WELCON

Servo Drive

Hardware Manual

WER-D048/60-FS04A7_V04

welcon SYSTEMS

2024-04-30

(15434) Room 812, 555, Byeolmang-ro, Danwon-gu, Ansan-si, Gyeonggi-do, Republic of Korea PHONE +82 31 417 6735 FAX +82 417 6736

www.welconsystems.com

Precautions

- Please read this manual carefully before installing and commissioning.
- WELCON SYSTEMS assumes no responsibility whatsoever for any loss or damage arising out of use for any purpose.

Copyright Notice

© 2024 WELCON Systems. All rights reserved.

Copyright in this document is reserved exclusively by WELCON SYSTEMS. That is, the owner of the text, images, and all other materials listed in this document is WELCON SYSTEMS. Therefore, the unauthorized distribution, transfer, or duplication of the text, images, and other materials in this document without the written permission of the copyright holder, WELCON SYSTEMS, is prohibited.

© 2024 WELCON Systems. All rights reserved.
www.welconsystems.com

Product Name for Welcon Drive

WE 2S-D 024/01-FS0057-E

Product Type

WE WELCON Standard
****** User Code (only for customized order)

Drive Shape

R Rectangle Type Board
C Circle Type Board
M Miniature Board
2S 2-Axis Slot Type (Backboard necessary)
2A 2-Axis Stand-Alone Type

Power

D DC
A AC

Voltage

024 12~24V
048 12~48V
310 12~310V

Continuous Current

P2 0.2A rms
P5 0.5A rms
01 1A rms
02 2A rms
03 3A rms
05 5A rms
08 8A rms
10 10A rms
20 20A rms
25 25A rms
40 40A rms
60 60A rms

Feedback Sensor (Hexadecimal)

Bit0	Incremental Encoder	**Bit1**	Dual Incremental Encoder	**Bit2**	Separated Digital Hall Sensor	**Bit3**	Shared Digital Hall Sensor
Bit4	Sin/Cos Encoder	**Bit5**	BISS/SSI Encoder	**Bit6**	Analog Hall Sensor	**Bit7**	Tamagawa/ Panasonic Encoder
Bit8	Potentiometer	**Bit9**	SPI	**Bit10**	EnDat	**Bit11**	PWM
Bit11	Reserved	**Bit12**	Reserved	**Bit13**	Reserved	**Bit14**	Dual Serial Encoder

Ex) 0057= 0000 0000 0101 0111
Incremental(Bit0) + Dual Incremental (Bit1) + Separated Digital Hall (Bit2) + Sin/Cos (Bit4) + Analog Hall (Bit6)

Communication

E EtherCAT
C CAN
R RS-485

© 2024 WELCON Systems. All rights reserved.

CONTENTS

Precautions 2
Copyright Notice 2
CONTENTS 4
1. Safety Information 6
1.1. Attention Symbols 6
1.2. Warnings 7
1.3. Cautions 7
1.4. Use environment 7
2. Technical Information 8
2.1. Mechanical Data 8
2.2. Mounting Dimension & Ways 9
2.3. Electrical Data 10
2.4. Protections & Limitations 12
3. Wiring 13
3.1. Wiring Legend 13
3.2. Wire Size 13
3.3. Wiring Precautions 14
3.3.1. Grounding 14
3.3.2. Feedback and Motor UVW Wires 15
3.4. Tools 16
3.5. Connections 16
3.6. Regenerative resistance 17
3.7. Control Power 18
3.7.1. Control Power Wiring 19
3.8. Motor Power 20
3.8.1. Motor Power Wiring 20
3.9. Motor UVW 21
3.9.1. Motor UVW Wiring 22

© 2024 WELCON Systems. All rights reserved.

3.10. Digital Encoder (Port A) 23
3.10.1. Digital Encoder(Port A) Wiring 24
3.11. Digital Encoder (Port B) 25
3.11.1 Digital Encoder(Port B) Wiring 26
3.12. Serial Encoder 27
3.12.1 Serial Encoder Wiring 28
3.13. Digital I/O & Analog Input 29
3.13.1 Digital Inputs(PNP Type) Wiring 30
3.13.2 Digital Inputs(NPN Type) Wiring 31
3.13.3 Digital Outputs(NPN Type) Wiring 32
3.13.4 Analog Input Wiring 32
3.13.5 Motor Temperature Wiring 33
3.14 STO 34
3.14.1. STO Inputs(PNP Type) Wiring 35
3.14.2. STO Inputs(NPN Type) Wiring 35
3.14.3. STO Output(NPN Type) Wiring 36
3.14.4. STO Disabling 36
3.15. EtherCAT 37
3.15.1. EtherCAT Wiring 38
3.16. CAN 39
3.16.1. Terminating Resistor 39
3.16.2. CAN Wiring 40
3.17. RS-485 41
3.17.1. Terminating Resistor 41
3.17.2. RS-485 Wiring 42
3.18. USB 43
3.18.1. USB Wiring 44

© 2024 WELCON Systems. All rights reserved.

1. Safety Information

- Safety accidents and damage to the product may occur, so be sure to read the safety instructions before use and use it correctly.

1.1. Attention Symbols

In the course of the present document, the following symbols and signs will be used.

Type	Symbol	Description
Safety Alert		Indicates a **probable hazardous situation** or calls the attention to unsafe practices. If not avoided, it **may result in injury**.
		Indicates an **imminent hazardous situation**. If not avoided, it **will result in death or serious injury**.
Information		Indicates an activity you must perform prior continuing, or gives information on a particular item you need to observe.

© 2024 WELCON Systems. All rights reserved.
www.welconsystems.com

1.2. Warnings

- Do not connect/disconnect the main power of the servo drive while the power is on.
- Do not connect/disconnect the servo drive encoder cable and I/O while the power is on. Motor and servo drive may be damaged.
- The power cable can carry high voltage even when the motor is not moving.
- The main power of the servo drive must be accurately input according to the drive specifications. It may cause damage to the drive
- Do not connect power directly to the servo drive U, V, W output terminals.
- After turning off the servo drive power, disconnect the power after the capacitor is completely discharged.

1.3. Cautions

- Be sure to separate U, V, W cables and encoder cables before wiring.
- After turning off the power, proceed with wiring the U, V, W cables and encoder cables.
- Do not drop it or subject it to strong impact.
- Do not install near flammable substances or water.
- Make sure that no sheath or copper wire gets inside the servo drive.
- It is recommended to use shielded cables for encoder cables.
- For EtherCAT cables, it is recommended to use CAT.6 cables.
- Check the U, V, W and encoder cables of the motor before turning on the power.
- It is recommended to connect the encoder cable and U, V, W and power FG to prevent noise.
- Be careful not to separate the connector from the board when connecting or disconnecting the cable
- Additional cooling and/or heatsink may be required to achieve rated performance.

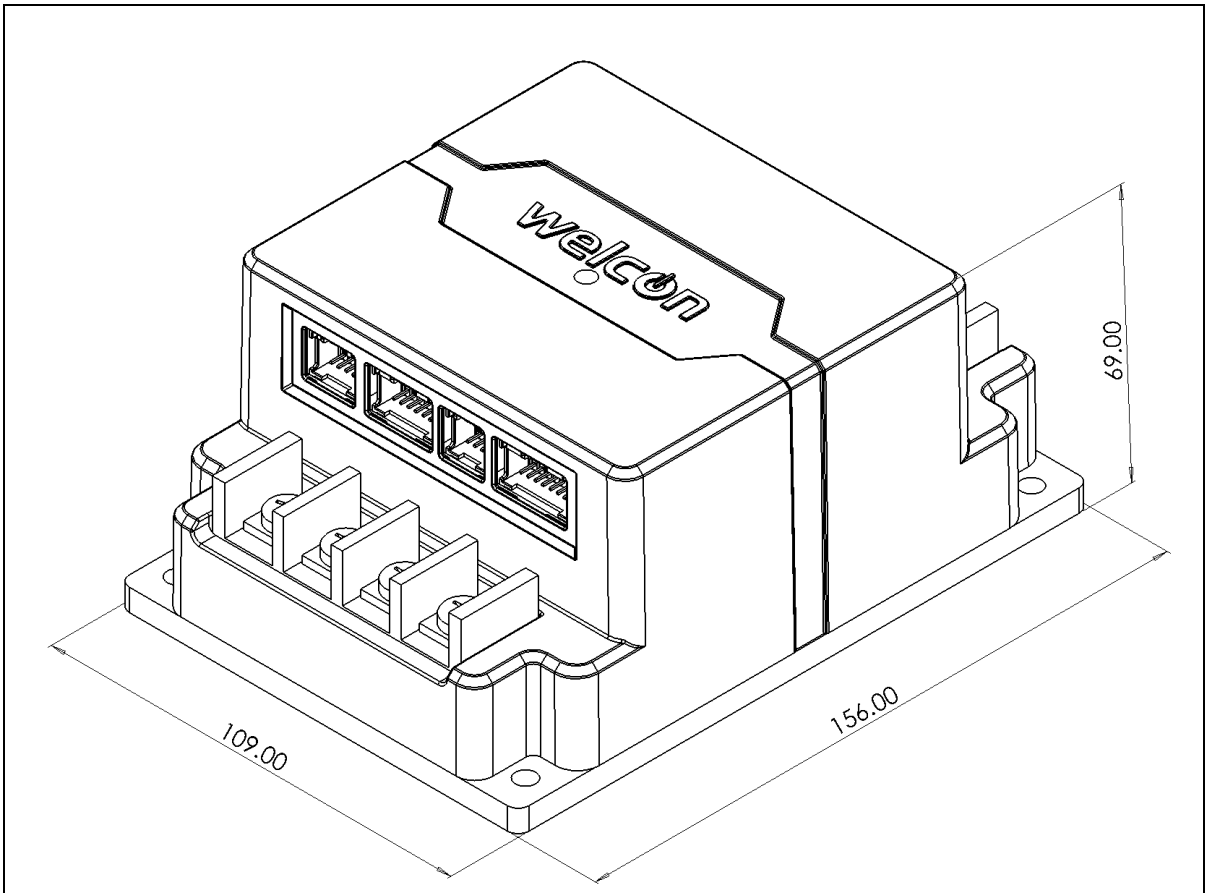
1.4. Use environment

환경	조건
Operating Temperature	0 °C to 50 °C
Maximum Humidity	90[%] RH
Pollution Degree	2
Operating Place	A place free of iron, flammable gas, dust, etc.

© 2024 WELCON Systems. All rights reserved.
www.welconsystems.com

2. Technical Information

2.1. Mechanical Data

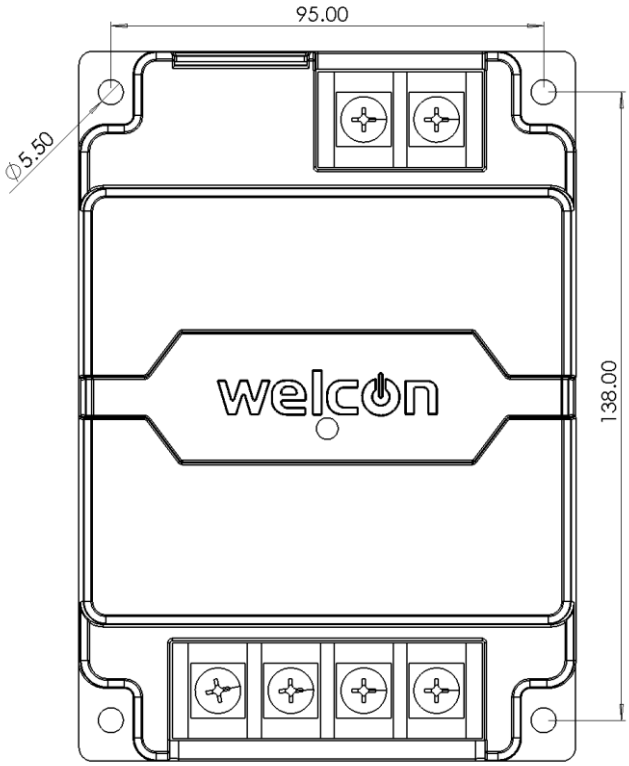


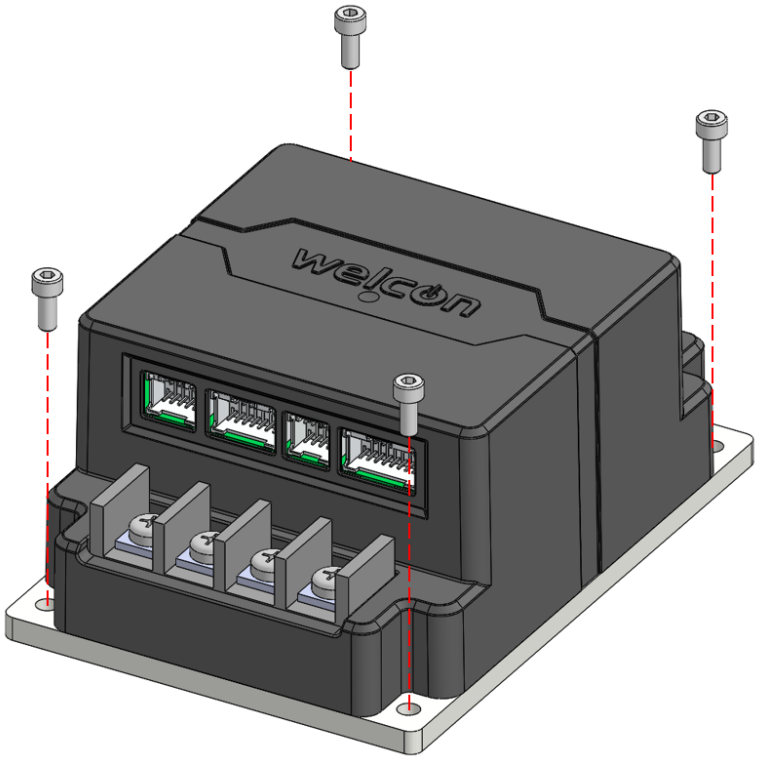
Item	Unit	Description
Weight	g	731
SIZE (L x W x H)	mm	156 * 109 * 69
Fastener	M3	-
Mounting Method	-	Panel / Wall Mount
Mounting Screw	M4	-

*For details, please refer to the 3D Modelling on the homepage.

© 2024 WELCON Systems. All rights reserved.
www.welconsystems.com

2.2. Mounting Dimension & Ways





© 2024 WELCON Systems. All rights reserved.
www.welconsystems.com

2.3. Electrical Data

WER-D048/60-FS04A7		
Description	**Units**	**60**
Continuous Output Current	A[rms]	60
Peak Output Current	A[rms]	120
Minimum Supply Voltage	VDC	10
Nominal Supply Voltage	VDC	48
Maximum Supply Voltage	VDC	90
Control Power Supply	VDC	24
Maximum Continuous Output Power	W	2880

Basic Specifications		
Feature	**Specification**	
Motors	DC/BLDC/PMSM/VCM	Rotary servo motors, Linear servo motors
Current(Torque) Control	Control Periodic	20KHz
	Control Loop	PI + Feed-forward
Velocity & Position Control	Control Periodic	4KHz
	Control Loop	Cascade P/PI + Feed-forward
	Filters	First order low pass filter, Four notch filters, First order adaptive windowing filters
Reference Command	Current/Velocity/Position	USB, CAN(CANopen), EtherCAT(CoE,FoE), RS-485
Auto Tuning	Method	Automatic self-configuration and optimization of motor phasing, wires, current loop, velocity control loop.
GUI	User Interface	WELSS(WelconServoStudio), Setting, Drive, Motor, Feedback, I/O, Motion
Input Voltage	Motor Voltage: 12~48VDC(H/W Limit 10 ~ 90V) Control Voltage: 24VDC	
Protective Functions	Under- and over-voltage, Over-current, Over-load(with I^2T), Drive over temperature	
Environment	Ambient temperature: Operation 0~50℃, Storage 0~70℃ Humidity: 10~90%, Vibration: 1.0g	
Compliance Standard	CE, TUV	

© 2024 WELCON Systems. All rights reserved.
www.welconsystems.com

Communication*		
Feature	**Specification**	
USB	Baud rate: up to 3Mbps, Maximum cable length: 3m	
CAN*	Bit rate: 125kbps ~ 1Mbps	
EtherCAT*	100Mbps Communication cycle time: up to 250μs	
RS-485*	Baud rate: 9200bps ~ 3Mbps	
I/O		
Feature	**Specification**	
Analog Input	Quantity	2
	Voltage Range	±10 VDC differential, Motor Temperature
	Input Resolution	14 bit
Digital Input	Quantity	6 + 2 STO (H/W)
	Signal	Configurable. Opto-isolated
	Voltage	24V
Digital Output	Quantity	2 + 1 STO (H/W)
	Signal	Configurable. Opto-isolated.
	Voltage	24V
	Max. Output Current	40mA
Brake	Use one of digital outputs (40mA)	
Motor Feedback		
General	Supply Voltage	5VDC
Incremental Encoder	Signal	CH1 : A-quad-B with or without index, RS422, Differential CH2 : A-quad-B with or without index, Single-ended
	A-quad-B Max Input Frequency	10MHz (before quadrature)
Digital Hall Sensor	Signal	Single-ended
	Type	Separated hall sensor
Serial Encoder	Type	SSI, BiSS-C, Tamagawa, Panasonic, EnDat2.x
	Bite rate	0.5Mbps, 1Mbps, 2Mbps, 2.5Mbps, 5Mbps

*** Optional (Refer to product code)**

© 2024 WELCON Systems. All rights reserved.

2.4. Protections & Limitations

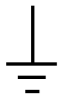
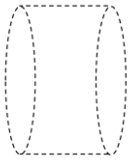
Protection Functionality	Switch-off threshold	Recovery threshold
Under Voltage	DC Link Voltage Minimum Limit	DC Link Voltage Minimum Limit + 0.5V
Over Voltage	DC Link Voltage Maximum Limit	DC Link Voltage Maximum Limit – 0.5V
Over Current	120 A	-
Over Temperature	100 ℃	95 ℃
Protection		
Motor overload and over-temperature	110% (at rated current)	

- Under Voltage and Over Voltage are related to the value set in DC Link Voltage Limit (Index: 0x5012).
- DC Link Voltage Minimum Limit (Subindex: 0x01) can only be set to a value of 10V or above.
- DC Link Voltage Maximum Limit (Subindex: 0x02) can only be set to a value of 90V or below.

© 2024 WELCON Systems. All rights reserved.
www.welconsystems.com

3. Wiring

3.1. Wiring Legend

Wiring Symbol	Description
	Earth Connection
	Protective Earth Connection
	Ground
	Twisted-pair wires
	Shielded Cable
	Power Supply

3.2. Wire Size

When selecting the wire gauge for the motor power wires, power supply wires, and ground wires, it is better to err on the side of larger diameter wire rather than too thin. This becomes more critical as the cable length increases. The following table provides recommendations for selecting the appropriate wire size for a specific current. These values should be used as reference only.

Use 24-28AWG for control wires(I/O, Feedback, Communication Wire) excluding main wires such as motor power.

Current(A)	Minimum Wire Size (AWG)	mm^2	Current(A)	Minimum Wire Size (AWG)	mm^2
10	20	0.518	45	12	3.31
15	18	0.823	60	10	5.26
20	16	1.31	80	8	8.37
35	14	2.08	120	6	13.3

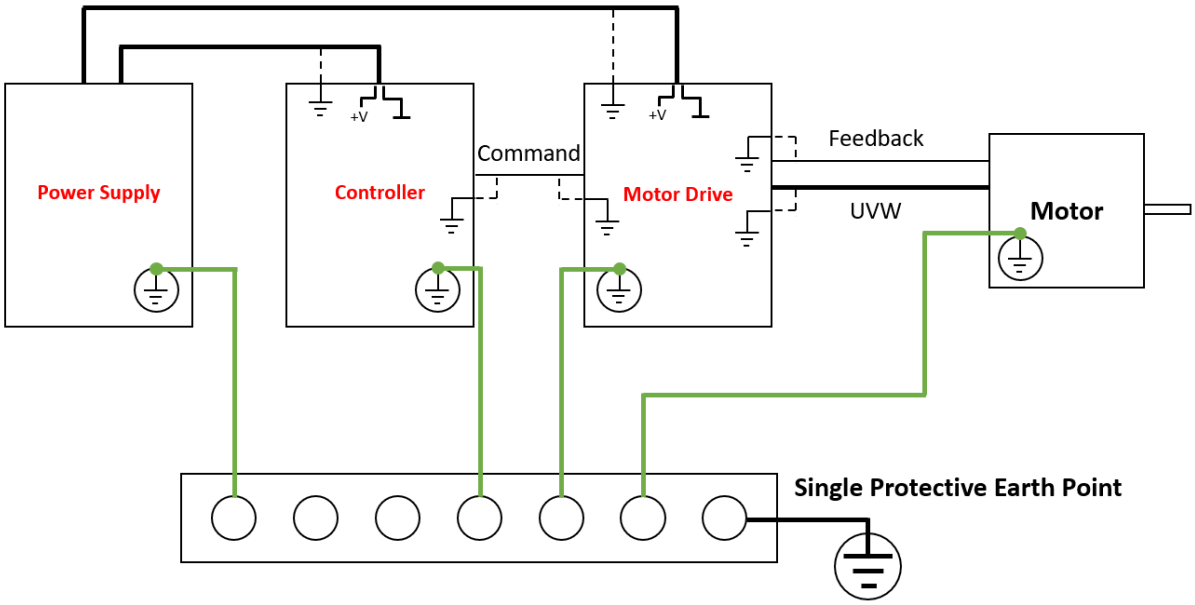
© 2024 WELCON Systems. All rights reserved.

3.3. Wiring Precautions

3.3.1. Grounding

The case grounds of all the system components should be connected to a single Protective Earth (PE) ground point.

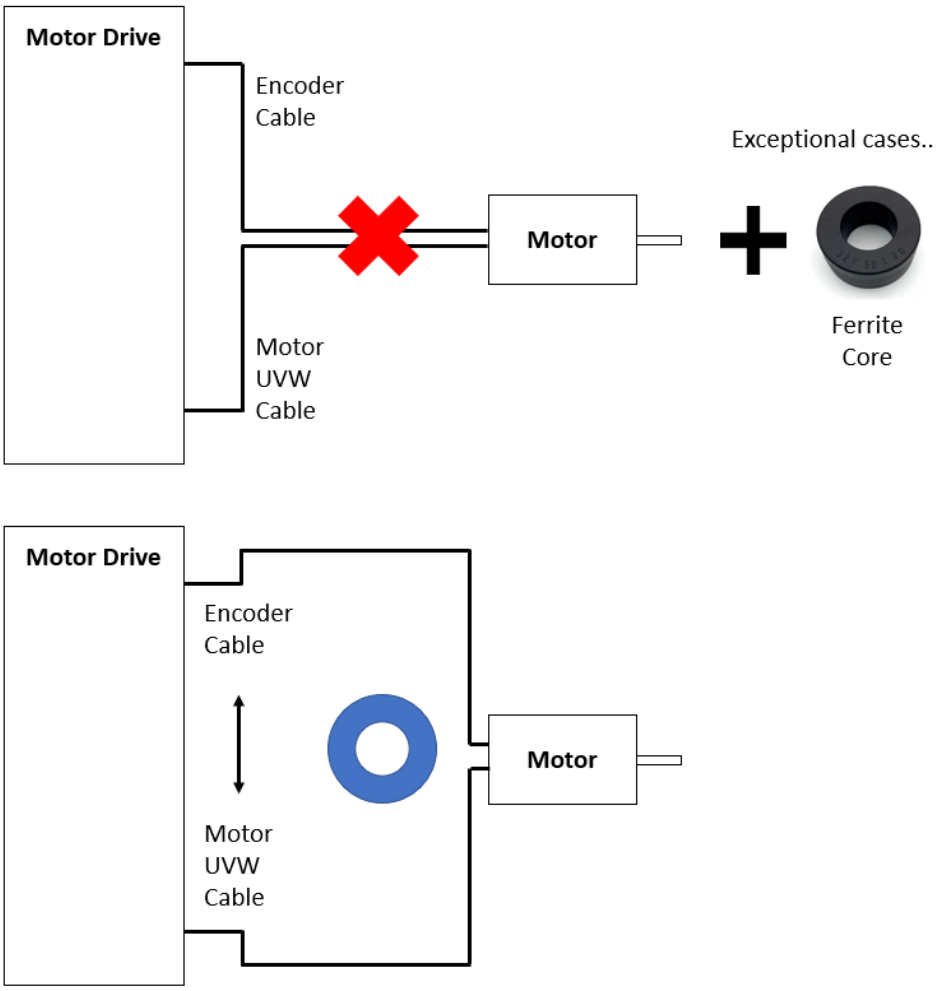
Grounding the case grounds at a central PE ground point through a single low resistance wire reduces the chance for ground loops and helps to minimize high frequency voltage differentials between components. All ground wires must be of a heavy gauge and be as short as possible.



© 2024 WELCON Systems. All rights reserved.
www.welconsystems.com

3.3.2. Feedback and Motor UVW Wires

Use of a twisted, shielded pair for the feedback wires is recommended. Ground the shield at one end only to the drive chassis ground. Also make sure that the feedback connector and D-sub shell preserve the shield continuity. Route cables and/or wires to minimize their length and exposure to noise sources. The Motor UVW wires are a major source of noise, and the Motor Feedback wires are susceptible to receiving noise. This is why it is never a good idea to route the Motor UVW wires with the Motor Feedback wires, even if they are shielded. Although both of these cables originate at the drive and terminate at the motor, try to find separate paths that maintain distance between the two.



If the two wires cannot be separated from each other, install a ferrite core to attenuate noise. For best results, wind the wire as much as possible, and always in the same direction.
When winding the ferrite core around the motor UVW wire, the ground(FG) wire must not pass through the ferrite core.

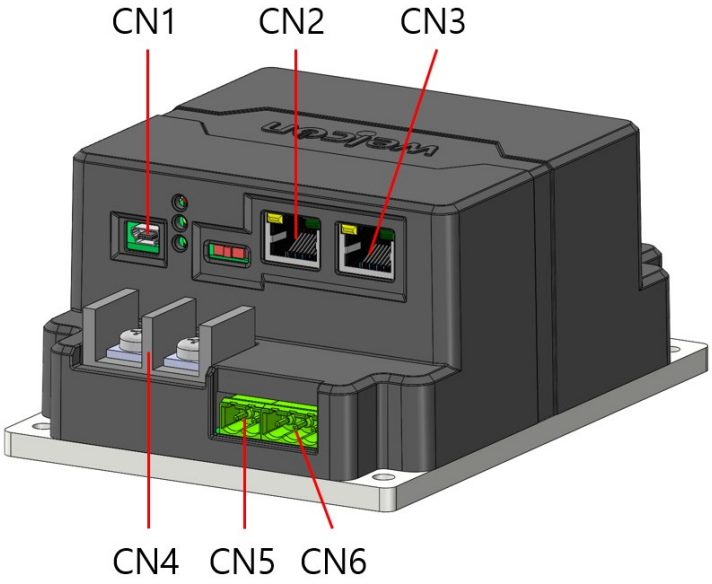
We have experience solving noise problems in systems with a cable length of 4-5m using King Magnetic's KMN-503220 product. The specifications of the ferrite core must be appropriately selected depending on the system.

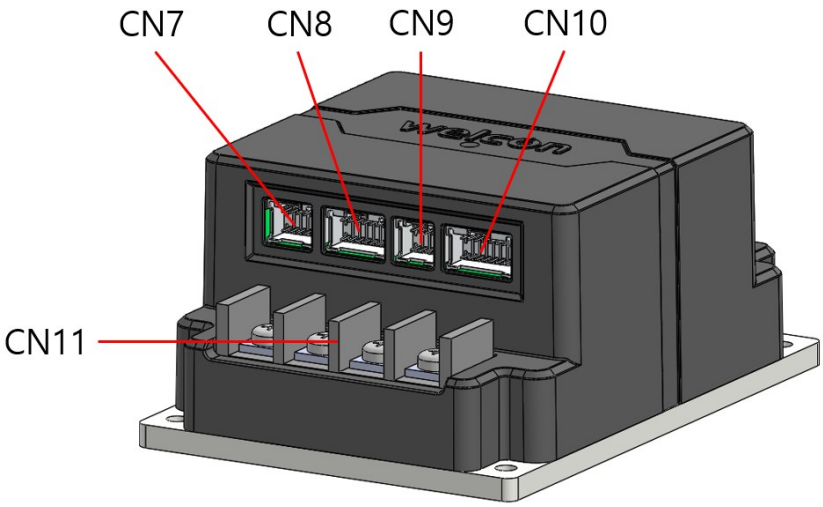
© 2024 WELCON Systems. All rights reserved.
www.welconsystems.com

3.4. Tools

Tool	Manufacturer	Part Number
Hand crimp Tool	MOLEX	63811-6300

3.5. Connections

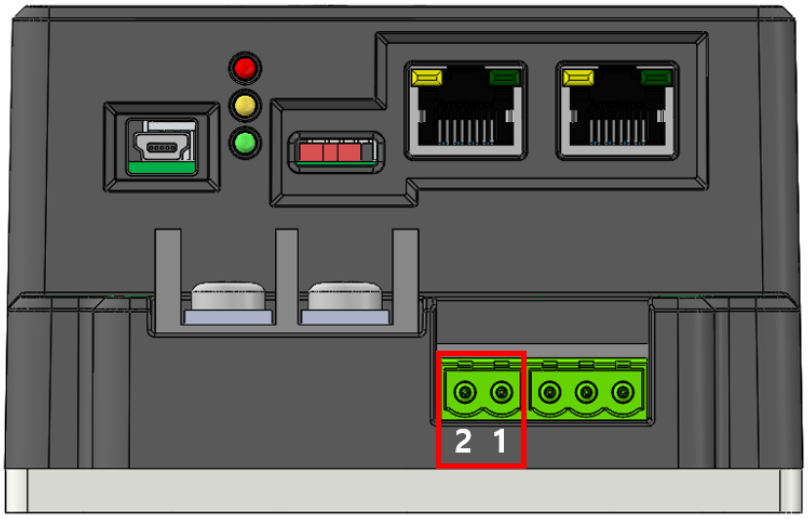




Connector	Function	Connector	Function
CN1	USB	**CN7**	STO
CN2	CAN / RS-485 / EtherCAT OUT	**CN8**	Digital I/O & Analog Input
CN3	CAN / RS-485 / EtherCAT IN	**CN9**	Serial Encoder
CN4	Motor Power	**CN10**	Digital Encoder
CN5	Regenerative resistance	**CN11**	Motor UVW
CN6	Control Power		

© 2024 WELCON Systems. All rights reserved.
www.welconsystems.com

3.6. Regenerative resistance



Dinkle_5ESDV-02P

Dinkle_5EHDRC-02P	J2
Pin	**Input Power**
1	R+
2	R-

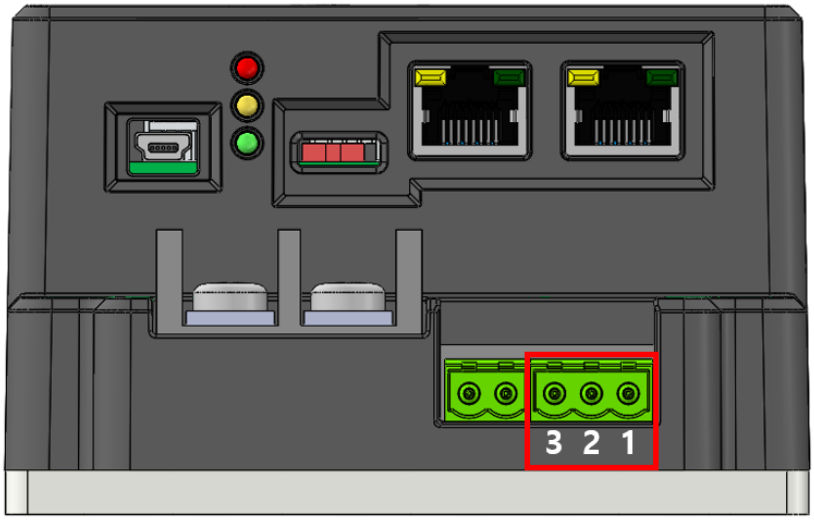
Warning

- In a system with a large inertia enough to generate regenerative power, you must connect a regenerative resistor to consume energy as heat. Please note that the drive may be damaged by regenerative power.
- Be sure to connect the regenerative resistor after changing the regen clamp cut-off voltage value(Object Index : 0x5013).

- For WER-D048/60-FS04A7, we recommend using a regenerative resistor of approximately 0.8 ohm. However, the appropriate resistance value and capacity vary depending on the load and acceleration/deceleration used in the system, so please calculate the capacity appropriate for your system.

© 2024 WELCON Systems. All rights reserved.
www.welconsystems.com

3.7. Control Power



Dinkle_5ESDV-03P

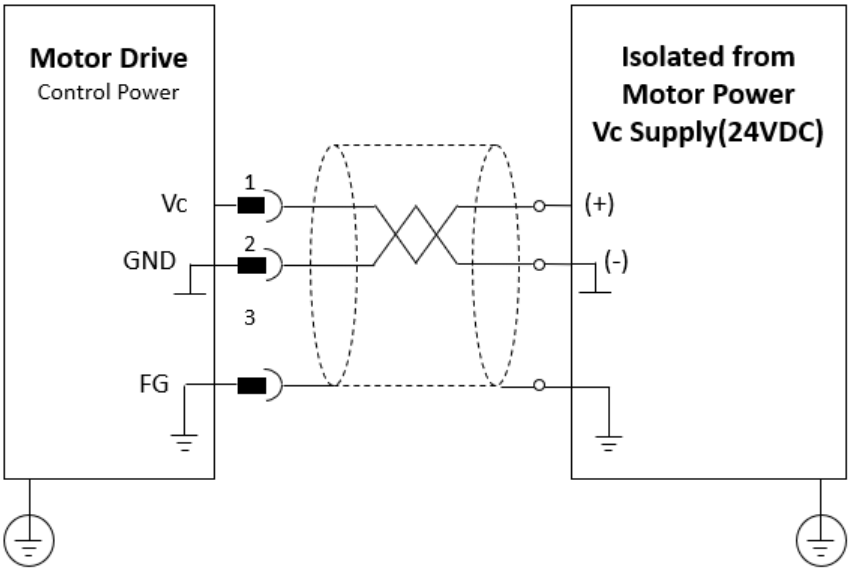
Dinkle_5EHDRC-03P		J1
Pin	Signal	Input Power
1	VCC	24VDC
2	GND	GND
3	FG	FG

Warning

- Do not connect/disconnect the servo drive while the power is on.
- Before applying power, make sure that the DC supply is within the specified range.
- make sure the proper plus and minus connections are in order.

© 2024 WELCON Systems. All rights reserved.
www.welconsystems.com

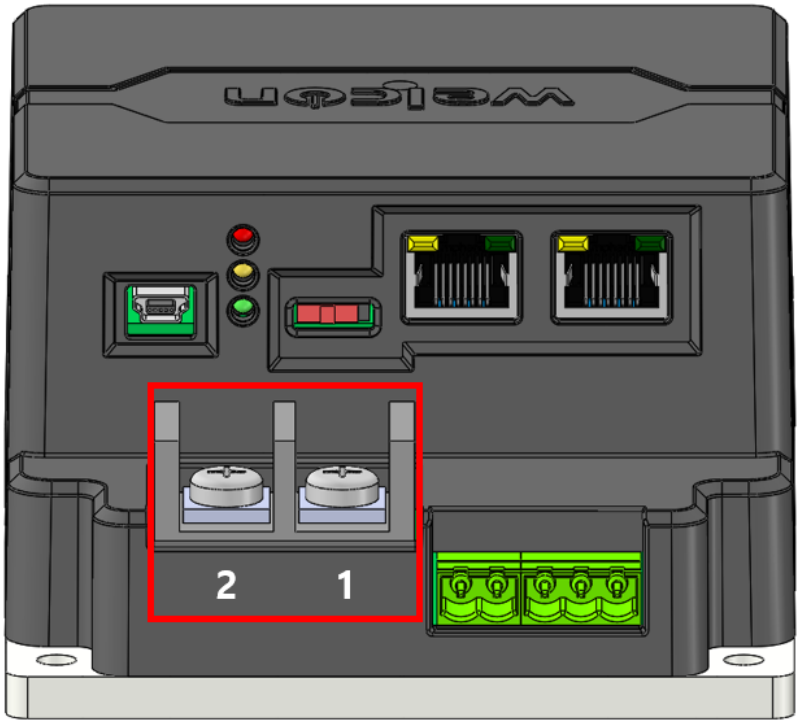
3.7.1. Control Power Wiring



[Control Power(24VDC) Connection Diagram]

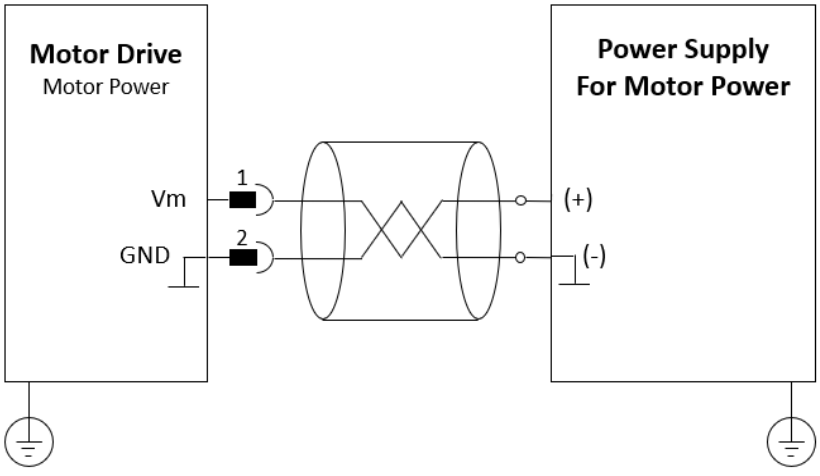
© 2024 WELCON Systems. All rights reserved.
www.welconsystems.com

3.8. Motor Power



BEE-RYONG_BR-1600HC-02P		TB1
Pin	Signal	Input Power
1	VCC	12~48VDC(HW Limit : 10 ~ 90 VDC)
2	GND	GND

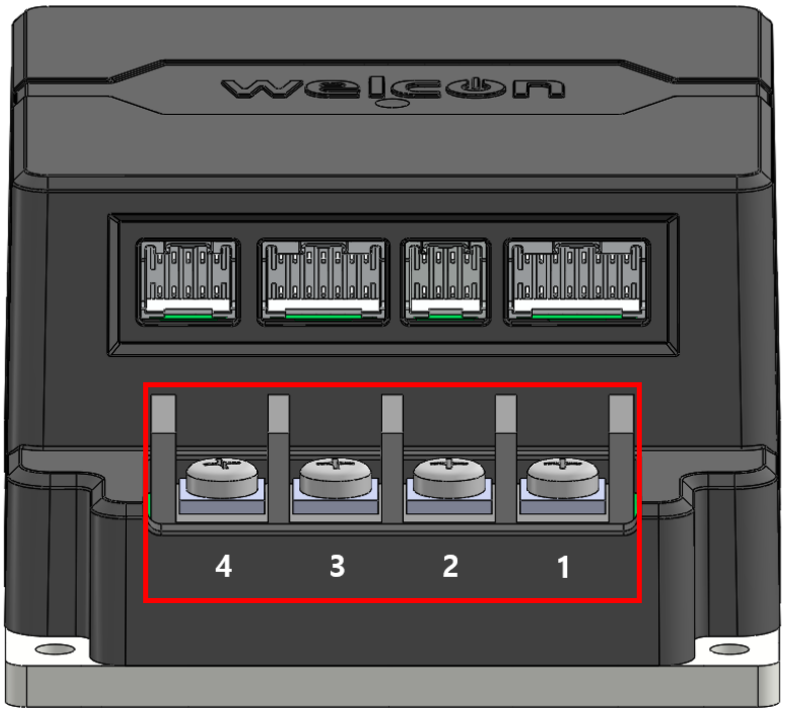
3.8.1. Motor Power Wiring



[Motor Power Connection Diagram]

© 2024 WELCON Systems. All rights reserved.
www.welconsystems.com

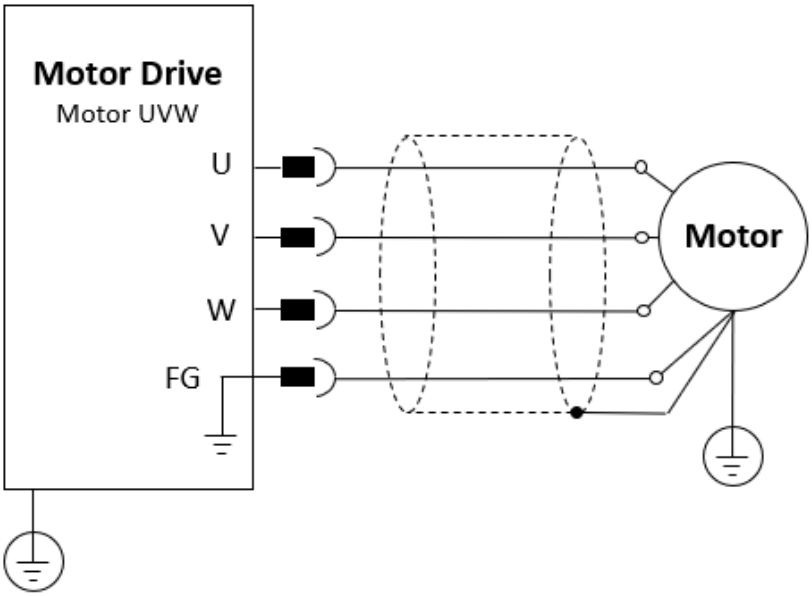
3.9. Motor UVW



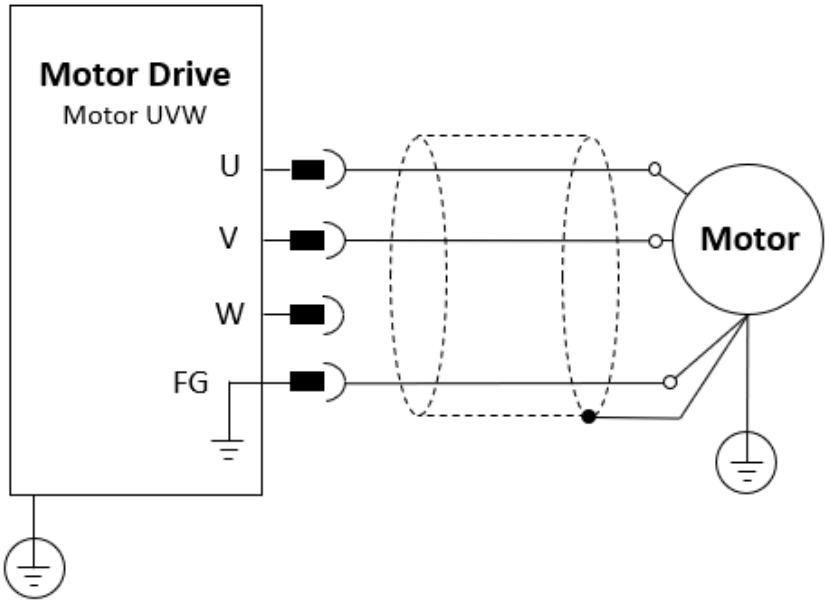
BEE-RYONG_BR-1600HC-04P	TB2
Pin	**Signal**
1	U (VCM or DC Motor : +)
2	V (VCM or DC Motor : -)
3	W
4	FG

© 2024 WELCON Systems. All rights reserved.
www.welconsystems.com

3.9.1. Motor UVW Wiring



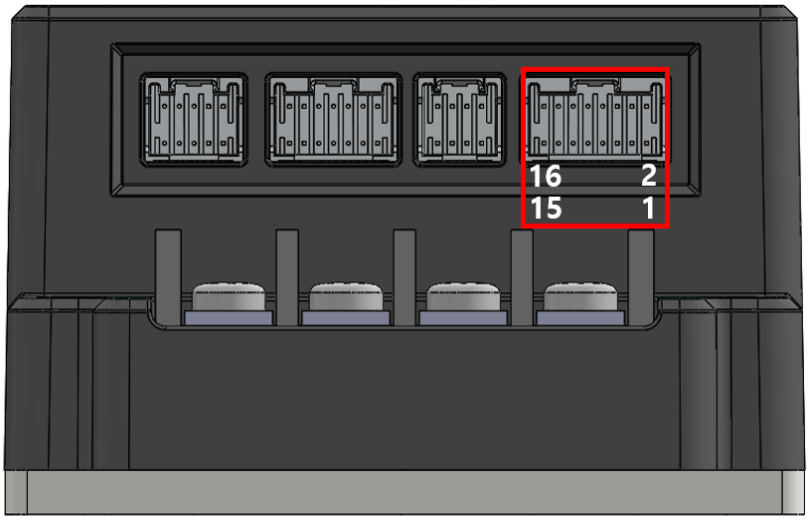
[Brushless / PMSM Motor UVW Connection Diagram]

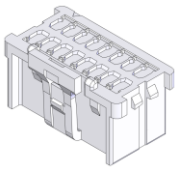


[Brushed DC / Voice Coil Motor UVW Connection Diagram]

© 2024 WELCON Systems. All rights reserved.
www.welconsystems.com

3.10. Digital Encoder (Port A)





Molex_51353-1600

Molex_56134-9000

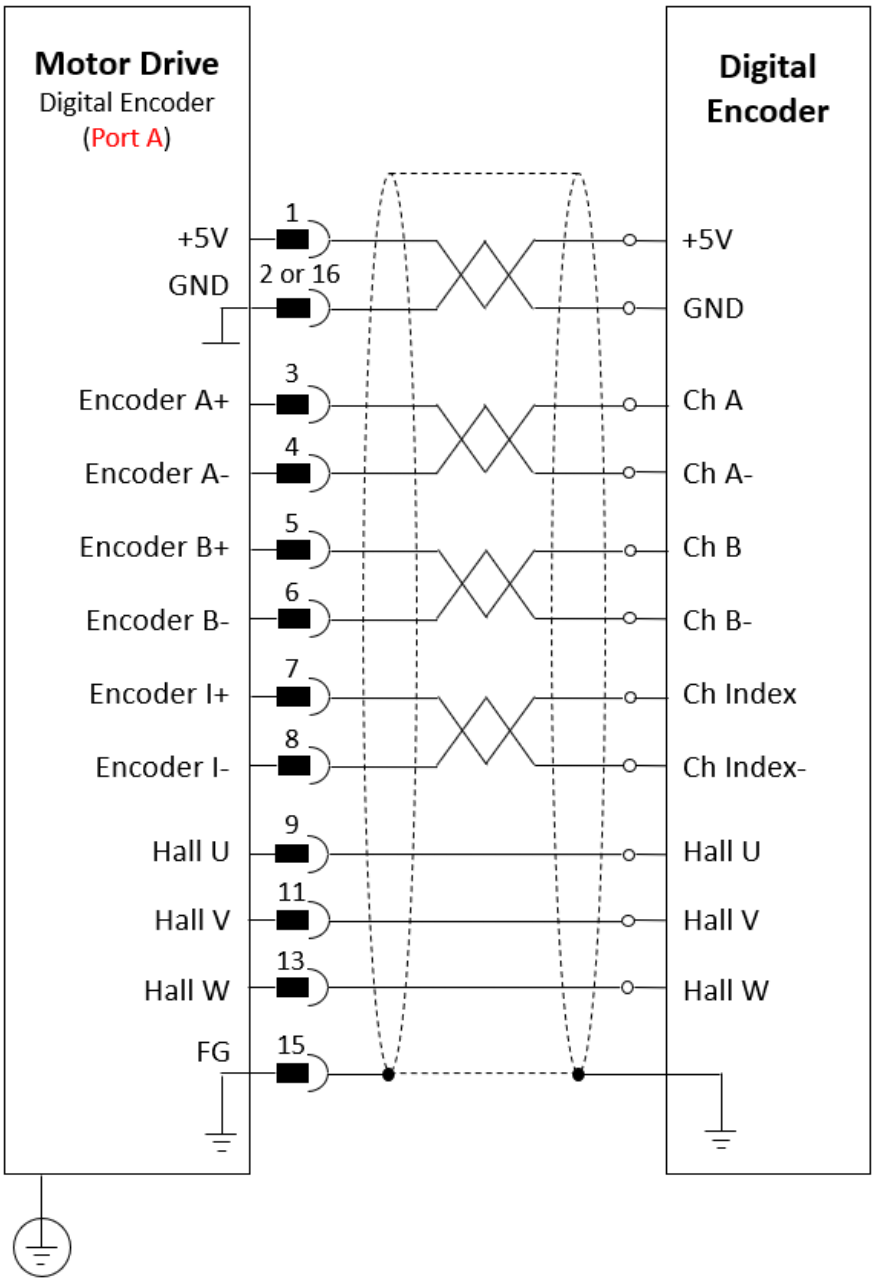
Molex_55959-1630	J501
Pin	**Signal**
1	5V
2	GND
3	Encoder A+
4	Encoder A-
5	Encoder B+
6	Encoder B-
7	Encoder I+
8	Encoder I-
9	Hall U
10	Not used
11	Hall V
12	Not used
13	Hall W
14	Not used
15	FG
16	GND

© 2024 WELCON Systems. All rights reserved.
www.welconsystems.com

3.10.1. Digital Encoder(Port A) Wiring

The cable's shield is connected to the chassis(PE) in the connector.

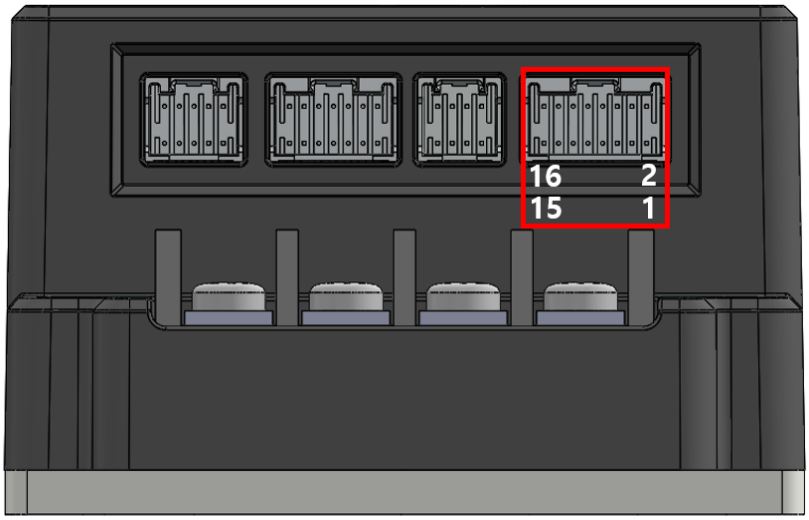
Earthing the Encoder and connecting the Earth(PE) to the drive FG is mandatory to insure reliable operatin, high noise immunity and rejection of voltage common mode interferences.

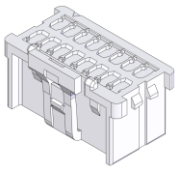


[Digital Encoder(Port A) Connection Diagram]

© 2024 WELCON Systems. All rights reserved.
www.welconsystems.com

3.11. Digital Encoder (Port B)





Molex_51353-1600

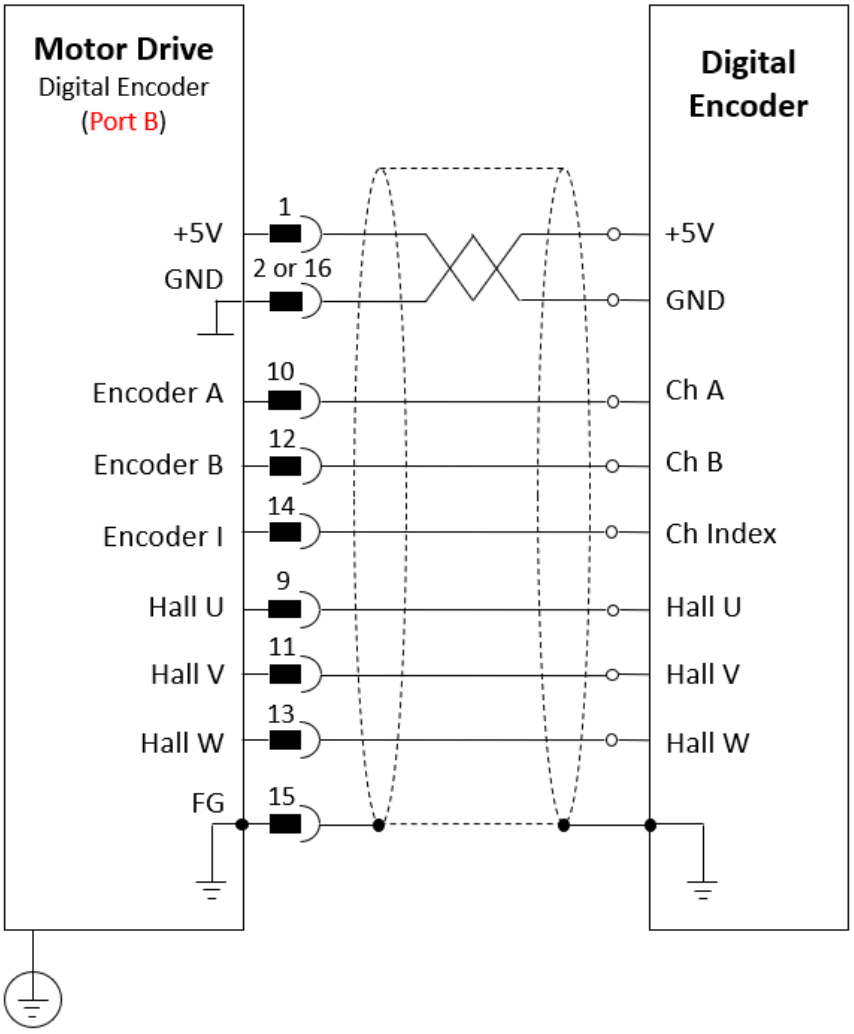
Molex_56134-9000

Molex_55959-1630	J501
Pin	**Signal**
1	5V
2	GND
3	Not Used
4	Not Used
5	Not Used
6	Not Used
7	Not Used
8	Not Used
9	Hall U
10	Encoder A
11	Hall V
12	Encoder B
13	Hall W
14	Encoder I
15	FG
16	GND

* When using Dual Feedback, only Hall Sensor A can be selected in WELSS UI.

© 2024 WELCON Systems. All rights reserved.

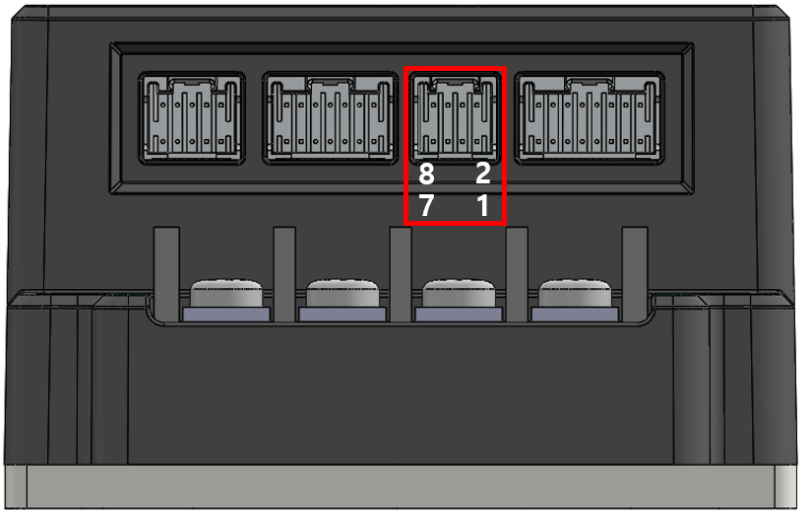
3.11.1 Digital Encoder(Port B) Wiring

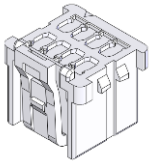


[Digital Encoder(Port B) Connection Diagram]

© 2024 WELCON Systems. All rights reserved.
www.welconsystems.com

3.12. Serial Encoder





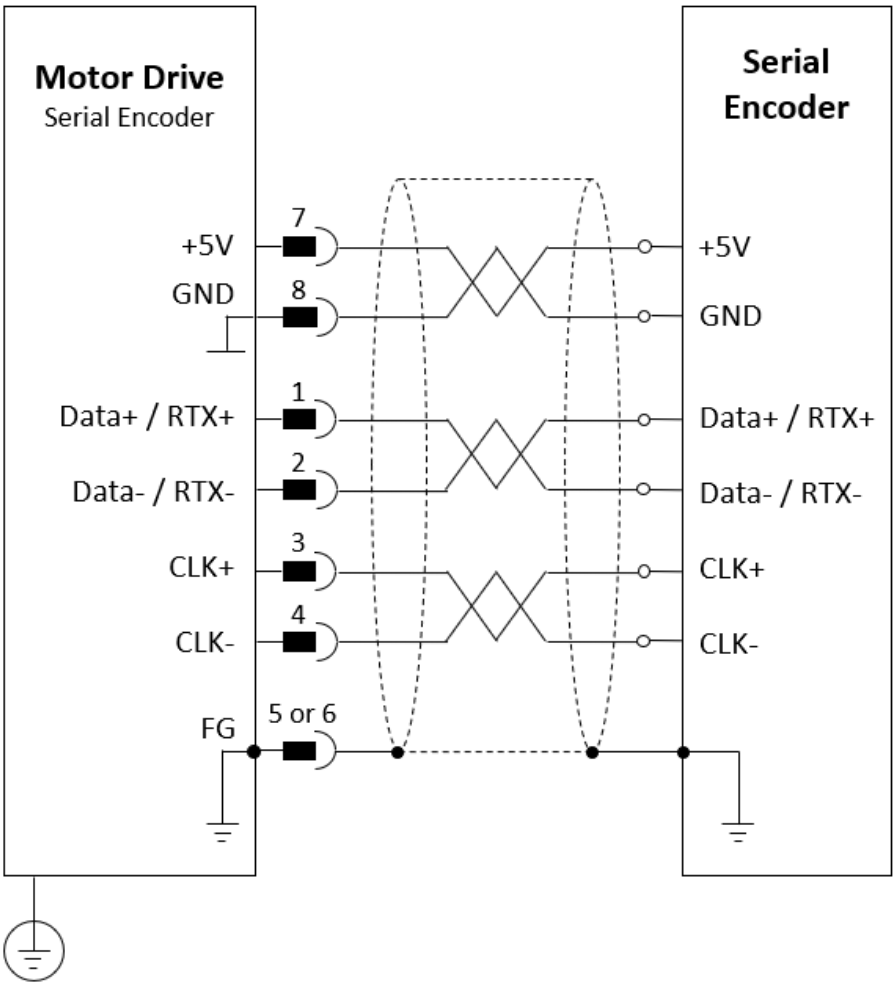
Molex_51353-0800

Molex_56134-9000

Molex_55959-0830	J602
Pin	**Signal**
1	DATA+ / RS485_RTX+
2	DATA- / RS485_RTX-
3	CLK+
4	CLK-
5	FG
6	FG
7	5V
8	GND

© 2024 WELCON Systems. All rights reserved.
www.welconsystems.com

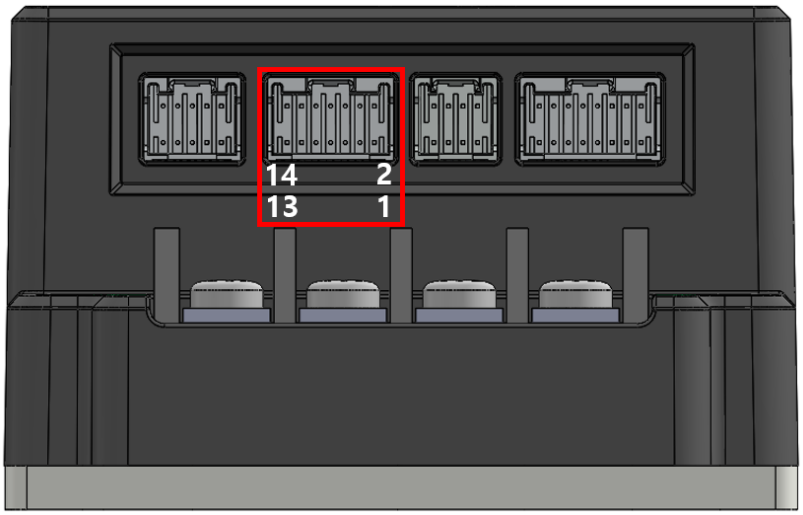
3.12.1 Serial Encoder Wiring

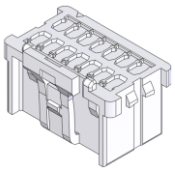


[Serial Encoder Connection Diagram]

© 2024 WELCON Systems. All rights reserved.
www.welconsystems.com

3.13. Digital I/O & Analog Input





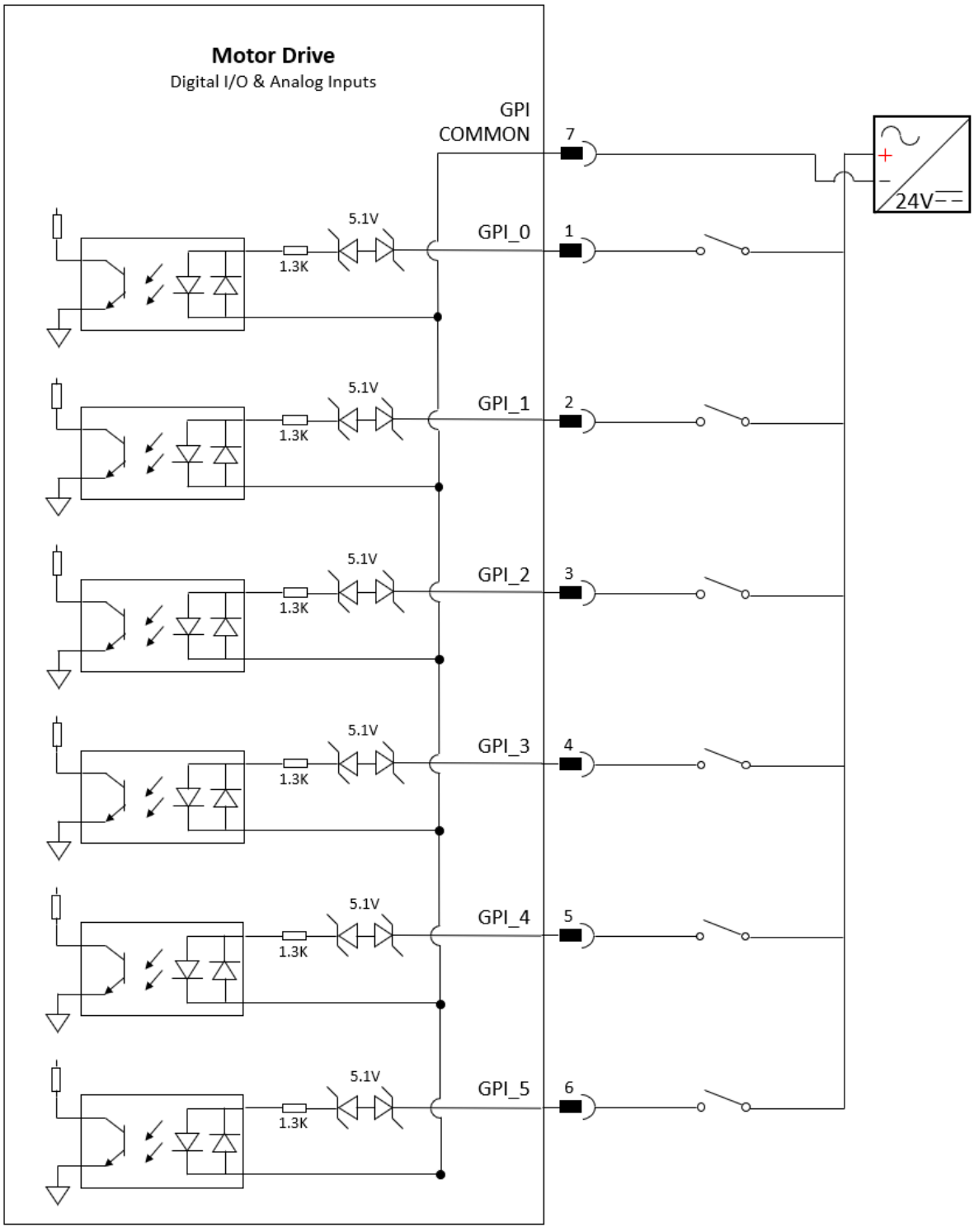
Molex_51353-1400

Molex_56134-9000

Molex_55959-1430	J701
Pin	**Signal**
1	GPI 0
2	GPI 1
3	GPI 2
4	GPI 3
5	GPI 4
6	GPI 5
7	GPI_COMMON
8	GPO 0
9	GPO 1
10	GPO_COMMON
11	Analog Input+
12	Analog Input-
13	Motor Temperature+
14	Motor Temperature-

© 2024 WELCON Systems. All rights reserved.
www.welconsystems.com

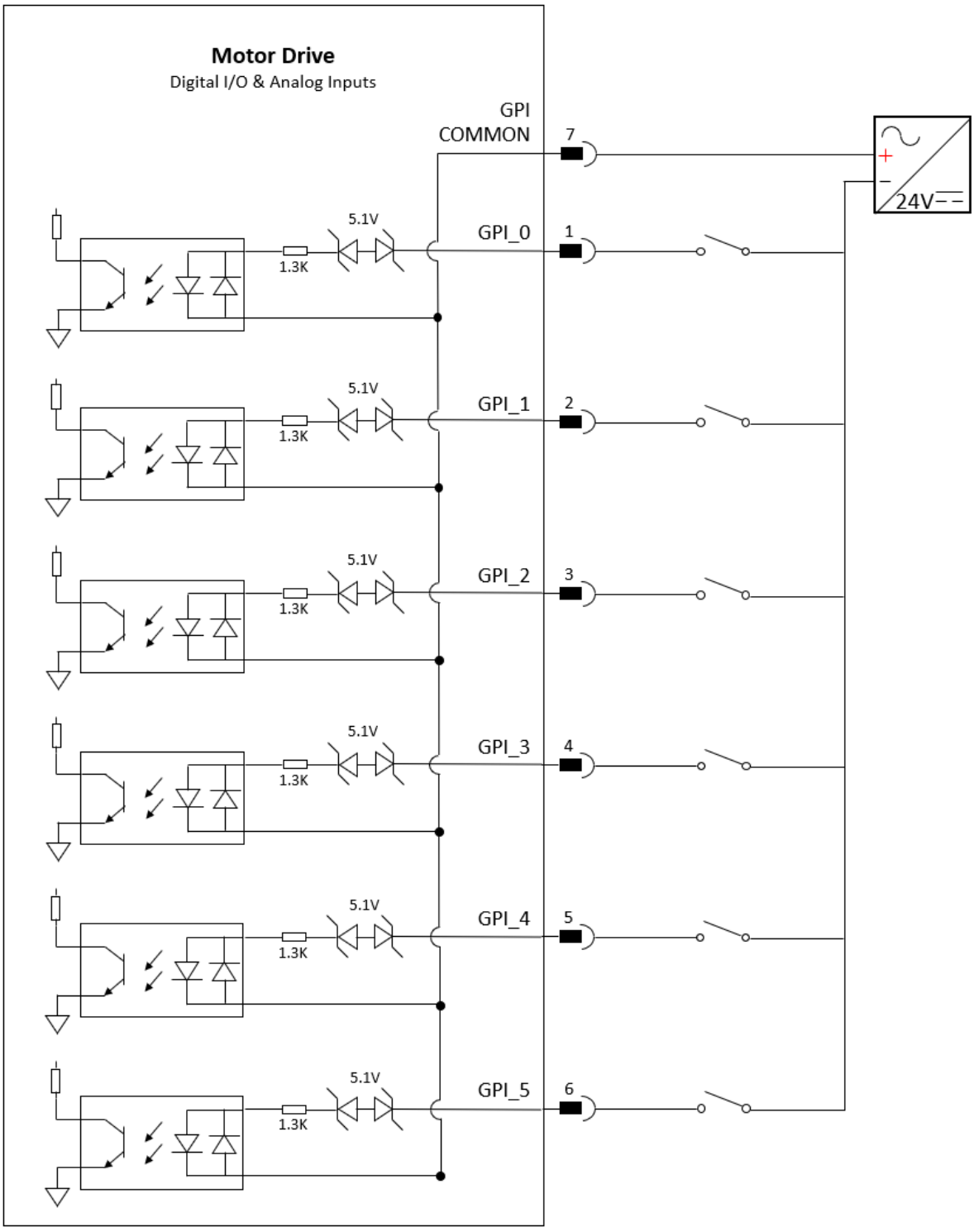
3.13.1 Digital Inputs(PNP Type) Wiring



[Digital Inputs(PNP Type) Connection Diagram]

© 2024 WELCON Systems. All rights reserved.
www.welconsystems.com

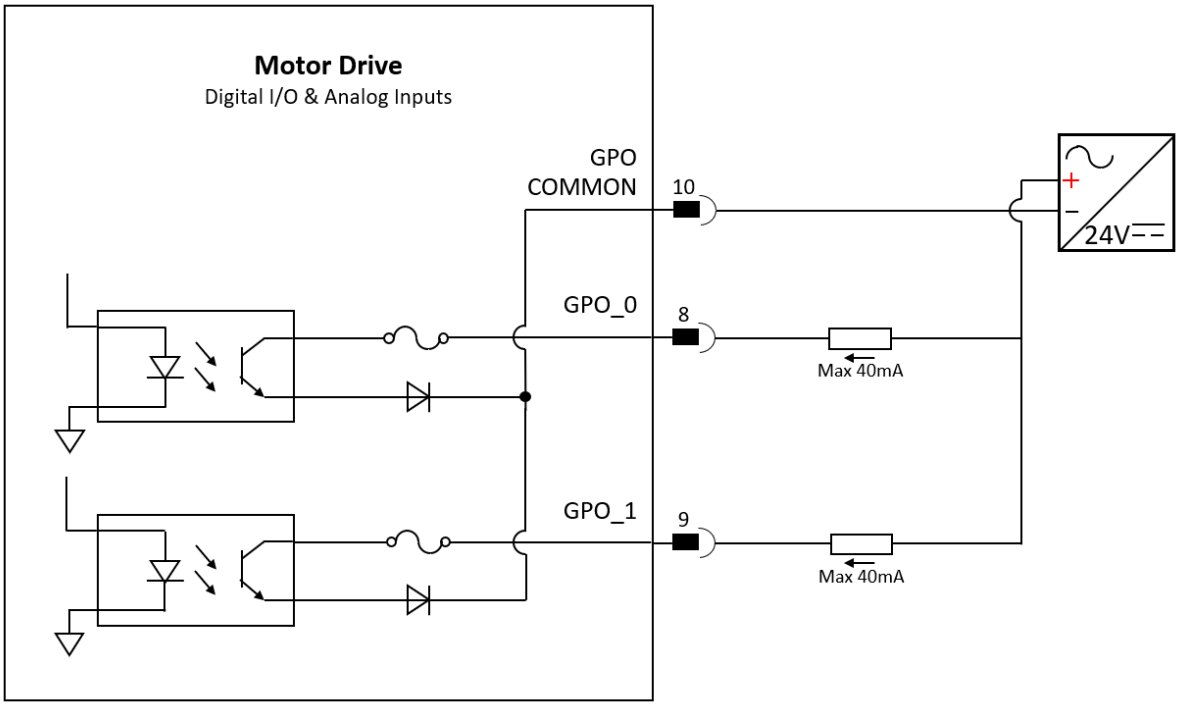
3.13.2 Digital Inputs(NPN Type) Wiring



[Digital Inputs(NPN Type) Connection Diagram]

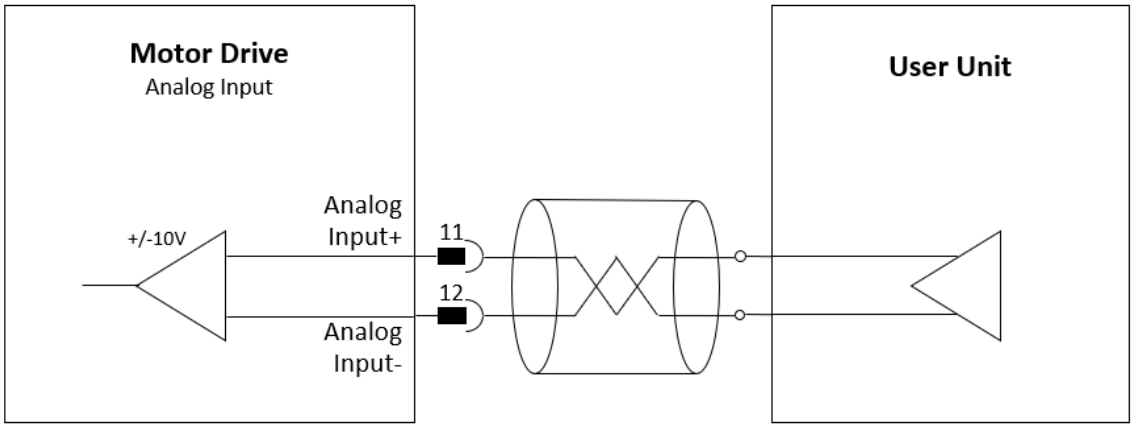
© 2024 WELCON Systems. All rights reserved.
www.welconsystems.com

3.13.3 Digital Outputs(NPN Type) Wiring



[Digital Outputs(NPN Type) Connection Diagram]

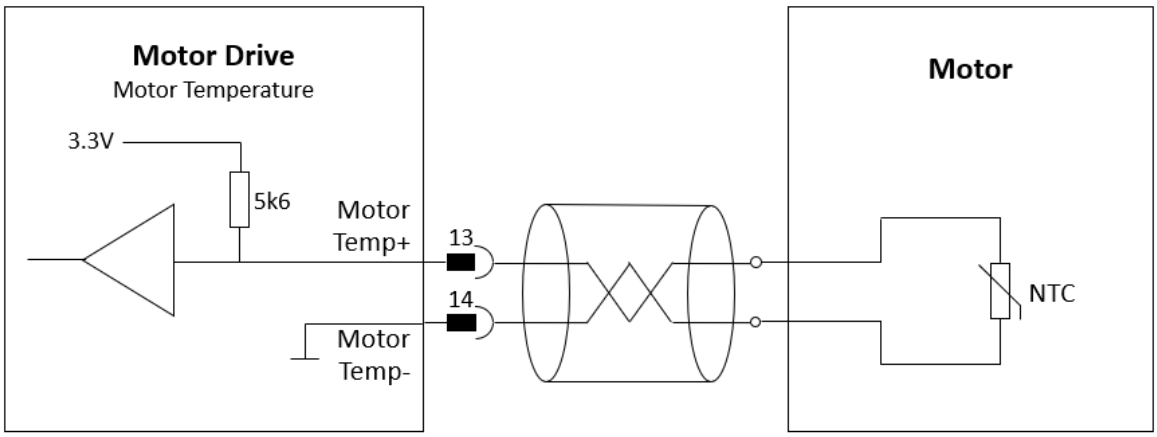
3.13.4 Analog Input Wiring



[Analog Input Connection Diagram]

© 2024 WELCON Systems. All rights reserved.
www.welconsystems.com

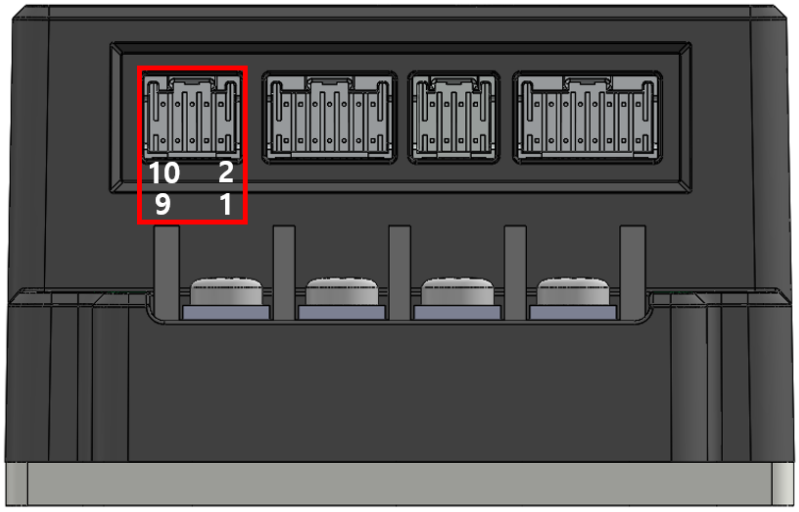
3.13.5 Motor Temperature Wiring

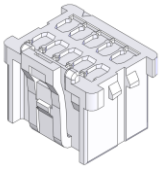


[Motor Temperature Connection Diagram]

© 2024 WELCON Systems. All rights reserved.
www.welconsystems.com

3.14 STO





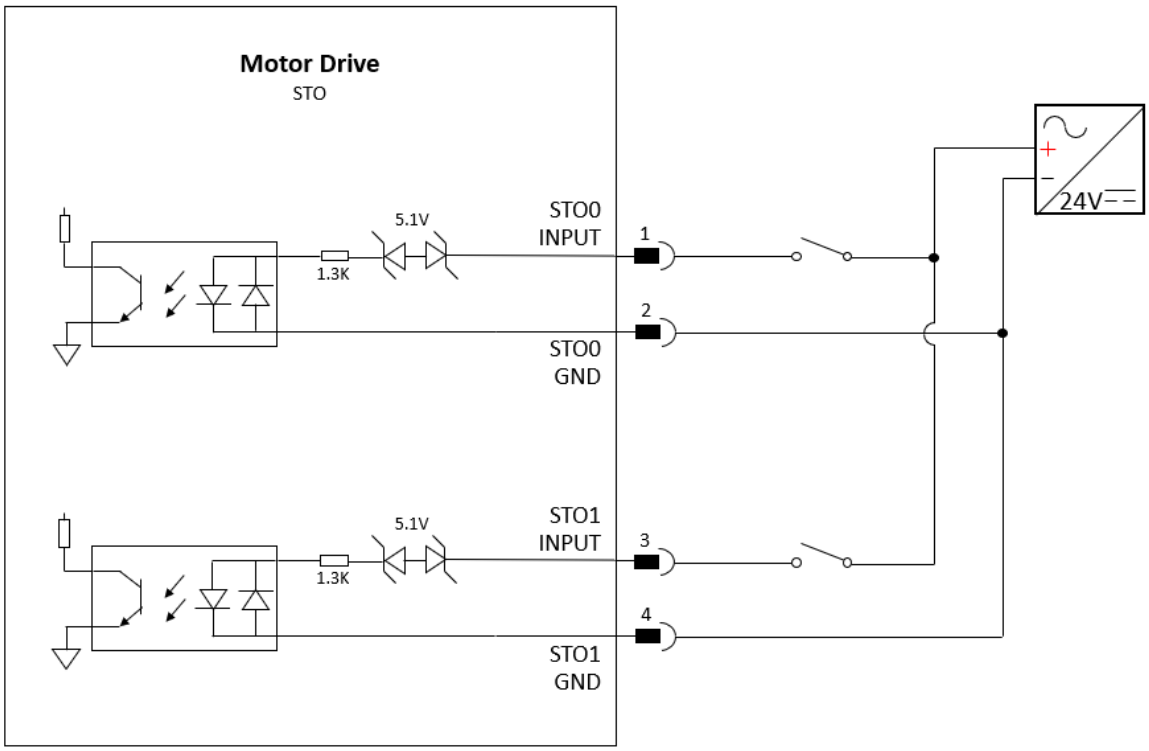
Molex_51353-1000

Molex_56134-9000

Molex_55959-1030	J102
Pin	**Signal**
1	STO0_INPUT
2	STO0_GND
3	STO1_INPUT
4	STO1_GND
5	STO_OUTPUT
6	STO_GND
7	GND
8	STO0_Disable
9	GND
10	STO1_Disable

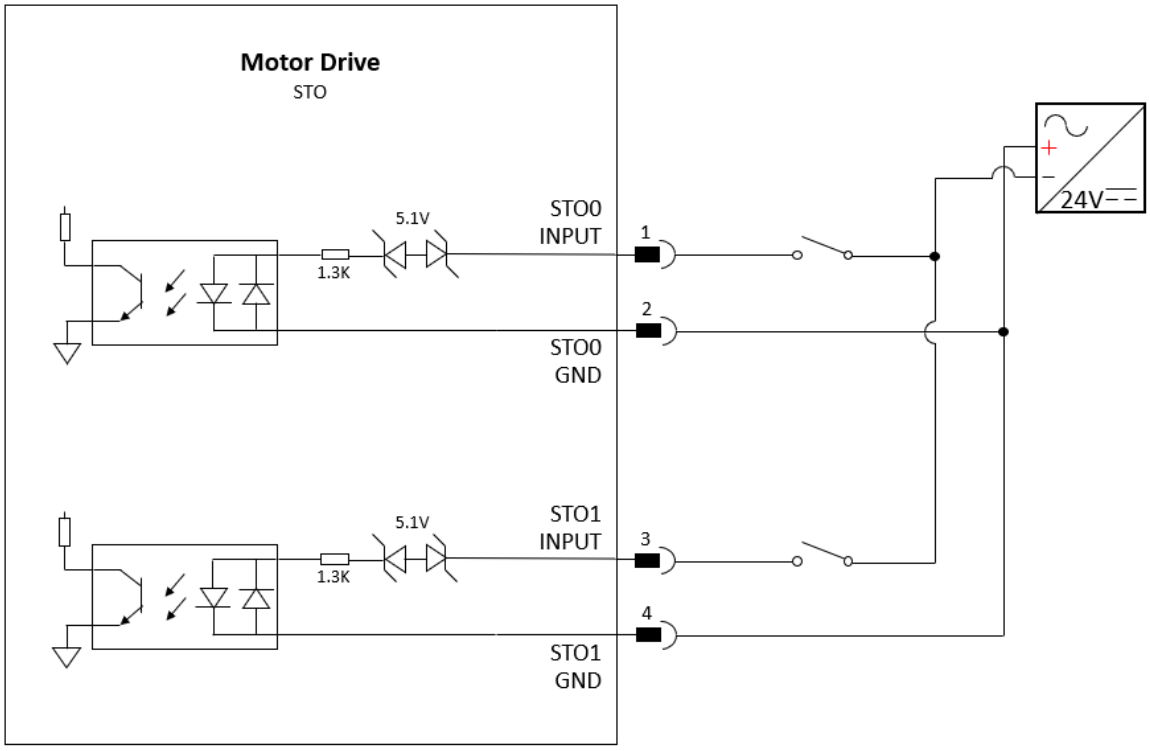
© 2024 WELCON Systems. All rights reserved.
www.welconsystems.com

3.14.1. STO Inputs(PNP Type) Wiring



[STO(PNP Type) Connection Diagram]

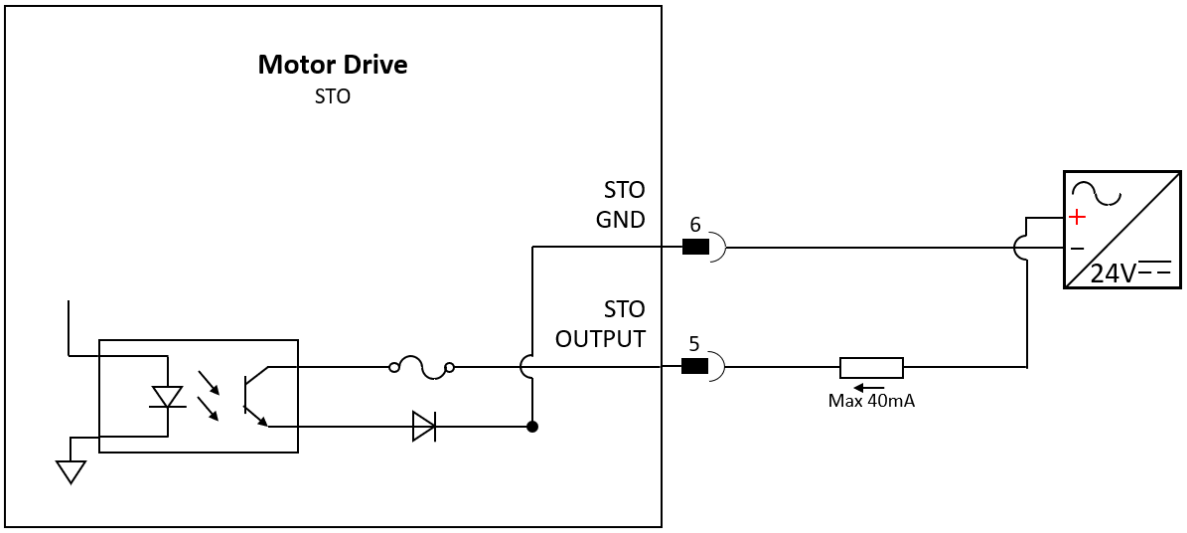
3.14.2. STO Inputs(NPN Type) Wiring



[STO(NPN Type) Connection Diagram]

© 2024 WELCON Systems. All rights reserved.
www.welconsystems.com

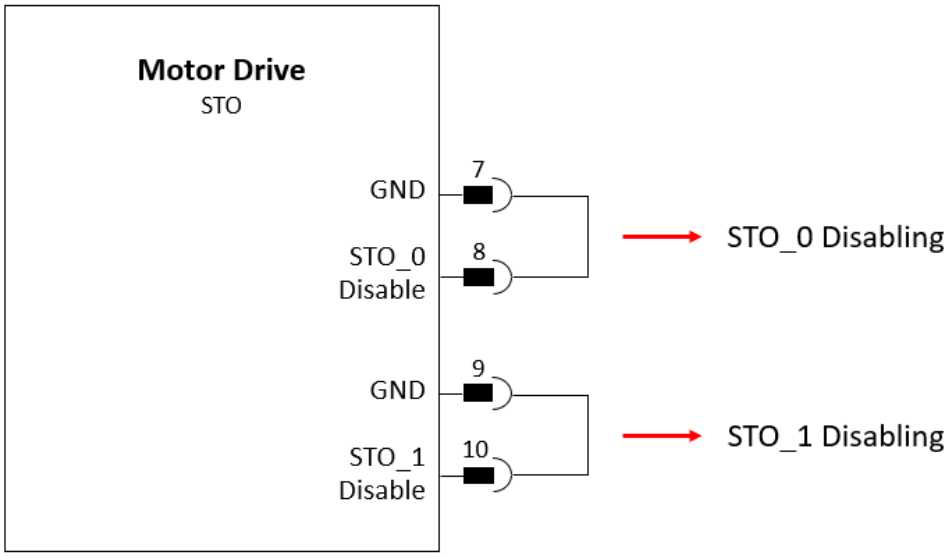
3.14.3. STO Output(NPN Type) Wiring



[STO Output(NPN Type) Connection Diagram]

3.14.4. STO Disabling

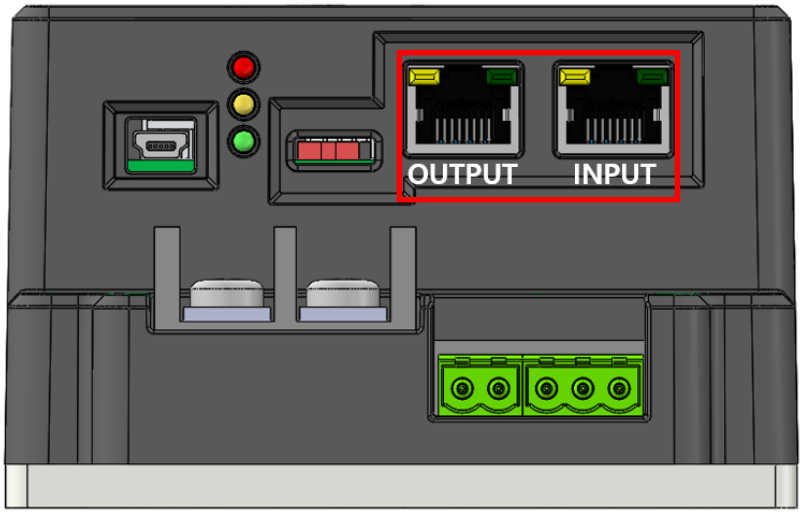
For applications not using STO functionality, STO may be disabled by wiring the designated pins together as given below in figure.



© 2024 WELCON Systems. All rights reserved.
www.welconsystems.com

3.15. EtherCAT

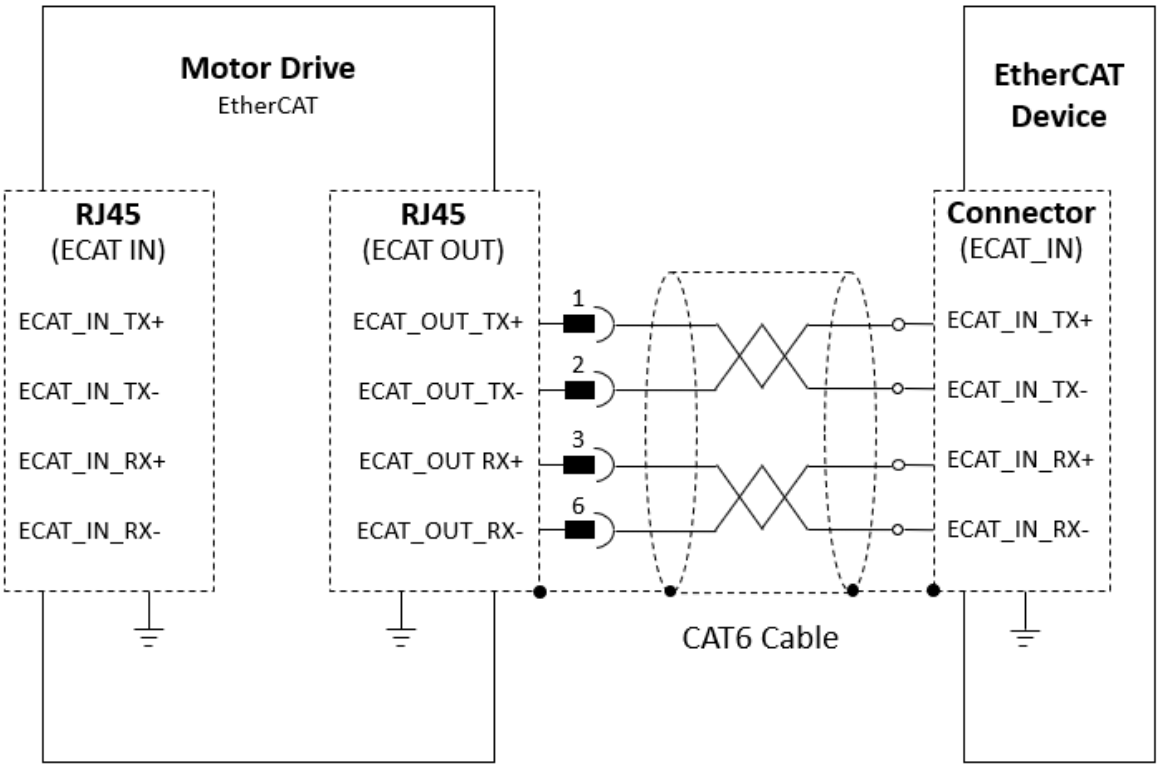
Fieldbus Type	Product Number
EtherCAT	WER-D048/60-FS04A7-E



Meritec_N3J11-017-02	J801, J802
Pin	**Signal**
1	EtherCAT Tx+
2	EtherCAT Tx-
3	EtherCAT Rx+
4	NC
5	NC
6	EtherCAT RX-
7	NC
8	NC

© 2024 WELCON Systems. All rights reserved.
www.welconsystems.com

3.15.1. EtherCAT Wiring

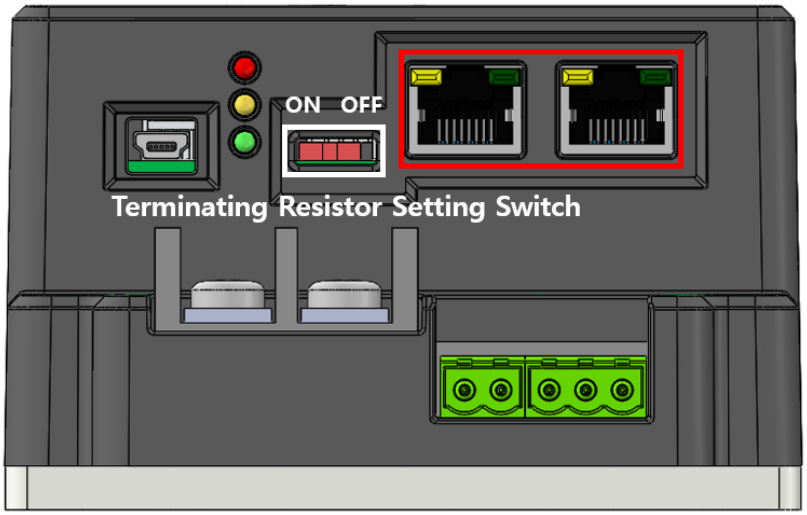


[EtherCAT Connection Diagram]

© 2024 WELCON Systems. All rights reserved.
www.welconsystems.com

3.16. CAN

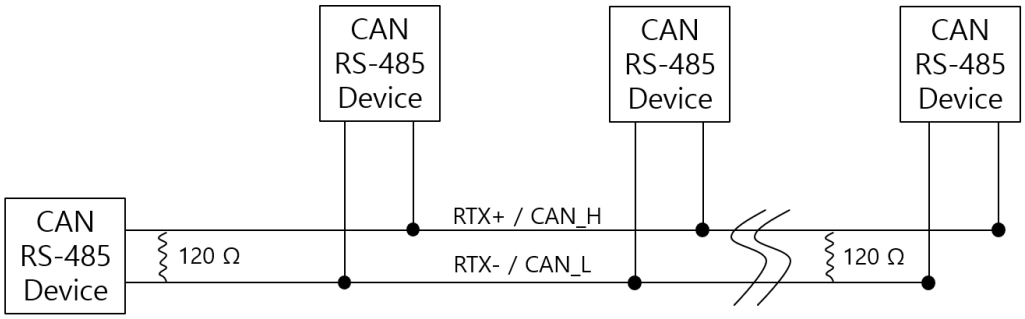
Fieldbus Type	Product Number
CAN	WER-D048/60-FS04A7-C



Meritec_N3J11-017-02	J801, J802
Pin	**Signal**
1	HIGH
2	LOW
3	GND
4	NC
5	NC
6	NC
7	NC
8	NC

3.16.1. Terminating Resistor

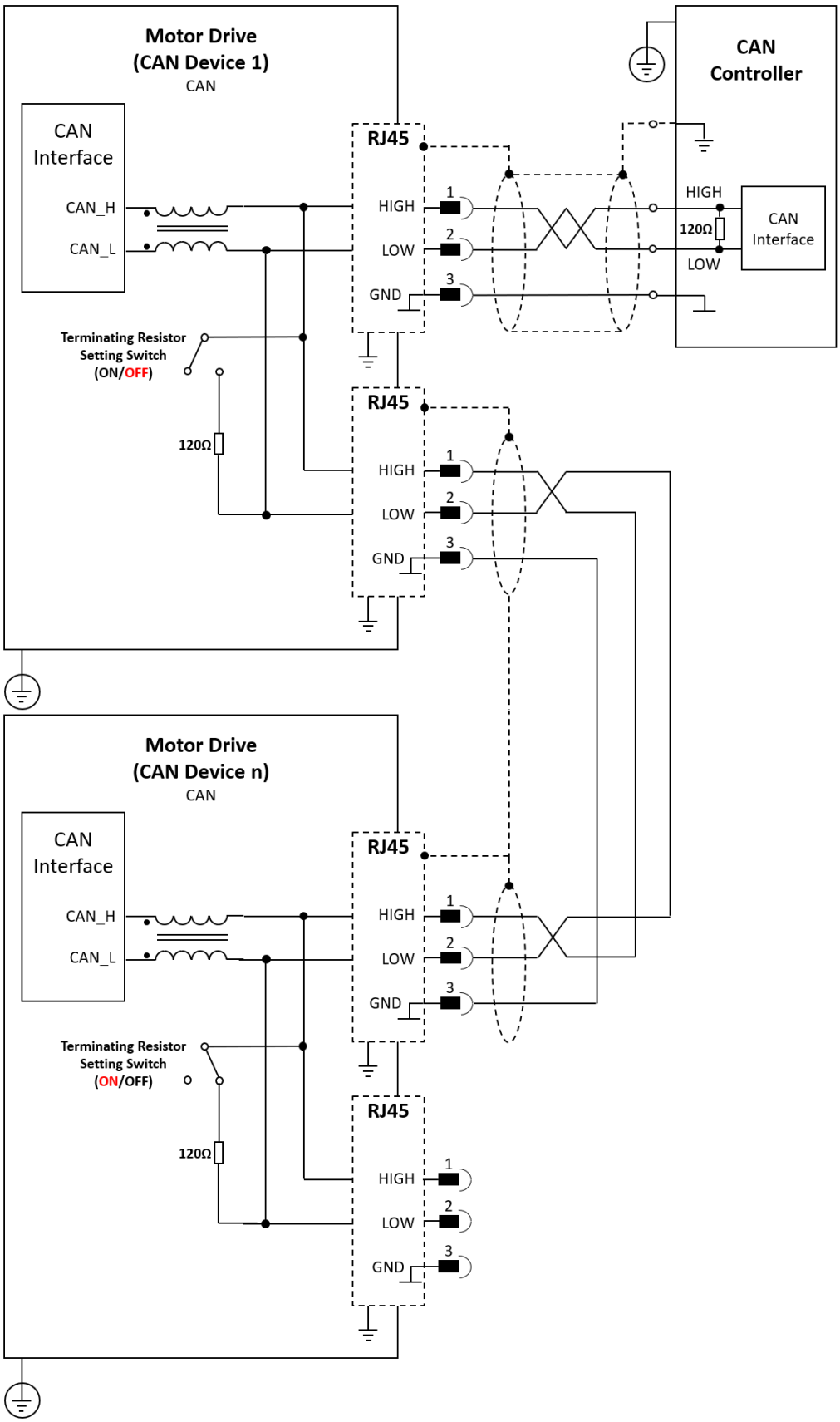
- Connect the terminating resistor to both ends of the CAN or RS 485 signal line using the terminating resistor setting switch.



[CAN or RS-485 Communication]

© 2024 WELCON Systems. All rights reserved.
www.welconsystems.com

3.16.2. CAN Wiring

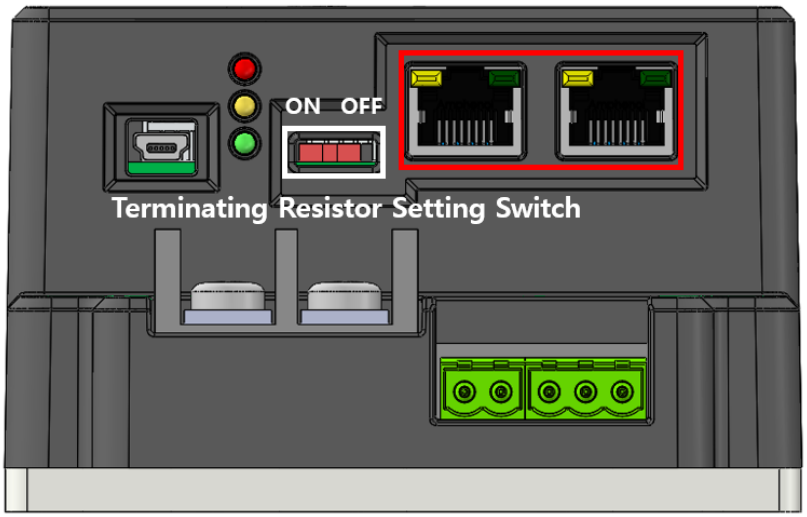


[CAN Connection Diagram]

© 2024 WELCON Systems. All rights reserved.
www.welconsystems.com

3.17. RS-485

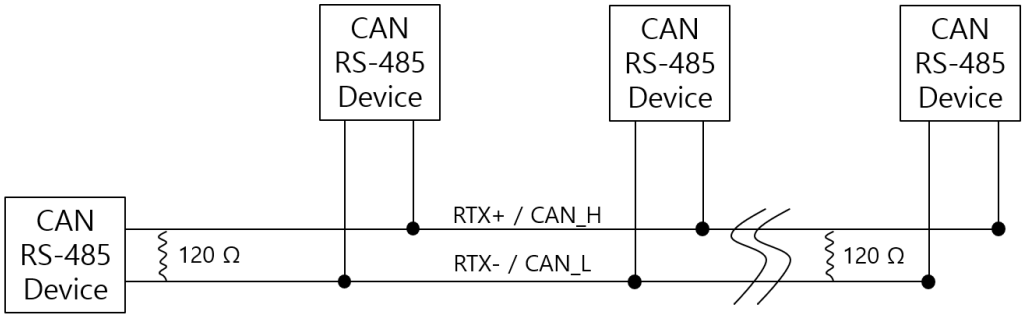
Fieldbus Type	Product Number
RS-485	WER-D048/60-FS04A7-R



Meritec_N3J11-017-02	J801, J802
Pin	**Signal**
1	RTX+
2	NC
3	GND
4	RTX-
5	NC
6	NC
7	NC
8	NC

3.17.1. Terminating Resistor

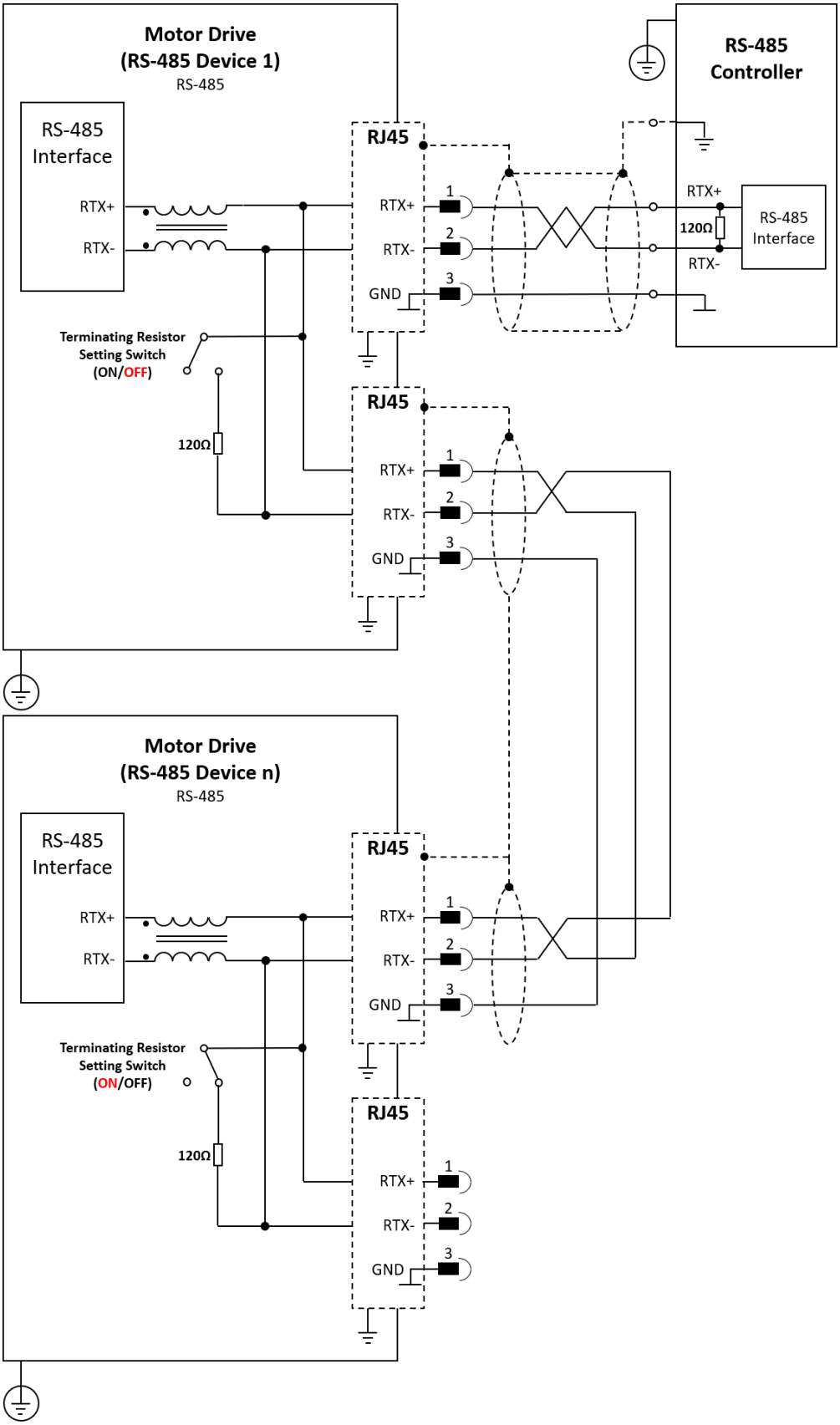
- Connect the terminating resistor to both ends of the CAN or RS 485 signal line using the terminating resistor setting switch.



[CAN or RS-485 Communication]

© 2024 WELCON Systems. All rights reserved.
www.welconsystems.com

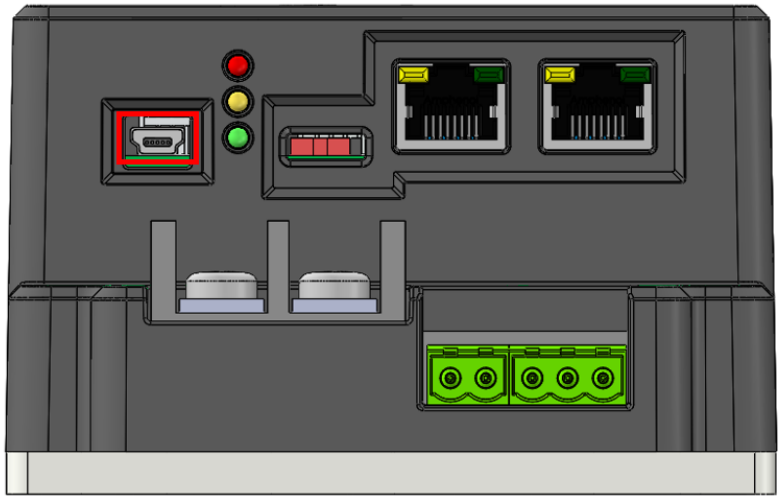
3.17.2. RS-485 Wiring



[RS-485 Connection Diagram]

© 2024 WELCON Systems. All rights reserved.
www.welconsystems.com

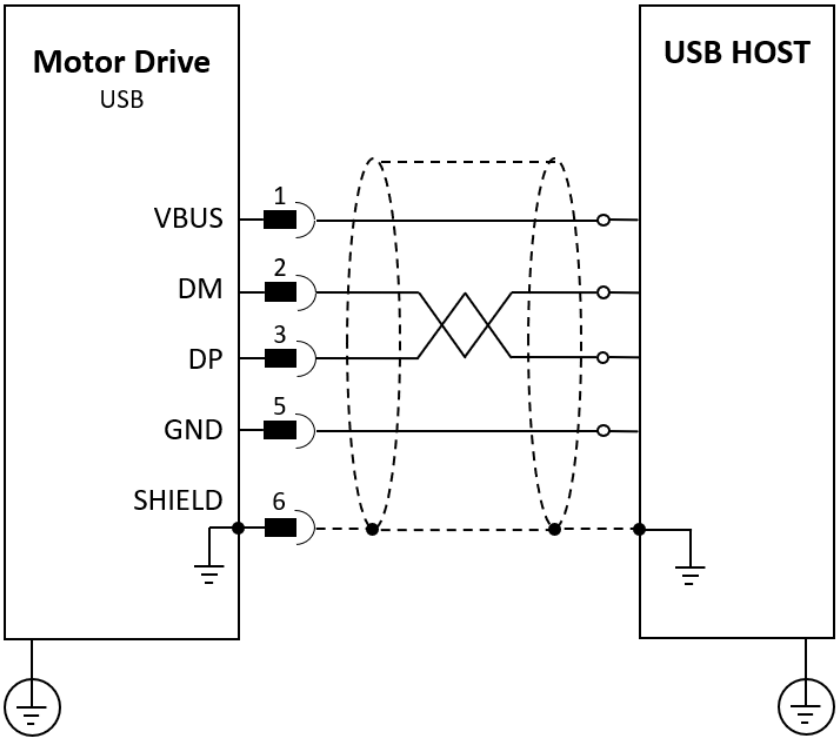
3.18. USB



USB-Mini Type B (Keystone Model:934)	J101
Pin	**Signal**
1	VBUS
2	DM
3	DP
4	Not Used
5	GND
6	SHIELD

© 2024 WELCON Systems. All rights reserved.
www.welconsystems.com

3.18.1. USB Wiring



USB Connection Diagram

© 2024 WELCON Systems. All rights reserved.
www.welconsystems.com

© 2024 WELCON Systems. All rights reserved.

Copyright in this document is reserved exclusively by WELCON SYSTEMS. That is, the owner of the text, images, and all other materials listed in this document is WELCON SYSTEMS. Therefore, the unauthorized distribution, transfer, or duplication of the text, images, and other materials in this document without the written permission of the copyright holder, WELCON SYSTEMS, is prohibited.

WELCON SYSTEMS

(15434) Room 812, 555, Byeolmang-ro, Danwon-gu, Ansan-si, Gyeonggi-do, Republic of Korea

PHONE +82 31 417 6735

FAX +82 31 417 6736

www.welconsystems.com

© 2024 WELCON Systems. All rights reserved.

www.welconsystems.com