Application Note: SY67134

Medium Voltage H-Bridge IC

General Description

The SY67134 is a H-bridge motor driver solution for motion-control applications. 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 SY67134 operates with a power-supply voltage range from 5V to 40V, and 3.6A maximum output current. To be compatible with industry-standard devices, the SY67134 uses the PWM input interface. The SY67134 also provides over current protection, under voltage lockout and thermal shutdown protection. The device is packaged in SO8E.

Ordering Information

SY67134 □(□□)□

- Temperature Code
- Package Code
- Optional Spec Code

Ordering Number	Package type	Note
SY67134FCC	SO8E	

Features

- Power Supply Voltage Range from 5V to 40V
- 3.6A Maximum Drive Current
- H-bridge Motor Driver
- PWM Interface
- Low Power Standby Mode with Less than 15μA Supply Current
- Internal Over Current Protection, Under Voltage Lockout and Thermal Shutdown
- Automatic Fault Recovery
- Synchronous Rectification
- Compact Package: SO8E

Applications

- Consumer Products
- Robotics

Typical Application

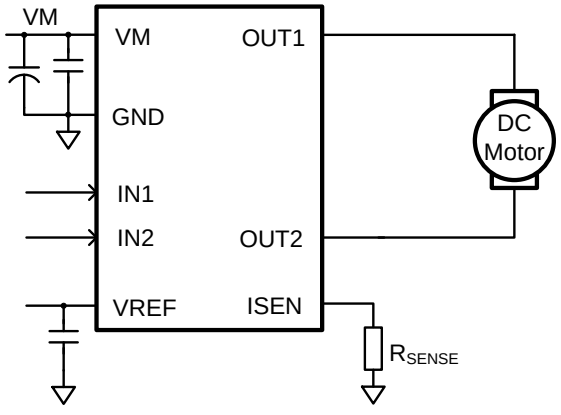
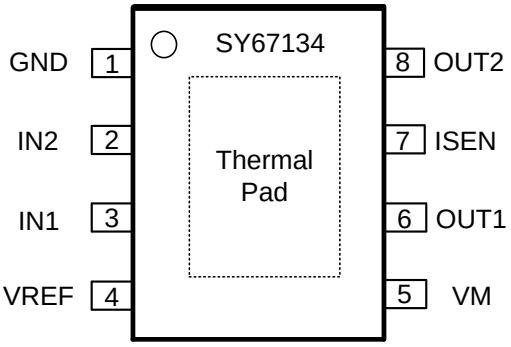


Figure1. Typical Application Circuit

Pin out (Top View)



(SO8E)

Top Mark: CFX*xyz* (device code: **CFX**, ***x=year code, y=week code, z= lot number code)***

Name	Number	Description
GND	1	Ground pin.
IN2	2	Logic input 2 pin. Logic high set OUT2 High, this pin has an internal pull-down resistor.
IN1	3	Logic input 1 pin. Logic high set OUT1 High, this pin has an internal pull-down resistor.
VREF	4	Current regulator voltage reference. I_{CHOP}=VREF/10/R_{SENSE}. Decouple this pin to GND with at least 0.1uF ceramic capacitor.
VM	5	Power supply pin. Decouple this pin to GND with 10uF ceramic cap and sufficient electronic capacitor.
OUT1	6	Output 1 pin. Connect this pin to motor winding.
ISEN	7	Current sense resistor connection 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

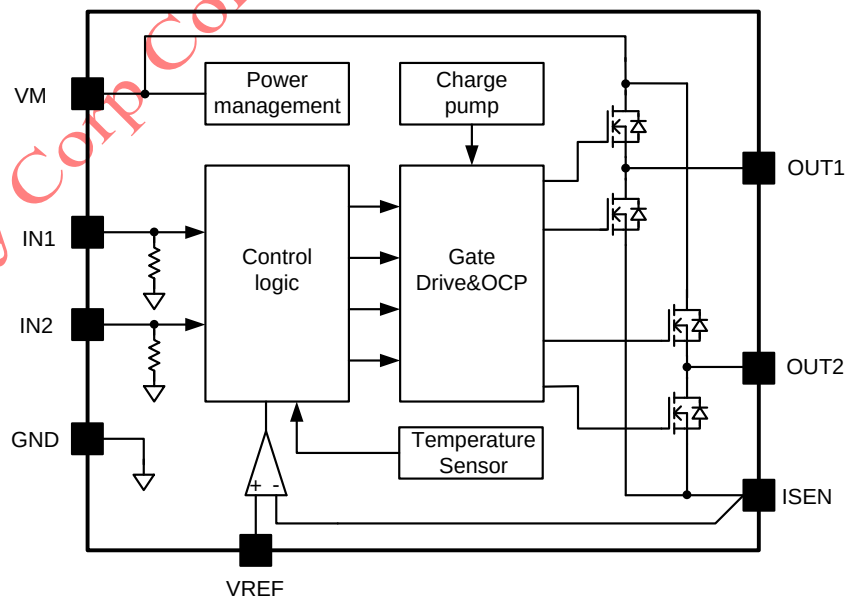


Figure2. Block Diagram

Absolute Maximum Ratings (Note 1)

VM, OUT1, OUT2 ---------- -0.3V to 40V
IN1, IN2 ---------- -0.3V to 6V
VREF ---------- -0.3V to 4V
ISEN---------- -0.3V to 4V
Junction Temperature (T_J) ---------- -40℃ to +150℃
Storage Temperature ---------- -55℃ to +150℃
Package Thermal Resistance
θ_{JA} (Note 2) ---------- 62℃/W
θ_{JC} (Note 2) ---------- 20℃/W

Recommended Operating Conditions

VM, OUT1, OUT2 ---------- 5V to 32V
IN1, IN2 ---------- 0V to 5V
VREF ---------- 0V to 3.3V
ISEN---------- -0.3V to 0.3V
R_{SENSE}----------less than 100mΩ
Logic Input PWM Frequency ---------- 0Hz to 100 kHz
H-Bridge Output Current (Note3) ---------- 0 to 3.6A
Junction Temperature Range ---------- -40℃ to 125℃
Ambient Temperature Range ---------- -40℃ to 85℃

Electrical Characteristics

(T_A = 25℃, V_M=24V, unless otherwise specified)

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Power Supply						
Supply Voltage Range	V_M		5		32	V
Under Voltage Threshold	V_{UVLO_TH}	V_M Rising		4.7	5	V
Under Voltage Hysteresis	V_{UVLO_HYS}			200		mV
VM Operating Supply Current	I_{IN}	Low power standby mode			15	μA
		<30kHz PWM, OUTx float			3	mA
Logic Level Input						
Input Low Voltage	V_{IL}				0.5	V
Input High Voltage	V_{IH}		1.5			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}				500	mΩ
Off-State Leakage Current	I_{OFF}				±500	nA
Dead time	T_D	(Note 4)			500	ns
Current Regulation						
Current Regulation Reference Voltage	V_{REF}	Use external voltage as VREF	0.1		3	V
Current Gain	A_V	VREF/I_{CHOP}, VREF=2V	9.5		10.5	V/V
Blank Time	T_{BLANK}		1	2	3	μs
Constant Off-time	T_{OFF}		12	24	35	μs
Timing						
Time to Standby Mode	T_{ESTB}	IN1=IN2< V_{IL}, (Note 4)		1		ms
Protection						
Output Over Current Limit	I_{OCP}		3.65	4.5	5.5	A
OCP Regulate Time	t_{REG}	(Note 4)		1.5		μs
OCP Retry Time	t_{RTY}	(Note 4)		3		ms
Thermal Shutdown Temperature	T_{SD}	(Note 4)		165		℃
Thermal Shutdown Hysteresis	T_{HYS}	(Note 4)		30		℃

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

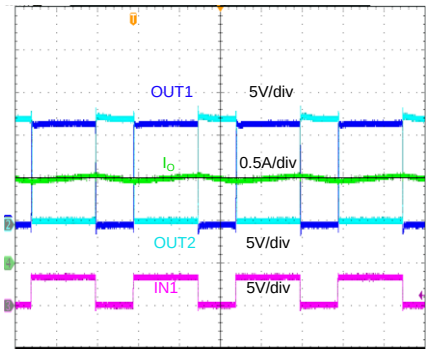
Note 2: θ_{JA} is measured in the natural convection at T_A = 25℃ on a two- layer SILERGY Evaluation Board.

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

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

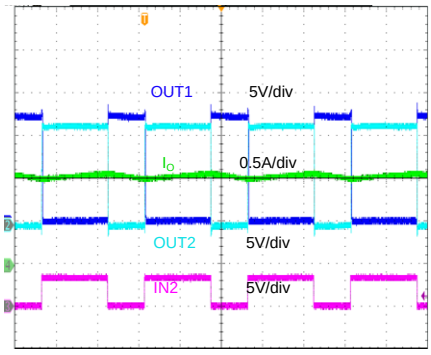
Typical Performance Characteristics

Operation Waveform
(VM=12V, Io=1A, IN1=PWM)



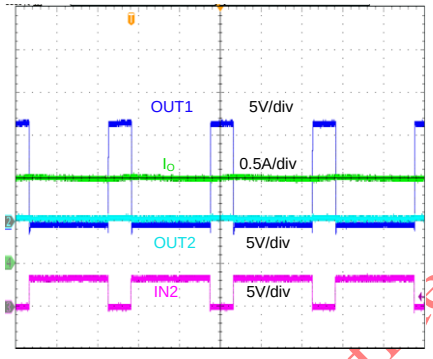
Time (20μs/div)

Operation Waveform
(VM=12V, Io=1A, IN2=PWM)



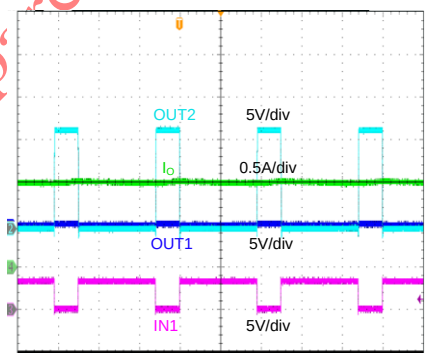
Time (20μs/div)

Operation Waveform
(VM=12V, Io=1A, IN2=PWM, IN1=High)



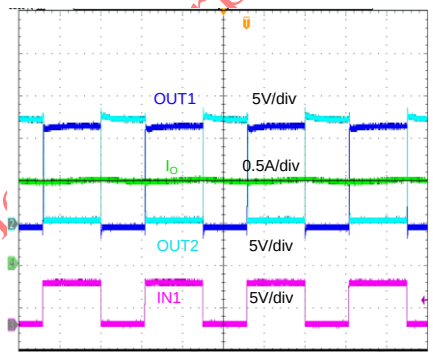
Time (20μs/div)

Operation Waveform
(VM=12V, Io=1A, IN1=PWM, IN2=High)



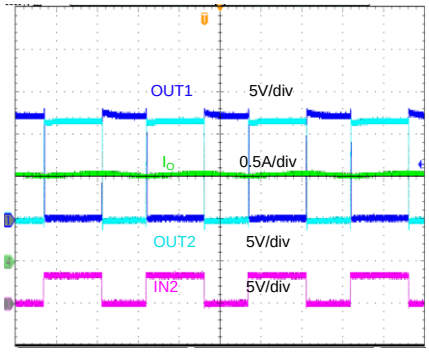
Time (20μs/div)

Operation Waveform
(VM=12V, Io=1A, IN1=IN2)



Time (20μs/div)

Operation Waveform
(VM=12V, Io=1A, IN2=IN1)



Time (20μs/div)

Functional Description

H-Bridge Control

The bridge is controlled by a PWM input interface, and the following table shows the control logic of the device:

Table 1. Truth Table

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 will be active 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. Any PWM commands are issued to the device, before the IC comes out of standby mode, the charge pump should be allowed to reach its regulated voltage (a maximum delay of 200us).

Current Regulation

When voltage of the current sense resistor is equals to the comparator trip value, the IC will enter into mix decay mode. The IC decays the current at fixed off time of 24us. The PWM chopping current is set by a comparator which compares the voltage across a current sense resistor connected to the ISEN pin with a reference voltage.

The chopping current is calculated in Equation 1.

$$I_{CHOP} = \frac{VREF}{10 \times R_{SENSE}} \quad (1)$$

Example:

If a 0.05Ω sense resistor is used, and VREF=1V, the chopping current will be 1V/10/0.05 Ω = 2A.

Once the chopping current threshold is reached, the H-bridge will switch to decay mode. At the beginning of decay, the motor runs at fast decay, then the motor runs at slow decay.

Note that if current control is not needed, the ISEN pin should be connected to ground directly.

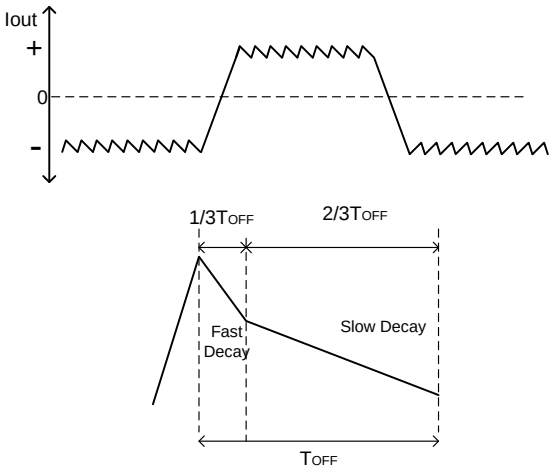


Figure 3. Current Regulation and Decay timing

Synchronous Rectification

When the current regulation is triggered, load current will recirculate. The IC turn on the MOSFETs, and short the body diode. This helps to lower the power disspation. When a zero current is detected, the synchronous rectification will be turn off to prevent reversal of the load current.

Protection Circuits

The device is fully protected against under voltage, over current and thermal shutdown.

Over Current Protection (OCP)

An analog current limit circuit on each FET limits the current through the FET. If this analog current limit persists for longer than the OCP regulation time, all FETs in the H-bridge will be disabled. The driver will be re-enabled after the OCP retry period (t_{RTY}) passed. If the fault condition is still present, the cycle will repeat. If the fault is no longer present, normal operation will resume.

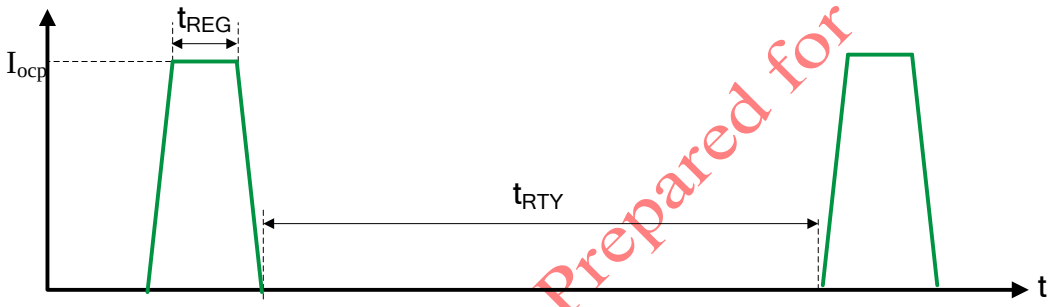


Figure 4. OCP schematic

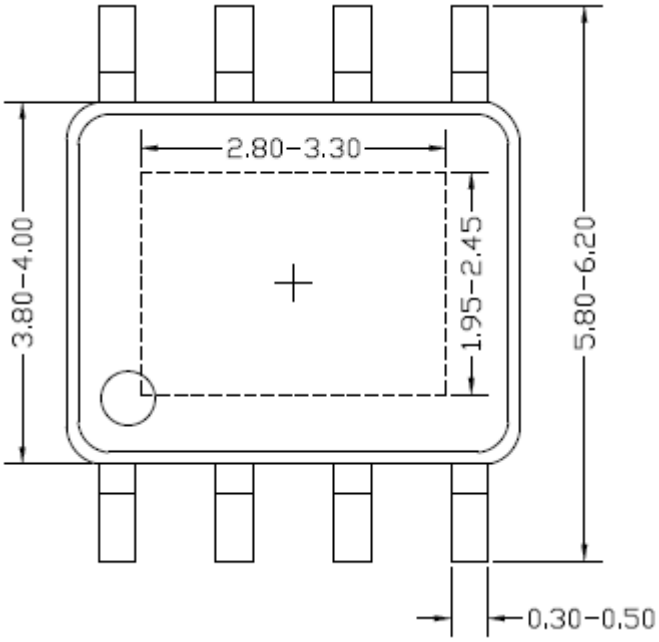
Under Voltage Lockout (UVLO)

If at any time the voltage on the VM pin falls below the under voltage lockout threshold voltage, all circuitry in the device will be disabled and internal logic will be reset. Operation will resume when VM rises above the UVLO threshold.

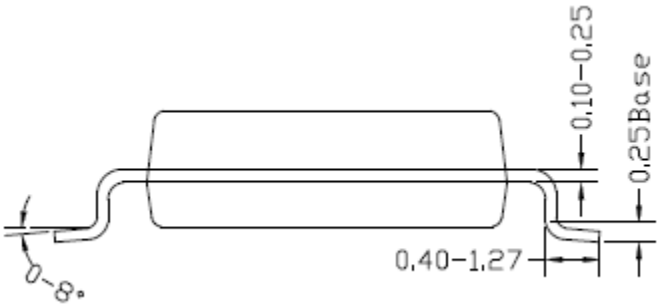
Thermal Shutdown Protection (TSD)

The device has thermal shutdown as described in the Protection Circuits section. If the die temperature exceeds approximately 165℃, the device will be 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 a too high ambient temperature.

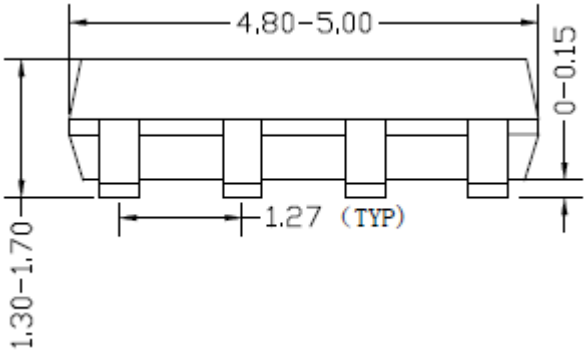
SO8E Package Outline & PCB layout



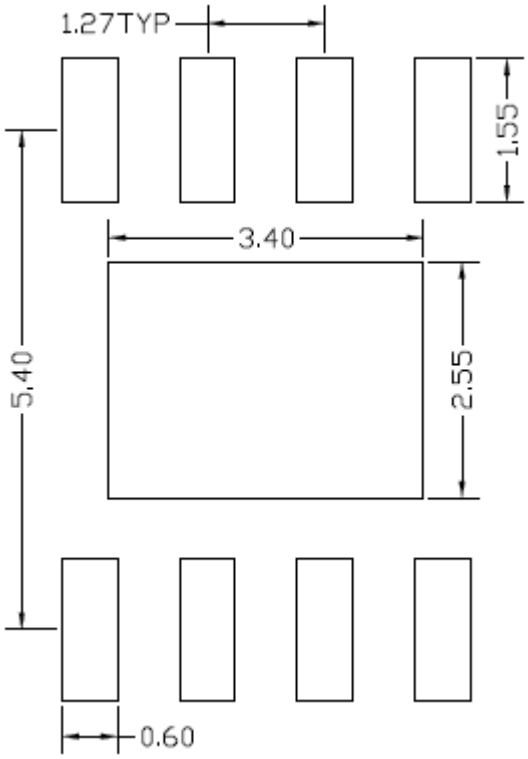
Top view



Side view



Front view



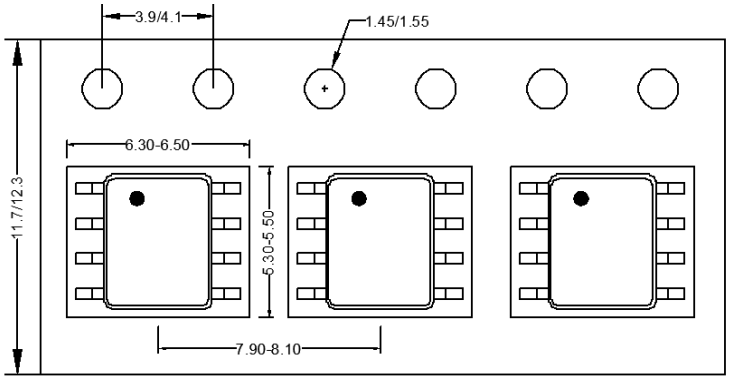
Recommended PCB Layout (Reference Only)

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

Taping & Reel Specification

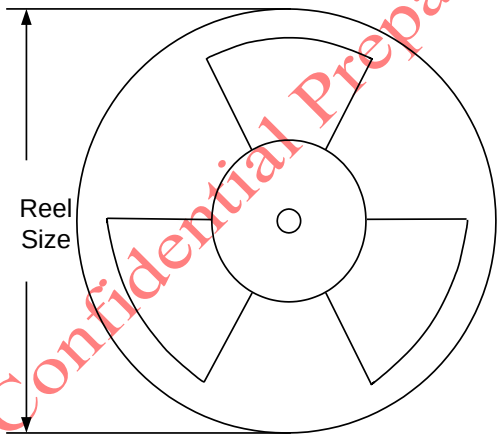
1. Taping orientation

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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