

**Purpose:**

This document describes wiring terminals, main circuit terminal connections and main circuit terminal wiring specifications for the standard E7 drive.

The contents of this document are included in the E7 User Manual TM.E7.01:

- Chapter 2, pages 2-1 through 2-7
  - Section: Wiring Main Circuit Terminals
    - Table 2.1 208-240Vac Wire Sizes and Connector Specifications
    - Table 2.2 480Vac Wire Sizes and Connector Specifications

Information in this document supercedes that contained in TM.E7.01 with dates 5/1/06, Rev: 06-05, and earlier. The data in this document reflects the most recent information provided by Yaskawa regarding these specific wire size tables.

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**Applicability:**

This document applies to the following models of E7 drives:

CIMR-E7U20P4	CIMR-E7U40P4
CIMR-E7U20P7	CIMR-E7U40P7
CIMR-E7U21P5	CIMR-E7U41P5
CIMR-E7U22P2	CIMR-E7U42P2
CIMR-E7U23P7	CIMR-E7U43P7
CIMR-E7U25P5	CIMR-E7U45P5
CIMR-E7U27P5	CIMR-E7U47P5
CIMR-E7U2011	CIMR-E7U49P0
CIMR-E7U2015	CIMR-E7U4011
CIMR-E7U2018	CIMR-E7U4015
CIMR-E7U2022	CIMR-E7U4018
CIMR-E7U2030	CIMR-E7U4024
CIMR-E7U2037	CIMR-E7U4030
CIMR-E7U2045	CIMR-E7U4037
CIMR-E7U2055	CIMR-E7U4045
CIMR-E7U2075	CIMR-E7U4055
CIMR-E7U2090	CIMR-E7U4075
CIMR-E7U2110	CIMR-E7U4090
	CIMR-E7U4110
	CIMR-E7U4160
	CIMR-E7U4185
	CIMR-E7U4220
	CIMR-E7U4300

# Chapter 2

## Electrical Installation

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*This chapter describes wiring terminals, main circuit terminal connections, main circuit terminal wiring specifications, control circuit terminals, and control circuit wiring specifications.*

Terminal Block Configuration .....	2-2
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Control Wiring.....	2-12

# Terminal Block Configuration

The wiring terminals are shown in Fig 2.1.

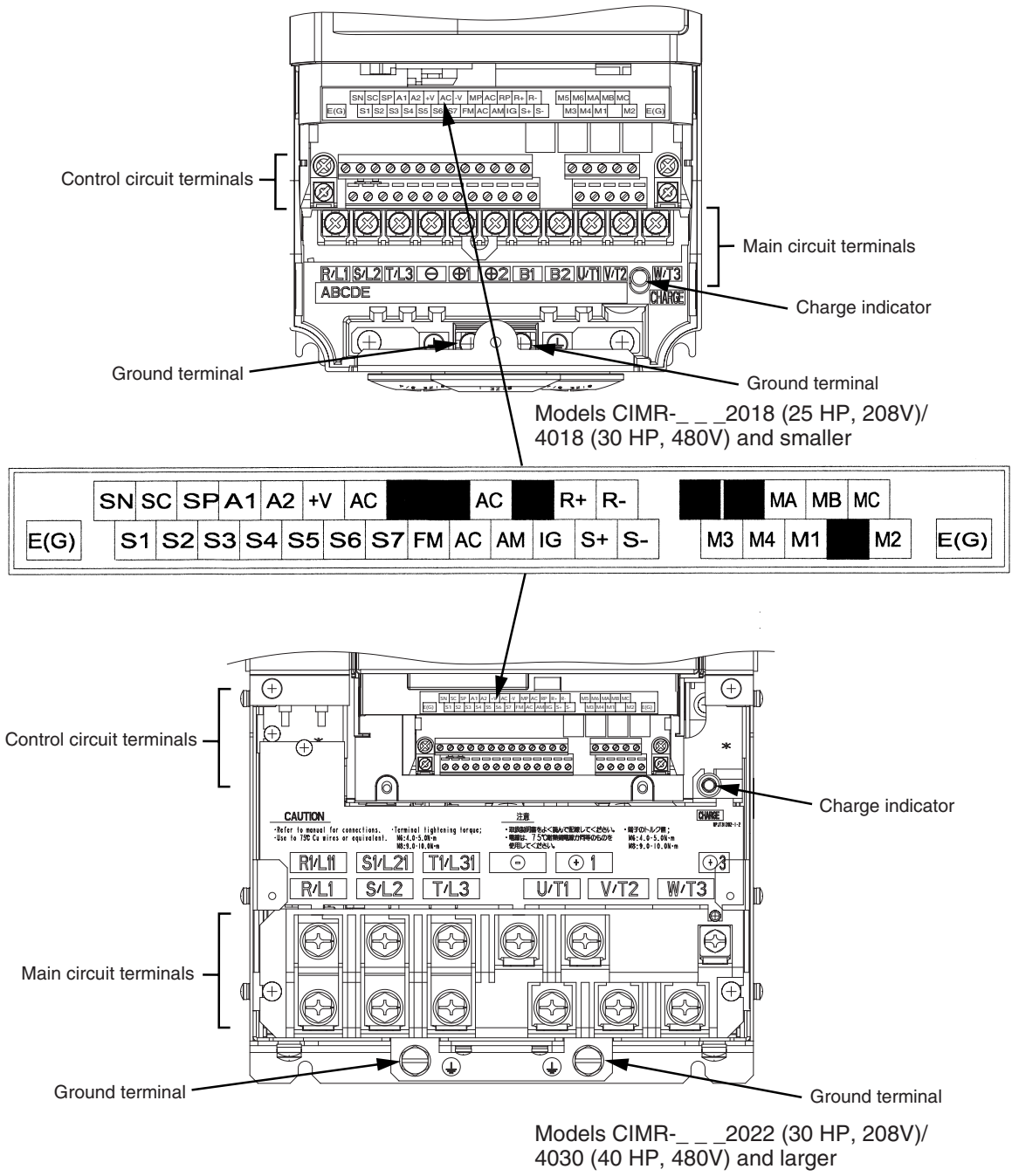


Fig 2.1 Drive Terminal Configuration

# Wiring Main Circuit Terminals

## ◆ Applicable Wire Sizes and Closed-loop Connectors

Select the appropriate wires and crimp terminals from Table 2.1 to Table 2.2.

Table 2.1 208-240Vac Wire Sizes and Connector Specifications						
Drive Model CIMR-E7U	Nominal Hp	Terminal Symbol	Terminal Screws	Clamping Torque lb. in. (N•m)	Recommended Wire Size AWG (mm <sup>2</sup> )	Wire Type
20P4	0.5/0.75	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, B1, B2, U/T1, V/T2, W/T3	M4	13.3 (1.5)	14 (2.1)	600Vac UL Approved vinyl-sheathed or equivalent
		⊕				
20P7	2	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, B1, B2, U/T1, V/T2, W/T3	M4	13.3 (1.5)	14 (2.1)	
		⊕				
21P5	1.5/2	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, B1, B2, U/T1, V/T2, W/T3	M4	13.3 (1.5)	14 (2.1)	
		⊕				
22P2	3	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, B1, B2, U/T1, V/T2, W/T3	M4	13.3 (1.5)	12 (3.3)	
		⊕				
23P7	5	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, B1, B2, U/T1, V/T2, W/T3	M4	13.3 (1.5)	10 (5.3)	
		⊕				
25P5	7.5	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, B1, B2, U/T1, V/T2, W/T3	M4	13.3 (1.5)	10 (5.3)	
		⊕				
27P5	10	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, B1, B2, U/T1, V/T2, W/T3	M5	22.1 (2.5)	8 (8)	
		⊕				
2011	15	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, B1, B2, U/T1, V/T2, W/T3	M5	22.1 (2.5)	6 (13.3)	
		⊕				
2015	20	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, U/T1, V/T2, W/T3	M6	44.3 (5.0)	4 (21.2)	
		B1, B2	M5	22.1 (2.5)	6 (13.3)	
		⊕	M6	44.3 (5.0)	6 (13.3)	
2018	25	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, U/T1, V/T2, W/T3	M8	88.5 (10.0)	2 (33.6)	
		B1, B2	M5	22.1 (2.5)	6 (13.3)	
		⊕	M6	44.3 (5.0)	4 (21.2)	
2022	30	R/L1, S/L2, T/L3, ⊖, ⊕1, U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M8	88.5 (10.0)	1 (42.4)	
		⊕3	M6	45.1 (5.1)	4 (21.2)	
		⊕	M8	88.5 (10.0)	4 (21.2)	
2030	40	R/L1, S/L2, T/L3, ⊖, ⊕1 U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M8	88.5 (10.0)	1/0 (53.5)	
		⊕3	M6	45.1 (5.1)	4 (21.2)	
		⊕	M8	88.5 (10.0)	2 (38)	

Table 2.1 208-240Vac Wire Sizes and Connector Specifications

Drive Model CIMR-E7U	Nominal Hp	Terminal Symbol	Terminal Screws	Clamping Torque lb. in. (N•m)	Recommended Wire Size AWG (mm <sup>2</sup> )	Wire Type
2037	50	R/L1, S/L2, T/L3, ⊖, ⊕ <sub>1</sub> U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M10	199 (22.5)	4/0 (100)	600Vac UL Approved vinyl-sheathed or equivalent
		⊕ <sub>3</sub>	M8	88.5 (10.0)	4 (22)	
		⊖	M10	203.6 (23)	2/0 (67.4)	
		r/l <sub>1</sub> , s/l <sub>2</sub>	M4	12.4 (1.4)	14 (2.1)	
2045	60	R/L1, S/L2, T/L3, ⊖, ⊕ <sub>1</sub> U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M10	199 (22.5)	300 (152)	
		⊕ <sub>3</sub>	M8	88.5 (10.0)	4 (21.2)	
		⊖	M10	199 (22.5)	3/0 (85)	
		r/l <sub>1</sub> , s/l <sub>2</sub>	M4	12.4 (1.4)	14 (2.1)	
2055	75	R/L1, S/L2, T/L3, ⊖, ⊕ <sub>1</sub>	M12	347 (39.2)	1/0 X 2P (53.5 X 2P)	
		U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M10	199 (22.5)	1/0 X 2P (53.5 X 2P)	
		⊕ <sub>3</sub>	M8	88.5 (10.0)	2/0 (67.4)	
		⊖	M10	199 (22.5)	4/0 (107.2)	
		r/l <sub>1</sub> , s/l <sub>2</sub>	M4	12.4 (1.4)	14 (2.1)	
2075	75/100	R/L1, S/L2, T/L3, ⊖, ⊕ <sub>1</sub>	M12	347 (39.2)	4/0 X 2P (80 X 2P)	
		U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M10	199 (22.5)	3/0 X 2P (85 X 2P)	
		⊕ <sub>3</sub>	M8	88.5 (10.0)	2/0 (67.4)	
		⊖	M10	199 (22.5)	2/0 X 2P (67.4 X 2P)	
		r/l <sub>1</sub> , s/l <sub>2</sub>	M4	12.4 (1.4)	14 (2.1)	
2090	125	R/L1, S/L2, T/L3, ⊖, ⊕ <sub>1</sub>	M12	347 (39.2)	250 x2P (127 x2P)	
		U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M12	347 (39.2)	4/0 X 2P (107.2 X 2P)	
		⊕ <sub>3</sub>	M8	88.5 (10.0)	2/0 (67.4)	
		⊖	M12	347 (39.2)	2/0 X 2P (67.4 X 2P)	
		r/l <sub>1</sub> , s/l <sub>2</sub>	M4	12.4 (1.4)	14 (2.1)	
2110	150	R/L1, S/L2, T/L3, ⊖, ⊕ <sub>1</sub>	M12	347 (39.2)	300 X 2P (152 X 2P)	
		U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M12	347 (39.2)	300 X 2P 152 X 2P	
		⊕ <sub>3</sub>	M8	88.5 (10.0)	2/0 (67.4)	
		⊖	M12	347 (39.2)	4/0 X 2P (107.2 X 2P)	
		r/l <sub>1</sub> , s/l <sub>2</sub>	M4	12.4 (1.4)	16 (1.25)	

\* Use 75°C copper wire or equivalent

Table 2.2 480Vac Wire Sizes and Connector Specifications

Drive Model CIMR-E7U	Nominal Hp	Terminal Symbol	Terminal Screws	Clamping Torque lb. in. (N•m)	Recommended Wire Size AWG (mm <sup>2</sup> )	Wire Type
40P4	0.5/0.75	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, B1, B2, U/T1, V/T2, W/T3	M4	13.3 (1.5)	14 (2.1)	600Vac UL Approved vinyl-sheathed or equivalent
		⊕				
40P7	1	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, B1, B2, U/T1, V/T2, W/T3	M4	13.3 (1.5)	14 (2.1)	
		⊕				
41P5	1.5/2	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, B1, B2, U/T1, V/T2, W/T3	M4	13.3 (1.5)	14 (2.1)	
		⊕				
42P2	3	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, B1, B2, U/T1, V/T2, W/T3	M4	13.3 (1.5)	14 (2)	
		⊕				
43P7	5	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, B1, B2, U/T1, V/T2, W/T3	M4	13.3 (1.5)	14 (2.1)	
		⊕			14 (2.1)	
45P5	7.5	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, B1, B2, U/T1, V/T2, W/T3	M4	13.3 (1.5)	12 (3.5)	
		⊕			14 (2)	
47P5	10	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, B1, B2, U/T1, V/T2, W/T3	M4	13.3 (1.5)	10 (5.5)	
		⊕			12 (3.5)	
49P0/4011	15/20	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, B1, B2, U/T1, V/T2, W/T3	M5	22.1 (2.5)	8 (8)	
		⊕			10 (5.5)	
4015	25	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, B1, B2, U/T1, V/T2, W/T3	M5	22.1 (2.5)	8 (8)	
		⊕				
4018	30	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕3, U/T1, V/T2, W/T3, B1, B2	M6	44.3 (5.0)	6 (13.3)	
		⊕	M5	21.1 (2.5)	8 (8)	
		⊕	M6	44.3 (5.0)	6 (13.3)	
4024/4030	40/50	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕3, U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M6	44.3 (5.0)	3 (26.7)	
		⊕	M8	88.5 (10.0)	6 (13.3)	
4037	60	R/L1, S/L2, T/L3, ⊖, ⊕1, U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M8	88.5 (10.0)	2 (33.6)	
		⊕3	M6	44.3 (5.0)	4 (21.2)	
		⊕	M8	88.5 (10.0)	4 (21.2)	
4045	75	R/L1, S/L2, T/L3, ⊖, ⊕1, U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M8	88.5 (10.0)	2 (33.6)	
		⊕3	M6	44.3 (5.0)	4 (21.2)	
		⊕	M8	88.5 (10.0)	4 (21.2)	

Table 2.2 480Vac Wire Sizes and Connector Specifications

Drive Model CIMR-E7U	Nominal Hp	Terminal Symbol	Terminal Screws	Clamping Torque lb. in. (N•m)	Recommended Wire Size AWG (mm <sup>2</sup> )	Wire Type
4055	100	R/L1, S/L2, T/L3, ⊖, ⊕ <sub>1</sub> , U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M8	88.5 (10.0)	2/0 (33.6)	600Vac UL Approved vinyl-sheathed or equivalent
		⊕ <sub>3</sub>	M6	44.3 (5.0)	4 (21.2)	
		⊖	M8	88.5 (10.0)	1 (42.4)	
4075	125	R/L1, S/L2, T/L3, ⊖, ⊕ <sub>1</sub>	M12	347 (39.2)	4/0 (107.2)	
		U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M10	199 (22.5)	3/0 (85)	
		⊕ <sub>3</sub>	M8	88.5 (10.0)	4/0 (107.2)	
		⊖	M12	347 (39.2)	1/0 (53.5)	
		r/ℓ <sub>1</sub> , ø200/ℓ <sub>2</sub> 200, ø400/ℓ <sub>2</sub> 400	M4	12.4 (1.4)	14 (2.1)	
4090	150	R/L1, S/L2, T/L3, ⊖, ⊕ <sub>1</sub>	M12	347 (39.2)	250 (127)	
		U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M10	199 (22.5)	4/0 (107.2)	
		⊕ <sub>3</sub>	M8	88.5 (10.0)	4/0 (107.2)	
		⊖	M12	347 (39.2)	2/0 (67.4)	
		r/ℓ <sub>1</sub> , ø200/ℓ <sub>2</sub> 200, ø400/ℓ <sub>2</sub> 400	M4	12.4 (1.4)	14 (2.1)	
4110	200	R/L1, S/L2, T/L3, ⊖, ⊕ <sub>1</sub>	M12	347 (39.2)	2/0 X 2P (67.4 X 2P)	
		U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M12	347 (39.2)	1/0 X 2P (53.5 X 2P)	
		⊕ <sub>3</sub>	M8	88.5 (10.0)	2/0 (67.4)	
		⊖	M12	347 (39.2)	4/0 (107.2)	
		r/ℓ <sub>1</sub> , ø200/ℓ <sub>2</sub> 200, ø400/ℓ <sub>2</sub> 400	M4	12.4 (1.4)	14 (2.1)	
4160	250	R/L1, S/L2, T/L3, ⊖, ⊕ <sub>1</sub>	M12	347 (39.2)	4/0 X 2P (107.2 X 2P)	
		U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M12	347 (39.2)	3/0 X 2P (85 X 2P)	
		⊕ <sub>3</sub>	M8	88.5 (10.0)	2/0 (67.4)	
		⊖	M12	347 (39.2)	1/0 X 2P (53.5 X 2P)	
		r/ℓ <sub>1</sub> , ø200/ℓ <sub>2</sub> 200, ø400/ℓ <sub>2</sub> 400	M4	12.4 (1.4)	14 (2.1)	

Table 2.2 480Vac Wire Sizes and Connector Specifications

Drive Model CIMR-E7U	Nominal Hp	Terminal Symbol	Terminal Screws	Clamping Torque lb. in. (N•m)	Recommended Wire Size AWG (mm <sup>2</sup> )	Wire Type
4185	300/350	R/L1, S/L2, T/L3, ⊖, ⊕ <sub>1</sub>	M8	88.5 (10.0)	300 X 2P (152 X 2P)	600Vac UL Approved vinyl-sheathed or equivalent
		U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L33	M8	88.5 (10.0)	300 X 2P (152 X 2P)	
		⊕ <sub>3</sub>	M8	88.5 (10.0)	2/0 (67.4)	
		⊖	M16	867.4 (98.0)	3/0 X 2P (85 X 2P)	
		r/l <sub>1</sub> , ø200/l <sub>2</sub> 200, ø400/l <sub>2</sub> 400	M4	12.4 (1.4)	14 (2.1)	
4220	400/450	R/L1, S/L2, T/L3, ⊖, ⊕ <sub>1</sub>	M8	88.5 (10.0)	500 X 2P (253 X 2P)	
		U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L33	M8	88.5 (10.0)	400 X 2P (203 X 2P)	
		⊕ <sub>3</sub>	M8	88.5 (10.0)	2/0 (67.4)	
		⊖	M16	867.4 (98.0)	250 X 2P (127 X 2P)	
		r/l <sub>1</sub> , ø200/l <sub>2</sub> 200, ø400/l <sub>2</sub> 400	M4	12.4 (1.4)	14 (2.1)	
4300	500+	R/L1, S/L2, T/L3, ⊖, ⊕ <sub>1</sub>	M8	88.5 (10.0)	700 X 2P (355 X 2P)	
		U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L33	M8	88.5 (10.0)	600 X 2P (304 X 2P)	
		⊕ <sub>3</sub>	M8	88.5 (10.0)	2/0 (67.4)	
		⊖	M8	867.4 (98.0)	400 X 2P (203 X 2P)	
		r/l <sub>1</sub> , ø200/l <sub>2</sub> 200, ø400/l <sub>2</sub> 400	M16	12.4 (1.4)	14 (2.1)	

\* Use 75°C copper wire or equivalent.

**IMPORTANT**

Determine the wire size for the main circuit so that line voltage drop is within 2% of the rated voltage. Line voltage drop is calculated as follows:

$$\text{Line voltage drop (V)} = \sqrt{3} \times \text{wire resistance } (\Omega/\text{km}) \times \text{wire length (m)} \times \text{current (A)} \times 10^{-3}$$

**WARNING**

Prior to removing any protective cover or wiring any part of the Drive, remove all power sources, including main input power and control circuit power. Wait a minimum of 5 minutes after power removal, before removing any cover. The charge lamp located within the Drive should be off prior to working inside. Even if the charge lamp is off, one must measure the AC input, output, and DC Bus potential to insure safe levels prior to resuming work. Failure to adhere to this warning may result in personal injury or death.

## ◆ Main Circuit Terminal Functions

Main circuit terminal functions are summarized according to terminal symbols in Table 2.3. Wire the terminals correctly for the desired purpose.

Table 2.3 Main Circuit Terminal Functions (208-240Vac and 480Vac)			
Purpose	Terminal Designation	Model: CIMR-E7U_ _ _ _	
		208-240Vac	480Vac
Main circuit power input	R/L1, S/L2, T/L3	20P4 to 2110	40P4 to 4300
	R1/L11, S1/L21, T1/L31	2022 to 2110	4030 to 4300
Drive outputs	U/T1, V/T2, W/T3	20P4 to 2110	40P4 to 4300
DC power input	⊕1, ⊖	20P4 to 2110	40P4 to 4300
DC reactor connection	⊕1, ⊕2	20P4 to 2018	40P4 to 4018
Ground	⊖	20P4 to 2110	40P4 to 4300

## ◆ Main Circuit Configurations 208-240Vac

The 208-240Vac main circuit configurations of the Drive are shown in Table 2.4.

Table 2.4 Drive Main Circuit Configurations	
208-240 VAC	
<p>CIMR-___ 20P4 to 2018 (1/2 Hp to 25 Hp)</p> <p>Note 1</p>	<p>CIMR-___ 2022 and 2030 (30 Hp to 40 Hp)</p> <p>Notes 1 &amp; 3</p>
<p>CIMR-___ 2037 to 2110 (50 Hp to 150 Hp)</p> <p>Notes 1 &amp; 3</p>	<p>---</p>
<p>Note 1. Input fuses or molded case circuit breakers are required for proper branch circuit protection for all Drives. Failure to use recommended fuses/circuit breakers (See Appendix E) may result in damage to the wiring, Drive and/or personal injury.</p> <p>2. Control power is supplied internally from the main circuit DC power supply for all Drives.</p> <p>3. Consult your Yaskawa representative before using 12-pulse rectification.</p>	

## ◆ Main Circuit Configurations 480Vac

The 480Vac main circuit configurations of the Drive are shown in Table 2.5.

Table 2.5 Drive Main Circuit Configurations	
480 VAC	
<p>CIMR-___ 40P4 to 4018 (1/2 Hp to 30 Hp)</p> <p>Note 1</p>	<p>CIMR-___ 4024 to 4055 (40 Hp to 100 Hp)</p> <p>Notes 1 &amp; 3</p>
<p>CIMR-___ 4075 to 4160 and CIMR-___ 4185 to 4300 (125 Hp to 500 Hp)</p> <p>Notes 1 &amp; 3</p>	<p>---</p>
<p>Note 1. Input fuses or molded case circuit breakers are required for proper branch circuit protection for all Drives. Failure to use recommended fuses/circuit breakers (See Appendix E) may result in damage to the wiring, Drive and/or personal injury.</p> <p>2. Control power is supplied internally from the main circuit DC power supply for all Drives.</p> <p>3. Consult your Yaskawa representative before using 12-pulse rectification.</p>	

## Cable Length between Drive and Motor

The E7 should be installed as close as possible to the motor to minimize the length of load side power cable needed between the Drive and the motor.

If the cable between the Drive and the motor is long, the high-frequency leakage current will increase, causing the Drive output current to increase as well. This may affect peripheral devices. To prevent this, reduce the cable length whenever possible, or if necessary, adjust the carrier frequency (set in C6-02) as shown in Table 2.6.

The line side power cables, load side power cables and the control wiring should all be run in a separate conduit. Careful attention to this recommended design practice will avoid many potential motor and Drive related problems.

Motor Cable Length	164 ft. (50m) maximum	328 ft. (100m) maximum	More than 328 ft.(100m)
Carrier Frequency	15kHz maximum	10kHz maximum	5kHz maximum

(See the limitations on carrier frequency, based on Drive capacity and model number in Appendix B).

## ■ Ground Wiring

Observe the following precautions when connecting the ground wire:

1. 208-240Vac Drives should have a ground connection with resistance of less than  $100\Omega$ .
2. 480Vac Drives should have a ground connection with resistance of less than  $10\Omega$ .
3. Do not share the ground wire with other devices, such as motors or large-current electrical equipment.
4. Always use a ground wire that complies with technical standards on electrical equipment and minimize the length of the ground wire. Leakage current flows through the Drive. Therefore, if the distance between the ground rod and the ground terminal is too long, potential on the ground terminal of the Drive will become unstable.
5. When using more than one Drive, be careful not to loop the ground wire. See Fig 2.4.

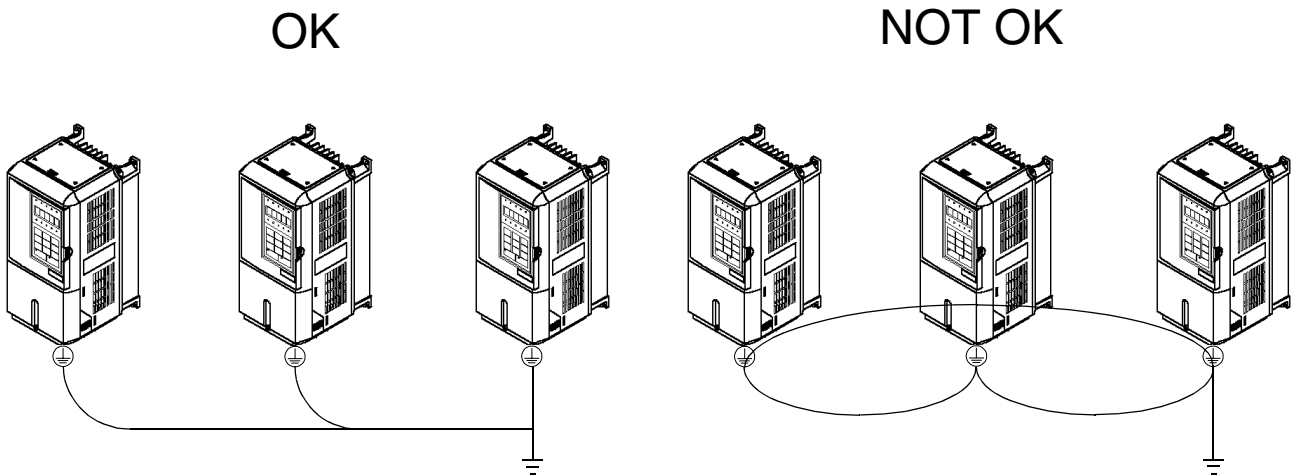


Fig 2.2 Ground Wiring Examples

## ■ Control Circuit Ground Terminals

The removable Drive control terminal card provides two ground terminals (marked TB3 and TB4) to accept the control wire shield connection. The control wire shield should be connected on this end only, the opposite end should be isolated with electrical tape.

### IMPORTANT

Grounding of the E7 enclosure and motor is required for proper system operation.

# Control Wiring

## ◆ Control Circuit Wire Sizes

The auto mode speed reference (speed command) field wiring connection is made to E7 Drive terminals A1 or A2 (signal positive), AC (signal common) and G (shield). Keep this lead length as short as possible to maintain signal quality. Insulated twisted shielded pair wire (2 conductor # 18 ga, Belden 8760 or equivalent) is required. Do not run these wires in the same conduit as other AC power or control wires. The shield must be connected on this end only, stub and isolate the other end. The A2 signal employed is 4 to 20 mA with parameter H3-08 set for “2: 4 - 20 mA”. For 0 to 10 VDC, parameter H3-08 is set for “0: 0 - 10 VDC” and the E7 control board DIP switch S1-2 must be in the OFF position. (See Fig 2.4).

For remote operation, keep the length of the control wiring to 50m or less. Separate the control wiring from high-power lines (input power, motor leads or relay sequence circuits) to reduce noise induction from peripheral devices.

When setting speed commands (frequency references) from an external speed potentiometer (and not from the Digital Operator), use shielded twisted-pair wires and ground the shield to terminal E(G), as shown in Fig 2.3. Terminal numbers and wire sizes are shown in Table 2.7.

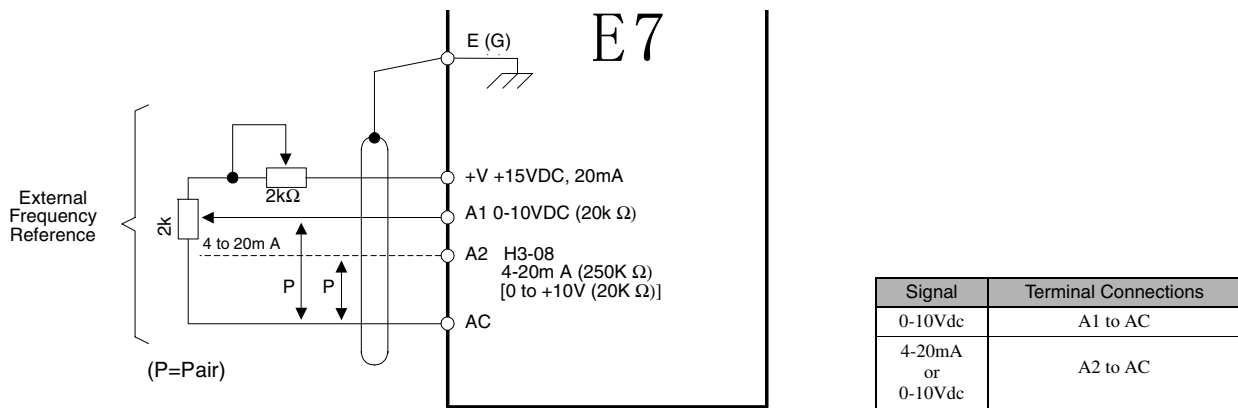


Fig 2.3 Analog Input Terminal Configuration

Table 2.7 Terminal Numbers and Wire Sizes (Same for all Drives)					
Terminals	Terminal Screws	Tightening Torque lb-in (N•m)	Possible Wire Sizes AWG (mm <sup>2</sup> )	Recommended Wire Size AWG (mm <sup>2</sup> )	Wire Type
S1, S2, S3, S4, S5, S6, S7 SN, SC, SP, +V, A1, A2, AC, MI, M2, M3, M4, MA, MB, MC, FM, AC, AM, R+, R-, S+, S-, IG	Phoenix type *3	4.2 to 5.3 (0.5 to 0.6)	Stranded wire: 26 to 16 (0.14 to 1.5)	18 (0.75)	<ul style="list-style-type: none"> <li>Shielded, twisted-pair wire*1</li> <li>Shielded, polyethylene-covered, vinyl sheath cable</li> </ul>
E(G)	M3.5	7.0 to 8.8 (0.8 to 1.0)	20 to 14 (0.5 to 2*2)	12 (1.25)	

\*1. Use shielded twisted-pair cables to input an external speed command.  
 \*2. Yaskawa recommends using straight solderless terminals on digital inputs to simplify wiring and improve reliability.  
 \*3. Yaskawa recommends using a thin-slot screwdriver with a 3.5 mm blade width.

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## ◆ Wiring Checks

After all wiring is completed, perform the following checks:

1. Is all wiring correct?
2. Have all wire clippings, screws or other foreign material been removed from the Drive enclosure?
3. Are all terminal screws tight?

## ◆ Control Circuit Terminal Functions

The factory default functions of the control circuit terminals for 2-wire control are shown in Table 2.8.

Type	No.	Signal Name	Description	Signal Level	
Digital input signals	S1	Forward run/stop command	Forward run when CLOSED; stopped when OPEN.	24 Vdc, 8 mA Photocoupler isolation	
	S2	Reverse run/stop command	Reverse run when CLOSED; stopped when OPEN.		
	S3	External fault input	Fault when CLOSED.		Multi-function digital inputs Functions set by H1-01 to H1-05.
	S4	Fault reset	Reset when CLOSED		
	S5	Multi-step speed reference 1 (Master/auxiliary switch)	Auxiliary frequency reference when CLOSED.		
	S6	Multi-step speed reference 2	Multi-step setting 2 when CLOSED.		
	S7	Jog frequency reference	Jog frequency when CLOSED.		
	SN	Digital input common	Refer to Table 2.10 for connection details.		
	SC				
SP					
Analog input signals	+V	+15Vdc power supply	+15Vdc power supply for analog inputs or transmitters	+15Vdc (Max. current: 20 mA)	
	A1	Analog input or Speed Command	0 to +10Vdc/100%	0 to +10 V(20 kΩ)	
	A2	Multi-function analog input	4 to 20 mA/100% 0 to +10Vdc/100% (H3-0)	Function set by H3-09.	4 to 20 mA(250Ω) 0 to +10 V(20kΩ)
	AC	Analog common	–	–	
	E(G)	Shield wire, optional ground line connection point	–	–	
Digital output signals	M1	During Run (N.O. contact)	CLOSED during operation	Multi-function digital output Function set by H2-01.	Dry contacts Contact capacity: 1 A max. at 250Vac 1 A max. at 30Vdc
	M2				
	M3	Remote/Auto Operation (N.O. contact)	CLOSED when local control	Multi-function digital output Function set by H2-02.	
	M4				
	MA	Fault output signal (SPDT)	MA/MC: CLOSED during fault condition MB/MC: OPEN during fault condition		
	MB				
MC					
Analog output signals	FM	Multi-function analog output	(output frequency) 0 to +10Vdc/100% frequency	Multi-function analog monitor 1 Function set by H4-01	0 to +10Vdc max. ±5% 2 mA max.
	AC	Analog common	–		
	AM	Multi-function analog output	(output current) 0 to +10Vdc/100% Drive's rated output current	Multi-function analog monitor 2 Function set by H4-04	
RS-485/422	R+	Modbus communication input	For 2-wire RS-485, jumper R+ and S+ and jumper R- and S-.		Differential input, PHC isolation
	R-				
	S+	Modbus communication output			Differential input, PHC isolation
	S-				
IG	Signal common	–	–		

## ◆ DIP Switch S1

DIP Switch S1 is described in this section. The functions of DIP switch S1 are shown in Table 2.9.

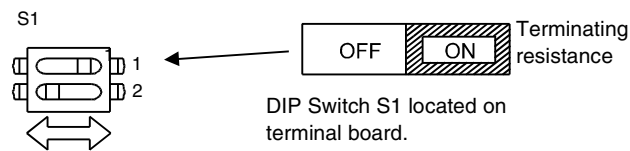
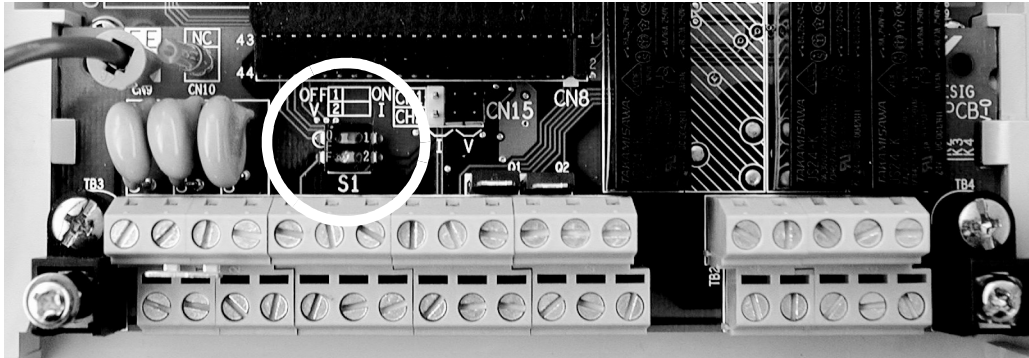


Fig 2.4 DIP Switch S1 Location

Table 2.9 DIP Switch S1		
Name	Function	Setting
S1-1	RS-485 and RS-422 terminating resistance	OFF: No terminating resistance ON: Terminating resistance of 110Ω Factory Default = OFF
S1-2	Input method for analog input A2	OFF: 0-10 Vdc (internal resistance: 20KΩ) ON: 4-20mA (internal resistance: 250Ω) Factory Default = ON

## ◆ Shunt Connector CN15

The shunt connector CN15 is described in this section. Shunt connector along with parameters H4-07 and H4-08 select the signal range of the analog output terminals FM and AM.

Shunt connector CN15 is only available when the optional Terminal Card with the 4-20mA Analog Output Monitor is installed (Model No. ETC618120). See Chapter 7, Maintenance, for installation of the optional Terminal Card.

The function of various shunt connector CN15 configurations is shown in Table 2.10.

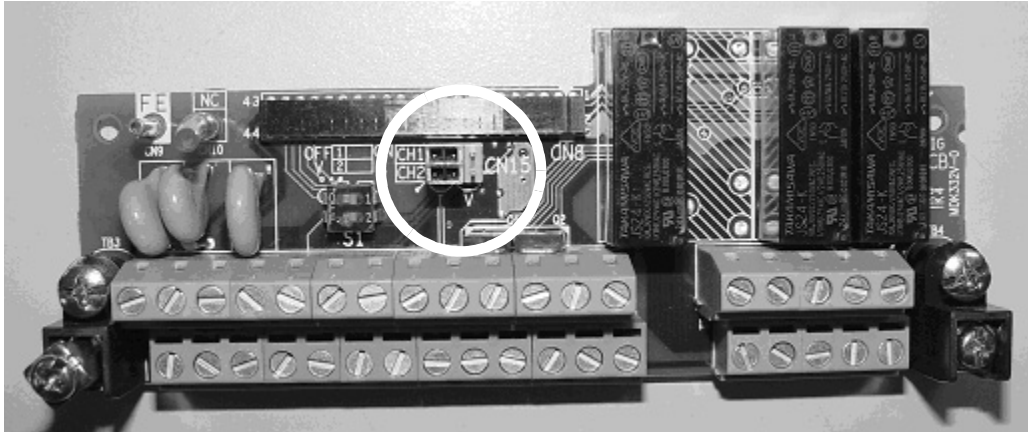


Fig 2.5 Shunt Connector CN15 Location

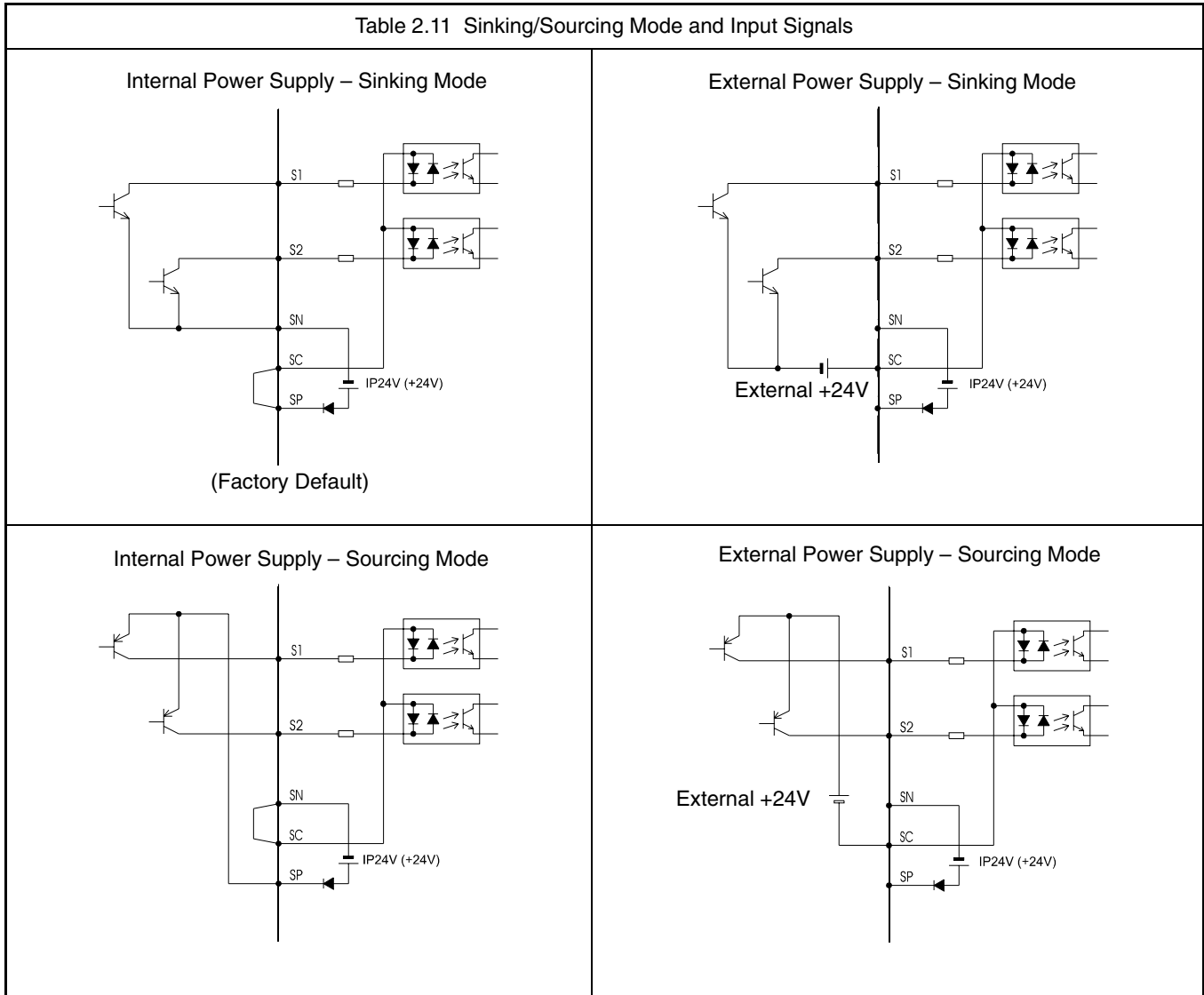
CN15	Analog Output Monitor Configurations
	Voltage Output (0-10Vdc) for terminals FM-AC (CH1) and AM-AC (CH2)
	Current Output (4-20mA) for terminals FM-AC (CH1) and AM-AC (CH2)
	Voltage Output (0-10Vdc) for terminals FM-AC (CH1) Current Output (4-20mA) for terminals AM-AC (CH2)
	Current Output (4-20mA) for terminals FM-AC (CH1) Voltage Output (0-10Vdc) for terminals AM-AC (CH2)

The software configuration for the analog output monitor signal type is listed below:

Parameter No.	Parameter Name Digital Operator Display	Description	Setting Range	Factory Setting	Menu Location
H4-07	Terminal FM Signal Level Selection AO Level Select1	0: 0 - 10 V 2: 4-20 mA	0 or 2	0	Programming
H4-08	Terminal AM Signal Level Selection AO Level Select2	0: 0 - 10 V 2: 4-20 mA	0 or 2	0	Programming

## ◆ Sinking/Sourcing Mode

The input terminal logic can be switched between sinking mode (0V common) and sourcing mode (+24V common) by using the terminals SN, SC, and SP. An external power supply can also be connected, providing more freedom in signal input methods.



# ◆ Terminal Connections

Connections to Drive terminals are shown in Fig 2.6.

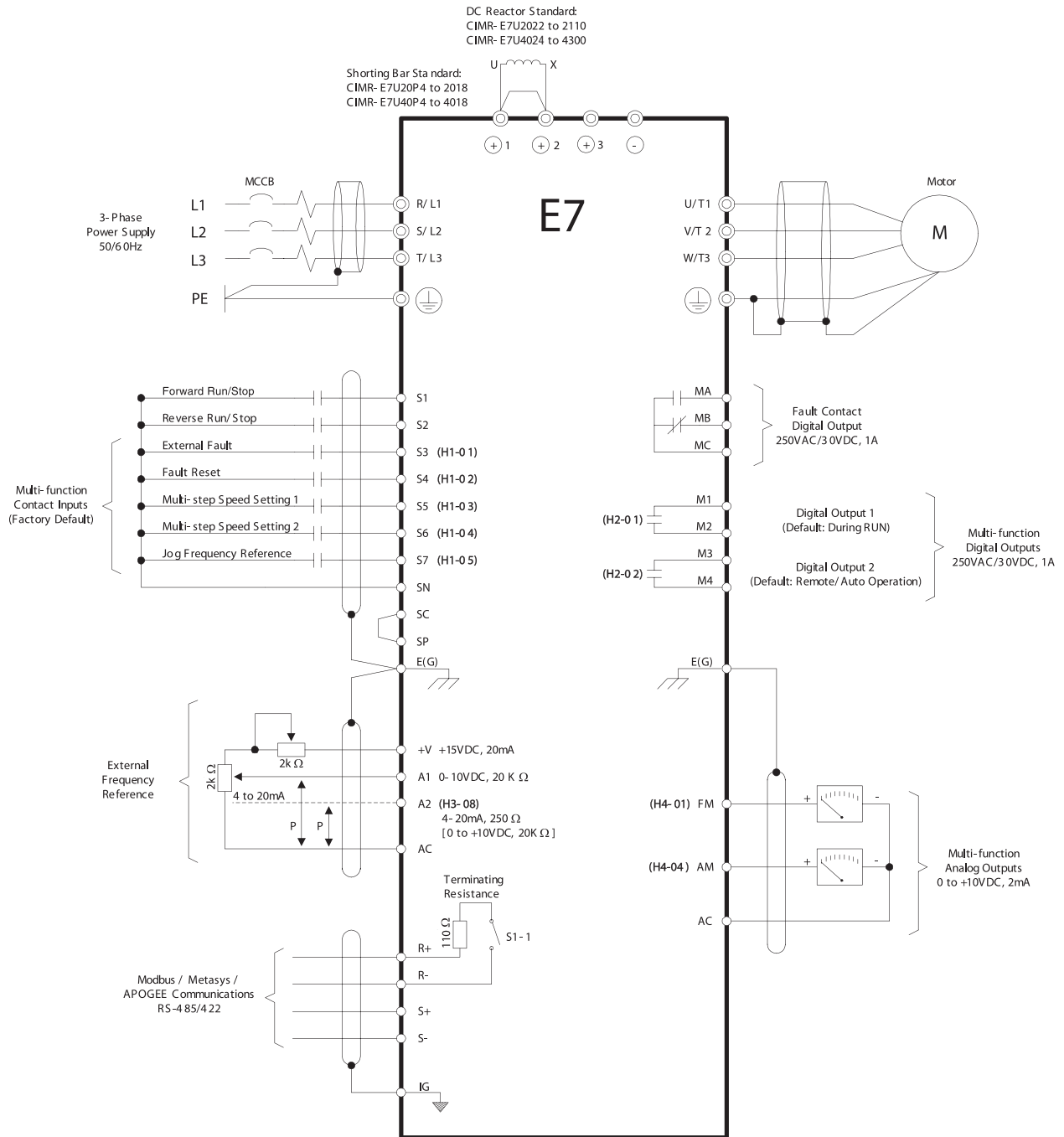


Fig 2.6 Terminal Connections

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## ◆ Control Circuit Wiring Precautions

Observe the following precautions when wiring control circuits:

1. Separate control wiring from power/motor wiring (terminals R/L1, S/L2, T/L3, U/T1, V/T2, W/T3,  $\ominus$ ,  $\oplus 1$ ,  $\oplus 2$ , and  $\oplus 3$ ) and other high-power lines.
2. Separate wiring for control circuit terminals MA, MB, MC, M1, M2, M3, and M4 (digital outputs) from wiring to other control circuit terminals.
3. If using an optional external power supply, ensure it is a UL Listed Class 2 power supply source.
4. Use twisted-pair or shielded twisted-pair cables for control circuits to prevent operating faults. Prepare cable ends as shown in *Fig 2.7*.
5. Connect the shield wire to terminal E(G).
6. Insulate the shield with tape to prevent contact with other signal lines and equipment.

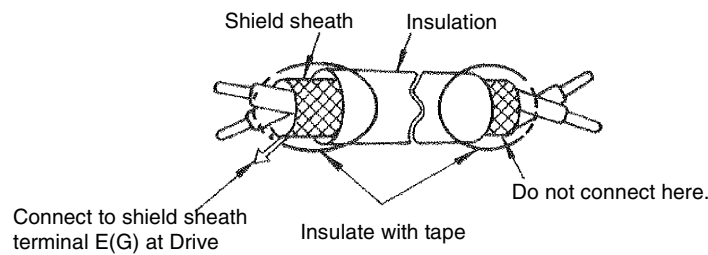


Fig 2.7 Preparing the Termination of Shielded Twisted-pair Cables

## ◆ Field Wiring Diagram

Use this diagram to document field wiring. It may be helpful to copy this page.

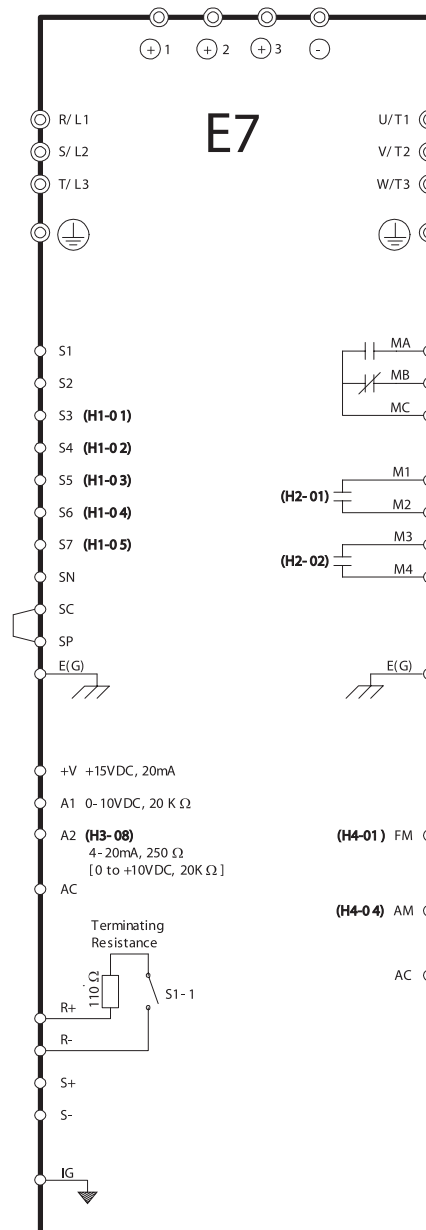


Fig 2.8 Field Wiring Diagram