

General Description

The OCH2971 is a 5V single-phase full-wave FanMotor Driver with the built-in hall element. It is part of the DC brushless Fan Motor Driver series. The OCH2971 has a compact package. It has the silent drive by soft switching and the low battery consumption via its stand-by function. The OCH2971 is best used for notebook PC cooling fans.

Placing the device in a variable magnetic field, if the magnetic flux density is larger than threshold B_{OP} , the Out2 is turned to sink and Out1 is turned to drive. This output state is held until the magnetic flux density reverses and falls below B_{RP} , then causes Out2 to be returned to drive and out1 turned to sink.

OCH2971 is available in SOT23-6F package and is rated over the -40°C to 125°C .

Features

- One-chip Solution (Hall Element + Driver)
- Input Voltage Range: 1.8V to 6V
- High Sensitivity Hall Sensor
 $B_{OP}(12\text{GS})$, $B_{RP}(-12\text{GS})$
- Start Voltage 1.65V(min.)
- PWM Soft Switch Driver
- Quick Start
- Stand-By function
- FG Output
- Lock Protection And Automatic Restart
- Speed Controllable By PWM Input Signal
- Thermal Shutdown Protection
- -40°C to $+125^{\circ}\text{C}$ Temperature Range
- RoHS Compliant
- Available in SOT23-6F package

Applications

- Notebook PC cooling fans
- Single Coil DC Brushless Fan
- Single Coil DC Brushless Motor

Pin Configuration

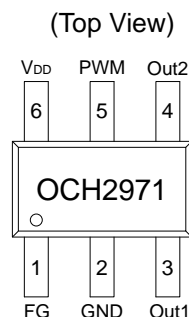


Figure 1, Pin Assignments Of OCH2971

Pin Name	Pin Number	Pin Function
FG	1	FG Signal Output
GND	2	Ground
Out1	3	Output 1
Out2	4	Output 2
PWM	5	PWM Signal Input
V _{DD}	6	Positive Power Supply

■ Typical Application Circuit

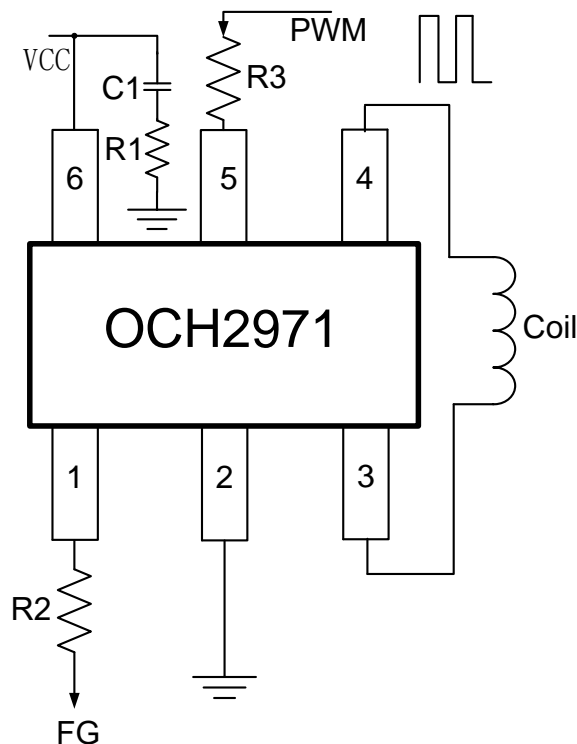


Figure 2, Typical Application Circuit Of OCH2971

Note1:When the power pulse is relatively large, Must use least $R1=1\Omega$, $C1=1\mu F$ (ceramic capacitor) for the decoupling between V_{DD} and GND and place the capacitor as close to the IC asPossible.

Note2:The R2 & R3 is used to prevent PWM and FG/RD pin, typical value is 100 Ω .

■ Ordering Information

PartNumber	Signal Type	Package Type	Packing Qty.	B _{OP} (Gauss)	B _{RP} (Gauss)	Temperature	Eco Plan	Lead
OCH2971TOAE	FG	SOT23-6F	3000pcs /Reel	12(Typ.)	-12(Typ.)	-40~ +125°C	ROHS	Cu

■ Block Diagram

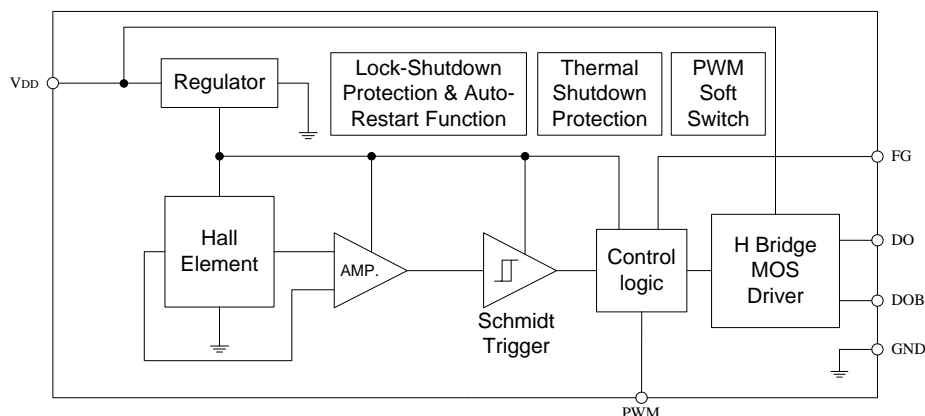


Figure 3, Block Diagram Of OCH2971



■ Absolute Maximum Ratings^{2/3/4} (T_A=25°C, unless otherwise noted)

Parameter	Symbol	Rating	Unit
V _{DD} Pin To Gnd Voltage	V _{DD}	-0.3 to +7	V
DO、DOB、FG Pin Output Voltage	V _{OUT}	-0.3 to +7	V
PWM Pin Input Voltage	V _{PWM}	-0.3 to +7	V
FG Pin Output Sink Current	I _{FG/RD}	20	mA
HoldCurrent(Hold0.5sec)	I _H	1.5	A
Junction temperature	T _J	150	°C
Thermal Resistance	θ _{JA}	238	°C/W
Maximum Power Dissipation	P _D	525	mW
Storage Temperature Range	T _S	-55 to +150	°C
Maximum Soldering Temperature (at leads, 10 sec)	T _{LEAD}	260	°C

Note2: The maximum dissipation power P_D allowed at any ambient temperature point is calculated: $P_D(\max) = (T_J - T_A) / \theta_{JA}$, T_J = 150°C. When applied, do not exceed the maximum rating to prevent chip damage, and work for a long time at maximum rating may affect chip reliability.

Note3: Stresses above those listed in absolute maximum ratings may cause permanent damage to the device. Functional operation at conditions other than the operating conditions specified is not implied. Only one absolute maximum rating should be applied at any one time.

Note 4: The device is not guaranteed to function outside of its operating conditions.

■ Recommended Operating Conditions^{3/4/5}

Parameter	Symbol	Rating	Unit
V _{DD} Pin Voltage to GND	V _{DD}	1.8 To 6	V
Operating Temperature Range	T _{OP}	-40 To +125	°C

Note5: In practical application, the effect of fan coil heating on the chip must take into account, with the actual over temperature protection point of actual test of high temperature fan for reference. On the basis of pre leave relatively safe temperature allowance, avoid chip in the critical limit (maximum ratings) for a long time and affects the reliability.



■ Electrical Characteristics

Typical values are at $T_A = +25^{\circ}\text{C}$, $V_{DD} = 5\text{V}$, unless otherwise noted.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
I_{DD}	Supply Current	Output Open	-	3	5	mA
I_{DD1}	Stand-by Current	Standby Mode, PWM=GND	20	43	100	μA
$R_{DS(ON)}$	Output On-Resistance	$I_O = 0.3\text{A}$, Upper PMOS and Lower NMOS total	-	0.55	-	Ω
$V_{FG(ON)}$	Output On-Resistance	$I_{FG} = 5\text{mA}$	-	0.125	-	V
I_{FGOL}	FG Pin OFF Leakage Current	$V_{FG} = 6\text{V}$	-	<0.1	1	μA
I_{FL}	FG Pin limiting Current	FG Pin Short To V_{DD} Pin Current	-	40	60	mA
T_{ON}	Locked Protection On Time		-	0.5	-	Sec
T_{OFF}	Locked Protection Off Time		-	5	-	Sec
V_{PWMH}	PWM Signal High Level		$0.55 \cdot V_{DD}$	-	$V_{DD} + 0.5$	V
V_{PWML}	PWM Signal Low Level		0	-	$0.2 \cdot V_{DD}$	V
F_{PWM}	PWM Input Frequency		0.2	-	50	KHZ
F_{PMWOUT}	PWM Output Frequency		-	30	-	KHZ
T_{QT}	Quick Start Enable Time		-	66.5	-	mS
P_{PWR}	PWM Soft Switch Width (Rise)		-	32	-	°
P_{PWF}	PWM Soft Switch Width (fall)		-	32	-	°
D_{ST}	Start Up PWM input Duty		6	7.8	9	%
T_{SD}	Thermal Shutdown Temperature		-	175	-	$^{\circ}\text{C}$
T_{SH}	Thermal Shutdown Hysteresis		-	35	-	$^{\circ}\text{C}$

■ Magnetic Characteristics

$V_{DD} = 5\text{V}, T_A = 25^{\circ}\text{C}$					
Parameter	Symbol	Min.	Typ.	Max.	Unit
South Pole Operate point	B_{OP}	4	12	20	G
North Pole Release Point	B_{RP}	-20	-12	-4	G
Hysteresis	B_{HY}	8	24	40	G

■ Driver Output Vs. Magnetic Pole

Magnetic Pole	Test Conditions	OUT1	OUT2
South Pole	$B > B_{OP}$	High	Low
North Pole	$B < B_{RP}$	Low	High



■ Operating Characteristics

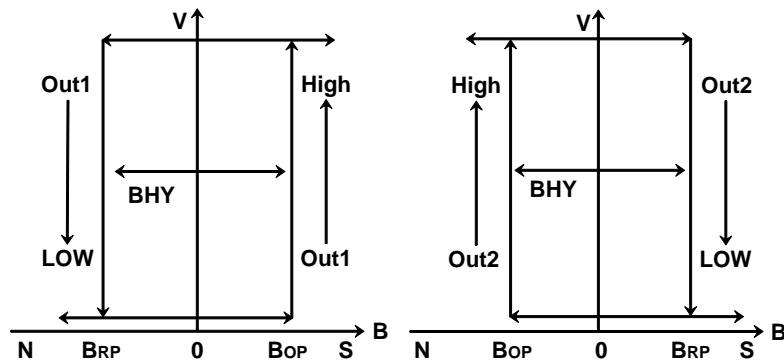


Figure 4, Magnetic Hysteresis Characteristics OCH2971

Truth Table (SOT23-6F)

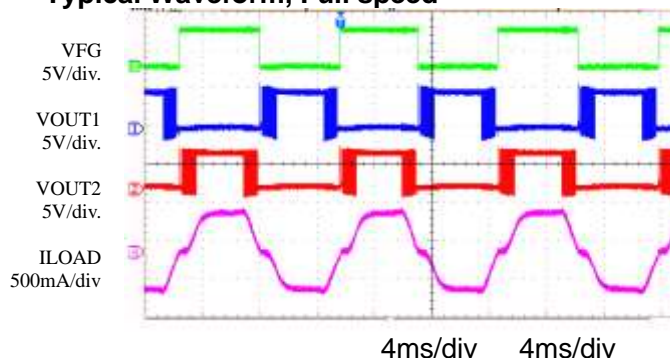
Input		Output			Mode
B	PWM	Out1	Out2	FG	
S-B _{OP}	-	H	L	L	Operation Mode (PWM Pin NC)
N-B _{RP}	-	L	H	OFF	
S-B _{OP}	H	H	L	L	Operation Mode (PWM Speed Control State)
N-B _{RP}	L	L	H	OFF	
S-B _{OP}	-	L	L	OFF	Lock Mode
N-B _{RP}	-	L	L	OFF	
-	L	OFF	OFF	OFF	Standby Mode



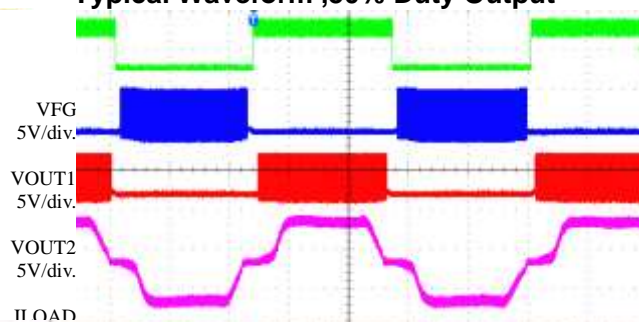
■ Typical Performance Characteristics

VCC = 5V, TA = 25°C, tested with fan unit, unless otherwise noted.

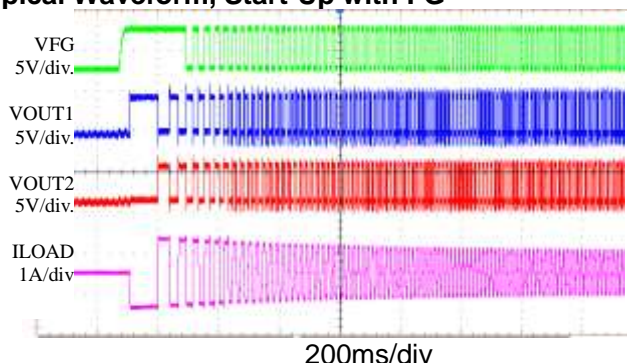
Typical Waveform, Full speed



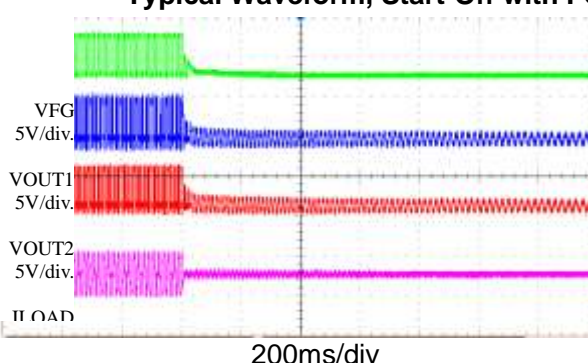
Typical Waveform ,50% Duty Output



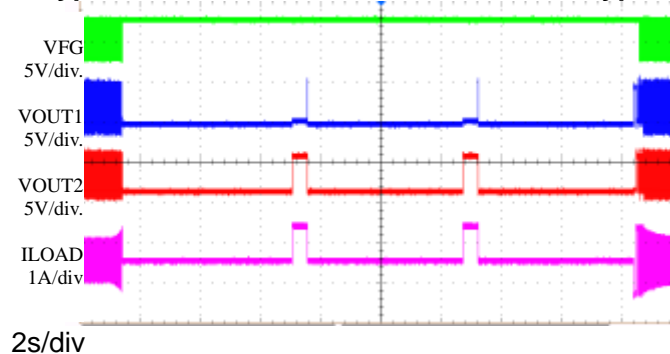
Typical Waveform, Start-Up with FG



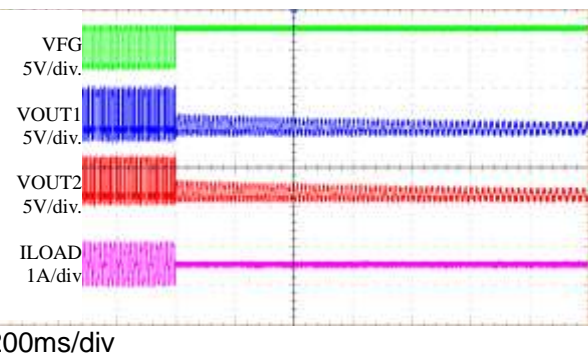
Typical Waveform, Start-Off with FG



Typical Waveform, Rotor Lock & Release

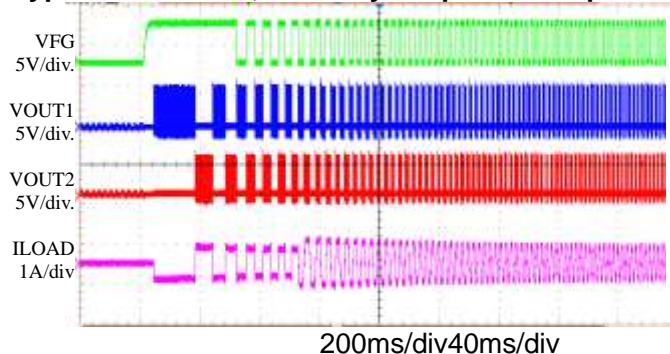


Typical Waveform, Shutdown with FG

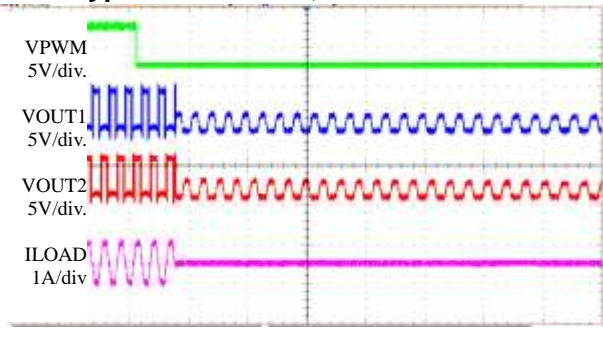


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Typical Waveform,80% Duty Output Start-Up with FG



Typical Waveform, Shutdown with PWM



PWM Speed Control

The rotation speed of the motor can be changed depending on the PWM input duty to the PWM pin. When the PWM pin is open or PWM input duty is above 98.5%, the Output PWM duty becomes 100 %. And When PWM input duty is below 5.1%, IC will shutdown the output. When the PWM pin is connect to GND, IC will be in standby mode, the IC supply current is $43\ \mu\text{A}$ (typ.) The characteristic of the PWM input/output duty is shown as Figure 5.

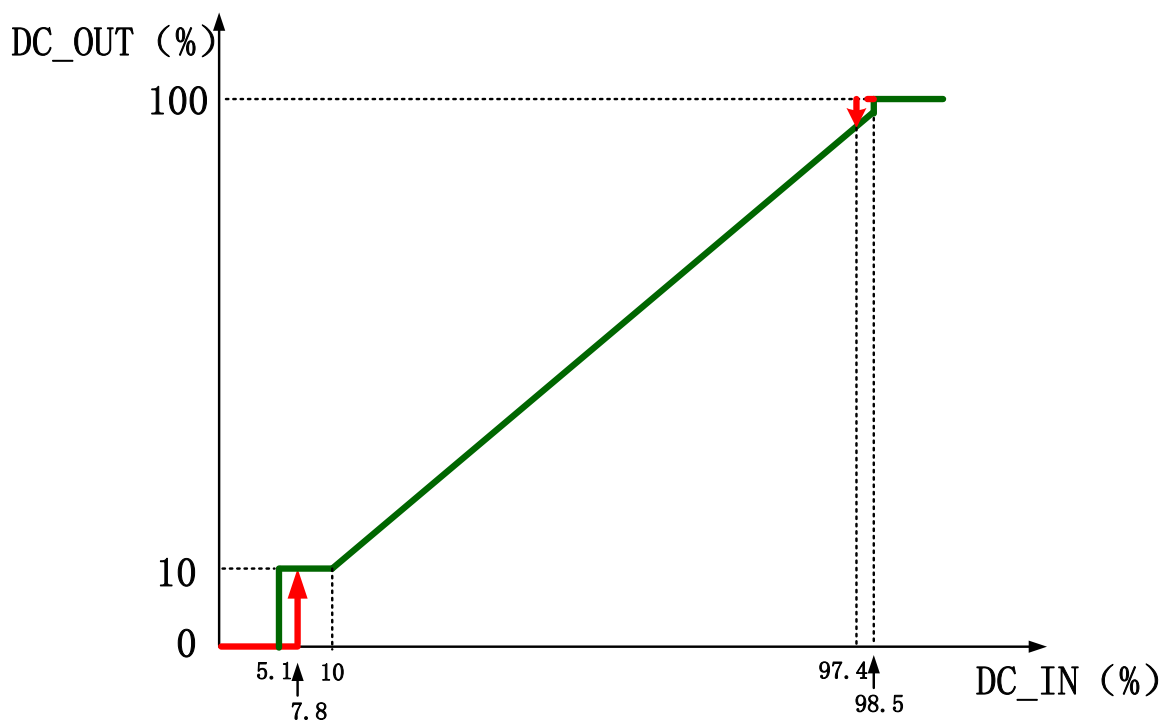


Figure 5 PWM Output Duty vs. PWM Input Duty

PWM Soft-Switch Function

The soft switching drive is a function that the output duty changes between 0% and the PWM output duty at the timing of the output phase change. To smooth off the current waveform, the coefficient table that the output duty gradually changes is set inside the IC. When one period of the FG signal is assumed 360° , the section of the soft switching is about 32° (Typ). As shown in Figure 6, this IC is controlled same the section of the soft switching with various magnetic waveforms, such as the rectangular wave, the trapezoidal wave and the sine wave. The output PWM frequency is 30 kHz (Typ). Hence, the input PWM frequency is not equal to the output PWM frequency.

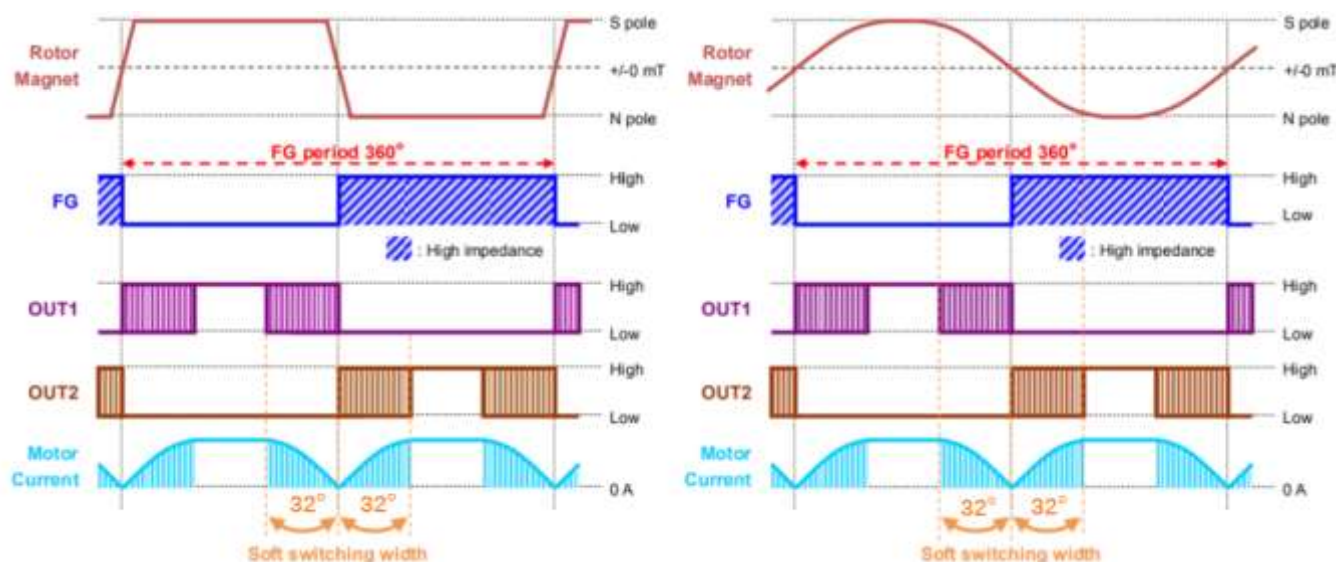


Figure 6 PWM Soft-switching Drive Waveform



Functional Descriptions - Continued

Quick Start and Standby Mode

This IC would enter standby mode when the PWM input keeps low level for then 66.5ms(typ.). In standby mode, it will shutdown amplifier and FG. In standby mode, the lock protection function doesn't work, therefore, starting fan is unobstructed when releasing standby mode. Figure 7.

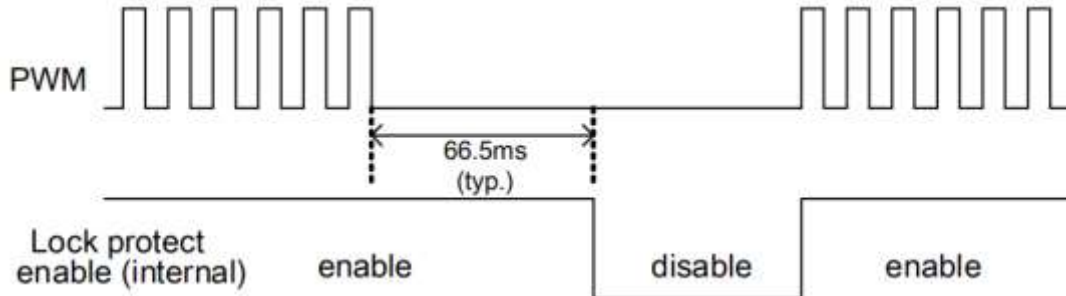


Figure 7Timing Chart Of Stand-by Mode and Quick Start

Functional Descriptions - Continued

Lock Protection and Automatic Restart

The motor rotation is detected by the hall signal, while the lock detection ON time (tON) and the lock detection OFF time (tOFF) are set by the IC internal counter. Timing chart is shown as Figure 8.

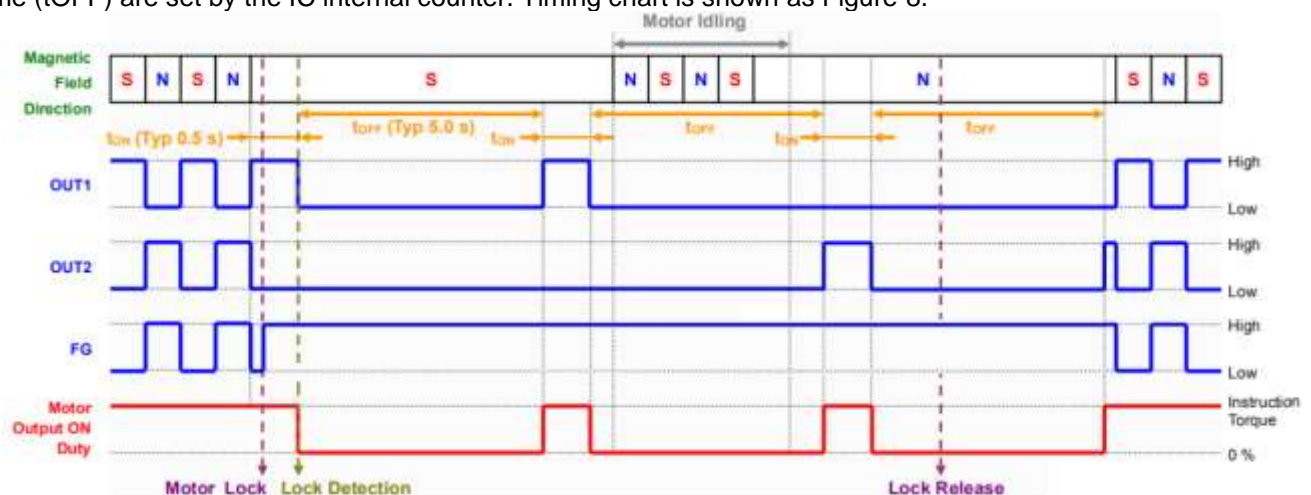


Figure 8Timing Chart of Lock Protection

■ Hall Sensor Location

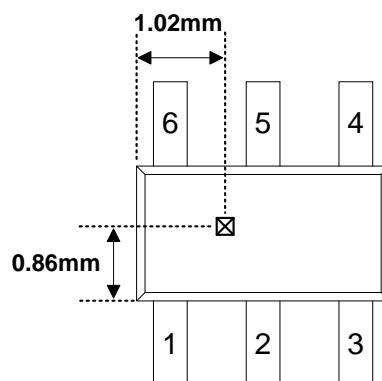
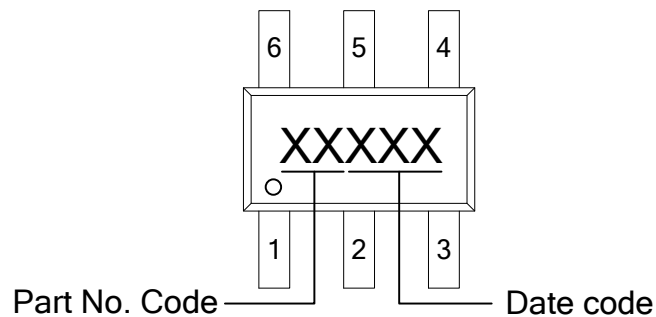


Figure 9, Hall Sensor Location

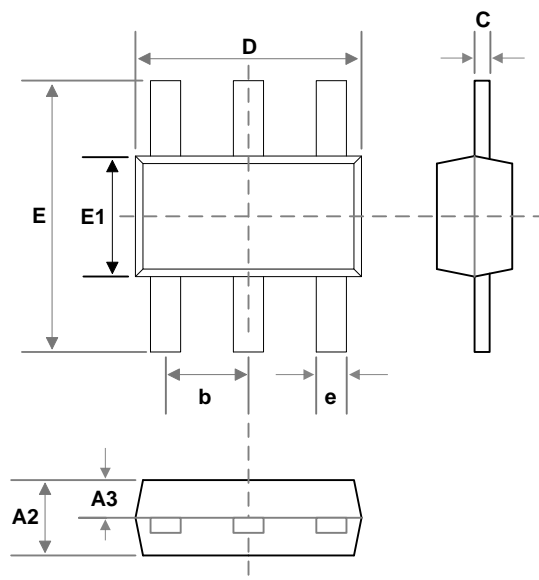


■ Marking Information



■ Package Information

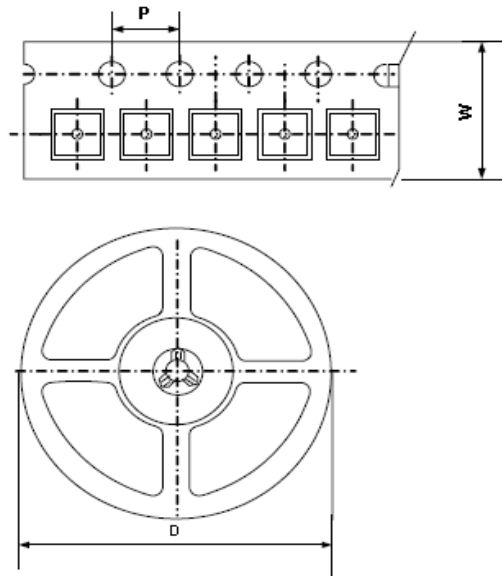
SOT23-6F (TO23-6F)



Symbol	Dimensions In Millimeters			Dimensions In Inches		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A2	1.00	1.10	1.20	0.03	0.04	0.04
A3	0.40	0.45	0.50	0.01	0.02	0.02
b	0.90	0.95	1.00	0.03	0.04	0.04
C	0.12	0.13	0.14	0.01	0.01	0.01
D	2.70	2.90	3.10	0.11	0.11	0.12
E	3.40	3.60	3.80	0.13	0.14	0.15
E1	1.50	1.60	1.70	0.06	0.06	0.07
e	-	0.35	-	-	0.01	-



■ Packing Information



Package Type	Carrier Width (W)	Pitch (P)	Reel Size(D)	Packing Minimum
SOT23-6F(TO23-6F)	8.0±0.1 mm	4.0±0.1 mm	180±1 mm	3000pcs

Note: Carrier Tape Dimension, Reel Sizeand Packing Minimum



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