

Three-Phase Sensorless Fan Driver IC

FEATURES AND BENEFITS

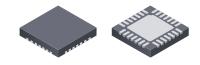
- Speed curve configuration via EEPROM
- I²C serial port
- Sinusoidal modulation for reduced audible noise and low vibration
- Sensorless (no Hall sensors required)
- Low R_{DS(ON)} power MOSFETs
- 3.3 V / 20 mA linear regulator
- PWM or analog speed input
- FG speed output
- Slew rate control
- Lock detection
- Soft start
- Low power standby mode
- Overcurrent protection
- Overvoltage protection

PACKAGES:



20-lead TSSOP with exposed thermal pad (LP package)

Not to scale



28-contact QFN with exposed thermal pad 5 mm × 5 mm × 0.90 mm (ET package)

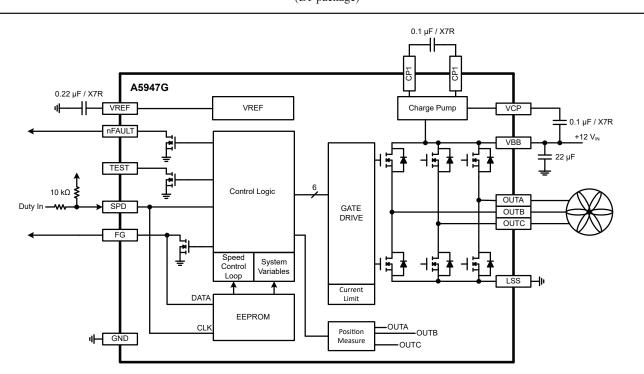


Figure 1: Typical Application

DESCRIPTION

The A5947G three phase motor driver IC incorporates sensorless sinusoidal drive to minimize vibration for a wide variety of fan applications. Sensorless control eliminates the requirement for Hall sensors.

A flexible closed-loop speed control system is integrated into the IC. EEPROM is used to tailor the common functions of the fan speed curve to a specific application. This eliminates the requirement for a microprocessor-based system and minimizes programming requirements.

The A5947G is available in a 28-contact 5 mm \times 5 mm QFN with exposed thermal pad (suffix ET) and a 20-lead TSSOP with exposed thermal pad (suffix LP).

SELECTION GUIDE

Part Number	Operating Temperature Range (T _A) (°C)	Packaging	Packing
A5947GETTR-T	-40 to 105	28-contact QFN with exposed thermal pad	1500 pieces per 7-inch reel
A5947GLPTR-T	-40 to 105	20-lead TSSOP with exposed power pad	4000 pieces per 13-inch reel



ABSOLUTE MAXIMUM RATINGS

Characteristic	Symbol	Notes	Rating	Unit
Supply Voltage	V _{BB}		-0.7 to 40	V
Logic Input Voltage Range	V _{IN}	SPD	-0.3 to 6	V
Logic Output	Vo	FG, nFAULT, TEST	–0.3 to 6	V
Output Current	I _{OUT}		3.6	А
Output Voltage	V _{OUT}	OUTA, OUTB, OUTC	V _{BB} + 1	V
VCP	V _{CP}		$V_{BB} - 0.3$ to V_{BB} + 8	V
CP1	V _{CP1}		–0.3 to V _{BB} + 0.3	V
CP2	V _{CP2}		V_{BB} – 0.3 to V_{CP} + 0.3	V
Maximum EEPROM write cycles	EEPROM _{W(MAX)}		1000	cycles
Junction Temperature	TJ		150	°C
Storage Temperature Range	T _{stg}		-55 to 150	°C
Operating Temperature Range	T _A	Range G	-40 to 105	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Test Conditions*	Value	Unit
	D	28-contact QFN (package ET), on 2-sided PCB 1-in. ² copper		°C/W
Package Thermal Resistance	$R_{\theta JA}$	20-lead TSSOP (package LP), on 2-sided PCB 1-in. ² copper	34	°C/W

*Additional thermal information available on the Allegro website.

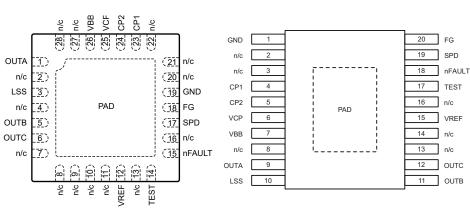
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PINOUT DIAGRAMS AND TERMINAL LIST TABLE

ET Package Pinouts

LP Package Pinouts

Terminal List Table

Terminal	Terminal Number		Function	
ET Package	LP Package	Name	Function	
19	1	GND	Ground	
20,21,22	2,3	n/c	No connect	
23	4	CP1	Charge pump capacitor	
24	5	CP2	Charge pump capacitor	
25	6	VCP	Charge pump capacitor	
26	7	VBB	Input supply	
27,28	8	n/c	No connect	
1	9	OUTA	Motor terminal	
2		n/c	No connect	
3	10	LSS	Low side source connection	
4		n/c	No connect	
5	11	OUTB	Motor terminal	
6	12	OUTC	Motor terminal	
7,8,9,10,11	13,14	n/c	No connect	
12	15	VREF	Reference voltage output	
13	16	n/c	No connect	
14	17	TEST	Logic output signal	
15	18	nFAULT	Logic output signal	
16		n/c	No connect	
17	19	SPD	Logic input – speed demand	
18	20	FG	Logic output signal	
-	-	PAD	Exposed pad for enhanced thermal dissipation	



Three-Phase Sensorless Fan Driver IC

ELECTRICAL CHARACTERISTICS: Valid for $T_A = 25^{\circ}$ C, $V_{BB} = 4$ to 40 V, unless noted otherwise

Characteristics	Symbol	Test Conditions	Min.	Тур.	Max.	Unit
GENERAL		·	· · ·			
	I _{BB}	Active mode (PWM duty < DC_ON)	_	13.5	15	mA
VBB Supply Current	I _{BBS}	V _{BB} = 34 V, standby mode	_	10	40	μA
Reference Voltage	V _{REF}	I = 0 to 20 mA, V _{BB} = 6 to 40 V	3.15	3.3	3.45	V
Charge Pump	V	Relative to V_{BB} , V_{BB} = 8 V	6.5	7.2	7.7	V
Charge Fullip	V _{CP}	Relative to V_{BB} , V_{BB} = 4 V	3.5	3.7	_	V
POWER DRIVER						
		I = 1.5 A, T _J = 25°C, V _{BB} = 12 V	-	510	-	mΩ
Total Driver On-Resistance		I = 1.5 A, T _J = 125°C, V _{BB} = 12 V	-	760	860	mΩ
(Sink + Source)	R _{DS(ON)}	I = 1.5 A, T _J = 25°C, V _{BB} = 4 V	-	680	-	mΩ
		I = 1.5 A, T _J = 125°C, V _{BB} = 4 V	_	950	1200	mΩ
Source Driver On-Resistance	R _{DS(ON)SRC}	T _J = 125°C, V _{BB} = 12 V	-	380	_	mΩ
Sink Driver On-Resistance	R _{DS(ON)SNK}	T _J = 125°C, V _{BB} = 12 V	_	380	_	mΩ
Motor PWM Frequency	f _{PWM}	$T_J = 25^{\circ}C$	23.52	24.5	25.48	kHz
SPEED CONTROL						
PWM Input Frequency Range	f _{PWMIN}		34	-	65000	Hz
Duty Cycle On Threshold	DC _{ON}	Relative to target	-0.5	-	0.5	%
Duty Cycle Off Threshold	DC _{OFF}	Relative to target	-0.5	_	0.5	%
SPD Standby Threshold (Analog)	V _{SPDTH}		0.43	0.7	1	V
SPD On Threshold	V _{SPDON}	DC _{ON} = 10%	210	240	270	mV
SPD Off Threshold	V _{SPDOFF}	DC _{OFF} = 8%	160	190	220	mV
SPD Max	V _{SPDMAX}		_	2.49	_	V
SPD ADC Resolution	V _{SPDLSB}		_	4.892	_	mV
SPD ADC Accuracy	SPD _{ACC}	V_{BB} = 12 V, V_{SPD} = 0.2 V to V_{SPDMAX}	-10	_	10	LSB
Speed Setpoint	f _{SPD}	Duty cycle input; T _J = 25°C	-5	_	5	%

^[1] Specified limits are tested at a single temperature and assured over temperature range by design and characterization.

Continued on next page ...



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Characteristics	Symbol	Test Conditions	Min.	Тур.	Max.	Unit
PROTECTION CIRCUITS			^		· · · · · · · · · · · · · · · · · · ·	
Lock Timing	t _{LOCK}	Relative to target	-5	_	5	%
		UVLO = 0, V _{BB} rising	3.7	3.85	4	V
VBB Undervoltage Threshold	V _{BBUVLO}	UVLO = 1, V _{BB} rising	8.4	8.65	9.02	V
		UVLO = 0	160	300	480	mV
VBB Undervoltage Hysteresis	V _{BBHYS}	UVLO = 1	1.8	2	2.2	V
Overcurrent Limit	I _{OCL}	V _{BB} = 8 V	2.5	3	3.5	А
Overcurrent Protection	I _{OCP}		3.94	7	_	А
V/DD 0		VBBOV = 0, V _{BB} rising	18.2	19	19.8	V
VBB Overvoltage	V _{BBOV}	VBBOV = 1, V _{BB} rising	36.8	37.5	39.3	V
VBB Overvoltage Hystersis	V _{BBOVHYS}		1.5	2	2.5	V
VREF UVLO	V _{REFUVLO}	V _{REF} rising	2.9	3	3.15	V
VREF UVLO Hystersis	V _{REFHYS}		150	250	350	mV
VREF Overcurrent Limit	V _{REFOCL}	V _{BB} = 12 V	30	65	120	mA
VCP UVLO	V _{CPUVLO}	V _{CP} rising	2.5	2.75	3.0	V
VCP UVLO HYS	V _{CPUVLOHYS}		_	110	_	mV
Thermal Shutdown Temperature	T _{JTSD}	Temperature increasing	150	165	180	°C
Thermal Shutdown Hysteresis	ΔT_{J}	Recovery = $T_{JTSD} - \Delta T_J$	_	20	_	°C
LOGIC/INPUT OUTPUT/I ² C				`	· · · · · · · · · · · · · · · · · · ·	
Logic Input Current (SPD, FG)	I _{IN}	V _{IN} = 0 to 5.5 V	-5	<1	5	μA
Logic Input Low Level	V _{IL}		0	_	0.8	V
Logic Input High Level	V _{IH}		2	_	5.5	V
Logic Input Hysteresis	V _{HYS}		200	300	600	mV
Output Saturation Voltage (FG, RD)	V _{SAT}	I = 5 mA	_	_	0.3	V
Output Leakage	I _{OUT}	V = 5.5 V, switch OFF	-	_	5	μΑ
I ² C TIMING					· · · · · · · · · · · · · · · · · · ·	
SCL Clock Frequency	f _{CLK}		3	-	400	kHz
Bus Free-Time Between Stop/Start	t _{BUF}		1.3	_	_	μs
Hold Time Start Condition	t _{HD:STA}		0.6	_	_	μs
Setup Time for Start Condition	t _{SU:STA}		0.6	_	_	μs
SCL Low Time	t _{LOW}		1.3	_	_	μs
SCL High Time	t _{HIGH}		0.6	_	_	μs
Data Setup Time	t _{SU:DAT}		100	_	_	ns
Data Hold Time	t _{HD:DAT}		0	_	900	ns
Setup Time for Stop Condition	t _{SU:STO}		0.6	_	_	μs

ELECTRICAL CHARACTERISTICS (continued): Valid for $T_A = 25^{\circ}$ C, $V_{BB} = 4$ to 40 V, unless noted otherwise

^[1] Specified limits are tested at a single temperature and assured over temperature range by design and characterization.



FUNCTIONAL DESCRIPTION

Basic Operation

The A5947G targets fan applications to meet the objectives of minimal vibration, high efficiency, and the ability to customize the IC to the speed control specification.

In typical systems, an MCU is required to meet each application specification. The A5947G integrates the basic closed-loop speed control function, thus allowing elimination of the cost, PCB space, and programming requirements of a custom MCU.

For each specific application, the EEPROM settings can be created with the Allegro EVB and software.

The speed of the fan is typically controlled by variable duty cycle PWM input. The duty cycle is measured and converted to a 9-bit number. This 9-bit "demand" is translated to a PWM duty cycle applied to the motor windings, effectively a percentage of the power supply voltage.

Protection features include lock detection with restart, overcurrent limit, overvoltage protection, motor output short circuit, supply undervoltage monitor, and thermal shutdown.

Standby mode can be achieved by holding SPD pin low for longer than the programmed lock off-time.

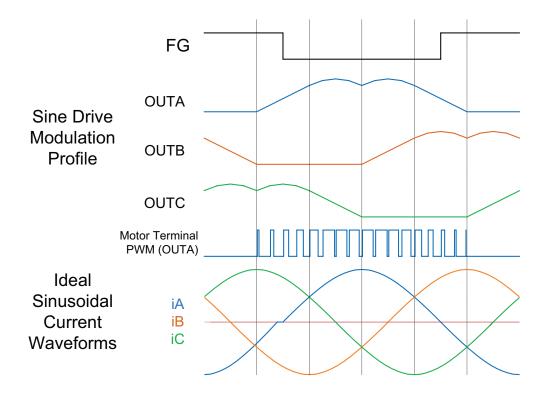


Figure 2: Sinusoidal Drive Sequence



FG. Open-drain output, represents the speed of the motor for normal operation. The electrical frequency of the motor may be different than FG output.

 $\begin{aligned} f_{ELEC} &= f_{FGOUT} \times NumberOfPolePairs \ / \ 2 \\ f_{FGOUT} &= f_{ELEC} \times 2 \ / \ NumberOfPolePairs \\ RPM &= f_{ELEC} \times 60 \ / \ NumberOfPolePairs \\ RPM &= 30 \times f_{FGOUT} \end{aligned}$

Additionally, the FG pin serves as the data line, (SDA) for I²C communication.

SPD. Speed demand input. The demand can be in the form of duty cycle, analog voltage, or direct I²C command.

An EEPROM setting will determine choice of duty or analog input. Additionally, the SPD pin serves as the clock line (SCL) for I²C communication.

Analog control. Voltage applied to SPD pin will set speed demand. An internal 9-bit A/D converter will translate the input to a speed demand.

Applied Duty (%) = Code / 511 Code = $V_{IN(SPD)}$ / 4.89 mV + 2 where code = [0...511]

TEST. Open drain output, low when motor off, high at end of open loop startup.

nFAULT. An active low output to represent the following fault conditions: VBB undervoltage, VBB overvoltage, thermal shutdown, VCP undervoltage, rotor lock, and output VDS fault (OCP).

OCL. Overcurrent limit. When the OCL level is reached, the PWM on pulses will be terminated early to prevent further increase of current.

SLEW. The motor output slew rate (dv/dt) can be reduced by adjustment of EEPROM variable SLEW.

SL	Nominal	
MSB	LSB	(ns)
0	0	100
0	1	150

OCP. Overcurrent protection, VDS monitor. To protect from short-to-ground, shorted load, or short-to-battery conditions for the motor lines, the voltage across the power outputs is monitored at all times when the MOSFET is turned on. There will be a short blank time before the motor outputs are disabled if the overcurrent protection limit I_{OCP} is exceeded. The fault is latched off. EEPROM bit OCPOPT will select option to reset latch with choice of lock timeout or PWM on/off command.

Note: During the shorted event, the absolute maximum ratings may be exceeded for the blank time.

OVP. The A5947G outputs can be disabled if power supply voltage exceeds programmed threshold. With OVPOPT = 1, the outputs will remain disabled for t_{LOCK} to allow motor to coast down to slower speed. After t_{LOCK} , a normal startup will resume operation assuming V_{BB} has fallen below the hysteresis level.

VBBOV	VBBOVDIS	OVPOPT	OVPTH	OVP Function
х	1	1	Outputs continue to run with V _{BB} > V _{BBOV}	Disabled
0	х	0	19 V	Disable outputs when V _{BB} > V _{BBOV}
0	0	1	19 V	Latch off for t_{LOCK}
1	х	0	38 V	Disable outputs when V _{BB} > V _{BBOV}
1	0	1	38 V	Latch off for t_{LOCK}

Standby Mode. A low power mode is activated if SPD pin is held low. Standby Mode will turn off all circuitry including charge pump and VREF. Upon power up, the A5947G will immediately wake up. If SPD remains low for the programmed lock time, standby mode will be activated. Standby mode can be disabled via EEPROM bit.

Lock Detect. The A5947G will turn off for the programmed time (t_{LOCK}) when the rotor is in a locked condition. A normal startup occurs after the lock timeout. EEPROM variable RETRY provides an option to count the number of lock events and prevent restart attempts after the count is exceeded. To resume operation after retry count is exceeded, PWM must be cycled OFF \rightarrow ON. Lock event count can also be triggered by thermal shutdown events, OVP, or OCP events.

Thermal Shutdown (TSD). The A5947G protects itself from overheating with an internal thermal monitoring circuit. If the junction temperature exceeds the upper threshold T_{JTSD} , the outputs will be disabled, and a lock timeout will be triggered. Device temperature must fall below the hysteresis level, ΔT_J , to allow a normal restart sequence.

EEPROM Security. EEPROM can be password protected to prevent readback of the stored configuration. The IC will be shipped without password protection. Sequence to protect IC:

- 1. Power up.
- 2. Write 16-bit number to EEPROM register 7 per normal I²C EEPROM sequence.
- 3. Remember this password.
- 4. Power down.



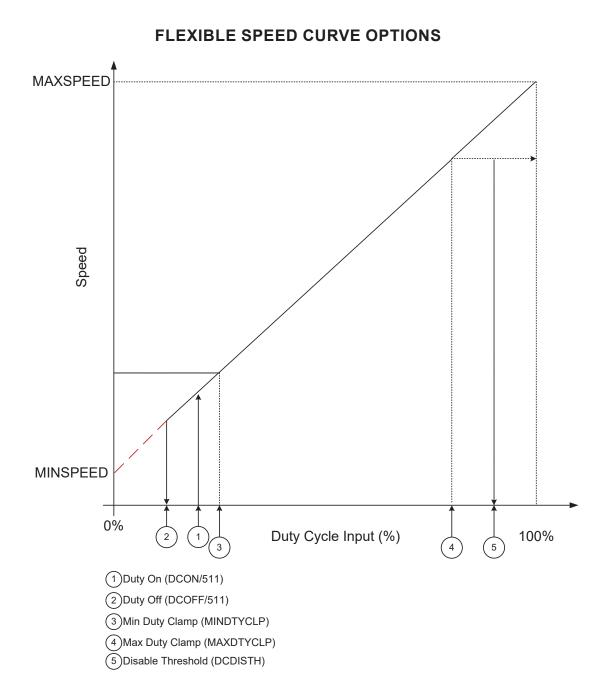
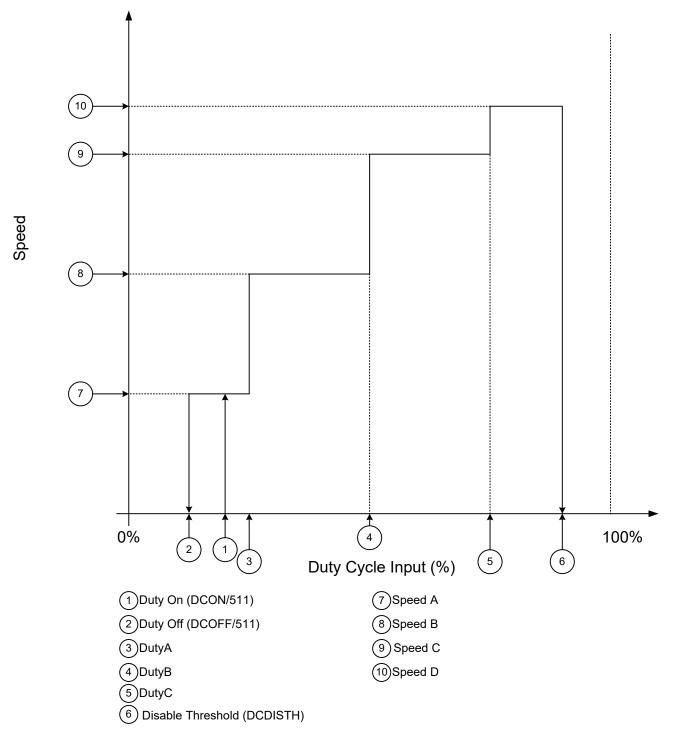


Figure 3: Slope is set by selection of 100% speed, (MAXSPEED), and y-intercept (MINSPEED).









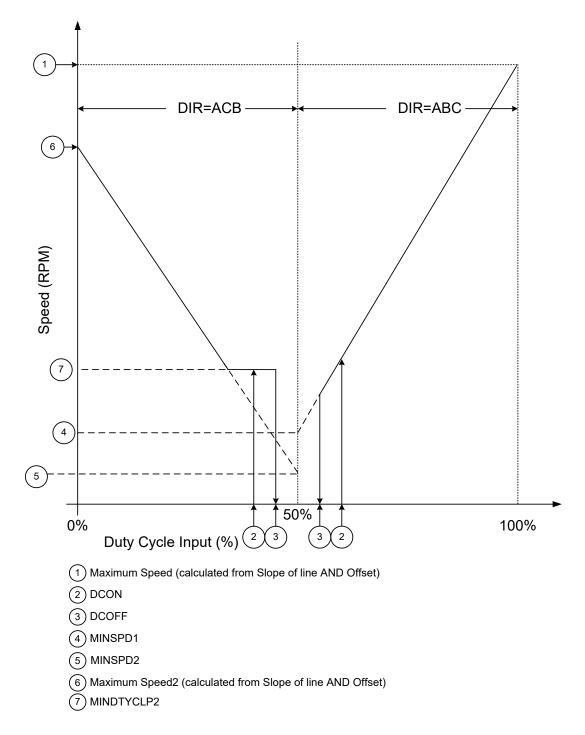


Figure 5: Direction Change Based on 50% Reference



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EEPROM MAP

ADDR	REG	Bits	Name	Description	Default Setting	Default Value
0	64	15:0	Reserved	Allegro reserved	n/a	
1	65	15:0	Reserved	Allegro reserved	n/a	
2	66	15:0	Reserved	Allegro reserved	n/a	
3	67	15:0	Reserved	Allegro reserved	n/a	
4	68	15:0	CAS	Customer Code	n/a	
5	69	15:0	Reserved	Allegro reserved	n/a	
6	70	15:0	Extra	For customer use	n/a	
7	71	15:0	PASSWORD	Password	n/a	
		3:0	MAXDTYCLP	Range = 100% to 76.5%, LSB = 1.56%	100%	0
		9:4	MINDTYCLP	Range = 0 to 50% LSB = 0.8%	0%	0
8	72	13:10	DCDISTH	Range = 100% to 78.2%, LSB = 1.56% DCDISTH(%) = 100% - (code - 1) × 1.56%	Disabled	0
		15:14	DCDISHYS	0.8% / 1.6% / 2.4% / 3.2%	0.8%	0
	70	8:0	STRTDMD	Range = 0 to VBBRNG, LSB = VBBRNG / 511	1.41 V	38
9	73	15:9	DMDPOST	Range=0 to 100%, LSB = 0.8%	87.4%	111
10	74	7:0	TCOAST	Coast time for brake or dir change	3 seconds	30
10	74	15:8	OPNLPMAX	Max speed limit for open loop mode	15104 rpm	59
11	75	7:0	ACCELT	Range = 0 to 10.2 seconds, LSB = 40 ms	760 ms	19
11	75	15:8	ACCEL	Range = 0 to 99.6 Hz/s LSB = 0.41	37.5 Hz/s	96
12	76	7:0	DCON	Range = 0 to 100% LSB = 0.4%	9.8%	25
12	76	10:8	DCHYS	Range = 0.6 to 6.1% LSB = 0.8%	2.9%	3
		3:0	DMDRMPAL	Range = 3.8 to 63.8 ms/count, LSB = 4.0	23.8 ms/count	5
13	77	7:4	DMDRMPAH	Range = 2.0 to 32/count, LSB = 2.0	5.8 ms/count	2
15		11:8	DMDRMPDL	Range = 3.8 to 63.8 ms/count, LSB = 4.0	27.8 ms/count	6
		15:12	DMDRMPDH	Range = 3.8 to 63.8 ms/count, LSB = 4.0	27.8 ms/count	6
		6:0	KP	Closed Loop Kp	16	16
14	78	7	PIGAIN	0:low Speed, 1:high Speed	0	0
		15:8	KI	Closed Loop	12	12
15	79	7:0	MAXSPD	Maximum Electrical Frequency	509 Hz	24
	15	15:8	TLOCK	0 to 25.4 seconds, 255 = latchoff	5 seconds	50
16	80	13:0	SPDSLP1	Calculated Slope of Speed Curve	10000 rpm Maxspeed	1252
17	81	11:0	MINSPEED	Range = 0 to 4095, res = 1 rpm	0 rpm	0
	01	15:12	TRAPDTY	Duty to switch to trap drive LSB = 6.25%	Sine Only	0
		0	CL	Speed Control Mode 0 = OpenLoop, 1 = Closed	Open	0
		1	DIR	$0 = A \rightarrow C \rightarrow B, 1 = A \rightarrow B \rightarrow C$	A→C→B	0
		2	UVLO	0 = Low (3.85 V), 1 = High (8.65 V)	High	1
	18 82 -	3	SPDSEL	Speed Control Select 0 = PWM Duty, 1 = Analog	PWM	0
		6:4	PP	Pole Pair = PP+1	2 Pole-Pair	1
18		8:7	ALIGN	$0{:}3 \rightarrow 500$ ms / 1 second / 1.5 seconds / 2 seconds	1 second	1
10		9	OVPOPT	0: disable, 1: lock detect	Lock Detect	1
		10	SLEW	Output dv/dt select	100 ns	0
		11	Unused	Must Set to 0	n/a	0
		13:12	BEMFHYS	Bemf Hys Level for Startup	40 mV	1
		14	SOWAUTO	Initial Value of Window	21 degrees	1
		15	OCPOPT	0 = Reset after Tlock, 1= After PWM on/off	Tlock	0

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1 0 STRONS Somely Mode 1 = fields, 1 = iDouble Dealed 1 1 PMMF Mox PMM Section Mox PMM Section Mox PMM Sectin Mox PMM Section Mox PMM Section Mox PMM Section Mox P	ADDR	REG	Bits	Name	Description	Default Setting	Default Value
19			0	STBYDIS	Standby Mode 0 = Enable, 1 = Disable	Disabled	1
4.3 BEAFLI Time Filter 4 4 gs 4 4 gs 0 19 4.3 GEMA Temperature Companion (0.11, 0n) Databeted 0 19 4.3 GEMA Temperature Companion (0, 11, 0n) Benydroxica 0 10 9.3 GTUFOT Differ Time (ine ger step) 1.3 0 11.0 Differ Time (ine ger step) 1.3 0 0 11.1 Differ Time (ine ger step) 1.3 0 0 11.1 Differ Time (ine ger step) 1.3 0 0 11.2 Differ Time (ine ger step) 0 1.3 0 11.1 VEBOVO 0 = 194.1 = 304 1.5 1.5 0 11.1 VEBOVO 0 = 194.1 = 304 0 1.5 0 0 11.1 VEBOVO 0 = 194.1 = 304 0 1.5 0 0 11 1 1 1 1 1 1 1 12 STAL 1.5 abbs 1.5 abbs<			1	PWMF	Motor PWM Selection	24 kHz	0
9 94 15 TCEN8 Trepesture Conjensation 0.0f. 1. 0n Disabilid 0 19 6 WKNMLL 0. Respectiverize. Usake and stop Respectiverize 0.00 10 7 POSTCASC 0.500 ns.1 0.00 0.00 0.00 10 0.500 ns.1 0.500 ns.1 0.00 0.00 0.00 0.00 11.0 DTHSTR Differstree inpart stage 8 0.00 0.00 11.0 DTHSTR Differstree inpart stage 0.00<			2	DTYIN	0: Low F (34hz), 1: High F	Low	0
9 84 6 WNOMLL 0.Resynchronice Resynchronice 0 19 7 POSTCOAST 0.Soom, 1-100 m. 500 m. 0.00 110 DTHET Differ mice or step 1.3 0 110 DTHET Differ mice or step 8 0 12 DTHENB 0.Inter mice or step 8 0 14 VBBOVDB 0.Enabled, 1.Enable differ function Detabled 0.00 14 VBBOVDB 0.191/1.3 VB 0.191/1.3 VB 0.00 15 VBBOVDB 0.191/1.3 VB 0.191/1.3 VB 0.00 16 VBBOVDB 0.191/1.3 VB 0.191/1.3 VB 0.00 16 VBBOVDB 0.191/1.3 VB 0.00 0.00 16 VBBOVDB 0.191/1.3 VB 0.00 0.00 16 VBBOVDB 0.191/1.3 VB 0.00 0.00 0.00 0.00 16 DTFMENB 0.191/1.5 VB VB 0.00 VDC 0.00 VDC 0.00 VDC 0.00 VDC 0.00 VDC			4:3	BEMFILT	Time Filter	4 µs	0
19 83 7 POSTCOAST 0 = 500 m, 1 = 100 ms 500 m, 1 500 ms 0 11:0 0DHDT Difference (mp per itsp) 1.3 0 11:0 DDHST Difference (mp per itsp) 8 0 12 0THENS 0 = 5 tabled, 1 = Enable dher lundon 0 0 13 VBSOVIDS 0 = 5 tabled, 1 = Enable dher lundon 0 0 14 VBSOVIDS 0 = 19 V, 1 = 3V 0 0 0 15 VBBRMG 0 = 19 V, 1 = 3V 0 0 0 15 VBBRMG 0 = 19 V, 1 = 3V 0 0 0 16 VBBRMG 0 = 19 V, 1 = 3V 0 0 0 15 VBBRMG 0 = 10 V/ 1 = 3V 0 0 0 16 DTNN 0 Formal + 10 math 0 0 0 16 DTNN 0 = 10 V/ 1 = 3V 0 0 0 0 16 DTNN 0 = 0 Contrel + 5 math 0 0			5	TCENB	Temperature Compensation 0: Off, 1: On	Disabled	0
98 DTHOT Disk time (ms por skop) 1.1 0 11:00 DTHSTP Disk number of skaps 8 0 12:0 DTHSTP Disk number of skaps 8 0 13:0 OHEW DINSTP Disk number of skaps 9 0 14:0 VBBOV/DIS 0 = Taskelo (International Staps) 9 0 0 14:0 VBBOV/DIS 0 = 19 (1 + 38 V 99 V 0 0 14:0 VBBOV/DIS 0 = 19 (1 + 38 V 99 V 0 0 14:0 VBBOV/DIS 0 = 19 (1 + 38 V 99 V 0 0 14:0 VBBOV/DIS 0 = 19 (1 + 38 V 99 V 0 0 14:0 VBBOV/DIS 0 = 19 (1 + 38 V 0			6	WINDMILL	0: Resynchronize, 1: brake until stop	Resynchronize	0
International of steps S 0 11:0 DITH STP Dither number of steps S 0 12 DITH STP 0 instate, 1 = Disable Disable 0 13 VBB ONDIS 0 = Enable Enable 0 14 VBB ONDIS 0 = Enable 19.V 0 15 VBB NG 0 = 19.V 1 = 38.V 19.V 0 15 VBB NG 0 = 19.V 1 = 38.V 19.V 0 11 Reserved Starmat, 1 = truest Date 19.V 0 2 STAR 1 = Enable Starmate Normal 0 2 STAR 1 = Enable Starmate Dashbed 0 2 STAR 1 = Enable Starmate Dashbed 0 3 DIRSO 1 = Enable Starmate Dashbed 0 4 BRCOFF 0 = coast, 1 = Banke Dashbed 0 5 STRT 0 = Adagn, 1 = One cogle 2 = 10-D2T, 3 = 10-DT One Cogle 1 7 POTOFT 0 = coast, 1	19	83	7	POSTCOAST	0 = 500 ms, 1 = 100 ms	500 ms	0
Image: Probability Image:			9:8	DITHDT	Dither time (ms per step)	1.3	0
Image: basis			11:10	DITHSTP	Dither number of steps	8	0
Interpretation Interpretation Interpretation Interpretation Interpretation 20 Interpretation Interpretation Interpretation Interpretation Interpretation 21 Interpretation Interpretation Interpretation Interpretation Interpretation 22 Interpretation Interpretation Interpretation Interpretation Interpretation 23 Interpretation Interpretation Interpretation Interpretation Interpretation 24 Interpretation Interpretation Interpretation Interpretation Interpretation 25 Interpretation Interpretation Interpretation Interpretation Interpretation 26 Interpretation Interpretation Interpretation Interpretation Interpretation 27 Interpretation Interpretation Interpretation Interpretation Interpretation 28 Interpretation Interpretation Interpretation Interpretation Interpretation 29 Interpretation I			12	DITHENB	0 = Disabled, 1 = Enable dither function	Disabled	0
Image: bit is is is in the start of the start o			13	VBBOVDIS	0 = Enable, 1 = Disable	Enabled	0
0 DTYNV 0 = Normal. 1 = Invert Normal 0 1 Reserved Alligo Reserved - Sait b One 1 1 1 2 STAR 1 = Endels Statistics Disabled 0 3 DIRSO 1. Enable Direction change based on 50% duty Disabled 0 4 BRKOFF 0 = cost, 1 = Brake Disabled 0 65 STRT 0 = Algin, 1 = One cycle, 2 = IPD ZT, 3 = IPD-T One Cycle 1 7 IPDTOPT 0 = Stow Decay, 1 = Brake Stow 0 1 8 Reserved Stow Decay, 1 = Brake One Cycle 1 1 14 BRKOFF 0 = cols biolo, RES 32 pm Stow 0 1 14 Reserved Range = 10 is 160, RES 32 pm 3008 pm 94 1 21 R6 7.0 SPEEDA Range = 10 is 160, RES 32 pm 4000 pm 125 22 R7 5.0 DUTYB Range = 137 to 100%, LSB = 1.56% 40.51% 25 23			14	VBBOV	0 = 19 V, 1 = 38 V	19 V	0
1 Reserved Alegro Reserved - Saito One 1 1 2 STAIR 1 = Enable Staircase Disabled 0 3 DIRSO 1. Enable Staircase Disabled 0 4 BRKOF 0 = coast. 1 = Brake Disabled 0 6 STRT 0 = coast. 1 = Brake Disabled 0 7 IPDTOPT 0 = Slow Decay, 1 = Fast Decay One Cycle 1 7 IPDTOPT 0 = Slow Decay, 1 = Fast Decay Slow 0 8 Reserved Range = 1.37 to 10% LSB = 1.56% Slow 0 1 7 IPDTOPT Range = 0.0 to 10% LSB = 1.56% Slow 0.808 rpm 38 21 R 7.0 SPEEDA Range = 0.0 to 10% LSB = 1.56% 20.05 rpm 30.08 rpm 34 22 R 7.0 SPEEDA Range = 0.0 to 10% LSB = 1.56% 20.05 rpm 20.05 rpm <td></td> <td></td> <td>15</td> <td>VBBRNG</td> <td>0 = 19 V, 1 = 38 V</td> <td>19 V</td> <td>0</td>			15	VBBRNG	0 = 19 V, 1 = 38 V	19 V	0
20 84			0	DTYINV	0 = Normal, 1 = Invert	Normal	0
20 84 3 DIR50 1:Enable Direction change based on 50% duty Disabled 0 20 44 BRKOFF 0 = cosst, 1 = Brake Disabled 0 65 STRT 0 = align, 1 = One cycle, 2 = IPO-T, 3 = IPO-T One Cycle 1 7 IPOTOPT 0 = Slow Decay, 1 = Fast Decay Slow 0 7 IPOTOPT 0 = Slow Decay, 1 = Fast Decay Slow 0 8 Reserved Range = 137 to 100%, LSB = 156% Slow 0.085% 363 21 14.9 DUTYC Range = 10 s 1610, RES 32 rpm 2016 rpm 63 7 SPEEDA Range = 10 s 1610, RES 32 rpm 4000 rpm 125 7 15.8 SPEEDO Range = 10 s 1610, RES 32 rpm 4000 rpm 125 7 3 7.0 SPEEDO Range = 10 s 1610, RES 32 rpm 4000 rpm 125 7 15.8 SPEEDO Range = 10 s 1610, RES 32 rpm 4001 rpm 125 7 13.8 DUTYA Range = 10 to 5040, RES 32 rpm <t< td=""><td></td><td></td><td>1</td><td>Reserved</td><td>Allegro Reserved – Set to One</td><td>1</td><td>1</td></t<>			1	Reserved	Allegro Reserved – Set to One	1	1
20 84 4 BRKOFF 0 = coast, 1 = Brake Disabled 0 65 STRT 0 = Align, 1 = One cycle, 2 = IPD-ZT, 3 = IPD-T One Cycle 1 7 IPDTOPT 0 = Slow Decay, 1 = Fast Decay Slow 0 8 Reserved Set to 1 1 14:9 DUTYC Range = 1.37 to 100%, LSB = 1.56% 60.86% 38 21 14:8 SPEEDA Range = 1.0 s160, RES 32 rpm 60.86% 38 21 7.0 SPEEDA Range = 1.0 s160, RES 32 rpm 3008 rpm 94 22 7.0 SPEEDA Range = 1.0 s160, RES 32 rpm 4000 rpm 125 23 7.0 SPEEDA Range = 1.0 s160, RES 32 rpm 4000 rpm 125 24 7.0 SPEEDA Range = 1.0 s160, RES 32 rpm 4051% 22.16% 12 23 87 5.0 DUTYA Range = 1.0 s160, RES 32 rpm 4051% 22.16% 12 24 87 5.0 DUTYA Range = 0.0 s160, RES 42 rpm <t< td=""><td></td><td></td><td>2</td><td>STAIR</td><td>1 = Enable Staircase</td><td>Disabled</td><td>0</td></t<>			2	STAIR	1 = Enable Staircase	Disabled	0
Image: branch stripping branch str			3	DIR50	1: Enable Direction change based on 50% duty	Disabled	0
$ \begin{array}{ c c c c } \hline \begin{tabular}{ c c c } \hline \hline \end{tabular} \\ \hline \end{tabular} \\ \hline \end{tabular} \\ \hline \hline \en$	20	84	4	BRKOFF	0 = coast, 1 = Brake	Disabled	0
$ \begin{array}{ c c c c c c } \hline 8 & Reserved & Set 0 & 1 & 1 \\ \hline 14.9 & DUTYC & Range = 1.37 to 100\%, LSB = 1.56\% & 60.86\% & 38 \\ \hline 14.9 & DUTYC & Range = 0.16 8160, RES 32 rpm & 2016 rpm & 63 \\ \hline 15.8 & SPEEDB & Range = 0 to 8160, RES 32 rpm & 3008 rpm & 94 \\ \hline 15.8 & SPEEDC & Range = 0 to 8160, RES 32 rpm & 4000 rpm & 125 \\ \hline 15.8 & SPEEDD & Range = 0 to 8160, RES 32 rpm & 4000 rpm & 125 \\ \hline 15.8 & SPEEDD & Range = 0 to 8160, RES 32 rpm & 4000 rpm & 125 \\ \hline 15.8 & SPEEDD & Range = 0 to 8160, RES 32 rpm & 4992 rpm & 156 \\ \hline 15.8 & SPEEDD & Range = 0 to 8160, RES 32 rpm & 4992 rpm & 156 \\ \hline 15.8 & SPEEDD & Range = 1.37 to 100\%, LSB = 1.56\% & 20.16\% & 12 \\ \hline 13.8 & DUTYA & Range = 1.37 to 100\%, LSB = 1.56\% & 20.16\% & 12 \\ \hline 13.8 & DUTYB & Range = 1.37 to 100\%, LSB = 1.56\% & 0.01\% & 0.05\% \\ \hline 13.8 & DUTYB & Range = 1.37 to 100\%, LSB = 1.56\% & 0.01\% & 0.05\% \\ \hline 15.1 & MINSPO2 & Range = 0 to 4050, res = 1 rpm (DIR50 mode) & 0.0 \\ \hline 15.1 & RETRY & Number of retry atempts when rotor locked (0 = function disabled) & 0.05\% \\ \hline 15.1 & RETRY & Number of retry atempts when rotor locked (0 = function disabled) & 0.0 \\ \hline 15.1 & RETRY & Number of retry atempts when rotor locked (0 = function disabled) & 0.0 \\ \hline 15.1 & RETRY & Number of retry atempts when rotor locked (0 = function disabled) & 0.0 \\ \hline 15.1 & Unused & Range = 0 to 50\%, LSB = 0.8\% (DIR50) & 0.0 \\ \hline 15.1 & Unused & 0.0 \\ \hline 15.1 & Unused & SIPPSWDTY & Slope Switch Duty for dual slope mode & 0 & 0 \\ \hline 15.1 & Unused & Allegro Reserved - Locked & nia & nia \\ \hline 11.8 & STRTF & Frequency for 1-cycle startup Mode & 11Hz & 16 \\ \hline 11.8 & STRTF & Frequency for 1-cycle startup Mode & 11Hz & 16 \\ \hline 11.0 & 10.0 & 0 \\ \hline 11.0 & Reserved & Allegro Reserved - Must be Set to Zero & 0 & 0 \\ \hline 11.0 & Reserved & Malegro Reserved - Must be Set to Zero & 0 & 0 \\ \hline 11.0 & Start & Reserved - Must be Set to Zero & 0 & 0 \\ \hline 11.0 & Start & Reserved - Must be Set to Zero & 0 & 0 \\ \hline 11.0 & Start & Reserved - Must be Set to Zero & 0 & 0 \\ \hline 11.0 & Start & Reserved - Must be Set to Zero & 0 & 0 \\ \hline 11.$			6:5	STRT	0 = Align, 1 = One cycle, 2 = IPD-ZT, 3 = IPD-T	One Cycle	1
Interpretation14.9DUTYCRange = 1.37 to 10%, LSB = 1.56%60.86%3.821867.0SPEEDARange = 0 to 8160, RES 32 pm2016 pm6.321867.0SPEEDBRange = 0 to 8160, RES 32 pm3.008 pm9.422867.0SPEEDCRange = 0 to 8160, RES 32 pm4.4000 pm1.2523877.0SPEEDCRange = 0 to 8160, RES 32 pm4.4000 pm1.2524865.0DUTYARange = 1.37 to 10%, LSB = 1.56%2.0 16%1.223875.0DUTYARange = 1.37 to 10%, LSB = 1.56%4.0.51%2.0 16%248811.0MINSPD2Range = 0.13 to 10%, LSB = 1.56%4.0.51%2.0 16%248811.0MINSPD2Range = 0.137 to 10%, LSB = 1.56%4.0.51%2.0 16%2513.8DUTYBRange = 0.137 to 10%, LSB = 1.56%4.0.51%2.0 16%2613.8DUTYBRange = 0.137 to 10%, LSB = 1.56%4.0.51%2.0 16%278811.0MINSPD2Range = 0.10 50%, LSB = 0.8% (DIR50)002613.6SLP2WDTYSlope Switch Duty for dual slope mode)10000 rpm Maxgeed1.252279115.0SLP2WDTYSlope Switch Duty for dual slope mode00289215.0SLP2WDTYSlope Switch pm for dual slope mode00279115.0SLP2WDTYSlope Switch pm for dual slope mode00			7	IPDTOPT	0 = Slow Decay, 1 = Fast Decay	Slow	0
21857.0SPEEDARange 0 to 8160. RES 32 rpm2016 rpm63228615.8SPEEDBRange 0 to 8160. RES 32 rpm3008 rpm9422867.0SPEEDCRange 0 to 8160. RES 32 rpm4000 rpm12523875.0DUTYARange 1 37 to 100%, LSB = 1.56%20.16%1224875.0DUTYARange 1 37 to 100%, LSB = 1.56%40.51%25248811.0MINSPD2Range 1 37 to 100%, LSB = 1.56%0.00248811.0MINSPD2Range -0 to 4095, res = 1 rpm (DIR50 mode)0.00258913.0SPDSLP2Calculated Slope of Speed Curve (DIR50 and dual slope mode)10000 rpm Maxspeed1252269013.6SLPSWDTYSlope Switch Duty for dual slope mode)0.00279115.0SLPSWDTYSlope Switch Duty for dual slope mode0.00289215.0ReservedAllegro Reserved - Lockedn/an/a299315.0ReservedAllegro Reserved - Lockedn/a10309415.0ReservedAllegro Reserved - Must be Set to Zero0.00			8	Reserved		Set to 1	1
$ \begin{array}{c c c c c c } \hline 15.8 & SPEEDB & Range = 0 to $160, RES 32 rpm & 3000 rpm & 94 \\ \hline 15.8 & SPEEDC & Range = 0 to $160, RES 32 rpm & 4000 rpm & 125 \\ \hline 15.8 & SPEEDD & Range = 0 to $160, RES 32 rpm & 4992 rpm & 156 \\ \hline 15.8 & SPEEDD & Range = 0 to $160, RES 32 rpm & 4992 rpm & 156 \\ \hline 15.8 & SPEEDD & Range = 1.37 to 100\%, LSB = 1.56\% & 20.65\% & 12 \\ \hline 13.8 & DUTYB & Range = 1.37 to 100\%, LSB = 1.56\% & 40.51\% & 25 \\ \hline 13.8 & DUTYB & Range = 1.37 to 100\%, LSB = 1.56\% & 40.51\% & 25 \\ \hline 13.8 & DUTYB & Range = 1.37 to 100\%, LSB = 1.56\% & 40.51\% & 25 \\ \hline 15.12 & RETRY & Number of retry attempts when rotor locked (0 = function disabled) & 0 & 0 \\ \hline 15.12 & RETRY & Number of retry attempts when rotor locked (0 = function disabled) & Disabled & 0 \\ \hline 15.12 & RETRY & Number of retry attempts when rotor locked (0 = function disabled) & 0 \\ \hline 15.12 & RETRY & Number of retry attempts when rotor locked (0 = function disabled) & 0 \\ \hline 15.12 & RETRY & Number of retry attempts when rotor locked (0 = function disabled) & 0 \\ \hline 15.12 & RETRY & Number of retry attempts when rotor locked (0 = function disabled) & 0 \\ \hline 15.12 & RETRY & Number of retry attempts when rotor locked (0 = function disabled) & 0 \\ \hline 15.14 & Unused & Range = 0 to 50\%, LSB = 0.8\% (DIR50) & 0 & 0 \\ \hline 13.6 & SLPSWDTY & Slope Switch Duty for dual slope mode & 0 & 0 \\ \hline 15.14 & Unused & Infa & Infa & Infa \\ \hline 15.14 & Unused & Allegro Reserved - Locked & Infa & Infa \\ \hline 16. \\ \hline 17. & 10 & Reserved & Allegro Reserved - Locked & Infa & Infa \\ \hline 16. \\ \hline 15.8 & STRTF & Frequency for 1-cycle startup Mode & 1 Hz & 16 \\ \hline 16. \\ \hline 16. & 15.10 & Reserved - Matty ES to Zero & 0 & 0 \\ \hline 15.8 & STRTF & Frequency for 1-cycle startup Mode & 1 Hz & 16 \\ \hline 16. \\ \hline 16. & 15.0 & Reserved - Matty ES to Zero & 0 & 0 \\ \hline 16. & 15.0 & Reserved - Matty ES to Zero & 0 & 0 \\ \hline 16. & 15.0 & Reserved - Matty ES to Zero & 0 & 0 \\ \hline 16. & 15.0 & Reserved - Matty ES to Zero & 0 & 0 \\ \hline 16. & 15.0 & Reserved - Matty ES to Zero & 0 & 0 \\ \hline 16. & 1 & 15.0 & Reserved - Matty ES to Zero & 0 & 0 $			14:9	DUTYC	Range = 1.37 to 100%, LSB = 1.56%	60.86%	38
InterpretationInterpretationInterpretationInterpretationInterpretationInterpretation 22 15.8 SPEEDBRange = 0 to 8160, RES 22 rpmInterpretationInterpretationInterpretation 22 15.8 SPEEDDRange = 0 to 8160, RES 22 rpmInterpretationInterpretationInterpretation 23 87 5.0 DUTYARange = 1.37 to 100%, LSB = 1.5%InterpretationInterpretationInterpretation 23 87 5.0 DUTYBRange = 1.37 to 100%, LSB = 1.5%InterpretationInterpretationInterpretation 24 87 11.0 MINSPD2Range = 0 to 4095, res = 1 rpm (DIR50 mode)InterpretationInterpretationInterpretation 24 87 11.0 MINSPD2Range= 0 to 4095, res = 1 rpm (DIR50 mode)InterpretationInterpretationInterpretation 24 87 11.0 MINSPD2Range= 0 to 50%, LSB = 0.8% (DIR50)InterpretationInterpretationInterpretation 25 89 13.0 SPDSLP2Calculated Slope of Speed Curve (DIR50 and dual slope mode)InterpretationInterpretationInterpretation 26 90 13.6 SLPSWDTYSlope Switch Duty for dual slope modeInterpretationInterpretation 27 91 15.0 SLPSWRPMSlope Switch rpm for dual slope modeInterpretationInterpretation 27 91 15.0 ReservedAlegro Reserved-LuckedInterpretationInterpretation 2	01	05	7:0	SPEEDA	Range = 0 to 8160, RES 32 rpm	2016 rpm	63
$ \begin{array}{c c c c c c c c c c } \hline 22 & 86 & \hline 158 & SPEEDD & Range = 0 to 8160, RES 32 rpm & 1492 rpm & 156 \\ \hline 158 & SPEEDD & Range = 1.37 to 100\%, LSB = 1.56\% & 20.16\% & 12 \\ \hline 13.8 & DUTYA & Range = 1.37 to 100\%, LSB = 1.56\% & 20.16\% & 22.16\% & 25 \\ \hline 13.8 & DUTYB & Range = 1.37 to 100\%, LSB = 1.56\% & 40.51\% & 25 \\ \hline 13.8 & DUTYB & Range = 0 to 905, res = 1 rpm (DIR50 mode) & 0 & 0 \\ \hline 15.12 & RETRY & Number of retry attempts when rotor locked (0 = function disabled) & Disabled & 0 \\ \hline 15.12 & RETRY & Number of retry attempts when rotor locked (0 = function disabled) & 10000 rpm Maxspeed & 1252 \\ \hline 28 & 13.0 & SPDSLP2 & Calculated Slope of Speed Curve (DIR50 and dual slope mode) & 10000 rpm Maxspeed & 1252 \\ \hline 29 & 13.6 & SLPSWDTY & Slope Switch Duty for dual slope mode & 0 & 0 \\ \hline 15.14 & Unused & Infa & Infa & Infa & Infa \\ \hline 27 & 91 & 15.0 & SLPSWRPM & Slope Switch rpm for dual slope mode & 0 & 0 \\ \hline 15.14 & Unused & Infa \\ \hline 29 & 9.3 & \hline 7.0 & IPDRMP & Duty Ramp for IPD-T & 10 ms & 9 \\ \hline 20 & 9.4 & 15.0 & Reserved & Allegro Reserved - Locked & Must be Set to Zero & 0 & 0 \\ \hline 30 & 94 & 15.0 & Reserved & Allegro Reserved - Must be Set to Zero & 0 & 0 \\ \hline 30 & 94 & 15.0 & Reserved & Allegro Reserved - Must be Set to Zero & 0 & 0 \\ \hline 30 & 94 & 15.0 & Reserved & Allegro Reserved - Must be Set to Zero & 0 & 0 \\ \hline 31 & 15.0 & Reserved & Allegro Reserved - Must be Set to Zero & 0 & 0 \\ \hline 31 & 15.0 & Reserved & Allegro Reserved - Must be Set to Zero & 0 & 0 \\ \hline 31 & 15.0 & Reserved & Allegro Reserved - Must be Set to Zero & 0 & 0 \\ \hline 31 & 15.0 & Reserved & Allegro Reserved - Must be Set to Zero & 0 & 0 \\ \hline 31 & 15.0 & Reserved & Allegro Reserved - Must be Set to Zero & 0 & 0 \\ \hline 31 & 15.0 & Reserved & Allegro Reserved - Must be Set to Zero & 0 & 0 \\ \hline 31 & 15.0 & Reserved & Allegro Reserved - Must be Set to Zero & 0 & 0 \\ \hline 31 & 15.0 & Reserved & Must be Set to Zero & 0 & 0 \\ \hline 31 & 15.0 & Reserved & Must be Set to Zero & 0 & 0 \\ \hline 31 & 15.0 & Reserved & Must be Set to Zero & $	21	85	15:8	SPEEDB	Range = 0 to 8160, RES 32 rpm	3008 rpm	94
InstantInstanceSPEEDDRange = 0 to 8160, RES 32 rpm4992 rpm4992 rpm15623875.0DUTYARange = 1.37 to 100%, LSB = 1.56%20.16%1213.8DUTYBRange = 1.37 to 100%, LSB = 1.56%40.51%25248811:0MINSPD2Range = 0 to 4095, res = 1 rpm (DIR50 mode)00258913.0SPDSLP2Calculated Slope of Speed Curve (DIR50 mode)000258913.0SPDSLP2Calculated Slope of Speed Curve (DIR50 and dual slope mode)10000 rpm Maxspeed1252269015.0MINDTYCLP2Range = 0 to 50%, LSB = 0.8% (DIR50)000279113.6SLPSWDTYSlope Switch Duty for dual slope mode000279115.0ReservedSlope Switch rpm for dual slope mode000289215.0ReservedAllegro Reserved - Lockedn/an/a29937.0IPDRMPDuty Ramp for IPD-T10 ms9309415.0ReservedAllegro Reserved - Must be Set to Zero00	00	00	7:0	SPEEDC	Range = 0 to 8160, RES 32 rpm	4000 rpm	125
$ \begin{array}{c c c c c c c } \hline 13.8 & DUTYB & Range = 1.37 to 100\%, LSB = 1.56\% & 40.51\% & 25 \\ \hline 13.8 & DUTYB & Range = 1.37 to 100\%, LSB = 1.56\% & 40.51\% & 25 \\ \hline 13.8 & DUTYB & Range = 0 to 4095, res = 1 rpm (DIR50 mode) & 0 & 0 \\ \hline 15.12 & RETRY & Number of retry attempts when rotor locked (0 = function disabled) & Disabled & 0 \\ \hline 15.12 & RETRY & Number of retry attempts when rotor locked (0 = function disabled) & Disabled & 0 \\ \hline 15.12 & RETRY & Number of retry attempts when rotor locked (0 = function disabled) & Disabled & 0 \\ \hline 15.12 & RETRY & Range = 0 to 50\%, LSB = 0.8\% (DIR50) & 0 & 0 \\ \hline 15.13 & SPDSLP2 & Calculated Slope of Speed Curve (DIR50 and dual slope mode) & 10000 rpm Maxspeed & 1252 \\ \hline 15.14 & Unused & 0 & 0 \\ \hline 15.14 & Unused & 0 & 0 \\ \hline 15.14 & Unused & 0 & 0 \\ \hline 15.14 & Unused & SLPSWDTY & Slope Switch Duty for dual slope mode & 0 & 0 \\ \hline 15.14 & Unused & 0 & 0 \\ \hline 15.14 & Unused & 0 & 0 \\ \hline 15.14 & Unused & 0 & 0 \\ \hline 15.14 & Unused & Alegro Reserved - Locked & n/a & n/a \\ \hline 19.9 & 15.0 & Reserved & Alegro Reserved - Locked & n/a & n/a \\ \hline 19 & 15.8 & STRTF & Frequency for 1-cycle startup Mode & 114z & 16 \\ \hline 10 & 14z & 16 \\ \hline 10 & 15.0 & Reserved & Alegro Reserved - Must be Set to Zero & 0 & 0 \\ \hline 10 & 15.0 & Reserved & Melgro Reserved - Must be Set to Zero & 0 & 0 \\ \hline 10 & 15.0 & Reserved & Melgro Reserved - Must be Set to Zero & 0 & 0 \\ \hline 10 & 15.0 & Reserved & Melgro Reserved - Must be Set to Zero & 0 & 0 \\ \hline 10 & 15.0 & Reserved & Melgro Reserved - Must be Set to Zero & 0 & 0 \\ \hline 10 & 15.0 & Reserved & Melgro Reserved - Must be Set to Zero & 0 & 0 \\ \hline 10 & 15.0 & Reserved & Melgro Reserved - Must be Set to Zero & 0 & 0 \\ \hline 10 & 15.0 & Reserved & Melgro Reserved - Must be Set to Zero & 0 & 0 \\ \hline 10 & 15.0 & Reserved & Melgro Reserved - Must be Set to Zero & 0 & 0 \\ \hline 10 & 15.0 & Reserved & Melgro Reserved - Must be Set to Zero & 0 & 0 \\ \hline 10 & 15.0 & Reserved & Melgro Reserved - Must be Set to Zero & 0 & 0 \\ \hline 10 & 15.0 & Reserved & Melgro Reserved - Must be Set to Zero & 0 & 0 \\ \hline 10 & 15.$	22	86	15:8	SPEEDD	Range = 0 to 8160, RES 32 rpm	4992 rpm	156
$ \begin{array}{ c c c c } \hline \begin{tabular}{ c c c c } \hline \begin{tabular}{ c c c c c } \hline \begin{tabular}{ c c c c c c c c c c c c c c c c c c c$			5:0	DUTYA	Range = 1.37 to 100%, LSB = 1.56%	20.16%	12
$ \begin{array}{c c c c c c c c } \hline 24 & 88 & \hline 15:12 & RETRY & Number of retry attempts when rotor locked (0 = function disabled) & Disabled & 0 \\ \hline 15:12 & RETRY & Number of retry attempts when rotor locked (0 = function disabled) & 10000 rpm Maxspeed & 1252 \\ \hline 25 & 89 & 13:0 & SPDSLP2 & Calculated Slope of Speed Curve (DIR50 and dual slope mode) & 10000 rpm Maxspeed & 1252 \\ \hline 26 & 90 & \hline 13:6 & SLPSWDTY & Slope Switch Duty for dual slope mode & Disabled & 0 \\ \hline 13:6 & SLPSWDTY & Slope Switch Duty for dual slope mode & Disabled & 0 \\ \hline 15:14 & Unused & 0 & 0 \\ \hline 27 & 91 & 15:0 & SLPSWRPM & Slope Switch rpm for dual slope mode & 0 & 0 \\ \hline 28 & 92 & 15:0 & Reserved & Allegro Reserved - Locked & n/a & n/a \\ \hline 29 & 93 & \hline 7.0 & IPDRMP & Duty Ramp for IPD-T & 10 ms & 9 \\ \hline 15:8 & STRTF & Frequency for 1-cycle startup Mode & 1 Hz & 16 \\ \hline 30 & 94 & 15:0 & Reserved & Allegro Reserved - Must be Set to Zero & 0 & 0 \\ \hline \end{array}$	23	87	13:8	DUTYB	Range = 1.37 to 100%, LSB = 1.56%	40.51%	25
InitialInitialRETRYNumber of retry attempts when rotor locked (0 = function disabled)Disabled0258913:0SPDSLP2Calculated Slope of Speed Curve (DIR50 and dual slope mode)10000 rpm Maxspeed125226905:0MINDTYCLP2Range = 0 to 50%, LSB = 0.8% (DIR50)000269013:6SLPSWDTYSlope Switch Duty for dual slope mode000279115:0SLPSWRPMSlope Switch Duty for dual slope mode000289215:0ReservedAllegro Reserved - Lockedn/an/a029937:0IPDRMPDuty Ramp for IPD-T10 ms916309415:0ReservedMalegro Reserved - Must be Set to Zero000	04	00	11:0	MINSPD2	Range=0 to 4095, res = 1 rpm (DIR50 mode)	0	0
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	24	80	15:12	RETRY	Number of retry attempts when rotor locked (0 = function disabled)	Disabled	0
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	25	89	13:0	SPDSLP2	Calculated Slope of Speed Curve (DIR50 and dual slope mode)	10000 rpm Maxspeed	1252
$ \begin{array}{ c c c c c c } \hline \hline & $			5:0	MINDTYCLP2	Range = 0 to 50%, LSB = 0.8% (DIR50)	0	0
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	26	90	13:6	SLPSWDTY	Slope Switch Duty for dual slope mode	Disabled	0
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $			15:14	Unused		n/a	
29 93 7:0 IPDRMP Duty Ramp for IPD-T 10 ms 9 15:8 STRTF Frequency for 1-cycle startup Mode 1 Hz 16 30 94 15:0 Reserved Must be Set to Zero 0 0	27	91	15:0	SLPSWRPM	Slope Switch rpm for dual slope mode	0	0
29 93 15:8 STRTF Frequency for 1-cycle startup Mode 1 Hz 16 30 94 15:0 Reserved Allegro Reserved – Must be Set to Zero 0 0	28	92	15:0	Reserved	Allegro Reserved - Locked	n/a	n/a
15:8 STRTF Frequency for 1-cycle startup Mode 1 Hz 16 30 94 15:0 Reserved Allegro Reserved – Must be Set to Zero 0 0	20	02	7:0	IPDRMP	Duty Ramp for IPD-T	10 ms	9
	29	93	15:8	STRTF	Frequency for 1-cycle startup Mode	1 Hz	16
31 95 15:0 Reserved Allegro Reserved - Locked n/a n/a	30	94	15:0	Reserved	Allegro Reserved – Must be Set to Zero	0	0
	31	95	15:0	Reserved	Allegro Reserved - Locked	n/a	n/a

EEPROM MAP (continued)



Three-Phase Sensorless Fan Driver IC

SERIAL PORT CONTROL OPTION

Normally the IC is controlled by duty cycle input and uses the EEPROM data that is stored to create the speed curve profile. However, it is possible to use direct serial port control to avoid programming EEPROM.

When using direct control, the input duty cycle command is replaced by writing a 9-bit number to register 165.

Example:

REGADDR[data]: (in decimal)

 $165[511] \rightarrow \text{Duty} = 100\%$

 $165[102] \rightarrow \text{Duty} = 102 / 511 = 20\%$

Upon power up, the IC defaults to duty cycle input mode. To use serial port mode, the internal registers should be programmed before turning the part on. The sequence to use serial port mode is:

1. Drive FG and SPD pins low*

2. Power-up IC

3. Program registers for parameter setting that correspond to each of the EEPROM memory locations.

A. REGADDR = 64 + EEPROM ADDR.

- B. Program register addresses 72 to 94 corresponding to EEPROM addresses 8 to 30.
- C. It may be helpful to use the GUI text file to help define the hex data for each of the EEPROM addresses.
- 4. Write to register 165 to start motor

* Note: If SPD is not driven low before power up, motor will try to start immediately as the default high value will demand 100% on signal.



Three-Phase Sensorless Fan Driver IC

I²C Control Registers

REG	Bits		Function	Description
165	[8:0]	r/w	Speed Demand Input	Duty (%) = code / 511
128	[8:0]	r	Duty applied	Actual demand to the motor windings
138	[7:0]	r	Die temp	Temp °C = 3 + (CODE – 133) / 2
144	[15:0]	r/w	Number of startup failures	Cleared by writing zero or powerup
145	[15:0]	r/w	Number of startup attempts	Cleared by writing zero or powerup
147	[9:0]		Fault Status	
	0	r	Low-side VDS A	
	1	r	Low-side VDS B	
	2	r	Low-side VDS C	
	3	r	High-side VDS A	
	4	r	High-side VDS B	
	5	r	High-side VDS C	
	6	r	TSD	
	7	r	Charge Pump UVLO	
	8	r	VBB UVLO	
	9	r	VBB Overvoltage	
148	[15:0]		Lock detect criteria	
	0	r	Switch Over Error	
	1	r	Too Slow	
	2	r	Too Fast	
	3	r	Out of Sync	
	4	r	Bad Acceleration	
	5	r	Windmill Error	
	6	r	Max Phase Advance	
	14:7		Unused	
	15	w	Clear	Write 1 to clear the latched faults



Serial Port

The A5947G uses standard fast mode I²C serial port format to program the EEPROM or to control the IC speed serially. The serial port can be used for startup configuration, fault readback, direction control, or input duty request. The SPD pin functions as the clock (SCL) input, and the FG pin is the data line (SDA). No special sequence is needed to begin transferring data. If the motor is running, the FG may pull then data line low while trying to initialize into serial port mode. Once an I²C command is received, the SPD input is ignored, and the motor will turn off as if a PWM duty command of 0% was sent.

The A5947G 7-bit slave address is 0x55.

I²C Timing Diagrams

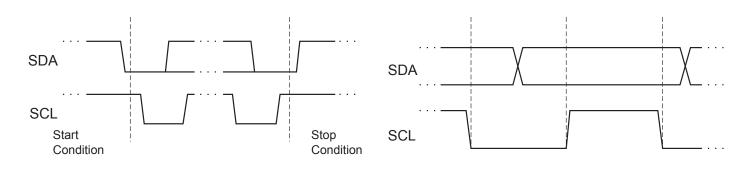


Figure 6: Start and Stop Conditions

Figure 7: Clock and Data Bit Synchronization

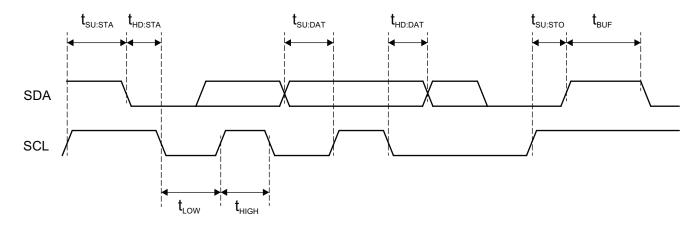
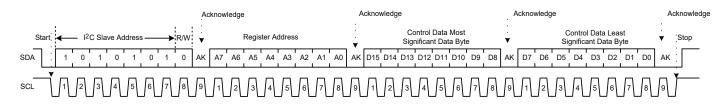


Figure 8: I²C-Compatible Timing Requirements



Write Command

- 1. Start Condition
- 2. 7-bit I²C Slave Address (Device ID) 1010101, R/W Bit = 0
- 3. Internal Register Address
- 4. 2 data bytes, MSB first
- 5. Stop Condition





Read Command

- 1. Start Condition
- 2. 7-bit I²C Slave Address (Device ID) 1010101, R/W Bit = 0
- 3. Internal Register Address to be read
- 4. Stop Condition
- 5. Start Condition
- 6. 7-bit I²C Slave Address (Device ID) 1010101, R/W Bit = 1
- 7. Read 2 data bytes
- 8. Stop Condition

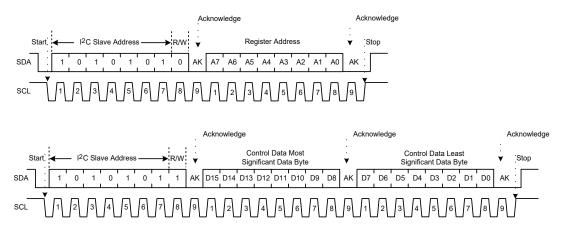


Figure 10: Read Command



Programming EEPROM

The A5947G contains 32 words of 16-bit length. The EEPROM is controlled with the following I^2C registers. Refer to application note for EEPROM definition.

Table 1: EEPROM Control – Register 161 (Used to control programming of EEPROM)

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	0	0	0 0 0 0 0 0 0 0 0 RD WR ER								ER	EN	
Bi	it	Nan	ne		Description										
0)	EN	1	Set EEPROM voltage required for writing or erasing											
1		EF	र	Sets mod	Sets mode to erase										
2	!	WF	र	Sets mod	Sets mode to write										
3	;	RE)	Sets mode to read											
15	:4	n/a	a	Do not us	Do not use; always set to zero during programming process										

Table 2: EEPROM Address – Register 162 (Used to set the EEPROM address to be altered)

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	0	0	0	0		eeADDRESS			
Bi	it	Nan	ne		Description										
4:0	0	eeADDI	RESS	Used to s	Used to specify EEPROM address to be changed.										
15:	:5	n/a	a	Do not use; always set to zero during programming process											

Table 3: EEPROM DataIn - Register 163 (Used to set the EEPROM new data to be programmed)

												-			
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	eeDATAin														
Bi	Bit Name Description														
15	:0	eeDA	TAin	Used to s	Used to specify the new EEPROM data to be changed										



15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	eeDATAout														
Bi	it	Nam	ne	Description											
15	:0	eeDAT	Aout	Used to r	Used to readback EEPROM data from address defined in register 162										

Table 4: DataOUT – Register 164 (Used for read operations)

There are 3 basic commands: Read, Erase, and Write. To change the contents of a memory location, the word must be first erased. The EEPROM programming process (writing or erasing) takes 12 ms per word.

Each word must be written individually.

Example #1: Write EEPROM address 5 to 261 (0x0105)

1) Erase the word

	I ² C Write REGADDR[Data]	; comment
a.	162[5]	; set EEPROM address to erase
b.	163[0]	; set 0000 as Data In
C.	161[3]	; set control to Erase and Voltage High
d.	Wait 12 ms	; requires 12 ms High Voltage Pulse to Write
2) Write	the new data	
a.	162[5]	; set EEPROM address to write
b.	163[261]	; set Data In = 261
C.	161[5]	; set control to Write and Set Voltage High
d.	Wait 12 ms	; requires 12 ms High Voltage Pulse to Write

Example #2: Read EEPROM address 5 to confirm correct data properly programmed

- 1) Read the word
 - a. 5[I2C Read]
- ; set EEPROM address to read



PIN DIAGRAMS

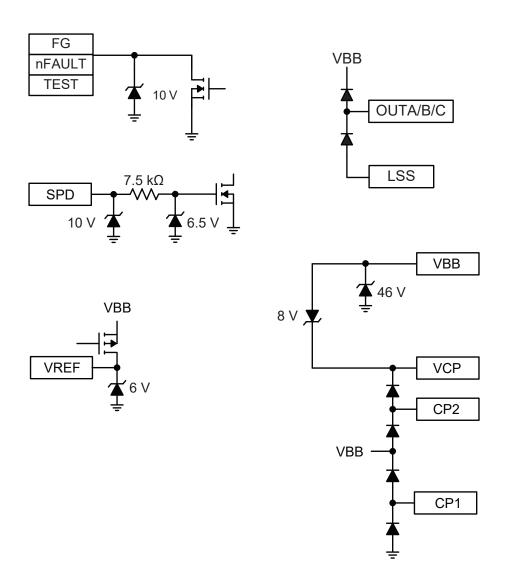


Figure 11: Pin Diagrams



PACKAGE OUTLINE DRAWINGS

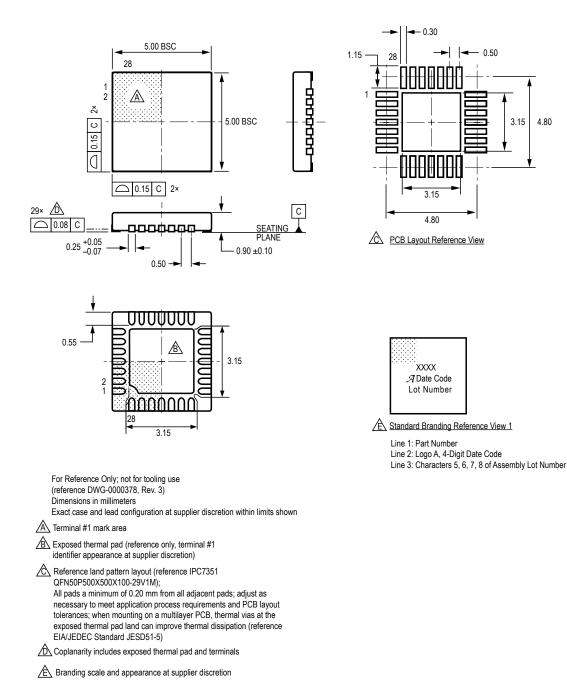
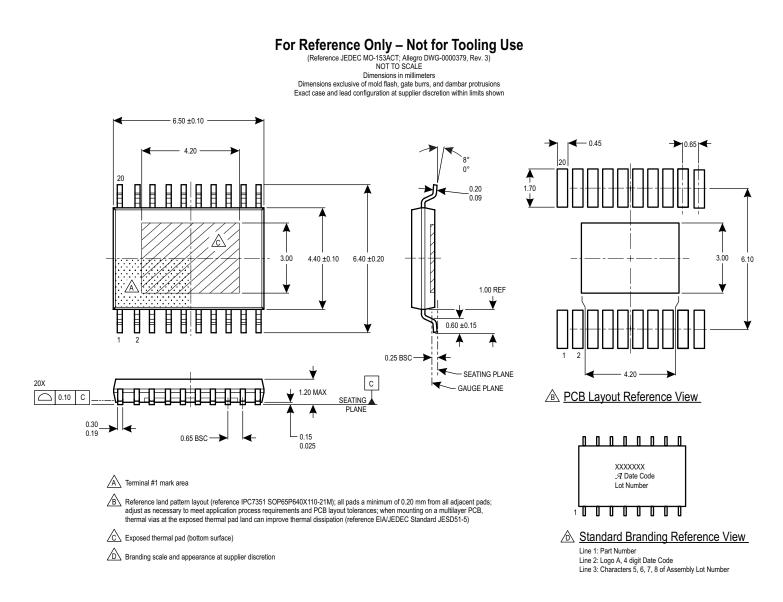
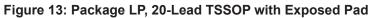


Figure 12: Package ET, 28-Contact QFN with Exposed Pad



Three-Phase Sensorless Fan Driver IC









Revision History

Number	Date	Description					
-	July 14, 2021	Initial release					
1	July 8, 2022	Updated package drawing (page 21)					

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