

## Features

- AEC Q100 Qualified
- 9A Peak Source/Sink Drive Current
- Wide Operating Voltage Range: 4.5V to 35V
- AEC Q100 Grade 1 -40°C to +125°C Operating Temperature Range
- Logic Input Withstands Negative Swing of up to 5V
- Matched Rise and Fall Times
- Low Propagation Delay Time
- Low, 10 $\mu$ A Supply Current
- Low Output Impedance

## Applications

- Automotive DC/DC Regulators
- Electronic Power Steering
- Electric Vehicle Power Train Drives
- Brushless DC Motors

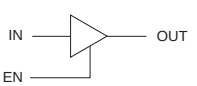
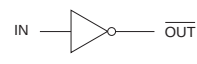
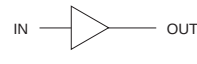


## Description

The IXD\_609SI is an automotive grade, high-speed gate driver that is qualified according to AEC Q100 standards. The IXD\_609SI output can source and sink 9A of peak current, while producing rise and fall times of less than 45ns. Both the output and input are rated to 35V. The input is virtually immune to latch-up, and proprietary circuitry eliminates cross conduction and "shoot-through." The IXD\_609SI has a Grade 1, -40°C to +125°C ambient operating temperature range.

The IXDD609SI is configured as a non-inverting driver with an enable, the IXDN609SI is configured as a non-inverting driver, and the IXDI609SI is configured as an inverting driver. The AEC Q100 qualified IXD\_609SI is available in an 8-pin Power SOIC package with an exposed metal back.

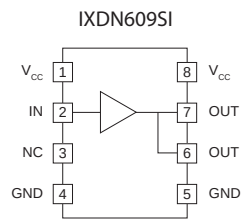
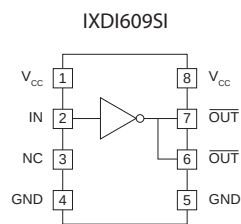
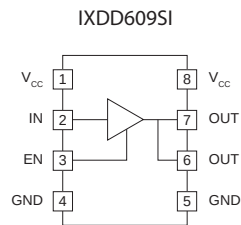
## Ordering Information

| Part Number | Logic Configuration                                                                 | Package Type                                | Packing Method | Quantity |
|-------------|-------------------------------------------------------------------------------------|---------------------------------------------|----------------|----------|
| IXDD609SI   |  | 8-Pin Power SOIC<br>with Exposed Metal Back | Tube           | 100      |
| IXDD609SITR |                                                                                     |                                             | Tape & Reel    | 2000     |
| IXDI609SI   |  |                                             | Tube           | 100      |
| IXDI609SITR |                                                                                     |                                             | Tape & Reel    | 2000     |
| IXDN609SI   |  |                                             | Tube           | 100      |
| IXDN609SITR |                                                                                     |                                             | Tape & Reel    | 2000     |

|                                                                                   |           |
|-----------------------------------------------------------------------------------|-----------|
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## 1 Specifications

### 1.1 Pin Configurations



### 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          |
| $\overline{\text{OUT}}$ | Inverted Output - Sources or sinks current to turn-on or turn-off a discrete MOSFET or IGBT |
| V <sub>CC</sub>         | Supply Voltage - Provides power to the device                                               |
| GND                     | Ground - Common ground reference for the device                                             |
| NC                      | Not connected                                                                               |

### 1.3 Absolute Maximum Ratings

| Parameter            | Symbol                            | Minimum | Maximum              | Units |
|----------------------|-----------------------------------|---------|----------------------|-------|
| Supply Voltage       | V <sub>CC</sub>                   | -0.3    | 40                   | V     |
| Input Voltage        | V <sub>IN</sub> , V <sub>EN</sub> | -5      | V <sub>CC</sub> +0.3 | V     |
| Output Current       | I <sub>OUT</sub>                  | -       | ±9                   | A     |
| Junction Temperature | T <sub>J</sub>                    | -55     | +150                 | °C    |
| Storage Temperature  | T <sub>STG</sub>                  | -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 <sub>CC</sub> | 4.5 to 35   | V     |
| Operating Temperature Range | T <sub>A</sub>  | -40 to +125 | °C    |

### 1.5 Electrical Characteristics: $T_A = 25^\circ\text{C}$

Test Conditions:  $4.5\text{V} \leq V_{CC} \leq 35\text{V}$  (unless otherwise noted).

| Parameter                                                   | Conditions                                 | Symbol       | Minimum        | Typical | Maximum     | Units            |
|-------------------------------------------------------------|--------------------------------------------|--------------|----------------|---------|-------------|------------------|
| Input Voltage, High                                         | $4.5\text{V} \leq V_{CC} \leq 18\text{V}$  | $V_{IH}$     | 3.0            | -       | -           | V                |
| Input Voltage, Low                                          | $4.5\text{V} \leq V_{CC} \leq 18\text{V}$  | $V_{IL}$     | -              | -       | 0.8         |                  |
| Input Current                                               | $0\text{V} \leq V_{IN} \leq V_{CC}$        | $I_{IN}$     | -              | -       | $\pm 10$    | $\mu\text{A}$    |
| EN Input Voltage, High                                      | IXDD609SI only                             | $V_{ENH}$    | $2/3V_{CC}$    | -       | -           | V                |
| EN Input Voltage, Low                                       | IXDD609SI 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                               | $V_{CC}=18\text{V}, I_{OUT}=-100\text{mA}$ | $R_{OH}$     | -              | 0.6     | 1           | $\Omega$         |
| Output Resistance, Low State                                | $V_{CC}=18\text{V}, I_{OUT}=100\text{mA}$  | $R_{OL}$     | -              | 0.4     | 0.8         |                  |
| Output Current, Continuous                                  | Limited by package power dissipation       | $I_{DC}$     | -              | -       | $\pm 2$     | A                |
| Rise Time                                                   | $V_{CC}=18\text{V}, C_{LOAD}=10\text{nF}$  | $t_r$        | -              | 22      | 35          | ns               |
| Fall Time                                                   | $V_{CC}=18\text{V}, C_{LOAD}=10\text{nF}$  | $t_f$        | -              | 15      | 25          |                  |
| On-Time Propagation Delay                                   | $V_{CC}=18\text{V}, C_{LOAD}=10\text{nF}$  | $t_{ondly}$  | -              | 40      | 60          |                  |
| Off-Time Propagation Delay                                  | $V_{CC}=18\text{V}, C_{LOAD}=10\text{nF}$  | $t_{offdly}$ | -              | 42      | 60          |                  |
| Enable to Output-High Delay Time (IXDD609SI Only)           | $V_{CC}=18\text{V}$                        | $t_{ENOH}$   | -              | 25      | 60          |                  |
| Disable to High Impedance State Delay Time (IXDD609SI Only) | $V_{CC}=18\text{V}$                        | $t_{DOLD}$   | -              | 35      | 60          |                  |
| Enable Pull-Up Resistor                                     | -                                          | $R_{EN}$     | -              | 200     | -           | $\text{k}\Omega$ |
| Power Supply Current                                        | $V_{CC}=18\text{V}, V_{IN}=3.5\text{V}$    | $I_{CC}$     | -              | 1       | 2           | $\text{mA}$      |
|                                                             | $V_{CC}=18\text{V}, V_{IN}=0\text{V}$      |              | -              | <1      | 10          |                  |
|                                                             | $V_{CC}=18\text{V}, V_{IN}=V_{CC}$         |              | -              | <1      | 10          |                  |

### 1.6 Electrical Characteristics: $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$

Test Conditions:  $4.5\text{V} \leq V_{CC} \leq 35\text{V}$  unless otherwise noted.

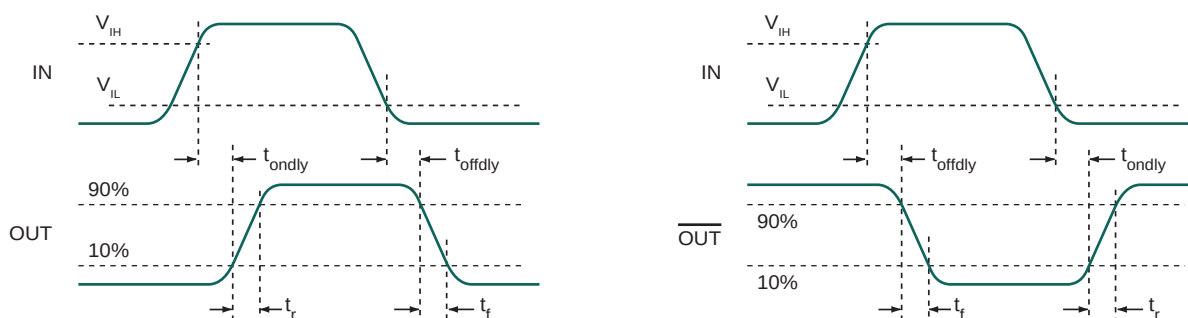
| Parameter                                  | Conditions                                 | Symbol       | Minimum        | Maximum  | Units         |
|--------------------------------------------|--------------------------------------------|--------------|----------------|----------|---------------|
| Input Voltage, High                        | $4.5\text{V} \leq V_{CC} \leq 18\text{V}$  | $V_{IH}$     | 3.3            | -        | V             |
| Input Voltage, Low                         | $4.5\text{V} \leq V_{CC} \leq 18\text{V}$  | $V_{IL}$     | -              | 0.65     |               |
| Input Current                              | $0\text{V} \leq V_{IN} \leq V_{CC}$        | $I_{IN}$     | -              | $\pm 10$ | $\mu\text{A}$ |
| Output Voltage, High                       | -                                          | $V_{OH}$     | $V_{CC}-0.025$ | -        | V             |
| Output Voltage, Low                        | -                                          | $V_{OL}$     | -              | 0.025    |               |
| Output Resistance, High State              | $V_{CC}=18\text{V}, I_{OUT}=-100\text{mA}$ | $R_{OH}$     | -              | 2        | $\Omega$      |
| Output Resistance, Low State               | $V_{CC}=18\text{V}, I_{OUT}=100\text{mA}$  | $R_{OL}$     | -              | 1.5      |               |
| Output Current, Continuous                 | Limited by package power dissipation       | $I_{DC}$     | -              | $\pm 1$  | A             |
| Rise Time                                  | $V_{CC}=18\text{V}, C_{LOAD}=10\text{nF}$  | $t_r$        | -              | 40       | ns            |
| Fall Time                                  | $V_{CC}=18\text{V}, C_{LOAD}=10\text{nF}$  | $t_f$        | -              | 30       |               |
| On-Time Propagation Delay                  | $V_{CC}=18\text{V}, C_{LOAD}=10\text{nF}$  | $t_{ondly}$  | -              | 75       |               |
| Off-Time Propagation Delay                 | $V_{CC}=18\text{V}, C_{LOAD}=10\text{nF}$  | $t_{offdly}$ | -              | 75       |               |
| Enable to Output-High Delay Time           | IXDD609SI only, $V_{CC}=18\text{V}$        | $t_{ENOH}$   | -              | 75       |               |
| Disable to High Impedance State Delay Time | IXDD609SI only, $V_{CC}=18\text{V}$        | $t_{DOLD}$   | -              | 75       |               |
| Power Supply Current                       | $V_{CC}=18\text{V}, V_{IN}=3.5\text{V}$    | $I_{CC}$     | -              | 2.5      | $\text{mA}$   |
|                                            | $V_{CC}=18\text{V}, V_{IN}=0\text{V}$      |              | -              | 150      |               |
|                                            | $V_{CC}=18\text{V}, V_{IN}=V_{CC}$         |              | -              | 150      |               |

## 1.7 Thermal Characteristics

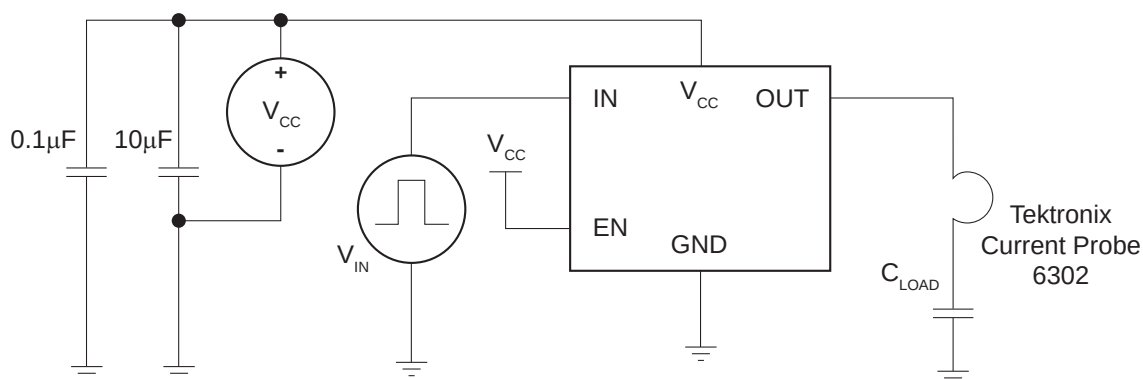
| Package               | Parameter                               | Symbol        | Rating | Units                |
|-----------------------|-----------------------------------------|---------------|--------|----------------------|
| SI (8-Pin Power SOIC) | Thermal Resistance, Junction-to-Ambient | $\theta_{JA}$ | 85     | $^{\circ}\text{C/W}$ |
|                       | Thermal Resistance, Junction-to-Case    | $\theta_{JC}$ | 10     |                      |

## 2 IXD\_609SI Performance

### 2.1 Timing Diagrams

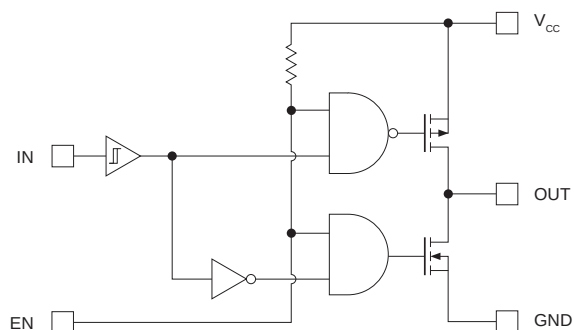


### 2.2 Characteristics Test Diagram



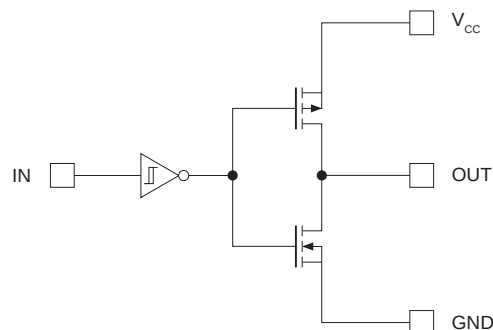
### 3 Block Diagrams & Truth Tables

#### 3.1 IXDD609SI



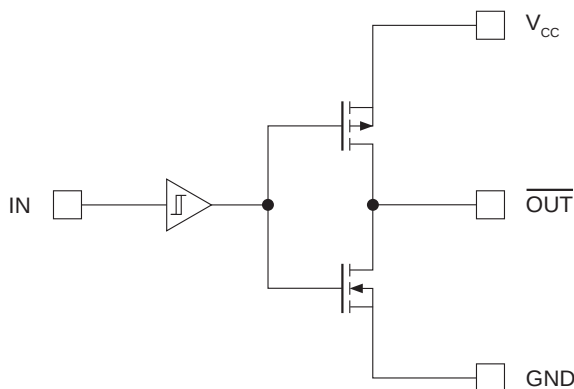
| IN | EN        | OUT |
|----|-----------|-----|
| 0  | 1 or open | 0   |
| 1  | 1 or open | 1   |
| x  | 0         | Z   |

#### 3.3 IXDN609SI



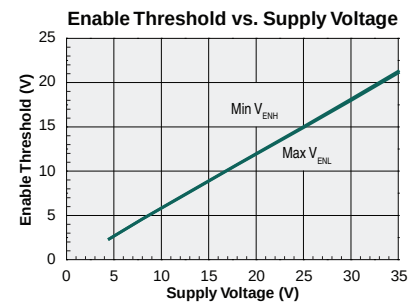
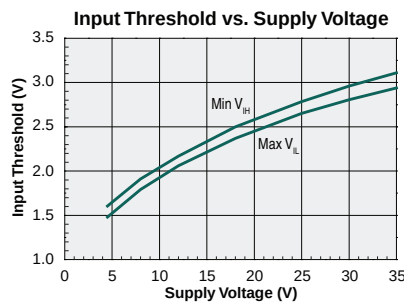
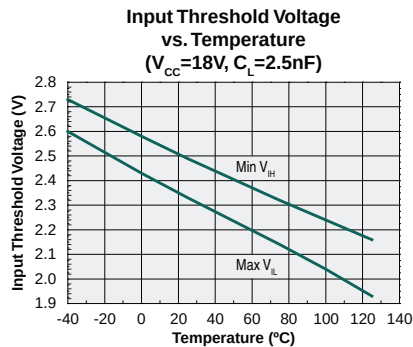
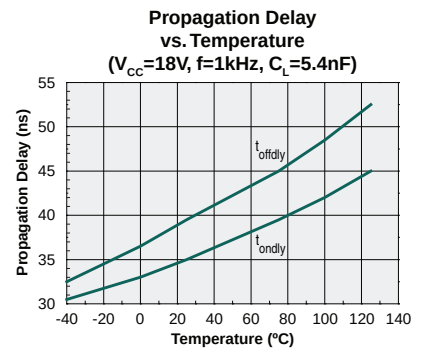
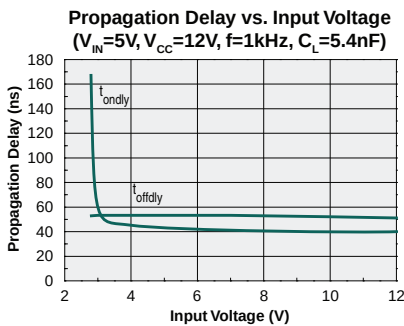
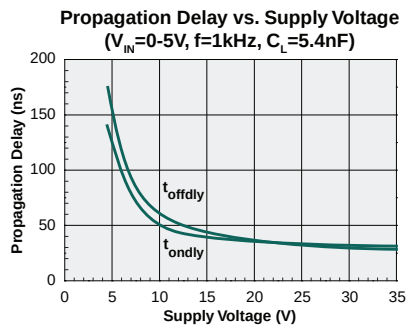
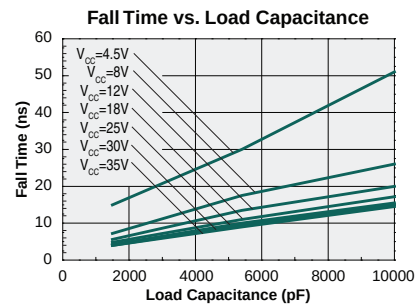
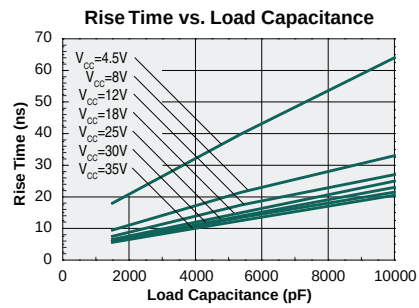
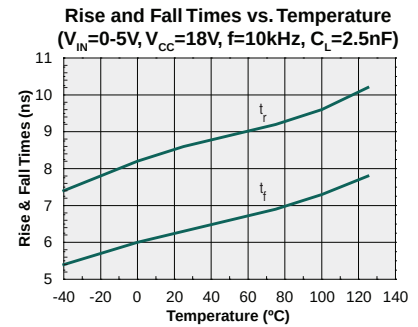
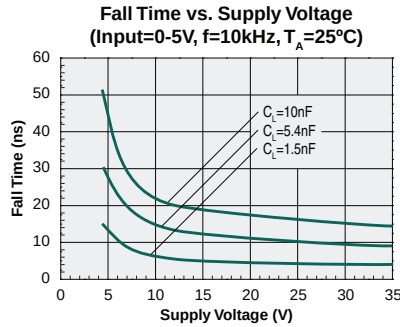
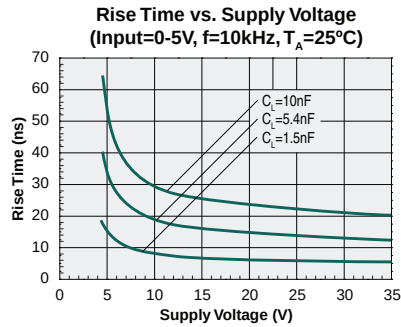
| IN | OUT |
|----|-----|
| 0  | 0   |
| 1  | 1   |

#### 3.2 IXDI609SI

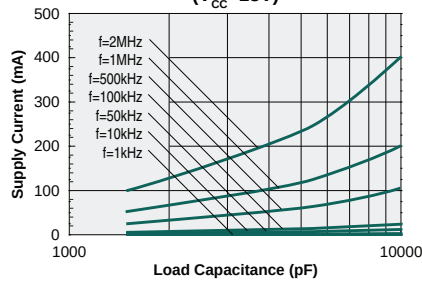


| IN | $\overline{\text{OUT}}$ |
|----|-------------------------|
| 0  | 1                       |
| 1  | 0                       |

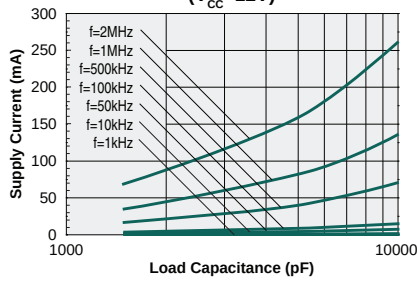
## 4 Typical Performance Characteristics



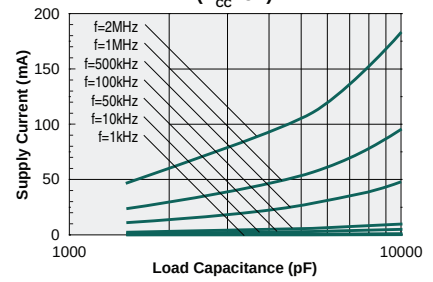
**Supply Current vs. Load Capacitance**  
( $V_{CC}=18V$ )



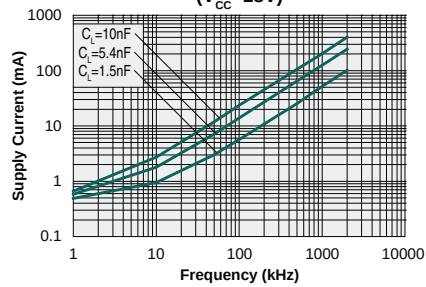
**Supply Current vs. Load Capacitance**  
( $V_{CC}=12V$ )



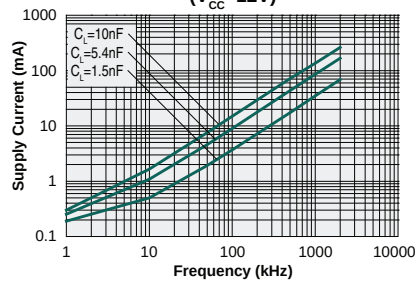
**Supply Current vs. Load Capacitance**  
( $V_{CC}=8V$ )



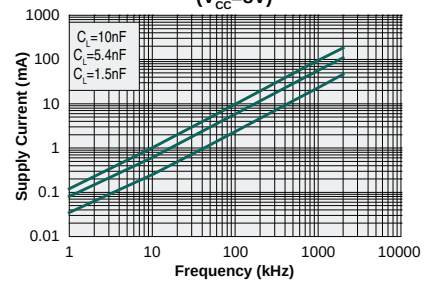
**Supply Current vs. Frequency**  
( $V_{CC}=18V$ )



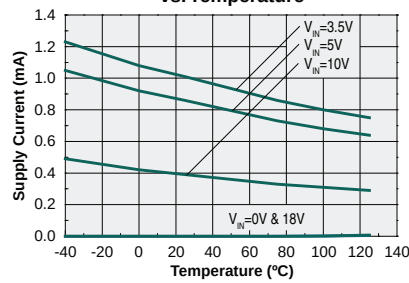
**Supply Current vs. Frequency**  
( $V_{CC}=12V$ )



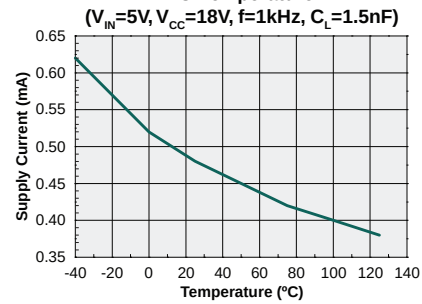
**Supply Current vs. Frequency**  
( $V_{CC}=8V$ )



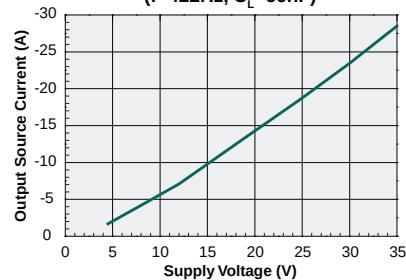
**Quiescent Supply Current**  
**vs. Temperature**



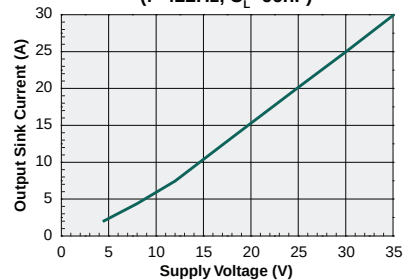
**Dynamic Supply Current**  
**vs. Temperature**



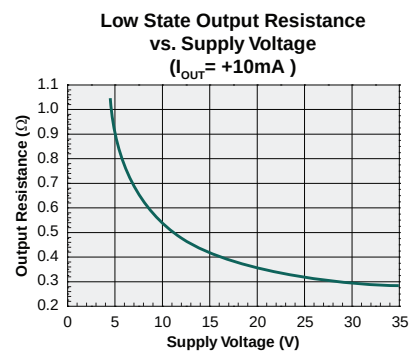
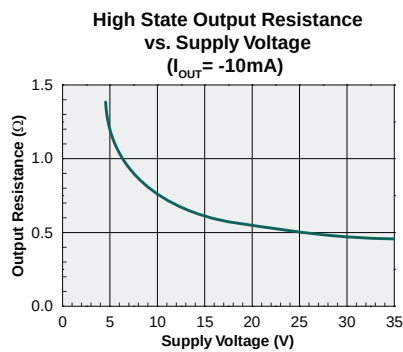
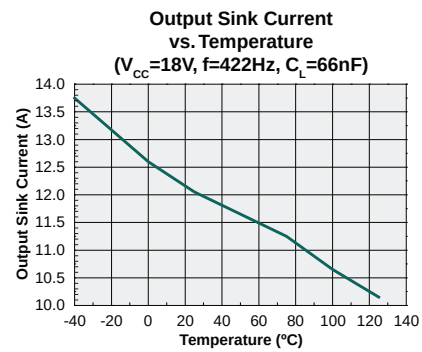
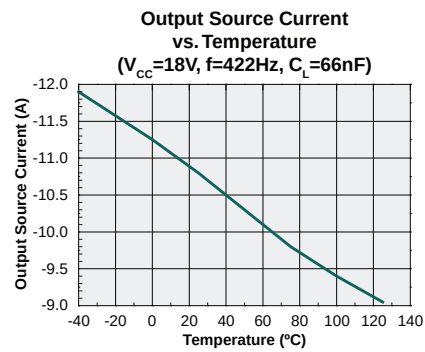
**Output Source Current**  
**vs. Supply Voltage**  
( $f=422Hz$ ,  $C_L=66nF$ )



**Output Sink Current**  
**vs. Supply Voltage**  
( $f=422Hz$ ,  $C_L=66nF$ )







## 5 Manufacturing Information

### 5.1 Moisture Sensitivity



All plastic encapsulated semiconductor packages are susceptible to moisture ingress. 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_609SI | MSL 1                                           |

### 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 ( $T_C - 5^\circ\text{C}$ ) 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.

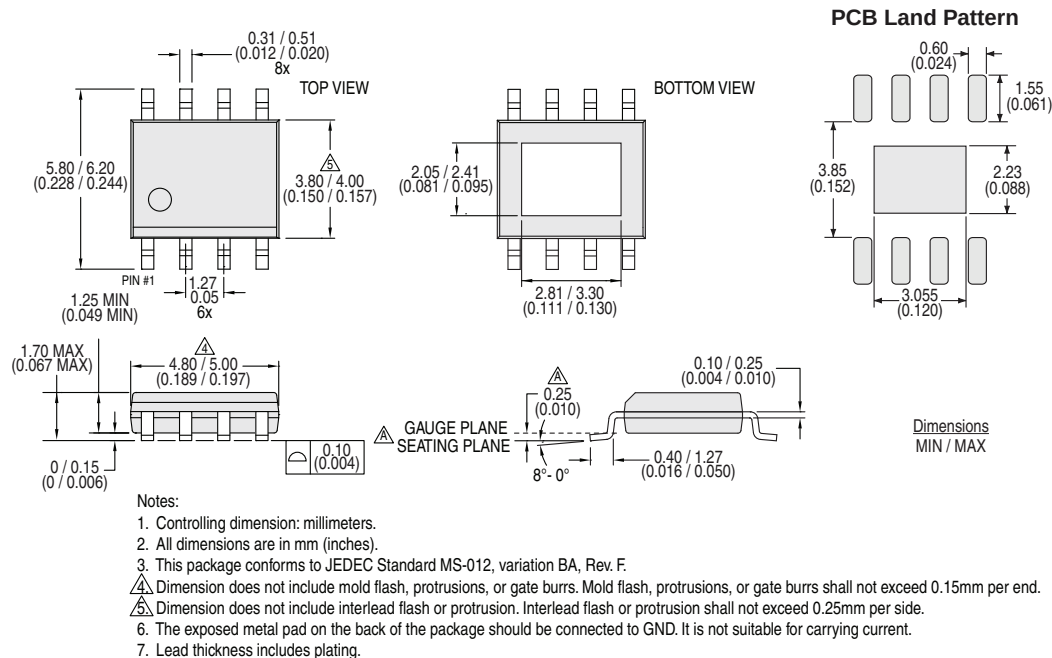
| Device    | Classification Temperature ( $T_C$ ) | Dwell Time ( $t_p$ ) | Max Reflow Cycles |
|-----------|--------------------------------------|----------------------|-------------------|
| IXD_609SI | 260°C                                | 30 seconds           | 3                 |

### 5.4 Board Wash

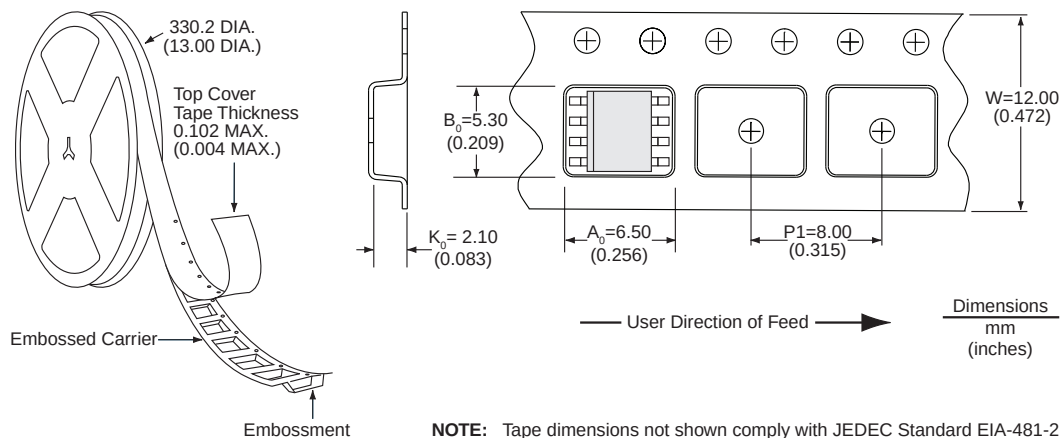
IXYS Integrated Circuits Division recommends the use of no-clean flux formulations. Board washing to reduce or remove flux residue following the solder reflow process is acceptable provided proper precautions are taken to prevent damage to the device. These precautions include but are not limited to: 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. Mechanical dimensions.



### 5.4.1 SI Package (8-Pin Power SOIC with Exposed Metal Back)



### 5.4.2 Tape & Reel Information for SI Package



For additional information please visit our website at: [www.ixysic.com](http://www.ixysic.com)

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