MH3610KVS is a one-chip solution designed in mixed signal CMOS technology for driving single-coil brushless DC motors like PWM cooling fans. The device integrates a voltage regulator, Hall sensor with advanced offset cancellation system, a power output H-bridge all controlled by a sophisticated digital state machine, all in a single package. The included voltage regulator operates from 3.5V to 16V, hence covering a wide range of applications. With the built-in reverse voltage protection, no diode on the supply line is required. In case of critical low voltage operation, the Brown-Out Detection will automatically stop the device operation until normal supply voltage in the operational range is applied.

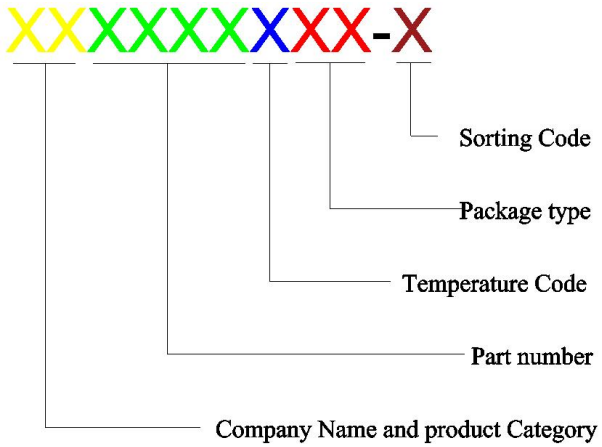
Features and Benefits

- Wide operating voltage range:3.5V~16V
- Allowing speed regulation through PWM or DC voltage control
- PWM input duty cycle with wide input frequency range from 100Hz to 100KHz
- Soft start suppresses peak currents during start up
- Minimal speed setting
- Built-in PWM input resister
- Soft switching：Optimum low noise performance at different rotation speed with no external components
- Integrated protection：Reverse Voltage、Locked Rotor、Brown-Out、Thermal Shutdown and High ESD Rating
- Built-in FG output

Applications

- Single Phase BLDC Motors
- Single Phase BLDC Fan
- CPU/GPU Cooling Fan

Ordering Information



Company Name and Product Category

MH:MST Hall Effect/MP:MST Power MOSFET

Part number

181,182,183,184,185,248,249,276,477,381,381F,381R,382…..

If part # is just 3 digits, the forth digit will be omitted.

Temperature range

E: 85 ℃, I: 105 ℃, K: 125 ℃, L: 150 ℃

Package type

UA:TO-92S,VK:TO-92S(4pin),VF:TO-92S(5pin),VS/VP:SOP8

SO:SOT-23,SQ:QFN-3,ST:TSOT-23,SN:SOT-553,SD:DFN2*2-6L

SR:SOT-26L,SM:DFN1.6*1.6-6L,SY:DFN3*3*1-10L

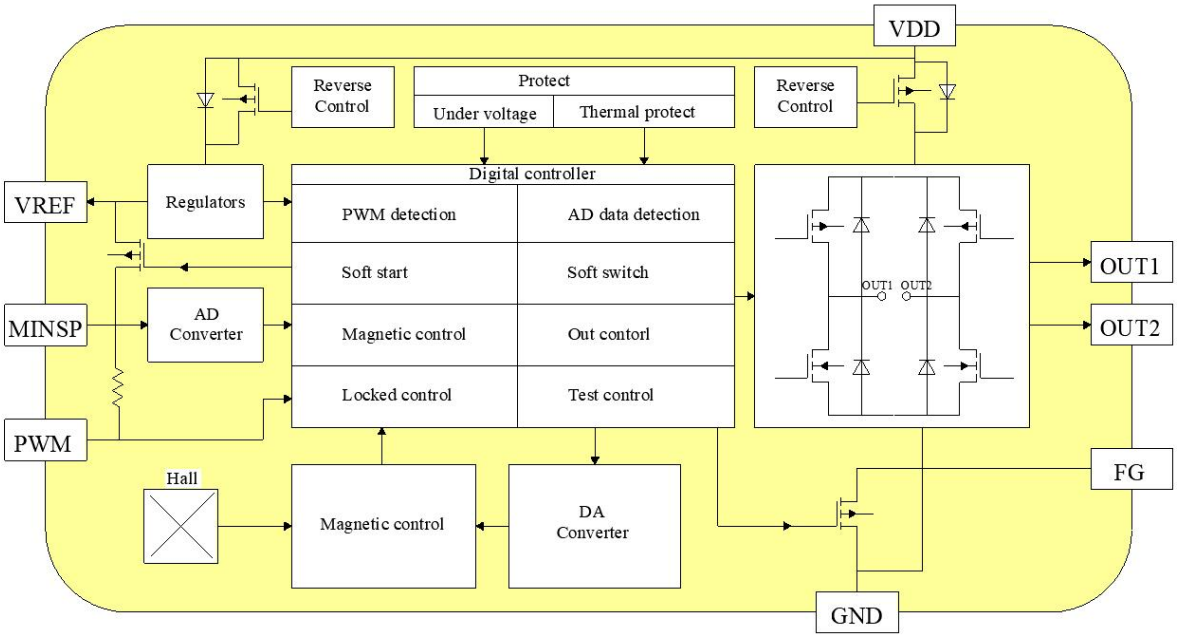
Sorting

α,β,Blank…..

Part No.	Temperature Suffix	Package Type
MH3610KVS	K (-40℃ to +125℃)	VS (SOP8 Straight Lead）
MH3610KVS-DB	K (-40℃ to +125℃)	VS (SOP8 Straight Lead）

K spec is using in industrial and automotive application. Special Hot Testing is utilized.

Functional Diagram



Absolute Maximum Ratings *At (Ta=25℃)*

Parameter	Symbol	Value	Units
Supply Voltage	V_{DD}	+18	V
Supply Current	I_{DD}	+20	mA
Reverse Supply Voltage	V_{DDREV}	-18	V
Reverse Supply Current	I_{DDREV}	-20	mA
FG Output Voltage	V_{FG}	+18	V
FG Output Current	I_{FG}	+30	mA
Reverse FG Output Current	I_{FG}	-50	mA
PWM Input Voltage	V_{PWM}	+7	V
Reverse PWM Input Voltage	V_{PWM}	-0.3	V
MINSP Input Voltage	V_{MINSP}	+3.6	V
Reverse MINSP Input Voltage	V_{MINSP}	-0.3	V
Reverse Current on MINSP or PWM	I_{MINSP}, I_{PWM}	-10	mA
Average Output Current	I_{OUT}	+550	mA
Peak Output Current	I_{OUT}	+1000	mA
Operating Temperature Range	T_A	-40to+150	℃
Storage Temperature Range	T_S	-55to+165	℃
Maximum Junction Temperature	T_J	+165	℃
ESD Sensitivity - HBM	-	6000	V
Magnetic Flux Density	B	Unlimited	mT

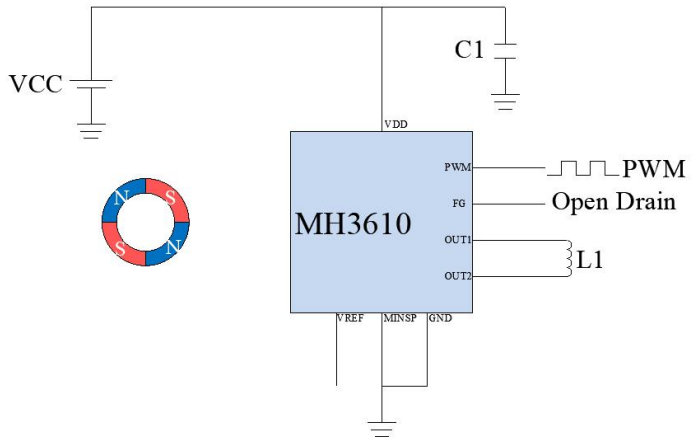
Electrical Specifications

(Ta=25 ℃,VDD=12V,unless otherwise specified)

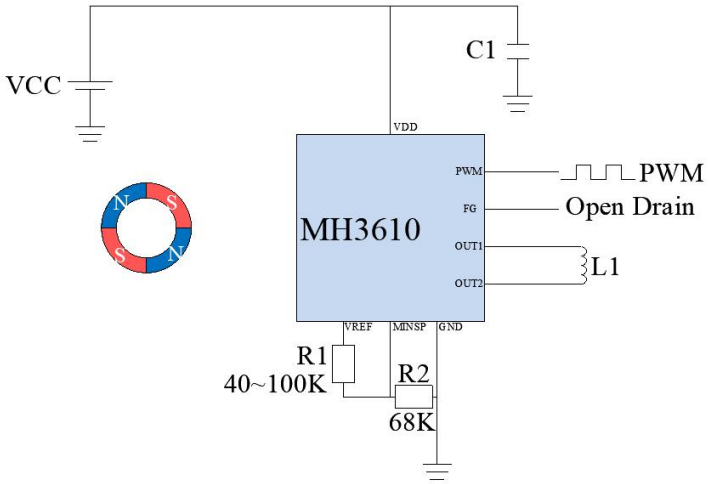
Parameters	Symbol	Test Conditions	Min	Typ.	Max	Units
Supply Voltage	V_{DD}		3.5	12	16	V
Supply Current	I_{DD}		-	3	6	mA
Reverse Supply Current	I_{DDREV}	V_{DD}= -16V	-	-	10	uA
PWM Input Low Voltage	V_{IL}		-	-	0.8	V
PWM Input High Voltage	V_{IH}		2.1		5.5	V
PWM Input Frequency	F_{IN}	-2%<DCERR<2%	0.1	-	100	KHz
PWM internal pull-up resistor	R_{IN}		-	10	-	kΩ
Full Bridge On Resistance	R_{DSON}	TJ=25℃	-	3.0	-	Ω
Full Bridge On Resistance	R_{DSON}	TJ=105℃	-	4.0	-	Ω
Output PWM frequency	F_{OUT}	10%<DC_{IN}<100%	-	22.5	-	KHz
Output Duty Cycle Range	DC_{OUT}	V_{MINSP}=0V	0	-	100	%
Output Duty Cycle Range	DC_{OUT}	Resistor R1 between MINSP to VREF, DC_{IN}<10%	10	-	100	%
Minimal Speed Setting Resistor	R_{MINSP}	DC_{IN}<10%,10%<DC_{OUT} <100%,R_{REF}=68k	40	-	100	KΩ
Output Duty Cycle Mismatch	DC_{ERR}	DC_{OUT}–DC_{IN}, V_{DD}=12V,T_A=25℃	-2	-	2	%
Freewheel Period	T_{FW}		-	1	-	ms
Soft Start Initial Overdrive	K_{SOFT}		-	30	-	%
Soft Start Rotation Detector	E_{SOFT}		-	4	-	edges
Soft Start Duration	T_{SOFT}		-	1.0	-	s
FG Output Saturation Voltage	V_{OL}	B>B_{OP},I_{OUT}=5mA	-	0.2	0.5	V
FG Output Current Limit	I_{CL}	B>B_{OP}	-	25	-	mA
FG Output Leakage Current	I_{OFF}	V_{OUT}=16V,V_{DD}=12V, B<Brp	-	0.1	10	uA
Minimum recommended magnetic field	B_{HALL}	B_{OP}=|B_{HALL}| B_{RP}= -|B_{HALL}|	-	±15	±25	Gauss
Output Slope Duration	T_{SLOPE}	Total Regulation Range	300	-	4000	us
Slope to Torque Ratio	S_{LRATIO}		-	12.5	-	%
Reference Output Voltage	V_{REF}		2.9	3.1	3.4	V
Reference Output Current Capability	I_{REF}		-	-	5	mA
Brown-Out Detector Threshold	V_{BOD}		2.8	3.1	3.4	V
Brown-Out Detector Reaction Time	T_{BOD}		-	8	-	ms
Locked Rotor Protection ON time	T_{ON}		-	1.0	-	s
Locked Rotor Protection OFF time	T_{OFF}		-	4.0	-	s

Typical Application Circuit

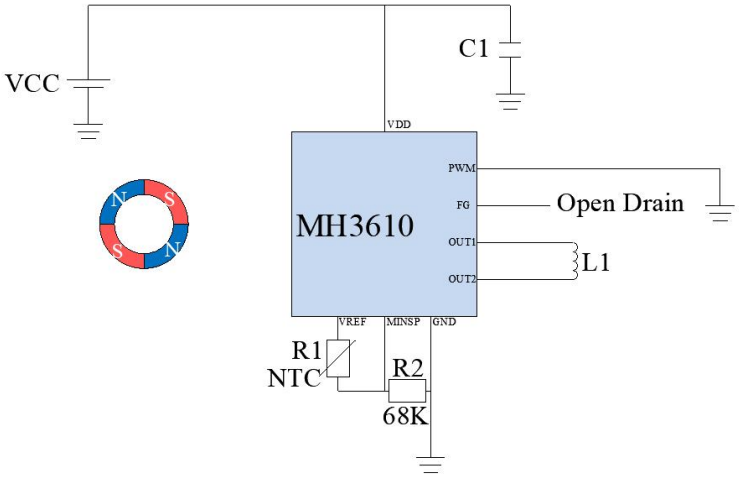
(1) PWM Cooling Fan (without minimal speed setting)



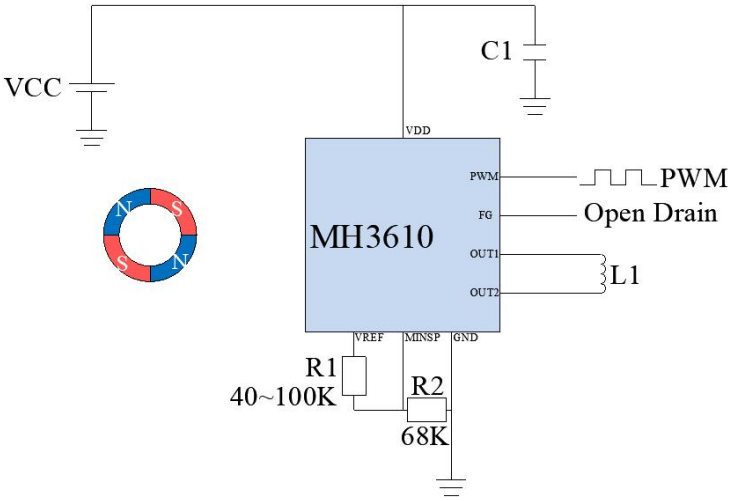
(2) PWM Cooling Fan (with minimal speed setting)



(3) Temperature Controlled Cooling Fan



(4) 2-Speed Cooling Fan



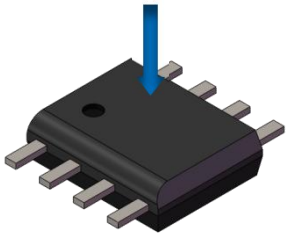
Output Behavior versus Magnetic Pole

(Ta=25 ℃,V_{DD}=12V,unless otherwise specified)

Parameter	*Test Conditions*	*OUT1*	*OUT2*	*FG*
South	B>BOP	Low	High	Low
North	B<BRP	High	Low	High

MH3610KVS

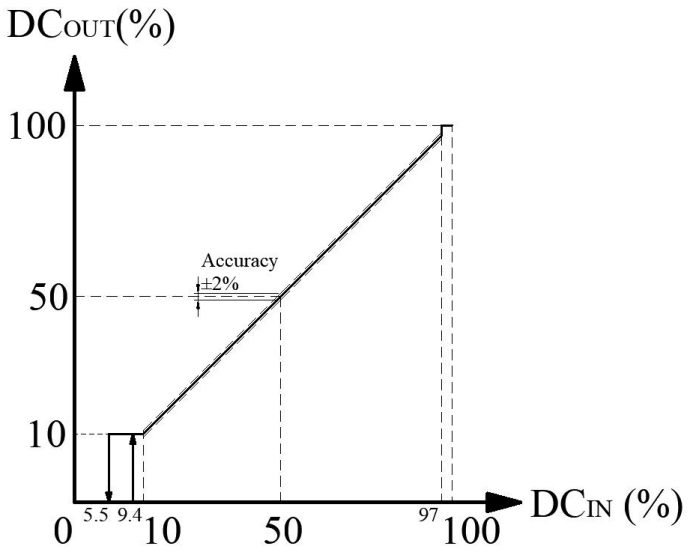
South



General Description

(1) PWM Input

The PWM input allows very wide input frequency range (100Hz to 100kHz) while the output PWM frequency is kept constant above the audible frequency range. The input duty cycle controls the driving of the output duty cycle applied to the motor coil, thus the rotation speed is directly proportional to the input duty cycle with very high accuracy of +/-2% ensuring very good linearity.



The PWM input features a built-in pull-up resistor of 10kohms tied to the Reference Output Voltage (VREF). Since the interface providing the PWM signal is generally open-collector/drain type, an external resistor is not anymore required. In addition, it provides a fail/safe functionality as it will drive the motor at full speed in case of PWM signal wire-break.

(2) Soft Switching

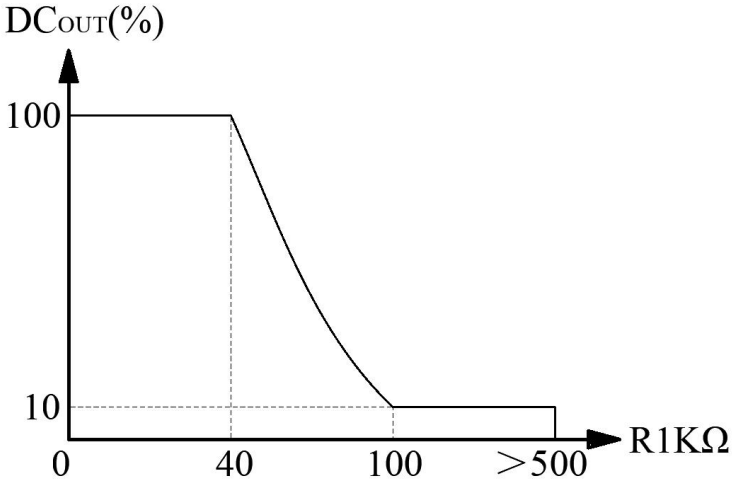
Soft Switching is performed using the output duty cycle rather than analogue voltage sweep, leading to much less power dissipation. The device automatically adjusts its slope duration targeting 12.5% from the torque period independently of the rotor magnet strength, producing an optimum balance between high efficiency and low noise performance. The possibility for very long slope duration guarantees extremely quiet operation even at very low rotation speed.

(3) Soft Start

The Intelligent Soft Start prevents very high peak current during start-up. An additional system guarantees proper motor start-up even with low PWM input duty cycle, ensuring enough initial torque to the motor is generated to enable rotation. When motor rotation is detected the output duty cycle is adjusted linearly to the input duty cycle.

(4) MINSP Controlled

The Minimal Speed input allows setting of a minimum required rotation speed of the motor by using 2 inexpensive resistors. This is especially useful for applications where minimum cooling is a requirement to avoid system damage (example: computer CPU, VGA graphics, etc).



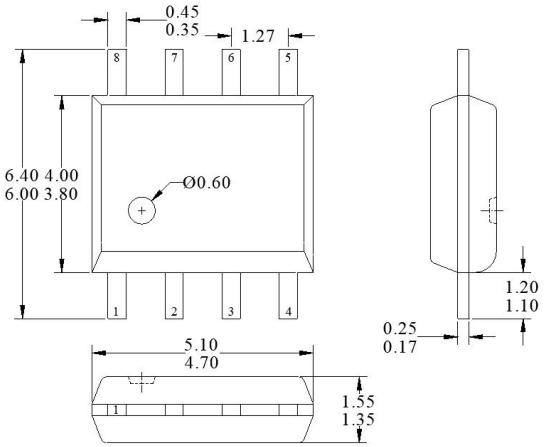
(5) FG Output

The tachometer open drain output (FG) feedback motor rotation speed to the system and is fully protected against short-circuit.

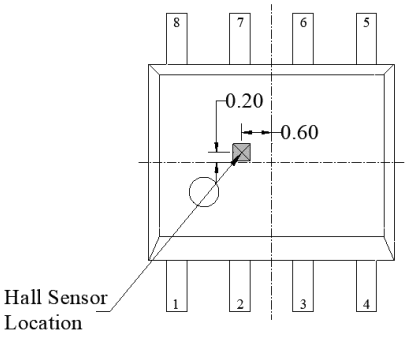
Sensor Location, Package Dimension and Marking

VS Package（SOP8-Straight Lead）

(Top View)



Hall Plate Chip Location

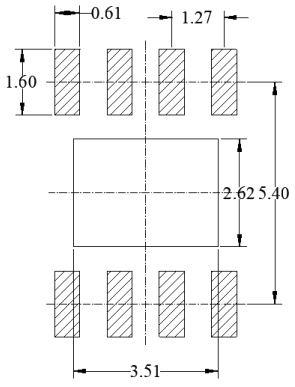


NOTES:

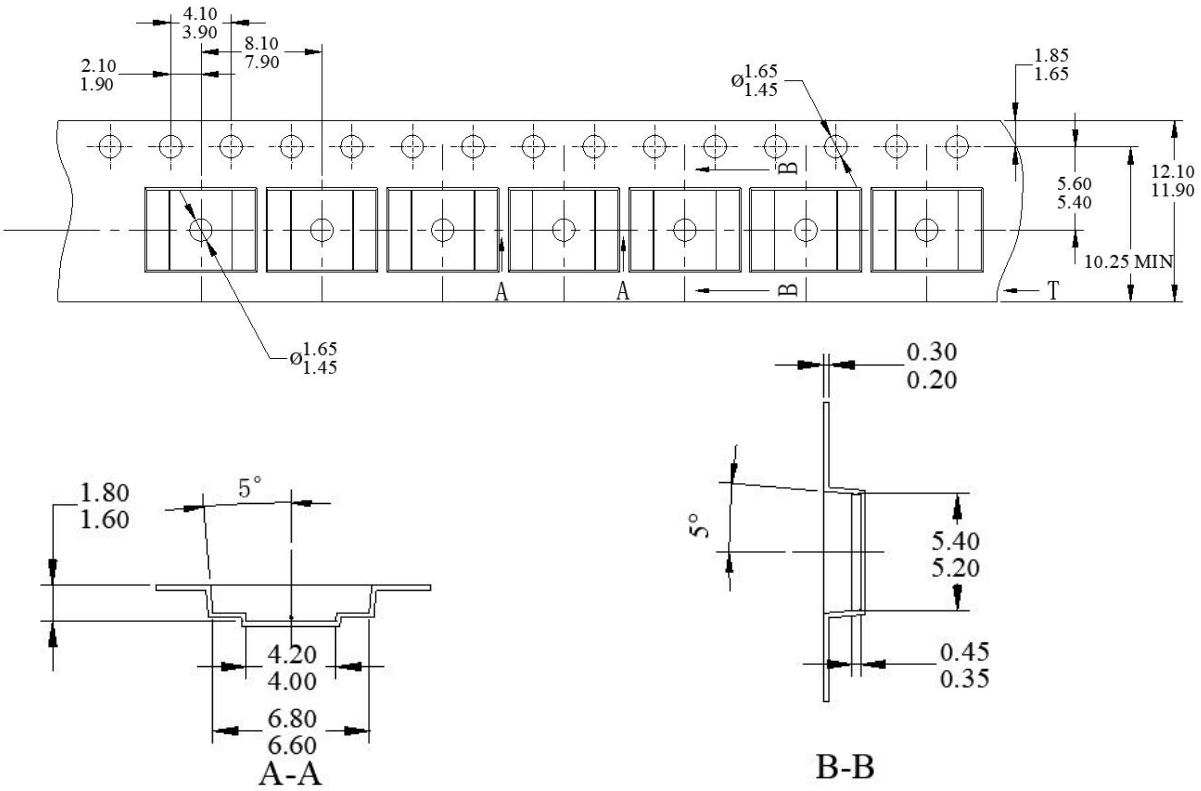
1. Controlling dimension: mm
2. Leads must be free of flash and plating voids
3. Lead thickness after solder plating will be 0.254mm maximum
4. Marking:Bottom Side； Line1:3610； Line2: Date Code, Refer to DC table.
5. PINOUT:

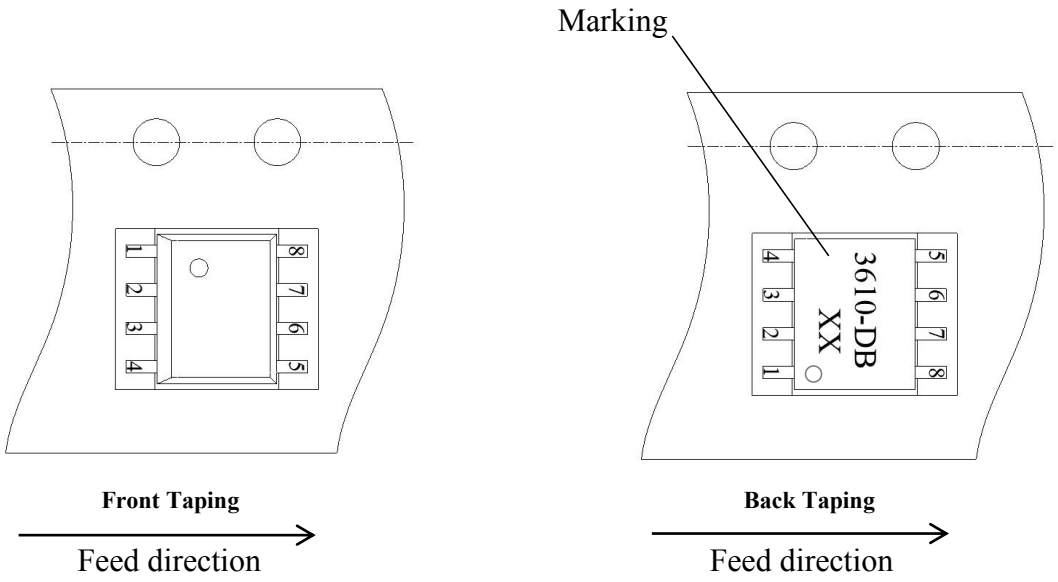
Pin No.	Pin Name	Pin No.	Pin Name
1	PWM	5	OUT2
2	FG	6	GND
3	OUT1	7	MINSP
4	VDD	8	VREF

(For reference only) Land pattern



VS package Tape On Reel Dimension





Front Taping

Feed direction

Back Taping

Feed direction