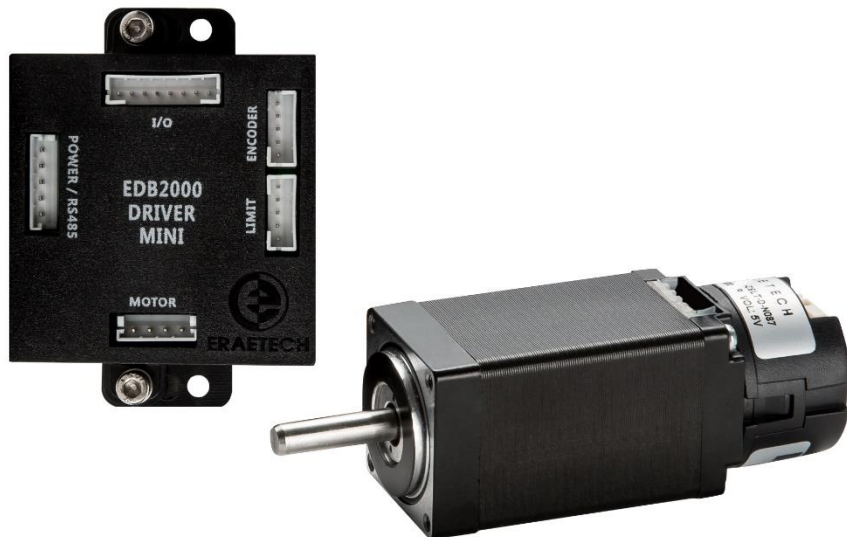# EDB-MINI-P Hardware Manual

Single Axis step motor drive

Full Closed Loop System

Max. 2.8A /DC 24V

Step/Direction controlled by pulses

1. Feature

EDB-MINI-P is a single axis step motor drive, controlled by pulses from pulse generator, and supports RS485 serial communication for firmware update or motor setting. The best feature of EDB-MINI-P is very simple and small size design, and it can apply up to size NEMA 8, 11, 17 2-phases bipolar step motor. It also includes A/B/Z incremental optical encoder for Closed-Loop control. It has up to 2.8A current (programmable) and DC 24V as power voltage. EDB-MINI-P has been designed for flexible installation and small size, so it has open-collector encoder input, not the differential. If it could get noisy on encoder, so please keep the encoder cable as short as possible (within 50cm).

Main Features

2-phases bipolar step motor drive

- 256 micro steps for each full-step

- Highly efficient for energy of motion and power

- Efficient real time current control

- stallGuard2™ for detection of stall

Interface

- RS485 serial communication interface
- Incremental A/B/N encoder interface
- Dedicated purpse HOME, LEFT, RIGHT sensor inputs (NPN, PNP programmable by software)
- Open-drain outputs and 3 inputs (2 digital inputs and 1 analogue input)

Software

- Working with pulses signal from pulse generator such as PLC or pulse controller
- Full Closed-Loop using high quality optical incremental encoder
- ERAE-TECH software tool EMCL-IDE (download from erae-tech official web-site)

Electrical Data

- Supply Voltage: +10V … +24V DC
- Motor Current: Up to 2.8A (programmable)

Mechanical Data

- 64mm x 49mm x 16mm (excluded cable)

Please refer EDB-Series firmware manual for additional information such as programming.

2. Electrical and Mechanical Interface

2.1 Dimension

EDB-MINI-P has 64mm x 49mm x 16mm as dimension. It has two mount holes for installation. EDB-MINI series is designed very small dimension for flexible installation. (refer picture 3.1)

2.2 Connector

  EDB-MINI-P provides five connectors such as power, RS485, step/dir input, I/O, and incremental encoder (only open collector, for differential encoder, please refer EDB-EXCEL or EDB-COMPACT series)

Figure 3.1 EDB-MINI-P Design

Label	Connector type	Female connector type
POWER / RS485	JST B6B-EH-A (JST EH series, 6pins, 2.5mm pitch)	Connector housing: JST EHR-6 Contacts: JST SEH-001T-P0.6
I/O	JST B8B-PH-K-S (JST PH series, 8pins, 2mm pitch)	Connector housing: JST PHR-8 Contacts: JST SPH-002T-P0.5S
MOTOR	JST B4B-EH-A (JST EH series, 4pins, 2.5mm pitch)	Connector housing: JST EHR-4 Contacts: JST SEH-001T-P0.6
Step/Dir	JST B5B-PH-K-S (JST PH series, 5pins, 2mm pitch)	Connector housing: JST PHR-5 Contacts: JST SPH-002T-P0.5S
ENCODER	JST B5B-PH-K-S (JST PH series, 5pins, 2mm pitch)	Connector housing: JST PHR-5 Contacts: JST SPH-002T-P0.5S

Table 2.1 Information about connectors and female connectors

2.2.1 POWER / RS485

EDB-MINI-P provides a connector for power and RS485 serial communication (JST EH series)
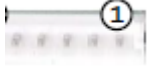
	Pin	Label	Name	Description
	1	GND	Power GND	System supply ground power
	2	VDD	Supply voltage	Supply voltage
	3	GND	Ground	Ground for RS485
	4	RS485 +	Communication	RS485 +
	5	RS485 -	Communication	RS485 -

Table 2.2 Connector for Power and RS485

Warning:

Please keep the power supply voltage under 28V.

Otherwise, it can be caused serious damage on drive. Especially, when supply voltage is near upper limit 28V, then please supply the power with limit for not overvoltage.

2.2.2 MOTOR

Connector for motor is JST EH series 4 pins, 2.5mm pitch connector. It provides to supply power to 4 wires for two-phases bipolar step motor.

	Pin	Label	Usage	Description
	1	A	Output	1 of motor A-Phase
	2	A-	Output	2 of motor A-Phase
	3	B	Output	1 of motor B-Phase
	4	B-	Output	2 of motor B-Phase

Table 2.3 Motor Connector

Warning:

Please do not connect or disconnect while drive is working or motor is getting current on it. It can be caused permanent damage on drive.

2.2.3 I/O Connector

It provides 8 pins JST PH series 2mm pitch connector. It has three open-drain outputs, 2 digital inputs, and I analogue input.

	Pin	Label	Usage	Description
	1	GND	Power (GND)	System and signal ground
	2	VDD	Power (Supply)	VDD, connected to power and RS485 VDD pins
	3	ALARM OUT OUT_0	Output	Alarm output Or general purpose open-drain output 0 (SIO 0, 2, 0/1 //sets as general purpose output)
	4	POS_REACHED OUT_1	Output	Pos.reached output Or general purpose open-drain output 1 (SIO 1, 2, 0/1 // sets as general purpose output)
	5	POS_ERROR OUT_2	Output	Position error output Or general purpose open-drain output 2 (SIO 2, 2, 0/1 // sets as general purpose output)
	6	ENABLE_IN IN_2	Input	Servo On input Or general purpose input 2 (GIO 2, 0 // read out status of general purpose input 2)
	7	RESET_IN IN_1	Input	Reset input Or general purpose input 1 (GIO 1, 0 // read out status of general purpose input 1)
	8	ANALOG_IN IN_0	Input	Analogue input Voltage input range : 0...+10V Resolution: 12bit (0 ...4096) (GIO 0, 1 // Read out analogue value on input 0) Or general purpose input 0 (GIO 0, 0 // read out status of general purpose input 1)

Table 2.4 I/O Connector

Please refer 2.5.9 General purpose I/O on firmware manual for dedicated I/O configuration.

Warning:

- All inputs have pull-down resistors, input series resistors and protection diodes. This way the inputs are protected for voltages up-to nom. +24V. The pull-down resistors also ensure a valid (low) level when left unconnected.
- All outputs are open-drain outputs supporting sink currents of up-to 100mA. They offer integrated pull-up resistors (4k7) to +5V in order to ensure stable and valid logic levels (+5V) without additional external components when not activated.
-

2.2.4 Step/Direction

It provides connector for step/direction input. The connector is 5 pin JST PH series 2mm pitch.

Pin	Label	Usage	Description
1	GND	Power GND	System supply Ground
2	STEP+	Input	Step signal input, line drive (inverted X)
3	STEP-	Input	Step signal input, line drive (inverted O)
4	DIR+	Input	Direction signal input, line drive (inverted X)
5	DIR-	Input	Direction signal input, line drive (inverted O)

Table 2.5 S/D connector

Noted:

- It provides 120R terminated resistors

- TTL or open-collector signals should be firstly converted. Please use standard line drive IC AM26LS31/ AM26C31 or similar products with it.

2.2.5 A/B/Z Incremental Encoder Connector

For connection of an external incremental A/B/N encoder a 5pin JST PH-series 2mm pitch single row connector is available. This connector offers +5V supply (max. 100mA) for an external encoder and accepts either +5V TTL or open-collector signals as standard. The external encoder may be used as an alternative to the on-board hall sensor based encoder IC. Selection of encoder can be done in software.

	Pin	Label	Usage	Description
	1	GND	Power GND	System and signal ground
	2	+5V_OUT	Power supply out	+5V output from on-board DC/DC converter. May be used in order to supply +5V to an external encoder. Up-to 100mA may be drawn from this output
	3	A+	INPUT	Incremental encoder channel A input
	4	B+	INPUT	Incremental encoder channel B input
	5	Z+	INPUT	Incremental encoder Zero channel input

Table 2.6 A/B/Z external encoder connector

Warning:

EDB-MINI-C has been designed as very small size with open-collector encoder inputs. Please keep the encoder cable as short as possible in order to prevent noisy on encoder.

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-MINI-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 product includes a 24V suppressor diode for over-voltage protection.

warning:

Add external power supply capacitors!

It is recommended to connect an electrolytic capacitor of significant size (e.g. 470µF/35V) to the power supply lines next to the EDB-MINI-P (ex: 470µF/35V)

Formula of calculation for capacitor size: $c = 1000 \; _{µF/A} \times I_{SUPPLY}$

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, 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 its 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.

Keep the power supply voltage below the upper limit of 28V.

Otherwise the driver electronics will seriously be damaged! Especially, when the selected operating voltage is near the upper limit a regulated power supply is highly recommended. Please see also chapter 0, operating values.

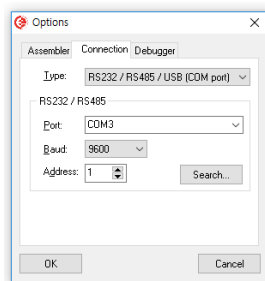**There is no reverse polarity protection.**

It will short any reversed supply voltage due to internal diodes of the driver transistors.
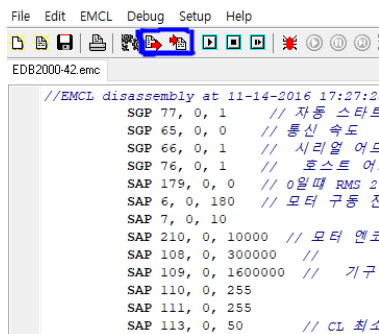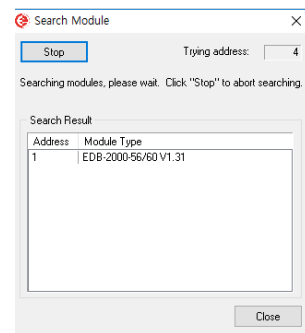
4. RS485

EDB-MINI-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-MINI-P provides 2 wires RS485 bus interface. Since EDB-MINI-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 values 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

The on-board stepper motor driver operates current controlled. The driver current may be programmed in software in two ranges (low current range up-to 1.5A RMS and high current range up-to 2.8A RMS) with 32 effective scaling steps in hardware for each range.

Range setting in software (EMCL)

This is the value for TMCL axis parameter 179 (Vsense). This value defines the current range. This value can be set using the following EMCL command

EX) SAP 179, 0, <value>   // 0= high current range 2.8A

                           // 1= low current range 1.5A

    You can set 0 or 1 at <value>. If you want to know the current value setting, you can check with GAP command or DISASSEMBLE function.

Motor Current Setting I_{RMS} [A]

Resulting motor current based on range and motor current setting.

   EX) SAP 6, 0, <value>   // Motor running current

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

    At <value>, the range of value is 0...255. For more information, please refer the EDB-series firmware manual.

Recommended current depends on motor sizes

Unit	Motor size	Current Range (SAP 179)	Motor current (SAP 6)
EDB-MINI-P-20	NEMA 8 (0.5A)	1	60
EDB-MINI-P-28	NEMA 11 (0.7A)	1	120
EDB-MINI-P-42	NEMA 17 (2.0A)	0	180

- **SAP 179, 0, 1 (Max current 1.5A)**

Motor current setting in EMCL SAP 6, 0, <value>	Current scaling step	Motor current I_{COIL_PEAK} [A]	Motor 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

- **SAP 179, 0, 0 (Max current 2.8A)**

Motor current SAP 6, 0, <value>	Current Scailing	Motor peak current I_{COIL_PEAK} [A]	Motor RMS Current I_{COIL_RMS} [A]
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. Please refer the EDB-series firmware manual.

6. LED

The board offers one LED in order to indicate board status. The function of the LED is dependent on the firmware version. With standard firmware the green LED should be flashing slowly during operation.

Status	Label	Description
Flashing	Run	This green LED flashes slowly during operation.

EDB-MINI-P LED

Pic 6.1 EDB-MINI-P LED

7. Reset to Factory Defaults

To reset factory defaults please follow instruction below:

1. Switch OFF power supply.

2. Short CLK and DIO pads of programming connector pads. (see picture 7.1)

3. Switch ON power supply (LED should start flashing with increased frequency).

4. Switch OFF power supply.

Pic 7.1 Reset to factory defaults (bottom view of pcb)

We do not recommend hardware reset to factory default. If you have some problem, please request A/S to Erae-Tech.

8. Operational Ratings

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

In no case shall the maximum values be exceeded!

Symbol	Parameter	Min	Typ	Max	Unit
VDD	Power supply voltage for operation	9	12... 24*)	28	V
ICOIL_peak	Motor coil current for sine wave peak (chopper regulated, adjustable via software)	0		4	A
ICOIL_RMS	Continuous motor current (RMS)	0		2.8	A
IDD	Power supply current		<< ICOIL	1.4 * ICOIL	A
TENV	Environment temperature at rated current (no forced cooilng required)	-30	tbd	+60	°C

Table 8.1 General operational ratings of module

Operational ratings of multipurpose I/Os

Symbol	Parameter	Min	Typ	최대	유니트
$V_{OUT\_0/1/2}$	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
$V_{OUT\ 0/1/2/3}$	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_0/1/2	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 8.2 Operational ratings of I/Os

*) approximately, 0...+10.56V at 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).

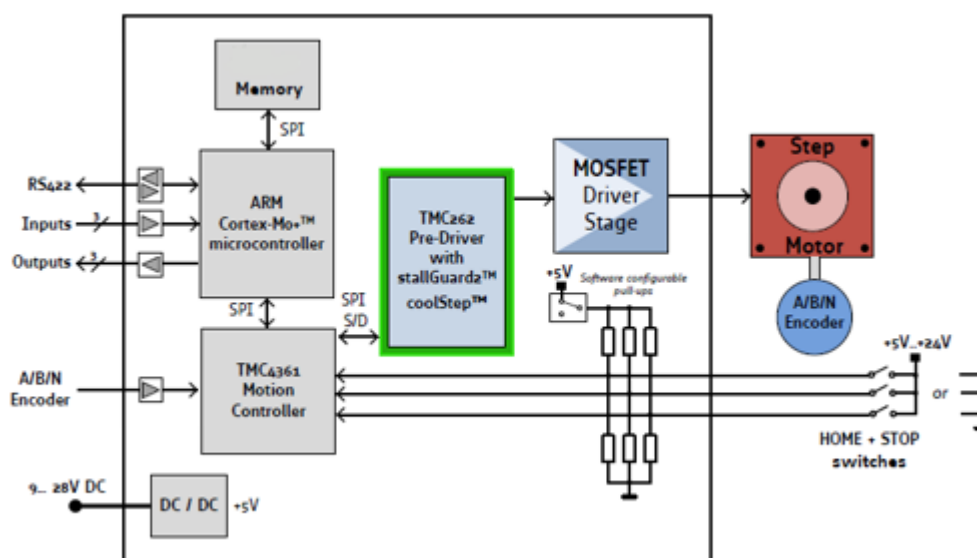| Symbol	Parameter	Min	Typ	Max	Unit
N_{RS485}	The numbers of nodes connected to single RS485 network			16	

Table 8.3 RS485 operational rating

9. Functional Description

EDB-MINI-P is a drive product which can be controller through pulse signals from pulse generator.   The nominal supply voltage of the unit is 12V or 24V DC. The product is designed for working with step/dir pulse signals. Full remote control of device with feedback is possible. The firmware of the product can be updated vis RS485 serial interface.

In Figure 9.1 the main parts of EDB-MINI-P are shown:

- The microprocessor, which runs the EMCL operating system (connected to EMCL memory)

- The motion controller, which calculates ramps and speed profiles internally

- The power driver with stallGuard2™ and its energy efficient coolStep™ feature
- MOSFET driver stage
- Interface for an external (ex. Optical) incremental A/B/N encoder
- EDB-MINI-P has no function for encoder output A/B/Z. For this function, please refer EDB-EXCEL and COMPACT.

Pic 9.1 EDB-MINI-P Main parts

For more commands or information, please refer EDB-series firmware manual.

10. Revision History

Date	Version	Written by	Revised contents
2018-08-01	V 1.0	MY	