



MASTERFLUX

Sierra 80 Volt

**Brushless DC Motor Controller
Product Specification**

Assembly 025F0164

600A0830

Rev. A

February 15, 2011

Revision History

ECN #	Date	Rev	Description	By
EC37598	02/15/11	A	Initial Release	DS



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Device Overview

Features

- **Locked rotor detection**
- **Motor Drive FET thermal shutdown**
- **Motor case thermal shutdown**
- **Under/Over voltage shutdown**
- **Low speed protection**
- **Current limiting**
- **Fault output**
- **Tachometer output**
- **Serial port for Diagnostics information**
- **Logic power on/off control**

General Product Description

The 025F0164 Motor Controller has been designed to provide efficient control and monitoring of a DC powered brushless hermetic compressor. The controller provides a constant speed as specified by the speed input independent of motor voltage and load, unless one of the following limitations is exceeded. Current limit, this is where the average current the motor requires to maintain the commanded speed and load exceeds 30 amps. If the load requires more than 30 amps then the speed will be reduced accordingly. Voltage limitation, this is where the motor supply voltage is not high enough to achieve the commanded speed. Fault conditions are monitored continuously. Upon detection of a fault, the motor is shut down. The motor controller will make up to eleven attempts to restart the motor after the fault condition is cleared. The controller will indicate the fault state by a TTL level output. For a Locked Rotor fault or An Under Voltage fault or Over Voltage fault the controller will delay for ten seconds before attempting to restart the motor and also delay for ten seconds between subsequent start attempts. For an Over Temperature fault the controller will delay for five seconds before attempting a restart and also delay for five seconds between subsequent restart attempts. Once the fault condition is cleared and the motor is restarted then the TTL level fault indicator is cleared. If the motor fails to start after eleven tries for a Locked Rotor fault or an Over Temperature fault it will cease trying to restart the motor and power must be cycled off and on before the motor can be restarted. The speed command is controlled by a 0 to 5 volt non-isolated analog input. The controller provides a TTL level tachometer output.

Power is supplied through two Wurth Elektronik press fit connectors. Control and indicator signals connect to a six pin Molex header.

The motor drive transistors are cooled by a aluminum finned heatsink. A temperature sensor embedded in the heatsink measures the heatsink temperature. The motor controller will shut down the motor if the heatsink temperature exceeds 85° C. The heatsink



provides the mounting points for the assembly with two threaded holes at each end. The heatsink is electrically isolated from the circuitry.

There is no input fusing or reverse polarity protection provided.

The controller will operate from 0° to 50° C.

The PCA is coated with a type SR (silicone resin) based material to protect it from corrosion. Material is UL recognized.

The controller is capable of controlling the following compressor models:
SIERRA04-0982Y3.

Note: See sales representative for complete list.

Operation

ON/OFF and Speed Control

The (non-isolated) analog speed input provides the ON/OFF and speed control. When the speed input is less than 0.5V the motor is stopped. When the speed input is between 0.8V and 1.0V the motor is commanded ON at which point the motor will run at 3000 RPM for a period of thirty seconds in order to ensure proper oiling of the mechanism. After the thirty second time the motor will run at the commanded speed. The speed input is scaled to 1.0V is 1800 RPM and 5.0V is 6500 RPM. If for any reason (such as excessive load) the motor should slow down to 1500 RPM the controller will output a fault and the motor will be shut down. The motor controller will run the motor at the set-point speed independent of the load on the motor and the motor voltage provided that the speed is not limited by the motor voltage or maximum current. Five volts and ground are available on the control connector. Connect five volts to one leg of a 10K Ohm potentiometer. Connect the other to ground. Connect the wiper of the potentiometer to the speed input for variable speed operation.

Note: The controller presents a capacitive load to the system. On initial application of power, a substantial in-rush current will result if not limited by external components.

Tachometer Output

The motor speed is indicated by a 0 to 5 volt non- isolated pulse. The frequency of the pulse is proportional to motor speed. $RPM = 2.5 \times Hz$.

Fault Indicator Output

The controller will signal a fault condition by outputting a logic high value on the fault indicator output. The fault indicator will be active after a stall is detected, or an under or over voltage or over temperature condition of either the heatsink or the shell temperature sensor.



Electrical Ratings / Specifications

Absolute Maximum Ratings

Parameter	Min.	Max.	Units
V_M	0	130	V
Speed Set-point (non isolated)	-0.3	5.05	V
Fault output current sourced (non isolated)		-10	mA
Fault output current sunk (non isolated)		10	mA

Operating Conditions

Parameter	Comments	Min.	Max.	Units
Operating Temperature Range		0	50	°C
Heatsink Temperature			85	°C



Electrical Characteristics

Parameter	Conditions	Min.	Nom.	Max.	Units
V _{CC}	I _{OUT} < 50 mA	4.95	5.0	5.05	V
Tachometer Output					
Output Low Voltage	I _{OL} = 0.4 mA			0.6	V
Output High Voltage	I _{OH} = -0.1 mA	2.2			V
Fault Output					
Output Impedance	All		200		Ohms
Output Low Voltage	I _{OL} = 1.0 mA			0.8	V
Output High Voltage	I _{OH} = -3.0 mA	3.4			V
Voltage Fault					
High Voltage Shutdown (V _{HS})		93	97	101	V
High Voltage Resume (V _{HR})		91	95	99	V
Hysteresis (V _{HS} - V _{HR})		1			V
Low Voltage Shutdown (V _{LS})		57	60	63	V
Low Voltage Resume (V _{LR})		61	64	67	V
Hysteresis (V _{LR} - V _{LS})		2			V
Temperature Fault					
High Temp Shutdown (T _{HS})		80	85	90	°C
High Temp Resume (T _{HR})		75	80	85	°C
T _{HS} - T _{HR}		4			°C
V_M					
Operating Range		68		90	V
Current	(Note 1)			30	A
Motor Speed					
Off				0.5	V
Minimum Speed	Command voltage 1	1700	1800	1900	RPM
Maximum Speed	Command voltage 4.75 to 5	6400	6500	6600	RPM
Logic on/off control					
	I _{OL} = (+V _m / 47K) sink		1.7	3	ma
Note 1: Measured current is steady state. The controller presents a capacitive load to the system. On initial application of power, a substantial in-rush current will result if not limited by external components.					



Connectors

Power

Motor power (V_M) is supplied through the power connectors J1 and J2. The power connectors are Wurth Elektronik part number 7461098. The shank accepts an M6 metric nut for connecting to a ring terminal or similar connector (nut and cable not supplied). Connect the positive voltage to (J1). Connect the return to (J2).

Pin	Signal Name	Type
J1	+V _M	Input
J2	Ground	Input

Control

The control connector, reference designator JP1, is a six pin shrouded header, AMP part number 5-103639-5. The mating connector is AMP part number 104257-5.

JP1 pin two is used to turn logic power on and off. Pin two is pulled up to +V_M through a 47K resistor with an 18V zener to limit the voltage. If JP1 pin two is grounded it will disable the logic power to the controller.

Pin	Signal Name	Type
1	Ground	Output
2	Logic power on/off	Input
3	Fault	Output
4	Tachometer	Output
5	+5 Volts	Output
6	Speed set-point	Input

Compressor

The three compressor phase leads A, B, and C connect to the three connectors with the corresponding labels. The connectors are Wurth Elektronik part number 7461383. The shank accepts an M5 metric nut for connecting to a ring terminal or similar connector (nut and cable not supplied).

Note:

When fabricating the compressor cable/wiring harness, AMP Faston connectors, part number 61187-1 can be used for connecting to the three terminals on the compressor.



Compressor Shell Temperature Switch

JP4 is a two pin header with latch, Molex part number 70543-0001 for connection to the normally closed compressor shell temperature switch (cable not supplied).

The mating connector is Molex part number 50-57-9402.

JP4

	Signal Name	Type
1	Shell Temperature Switch	Input/Output
2	Shell Temperature Switch	Input/Output

Serial Port

The serial Port connector (JP5) is a 4 Pin shrouded header with latch Molex part # 70543-0038, mating connector is Molex part number 14-56-7042.

JP5

Pin	Signal Name	Type
1	Vcc	
2	Transmit	Output
3	Receive	Input
4	Ground	

The serial interface is intended for diagnostic purposes during the product development phase in an Electro Static Discharge (ESD) controlled environment. A serial interface adapter is required to connect to the serial port on a computer. The serial interface is configured for 19.2 K baud, 8 data bits, 1 stop bit, no parity, and no flow control. The controller will report the following operating parameters once per second over the serial interface:

Temperature - heatsink temperature in °C

Power Supply – Volts

Current – average current delivered to motor

Motor Speed – actual speed in RPM

Fault – in the event of a fault a brief description of the fault is reported (see below)



Fault Reporting	
STALLED	If the controller detects a locked rotor it will shut down the motor, delay for 20 seconds and attempt to restart the motor. If the motor does not restart after 10 attempts, the controller will indicate a fault condition by activating the fault indicator output. The controller will continually attempt to restart the motor. If the controller is successful in restarting the motor, the fault indicator will be deactivated after 30 seconds.
STARTUP FAILED	The controller will detect if the motor has failed to start. After a 20 second pause the controller will attempt to restart the motor. If the motor does not start after 10 attempts, the controller will indicate a fault condition by activating the fault indicator output. The controller will continually attempt to start the motor. If the controller is successful in starting the motor, the fault indicator will be deactivated after 30 seconds.
MOTOR OVERHEAT	If the compressor shell temperature switch opens, the controller will shut down the motor and delay for 2 minutes. The controller will indicate the fault condition by activating the fault indicator. After the delay period the controller will recheck the compressor shell temperature switch state. If the compressor shell temperature switch is closed the controller will restart the motor and deactivate the fault indicator.
UNDER / OVER VOLTAGE	If the motor voltage is outside of the operating limits, the controller will shut down the motor and will delay for 10 seconds. After the delay period, the controller will recheck the voltage conditions. If the voltage is within the operating limits the motor will restart.
OVER CURRENT	Hard current limit – if the controller detects an over-current condition it will shut down the motor and activate the fault indicator. The power must be cycled to clear this fault.
CONTROLLER OVERHEAT	If the controller (heatsink) temperature rises above 85°C the controller will shut down the motor and delay for 2 minutes. After the delay period the controller will recheck the module temperature. If the temperature has fallen below 85 °C the controller will restart the motor. The controller will indicate a fault condition by activating the fault indicator. The controller will continue to monitor the heatsink temperature. The controller will restart the motor and deactivate the fault indicator when the heatsink temperature falls below 85 °C.
LOW SPEED	The compressor must maintain a minimum speed of 1500 RPM for proper lubrication. If the controller detects a low speed condition, it will shut down the motor, delay for 20 seconds and attempt to restart the motor. If the motor does not restart after 10 attempts, the controller will indicate a fault condition by activating the fault output. The controller will continually attempt to restart the motor. If the controller is successful in restarting the motor and maintaining a speed above 1500 RPM for 30 seconds, the fault indicator will be deactivated

RoHS Compliance

This assembly is compliant to the RoHS directive set forth by the European Union.



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