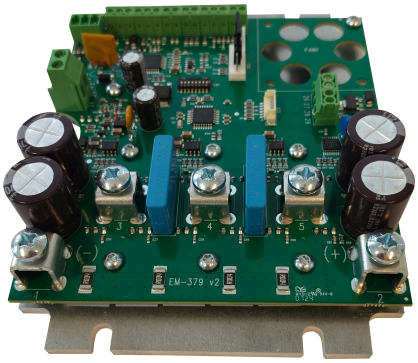
EM-379 BRUSHLESS (BLDC) MOTOR DRIVER 12-48V 60A



FEATURES

- Only 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
- Cooling via base plate (isolated)
- Low height
- Speed and torgue 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 ±5V or ±10V
- "Ardupilot" pwm control option
- Fault and overcurrent outputs
- Good efficiency

GENERAL

EM-379 is a brushless DC-motor driver with hall sensor feedback. The unit has a mosfet power stage with good efficiency 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 cooling of this device do with aluminium base plate and in high power application can be needed additional heatsink or fastening to sufficient metal body.

The unit has basic digital command inputs such direction, brake, start/stop, disable and there are analog inputs for speed and current control. The digitally presetable second speed (speed-2) is possible to activate with digital command input. Alternatively this driver can be controlled and monitored with Rs-485 and modbus. Driver has two NPN outputs for fault and overcurrent indication use. 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. Some inputs and outputs functions can be set with parameters.

There are two control options for speed. Direct control (open loop) sets motor voltage in propotion 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. Driver has also two optional control method which can be actived with add small auxliary card to A1-socket. Options are symmetric control with +/- signal for example from joystick and the another is so called ardupilot pwm signal which is commonly use in remote control receiver.

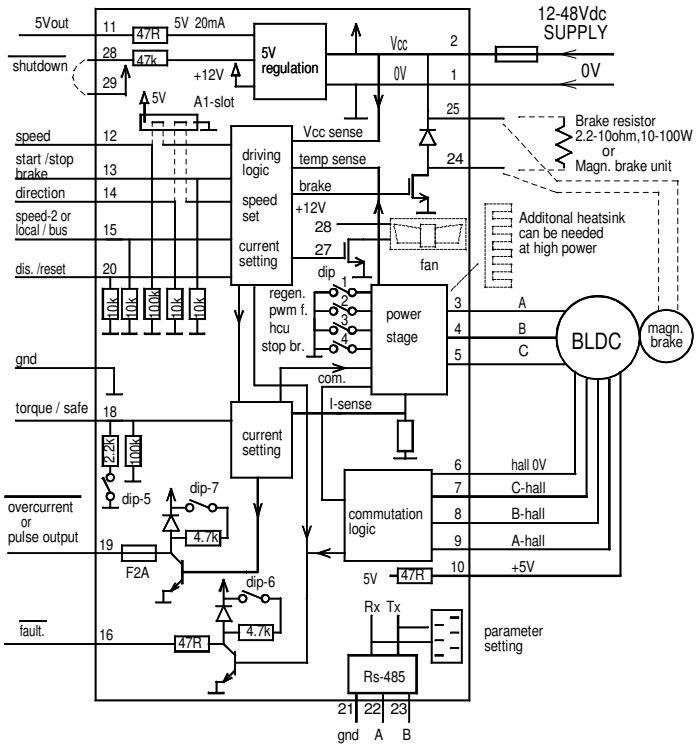
Settings can be done digitally with EM-236A interface unit or with Emen-Tool lite program installed in PC and EM-328 adapter cable. Parameters are stored into non-volatile memory of device. Device has also some dip-switches which can be set regeneration mode and special "stop brake" and "hold current" modes to improve stop situation torque.

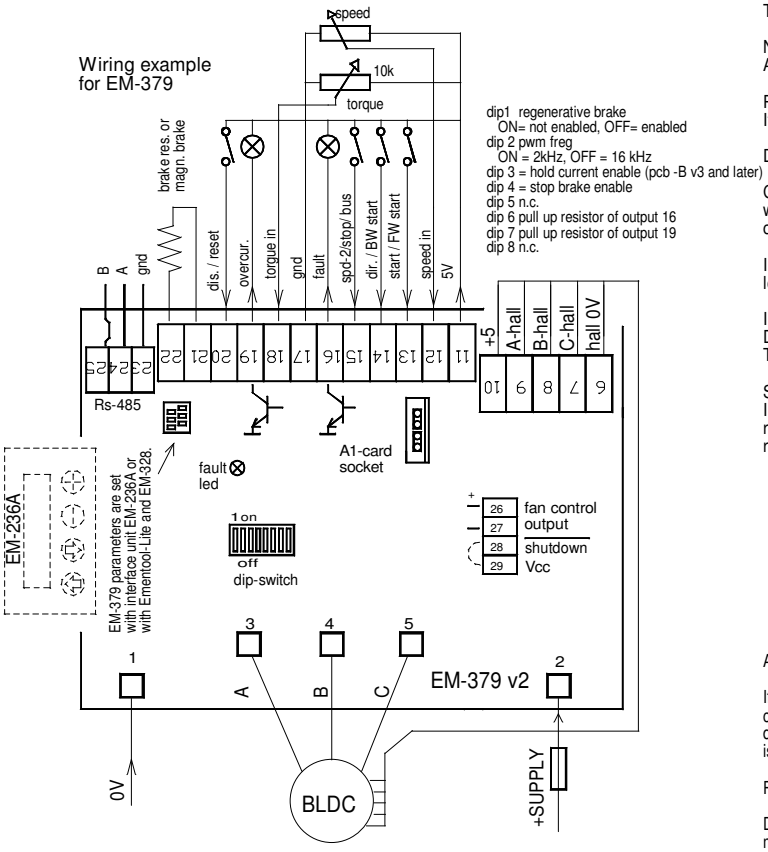
The special input "shutdown" sets driver to the low power consumption mode, this input overtakes all other control inputs and also overtake take the program and shut down the motor. The device has cooling fan output available, which can be controlled with its designated output. This output switch on the fan, when temperature rises over 65°C

TECHNICAL DATA

Supply voltage 12-48V (11-60Vdc)
Overvoltage limit 15-65V (adjustable)
Idle current typ. 30mA
Idle current, shutdown "open" or low < 0.5mA
Max. current 60A cont (Tamb. 50 °C)
Max. current 70A cont. with fan cooling
Max. current peak 80A (max. 5s)
NOTICE ! Continuous current >20A will need additional heatsink
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 < 1V (= 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
Overcurrent output NPN max. 2A/60V
Fault output NPN max. 50V 50mA
Output for fan cooling 12V max. 100mA
EMC measured
PCB material flammability class UL94V-0
Dimensions 143x110x32mm
Weight 340g / with fan 360 g

EM-379 pcb. v2





SETTABLE PARAMETERS (prog. EM-379 v2.7)

1. Mode: 0-3 (0)
   0= open loop, 1= closed loop, 2= closed loop "slow",
   3= motor current zero calibration. cal. time 5s. Use this cal.
   only when motor is stopped and then return mode 0,1 or 2
2. Closed loop range 0-4 (3)
   0=15000rpm, 1=7500rpm, 2=5000rpm 3=2500rpm, 4=1500rpm
   above ranges is for 4 -pole motor (2-pole pair). For the motor
   with higher number of poles the max. rpm is smaller in the ratio
   of number of poles
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 0-200 (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

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 overcur. 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, 1, 2 or 15-65V / 15-65 (55)
    0= magn. brake out, 1= magn brake out "slow", 2= magn. brake out "fast"
    15-65= Threshold level for pin 21 activation (brake res. out)
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)
21. Hold current 0-50 / 0=disable / 1-50 hold pwm (0)
    Notice! hold current activation need also dip-3 = "on"

TAKE IN USE

Nominal supply voltage is 12-48Vdc, ripple repetative 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.

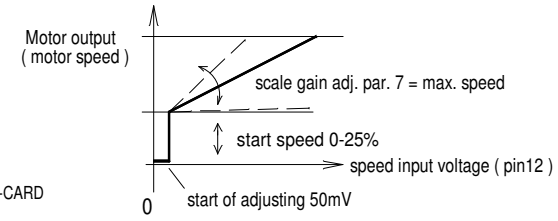
Default settings are in brackets in the parameter list. These are good start-up values.

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, In this last mode the 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.



If symmetrical control is needed (±5V or ±10V), then an EM-A1 auxliary 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 SPEED and DIR. inputs

REGENERATION BRAKE

Driver can be set regenerative or non-regenrative mode with Dip-1. In regen. mode the driver feeds energy back to battery eg. when slowing down. But if uses standard power power supply it cannot absorb energy and then must to use braking resistor to absorb braking energy. The braking resistor activation level set with parameter 18, recommended set value is 10% over unloaded supply voltage. voltage. Notice also that in high inertia system not adjust stop ramp too small to avoid too high braking current.

SPECIAL STOP MODES

The -A pcb. version card has added also two extra brake feature. With dip-3 can be set "hold current". This feature will activate when motor is stopped. This hold current increases "hold" torgue in stop sitution. The hold current set with param. 21
With dip-4 can set "stop brake" feature it connets motor wires togeher in stop situation and this way increases hold torque at stop situation.

MAGNETIC BRAKE

If motor has integrated magnetic brake the driver can be set to control this brake unit. The brake unit normally energized (released) when motor start to run. This mode set with parameter 18 options 0-2. Notice the regen. braking reistor option cannot use same time with magn. brake, then if needed use the external brake res. eg. EM-A43

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.

Shutdown input shut off the control voltage of device and it also reduce the idle current consumption. Shutdowned If this pin is open or connected to gnd

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 See chapters BRAKE and MAGNETIC brake above

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

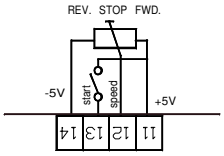
LED INDICATIONS

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

RS-485

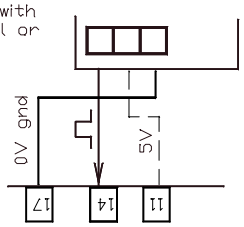
Rs-485 communication port for Modbus RTU. This feature has own "Modbus register definion" guide. Modbus can be activated with set parameter 13 = 2

Option when EM.A1-card is installed Into A1-socket
-5..0...+5V symmetric control

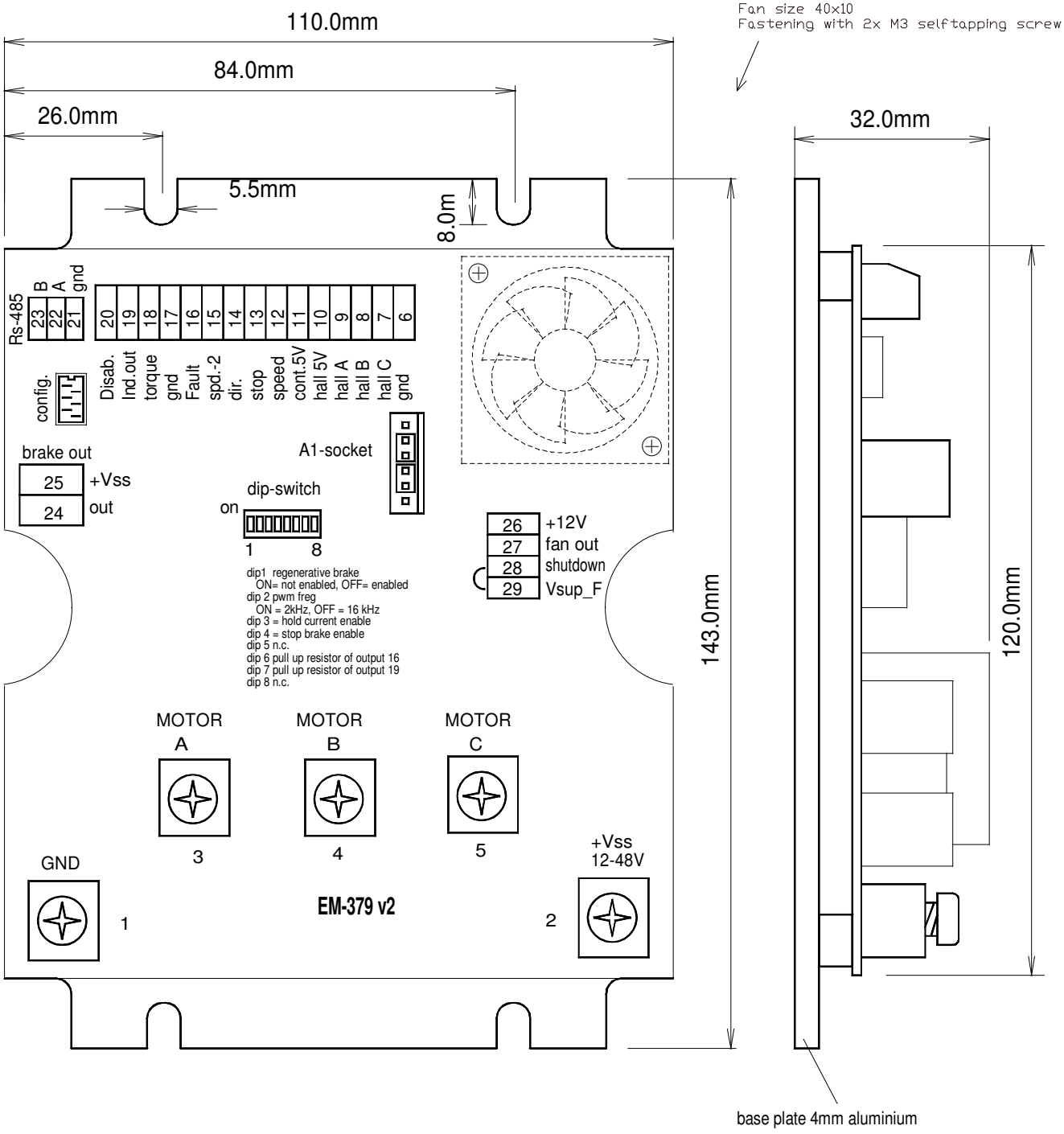


Option when EM-A46 card installed in EM-A1 socket
With this A46 card device can be controlled with Ardupilot pwm signal or RF-remote control

REMOTE CONTROL RECEIVER



Optional fan can be added into corner of printed board.
Fan 12V less 1W
Fan size 40x10
Fastening with 2x M3 selftapping screw



base plate 4mm aluminium

COMPANY	ELECTROMEN OY	
DRAWN	DATE	TITLE
K.M.K	21.4.26	Dimensions EM-379 v2