Application Note: SY6712

Low Voltage H-Bridge IC

General Description

The SY6712 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 SY6712 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 SY6712 use the PWM (IN/IN) input interface.

The SY6712 provides over current protection, short circuit protection, under voltage lockout and over temperature protection.

Ordering Information

SY6712 □(□□)□

- Temperature Code
- Package Code
- Optional Spec Code

Ordering Number	Package type	Note
SY6712ABC	SOT23-6	

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 with less than 160μA supply current
- Internal over current protection, short circuit protection, under voltage lockout and over temperature protection
- Internal charge pump with capacitor inside
- Compact package: SOT23-6

Applications

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

Typical Applications

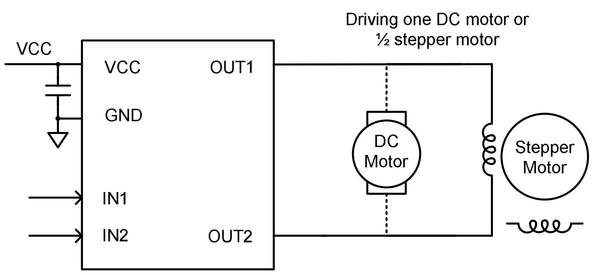
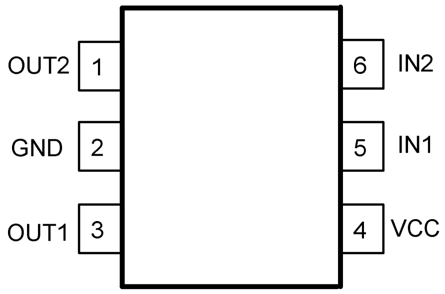


Figure 2. Schematic Diagram

Pinout (top view)



(SOT23-6)

Part Number	Package type	Top Mark[①]
SY6712ABC	SOT23-6	**Efxyz**

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

Name	Number	Description
OUT1	3	Output 1 pin. Connect this pin to motor winding.
OUT2	1	Output 2 pin. Connect this pin to motor winding.
GND	2	Ground pin.
IN2	6	Input 2 pin. Logic high set OUT2 high, this pin has a internal pull-down resistor.
IN1	5	Input 1 pin. Logic high set OUT1 high, this pin has a internal pull-down resistor.
VCC	4	Power supply pin. Decouple this pin to GND pin with 1uF ceramic cap.
GND	2	Ground pin for thermal dissipation.

Absolute Maximum Ratings (Note 1)

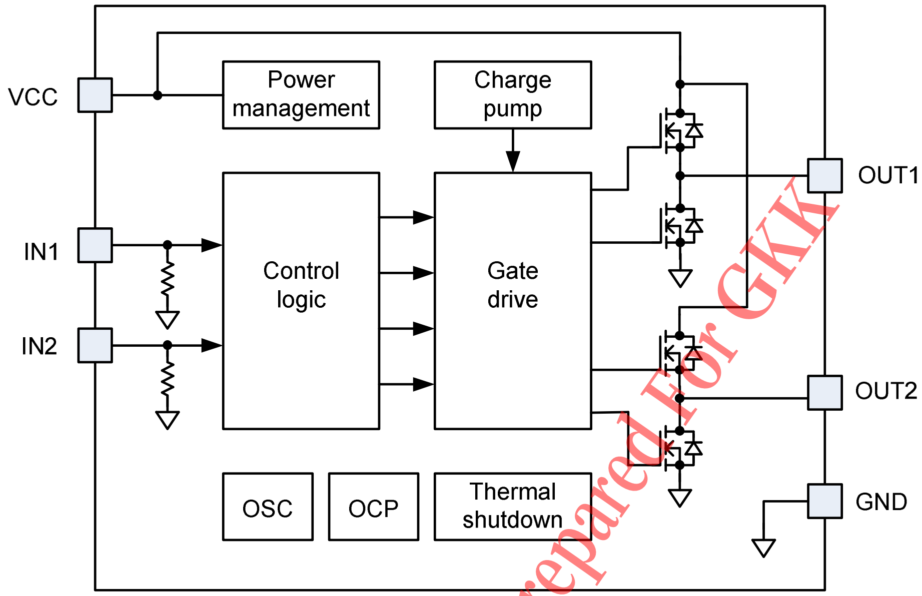
VCC, OUT1, OUT2 -- 16V
IN1, IN2 -- 6V
Junction Temperature (T_J) --- -40°C to +150°C
Storage Temperature -- -65°C to +150°C
Power Dissipation, P_D @ T_A = 25°C, SOT23-6 --0.6W
Package Thermal Resistance

θ_{JA} (Note 2), SOT23-6-- 170°C/W
θ_{JC}, SOT23-6--130°C/W

Recommended Operating Conditions

VCC --- 2.5V to 12V
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°C to 125°C
Ambient Temperature Range -- -40°C to 85°C

Block Diagram



Electrical Characteristics

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

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Power Supplies						
VCC Operating Supply Current	I_{CC}	No PWM		160		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°C		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

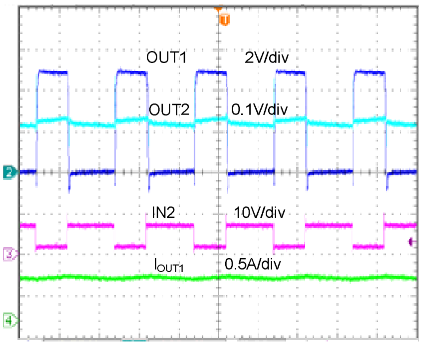
Note 1: Stresses beyond the "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specification is not implied. Exposure to absolute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

Note 2: θ_{JA} is measured in the natural convection at TA = 25°C on a low effective single layer thermal conductivity test board of JEDEC 51-3 thermal measurement standard.

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

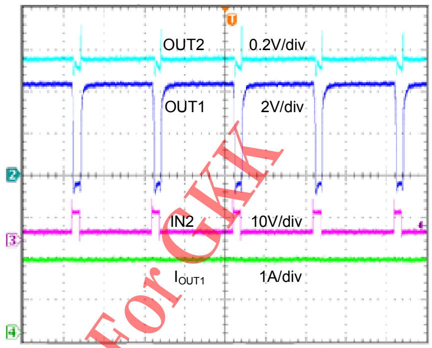
Typical performance characteristics

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



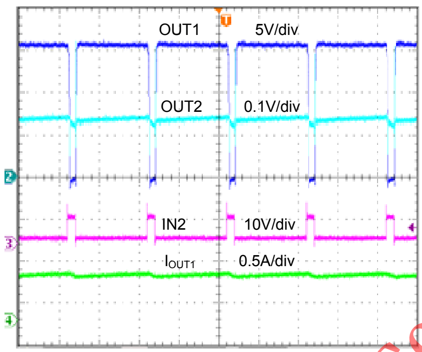
Time (2μs/div)

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



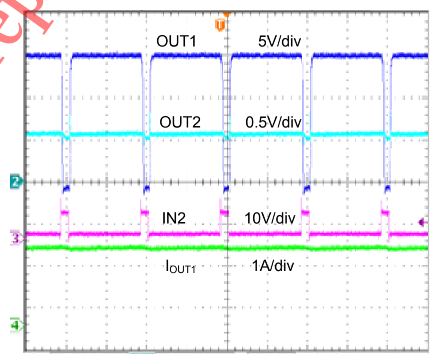
Time (2μs/div)

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



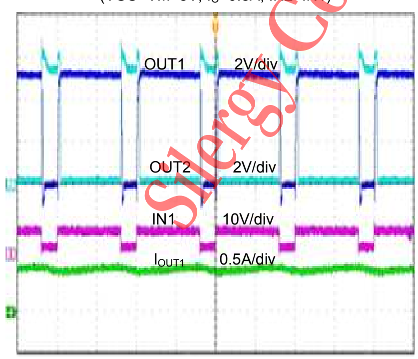
Time (2μs/div)

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



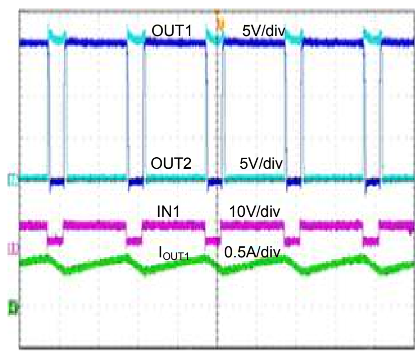
Time (2μs/div)

Operation Waveform
(VCC=VM=5V, I_O=0.5A, IN2=IN1)



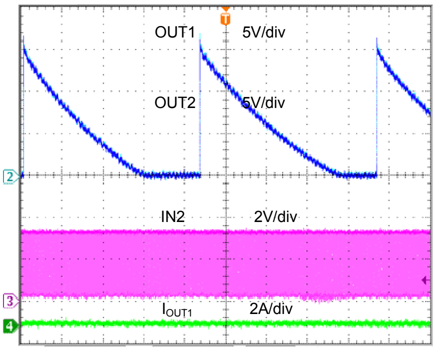
Time (2μs/div)

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



Time (2μs/div)

Short Circuit Protection
(VCC=VM=16V, OUT1 pin short to OUT2 pin, IN1=High)



Time (200μs/div)

Operation

Timing Requirements

(T_A = 25°C, VCC=3V, VM=5V, RL=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

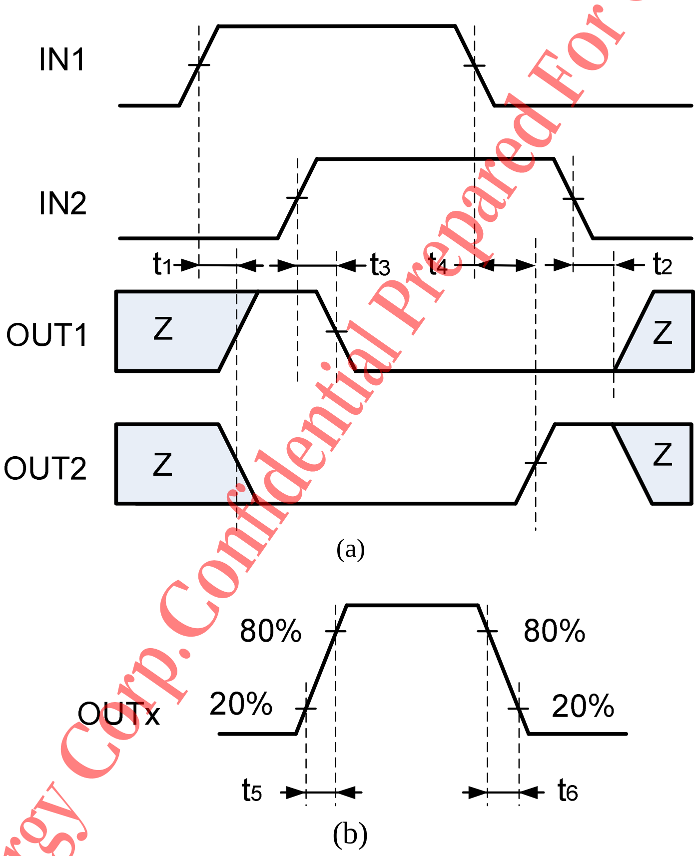


Figure 3. Input/Output Timing

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

Over Current Protection (OCP)

An 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.

Thermal Information

Thermal Protection

The device has thermal shutdown (TSD) as described in the Protection Circuits section. If the die temperature exceeds approximately 150°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 ambient temperature.

Power Dissipation

Power dissipation in the device is dominated by the power dissipated in the output MOSFET resistance, or R_{DSON}. Average power dissipation can be roughly estimated by:

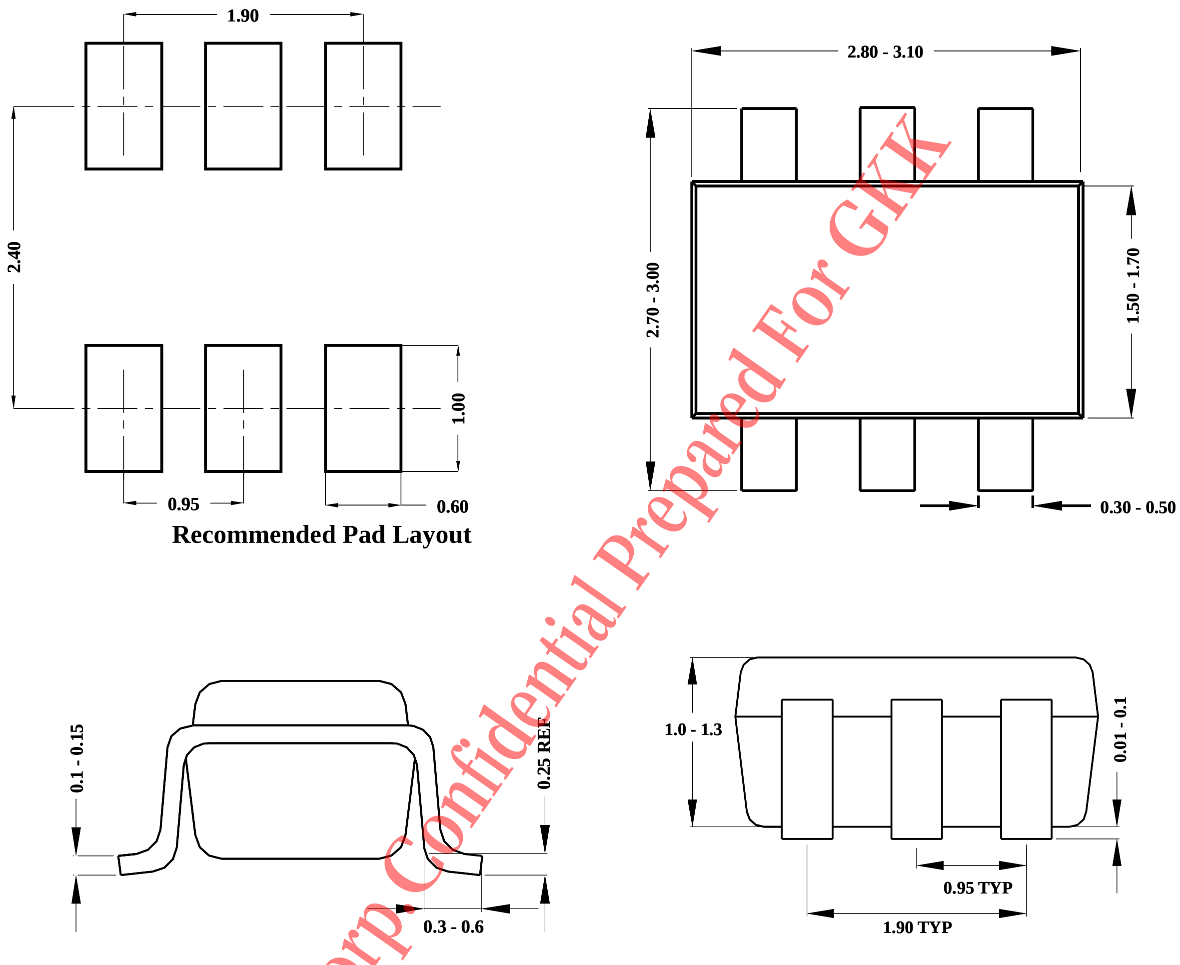
$$P_{TOT} = R_{DSON} \times I_{OUT(RMS)}^{2} \qquad (1)$$

where P_{TOT} is the total power dissipation, R_{DSON} is the resistance of the HS plus LS MOSFETs, and $I_{OUT(RMS)}$ is the RMS or DC output current being supplied to the load.

The maximum amount of power that can be dissipated in the device is dependent on ambient temperature and heatsinking.

Note that $R_{DS(ON)}$ increases with temperature, so as the device heats, the power dissipation increases.

SOT23-6 Package outline & PCB layout design

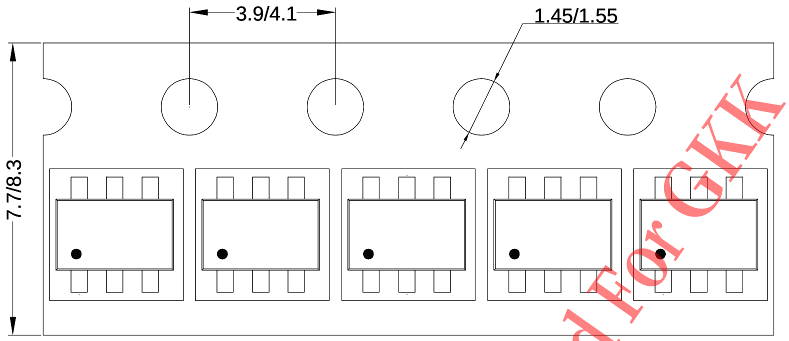


Notes: All dimensions are in millimeters.
All dimensions don’t include mold flash & metal burr.

Taping & Reel Specification

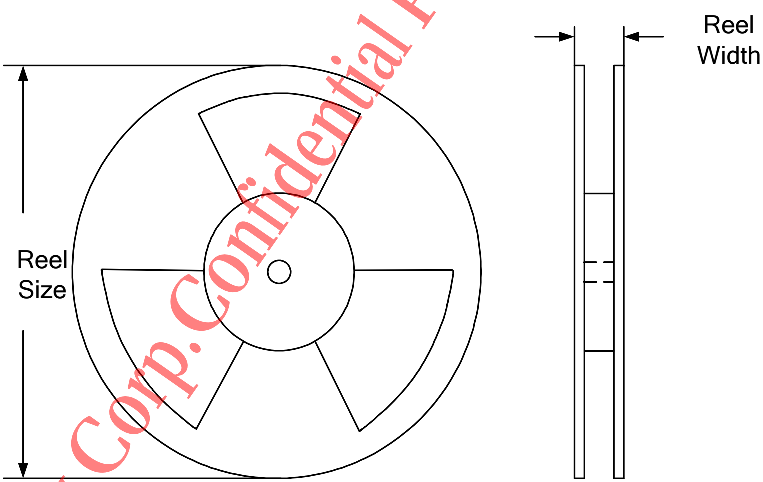
1. Taping orientation

SOT23-6



Feeding direction →

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
SOT23-6	8	4	7"	8.4	280	160	3000

3. Others: NA

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