FLXMOD

smitec

MDR A2

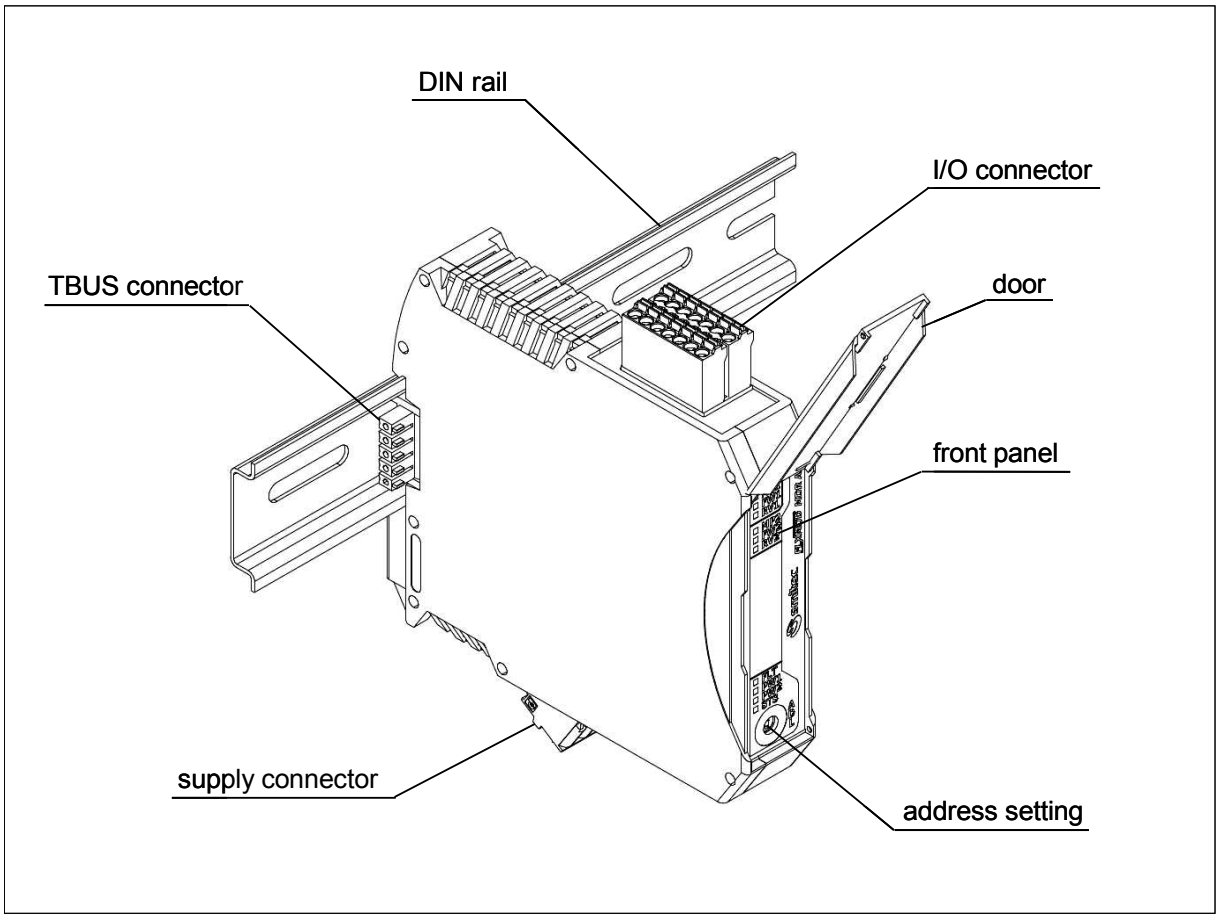
Dual DC brush motor driver with Hall sensors interface

Datasheet

Description

Driver module for DC brush motors, dual output and interface for Hall sensors. Main characteristics:

- dual power output with MOSFET H-bridge
- PWM control with software-programmable frequency
- Hall sensor interface for speed/position control
- overload and overcurrent protection
- status and diagnostic LEDs



Ordering informations

Products	SMITEC part number
Module with 2 outputs for DC-motor drive, complete with accessories (power connector, inputs connector and TBUS connector)	KZ010203

Accessories	SMITEC part number
Power supply connector (Phoenix Contact p/n 1910377)	KF100009
I/O connector (Phoenix Contact p/n 1738856)	KF101049
TBUS connector (Phoenix Contact p/n 2713722)	KF101034

Documentation	SMITEC part number
Installing instructions for MDR A2 (multilanguage)	DK400048
Datasheet for MDR A2 (english)	DK400067
FLXMOD system integration manual (english)	DK400076

Technical data

General data	
Housing dimensions (width x height x depth)	22.5 mm x 99.0 mm x 114.5 mm
Weight	107 g (without connectors), 126 g (with connectors)
Permissible operating temperature	+5° to +55°C
Permissible storage and transport temperature	-25° to +85°C
Permissible humidity	10% to 95%, not condensing
Permissible air pressure (operation)	80 to 106 kPa (up to 2000 m above sea level)
Permissible air pressure (storage and transport)	70 to 106 kPa (up to 3000 m above sea level)
Degree of protection	IP20 according to IEC 60529
Connection method for connectors	Spring cage terminals
Conductor cross-section (power connector)	0.2 to 2.5 mm^2 (24 – 12 AWG)
Conductor cross-section (output connector)	0.2 to 1.5 mm^2 (24 – 16 AWG)
Functional earth connection	To the DIN rail with spring contact
Mode state visual indicators	Fault (FLT), status (STS), power (PWR1 and PWR2), motor power (MP1 and MP2), forward (FW1 and FW2) and reverse (RV1 and RV2) LED lamps

Power supply	
Main power supply V_M	24 V DC (-15% ÷ +20% according to IEC 61131-2)
Auxiliary power supply V_A	24 V DC (-15% ÷ +20% according to IEC 61131-2)
Maximum allowed ripple on V_M and V_A	5% of supply voltage (according to IEC 61131-2)
Current consumption from main supply	8 A max.
Current consumption from auxiliary supply	150 mA max.
Supply overvoltage protection on V_M	Unidirectional Zener clamp (V_z > 30 V)
Supply overvoltage protection on V_A	Bidirectional Zener clamp (V_z > 30 V)
Supply reverse polarity protection on V_M	Input shunt diode, reverse connected
Supply reverse polarity protection on V_A	Series diode
Supply fuse	12 A on main supply (V_M) not replaceable by the user; 1 A on auxiliary supply (V_A) not replaceable by the user
Local bus power supply	5 V DC (from local bus)
Local bus supply protections	None
Power presence visual indicators	Two green LED lamps, lighted if main supply (PW1) and auxiliary supply (PW2) is present

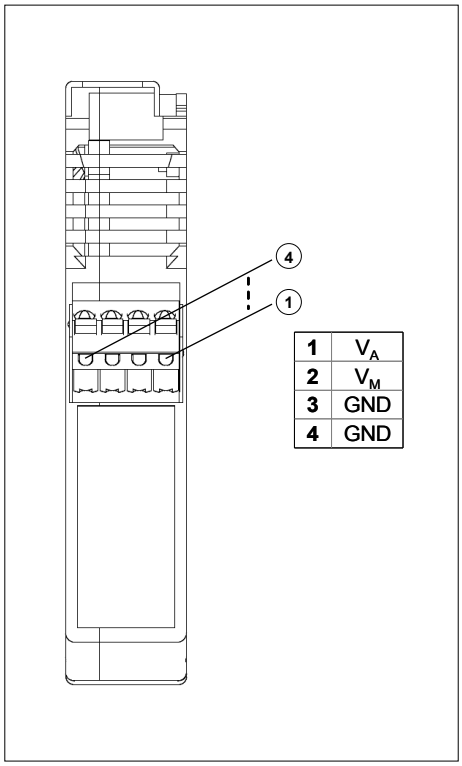
Power outputs	
Number of outputs	2 H-bridge outputs with power MOSFETs
Output current	5.5 A max. (one output used), 4 A max. (two outputs used)
Type of load	24 V DC brush motor
Output current limitation	> 30 A
Voltage output range	$-V_A$ to $+V_A$, positive and negative
PWM frequency range on channel 1	Software selectable, 5 different values: 76.6 Hz, 312 Hz, 609 Hz, 2.44 kHz and 9.80 kHz
PWM frequency range on channel 2	Software selectable, 255 different values from 38.4 Hz to 9.80 kHz, according to the following formula: $f_{PWM} = \frac{9804}{n+1}$ Where *n* is an integer ranging from 0 to 254.
PWM range	0 ÷ 100%, forward and reverse
Outputs common potential isolation from GND	500 VAC, functional isolation only
Isolation between channels	none
Output state visual indicators	Three orange LED lamps for every output, indicating motor energized (MPx) and rotation direction (FWx and RVx)

Hall sensors inputs	
Number of digital inputs	Four (two for each motor)
Type of inputs	For open collector sensors, 1.5 kΩ pull-up integrated on-board, 24 V tolerant
Input logic levels	V_L = 1.5 V max, V_H = 2.4 V min, Schmitt-triggered
Input frequency range	From 0 to 4 kHz
Hall sensors internal supply	5 V ± 10% / 100 mA, short-circuit protected

Interface	
Local bus	Proprietary FLXIO™
Module address setting	With rotary switch on front panel
Bus connections	By TBUS connectors on DIN rail
Interface circuitry protections	ESD protections
Level of ESD protection	±8 kV (IEC 61000-4-2, contact discharge)

Connections

The module has two connectors: a power connector and an I/O connector. They allow easy "plug and play" of the module, and also a fast replacement of a faulty unit.



Power connector

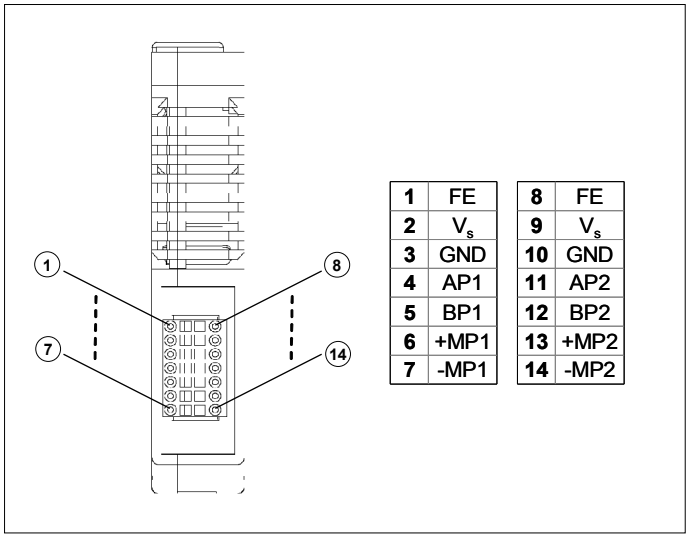
The power connector is located on the bottom wall of the module. For the pinout, refer to the illustration at right.
Its function is to provide the supply for the I/O circuitry, whilst the CPU of the module is fed by the TBUS connector on the back of the unit. Two different supplies are needed for the module: a main supply (V_M) and an auxiliary supply (V_A). V_M supplies the power output stage (an H-bridge realized with power MOSFETs), whilst V_A feeds the Hall sensors and related acquisition circuitry in the event of a main supply failure.
The Hall section supply is obtained diode-ORing V_A and V_M supplies. Therefore, if the user doesn't need to retain motor's position in case of main supply failure, auxiliary supply connection is unnecessary. This condition usually occurs when the system provides some position zeroing system, or where position loss is not of concern. Where motor's position mustn't be lost in case of a main supply failure, the user should provide an uninterruptable external power supply (e.g. a battery and relevant charging apparatus) on pin V_A. This arrangement greatly reduces the size of the backup system, due to the limited current consumption of the sensor interface.

Warning: V_A and V_M supplies must have the same common potential (GND). Disregarding this rule could lead to module and/or system failure.

Refer to the FLXMOD System Integration Manual for power connections topology.

I/O Connector

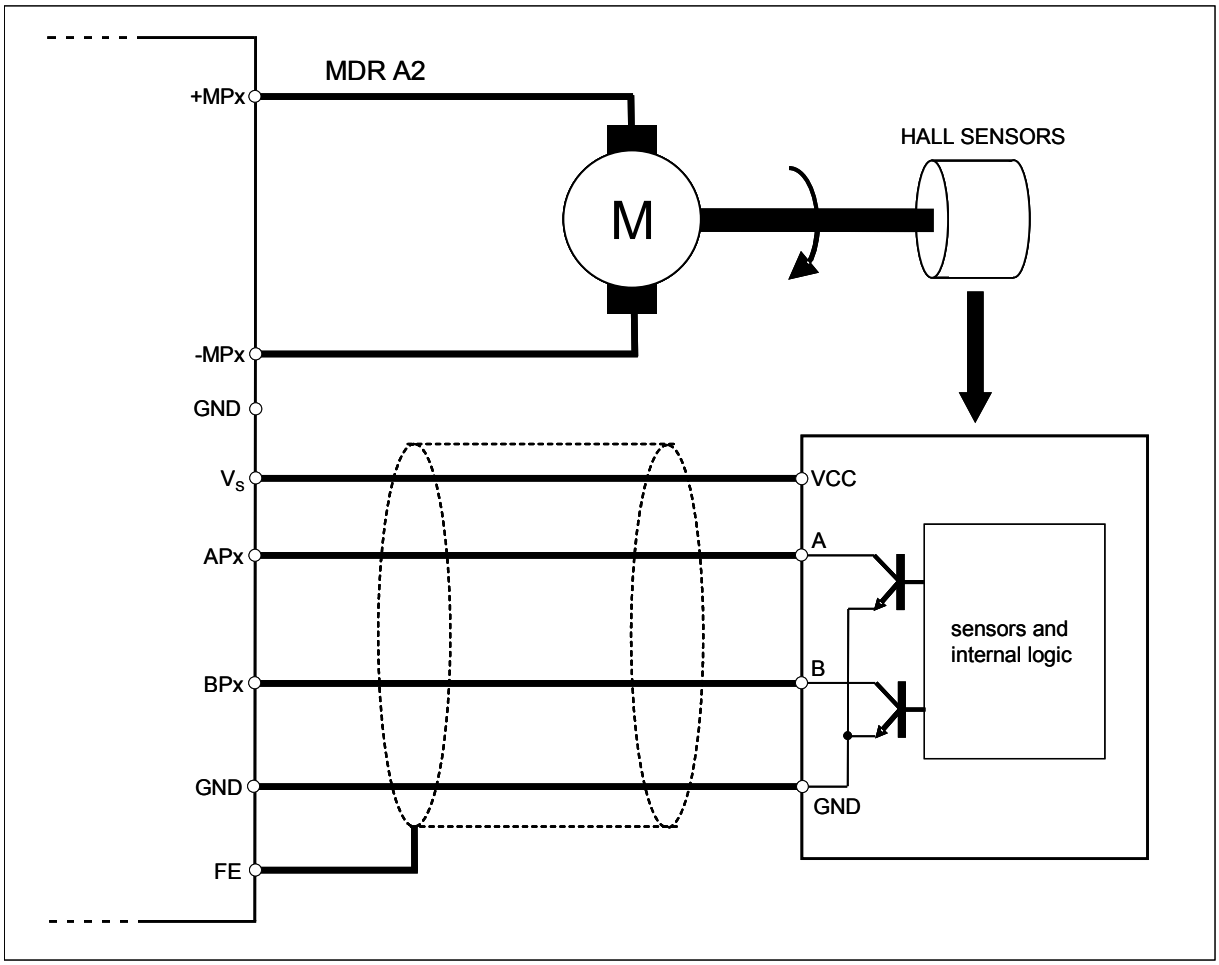
Located on the upper side of the module, this connector (see illustration) permits the wiring of the motors and of the Hall sensors.
As you can see, each row of the connector has the same pinout, to ease the wiring and prevent mistakes.



1	FE	**8**	FE
2	V_s	**9**	V_s
3	GND	**10**	GND
4	AP1	**11**	AP2
5	BP1	**12**	BP2
6	+MP1	**13**	+MP2
7	-MP1	**14**	-MP2

Connection notes

As stated previously, the module can drive two brush DC-motors with related Hall sensors; the following illustration shows the correct method of wiring.



Recommended connections for motors and Hall sensors

When the wiring of the motor is straightforward, a bit of care is required for the Hall sensors. The module internal circuitry is tailored to standard open-collector (or open-drain) digital output Hall sensors; pull-up resistors are integrated inside the module, and sensors should be fed by V_S pin.
If the system should work in a noisy environment, the use of shielded wire is recommended; the shield must be connected to the FE pin of the connector.

Warning: Use a cable with cross-section suited to the current involved. A wire smaller than necessary can cause risk of fire and unwanted voltage drops.

Warning: Hall sensors internal power supply has a current capability of 100 mA max. Never exceed it or the system will be damaged.

Warning: Reduce the risk of Hall sensors reading errors routing wires away enough from noise sources (e.g. inverter input/output wires, switching power supplies, switching contacts, etc..).

Notes on motors

As previously stated, the module can drive DC brush-motors only. During rotation, a little sparkling on the collector is usually generated; some motors manufacturers used to insert noise-suppressing capacitors between contacts.
Driving the motor in PWM fashion causes abrupt charging/discharging of these capacitors, greatly increasing commutation losses of the output stage and consequently reducing the available output current. In extreme cases, the module couldn't start due to an overcurrent error.
Proper remedies at this problem are:

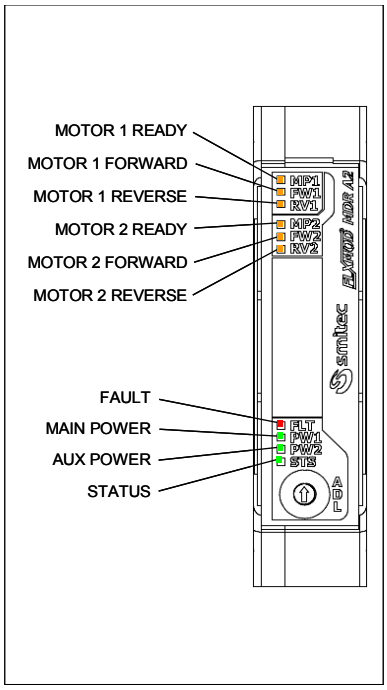
- remove capacitors from motor or reduce capacitance value
- replace capacitors with RC suppression networks
- reduce PWM switching frequency (whenever possible)
- derate the output current available to compensate for losses
- insert choke coils between module and motors (peak current reduction)

Module addressing

Before operation you must set the address of the module by the rotary switch reachable from the front panel; the operation is easily done opening the transparent plastic cover and turning the rotor with a small bladed screwdriver.
The address determination is described in the FLXMOD System Integration Manual.

Diagnostic and status indicators

Each module is provided with a series of LED lamps on the front panel (see illustration), that indicates the status of the unit, the setting of every output (voltage or current) and a possible diagnostic warning. For the sake of clarity, different lamp colours are employed.



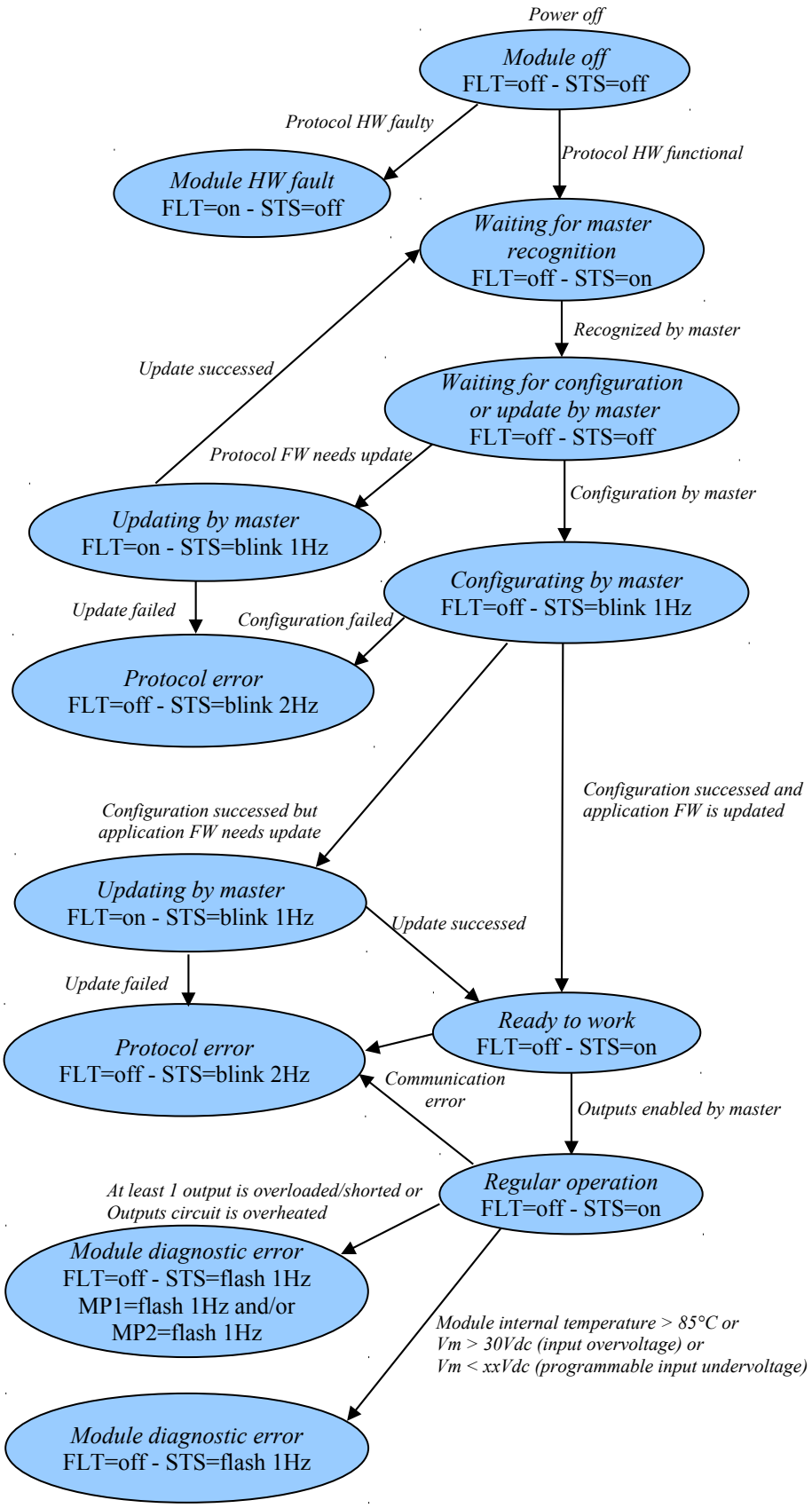
The green power (**PWR**) LED is lighted if the 24 V supply (V_M) is present and the internal fuse is not blown.
Self monitoring of supply voltage is also implemented to deliver a best self-diagnosis. The module switches in diagnostic error when V_M > 30Vdc and when V_M < of the value set up by the master module (low voltage check is disabled by default); this status is displayed by **STS** LED.

The green power (**PW2**) LED is lighted if the 24 V auxiliary power supply (V_A), used for Hall sensor interface, is present and the internal fuse is not blown.

The **MP1** and **MP2** LEDs if lighted indicate that respectively the motor output #1 and #2 are ready to go (start command received and absence of fault errors).
This module is provided by outputs short circuit and overload protection. In case of short-circuit of at least one motor output, it immediately shuts down the involved output; then, for safety reasons, the internal logic shuts down all outputs and a diagnostic error is issued by **STS** LED and output relative **MP** LED.
In output/s overload condition the self-diagnostic may take some time before the diagnostic error is issued, depending on the severity of the overload (thermal protection). The actions taken in this case are the same of above.

The **FW1** and **RV1** LEDs turn on if the motor #1 has done a step respectively in the forward or reverse direction. If the module doesn't detect any change for more than one second in the direction of rotation, the relevant LED turns off. **FW2** and **RV2** LEDs manifest the same behaviour (motor #2).

The status of the unit is indicated by both status (**STS**) and fault (**FLT**) LEDs; their behaviour is described in the following logic state chart. The exact cause of a diagnostic error can be read out by master module and the application software.


Power off
Module off
FLT=off - STS=off
Protocol HW faulty
Protocol HW functional
Module HW fault
FLT=on - STS=off
Waiting for master recognition
FLT=off - STS=on
Recognized by master
Update successed
Waiting for configuration or update by master
FLT=off - STS=off
Protocol FW needs update
Configuration by master
Updating by master
FLT=on - STS=blink 1Hz
Configurating by master
FLT=off - STS=blink 1Hz
Update failed
Configuration failed
Protocol error
FLT=off - STS=blink 2Hz
Configuration successed and application FW is updated
Configuration successed but application FW needs update
Updating by master
FLT=on - STS=blink 1Hz
Update successed
Update failed
Ready to work
FLT=off - STS=on
Protocol error
FLT=off - STS=blink 2Hz
Communication error
Outputs enabled by master
Regular operation
FLT=off - STS=on
At least 1 output is overloaded/shorted or
Outputs circuit is overheated
Module diagnostic error
FLT=off - STS=flash 1Hz
MP1=flash 1Hz and/or
MP2=flash 1Hz
Module internal temperature > 85°C or
Vm > 30Vdc (input overvoltage) or
Vm < xxVdc (programmable input undervoltage)
Module diagnostic error
FLT=off - STS=flash 1Hz