ST1117A/B/C(-P/-M)

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Single Coil Brushless DC Motor Drivers

(1.5 to 8.5 Volts)

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ST1117A(-P/-M) / ST1117B(-P/-M) / ST1117C(-P/-M)

Single Coil Brushless DC Motor Drivers (1.5 to 8.5 Volts)

General Specifications

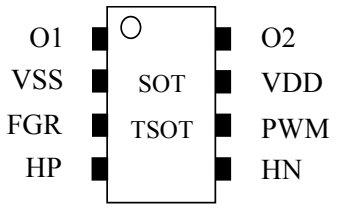
The device is a single coil DC brushless motor driver IC with PWM control, lock protection, power polarity reverse protection and frequency generator. The driver is optimal for single coil fan applications with less external components.

Features and Benefits

- Support single-phase full wave Brushless DC Motor Driver
- Built-in Hall sensor input amplifier
- Low voltage startup (VDD=1.5V)
- High output sinking and driving capability
- Lock detection and automatic self-restart
- Without external timing capacitor,
  Reduces the numbers of external component required
- External PWM control signal input
- With FG/2 output for ST1117A / ST1117A-P / ST1117A-M
  With FG output for ST1117B / ST1117B-P / ST1117B-M
  With RD output for ST1117C / ST1117C-P / ST1117C-M
- Thin, compact, highly reliable package (SOT-28, TSOT-28, SOP-8, MSOP-8)
- Thermal shutdown protection

Pin Description

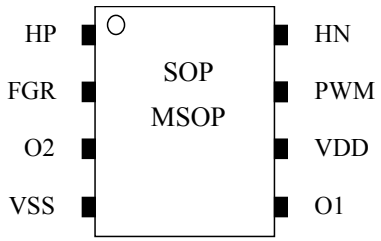
ST1117A / ST1117B / ST1117C : SOT-28, TSOT-28



Package : SOT-28 / TSOT-28

NO.	NAME	DESCRIPTION
1	O1	Output driving & sinking pin
2	VSS	Ground pin
3	FGR	Frequency generator or rotating detector ST1117A : FG/2 ST1117B : FG ST1117C : RD
4	HP	Hall sensor in+
5	HN	Hall sensor in-
6	PWM	Input pin for PWM Control
7	VDD	Power supply pin
8	O2	Output driving & sinking pin

ST1117A-P / ST1117B-P / ST1117C-P : SOP-8
ST1117A-M / ST1117B-M / ST1117C-M : MSOP-8



Package : SOP 8 / MSOP8

NO.	NAME	DESCRIPTION
1	HP	Hall sensor in+
2	FGR	Frequency generator or rotating detector ST1117A-P (-M) : FG/2 ST1117B-P (-M) : FG ST1117C-P (-M) : RD
3	O2	Output driving & sinking pin
4	VSS	Ground pin
5	O1	Output driving & sinking pin
6	VDD	Power supply pin
7	PWM	Input pin for PWM Control
8	HN	Hall sensor in-

Absolute Maximum Ratings (Unless otherwise noted, VDD=5V, T_A = 25 °C)

Characteristic	Symbol	Rating	Unit
Supply Voltage*	V_{DD}	1.5 ~ 8.5	V
Maximum Input Voltage	V_{IN}	V_{DD}+0.4	V
Output Current	I_{OUT}	400	mA
Output Current at Lock (SOT-28)	I_{OL1}	1	A
Output Current at Lock (SOP-8)	I_{OL2}	1.2	A
Maximum FGR Output Current	I_{FGR_MAX}	10	mA
Maximum FGR Output Voltage	V_{FGR_MAX}	9	V
PWM control frequency	f_{PWM}	100	KHz
Power Dissipation (TSOT-28)	P_{D1}	568	mW
Power Dissipation (SOT-28)	P_{D2}	592	mW
Power Dissipation (SOP8)	P_{D3}	796	mW
Power Dissipation (MSOP8)	P_{D4}	657	mW
Operating Temperature Range	T_{OPR}	-40 ~ 125	°C
Storage Temperature Range	T_{STG}	-65 ~ 150	°C
Operating Junction Temperature	T_J	150	°C
Thermal Resistance, Junction to Ambient (TSOT-28)	θ_{JA_TSOT28}	220	°C/ W
Thermal Resistance, Junction to Case (TSOT-28)	θ_{JC_TSOT28}	92	°C/ W
Thermal Resistance, Junction to Ambient (SOT-28)	θ_{JA_SOT28}	211	°C/ W
Thermal Resistance, Junction to Case (SOT-28)	θ_{JC_SOT28}	92	°C/ W
Thermal Resistance, Junction to Ambient (SOP-8)	θ_{JA_SOP8}	157	°C/ W
Thermal Resistance, Junction to Case (SOP-8)	θ_{JC_SOP8}	56	°C/ W
Thermal Resistance, Junction to Ambient (MSOP-8)	θ_{JA_MSOP8}	190	°C/ W
Thermal Resistance, Junction to Case (MSOP-8)	θ_{JC_MSOP8}	56	°C/ W

Notes:* The maximum power supply voltage & output current must be under the allowable package power dissipation.

Electrical Characteristics (Unless otherwise noted, VDD=5V, T_A = 25 °C)

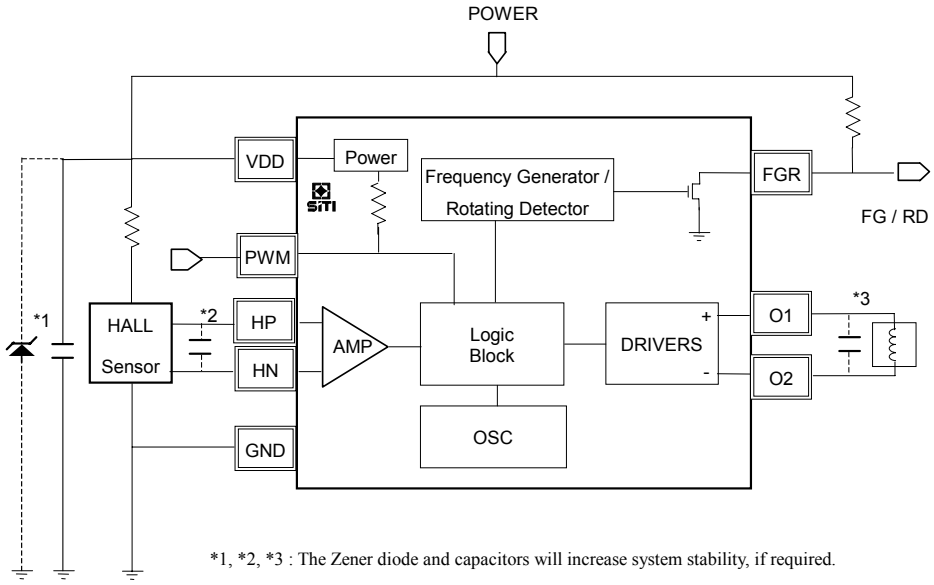
Characteristic	Sym.	Condition	Limit			Unit
			Min.	Typ.	Max.	
Hall input sensitivity	V_{HN}	Zero to peak	-	7	25	mV
PWM Input Voltage "H"	V_{IH}	-	0.5*V_{DD}	-	V_{DD}+0.4	V
PWM Input Voltage "L"	V_{IL}	-	-0.4	-	0.15*V_{DD}	V
PWM Input Current "H"	I_{IH}	V_{IN} = V_{DD}	-	0.15	1	μA
PWM Input Current "L"	I_{IL}	V_{IN} = 0V	-	0.3	2	mA
O1/O2 Output Voltage High	V_{OH}	I_{OUT} = 300 mA	4.6	4.7	-	V
O1/O2 Output Voltage Low	V_{OL}	I_{OUT} = 300 mA	-	0.25	0.3	V
O1/O2 Output Current	I_{OUT}	R_L = 30Ω	150	160	165	mA
FGR Leakage Current	I_{Leak}	V_{FGR} = 5V	-	1	3	μA
FGR Output Current	I_{FGR}	V_{FGROL} = 0.4V	5	8	-	mA
FGR Output Voltage Low	V_{FGROL}	I_{FGR}= 5 mA	-	0.25	0.4	V
On Time	T_{ON}	-	150	180	250	ms
Duty Ratio	R_{DR}	T_{OFF} / T_{ON}	6	7	8	
Thermal Shutdown Temperature	T_{SD}*	-	130	180	200	°C

Notes:* T_{SD} is design target value, the parameter is not tested in independent IC.

Truth Table

HP	HN	PWM	O1	O2
H	L	H	H	L
L	H	H	L	H
-	-	L	OFF	OFF

Block Diagram & Application Circuit



*1, *2, *3 : The Zener diode and capacitors will increase system stability, if required.

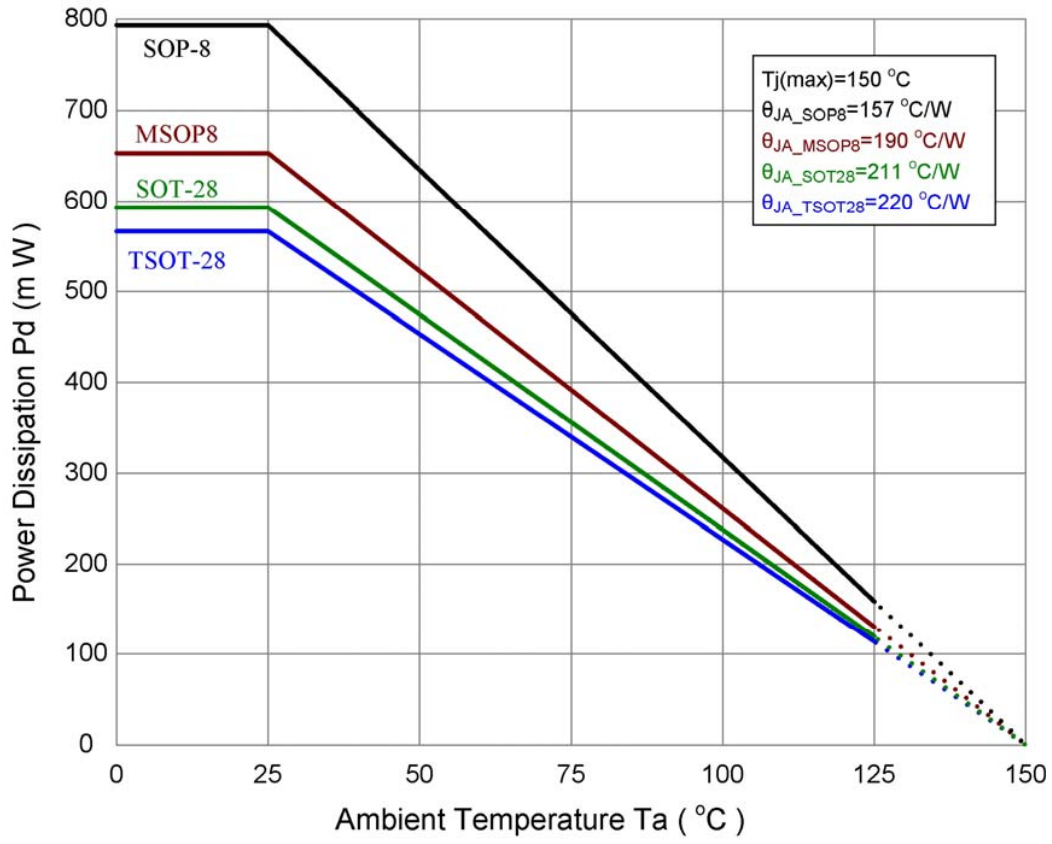
Application Notes

- The device is operated within wide supply voltage range from 1.5 to 8.5 Volts. The design, specifications and performance have been optimized for 3V and 5V brushless DC motor applications.
- The output driver node O1/O2 will be "turned to drive/sink" when V(HP) > V(HN). Similarly, the output O1/O2 will be "turned to sink/drive" when V(HP) < V(HN).
- The output frequency on **FGR** pin is dividing the hall switching frequency with 2 for ST1117A (-P,-M), the same frequency with hall switching for ST1117B (-P,-M), and the rotating detection for ST1117C (-P,-M). With suitable pull up, the fan tachometer output can be used directly with bipolar or MOS logic for motor speed monitoring/control. To get better FG signal output, increasing stability of power system is required.
- The pull up resistor about 20KΩ is connected to PWM pin already. The PWM command is active high. If low acoustic noise is desired, the external PWM frequency is recommended below 200Hz or 20KHz ~ 40KHz.
- There is no need of external timing capacitor for lock protection and auto-restart function. For 5V application, the drivers will be shut down roughly 1 to 3 seconds after the motor is locked. When the drivers have been shut down, the automatic self-restart circuit will try to power up the drivers every 1 to 3 seconds until lock is released.
- There is no requirement of protection diode for power reverse fault in normal applications. The power polarity reverse protection circuit is built-in.
- The capacitor between two ends of coil (*3 in application circuit) is proposed to connect 0.1μF for PWM application and 1μF for full-speed application.
- The connection of the capacitor or Zener Diode (*1 in application circuit) between VDD and GND, the capacitor (*2 in application circuit) between two Hall sensor output and the capacitor (*3 in application circuit) between two ends of coil will increase system stability when motor is rotating.

- The power dissipated by the IC varies widely with the supply voltage, the output current, and loading. It is important to ensure the application does not exceed the allowable power dissipation of the IC package. The maximum allowable power consumption can be calculated by the following equation:

$$Pd(Power\ Dissipation)(Watt) = \frac{Tj(Junction\ Temperature)(\max)(^{o}C) - Ta(Ambient\ Temperature)(^{o}C)}{\theta_{JA}(Thermal\ \ \mathrm{Re}sis\tan ce, Junction\ to\ Ambient)(^{o}C/Watt)}$$

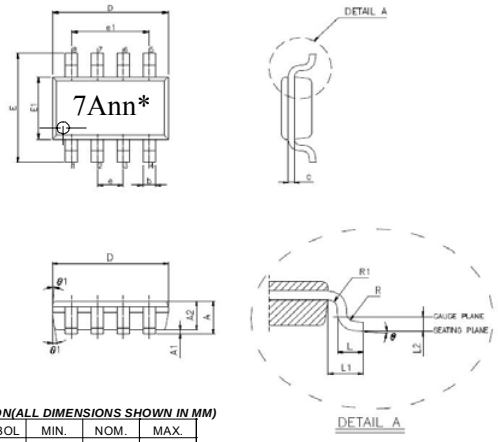
The relationship between power dissipation and operating temperature can refer to the figure below:



Package Specifications

ST1117A / ST1117B / ST1117C : TSOT28

(8-pin TSOT-28)



VARIATION(ALL DIMENSIONS SHOWN IN MM)

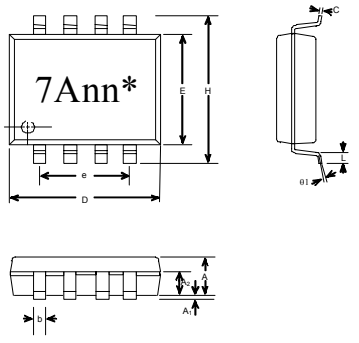
SYMBOL	MIN.	NOM.	MAX.
A	0.750	-	0.800
A1	0	-	0.050
A2	0.700	0.750	0.775
b	0.220	-	0.380
c	0.100	-	0.200
D	2.800	2.900	3.000
E	2.600	2.800	3.000
E1	1.500	1.600	1.700
e	0.650 BSC		
e1	1.950 BSC		
L	0.370	0.450	0.600
L1	0.600 REF		
L2	0.250 BSC		
R	0.100	-	-
R1	0.100	-	0.250
θ	0°	4°	8°
θ1	4°	10°	12°

***Note :** The "7Ann"is the package marking where the first two characters "7A" are product identification code shown as following table, the last 2 characters "nn" are date code or lot number, and therefore being subject to change.

Product	Mark(ID + Date Code)
ST1117A	7Ann
ST1117B	7Bnn
ST1117C	7Cnn

ST1117A / ST1117B / ST1117C : SOT28

(8-pin SOT-28)



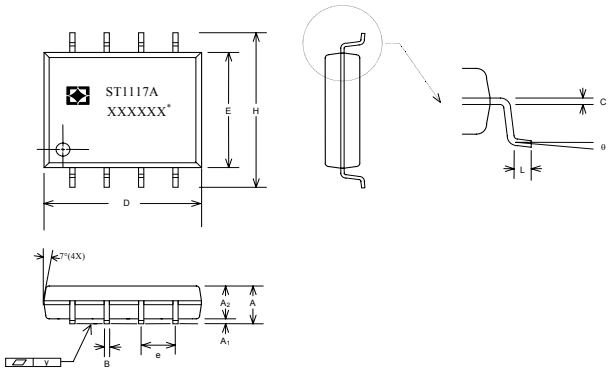
SYMBOL	Dimensions in Millimeters		
	MIN	NOM	MAX
A	-	-	1.450
A_1	0.000	-	0.150
A_2	0.900	1.150	1.300
b	0.220	-	0.380
C	0.080	-	0.220
D	2.900 BSC		
E	2.800 BSC		
e	0.650 BSC		
H	2.60	2.80	3.00
L	0.300	0.450	0.600
θ1	0°	4°	8°

***Note :** The "7Ann" is the package marking where the first two characters "7A" are product identification code shown as following table, the last 2 characters "nn" are date code or lot number, and therefore being subject to change.

Product	Mark(ID + Date Code)
ST1117A	7Ann
ST1117B	7Bnn
ST1117C	7Cnn

ST1117A-P / ST1117B-P / ST1117C-P: SOP8

(8-pin SOP)

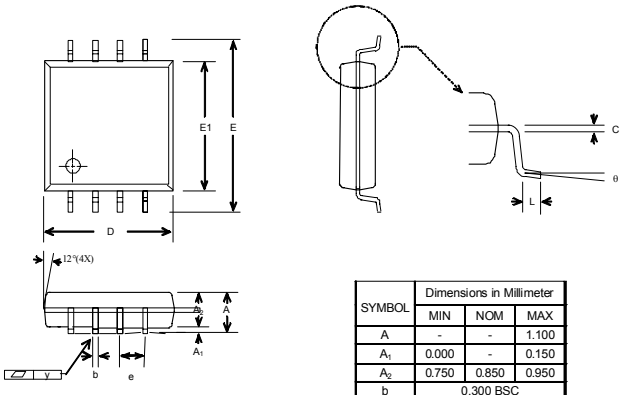


SYMBOL	Dimensions in Millimeter			Dimensions in Inches		
	MIN	NOM	MAX	MIN	NOM	MAX
A	1.35	1.60	1.75	0.053	0.063	0.069
A_1	0.10	–	0.25	0.004	–	0.010
A_2	–	1.45	–	–	0.057	–
B	0.33	–	0.51	0.013	–	0.020
C	0.19	–	0.25	0.007	–	0.010
D	4.80	–	5.00	0.189	–	0.197
E	3.80	–	4.00	0.150	–	0.157
e	–	1.27	–	–	1.27	–
H	5.80	–	6.20	0.228	–	0.244
L	0.40	–	1.27	0.016	–	0.050
Y	–	–	0.10	–	–	0.004
θ	0°	–	8°	0°	–	8°

* The package marking "ST1117A" is product code for ST1117A and will change to "ST1117B" for ST1117B and "ST1117C" for ST1117C. The "XXXXXX" is a lot number and therefore being subject to change.

ST1117A-M / ST1117B-M / ST1117C-M: MSOP8

(8-pin MSOP)



SYMBOL	Dimensions in Millimeter		
	MIN	NOM	MAX
A	-	-	1.100
A_1	0.000	-	0.150
A_2	0.750	0.850	0.950
b	0.300 BSC		
D	3.000 BSC		
E	4.900 BSC		
E1	3.000 BSC		
e	0.650 BSC		
L	0.400	0.600	0.800
θ	0°	–	8°

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