International
IOR Rectifier

July 15, 2010

Automotive Grade AUIRS2302S(TR)

HALF-BRIDGE DRIVER

Features

- Floating channel designed for bootstrap operation
- Fully operational to +600V
- Tolerant to negative transient voltage – dV/dt immun
- Gate drive supply range from 5V to 20V
- Undervoltage lockout for both channels
- 3.3V, 5V and 15V input logic compatible
- Cross-conduction prevention logic
- Matched propagation delay for both channels
- High-side output in phase with IN input
- Logic and power ground ± 5V offset
- Internal 540ns deadtime
- Lower di/dt gate driver for better noise immunity
- Shutdown input turns off both channels
- Leadfree, RoHS compliant
- Automotive qualified*

Typical Applications

- Braking Pump
- Compressor
- Electric Stability program
- power steering
- MOSFET and IGBT gate drivers

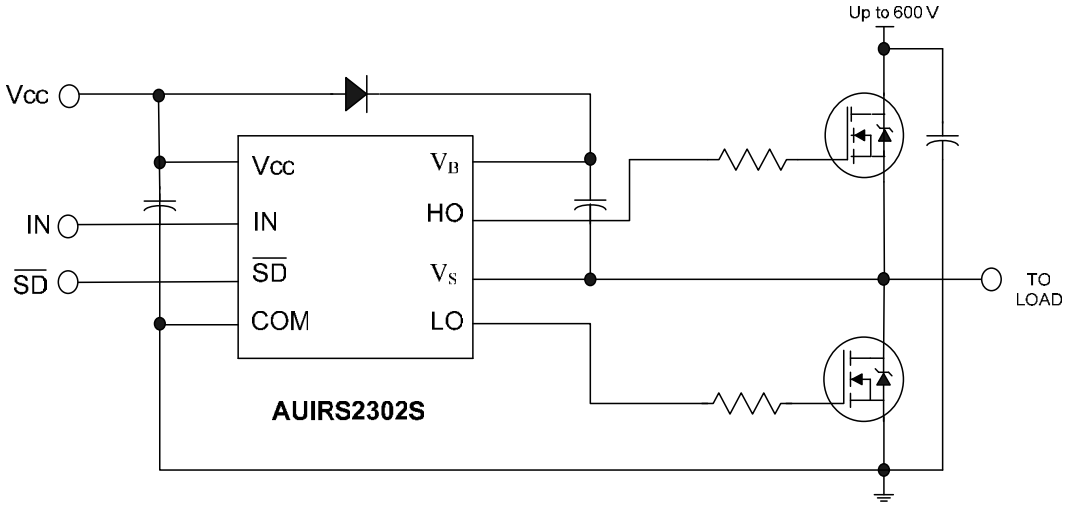
Product Summary

V_{OFFSET}	600V Max
V_{OUT}	5V – 20V
I_{o+} & I_{o-} (min)	120mA / 250mA
t_{ON} & t_{OFF} (typical)	720ns / 250ns
Delay Matching (max.)	60ns

Package Options

8-Lead SOIC

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.

* Qualification standards can be found on IR's web site ww.irf.com

Description

The AUIRS2302S is a high voltage, high speed power MOSFET and IGBT driver 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 3.3V 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 600V.

Feature Comparison

Part Numbers	Input Logic	Cross-conduction prevention logic	Deadtime (ns)	Ground Pins	t_{on}/t_{off} (ns)
2106/2301	HIN/LIN	no	none	COM	220/200
21064				V_{SS}/COM	
2108	HIN/$\overline{\text{LIN}}$	yes	Internal 540	COM	220/200
21084			Programmable 540 – 5000	V_{SS}/COM	
2109/2302	IN/ $\overline{\text{SD}}$	yes	Internal 540	COM	720/250
21094			Programmable 540 - 5000	V_{SS}/COM	
2304	HIN/LIN	yes	Internal 100	COM	160/140

Qualification Information†

Qualification Level		Automotive (per AEC-Q100††)	
		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.	
Moisture Sensitivity Level		SOIC8	MSL3††† 260°C (per IPC/JEDEC J-STD-020)
ESD	Machine Model	Class M2 (per AEC-Q100-003)	
	Human Body Model	Class H1C (per AEC-Q100-002)	
	Charged Device Model	Class C5 (per AEC-Q100-011)	
IC Latch-Up Test		Class II, Level A (per AEC-Q100-004)	
RoHS Compliant		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. These are stress ratings only, functional operation of the device at these or any other condition beyond those indicated in the "Recommended Operating Condition" is not implied. Exposure to absolute maximum-rated conditions for extended periods may affect device reliability. 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 absolute voltage	-0.3	625	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	25	
V_{LO}	Low-side output voltage	-0.3	V_{CC} + 0.3	
V_{IN}	Logic input voltage (IN & $\overline{SD}$)	COM -0.3	V_{CC} + 0.3	
dV_S/dt	Allowable offset supply voltage transient	—	50	V/ns
P_D	Package power dissipation @ TA ≤ 25°C	—	0.625	W
Rth_{JA}	Thermal resistance, junction to ambient	—	200	°C/W
T_J	Junction temperature	—	150	°C
T_S	Storage temperature	-50	150	
T_L	Lead temperature (soldering, 10 seconds)	—	300	

Recommended Operating Conditions

The input/output logic timing diagram is shown in Fig. 1. For proper operation the device should be used within the recommended conditions. The V_S offset rating is tested with all supplies biased at 15V differential.

Symbol	Definition	Min.	Max.	Units
V_B	High-side floating supply absolute voltage	V_S + 5	V_S + 20	V
V_S	High-side floating supply offset voltage	† 1	600	
V_{HO}	High-side floating output voltage	V_S	V_B	
V_{CC}	Low-side and logic fixed supply voltage	5	20	
V_{LO}	Low-side output voltage	0	V_{CC}	
V_{IN}	Logic input voltage (IN & $\overline{SD}$)	COM	V_{CC}	
T_A	Ambient temperature	-40	150	°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 the Design Tip DT97 -3 for more details).

Static Electrical Characteristics

Unless otherwise noted, these specifications apply for an operating junction temperature range of -40°C ≤ T_j ≤ 125°C with bias conditions of V_{BIAS} (VCC or VBS) = 15V. The V_{IN}, V_{TH} parameters are referenced to COM and are applicable to all logic input leads: IN and $\overline{SD}$. The VO 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_{IH}	Logic "1" input voltage for HO & logic "0" for LO	2.5	—	—	V	V_{CC} = 10V to 20V
V_{IL}	Logic "0" input voltage for HO & logic "1" for LO	—	—	0.8		
$V_{SD,TH+}$	$\overline{SD}$ input positive going threshold	2.5	—	—		
$V_{SD,TH-}$	$\overline{SD}$ input negative going threshold	—	—	0.8		
V_{OH}	High level output voltage, V_{BIAS} - V_O	—	—	0.2		I_O = 2mA
V_{OL}	Low level output voltage, V_O	—	—	0.1		
I_{LK}	Offset supply leakage current	—	—	50	µA	V_B = V_S = 600V
I_{QBS}	Quiescent V_{BS} supply current	20	180	300		V_{IN} = 0V or 5V
I_{QCC}	Quiescent V_{CC} supply current	0.4	1.0	1.6	mA	
I_{IN+}	Logic "1" input bias current	—	5	20	µA	V_{IN} = 5V, $\overline{SD}$ = 0V
I_{IN-}	Logic "0" input bias current	—	—	5		V_{IN} = 0V, $\overline{SD}$ = 5V
V_{CCUV+} V_{BSUV+}	V_{CC} and V_{BS} supply undervoltage positive going threshold	3	4.1	5.2	V	
V_{CCUV-} V_{BSUV-}	V_{CC} and V_{BS} supply undervoltage negative going threshold	2.8	3.8	4.8		
V_{CCUVH} V_{BSUVH}	Hysteresis	0.05	0.3	—		
I_{O+}	Output high short circuit pulsed current(†)	120	200	—	mA	V_O = 0V, PW ≤ 10µs
I_{O-}	Output low short circuit pulsed current(†)	250	350	—		V_O = 15V, PW ≤ 10µs

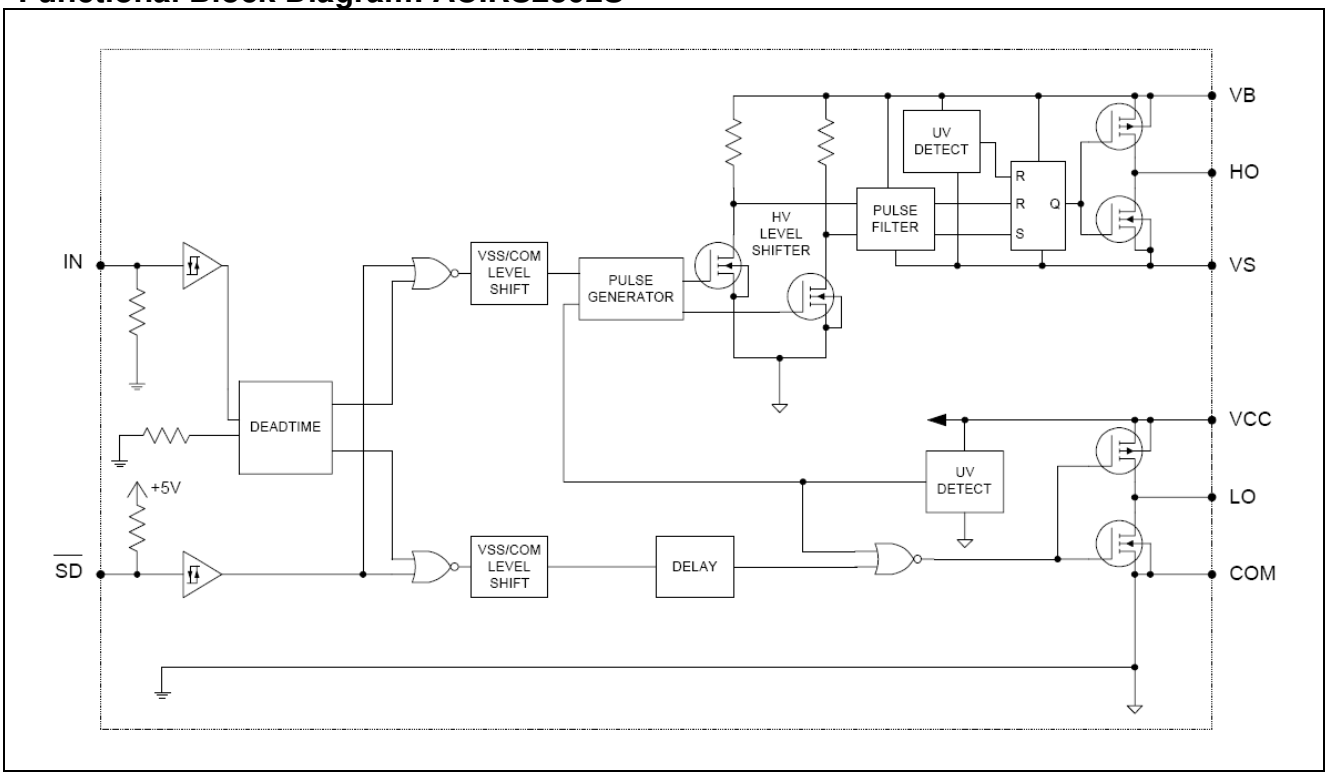
(†) Guaranteed by design

Dynamic Electrical Characteristics

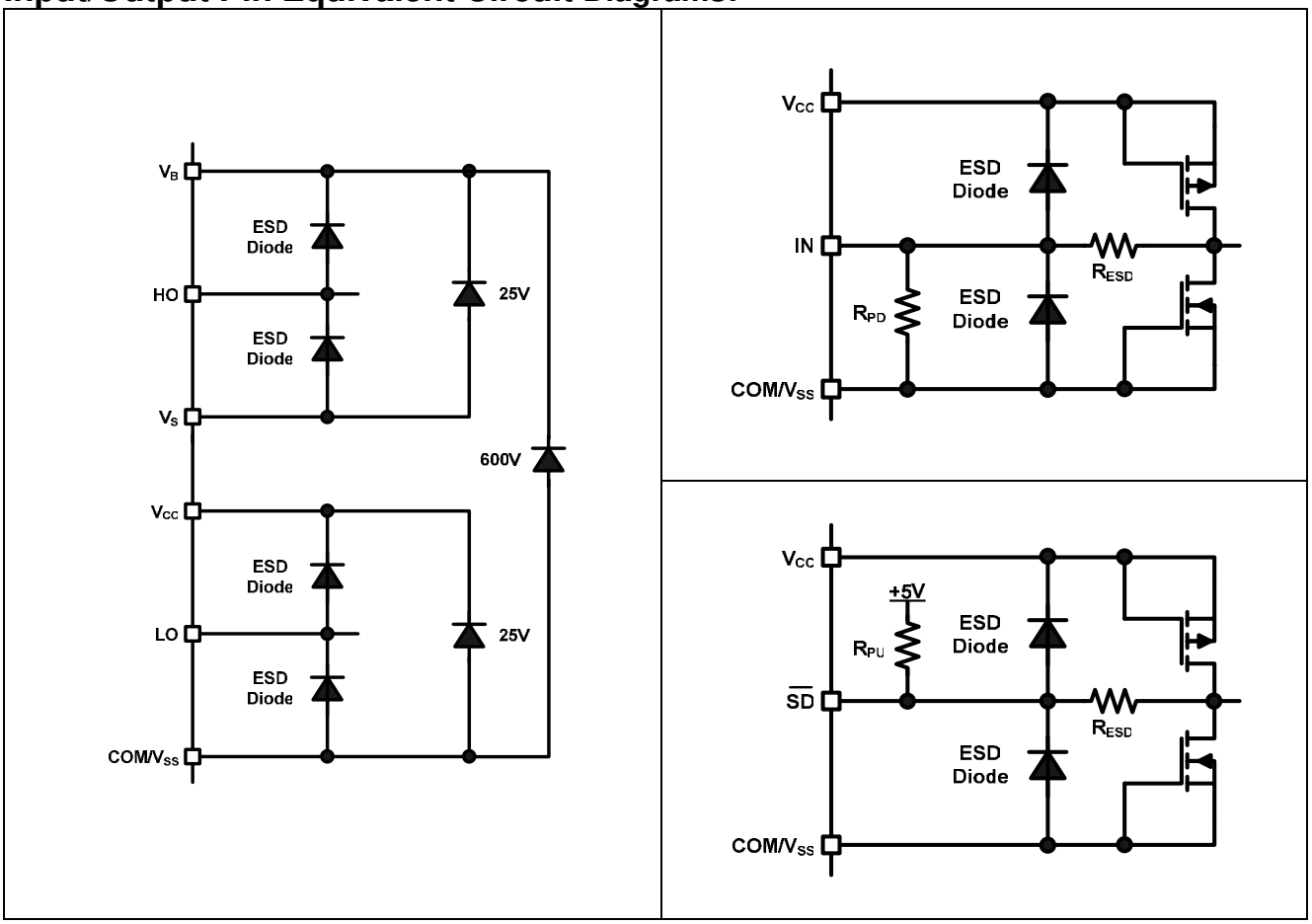
Unless otherwise noted, these specifications apply for an operating junction temperature range of -40°C ≤ T_j ≤125°C with bias conditions of V_{BIAS} (VCC, VBS) = 15V, CL = 1000 pF. The dynamic electrical characteristics are measured using the test definitions shown in Figure 2.

Symbol	Definition	Min	Typ	Max	Units	Test Conditions
t_{on}	Turn-on propagation delay	550	720	950	ns	V_S = 0 V
t_{off}	Turn-off propagation delay	—	250	300		V_S = 0 V or 600 V
t_{sd}	Shutdown propagation delay	—	240	280		
MT	Delay matching, HS & LS turn-on/off	—	0	50		
t_r	Turn-on rise time	—	100	220		V_S = 0 V
t_f	Turn-off fall time	—	25	80		
DT	Deadtime: LO turn-off to HO turn-on (DT_{LO-HO}) & HO turn-off to LO turn-on (DT_{HO-LO})	300	440	580		
MDT	Delay matching = DT_{LO-HO} - DT_{HO-LO}	—	0	60		

Functional Block Diagram: AUIRS2302S



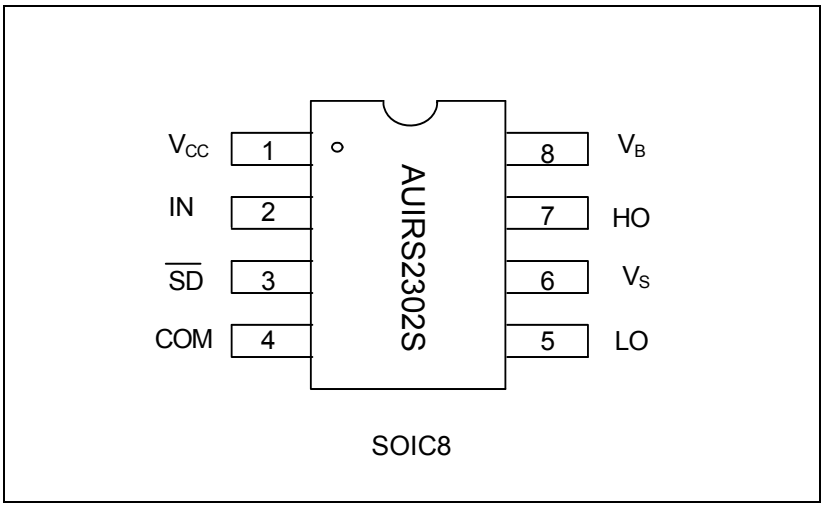
Input/Output Pin Equivalent Circuit Diagrams:



Lead Definitions:

Symbol	Description
V_{CC}	Low-side and logic fixed supply
IN	Logic input for high and low side gate driver outputs (HO and LO), in phase with HO
$\overline{SD}$	Logic input for shutdown
COM	Low-side return
LO	Low-side gate drive output
V_S	High-side floating supply return
HO	High-side gate drive output
V_B	High-side floating supply

Lead Assignments



SOIC8

Application Information and Additional Details

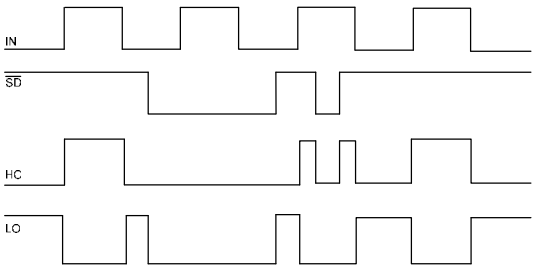


Figure 1: Input/Output Timing Diagram

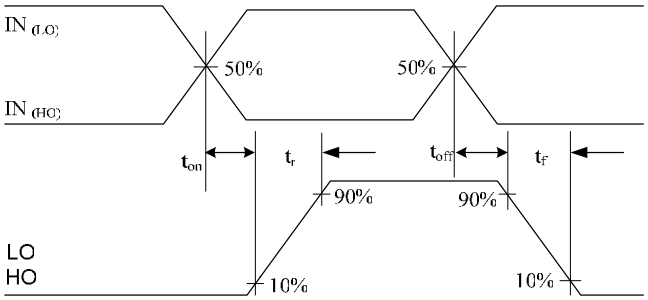


Figure 2: Switching Time Waveform Definitions

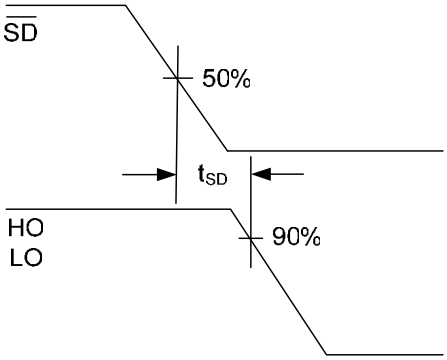


Figure 3: Delay Matching Waveform Definitions

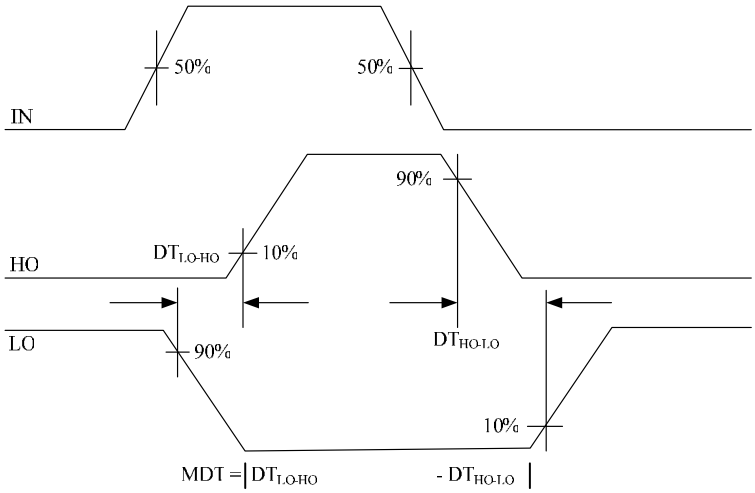


Figure 4: Deadtime Waveform Definitions

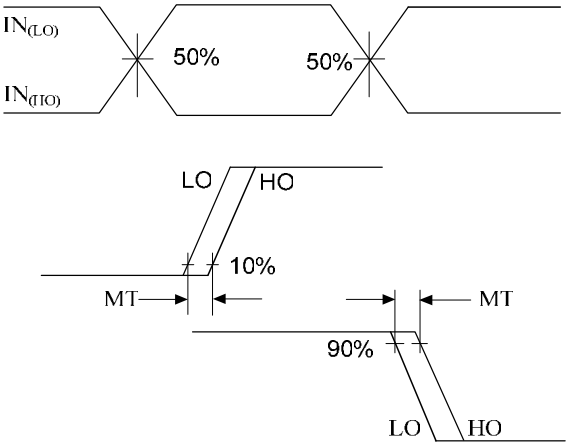


Figure 5: Delay Matching Waveform Definitions

Tolerability to Negative VS Transients

The AUIRS2302S has been seen to withstand negative V_S transient conditions on the order of -25V for a period of 100 ns (V_{BIAS} (V_{CC}, V_{BS}) = 15V and T_A = 25°C).
An illustration of the AUIRS2302S performance can be seen in Figure 6.
Even though the AUIRS2302S have 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.

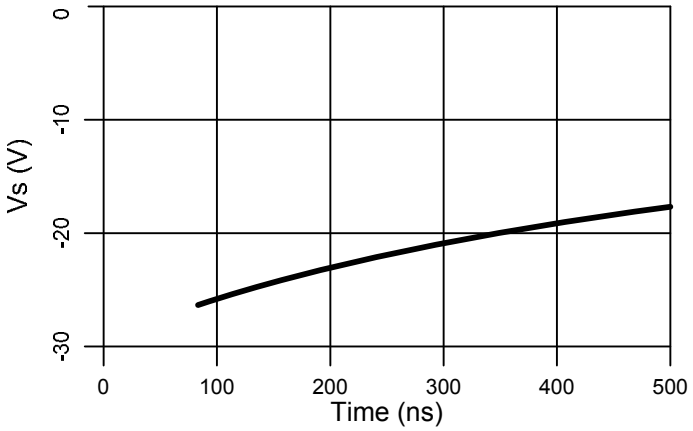


Figure 6: -Vs Transient results

Parameter Temperature Trends

Figures illustrated in this chapter provide information on the experimental performance of the AUIRS2302S 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 ºC, 25 ºC, and 125 ºC) 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).

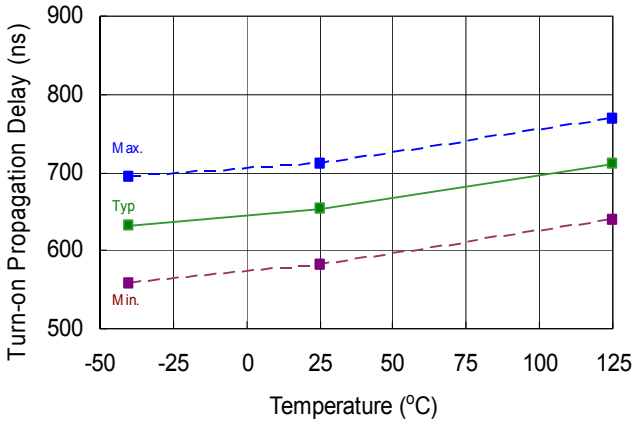


Figure 7. Turn-On Time vs. Temperature

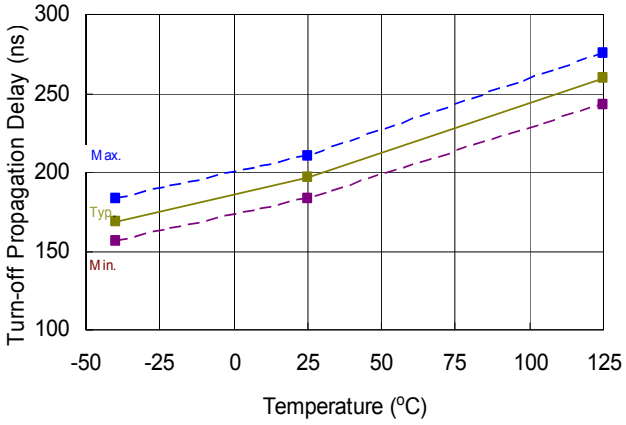


Figure 8. Turn-Off Time vs. Temperature

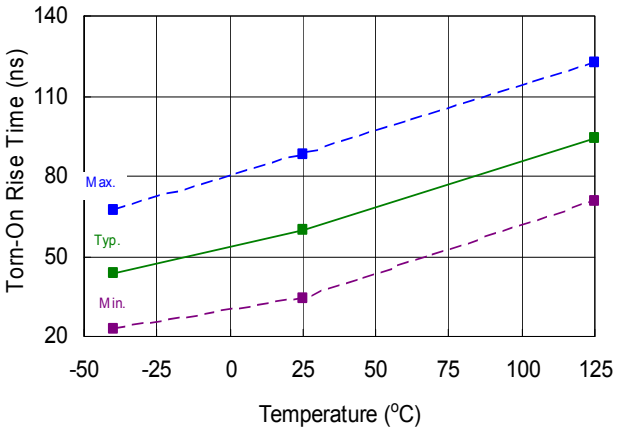


Figure 9. Turn-On Rise Time vs. Temperature

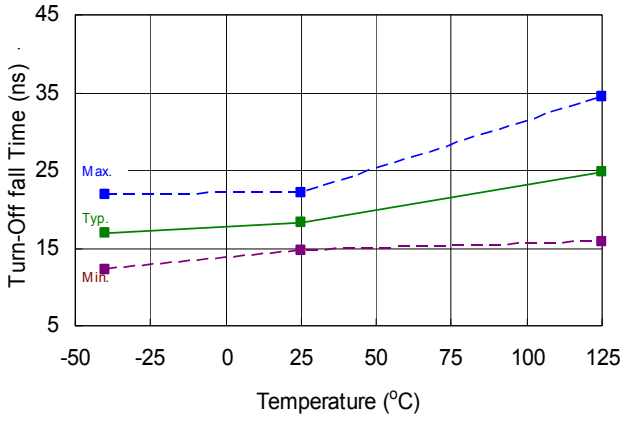


Figure 10. Turn-Off Fall Time vs. Temperature

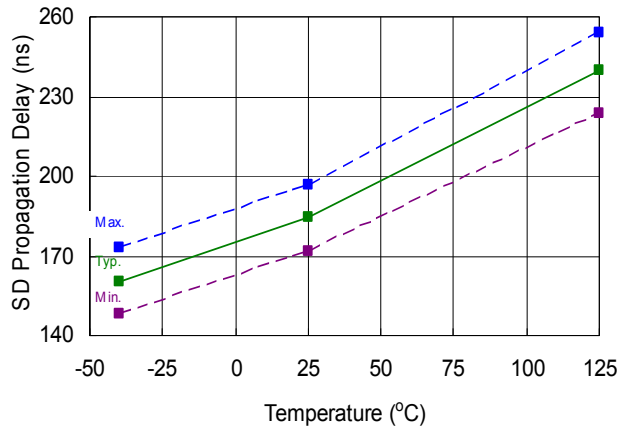


Figure 11. Shutdown Time vs. Temperature

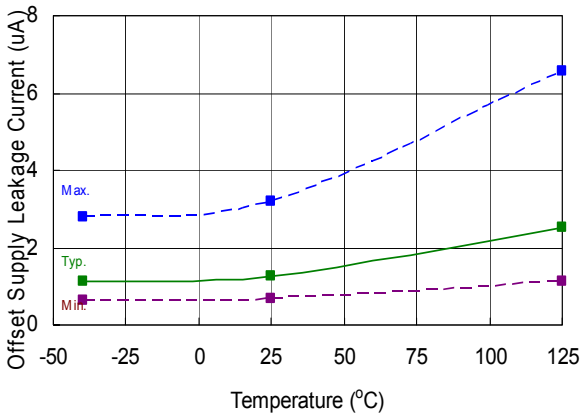


Figure 12. Offset Supply Current vs. Temperature

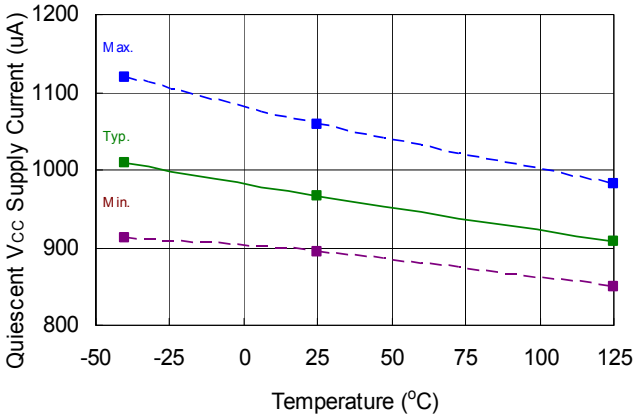


Figure 13. V_{CC} Supply Current vs. Temperature

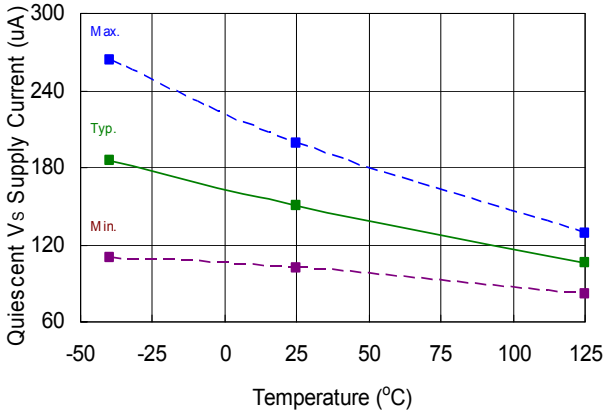


Figure 14. V_{BS} Supply Current vs. Temperature

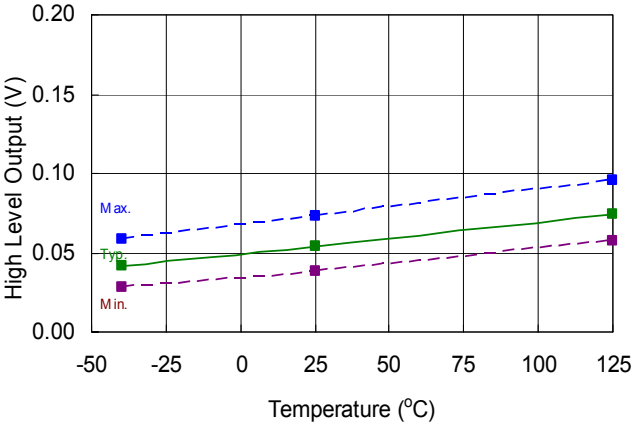


Figure 15. High Level Output Voltage vs. Temperature (Io = 2mA)

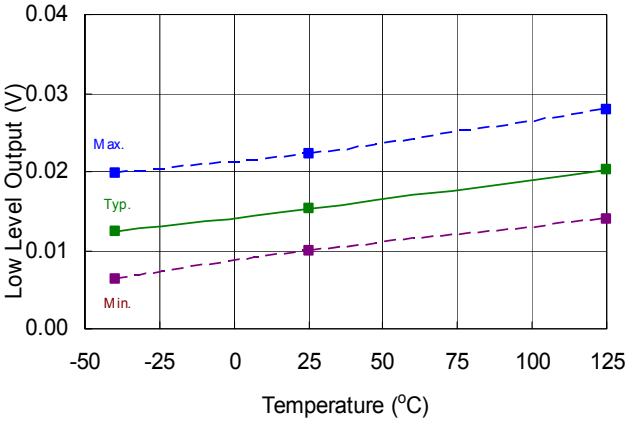


Figure 16. Low Level Output Voltage vs. Temperature (Io = 2mA)

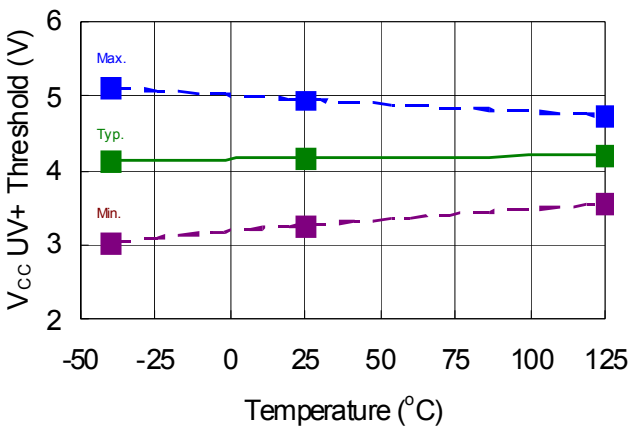


Figure 17. V_{CC} UV+ Threshold Voltage vs. Temperature

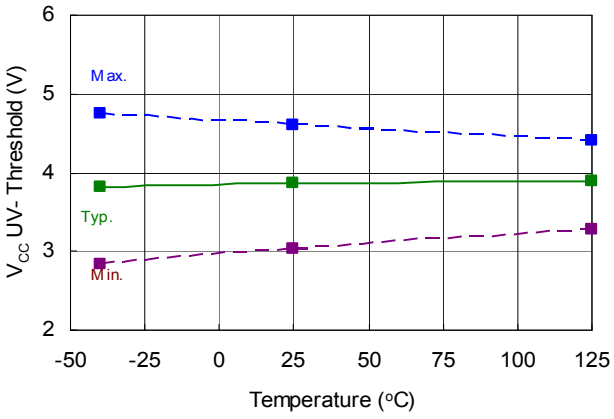


Figure 18. V_{BS} UV- Threshold Voltage vs. Temperature

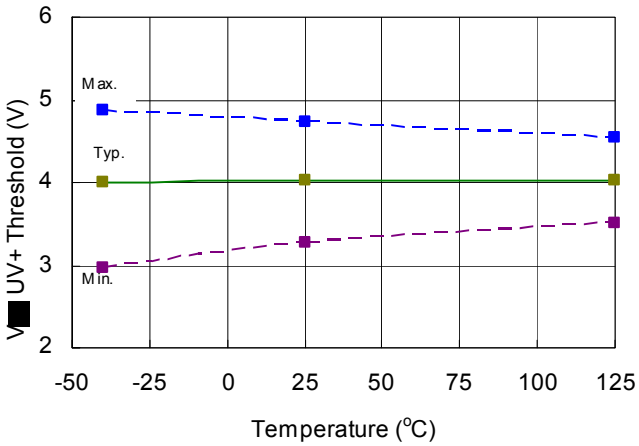


Figure 19. V_{BS} UV+ Threshold Voltage vs. Temperature

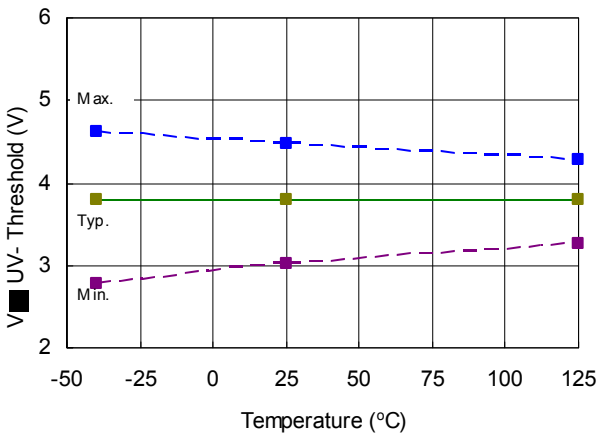
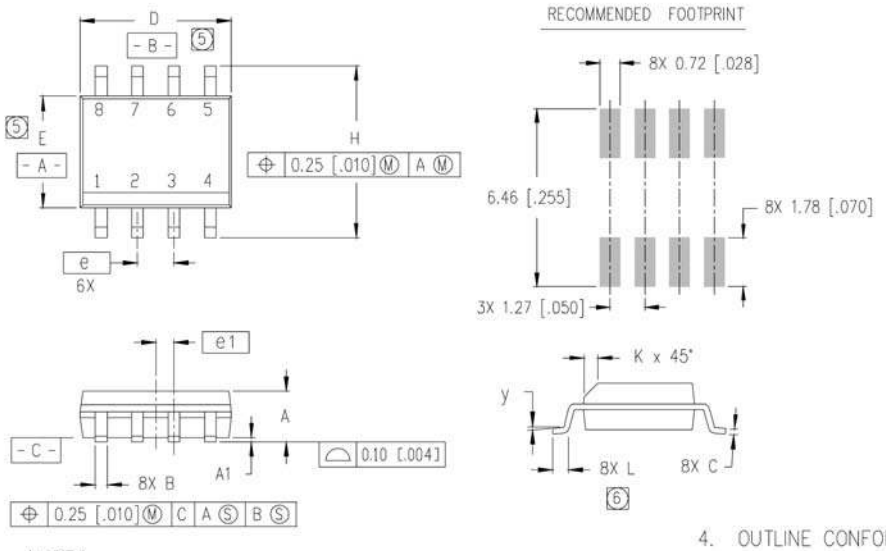


Figure 20. V_{BS} UV- Threshold Voltage vs. Temperature

Package Details



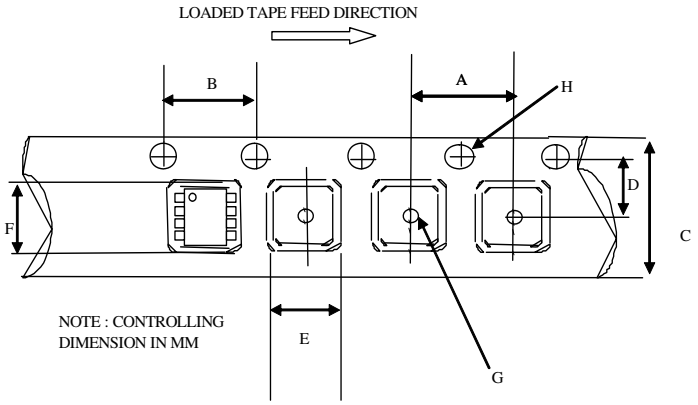
DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	.0532	.0688	1.35	1.75
A1	.0040	.0098	0.10	0.25
B	.014	.018	0.36	0.46
C	.0075	.0098	0.19	0.25
D	.189	.196	4.80	4.98
E	.150	.157	3.81	3.99
e	.050 BASIC		1.27 BASIC	
e1	.025 BASIC		0.635 BASIC	
H	.2284	.2440	5.80	6.20
K	.011	.019	0.28	0.48
L	.016	.050	0.41	1.27
y	0°	8°	0°	8°

NOTES:

1. DIMENSIONING & TOLERANCING PER ANSI Y14.5M-1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
4. OUTLINE CONFORMS TO JEDEC OUTLINE MS-012AA.
5. DIMENSION DOES NOT INCLUDE MOLD PROTRUSIONS. MOLD PROTRUSIONS NOT TO EXCEED 0.25 [.006].
6. DIMENSION IS THE LENGTH OF LEAD FOR SOLDERING TO A SUBSTRATE.

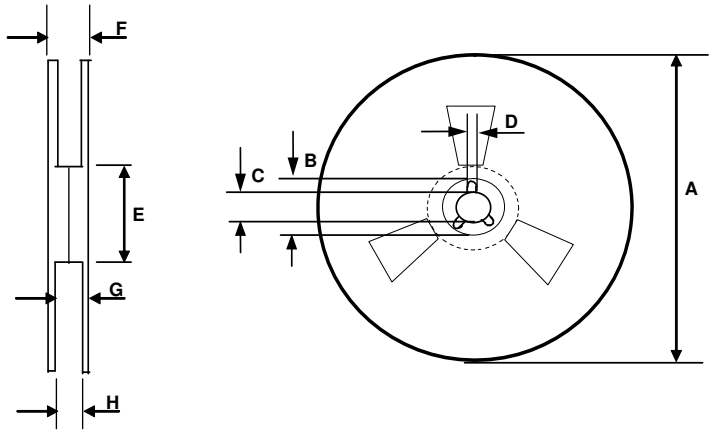
8 Lead SOIC

Tape and Reel Details



CARRIER TAPE DIMENSION FOR 8SOICN

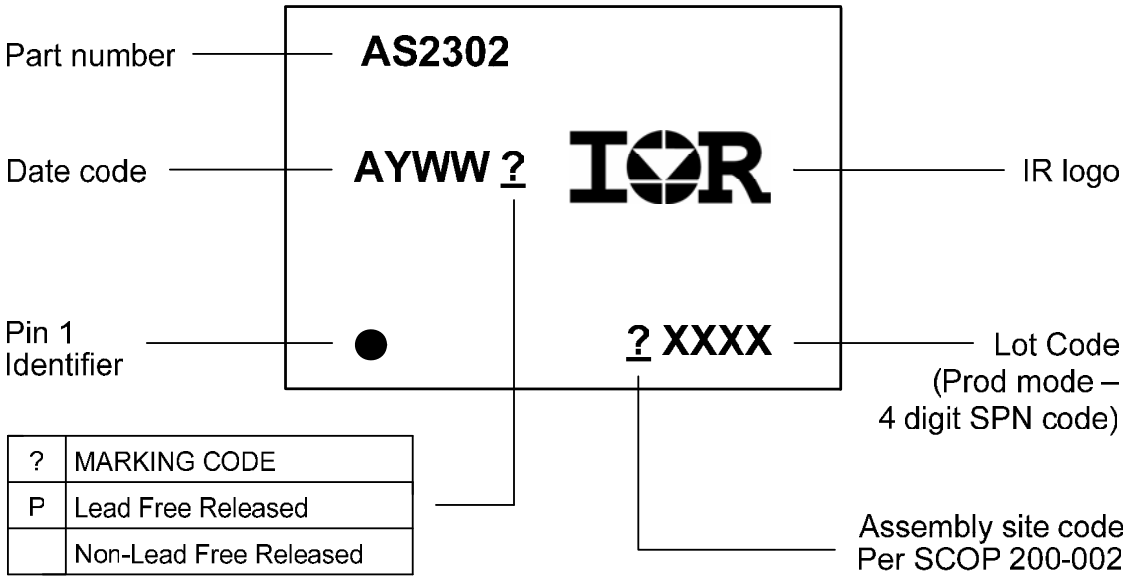
	Metric		Imperial	
Code	Min	Max	Min	Max
A	7.90	8.10	0.311	0.318
B	3.90	4.10	0.153	0.161
C	11.70	12.30	0.46	0.484
D	5.45	5.55	0.214	0.218
E	6.30	6.50	0.248	0.255
F	5.10	5.30	0.200	0.208
G	1.50	n/a	0.059	n/a
H	1.50	1.60	0.059	0.062



REEL DIMENSIONS FOR 8SOICN

	Metric		Imperial	
Code	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

Part Marking Information



?	MARKING CODE
P	Lead Free Released
	Non-Lead Free Released

Ordering Information

Base Part Number	Package Type	Standard Pack		Complete Part Number
		Form	Quantity	
AUIRS2302S	SOIC8	Tube/Bulk	95	AUIRS2302S
		Tape and Reel	2500	AUIRS2302STR

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