1 Features and Benefits

- Motor driver with 4 half-bridges
  - Ron =0.35Ω typ. for 1 Half-bridge + Shunt
  - 2x NFETs for each half-bridge
  - On-chip charge-pump for top-NFETs
  - V_{ds} protection for all NFETs
- Control interface:
  - PWM, UART, I²C
- Motor Control Logic
  - Sensorless FOC Drive for BLDC fans/pumps
  - Configurable motor parameters
- Package: SO8-ep
- IC temperature range -40°C to 150°C (ambient temperature: -40°C to 125°C)
- AEC-Q100 qualified
- Periphery
  - motor PWM timers, general timers
  - 13-bit ADC with < 2 µs update rate for differential current, 12-bit for voltage, temperature channels
  - Differential Current sensing +/-4A
  - Temperature sensor, over-temperature protection
  - Over-current, over-voltage and under-voltage protection
- Voltage regulators
  - Internal voltage regulators, powered from 24V or 12V supply
  - Motor operating supply Vs = 5.5V to 26V
  - Logic active down to 4V
  - Low standby current consumption of typ. 25µA in sleep mode
  - Wake-up via COMM or IO0 interface (PWM, I2C, UART)

2 Application Example

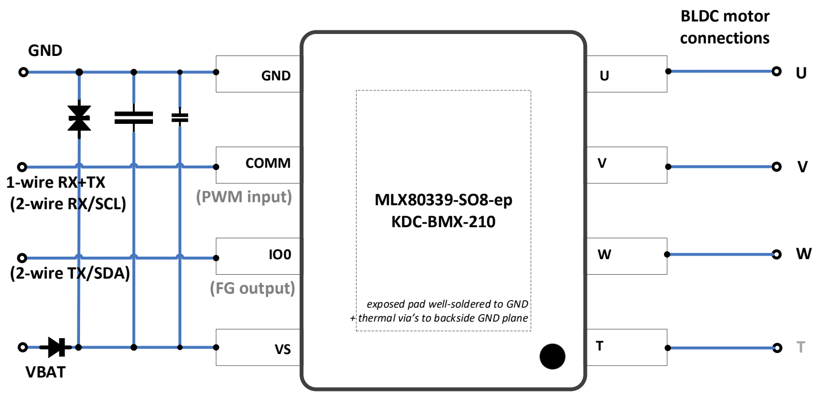


Figure 1: Application Example

- Sensorless BLDC fan, pump, up to 1.6Arms (0.35Ω Ron), maximum 20W at 12V, 40W at 24V
- Simple & fast control of many 80339 motors on the same digital bus with detailed feedback
- Customers can do fast application configuration via the MLX Code-free-Start-to-Run tool [1]

3 Ordering Information

Order Code	Temp. Range	Package	Delivery	Remark
MLX80339 KDC-BMX-210-RE	-40 - 125 °C	SO8-ep	Reel	Code-free BLDC fan or pump driver (U,V,W)

Table 1: Ordering information

4 Code-free Family Concept

	MLX80339 (24V)	MLX80348 (48V)	MLX80349 (48V)
Operating voltage (motor power)	**5.5V...26V (<40W)**	8V...80V (<1500W)	8V...80V (<150W)
Driver	**4x Driver on-chip typ. 0.35Ω Halfbridge**	3x PreDriver for 100nC FETs	3x PreDriver for 20nC FETs
Motor current sense	**Low side, On-chip**	1...3x Low side, External shunt(s)	Low side, External shunt
ADC for motor current, voltage, temperature	**13-bit differential**	13-bit differential	13-bit differential
ECU interface	**pwm, I^2C, uart**	analog, pwm, I^2C, uart	analog, pwm, I^2C, uart
Sensorless FOC support	**Yes**	Yes	Yes
Maximum IC Temperature (with validated mission profile)	**T_j = 150°C**	Tj = 150°C	Tj = 150°C
Package	**SO8-ep**	QFN32, 5x5	QFN24, 4x4

Table 2: Code-free Family

5 Revision History

Version	Date	Description
001	31/03/2026	Initial version
002	27/05/2026	Updated section 12.3.6, section 14, section 15.1.4, section 15.1.6, section 16.1.3, section 16.8, added section 16.6(stall behaviour)

Table 3: Revision history

6 Contents

7 Abbreviations

ADC	Analog Digital converter
API	Application Program Interface
ASSP	Application Specific Standard Product
BLDC	Brushless DC (motor)
CRC	Cyclic Redundancy Code
ECU	Electronic Control Unit (with µ-Controller/µ-Processor)
EEPROM	Electrically Erasable/Programmable Read-Only Memories, for Configuration
EMC	Electromagnetic Compatibility
ESD	Electrostatic Discharge
FG	Frequency Generator (tachometer output in PWM/legacy mode)
FOC	Field-Oriented Control
HV	High Voltage Pin
I2C	Inter-Integrated Circuit
ID	Identifier
IO	Input Output
IO0	Input/Output pin 0 (used as FG pin in PWM mode)
IP	Intellectual Property
LSB	Least Significant Byte
LV	Low Voltage Pin
MSB	Most Significant Byte
OC	OverCurrent
OL	Open Loop
OT	OverTemperature
OV	OverVoltage
PCB	Printed Circuit Board
PHY	Physical Layer
PPM	Pulse Position Modulation (physical layer for fast Flash programming)
PWM	Pulse Width Modulator
RPM	Revolutions Per Minute
RX	Receive (serial communication)
SCL	Serial Clock Line (I2C)
SDA	Serial Data Line (I2C)
SMD	Surface Mount Device
SO8	Small Outline 8-pin package
SOIC8	Small Outline Integrated Circuit, 8-pin package
SRP	Static-Rotor-Position
STR	Code-Free Start-to-Run
TX	Transmit (serial communication)
UART	Universal Asynchronous Receiver/Transmitter
UV	Under Voltage
VS	Supply Voltage

8 References

The following documents & tools are referred to in this document:

[1] MLX Code-free-Start-to-Run web-tool & GUI to characterize and configure the motor *https://www.melexis.com/MLX80339-210*
[2] MCM81339 PCB to connect to PC USB and BLDC motor, and run motor characterization *https://github.com/melexis/mcm-81339-pcb*
[3] ECU firmware examples to control MLX80339 via PWM, UART, I2C *https://github.com/melexis/mlx-codefree-communication*

[4] Guidelines for storage and handling of plastic encapsulated ICs https://www.melexis.com/en/tech-info/ic-handling-and-assembly/storage-and-handling
[5] Guidelines for lead forming of SIP Hall Sensors https://www.melexis.com/lead-forming
[6] Guidelines for welding of PCB-less devices https://www.melexis.com/welding
[7] Guidelines for IC handling and assembly https://www.melexis.com/ic-handling-and-assembly

9 IC Block diagram

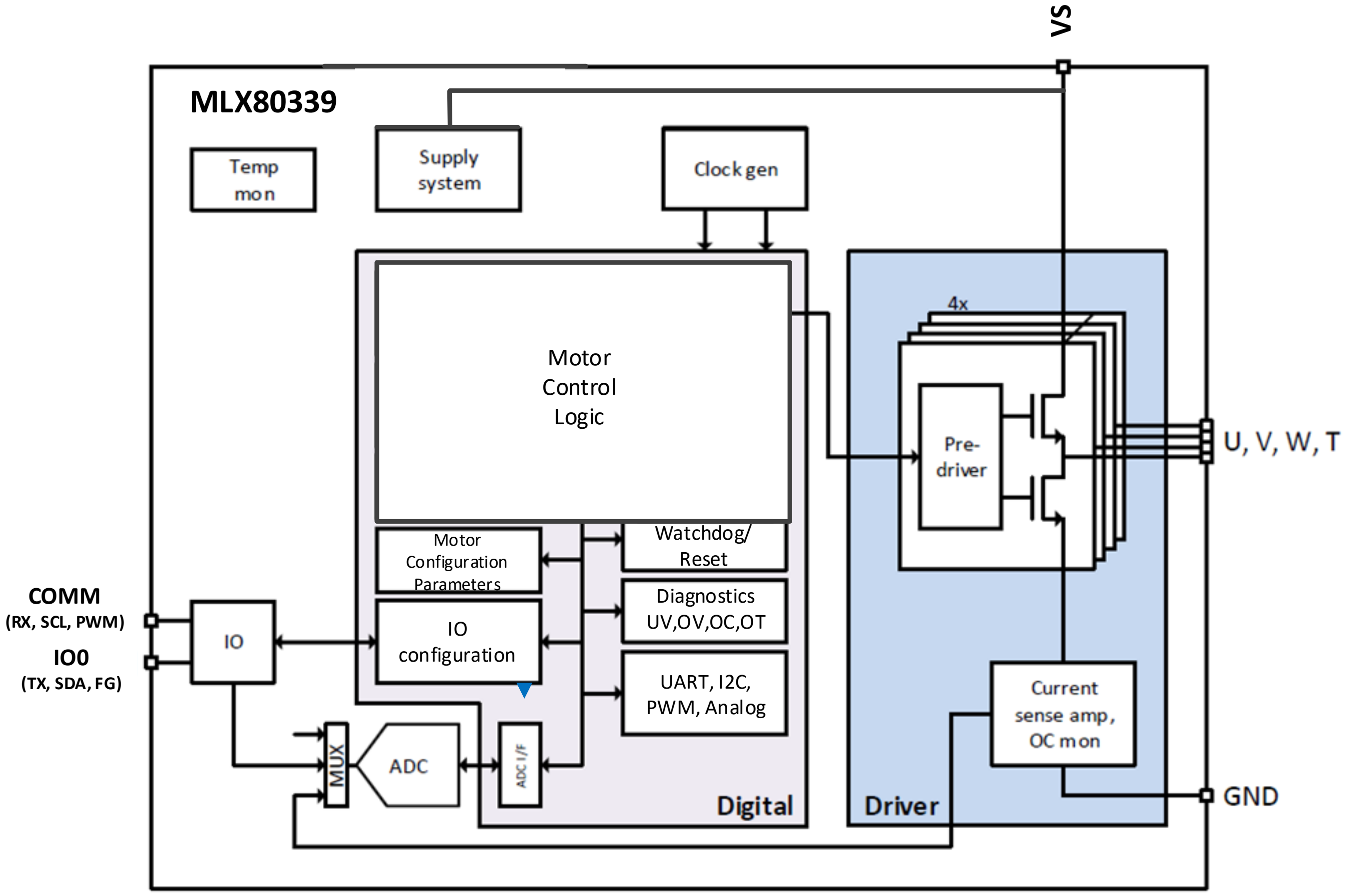
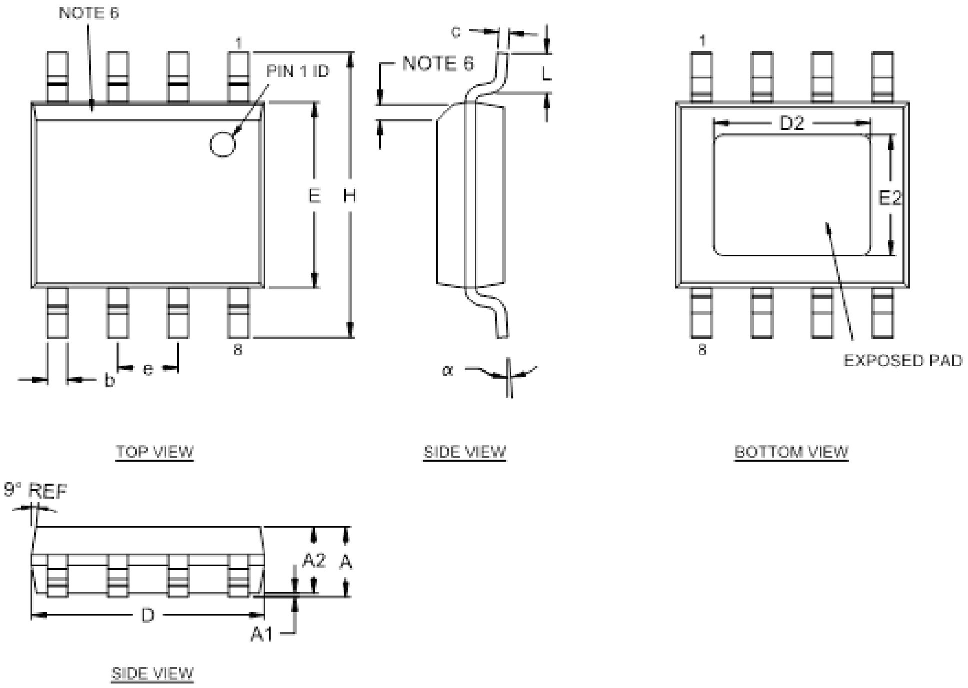


Figure 2: IC Block diagram

10 Packaging, IC Handling and Assembly

10.1 Package data SO8-ep



SYMBOL	MINIMUM	NOMINAL	MAXIMUM
A	1.40	---	1.68
A1	0.00	---	0.13
A2	1.37	---	1.58
D	4.80	4.90	5.00
E	3.81	3.90	3.99
D2	3.00	3.30	3.55
E2	2.29	2.50	2.79
H	5.80	6.00	6.20
L	0.41	---	1.27
b	0.36	0.41	0.46
c	0.19	---	0.25
e	1.27 BSC		
α	0°	---	8°

NOTE :

1. ALL DIMENSIONS IN MILLIMETERS (mm) UNLESS OTHERWISE STATED.
2. DIMENSION D DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS OF MAX 0.15 mm PER SIDE.
3. DIMENSION E DOES NOT INCLUDE INTERLEADS FLASH OR PROTRUSIONS OF MAX 0.25 mm PER SIDE.
4. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION OF MAX 0.10 mm.
5. LEAD TO LEAD COPLANARITY MAX 0.100 mm.
6. MOLD CHAMFER ANGLE CAN DIFFER. DEPENDING ON MOLD TOOLING IT IS POSSIBLE TO HAVE NO CHAMFER OR A 45 DEGREE CHAMFER WITH TYPICAL WIDTH OF 0.33 mm. CONTACT MELEXIS IN CASE OF QUESTIONS.
7. DAMBAR CUT PORTION AT THE LEAD SHOULDER CAN HAVE TRACES OF EXPOSED COPPER. CONTACT MELEXIS IN CASE OF QUESTIONS.

Figure 3: Package Drawing SOIC8 with exposed pad

10.2 Package pin-out

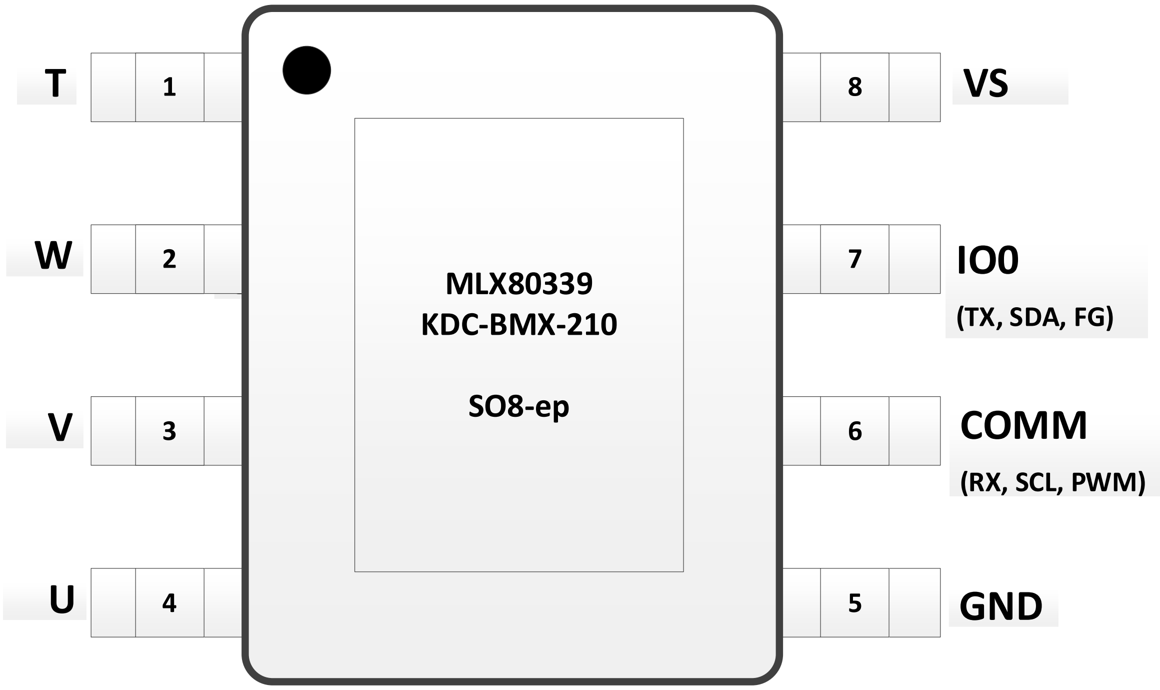


Figure 4: Pin-out diagram SO8-ep (-210)

SO8-ep		8-pins accessible	-210 variant (BLDC)
1	T	T-phase	Not used for BLDC motor
2	W	W-phase	Connect to BLDC motor
3	V	V-phase	Connect to BLDC motor
4	U	U-phase	Connect to BLDC motor
5	GND	Ground	
6	COMM	Communication input/output	Used for UART RX (TX), I2C-SCL, PWM-in
7	IO0	Communication input/output	Used for UART TX, I2C-SDA, FG-out
8	VS	Supply voltage	For Logic & Motor Driver (VS=VSM)

Table 4: Pin-out description for SO8-ep, -210 variant

10.3 Package Marking

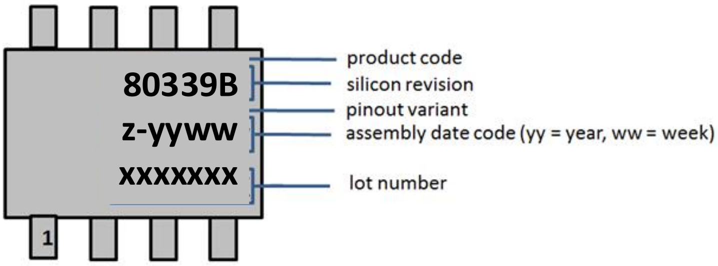


Figure 5: Package Marking SOIC8-EP

10.4 Storage and handling of plastic encapsulated ICs

Plastic encapsulated ICs shall be stored and handled according to their MSL categorization level (specified in the packing label) as per J-STD-033.

Electronic semiconductor products are sensitive to Electro Static Discharge (ESD). The component assembly shall be handled in EPA (Electrostatic Protected Area) as per ANSI S20.20

For more information refer to Melexis *Guidelines for storage and handling of plastic encapsulated ICs* *[4]*

10.5 Assembly of encapsulated ICs

For Surface Mounted Devices (SMD, as defined according to JEDEC norms), the only applicable soldering method is reflow.

For Through Hole Devices (THD), the applicable soldering methods are reflow, wave, selective wave and robot point-to-point. THD lead pre-forming (cutting and/or bending) is applicable under strict compliance with Melexis *Guidelines for lead forming of SIP Hall Sensors* [5].

Melexis products soldering on PCB should be conducted according to the requirements of IPC/JEDEC and J-STD-001. Solder quality acceptance should follow the requirements of IPC-A-610.
For PCB-less assembly refer to the relevant application notes or contact Melexis.

Electrical resistance welding or laser welding can be applied to Melexis products in THD and specific PCB-less packages following the *Guidelines for welding of PCB-less devices* [6].

Environmental protection of customer assembly with Melexis products for harsh media application, is applicable by means of coating, potting or overmolding considering restrictions listed in the relevant application notes [7].

For other specific process, contact Melexis via www.melexis.com/technical-inquiry

10.6 Environment and sustainability

Melexis is contributing to global environmental conservation by promoting non-hazardous solutions. For more information on our environmental policy and declarations (RoHS, REACH…) visit www.melexis.com/environmental-forms-and-declarations

11 Typical application schematic

In the following schematic example, external components are indicated that may be needed to protect the IC against EMC / ESD pulses. Depending on ECU conditioned power, overvoltage and reverse polarity, some components may not be needed. Capacitor needs or capacitor values will depend on specific OEM ESD/EMC requirements, see also section Application circuit advice for improved ESD and EMC behaviour. More info is available in the MLX80339 hardware application chapter.

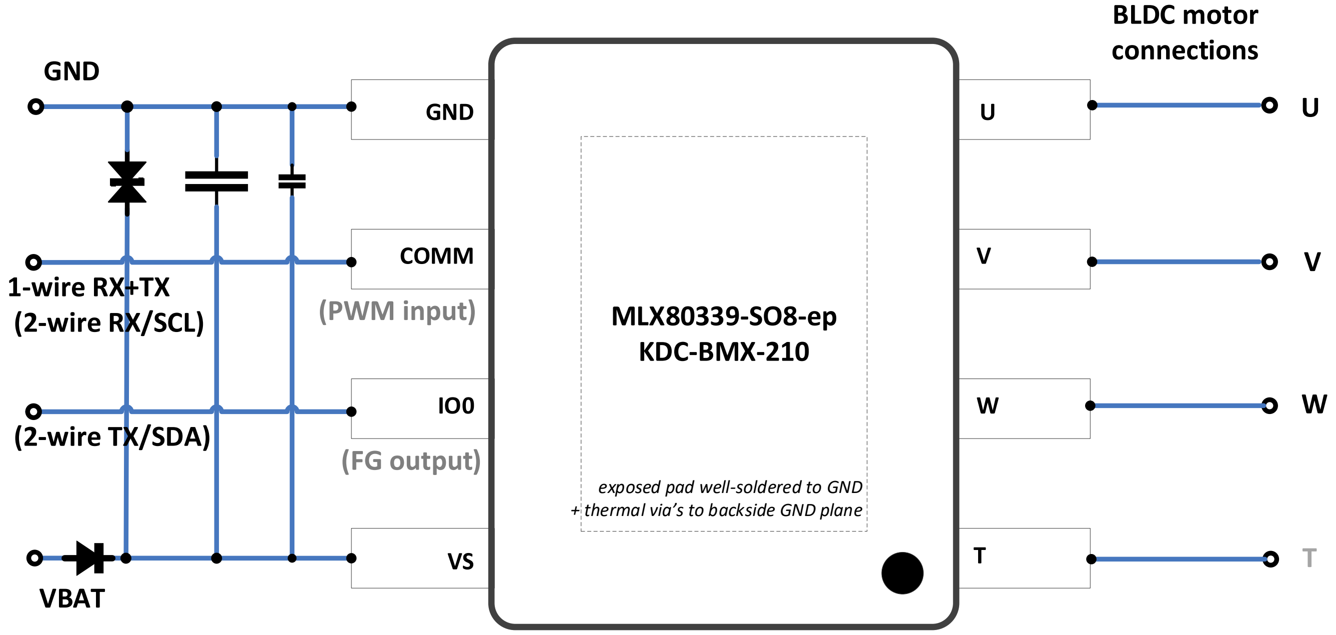


Figure 6: Typical motor schematic with MLX80339 (SO8-ep)

12 Electrical characteristics

12.1 Absolute maximum ratings

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Supply voltage	VS	-0.3	12/24	28	V	
COMM input (output)	VCOMM	-0.3	3.3	VS+0.3	V	vs. GND (RX, SCL, PWM)
IO0 output	VOUT_DIG	-0.3	3.3	3.6	V	IO0 (TX, SDA, FG)
HV phase voltage	VAN_HV	-0.3		VS+0.3	V	U, V, W, T driver phases
ESD HBM capability	ESD_HBM	-2		2	kV	All pins
ESD CDM capability	ESD_CDM	-500		500	V	All pins
Junction temperature	TJ	-40		150	ºC	

Table 5: Absolute maximum ratings

[1] ISO 7637 test pulses are applied to VS via a reverse polarity diode, a TVS and a blocking capacitor.

12.2 Operating range

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Supply voltage	V_S	6.5		26	V	Driver full performance
Supply voltage	V_S	5.5		6.5	V	Driver reduced performance [1]
Supply voltage	V_S	4		26	V	Analog + Digital full performance
Junction temperature	T_J	-40		150	ºC	Limited time at Tj=150 ºC [2]

Table 6: Operating range

[1] Motor driver functional at reduced performance (higher bridge resistance, reduced accuracy of current sense amplifier)
[2] Extended temperature range with Tj=150 ºC is only allowed for a limited time, customer's mission profile has to be agreed by Melexis as an obligatory part of the Part Submission Warrant (PSW).

12.3 Electrical specifications

12.3.1 Current consumption

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Working current (motor logic)	INOM		10	15	mA	Motor not running

Table 7: Electrical specifications: current consumption

12.3.2 Supply system

12.3.2.1 VS under-voltage and over-voltage

The purpose of the hardware overvoltage (OV) and undervoltage (UV) protection is to protect the IC from damage during extreme electrical conditions. The user can configure the application over- and undervoltage levels which are below hardware OV and above the hardware UV protection levels for supply VS.

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
VS under-voltage detection threshold	VTH_UV_VS	3.5	4	4.5	V	
VS under-voltage detection hysteresis	VHY_UV_VS	0.1	0.5	1	V	
VS over-voltage detection threshold	VTH_OV_VS	26	28	30	V	
VS over-voltage detection hysteresis	VHY_OV_VS	0.5	1	2	V	

Table 8: Electrical specifications: hardware VS over- and under-voltage detection

12.3.2.2 Wake-up circuit

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Wake-up COMM pin	TFILT_WU_COM	15		80	µs	

Table 9: Electrical specifications: wake-up circuit

12.3.3 Motor driver module

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Half-bridge phase current	IHB			2.3	A_{pk}	During normal operation
Half-bridge phase current	IHB			1.6	A_{rms}	During normal operation
Half-bridge resistance	RHB		0.35		Ω	TopFET + BottomFet + Shunt
FET over-current detection threshold	ITH_DS_HS	3.0	3.9	4.8	A	Short-circuit protection
FET over-current detection hysteresis	IHY_DS		0.1		A	

Table 10: Electrical specifications: output stage

12.3.4 Current sense amplifier

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Sense resistor	RCS		0.035		Ω	
Input range	ICS	-4		4	A	Current sensing range
Over-current detection threshold	ITH_OC	0		4	A	
Over-current detection accuracy	ITH_OC	-10		10	%	OCD threshold > 2A
Over-current settling	TSET_ TH_OC			10	µs	Settling time after adjustment

Table 11: Electrical specifications: current sense amplifier

12.3.5 VS supply sensor

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Voltage range for ADC measurement				28	V	Measurement of VS supply

Table 12: Electrical specifications: VS supply sensor

12.3.6 Over-temperature detection

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
OTD activation threshold	TTH_OT_ACT	150	160	170	ºC	Temperature ramping up

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
OTD release threshold	TTH_OT_REL	120	130	140	ºC	Temperature ramping down
OTD hysteresis	THY_OT	10	30		ºC	

Table 13: Electrical specifications: over-temperature detection

12.3.7 Communication IO (COMM, IO0)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Digital input L=>H				2.4	V	COMM = UART RX, I2C SCL
Digital input H=>L		1			V	COMM = UART RX, I2C SCL
Digital hysteresis		0.1			V	
Digital output low				0.4	V	IO0 = UART TX, I2C SDA, FG COMM = UART TX ILOAD < 3mA
Digital output high		2.9V			V	IO0 = UART TX, I2C SDA, FG COMM = UART TX ILOAD < 3mA
High-voltage input range		0		28	V	COMM pin for PWM or Analog interface
I2C SDA hold time (vs SCL = COMM)		320	450	580	ns	IO0 pin setting for Standard-mode and Fast-mode

Table 14: Electrical specifications: IO

13 Functional description

13.1 Communication

The MLX80339 supports 3 communication modes to control the motor: PWM, I2C and UART (1-wire or 2-wire). The MLX Code-free GUI tool [1] can configure the communication protocol (see Figure 7). IC configuration register details are found in the Communication Configuration.

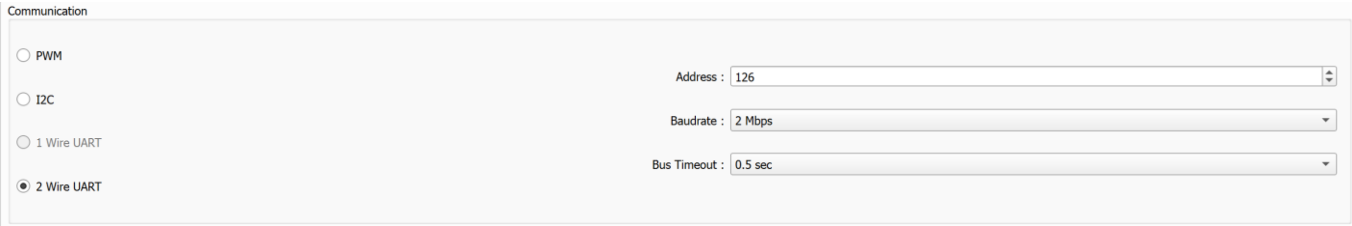


Figure 7: Melexis Code-free GUI to define the communication mode

13.1.1 PWM interface (PWM, FG)

In PWM mode, the IC controls the motor speed based on the on/off duty cycle of a digital signal applied to the COMM pin. The measured duty cycle is converted into speed based on an 8 point piece-wise linear transfer curve which can be configured via the Code-free GUI as shown in Figure 8. Below the min and above the max PWM duty cycle, the motor speed drops to zero.

The accepted PWM input frequency can be from 100 Hz to 50 kHz. A narrower target frequency can be configured with a tolerance of ±10%. Frequencies outside the defined range are rejected and will trigger a Bus Time out (if enabled) and stops the motor.

Once the motor is moving, the digital output signal appears on pin IO0 (FG pin). The frequency of this signal is the measured motor rotation frequency (1 on/off period per electrical rotation, which is the mechanical rotation x motor pole-pairs).

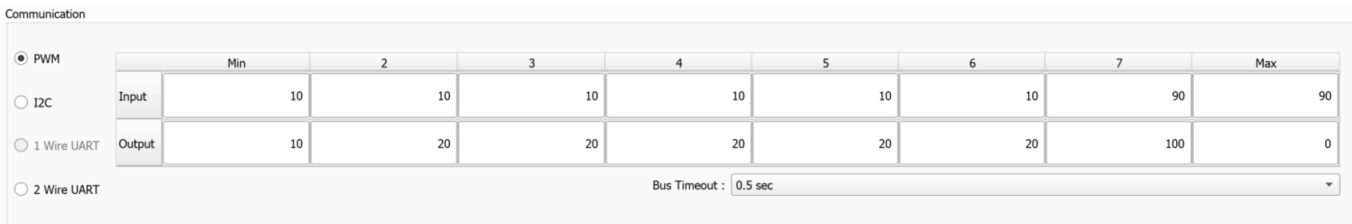


Figure 8: PWM communication mode: define transfer function input (duty%) to output (maxspeed%)

13.1.2 UART Serial Interface (RX, TX)

The MLX80339 features a digital serial interface that offers finer control & status feedback features. The external ECU sends commands for motor speed (relative speed % or absolute RPM) and reads back real-time status (Speed, Current, Voltage, Temperature). The digital datarate (Baudrate) can be configured from 9.6K to 2Mbaud as shown in the dropdown menu of Figure 7. The ECU must use the same Baudrate for messages on the bus as the IC configured Baudrate.

13.1.2.1 Single-Wire UART

COMM pin is used for bidirectional communication on one wire (RX and TX). The COMM in is configured in Open-Drain mode and external pull-up resistor is required on the bus to define the logic high level.

13.1.2.2 Dual-Wire UART

COMM pin is used for IC Reception (RX), and IO0 is used for IC Transmission (TX). The IO0 output stage automatically adapts based on the configured IC Address:

- Standard Mode: Open-Drain (requires pull-up resistor), needed when more IC's are on the bus
- Direct Drive Mode: if the address is set to 126 (0x7E), the IO0 pin switches to push-pull mode (0V-3.3V). No external pull-up resistor is needed, can only be used when 1x IC is on the bus

13.1.3 I2C interface (SCL, SDA)

The MLX80339 features a robust I2C interface for motor control, allowing an external ECU to command motor speed and read back real-time status (Speed, Current, Voltage, Temperature) in a similar way as with the Serial UART interface. I2C can work from low speed, eg 10Kbit/s to high-speed 1Mbit/s, depending on the pull-up resistor (1K for high speed). In I2C mode, the communication pins are mapped as follows:

- SCL (Serial Clock): mapped to the COMM pin. The pin operates as a high-impedance input.
- SDA (Serial Data): mapped to the IO0 pin, high-voltage open drain needing a pull up resistor.

The IC responds to a programmable 7-bit address (1 to 126) stored in the application configuration. This allows multiple fans or positioning actuators to be controlled individually on the same I2C bus by 1 ECU.

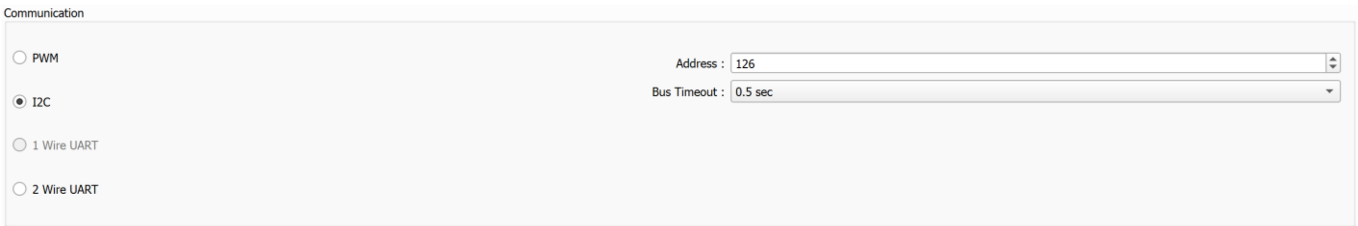


Figure 9: I2C communication mode: define IC address and Bus timeout

13.2 Motor Control

The MLX80339 motor control can be configured for critical parameters like (see Figure 10)

- Direction:
  - UVW rotation: phase U = 0deg, V=120deg, W=240deg
  - UWV rotation: phase U = 0deg, W=120deg, V=240deg
- Start Mode
  - Open Loop: slow startup
  - V90: fast startup
- Motor voltage type: 12V typical or 24V typical
- Maximum speed: in mechanical RPM
  - The real maximum speed may be limited by too low supply voltage
- Minimum speed: in percentage
  - The minimum speed expressed in percentage of the maximum speed; typically 10%
  - Below this speed the motor will stop spinning
- Startup current: from eg 100mA to max 2000mA
  - higher value to start bigger high-inertia motors, or motors with high startup load
- Maximum run current: from eg 100mA to max 2000mA
  - run current is higher for higher speeds, a lower max may limit maximum speed
- Acceleration & Deceleration: defines the rampup & rampdown time for speed changes
- Boost: can give a few % extra speed (RPM) at the cost of higher supply current

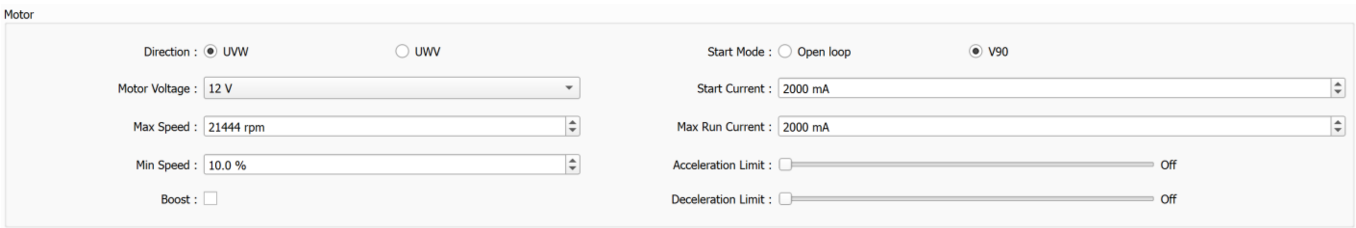


Figure 10: Motor control parameters

After the first speed command from the ECU, the IC will auto-detect the motor position and apply the best start & rampup procedure based on the configured motor parameters. The motor will stop after a zero or too-low-speed command, it stops also if there is no signal on the bus (bus timeout if defined), or if an electrical error has occurred (see diagnostics).

13.3 Diagnostics & protection

The IC continuously checks if the motor operating parameters are in a safe range to prevent application errors or IC damage. The user can set the maximum motor current and prevent overcurrent OC (see previous chapter), undervoltage limit (UV), overvoltage limit (OV) and IC overtemperature (OT) (see Figure 11). The minimum undervoltage and maximum overvoltage limits and steps depend on the motor type (12V or 24V). IC Overtemperature ranges from 85°C to 150°C. When the limit is reached, the motor speed will drop to zero, the motor restarts if the voltage is back in normal range taking into account a 1V hysteresis, or if the temperature is back in range taking into account a 10°C hysteresis.

Warning: the IC temperature can be much higher than the ambient temperature due to the thermal heating of the IC while driving high currents!

Info: besides the customer application defined operating limits, there are also the extreme IC UV, OV, OT, OC hardware limits as specified in Electrical specifications to avoid IC damage.

Figure 11: User Diagnostics setting

13.4 Motor application

Melexis Code-free start-to-run is an essential web-tool to characterize the customer's motor together with the MCM81339 board. Within 15 minutes it results in a complete set of predefined motor parameters to test the motor in efficient & silent FOC control mode. The customer can tune motor parameters afterwards for best fit with the application. When tuning is finished, the configuration file can be exported to configure pre-production IC's for design validation or production validation with the same configuration file. For more info, see [1], [2].

The customer can test the correct drive of the motor after characterization & configuration. The customer uses the Code-free PC GUI to start the motor to a target RPM speed, or can vary target speed and supply voltage, while getting measurements over time on speed, current, voltage and temperature in digital UART or I2C mode, or only speed measurements in legacy PWM mode via FG pin. See Figure 12.

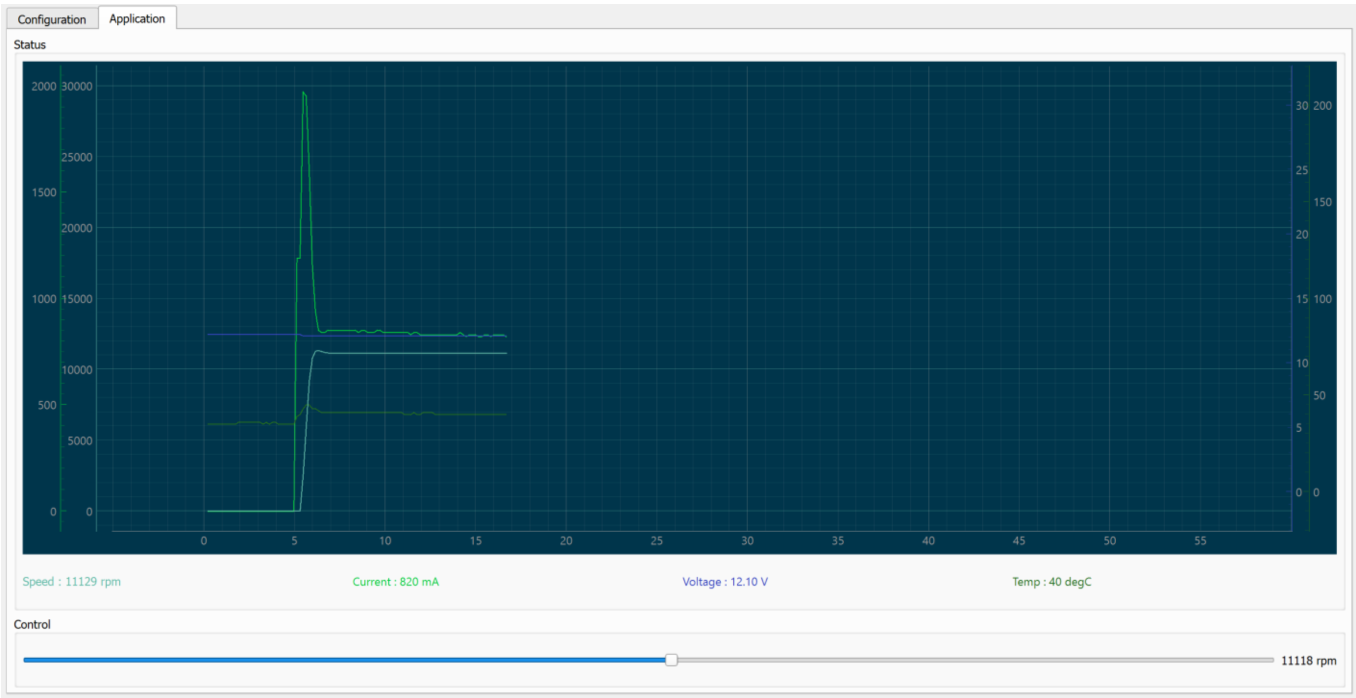


Figure 12: Motor application

14 EMC requirements for transient immunity

In order to minimize EMC influences, the PCB has to be designed according to EMC guidelines. The 80339 applies the requirements in the application according to the specifications ISO 7637-2 (12V applications).

The automotive test pulses are applied to the module in the application environment using recommended external circuitry. Therefore, care must be taken that the test pulses shall be applied on global pins only. Global pins are pins wired to a module connector (COMM or IO0).

Supply Pin VS is protected via the reverse polarity diode and the supply capacitors. No damage will occur for defined test pulses. A deviation of characteristics is allowed during pulse 1; but the module shall recover to the normal function after each pulse. During test pulses 2a, 3a and 3b, the module shall work within characteristic limits.

Test pulses are used according to ISO 7637-2, -3. To fulfil other requirements or test pulse definitions changes in the values of the external circuitries might be mandatory.

Description of functional status:

- A: All functions of the device are performed as designed during and after the disturbance occurs.
- B: All functions of the device are performed as designed while the disturbance occurs. One or more functions can violate the specified tolerances. All functions return automatically within their normal limits after the disturbance is removed.
- C: A function of a device does not perform as designed while the disturbance occurs but returns automatically to the normal operation after the disturbance is removed
- D: A function of a device does not perform as designed while the disturbance occurs and does not return automatically to the normal operation after the disturbance is removed. The device needs to be reset by a simple operation/action to return to the specified limits/function.

14.1 Supply lines

Test Pulse	Symbol	Value	Dim	Coupling	Test Duration, Functional Status
Transient test pulses according to ISO 7637-2 (supply lines), U_A=13.5V.					
1	U_S	-100	V	Direct	500 pulses, functional state A
2a	U_S	+75	V	Direct	500 pulses, functional state A
3a[1]	U_S	-150	V	Direct	1h, functional state A
3b[1]	U_S	+100	V	Direct	1h, functional state A

Table 15: Test pulses Supply Lines

14.2 Signal lines

Test Pulse	Symbol	Value	Dim	Coupling	test condition, functional status
Transient test pulses in accordance to ISO 7637-3 (signal lines).					
DCC slow –	U_S	-30	V	Direct capacitive coupled: 100nF	500 pulses, functional state A
DCC slow +	U_S	+30	V	Direct capacitive coupled: 100nF	500 pulses, functional state A
CCC fast a[1]	U_S	-60	V	Direct capacitive coupled: 220pF	10 min, functional state A
CCC fast b[1]	U_S	+40	V	Direct capacitive coupled: 220pF	10 min, functional state B

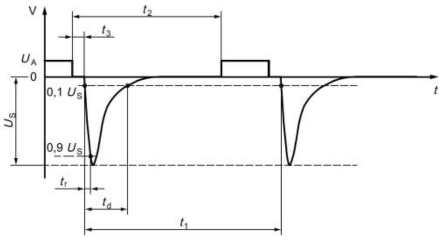
Table 16: Test pulses Signal Lines

[1] ***Values might be lower at high communication speeds***

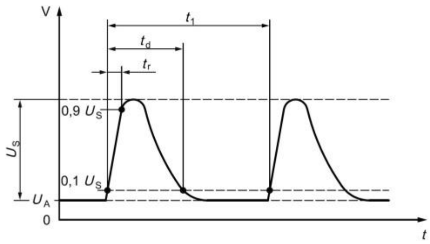
14.3 EMC test pulse definition

EMC Test Pulse shapes (ISO7637-2 (supply lines))

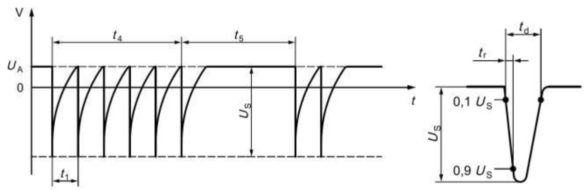
Test Pulse 1
Ri = 10 Ohm



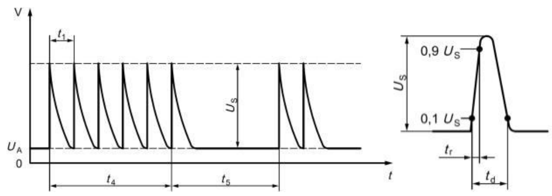
Test pulse 2a
Ri = 2 Ohm



Test Pulse 3a
Ri = 50 Ohm

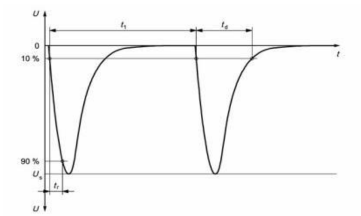


Test Pulse 3b
Ri = 50 Ohm

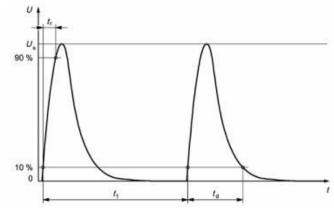


EMC Test Pulse shapes (ISO7637-3 (non-supply lines))

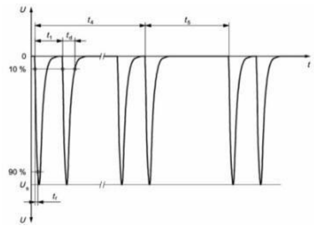
Test Pulse 'DCC slow -'
Ri = 2 Ohm



Test pulse 'DCC slow +'
Ri = 2 Ohm



Test Pulse 'Fast a, CCC'
Ri = 50 Ohm



Test Pulse 'Fast b, CCC'
Ri = 50 Ohm

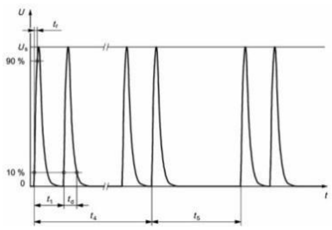


Figure 13: Test pulse shapes ISO7637-2 and -3

14.4 Application circuit advice for improved ESD and EMC behaviour

For good EMC performance, the following minimum application circuit is required.

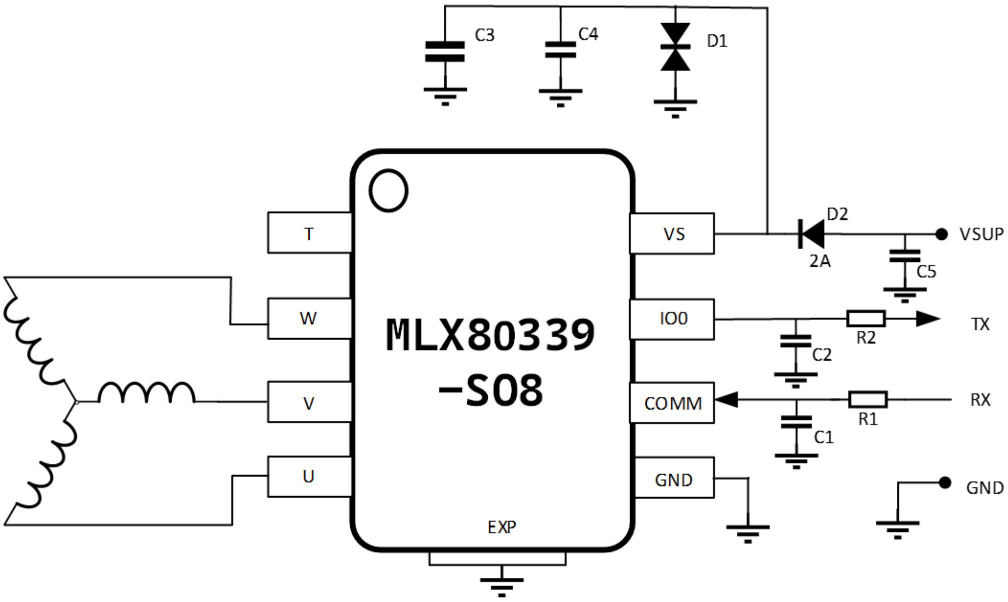


Figure 14: Application circuit

14.4.1 External circuitry on supply lines

Symbol	Value	Dim	Comment
D1	26V	V	TVS diode: stand-off voltage 26V, example SMAJ26CA For 24V applications this 26V TVS is mandatory.
D2	≥2	A	Reverse polarity diode, current level depending on motor application
C3	≥10	µF	Multiples of ceramic SMD X7R 4.7uF ≥ 35V
C4	100	nF	Ceramic SMD: ≥35V
C5	2.2	uF	Ceramic SMD: ≥35V

Table 17: External circuitry on supply lines

14.4.2 External circuitry on IO0 and COMM

Symbol	Value	Dim
R1	150	Ohm
C1	250	pF
R2	150	Ohm
C2	250	pF

Table 18: External circuitry on IO0 and COMM

15 Digital application use

15.1 ECU digital interface

While the legacy cooling fan control is done via straightforward PWM & FG signals, MLX80339 offers a refined digital control & feedback mode that can be implemented on a simple microcontroller (ECU), which can address 1 or many motor IC's on the same I2C or UART bus. Complete ECU software code examples for PWM, I2C and UART control are available [3].

15.1.1 Set configuration (W)

(8 Byte ECU command message, written by ECU to IC)

Byte	Description	Access
Byte1	2*Address + 1 (W)	W
Byte2	0x00	W
Byte3	Command **0x15**	W
Byte4	0x00	W
Byte5	0x00	W
Byte6	0x00	W
Byte7	0x00	W
Byte8	CRC	W

Table 19: Set configuration (W), ECU requests to get info about the IC at the specified address

15.1.2 Get configuration (R)

(9 Bytes feedback message, 1 byte ECU write for IC address, 8 bytes received from IC)

Byte	Description	Access
Byte1	2*Address + 0 (R)	W
Byte2	Max RPM Speed in RPM (MSB)	R
Byte3	Max RPM Speed in RPM (LSB)	R
Byte4	Max Current in mA	R
Byte5	Product ID = #10	R
Byte6	Max_Speed_Mult [7:6] + #Pole_Pairs [5:0]	R
Byte7	Current_Resolution [5:2] + App_Supply_Level [1:0]	R
Byte8	Set command (0x15)	R
Byte9	CRC	R

Table 20: Get configuration (R), IC info answer to ECU

- Max Speed: max mechanical RPM speed: (1-65535) * [Speed multiplier]
- Max Current: maximum motor peak-current in mA. Valid range from: (1-255) * [Current Scale]
- Product ID: Unique number of the Code-free IC, #10 for 80339 -210.
- Voltage class: 0=12V; 1=24V;

15.1.3 Set relative speed (W)

(8 Byte ECU command message, written by ECU to IC)

Byte	Description	Access
Byte1	2*Address + 1 (W)	W
Byte2	0x00	W
Byte3	Command **0x01**	W
Byte4	Speed-Target in 0.5% (0...200)	W
Byte5	n.a.	W
Byte6	n.a	W
Byte7	Direction 0x00: default rotation direction 0x01: inverse rotation direction	W
Byte8	CRC	W

Table 21: Set relative speed (W)

15.1.4 Get relative speed (R)

(9 Bytes feedback message, 1 byte ECU write for IC address, 8 bytes received from IC)

Byte	Description	Access
Byte1	2*Address + 0 (R)	W
Byte2	Speed-measured in 0.5% (0...200)	R
Byte3	n.a.	R
Byte4	Motor current **	R
Byte5	IC Voltage in 0.1V steps **	R
Byte6	IC temperature in 1°C steps **	R
Byte7	Status Bit 7: Over Voltage Bit 6: Under Voltage Bit 5: Over Temperature Bit 4: Over Current Bit 3: Stall Bit 2: Motor Not Connected Bit 1: Electrical Error Bit 0: Reserved	R
Byte8	Set command (0x01)	R
Byte9	CRC	R

Table 22: Get relative speed (R)

- Motor current: resolution set via configuration; typical value = 10mA/LSB (max 2550mA)
- IC voltage: 0x00 offset => 3V; 0xFF => 28.5V;
- IC temperature: 0x00 offset => -50C; 0xC8 =>150˚C ;

15.1.5 Set absolute speed (W)

(8 Byte command message, written by ECU to IC)

Byte	Description	Access
Byte1	2*Address + 1 (W)	W
Byte2	0x00	W
Byte3	Command **0x03**	W
Byte4	Speed-Target RPM (MSB)	W
Byte5	Speed-Target RPM (LSB)	W
Byte6	n.a	W
Byte7	Direction 0x00: default rotation direction 0x01: inverse rotation direction	W
Byte8	CRC	W

Table 23: Set absolute speed (W)

15.1.6 Get absolute speed (R)

(9 Bytes feedback message, 1 byte ECU write for IC address, 8 bytes received from IC)

Byte	Description	Access
Byte1	2*Address + 0 (R)	W
Byte2	RPM-measured (MSB)	R
Byte3	RPM-measured (LSB)	R
Byte4	Motor current **	R
Byte5	IC Voltage in 0.1V steps **	R
Byte6	IC temperature in 1°C steps **	R
Byte7	Status Bit 7: Over Voltage Bit 6: Under Voltage Bit 5: Over Temperature Bit 4: Over Current Bit 3: Stall Bit 2: Motor Not Connected Bit 1: Electrical Error Bit 0: Reserved	R
Byte8	Set command (0x03)	R
Byte9	CRC	R

Table 24: Get absolute speed (R)

- Motor current: resolution set via configuration; typical value = 10mA/LSB (max 2550mA)
- IC voltage: 0x00 offset => 3V;   0xFF => 28.5V;
- IC temperature: 0x00 offset => -50C; 0xC8 =>150°C ;

16 Configuration Registers

This appendix describes the user-accessible configuration registers of the MLX80339.
For fields marked as pre-filled by **Code-free STR** in the configuration tables, the MLX Code-free Start-to-Run (STR) tool automatically defines a default value during motor characterization. These defaults are chosen to provide safe and functional initial behaviour. The values are generated by the Start-to-Run tool and stored in the resulting configuration hex file. This file can be used in production environments to program the non-volatile EEPROM. Manual modification should be done with care.

16.1 Communication Configuration

This section defines the communication interface type and the associated parameters. For the tables below, bit positions are shown as LSB-based layout starting at bit 0 for each field independently. This representation emphasizes field width only.

16.1.1 Bit Assignment

Name	Description
Comm_Type[2:0]	Communication type selection
Bus_Timeout[2:0]	Bus timeout configuration
MODE_PARAM[9:0]	Mode-dependent parameter field

Table 25: Communication bit assignment

Note: *MODE_PARAM* interpretation depends on **Comm_Type**. **Bus_Timeout** is common to all communication modes.

16.1.2 Communication Mode Overview

Comm_Type value	Communication mode
0b000	PWM
0b001	UART, 1-wire
0b010	UART, 2-wire
0b011	I^2C
0b100…0b111	Reserved (do not use)

Table 26: comm_type encoding

16.1.3 Comm_Type = 0b000 – PWM Mode

Name	Description
Comm_Type[2:0]	0b000 = PWM
Bus_Timeout[2:0]	Bus timeout (motor stops if no valid PWM is detected)
Freq_Range_Base[6:0]	PWM input frequency base. 0 or 1 disables frequency checking
Freq_Range_Exp[2:0]	PWM input frequency range exponent

Table 27: PWM mode

16.1.3.1 Bus_Timeout encoding

Value	Timeout
0	Disabled
1	0.5 s
2	1 s
3	2 s
4	3 s
5	4 s
6	6 s
7	8 s

Table 28: BUS timeout encoding

16.1.3.2 Unchecked PWM frequency encoding

Follow these settings if you do not wish that your PWM frequency is checked.

Freq_Range_Exp Value	Freq_Range_Base Value	PWM range
0	0	Unchecked PWM input **from 1 kHz to 50 kHZ**
0	1	Unchecked PWM input **from 100 Hz to 1 kHz (excluded)**

Table 29: Unchecked PWM frequency encoding

16.1.3.3 Checked PWM frequency encoding

The PWM frequency will be checked and rejected if outside the defined +/-10% range. Additionally, a "Bus Time Out" diagnostic will be generated.

The required PWM frequency is composed of a 7bit base and 3bits exponent. This results in an exponential curve from 0 … 65024 Hz

Target frequency = (((**Freq_Range_Base** + 2^7) * 2^**Freq_Range_Exp**) - 2^7) * 2

The resulting & acceptable frequency range is from 100 Hz to 50 KHz. Here are some typical values.

PWM frequency	Freq_Range_Exp	Freq_Range_Base
100 Hz	000	0110010
200 Hz	000	1100100
300 Hz	001	0001011
400 Hz	001	0100100
500 Hz	001	0111101
600 Hz	001	1010110
700 Hz	001	1101111
800 Hz	010	0000100
896 Hz	010	0010000
1000 Hz	010	0011101
9984 Hz	101	0100000
19968 Hz	110	0011110
29952 Hz	110	1101100
39936 Hz	111	0011101
49920 Hz	111	1000100

Table 30: Checked PWM frequency encoding

16.1.4 Comm_Type = 0b001 – UART, 1-wire

Name	Description
Comm_Type[2:0]	0b001 = UART 1-wire
Bus_Timeout[2:0]	Bus timeout configuration
Baudrate[2:0]	UART baud rate selection
Responder_Address[6:0]	Device address (0…127)

Table 31: UART 1-wire

16.1.4.1 Baudrate encoding

Value	Baudrate
0	9.6 kbaud
1	19.2 kbaud
2	115.2 kbaud
3	460.8 kbaud
4	1 Mbaud
5	2 Mbaud

Table 32: Baudrate encoding

16.1.5 Comm_Type = 0b010 – UART, 2-wire

Same field widths and encodings as UART 1-wire. RX and TX are mapped to separate pins (COMM and IO0 respectively).

16.1.6 Comm_Type = 0b011 – I²C Mode

Name	Description
Comm_Type[2:0]	0b011 = I²C
Bus_Timeout[2:0]	Bus timeout configuration
Responder_Address[6:0]	7-bit I²C address (1…126)

Table 33: I2C mode

16.2 Motor Configuration

This section defines basic motor configuration parameters required for correct commutation and scaling.

16.2.1 Motor supply voltage, rotation direction, and pole pairs

16.2.1.1 Bit Assignment

Name	Description
App_Supply_Level[1:0]	Default application voltage level
UVW_UWV[0:0]	Rotation direction selection
Pole_Pairs[5:0]	Number of pole pairs

Table 34: Motor Configuration

16.2.1.2 App_Supply_Level encoding

Value	Motor supply voltage
0b00	12 V
0b01	24 V
0b10 … 0b11	Reserved (do not use)

Table 35: Motor supply voltage

16.2.1.3 UVW_UWV encoding

Value	Rotation direction
0	**UVW**
1	**UWV**

Table 36: Motor rotation direction

16.2.1.4 Pole_Pairs encoding

Range: 1 … 64 pole pairs.
Polepairs = Pole_Pairs

16.3 Motor Speed Control

These settings define the allowed motor speed range and optional slew-rate limiting for speed changes. The effective maximum motor speed is calculated as: MaxSpeed [RPM] = Maximum_Motor_Speed × Max_Speed_Mult.

16.3.1 Maximum motor speed (Code-free STR defined)

This setting defines the base value for the maximum motor speed in mechanical revolutions per minute (RPM).

16.3.1.1 Bit Assignment

Name	Description
Maximum_Motor_Speed[15:0]	Maximum motor speed base value (RPM)

Table 37: Maximum motor speed

Maximum_Motor_Speed encoding: Unsigned integer, range 0 … 65535 RPM.

16.3.2 Speed multiplier and slew-rate limiter (Code-free STR defined)

This setting defines a multiplier applied to Maximum_Motor_Speed and parameters that limit how fast the commanded speed may change.

16.3.2.1 Bit Assignment

Name	Description
Max_Speed_Mult[1:0]	Speed multiplier selection
SR_Limiter_Acceleration[5:0]	SR limiter acceleration setting
SR_Limiter_Deceleration[5:0]	SR limiter deceleration setting

Table 38: Speed multiplier and slew rate

16.3.2.2 Max_Speed_Mult encoding (Code-free STR defined)

Value	Multiplier
0b00	×1
0b01	×2
0b10	×3
0b11	×4

Table 39: Speed multiplier

16.3.2.3 Slew-rate (SR) limiter behaviour

The SR limiter constrains how quickly the internal speed reference may increase or decrease, expressed as a fraction of MaxSpeed.

Value	Effective slew rate
0	SR limiter disabled
1…31	(Value × 8)% of MaxSpeed per second

Table 40: Effective slew rate

Note: A value of 0 disables slew-rate limiting for the corresponding direction.

16.3.3 Minimum Motor Speed (Code-free STR defined)

This setting defines the lowest speed that the motor can handle in closed loop operation. Below this minimum speed the motor will go to 0 rpm.

16.3.3.1 Bit Assignment

Name	Description
Minimum_Motor_Speed[7:0]	Minimum motor speed as percentage of MaxSpeed

16.3.3.2 Minimum_Motor_Speed encoding

Range: 0 … 200 in steps of 0.5%
Minimum motor speed = (Minimum_Motor_Speed / 200) × MaxSpeed

16.3.4 Safety speed (communication fallback) (Code-free STR defined)

When communication with the ECU is lost, the controller can enforce a predefined safety speed.

16.3.4.1 Bit Assignment

Name	Description
Safety_Speed[6:0]	Safety speed as percentage of MaxSpeed

Table 41: Safety speed

16.3.4.2 Safety_Speed encoding

Range: 0 … 100
safety_speed = (Safety_Speed / 100) × Maximum_Motor_Speed
Note: A value of 0 disables safety speed enforcement.

16.3.4.3 Example values

Encoded value	SafetySpeed factor
0	0% of MaxSpeed
50	50% of MaxSpeed
100	100% of MaxSpeed

Table 42: SafetySpeed encoding

16.4 Motor Current Control

These settings define the motor current scaling and limits used by the controller.

16.4.1 Current resolution

This setting selects the current resolution used for the 8-bit current limit fields.

16.4.1.1 Bit Assignment

Name	Description
Current_Resolution[3:0]	Current resolution selection

Table 43: Motor current resolution

16.4.1.2 Current_Resolution encoding (mA/LSB) (Code-free STR defined)

Value	Resolution
0	0.1 mA/LSB
1	0.2 mA/LSB
2	0.5 mA/LSB
3	1 mA/LSB
4	2 mA/LSB
5	5 mA/LSB
6	**10 mA/LSB = DEFAULT**
7	20 mA/LSB
8	50 mA/LSB
9	100 mA/LSB
10	200 mA/LSB
11	500 mA/LSB
12	1 A/LSB
13	1 A/LSB
14	1 A/LSB
15	1 A/LSB

Table 44: Motor current resolution details

Note: Values above 12..15 are clipped to a maximum resolution of 1 A/LSB.

16.4.2 Start-up and maximum run current

This setting defines two 8-bit current limits using the selected resolution.

16.4.2.1 Bit Assignment

Name	Description
Startup_Current[7:0]	Start-up / open-loop start current
Max_Run_Current[7:0]	Maximum run current

Table 45: Motor startup and max current

16.4.2.2 Encoding

Current [mA] = Value × Resolution(mA/LSB)

16.5 Motor Startup and Commutation (Code-free STR defined)

16.5.1 Start-up method and initial forced alignment

At standstill, the controller establishes an initial electrical angle reference using Static-Rotor-Position (SRP) or forced alignment.

16.5.1.1 Bit Assignment

Name	Description
SRP_or_Align[0:0]	Start method selection (0 = SRP, 1 = Forced alignment)
Time[6:0]	Forced alignment time
Pulse_Time[6:0]	Static rotor position pulse time
Safety_Align_Time[6:0]	Safety forced alignment time

Table 46: Motor startup method

16.5.1.2 Time (forced alignment) interpretation

Forced alignment: time = 50 ms × (time + 1).

16.5.1.3 Pulse_Time (static rotor position) interpretation

SRP: Pulse period/window = 5 µs × (Pulse_Time + 1).

16.5.1.4 Example values

Encoded value	Steps	Forced alignment time	SRP pulse period/window
0	1	50 ms	5 µs
9	10	500 ms	50 µs
127	128	6.4 s	640 µs

Table 47: Motor startup alignment time

16.5.2 Start behaviour

After rotor position is defined, the controller accelerates the motor either in fast start (V90) or smooth start (open-loop) profile.

16.5.2.1 Bit Assignment

Name	Description
V90_or_Open_Loop[0:0]	0 = V90 (fast start), 1 = Open-loop (slow start)
Acceleration_Time[6:0]	V90 time / Open-loop acceleration time

Table 48: Motor startup profile

16.5.2.2 Acceleration_Time encoding

Time = 10 ms × (Acceleration_Time + 1)

16.5.2.3 Example values

Encoded value	Steps	Time
0	1	10 ms
9	10	100 ms
127	128	1.28 s

Table 49: Motor startup rampup time

16.6 Motor Stall detection (Code-free STR defined)

Several methods can be used to detect motor stall. The MLX80339-210 implements two configurable stall detection mechanisms: current-based stall detection and speed-based stall detection. Both mechanisms can be enabled at the same time.

16.6.1 Motor current stall detection

The MLX80339-210 implements a current-based stall detection mechanism that identifies a motor stall by monitoring the amplitude of the current drawn by the motor and comparing it to **Max_Run_Current** (see section 16.4.2). If a stall is detected, the stall diagnostic bit is set in the status register, bit 3. See also section 15.1.4 and section 15.1.6.

16.6.1.1 Bit Assignment

Name	Description
Stall_A_Enable[0:0]	0 = Disabled, 1 = Enabled **(DEFAULT)**
Stall_A_Threshold[6:0]	Stall current threshold (0...127%); **DEFAULT = 25%**
Stall_A_Count[3:0]	Stall "A" count (0...15); **DEFAULT = 15**

Table 50: Motor current stall bit assignment

16.6.1.2 Stall_A_Threshold interpretation

The actual current is compared to the current stall threshold:

Current stall threshold = Max_Run_Current × (1 + Stall_A_Threshold / 100)

16.6.1.3 Stall_A_Count interpretation

This field defines how many consecutive threshold violations are required before the stall diagnostic bit is set.

Stall_A_Count = 0 ... 15

16.6.2 Motor speed stall detection

The MLX80339-210 implements a speed-based stall detection mechanism that identifies a motor stall by monitoring the actual motor speed and comparing it to **Maximum_Motor_Speed** (see section16.3.1). If a stall is detected, the stall diagnostic bit is set in the status register, bit 3. See also section 15.1.4 and section 15.1.6.

16.6.2.1 Bit Assignment

Name	Description
Stall_B_Enable[0:0]	0 = Disabled, 1 = Enabled **(DEFAULT)**
Stall_B_Threshold[6:0]	Stall current threshold (0...127%); **DEFAULT = 8%**
Stall_B_Count[3:0]	Stall “B” count (0...15); **DEFAULT = 15**

Table 51: Motor speed stall bit assignment

16.6.2.2 Stall_B_Threshold interpretation

The actual speed is compared to the speed stall threshold:

Speed stall threshold = Maximum_Motor_Speed × (1 + Stall_B_Threshold / 100)

16.6.2.3 Stall_B_Count interpretation

This encodes how many times the threshold needs to be exceeded before the stall diagnostic bit is set.

Stall_B_Count = 0 ... 15

16.6.3 Motor angle stall detection

The MLX80339-210 implements a rotor angle-based stall detection mechanism that identifies a motor stall by comparing the target rotor angle versus the calculated angle. If a stall is detected, the stall diagnostic bit is set in the status register, bit 3. See also section 15.1.4 and section 15.1.6.

16.6.3.1 Bit Assignment

Name	Description
Stall_C_Enable[0:0]	0 = Disabled **(DEFAULT)** , 1 = Enabled)

Stall_C_Threshold[6:0]	Stall angle mismatch (0...127 deg); **DEFAULT = 30 deg**
Stall_C_Count[3:0]	Stall “C” count (0...15); **DEFAULT = 6**

Table 52: Motor angle stall bit assignment

16.6.3.2 Stall C Treshold Interpretation

The target rotor angle is compared to the calculated angle. A mismatch greater than the threshold will fire the angle stall detection.

Stall angle threshold = Target rotor angle – calculated angle

16.6.3.3 Stall C Count interpretation

This encodes how many times the threshold needs to be exceeded before the stall diagnostic bit is set.

Stall_C_Count = 0 ... 15

16.7 PWM Speed Curve Configuration

This register group defines a 7-segment piece-wise linear mapping between the PWM input duty cycle and the commanded motor speed in RPM. It is only applicable when the communication mode is configured as PWM.

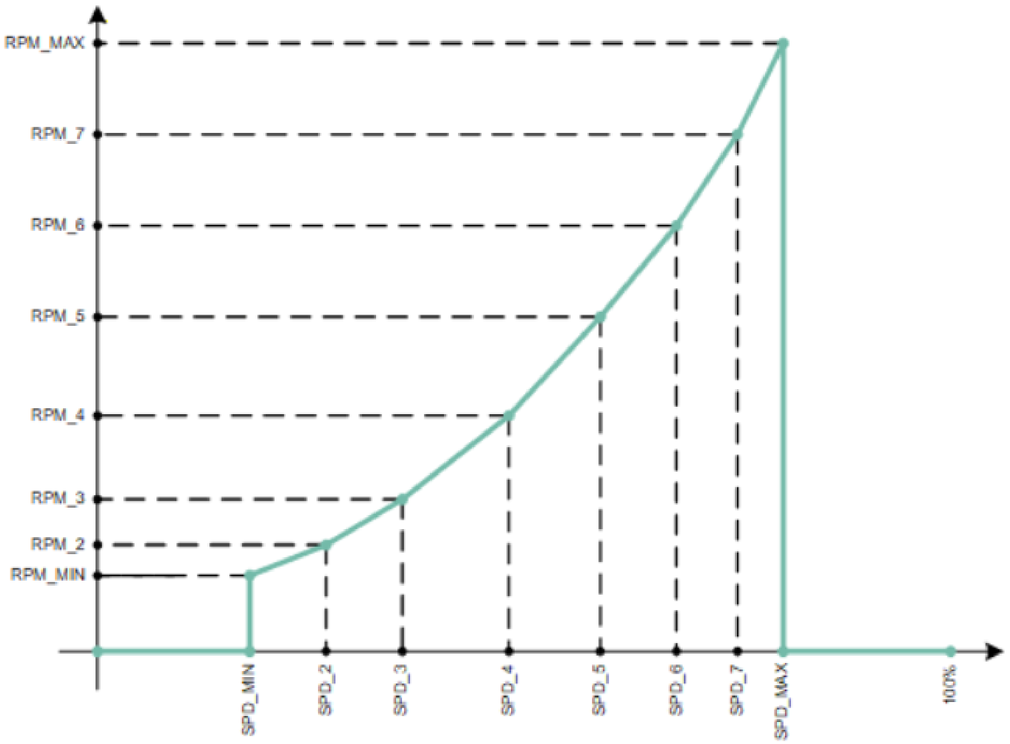


Figure 15: PWM speed curve Configuration with clamping behaviour

This figure illustrates the PWM-to-speed transfer characteristic used by the PWM speed curve configuration. The curve is defined by configurable RPM points between **RPM_MIN** and **RPM_MAX**, with linear interpolation applied between consecutive points.

Within the active PWM input range (**SPD_MIN** to **SPD_MAX**), the commanded motor speed follows the defined curve. Outside this range, the output behaviour depends on the selected curve type:

- **Return-to-zero curve**: the output speed is forced to **0 RPM** below **SPD_MIN** and above **SPD_MAX**.
- **Non return-to-zero curve**: the output speed is clamped to **RPM_MIN** below **SPD_MIN** and to **RPM_MAX** above **SPD_MAX**.

The example shown illustrates the resulting speed behaviour outside the active PWM range.

Restrictions:
SPD_MIN must be lower than SPD_MAX

RPM_2 … RPM_7: Curve RPM values. Values must be non-decreasing; multiple points may share the same value.

Multiple PWM points can be mapped on top of each other in case less segments are required

All fields in the table below are 8-bit wide and encoded in units of 0.5%.
Valid values range from 0 to 200. Values greater than 200 are interpreted as 0.

Field name	Description
SPD_MIN[7:0]	Minimum PWM input threshold
RPM_MIN[7:0]	Minimum motor speed used by the PWM curve
SPD_2[7:0]	Intermediate curve PWM value
RPM_2[7:0]	Intermediate curve RPM value
SPD_3[7:0]	Intermediate curve PWM value
RPM_3[7:0]	Intermediate curve RPM value
SPD_4[7:0]	Intermediate curve PWM value
RPM_4[7:0]	Intermediate curve RPM value
SPD_5[7:0]	Intermediate curve PWM value
RPM_5[7:0]	Intermediate curve RPM value
SPD_6[7:0]	Intermediate curve PWM value
RPM_6[7:0]	Intermediate curve RPM value
SPD_7[7:0]	Intermediate curve PWM value
RPM_7[7:0]	Intermediate curve RPM value
SPD_MAX[7:0]	Upper PWM input threshold
RPM_MAX[7:0]	Upper motor speed used by the PWM curve

Table 53: 8 point PWM speed curve definition

16.7.1 PWM Speed Curve type

This mode defines the speed of the motor in case the PWM values are outside the range defined by SPD_MIN & SPD_MAX.

- “Return to zero” results in clamping to zero outside the RPM_MIN and RPM_MAX range.
- “Non return to zero” results in clamping at RPM_MIN & RPM_MAX

Name	Description
Speed_Curve_Type[2:0]	**0** = No speed curve. Output follows input **3** = Non return-to-zero curve (clamped at RPM_MIN / RPM_MAX) **5** = Return-to-zero curve (speed forced to 0 outside range)

Table 54: PWM speed curve

16.8 Diagnostics and Protection

The MLX80339-210 supports several diagnostic events. Some events are managed internally by the device, while others can be configured by the user in the application.

All diagnostic events are collected in one byte, which is available when reading the relative or absolute speed. See sections 15.1.4 and 15.1.6

16.8.1 Diagnostic status encoding

Bit	Diagnostic event	Configured by
7	Over Voltage	Application
6	Under Voltage	Application
5	Over Temperature	Application
4	Over Current	Internal
3	Stall	Application
2	Motor Not Connected	Internal
1	Electrical Error	Internal
0	Reserved	Internal

Table 55: Diagnostic status encoding

The remainder of this section describes the configuration of the diagnostic events managed by the application. The restart behaviour after any diagnostic event is described at the end of this section.

16.8.2 Undervoltage threshold (Code-free STR defined)

16.8.2.1 Bit Assignment

Name	Description
App_Under_Voltage[3:0]	Undervoltage offset index

Table 56: Undervoltage threshold

16.8.2.2 Encoding

The undervoltage threshold is derived from the nominal supply class selected in Motor Configuration. Step size depends on motor supply selection:

- 12 V supply: 0.5 V/step
- 24 V supply: 1 V/step

Undervoltage threshold = Vnom – (Step × App_Under_Voltage).

Note that a hysteresis of 1V is applied.

16.8.2.3 Example values

Supply class	Vnom	Step	App_Under_Voltage	Threshold
12 V	12 V	0.5 V	**4**	10 V
12 V	**12 V**	**0.5 V**	**12 = DEFAULT**	**6 V**
24 V	24 V	1 V	**4**	20 V
24 V	**24 V**	**1 V**	**15 = DEFAULT**	**9 V**

Table 57: Undervoltage threshold details

16.8.3 Overvoltage threshold (Code-free STR defined)

16.8.3.1 Bit Assignment

Name	Description
App_Over_Voltage[3:0]	Overvoltage offset index

Table 58: Overvoltage threshold

16.8.3.2 Encoding

Step size depends on motor supply selection:

- 12 V supply: 0.5 V/step
- 24 V supply: 1 V/step

Overvoltage threshold = Vnom + (Step × App_Over_Voltage).

Note that a hysteresis of 1V is applied.

16.8.3.3 Example values

Supply class	Vnom	Step	App_Over_Voltage	Threshold
12 V	12 V	0.5 V	**4**	14 V
12 V	**12 V**	**0.5 V**	**14 = DEFAULT**	**19 V**
24 V	24 V	1 V	**4**	26 V
24 V	**24 V**	**1 V**	**4 = DEFAULT**	**28 V**

Table 59: Overvoltage threshold details

16.8.4 Overtemperature threshold (Code-free STR defined)

16.8.4.1 Bit Assignment

Name	Description
Over_Temperature[3:0]	Overtemperature offset index

Table 60: Overtemperature threshold

16.8.4.2 Encoding

OverTemp threshold = 80 °C + (Over_Temperature × 5 °C)
Valid range: Over_Temperature = 0 … 15 → 80 °C … 155 °C.

Note that a hysteresis of 10° deg C is applied.

16.8.4.3 Example values

Over_Temperature	OverTemp threshold
0	80 °C
9	**125 °C = DEFAULT**
15	155 °C

Table 61: Overtemperature threshold details

16.8.5 Diagnostic Retry Behaviour

If one of the diagnostic events occurs, the motor enters the diagnostic state and is switched off

When the source of the diagnostic event is no longer present, the MLX80339-210 attempts to restart the motor.

The retry behaviour is configured by the following fields.

Name	Description
Diagnostic_Retry_Delay_Timer[2:0]	Time between restarts
Diagnostic_Retry_Counter[2:0]	Number of retry attempts

Table 62: Diagnostic retry configuration fields

16.8.5.1 Diagnostic_Retry_Delay_Timer encoding

Diagnostic_Retry_Delay_Timer	Delay Time [s]
0	0
1	0.5
2	1
3	**2 = DEFAULT**
4	3
5	4
6	5
7	7

Table 63: Diagnostic retry delay timer encoding

16.8.5.2 Diagnostic_Retry_Counter encoding

Diagnostic_Retry_Counter	Retry Attempts
0	0
1	1
2	2
3	**3 = DEFAULT**
4	4
5	8
6	16
7	infinite

Table 64: Diagnostic retry counter encoding

Whenever the motor is restarted manually via an I2C, UART, or PWM command, the default value of Diagnostic_Retry_Counter is reloaded.

16.9 Configuration Field Overview

The table below summarizes all user-accessible configuration fields described in this appendix, grouped by functional category.

Field name	Category	Description
Comm_Type	Communication Configuration	Communication interface selection
Bus_Timeout	Communication Configuration	Bus timeout supervision
Freq_Range_Base	Communication Configuration	PWM input frequency base
Freq_Range_Exp	Communication Configuration	PWM input frequency exponent
Baudrate	Communication Configuration	UART baud rate selection
Responder_Address	Communication Configuration	Device address
MODE_PARAM	Communication Configuration	Mode-dependent parameter field
App_Supply_Level	Motor Configuration	Motor supply voltage selection
UVW_UWV	Motor Configuration	Rotation direction
Pole_Pairs	Motor Configuration	Number of motor pole pairs
Maximum_Motor_Speed	Motor Speed Control	Maximum motor speed base value
Max_Speed_Mult	Motor Speed Control	Speed multiplier
SR_Limiter_Acceleration	Motor Speed Control	Acceleration slew-rate limiter
SR_Limiter_Deceleration	Motor Speed Control	Deceleration slew-rate limiter
Minimum_Motor_Speed	Motor Speed Control	Minimum motor speed
Safety_Speed	Motor Speed Control	Safety speed on communication loss
Current_Resolution	Motor Current Control	Current resolution selection
Startup_Current	Motor Current Control	Start-up / open-loop current limit
Max_Run_Current	Motor Current Control	Maximum run current
SRP_or_Align	Motor Startup and Commutation	SRP or forced alignment selection
Time	Motor Startup and Commutation	Forced alignment timing

Field name	Category	Description
Pulse_Time	Motor Startup and Commutation	Static rotor position pulse time
Safety_Align_Time	Motor Startup and Commutation	Safety forced alignment time
V90_or_Open_Loop	Motor Startup and Commutation	V90 or open-loop profile selection
Acceleration_Time	Motor Startup and Commutation	Open-loop acceleration time
Stall_A_Enable	Motor Current Stall	Current stall enable
Stall_A_Threshold	Motor Current Stall	Current threshold level
Stall_A_Count	Motor Current Stall	Current stall count threshold
Stall_B_Enable	Motor Speed Stall	Speed stall enable
Stall_B_Threshold	Motor Speed Stall	Speed threshold level
Stall_B_Count	Motor Speed Stall	Speed stall count threshold
Stall_C_Enable	Motor Angle Stall	Angle stall enable
Stall_C_Threshold	Motor Angle Stall	Angle threshold level
Stall_C_Count	Motor Angle Stall	Angle stall count threshold
SPD_MIN	PWM Speedcurve Configuration	Minimum PWM input threshold
RPM_MIN	PWM Speedcurve Configuration	Minimum motor speed used by the PWM curve
SPD_2	PWM Speedcurve Configuration	Intermediate curve PWM value
RPM_2	PWM Speedcurve Configuration	Intermediate curve RPM value
SPD_3	PWM Speedcurve Configuration	Intermediate curve PWM value
RPM_3	PWM Speedcurve Configuration	Intermediate curve RPM value
SPD_4	PWM Speedcurve Configuration	Intermediate curve PWM value
RPM_4	PWM Speedcurve Configuration	Intermediate curve RPM value
SPD_5	PWM Speedcurve Configuration	Intermediate curve PWM value
RPM_5	PWM Speedcurve Configuration	Intermediate curve RPM value
SPD_6	PWM Speedcurve Configuration	Intermediate curve PWM value
RPM_6	PWM Speedcurve Configuration	Intermediate curve RPM value
SPD_7	PWM Speedcurve Configuration	Intermediate curve PWM value
RPM_7	PWM Speedcurve Configuration	Intermediate curve RPM value

Field name	Category	Description
SPD_MAX	PWM Speedcurve Configuration	Upper PWM input threshold
RPM_MAX	PWM Speedcurve Configuration	Upper PWM input threshold
Speed_Curve_Type	PWM Speedcurve Configuration	Speed curve type
App_Under_Voltage	Diagnostics and Protection	Undervoltage threshold index
App_Over_Voltage	Diagnostics and Protection	Overvoltage threshold index
Over_Temperature	Diagnostics and Protection	Overtemperature threshold index
Diagnostic_Retry_Delay_Timer	Diagnostics and Protection	Time between restarts
Diagnostic_Retry_Counter	Diagnostics and Protection	Number of retry attempts

Table 65: Configuration field overview

17 Disclaimer

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