SY6705B

Medium Voltage H-Bridge IC

General Description

The SY6705B is an H-bridge motor driver solution for motion-control applications. The device can drive one winding of a stepper motor or one brush DC motor. The highly integrated H-bridge driver block consists of two half-bridges with internal logic control, gate drive, over current protection and charge pump circuit. The device is packaged in SO8E package.

The SY6705B operates with a power-supply voltage range from 8V to 40V, and 3.5A maximum output current.

To be compatible with industry-standard devices, the SY6705B uses the PWM (IN/IN) input interface.

The SY6705B provides over current protection, short circuit protection, under voltage lockout and over temperature protection.

Features

- H-bridge Motor Driver
  - Drives a Brush DC Motor or One Winding of a Stepper Motor or Other Loads
  - Low MOSFET On-resistance:
- 3.5A Maximum Drive Current
- Power Supply Voltage Range From 8V to 40V
- PWM (IN/IN) Interface
- Low Power Standby Mode with Less Than 12μA Supply Current
- Internal Over Current Protection, Short Circuit Protection, Under Voltage Lockout and Over Temperature Protection
- Internal Charge Pump with Capacitor Inside
- Synchronous Rectification
- Compact Package: SO8E

Ordering Information

SY6705 □(□□)□

- Temperature Code
- Package Code
- Optional Spec Code

Ordering Number	Package type	Note
SY6705BFCC	SO8E	

Applications

- Cameras
- Consumer Products
- Robotics
- Medical Devices

Typical Application

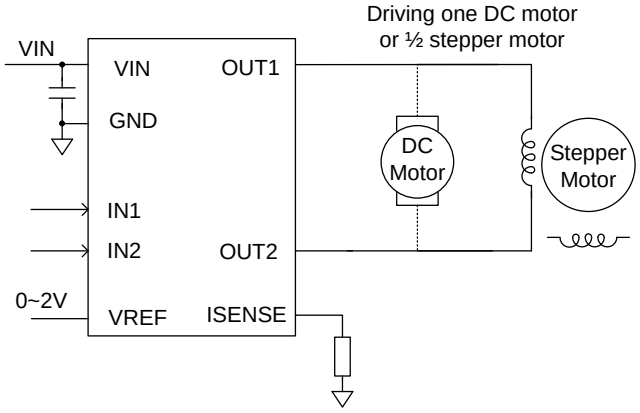
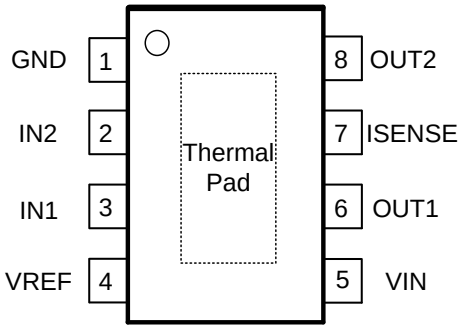


Figure1. Schematic Diagram

Pinout (top view)



SO8E

Part Number	Package type	Top Mark①
SY6705BFCC	SO8E	**BKC*xyz***

Note①： ***x=year code, y=week code, z= lot number code.***

Pin Name	Pin Number	Description
GND	1	Ground pin.
IN2	2	Input 2 pin. Logic high set OUT2 High, this pin has an internal pull-down resistor.
IN1	3	Input 1 pin. Logic high set OUT1 High, this pin has an internal pull-down resistor.
VREF	4	Current regulator voltage reference. Ilimit=VREF/10/RSENSE.
VIN	5	Power supply pin. Decouple this pin to GND pin with 10uF ceramic cap.
OUT1	6	Output 1 pin. Connect this pin to motor winding.
ISENSE	7	Current sense resistor connect pin.
OUT2	8	Output 2 pin. Connect this pin to motor winding.
Thermal Pad	-	Exposed pad for enhanced thermal dissipation. Connect to ground for maximum thermal efficiency.

Block Diagram

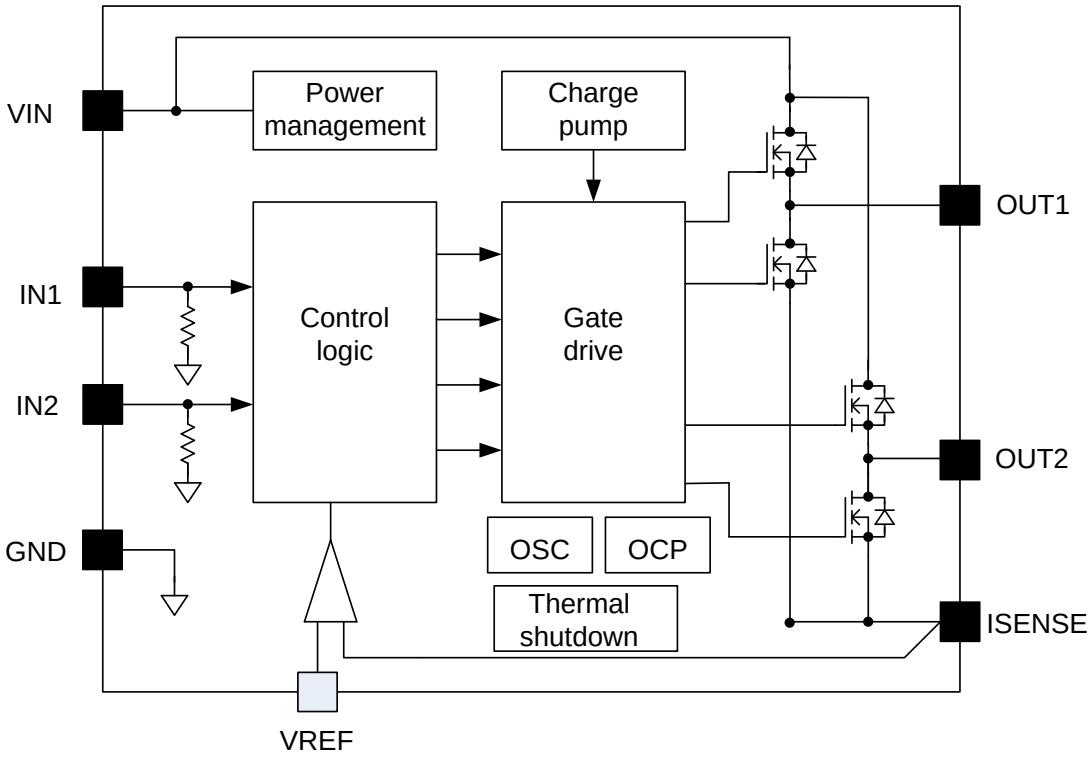


Figure2. Block Diagram

Absolute Maximum Ratings (Note 1)

VIN, OUT1, OUT2 ---------- 40V
IN1, IN2 ---------- -0.3 to 7V
VREF ---------- -0.3 to 4V
ISENSE---------- -0.25 to 0.25V
Junction Temperature (T_J) ---------- -40°C to +150°C
Storage Temperature ---------- -55°C to +150°C
Package Thermal Resistance
θ_{JA} (Note 2) ---------- 62°C/W
θ_{JC} ---------- 20°C/W

Recommended Operating Conditions

VIN ---------- 8V to 32V
IN1, IN2 ---------- 0V to 5.5V
Logic Input PWM Frequency ---------- 0Hz to 100KHz
H-Bridge Output Current (Note3) ---------- 0A to 3.5A
Junction Temperature Range ---------- -40°C to 125°C
Ambient Temperature Range ---------- -40°C to 85°C

Electrical Characteristics

(T_A = 25°C, V_{IN}=24V, unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Power Supplies						
Supply Voltage Range	VIN		8	-	32	V
Under Voltage Threshold	V_{UVLO_TH}	VIN Rising	6.6	7.4	7.8	V
Under Voltage Hysteresis	V_{UVLO_HYS}			400		mV
VIN Operating Supply Current	I_{IN}	Low power standby mode	4	8	12	μA
		<30KHz PWM, OUTx Float		1.2	2	mA
Logic Level Input						
Input Low Voltage	V_{IL}		-	-	0.8	V
Input High Voltage	V_{IH}		2.4	-	-	V
Input Low Current	I_{IL}	V_{INx}=0V	-1	0	1	μA
Input High Current	I_{IH}	V_{INx}=3.3V	20	50	100	μA
H-Bridge MOSFETs						
HS + LS MOSFETs On Resistance	R_{dson}	I_O=2.5A, T_J=25℃	340	420	500	mΩ
Off-State Leakage Current	I_{OFF}	VOUT=0V			±500	nA
Current Regulation						
Current Regulation Reference Voltage	$VREF_{external}$	Use External Voltage as VREF	0	-	2	V
Current Gain	A_V	VREF/ISENSE, VREF=2V	9.5	-	10.5	V/V
		VREF/ISENSE, VREF=1V	9.0	-	10.5	V/V
		VREF/ISENSE, VREF=0.4V	8.9	-	10.8	V/V
Crossover Delay	t_{CRD}	Note4	50	-	500	ns
Blank Time	t_{BLANK}		1.5	2.5	3.5	μs
Constant Off Time	t_{OFF}		10	20	30	μs
Timing						
Standby Timer	t_{ST}	IN1=IN2< $V_{ISTANDBY}$, Note4	-	1	-	ms
Protection						
Output Over Current Limit	I_{OCP}		3.5	4.5	5.5	A
Thermal Shutdown Temperature	T_{SD}		-	160	-	℃
Thermal Shutdown Hysteresis	T_{HYS}		-	15	-	℃

Note 1: Stresses beyond the "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

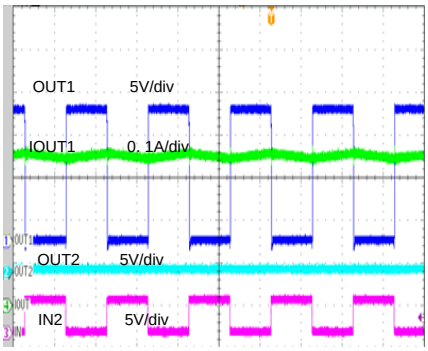
Note 2: θ_{JA} is measured in the natural convection at T_A = 25°C on a two- layer SILERGY Evaluation Board.

Note 3: Power dissipation and thermal limits must be observed.

Note 4: This parameter is not test, and it is guaranteed by design.

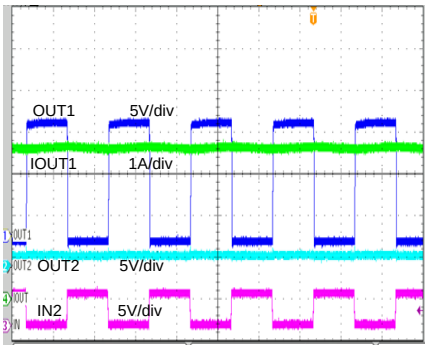
Typical performance characteristics

Operation Waveform
(VIN=15V IO=0.35A IN1=High Rsense=0Ω)



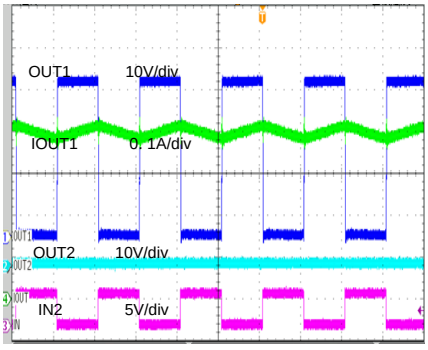
Time (10μs/div)

Operation Waveform
(VIN=15V IO=3.5A IN1=High Rsense=0Ω)



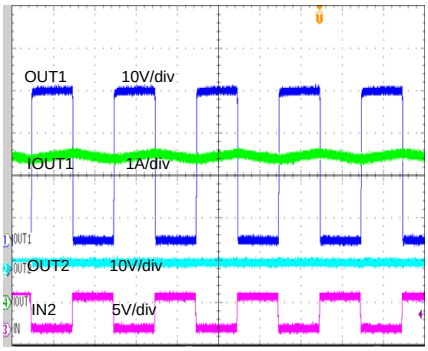
Time (10μs/div)

Operation Waveform
(VIN=36V IO=0.35A IN1=High Rsense=0Ω)



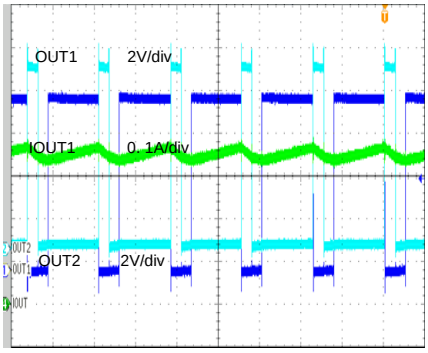
Time (10μs/div)

Operation Waveform
(VIN=36V IO=3.5A IN1=High Rsense=0Ω)



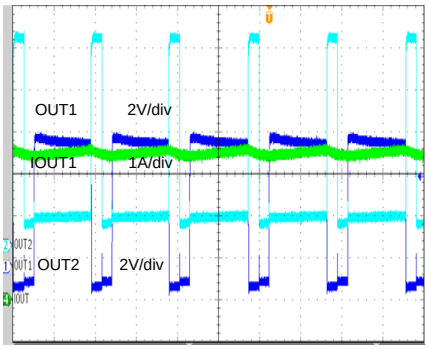
Time (10μs/div)

Operation Waveform
(VIN=8V IO=0.35A IN1=High IN2=Low Rsense=50mΩ)



Time (40μs/div)

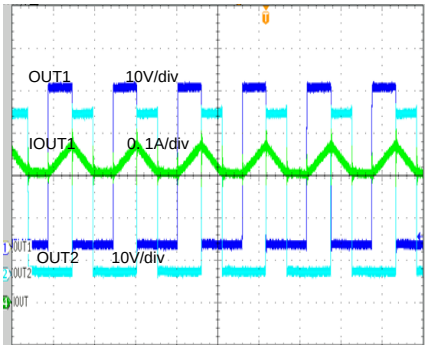
Operation Waveform
(VIN=8V IO=3.5A IN1=High IN2=Low Rsense=50mΩ)



Time (40μs/div)

Operation Waveform

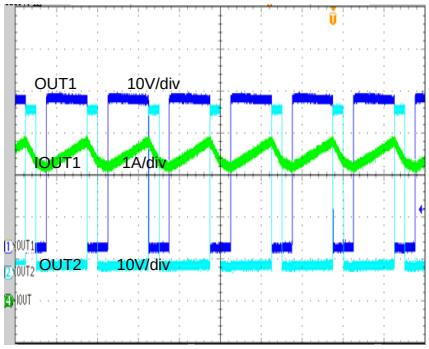
(VIN=36V IO=0.35A IN1=High IN2=Low Rsense=50mΩ)



Time (20μs/div)

Operation Waveform

(VIN=36V IO=3.5A IN1=High IN2=Low Rsense=50mΩ)



Time (20μs/div)

Timing Requirements

(T_A = 25°C, V_{IN}=24V, R_L=20Ω, unless otherwise specified)

No.	Parameter		Min	Max	Unit
1	t_1	Output Enable Time		120	ns
2	t_2	Output Disable Time		120	ns
3	t_3	Delay Time, INx High to OUTy Low		120	ns
4	t_4	Delay Time, INy Low to OUTx High		120	ns
5	t_5	Output Rise Time	50	150	ns
6	t_6	Output Fall Time	50	150	ns

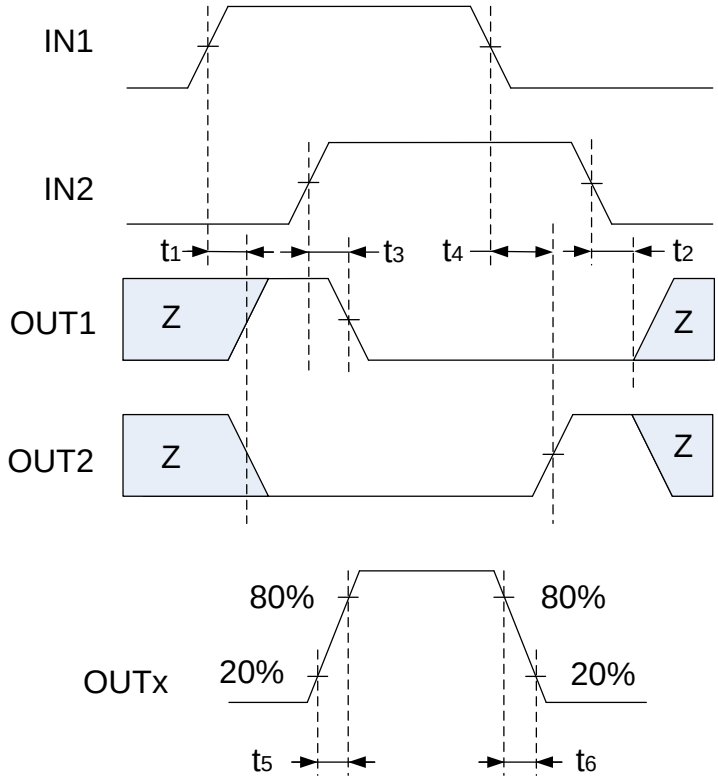


Figure3. Input/Output Timing

Functional Description

H-Bridge Driving Control

The Bridge is controlled by a PWM input interface, also called IN/IN interface. The following table shows the control logic of the device:

IN1	IN2	OUT1	OUT2	Function (DC Motor)
0	0	Z	Z	Coast
0	1	L	H	Reverse
1	0	H	L	Forward
1	1	L	L	Brake

Standby Mode

Low power standby mode is actived when both input IN1 AND IN2 pin voltage are logic low for longer than 1ms. Standby Mode disables most of the internal circuitry, including the charge pump and the regulator. When SY6705B is coming out of standby mode, the charge pump should be allowed to reach its regulated voltage (a maximum delay of 200us) before any PWM commands are issued to the device.

Current Regulation

When voltage of the current sense resistor is equals to the comparator trip value, SY6705B resets the PWM and turns off the FETs. SY6705B decays the current at fixed off time of 25us. At the beginning of decay, the motor runs at fast decay, and at the second half off time, the motor runs at slow decay.

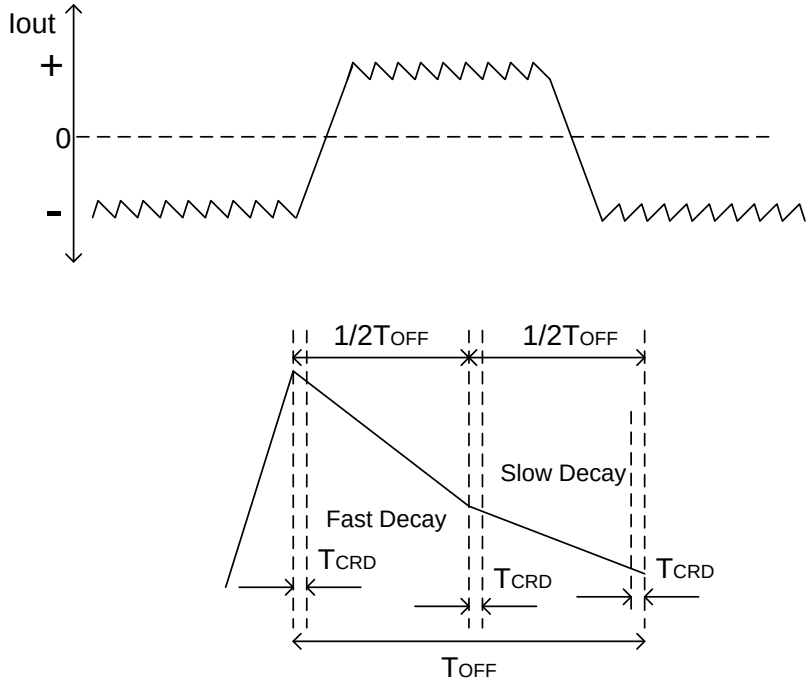


Figure 4.Current Regulation and Decay timing

Synchronous Rectification

When the current regulation is triggered, load current will recirculate. The SY6705B turn on the MOSFET, and short the bode diode. This helps to lower the power dissipation. When a zero current is detected, the synchronous rectification is turn off to prevent reversal of the load current.

Protection Circuits

The device is fully protected against undervoltage, overcurrent, short circuit and overtemperature.

Over Current Protection (OCP)

An analog current limit circuit on each MOSFET limits the current through the MOSFET by removing the gate drive. When OCP occurs, all MOSFETs in the H-bridge are disabled. The OCP latch can only be cleared by coming out of Low Power Standby Mode or by cycling the power to VIN.

Short Circuit Protection (SCP)

When circuit conditions are on both high and low side devices, that is, a short to ground, supply, or across the motor winding all result in an short circuit protection. When SCP occurs, SY6705B will shutdown all the PowerFETs.

Undervoltage Lockout (UVLO)

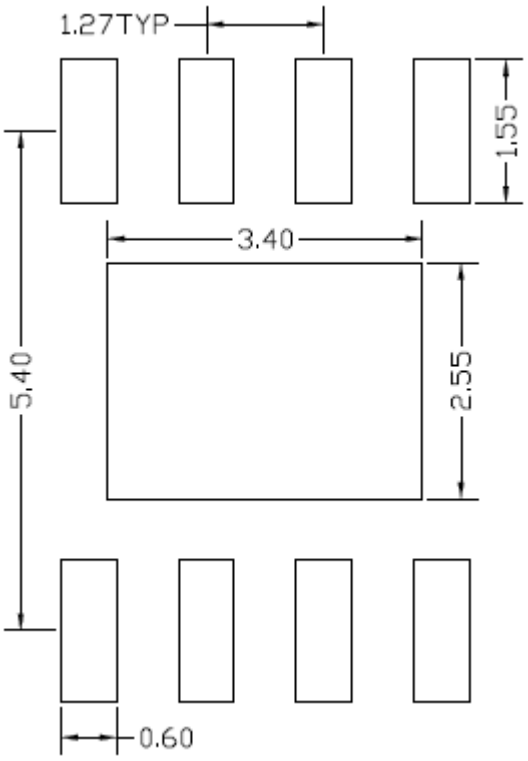
If at any time the voltage on the VIN pin falls below the undervoltage lockout threshold voltage, all circuitry in the device is disabled and internal logic is reset. Operation resumes when VIN rises above the UVLO threshold.

Thermal Protection

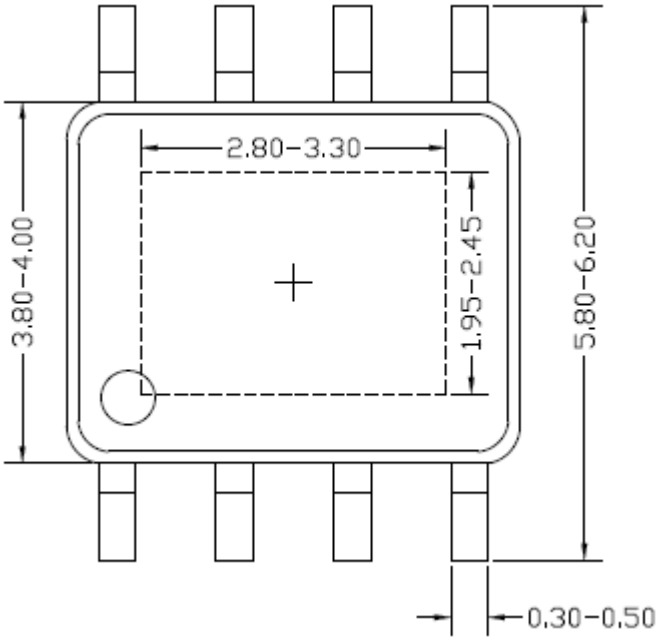
The device has thermal shutdown (TSD) as described in the Protection Circuits section. If the die temperature exceeds approximately 160°C, the device is disabled until the temperature drops to a safe level.

Any tendency of the device to enter thermal shutdown is an indication of either excessive power dissipation, insufficient heatsinking, or too high an ambient temperature.

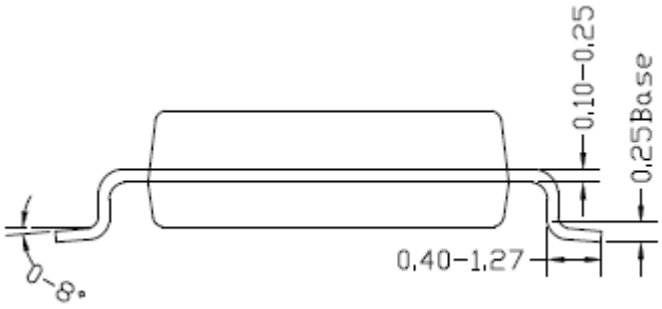
SO8E Package Outline & PCB layout



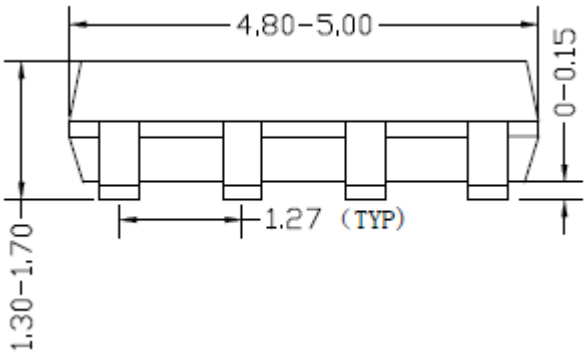
Recommended PCB Layout (Reference Only)



Top view



Side view



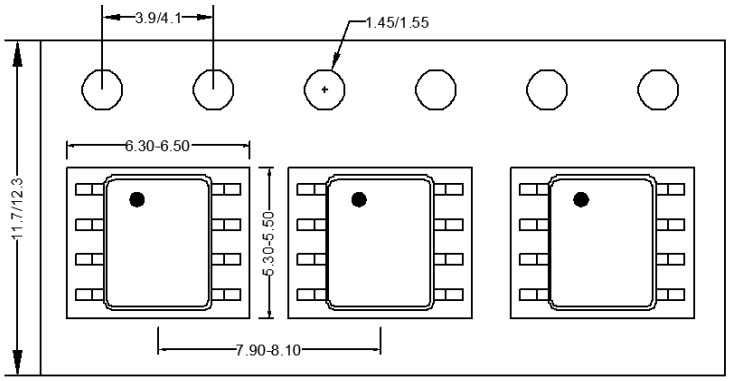
Front view

Notes: **All dimension in millimeter and exclude mold flash & metal burr.**

Taping & Reel Specification

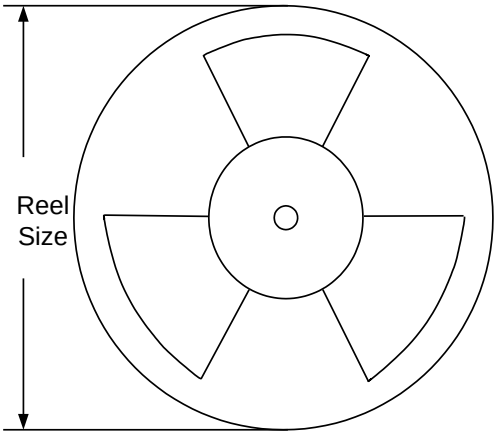
1. Taping orientation

SO8E



Feeding direction ⟶

2. Carrier Tape & Reel specification for packages



Package types	Tape width (mm)	Pocket pitch(mm)	Reel size (Inch)	Trailer * length(mm)	Leader * length (mm)	Qty per reel (pcs)
SO8E	12	8	13"	400	400	2500

3. Others: NA

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