Features

- 8-channel 50-V Low-side Driver 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°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-kV HBM, 500-V CDM
- Available in 16-pin TSSOP-16 Package

Description

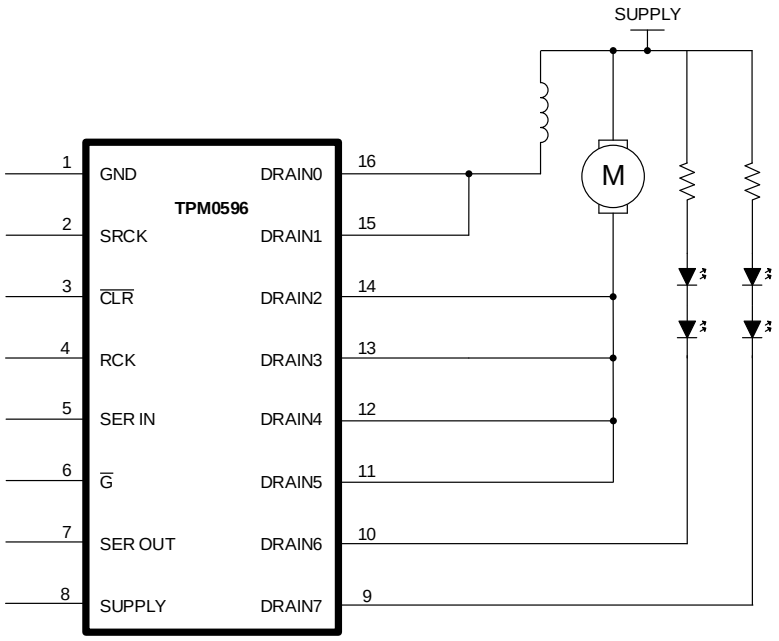
The TPM0596 is a high-voltage, high-current NMOS transistor array with shift register interface. This device consists of eight channels of low-side NMOS transistors with high-voltage outputs and free-wheeling diode for inductive loads.

The maximum drain-current rating of a single NMOS channel is 500 mA. The device supports wide I/O voltage range from 1.8V to 5V. The transistors can be paralleled for higher current capability.

The TPM0596 can replace traditional bipolar Darlington arrays with better thermal efficiency and reliability and saves I/Os.

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
2020/12/15	Rev A.0	Initial Version
2022/3/10	Rev A.1	Updated transport media, quantity
2022/3/10	Rev A.2	Correction on interface description

Order Information

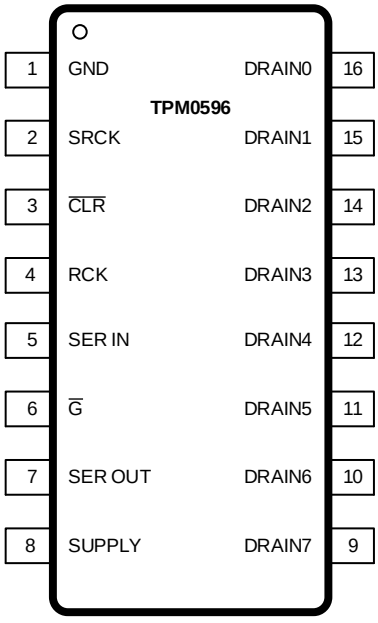
Order Number	Operating Ambient Temperature Range	Package	Marking Information	MSL	Transport Media, Quantity
TPM0596-TS3R	-40 °C – 125 °C (1)	TSSOP16	M0596	MSL3	3000

(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

TSSOP-16

Top-view



Pin Functions

Pin		I/O	Description
$\overline{CLR}$	3	Input	Shift register clear, active-low
$\overline{G}$	6	Input	Output gating, active-low
GND	1	Ground	Device ground
DRAIN0	16	Output	Low-side driver output

DRAIN1	15	Output	Low-side driver output
DRAIN2	14	Output	Low-side driver output
DRAIN3	13	Output	Low-side driver output
DRAIN4	12	Output	Low-side driver output
DRAIN5	11	Output	Low-side driver output
DRAIN6	10	Output	Low-side driver output
DRAIN7	9	Output	Low-side driver output
RCK	4	Input	Register clock
SER IN	5	Input	Serial data input
SER OUT	7	Output	Serial data output
SRCK	2	Input	Shift register clock
SUPPLY	8	Power	Device supply voltage, should be tied above 3.3V.

Absolute Maximum Ratings Note 1

Parameters	Rating
Power Supply Voltage, SUPPLY	−0.3 V to 55 V
Output Voltage Range DRAIN0 − DRAIN7	−0.3 V to 55 V
Input Voltage Range SER IN, RCK, SRCK, $\overline{CLR}$, $\overline{G}$	−0.3 V to 30 V
Continuous output channel current DRAIN0 − DRAIN7	500 mA
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	±2500	V
CDM	Charged Device Model ESD	ANSI/ESDA/JEDEC JS-002	±1500	V

Recommended Operation Conditions Note 1

Parameters	Rating
Power Supply Voltage, SUPPLY	4.5 V to 50 V
Output Voltage Range DRAIN0 − DRAIN7	0 V to 50 V
Logic low voltage	0.9 V
Logic high voltage	1.5 V
Continuous output current DRAIN0 − DRAIN7	500 mA
Operating Ambient Temperature Range	–40 °C to 125 °C

Thermal Information

Package Type	θ_{JA}	θ_{JC}	Unit
TSSOP16	114.5	50.5	°C/W

Electrical Characteristics

All test condition is V_{COM} = 12 V, T_A = −40 °C – 125 °C, unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
V_{UVLO}	COM Under-voltage Lock-Out Threshold	Outputs off;	2.8	3.4	3.6	V
$R_{DS(on)}$	DRAIN0-DRAIN7 output drain-source on-state resistance	I_{OUTx} = 50 mA, V_{SUPPLY} = 4.5 V T_J = −40 °C – 125 °C		1.98	5	Ω
		I_{OUTx} = 100 mA, V_{SUPPLY} = 4.5 V T_J = −40 °C – 125 °C		2.03	5	
I_{DS-OFF}	Off-state output leakage current	Outputs off; V_{DRAINx} = 12 V		10	500	nA
V_{OH}	High-level output voltage, SER OUT	I_{OH} = −20 μA	4.4	5.5	6.6	V
		I_{OH} = −4 mA	4.2	5.1	6.0	V
V_{OL}	Low-level output voltage, SER OUT	I_{OL} = 20 μA		0.005	0.01	V
		I_{OL} = 4 mA		0.3	0.5	V
V_{FWD}	Clamp forward voltage	I_F = 100 mA		325		mV
$I_{IN(ON)}$	High-Level input current	V_I = 5 V			20	μA
$I_{IN(OFF)}$	Low-Level input current	V_I = 0 V			-1	μA
I_{COM}	Quiescent supply current	Outputs off; V_{DRAINx} = 12 V		15	500	μA
I_{COM}	Active supply current	Outputs on; V_{DRAINx} = 0 V		50	500	μA
t_{pLH}	Propagation delay time, LOW to HIGH, from $\bar{G}$ to DRAINx	$V_{pull-up}$ = 12 V; $R_{pull-up}$ = 48Ω		350		ns
t_{pHL}	Propagation delay time, HIGH to LOW, from $\bar{G}$ to DRAINx	$V_{pull-up}$ = 12 V; $R_{pull-up}$ = 48Ω		350		ns
T_{OTP}	Thermal Shutdown Threshold	Outputs off;	150	165		°C

Typical Performance Characteristics

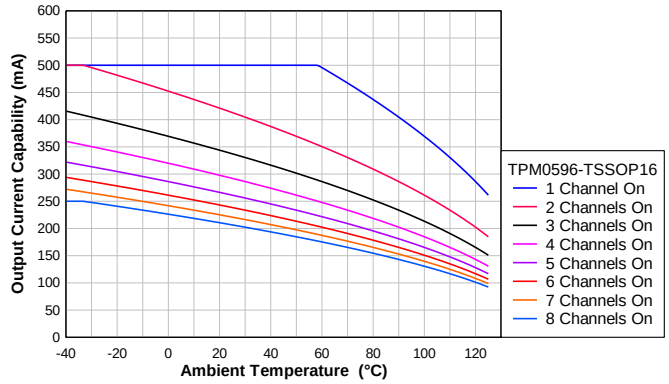


Figure 1. Output Current Capability vs. Ambient Temperature

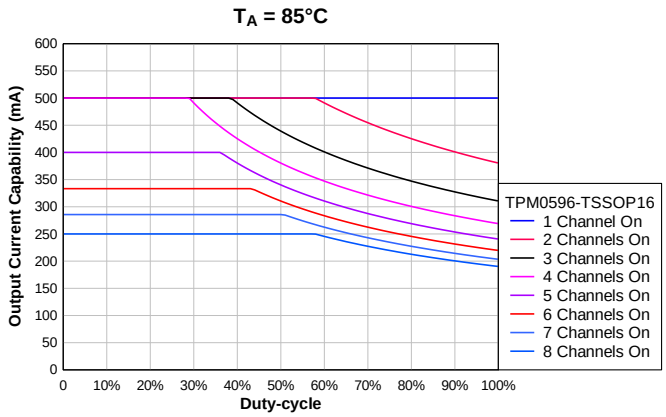


Figure 2. Output Current Capability vs. Dutycycle, T = 85 ℃

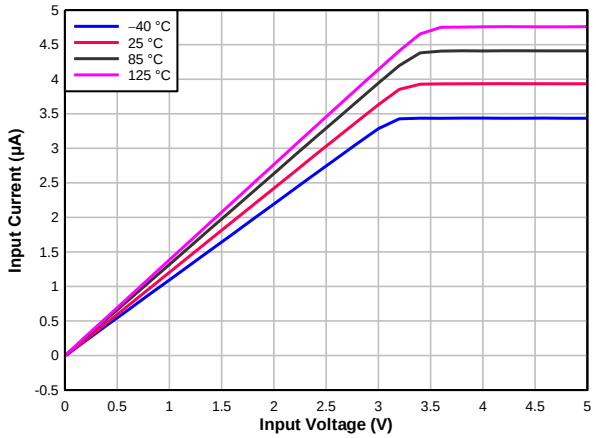


Figure 3. Input Current vs. Input Voltage

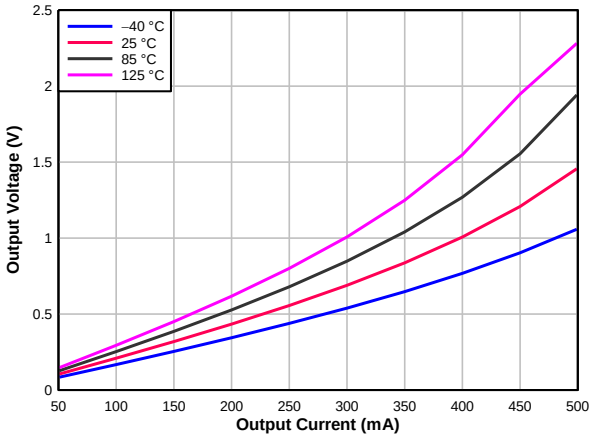


Figure 4. Output Voltage vs. Output Current

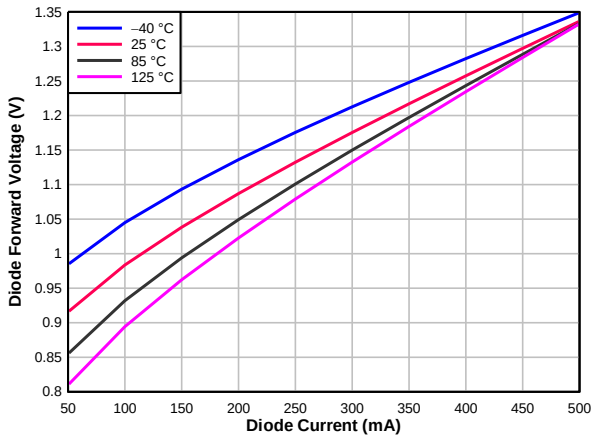


Figure 5. Output Diode Forward Voltage Drop vs. Diode Current

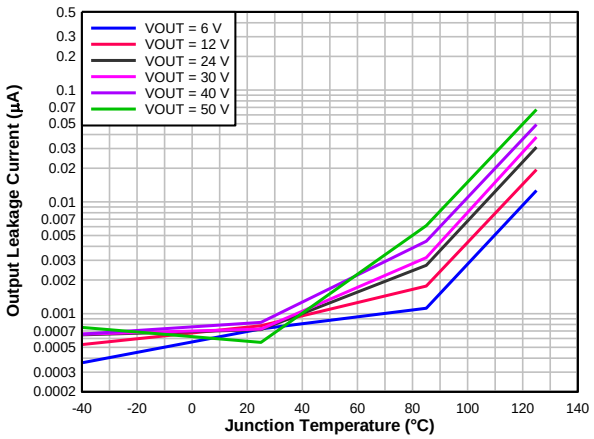


Figure 6. Output Leakage Current vs. Temperature

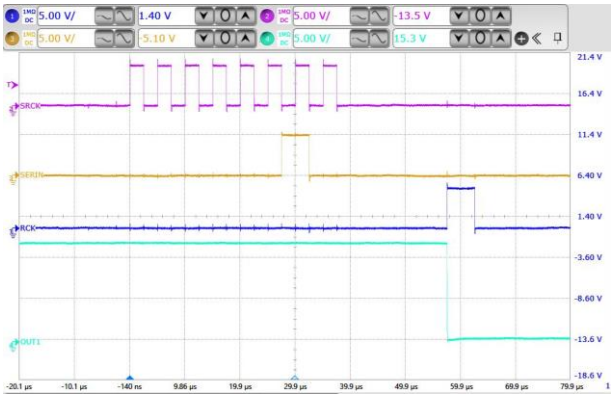


Figure 7. Serial Interface Control

Detailed Description

TPM0596 is an 8-ch low-side driver array. It consists of 8 channels of high-voltage low-side MOSFET. Its outputs can drive inductive loads up to 500mA per channel with wide temperature range. Its outputs can drive inductive loads, such as solenoids, relays, motors and lamps up to 500mA per channel with wide temperature range. Multiple channels can be paralleled to increase driving capabilities or reduce thermal dissipation.

TPM0596 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 device uses serial shift register to control outputs. Shift register interface helps system to save I/Os by using minimal 3 pins only. 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 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.

The minimal I/Os are SRCK, RCK, SER IN. SER OUT is optional to read back the shift register values to improve system robustness. SER OUT needs external pull-up resistor, 3PEAK recommends a 10kΩ pull-up resistor. $\overline{G}$ is output gating control input, setting $\overline{G}$ to low enables all outputs. $\overline{CLR}$ is the chip level clear input. Setting $\overline{CLR}$ to low can clear the internal shift registers.

Integrated over temperature protection and under-voltage lock out protection provides advanced robustness to the system comparing to older generation of Darlington arrays. The low on-resistance of output ensures lower power dissipated on the device. The low on-resistance increases driving efficiency and reduces device temperature, thus improves the system robustness.

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

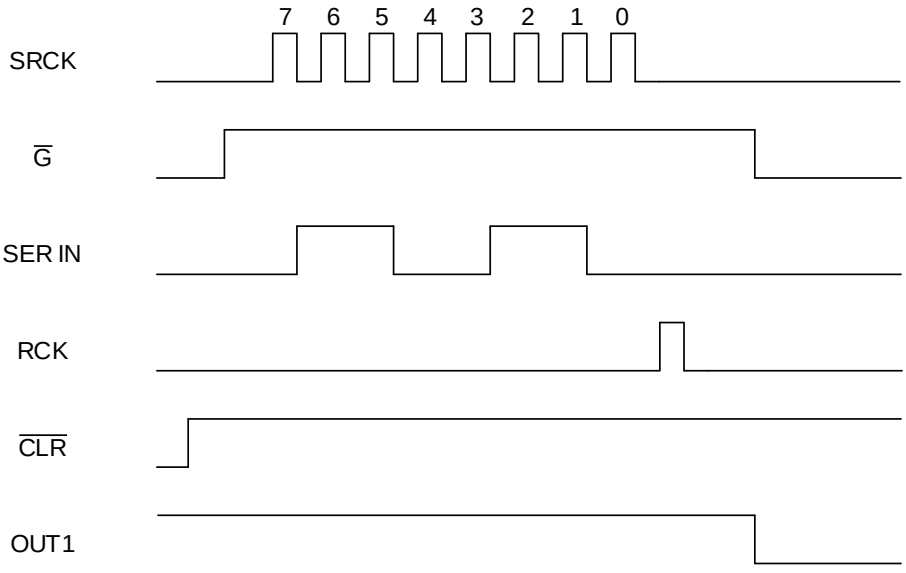


Figure 8 Shift Register Diagram

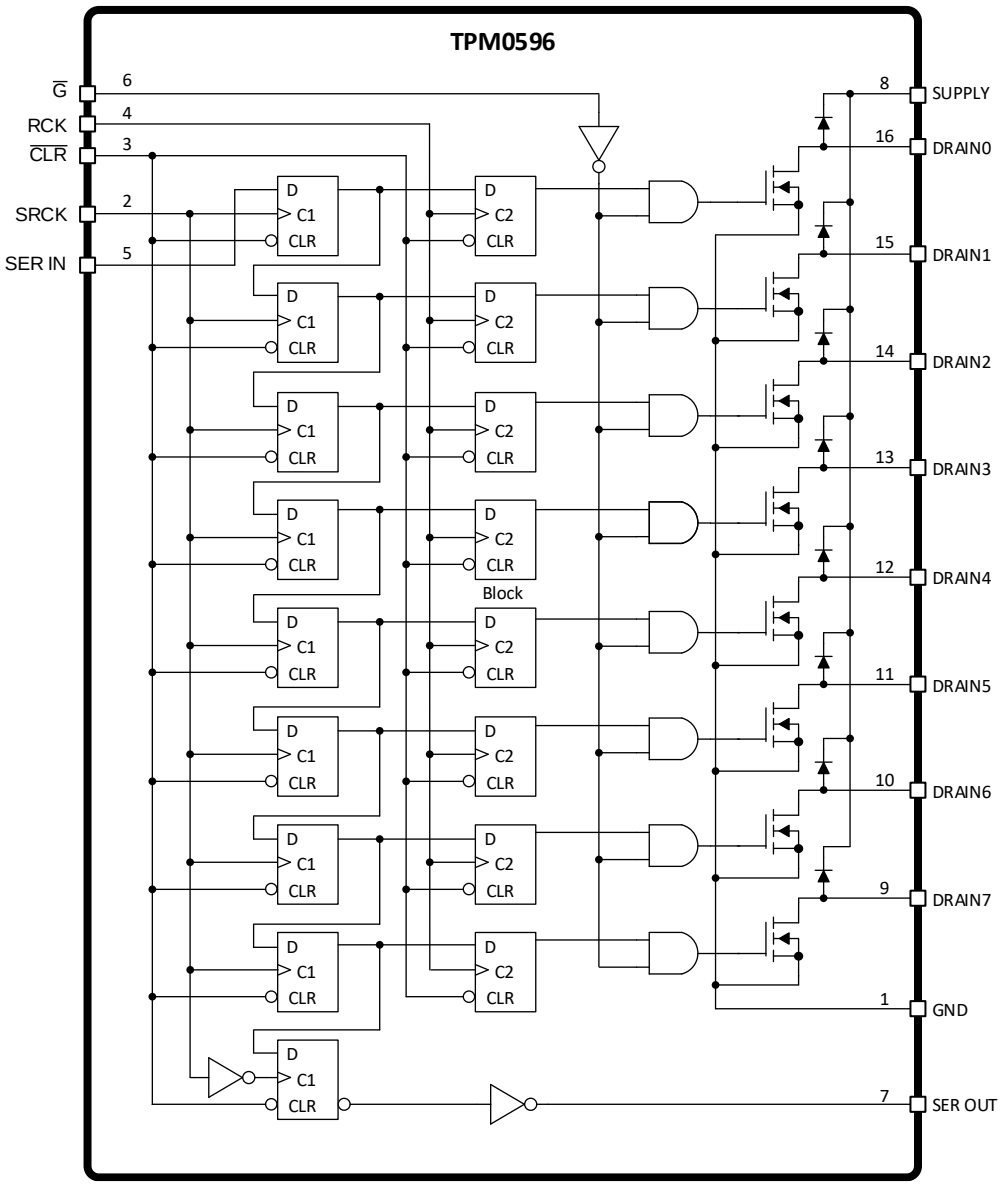


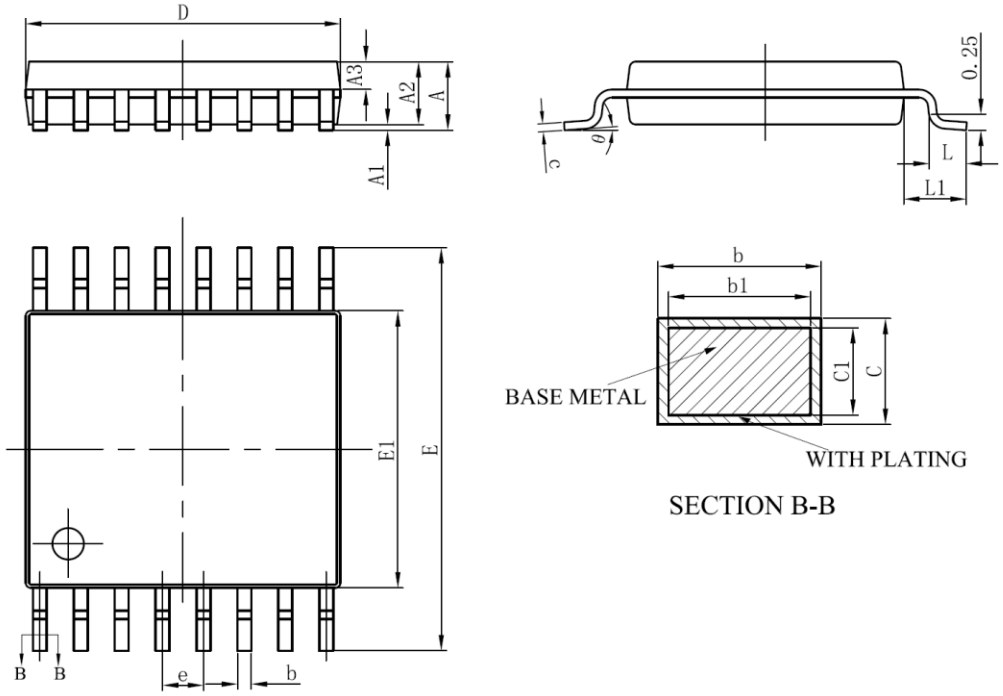
Figure 9 Functional Block Diagram

Device Thermal Capability

DRAIN0 to DRAIN7 drives loads with 100-Ω resistance and 1.36-mH inductance with 10kHz frequency and 50% dutycycle. The package top temperature is measured as 58.9 °C.

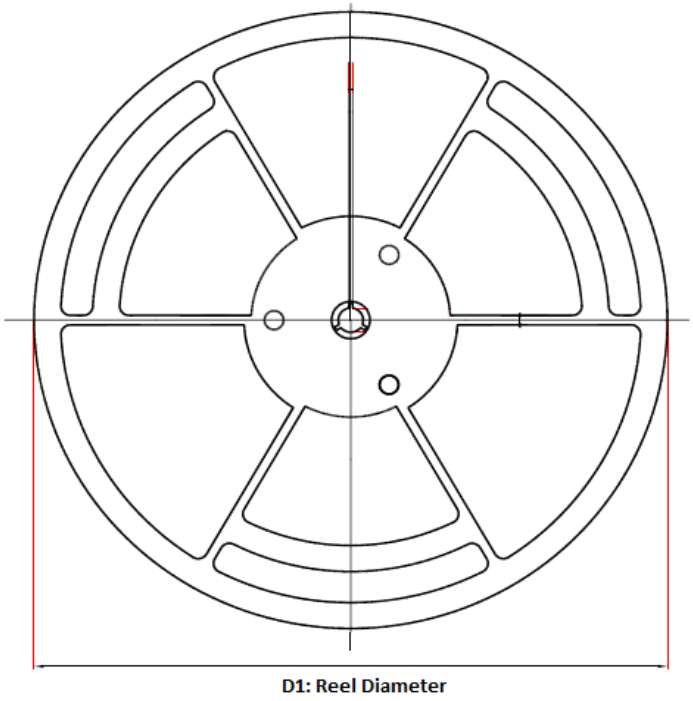
Package Outline Dimensions

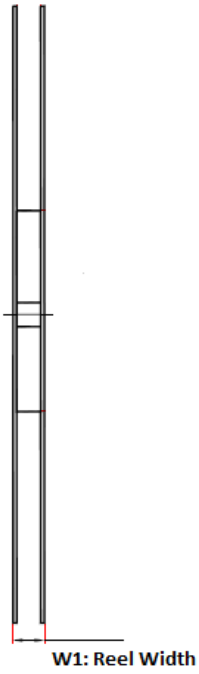
TSSOP16

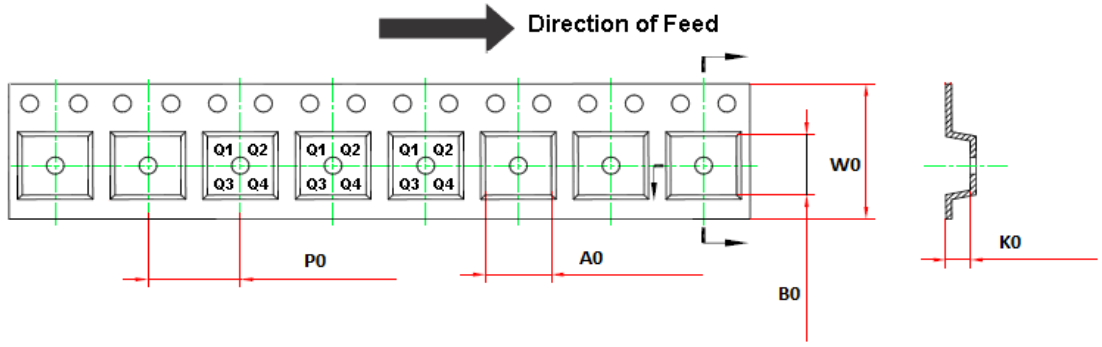


SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	—	—	1.20
A1	0.05	—	0.15
A2	0.90	1.00	1.05
A3	0.39	0.44	0.49
b	0.20	—	0.28
b1	0.19	0.22	0.25
c	0.13	—	0.17
c1	0.12	0.13	0.14
D	4.90	5.00	5.10
E	6.20	6.40	6.60
E1	4.30	4.40	4.50
e	0.65BSC		
L	0.45	0.60	0.75
L1	1.00BSC		
θ	0	—	8°

Tape and Reel Information







Order Number	Package	D1 (mm)	W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	W0 (mm)	Pin1 Quadrant
TPM0596-TS3R	TSSOP16	330	17.6	6.8	5.4	1.3	8	12	Q1

IMPORTANT NOTICE AND DISCLAIMER