High-Side and Low-Side Gate Driver

MCP14LH2101

Description

The MCP14LH2101 is a high-voltage, high-speed gate driver capable of driving N-channel MOSFETs and IGBTs in a high-side/low-side configuration. Microchip's high voltage process enables the MCP14LH2101 high-side to switch to 600V in a bootstrap operation. The 50 ns (maximum) propagation delay matching between the high and the low-side drivers allows high frequency switching.

The MCP14LH2101 logic inputs are compatible with standard TTL and CMOS levels (down to 3.3V) for easy interfacing with controlling devices. The driver outputs feature high pulse current buffers designed for minimum driver cross conduction. The low-side gate driver and logic share a common ground.

The MCP14LH2101 is available in a space-saving 8-pin SOIC package; the operating temperature extends from -40°C to +125°C.

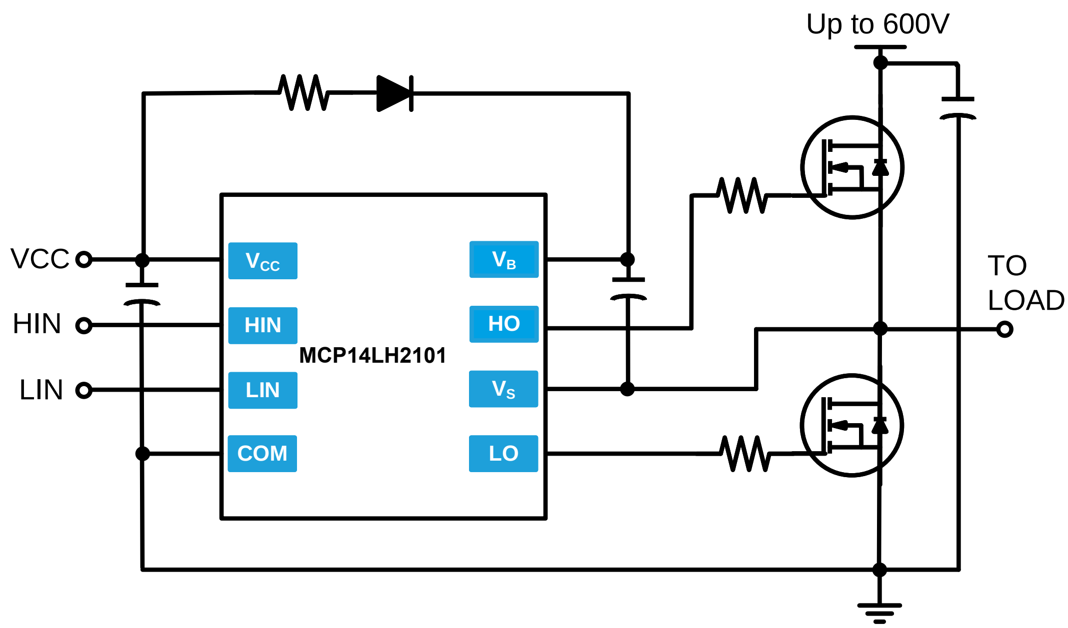
Features

- Floating High-side Driver in Bootstrap Operation up to 600V
- Drives Two N-Channel MOSFETs or IGBTs in a High-side/Low-side Configuration
- Outputs Tolerant to Negative Transients
- Drive current, IO+/IO- = 290 mA/600 mA Typical
- Wide Low-side Gate Driver and Logic Supply: 10V to 20V
- Logic Inputs CMOS and TTL Compatible (Down to 3.3V)
- Schmitt Triggered Logic Inputs with Internal Pull Down
- Undervoltage Lockout for V_{CC}
- Space-saving SOIC-8 Package Available
- Extended Temperature Range: −40°C to +125°C

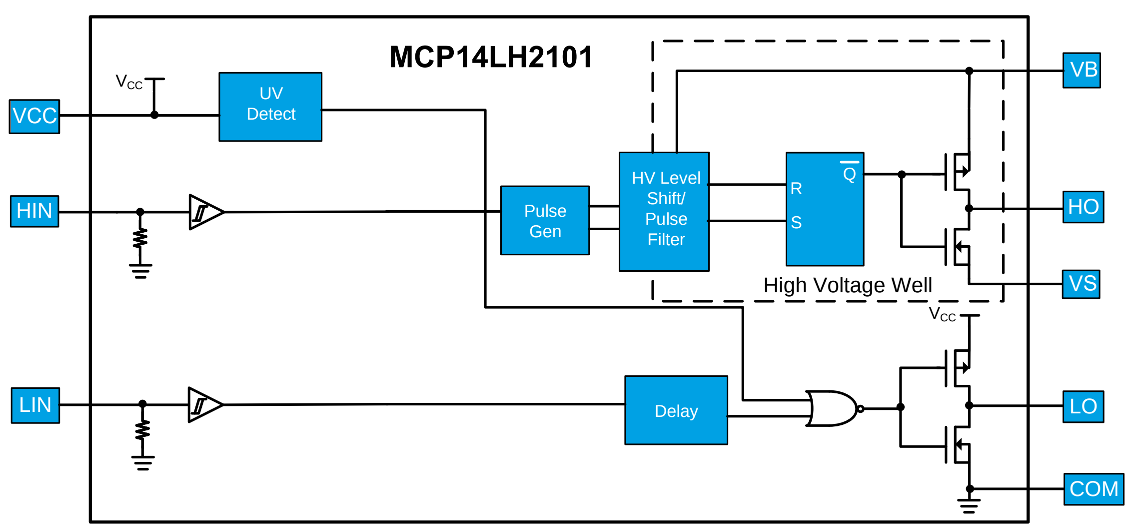
Applications

- DC-DC Converters
- AC-DC Inverters
- Motor Controls
- Class D Power Amplifiers

Typical Application



Block Diagram

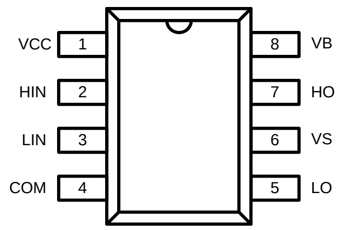


1. Pin Configuration

Pin No.	Pin Name	Pin Description
1	VCC	Low-side and logic fixed supply
2	HIN	Logic input for high-side gate driver output (HO), in phase
3	LIN	Logic input for low-side gate driver output (LO), in phase
4	COM	Low-side return
5	LO	Low-side gate drive output
6	VS	High-side floating supply return
7	HO	High-side gate drive output
8	VB	High-side floating supply

1.1. Package Type

Figure 1-1. SOIC-8 Package (Top View)



2. Electrical Characteristics

2.1. Absolute Maximum Ratings

Parameters	Symbol	Min.	Max.	Unit
High-side Floating Supply Voltage	V_B	−0.3V	+624	V
High-side Floating Supply Offset Voltage	V_S	V_B – 24	V_B + 0.3	V
High-side Floating Output Voltage	V_{HO}	V_S – 0.3	V_B + 0.3	V
Offset Supply Voltage Transient	dV_S/dt	—	50	V/ns
Low-side and Logic Supply Voltage	V_{CC}	−0.3V	24	V
Low-side Output Voltage	V_{LO}	−0.3V	V_{CC} + 0.3	V
Logic Input Voltage (HIN and LIN)	V_{IN}	−0.3V	V_{CC} + 0.3	V
Package Power Dissipation at $T_A \le 25°C$ (SOIC-8)	P_D	—	0.625	W
Thermal Resistance, Junction to Ambient (SOIC-8, Note)	θ_{JA}	—	200	°C/W
Junction Operating Temperature	T_J	−40	+150	°C
Lead Temperature (soldering, 10 seconds)	T_L	—	+300	°C
Storage Temperature	T_{stg}	−55	+150	°C

WARNING 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.

Note: When mounted on a standard JEDEC 2-layer FR-4 board.

2.2. Recommended Operating Conditions

Parameter	Symbol	Min.	Max.	Unit
High-side Floating Supply Absolute Voltage	V_B	V_S + 10	V_S + 20	V
High-side Floating Supply Offset Voltage	V_S	See Note	600	V
High-side Floating Output Voltage	V_{HO}	V_S	V_B	V
Low side and Logic Fixed Supply Voltage	V_{CC}	10	20	V
Low-side Output Voltage	V_{LO}	0	V_{CC}	V
Logic Input Voltage (HIN and LIN)	V_{IN}	0	5	V
Ambient Temperature	T_A	−40	125	°C

Note: Logic operational for V_S of −5V to +600V.

2.3. DC Electrical Characteristics

V_{BIAS} (V_{CC}, V_{BS}) = 15V, T_A = 25°C , unless otherwise specified.						
Parameter (Note 1)	**Symbol**	**Min.**	**Typ.**	**Max.**	**Unit**	**Conditions**
Logic "1" Input Voltage	V_{IH}	2.5	—	—	V	V_{CC} = 10V to 20V (Note 2)
Logic "0" Input Voltage	V_{IL}	—	—	0.8	V	VCC = 10V to 20V (Note 2)
High Level Output Voltage, $V_{BIAS} - V_O$	V_{OH}	—	0.05	0.2	V	I_O = 2 mA
Low Level Output Voltage, V_O	V_{OL}	—	0.02	0.1	V	I_O = 2 mA
Offset Supply Leakage Current	I_{LK}	—	—	50	µA	VB = VS = 600V
Quiescent V_{BS} Supply Current	I_{BSQ}	—	30	55	µA	V_{IN} = 0V or 5V

DC Electrical Characteristics (continued)						
V_{BIAS} (V_{CC}, V_{BS}) = 15V, T_A = 25°C , unless otherwise specified.						
Parameter (Note 1)	Symbol	Min.	Typ.	Max.	Unit	Conditions
Quiescent V_{CC} Supply Current	I_{CCQ}	—	150	270	µA	V_{IN} = 0V or 5V
Logic “1” Input Bias Current	I_{IN+}	—	3	10	µA	V_{IN} = 0V
Logic “0” Input Bias Current	I_{IN-}	—	—	5	µA	V_{IN} = 5V
V_{CC} Supply Undervoltage Positive Going Threshold	V_{CCUV+}	8	8.9	9.8	V	
V_{CC} Supply Undervoltage Negative Going Threshold	V_{CCUV-}	7.4	8.2	9	V	
Output High Short Circuit Pulsed Current	I_{O+}	130	290	—	mA	V_O = 0V, V_{IN} = Logic “1”, PW ≤ 10 µs
Output Low Short Circuit Pulsed Current	I_{O-}	270	600	—	mA	V_O = 15V, V_{IN} = Logic “0”, PW ≤ 10 µs

Notes:

1. The V_{IN}, V_{TH} and I_{IN} parameters are referenced to COM. The V_O and I_O parameters are referenced to COM and are applicable to the respective output pins: HO and LO.
2. For optimal operation, it is recommended that the input pulse (to HIN and LIN) should have an amplitude of 2.5V minimum, with a Pulse Width (PW) of 300 ns, minimum.

2.4. AC Electrical Characteristics

V_{BIAS} (V_{CC}, V_{BS}) = 15V, T_A = 25°C and C_L = 1000 pF, unless otherwise specified.						
Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Turn-on Propagation Delay	t_{on}	—	160	220	ns	V_S = 0V, see Figure 3-2
Turn-off Propagation Delay	t_{off}	—	150	220	ns	V_S = 600V, see Figure 3-2
Turn-on Rise Time	t_r	—	70	170	ns	See Figure 3-2
Turn-off Fall Time	t_f	—	35	90	ns	See Figure 3-2
Delay Matching	t_{DM}	—	—	50	ns	See Figure 3-3

3. Timing Waveforms

Figure 3-1. Input/Output Timing Diagram

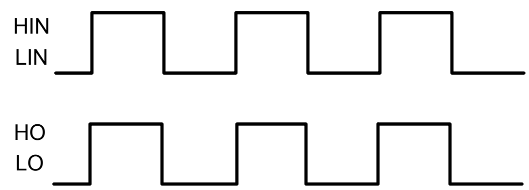


Figure 3-2. Switching Time Waveform Definitions

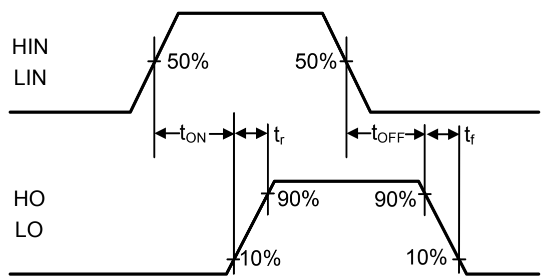
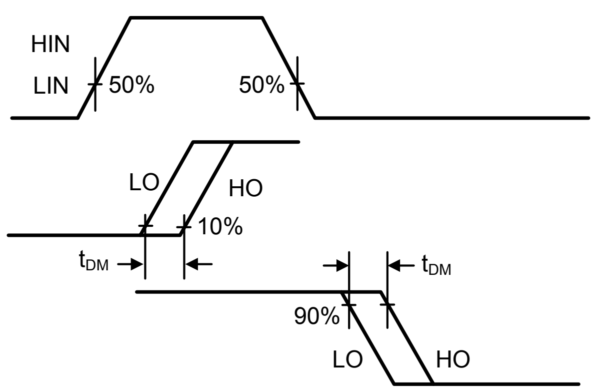
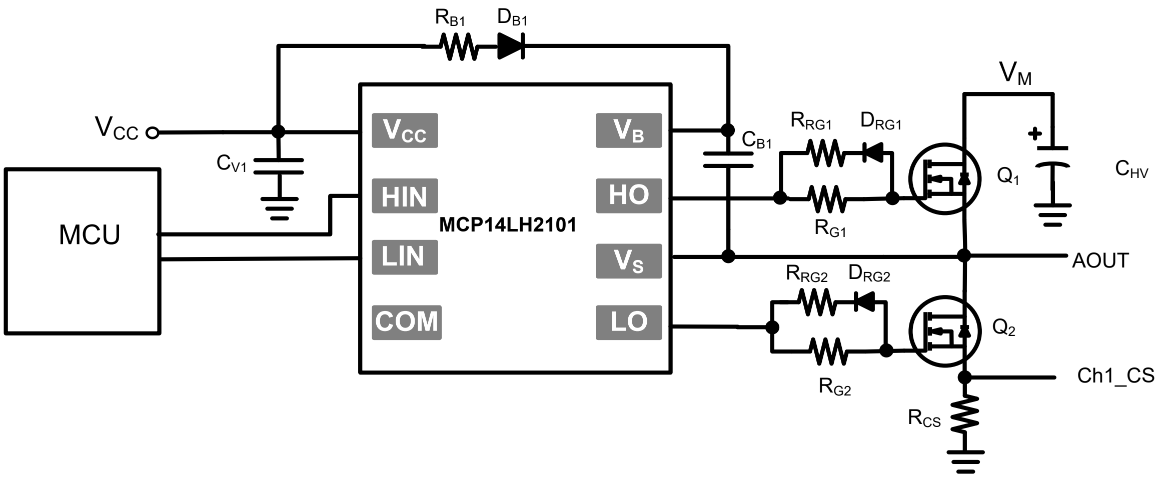


Figure 3-3. Delay Matching Waveform Definitions



4. Application Information

Figure 4-1. Single Phase (of Four) for Stepper Motor Driver Application Using the MCP14LH2101



- RRG1 and RRG2 values are typically between 0Ω and 10Ω, exact value decided by MOSFET junction capacitance and drive current of gate driver; 10Ω is used in this example.
- RG1 and RG2 values are typically between 10Ω and 100Ω, exact value decided by MOSFET junction capacitance and drive current of gate driver; 50Ω is used in this example.
- RB1 value is typically between 3Ω and 20Ω, exact value depending on bootstrap capacitor value and amount of current limiting required for bootstrap capacitor charging; 10Ω is used in this example. Also DB should be an ultra fast diode of 1A rating minimum and voltage rating greater than system operating voltage.
- It is recommended that the input pulse (to HIN and LIN) should have an amplitude of 2.5V minimum (for VDD=15V) with a minimum pulse width of 300 ns.

5. Typical Characteristics

Figure 5-1. Output Source Current vs. Supply Voltage

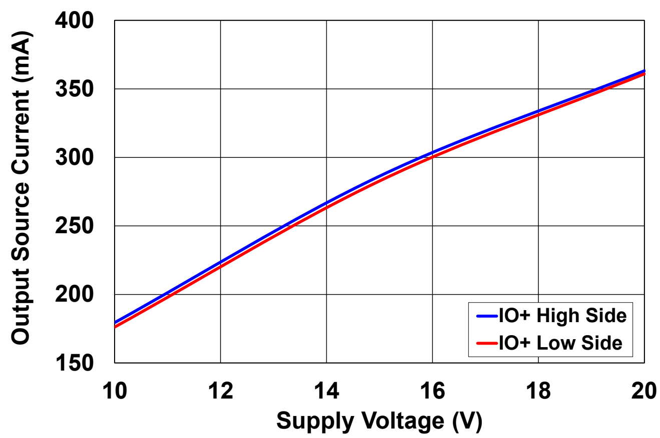


Figure 5-2. Output Source Current vs. Temperature

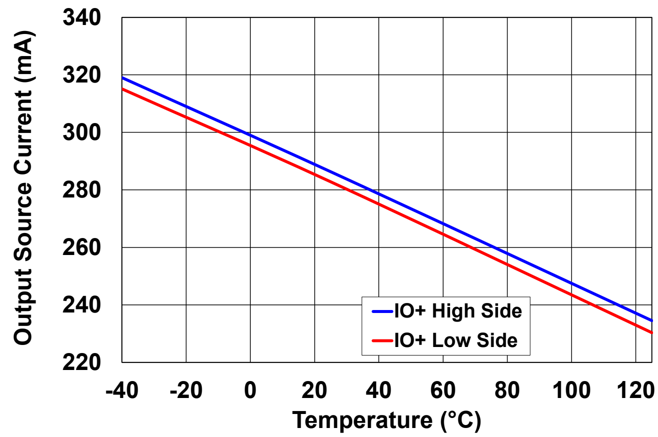


Figure 5-3. Output Sink Current vs. Supply Voltage

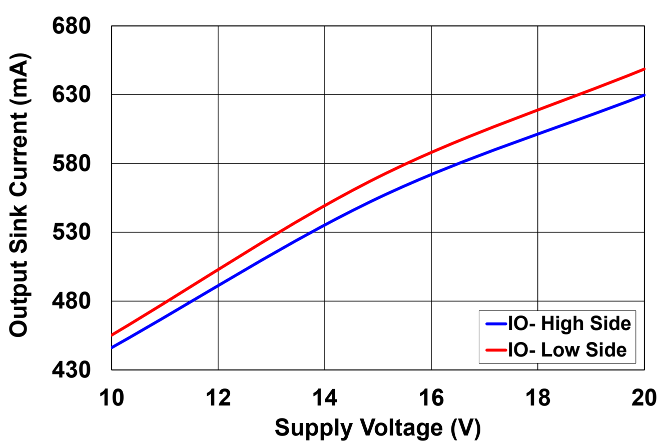


Figure 5-4. Output Sink Current vs. Temperature

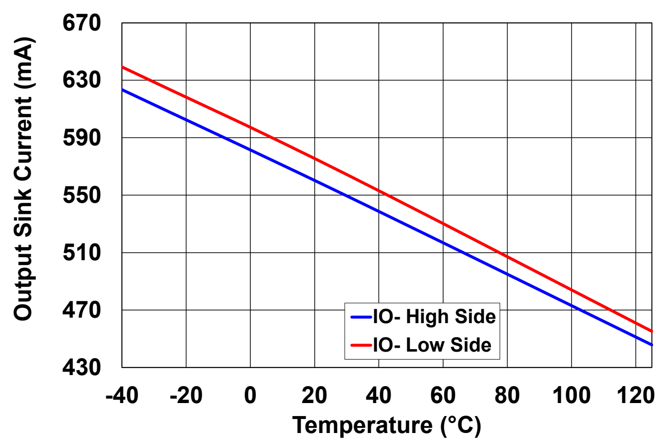


Figure 5-5. Logic 1 Input Voltage vs. Supply Voltage

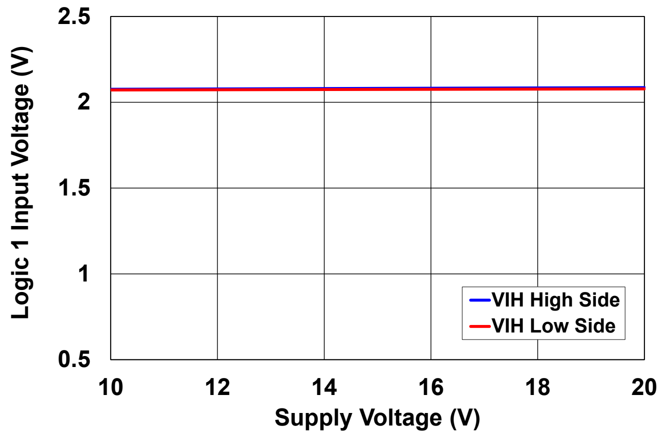


Figure 5-6. Logic 1 Input Voltage vs. Temperature

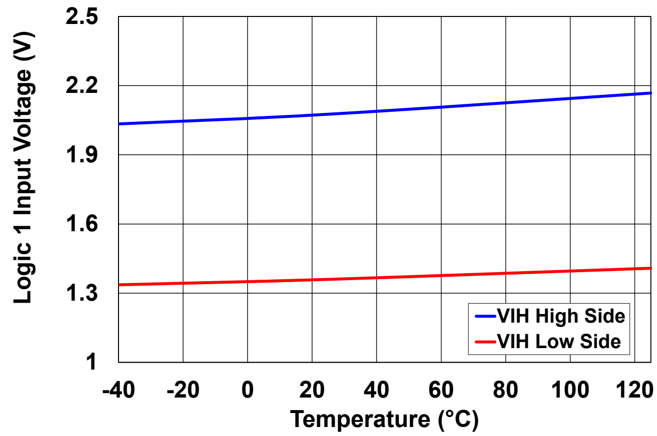


Figure 5-7. Logic 0 Input Voltage vs. Supply Voltage

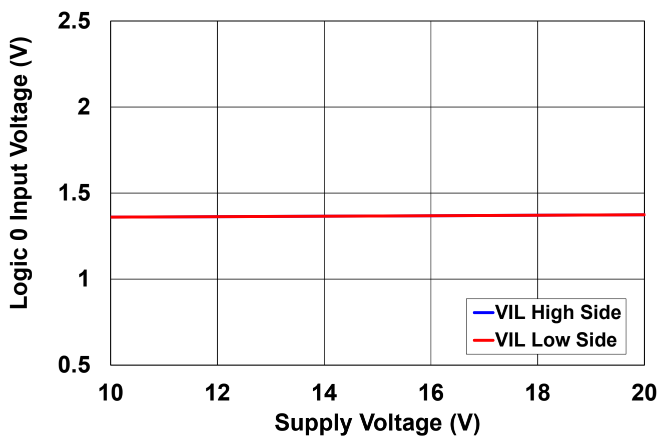


Figure 5-8. Logic 0 Input Voltage vs. Temperature

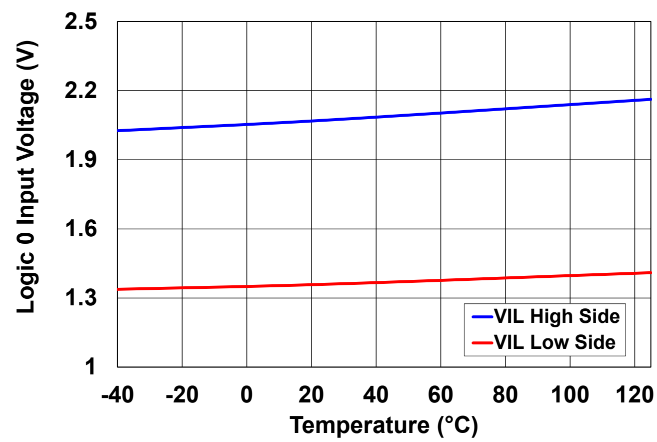


Figure 5-9. Quiescent Current vs. Supply Voltage

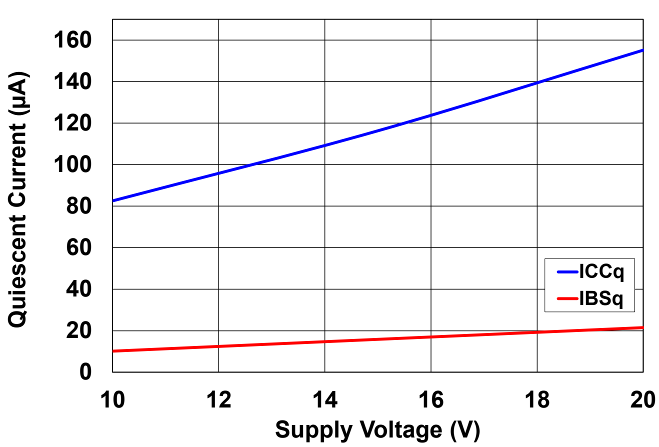


Figure 5-10. Quiescent Current vs. Temperature

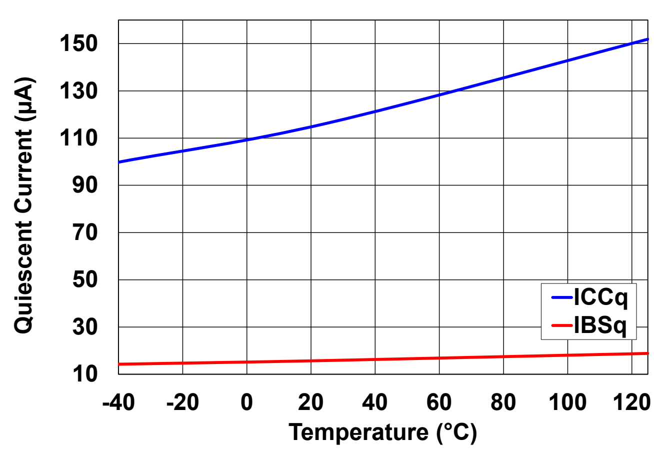


Figure 5-11. Turn-on Propagation Delay vs. Supply Voltage

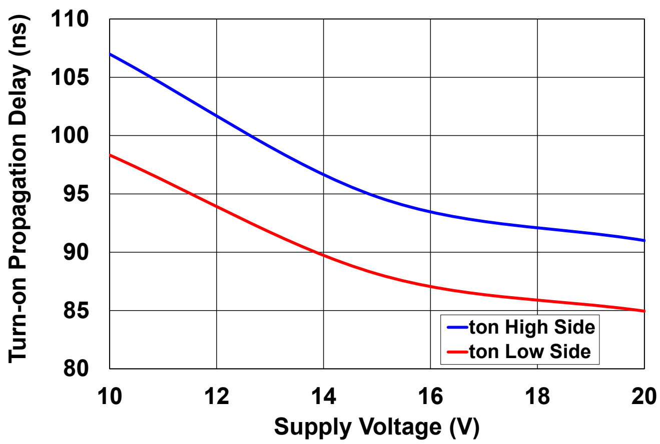


Figure 5-12. Turn-on Propagation Delay vs. Temperature

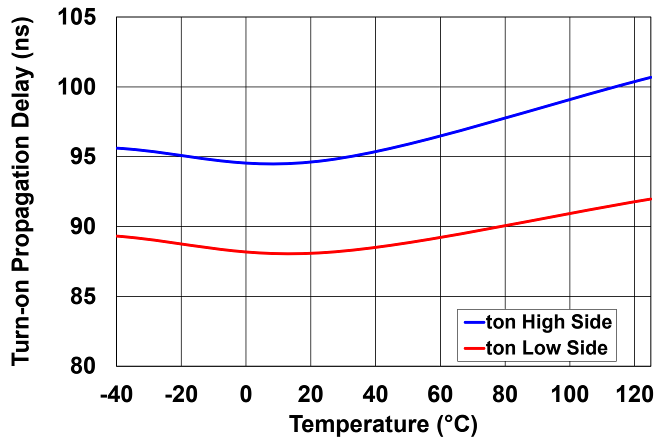


Figure 5-13. Turn-off Propagation Delay vs. Supply Voltage

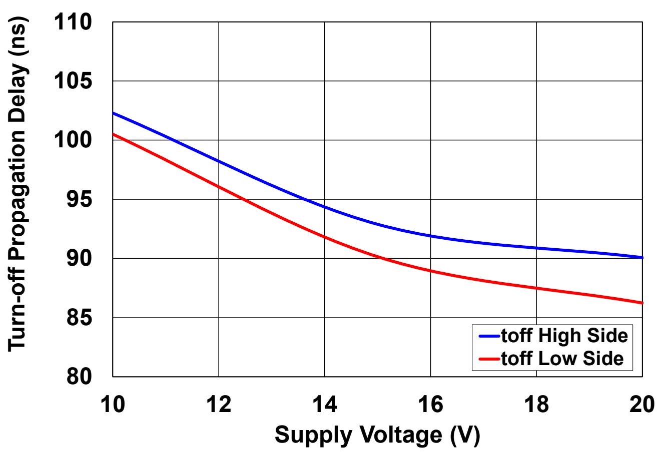


Figure 5-14. Turn-off Propagation Delay vs. Temperature

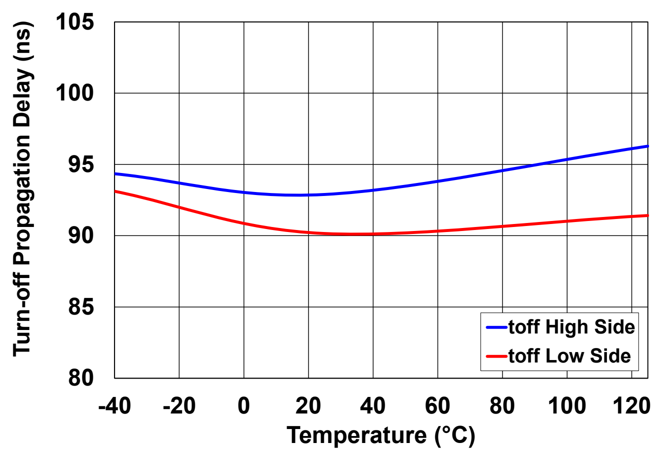


Figure 5-15. Rise Time vs. Supply Voltage

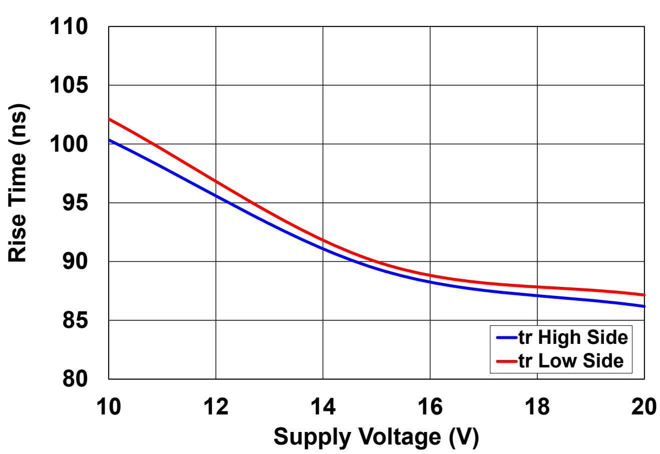


Figure 5-16. Rise Time vs. Temperature

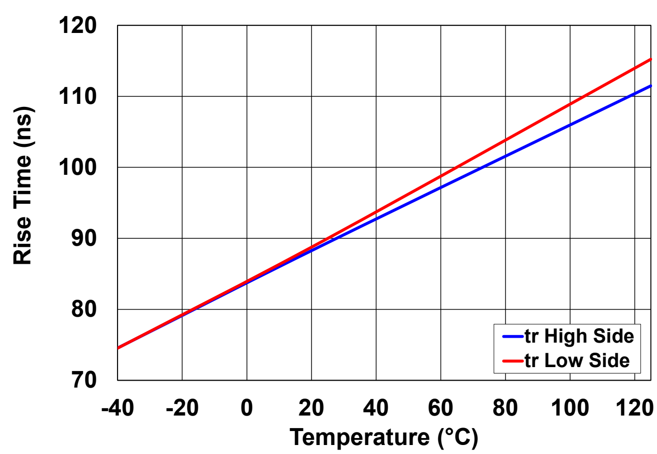


Figure 5-17. Fall Time vs. Supply Voltage

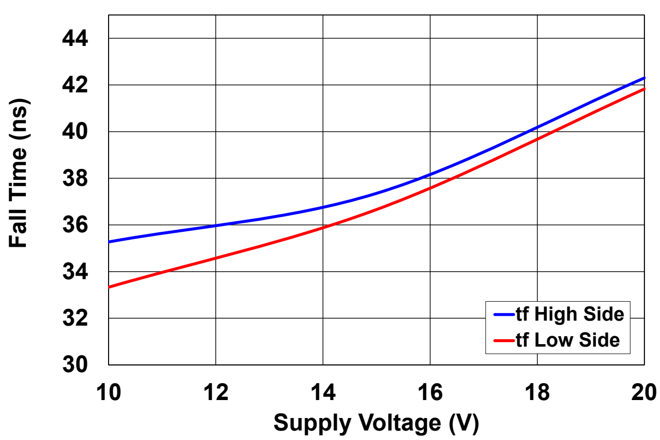


Figure 5-18. Fall Time vs. Temperature

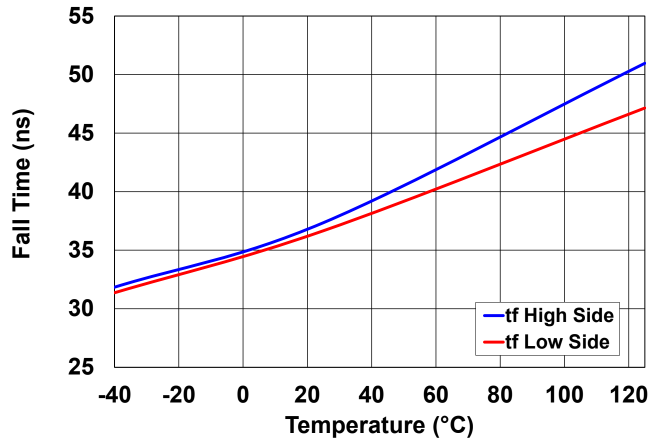


Figure 5-19. Delay Matching vs. Supply Voltage

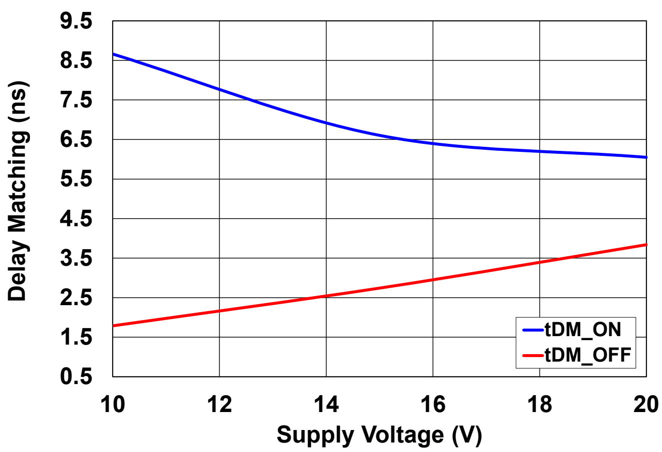


Figure 5-20. Delay Matching vs. Temperature

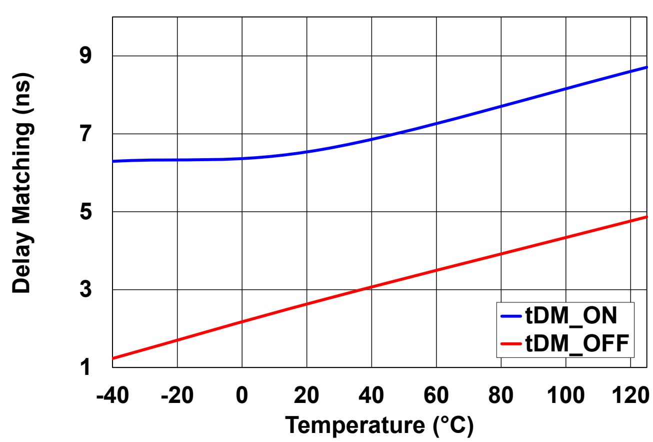


Figure 5-21. V_{CC} UVLO vs. Temperature

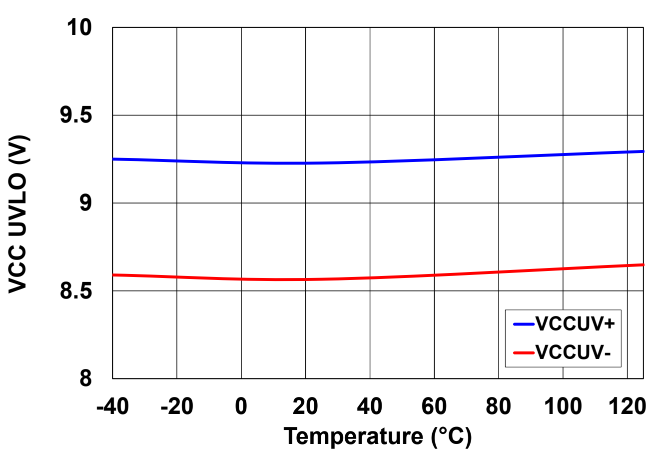
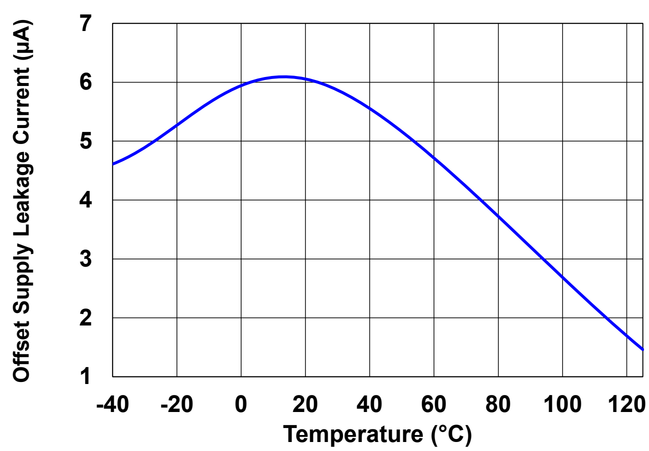


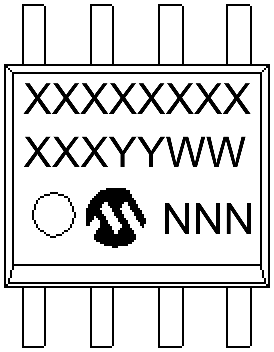
Figure 5-22. Offset Supply Leakage Current vs. Temperature



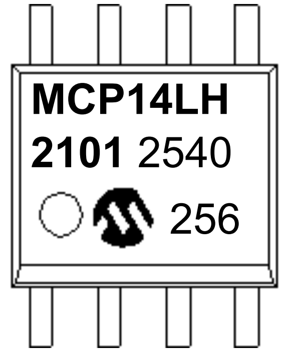
6. Packaging Information

Package Marking Information

8-Pin SOIC:



Example:



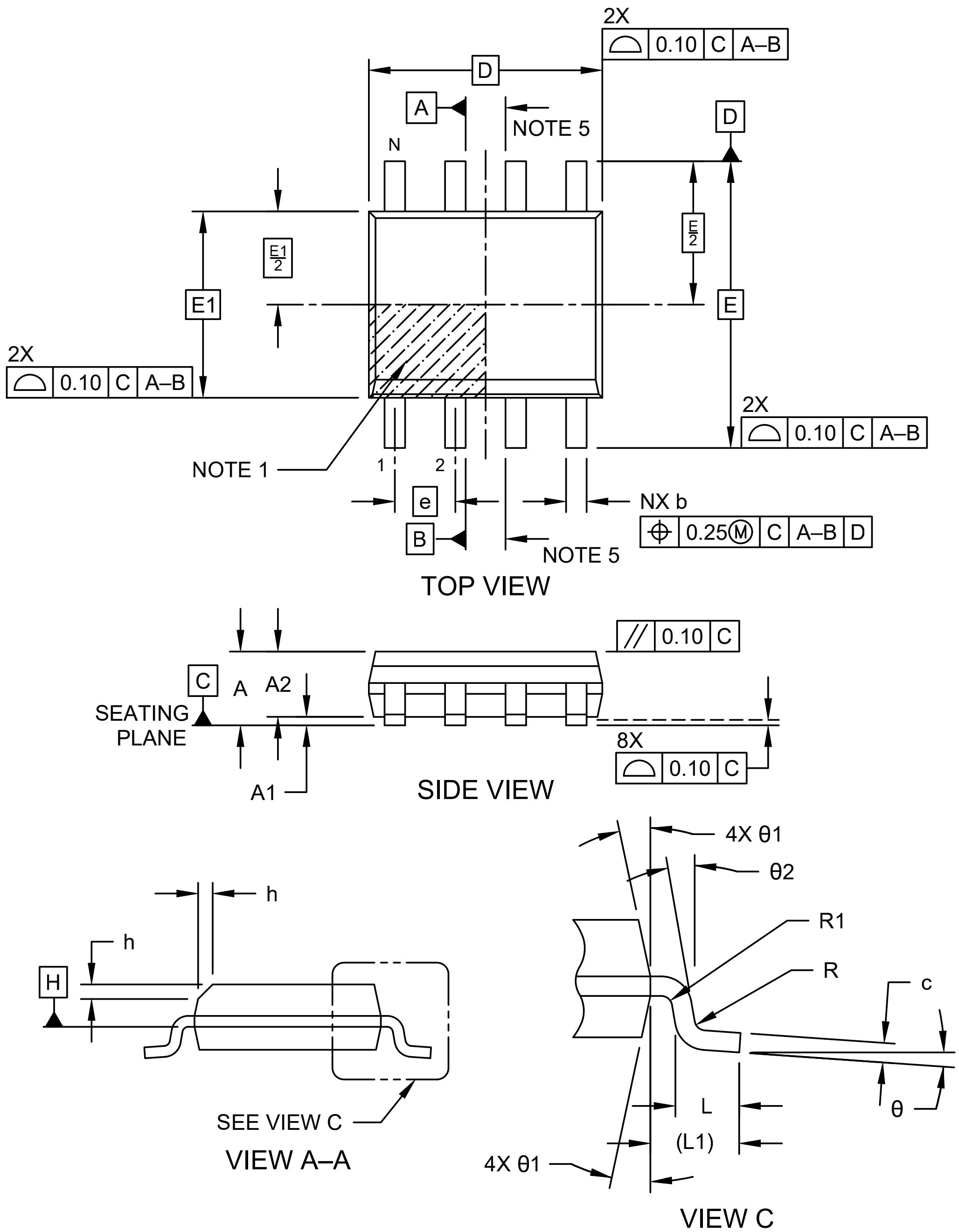
Legend:	XX...X	Product Code or Customer-specific information
	Y	Year code (last digit of calendar year)
	YY	Year code (last 2 digits of calendar year)
	WW	Week code (week of January 1 is week '01')
	NNN	Alphanumeric traceability code
	(e3)	Pb-free JEDEC designator for Matte Tin (Sn)
	*	This package is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

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 not include the corporate logo.

Package Outline Drawings

8-Lead Plastic Small Outline (SN) - Narrow, 3.90 mm (.150 In.) Body [SOIC]

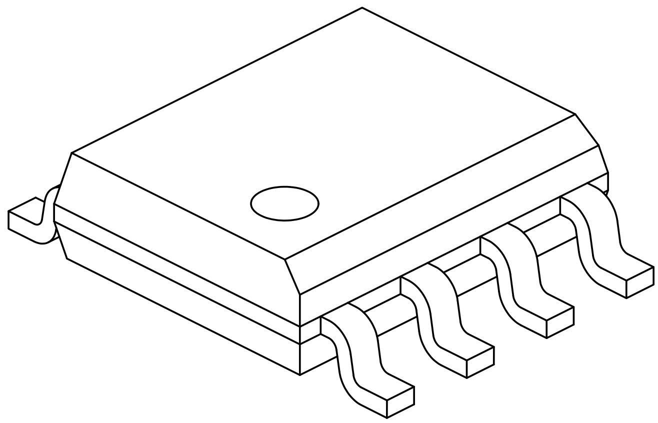
Note:	For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



Microchip Technology Drawing No. C04-00057-SN Rev L Sheet 1 of 2

8-Lead Plastic Small Outline (SN) - Narrow, 3.90 mm (.150 In.) Body [SOIC]

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	8		
Pitch	e	1.27 BSC		
Overall Height	A	–	–	1.75
Molded Package Thickness	A2	1.25	–	-
Standoff §	A1	0.10	–	0.25
Overall Width	E	6.00 BSC		
Molded Package Width	E1	3.90 BSC		
Overall Length	D	4.90 BSC		
Chamfer (Optional)	h	0.25	–	0.50
Foot Length	L	0.40	–	1.27
Footprint	L1	1.04 REF		
Lead Thickness	c	0.17	–	0.25
Lead Width	b	0.31	–	0.51
Lead Bend Radius	R	0.07	–	–
Lead Bend Radius	R1	0.07	–	–
Foot Angle	θ	0°	–	8°
Mold Draft Angle	θ1	5°	–	15°
Lead Angle	θ2	0°	–	–

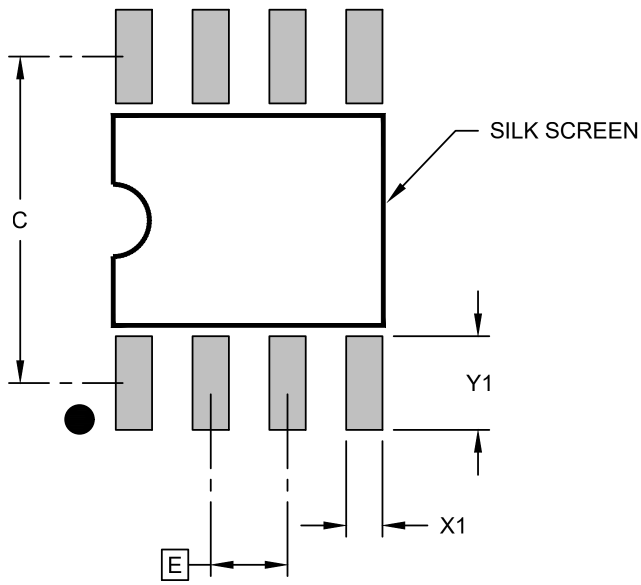
Notes:

1. The Pin 1 visual index feature may vary, but it must be located within the hatched area.
2. § Significant Characteristic
3. Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.15mm per side.
4. 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.
5. Datums A & B to be determined at Datum H.

Microchip Technology Drawing No. C04-00057-SN Rev L Sheet 2 of 2

8-Lead Plastic Small Outline (SN) - Narrow, 3.90 mm (.150 In.) Body [SOIC]

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



RECOMMENDED LAND PATTERN

Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Contact Pitch	E	1.27 BSC		
Contact Pad Spacing	C		5.40	
Contact Pad Width (X8)	X1			0.60
Contact Pad Length (X8)	Y1			1.55

Notes:

1. Dimensioning and tolerancing per ASME Y14.5M
   BSC: Basic Dimension. Theoretically exact value shown without tolerances.

Microchip Technology Drawing C04-02057-SN Rev L

7. Revision History

Doc Rev	Date	Section	Comments
A	11/2025		Initial release of this document.

Product Identification System

To order or obtain information, for example, on pricing or delivery, contact Microchip: https://www.microchip.com/en-us/about/contact-us.

PART NO.	[T]	-X	/XX
Device	Tape and Reel[(1)]	Temperature Range	Package

Device:	MCP14LH2101: High-side and Low-side Gate Driver	
Tape and Reel Option[(1)]:	Blank	= Tube
	T	= Tape and Reel
Temperature Range:	E	= −40°C to +125°C (Extended)
Package:	SN	= Plastic Small Outline IC, 3.90 mm, SOIC, 8-Pin, (Package Code: SN)

Examples:

- MCP14LH2101T-E/SN: High-side and Low-side Gate Driver, Tape and Reel, Extended Temperature Range, SOIC-8 Package

Notes:

1. 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 availability with the Tape and Reel option.
2. Small form-factor packaging options may be available. Please check www.microchip.com/packaging for small-form factor package availability, or contact your local Sales Office.

Product Change Notification Service

Microchip's product change notification service helps keep customers current on Microchip products. Subscribers will receive email notification whenever there are changes, updates, revisions or errata related to a specified product family or development tool of interest.

To register, go to www.microchip.com/pcn and follow the registration instructions.

Microchip Information

Trademarks

The “Microchip” name and logo, the “M” logo, and other names, logos, and brands are registered and unregistered trademarks of Microchip Technology Incorporated or its affiliates and/or subsidiaries in the United States and/or other countries (“Microchip Trademarks”). Information regarding Microchip Trademarks can be found at https://www.microchip.com/en-us/about/legal-information/microchip-trademarks.

ISBN: 979-8-3371-2284-7

Legal Notice

This publication and the information herein may be used only with Microchip products, including to design, test, and integrate Microchip products with your application. Use of this information in any other manner violates these terms. Information regarding device applications is provided only for your convenience and may be superseded by updates. It is your responsibility to ensure that your application meets with your specifications. Contact your local Microchip sales office for additional support or, obtain additional support at www.microchip.com/en-us/support/design-help/client-support-services.

THIS INFORMATION IS PROVIDED BY MICROCHIP “AS IS”. MICROCHIP MAKES NO REPRESENTATIONS OR WARRANTIES OF ANY KIND WHETHER EXPRESS OR IMPLIED, WRITTEN OR ORAL, STATUTORY OR OTHERWISE, RELATED TO THE INFORMATION INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTIES OF NON-INFRINGEMENT, MERCHANTABILITY, AND FITNESS FOR A PARTICULAR PURPOSE, OR WARRANTIES RELATED TO ITS CONDITION, QUALITY, OR PERFORMANCE.

IN NO EVENT WILL MICROCHIP BE LIABLE FOR ANY INDIRECT, SPECIAL, PUNITIVE, INCIDENTAL, OR CONSEQUENTIAL LOSS, DAMAGE, COST, OR EXPENSE OF ANY KIND WHATSOEVER RELATED TO THE INFORMATION OR ITS USE, HOWEVER CAUSED, EVEN IF MICROCHIP HAS BEEN ADVISED OF THE POSSIBILITY OR THE DAMAGES ARE FORESEEABLE. TO THE FULLEST EXTENT ALLOWED BY LAW, MICROCHIP’S TOTAL LIABILITY ON ALL CLAIMS IN ANY WAY RELATED TO THE INFORMATION OR ITS USE WILL NOT EXCEED THE AMOUNT OF FEES, IF ANY, THAT YOU HAVE PAID DIRECTLY TO MICROCHIP FOR THE INFORMATION.

Use of Microchip devices in life support and/or safety applications is entirely at the buyer’s risk, and the buyer agrees to defend, indemnify and hold harmless Microchip from any and all damages, claims, suits, or expenses resulting from such use. No licenses are conveyed, implicitly or otherwise, under any Microchip intellectual property rights unless otherwise stated.

Microchip Devices Code Protection Feature

Note the following details of the code protection feature on Microchip products:

- Microchip products meet the specifications contained in their particular Microchip Data Sheet.
- Microchip believes that its family of products is secure when used in the intended manner, within operating specifications, and under normal conditions.
- Microchip values and aggressively protects its intellectual property rights. Attempts to breach the code protection features of Microchip products are strictly prohibited and may violate the Digital Millennium Copyright Act.
- Neither Microchip nor any other semiconductor manufacturer can guarantee the security of its code. Code protection does not mean that we are guaranteeing the product is “unbreakable”. Code protection is constantly evolving. Microchip is committed to continuously improving the code protection features of our products.