

Integrated High-Side Switch

Features

- MOSFET On-Resistance
 - 1.5Ω Typical at 5V
 - 0.95Ω Typical at 12V
- 3V to 13.5V Input
- 25 μA Typical On-State Supply Current at 5V
- <1 μA Typical Off-State Supply Current at 5V
- Current Limit
- Thermal Shutdown
- Slow Turn-On

Applications

- 3.3V to 13.5V Power Management

General Description

The MIC2514 is an integrated high-side power switch that consists of a TTL-compatible input and protected P-channel MOSFET. The MIC2514 can be used instead of a separate high-side driver and MOSFET in many low voltage applications.

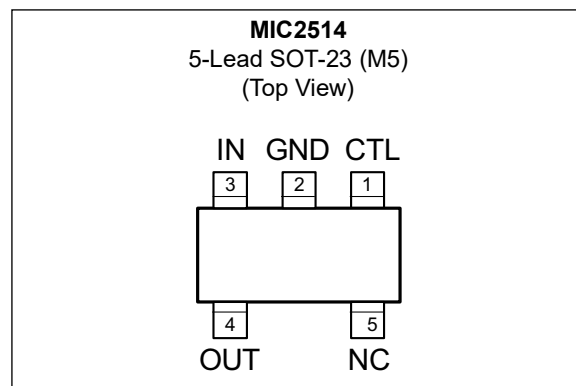
The MIC2514 switches voltage ranging from 3V to 13.5V and delivers more than 400 mA continuous current. A slow turn-on feature prevents high inrush current when switching capacitive loads. The internal control circuitry is powered from the unswitched 3V to 13.5V input.

Current limiting is internally fixed at approximately 1.9A and requires no external components.

Thermal shutdown turns off the output if the die temperature exceeds approximately 170°C.

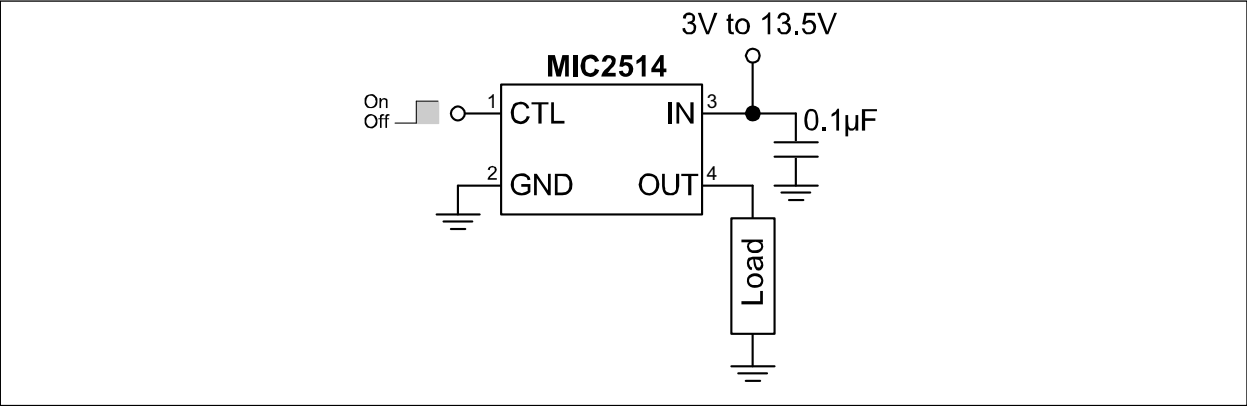
The MIC2514 is available in the 5-lead SOT-23-5 package with a temperature range of -40°C to +85°C.

Package Type

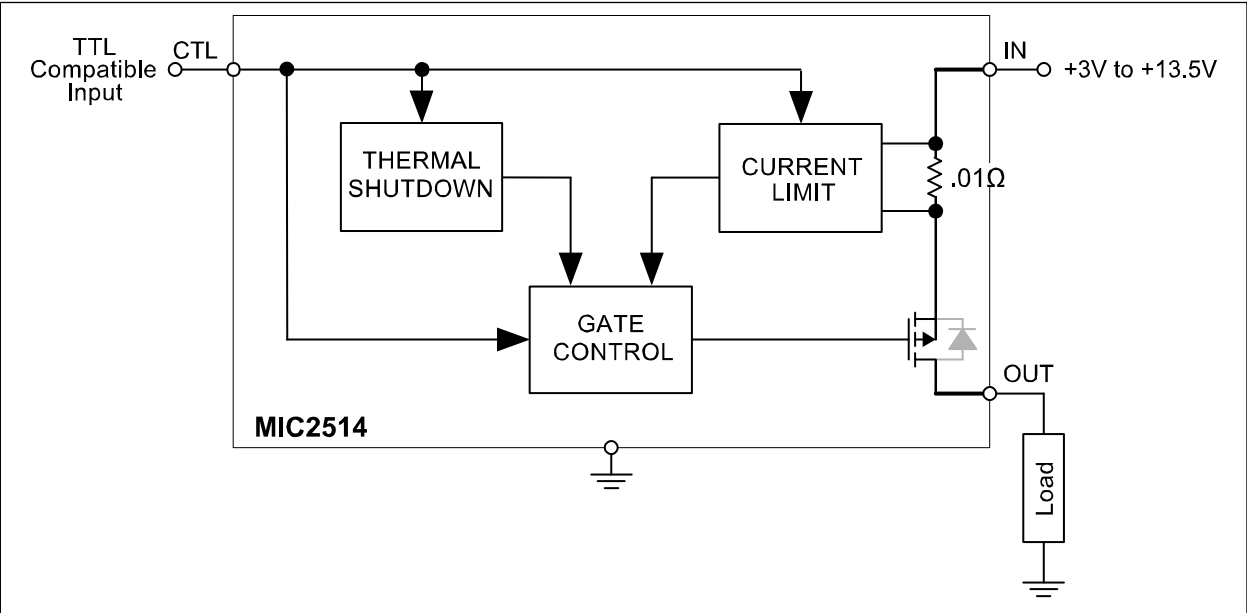


MIC2514

Typical Application Circuit



Functional Block Diagram



1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings †

Supply Voltage (V_{IN})	+20V
Output Current (I_{OUT})	Internally Limited
Control Input (V_{CTRL})	-0.3V to +15V

Operating Ratings ‡

Supply Voltage (V_{IN})	+3.0V to +13.5V
Control Input (V_{CTRL})	-0.3V to V_{IN}

† **Notice:** Stresses above those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device at those or any other conditions above those indicated in the operational sections of this specification is not intended. Exposure to maximum rating conditions for extended periods may affect device reliability.

‡ **Notice:** The device is not guaranteed to function outside its operating ratings.

Note: Device is ESD sensitive. Handling precautions are recommended.

ELECTRICAL CHARACTERISTICS

$V_{IN} = 5V$; $T_A = 25^\circ C$, **bold** values valid for $-40^\circ C \leq T_A \leq +85^\circ C$, unless noted. [Note 1](#)

Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions
Supply Current	I_{CC}	—	0.6	10	μA	$V_{CTL} = \text{logic } 0, V_{IN} = 5V$
		—	2.0	25		$V_{CTL} = \text{logic } 0, V_{IN} = 13.5V$
		—	10	20		$V_{CTL} = \text{logic } 1, V_{IN} = 3V$
		—	25	40		$V_{CTL} = \text{logic } 1, V_{IN} = 5V$
		—	95	200		$V_{CTL} = \text{logic } 1, V_{IN} = 13.5V$
Control Input Voltage	V_{CTL}	0	—	0.79	V	$V_{CTL} = \text{logic } 0, 3V \leq V_{IN} \leq 13.5V$
		0.8	1.45	2.0		$V_{CTL} = \text{logic } 1, 3V \leq V_{IN} \leq 5V$
		0.8	1.65	2.3		$V_{CTL} = \text{logic } 1, 5V \leq V_{IN} \leq 13.5V$
Output MOSFET Resistance		—	2.4	4.5	Ω	$V_{IN} = 3V$
		—	1.5	2.4		$V_{IN} = 5V$
		—	—	2.7		
		—	0.95	1.5		$V_{IN} = 12V$
		—	—	1.7		
Current Limit Threshold	I_{LIM}	—	0.5	1.5	A	$V_{IN} = 3V$
		1.0	1.4	2.0		$V_{IN} = 5V$
		1.2	1.9	2.5		$V_{IN} = 12V$

Note 1: Device production tested at $25^\circ C$, but device is ensured over indicated temperature range.

MIC2514

TEMPERATURE SPECIFICATIONS

Parameters	Sym.	Min.	Typ.	Max.	Units	Conditions
Temperature Ranges						
Ambient Temperature Range	T _A	-40	—	+85	°C	—
Storage Temperature Range	T _S	-65	—	+150	°C	—
Package Thermal Resistances						
Thermal Resistance, 5-Ld SOT-23	θ _{JA}	—	220	—	°C/W	—
	θ _{JC}	—	130	—	°C/W	—

2.0 TYPICAL PERFORMANCE CURVES

Note: The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only. The performance characteristics listed herein are not tested or guaranteed. In some graphs or tables, the data presented may be outside the specified operating range (e.g., outside specified power supply range) and therefore outside the warranted range.

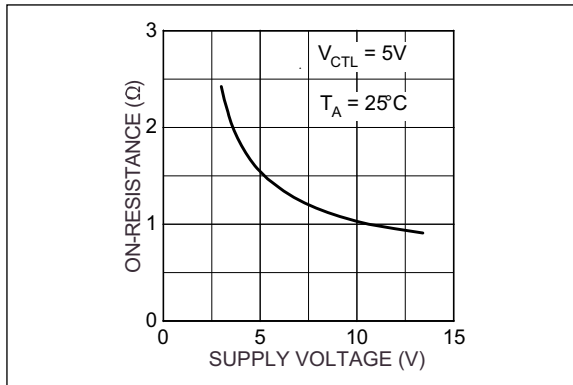


FIGURE 2-1: On-Resistance vs. Supply Voltage.

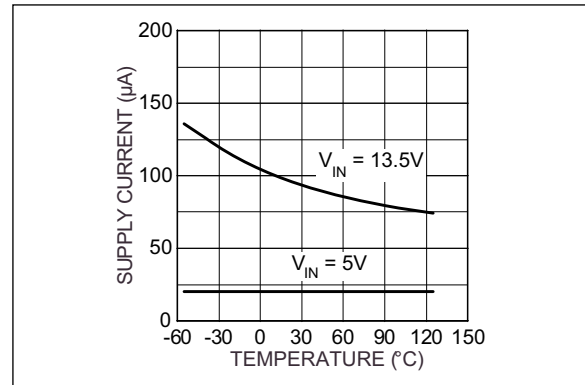


FIGURE 2-4: On-State Supply Current vs. Temperature.

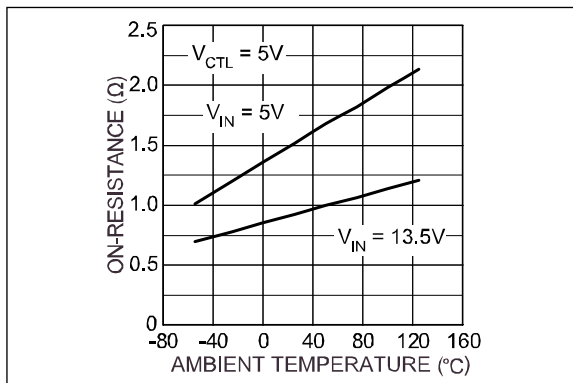


FIGURE 2-2: On-Resistance vs. Temperature.

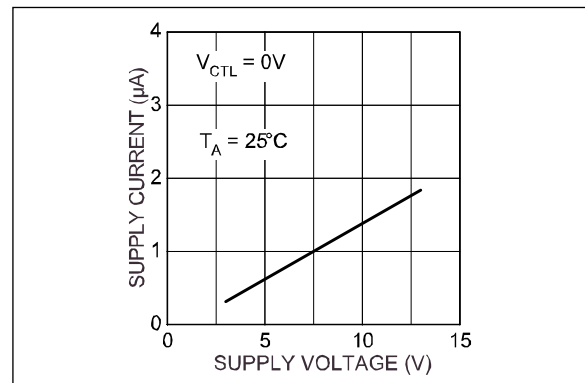


FIGURE 2-5: Off-State Current Supply vs. Supply Voltage.

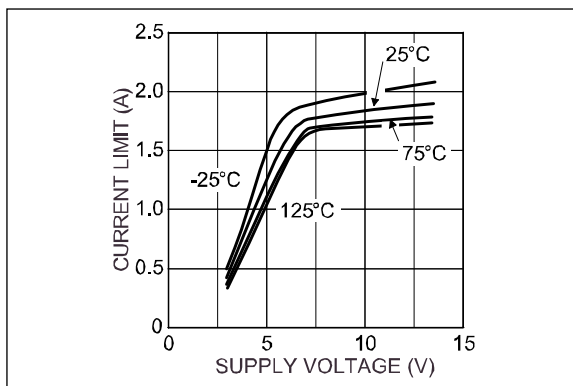


FIGURE 2-3: Current Limit vs. Supply Voltage.

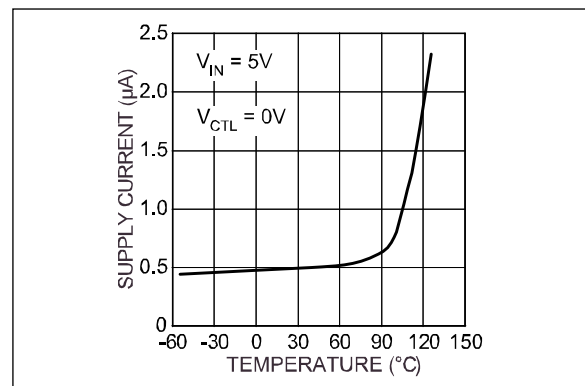


FIGURE 2-6: Off-State Supply Current vs. Temperature.

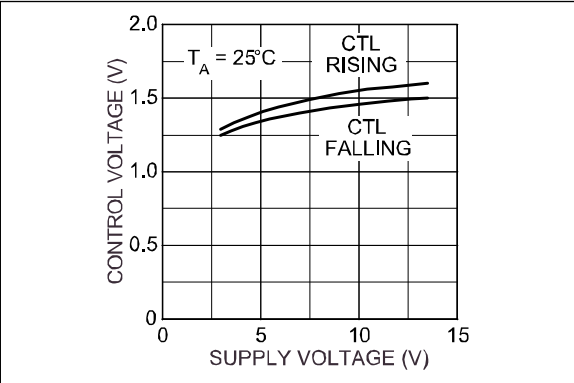


FIGURE 2-7: Control Input Threshold vs. Supply Voltage.

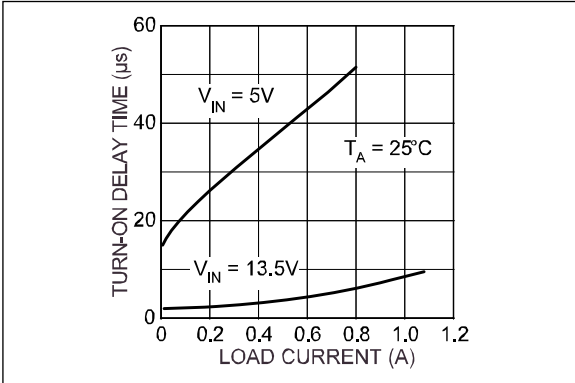


FIGURE 2-10: Turn-On Delay Time vs. Load Current.

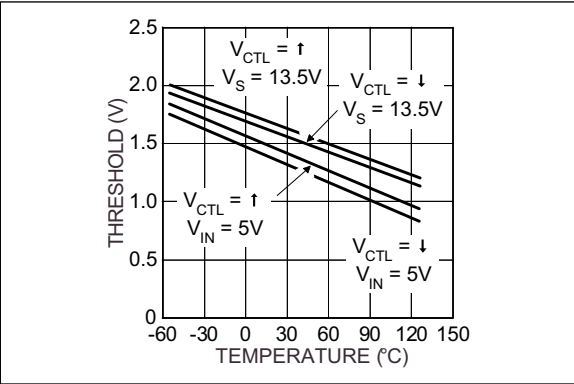


FIGURE 2-8: Control Input Threshold vs. Temperature.

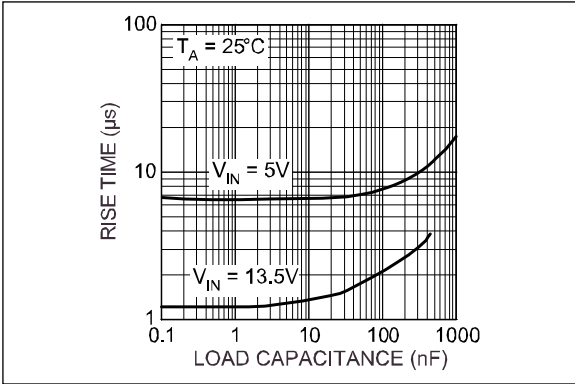


FIGURE 2-11: Rise Time vs. Load Capacitance.

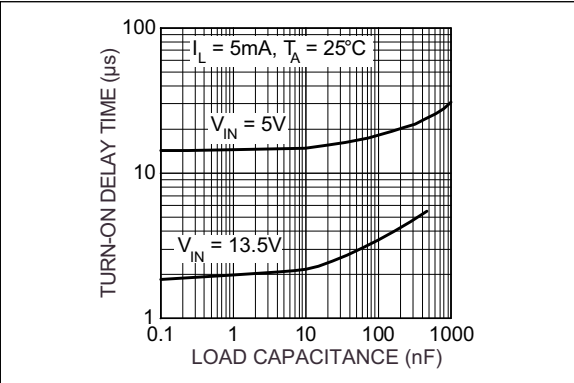


FIGURE 2-9: Turn-On Delay Time vs. Load Capacitance.

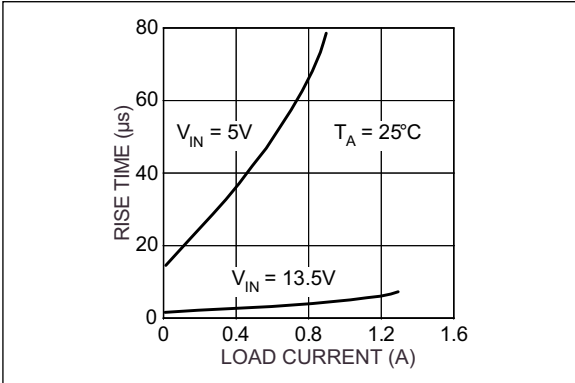


FIGURE 2-12: Rise Time vs. Load Current.

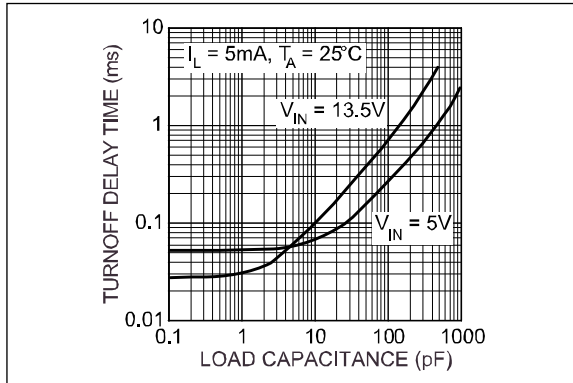


FIGURE 2-13: Turn-Off Delay Time vs. Load Capacitance.

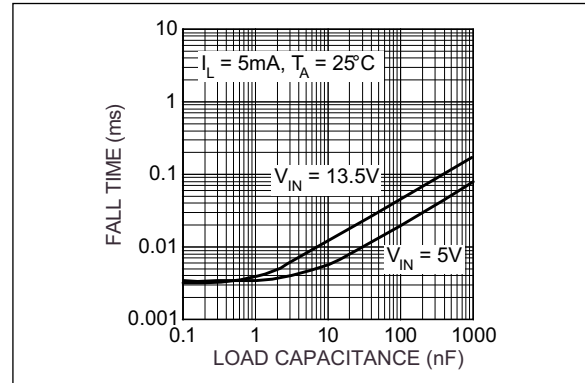


FIGURE 2-16: Fall Time vs. Load Capacitance.

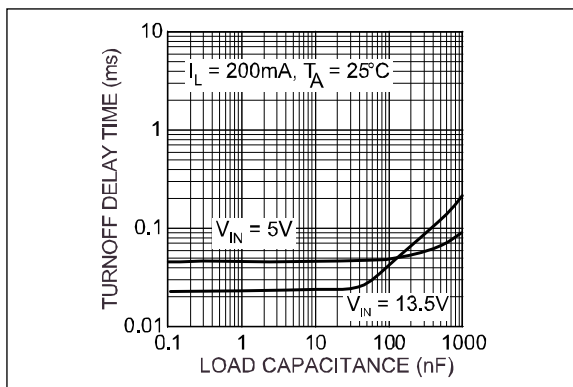


FIGURE 2-14: Turn-Off Delay Time vs. Load Capacitance.

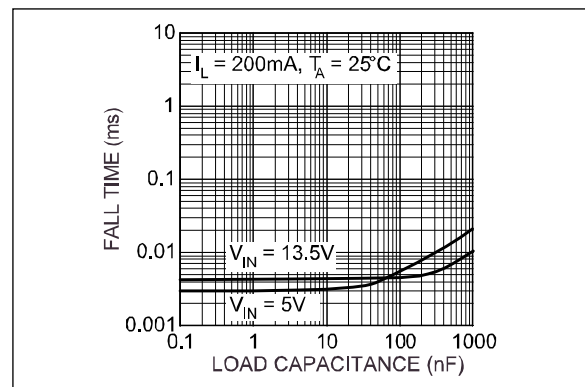


FIGURE 2-17: Fall Time vs. Load Capacitance.

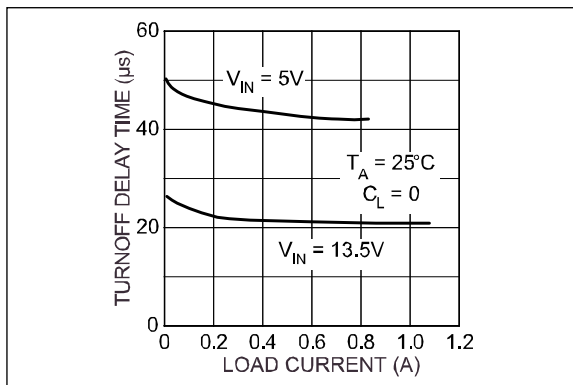


FIGURE 2-15: Turn-Off Delay Time vs. Load Current.

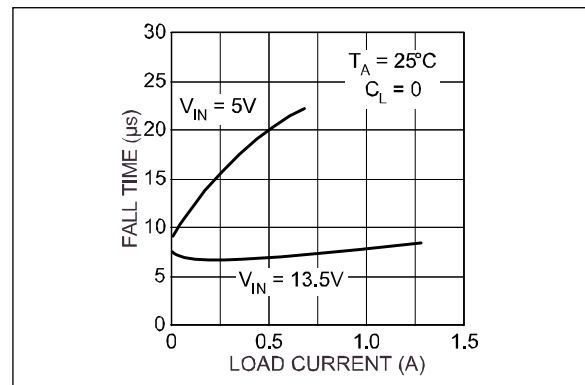


FIGURE 2-18: Fall Time vs. Load Current.

3.0 PIN DESCRIPTIONS

The descriptions of the pins are listed in [Table 3-1](#).

TABLE 3-1: PIN FUNCTION TABLE

Pin Number	Pin Name	Description
1	CTL	Control (Input): Non-inverting TTL compatible control input. High = on, low = off.
2	GND	Ground.
3	IN	Supply Input: Output MOSFET source. Also supplies the IC's internal circuitry. Connect to supply.
4	OUT	Switch Output: Output MOSFET drain. Connect to switched side of load.
5	NC	Not internally connected. Connect to ground plane for lowest package thermal resistance.

4.0 FUNCTIONAL DESCRIPTION

The MIC2514 is a non-inverting high-side switch. A logic-high control input turns on the output transistor, and a logic-low turns off the output transistor. Fault conditions turn off the output transistor.

4.1 Control Input

Applying a logic-high input to CTL (control input) activates the thermal shutdown and gate control circuits. If there are no fault conditions, the output MOSFET turns on.

4.2 Gate Control

The gate control circuit applies the supply voltage to the output MOSFET gate, turning it off, or forces the MOSFET gate below the supply voltage, turning it on, as determined by CTL and thermal shutdown.

4.3 Input and Output

IN (input) is the supply connection to the logic circuitry and the source of the output MOSFET. OUT (output) is the drain of the output MOSFET. In a typical circuit; current flows through the switch from IN to OUT toward the load.

The output MOSFET has an intrinsic body diode which will conduct if OUT is forced to a higher voltage than IN.

4.4 Thermal Shutdown

Thermal shutdown turns off the output MOSFET if the die temperature exceeds approximately 170°C. Thermal shutdown releases the output after the die temperature decreases 10°C.

4.5 Current Limit

The current limit is preset internally. The preset level prevents damage to the output MOSFET but allows a typical current of 1.9A through the output MOSFET for the MIC2514. This current limit is sufficient to protect the bond wire and the output device from instantaneous high current. Package thermal ratings and power dissipation should be considered when determining safe continuous operating current. Output current is monitored by sensing the voltage drop across the output MOSFET source metal resistance.

5.0 PACKAGING INFORMATION

5.1 Package Marking Information

5-Lead SOT-23* (Front)	Example	5-Lead SOT-23* (Back)	Example
XXX	F10	NNN	RF9

Legend: XX...X Product code or customer-specific information
Y Year code (last digit of calendar year)
YY Year code (last 2 digits of calendar year)
WW Week code (week of January 1 is week '01')
NNN Alphanumeric traceability code
(e3) Pb-free JEDEC® designator for Matte Tin (Sn)
* This package is Pb-free. The Pb-free JEDEC designator ((e3)) can be found on the outer packaging for this package.

●, ▲, ▼ Pin one index is identified by a dot, delta up, or delta down (triangle mark).

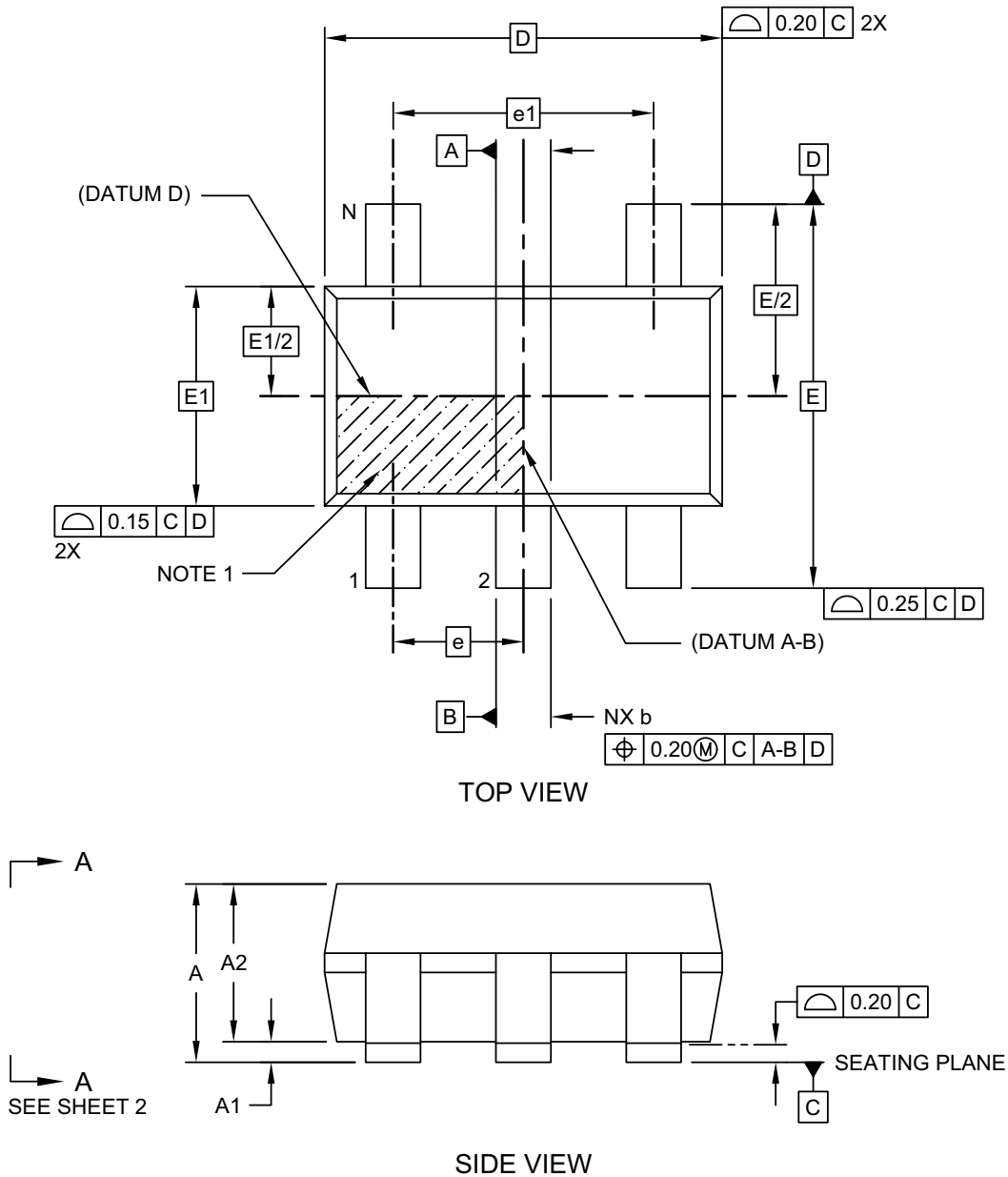
Note: In the event the full Microchip part number cannot be marked on one line, it will be carried over to the next line, thus limiting the number of available characters for customer-specific information. Package may or may not include the corporate logo.

Underbar (_) and/or Overbar (¯) symbol may not be to scale.

Note: If the full seven-character YYWWNNN code cannot fit on the package, the following truncated codes are used based on the available marking space:
6 Characters = YWWNNN; 5 Characters = WWNNN; 4 Characters = WNNN; 3 Characters = NNN;
2 Characters = NN; 1 Character = N

5-Lead Plastic Small Outline Transistor (6BX) [SOT-23]

Note: For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>

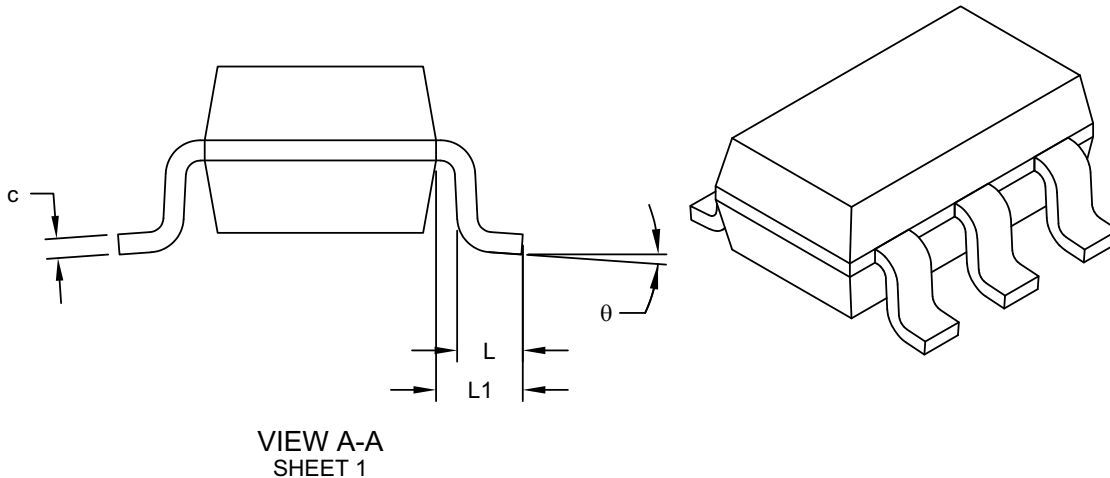


Microchip Technology Drawing C04-091-6BX Rev H Sheet 1 of 2

MIC2514

5-Lead Plastic Small Outline Transistor (6BX) [SOT-23]

Note: For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>



		Units	MILLIMETERS		
Dimension Limits			MIN	NOM	MAX
Number of Pins	N		5		
Pitch	e		0.95 BSC		
Outside lead pitch	e1		1.90 BSC		
Overall Height	A	0.90	-	-	1.45
Molded Package Thickness	A2	0.89	-	-	1.30
Standoff	A1	-	-	-	0.15
Overall Width	E		2.80 BSC		
Molded Package Width	E1		1.60 BSC		
Overall Length	D		2.90 BSC		
Foot Length	L	0.30	-	-	0.60
Footprint	L1		0.60 REF		
Foot Angle	θ	0°	-	-	10°
Lead Thickness	c	0.08	-	-	0.26
Lead Width	b	0.20	-	-	0.51

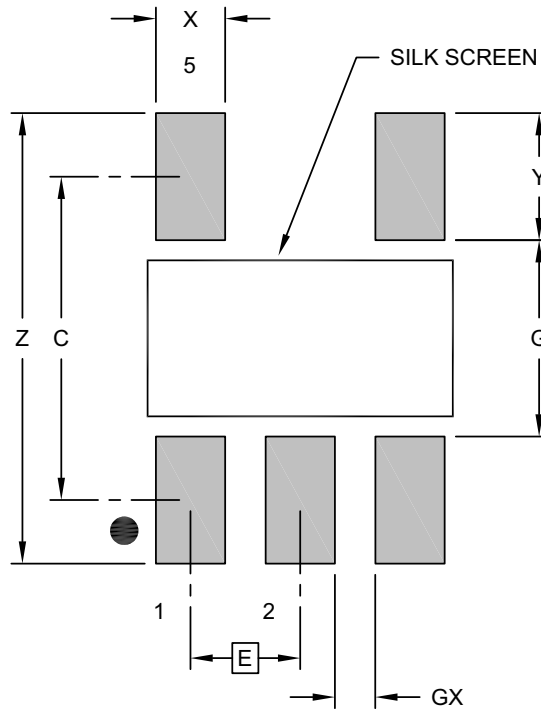
Notes:

- Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.25mm per side.
- Dimensioning and tolerancing per ASME Y14.5M
BSC: Basic Dimension. Theoretically exact value shown without tolerances.
REF: Reference Dimension, usually without tolerance, for information purposes only.

Microchip Technology Drawing C04-091-6BX Rev H Sheet 2 of 2

5-Lead Plastic Small Outline Transistor (6BX) [SOT-23]

Note: For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>



RECOMMENDED LAND PATTERN

Dimension Limits	Units	MILLIMETERS		
		MIN	NOM	MAX
Contact Pitch	E		0.95 BSC	
Contact Pad Spacing	C		2.80	
Contact Pad Width (X5)	X			0.60
Contact Pad Length (X5)	Y			1.10
Distance Between Pads	G	1.70		
Distance Between Pads	GX	0.35		
Overall Width	Z			3.90

Notes:

1. Dimensioning and tolerancing per ASME Y14.5M

BSC: Basic Dimension. Theoretically exact value shown without tolerances.

Microchip Technology Drawing No. C04-2091-6BX Rev H

MIC2514

NOTES:

APPENDIX A: REVISION HISTORY

Revision A (May 2024)

- Converted Micrel document MIC2514 to Microchip data sheet DS20006898A.
- Minor text changes throughout.

MIC2514

NOTES:

PRODUCT IDENTIFICATION SYSTEM

To order or obtain information, e.g., on pricing or delivery, contact your local Microchip representative or sales office.

<u>Part Number</u>	<u>X</u>	<u>XX</u>	<u>-XX</u>	Examples:
Device	Temperature Range	Package	Media Type	
Device:	MIC2514:	Integrated High-Side Switch		a) MIC2514YM5-TR: MIC2514, –40°C to +85°C Temp. Range, 5-Lead SOT-23, 3,000/Reel Note: Tape and Reel identifier only appears in the catalog part number description. This identifier is used for ordering purposes and is not printed on the device package. Check with your Microchip Sales Office for package avail- ability with the Tape and Reel option.
Temperature Range:	Y	=	–40°C to +85°C	
Package:	M5	=	5-Lead SOT-23	
Media Type:	TR	=	3,000/Reel	

MIC2514

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