

## Features

- 7-channel Darlington Array
- 500-mA Rated Drain Current (Per Channel)
- Very Low Output Leakage < 10 nA Per Channel
- Power Efficient with Low  $R_{DS-on}$
- Extended Temperature Range:  $T_A = -40^{\circ}\text{C}$  to  $125^{\circ}\text{C}$
- High-Voltage Outputs: 40 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
- Enhanced ESD Protection Exceeds JESD 22 – 2.5-kV HBM, 1.5-kV CDM
- Available in SOP16 and TSSOP16 Packages

## Applications

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

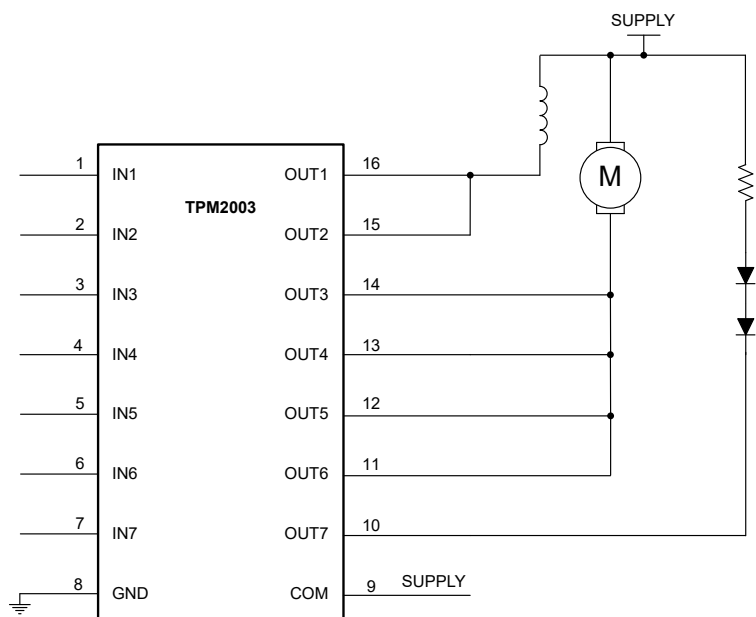
## Description

The TPM2003 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 diodes for inductive loads.

The maximum drain-current rating of a single NMOS channel is 500 mA. The device supports a wide I/O voltage range from 1.8 V to 30 V. The transistors can drive in parallel for higher current capability. Enhanced ESD performance enhances system-level reliability.

The TPM2003 can replace traditional Bipolar Darlington arrays with better thermal efficiency and reliability.

## Typical Application Circuit



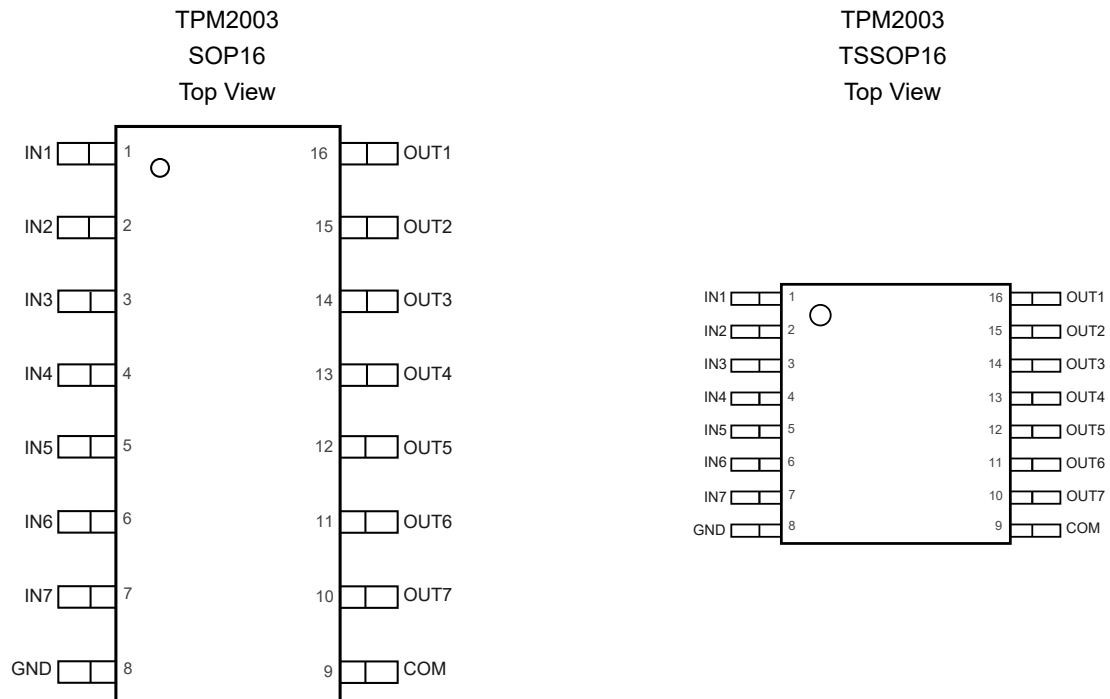
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## Revision History

Date	Revision	Notes
2020-11-02	Rev A.0	Release for production.
2022-05-17	Rev A.1	Misc correction.
2023-08-22	Rev A.2	Updated max operating voltage to 40 V, abs max to 45 V.

### Pin Configuration and Functions


**Table 1. Pin Functions: TPM2003**

Pin No	Pin Name	I/O	Description
9	COM	Power	Device supply voltage, should be tied above 4.3V.
8	GND	Ground	Device ground
1	IN1	Input	Logic Input. High-active to pull down OUT1
2	IN2	Input	Logic Input. High-active to pull down OUT2
3	IN3	Input	Logic Input. High-active to pull down OUT3
4	IN4	Input	Logic Input. High-active to pull down OUT4
5	IN5	Input	Logic Input. High-active to pull down OUT5
6	IN6	Input	Logic Input. High-active to pull down OUT6
7	IN7	Input	Logic Input. High-active to pull down OUT7
16	OUT1	Output	Low-side driver output, IN1 high to pull down OUT1
15	OUT2	Output	Low-side driver output, IN2 high to pull down OUT2
14	OUT3	Output	Low-side driver output, IN3 high to pull down OUT3
13	OUT4	Output	Low-side driver output, IN4 high to pull down OUT4
12	OUT5	Output	Low-side driver output, IN5 high to pull down OUT5
11	OUT6	Output	Low-side driver output, IN6 high to pull down OUT6
10	OUT7	Output	Low-side driver output, IN7 high to pull down OUT7

## Specifications

### Absolute Maximum Ratings <sup>(1)</sup>

Parameter		Min	Max	Unit
	Power Supply Voltage, COM	-0.3	+45	V
	Output Voltage Range OUT1 – OUT7	-0.3	+45	V
	Input Voltage Range IN1 – IN7	-0.3	+30	V
	Continuous Output Channel Current OUT1 – OUT7		500	mA
	Continuous Ground Current GND-pin		2	A
T <sub>J</sub>	Operating Junction Temperature Range	-40	125	°C
T <sub>STG</sub>	Storage Temperature Range	-65	150	°C
T <sub>L</sub>	Lead Temperature (Soldering, 10 sec)		260	°C

- (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.
- (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 10 mA.
- (3) Power dissipation and thermal limits must be observed.

### ESD, Electrostatic Discharge Protection

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 Operating Conditions

Parameter		Min	Max	Unit
	Power Supply Voltage, COM	4.3	40	V
	Output Voltage Range OUT1 – OUT7	0	40	V
	IN Logic-low Voltage		0.9	V
	IN Logic-high Voltage		1.5	V
	Continuous Output Current OUT1-OUT7		500	mA
	Operating Ambient Temperature Range	-40	125	°C

### Thermal Information

Package Type	$\theta_{JA}$	$\theta_{JC}$	Unit
TSSOP16	114.5	50.5	°C/W
SOP16	84.3	30.5	°C/W

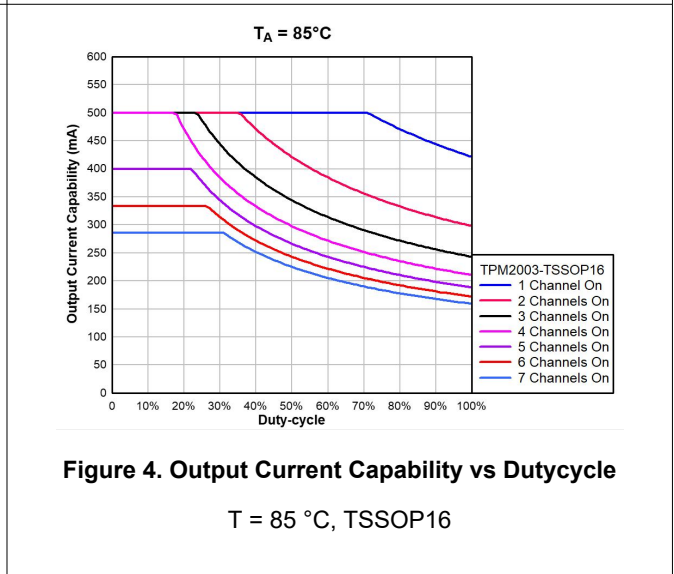
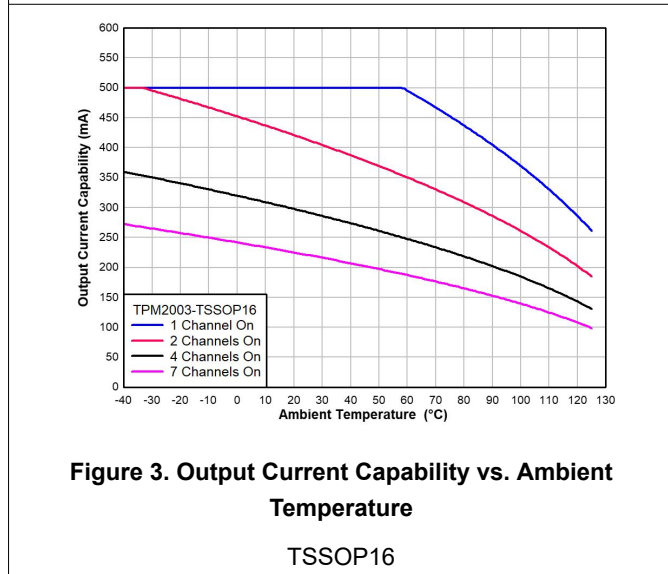
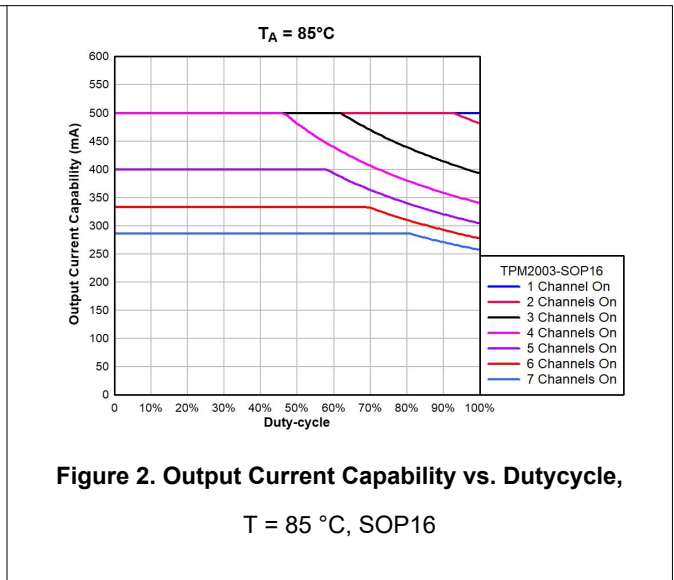
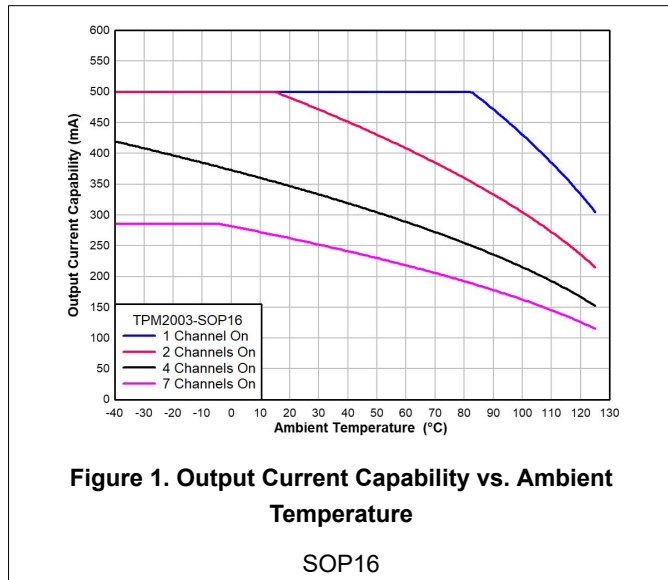
**Electrical Characteristics**

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

Parameter		Conditions	Min	Typ	Max	Unit
$V_{UVLO}$	COM Under-voltage Lock-Out Threshold	$I_{NX} = 0\text{ V}$ ;	2.1	3.5	4.3	V
$V_{DS}$	OUT1–OUT7 Low-Level Output Voltage	$I_{NX} = 5\text{ V}$ ; $I_{OUTX} = 100\text{ mA}$ , $T_J = 25\text{ }^\circ\text{C}$		200	320	mV
		$I_{NX} = 5\text{ V}$ ; $I_{OUTX} = 200\text{ mA}$ , $T_J = 25\text{ }^\circ\text{C}$		420	650	
		$I_{NX} = 5\text{ V}$ ; $I_{OUTX} = 350\text{ mA}$ , $T_J = 25\text{ }^\circ\text{C}$		800	1100	
$I_{DS-OFF}$	Off-state Output Leakage Current	$I_{NX} = 0\text{ V}$ ; $V_{OUTX} = 12\text{ V}$		10	500	nA
$V_{FWD}$	Clamp Forward Voltage	$I_F = 350\text{ mA}$		1.217		V
$I_{IN(ON)}$	IN1–IN7 Input On-State Current	$I_{NX} = 1.5\text{ V to }5\text{ V}$			10	$\mu\text{A}$
$I_{IN(OFF)}$	IN1–IN7 Input Off-State Current	$I_{NX} = 0\text{ V}$			10	$\mu\text{A}$
$I_{COM}$	Quiescent Supply Current	$I_{NX} = 0\text{ V}$ ; $V_{OUTX} = 12\text{ V}$			500	$\mu\text{A}$
$I_{COM}$	Active Supply Current	$I_{NX} = 5\text{ V}$ ; $V_{OUTX} = 0\text{ V}$			500	$\mu\text{A}$
$t_{PLH}$	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	$I_{NX} = 0\text{ V}$ ;		165		$^\circ\text{C}$

### Typical Performance Characteristics

All test conditions:  $V_{OUT} = 12\text{ V}$ ,  $T_A = +25^\circ\text{C}$ , unless otherwise noted.



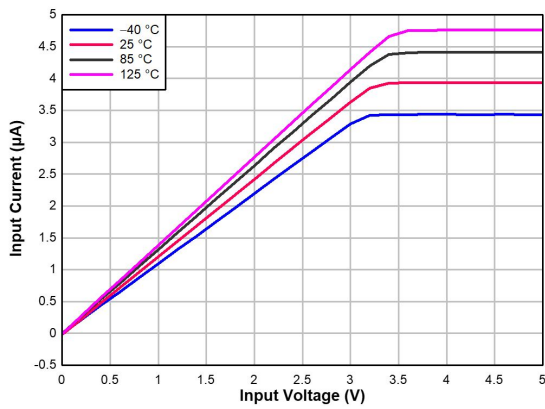


Figure 5. Input Current vs. Input Voltage

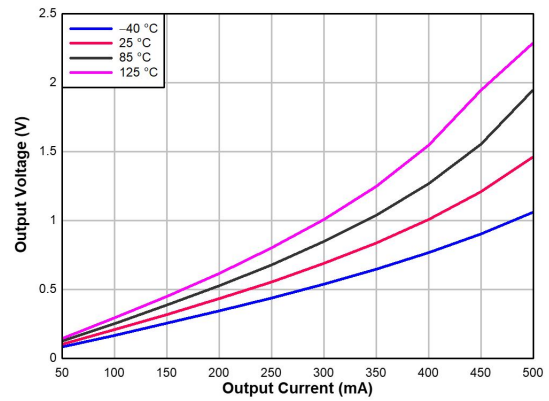


Figure 6. Output Voltage vs. Output Current

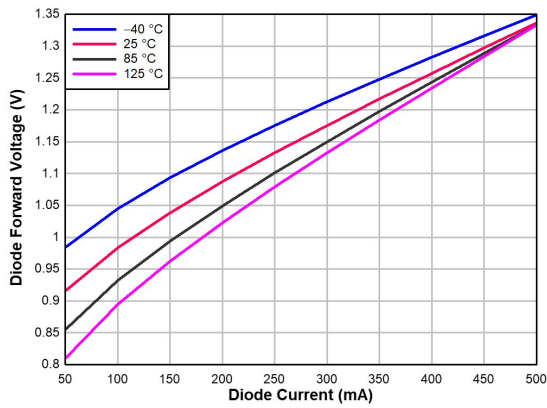


Figure 7. Output Diode Forward Voltage Drop vs. Diode Current

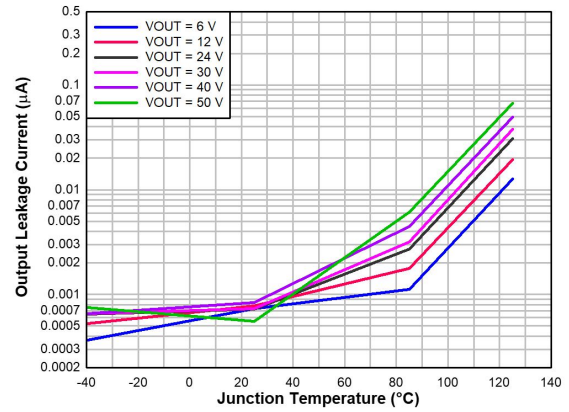


Figure 8. Output Leakage Current vs. Temperature

INx = 0 V

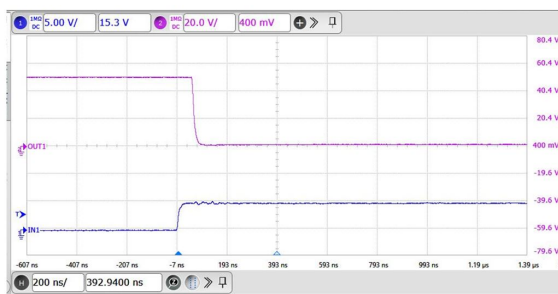


Figure 9. Output Falling Edge

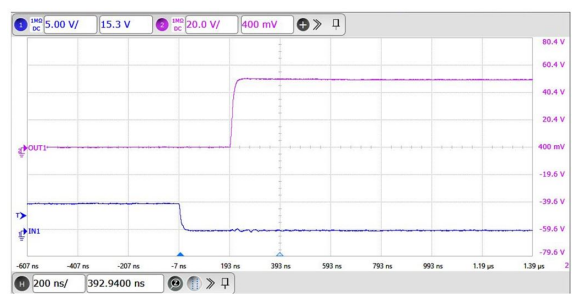


Figure 10. Output Rising Edge



## Detailed Description

### Overview

The TPM2003 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 diodes for inductive loads.

The maximum drain-current rating of a single NMOS channel is 500 mA. The device supports a wide I/O voltage range from 1.8 V to 30 V. The transistors can drive in parallel for higher current capability. Enhanced ESD performance enhances system-level reliability.

### Functional Block Diagram

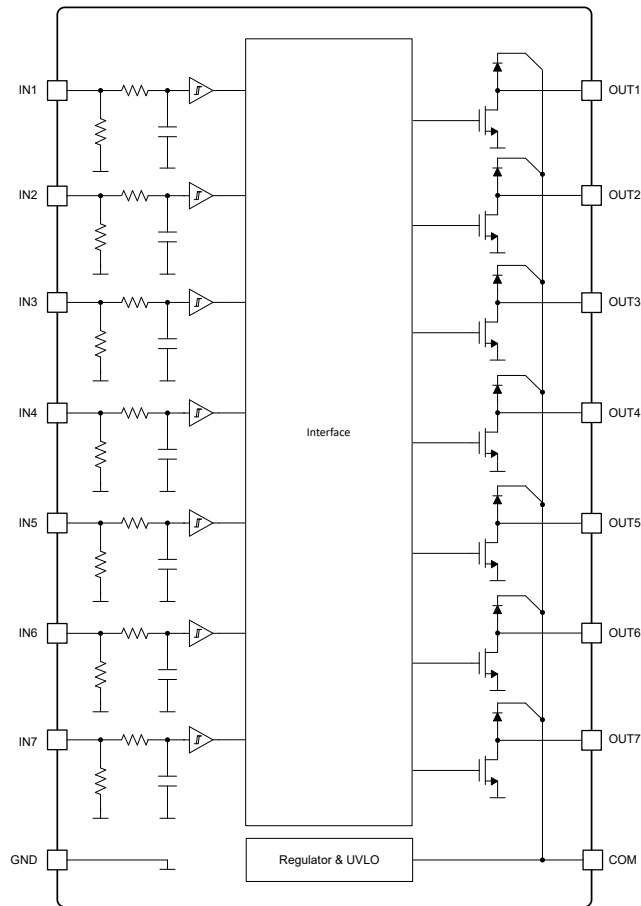


Figure 11. Functional Block Diagram

## Feature Description

For each channel, the 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 the COM pin to bias internal circuits with an 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, the TPM2003 has integrated R-C filter to avoid noise on INx. INx can also support maximum 30-V high voltage input for industrial systems.

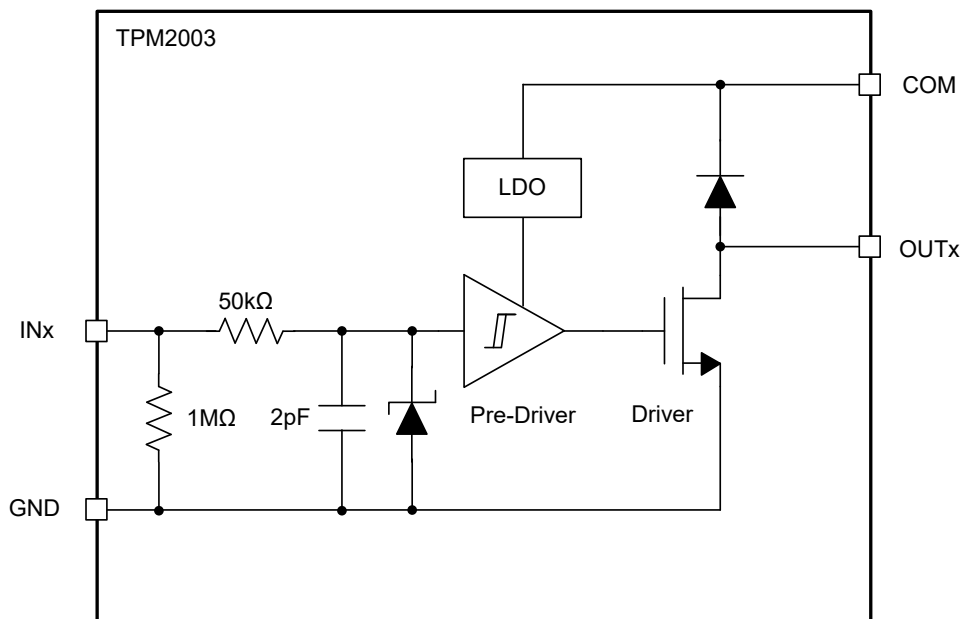
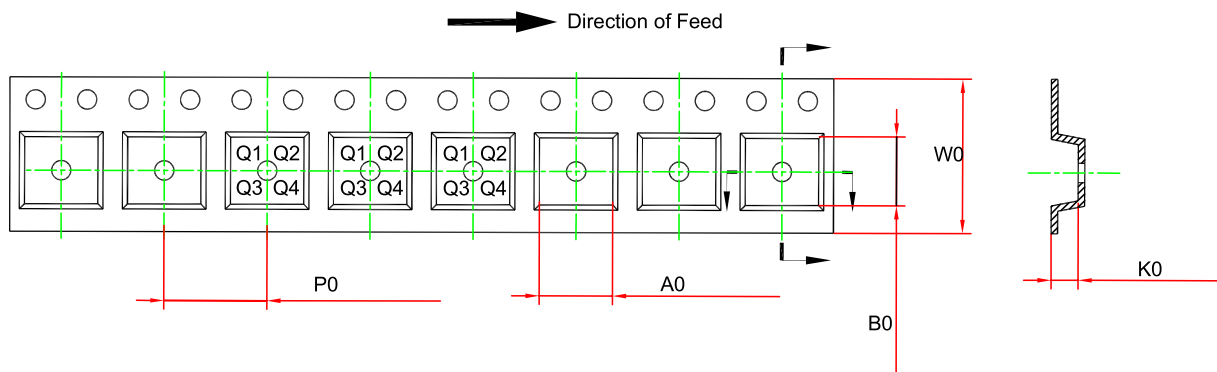
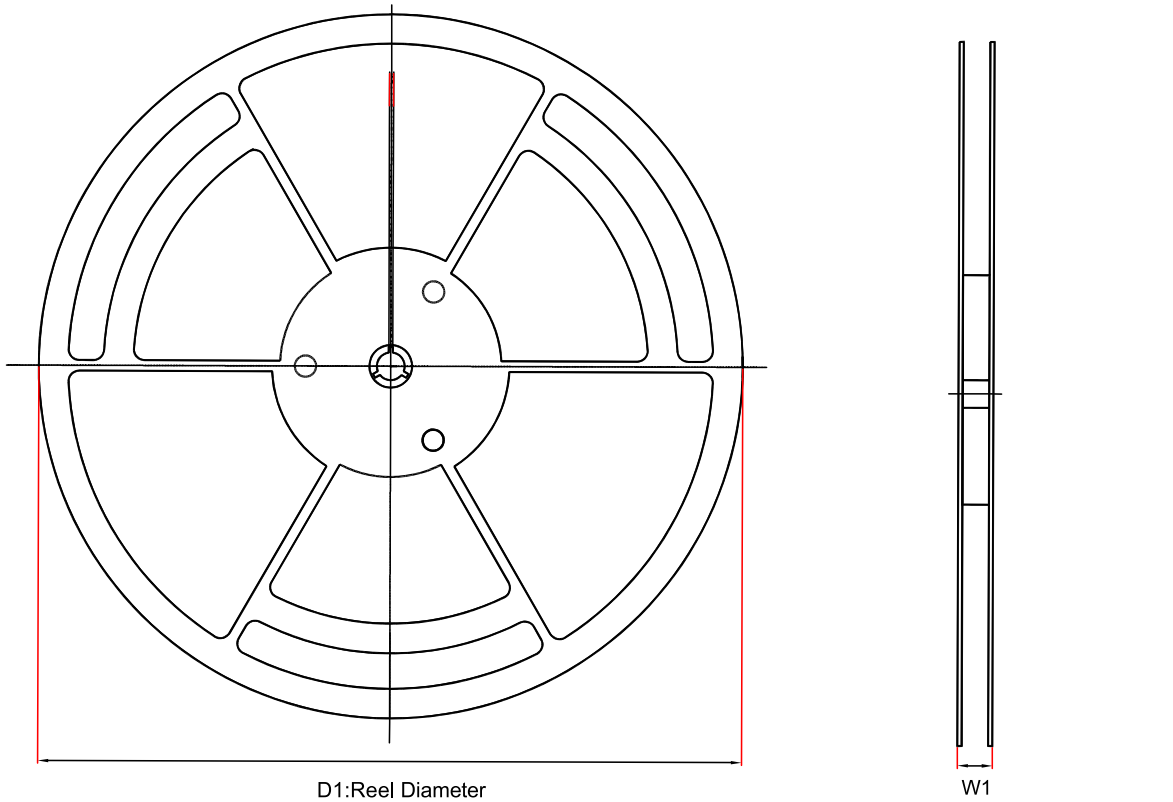


Figure 12. Single Channel Circuit

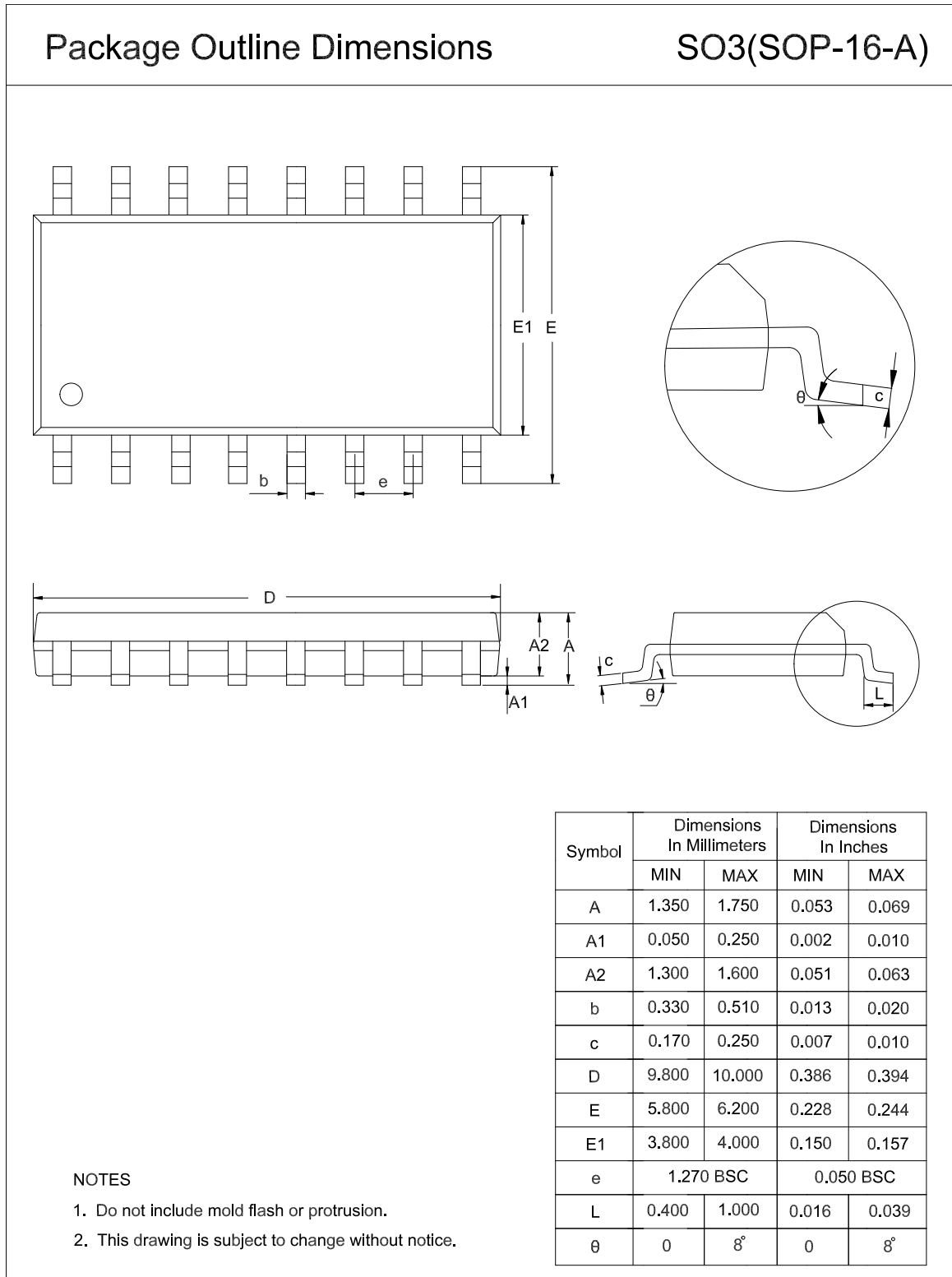
### Tape and Reel Information



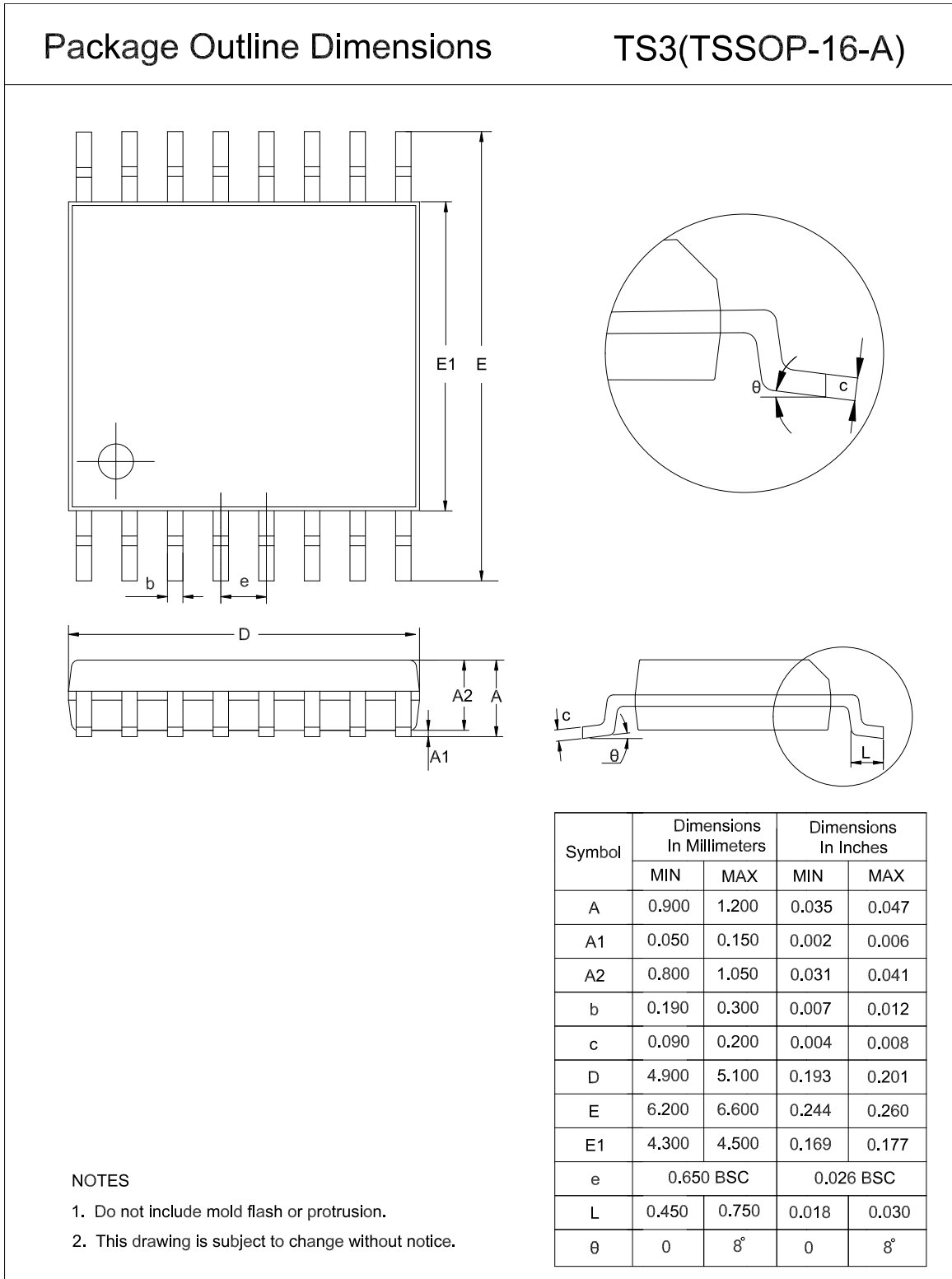
Order Number	Package	D1 ( mm )	W1 ( mm )	A0 ( mm )	B0 ( mm )	K0 ( mm )	P0 ( mm )	W0 ( mm )	Pin1 Quadrant
TPM2003-SO3R	SOP16	330.0	21.6	6.7	10.4	2.1	8.0	16.0	Q1
TPM2003-TS3R	TSSOP16	330.0	17.6	6.8	5.4	1.3	8.0	12.0	Q1

Package Outline Dimensions

SOP16



TSSOP16



## Order Information

Order Number	Operating Ambient Temperature Range	Package	Marking Information	MSL	Transport Media, Quantity	Eco Plan
TPM2003-SO3R	-40 °C to 125 °C	SOP16	M2003	MSL3	2500	Green
TPM2003-TS3R	-40 °C to 125 °C	TSSOP16	M2003	MSL3	3000	Green

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

**Green:** 3PEAK defines "Green" to mean RoHS compatible and free of halogen substances.

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