GUÍA RÁPIDA DE TARJETAS OPCIONALES DEL CQM1H

ESTE MANUAL CONTIENE:

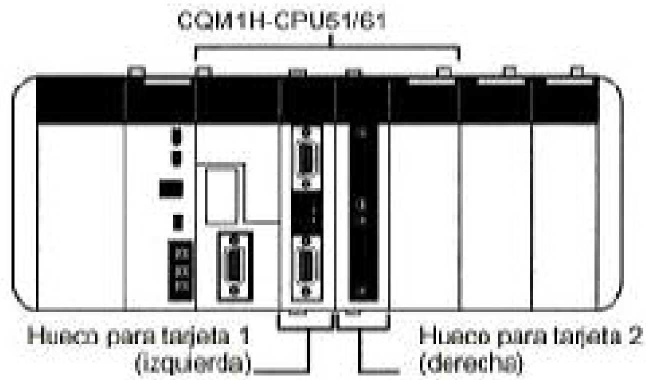
1 Introducción

En esta guía rápida se van a tratar las diferentes Tarjetas Opcionales que existen para el CQM1H, su conexión, funcionamiento y modo de operación.

Las tarjetas opcionales que se tienen son las siguientes:

- **CQM1H-CTB41**: Tarjeta de Contador de Alta Velocidad.
- **CQM1H-PLB21**: Tarjeta de E/S de Pulsos.
- **CQM1H-ABB21**: Tarjeta de Encoder Absoluto.
- **CQM1H-AVB41**: Tarjeta de Selectores Analógicos.
- **CQM1H-MAB42**: Tarjeta de E/S Analógicas.
- **CQM1H-SCB41**: Tarjeta Serie de Comunicaciones (Comboard).

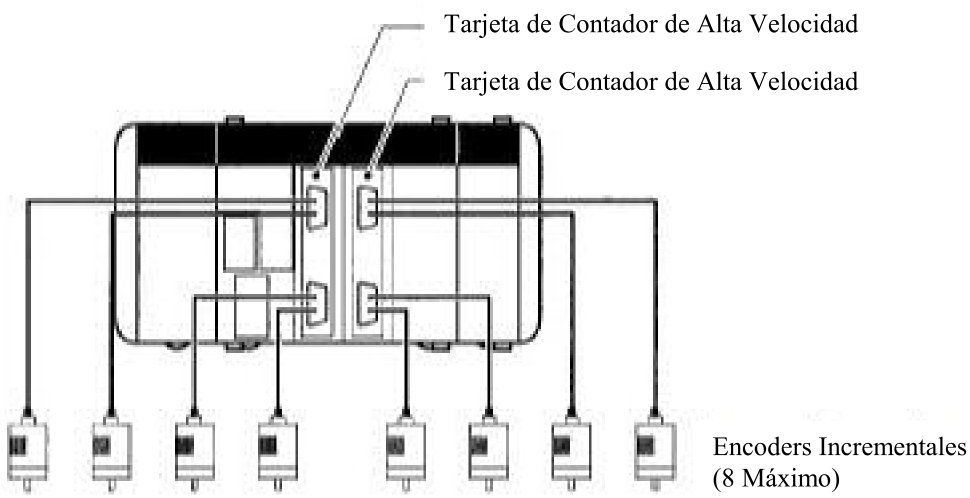
Las tarjetas opcionales **sólo** se pueden utilizar en el **CQM1H-CPU51** y en el **CQM1H-CPU61**.



Nombre	Especificaciones	Referencia	Montaje	
			Hueco 1 (Izquierda)	Hueco 2 (Derecha)
Tarjeta de Contador de Alta Velocidad	Entradas de Pulsos (contador de alta velocidad): 4 puntos (50KHz/500KHz seleccionable) Salidas Externas: 4 puntos	CQM1H-CTB41	SI	SI
Tarjeta de E/S de Pulsos	Entradas de Pulsos (Contador de Alta Velocidad): 2 puntos (de una fase: 50 KHz, diferencia de fase: 25 KHz) Salida de Pulsos: 2 puntos (50 KHz)	CQM1H-PLB21	NO	SI
Tarjeta de Encoder Absoluto	Entradas de Encoder (Código Binario Gray): 2 puntos (4 KHz)	CQM1H-ABB21	NO	SI
Tarjeta de Selectores Analógicos	Selecciones Analógicas (potenciómetros): 4 puntos	CQM1H-AVB41	SI, en cualquiera de los dos, pero NO EN LOS DOS A LA VEZ	
Tarjeta de E/S Analógicas	Cuatro Entradas: 0 a 5V, 0 a 10V, -10 a +10V, 0 a 20 mA Dos Salidas: 0 a 20 mA, -10 a +10V	CQM1H-MAB42	NO	SI
Tarjeta de Comunicaciones Serie	Un Puerto RS-232C y un puerto RS-422A/485	CQM1H-SCB41	SI	NO

2 CQM1H-CTB41

Es una tarjeta de Contador de Alta Velocidad que tiene 4 Entradas de Pulsos y 4 Salidas Externas como Resultado de la Comparación.



2.1 Funciones

Entradas de Pulsos 1 a 4 de Contador de Alta Velocidad

La CQM1H-CTB41 es capaz de contar pulsos desde 50 a 500 KHz a través de los puertos 1 a 4, y desarrollar tareas en función del número de pulsos contados. Los 4 puertos se pueden utilizar independientemente.

Modos de Entrada

Se dispone de 3 modos de entrada:

- Modo de Fase Diferencial (1x/2x/4x)
- Modo Adelante/Atrás
- Modo de Pulso y Dirección

Operación de Comparación

Cuando el PV (Valor Presente) del Contador de Alta Velocidad coincide con un valor objeto o está dentro de un rango de comparación de los programados, dicho resultado se muestra en los bits internos y externos de salida.

Salidas Externas

Se puede producir la activación de hasta 4 salidas externas cuando el PV del contador coincide con uno de los valores objeto o está dentro de uno de los rangos de comparación.

Nota: La Tarjeta de Contador de Alta Velocidad no viene provista de Interrupciones de Contador de Alta Velocidad. Simplemente compara el PV del contador con valores objeto o rangos de comparación, y activa un bit de salida interno o externo.

2.2 Slots que se pueden Utilizar

La Tarjeta de Contador de Alta Velocidad se puede instalar en el slot 1 (slot izquierdo) o en el slot 2 (slot derecho) del CQM1H-CPU51/61. Ambos slots pueden estar ocupados por una de estas tarjetas al mismo tiempo (por tanto se pueden tener montadas dos tarjetas de este tipo en una sola CPU).

2.3 Especificaciones

Instrucciones

Se utilizan las instrucciones: CTBL(63), INI(61) y PRV(62).

Relación de Bits de Control, Flags, e Información de Estado

<table>
<tr><th colspan="2">Palabra</th><th rowspan="2">Bits</th><th colspan="2" rowspan="2">Nombre</th><th rowspan="2">Función</th></tr>
<tr><th>Slot 1</th><th>Slot 2</th></tr>
<tr><td>IR 200</td><td>IR 232</td><td>00 a 15</td><td rowspan="2">Contador 1</td><td>PV (4 dígitos de menor peso)</td><td rowspan="8">El PV del Contador de Alta Velocidad de cada puerto se almacena después de cada ciclo.
Nota: la forma de almacenar el PV (en Hex o en BCD) se puede especificar en el Setup (DM6602 a DM6611).</td></tr>
<tr><td>IR 201</td><td>IR 233</td><td>00 a 15</td><td>PV (4 dígitos de mayor peso)</td></tr>
<tr><td>IR 202</td><td>IR 234</td><td>00 a 15</td><td rowspan="2">Contador 2</td><td>PV (4 dígitos de menor peso)</td></tr>
<tr><td>IR 203</td><td>IR 235</td><td>00 a 15</td><td>PV (4 dígitos de mayor peso)</td></tr>
<tr><td>IR 204</td><td>IR 236</td><td>00 a 15</td><td rowspan="2">Contador 3</td><td>PV (4 dígitos de menor peso)</td></tr>
<tr><td>IR 205</td><td>IR 237</td><td>00 a 15</td><td>PV (4 dígitos de mayor peso)</td></tr>
<tr><td>IR 206</td><td>IR 238</td><td>00 a 15</td><td rowspan="2">Contador 4</td><td>PV (4 dígitos de menor peso)</td></tr>
<tr><td>IR 207</td><td>IR 239</td><td>00 a 15</td><td>PV (4 dígitos de mayor peso)</td></tr>
<tr><td rowspan="6">IR 208:
Contador 1
IR 209:
Contador 2
IR 210:
Contador 3
IR 211:
Contador 4</td><td rowspan="6">IR 240:
Contador 1
IR 241:
Contador 2
IR 242:
Contador 3
IR 243:
Contador 4</td><td>00 a 07</td><td colspan="2">Resultado de la Comparación: Salidas Internas. Bits 00 a 07</td><td>Contiene el bit especificado por el operando de CTBL(63) cuando se cumple una condición</td></tr>
<tr><td>08 a 11</td><td colspan="2">Resultado de la Comparación: Bits para las Salidas Externas 1 a 4</td><td>Contiene el bit especificado por el operando de CTBL(63) cuando se cumple una condición</td></tr>
<tr><td>12</td><td colspan="2">Flag de Operación de Cuenta</td><td>0: Parado
1: Operando</td></tr>
<tr><td>13</td><td colspan="2">Flag de Comparación</td><td>Indica si una comparación está o no en progreso:
0: Parado
1:Operando</td></tr>
<tr><td>14</td><td colspan="2">Flag de Overflow/Underflow del PV</td><td>Indica si se ha producido o no un Overflow o Underflow:
0: Normal
1: Oveflow o Underflow</td></tr>
<tr><td>15</td><td colspan="2">Flag de Error del SV</td><td>0: Normal
1: Error de Configuración</td></tr>
</table>

Palabra		Bits	Nombre	Función
Slot 1	Slot 2			
IR 212	AR 05	00	Bit de Reset del Contador 1	Reset por Fase Z y Software 0: No Reset con Fase Z 1: Reset con Fase Z Reset por Software 0: No Reset 0→1: Reset
		01	Bit de Reset del Contador 2	
		02	Bit de Reset del Contador 3	
		03	Bit de Reset del Contador 4	
		08	Bit de Comienzo de Comparación del Contador 1	0→1: Comienzo de la Comparación 1→0: Paro de la Comparación
		09	Bit de Comienzo de Comparación del Contador 2	
		10	Bit de Comienzo de Comparación del Contador 3	
		11	Bit de Comienzo de Comparación del Contador 4	
		12	Bit de Stop del Contador 1	0: Operación Continua 1: Paro de Operación
		13	Bit de Stop del Contador 2	
		14	Bit de Stop del Contador 3	
		15	Bit de Stop del Contador 4	
IR 213	AR 06	00	Bit para Forzar a Set la Salida Externa 1	0: No afecta el Estado de la Salida 1: Fuerza la Salida a ON
		01	Bit para Forzar a Set la Salida Externa 2	
		02	Bit para Forzar a Set la Salida Externa 3	
		03	Bit para Forzar a Set la Salida Externa 4	
		04	Bit para Habilitar el Forzado de Salidas Externas	0: Deshabilitado el Forzado de las Salidas 1 a 4 1: Habilitado el Forzado de las Salidas 1 a 4
SR 254		15	Flag de Error de la Tarjeta Opcional	0: No hay Error 1: Error Se pone a ON cuando se produce un Error en la Tarjeta Opcional montada en el Slot 1 ó 2.
AR 04		00 a 07	Código de Error de la Tarjeta Opcional del Slot 1	00 Hex: Normal 01 ó 02 Hex: Error Hardware 03 Hex: Error en el Setup
		08 a 15	Código de Error de la Tarjeta Opcional del Slot 2	

Relación de la Configuración del Setup

Palabra		Bits	Función	Cuando se Lee la Configuración
Slot 1	Slot 2			
DM 6602	DM 6611	00 a 03	Formato en el que se almacena el PV de los Contadores de 1 a 4. 0: 8 Dígitos Hexadecimal 1: 8 Dígitos BCD	Cuando se da la alimentación
		04 a 07	No utilizado	
		08 a 11	Configuración de las Salidas Externas 1 a 4 0: PNP 1: NPN	
		12 a 15	No Utilizado	
DM 6640	DM 6643	00 a 03	Modo de Entrada del Contador de Alta Velocidad 1 0 Hex: Entrada en Fase Diferencial 1x 1 Hex: Entrada en Fase Diferencial 2x 2 Hex: Entrada en Fase Diferencial 4x 3 Hex: Entrada en Pulso Adelante/Atrás 4 Hex: Entrada en Pulso y Dirección	Cuando comienza la operación
		04 a 07	Frecuencia de Cuenta, Modo de Rango Numérico y Método de Reset del Contador de Alta Velocidad 1. Referido a la siguiente tabla de más abajo.	
		08 a 11	Modo de Entrada del Contador de Alta Velocidad 2 (Referido a la explicación dada más arriba para el Contador 1)	
		12 a 15	Frecuencia de Cuenta, Modo de Rango Numérico y Método de Reset del Contador de Alta Velocidad 2. (Referido a la siguiente tabla de más abajo)	
DM 6641	DM 6644	00 a 03	Modo de Entrada del Contador de Alta Velocidad 3 (Referido a la explicación dada más arriba para el Contador 1)	
		04 a 07	Frecuencia de Cuenta, Modo de Rango Numérico y Método de Reset del Contador de Alta Velocidad 3. (Referido a la siguiente tabla de más abajo)	
DM 6641	DM 6644	08 a 11	Modo de Entrada del Contador de Alta Velocidad 4 (Referido a la explicación dada más arriba para el Contador 1)	Cuando comienza la operación
		12 a 15	Frecuencia de Cuenta, Modo de Rango Numérico y Método de Reset del Contador de Alta Velocidad 4. (Referido a la siguiente tabla de más abajo)	

Frecuencia de Cuenta, Modo de Rango Numérico y Método de Reset de los Contadores de Alta Velocidad

Valor	Frecuencia de Cuenta	Modo de Rango Numérico	Método de Reset
0 Hex	50 KHz	Modo Lineal	Fase Z + Software
1 Hex			Software
2 Hex		Modo Circular	Fase Z + Software
3 Hex			Software
4 Hex	500 KHz	Modo Lineal	Fase Z + Software
5 Hex			Software
6 Hex		Modo Circular	Fase Z + Software
7 Hex			Software

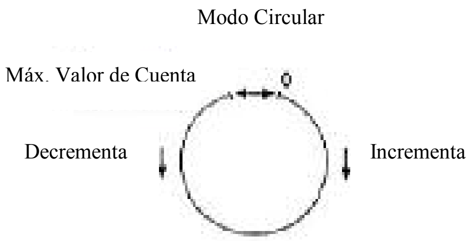
2.4 Contadores de Alta Velocidad de 1 a 4

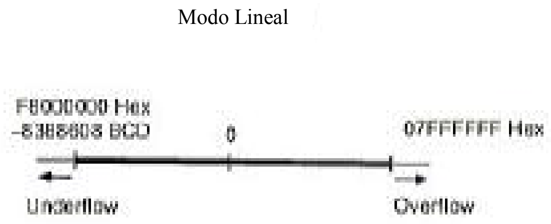
Señales de Entrada y Modos de Entrada

- Modo de Fase Diferencial (Velocidad de Cuenta: 25 KHz ó 250 KHz)
- Modo Adelante/Atrás (Velocidad de Cuenta: 50 KHz ó 500 KHz)
- Modo Pulso/Dirección (Velocidad de Cuenta: 50 KHz ó 500 KHz)

Rangos Numéricos

- Modo Circular: de 00000000 a 08388607 en BCD ó de 00000000 a 07FFFFFF en Hex.
- Modo Lineal: de –8388608 a 8388607 en BCD ó de F8000000 a 07FFFFFF en Hex.





Métodos de Reset

- Reset de Fase Z + Software.
- Reset por Software.

Métodos de Chequeo para las Interrupciones de Contador de Alta Velocidad

- Método por Valores Coincidentes (hasta 48 valores objeto).
- Método por Rangos de Comparación (hasta 16 rangos).

Procedimiento para Utilizar los Contadores de Alta Velocidad

Determinar el Rango de Cuenta, Modo de Entrada, Método de Reset, Modo de Rango Numérico, formato en el que se almacena el PV del contador, y el método de salidas externas.

Rango de Cuenta: 50 KHz/500 KHz
Modo de Entrada: Fase Diferencial, Pulso/Dirección, Adelante/Atrás.
Método de Reset: Fase Z+Software; Software.
Modo de Rango Numérico: Modo Circular o Modo Lineal.
Formato del PV: 8 Dígitos BCD u 8 Dígitos Hexadecimal.
Método de las Salidas Externas: NPN o PNP.

↓

Configurar la Tensión de Entrada (switches de la Tarjeta)

↓

Montar la Tarjeta y Cablear las Entradas

↓

Setup del PLC
(Slot 1: DM6602, DM6640, DM6641)
(Slot 2: DM6611, DM6643, DM6644)

Rango de Cuenta: 50 KHz/500 KHz
Modo de Entrada: Fase Diferencial, Adelante/Atrás, Pulso/Dirección
Método de Reset: Fase Z+Software, Software
Modo de Rango Numérico: Modo Circular o Modo Lineal.
Formato del PV: 8 Dígitos BCD u 8 Dígitos Hexadecimal.
Método de las Salidas Externas: NPN o PNP.

↓

Determinar el Método de Chequeo de Cuenta (comparación) y bits internos/externos de salida.

Métodos de Comparación: por Valores Coincidentes o por Rangos de Comparación.
Bits de Salida cuando se cumplen las condiciones de comparación: Internos y Externos

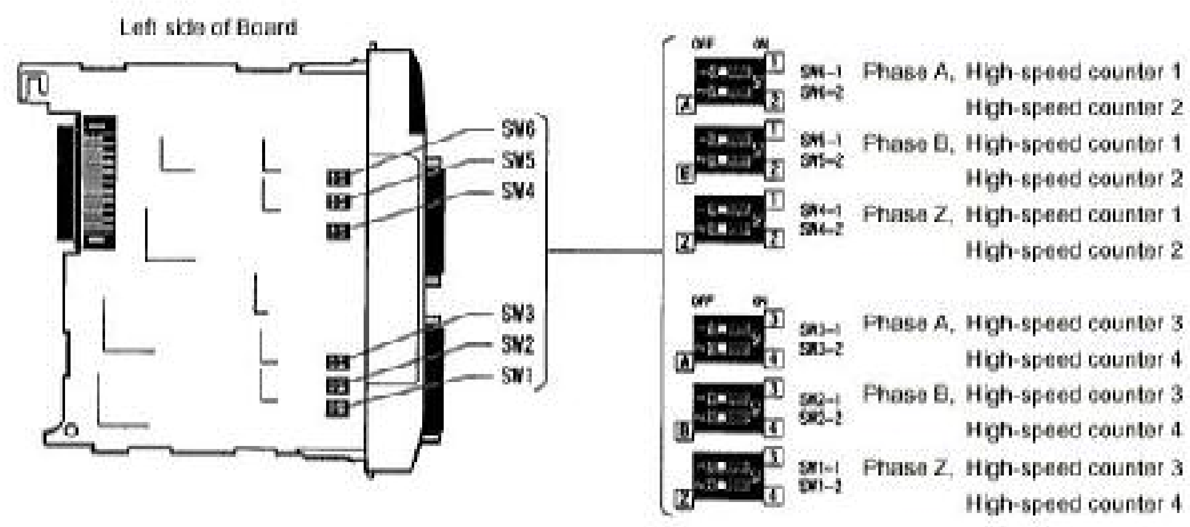
↓

Programa Ladder del PLC

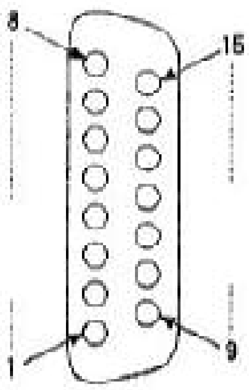
TABLA DE COMPARACIÓN DE REGISTROS (CTBL(63)): Especificación del Puerto, Registro de la Tabla de Comparación, Comienzo de la Comparación.
MODO DE CONTROL (INI(61)): Especificación del Puerto, cambio del PV, Comienzo de la Comparación.
LECTURA DEL PV (PRV(62)): Lectura del PV del Contador de Alta Velocidad y el Estado de la Comparación.

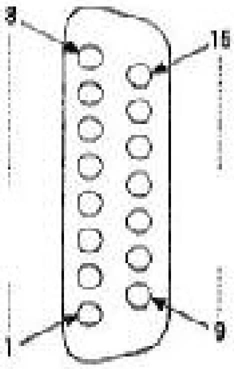
Switches para el Nivel de Tensión de las Entradas

Contador 1	Contador 2	Contador 3	Contador 4	Estado	Configuración	
SW6-1	SW6-2	SW3-1	SW3-2	ON	Entrada del Contador:	Line Driver
				OFF	Entrada de Tensión A	24 VDC (defecto)
SW5-1	SW5-2	SW2-1	SW2-2	ON	Entrada del Contador:	Line driver
				OFF	Entrada de Tensión B	24 VDC (defecto)
SW4-1	SW4-2	SW1-1	SW1-2	ON	Entrada del Contador:	Line Driver
				OFF	Entrada de Tensión Z	24 VDC (defecto)

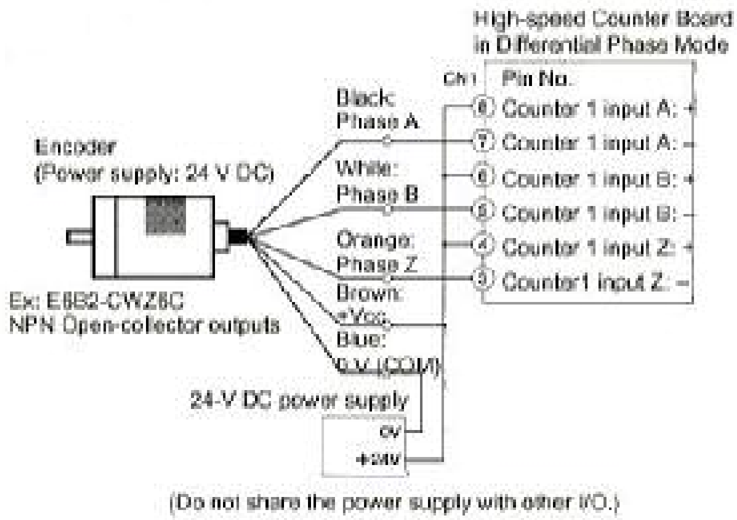


Pineado de los Conectores CN1 y CN2

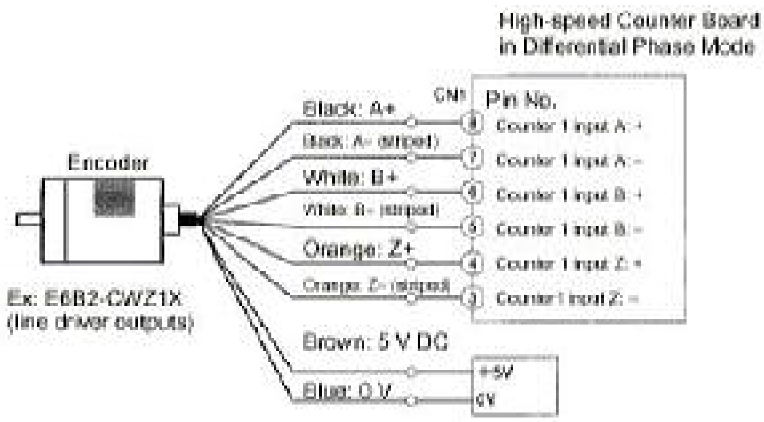
Situación de los Pines	Nº de Pin	Nombre	Función
	1	2OUT	Salida Externa 2
	2	1OUT	Salida Externa 1
	3	1Z-	Entrada de Contador 1: Z-
	4	1Z+	Entrada de Contador 1: Z+
	5	1B-	Entrada de Contador 1: B-
	6	1B+	Entrada de Contador 1: B+
	7	1A-	Entrada de Contador 1: A-
	8	1A+	Entrada de Contador 1: A+
	9	+DC	Alimentación para las Salidas Externas 1 a 4. 5 a 24 VDC
	10	2Z-	Entrada de Contador 2: Z-
	11	2Z+	Entrada de Contador 2: Z+
	12	2B-	Entrada de Contador 2: B-
	13	2B+	Entrada de Contador 2: B+
	14	2A-	Entrada de Contador 2: A-
	15	2A+	Entrada de Contador 2: A+

Situación de los Pines	Nº de Pin	Nombre	Función
	1	3Z-	Entrada de Contador 3: Z-
	2	3Z+	Entrada de Contador 3: Z+
	3	3B-	Entrada de Contador 3: B-
	4	3B+	Entrada de Contador 3: B+
	5	3A-	Entrada de Contador 3: A-
	6	3A+	Entrada de Contador 3: A+
	7	4OUT	Salida Externa 4
	8	3OUT	Salida Externa 3
	9	4Z-	Entrada de Contador 4: Z-
	10	4Z+	Entrada de Contador 4: Z+
	11	4B-	Entrada de Contador 4: B-
	12	4B+	Entrada de Contador 4: B+
	13	4A-	Entrada de Contador 4: A-
	14	4A+	Entrada de Contador 4: A+
	15	-DC	Alimentación para las Salidas Externas 1 a 4. 0 V

Conexión de un Encoder de Colector Abierto de 24 VDC



Conexión de un Encoder con Salida Line Driver



2.5 Ejemplo

El siguiente ejemplo muestra como se puede utilizar el Contador de Alta Velocidad 1 en la Tarjeta Opcional CQM1H-CTB41 montada en el Slot 2. Se va a realizar una comparación por valores coincidentes para que se pongan a ON los bits correspondientes de salida internos y externos, en función del PV del contador.

El Bit de Reset se mantiene a ON en el programa para que el PV del contador se resetee con la señal de Fase Z, después de que se alcance el último valor objeto de comparación.

Antes de ejecutar el programa, se tiene que configurar el CQM1H tal y como se muestra debajo, teniendo que apagar y encender o pasar de PROGRAM a MONITOR el PLC, para que se habilite la nueva configuración en el DM6611.

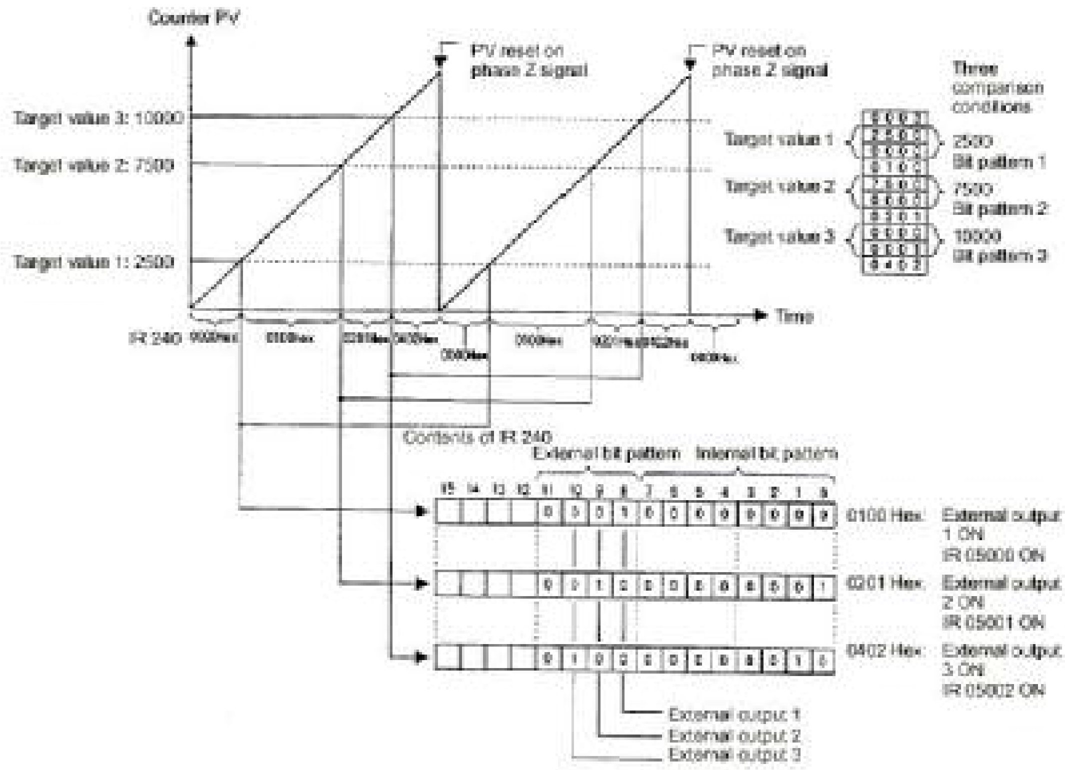
DM 6611: 0001 (Salidas 1 a 4 en modo PNP, y el PV de los contadores 1 a 4 se almacenará en 8 Dígitos BCD)

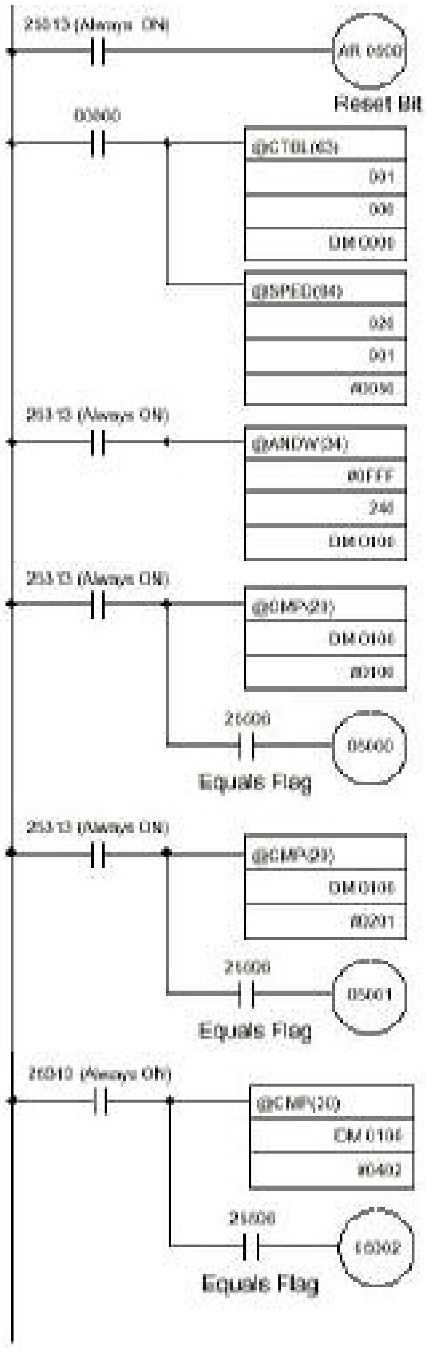
DM 6643: 0003 (Contador de Alta Velocidad 1: Frecuencia de 50KHz; Modo Lineal; Reset por Fase Z + Software; Modo Adelante/Atrás).

Cuando el PV alcance el valor de 2500, IR 05000 se pondrá a ON y la Salida Externa 1 se pondrá a ON.

Cuando el PV alcance el valor de 7500, IR 05001 se pondrá a ON y la Salida Externa 2 se pondrá a ON.

Cuando el PV alcance el valor de 10000, IR 05002 se pondrá a ON y la Salida Externa 3 se pondrá a ON.





DM 0000: 0003 -- Tres Condiciones de Comparación
DM 0001: 2500 -- Valor Objeto 1: 2500
DM 0002: 0000
DM 0003: 0100 – Bit de Salida Externa 1
DM 0004: 7500 – Valor Objeto 2: 7500
DM 0005: 0000
DM 0006: 0201 – Bit de Salida Externa 2 y Bit de Salida Interna 0
DM 0007: 0000 – Valor Objeto 3: 10000
DM 0008: 0001
DM 0009: 0402 – Bit de Salida Externa 3 y Bit de Salida Interna 1

3 CQM1H-PLB21

La Tarjeta Opcional de E/S de Pulsos CQM1H-PLB21 dispone de 2 Entradas de Pulsos y 2 Salidas de Pulsos.
La Tarjeta Opcional CQM1H-PLB21 es exactamente igual que los puertos de Entrada/Salida (CN1 y CN2) de pulsos que incorporaba el CQM1-CPU43. Se comporta del mismo modo, se programa y pone en marcha de la misma forma, y tienen las mismas características.

3.1 Slot en el que se puede montar

Esta tarjeta sólo se puede montar en el **Slot 2 (slot derecho) de la CPU**, por tanto sólo se puede montar 1 Tarjeta por CPU.

3.2 Entradas de Pulsos 1 y 2

Las Entradas de Pulsos 1 y 2 se pueden utilizar como Contadores de Alta Velocidad para contar entradas de pulsos de hasta 50 KHz (para señales de fase simple) ó 25 KHz (para fase diferencial). Los procesos de interrupción se pueden desarrollar teniendo en cuenta el PV de los contadores.

Modo de Entrada
Están disponibles los tres modos de entrada siguientes:

- Modo de Fase Diferencial (4x)
- Modo Pulso y Dirección
- Modo Adelante/Atrás

Interrupciones
La tarjeta CQM1H-PLB21 puede ejecutar una subrutina de interrupción cuando el valor del contador de alta velocidad coincide con un valor objeto (previamente programado), o una subrutina de interrupción cuando el PV del contador cae dentro de un rango de comparación especificado.

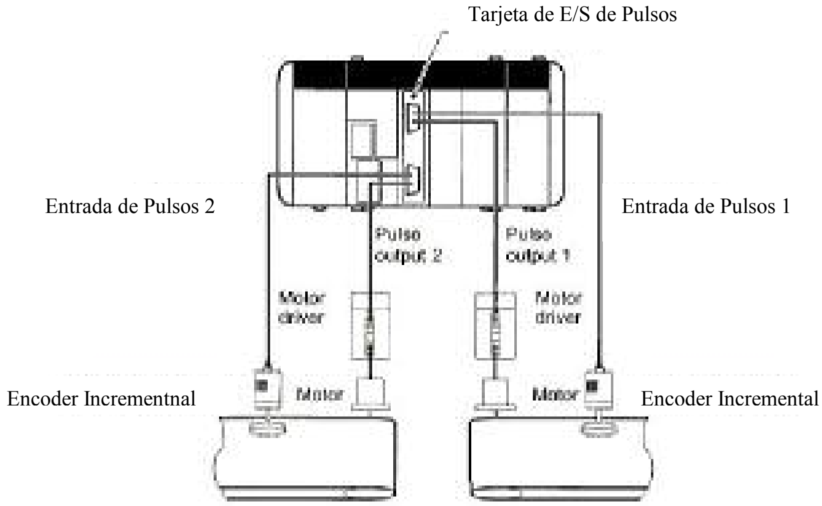
3.3 Salida de Pulsos 1 y 2

La tarjeta opcional CQM1H-PLB21 dispone de 2 salidas de pulsos entre 10 Hz y 50 KHz a través de los puertos 1 y 2. En ambos se puede configurar un ciclo de trabajo fijo o variable.

3.4 Puertos 1 y 2

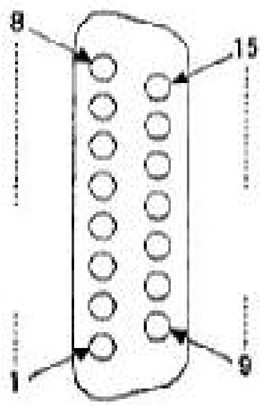
A través de estos puertos se pueden utilizar simultáneamente las 2 Entradas de Pulsos (Contador de Alta Velocidad) y las 2 Salidas de Pulsos.

3.5 Configuración del Sistema



3.6 Pineado del Puerto CN1 y CN2

La disposición de pines es idéntica para los puertos CN1 y CN2:

Situación de los Pines	Nº de Pin	Nombre	Función
	1	Común de Entrada	Entrada de Pulsos
	2	Entrada de Pulsos Z: 24 VDC	
	3	Entrada de Encoder A: 24 VDC	
	4	Entrada de Encoder B: 24 VDC	
	5	Salida de Pulsos CCW	Salida de Pulsos
	6	Salida de Pulsos CW/Salida PWM(--)	
	7	Fuente de Alimentación de 5 VDC para la Salida	
	8	Fuente de Alimentación de 5 VDC para la Salida	
	9	Entrada de Pulsos Z: 12 VDC	Entrada de Pulsos
	10	Entrada de Encoder A: 12 VDC	
	11	Entrada de Encoder B: 12 VDC	
	12	Común de Salida (0 V)	Salida de Pulsos
	13	Salida de Pulsos CCW (con resistencia de 1.6KΩ	
	14	Salida de Pulsos CW/Salida PWM(--) (con resistencia de 1.6KΩ	
	15	Fuente de Alimentación para la Salida	

3.7 Especificaciones del Contador de Alta Velocidad

Especificaciones del Contador

Elemento			Especificación		
Número de Contadores			2 Contadores (puertos)		
Modos de Entrada (Configurables para cada puerto en el Setup del PLC)			Entrada en Fase Diferencial	Entrada de Pulso/Dirección	Entrada de Pulso Adelante/Atrás
Número del Pin de Entrada	Puerto 1	Puerto 2	---		
	3/10	3/10	Entrada de Fase A	Entrada de Dirección	Entrada de Pulsos Decremental
	4/11	4/11	Entrada de Fase B	Entrada de Pulsos	Entrada de Pulsos Incremental
	2/9	2/9	Entrada de Fase Z	Entrada de Reset	Entrada de Reset
Método de Entrada			Diferencia de Fase de 4 (Fijo)	Pulsos de Fase Simple + Dirección	Pulsos de Fase Simple x 2
Frecuencia de Cuenta			25 KHz	50 KHz	50 KHz
Valor de Cuenta			Modo Lineal: -8388608 a 8388607 Modo Circular: 0 a 64999		
PV del Contador			Puerto 1: IR 233 (mayor peso) e IR 232 (menor peso) Puerto 2: IR 235 (mayor peso) e IR 234 (menor peso) Formato de los Datos: 8 Dígitos BCD Modo Lineal: F8388608 a 8388607 (F para valores negativos). Modo Circular: 00000000 a 00064999.		
Método de Control	Valor Objeto		Hasta 48 valores objeto e interrupciones		
	Rango de Comparación		Hasta 8 Límites Superiores, Inferiores e Interrupciones		
Método de Reset del Contador			Señal de la Fase Z + Reset de Software Reset por Software Bits de Reset: (Puerto 1: SR 252.01) y (Puerto 2: SR 252.02)		

3.8 Especificaciones de la Salida de Pulsos

Elemento	Especificaciones			
	Ciclo de Trabajo Fijo			Ciclo de Trabajo Variable
	Sin Aceleración/Deceleración Trapezoidal	Mismo Rango de Aceleración/Deceleración	Rangos Separados de Aceleración/Deceleración	
Instrucción	PULS(65)/SPED(64)	PLS2(--)	PULS(65)/ACC(--)	PWM(--)
Frecuencia de Salida	10 Hz a 50 KHz 10 Hz a 20 KHz para motor paso a paso	0 Hz a 50 KHz	100 Hz a 50 KHz	91.6 Hz, 1.5 KHz, 5.9 KHz
Saltos de Frecuencia de Salida	1 o 10 Hz	10 Hz		---
Factor de Ciclo de Trabajo	50 % Fijo			1 a 99%
Número de Pulsos de Salida	1 a 16777215			---
Rango de Aceleración/Deceleración	---	10 Hz a 2 KHz (cada 4.08 ms)		---

4 CQM1H-ABB21

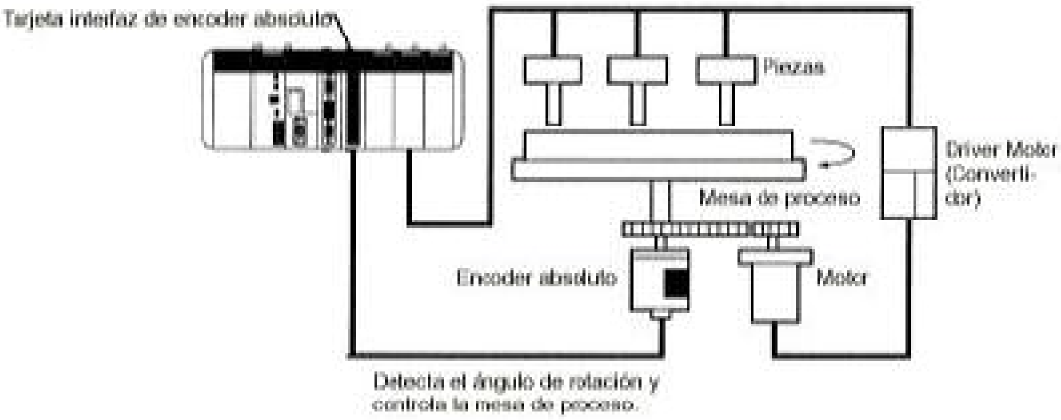
Se trata de una Tarjeta Opcional de Encoder Absoluto que cuenta dos entradas de pulsos en código binario gray desde un encoder absoluto (ABS) a través de los puertos 1 y 2 a un máximo de 4KHz de frecuencia.
La Tarjeta Opcional CQM1H-ABB21 es exactamente igual que los puertos de Entrada de Encoder Absoluto que incorporaba el CQM1-CPU44. Se comporta del mismo modo, se programa y pone en marcha de la misma forma, y tienen las mismas características.

Modos de Operación
Modo BCD y Modo 360º.

Resoluciones
Se puede configurar una de las siguientes: 8 bits (0 a 255), 10 bits (0 a 1023), o 12 bits (0 a 4095). La resolución debería coincidir con la que tenga el encoder que se conecte.

Interrupciones
Se puede ejecutar una subrutina de interrupción cuando el PV (Valor Presente) del contador absoluto de alta velocidad coincida con un valor objeto especificado o caiga dentro de uno de los rangos de comparación programados.

4.1 Configuración del Sistema

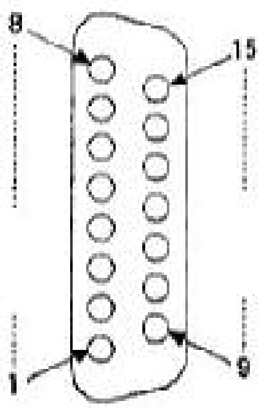


4.2 Slot en el que se puede montar

La Tarjeta de Encoder Absoluto sólo se puede montar en el **Slot 2 (Slot Derecho)** del CQM1H-CPU51 ó CQM1H-CPU61.

4.3 Pineado del Puerto CN1 y CN2

La disposición de pines es idéntica para los puertos CN1 y CN2:

Situación de los Pines	Nº de Pin	Nombre
	1	Común de Entrada
	2	Bit 2^{11} del código gray binario del encoder
	3	Bit 2^{9} del código gray binario del encoder
	4	Bit 2^{7} del código gray binario del encoder
	5	Bit 2^{5} del código gray binario del encoder
	6	Bit 2^{3} del código gray binario del encoder
	7	Bit 2^{1} del código gray binario del encoder
	8	No utilizado
	9	Común de Entrada
	10	Bit 2^{10} del código gray binario del encoder
	11	Bit 2^{8} del código gray binario del encoder
	12	Bit 2^{6} del código gray binario del encoder
	13	Bit 2^{4} del código gray binario del encoder
	14	Bit 2^{2} del código gray binario del encoder
	15	Bit 2^{0} del código gray binario del encoder

4.4 Especificaciones de las Entradas de Encoder Absoluto

<table>
<tr><th colspan="2">Elemento</th><th>Especificaciones</th></tr>
<tr><td colspan="2">Número de Puntos de Entrada</td><td>2 puntos</td></tr>
<tr><td colspan="2">Código de Entrada</td><td>Código Binario Gray</td></tr>
<tr><td colspan="2">Modos de Operación</td><td>Modo BCD o Modo 360º (Configurado en el Setup del PLC)</td></tr>
<tr><td colspan="2">Resoluciones</td><td>8 bit, 10 bit, o 12 bit (Configurado en el Setup del PLC)</td></tr>
<tr><td colspan="2">Compensación de Origen</td><td>Si (se puede designar la actual posición como origen), la compensación se puede configurar en el Setup del PLC</td></tr>
<tr><td colspan="2">Frecuencia de cuenta</td><td>4 KHz máx.</td></tr>
<tr><td colspan="2" rowspan="2">Almacenamiento del PV de los contadores</td><td>Puerto 1: IR233 (parte de mayor peso) e IR232 (parte de menor peso)
Puerto 2: IR235 (parte de mayor peso) e IR234 (parte de menor peso)</td></tr>
<tr><td>Los datos se almacenan como 4 dígitos en BCD.
Nota: el rango de valores queda determinado por el modo de operación (BCD o 360º) y la resolución (8, 10 ó 12 bits).</td></tr>
<tr><td rowspan="2">Métodos de Control</td><td>Por Valor Objeto</td><td>Se pueden registrar hasta 48 valores objeto e interrupciones</td></tr>
<tr><td>Por Rangos de Comparación</td><td>Se pueden almacenar hasta 8 límites superiores, límites inferiores e interrupciones</td></tr>
</table>

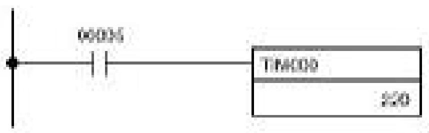
5 CQM1H-AVB41

Se trata de una Tarjeta Opcional de Selectores Analógicos.
La Tarjeta Opcional CQM1H-AVB41 es exactamente igual que los selectores que incorporaba el CQM1-CPU42. Se comporta del mismo modo, se programa y pone en marcha de la misma forma, y tienen las mismas características.

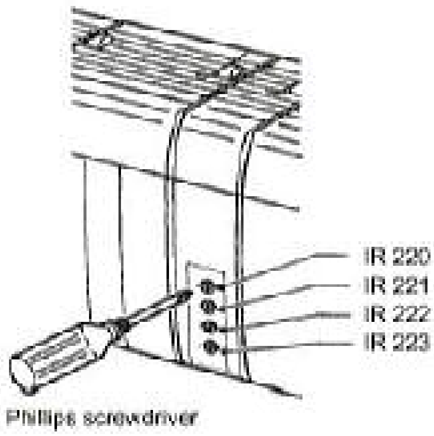
5.1 Función

Cada uno de los valores que representan la posición en la que se encuentran los selectores analógicos (que son resistores variables) localizados en el frente de la tarjeta, se almacenan como 4 dígitos en BCD entre 0000 y 0200 de IR220 a IR223 para los selectores 0 a 3 respectivamente.

A modo de ejemplo, el operador puede utilizar un selector analógico para variar el tiempo de configuración de un temporizador, mediante un destornillador, para manipular el selector analógico seleccionado para dicha función. Así el siguiente ejemplo muestra los 4 dígitos en BCD de 0000 a 0200 en el canal IR220 para poder variar el tiempo del temporizador TIM000.



El valor de configuración de TIM000 se configura externamente con IR220. (El temporizador se ejecuta utilizando el valor configurado a través del selector analógico 0.)



5.2 Slot en el que se puede montar

La tarjeta de Selectores Analógicos se puede instalar o en el slot 1(slot izquierdo) o en el slot 2 (slot derecho) del CQM1H-CPU51 ó CQM1H-CPU61. Sin embargo, no se pueden utilizar ambos slots al mismo tiempo con dos tarjetas de selectores analógicos.

5.3 Nombres y Funciones

Los cuatro controles analógicos de la Tarjeta de Selectores Analógicos están localizados en el frente de la tarjeta. El frente de la tarjeta no tiene ningún indicador.

El valor de los canales que representan a cada selector se incrementa o decrementa girando a derechas o izquierdas los selectores analógicos respectivamente. Es necesario utilizar un destornillador de estrella.

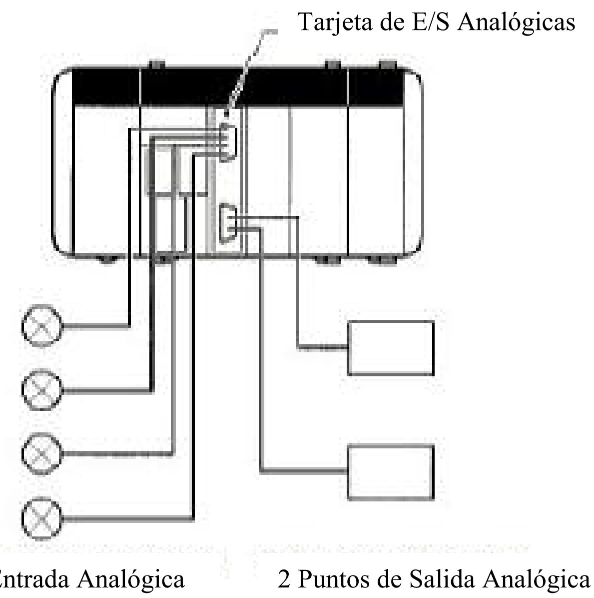
6 CQM1H-MAB42

Se trata de una Tarjeta Opcional de E/S Analógicas que tiene 4 Entradas Analógicas y 2 Salidas Analógicas.

Los rangos de señal que se pueden utilizar para cada una de las entradas analógicas son de: –10v a +10v, 0 a 5v, y 0 a 20mA. Se puede configurar el rango de forma individual para cada punto de entrada. La configuración de los rangos, para los puntos de entrada, se realiza en el DM6611.
Los rangos de señal que se pueden utilizar para cada una de las salidas analógicas son de: –10 a +10v y de 0 a 20mA. Se puede configurar el rango de forma individual para cada punto de salida. La configuración de los rangos se realiza en el DM6611.

La Tarjeta Opcional CQM1H-MAB42 es exactamente igual que los puertos de entradas y salidas analógicos que incorporaba el CQM1-CPU45. Se comporta del mismo modo, se programa y pone en marcha de la misma forma, y tienen las mismas características.

6.1 Configuración del Sistema

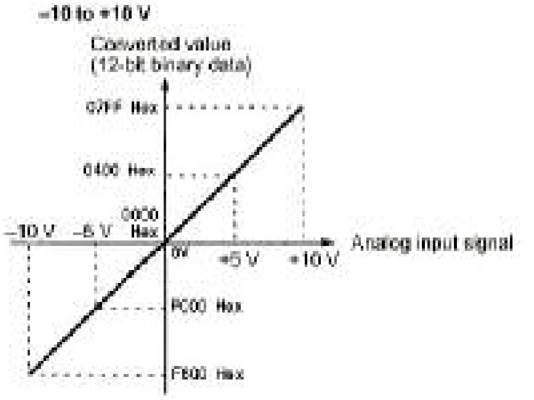


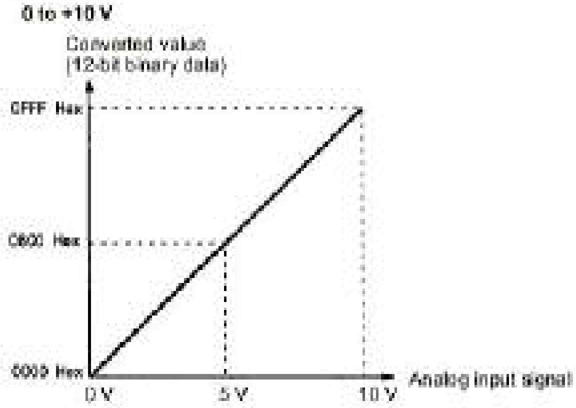
6.2 Slot en el que se puede montar

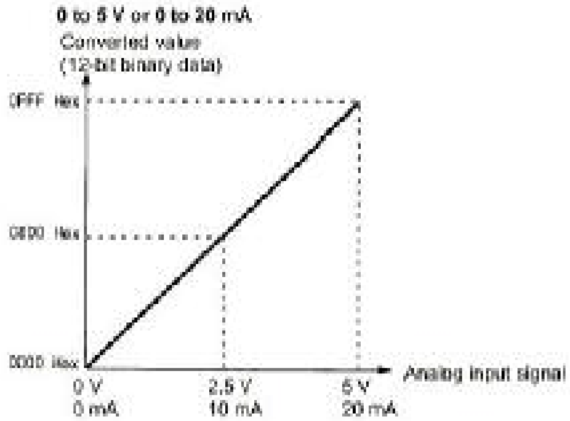
La Tarjeta de E/S Analógicas CQM1H-MAB42 sólo se puede montar en el **Slot 2 (slot derecho)** del CQM1H-CPU51 ó CQM1H-CPU61.

6.3 Especificaciones

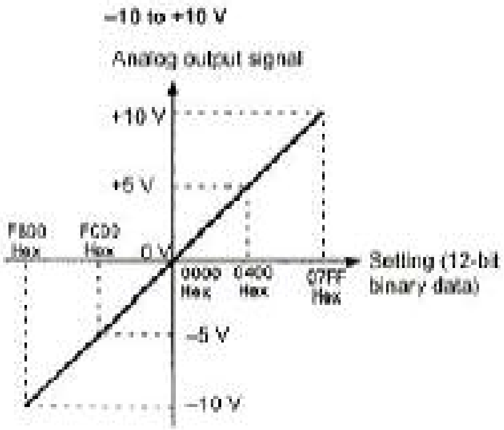
Entradas Analógicas: Valores de los Datos de Entrada y los Convertidos

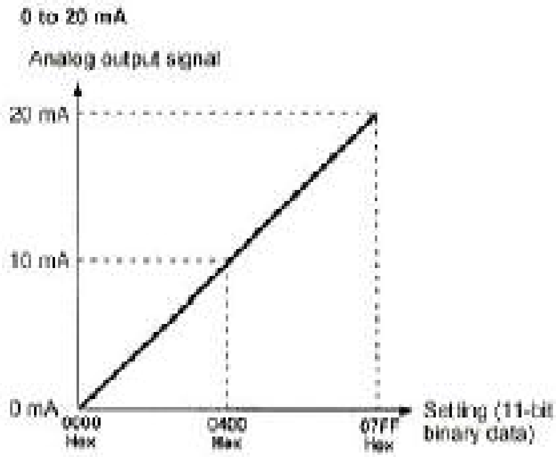






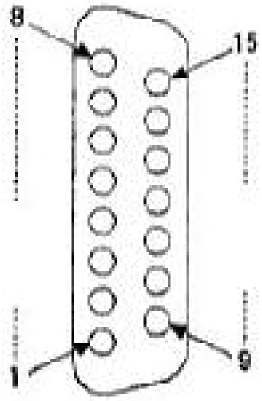
Salidas Analógicas: Configuración y Dato de Salida



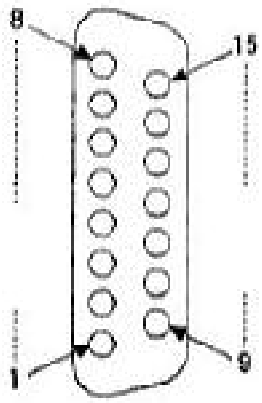


6.4 Pineado del Puerto CN1 y CN2

CN1: Entradas Analógicas

Situación de los Pines	Nº de Pin	Nombre	Función
	1	V4+	Entrada Analógica 4: Entrada de Tensión +
	2	V4-	Entrada Analógica 4: común (entrada de tensión -, entrada de corriente -)
	3	V3+	Entrada Analógica 3: Entrada de Tensión +
	4	V3-	Entrada Analógica 3: común (entrada de tensión -, entrada de corriente -)
	5	V2+	Entrada Analógica 2: Entrada de Tensión +
	6	V2-	Entrada Analógica 2: común (entrada de tensión -, entrada de corriente -)
	7	V1+	Entrada Analógica 1: Entrada de Tensión +
	8	V1-	Entrada Analógica 1: común (entrada de tensión -, entrada de corriente -)
	9	I4+	Entrada Analógica 4: entrada de corriente +
	10	NC	No utilizar
	11	I3+	Entrada Analógica 3: entrada de corriente +
	12	NC	No utilizar
	13	I2+	Entrada Analógica 2: entrada de corriente +
	14	NC	No utilizar
	15	I1+	Entrada Analógica 1: entrada de corriente +

CN2: Salidas Analógicas

Situación de los Pines	Nº de Pin	Nombre	Función
	1	NC	No utilizado
	2	NC	No utilizado
	3	I2-	Salida Analógica 2: común (salida de corriente -)
	4	V2-	Salida Analógica 2: común (salida de tensión -)
	5	NC	No utilizado
	6	NC	No utilizado
	7	I1-	Salida Analógica 1: común (salida de corriente -)
	8	V1-	Salida Analógica 1: común (salida de tensión -)
	9	NC	No utilizado
	10	I2+	Salida Analógica 2: salida de corriente +
	11	V2+	Salida Analógica 2: salida de tensión +
	12	NC	No utilizado
	13	NC	No utilizado
	14	I1+	Salida Analógica 1: salida de corriente +
	15	V1+	Salida Analógica 1: salida de tensión +

6.5 Especificaciones de las Entradas Analógicas

Elemento		Especificación	
Señales de Entrada		Entrada en Tensión	Entrada en Corriente
Número de Puntos de Entrada Analógica		4 Entradas	
Rangos de la Señal de Entrada		-10 a 10 V 0 a 10 V 0 a 5 V	0 a 20 mA
Registros en los que se almacenan las entradas analógicas		Entrada Analógica 1: IR 232 Entrada Analógica 2: IR 233 Entrada Analógica 3: IR 234 Entrada Analógica 4: IR 235	
Tiempo de Conversión A/D		1.7 ms máx./punto	
Resolución		1/4096	
Dato de Salida de la Conversión A/D		Dato de 12 bits en Binario -10 a +10 V:F800 a 07FF Hex 0 a 10 V, 0 a 5 V: 0000 a 0FFF Hex **Nota** las tensiones negativas (-10V ≤ tensión de entrada < 0V) se almacenan en complemento a dos.	Dato de 12 bits en Binario 0 a 20 mA: 0000 a 0FFF en Hex
Impedancia de Entrada		1 MΩ típico	250 Ω típico
Máximo Rango de Entrada Absoluto		±15 V	±30 mA
Precisión total	23±2ºC	±0.5% del FS	
	0 a 55ºC	±1.0% del FS	

6.6 Especificaciones de las Salidas Analógicas

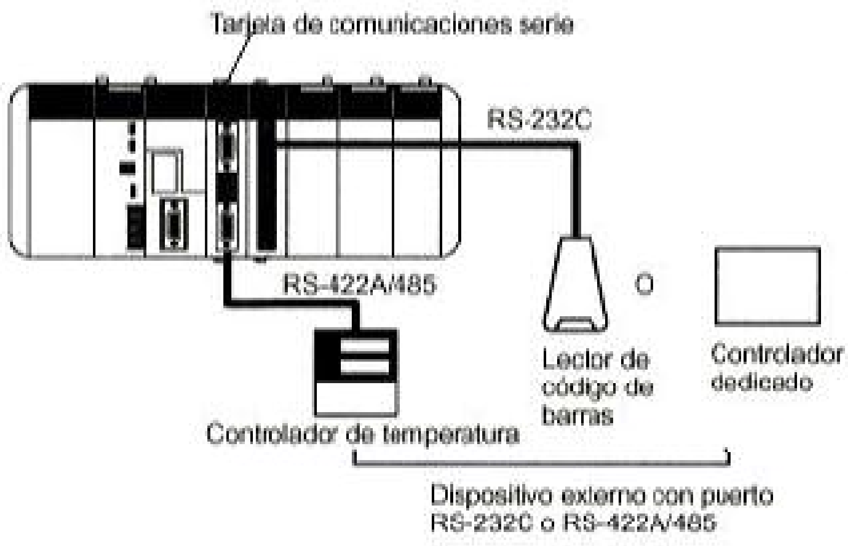
Elemento		Especificaciones	
Señales de Salida		Salida en Tensión	Salida en Corriente
Número de Puntos de Salida Analógica		2 salidas	
Rangos de la Señal de Salida		-10 a 10 V	0 a 20 mA
Tiempo de Conversión D/A		1.7 ms máx./2 puntos	
Resolución		1/4095	1/2047
Registros en los que se almacenan las salidas analógicas		Salida Analógica 1: IR 236 Salida Analógica 2: IR 237	
Impedancia de Salida		2 KΩ mín.	350 Ω máx.
Configuración del dato		Dato de 12 bits en Binario -10 a +10 V: F800 a 07FF Hex **Nota** las tensiones negativas (-10V ≤ tensión de entrada < 0V) se almacenan en complemento a dos.	Dato de 11 bits en Binario 0 a 20 mA: 0000 a 07FF en Hex
Precisión Total	23±2ºC	0 a 55ºC	
	0 a 55ºC	±1.0% del FS	

7 CQM1H-SCB41

La Tarjeta Opcional CQM1H-SCB41 se trata de otra de las nuevas tarjetas opcionales que se pueden utilizar con el CQM1H-CPU51/61, que puede ser instalada, únicamente, en el slot 1 (slot izquierdo) de la CPU. Esta tarjeta no puede ser instalada en el slot 2 (slot derecho).
Esta tarjeta tiene dos puertos serie de comunicaciones, de esta forma se puede incrementar fácilmente el número de puertos del CQM1H.

7.1 Características

La tarjeta serie de comunicaciones permite aumentar el número de puertos serie del CQM1H sin necesidad de utilizar ningún slot de E/S. Permite programar Macros de Protocolo (algo que no es posible realizar en los puertos de la CPU), por tanto, proporciona la posibilidad de conectar fácilmente cualquier dispositivo de propósito general que tenga un puerto serie.



La tarjeta tiene ambos puertos: RS-232C y RS-422A/485. El puerto RS422A/485 da la posibilidad de realizar conexiones 1:N con dispositivos de propósito general sin necesidad de utilizar ningún conversor. Las conexiones 1:N se pueden utilizar con Macros de Protocolo o con NT-Link 1:N.

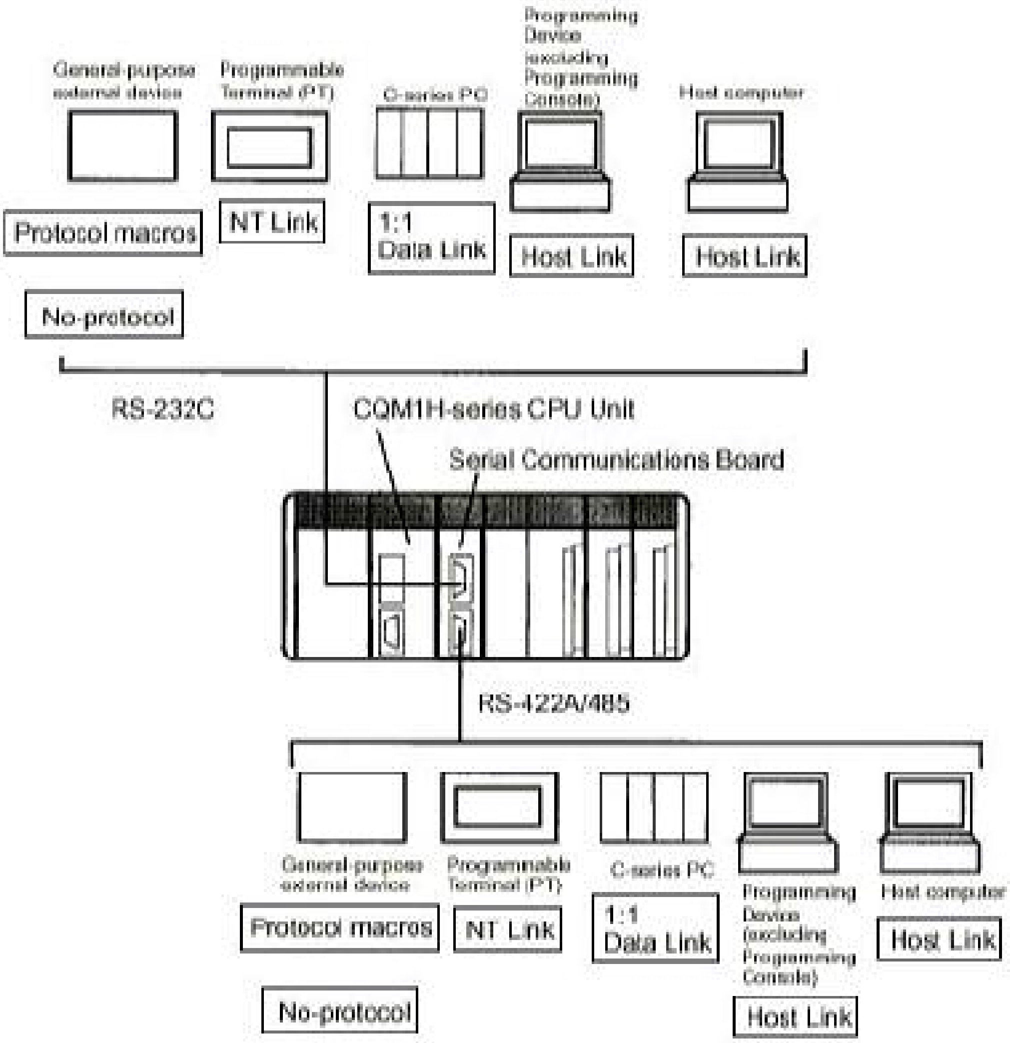
7.2 Configuración del Sistema

La Tarjeta Serie de Comunicaciones soporta los siguientes modos de comunicación:

- Host Link: comunicaciones con un ordenador, dispositivo de programación o Terminal Programable.
- Protocolo Libre: comunicaciones sin protocolo (TXD y RXD) con dispositivos externos estándar.
- Macro de Protocolo: comunicaciones de acuerdo con las especificaciones de comunicaciones del dispositivo externo.
- PC-Link 1:1: enlace 1:1 con un CQM1H, CQM1 u otro PLC de serie C.
- NT-Link 1:N: comunicaciones 1:1 ó 1:N con terminales programables.
- NT-Link 1:1: comunicaciones 1:N con terminales programables.

En el siguiente diagrama se puede ver un ejemplo de los distintos dispositivos que se pueden conectar a la tarjeta.

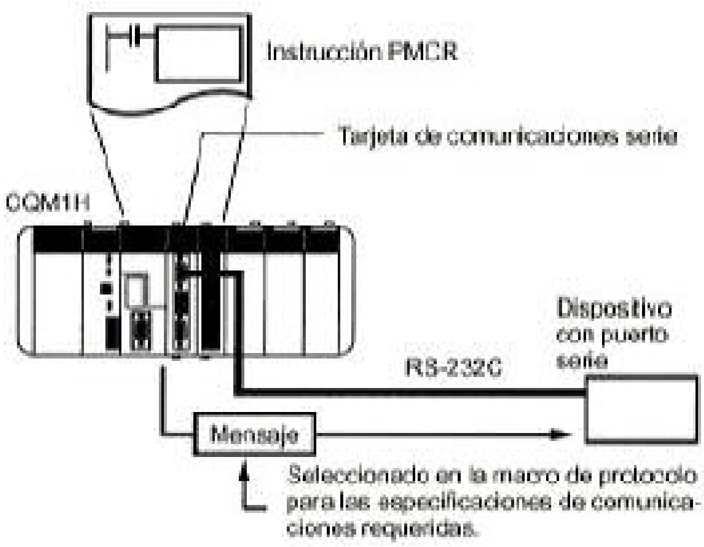
Nota: Los modos NT-Link 1:1 y NT-Link 1:N utilizan distintos protocolos y no son compatibles entre sí.



7.3 Macros de Protocolo

Las macros de protocolo proporcionan un sistema para crear protocolos de comunicaciones de datos, de acuerdo con las especificaciones de comunicaciones de dispositivos externos con puerto serie (semi-dúplex, sincronización start-stop). Las macros de protocolo se crean con el Software de Soporte **"CX-Protocol"**, para después grabar las macros creadas en la tarjeta de comunicaciones serie, donde se podrán ejecutar en cualquier momento utilizando la instrucción PMCR en el programa de diagrama de relés de la CPU.

Con el CX-Protocol y la tarjeta de comunicaciones serie, se suministran protocolos estándar para comunicar con dispositivos OMRON, tales como controladores de temperatura, procesadores inteligentes de señal, lectores de código de barras y módems. Los protocolos estándar también se pueden modificar con el CX-Protocol para aplicaciones específicas.



7.4 Especificaciones de la Tarjeta de Comunicaciones Serie

Elemento		Especificaciones
Modelo		CQM1H-SCB41
Clasificación de la Unidad		Tarjeta Opcional de la serie CQM1H
CPUs aplicables		CQM1H-CPU61/51
Huecos de montaje y Número de Tarjetas		Se puede montar 1 tarjeta en el hueco 1 (izquierdo)
Puertos de Comunicaciones Serie	Puerto 1	RS-232C: 19.2 Kbps máx., 15 m máx.
	Puerto 2	RS-422A/485: 19.2 Kbps máx., 500 m máx.
Protocolos	Puerto 1	Cada puerto se puede seleccionar independientemente a modo Host Link , Protocolo Libre, Macro de Protocolo, PC-Link 1:1, NT-Link 1:1 o NT-Link 1:N.
	Puerto 2	
Consumo		200 mA máx.

PLC Cable and Wiring Guide

OMRON®

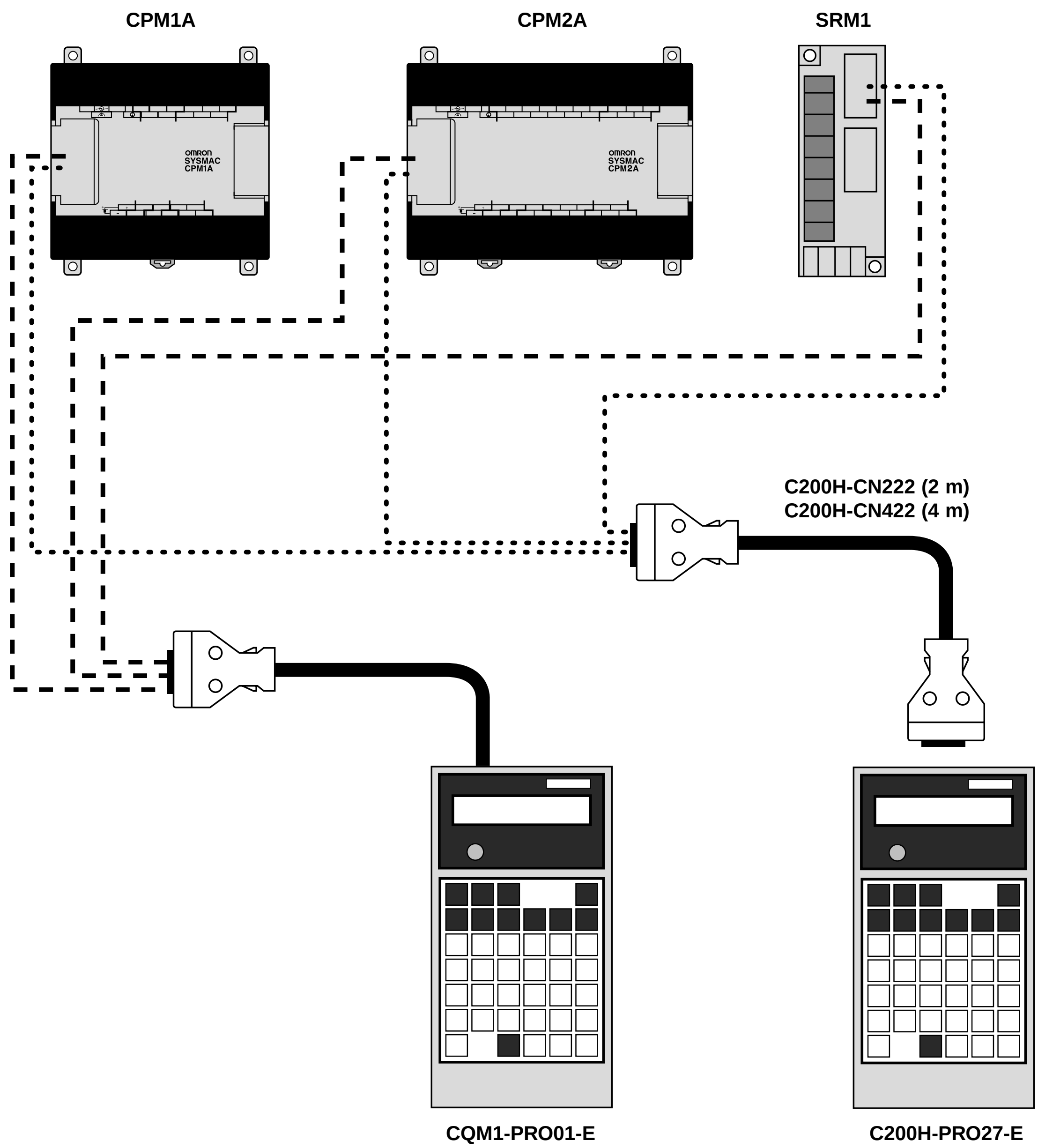
Table of Contents

Reference Information

PLC Connections

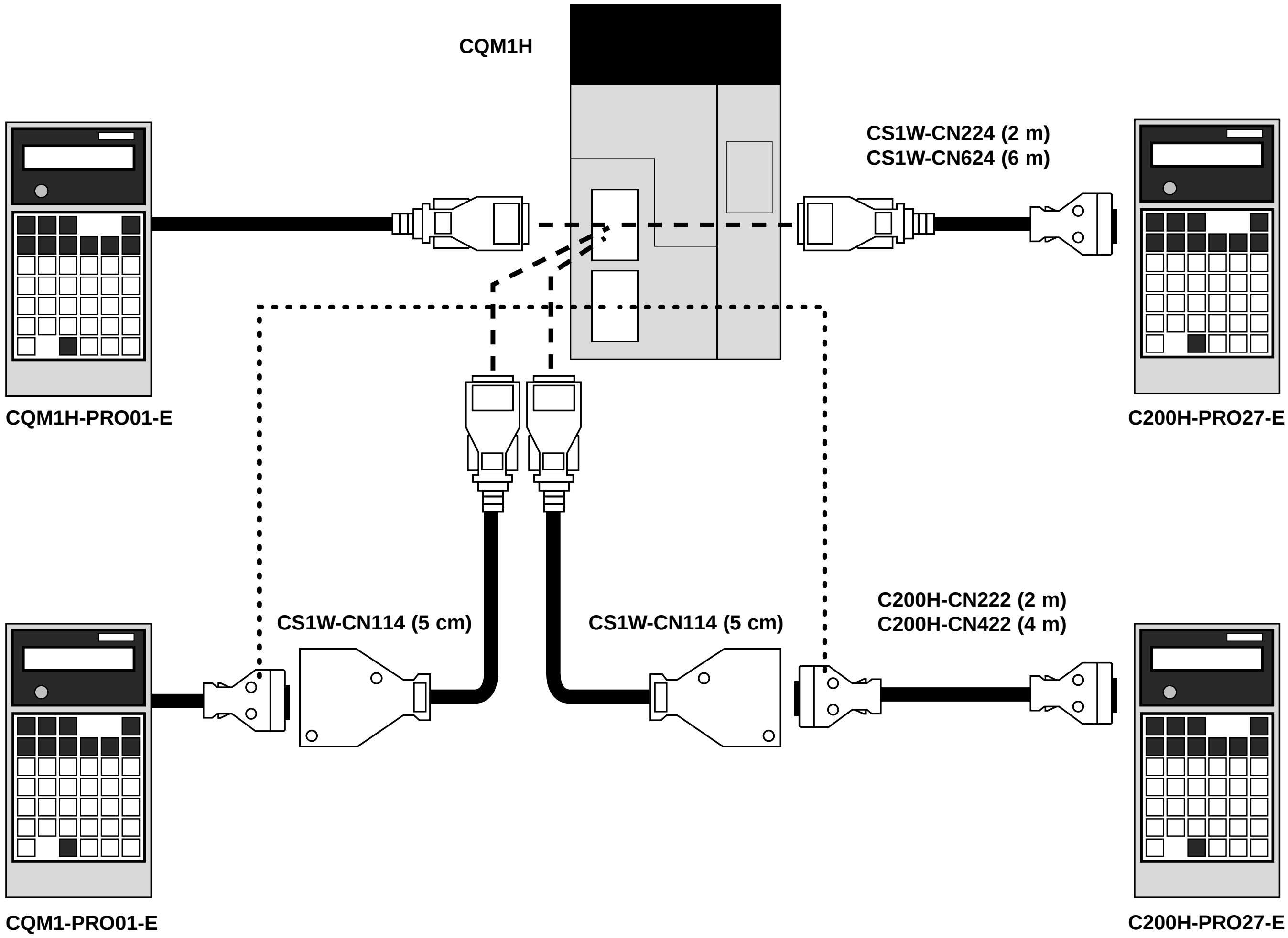
The following pages illustrate the cabling options for connecting Omron programmable controllers with computers, Omron's HMIs, hand-held programmers, high-density I/O modules and I/O terminal blocks.

Hand-held Programmers and CPM1A, CPM2A, SRM1 Peripheral Port



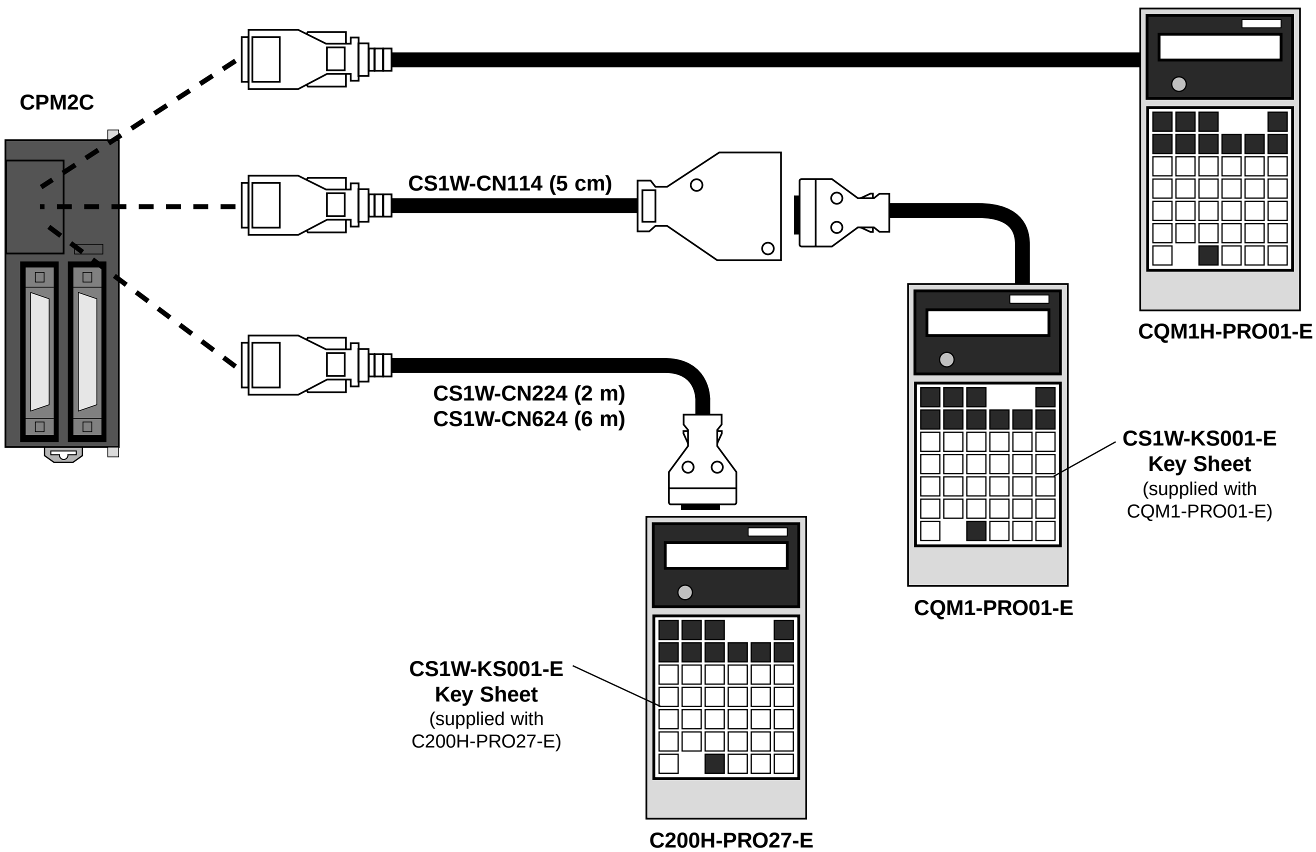
Reference Information

Hand-held Programmers and CQM1H Peripheral Port



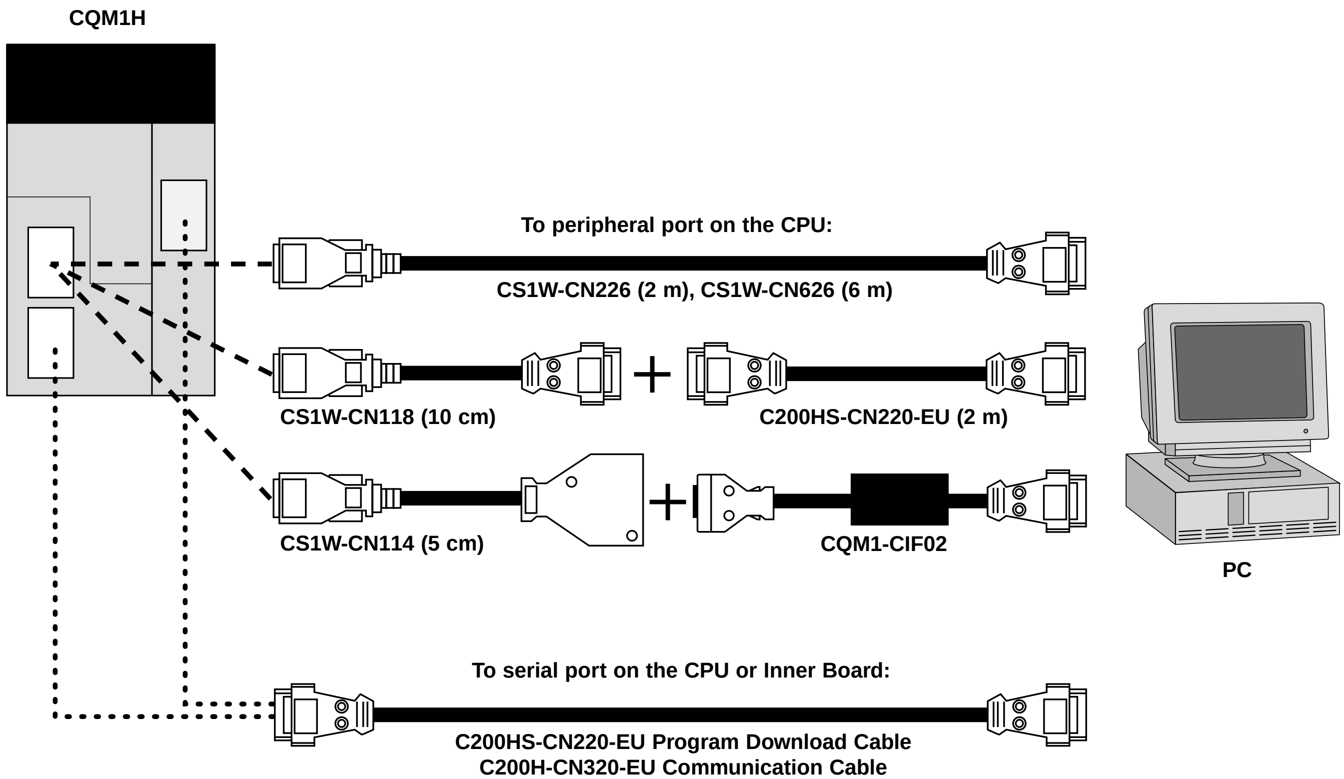
Reference Information

Hand-held Programmer and CPM2C Communication Port

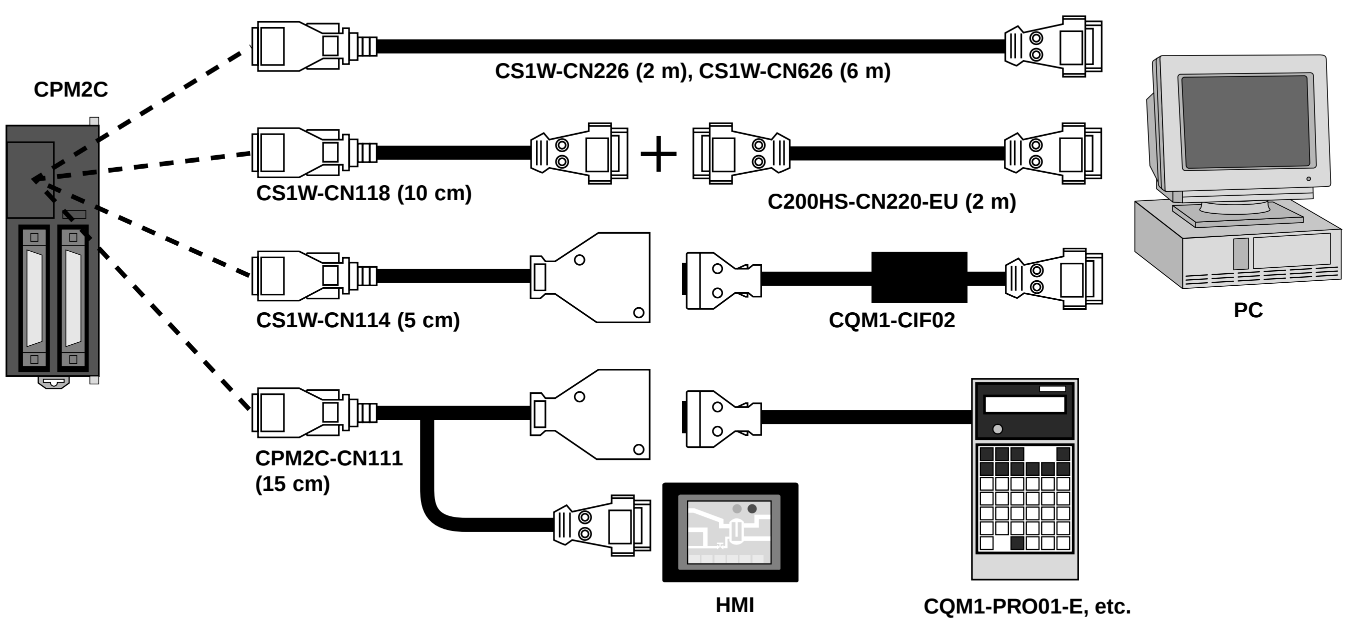


Reference Information

CQM1H and PC

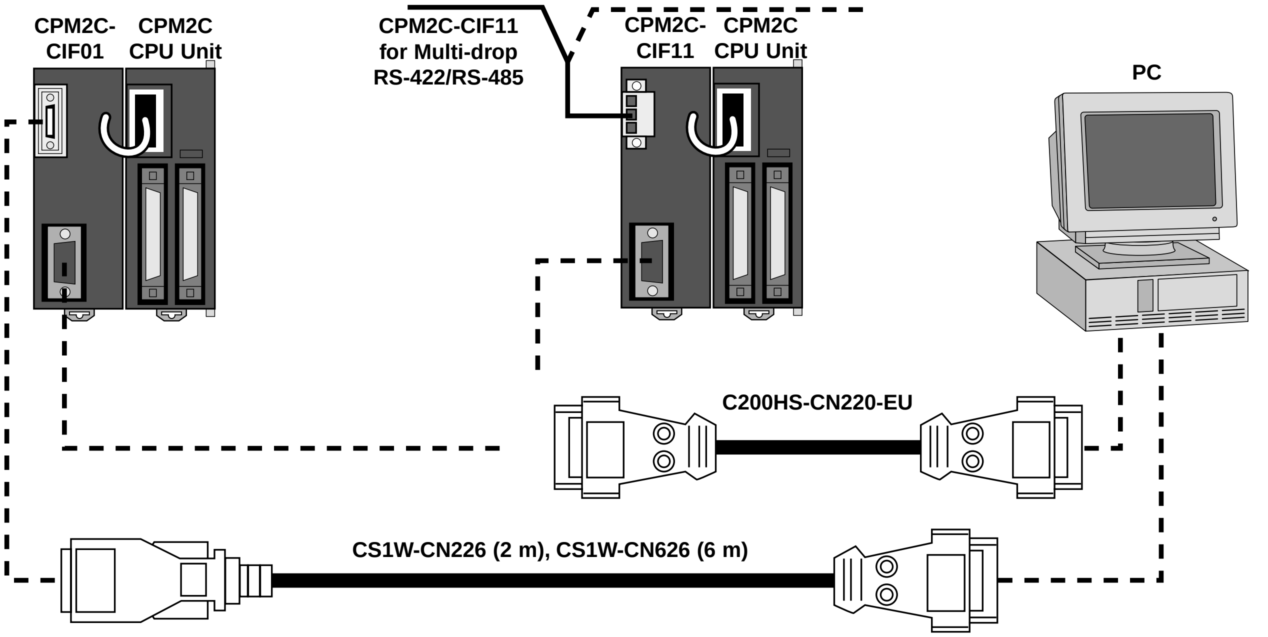


CPM2C and PC



Reference Information

CPM2C + Serial Communication Adapter and PC

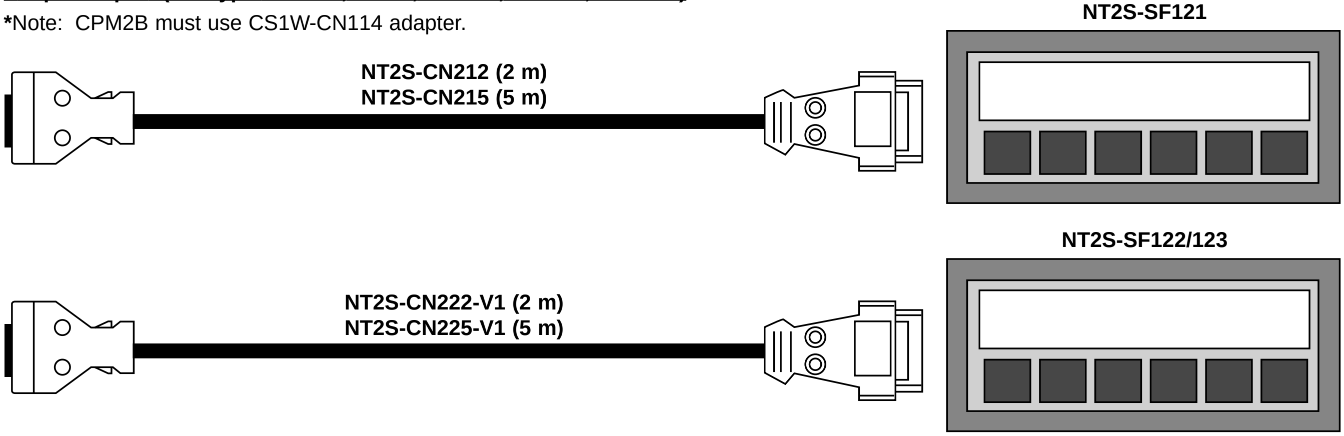


NT2S Message Display and Programmable Controllers

Peripheral port (Old type: C200H, SRM1, CPM2A, CPM1A, CPM2B*)

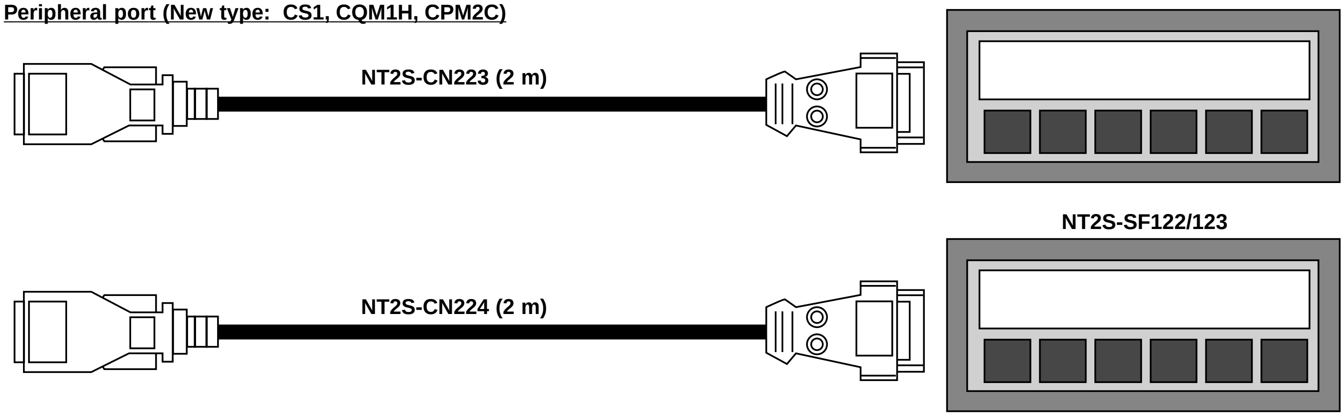
*Note: CPM2B must use CS1W-CN114 adapter.

NT2S-SF121



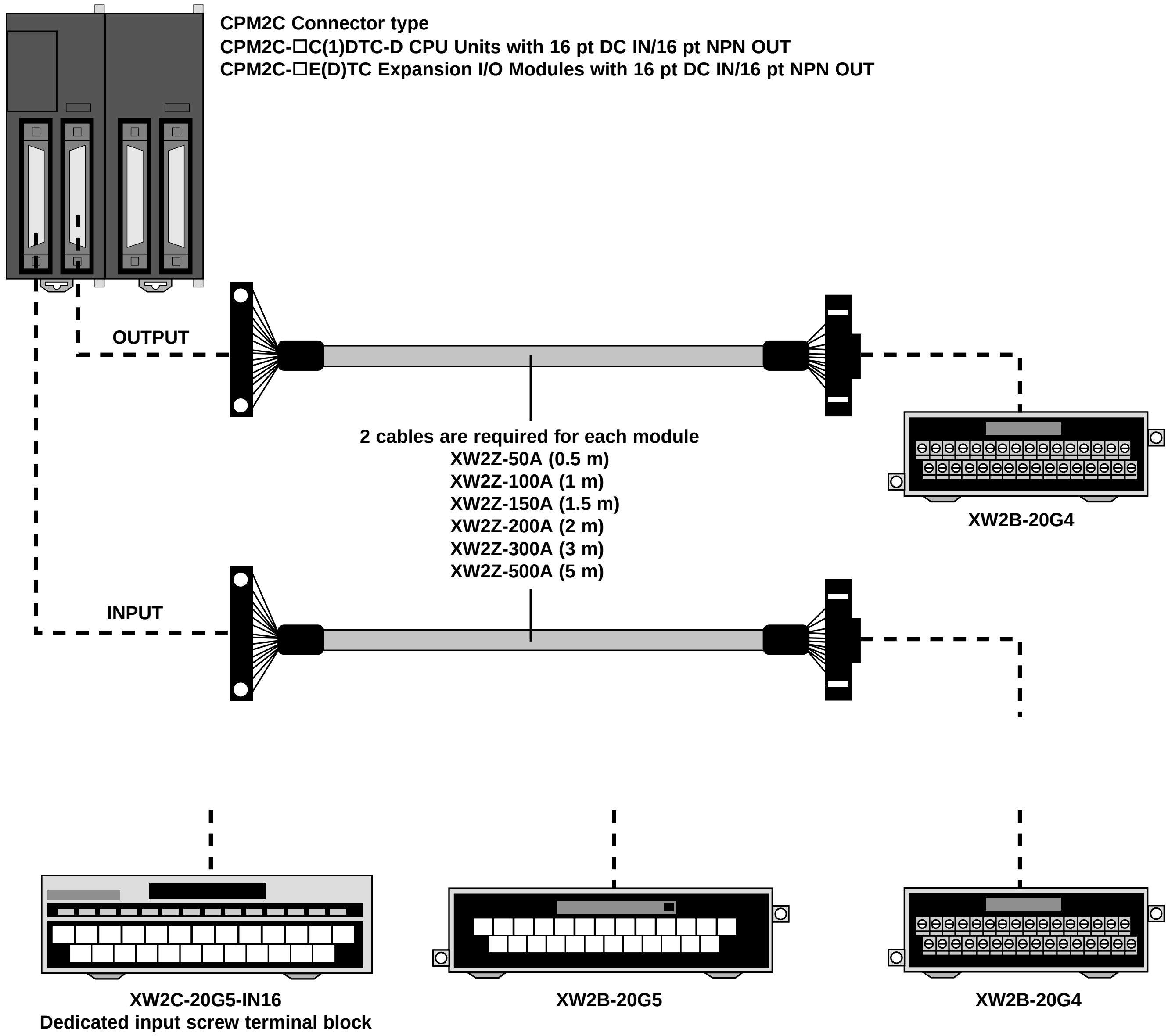
NT2S-SF121

Peripheral port (New type: CS1, CQM1H, CPM2C)



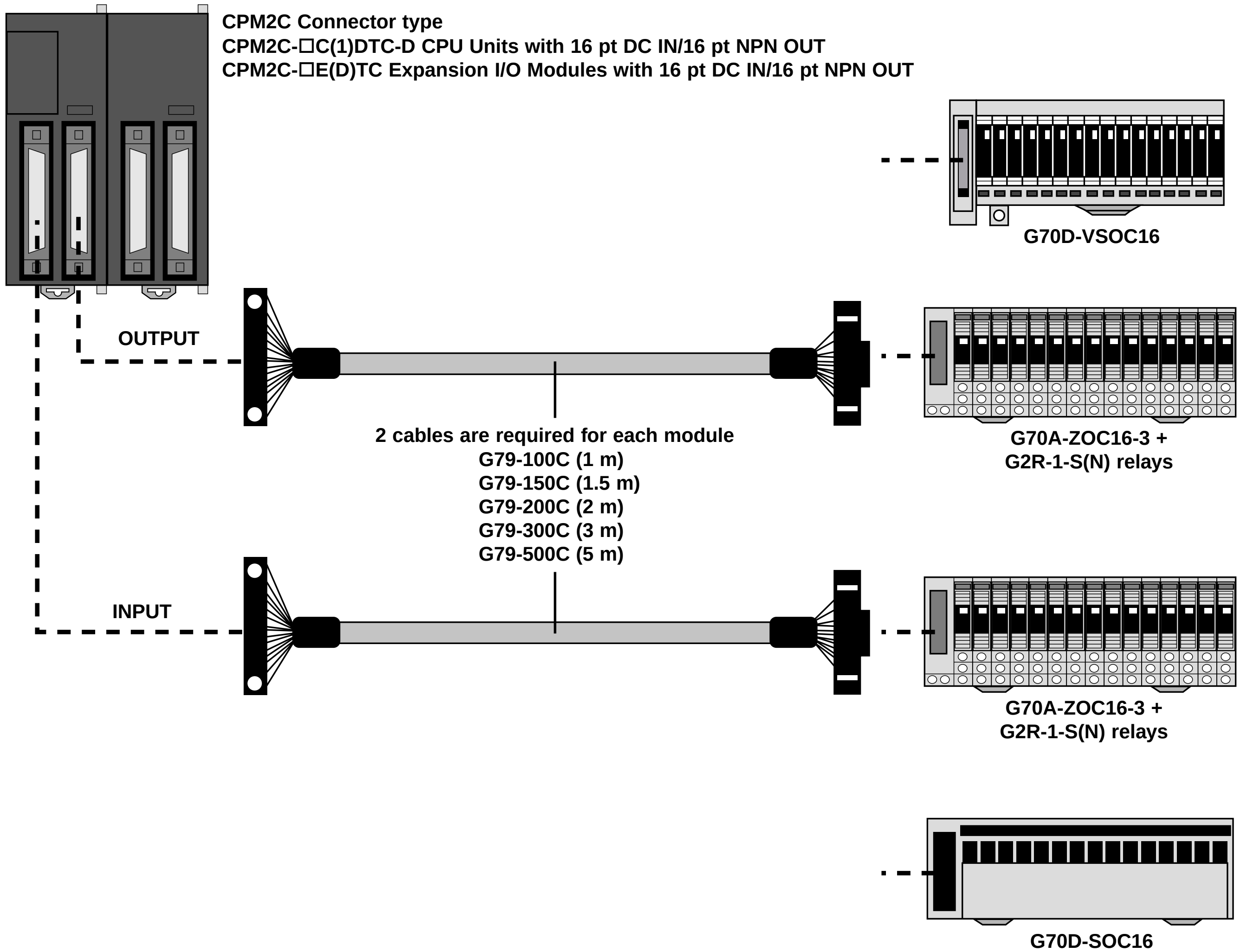
Reference Information

CPM2C CPU and Expansion I/O + XW2B/XW2C 20-pin Screw Terminal Blocks

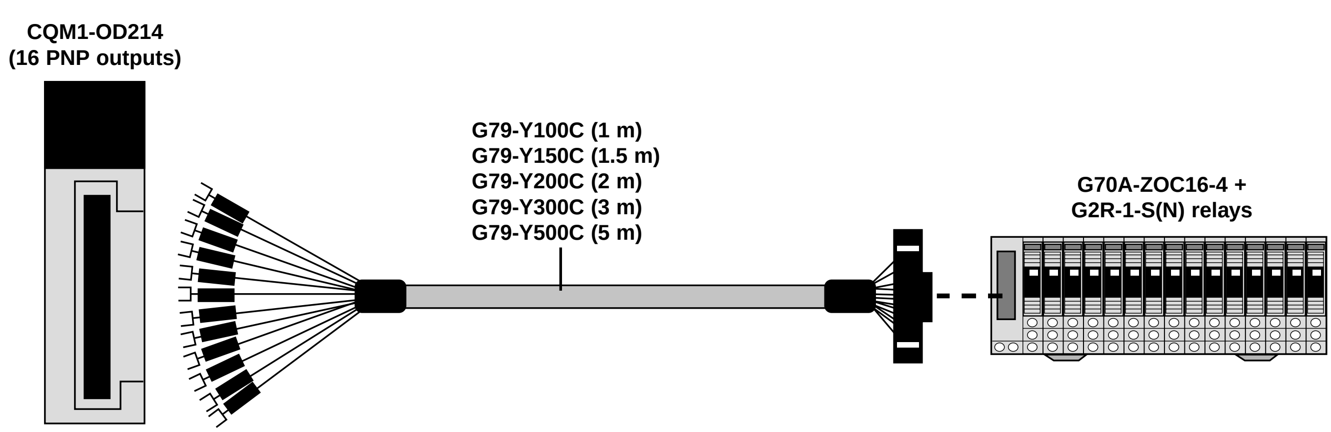


Reference Information

CPM2C CPU and Expansion I/O + G70A, G70D Relay I/O Blocks

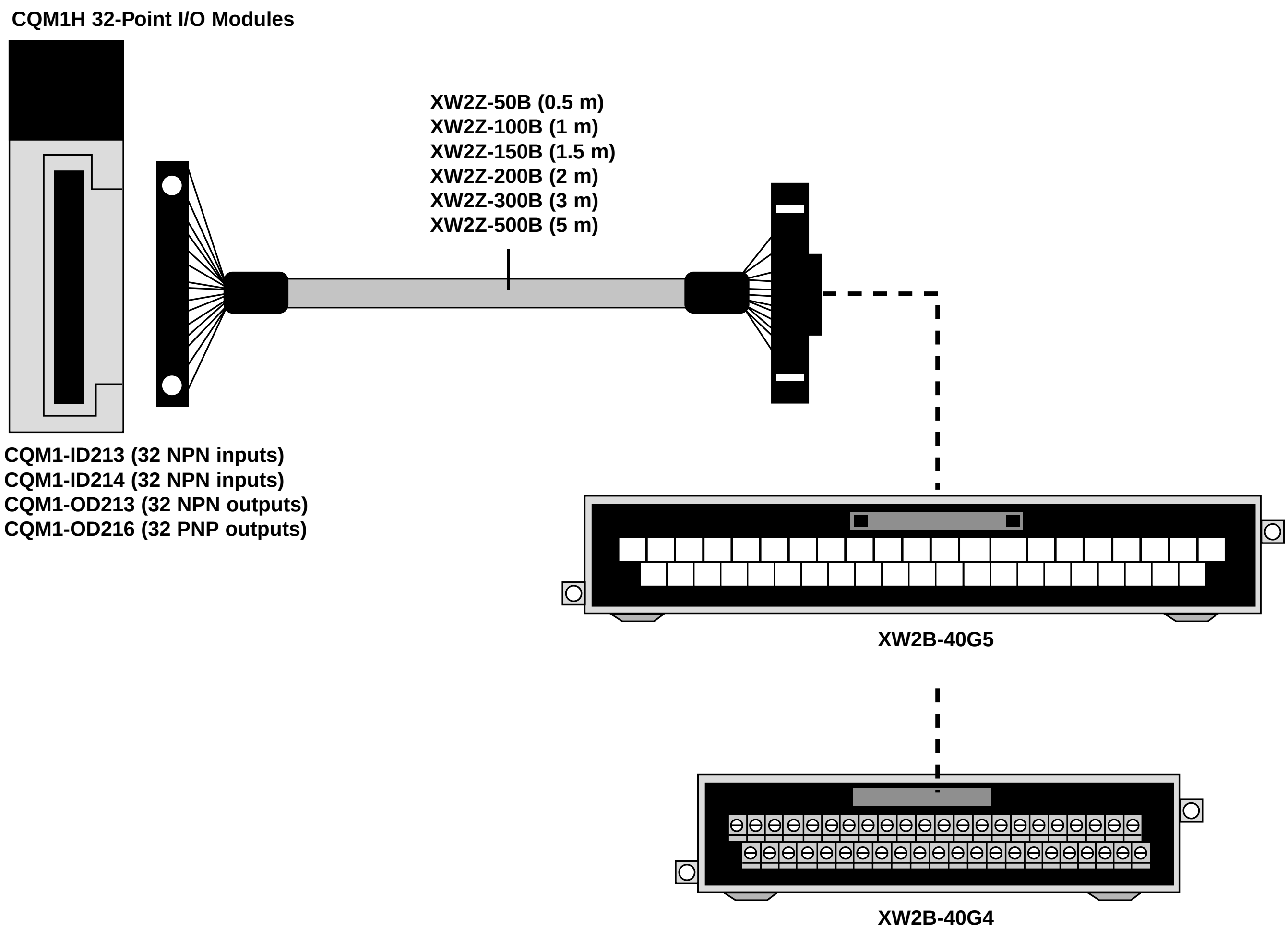


CQM1H 16-point PNP Output Module + G70A Relay I/O Block



Reference Information

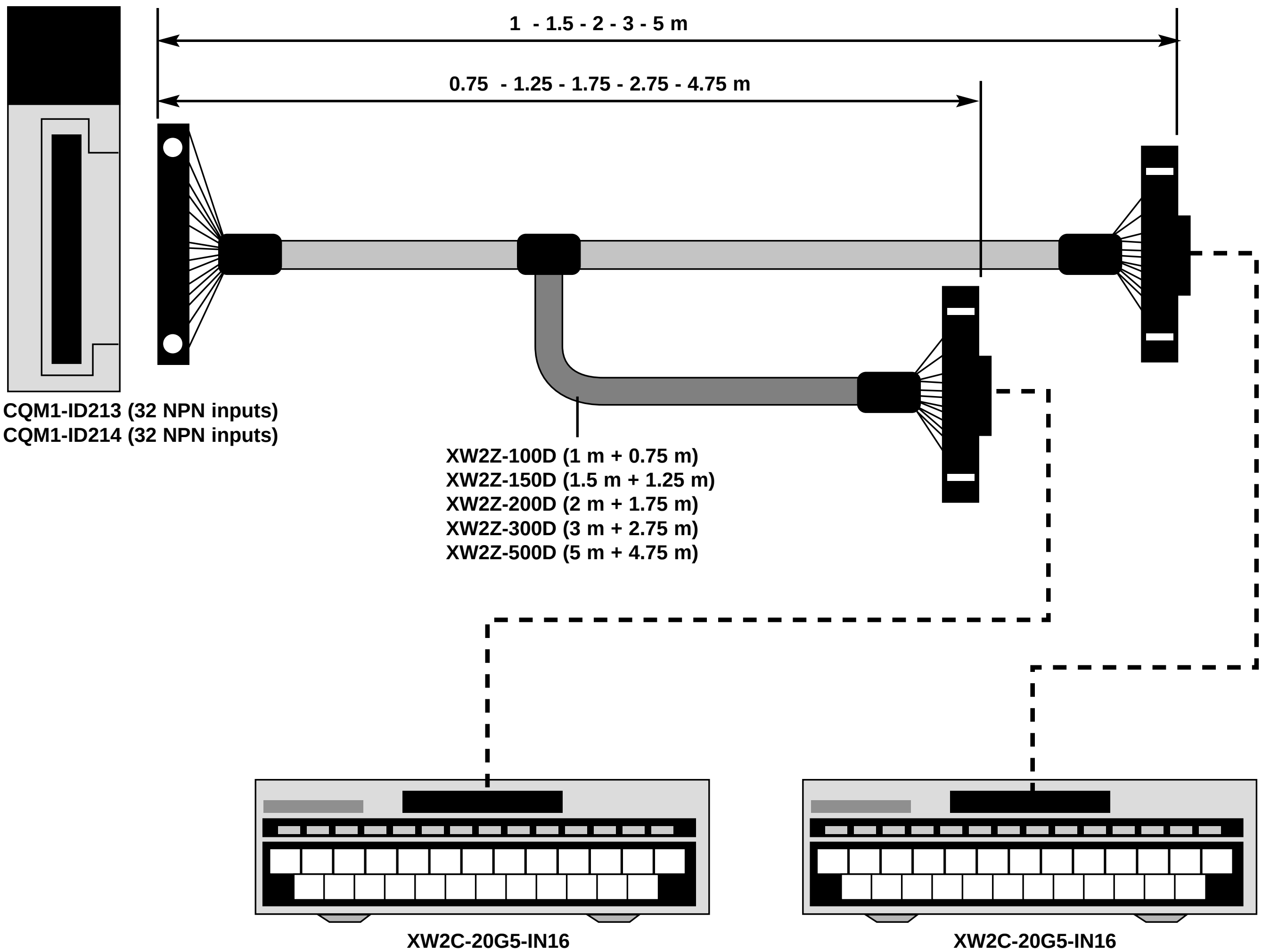
CQM1H High-Density I/O Modules + XW2B Screw Terminal Blocks



Reference Information

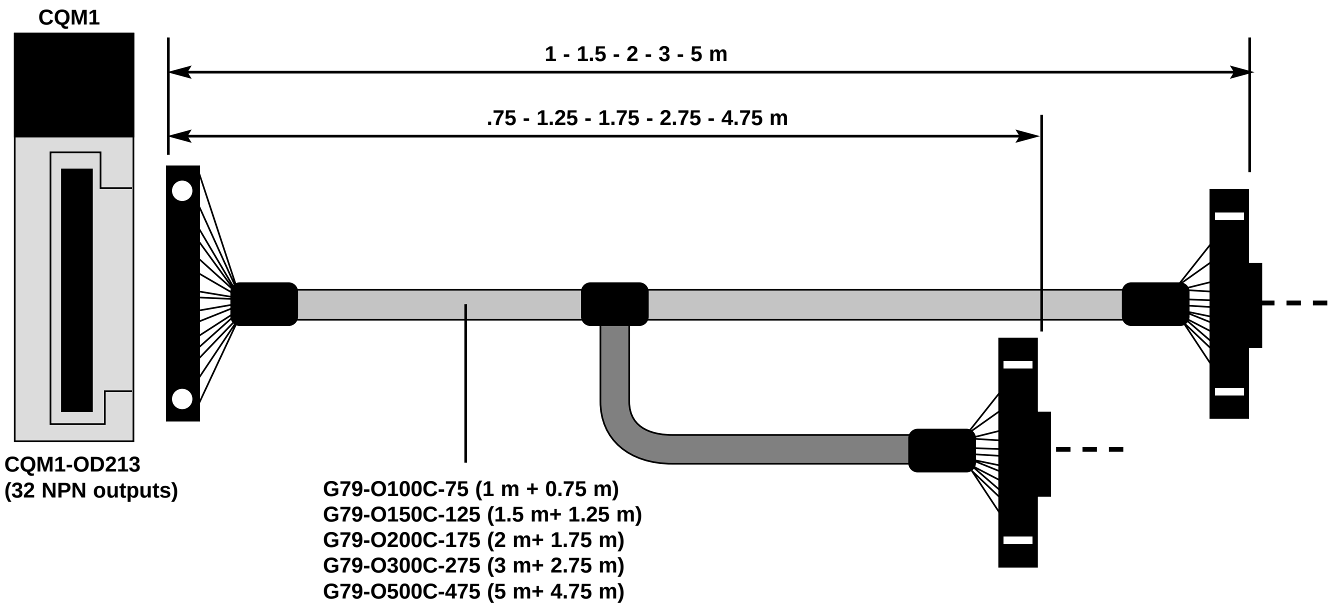
CQM1H High-Density Input Modules + XW2C Input Screw Terminal Blocks

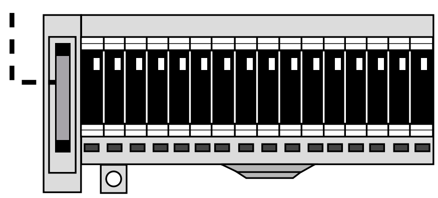
CQM1H 32-Point Input Modules

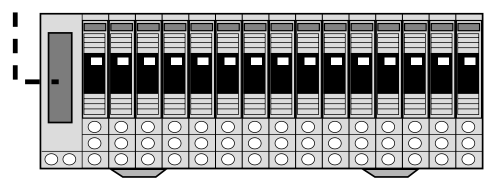


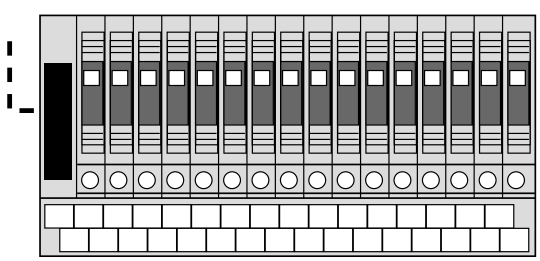
Reference Information

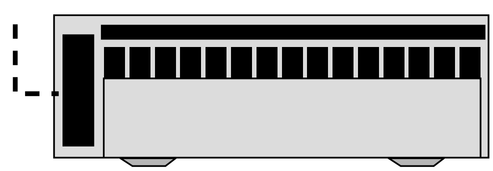
CQM1H High-Density Output Modules + Output Relay Blocks




G70D-VSOC16

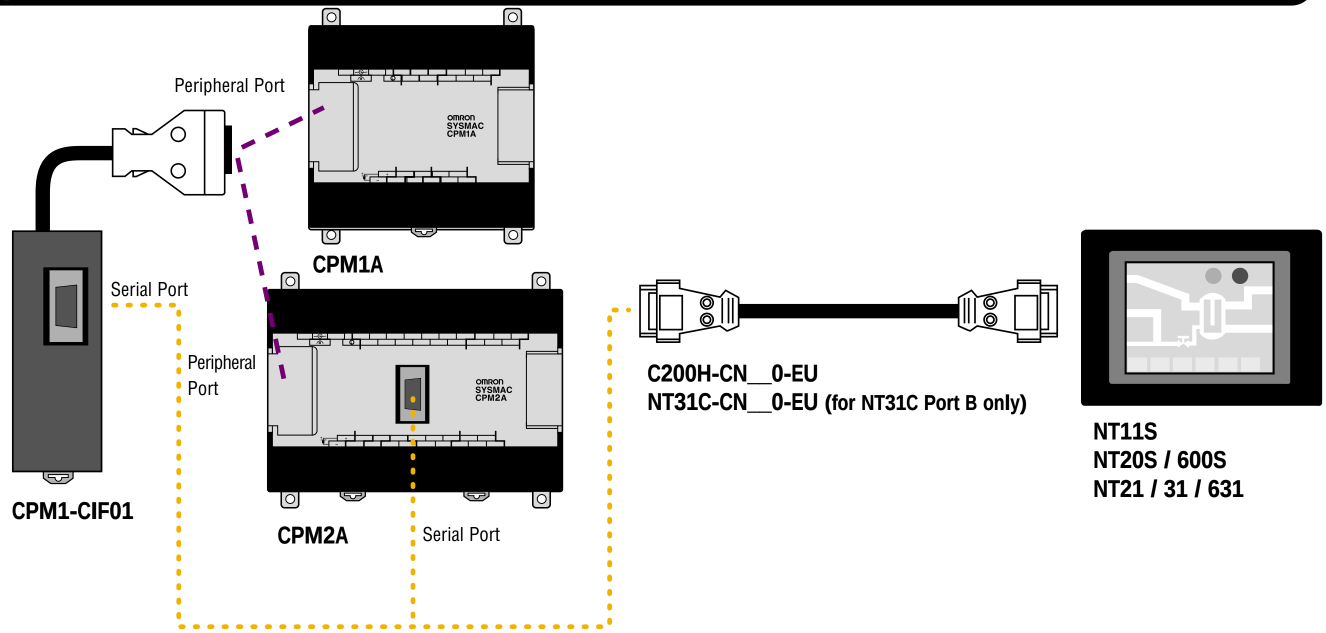

G70A-ZOC16-3 +
G2R-1-S(N) relays


G7TC-OC16 Relay Block or
P7TF-OS16 Block Base with
G7T-1112S Relays or
G3TA-ODX02S SSRs

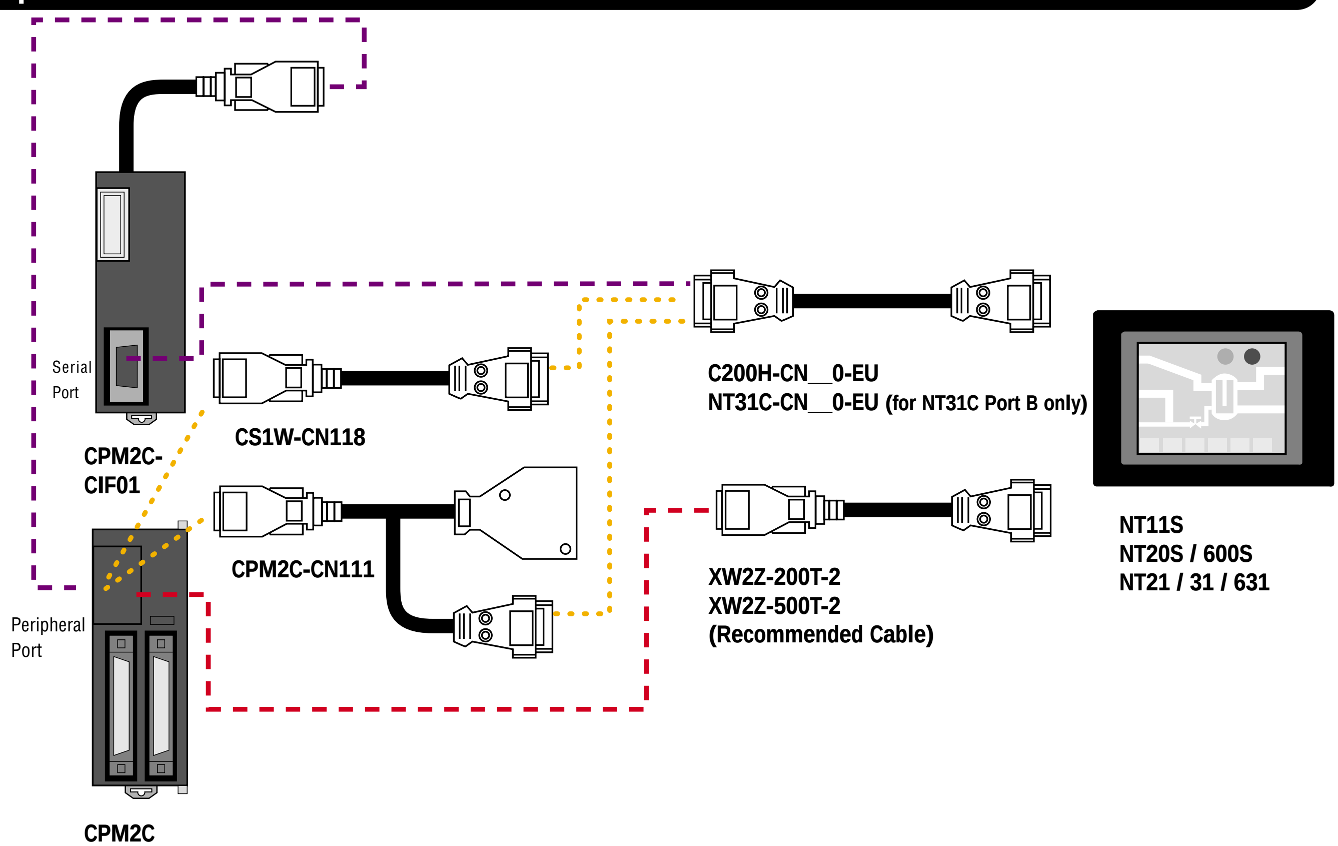

G70D-SOC16

Cable Solutions for Omron PLCs

Operator Interface Terminals and CPM1A/CPM2A

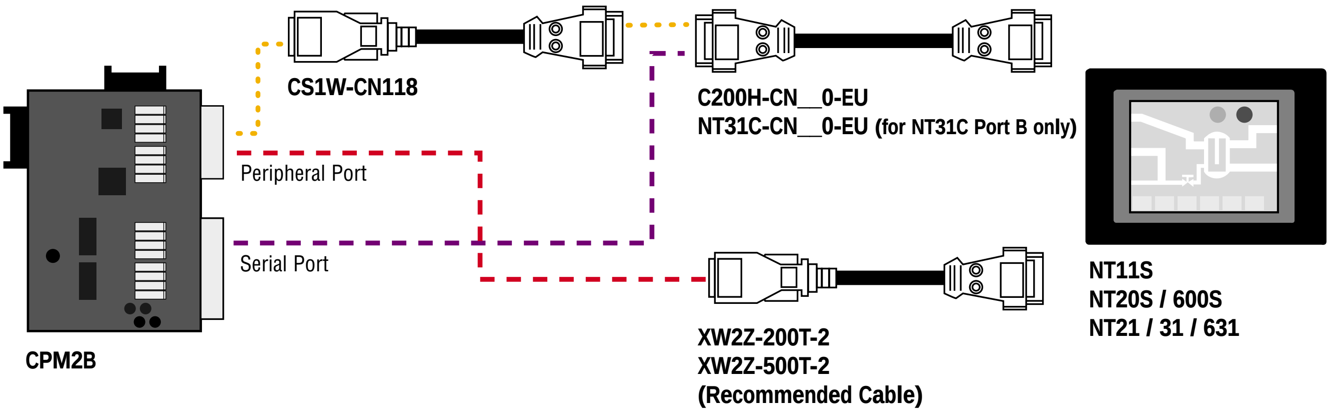


Operator Interface Terminals and CPM2C PLC

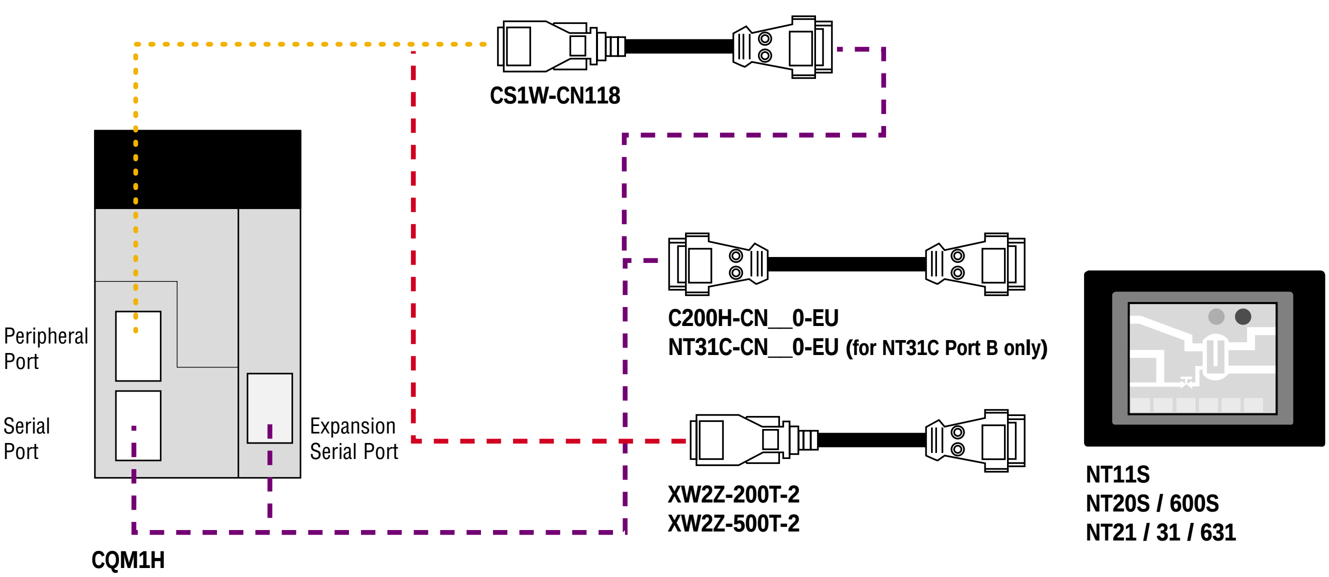


Cable Solutions for Omron PLCs

Operator Interface Terminals and CPM2B PLC

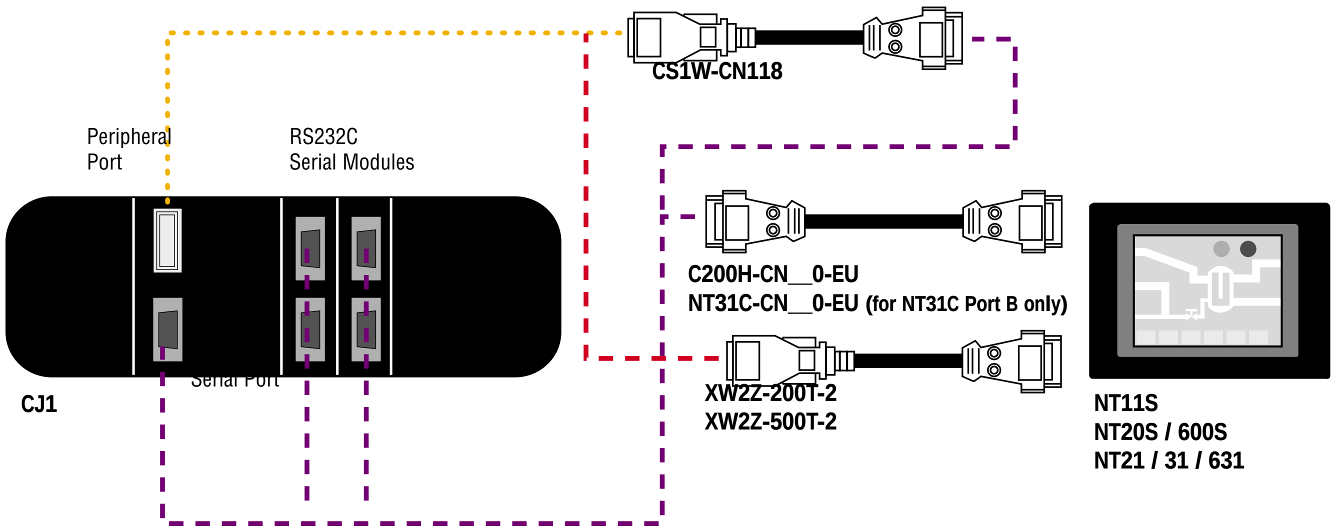


Operator Interface Terminals and CQM1H PLC

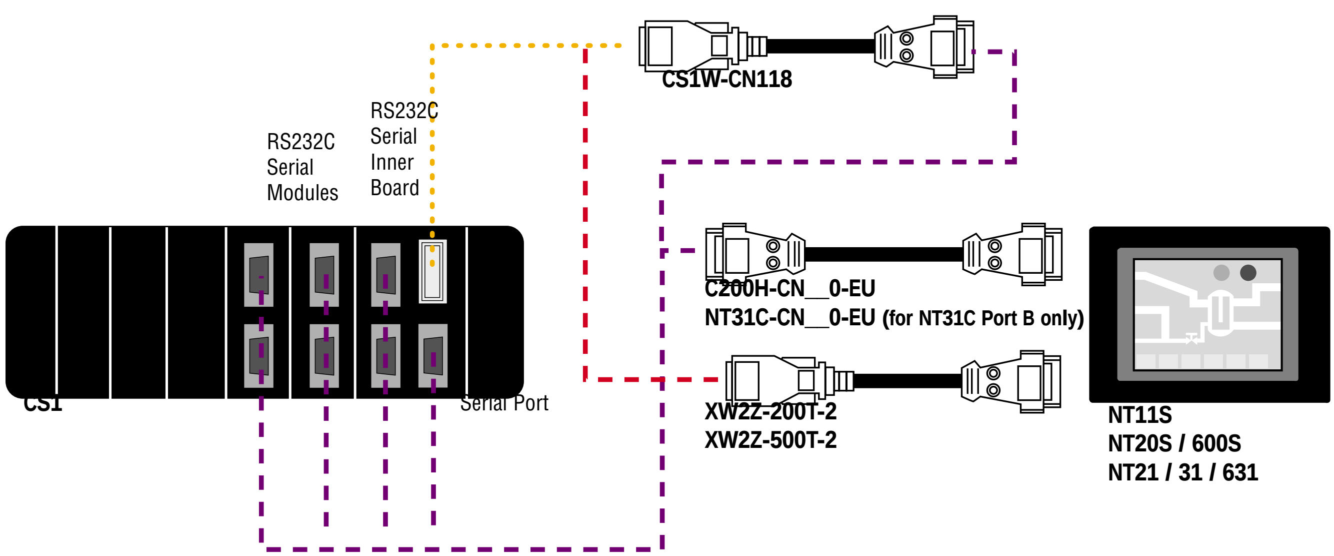


Cable Solutions for Omron PLCs

Operator Interface Terminals and CJ1 PLC

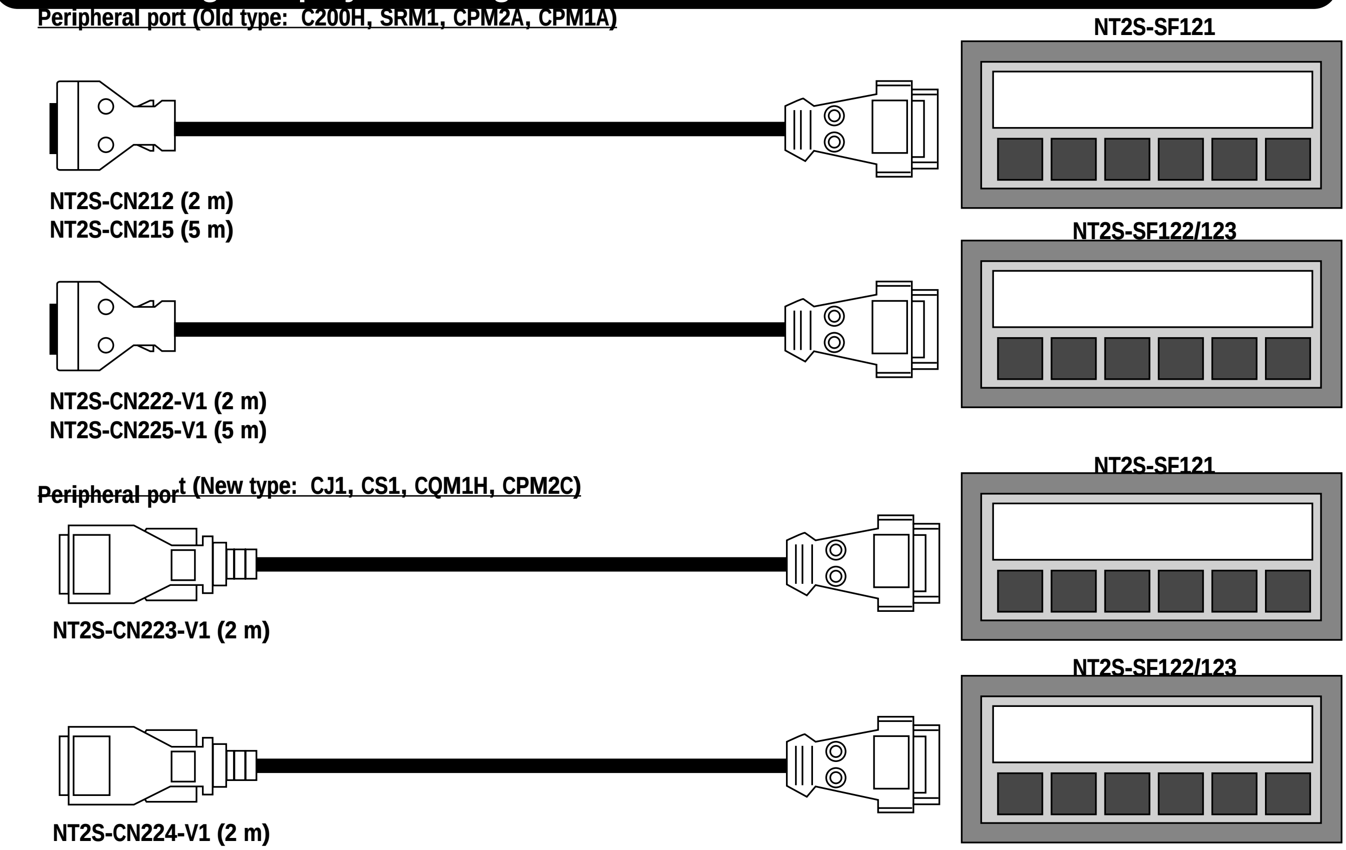


Operator Interface Terminals and CS1 PLC

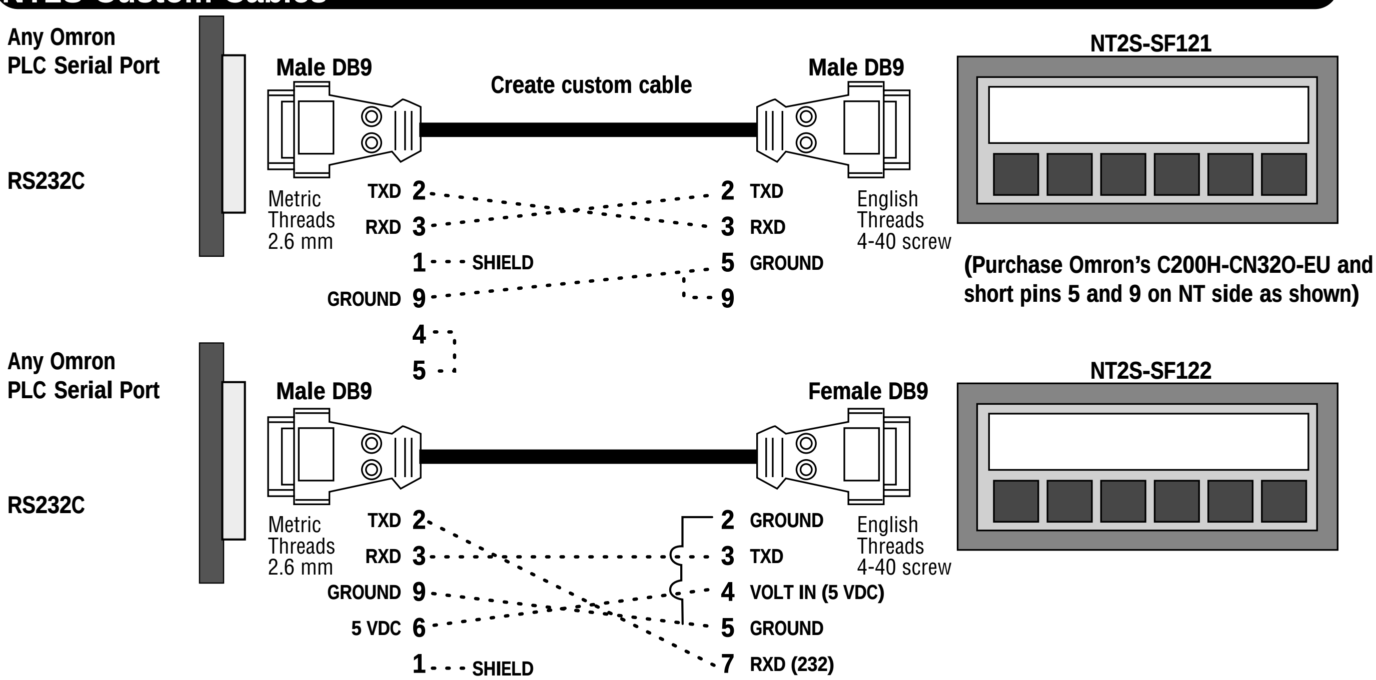


Cable Solutions for Omron PLCs

NT2S Message Display and Programmable Controllers



NT2S Custom Cables



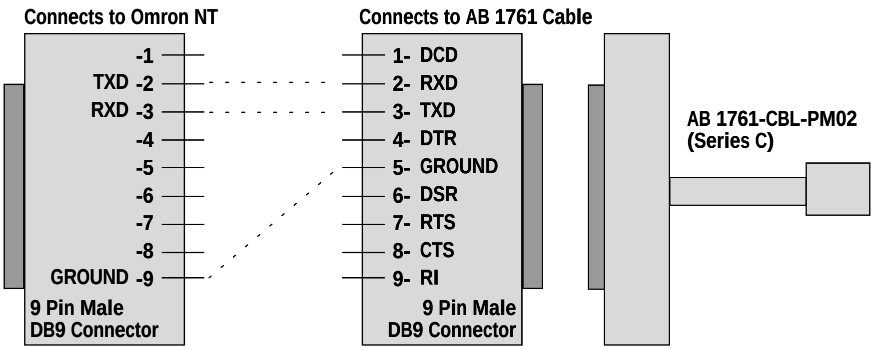
Custom Cable Ordering Information

Description	Part Number
Metric thread shell and screws - 2.6 mm	XM2S-0911
English thread shell and screws - 4-40 screw	XM2S-0913
Male connector	XM2A-0901
Female connector	XM2D-0901

Cable Solutions for Multi-Vendor PLCs

Allen Bradley MicroLogix 1200

An alternative cable configuration uses a custom RS-232 9-to-9 PIN cable connecting to the Allen-Bradley 1767-CBL-PM02(Series C). The diagram below shows the pinouts for the custom RS-232 cable:

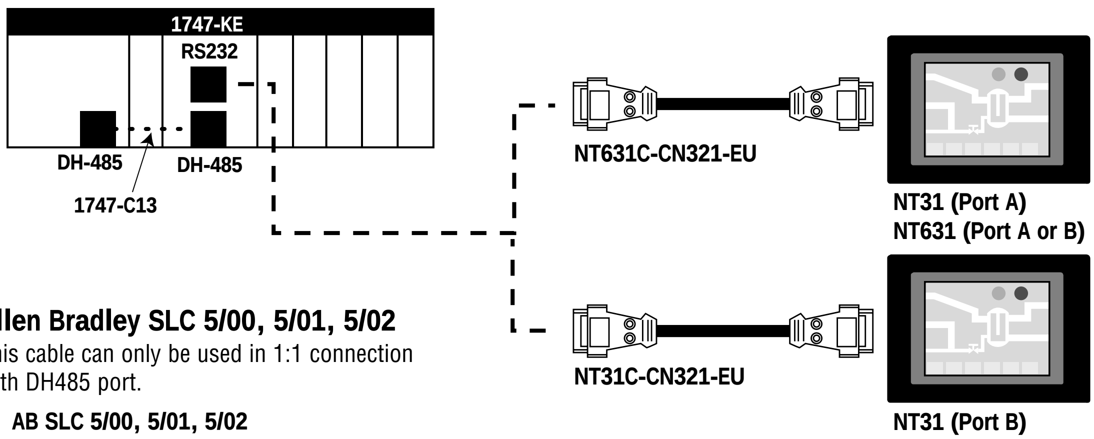


AB MicroLogix 1200 Communication Cables	
1761-CBL-PM02(Series C)	DB9 to 8 pin mini-din connector (order from AB)

Allen Bradley SLC 5/02

Communicates via AB's DF1 protocol. This PLC comes with only a DH-485 port. The Allen-Bradley 1747-KE module must be purchased to provide a serial connection on the SLC 5/02. Connect the communication cable from the NT to the serial port on the 1747-KE module.

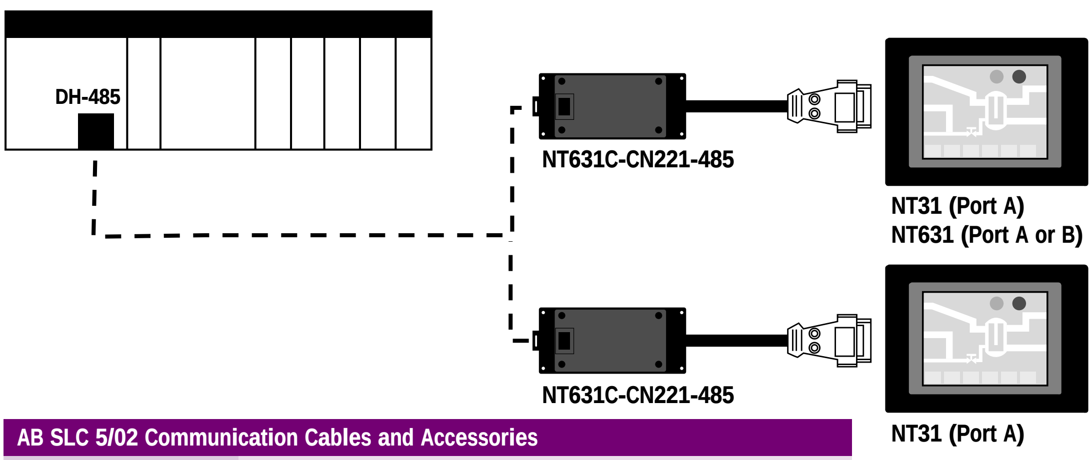
AB SLC 5/02



Allen Bradley SLC 5/00, 5/01, 5/02

This cable can only be used in 1:1 connection with DH485 port.

AB SLC 5/00, 5/01, 5/02



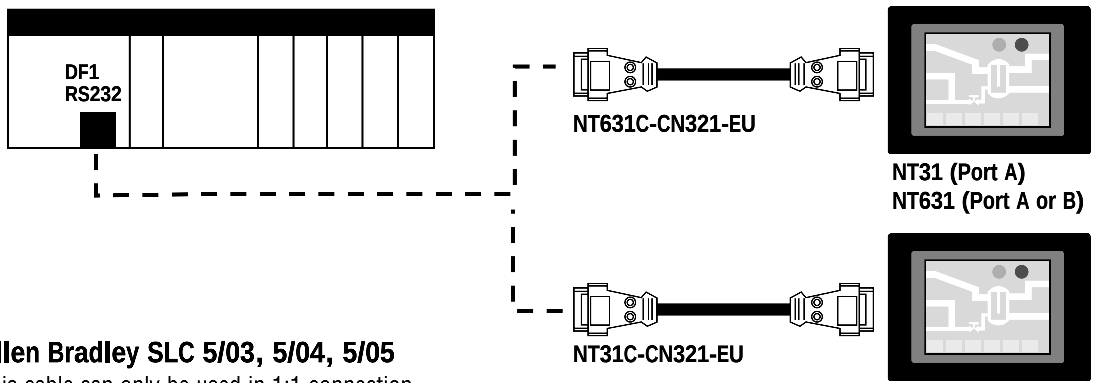
AB SLC 5/02 Communication Cables and Accessories	
NT31C-CN321-EU	3.0 m cable, 25 to 9 pin, NT to AB SLC PLC
NT631C-CN321-EU	3.0 m cable, 9 to 9 pin, NT to AB SLC PLC
1747-KE	DB9 Serial Port Module (order from AB)
1747-C13	DH-485 module connection cable
V060-E1-2	Operation Manual – Multi-vendor Connection

Cable Solutions for Multi-Vendor PLCs

Allen Bradley SLC 5/03, 5/04, 5/05

Communicates via AB's DF1 protocol. Connect the communication cable from the NT to a serial port on the PLC using Omron cable part numbers.

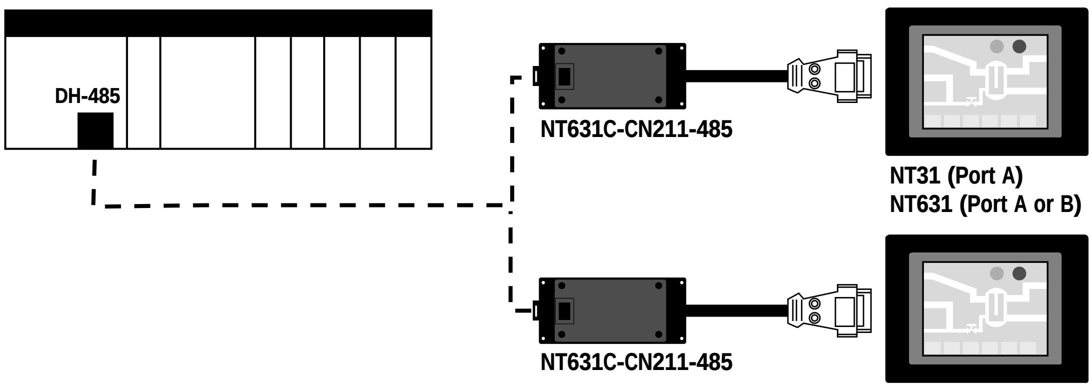
AB SLC 5/03, 5/04, 5/05



Allen Bradley SLC 5/03, 5/04, 5/05

This cable can only be used in 1:1 connection with DH485 port.

AB SLC 5/03, 5/04, 5/05

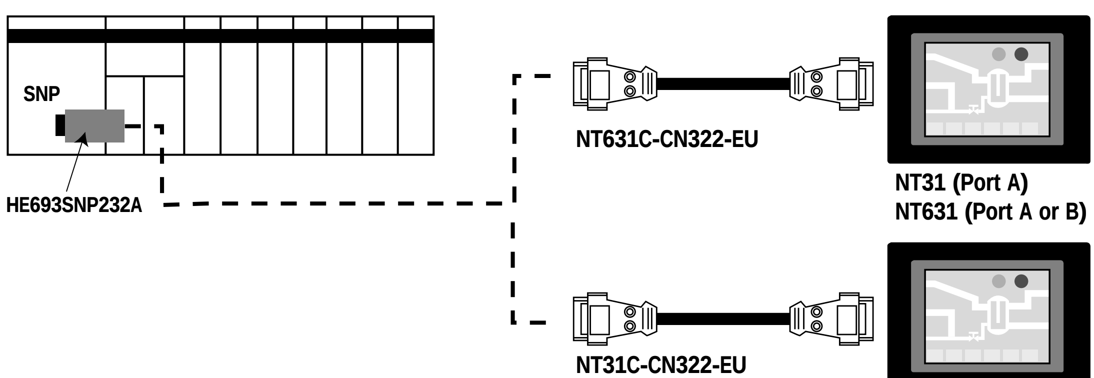


AB SLC 5/02 Communication Cables and Accessories	
NT31C-CN321-EU	3.0 m cable, 25 to 9 pin, NT to AB SLC PLC
NT631C-CN321-EU	3.0 m cable, 9 to 9 pin, NT to AB SLC PLC
V060-E1-2	Operation Manual – Multi-vendor Connection

GE 90-20 and 90-30 Series PLCs

Communicates via GE's SNP-X protocol. The Omron NT is communicating RS-232, while the GE PLC uses RS-422. An RS232 to RS422 converter (HE693SNP232A) is needed to complete communications.

GE 90-20 and 90-30 Series



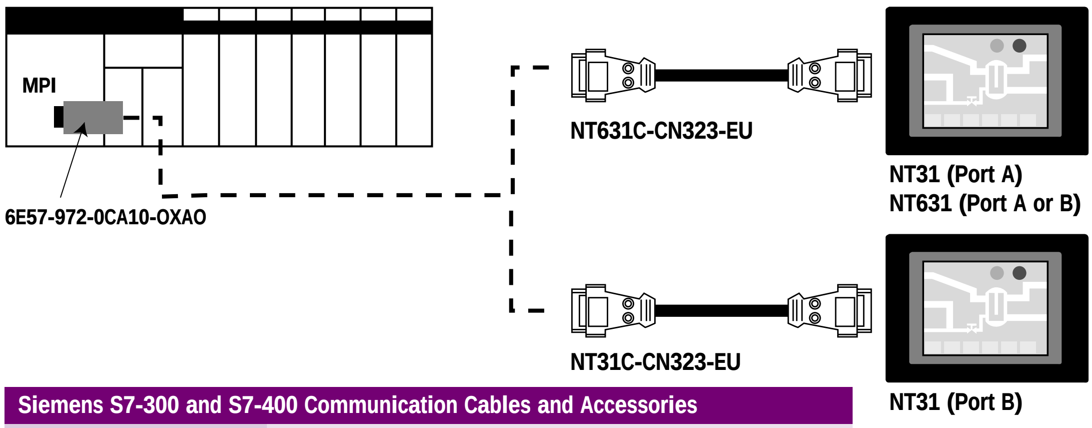
GE 90-20 and 90-30 Series Communication Cables and Accessories	
NT31C-CN322-EU	3.0 m cable, 25 to 9 pin, NT to GE PLC
NT631C-CN322-EU	3.0 m cable, 9 to 9 pin, NT to GE PLC
HE693SNP232A	RS232 to RS422 adapter (order from GE)
V060-E1-2	Operation Manual – Multi-vendor Connection

Cable Solutions for Multi-Vendor PLCs

Siemens S7-300 and S7-400 Series PLCs

Communicates with Siemens HMI Adapter protocol. The Omron NT is communicating RS-232 to the Siemens HMI adapter, 6E57-972-OCA10-OXAO. The adapter is necessary to convert the HMI Adapter protocol into the Siemens proprietary MPI protocol.

Siemens S7-300 and S7-400 Series

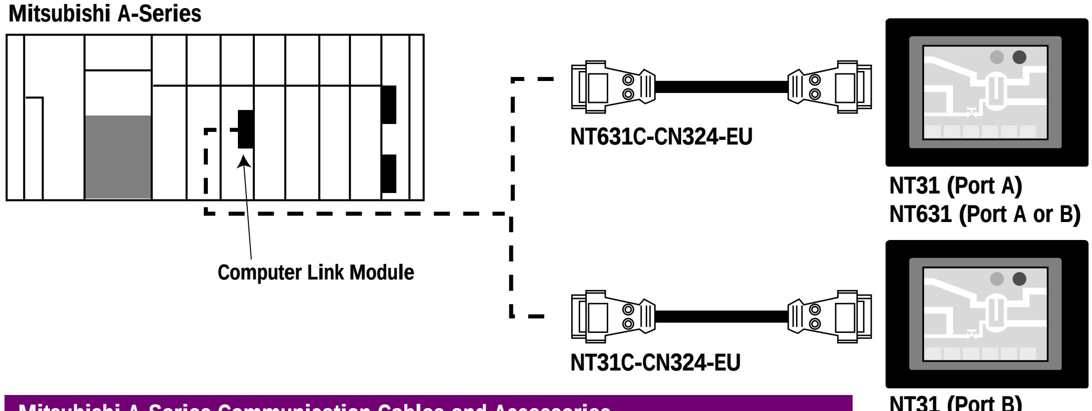


Siemens S7-300 and S7-400 Communication Cables and Accessories	
NT31C-CN323-EU	3.0 m cable, 25 to 9 pin, NT to Siemens PLC
NT631C-CN323-EU	3.0 m cable, 9 to 9 pin, NT to Siemens PLC
6E57-972-OCA10-OXAO	HMI Adapter for MPI protocol (order from Siemens)
V060-E1-2	Operation Manual – Multi-vendor Connection

Mitsubishi A-Series PLCs

Communicates using Mitsubishi's Computer Link protocol. The Omron NT and the Mitsubishi A-Series PLC are communicating using RS-232 communications. Communications can be RS-422 by using custom cables as specified in Operation Manual V042-E1-1.

Mitsubishi A-Series

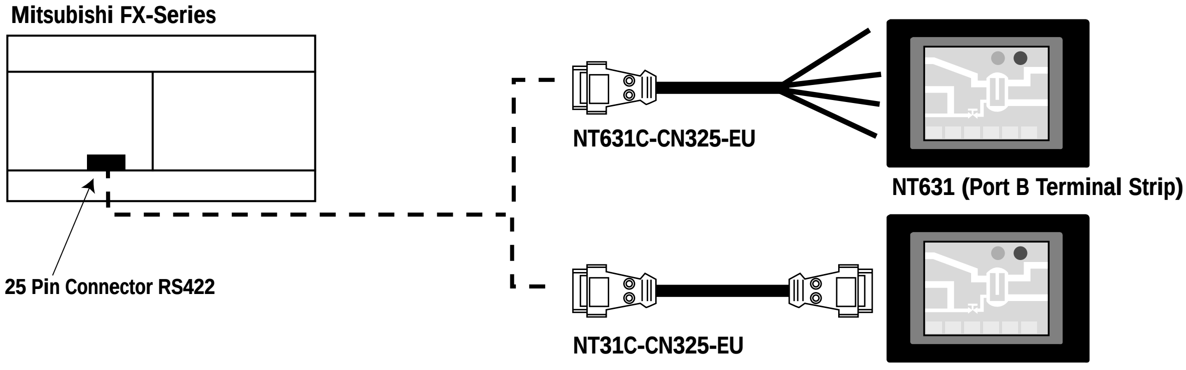


Mitsubishi A-Series Communication Cables and Accessories	
NT31C-CN324-EU	3.0 m cable, 25 to 9 pin, NT to Mits-A PLC
NT631C-CN324-EU	3.0 m cable, 9 to 9 pin, NT to Mits-A PLC
V042-E1-1	Operation Manual – PC (Mitsubishi) Connection

Cable Solutions for Multi-Vendor PLCs

Mitsubishi FX-Series PLCs

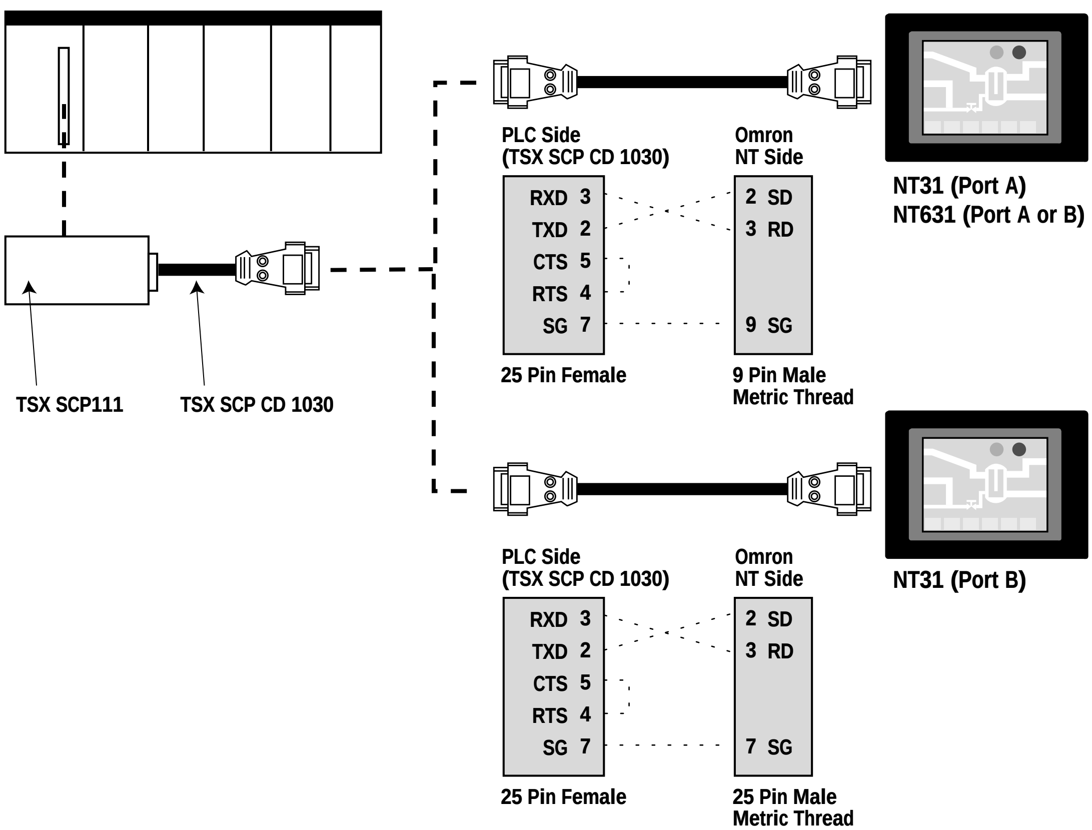
Communicates via Mitsubishi's Computer Link protocol. The Omron NT and Mitsubishi FX-Series PLC are communicating using RS422 communications. The NT31 cable connects from the 25-pin port B, while the NT631 connects from the RS422 terminal screws for Port B.



Mitsubishi A-Series Communication Cables and Accessories	
NT31C-CN325-EU	3.0 m cable, 25 to 25 pin, NT to Mits-FX PLC
NT631C-CN325-EU	3.0 m cable, 4 Wires to 25 pin, NT to Mits-FX PLC
FX-20P-CADP	Cable for FX0 & FX0N PLC (buy from Mitsubishi)
V042-E1-1	Operation Manual – PC (Mitsubishi) Connection

Modicon TSX Micro 37-21/22 & Premium Series PLCs

For RS-232C connection:

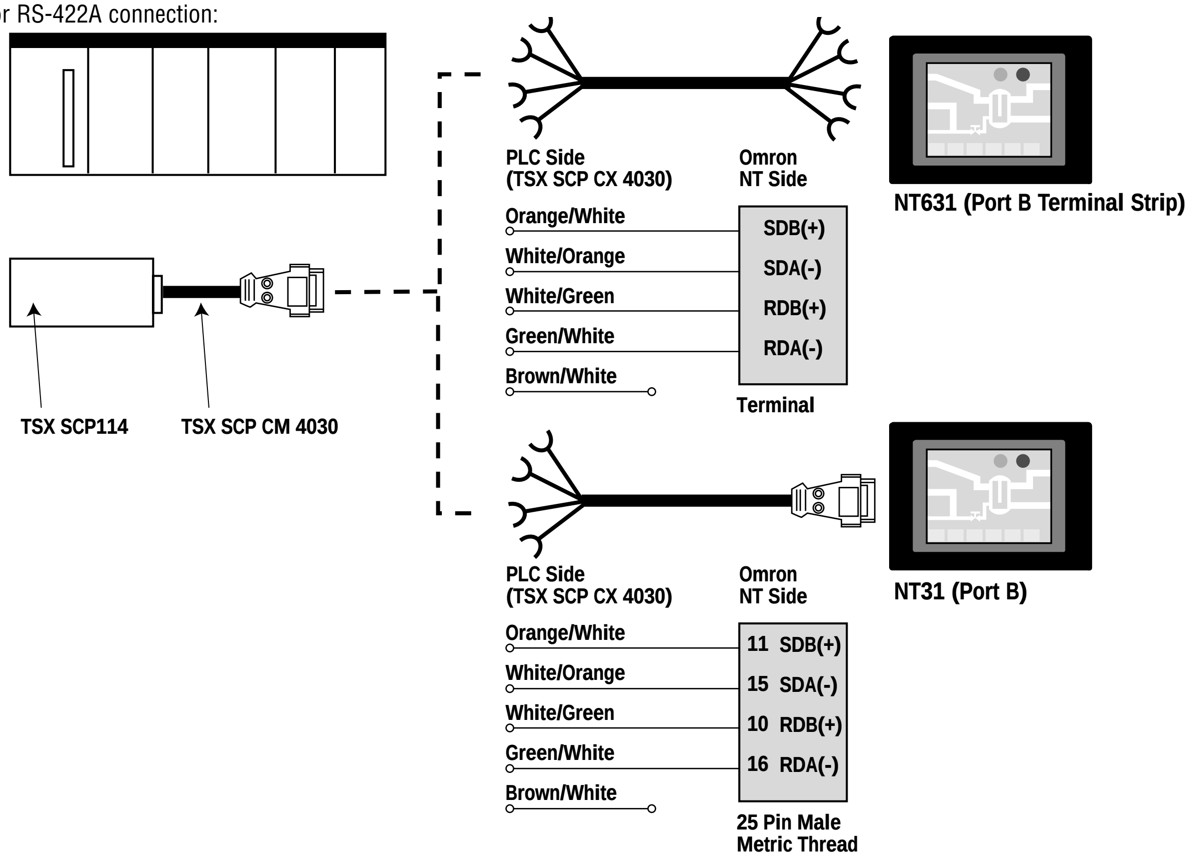


Modicon TSX Series Communication Cables and Accessories	
TSX SCP111	Multi-protocol PCMCIA card for RS-232C
TSX SCP114	Multi-protocol PCMCIA card for RS-422A
TSX SCP CD 1030	Connecting cable for PCMCIA for RS-232C
TSX SCP CM 4030	Connecting cable for PCMCIA for RS-422A

Cable Solutions for Multi-Vendor PLCs

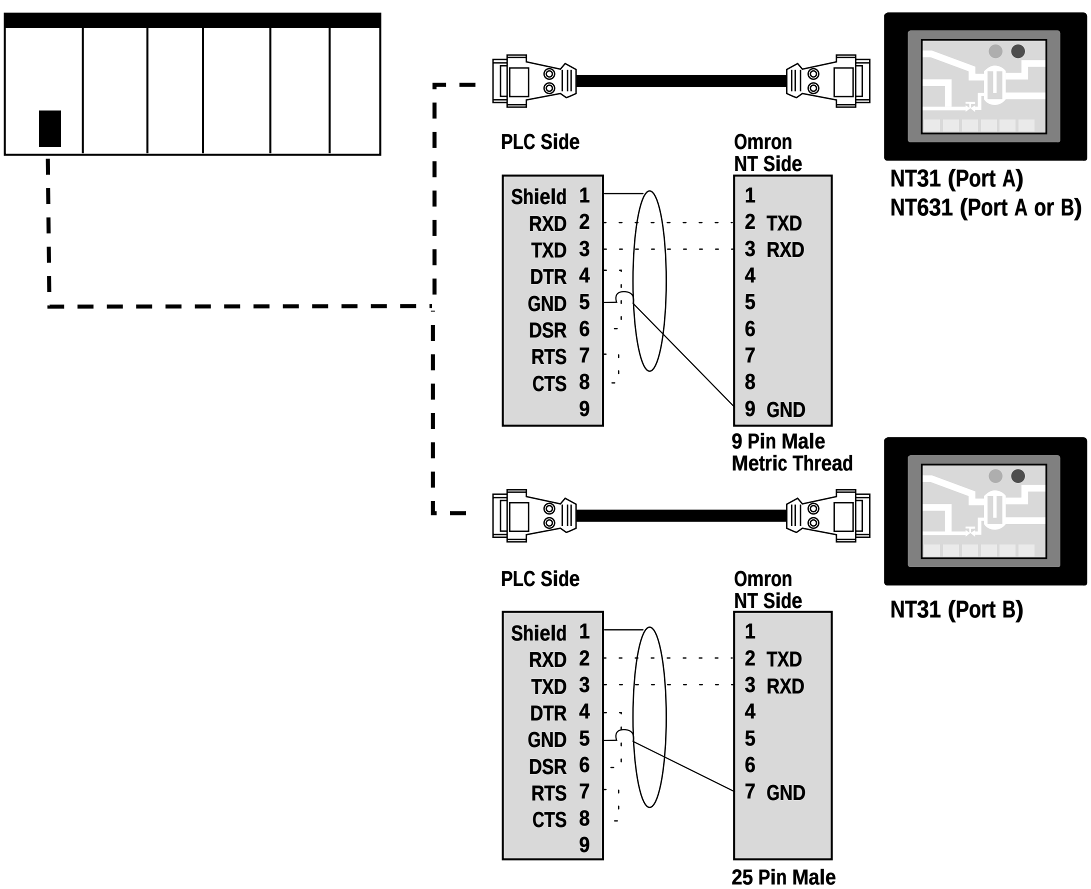
Modicon TSX Micro 37-21/22 & Premium Series PLCs

For RS-422A connection:



Modicon TSX Quantum Series PLCs

For RS-232C connection:



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OMRON®

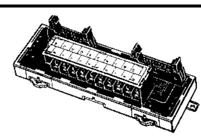
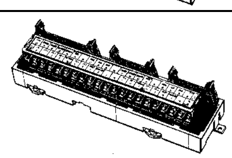
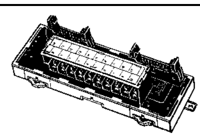
Position Control Terminal Block — XW2B

Simplify Wiring between Motor Controls and Omron's Position Control PLC Modules

- Relays control signals between a servo driver and the PLC position control module or CQM1 PLC with built-in pulse I/O capability
- Connectors are wired with a single screwdriver and no soldering is required
- Dedicated cables connect terminal blocks to position control modules
- Requires 24 VDC for control signal use
- Terminal block organizes wiring and saves space; uses M3 screws
- Mounts to DIN track or with screws for panel mounting

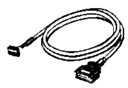
Ordering Information

POSITION CONTROL TERMINAL BLOCKS

Appearance	Applicable servo driver	Applicable position control module/CQM1 CPU	Part number
	U-series: R88D-UP□□□	C200H-NC112 C200HW-NC113	**XW2B-20J6-1B**
		C200H-NC211 C200HW-NC213 C200HW-NC413	**XW2B-40J6-2B**
		CQM1-CPU43-EV1	**XW2B-20J6-3B**

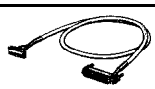
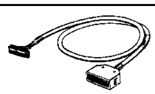
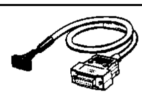
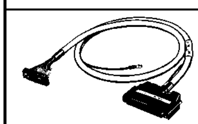
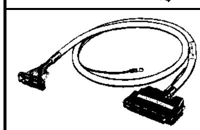
■ CABLES

Cables Between Servo Driver and Terminal Block

Appearance	Position control terminal block	Applicable servo driver	Cable length	Part number
	XW2B-20J6-1B, XW2B-40J6-2B (See note) XW2B-20J6-3B	R88D-UP□□□	1 m (3.28 ft)	**XW2Z-100J-B1**
			2 m (6.56 ft)	**XW2Z-200J-B1**

Note: Two cables will be required on the Servo Driver side if the XW2B-40J6-2B Terminal Block is used for two-axis control.

Cables Between PLC Position Control Module and Terminal Block

Appearance	Position control terminal block	Applicable position control module	Cable length	Part number
	XW2B-20J6-1B	C200H-NC112 (for one axis)	0.5 m (1.64 ft)	**XW2Z-050J-A1**
			1 m (3.28 ft)	**XW2Z-100J-A1**
	XW2B-40J6-2B	C200H-NC211 (for two axes)	0.5 m (1.64 ft)	**XW2Z-050J-A2**
			1 m (3.28 ft)	**XW2Z-100J-A2**
	XW2B-20J6-3B (See note 1)	CQM1-CPU43-EV1 (for one or two axes)	0.5 m (1.64 ft)	**XW2Z-050J-A3**
			1 m (3.28 ft)	**XW2Z-100J-A3**
	XW2B-20J6-1B	C200H-NC113 (for one axis)	0.5 m (1.64 ft)	**XW2Z-050J-A6**
			1 m (3.28 ft)	**XW2Z-100J-A6**
	XW2B-40J6-2B (See note 2)	C200HW-NC213 (for two axes) C200HW-NC413 (for four axes)	0.5 m (1.64 ft)	**XW2Z-050J-A7**
			1 m (3.28 ft)	**XW2Z-100J-A7**

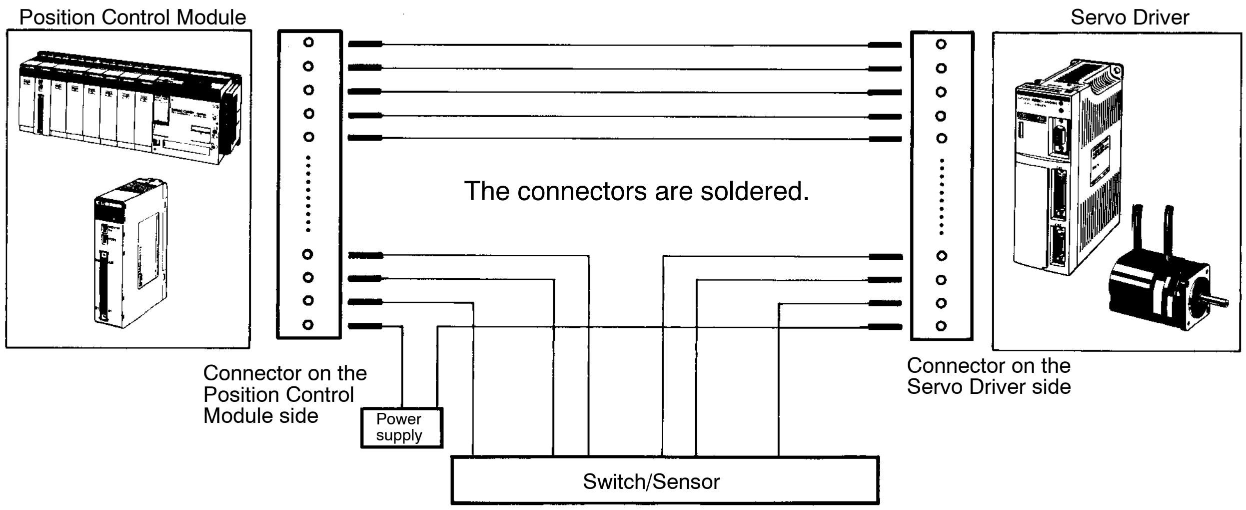
Note: 1. Two cables each will be required on the Servo Terminal Block and Position Control Module side, and on the Servo Driver side if the CQM1-CPU43 is used for two axes.

2. Two cables each will be required on the Servo Terminal Block and Position Control Module side, and on the Servo Driver side if the C200HW-NC413 (four axes) is used for two axes.

Application Examples

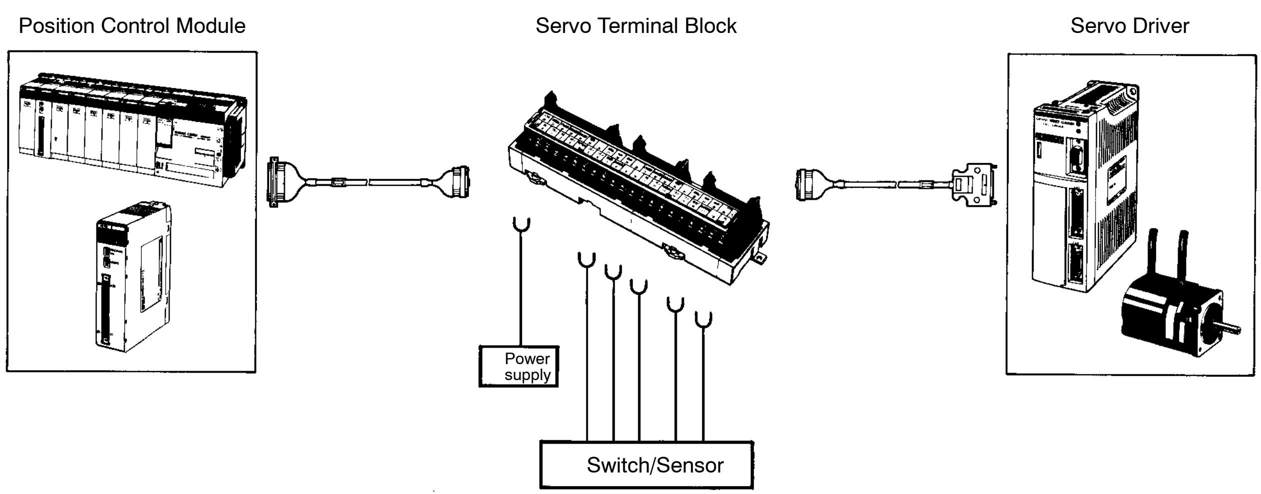
■ REDUCE WIRING TO EXTERNAL SENSORS, SWITCHES AND POWER SUPPLY

Conventional Method Requires Major Wiring Effort.



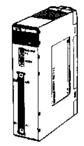
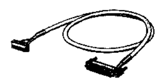
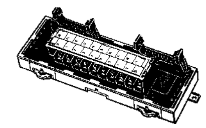
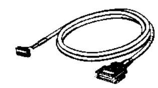
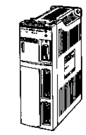
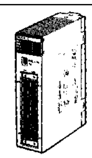
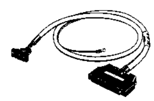
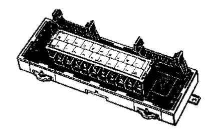
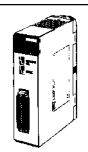
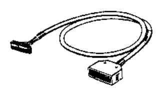
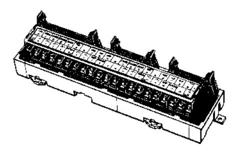
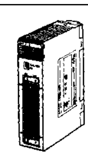
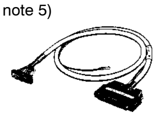
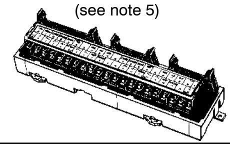
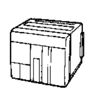
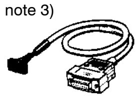
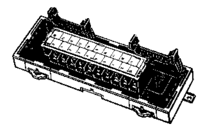
Servo Control Terminal Block

All wires are connected to the Servo Control Terminal Block with ease.



- Relays control signals between the Servo Driver and the Position Control Module with minimal wiring effort.
- Connectors are wired with a single screwdriver and no soldering is required.
- Dedicated Cable connects Units.

■ TYPICAL CONFIGURATIONS

Position Control Module, and CQM1	Cable on the Position Control Module side	Servo Terminal Block	Cable on the Servo Driver side	Servo Driver
			(see note 2, 3 and 4) 	
Position Control Module (for one axis) for C200H	Cable for C200H-NC112	Servo Terminal Block for C200H-NC112	U-series Cable	U-series Servo Driver
C200H-NC112	XW2Z-□□□J-A1	XW2B-20J6-1B (see note 1)	XW2Z-□□□J-B1	R88D-UP□□□
				
Position Control Module (for one axis) for C200H	Cable for C200HW-NC113	Servo Terminal Block for C200HW-NC113		
C200HW-NC113	XW2Z-□□□J-A6	XW2B-20J6-1B (see note 1)		
				
Position Control Module (for two axis) for C200H	Cable for C200H-NC211	Servo Terminal Block for C200H-NC211		
C200H-NC211	XW2Z-□□□J-A2	XW2B-40J6-2B (see note 1)		
	(see note 5) 	(see note 5) 		
Position Control Module (for two axes/four axes) for C200HW	Cable for C200HW-NC213 (two axes) and C200HW-NC413 (four axes)	Servo Terminal Block for C200HW-NC213 (two axes) and C200HW-NC413 (four axes)		
C200HW-NC213 C200HW-NC413	XW2Z-□□□J-A7	XW2B-40J6-2B (see note 4)		
	(see note 3) 	(see note 3) 		
CQM1 (for one/two axes)	Cable for CQM1-CPU43-EV1	Servo Terminal Unit for CQM1-CPU43-EV1		
CQM1-CPU43-EV1	XW2Z-□□□J-A3	XW2B-20J6-3 (see note 1)		

Note: 1. Has the functions of the conventional XW2B-20J6-1, XW2B-40J6-2 and XW2B-20J6-3.
2. Two cables will be required on the Servo driver side if the C200H-NC211 (for two axes) is used.
3. Two cables each are required on the Servo Terminal Block and Position Control Module side and on the Servo Driver side if the CQM1-CPU43-EV1 is used for two axes.
4. Two cables each will be required on the Servo Terminal Block and Position Control Module side and on the Servo Driver side if the C200HW-NC413 (four axes) is used.

Specifications

■ POSITION CONTROL TERMINAL BLOCKS

Item	XW2B-□□J6-□B
Rated current	1 A at a temperature of 30°C (86°F) max.
Rated voltage	24 VdC
Insulation resistance	5 MΩ min. at 500 VDC
Dielectric strength	500 VAC for 1 minute with a current leakage of 1 mA max.
Enclosure rating	IP00
Electrical protection	Class 0
Ambient temperature	Operating: –0°C to 55°C (32°F to 131°F)

■ CONNECTORS

Item	XW2Z-□J-A□/-B□
Rated current	1 A
Rated voltage	24 VDC
Contact resistance	20 mΩ max. with 100 mA max. at 20 mV max. (See note 1)
Insulation resistance	5 MΩ min. at 500 VDC
Dielectric strength	500 VAC for 1 minute with a current leakage of 1 mA max. (See note 2)
Enclosure rating	IP00
Electrical protection	Class 0
Ambient temperature	Operating: 0°C to 55°C (32°F to 131°F)

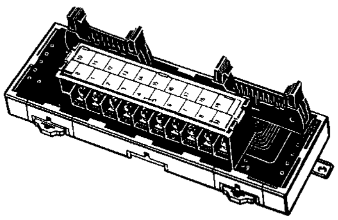
Note: 1. The resistance indicated is the contact resistance of the connector.
2. The voltage indicated is the dielectric strength of the connector.

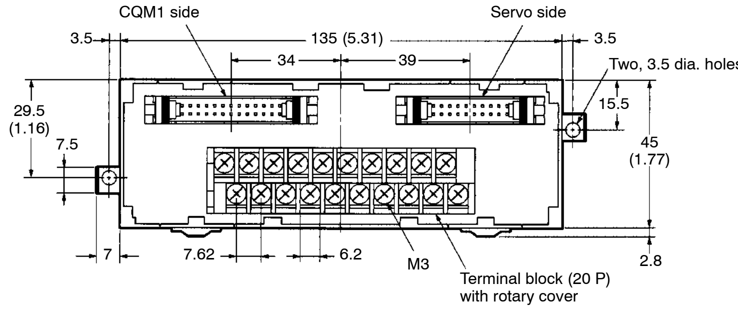
Dimensions

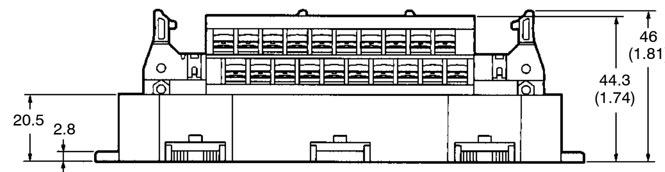
Unit: mm (inch)

■ POSITION CONTROL TERMINAL BLOCKS

XW2B-20J6-1B







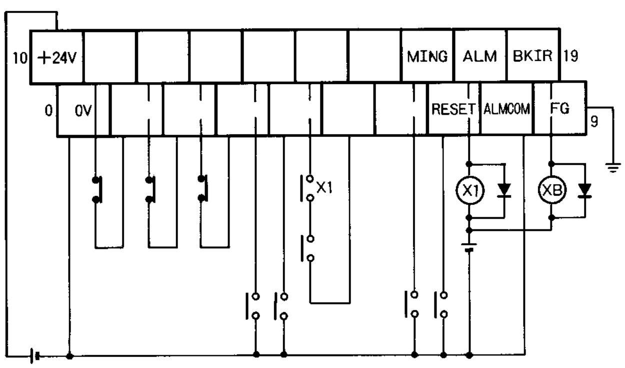
Note: The terminal block has a terminal pitch of 7.62 mm.

Connection to Terminal Block

The terminal signal name varies with the servo driver. Refer to the Operation Manual of the servo driver in use.

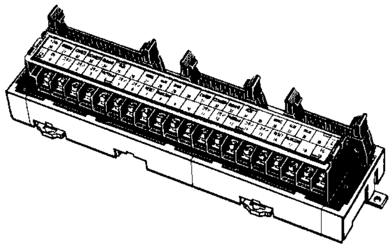
Identify the servo driver in use by writing the name on the terminal nameplates provided. Affix the nameplate to the terminal cover.

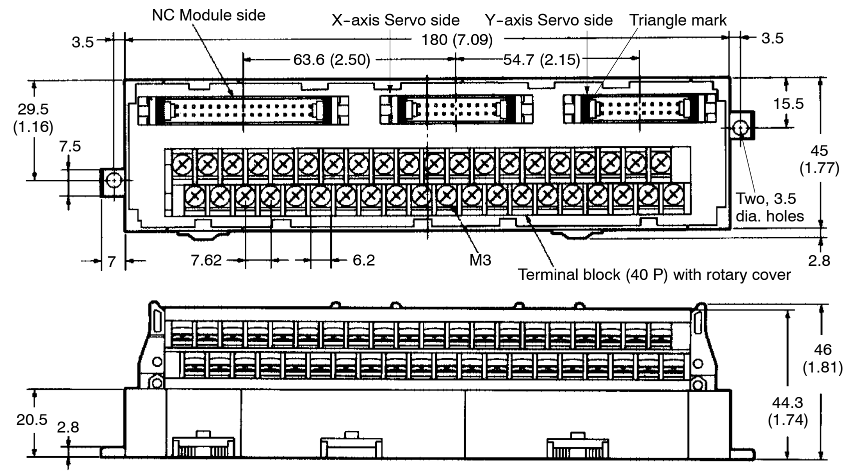
Connection to One Axis Position Control Modules
C200H-NC112-U/C200HW-NC113-U



Note:
1. Use mode 2 for origin search.
2. The XB contact is used to turn the electromagnetic brake ON and OFF.
3. The open terminal must be left unconnected.
4. 0 V and Common terminals are connected internally.
5. The suitable crimp terminal is R1.25-3 (round or fork type).

XW2B-40J6-2B





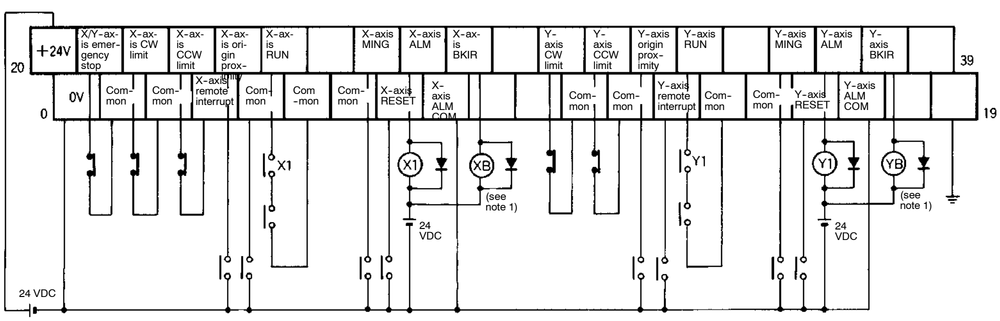
Note: The terminal block has a terminal pitch of 7.62 mm.

Connection to Terminal Block

The terminal signal name varies with the servo driver. Refer to the Operation Manual of the servo driver in use.

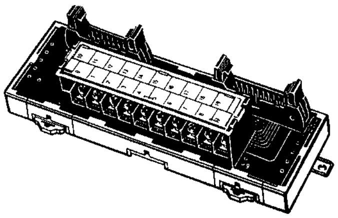
Identify the servo driver in use by writing the name on the terminal nameplates provided. Affix the nameplate to the terminal cover.

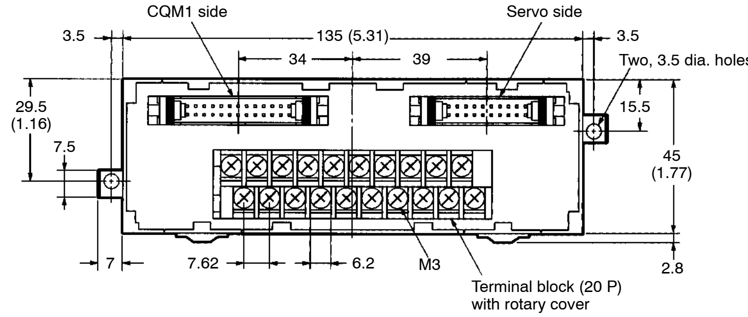
onnection to Multi Axis Position Control Modules 200H-NC211-U/C200HW-NC213-U/C200HW-NC413-U



Note: 1. The XB contact is used to turn the electromagnetic brake on and off.
2. Use mode 2 for origin search.
3. When only a single axis is used, short-circuit the unused axis' CW limit and CCW limit to the common terminal.
4. The open terminal must be left unconnected.
5. 0 V and common terminals are connected internally.
6. The suitable crimp terminal is R1.25-3 (round or fork type).

XW2B-20J6-3B

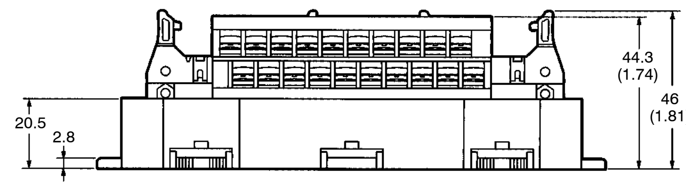




Connection to Terminal Block

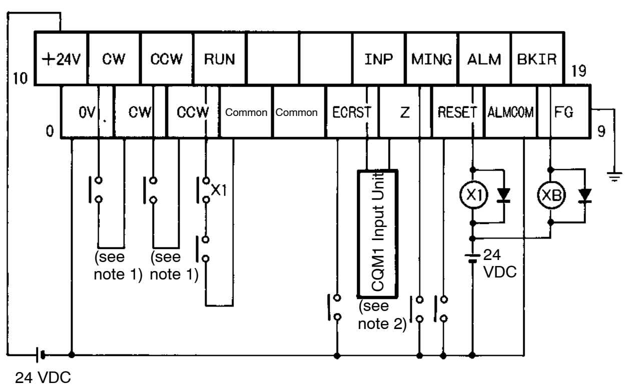
The terminal signal name varies with the servo driver. Refer to the Operation Manual of the servo driver in use.

Identify the servo driver in use by writing the name on the terminal nameplates provided. Affix the nameplate to the terminal cover.



Note: The terminal block has a terminal pitch of 7.62 mm.

Connection to Position Control PLC
CQM1-CPU43-EV1 for 1- or 2-Axis Control



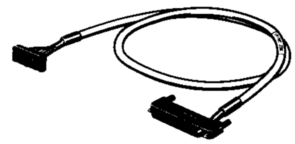
Note: 1. When this signal is input, the output pulses of the CQM1 can be input to the high-speed counters directly.
2. Input this signal output to the CQM1 input modules
3. The XB contact is used to turn the electromagnetic brake on and off.
4. Phase Z is an open collector output.
5. The open terminal must be left unconnected.
6. 0 V and common terminals are connected internally.
7. The suitable crimp terminal is R1.25-3 (round or fork type).

■ XW2Z CONNECTING CABLES

Use the cables to connect the PLC Position Control Module to the XW2B Servo Terminal Blocks.

For C200H-NC112 Use

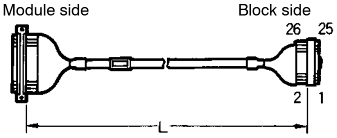
XW2Z-□□□J-A1



Connector

Position Control Module side

Servo Terminal Block side



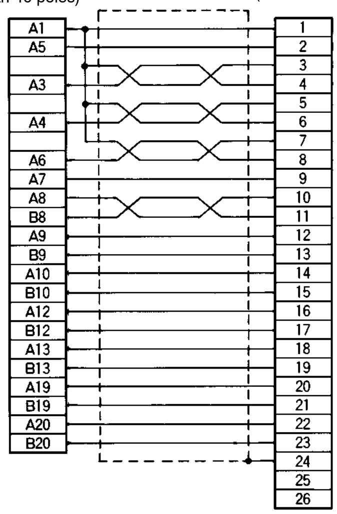
FCN-367J040-AU/ F (Fujitsu)

XG4M-2630-T

Wiring Diagram
XW2Z-□□□J-A1

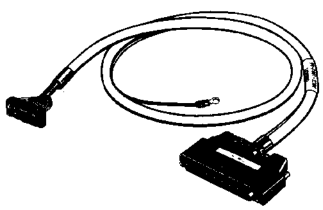
C200H-NC112 (PCB I/O connector with 40 poles)

XW2B-20J6-1B (XG4M-2630)



For C200HW-NC113 Use

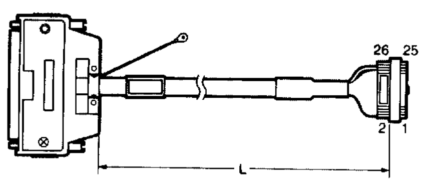
XW2Z-□□□J-A6



Connector

Position Control Module side

Servo Terminal Block side



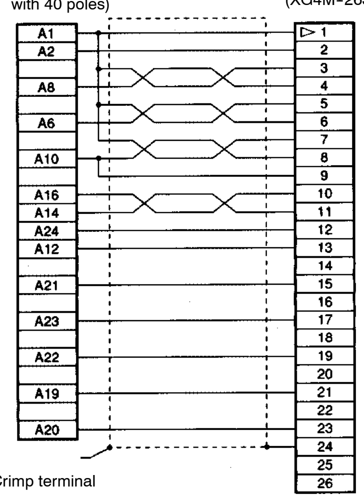
FCN-367J040-AU/ F (Fujitsu)

XG4M-2630-T

Wiring Diagram
XW2Z-□□□J-A6

C200H-NC113 (PCB I/O connector with 40 poles)

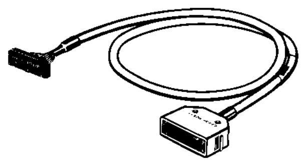
XW2B-20J6-1B (XG4M-2630-T)



Crimp terminal

For C200H-NC211 Use

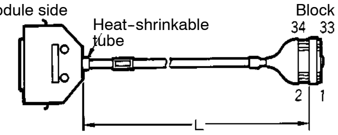
XW2Z-□□□J-A2



Connector

Position Control Module side

Servo Terminal Block side



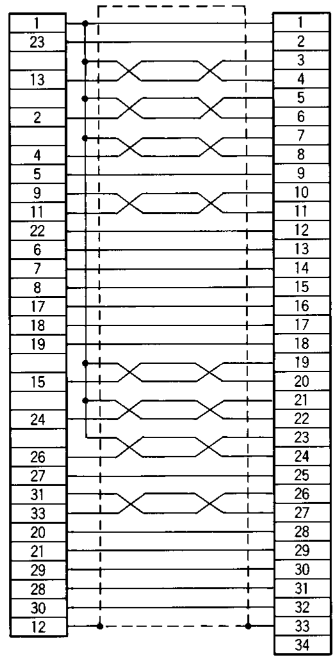
MR-34LF
(Honda Tsushin Kogyo)

XG4M-3430-T

Wiring Diagram
XW2Z-□□□J-A2

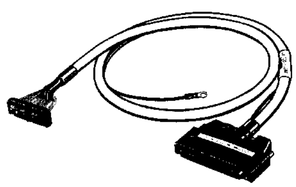
C200H-NC211
(Multi-pole square connector with 34 poles)

XW2B-40J6-2B
(XG4M-3430)



For C200HW-NC213/NC413 Use

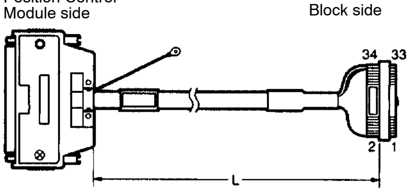
XW2Z-□□□J-A7



Connector

Position Control Module side

Servo Terminal Block side



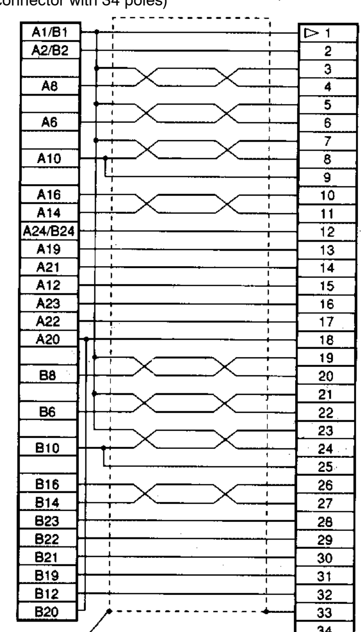
MR-34LF
(Honda Tsushin Kogyo)

XG4M-3430-T

Wiring Diagram
XW2Z-□□□J-A7

C200H-NC213/NC413
(Multi-pole square connector with 34 poles)

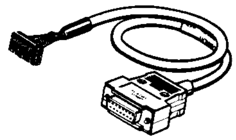
XW2B-40J6-2B
(XG4M-3430-T)



Crimp terminal

For CQM1 Use

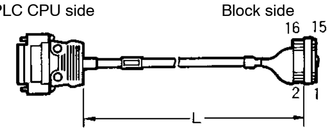
XW2Z-□□□J-A3



Connector

Position Control PLC CPU side

Servo Terminal Block side



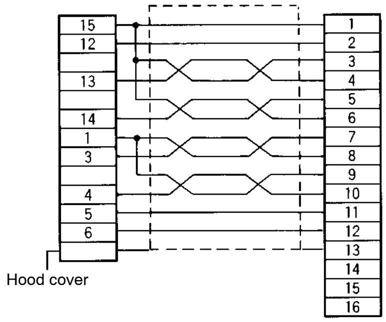
XM2D-1501 Socket
XM2S-1511 Hood

XG4M-1630-T

Wiring Diagram
XW2Z-□□□J-A3

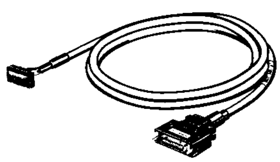
CQM1-CPU43-EV1 (XM2D-1501)

XW2B-20J6-3B (XG4M-1630)



For U-Series Servo Driver and Motion Contorl Terminal Block

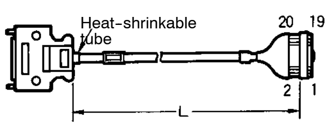
XW2Z-□□□J-B1



Connector

Servo Driver side

Servo Terminal Block side



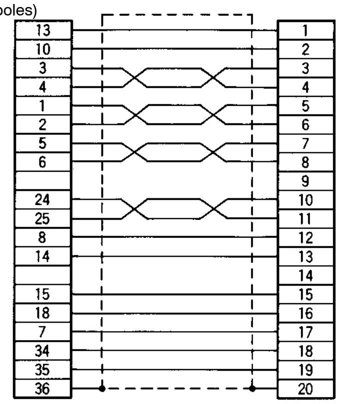
10136-3000VE Plug
10336-52A0-008
Hood (both Sumitomo 3M)

XG4M-2030-T

Wiring Diagram
XW2Z-□□□J-B1

R88D-UP□□□ (Half-pitch connector with 36 poles)

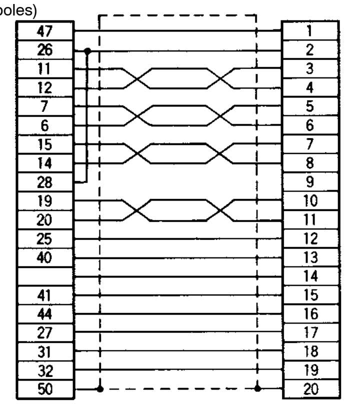
XW2B-□□J6-□B (XG4M-2030)



XW2Z-□□□J-B5

R88D-UP□□□ (Half-pitch connector with 36 poles)

XW2B-□□J6-□B (XG4M-2030)



Precautions

■ WIRING

The open terminal must be left unconnected.

0 V and common terminals are connected internally.

Do not wire the Servo Terminal Block while power is supplied to the unit, or the terminals may be short-circuited with the cable and the Unit may malfunction.

■ TERMINAL WIRE CONNECTIONS

The suitable crimp terminal is R1.25-3 (round or fork type).

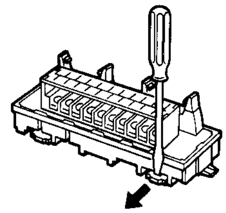
Terminal Screw Tightening Torque

When connecting crimp terminals or wires to the terminal block, be sure to tighten each crimp terminal or wire to 0.5 to 0.8 N • m (4.9 to 7.8 kgf • cm).

■ TRACK MOUNTING

More than one XW2B Servo Terminal Unit can be densely mounted to a DIN track, in which case, move the mounting stays from both sides of the XW2B to the bottom of the XW2B.

Secure both ends of the XW2B with end plates.



NOTE: DIMENSIONS SHOWN ARE IN MILLIMETERS. To convert millimeters to inches divide by 25.4.

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Quickstart Tutorial V7.10

In approximately one hour, completing this tutorial will give you a basic working knowledge of CitectHMI/SCADA version 7.10 software.

Learn how to build a small project, configure dynamic graphics, create alarms and trends, and then run your project like a real plant.

This tutorial will also show you some shortcuts that, over time, will save you far more than the one hour you may take to complete the exercises inside.

CitectSCADA

Quickstart Tutorial V7.10

Quickstart Tutorial

Welcome, and thank you for purchasing CitectHMI or CitectSCADA. We would like your experience with the product to be a pleasant one, so we have created this tutorial to help new users get familiar with some of the fundamental features of the product.

The tutorial is designed so that you can complete it in around one hour. The tutorial is not intended as a substitute for attending a CitectHMI/SCADA training course. We encourage you to attend a training course to complete your basic training, learn how to use time saving tools or go on to learn some of the more advanced features of the product.

This tutorial assumes that you have already successfully installed the CitectSCADA product on your computer. You do not require a Citect license to complete this tutorial.

Repetition is an important part of learning or memorizing. One way you can speed up your familiarization is to take a few minutes to click through all the menus in the of something, don't be concerned just move on to the next one anyway. You may not consciously remember everything product and (briefly) try and figure out what each item might be for, if you can't make sense you see, but it helps to set a framework for when you revisit these items in the tutorial and in this way you will remember them much better.

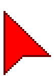
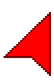
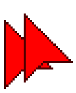
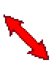
By completing this tutorial you will learn the following…

- Creating a New Project
- Setting Up Communications with a PLC
- Adding and Configuring tags
- Creating New Graphics pages
  - Use Templates
  - Button Commands
  - Disabling Buttons
  - Dynamic Symbols
  - Drawing objects
  - Manipulating objects Copy, Paste, Align, Send to Back, Color Fill, Control Commands, Setting values
  - Drawing Text
  - Displaying analog values
  - Drawing Pipes
  - Grouping Objects
  - Defining Alarms
  - Configure an alarm page
  - Storing Trend Data
  - Configuring a trend page
- Operating Runtime Displays
- Applying Security
- Using Administration Tools
  - Creating Runtime Menus
  - Tag Debug Utility
- Backing up and restoring a project

Disclaimer

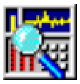
Trademarks

Definition of Terms

Click	= Briefly press left mouse button
Double Click	= Press left mouse button twice – quickly
Right Click	= Briefly press right mouse button
Check	= A tick or cross in an options box 
Type Text	= Type in the word Text
Drag	= Position mouse, click and hold left mouse button, move mouse, then release mouse button
Alt+Tab	= Press the Alt key, hold it down, then press the Tab key
	Single Click
	Right Click
	Double Click
	Click and drag
	Type

Quickstart Tutorial V7.10

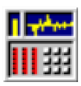
CitectHMI/SCADA is made up of a several configuration tools and a runtime section.



Citect Explorer – Top level configuration interface

Citect Project Editor – Mainly used for entering database type information

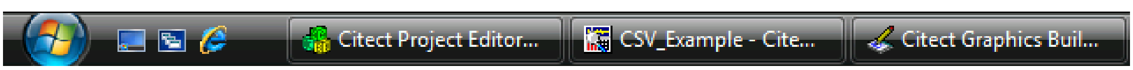
Citect Draw – Used for creating graphics



Citect Runtime – Provides the active operator interface

You can switch between these applications by:

1. Using the icons at the top left of each application, or
2. Holding down the Alt key, then pressing Tab until the application you want is selected, then release the alt key (Alt+Tab), or
3. Clicking on the icons that appear on the Windows task bar as shown below.



To make sure that you have selected the correct icon you can let the mouse hang over the icon for about 2 seconds and a tool tip will appear to guide you.

Create a New Project Folder

Run the Citect Explorer.

Click on Start

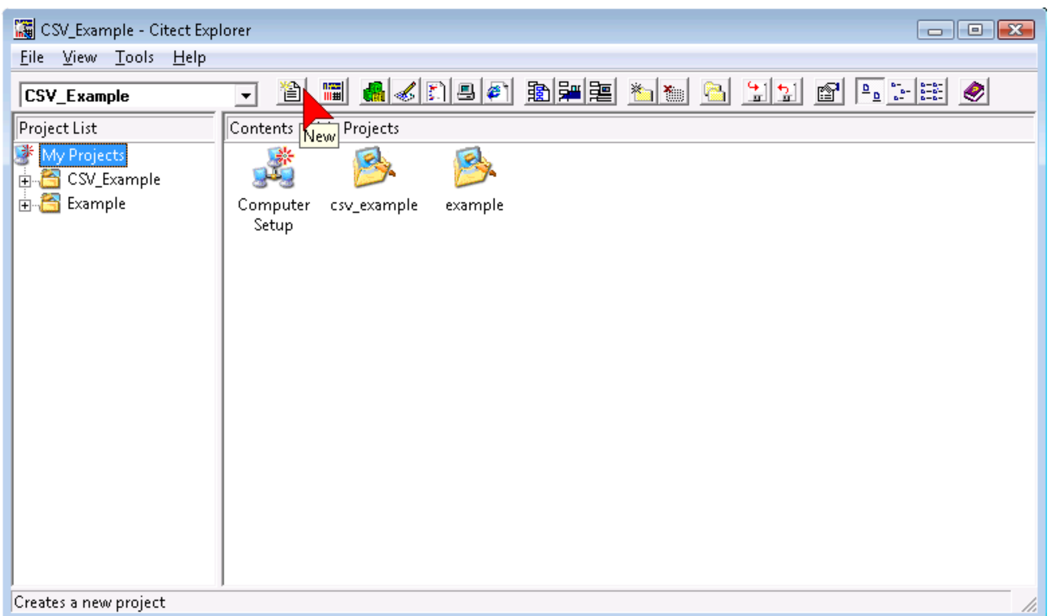
Click All Programs

Click Citect

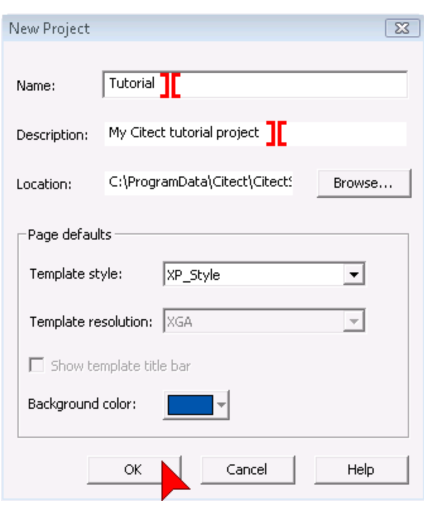
Click CitectSCADA 7.10

Click CitectSCADA Explorer

On the Tool Bar, click on the New Project icon 



In the New Project Dialog Box, type Tutorial in the Name field to give the new project a name, give it a description, then click OK.



As you go through this tutorial you might like to click on the Help button located on many of the dialogs as this will show you some of the other options available to you that are not covered by this tutorial.

Project Folders store all of the CitectSCADA files for your project including graphic pages, tag definitions, code etc.

Clicking on a different project in Citect Explorer immediately changes the project you are working in.

You can combine multiple configuration projects into a single runtime project using the “project include” feature described in the online help.

Tip

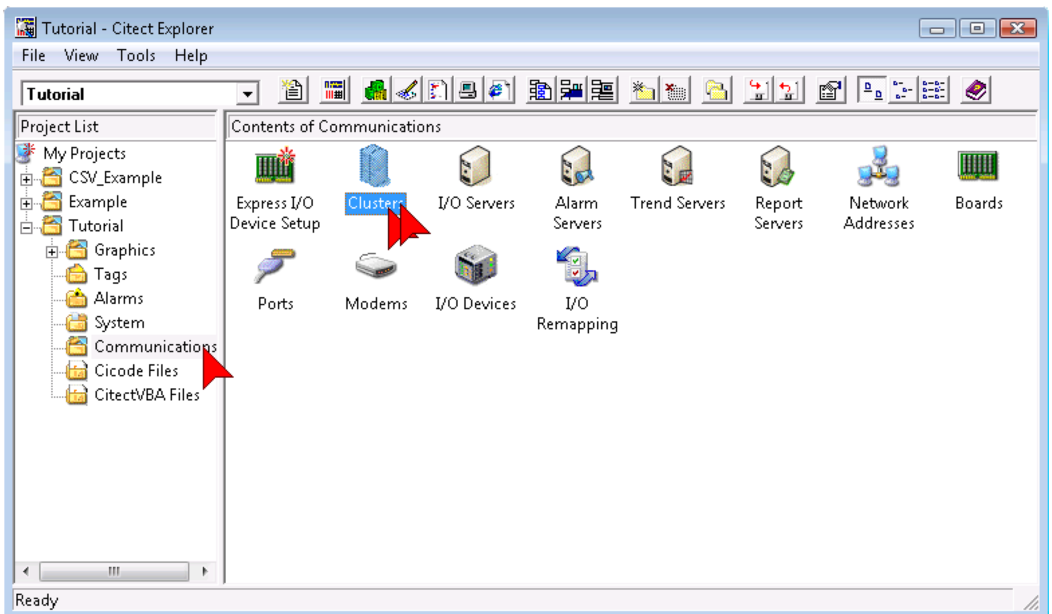
Consider using the Quickstart Project as this can save you a lot of time.

Use the Example project to get ideas and learn how things are made by pulling them apart.

Configuring Clusters

Clusters define where server processes (IO communications, data logging, alarming, etc), are run, and how different server processes interact with each other for redundancy purposes (refer to the online help for more details). Every CitectSCADA system must have at least one cluster defined, with related Network Addresses and Server roles also defined.

Expand your project tree on the left-hand side of Citect Explorer and select Communications. Then double-click on Clusters.



If the Project Editor does not appear, then use Alt+Tab until it appears.

CitectSCADA allows you to quickly and easily switch between different projects, simply by selecting them in the Project List.

TIP

Make sure all pages are saved or closed in the Graphics Builder before changing projects.

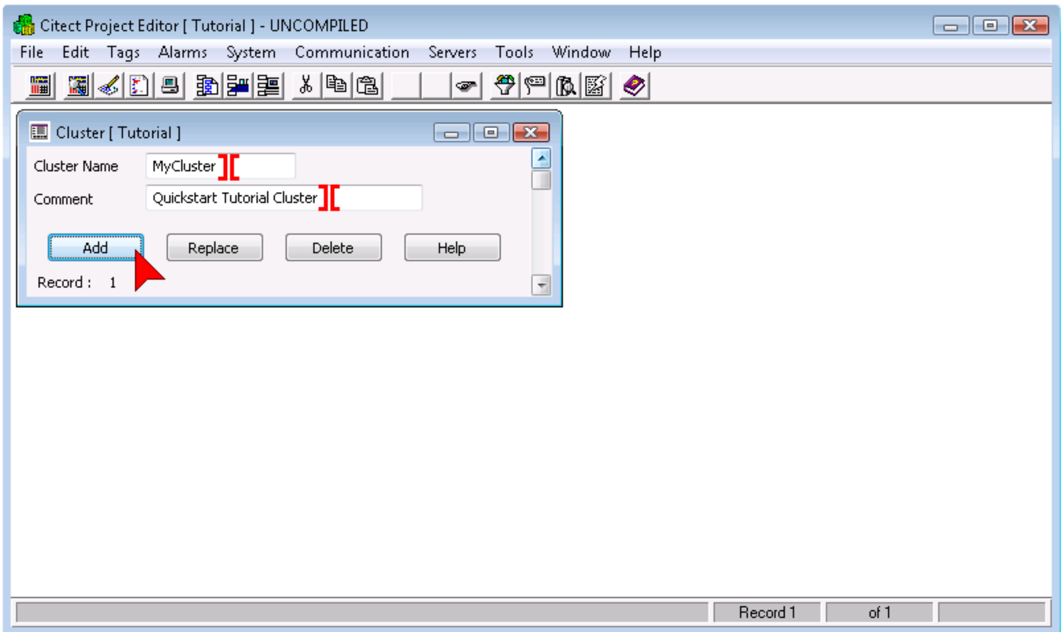
When you backup a project, everything related to that project, including Cicode or VBA script, is backed up and easily transported to other computers. The only exception is any 3rd party items which need to be installed separately such as ActiveX objects.

TIP

When networking your system, the project does not need to be copied to every computer. Refer *projects, Managing your projects, Linking projects*

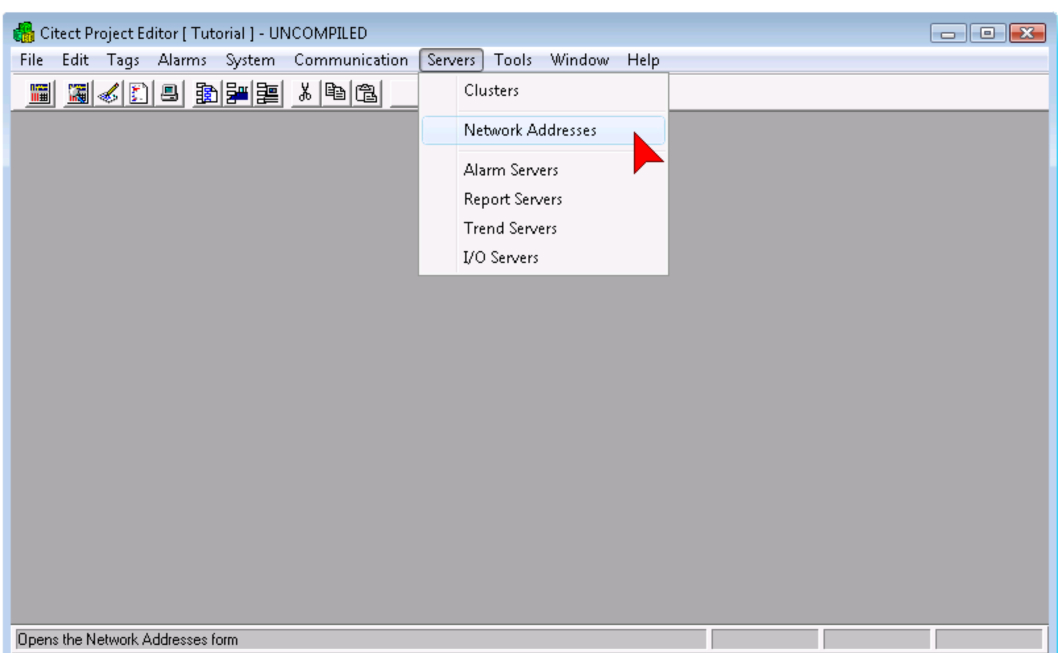
Configuring Clusters continued…

In the Clusters form that appears, define a cluster called MyCluster; give it an appropriate description in the Comment field, then Click Add.



Close the Clusters window by clicking on the or pressing ESC.

From the pull-down menu at the top of the Citect Project Editor, click on Servers, then Network Addresses.



IMPORTANT

Do NOT press ENTER before filling in all the required fields in a form. Each time you press ENTER a new record will be added to the project creating duplicates which will cause compilation failures.

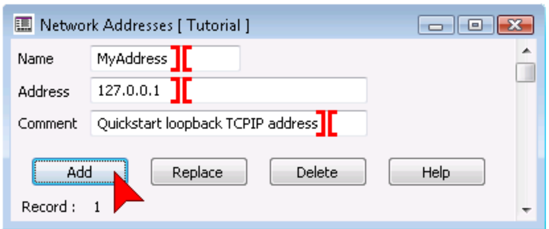
Similarly, make sure you only single-click the Add button, rather than double-clicking, otherwise duplicate records will be added causing complication failures.

For learners, it is better to use the Add button instead of the ENTER key. If you add an extra record by mistake, you can use the Delete button to mark it for deletion. Once marked for deletion the record will be ignored.

If you press delete by mistake you can press it again to undelete. To view records marked for deletion go to Tools, select Options and check Show Deleted.

Configuring Clusters continued...

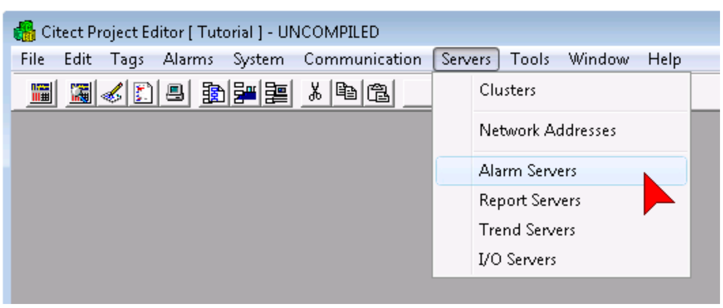
In the Network Addresses form, enter the `Name` “MyAddress”, the `Address` “127.0.0.1”, and an appropriate `Comment`.



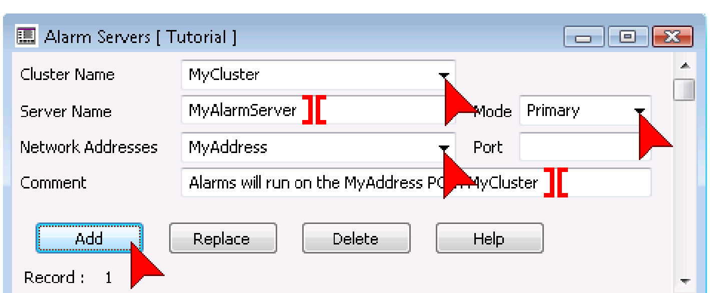
When you are finished, click `Add`, then close the form. This assigns the loopback TCP/IP address to the system which is appropriate for Standalone systems only. We will then use that address for our server roles.

We now need to assign both the Cluster and the Network Address to the various server roles that are required on this Citect system. This includes IO Communications, Alarming, Trending and Reporting roles.

From the `Servers` menu select each of the server tasks in turn, and configure them as shown below:



Use the pull-down lists where provided to minimise the chance of mistakes.



TIP

Network Addresses define which computers are available on the network to operate as Citect Servers.

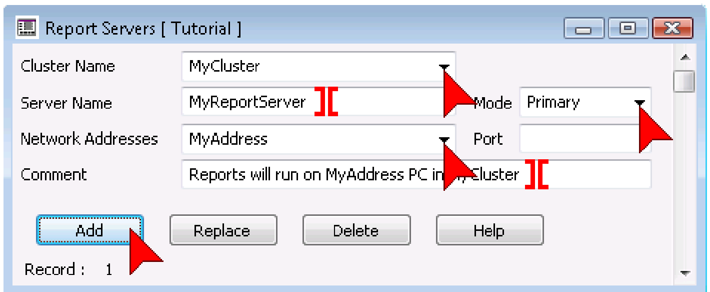
We can identify these computers by TCP/IP address, or computer name.

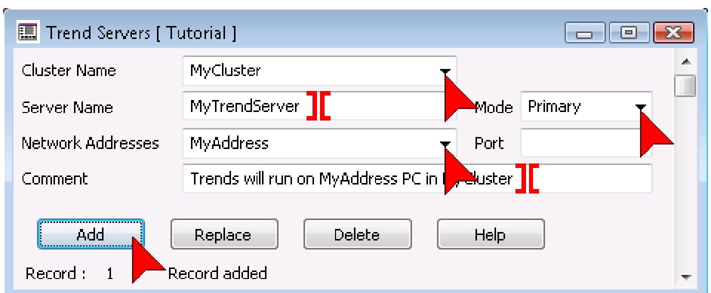
The universal loopback address 127.0.0.1 is <u>only</u> appropriate for standalone systems with no clients.

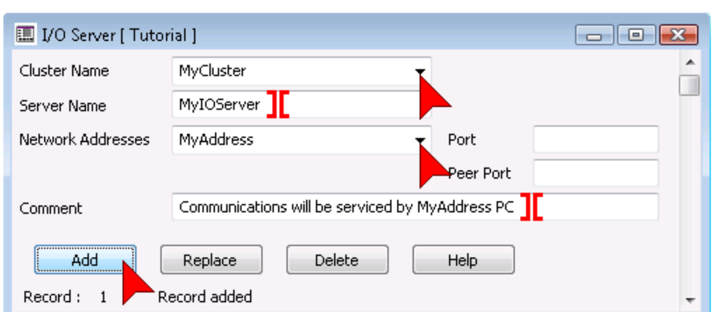
For networked or redundant systems, refer to the online help for details on how to configure additional Network Addresses and use them in your Server definitions

Configuring Clusters continued...

This identifies the Alarm Server process to run on the computer with *MyAddress* TCP/IP address, within the *MyCluster* server group, in the *Primary* mode. The Server Name “MyServer” will be used by networked clients to connect to this server to acquire the alarm information for display purposes. Continue for Report, Trend and IO Servers as shown below:







We have now completed our Server setup and are ready to define our communications path to the PLC.

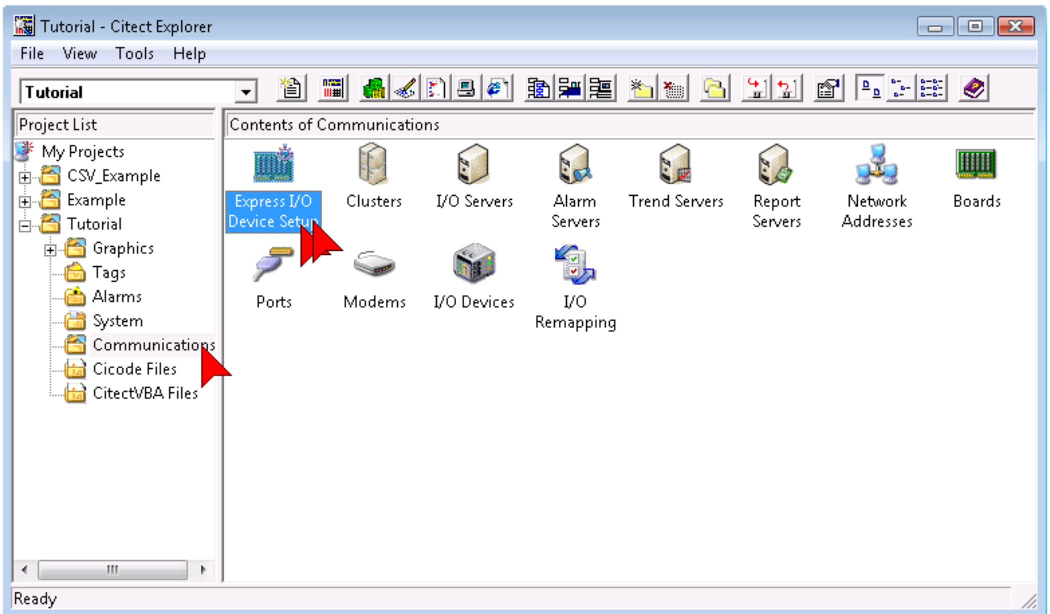
The Tutorial project defines a single PC inside of a single cluster, and due to the loopback TCPIP address, is incapable of communicating to other CitectSCADA nodes or clients.

Refer to the online help for details on Primary and Standby server functions, and Clustering options for networked systems.

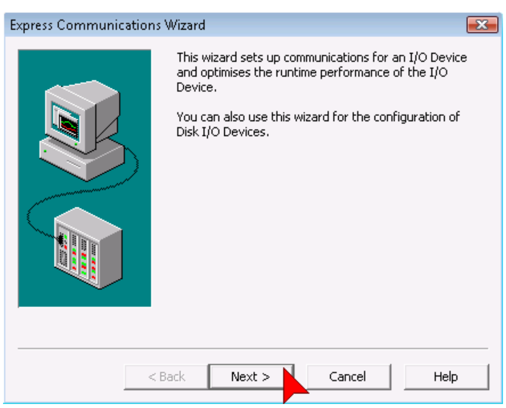
Configure an I/O Device

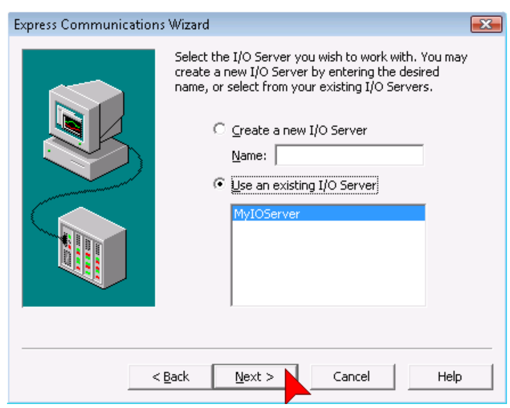
Use Alt+Tab to return to the Citect Explorer. Make sure the Tutorial project is selected in the project list on the left-hand side and that the `Communications` folder is open.

`Double click on Express I/O Device Setup.`

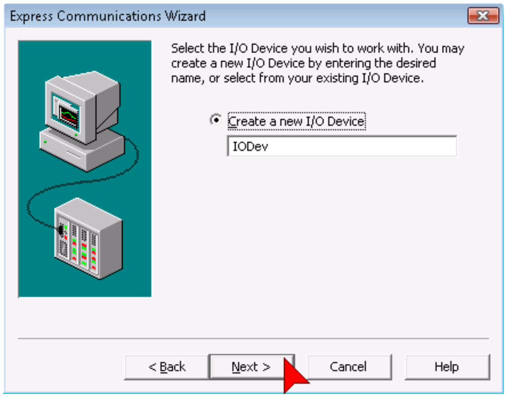


`On the Express Communications Wizard, just press the Next` button for the first three steps, making sure your "MyIOServer" is selected as the existing I/O Server in the second step.





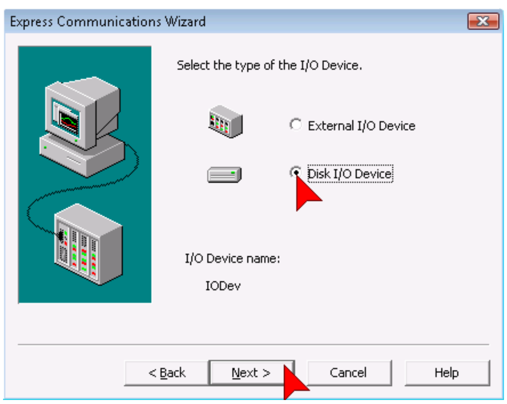
Configuring I/O Device continued…



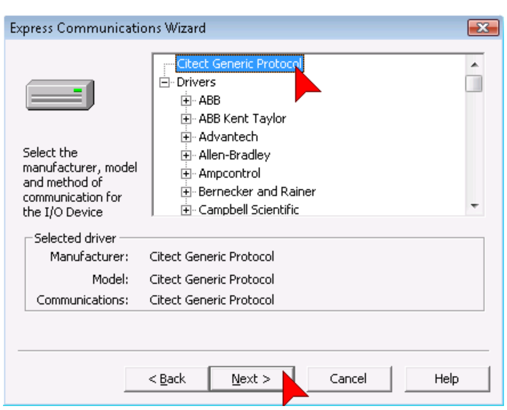
Disk I/O Devices are serviced by the Citect I/O Server, which means all networked clients are looking at the same data. Disk data values are retained on shutdown as they reside on the I/O Server's hard drive.

Local Tags are serviced by each individual Citect node, so each client is looking only at its own data. Local Tag values are not retained when the Citect node is shutdown.

On the fourth step, click Disk I/O Device, then click Next. This configures the system to use a hard-drive based device instead of a real-world device. Disk I/O devices are useful for simulation and testing situations, as well as for persisting recipe or other information at the SCADA level instead of in the PLC.

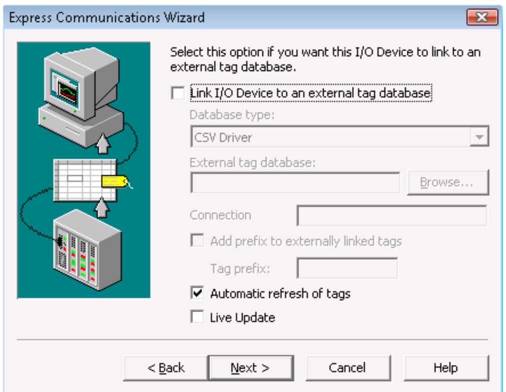


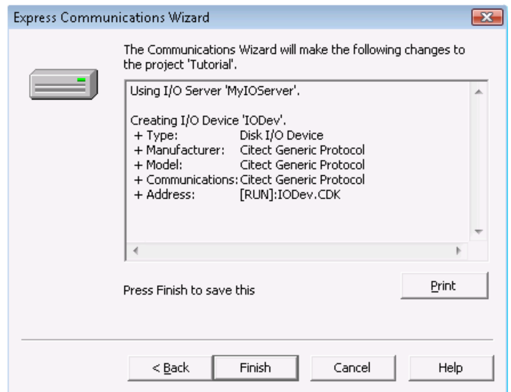
On the fifth step, scroll to the top of the protocol list and select Citect Generic Protocol by clicking on it, then click Next.



Configuring I/O Device continued…

On the final two screens you just need to press the ***`Next`*** *&* ***`Finish`*** *buttons.*



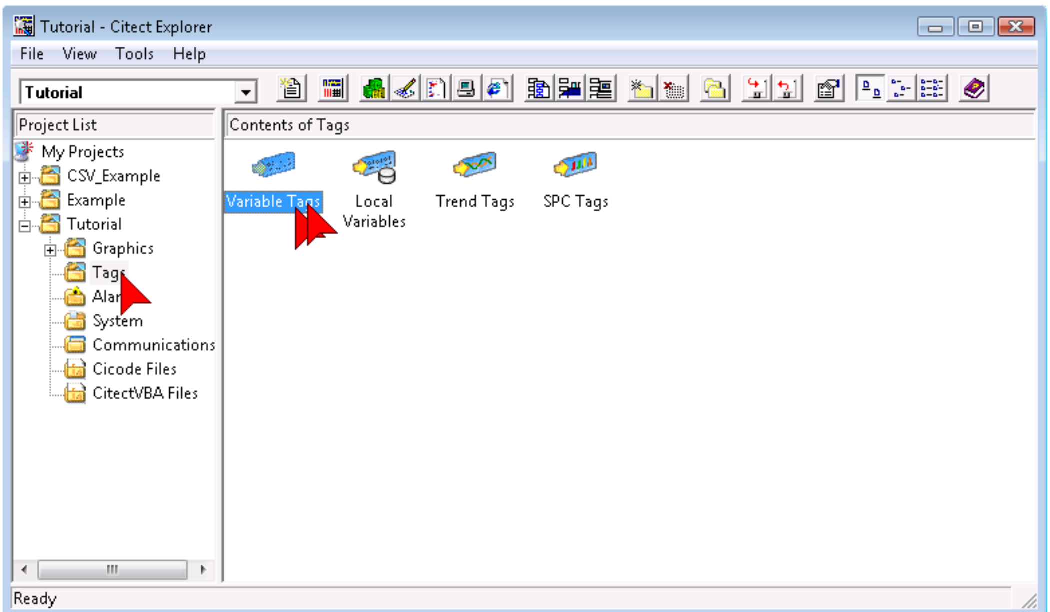


Your system has now been configured to access a disk-based PLC to write and read data. Now we need to configure the tags in this PLC that the system will use to control equipment. In this tutorial we will be controlling a pump, its mode, and its speed.

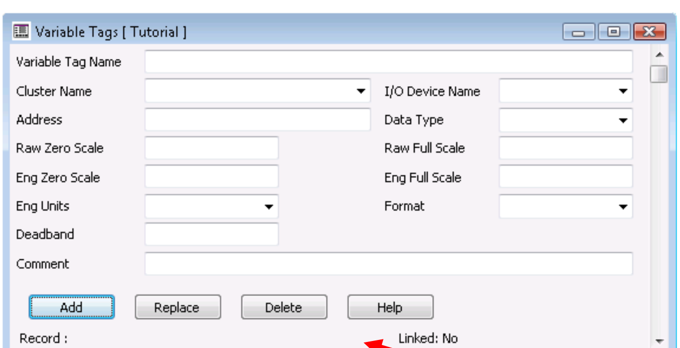
Configuring Tags

Variable Tags are a core building block for a CitectSCADA project. Tags provide the link between the operator and the real-world. We will create three tags to represent our pump, a Run/Stopped status tag, an Auto/Manual control tag and a Speed control tag.

Making sure the **Tutorial** project is selected, **click** on the **Tags** folder. Then **Double Click** on **Variable Tags** in the right-hand pane.



This will bring the Project Editor to the foreground and display the Variable Tags dialog. If it does not appear, use Alt+Tab to switch the view to the Project Editor.



The Project Editor is mainly for editing database type information.

The Variable Tags Database has one record for each Tag you define.

Each Tag has multiple fields. (Variable Tag name, Data Type, Address etc)

You can see the record number indicated in the bottom left of the dialog box

IMPORTANT
Do NOT press **ENTER** before filling in all the required fields. Each time you press ENTER a new record will be added to the project creating duplicates which will cause compilation failures.

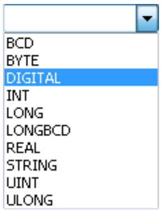
Similarly, make sure you only single-click the Add button, rather than double-clicking, otherwise duplicate records will be added causing complication failures.

For learners, it is better to use the Add button instead of the ENTER key. If you add an extra record by mistake, you can use the Delete button to mark it for deletion. Once marked for deletion the record will be ignored.

If you press delete by mistake you can press it again to undelete. To view records marked for deletion go to Tools, select Options and check **Show Deleted**.

To permanently remove deleted records from the project, go to File then select **Pack**.

Configuring Tags continued…

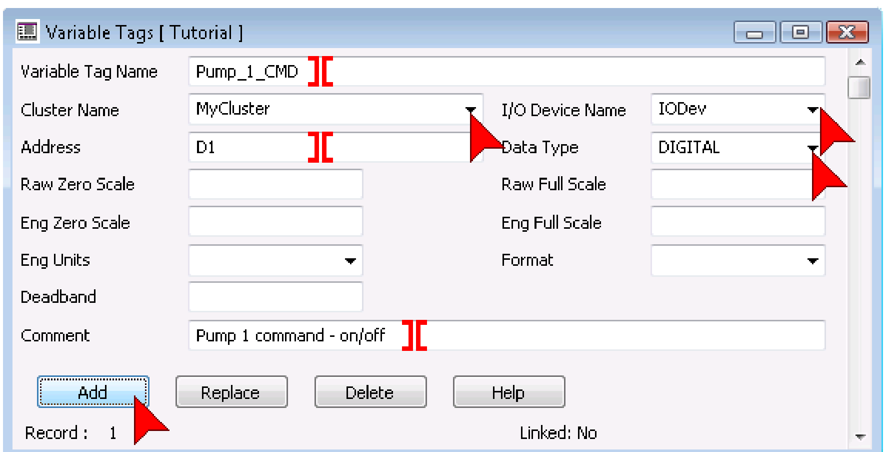


CAUTION
Where a drop down is provided you should use it. If you mistype data into fields that require specific settings you may cause compile errors.

Next you will configure three tags as shown below. Remember to fill in the form before pressing **Add** or **Enter.** Use the Tab key or the mouse to move between fields.

To make corrections after you have pressed add, you can move to the Tag or record by using the scroll bars on the right-hand side, then press **Replace** when you have made the changes.

The cursors have been added as a guide to show you where you should type and where you should click.



If you are having difficulty reading from the screen grabs here is the information in plain format.

	Pump_1_CMD	Data Type	**DIGITAL**
I/O Device Name	**IODev**	Address	**D1**
Raw Zero Scale		Raw Full Scale	
Eng Zero Scale		Eng Full Scale	
Eng Units		Format	
Comment	**Pump 1 Command – On/Off**		

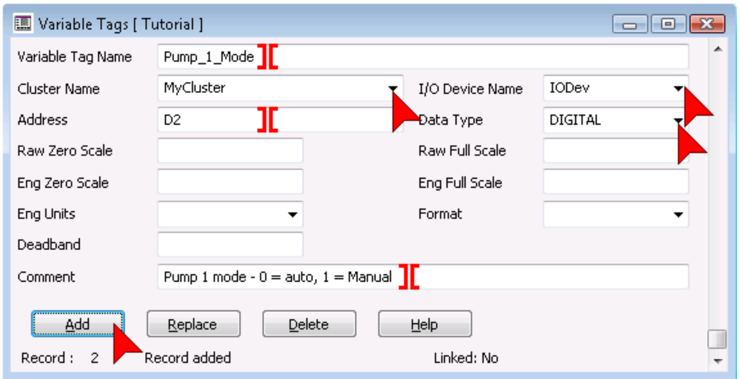
You can save a lot of time configuring tags by entering similar types of Tags together and just changing the parts that are different before pressing **Add**.

Use the mouse to highlight the parts that you want to change, then just overtype. Eg; Pump_1_CMD can easily be changed to Pump_1_Mode. Highlight CMD then type Mode.

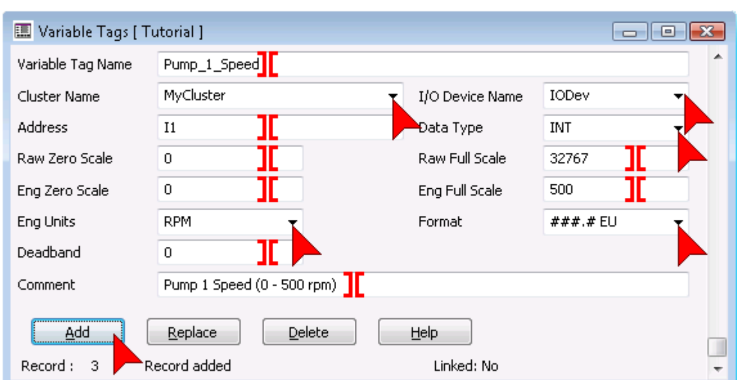
For address based protocols, if you arrange your variables in your PLC into blocks where all the Digitals are contiguous and all the Integers are contiguous then the performance will be significantly improved as the CitectSCADA software will be able to read large blocks of data in a single communication message instead of multiple messages.

TIP
It does not matter what order the addresses are entered into the variables records, what matters is the contiguous block of addresses in the PLC.

Configuring Tags continued…



Variable Tag Name	**Pump_1_Mode**	Data Type	**DIGITAL**
I/O Device Name	**IODev**	Address	**D2**
Raw Zero Scale		Raw Full Scale	
Eng Zero Scale		Eng Full Scale	
Eng Units		Format	
Comment	**Pump 1 Mode – 0 =Auto, 1 = Manual**		



Variable Tag Name	**Pump_1_Speed**	Data Type	**INT**
I/O Device Name	**IODev**	Address	**I1**
Raw Zero Scale	**0**	Raw Full Scale	**32767**
Eng Zero Scale	**0**	Eng Full Scale	**500.0**
Eng Units	**RPM**	Format	**###.#EU**
Comment	**Pump 1 Speed (0 – 500 rpm)**		

NOTE: For the Format field, "EU" needs to be typed up after ###.#

When you are finished, use the scroll bar on the right to scroll through each tag (record) and double check that you have entered the correct information. On the last tag, check that the number of tags (records) = 3.

CitectSCADA automatically saves your configuration to disk each time you add, replace or delete a record.

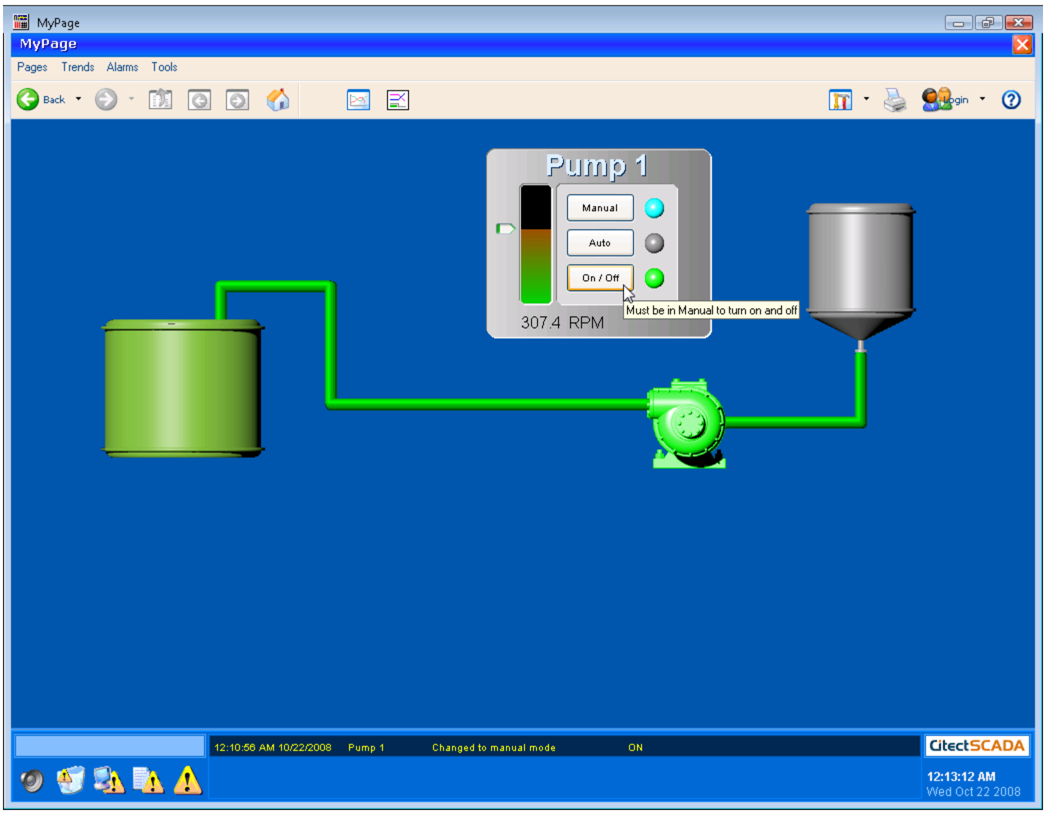
Graphics behave differently where you must save your pages as you develop them.

TIP
Engineering Units which are not included with CitectSCADA's default pull-down list can be typed in manually. Any text can be entered as engineering units.

Close the Variable Tags window by clicking on the  or pressing ESC.

Creating Graphic Pages

Before you start let's take a look at what you will create.



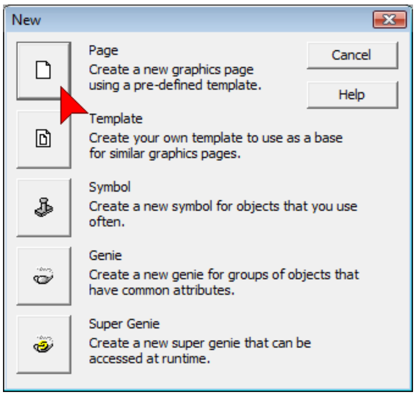
This page contains a number of buttons that allow the operator to control the pump's mode and operation, as well as a slider to control its speed.

The pump itself will animate red or green depending on whether it is running or not, and the lights, bar graph and number will indicate its mode, operation and speed.

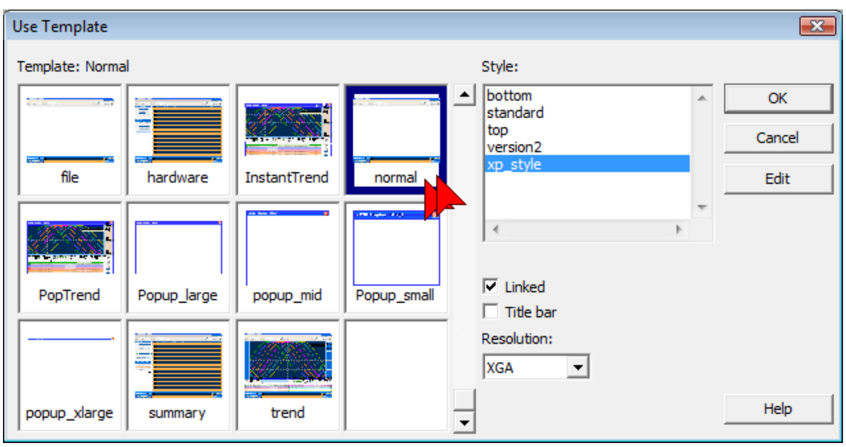
Creating Graphic Pages, Creating a new page

Switch to the **Graphics Builder – click** on the Graphics Builder icon .

Click on the New Page icon. A popup form will appear allowing you to select what type of new graphics object you would like to create.



Click on the Page button. An additional popup form will appear allowing you to select a base template from which to create your new page.



Instead of double clicking on Normal we could single click on Normal and then click OK – but that takes more time.

Make sure XP_Style is selected in the Style box, then Double Click the Normal template as shown.

The fastest way to drive any application is with the keyboard. Most programs have shortcut keys – you may be surprised how quickly you can learn them.

Templates provide a vast range of pre-built functionality, making the task of building a new project with CitectSCADA extremely fast.

All pages must be based on a template, even if it is a blank template.

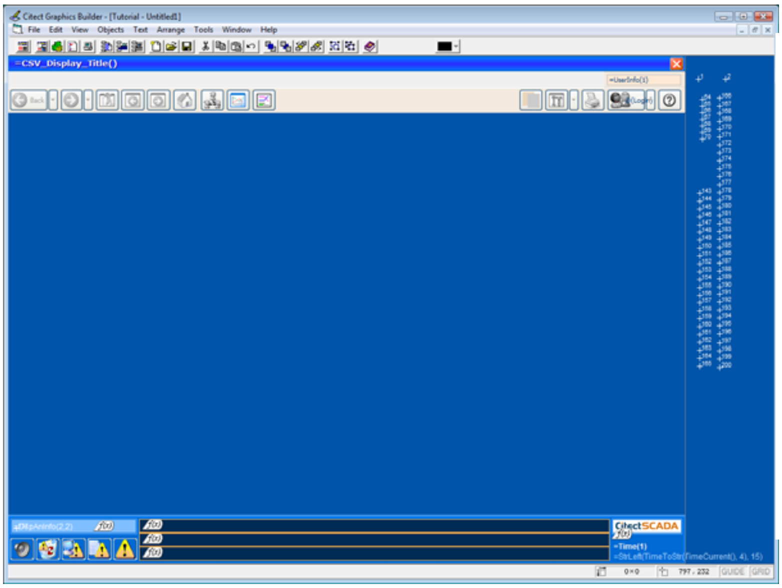
If you want to customize the look and feel of your pages, you can create your own templates from scratch, or copy the existing ones and modify them.

NOTE
Never modify templates, symbols or other items in the Example, Include or CSV_Include projects! These projects will be automatically re-loaded when you upgrade to the next version and your changes will be lost. Always copy items to your local project before modifying

Creating Graphic Pages, Saving your page

You can move the Toolbox by placing the cursor on the title bar, hold down the left mouse key while moving the mouse.

We are using the built-in templates to get a jump-start on your page. There are navigation buttons already configured for you and using templates helps to ensure a consistent look and feel throughout your project. This is very important if you want to make it easy-to-use for your operators.



Templates are displayed pretty much as they appear at runtime.

###.## indicates dynamic values that will change at runtime.

+1, +2 etc are Animation Numbers that are used as references for graphics objects that will be displayed at these locations in runtime. Animation Numbers are not displayed at runtime.

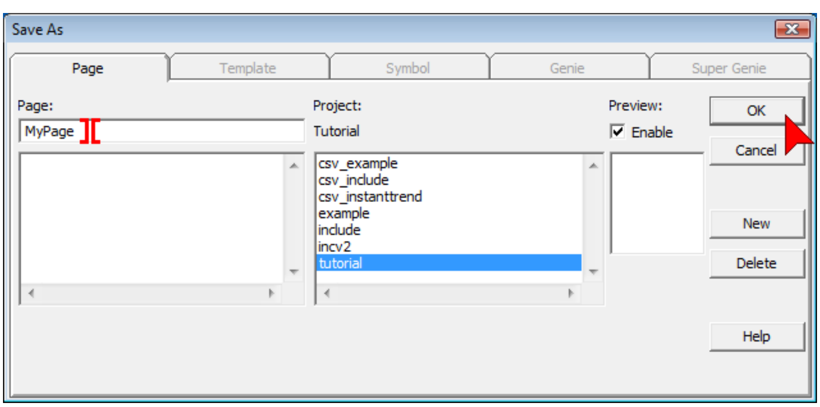
ƒ(x) is a script that is executed with the page.

If your toolbox does not appear, it can be toggled by pressing the F3 button, or selecting it from the View menu.

It is good practice to save your graphics pages regularly, so let's begin the habit right now.

Click on the Save icon on the menu bar .

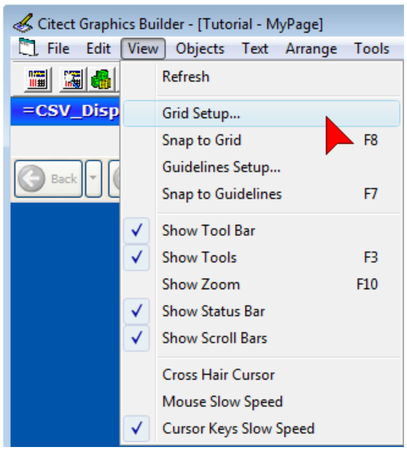
Type MyPage in the Page edit box, then press OK.



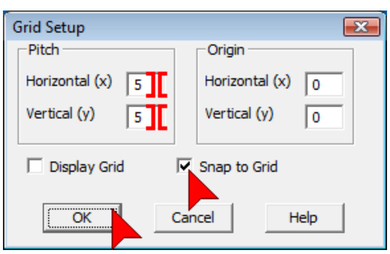
Creating Graphics pages, setting up the Grid

Firstly we will setup a grid which will allow our cursor to snap to uniformly positioned locations on the screen, making it easier to size and position objects in relation to each other.

On the toolbar, click View, then Grid Setup.



In the Grid Setup form, change the size of the grid from 8 x 8 pixels, to 5 x 5 pixels as shown below. Select Snap to Grid, and then click OK to close the form.



Now we are ready to create and position our graphics objects.

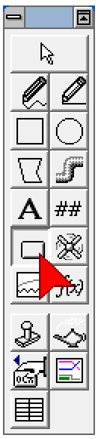
The Grid is not a necessary item for configuring graphics pages, however it vastly increases the ability to create uniform sized and positioned objects, which in turn makes your pages easier to visualize.

If the Grid prevents you from positioning an object exactly where you want it, it can be toggled on and off using the **F8** key.

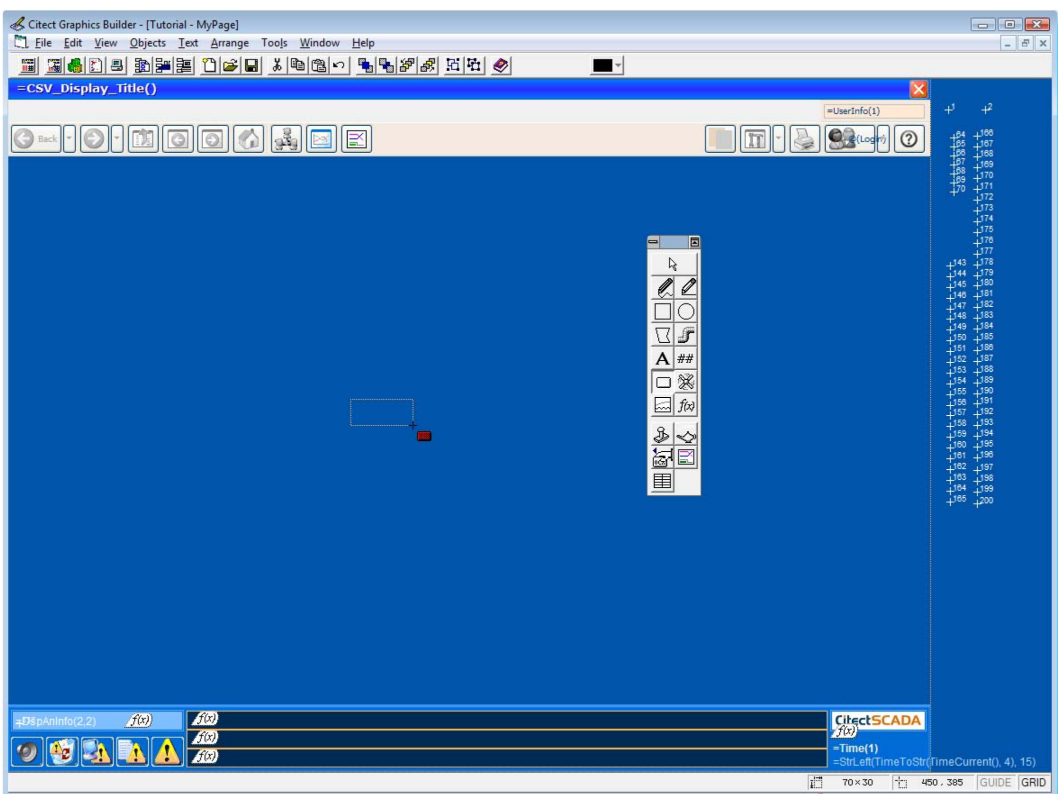
Creating Graphics pages, Configuring buttons

Next we will configure some buttons to control the mode of the pump.

On the Toolbox click on the button icon.



To draw the button, click and hold the left mouse button while moving the mouse then release the left mouse button (ie. click and drag the mouse).



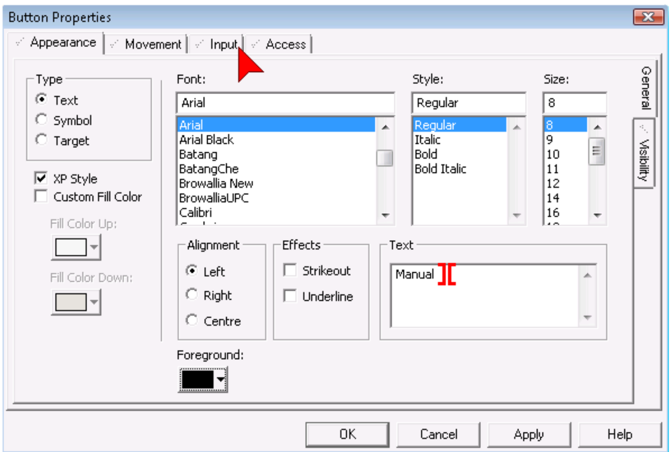
The **position** and **size** of the currently selected object are shown at the bottom right of the graphics builder status bar.

The Toolbox options are, from left-to-right and top-to-bottom:

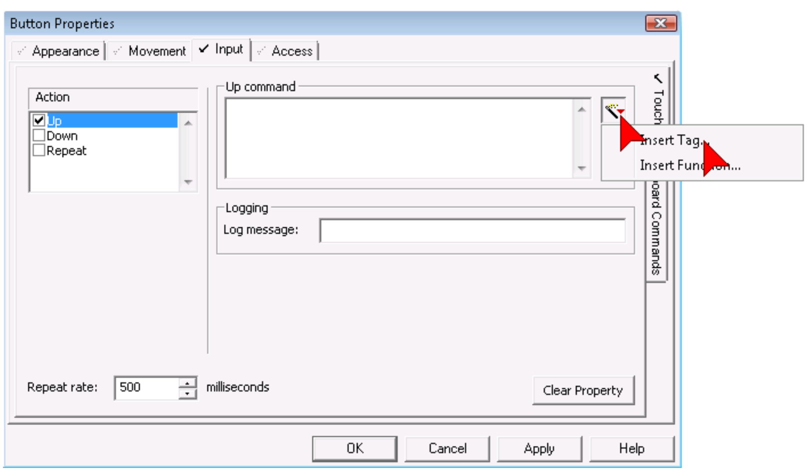
Free-form line
- Straight line
- Square/Rectangle
- Circle/Oval
- Polygon
- Pipe
- Text
- Number
- Button
- Animated symbol
- Trend
- Function
- Static symbol
- Genie
- ActiveX
- Process Analyst
- Database Exchange

Creating Graphics Pages, Configuring Buttons continued…

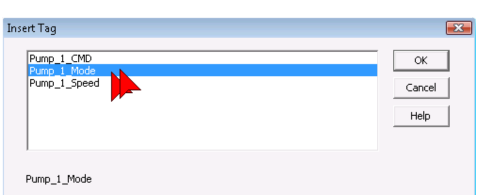
Once you release the mouse button, the Button Properties dialog popup will appear. Double Click on the word button in the Text edit box. This is a quick way to select a complete word. Next type Manual.



Click on the Input tab at the top of the form to configure the action the button will perform.
Click on the Insert button.
Click on Insert Tag option.

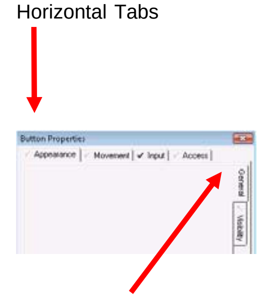


In the Insert Tag Dialog Double Click on Pump_1_Mode.



If you don't see the expected property sheet as you go through these exercises, then you may need to locate the correct sheet by looking at the screens on the page then click on the horizontal & vertical tabs to find the right sheet.

Horizontal Tabs

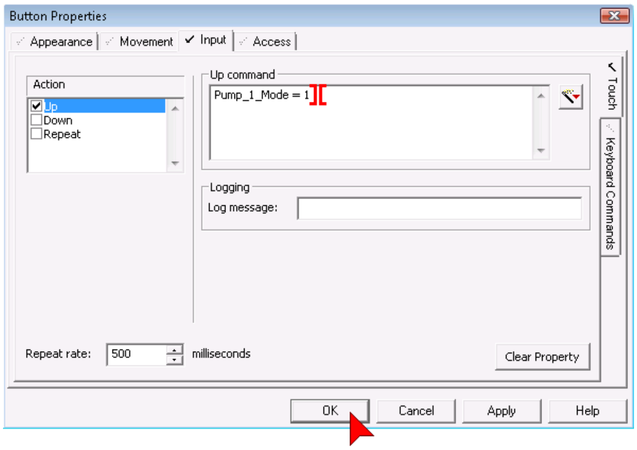


Vertical Tabs

TIP
Tabs with ticks on them indicate that configuration exists on that tab

Creating Graphics Pages, Configuring Buttons continued…

Pump_1_Mode will be inserted into the Up Command edit box. Click your mouse to the right of the Tag Pump_1_Mode and type **"= 1"**.



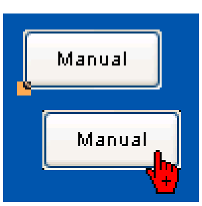
When the project is running, pressing on the Manual Button will set the tag Pump_1_Mode to a value of "1" to represent "Manual" mode. Repeated pressing of the button will continue to set the same value of "1" into the tag. Therefore we need a second button to set the tag to a value of "0" or "Auto" mode.

We will achieve this by copying the first button and modifying the copy. We do this because it is often quicker to make copies of objects than to draw them from scratch. This also guarantees consistency of object sizes.

Here is a quick way to make a copy and position an object.

- Place the cursor over the Manual Button.
- Hold down the Ctrl key.
- Hold down the left mouse button.
- Move the mouse to position the copy.
- Release the left mouse button.

You don't need to be precise with position at this time – we will fix that later using an alignment tool.



If you move the mouse immediately after holding down left mouse button, then you will only see the outline of the object as it is moved.

If you wait half a second before moving the mouse, you will see the object itself being moved, making it easier to position it in its new location.

The + sign will appear on the hand after pressing the Ctrl Key indicating a copy operation rather than a move operation.

There are many ways to copy objects.

Ctrl + D will duplicate the currently selected object.

Ctrl + C will copy an object to clipboard.

Ctrl + V will paste an object from clipboard.

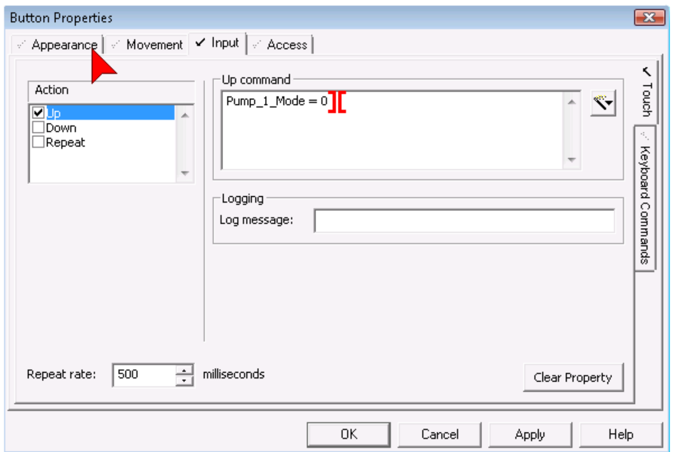
These last two work in almost all windows programs so are well worth remembering.

You can also select Copy, Paste or Duplicate from the Edit menu or by using the icons on the menu bar.

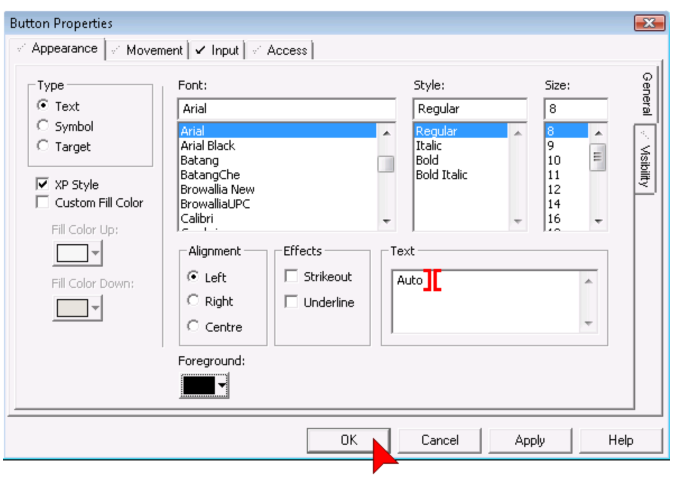
Copying objects also ensures that their dimensions are identical to each other, creating a more visually appealing user interface.

Creating Graphics Pages, Configuring Buttons continued…

Double Click on the new button.
In the Up Command edit box, replace the **= 1** with a **= 0**. This will turn the digital tag Pump_1_Mode false to represent Auto mode.



Click on the Appearance Tab to change the text label on the button.

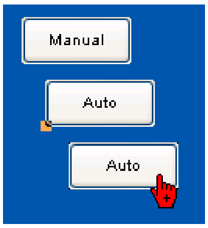


Double Click on the word Manual in the Text edit box, replace the text with Auto.
Click OK when finished.

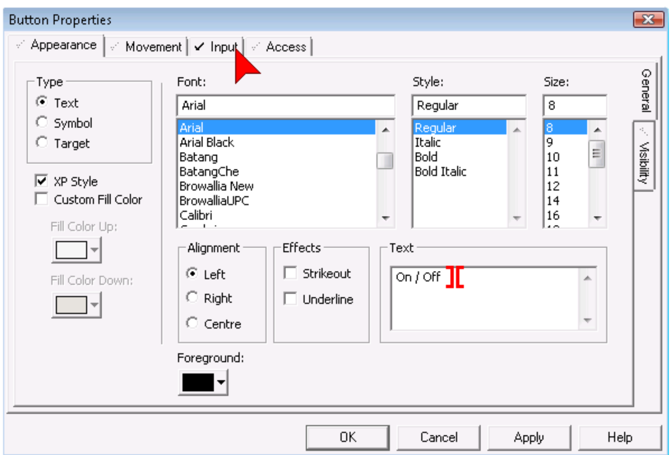
We now have two buttons that will set the control mode of the pump to Auto or Manual. Next we need a control to turn the pump on and off. Instead of using two buttons, one for on and another for off, this time we'll use just one button.

Creating Graphics Pages, Configuring Buttons continued…

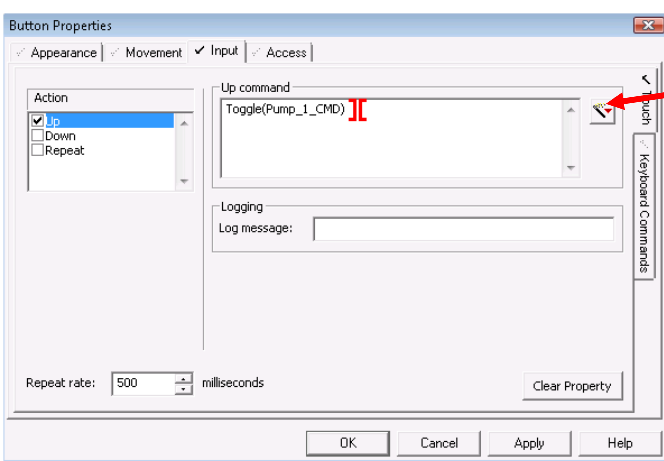
Make a copy of the Auto Button (hold the Ctrl key, then click and drag the Auto Button to create a copy in a new location).



Double-Click the new button to access its animation properties, then change the button Text to read "On/Off". Click on the Input tab when finished.



In the Up Command edit box replace the current text with Toggle(Pump_1_CMD).



You can also use the Insert button to lookup the Toggle function and paste it into the Up Command.

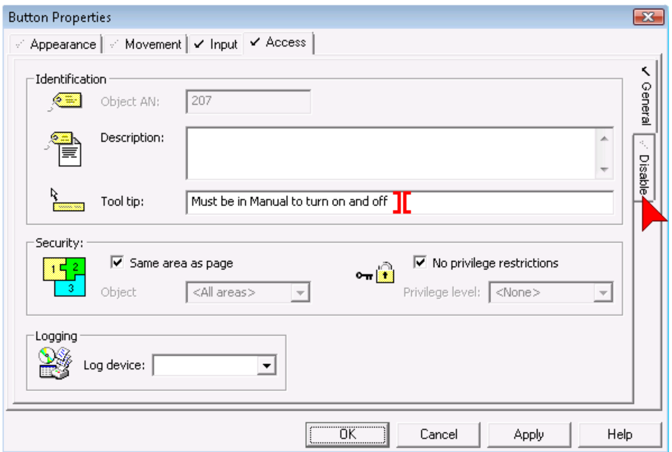
You can also use the reserved word TRUE instead of a 1, and FALSE instead of a 0.

TRUE and FALSE are not case sensitive, but upper-case is a common convention used to indicate a reserved word.

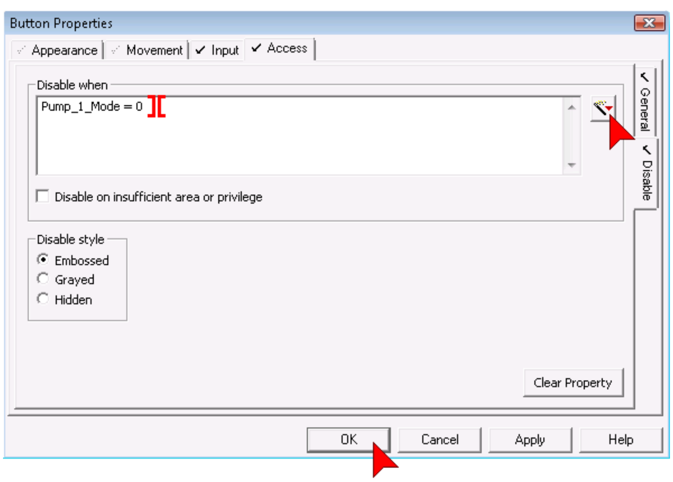
Creating Graphics Pages, Configuring Buttons continued…

We will now inhibit the Manual On/Off button from working while the pump is in Auto mode and we'll add a tool tip on the way to explain this to operators.

Click on the **Access** Tab at the top of the button form. In the **Tool tip** edit box **type "Must be in Manual to turn on and off"** then **click** the **Disable** tab (on the vertical tabs).



Click on the Insert icon .
Click Insert Tag.
Double Click on Pump_1_Mode and Add the text **= 0** after the tag.
Leave the disabled style as Embossed.



Click OK when you're finished.

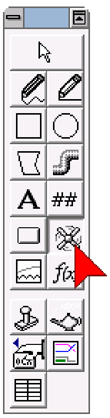
When Pump_1_Mode is "0" or FALSE (i.e. in Auto) this button will be disabled. The button's appearance will be altered using the Embossed style to indicate that it is disabled and it will not highlight when the cursor moves over it. The tool tip will still work normally.

Under the access tab you may notice there is a section called security. This is a very powerful feature in CitectSCADA that allows you to precisely define who can access what. Configuring security is covered in the CitectSCADA Configuration training course.

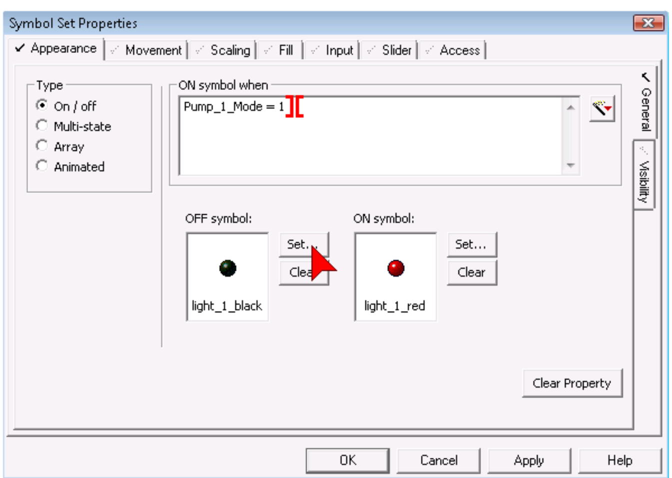
Creating Graphics Pages, Configuring Symbol Sets

Our control buttons for our pump are now complete. We will now add symbol indicators to show what state the pump is in. These indicator lights will show whether the pump is on or off, and whether it is in auto or manual mode.

On the Toolbox click on the Symbol Set Tool.



Position the cursor next to the Manual button, then click to place the symbol on the page. In the ON symbol when edit box `type` Pump_1_Mode = 1.

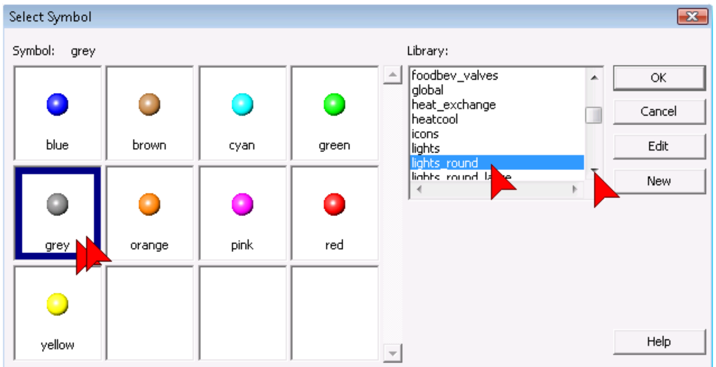


Click on the OFF symbol Set… button to select a different symbol to display for this state. A new popup form will be displayed, with a list of symbol libraries to the right, and thumbnails of the symbols within the selected library on the left.

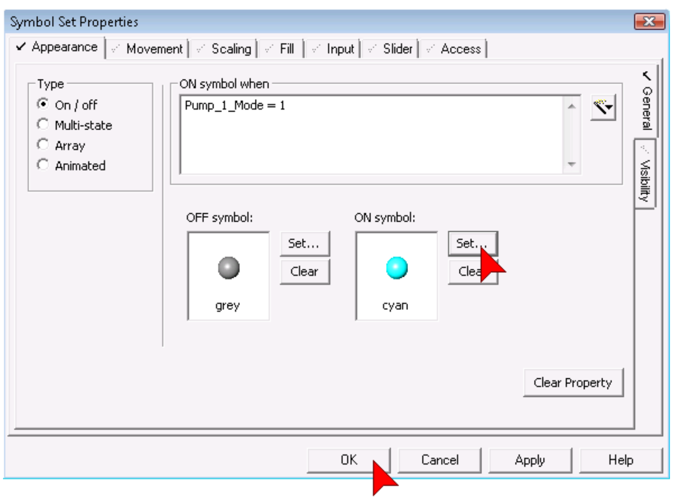
Scroll down the libraries until you find the “Lights Round” library, then Click on it to select it. The thumbnails on the left will change.

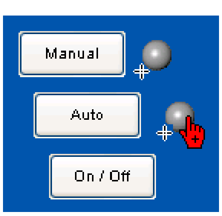
Creating Graphics Pages, Configuring Symbol Sets continued…

Select the Grey light by Double-Clicking on it. This will replace the original black light with a new grey light for the off state of the animation.



Repeat this exercise for the ON symbol state, this time selecting the cyan light from the lights round library. Click OK when your configuration of the manual symbol is complete.

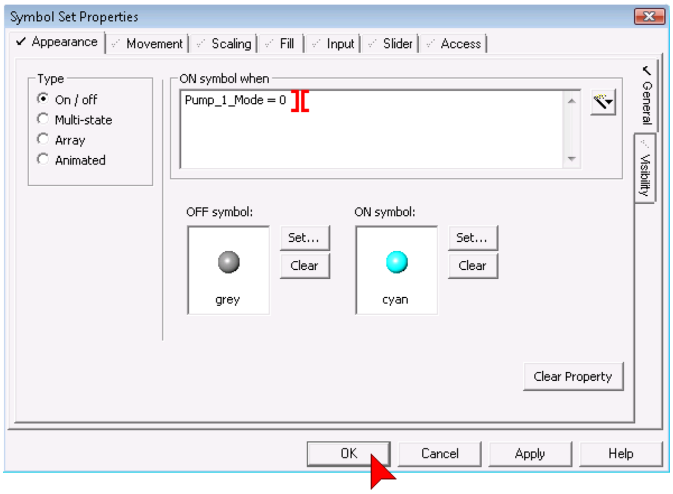




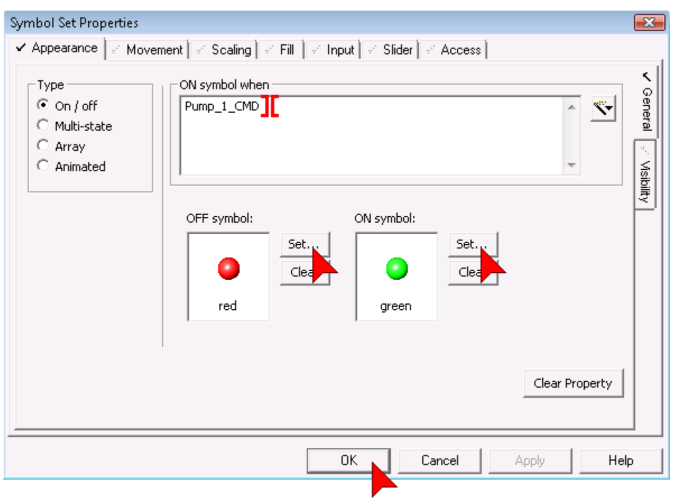
Copy the Symbol Set and place the new one next to the Auto button. Again, don't worry about positioning the symbol perfectly as we will align the various objects shortly.

Double-Click the copied symbol to access its animation properties. In the ON symbol when edit box replace the expression with Pump_1_Mode = 0 then click OK.

Creating Graphics Pages, Configuring Symbol Sets continued…



Make a third copy of the symbol set and position it next to the On/Off button. In the On symbol when edit box replace the text with Pump_1_CMD. Click the OFF symbol Set… button and select the Red light from the lights round library, then select the **Green** light for the ON symbol.



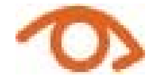
At Runtime, when Pump_1_CMD is on (i.e. equals “1”) the Green Light will be displayed, and when it is off (i.e. equals “0”) the Red Light will be displayed.

TIP

DIGITAL tag types do not require “=1” in their symbol detection logic because CitectSCADA knows that they only have two states corresponding to the two symbol states available.

This is a little different to when we were writing commands to the tag and we had to explicitly tell CitectSCADA which state to set the DIGITAL tag to.

Creating Graphics Pages, Aligning Objects

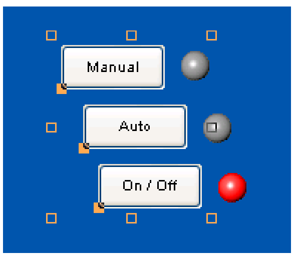


TIP
Another way to select multiple objects is to drag the cursor around them while holding the left mouse button down to "lasso" the objects. You will need to be careful not to select additional objects if you use this method.

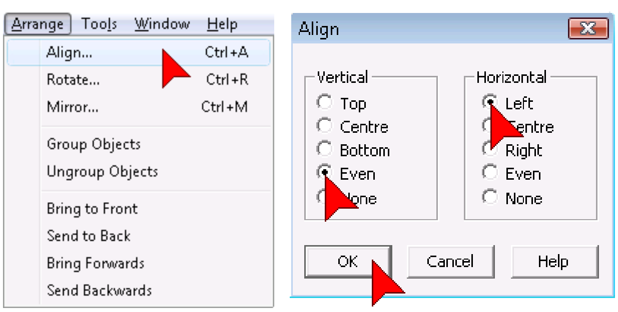
It is worthwhile making your pages look aesthetically pleasing as it will encourage operators to use the system and also makes it faster to find information on the screen. Making sure everything is drawn precisely, aligned correctly and evenly spaced also helps to make your pages look professional.

You can align objects manually by dragging them around the screen until you have positioned them satisfactorily, and for which the Grid is an excellent assistant, however sometimes we want to align a group of objects quickly relative to each other. For this we use the Align tool.

Select all three buttons by clicking on each of them, while holding the CTRL key down for the last two. All three buttons should have a selection indication at their button left, and be bounded by a large transparent rectangle identified by the four corners, and four center points as shown below.



From the Graphics Builder toolbar, select Arrange, and then Align. An alignment popup form will appear, asking you how you would like to arrange the selected objects. Select Left for the horizontal alignment and Even for the vertical alignment, then **Click OK**.



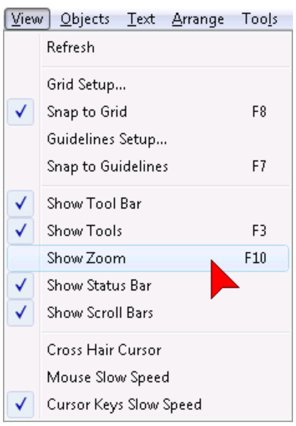
Repeat this exercise for the lights to the right of the buttons. Try selecting a button and a light and aligning them vertically via the Centre selection before aligning all three lights Evenly. Keep going until you are satisfied with the arrangement of the objects on your screen.

Creating Graphics Pages, Aligning Objects continued…

TIP
The Zoom tool can be quickly toggled on and off using the **`F10`** key

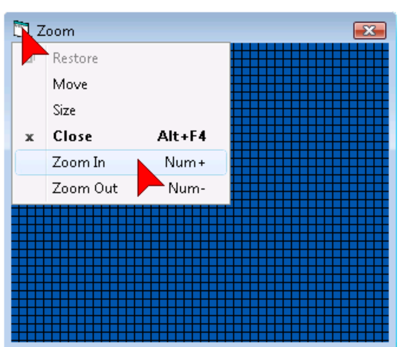
You may notice that the lights are not perfectly in line with the center line of the buttons. This is because the hot spot or anchor point for this symbol is in the top left of the symbol rather than in the middle. To correct for this we will use the zoom and the nudge tools.

To make sure your objects are aligned or positioned perfectly you can use the Zoom tool. From the **`Menu`** select **`View, Show Zoom.`**

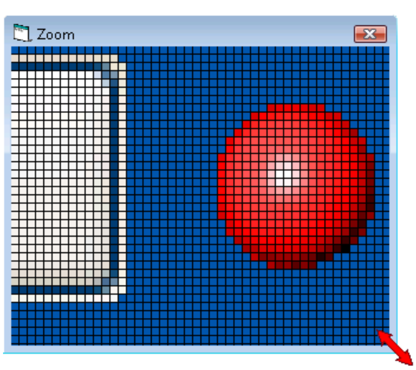


The zoom tool will display an enlarged view of the region around your cursor. You can alter the "magnification" by clicking in the top left corner of the zoom window

You can move the zoom window by placing the cursor on the title bar (the big blue bar at the top) then hold down the left mouse button and move the mouse.



You can change the magnification of the zoom by clicking on the pop-up's window icon, and selecting to Zoom In or Zoom Out as required.

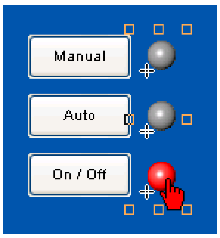


You can change the size of the zoom window by placing the cursor over one corner until the resize cursor is shown, then hold down the left mouse button and move the mouse.

Creating Graphics Pages, Aligning Objects continued…

Since the lights are in the correct position relative to each other, we will select all the lights so that we can move them together as a group. Place **cursor** above and to left of top button**;** hold down left mouse button and move mouse, then release mouse button to lasso all three buttons.

If you have the Grid tool turned on, press **F8** to disable the **Snap to Grid** function, otherwise the buttons will only move to the nearest grid position.



You can now precisely position the lights by placing the cursor over the selected objects (make sure the hand cursor appears) then press Enter (or hold down left mouse button), next use the arrow keys on the keyboard to move the buttons one pixel at a time in the direction that you want. Use the zoom box to see exactly where the objects are positioned to the nearest pixel. Press enter again to set the position (or release left mouse button if you used that method).

Save your page.

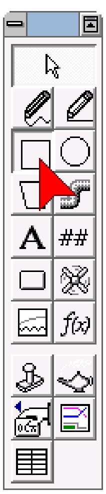
TIP
Windows XP style buttons have a grey border around the button. If you do not want a grey background for your buttons it is suggested that you uncheck the XP Style option under the Appearances tab of your buttons.

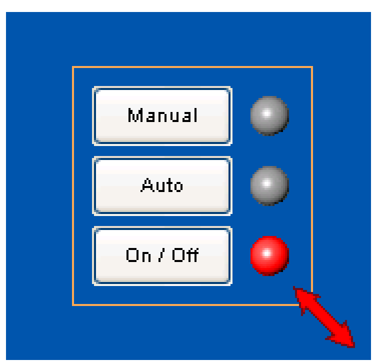
Creating Graphics Pages, Formatting with Rectangles

Next we will create a grey background to highlight our control panel.

Press F8 to turn the Snap to Grid selection back on. On the Toolbox click on the Rectangle Tool.

Click and drag to place a rectangle around your buttons and lights.

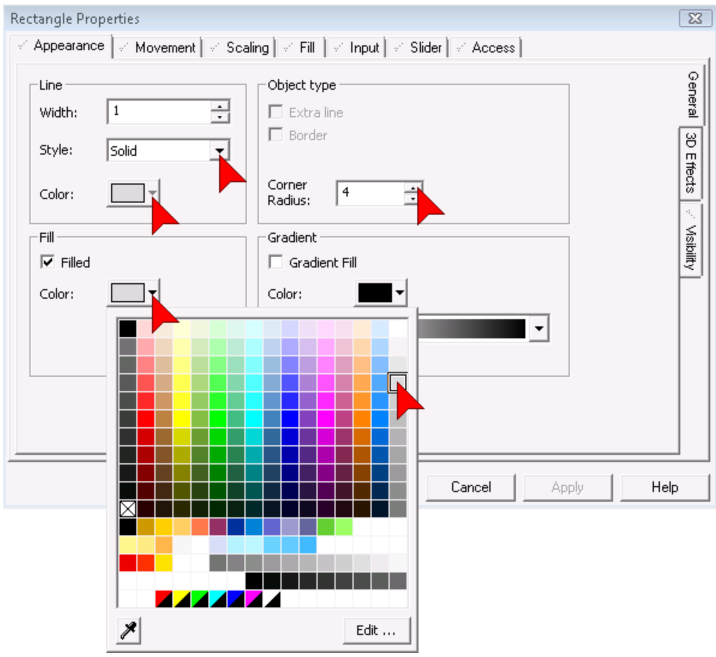




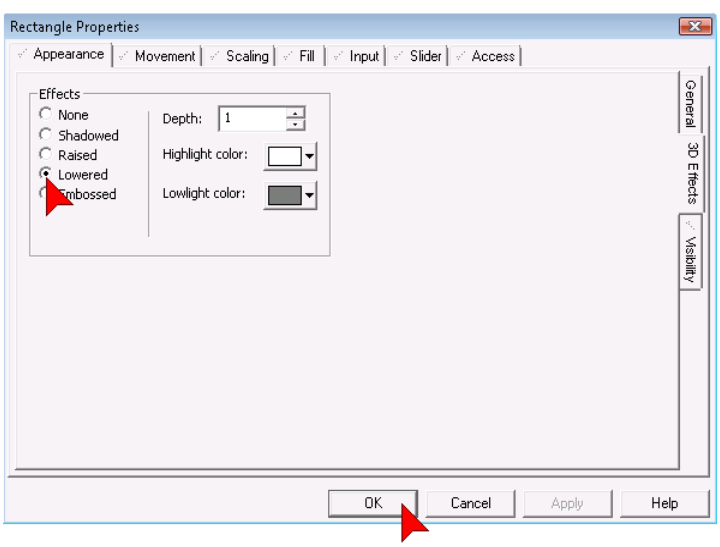
Once the rectangle is positioned, you can easily resize it by clicking and dragging the bounding boxes in each corner, and the center of each side.

Creating Graphics Pages, Formatting with Rectangles continued…

When the Rectangle Properties dialog popup appears, change the Style to Solid, the Corner Radius to 4, the Line Color to Grey, and the **Fill Color** to grey as shown below.



When you are finished, click on the 3D Effects vertical tab on the right-hand side of the form.



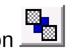
Select Lowered from the various 3D Effects available, and retain the default depth and color options, then click OK.

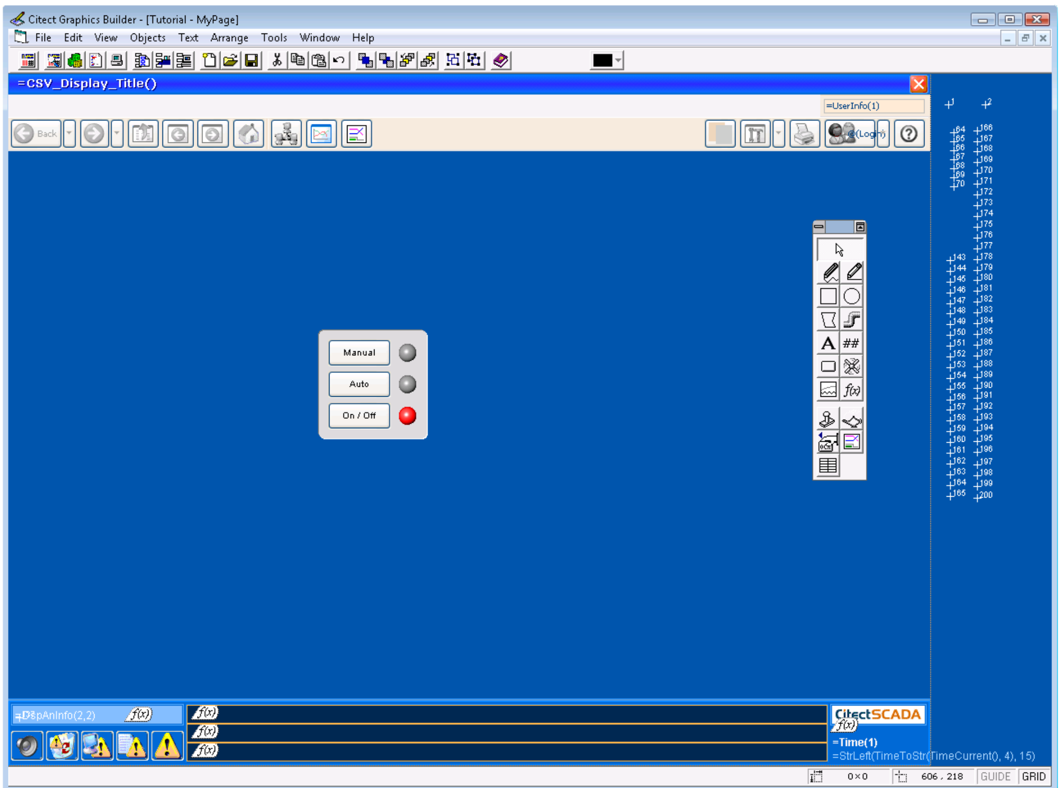
TIP
Once a shape has been created you can click and drag the node points (1 per corner and 1 per side), to modify its size and shape.

TIP
Holding the Ctrl key down while sizing a rectangle or oval forces the object to have the same vertical and horizontal dimensions. This allows you to easily create squares and circles respectively, rather than rectangles and ovals.

Creating Graphics Pages, Formatting with Rectangles continued…

The rectangle should now cover all of your buttons and lights, obscuring them from view. We need to send the rectangle to the back layer to allow the buttons and lights to appear in front of it.

Select the rectangle by clicking on it, then click the Send-to-Back button  or alternatively select Arrange, then Send to Back from the menu bar.



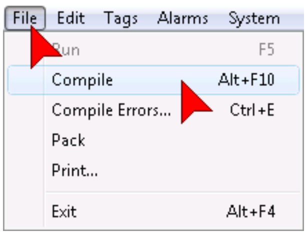
Your page should now look similar to the above. Save your page.

Testing Graphics Pages, Computer Setup Wizard

The Computer Setup Wizard is typically run only once per project for each computer on which CitectSCADA will run.

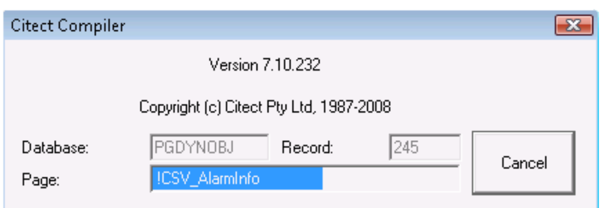
It's time to test your configuration and see how your page looks and feels to an operator. Firstly however, we need compile the project to make sure we have not made any configuration errors, and then we will run the CitectSCADA Computer Setup Wizard to configure how you want this computer to behave within your overall CitectSCADA network.

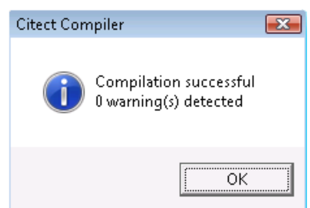
Switch to the Citect Project Editor using Alt+Tab. From the File `menu, select` Compile.



Alternatively you can use the compile button  on the menu bar.

You should see a compilation progress bar, followed by a Compilation Success popup.





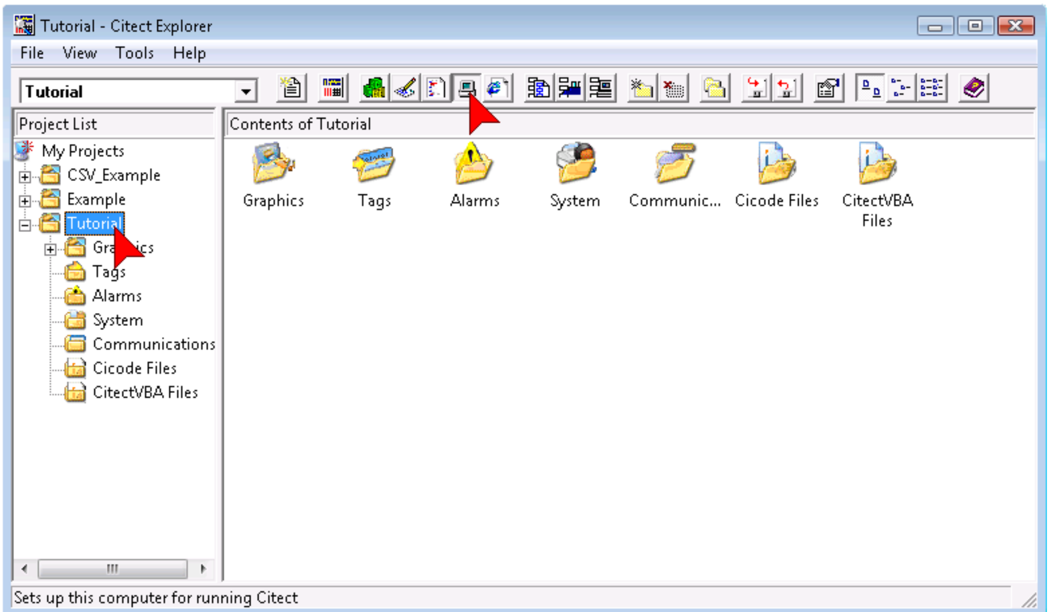
If your compilation fails, you can double-click on an error from the list provided to take you directly to the location of the incorrect configuration, or you can review your work using this document to ensure that you have performed all steps correctly.

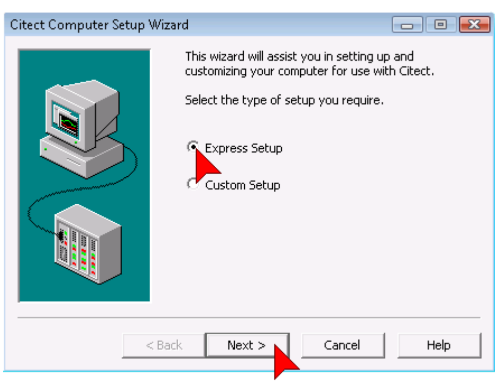
Quickstart Tutorial V7.10

Testing Graphics Pages, Computer Setup Wizard continued…

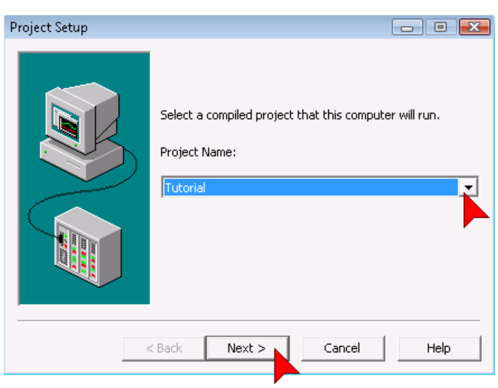
We will now setup our Computer's role within the CitectSCADA network. Switch to Citect Explorer using Alt+Tab.

In the Project List tree make sure the Tutorial project is selected.
In the menu bar, click the Computer Setup button.



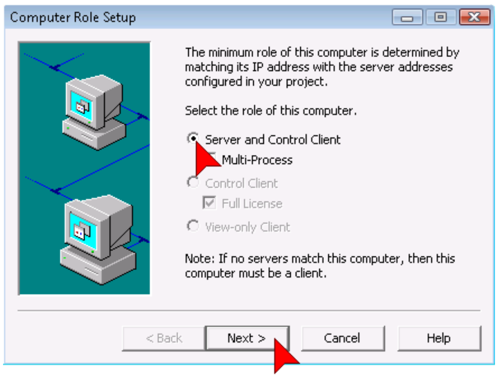


Check Express Setup then click Next.



Click the Project Name Drop Down and select Tutorial, then click Next.

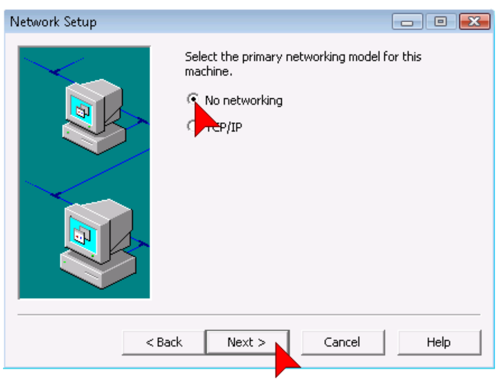
Testing Graphics Pages, Computer Setup Wizard continued…



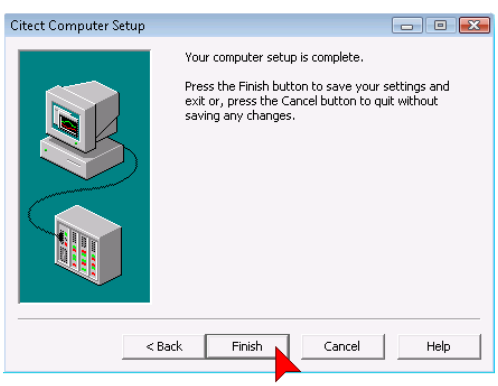
Check Server and Display Client, then click Next. Make sure you left the Multi-Process box unchecked.

Multi-Processing is used to distribute server tasks across multiple CPUs and cannot be used without a license key.

Networking enables communications from this CitectSCADA node to other CitectSCADA nodes on the network. It cannot be used without a license key.



Change the networking selection from the default of Discovery to No Networking, and then click Next. This will isolate this CitectSCADA on the network to allow it to run as a Stand-alone system.



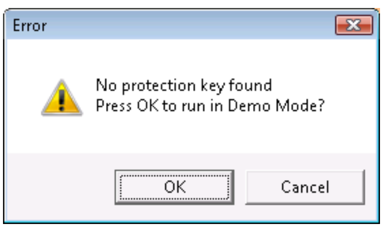
Click Finish.

We are now ready to run our project and test our controls.

Testing Graphics Pages, Runtime

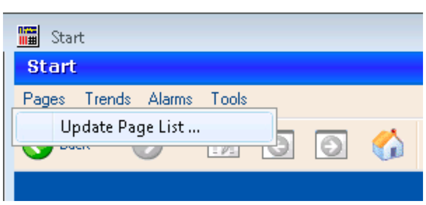
Press the Run  button. The Runtime Manager dialog will appear, showing the startup process and status.

If you have not inserted a protection key you will see the following message:

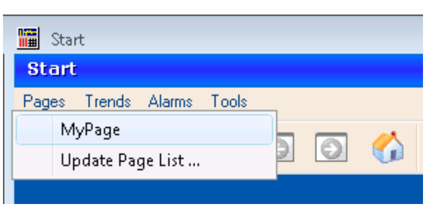


Click OK to run the project in demonstration mode.

The default startup page contains a number of menu items which can be configured in runtime. To configure the page navigation portion of this menu, click on **Pages**.



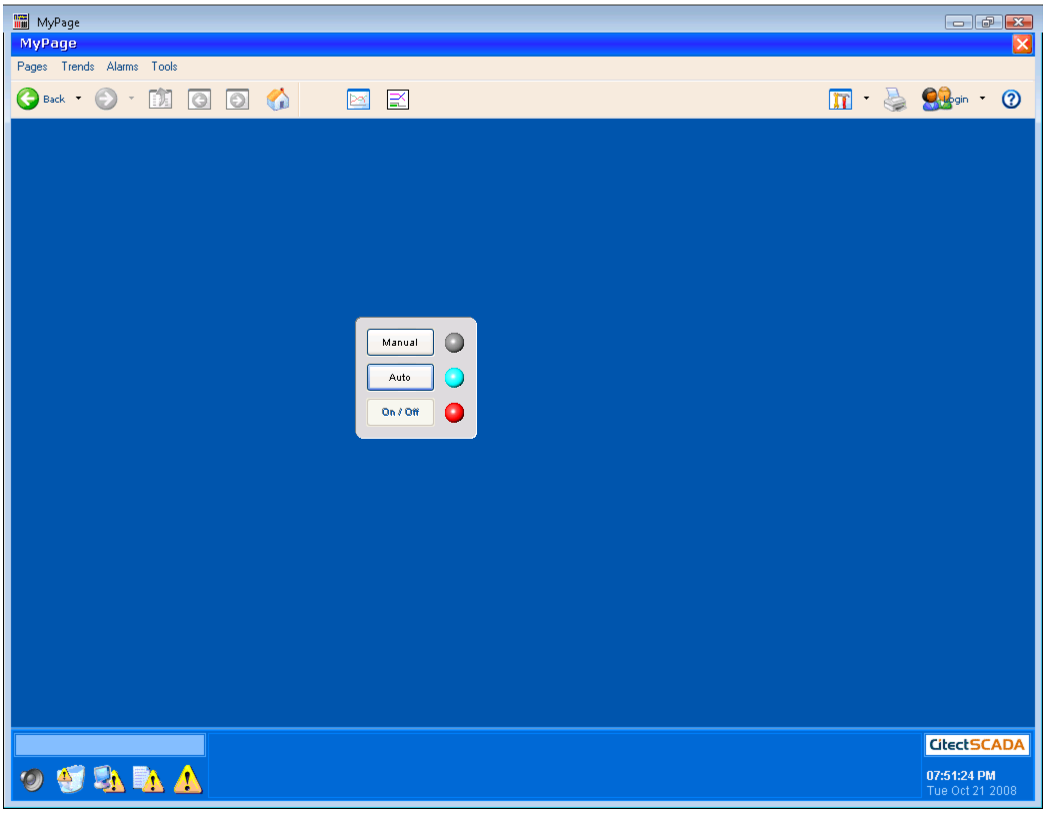
Click Update Page List**…** on the Pages menu will force CitectSCADA to update its runtime menu to include any unlisted (eg. new) pages. Click it now.



Returning to the Pages menu you will now see your page included in the navigation menu. Click on MyPage now.

Your page will now display.

Testing Graphics Pages, Runtime continued…



Click on the Manual button then the Auto button and check to see that the appropriate light turns cyan. Also check that the On/Off button becomes unavailable for selection whilst in Auto mode.

Move the mouse over the On/Off button and wait a couple of seconds to see that the tool tip appears.

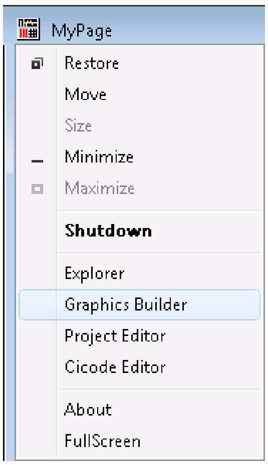
See what happens if you click on the On/Off button.

Click on Manual, and then try clicking on the On/Off button again.

If you’ve made it to this point, give yourself a gold star and take a moment to stretch your muscles.

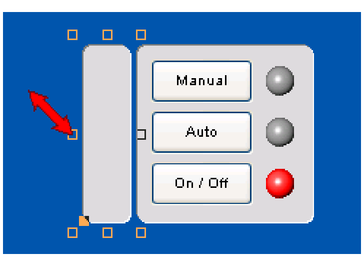
Creating Graphics Pages, Analog Indicators & Controls

To switch from runtime back to Graphics Builder, press Alt+Space together, then click on Graphics Builder.



Select the grey rectangle you have already created and copy it by dragging it and holding the Ctrl key down on your keyboard (alternatively use standard windows copy and paste controls). Position it to the left of the existing rectangle and drag the resize nodes to change it to a tall, narrow rectangle as shown below.

Use the Zoom and nudge, Align, or Grid tool to precisely position the Rectangle in line with the existing rectangle.

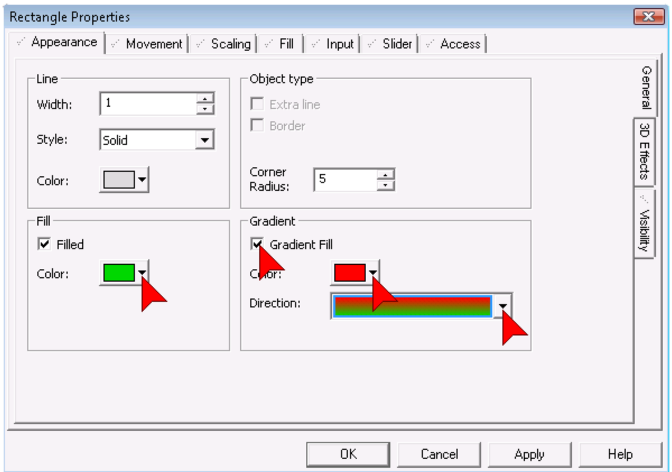


Double-click the rectangle to access the rectangle properties form.

Select the **Appearances** tab on the horizontal tabs, and the **General** tab on the vertical tabs.

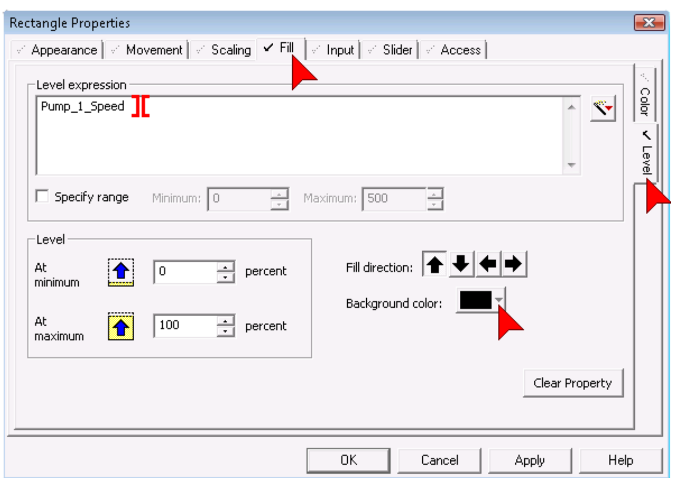
Change the **Filled Color** to bright green.
Check the **Gradient Fill** option and select bright red as the **Gradient Color**.
From the pull-down options, change the **Gradient Direction** to vertical.

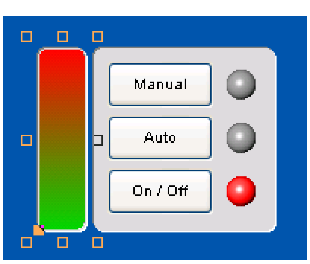
Creating Graphics Pages, Analog Indicators & Controls continued…



Once finished configuring the rectangle's appearance, click on the **`Fill`** tab and select **`Level`** from the vertical tabs on the right-hand side of the form.

Use the **`Insert`** button to insert the tag **`Pump_1_Speed`**. Change the **`Background Color`** `to black then` **`click OK`**.





This rectangle will fill and change color as the pump speed increases. The range for the analogue value (0 to 500 RPM), is automatically derived from its tag definition that we built earlier.

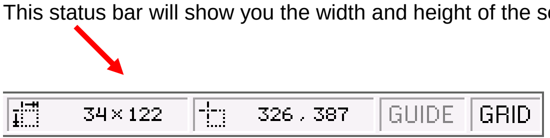
Next we will create a slider to allow operator control of the pump speed when it is in manual mode.

Quickstart Tutorial V7.10

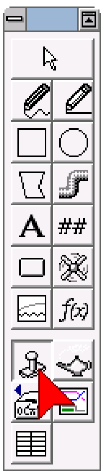
Creating Graphics Pages, Analog Indicators & Controls continued…

You will need to know the how far (in pixels) the slider needs to move. To find this out select the gradient rectangle (bounding boxes will appear), and look at information provided in the status bar at the bottom right corner of the Graphics Builder.

This status bar will show you the width and height of the selected object. Write down the height of the rectangle.

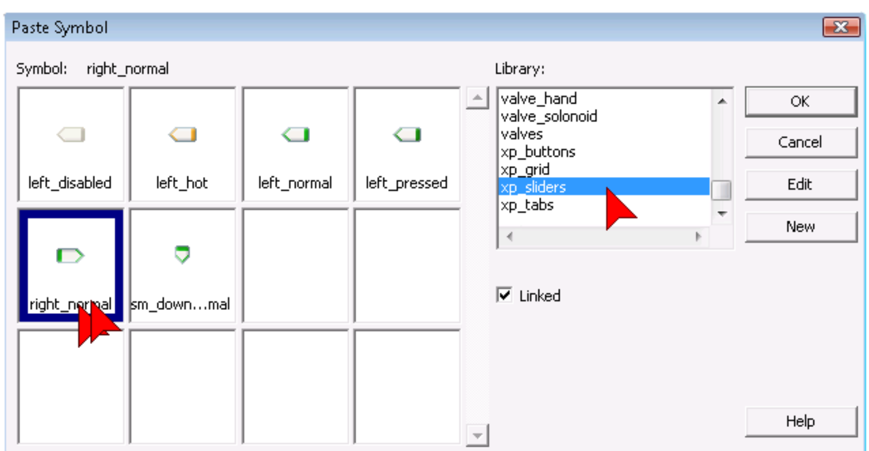


NOTE: If the status bar is not visible, go to the View menu on the menu bar and click on Show Status Bar.



On the Toolbox click on the Paste Symbol tool.

When the Symbol selection popup appears, use the scroll bars to locate the xp_sliders library and then Click on it to select that library.



Double Click on right_normal to place it on the page.

Creating Graphics Pages, Analog Indicators & Controls continued…

Position the pointer at the left bottom side of the gradient rectangle using Zoom and Nudge or the Align tool.

Double Click on the Pointer Symbol to open the Symbol Properties form.

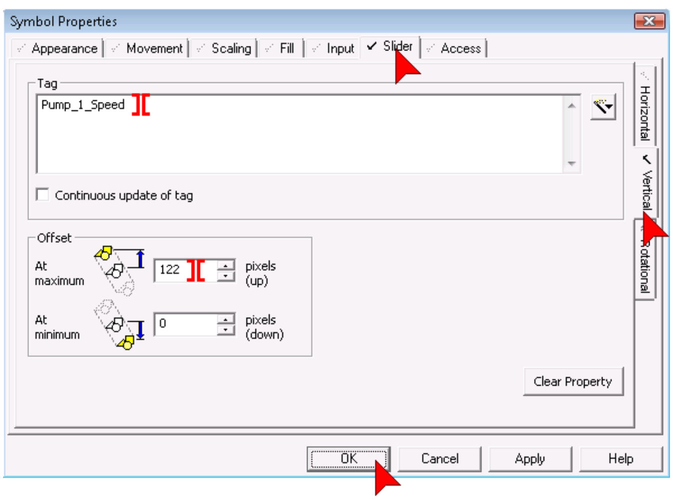
Click on the Slider Tab, then click on the Vertical Tab on the right-hand side.

Use the Insert button to insert the Pump_1_Speed tag.

Note that if the Continuous update of tag option is checked, then the tag will be written to while it is being dragged.

In the At Maximum edit box type the height in pixels that you wrote down earlier.

Click OK.



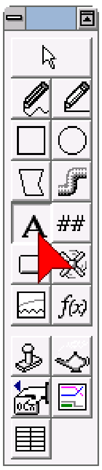
Now is a good time for a regular page save. Click the save icon.

You can compile, and run the project again to test these changes before continuing to the next chapter. If CitectSCADA is still running from your previous test, you will need to compile and change pages before updates are picked up by the running system.

Advanced exercise: If you're feeling adventurous, you can add a disable function to the slider (just like for the on/off button), under the Access tab.

Creating Graphics Pages, Configuring Text

We will now place some static text above the buttons to label the controls.



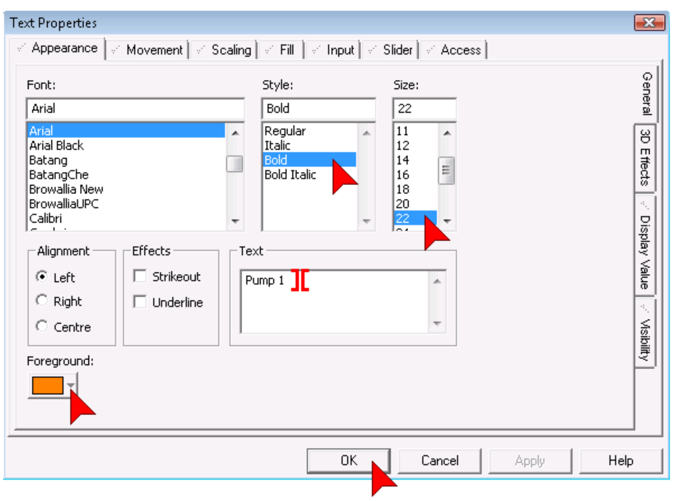
Click on the letter A on the Toolbox.

Type Pump 1.

Note: If you do not see the letters that you type it is most likely because the currently selected color is the same as the background color of the page.

Place the cursor above the buttons and click to position the text that you have typed. An appearance form will be displayed to allow further customization of the text.

Select Bold, font size 22 (point) and change the Foreground color to orange.
Click OK.



Creating Graphics Pages, Creating Colors

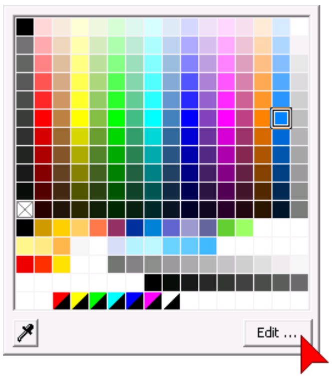
CitectSCADA supports True Colors. This allows far greater flexibility when importing images, as well as managing colors quickly and easily.

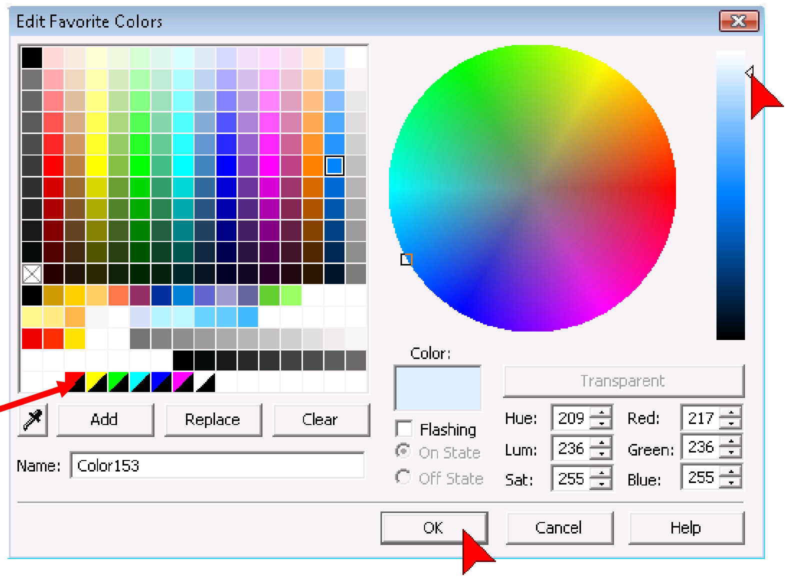
The default palette contains 128 commonly used colors however this does not restrict the number of colors you can actually use in your project.

Double-click on the Pump 1 text on your graphics page to open the Text Properties form again. Click on the Foreground color.

Creating Graphics Pages, Creating Colors continued…

Click on Edit. Another color form will display, allowing you to customize the color either using the mouse, or by entering the RBG indices for specific values.

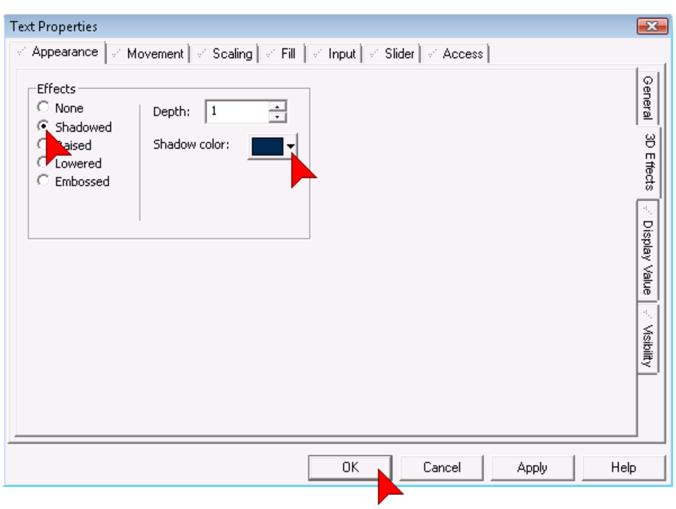


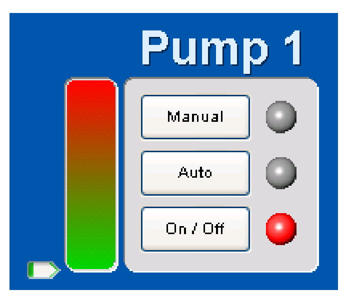


Flashing colors

You can use a variety of options in this color editing dialog to adjust the color to any of the 32 million true colors available (provided your computer supports 32bit colors). In our case, we will simply Slide the Shading Cursor on the right-hand side up to a very pale shade, then click OK to finish and transfer the new color to your graphics object.

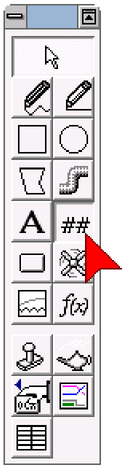
Once you are satisfied with the color of your text we will add a 3D Effect of Black Shadowing using the 3D Effects tab on the right side of the Text Properties dialog popup.





Save your page.

Creating Graphics Pages, Configuring Numbers

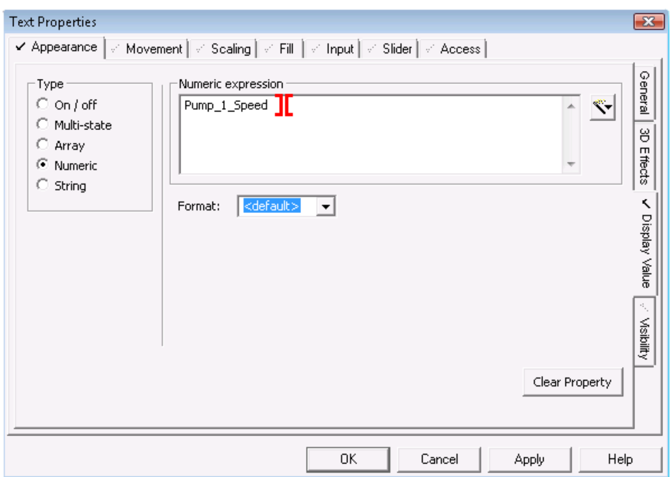


On the Toolbox, click on the number tool.

Click to place the number below the gradient rectangle.

The Number tool is actually the Text tool. When you access it via the number tool icon you are presented with the Display Value sheet instead of the General Appearance sheet.

Use the Insert Tag button to enter the tag Pump_1_Speed. Leave the data format field to the default, and the format you specified in the tag definition will be used.



Click on the General tab on the right-hand side and set the font to Black, 12 point, then Click OK.

Creating Graphics Pages, 3D rectangles

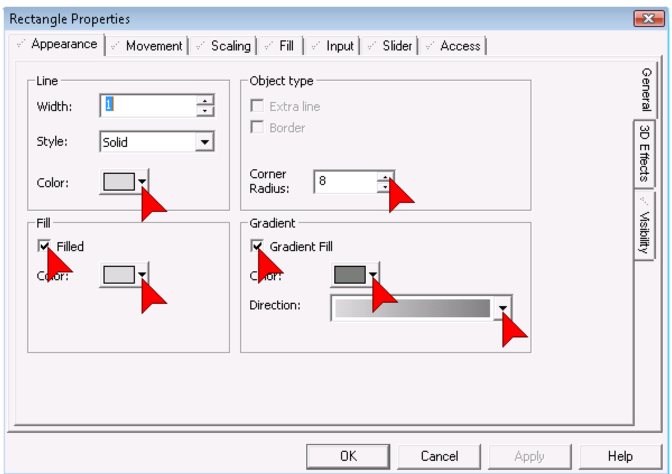
Next we'll add some cosmetics to make the display more appealing.

Draw a large rectangle that covers all the things you have drawn so far (or copy the one you already have on the page).

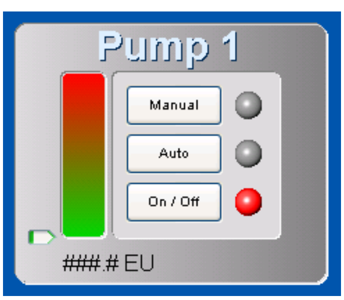
Set the Line color to Light Grey (see next page).

Check the **Filled** check-box and set the **Filled color** to **Light Grey** also.

Set the **Corner Radius** to **8**, and activate the **Gradient Fill** with a medium grey hue.



Click on **3D Effects** tab and select **Lowered**.



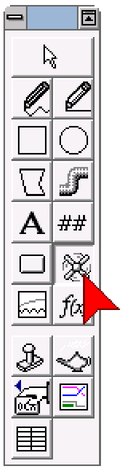
Since it will be difficult to see your work with the large rectangle in front of it, we need to send it to the back.

Make sure the new rectangle is selected, then **click** on the **Send to Back** button  on the **Tool Bar**, or select **Send to Back** from the **Arrange** menu.

Click OK when finished.

Creating Graphics Pages, Pumps & Piping

Next we will add a picture of the pump and some piping.



Click on the Symbol Set tool.

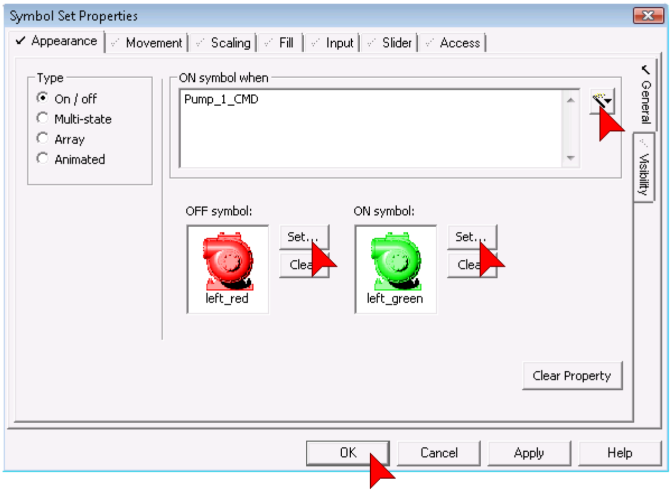
Click below the new rectangle to place the symbol set on the page.

Click on the **Set** button next to the OFF Symbol edit box to change the Off symbol from a black light to a red pump**.** In the Library list, use the scroll bars to scroll down and then **click** on pump_base_xlarge. In the Symbol window, Double Click on the left_red symbol.

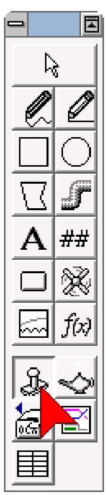
Click on the Set button next to the On Symbol edit box to change the On symbol from a red light to a green pump**.** Using the same technique as above, locate the left_green pump then Double Click on it.

Use the Insert button to insert the tag Pump_1_CMD. Click OK.

Creating Graphics Pages, Pumps & Piping continued…

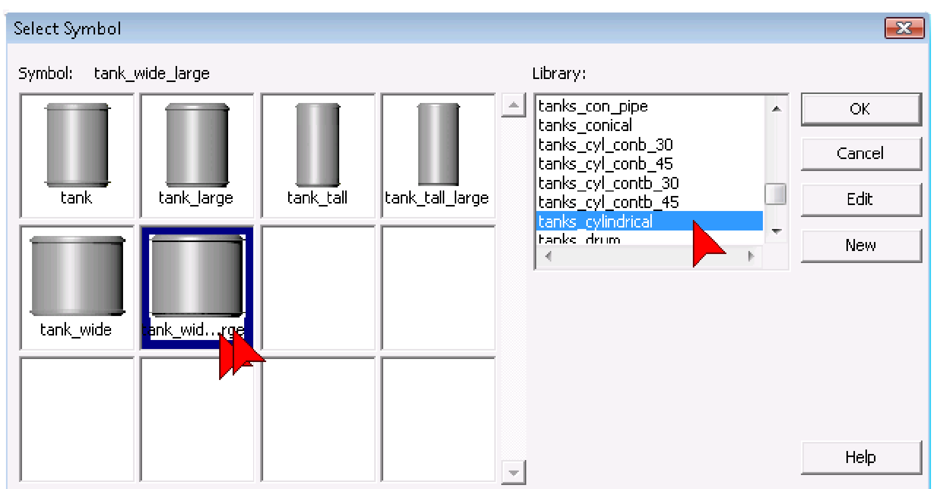


Configuration of the pump's animation is now complete. We now need to add source and destination receptacles along with accompanying pipework and the page will be complete.



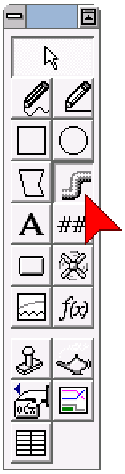
Click on the Static Symbol Tool in the ToolBox.

Using the scroll bars, locate the tanks cylindrical symbol library, and then Double Click tank_wide_large. Click and drag the tank to position it on the left-hand side of the page.



Repeat for a second tank, this time using the tanks_cyl_conb_30 library, with the tank_large symbol, positioned on the right side of the page, above the pump.

Creating Graphics Pages, Pumps & Piping continued…



Click on the Pipe Tool in the ToolBox.

The Pipe tool generates 3D rendered polylines with node points that identify bends or junctions. Pipes can be color filled the same as any other drawing object in CitectSCADA, and will render the flooded color in 3D.

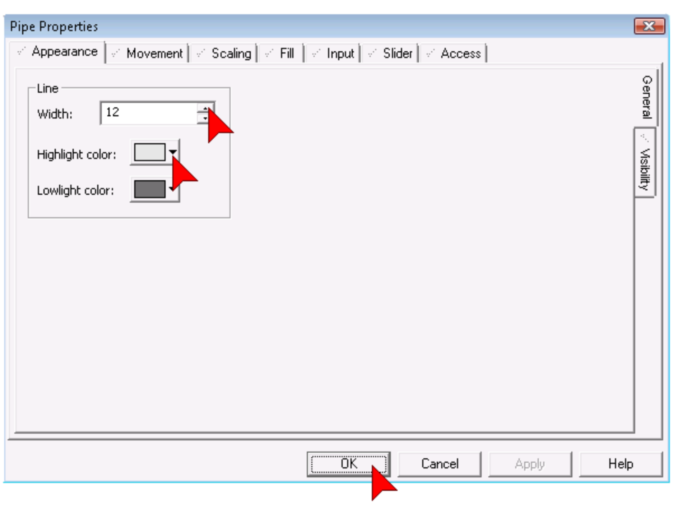
We will now draw two separate pipes, one from the source tank on the left side of the page, and one to the destination tank on the right side of the page.

To draw the right-hand pipe:

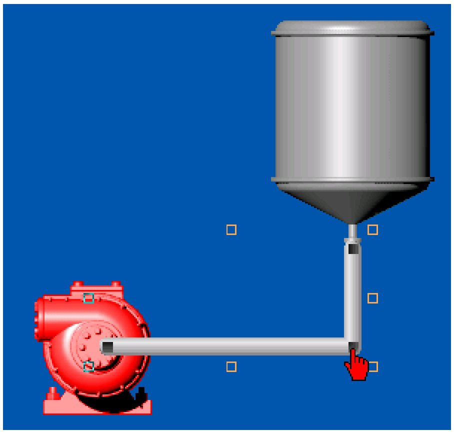
1. With the pipe tool selected, Hold down the Ctrl Key (Forces only horizontal and vertical lines to be drawn)
2. Place cursor on top of the right-hand tank in the approximate center, click and hold down the left mouse button and move mouse downwards. Release mouse key when you have moved far enough to draw the first leg of the pipe.
3. Move mouse to the left (release the Ctrl Key to allow diagonal pipes if you wish), and click again to create the second leg in the pipe.
4. Continue until you are satisfied with your pipe's route and Double Click to end the pipe at the pump.

Note that you can return and adjust the individual junctions of the pipe to fine-tune its position and shape later.

Release the Ctrl Key when you are finished the pipe and the pipe properties form is displayed. Select a pipe highlight color of light grey and a width of 12, and then click OK to close the pipe properties form.



Creating Graphics Pages, Pumps & Piping continued…



To adjust the pipe, select it by clicking on it. The ends and bends of the pipe will have small nodes shown, which can be clicked on and dragged to reposition them.

Bounding boxes allow the dimensions of the pipe to be adjusted, and will scale the pipe accordingly, and will not adjust the width of the pipe.

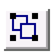
Carefully manipulate your pipe to align with the outlet of the tank, and feed into the pump approximately halfway through its radius.

Repeat this process to create another pipe on the left-hand side of the pump feeding into the second tank. Don't worry if you add a small section to one end of the pipe when you double-click as the pump or tank symbol will conceal it once we push them to the back layer.

When items are grouped, double-clicking on them will access the group configuration, however objects inside of the group can have their own animation properties independently of the group's properties.

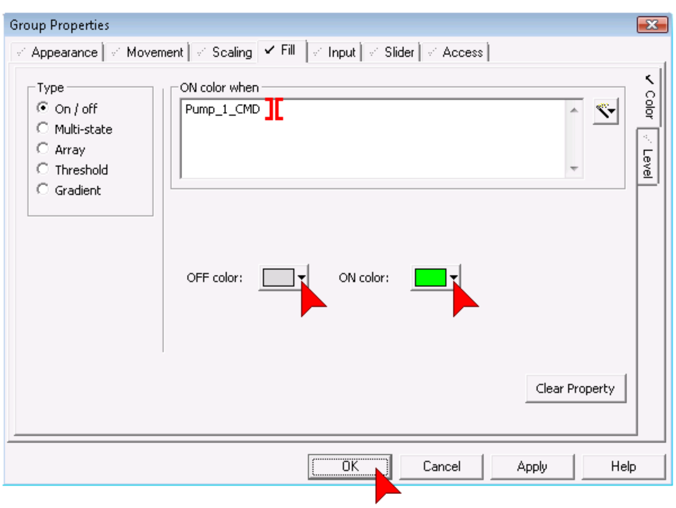
To access the individual objects within the group, hold the CTRL key down while double-clicking the object.

Once you are satisfied with the position and shape of both pipes, select both pipes by holding down the Ctrl Key and clicking on each pipe. Release the Ctrl Key.

Click the Group button  on the tool bar (or select Group from the Arrange menu).

Click the Send to Back button  on the tool bar (or select Sent to Back from the Arrange menu).

Double Click on either of the pipes that you have drawn. You will notice that the configuration dialog displayed is for Group Properties rather than Pipe Properties. All configurations you now perform will apply to all objects contained within the group, in this case, the two pipes.



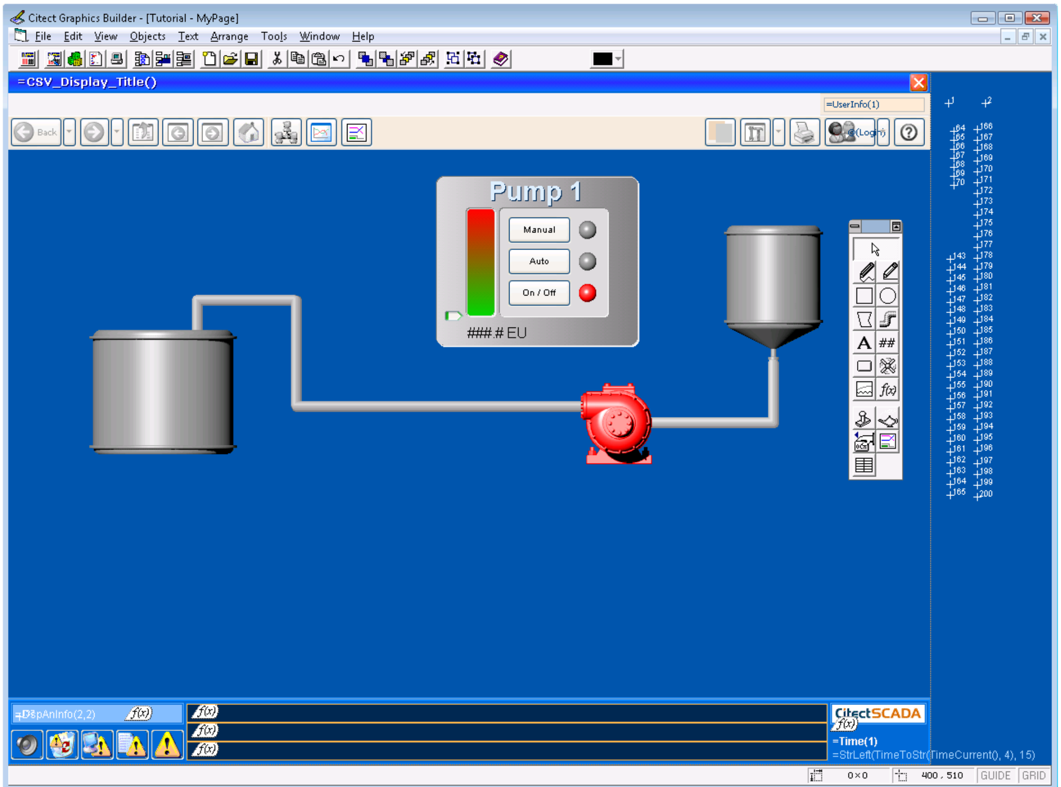
Click on the Fill Tab. Insert Pump_1_CMD tag into the ON color edit box.

Set the Off Color to light grey and the On Color to Green. Click OK**.**

Your configuration of the pipe work is now complete.

Save the page.

Creating Graphics Pages, Pumps & Piping continued…



Your graphical configuration for this tutorial is now complete. You can test this by running the project again, and then continue to the following sections which address color management, alarm handling, and trending, as well as customizing the navigation menu and Administration Tools.

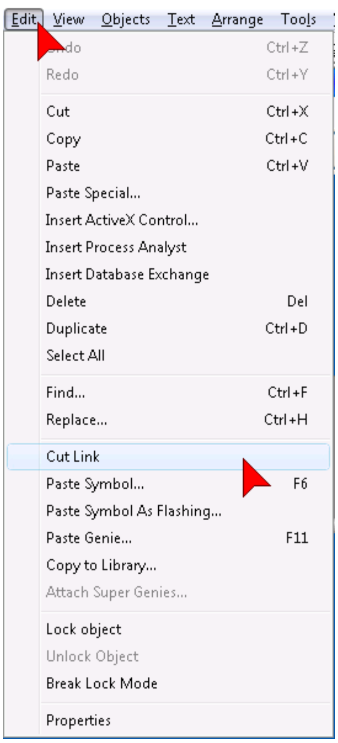
If you'd like to practice the skills you have just learned, try adding a bar graph to the tank to indicate level (you can add a slider to simulate a level transmitter).

Creating Graphics Pages, Managing True Colors

CitectSCADA comes with two excellent tools for adjusting colors, making it very easy to manipulate images from shades of red to green to yellow and so on, even for very complex true-color images.

We will manipulate a simple image in this example, but the same principles apply to any true color image that you create or import to the application.

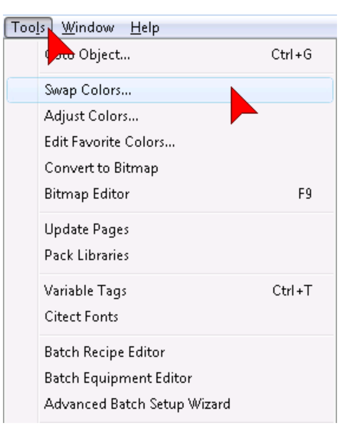
Click on the left-hand **Tank** symbol to select it.



From the **Edit** menu, select **Cut Link**. This will sever the symbol's link with the library and allow us to manipulate it as a stand-alone object. If we did not sever this link, then we would have to modify the object in the library rather than on the page, which would distribute the change to all instances of the object throughout the project.

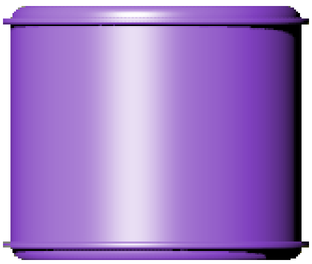
Note that you should never modify the libraries that are supplied with the product. If you require a variation of these objects, you should copy them into your own library, and create the variations there.

From the **Tools** menu, select **Swap Colors**.



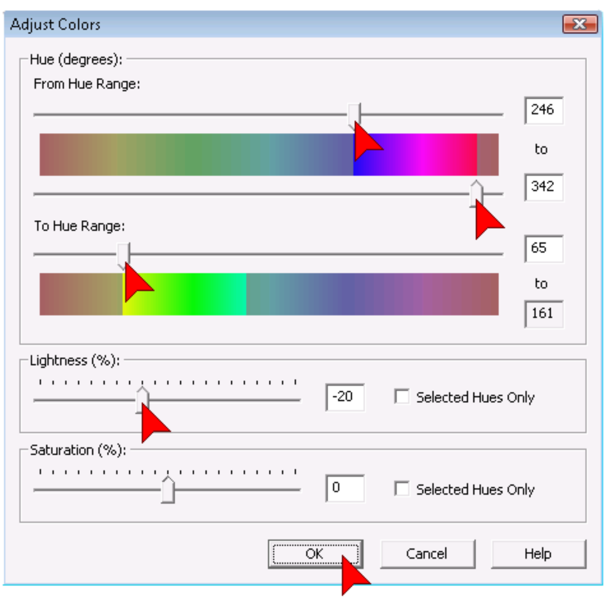
Creating Graphics Pages, Managing True Colors continued…

Making sure that the Swap Range option is selected, select any shade of grey for the From Color, and any shade of purple for the To Color, then click OK. The tank should now be a 3D rendered purple variation of the original grey object.



For more flexible color management, you can use the Adjust Colors tool, also available from the Tools menu. This tool allows you to select from a flexible range of colors for migrating from one hue to another, as well as adjusting saturation and darkness at the same time. This can be very useful when one color range does not translate well to another.

Use the Adjust Colors tool to change your purple tank to green, and darken the hue by 20%.



Accessing Alarm and Trend Display Pages

CitectSCADA comes with a number of pre-built pages. If you do not specifically define these pages in your project to create your own look and feel, then CitectSCADA will use its defaults instead. This includes:

- *Alarm*
- *Summary Alarms*
- *Disabled Alarms*
- *Hardware Alarms*
- *Trends*
- *Double Trends*
- *Popup Trends*
- *Instant Trends*
- *Administration Tools*

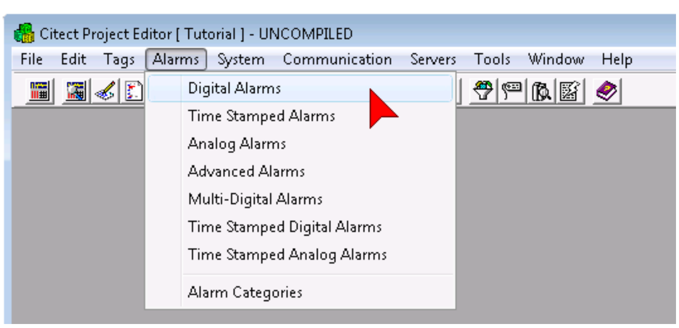
As well as the page template which we are already using which provides built-in navigation and alarm shortlist features.

These pages provide comprehensive functionality and can be accessed directly from the navigation menu provided at the top of each page, or via the alarm icons at the bottom left of each page. However to make these pages useful, we must first define some alarms and trends in the project.

Unlike other SCADA packages, Citect's Digital Alarms support a combination of two variable tags for alarming purposes. This makes it easy to mask alarms via a second PLC flag (eg. area in maintenance mode), without writing additional PLC

Configuring Alarms

Switch to Citect Project Editor (**click** on the icon or use Alt+Tab keys). In the Project Editor Menu click on **Alarms**, then **click** on Digital Alarms.

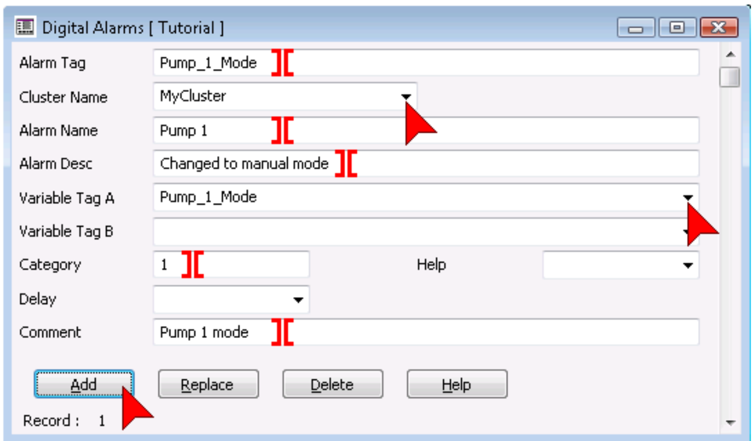


Fill in the Digital Alarms form for a single alarm as shown below. Remember it is better to use the drop downs to ensure data is entered correctly. When the form is complete click Add.

Remember that pressing Enter will add another record to your alarm list, so make sure the form is complete first, or use the Add button.

Configuring Alarms continued…

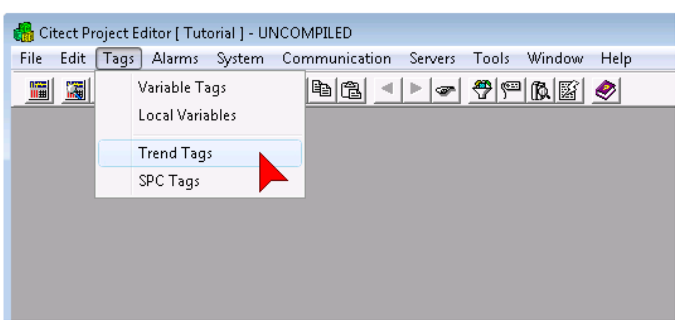
TIP
In the Variable Tag fields, you can place an expression (eg. Pump_1_Mode = 0) to reverse the alarm detection logic.



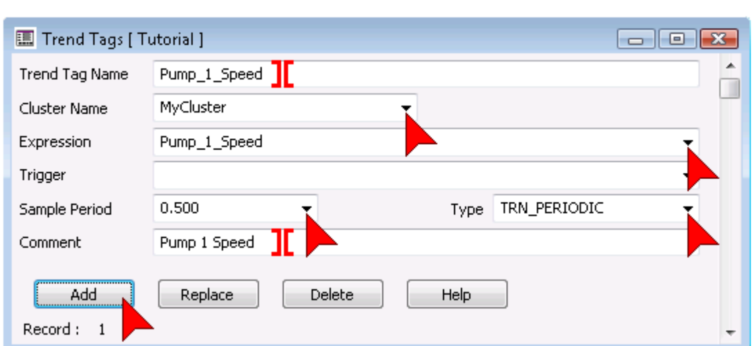
Click on the icon to close the Digital Alarms form when you are finished.

Configuring Trends

Now we need to configure a trend tag to store trend data. Switch to Citect Project Editor (click on icon or use Alt+Tab keys). On the Project Editor Menu, click on Tags then click on Trend Tags.



Fill in the Trend tag form as below then click Add. Remember to use drop downs where possible.



Configuring Trends continued…

Privilege levels are unique by default, not hierarchical. This means that a user with privilege level 6 does not automatically get access to level 5 functions.

ant your users to cess to more than ilege level, then you should include all of those levels in the privilege field as shown in the configuration examples.

To change the behavior of the system to hierarchical privileges, refer to the online help

This configuration will log the Pump_1_Speed to disk every ½ second. Most installations would typically log the majority of their data at 2 seconds or slower except for their key operating parameters.

There are many more trend features available in Citect. Press F2 with this form open to see some of the advanced possibilities. Pressing F2 again will return you to the basic menus.

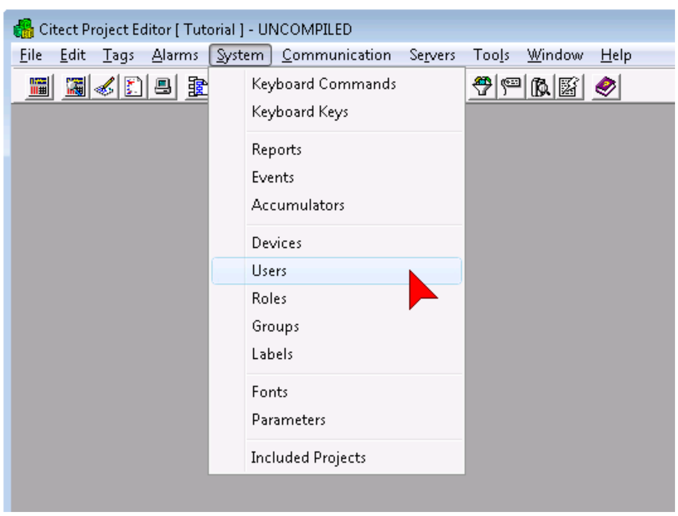
Click on the icon to close the Trend Tags dialog.

Configuring Security

Most projects require secure user authentication before they will allow control activities to be executed from the HMI. In Citect this can be achieved via local users, or Windows users.

In addition to any security that we might configure on our own objects, we also need to define security login credentials to access all of the functionality available from the built-in pages supplied with Citect. Switch to the Citect Project Editor.

On the Project Editor Menu, click on System then click on Users.



Fill in the User form as below then click Add.

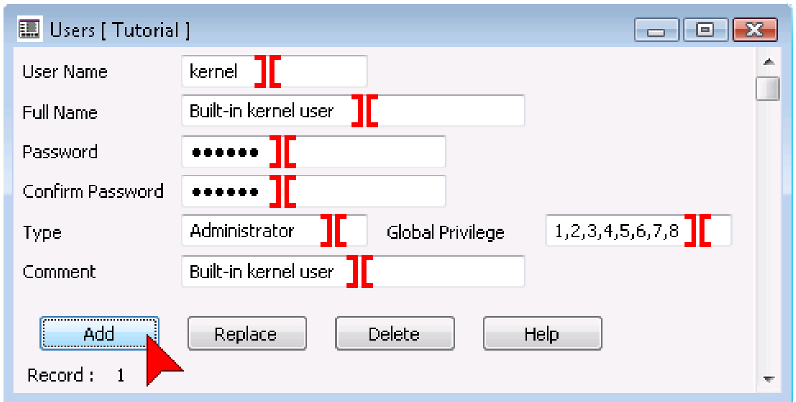
Local users are managed from within the Citect configuration environment.

Windows users (refer Roles below) are managed from either the Windows operating system, or a networked domain server.

Configuring Security continued…

additional options allocations. Press **F2** to view the additional parameters available for Users and Roles.

Global privileges assign access rights across all areas of the project.

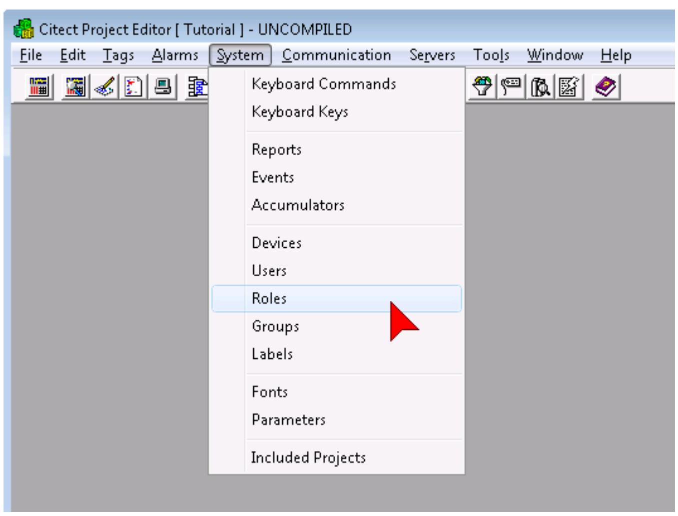


The password fields contain “*” to hide passwords from prying eyes. Do not type *****, instead type citect into this field. The asterixes or hidden characters will appear as you type.

This user has been configured for maximum security privileges throughout the project and will be able to access the advanced tools available from the navigation bar.

We will also add a Windows Administrator group, and a Windows Restricted user with fewer privileges.

On the Project Editor Menu, click on System then click on Roles.

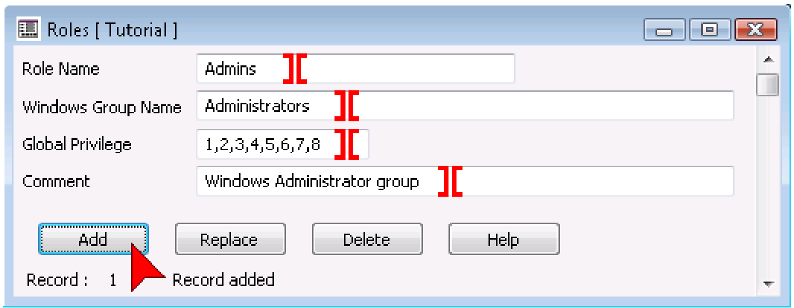


Configure the Windows Administrator group to have full access across all areas of the project, similar to the kernel user we have just added.

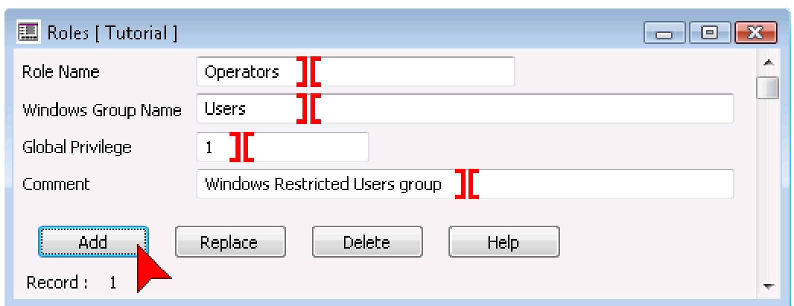
Configuring Security continued…

You can replace individual found items by
ıem and
place.

TIP
If a graphics page is open when changes are made to it using the replace feature, you will need to manually save the page to persist the changes



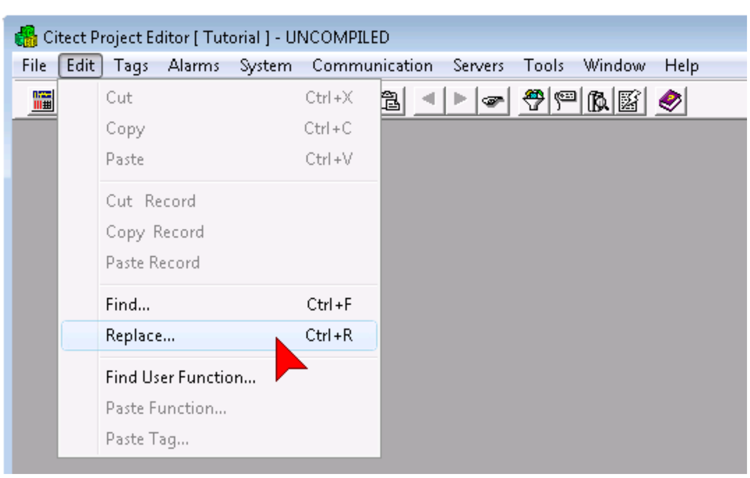
Add the Windows Users group to have access to privilege level 1 across all areas of the project.



Click the close  button when you have finished.

Using Find and Replace

We are going to perform rework on the variable tag Pump_1_CMD. We are going to change its name to Pump_1_RUN to better represent its function. Rather than searching the entire project for each place this tag is used, we are going to use the project search and replace feature to perform this exchange for us.

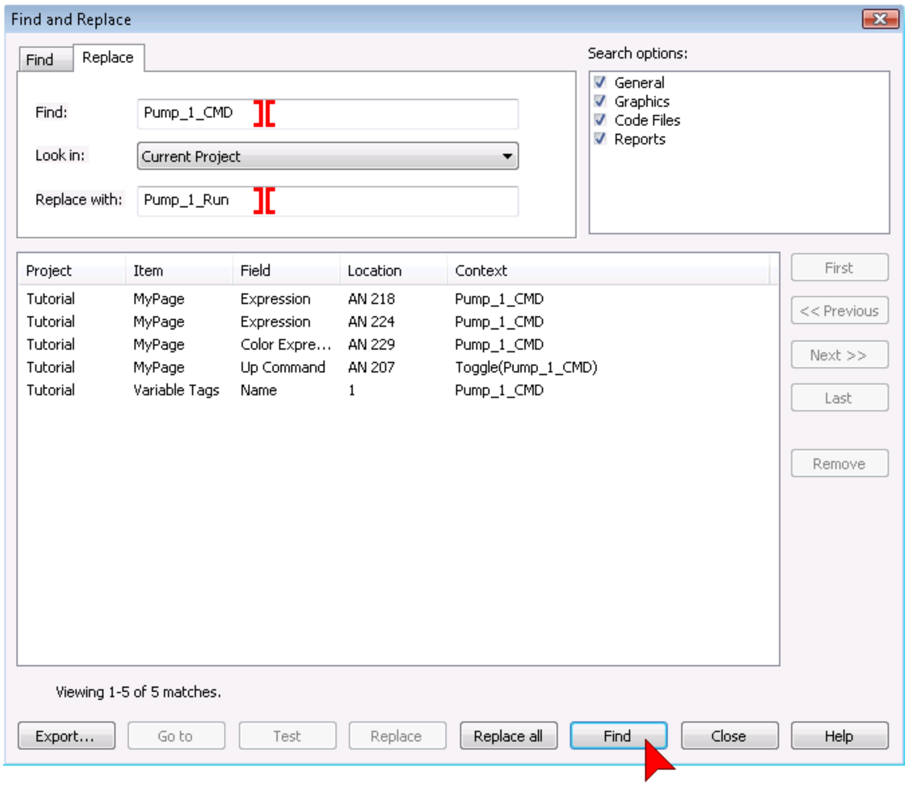


Switch to the Citect Project Editor. In the Project Editor Menu, **click** on Edit then click on Replace (or use Ctrl-R).

Using Find and Replace continued…

Type Pump_1_CMD in the Find box, and Pump_1_RUN in the Replace with box. Make sure Current Project is selected, along with all search options checked.

Click Find.



The utility will display a list of all locations where the Pump_1_CMD tag is found.

Click Replace all.

Confirm the replace when prompted, and (if you still have the page open), switch to the graphics builder to save changes to your page.

Congratulations. You have completed the offline configuration portion of this tutorial. The following sections show you how to configure the online portions of the project.

Runtime

Use the back  button at runtime to go back through the pages that you have visited.

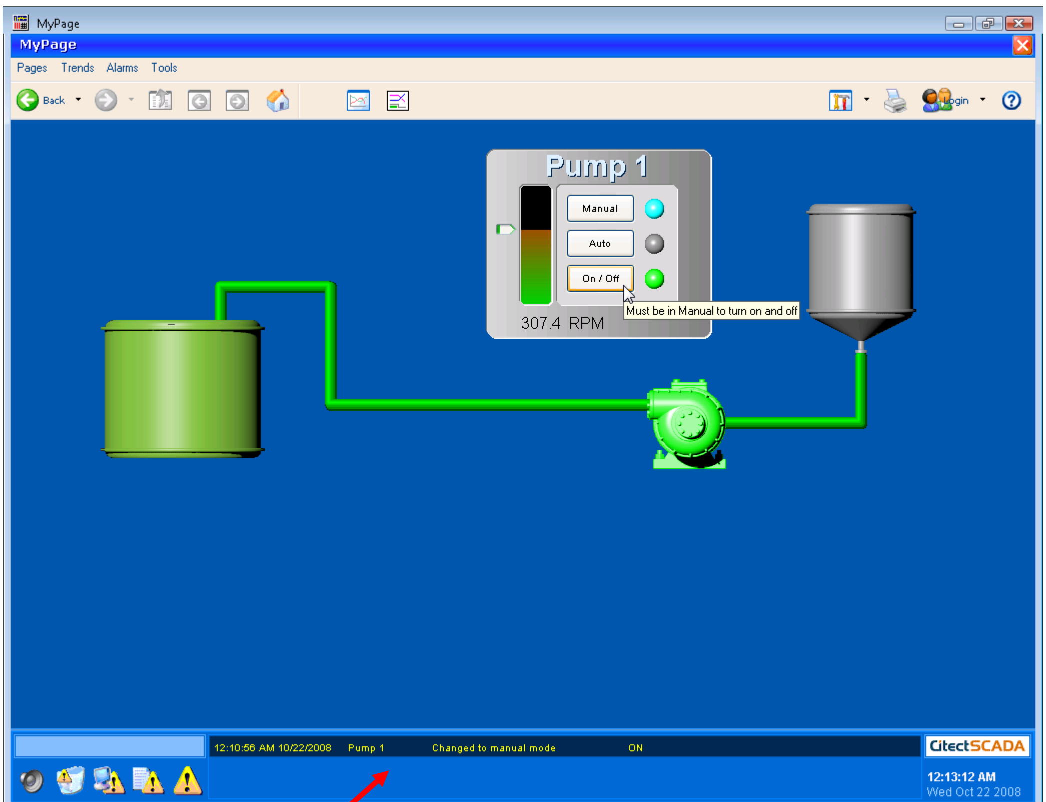
Now it's time to run your project and test it to make sure that you have completed the tutorial correctly.

Compile your project, then Click on the Runtime  icon.

Use the navigation menu to access your graphics display called MyPage.

Click on Auto button then click On Manual. Click On/Off.

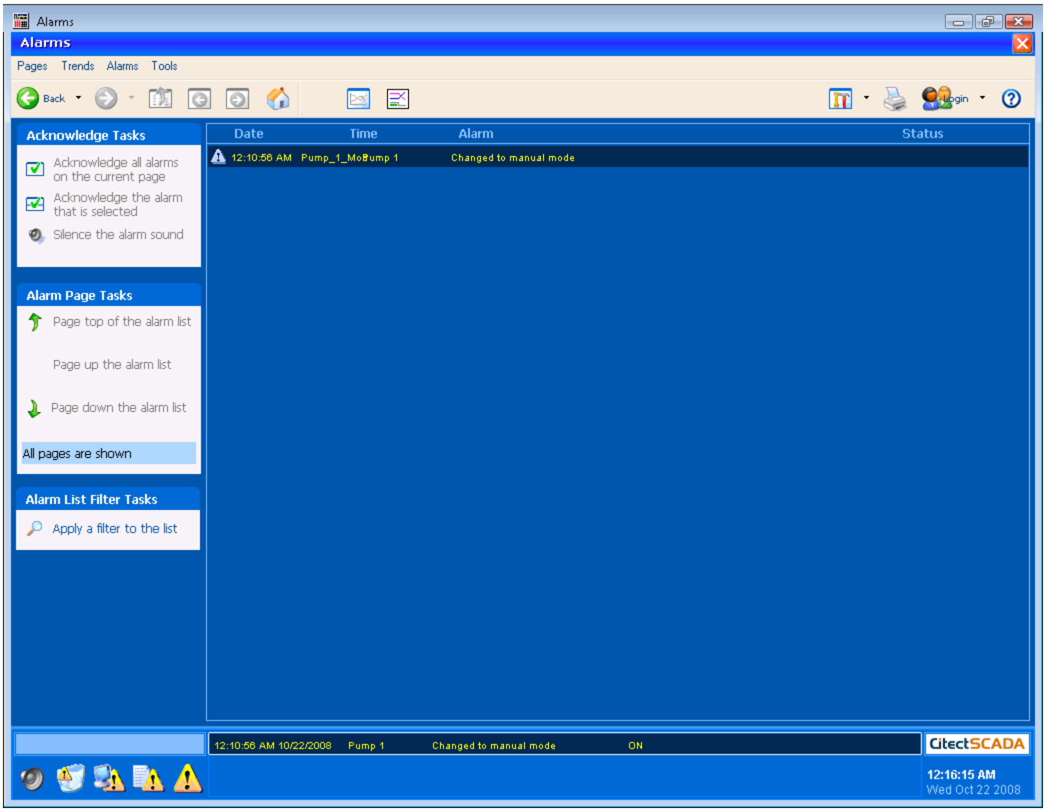
You will see that both pipes change color as the group properties you configured will be applied to everything in the group, in this case both pipes.



You will also see an alarm is generated and displayed on the alarm bar at the bottom of the page when you switch to Manual mode. The Alarm icon at the bottom left will flash to indicate that you have new, unacknowledged alarms. Click on this Alarm icon to view the Alarm page.

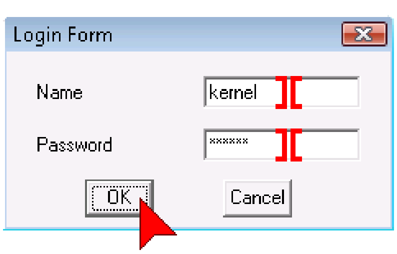
Runtime continued…

Windows users local to the Citect PC can use the login name directly, but domain users will require the domain name, followed by a back-slash, then the user name.

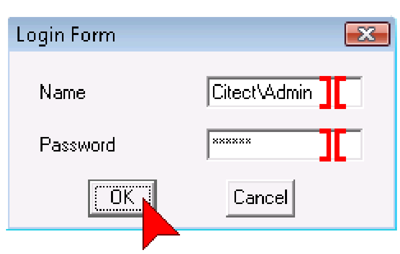


If you try to acknowledge the alarm from the alarm menu at the top left of the screen, or by right-clicking on an alarm, you will notice that you do not have access to these features. By default you require a privilege level of 1 to use these features.

Click on the Logon button or pull-down menu on the navigation bar. This will produce a Login form in which you can enter your user name and password as shown below. Use the local Citect user we created called kernel, with a password of citect. Alternatively, if you know your local computer admin account, or domain admin account, you can login using those credentials as shown in the second example below.

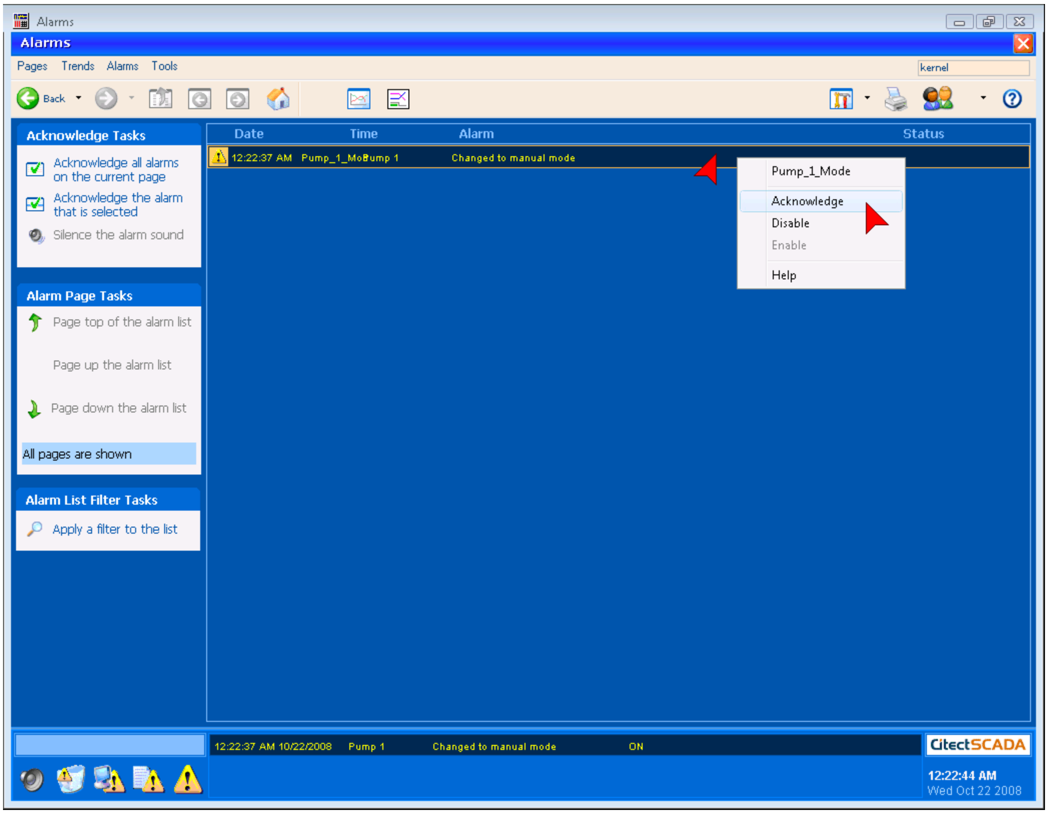


OR



If your login was successful, you should see the logged in user name at the top right of the page. The alarm acknowledge functions will now be available to you.

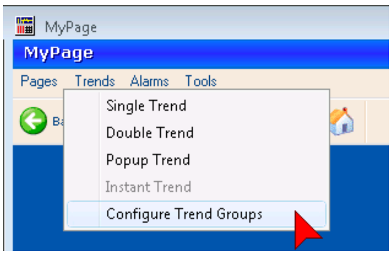
Runtime continued…



Once logged in, try accessing the alarm acknowledgement features again. This time they will work.

You will notice that the alarm changes color once acknowledged, and disappears when you return the pump to automatic. If the pump returns to automatic and you have not acknowledged the alarm, it will remain on the screen until you do acknowledge it. This ensures that the operator never misses an alarm incident.

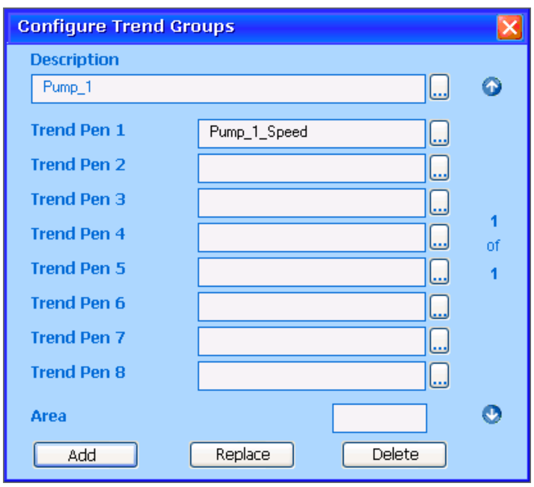
Runtime, Trends



From the navigation menu, select **Configure Trend Groups** from the **Trends** navigation menu.

Trend Groups configuration can also be accessed from the Admin Tools option under the Tools menu

Type in a name for your first trend group, nominally Pump_1. Then use the build buttons to add Pump_1_Speed to the group.



When you are finished, click Add, then close the window by clicking on the  icon

Now select Single Trend from the Trends navigation menu.

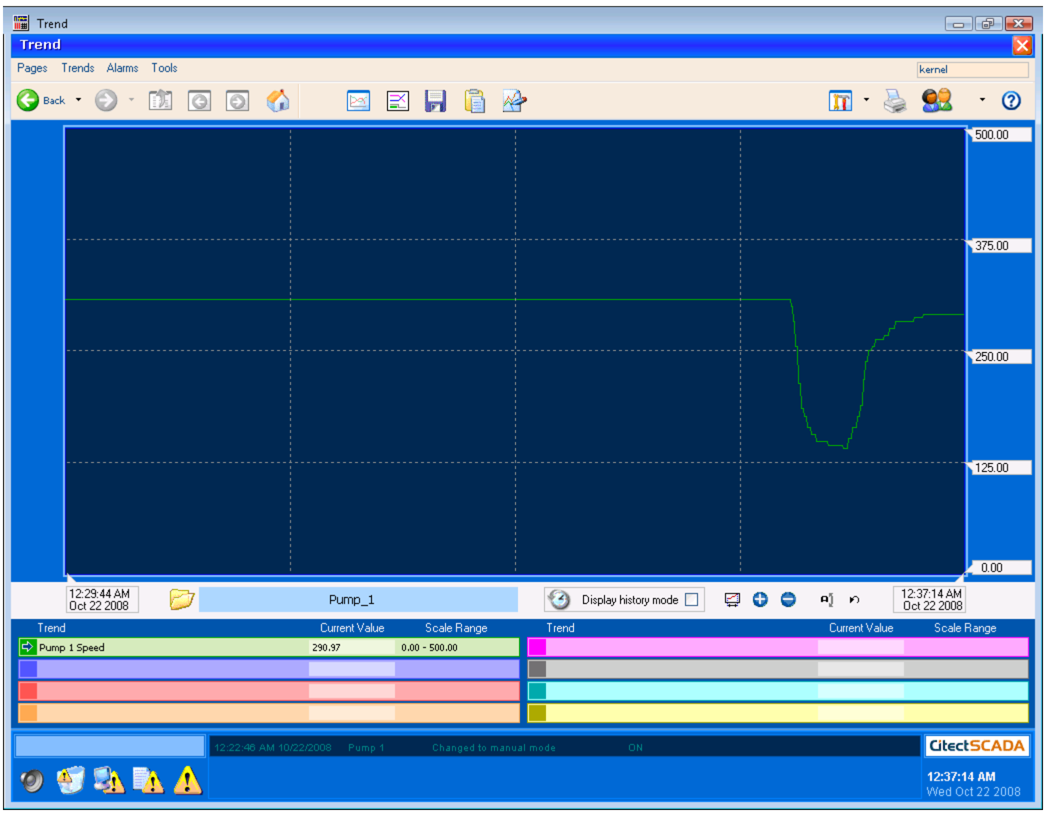
Use the Trend Groups button  to select a trend group for display. By manipulating the pump speed via the slider on MyPage, you should now see the trend value changing on the graph.

There are many powerful features available on this page, including:

- Trend cursor   Click and slide along the graph to locate the cursor which displays tool-tips to describe each pen at that location
- History mode   Allows you to quickly and easily access historical data
- Zoom in/out   Allows you to quickly and easily zoom the trend graph by highlighting an area and pressing the zoom button
- Scaling Allows you to change the minimum and maximum ranges for each pen
- Export Allows you to export raw time-stamped data to the clipboard or a file

Runtime, Trends continued…

Take some time to get used to these features as they are key components to assisting you in analyzing and interpreting your production information.

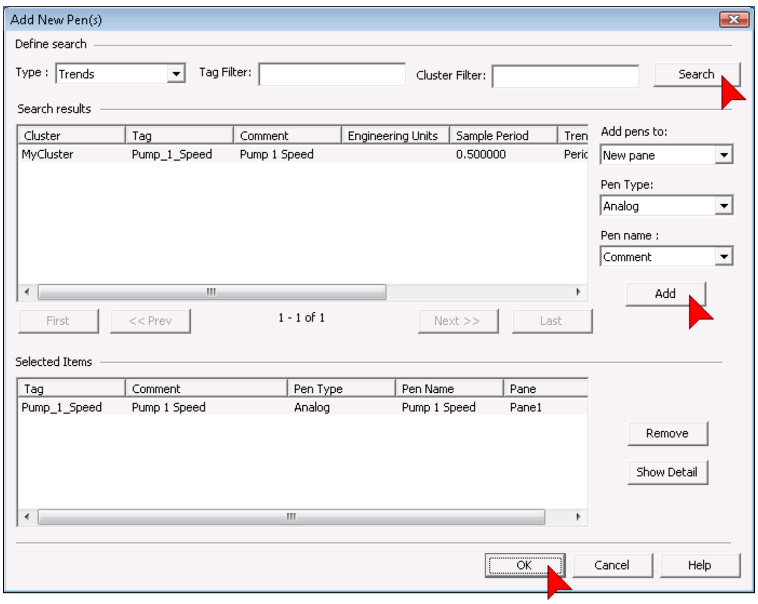


Runtime, Process Analyst

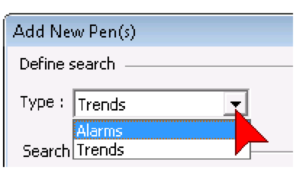
CitectSCADA has facility for viewing trends and alarms. The Process Analyst is an ActiveX object that can be embedded on your own page, or you can use the default page provided.

Click on the Process Analyst  button to display this page. Initially this is an empty container ready to be configured.

Click on the Add Pens  button.



Click on Search to find all configured trend pens. Select the Pump_1_Speed pen and click Add.



Now change the Type from Trends to Alarms. Repeat your search and select Pump_1_Mode from the alarm list. Click Add then, when you are finished, click OK.

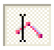
A new display pane will be added to the page displaying both the Pump_1_Speed analogue pen as well as the Pump_1_Mode digital alarm pen. If the gridlines do not appear, click on the graph area and it will refresh the display.

Experiment with some of the control buttons (described on the next page), or click-and-drag on the graph itself to move through history.

The Process Analyst can have many display panes. Each pane supports both digital and analogue pens.

To create multiple panes, you will need to customize the toolbar so that the **Add Panes** button is available to you (see the Online Help). Alternatively, you can create a new pane each time you are selecting new pens for display.

Runtime, Process Analyst continued…

 Display/remove pen cursor. Once displayed, click and drag the cursor to reposition it on the graph.

 Display/remove pen cursor labels. Once displayed, click and drag them to reposition them on the graph.

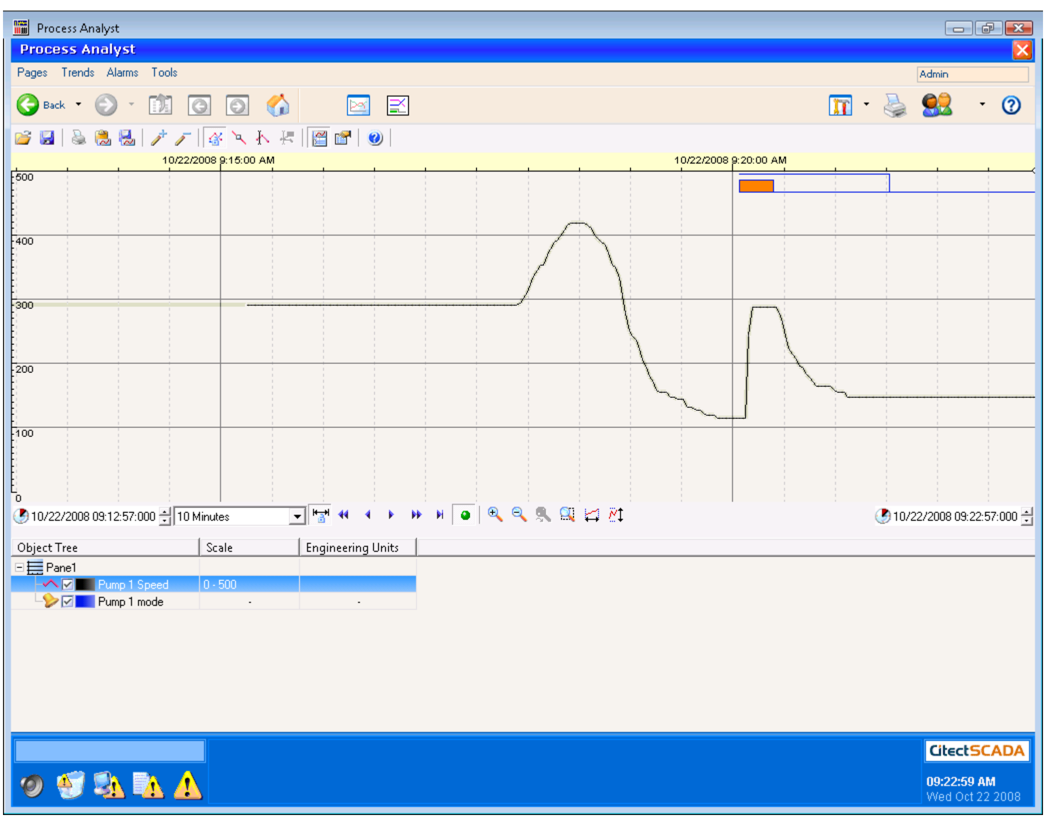
 Toggle the object pane at the bottom of the page which lists display pens. This creates more room for the graph pane.

 Toggle Auto-Scroll.

 Zoom in 50%

 Zoom out

 Zoom using a click-and-drag zoom box

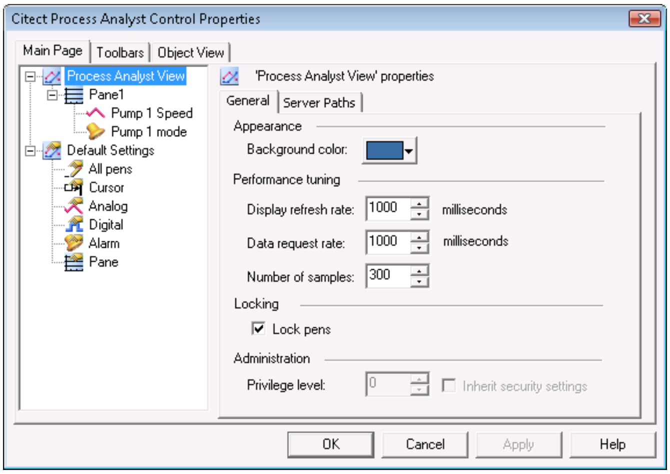


We will now modify the appearance of the Process Analyst display. Click on the Properties  button.

Runtime, Process Analyst continued…

Interpolation is the manner in which the display shows links between sample points. Straight means that it draws a line directly between two points. Stepped means it holds the last sample value until it reaches the time of the new sample, and then 'steps' to the new value.

Stepped interpolation is a more accurate indication of the samples that Citect SCADA has recorded



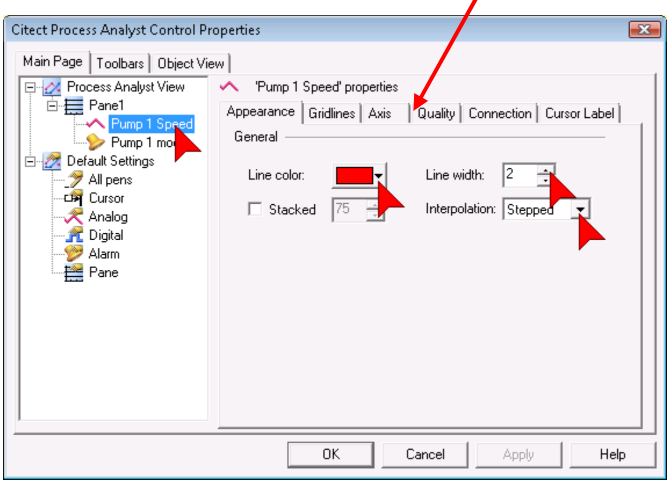
Expand the tree to Pane 1 and modify the background color. You can select from the color palette, or create new palette items by entering the Red, Green and Blue values directly.

In this case, enter 250, 250, 190, for Red, Green and Blue respectively, then click Add to Custom Colors.

Select this new color and click OK to record the change.

Click Apply to see the effect on your Process Analyst view.

Now select Pump 1 Speed in RPM beneath Pane 1 in the properties tree.

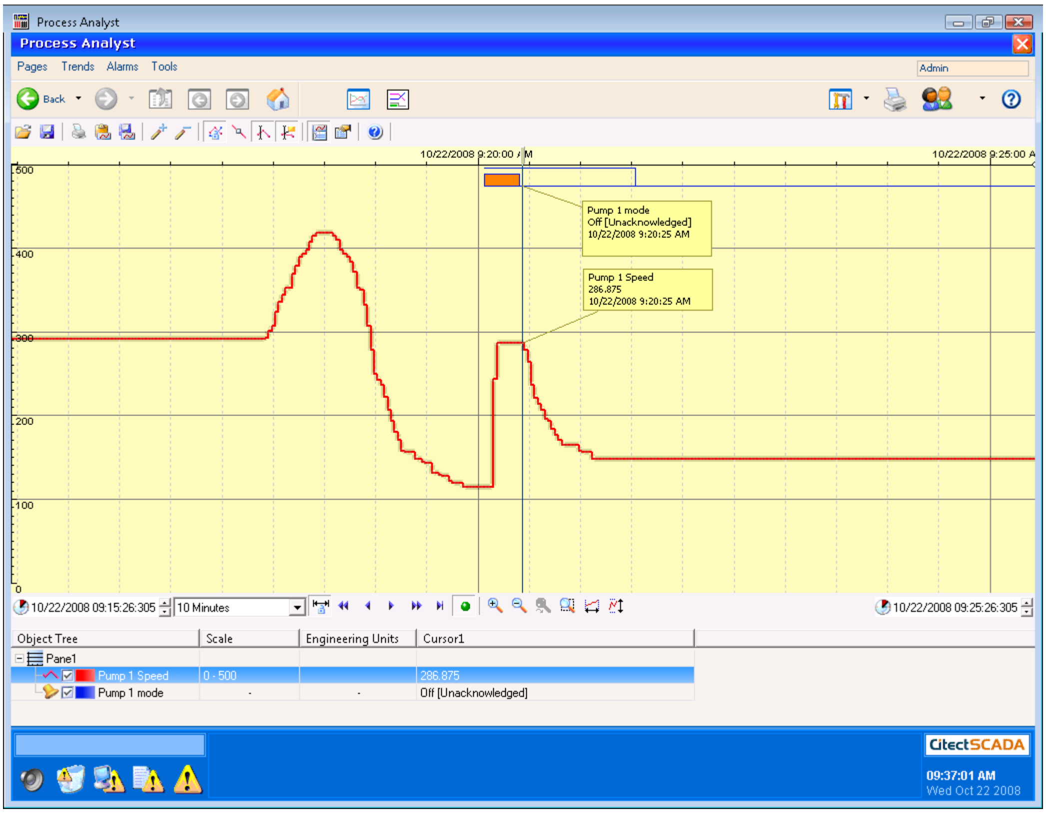


Change the line color to bright red and the width to 2, and the interpolation from Straight to Stepped.

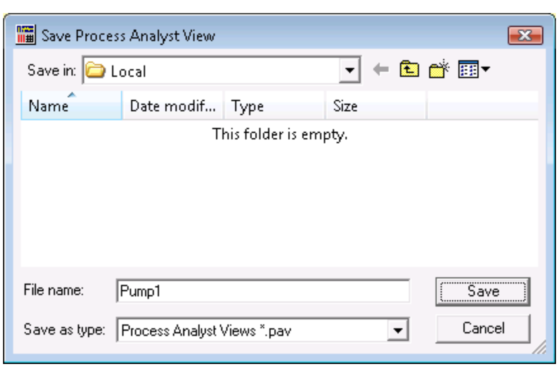
Click OK to see the effect on your Process Analyst view and close the properties window.

Runtime, Process Analyst continued…

Finally, resize the Object pane to maximize the graph pane while still showing the list of pens.



Your Process Analyst view is now complete, but <u>before</u> you leave the page, click on the Save button. This will allow you to save the Process Analyst configuration you have just entered, and retrieve it again later on.

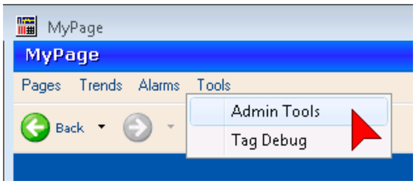


Fill in the file name and click Save. This will allow you to return to this view quickly at a later time using the Load View button.

Administrative Tools

CitectSCADA comes with a number of commonly used administrative and debugging tools built into its default menu.

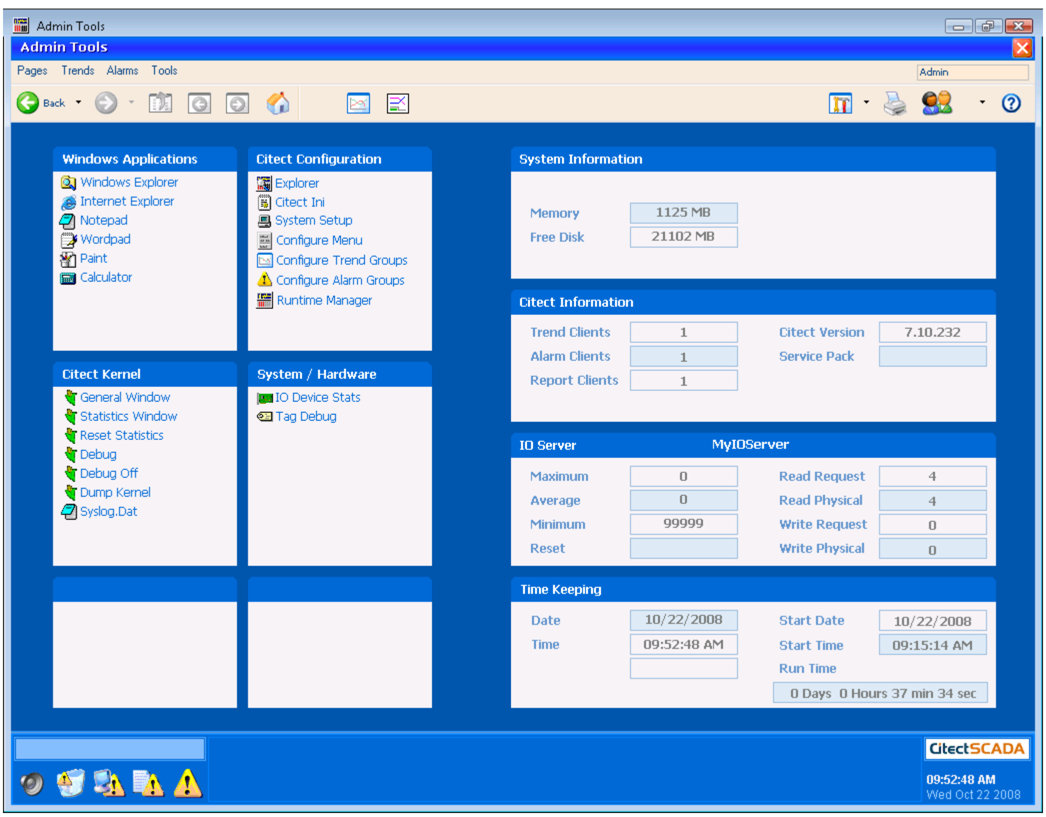
CitectSCADA Kernel and other advanced debugging utilities are covered in the CitectSCADA training courses.



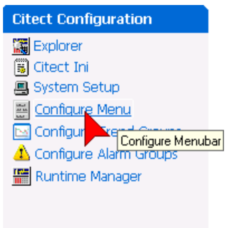
Select Admin Tools from under the Tools menu. If you are not logged in, the menu options will be greyed out and inaccessible.

If required, login as the Administrator as shown previously using either the kernel user, or a Windows Administrator user.

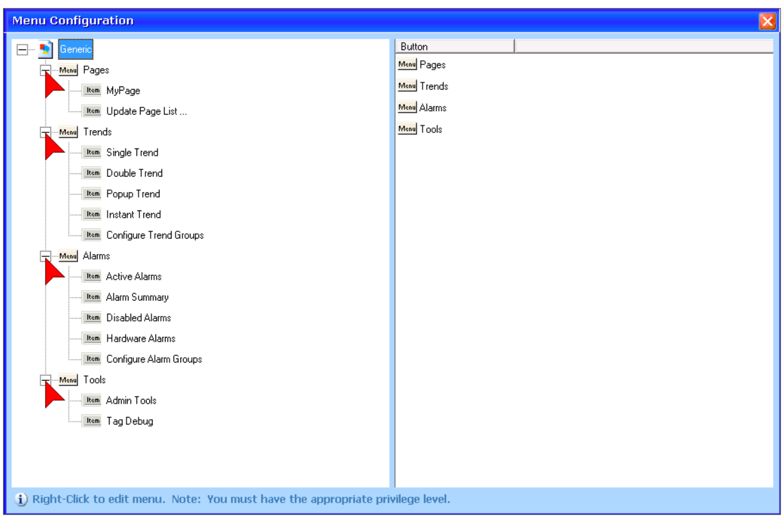
Once logged in with the appropriate privilege level, the Admin Tool menu will change color to blue and become accessible. As well as access to common applications and file management tools, this page also allows access to System Setup (The Computer Setup Wizard), runtime and communications statistics, and online menu configuration.



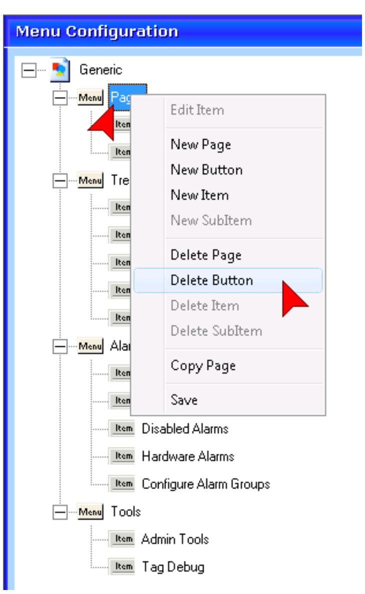
Administrative Tools, Configuring the Menu



In the **Citect Configuration** box, select Configure Menu**.**



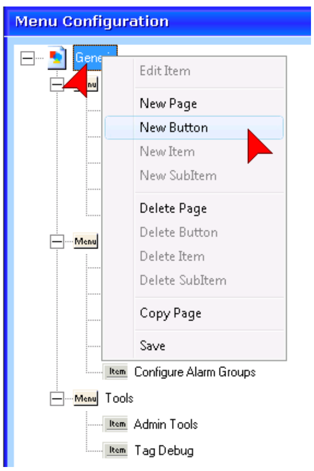
Expand the menu system by clicking on each **+** item. Each <u>menu</u> Button is a separate pull-down menu on the navigation bar. By right-clicking on each item, you can modify the items in its pull-down menu.



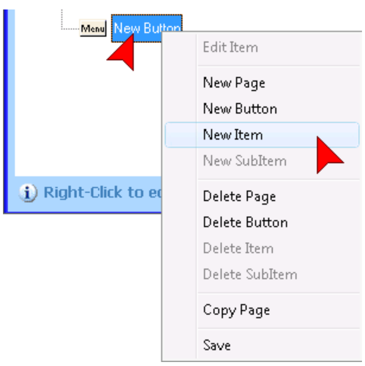
Right-click on Pages under the Generic node.

Select Delete Button from the available options. This will remove the entire Pages pull-down menu. We will now create our own Pages menu.

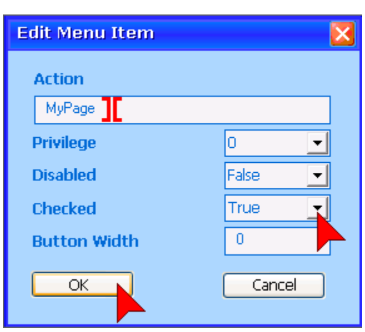
Administrative Tools, Configuring the Menu continued…



Right-click anywhere in the left-hand pane and select **New Button** from the available options.



Right-click on this new Button and select **New Item** from the available options.



Right-click on this new Item and select **Edit Item** from the available options. **Type MyPage** as the Action, and select **True** from the pull-down list for the **Checked** option.
Click OK.

Actions must refer either to the name of a page to display or a Cicode function.

If specifying a Cicode function, it must be prefixed by a question mark ("?").

Menu Configuration allows the following types of items to be added to the menu:

New Page
Items under new Pages will only be available when the user is looking at a page of the same name. This allows menu items to be hidden unless on a particular page.

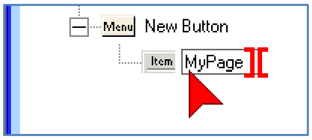
New Button
Adds another button to the navigation bar allowing additional pull-down menus to be created.

New Item
Adds an item into the pull-down menu of a Button.

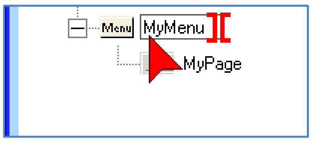
New Sub-Item
Extends pull-down menus to have child-menus which will appear when selected from the parent menu.

Administrative Tools, Configuring the Menu continued…

This pull-down item is now configured to display MyPage when it is selected from the navigation bar.



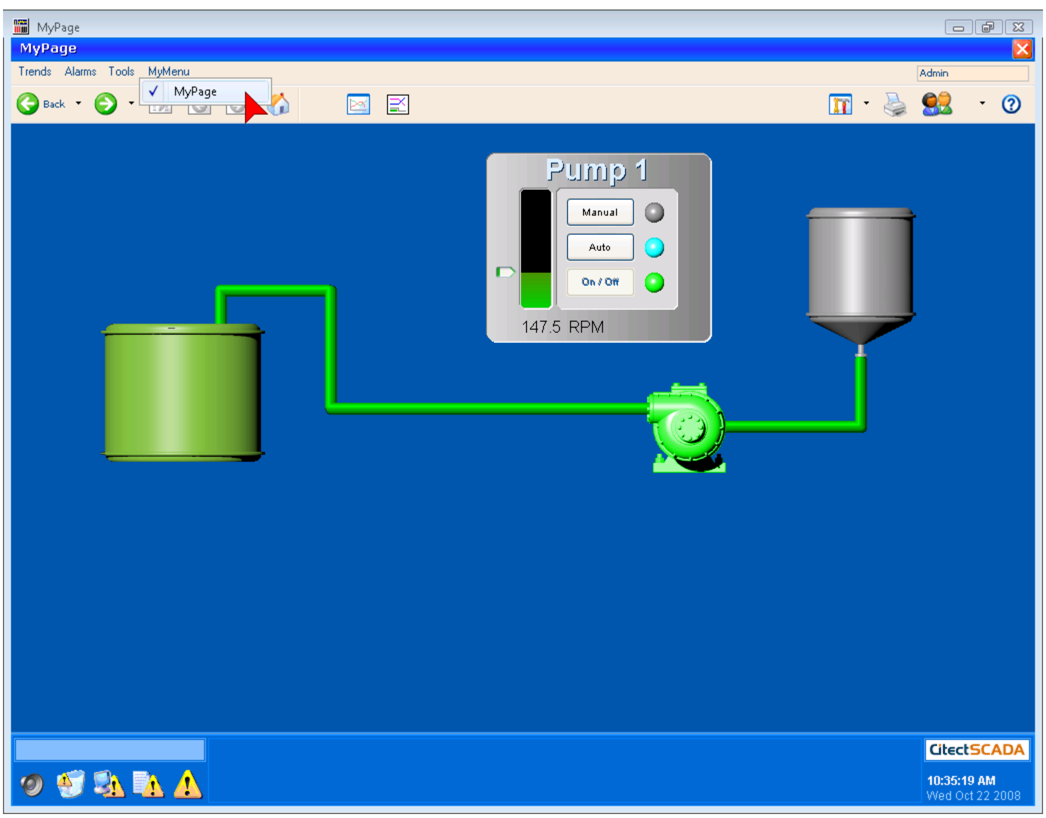
Single-click on the New Item, and change its name to My Page.



Single-click on the New Button, and change its name to My Menu.

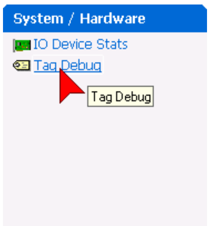
Click on the icon to close the Menu Configuration dialog. When prompted, make sure you save the changes you have made.

These changes will take effect when you next change pages. Select a new page from the navigation bar, and verify that your new menu appears with the new page as shown below.



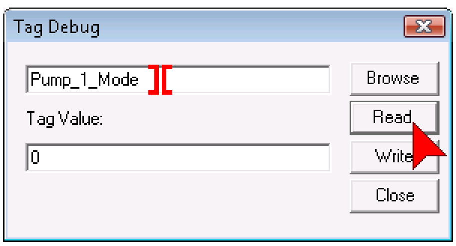
Administrative Tools, Tag Debug

Finally we will look at an extremely useful testing and commissioning tool – the Tag Debugger.



Return to the Administration Tools page, and select Tag Debug from the Tools menu.

In the dialog provided, type in Pump_1_Mode (alternatively use the Browse feature to navigate and select the same tag), and then click Read.



If the pump is currently in Manual, the Tag Value should return a “1”. If it is Automatic it should return a “0”. Verify that the correct value was returned by checking the state of the lights on MyPage.

Change the value to the opposite state by typing a 1 or 0 into the Tag Value to replace the value that was read. Click Write.

Verify that the new value was written to the tag both by clicking Read again, and by checking the state of the lights on MyPage.

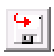
WARNING
Tag Debug is a powerful utility that can access any tag in the CitectSCADA system and both verify its state/value as well as change it. As such, it should be used with caution, especially when changing values for tags which control equipment!

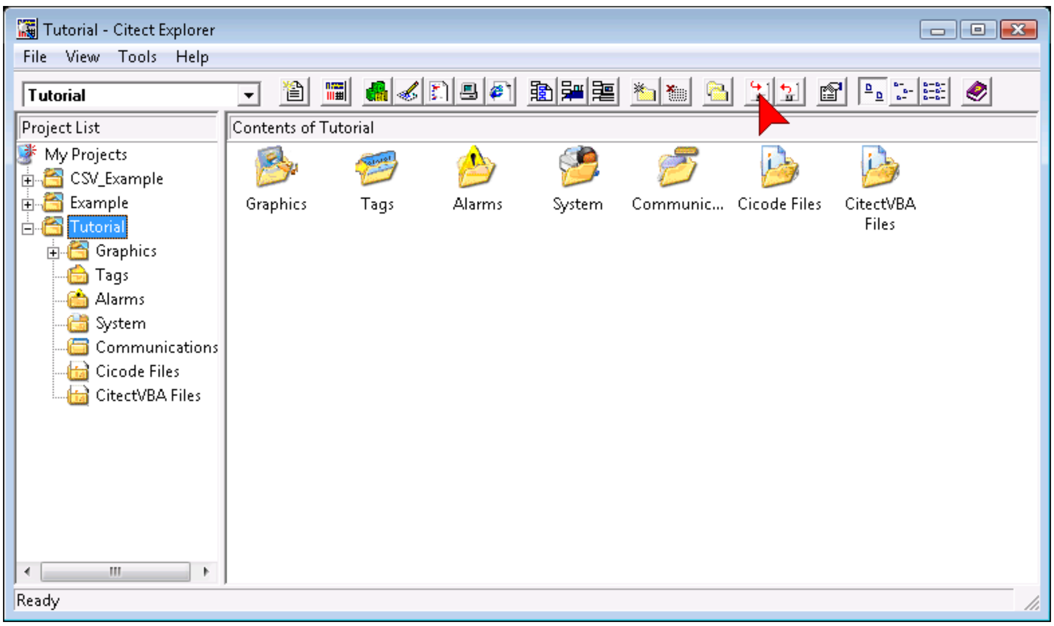
Quickstart Tutorial V7.10

Backing Up Your Project

It is important to keep backup copies of your project, so that you can always recover from a disaster with minimum effort.

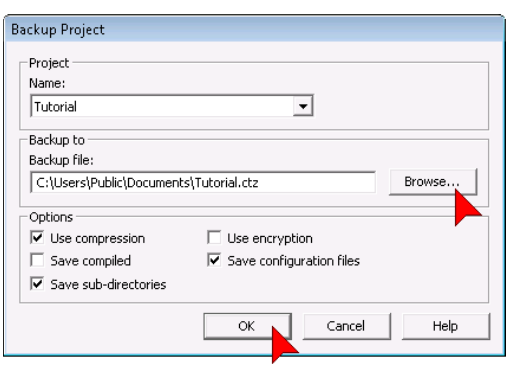
Make sure you are in the Citect Explorer (click on the  icon or use Alt+Tab), and have the Tutorial project selected.

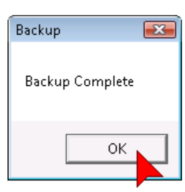
Click on the Backup icon .



Use the Browse button to locate a directory where you want to save your files to.
Alternately you can type the directory and filename into the Backup File edit box. If the directory does not exist CitectSCADA will automatically create it for you when it saves the file.

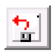
Click OK and when the Backup Complete message pops up, click OK on that also.

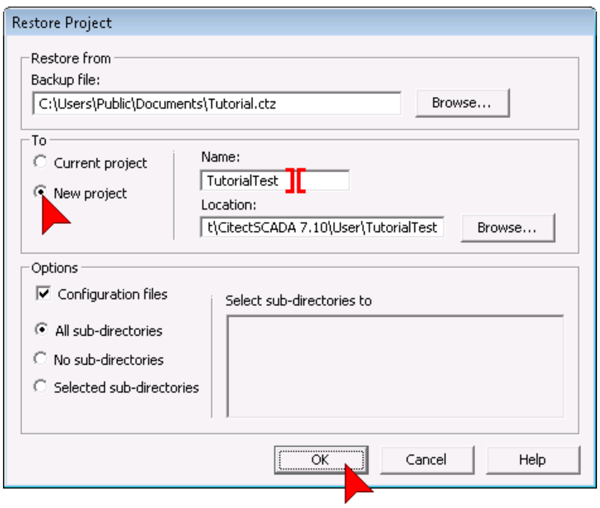




Restoring Your Project

With any software, it is good practice to check and make sure you can restore from your backup copies. It is very rare to experience problems restoring from a CitectSCADA backup but the time taken to check is a tiny fraction compared to the time it would take to recreate the project from scratch.

Click on the Restore icon  (it is next to the backup icon), on the menu bar click Tools then Restore.



Click on the Browse button to locate your backup file.

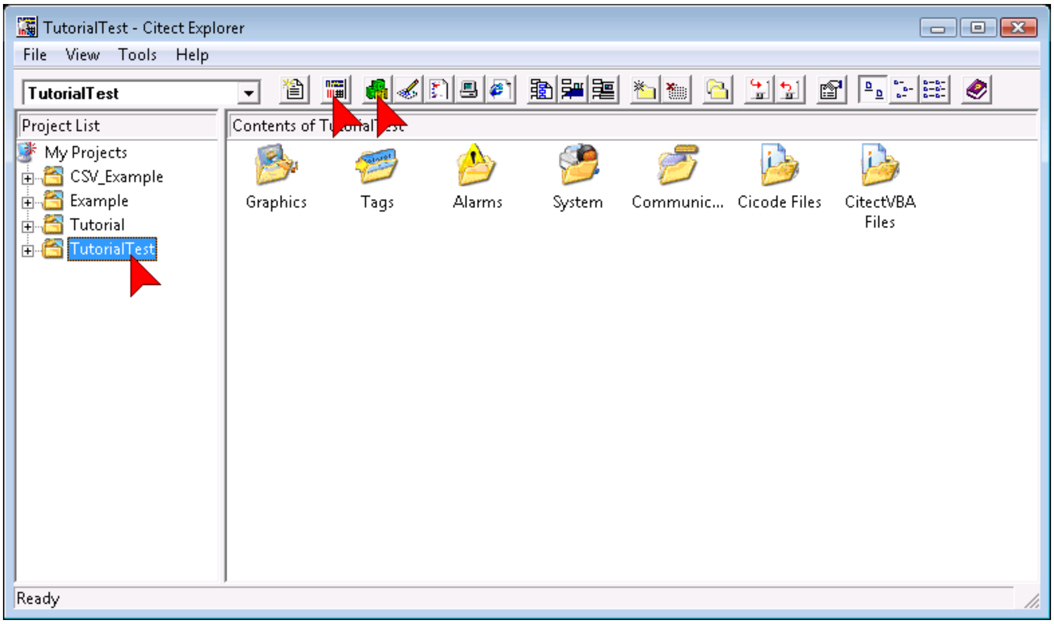
We will restore to a new project, test it, and then delete it, as this is a much better test than restoring over the existing project and less chance of anything going wrong (eg; what if the power fails half way through restoring over the top of your existing project or your backup has a fault in it?).

Make sure New Project is checked. In the Name edit box type a name for the new project e.g; TutorialTest then click OK.

When the restore is completed (click OK on the Restore Complete Dialog), click on the TutorialTe**st** project to switch to that project, then change to the Citect Project Editor to **compile** the project before clicking on the Computer Setup Wizard and repeating the Setup steps identified earlier in this tutorial to configure the computer to run the Tutorial Test project in stand-alone mode.

Make sure you have shutdown the Tutorial project prior to attempting to run the TutorialTest project.

Restoring Your Project continued…



Click on the Citect Runtime icon  to make run your project and prove your backup and restore operation was successful.

To delete the TutorialTest project, click File on the Citect Explorer menu, then click Delete Project.

Congratulations! By now you should have a basic working knowledge of CitectHMI/SCADA software. If you are keen to build your level of competency we recommend that you attend a Citect Training Course. Details of training courses can be found at www.citect.com or by contacting your local Citect office or distributor.

Troubleshooting

If you experience results that are different to what you see in the tutorial…

1. Go back and double check what you have done. Most likely you have done something different from the instructions.
2. The tutorial largely assumes CitectHMI/SCADA is freshly installed and default settings haven't been changed. By taking a closer look at the screens in the tutorial you may be able to identify any differences.
3. If problem is in Runtime, shutdown runtime and restart it.
4. Read the Online Help. Most dialog boxes have a help button that provides context sensitive information with just a mouse click.
5. Read the CitectHMI/SCADA knowledgebase. This is available on the CitectHMI/SCADA software CD or from our website www.citect.com.
6. Worst case, start again, just create a new project and call it Tutorial2. The upside to this is the extra practice will make you more proficient.

If nothing appears to happen when you press a button, do not press it repeatedly in the hope that something will happen – chances are your PC is busy trying to do what you've already asked it to do.

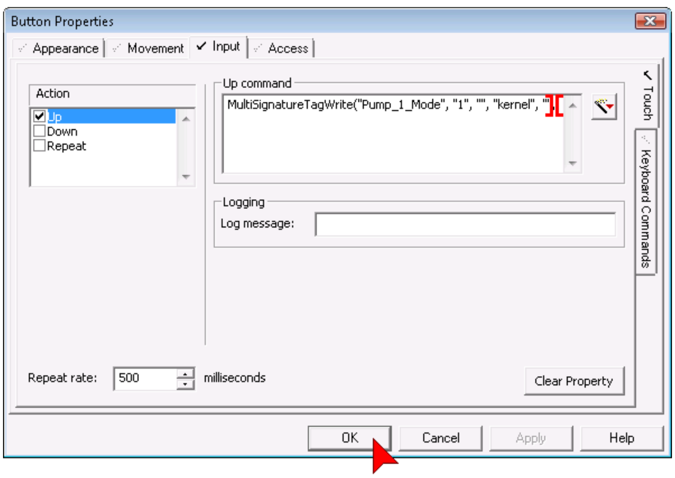
Addendum – Security Validation

CitectSCADA V7.10 contains additional security functions to make it easier for companies to implement electronic signatures and multi-user validation. This last exercise will modify the Pump 1 manual button to require signature validation before setting the Pump_1_Mode value to 1.

Switch to the Graphics Builder – click on the Graphics Builder icon .

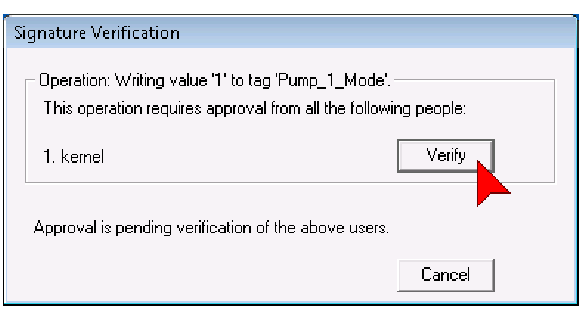
Open your MyPage graphics display, and double-click on the Manual button to access it's animation properties. Click on the Input tab, and modify the command to:

MultiSignatureTagWrite("Pump_1_Mode", "1", "", "kernel", "", "", "")



Save your page.
Switch to the Citect Editor and compile your project.
Run your project.

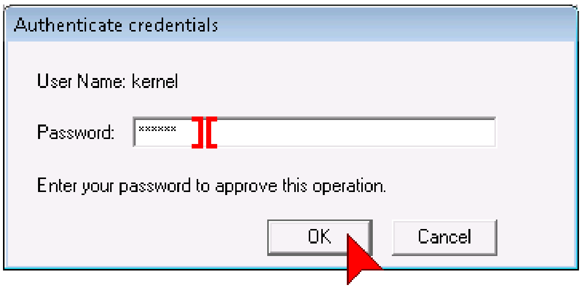
Once the project is running, open MyPage, and click on the Manual button. Instead of immediately changing the pump's mode to manual, Citect will display an electronic signature verification form.



Click on the Verify button.

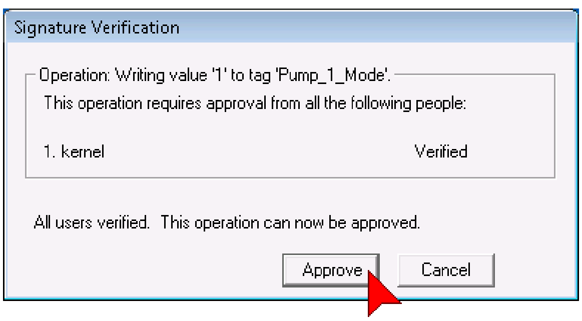
Addendum – Security Validation continued…

A new verification form is displayed, prompting for the kernel user's password. This will display even if the kernel user is already logged in.



Type in the kernel user's password **citect**, then **Click OK**.

A final verification form is displayed, allowing the user to verify that the action should be performed.



Click Approve. The pump mode will now be changed to Manual.

Further information on electronic signatures and user validation can be found in the online help.

OMRON®

Safety Relay Unit | G9S

Ideal for Safety Door and Emergency Stop Switch Circuits

- Slim two-pole models only 22.5 mm wide
- Three-pole models only 68 mm wide
- Five-pole models only 91 mm wide
- OFF-delay feature in three-pole models
- Incorporates LED indicators for monitoring relays
- Uses replaceable fuses
- Finger-protection construction
- Both DIN track mounting and screw mounting possible (two-pole models)
- Approved Standards

Agency	Standard	File No.
BIA	EN60204-1 EN954-1	R974021
UL	UL508	E95399
CSA	CSA22.2No.14	LR35535

Note: Be sure to refer to the *Precautions* on page 15.

Ordering Information

BASIC MODELS

Number of poles	Main contact form	Number of input channels	Rated voltage	**Part number**
2	DPST-NO	1 channel	24 VDC	**G9S-2001 DC24**
		2 channels		**G9S-2002 DC24**
3 (See Note.)	3PST-NO	2 channels	24 VDC	**G9S-301 DC24**
			24 VAC	**G9S-301 AC24**
			120 VAC	**G9S-301 AC120**
			240 VAC	**G9S-301 AC240**
5 (See Note.)	5PST-NO		24 VDC	**G9S-501 DC24**
			24 VAC	**G9S-501 AC24**
			120 VAC	**G9S-501 AC120**
			240 VAC	**G9S-501 AC240**

Note: Auxiliary contact is SPST-NC.

■ OFF-DELAY MODELS

Number of poles	Main contact form	OFF-delay form	Number of input channels	OFF-delay time	Rated voltage	**Part number**
3	3PST-NO	DPST-NO	2 channels	1 s	24 VDC	**G9S-321-T01 DC24**
					24 VAC	**G9S-321-T01 AC24**
					120 VAC	**G9S-321-T01 AC120**
					240 VAC	**G9S-321-T01 AC240**
				10 s	24 VDC	**G9S-321-T10 DC24**
					24 VAC	**G9S-321-T10 AC24**
					120 VAC	**G9S-321-T10 AC120**
					240 VAC	**G9S-321-T10 AC240**
				30 s	24 VDC	**G9S-321-T30 DC24**
					24 VAC	**G9S-321-T30 AC24**
					120 VAC	**G9S-321-T30 AC120**
					240 VAC	**G9S-321-T30 AC240**

Note: Each model has an SPST-NC auxiliary contact.

Specifications

■ RATINGS

Controller Block

Part number	Rated voltage	Rated current	Rated power consumption
G9S-2001 G9S-2002	24 VDC	66 mA±20%	Approx. 1.6 W
G9S-301	24 VDC	62.5 mA ±20%	Approx. 1.5 W
	24 VAC	125 mA ±20%	Approx. 3 VA (60 Hz)
	120 VAC	25 mA ±20%	
	240 VAC	12.5 mA ±20%	
G9S-501	24 VDC	127 mA ±20%	Approx. 3 W
	24 VAC	229.2 mA ±20%	Approx. 5.5 VA (60 Hz)
	120 VAC	45.8 mA ±20%	
	240 VAC	22.9 mA ±20%	
G9S-321-T□	24 VDC	150 mA ±20%	Approx. 3.6 W
	24 VAC	256.2 mA ±20%	Approx. 6.1 VA (60 Hz)
	120 VAC	50.8 mA ±20%	
	240 VAC	25.4 mA ±20%	

Note: The above ratings are at an ambient temperature of 23°C.

Contact

Part number		G9S-301 G9S-501 G9S-321-T	G9S-2001 G9S-2002
Rated load		3 A at 240 VAC; (See Note.) cosϕ = 0.4	5 A at 240 VAC; cosϕ = 0.4
	AC15 (IEC-947-5-1/ Table 4)	3 A at 240 VAC; cosϕ = 0.3; 6,050 operations	
	DC13 (IEC-947-5-1/ Table 4)	1 A at 24 VDC; L/R=100 ms; 6,050 operations	
Rated carry current		5 A	
Max. switching voltage		250 VAC, 24 VDC	
Max. switching capacity		AC: 1,250 VA; DC: 120 W	
Min. permissible load		50 mA at 24 VDC (operating frequency: 60 operations/min.)	

Note: If the load is 5 A at 240 VAC, the service life will be 40,000 times.

■ CHARACTERISTICS

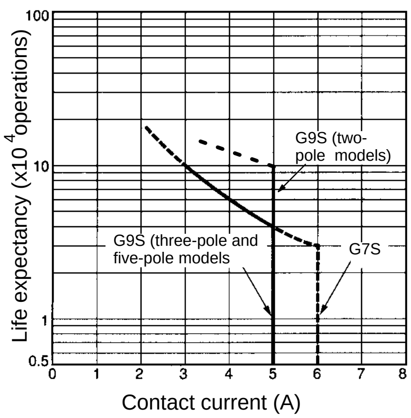
Part number		G9S-2001 G9S-2002	G9S-301	G9S-501	G9S-321-T□
Input voltage/frequency		24 VDC ±10%, 50/60 Hz	24 VDC - 15% ±10%, 50/60 Hz; 24 VAC - 15% ±10% 50/60 Hz; 120 VAC - 15% ±10%, 50/60 Hz; 240 VAC -15% ±10%, 50/60 Hz		
Fuse protection		---	0.4 A		
Contact form of safety circuit		DPST-NO	3PST-NO	5PST-NO	3PST-NO
Contact form of auxiliary circuit		---	SPST-NC	SPST-NC	SPST-NC
Contact form of safety OFF-delay circuit		---			DPST-NO
Contact resistance		200 mΩ	300 mΩ max. (measurement conditions: 5 VDC, 10 mA, voltage drops.)		
Operate time	(Rated voltage operation, does not include bounce time)	50 ms	300 ms max.		300 ms
Release time		50 ms	100 ms max.		100 ms; OFF-delay: 1 s, 10 s, 30 s
Max. switching frequency	Mechanical	1,800 operations/hr			
	Rated load	1,800 operations/hr			
Insulation resistance (at 500 VDC)		100 MΩ min. between control circuit and the safety and auxiliary circuits, between the safety circuits and auxiliary circuits, and between safety circuits			
Rated insulation voltage P.D. 3 (outside), P.D. 2 (inside) (IEC664-1, DIN VDE 0110/’89)		250 V			
Rated impulse withstand voltage Overvoltage category 3 (IEC664-1, DIN VDE 0110/’89)		4 kV			
Dielectric strength		2,500 VAC (50/60 Hz for 1 min.) between control circuit and the safety and auxiliary circuits, between the safety circuits and auxiliary circuits, and between safety circuits			
Vibration resistance (IEC68-2-6)	Mechanical	10 to 55 Hz, 0.75-mm double amplitude			
	Electrical	10 to 55 Hz, 0.5-mm double amplitude			
Shock resistance (IEC68-2-27)	Mechanical	300 m/s^2 (approx. 30G) for 11 ms			
	Electrical	50 m/s^2 (approx. 5G) for 11 ms			
Minimum applicable load (P standard reference value)		24 VDC, 50 mA			
Ambient temperature	Operating	–25°C to 55°C (–13°F to 131°F)			
	Storage	–25°C to 55°C (–13°F to 131°F)			
Relative humidity	Operating	38% to 85% RH			
	Storage	38% to 85% RH			
Enclosure rating (IEC529)	Terminals	IP20			
	Enclosure	IP40			
Terminal tightening torque		10 kgf • cm (0.98 N • m)			
Weight (See Note.)		Approx. 180 g	Approx. 365 g	Approx. 550 g	Approx. 580 g
Approved standards		UL508, CSA22.2 No. 14, EN954-1, EN60204-1			
EMC		EMI: EN55011 group 1 class A EMS: EN50082-2			

Note: These weights are for DC models. AC models are 200 g heavier.

LIFE EXPECTANCY

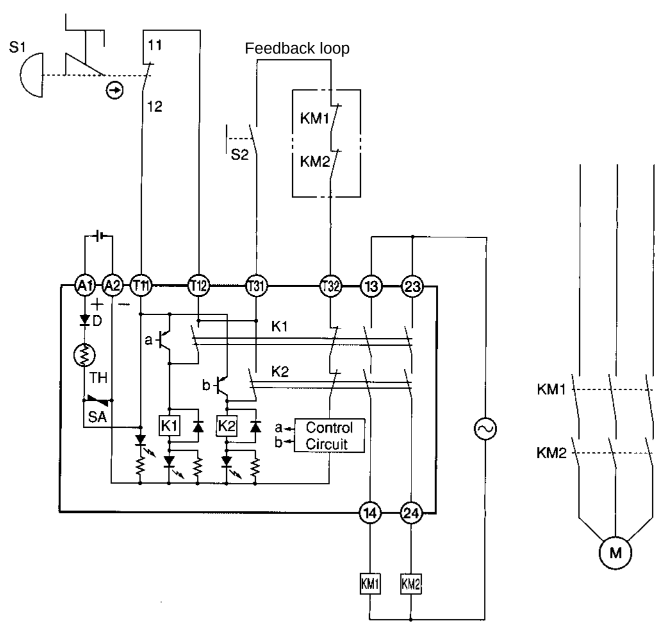
Mechanical life	1,000,000 operations min. with a switching frequency of approx. 1,800 operations/h
Electrical life	100,000 operations min. at the rated load with a switching frequency of approx. 1,800 operations/h

Life Expectancy Curve
(240 VAC, cosϕ 0.4, cosϕ = 1)

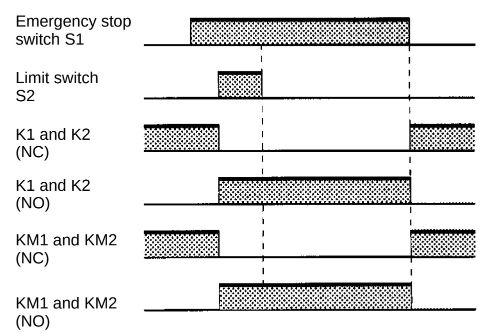


Operation

G9S-2001 WITH SINGLE-CHANNEL MANUAL-RESET EMERGENCY STOP SWITCH INPUT

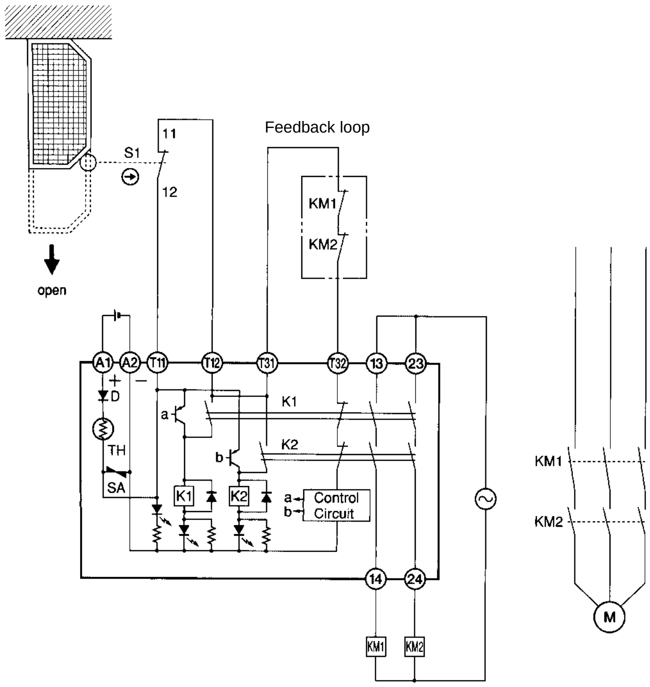


Timing Chart

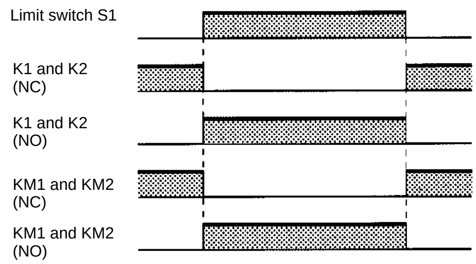


S1:	Limit switch
S2:	Starter switch
KM1 and KM2:	Magnet Contactor
M:	3-phase motor

G9S-2001 WITH SINGLE-CHANNEL AUTO-RESET LIMIT SWITCH INPUT

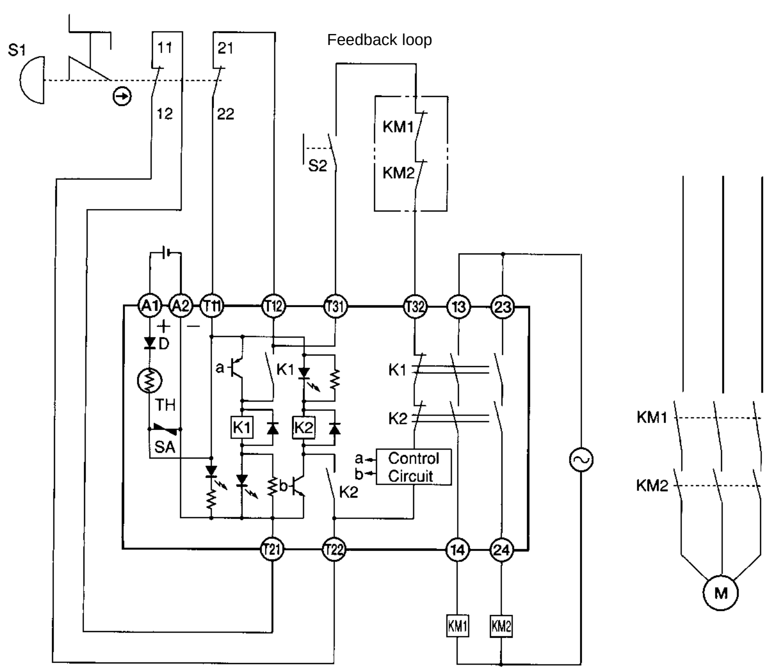


Timing Chart

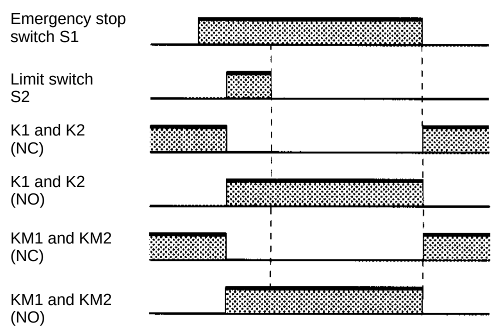


S1:	Safety Limit Switch with positive opening mechanism (D4D and D4B)
KM1 and KM2:	Magnet Contactor
M:	3-phase motor

G9S-2002 WITH 2-CHANNEL MANUAL-RESET EMERGENCY STOP SWITCH INPUT

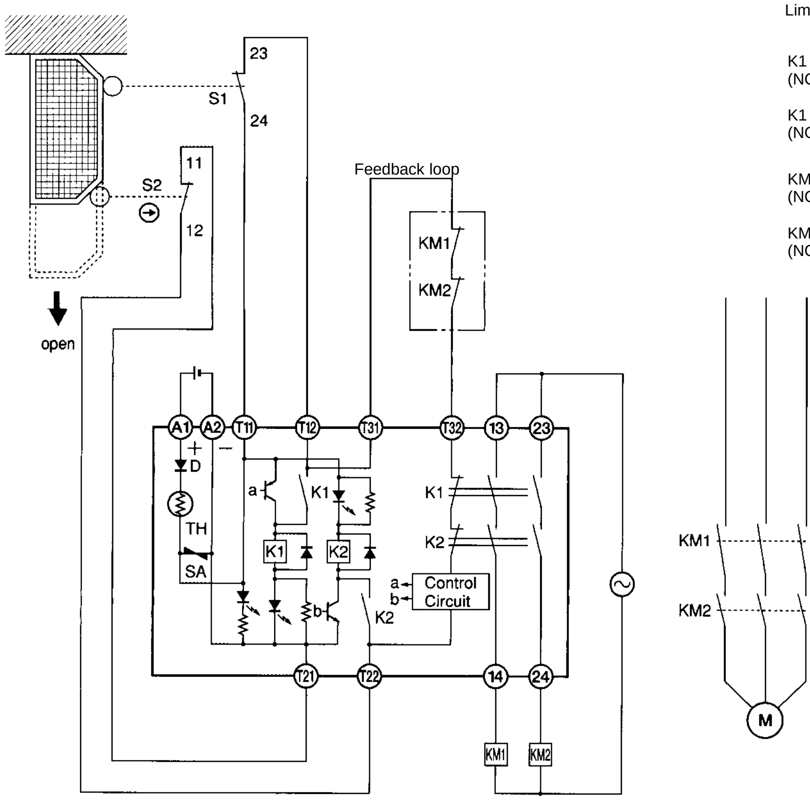


Timing Chart

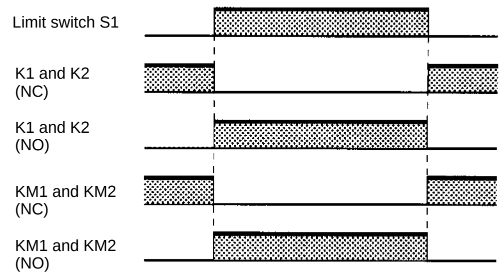


S1:	Emergency stop switch with positive opening mechanism
S2:	Starter switch
KM1 and KM2:	Magnet Contactor
M:	3-phase motor

■ G9S-2002 WITH 2-CHANNEL AUTO-RESET LIMIT SWITCH INPUT

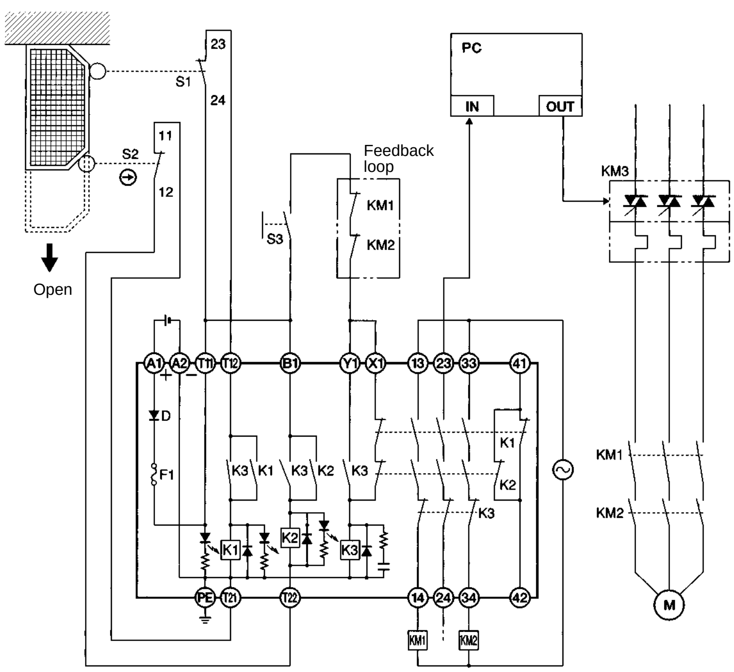


Timing Chart

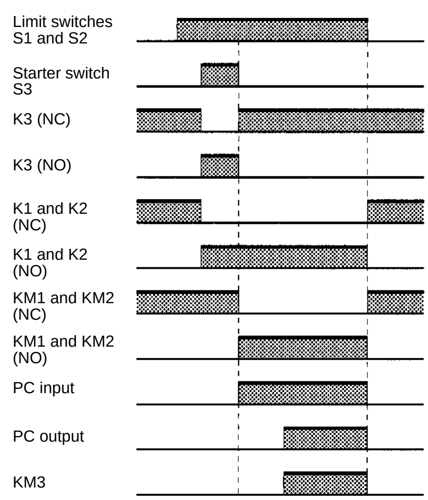


S1: Limit switch
S2: Safety Limit Switch with positive opening mechanism (D4D and D4B)
KM1 and KM2: Magnet Contactor
M: 3-phase motor

■ G9S-301 (24 VDC) WITH 2-CHANNEL LIMIT SWITCH INPUT

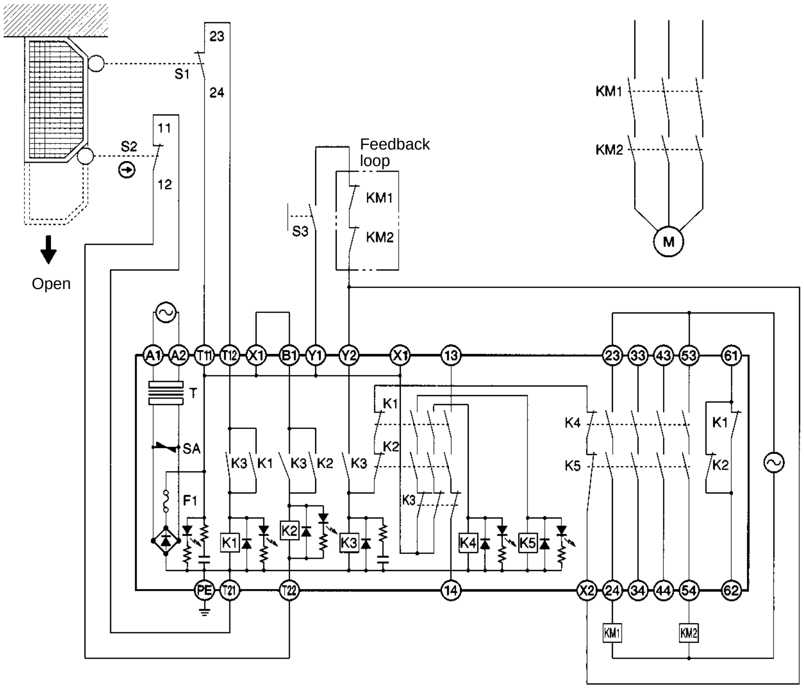


Timing Chart

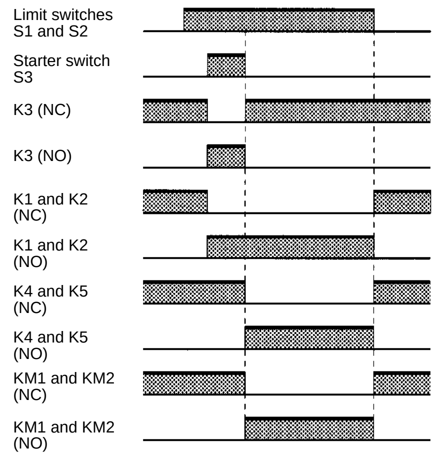


S1: Limit switch
S2: Safety Limit Switch with positive opening mechanism (D4D and D4B)
S3: Starter switch
KM1 and KM2: Magnet Contactor
KM3: G3J Solid-state Contactor
M: 3-phase motor

■ G9S-501 (AC MODEL) WITH 2-CHANNEL LIMIT SWITCH INPUT

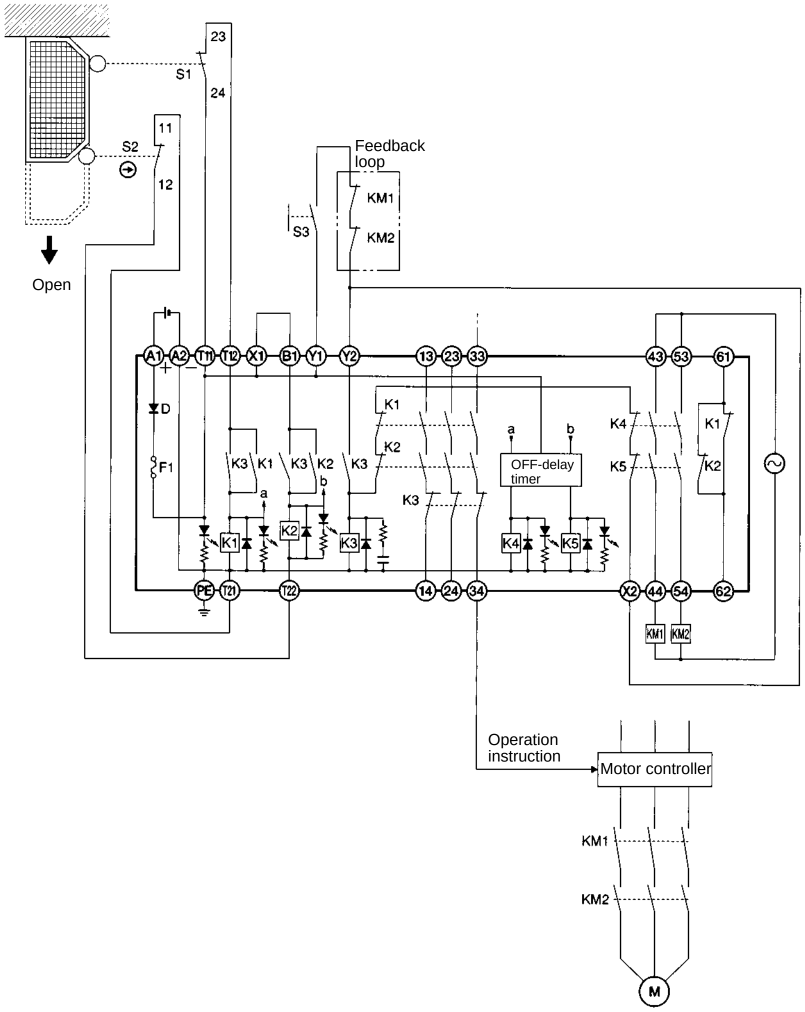


Timing Chart

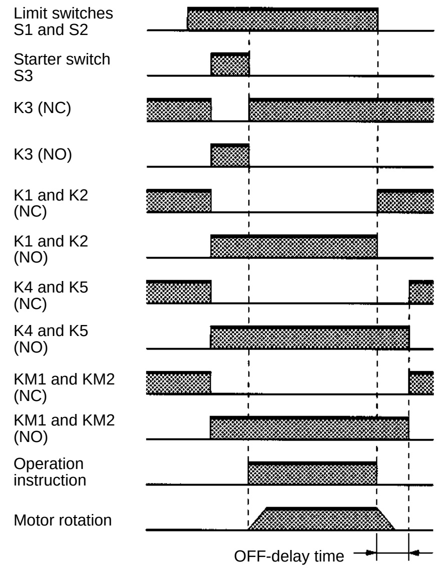


S1: Limit switch
S2: Safety Limit Switch with positive opening mechanism (D4D and D4B)
S3: Starter switch
KM1 and KM2: Magnet Contactor
M: 3-phase motor

■ G9S-321-T□ (24 VDC) WITH 2-CHANNEL LIMIT SWITCH INPUT

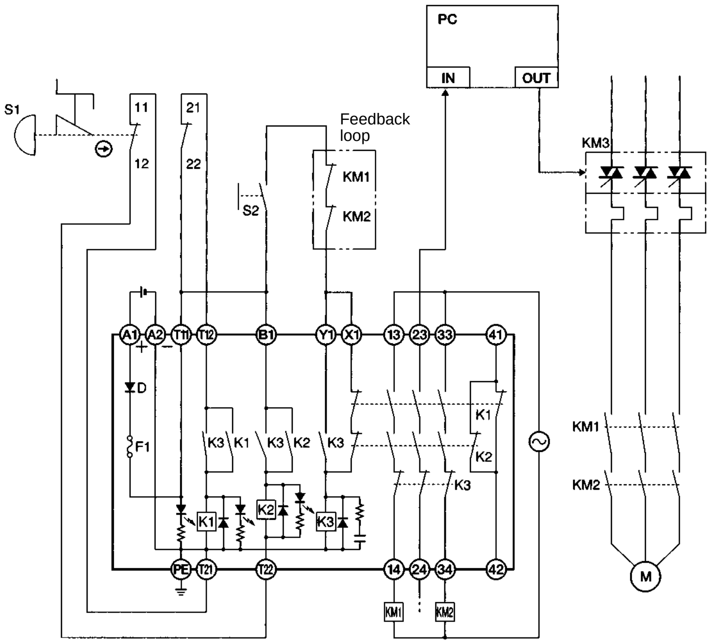


Timing Chart

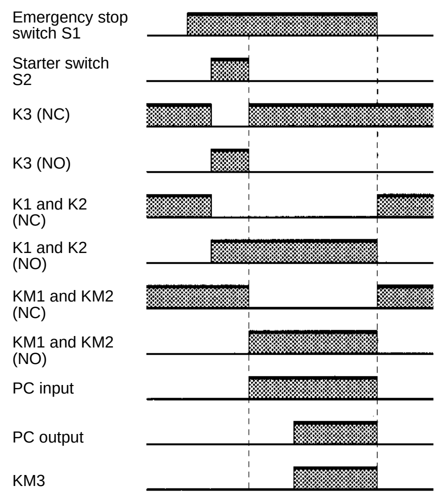


S1:	Limit switch
S2:	Safety Limit Switch with positive opening mechanism (D4D and D4B)
S3:	Starter switch
KM1 and KM2:	Magnet Contactor
M:	3-phase motor

■ G9S-301 (24 VDC) WITH 2-CHANNEL EMERGENCY STOP SWITCH INPUT

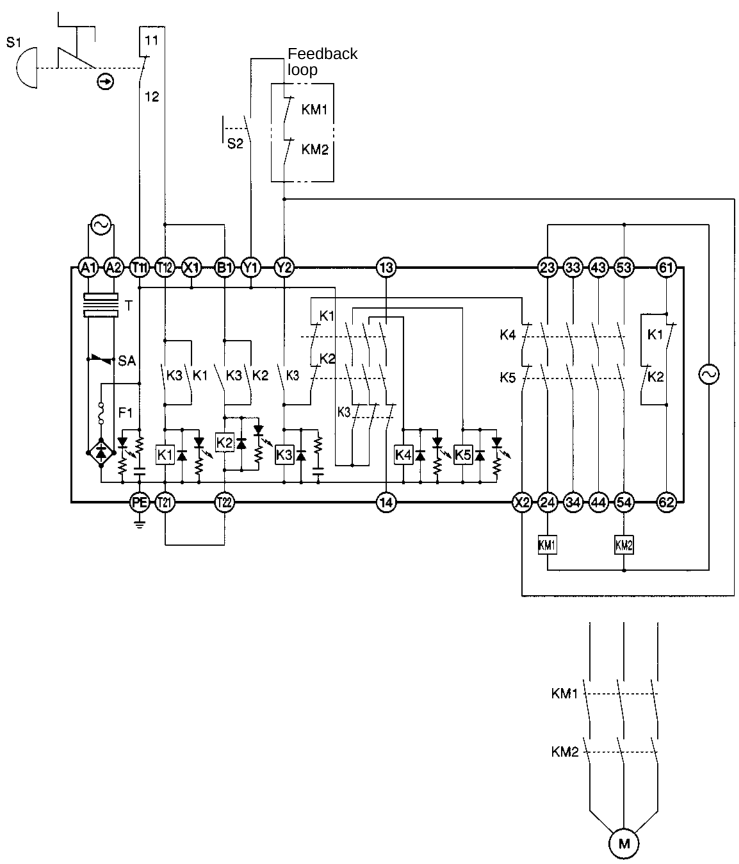


Timing Chart

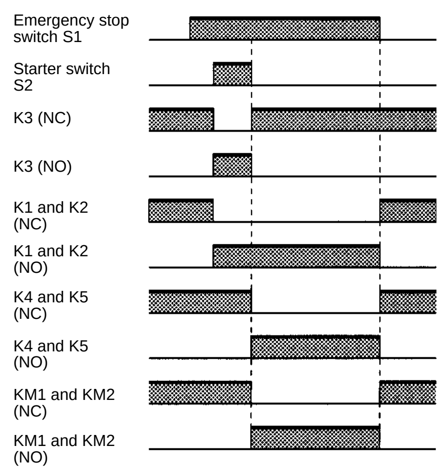


S1: Emergency stop switch
S2: Starter switch
KM1 and KM2: Magnet Contactor
KM3: G3J Solid-state Contactor
M: 3-phase motor

■ G9S-501 (AC) WITH SINGLE-CHANNEL EMERGENCY STOP SWITCH INPUT

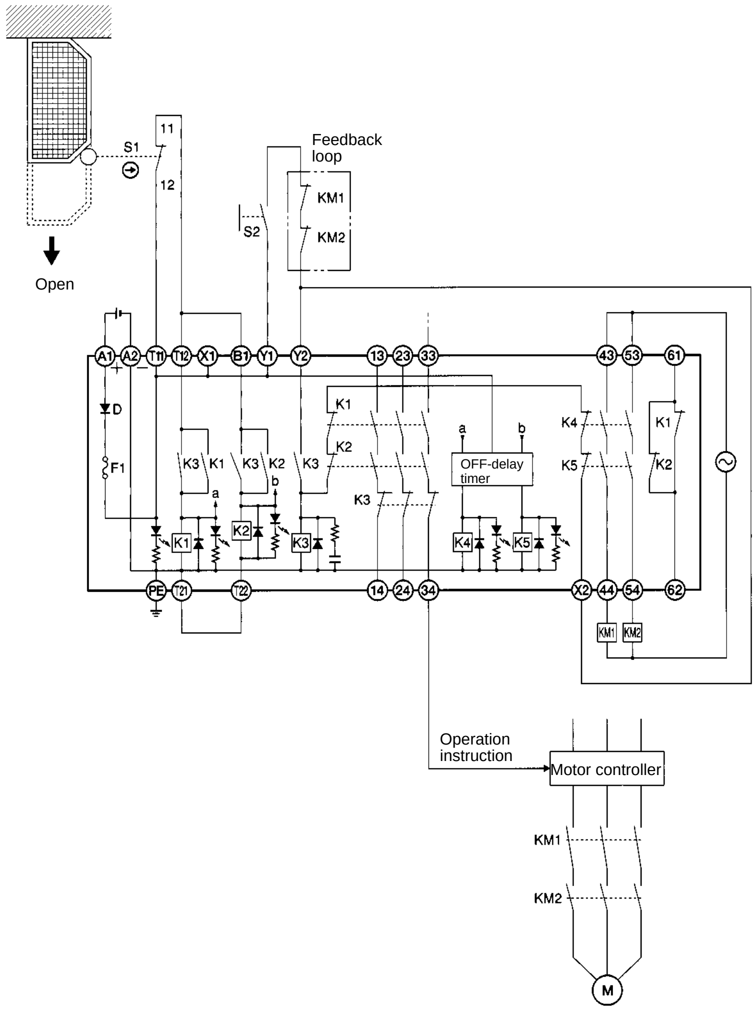


Timing Chart

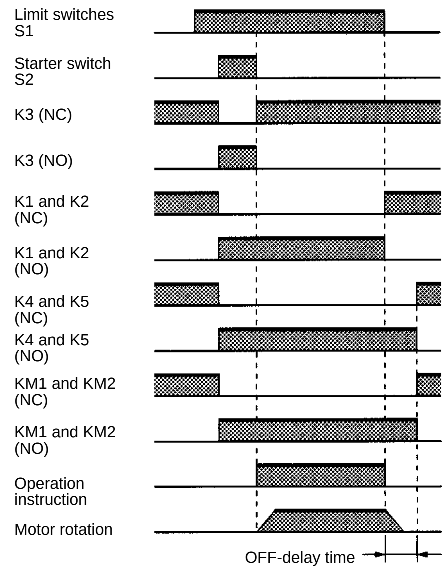


S1: Emergency stop switch
S2: Starter switch
KM1 and KM2: Magnet Contactor
M: 3-phase motor

■ G9S-321-T■ (24 VDC) WITH SINGLE-CHANNEL LIMIT SWITCH INPUT

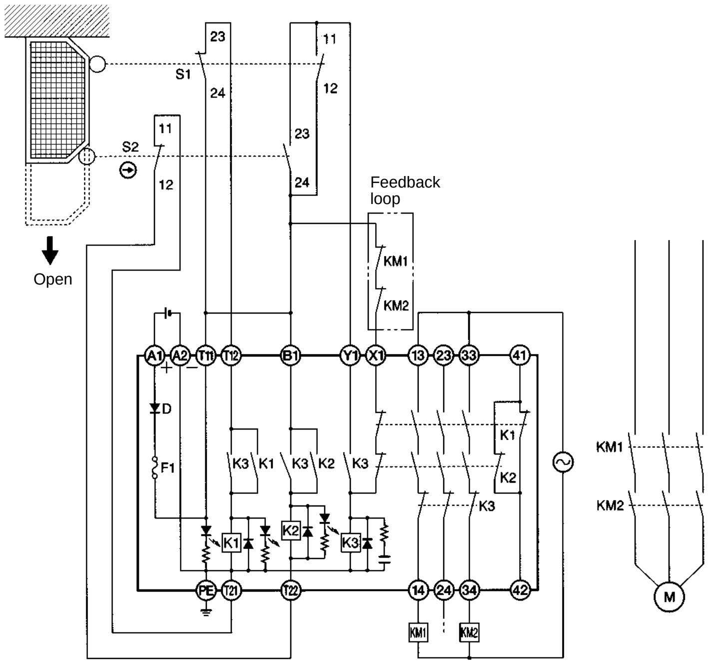


Timing Chart

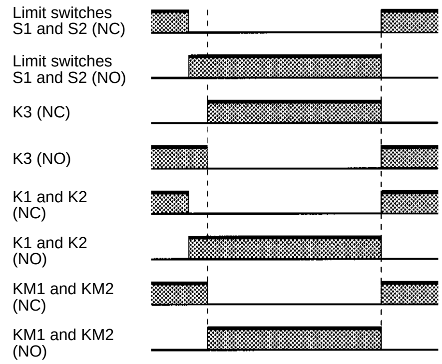


S1:	Safety Limit Switch with positive opening mechanis (D4D and D4B)
S2:	Starter switch
KM1 and KM2:	Magnet Contactor
M:	3-phase motor

■ G9S-301 (24 VDC) WITH 2-CHANNEL AUTO-RESET LIMIT SWITCH INPUT



Timing Chart

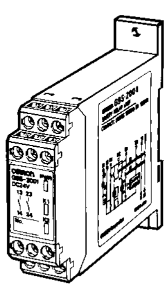


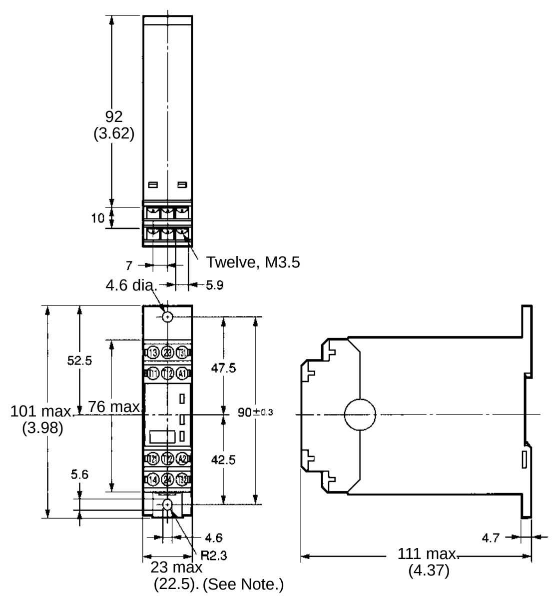
S1:	Limit switch
S2:	Safety Limit Switch with positive opening mechanism (D4D and D4B)
KM1 and KM2:	Magnet Contactor
M:	3-phase motor

Dimensions

Unit: mm (inch)

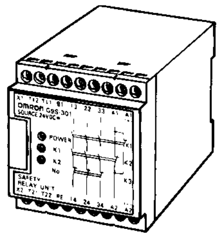
■ G9S-2001 G9S-2002

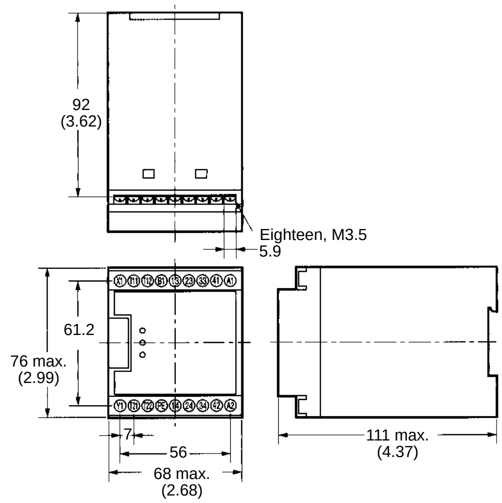




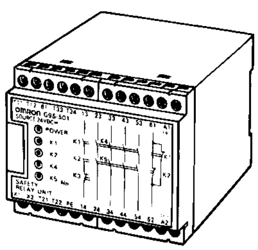
Note: This is an average value

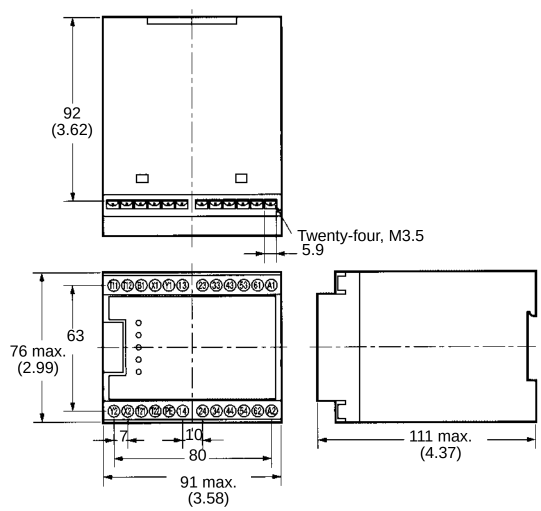
G9S-301





G9S-321-T□ G9S-501

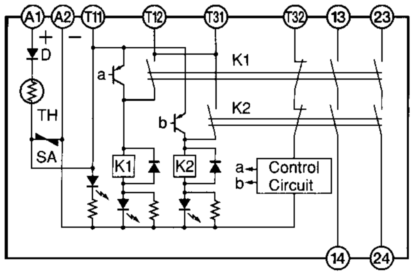




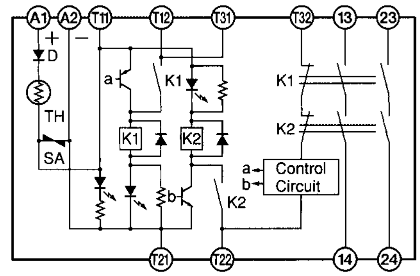
Installation

■ INTERNAL CONNECTIONS

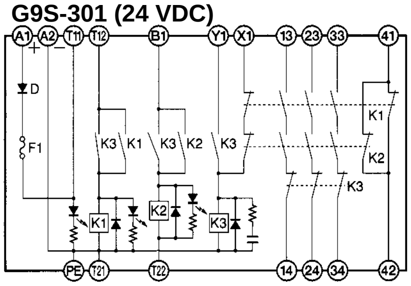
G9S-2001



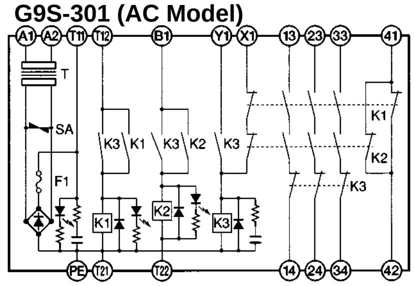
G9S-2002



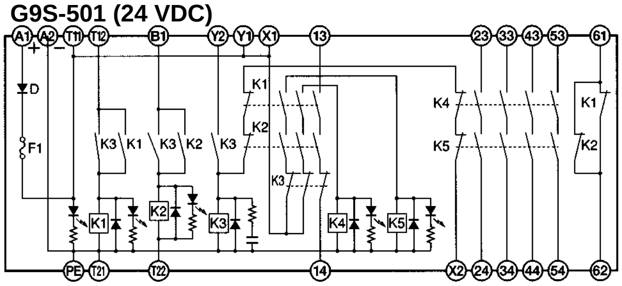
G9S-301 (24 VDC)



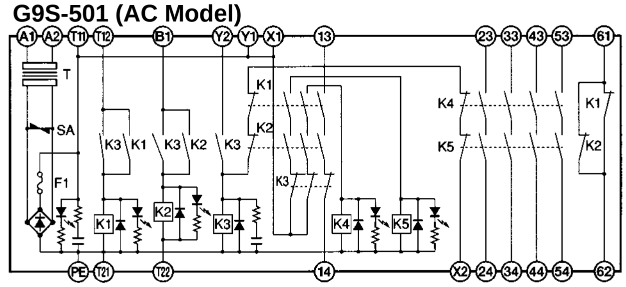
G9S-301 (AC Model)



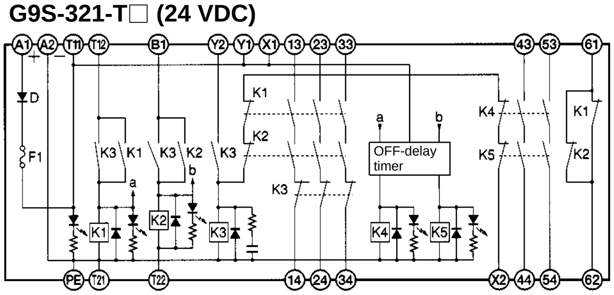
G9S-501 (24 VDC)



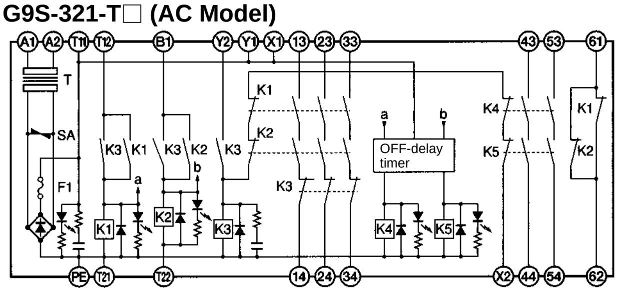
G9S-501 (AC Model)



G9S-321-T□ (24 VDC)



G9S-321-T□ (AC Model)



Precautions

WIRING

Be sure to turn off the G9S before wiring the G9S. Do not touch the terminals of the G9S while the power is turned on because the terminals are charged and may cause an electric shock.

Use the following to wire the G9S.
Strand wire: 0.75 to 1.5 mm^2 16 to 18 AWG
Steel wire: 1.0 to 1.5 mm^2 16 to 18 AWG

Tighten each screw to a torque of 0.78 to 1.18 N•m (8 to 12 kgf•cm), or the G9S may malfunction or generate heat.

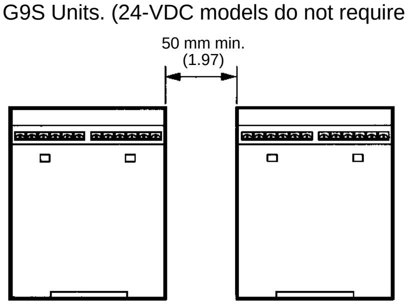
External inputs connected to T11 and T12 or T21 and T22 of the G9S-301 must be no-voltage contact inputs.

PE is a ground terminal.

When a machine is grounded at the positive, the PE terminal should not be grounded.

MOUNTING MULTIPLE UNITS

If the output current is 3 A or more, make sure that there is a minimum distance of 50 mm (1.97 in) each between all adjacent G9S Units. (24-VDC models do not require this spacing.)



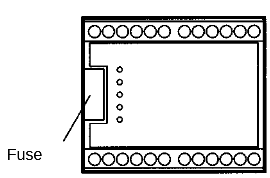
FUSE REPLACEMENT

Three- and Five-pole Models

The power input circuit of the G9S includes a fuse to protect the G9S from damage that may be caused by short-circuiting. The fuse is mounted to the side panel. Use the following type of fuse as a replacement.
Littel Fuse 218.4 (rated current 0.4 A), IEC127 approval.

Use a flat-blade screwdriver to remove the fuse cover.

Be sure to turn off the G9S before replacing the fuse.



APPLICABLE SAFETY CATEGORY (EN954-1)

All G9S-series Relays fall under Safety Category 4 of EN954-1 except the G9S-32I-T and G9S-2001. The G9S-32I-T has an OFF-delay output block falling under Safety Category 3 and G9S-2001 falls under Safety Category 1.

The above is provided according to circuit examples presented by OMRON. Therefore, the above may not apply to all operating environments.

The applicable safety category is determined from the whole safety control system. Make sure that the whole safety control system meets EN954-1 requirements.

Wire the G9S-2001 or G9S-2002 for auto-reset. If either one of them is connected to a manual-reset switch, EN954-1 requirements will not apply.

Safety Category 4 of EN954-1

Wire the G9S-2001 or G9S-2002 for auto-reset. If either one of them is connected to a manual-reset switch, EN954-1 requirements will not apply.

Apply 2-channel external input to the T11 and T12 terminals and T21 and T22 terminals through switches each incorporating a force-separation mechanism. If limit switches are used, make sure that at least one of them incorporates a force-separation mechanism.

Refer to *Application Examples* and input a signal for the normally-closed contact of the contactor (i.e., input to X1 of the G9S-301, X2 of the G9S-501, or X2 of the G9S-321-T).

Be sure to ground the PE terminal. If the relay is operating with DC, the power supply may be grounded instead.

NOTE: DIMENSIONS SHOWN ARE IN MILLIMETERS. To convert millimeters to inches divide by 25.4.

OMRON®

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Schaumburg, IL 60173
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Cat. No. CEDSAX3 10/99 Specifications subject to change without notice. Printed in U.S.A.

Cat. No. I522-E1-2

OMRON

USER'S MANUAL

OMNUC U-SERIES UE Models

MODELS R88M-UE□
(AC Servomotors)

MODELS R88D-UEP□
(AC Servo Drivers)

AC SERVOMOTORS/DRIVERS (100 to 750 W Pulse-train Inputs)

Thank you for choosing this OMNUC U-series UE models product. Proper use and handling of the product will ensure proper product performance, lengthen product life, and may prevent possible accidents.
Please read this manual thoroughly and handle and operate the product with care.

General Instructions

1. Refer to Precautions first and carefully read and be sure to understand the information provided.
2. Familiarize yourself with this manual and understand the functions and performance of the Servomotor and Servo Driver for proper use.
3. The Servomotor and Servo Driver must be wired and the Parameter Unit must be operated by experts in electrical engineering.
4. We recommend that you add the following precautions to any instruction manuals you prepare for the system into which the product is being installed.
   - Precautions on the dangers of high-voltage equipment.
   - Precautions on touching the terminals of the product even after power has been turned off. (These terminals are live even with the power turned off.)
5. Do not perform withstand voltage or other megameter tests on the product. Doing so may damage internal components.
6. Servomotors and Servo Drivers have a finite service life. Be sure to keep replacement products on hand and to consider the operating environment and other conditions affecting the service life.
7. Do not set any parameter not described in this manual, otherwise the Servomotor or Servo Driver may malfunction. Contact your OMRON representatives if you have any inquiry.

NOTICE

Before using the product under the following conditions, consult your OMRON representatives, make sure that the ratings and performance characteristics of the product are good enough for the systems, machines, or equipment, and be sure to provide the systems, machines, or equipment with double safety mechanisms.

1. Conditions not described in the manual.
2. The application of the product to nuclear control systems, railroad systems, aviation systems, vehicles, combustion systems, medical equipment, amusement machines, or safety equipment.
3. The application of the product to systems, machines, or equipment that may have a serious influence on human life and property if they are used improperly.

Items to Check After Unpacking

Check the following items after removing the product from the package:

- Has the correct product been delivered (i.e., the correct model number and specifications)?
- Has the product been damaged in shipping?

The product is provided with this manual. No connectors or mounting screws are provided.

USER'S MANUAL

OMNUC U-SERIES UE Models

MODELS R88M-UE□
(AC Servomotors)

MODELS R88D-UEP□
(AC Servo Drivers)

AC SERVOMOTORS/DRIVERS (100 to 750 W Pulse-train Inputs)

Notice:

OMRON products are manufactured for use according to proper procedures by a qualified operator and only for the purposes described in this manual.

The following conventions are used to indicate and classify precautions in this manual. Always heed the information provided with them. Failure to heed precautions can result in injury to people or damage to the product.

⚠ DANGER Indicates information that, if not heeded, is likely to result in loss of life or serious injury.

⚠ WARNING Indicates information that, if not heeded, could possibly result in loss of life or serious injury.

⚠ Caution Indicates information that, if not heeded, could result in relatively serious or minor injury, damage to the product, or faulty operation.

OMRON Product References

All OMRON products are capitalized in this manual. The word "Unit" is also capitalized when it refers to an OMRON product, regardless of whether or not it appears in the proper name of the product.

The abbreviation "Ch," which appears in some displays and on some OMRON products, often means "word" and is abbreviated "Wd" in documentation in this sense.

The abbreviation "PC" means Programmable Controller and is not used as an abbreviation for anything else.

Visual Aids

The following headings appear in the left column of the manual to help you locate different types of information.

Note Indicates information of particular interest for efficient and convenient operation of the product.

General Precautions

Observe the following precautions when using the OMNUC Servomotor and Servo Driver.

This manual may include illustrations of the product with protective covers removed in order to describe the components of the product in detail. Make sure that these protective covers are on the product before use.

Consult your OMRON representative when using the product after a long period of storage.

⚠ WARNING Do not touch the internal circuitry of the Servo Driver. Doing so may result in an electric shock.

⚠ WARNING Be sure to ground the FG terminals of the Servomotor and Servo Driver. Not doing so may result in an electric shock.

⚠ WARNING Do not connect or disconnect the front cover, terminal cover, Parameter Unit, or peripheral devices while power is being supplied to the product. Doing so may result in an electric shock.

⚠ WARNING Make sure that the product is operated, maintained, or inspected by authorized people only. Not doing so may result in an electric shock.

⚠ WARNING Do not be wire or inspect the product within five minutes after power to the product is turned off. Doing so may result in an electric shock.

⚠ WARNING Do not damage, press, or put excessive stress or heavy objects on the cables. Doing so may result in an electric shock.

⚠ WARNING Do not touch the rotating part of the Servomotor in operation. Doing so may result in an injury.

⚠ Caution Do not modify the product. Doing so may damage the product.

⚠ Caution Use the Servomotor in proper combination with the Servo Driver. Not doing so may result in a fire or damage to the Servomotor or Servo Driver.

⚠ Caution Do not store or install the product in the following locations. Doing so may result in fire or damage to the product.

- Locations subject to direct sunlight.
- Locations subject to temperatures beyond the specified ranges.
- Locations subject to humidities beyond the specified ranges.
- Locations subject to rapid changes in temperature and possible condensation.
- Locations subject to corrosive or flammable gases.
- Locations subject to dust, dirt, chloride, or iron powder.
- Locations subject to splashes of water, oil, chemicals, or other liquids.
- Locations subject to direct vibration or shock.

⚠ Caution Do not touch the Inverter radiator, Regeneration Unit, or Servomotor while power is being supplied or for a while after the power is turned off. Doing so may result in a burn injury.

Storage and Transportation Precautions

⚠ **Caution** Do not carry the Servomotor by the cable or shaft of the Servomotor. Doing so may result in an injury or Servomotor malfunction.

⚠ **Caution** Do not pile up the products excessively. Doing so may result in an injury or product malfunction.

⚠ **Caution** Use motor eye bolts only for transporting the Servomotor. Do not use them for transporting the machines. Doing so may result in an injury or machine malfunction.

Installation and Wiring Precautions

⚠ **Caution** Do not stand on the product or put heavy objects on the product. Doing so may result in an injury.

⚠ **Caution** Make sure that the product is well ventilated and the interior of the product is free of foreign matter. Not doing so may result in a fire.

⚠ **Caution** Mount the product properly. Not doing so may result in a product malfunction.

⚠ **Caution** Keep the specified distance between the Servo Driver and the interior surface of the control panel or any other machine. Not doing so may result in a fire or Servomotor malfunction.

⚠ **Caution** Protect the product from excessive shock. Not doing so may result in a product malfunction.

⚠ **Caution** Wire the system correctly. Not doing so may result in an out-of-control Servomotor and injury.

⚠ **Caution** Tighten mounting screws, terminal screws, and cable connector screws firmly. Loose screws may result in a product malfunction.

⚠ **Caution** Use crimp terminals when wiring. Connecting bare twisted wires directly to terminals may result in fires.

⚠ **Caution** Use the power supply voltages specified in this manual. Incorrect voltages may damage the product.

⚠ **Caution** Take steps to ensure that the rated power supply voltage is maintained in locations with poor power supply conditions. Improper power supply voltages may damage the product.

⚠ Caution Install safety measures, such as circuit breakers, to protect against shorts in external wiring. Insufficient safety measures may result in fires.

⚠ Caution Install a safety stop on each machine. Not doing so may result in an injury. A brake is not considered a safety stop.

⚠ Caution Install an emergency stop to shut off power to the system instantly. Not doing so may result in an injury.

⚠ Caution Take sufficient measures to protect the product in the following locations. Insufficient protection may damage the product.

- Locations where static electricity and other noise is generated.
- Locations subject to strong electromagnetic or magnetic fields.
- Locations subject to radioactive exposure.
- Locations close to power lines.

Operation and Adjustment Precautions

⚠ Caution Confirm the settings of all parameters to be sure they are correct before starting actual operation. Incorrect parameters may damage the product.

⚠ Caution Do not make extreme changes in the settings of the product. Doing so may result in unstable operation of the product and injury.

⚠ Caution Confirm the operation of the motor before connecting it to the mechanical system. Unexpected motor operation may result in injury.

⚠ Caution If an alarm is ON, remedy the cause, make sure the system is safe, reset the alarm, and restart the system. Not doing so may result in an injury.

⚠ Caution The system may restart abruptly when power is resupplied after an instantaneous power failure. Take safety measures to prevent accidents that may result in an injury.

⚠ Caution Do not use the built-in brake of the Servomotor for normal control of the Servomotor. Doing so may result in a Servomotor malfunction.

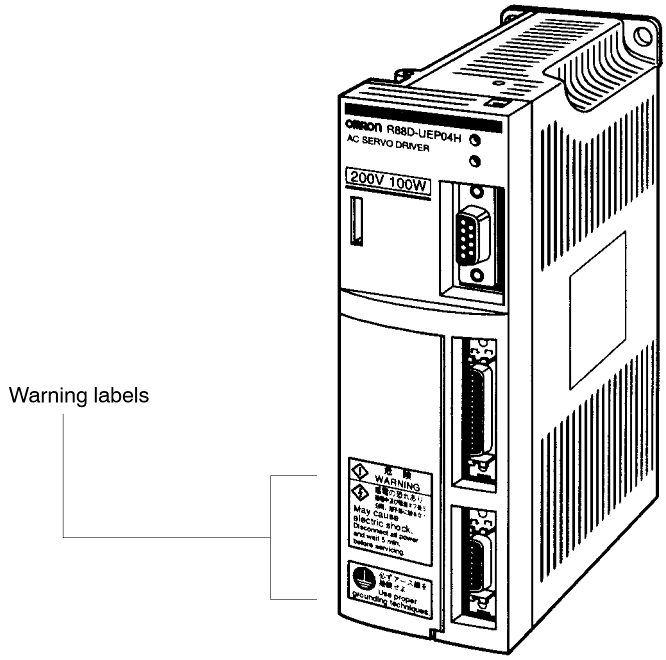
Maintenance and Inspection Precautions

⚠ Caution After replacing a Unit, always transfer all data required for operation before attempting to restart operation. Improper data settings may damage the product.

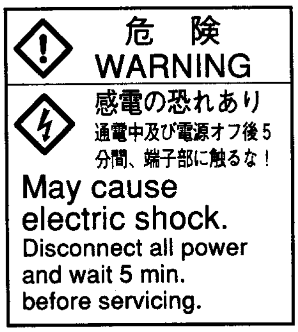
⚠ Caution Do not disassemble or repair the product. Doing so may result in an electric shock and injury.

Warning Labels

Warning labels are pasted on the product as shown in the following illustration. Be sure to follow the instructions given there.



Warning Labels for Non-conforming Models

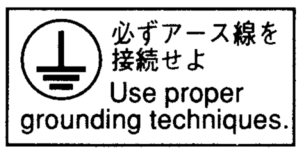


Warning label 1

Warning label 2

Warning Labels for Models Conforming to EC Directives

Warning label 1



Warning label 2

VISUAL INDEX

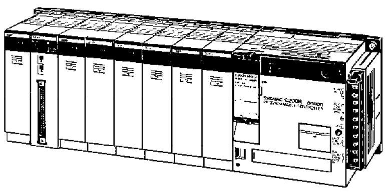
For users who wish to operate soon.

❏ The following portions of this manual provide the minimum information required for operation. Be sure you fully understand at least the information in these portions before attempting operation.

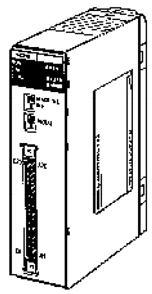
Chapter 2 System Design and Installation, and sections 3-1, 3-2, 3-3, 3-4, 3-5, and 3-6 of Chapter 3 Operation.

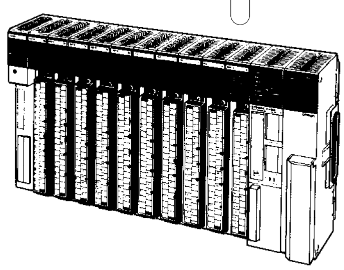
Instructions for jog operation using a Parameter Unit are provided in 3-6.

SYSMAC C200HX/HG/HE
Programmable Controller



Position Control Unit
C200H-NC112
C200H-NC211

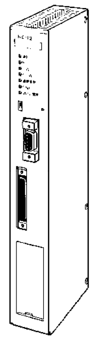




SYSMAC C/CV-series
Programmable Controller

Pulse input

Controller Connecting Cable
Chapter 5: 5-3-1



Position Control Unit
3G2A5-NC111-EV1

Function Setting (Parameter Setting)	
❏ Setting and Checking User Parameters:	Chapter 3, section 3-5-1
❏ Electronic Gear:	Chapter 3, section 3-5-3
❏ Magnetic and Dynamic brakes:	Chapter 3, section 3-5-4

Trial Operation and Adjustment	
❏ Trial Operation:	Chapter 3, section 3-6-1
❏ Auto-tuning:	Chapter 3, section 3-7-1
❏ Manually Adjusting Gain:	Chapter 3, section 3-7-2

Troubleshooting and Remedies	
❏ Using Displays:	Chapter 4, section 4-1
❏ Protective and Diagnostic Functions:	Chapter 4, section 4-2
❏ Troubleshooting:	Chapter 4, section 4-3

DIGITAL INNOVATION

OMNUC U is a series of fully software-controlled AC servo drivers built on advanced OMRON software servo technology. It provides high performance, a sensitive man-machine interface, and economy.

OMNUC U Series

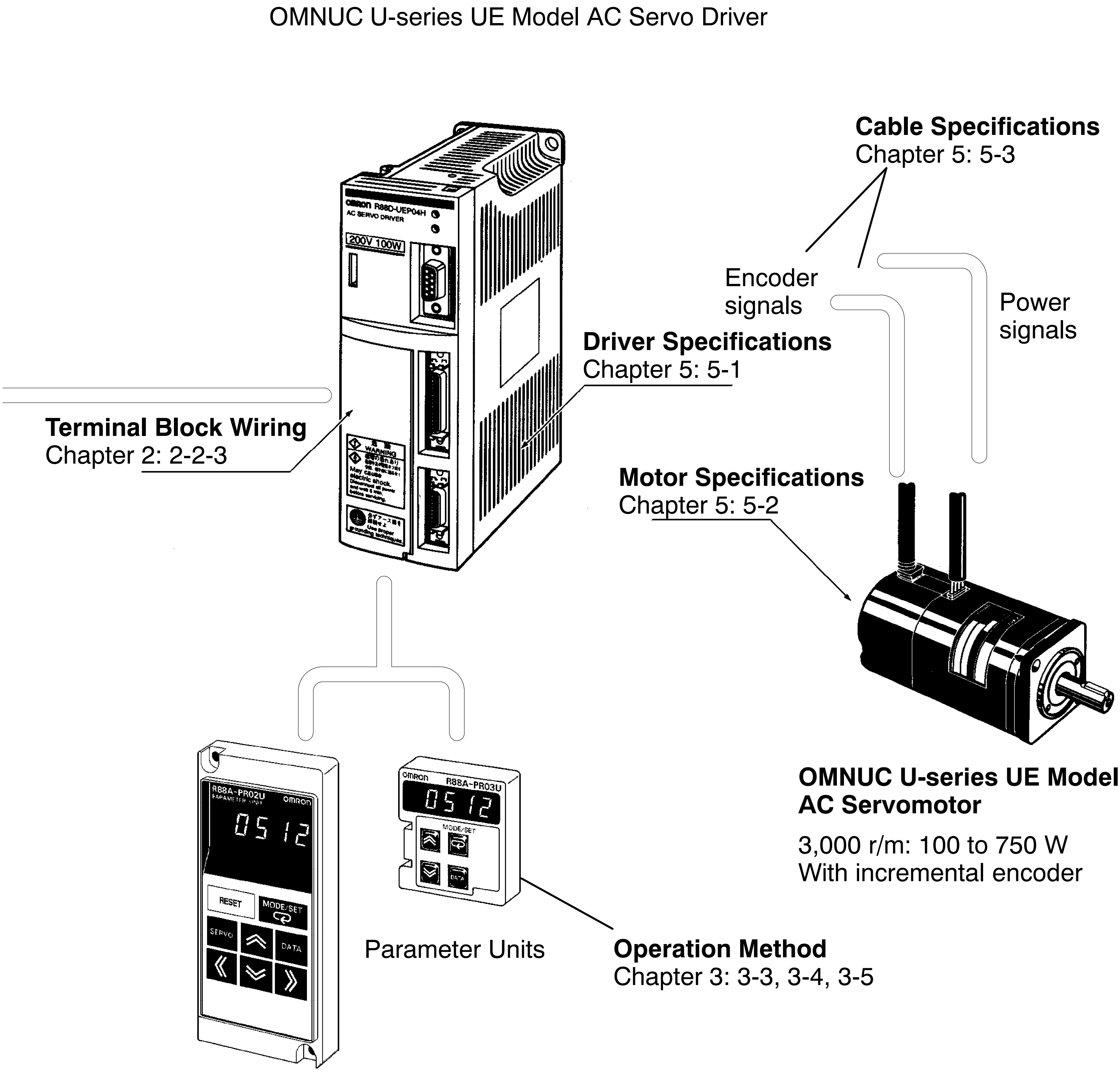


Table of Contents

Table of Contents

Chapter 1

· Introduction ·

1-1 Features

OMNUC AC Servo Drivers control the power supplied to AC Servomotors with pulse-train input signals and perform precision position control. There are 5 types of AC Servomotors: 100-W, 200-W, 300-W, 400-W, and 750-W.

■ Motor Output Capacity

AC Servomotors with the following output capacities are available.

• For 200/230-VAC (170 to 253 V) single-phase, 50/60-Hz Input
  100 W, 200 W, 400 W, and 750 W

• For 100/115-VAC (85 to 127 V) single-phase, 50/60-Hz Input
  100 W, 200 W, and 300 W

Note 1. Each Servomotor is available with or without a brake.

Note 2. Each motor shaft has a straight axis with a key.

■ EC Directives (CE Markings)

AC Servomotor and Servo Drivers that conform to EC low-voltage and EMC directives are now available. These provide the same performance and functions as the rest of the U Series UE Models, and will aid in obtaining specifications.

■ Control Functions

Controls the position and speed of the Servomotor very precisely with pulse-train input signals. Any one of the following 3 pulse trains can be selected: forward/reverse pulses, feed pulses/directional signals, or 90° differential phase (A/B phases) signals.

■ Auto-tuning

The gain can be adjusted automatically when the responsiveness has been selected to match the rigidity of the mechanical system. The auto-tuning feature automatically finds the optimum adjustment to match the load, with no need for difficult operations.

■ Monitor

Displays the driver's operating status on the Parameter Unit.

The following items can be monitored: speed feedback, torque commands, number of pulses from the U-phase edge, electrical angle, internal status (bit display), command pulse's speed, position deviation, and the input pulse counter.

■ Jog Operation

Forward/Reverse motor operation can be controlled from the Parameter Unit.

■ Electronic Gear Function

The number of pulses used to rotate the motor is calculated by multiplying the number of command pulses by the electronic gear ratio. This function is useful in the following kinds of cases.

• When you want to finely adjust the position and speed of two lines that need to be synchronized

• When you want to increase the control pulse frequency of a controller with a low pulse frequency

• When you want to set the movement/pulse to a certain amount, such as 0.01 mm/pulse

The electronic gear ratio is set with parameters G1 and G2 (G1=numerator and G2=denominator). The setting range for parameters G1 and G2 is 1 to 65,535. The setting range for the gear ratio is 0.01 to 100, i.e., $0.01 \leq G1/G2 \leq 100$.

■ Pulse Smoothing Function

Even high-frequency commands can be executed smoothly by including acceleration/deceleration in the command pulses. The same setting is used for both the acceleration and deceleration times, and the setting range is 0 to 64 ms.

■ Reverse Mode

Forward/Reverse commands can be switched in the parameters, without changing the wiring to the motor or encoder.

■ Brake Interlock Output

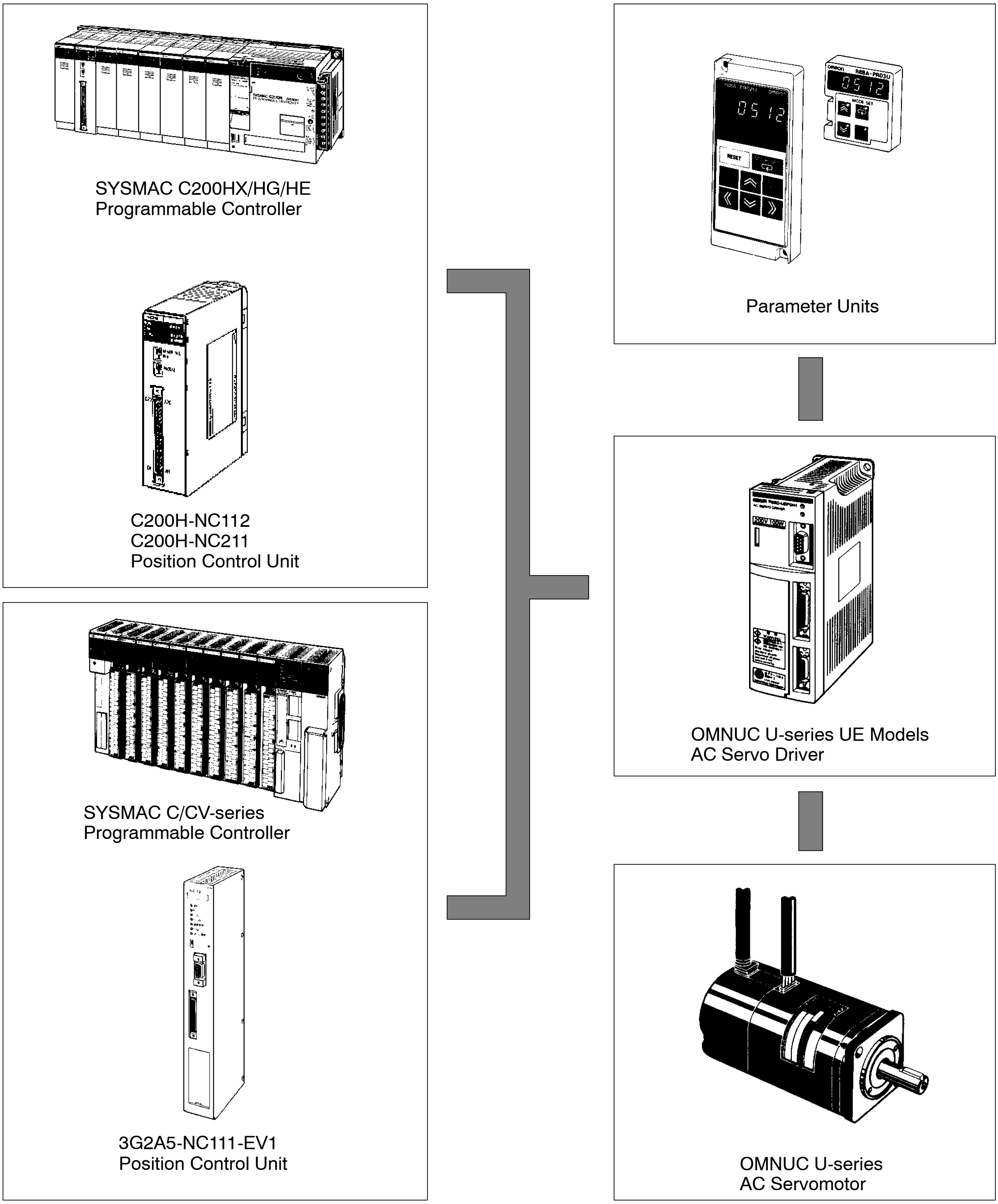
Outputs a timing signal interlocked with the motor's ON/OFF status and rotational speed. The holding brake of a motor with a brake can be operated reliably.

■ Computer Monitor Software

The special Servo Driver Communications Software allows parameter setting, speed and current monitoring, I/O monitoring, auto-tuning, and jog operations to be performed from a personal computer. It is also possible to perform multiple-axis communications that set the parameters and monitor the operation of several drivers. Refer to the *Computer Monitor Software Instruction Manual (I513)* for OMNUC U-series Servo Drivers for more details.

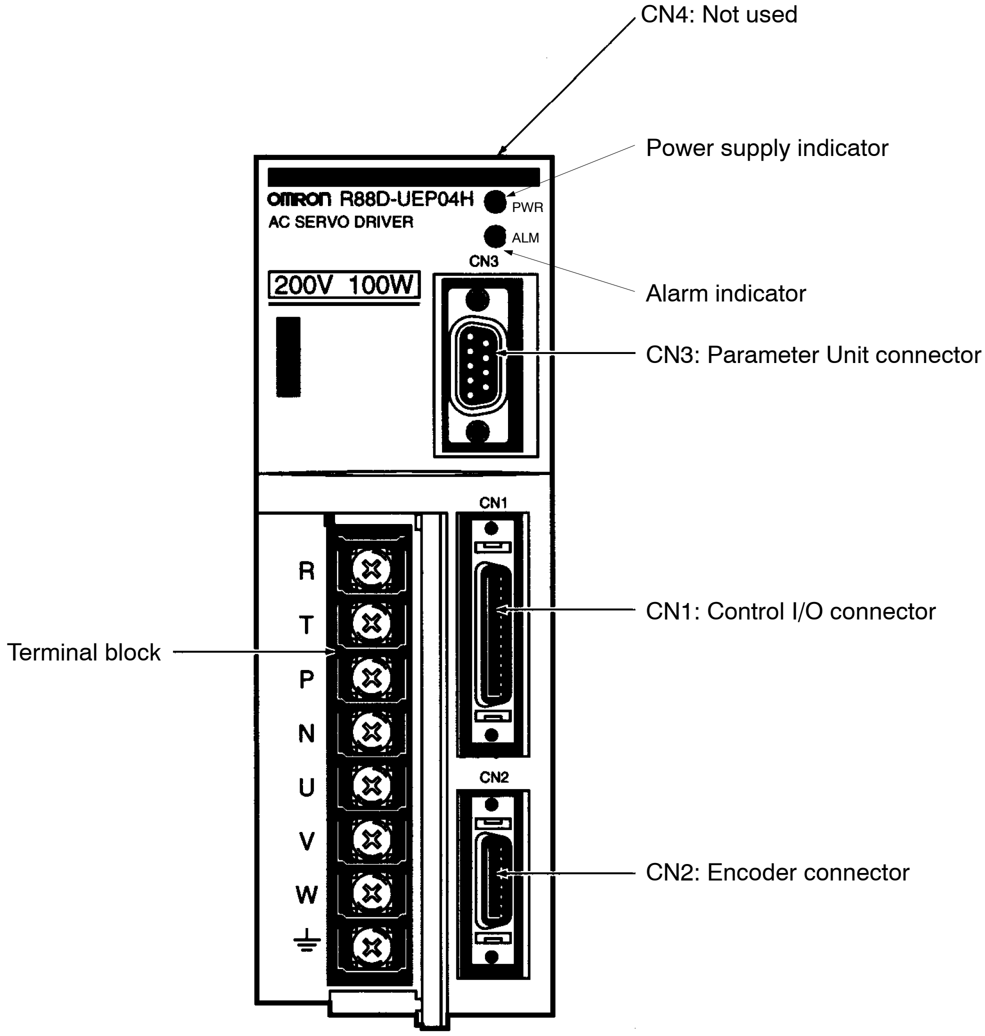
Note Version 1.1 or later of the Computer Monitor Software supports the UE Models.

1-2 System Configuration



1-3 Servo Driver Nomenclature

■ Front View



1-4 EC Directives and Applicable Models

■ EC Directives

EC Directive	Product	Directive	Remarks
Low voltage	AC Servo Driver	EN61010-1	Safety requirements for electrical equipment for measurement, control, and laboratory use.
	AC Servomotor	IEC34-1, -5, -8, -9	Rotating electrical machines.
EMC	AC Servo Driver AC Servomotor	EN55011 class A group 1	Limits and methods of measurement of radio disturbance characteristics of industrial, scientific, and medical (ISM) radio-frequency equipment.
		EN50082-2	Electromagnetic compatibility generic immunity standard, Part 2 Industrial environment.

Note Installation under the conditions specified in *2-3-3 Wiring Products Conforming to EMC Directives* is required to conform to EMC Directives.

■ Applicable Models

Power supply	Output capacity	AC Servo Drivers	AC Servomotors
			With incremental encoder
200 VAC	100 W	R88D-UEP04V	R88M-UE10030V-S1
	200 W	R88D-UEP08V	R88M-UE20030V-S1
	400 W	R88D-UEP12V	R88M-UE40030V-S1
	750 W	R88D-UEP20V	R88M-UE75030V-S1
100 VAC	100 W	R88D-UEP10W	R88M-UE10030W-S1
	200 W	R88D-UEP12W	R88M-UE20030W-S1
	300 W	R88D-UEP15W	R88M-UE30030W-S1

Note The above models with brakes are also applicable. Change the suffix to “BS1” for models with brakes.

Chapter 2

• System Design and Installation •

Installation and Wiring Precautions

⚠ **Caution** Do not stand on the product or put heavy objects on the product. Doing so may result in an injury.

⚠ **Caution** Make sure that the product is well ventilated and the interior of the product is free of foreign matter. Not doing so may result in a fire.

⚠ **Caution** Mount the product properly. Not doing so may result in a product malfunction.

⚠ **Caution** Keep the specified distance between the Servo Driver and the interior surface of the control panel or any other machine. Not doing so may result in a fire or Servomotor malfunction.

⚠ **Caution** Protect the product from excessive shock. Not doing so may result in a product malfunction.

⚠ **Caution** Wire the system correctly. Not doing so may result in an out-of-control Servomotor and injury.

⚠ **Caution** Tighten mounting screws, terminal screws, and cable connector screws firmly. Loose screws may result in a product malfunction.

⚠ **Caution** Use crimp terminals when wiring. Connecting bare twisted wires directly to terminals may result in fires.

⚠ **Caution** Use the power supply voltages specified in this manual. Incorrect voltages may damage the product.

⚠ **Caution** Take steps to ensure that the rated power supply voltage is maintained in locations with poor power supply conditions. Improper power supply voltages may damage the product.

⚠ **Caution** Install safety measures, such as circuit breakers, to protect against shorts in external wiring. Insufficient safety measures may result in fires.

⚠ **Caution** Install a safety stop on each machine. Not doing so may result in an injury. A brake is not considered a safety stop.

⚠ **Caution** Install an emergency stop to shut off power to the system instantly. Not doing so may result in an injury.

⚠ **Caution** Take sufficient measures to protect the product in the following locations. Insufficient protection may damage the product.

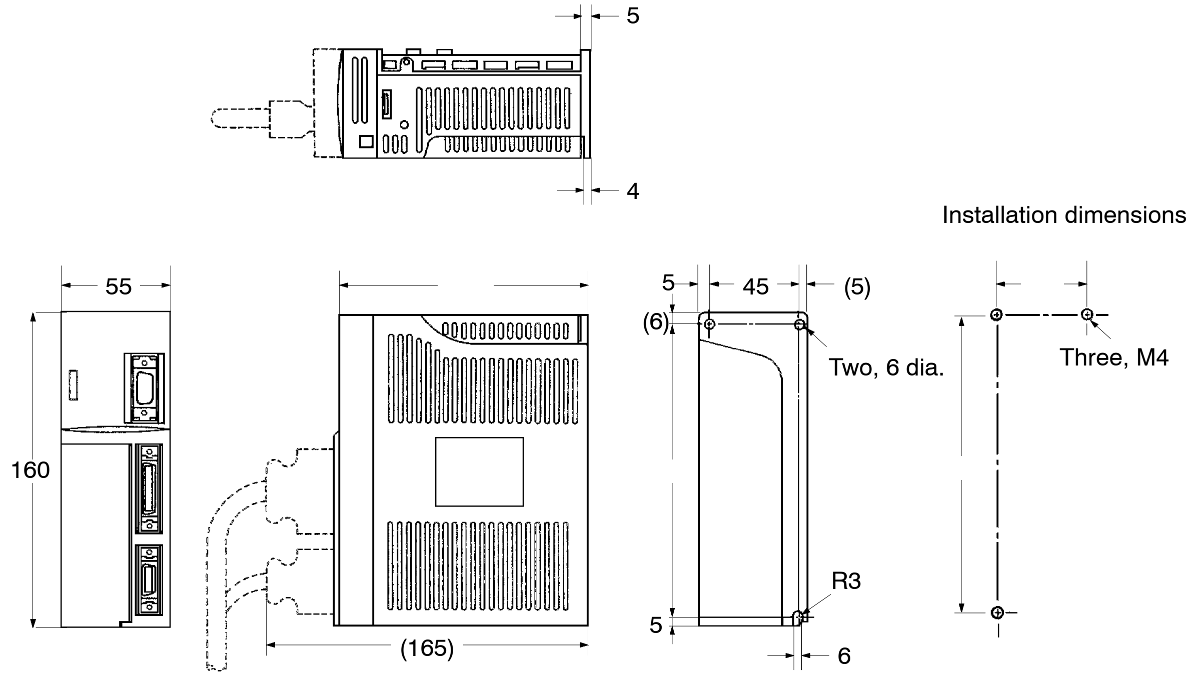
- Locations where static electricity and other noise is generated.
- Locations subject to strong electromagnetic or magnetic fields.
- Locations subject to radioactive exposure.
- Locations close to power lines.

2-1 Installation

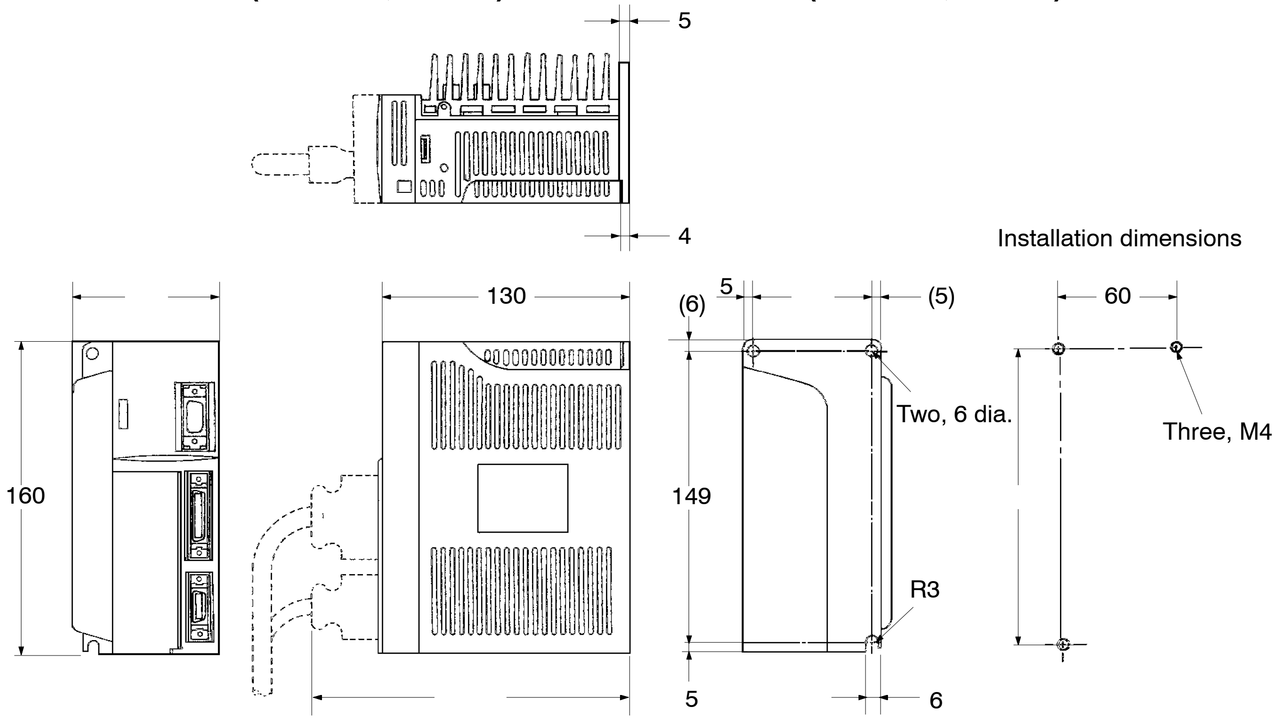
2-1-1 External Dimensions (Unit: mm)

■ AC Servo Drivers, Non-conforming Models

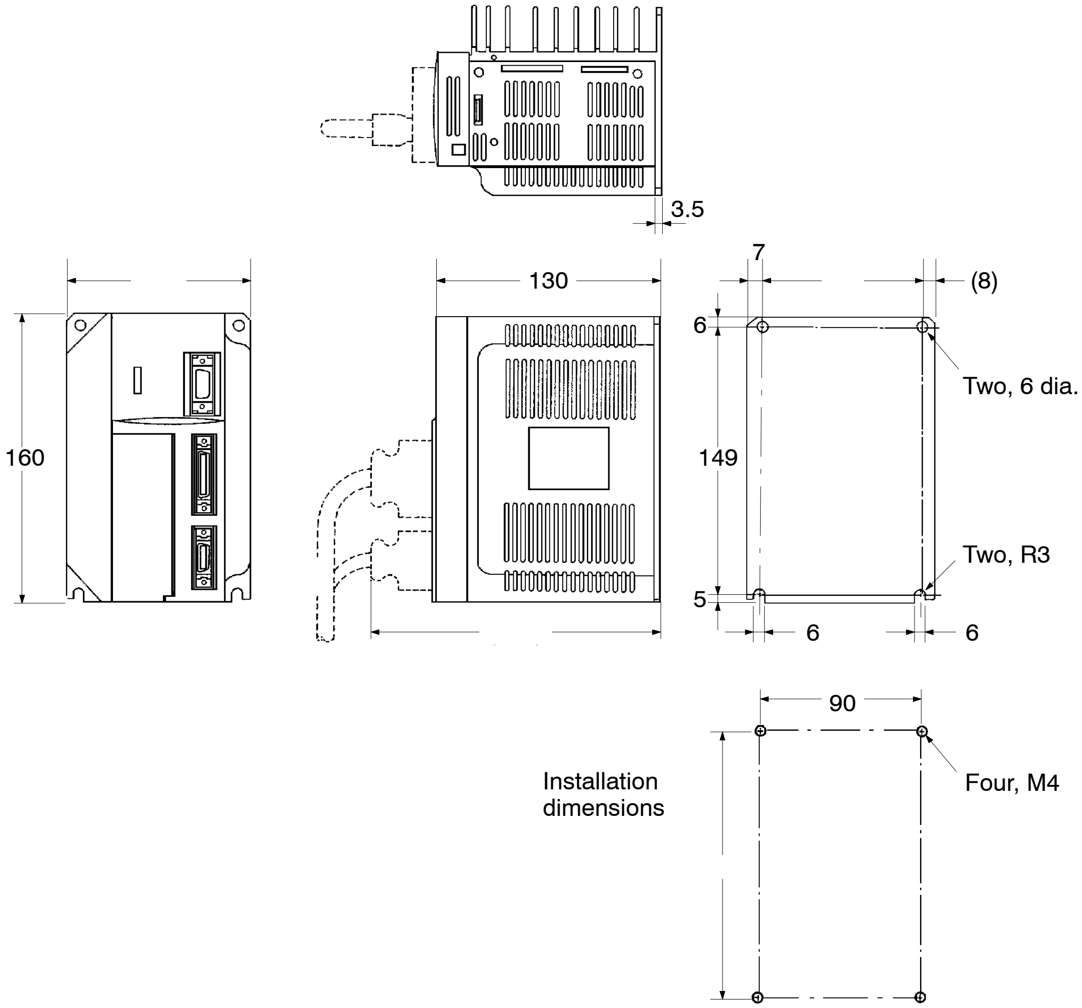
● R88D-UEP04H/UEP08H (200 VAC, 100, 200 W)
R88D-UEP10L (100 VAC, 100 W)



● R88D-UEP12H (200 VAC, 400 W) and R88D-UEP12L (100 VAC, 200 W)

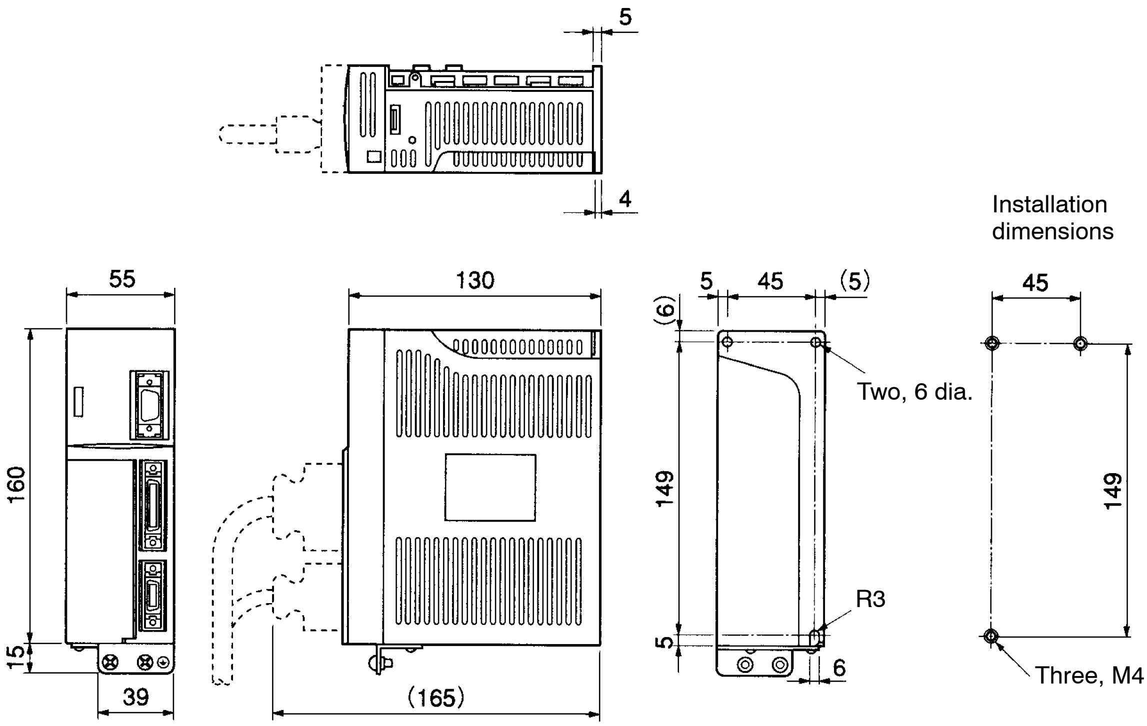


- **R88D-UEP20H (200 VAC, 750 W) and R88D-UEP15L (100 VAC, 300 W)**

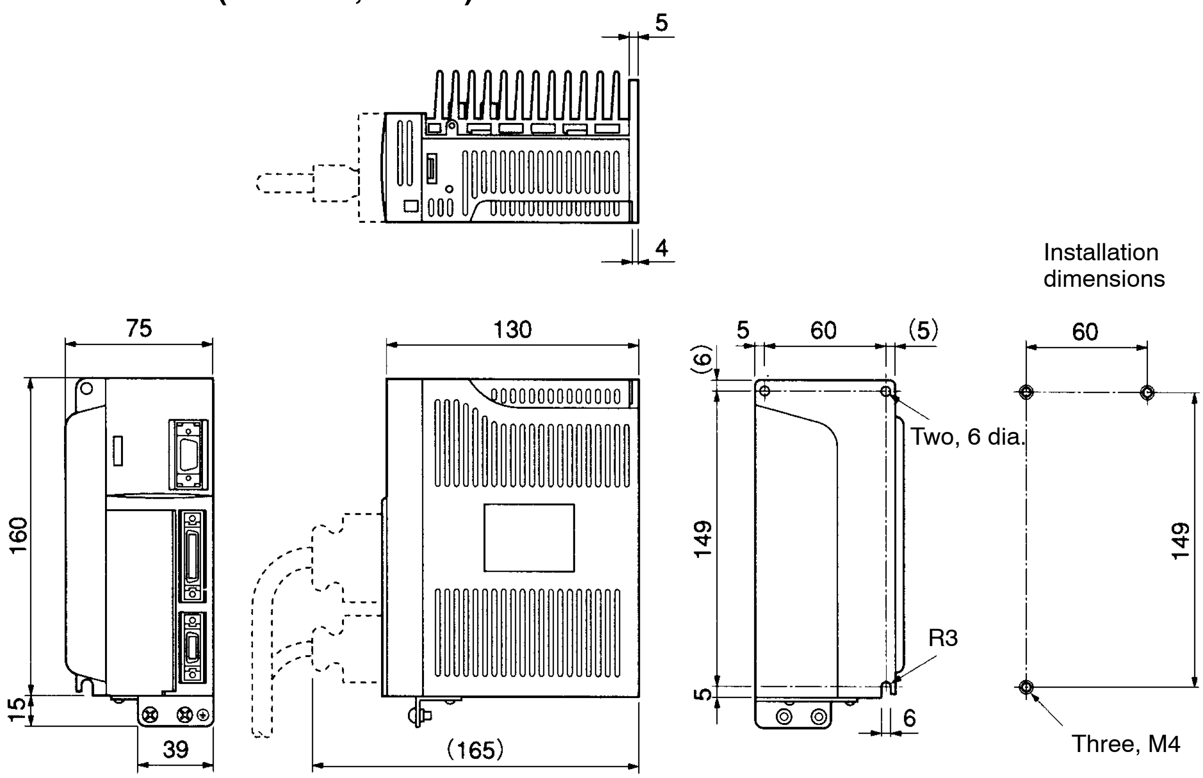


■ AC Servo Drivers Conforming to EC Directives

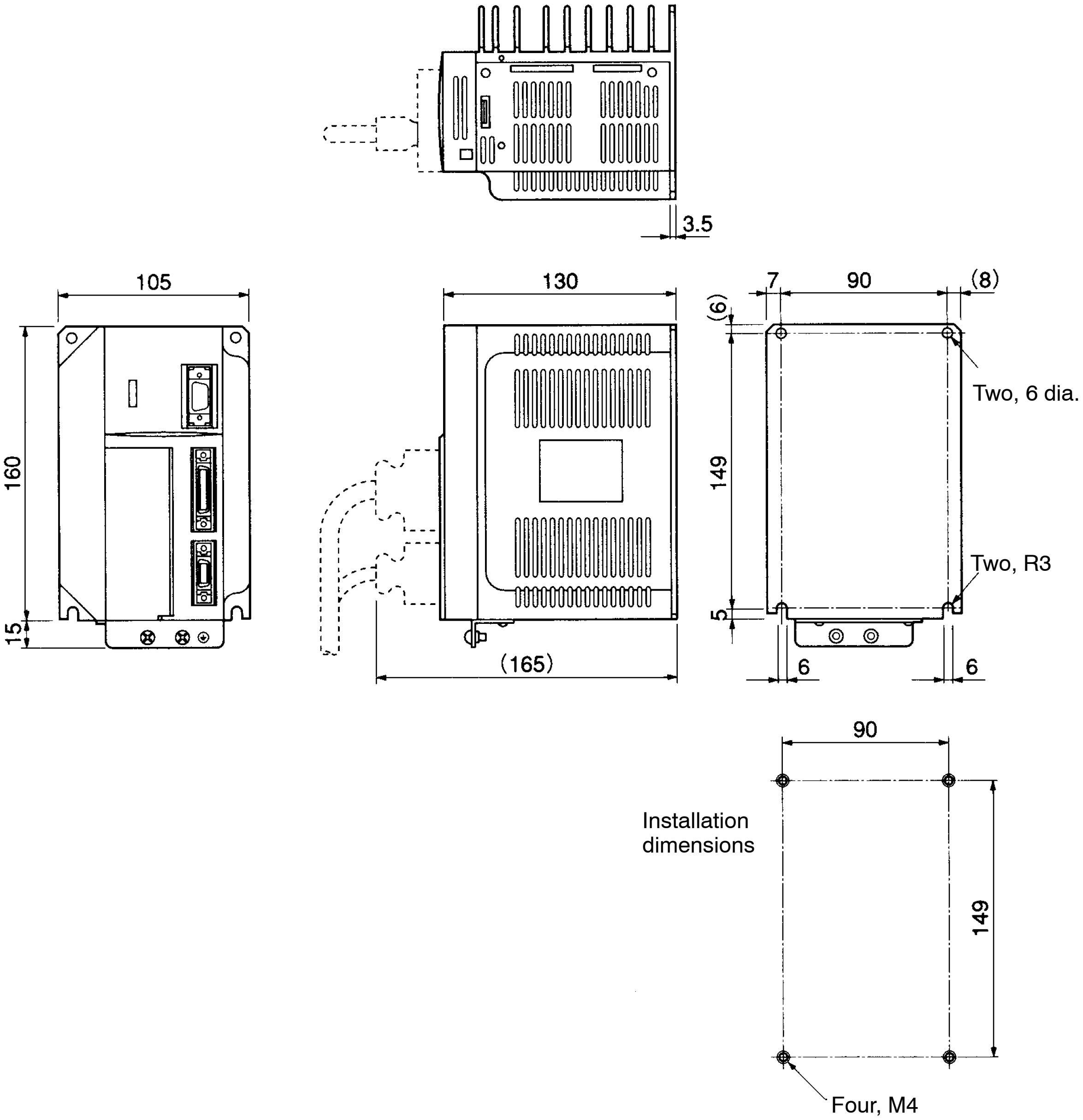
**● R88D-UEP04V/UEP08V (200 VAC, 100, 200 W)
R88D-UEP10W (100 VAC, 100 W)**



**● R88D-UEP12V (200 VAC, 400 W)
R88D-UEP12W (100 VAC, 200 W)**

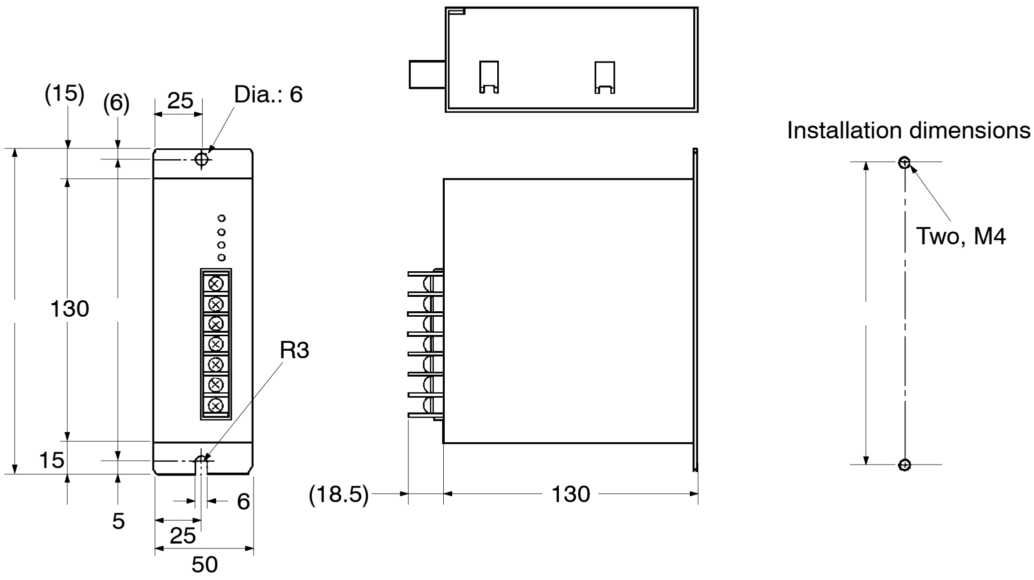


- **R88D-UEP20V (200 VAC, 750 W)**
  R88D-UEP15W (100 VAC, 300 W)



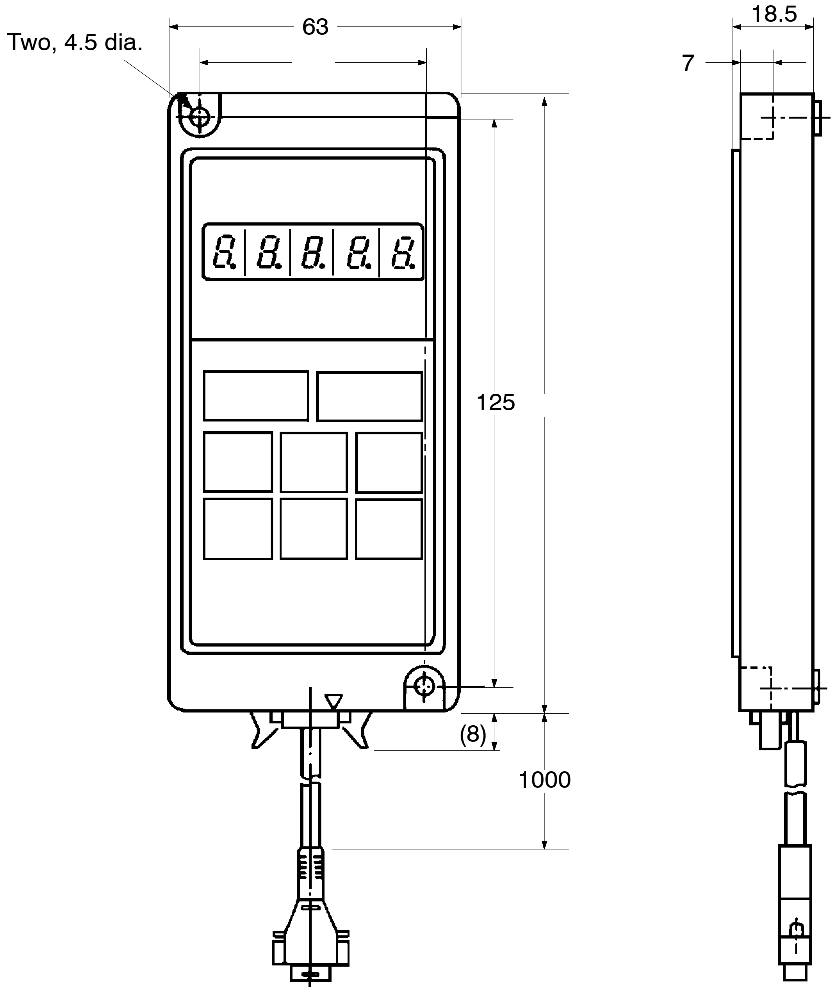
■ Regeneration Unit

● R88A-RG08UA

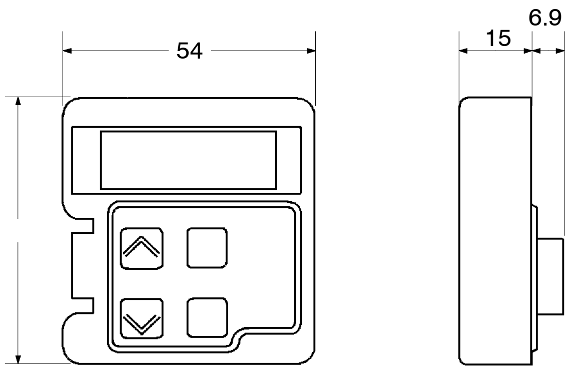


■ Parameter Units

● R88A-PR02U

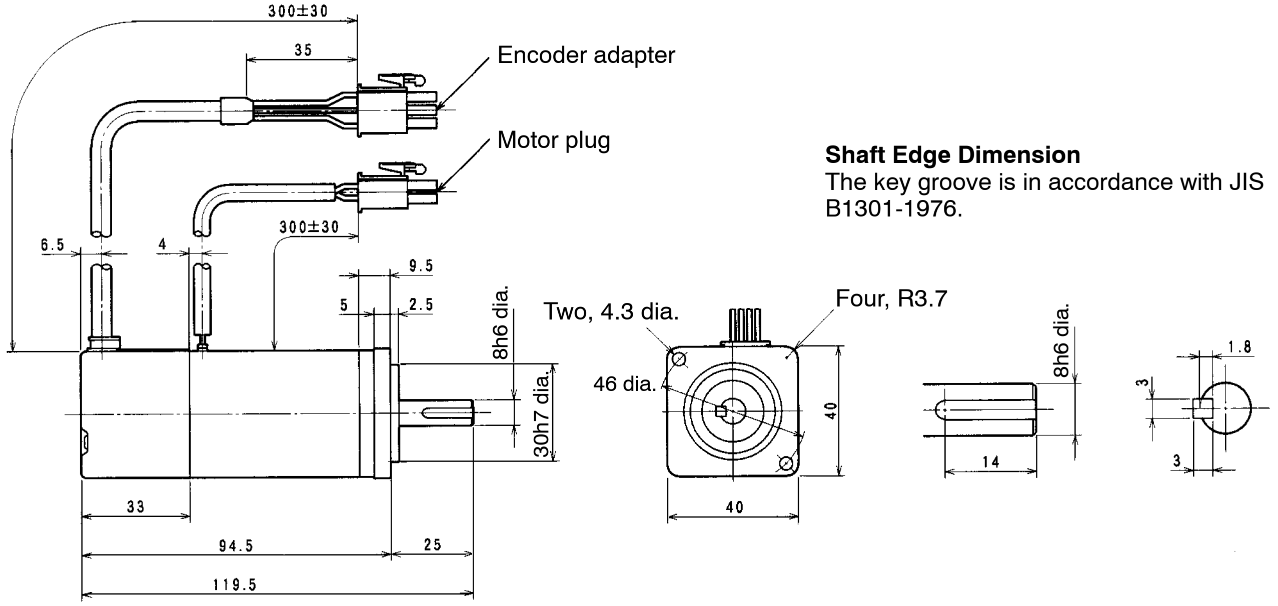


● R88A-PR03U



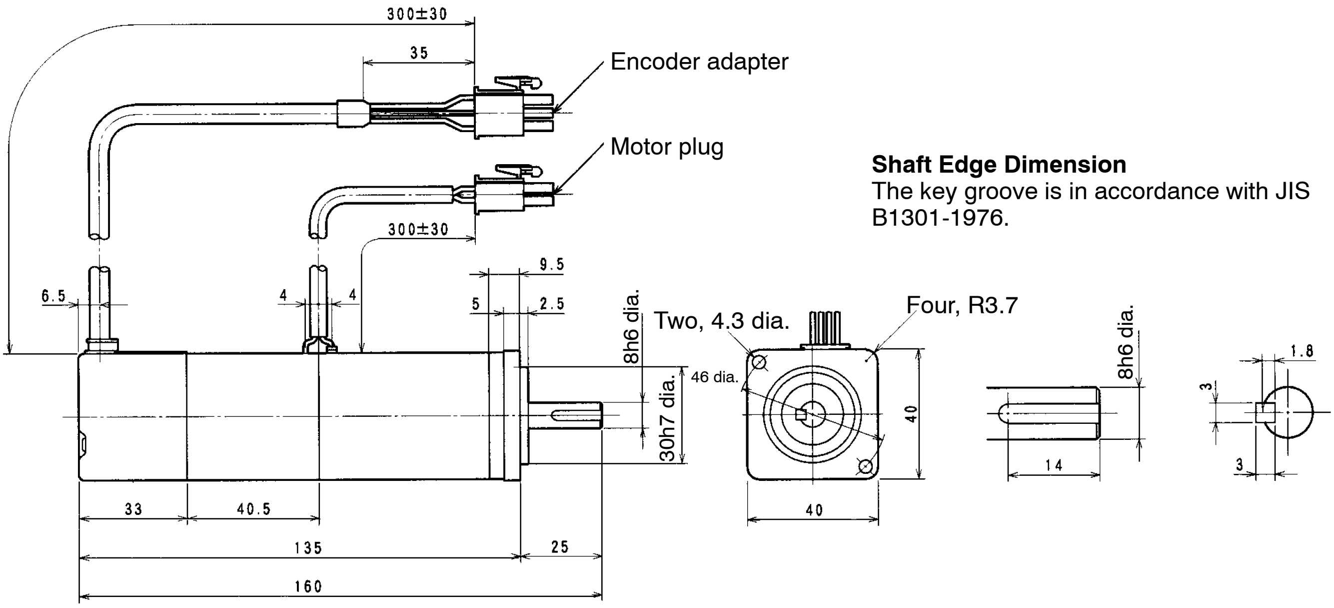
■ AC Servomotors, Non-conforming Models

• 100-W Standard Models:1
R88M-UE10030H-S1
R88M-UE10030L-S1



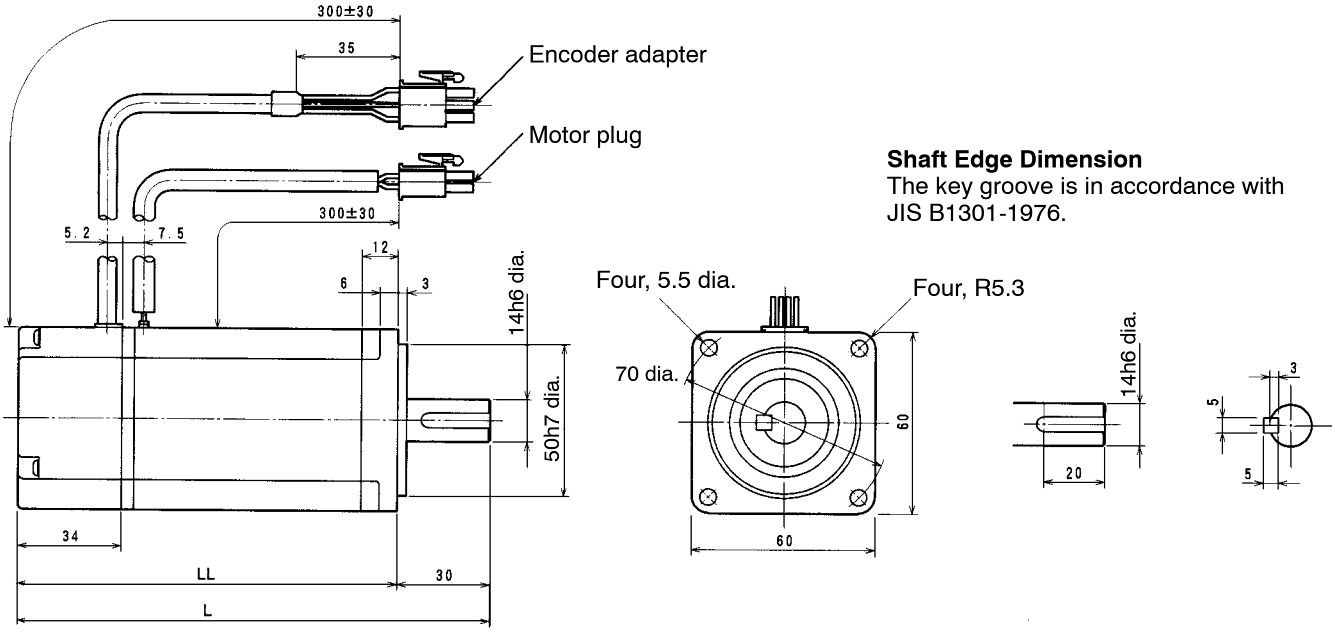
Shaft Edge Dimension
The key groove is in accordance with JIS B1301-1976.

• 100-W Models with Brake:
R88M-UE10030H-BS1
R88M-UE10030L-BS1

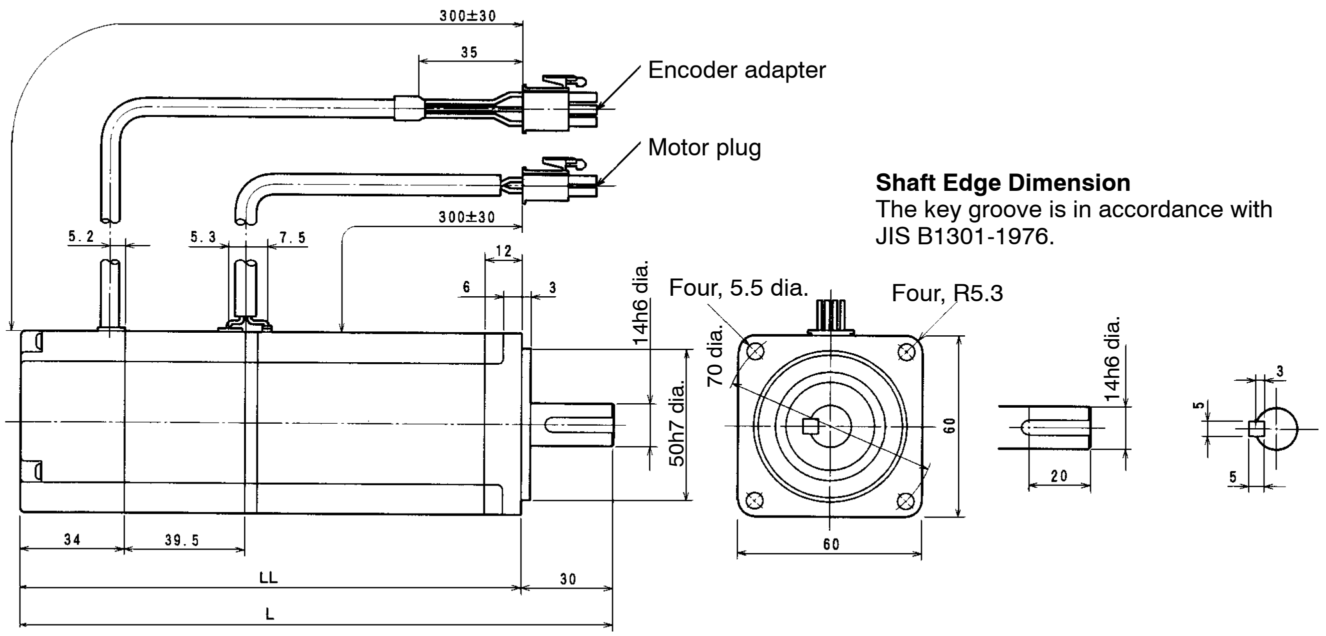


Shaft Edge Dimension
The key groove is in accordance with JIS B1301-1976.

- **200-W/300-W/400-W Standard Models: R88M-UE20030H-S1, R88M-UE40030H-S1, R88M-UE20030L-S1, R88M-UE30030L-S1**



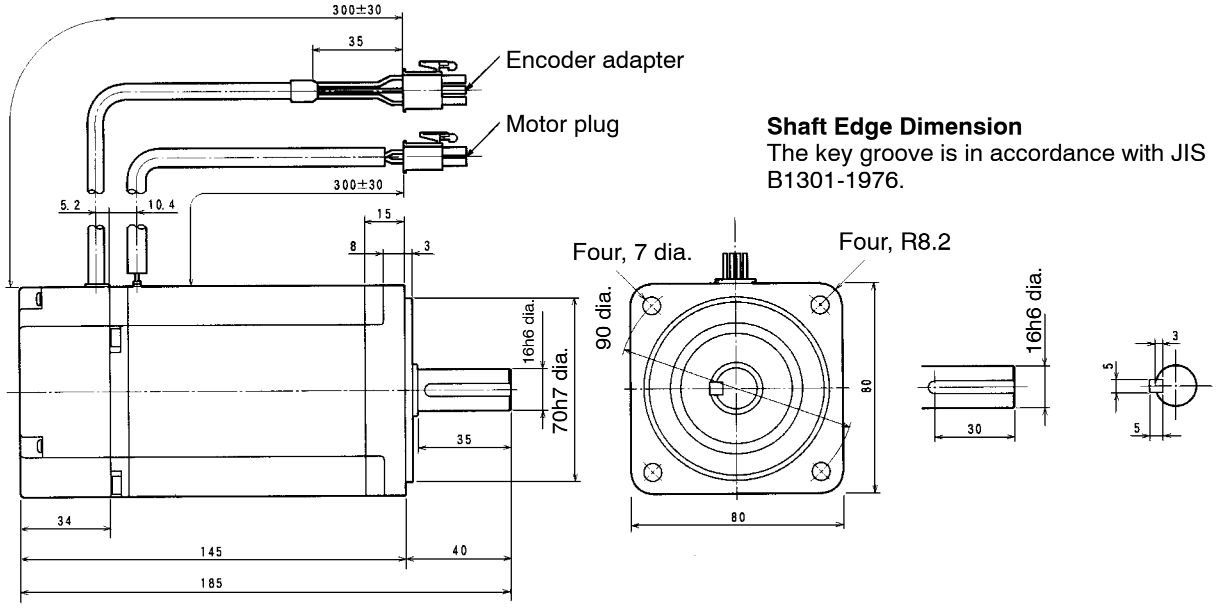
- **200-W/300-W/400-W Models with Brake: R88M-UE20030H-BS1, R88M-UE40030H-BS1, R88M-UE20030L-BS1, R88M-UE30030L-BS1**



Standard Models		
Model	**L**	**LL**
R88M-UE20030H-S1 R88M-UE20030L-S1	126.5	96.5
R88M-UE40030H-S1	154.5	124.5
R88M-UE30030L-S1		

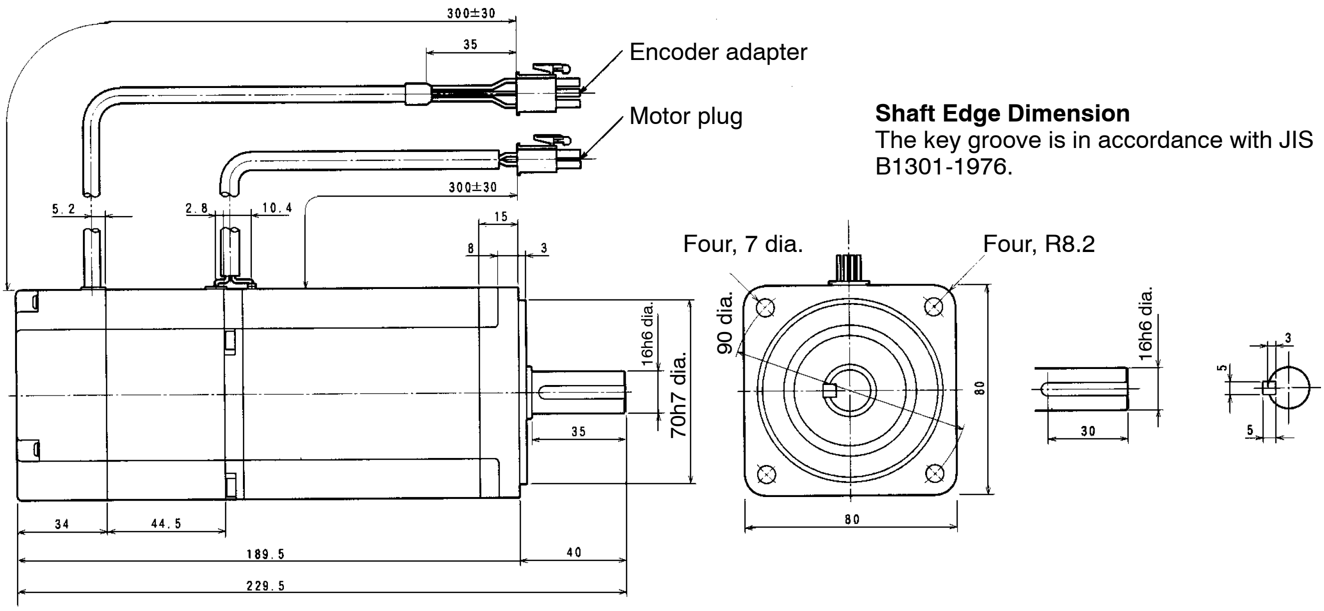
Models with Brake		
Model	**L**	**LL**
R88M-UE20030H-BS1 R88M-UE20030L-BS1	166	136
R88M-UE40030H-BS1	194	164
R88M-UE30030L-BS1		

- **750-W Standard Models: R88M-UE75030H-S1**



Shaft Edge Dimension
The key groove is in accordance with JIS B1301-1976.

- **750-W Models with Brake: R88M-UE75030H-BS1**

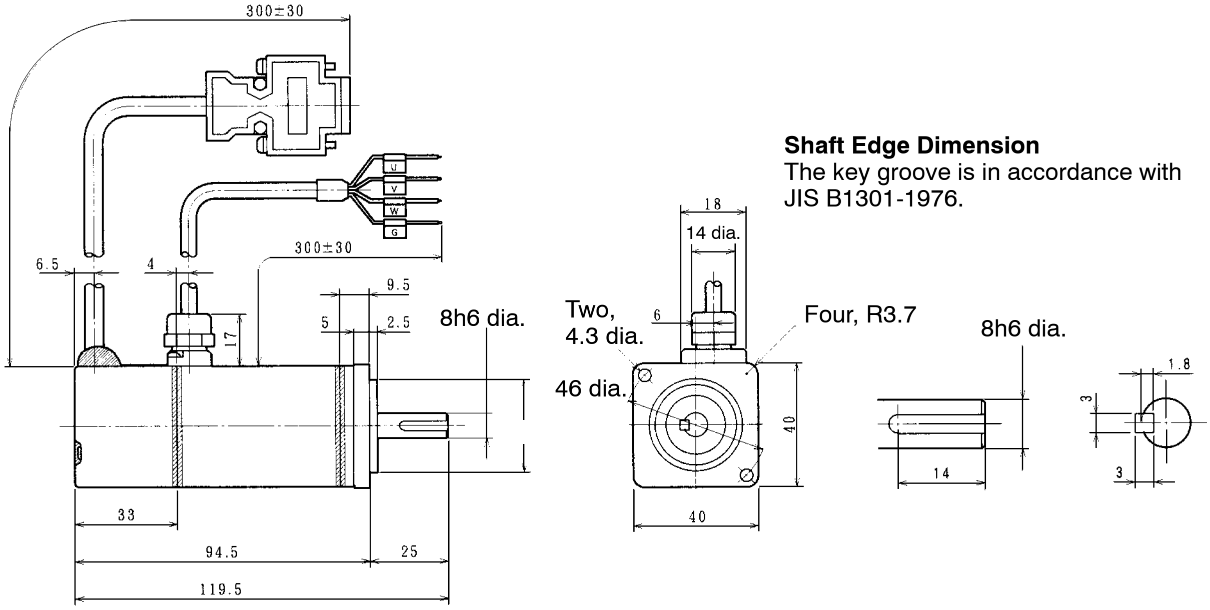


Shaft Edge Dimension
The key groove is in accordance with JIS B1301-1976.

■ AC Servomotors Conforming to EC Directives

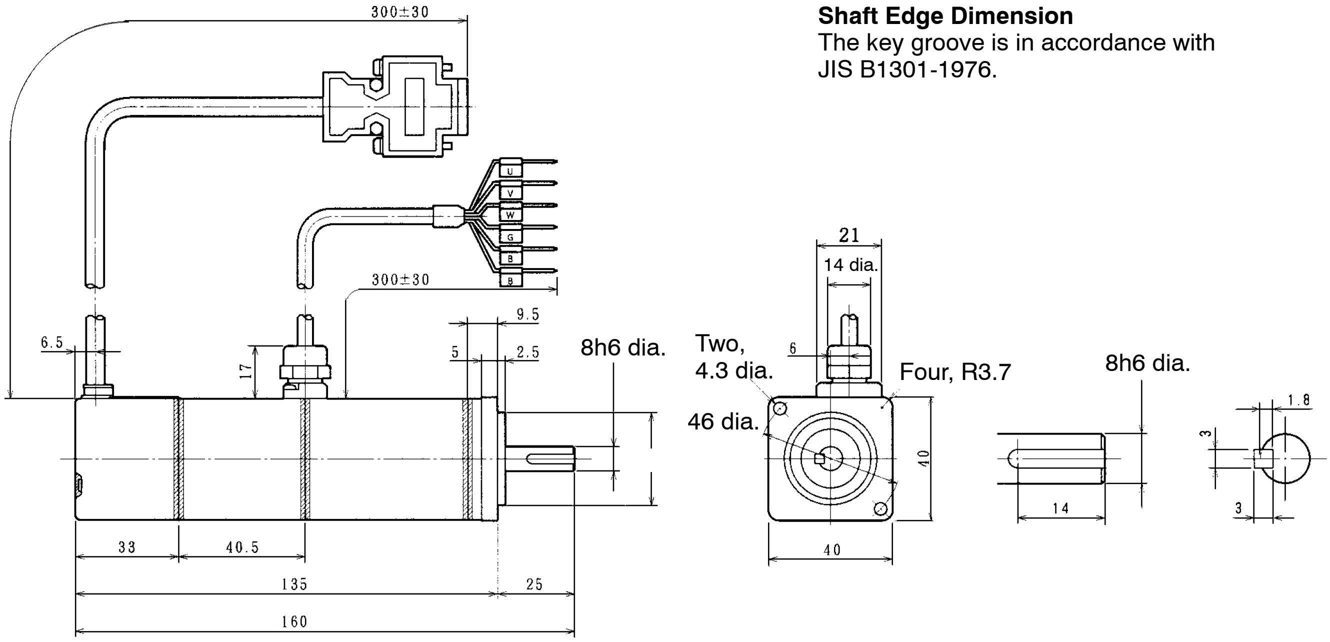
• 100-W Standard Models: R88M-UE10030V-S1, R88M-UE10030W-S1

Shaft Edge Dimension
The key groove is in accordance with JIS B1301-1976.

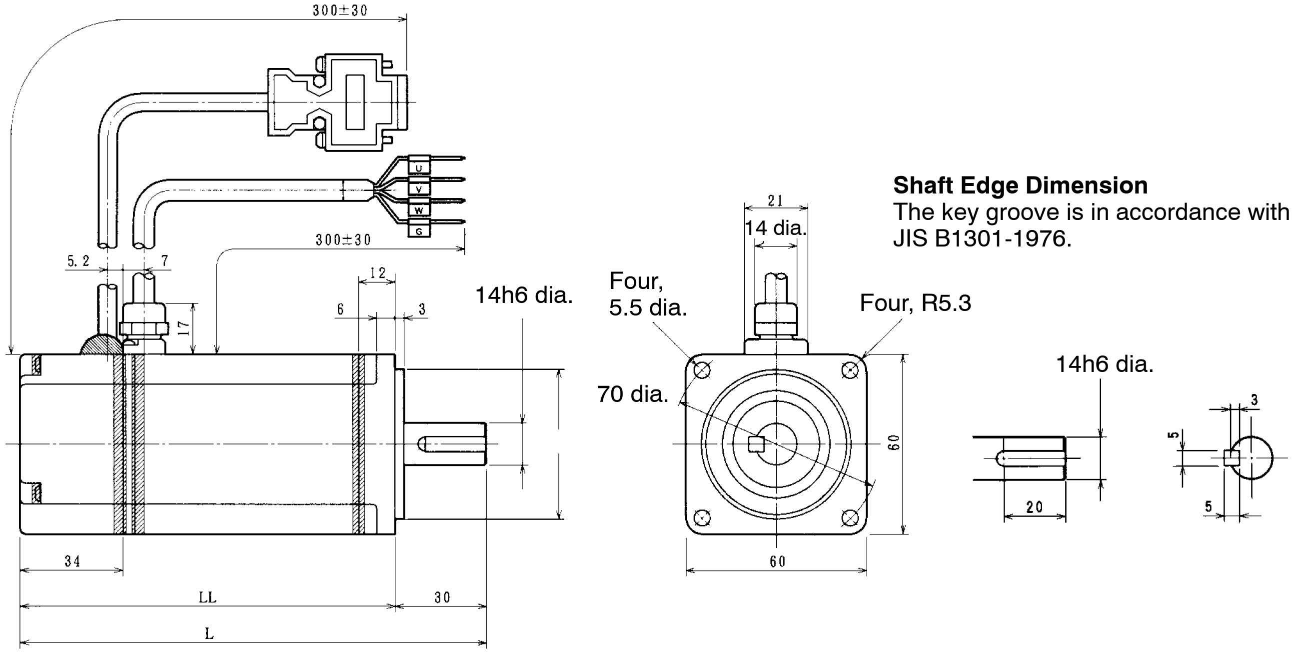


• 100-W Models with Brake: R88M-UE10030V-BS1, R88M-UE10030W-BS1

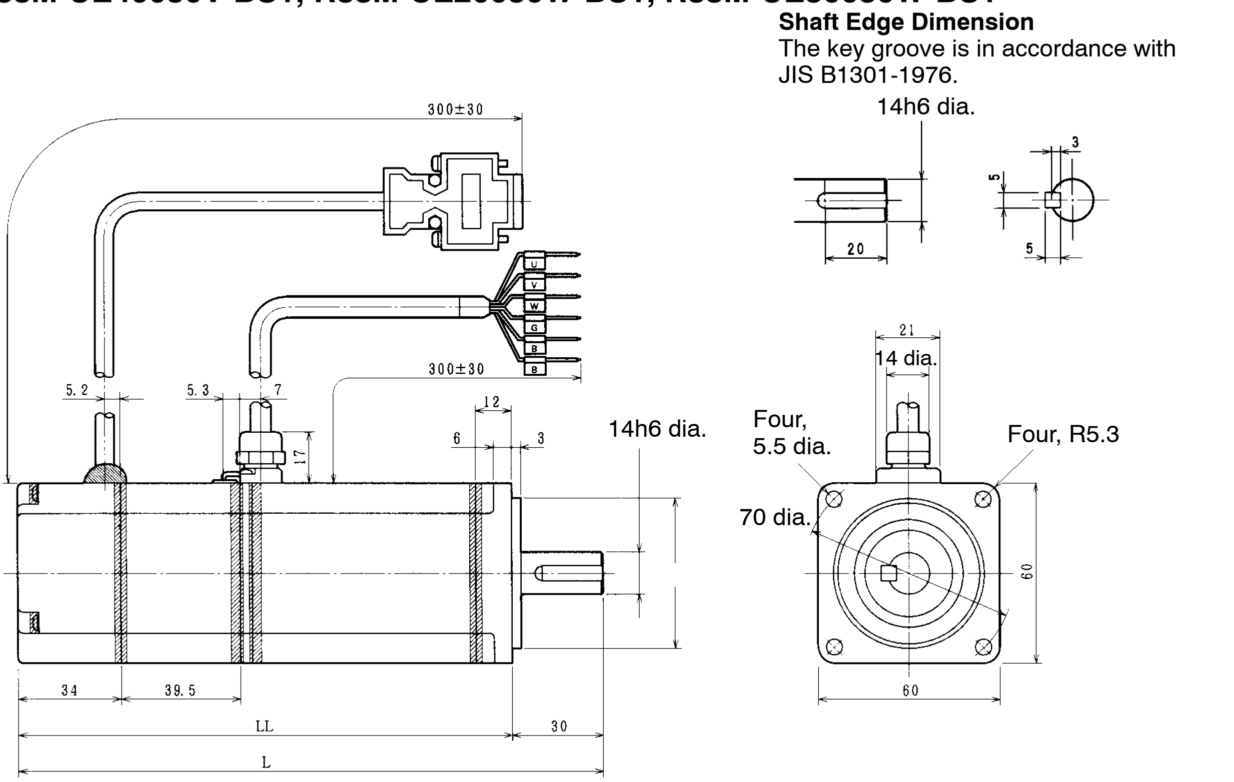
Shaft Edge Dimension
The key groove is in accordance with JIS B1301-1976.



- **200-W/300-W/400-W Standard Models: R88M-UE20030V-S1, R88M-UE40030V-S1 R88M-UE20030W-S1, R88M-UE30030W-S1**



- **200-W/300-W/400-W Models with Brake: R88M-UE20030V-BS1, R88M-UE40030V-BS1, R88M-UE20030W-BS1, R88M-UE30030W-BS1**

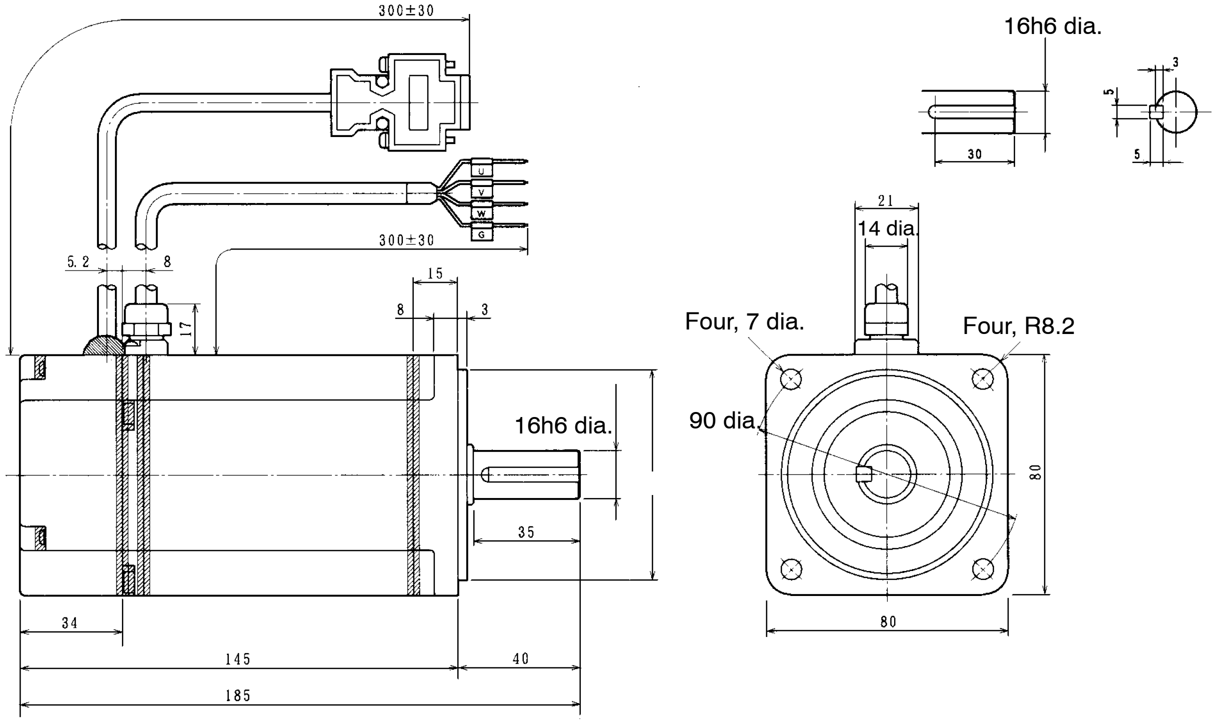


Standard Models	Standard Models	
Model	**L**	**LL**
R88M-UE20030V-S1 R88M-UE20030W-S1	126.5	96.5
R88M-UE40030V-S1 R88M-UE30030-W-S1	154.5	124.5

Models with Brake		
Model	**L**	**LL**
R88M-UE20030V-BS1 R88M-UE20030W-BS1	166	136
R88M-UE40030V-BS1 R88M-UE30030W-BS1	194	164

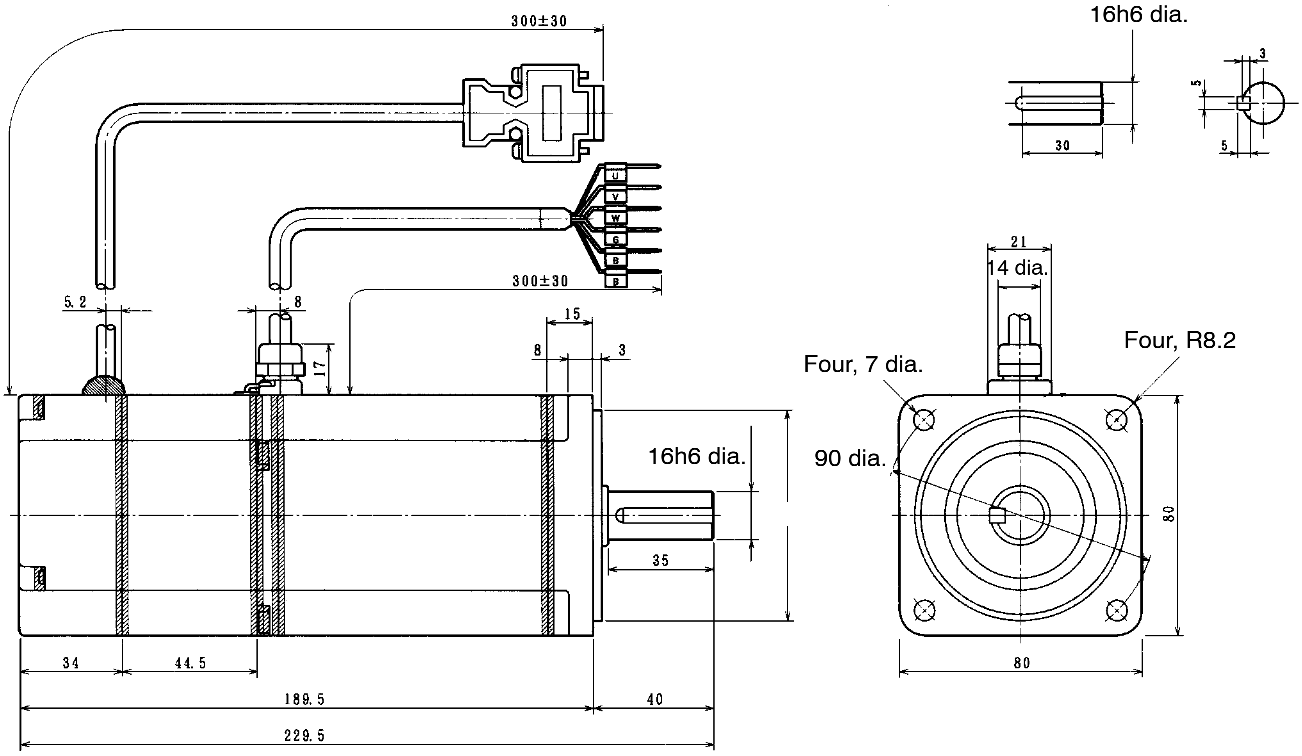
- **750-W Standard Models: R88M-UE75030V-S1**

Shaft Edge Dimension
The key groove is in accordance with JIS B1301-1976.



- **750-W Models with Brake: R88M-UE75030V-BS1**

Shaft Edge Dimension
The key groove is in accordance with JIS B1301-1976.

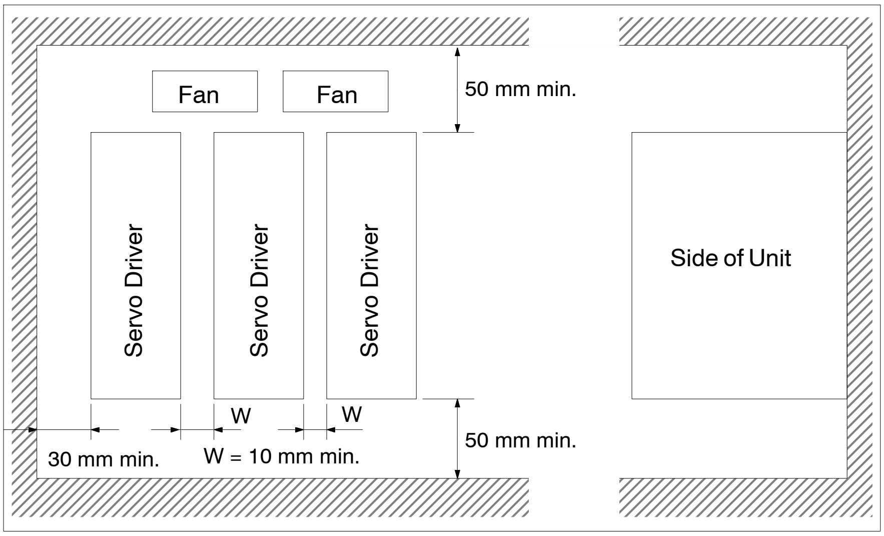


2-1-2 Installation Conditions

■ AC Servo Drivers

• Space Around Drivers

- Install Servo Drivers according to the dimensions shown in the following illustration to ensure proper heat dispersion and convection inside the panel. Also install a fan for circulation if Servo Drivers are installed side by side to prevent uneven temperatures from developing inside the panel.
- Mount the Servo Drivers vertically (so that the model number and writing can be read).



• Operating Environment

Be sure that the environment in which Servo Drivers are operated meets the following conditions.

- Ambient operating temperature: 0°C to +50°C
- Ambient operating humidity: 35% to 85% (RH, with no condensation)
- Atmosphere: No corrosive gases.

• Ambient Temperature

- Servo Drivers should be operated in environments in which there is minimal temperature rise to maintain a high level of reliability.
- Temperature rise in any Unit installed in a closed space, such as a control box, will cause the ambient temperature to rise inside the entire closed space. Use a fan or a air conditioner to prevent the ambient temperature of the Servo Driver from exceeding 50°C.
- Unit surface temperatures may rise to as much as 30°C above the ambient temperature. Use heat-resistant materials for wiring, and keep separate any devices or wiring that are sensitive to heat.
- The service life of a Servo Driver is largely determined by the temperature around the internal electrolytic capacitors. The service life of an electrolytic capacitor is affected by a drop in electrolytic volume and an increase in internal resistance, which can result in overvoltage alarms, malfunctioning due to noise, and damage to individual elements. If a Servo Driver is always operated at the maximum ambient temperature of 50°C, then a service life of approximately 50,000 hours can be expected. A drop of 10°C in the ambient temperature will double the expected service life.

• Keeping Foreign Objects Out of Units

- Place a cover over the Units or take other preventative measures to prevent foreign objects, such as drill filings, from getting into the Units during installation. Be sure to remove the cover after installation is complete. If the cover is left on during operation, heat buildup may damage the Units.
- Take measures during installation and operation to prevent foreign objects such as metal particles, oil, machining oil, dust, or water from getting inside of Servo Drivers.

■ AC Servomotors

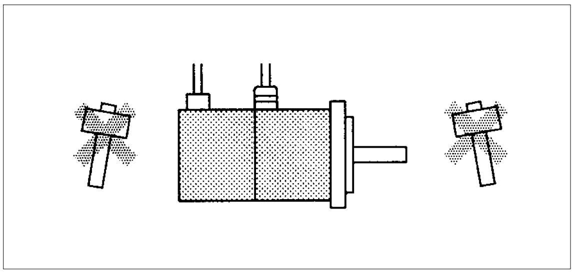
• Operating Environment

Be sure that the environment in which the Servomotor is operated meets the following conditions.

- Ambient operating temperature: 0°C to +40°C
- Ambient operating humidity: 20% to 80% (RH, with no condensation)
- Atmosphere: No corrosive gases.

• Impact and Load

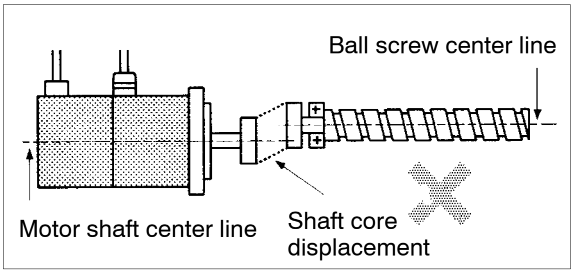
- The Servomotor is resistant to impacts of up to 10 G {98 m/s^2}. Do not subject it to heavy impacts or loads during transport, installation, or positioning. In addition, do not hold onto the encoder, cable, or connector areas when transporting it.
- Always use a pulley remover to remove pulleys, couplings, or other objects from the shaft.



- Secure cables so that there is no impact or load placed on the cable connector areas.

• Connecting to Mechanical Systems

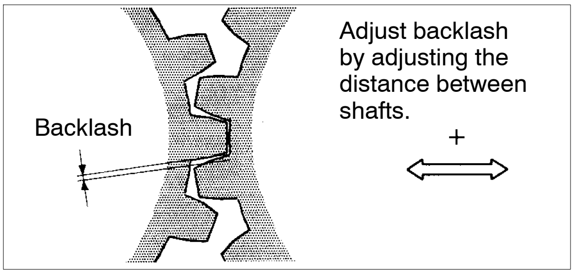
- The axial loads for Servomotors are specified in section 5-2-3. If an axial load greater than that specified is applied to a Servomotor, it will reduce the service life of the motor bearings and may damage the motor shaft. When connecting to a load, use couplings that can sufficiently absorb mechanical eccentricity and variation.



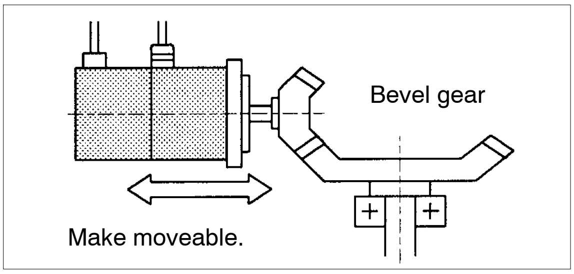
Recommended Coupling

Name	Maker
Oldham coupling	Myghty Co., Ltd

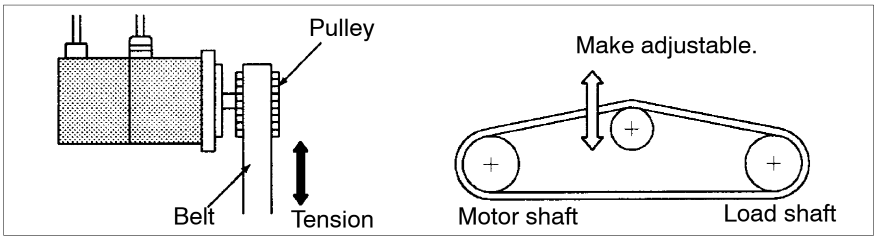
- For spur gears, an extremely large radial load may be applied depending on the gear precision. Use spur gears with a high degree of accuracy (for example, JIS class 2: normal line pitch error of 6 μm max. for a pitch circle diameter of 50 mm). If the gear precision is not adequate, allow backlash to ensure that no radial load is placed on the motor shaft.



- Bevel gears will cause a load to be applied in the thrust direction depending on the structural precision, the gear precision, and temperature changes. Provide appropriate backlash or take other measures to ensure that no thrust load is applied which exceeds specifications.



- Do not put rubber packing on the flange surface. If the flange is mounted with rubber packing, the motor flange may separate due to the tightening strength.
- When connecting to a V-belt or timing belt, consult the maker for belt selection and tension. A radial load twice the belt tension will be placed on the motor shaft. Do not allow a radial load exceeding specifications to be placed on the motor shaft due to belt tension. If an excessive radial load is applied, the motor shaft may be damaged. Set up the structure so that the radial load can be adjusted. A large radial load may also be applied as a result of belt vibration. Attach a brace and adjust Servo Driver gain so that belt vibration is minimized.



• Water and Drip Resistance

- The Servomotor does not have a water-proof structure. Except for the connector areas, the protective structure is covered by the following JEM (The Japan Electrical Manufacturers' Association) standards.

Non-conforming Models:	IP-42
EC Directive Models:	IP-44 (except shaft penetration point)

- If the Servomotor is used in an environment in which condensation occurs, water may enter inside of the encoder from the end surfaces of cables due to motor temperature changes. Either take measures to ensure that water cannot penetrate in this way, or use water-proof connectors. Even when machinery is not in use, water penetration can be avoided by taking measures, such as keeping the motor in servo-lock status, to minimize temperature changes.
- If machining oil with surfactants (e.g., coolant fluids) or their spray penetrate inside of the motor, insulation defects or short-circuiting may occur. Take measures to prevent machining oil penetration.

• Other Precautions

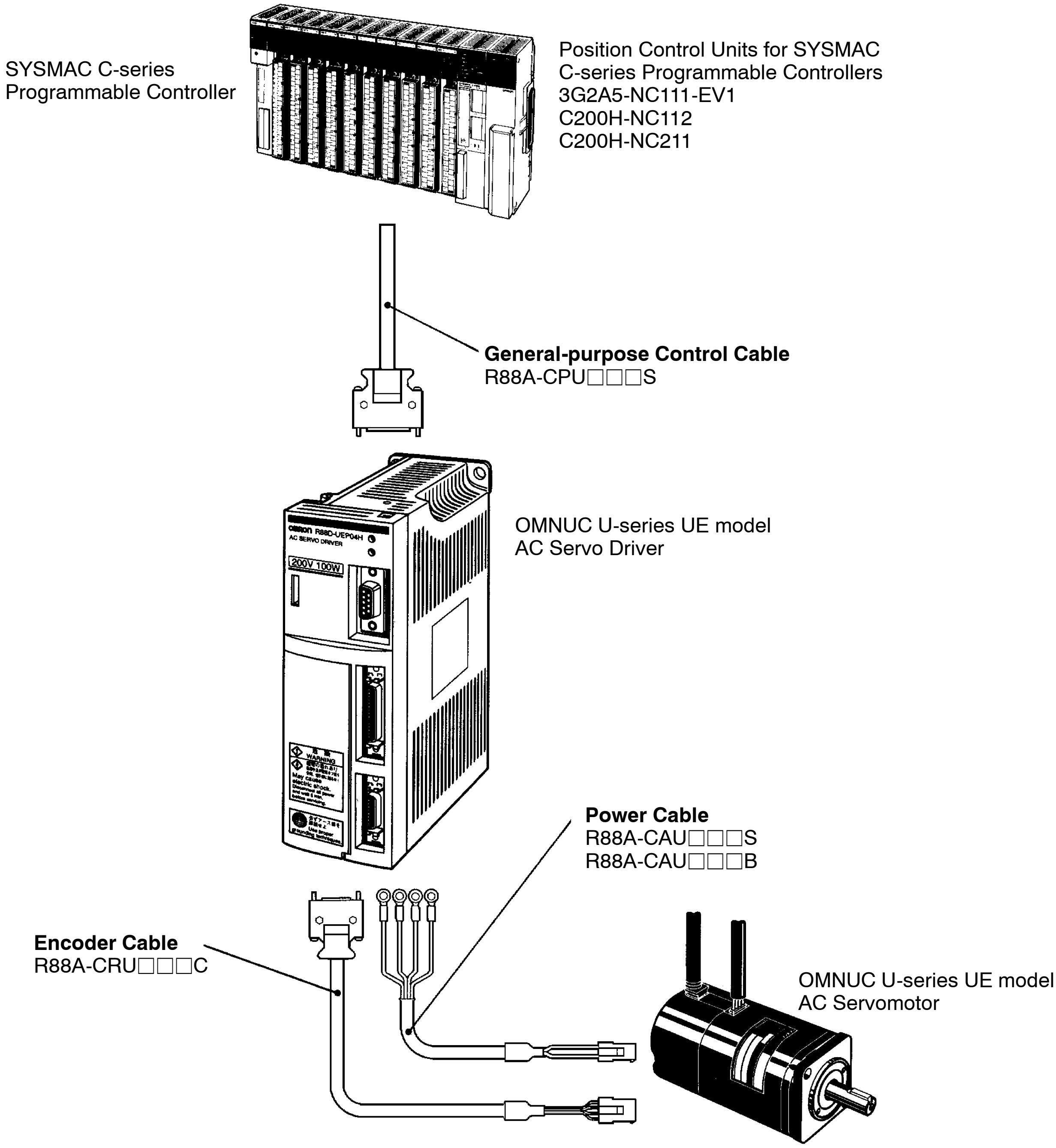
- Do not apply commercial power directly to the Servomotor. The Servomotors run on synchronous AC and use permanent magnets. Applying 3-phase power will burn out the motor coils.
- Do not carry or otherwise handle the Servomotor by its cable, otherwise the cable may become disconnected or the cable clamp may become damaged.
- Take measures to prevent the shaft from rusting. The shafts are coated with anti-rust oil when shipped, but anti-rust oil or grease should also be applied when connecting the shaft to a load.
- Absolutely do not remove the encoder cover or take the motor apart. The magnet and the encoder are aligned in the Servomotor. If they become misaligned, the motor will not operate.

2-2 Wiring Non-conforming Products

2-2-1 Connecting OMRON Servo Controllers

Use general-purpose control cables (purchased separately) to connect U-series UE model AC Servomotors and Servo Drivers to OMRON Servo Controllers.

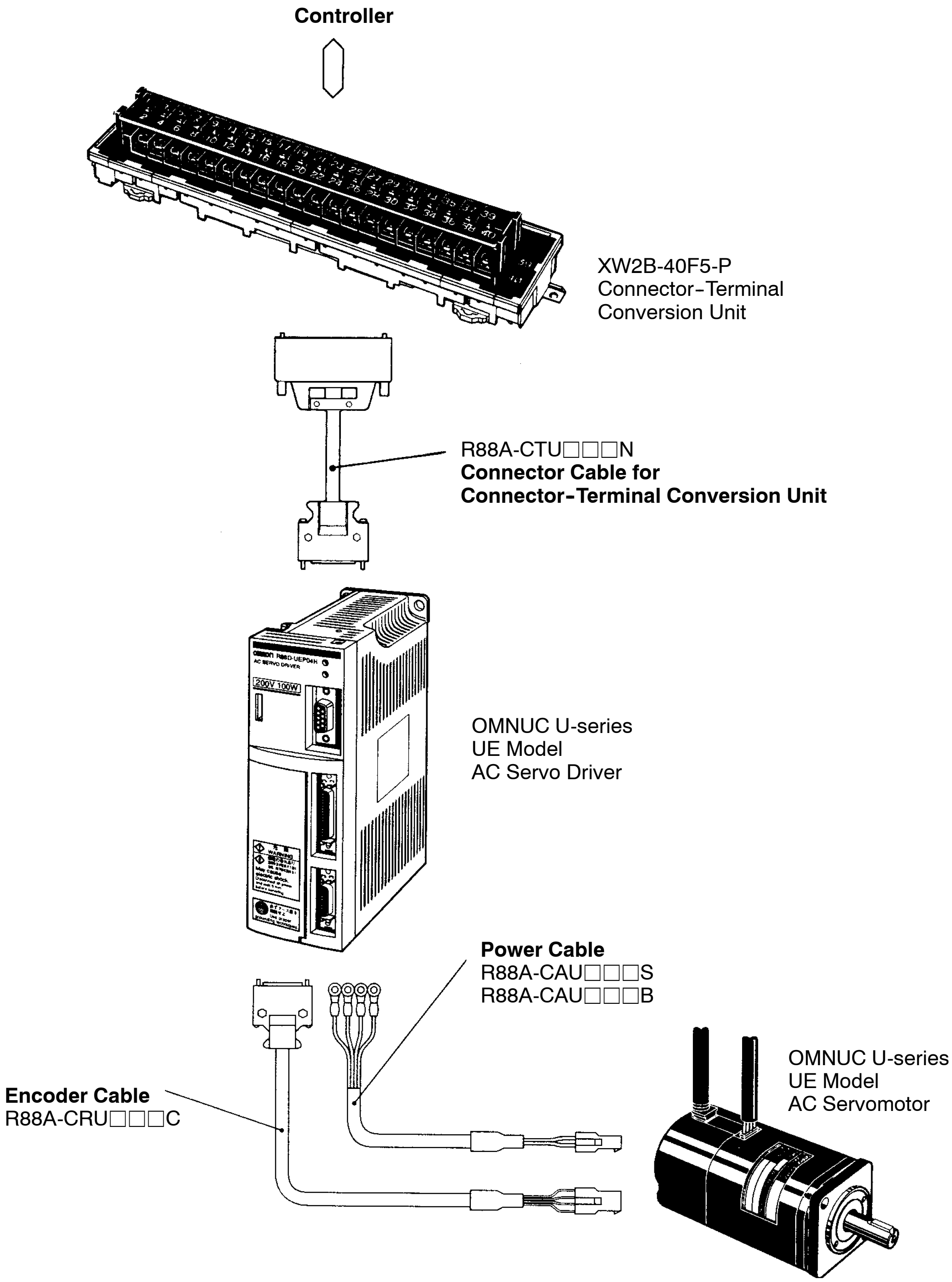
■ Connecting SYSMAC C-series Position Control Units



Note Refer to *Chapter* 5 *Specifications* for connector and cable specifications.

2-2-2 Connector–Terminal Conversion Unit

The AC Servo Driver can be easily connected to the Connector–Terminal Conversion Unit through a special cable without soldering.

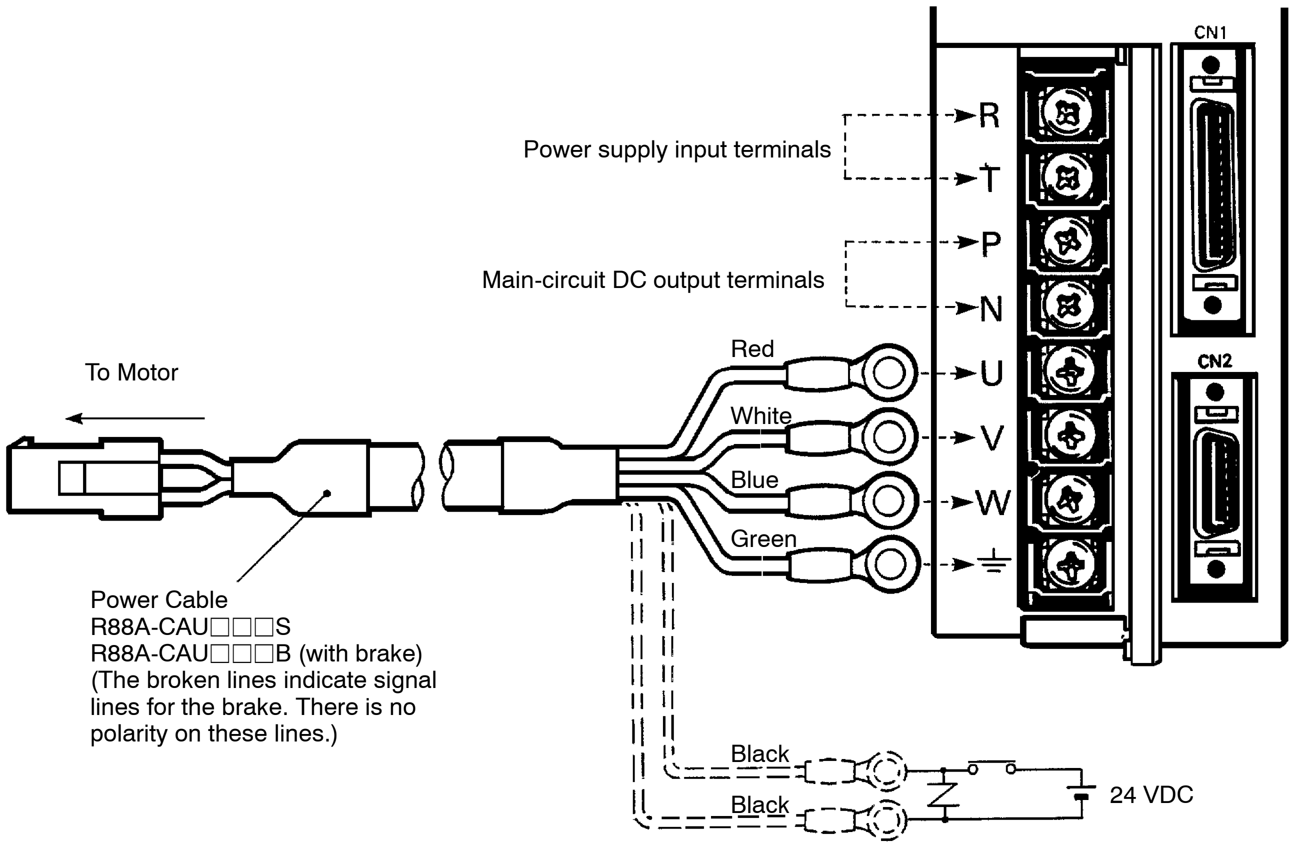


Note Refer to *Chapter* 5 *Specifications* for connector and cable specifications.

2-2-3 Wiring Servo Drivers

Provide proper wire diameters, ground systems, and noise resistance when wiring terminal blocks.

■ Wiring Terminal Blocks



Terminal label	Name	Function	
R	Power supply input	The commercial power supply input terminals for the main circuit and the control circuitry. The power supply voltage depends on the model being used. R88D-UEP□□H: Single-phase 200/230 VAC (170 to 253 V) 50/60 Hz R88D-UEP□□L: Single-phase 100/115 VAC (85 to 127 V) 50/60 Hz	
T			
P	Main circuit DC output	The terminals for connecting Regeneration Units (R88A-RG08UA). Connect these terminals when there is a high level of regenerative energy. (See note)	
N			
U	Motor connection terminals	Red	These are the output terminals to the Servomotor. Be careful to wire them correctly.
V		White	
W		Blue	
⏚	Frame ground	Green	The ground terminal for both the motor output and power supply input. Ground to a class-3 ground (to 100 Ω or less) or better.

Note Refer to *3-8 Regenerative Energy Absorption* for a method to calculate regeneration energy.

■ Terminal Block Current and Wire Sizes

The following table shows the rated effective currents flowing to the Servo Driver and the sizes of the electrical wires.

• Servo Drivers with 200-VAC Input (R88D-UEP□□H)

Driver (Watts)	R88D-UEP04H (100 W)	R88D-UEP08H (200 W)	R88D-UEP12H (400 W)	R88D-UEP20H (750 W)
Power supply input current (R, T)	2.5 A	4.0 A	6.0 A	11.0 A
Motor output current (U, V, W)	0.87 A	2.0 A	2.6 A	4.4 A
Power supply input terminal wire size	0.75 mm^2 or AWG 18 min.		1.25 mm^2	2.0 mm^2
Motor output terminal wire size	0.5 mm^2 or AWG 20	AWG 20 (see note) to AWG 18		
	Use OMRON standard cable. The applicable wire size for motor connectors is AWG22 to AWG18.			
Ground terminal wire size	Use 2.0-mm^2 external ground wires. Use the same wire as used for the motor output.			

Note If the cable length is 15 meters or longer for a 750-W Servomotor, the momentary maximum torque at rotation speeds of 2,500 r/min or higher may drop by approximately 7%.

• Servo Drivers with 100-VAC Input (R88D-UEP□□L)

Driver model (Watts)	R88D-UEP10L (100 W)	R88D-UEP12L (200 W)	R88D-UEP15L (300 W)
Power supply input current (R, T)	4.5 A	8.0 A	10.0 A
Motor output current (U, V, W)	2.2 A	2.7 A	3.7 A
Power supply input terminal wire size	0.75 mm^2 or AWG 18 min.	1.25 mm^2	2 mm^2
Motor output terminal wire size	AWG 20 to AWG 18		
	Use OMRON standard cable. The applicable wire size for motor connectors is AWG22 to AWG18.		
Ground terminal wire size	Use 2.0-mm^2 external ground wires. Use the same wire as used for the motor output.		

■ Wire Sizes and Allowable Current

The following table shows allowable currents when there are three electrical wires. Use values equal to or lower than the specified values.

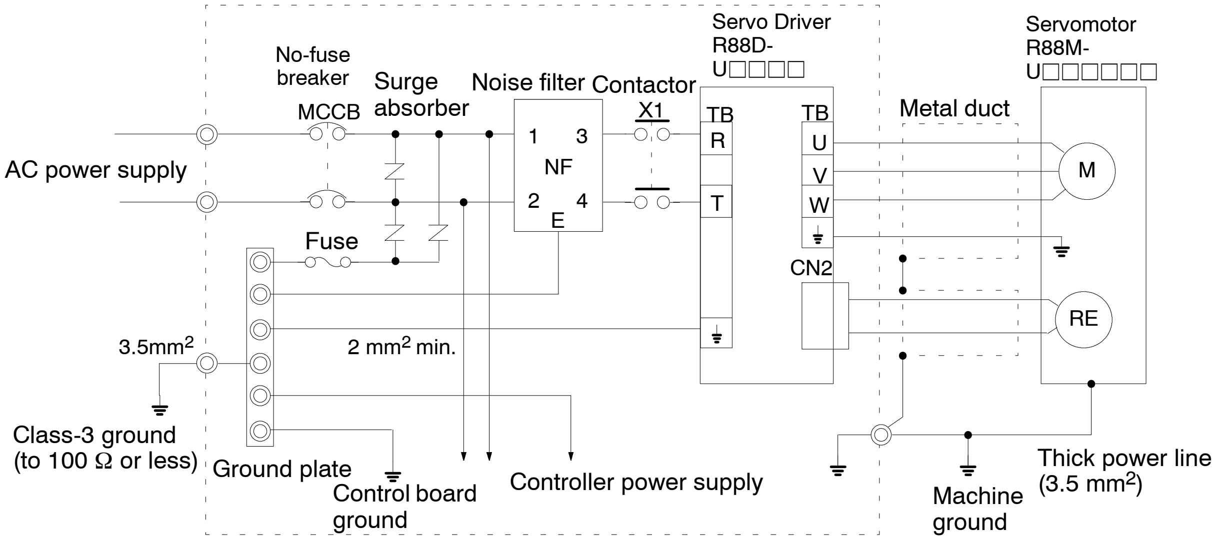
• Heat-resistant Vinyl Wiring, UL1007, Rated Temperature 80°C (Reference Value)

AWG size	Nominal cross-sectional area (mm^2)	Configuration (wires/mm^2)	Conductive resistance (Ω/km)	Allowable current (A) for ambient temperature		
				40°C	50°C	60°C
20	0.5	19/0.18	39.5	6.6	5.6	4.5
---	0.75	30/0.18	26.0	8.8	7.0	5.5
18	0.9	37/0.18	24.4	9.0	7.7	6.0
16	1.25	50/0.18	15.6	12.0	11.0	8.5

2-2-4 Wiring for Noise Resistance

■ Wiring Method

Noise resistance will vary greatly depending on the wiring method used. Resistance to noise can be increased by paying attention to the items described below.



• Ground the motor's frame to the machine ground when the motor is on a movable shaft.

• Use a grounding plate for the frame ground for each Unit, as shown in the illustration, and ground to a single point.

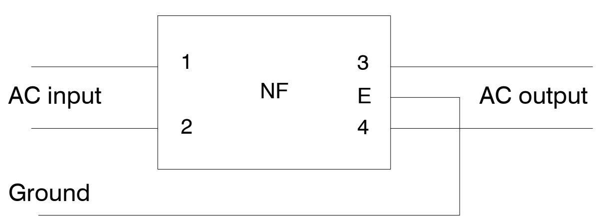
• Use ground lines with a minimum thickness of 3.5 mm^2, and arrange the wiring so that the ground lines are as short as possible.

• If no-fuse breakers (MCCB) are installed at the top and the power supply line is wired from the lower duct, use metal tubes for wiring and make sure that there is adequate distance between the input lines and the internal wiring. If input and output lines are wired together, noise resistance will decrease.

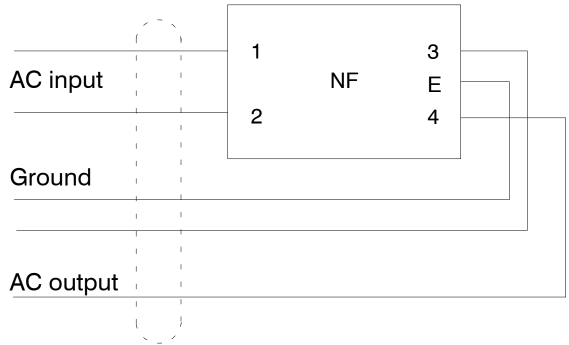
• No-fuse breakers (MCCB), surge absorbers, and noise filters (NF) should be positioned near the input terminal block (ground plate), and I/O lines should be isolated and wired using the shortest means possible.

• Wire the noise filter as shown at the left in the following illustration. The noise filter should be installed at the entrance to the control panel whenever possible.

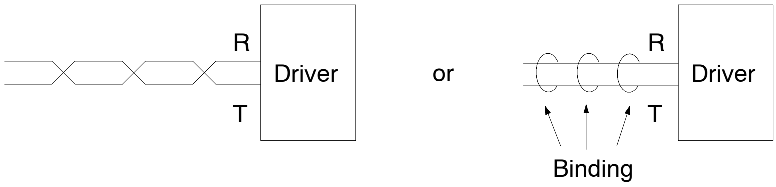
Good: Separate input and output



NO: Noise not filtered effectively



• Use twisted-pair cables for the power supply cables whenever possible, or bind the cables.



• Separate power supply cables and signal cables when wiring.

■ Selecting Components

This section describes the standards used to select components required to increase noise resistance. Select these components based on their capacities, performances, and applicable ranges.

Recommended components have been listed; refer to the manufacturer of each component for details.

• No-fuse Breakers (MCCB)

When selecting no-fuse breakers, take into consideration the maximum input current and the inrush current. The momentary maximum output for a servo system is approximately three times that of the rated output, and a maximum output of three seconds can be executed. Therefore, select no-fuse breakers with an operating time of at least five seconds at 300% of the rated maximum output. General-purpose and low-speed no-fuse breakers are generally suitable. Refer to the table in *2-2-3 Terminal Block Wiring* for the power supply input currents for each motor, and then add the current consumption for the number of shafts, other controllers, etc., to make the selection.

The Servo Driver inrush current flows at a maximum of 50 A for 20 ms when 200 V is input. With low-speed no-fuse breakers, a inrush current 7 to 8 times the rated current flows for 0.1 second. When making the selection, take into consideration the entire inrush current for the system.

• Surge Absorbers

Use surge absorbers to absorb surges from power supply input lines due to lightning, abnormal voltages, etc. When selecting surge absorbers, take into account the varistor voltage, the amount of surge immunity, and the amount of energy resistance. For 200-VAC systems, use a varistor voltage of 470 V. The surge absorbers shown in the following table are recommended.

Maker	Model	Varistor voltage	Max. limit voltage	Surge immunity	Energy resistance	Fuse capacity	Type
Matsushita Electric Parts	ERZC10DK471(W)	470 V	775 V	1,250 A	45 J	3 to 5 A	Disk
	ERZC14DK471(W)	470 V	775 V	2,500 A	80 J	3 to 10 A	
	ERZC20DK471(W)	470 V	775 V	4,000 A	150 J	5 to 15 A	
	ERZC20EK471(W)	470 V	775 V	5,000A	150 J	---	Block
Ishizuka Electronics Co.	Z10L471	470 V	773 V	1,000A	15 W•s	3 to 5 A	Disk
	Z15L471	470 V	738 V	1,250 A	20 W•s	3 to 5 A	
	Z21L471	470 V	733 V	3,000 A	30 W•s	5 to 10 A	
	Z25M471S	470 V	810 V	10,000 A	235 J	---	Block
Okaya Electric Ind.	R·A·V -781BWZ-2A	---	783 V	1,000 A	---	---	Block
	R·A·V -781BXZ-2A	---	783 V	1,000 A	---	---	
	R·A·V -401·621BYR-2	---	620 V	1,000 A	---	---	

Note 1. The (W) Matsushita models are UL and CSA certified.

Note 2. Refer to manufacturers documentation for operating details.

Note 3. The surge immunity is for a standard impulse current of 8/20 μs. If pulses are wide, either decrease the current or change to a larger-capacity surge absorber.

Note 4. The energy resistance is the value for 2 ms. It may not be possible to retard high-energy pulses at less than 700 V. In that case, absorb surges with an insulated transformer or reactor.

• Noise Filters for Power Supply Input

Use a noise filter to attenuate extraneous noise and to diminish noise radiation from the Servo Driver. Select a noise filter with a load current of at least twice the rated current. The following table shows noise filters that reduce by 40 dB noise between 200 kHz and 30 MHz.

Maker	Model	Rated current	Remarks
Tokin	LF-210N	10 A	For single-phase
	LF-215N	15 A	
	LF-220N	20 A	

To attenuate noise at frequencies of 200 kH or less, use an insulated transformer and a noise filter. For high frequencies of 30 MHz or more, use a ferrite core and a high-frequency noise filter with a through-type capacitor.

• Noise Filters for Motor Output

Use noise filters without built-in capacitors on the Servomotor output lines. Output lines cannot use the same noise filters as the power supply. General-purpose noise filters are made for a power supply frequency of 50/60 Hz; if they are connected to an output of 7.8 to 11 kHz (the Servo Driver PWM frequency), an extremely large leakage current (approx. 100 times normal) will flow to the capacitor in the noise filter. The following table shows the noise filters that are recommended for motor output.

Maker	Model	Rated current	Remarks
Tokin	LF-310KA	10 A	Three-phase block noise filter
	LF-320KA	20 A	
	ESD-R-47B	---	EMI core for radiation noise
Fuji Electrochemical Co.	RN80UD	---	10-turn for radiation noise

Note 1. The Servomotor output lines cannot use the same noise filters used for power supplies.

Note 2. Typical noise filters are used with power supply frequencies of 50/60 Hz. If these noise filters are connected to outputs of 7.8 to 11 KHz (the Servo Driver's PWM frequency), a very large (about 100 times larger) leakage current will flow through the noise filter's condenser and the Servo Driver could be damaged.

• Surge Killers

Install surge killers for loads that have induction coils, such as relays, solenoids, brakes, clutches, etc. The following table shows types of surge killers and recommended products.

Type	Features	Recommended products
Diode	Diodes are relatively small devices such as relays used for loads when reset time is not an issue. The reset time is increased because the surge voltage is the lowest when power is cut off. Used for 24/48-VDC systems.	Use a fast-recovery diode with a short reverse recovery time. Fuji Electric Co., ERB44-06 or equivalent
Thyristor or Varistor	Thyristor and varistor are used for loads when induction coils are large, as in electromagnetic brakes, solenoids, etc., and when reset time is an issue. The surge voltage when power is cut off is approximately 1.5 times that of the varistor.	Select varistor voltage as follows: 24-VDC system varistor: 39 V 100-VDC system varistor: 200 V 100-VAC system varistor: 270 V 200-VAC system varistor: 470 V
Capacitor + resistor	Use capacitors and resistors for vibration absorption of surge when power is cut off. The reset time can be shortened by proper selection of the capacitor or resistor.	Okaya Electric Ind. CR-50500 0.5 μF-50 Ω CRE-50500 0.5 μF-50 Ω S2-A-0 0.2 μF-500 Ω

Note Thyristors and varistors are made by the following companies. Refer to manufacturers documentation for operating details. Thyristors: Ishizuka Electronics Co.
Varistors: Ishizuka Electronics Co., Matsushita Electric Parts

• Contactors

When selecting contactors, take into consideration the circuit's inrush current and the momentary maximum current. The Servo Driver inrush current is 50 A, and the momentary maximum current is approximately twice the rated current. The following table shows the recommended contactors.

Maker	Model	Rated current	Momentary maximum current	Coil voltage
OMRON	G6C-2BND	10 A	---	24 VDC
	LY2-D	10 A	---	24 VDC
	G7L-2A-BUBJ	25 A	---	24 VDC, 200 to 240 VAC
	J7AN-E3	15 A	120 A	24 VDC
	LC1-D093A60	11 A	200 A	24 VDC, 200/220 VAC, 200 to 240 VAC

• Leakage Breakers

Select leakage breakers designed for inverters. Since switching operations take place inside the Servo Driver, high-frequency current leaks from the armature of the Servomotor. With inverter leakage breakers, high-frequency current is not detected, preventing the breaker from operating due to leakage current. Another way to prevent leakage current from being detected is to install an insulating transformer.

When selecting leakage breakers, remember to also add the leakage current from devices other than the Servomotor, such as machines using a switching power supply, noise filters, inverters, and so on.

The following table shows the Servomotor leakage currents for each Servo Driver.

Driver	Leakage current (direct) (including high-frequency current)	Leakage current (resistor-capacitor, in commercial power supply frequency range)
R88D-UEP04H to -UEP08H	80 mA	3 mA
R88D-UEP12H	60 mA	4 mA
R88D-UEP20H	110 mA	5 mA

Note 1. Leakage current values shown above are for motor power lines of 10 m or less. The values will change depending on the length of power cables and the insulation.

Note 2. Leakage current values shown above are for normal temperatures and humidity. The values will change depending on the temperature and humidity.

Note 3. Leakage current for 100-VAC-input Servomotors is approximately half that of the values shown above.

■ Improving Encoder Cable Noise Resistance

Signals from the encoder are either A, B, or S phase. The frequency for A- or B-phase signals is 76.8 kHz max., while the transmission speed for S-phase signals is 307 kbps. Follow the wiring methods outlined below to improve encoder noise resistance.

- Be sure to use dedicated encoder cables.
- If lines are interrupted in the middle, be sure to connect them with connectors, making sure that the cable insulation is not peeled off for more than 50 mm. In addition, be sure to use shielded wire.
- Do not coil cables. If cables are long and are coiled, mutual induction and inductance will increase and will cause malfunctions. Be sure to use cables fully extended.
- When installing noise filters for encoder cables, use ferrite cores. The following table shows the recommended ferrite core models.

Maker	Name	Model
Tokin	EMI core	ESD-QR-25-1
TDK	Clamp filter	ZCAT2032-0930
		ZCAT3035-1330
		ZCAT2035-0930A

- Do not wire the encoder cable in the same duct as power cables and control cables for brakes, solenoids, clutches, and valves.

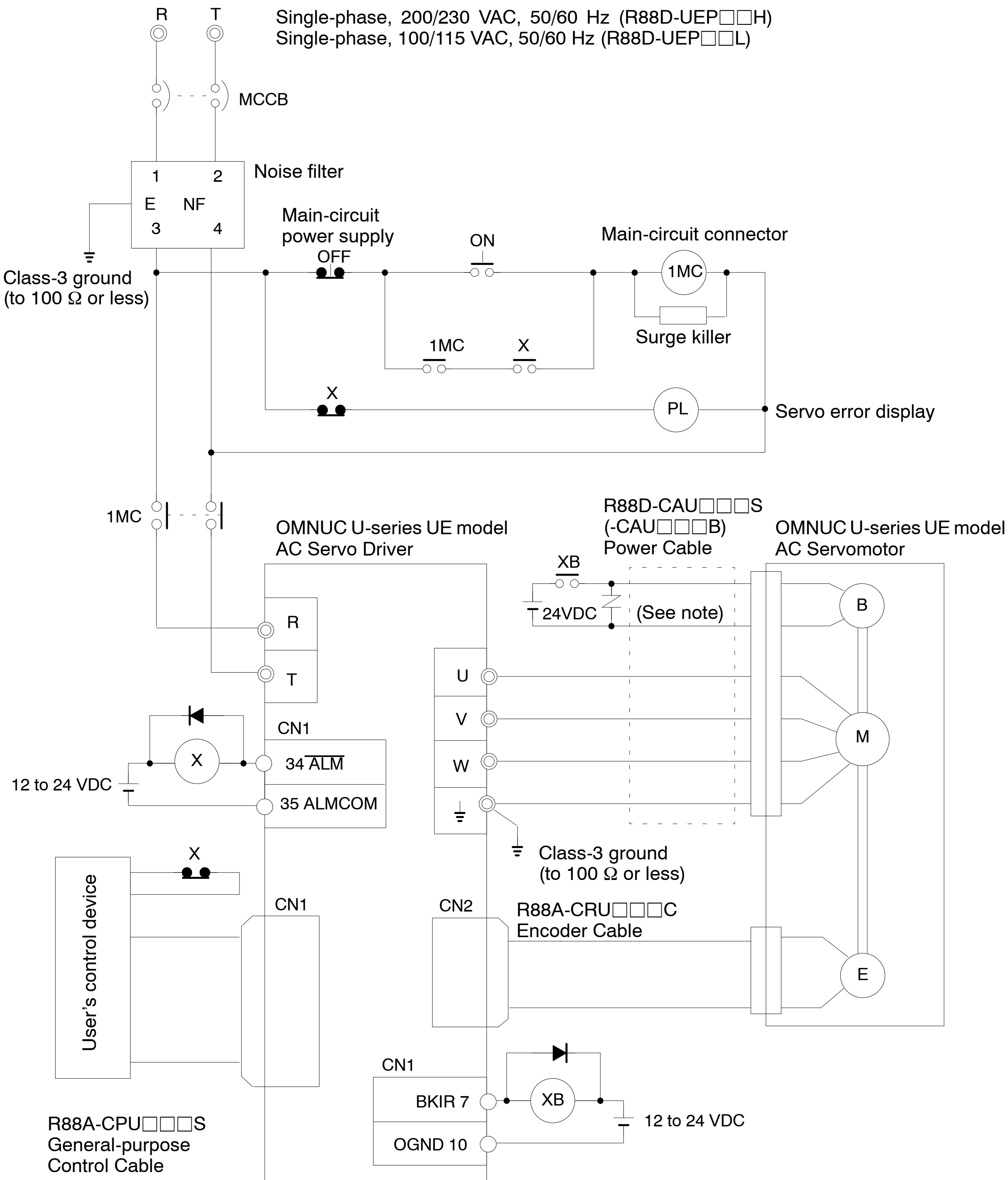
■ Improving Control I/O Signal Noise Resistance

Position can be affected if control I/O signals are influenced by noise. Follow the methods outlined below for the power supply and wiring.

- Use completely separate power supplies for the control power supply (especially 12 to 24 VDC) and the external operation power supply. In particular, be careful not to connect two power supply ground wires. Install a noise filter on the primary side of the control power supply.
- Use separate power supplies for control power and for power for the pulse command and deviation counter reset input lines. Do not connect the ground wires for these two power supplies to the same ground.
- We recommend line drivers for the pulse command and deviation counter reset outputs.
- For the pulse command and deviation counter reset input lines, be sure to use twisted-pair shielded cable, and connect both ends of the shield wire to ground.
- If the control power supply wiring is long, noise resistance can be improved by adding 1-μF laminated ceramic capacitors between the control power supply and ground at the Servo Driver input section and the controller output section.
- For encoder output (Z phase) lines, be sure to use twisted-pair shielded cable, and connect both ends of the shield wire to ground.
- Wiring must be 1 m or less when using open-collector outputs.

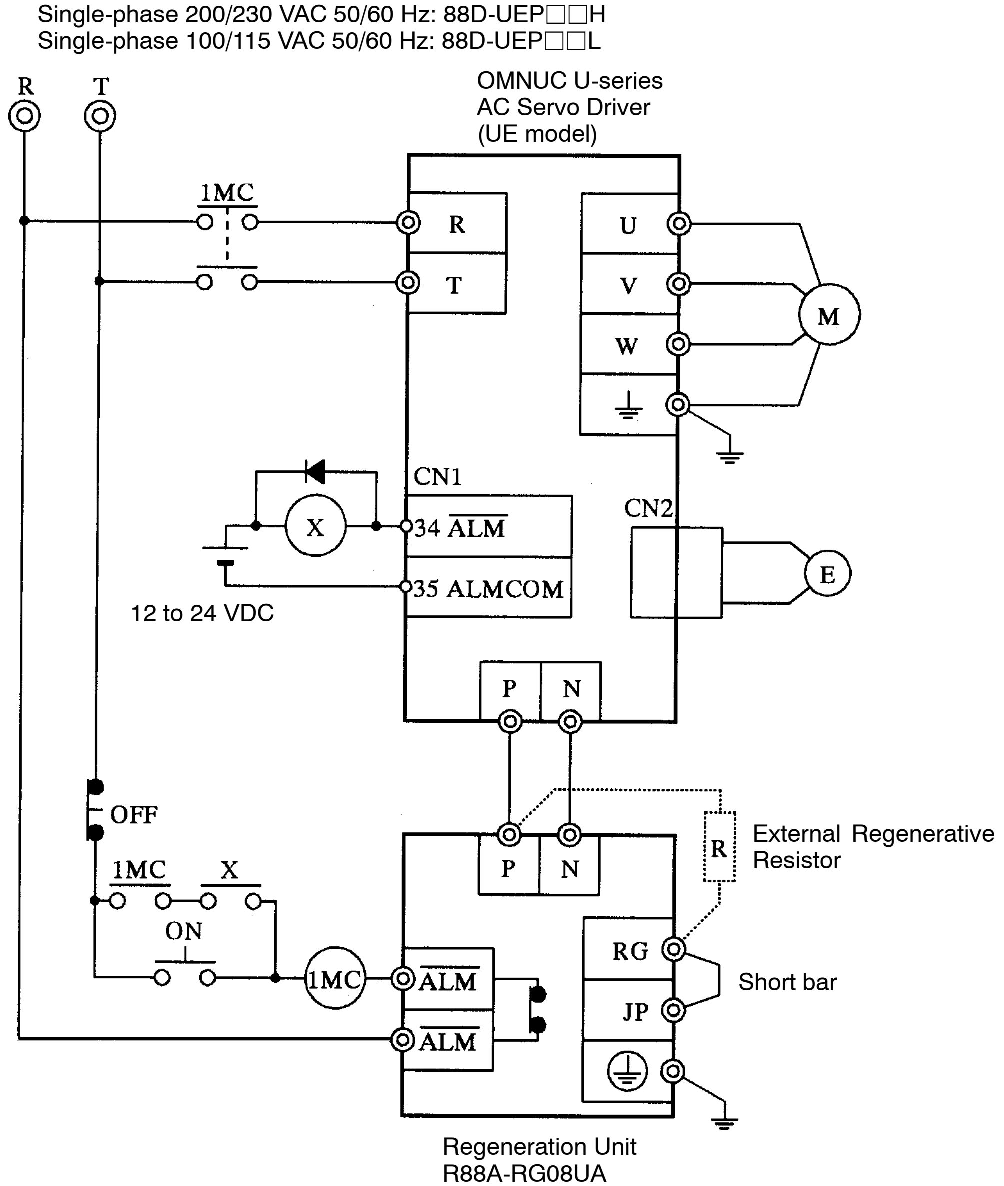
2-2-5 Peripheral Device Connection Examples

■ Connecting to Peripheral Devices



Note Use an independent power supply when using an electromagnetic brake.

■ Connecting a Regeneration Unit



Note 1. Disconnect the short bar from terminals RG and JP before connecting the External Regenerative Resistor.

Note 2. Connect the External Regenerative Resistor between terminals P and RG.

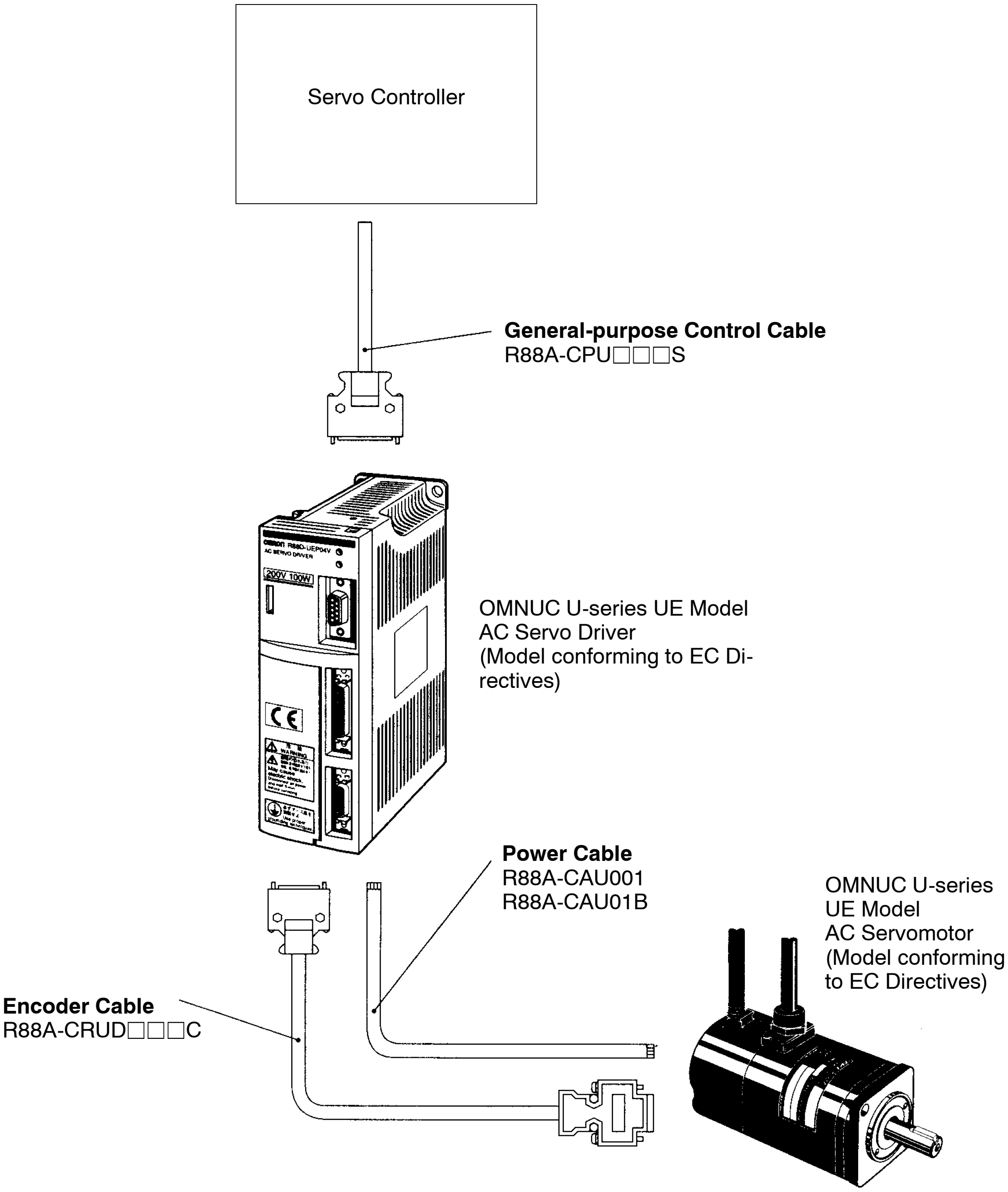
Note 3. The Regeneration Unit does not conform to EC Directives.

2-3 Wiring Products Conforming to EC Directives

2-3-1 Connecting Servo Controllers

Use general-purpose control cables (purchased separately) to connect U-series UE Model AC Servomotors and Servo Drivers to OMRON Servo Controllers.

■ Connecting to a Servo Controller

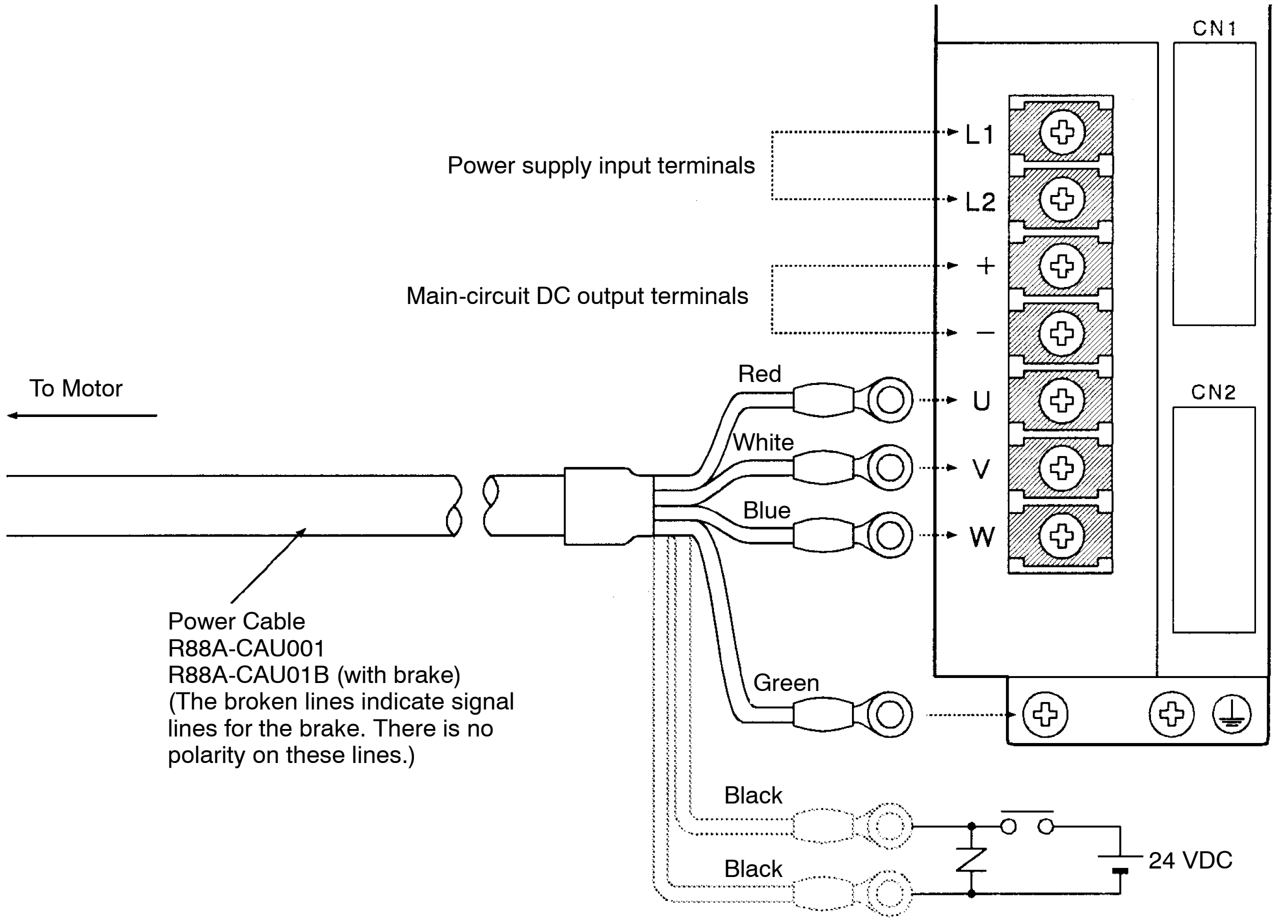


Note Refer to *Chapter* 5 *Specifications* for connector and cable specifications.

2-3-2 Wiring Servo Drivers

Provide proper wire diameters, ground systems, and noise resistance when wiring terminal blocks.

■ Wiring Terminal Blocks



Terminal label	Name	Function	
L1	Power supply input	The commercial power supply input terminals for the main circuit and the control circuitry.	
L2		R88D-UEP□□V: Single-phase 200/230 VAC (170 to 253 V) 50/60 Hz R88D-UEP□□W: Single-phase 100/115 VAC (85 to 127 V) 50/60 Hz	
+	Main circuit DC output	When there is a high level of regenerative energy in a multi-axis system, the + terminals can be connected together and the – terminals can be connected together to increase the ability to absorb regenerative energy	
–			
U	Motor connection terminals	Red	These are the output terminals to the Servomotor. Be careful to wire them correctly.
V		White	
W		Blue	
⏚	Frame ground	Green	Ground to a class-3 ground (to 100 Ω or less) or better.

Note Refer to 3-8 *Regenerative Energy Absorption* for the methods to calculate regenerative energy.

■ Terminal Block Wire Sizes

The following table shows the rated effective currents flowing to the Servo Driver and the sizes of the electrical wires.

• Servo Drivers with 200-VAC Input (R88D-UEP□□V)

Driver (Watts)	R88D-UEP04V (100 W)	R88D-UEP08V (200 W)	R88D-UEP12V (400 W)	R88D-UEP20V (750 W)
Power supply input current (L1, L2)	2.5 A	4.0 A	6.0 A	11.0 A
Motor output current (U, V, W)	0.87 A	2.0 A	2.6 A	4.4 A
Power supply input terminal wire size	0.75 mm² or AWG 18 min.		1.25 mm²	2.0 mm²
Motor output terminal wire size	0.5 mm² or AWG 20	AWG 20 (see note) to AWG 18		
	Use OMRON standard cable. The applicable wire size for motor connectors is AWG22 to AWG18.			
Protective earth terminal wire size	Use 2.0-mm² external ground wires. Use the same wire as used for the motor output.			

Note If the cable length is 15 meters or longer for a 750-W Servomotor, the momentary maximum torque at rotation speeds of 2,500 r/min or higher may drop by approximately 7%.

• Servo Drivers with 100-VAC Input (R88D-UEP□□W)

Driver model (Watts)	R88D-UEP10W (100 W)	R88D-UEP12W (200 W)	R88D-UEP15W (300 W)
Power supply input current (L1, L2)	4.5 A	8.0 A	10.0 A
Motor output current (U, V, W)	2.2 A	2.7 A	3.7 A
Power supply input terminal wire size	0.75 mm² or AWG 18 min.	1.25 mm²	2 mm²
Motor output terminal wire size	AWG 20 to AWG 18		
	Use OMRON standard cable. The applicable wire size for motor connectors is AWG22 to AWG18.		
Protective earth terminal wire size	Use 2.0-mm² external ground wires. Use the same wire as used for the motor output.		

■ Wire Sizes and Allowable Current

The following table shows allowable currents when there are three electrical wires. Use values equal to or lower than the specified values.

• Heat-resistant Vinyl Wiring, UL1007, Rated Temperature 80°C (Reference Value)

AWG size	Nominal cross-sectional area (mm²)	Configuration (wires/mm²)	Conductive resistance (Ω/km)	Allowable current (A) for ambient temperature		
				40°C	50°C	60°C
20	0.5	19/0.18	39.5	6.6	5.6	4.5
---	0.75	30/0.18	26.0	8.8	7.0	5.5
18	0.9	37/0.18	24.4	9.0	7.7	6.0
16	1.25	50/0.18	15.6	12.0	11.0	8.5

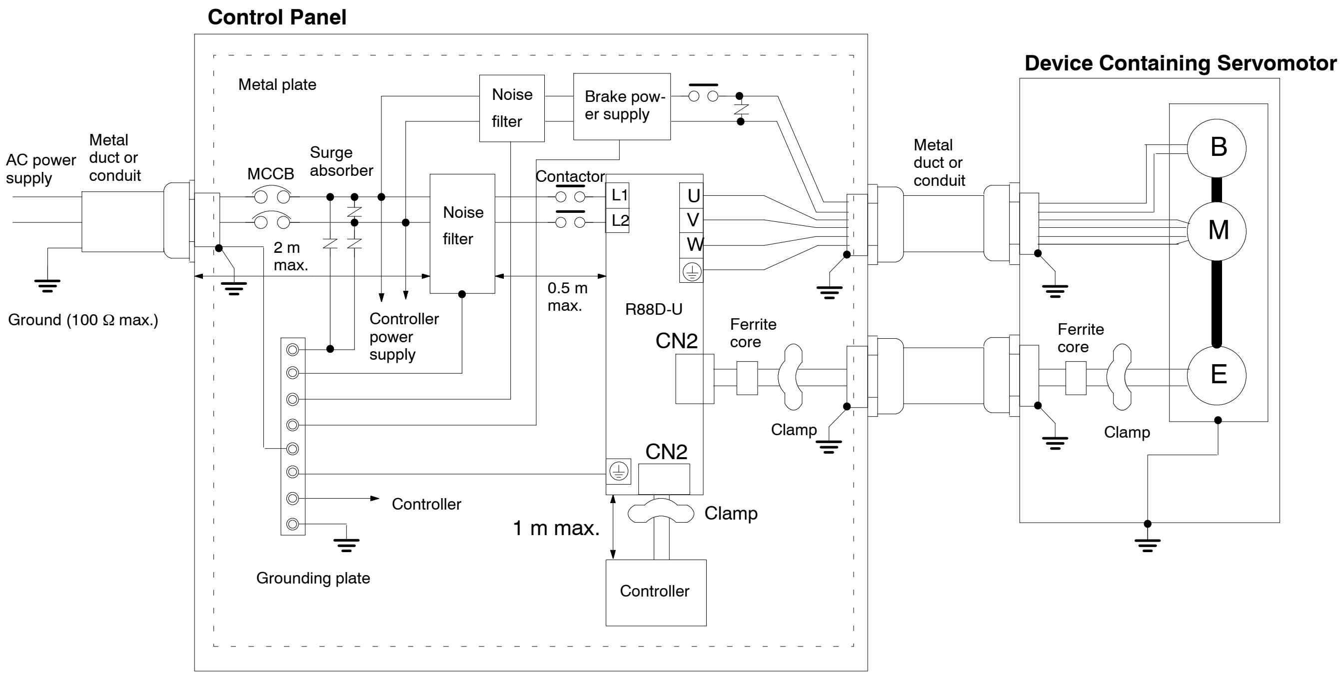
2-3-3 Wiring Products Conforming to EMC Directives

Models conforming to EC Directive will meet the requirements of the EMC Directives EN55011 Class A Group 1 (EMI) and EN50082-2 (EMS) if they are wired under the conditions described in this section. If the connected devices, wiring, and other conditions cannot be made to fulfill the installation and wiring conditions when the product is incorporated into a machine, the compliance of the overall machine must be confirmed.

The following conditions must be met to conform to EMC Directives.

- The Servo Driver must be installed in a metal case (control panel).
- Noise filters and surge adsorbers must be installed on all power supply lines.
- Shielded cables must be used for all I/O signal lines and encoder lines. (Use tin-plated, soft copper wires for the shield weaving.)
- All cables leaving the control panel must be wired in metal ducts or conduits with blades.
- Ferrite cores must be attached to the shielded cable and the shield must be clamped directly to the ground plate to ground it.

■ Wiring Methods

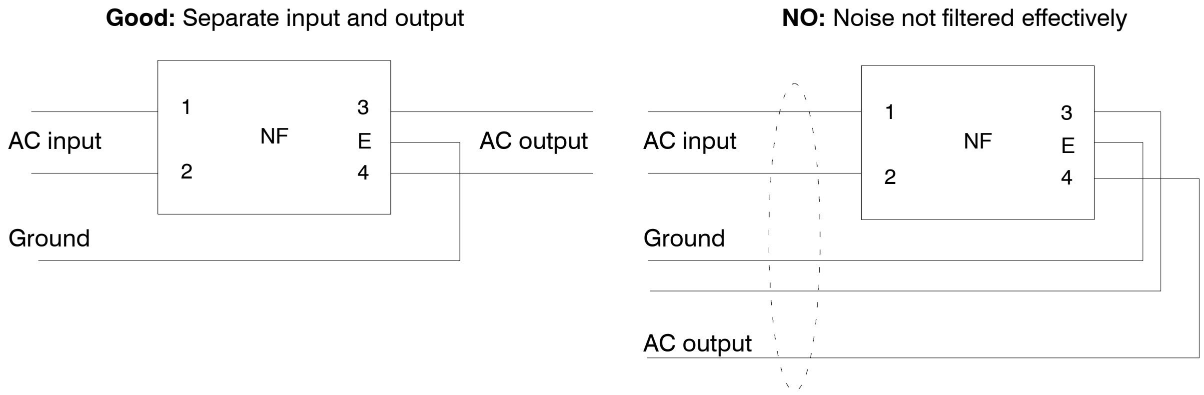


Note 1. The cable winding for the ferrite core must be 1.5 turns.

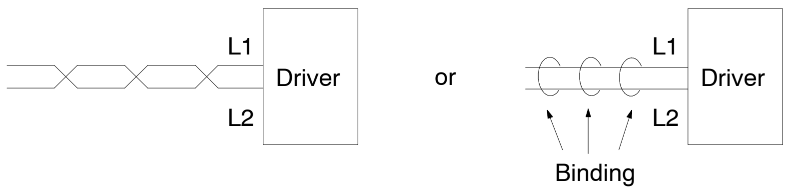
Note 2. Remove the sheath from the cable and ground it directly to the metal plate at the clamps.

- Ground the motor's frame to the machine ground when the motor is on a movable shaft.
- Use the grounding plate for the protective earth for each Unit, as shown in the illustration, and ground to a single point.
- Use ground lines with a minimum thickness of 3.5 mm^2, and arrange the wiring so that the ground lines are as short as possible.
- If no-fuse breakers (MCCB) are installed at the top and the power supply line is wired from the lower duct, use metal tubes for wiring and make sure that there is adequate distance between the input lines and the internal wiring. If input and output lines are wired together, noise resistance will decrease.
- No-fuse breakers (MCCB), surge absorbers, and noise filters (NF) should be positioned near the input terminal block (ground plate), and I/O lines should be isolated and wired using the shortest means possible.

• Wire the noise filter as shown at the left in the following illustration. The noise filter should be installed at the entrance to the control panel whenever possible.



• Use twisted-pair cables for the power supply cables whenever possible, or bind the cables.



• Separate power supply cables and signal cables when wiring.

■ Control Panel Structure

Any gaps in the cable entrances, mounting screws, cover, or other parts of a control panel can allow electric waves to leak from or enter the control panel. The items described in this section must be abided by in panel design and selection to ensure that electric waves cannot leak or enter the control panel.

• Case Structure

• Use a metal control panel with welded joints on the top, bottom, and all sides. The case must be electrically conductive.

• When assembling the control panel, remove the coating from all joints (or mask the joints when coating) to ensure electrical conductivity.

• Be sure that no gaps are created when installing the control panel, as can be cause by distortion when tightening screws.

• Be sure there are not any electrically conductive parts that are not in electrical contact.

• Ground all Units mounted in the control panel to the panel case.

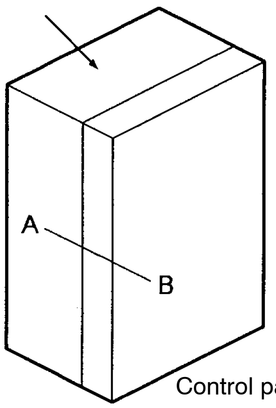
• Cover Structure

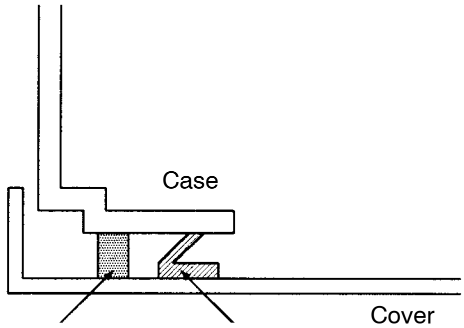
• Use a metal cover.

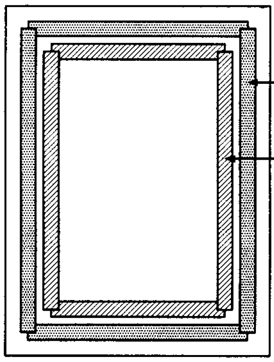
• Use a water-proof structure, as shown in the following diagram, and be sure there are no gaps.

• Use electrically conductive packing between the cover and the case, as shown in the following diagram. (Remove the coating the contact points of the packing (or mask the contact points when coating) to ensure electrical conductivity.)

• Be sure that no gaps are created when installing the cover, as can be cause by distortion when tightening screws.







Case (inside)

■ Selecting Components

• No-fuse Breakers (MCCB)

When selecting no-fuse breakers, take into consideration the maximum output current and the inrush current. The momentary maximum output for a servo system is approximately three times that of the rated output, and a maximum output of three seconds can be executed. Therefore, select no-fuse breakers with an operating time of at least five seconds at 300% of the rated maximum output. General-purpose and low-speed no-fuse breakers are generally suitable. Refer to the table in *2-2-3 Terminal Block Wiring* for the power supply input currents for each motor, and then add the current consumption for the number of shafts, other controllers, etc., to make the selection.

The Servo Driver inrush current flows at a maximum of 50 A for 20 ms when 200 V is input. With low-speed no-fuse breakers, a inrush current 7 to 8 times the rated current flows for 0.1 second. When making the selection, take into consideration the entire inrush current for the system.

• Surge Absorbers

Use surge absorbers to absorb surges from power supply input lines due to lightning, abnormal voltages, etc. When selecting surge absorbers, take into account the varistor voltage, the amount of surge immunity, and the amount of energy resistance. For 200-VAC systems, use a varistor voltage of 470 V. The surge absorbers shown in the following table are recommended.

Maker	Model	Max. limit voltage	Surge immunity	Type	Remarks
Okaya Electric Ind.	R·A·V-781BYZ-2	783 V	1,000 A	Block	For power supply line
	R·A·V-781BXZ-4	783 V	1,000 A		For power supply line ground

Note 1. Refer to manufacturers documentation for operating details.

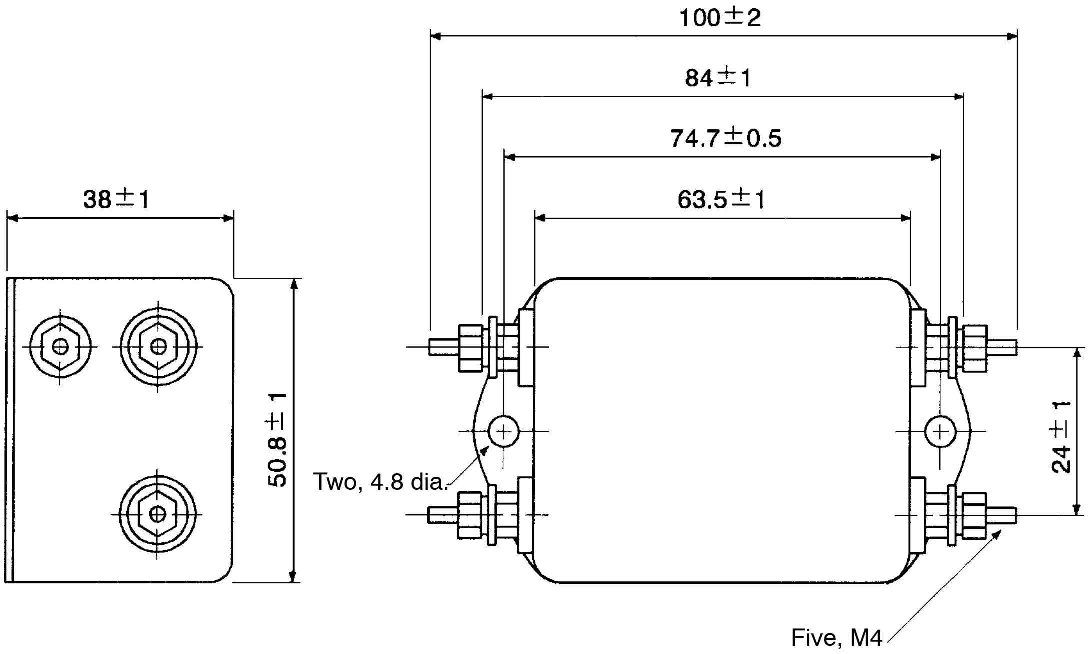
Note 2. The surge immunity is for a standard impulse current of 8/20 µs. If pulses are wide, either decrease the current or change to a larger-capacity surge absorber.

• Noise Filters

Use the following noise filters on the power supplies for the Servo Driver and brake. These filters are manufactured by Okaya Electric Ind.

Application	Model	Rated current	Test voltage	Insulation resistance	Leakage current (max.)	Attenuation characteristic	
						Normal (MHz)	Common (MHz)
200 V, 100 W Brake power supply	SUP-P5H-EPR-4	5 A	Between terminals: 1,250 Vrms, 50/60 Hz, 60 s Between terminals and case: 2,000 V rms, 50/60 Hz, 60 s	Between terminals and case: 6,000 MΩ min. (at 500 VDC)	0.6 mA (at 250 Vrms 60 Hz)	0.5 to 30	0.2 to 30
200 V, 200 or 400 W 100 V, 100 W	SUP-P8H-EPR-4	8 A				0.6 to 30	0.3 to 30
200 V, 750 W 100 V, 200 or 300W	SUP-P10H-EPR-4	10 A				0.7 to 30	0.4 to 30

The appearance of the noise filters is shown below. Screw terminals are used.



• Surge Killers

Install surge killers for loads that have induction coils, such as relays, solenoids, brakes, clutches, etc. The following table shows types of surge killers and recommended products.

Type	Features	Recommended products
Diode	Diodes are relatively small devices such as relays used for loads when reset time is not an issue. The reset time is increased because the surge voltage is the lowest when power is cut off. Used for 24/48-VDC systems.	Use a fast-recovery diode with a short reverse recovery time. Fuji Electric Co., ERB44-06 or equivalent
Thyristor or Varistor	Thyristor and varistor are used for loads when induction coils are large, as in electromagnetic brakes, solenoids, etc., and when reset time is an issue. The surge voltage when power is cut off is approximately 1.5 times that of the varistor.	Select varistor voltage as follows: 24-VDC system varistor: 39 V 100-VDC system varistor: 200 V 100-VAC system varistor: 270 V 200-VAC system varistor: 470 V
Capacitor + resistor	Use capacitors and resistors for vibration absorption of surge when power is cut off. The reset time can be shortened by proper selection of the capacitor or resistor.	Okaya Electric Ind. CR-50500 0.5 μF-50 Ω CRE-50500 0.5 μF-50 Ω S2-A-0 0.2 μF-500 Ω

Note Thyristors and varistors are made by the following companies. Refer to manufacturers documentation for operating details. Thyristors: Ishizuka Electronics Co.
Varistors: Ishizuka Electronics Co., Matsushita Electric Parts

• Contactors

When selecting contactors, take into consideration the circuit's inrush current and the momentary maximum current. The Servo Driver inrush current is 50 A, and the momentary maximum current is approximately twice the rated current. The following table shows the recommended contactors.

Maker	Model	Rated current	Momentary maximum current	Coil voltage
OMRON	J7AN-E3	15 A	120 A	24 VDC

• Leakage Breakers

- Select leakage breakers designed for inverters.
- Since switching operations take place inside the Servo Driver, high-frequency current leaks from the armature of the Servomotor. With inverter leakage breakers, high-frequency current is not detected, preventing the breaker from operating due to leakage current.
- When selecting leakage breakers, also remember to add the leakage current from devices other than the Servomotor, such as machines using a switching power supply, noise filters, inverters, and so on.
- For detailed information about the selection methods of leakage breakers, refer to catalogs provided by manufacturers.
- The following table shows the Servomotor leakage currents for each Servo Driver.

Driver	Leakage current (direct) (including high-frequency current)	Leakage current (resistor-capacitor, in commercial power supply frequency range)
R88D-UEP04V to -UEP08V	80 mA	3 mA
R88D-UEP12V	60 mA	4 mA
R88D-UEP20V	110 mA	5 mA

Note 1. Leakage current values shown above are for motor power lines of 10 m or less. The values will change depending on the length of power cables and the insulation.

Note 2. Leakage current values shown above are for normal temperatures and humidity. The values will change depending on the temperature and humidity.

Note 3. Leakage current for 100-VAC-input Servomotors is approximately half that of the values shown above.

■ Improving Encoder Cable Noise Resistance

The following encoder signals are used: A, B, and S phase. The frequency for A- or B-phase signals is 154 kHz max.; the transmission speed for S-phase signals is 616 kbps.

Follow the wiring methods outlined below to improve encoder noise resistance.

- Be sure to use dedicated encoder cables.
- If lines are interrupted in the middle, be sure to connect them with connectors, making sure that the cable insulation is not peeled off for more than 50 mm. In addition, be sure to use shielded wire.
- Do not coil cables. If cables are long and are coiled, mutual induction and inductance will increase and will cause malfunctions. Be sure to use cables fully extended.
- When installing noise filters for encoder cables, use ferrite cores. The following table shows the recommended ferrite core models.

Maker	Name	Model
Tokin	EMI core	ESD-QR-25-1
TDK	Clamp filter	ZCAT2032-0930
		ZCAT3035-1330
		ZCAT2035-0930A

- Do not wire the encoder cable in the same duct as power cables and control cables for brakes, solenoids, clutches, and valves.

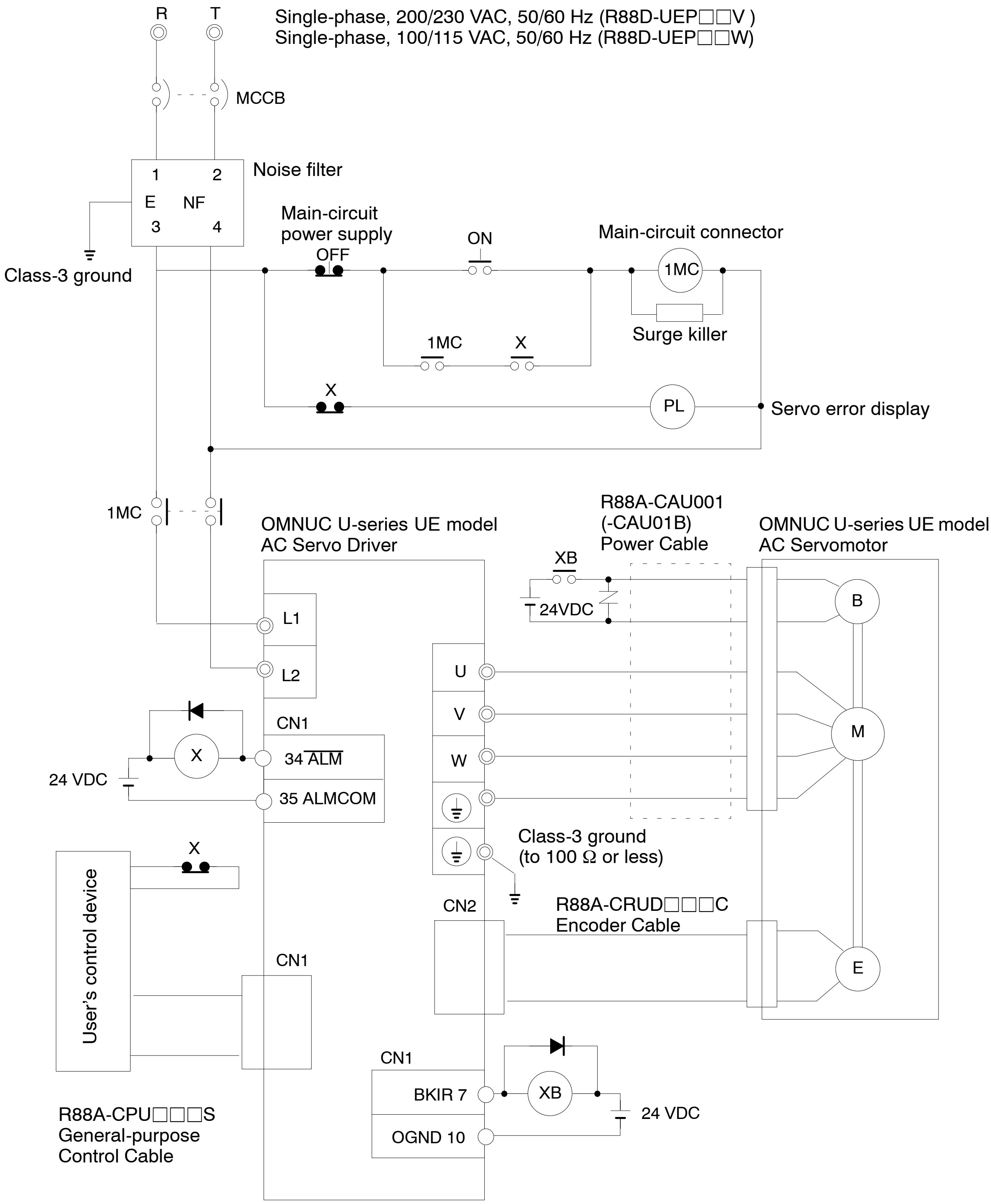
■ Improving Control I/O Signal Noise Resistance

Position can be affected if control I/O signals are influenced by noise. Follow the methods outlined below for the power supply and wiring.

- Use completely separate power supplies for the control power supply (especially 24 VDC) and the external operation power supply. In particular, be careful not to connect two power supply ground wires. Install a noise filter on the primary side of the control power supply.
- For speed and torque command input lines, be sure to use twisted-pair shielded cable, and connect both ends of the shield wire to ground.
- If the control power supply wiring is long, noise resistance can be improved by adding 1-µF laminated ceramic capacitors between the control power supply and ground at the Servo Driver input section and the controller output section.
- For encoder output (Z phase) lines, be sure to use twisted-pair shielded cable, and connect both ends of the shield wire to ground.

2-3-4 Peripheral Device Connection Examples

■ Connecting to Peripheral Devices



Chapter 3

· Operation ·

Operation and Adjustment Precautions

⚠ **Caution** Confirm the settings of all parameters to be sure they are correct before starting actual operation. Incorrect parameters may damage the product.

⚠ **Caution** Do not make extreme changes in the settings of the product. Doing so may result in unstable operation of the product and injury.

⚠ **Caution** Confirm the operation of the motor before connecting it to the mechanical system. Unexpected motor operation may result in injury.

⚠ **Caution** If an alarm is ON, remedy the cause, make sure the system is safe, reset the alarm, and restart the system. Not doing so may result in an injury.

⚠ **Caution** The system may restart abruptly when power is resupplied after an instantaneous power failure. Take safety measures to prevent accidents that may result in an injury.

⚠ **Caution** Do not use the built-in brake of the Servomotor for normal control of the Servomotor. Doing so may result in a Servomotor malfunction.

3-1 Operational Procedure

3-1-1 Beginning Operation

Before beginning operation, be sure to make the initial settings for the Servo Driver. Make function settings as required according to the use of the Servomotor.
Any incorrect settings in the parameters could cause unexpected motor operation, creating an extremely dangerous situation. Use the procedures provided in this section to carefully set all parameters.

■ Startup Procedure

1. Mounting and Installation

   Install the Servomotor and Servo Driver according to the installation conditions: **Chapter 2, section 2-1.**

2. Wiring and Connections

   Connect to power supply and peripheral devices: **Chapter 2, section 2-2, 2-3.**
   The specified installation and wiring conditions are particularly important to ensure that models conforming to EC Directives actually conform to the EC Directive in the final system.

3. Turning on Power Supply

   Before turning on the power supply, check the necessary items. In order to make the initial settings, turn on an application power supply: **Chapter 3, section 3-2.**

4. Checking Display Status

   Check by means of the displays to see whether there are any internal errors in the Servo Driver: **Chapter 3, section 3-2**

5. Initial Settings

   Make the settings for the operation setup parameters (initial settings): **Chapter 3, section 3-4.**

6. Function Settings

   By means of the user parameters, set the functions according to the operating conditions: **Chapter 3, section 3-5.**

7. Trial Operation

   Check to see whether protective functions such as emergency stop and operational limits are working reliably. Check operation at both low speed and high speed: **Chapter 3, section 3-6.**

8. Adjustments

   Execute auto-tuning. Manually adjust the gain as required: **Chapter 3, section 3-7.**

9. Operation

   Operation can now begin. If any trouble should occur, refer to *Chapter 4 Applications*: **Chapter 4.**

3-2 Turning On Power and Checking Displays

3-2-1 Items to Check Before Turning On Power

■ Checking Power Supply Voltage

• Check to be sure that the power supply voltage is within the ranges shown below.

R88D-UEP□□H (200 VAC specifications):	Single-phase 200/230 VAC (170 to 253 V) 50/60 Hz
R88D-UEP□□L (100 VAC specifications):	Single-phase 100/115 VAC (85 to 127 V) 50/60 Hz
R88D-UEP□□V (200 VAC specifications):	Single-phase 200/230 VAC (170 to 253 V) 50/60 Hz
R88D-UEP□□W (100 VAC specifications):	Single-phase 100/115 VAC (85 to 127 V) 50/60 Hz

■ Checking Terminal Block Wiring

• The power supply input R and T phases must be properly connected to the terminal block.

• The Servomotor's red (U), white (V), and blue (W) power lines and the green ground wire (⏚) must be properly connected to the terminal block.

■ Checking the Servomotor

• There should be no load on the Servomotor. (Do not connect to the mechanical system.)

• The power line connectors at the Servomotor must be securely connected.

■ Checking the Encoder Connectors

• The encoder connectors (CN2) at the Servo Driver must be securely connected.

• The encoder connectors at the Servomotor must be securely connected.

■ Checking the Control Connectors

• The control connectors must be securely connected.

• The Run command must be OFF.

■ Checking the Parameter Unit Connection

• The Parameter Unit (R88A-PR02U or R88A-PR03U) must be securely connected to connector CN3.

3-2-2 Turning On Power and Confirming the Display

■ Turning On Power

• Confirm that it is safe to turn on the power supply and then turn on the power supply.

■ Checking Displays

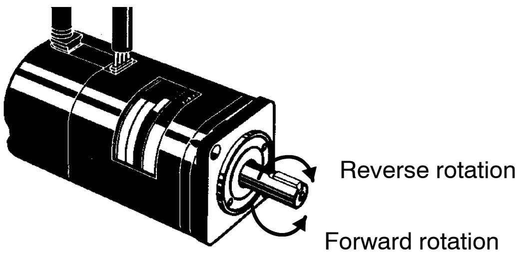
- When the power is turned on, one of the codes shown below will be displayed.

Normal (Base block)	Error (Alarm Display)
-. b b	-. A. 0 2

Note **1.** "Base block" means that the Servomotor is not receiving power.

Note **2.** The alarm code (the number shown in the alarm display) changes depending on the contents of the error.

- If the display is normal (i.e., no errors), use it as a monitor mode speed display. Manually turn the Servomotor shaft clockwise and counterclockwise, and check to be sure that it agrees with the positive and negative on the speed display. If it does not agree, then the encoder signal line may be wired incorrectly.



Display example

0 0 3 8	Forward rotation
0 0 2 5	Reverse rotation

Note To monitor the speed feedback value, press the MODE/SET Key and go into monitor mode `un 00`. Then press the DATA Key.

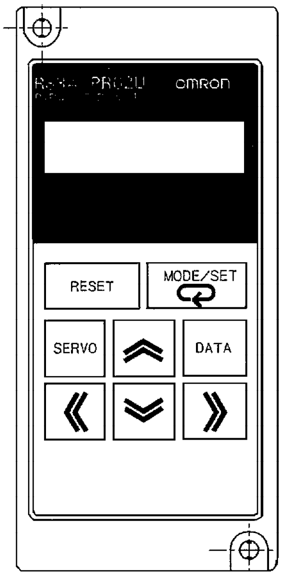
- If there is an error, refer to *Chapter 4 Application* and take the necessary countermeasures.

3-3 Using Parameter Units

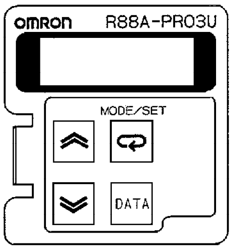
The key operations for the Hand-held R88A-PR02U Parameter Unit and the Mounted R88A-PR03U Parameter Unit vary depending on the functions used.

3-3-1 Parameter Unit Keys and Functions

Hand-held
Parameter Unit
R88A-PR02U



Mounted
Parameter Unit
R88A-PR03U



PR02U	PR03U	Function
RESET	∧ + ∨	Alarm reset
↩	↩	Mode switching Data memory
SERVO	DATA	Servo ON/OFF during jog operations
DATA	DATA	Switching between parameter display and data display; data memory
∧	∧	Increments parameter numbers and data values.
∨	∨	Decrements parameter numbers and data values.
《	---	Left shift for operation digits
》	---	Right shift for operation digits

3-3-2 Modes and Changing Modes

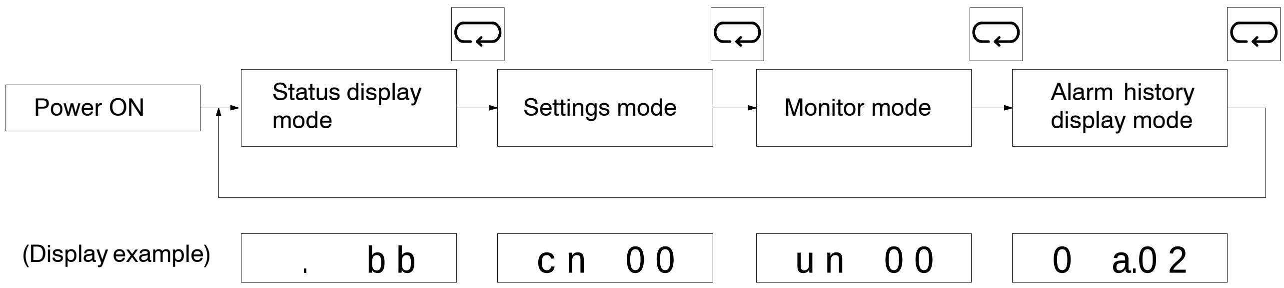
■ Modes

OMNUC U-series AC Servo Drivers have four operating modes, as described in the following table. For example, the Settings Mode is used to set parameters.

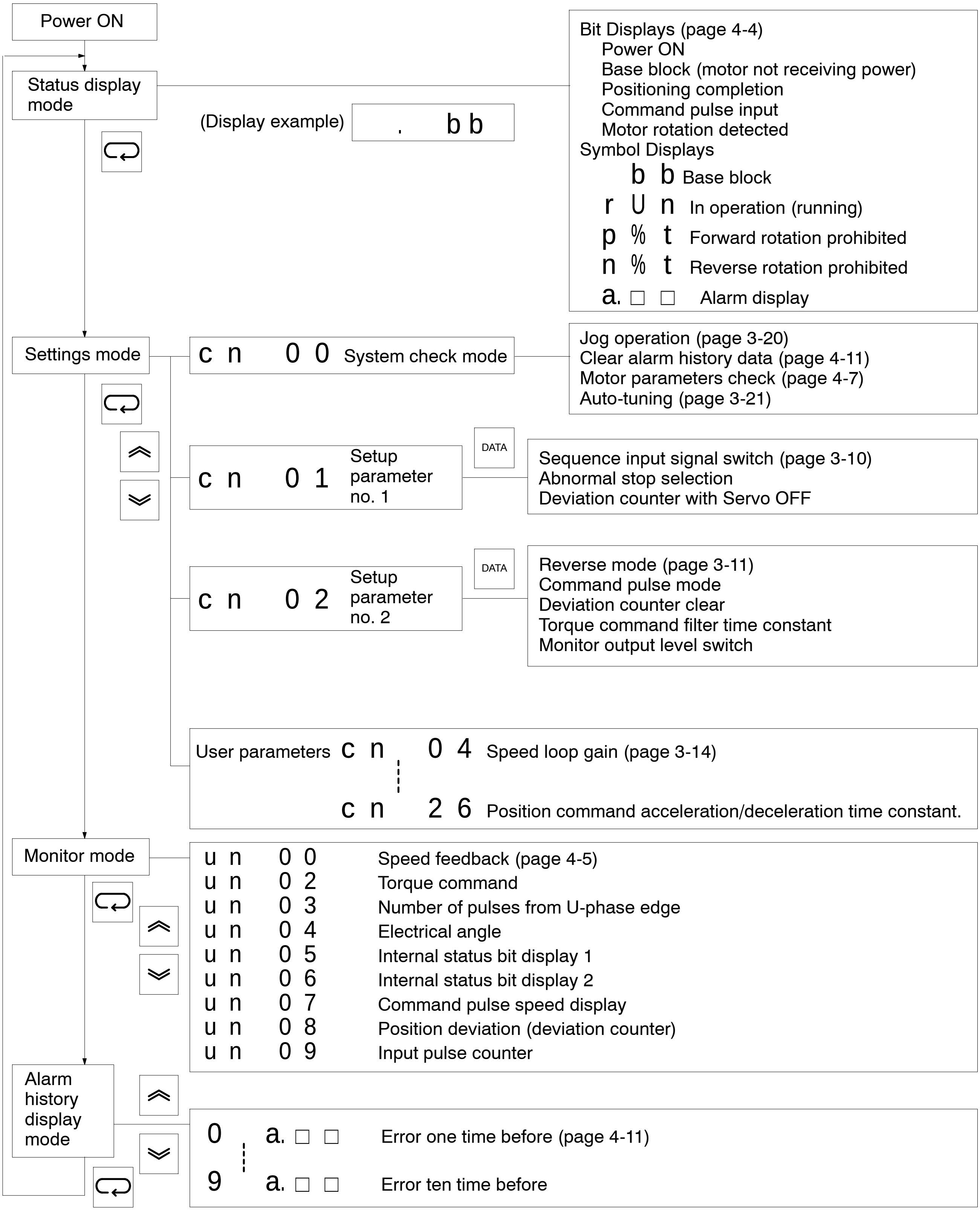
Mode	Function
Status display mode	Bit display (indicating internal status via indicators): Power supply ON display, base block, positioning completion, and rotation detection, command pulse input Symbol display (indicating internal status via 3-digit 7-segment display): Base block, operating, forward rotation prohibited, reverse rotation prohibited, alarm display
Settings mode	System check: Jog operations, alarm history data clear, motor parameters check, auto-tuning Setting and checking setup parameters Setting and checking user parameters
Monitor mode	Speed feedback, torque commands, number of pulses from U-phase, electrical angle, internal status bit display, command pulse speed display, position deviation, input pulse counter
Alarm history display mode	Displays contents of alarms that have been previously generated (up to a maximum of 10).

■ Changing Modes

To change modes, press the MODE/SET Key.



3-3-3 Mode Changes and Display Contents



3-4 Initial Settings: Setup Parameters

Setup parameters are parameters that are essential for starting up the system. They include I/O signal function changes, selection of processing for momentary stops and errors, command pulse modes, and so on. Set them to match the user system.
Once the parameters have been set, they become effective when the power supply is turned on again after having been turned off. (Check to see that the LED display has gone off.)

3-4-1 Setting and Checking Setup Parameters (Cn-01, 02)

■ Displaying Setup Parameters

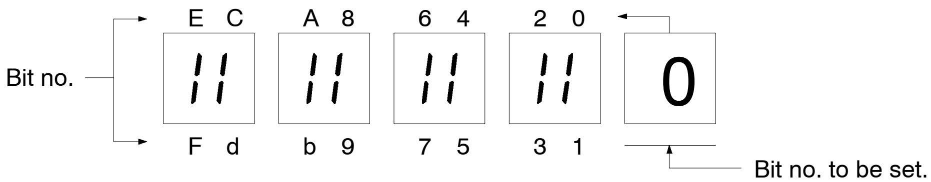
There are two setup parameters: No. 1 (Cn-01) and No. 2 (Cn-02).

To display the contents of setup parameters, execute the following key operations.

1. To go into settings mode (cn 00), press the MODE/SET Key.
2. To display the setup parameter number (cn 01 or cn 02), press the Up and Down keys.
3. To display the contents of the setup parameter, press the DATA key.

To display the setting of setup parameter No. 2, press the Up Key twice at step 2. before pressing the DATA Key.

The contents of the setup parameters are displayed as follows:



In the leftmost four digits, 16 bits of information are displayed. In the rightmost digit, the bit number that can be set is displayed. It can be checked whether the bit information is “0” (not lit) or “1” (lit), according to the 7-segment display vertical bar. To change the set value, first set the bit number in the rightmost digit, and then set the appropriate bit to “0” or “1.”

■ Setting Setup Parameters

First, display the setting of the setup parameter (No. 1 or No. 2) using the procedure given above. To change a setting, specify the bit to be changed and then set it to “1” or “0.”

• Making Settings with Hand-held Parameter Unit (R88A-PR02U)

1. Use the Right and Left Keys to display in the rightmost digit the bit number that is to be set.
2. Using the Up (or Down) Key, reverse the lit/not lit status of the appropriate bit number. For “lit,” set the bit number to “1.” For “not lit,” set it to “0.”
3. Repeat steps 1 and 2 above as required.
4. Save the data in memory by pressing the MODE/SET Key (or the DATA Key).
5. With this, the parameter setting operation is complete. Pressing the DATA Key at this point will bring back the parameter number display.

• Making Settings with Mounted Parameter Unit (R88A-PR03U)

1. Use the Up and Down Keys to display in the rightmost digit the bit number that is to be set.
2. Using the MODE/SET Key, reverse the lit/not lit status of the appropriate bit number. For “lit,” set the bit number to “1.” For “not lit,” set it to “0.”

3. Repeat steps 1 and 2 above as required.
4. Save the data in memory by pressing the DATA Key.
5. With this, the parameter setting operation is complete. Pressing the DATA Key at this point will bring back the parameter number display.

3-4-2 Setup Parameter Contents (Cn-01 and Cn-02)

■ Setup Parameter No. 1 (Cn-01)

Item	Bit no.	Factory setting	Setting	Explanation
Sequence input signal switching	0	0	0	Servo turned ON or OFF by Run command (externally input).
			1	Servo always ON.
	1	0	---	Not used.
	2	1	0	Enables forward drive prohibit input (POT).
			1	Permits always-forward drive.
	3	1	0	Enables reverse drive prohibit input (NOT).
			1	Permits always-reverse drive.
	4	0	---	Not used.
	5	1	---	Not used.
	6	1	---	Not used.
	7	1	---	Not used.
Abnormal stop	8	0	0	The dynamic brake decelerates to stop the Servomotor at the time of overtraveling.
			1	The maximum torque decelerates to stop the Servomotor at the time of overtraveling.
	9	0	---	Not used.
Deviation counter with Servo OFF	A	0	0	Clear counter for alarms occurring while Servo is OFF
			1	Do not clear counter for alarms occurring while Servo is OFF
	b	1	---	Not used.
	C	0	---	Not used.
	d	0	---	Not used.
	E	0	---	Not used.
	F	0	---	Not used.

Note 1. Do not change the settings of bits 1, 4 through 7, 9, or b through F of setup parameter 1 (Cn-01).

Note 2. These parameters become effective only after power is reset. Confirm that the indicators go out before turning power back on. (Check to see that the LED display has gone off)

■ Setup Parameter No. 2 (Cn-02)

Item	Bit no.	Factory setting	Setting	Explanation
Reverse rotation mode	0	0	0	CCW direction is taken as forward rotation.
			1	CCW direction is taken as reverse rotation.
	1	0	---	Not used.
	2	0	---	Not used.
Command pulse mode	5, 4, 3	0, 0, 1	0, 0, 0	Feed pulse / Forward/reverse signal
			0, 0, 1	Forward rotation pulse / Reverse rotation pulse
			0, 1, 0	90° phase difference (A/B phase) signal (1X)
			0, 1, 1	90° phase difference (A/B phase) signal (2X)
			1, 0, 0	90° phase difference (A/B phase) signal (4X)
	6	0	---	Not used.
	7	0	---	Not used.
	8	0	---	Not used.
	9	0	---	Not used.
Deviation counter clear	A	1	0	The deviation counter is cleared at H level.
			1	The deviation counter is cleared at differential rising edge.
	b	0	---	Not used.
Torque command filter time constant	C	0	0	Primary filter
			1	Secondary filter
	d	0	---	Not used.
Parameter Unit monitor output lever change	E	0	0	Position deviation monitor set for 1 command.
			1	Position deviation monitor set for 100 commands.
	F	0	---	Not used.

Note 1. Do not change the settings of bits 1, 2, 6 through 9, b, d, or F of setup parameter 2 (Cn-02).

Note 2. These parameters become effective only after power is reset. Confirm that the indicators go out before turning power back on. (Check to see that the LED display has gone off)

3-4-3 Important Setup Parameters (Cn-01 and Cn-02)

This section explains the particularly important setup parameters. If these parameters aren't set properly, the motor might not operate or might operate unpredictably. Set these parameters appropriately for the system being used.

■ Command Pulses in Position Control

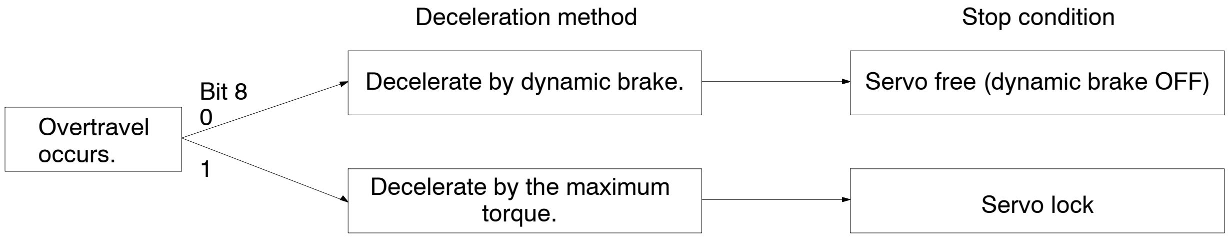
Bits 3, 4, and 5 of Cn-02 specify the kind of command pulse mode used for position control, as shown in the following table.

Cn-02 bit 3	Cn-02 bit 4	Cn-02 bit 5	Selected command pulse mode
0	0	0	Feed pulse (PULS)/Direction signal (SIGN)
1	0	0	Forward pulse (CCW)/Reverse pulse (CW) (Factory setting)
0	1	0	90° differential phase (A/B phase) signal (1×)
1	1	0	90° differential phase (A/B phase) signal (2×)
0	0	1	90° differential phase (A/B phase) signal (4×)

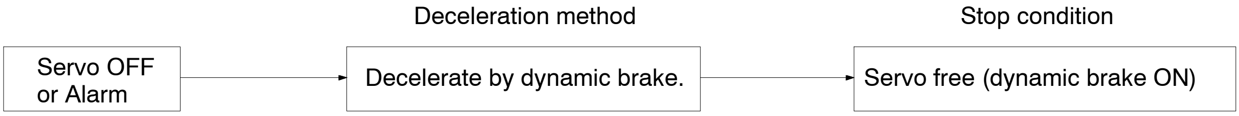
Note One of three multiples can be selected when inputting a 90° differential phase signal (1×, 2×, or 4×). If the 4× multiple is selected, the input pulses are multiplied by a factor of 4, so the number of motor revolutions (speed and angle) are 4 times the number when the 1× multiple is selected.

■ Overtraveling Servomotor Deceleration to Stop (Bit 08 of Cn-01)

Select either one of the following methods of motor deceleration to stop at the time of overtraveling.



While the Servomotor is in servo OFF condition, the following motor deceleration method is used when an alarm goes off.



3-5 Setting Functions: User Parameters

Execute the user parameter settings in order as follows:

Go into settings mode. . . . . MODE/SET Key

Display the pertinent parameter number. . . . . . Direction Keys (Handy-type)
Up and Down Keys (Mounted-type)

Display the contents (data) of the parameter. . DATA Key

Change the data. . . . . Direction Keys (Handy-type)
Up and Down Keys (Mounted-type)

Save the data in memory. . . . . MODE/SET and DATA Keys

3-5-1 Setting and Checking User Parameters (Cn-04 to 26)

■ Displaying User Parameters

Perform the following procedures on the Parameter Unit to display the user parameters.

● Displaying with Handy-type (R88A-PR02U)

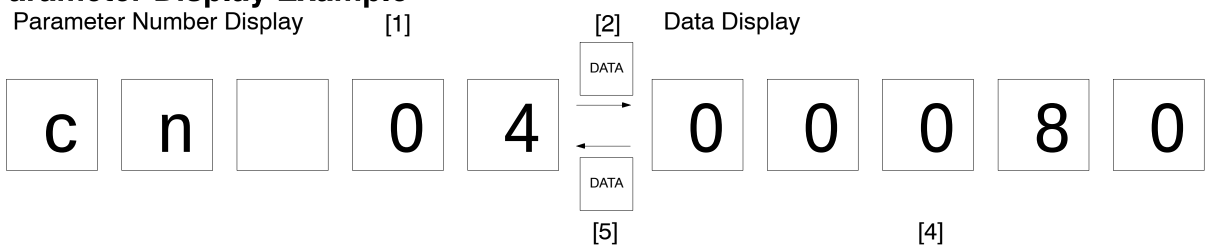
1. Press the MODE/SET Key to go into settings mode (cn □□).
2. Press the Direction Keys to display the desired user parameter number.
   Press the Right and Left Keys to select the digit to be set. The digit whose value can be set will blink.
   Press the Up and Down Keys to increment or decrement the digit.
3. Press the DATA Key to display the setting of the specified parameter.
4. Press the DATA Key again to return to the parameter number display.

Note If only the Up or Down Key is pressed at step 2., the parameter number can be set directly. In this case, the rightmost digit will blink. The number cannot be set if the second digit (the 10s digit) is blinking (i.e., blinking indicates the digit that can be changed).

• Displaying with Mounted-type (R88A-PR03U)

1. Press the MODE/SET Key to go into settings mode (cn □□).
2. Press the Up and Down Keys to display the desired user parameter number.
   The number will be incremented or decremented each time the Up or Down Key is pressed.
3. Press the DATA Key to display the setting of the specified parameter.
4. Press the DATA Key again to return to the parameter number display.

• Parameter Display Example



■ Setting User Parameters

First, use the previous procedure to display the settings of the user parameter. Then use the following procedures to set user parameters.

• Making Settings with Handy-type (R88A-PR02U)

1. Use the Right and Left Keys to select the digit that is to be set. The digit for which the value can be changed will blink.
2. Press the Up and Down Keys to change the value of the digit.
3. Repeat the previous two steps as required to set the parameter.
4. Press the MODE/SET or DATA Key. The parameter will be set and the display will blink.
5. Press the DATA Key again to return to the parameter number display.
6. Repeat steps 1 through 5 above as required to set other parameters.

Note 1. Settings can also be made by pressing only the Up and Down Keys in stead of using steps 1. and 2. This will enable setting digits higher than the one that is blinking. Use whichever method is faster for the number of digits that need to be set.

Note 2. The Down Key can be pressed when all digits higher than the blinking one are zeros to set the minimum value in the setting range.

Note 3. The fifth digit (i.e., the leftmost digit) cannot be made to blink by pressing the Left Key. The fifth digit can be set from the fourth digit. For example, to set “10000,” press the Left Key to make the fourth digit blink and then press the Up Key again once the fourth digit reaches “9.” The fifth digit will change to “1” and the fourth digit will change to “0.”

• Making Settings with Mounted-type (R88A-PR03U)

1. Using the Up and Down Keys, set the data. If the keys are held down, the numbers will change 10 at a time. If the keys are held down even longer, the numbers will change 100 and then 1,000 at a time.
2. Press the MODE/SET Key (or the DATA Key). The parameter will be set and the display will blink.
3. Pressing the DATA Key again will bring back the parameter number display.
4. Repeat steps 1 through 4 above as required to set other parameters.

3-5-2 User Parameter Chart

PRM No.	Parameter name	Factory setting	Unit	Setting range	Explanation
Cn-00	System check mode	---	---	---	Refer to system check mode explanation.
Cn-01	Setup parameter no. 1	---	---	---	Refer to setup parameter no. 1 explanation.
Cn-02	Setup parameter no. 2	---	---	---	Refer to setup parameter no. 2 explanation.
Cn-04	Speed loop gain (See note 1)	80	Hz	1 to 2,000	Adjusts speed loop response.
Cn-05	Speed loop integration constant	20	ms	2 to 10,000	Speed loop integration constant.
Cn-12	Brake timing	0	10 ms	0 to 50	Delay time setting from brake command until servo turns off.
Cn-17	Torque command filter time constant	4	100 μs	0 to 250	Setting for torque command filter time constant (6.4 to 398 Hz).
Cn-1A	Position loop gain	40	1/s	1 to 500	For position loop response adjustment.
Cn-1b	Positioning completion range	3	Command units	0 to 250	Sets the range for the positioning completion signal output.
Cn-24	Electronic gear ratio G1 (numerator) (see note 2)	4	---	1 to 65,535	Setting range $0.01 \le G1/G2 \le 100$
Cn-25	Electronic gear ratio G2 (denominator) (see note 2)	1	---	1 to 65,535	
Cn-26	Position command acceleration/deceleration time constant	0	0.1 ms	0 to 640	Sets the setting number for smoothing.

Note 1. Cn-04 (speed loop gain) is factory set for three times the load inertia. Therefore, if the load inertia is extremely small, some oscillation may occur. If it does, then lower Cn-04 to 20 or less.

Note 2. After the settings for Cn-24 (Electronic gear ratio G1 (numerator)), and Cn-25 (Electronic gear ratio G2 (denominator)) have been made, they become effective when the power is turned on again after having been cut off. (Check to see that the LED display has gone off.)

3-5-3 Electronic Gear

■ Function

- The motor will be driven with a pulse determined by multiplying the command pulse count by the electronic gear ratio.
- The electronic gear is useful for the following applications:
  - To fine-tune the position and speed of two lines that must be synchronized.
  - When using a positioner with a low command pulse frequency.
  - To set the machine movement per pulse to a specific value, such as 0.01 mm.

■ Setting User Parameters

- The electronic gear is set as G1 divided by G2 (G1/G2). G1 is set in user parameter Cn-24; G2 is set in Cn-25. The target pulse count is computed as follows:

Target pulse count = Command pulse count x G1/G2

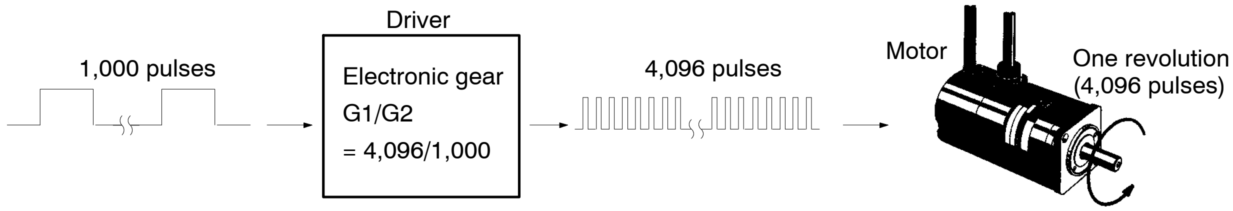
- If G1/G2 = 1, the motor will turn once for every 4,096 command pulses (driver running at a factor of 4X).
- One pulse for the position deviation (deviation counter) display and positioning completion range will be equivalent to one input pulse (here the unit is said to be the command).

PRM No.	Parameter name	Factory setting	Unit	Setting range	Explanation
Cn-24	Electronic gear ratio G1 (numerator)	4	---	1 to 65,535	Setting range 1/100 ≤ G1/G2 ≤ 100
Cn-25	Electronic gear ratio G2 (denominator)	1	---	1 to 65,535	

Note The factory settings will produce turn the motor once for every 1,024 input pulses.

■ Example

If G1 is set to 4,096 and G2 is set to 1,000, the motor will turn once for every 1,000 input pulses (output as 4,096 pulses). The motor speed will also be 4,096/1,000 times faster.



3-5-4 Brake Interlock (For Motors with Brakes)

■ Magnetic Brakes

The magnetic brakes for Servomotors with brakes are specialized holding brakes with non-magnetized operation. Therefore set the parameters so that the brake power supply is turned off after the Servomotor stops. If the brake is applied while the Servomotor is operating, the brake will suffer abnormal wear or even damage, and will quickly become defective.

For wiring methods, refer to *2-2-5 Peripheral Device Connection Examples*.

■ Function

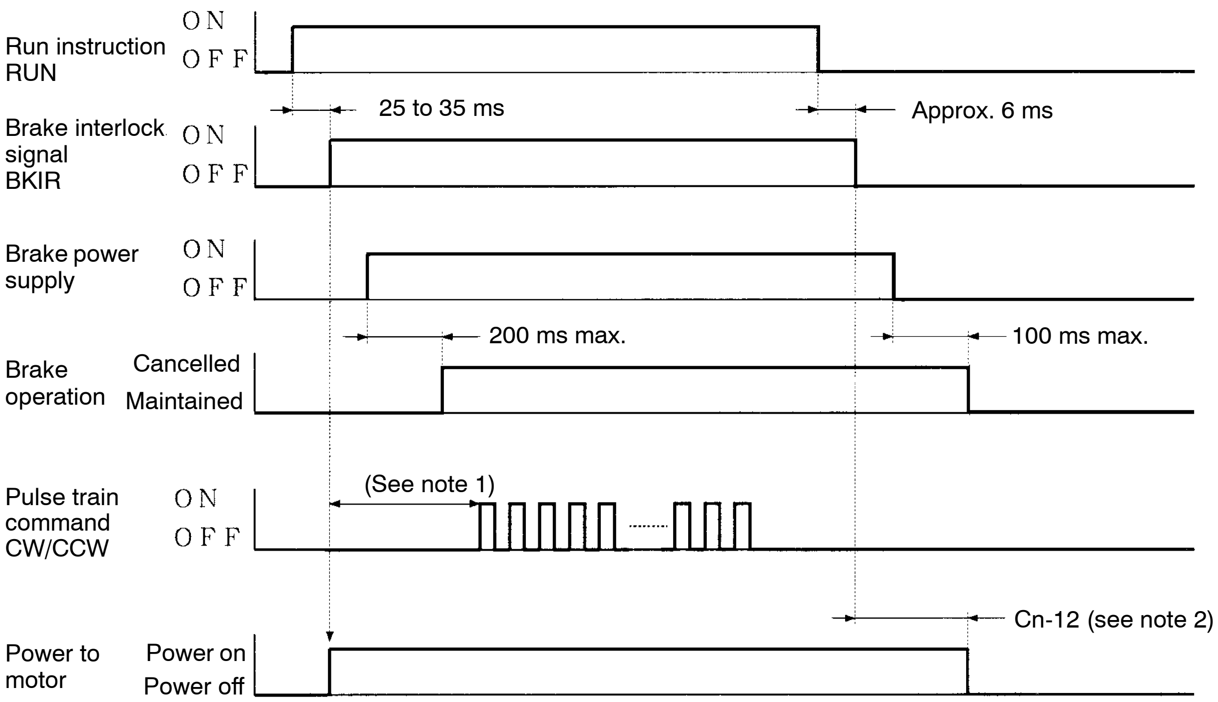
The output timing of the brake interlock signal (BKIR) that control turning the magnetic brake ON and OFF can be set.

■ Parameters to be Set

PRM No.	Parameter name	Factory setting	Unit	Setting range	Explanation
Cn-12	Brake timing	0	10 ms	0 to 50	Delay time setting from brake command until servo turns off.

■ Operation

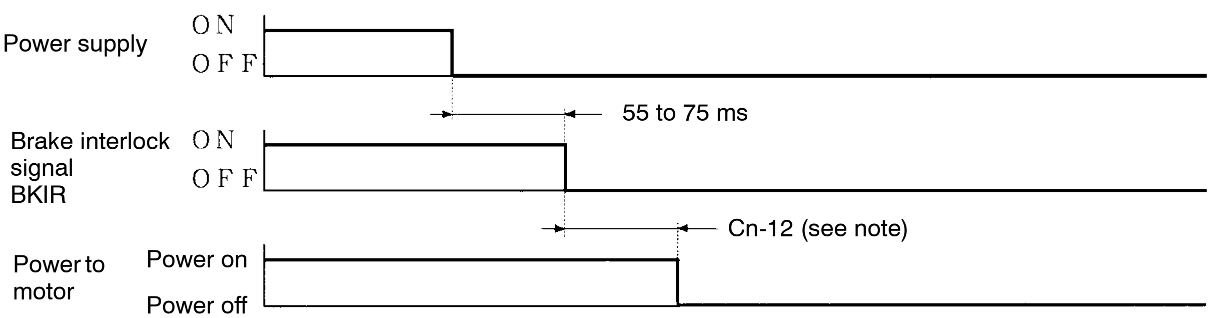
• Timing for Run Command (RUN) (When Servomotor is Stopped)



Note 1. It takes up to 200 ms for the brake to be cleared after the brake power supply has been turned on. Taking this delay into account, have the speed command be given after the brake has been cleared.

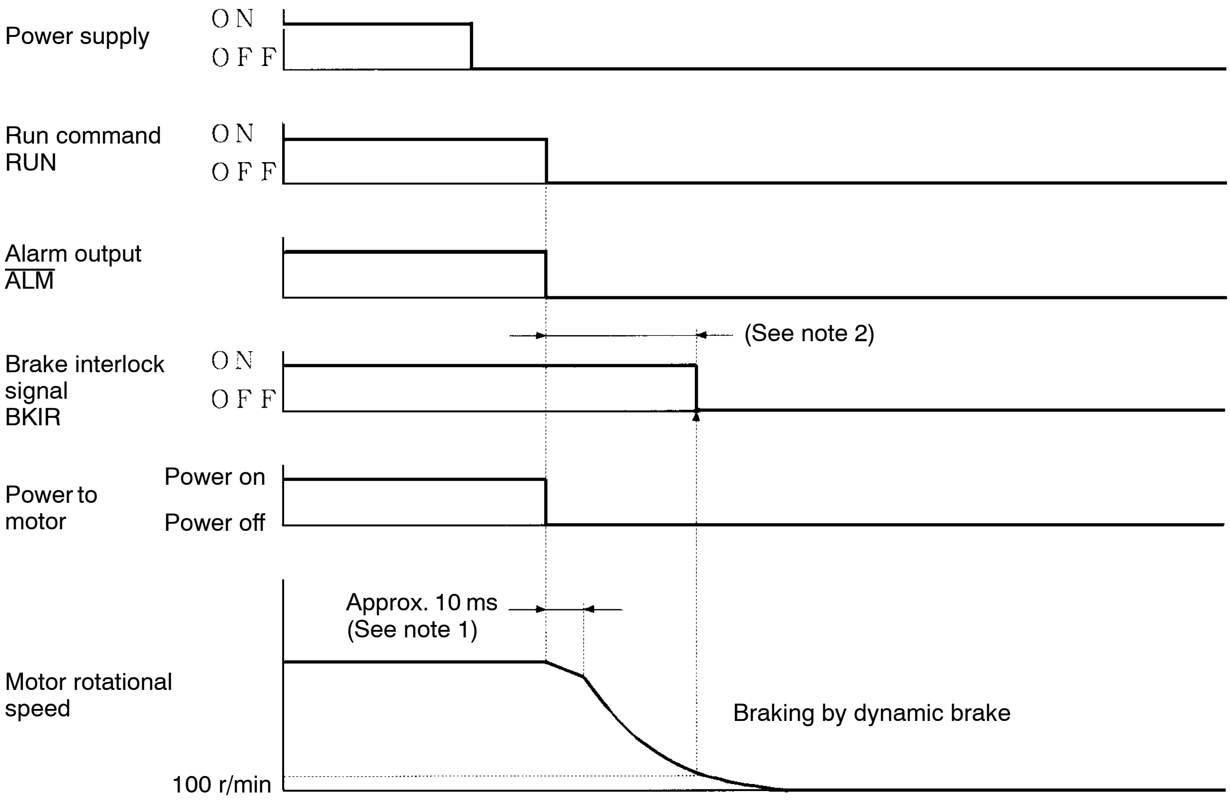
Note 2. It takes up to 100 ms for the brake to be held after the brake power supply has been turned off. When using it for the vertical shaft, take this delay into account and set brake timing 1 (Cn-12) so that the Servomotor will not receive power until after the brake is held.

• Timing for Power Supply (When Servomotor is Stopped)



Note It takes up to 100 ms for the brake to be held after the brake power supply has been turned off. When using it for the vertical shaft, take this delay into account and set brake timing 1 (Cn-12) so that the Servomotor will not receive power until after the brake is held.

• Timing for Run Command (RUN), Errors, Power Supply: Servomotor Stopped



Note 1. For the approximately 10 ms it takes from when the power to the Servomotor turns off until the dynamic brake operates, the Servomotor rotates by momentum.

Note 2. If the motor rotational speed falls to 100 r/min or below, or if 500 ms elapse after power to the Servomotor is interrupted, the brake interlock signal (BKIR) will turn OFF.

Note 3. The dynamic brake decelerates to stop the Servomotor when the RUN signal is OFF, alarm output is ON, or power is turned off. The Servomotor will be in servo free condition with the dynamic brake ON after the Servomotor stops rotating.

3-6 Trial Operation

After the wiring is complete and the parameter settings have been made, conduct a trial operation. First, check with rotation of the motor without connecting a load (i.e., without connecting the mechanical system). Then, connect the mechanical system, auto-tune the system, and confirm that the correct operation pattern is performed.

3-6-1 Preparations for Trial Operation

■ Preparations

• Power Off

The power supply must be toggled to apply some of the parameter settings. Always turn off the power supply before starting.

• No Motor Load

Do not connect a load to the motor shaft during trial operation, just in case the motor runs out of control.

• Stopping the Motor

Make sure that the power switch can be turned off or the Run command used to stop the motor immediately in case of trouble.

• Connecting a Parameter Unit

Connect a Parameter Unit to the CN3 connector on the front of the Servo Driver if one is not already connected.

■ Actual Trial Operation

(1) Powering Up

- With the run command (RUN) OFF, apply an AC voltage.
- After internal initialization, the mode will be the status display mode.

Display example:	-.			b	b

- Set the speed loop gain (Cn-04) to 20 or less. (Match the gain with no load.)

1. Confirm the initial display shown above.
2. Press the MODE/SET Key to enter the settings mode.
3. Press the Up Key to specify user parameter Cn-04.
4. Press the DATA Key to display the setting of Cn-04.
5. Press the Down Key to change the setting to 20.
6. Press the DATA Key to record the new setting in memory.

7. Press the DATA Key again to return to the parameter number display.

(2) Jog Operations (See *3-6-2 Jog Operations*.)

• Perform jog operations using the Parameter Unit and confirm the following:
Does the motor turn in the correct direction?
Is there any unusual sound or vibration?
Do any error occur?

• If an error occurs, refer to *Chapter 4 Application* for troubleshooting.

(3) Connect a load and auto-tune (See *3-7 Making Adjustments*.)

• Connect the motor shaft to the load (mechanical system) securely, being sure to tighten screws so that they will not become loose.

• Perform auto-tuning with the Parameter Unit.

(4) Turning ON the Run command Input

• Turn ON the run command input. The Servomotor will go into servo-ON status.

• Give a speed command, or carry out the following check with a jogging operation.

(5) Low Speed Operation

• Operate at low speed.
Apply a low-frequency pulse command.
The meaning of "low speed" can vary with the mechanical system. Here, "low speed" means approximately 10% to 20% of the actual operating speed.

• Check the following items.

Is the emergency stop operating correctly?
Are the limit switches operating correctly?
Is the operating direction of the machinery correct?
Are the operating sequences correct?
Are there any abnormal sounds or vibration?
Is anything abnormal occurring?

• If anything abnormal occurs, refer to *Chapter 4 Application* and apply the appropriate countermeasures.

(6) Operation Under Actual Load Conditions

• Operate the Servomotor in a regular pattern and check the following items.

Is the speed correct? (Use the speed display.)
Is the load torque roughly equivalent to the measured value? (Use the torque command display.)
Are the positioning points correct?
When an operation is repeated, is there any discrepancy in positioning?
Are there any abnormal sounds or vibration?
Is either the Servomotor or the Servo Driver abnormally overheating?
Is anything abnormal occurring?

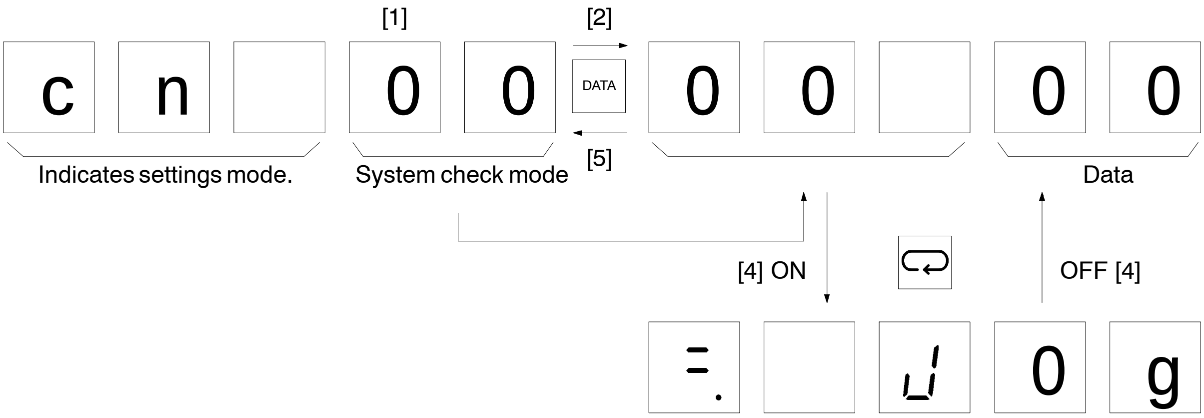
• If anything abnormal occurs, refer to *Chapter 4 Application* and apply the appropriate countermeasures.

(7) Readjust the gain.

• If the gain could not be adjusted completely using auto-tuning, perform the procedure in *3-7 Making Adjustments* to adjust the gain.

3-6-2 Jog Operations

Jog operations rotate the Servomotor in a forward or reverse direction using the Parameter Unit. Jog operations are made possible when system check mode Cn-00 is set to “00.” The items in parentheses in the following explanation indicate operations using the Handy-type Parameter Unit.



■ Operating Procedure (Key in Parentheses are for Mounted-type Parameter Units)

1. Confirm that the initial display is shown (–. bb).
2. Press the MODE/SET Key to enter the settings mode.
3. Using the Up and Down Keys, set parameter number “00.” (System check mode)
4. Press the DATA Key to display the setting of Cn-00.
5. Using the Up and Down Keys, set the parameter to “00.” (Jog operation)
6. Press the MODE/SET Key to shift to the jog display.
7. Press the SERVO (DATA) Key to turn on the servo.
8. Press the Up Key to jog forward. Forward operation will continue as long as the key is held down.
9. Press the Down Key to jog in reverse. Reverse operation will continue as long as the key is held down.
10. Press the SERVO (DATA) Key to turn off the servo.
11. Press the MODE/SET Key to return to the data display.
12. Press the DATA Key to return to the settings mode.

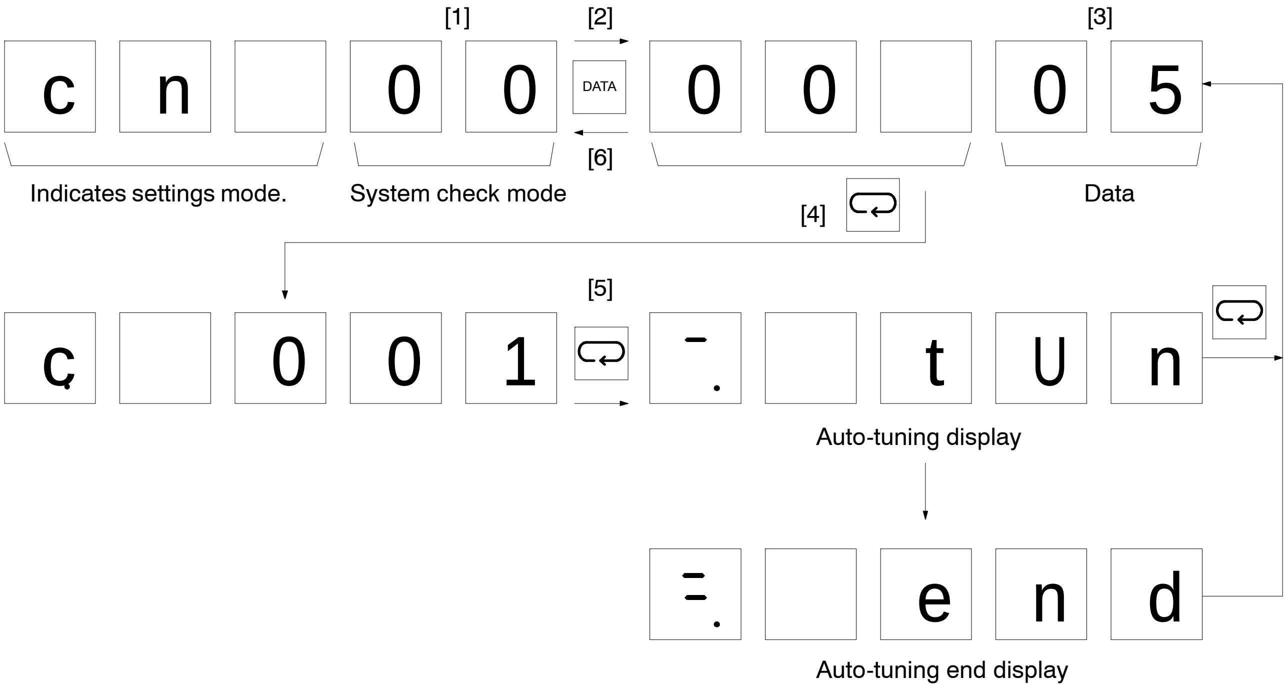
Note The motor speed for jogging is 500 r/min. The jogging speed cannot be changed.

3-7 Making Adjustments

3-7-1 Auto-tuning

Auto-tuning rotates the Servomotor with a load connected (mechanical system), and automatically adjusts the position loop gain, the speed loop gain, and the speed loop integration time constant. When adjustments cannot be made by auto-tuning, refer to *3-7-2 Manually Adjusting Gain*.

■ Executing Auto-tuning



1. Confirm that the initial display is shown (–. bb).
2. Press the MODE/SET Key to enter the settings mode.
3. Using the Up and Down Keys, set parameter number "00." (System check mode)
4. Press the DATA Key to display the setting of Cn-00.
5. Using the Up and Down Keys, set the parameter to "05." (Auto-tuning)
6. Press the MODE/SET Key to switch to the mechanical rigidity selection display.
7. Using the Up and Down Keys, adjust the rigidity to the mechanical system.(Refer to *Selecting Mechanical Rigidity* below.)
8. Press the MODE/SET Key to switch to the auto-tuning display.
9. Press the SERVO (DATA) Key to turn on the servo. (This step is not required if the Run Command Input is ON.)
10. Perform auto-tuning, using the Up Key for forward operation and the Down Key for reverse operation. Continue pressing the key until "End" is displayed, indicating that auto-tuning has been completed.

11. Release the key. The data display will return.
12. Press the DATA Key to return to the settings mode.

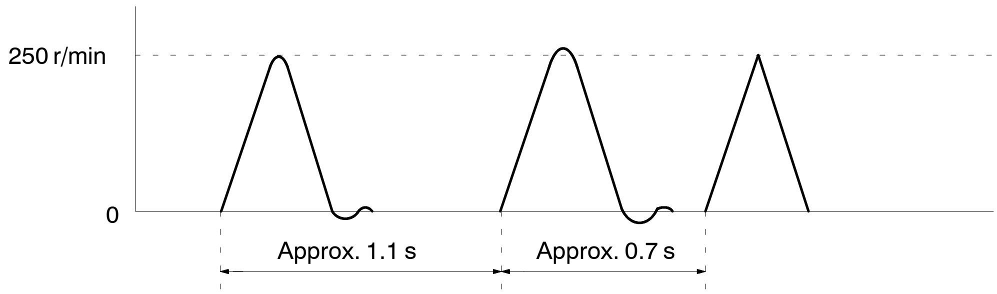
■ Selecting Mechanical Rigidity

Select the set value to match the rigidity of the mechanical system.

Response	Set value	Position loop gain (1/s)	Representative applications
Low	001	16	Articulated robots, harmonic drives, chain drives, belt drives, rack and pinion drives, etc.
	002	28	
Medium	003	40	XY tables, Cartesian-coordinate robots, general-purpose machinery, etc.
High	004	56	Ball screws (direct coupling), feeders, etc.
	005	78	
	006	108	
	007	130	

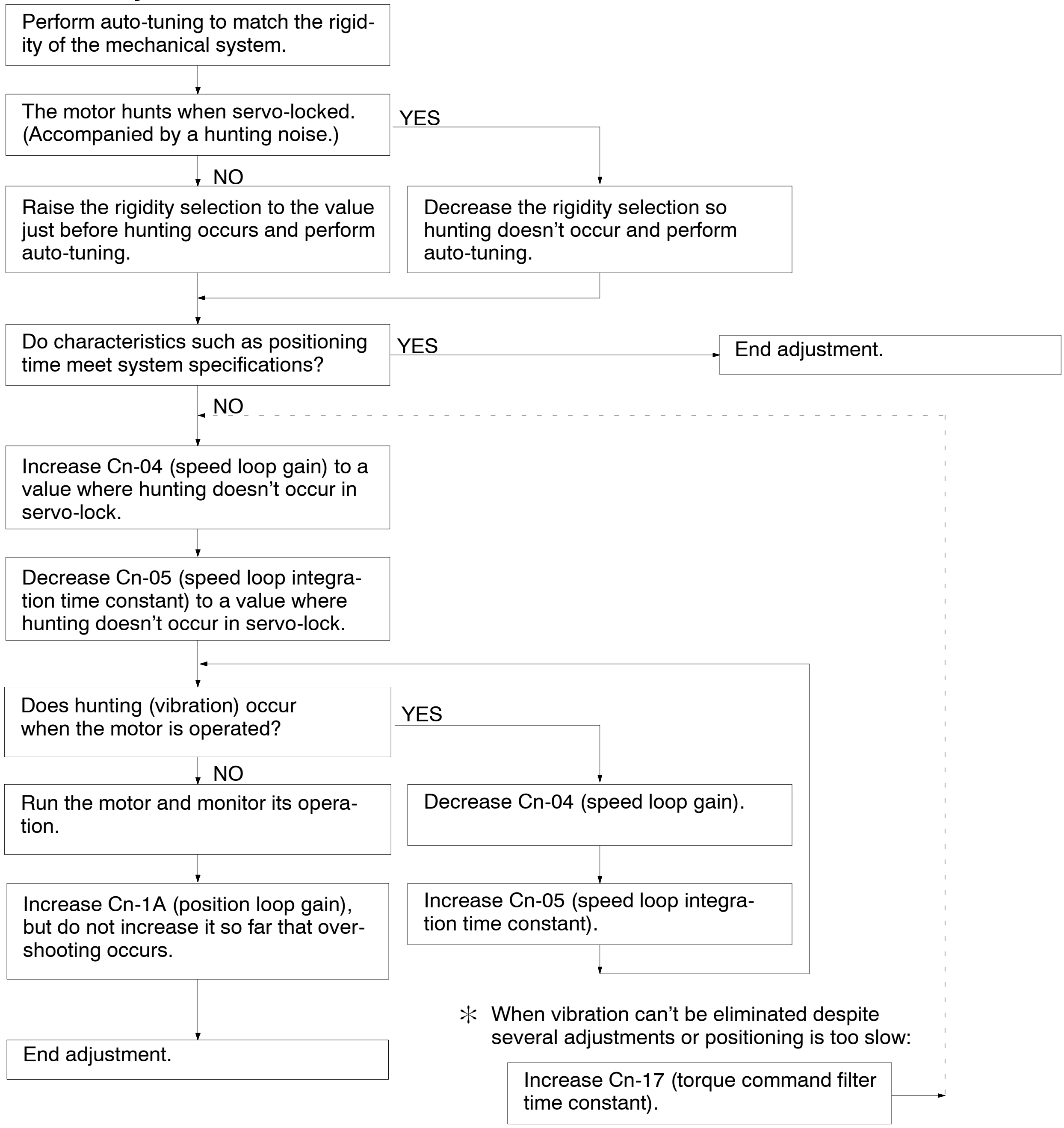
■ Auto-tuning

- Auto-tuning will not be complete until at least three operations have been completed. Be sure there is plenty of room for the machine to operate.
- If the auto-tuning is not complete after three operation, operations will be repeat as long as the key is held down.
- The motor speed for auto-tuning is approximately 250 r/min. The auto-tuning speed cannot be changed.
- Auto-tuning will automatically change the setting of the user parameter position loop gain (Cn-1A), speed loop gain (Cn-04), and speed loop integration time constant (Cn-05). These values will not be changed, however, until the auto-tuning operation has been completed.
- If auto-tuning does not complete or if the gain set via auto-tuning is not sufficient, adjust the gain manually using the procedure in *3-7-2 Manually Adjusting Gain*.



3-7-2 Manually Adjusting Gain

■ Gain Adjustment Flowchart



• Gain Adjustment Standards

The following table shows reference values for gain adjustment. Adjustments can be made quickly if these values are used as standards. Make the initial gain setting based on the load inertia.

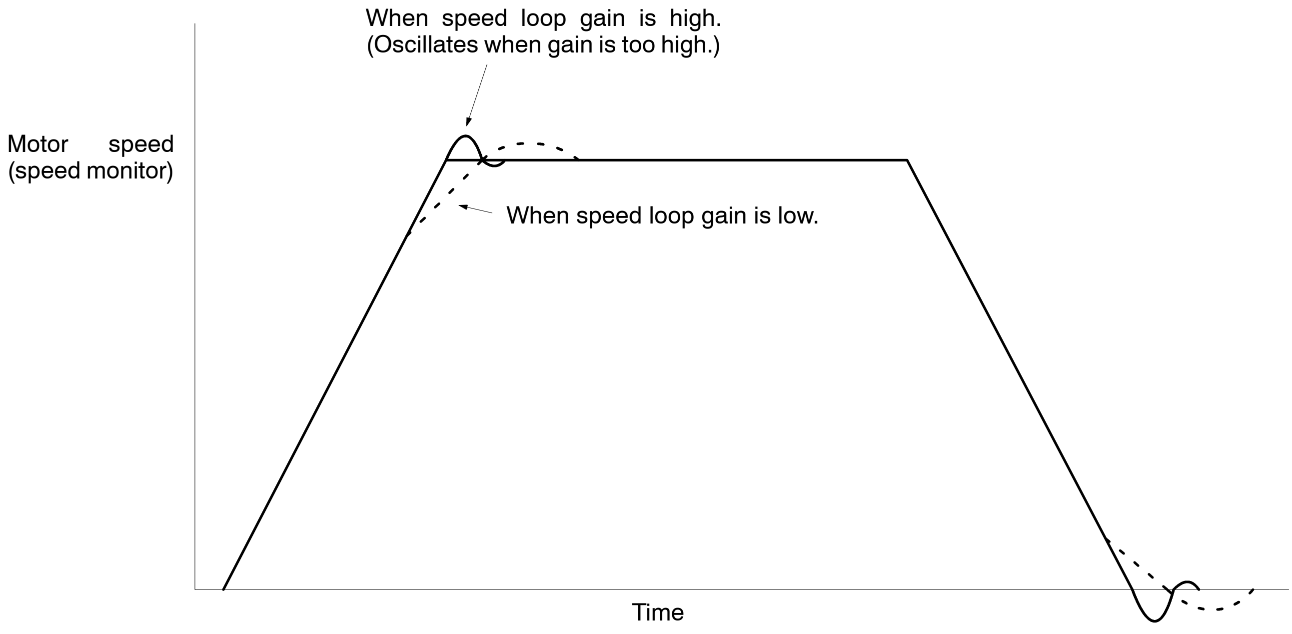
Load inertia factor	Speed loop gain Cn-04 (Hz)	Speed loop integration constant Cn-05 (ms)	Position loop gain Cn-1A (1/s)	Comments
1	80	40	60	High rigidity
3	80	20	40	Factory setting
3	120	30	40	---
10	350	40	40	---
20	420	80	20	Moderate rigidity
20	200	120	10	Low rigidity

■ Adjustment Parameters

• Adjusting Speed Loop Gain

PRM No.	Parameter name	Factory setting	Unit	Setting range	Explanation
Cn-04	Speed loop gain	80	Hz	1 to 2,000	Adjusts the speed loop response. As the gain is increased, the servo rigidity is strengthened. The greater the inertia rate, the higher this is set. If the gain is set too high, oscillation will occur.

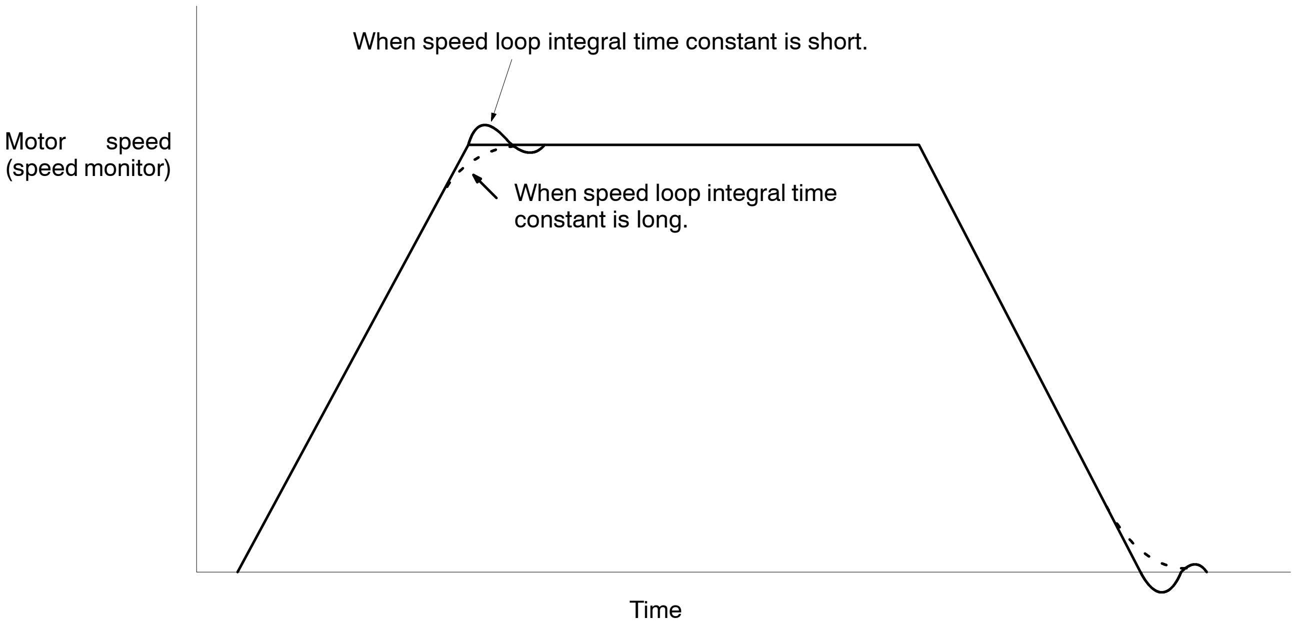
When the speed loop gain is manipulated, the response is as shown in the diagram below.



• Adjusting the Speed Loop Integration Time Constant

PRM No.	Parameter name	Factory setting	Unit	Setting range	Explanation
Cn-05	Speed loop integration constant	20	1 ms	2 to 10,000	Speed loop integration constant. As the constant is increased, the response is shortened and the resiliency toward external force is weakened. If it is set too short, vibration will occur.

When the speed loop integration time constant is manipulated, the response is as shown in the diagram below.



PRM No.	Parameter name	Factory setting	Unit	Setting range	Explanation
Cn-17	Torque command filter time constant	4	0.1 ms	0 to 250	Sets torque command filter time constant. Increase the time constant to reduce oscillation and vibration due to machinery resonance frequency. The filter characteristic is switched using the torque command filter time constants.
Cn-1A	Position loop gain	40	1/s	1 to 500	For servo-lock strength adjustment when position lock function is used. Adjust to match mechanical rigidity.

• Position Loop Gain

Adjust the position loop gain according to the rigidity of the machine.

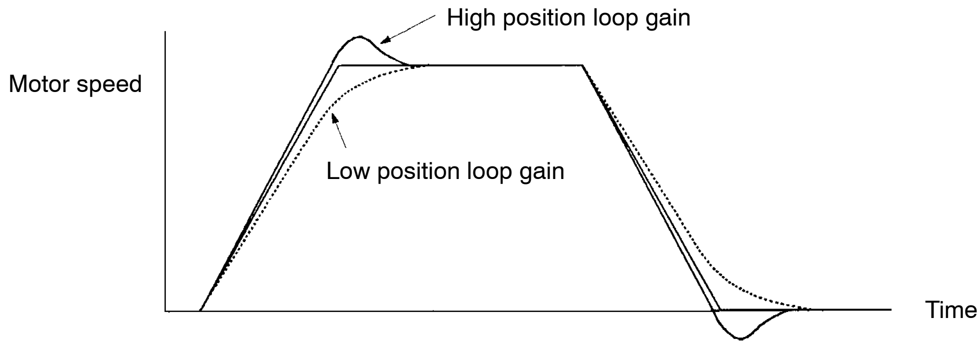
The responsiveness of the servo system is determined by the position loop gain. When a servo system has high position loop gain, the responsiveness is greater and positioning can be faster. In order for position loop gain to be raised, the mechanical rigidity and the characteristic frequency must be increased. For general NC machine tools, the range is 50 to 70 (1/s); for general machinery and assembly devices, it is 30 to 50 (1/s); for industrial robots, it is 10 to 30 (1/s).

The factory setting for position loop gain is 40 (1/s), so it should be lowered for systems with low rigidity. If a system has low rigidity or low characteristic frequency, increasing the position loop gain sympathetic vibration of machinery will occur and an alarm will be generated.

Position loop gain is generally expressed as follows:

$$\text{Position loop gain (Kp)} = \frac{\text{Instruction command frequency (pulses/s)}}{\text{Deviation counter's residual pulse amount (pulses)}} \ (1/s)$$

The response is as shown in the following diagram when the position loop gain is manipulated.



PRM No.	Parameter name	Factory setting	Unit	Setting range	Explanation
Cn-1b	Positioning completion range	3	Command units	0 to 250	Sets the range for the positioning completion signal output. (Generally set according to the precision required by the system.) Increasing the positioning completion range too much can cause the positioning completion output to turn ON during low-speed operation or other times when there are few residual pulses.

• Feed-forward Amount

The feed-forward amount is effective when the position loop gain is set to less than 25 l/s. It will not be very effective when the position loop gain is higher than 25 l/s.

Increasing the feed-forward amount to much will cause excessive overshooting.

The feed-forward amount is not sent through the deviation counter, but is applied directly to the speed loop. The differential of the deviation counter is thus not applied, causing a faster response when the load response is delayed from the commands.

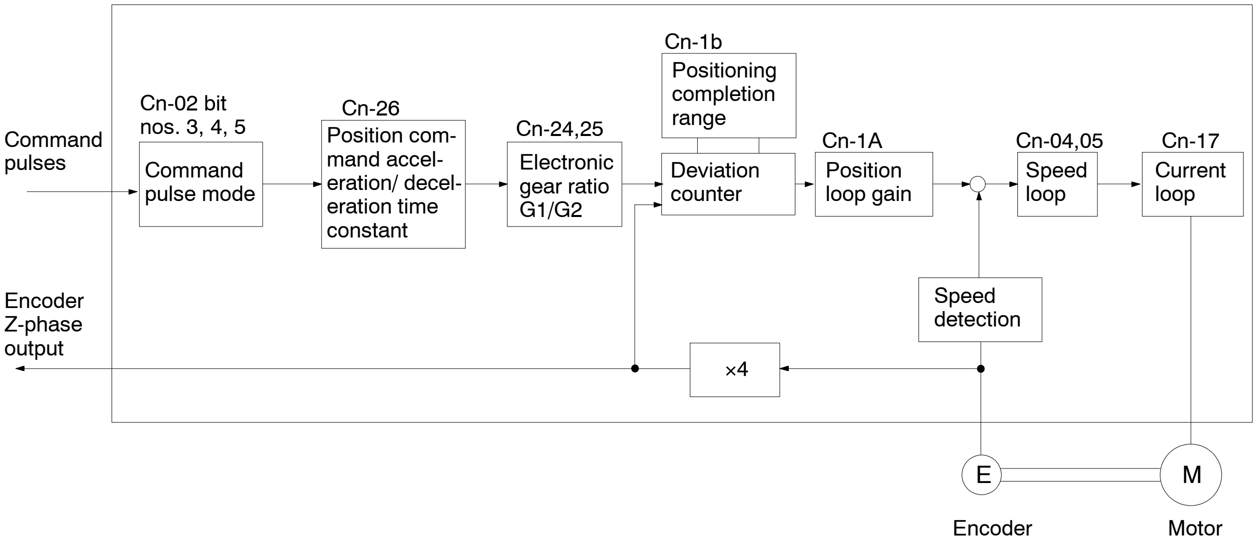
Be sure that the position loop is completely adjusted and that the speed loop is operating safely before adjusting the feed-forward amount.

Increasing the feed-forward amount too much will cause the speed command to oscillate, resulting in abnormal noise from the motor. Increase the feed-forward amount slowly from 0%, adjusting it so that the positioning completion output is not adversely affected (e.g., turn repeatedly ON and OFF) and so that the speed does not overshoot.

PRM No.	Parameter name	Factory setting	Unit	Setting range	Explanation
Cn-26	Position command acceleration/deceleration time constant	0	× 0.1 ms	0 to 640	Sets the time constant for smoothing (position command soft start function). Even if the position command pulses are input in steps, the time constant set here will be used to accelerate/decelerate the motor. The same time will be used for both acceleration and deceleration. Set this parameter to 0 when using a position controller that has an acceleration/deceleration function.

■ Position Loop Adjustment

• Position Loop Block Diagram



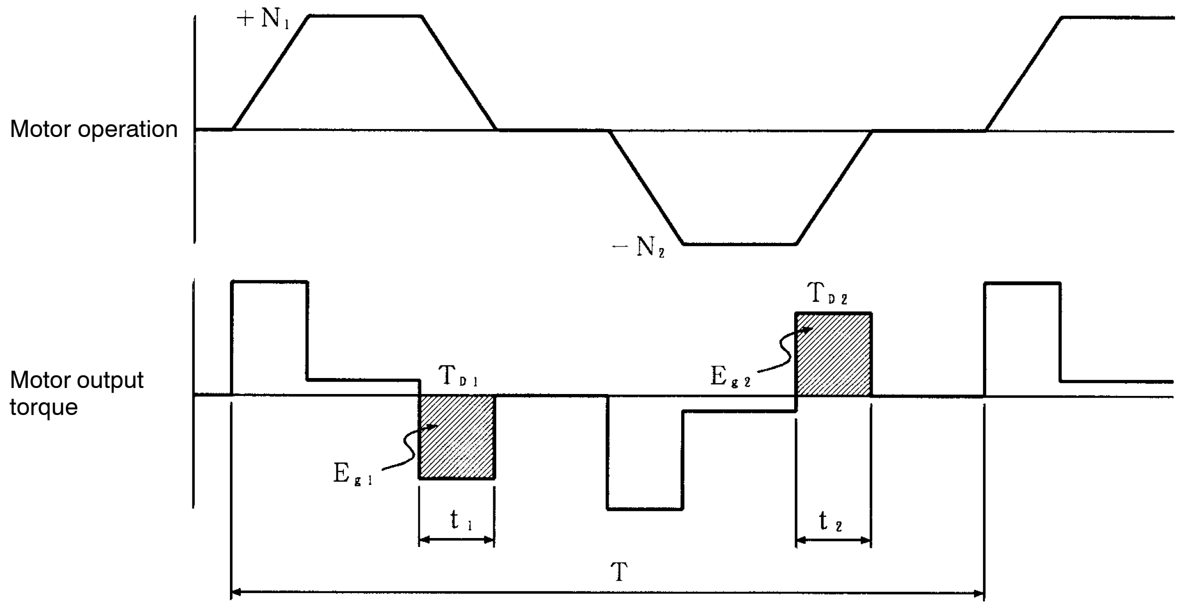
3-8 Regenerative Energy Absorption

Regenerative energy produced at times such as Servomotor deceleration is absorbed by the Servo Driver's internal capacitors, thereby preventing an increase in DC voltage. If the regenerative energy from the Servomotor becomes too large, however, an overvoltage error will occur. In such cases, it is necessary to connect a Regeneration Unit to increase the capacity for absorbing regenerative energy.

3-8-1 Calculating Regenerative Energy

Regenerative energy is produced when the direction of Servomotor rotation or output torque is reversed. The methods for calculating regenerative energy for the horizontal and vertical shafts are explained below.

■ Horizontal Axle



Note In the output torque graph, when the rotation direction and the torque direction match it is shown as positive.

The regenerative energy for each section can be found by means of the following formulas:

$E_{g1} = 1/2 \bullet N_1 \bullet T_{D1} \bullet t_1 \bullet 1.027 \times 10^{-2}$ [J]
$E_{g2} = 1/2 \bullet N_2 \bullet T_{D2} \bullet t_2 \bullet 1.027 \times 10^{-2}$ [J]

N_1, N_2: Rotation speed at beginning of deceleration [r/min]
T_{D1}, T_{D2}: Deceleration torque [kgf • cm]
t_1, t_2: Deceleration time [s]

Note There is some loss due to winding resistance, so the actual regenerative energy will be approximately 90% of the figure derived by the formula.

The maximum regenerative energy for the Servo Driver's internal capacitors only can be found by means of the following formula:

$E_g = (E_{g1}, E_{g2})$ [J]
E_g is the larger of E_{g1} and E_{g2}.

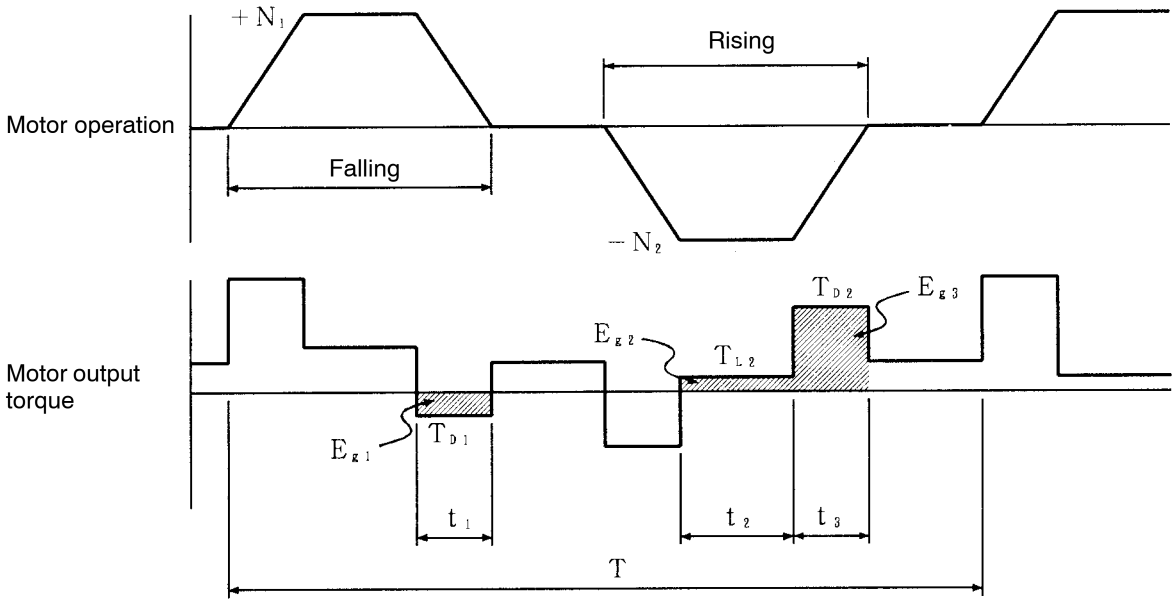
When regenerative energy is absorbed at the Servo Driver only, E_g must not exceed the amount of regenerative energy that can be absorbed at the Servo Driver. In addition, the average regenerative power when a Regeneration Unit is connected can be found by means of the following formula:

$P_r = (E_{g1} + E_{g2})/T$ [W]
T: Operation cycle [s]

E_g must not exceed the maximum regeneration absorption capacity of the Servo Driver when only the Servo Driver is used to absorb regenerative energy. When a Regeneration Unit is connected, the average regenerative power (P_t) must not exceed the regeneration processing power of the Regeneration Unit.

Connect an external regeneration resistor when the regeneration processing power of the Regeneration Unit (12 W) is exceeded. Refer to *3-8-3 Absorption of Regenerative Energy with the External Regeneration Resistor* for details on external regeneration resistors.

■ Vertical Axle



Note In the output torque graph, when the rotation direction and the torque direction match it is shown as positive.

The regenerative energy for each section can be found by means of the following formulas:

$E_{g1} = 1/2 \bullet N_1 \bullet T_{D1} \bullet t_1 \bullet 1.027 \times 10^{-2}$ [J]
$E_{g2} = N_2 \bullet T_{L2} \bullet t_2 \bullet 1.027 \times 10^{-2}$ [J]
$E_{g3} = 1/2 \bullet N_2 \bullet T_{D2} \bullet t_3 \bullet 1.027 \times 10^{-2}$ [J]

N_1, N_2: Rotation speed at beginning of deceleration [r/min]
T_{D1}, T_{D2}: Torque when declining [kgf • cm]
T_{L2}: Deceleration torque [kgf • cm]
t_1, t_3: Travel time equivalent to torque when declining [s]
t_2: Deceleration time [s]

Note There is some loss due to winding resistance, so the actual regenerative energy will be approximately 90% of the figure derived by the formula.

The maximum regenerative energy for the Servo Driver's internal capacitors only can be found by means of the following formula:

E_g is the larger of E_{g1}, $E_{g2} + E_{g3}$.

When regenerative energy is absorbed at the Servo Driver only, E_g must not exceed the amount of regenerative energy that can be absorbed at the Servo Driver. In addition, the average regenerative power when a Regeneration Unit is connected can be found by means of the following formula:

$P_r = (E_{g1} + E_{g2} + E_{g3})/T$ [W]
T: Operation cycle [s]

E_g must not exceed the maximum regeneration absorption capacity of the Servo Driver when only the Servo Driver is used to absorb regenerative energy. When a Regeneration Unit is connected, the average regenerative power (P_t) must not exceed the regeneration processing power of the Regeneration Unit.

Connect an external regeneration resistor when the regeneration processing power of the Regeneration Unit (12 W) is exceeded. Refer to *3-8-3 Absorption of Regenerative Energy with the External Regeneration Resistor* for details on external regeneration resistors.

3-8-2 Servo Driver Absorbable Regenerative Energy

■ Regenerative Energy Absorbed Internally

The Servo Driver absorbs regenerative energy by means of an internal capacitor. If there is more regenerative energy than can be absorbed by the capacitor, an overvoltage error will be generated and operation cannot continue. The amounts of regenerative energy that can be absorbed by the various Servo Drivers alone are shown in the tables below. If regenerative energy exceeding these values is produced, take the following measures.

- Connect a Regeneration Unit (R88A-RG08UA). (Non-conforming Models)
- Lower the operating rotation speed. (The regenerative energy is proportional to the square of the rotation speed.)
- Lengthen the deceleration time. (Reduce the amount of regenerative energy per unit time.)
- When using multiple axes, the + terminals can be connected together and the – terminals can be connected together to use regenerative energy as the drive energy for the other axes. (Models Conforming to EC Directives)

• 200-VAC Input Type

Model	Absorptive regeneration energy (J)	Maximum applicable load inertia ($\times 10^{-4}$ kg•m^2)	Remarks (see note *3)
R88D-UEP04H/UEP04V (100 W)	13.3	1.2	Rotor inertia × 30, 4,500 r/min
R88D-UEP08H/UEP08V (200 W)	23.9	3.69	Rotor inertia × 30, 3,000 r/min
R88D-UEP12H/UEP12V (400 W)	21.1	3.8	Rotor inertia × 20, 3,000 r/min
R88D-UEP20H/UEP20V (750 W)	52.2	13.4	Rotor inertia × 20, 3,000 r/min

Note 1. The input voltage is the value at 200 VAC. As the input voltage is increased, the amount of regenerative energy that can be absorbed is decreased.

Note 2. For Servomotors with brakes, add the brake inertia to the load inertia.

Note 3. This is the applicable range for the horizontal shaft. (No external force should be applied.)

- **100-VAC Input Type**

Model	Absorptive regeneration energy (J)	Maximum applicable load inertia ($x10^{-4}$ kg•m^2)	Remarks (see note *3)
R88D-UEP10L/UEP10W (100 W)	13.3	1.2	Rotor inertia × 30, 4,500 r/min
R88D-UEP12L/UEP12W (200 W)	23.9	3.69	Rotor inertia × 30, 3,000 r/min
R88D-UEP15L/UEP15W (300 W)	99.5	3.8	Rotor inertia × 20, 4,500 r/min

Note 1. The input voltage is the value at 100 VAC. As the input voltage is increased, the amount of regenerative energy that can be absorbed is decreased.

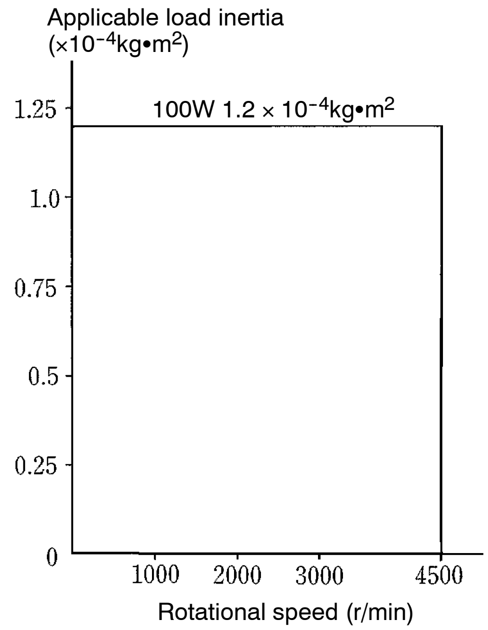
Note 2. For Servomotors with brakes, add the brake inertia to the load inertia.

Note 3. This is the applicable range for the horizontal shaft. (No external force should be applied.)

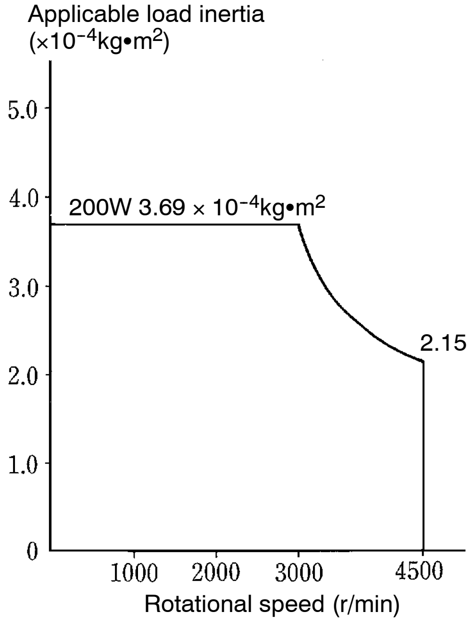
■ Range for Absorbing Regenerative Energy

The relationship between rotational speed and the load inertia that can be absorbed by a Servo Driver alone is shown in the diagrams below. If a Servo Driver is operated outside of this range, a Regeneration Unit must be connected. These diagrams show the applicable range for the horizontal shaft. If an external force acts in the same direction as the Servomotor rotation, due to factors such as the fall time on the vertical shaft, be sure to measure the regenerative energy and check to see that the amount that can be absorbed is not exceeded.

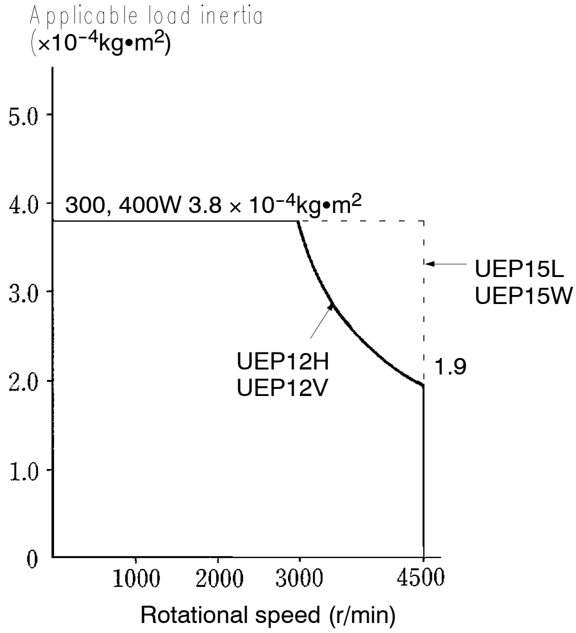
- **R88D-UEP04H/UEP04V (100 W)**
  R88D-UEP10L/UEP10W (100 W)



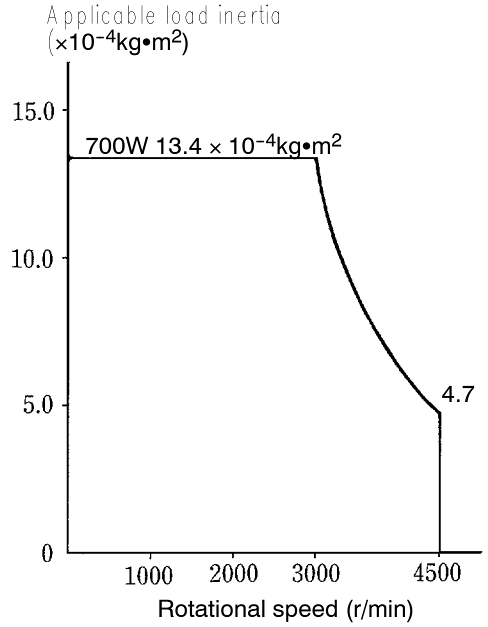
- **R88D-UEP08H/UEP08V (200 W)
R88D-UEP12L/UEP12W (200 W)**



- **R88D-UEP12H/UEP12V (400 W)
R88D-UEP15L/UEP15W (300 W)**



● **R88D-UEP20H/UEP20V (750 W)**



3-8-3 Absorption of Regenerative Energy with the External Regeneration Resistor

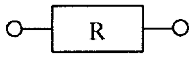
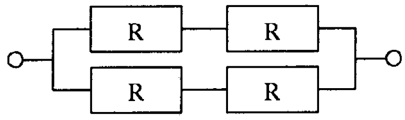
Connect one or more external regeneration resistors when a Regeneration Unit (R88A-RG08UA) cannot absorb all of the regenerative energy. Remove the short bar from between the RG and JP terminals on the Regeneration Unit and connect the resistor between the P and RG terminals. Connecting to the wrong terminals may destroy the Regeneration Unit, so connect the resistor carefully. (The Regeneration Unit does not conform to EC Directives.)
The external regeneration resistor will heat to approximately 120°C. Do not install it near devices or wiring that is sensitive to heat. Install heat radiation plates suitable to the radiation conditions.

■ External Regeneration Resistors

● **Models**

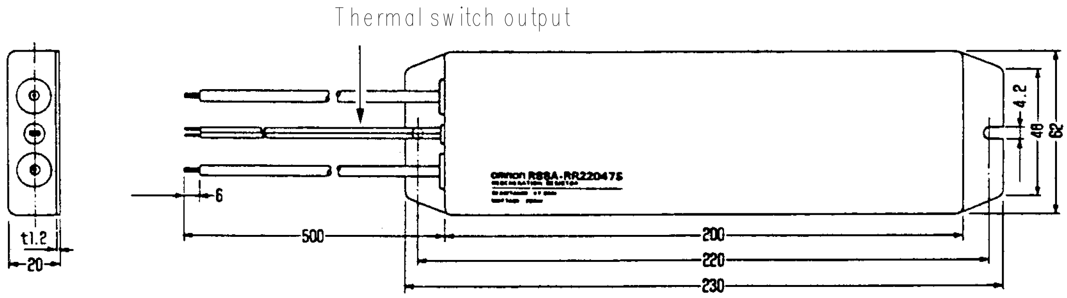
Model	Resistance	Nominal capacity	Regeneration absorption at 120°C	Heat radiation conditions	Thermal switch output specifications
R88A-RR22047S	47Ω ±5%	220 W	70 W	t1.0 × □350 (SPCC)	Operating temperature: 170°C N.C. contact

• Combining External Regeneration Resistors

Item	Regeneration absorption capacity	
	70 W	280 W
Combining external regeneration resistors		

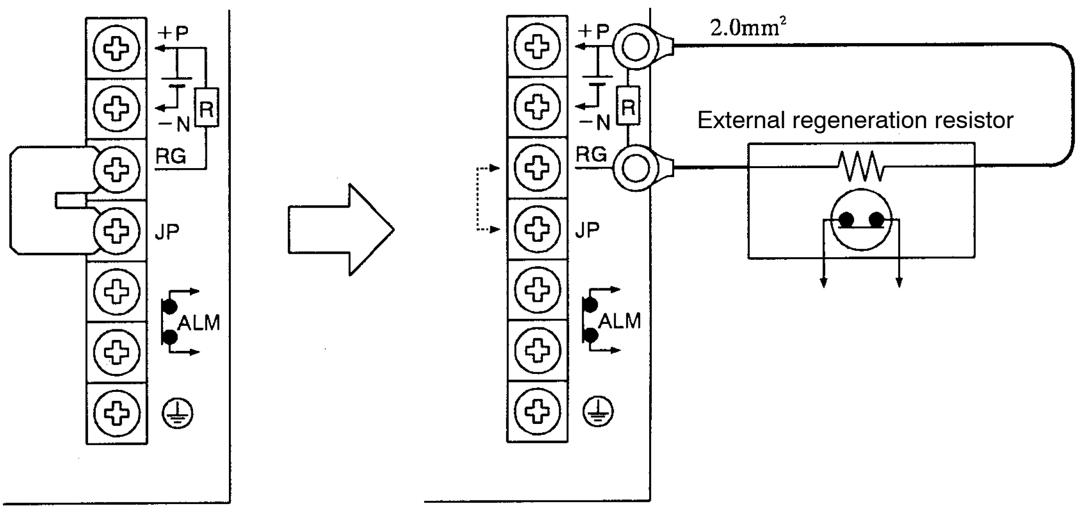
Note Use a combination with an absorption capacity larger than the average regenerative power (P_r).

• Dimensions (Unit: mm)



■ Wiring External Regeneration Resistors

Remove the short bar from between the RG and JP terminals on the Regeneration Unit and connect the resistor(s) between the P and RG terminals.

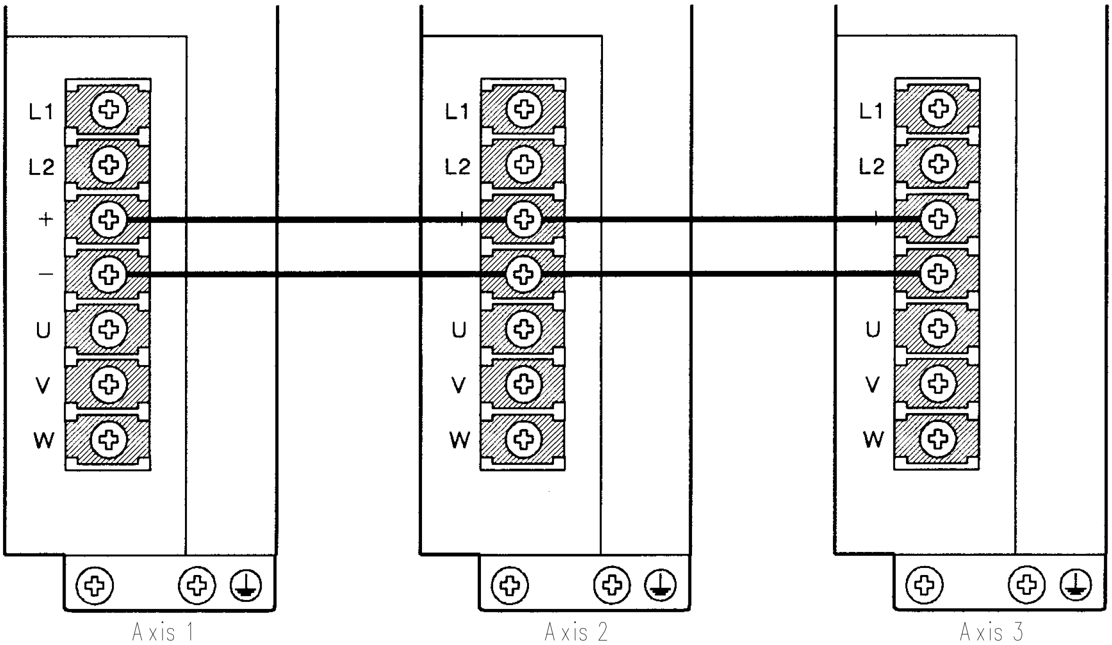


Note The thermal switch output must be connected in the same way as the ALM output from the Regeneration Unit, i.e., so that power supply is broken when the contacts open.

3-8-4 Processing Regenerative Energy with Multiple Axes (Models Conforming to EC Directives)

When using multiple axes, the + terminals on the Servo Drivers can be connected together and the – terminals can be connected together to use regenerative energy as the drive energy for the other axes, thus absorbing the energy. Servo Drivers with different power supply voltages, however, cannot be connected. Also, regeneration absorption capacity will not be increased when all axes simultaneously produce regenerative energy.

■ Wiring Method (Example for 3 Axes)



Note 1. Do not open or close the connections between the + or – terminals while power is being supplied. The Units may be destroyed.

Note 2. Do not connect Servo Drivers that are using different power supply voltages. The Units may be destroyed.

Regeneration absorption capacity will not be increased when all axes simultaneously produce regenerative energy. Take one or more of the following methods if this occurs.

- Reduce the number of rotations being used. (Regenerative energy is directly proportional to the square of the number of rotations.)
- Increase the deceleration time. (This will reduce the regenerative energy per unit time.)

4

Chapter 4

・Application・

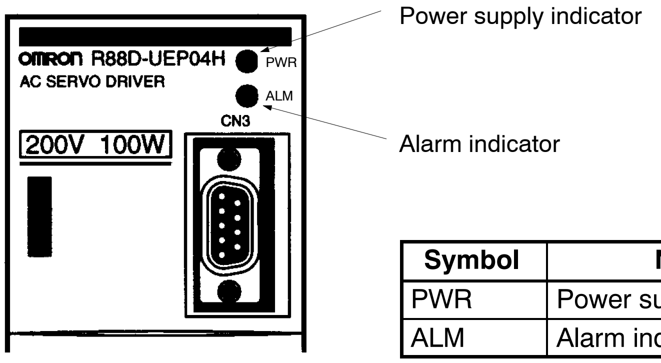
4-1 Using Displays

4-1-1 Display Functions

OMRON U-series AC Servomotors have unique servo software that enables quantitative monitoring in real time, on digital displays, of changes in a variety of characteristics. Use these displays for checking the various characteristics during operation.

■ Servo Driver Displays

There are two LED indicators on the Servo Driver itself. One is for the power supply and another is for alarms.



Symbol	Name	Function
PWR	Power supply indicator	Lit when AC power supply is normal.
ALM	Alarm indicator	Lit when error occurs.

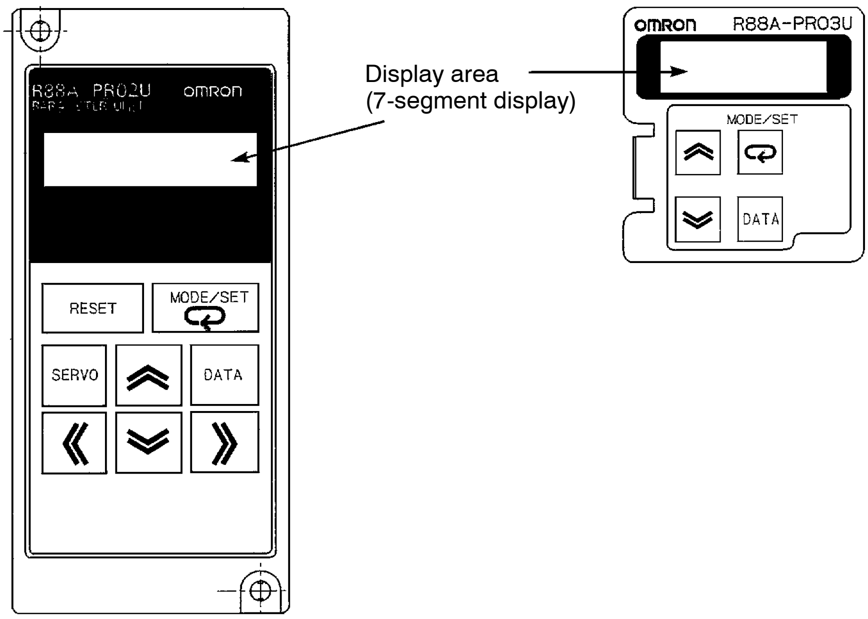
If the alarm indicator is lit, connect a Parameter Unit and check the contents of the alarm.

■ Parameter Unit Displays

When a Parameter Unit is connected, monitoring can be conducted by means of a 5-digit 7-segment LED.

R88A-PR02U Handy Type

R88A-PR03U Mounted Type



■ Parameter Unit Key Functions

The contents displayed by the Parameter Unit can be changed by key operations.

Handy-type Parameter Unit R88A-PR02U	Mounted Parameter Unit R88A-PR03U	Function
RESET	︽ + ︾	Alarm reset
↩	↩	Mode switching; data memory
SERVO	DATA	Servo ON/OFF during jog operations
DATA	DATA	Switching between parameter display and data display; data memory
︽	︽	Increments parameter numbers and data values.
︾	︾	Decrements parameter numbers and data values.
《	---	Left shift for operation digits
》	---	Right shift for operation digits

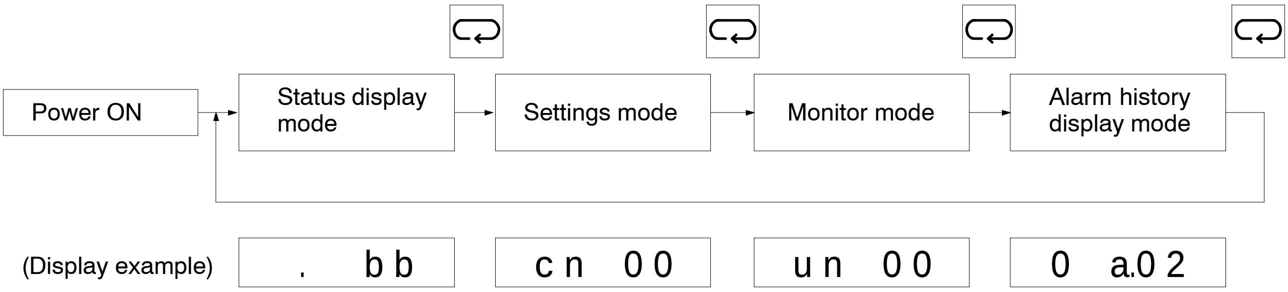
■ Types of Modes

There are four types of modes for Parameter Unit displays. The functions in each mode are shown in the following table.

Mode	Function
Status display mode	Bit display (indicating internal status via indicators): Power supply ON display, base block, positioning completed, rotation detection and command pulse input Symbol display (indicating internal status via 3-digit 7-segment display): Base block, operating, forward rotation prohibited, reverse rotation prohibited, alarm display
Settings mode	System check: Jog operations, alarm history data clear, motor parameters check, auto-tuning Setting and checking setup parameters Setting and checking user parameters
Monitor mode	Speed feedback, torque commands, number of pulses from U-phase, electrical angle, internal status bit display, command pulse speed, position deviation, and input pulse counter.
Alarm history display mode	Displays contents of alarms that have been previously generated (up to a maximum of 10).

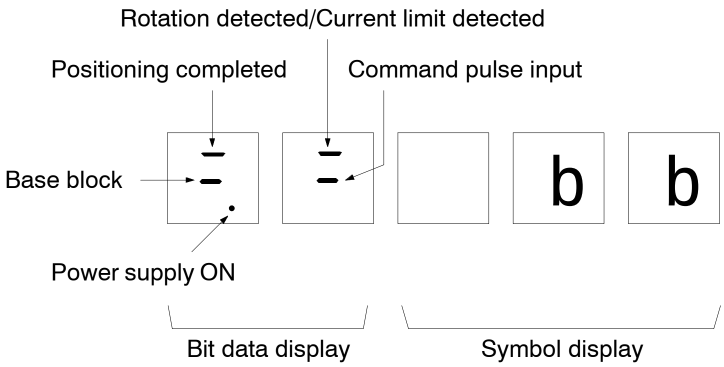
■ Changing the Mode

Use the MODE/SET Key to change from one mode to another.



4-1-2 Status Display Mode

The status display mode is entered when powering up or by means of the MODE/SET Key. In the status display mode, Servo Driver status is displayed in two ways: bit data and symbols. These displays are shown in the following illustration.



■ Bit Data Display Contents

Bit data	Contents
Power supply ON	Lit when Servo Driver power supply is ON.
Base block	Lit during base block (no power to motor); dimmed when servo is ON.
Positioning completed	Lit when the pulse count remaining on the deviation counter is equal to or less than the positioning completed range set in Cn-1b.
Rotation detection	Lit when the motor rotational speed is 20 r/min or higher.
Command pulse input	Lit when the specified command pulse is being input.

■ Symbol Display Contents

Symbol display	Contents
bb	Base block (no power to motor)
rUn	Operating
p%t	Forward rotation prohibited
n%t	Reverse rotation prohibited
a.□□	Alarm display (Refer to alarm table.)

4-1-3 Monitor Mode (Un-)

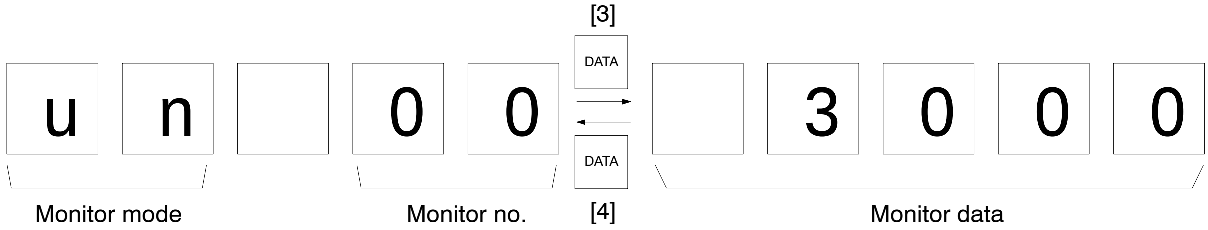
■ Types of Monitoring

In monitor mode, nine types of monitoring can be carried out.

Monitor no.	Monitor contents	Unit	Explanation
00	Speed feedback	r/min	Displays actual rotational speed of motor.
02	Torque command	%	The command to the current loop is displayed as 100% of the rated torque.
03	Number of pulses from U-phase edge	Pulses	The number of pulses from the U-phase edge is displayed in units of encoder resolution. Displays pulse number with 1/4 turn being 1024 pulses (with an error of approx. ±5 pulses).
04	Electrical angle	Degrees	Displays the electrical angle of the motor.
05	Internal status bit display 1	---	Displays Servo Driver internal information as either lit or not lit.
06	Internal status bit display 2	---	
07	Command pulse speed display	r/min	Displays the command pulse counter converted to a frequency (r/min).
08	Position deviation (deviation counter)	Pulses	Displays the pulse count (position deviation) remaining on the deviation counter in command units (based on input pulses).
09	Input pulse counter	Command units	Counts and displays the input pulses.

■ Operation in Monitor Mode

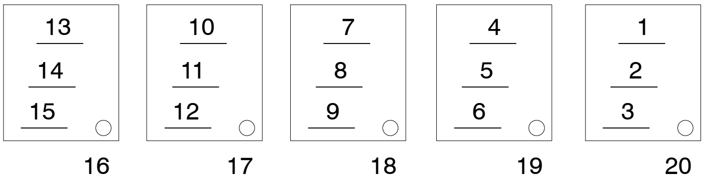
In order to conduct monitoring, first go into monitor mode and then set the monitor number and press the DATA Key. The items in parentheses in the following explanation indicate operations using the Handy-type Parameter Unit.



1. Press the MODE/SET Key to go into monitor mode.
2. Using the Up and Down (and Right and Left) Keys, set the monitor number.
3. Press the DATA Key to display the monitor data.
4. Press the DATA Key to return to the monitor number display.
5. Press the MODE/SET Key to move from monitor mode to alarm history display mode.

■ Internal Status Bit Display (Un-05, Un-06)

Internal status is displayed by 7-segment bit lighting. The bit number allocation is shown in the following diagram.



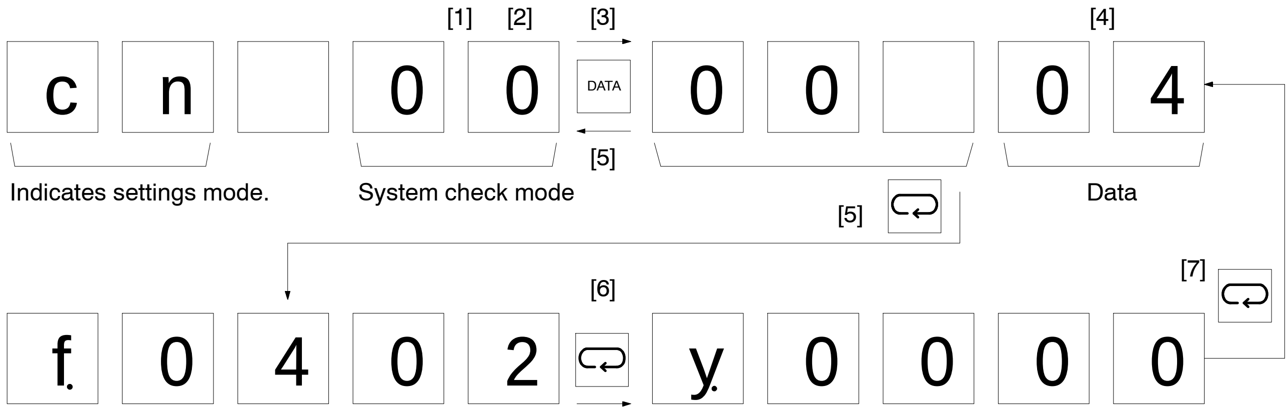
Monitor no.	Bit no.	Symbol	Contents
Un-05	1	ALM	Lit when alarm is generated.
	2	DBON	Lit during dynamic brake operation.
	3	DIR	Lit when in reverse rotation mode (when Cn-02 bit no. 0 = 1).
	4	TGON	Lit when the motor rotational speed is 20 r/min or greater.
	5	INP	Lit when the motor rotational speed reaches the speed command value.
	6	PCON	Lit when the speed control loop is in P control.
	7		Not used
	8		Not used
	9	SVON	Lit when motor is receiving power.
	10	A	Encoder A phase (Lit when there is a signal)
	11	B	Encoder B phase (Lit when there is a signal)
	12	Z	Encoder Z phase (Lit when there is a signal)
	13	PU	Poll sensor U phase
	14	PV	Poll sensor V phase
	15	PW	Poll sensor W phase
	16	RUN	Lit when run command is ON.
	17	MING	Lit when the gain is reduced.
	18	POT	Lit when forward drive prohibit input is ON.
	19	NOT	Lit when reverse drive prohibit input is ON.
	20	Not used	
Un-06	1	CW	Lit when clockwise command pulses are being input.
	2	CCW	Lit when counterclockwise command pulses are being input.
	3	ECRST	Lit when the deviation counter reset input is ON.
	4 to 20	Not used	

4-1-4 Checking Servomotor Parameters (Cn-00 Set to 04)

Servomotor parameters can be checked when system check mode Cn-00 is set to “04.” Servomotor parameters are the Servomotor specifications that can be controlled by that Servo Driver. They are not the specifications of the Servomotor that is connected. Use this to check whether the Servo Driver and Servomotor combination is suitable.

■ Servomotor Parameter Checking Operation

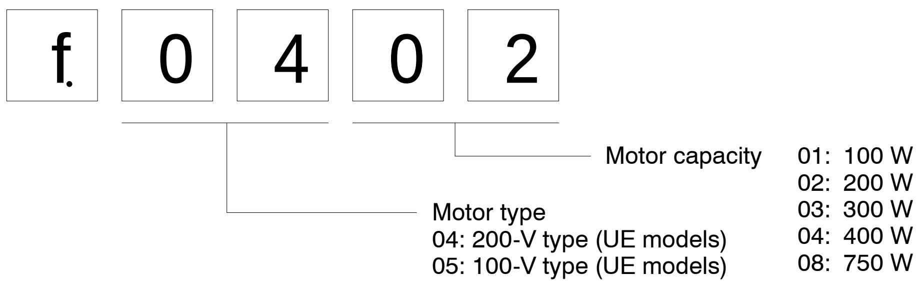
The items in parentheses in the following explanation indicate operations using the Handy-type Parameter Unit.



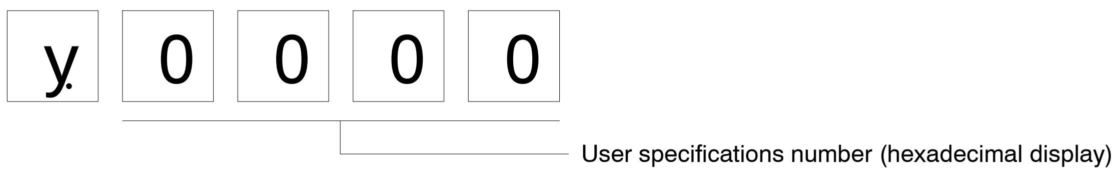
1. Press the MODE/SET Key to switch to the settings mode.
2. Using the Up and Down Keys, set parameter number "00." (System check mode)
3. Press the DATA Key to display the setting of Cn-00.
4. Using the Up and Down Keys, change the setting to "04." (Servomotor parameter check)
5. Press the MODE/SET Key, and check the Servomotor parameters in order.
6. Press the MODE/SET Key to display special specifications in hexadecimal.
7. Press the MODE/SET Key to return to the data display for the system check mode.

■ Parameter Display Contents

● Servomotor Parameters



● Special Specifications



4-2 Protective and Diagnostic Functions

4-2-1 Alarm Displays and Alarm Code Outputs

The Servo Driver has the error detection functions shown below. When an error is detected, the alarm output ($\overline{\text{ALM}}$) is output, the Servo Driver's internal power drive circuit is turned off, and the alarm is displayed.

■ Alarm Table

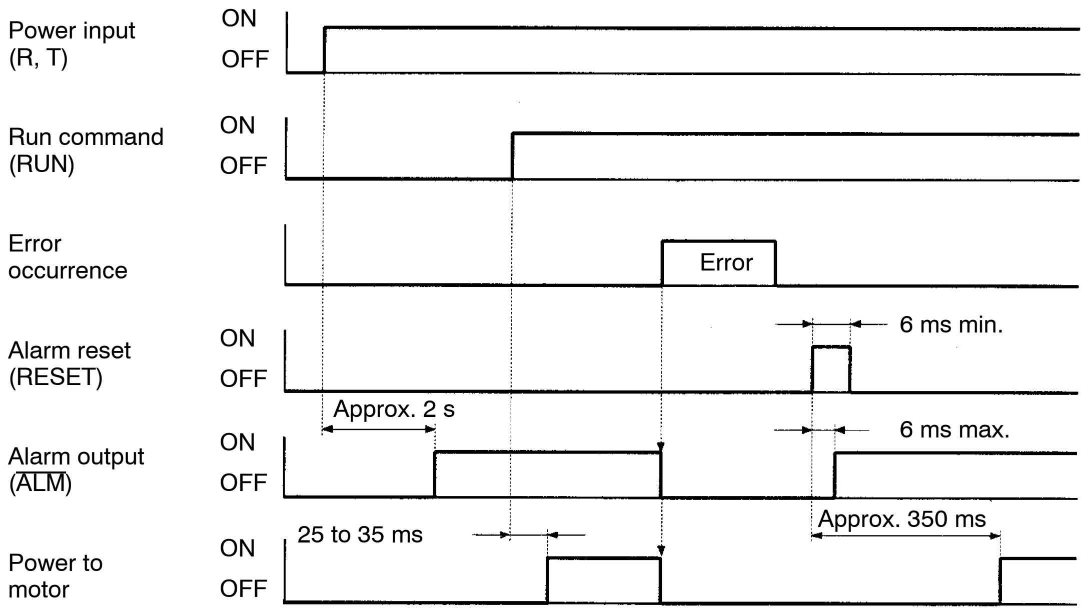
Display	Alarm $\overline{\text{ALM}}$	Error detection function	Detection contents
a.02	OFF	Parameter corruption	The checksum for the parameters read from the EEPROM does not match.
a.04	OFF	Parameter setting error	Incorrect parameter setting.
a.10	OFF	Overcurrent	Overcurrent or overheating detected.
a.31	OFF	Deviation counter overflow	The pulses remaining on the deviation counter exceed the deviation counter overflow level.
a.40	OFF	Overvoltage	Main circuit DC voltage exceeded the allowable value.
a.51	OFF	Over speed	Detected at 4,950 r/min.
a.70	OFF	Overload	Detected at reverse limit characteristics when the output torque exceeds120% of the rated torque.
a.c1	OFF	Runaway detected.	Faulty power or encoder wiring.
a.c2	OFF	Phase error detected.	Connector not properly connected. Encoder not properly wired.
a.c3	OFF	Encoder A or B phase wire disconnection.	Either Phase A or Phase B signal was disconnected or short circuited.
a.c4	OFF	Encoder S phase wire disconnection.	Encoder S phase was disconnected or short circuited.
a.f3	OFF	Momentary power failure alarm	The power supply was re-started within the power retention period.
a.99	ON	Alarm reset power supply turned on.	This is history data only, and is not an alarm.
cpf00	OFF	Parameter Unit transmission error 1	Data could not be transmitted after the power supply was turned on. (It no longer exists in the alarm history.)
cpf01	---	Parameter Unit transmission error 2	Transmission timeout error (It no longer exists in the alarm history.)

Note "---" means indefinite.

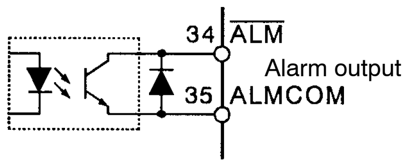
4-2-2 Alarm Output

This section describes the timing of alarm outputs when power is turned on and when alarms occur. The method used to clear alarms is also described.

■ Timing Chart



■ Alarm Output Circuit



Output specifications: 30 VDC, 50 mA max.
Normal: Output transistor ON
Error (alarm): Output transistor OFF

■ Clearing Alarms

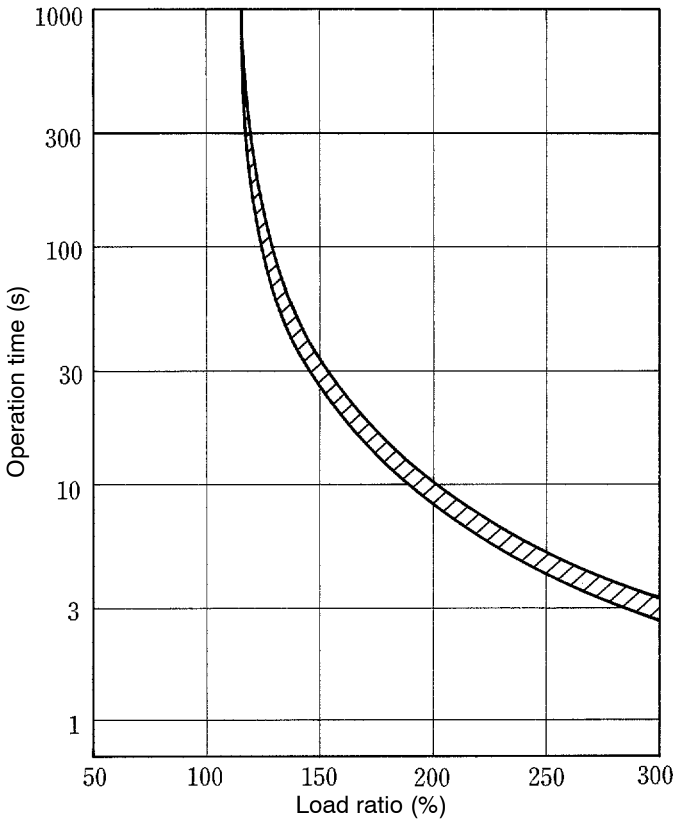
- Any of the following methods can be used to clear alarms:
  Turn ON the alarm reset signal (RESET).
  Toggle the power supply.
  Press the Reset Key on the Parameter Unit.
  Overcurrent alarms (A.10), however, cannot be cleared by toggling the power supply.
- Operation will start as soon as the alarm is cleared if the alarm is cleared while the Run command (RUN) is ON, possibly creating a dangerous situation. Turn OFF the Run command before clearing alarms. Take adequate safety precautions if an alarm is going to be cleared while the Run command is ON or when the Servo Always ON (Cn-01, bit 0 set to 1) is used.

4-2-3 Overload Characteristics (Electron Thermal Characteristics)

An overload protection function (electron thermal) is built into the Servo Driver to protect against Servo Driver or Servomotor overload. If an overload (A.70) does occur, first clear the cause of the error and then wait at least one minute for the Servomotor temperature to drop before turning on the power again. If the power is turned on again too soon, the Servomotor coil may be damaged.

■ Overload Characteristic Graph

The characteristic between the load ratio and the electronic thermal operating time is shown in the following graph.



Note 1. The load ratio is calculated in relation to the Servomotor's rated current.

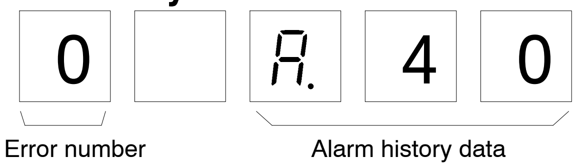
$$\text{Load ratio (\%)} = \frac{\text{Servomotor current}}{\text{Servomotor rated current}} \times 100$$

Note 2. For example, if a current three times the rated motor current is applied continuously, and overload will be detected in approximately 3 s.

4-2-4 Alarm History Display Mode

The Servo Driver stores the history of the 10 most recent alarms that have been generated. The alarm history can be displayed by going into the alarm history display mode and using the Up and Down Keys.
To clear the alarm history, set the system check mode to “02” and press the MODE/SET Key.

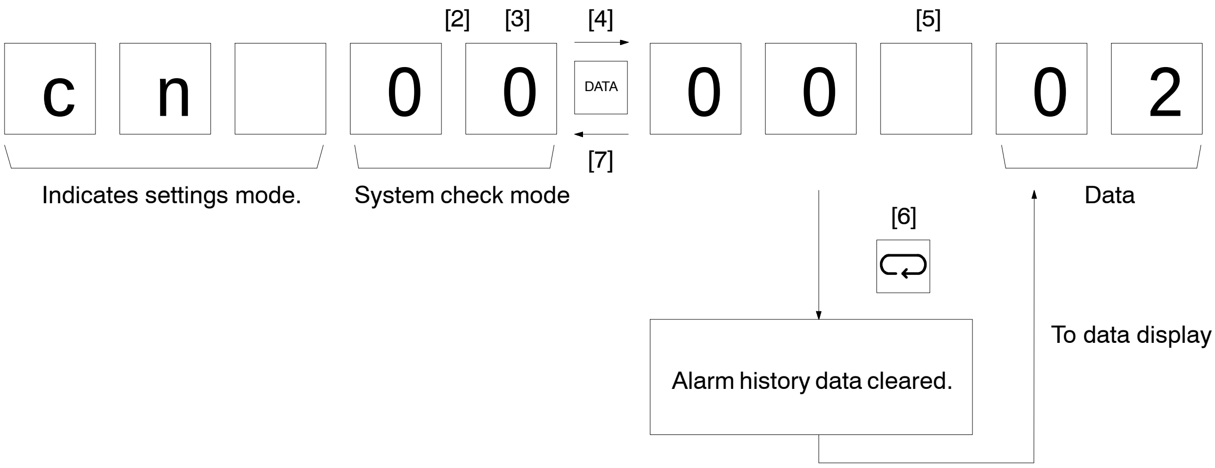
■ Displaying the Alarm History



1. Confirm that the initial display is shown (–. bb).
2. Press the MODE/SET Key to go to the alarm history display mode.
3. Use the Up and Down Keys to go up and down through the error occurrence numbers and display the corresponding alarm history data. (The larger the error occurrence number, the less recent the alarm is.)

■ Clearing Alarm History Data

Alarm history data initialization is executed in the system check mode. The items in parentheses in the following explanation indicate operations using the Handy-type Parameter Unit.



1. Confirm that the initial display is shown (–. bb).
2. Press the MODE/SET Key to enter the settings mode.
3. Using the Up and Down Keys, set parameter number “00.” (System check mode)
4. Press the DATA Key to display the setting of Cn-00.
5. Using the Up and Down Keys, set the parameter to “02.” (Alarm history clear)
6. Press the MODE/SET Key to clear the alarm history data.
7. Press the DATA Key to return to the settings mode.

4-3 Troubleshooting

When an error occurs, check the error contents by means of the operating status and alarm display, investigate the cause and apply the appropriate countermeasures.

■ Error Diagnosis by Means of Operating Status

Symptom	Probable cause	Items to check	Countermeasures
The power supply indicator (PWR) does not light even when the power supply is turned on.	Power supply lines are incorrectly wired.	• Check the power supply voltage. • Check the power supply lines.	• Correct the power supply. • Correct the wiring.
The motor does not operate even when command pulses are input. (No alarm is output.)	The RUN signal is OFF (when Cn-01 bit no. 0 is "0").	Check the RUN signal's ON and OFF by means of the monitor mode.	• Input the RUN signal. • Correct the wiring.
	The correspondence between the Servo Driver and the Servomotor is incorrect.	Check the models.	Combine models that correspond correctly.
	The POT and NOT signals are OFF (when Cn-01 bit nos. 2 and 3 are "0").	Check whether POT and NOT are displayed in status display mode.	• Turn ON the POT and NOT signals. • If POT and NOT are not being used, set Cn-01 bit nos. 2 and 3 to "1."
	The deviation counter reset input (ECRST) is ON.	Check the deviation counter reset signal in monitor mode (internal status bit display).	• Turn OFF the ECRST signal. • Correct the wiring.
	An error occurred with the RESET signal ON.	Check the RESET signal's ON and OFF by means of the monitor mode.	Turn the RESET signal OFF and take measures according to the alarm display.
	The setting for the command pulse mode is not correct (Cn-02 bits 3, 4, 5).	Check positioner's command pulse type and Driver's command pulse mode.	Set according to the controller command pulse type.
The motor operates momentarily, but then it does not operate.	The Servomotor power lines or encoder lines are wired incorrectly.	Check the Servomotor power line U, V, and W phases, and the encoder line wiring.	Correct the wiring.
Servomotor operation is unstable.	The Servomotor power lines or encoder lines are wired incorrectly.	Check the Servomotor power line U, V, and W phases, and the encoder line wiring.	Correct the wiring.
	There are eccentricities or looseness in the coupling connecting the Servomotor shaft and the mechanical system, or there are load torque fluctuations according to how the pulley gears are engaging.	• Check the machinery. • Try operating the Servomotor without a load.	Adjust the machinery.
	Gain is wrong.	---	• Use auto-tuning. • Adjust the gain manually.

Symptom	Probable cause	Items to check	Countermeasures
Servomotor is overheating.	The ambient temperature is too high.	Check to be sure that the ambient temperature around the Servomotor is no higher than 40°C.	Lower the ambient temperature to 40°C or lower. (Use a cooler or fan.)
	Ventilation is obstructed.	Check to see whether anything is blocking ventilation.	Ensure adequate ventilation.
	There is an overload.	Check the torque command value by means of monitor mode.	• Lighten the load. • Change to a larger capacity Servomotor.
	The correspondence between the Servo Driver and the Servomotor is incorrect.	Check the models.	Combine models that correspond correctly.
There are unusual noises.	The machinery is vibrating.	Inspect the machinery to see whether there are any foreign objects in the movable parts, or whether there is any damage, deformation, or looseness.	Fix any problems causing vibration.
	The speed loop gain adjustment is insufficient.	---	• Use auto-tuning. • Adjust the gain manually (speed loop gain).
Vibration is occurring at the same frequency as the applicable power supply.	Inductive noise is occurring.	• Check to see whether the Servo Driver control signal lines are too long. • Check to see whether control signal lines and power supply lines are too close to each other.	• Shorten the control signal lines. • Separate control signal lines from power supply lines. • Use a low-impedance power supply for control signals.

■ Error Diagnosis by Means of Alarm Display (Parameter Unit)

Alarm display	Error content	Condition when error occurred	Probable cause	Countermeasures
a.02	Parameter corruption	Occurred when power was turned on.	Internal memory error	Replace Servo Driver.
a.04	Parameter setting error	Occurred when power was turned on.	A user parameter was set to a value outside of the setting range previously.	Change the user parameter setting so it is within the setting range.
			Control board defective.	Replace Servo Driver.
a.10	Overcurrent	Occurred when power was turned on.	Control board defective.	Replace Servo Driver.
		Occurred when Servo was turned on.	• Current feedback circuit error • Main circuit transistor module error	Replace Servo Driver.
			Servomotor power line is short-circuited or grounded.	• Correct the power line short-circuiting or grounding. • Measure the insulation resistance at the Servomotor itself. If there is short-circuiting, replace the Servomotor.
			There is faulty wiring at the U, V, or W phase, or the GR.	Correct the wiring.
			Servomotor coil are damaged.	Measure the winding resistance. If the coil are damaged, replace the Servomotor.
	Overheating	Occurred during operation. Occurred even though power was on. If reset is executed after waiting for a time, operation resumes.	The ambient temperature for the Servo Driver is higher than 50°C.	Bring the ambient temperature for the Servo Driver down to 50°C or lower.
			The load torque is too high.	• Lighten the load. • Lengthen the acceleration time. • Select another Servomotor.
a.31	Deviation counter overflow	Occurred when Servomotor did not operate even when command pulse train was input.	Servomotor power lines or encoder lines are wired incorrectly.	Correct the wiring.
			The Servomotor is mechanically locked.	Unlock the Servomotor shaft.
		Occurred at high-speed operation.	Servomotor power lines or encoder lines are wired incorrectly.	Correct the wiring.
		Occurred when a long command pulse was given.	The gain adjustment is insufficient.	Adjust the gain.
			The acceleration/deceleration times are too extreme.	Lengthen the acceleration/deceleration time.
			The load is too large.	• Lighten the load. • Select another Servomotor.

Alarm display	Error content	Condition when error occurred	Probable cause	Countermeasures
a.40	Overvoltage	Occurred when power was turned on.	The power supply voltage is outside of the allowable range.	• The supply voltage must be 170 to 253 VAC when 200 VAC is specified. • The supply voltage must be 85 to 127 VAC when 100 VAC is specified.
		Occurred during Servomotor deceleration.	The load inertia is too large.	• Lengthen the deceleration time. • Reset the motor.
			The power supply voltage is outside of the allowable range.	• The supply voltage must be 170 to 253 VAC when 200 VAC is specified. • The supply voltage must be 85 to 127 VAC when 100 VAC is specified.
			Regeneration Unit error	Replace the Regeneration Unit
		Occurred while lowering (vertical shaft)	Gravity torque is too large.	• Add a counterbalance to the machine, and reduce the gravity torque. • Reduce the lowering speed. • Connect a Regeneration Unit.
a.51	Over speed	High-speed rotation occurred when command was input.	The rotational speed exceeded 4,950 r/min due to overshooting.	• Adjust the gain. • Lower the maximum speed of the command.
			Encoder is wired incorrectly.	Correct the wiring.
a.70	Overload	Occurred during operation.	Operating at more than 120% of the rated torque.	• If the Servomotor shaft is locked, unlock it. • If Servomotor power lines are incorrectly wired, correct them. • Lighten the load. • Lengthen the acceleration time. • Adjust the gain.
			Power supply voltage dropped.	• The supply voltage must be 170 to 253 VAC when 200 VAC is specified. • The supply voltage must be 85 to 127 VAC when 100 VAC is specified.
a.c1	Runaway detected	Some movement occurred at the beginning of operation.	• Encoder lines wired incorrectly. • Servomotor power lines wired incorrectly.	Correct the wiring.
a.c2	Phase error detected	Some movement occurred at the beginning of operation.	• Encoder lines disconnected. • Connector contact faulty.	• Correct the wiring. • Insert the connectors correctly.

Alarm display	Error content	Condition when error occurred	Probable cause	Countermeasures
a.c3	Encoder A, B phase wire disconnection.	Some movement occurred at the beginning of operation.	• Encoder lines disconnected. • Connector contact faulty.	• Correct any disconnected lines. • Insert connectors correctly.
			Encoder lines wired incorrectly.	Correct the wiring.
			Encoder defective.	Replace the Servomotor.
			Servo Driver defective.	Replace Servo Driver.
a.c4	Encoder S phase wire disconnection.	Some movement occurred at the beginning of operation.	• Encoder lines disconnected. • Connector contact faulty.	• Correct any disconnected lines. • Insert connectors correctly.
			Encoder lines wired incorrectly.	Correct the wiring.
			Encoder defective.	Replace the Servomotor.
			Servo Driver defective.	Replace Servo Driver.
a.f3	Momentary power failure alarm		• A momentary power failure occurred. • The power supply was restarted within the power retention period.	• Reset and then run again.
cpf00	Parameter Unit transmission error 1	Occurred when power was turned on.	Servo Driver defective.	Replace Servo Driver.
cpf01	Parameter Unit transmission error 2	Occurred while the Parameter Unit was being used.	Internal element is malfunctioning.	Reset and then run again.
			Internal element is damaged.	Replace Servo Driver.

4-4 Periodic Maintenance

⚠ **Caution** After replacing a Unit, always transfer all data required for operation before attempting to restart operation. Improper data settings may damage the product.

⚠ **Caution** Do not disassemble or repair the product. Doing so may result in an electric shock and injury.

Servo Motors and Drives contain many components and will operate properly only when each of the individual components is operating properly. Some of the electrical and mechanical components require maintenance depending on application conditions. In order to ensure proper long-term operation of Servo Motors and Drivers, periodic inspection and part replacement is required according to the life of the components.

The periodic maintenance cycle depends on the installation environment and application conditions of the Servo Motor or Driver. Recommended maintenance times are listed below for Servo Motors and Drivers. Use these are reference in determining actual maintenance schedules.

■ Servo Motors

- Recommended Periodic Maintenance
  Oil Seal: 2,000 hours
  Bearings: 20,000 hours

  Application Conditions: Ambient motor operating temperature of 40°C, within allowable shaft load, rated operation (rated torque and r/m), installed as described in operation manual.
- The radial loads during operation (rotation) on timing pulleys and other components contacting belts is twice the still load. Consult with the belt and pulley manufacturers and adjust designs and system settings so that the allowable shaft load is not exceeded even during operation. If a motor is used under a shaft load exceeding the allowable limit, the motor shaft can break, the bearings can burn out, and other problems can occur.

■ Servo Driver and Regeneration Units

- Recommended Periodic Maintenance
  Aluminum analytical capacitors: 50,000 hours

  Application Conditions: Ambient driver (regeneration unit) operating temperature of 50°C, rated operation (rated torque), installed as described in operation manual.
- The life of aluminum analytical capacitors is greatly affected by the ambient operating temperature. Generally speaking, an increase of 10°C in the ambient operating temperature will reduce capacitor life by 50%. We recommend that ambient operating temperature be lowered and the power supply time be reduced as much as possible to lengthen the maintenance times for Servo Drivers and Regeneration Units.
- It is recommended that the Servo Driver and Regeneration Unit be inspected at five-year intervals if they are used under conditions worse than the above or not used over a long time of time. Contact your OMRON representative for inspection and the necessity of any component replacement.

Chapter 5

· Specifications ·

5-1 Servo Driver Specifications

5-1-1 General Specifications

Item	Specifications
Operating ambient temperature	0°C to 50°C
Operating ambient humidity	35% to 85% RH (with no condensation)
Storage ambient temperature	–10°C to 75°C
Storage ambient humidity	35% to 85% RH (with no condensation)
Storage and operating atmosphere	No corrosive gasses.
Vibration resistance	10 to 55 Hz in X, Y, and Z directions with 0.10-mm double amplitude; acceleration: 4.9 m/s^2 {0.5 G} max.; time coefficient: 8 min; 4 sweeps
Impact resistance	Acceleration 19.6 m/s^2 {2 G} max., in X, Y, and Z directions, three times
Insulation resistance	Between power line terminals and case: 5 MΩ min. (at 1,000 VDC)
Dielectric strength	Non-conforming Models Between power line terminals and case: 1,000 VAC for 1 min (20 mA max.) at 50/60 Hz Models Conforming to EC Directives Between power line terminals and case: 1,500 VAC for 1 min at 50/60 Hz
Protective structure	Built into panel.

Note 1. The above items reflect individual evaluation testing. The results may differ under compounded conditions.

Note 2. Absolutely do not conduct a withstand voltage test or a megger test on the Servo Driver. If such tests are conducted, internal elements may be damaged.

Note 3. Depending on the operating conditions, some Servo Driver parts will require maintenance. Refer to *4-4 Periodic Maintenance* for details.

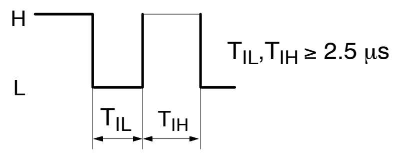
Note 4. The service life of the Servo Driver is 50,000 hours at an average ambient temperature of 50°C (at the rated torque and the rated rotation speed).

5-1-2 Performance Specifications

■ 200-VAC Input Servo Drivers, Non-conforming Models

Item		R88D -UEP04H	R88D -UEP08H	R88D -UEP12H	R88D -UEP20H
Continuous output current (0-P)		1.2 A	2.8 A	3.7 A	6.2 A
Momentary max. output current (0-P)		4.0 A	8.5 A	11.3 A	19.7 A
Input power supply		Single-phase 200/230 VAC (170 to 253 V) 50/60 Hz			
Control method		All-digital servo			
Speed feedback		Optical encoder, 1,024 pulses/revolution			
Applicable load inertia		Maximum of 30 times motor's rotor inertia		Maximum of 20 times motor's rotor inertia	
Inverter method		PWM method based on IGBT			
PWM frequency		11 kHz			7.8 kHz
Applicable Servomotor		R88M -UE10030H-S1	R88M -UE20030H-S1	R88M -UE40030H-S1	R88M -UE75030H-S1
Applicable Servomotor wattage		100 W	200 W	400 W	750 W
Cable length between motor and driver		20 m max.			
Weight (approximate)		Approx. 0.9 kg		Approx. 1.2 kg	Approx. 1.5 kg
Capacity	Maximum pulse frequency	200 kpps			
	Position loop gain	1 to 500 (1/s)			
	Electronic gear	Electronic gear ratio setting range: 0.01 ≤ (G1/G2) ≤ 100 (G1, G2 = 1 to 65,535)			
	Positioning completed range	0 to 250 command units			
	Position acceleration/deceleration time constant	0 to 64.0 ms (The same setting is used for acceleration and deceleration.)			
Input signals	Position command pulse input (see note)	TTL, line driver input with photoisolation, input current: 6 mA at 3 V Feed pulse and direction signal, forward pulse and reverse pulse, or 90° differential phase (A and B phases) signal (set via parameter). Pulse width: See note.			
	Deviation counter reset	TTL, line driver input with photoisolation, input current: 6 mA at 3 V			
	Sequence input	24-VDC, 5-mA photocoupler input, external power supply: 12 to 24 VDC, 30 mA min.			
Output signals	Position feedback output	Z-phase, open-collector output, 30 VDC, 20 mA 1 pulse/revolution (OFF on Z phase detection)			
	Sequence output	Alarm output, brake interlock, positioning completion; open-collector outputs: 30 VDC, 50 mA			
External regeneration processing		Required for regeneration of more than 30 times the motor's rotor inertia.		Required for regeneration of more than 20 times the motor's rotor inertia.	
Protective functions		Overcurrent, grounding, overload, overvoltage, overspeeding, runaway prevention, transmission errors, encoder errors, deviation counter overflow			

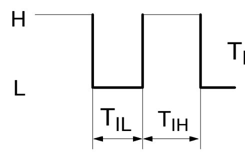
Note The input pulse width must meet the following conditions.



■ 100-VAC Input Servo Drivers, Non-conforming Models

Item		R88D-UEP10L	R88D-UEP12L	R88D-UEP15L
Continuous output current (0-P)		3.1 A	3.8 A	4.8 A
Momentary max. output current (0-P)		10 A	12 A	15 A
Input power supply		Single-phase 100/115 VAC (85 to 127 V) 50/60 Hz		
Control method		All-digital servo		
Speed feedback		Optical encoder, 1,024 pulses/revolution		
Applicable load inertia		Maximum of 30 times motor's rotor inertia		20 times max.
Inverter method		PWM method based on IGBT		
PWM frequency		11 kHz		7.8 kHz
Applicable Servomotor		R88M-UE10030L-S1	R88M-UE20030L-S1	R88M-UE30030L-S1
Applicable Servomotor wattage		100 W	200 W	300 W
Cable length between motor and driver		20 m max.		
Weight (approximate)		Approx. 0.9 kg	Approx. 1.2 kg	Approx. 1.5 kg
Capacity	Max. pulse frequency	200 kpps		
	Position loop gain	1 to 500 (1/s)		
	Electronic gear	Electronic gear ratio setting range: 0.01 ≤ (G1/G2) ≤ 100 (G1, G2 = 1 to 65,535)		
	Positioning completed range	0 to 250 command units		
	Position acceleration/deceleration time constant	0 to 64.0 ms (The same setting is used for acceleration and deceleration.)		
Input signals	Position command pulse input (see note)	TTL, line driver input with photoisolation, input current: 6 mA at 3 V Feed pulse and direction signal, forward pulse and reverse pulse, or 90° differential phase (A and B phases) signal (set via parameter). Pulse width: See note.		
	Deviation counter reset	TTL, line driver input with photoisolation, input current: 6 mA at 3 V		
	Sequence input	24-VDC, 5-mA photocoupler input, external power supply: 12 to 24 VDC, 30 mA min.		
Output signals	Position feedback output	Z-phase, open-collector output, 30 VDC, 20 mA 1 pulse/revolution (OFF on Z phase detection).		
	Sequence output	Alarm output, brake interlock, positioning completion; open collector outputs: 30 VDC, 50 mA		
External regeneration processing		Required for regeneration of more than 30 times the motor's rotor inertia.		Required for regeneration of more than 20 times the motor's rotor inertia.
Protective functions		Overcurrent, grounding, overload, overvoltage, overspeeding, runaway protection, transmission errors, encoder errors, deviation counter overflow		

Note The input pulse width must be meet the following conditions.

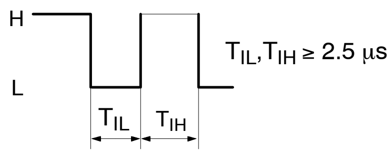


$T_{IL}, T_{IH} \geq 2.5\ \mu s$

■ 200-VAC Input Servo Drivers, Models Conforming to EC Directives

Item		R88D -UEP04V	R88D -UEP08V	R88D -UEP12V	R88D -UEP20V
Continuous output current (0-P)		1.2 A	2.8 A	3.7 A	6.2 A
Momentary max. output current (0-P)		4.0 A	8.5 A	11.3 A	19.7 A
Input power supply		Single-phase 200/230 VAC (170 to 253 V) 50/60 Hz			
Control method		All-digital servo			
Speed feedback		Optical encoder, 1,024 pulses/revolution			
Applicable load inertia		Maximum of 30 times motor's rotor inertia		Maximum of 20 times motor's rotor inertia	
Inverter method		PWM method based on IGBT			
PWM frequency		11 kHz			7.8 kHz
Applicable Servomotor		R88M -UE10030V-S1	R88M -UE20030V-S1	R88M -UE40030V-S1	R88M -UE75030V-S1
Applicable Servomotor wattage		100 W	200 W	400 W	750 W
Cable length between motor and driver		20 m max.			
Weight (approximate)		Approx. 0.9 kg		Approx. 1.2 kg	Approx. 1.5 kg
Capacity	Maximum pulse frequency	200 kpps			
	Position loop gain	1 to 500 (1/s)			
	Electronic gear	Electronic gear ratio setting range: 0.01 ≤ (G1/G2) ≤ 100 (G1, G2 = 1 to 65,535)			
	Positioning completed range	0 to 250 command units			
	Position acceleration/deceleration time constant	0 to 64.0 ms (The same setting is used for acceleration and deceleration.)			
Input signals	Position command pulse input (see note)	TTL, line driver input with photoisolation, input current: 6 mA at 3 V Feed pulse and direction signal, forward pulse and reverse pulse, or 90° differential phase (A and B phases) signal (set via parameter). Pulse width: See note.			
	Deviation counter reset	TTL, line driver input with photoisolation, input current: 6 mA at 3 V			
	Sequence input	24-VDC, 5-mA photocoupler input, external power supply: 12 to 24 VDC, 30 mA min.			
Output signals	Position feedback output	Z-phase, open-collector output, 30 VDC, 20 mA 1 pulse/revolution (OFF on Z phase detection).			
	Sequence output	Alarm output, brake interlock, positioning completion; open-collector outputs: 30 VDC, 50 mA			
External regeneration processing		Required for regeneration of more than 30 times the motor's rotor inertia.		Required for regeneration of more than 20 times the motor's rotor inertia.	
Protective functions		Overcurrent, grounding, overload, overvoltage, overspeeding, runaway prevention, transmission errors, encoder errors, deviation counter overflow			

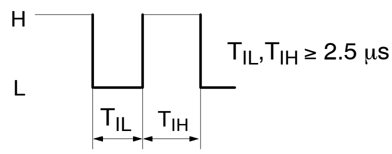
Note The input pulse width must meet the following conditions.



■ 100-VAC Input Servo Drivers, Models Conforming to EC Directives

Item		R88D-UEP10W	R88D-UEP12W	R88D-UEP15W
Continuous output current (0-P)		3.1 A	3.8 A	4.8 A
Momentary max. output current (0-P)		10 A	12 A	15 A
Input power supply		Single-phase 100/115 VAC (85 to 127 V) 50/60 Hz		
Control method		All-digital servo		
Speed feedback		Optical encoder, 1,024 pulses/revolution		
Applicable load inertia		Maximum of 30 times motor's rotor inertia		20 times max.
Inverter method		PWM method based on IGBT		
PWM frequency		11 kHz		7.8 kHz
Applicable Servomotor		R88M-UE10030W-S1	R88M-UE20030W-S1	R88M-UE30030W-S1
Applicable Servomotor wattage		100 W	200 W	300 W
Cable length between motor and driver		20 m max.		
Weight (approximate)		Approx. 0.9 kg	Approx. 1.2 kg	Approx. 1.5 kg
Capacity	Max. pulse frequency	200 kpps		
	Position loop gain	1 to 500 (1/s)		
	Electronic gear	Electronic gear ratio setting range: 0.01 ≤ (G1/G2) ≤ 100 (G1, G2 = 1 to 65,535)		
	Positioning completed range	0 to 250 command units		
	Position acceleration/deceleration time constant	0 to 64.0 ms (The same setting is used for acceleration and deceleration.)		
Input signals	Position command pulse input (see note)	TTL, line driver input with photoisolation, input current: 6 mA at 3 V Feed pulse and direction signal, forward pulse and reverse pulse, or 90° differential phase (A and B phases) signal (set via parameter). Pulse width: See note.		
	Deviation counter reset	TTL, line driver input with photoisolation, input current: 6 mA at 3 V		
	Sequence input	24-VDC, 5-mA photocoupler input, external power supply: 12 to 24 VDC, 30 mA min.		
Output signals	Position feedback output	Z-phase, open-collector output, 30 VDC, 20 mA 1 pulse/revolution (OFF on Z phase detection)		
	Sequence output	Alarm output, brake interlock, positioning completion; open collector outputs: 30 VDC, 50 mA		
External regeneration processing		Required for regeneration of more than 30 times the motor's rotor inertia.		Required for regeneration of more than 20 times the motor's rotor inertia.
Protective functions		Overcurrent, grounding, overload, overvoltage, overspeeding, runaway protection, transmission errors, encoder errors, deviation counter overflow		

Note The input pulse width must be meet the following conditions.



5-1-3 I/O Specifications

■ Terminal Block Specifications, Non-conforming Models

Signal	Function	Condition	
R T	Power supply input	R88D-UEP□□H (200-VAC Units): Single-phase 200/230 VAC (170 to 253 VAC) 50/60 Hz R88D-UEP□□L (100-VAC Units): Single-phase 100/115 VAC (85 to 127 VAC) 50/60 Hz	
P N	Main circuit DC output	These are the connection terminals for the Regeneration Unit (R88A-RG08UA). Connect these when the regeneration energy is high.	
U	Servomotor U-phase output	Red	These are the terminals for outputs to the Servomotor.
V	Servomotor V-phase output	White	
W	Servomotor W-phase output	Blue	
⏚	Frame ground	Green	This is the connection terminal. Use a 100 Ω or less (class-3) or better ground. It is used in common for Servomotor output and power supply input.

■ Terminal Block Specifications, Models Conforming to EC Directives

Signal	Function	Condition	
L1 L2	Power supply input	R88D-UEP□□V (200-VAC Units): Single-phase 200/230 VAC (170 to 253 VAC) 50/60 Hz R88D-UEP□□W (100-VAC Units): Single-phase 100/115 VAC (85 to 127 VAC) 50/60 Hz	
+ –	Main circuit DC output	When using multiple axes and there is excessive regenerative energy, the + terminals can be connected together and the – terminals can be connected together to increase the regeneration absorption capacity.	
U	Servomotor U-phase output	Red	These are the terminals for outputs to the Servomotor.
V	Servomotor V-phase output	White	
W	Servomotor W-phase output	Blue	
⏚	Protective earth terminal	Green	This is the connection terminal. Use a 100 Ω or less (class-3) or better ground.

■ CN1: Control I/O Specifications

• CN1: Control Input

Pin No.	Signal name	Function	Contents
1	+PULS/CW/A	Feed pulse, reverse pulse, 90° differential phase pulse (A phase)	Line driver input: 6 mA at 3V Open collector input: 15 mA at –5V Switched between feed pulse and direction signal, reverse pulse and forward pulse, and 90° differential phase pulse (A and B phases) using bits 3, 4, and 5 of the Cn-02 setup parameter Maximum frequency: 200 kpps
2	–PULS/CW/A		
3	+SIGN/ CCW/B	Direction signal, forward pulse, 90° differential phase pulse (B phase)	
4	–SIGN/ CCW/B		
5	+ECRST	Deviation counter reset	Line driver input: 6 mA at 3V ON: Disables command input and resets deviation counter. Operation can be switched between a status signal (high level) and a differential signal (rising edge) using bit A in setup parameter Cn-02.
6	–ECRST		
11	---	---	Do not connect.
12	---	---	
13	+24VIN	+12- to 24-V power supply input for control DC	Power supply for pin nos. 14, 15, 16, 17, 18; +12- to 24-V input
14	RUN	Run command input	ON: Servo ON, when setup parameter Cn-01 bit no. 0 = 0. When setup parameter Cn-01 bit no. 0 = 1, this signal is not used. (Automatically set to Servo ON.)
15	MING	Gain deceleration input	ON: Decrease speed loop gain.
16	POT	Forward drive prohibit input	Forward rotation overtravel input (OFF when prohibited). When setup parameter Cn-01 bit no. 2 = 1, this signal is not used.
17	NOT	Reverse drive prohibit input	Reverse rotation overtravel input (OFF when prohibited). When setup parameter Cn-01 bit no. 3 = 1, this signal is not used.
18	RESET	Alarm reset input	ON: Servo alarm status is reset.
28	---	---	Do not connect.
29	---	---	

• CN1: Control Output

Pin No.	Signal name	Function	Contents
7	BKIR	Brake interlock output	Outputs external brake interlock signal.
8	INP	Positioning competed output	Turned ON when the pulse count remaining in the deviation counter is equal to or less than the positioning completed range set in user parameter Cn-1b.
9	---	---	Do not connect.
10	OGND	Output ground common	Output ground common for BKIR, VCMP, INP, TGON/CLIMT
19 to 27	---	---	Do not connect.
30	---	---	
31	---	---	
32	Z	Encoder Z phase output	Encoder Z phase output 1 pulse/revolution (OFF when Z phase is detected) Open-collector output, 30 VDC, 10 mA
33	ZCOM	Encoder Z phase output ground	
34	$\overline{\text{ALM}}$	Alarm output	When an alarm is generated for the Servo Driver, the output is OFF. Open collector output.
35	ALMCOM	Alarm output GND	
36	FG	Frame ground	Ground terminal for shield wire of cable and FG line.

Note Pin 36 is not used on models conforming to EC Directives. Instead, connect the cable shield to the connector plug and ground it directly using a clamp.

• Connectors Used (36P)

Nippon Amp	Receptacle at Servo Driver	178239-5
Sumitomo 3M	Soldered plug at cable side	10136-3000VE
	Case at cable side	10336-52A0-008

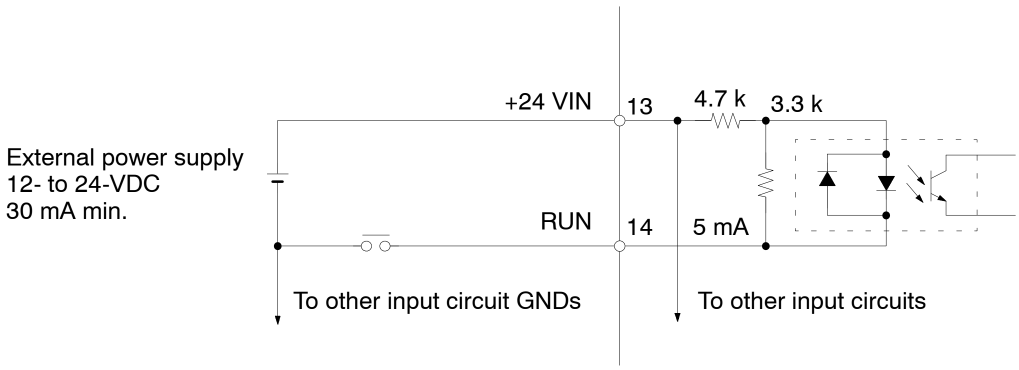
● Pin Arrangement

Pin	Signal	Name	Pin	Signal	Name	Pin	Signal	Name	Pin	Signal	Name
2	–PULS /CW/A	–feed pulse, reverse pulse, A phase	1	+PULS /CW/A	+feed pulse, reverse pulse, A phase	20	---	Not used.	19	---	Not used.
4	–SIGN/ CCW/B	–direction signal, forward pulse, B phase	3	+SIGN/ CCW/B	+direction signal, forward pulse, B phase	22	---	Not used.	21	---	Not used.
6	–ECRST	–deviation counter reset	5	+ECRST	+deviation counter reset	24	---	Not used.	23	---	Not used.
8	INP	Positioning completed output	7	BKIR	Brake interlock output	26	---	Not used.	25	---	Not used.
10	OGND	Output ground common	9	---	Not used.	28	---	Not used.	27	---	Not used.
12	---	Not used.	11	---	Not used.	30	---	Not used.	29	---	Not used.
14	RUN	Run command input	13	+24VIN	Control DC +12- to 24-V input	32	Z	Encoder Z phase output	31	---	Not used.
16	POT	Forward rotation drive prohibit input	15	MING	Gain deceleration	34	$\overline{\text{ALM}}$	Alarm output	33	ZCOM	Encoder Z phase output ground
18	RESET	Alarm reset input	17	NOT	Reverse rotation drive prohibit input	36	FG (see note)	Frame ground	35	ALMCOM	Alarm output GND

Note Pin 36 is not used on models conforming to EC Directives.

■ Control Input Interface

The input circuit for the control I/O connector (CN1) is as shown in the following diagram.



● Run Command (14: RUN)

This is the input that turns on the power drive circuit for the main circuit of the Servo Driver. If this signal is not input (i.e., servo-off status), the Servomotor cannot operate. Depending on the setting of setup parameter Cn-01, bit no. 0, this signal can be bypassed. In that case, the servo will be turned on after the power is turned on.

• Gain Reduction (15: MING)

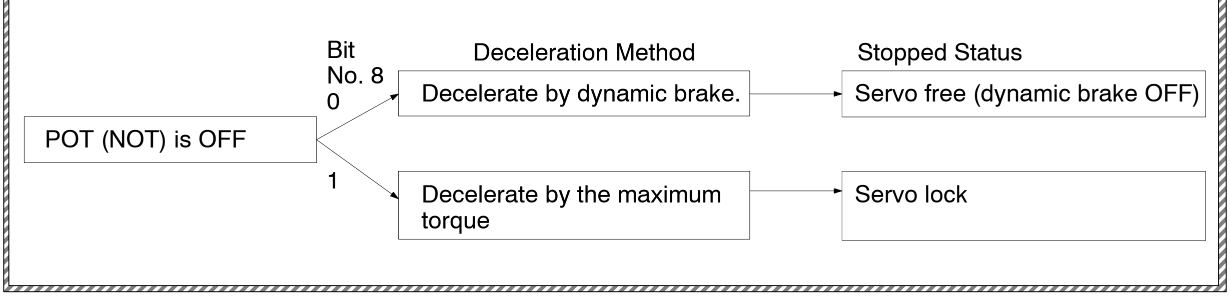
Input this signal to lower the loop gain for the control loop, and to weaken servo rigidity (repellant force with respect to external force).

In addition, when parts are inserted after positioning, the insertion operation is made easier because the repellant force with respect to external force is weakened by the inputting of this signal. This cannot be used for the vertical shaft where a gravity load is applied, because position deviation will occur.

• Forward Drive Prohibit (16: POT, Cn-01 bit No. 2 = 0) Reverse Drive Prohibit (17: NOT, Cn-01 bit No. 3 = 0)

These two signals are the inputs for forward and reverse drive prohibit (overtravel). When they are input, driving is possible in the respective directions. When driving is prohibited, movement will stop according to the setting of bit no. 8 of setup parameter no. 1 (Cn-01). Alarm status will not be generated at the Driver. When drive prohibition is not used, clear the function by connecting the respective signal to the external power supply +24-V GND or setting setup parameter Cn-01, bit nos. 2, 3 = 1,1.

Stopping Methods when Forward/Reverse Drive Prohibit is OFF



Note The position loop is not valid when stopping with this mode.

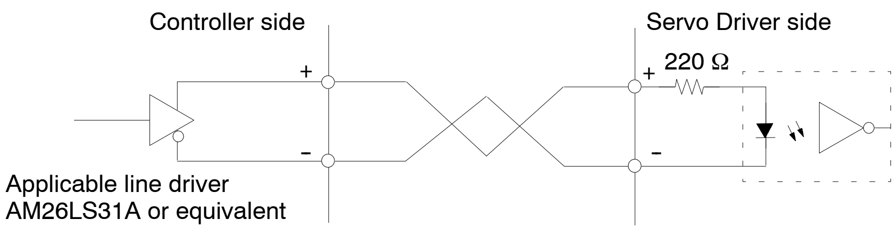
• Alarm Reset (18: RESET)

This is the external reset signal input for the servo alarm. The alarm is reset when the signal turns ON. Remove the cause of the alarm and then restart operation. In order to prevent danger, turn OFF the run command before inputting the reset signal.

• Command Pulse Inputs and Deviation Counter Reset Inputs

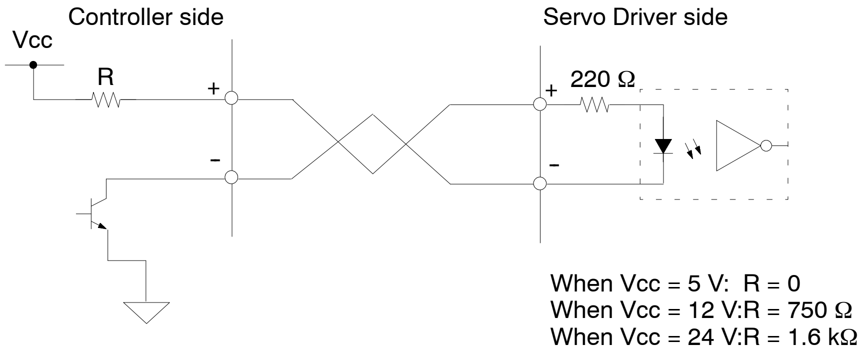
The input circuits for command pulse and deviation counter reset inputs are shown in the following diagram.

Line-driver Input



Open-collector Input

When connected with open collector output, insert a current limit resistor as shown below.



• Deviation Counter Reset (5, 6: +ECRST/–ECRST)

The contents of the deviation counter will be reset and the position loop will be disabled when the deviation counter reset signal turns ON.

The deviation counter reset signal must be input for at least 20 μs to be effective. The counter may or may not be reset if the input signal is less than 20 μs.

The setting of Cn-02 bit No. A determines whether setting is performed on the high signal level or on the rising edge of the signal.

• +Feed Pulse/Reverse Pulse/90° Differential Pulse A Phase (CN1-1: +PULS/+CW/+A)
–Feed Pulse/Reverse Pulse/90° Differential Pulse A Phase (CN1-2: –PULS/–CW/–A)
+Direction Signal/Forward Pulse/90° Differential Pulse B Phase (CN1-3: +SIGN/+CCW/+B)
–Direction Signal/Forward Pulse/90° Differential Pulse B Phase (CN1-4: –SIGN/–CCW/–B)

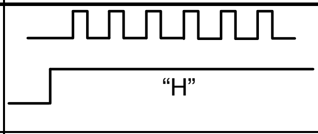
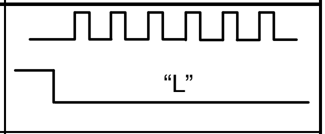
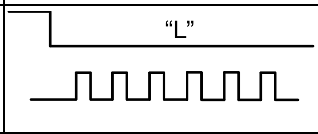
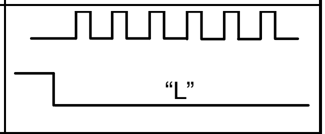
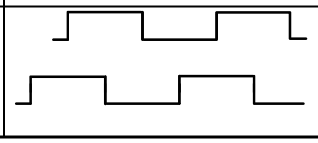
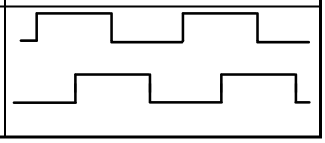
The functions of the above pulses depend on the command pulse mode. Positive command pulse logic is used.

• Command Pulse Mode (Cn-02 bit nos. 5, 4, 3)

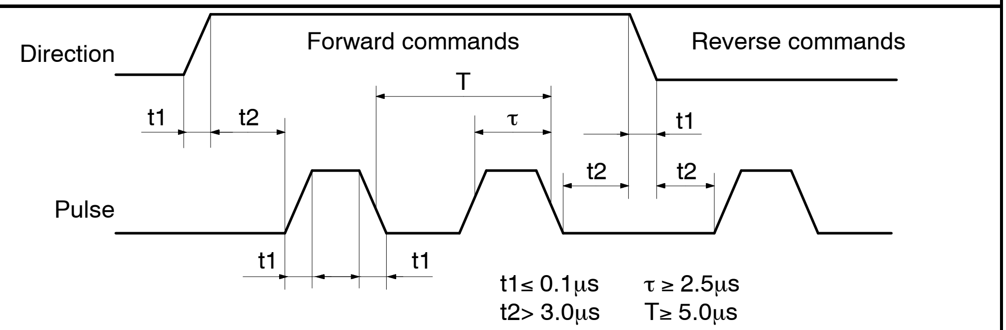
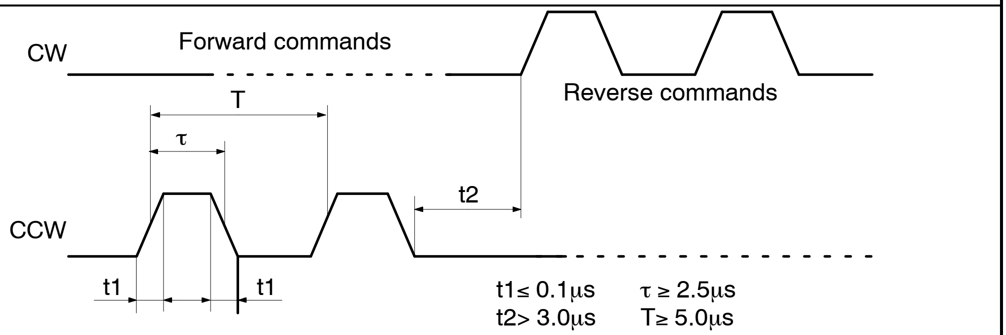
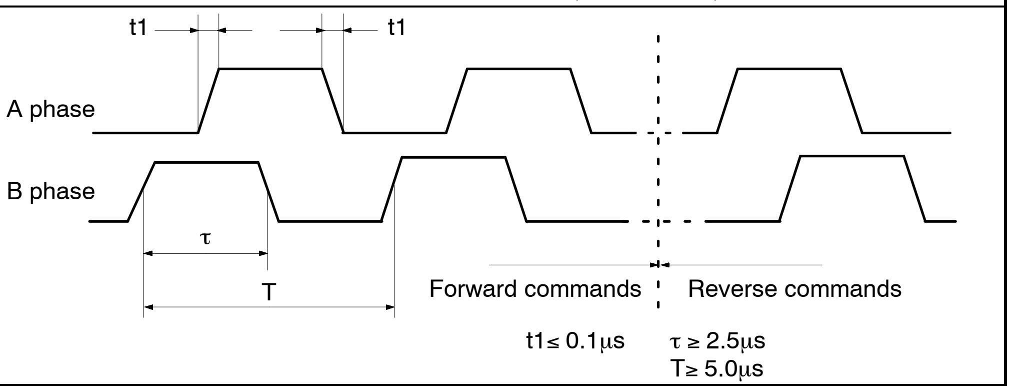
Cn-02 bit nos. 5, 4, 3 = 0, 0, 0	Feed pulses and direction signal
Cn-02 bit nos. 5, 4, 3 = 0, 0, 1	Forward pulse and reverse pulse (factory default)
Cn-02 bit nos. 5, 4, 3 = 0, 1, 0	90° differential phase (A and B phases) signal (1X)
Cn-02 bit nos. 5, 4, 3 = 0, 1, 1	90° differential phase (A and B phases) signal (2x)
Cn-02 bit nos. 5, 4, 3 = 1, 0, 0	90° differential phase (A and B phases) signal (4X)

• Command Pulse Logic Reversal (Cn-02 bit no. d)

Cn-02 bit no. d = 0	Positive logic
Cn-02 bit no. d = 1	Negative logic

Logic	Bits 5	Bits 4	Bits 3	Input factor	Command pulse mode	Input pins	Forward motor commands	Reverse motor commands
Positive	0	0	0	---	Forward pulse and direction signal	1: +PULS 2: −PULS 3: +SIGN 4: −SIGN	 	
	0	0	1	---	Reverse pulse and forward pulse	1: +CW 2: −CW 3: +CCW 4: −CCW	 	
	0	1	0	×1	90° differential phase signals	1: +A 2: −A 3: +B 4: −B		
	0	1	1	×2				
	1	0	0	×4				

• Command Pulse Timing

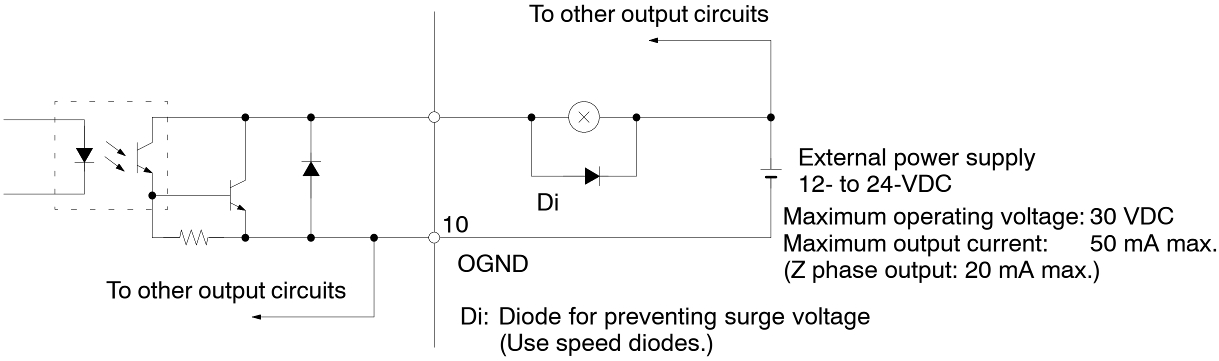
Command pulse mode	Timing
Forward pulse and direction signal Maximum frequency: 200 kpps	
Reverse pulse and forward pulse Maximum frequency: 200 kpps	
90° differential phase signals (A and B pulses) Maximum frequency: 200 kpps	

Note Although the above timing charts show positive logic, the same conditions hold for negative logic.

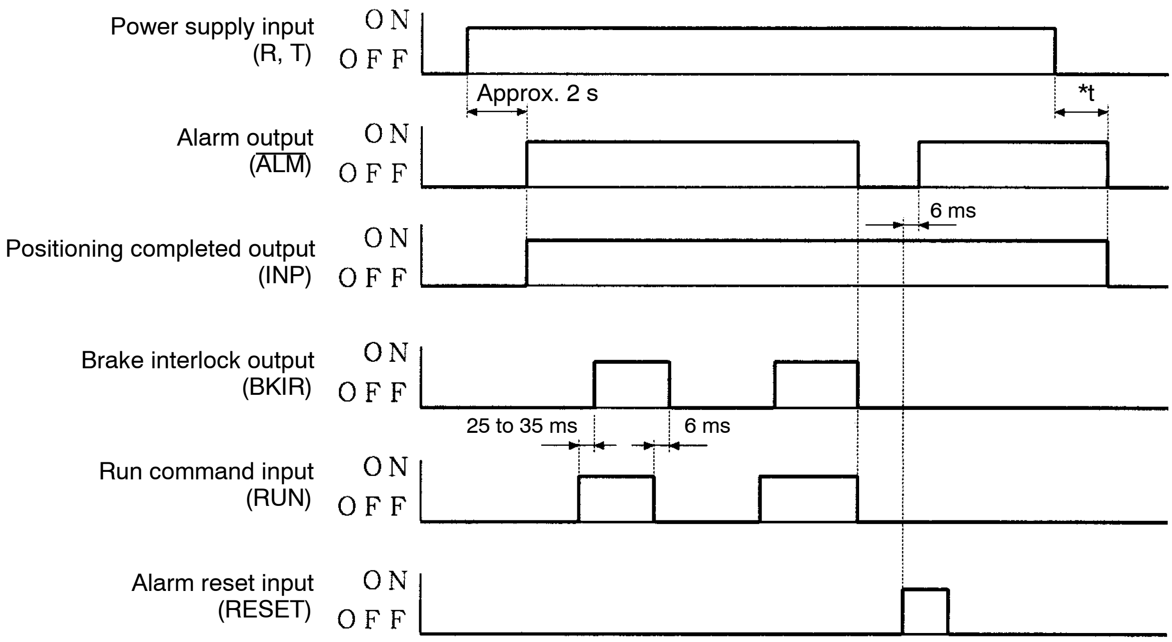
L level: I_L [illegible] 1 mA
H level: I_H [illegible] 2 mA

■ Control Output Interface

The output circuit for the control I/O connector (CN1) is as shown in the following diagram.



• Control Output Sequence



*t = Approx. 10 s: R88D-UEP04H/-UEP08H/-UEP12H
R88D-UEP10L/-UEP12L
R88D-UEP04V/-UEP08V/-UEP12V
R88D-UEP10W/-UEP12W
Approx. 15 s: R88D-UEP20H/-UEP15L
R88D-UEP20V/-UEP15W

• Brake Interlock (7: BKIR)

This outputs the external brake timing signal set in Cn-12. Refer to *3-5-4 Brake Interlock (For Motors with Brakes)* for details.

• Positioning Completed Output (8: INP)

This output is turned ON when the pulse count remaining on the deviation counter is less than the positioning completed range set in user parameter Cn-1b. If the command speed is low and the positioning completed range is large, the positioning completed output will remain ON.

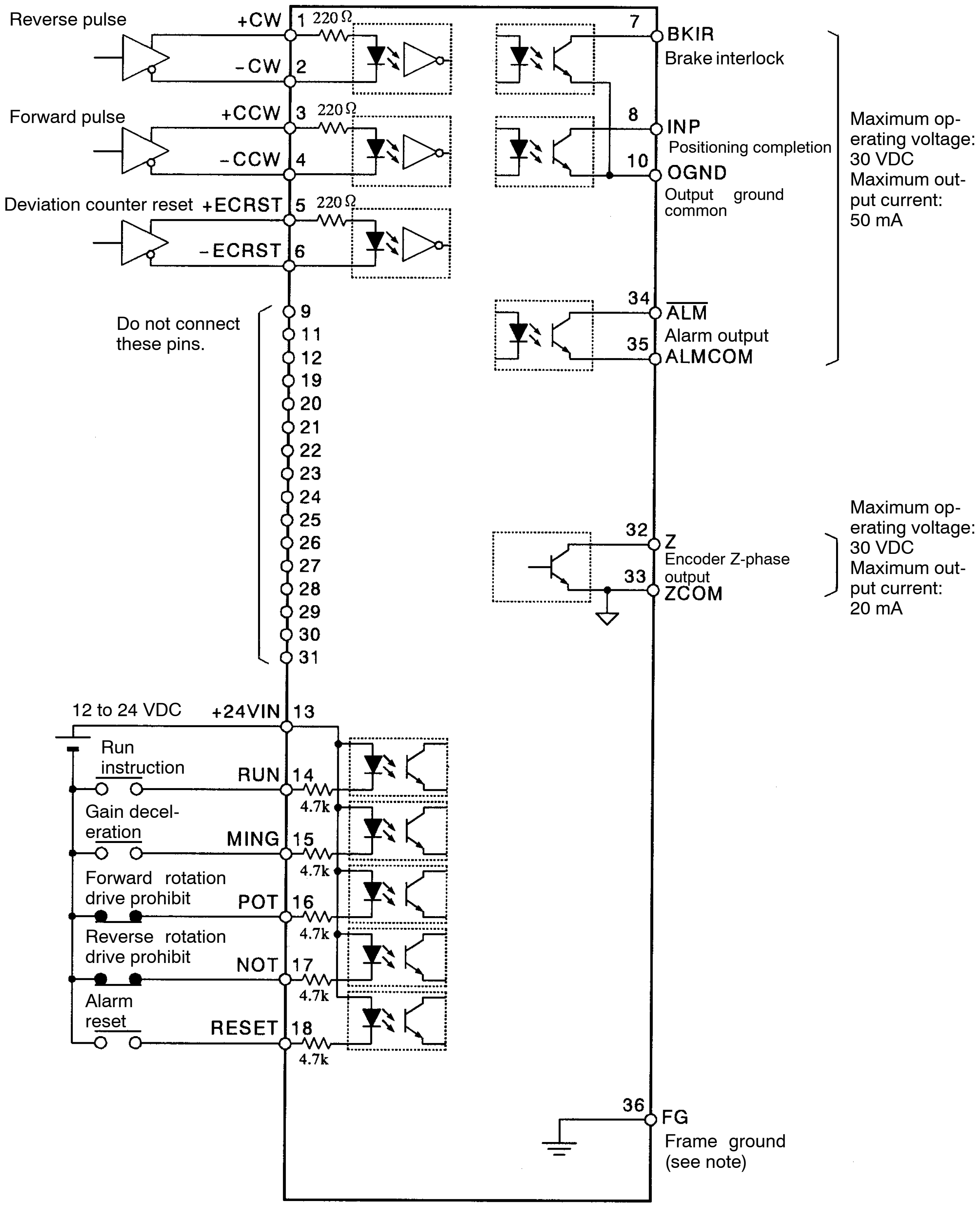
• Alarm Output/Alarm Output Ground (34/35: $\overline{\text{ALM}}$/ALMCOM)

When the Servo Driver detects an error, outputs are turned OFF. At that time, an alarm code (see below) is output according to the contents of the error. This output is OFF at the time of powering up, and turns ON when the power-up processing is completed.

• Encoder Z-phase Output (32 and 33: Z and ZCOM)

The encoder Z-phase signal is output from the Servomotor. The output (i.e., 20-mA open collector output at 30 VDC) is OFF when the Z phase is detected.

■ Control I/O Signal Connections and External Signal Processing



Note Pin 36 is not used on models conforming to EC Directives.

■ CN2: Encoder Input Specifications

Pin No.	Signal name	Function	Interface
1, 2, 3	E0V	Encoder power supply GND	Power supply outlet for encoder: 5 V, 350 mA
4, 5, 6	E5V	Encoder power supply +5 V	
7	NC	Not used	Do not connect.
8, 9	NC	Not used	Do not connect.
10, 11	NC	Not used	Do not connect.
12, 13	NC	Not used	Do not connect.
14	S+	Encoder + S-phase input	Line driver input (conforming to EIA-RS422A) (Input impedance: 220 Ω)
15	S–	Encoder – S-phase input	
16	A+	Encoder + A-phase input	Line driver input (conforming to EIA-RS422A) (Input impedance: 220 Ω)
17	A–	Encoder – A-phase input	
18	B+	Encoder + B-phase input	Line driver input (conforming to EIA-RS422A) (Input impedance: 220 Ω)
19	B–	Encoder – B-phase input	
20 (see note)	FG	Shielded ground	Cable shielded ground

Note Pin 20 is not used on models conforming to EC Directives. Instead, connect the cable shield to the connector plug and ground it directly using a clamp.

• Connectors Used (20P)

Nippon Amp	Receptacle at Servo Driver	178239-2
Sumitomo 3M	Soldered plug at cable side	10120-3000VE
	Case at cable side	10320-52A0-008

• Pin Arrangement

Pin	Signal	Function	Pin	Signal	Function	Pin	Signal	Function	Pin	Signal	Function
2	E0V	Encoder power supply GND	1	E0V	Encoder power supply GND	12	NC		11	NC	
4	E5V	Encoder power supply +5 V	3	E0V	Encoder power supply GND	14	S+	Encoder + S-phase input	13	NC	
6	E5V	Encoder power supply +5 V	5	E5V	Encoder power supply +5 V	16	A+	Encoder + A-phase input	15	S–	Encoder – S-phase input
8	NC		7	NC		18	B+	Encoder + B-phase input	17	A–	Encoder – A-phase input
10	NC		9	NC		20	FG (see note)	Frame ground	19	B–	Encoder – B-phase input

Note Pin 20 is not used with models conforming to EC Directives

• Encoder Pulse Input Signals (A-, B-, S-phase)

Inputs signals output from the Servomotor encoder. In S-phase, servo sensor U-, V-, W-, and Z-phase are transmitted according to A- and B-phase logic.

• Encoder Power Supply Grounds (1 to 3: E0V) and Encoder Power Supply 5 V (E5V: 4 to 6)

Outputs +5.2 ±0.1 V as the power supply for the Servomotor encoder. The encoder power supply cannot be used for other purposes.

■ CN3: Parameter Unit Input Specifications

Pin No.	Signal name	Function	I/O interface
1	TXD+	Transmission data +	This is the send data line-driver output to the Parameter Unit (or a personal computer).
2	TXD–	Transmission data –	
3	RXD+	Reception data +	This is the send data line-driver input from the Parameter Unit (or a personal computer).
4	RXD–	Reception data –	
5	PRMU	Unit switching	This is the switching terminal for a Parameter Unit or personal computer. If the pin is open, it is for a personal computer. If connected to +5V, it is for a Parameter Unit.
6	RT1	Termination resistance enabled/disabled	This is the termination resistance terminal for the line receiver. For 1-to-1 communications or for the final Servo Driver, short-circuit RT1-RT2.
7	RT2		
8	+5V	+5 V output	This is the +5 V output to the Parameter Unit.
9	GND	Ground	

• Pin Arrangement

1	TXD+	Transmission data +
2	TXD–	Transmission data –
3	RXD+	Reception data +
4	RXD–	Reception data –
5	PRMU	Unit switching
6	RT1	Termination resistance on/off
7	RT2	
8	+5V	+5-V output
9	GND	Ground

• Connectors Used (D-sub Connector, 9 Pin)

Dai-ichi Denshi Kogyo	Socket at Servo Driver	17LE-13090-27 (D2BC)
	Soldered plug at cable side	17JE-23090-02 (D1)
	Cover at cable side	17JE-09H-15
OMRON	Soldered plug at cable side	XM2A-0901
	Cover at cable side	XM2S-0912

■ CN4: Not Used

5-1-4 Explanation of User Parameters

Refer to *3-4-2 Setup Parameter Contents* and *3-5-2 User Parameter Chart* for a table of user parameters and setup parameters.

• Speed Loop Gain: Cn-04

This is the proportional gain for the speed controller. The adjustable range is 1 to 2,000 Hz (the response frequency when equivalent inertia is used). As the number is increased, the gain is increased.

The factory setting is for 80 (Hz). Using the factory setting for the Servomotor alone or with a small load inertia will cause vibration to occur, so set the value to a maximum of 20 (Hz) for operation.

• Speed Loop Integration Constant: Cn-05

This is the integration time for the speed controller. The adjustable range is 2 to 10,000 (ms), and it is factory set to 20 (ms). As the number is increased, the gain is decreased.

• Brake Timing: Cn-12

These parameters determine the output timing of the brake interlock signal (BKIR), which controls the electromagnetic brake.

Brake timing sets the delay time from the time of brake interlock goes OFF until the servo turns off.

A dynamic brake will be applied when the Run command turns OFF while the motor is operating, when a servo error occurs, or when power is turned off. The brake interlock output (BKIR) will turn OFF when the motor speed is reduced to 100 r/min or less. The brake interlock output (BKIR) will also turn OFF if power is not supplied to the motor for 500 ms even if the motor speed is greater than 100 r/min.

This setting is used to prevent destroying the holding brake on the servomotor or the machine.

• Torque Command Filter Time Constant: Cn-17

This sets the low-pass filter time constant for the torque command. The setting range is 0 to 250 (× 100 μs), and the factory setting is 4 (× 100 μs).

The relationship between the filter time constant and the cut-off frequency can be found by means of the following formula:

fc (Hz) = $1 / (2\pi T)$: T= Filter time constant

If T= 400 (μs), fc will be approximately 400 (Hz).

When the characteristic vibration of the machinery is within the response frequency of the servo loop, Servomotor vibration will occur. In order to prevent this sympathetic vibration based on the characteristic vibration of the machinery, set the torque filter time constant to a value that will eliminate the vibration (i.e., set it to a high value).

• Position Loop Gain: Cn-1A

Adjust the position loop gain to the rigidity of the machine. Set to between 50 and 70 (1/s) for general NC machine tools, to between 30 and 50 (1/s) for general and assembly machines, and to 10 to 30 (1/s) for industrial robots.

Load alarms will be caused by machine oscillation if the position loop gain is increased for systems with low rigidity or systems with intrinsically low-frequency vibration.

The setting range is 1 to 500 (1/s), and the factory setting is 40 (1/s).

• Positioning Completed Range: Cn-1b

This sets the deviation counter value for outputting the positioning completed output (INP). When the deviation counter value falls below this setting, the positioning completed output turns ON. The setting range is 0 to 250 (command units), and the factory setting is 3 (command units).

• Electronic Gear Ratio G1 (Numerator): Cn-24
Electronic Gear Ratio G2 (Denominator): Cn-25

The motor will be operated by the pulses resulting from the number of command pulses multiplied by the gear ratio (G1/G2).

The setting range for both G1 and G2 is 65,535, and the settings are restricted as follows:
$(1/100) \leq (G1/G2) \leq 100$.

The factory setting is : G1 =4, G2 = 1 (i.e., an electronic gear ratio of 4/1). At the factory setting, inputting 1,024 pulses will cause one Servomotor revolution.

• Position Command Acceleration/Deceleration Time Constant: Cn-26

This executes smoothing processing on command pulses for Servomotor operation. It is valid in the following cases:

- There is no acceleration or deceleration for command pulses.
- The command pulse frequency changes suddenly.
- The electronic gear ratio setting is large ($G1/G2 \geq 10$).

The setting range is 0 to 640 (× 0.1 ms), and the factory setting is 0 (× 0.1 ms).

5-2 Servomotor Specifications

5-2-1 General Specifications

Item	Specifications
Operating ambient temperature	0°C to 40°C
Operating ambient humidity	20% to 80% RH (with no condensation)
Storage ambient temperature	–10°C to 75°C
Storage ambient humidity	20% to 85% RH (with no condensation)
Storage and operating atmosphere	No corrosive gasses.
Vibration resistance	10 to 150 Hz in X, Y, and Z directions with 0.2-mm double amplitude; acceleration: 24.5 m/s^2 {2.5 G} max.; time coefficient: 8 min; 4 sweeps
Impact resistance	Acceleration 98 m/s^2 {10 G} max., in X, Y, and Z directions, three times
Insulation resistance	Between power line terminals and case: 10 MΩ min. (500 VDC megger)
Dielectric strength	Between power line terminals and case: 1,500 VAC for 1 min (10 mA max.) at 50/60 Hz (JEC 2121)
Run position	All directions
Insulation grade	Type B (JIS C4004)
Structure	Totally-enclosed self-cooling
Protective structure	Non-conforming Models: IP-42 (JEM1030) Models Conforming to EC Directives: IP-44 (IEC34-5) (excluding shaft opening) (Cannot be used in environment with water-soluble cutting fluids.)
Vibration grade	V-15 (JEC2121)
Mounting method	Flange-mounting

Note 1. Vibration may be amplified due to sympathetic resonance of machinery, so use the Servomotor Driver under conditions which will not exceed 19.6 m/s^2 {2 G} over a long period of time.

Note 2. The above items reflect individual evaluation testing. The results may differ under compounded conditions.

Note 3. The Servomotor cannot be used in a misty atmosphere.

Note 4. The drip-proofing specifications for non-conforming models are special specifications covered by IP-44. (Models with drip-proof specifications provide drip-proofing on Servomotors with oil seals.)

5-2-2 Performance Specifications

■ 200 VAC Servomotors

Item	Unit	R88M -UE10030H-S1 -UE10030V-S1	R88M -UE20030H-S1 -UE20030V-S1	R88M -UE40030H-S1 -UE40030V-S1	R88M -UE75030H-S1 -UE75030V-S1
Rated output (see note)	W	100	200	400	750
Rated torque (see note)	N•m	0.318	0.637	1.27	2.39
	kgf•cm	3.25	6.49	13.0	24.3
Rated rotational speed	r/min	3,000	3,000	3,000	3,000
Momentary maximum rotational speed	r/min	4,500	4,500	4,500	4,500
Momentary maximum torque (see note)	N•m	0.96	1.91	3.82	7.10
	kgf•cm	9.75	19.5	39.0	72.9
Momentary maximum/rated current ratio	%	322	300	308	316
Rated current (see note)	A (rms)	0.87	2.0	2.6	4.4
Momentary maximum current (see note)	A (rms)	2.8	6.0	8.0	13.9
Rotor inertia	kg•m^2 (GD^2/4)	0.40×10^{-5}	1.23×10^{-5}	1.91×10^{-5}	6.71×10^{-5}
	kgf•cm•s^2	0.41×10^{-4}	1.26×10^{-4}	1.95×10^{-4}	6.85×10^{-4}
Torque constant (see note)	N•m/A	0.408	0.355	0.533	0.590
	kgf•cm/A	4.16	3.62	5.44	6.01
Induced voltage constant (see note)	mV/ (r/min)	14.0	12.4	18.6	20.6
Power rate (see note)	kW/s	25.4	32.8	84.6	85.1
Mechanical time constant	ms	0.5	0.4	0.3	0.3
Winding resistance	Ω	6.99	1.34	1.23	0.45
Winding impedance	mH	13.2	7.2	7.9	5.7
Electrical time constant	ms	1.9	5.4	6.4	13
Weight	kg	Approx. 0.5	Approx. 1.1	Approx. 1.7	Approx. 3.4
Corresponding Servo Driver		R88D-UEP04H -UEP04V	R88D-UEP08H -UEP08V	R88D-UEP12H -UEP12V	R88D-UEP20H -UEP20V

Note The values for torque and rotational speed characteristics, are the values at an armature winding temperature of 100°C, combined with the Servo Driver. Other values are at normal conditions (20°C, 65%). The maximum momentary torque is a reference value.

• AC Servomotor Heat Radiation Conditions

When an AC Servomotor is continuously operated at the rated conditions, a heat radiation plate equivalent to an rectangular aluminum plate of t6 × 250 mm is required at the Servomotor flange mounting area. (This is for horizontal mounting, with nothing around the Servomotor and no interference from heat convection currents.)

■ 100 VAC Servomotors

Item	Unit	R88M -UE10030L-S1 -UE10030W-S1	R88M -UE20030L-S1 -UE20030W-S1	R88M -UE30030L-S1 -UE30030W-S1
Rated output (see note)	W	100	200	300
Rated torque (see note)	N•m	0.318	0.637	0.954
	kgf•cm	3.25	6.49	9.74
Rated rotational speed	r/min	3,000	3,000	3,000
Momentary maximum rotational speed	r/min	4,500	4,500	4,500
Momentary maximum torque (see note)	N•m	0.96	1.91	3.72
	kgf•cm	9.75	19.5	38.0
Momentary maximum/rated current ratio	%	323	311	400
Rated current (see note)	A (rms)	2.2	2.7	3.7
Momentary maximum current (see note)	A (rms)	7.1	8.4	14.8
Rotor inertia	kg•m^2 (GD^2/4)	0.40×10^{-5}	1.23×10^{-5}	1.91×10^{-5}
	kgf•cm•s^2	0.41×10^{-4}	1.26×10^{-4}	1.95×10^{-4}
Torque constant (see note)	N•m/A	0.156	0.255	0.279
	kgf•cm/A	1.59	2.60	2.85
Induced voltage constant (see note)	mV/(r/min)	5.43	8.9	9.74
Power rate (see note)	kW/s	25.4	32.8	47.3
Mechanical time constant	ms	0.6	0.4	0.3
Winding resistance	Ω	1.22	0.706	0.435
Winding impedance	mH	2.0	4.0	2.3
Electrical time constant	ms	1.6	5.7	5.3
Weight	kg	Approx. 0.5	Approx. 1.1	Approx. 1.7
Corresponding Servo Driver		R88D-UEP10L -UEP10W	R88D-UEP12L -UEP12W	R88D-UEP15L -UEP15W

Note The values for torque and rotational speed characteristics, are the values at an armature winding temperature of 100°C, combined with the Servo Driver. Other values are at normal conditions (20°C, 65%). The maximum momentary torque is a reference value.

• AC Servomotor Heat Radiation Conditions

When an AC Servomotor is continuously operated at the rated conditions, a heat radiation plate equivalent to an rectangular aluminum plate of t6 × 250 mm is required at the Servomotor flange mounting area. (This is for horizontal mounting, with nothing around the Servomotor and no interference from heat convection currents.)

■ Specifications for Servomotors with Magnetic Brakes

The magnetic brakes installed in Servomotors with brakes are status-holding brakes with non-magnetized operation. The magnetic brake is released when a magnetic current (24 VDC) is applied. The magnetic brake is not meant to be used for braking. Using it for braking will damage it. During Servomotor operation, be sure to release the magnetic brake by applying a magnetic voltage. The specifications for Servomotors with brakes are similar to those for Servomotors without brakes, so except for inertia and weight, the various constants are all the same.
The inertia for magnetic brakes is the load inertia.
Use a separate power supply for the magnetic brake excitation power.

• Specifications for AC Servomotors With Brakes (Specifications in Common for 100 and 200 VAC)

Item	Unit	R88M -UE10030□-BS1	R88M -UE20030□-BS1	R88M -UE30030□-BS1	R88M -UE40030□-BS1	R88M -UE75030□-BS1
Rotor inertia	kg•m^2 (GD^2/4)	0.40×10^{-5}	1.23×10^{-5}	1.91×10^{-5}	1.91×10^{-5}	6.71×10^{-5}
	kgf•cm•s^2	0.41×10^{-4}	1.26×10^{-4}	1.95×10^{-4}	1.95×10^{-4}	6.85×10^{-4}
Brake inertia	kg•m^2 (GD^2/4)	0.09×10^{-5}	0.58×10^{-5}			1.40×10^{-5}
	kgf•cm•s^2	0.09×10^{-4}	0.59×10^{-4}			1.43×10^{-4}
Total inertia	kg•m^2 (GD^2/4)	0.49×10^{-5}	1.81×10^{-5}	2.49×10^{-5}	2.49×10^{-5}	8.11×10^{-5}
	kgf•cm•s^2	0.50×10^{-4}	1.85×10^{-4}	2.54×10^{-4}	2.54×10^{-4}	8.28×10^{-4}
Weight (approx.)	kg	0.8	1.6	2.2	2.2	4.3
Magnetized voltage	V	24 VDC ±10% (No polarity)				
Power consumption	W (at 20°C)	6	6.5			6
Current consumption	A (at 20°C)	0.25	0.27			0.25
Static friction torque	N•m	0.34 min.	1.5 min.			2.5 min.
	kgf•cm	3.5 min.	15.0 min.			25.0 min.
Absorption time (see note 1)	ms	(60 max.)	(100 max.)			(200 max.)
Release time (see note 1)	ms	(30 max.)	(40 max.)			(50 max.)
Backlash	---	(±1°)				
Rating	---	Continuous				
Insulation grade	---	Type F				

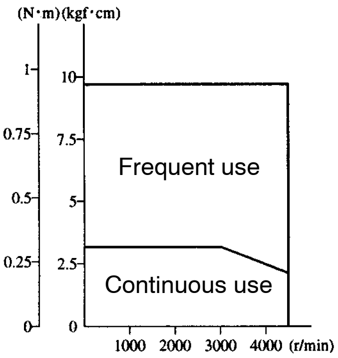
Note 1. The operation time measurement is the measured value with a surge killer (CR50500, by Okaya Electric Industrial Co.) installed.

Note 2. The items in parentheses are reference values.

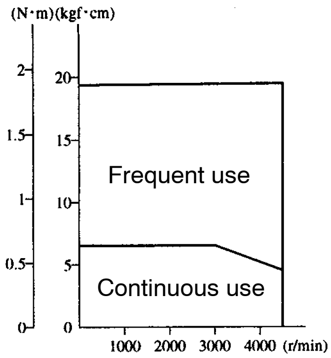
5-2-3 Torque and Rotational Speed Characteristics

■ Torque Characteristics (With 3-m Standard Cable and 200-VAC Input)

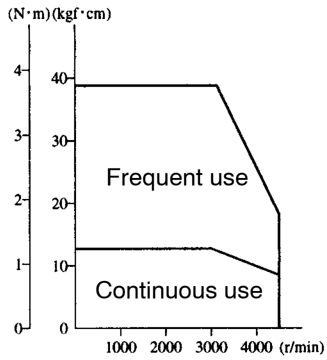
R88M-UE10030H-S1
-UE10030V-S1



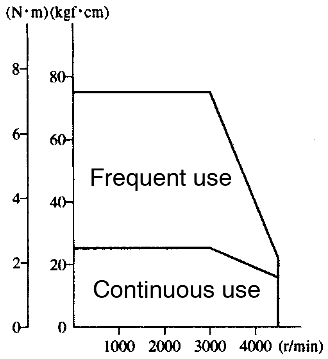
R88M-UE20030H-S1
-UE20030V-S1



R88M-UE40030H-S1
-UE40030V-S1

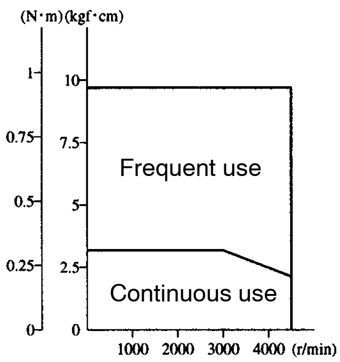


R88M-UE75030H-S1
-UE75030V-S1

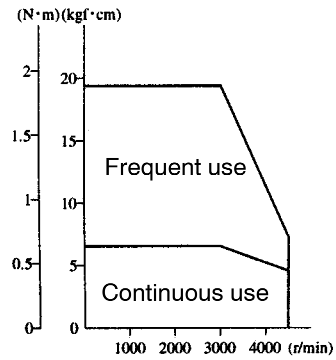


■ Torque Characteristics (With 3-m Standard Cable and 100-VAC Input)

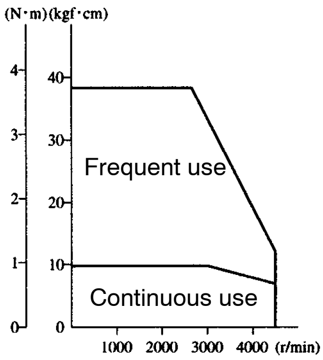
R88M-UE10030L-S1
-UE10030W-S1



R88M-UE20030L-S1
-UE20030W-S1



R88M-UE30030L-S1
-UE30030W-S1



■ Servomotor and Mechanical System Temperature Characteristics

- U-series AC Servomotors use rare earth magnets (neodymium-iron magnets). The temperature coefficient for these magnets is approximately -0.13%/°C. As the temperature drops, the Servomotor's momentary maximum torque increases, and as the temperature rises the Servomotor's momentary maximum torque decreases. When the normal temperature of 20°C and -10°C are compared, the momentary maximum torque increases by approximately 4%. Conversely, when the magnet warms up to 80°C from the normal temperature of 20°C, the momentary maximum torque decreases by approximately 8%.

- Generally, in a mechanical system, when the temperature drops the friction torque increases and the load torque becomes larger. For that reason, overloading may occur at low temperatures. In particular, in systems which use deceleration devices, the load torque at low temperatures may be nearly twice the load torque at normal temperatures. Check with a monitor (using a torque command) to see whether overloading is occurring at low temperatures, and how much the load torque is. Likewise, check to see whether there abnormal Servomotor overheating or alarms are occurring at high temperatures.
- An increase in load friction torque increases the apparent load inertia. Therefore, even if the Servo Driver parameters are adjusted at a normal temperature, there may not be optimal operation at low temperatures. Check to see whether there is optimal operation at low temperatures too.

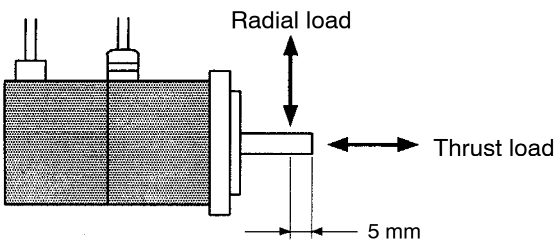
5-2-4 Allowable Loads on Servomotor Shafts

The allowable loads on Servomotor shafts are shown in the following table. Operate the Servomotor at no more than the allowable radial and thrust loads. At the time of assembly, assemble the Servomotor at no more than the momentary maximum radial and thrust loads (static pressure).

Servomotor	Momentary allowable radial load (static pressure)		Momentary allowable thrust load (static pressure)		Allowable radial load		Allowable thrust load	
	N	kgf	N	kgf	N	kgf	N	kgf
R88M-UE10030□-S1	186	19	127	13	78	8	54	5.5
R88M-UE20030□-S1	490	50	176	18	245	25	74	7.5
R88M-UE30030□-S1	490	50	176	18	245	25	74	7.5
R88M-UE40030□-S1	490	50	176	18	245	25	74	7.5
R88M-UE75030□-S1	735	75	392	40	392	40	147	15

Note 1. The allowable loads are the same for motors with brakes.

Note 2. The allowable radial load is the value at a point 5 mm from the end of the shaft.



Note 3. The allowable radial and thrust loads are values determined with a service life of 20,000 hours taken as a criteria.

Note 4. The service life of bearing grease is 20,000 hours at a Servomotor ambient temperature of 40°C, and under the rated operating conditions.

Note 5. Absolutely do not impact the Servomotor or the output shaft by striking them with an implement such as a hammer. Doing so will damage the Servomotor and encoder bearings.

Note 6. Make sure that the radial load is within the allowable range when there is a radial load applied. If the Servomotor is operated at more than the allowable radial load, the shaft may suffer damage due to fatigue.

Note 7. Applying an excessive load even once can damage the bearings and eventually cause a breakdown.

5-2-5 Encoder Specifications

Item	Standards
Encoder method	Optical incremental encoder
Number of output pulses	A, B phase: 1,024 pulses/revolution Z phase: 1 pulse/revolution
Power supply voltage	5 VDC±5%
Power supply current	DC, 350 mA (for load resistance of 220 Ω)
Phase characteristics	90° ±43.2°
Phase relationship	For rotation in the CW direction, A phase is advanced by 90° compared to B phase.
Maximum rotational speed	4500 r/min
Maximum response frequency	76.8 kHz
Output signals	+A, –A, +B, –B, +S, –S
Output impedance	Conforming to EIA RS-422A. Output based on AM26LS31CN or equivalent.
Serial communications data	Z phase, poll sensor, U, V, W phase
Serial communications method	Combination communications method based on A, B, and S phases.

5-3 Cable Specifications

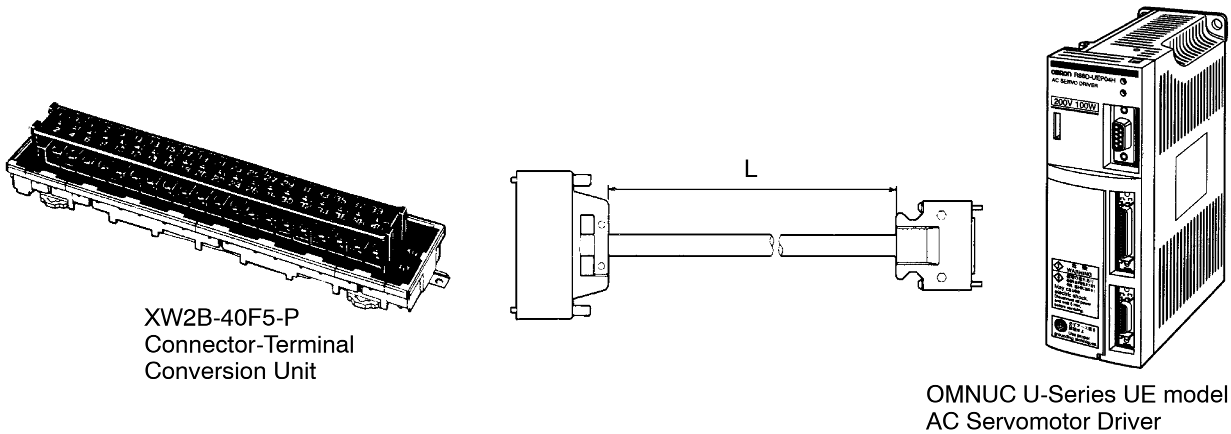
5-3-1 Controller Connecting Cable

■ Connector–Terminal Block Conversion Unit Cables

• Types of Cable

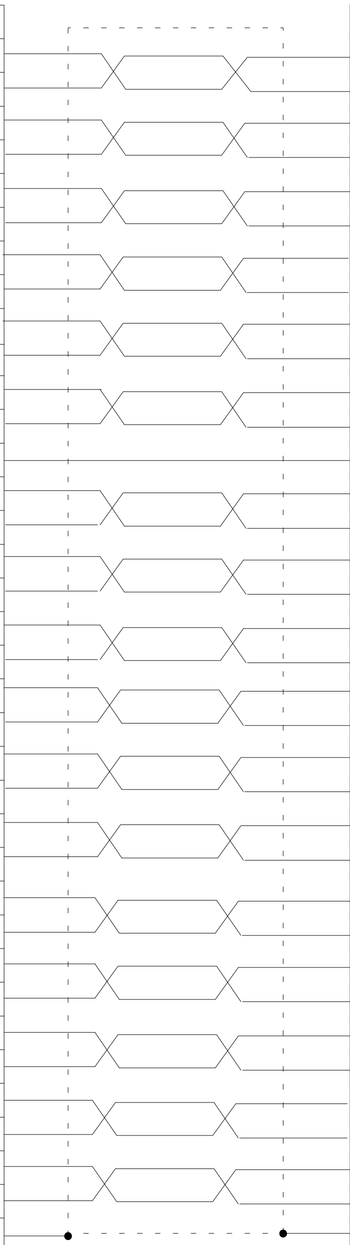
Model	Length (L)	Outer diameter of sheath
R88A-CTU001N	1 m	9.9 dia.
R88A-CTU002N	2 m	

• Connection Configuration



● Wiring

No.	No.		No.	Signal
1	A	1	1	+CW
2	B	1	2	−CW
3	A	2	3	+CWW
4	B	2	4	−CWW
5	A	3	5	+ECRST
6	B	3	6	−ECRST
7	A	4	7	BKIR
8	B	4	8	INP
9	A	5	9	
10	B	5	10	0GND
11	A	6	11	
12	B	6	12	
13	A	7	13	+24 VIN
14	B	7	14	RUN
15	A	8	15	MIGN
16	B	8	16	POT
17	A	9	17	NOT
18	B	9	18	RESET
19	A	10	19	
20	B	10	20	
21	A	11	21	
22	B	11	22	
23	A	12	23	
24	B	12	24	
25	A	13	25	
26	B	13	26	
27	A	14	27	
28	B	14	28	
29	A	15	29	
30	B	15	30	
31	A	16	31	
32	B	16	32	Z
33	A	17	33	ZCOM
34	B	17	34	$\overline{\text{ALM}}$
35	A	18	35	ALMCOM
36	B	18	Shell	FG
37	A	19		
38	B	19		
39	A	20		
40	B	20		



Cable: AWG24 × 18P

Connector plug: Fujitsu's FCN-361J040-AU
Connector cover: Fujitsu's FCN-360C040-B

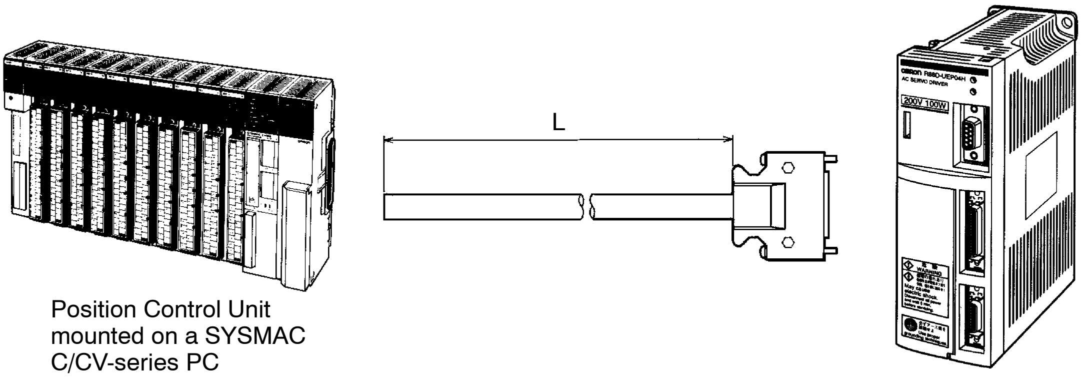
Connector plug
Sumitomo 3M's 10136-3000VE
Connector cover
Sumitomo 3M's 10336-52A0-008

■ General-purpose Control Cable

• Types of Cable

Model	Length (L)	Outer diameter of sheath
R88A-CPU001S	1 m	9.9 dia.
R88A-CPU002S	2 m	

• Connection Configuration



Position Control Unit
mounted on a SYSMAC
C/CV-series PC

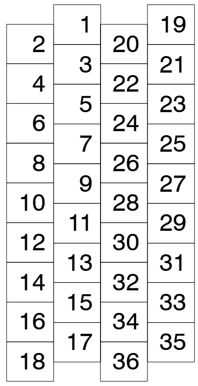
OMNUC U-Series UE model
AC Servomotor Driver

● Wiring

No.	Insulation color	Dot mark	Dot mark color	Signal name
1	Orange	–	Black	+CW
2	Orange	–	Red	–CW
3	Gray	–	Black	+CCW
4	Gray	–	Red	–CCW
5	White	–	Black	+ECRST
6	White	–	Red	–ECRST
7	Yellow	–	Black	BKIR
8	Yellow	–	Red	INP
9	Pink	–	Black	
10	Pink	–	Red	0GND
11	Gray	– –	Black	
12	Gray	– –	Red	
13	Orange	– –	Black	+24VIN
	Orange	– –	Red	
14	White	– –	Black	RUN
15	White	– –	Red	MING
16	Yellow	– –	Black	POT
17	Yellow	– –	Red	NOT
18	Pink	– –	Black	RESET
19	Pink	– –	Red	
20	Orange	– – –	Black	
21	Orange	– – –	Red	
22	Gray	– – –	Black	
23	Gray	– – –	Red	
24	White	– – –	Black	
25	White	– – –	Red	
26	Yellow	– – –	Black	
27	Yellow	– – –	Red	
28	Pink	– – –	Black	
29	Pink	– – –	Red	
30	Orange	– – – –	Black	
31	Orange	– – – –	Red	
32	Gray	– – – –	Black	Z
33	Gray	– – – –	Red	ZCOM
34	White	– – – –	Black	$\overline{\text{ALM}}$
35	White	– – – –	Red	ALMCOM
Shell	Shield	---	---	FG

Cable: AWG24X18P

Connector Pin Arrangement



Connector plug model: 10136-3000VE (Sumitomo 3M)
Connector case model: 10336-52A0-008 (Sumitomo 3M)

5-3-2 Encoder Cable

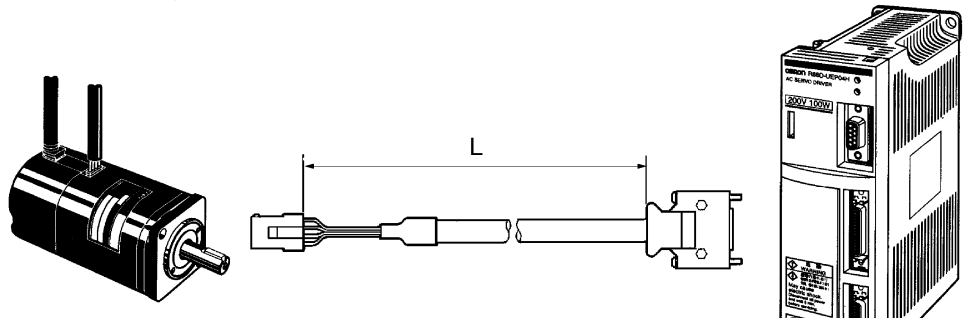
■ Encoder Cables for Non-conforming Models

• Types of Cable

Model	Length (L)	Outer diameter of sheath
R88A-CRU003C	3 m	8 dia.
R88A-CRU005C	5 m	
R88A-CRU010C	10 m	
R88A-CRU015C	15 m	
R88A-CRU020C	20 m	

(Up to a maximum of 20 m between the Monitor and the Servo Driver.)

• Connection Configuration



OMNUC U-Series UE model
AC Servomotor

OMNUC U-Series UE model
AC Servomotor Driver

• Wiring

Symbol	No.	Wire	No.	Symbol
A+	1	AWG24 (blue)	16	A+
A–	2	AWG24 (white/blue)	17	A–
B+	3	AWG24 (yellow)	18	B+
B–	4	AWG24 (white/yellow)	19	B–
S+	5	AWG24 (green)	14	S+
S–	6	AWG24 (white/green)	15	S–
E0V	7	AWG22 (black)	1	E0V
E5V	8	AWG22 (red)	4	E5V
FG	9	AWG22 (green/yellow)	20	FG

Cable: AWG22 × 3C + AWG24 × 3P
UL2589

Cable Side

Connector housing model: 172161-1 (Nippon Amp)
Connector socket contact model: 170365-1 (Nippon Amp)
Crimping tool: 724649-1
Pulling tool: 724668-2

Connector plug model: 10120-3000VE (Sumitomo 3M)
Connector case model: 10320-52A0-008 (Sumitomo 3M)

Motor Side

Connector plug model: 172169-1 (Nippon Amp)
Connector pin contact model: 170359-1 (Nippon Amp)

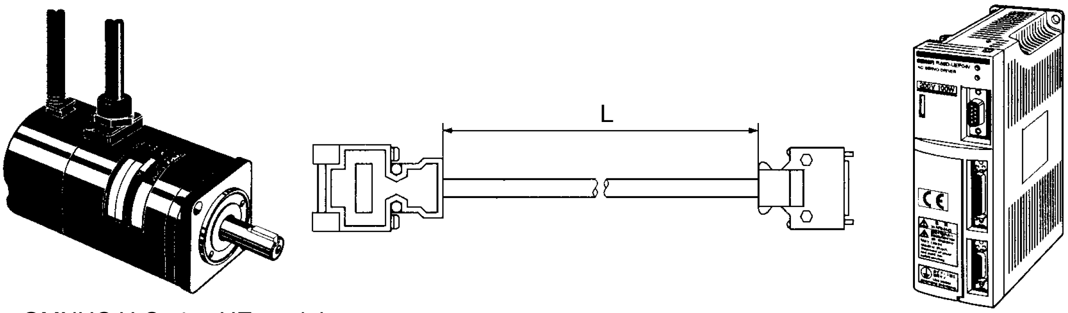
■ Encoder Cables for Models Conforming to EC Directives

• Types of Cable

Model	Length (L)	Outer diameter of sheath
R88A-CRUD003C	3 m	8 dia.
R88A-CRUD005C	5 m	
R88A-CRUD010C	10 m	
R88A-CRUD015C	15 m	
R88A-CRUD020C	20 m	

(Up to a maximum of 20 m between the Monitor and the Servo Driver.)

• Connection Configuration



OMNUC U-Series UE model
AC Servomotor

OMNUC U-Series UE model
AC Servomotor Driver

• Wiring

Symbol	No.	Wire	No.	Symbol
A+	1	AWG24 (blue)	16	A+
A−	2	AWG24 (white/blue)	17	A−
B+	3	AWG24 (yellow)	18	B+
B−	4	AWG24 (white/yellow)	19	B−
S+	5	AWG24 (green)	14	S+
S−	6	AWG24 (white/green)	15	S−
E0V	7	AWG22 (black)	1	E0V
E5V	8	AWG22 (red)	4	E5V
FG	9	AWG22 (green/yellow)	20	
			Shell	FG

Cable: AWG22 × 3C + AWG24 × 3P
UL2589

Cable Side

Connector model: 17J E 13090-02D8A (DDK)

Connector plug model: 10120-3000VE (Sumitomo 3M)
Connector case model: 10320-52A0-008 (Sumitomo 3M)

5-3-3 Power Cable

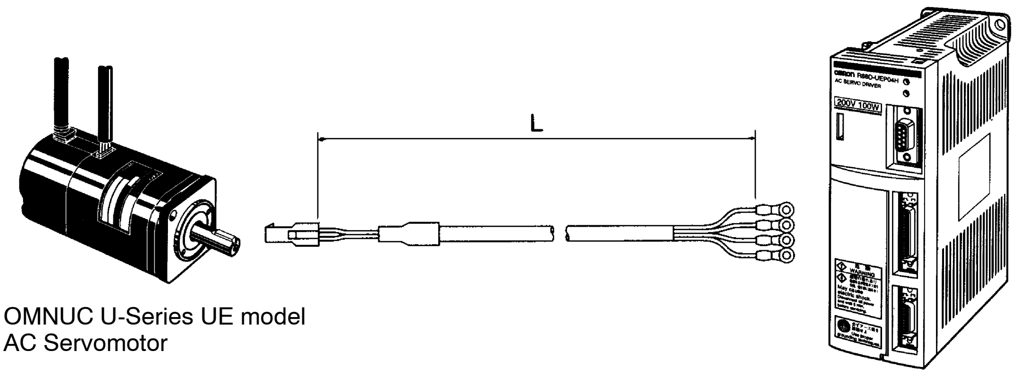
■ Power Cable for Servomotors Without Brakes, Non-conforming Models

• Types of Cable

Model	Length (L)	Outer diameter of sheath
R88A-CAU003S	3 m	5.8 dia.
R88A-CAU005S	5 m	
R88A-CAU010S	10 m	
R88A-CAU015S	15 m	
R88A-CAU020S	20 m	

(Up to a maximum of 20 m between the Monitor and the Servo Driver.)

• Connection Configuration



OMNUC U-Series UE model
AC Servomotor

OMNUC U-Series UE model
AC Servomotor Driver

• Wiring

Symbol	No.
U-phase	1
V-phase	2
W-phase	3
GR	4

Cable: AWG20 × 4C
UL2517

Crimp-style terminal

Cable Side

Connector housing model: 172159-1 (Nippon Amp)
Connector socket contact model: 170366-1 (Nippon Amp)

Crimping tool: 724651-1
Pulling tool: 724668-2

Motor Side

Connector plug model: 172167-1 (Nippon Amp)
Connector pin contact model: 170359-1 (Nippon Amp) for 100-W use
170360-1 (Nippon Amp) for 200 to 750-W use

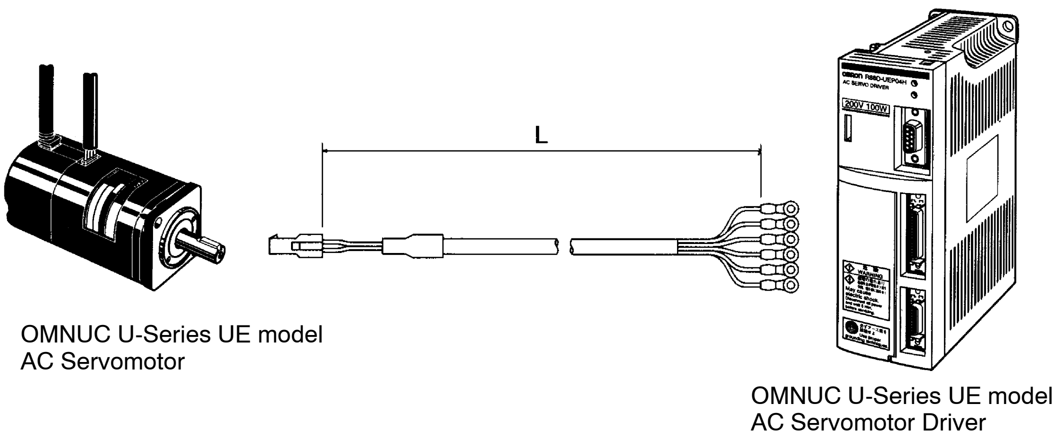
■ Power Cable for Servomotors With Brakes, Non-conforming Models

• Types of Cable

Model	Length (L)	Outer diameter of sheath
R88A-CAU003B	3 m	6.8 dia.
R88A-CAU005B	5 m	
R88A-CAU010B	10 m	
R88A-CAU015B	15 m	
R88A-CAU020B	20 m	

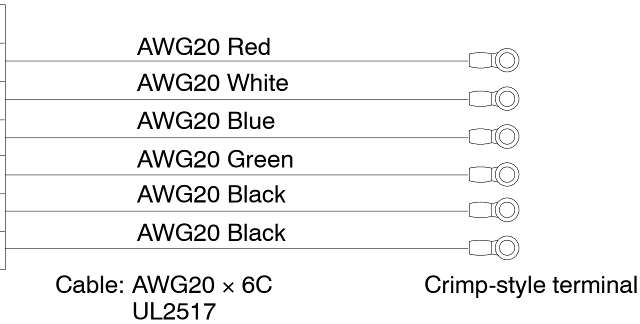
(Up to a maximum of 20 m between the Monitor and the Servo Driver.)

• Connection Configuration



• Wiring

Symbol	No.
U-phase	1
V-phase	2
W-phase	3
GR	4
Brake	5
Brake	6



Cable Side

Connector housing model:	172160-1 (Nippon Amp)
Connector socket contact model:	170366-1 (Nippon Amp)
Crimping tool:	724651-1
Pulling tool:	724668-2

Motor Side

Connector plug model:	172168-1 (Nippon Amp)
Connector pin contact model:	170359-1 (Nippon Amp) for 100-W use
	170360-1 (Nippon Amp) for 200 to 750-W use

■ Power Cable for Servomotors Without Brakes, Models Conforming to EC Directives

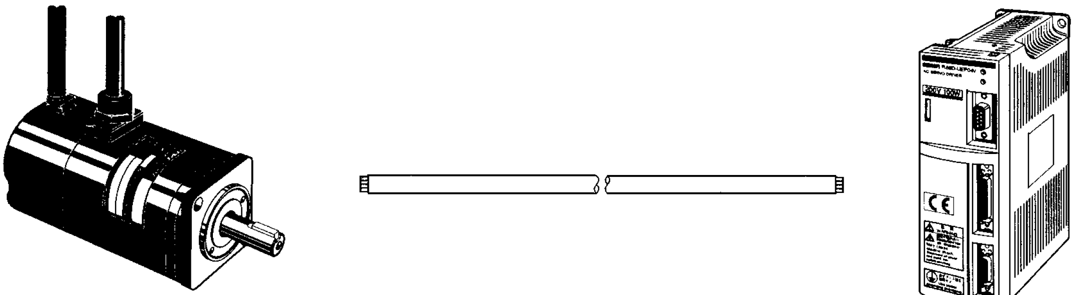
• Types of Cable

Model	Length (L)	Outer diameter of sheath
R88A-CAU001	1 m	5.8 dia.

Note 1. Power cables will be cut to the specified length in 1-m increments.

Note 2. The maximum distance between the Servomotor and the Servo Driver is 20 m.

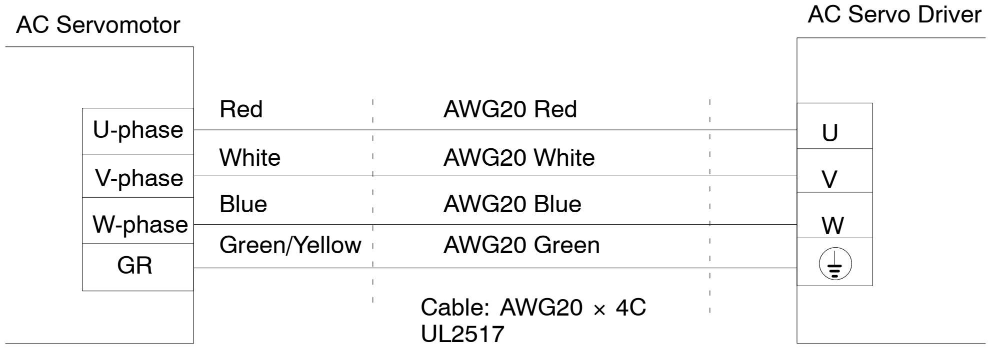
• Connection Configuration



OMNUC U-Series UE model
AC Servomotor

OMNUC U-Series UE model
AC Servomotor Driver

• Wiring



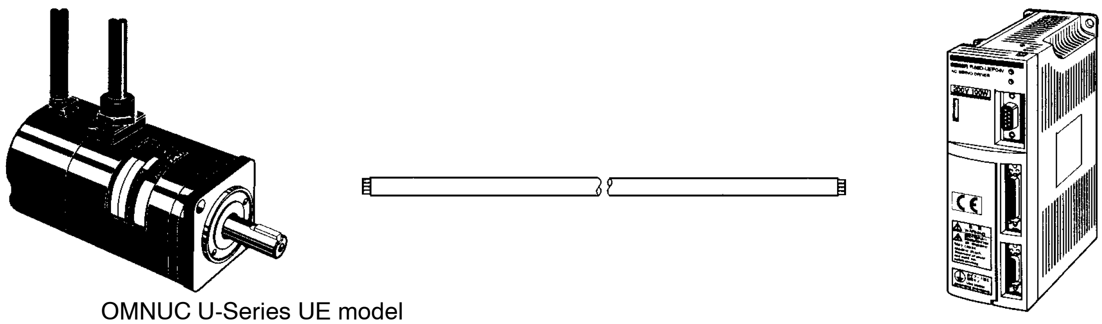
■ Power Cable for Servomotors With Brakes, Models Conforming to EC Directives

Model	Length (L)	Outer diameter of sheath
R88A-CAU01B	1 m	6.8 dia.

Note 1. Power cables will be cut to the specified length in 1-m increments.

Note 2. The maximum distance between the Servomotor and the Servo Driver is 20 m.

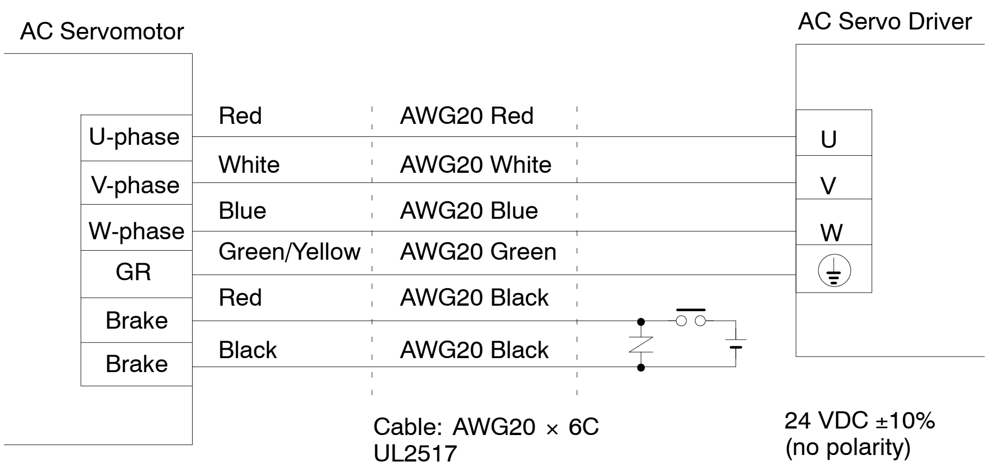
• Connection Configuration



OMNUC U-Series UE model
AC Servomotor

OMNUC U-Series UE model
AC Servomotor Driver

• Wiring



5-4 Parameter Unit Specifications

■ General Specifications

Item	Standards
Operating ambient temperature	0°C to 55°C
Storage ambient temperature	–10°C to 75°C
Operating ambient humidity	35% to 85% RH (with no condensation)
Storage ambient humidity	35% to 85% RH (with no condensation)
Storage and operating atmosphere	No corrosive gasses.
Vibration resistance	4.9 m/s^2 {0.5 G} max.
Impact resistance	Acceleration 19.6 m/s^2 {2 G} max.

■ Performance Specifications

<table>
<tr><th colspan="2">Model</th><th colspan="2">R88A-PR02U</th><th colspan="2">R88A-PR03U</th></tr>
<tr><td colspan="2">Type</td><td colspan="2">Hand held</td><td colspan="2">Mounted</td></tr>
<tr><td colspan="2">Accessory cable</td><td colspan="2">1,000 mm</td><td colspan="2">(Connected by connectors.)</td></tr>
<tr><td colspan="2">Accessory connectors</td><td colspan="2">7910-7500SC (10 pins)</td><td colspan="2">D sub-connector (9 pins)</td></tr>
<tr><td colspan="2">Display</td><td colspan="4">7-segment LED, 5 digits</td></tr>
<tr><td colspan="2">External dimensions</td><td colspan="2">63 × 135 × 18.5 (W × H × D)</td><td colspan="2">54 × 57.5 × 15 (W × H × D)</td></tr>
<tr><td rowspan="7">Communications specifications</td><td>Standard</td><td colspan="2">RS-232C</td><td colspan="2">RS-422A</td></tr>
<tr><td>Communications method</td><td colspan="4">Asynchronous (ASYNC)</td></tr>
<tr><td>Baud rate</td><td colspan="4">2,400 bps</td></tr>
<tr><td>Start bits</td><td colspan="4">1 bit</td></tr>
<tr><td>Data</td><td colspan="4">8 bits</td></tr>
<tr><td>Parity</td><td colspan="4">None</td></tr>
<tr><td>Stop bits</td><td colspan="4">1 bit</td></tr>
<tr><td colspan="2" rowspan="2">Errors detected by Parameter Unit</td><td rowspan="2">Display</td><td>CPF00</td><td colspan="2">Cannot transmit even after 5 seconds have elapsed since power supply was turned on.</td></tr>
<tr><td>CPF01</td><td colspan="2">A BCC error or faulty reception data has occurred for five consecutive times, or a time overrun (1 s) has occurred for three consecutive times.</td></tr>
</table>

5-5 Regeneration Unit Specifications

■ R88A-RG08UA Regeneration Unit

• General Specifications

Item	Standards
Operating ambient temperature	0°C to 55°C
Storage ambient temperature	−10°C to 75°C
Operating ambient humidity	35% to 85% RH (with no condensation)
Storage ambient humidity	35% to 85% RH (with no condensation)
Storage and operating atmosphere	No corrosive gasses.
Vibration resistance	4.9 m/s^2 {0.5 G} max.
Impact resistance	Acceleration 19.6 m/s^2 {2 G} max.

• Performance Specifications

Model	R88A-RG08UA
Regeneration operating voltage	380 V_{DC}
Regeneration processing current	8 A_{DC}
Average regeneration power	12 W (internal resistance: 50 Ω, 60 W)
Externally connected regeneration resistance	47 Ω±5%
Error detection function	Regeneration resistance disconnection, regeneration transistor damage, overvoltage
Alarm output	SPST-NC contact (open contact at time of protective function operation) (200 VAC drive possible.)
External dimensions	55 × 160 × 130 (W × H × D)

• Indicator LED Specifications

Name	Specifications
POWER	Lit while power flows between P and N terminals.
REGEN	Lit during regeneration operation.
ALARM-REGEN	Lit for regeneration resistance disconnection or regeneration transistor damage.
ALARM-OV	Lit when overvoltage occurs.

Note 1. When the error detection function operates, an alarm is output from the Unit.

Note 2. Create a sequence so that the power supply (R−T) to the Servo Driver is cut off when an alarm is generated.

Note 3. When the error detection function operates and the Servo Driver's power supply is cut off, the Regeneration Unit won't be restored to its normal status until 2 to 3 seconds have elapsed, even if the power supply is turned on again. (Normal status is restored after the electrolytic capacitor in the Servo Driver has been discharged and the voltage between P and N drops.)

Note 4. The Regeneration Unit does not conform to EC Directives.

5-6 Front-mounting Bracket Specifications

The Front-surface Mounting Brackets (R88A-TK01U/TK02U) are used to mount a Servo Driver from the front surface. The model of the Bracket depends on the model of the Servo Driver.
These Mounting Brackets cannot be used with models conforming to EC Directives.

■ Combinations

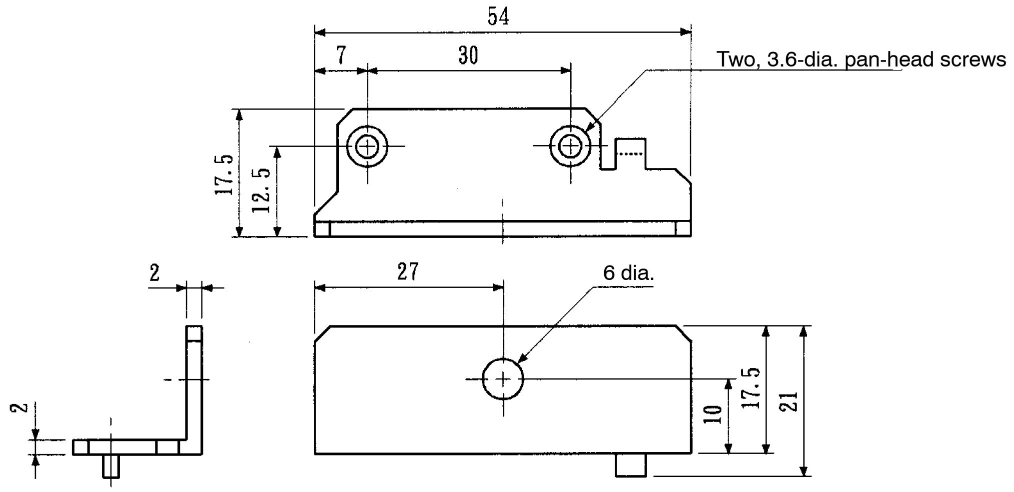
Servo Driver			Front-surface Mounting Bracket model
Model	**Supply voltage**	**Power**	
R88D-UEP04H	200 V	100 W	R88A-TK01U
R88D-UEP08H		200 W	
R88D-UEP12H		400 W	
R88D-UEP20H		750 W	R88A-TK02U
R88D-UEP10L	100 V	100 W	R88A-TK01U
R88D-UEP12L		200 W	
R88D-UEP15L		300 W	R88A-TK02U

Note The Brackets come with a top bracket, a bottom bracket, and five mounting screws.

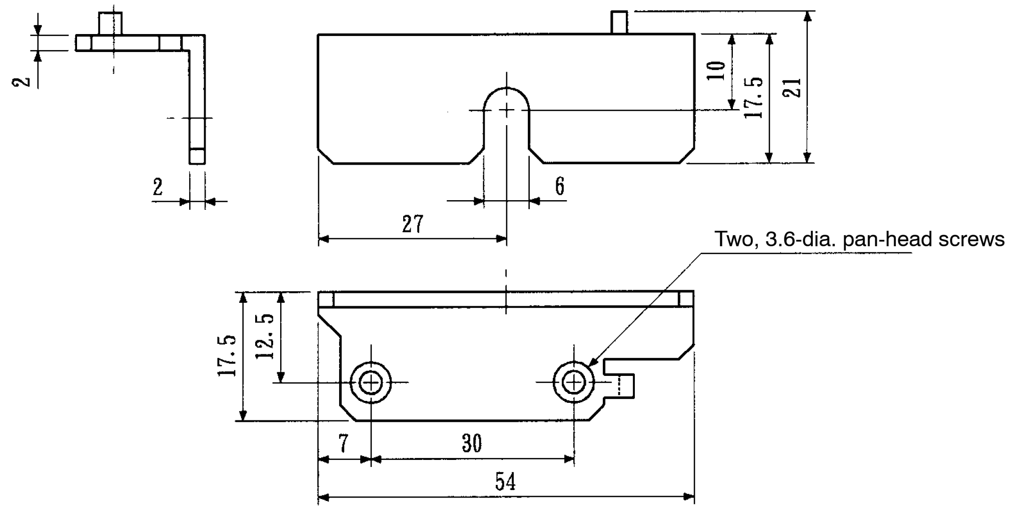
■ Dimensions

● R88A-TK01U

Top Mounting Bracket

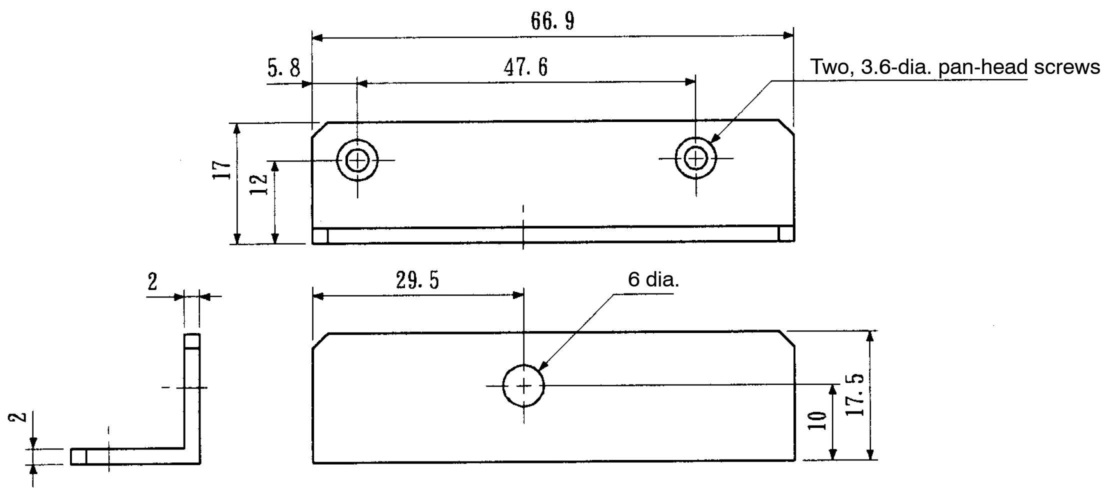


Bottom Mounting Bracket

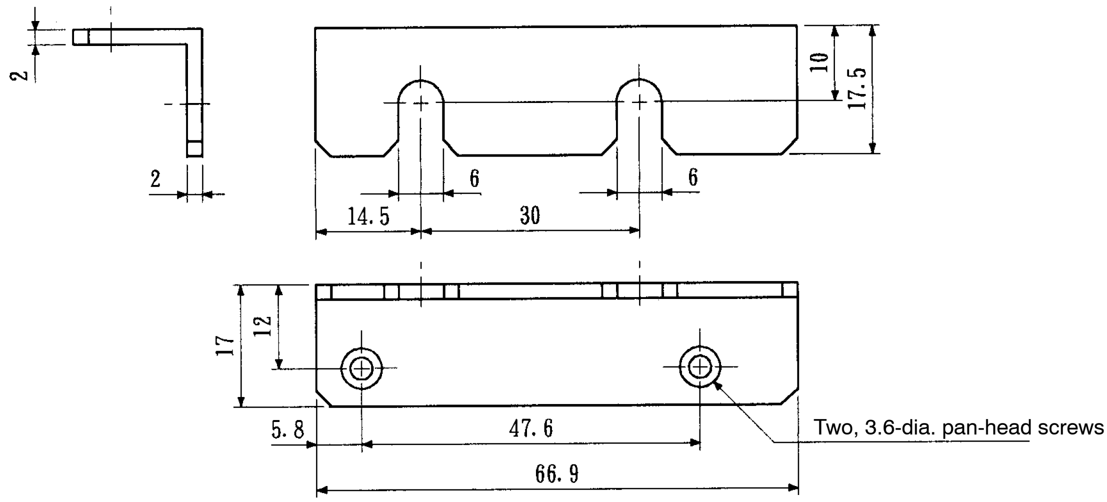


- **R88A-TK02U**

Top Mounting Bracket

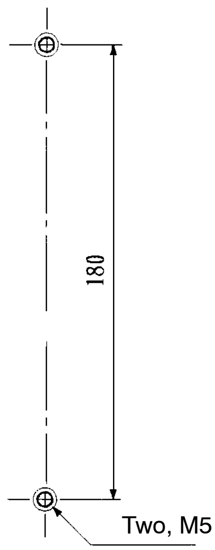


Bottom Mounting Bracket

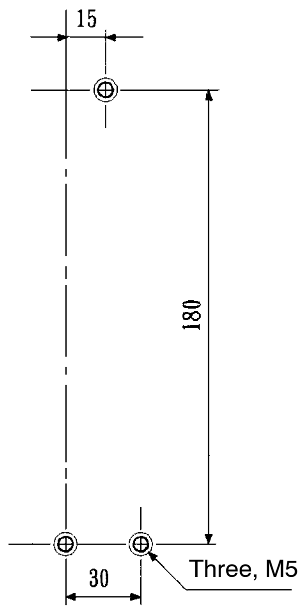


■ Mounting Dimensions

● **R88A-TK01U**



● **R88A-TK02U**

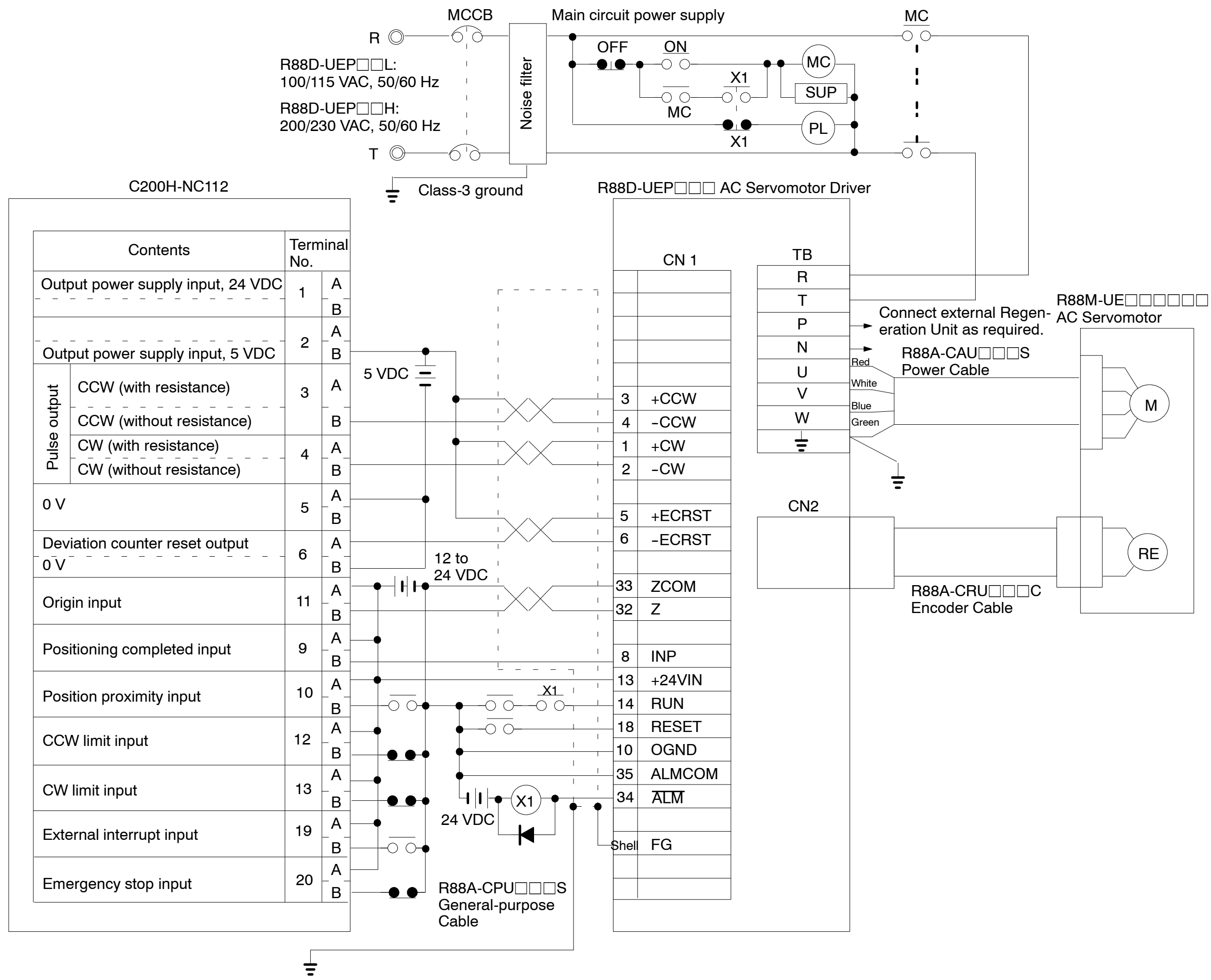


Chapter 6

· Supplementary Materials ·

6-1 Connection Examples

■ Connecting to SYSMAC C200H-NC112 Position Control Unit with 5-VDC Power Supply



Note 1. Incorrect signal wiring can cause damage to Units and the Servo Driver.

Note 2. Leave unused signal lines open and do not wire them.

Note 3. Use mode 2 for origin search.

Note 4. Use a dedicated power supply (24 +5 VDC) for command pulse signals.

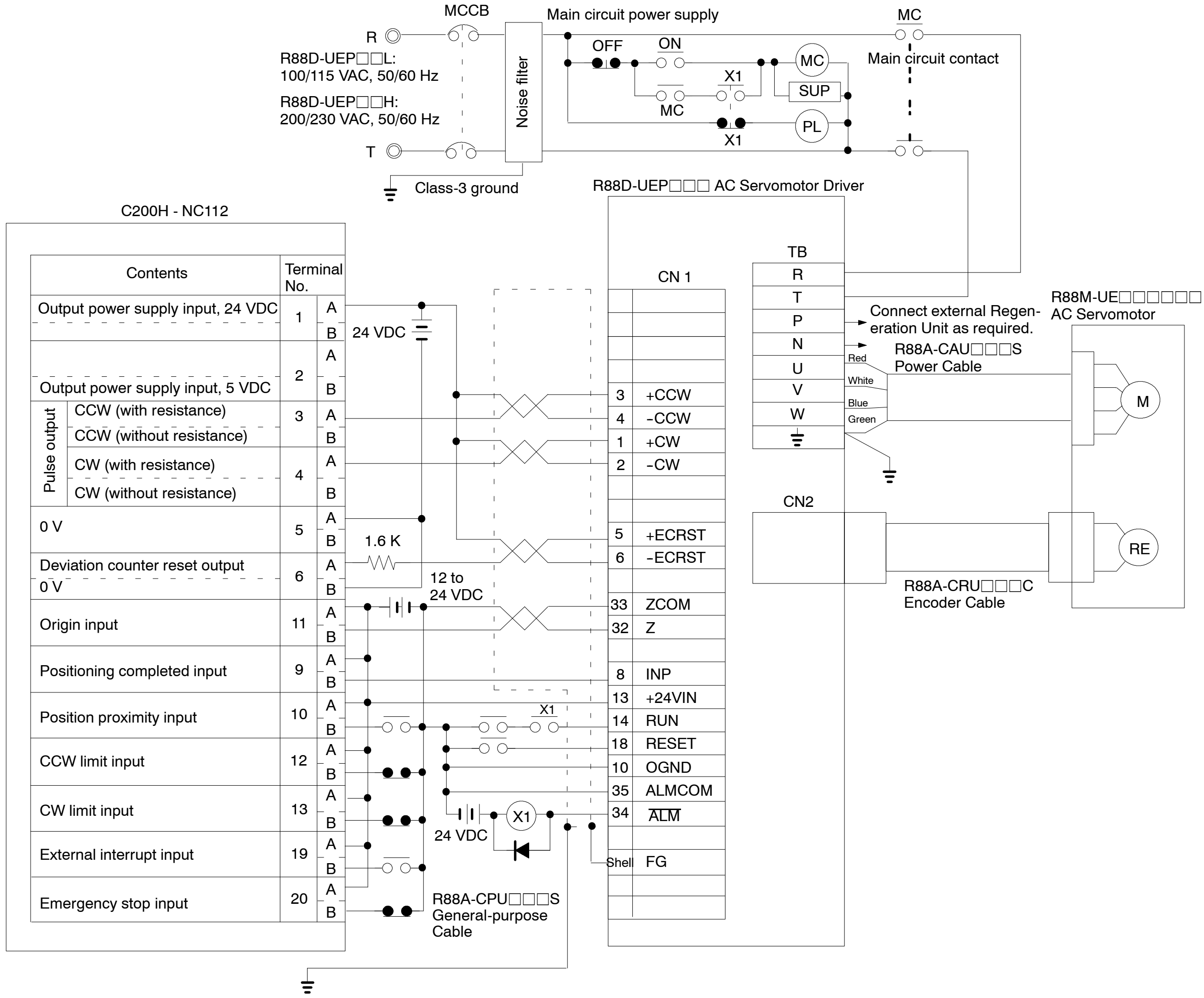
Note 5. ERB44-02 diodes (by Fuji Electric) or equivalent are recommended for surge absorption.

Note 6. Use the RUN signal to set whether the Servo can be turned ON/OFF.

Note 7. Class-3 grounds must be to 100 Ω or less.

Note 8. The Servo Relay Unit and Cables for the R88D-UP□□□ cannot be used.

■ Connecting to SYSMAC C200H-NC112 Position Control Unit with 24-VDC Power Supply



Note 1. Incorrect signal wiring can cause damage to Units and the Servo Driver.

Note 2. Leave unused signal lines open and do not wire them.

Note 3. Use mode 2 for origin search.

Note 4. Use a dedicated power supply (24 VDC) for command pulse signals.

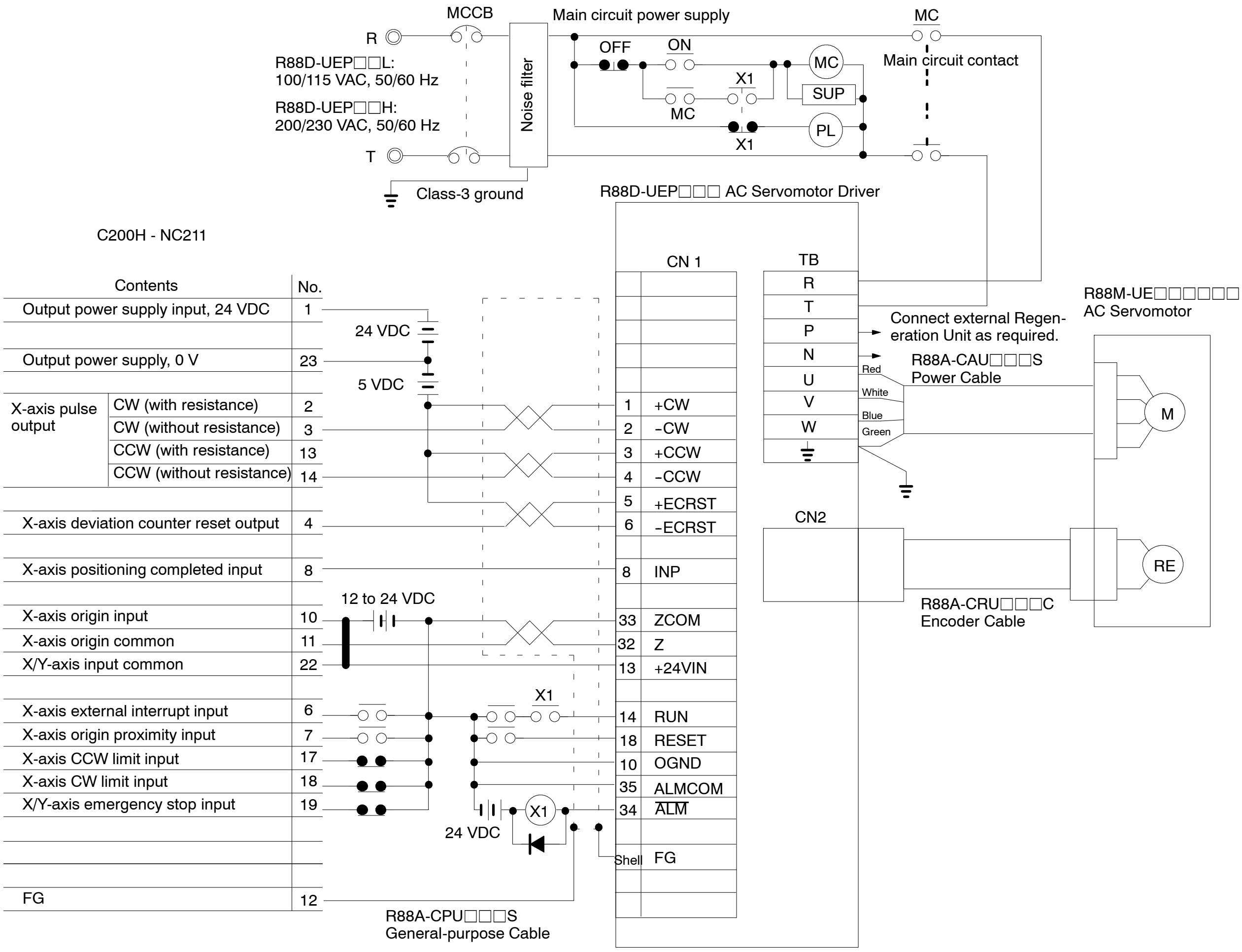
Note 5. ERB44-02 diodes (by Fuji Electric) or equivalent are recommended for surge absorption.

Note 6. Use the RUN signal to set whether the Servo can be turned ON/OFF.

Note 7. Class-3 grounds must be to 100 Ω or less.

Note 8. The Servo Relay Unit and Cables for the R88D-UP□□□ cannot be used.

■ Connecting to SYSMAC C200H-NC211 Position Control Unit with 5-VDC Power Supply



Note 1. Incorrect signal wiring can cause damage to Units and the Servo Driver.

Note 2. Leave unused signal lines open and do not wire them.

Note 3. Use mode 2 for origin search.

Note 4. Use a dedicated power supply (24 VDC) for command pulse signals.

Note 5. ERB44-02 diodes (by Fuji Electric) or equivalent are recommended for surge absorption.

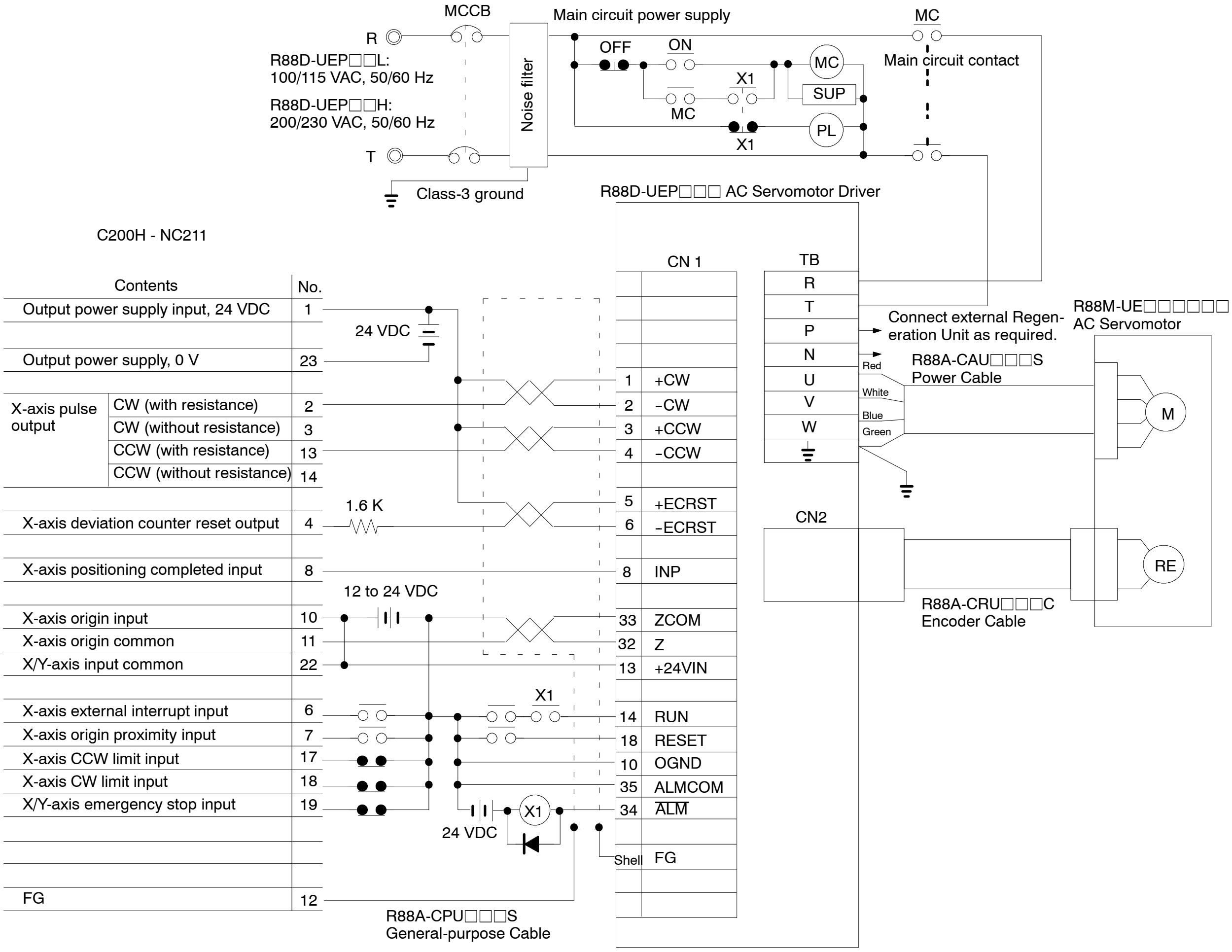
Note 6. This wiring diagram is an example of X-axis wiring only. If two-axis control is used, the external input and Servo Driver wiring must be done in the same way for the Y axis.

Note 7. Use the RUN signal to set whether the Servo can be turned ON/OFF.

Note 8. Class-3 grounds must be to 100 Ω or less.

Note 9. The Servo Relay Unit and Cables for the R88D-UP□□□ cannot be used.

■ Connecting to SYSMAC C200H-NC211 Position Control Unit with 24-VDC Power Supply



Note 1. Incorrect signal wiring can cause damage to Units and the Servo Driver.

Note 2. Leave unused signal lines open and do not wire them.

Note 3. Use mode 2 for origin search.

Note 4. Use a dedicated power supply (24 VDC) for command pulse signals.

Note 5. ERB44-02 diodes (by Fuji Electric) or equivalent are recommended for surge absorption.

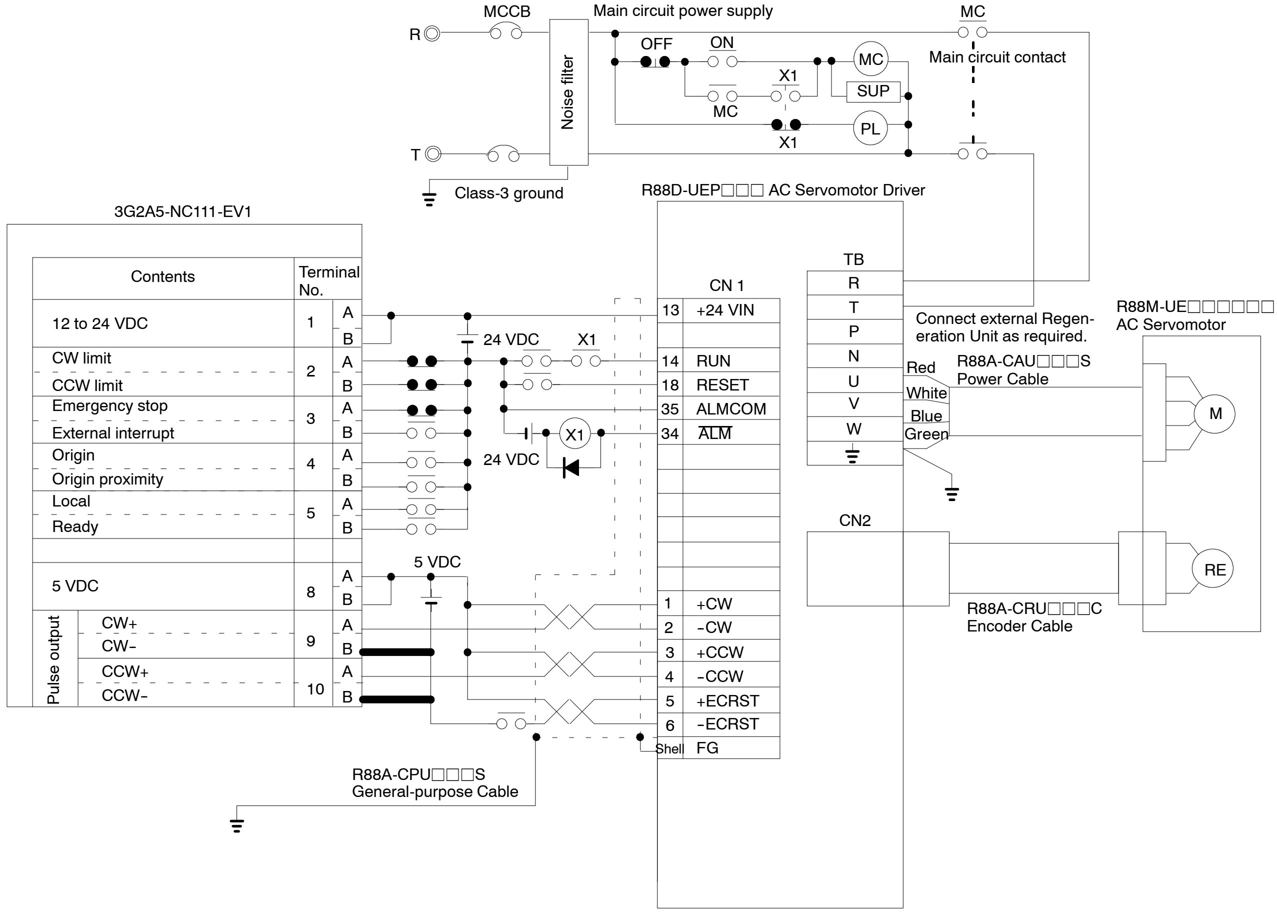
Note 6. This wiring diagram is an example of X-axis wiring only. If two-axis control is used, the external input and Servo Driver wiring must be done in the same way for the Y axis.

Note 7. Use the RUN signal to set whether the Servo can be turned ON/OFF.

Note 8. Class-3 grounds must be to 100 Ω or less.

Note 9. The Servo Relay Unit and Cables for the R88D-UP□□□ cannot be used.

■ Connecting to SYSMAC 3G2A5-NC111-EV1 Position Control Unit



Note 1. Incorrect signal wiring can cause damage to Units and the Servo Driver.

Note 2. Leave unused signal lines open and do not wire them.

Note 3. ERB44-02 diodes (by Fuji Electric) or equivalent are recommended for surge absorption.

Note 4. When using a 3G2A5-NC111-EV1 Position Control Unit, origin search is carried out according to the origin and origin proximity inputs. Set the origin and origin proximity for the mechanical system. Even after the 3G2A5-NC111-EV1 completes the origin search and pulses are stopped, pulses are still accumulated in the deviation counter in the Servo Driver. The Servomotor will move for the amount of residual pulses and then stop, so there may be a discrepancy with the origin. In order to minimize the amount of the discrepancy, set the origin search proximity speed as low as possible.

Note 5. Use the RUN signal to set whether the Servo can be turned ON/OFF.

Note 6. Class-3 grounds must be to 100 Ω or less.

6-2 OMNUC U-Series Standard Models

■ Non-conforming Models

● Servomotors

Specification				Model
Straight shafts with keys	Standard (no brake)	200 VAC	100 W	R88M-UE10030H-S1
			200 W	R88M-UE20030H-S1
			400 W	R88M-UE40030H-S1
			750 W	R88M-UE75030H-S1
		100 VAC	100 W	R88M-UE10030L-S1
			200 W	R88M-UE20030L-S1
			300 W	R88M-UE30030L-S1
	With brake	200 VAC	100 W	R88M-UE10030H-BS1
			200 W	R88M-UE20030H-BS1
			400 W	R88M-UE40030H-BS1
			750 W	R88M-UE75030H-BS1
		100 VAC	100 W	R88M-UE10030L-BS1
			200 W	R88M-UE20030L-BS1
			300 W	R88M-UE30030L-BS1

● Servo Drivers with Pulse-train Inputs

Specification			Model
Pulse-train input	200 VAC	100 W	R88D-UEP04H
		200 W	R88D-UEP08H
		400 W	R88D-UEP12H
		750 W	R88D-UEP20H
	100 VAC	100 W	R88D-UEP10L
		200 W	R88D-UEP12L
		300 W	R88D-UEP15L

● Parameter Unit

Specification	Model
Handy type	R88A-PR02U
Mounted type	R88A-PR03U

● Regeneration Unit

Specification	Model
Regeneration processing current: 8 A	R88A-RG08UA

● External Regeneration Resistor

Specification	Model
Regeneration capacity: 70 W, 47 Ω	R88A-RR22047S

• Encoder Cables

Specification		Model
Connectors at both ends	3 m	R88A-CRU003C
	5 m	R88A-CRU005C
	10 m	R88A-CRU010C
	15 m	R88A-CRU015C
	20 m	R88A-CRU020C
Cable only	1-m units	R88A-CRU001

• Power Cables

Specification			Model
For standard motors (no brake)	Connector at one end	3 m	R88A-CAU003S
		5 m	R88A-CAU005S
		10 m	R88A-CAU010S
		15 m	R88A-CAU015S
		20 m	R88A-CAU020S
For motors with brakes	Connector at one end	3 m	R88A-CAU003B
		5 m	R88A-CAU005B
		10 m	R88A-CAU010B
		15 m	R88A-CAU015B
		20 m	R88A-CAU020B

• General-purpose Control Cables

Specification		Model
For general-purpose controllers, connector at one end	1 m	R88A-CPU001S
	2 m	R88A-CPU002S

• Connectors and Terminal Blocks

Specification		Model
Control cable connector		R88A-CNU01C
Connector terminal block		XW2B-40F5-P
Connection cable for connector terminal block	1 m	R88A-CTU001N
	2 m	R88A-CTU002N

• Front-surface Mounting Brackets

Specification	Model
For the following Servo Drivers 200 VAC: 100 to 400 W 100 VAC: 100, 200 W	R88A-TK01U
For the following Servo Drivers 200 VAC: 750 W 100 VAC: 300 W	R88A-TK02U

■ Models Conforming to EC Directives

● Servomotors

Specification				Model
Straight shafts with keys	Standard (no brake)	200 VAC	100 W	R88M-UE10030V-S1
			200 W	R88M-UE20030V-S1
			400 W	R88M-UE40030V-S1
			750 W	R88M-UE75030V-S1
		100 VAC	100 W	R88M-UE10030W-S1
			200 W	R88M-UE20030W-S1
			300 W	R88M-UE30030W-S1
	With brake	200 VAC	100 W	R88M-UE10030V-BS1
			200 W	R88M-UE20030V-BS1
			400 W	R88M-UE40030V-BS1
			750 W	R88M-UE75030V-BS1
		100 VAC	100 W	R88M-UE10030W-BS1
			200 W	R88M-UE20030W-BS1
			300 W	R88M-UE30030W-BS1

● Servo Drivers with Pulse-train Inputs

Specification			Model
Pulse-train inputs	200 VAC	100 W	R88D-UEP04V
		200 W	R88D-UEP08V
		400 W	R88D-UEP12V
		750 W	R88D-UEP20V
	100 VAC	100 W	R88D-UEP10W
		200 W	R88D-UEP12W
		300 W	R88D-UEP15W

● Parameter Units

Specification	Model
Handy type	R88A-PR02U
Mounted type	R88A-PR03U

● Encoder Cables

Specification		Model
Connectors at both ends	3 m	R88A-CRUD003C
	5 m	R88A-CRUD005C
	10 m	R88A-CRUD010C
	15 m	R88A-CRUD015C
	20 m	R88A-CRUD020C
Cable only	1-m units	R88A-CRU001

• Power Cables (Cables Only)

Specification		Model
For standard motor (no brake)	1-m units	R88A-CAU001
For motor with brake	1-m units	R88A-CAU01B

• General-purpose Control Cables

Specification		Model
For general-purpose controller, connector at one end	1 m	R88A-CPU001S
	2 m	R88A-CPU002S

6-3 Parameter Setting Forms

■ User Parameters

PRM No.	Parameter name	Factory setting	Unit	Setting range	Setting
Cn-04	Speed loop gain (see note 1)	80	Hz	1 to 2,000	
Cn-05	Speed loop integration constant	20	ms	2 to 10,000	
Cn-12	Brake timing	0	10 ms	0 to 50	
Cn-17	Torque command filter time constant	4	100 μs	0 to 250	
Cn-1A	Position loop gain	40	1/s	1 to 500	
Cn-1b	Positioning completion range	3	Command units	0 to 250	
Cn-24	Electronic gear ratio G1 (numerator) (see note 2)	4	---	1 to 65,535	
Cn-25	Electronic gear ratio G2 (denominator) (see note 2)	1	---	1 to 65,535	
Cn-26	Position command acceleration/deceleration time constant	0	× 0.1 ms	0 to 640	

Note 1. Cn-04 (speed loop gain) is factory-set for three times the load inertia. Therefore, if the load inertia is extremely small, some oscillation may occur. If it does, then lower Cn-04 to 20 or less.

Note 2. After the settings Cn-24 (Electronic gear ratio G1 (numerator)) or Cn-25 (Electronic gear ratio G2 (denominator)) have been made, they become effective when the power is turned on again after having been cut off. (Check to see that the LED display has gone off.)

■ Setup Parameters No. 1 (Cn-01)

Item	Bit No.	Factory setting	Setting	Explanation	Setting
Sequence input signal switching	0	0	0	Servo turned ON or OFF by Run command (externally input).	0 =
			1	Servo always ON.	
	1	0	---	No used.	1 = 0
	2	1	0	Enables forward drive prohibit input (POT).	2 =
			1	Permits always-forward drive.	
	3	1	0	Enables reverse drive prohibit input (NOT).	3 =
			1	Permits always -reverse drive.	
	4	0	---	Not used.	4 = 0
	5	1	---	Not used.	5 = 1
	6	1	---	Not used.	6 = 1
	7	1	---	Not used.	7 = 1
Emergency stop selection	8	0	0	Stops the motor using a dynamic brake for overtravel.	8 =
			1	Stops the motor using maximum torque for overtravel.	
	9	0	---	Not used.	9 = 0
Deviation counter with Servo OFF	A	0	0	Clears the counter when the servo shuts off or when an error occur.	A =
			1	Does not clear the counter when the servo shuts off or when an error occur.	
	b	1	---	Not used.	b = 1
	C	0	---	Not used.	C = 0
	d	0	---	Not used.	d = 0
	E	0	---	Not used.	E = 0
	F	0	---	Not used.	F = 0

Note 1. Do not change the setting of bits 1, 4 to 7, 9, and b to F of setup parameter no. 1 (Cn-01).

Note 2. These parameters become effective only after power is reset. Confirm that the indicators go out before turning power back on. (Check to see that the LED display has gone off.)

■ Setup Parameters No. 2 (Cn-02)

Item	Bit no.	Factory setting	Setting	Explanation	Setting
Reverse rotation mode	0	0	0	CCW direction is taken as forward rotation.	0 =
			1	CCW direction is taken as reverse rotation.	
	1	0	---	No used.	1 = 0
	2	0	---	Not used.	2 = 0
Command pulse mode	5, 4, 3	0, 0, 1	0, 0, 0	Feed pulse and Forward/reverse signal	3 = 4 = 5 =
			0, 0, 1	Forward rotation pulse and Reverse rotation pulse	
			0, 1, 0	90° phase difference (A/B phase) signal (1X)	
			0, 1, 1	90° phase difference (A/B phase) signal (2X)	
			1, 0, 0	90° phase difference (A/B phase) signal (4X)	
	6	0	---	Not used	6 = 0
	7	0	---	Not used	7 = 0
	8	0	---	Not used	8 = 0
	9	0	---	Not used	9 = 0
Deviation counter clear	A	1	0	Clears the deviation counter when the signal is high level	A =
			1	Clears the deviation counter on the rising edge of the signal	
	b	0	---	Not used.	b = 0
Torque command filter time constant	C	0	0	Primary filter	C =
			1	Secondary filter	
	d	0	---	Not used.	d = 0
Parameter Unit monitor output lever change	E	0	0	Position deviation monitor set for 1 command.	E =
			1	Position deviation monitor set for 100 command.	
	F	0	---	Not used	F = 0

Note 1. Do not change the settings of bits 1, 2, 6 to 9, b, d, and F of setup parameter no. 2 (Cn-02).

Note 2. These parameters become effective only after power is reset. Confirm that the indicators go out before turning power back on. (Check to see that the LED display has gone off.)