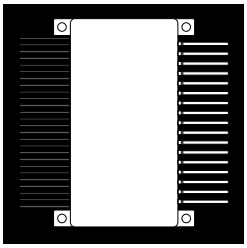
Preliminary Data Sheet

FULL-FEATURED, 'SMART-POWER' MODULE FOR HIGH-VOLTAGE DIRECT DRIVE OF 3-PHASE BRUSHLESS DC MOTORS



50 Amp, Push-Pull, Smart-Power Hybrid Commutates, Controls, And Directly Drives High-Voltage, High-Power 3q BLDC Motors

FEATURES

- Merged Commutation, Control, And Power Electronics 'System'
- High-Current, IGBT Outputs For Lowest Loss
- Output Current Continuous to 50 Amperes
- Peak Output Current To 100 Amperes
- Selectable 2 Or 4 Quadrant Operation
- Efficient, Low-Power, Bipolar Analog Control Circuitry
- Directly Compatible With Open-Collector Hall Sensor ICs
- Internal Reference Powers Sensors
- Programmable Overcurrent Sensing (*Custom Options)
- Operating Voltage Range: 30V To 500V (*Custom Options)
- Analog Speed Control (*Custom Options)
- Closed Loop Operation (*Custom Options)
- PWM Speed Control (µP Compatible)
- Tachometer Output (RPM Indicator)
- Forward/Reverse (Direction) Control
- Useable With Sensor Angle Spacings of 120° or 60°
- Output Enable Function (Coast)
- Dynamic Braking (2 Or 4 Quadrant)
- Under voltage Lockout (Commutation/Controller IC)
- Custom Options (Provisions For Integrating Additional Components)

DESCRIPTION

The OM9369SF provides full-featured, versatile 'smart-power' electronics via integrating all the 3-phase commutation, control, level translation and interface to high-voltage, high-power outputs for delta and wye connected brushless dc (BLDC) motors. Only Hall effect sensors for rotational and directional signals are necessary to complete the essential 3q motor electronics. The very broad operating voltage range permits use with 115/230 VAC power and 120 VDC, 150 VDC and/or 270 VDC power systems usually associated with aircraft and space applications. Custom options such as changing the output IGBT type are very viable.

Analog and/or PWM speed control is readily implemented with external components. Custom modules allow integrating specific values of passive speed control and overcurrent sensing components. These 'turn-key', fully tested hybrids, essentially, constitute a 3q BLDC motion control 'system' within a single package. They provide the values of performance, reliability, simplicity, and versatility for many fractional horsepower 3-phase motors. Although this part type is hermetic and MIL-rated, industrial versions are available; and in all versions all circuitry is electrically isolated from the package.

ABSOLUTE MAXIMUM RATINGS

Motor Supply Voltage Range, V_{SS} ..... 10V to 500V
Continuous Output Current, I_{OUT} 50A
Pulsed Output Current, I_{DM} 100A
Logic/Control Supply Range, V_{CC} ..... 10V to 20V
Digital Inputs (Dir., Sensor Inputs, OV-Coast, Speed-In, Quad) ..... -0.3V to 8V
Reference Output Current (Source) 50mA
Error Amp Input Voltage Range, ... -0.3V to V_{CC}
Error Amp Output Current (Source or Sink), I_{OUT} 5mA
Current Sense Input Voltage Range (Non-inverting/Inverting), V_{SENSE} ..... -1.3V to 6V
PWM Input Voltage ..... -0.3 to 6V
Output Current, I_{SENSE} ..... -10mA
Tach Output Current ..... ±10mA
Thermal Resistance, Junction to Case, R_{qJC} ..... 0. 5°C/W
Operating Temperature Range, T_C ..... -55°C to +125°C
Storage Temperature Range, T_{stg} ..... -65°C to +150°C
Isolation Voltage, V_{ISO} 1500V

RECOMMENDED OPERATING CONDITIONS (Up to T_C = 90°C)

2.1

Supply Voltage, V_{SS} ..... 30V to 400V
Continuous Output Current, I_{OUT}
  Using Internal Sense Resistor*
    Output IGBT 25A
    Output Diode 25A
  Using External Sense Resistor
    Output IGBT 40A
    Output Diode 35A
Pulsed Output Current, I_{DM} 60A
Control/Logic Supply, V_{CC} ..... 15V ±10%
Logic Thresholds, V_{INH} ..... 1.6V (min)
  V_{INL} ..... 0.8V (max)

* Internal 10m current sense resistor limited to 6.6W dissipation. Other values are available, please contact factory for more information.

THREE PHASE, SIX STEP COMMUTATION TRUTH TABLE

This table shows the outputs of the gate drive and open collector outputs for given hall input codes and direction signals.

This module operates with position sensor encoding that has either one or two signals high at a time, never all low or all high. This coding is sometimes referred to as “120° Coding” because the coding is the same as coding with position sensors spaced 120 magnetic degrees about the rotor. In response to these position sense signals, only one low-side driver will turn on and one high-side driver will turn on at any time.

INPUTS				OUTPUTS		
DIR	H1	H2	H3	q_C	q_B	q_A
1	0	0	1	SOURCE	SINK	-
1	0	1	1	SOURCE	-	SINK
1	0	1	0	-	SOURCE	SINK
1	1	1	0	SINK	SOURCE	-
1	1	0	0	SINK	-	SOURCE
1	1	0	1	-	SINK	SOURCE
0	1	0	1	-	SOURCE	SINK
0	1	0	0	SOURCE	-	SINK
0	1	1	0	SOURCE	SINK	-
0	0	1	0	-	SINK	SOURCE
0	0	1	1	SINK	-	SOURCE
0	0	0	1	SINK	SOURCE	-
X	1	1	1	-	-	-
X	0	0	0	-	-	-

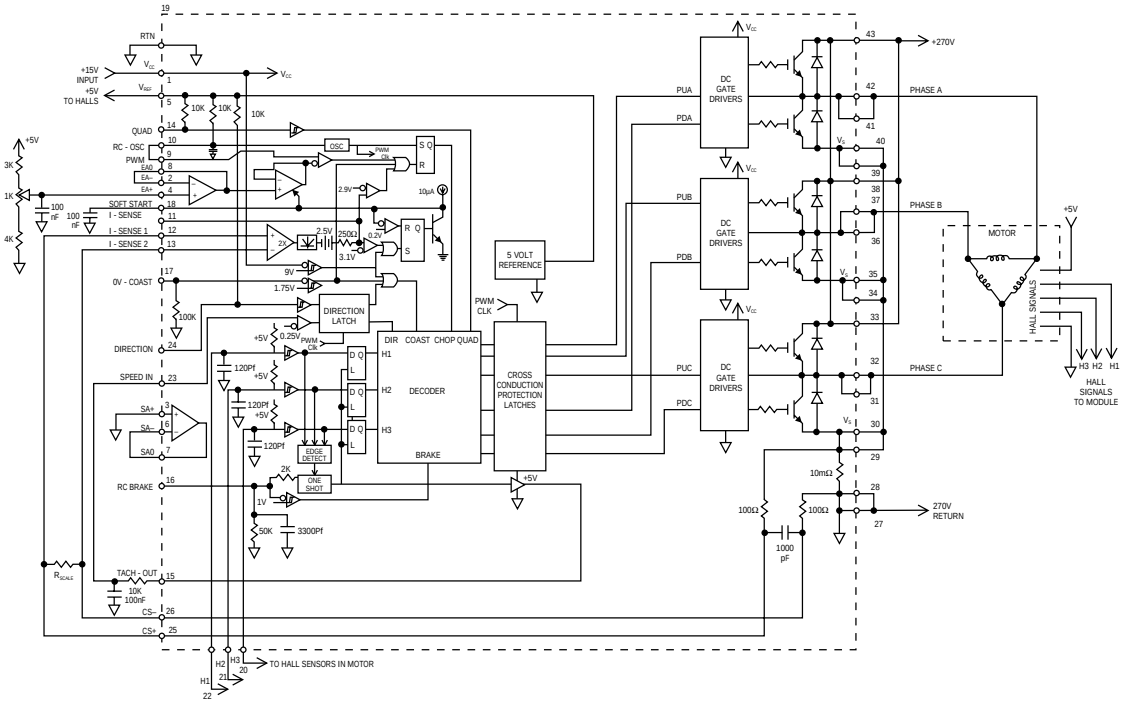
ELECTRICAL CHARACTERISTICS

(Unless otherwise noted T_A = 25°C; V_{CC} = 15V, R_{OSC} = 10K to V_{REF}; C_{OSC} = 10nF; R_{TACH} = 33k; C_{TACH} = 10nF; and all outputs unloaded. $T_A = T_J$)

PARAMETER	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
Power Output Section					
IGBT Leakage Current, I_{CES}	(V = 450V)			200	µA
	@ T_C = +125°C			1000	
Diode Leakage Current, I_R	(V = 450V)			250	µA
	@ T_C = +125°C			7000	
IGBT Output ON Voltage, $V_{CE(SAT)}$	I_{OUT} = 40A (per truth table)			3.0	V
	I_{OUT} = 40A, @ T_C = +100°C			3.1	
Diode Output ON Voltage, V_F	I_{OUT} = 36A (per truth table)			2.4	V
	I_{OUT} = 36A, @ T_C = +100°C			2.2	
Diode Reverse Recovery Time, t_{rr}*				50	ns
Overall					
V_{CC} Supply Current	Over Operating Range		16	32	mA
V_{CC} Turn-On Threshold	Over Operating Range	8.65	8.95	9.45	V
V_{CC} Turn-Off Threshold	Over Operating Range	7.75	8.05	8.55	V
Overvoltage/Coast					
OV-Coast Inhibit Threshold	Over Operating Range	1.65	1.75	1.85	V
OV-Coast Restart Threshold		1.55	1.65	1.75	V
OV-Coast Hysteresis		0.05	0.10	0.15	V
OV-Coast Input Current		-10	-1	0	µA
Logic Inputs					
H1, H2, H3 Low Threshold	Over Operating Range	0.8	1.0	1.2	V
H1, H2, H3 High Threshold	Over Operating Range	1.6	1.9	2.0	V
H1, H2, H3 Input Current	Over Operating Range, to 0V	-400	-250	-120	µA
Quad Sel, Dir Thresholds	Over Operating Range	0.8	1.4	2.0	V
Quad Sel, Dir Hysteresis			70		mV
Quad Sel, Input Current		-30	50	150	µA
Dir Input Current		-30	-1	30	µA
PWM Amp/Comparator					
E/A In(+), E/A(-) Input Current	To 2.5V	-150	45	0	nA
PWM In Input Current	To 2.5V	0	3	30	µA
Error Amp Input Offset	0V < $V_{COMMON-MODE}$ < 3V	5	±2	5	mV
Error Amp Voltage Gain		50	100		V/mV
E/A Out Range		-0.3	V_{CC} -1	V_{CC} -2	V
S_{START} Pull-up Current	To 0V	-16	-10	-5	µA
S_{START} Discharge Current	To 2.5V	0.1	0.4	3.0	mA
S_{START} Restart Current		0.1	0.2	0.3	V
Gain	I_{SENSE1} = .3V, I_{SENSE2} = .5V to .7V	1.75	1.95	2.15	V/V
Level Shift	I_{SENSE1} = .3V, I_{SENSE2} = .3V	2.4	2.5	2.65	V
Peak Current Threshold	I_{SENSE1} = 0V, Force I_{SENSE2}	0.14	0.20	0.26	V
Over Current Threshold	I_{SENSE1} = 0V, Force I_{SENSE2}	0.26	0.30	0.36	µA
I_{SENSE1}, I_{SENSE2} Input Current	To 0V	-850	-320	0	µA
I_{SENSE1}, I_{SENSE2} Offset Current	To 0V		±2	±12	µA
Range $I_{SENSE}1$, $I_{SENSE}2$		-1		2	V
Tachometer/Brake					
Tach-Out High Level	Over Operating Range, 10k to 2.5V	4.7	5	5.3	V
Tach-Out Low Level	Over Operating Range, 10k to 2.5V			0.2	V
On Time		170	220	280	µs
On Time Change With Temp	Over Operating Range		.1		%
RC-Brake Input Current	To 0V	-4.0	-1.9		mA
Threshold to Brake, RC Brake	Over Operating Range	0.8	1.0	1.2	V
Brake Hysteresis, RC-Brake			0.09		V
Speed-In Threshold	Over Operating Range	220	257	290	mV
Speed-In Input Current		-30	-5	30	µA
Oscillator					
Frequency		16	20	24	kHz
Frequency	Over Operating Range	14		26	kHz
Reference					
Output Voltage		4.9	5.0	5.1	V
Output Voltage	Over Operating Range	4.7	5.0	5.3	V
Load Regulation	0mA to -20mA Load	-40	-5		mV
Line Regulation	10V to 18V V_{CC}	-10	-1	10	mV
Short Circuit Current	Over Operating Range	50	100	150	mA
Miscellaneous					
Output Turn-On Delay			1		µs
Output Turn-Off Delay			1		µs

* V_F = 1A; di/dt = -15A/µs; V_F = 30V.

REPRESENTATIVE APPLICATION
OM9369SF 3q BLDC MOTOR DRIVER



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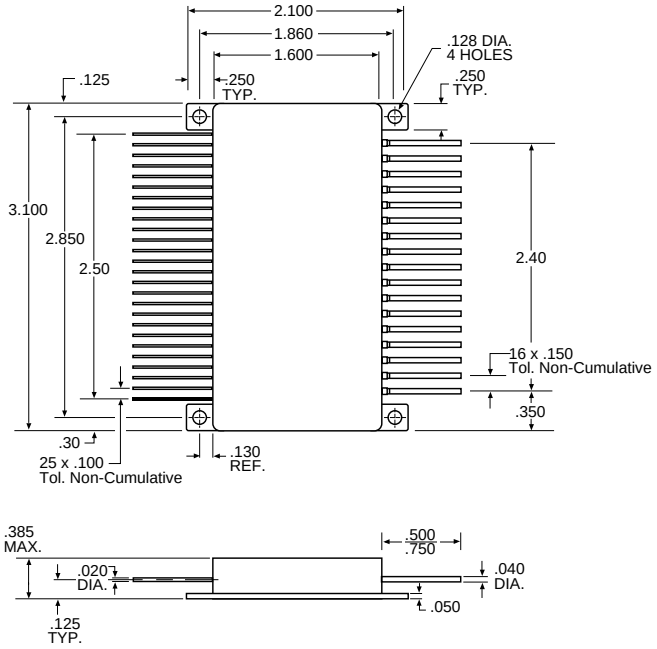
MECHANICAL OUTLINE AND PIN CONNECTION



Pin 1: V_{CC} Input, Nominally +15V
Pin 2: Error Amp Inverting Input
Pin 3: Spare Amplifier, Non-Inverting Input
Pin 4: Error Amp Non-Inverting Input
Pin 5: +5V Reference Output
Pin 6: Spare Amplifier, Inverting Input
Pin 7: Spare Amplifier, Output
Pin 8: Error Amp Output
Pin 9: PWM Input
Pin 10: Oscillator Timing Pin
Pin 11: I_{SENSE} Input/Output
Pin 12: I_{SENSE} +, Input
Pin 13 I_{SENSE} -, Input
Pin 14: Quad Select Input
Pin 15: Tachometer Output
Pin 16: RC - Brake Timing Pin
Pin 17: Overvoltage-Coast Input
Pin 18: Soft-Start Timing Pin
Pin 19: Ground
Pin 20: H3 Hall Input
Pin 21: H2 Hall Input
Pin 22: H1 Hall Input
Pin 23: Speed Input
Pin 24: Direction Input
Pin 25: CS+, Current Sense Output
Pin 26: CS-, Current Sense Output
Pin 27: 270 V Return
Pin 28: 270 V Return
Pin 29: V_S
Pin 30: V_S
Pin 31: Phase C_{OUT}
Pin 32: Phase C_{OUT}
Pin 33: +270 V
Pin 34: V_S
Pin 35: V_S
Pin 36: Phase B_{OUT}
Pin 37: Phase B_{OUT}
Pin 38: +270 V
Pin 39: V_S
Pin 40: V_S
Pin 41: Phase A_{OUT}
Pin 42: Phase A_{OUT}
Pin 43: +270V

NOTE: Multiple connections are essential for all high-current/power leads. +270V must be connected together (3 places, 3 pins), V_S (3 places, 6 pins), q_A, q_B, q_C and 270V return (1 place each, 2 pins each). See application schematic for details.