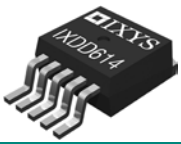
IXYS
INTEGRATED CIRCUITS DIVISION



IXD_614
14-Ampere Low-Side Ultrafast MOSFET Drivers

Features

- 14A Peak Source/Sink Drive Current
- Wide Operating Voltage Range: 4.5V to 35V
- -40°C to +125°C Extended Operating Temperature Range
- Logic Input Withstands Negative Swing of up to 5V
- Low Propagation Delay Time
- Low, 10µA Supply Current
- Low Output Impedance

Applications

- Efficient Power MOSFET and IGBT Switching
- Switch Mode Power Supplies
- Motor Controls
- DC to DC Converters
- Class-D Switching Amplifiers
- Pulse Transformer Driver

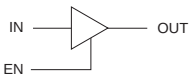
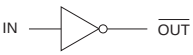
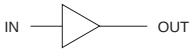
Description

The IXDD614 / IXDI614 / IXDN614 high-speed gate drivers are especially well suited for driving the latest IXYS MOSFETs and IGBTs. Each output can source and sink 14A of peak current while producing voltage rise and fall times of less than 30ns. Internal circuitry eliminates cross-conduction and current "shoot-through," making the driver virtually immune to latch up. Low propagation delay with fast rise and fall times make the IXD_614 family ideal for high-frequency and high-power applications.

The IXDD614 is configured as a non-inverting driver with an enable. The IXDN614 is configured as a non-inverting driver, and the IXDI614 is configured as an inverting driver.

The IXD_614 family is available in an 8-pin DIP (PI), an 8-pin Power SOIC with an exposed metal back (SI), a 5-pin TO-220 (CI), and a 5-pin TO-263 (YI) package.

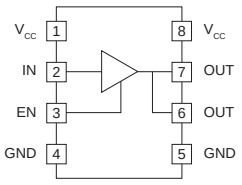
Ordering Information

Part Number	Logic Configuration	Package Type	Packing Method	Quantity
IXDD614PI		8-Pin DIP	Tube	50
IXDD614SI		8-Pin Power SOIC with Exposed Metal Back	Tube	100
IXDD614SITR		8-Pin Power SOIC with Exposed Metal Back	Tape & Reel	2000
IXDD614CI		5-Pin TO-220	Tube	50
IXDD614YI		5-Pin TO-263	Tube	50
IXDI614PI		8-Pin DIP	Tube	50
IXDI614SI		8-Pin Power SOIC with Exposed Metal Back	Tube	100
IXDI614SITR		8-Pin Power SOIC with Exposed Metal Back	Tape & Reel	2000
IXDI614CI		5-Pin TO-220	Tube	50
IXDI614YI		5-Pin TO-263	Tube	50
IXDN614PI		8-Pin DIP	Tube	50
IXDN614SI		8-Pin Power SOIC with Exposed Metal Back	Tube	100
IXDN614SITR		8-Pin Power SOIC with Exposed Metal Back	Tape & Reel	2000
IXDN614CI		5-Pin TO-220	Tube	50
IXDN614YI		5-Pin TO-263	Tube	50

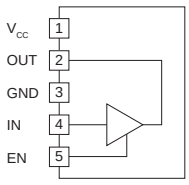
1 Specifications

1.1 Pin Configurations

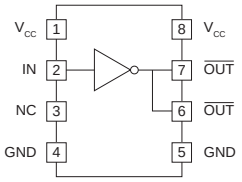
IXDD614 PI / SI



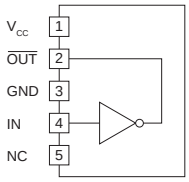
IXDD614 CI / YI



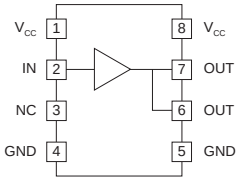
IXDI614 PI / SI



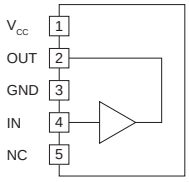
IXDI614 CI / YI



IXDN614 PI / SI



IXDN614 CI / YI



1.2 Pin Definitions

Pin Name	Description
IN	Logic Input
EN	Output Enable - Drive pin low to disable output, and force output to a high impedance state
OUT	Output - Sources or sinks current to turn-on or turn-off a discrete MOSFET or IGBT
$\overline{OUT}$	Inverted Output - Sources or sinks current to turn-on or turn-off a discrete MOSFET or IGBT
V_{CC}	Supply Voltage - Provides power to the device
GND	Ground - Common ground reference for the device
NC	Not connected

Note: IXYS Integrated Circuits Division recommends that the exposed metal pad on the back of the “SI” package be connected to GND. The pad is not suitable for carrying current.

1.3 Absolute Maximum Ratings

Parameter	Symbol	Minimum	Maximum	Units
Supply Voltage	V_{CC}	-0.3	40	V
Input Voltage	V_{IN} , V_{EN}	-5	V_{CC}+0.3	V
Output Current	I_{OUT}	-	±14	A
Junction Temperature	T_J	-55	+150	°C
Storage Temperature	T_{STG}	-65	+150	°C

Unless stated otherwise, absolute maximum electrical ratings are at 25°C

Absolute maximum ratings are stress ratings. Stresses in excess of these ratings can cause permanent damage to the device. Functional operation of the device at conditions beyond those indicated in the operational sections of this data sheet is not implied.

1.4 Recommended Operating Conditions

Parameter	Symbol	Range	Units
Supply Voltage	V_{CC}	4.5 to 35	V
Operating Temperature Range	T_A	-40 to +125	°C

1.5 Electrical Characteristics: T_A = 25°C

Test Conditions: 4.5V ≤ V_{CC} ≤ 35V (unless otherwise noted).

Parameter	Conditions	Symbol	Minimum	Typical	Maximum	Units
Input Voltage, High	4.5V ≤ V_{CC} ≤ 18V	V_{IH}	3.0	-	-	V
Input Voltage, Low	4.5V ≤ V_{CC} ≤ 18V	V_{IL}	-	-	0.8	
Input Current	0V ≤ V_{IN} ≤ V_{CC}	I_{IN}	-	-	±10	µA
EN Input Voltage, High	IXDD614 only	V_{ENH}	2/3V_{CC}	-	-	V
EN Input Voltage, Low	IXDD614 only	V_{ENL}	-	-	1/3V_{CC}	
Output Voltage, High	-	V_{OH}	V_{CC}-0.025	-	-	V
Output Voltage, Low	-	V_{OL}	-	-	0.025	
Output Resistance, High State	V_{CC}=18V, I_{OUT}=-100mA	R_{OH}	-	0.4	0.8	Ω
Output Resistance, Low State	V_{CC}=18V, I_{OUT}=100mA	R_{OL}	-	0.3	0.6	
Output Current, Continuous	Limited by package power dissipation	I_{DC}	-	-	±4	A
Rise Time	C_{LOAD}=15nF, V_{CC}=18V	t_R	-	25	35	ns
Fall Time	C_{LOAD}=15nF, V_{CC}=18V	t_F	-	18	25	
On-Time Propagation Delay	C_{LOAD}=15nF, V_{CC}=18V	$t_{ONDELAY}$	-	50	70	
Off-Time Propagation Delay	C_{LOAD}=15nF, V_{CC}=18V	$t_{OFFDELAY}$	-	50	70	
Enable to Output-High Delay Time	IXDD614 only	t_{ENOH}	-	31	60	
Disable to High Impedance State Delay Time	IXDD614 only	t_{DOLD}	-	44	70	
Enable Pull-Up Resistor	IXDD614 only	R_{EN}	-	200	-	kΩ
Power Supply Current	V_{CC}=18V, V_{IN}=3.5V	I_{CC}	-	1	2	mA
	V_{CC}=18V, V_{IN}=0V		-	<1	10	µA
	V_{CC}=18V, V_{IN}=V_{CC}		-	<1	10	

1.6 Electrical Characteristics: T_A = - 40°C to +125°C

Test Conditions: 4.5V ≤ V_{CC} ≤ 35V.

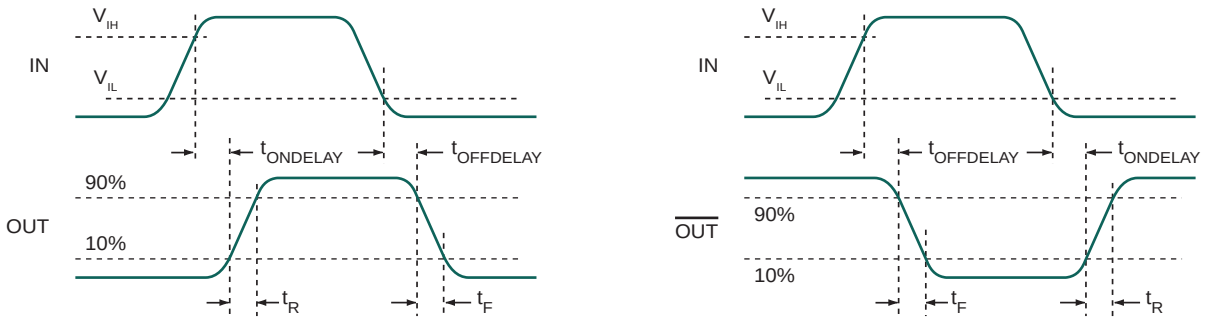
Parameter	Conditions	Symbol	Minimum	Maximum	Units
Input Voltage, High	4.5V ≤ V_{CC} ≤ 18V	V_{IH}	3.3	-	V
Input Voltage, Low	4.5V ≤ V_{CC} ≤ 18V	V_{IL}	-	0.65	
Input Current	0V ≤ V_{IN} ≤ V_{CC}	I_{IN}	-	±10	µA
Output Voltage, High	-	V_{OH}	V_{CC}-0.025	-	V
Output Voltage, Low	-	V_{OL}	-	0.025	
Output Resistance, High State	V_{CC}=18V, I_{OUT}=-100mA	R_{OH}	-	1.5	Ω
Output Resistance, Low State	V_{CC}=18V, I_{OUT}=100mA	R_{OL}	-	1.2	
Output Current, Continuous	Limited by package power dissipation	I_{DC}	-	±1	A
Rise Time	C_{LOAD}=15nF, V_{CC}=18V	t_R	-	50	ns
Fall Time	C_{LOAD}=15nF, V_{CC}=18V	t_F	-	40	
On-Time Propagation Delay	C_{LOAD}=15nF, V_{CC}=18V	$t_{ONDELAY}$	-	90	
Off-Time Propagation Delay	C_{LOAD}=15nF, V_{CC}=18V	$t_{OFFDELAY}$	-	90	
Enable to Output-High Delay Time	IXDD614 only	t_{ENOH}	-	75	
Disable to High Impedance State Delay Time	IXDD614 only	t_{DOLD}	-	85	
Power Supply Current	V_{CC}=18V, V_{IN}=3.5V	I_{CC}	-	3	mA
	V_{CC}=18V, V_{IN}=0V		-	150	µA
	V_{CC}=18V, V_{IN}=V_{CC}		-	150	

1.7 Thermal Characteristics

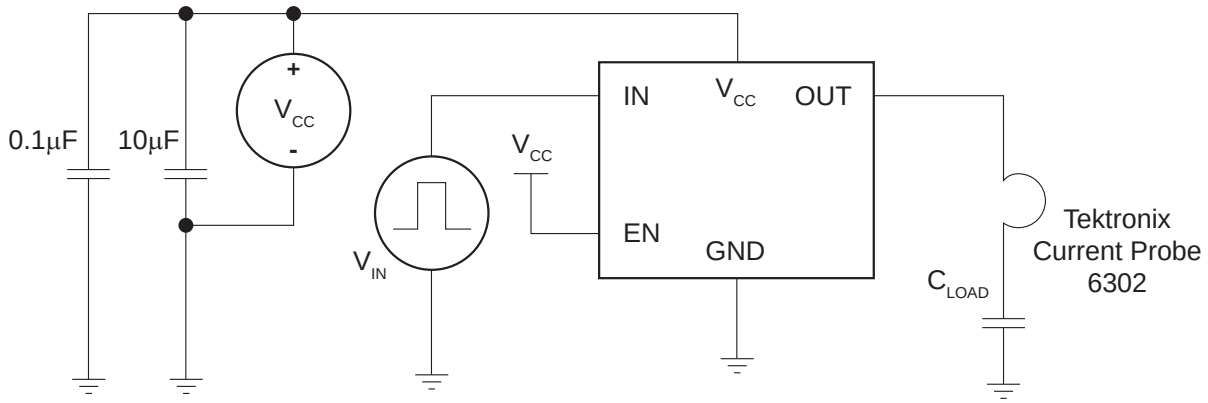
Package	Parameter	Symbol	Rating	Units
CI (5-Pin TO-220)	Thermal Impedance, Junction-to-Ambient	θ_{JA}	36	°C/W
PI (8-Pin DIP)			125	
SI (8-Pin Power SOIC)			85	
YI (5-Pin TO-263)			46	
CI (5-Pin TO-220)	Thermal Impedance, Junction-to-Case	θ_{JC}	3	°C/W
SI (8-Pin Power SOIC)			10	
YI (5-Pin TO-263)			2	

2 Performance

2.1 Timing Diagrams

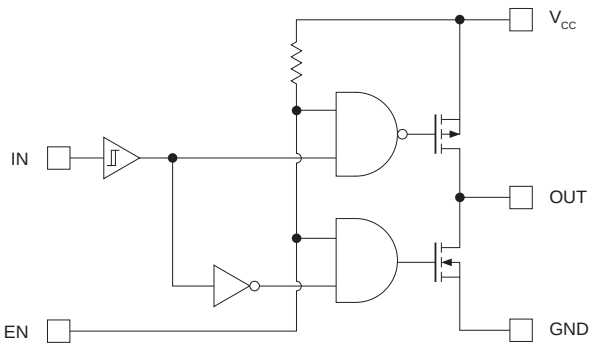


2.2 Characteristics Test Diagram



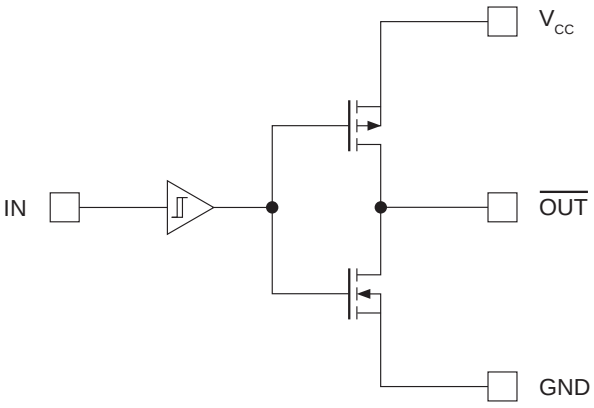
3 Block Diagrams & Truth Tables

3.1 IXDD614



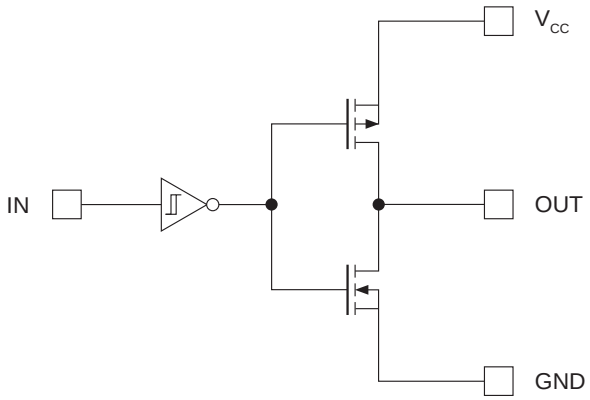
IN	EN	OUT
0	1 or open	0
1	1 or open	1
x	0	Z

3.2 IXDI614



IN	$\overline{OUT}$
0	1
1	0

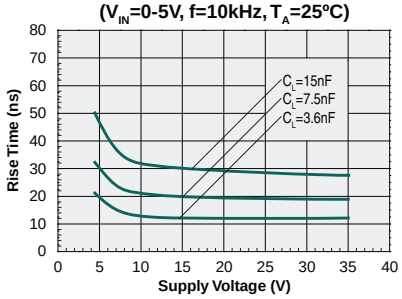
3.3 IXDN614



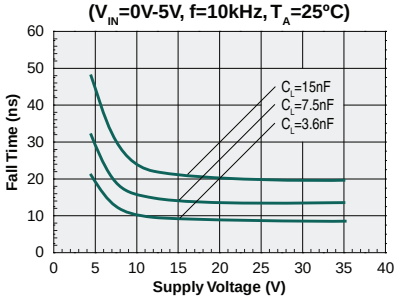
IN	OUT
0	0
1	1

4 Typical Performance Characteristics

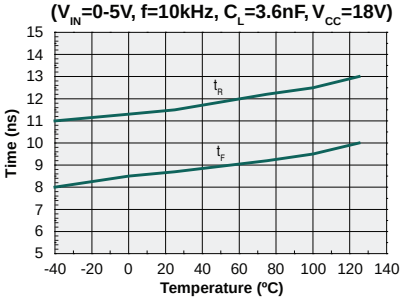
Rise Time vs. Supply Voltage
(V_{IN}=0-5V, f=10kHz, T_A=25ºC)



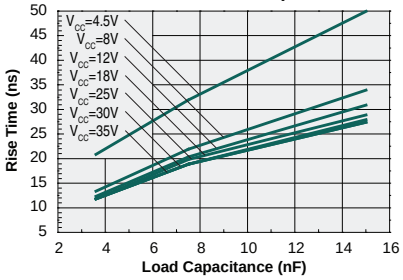
Fall Time vs. Supply Voltage
(V_{IN}=0V-5V, f=10kHz, T_A=25ºC)



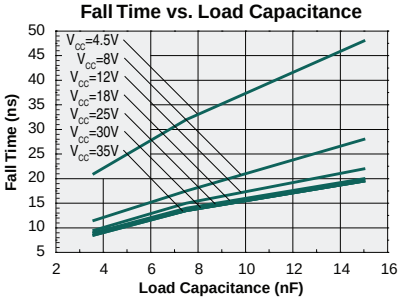
Rise & Fall Time vs. Temperature
(V_{IN}=0-5V, f=10kHz, C_L=3.6nF, V_{CC}=18V)



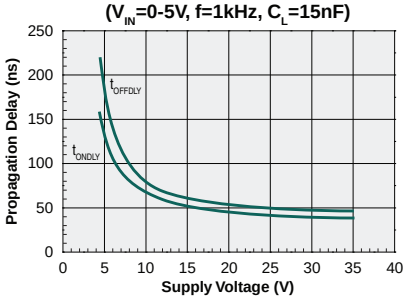
Rise Time vs. Load Capacitance



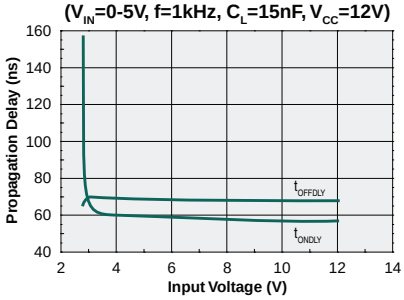
Fall Time vs. Load Capacitance



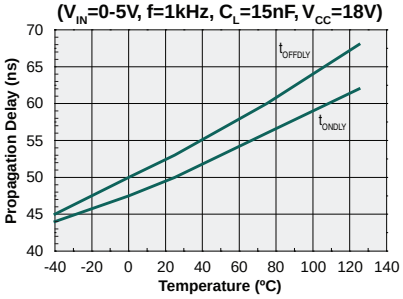
Propagation Delay vs. Supply Voltage
(V_{IN}=0-5V, f=1kHz, C_L=15nF)



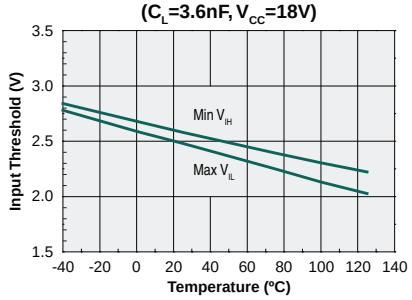
Propagation Delay vs. Input Voltage
(V_{IN}=0-5V, f=1kHz, C_L=15nF, V_{CC}=12V)



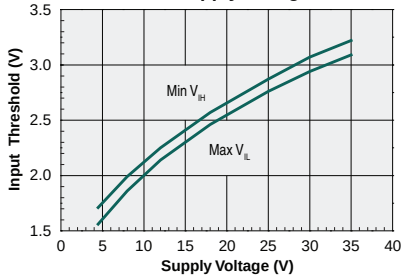
Propogation Delay
vs. Junction Temperature
(V_{IN}=0-5V, f=1kHz, C_L=15nF, V_{CC}=18V)



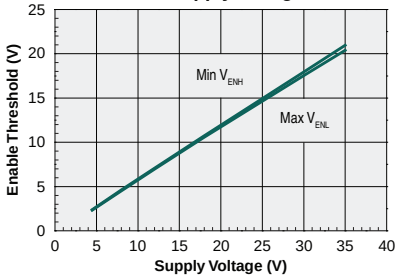
Input Threshold
vs. Temperature
(C_L=3.6nF, V_{CC}=18V)



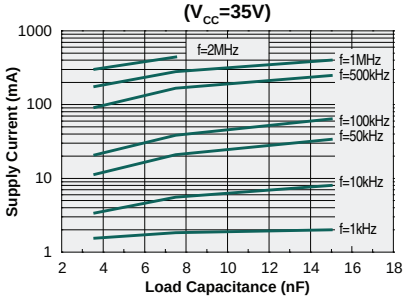
Input Threshold
vs. Supply Voltage



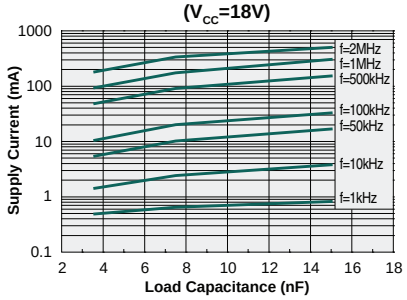
Enable Threshold
vs. Supply Voltage



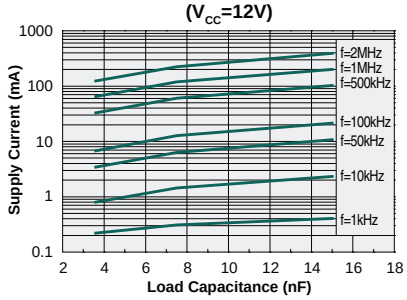
Supply Current vs. Load Capacitance (V_{CC}=35V)



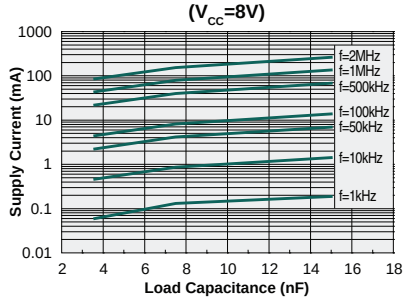
Supply Current vs. Load Capacitance (V_{CC}=18V)



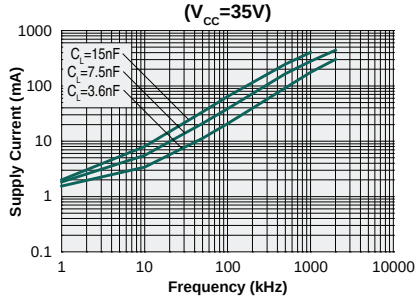
Supply Current vs. Load Capacitance (V_{CC}=12V)



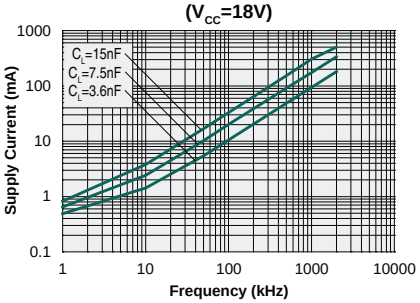
Supply Current vs. Load Capacitance (V_{CC}=8V)



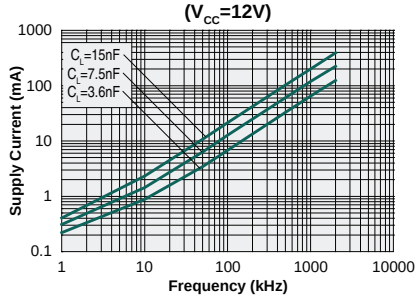
Supply Current vs. Frequency (V_{CC}=35V)



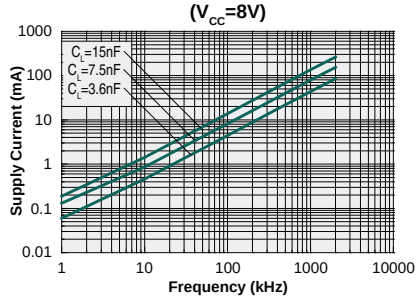
Supply Current vs. Frequency (V_{CC}=18V)



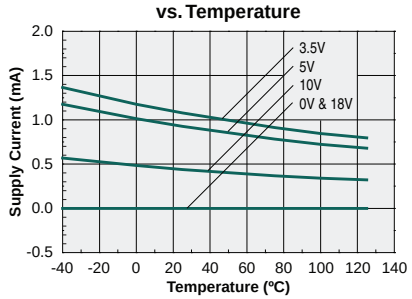
Supply Current vs. Frequency (V_{CC}=12V)



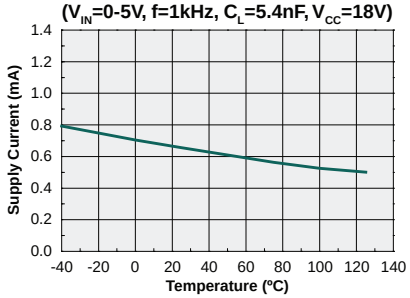
Supply Current vs. Frequency (V_{CC}=8V)



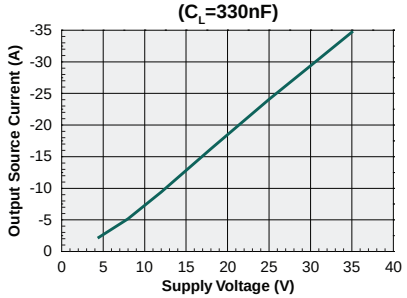
Quiescent Supply Current vs. Temperature



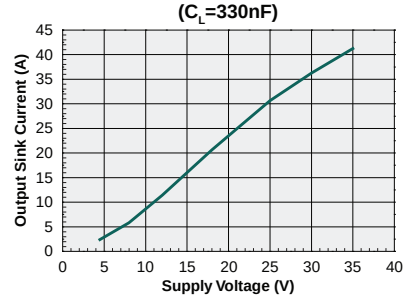
Dynamic Supply Current vs. Temperature (V_{IN}=0-5V, f=1kHz, C_L=5.4nF, V_{CC}=18V)



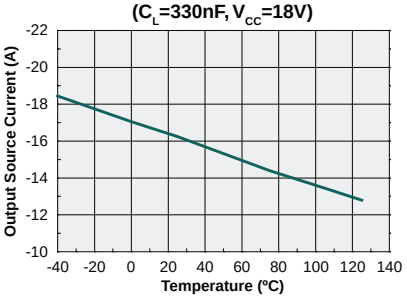
Output Source Current vs. Supply Voltage (C_L=330nF)



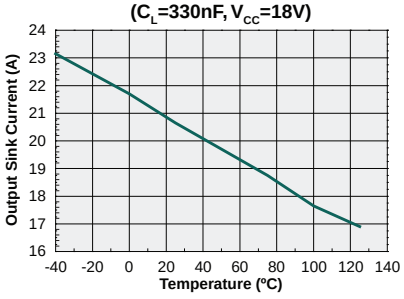
Output Sink Current vs. Supply Voltage (C_L=330nF)



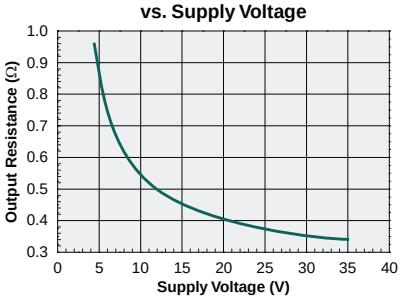
Output Source Current vs. Temperature (C_L=330nF, V_{CC}=18V)



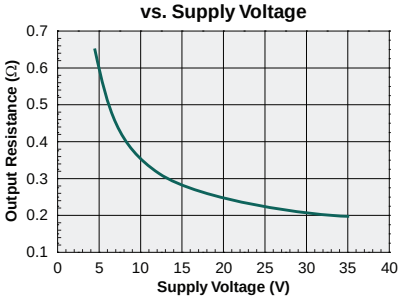
Output Sink Current vs. Temperature (C_L=330nF, V_{CC}=18V)



High-State Output Resistance @ -10mA vs. Supply Voltage



Low-State Output Resistance @ +10mA vs. Supply Voltage



5 Manufacturing Information

5.1 Moisture Sensitivity

All plastic encapsulated semiconductor packages are susceptible to moisture ingression. IXYS Integrated Circuits Division classifies 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)** classification 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) Classification
IXD_614SI / IXD_614PI /IXD_614CI	MSL 1
IXD_614YI	MSL 3

5.2 ESD Sensitivity

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

5.3 Soldering Profile

Provided in the table below is the Classification Temperature (T_C) of this product and the maximum dwell time the body temperature of this device may be (T_C - 5)ºC or greater. The classification temperature sets the Maximum Body Temperature allowed for this device during lead-free reflow processes. For through-hole devices, and any other processes, the guidelines of J-STD-020 must be observed.

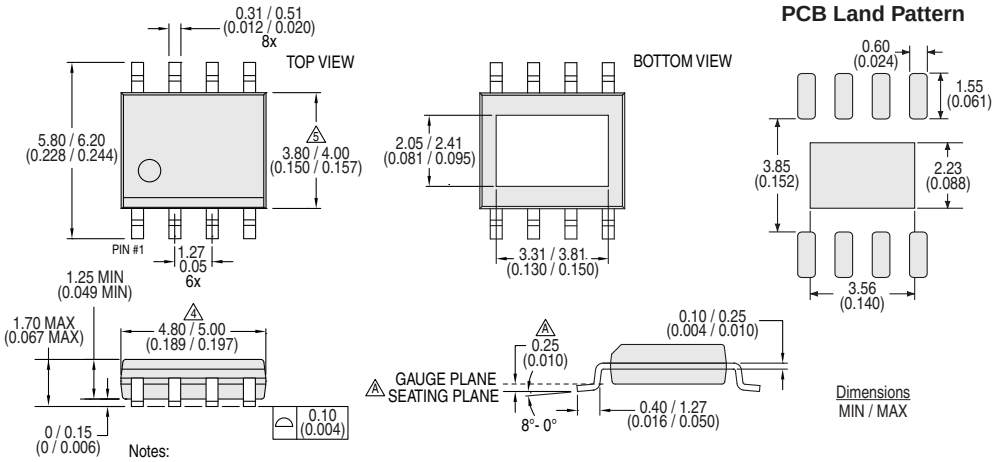
Device	Classification Temperature (T_C)	Dwell Time (t_p)	Max Reflow Cycles
IXD_614CI	245°C	30 seconds	1
IXD_614YI	245°C	30 seconds	3
IXD_614PI	250°C	30 seconds	3
IXD_614SI	260°C	30 seconds	3

5.4 Board Wash

IXYS Integrated Circuits Division recommends the use of no-clean flux formulations. Board washing to reduce or remove flux residue following the solder reflow process is acceptable provided proper precautions are taken to prevent damage to the device. These precautions include but are not limited to: using a low pressure wash and providing a follow up bake cycle sufficient to remove any moisture trapped within the device due to the washing process. Due to the variability of the wash parameters used to clean the board, determination of the bake temperature and duration necessary to remove the moisture trapped within the package is the responsibility of the user (assembler). Cleaning or drying methods that employ ultrasonic energy may damage the device and should not be used. Additionally, the device must not be exposed to flux or solvents that are Chlorine- or Fluorine-based.

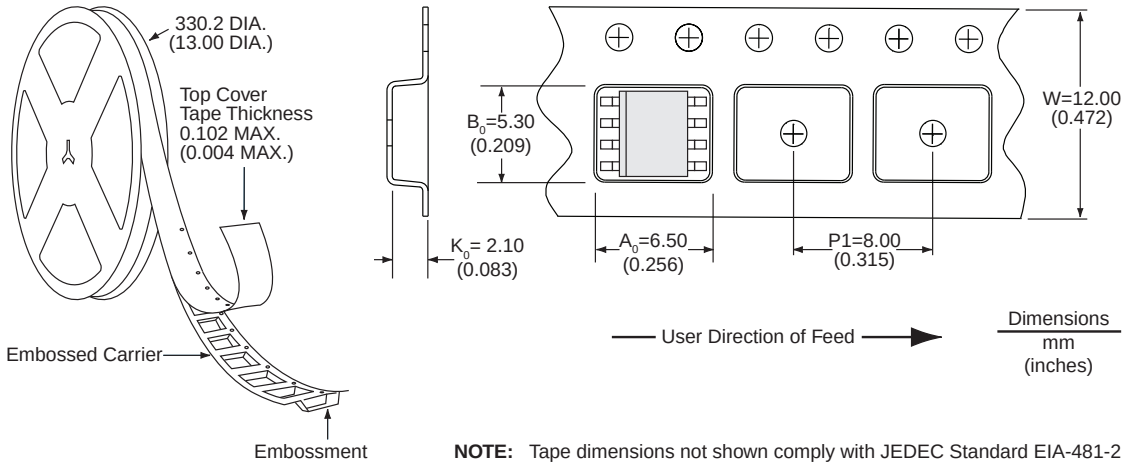
5.5 Mechanical Dimensions

5.5.1 SI (8-Pin Power SOIC with Exposed Metal Back)



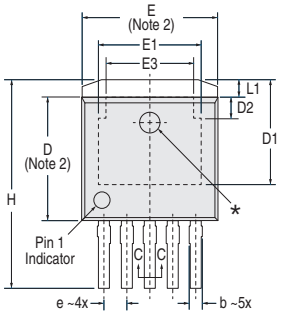
Notes:
1. Controlling dimension: millimeters.
2. All dimensions are in mm (inches).
3. This package conforms to JEDEC Standard MS-012, variation BA, Rev. F.
4. Dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15mm per end.
5. Dimension does not include interlead flash or protrusion. Interlead flash or protrusion shall not exceed 0.25mm per side.
6. The exposed metal pad on the back of the package should be connected to GND. It is not suitable for carrying current.
7. Lead thickness includes plating.

5.5.2 SI Package Tape & Reel Information



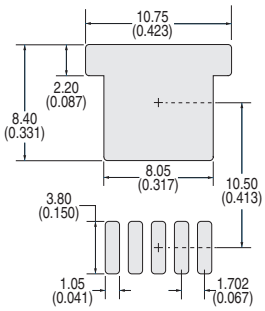
NOTE: Tape dimensions not shown comply with JEDEC Standard EIA-481-2

5.5.3 YI (5-Pin TO-263)



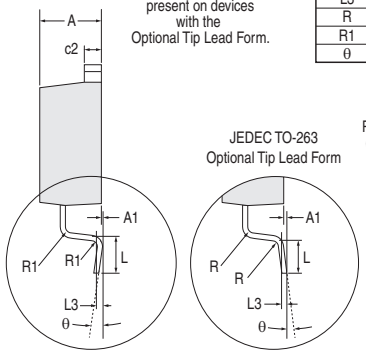
SYMBOL	MM		INCH	
	MIN	MAX	MIN	MAX
A	4.064	4.826	0.160	0.190
A1	0.000	0.254	0.000	0.010
b	0.508	0.991	0.020	0.039
b1	0.508	0.889	0.020	0.035
c	0.381	0.737	0.015	0.029
c1	0.381	0.584	0.015	0.023
c2	1.143	1.651	0.045	0.065
D	8.382	9.652	0.330	0.380
D1	6.858	7.700	0.270	0.303
D2	1.358	1.562	0.053	0.062
E	9.652	10.668	0.380	0.420
E1	6.223	8.000	0.245	0.315
E3	5.092	6.869	0.200	0.270
e	1.702 BSC		0.067 BSC	
H	14.605	15.875	0.575	0.625
L	1.778	2.794	0.070	0.110
L1	1.000	1.676	0.039	0.066
L3	0.254 BSC		0.010 BSC	
R	0.460 TYP		0.018 TYP	
R1	0.506 TYP		0.02 TYP	
θ	-	8°	-	8°

Recommended PCB Pattern

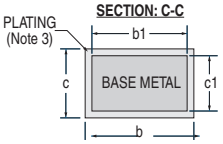


Dimensions
mm
(inches)

* Circular feature will be present on devices with the Optional Tip Lead Form.

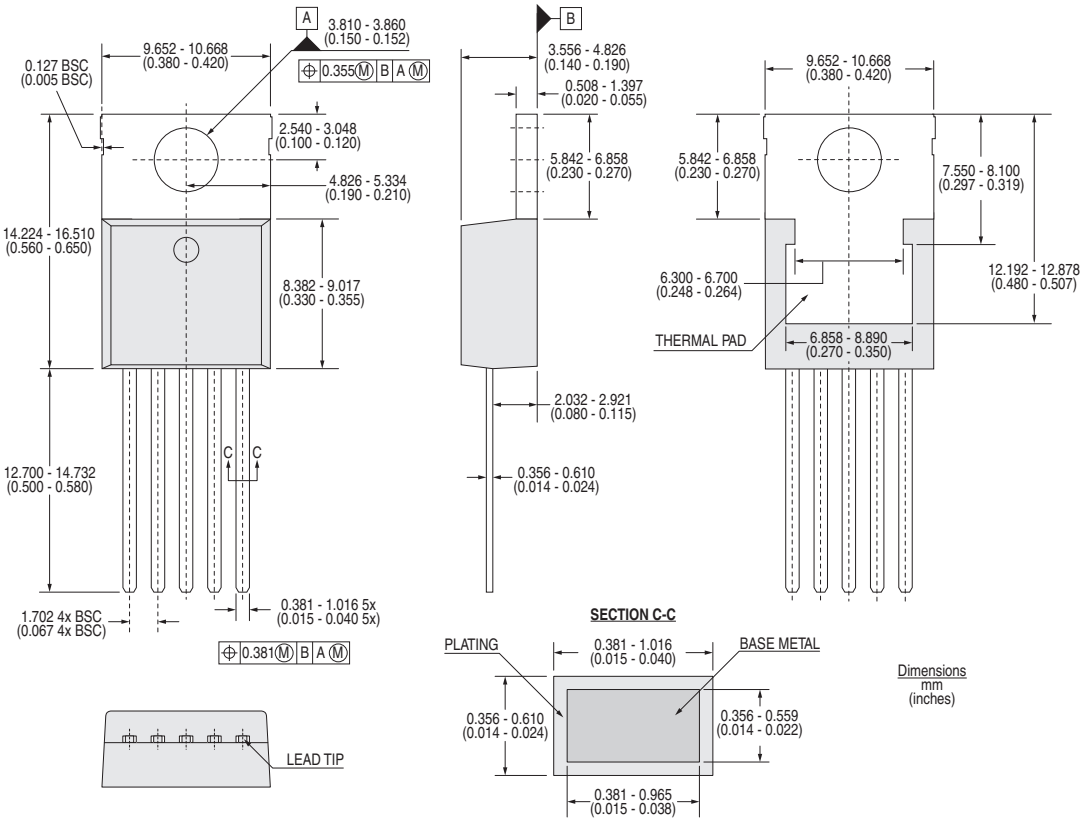


SECTION: C-C



NOTES:
1. Reference JEDEC TO-263 Type "BA".
2. Dimension does not include mold flash; mold flash shall not exceed 0.127mm (0.005 inch) per side.
3. Minimum plating: 1000 microinches.
4. Controlling dimension: millimeters.

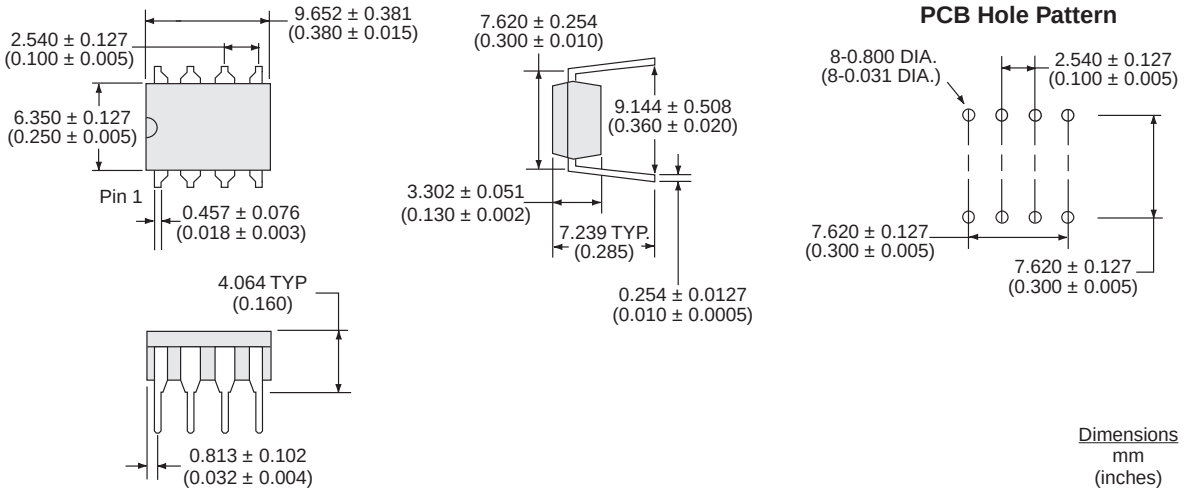
5.5.4 CI (5-Pin TO-220)



SECTION C-C

Dimensions
mm
(inches)

5.5.5 PI (8-Pin DIP)



Dimensions
mm
(inches)

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

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