EDB-EXCEL-P Hardware Manual

Single axis step motor drive

Full Closed Loop System

Max. 2.8A /DC 24V (5.5A / DC 48V for 86)

Step/Direction controlled by pulses

1 Feature

EDB-EXCEL-P is a single-axis step motor drive, controlled by pulses from pulse generator, and it can be set the motor tuning values via RS485 serial communication. It allows NEMA8, 11, 17, 23, 24, 34 (NEMA34 has different drive). And it also has incremental optical encoder for Closed Loop system, and possible to send encoder output to external device. It supplies power voltage 24V DC for EDB-EXCEL-P-20/28/42 and 24/48V for EDB-EXCEL-P-56/60/86.

Main Features

Two-phases Bipolar Step motor Drive

- Up to 256 microsteps per full step
- High-efficient operation, low power dissipation
- Dynamic current control
- stallGuard2™ feature for stall detection

Interfaces

- RS485 Serial Communication for motor setting
- Incremental A/B/N Encoder Interface for optical encoder
- Dedicated HOME, LEFT, RIGHT sensor inputs (NPN, PNP programmable)
- 3 open-drain outputs and 3 inputs (2 digital and one dedicated analog input)

Software

- Working with pulses signal from pulse generator such as PLC or pulse controller
- Full Closed-Loop system with incremental encoder in-built
- Full supported by EMCL-IDE (PC based integrated development environment)

Electrical data

- Supply voltage: +10V … +24V DC for EDB-EXCEP-P-20/28/42 and
  +10V…+48V DC for EDB-EXCEL-P-56/60/86
- Motor current: Up to 2.8A (Programmable) 5.5A (EDB-EXCEL-P-86)

Mechanical data

- 132mm x 83mm x 30mm

- Please see the EDB-firmware manual for additional information about functionality and EMCL programming

2. Mechanical and Electrical Interfacing

2.1 Dimension and Mounting Holes

The dimension of EDB-EXCEL-P is 132mm x 83mm x 30mm. . It has total 6 mount holes in two direction, so you can mount it as you want. It provides four LED, so you can check the status of drive in any time. (refer to figure 2.1)

2.2 Connector

. EDB-EXCEL-P provides seven connectors including power, motor, encoder, limit, external brake, and I/O.
EDB-EXCEL-P-86 provides four connectors including power, motor, encoder, and I/O.

Figure 2.1 EDB-EXCEL-P design

Label	Connector	Matching connector
POWER	LAD1140-2	MOLEX 5557-02
MOTOR	LAD1140-4	MOLEX 5557-04
ENCODER	MOLEX 55959-1030	MOLEX 51353-1000
LIMIT / SD	MOLEX 55959-0830	MOLEX 51353-0800
I/O	MOLEX 55959-2030	MOLEX 51353-2000
BRK	SMAW 250-02P	SMAW 250-02P FEMALE
RS485	RJ45	

Table 2.1 EDB-EXCEL-P connector and matching connector

2.2.1 POWER

EDB-EXCEL-P provides 2pins connectors for power supply (LAD1140-2).

	Pin	Label	Direction	Description
	1	GND	Power GND	Common system supply and signal ground
	2	VDD	Voltage	Supply Voltage

Table 2.2 Power connector

Caution:

Please keep the power supply voltage under the upper limit 28V. (53V for EDB-EXCEL-C-86)

If not, the driver will get seriously damaged. We recommended putting regulated power supply when the operation voltage comes close to the upper limit voltage.

2.2.2 MOTOR

Motor connector is LAD1140-4. This connector is supplying power to motor.

	Pin	Label	Direction	Description
	1	A	Output	1 on A phase of motor
	2	A-	Output	2 on A phase of motor
	3	B	Output	1 on B phase of motor
	4	B-	Output	2 on B phase of motor

Table 2.3 Motor connector

Caution:

Do not connect or disconnect when the motor/driver is working. It will damage on the driver seriously.

2.3.3 ENCODER

It provides connector for external incremental A/B/Z encoder. Connector type is MOLEX 55959-1030. It is differential type and also provides +5V power supply. It uses usually optical A/B/Z incremental encoder.

Pin	Label	Direction	Description
1	+5V_OUT	Output	+5V output from DC converter on board. It supplies +5V to encoder.
2	GND	GND	System and signal ground
3	A+	Input	Input for incremental encoder A+
4	A-	Input	Input for incremental encoder A-
5	B+	Input	Input for incremental encoder B+
6	B-	Input	Input for incremental encoder B-
7	Z+	Input	Input for incremental encoder Z+
8	Z-	Input	Input for incremental encoder Z-
9	FG		
10	FG		

Table 2.4 Encoder connector

2.2.4 I/O (EDB-EXCEL-P-20/28/42/56/60)

It provides MOLEX 55959-2030. It has Step/Dir pulse inputs, encoder outputs, three open-drain outputs, two digital inputs, and one analog input.

Pin	Label	Direction	Description
1	GND	GND	ground
2	GND	GND	ground
3	STEP- (CW-)	Input	Pulse input from pulse generator, STEP-
4	STEP+ (CW+)	Input	Pulse input from pulse generator STEP+
5	DIR- (CCW-)	Input	Pulse input from pulse generator DIR-
6	DIR+ (CCW+)	Input	Pulse input from pulse generator DIR+
7	ENCODER A+	Output	Encoder A+ output
8	ENCODER A-	Output	Encoder A- output
9	ENCODER B+	Output	Encoder B+ output
10	ENCODER B-	Output	Encoder B- output
11	ENCODER Z+	Output	Encoder Z+ output
12	ENCODER Z-	Output	Encoder Z- output
13	ENABLE_IN IN_2	Input Input	Enable/Servo on off input Or General purpose input 2 (GIO 2, 0 // get logic level of input 2)
14	RESET_IN IN_1	Input Input	Reset Input Or General purpose input 1 (GIO 1, 0 // get logic level of input 1)
15	ANALOG_IN IN_0	Input Input	Analog dedicated input Range of input voltage: 0…+10V Resolution: 12 bit (0 …4096) (GIO 0, 1 // get analog value of input 0) Or General purpose input 0 (GIO 0, 0 // get logic level of input 0)
16	POS_ERROR OUT_2	Output Output	Position error output Or general purpose output 2 (SIO 2, 2, 0/1 //set output2)
17	POS_REACHED OUT_1	Output Output	Position reached output Or general purpose output 1 (SIO 1, 2, 0/1 // set output1)
18	ALARM OUT OUT_0	Output Output	Alarm output Or general purpose output 0 (SIO 0, 2, 0/1 // set output0)
19	VDD		
20	EXT +24		

Table 2.5 I/O connector (For EDB-EXCEL-P-20/28/42/56/60)

2.2.5 I/O (NEMA34, for EDB-EXCEL-P-86)

It provides MOLEX 55959-2030 including RS485, limit sensors, encoder outputs, three open-drain output, two digital inputs, and one analog input.

Pin	Label	Direction	Description
1	RS485+	In/out	RS485 + serial communication
2	RS485-	In/out	RS485 - serial communication
3	GND	GND	System and signal ground
4	STEP+	Input	Step signal input, line drive (inverted X)
5	STEP-	Input	Step signal input, line drive (inverted O)
6	DIR+	Input	Direction signal input, line drive (inverted X)
7	DIR-	Input	Direction signal input, line drive (inverted O)
8	ENCODER A+	Output	Encoder A+ output
9	ENCODER A-	Output	Encoder A- output
10	ENCODER B+	Output	Encoder B+ output
11	ENCODER B-	Output	Encoder B- output
12	ENCODER Z+	Output	Encoder Z+ output
13	ENCODER Z-	Output	Encoder Z- output
14	ANALOG_IN IN_0	Input Input	Analog dedicated input Range of input voltage: 0...+10V Resolution: 12 bit (0 ...4096) (GIO 0, 1 // get analog value of input 0) Or General purpose input 0 (GIO 0, 0 // get logic level of input 0)
15	RESET_IN IN_1	Input Input	Reset Input Or General purpose input 1 (GIO 1, 0 // get logic level of input 1)
16	ENABLE_IN IN_2	Input Input	Enable/Servo on off input Or General purpose input 2 (GIO 2, 0 // get logic level of input 2)
17	BRK RES OUT	Output	Brake output
18	POS_ERROR OUT_2	Output Output	Position error output Or general purpose output 2 (SIO 2, 2, 0/1 //set output2)
19	POS_REACHED OUT_1	Output Output	Position reached output Or general purpose output 1 (SIO 1, 2, 0/1 // set output1)
20	ALARM OUT OUT_0	Output Output	Alarm output Or general purpose output 0 (SIO 0, 2, 0/1 // set output0)

Table 2.6 I/O connector (For EDB-EXCEL-P-86)

2.2.6 BRK

It provides YEONHO SMAW 250-02P for external brake (except EDB-EXCEL-P-86).

Pin	Label	Direction	Description
1	OUT	Output	Output power for external brake
2	GND	GND	Ground

Table 2.7 BRK connector (Except EDB-EXCEL-P-86)

2.2.7 LIMIT

It provides connector for external sensor inputs (Except EDB-EXCEL-P-86)

Pin	Label	Direction	Description
1	GND	GND	Ground
2	OUT	Output	Output
3	LIMIT R	Input	Right limit sensor input
4	LIMIT L	Input	Left limit sensor input
5	LIMIT H	Input	Home limit sensor input
6	GND	GND	Ground
7	GND	GND	Ground
8	GND	GND	Ground

Table 2.8 LIMIT connector (Except EDB-EXCEL-C-86)

2.2.8 RS485

EDB-EXCEL-C provides two RJ45 connector for chain of RS485 serial interface system

(Except EDB-EXCEL-P-86)

Pin	Label	Direction	Description
1	GND	GND	Ground
2	GND	GND	Ground
3	485+	IN/OUT	RS485 +
4	GND	GND	Ground
5	GND	GND	Ground
6	485-	IN/OUT	RS485 -
7	GND	GND	Ground
8	GND	GND	Ground

Table 2.9 RS485 (Except EDB-EXCEL-P-86)

3. Power Supply

For proper operation care has to be taken with regard to power supply concept and design. Due to space restrictions the EDB-EXCEL-P includes about 80μF/35V of supply filter capacitors. These are ceramic capacitors which have been selected for high reliability and long life time. The module includes a 24V suppressor diode for over-voltage protection.

Caution:

Add external power supply capacitors

Recommended to connect an electrolytic capacitor of significant size to power supply line to EDB-EXCEL-P
(ex: 470μ F/35V)

Formula for calculation of capacitor: $c = 1000\ \mu_{F/A} \times I_{SUPPLY}$

In addition to power stabilization (buffer) and filtering this added capacitor will also reduce any voltage spikes which might otherwise occur from a combination of high inductance power supply wires and the ceramic capacitors. In addition to it will limit slew-rate of power supply voltage at the module. The low ESR of ceramic-only filter capacitors may cause stability problems with some switching power supplies.

Do not connect or disconnect motor during operation.

Motor cable and motor inductivity might lead to voltage spikes when the motor is disconnected / connected while energized. These voltage spikes might exceed voltage limits of the driver MOSFETs and might permanently damage them. Therefore, always disconnect power supply before connecting / disconnecting the motor.

Please keep the power supply voltage under the upper limit 28V.

If not, the driver will get seriously damaged. We recommended putting regulated power supply when the operation voltage comes close to the upper limit voltage. EDB-EXCEL-P-86 has upper limit voltage 55V DC
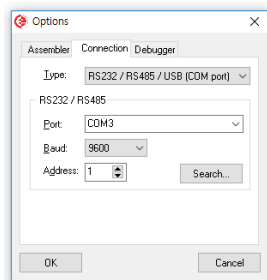
There is no reverse polarity protection.

EDB-EXCEL-C will short any reversed supply voltage due to internal diodes of the driver transistors.
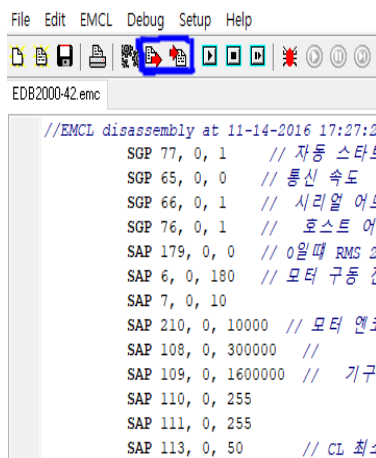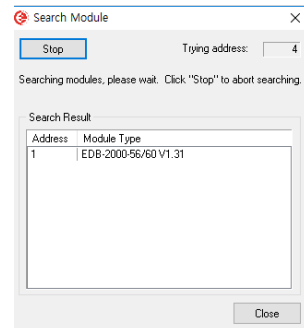
4. RS485

EDB-EXCEL-P provides 2 wires RS485 bus interface for main system control and communication. For proper operation, following details are required when RS485 communication network setting. For control the main system and communication, EDB-EXCEL-P provides 2 wires RS485 bus interface. Since EDB-EXCEL-P is controlled by pulses from pulse generator, so it does not need RS485 serial interface for working, but it needs RS485 to set the motor and to modify motor parameters via EMCL-IDE. Please refer the below way to set motor parameter and setting values.

1. Execute EMCL-IDE. You can download EMCL-IDE from Erae-tech official web-site.

2. Click Setup – Option on upper tab, then click the 'Connection'.

3. Like picture on left, you can see the window. Com part will be automatically chosen. Basic baud rate is 9600. If you set the different baud rate, please match the baud rate and click OK.

4. You can see the product information just like right picture after you click 'start' on the window. Double click the information of the product, then it will connect the PC to product via RS485 serial communication.

5. Two icons in the blue box are 'DISASSEMBLE' and 'DOWNLOAD'. 'DISASSEMBLE' is function to load the program code from product to EMCL window and 'DOWNLOAD' is putting the program code from EMCL window to product.

6. If you want to modify the parameter, then firstly click 'DISASSEMBLE' to load the parameters to EMCL window. Then, you change the parameter values you want. If every value is changed, then click 'DOWNLOAD'. Lastly, click the 'RUN' to operate the product with new values.

<Examples of Parameters>

Parameter	Label	Value	Parameter	Label	Value
SGP 77	Auto start	0: OFF 1: ON	SAP 6	Run current	Motor run current
SGP 65	Baud rate	0:9600 1:14400...	SAP 113	CL minimum current	Minimum run current in Closed Loop mode
SGP 66	Serial AD	Setting serial address	SAP 254	S/D mode	0: mode off 1: mode on

For additional parameters please refer to EDB-firmware manual.

5. Motor Drive Current

EDB-EXCEL-P is working with controlled current. Max. current of drive is programmable by software (ex: SAP 179, 0, 0=2.8A, SAP 179, 0, 1= 1.5A). Also, it can be set in 32 detailed ranges after setting SAP179.

Max. current range setting

It can be programmable with SAP 179. It chooses the range of max. current. It can be set by EMCL parameter like below:

Ex) SAP 179, 0, <range>   // 0= max. current 2.8A (5.5A for EDB-EXCEL-P-86)

　　　　　　　　　　　　　 // 1= max current 1.5A

You can put 0 or 1 into <value>. If you want to get the current setting value, you can use GAP command or DISASSEMBLE function on EMCL.

Motor current setting

It can be set with SAP 6 (motor operation current) and SAP 7 (holding current). It sets motor's operation/holding current value. We recommend to set SAP 7 under value 20.

EX) SAP 6, 0, <value>   // operation current

　　SAP 7, 0, <value>   // holding current

  You can put 0 ... 255 into <value>. If you want to get the current setting value, you can use GAP command or DISASSEMBLE function on EMCL.

For additional information, please refer EDB-firmware manual.

Motor current I_{RMS} [A]
It is current value based on max. current range setting (SAP 179) and motor current setting (SAP 6).

Current value depending on motor sizes

Unit	Motor size	Max current (SAP 179)	Motor current (SAP 6)
EDB-EXCEL-C-20	NEMA 8 (0.5A)	1	60
EDB-EXCEL-C-28	NEMA 11 (0.7A)	1	120
EDB-EXCEL-C-42	NEMA 17 (2.0A)	0	180
EDB-EXCEL-C-56	NEMA 23 (2.8A)	0	180
EDB-EXCEL-C-60	NEMA 24 (3.0A)	0	180
EDB-EXCEL-C-86	NEMA 34 (5.5A)	0	180

- **Set by SAP 179, 0, 1 (Max. current range 1.5A) except EDB-EXCEL-P-86**

Motor current SAP 6, 0, <value>	Current scaling	Motor peak current I_{COIL_PEAK} [A]	Motor RMS current I_{COIL_RMS} [A]
0...7	0	0.063	0.049
8...15	1	0.138	0.097
16...23	2	0.206	0.146
24...31	3	0.275	0.194
32...39	4	0.344	0.243
40...47	5	0.413	0.292
48...55	6	0.481	0.340
56...63	7	0.550	0.389
64...71	8	0.619	0.438
72...79	9	0.688	0.486
80...87	10	0.756	0.535
88...95	11	0.825	0.583
96...103	12	0.894	0.632
104...111	13	0.963	0.681
112...119	14	1.031	0.729
120...127	15	1.100	0.778
128...135	16	1.169	0.826
136...143	17	1.238	0.875
1444...151	18	1.306	0.924
152...159	19	1.375	0.972
160...167	20	1.111	1.021
168...175	21	1.513	1.069
176...183	22	1.581	1.118
184...191	23	1.650	1.167
192...199	24	1.719	1.215
200...207	25	1.788	1.264
208...215	26	1.856	1.313
216...223	27	1.925	1.361
224...231	28	1.944	1.410
232...239	29	2.063	1.458
240...247	30	2.131	1.507
248...255	31	2.200	1.556

- **Set by SAP 179, 0, 0 (Max. current range 2.8A) except EDB-EXCEL-P-86**

Motor current SAP 6, 0, <value>	Current scaling	Motor peak current I_{COIL_PEAK} [A]	Motor RMS current I_{COIL_RMS} [A]	Motor current SAP 6, 0, <value>
0...7	0	0.127		0.090
8...15	1	0.254		0.180
16...23	2	0.381		0.270
24...31	3	0.508		0.359
32...39	4	0.635		0.449
40...47	5	0.763		0.539
48...55	6	0.890		0.629
56...63	7	1.017		0.719
64...71	8	1.144		0.809
72...79	9	1.271		0.899
80...87	10	1.398		0.988
88...95	11	1.525		1.078
96...103	12	1.652		1.168
104...111	13	1.779		1.258
112...119	14	1.906		1.348
120...127	15	2.033		1.438
128...135	16	2.160		1.528
136...143	17	2.288		1.618
1444...151	18	2.415		1.707
152...159	19	2.542		1.797
160...167	20	2.669		1.887
168...175	21	2.796		1.977
176...183	22	2.923		2.067
184...191	23	3.050		2.157
192...199	24	3.177		2.247
200...207	25	3.305		2.336
208...215	26	3.431		2.426
216...223	27	3.558		2.516
224...231	28	3.685		2.606
232...239	29	3.813		2.696
240...247	30	3.940		2.786
248...255	31	4.050		2.876

In addition to the settings in the table, the motor current may be switched off completely (free-wheeling) using axis parameter 204 (see EDB-firmware manual).

6. LED

In order to show the status of drive, it provides four LEDs. Power, In position, Alarm Out, and Position error are four LEDs.

LED	Label	Color	Description
1	POWER	GRN	Turned ON when power is ON
2	IN.Position	GRN	It shows position command is completed.
3	Pos.Error	RED	It has deviation between command pos. and real pos.
4	Alarm Out	RED	It shows occurrence of motor error.

Table 6.1 LED status table.

Figure 6.1 EDB-EXCEL-P LED

7 Operational Ratings

The operational ratings show the intended or the characteristic ranges and should be used as design values.

Never exceed the max. value in any case. Refer to (..) for EDB-EXCEL-P-56/60/86

Symbol	Parameter	Min	Typ	Max	Unit
VDD	Power supply voltage for operation (20/28/42) (56/60/86)	9 (18)	12... 24*), (12...48)	28 (53)	V
ICOIL_peak	Motor coil current for sine wave peak (86)	0		4 (7.8)	A
ICOIL_RMS	Continuous motor current (RMS) (86)	0		2.8 (5.5)	A
IDD	Power supply current		<< ICOIL	1.4 * ICOIL	A
TENV	Environment temperature at rated current		tbd		°C

Table 7.1 EDB-EXCEL-P general operational ratings

Operational ratings of I/O

Symbol	Parameter	Min	Typ	Max	Unit
$V_{OUT\_0/1/2}$	Voltage at open-drain output OUT 0/1/2	0		$+VDD$	V
$I_{OUT\_0/1/2}$	Output sink current of open-drain output OUT 0/1/2			100	mA
$V_{OUT\_0/1/2}$	Voltage at output OUT_0/1/2 (when switched off and without external load)		+5		V
$V_{IN\_0/1/2}$	Input voltage for IN_0, IN_1, IN_2	0		$+VDD$	V
$V_{IN\_L\ 1/2}$	Low level voltage for IN_1 and IN_2 (digital inputs)	0		1.7	V
$V_{IN\_H\ 1/2}$	High level voltage for IN_1 and IN_2 (digital inputs)	3.2		$+VDD$	V
V_{ANALOG_IN}	Measurement range for analog input ANALOG_IN (IN_0)	0		+10*	V

Table 7.2 I/O operational rating

Noted:

  approx. 0...+10.56V at the analog input IN_0 is translated to 0..4095 (12bit ADC, raw values). Above approx. +10.56V the analog input will saturate but, not being damaged (up-to VDD).

8. Functional Description

EDB-EXCEL-P is a drive product which is controlled through pulse signals from pulse generator. The nominal

supply voltage of the unit is 12V or 24V DC for EDB-EXCEL-P-20/28/42 and 24V or 48V for EDB-EXCEL-P-56/60/86. Full remote control of device with feedback is possible. The firmware of the product can be updated via RS485 serial interface.

The main parts of EDB-EXCEL-P is shown at figure 8.1

- the microprocessor, which runs the EMCL operating system (connected to EMCL memory)
- the motion controller, which calculates ramps and speed profiles internally in hardware
- the power driver with stallGuard2™ and its energy efficient coolStep™ feature
- the MOSFET driver stage
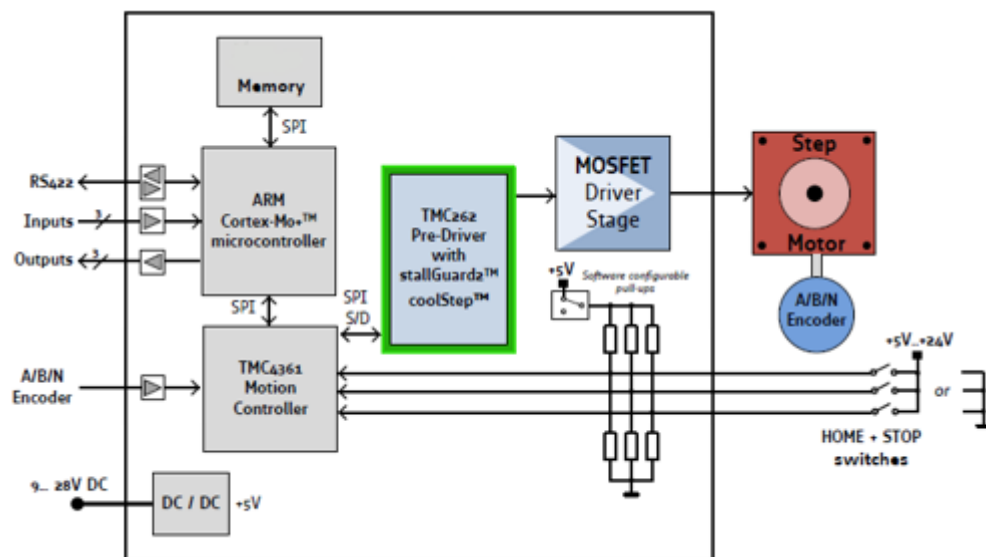- interface for an external optical incremental A/B/N encoder

Figure 8.1 Main parts of the EDB-EXCEL-P

EDB-EXCEL-P is set easily at software EMCL-IDE which is based on PC. It can be easily set with commands such as current and holding current.

For more EMCL commands, please refer to EDB-firmware manual.

9. Revision History

Date	Version	Written	Content
2018-08-01	V 1.0	MY	