

# EM-347B and EM-347B-fan BRUSHLESS ( BLDC ) MOTOR DRIVER 12-48V 50A



## GENERAL

EM-347B is a brushless DC-motor driver with hall sensor feedback. The unit has a mosfet power stage with good efficiency and it meets today's EMC requirements. The driver can be used with 120° commutation. This driver has true 4Q power stage, which makes it possible to use regenerative braking. In this braking method the supply voltage rises, but voltage rising can be controlled with a braking resistor. If using battery supply, then the braking energy can be lead back into the battery and a braking resistor will not be needed. The unit has basic digital command inputs like direction, brake, start/stop, disable and there are analog inputs for speed and current control. One digitally presetable second speed (speed-2) is possible to activate with digital command input. EM-347-48V has two NPN outputs for fault and overcurrent indication use. Some input and output functions can be modified with parameters. Driver includes overvoltage, undervoltage and overtemperature protection. These fault situations are indicated with fault on-board LED. Overtemperature and current limit situations can be reset with reset input, reset-timer or by setting analog speed control to value to 0.

There are two control options for speed. Direct control ( open loop ) sets motor voltage in proportion to control voltage as with a standard DC-motor. Closed loop uses hall sensor feedback for speed control. This mode offers good speed regulation. Start and stop ramps work in both modes. Speed adjust range, closed loop rpm range and ramps can be set with parameters. Analog inputs are filtered so that they can also use PWM signal for controlling speed and current.

Settings can be done digitally with EM-236 interface unit or with Emen-Tool lite program installed in PC and EM-268 adapter cable. Parameters are stored into non-volatile memory of device. This interface unit can also monitor the current and rpm of motor. If necessary, the device also has an optional cooling fan available, which can be controlled with its designated output. This output switches on fan, when temperature rises over 65 deg.

This B-version has added shutdown control input to put driver to low pow consumption mode and also there is added Rs-485 port for Modbus communication. B-version has also few new stop braking option. In "stop brake" mode the all motor wire shorted in stop situation and it gives better hold torque as usually. The another special stop mode is "hold current" this generates very strong hold torque.

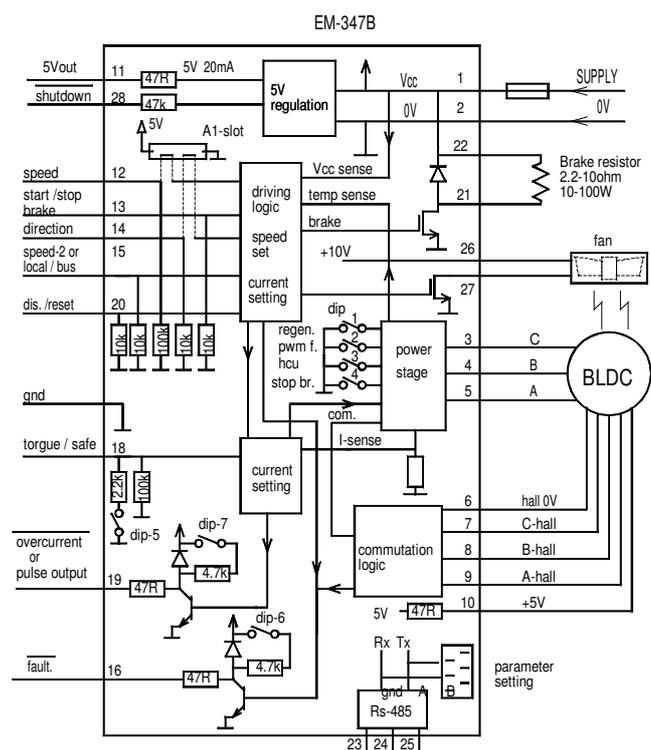
The device can be installed in DIN-rail base and some enclosure options are also available.

## TECHNICAL DATA

Supply voltage 12-48V ( 11-60Vdc )  
 Overvoltage limit 15-65V ( adjustable )  
 Idle current typ. 30mA  
 Idle current, shutdown=gnd 0.2mA  
 Max. current 50A cont ( Tamb. 50 °C )  
 Max. current 60A cont. with fan cooling  
 Max. current peak 80A ( max. 5s )  
 Max. brake output ( pin-21 ) current 20A  
 Brake resistor recom.value 1.5-10ohm  
 Pwm frequency typ. 16kHz  
 Overtemperature shut down 90°C  
 Fan output switch on > 65°C  
 Current limit setting 1-100A ( step 1 A )  
 Current limit analog scale 0-5V = 0-100A  
 Logic level of digital inputs  
 "off" = 0-1V or open / "on"= 4-30V  
 Input impedance of logic inputs 10k  
 Shutdown input open or gnd ( gnd= low idle )  
 Response time of digital input 2ms  
 Analog input range 0-5V up to 0-10V  
 Input impedance of analog inputs 100k  
 Input filter of analog input 100Hz  
 Rs-485 9600 / 19200baud Modbus RTU  
 Overcur. and fault outputs NPN max 50mA/60V  
 Output for fan cooling 12V max. 100mA  
 EMC measured for industrial environment  
 PCB material flammability class UL94V-0  
 Dimensions 140x122x43mm ( 56mm with fan )  
 Weight 520g / with fan 550 g

## FEATURES

- To the motors with HALL sensors
- motors 12V recom. up to 800W
- motors 24V recom. up to 1200W
- motors 48V recom. up to 1600W
- Three phase output
- Speed and torque adjustment
- Open/closed loop modes
- Dynamic braking
- Control output for cooling fan.
- True 4Q-power stage
- Braking resistor output
- Selectable brake mode
- Current limit and trip
- Symmetrical control option  $\pm 5V$  or  $\pm 10V$
- Fault and overcurrent outputs
- Good efficiency
- Low EMC emissions
- DIN-rail mountable
- Rpm-pulse output option
- B-board has extended voltage range
- B-board has shutdown input for idle reduction
- B-board replaced earlier A-versions ( all voltage )
- B-board has Rs-485 port ( Modbus RTU )
- B-board support B version firmwares
- B-version HW and SW offer special stop modes
- B-version board v3 support hold current option



TAKE IN USE

Nominal supply voltage is 24-48Vdc, ripple repetitive peak max.63V. An external supply fuse is recommended ( 10-60A ).

Pay attention when connecting motor wires, because there are a lot of combinations. If motor takes much current or runs roughly, then change wiring.

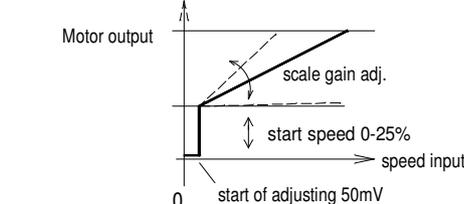
Default settings are in brackets in the parameter list. These are good start-up values.

Current limit has two mode, I-trip means overcurrent shutdown and the motor shutdown when current limit is exceeded or optionally continuous current limitation mode, when current is only limited, this last mode I-trip is disabled with parameter 5

In example picture to the left, all inputs are connected, but the device also works with less wiring. So only connect needed functions.

In high power applications, a DC-fan can be installed into driver to improve cooling. Driver has its own connector for fan. This output offers regulated DC- voltage ( 12V ). This output will activate when driver temperature exceeds 65°C.

Speed adjusting input range can be set with parameters 6 and 7. See picture below. In closed loop mode the speed range setting done with parameter-2. These rpm range values are calculated for 2-pole motor, for example 8-pole motor the rpm ranges are 4-time smaller.



A1-CARD

If symmetrical control is needed ( $\pm 5V$  or  $\pm 10V$  ), then an EM-A1 auxiliary card can be added into A1 slot. In symmetrical control the rotation direction determined by the polarity of the control signal and the middle point ( 0 ) is same as STOP. The installing of EM-A1 modified inputs: SPEED input 0-5V / 0-10V changes to  $\pm 5V$  or  $\pm 10V$  input. DIRECTION input changes to -5V output. This voltage can be used for potentiometer, see drawing. Instead of a potentiometer, a symmetrical voltage signal can also be used.

STOP and BRAKE

Driver has two options a brake motor. First option uses stop ramp and regenerate energy back to driver during slowing down. In this mode the regenerating energy has to lead battery or braking resistor. If there is battery power supply then energy goes automatically back to the battery. But in power supply use there has to use braking resistor, its output is activated when voltage exceeds value which has set with parameter-18, recommended set value is 10% over unloaded supply voltage. The second option is dynamic brake which means that stop ramp by-passed and motor poles shorted, this offer quick stop, but current can be rise very high in braking, so this is NOT RECOMMENDED for braking in cases where motor has high inertia! Braking options can be selected with parameter 11 and 13

CONTROL INPUTS

Speed input is an analog control input for speed setting. Signal can be set between 0-5V and 0-10V. Speed scaling can be done with parameters 6 and 7.

Torque input is an analog input for current limit setting. 0-5V signal to 0-100A current. This input can be set to work as analog input when parameter 12 is set = 0

Start/stop input can be used start and stop and brake motor. Parameter 11 can be set different start and stop options. Stop means that motor stops with stop ramp. Brake means that motor stops quickly with dynamic brake. This input can be set work also as FW-start. Input functions can be set with parameter 11.

Direction input is a digital input. It will change the rotation direction. It uses stop/start ramps during change. This input can set also as BW-start input, see param. 11

Speed-2 input is a digital input that activates speed-2. Speed-2 input can be used also as stop in. Speed-2 input can be used also as LOCAL/BUS mode nput this input function can be set with parameter 13

Reset /disable input is a digital input, that disables the driver. Motor goes to freewheeling ( all poles floating ). This input can also be set to work as reset with parameters 14 and 15. This input has the highest priority.

Rs-485 communication port for Modbus RTU. This feature has own "Modbus register definition" guide. Modbus can be activated with set parameter 13 = 2

Shutdown in shut off the control voltage of device and it also reduce the idle current consumption. If this pin pull to ground ( gnd ) then device is disabled

CONTROL OUTPUTS

Fault output: ( Pin-16 NPN open collector output ) this activates with general fault, Overtemperature, Overvoltage, Undervoltage. but this output can also indicates I-Trip if parameter 16 is set to = 0

Overcurrent output : (pin-19 NPN open collector output ) This output indicates when current limit is exceeded. but this ouput can be set also indicate I-trip situation or work as rpm pulse output. This output set with parameter 17

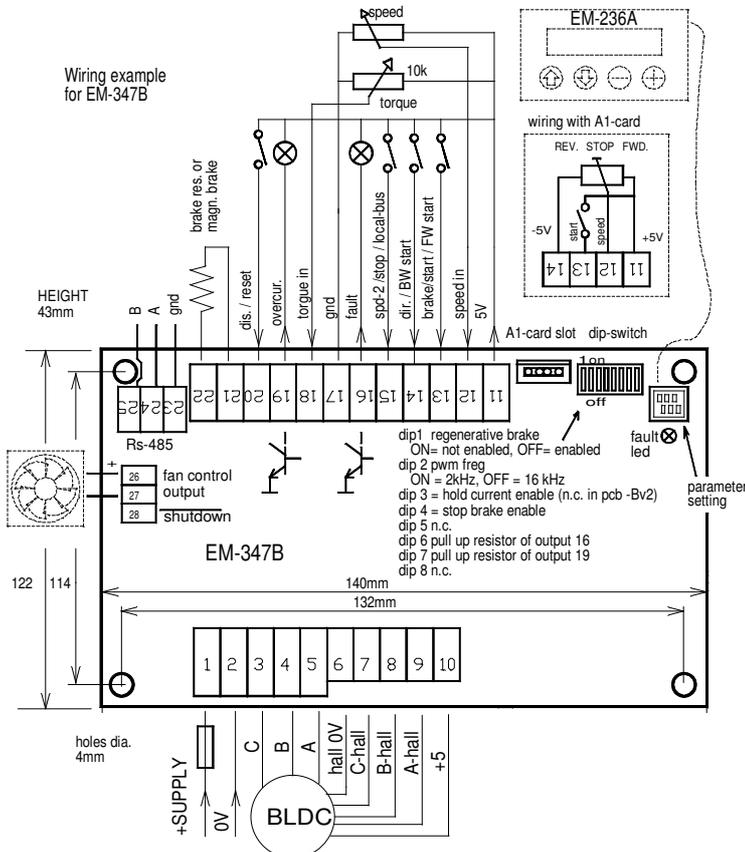
Brake output is NPN open collector output, pin-21 This can be used to control magnetic brake or brake resistor. This set with param 18.

MONITOR VALUES

- 1. Current 0-250A / 0-250
- 2. Braking current 0-250A / 0-250
- 3. Hall freq. 0-1000Hz / 0-1000
- 4. Operating voltage 0-75V / 0-750
- 5. PWM 0-100% / 0-255

LED INDICATIONS

- Fault led:
- Fast blinking = I-trip or overvoltage
- Random blinking = current limit, or braking current limit
- Continuous = overtemp, undervoltage or disable input "on"



SETTABLE PARAMETERS ( prog. EM-347B v1.2)

EM-347 parameters are set with interface unit EM-236 or with Ementool-Lite and EM-268.

1. Mode: 0-2 ( 0 )  
0= open loop  
1= closed loop  
2= closed loop " high inertia "
2. Closed loop range 0-4 ( 3 )  
0=3000rpm 2=9000rpm 4=3000rpm  
1=15000rpm 3=5000rpm
3. Start ramp 0-5s / 0-50 ( 1s )
4. Stop ramp 0-5s / 0-50 ( 1s )
5. I-trip delay 0.01-2.5s / 0-255 0=no trip ( 0.2s )
6. Scale start speed 0-25.5% / 0-255 ( 0 )
7. Scale gain 0-2.55 / 0-255 ( 200 )
8. Closed loop dynamic P-factor 1-200 ( 6 )  
or Rxl compensation in open open loop
9. Closed loop dynamic I-factor 1-200 ( 10 )
10. Braking current limit 10-50A / 10-50 ( 50 )
11. Pins 13 and 14 input mode 0-4 ( 1 )  
0=Stop / start pin 13 / dir. pin 14  
1=Start / stop pin 13 / dir. pin 14  
2=Start / brake pin 13 / dir. pin 14 ( without ramp )  
3=Start FW pin 13 / start BW pin 14 ( continuous )  
4=Start FW pin 13 / start BW pin 14 ( impulse )
12. Current limit 0-100A / 1-100 ( 40 )  
0= Current setting with pin 18
13. Speed-2 or Local/Bus input mode 0-100 ( 50 )  
0= stop input with rising edge ( with ramp )  
1= brake input with rising edge ( without ramp )  
2= Local / Bus selection ( if open then Modbus selected )  
10-100 = speed-2 preset value  
101-150 = enables and set hold current ( also dip 3 must set "on" )
14. I-trip reset and disable input ( 0 )  
0= I-trip reset only with disable input  
1= I-trip reset with disable in and with speed in to 0  
2= I-trip reset with disable in and with dir. input  
3= I-trip reset with new start command or speed set to zero.  
Disable input works as emerg. input, Releasing the disable input does not cause start, it requires a new start command  
10-200 = Timer reset 1-20s. ( 0 )
15. Over temp reset mode ( 0 )  
0= Only with disable input  
1= With speed input change 0 to up and values 10-200 timer reset 1-20s.
16. I-trip and overcurrent indication ( 0 )  
0= I-trip ind. to pin 16 & overcurr. ind. to pin 19  
1= No I trip indication to pin 16 and overcurr. to 19  
2= I-trip indication to pin 19  
3= Pin 19 reserved only for I-trip indication
17. Pulse output for pin 19 0-5 ( 0 )  
0= pin 19 set with parameter 16  
1= 3pulse/round ( possible only when param 2 is 2,3 or 4 )  
2= 1pulse/round  
3= 1pulse/ 2round  
4= 1pulse/ 3round  
5= 1pulse/ 6round  
6= I-motor to freq. output -40...0...50A <=> 10...50...100Hz
18. Brake out pin 21 0 or 15-65V / 15-65 ( 55 )  
0= brake out pin 21 is set to work like magn. brake cont. out  
15-65= Threshold level for pin 21 activation
19. Baud rate 0...5 ( 0 )  
0= 9600, even, 1 stop, 3= 19200, even, 1 stop  
1= 9600, odd, 1 stop 4= 19200, odd, 1 stop  
2= 9600, none, 2 stop 5= 19200, none, 2 stop
20. Modbus Address 1...247 ( 1 )