NCP5181

High Voltage High and Low Side Driver

The NCP5181 is a High Voltage Power MOSFET Driver providing two outputs for direct drive of 2 N−channel power MOSFETs arranged in a half−bridge (or any other high−side + low−side) configuration.

It uses the bootstrap technique to insure a proper drive of the High−side power switch. The driver works with 2 independent inputs to accommodate any topology (including half−bridge, asymmetrical half−bridge, active clamp and full−bridge…).

Features

- High Voltage Range: up to 600 V
- dV/dt Immunity ±50 V/nsec
- Gate Drive Supply Range from 10 V to 20 V
- High and Low DRV Outputs
- Output Source / Sink Current Capability 1.4 A / 2.2 A
- 3.3 V and 5 V Input Logic Compatible
- Up to V_{CC} Swing on Input Pins
- Matched Propagation Delays between Both Channels
- Outputs in Phase with the Inputs
- Independent Logic Inputs to Accommodate All Topologies
- Under V_{CC} LockOut (UVLO) for Both Channels
- Pin to Pin Compatible with IR2181(S)
- These are Pb−Free Devices

Applications

- High Power Energy Management
- Half−bridge Power Converters
- Any Complementary Drive Converters (asymmetrical half−bridge, active clamp)
- Full−bridge Converters
- Bridge Inverters for UPS Systems

PIN ASSIGNMENT

PIN	FUNCTION
IN_HI	Logic Input for High Side Driver Output In Phase
IN_LO	Logic Input for Low Side Driver Output In Phase
GND	Ground
DRV_LO	Low Side Gate Drive Output
V_{CC}	Low Side and Main Power Supply
V_{BOOT}	Bootstrap Power Supply
DRV_HI	High Side Gate Drive Output
BRIDGE	Bootstrap Return or High Side Floating Supply Return

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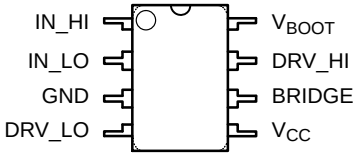
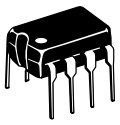
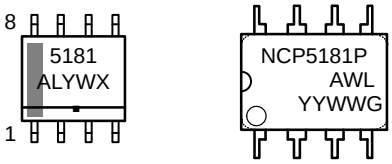


SOIC−8
D SUFFIX
CASE 751



PDIP−8
P SUFFIX
CASE 626

MARKING DIAGRAMS



NCP5181P,
5181 = Specific Device Code
A = Assembly Location
L = Wafer Lot
Y, YY = Year
W, WW = Work Week
G or ▪ = Pb−Free Package

ORDERING INFORMATION

Device	Package	Shipping†
NCP5181PG	PDIP−8 (Pb−Free)	50 Units/Tube
NCP5181DR2G	SOIC−8 (Pb−Free)	2.500/Tape & Reel

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specification Brochure, BRD8011/D.

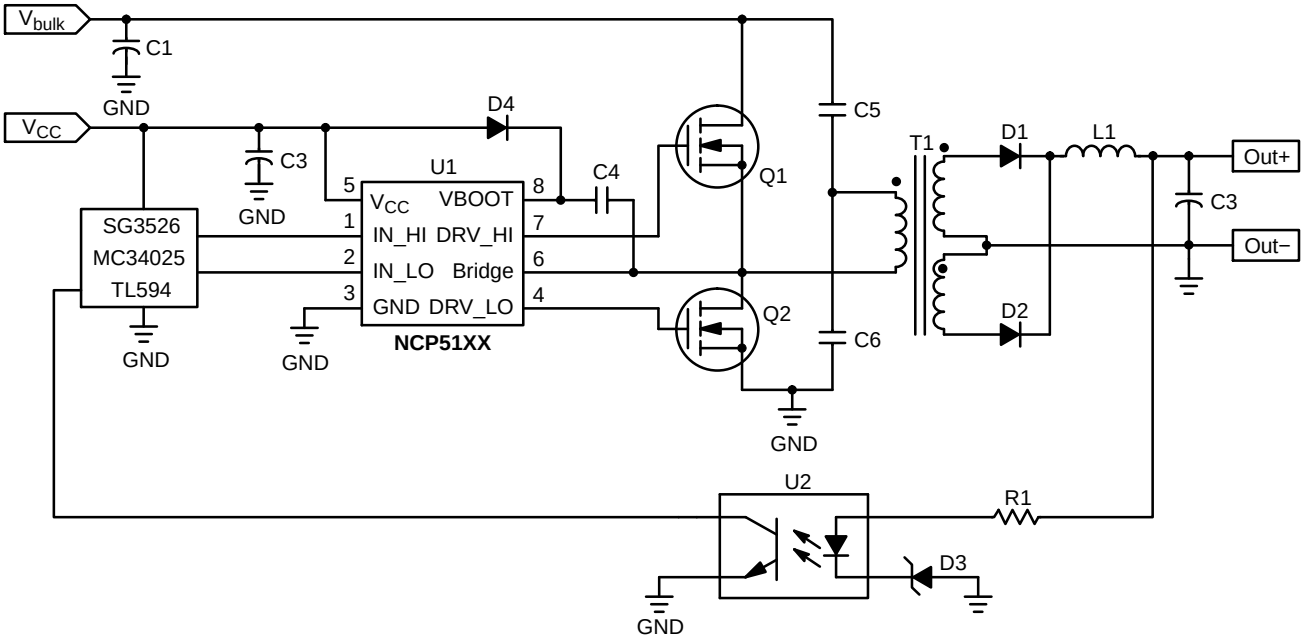


Figure 1. Typical Application

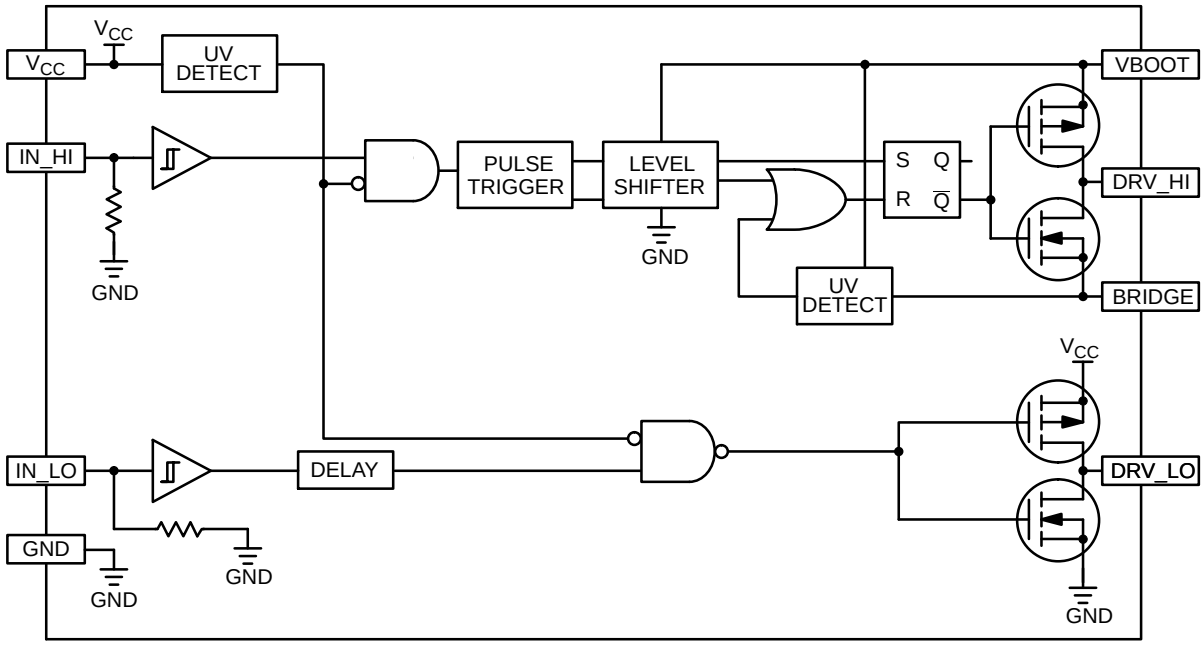


Figure 2. Detailed Block Diagram

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Main Power Supply Voltage	V_{CC}	−0.3 to 20	V
VHV: High Voltage BOOT Pin	V_{BOOT}	−1 to 620	V
VHV: High Voltage BRIDGE Pin	V_{BRIDGE}	−1 to 600	V
VHV: Floating Supply Voltage	$V_{BOOT} - V_{BRIDGE}$	0 to 20	V
VHV: High Side Output Voltage	V_{DRV_HI}	V_{BRIDGE}−0.3 to V_{BOOT}+0.3	V
Low Side Output Voltage	V_{DRV_LO}	−0.3 to V_{CC}+0.3	V
Allowable Output Slew Rate	dV_{BRIDGE}/d_t	50	V/ns
Inputs IN_HI, IN_LO	V_{IN_XX}	−1.0 to V_{CC}+0.3	V
ESD Capability: Human Body Model (All Pins Except Pins 6−7−8) Machine Model (All Pins Except Pins 6−7−8)		 2.0 200	 kV V
Latchup Capability per Jedec JESD78			
Power Dissipation and Thermal Characteristics PDIP8: Thermal Resistance, Junction−to−Air SO−8: Thermal Resistance, Junction−to−Air	 $R_{\theta JA}$ $R_{\theta JA}$	 100 178	°C/W
Maximum Operating Junction Temperature	T_{J_max}	+150	°C

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

ELECTRICAL CHARACTERISTICS (V_{CC} = V_{boot} = 15 V, V_{gnd} = V_{bridge}, −40°C < T_A < 125°C, Outputs loaded with 1 nF)

Rating	Symbol	T_A −40°C to 125°C			Units
OUTPUT SECTION					
		Min	**Typ**	**Max**	
Output High Short Circuit pulsed Current V_{DRV} = 0 V, PW ≤ 10 μs, (Note 1)	$I_{DRVhigh}$	−	1.4	−	A
Output Low Short Circuit Pulsed Current V_{DRV} = V_{CC}, PW ≤ 10 μs, (Note 1)	I_{DRVlow}	−	2.2	−	A
Output Resistor (Typical Value @ 25°C Only) Source	R_{OH}	−	5	12	Ω
Output Resistor (Typical Value @ 25°C Only) Sink	R_{OL}	−	2	8	Ω
DYNAMIC OUTPUT SECTION					
Rating	**Symbol**	**Min**	**Typ**	**Max**	**Units**
Turn−on Propagation Delay (V_{bridge} = 0 V)	t_{ON}	−	100	170	ns
Turn−off Propagation Delay (V_{bridge} = 0 V or 50 V) (Note 2)	t_{OFF}	−	100	170	ns
Output Voltage Risetime (from 10% to 90% @ V_{CC} = 15 V) with 1 nF Load	t_r	−	40	60	ns
Output Voltage Falling Edge (from 90% to 10% @ V_{CC} = 15 V) with 1 nF Load	t_f	−	20	40	ns
Propagation Delay Matching between the High Side and the Low Side @ 25°C (Note 3)	Δ_t	−	20	35	ns
Minimum Input Pulse Width that Changes the Output	t_{PW}	−	−	100	ns
INPUT SECTION					
Low Level Input Voltage Threshold	V_{IN}	−	−	0.8	V
Input Pulldown Resistor (V_{IN} < 0.5 V)	R_{IN}	−	200	−	kΩ
High Level Input Voltage Threshold	V_{IN}	2.3	−	−	V
SUPPLY SECTION					
V_{CC} UV Startup Voltage Threshold	V_{CC_stup}	7.9	8.9	9.8	V
V_{CC} UV Shutdown Voltage Threshold	V_{CC_shtdwn}	7.3	8.2	9.0	V
Hysteresis on V_{CC}	V_{CC_hyst}	0.3	0.7	−	V
V_{boot} Startup Voltage Threshold Reference to Bridge Pin (V_{boot_stup} = V_{boot} − V_{bridge})	V_{boot_stup}	7.9	8.9	9.8	V
V_{boot} UV Shutdown Voltage Threshold	V_{boot_shtdwn}	7.3	8.2	9.0	V
Hysteresis on V_{boot}	V_{boot_shtdwn}	0.3	0.7	−	V
Leakage Current on High Voltage Pins to GND (V_{BOOT} = V_{BRIDGE} = DRV_HI = 600 V)	I_{HV_LEAK}	−	0.5	40	μA
Consumption in Active Mode (V_{CC} = V_{boot}, f_{sw} = 100 kHz and 1 nF Load on Both Driver Outputs)	I_{CC1}	−	4.5	6.5	mA
Consumption in Inhibition Mode (V_{CC} = V_{boot})	I_{CC2}	−	250	400	μA
V_{CC} Current Consumption in Inhibition Mode	I_{CC3}	−	215	−	μA
V_{boot} Current Consumption in Inhibition Mode	I_{CC4}	−	35	−	μA

*Note: see also characterization curves
1. Guaranteed by design.
2. Turn−off propagation delay @ V_{bridge} = 600 V is guaranteed by design
3. See characterization curve for Δ_t parameters variation on the full range temperature.
4. Timing diagram definition see Figures 4, 5 and 6.

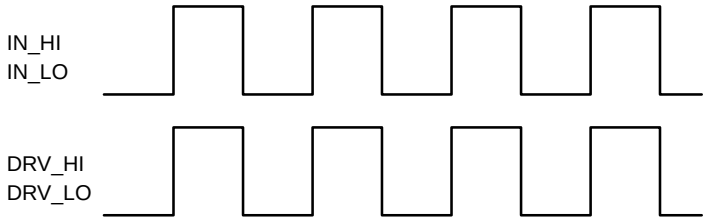


Figure 3. Input/Output Timing Diagram

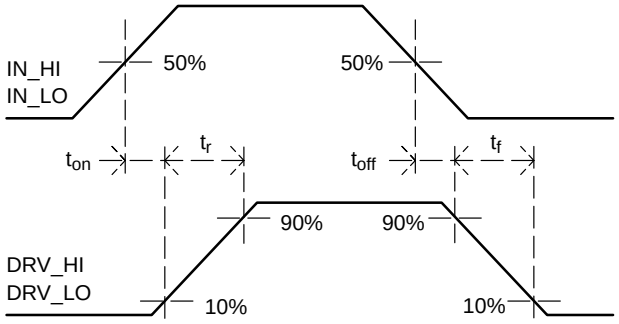


Figure 4. Switching Time Waveform Definitions

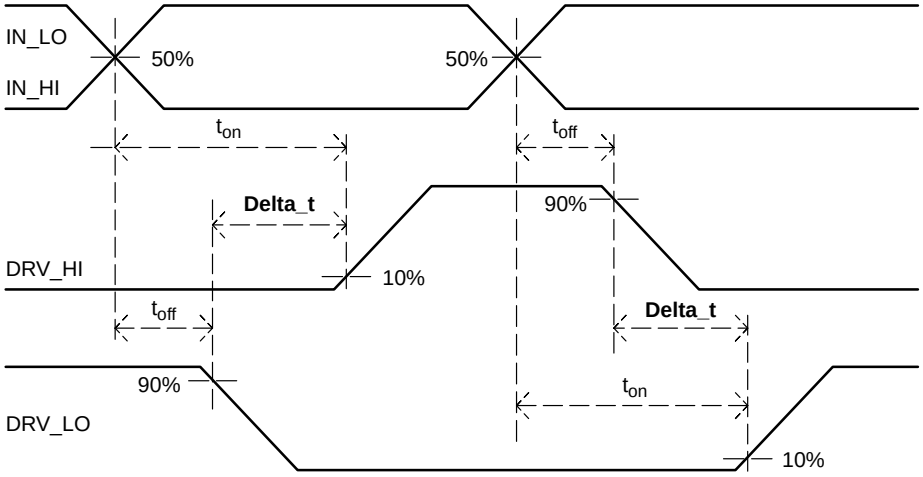


Figure 5. Delay Matching Waveforms Definition

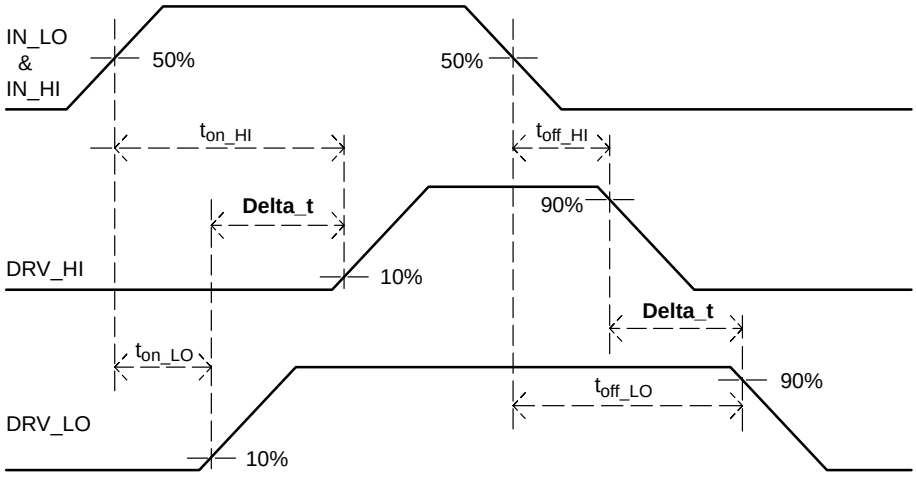


Figure 6. Other Delay Matching Waveforms Definition

TYPICAL CHARACTERISTICS

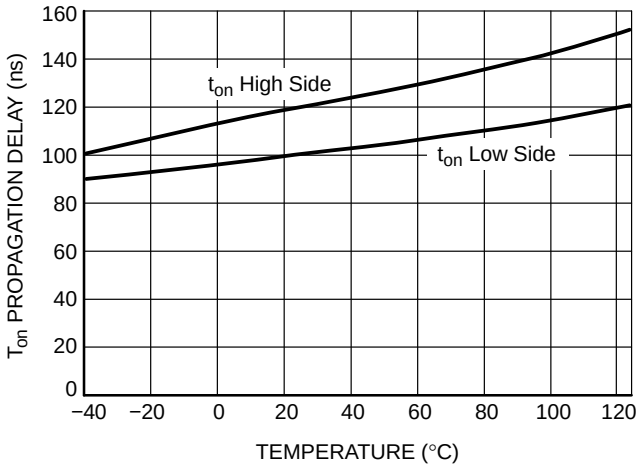


Figure 7. Turn−on Propagation Delay vs. Temperature

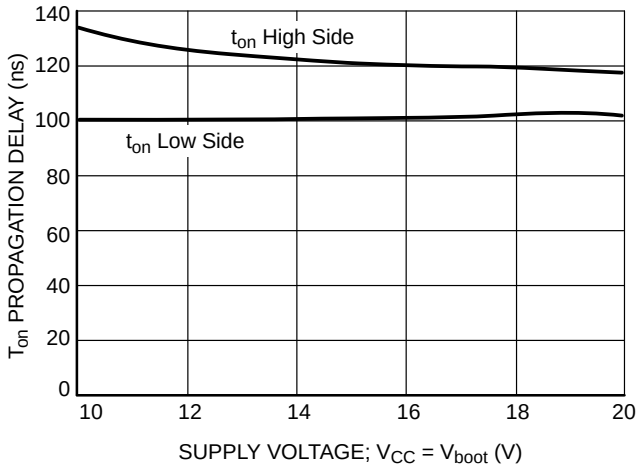


Figure 8. Turn−on Propagation Delay vs. V_{CC} Voltage (V_{CC} = V_{boot})

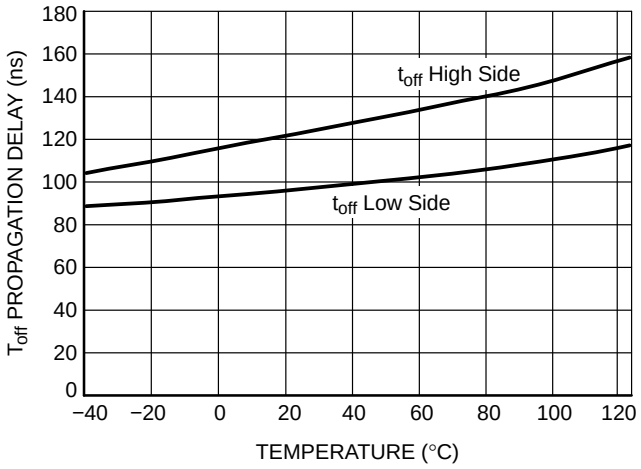


Figure 9. Turn−off Propagation Delay vs. Temperature

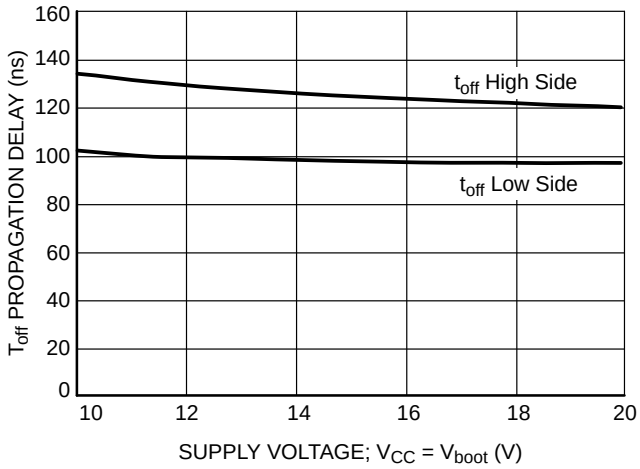


Figure 10. Turn−off Propagation Delay vs. V_{CC} Voltage (V_{CC} = V_{boot})

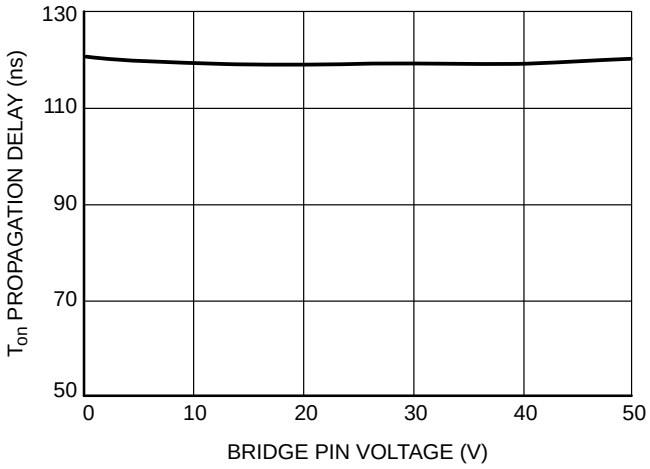


Figure 11. High Side Turn−on Propagation Delay vs. V_{BRIDGE} Voltage

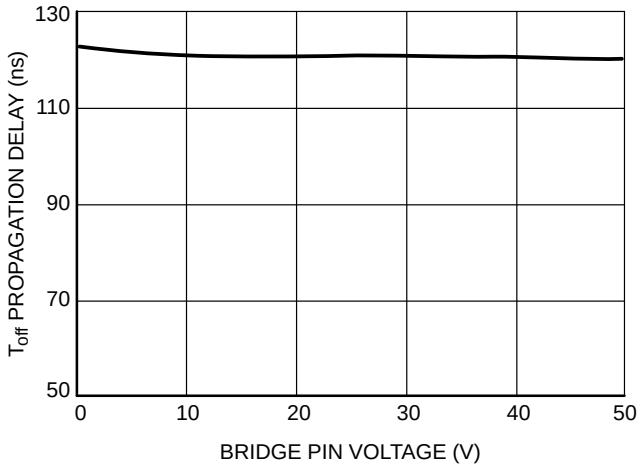


Figure 12. High Side Turn−off Propagation Delay vs. V_{BRIDGE} Voltage

TYPICAL CHARACTERISTICS

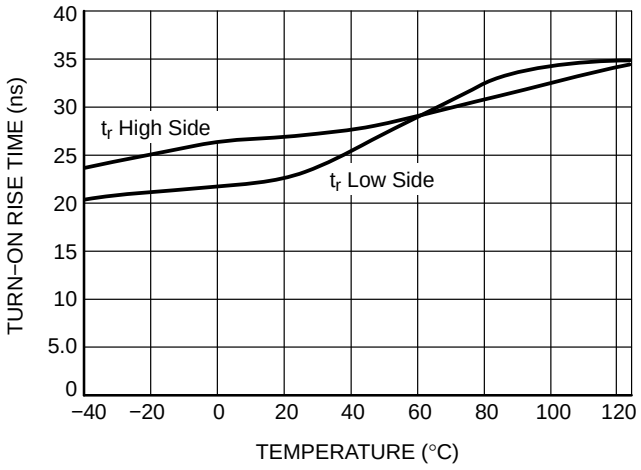


Figure 13. Turn−on Rise Time vs. Temperature

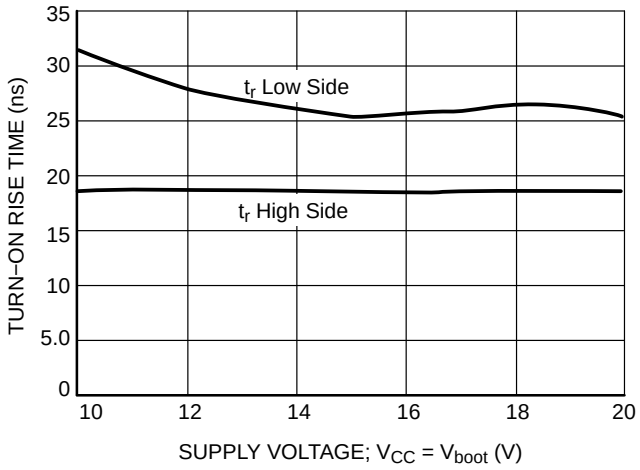


Figure 14. Turn−on Rise Time vs. V_{CC} Voltage (V_{CC} = V_{boot})

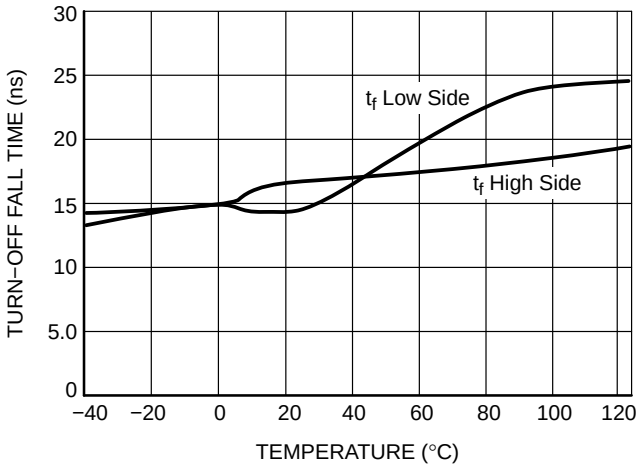


Figure 15. Turn−off Fall Time vs. Temperature

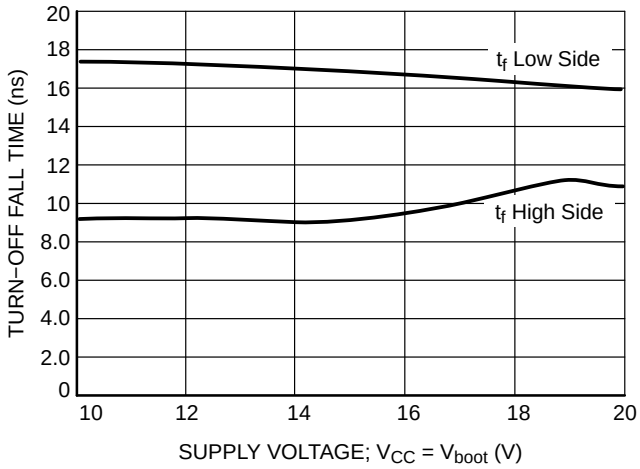


Figure 16. Turn−off Fall Time vs. V_{CC} Voltage (V_{CC} = V_{boot})

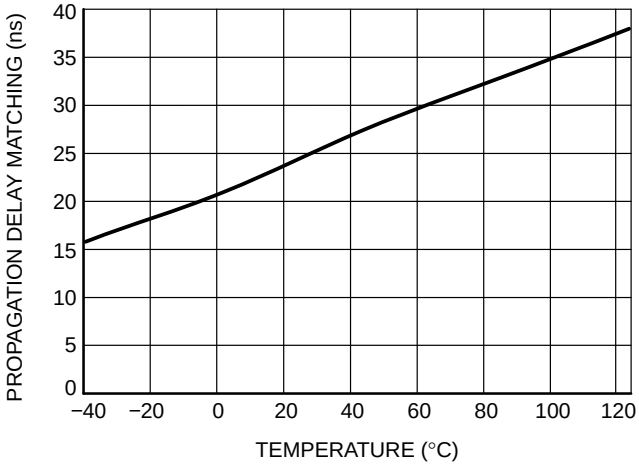


Figure 17. Propagation Delay Matching Between High Side and Low Side Driver

TYPICAL CHARACTERISTICS

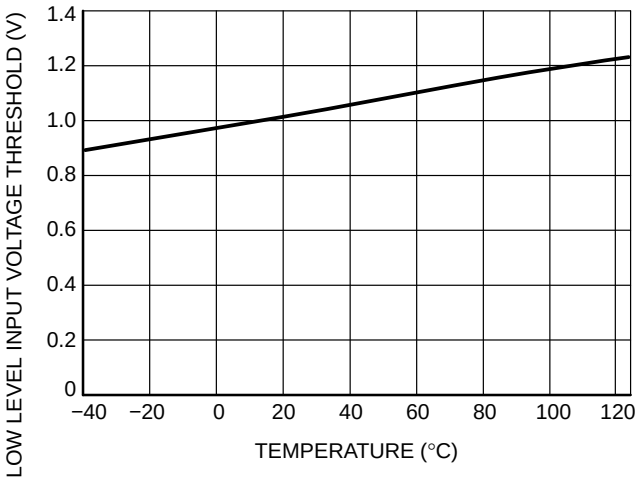


Figure 18. Low Level Input Voltage Threshold vs. Temperature

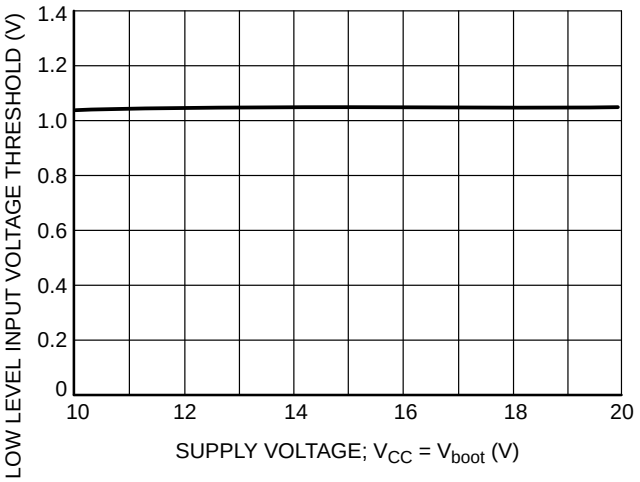


Figure 19. Low Level Input Voltage Threshold vs. V_{CC} Voltage

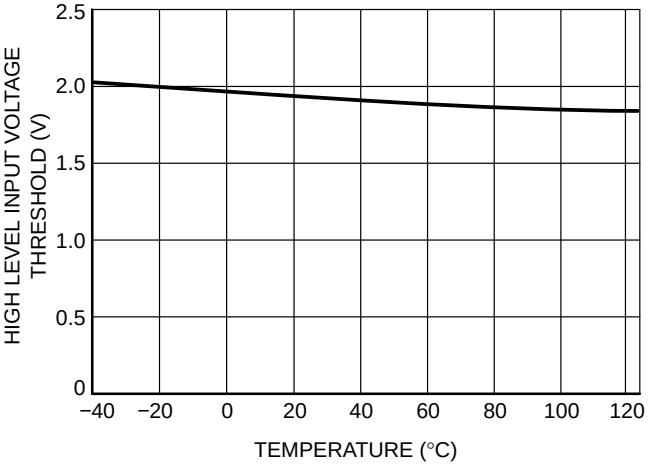


Figure 20. High Level Input Voltage Threshold vs. Temperature

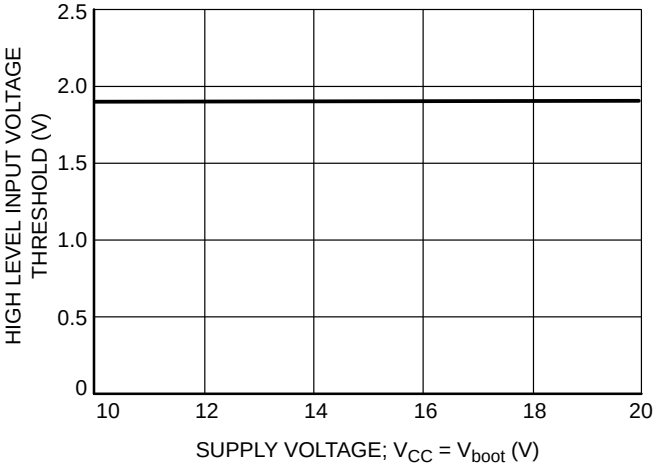


Figure 21. High Level Input Voltage Threshold vs. V_{CC} Voltage

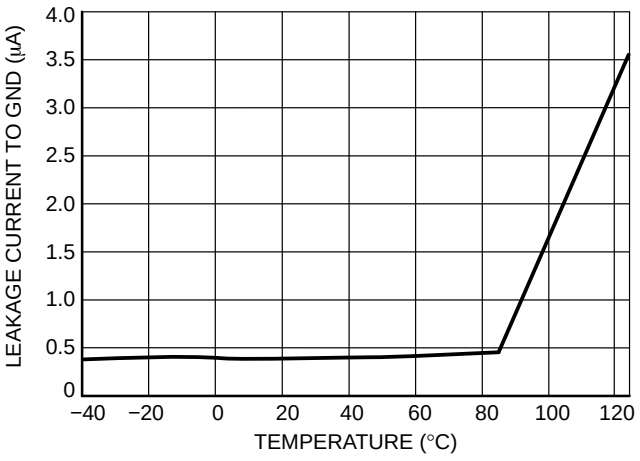


Figure 22. Leakage Current on High Voltage Pins (600 V) to Ground vs. Temperature

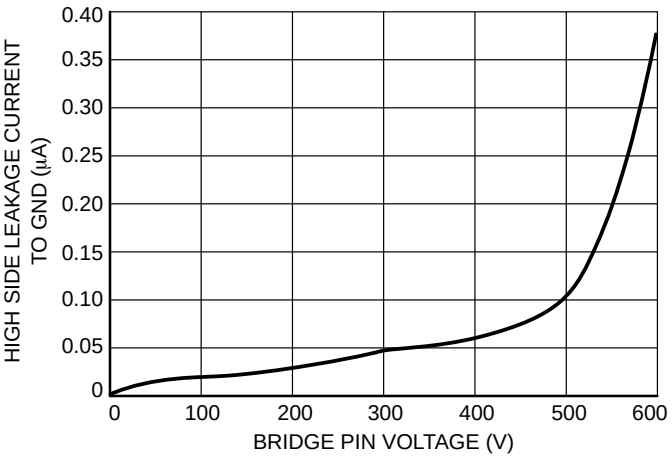


Figure 23. Leakage Current on High Voltage Pins to Ground vs. V_{bridge} Voltage (V_{bridge} = V_{boot} = V_{DRV_HI})

TYPICAL CHARACTERISTICS

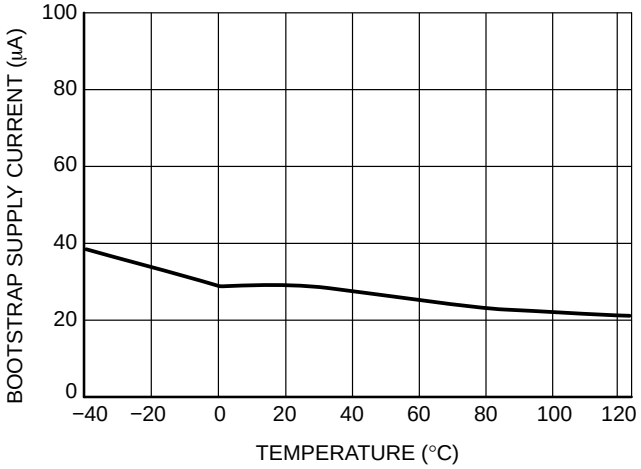


Figure 24. High Side Supply Current vs. Temperature

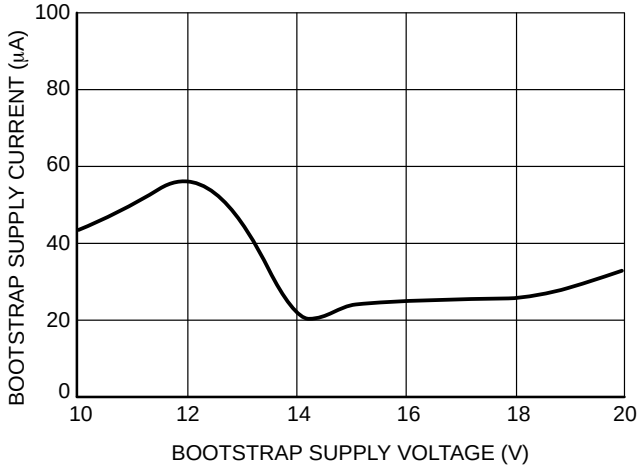


Figure 25. High Side Supply Current vs. Bootstrap Supply Voltage

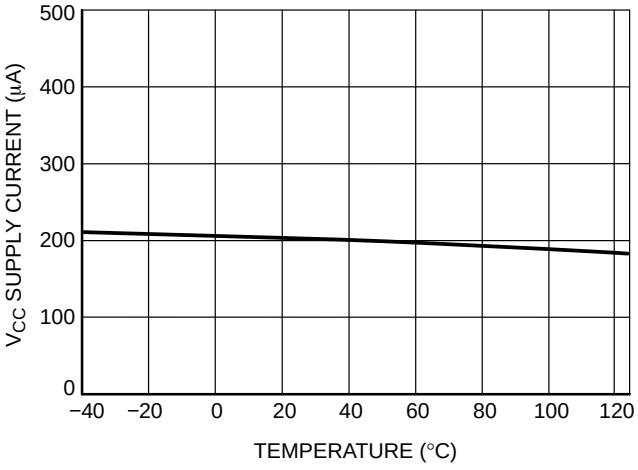


Figure 26. V_{CC} Supply Current vs. Temperature

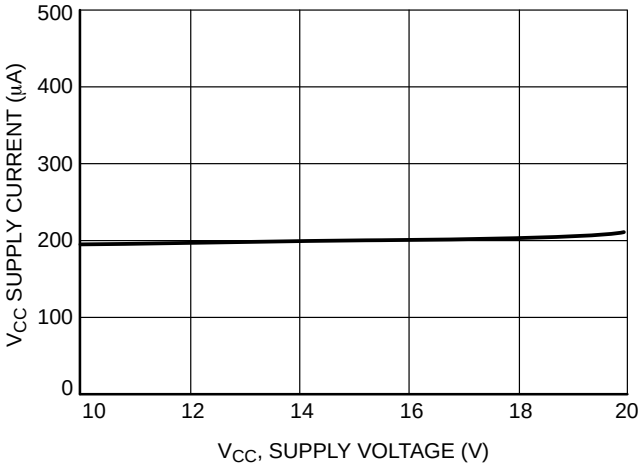


Figure 27. V_{CC} Supply Current vs. V_{CC} Supply Voltage

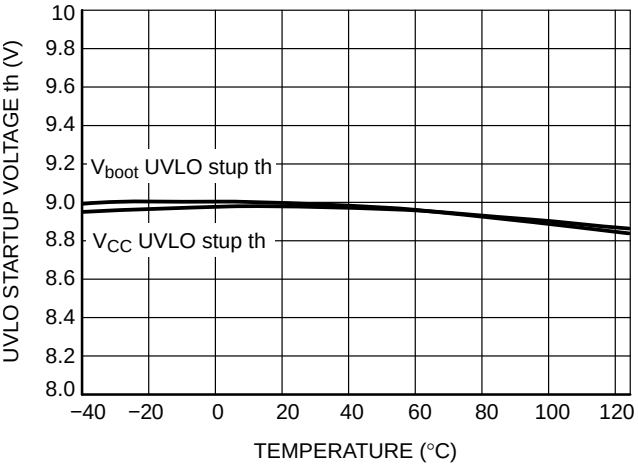


Figure 28. UVLO Start Up Voltage vs. Temperature

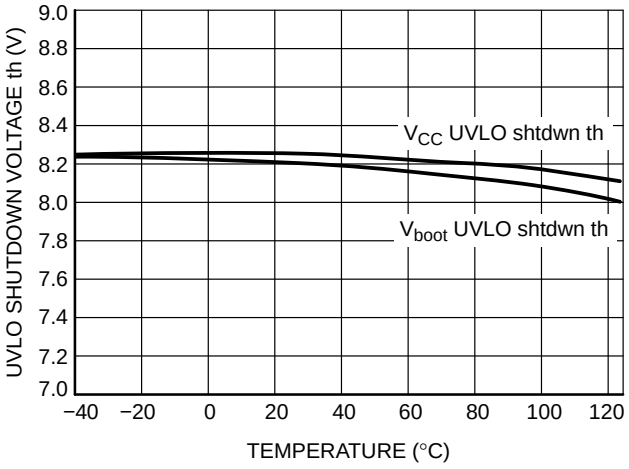


Figure 29. UVLO Shut Down Voltage vs. Bootstrap Supply Voltage

TYPICAL CHARACTERISTICS

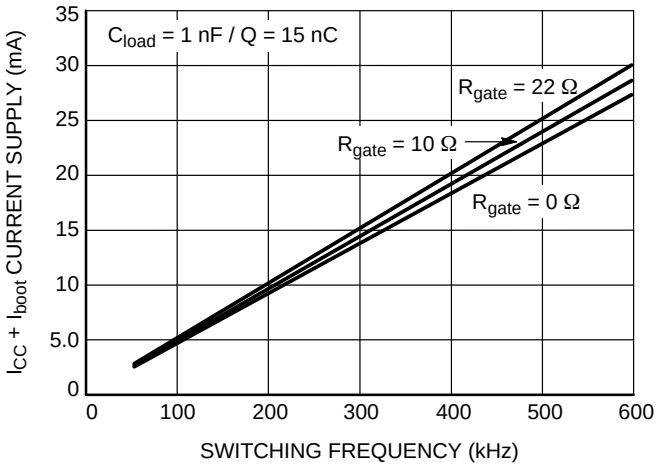


Figure 30. ICC1 Consumption vs. Switching Frequency with 15 nC Load on Each Driver

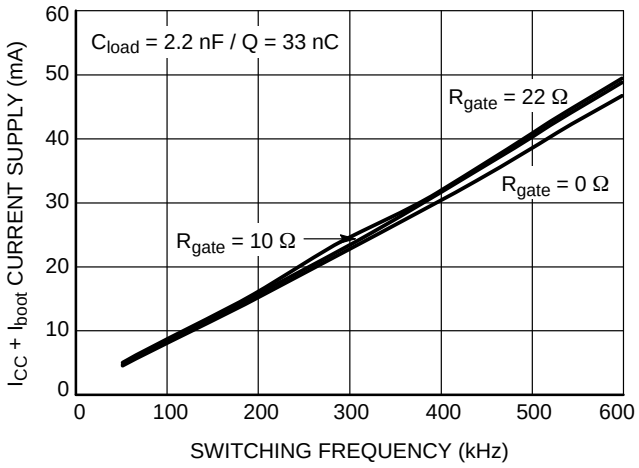


Figure 31. ICC1 Consumption vs. Switching Frequency with 33 nC Load on Each Driver

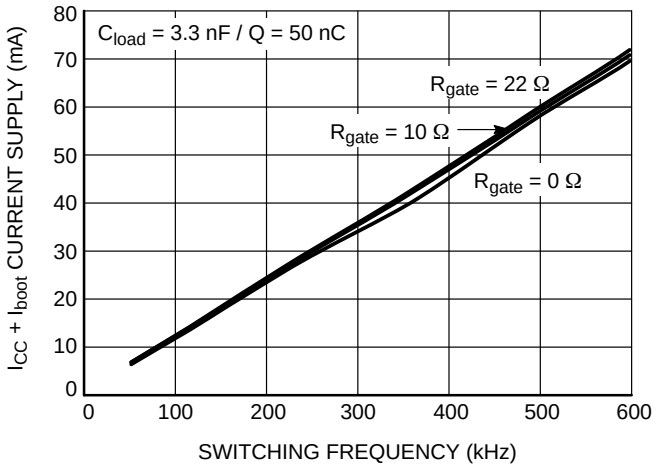


Figure 32. ICC1 Consumption vs. Switching Frequency with 50 nC Load on Each Driver

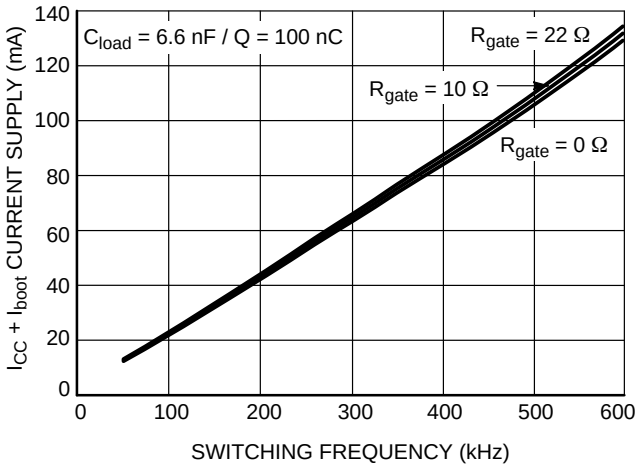


Figure 33. ICC1 Consumption vs. Switching Frequency with 100 nC Load on Each Driver

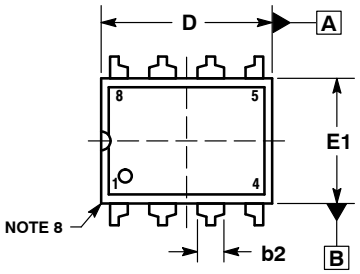
MECHANICAL CASE OUTLINE
PACKAGE DIMENSIONS

ON Semiconductor®

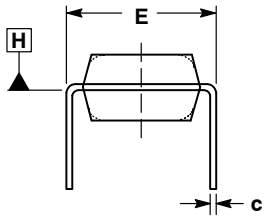
SCALE 1:1

PDIP–8
CASE 626–05
ISSUE P

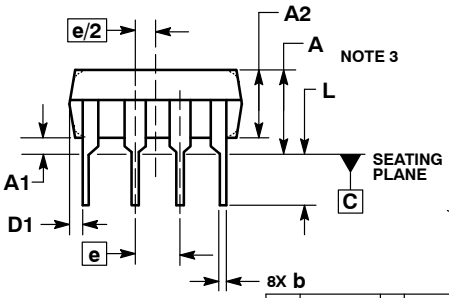
DATE 22 APR 2015



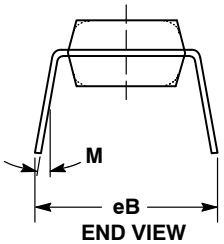
TOP VIEW



END VIEW
WITH LEADS CONSTRAINED
NOTE 5



SIDE VIEW



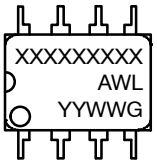
END VIEW
NOTE 6

NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: INCHES.
3. DIMENSIONS A, A1 AND L ARE MEASURED WITH THE PACKAGE SEATED IN JEDEC SEATING PLANE GAUGE GS–3.
4. DIMENSIONS D, D1 AND E1 DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS. MOLD FLASH OR PROTRUSIONS ARE NOT TO EXCEED 0.10 INCH.
5. DIMENSION E IS MEASURED AT A POINT 0.015 BELOW DATUM PLANE H WITH THE LEADS CONSTRAINED PERPENDICULAR TO DATUM C.
6. DIMENSION eB IS MEASURED AT THE LEAD TIPS WITH THE LEADS UNCONSTRAINED.
7. DATUM PLANE H IS COINCIDENT WITH THE BOTTOM OF THE LEADS, WHERE THE LEADS EXIT THE BODY.
8. PACKAGE CONTOUR IS OPTIONAL (ROUNDED OR SQUARE CORNERS).

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	----	0.210	---	5.33
A1	0.015	----	0.38	---
A2	0.115	0.195	2.92	4.95
b	0.014	0.022	0.35	0.56
b2	0.060 TYP		1.52 TYP	
C	0.008	0.014	0.20	0.36
D	0.355	0.400	9.02	10.16
D1	0.005	----	0.13	---
E	0.300	0.325	7.62	8.26
E1	0.240	0.280	6.10	7.11
e	0.100 BSC		2.54 BSC	
eB	----	0.430	---	10.92
L	0.115	0.150	2.92	3.81
M	----	10°	---	10°

STYLE 1:
PIN 1. AC IN
2. DC + IN
3. DC – IN
4. AC IN
5. GROUND
6. OUTPUT
7. AUXILIARY
8. V_{CC}

GENERIC MARKING DIAGRAM*



XXXX = Specific Device Code
A = Assembly Location
WL = Wafer Lot
YY = Year
WW = Work Week
G = Pb–Free Package

*This information is generic. Please refer to device data sheet for actual part marking. Pb–Free indicator, “G” or microdot “ ▪”, may or may not be present.

DOCUMENT NUMBER:	98ASB42420B	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped “CONTROLLED COPY” in red.
DESCRIPTION:	PDIP–8	PAGE 1 OF 1

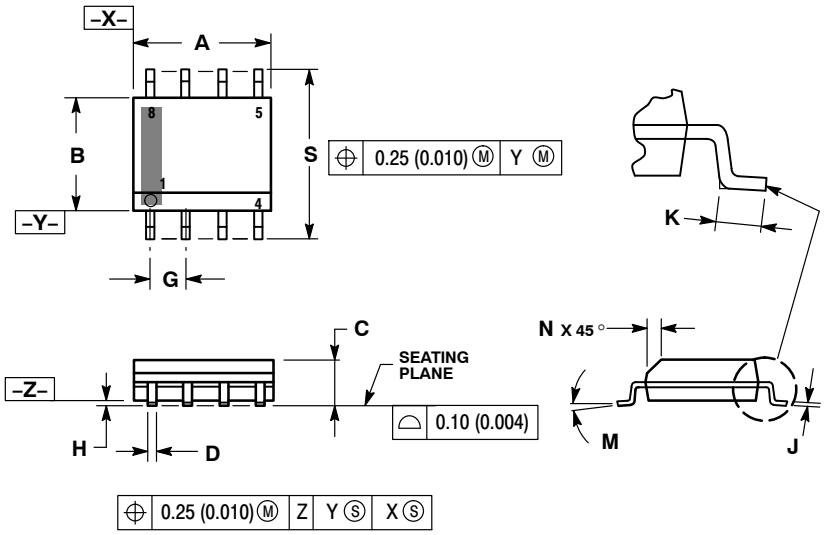
MECHANICAL CASE OUTLINE
PACKAGE DIMENSIONS

ON Semiconductor®

SCALE 1:1

SOIC−8 NB
CASE 751−07
ISSUE AK

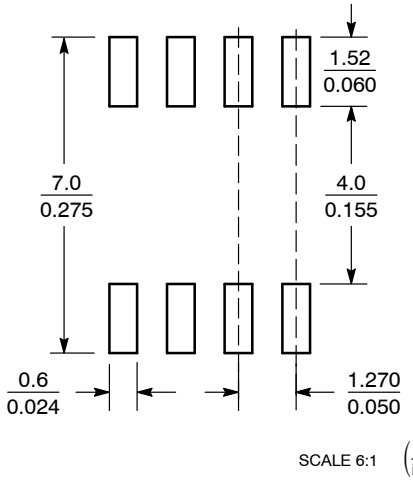
DATE 16 FEB 2011



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. 751−01 THRU 751−06 ARE OBSOLETE. NEW STANDARD IS 751−07.

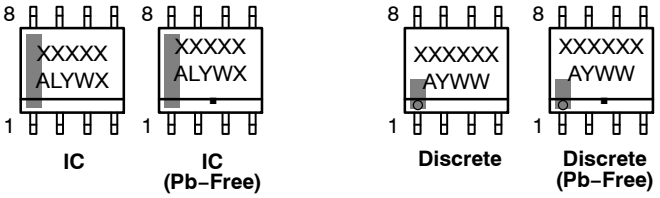
	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	4.80	5.00	0.189	0.197
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.053	0.069
D	0.33	0.51	0.013	0.020
G	1.27 BSC		0.050 BSC	
H	0.10	0.25	0.004	0.010
J	0.19	0.25	0.007	0.010
K	0.40	1.27	0.016	0.050
M	0°	8°	0°	8°
N	0.25	0.50	0.010	0.020
S	5.80	6.20	0.228	0.244

SOLDERING FOOTPRINT*



*For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

GENERIC MARKING DIAGRAM*



XXXXX = Specific Device Code
A = Assembly Location
L = Wafer Lot
Y = Year
W = Work Week
▪ = Pb−Free Package

XXXXXX = Specific Device Code
A = Assembly Location
Y = Year
WW = Work Week
▪ = Pb−Free Package

*This information is generic. Please refer to device data sheet for actual part marking. Pb−Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.

STYLES ON PAGE 2

DOCUMENT NUMBER:	**98ASB42564B**	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.	
DESCRIPTION:	**SOIC−8 NB**		**PAGE 1 OF 2**

SOIC−8 NB
CASE 751−07
ISSUE AK

DATE 16 FEB 2011

STYLE 1:
PIN 1. EMITTER
2. COLLECTOR
3. COLLECTOR
4. EMITTER
5. EMITTER
6. BASE
7. BASE
8. EMITTER

STYLE 2:
PIN 1. COLLECTOR, DIE, #1
2. COLLECTOR, #1
3. COLLECTOR, #2
4. COLLECTOR, #2
5. BASE, #2
6. EMITTER, #2
7. BASE, #1
8. EMITTER, #1

STYLE 3:
PIN 1. DRAIN, DIE #1
2. DRAIN, #1
3. DRAIN, #2
4. DRAIN, #2
5. GATE, #2
6. SOURCE, #2
7. GATE, #1
8. SOURCE, #1

STYLE 4:
PIN 1. ANODE
2. ANODE
3. ANODE
4. ANODE
5. ANODE
6. ANODE
7. ANODE
8. COMMON CATHODE

STYLE 5:
PIN 1. DRAIN
2. DRAIN
3. DRAIN
4. DRAIN
5. GATE
6. GATE
7. SOURCE
8. SOURCE

STYLE 6:
PIN 1. SOURCE
2. DRAIN
3. DRAIN
4. SOURCE
5. SOURCE
6. GATE
7. GATE
8. SOURCE

STYLE 7:
PIN 1. INPUT
2. EXTERNAL BYPASS
3. THIRD STAGE SOURCE
4. GROUND
5. DRAIN
6. GATE 3
7. SECOND STAGE Vd
8. FIRST STAGE Vd

STYLE 8:
PIN 1. COLLECTOR, DIE #1
2. BASE, #1
3. BASE, #2
4. COLLECTOR, #2
5. COLLECTOR, #2
6. EMITTER, #2
7. EMITTER, #1
8. COLLECTOR, #1

STYLE 9:
PIN 1. EMITTER, COMMON
2. COLLECTOR, DIE #1
3. COLLECTOR, DIE #2
4. EMITTER, COMMON
5. EMITTER, COMMON
6. BASE, DIE #2
7. BASE, DIE #1
8. EMITTER, COMMON

STYLE 10:
PIN 1. GROUND
2. BIAS 1
3. OUTPUT
4. GROUND
5. GROUND
6. BIAS 2
7. INPUT
8. GROUND

STYLE 11:
PIN 1. SOURCE 1
2. GATE 1
3. SOURCE 2
4. GATE 2
5. DRAIN 2
6. DRAIN 2
7. DRAIN 1
8. DRAIN 1

STYLE 12:
PIN 1. SOURCE
2. SOURCE
3. SOURCE
4. GATE
5. DRAIN
6. DRAIN
7. DRAIN
8. DRAIN

STYLE 13:
PIN 1. N.C.
2. SOURCE
3. SOURCE
4. GATE
5. DRAIN
6. DRAIN
7. DRAIN
8. DRAIN

STYLE 14:
PIN 1. N−SOURCE
2. N−GATE
3. P−SOURCE
4. P−GATE
5. P−DRAIN
6. P−DRAIN
7. N−DRAIN
8. N−DRAIN

STYLE 15:
PIN 1. ANODE 1
2. ANODE 1
3. ANODE 1
4. ANODE 1
5. CATHODE, COMMON
6. CATHODE, COMMON
7. CATHODE, COMMON
8. CATHODE, COMMON

STYLE 16:
PIN 1. EMITTER, DIE #1
2. BASE, DIE #1
3. EMITTER, DIE #2
4. BASE, DIE #2
5. COLLECTOR, DIE #2
6. COLLECTOR, DIE #2
7. COLLECTOR, DIE #1
8. COLLECTOR, DIE #1

STYLE 17:
PIN 1. VCC
2. V2OUT
3. V1OUT
4. TXE
5. RXE
6. VEE
7. GND
8. ACC

STYLE 18:
PIN 1. ANODE
2. ANODE
3. SOURCE
4. GATE
5. DRAIN
6. DRAIN
7. CATHODE
8. CATHODE

STYLE 19:
PIN 1. SOURCE 1
2. GATE 1
3. SOURCE 2
4. GATE 2
5. DRAIN 2
6. MIRROR 2
7. DRAIN 1
8. MIRROR 1

STYLE 20:
PIN 1. SOURCE (N)
2. GATE (N)
3. SOURCE (P)
4. GATE (P)
5. DRAIN
6. DRAIN
7. DRAIN
8. DRAIN

STYLE 21:
PIN 1. CATHODE 1
2. CATHODE 2
3. CATHODE 3
4. CATHODE 4
5. CATHODE 5
6. COMMON ANODE
7. COMMON ANODE
8. CATHODE 6

STYLE 22:
PIN 1. I/O LINE 1
2. COMMON CATHODE/VCC
3. COMMON CATHODE/VCC
4. I/O LINE 3
5. COMMON ANODE/GND
6. I/O LINE 4
7. I/O LINE 5
8. COMMON ANODE/GND

STYLE 23:
PIN 1. LINE 1 IN
2. COMMON ANODE/GND
3. COMMON ANODE/GND
4. LINE 2 IN
5. LINE 2 OUT
6. COMMON ANODE/GND
7. COMMON ANODE/GND
8. LINE 1 OUT

STYLE 24:
PIN 1. BASE
2. EMITTER
3. COLLECTOR/ANODE
4. COLLECTOR/ANODE
5. CATHODE
6. CATHODE
7. COLLECTOR/ANODE
8. COLLECTOR/ANODE

STYLE 25:
PIN 1. VIN
2. N/C
3. REXT
4. GND
5. IOUT
6. IOUT
7. IOUT
8. IOUT

STYLE 26:
PIN 1. GND
2. dv/dt
3. ENABLE
4. ILIMIT
5. SOURCE
6. SOURCE
7. SOURCE
8. VCC

STYLE 27:
PIN 1. ILIMIT
2. OVLO
3. UVLO
4. INPUT+
5. SOURCE
6. SOURCE
7. SOURCE
8. DRAIN

STYLE 28:
PIN 1. SW_TO_GND
2. DASIC_OFF
3. DASIC_SW_DET
4. GND
5. V_MON
6. VBULK
7. VBULK
8. VIN

STYLE 29:
PIN 1. BASE, DIE #1
2. EMITTER, #1
3. BASE, #2
4. EMITTER, #2
5. COLLECTOR, #2
6. COLLECTOR, #2
7. COLLECTOR, #1
8. COLLECTOR, #1

STYLE 30:
PIN 1. DRAIN 1
2. DRAIN 1
3. GATE 2
4. SOURCE 2
5. SOURCE 1/DRAIN 2
6. SOURCE 1/DRAIN 2
7. SOURCE 1/DRAIN 2
8. GATE 1

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