EDB-ALL-C Hardware Manual

Single axis step motor drive/controller

Full Closed Loop System

Max. 2.8A /DC 24V (24/48V for 56/60)

RS485 Serial Communication

1. Feature

EDB-ALL-C is a single-axis step motor drive/controller and provides RS485 serial communication. This is an integrated product with motor, encoder, drive, and controller for easy installation and wiring and it allows NEMA 11, 17, 23, 24. And it also has incremental optical encoder for Closed Loop system. It has 0.7A (NEMA 11) and up to 2.8A and 24/48V DC for power voltage (NEMA 11, 17 has 24V DC and NEMA 23, 24 has 24/48V DC)

Unit	Supply Voltage	Supply Current	Motor Size
EDB-ALL-C-28	24V DC	Up to 0.7A	NEMA 11
EDB-ALL-C-42	24V DC	Up to 2.8A	NEMA 17
EDB-ALL-C-56	24/48V DC	Up to 2.8A	NEMA 23
EDB-ALL-C-60	24/48V DC	Up to 2.8A	NEMA 24

Table 1.1: Supply voltage and current depends on motor sizes

Main Features

Motion Controller

- Motion profile calculation in real-time
- Motor tuning and control is possible via EMCL software (Position, velocity, acc/dec)
- High performance microcontroller for overall system control and serial communication protocol handling

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
- 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) except NEMA 11
- EDB-ALL-C-28 has one open-drain output)

Software

- Working with EMCL direct mode or Standalone (Up to 1024 commands memories)
- 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, EDB-ALL-C-56/60 is up to +48V DC
- Motor current: Up to 2.8A (Programmable)
  EDB-ALL-C-28 has up to 0.7A (Programmable)

Mechanical data

- Drive/controller box integrated on the top of motor

- EDB-ALL-C-28: 45mm x 31mm x 21mm (only for drive box)

  EDB-ALL-C-42: 64mm x 47mm x 21mm (only for drive box)

  EDB-ALL-C-56/60: 79mm x 64mm x 21mm (only for drive box)

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

2. Mechanical and Electrical Interfacing

2.1 Dimensions and Mounting Holes

You can see the dimension of EDB-ALL-C above mechanical data. EDB-ALL-C is drive/controller integrated product as one unit. You don't have to install external drive or controller and you can just wire it to power and PC for motor control. It has benefits on efficient space and simple wiring.

2.2 Connectors

EDB-ALL-C provides four connectors (NEMA11 has three connectors). You can refer the connector's specification at below tables.

Figure 2.1 EDB-ALL-C Design

Product	Label	Connector	Matching connector
EDB-ALL-C-28	Power	SMR-02V-B	SMP-02V-B
	RS485	SMR-03V-B	SMP-03V-B
	I/O	SMR-06V-B	SMP-06V-B

Table 2.1: EDB-ALL-C-28 connectors

Product	Label	Connector	Matching connector
EDB-ALL-C-42/56/60	Power	SMR-02V-B	SMP-02V-B
	RS485	SMR-03V-B	SMP-03V-B
	LIMIT	SMR-05V-B	SMP-05V-B
	I/O	SMR-08V-B	SMP-08V-B

Table 2.2: EDB-ALL-C-42/56/60 connectors

2.2.1 POWER (EDB-ALL-C All sizes)

EDB-ALL-C provides a connector for power supply (SMR series). Power connect is same for all sizes.

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

Table 2.3 Power Connector

Caution:

Please keep the power supply voltage under the upper limit 28V. (53V for EDB-ALL-C-56/60)

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 RS485 (EDB-ALL-C All sizes)

It provides 3 pin connectors for RS485 serial communication (SMR series). RS485 connector is same for all sizes.

Pin	Label	Direction	Description
1	RS485 +	IN/OUT	RS485 +
2	RS485 -	IN/OUT	RS485 -
3	GND	GND	Ground for RS485

Table 2.4 RS485 communication connector

Caution:

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

2.2.3 I/O Connector (EDB-ALL-C-28)

It provides 6 pins JST PH series. It has three open-drain outputs, two digital inputs, and one analog dedicated input.

Pin	Label	Direction	Description
1	24V OUT	power (GND)	
2	GND	power (supply)	
3	OUT_0	Output	General purpose open-drain output 0 SIO 0, 2, 0/1 // 출력 0 설정
4	HOME IN_0	Input	Home/Reference Input c GIO 0, 0 // get logic level of input 0
5	STOP_L IN_1	Input	Input for left sensor Or General purpose Input 1 GIO 1, 0 // get logic level of input 1
6	STOP_R IN_2	Input	Input for right sensor Or General purpose Input 2 GIO 2, 0 // get logic level of input 2

Table 2.5 I/O Connector (EDB-ALL-C-28)

Please refer 2.5.9 of firmware manual for dedicated I/O configuration.

Noted:

- 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 LIMIT Connector (EDB-ALL-C-42/56/60)

It provides HOME/L/R sensor connectors (SMR-05V-B)

Pin	Label	Direction	Description
1	GND	Power GND	System and signal ground
2	5V_OUT	Output	VDD, connected to VDD pin of the power and RS485 connector. A maximum of 0.2A may be drawn from this pin (protected via polyfuse (resettable fuse))
3	STOP_R	Input	Right sensor input
4	STOP_L	Input	Left sensor input
5	HOME	Input	Home sensor input

Table 2.6 Limit sensor connector

Noted:

- The three inputs HOME, STOP_L and STOP_R have pull-down resistors, input series resistors and protection diodes. This way inputs are protected for voltages up-to nom. +24V. The pull-down resistors also ensure a valid (low) level when left unconnected. For all three inputs pull-up resistors to +5V may be enabled (*default: enabled*). This way in addition to PNP switches NPN switches are supported, also.

2.2.5 I/O Connector (EDB-ALL-C-42/56/60)

For I/O wiring, it provides SMR-08V-B connector. The functionality is different depending on the size. Please check the highlighted red point for these differences.

Pin	Label	Direction	Description
1	ANALOG_IN IN_0	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)
2	RESET_IN IN_1	Input	Reset Input Or General purpose input 1 (GIO 1, 0 // get logic level of input 1)
3	ENABLE_IN IN_2	Input	Enable/Servo on off input Or General purpose input 2 (GIO 2, 0 // get logic level of input 2)
4	BRK Res out VDD (NEMA17)	Output VDD	Brake output (NEMA23, 24) In NEMA 17 size, connected to VDD pin of the power and RS485 connector
5	POS_ERROR OUT_2	Output	Position error output Or general purpose output 2 (SIO 2, 2, 0/1 //set output2)
6	POS_REACHED OUT_1	Output	Position reached output Or general purpose output 1 (SIO 1, 2, 0/1 // set output1)
7	ALARM_OUT OUT_0	Output	Alarm output Or general purpose output 0 (SIO 0, 2, 0/1 // set output0)
8	GND	Ground	System and signal ground

Table 2.7 I/O connector

Noted:

- 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.

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-ALL-C 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-ALL-C
(ex: 470µ F/35V)

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

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 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 keet 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.

.

There is no reverse polarity protection.

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

4. RS485

EDB-ALL-C provides 2 wires RS485 bus interface for main system control and communication. For proper operation, following details are required when RS485 communication network setting.

1. Bus structure

   The network topology should follow a bus structure as closely as possible. That is, the connection between each node and the bus itself
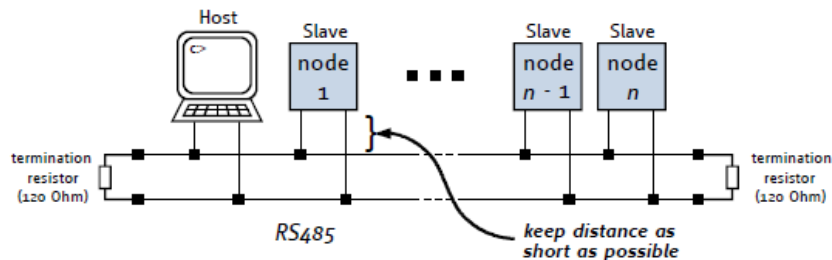
2. Bus termination:

   Especially for longer busses and/or multiple nodes connected to the bus and/or high communication speeds, the bus should be properly terminated at both ends. The EDB-ALL-C does not integrate any termination resistor. Therefore, 120 Ohm termination resistors at both ends of the bus have to be added externally.

3. Number of nodes

   The RS485 electrical interface standard (EIA-485) allows up to 32 nodes to be connected to a single bus. The bus transceivers used on EDB-ALL-C have a significantly reduced bus load. Basically, when a number of nodes are high, communication speed gets decreased. It is depended on length of bus cable, baud rate, and number of nodes.

4. Communication speed

   Max. RS485 baud rate is 115200 bit/s. Default is 9600 bit/s and it can be programmable. If you want to change the different baud rate, please refer the EDB-firmware manual.

5. Recommended terminated resistor on the edge of bus.

   It might occur communication error without terminated resistor on the edge of bus. For valid communication signal, we recommend to add the terminated resistors on the edge of bus,

5. Motor Drive Current

EDB-ALL-C 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

                            // 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 (SAP6)
EDB-ALL-C-20	NEMA 8	1	60
EDB-ALL-C-28	NEMA 11	1	120
EDB-ALL-C-42	NEMA 17	0	180
EDB-ALL-C-56	NEMA 23	0	180
EDB-ALL-C-60	NEMA 24	0	180

- **Set by SAP 179, 0, 1 (Max. current range 1.5A)**

Motor current	Current scaling	Motor peak current	Motor RMS current

SAP 6, 0, <value>		I_{COIL_PEAK} [A]	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)**

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	0.127	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. Reset to Factory Defaults

To reset factory defaults please follow instructions below:

1. Switch OFF power supply.

2. Short CLK and DIO pads of programming connector pads (see figure 4.1)

3. Turn on the power supply

4. Turn off power and remove the short circuit.

Figure 4.1 How to reset to factory default (on the bottom of PCB)

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

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.

Symbol	Parameter	Min	Typ	Max	Unit
VDD	Power supply voltage for operation (28/42)	9	12... 24*)	28	V
	(56/60)	9	12... 48*)	53	
ICOIL_peak	Motor coil current for sine wave peak	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		tbd		°C

Table 7.1 EDB-ALL-C 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-ALL-C is drive/controller integrated product which is controlled vis RS485 serial interface. The nominal supply voltage of the unit is 12V or 24V DC for EDB-ALL-C-28/42 and 24V or 48V for EDB-ALL-P-56/60. The product is designed for both standalone operation and direct mode. 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-ALL-C 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
- encoder output is unavailable in EDB-ALL-P, it is available at EDB-EXCEL/COMPACT.
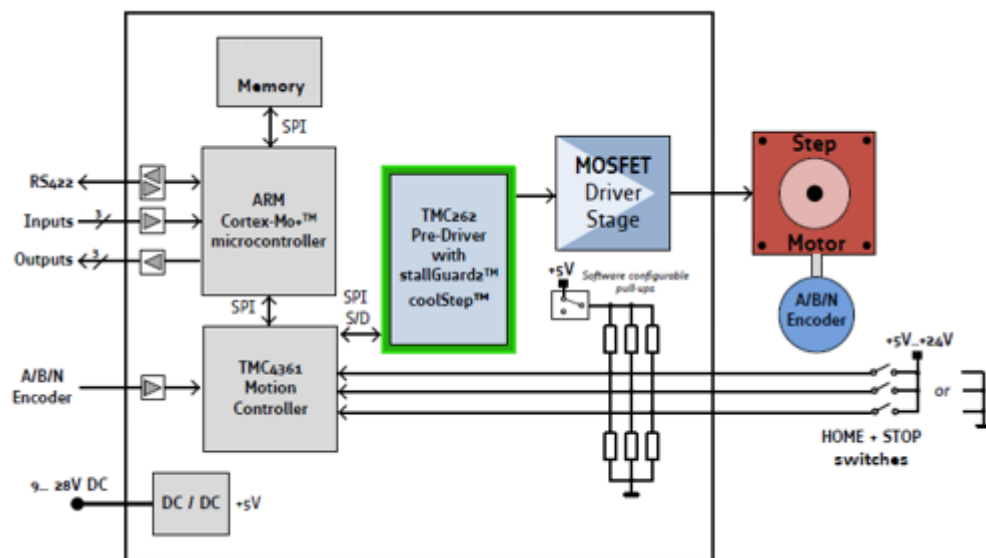

Figure 8.1 Main parts of the EDB-ALL-C

EDB-ALL-C is controlled easily at software EMCL-IDE which is based on PC. It can be easily controlled with commands such as position/velocity.

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

9. Revision History

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