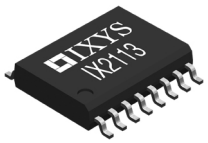
IX2113
600V High and Low Side Gate Driver



Driver Characteristics

Parameter	Rating	Units
V_{OFFSET}	600	V
$I_{O +/-}$ (Source/Sink)	2/2	A
V_{OUT}	10-20	V
t_{on}/t_{off}	113/100	ns
Delay Matching (Max)	20	ns

Features

- Floating Channel for Bootstrap Operation to +600V with Absolute Maximum Rating of +700V
- Outputs Capable of Sourcing and Sinking 2A
- Gate Drive Supply Range From 10V to 20V
- Enhanced Robustness due to SOI Process
- Tolerant to Negative Voltage Transients: dV/dt Immune
- 3.3V Logic Compatible
- Undervoltage Lockout for Both High-side and Low-Side Outputs
- Matched Propagation Delays

Description

The IX2113 is a high voltage integrated circuit that can drive high speed MOSFETs and IGBTs that operate at up to +600V. The IX2113 is configured with independent high-side and low-side referenced output channels, both of which can source and sink 2A. The floating high-side channel can drive an N-channel power MOSFET or IGBT 600V from the common reference.

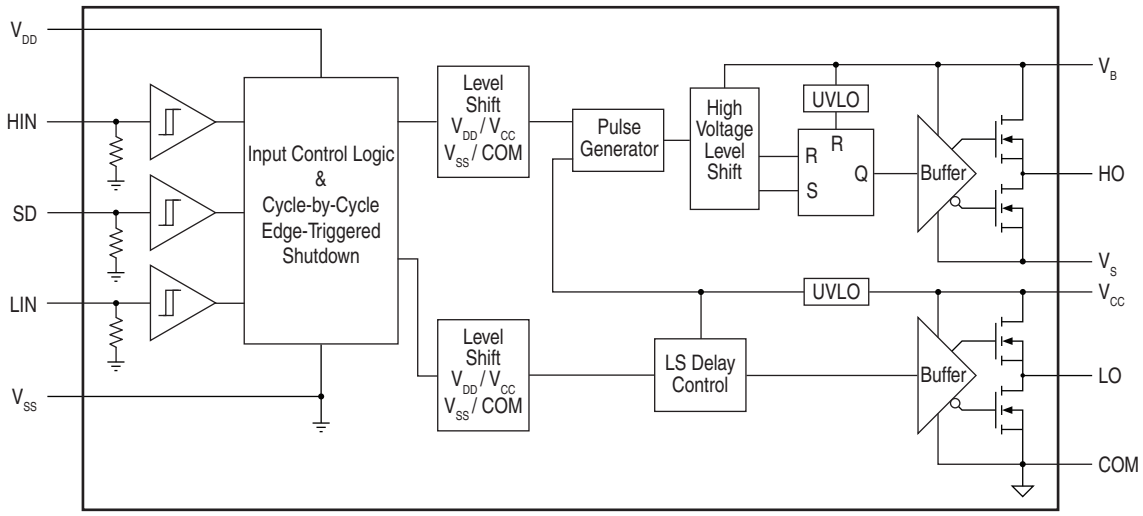
Manufactured on IXYS Integrated Circuits Division's proprietary high-voltage BCDMOS on SOI (silicon on insulator) process, the IX2113 is extremely robust, and is virtually immune to negative transients. The UVLO circuit prevents the turn-on of the MOSFET or IGBT until there is sufficient V_{BS} or V_{CC} supply voltage. Propagation delays are matched for use in high frequency applications.

The IX2113 is available in a 14-pin DIP package and in a 16-pin SOIC package.

Ordering Information

Part	Description
IX2113G	14-Pin DIP (25/Tube)
IX2113B	16-Pin SOIC (50/Tube)
IX2113BTR	16-Pin SOIC (1000/Reel)

IX2113 Functional Block Diagram



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1.2 Pin Description: 16-Pin SOIC Package 3
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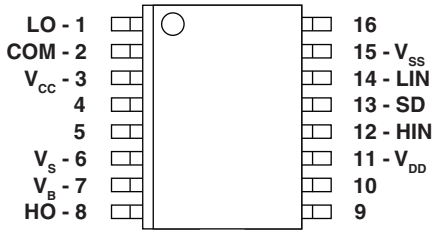
1 Specifications

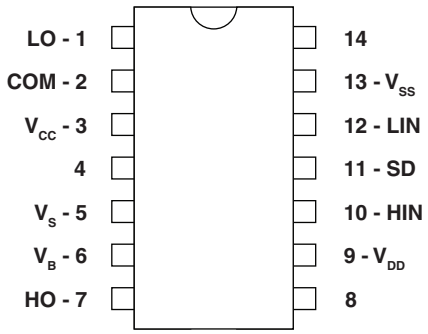
1.1 Package Pinout: 16-Pin SOIC Package



1.2 Pin Description: 16-Pin SOIC Package

Pin#	Name	Description
1	LO	Low-Side Gate Drive Output
2	COM	Low-Side Return
3	V_{CC}	Low-Side Supply
4	-	No Connection
5	-	No Connection
6	V_S	High-Side Floating Supply Return
7	V_B	High-Side Floating Supply
8	HO	High-Side Gate Drive Output
9	-	No Connection
10	-	No Connection
11	V_{DD}	Logic Supply
12	HIN	Logic Input for High-Side Gate Driver Output (HO), In-Phase
13	SD	Logic Input for Shutdown
14	LIN	Logic Input for Low-Side Gate Driver Output (LO), In-Phase
15	V_{SS}	Logic Ground
16	-	No Connection

1.3 Package Pinout: 14-Pin DIP Package



1.4 Pin Description: 14-Pin DIP Package

Pin#	Name	Description
1	LO	Low-Side Gate Drive Output
2	COM	Low-Side Return
3	V_{CC}	Low-Side Supply
4	-	No Connection
5	V_S	High-Side Floating Supply Return
6	V_B	High-Side Floating Supply
7	HO	High-Side Gate Drive Output
8	-	No Connection
9	V_{DD}	Logic Supply
10	HIN	Logic Input for High-Side Gate Driver Output (HO), In-Phase
11	SD	Logic Input for Shutdown
12	LIN	Logic Input for Low-Side Gate Driver Output (LO), In-Phase
13	V_{SS}	Logic Ground
14	-	No Connection

1.5 Absolute Maximum Ratings

Absolute maximum ratings indicate sustained limits beyond which damage to the device may occur. All voltage parameters are absolute voltages referenced to COM. The thermal resistance and power dissipation ratings are measured under board-mounted and still-air conditions.

Parameter		Symbol	Min	Max	Units
High-Side Floating Supply Voltage		V_B	-0.3	700	V
High-Side Floating Supply Offset Voltage		V_S	V_B-20	V_B+0.3	V
High-Side Floating Output Voltage		V_{HO}	V_S-0.3	V_B+0.3	V
Low-Side Fixed Supply Voltage		V_{CC}	-0.3	20	V
Low-Side Output Voltage		V_{LO}	-0.3	V_{CC}+0.3	V
Logic Supply Voltage		V_{DD}	-0.3	V_{SS}+20	V
Logic Supply Offset Voltage		V_{SS}	V_{CC}-20	V_{CC}+0.3	V
Logic Input Voltage (HIN, LIN, SD)		V_{IN}	V_{SS}-0.3	V_{DD}+0.3	V
Allowable Offset Supply Voltage Transient		dV_S/dt	-	50	V/ns
Package Power Dissipation @ $T_A \leq 25°C$	16-Pin SOIC	PD	-	1.25	W
	14-Pin DIP			1.6	
Thermal Resistance, Junction to Ambient	16-Pin SOIC	$R_{\theta JA}$	-	100	°C/W
	14-Pin DIP			75	
Junction Temperature		T_J	-	150	°C
Storage Temperature		T_S	-55	150	°C
Lead Temperature (Soldering, 10 Seconds)		T_L	-	300	°C

1.6 Recommended Operating Conditions

For proper operation, the device should be used within the recommended conditions. The V_S and V_{SS} offset ratings are tested with all supplies biased at a 15V differential.

Parameter	Symbol	Min	Max	Units
High-Side Floating Supply Absolute Voltage	V_B	V_S+10	V_S+20	V
High-Side Floating Supply Offset Voltage	V_S	-	600	
High-Side Floating Output Voltage	V_{HO}	V_S	V_B	
Low-Side Fixed Supply Voltage	V_{CC}	10	20	
Low-Side Output Voltage	V_{LO}	0	V_{CC}	
Logic Supply Voltage	V_{DD}	V_{SS}+3	V_{SS}+20	
Logic Supply Offset Voltage	V_{SS}	-5	5	
Logic Input Voltage (HIN, LIN, SD)	V_{IN}	V_{SS}	V_{DD}	
Ambient Temperature	T_A	-40	+125	°C

1.7 Dynamic Electrical Characteristics

V_{BIAS} (V_{CC}, V_{BS}, V_{DD})=15V, CL=1000 pF, T_A=25°C, and V_{SS}=COM unless otherwise specified.

Parameter	Conditions	Symbol	Min	Typ	Max	Units
Turn-On propagation Delay	V_S=0V	t_{on}	-	113	160	ns
Turn-Off propagation Delay	V_S=600V	t_{off}	-	100	150	
Shutdown propagation Delay		t_{SD}	-	94	160	
Turn-On Rise Time	-	t_r	-	9.4	35	
Turn-Off Fall Time	-	t_f	-	9.7	25	
Delay Matching, HS & LS Turn-On/Off	-	MT	-	-	20	

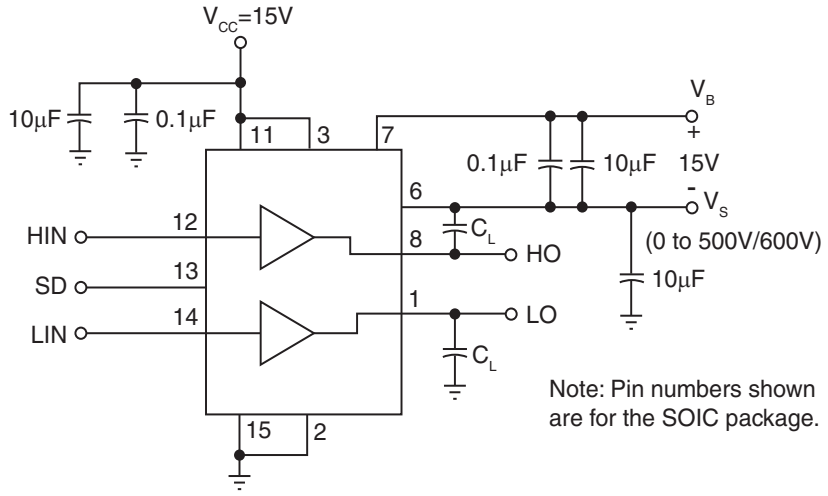
1.8 Static Electrical Characteristics

V_{BIAS} (V_{CC}, V_{BS}, V_{DD})=15V, T_A=25°C and V_{SS}=COM unless otherwise specified. The V_{IN}, V_{TH}, and I_{IN} parameters are referenced to V_{SS} and are applicable to all three logic input leads: HIN, LIN, and SD. The V_O and I_O parameters are referenced to COM and are applicable to the respective output leads: HO or LO.

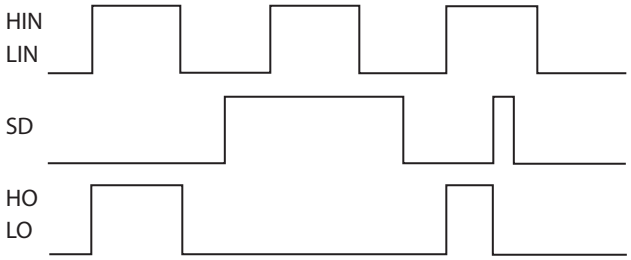
Parameter	Conditions	Symbol	Min	Typ	Max	Units
Logic “1” Input Voltage	V_{DD}=15V	V_{IH}	9.5	-	-	V
Logic “0” Input Voltage		V_{IL}	-	-	6	
Logic “1” Input Voltage	V_{DD}=3V	V_{IH}	2.5	-	-	V
Logic “0” Input Voltage		V_{IL}	-	-	0.8	
High-Level Output Voltage, V_{BIAS}-V_O	I_O=0A	V_{OH}	-	1.6	2.5	V
Low-Level Output Voltage, V_O	I_O=20mA	V_{OL}	-	-	0.15	
Offset Supply Leakage Current	V_B=V_S=600V	I_{LK}	-	-	60	µA
Quiescent V_{BS} Supply Current	V_{IN}=0V or V_{DD}	I_{QBS}	-	187	310	
Quiescent V_{CC} Supply Current	V_{IN}=0V or V_{DD}	I_{QCC}	-	300	420	
Quiescent V_{DD} Supply Current	V_{IN}=0V or V_{DD}	I_{QDD}	-	-	1	
Logic “1” Input Bias Current	V_{IN}=V_{DD}	I_{IN+}	-	22	40	µA
Logic “0” Input Bias Current	V_{IN}=0V	I_{IN-}	-	-	5	
V_{BB} Supply Undervoltage Positive Going Threshold	-	V_{BSUV+}	7.5	8.4	9.7	V
V_{BB} Supply Undervoltage Negative Going Threshold	-	V_{BSUV-}	7	7.8	9.4	
V_{CC} Supply Undervoltage Positive Going Threshold	-	V_{CCUV+}	7.4	8.4	9.6	
V_{CC} Supply Undervoltage Negative Going Threshold	-	V_{CCUV-}	7	7.8	9.4	
Output High Short Circuit Pulsed Current	V_O=0V, V_{IN}=V_{DD} , PW≤10µs	I_{O+}	2	2.5	-	A
Output Low Short Circuit Pulsed Current	V_O=15V, V_{IN}=0V, PW≤10µs	I_{O-}	2	2.5	-	

1.9 Test Waveforms

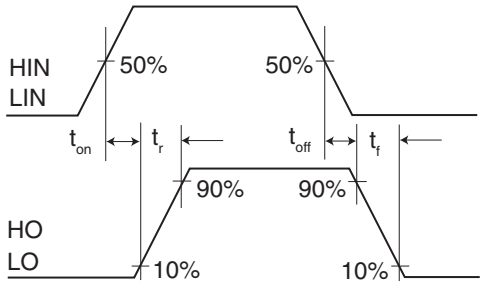
1.9.1 Switching Time Test Circuit



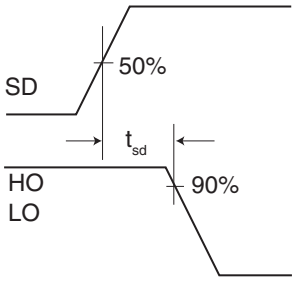
1.9.2 Input/Output Timing Diagram



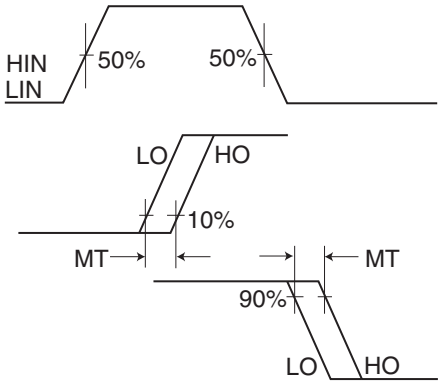
1.9.3 Switching Time Waveform Definition



1.9.4 Shutdown Waveform Definitions

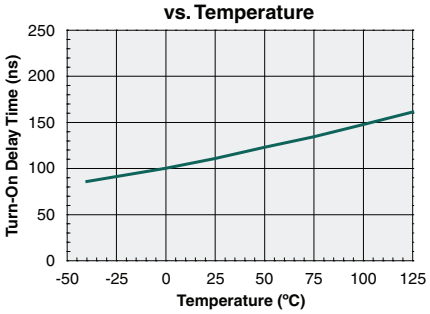


1.9.5 Delay Matching Waveform Definitions

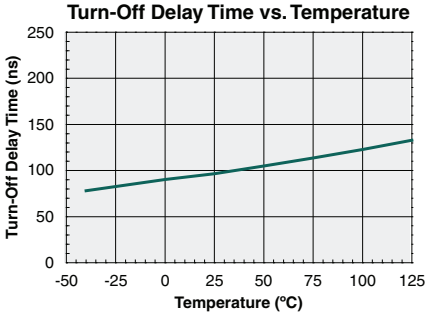


2 Typical Performance Data

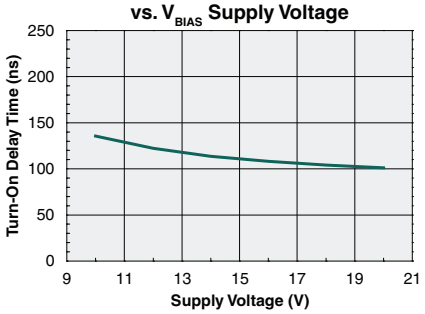
Turn-On Delay Time vs. Temperature



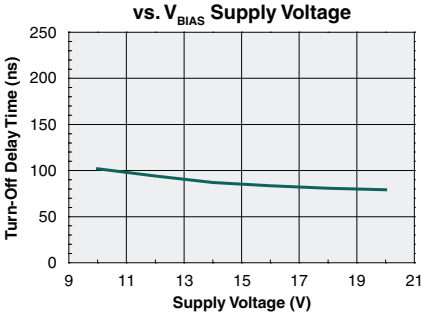
Turn-Off Delay Time vs. Temperature



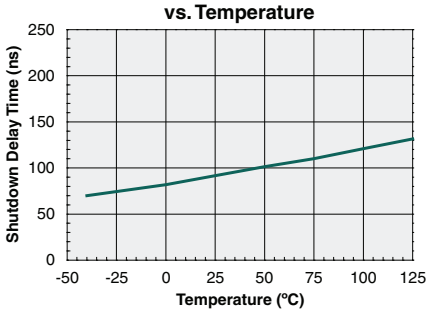
Turn-On Delay Time vs. V_{BIAS} Supply Voltage



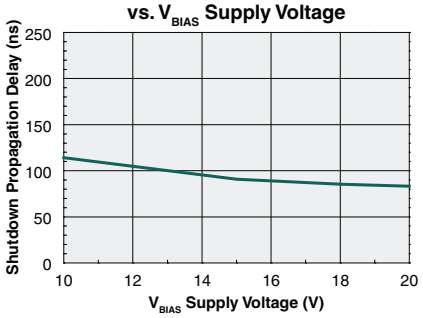
Turn-Off Delay Time vs. V_{BIAS} Supply Voltage



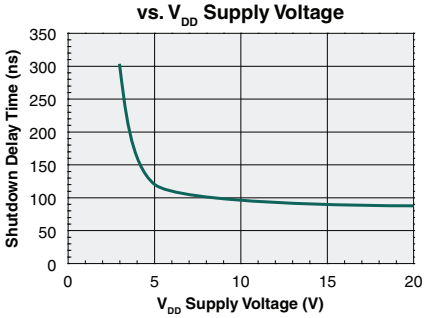
Shutdown Delay Time vs. Temperature



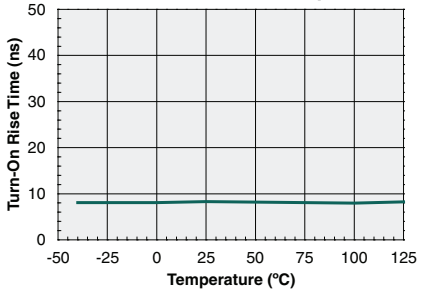
Shutdown Delay Time vs. V_{BIAS} Supply Voltage



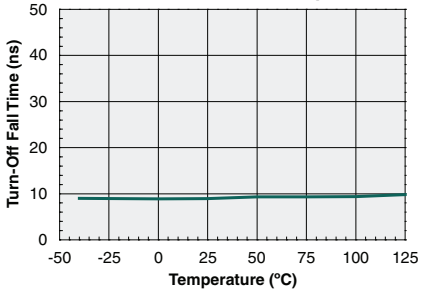
Shutdown Delay Time vs. V_{DD} Supply Voltage

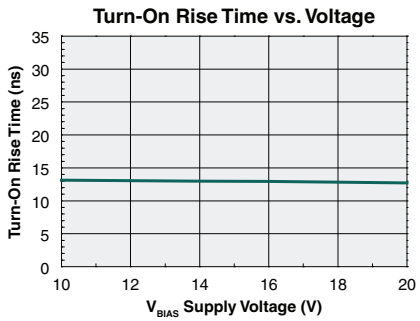


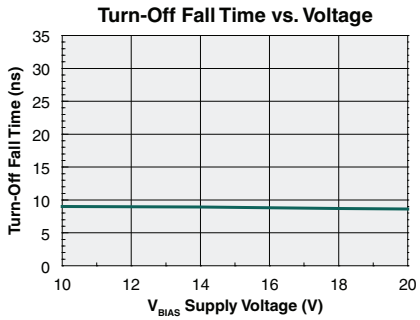
Turn-On Rise Time vs. Temperature

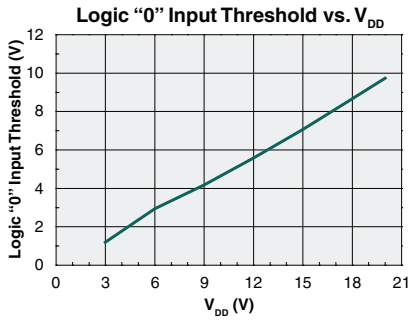


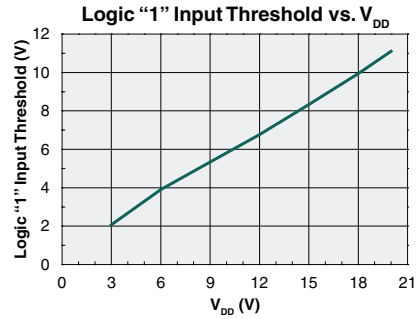
Turn-Off Fall Time vs. Temperature

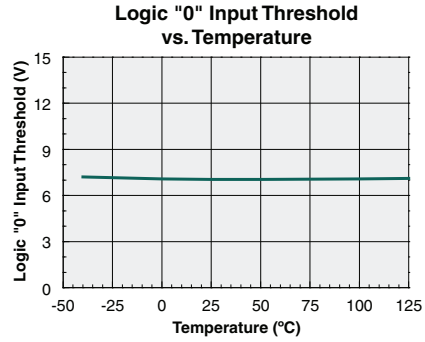


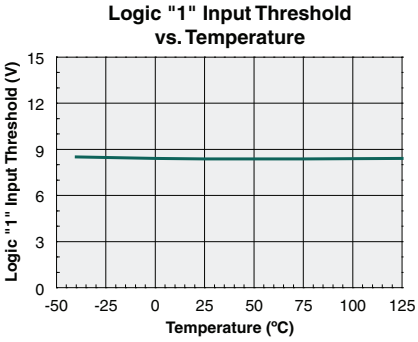

Turn-On Rise Time vs. Voltage
Turn-On Rise Time (ns)
0 5 10 15 20 25 30 35
10 12 14 16 18 20
VBIAS Supply Voltage (V)

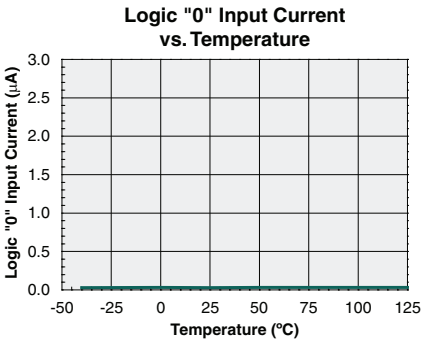

Turn-Off Fall Time vs. Voltage
Turn-Off Fall Time (ns)
0 5 10 15 20 25 30 35
10 12 14 16 18 20
VBIAS Supply Voltage (V)

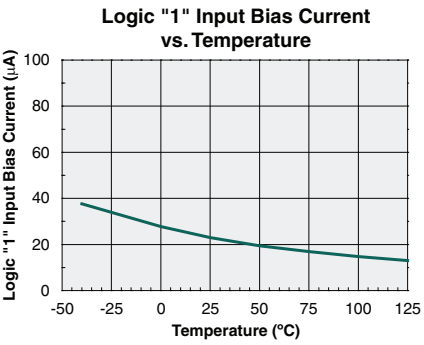

Logic “0” Input Threshold vs. VDD
Logic “0” Input Threshold (V)
0 2 4 6 8 10 12
0 3 6 9 12 15 18 21
VDD (V)

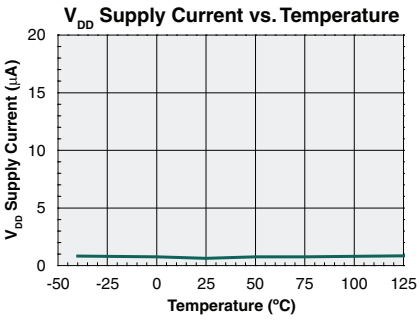

Logic “1” Input Threshold vs. VDD
Logic “1” Input Threshold (V)
0 2 4 6 8 10 12
0 3 6 9 12 15 18 21
VDD (V)

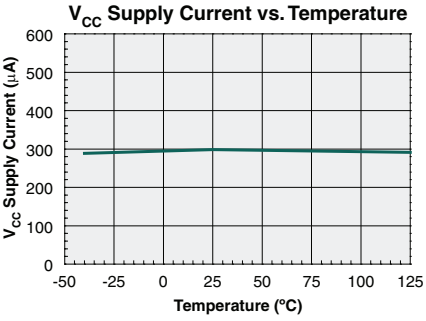

Logic "0" Input Threshold vs. Temperature
Logic "0" Input Threshold (V)
0 3 6 9 12 15
-50 -25 0 25 50 75 100 125
Temperature (ºC)


Logic "1" Input Threshold vs. Temperature
Logic "1" Input Threshold (V)
0 3 6 9 12 15
-50 -25 0 25 50 75 100 125
Temperature (ºC)


Logic "0" Input Current vs. Temperature
Logic "0" Input Current (µA)
0.0 0.5 1.0 1.5 2.0 2.5 3.0
-50 -25 0 25 50 75 100 125
Temperature (ºC)


Logic "1" Input Bias Current vs. Temperature
Logic "1" Input Bias Current (µA)
0 20 40 60 80 100
-50 -25 0 25 50 75 100 125
Temperature (ºC)


VDD Supply Current vs. Temperature
VDD Supply Current (µA)
0 5 10 15 20
-50 -25 0 25 50 75 100 125
Temperature (ºC)


VCC Supply Current vs. Temperature
VCC Supply Current (µA)
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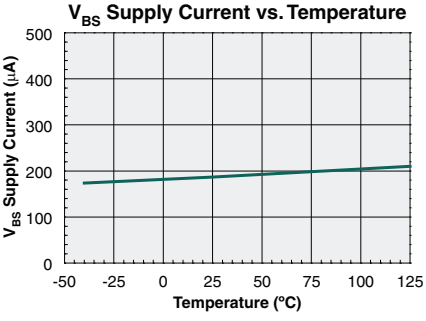
-50 -25 0 25 50 75 100 125
Temperature (ºC)


VBS Supply Current vs. Temperature
VBS Supply Current (µA)
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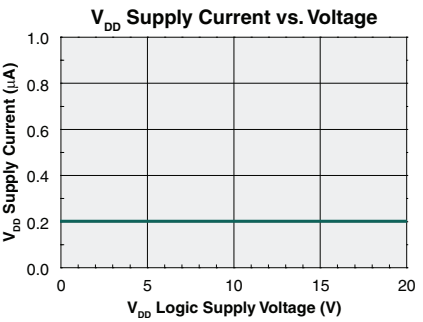
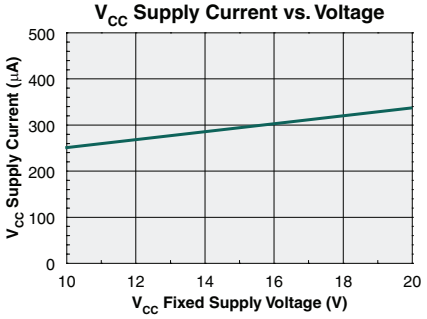
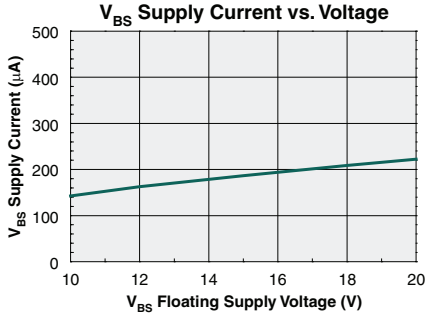
-50 -25 0 25 50 75 100 125
Temperature (ºC)


VDD Supply Current vs. Voltage
VDD Supply Current (µA)
0.0 0.2 0.4 0.6 0.8 1.0
0 5 10 15 20
VDD Logic Supply Voltage (V)

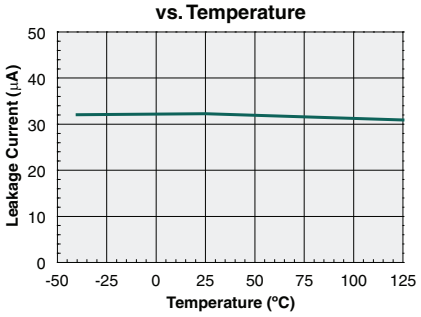
V_{CC} Supply Current vs. Voltage



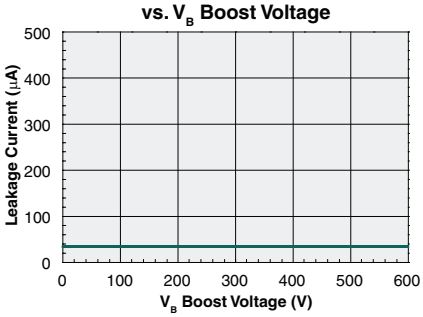
V_{BS} Supply Current vs. Voltage



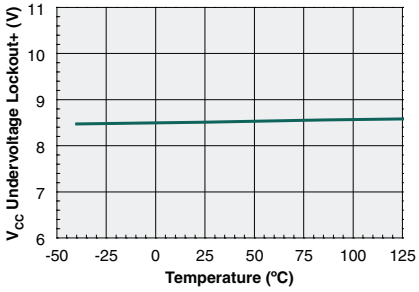
Offset Supply Leakage Current vs. Temperature



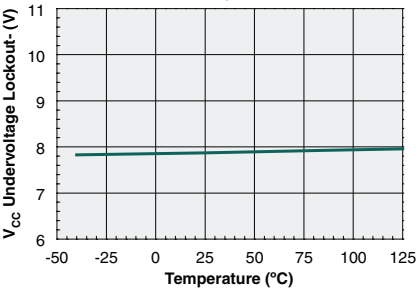
Offset Supply Leakage Current vs. V_B Boost Voltage



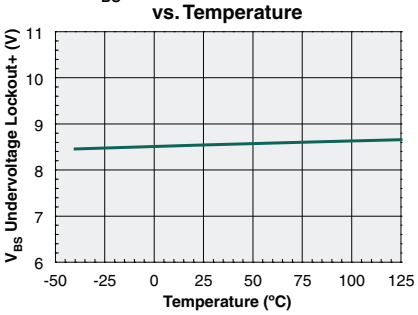
V_{CC} Undervoltage Lockout (+) vs. Temperature



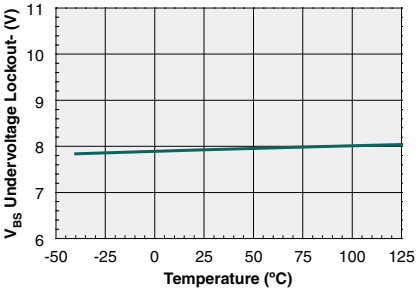
V_{CC} Undervoltage Lockout (-) vs. Temperature



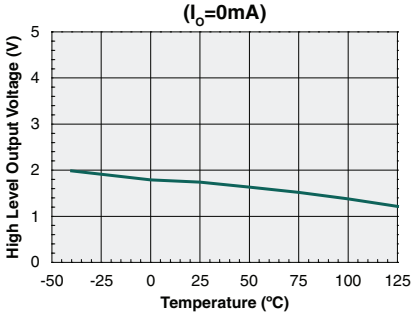
V_{BS} Undervoltage Lockout (+) vs. Temperature



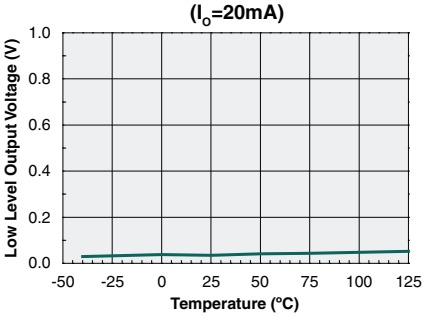
V_{BS} Undervoltage Lockout (-) vs. Temperature



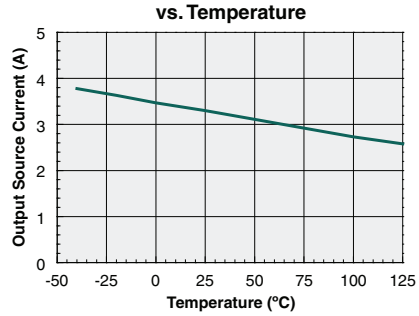
High Level Output Voltage vs. Temperature (I_O=0mA)



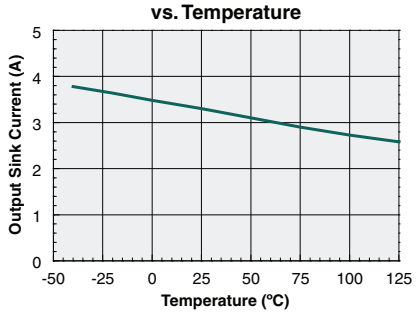
Low Level Output Voltage vs. Temperature (I_O=20mA)



Output Source Current vs. Temperature



Output Sink Current vs. Temperature



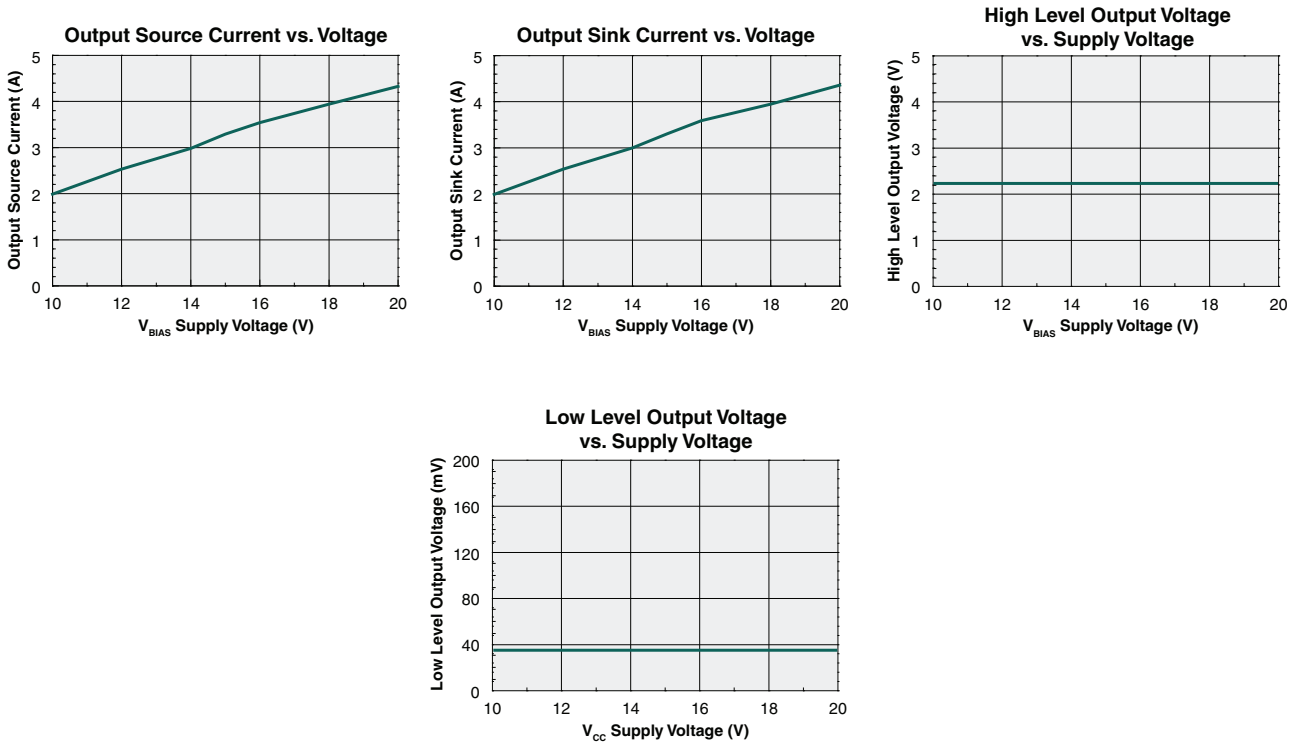
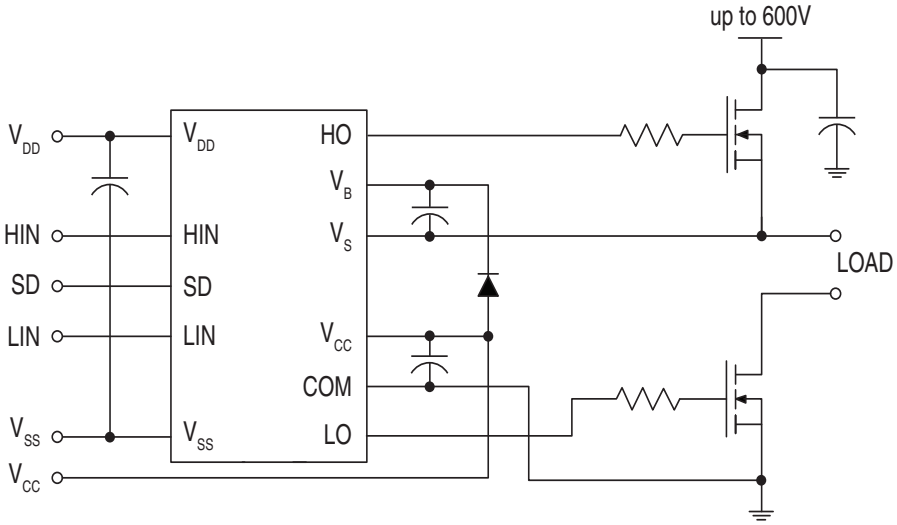


Figure 1. Typical Connection Diagram



3 Manufacturing Information

3.1 Moisture Sensitivity

All plastic encapsulated semiconductor packages are susceptible to moisture ingression. IXYS Integrated Circuits Division classified all of its plastic encapsulated devices for moisture sensitivity according to the latest version of the joint industry standard, **IPC/JEDEC J-STD-020**, in force at the time of product evaluation. We test all of our products to the maximum conditions set forth in the standard, and guarantee proper operation of our devices when handled according to the limitations and information in that standard as well as to any limitations set forth in the information or standards referenced below.

Failure to adhere to the warnings or limitations as established by the listed specifications could result in reduced product performance, reduction of operable life, and/or reduction of overall reliability.

This product carries a **Moisture Sensitivity Level (MSL) rating** as shown below, and should be handled according to the requirements of the latest version of the joint industry standard **IPC/JEDEC J-STD-033**.

Device	Moisture Sensitivity Level (MSL) Rating
IX2113B, IX2113G	MSL 1

3.2 ESD Sensitivity

This product is **ESD Sensitive**, and should be handled according to the industry standard **JESD-625**.

3.3 Reflow Profile

This product has a maximum body temperature and time rating as shown below. All other guidelines of **J-STD-020** must be observed.

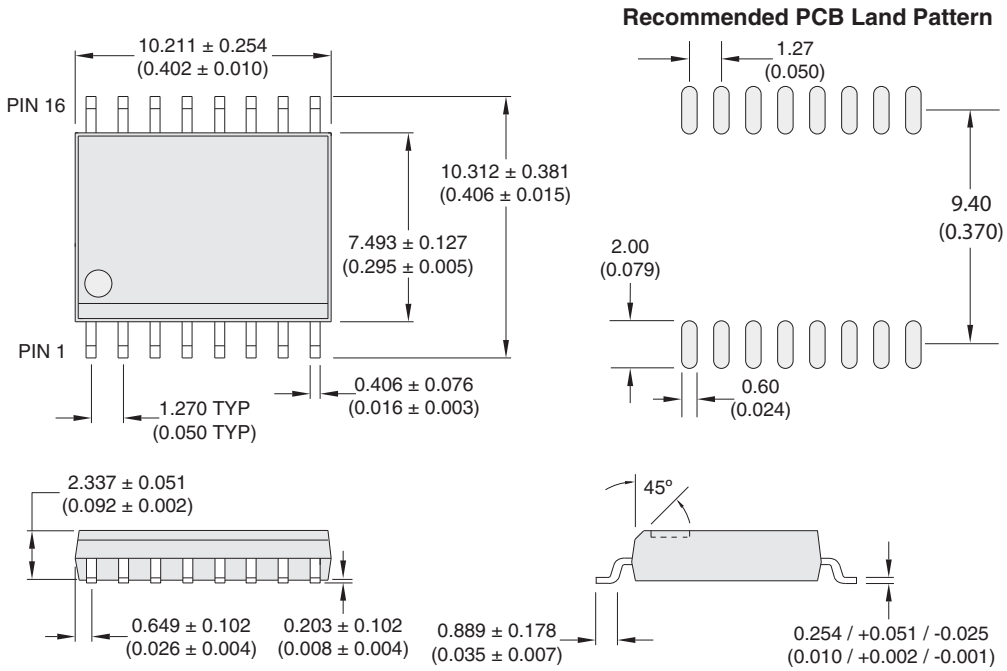
Device	Maximum Temperature x Time
IX2113B	260°C for 30 seconds
IX2113G	245°C for 30 seconds

3.4 Board Wash

IXYS Integrated Circuits Division recommends the use of no-clean flux formulations. However, board washing to remove flux residue is acceptable, and the use of a short drying bake may be necessary. Chlorine-based or Fluorine-based solvents or fluxes should not be used. Cleaning methods that employ ultrasonic energy should not be used.

3.5 Mechanical Dimensions

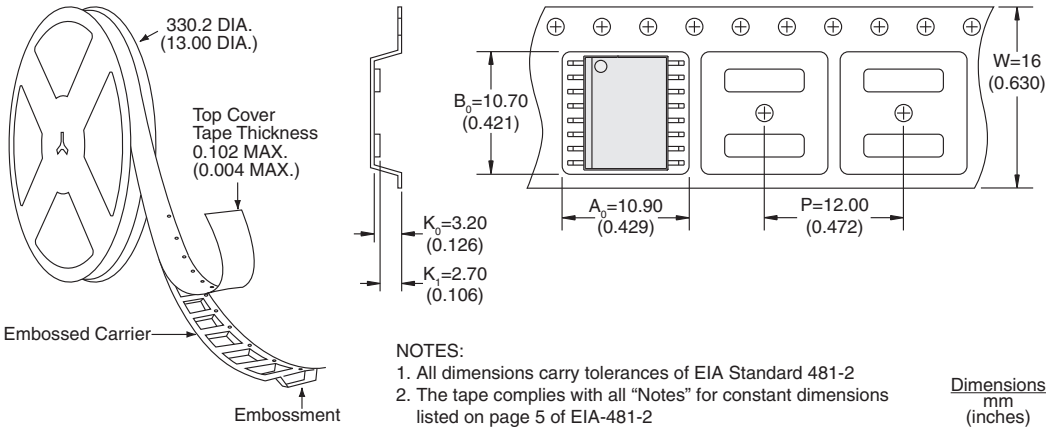
3.5.1 IX2113B: 16-Pin SOIC Package



NOTES:
1. Coplanarity = 0.1016 (0.004) max.
2. Leadframe thickness does not include solder plating (1000 microinch maximum).

DIMENSIONS
mm
(inches)

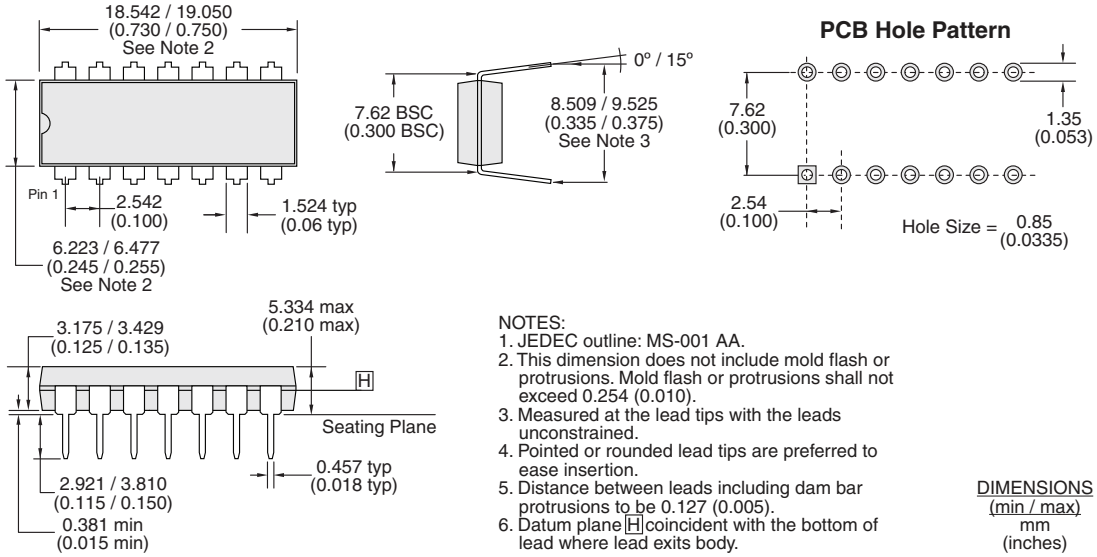
3.5.2 IX2113BTR: Tape & Reel Packaging for 16-Pin SOIC Package



NOTES:
1. All dimensions carry tolerances of EIA Standard 481-2
2. The tape complies with all "Notes" for constant dimensions listed on page 5 of EIA-481-2

Dimensions
mm
(inches)

3.5.3 IX2113G: 14-Pin DIP Through-Hole Package



NOTES:
1. JEDEC outline: MS-001 AA.
2. This dimension does not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.254 (0.010).
3. Measured at the lead tips with the leads unconstrained.
4. Pointed or rounded lead tips are preferred to ease insertion.
5. Distance between leads including dam bar protrusions to be 0.127 (0.005).
6. Datum plane H coincident with the bottom of lead where lead exits body.

DIMENSIONS
(min / max)
mm
(inches)

For additional information please visit our website at: www.ixysic.com

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Specification: DS-IX2113-R03
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