MASTERFLUX

Sierra Dual 80 Volt

Brushless DC Motor Controller
Product Specification

Assembly 025F0202

600A0888

Rev. A

January 16, 2012

Revision History

ECN #	Date	Rev	Description	By
EC41973	01/16/12	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**
- **Auto detect master slave configuration**

General Product Description

The 025F0202 Motor Controller is set up for "Dual Compressor" control. Two 025F0202 controllers link together via JP5 serial interface connector. The speed command is wired to the "MASTER" controller only. When the "MASTER" receives a run command it will run at 3000 rpm for 5 seconds then command the "SLAVE" controller to run at 3000 rpm for 30 seconds. After the delays both controllers will run at the commanded speed. The "MASTER" controller monitors the "SLAVE" controller speed and will track each other within +/- 250 rpm. If the speed between the controllers exceeds +/- 250 rpm both controllers will stop the compressors and fault. If serial communication between controllers is lost both controllers will stop the compressors and fault. Once communication is reestablished the controllers will attempt to restart.

The controller provides a constant speed as specified by the "MASTER" speed set-point 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 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 any fault, both "MASTER" and "SLAVE" compressors are stopped and both fault outputs are activated. Both controllers will delay for 30 seconds. After the delay and all faults are cleared the "MASTER" will attempt the start-up sequence described above.

 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.

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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

Master-Slave assignment
The 025F0202 Motor Controller is set up for "Dual Compressor" control. Two 025F0202 controllers link together via JP5 serial interface connector. The speed command is wired to the "MASTER" controller only. Upon initial power up each controller looks to see if a speed command is present. If the controller detects a speed command it is assigned "MASTER" then over the serial port assigns the "SLAVE" If for any reason two "MASTER" controllers are detected the controllers will stay in the faulted state and power must be cycled. After the "Master" and "SLAVE" have been assigned and the "SLAVE" receives a speed input the controllers will fault. If the communication is lost between the controllers both controllers will fault. Once communication has been reestablished the controller will turn off the fault indicators and if speed command is present attempt to start.

ON/OFF and Speed Control
The (non-isolated) analog speed input provides the ON/OFF and speed control. The speed command is wired to the "MASTER" controller only. When the "MASTER" speed input is les than 0.5V the compressor is stopped. When the "MASTER" speed input is between 0.8V and 1.0V the compressor is commanded ON at which point the compressor will run at 3000 rpm for 5 seconds then command the "SLAVE" controller to run at 3000 rpm for 30 seconds. After the delays both controllers 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 controllers will output a fault and the compressors will be shut down. The controller will run the compressor 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.

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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 square wave non- isolated output. The frequency of the square wave is proportional to motor speed. RPM = 2.5 X 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

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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		93	97	101	V
High Voltage Resume		91	95	99	V
Hysterisis (V_{HS} - $V_{HR)}$		1			V
Low Voltage Shutdown		57	60	63	V
Low Voltage Resume		61	64	67	V
Hysterisis ($V_{LR} - V_{LS)}$		2			V
Temperature Fault					
High Temp Shutdown		80	85	90	° C
High Temp Resume		75	80	85	° C
T_{HS} - T_{HR}		4			° C
V_M					
Operating Range		68		90	V
Current	(Note 1)			30	A
Motor Speed Input					
Off	Voltage must go below 0.5 to turn off (hysteresis)			0.5	V
Minimum Speed	0.8 to 1.0	1700	1800	1900	RPM
Maximum Speed	4.75 to 5	6400	6500	6600	RPM
Speed differential fault			250		RPM
Speed differential fault time			30		seconds
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.					

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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	+Vm	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 +Vm 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.

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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

Pin	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)

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Fault Reporting	
STALLED	If the controller detects a locked rotor it will shut down both compressors set the fault outputs then delay for 30 seconds. After the delay the controller will deactivate the fault indicator then attempt to restart the compressor. The controller will continually attempt to restart the motor.
STARTUP FAILED	The controller will detect if the compressor has failed to start. If the compressor fails to start both compressors will stop and set the fault outputs then delay for 30 seconds. After the 30 second delay the controller will deactivate the fault indicator then attempt to restart the compressors. The controller will continually attempt to restart the compressors.
MOTOR OVERHEAT	If the compressor shell temperature switch opens, the controller will shut down both compressors set the fault outputs then delay for 30 seconds. 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 attempt restart the compressor and deactivate the fault indicator.
UNDER / OVER VOLTAGE	If the input voltage is outside of the operating limits, the controller will shut down both compressors set the fault outputs then delay for 30 seconds. After the delay period, the controller will recheck the voltage conditions. If the voltage is within the operating limits the controllers will deactivate the fault indicator then attempt to restart.
OVER CURRENT	Hard current limit – If a current limit is detected both controllers will shut down the compressors set the fault outputs then delay for 30 seconds. After the delay period, the controller will recheck the conditions. If the condition is within the operating limits the controllers will deactivate the fault indicator then attempt to restart.
CONTROLLER OVERHEAT	If the compressor heat-sink temperature rises above 85°C the controller will shut down both compressors set the fault outputs then delay for 30 seconds. After the delay period the controller will recheck the controller temperature. If the controller temperature is within specification the controller will attempt restart the compressor and deactivate the fault indicator.
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 both compressors set the fault outputs then delay for 30 seconds. After the delay the controller will deactivate the fault indicator then attempt to restart the compressor.

RoHS Compliance

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

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