

Will1 Series Installation Guide

Ver. 1.7

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1. About this Guide

1.1 Safety Information

Please take the time to read this guide carefully to operate the Will1 Driver correctly and safely. The information here helps you avoid risk and ensure safety while operating. Please read this section carefully before installation.

Make sure all parts are grounded properly and ensure low electrical resistance with ground. Only qualified persons can proceed with the installation. Professional knowledge of electronics, installation, testing and motor operation are required for qualified persons.

There are sensitive electrical parts inside the Will1 Driver. If the installation fails, or the driver encounters heavy hit or drop, the parts will be damaged. The Will1 Driver should be kept away from highly-polluted condition or conductive objects. Make sure there is no static electricity and/or objects that might possess static electricity on an installer. To prevent accidents, make sure that all parts are properly tightened and limit switch as well as safety switch is functional; Keep the pavement clean and the motor operation area is empty.

1.1.3 Symbols



CAUTION
ISO 7000-0434 (2004-01)



Protective earth; protective ground
IEC 60417-5019 (2006-08)



WARNING, High voltage
IEC 60417-5036 (2002-10)



CAUTION, This surface can be hot
IEC 60417-5041 (2000-10)

1.1.2 Standards Conformance

The Will1 Driver conforms to the following industry safety standards:

Standards	Item
EN 61800-3:2004	Adjustable speed electrical power drive systems – Part 3: EMC requirements and specific test methods
EN 61800-5-1:2007	Adjustable speed electrical power drive systems – Part 5-1: Safety requirements – Electrical, thermal and energy

1.1.4 Disclaimer

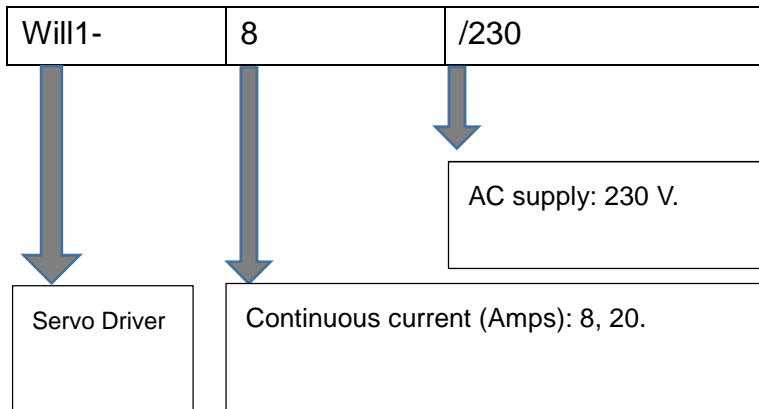
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4. The product specified in this document has been developed, produced, tested and documented in accordance with the relevant standards. Cpc is not responsible for damages, accidents, or injuries caused by any deviation from the configuration and installation described in this guide;
5. Furthermore, cpc is not responsible for the performance of new measurements or ensuring that regulatory requirements are met.
6. The product specified in this document is not assumed to be used in critical application including, but not limited to, medical equipment, transportation, aerospace and nuclear instruments, undersea equipment, power plant equipment, as well as disaster prevention and crime prevention equipment.
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1.2. Revision History

Revision	Date	Description	Remarks.
1.0	December 2015	Initial release	--
1.1	April 2016	1 st revision	--
1.2	July 2017	2 nd revision	Amended information of: 1. The Will1 driver—Second version; 2. The 20 A driver's dimension and mounting; Spec of power connectors; 3. Change of differential input equivalent circuits; Optional accessories and assembly steps, etc.
1.3	August 2017	3 rd revision	1. Amended content of specification (peak current time, regenerative resistor, etc.) 2. Revised chapter 3.1.2, point #3. 3. Amended dimensions of EMI Board.
1.4	March 2018	4 th revision	1. Adjusted/amended descriptions in chapters 3.1.2, 3.13.3, and 3.13.4. 2. Chapter 3.13.1.1: Corrected <diagram #2> and <diagram #3>. 3. Chapter 3.13.2: Added important notes for digital input (5V TTL). 4. Chapter 6: ┆ Change of product name: EMI Board renamed as Noise Filter Board. ┆ Added information of the new version (v.2.1) of Noise Filter Board. ┆ Corrected the height of 20A-type driver (when assembled with noise filter board).
1.5	June 2018	5 th revision	1. Added a picture indicating the place of nameplate.

			2. Corrected pin definitions of the controller port of Will1 Driver— Second version.
1.6	July, 2018	6 th revision	Corrected [Voltage and Phase] in specification.
1.7	September, 2018	7 th revision	Corrected pin number in the CLS wiring example (3.14.1).

1.3. Ordering Information



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1.5 How to use this guide

In order to install and operate the cpc Will1 driver correctly, you will need to refer to this manual together with a set of cpc documents. This Installation Guide is your first step; please carefully read the safety instructions in the first chapter, and then the other chapters regarding installation instructions as the following:

- Chapter 3, Installation, provides step-by-step instructions for mounting, connecting and powering up the Will1 driver.
- Chapter 4, Technical Specifications, lists all the driver rating and specifications.

Upon completing installation according to the instructions in this guide, your Will1 driver should be mounted and installed successfully. From then on, you will need to consult cpc GUI Software User Guide in order to setup and tune the system for optimal operation.

2. Features

2.1. Driver Description

Will1-xx/230 series servo drive is optimized for operating with linear Permanent Magnet Synchronous Motors (PMSM). It can operate in standalone configuration using an internal virtual scripting engine, support external analog or pulse commands, and can be a part of a fieldbus network such as CAN supporting industry standard CANopen DS402 profile.

2.2. Current Loop

- Fully digital
- 12-bit current loop resolution
- 20 KHz working frequency
- Automatic and manual gain tuning, to compensate for variations in the servo motors
- Frequency response and time response testing
- Automatic Phasing

2.3. Auto Phase

- Sensor less
- Digital Hall – up to 20 KHz

2.4. Velocity Loop

- Fully digital
- 10 KHz working frequency
- Automatic and manual gain tuning, to compensate for variations in the servo motors
- Frequency response and time response testing
- Gain switch by condition of digital input, demand, feedback, error or target reach
- 3 sets of notch or low-pass filter

2.5. Position Loop

- Incremental Encoder up to 20 Mega counts/s
- Position Count Range – $-2^{31} \sim 2^{31}$

2.6. Command

- A/B Incremental command – up to 4 Mega counts/s
- Pulse-direction command up to 4 Mega counts/s
- Up-down command up to 2 Mega counts/s
- Analog 10 V command to current, velocity or position

2.7. Gain Switch

- 3 sets of gain group
- Switching per Digital input, Demand, Feedback, Error, or Target Reach
- Controllable switching time.

2.8. Homing

- 31 kinds of standard method in CiA402
- 5 kinds of special method for homing with mechanical hard stop

2.9. Filter

- Current Filter
- Velocity Filter
- Auxiliary Command Filter

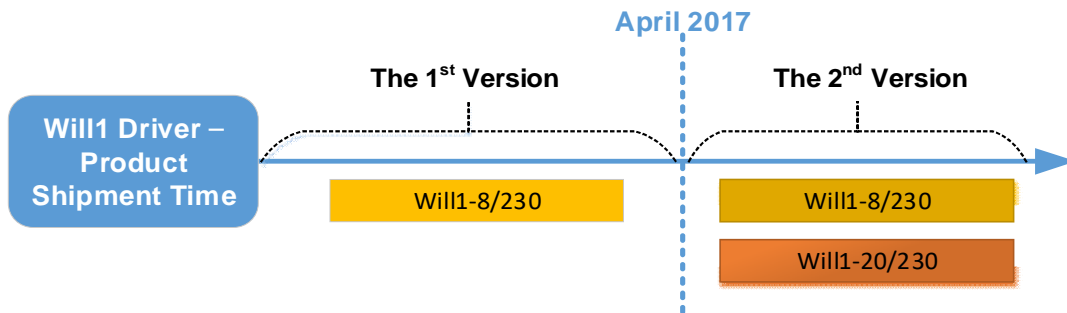
2.10. Script

- Point to point instruction up to 128 steps
- 16k bytes script FLASH memory
- User friendly interface
- Modular instructions

3. Installation

3.1. Installation Description

There have been **two** versions of the Will1 Driver so far. The products shipped after April 2017 are the second version.



Note:

The 8A-type Will1 driver (Will1-8/230) has **TWO** versions: the first version and the second version;

The 20A-type Will1 driver (Will1-20/230) has only **ONE** version: the second version.

i For Will1-8/230:

Please check the Model description shown on nameplate sticker on the lateral side of the 8A-type driver: Will1-8/230 is the **first** version; Will1-8/230 V2 is the **second** version.

See chapter 3.1.1.



i For Will1-20/230:

All Will1-20/230 drivers are the second version.

To install Will1-20/230, please refer to the information marked under the title of “...of the Will1 Driver Second Version” in this guide.

3.1.1 How to Tell the Version of a Will1-8/230 Driver:

1. Check the nameplate sticker on the lateral side of the 8A-type driver and read the MODEL description, AND
2. Connect the driver with UI (User Interface), then check the MODEL description shown in the information index (route: Setting > Driver >Information): Will1-AA2408I is the first version, and Will1-8/230 is the second version.

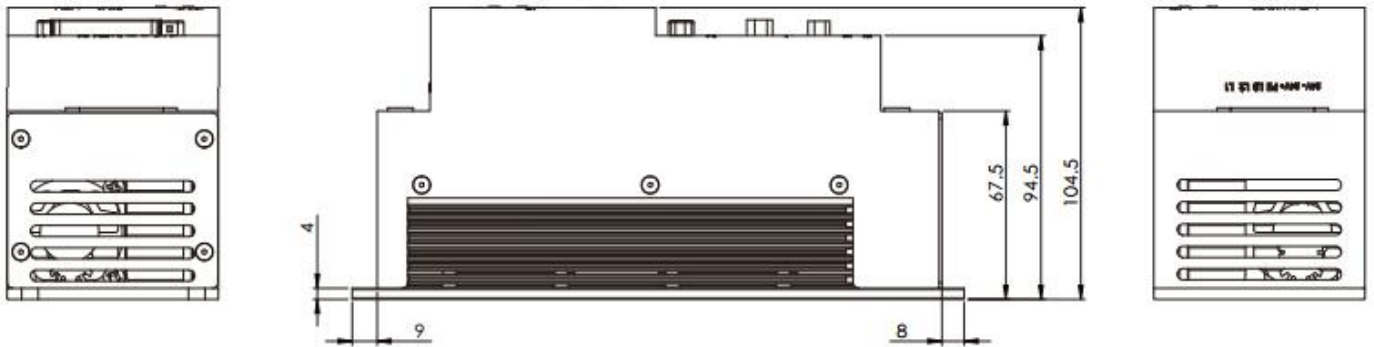
How to tell the version of a Will1-8/230 Driver	Model description shown on nameplate sticker	Model description shown in UI interface
The first version:	Will1-8/230	TC1-AA2408I
The second version:	Will1-8/230 V2	TC1-8/230

3.1.2 Differences Between the First Version and the Second Version of Will1 Drivers:

1. The controller port of the Second version is equipped with more output pins. **See 3.11.2.**
2. The digital I/O port of the Second version:
 - (1) All output signals are open-collector type.
 - (2) Pin #14 and #15 are revised to be signal ground. **See 3.9.2.**
3. Most of the circuit designs for open-collector digital outputs in the Second version are revised to include pull-up resistor. **See 3.13.4.2.**
4. The First version of Will1 driver can only accept differential input of pulse command; to be able to accept single-ended input, you will need to connect the RA- and RB- pins of the controller port with an external 1K-resistor at 5V.
The Second version of Will1 driver can accept both differential and single-end input signals. **See 3.13.1.1.**

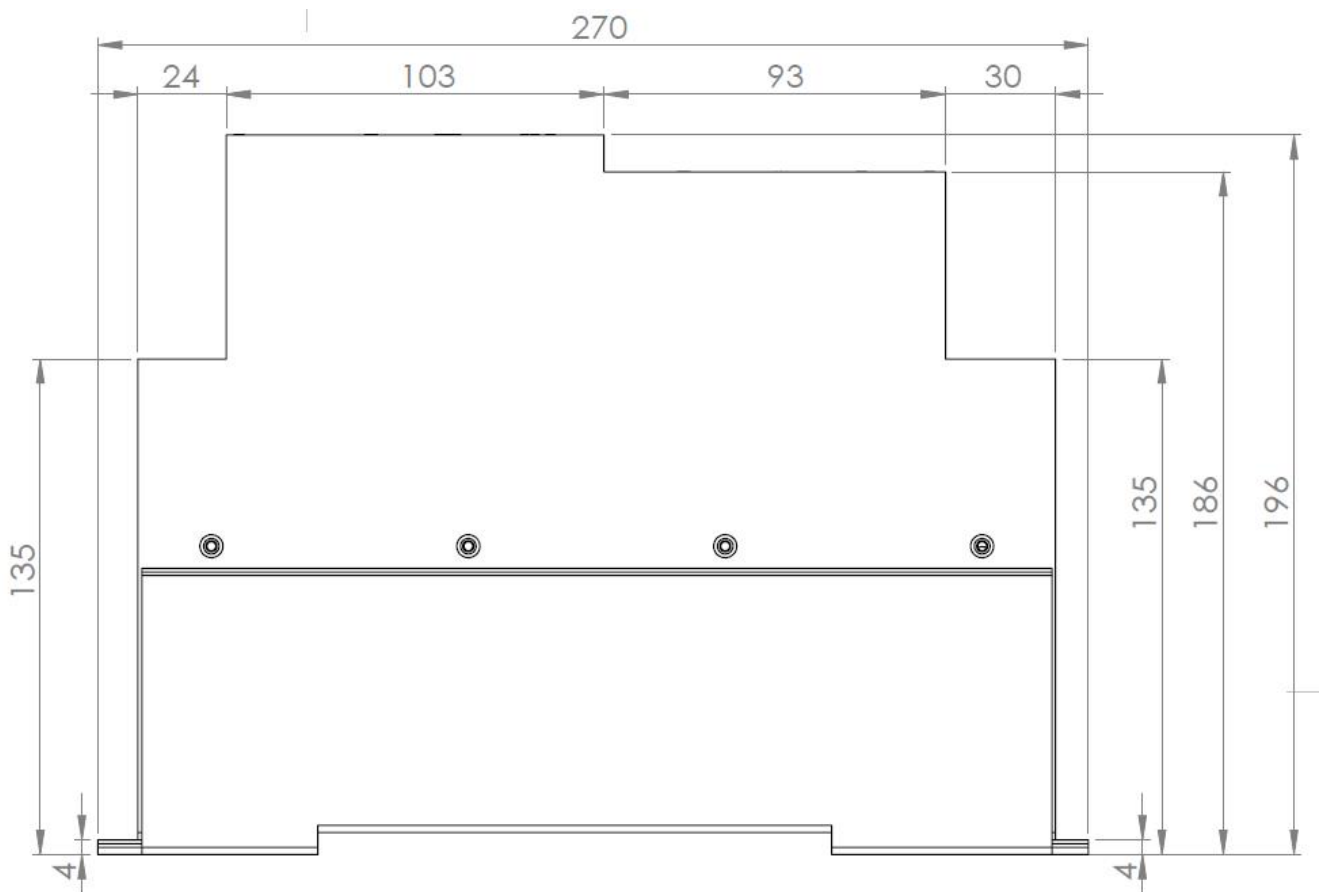
3.2. Dimensions

3.2.1. 8A-type Will1 Driver



Unit: mm

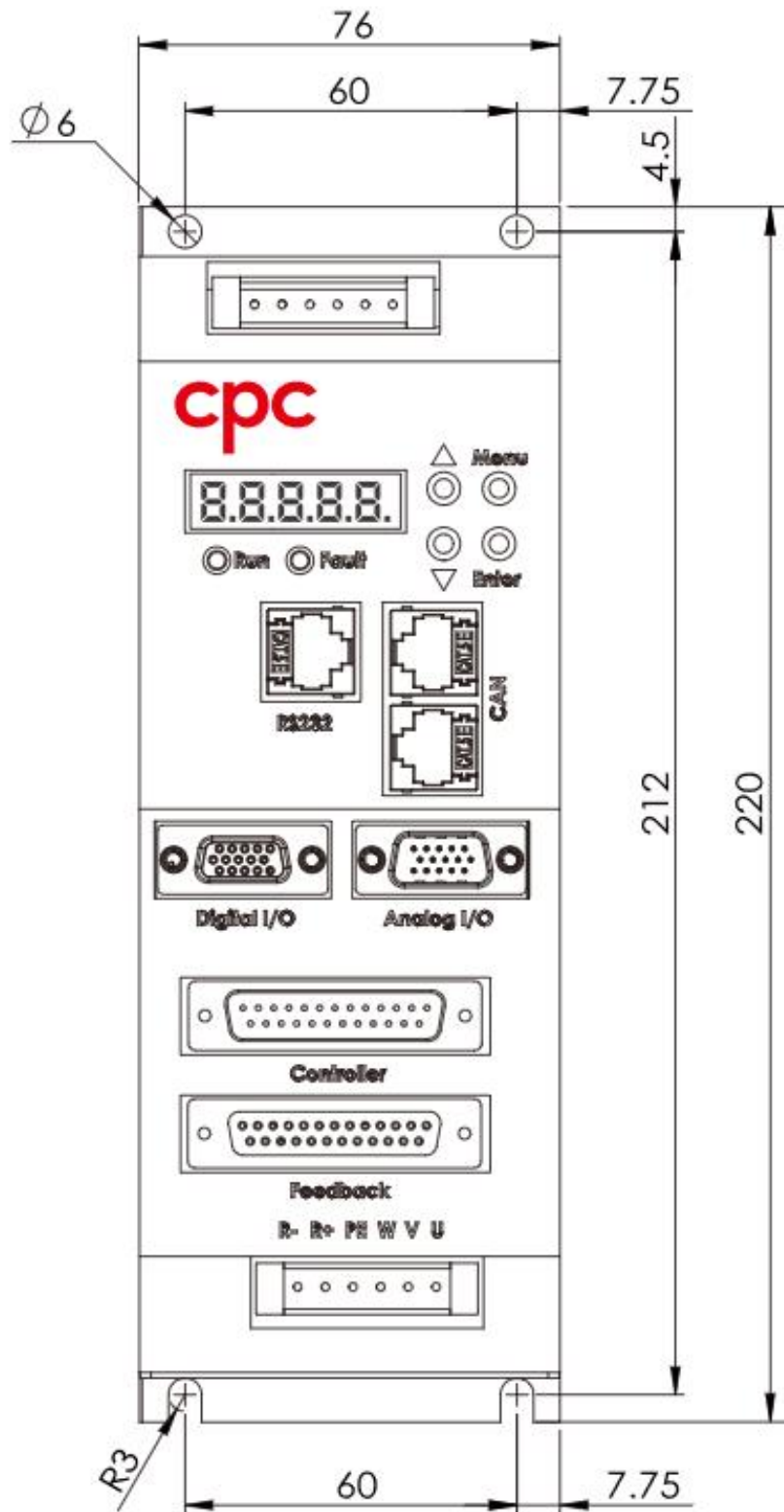
3.2.2. 20A-type Will1 Driver



Unit: mm

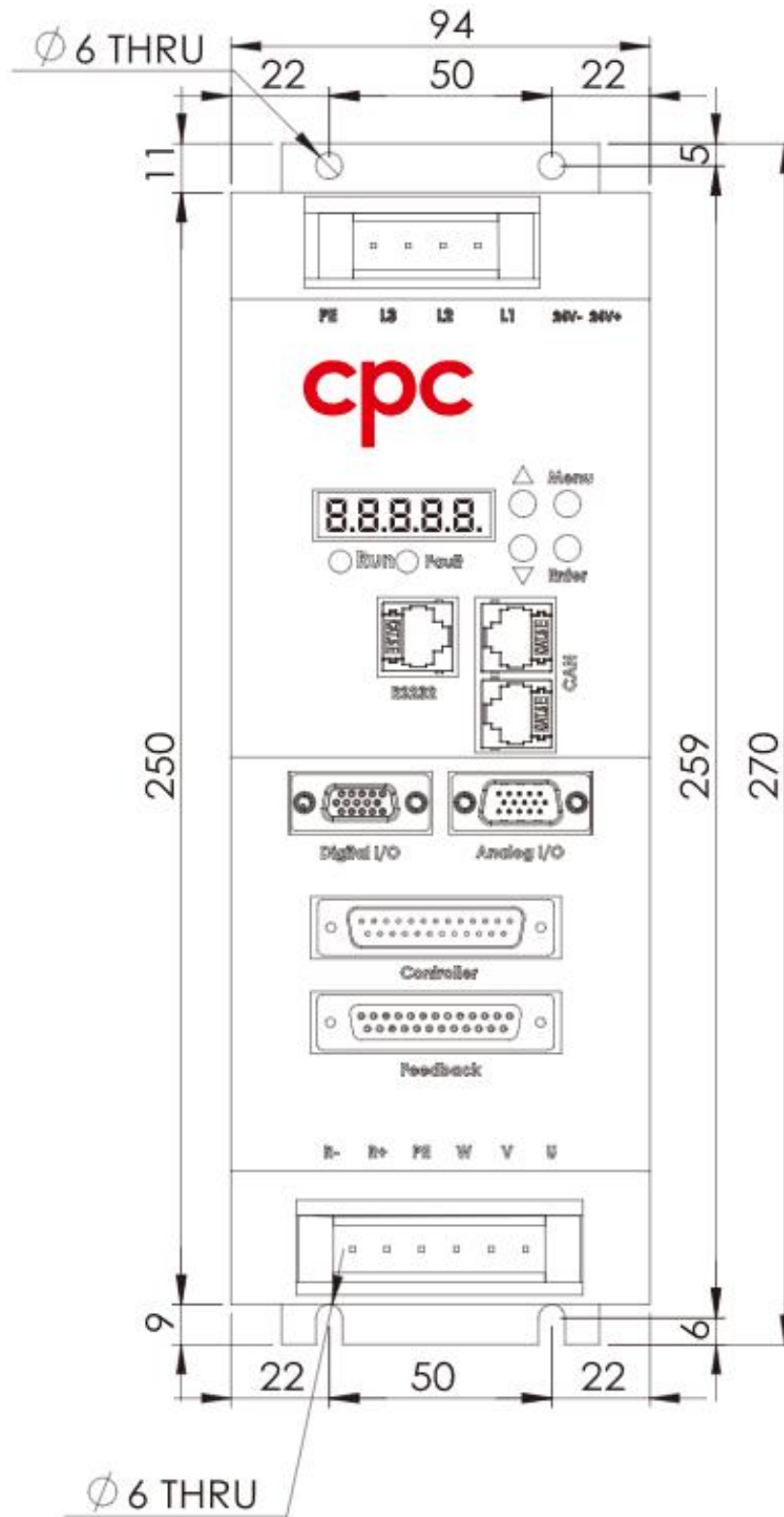
3.3. Mounting

3.3.1. 8A-type Will1 Driver



Unit: mm

3.3.2. 20A-type Will1 Driver



Unit: mm

3.4. Mechanical and Electrical Specifications

Specification			Will1 Series	
Model No.			Will1-8/230	Will1-20/230
Input Power	Voltage and Phase		1 Ø or 3 Ø 100 to 230 VAC	
	DC Bus Peak Voltage	[V]	390	
	Frequency	[Hz]	50 to 60	
	Power Rating	[W]	3000	7500
Control Logic Power	Voltage Range	[VDC]	24	
	Current	[A]	>0.5	
Output Power	Continuous Current	[A]	8 (5.66 RMS)	20 (14.14 RMS)
	Peak Current	[A]	20 (14.14 RMS)	60 (42.43 RMS)
	Peak Current Time		2.5 seconds	
	Peak Power Output	[kW]	4.4	12
	5 V Supply Current Output	[A]	0.5	
Encoder Input	Digital	Type	A/B Incremental (RS-422 signaling)	
		Work Frequency	Max. 20 Mega counts/s	
		Count Range	Max. 2 ³¹ counts	
	Analog (sin/cos)	Amplitude	N/A	
		Work Frequency	N/A	
Absolute	Type	N/A		
Encoder Output	Signal Type		RS-422	
	Work Frequency		Max. 20 Mega counts/s	
Feedback Position Error Mapping			Yes	
Regenerative Resistor	Active Voltage	[VDC]	Default:360	
	Stop Voltage	[VDC]	Default: 350	
	Resistance	[Ohm]	60	25
	Continuous dissipation	[Watt]	100	200
	DC Bus Capacitance	[uF]	1350	2240
	Pulse Braking Energy	[Joule]	2500	10000
	Braking Resistor Switch Cont. Current	[A]	20	20
Control Loop		Loop Frequency	5 KHz	

Specification			Will1 Series		
Model No.			Will1-8/230	Will1-20/230	
	Position Control	Trajectory Generator	Trapezoidal with S-curve filter		
		Counter Range	2,147,483,648 to 2,147,483,647 counts/second		
	Velocity Control	Loop Frequency	10 KHz		
		Output Filter	x3 (Low-pass or Notch)		
		Counter Range	2,147,483,648 to 2,147,483,647 counts/second		
	Current Control	Loop Frequency	20 KHz		
		Modulation	SVPWM		
	Auxiliary Command Input	Position Mode	A/B Incremental	Max. 4 Mega counts/s	
			Pulse/Direction	Max. 4 Mega counts/s	
CW/CCW			Max. 2 Mega counts/s		
Velocity Mode		Analog Voltage	10 V		
		Current Mode	10 V		
DS 402 Operation Modes			PP, PV, PT, HM, CST, CSV, CSP		
Serial Bus			RS232		
Pulse Command Frequency	RS422		Max. 10 MHz		
	5V Single-end		Max. 1 MHz		
	24V Single-end		N/A	N/A	
Total Digital Inputs			x22 (3.3~5 V)		
Total Digital Outputs (open-collector)			x2 (24 V, 500 mA); x6 (24 V, 20 mA)		
High Speed Position Compare Output			x1 (RS422)		
Analog Input	Input Type		x2 (10 V differential)		
	ADC Resolution		12 bit		
Autotuner			Current/Velocity/Position loop gain, motor phasing setup, sin/cos encoder calibration.		
Gain Switch Function			Yes		
Control Panel			x1 (5-digit LED), x4 (push buttons)		
Software Protection			Dynamic brake, motor over-current, over/under-position, over-velocity.		

Specification		Will1 Series	
Model No.		Will1-8/230	Will1-20/230
		Virtual/physical position limit switch, missing hall signal, external fault trigger, following error.	
Hardware Protection		Drive over-temperature, motor over-temperature.	
Dimensions (LxHxW) [mm]		220 x 105 x 76	270 x 195 x 94
Weight [Kg]		1.6	3.7
Application Environment	Operate Temperature	0 ~40	
	Storage Temperature	-20 ~85	
	Humidity	0~95%	
	Altitude	0~2000 m	
	Vibration	1 G	
	Protection Class	IP20	
Motor selection	1. Linear AC servo motor or Rotary AC servo motor.		
	2. Protective class I & Comply with IEC60034-1		
	3. Refer output power mentioned above for your selection of servo drive.		

3.5. Recommended Wire Cross-Sections

Feature	Connection	Detail
AC Input	L1, L2, L3	4 to 5 mm ² , 10 to 12 AWG
Auxiliary Power	24V+, 24V-	0.5 to 1 mm ² , 18 to 20 AWG
Motor	U, V, W	4 to 5 mm ² , 10 to 12 AWG
Protective Earth	PE	4 to 5 mm ² , 10 to 12AWG
Regenerative Resistor	R+, R-	4 to 5 mm ² , 10 to 12AWG

This product can cause a.c. current in the protective earthing conductor. Where a residual current-operated protective (RCD) or monitoring (RCM) device is issued for protection in case of direct or indirect contact, only an RCD or RCM of Type B is allowed on the supply side of this product.

Recommended method of connection:

a) A fixed connection **and** :

- ┆ a cross-section of the protective earthing conductor of at least 10 mm² Cu or 16 mm² Al, or
- ┆ automatic disconnection of the supply in case of discontinuity of the protective earthing conductor; or
- ┆ provision of an additional terminal for a second protective earthing conductor of the same cross-sectional area as the original protective earthing conductor,

OR

b) connection with an industrial connector according to IEC 60309 and a minimum protective earthing. Adequate strain relief shall be provided.

Marking for whole power drive system

DANGER: Where an isolating device is not intended to interrupt load current, a warning shall state: **DO NOT OPEN UNDER LOAD.**

The following requirements apply to any supply isolating device which does not disconnect all sources of power to the PDS (power drive system):

- ┆ If the isolating device is mounted in an equipment enclosure with the operating handle externally operable, a warning label shall be provided adjacent to the operating handle stating that it does not disconnect all power to the servo drive.
- ┆ Where a control circuit disconnecter can be confused with power circuit disconnecters due to size or location, a warning label shall be provided adjacent to the operating handle of the control circuit disconnecter stating that it does not disconnect all power to the servo drive.

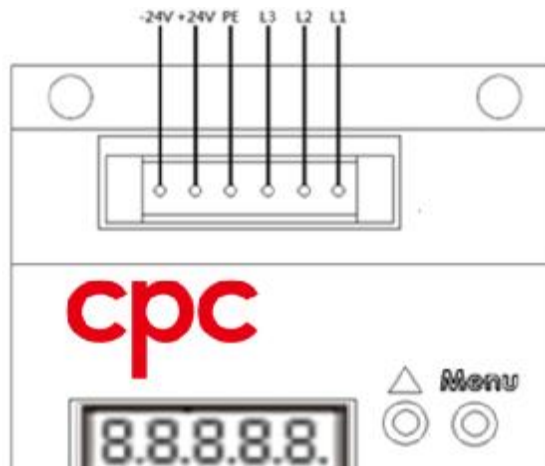
3.6. Driver Power Cable Wiring

The types of connectors used on the power port and the motor power port for the 8A-type and the 20A-type Will1 Drivers are different, see the chart here for further information:

Connector Type on Driver Side		8A-type Will1 Driver	20A-type Will1 Driver
Power Port(s)	AC Power In	6-pin 5.0mm pitch. (AC power and 24V DC power ports are arranged in one connector).	4-pin 7.62mm pitch. Vender/model used on driver: 【DINKLE ECH762VM-04P】 ; its matching connector: DINKLE EC762VM-04P.
	24 V DC Power In	Vender/model used on driver: 【DECA ME060-50006】 ; its matching connector: DECA MC101-50006	2-pin 5.0mm pitch (<u>without screw flange</u>). Vender/model used on driver: 【DECA ME300-50002】 ; its matching connector: DECA MC100-50002.
Motor Power Port		6-pin 5.0mm pitch. Vender/model used on driver: 【DECA ME060-50006】 ; its matching connector: DECA MC101-50006	6-pin 7.62mm pitch. Vender/model used on driver: 【DINKLE ECH762VM-06P】 ; its matching connector: DINKLE EC762VM-06P.

3.6.1. 8A-type Will1 Driver Power Cable Wiring

- Driver side connector: DECA ME060-50006



- Matching connector:

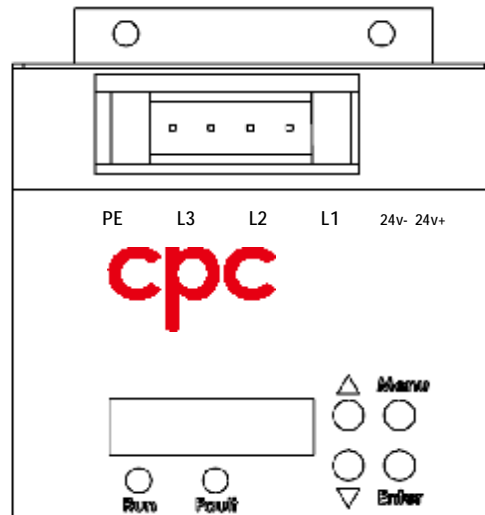


Vendor	Model number
DECA	MC101-50006

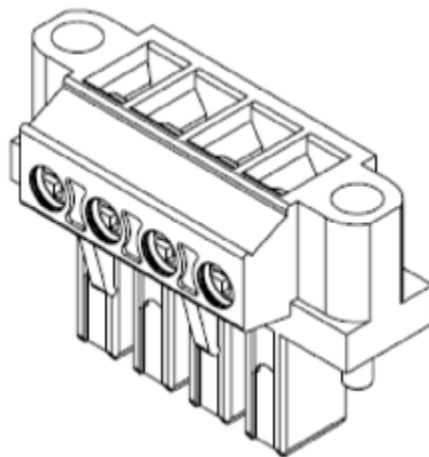
If screw flange is not needed, most 5.0mm pitch Eurostyle plug should match.

3.6.2. 20A-type Will1 Driver Power Cable Wiring

1. AC power port:
 - (1) Driver side connector: DINKLE ECH762VM-04P



- (2) Matching connector AC:



Vendor	Model number
DINKLE	EC762VM-04P

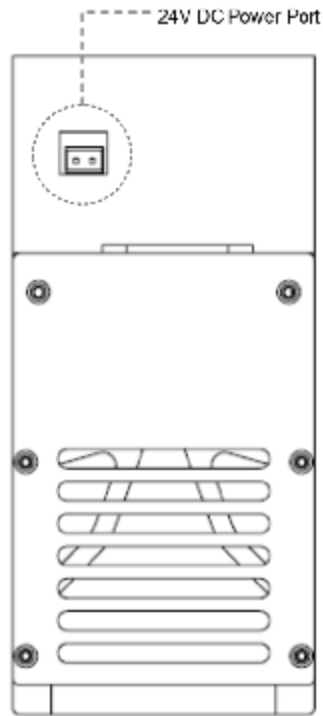
If screw flange is not needed, most 7.62mm pitch Eurostyle plug should match.

2. 24 V DC power port:

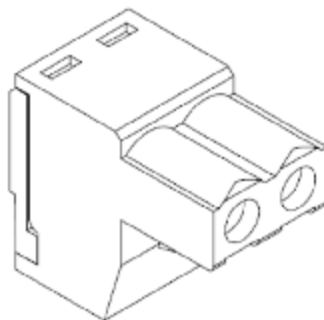
This port uses the connector of Eurostyle 2-pin 5.0 mm pitch.

(1) Driver side connector: DECA ME300-50002

Rear View of TC1-20/230
TC1-20/230



(2) Matching connector 24 V DC:

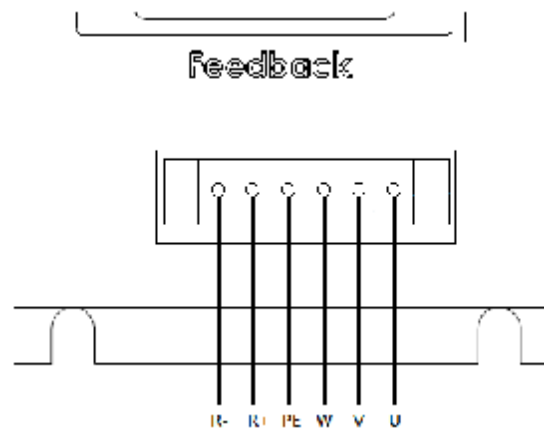


Vendor	Model number
DECA	MC100-50002

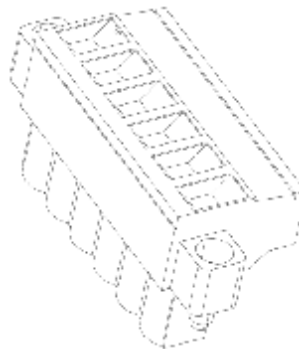
3.7. Motor Power Cable Wiring

Note that the 8A-type Will1 driver and the 20A-type Will1 driver use 5.0 mm pitch and 7.62 mm pitch of connector for motor power port/cable, respectively.

- i The vendor/model of the connector of motor power port:
 - (1) For 8A-type Will1 Driver: DECA ME060-50006.
 - (2) For 20A-type Will1 Driver: DINKLE ECH762VM-06P.



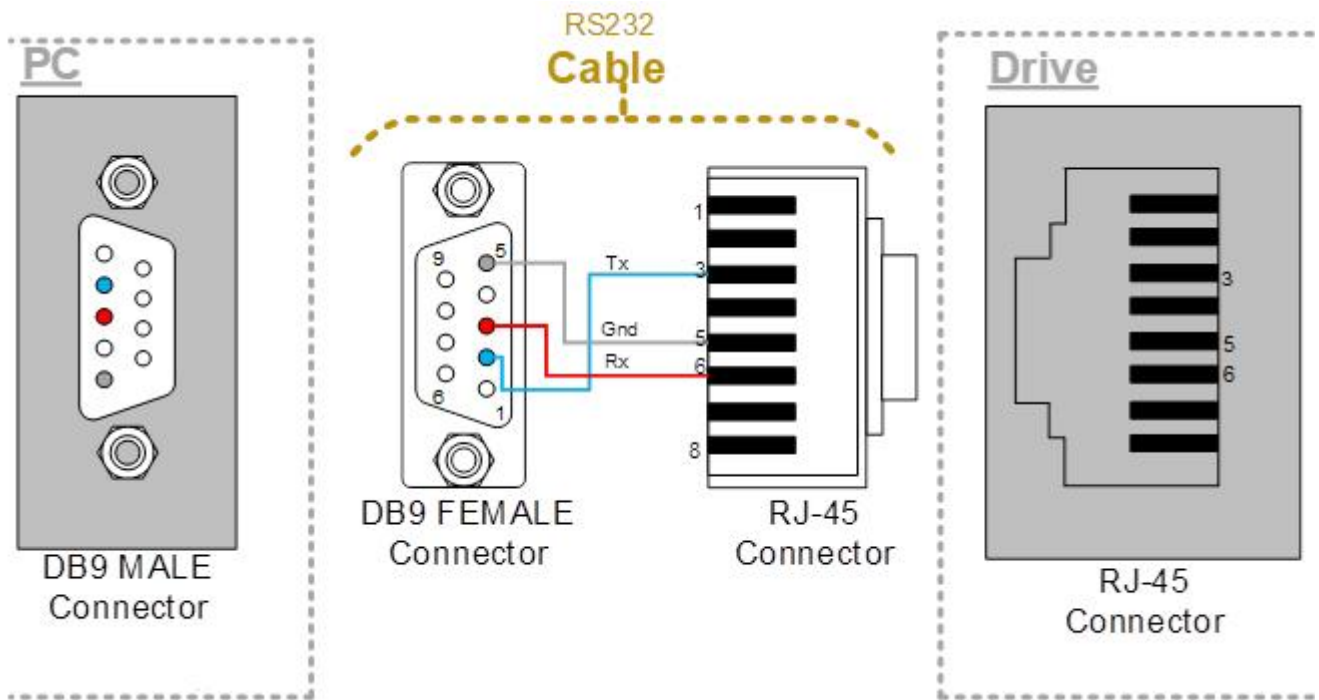
- i Matching connector:



Connector type of motor power <u>cable</u>	Vendor	Model number	Pitch
8A-type Will1 Driver	DECA	MC101-50006	5.0 mm
20A-type Will1 Driver	DINKLE	EC762VM-06P	7.62 mm

If screw flange is not needed, most Eurostyle plug should match.

3.8. Communication Cable Wiring



DB9 FEMALE connector of the cable

Pin#	Signal	Function
1	N/C	-
2	Tx	RS-232 transmit
3	Rx	RS-232 receive
4	N/C	-
5	GND	Ground
7, 8,9	N/C	-

RJ-45 connector of the cable

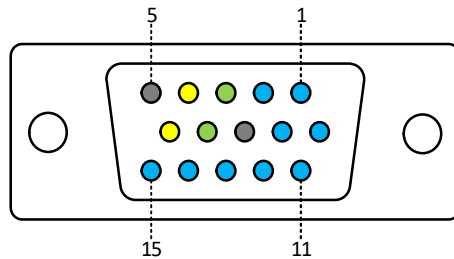
Pin#	Signal	Function
1, 2	N/C	-
3	Tx	RS-232 transmit
4	N/C	-
5	Gnd	Ground
6	Rx	RS-232 receive
7, 8	N/C	-

3.9. Digital I/O Cable Wiring

There are differences between the two versions of Will1 Driver. In the second version:

1. All digital output signals are open-collector type.
2. Pin #14 and #15 are revised to be signal ground. **See 3.9.2.**

3.9.1. Digital I/O Cable Wiring of the Will1 Driver—First Version

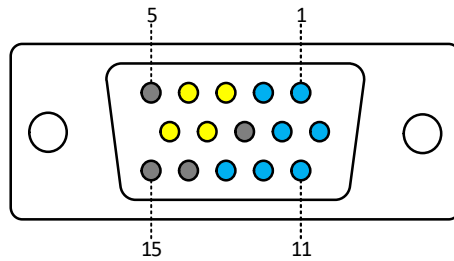


DB15 FEMALE connector of digital I/O port

Pin#	Signal	Digital I/O Function	Logic level
1	DI-A1	Input	5V TTL
2	DI-A3	Input	5V TTL
3	DO-A3	Output	5V TTL
4	DO-A1	Output	Open-collector
5	Gnd	Ground	-
6	DI-A0	Input	5V TTL
7	DI-A2	Input	5V TTL
8	Gnd	Ground	-
9	DO-A2	Output	5V TTL
10	DO-A0	Output	Open-collector
11	DI-A4	Input	5V TTL
12	DI-A5	Input	5V TTL
13	DI-A6	Input	5V TTL
14	DI-A7	Input	5V TTL
15	DI-A8	Input	5V TTL

- ※ Open-collector output rated maximum sink current: 500 mA.
- ※ 5V TTL output rated source current: 10 mA.

3.9.2. Digital I/O Cable Wiring of the Will1 Driver—Second Version



DB15 FEMALE connector of digital I/O port

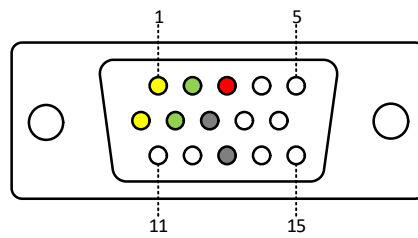
Pin#	Signal	Digital I/O Function	Logic level
1	DI-A1	Input	5V TTL
2	DI-A3	Input	5V TTL
3	DO-A3	Output	Open-collector
4	DO-A1	Output	Open-collector
5	Gnd	Ground	-
6	DI-A0	Input	5V TTL
7	DI-A2	Input	5V TTL
8	Gnd	Ground	-
9	DO-A2	Output	Open-collector
10	DO-A0	Output	Open-collector
11	DI-A4	Input	5V TTL
12	DI-A5	Input	5V TTL
13	DI-A6	Input	5V TTL
14	Gnd	Ground	-
15	Gnd	Ground	-

Open-collector rated maximum sink current:

DO-A0~A1 500 mA

DO-A2~A3 10 mA

3.10. Analog Cable Wiring



DB15 MALE connector

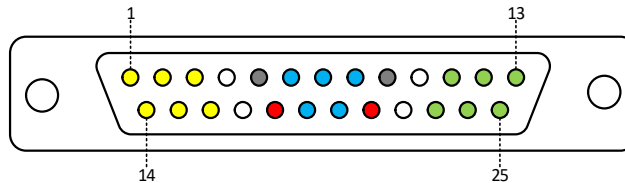
Pin#	Signal	Function
1	AI-0-	Analog Input 0 LOW Input
2	AI-1-	Analog Input 1 LOW Input
3	5V	5V supply output
4	N/C	-
5	N/C	-
6	AI-0+	Analog Input 0 HIGH Input
7	AI-1+	Analog Input 1 HIGH Input
8	Agnd	Analog ground
9	N/C	-
10	N/C	-
11	N/C	-
12	N/C	-
13	Agnd	Analog ground
14	N/C	-
15	N/C	-

3.11. Controller Cable Wiring

There are differences between the two versions of Will1 Driver.

The controller port of the second version includes 4 more output pins. **See 3.11.2.**

3.11.1. Controller Cable Wiring of the Will1 Driver—First Version

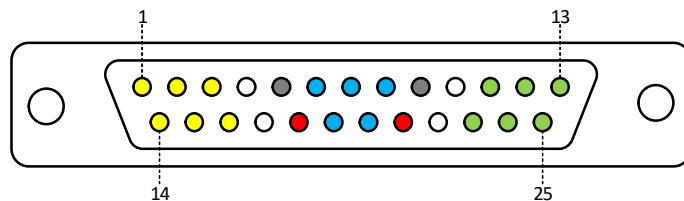


DB25 MALE connector of the driver

Pin#	Signal	Function		
		A/B/Z Mode	Step/Dir Mode	CW/CCW Mode
1	RA+	A+	STEP+	CW+
2	RB+	B+	DIR+	CCW+
3	RZ+	Z+	No connect	
4	N/C	-		
5	Gnd	Ground		
6	DI-C0	General purpose digital Input (Hall A)		
7	DI-C2	General purpose digital Input (Hall C)		
8	DI-C4	General purpose digital Input		
9	Gnd	Ground		
10	N/C	-		
11	OZ+	Buffered RZ/EZ signal HIGH output		
12	OB+	Buffered RB/EB signal HIGH output		
13	OA+	Buffered RA/EA signal HIGH output		
14	RA-	A-	STEP-	CW-
15	RB-	B-	DIR-	CCW-
16	RZ-	Z-	No connect	
17	N/C	-		
18	5V	5V supply output		
19	DI-C1	General purpose digital Input (Hall B)		
20	DI-C3	General purpose digital Input		
21	5V	5V supply output 5V		
22	N/C	-		
23	OZ-	Buffered RZ/EZ signal LOW output		
24	OB-	Buffered RB/EB signal LOW output		
25	OA-	Buffered RA/EA signal LOW output		

※ DI-C0~C2 can be used as motor hall sensor Input when hall source is set as Controller Port in GUI (Graphic User Interface).

3.11.2. Controller Cable Wiring of the Will1 Driver—Second Version

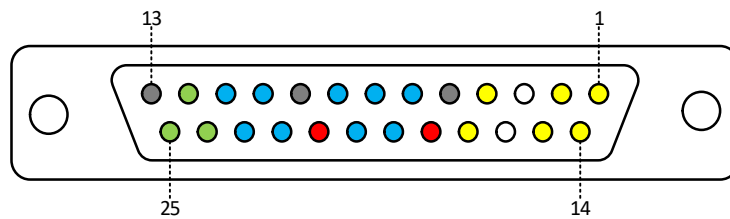


DB25 MALE connector of the driver

Pin#	Signal	Function		
		A/B/Z Mode	Step/Dir Mode	CW/CCW Mode
1	RA+	A+	STEP+	CW+
2	RB+	B+	DIR+	CCW+
3	RZ+	Z+	No connect	
4	DO-C0	General purpose digital output (Open-collector)		
5	Gnd	Ground		
6	DI-C0	General purpose digital Input		
7	DI-C2	General purpose digital Input (Hall A)		
8	DI-C4	General purpose digital input (Hall C)		
9	Gnd	Ground		
10	DO-C3	General purpose digital output (Open-collector)-		
11	OZ+	Buffered RZ/EZ signal HIGH output		
12	OB+	Buffered RB/EB signal HIGH output		
13	OA+	Buffered RA/EA signal HIGH output		
14	RA-	A-	STEP-	CW-
15	RB-	B-	DIR-	CCW-
16	RZ-	Z-	No connect	
17	DO-C1	General purpose digital output (Open-collector)-		
18	5V	5V supply output		
19	DI-C1	General purpose digital Input		
20	DI-C3	General purpose digital Input (Hall B)		
21	5V	5V supply output		
22	DO-C2	General purpose digital output (Open-collector)-		
23	OZ-	Buffered RZ/EZ signal LOW output		
24	OB-	Buffered RB/EB signal LOW output		
25	OA-	Buffered RA/EA signal LOW output		

- ※ DI-C2~C4 can be used as motor hall sensor Input when hall source is set as Controller Port in the Graphic User Interface (GUI).
- ※ Ox outputs (e.g., OZ+, OZ-, and OB+) can be set to provide a buffered copy of motor encoder feedback (Ex signals) for control device or of auxiliary reference (Rx signals) for next drive.
- ※ DO-C0~C3 Open-collector rated maximum sink current: 10 mA

3.12. Feedback Cable Wiring



DB25 FEMALE connector of the driver

Pin#	Signal	Function
1	EA+	Encoder A+
2	EB+	Encoder B+
3	N/C	-
4	EZ+	Encoder Index+
5	Gnd	Ground
6	DI-B0	General purpose digital Input
7	DI-B2	General purpose digital Input
8	DI-B4	General purpose digital Input
9	Gnd	Ground
10	DI-B6	General purpose digital Input
11	N/C	--
12	DI-B8	General purpose digital Input (Hall B)
13	Gnd	Ground
14	EA-	Encoder A-
15	EB-	Encoder B-
16	N/C	--
17	EZ-	Encoder Index-
18	5V	5V supply output
19	DI-B1	General purpose digital Input
20	DI-B3	General purpose digital Input
21	5V	5V supply output
22	DI-B5	General purpose digital Input
23	N/C	--
24	DI-B7	General purpose digital Input (Hall A)
25	DI-B9	General purpose digital Input (Hall C)

※ DI-B7~B9 can be used as motor hall sensor Input when hall source is set as **Feedback Port** in GUI (Graphic User Interface).

3.13. I/O Pin Electrical Characteristics

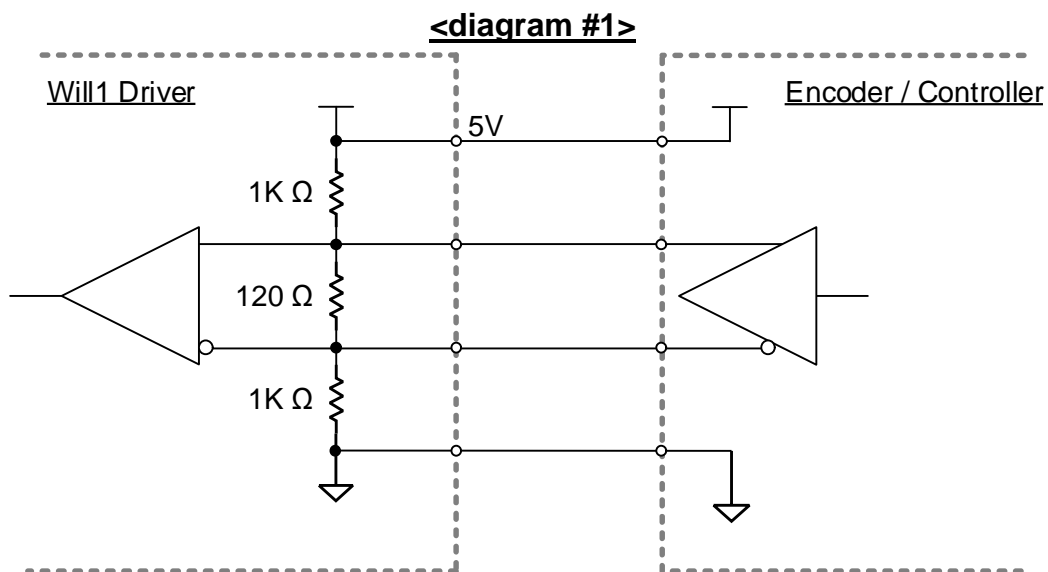
3.13.1. Differential Input Equivalent Circuit of Command and Feedback

As stated in point #4 in chapter 3.1.2, the circuit designs for the first version and the second version of Will1 Driver are different. Please see diagrams for wiring below.

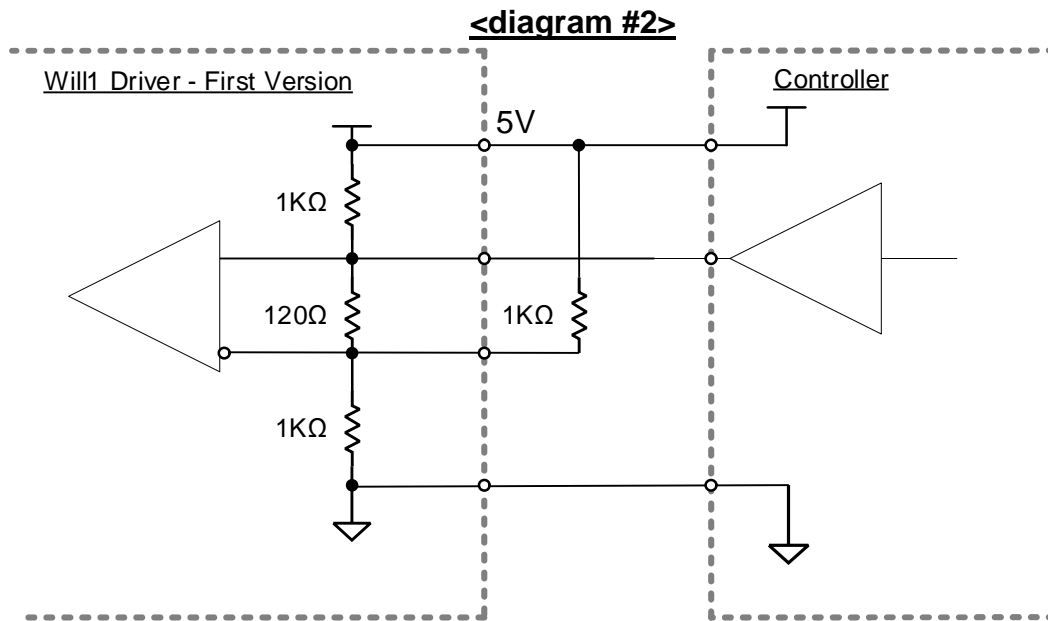
3.13.1.1 Differential Input Equivalent Circuit of the First Version of Will1 Driver.

Note:

- Diagram #1 is applicable to:
 - (1) control and feedback signals for the First Version of Will1 Driver, and also to
 - (2) feedback signals for the Second Version of Will1 Driver.



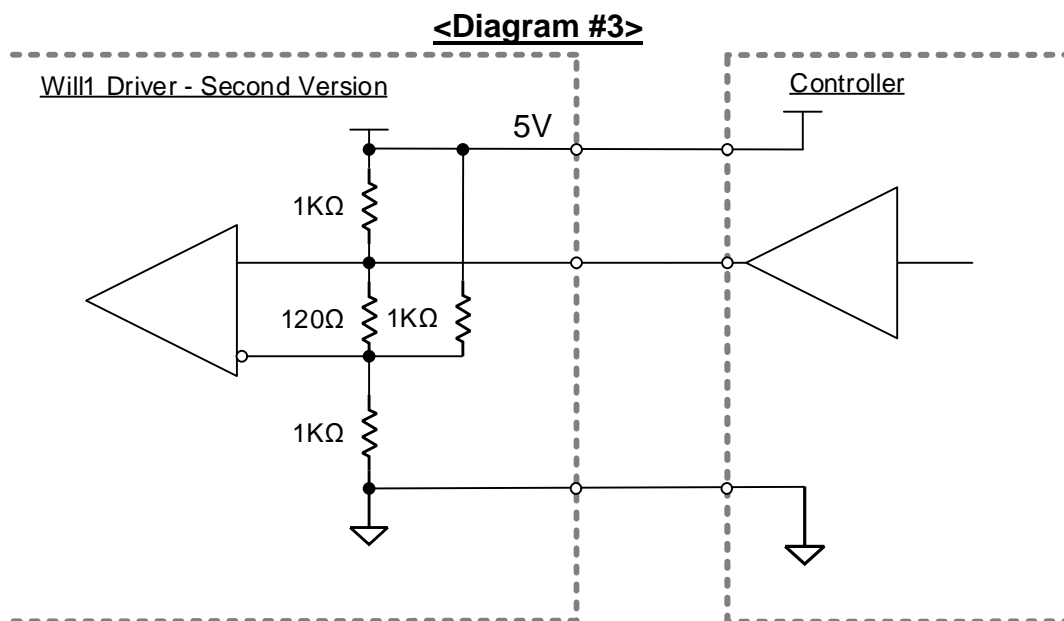
- When connecting the Will1 driver—First Version with other devices which send out **single-ended signals**, please wire in the same way as shown in diagram #2 below:



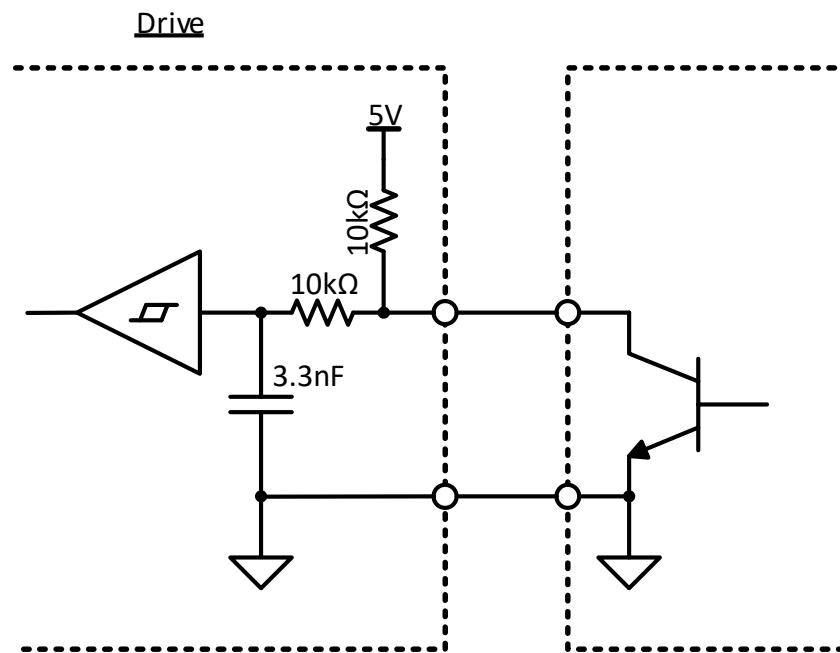
3.13.1.2 Differential Input Equivalent Circuit of the Second Version of Will1 Driver.

Note:

This diagram #3 is applicable to the control signals for Second Version of Will1 Driver.



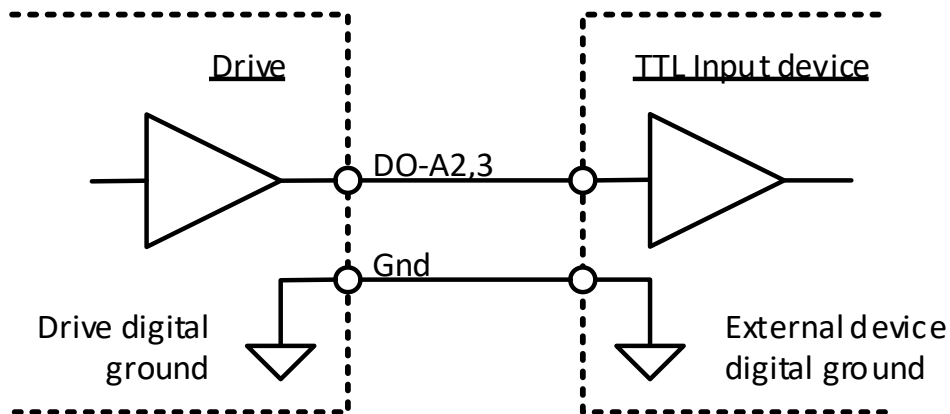
3.13.2. Digital Input (5V TTL)

**IMPORTANT:**

1. Input voltage cannot exceed 5 V.
2. Do NOT use PNP type output.

3.13.3 Digital Output (5V TTL)

Applicable only for first version of Will1 driver.



Note:

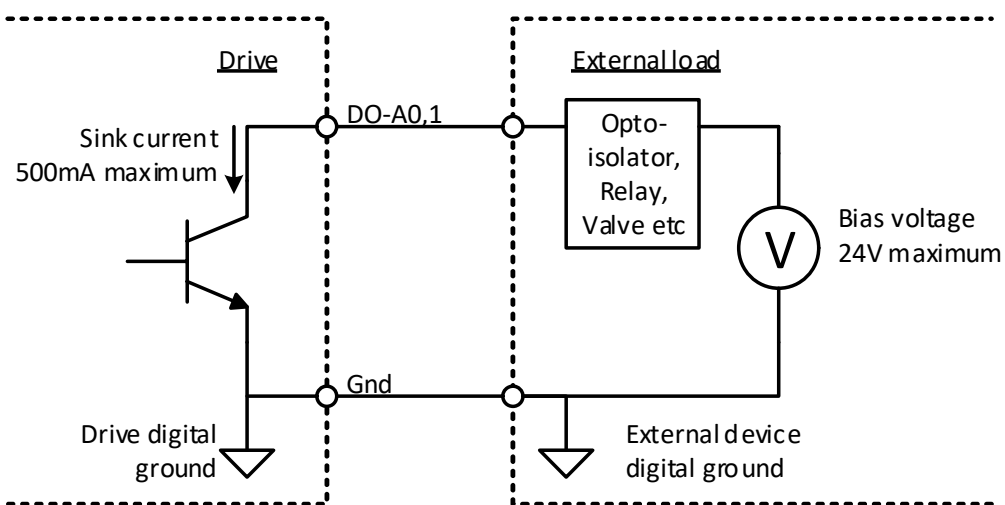
- | Only the first version of Will1 driver has the 5V TTL type of digital output.
- | Digital output type(s) used on **First** version of Will1 Driver: **5V TTL** and **Open-collector**;
Digital output type(s) used on **Second** version of Will1 Driver: **Open-collector** (with and without pull-up resistor).

3.13.4 Digital Output (Open-collector)

Note:

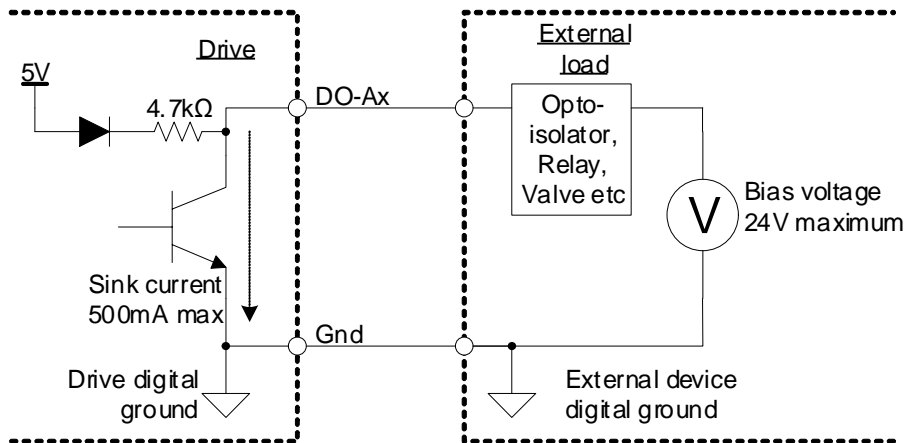
- | There are differences between the two versions of Will1 Driver. In the second version, **most** of the circuit designs for open-collector digital outputs (i.e., DO-A0, DO-A1, DO-A2, and DO-A3) are revised to include pull-up resistor.
- | 4 8A-type Will1 Driver—First Version è See 3.13.4.1.
- | 4 8A-type Will1 Driver—Second Version, or Will1-20/230 è See 3.13.4.2.

3.13.4.1. Digital Output(Open-Collector) of the Will1 Driver—First Version

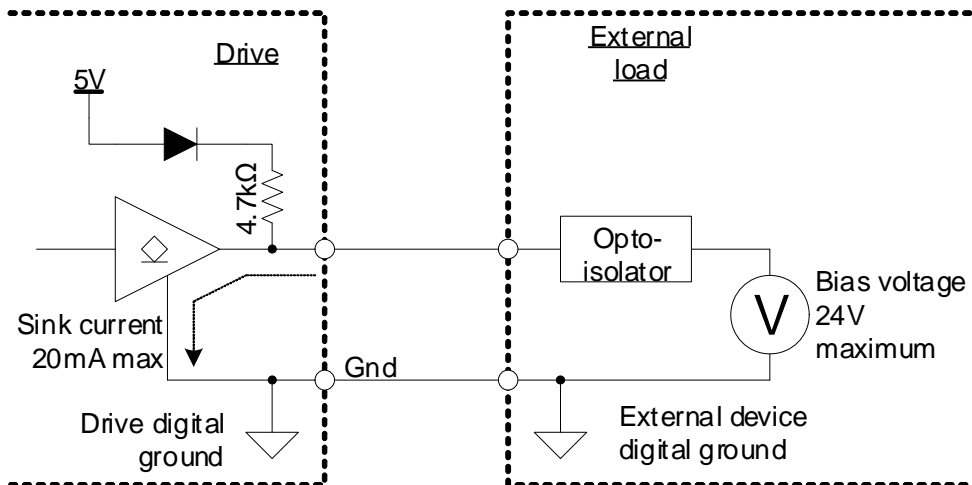


3.13.4.2. Digital Output(Open-Collector) of the Will1 Driver—Second Version

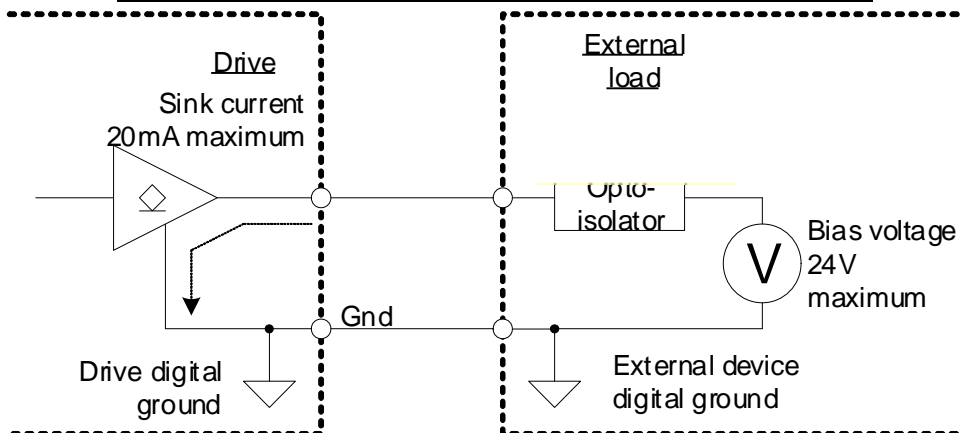
High current type (DO-A0, DO-A1)



Low current type (DO-A2~A3)



Low current type without internal pull-up (DO-C0~C3)

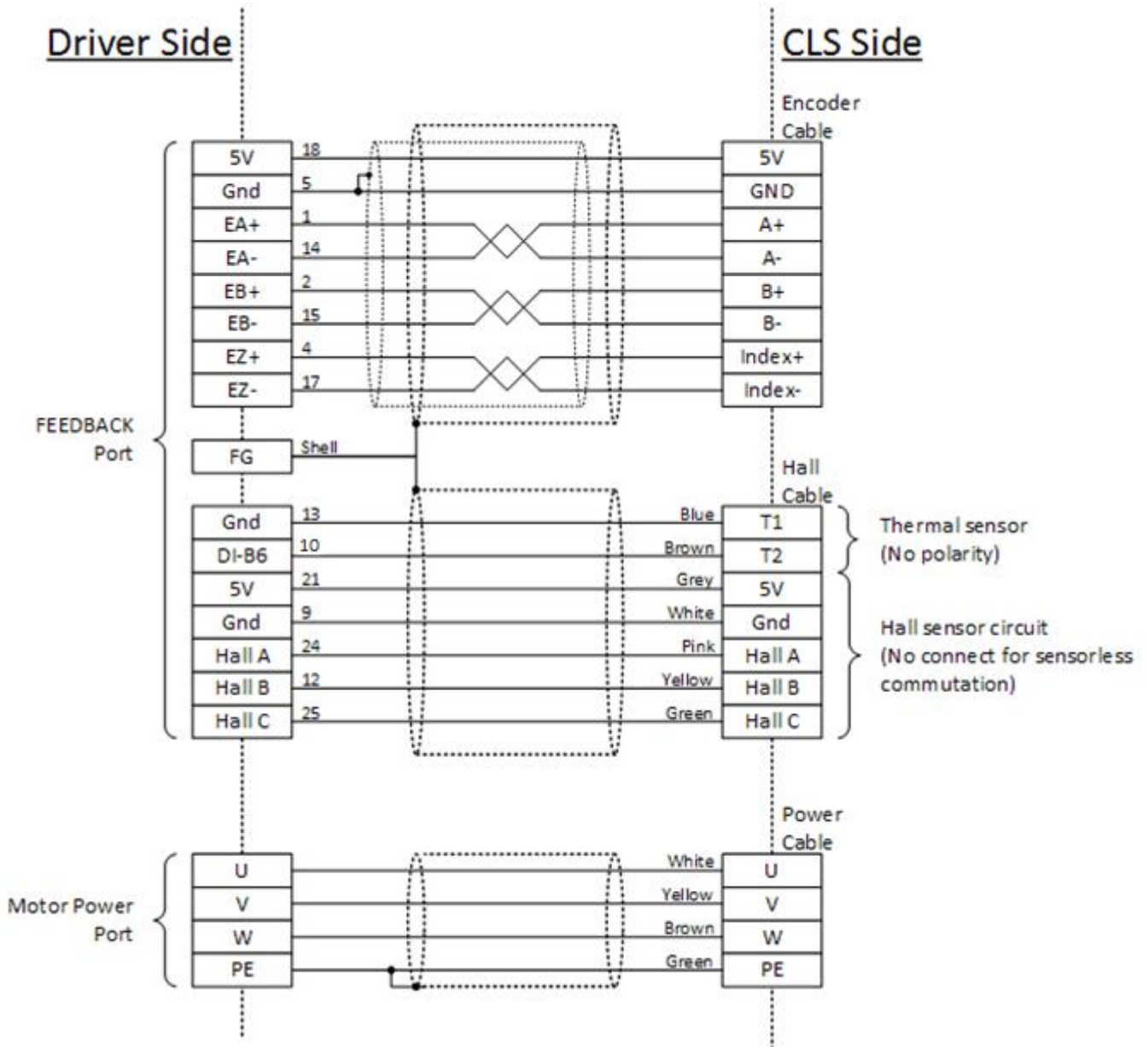


3.14. Connection Example

Note:

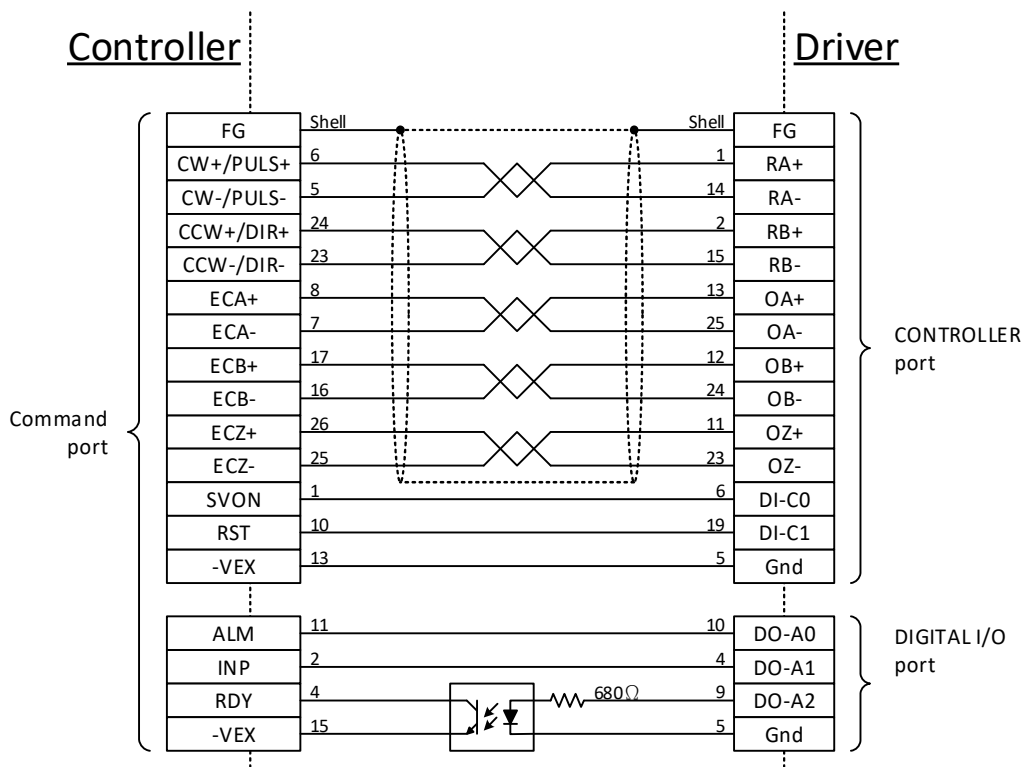
The connection examples given in this chapter are NOT applicable for version 2.1 of Noise Filter Board.

3.14.1. CLS Linear Stage



*Not applicable for version 2.1 of Noise Filter Board.

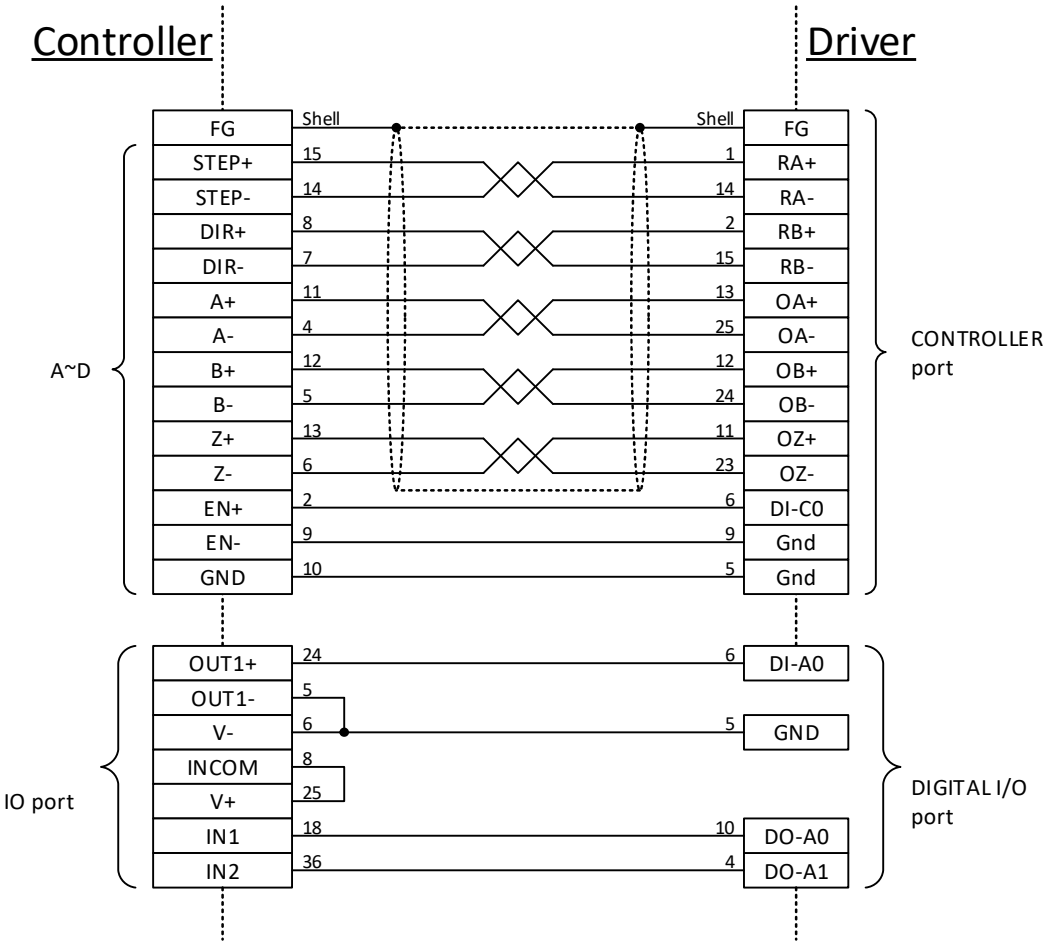
3.14.2. ADVANTECHADAM-3956



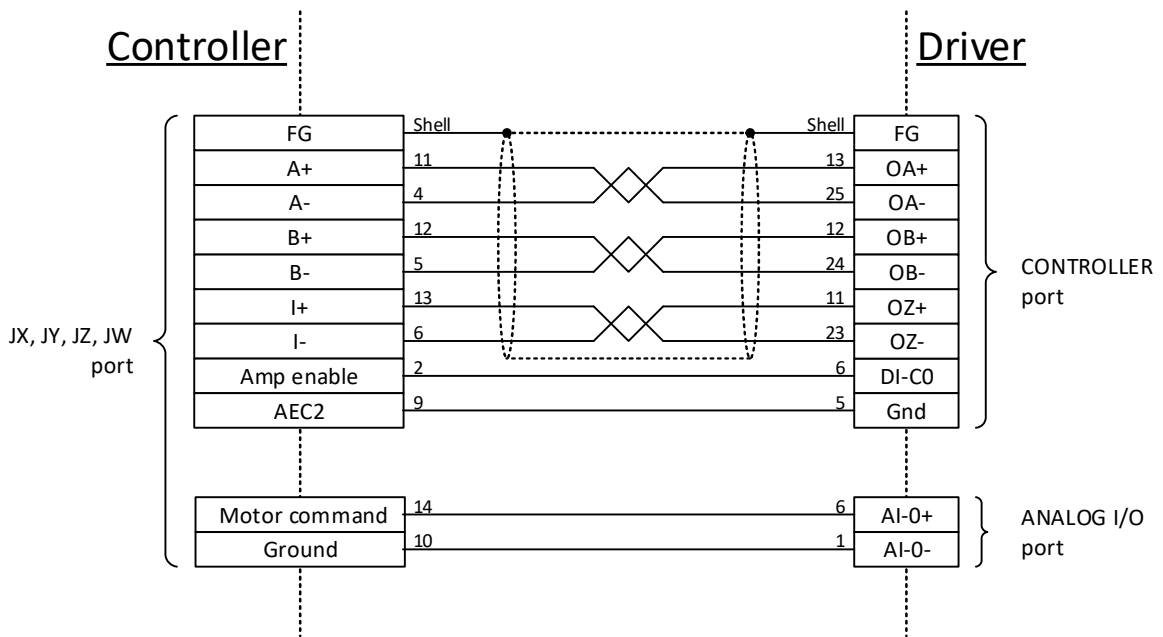
***Not applicable for version 2.1 of Noise Filter Board.**

- ※ It is assumed that 24 V supply is provided through other ports on the controller side.
- ※ Because DO-A2 is TTL output, an external conversion into open-collector output is required. Possible options of external conversion include external transistors (2222A or equivalent) and opto-isolators (SHARP PC817 or equivalent).
- ※ The connection example above is pin-to-pin compatible to ADLINK DIN-825-GP4.

3.14.3. GALIL DMC-B140-M

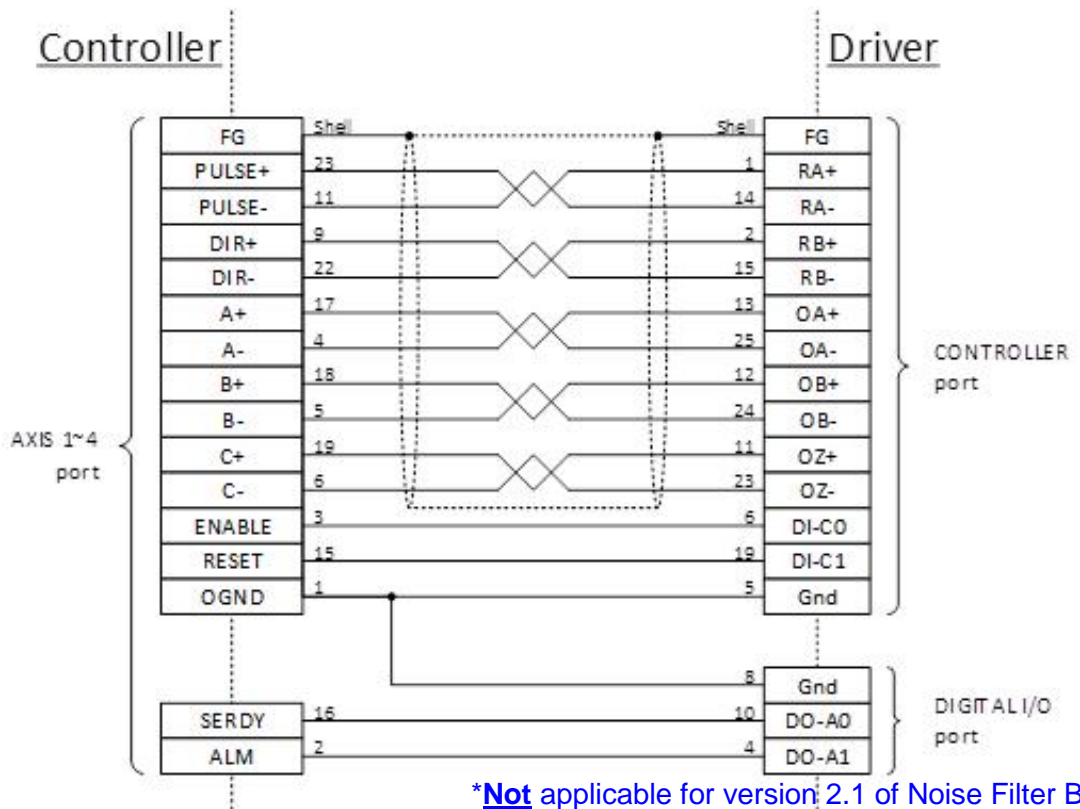


3.14.4. GALIL-IMC20105IG



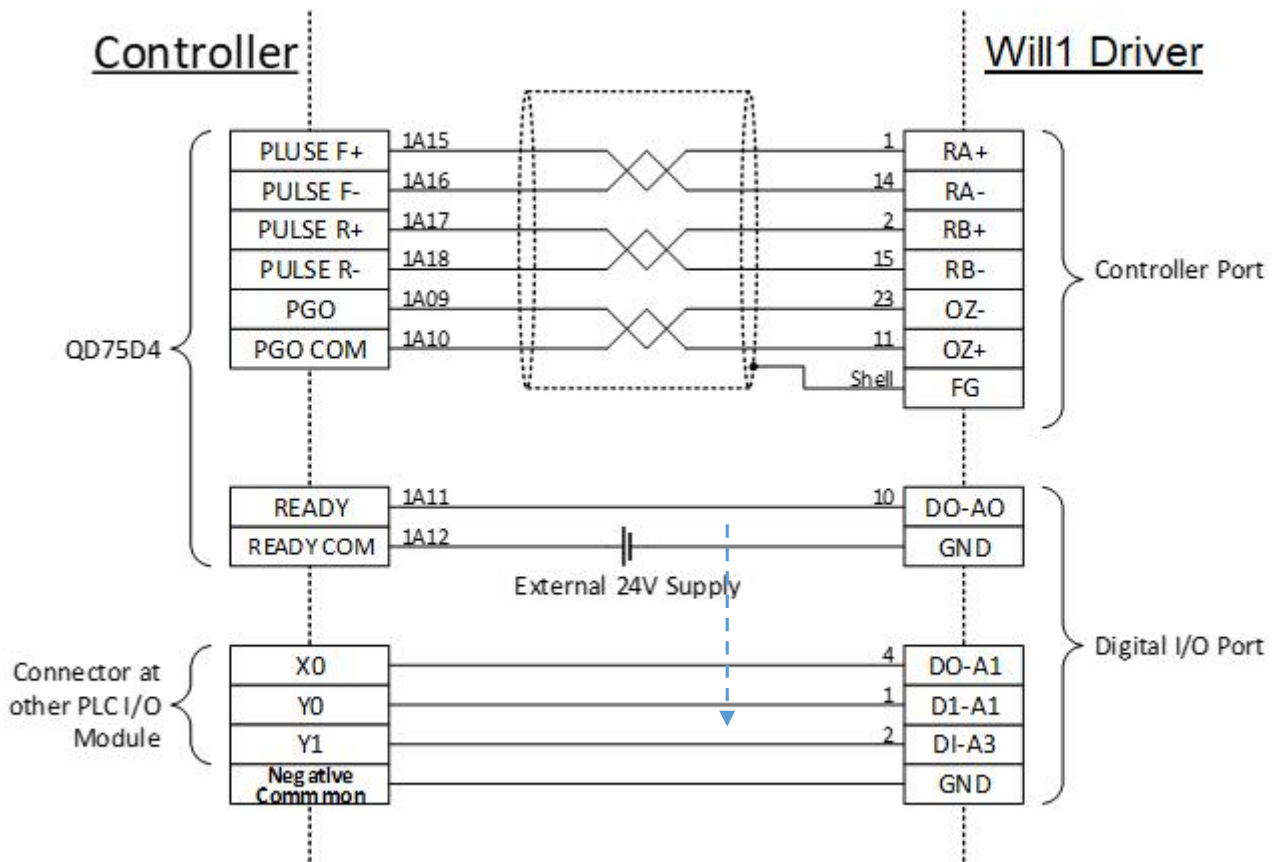
***Not** applicable for version 2.1 of Noise Filter Board.

3.14.5. Googoltech-GT2-400-ACC2 (V2.4)



***Not** applicable for version 2.1 of Noise Filter Board.

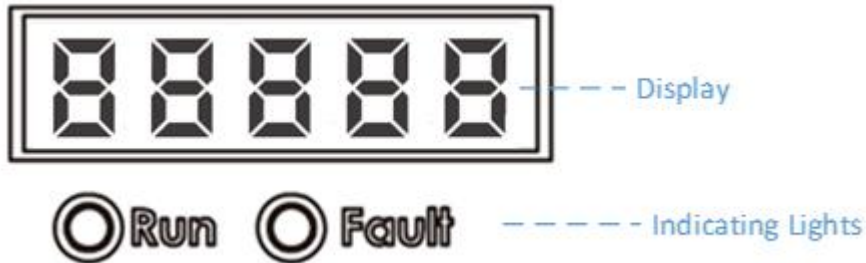
3.14.6. MITSUBISHI QD75D4



***Not** applicable for version 2.1 of Noise Filter Board.

4. Control Panel

4.1. Display and Indicating Lights



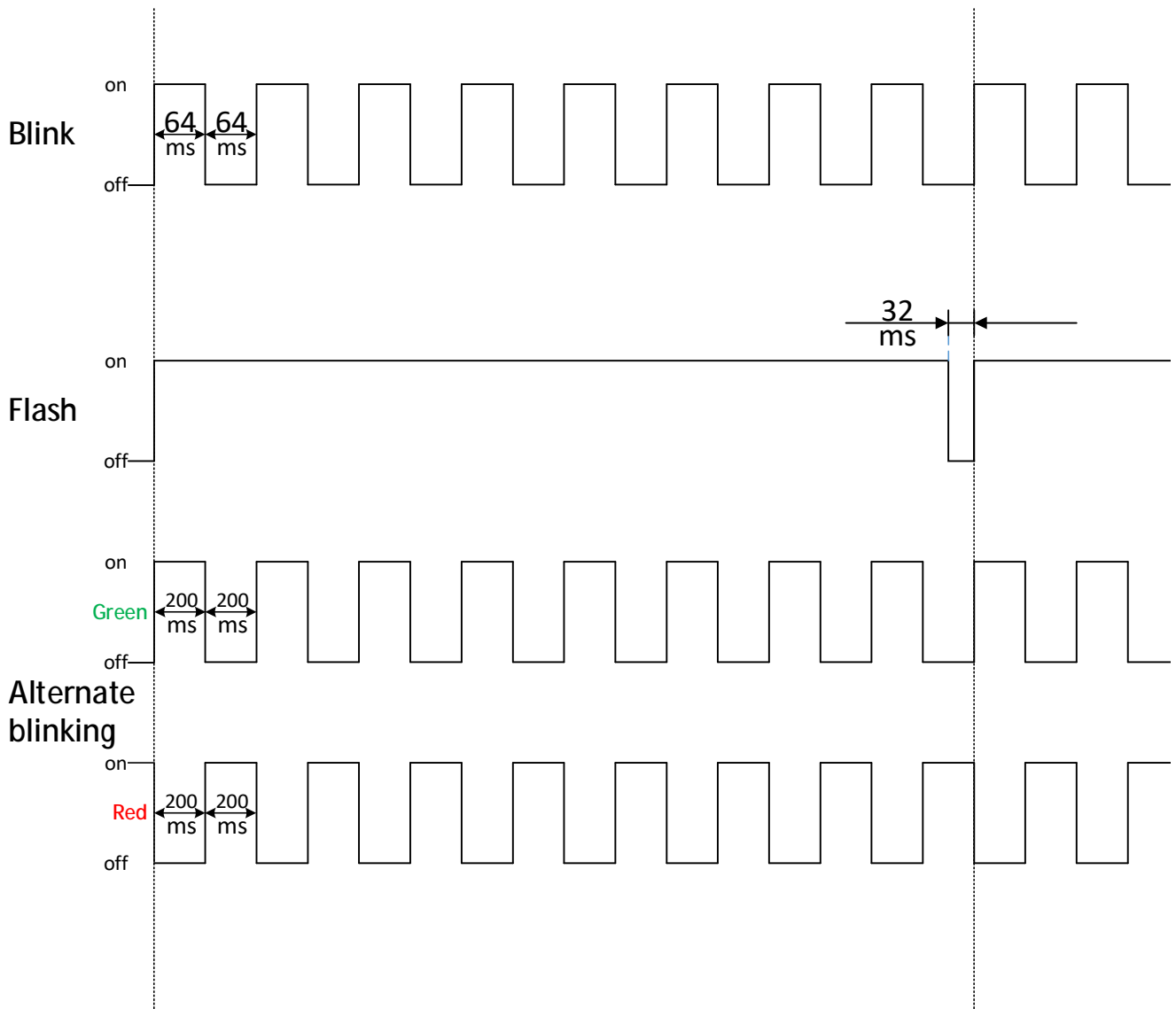
4.1.1. Driver Indicator states and flash rates

When observing the driver indicating lights, check the green light first and then the red light.

While the indicating light keeps turning on and off, there are three possible states: **blink**, **flash** or **alternate blinking**.

- | **Blink:**
The light is on for 64 ms and off for 64 ms.
- | **Flash:**
The light is on for 480 ms and off for 32 ms.
- | **Alternate blinking:**
The green light and red light are taking turns to be on for 200ms and off for 200 ms.

< Flash Rates of Driver Indicating Light >



4.1.2. Meanings of Driver Indicating Lights





Green (Run)	Red (Fault)	Description
Off	Off	Power off
	Blink	Fault active
	On	Fault (to be reset)
On	Off	Stand by
	On	Motor is off, waiting for external enable
Blink	Off	Motor is on
	Flash	Executing phase find or waiting for delay time (see note)
Flash	Off	Motor is off, and dynamic brake is active.
	Blink	Fault condition is active and dynamic brake is active.
	Flash	Motor is off, waiting for external enable, and dynamic brake is active.
	On	Fault (to be reset), and dynamic brake is active. (reset)
Green/Red Alternate Blinking		Parameter is being saved to flash.

Note:

Motors activation delay time is 100 ms.

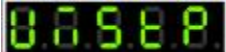












4.2. Buttons and Status Display

Buttons

Item	Description
	Switch data source
	Switch data source
<p data-bbox="240 801 357 846">Menu</p> 	None
 <p data-bbox="240 1081 347 1126">Enter</p>	None

~~

Status Display

Data Source	Description	Unit
	Script Step Number	
	Current Auxiliary Command	0.1 A
	Current Reference	0.1 A
	Current Feedback	0.1 A
	Velocity Auxiliary Command	cnt/s/1000
	Velocity Reference	cnt/s/1000
	Velocity Feedback	cnt/s/1000
	Position Auxiliary Command	cnt/1000
	Position Reference	cnt/1000
	Position Feedback (Default)	cnt/1000
	Position Error	cnt
	cpc internal use only	
		

5. Maintenance

5.1. General

DANGER:

To prevent electric shock, disconnect the power supply before maintenance.

CAUTION:

Any excessive adjustment could lead to a hazardous state of the servo drive.

Do not open this device for any inspection or maintenance. Contact service center for any of the servicing.

When the Will1 driver has an error, such as having over temperature, exceeding protection threshold, incorrect wiring, or having difficulty accessing signal, etc., the error log function will record the timing and the code of errors when errors occur. If the Will1 driver is shut down due to errors, users can trace the causes according the error log.

When the Will1 driver detects multiple errors, its display will show the code of the last-found error. The rest of the errors need to be checked via GUI interface.

5.2. Troubleshooting

Error Code	Error Message	Description	Action Required
2220	ContinuousOverCurrent_DeviceInternal	Drivers internal power stage is short	Check for unstable current loop gain
2310	ContinuousOverCurrent_MotorSide	Motor current exceeds limit	Check for unstable current loop gain
E3210	DCLinkOverVoltage	Internal DC capacitor over 375V.	Consider adding additional regenerative braking resistor.
3220	DCLinkUnderVoltage	Internal DC capacitor under 48V	Check high voltage supply AC
4310	ExcessTemperatureDrive	Drivers internal temperature over safe limit	Improve environment cooling condition
5520	ROM_EPROM	Factory calibration lost	Contact Customer Service
5530	EEPROM	Stored user parameters lost	Reload driver setting from file
7121	MotorBlocked	Motor stuck triggered	Check slide and guide or motor stuck setting
7122	MotorErrorOrCommutationMalfunc	Something wrong during phase find.	1. Check motor wiring, and 2. Execute phase find again.
7305	IncrementalSensor1Fault	Encoder feedback signal error	Check encoder wiring or improve system noise
7306	IncrementalSensor2Fault	Auxiliary encoder signal transition error	Check controller wiring or improve system noise

Error Code	Error Message	Description	Action Required
8481	OverVelocityAbsolute	Motor velocity feedback over velocity protection limit	Check motor operation or over-velocity protection setting
8611	FollowingError	Motor position error satisfy the condition of following error.	Check 1. Motor operation and 2. The setting of Following Error Window/Timeout.
8682	PositionLimitMinimum	Motor position feedback over position protection limit	Check motor operation or over-position protection setting
8683	PositionLimitMaximum	Motor position feedback under position protection limit	Check motor operation or under-position protection setting
90F0	ExternalAlarmDigitalInput	External alarm triggered	Check controller operation
FF01	<i>MainISROverload</i>	CPU overload.	Contact Customer Service.
FF02	CurrentSensorU	Motor current sensor error	Reboot driver
FF03	CurrentSensorV	Motor current sensor error	Reboot driver
FF05	HallSensorCodeInvalid	Invalid hall sensor code detected	Check hall sensor configuration
FF07	MotorCtrlOpModeInvalid	The code of Operation Mode is invalid	Check Operating Mode and wiring.
FF08	CommutationRequired	Attempting to activate motor without performing phase find first	1. Check phase find setting. 2. Execute phase find again.

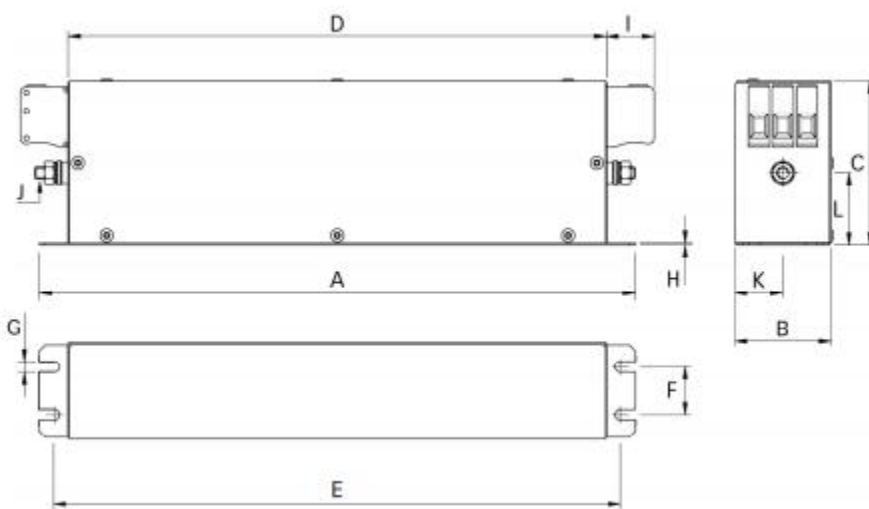
6. Optional Accessories and Assembly

6.1. AC Power Filter

1. Optional accessory of AC power filter made by SCHAFFNER. See information of matching model below:

- (1) 8A-type Will1 Driver: Uses SCHAFFNER FN3258-7-45 (7 Amperes).
- (2) 20A-type Will1 Driver: Uses SCHAFFNER FN3258-16-45 (16 Amperes).

2. Dimensions of AC Power Filter



Dimensions

	7 A	16 A
A	190	250
B	40	45
C	70	70
D	160	220
E	180	235
F	20	25
G	4.5	5.4
H	1	1
I	22	22
J	M5	M5
K	20	22.5
L2	29.5	29.5

All dimensions in mm; 1 inch = 25.4 mm

Unit: mm

*For further information about AC power filter please visit official website of SCHAFFNER.

6.2. Noise Filter Board (for Will1 Driver)

6.2.1 General

Noise Filter Board (**NF Board**) helps to shield off the noise from signal cables. Please insert Noise Filter Boards to the corresponding ports respectively.

Note:

1. There are two versions of NF Board for cpc Will1 driver: Version 1.0 and Version 2.1.
2. The differences between the two versions are:
 - (1) Pinout design: see chapter **6.2.2.4** and **6.2.3.4**.
 - (2) Electrical circuit design: see chapter **6.2.2.5** and **6.2.3.5**.
 - (3) NF Board version 2.1 contains an additional “NF Board for Digital I/O” which version 1.0 doesn’t have. Version 2.1 of NF Board for Controller is connected with this NF Board for Digital I/O through a wire, see chapter **6.2.3.1** (appearance).
3. For **version 2.1** of NF Board, the pinout allocation will be altered once NF Board is installed onto cpc Will1 driver. Please pay attention when wiring with digital I/O, controller, and feedback ports. See detailed information in chapter **6.2.3.4**.

The following aspects of NF Board will be elaborated in the following chapters:

- | Appearance
- | Dimensions (stand alone and after assembly)
- | Assembly direction and steps
- | Pinout design
- | Electrical circuit design

The dimensions mentioned hereafter are in mm.

6.2.2. Noise Filter Board—Version 1.0

6.2.2.1. Appearance

There are:

- (1) Noise Filter Board for Controller (Version 1.0);
- (2) Noise Filter Board for Feedback (Version 1.0)

- i Noise Filter Board for Controller (Version 1.0)

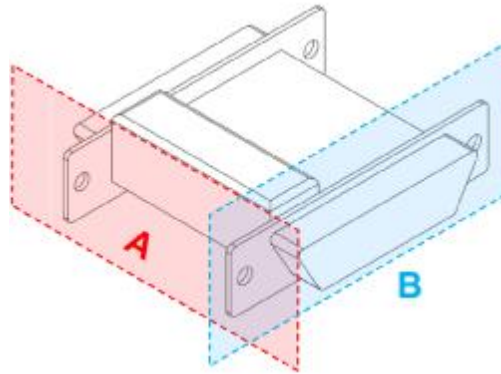


- i Noise Filter Board for Feedback (Version 1.0)



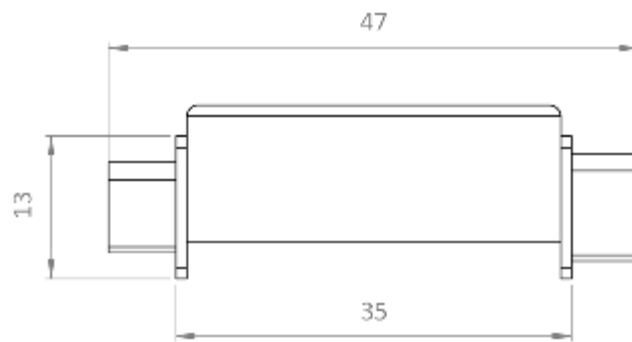
6.2.2.2. Dimensions

I Noise Filter Board for Controller and Feedback (Version 1.0)



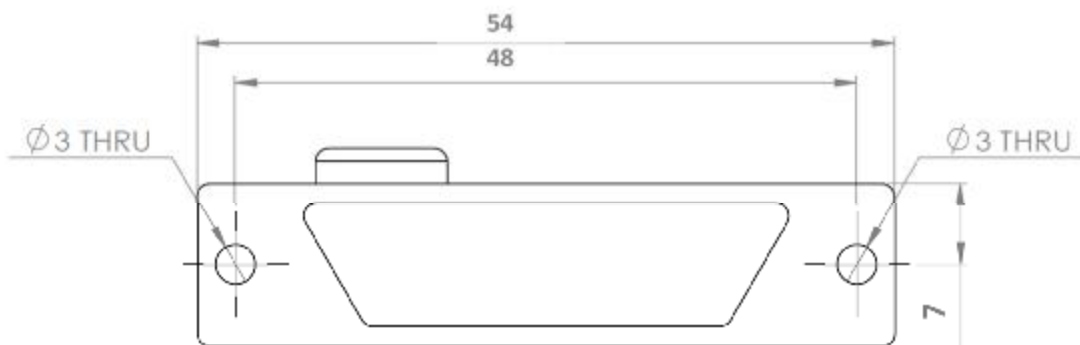
Noise Filter Board for Controller/Feedback (Version 1.0)

A side:

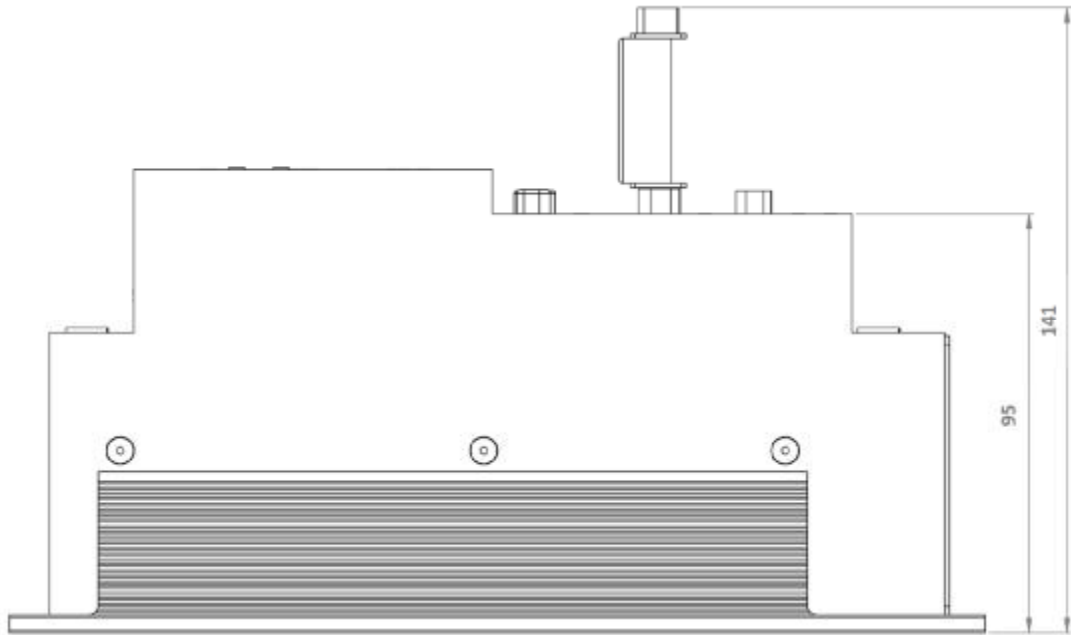


Unit: mm

B side:

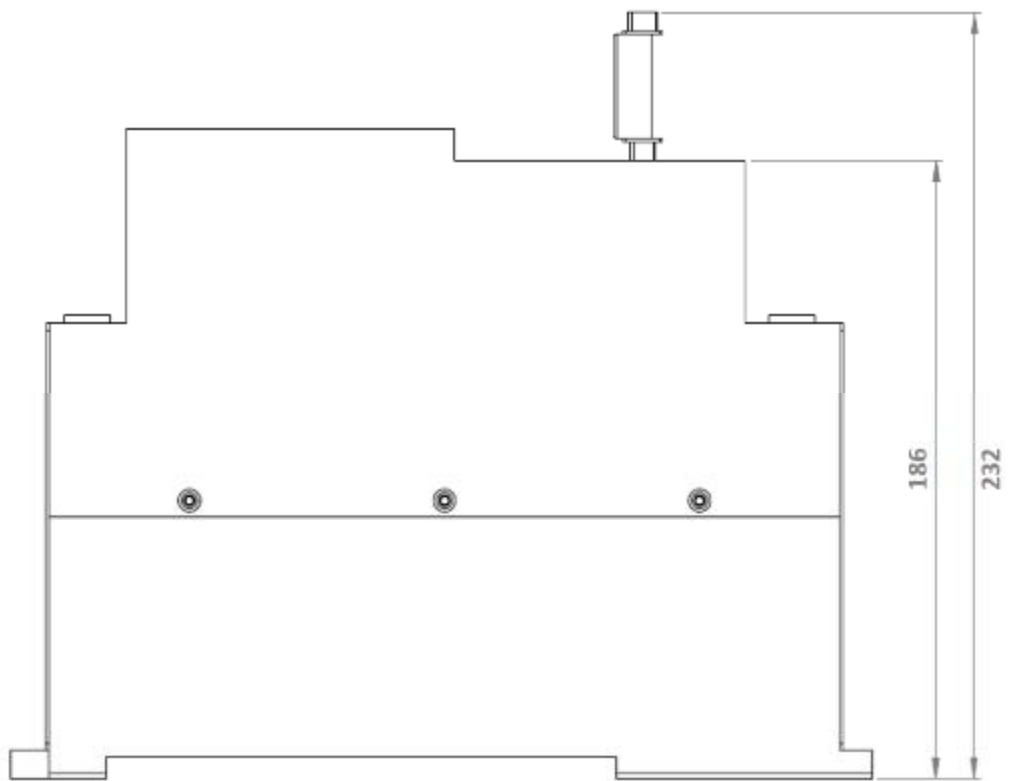


- I Driver equipped with Noise Filter Board (Version 1.0)
 - ø 8A-type Will1 Driver with NF Board



Unit: mm

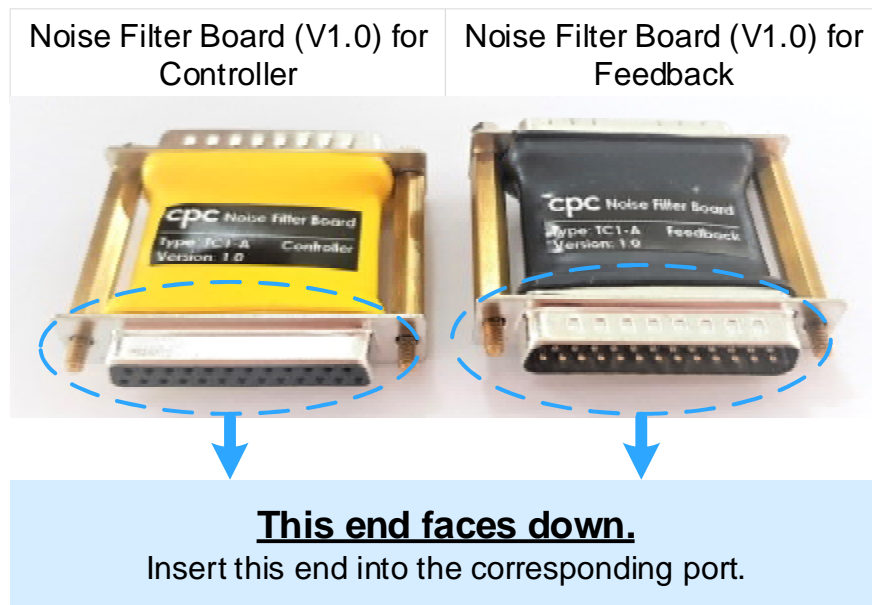
- ø 20A-type Will1 Driver with NF Board



Unit: mm

6.2.2.3. Assembly Direction and Steps

- | When assembling, pay attention to the correct direction.



- | Assembly steps (for Feedback)
 - (1) Loosen the small screws on the top of NF Board.
 - (2) Insert NF Board (for Feedback) into the Feedback port and tighten the hexagonal copper pillars at the same time.
 - (3) Tighten the small screws on the top of NF Board.
 - (4) Connect with signal cable.

6.2.2.4. Pinout Design

The pinout designs are as described in cpc Will1 Driver—Second version.

- | Controller cable wiring: same as chapter 3.11.2.
- | Digital I/O cable wiring: same as chapter 3.9.2.
- | Feedback cable wiring: same as chapter 3.12.

6.2.2.5. Electrical Circuit Design

Please see previous sections in chapter 13.3.

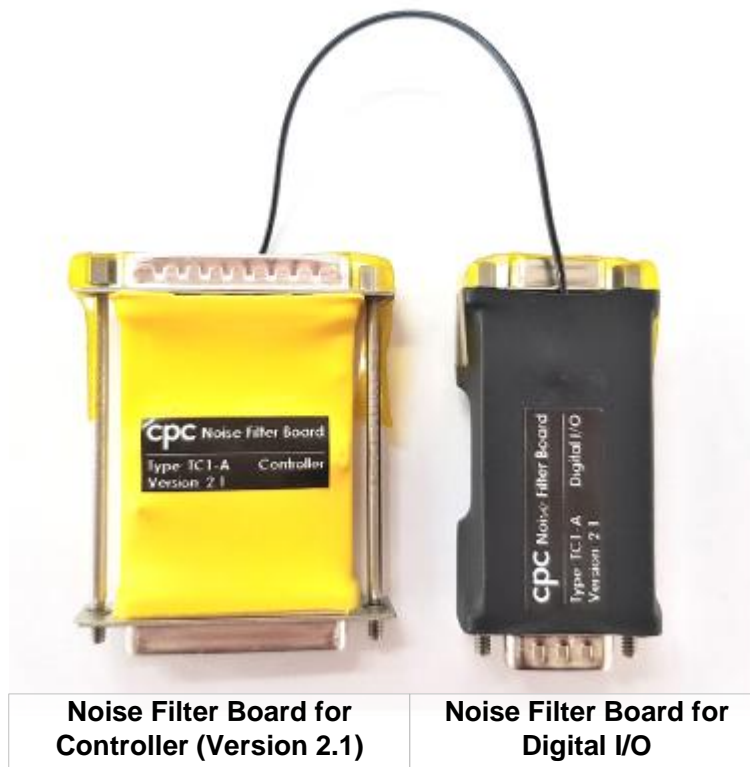
6.2.3. Noise Filter Board—Version 2.1

6.2.3.1. Appearance

There are:

- (1) Noise Filter Board for Controller (Version 2.1), which is connected with (2);
- (2) Noise Filter Board for Digital I/O;
- (3) Noise Filter Board for Feedback (Version 2.1)

- l Noise Filter Board for Controller (Version 2.1) and for Digital I/O



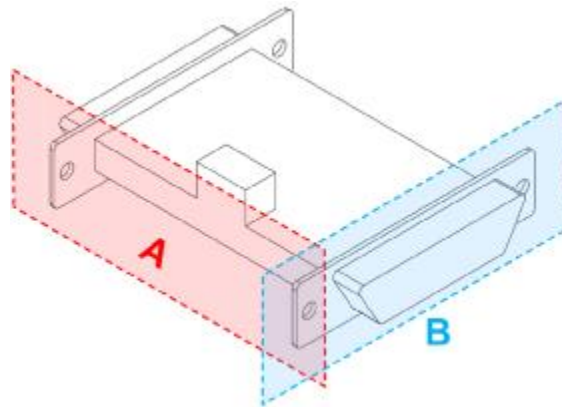
- l Noise Filter Board for Feedback (Version 2.1)



6.2.3.2. Dimensions

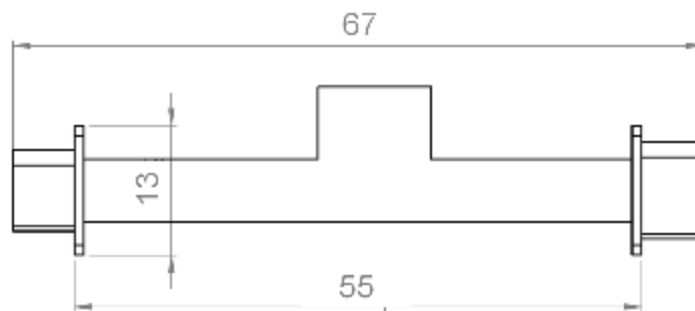
I Noise Filter Boards for Controller, Digital I/O, and Feedback

ø NF Board for Controller and Feedback



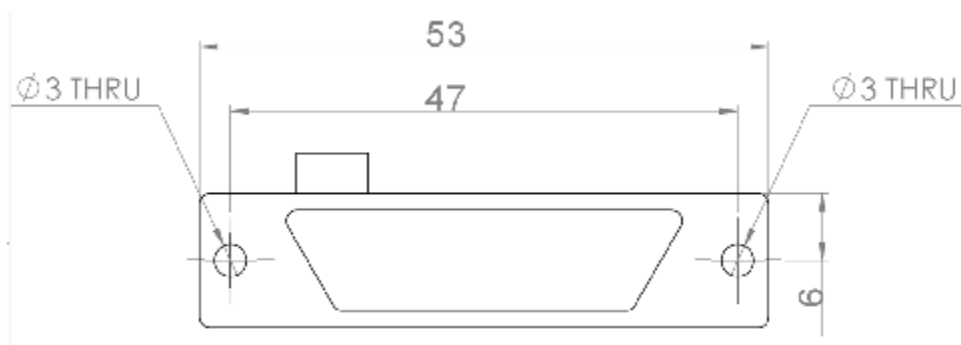
Noise Filter Board for Controller/Feedback (Version 2.1)

A side: A



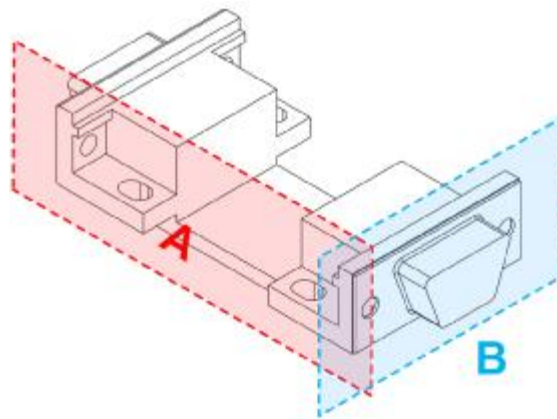
Unit: mm

B side: B



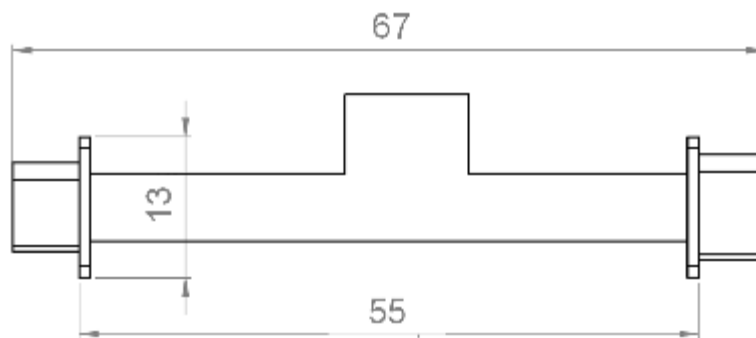
Unit: mm

ø NF Board for Digital I/O



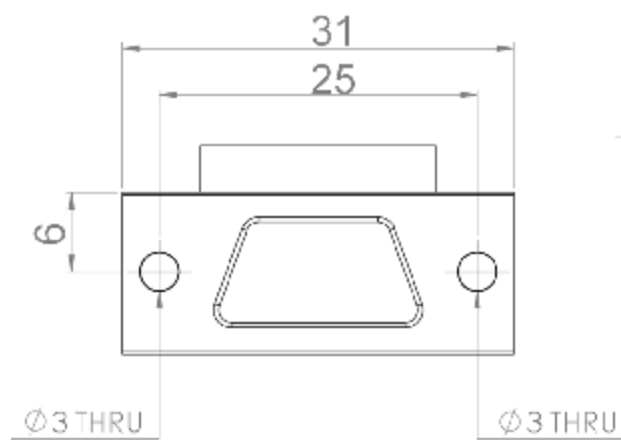
Noise Filter Board for Digital I/O (Version 2.1)

A side:



Unit: mm

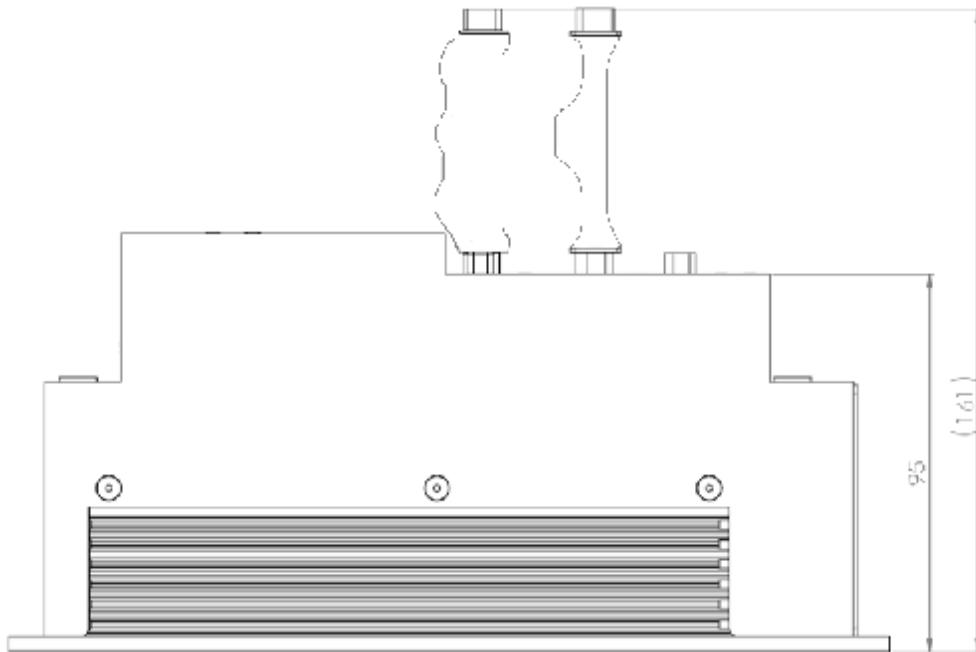
B side:



Unit: mm

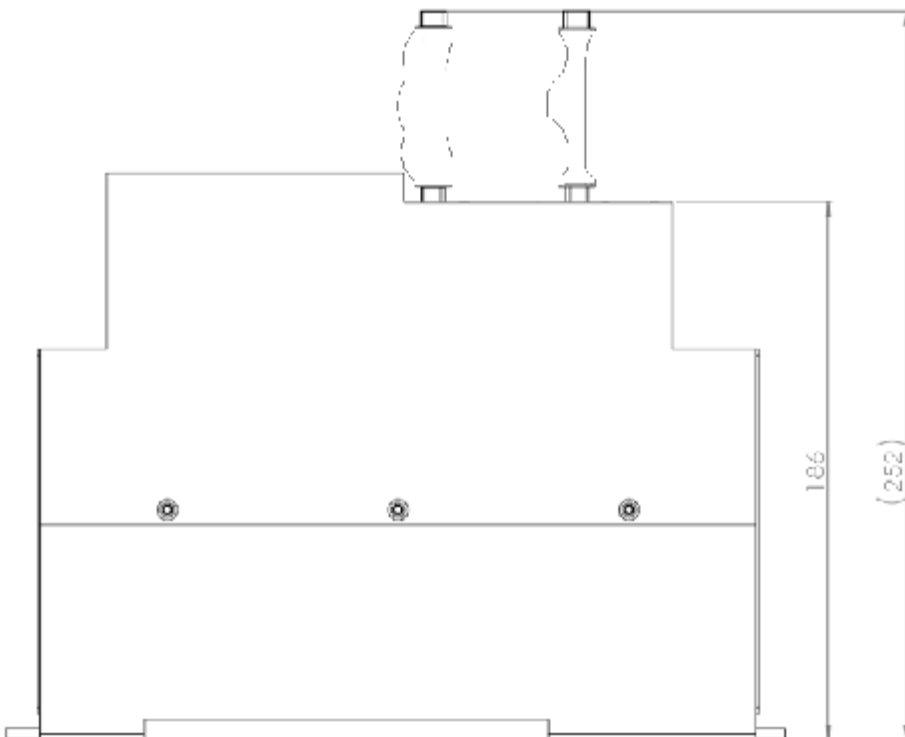
I Drivers equipped with Noise Filter Boards

ø 8A-type Will1 Driver



Unit: mm

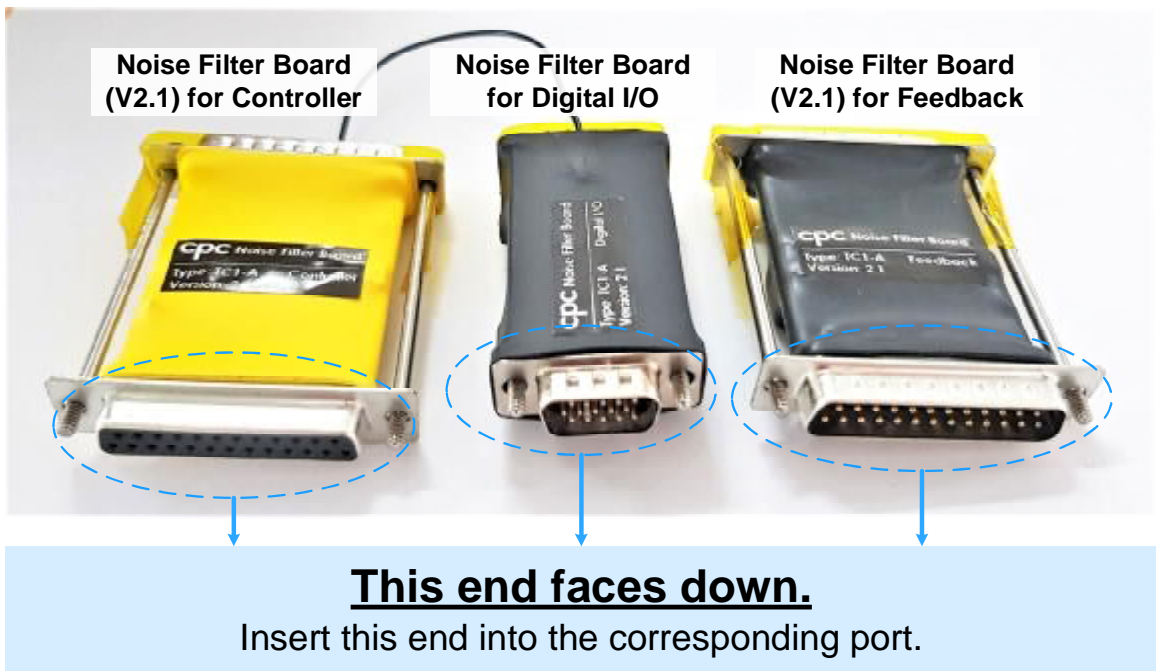
ø 20A-type Will1 Driver



Unit: mm

6.2.3.3. Assembly Direction and Steps

- When assembling, pay attention to the correct direction.

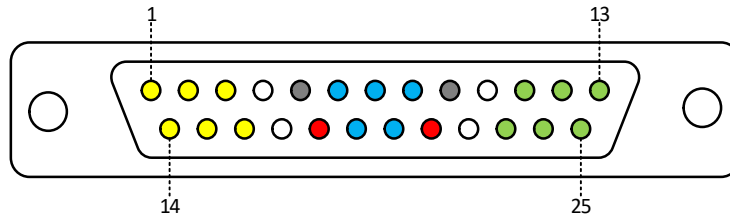


- Assembly steps (for Feedback)
 - (1) Inserted NF Board (for Feedback) into the Feedback port and tighten the hexagonal copper pillars **at the same time.**
 - (2) Connect with signal cable.

6.2.3.4. Pinout Design

The following 3 charts indicate the pinout designs when Noise Filter Boards (V2.1) are installed onto the cpc Will1 Driver.

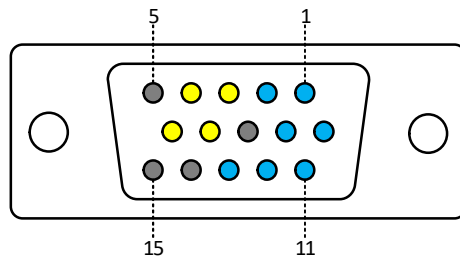
6.2.3.4.1. Controller cable wiring



DB25 MALE connector of the driver

Pin#	Signal	Function		
		A/B/Z Mode	Step/Dir Mode	CW/CCW Mode
1	RA+	A+	STEP+	CW+
2	RB+	B+	DIR+	CCW+
3	RZ+	Z+	No connect	
4	DO-C0	General purpose digital output (Open-collector)		
5	DO-CCOM-	Negative common		
6	DI-C0	General purpose digital Input		
7	DI-C2	General purpose digital Input		
8	DI-C4	General purpose digital input		
9	DO-CCOM-	Negative common		
10	DO-C3	General purpose digital output (Open-collector)		
11	OZ+	Buffered RZ/EZ signal HIGH output		
12	OB+	Buffered RB/EB signal HIGH output		
13	OA+	Buffered RA/EA signal HIGH output		
14	RA-	A-	STEP-	CW-
15	RB-	B-	DIR-	CCW-
16	RZ-	Z-	No connect	
17	DO-C1	General purpose digital output (Open-collector)		
18	DI-CCOM+	Input common		
19	DI-C1	General purpose digital Input		
20	DI-C3	General purpose digital Input		
21	DI-CCOM+	Input common		
22	DO-C2	General purpose digital output (Open-collector)		
23	OZ-	Buffered RZ/EZ signal LOW output		
24	OB-	Buffered RB/EB signal LOW output		
25	OA-	Buffered RA/EA signal LOW output		

- ※ DI-C0~C2 **cannot** be used as motor hall sensor Input.
- ※ Ox outputs (e.g., OZ+, OZ-, and OB+) can be set to provide a buffered copy of motor encoder feedback (Ex signals) for control device or of auxiliary reference (Rx signals) for next drive.
- ※ DO-C0~C3 Open-collector rated maximum sink current: 10 mA.

6.2.3.4.2. Digital I/O cable wiring

DB15 FEMALE connector of digital I/O port

Pin#	Signal	Digital I/O Function	Logic level
1	DI-A1	Input	5V TTL
2	DI-A3	Input	5V TTL
3	DO-A3	Output	Open-collector
4	DO-A1	Output	Open-collector
5	DO-ACOM	Negative common	-
6	DI-A0	Input	5V TTL
7	DI-A2	Input	5V TTL
8	DI-ACOM	Input common	-
9	DO-A2	Output	Open-collector
10	DO-A0	Output	Open-collector
11	DI-A4	Input	5V TTL
12	DI-A5	Input	5V TTL
13	DI-A6	Input	5V TTL
14	DI-ACOM	Input common	-
15	DI-ACOM	Input common	-

Open-collector rated maximum sink current:

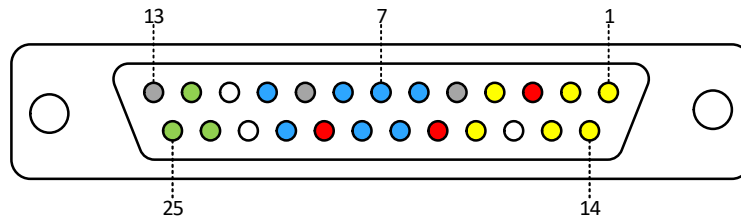
DO-A0~A1 10 mA

DO-A2~A3 10 mA

Open-collector (sink current):

DO-A0~A1 10 mA

DO-A2~A3 10 mA

6.2.3.4.3. Feedback cable wiring

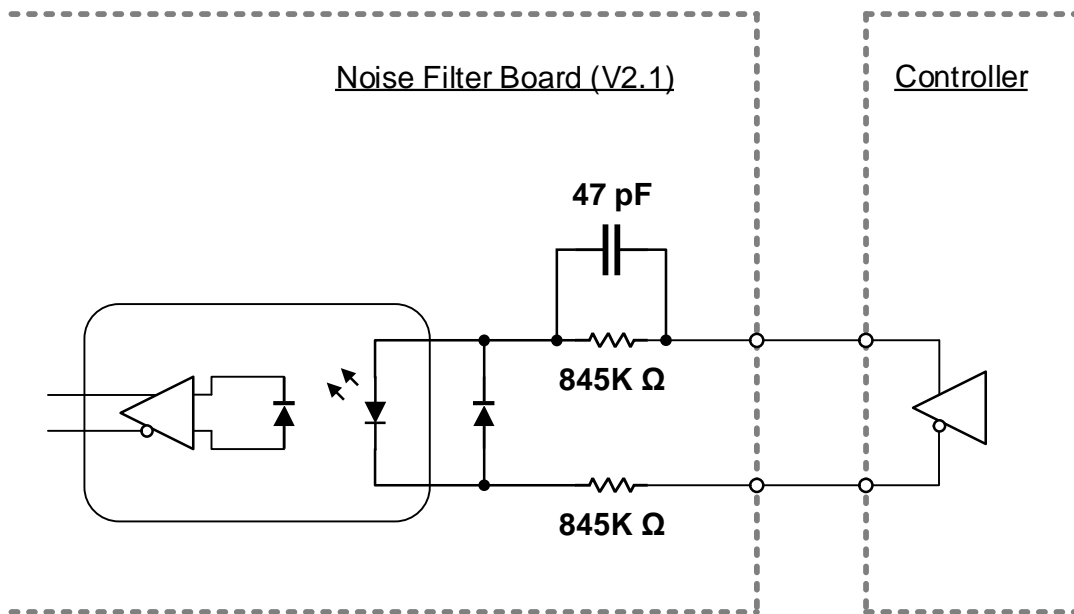
DB25 FEMALE connector of the driver

Pin#	Signal	Function
1	EA+	Encoder A+
2	EB+	Encoder B+
3	DI-BCOM	Input common
4	EZ+	Encoder Index+
5	Gnd	Ground
6	DI-B0	General purpose digital Input
7	DI-B2	General purpose digital Input
8	Temp. Sensor	Temperature sensor input
9	Temp. Gnd	Temperature sensor ground
10	DI-B6	General purpose digital Input
11	N/C	--
12	DI-B8	General purpose digital Input (Hall B)
13	Gnd	Ground
14	EA-	Encoder A-
15	EB-	Encoder B-
16	N/C	--
17	EZ-	Encoder Index-
18	5V	5V supply output
19	DI-B1	General purpose digital Input
20	DI-B3	General purpose digital Input
21	5V	5V supply output
22	DI-B5	General purpose digital Input
23	N/C	--
24	DI-B7	General purpose digital Input (Hall A)
25	DI-B9	General purpose digital Input (Hall C)

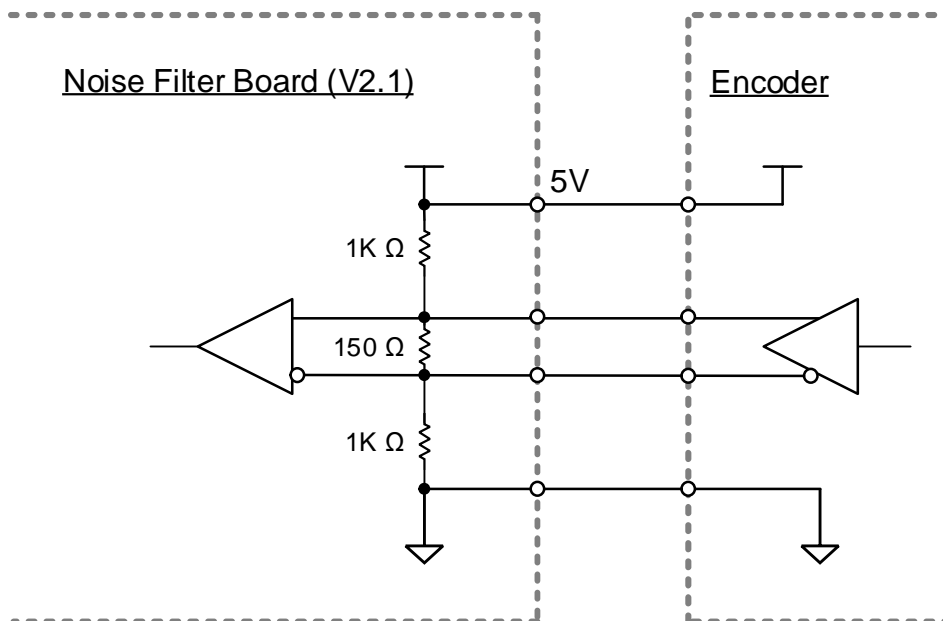
- ※ DI-B7~B9 can be used as motor hall sensor input when hall source is set as **Feedback Port** in the GUI (Graphic User Interface).
- ※ Pin 8 and 9 are **only** for the use of temperature sensor.

6.2.3.5. Electrical Circuit Design

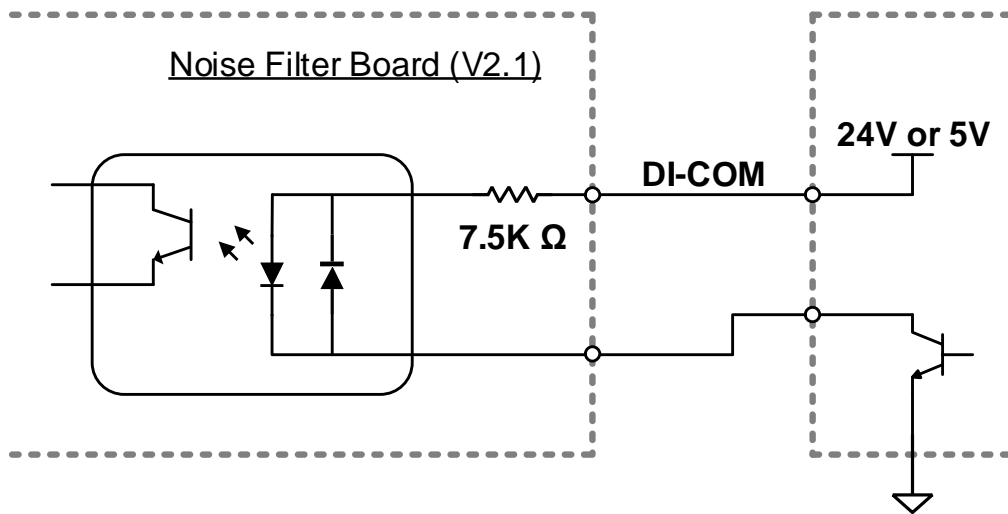
6.2.3.5.1. Differential Input Equivalent Circuit of Command



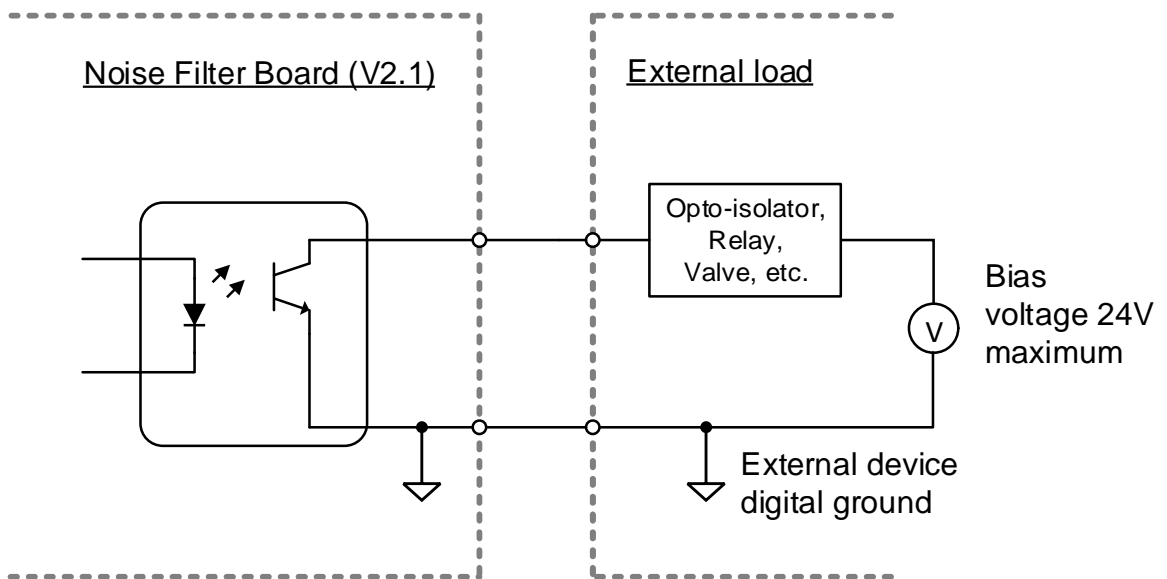
6.2.3.5.2. Differential Input Equivalent Circuit of Feedback



6.2.3.5.3. Digital Input

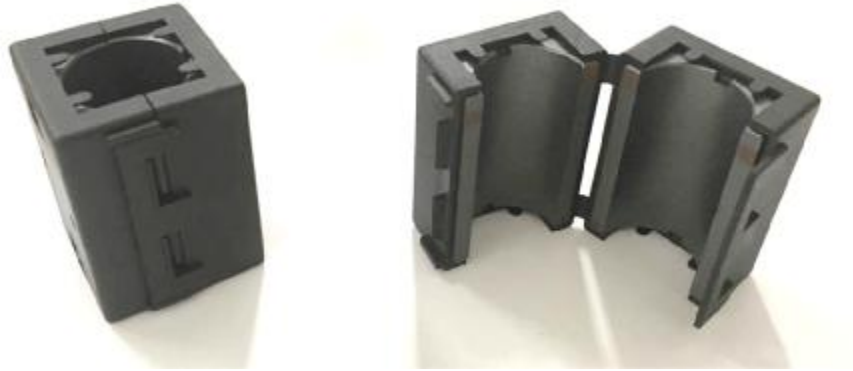


6.2.3.5.4. Digital Output (Open-collector)



6.3. Ferrite Choke

A ferrite choke helps to shield from the external noise.



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