

## Automotive Grade AUIRS211(0,3)S HIGH- AND LOW-SIDE DRIVER

### Features

- Floating channel designed for bootstrap operation
- Fully operational to +500 V or +600 V
- Tolerant to negative transient voltage – dV/dt immune
- Gate drive supply range from 10 V to 20 V
- Undervoltage lockout for both channels
- 3.3 V input logic compatible
- Separate logic supply range from 3.3 V to 20 V
- Logic and power ground  $\pm 5$  V offset
- CMOS Schmitt-triggered inputs with pull-down
- Cycle by cycle edge-triggered shutdown logic
- Matched propagation delay for both channels
- Output in phase with inputs
- Leadfree, roHS Compliant
- Automotive qualified\*

### Typical Applications

- Hybrid electric vehicles
- Air condition drives, pumps, fans
- Automotive general purpose dual LS/HS driver
- Automotive motor drives
- Automotive DC/DC converters
- Automotive injection control

### Product Summary

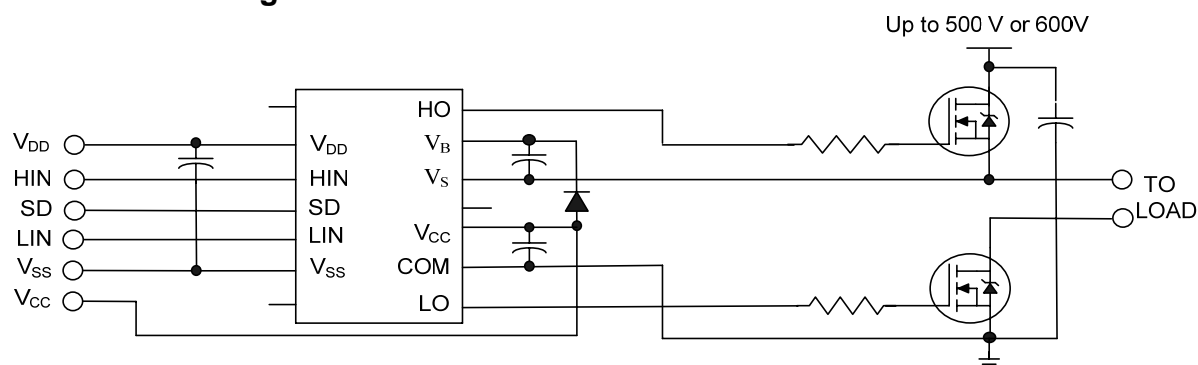
Topology		2 channels
$V_{\text{OFFSET}}$	AUIRS2110	500 V max
	AUIRS2113	600 V max
$V_{\text{OUT}}$		10 V – 20 V
$I_{\text{O+}} \& I_{\text{O-}}$ (typical)		2.5 A / 2.5 A
$t_{\text{ON}} \& t_{\text{OFF}}$ (typical)		140 ns & 120 ns
Delay Matching (max.)		35 ns max

### Package Option



16-Lead SOIC  
AUIRS211(0,3)S

### Typical Connection Diagram



(Refer to Lead Assignments for correct pin configuration). This/These diagram(s) show electrical connections only. Please refer to our Application Notes and Design Tips for proper circuit board layout.

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## Description

The AUIRS211(0,3)S are high voltage, high speed power MOSFET and IGBT drivers with independent high and low side referenced output channels. Proprietary HVIC and latch immune CMOS technologies enable ruggedized monolithic construction. The logic input is compatible with standard CMOS or LSTTL output, down to 3.3 V logic. The output drivers feature a high pulse current buffer stage designed for minimum driver cross-conduction. Propagation delays are matched to simplify use in high frequency applications. The floating channel can be used to drive an N-channel power MOSFET or IGBT in the high side configuration which operates up to 500 V or 600 V.

## Qualification Information<sup>†</sup>

<b>Qualification Level</b>		Automotive (per AEC-Q100 <sup>††</sup> )	
		Comments: This family of ICs has passed an Automotive qualification. IR's Industrial and Consumer qualification level is granted by extension of the higher Automotive level.	
<b>Moisture Sensitivity Level</b>		SOIC16W	MSL3 <sup>†††</sup> 260°C (per IPC/JEDEC J-STD-020)
<b>ESD</b>	Machine Model	Class M2 (Pass +/-200V) (per AEC-Q100-003)	
	Human Body Model	Class H1B (Pass +/-1000V) (per AEC-Q100-002)	
	Charged Device Model	Class C4 (Pass +/-1000V) (per AEC-Q100-011)	
<b>IC Latch-Up Test</b>		Class II, Level A (per AEC-Q100-004)	
<b>RoHS Compliant</b>		Yes	

† Qualification standards can be found at International Rectifier's web site <http://www.irf.com/>

†† Exceptions to AEC-Q100 requirements are noted in the qualification report.

††† Higher MSL ratings may be available for the specific package types listed here. Please contact your International Rectifier sales representative for further information.

## 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.

Symbol	Definition	Min.	Max.	Units
$V_B$	High-side floating supply voltage	(AUIRS2110)	-0.3	520 (†)
		(AUIRS2113)	-0.3	620 (†)
$V_S$	High-side floating supply offset voltage	$V_B - 20$	$V_B + 0.3$	V
$V_{HO}$	High-side floating output voltage	$V_S - 0.3$	$V_B + 0.3$	
$V_{CC}$	Low-side fixed supply voltage	-0.3	20	
$V_{LO}$	Low-side output voltage	-0.3	$V_{CC} + 0.3$	
$V_{DD}$	Logic supply voltage	-0.3	$V_{SS} + 20$ (†)	
$V_{SS}$	Logic supply offset voltage	$V_{CC} - 20$	$V_{CC} + 0.3$	
$V_{IN}$	Logic input voltage (HIN, LIN & SD)	$V_{SS} - 0.3$	$V_{DD} + 0.3$	
$dV_S/dt$	Allowable offset supply voltage transient (Fig. 2)	—	50	V/ns
$P_D$	Package power dissipation @ $T_A \leq 25^\circ\text{C}$	—	1.25	W
$R_{thJA}$	Thermal resistance, junction to ambient	—	100	$^\circ\text{C}/\text{W}$
$T_J$	Junction temperature	—	150	$^\circ\text{C}$
$T_S$	Storage temperature	-55	150	
$T_L$	Lead temperature (soldering, 10 seconds)	—	300	

† All supplies are fully tested at 25 V, and an internal 20 V clamp exists for each supply.

## Recommended Operating Conditions

The input/output logic timing diagram is shown in Figure 1. For proper operation the device should be used within the recommended conditions. The  $V_S$  and  $V_{SS}$  offset rating are tested with all supplies biased at 15 V differential.

Symbol	Definition		Min.	Max.	Units
V <sub>B</sub>	High-side floating supply absolute voltage		V <sub>S</sub> +10	V <sub>S</sub> +20	V
V <sub>S</sub>	High-side floating supply offset voltage	(AUIRS2110)	†	500	
		(AUIRS2113)	†	600	
V <sub>HO</sub>	High-side floating output voltage		V <sub>S</sub>	V <sub>B</sub>	
V <sub>CC</sub>	Low-side fixed supply voltage		10	20	
V <sub>LO</sub>	Low-side output voltage		0	V <sub>CC</sub>	
V <sub>DD</sub>	Logic supply voltage		V <sub>SS</sub> + 3	V <sub>SS</sub> + 20	
V <sub>SS</sub>	Logic ground offset voltage		-5 (††)	5	
V <sub>IN</sub>	Logic input voltage (HIN, LIN & SD)		V <sub>SS</sub>	V <sub>DD</sub>	
T <sub>A</sub>	Ambient temperature		-40	125	°C

† Logic operational for  $V_S$  of -4 V to +500 V. Logic state held for  $V_S$  of -4 V to  $-V_{BS}$ .  
(Please refer to the Design Tip DT97 -3 for more details).

†† When  $V_{DD} < 5$  V, the minimum  $V_{SS}$  offset is limited to  $-V_{DD}$ .

### Static Electrical Characteristics

Unless otherwise noted, these specifications apply for an operating junction temperature range of  $-40^{\circ}\text{C} \leq T_j \leq 125^{\circ}\text{C}$  with bias conditions of  $V_{\text{BIAS}}$  ( $V_{\text{CC}}$ ,  $V_{\text{BS}}$ ,  $V_{\text{DD}}$ ) = 15 V,  $V_{\text{SS}} = \text{COM}$ . The  $V_{\text{IL}}$ ,  $V_{\text{TH}}$  and  $I_{\text{IN}}$  parameters are referenced to  $V_{\text{SS}}$  and are applicable to all three logic input leads: HIN, LIN and SD. The  $V_{\text{O}}$  and  $I_{\text{O}}$  parameters are referenced to COM and are applicable to the respective output leads: HO or LO.

Symbol	Definition	Min	Typ	Max	Units	Test Conditions
$V_{\text{IH}}$	Logic "1" input voltage	9.5	—	—	V	
$V_{\text{IL}}$	Logic "0" input voltage	—	—	6.0		
$V_{\text{OH}}$	High level output voltage, $V_{\text{BIAS}} - V_{\text{O}}$	—	—	1.4		$I_{\text{O}} = 0 \text{ A}$
$V_{\text{OL}}$	Low level output voltage, $V_{\text{O}}$	—	—	0.15		$I_{\text{O}} = 20 \text{ mA}$
$I_{\text{LK}}$	Offset supply leakage current	—	—	50	$\mu\text{A}$	$V_{\text{B}} = V_{\text{S}} = 500 \text{ V}/600 \text{ V}$
$I_{\text{QBS}}$	Quiescent $V_{\text{BS}}$ supply current	—	70	130		$V_{\text{IN}} = 0 \text{ V}$ or $V_{\text{DD}}$
$I_{\text{QCC}}$	Quiescent $V_{\text{CC}}$ supply current	—	125	230		
$I_{\text{QDD}}$	Quiescent $V_{\text{DD}}$ supply current	—	5	30		$V_{\text{IN}} = V_{\text{DD}}$
$I_{\text{IN+}}$	Logic "1" input bias current	—	20	40		$V_{\text{IN}} = 0 \text{ V}$
$I_{\text{IN-}}$	Logic "0" input bias current	—	—	5.0		
$V_{\text{BSUV+}}$	$V_{\text{BS}}$ supply undervoltage positive going threshold	7.5	8.6	9.7	V	
$V_{\text{BSUV-}}$	$V_{\text{BS}}$ supply undervoltage negative going threshold	7.0	8.2	9.4		
$V_{\text{CCUV+}}$	$V_{\text{CC}}$ supply undervoltage positive going threshold	7.4	8.5	9.6		
$V_{\text{CCUV-}}$	$V_{\text{CC}}$ supply undervoltage negative going threshold	7.0	8.2	9.4		
$I_{\text{O+}}$	Output high short circuit pulsed current <sup>(†)</sup>	2.0	2.5	—	A	$V_{\text{O}} = 0 \text{ V}$ , $V_{\text{IN}} = V_{\text{DD}}$ $\text{PW} \leq 10 \text{ us}$
$I_{\text{O-}}$	Output low short circuit pulsed current <sup>(†)</sup>	2.0	2.5	—		$V_{\text{O}} = 15 \text{ V}$ , $V_{\text{IN}} = 0 \text{ V}$ $\text{PW} \leq 10 \text{ us}$

(†) Guaranteed by design

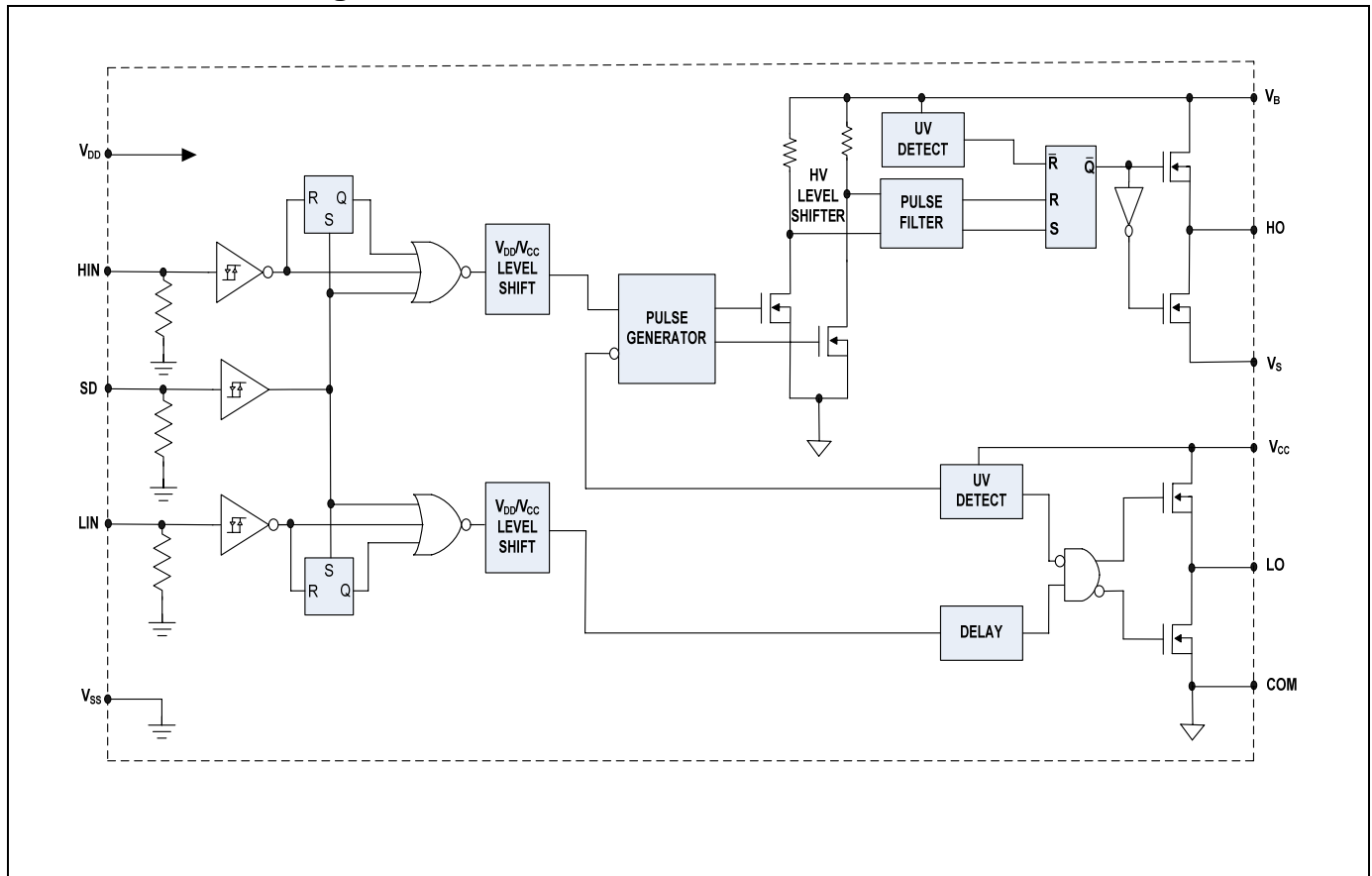
### Dynamic Electrical Characteristics

Unless otherwise noted, these specifications apply for an operating junction temperature range of  $-40^{\circ}\text{C} \leq T_j \leq 125^{\circ}\text{C}$  with bias conditions of  $V_{\text{BIAS}}$  ( $V_{\text{CC}}$ ,  $V_{\text{BS}}$ ,  $V_{\text{DD}}$ ) = 15 V,  $C_{\text{L}} = 1000 \text{ pF}$ , and  $V_{\text{SS}} = \text{COM}$ . The dynamic electrical characteristics are measured using the test circuit shown in Fig. 3.

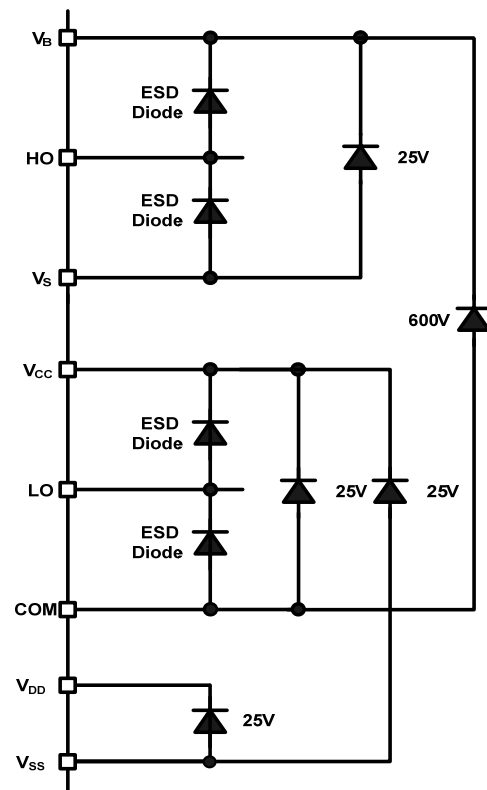
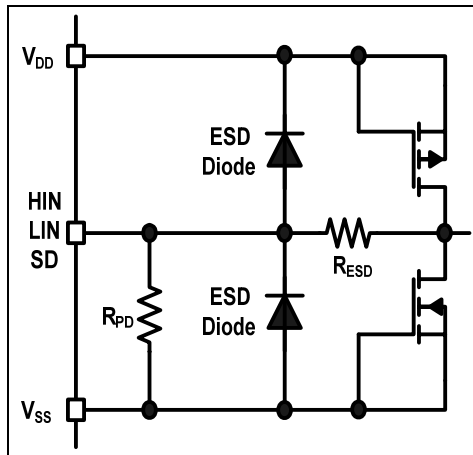
Symbol	Definition	Min	Typ	Max	Units	Test Conditions
$t_{\text{on}}$	Turn-on propagation delay	—	140	230	ns	$V_{\text{S}} = 0 \text{ V}$
$t_{\text{off}}$	Turn-off propagation delay	—	120	210		$V_{\text{S}} = 500 \text{ V}/600 \text{ V}$
$t_{\text{sd}}$	Shutdown propagation delay	—	125	220		
$t_{\text{r}}$	Turn-on rise time	—	25	40		
$t_{\text{f}}$	Turn-off fall time	—	15	30		
MT	Delay matching, HS & LS turn on/off	—	—	35		

Note: Please refer to figures in Parameter Temperature Trends section

## Functional Block Diagram



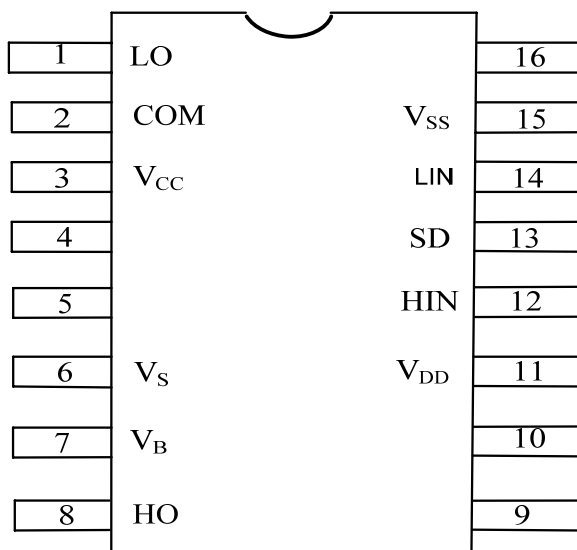
**Input/Output Pin Equivalent Circuit Diagrams**



## Lead Definitions

Pin	Symbol	Description
1	LO	Low-side gate drive output
2	COM	Low-side return
3	V <sub>CC</sub>	Low-side supply
4	NC	Not connected
5	NC	Not connected
6	V <sub>S</sub>	High-side floating supply return
7	V <sub>B</sub>	High-side floating supply
8	HO	High-side gate drive output
9	NC	Not connected
10	NC	Not connected
11	V <sub>DD</sub>	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 <sub>SS</sub>	Logic ground
16	NC	Not connected

## Lead Assignments

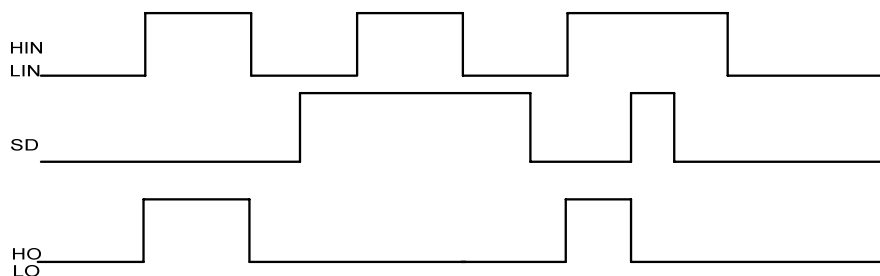


16 Lead SOIC (Wide Body)

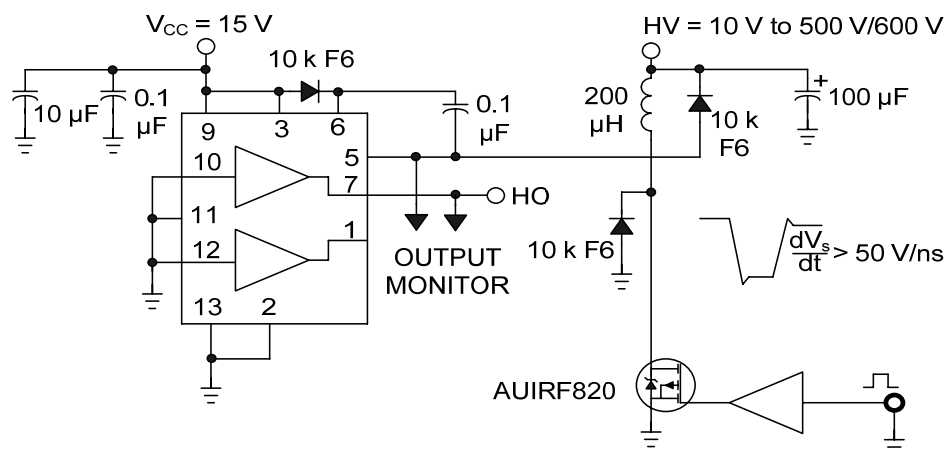
**AUIRS2110S/AUIRS2113S**

**Part Number**

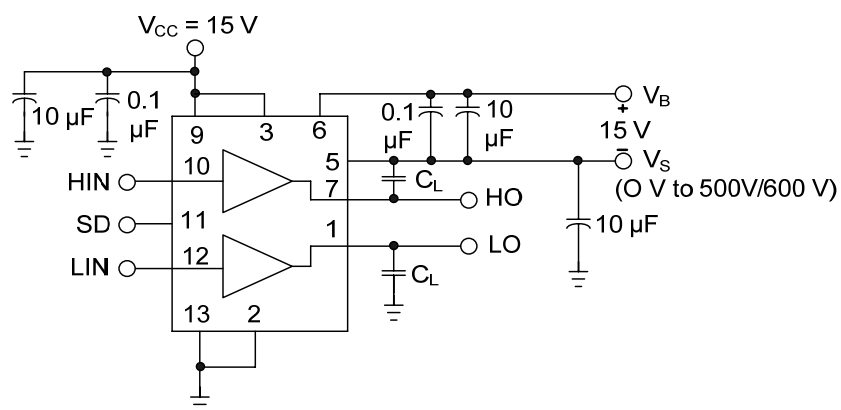
## Application Information and Additional Details



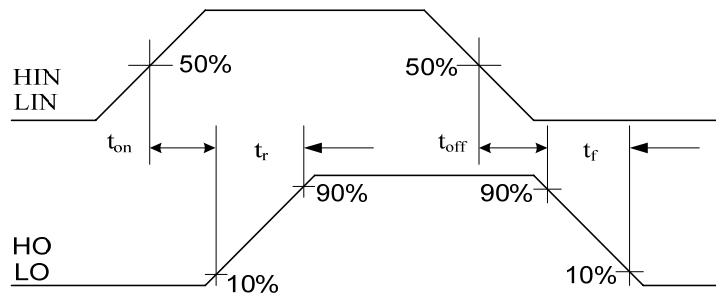
**Figure 1: Input/Output Timing Diagram**



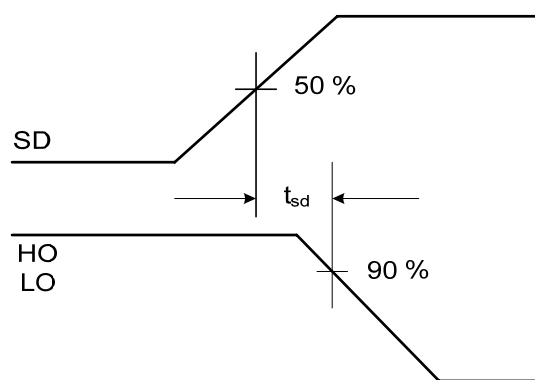
**Figure 2: Floating Supply Voltage Transient Test Circuit**



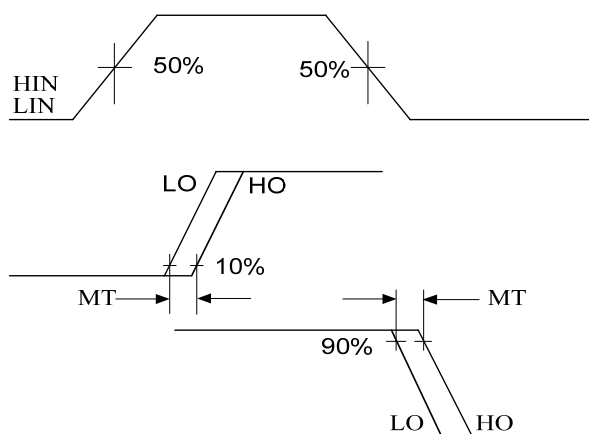
**Figure 3: Switching Time Test Circuit**



**Figure 4: Switching Time Waveform Definitions**



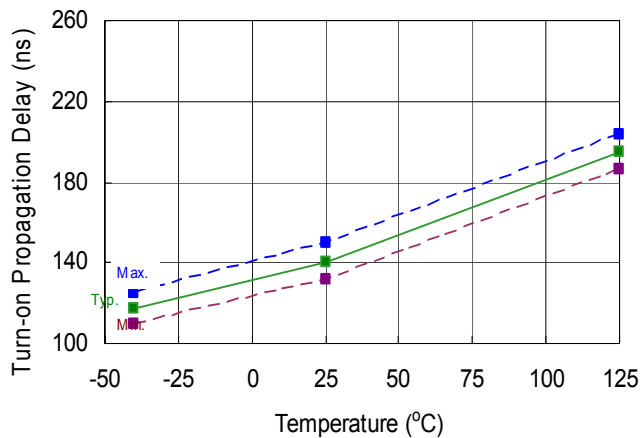
**Figure 5: Shutdown Waveform Definitions**



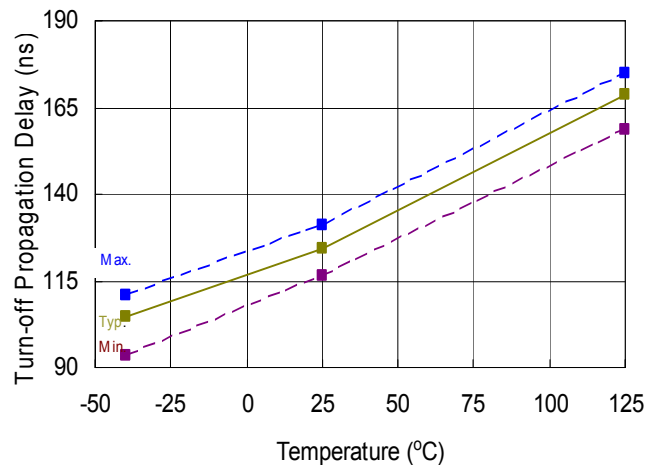
**Figure 6: Delay Matching Waveform Definitions**

## Parameter Temperature Trends

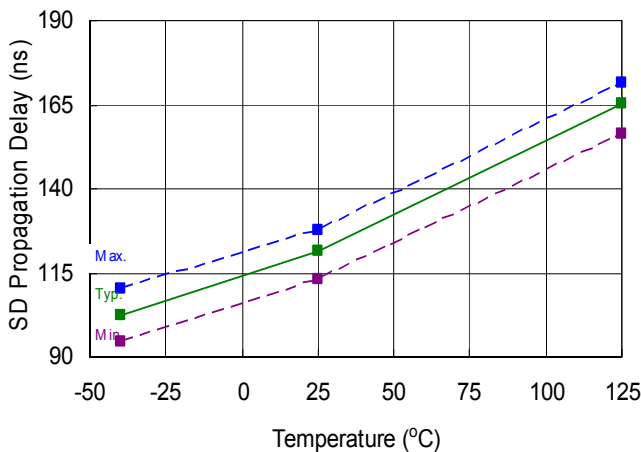
Figures illustrated in this chapter provide information on the experimental performance of the AUIRS211(0,3)S HVIC. The line plotted in each figure is generated from actual lab data. A large number of individual samples were tested at three temperatures (-40 °C, 25 °C, and 125 °C) in order to generate the experimental curve. The line consists of three data points (one data point at each of the tested temperatures) that have been connected together to illustrate the understood trend. The individual data points on the Typ. curve were determined by calculating the averaged experimental value of the parameter (for a given temperature).



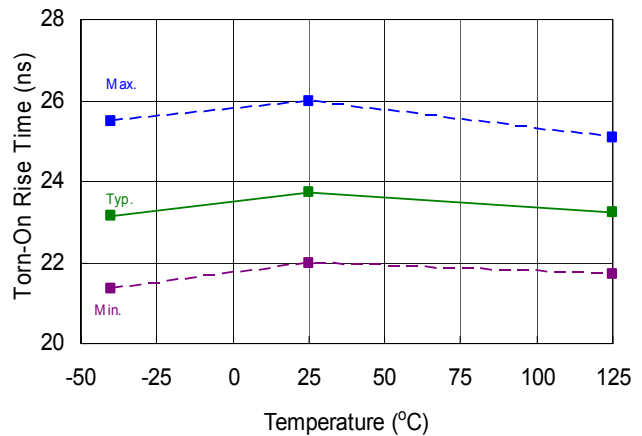
**Figure 7. Turn-On Time vs. Temperature**



**Figure 8. Turn-Off Time vs. Temperature**



**Figure 9. Shutdown Time vs. Temperature**



**Figure 10. Turn-On Rise Time vs. Temperature**

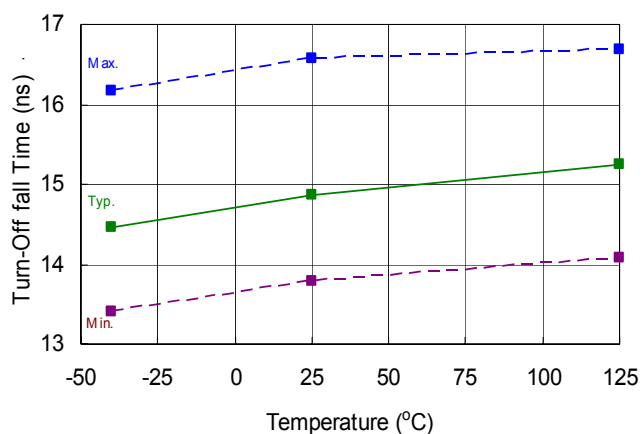


Figure 11. Turn-Off Fall Time vs. Temperature

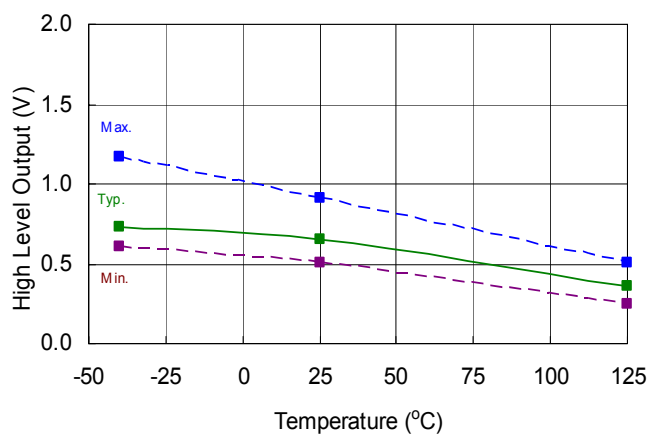


Figure 12. High Level Output Voltage vs. Temperature ( $I_O = 0 \text{ mA}$ )

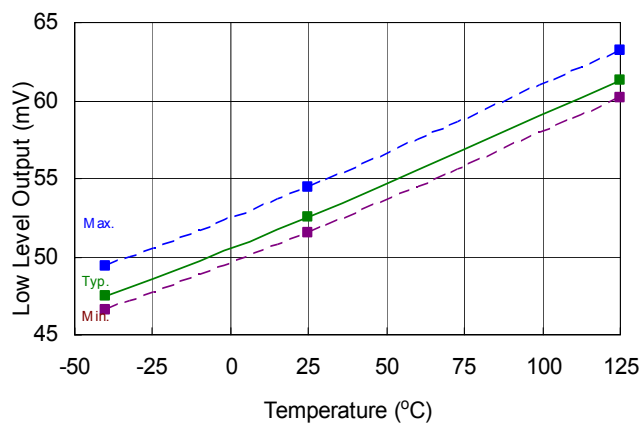


Figure 13. Low Level Output vs. Temperature

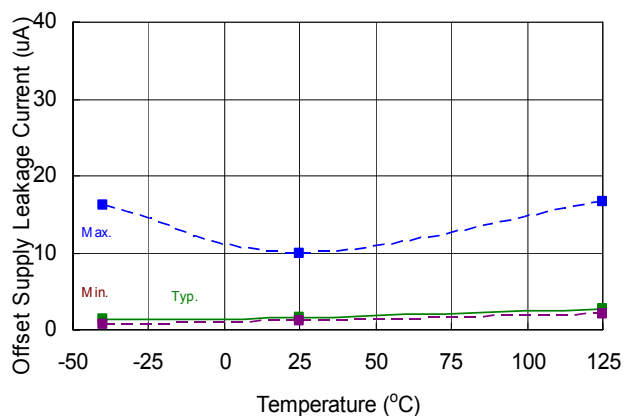


Figure 14. Offset Supply Current vs. Temperature

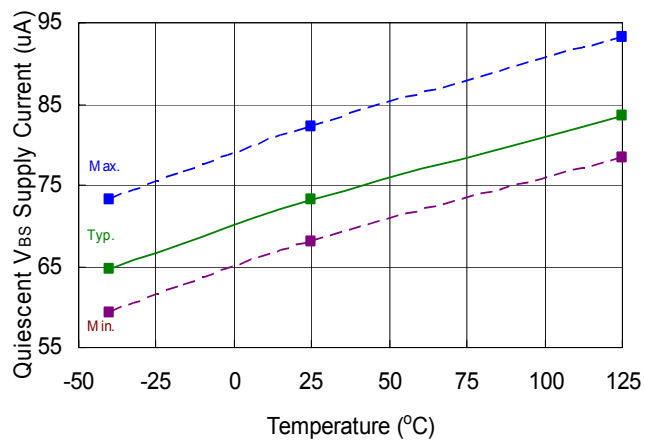


Figure 15.  $V_{BS}$  Supply Current vs. Temperature

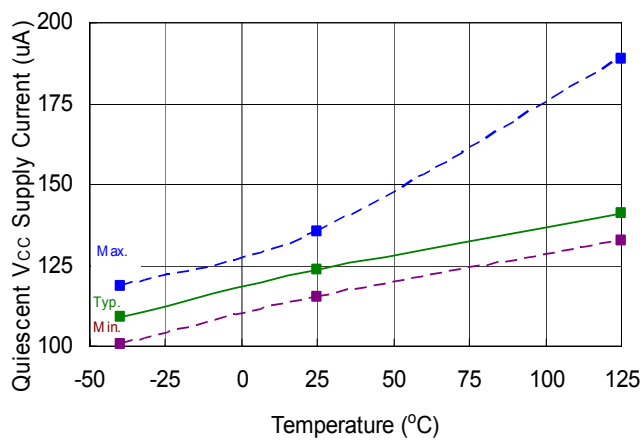


Figure 16.  $V_{CC}$  Supply Current vs. Temperature

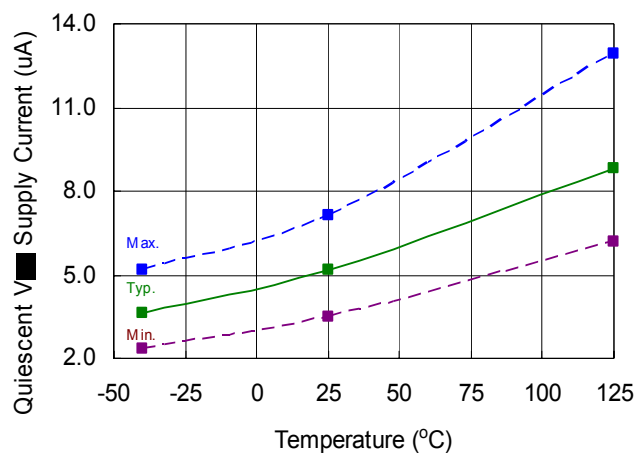


Figure 17.  $V_{DD}$  Supply Current vs. Temperature

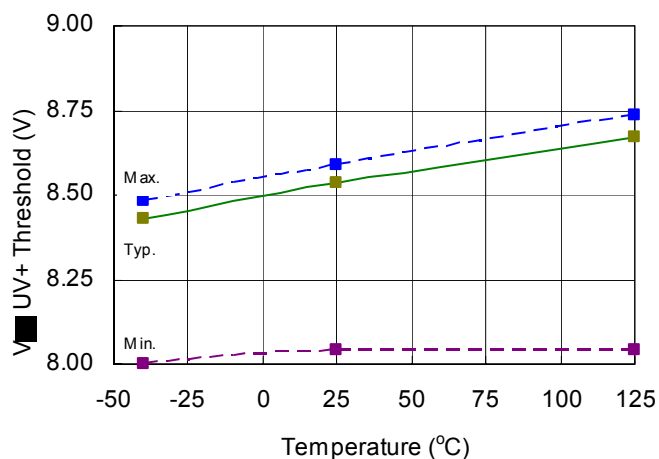


Figure 18.  $V_{BS}$  Undervoltage (+) vs. Temperature

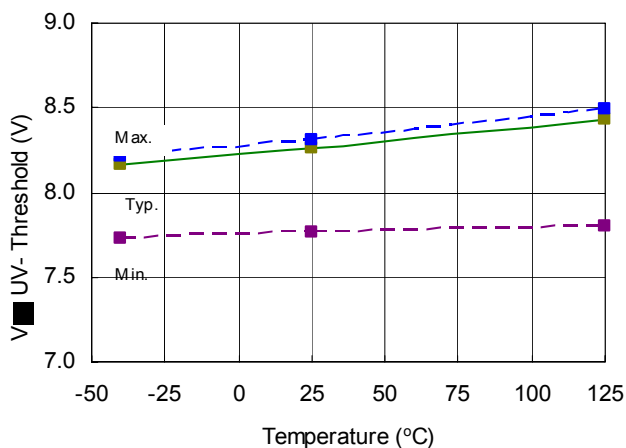


Figure 19.  $V_{BS}$  Undervoltage (-) vs. Temperature

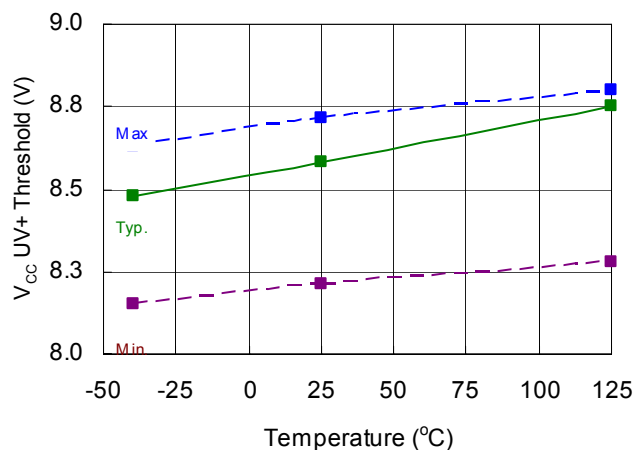


Figure 20.  $V_{CC}$  Undervoltage (+) vs. Temperature

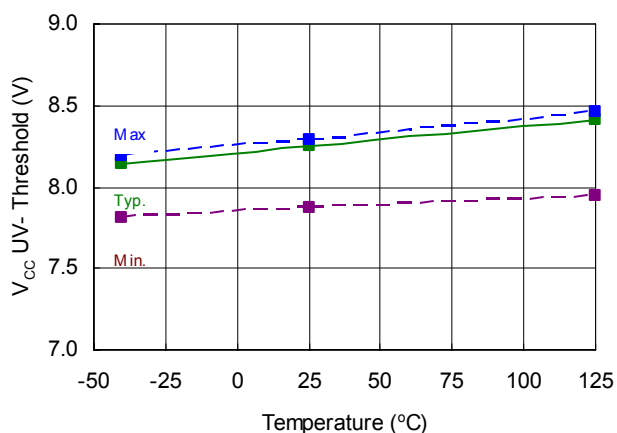
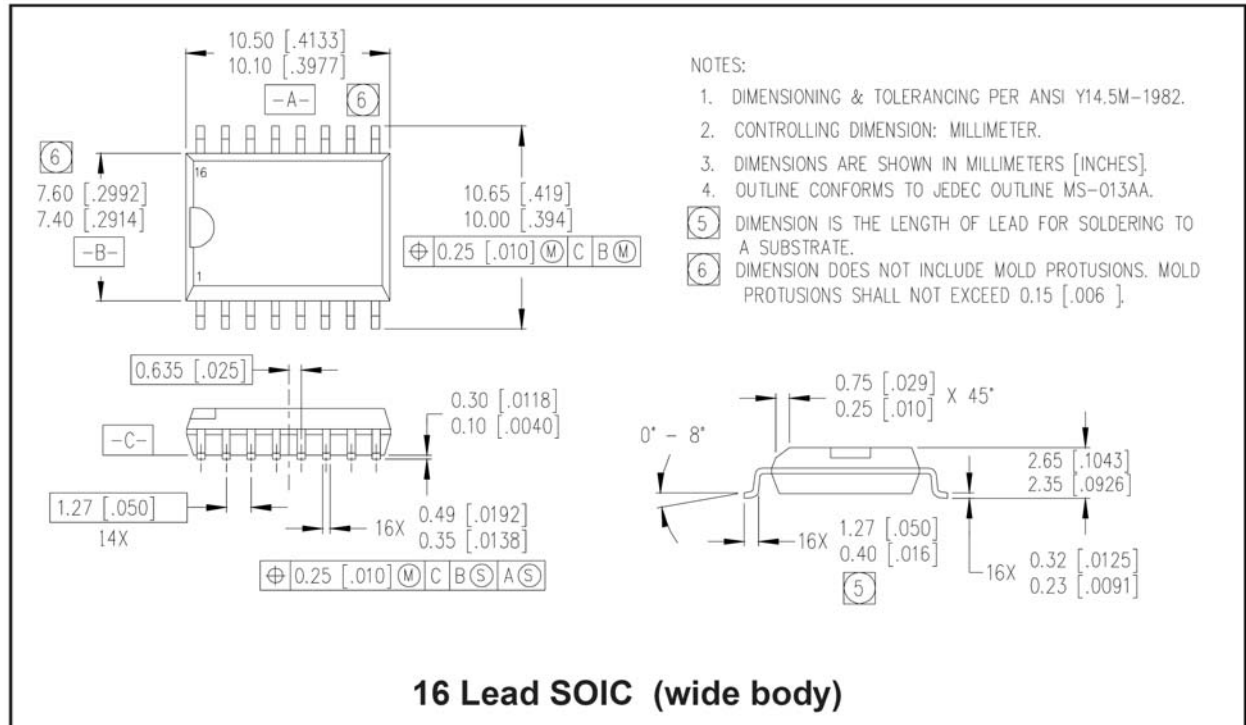
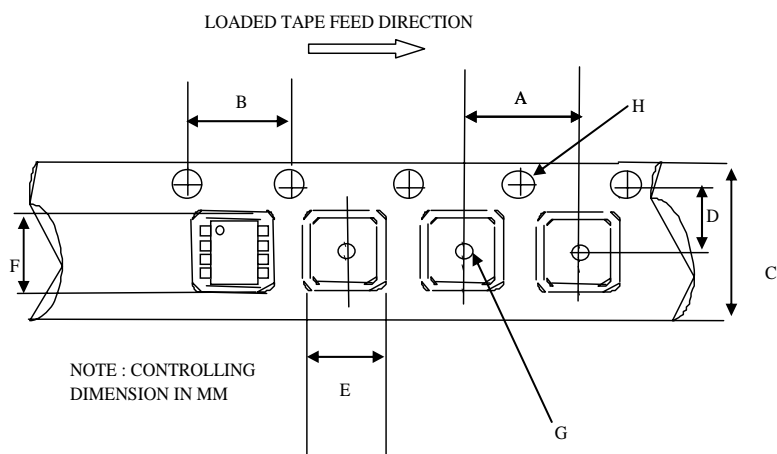


Figure 21.  $V_{CC}$  Undervoltage (-) vs. Temperature

## Package Details: SOIC16WB

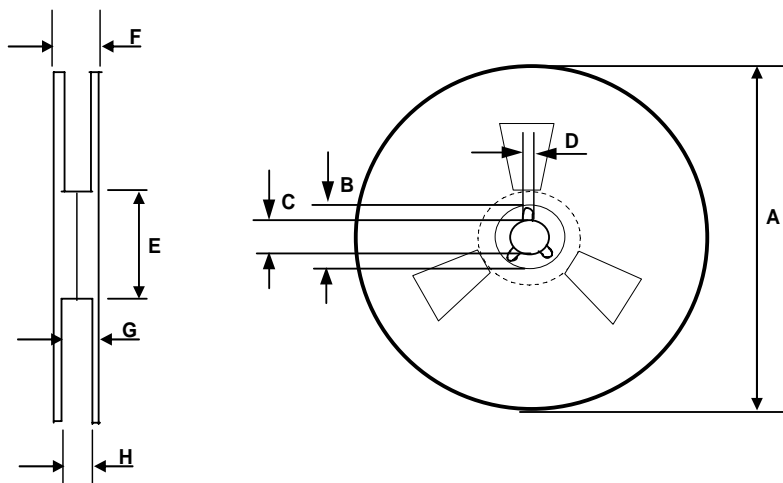


**Tape and Reel Details: SOIC16WB**



CARRIER TAPE DIMENSION FOR 16SOICN

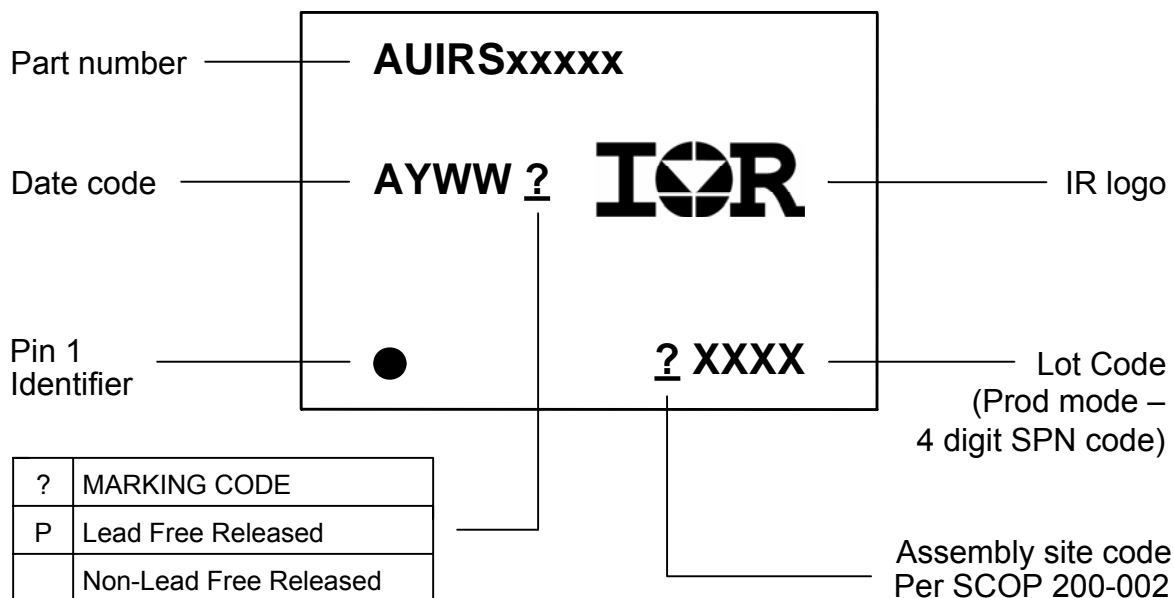
Code	Metric		Imperial	
	Min	Max	Min	Max
A	7.90	8.10	0.311	0.318
B	3.90	4.10	0.153	0.161
C	15.70	16.30	0.618	0.641
D	7.40	7.60	0.291	0.299
E	6.40	6.60	0.252	0.260
F	10.20	10.40	0.402	0.409
G	1.50	n/a	0.059	n/a
H	1.50	1.60	0.059	0.062



REEL DIMENSIONS FOR 16SOICN

Code	Metric		Imperial	
	Min	Max	Min	Max
A	329.60	330.25	12.976	13.001
B	20.95	21.45	0.824	0.844
C	12.80	13.20	0.503	0.519
D	1.95	2.45	0.767	0.096
E	98.00	102.00	3.858	4.015
F	n/a	22.40	n/a	0.881
G	18.50	21.10	0.728	0.830
H	16.40	18.40	0.645	0.724

## Part Marking Information



## Ordering Information

Base Part Number	Package Type	Standard Pack		Complete Part Number
		Form	Quantity	
AUIRS2110S	SOIC16W	Tube/Bulk	25	AUIRS2110S
		<b><i>Tape and Reel</i></b>	<b><i>1000</i></b>	AUIRS2110STR
AUIRS2113S	SOIC16W	Tube/Bulk	25	AUIRS2113S
		<b><i>Tape and Reel</i></b>	<b><i>1000</i></b>	AUIRS2113STR

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