

## Features

- Floating channel designed for bootstrap operation
- Fully operational to + 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 and 5 V input logic compatible
- Matched propagation delay for both channels
- Logic and power ground +/- 5 V offset
- Lower  $di/dt$  gate driver for better noise immunity
- Output source/sink current capability (typical) 1.9 A/2.3 A
- Lead free, RoHS compliant
- Automotive Qualified\*

## Typical Applications

- DC/DC converter
- pump and compressor
- piezo injection
- Starter/ alternator

## Product Summary

Topology	Half-Bridge
$V_{OFFSET}$	600 V
$V_{OUT}$	10 V – 20 V
$I_{o+}$ & $I_{o-}$ (typical)	1.9 A & 2.3 A
$t_{on}$ & $t_{off}$ (typical)	600 ns & 230 ns
Deadtime (typical)	400 ns ( $R_{DT} = 0 \Omega$ ) 5 $\mu$ s ( $R_{DT} = 200 \text{ k}\Omega$ )

## Package Options

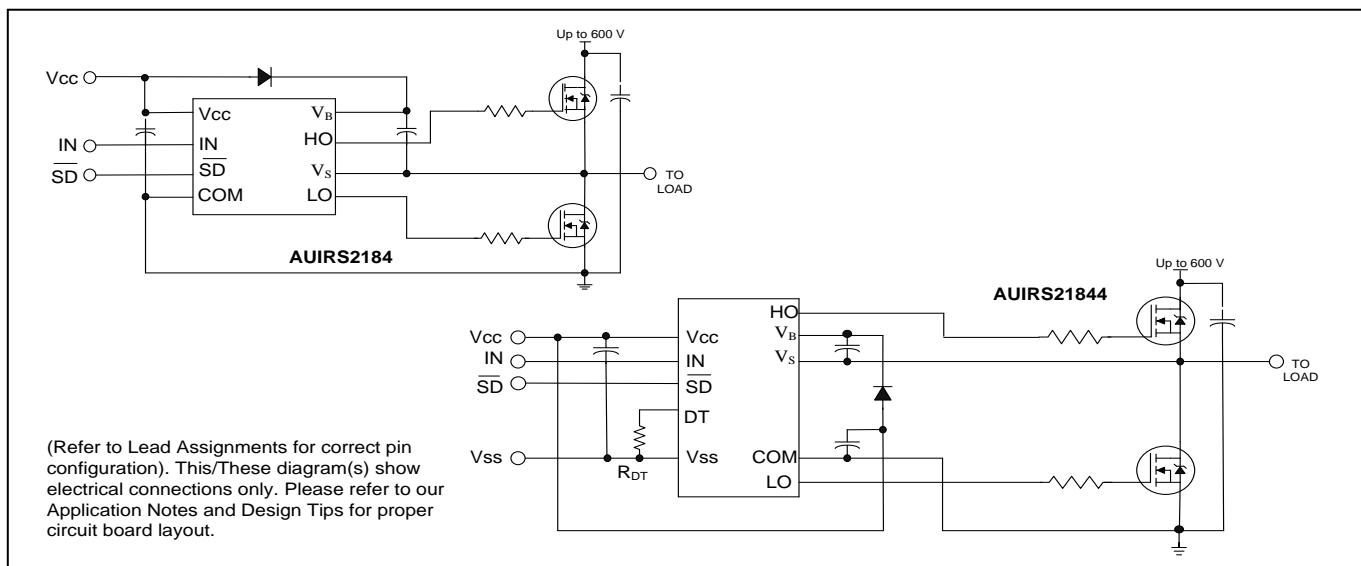


8-Lead SOIC  
AUIRS2184S



14-Lead SOIC  
Narrow Body  
AUIRS21844S

## Typical Connection



<b>Table of Contents</b>	<b>Page</b>
Description	3
Feature Comparison	3
Qualification Information	4
Absolute Maximum Ratings	5
Recommended Operating Conditions	6
Dynamic Electrical Characteristics	6
Static Electrical Characteristics	7
Functional Block Diagram	8
Input/Output Pin Equivalent Circuit Diagram	9-10
Lead Definitions	11
Lead Assignments	11
Application Information and Additional Details	12
Parameter Temperature Trends	13-17
Package Details	18
Tape and Reel Details	19-20
Part Marking Information	21
Ordering Information	22
Important Notice	23

## Description

The AUIRS2184(4)S are high voltage, high speed power MOSFET and IGBT drivers with dependent 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. The floating channel can be used to drive an N-channel power MOSFET or IGBT in the high-side configuration which operates up to 600 V.

## Feature Comparison: AUIRS2181(4)/AUIRS2183(4)/AUIRS2184(4)

Part	Input Logic	Cross-Conduction Prevention logic	Dead-Time	Ground Pins	Ton/Toff
2181	HIN/LIN	no	none	COM	160/200 ns
21814				V <sub>ss</sub> /COM	
2183	HIN/ <u>LIN</u>	yes	Internal 500ns	COM	160/200 ns
21834			Programmable 0.4 – 5 us	V <sub>ss</sub> /COM	
2184	IN/ <u>SD</u>	yes	Internal 500ns	COM	600/230 ns
21844			Programmable 0.4 – 5 us	V <sub>ss</sub> /COM	

**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>		SOIC8	MSL3 <sup>†††</sup> 260°C (per IPC/JEDEC J-STD-020)
		SOIC14N	
<b>ESD</b>	Machine Model	Class M1 (Pass +/-100V) (per AEC-Q100-003)	
	Human Body Model	Class H1C (Pass +/-1500V) (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 <sup>††††</sup> (per AEC-Q100-004)	
<b>RoHS Compliant</b>		Yes	

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

<sup>††</sup> Exceptions to AEC-Q100 requirements are noted in the qualification report.

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

<sup>††††</sup> IN, SD, DT Class II Level B at 40mA per JESD78.

## 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 lead. Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only; and functional operation of the device at these or any other condition beyond those indicated in the "Recommended Operating Conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability. The thermal resistance and power dissipation ratings are measured under board mounted and still air conditions. Ambient temperature ( $T_A$ ) is 25°C, unless otherwise specified.

Symbol	Definition	Min	Max	Units
$V_B$	High-side floating absolute voltage	-0.3	620	V
$V_S$	High-side floating supply offset voltage	$V_B - 25$	$V_B + 0.3$	
$V_{HO}$	High-side floating output voltage	$V_S - 0.3$	$V_B + 0.3$	
$V_{CC}$	Low-side and logic fixed supply voltage	-0.3	20 <sup>†</sup>	
$V_{LO}$	Low-side output voltage	-0.3	$V_{CC} + 0.3$	
DT	Programmable deadtime pin voltage	$V_{SS} - 0.3$	$V_{CC} + 0.3$	
$V_{IN}$	Logic input voltage (IN & $\bar{SD}$ )	$V_{SS} - 0.3$	$V_{CC} + 0.3$	
$V_{SS}$	Logic ground	$V_{CC} - 20$	$V_{CC} + 0.3$	
$dV_S/dt$	Allowable offset supply voltage transient	—	50	V/ns
$P_D$	Package power dissipation @ $T_A \leq 25^\circ\text{C}$	(8-lead SOIC)	—	0.625
		(14-lead SOIC)	—	1.0
$R_{thJA}$	Thermal resistance, junction to ambient	(8-lead SOIC)	—	200
		(14-lead SOIC)	—	120
$T_J$	Junction temperature	—	150	$^\circ\text{C}$
$T_S$	Storage temperature	-50	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 a 15 V differential.

Symbol	Definition	Min	Max	Units
$V_B$	High-side floating supply absolute voltage	$V_S + 10$	$V_S + 20$	V
$V_S$	High-side floating supply offset voltage	(††)	600	
$V_{HO}$	High-side floating output voltage	$V_S$	$V_B$	
$V_{CC}$	Low-side and logic fixed supply voltage	10	20	
$V_{LO}$	Low-side output voltage	0	$V_{CC}$	
$V_{IN}$	Logic input voltage (IN & $\overline{SD}$ ) (†††)	$V_{SS}$	$V_{CC}$	
DT	Programmable deadtime pin voltage	$V_{SS}$	$V_{CC}$	
$V_{SS}$	Logic ground	-5	5	
$T_A$	Ambient temperature	-40	125	°C

†† Logic operational for  $V_S$  of -5 V to +600 V. Logic state held for  $V_S$  of -5 V to  $-V_{BS}$ . (Please refer to Design Tip DT97-3 for more details).

††† HIN and LIN are internally clamped with a 5.2 V zener diode.

## 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  $V_{BIAS}$  ( $V_{CC}, V_{BS}$ ) = 15 V,  $V_{SS}$  = COM,  $C_L$  = 1000 pF.

Symbol	Definition	Min	Typ	Max	Units	Test Conditions
$t_{on}$	Turn-on propagation delay	—	600	900	ns	$V_S = 0 \text{ V}$
$t_{off}$	Turn-off propagation delay	—	230	400		$V_S = 0 \text{ V}$ or 600 V
$t_{sd}$	Shut-down propagation delay	—	220	350		
$MT_{on}$	Delay matching, HS & LS turn-on	—	3	90		
$MT_{off}$	Delay matching, HS & LS turn-off	—	15	40		
$t_r$	Turn-on rise time	—	15	60		$V_S = 0 \text{ V}$
$t_f$	Turn-off fall time	—	12	35		
DT	Deadtime: LO turn-off to HO turn-on ( $DT_{LO-HO}$ ) & HO turn-off to LO turn-on ( $DT_{HO-LO}$ )	280	375	520	$\mu\text{s}$	$R_{DT} = 0 \Omega$
		3.9	5	6		$R_{DT} = 200 \text{ k}\Omega$
MDT	Deadtime matching $DT_{LO-HO} - DT_{HO-LO}$	—	0	50	ns	$R_{DT} = 0 \Omega$
		—	0	600		$R_{DT} = 200 \text{ k}\Omega$

## Static Electrical Characteristics

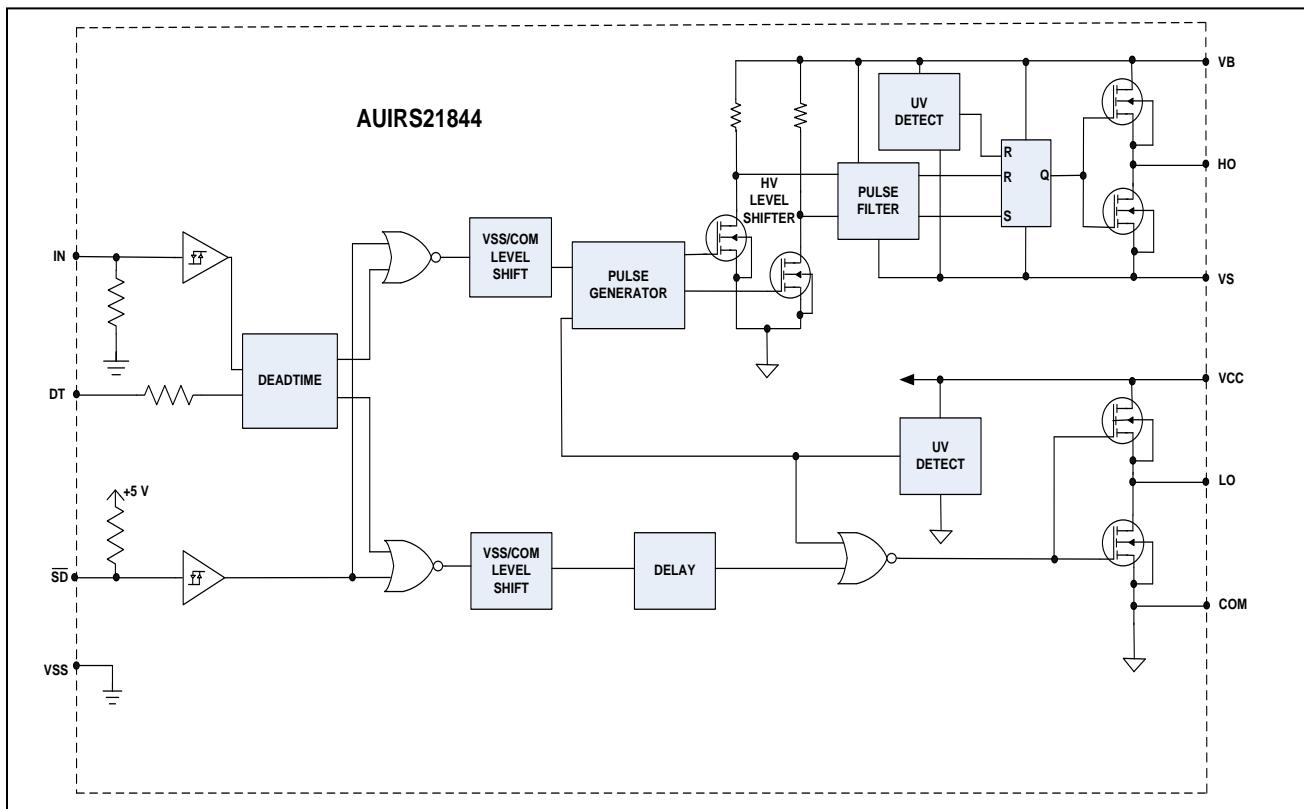
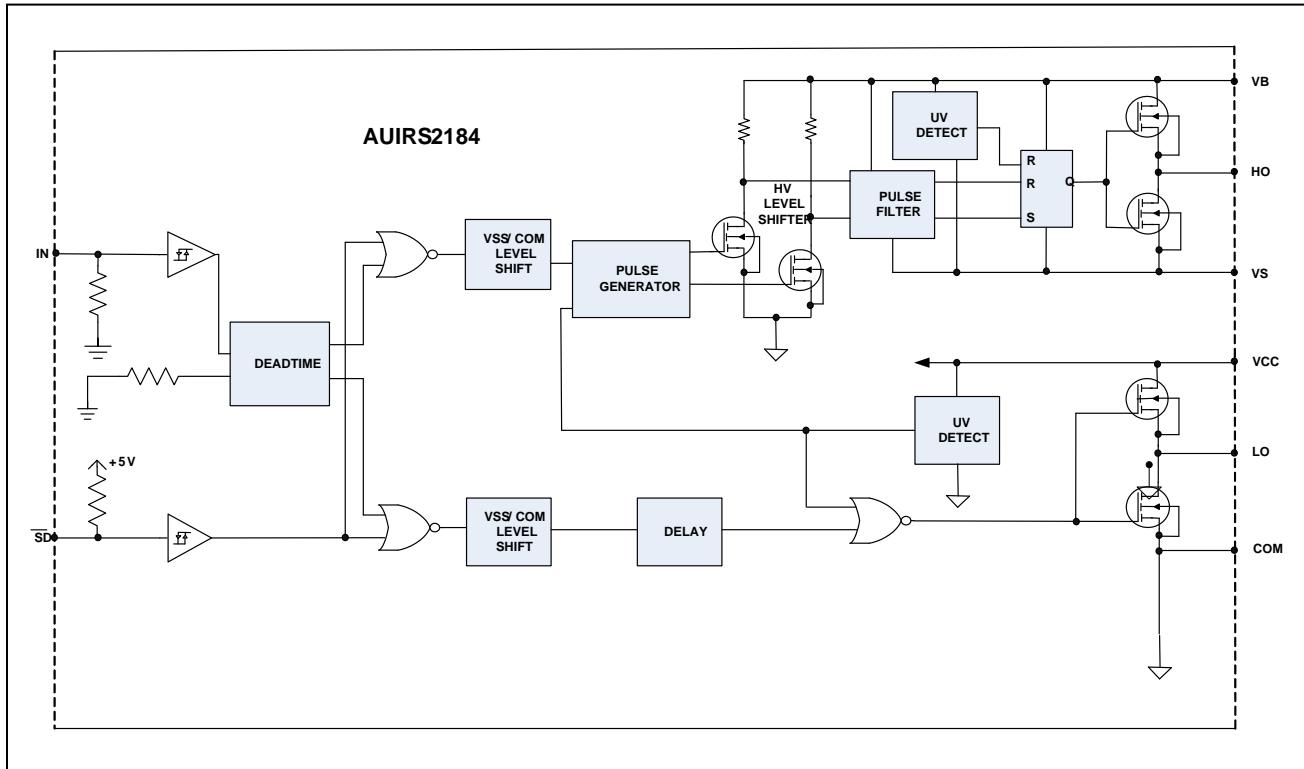
Unless otherwise noted, these specifications apply for an operating junction temperature range of  $-40^{\circ}\text{C} \leq T_{\text{J}} \leq 125^{\circ}\text{C}$  with bias conditions of  $V_{\text{BIAS}} (V_{\text{CC}}, V_{\text{BS}}) = 15 \text{ V}$ ,  $V_{\text{SS}} = \text{COM}$ . The  $V_{\text{IH}}$ ,  $V_{\text{IL}}$  and  $I_{\text{IN}}$  parameters are referenced to  $V_{\text{SS}}/\text{COM}$  and are applicable to the respective input leads: IN and  $\overline{\text{SD}}$ . The  $V_{\text{O}}$ ,  $I_{\text{O}}$  and  $R_{\text{on}}$  parameters are referenced to COM and are applicable to the respective output leads: HO and LO.

Symbol	Definition	Min	Typ	Max	Units	Test Conditions
$V_{\text{IH}}$	Logic "1" input voltage for HO & logic "0" for LO	2.5	—	—	V	$V_{\text{CC}} = 10 \text{ V to } 20 \text{ V}$
$V_{\text{IL}}$	Logic "0" input voltage for HO & logic "1" for LO	—	—	0.8		
$V_{\text{SD,TH+}}$	$\overline{\text{SD}}$ input positive going threshold	2.5	—	—		
$V_{\text{SD,TH-}}$	$\overline{\text{SD}}$ input negative going threshold	—	—	0.8		
$V_{\text{OH}}$	High level output voltage, $V_{\text{BIAS}} - V_{\text{O}}$	—	—	1.5		
$V_{\text{OL}}$	Low level output voltage, $V_{\text{O}}$	—	—	0.2		
$I_{\text{LK}}$	Offset supply leakage current	—	—	50	$\mu\text{A}$	$V_{\text{B}} = V_{\text{S}} = 600 \text{ V}$
$I_{\text{QBS}}$	Quiescent $V_{\text{BS}}$ supply current	10	50	130		
$I_{\text{QCC}}$	Quiescent $V_{\text{CC}}$ supply current	0.4	1.0	1.3	$\text{mA}$	$V_{\text{IN}} = 0 \text{ V or } 5 \text{ V}$
$I_{\text{IN+}}$	Logic "1" input bias current	—	25	60	$\mu\text{A}$	$\text{IN} = 5 \text{ V}, \overline{\text{SD}} = 0 \text{ V}$
$I_{\text{IN-}}$	Logic "0" input bias current	—	—	5.0		
$V_{\text{CCUV+}}$ $V_{\text{BSUV+}}$	$V_{\text{CC}}$ and $V_{\text{BS}}$ supply undervoltage positive going threshold	8.0	8.9	9.8	V	
$V_{\text{CCUV-}}$ $V_{\text{BSUV-}}$	$V_{\text{CC}}$ and $V_{\text{BS}}$ supply undervoltage negative going threshold	7.4	8.2	9.0		
$V_{\text{CCUVH}}$ $V_{\text{BSUVH}}$	Hysteresis	0.3	0.7	—		
$I_{\text{O25+}}^{(\dagger)}$	Output high short circuit pulsed current	1.4	1.9	—	A	$V_{\text{O}} = 0 \text{ V},$ $\text{PW} \leq 10 \text{ us},$ $T_{\text{J}} = 25^{\circ}\text{C}$
$I_{\text{O25-}}^{(\dagger)}$	Output low short circuit pulsed current	1.8	2.3	—		$V_{\text{O}} = 15 \text{ V},$ $\text{PW} \leq 10 \text{ us},$ $T_{\text{J}} = 25^{\circ}\text{C}$
$I_{\text{O+}}^{(\dagger) (\ddagger)}$	Output high short circuit pulsed current	1.2	—	—		$V_{\text{O}} = 0 \text{ V},$ $\text{PW} \leq 10 \mu\text{s}$
$I_{\text{O-}}^{(\dagger) (\ddagger)}$	Output low short circuit pulsed current	1.5	—	—		$V_{\text{O}} = 15 \text{ V},$ $\text{PW} \leq 10 \mu\text{s}$

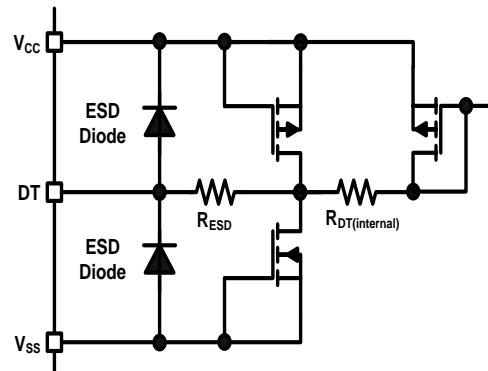
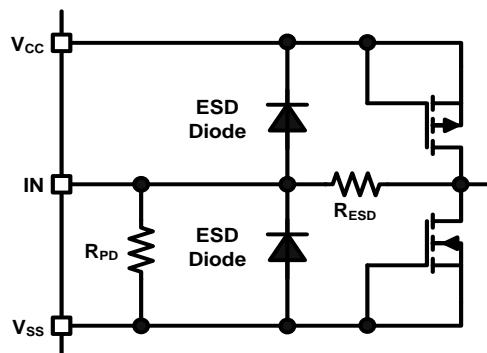
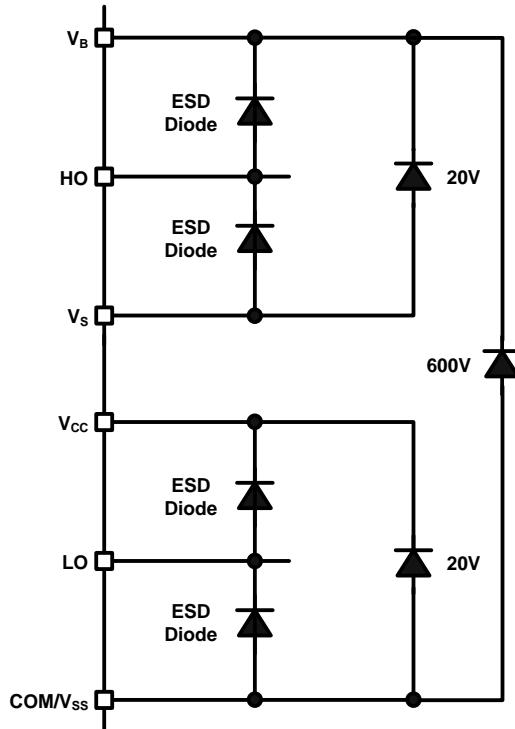
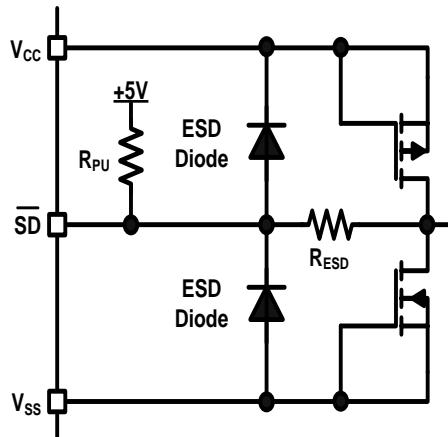
(†) Guaranteed by design

(‡‡)  $I_{\text{O+}}$  and  $I_{\text{O-}}$  decrease with rising temperature

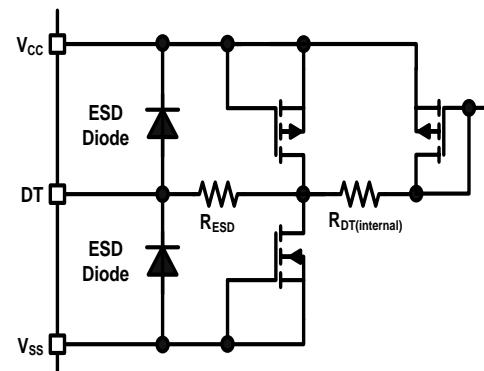
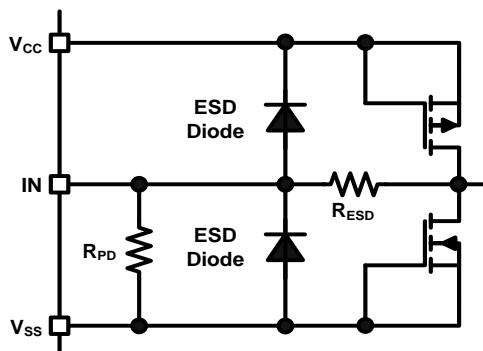
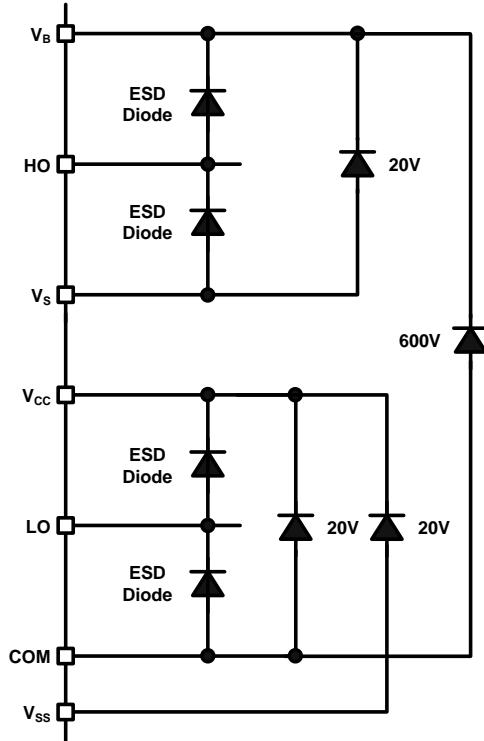
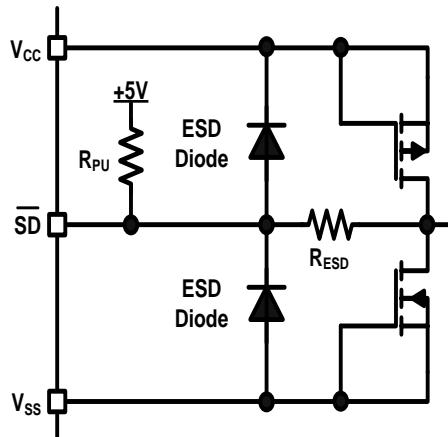
## Functional Block Diagram: AUIRS2184, AUIRS21844



## Input/Output Pin Equivalent Circuit Diagrams: AUIRS2184S



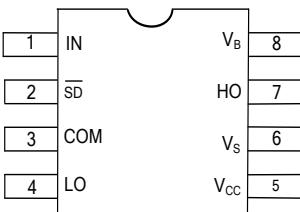
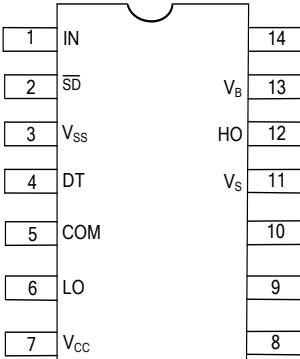
## Input/Output Pin Equivalent Circuit Diagrams: AUIRS21844S



## Lead Definitions

Symbol	Description
IN	Logic input for high-side and low-side gate driver outputs (HO and LO), in phase with HO (referenced to COM for AUIRS2184 and $V_{SS}$ for AUIRS21844)
Error!	Logic input for shutdown (referenced to COM for AUIRS2184 and $V_{SS}$ for AUIRS21844)
DT	Programmable deadtime lead, referenced to $V_{SS}$ (AUIRS21844 only)
$V_{SS}$	Logic ground (AUIRS21844 only)
$V_B$	High-side floating supply
HO	High-side gate drive output
$V_S$	High-side floating supply return
$V_{CC}$	Low-side and logic fixed supply
LO	Low-side gate drive output
COM	Low-side return

## Lead Assignments: AUIRS2184(4)S

 <p>8-Lead SOIC</p>	 <p>14-Lead SOIC Narrow Body</p>
AUIRS2184(S)	AUIRS21844(S)

## Application Information and Additional Details

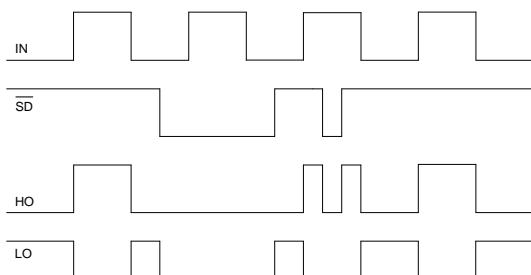


Figure 1: Input/Output Timing Diagram

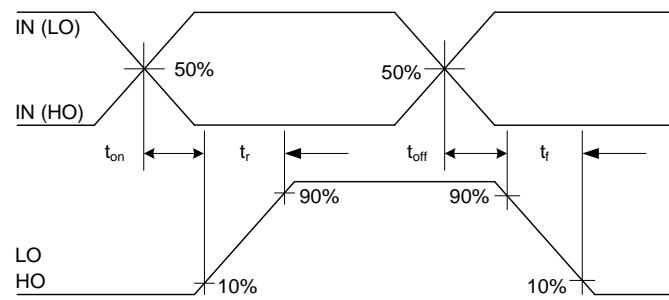


Figure 2: Switching Time Waveform Definitions

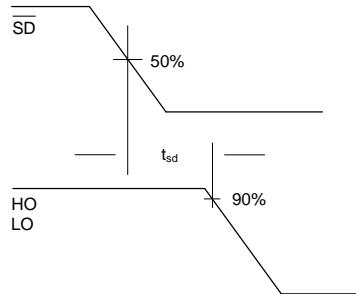


Figure 3: Shutdown Waveform Definitions

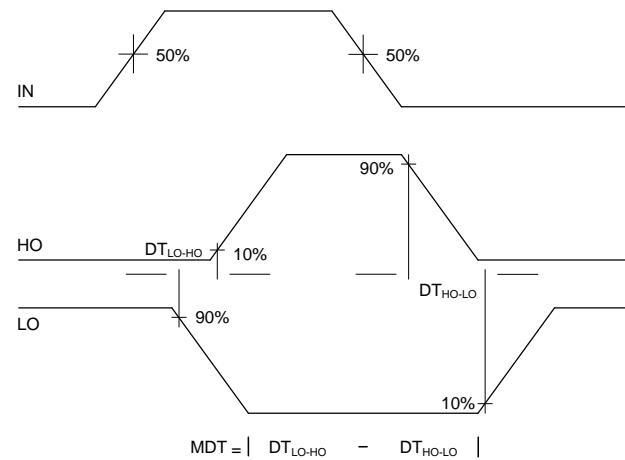


Figure 4: Deadtime Waveform Definitions

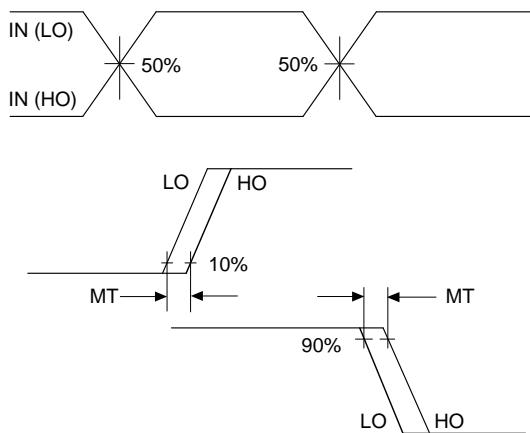


Figure 5: Delay Matching Waveform Definitions

## Tolerability to Negative VS Transients

The AUIRS21844S has been seen to withstand negative  $V_s$  transient conditions on the order of -20V for a period of 400 ns.

An illustration of the AUIRS21844S performance can be seen in Figure 7, where points above the lines represent pulses that the circuit can withstand (with  $V_{CC}=V_{BS}= 15V$ ).

Two curves are present in figure 7: one refers to ambient temperature  $T_A=25\text{ }^{\circ}\text{C}$ , the other refers to tests performed at  $T_A=-40\text{ }^{\circ}\text{C}$ ,  $25\text{ }^{\circ}\text{C}$  and  $125\text{ }^{\circ}\text{C}$ .

Even though the AUIRS21844S has been shown able to handle these negative  $V_s$  transient conditions, it is highly recommended that the circuit designer always limit the negative  $V_s$  transients as much as possible by careful PCB layout and component use.

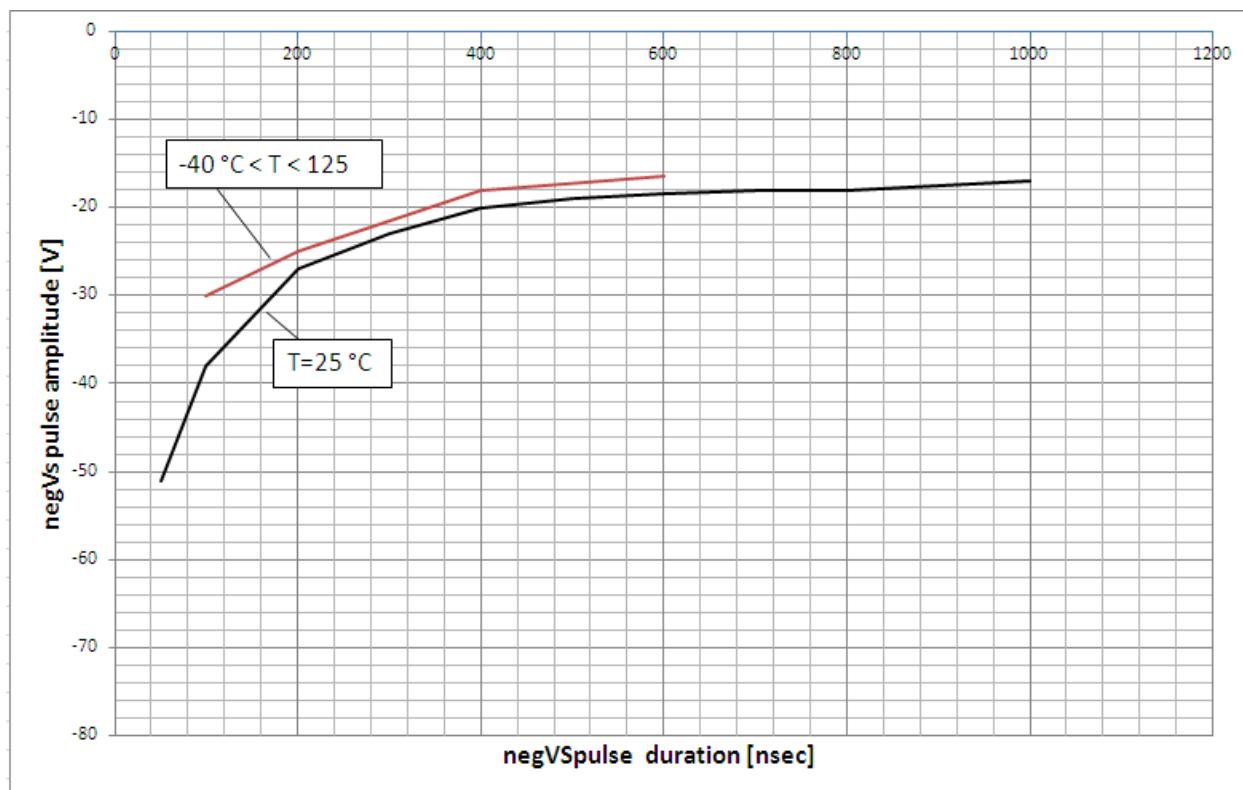


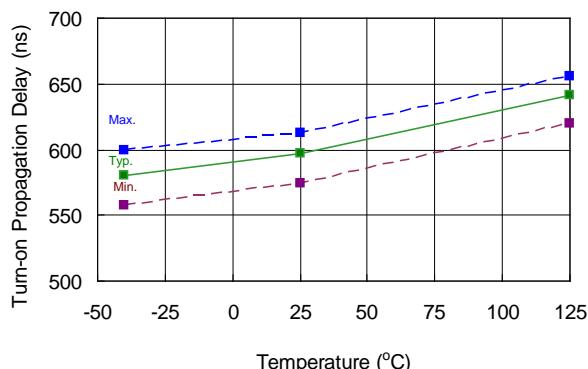
Figure 7: -Vs Transient results

## Parameter Trends vs. Temperature and vs. Supply Voltage

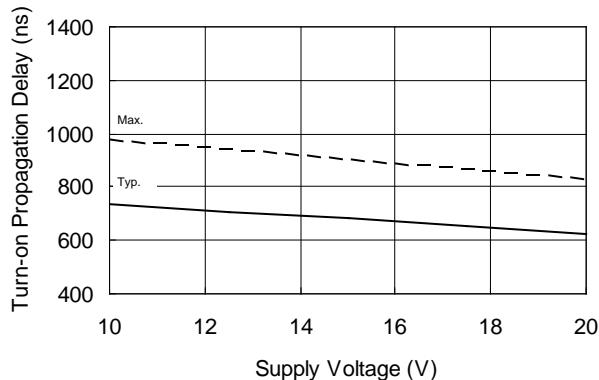
Figures of this chapter provide information on the experimental performance of the AUIRS2184(4)S HVIC. The line plotted in each figure is generated from actual lab data.

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).

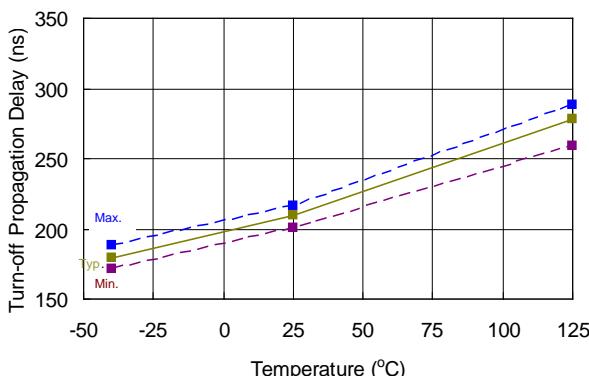
A different set of individual samples was used to generate curves of parameter trends vs. supply voltage.



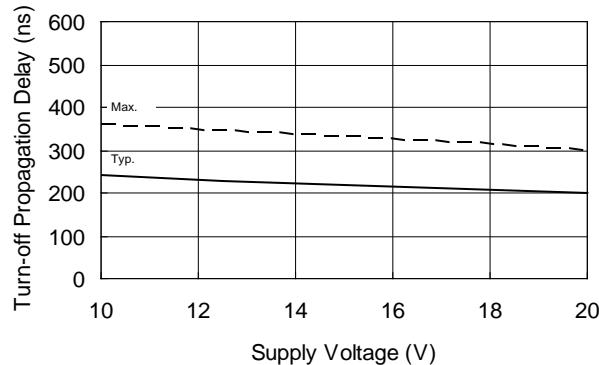
**Figure 6A. Turn-on Propagation Delay vs. Temperature**



**Figure 6B. Turn-on Propagation Delay vs. Supply Voltage**



**Figure 7A. Turn-off Propagation Delay vs. Temperature**



**Figure 7B. Turn-off Propagation Delay vs. Supply Voltage**

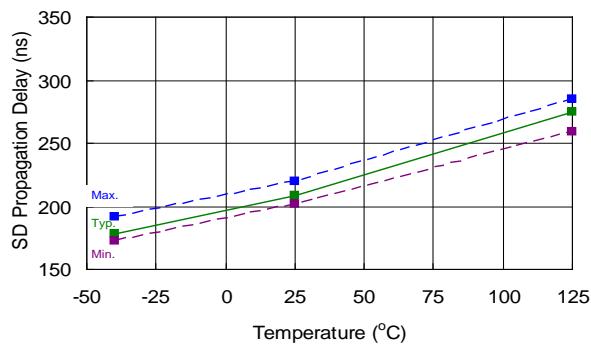


Figure 8A. SD Propagation Delay vs. Temperature

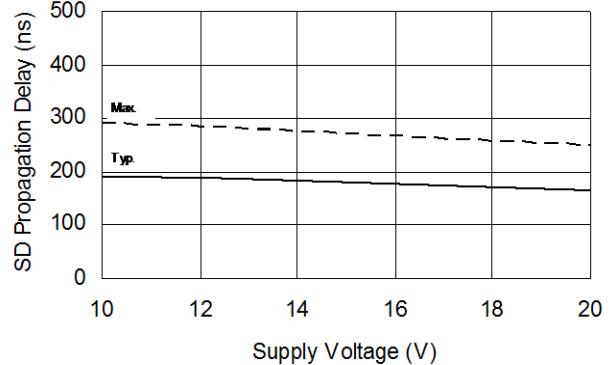


Figure 8B. SD Propagation Delay vs. Supply Voltage

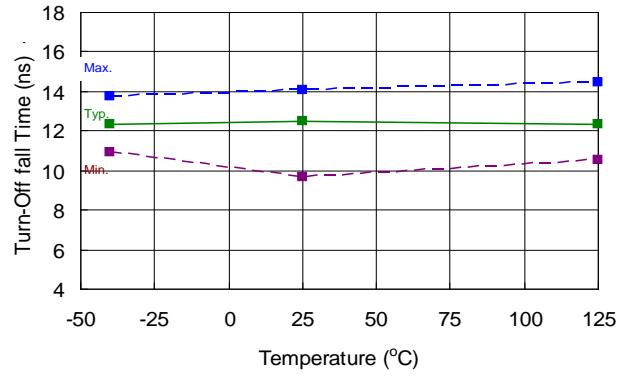


Figure 9A. Turn-off Fall Time vs. Temperature

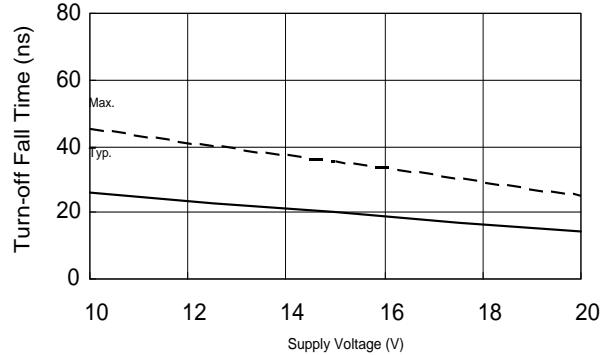


Figure 10B. Turn-off Fall Time vs. Supply Voltage

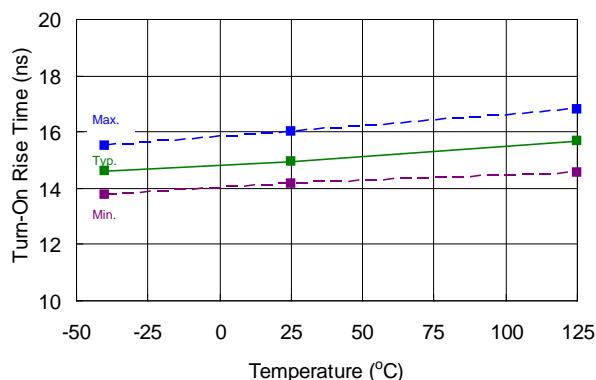
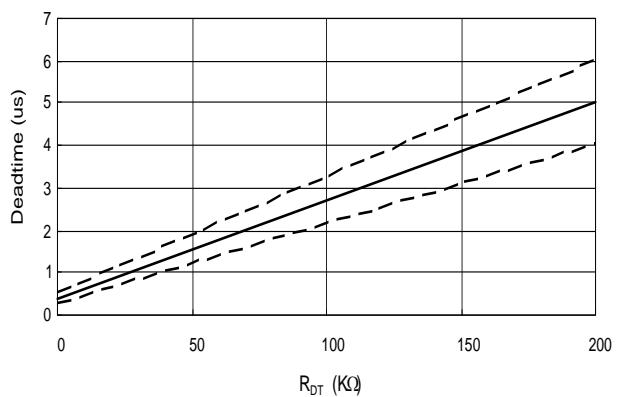


Figure 10. Turn-on Rise Time vs. Temperature

Figure 11. Deadtime vs R<sub>DT</sub>

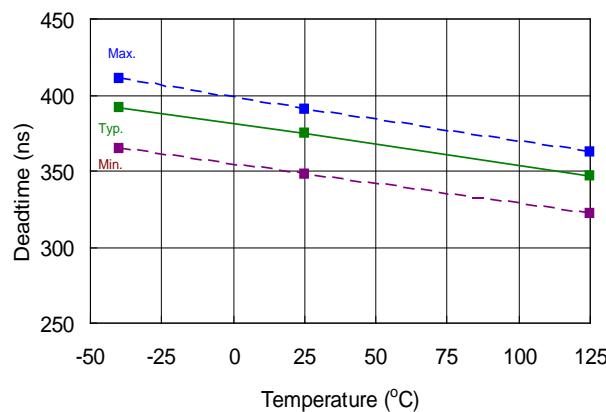


Figure 12A. Deadtime vs Temperature

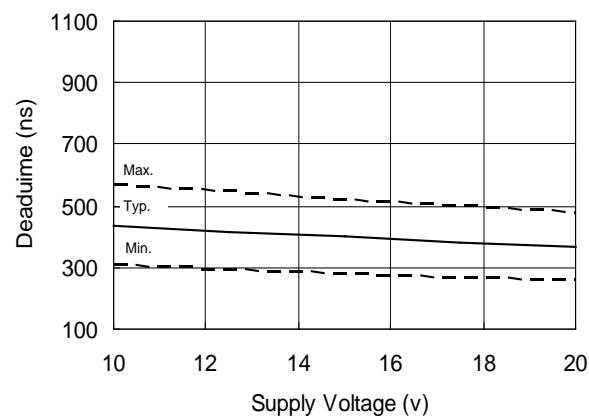


Figure 12B. Deadtime vs. Supply Voltage

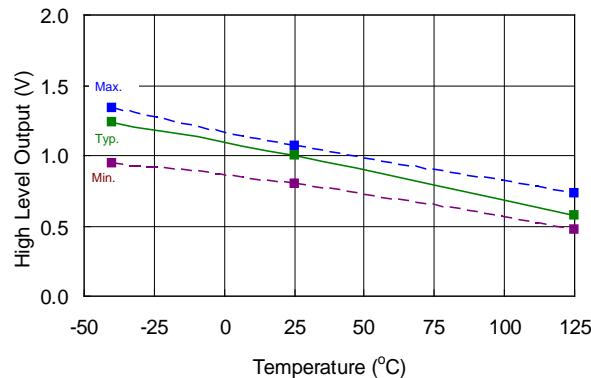
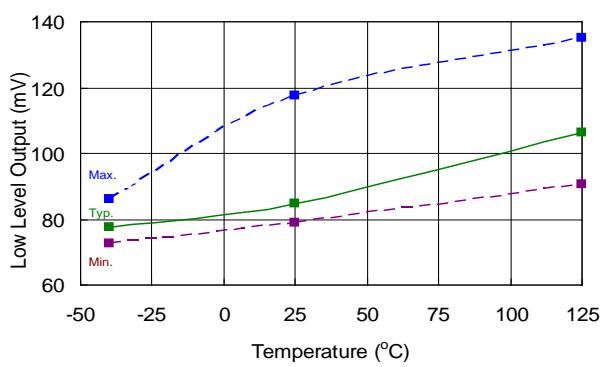
Figure 13. High Level Output vs. Temperature  
( $I_o = 0$  mA)

Figure 14. Low Level Output vs. Temperature

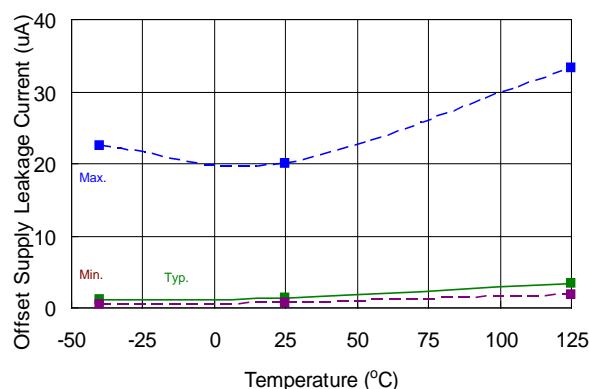
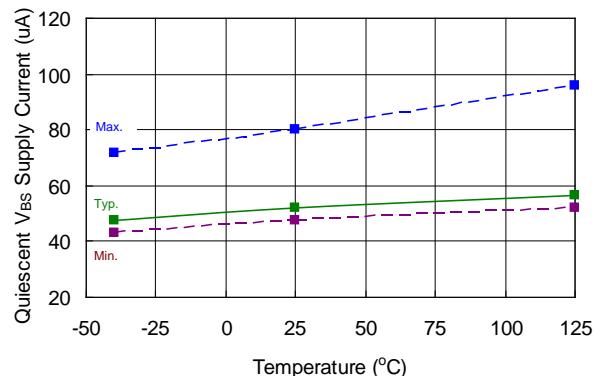


Figure 15. Offset Supply Leakage Current vs. Temperature

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

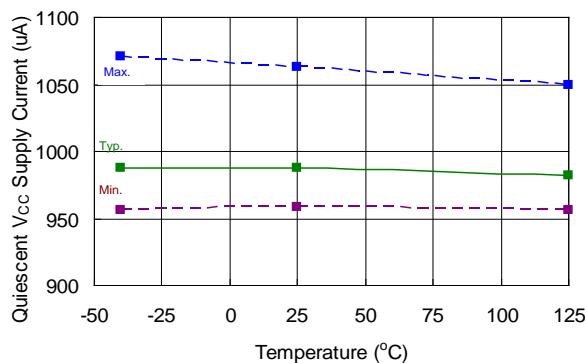
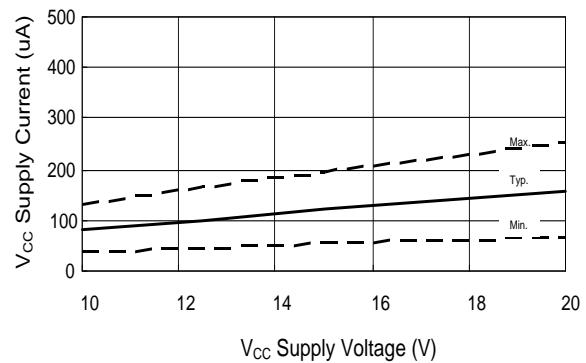
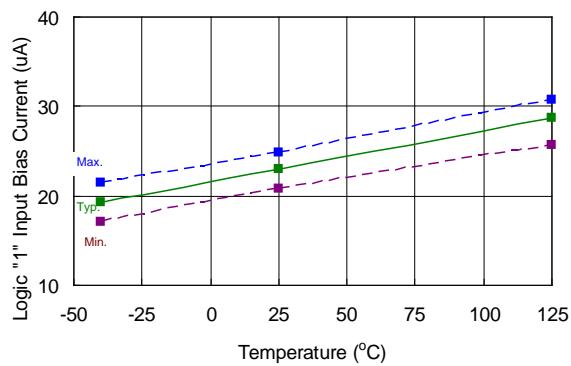
Figure 17A.  $V_{cc}$  Supply Current vs. TemperatureFigure 17B.  $V_{cc}$  Supply Current vs.  $V_{cc}$  Supply Voltage (V)

Figure 18. Logic "1" Input Bias Current vs. Temperature

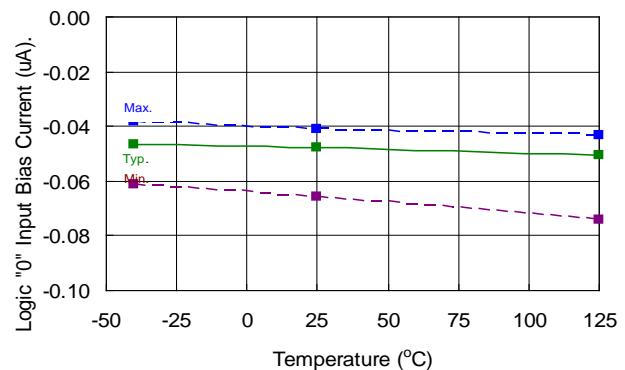
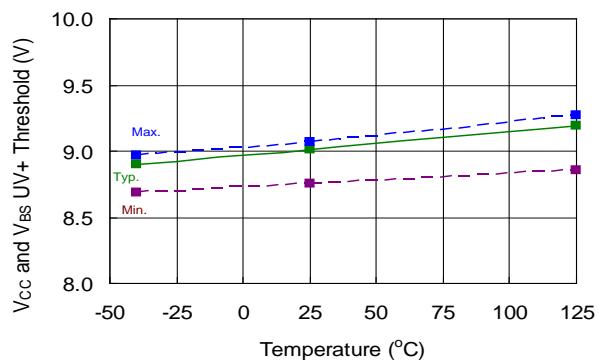
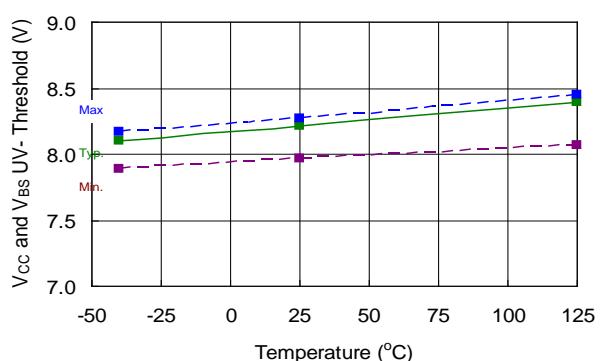


Figure 19. Logic "0" Input Bias Current vs. Temperature

Figure 20.  $V_{cc}$  and  $V_{bs}$  Undervoltage Threshold (+) vs. TemperatureFigure 21.  $V_{cc}$  and  $V_{bs}$  Undervoltage Threshold (-) vs. Temperature

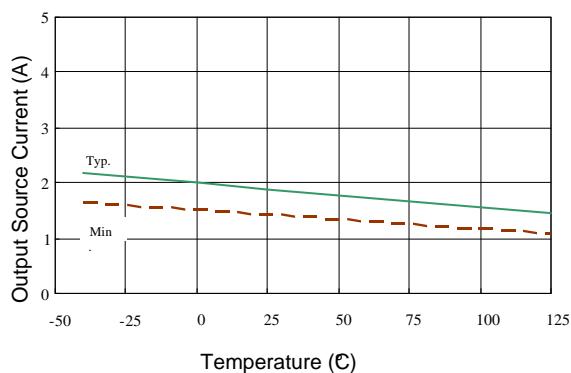


Figure 22. Output Source Current (A) vs. Temperature

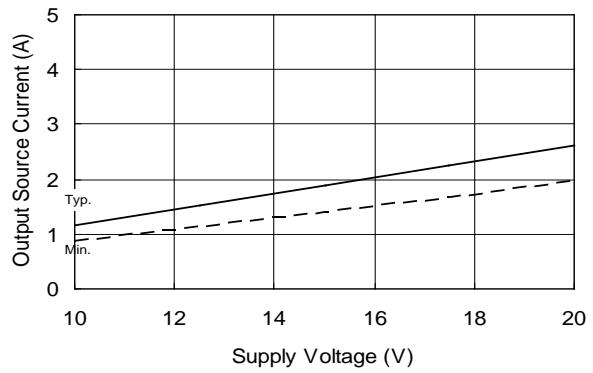


Figure 22A. Output Source Current (A) vs. Supply Voltage (V)

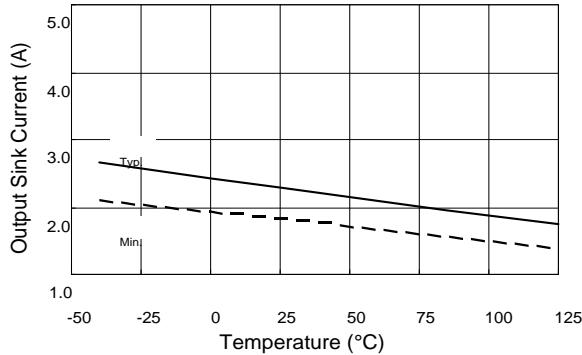


Figure 23. Output Sink Current (A) vs. Temperature

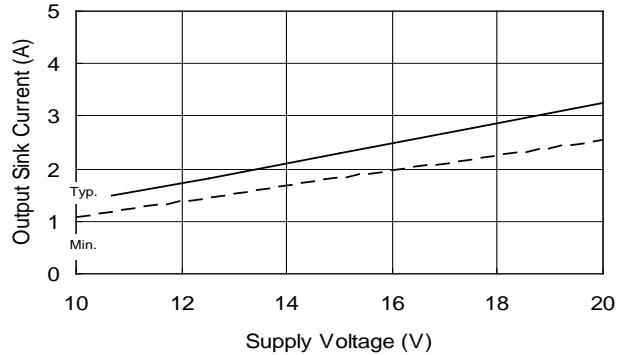
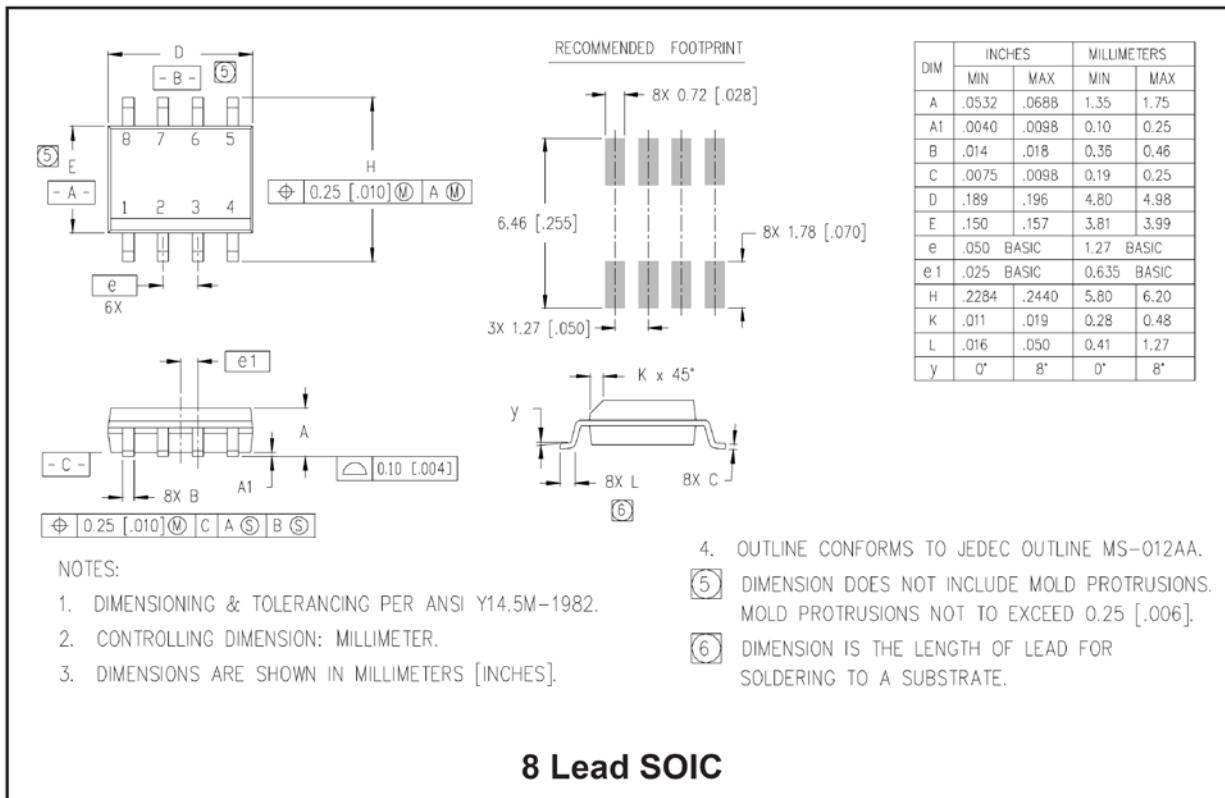
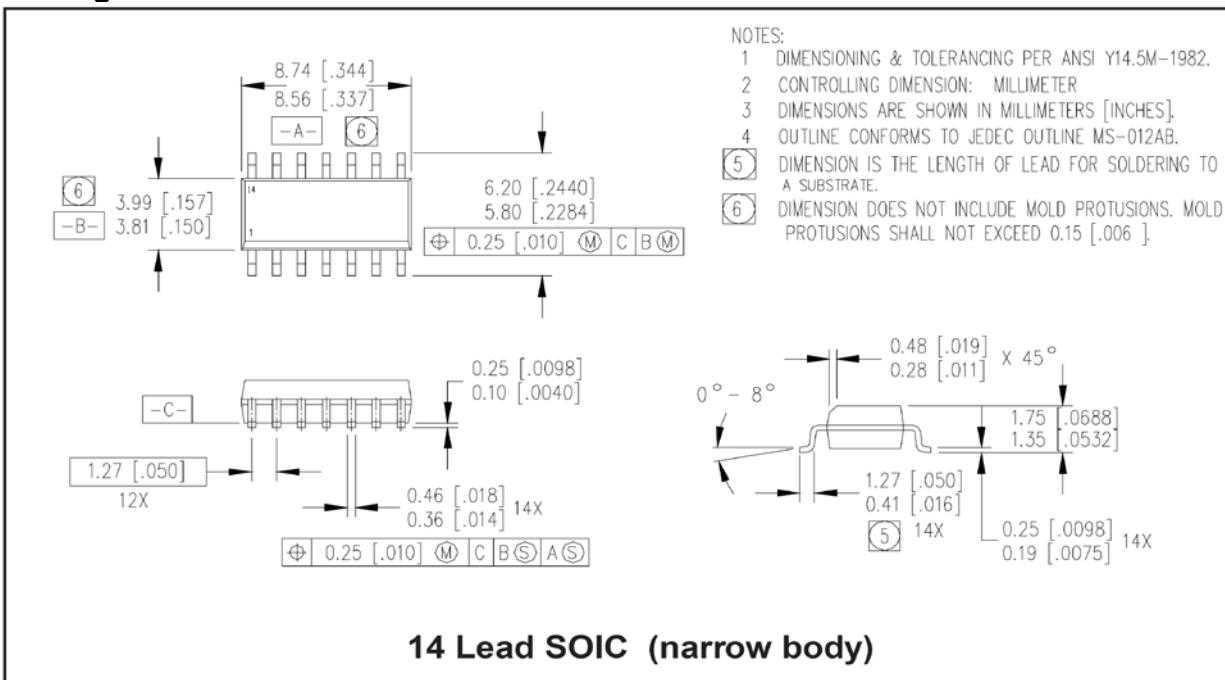


Figure 23A. Output Sink Current (A) vs. Supply Voltage (V)

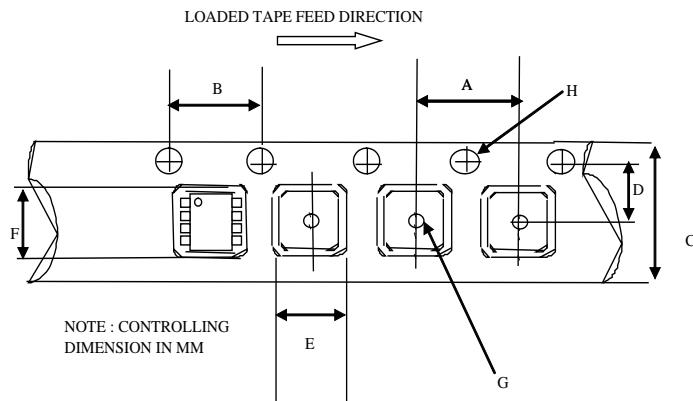
## Package Details: SOIC8



## Package Details: SOIC14N

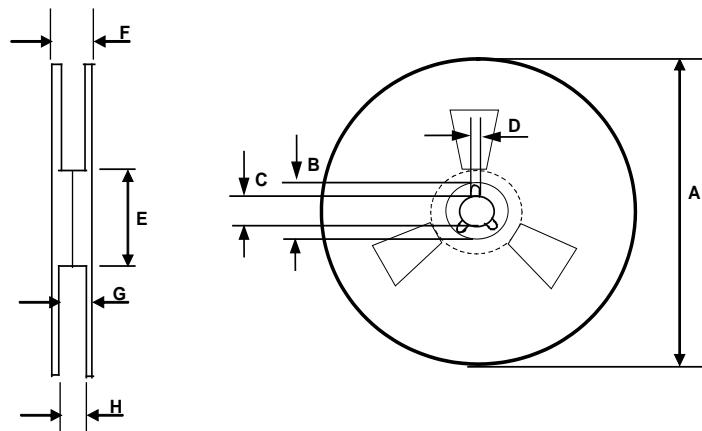


## Tape and Reel Details: SOIC8



CARRIER TAPE DIMENSION FOR 8SOICN

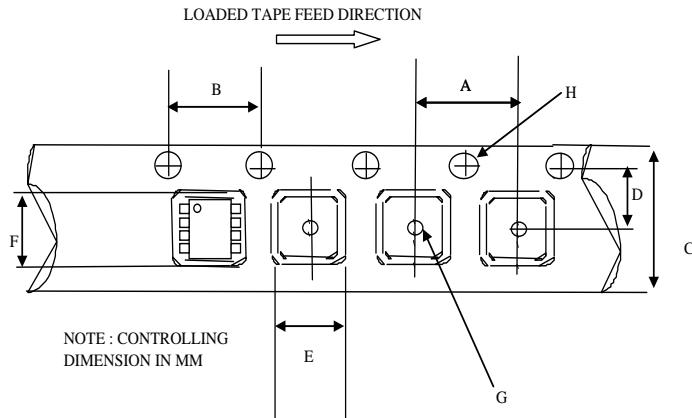
Code	Metric		Imperial	
	Min	Max	Min	Max
A	7.90	8.10	0.311	0.318
B	3.90	4.10	0.153	0.161
C	11.70	12.30	0.46	0.484
D	5.45	5.55	0.214	0.218
E	6.30	6.50	0.248	0.255
F	5.10	5.30	0.200	0.208
G	1.50	n/a	0.059	n/a
H	1.50	1.60	0.059	0.062



REEL DIMENSIONS FOR 8SOICN

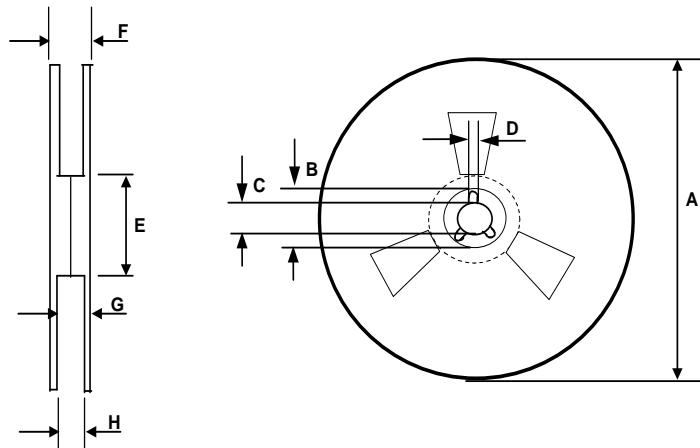
Code	Metric		Imperial	
	Min	Max	Min	Max
A	329.60	330.25	12.976	13.001
B	20.95	21.45	0.824	0.844
C	12.80	13.20	0.503	0.519
D	1.95	2.45	0.767	0.096
E	98.00	102.00	3.858	4.015
F	n/a	18.40	n/a	0.724
G	14.50	17.10	0.570	0.673
H	12.40	14.40	0.488	0.566

## Tape and Reel Details: SOIC14N



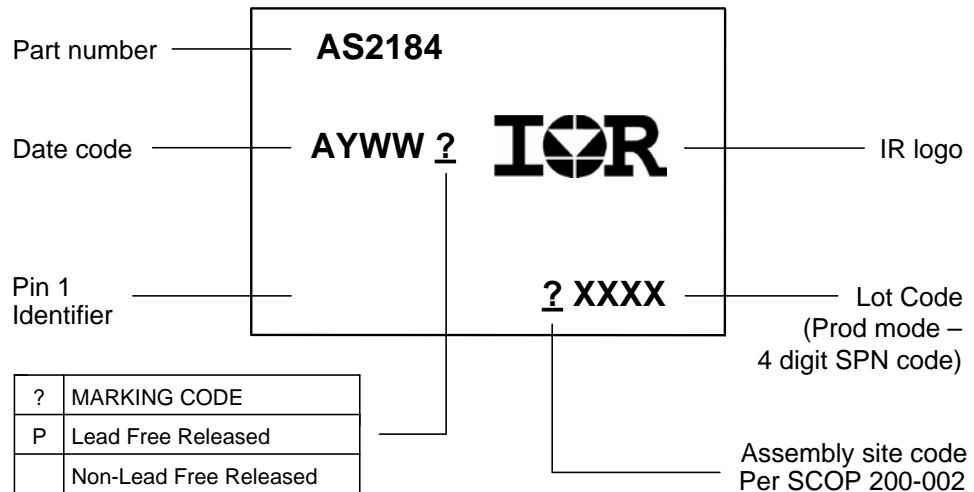
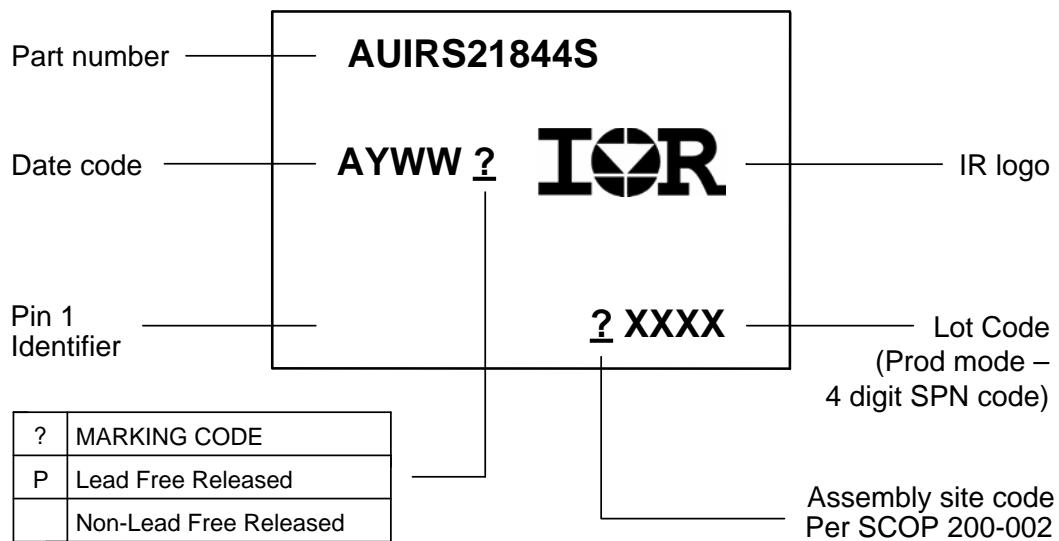
CARRIER TAPE DIMENSION FOR 14SOICN

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	9.40	9.60	0.370	0.378
G	1.50	n/a	0.059	n/a
H	1.50	1.60	0.059	0.062



REEL DIMENSIONS FOR 14SOICN

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****SOIC8:****SOIC14N:**

## Ordering Information

Base Part Number	Package Type	Standard Pack		Complete Part Number
		Form	Quantity	
AUIRS2184S	SOIC8	Tube/Bulk	55	AUIRS2184S
		<i>Tape and Reel</i>	<b>2500</b>	AUIRS2184STR
AUIRS21844S	SOIC14N	Tube/Bulk	55	AUIRS21844S
		<i>Tape and Reel</i>	<b>2500</b>	AUIRS21844STR

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Tel: (310) 252-7105

## Revision History

Date	Comment
04/29/08	Draft
5/6/08	Converted to automotive format
5/13/08	Corrected various formatting issues and typos (e.g. /SD) Corrected typical application dwg
5/16/08	Inserted figures 1-5
5/22/08	Added graphs for parameter temperature trends
5/26/08	Added missing graphs, added note on PbF and auto qualification on features list
5/28/08	Added date
9/30/08	Reviewed and updated various missing information
10/01/08	Inserted Input/Output Pin Equivalent Circuit Diagram
Feb 13 <sup>th</sup> , 2009	Typ application changes
6/04/09	Updated package information, qualification information, and tri-temp waveforms
8/4/09	Updated qualification information; graphs 27-42 changed 2181(4) to 2184(4)
8/6/09	Removed characterization graphs 27-42.
8/11/09	Updated package type and marking info
9/15/09	Corrected chapter with Parameter Trends SD max propagation delay changed from 270ns to 300ns Turn on rise time typ value changed from 40nsec to 20nsec
9/19/09	Rearranged temperature characteristic graphs and added actual part number on marking drawings
9/21/09	Added ESD passing voltages, updated table of contents.
9/22/09	Typ application section updated
9/23/09	Added note 1 for Vcc under Abs Max rating
12/17/09	Front page: changed ton/toff typ. to 600ns/230ns, Page6: changed Ton typ.=600ns; toff typ.=230ns; tsd typ.=220ns, max=350ns; MTon typ.=3ns; MToff typ.=15ns; tr typ=15ns; tf typ=12ns, DT (R <sub>DT</sub> @200Kohms) min=3.9uS; DT (0-ohm) typ=375ns; VOH max.=1.5V; iqbs min.=10uA, typ=50uA, max=130uA; Iqcc max.=1.3mA; added Important Notice page
12/22/09	Corrected MSL level on qual info page to MSL3 and updated MM ESD passing voltage to +/-100V instead of +/-150V.
02/24/2010	Updated disclaimer under Abs. Max. Rating Page 6: Added I <sub>O25+</sub> and I <sub>O25-</sub> specification and the note
Jul. 27, 2010	clamp diode values changed from 25V into 20V (in-out pin eq. circ. diagrams)
Aug 29 <sup>th</sup> , 2011	AUIRS2184 Functional Block diagram: COM no more shorted to Vss.
Dec 22 <sup>nd</sup> , 2012	Added paragraph "Tolerability to Negative VS Transients"