

Features

- 17-V H-bridge Driver
- MOSFET On-resistance $R_{ds(on)}$ HS + LS 0.85 Ω
- 0.5-A Max Output Current
- Supports 3-V to 17-V Operating Supply Voltage
- Support 3.3-V, 5-V PWM (IN1/IN2) interface
- Protection
 - Undervoltage Lockout (UVLO)
 - Over-Current Protection (OCP)
 - Thermal Shutdown (TSD)
- Small Package Footprint
 - SOT23-6 Package

Description

The TPM16050 is a high-voltage H-bridge driver dedicated for IR-CUT control in surveillance camera. It is optimized to control the IR-CUT with 20 Ω impedance and 3.3V, 5V or 12V supply voltage. It can provide up-to 0.5-A drive current. TPM16050 can sustain max 17V supply voltage.

It also supports an external 26.9 Ω /2.5W resistor in serial of supply pin VM, in order to protect low-voltage loads such as IR-CUT from voltage over-stress with 12V supply.

Internal protection features such as overcurrent protection, short circuit protection undervoltage lockout and over temperature improve reliability of the whole system.

Applications

- Surveillance Cameras
- E-Lock
- Consumer devices
- Toys

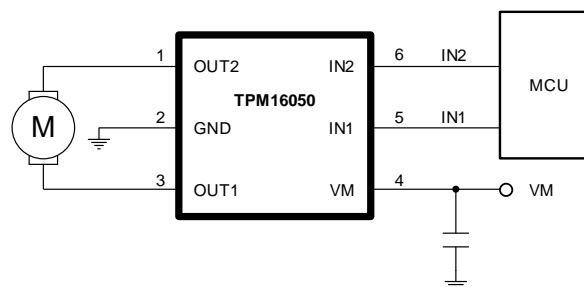


Figure 1 Application Diagram with Direct Supply

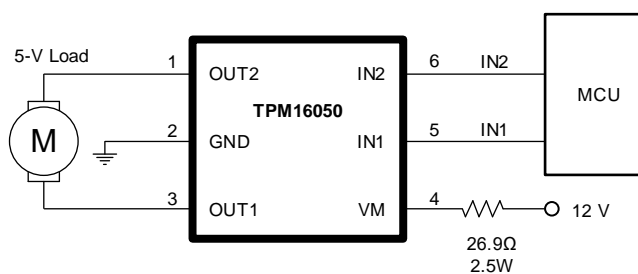


Figure 2 Application Diagram with Power Resistor Ballasting

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Revision History

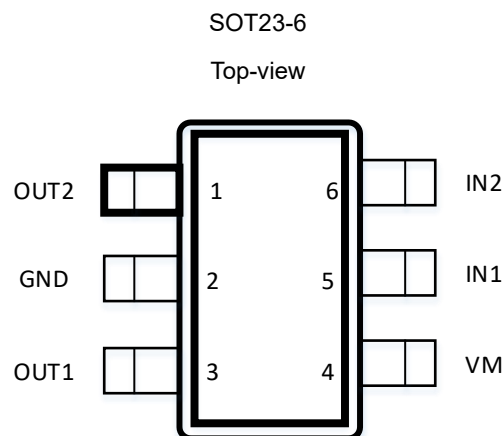
Date	Revision	Notes
2020/02/02	1.0	Release

Order Information

Order Number	Operating Temperature Range	Package	Marking Information	MSL	Transport Media, Quantity
TPM16050-S6TR	-40 °C – 125 °C ⁽¹⁾	SOT23-6	M65	MSL3	3000

(1) Ambient temperature indicates device operation condition. Application thermal behavior needs to be taken care of when operating in high temperature scenarios.

Pin Configuration and Functions



Pin Functions

Pin		I/O	Description
VM	4	Power	Device supply
IN1	5	Input	Bridge input 1
IN2	6	Input	Bridge input 2
OUT1	3	Output	H-Bridge output 1
OUT2	1	Output	H-Bridge output 2
GND	2	Ground	Device ground

Absolute Maximum Ratings ^{Note 1}

Parameters	Rating
Supply voltage, VM	-0.3 V to 18 V
Outputs, OUT1, OUT2	-0.3 V to 18 V
Digital Input Voltage, IN1, IN2	-0.3 V to 6 V
Peak output current	Internally limited
Continuous motor drive output current	0.5 A
Output Short-Circuit Duration ^{Note 3}	Infinite
Maximum Junction Temperature	150°C
Operating Junction Temperature Range	-40 to 150 °C
Storage Temperature Range	-65 to 150 °C
Lead Temperature (Soldering, 10 sec)	260 °C

Note 1: Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. Exposure to any Absolute Maximum Rating condition for extended periods may affect device reliability and lifetime.

Note 2: The inputs are protected by ESD protection diodes to each power supply. If the input extends more than 300mV beyond the power supply, the input current should be limited to less than 10mA.

Note 3: A heat sink may be required to keep the junction temperature below the absolute maximum. This depends on the power supply voltage and how many amplifiers are shorted. Thermal resistance varies with the amount of PC board metal connected to the package. The specified values are for short traces connected to the leads.

Note 4: Power dissipation and thermal limits must be observed.

ESD Rating

Symbol	Parameter	Condition	Minimum Level	Unit
HBM	Human Body Model ESD	ANSI/ESDA/JEDEC JS-001	±2	kV
CDM	Charged Device Model ESD	ANSI/ESDA/JEDEC JS-002	±1	kV

Thermal Information

Package Type	θ_{JA}	θ_{JC}	Unit
SOT23-6	129	67	°C/W

Electrical Characteristics

All test condition is $V_M = 12\text{ V}$, $T_A = -40^\circ\text{C} - 125^\circ\text{C}$, unless otherwise noted.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Power Supply						
V _M	V _M operating voltage		2.9		17	V
I _{VMQ}	V _M quiescent supply current	IN1/IN2 low, no load		450	680	μA
V _{UVLO}	V _M under voltage lockout	V _M rising		2.75	2.9	V
		V _M falling	2.4	2.55		
Input Characteristics						
V _{IL}	Input low voltage				0.8	V
V _{IH}	Input high voltage		2.2			V
I _{IL}	Input low current	V _{IN} = 0 V	-5		5	μA
I _{IH}	Input high current	V _{IN} = 3.3 V			50	μA
R _{PD}	Pull-down resistance			100		kΩ
H-Bridge FETs						
R _{DS(ON)}	HS+LS FET ON resistance	V _M = 12V, I _O = 250 mA, T _A = 25 °C		0.85		Ω
		V _M = 5V, I _O = 250 mA, T _A = 25 °C		0.85		
		V _M = 3.3V, I _O = 250 mA, T _A = 25 °C		1		
I _{OFF}	OFF-state leakage current			10		μA
Protection Circuits						
I _{OCP}	Overcurrent protection trip level	T _A = 25 °C	0.8	1	1.6	A
t _{DEG}	Overcurrent deglitch time			1		μs
t _{OCR}	Overcurrent protection retry time			1		ms
t _{DEAD}	Output dead time			100		ns
T _{SD}	Thermal shutdown temperature	Die temperature	150	160	180	°C
Timing						
t ₇	Output enable time	R _L = 20 Ω			300	ns
t ₈	Output disable time	R _L = 20 Ω			300	ns
t ₉	Delay time, INx high to OUTx high	R _L = 20 Ω			160	ns
t ₁₀	Delay time, INx low to OUTx low	R _L = 20 Ω			160	ns
t _R	Output rise time	R _L = 20 Ω	30		188	ns
t _F	Output fall time	R _L = 20 Ω	30		188	ns

Typical Performance Characteristics

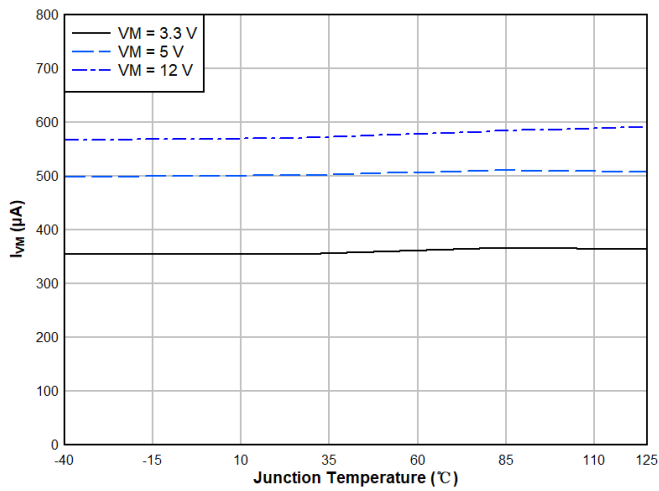
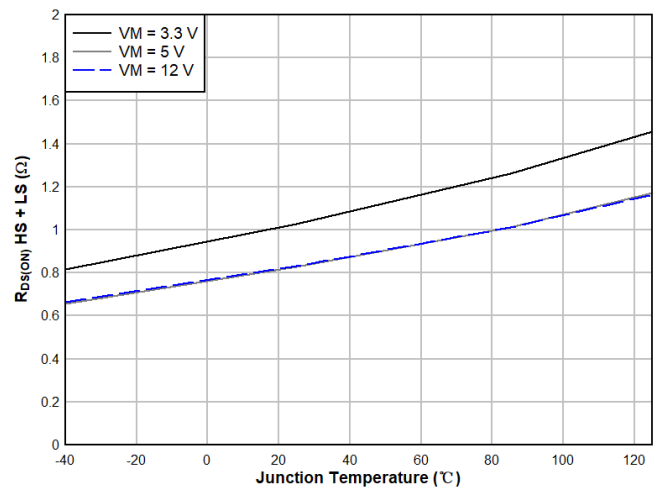
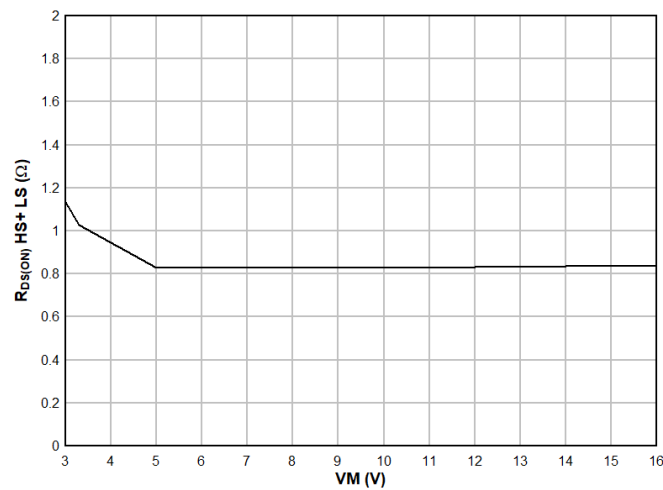


Figure 3. Supply current vs Ambient Temperature


Figure 4. HS + LS $R_{DS(ON)}$ vs Ambient Temperature

Figure 5. HS + LS $R_{DS(ON)}$ vs Ambient Temperature

Detailed Description

Overview

The TPM16050 provides a dedicated driver solution for IR-CUT application in surveillance cameras. The device has one H-bridge driver and can drive IR-CUT to move its filters in both directions. The device works with 3-V to 17-V supply. The device uses IN/IN interface. Protection features include

- Overcurrent protection
- Short circuit protection
- Over-temperature protection.
- Under-voltage lockout

Functional Block Diagram

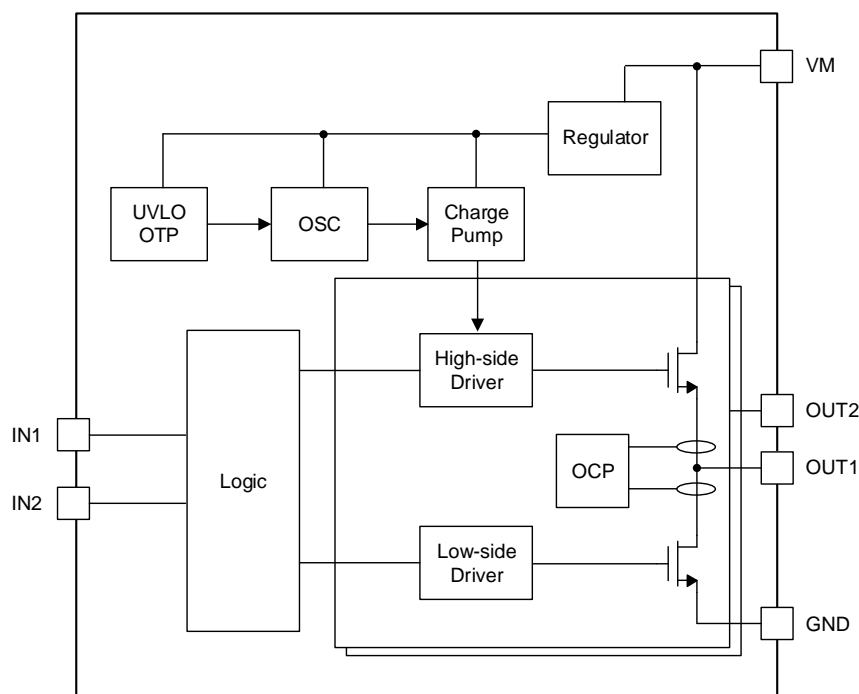


Figure 6 Functional Block Diagram

Feature Description

Timing

- All logic inputs have a deglitch circuitry to prevent noise from affecting the output state. The input deglitch time is around 100ns.
- The output slew delay time is the delay contributed by gate drivers. In order to control the output rise/fall time, the gate drive limits the slew rate of gate voltage of output FETs. Typical slew delay time is around 50ns.
- The rise and fall time of the outputs depend on VM voltage and load conditions, and are controlled slowly to reduce EMI. Typical rise and fall time are 100ns.
- The dead time is measured as the time when OUTx is Hi-Z between turning off one of the H-bridge FETs and turning on the other. When sourcing current out of the pin, the output falls to one diode drop below ground during dead time. When sinking current into the pin, the output rises to one diode drop above VM. The typical dead time is 100ns.
- The propagation time is measured as the between an input edge to an output change. This time is the sum of the input deglitch time, output slew delay, and output rise/fall time. The propagation time is around 350ns.

- It is recommended to keep IN1/IN2 to GND upon powering up to ensure clean start.

Bridge Control

The TPM16050 uses IN/IN mode to control H-bridge:

IN1	IN2	OUT1	OUT2	Function
0	0	Z	Z	Coast
0	1	L	H	Reverse
1	0	H	L	Forward
1	1	L	L	Brake

The highside driver has a weak internal pull-up to VM during Hi-Z state.

Protections

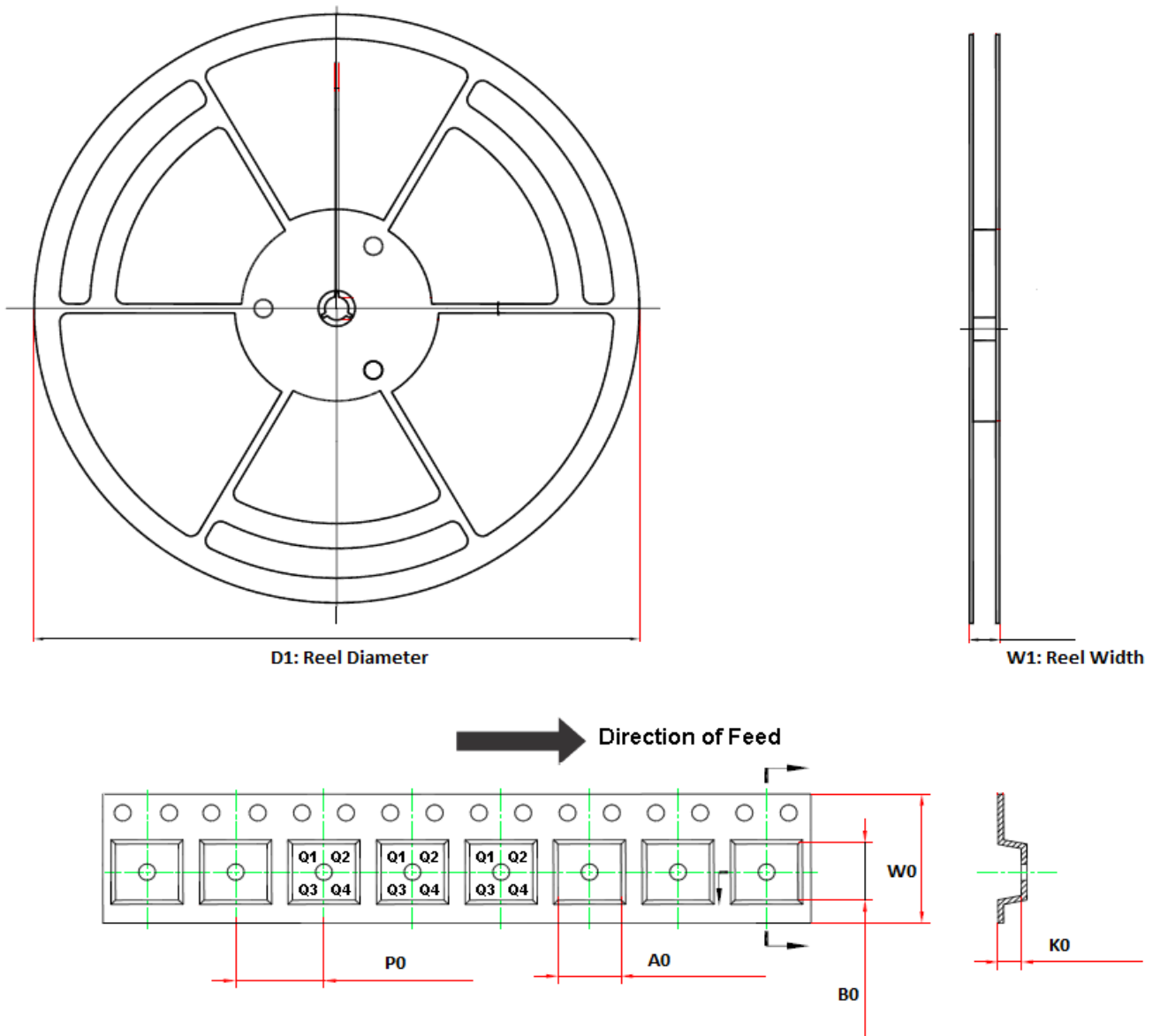
- Over-current protection (OCP): All FETs are protected by current limit circuitry. Whenever the channel current of anyone of FETs exceeds overcurrent protection trip level, I_{OCP} , and persists for longer than the overcurrent deglitch time, t_{DEG} , the H-bridge is disabled. After about 1ms, t_{OCR} , all bridges are re-enabled automatically.
- Short-circuit protection: thanks to the OCP function, the device is protected from OUT1 to OUT2 short-circuit, OUT1/OUT2 to ground short-circuit, and OUT1/OUT2 to VM short-circuit. When short-circuit occurs, no damage on IC and IR-CUT,
- Thermal shutdown (TSD): If the die temperature exceeds safe limits, all FETs in the H-bridge disable. Operation automatically resumes once the die temperature falls to a safe level.
- Under-voltage lockout (UVLO): If at any time the voltage on the VM pins falls below the under-voltage lockout threshold voltage, all circuitry in the device disable, and internal logic resets. Operation resumes when VM rises above the UVLO threshold.

Fault	Condition	Error Report	H-bridge	Internal circuits	Recovery
VM UVLO	$VM < UVLO$	None	Disabled	Disabled	$VM > UVLO$
Overcurrent (OCP)	$I_{OUT} > I_{OCP}$	None	Disabled	Operating	t_{OCR}
Thermal shutdown (TSD)	$T_J > T_{SD}$	None	Disabled	Operating	$T_J < T_{SD} - T_{HYS}$

Device Functional Modes

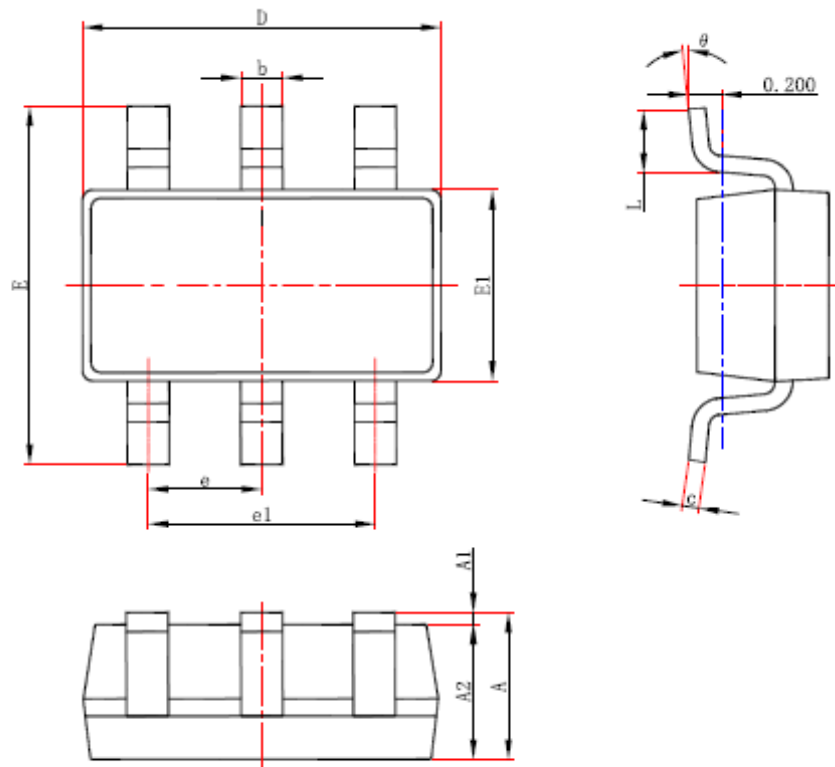
Operating Mode	Condition	H-Bridge	Internal Circuits
Operating	$VM > UVLO$	Operating	Operating
Sleep Mode	$VM = 0V$	Disabled	Disabled
Fault encountered	Any fault conditions met	Disabled	See previous table

Tape and Reel Information



Order Number	Package	D1	W1	A0	B0	K0	P0	W0	Pin1 Quadrant
TPM16050-S6TR	6-Pin SOT23	178.0	12.3	3.2	3.2	1.4	4.0	8.0	Q3

Package Outline Dimensions



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E1	1.500	1.700	0.059	0.067
E	2.650	2.950	0.104	0.116
e	0.950(BSC)		0.037(BSC)	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

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