Half-Bridge Gate Driver

MCP14H2103, MCP14H2104

Description

The MCP14H2103 and MCP14H2104 are high-voltage, high-speed gate drivers capable of driving N-channel MOSFETs and IGBTs in a half-bridge configuration. Microchip's high voltage process enables the MCP14H2103 and MCP14H2104 high-side to switch to 600V in a bootstrap operation.

The MCP14H2103 and MCP14H2104 logic inputs are compatible with standard TTL and CMOS levels (down to 3.3V) to interface easily with controlling devices. The driver outputs feature high pulse current buffers designed for minimum driver cross conduction.

The MCP14H2103 has a fixed internal deadtime of 420 ns (typical).

The MCP14H2103 and MCP14H2104 are offered in an SOIC-8 (N) package and operate over an extended -40°C to +125°C temperature range.

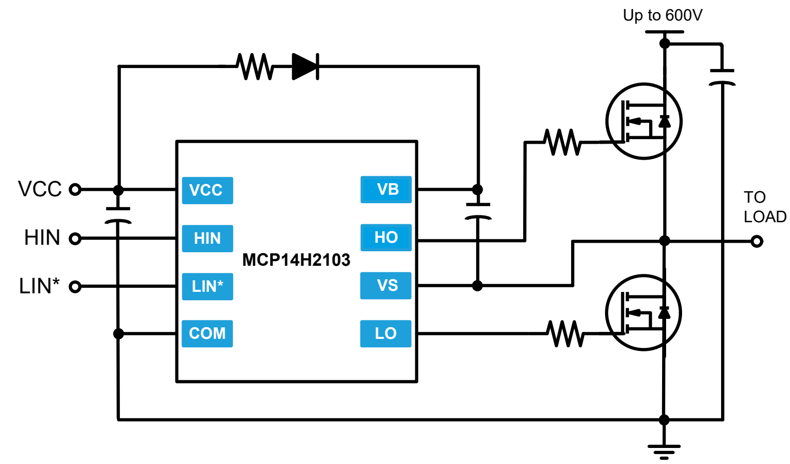
Features

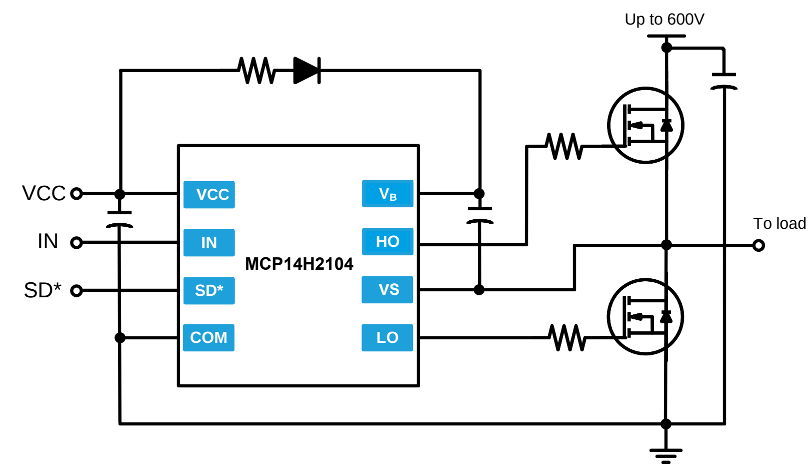
- Floating High-side Driver in Bootstrap Operation up to 600V
- Drives Two N-Channel MOSFETs or IGBTs in a Half-bridge Configuration
- Designed for Enhanced Performance in Noisy Motor Applications
- 290 mA Source/600 mA Sink Output Current Capability
- Outputs Tolerant to Negative Transients
- Internal Dead Time of 420 ns to Protect MOSFETs
- Wide Low-side Gate Driver Supply Voltage: 10V to 20V
- Logic Input (HIN and LIN*) 3.3V Capability (**MCP14H2103**)
- Logic Input (IN and SD*) 3.3V Capability (**MCP14H2104**)
- Schmitt Triggered Logic Inputs
- Undervoltage Lockout for V_{CC} (Logic and Low-Side Supply)
- Extended Temperature Range: −40°C to +125°C

Applications

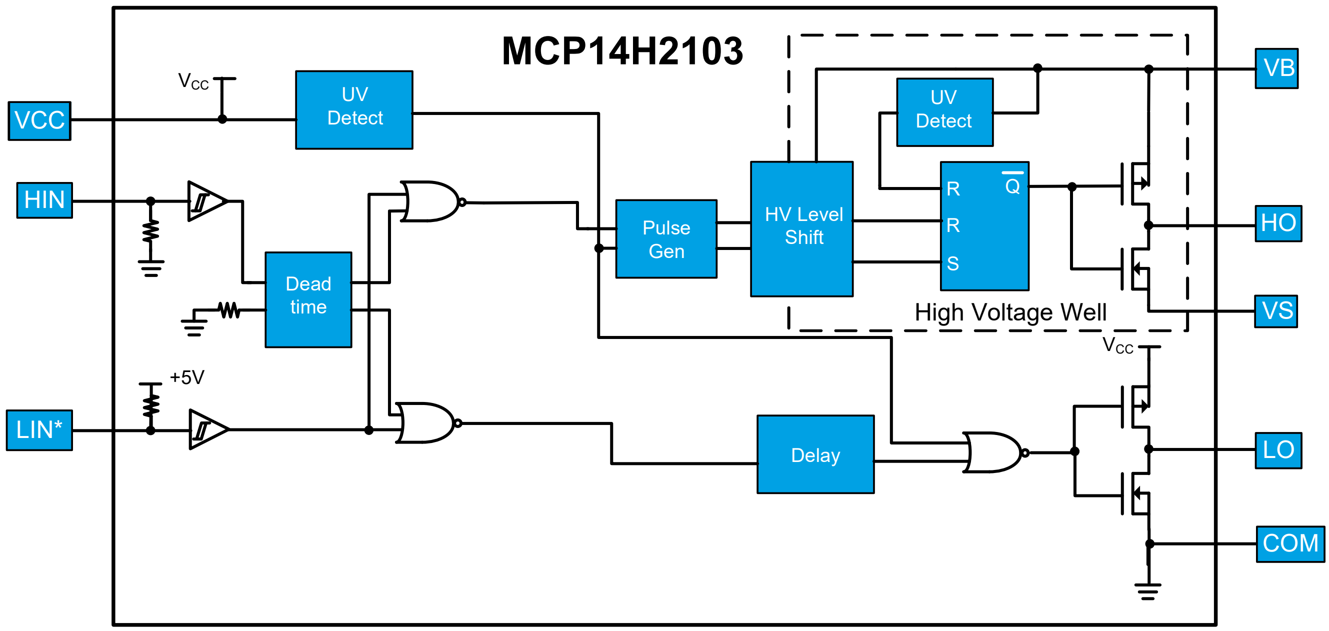
- Motor Controls
- DC-DC Converters
- AC-DC Inverters
- Motor Drives

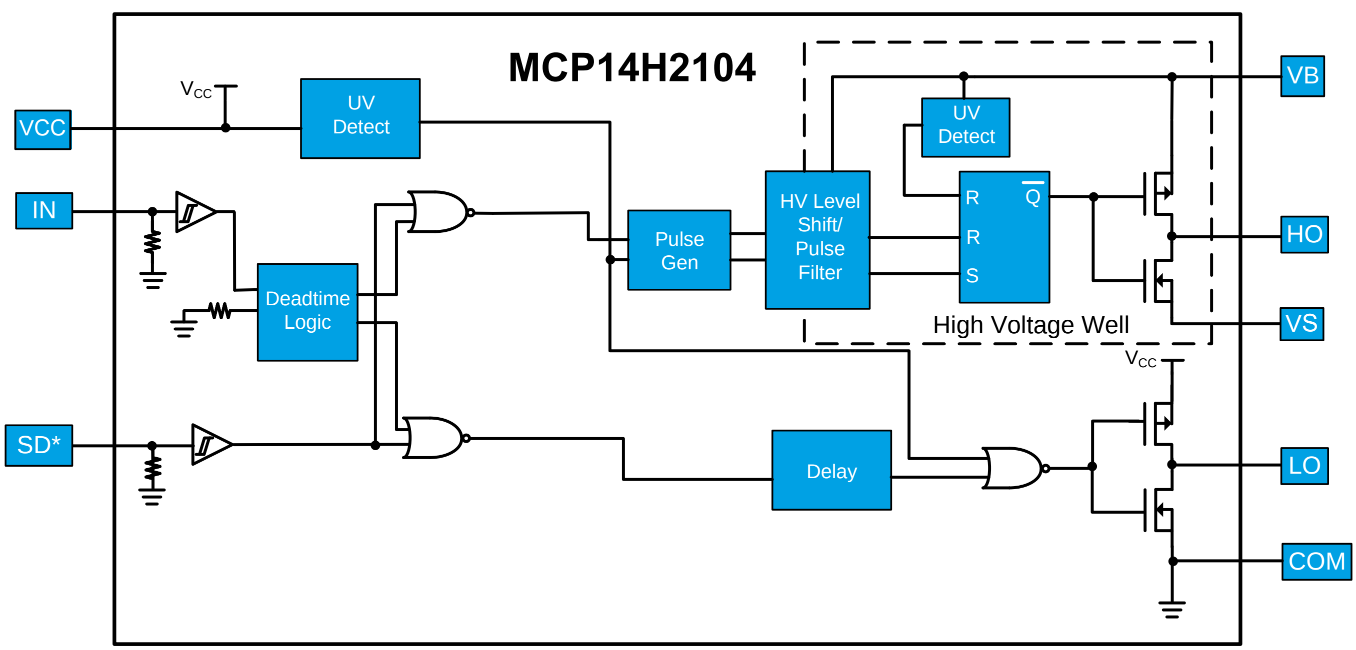
Typical Applications





Block Diagram





1. Pin Configuration

Pin No.	Pin Name MCP14H2103	Pin Name MCP14H2104	Pin Description
1	VCC	VCC	Logic and low-side supply
2	HIN	—	Logic input for high-side gate driver output in phase with HO
2	—	IN	Logic input for high-side and low-side gate driver outputs (HO and LO), in phase with HO
3	LIN*	—	Logic input for low-side gate driver output out of phase with LO
3	—	SD*	Logic input for shutdown, enabled low
4	COM	COM	Low-side and logic return
5	LO	LO	Low-side gate drive output
6	VS	VS	High-side floating supply return
7	HO	HO	High-side gate drive output
8	VB	VB	High-side floating supply

1.1. Package Type

Figure 1-1. SOIC-8 Package (MCP14H2103 - Top View)

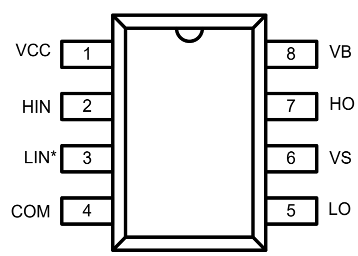
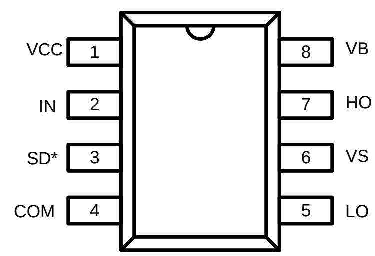


Figure 1-2. SOIC-8 Package (MCP14H2104 - Top View)



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 Fixed Supply Voltage	V_{CC}	−0.3V	24	V
Low-side Output Voltage	V_{LO}	−0.3V	V_{CC} + 0.3	V
Logic Input Voltage (**MCP14H2103**, HIN and LIN*)	V_{IN}	−0.3V	V_{CC} + 0.3	V
Logic Input Voltage (**MCP14H2104**, IN and SD*)	V_{IN}	−0.3V	V_{CC} + 0.3	V
SOIC-8 Package Power Dissipation at T_A ≤ 25°C	P_D	—	0.625	W
SOIC-8(N) Thermal Resistance (see Note)	$θ_{JA}$	—	200	°C/W
Junction Operating Temperature	T_J	—	+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 Fixed Supply Voltage	V_{CC}	10	20	V
Low-side Output Voltage	V_{LO}	0	V_{CC}	V
Logic Input Voltage (**MCP14H2103**, HIN and LIN*)	V_{IN}	0	5	V
Logic Input Voltage (**MCP14H2104**, IN and SD*)	V_{IN}	0	5	V
Ambient Temperature	T_A	−40	125	°C

Note: Logic operational for VS of −5V to +600V. For MCP14H2103 only - Logic state held for VS of -5V to -VBS.

2.3. DC Electrical Characteristics

V_{BIAS} (V_{CC}, V_{BS}) = 15V, T_A = 25°C , unless otherwise specified.						
Parameter (Note 1, Note 2)	**Symbol**	**Min.**	**Typ.**	**Max.**	**Unit**	**Conditions**
Logic “1” (HIN) & Logic “0” (LIN*) Input Voltage (**MCP14H2103**)	V_{IH}	2.5	—	—	V	V_{CC} = 10V to 20V (Note 3)
Logic “0” (HIN) & Logic “1” (LIN*) Input Voltage (**MCP14H2103**)	V_{IL}	—	—	0.8	V	V_{CC} = 10V to 20V (Note 3)

DC Electrical Characteristics (continued)

V_{BIAS} (V_{CC}, V_{BS}) = 15V, T_A = 25°C , unless otherwise specified.						
Parameter (Note 1, Note 2)	**Symbol**	**Min.**	**Typ.**	**Max.**	**Unit**	**Conditions**
Logic “1” (IN) & Logic “0” (SD*) Input Voltage (**MCP14H2104**)	V_{IH}	2.5	—	—	V	V_{CC} = 10V to 20V (Note 4)
Logic “0” (IN) & Logic “1” (SD*) Input Voltage (**MCP14H2104**)	V_{IL}	—	—	0.8	V	V_{CC} = 10V to 20V (Note 4)
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}	—	60	100	µA	V_{IN} = 0V or 5V
Quiescent V_{CC} Supply Current (**MCP14H2103**)	I_{CCQ}	—	350	500	µA	V_{IN} = 0V or 5V
Quiescent V_{CC} Supply Current (**MCP14H2104**)	I_{CCQ1}	—	350	500	µA	IN = 0V or 5V, SD* = 5V
Quiescent V_{CC} Supply Current in Shutdown (**MCP14H2104**)	I_{CCQ2}	—	590	750	µA	IN = 0V or 5V, SD* = 0V
Logic “1” Input Bias Current (**MCP14H2103**)	I_{IN+}	—	3	10	µA	HIN = 5V, LIN* = 0V
Logic “0” Input Bias Current (**MCP14H2103**)	I_{IN-}	—	—	5	µA	HIN = 0V, LIN* = 5V
Logic “1” Input Bias Current (**MCP14H2104**)	I_{IN+}	—	3	10	µA	IN = 5V, SD* = 0V
Logic “0” Input Bias Current (**MCP14H2104**)	I_{IN-}	—	—	5	µA	IN = 0V, SD* = 5V
V_{CC} Supply Undervoltage Positive Going Threshold	V_{CCUV+}	8.0	8.9	9.8	V	
V_{CC} Supply Undervoltage Negative Going Threshold	V_{CCUV-}	7.4	8.2	9.0	V	
V_{BS} Supply Undervoltage Positive Going Threshold	V_{BSUV+}	4.5	5.5	6.5	V	
V_{BS} Supply Undervoltage Negative Going Threshold	V_{BSUV-}	4.2	5.2	6.2	V	
Output High Short Circuit Pulsed Current	I_{O+}	130	290	—	mA	V_O = 0V, PW ≤ 10 µs
Output Low Short Circuit Pulsed Current	I_{O-}	270	600	—	mA	V_O = 15V, PW ≤ 10 µs

Notes:

1. The V_{IN}, V_{TH} and I_{IN} parameters are applicable to the two logic input pins: HIN and LIN*. The V_O and I_O parameters are applicable to the respective output pins: HO and LO.
2. The V_{IN}, V_{TH} and I_{IN} parameters are applicable to the two logic input pins: IN and SD*. The V_O and I_O parameters are applicable to the respective output pins: HO and LO.
3. 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 840 ns, minimum.
4. For optimal operation, it is recommended that the input pulse (to IN and SD*) should have an amplitude of 2.5V minimum, with a Pulse Width (PW) of 840 ns, minimum.

2.4. AC Electrical Characteristics

V_{BIAS} (V_{CC}, V_{BS}) = 15V, C_L = 1000 pF and T_A = 25°C , unless otherwise specified.						
Parameter	**Symbol**	**Min.**	**Typ.**	**Max.**	**Unit**	**Conditions**
Turn-on Propagation Delay	t_{on}	—	680	820	ns	V_S = 0V
Turn-off Propagation Delay	t_{off}	—	150	220	ns	V_S = 600V
Shutdown Propagation Delay (**MCP14H2104**)	t_{SD}	—	160	220	ns	
Delay Matching, HS and LS Turn-on/Turn-off	t_{DM}	—	—	60	ns	
Turn-on Rise Time	t_r	—	70	170	ns	V_S = 0V
Turn-off Fall Time	t_f	—	35	90	ns	V_S = 0V
Deadtime: $t_{DT\ LO\text{-}HO}$ and $t_{DT\ HO\text{-}LO}$	t_{DT}	300	420	650	ns	

3. Timing Waveforms

Figure 3-1. Input/Output Timing Diagram - MCP14H2103

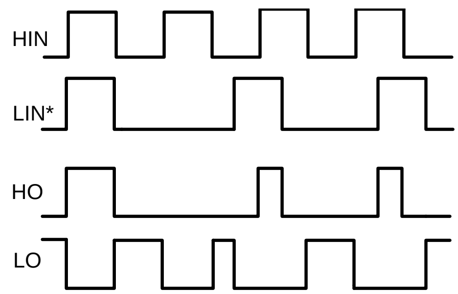


Figure 3-2. Switching Time Waveform Definitions - MCP14H2103

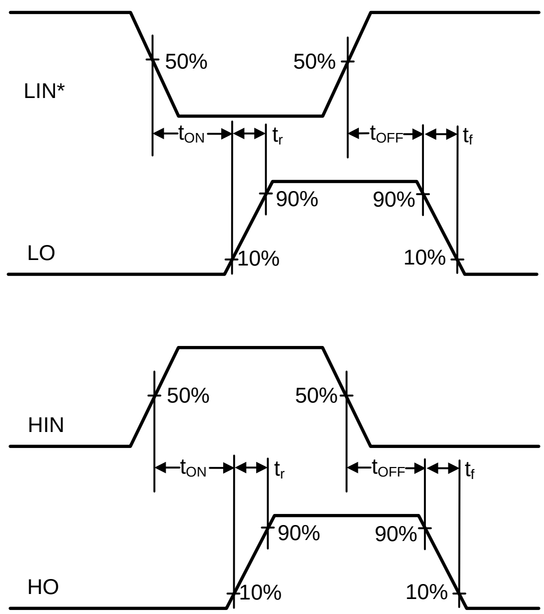


Figure 3-3. Deadtime Waveform Definitions - MCP14H2103

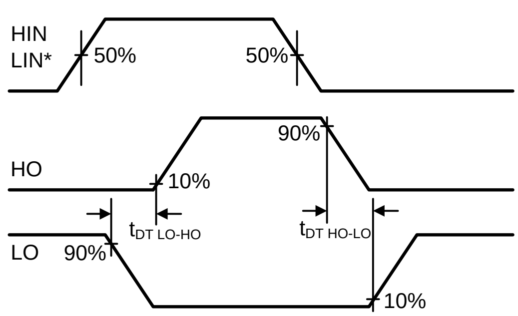


Figure 3-4. Input/Output Timing Diagram - MCP14H2104

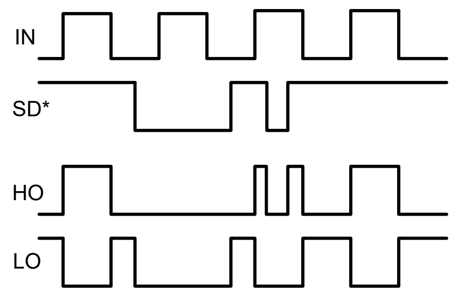


Figure 3-5. Shutdown Waveform Definition - MCP14H2104

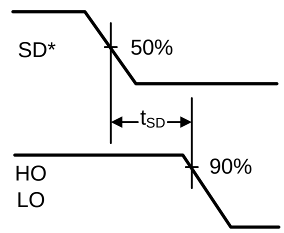
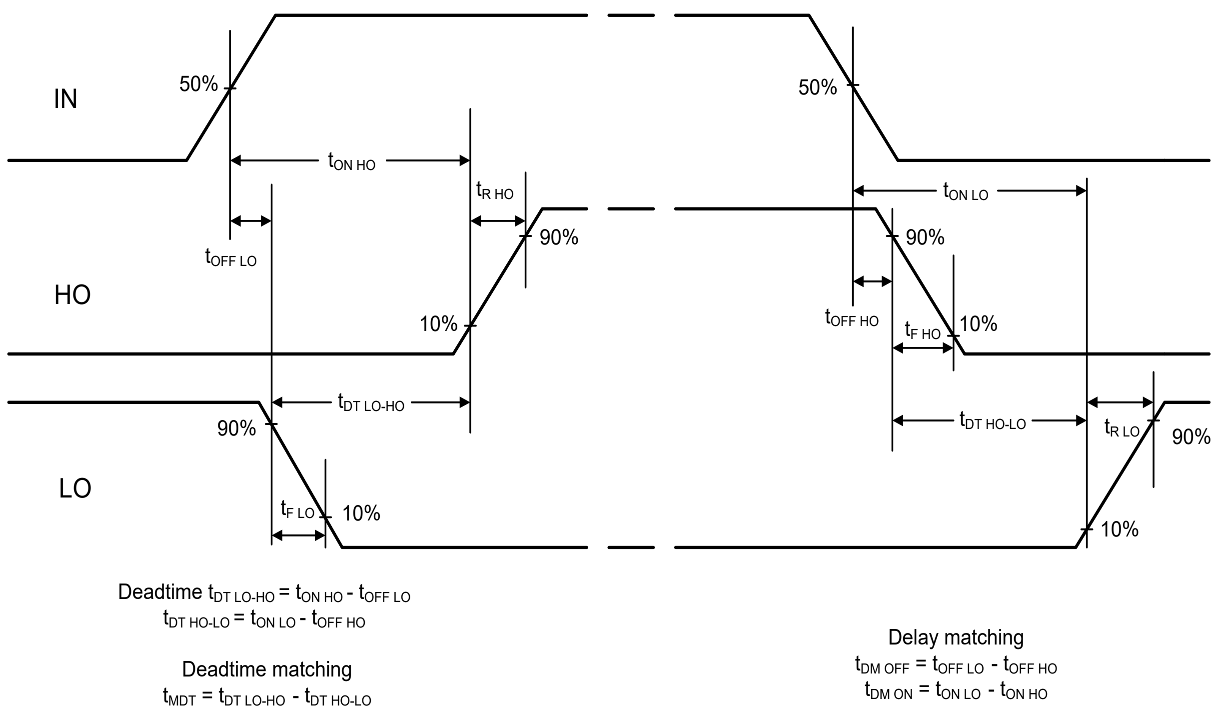


Figure 3-6. Switching Time Waveform Definitions - MCP14H2104



4. Typical Characteristics

Figure 4-1. Output Source Current vs. Supply Voltage

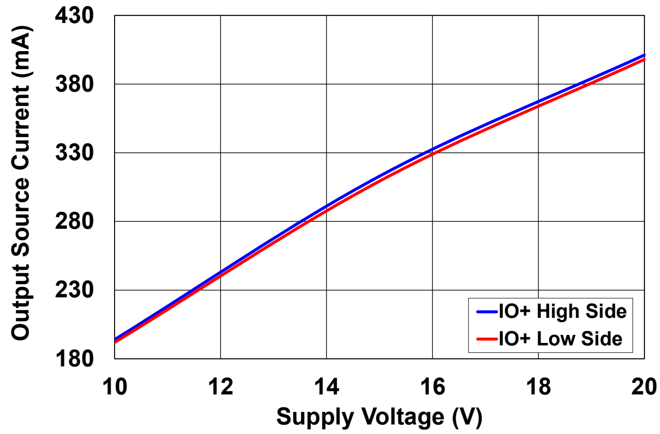


Figure 4-2. Output Source Current vs. Temperature

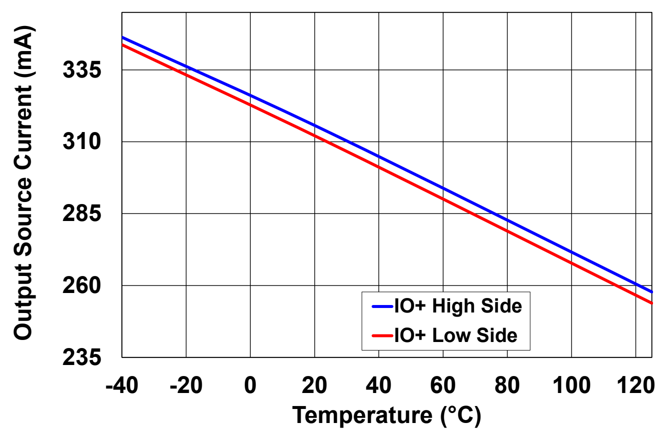


Figure 4-3. Output Sink Current vs. Supply Voltage

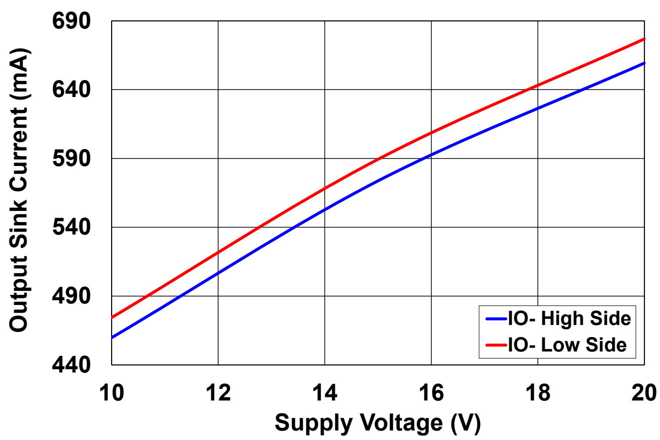


Figure 4-4. Output Sink Current vs. Temperature

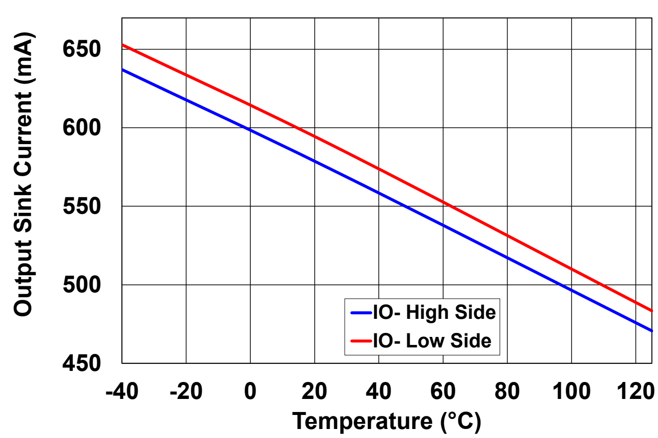


Figure 4-5. Logic 1 Input Voltage vs. Supply Voltage

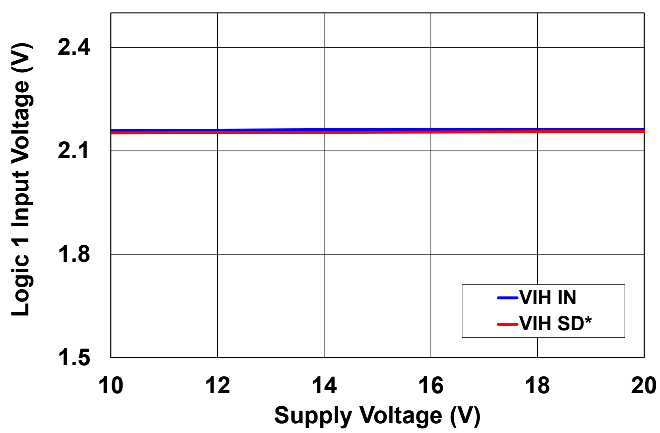


Figure 4-6. Logic 1 Input Voltage vs. Temperature

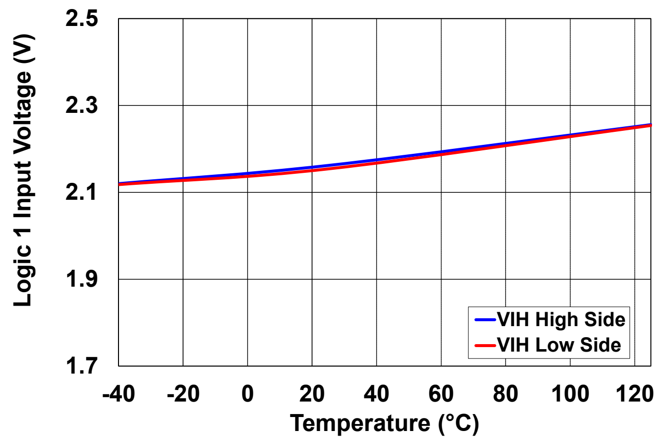


Figure 4-7. Logic 0 Input Voltage vs. Supply Voltage

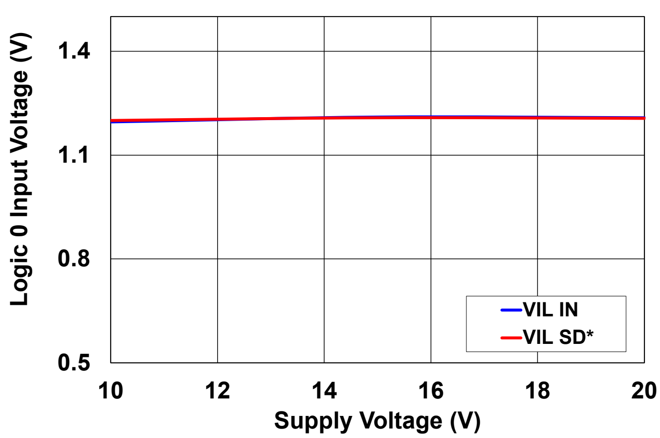


Figure 4-8. Logic 0 Input Voltage vs. Temperature

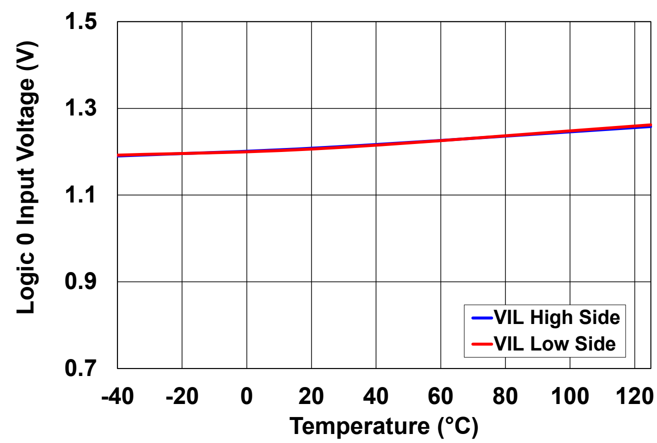


Figure 4-9. Quiescent Current vs. Supply Voltage

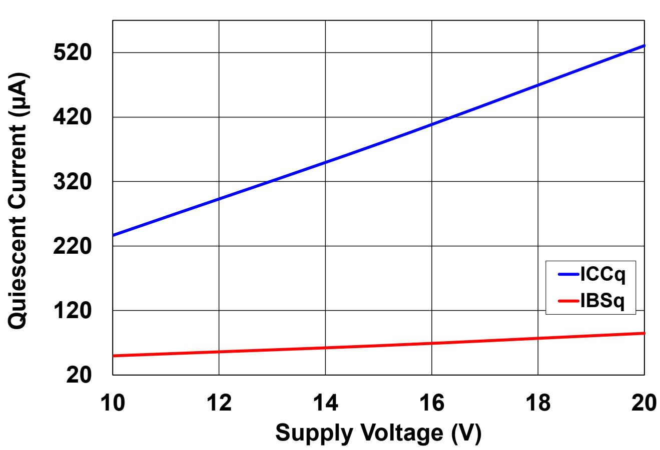


Figure 4-10. Quiescent Current vs. Temperature

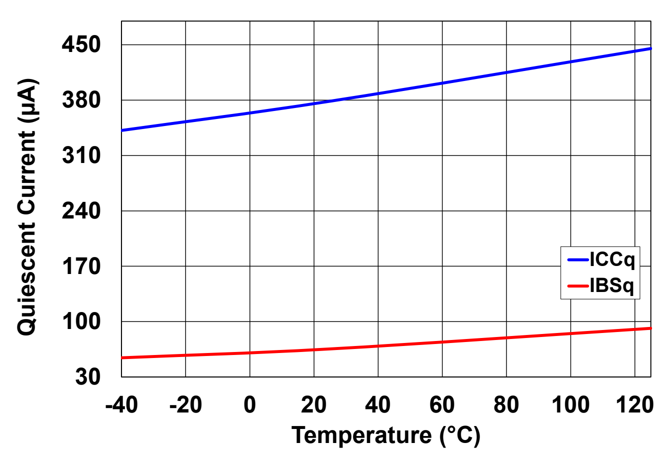


Figure 4-11. Turn-on Propagation Delay vs. Supply Voltage

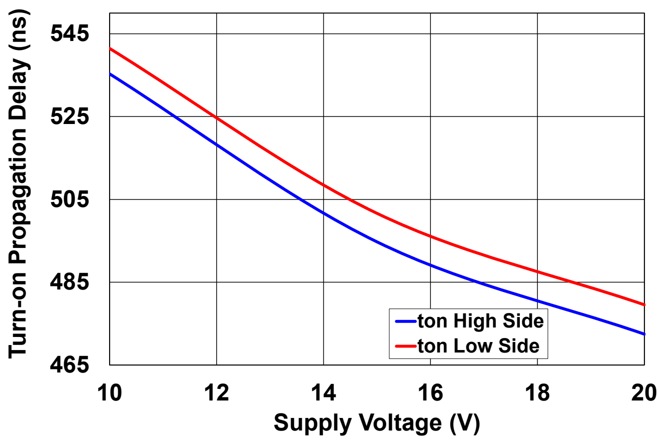


Figure 4-12. Turn-on Propagation Delay vs. Temperature

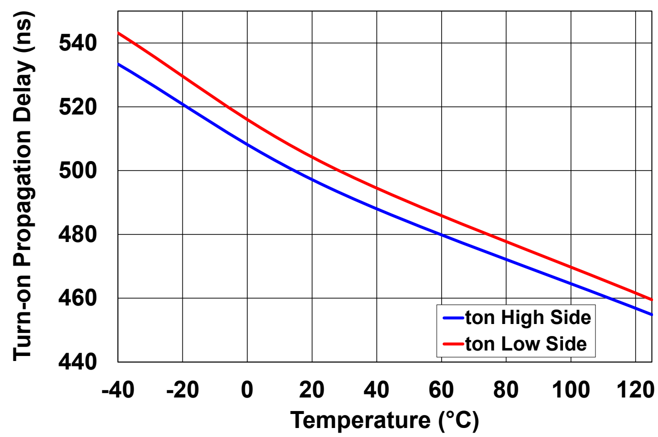


Figure 4-13. Turn-off Propagation Delay vs. Supply Voltage

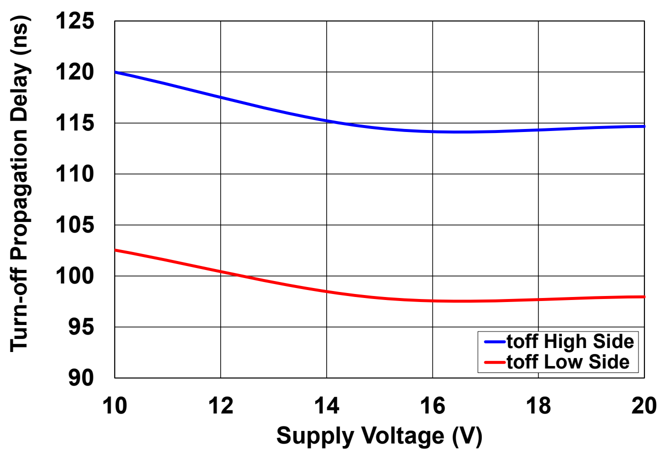


Figure 4-14. Turn-off Propagation Delay vs. Temperature

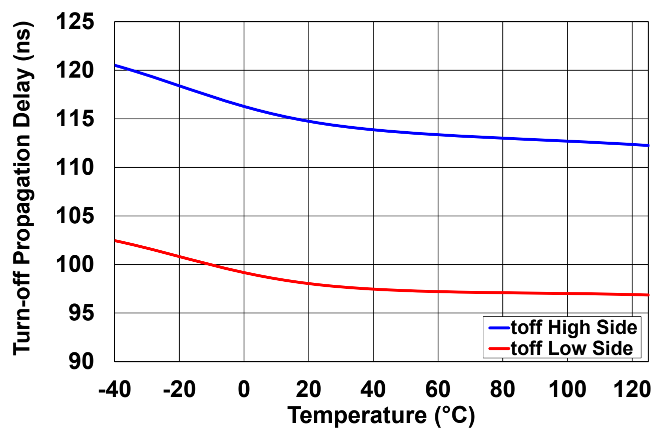


Figure 4-15. Rise Time vs. Supply Voltage

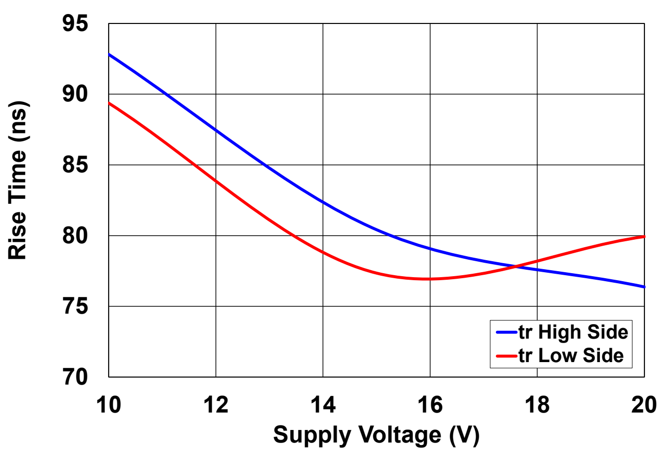


Figure 4-16. Rise Time vs. Temperature

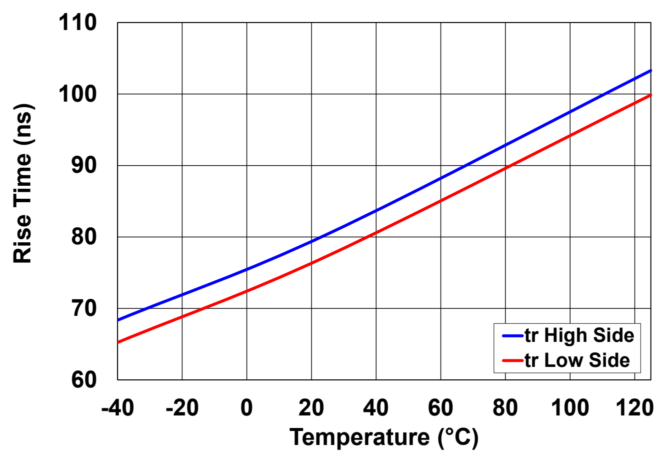


Figure 4-17. Fall Time vs. Supply Voltage

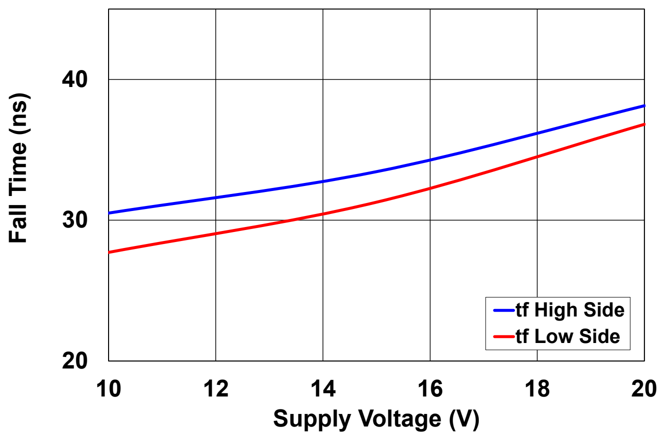


Figure 4-18. Fall Time vs. Temperature

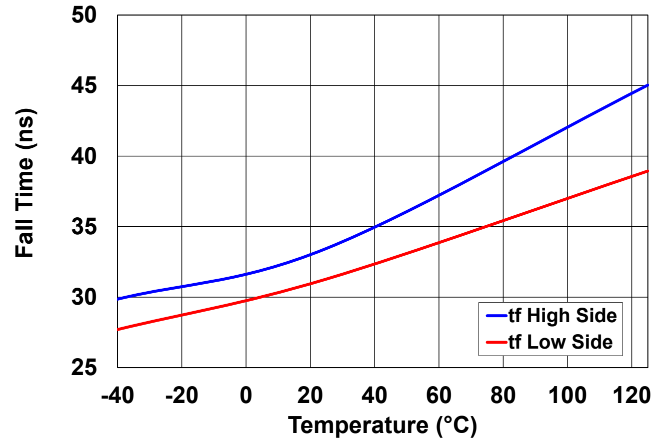


Figure 4-19. Delay Matching vs. Supply Voltage

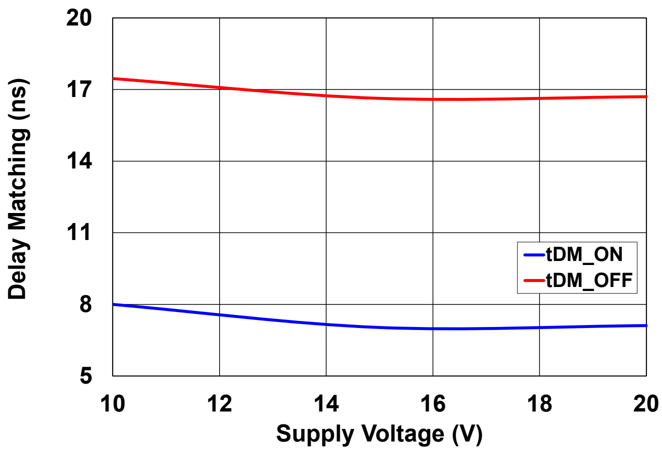


Figure 4-20. Delay Matching vs. Temperature

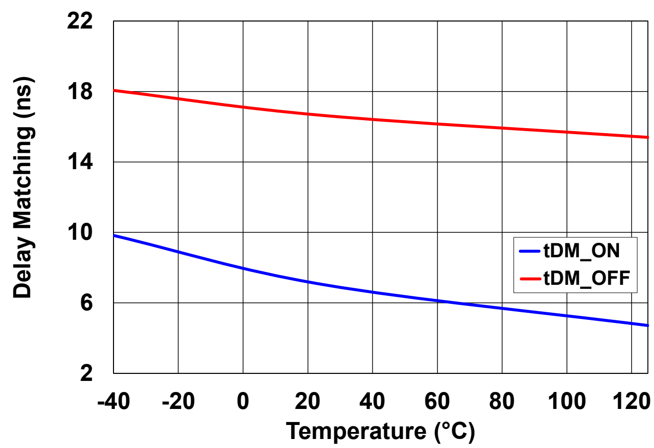


Figure 4-21. V_{CC} UVLO vs. Temperature

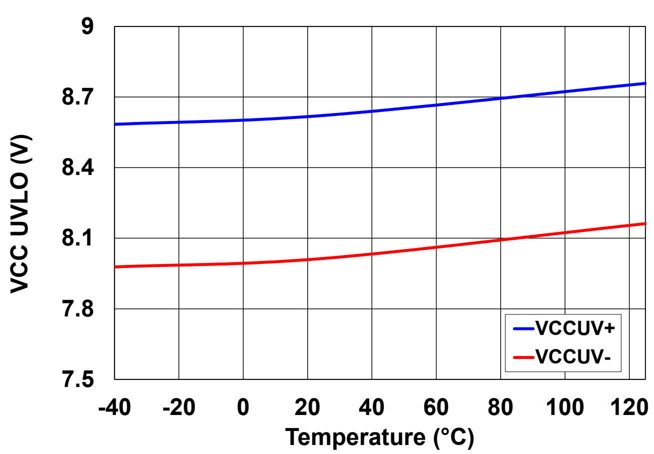
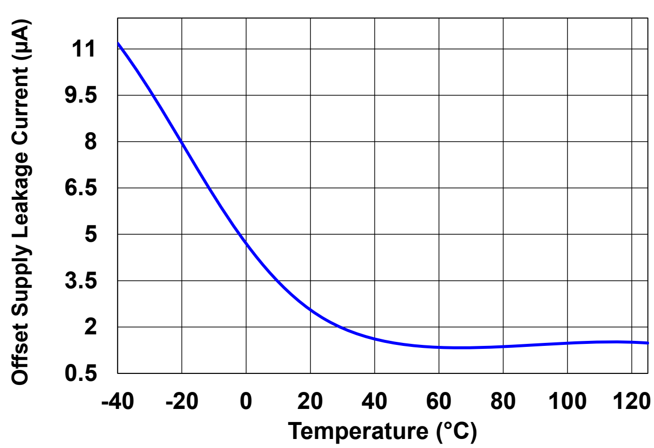
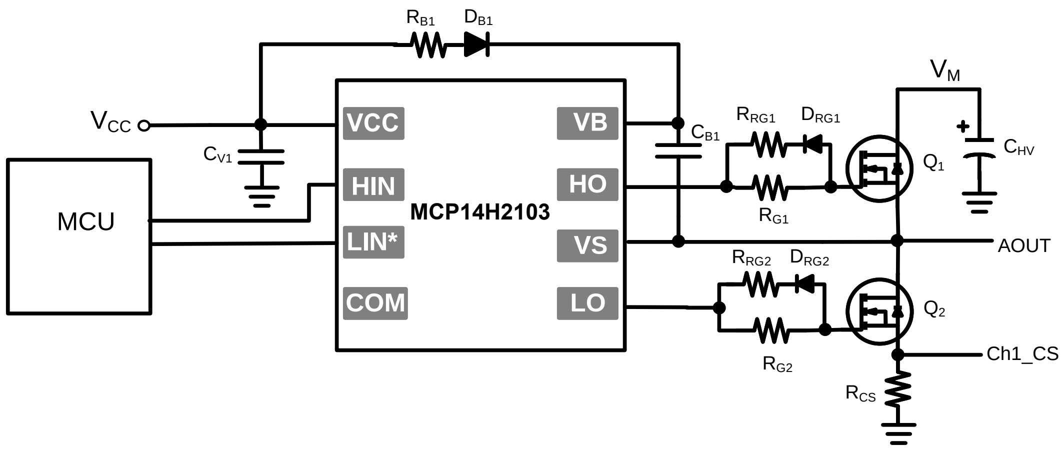


Figure 4-22. Offset Supply Leakage Current vs. Temperature



5. Application Information MCP14H2103

Figure 5-1. Single Phase (of four) for Stepper Motor Driver Application Using the MCP14H2103

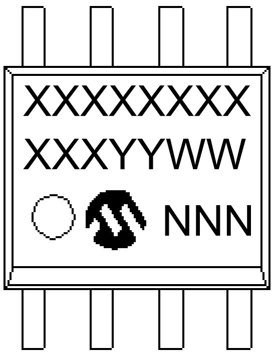


- RRG1 and RRG2 values are typically between 0Ω and 10Ω. The exact value is decided based on the MOSFET junction capacitance and the drive current of gate driver. A value of 10Ω is used in this example.
- It is **highly recommended** that the input pulse (to HIN and LIN*) should have an amplitude of 2.5V minimum (for VDD = 15V) with a minimum pulse width of 840 ns.
- RG1 and RG2 values are typically between 20Ω and 100Ω. The exact value is decide based on the MOSFET junction capacitance and drive current of the gate driver. A value of 50Ω is used in this example.
- RB1 value is typically between 3Ω and 20Ω. The exact value is calculated based on the bootstrap capacitor value and the amount of current limiting required for bootstrap capacitor charging. A value of 10Ω is used in this example. Also, DB should be an ultra fast diode with a minimum rating of 1A and a voltage rating greater than the system operating voltage.

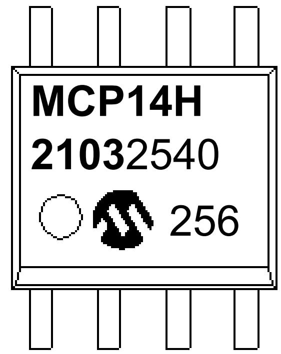
6. Packaging Information

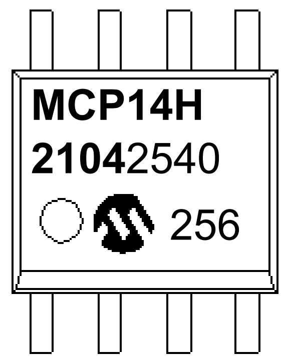
Package Marking Information

8-Pin SOIC:



Examples:





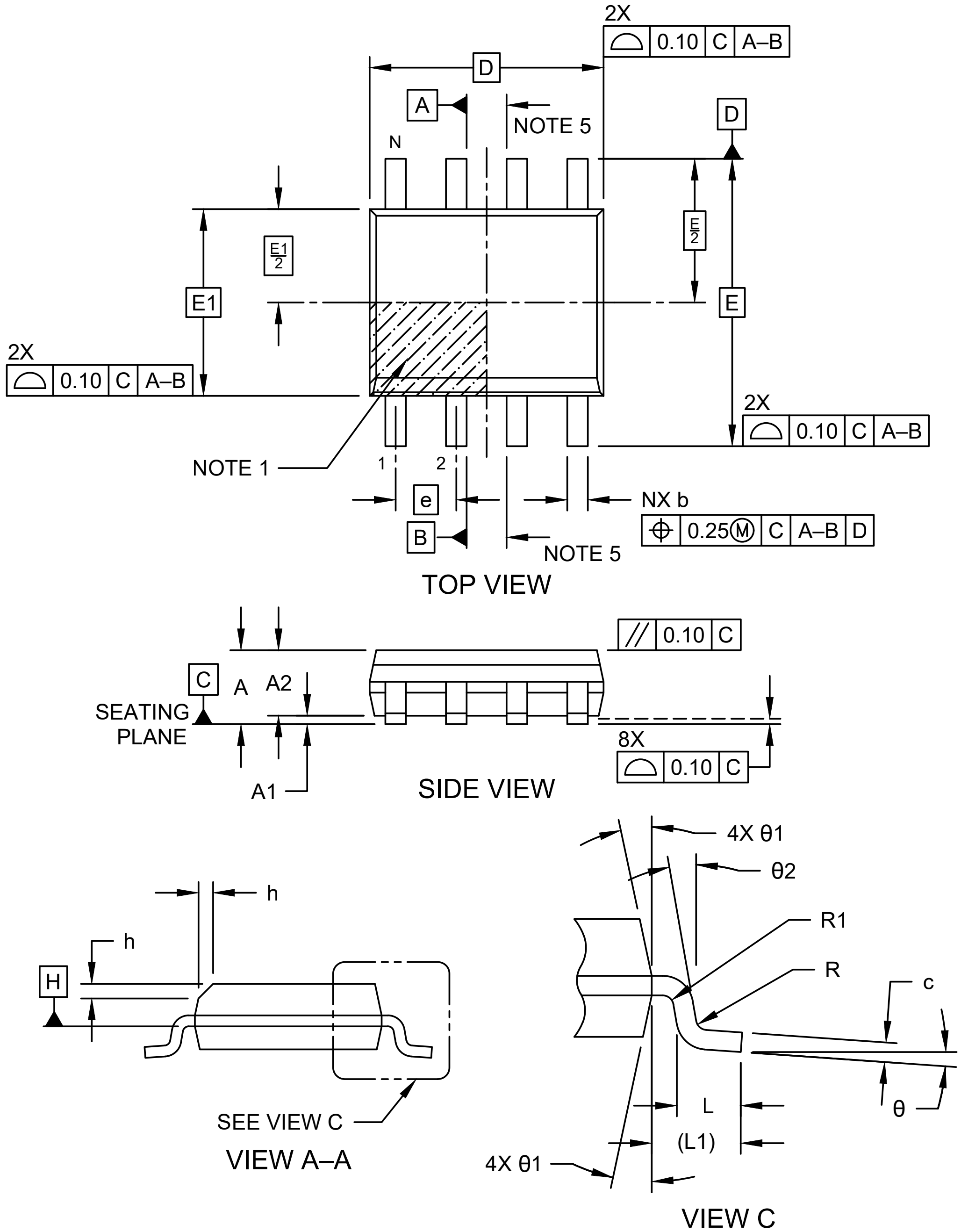
Legend:	XX...X	Product Code or Customer-specific information
	Y	Year code (last digit of calendar year)
	YY	Year code (last 2 digits of calendar year)
	WW	Week code (week of January 1 is week '01')
	NNN	Alphanumeric traceability code
	(e3)	Pb-free JEDEC designator for Matte Tin (Sn)
	*	This package is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

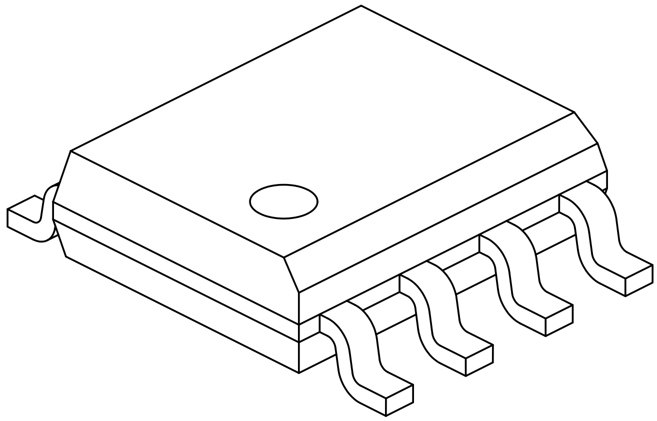
Note:	For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



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°	–	–

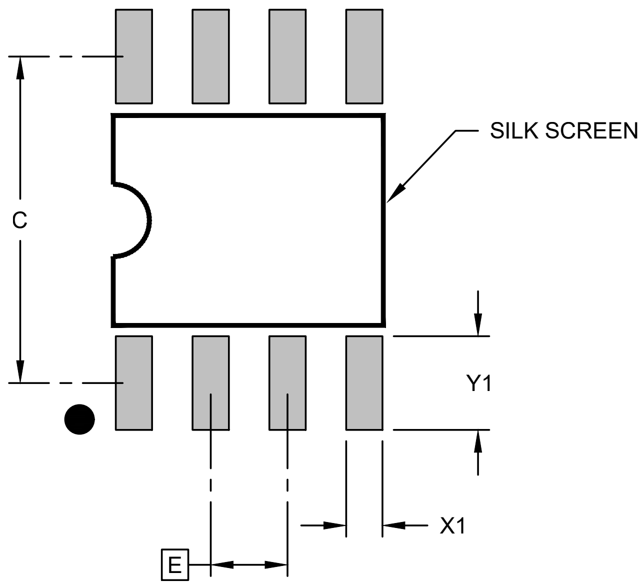
Notes:

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	November 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:	MCP14H2103, MCP14H2104: Half-Bridge 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:

- MCP14H2103T-E/SN: Half-Bridge Gate Driver, Tape and Reel, Extended Temperature Range, SOIC-8 Package
- MCP14H2104T-E/SN: Half-Bridge 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.

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