

50 V Code-Free FOC BLDC Motor Controller

FEATURES AND BENEFITS

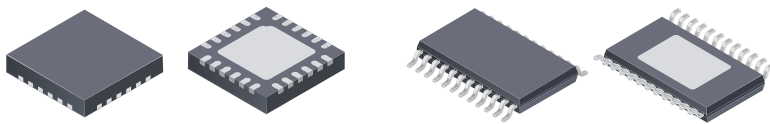
- Code-free sensorless field-oriented control (FOC)
- Proprietary non-reverse fast startup
- Soft-On Soft-Off (SOSO) for quiet operation
- Analog / PWM / Clock mode speed control
- Closed-loop speed control
- Configurable current limit
- Windmill startup operation
- Lock detection
- Short-circuit protection (OCP)
- Brake and direction inputs

APPLICATIONS

- Ceiling fans
- Pedestal fans
- Bathroom exhaust fans
- Home appliance fans and pumps



PACKAGES



24-contact QFN
with exposed thermal pad
4 mm × 4 mm × 0.75 mm
(ES package)

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

Not to scale

DESCRIPTION

The AMT49406 is a 3-phase, sensorless, brushless DC (BLDC) motor driver (gate driver) which can operate from 5.5 to 50 V.

A field-oriented control (FOC) algorithm is fully integrated to achieve the best efficiency and acoustic noise performance. The device optimizes the motor startup performance in a stationary condition, a windmill condition, and even in a reverse windmill condition.

Motor speed is controlled through analog, PWM, or CLOCK input. Closed-loop speed control is optional, and RPM-to-clock frequency ratio is programmable.

A simple I²C interface is provided for setting motor-rated voltage, rated current, rated speed, resistance, and startup profiles.

The AMT49406 is available in a 24-contact 4 mm × 4 mm QFN with exposed thermal pad (suffix ES) and a 24-lead TSSOP with exposed thermal pad (suffix LP). These packages are lead (Pb) free, with 100% matte-tin leadframe plating.

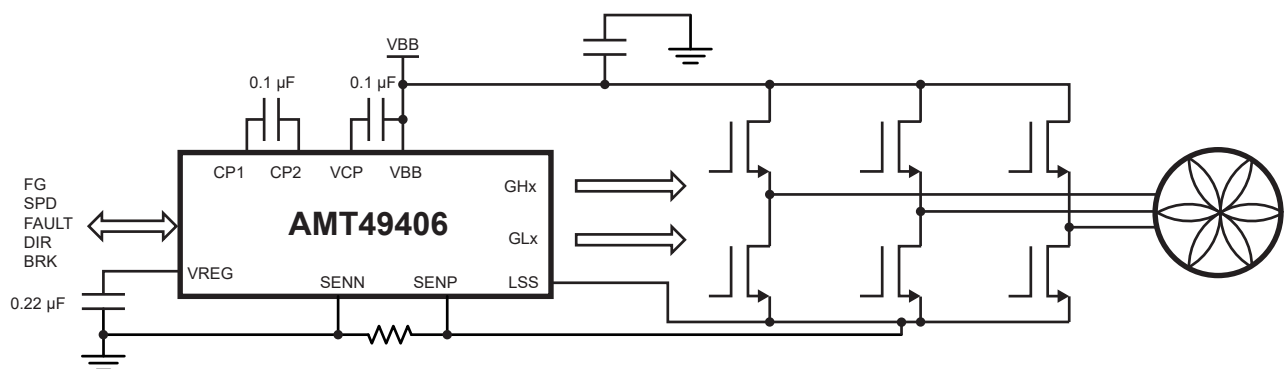


Figure 1: Typical Application

SELECTION GUIDE

Part Number	Ambient Temperature Range (T_A) (°C)	Packaging	Packing
AMT49406GESSR	-40 to 105	24-contact QFN with exposed thermal pad	6000 pieces per 13-inch reel
AMT49406GLPTR	-40 to 105	24-lead TSSOP with exposed thermal pad	4000 pieces per 13-inch reel



ABSOLUTE MAXIMUM RATINGS

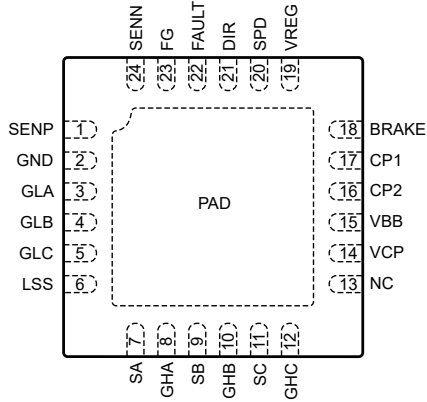
Characteristic	Symbol	Notes	Rating	Unit
Supply Voltage	V_{BB}		50	V
Logic Input Voltage Range	V_{IN}	SPD, BRAKE, DIR	-0.3 to 6	V
Logic Output	V_O	FG ($I < 5$ mA)	6	V
LSS	V_{LSS}	DC	± 500	mV
		$t_W < 500$ ns	± 4	V
VREG	V_{REG}		0 to 4	V
SENN, SENP	V_{SENN}, V_{SENP}	DC	± 500	mV
		$t_W < 500$ ns	± 4	V
Output Voltage	V_{OUT}	SA, SB, SC	-2 to $V_{BB} + 2$	V
GHx	V_{GHx}		$V_{Sx} - 0.3$ to $V_{CP} + 0.3$	V
GLx	V_{GLx}		$V_{LSS} - 0.3$ to 8.5	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
Junction Temperature	T_J		150	°C
Storage Temperature Range	T_{stg}		-55 to 150	°C
Operating Temperature Range	T_A	Range G	-40 to 105	°C

THERMAL CHARACTERISTICS

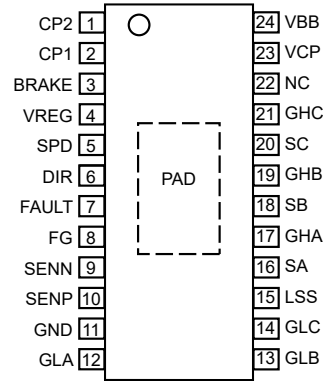
Characteristic	Symbol	Test Conditions*	Value	Unit
Package Thermal Resistance	$R_{\theta JA}$	24-contact QFN (package ES), on 2-sided PCB 1-in. ² copper	45	°C/W
		24-lead TSSOP (package LP), on 2-sided PCB 1-in. ² copper	36	°C/W

*Additional thermal information available on the Allegro website.

PINOUT DIAGRAMS AND TERMINAL LIST TABLE



ES Package Pinouts



LP Package Pinouts

Terminal List Table

Terminal Number		Name	Function
ES Package	LP Package		
16	1	CP2	Charge pump
17	2	CP1	Charge pump
18	3	BRAKE	Logic input
19	4	VREG	2.8 V regulator voltage
20	5	SPD	PWM or clock mode speed control
21	6	DIR	Direction control
22	7	FAULT	Fault indicator output
23	8	FG	Motor speed output
24	9	SENN	Current sense negative terminal
1	10	SENP	Current sense positive terminal
2	11	GND	Ground
3	12	GLA	Low-side gate drive output
4	13	GLB	Low-side gate drive output
5	14	GLC	Low-side gate drive output
6	15	LSS	Low-side source
7	16	SA	Motor output
8	17	GHA	High-side gate drive output
9	18	SB	Motor output
10	19	GHB	High-side gate drive output
11	20	SC	Motor output
12	21	GHC	High-side gate drive output
13	22	NC	No connect
14	23	VCP	Charge pump
15	24	VBB	Power supply
PAD	PAD	PAD	Exposed pad for enhanced thermal dissipation

ELECTRICAL CHARACTERISTICS [1]: Valid over operating ambient temperature range and operating voltage range, unless noted otherwise

Characteristics	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
GENERAL						
Supply Voltage Range	V_{BB}	Driving	5.5	–	48	V
		Operating	5.5	–	50	V
VBB Supply Current	I_{BB}	$I_{VREG} = 0$ mA	–	8	12	mA
		Standby mode	–	10	20	μ A
Reference Voltage	V_{REG}	$I_{OUT} = 10$ mA	2.7	2.86	2.95	V
GATE DRIVE						
High Side Gate Drive Output	V_{GH}	$V_{BB} = 8$ V	6.5	6.8	–	V
		$V_{BB} = 24$ V	6.5	6.8	–	V
Low Side Gate Drive Output	V_{GL}	$V_{BB} = 8$ V	6.5	7.3	–	V
		$V_{BB} = 24$ V	6.5	7.3	–	V
Gate Drive Source Current	I_{SO}		–	55	–	mA
Gate Drive Sink Current	I_{SI}		–	105	–	mA
MOTOR DRIVE						
PWM Duty On Threshold	PWM_{ON}	Relative to target	–0.5	–	0.5	%
PWM Duty Off Threshold	PWM_{OFF}	Relative to target	–0.5	–	0.5	%
PWM Input Frequency Range	$f_{PWM(MIN)}$	PWM input frequency setting = 0	2.5	–	100	kHz
		PWM input frequency setting = 1	80	–	3200	Hz
Clock Input Frequency Range	f_{CLOCK}	CLOCK mode	1	–	2000	Hz
SPD Standby Threshold (Analog Enter)	$V_{SPD(TH_ENT)}$		50	100	150	mV
SPD Standby Threshold (Analog Exit)	$V_{SPD(TH_EXIT)}$		0.4	0.75	1	V
SPD On Threshold	$V_{SPD(ON)}$	ON/OFF setting = 10%	210	250	290	mV
SPD Max	$V_{SPD(MAX)}$		–	2.5	–	V
SPD ADC Resolution	$V_{SPDADC(RES)}$		–	9.78	–	mV
SPD ADC Accuracy	$V_{SPDADC(ACC)}$	$V_{SPD} = 0.2$ to 2.5 V	–40	–	40	mV
Speed Closed Loop Accuracy	$f_{SPD(ACC)}$	PWM mode or Analog mode	–5	–	5	%
		Clock mode	–0.1	–	0.1	rpm
Dead Time	t_{DT}	Code = 9	–	400	–	ns
Motor PWM Frequency	f_{PWM}	$T_A = 25^\circ$ C	23.3	24.4	25.4	kHz
PROTECTION						
VBB UVLO	$V_{BB(UVLO)}$	V_{BB} rising	–	4.75	4.95	V
VBB UVLO Hysteresis	$V_{BB(HYS)}$		200	300	450	mV
Thermal Shutdown Temperature	T_{JTSD}	Temperature increasing	–	165	–	$^\circ$ C
Thermal Shutdown Hysteresis	ΔT_J	Recovery = $T_{JTSD} - \Delta T_J$	–	20	–	$^\circ$ C

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ELECTRICAL CHARACTERISTICS [1] (continued): Valid over operating ambient temperature range and operating voltage range, unless noted otherwise

Characteristics	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
LOGIC, IO, I²C						
Input Current	I _{IN}	SPD, FG; V _{IN} = 0 to 5.5 V	-5	1	5	μA
		BRK, DIR; V _{IN} = 5 V	-	50	-	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
FG Output Leakage	I _{FG}	V = 5.5 V	-	-	1	μA

[1] Specified limits are tested at 25°C and 125°C and statistically assured over operating temperature range by design and characterization.

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