Application Note: SY6702

Low Voltage H-Bridge IC

General Description

The SY6702 is an H-bridge motor driver solution for cameras, consumer products, toys, and other low-voltage or battery-powered 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 SY6702 operates with a power-supply voltage range from 2.5V to 16V, and 1.8A maximum output current.

To be compatible with industry-standard devices, the SY6702 use the PWM (IN/IN) input interface.

The SY6702 provides over current protection, short circuit protection, under voltage lockout and thermal shutdown.

Features

- H-bridge motor driver
  - Drives a brush DC motor or one winding of a stepper motor or other loads
  - Low MOSFET on-resistance: HS + LS < 380mΩ
- 1.8A maximum drive current
- Power supply voltage range from 2.5V to 16V
- PWM (IN/IN) interface
- Low power sleep mode with 120nA maximum Combined supply current
- Low power with less than 120 μA supply current
- Internal over current protection, short circuit protection, under voltage lockout and thermal shutdown
- Compact package: DFN2x2-8

Applications

- Cameras
- DSLR Lenses
- Consumer Products
- Toys
- Robotics
- Medical Devices

Ordering Information

SY6702 □(□□)□

- Temperature Code
- Package Code
- Optional Spec Code

Ordering Number	Package type	Note
SY6702DFC	DFN2x2-8	

Typical Applications

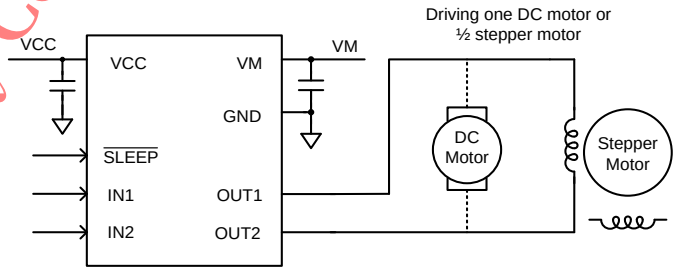
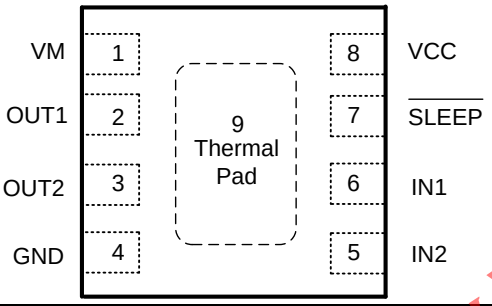


Figure 1. Schematic Diagram

Pinout (top view)



Part Number	Package type	Top Mark①
SY6702DFC	DFN2x2-8	**Eexyz**

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

Name	DFN2x2-8	Description
VM	1	Motor power supply pin. Decouple this pin to GND pin with 10uF ceramic cap.
OUT1	2	Output 1 pin. Connect this pin to motor winding.
OUT2	3	Output 2 pin. Connect this pin to motor winding.
GND	4	Ground pin.
IN2	5	Input 2 pin. Logic high set OUT2 high; this pin has a internal pull-down resistor.
IN1	6	Input 1 pin. Logic high set OUT1 high; this pin has a internal pull-down resistor.
$\overline{\text{SLEEP}}$	7	Sleep mode pin. Logic low puts device in low-power sleep mode, this pin has an internal pull-down resistor.
VCC	8	Device power supply pin. Decouple this pin to GND pin with 0.1uF ceramic cap.
Thermal Pad	9	Thermal Pad.

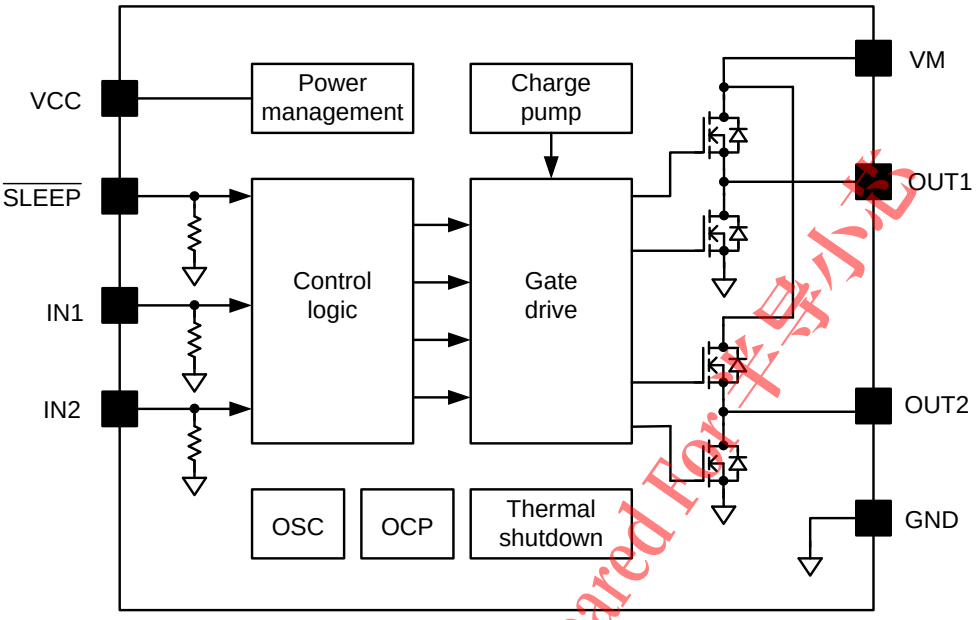
Absolute Maximum Ratings (Note 1)

VCC, OUT1, OUT2 ---------- 16V
VM ---------- 16V
$\overline{\text{SLEEP}}$ ---------- 6V
IN1, IN2 ---------- 6V
Junction Temperature (T_J) ---------- -40℃ to +150℃
Storage Temperature ---------- -65℃ to +150℃
Power Dissipation, P_D @ T_A = 25℃ ---------- 2.5W
Package Thermal Resistance (Note2)
θ_{JA}, ---------- 50℃/W
θ_{JC}, ---------- 62℃/W

Recommended Operating Conditions

VCC ---------- 2.5V to 16V
VM ---------- 2.5V to 16V
$\overline{\text{SLEEP}}$ ---------- 0V to 5.5V
IN1, IN2 ---------- 0V to 5.5V
Logic Input PWM Frequency ---------- 0Hz to 250kHz
H-Bridge Output Current (Note3) ---------- 0A to 1.8A
Junction Temperature Range ---------- -40℃ to 125℃
Ambient Temperature Range ---------- -40℃ to 85℃

Block Diagram



Electrical Characteristics

(T_A = 25℃,VM=VCC=5V, unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Power Supplies						
VM Operating Supply Current	I_{VM}	No PWM		40		μA
		50KHz PWM, OUTx Float		0.8		mA
VM Sleep Mode Current	I_{VMS}	$\overline{SLEEP}$=0V		30		nA
VCC Sleep Mode Current	I_{CCS}	$\overline{SLEEP}$=0V		5		nA
VCC Operating Supply Current	I_{CC}	No PWM		120		μA
		50KHz PWM, OUTx Float		0.7		mA
VCC Under voltage Lockout Voltage	V_{UVLO_RISE}	VCC Rising			2.2	V
	V_{UVLO_FALL}	VCC Falling			2.1	V
Logic Level Input						
Input Low Voltage	V_{IL}				0.8	V
Input High Voltage	V_{IH}		2			V
Input Hysteresis	V_{IHYS}			0.2		V
Input Low Current	I_{IL}	V_{IN}=0V	-5		5	μA
Input High Current	I_{IH}	V_{IN}=3.3V			50	μA
Pulldown Resistance	R_{PD}			100		kΩ
H-Bridge MOSFETs						
HS + LS MOSFETs On Resistance	R_{dson}	I_O=800mA, T_J=25℃		380	430	mΩ
Off-State Leakage Current	I_{OFF}	V_{OUT}=0V			±200	nA
Protection						
Output Over Current Limit	I_{OCP}		1.9		3.5	A
Over Current Retry Time	t_{OCPR}			1		ms
Thermal Shutdown Temperature	T_{SD}		140	150		°C
Thermal Shutdown hysteresis	T_{HYS}			20		°C

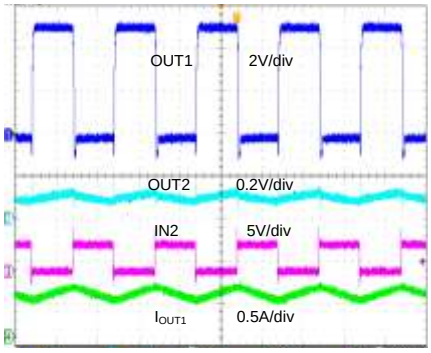
Note 1: Stresses beyond the "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specification is not implied. Exposure to absolute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

Note 2: θ_{JA} and θ_{JC} are measured in the natural convection at T_A = 25 ℃ on a high effective four-layer thermal conductivity test board of JEDEC 51-5and 51-7 thermal measurement standard.

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

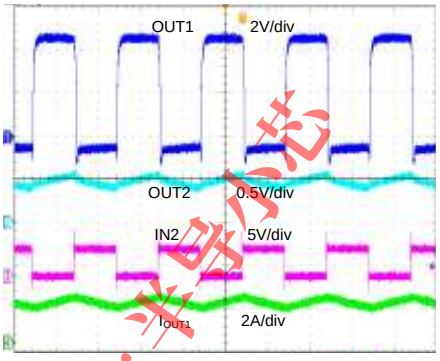
Typical performance characteristics

Operation Waveform
(VCC=VM=5V, I_O=0.5A, IN1=High)



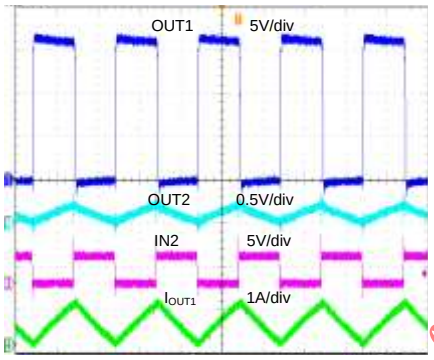
Time (2μs/div)

Operation Waveform
(VCC=VM=5V, I_O=1.8A, IN1=High)



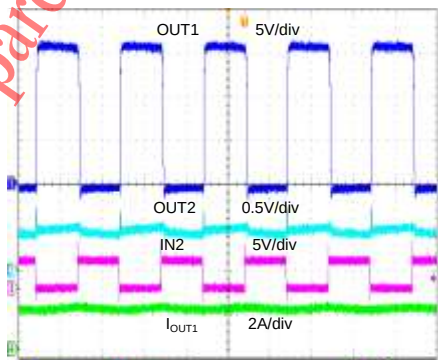
Time (2μs/div)

Operation Waveform
(VCC=VM=16V, I_O=0.5A, IN1=High)



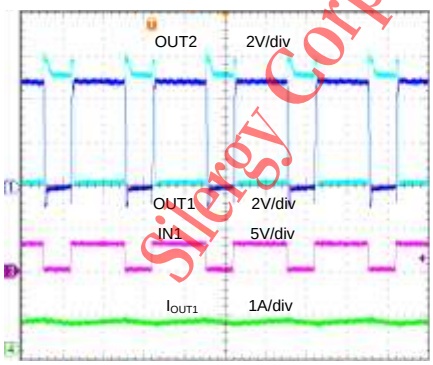
Time (2μs/div)

Operation Waveform
(VCC=VM=16V, I_O=1.8A, IN1=High)



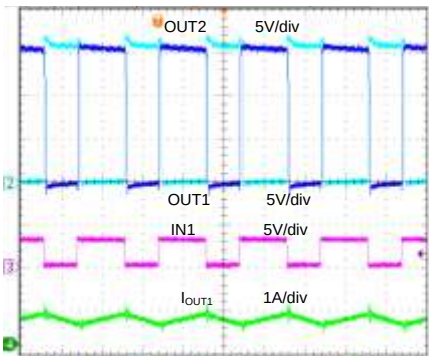
Time (2μs/div)

Operation Waveform
(VCC=VM=5V, I_O=0.5A, IN2=$\overline{IN1}$)



Time (2μs/div)

Operation Waveform
(VCC=VM=16V, I_O=0.5A, IN2=IN1)



Time (2μs/div)

Operation

Timing Requirements

(T_A = 25 ℃, VCC=3V, VM=5V, R_L=20Ω, unless otherwise specified)

			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

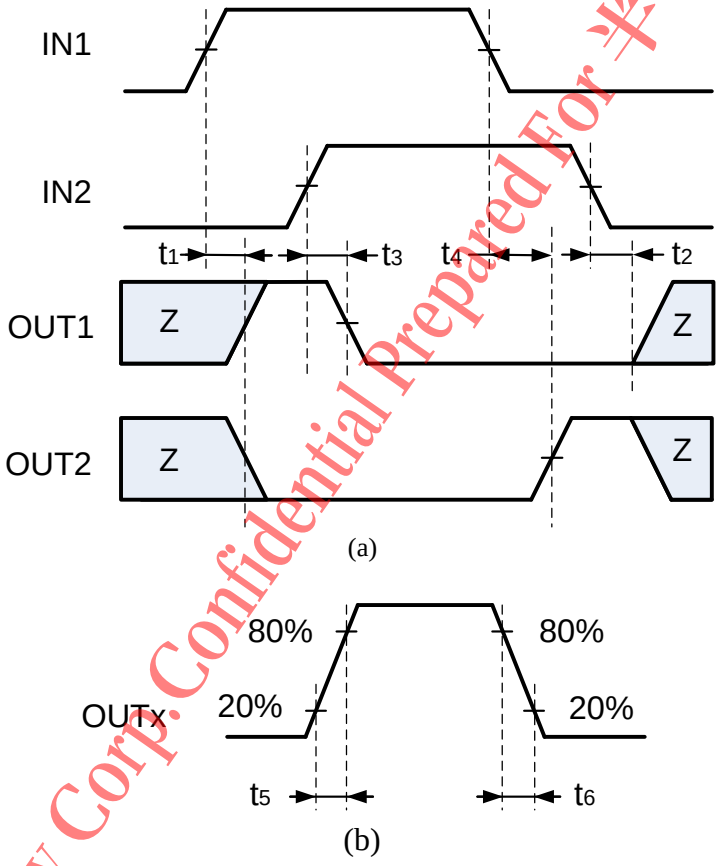


Figure 3. Input/Output Timing

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

Sleep Mode

If the $\overline{\text{SLEEP}}$ pin is brought to a logic-low state, the device enters a low-power sleep mode. In this state, all unnecessary internal circuitry is powered down.

Over Current Protection (OCP)

A current limit circuit on each MOSFET limits the current through the MOSFET by removing the gate drive. If this current limit persists for longer than the OCP time, all MOSFETs in the H-bridge are disabled. After approximately 1 ms, the bridge is re-enabled automatically.

Over current conditions on both high and low side devices, that is, a short to ground, supply, or across the motor winding all result in an over current shutdown.

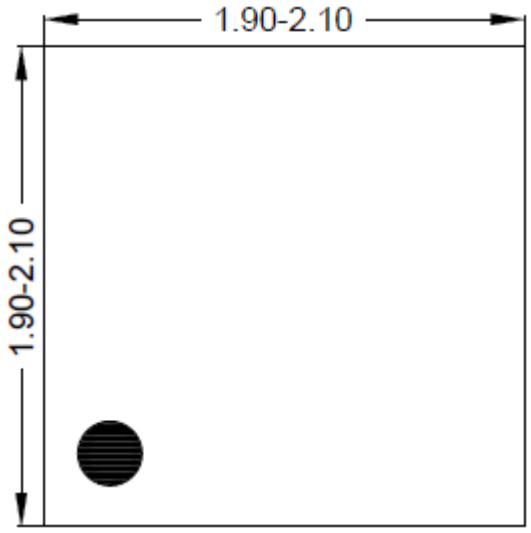
Thermal Shutdown (TSD)

If the die temperature exceeds safe limits, all MOSFETs in the H-bridge are disabled. Once the die temperature has fallen to a safe level, operation automatically resumes.

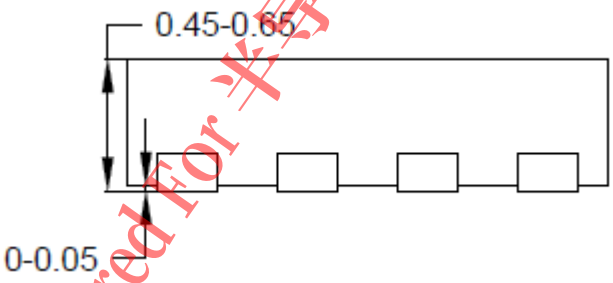
Under Voltage Lockout (UVLO)

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

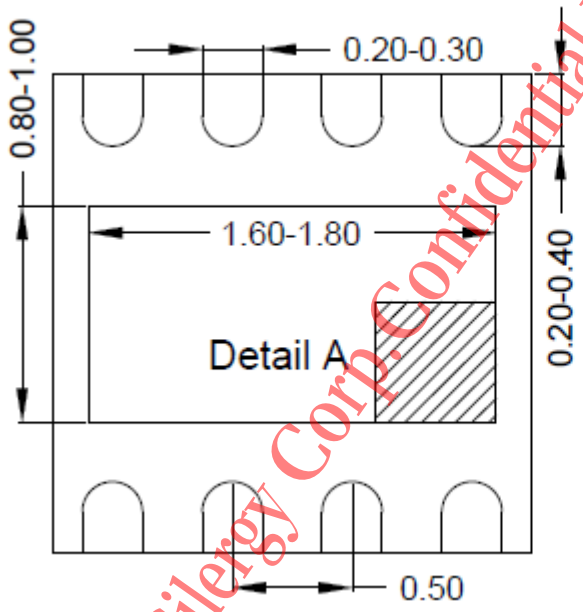
DFN2x2-8 Package Outline (Type C)

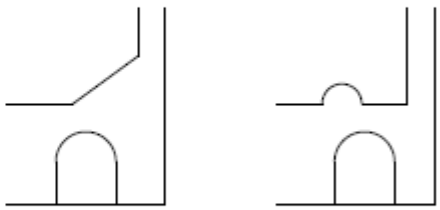


Top View



Side View

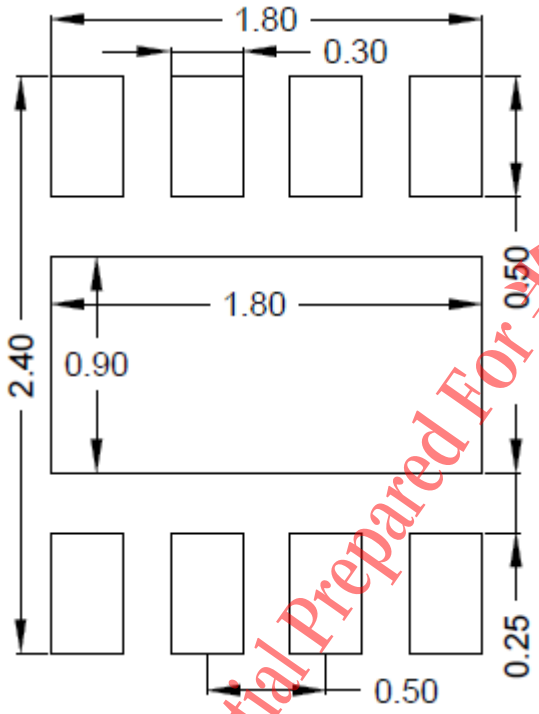




Detail A

Pin1 Identifier(Two options)

Bottom View



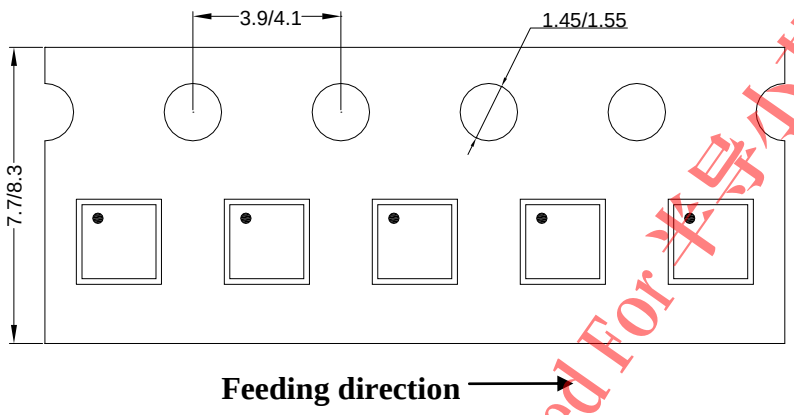
Recommended PCB layout
(Reference only)

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

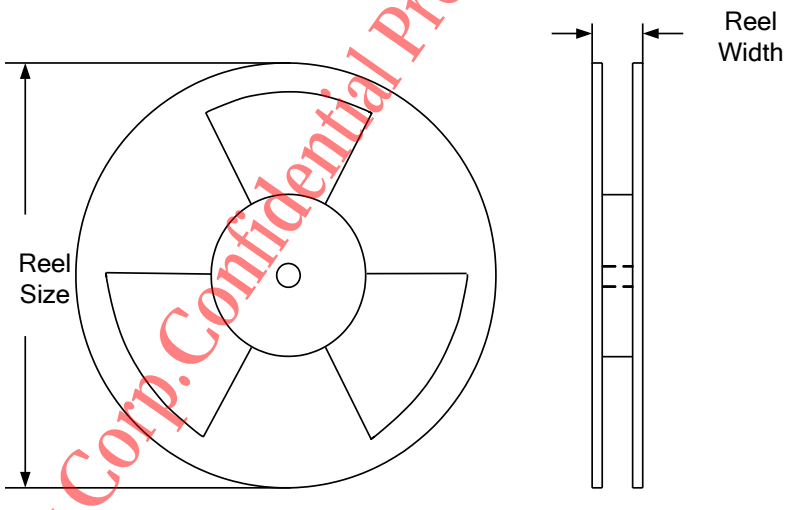
Taping & Reel Specification

1. Taping orientation

DFN2x2-8



2. Carrier Tape & Reel specification for packages



Package types	Tape width (mm)	Pocket pitch(mm)	Reel size (Inch)	Reel width(mm)	Trailer length(mm)	Leader length (mm)	Qty per reel
DFN2x2	8	4	7"	8.4	400	160	3000

3. Others: NA

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