

Features

- 1-A Rated Drain Current (Per Channel)
- Very Low Output Leakage < 20 nA Per Channel
- Power Efficient with Low R_{DS-on}
- Extended Temperature Range: $T_A = -40^{\circ}\text{C}$ to 125°C
- High-Voltage Outputs 50 V
- Compatible with 1.8-V to 5.0-V Logic Interface
- Integrated Free-wheeling Diodes for Inductive Load
- Improved Noise-immunity with integrated RC filter
- ESD Protection Exceeds JESD 22 – 2.5-kV HBM, 1.5-kV CDM
- Available in 10-pin MSOP-10 Package

Description

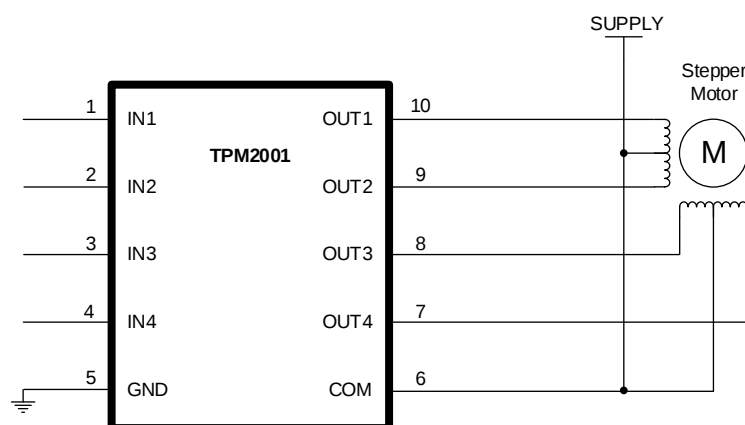
The TPM2001 is a high-voltage, high-current NMOS transistor array. This device consists of seven channels of low-side NMOS transistors with high-voltage outputs and free-wheeling diode for inductive loads.

The maximum drain-current rating of a single NMOS channel is 1 A. The device supports wide I/O voltage range from 1.8 V to 5 V. The transistors can be paralleled for higher current capability.

The TPM2001 can replace traditional Bipolar Darlington arrays with better thermal efficiency and reliability.

Applications

- Inductive Loads
 - Relays
 - Unipolar Stepper & Brushed DC Motors
 - Solenoids & Valves
- LED Indicators
- Logic Level Shifting
- Gate & IGBT Drive



Typical Application Diagram

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Revision History

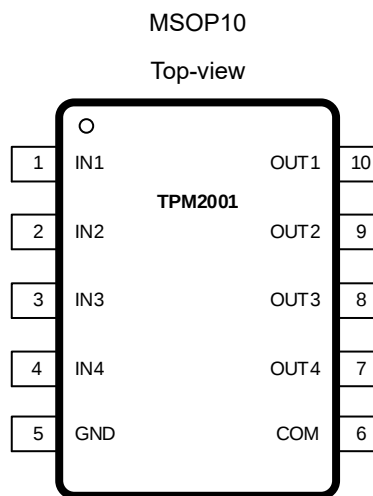
Date	Revision	Notes
2021/04/20	Rev A	Initial Release

Order Information

Order Number	Operating Ambient Temperature Range	Package	Marking Information	MSL	Transport Media, Quantity
TPM2001-VS2R	-40 °C – 125 °C ⁽¹⁾	MSOP-0	M201	MSL3	3000

(1) Ambient temperature indicates device operation condition range. 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
COM	6	Power	Device supply voltage, should be tied above 4.5V.
GND	5	Ground	Device ground
IN1	1	Input	Logic Input. High-active to pull down OUT1
IN2	2	Input	Logic Input. High-active to pull down OUT2
IN3	3	Input	Logic Input. High-active to pull down OUT3
IN4	4	Input	Logic Input. High-active to pull down OUT4
OUT1	10	Output	Low-side driver output, IN1 high to pull down OUT1
OUT2	9	Output	Low-side driver output, IN2 high to pull down OUT2
OUT3	8	Output	Low-side driver output, IN3 high to pull down OUT3
OUT4	7	Output	Low-side driver output, IN4 high to pull down OUT4

Absolute Maximum Ratings¹

Parameters	Rating
Power Supply Voltage, COM	-0.3 V to 55 V
Output Voltage Range OUT1 – OUT4	-0.3 V to 55 V
Input Voltage Range IN1 – IN4	-0.3 V to 30 V
Continuous output channel current OUT1 – OUT4	1 A
Continuous ground current GND-pin	2 A
Operating Junction Temperature Range	-40 °C to 150 °C
Storage Temperature Range	-65 °C 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 300 mV beyond the power supply, the input current should be limited to less than 10mA.

Note 3: 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	±2.5	kV
CDM	Charged Device Model ESD	ANSI/ESDA/JEDEC JS-002	±1.5	kV

Recommended Operation Conditions Note 1

Parameters	Rating
Power Supply Voltage, COM	4.3 V to 50 V
Output Voltage Range OUT1 – OUT4	0 V to 50 V
IN logic low voltage	0.9 V
IN logic high voltage	1.5 V
Continuous output current OUT1-OUT4	1 A
Operating Ambient Temperature Range	–40 °C to 125 °C

Thermal Information

Package Type	θ_{JA}	θ_{JC}	Unit
MSOP-10	125	48.96	°C/W

Electrical Characteristics

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{UVLO}	COM Under-voltage Lock-Out Threshold	$INx = 0\text{ V}$;	2.1	3.5	4.3	V
V_{DS}	OUT1–OUT7 low-level output voltage	$INx = 5\text{ V}$; $I_{OUTx} = 200\text{ mA}$		100		mV
		$INx = 5\text{ V}$; $I_{OUTx} = 400\text{ mA}$		210		
		$INx = 5\text{ V}$; $I_{OUTx} = 700\text{ mA}$		400		
I_{DS-OFF}	Off-state output leakage current	$INx = 0\text{ V}$; $V_{OUTx} = 12\text{ V}$		20	1000	nA
V_{FWD}	Clamp forward voltage	$I_F = 750\text{ mA}$		1.217		V
$V_{IN(H)}$	Input high threshold	$OUTx = L$			1.5	V
$V_{IN(L)}$	Input low threshold	$OUTx = H$	0.9			V
$I_{IN(ON)}$	IN1–IN7 input on-state current	$INx = 1.5\text{ V to }5\text{ V}$			20	μA
$I_{IN(OFF)}$	IN1–IN7 input off-state current	$INx = 0\text{ V}$			20	μA
I_{COM}	Quiescent supply current	$INx = 0\text{ V}$; $V_{OUTx} = 12\text{ V}$		15	500	μA
I_{COM}	Active supply current	$INx = 5\text{ V}$; $V_{OUTx} = 0\text{ V}$		50	500	μA
t_{PLH}	Propagation delay time, LOW to HIGH	$V_{INx} = 5\text{ V}$; $V_{pull-up} = 12\text{ V}$; $R_{pull-up} = 48\Omega$		350		ns
t_{PHL}	Propagation delay time, HIGH to LOW	$V_{INx} = 5\text{ V}$; $V_{pull-up} = 12\text{ V}$; $R_{pull-up} = 48\Omega$		350		ns
T_{OTP}	Thermal Shutdown Threshold	$INx = 0\text{ V}$;		165		$^{\circ}\text{C}$

Typical Performance Characteristics

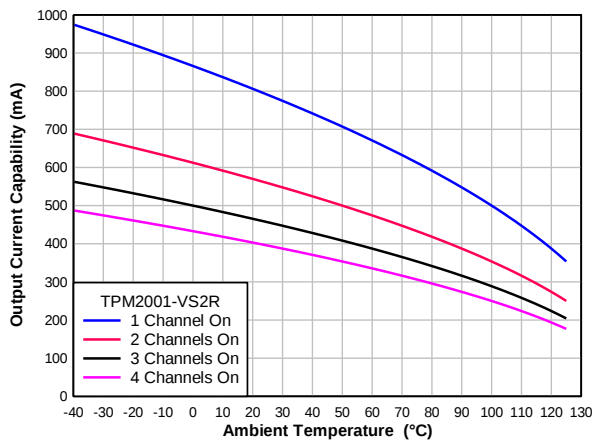


Figure 1. Output Current Capability vs. Ambient Temperature

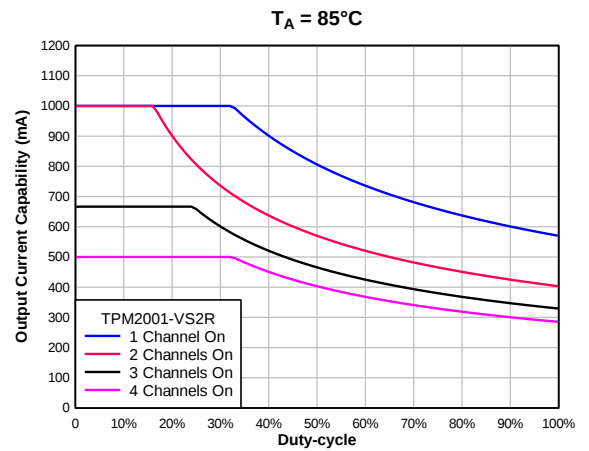


Figure 2. Output Current Capability vs. Duty-cycle, $T = 85^\circ\text{C}$

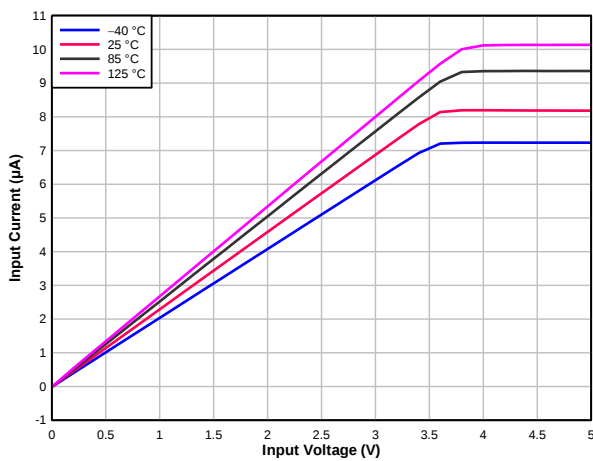


Figure 3. Input Current vs. Input Voltage

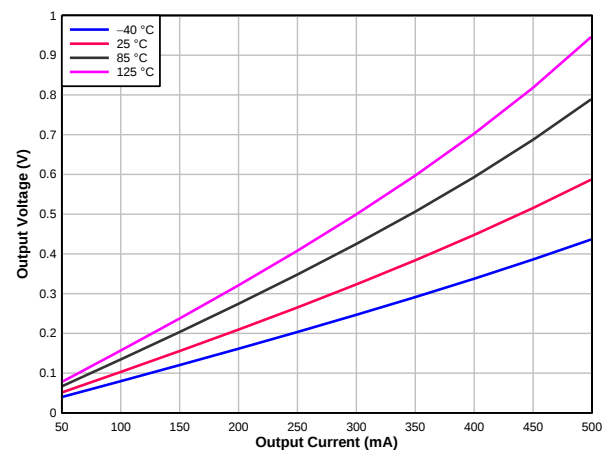


Figure 4. Output Voltage vs. Output Current

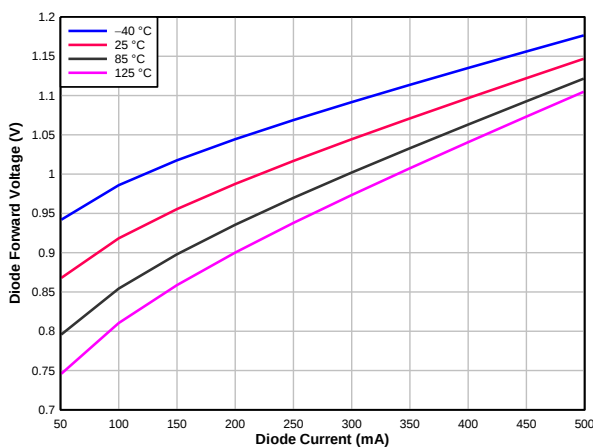


Figure 5. Output Diode Forward Voltage Drop vs. Diode Current

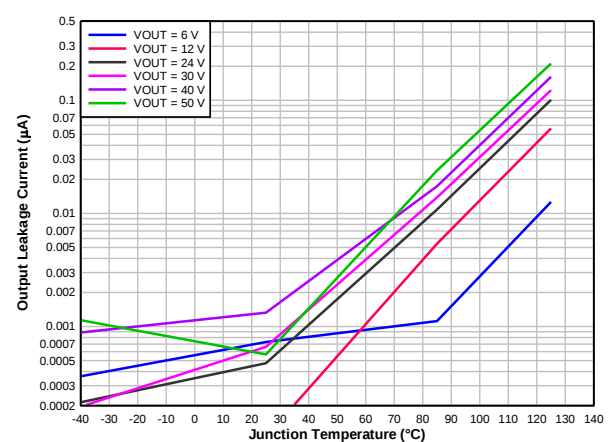


Figure 6. Output Leakage Current vs. Temperature

INX = 0 V

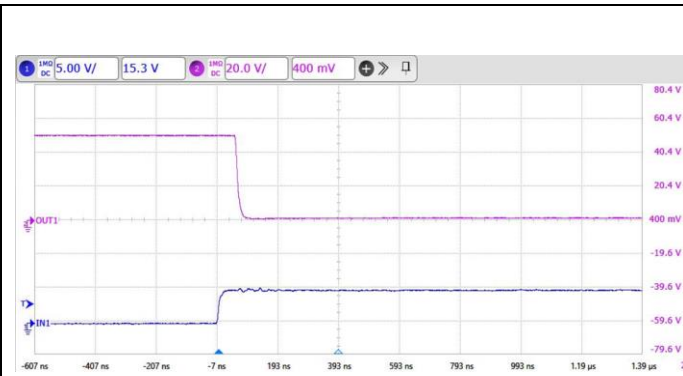


Figure 7. Output Falling Edge

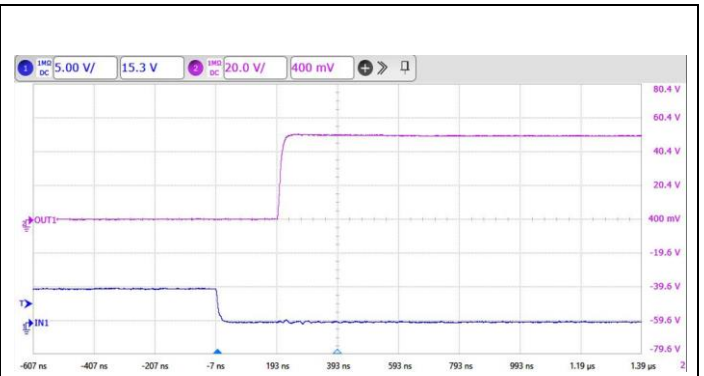


Figure 8. Output Rising Edge

Detailed Description

TPM2001 is a 4-ch low-side driver array. It consists of 4 channels of high-voltage low-side MOSFET. Its outputs can drive inductive loads, such as solenoids, relays, motors and lamps up to 1 A per channel with wide temperature range. Multiple channels can be paralleled to increase driving capabilities or reduce thermal dissipation.

TPM2001 has various benefits to increase system robustness and ease of use. It can replace discrete bipolar components and various version of bipolar-based Darlington arrays.

The input pins support a wide range of voltage ratings from 1.8V logic, TTL logic up to 30V voltage rail. With integrated noise-filter, the INx inputs improve system robustness in support robust industrial environment. The CMOS input gates can support modern microcontrollers without the needs of current sourcing capabilities on microcontroller GPIOs.

Integrated over temperature protection and under-voltage lock out protection provides advanced robustness to the system comparing to older generation of Darlington arrays. It is required that COM connected to a supply voltage higher than 4.3V.

The device also supports a wide ambient temperature range (−40°C to 125°C)

Functional Block Diagram

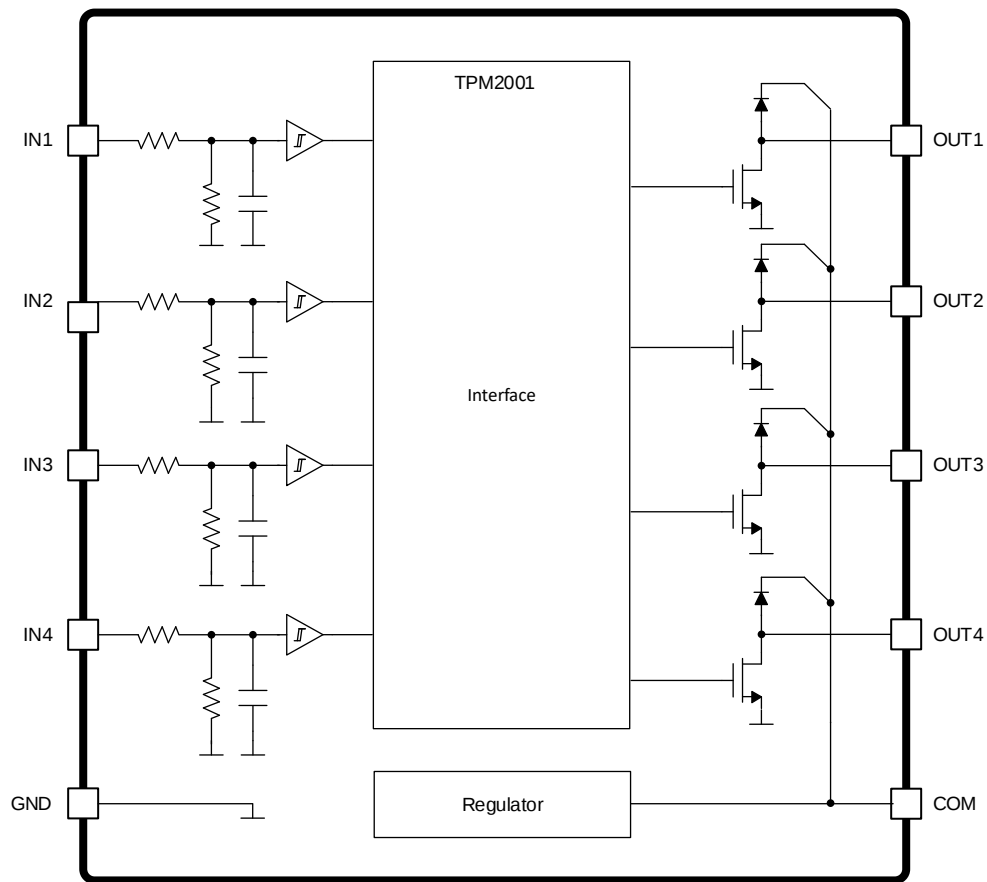


Figure 9 Functional Block Diagram

Feature Description

For each channel, input pin INx controls the output. When INx is logic HIGH, the output transistor is ON. When INx is logic LOW, the output transistor is OFF. The devices use power from COM pin to bias internal circuits with internal low-dropout linear regulator. The power transistor delivers current with low $R_{DS(ON)}$ to improve system-level efficiency. To improve system level reliability, TPM2001 has integrated R-C filter.

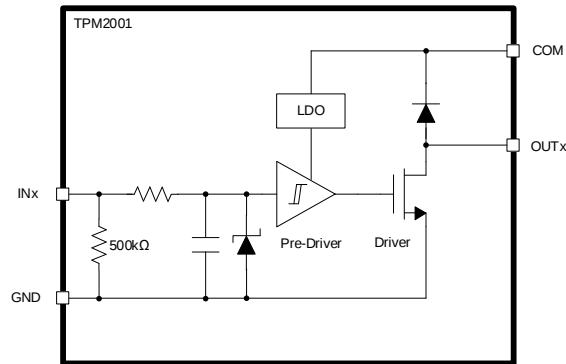
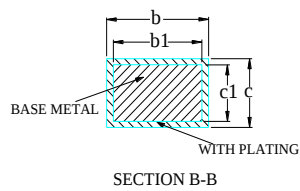
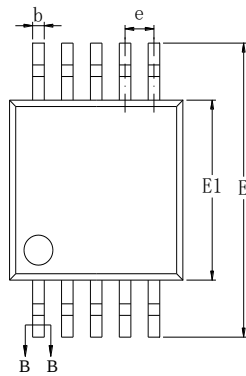
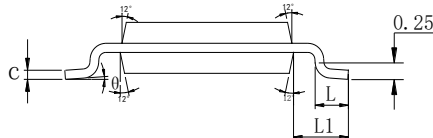
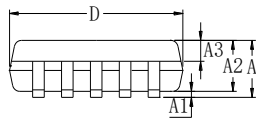


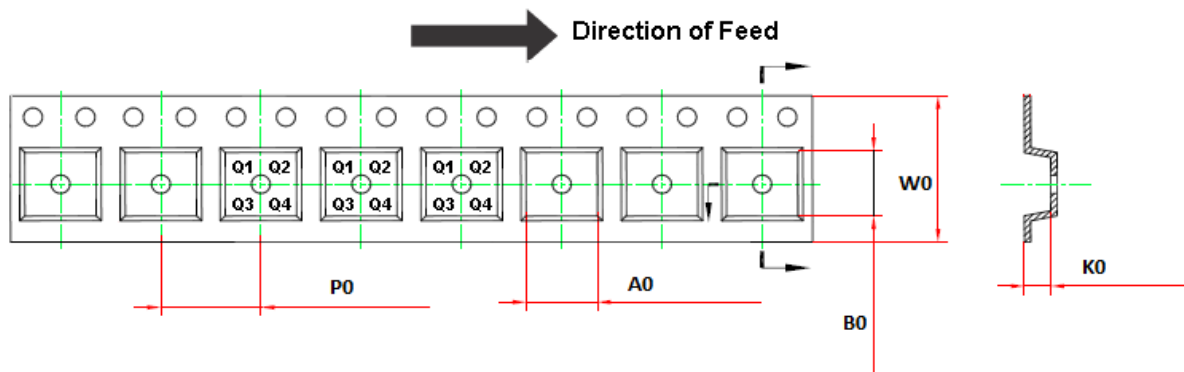
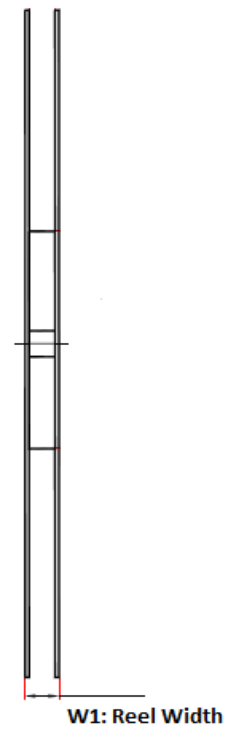
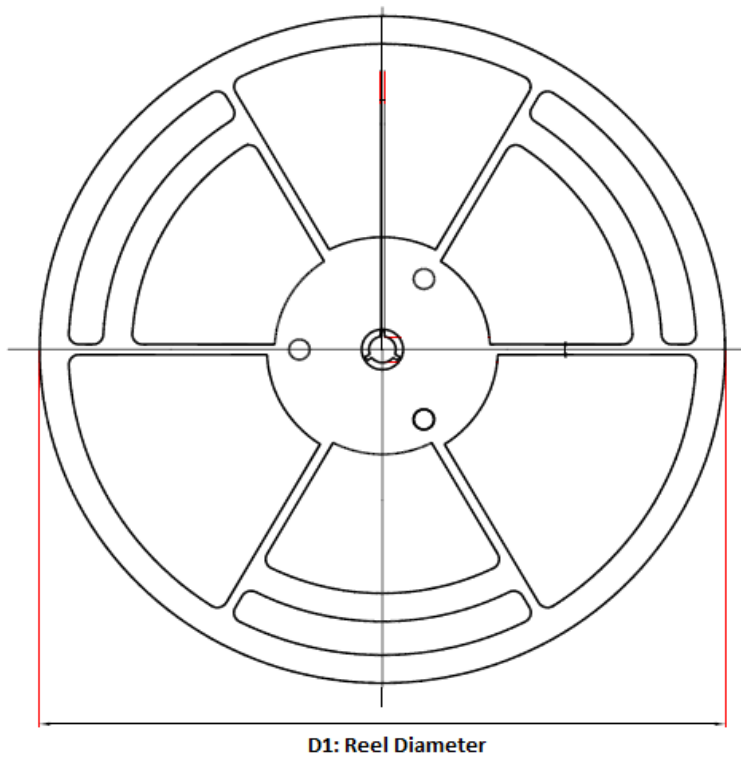
Figure 10 Single Channel Circuit

Package Outline Dimensions

MSOP-10



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	—	—	1.10
A1	0.05	—	0.15
A2	0.75	0.85	0.95
A3	0.30	0.35	0.40
b	0.18	—	0.26
b1	0.17	0.20	0.23
c	0.15	—	0.19
c1	0.14	0.15	0.16
D	2.90	3.00	3.10
E	4.70	4.90	5.10
E1	2.90	3.00	3.10
e	0.50BSC		
L	0.40	—	0.70
L1	0.95REF		
θ	0	—	8°



Order Number	Package	D1 (mm)	W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	W1 (mm)	Pin1 Quadrant
TPM2001-VS2R	MSOP-10	330.0	17.6	5.2	3.3	1.5	8.0	12.0	Q1

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