

# Half Bridge Gate Driver (Isolated High & Non-Isolated Low)

## NCD57200

The NCD57200 is a high voltage gate driver with one non-isolated low side gate driver and one galvanically isolated high or low side gate driver. It can directly drive two IGBTs in a half bridge configuration. Isolated high side driver can be powered with an isolated power supply or with Bootstrap technique from the low side power supply.

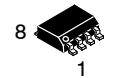
The galvanic isolation for the high side gate driver guarantees reliable switching in high power applications for IGBTs that operate up to 800 V, at high dv/dt. The optimized output stages provide a mean of reducing IGBT losses. Its features include two independent inputs with deadtime and interlock, accurate asymmetric UVLOs, and short and matched propagation delays. The NCD57200 operates with its V<sub>DD</sub>/V<sub>BS</sub> up to 20 V.

### Features

- High Peak Output Current (+1.9 A/-2.3 A)
- Low Output Voltage Drop for Enhanced IGBT Conduction
- Floating Channel for Bootstrap Operation up to +800 V
- CMTI up to 100 kV/μs
- Reliable Operation for V<sub>S</sub> Negative Swing to -800 V
- V<sub>DD</sub> & V<sub>BS</sub> Supply Range up to 20 V
- 3.3 V, 5 V, and 15 V Logic Input
- Asymmetric Under Voltage Lockout Thresholds for High Side and Low Side
- Matched Propagation Delay 90 ns
- Built-in 20 ns Minimum Pulse Width Filter (or Input Noise Filter)
- Built-in 340 ns Dead-Time and High and Low Inputs Interlock
- Non-Inverting Output Signal
- This Device is Pb-Free, Halogen Free/BFR Free and is RoHS Compliant

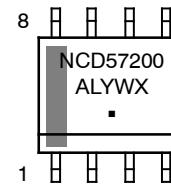
### Typical Applications

- Fans, Pumps
- Home Appliances
- Consumer Electronics
- General Purpose Half Bridge Applications



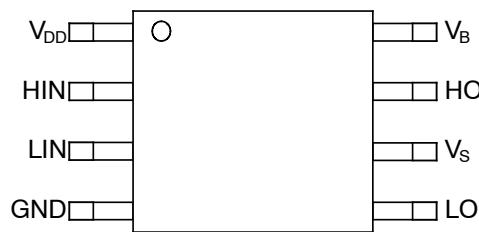
SOIC-8 NB  
CASE 751-07

### MARKING DIAGRAM



NCD57200	= Specific Device Code
A	= Assembly Location
L	= Wafer Lot
Y	= Year
W	= Work Week
■	= Pb-Free Package

### PIN CONNECTIONS



### ORDERING INFORMATION

See detailed ordering and shipping information on page 15 of this data sheet.

# NCD57200

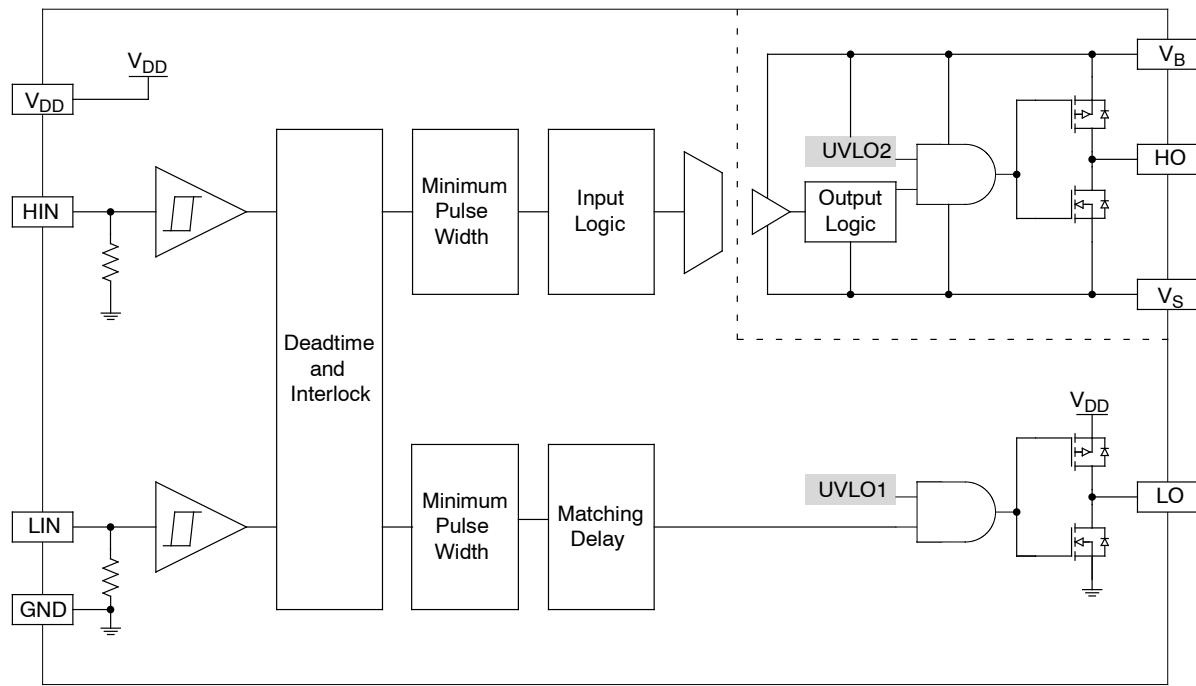


Figure 1. Simplified Block Diagram

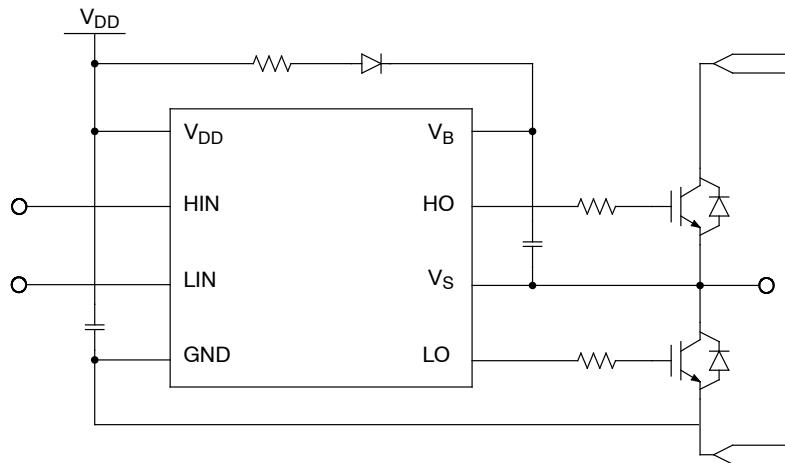


Figure 2. Simplified Application Schematics

Table 1. FUNCTION DESCRIPTION

Pin Name	No.	I/O	Description
V <sub>DD</sub>	1	Power	Low side and main power supply. A good quality bypassing capacitor is required from this pin to GND and should be placed close to the pins for best results. The under voltage lockout (UVLO) circuit enables the device to operate at power on when a typical supply voltage higher than V <sub>UVLO1-OUT-ON</sub> is present. Please see Figure 5 for more details. A filter time t <sub>UVF1</sub> helps to suppress noise on V <sub>DD</sub> pin.
HIN	2	I	High side non-inverting gate driver input. It has an equivalent pull- down resistor of 125 kΩ to ensure that output is low in the absence of an input signal. A minimum positive or negative going pulse width is required at HIN before HO reacts. It adopts 3.3 V logic signal thresholds for input voltage up to V <sub>DD</sub> . There is deadtime and interlocking logic between HIN and LIN.
LIN	3	I	Low side non-inverting gate driver input. It has an equivalent pull- down resistor of 125 kΩ to ensure that output is low in the absence of an input signal. A minimum positive or negative going pulse width is required at LIN before LO reacts. It adopts 3.3 V logic signal thresholds for input voltage up to V <sub>DD</sub> . There is deadtime and interlocking logic between HIN and LIN.
GND	4	Power	Logic ground and low side driver return.
LO	5	O	Low side driver output that provides the appropriate drive voltage and source/ sink current to the IGBT gate. LO is actively pulled low during startup and under UVLO1 condition. There is deadtime and interlocking logic to prevent unintended HO and LO cross conduction.
V <sub>S</sub>	6	Power	Bootstrap return or high side floating supply offset.
HO	7	O	Galvanically isolated high side driver output that provides the appropriate drive voltage and source/sink current to the IGBT gate. HO is actively pulled low during startup and under UVLOx condition. There is deadtime and interlocking logic to prevent unintended HO and LO cross conduction.
V <sub>B</sub>	8	Power	Bootstrap or high side floating power supply. A good quality bypassing capacitor is required from this pin to V <sub>S</sub> and should be placed close to the pins for best results. The under voltage lockout (UVLO) circuit enables the device to operate at power on when a typical supply voltage higher than V <sub>UVLO2-OUT-ON</sub> is present. Please see Figure 5 for more details. A filter time t <sub>UVF2</sub> helps to suppress noise on V <sub>B</sub> pin.

Table 2. SAFETY AND INSULATION RATINGS

Symbol	Parameter	Min	Typ	Max	Unit
	Installation Classifications per DIN VDE 0110/1.89 Table 1 Rated Mains Voltage	< 150 V <sub>RMS</sub>	-	-	
		< 300 V <sub>RMS</sub>	-	-	
		< 450 V <sub>RMS</sub>	-	-	
		< 600 V <sub>RMS</sub>	-	-	
		< 1000 V <sub>RMS</sub>	-	-	
CTI	Comparative Tracking Index (DIN IEC 112/VDE 0303 Part 1)	600	-	-	
V <sub>IORM</sub>	Maximum Working Insulation Voltage	800	-	-	V <sub>PK</sub>
E <sub>CR</sub>	External Creepage	4.0	-	-	mm
E <sub>CL</sub>	External Clearance	4.0	-	-	mm
DTI	Insulation Thickness	8.65	-	-	μm
T <sub>Case</sub>	Safety Limit Values – Maximum Values in Failure; Case Temperature	150	-	-	°C
P <sub>S,INPUT</sub>	Safety Limit Values – Maximum Values in Failure; Input Power	75	-	-	mW
P <sub>S,OUTPUT</sub>	Safety Limit Values – Maximum Values in Failure; Output Power	1335	-	-	mW
R <sub>IO</sub>	Insulation Resistance at TS, V <sub>IO</sub> = 500 V	10 <sup>9</sup>	-	-	Ω

**Table 3. ABSOLUTE MAXIMUM RATINGS** (Note 1) Over operating free- air temperature range unless otherwise noted

Parameter	Symbol	Minimum	Maximum	Unit
High- Side Offset Voltage (see Figure 2)	$V_S$	- 900	900	V
High- Side Supply Voltage (see Figure 2)	$V_B$	- 900	900	V
Low- Side Supply Voltage	$V_{DD}$	- 0.3	25	V
High- Side Floating Supply Voltage	$V_{BS}$	- 0.3	25	V
High- Side Output Voltage (HO) (see Figure 2)	$V_{HO}$	$V_S - 0.3$	$V_{BS} + 0.3$	V
Low- Side Output Voltage (LO)	$V_{LO}$	- 0.3	$V_{DD} + 0.3$	V
Logic Input Voltage (HIN, LIN)	$V_{IN}$	- 0.3	$V_{DD} + 0.3$	V
Allowable Offset Voltage Slew Rate (see Figure 32)	$dV_S/dt$		$\pm 100$	V/ns
Maximum Junction Temperature	$T_J(max)$	- 40	150	°C
Storage Temperature Range	$T_{STG}$	- 65	150	°C
ESD Capability, Human Body Model (Note 2)	ESDHBM		$\pm 4$	kV
ESD Capability, Charged Device Model (Note 2)	ESDCDM		$\pm 2$	kV
Moisture Sensitivity Level	MSL		1	-
Lead Temperature Soldering Reflow	TSLD		260	°C
(SMD Styles Only), Pb-Free Versions (Note 3)				

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.

1. Refer to ELECTRICAL CHARACTERISTICS and APPLICATION INFORMATION for Safe Operating Area.
2. This device series incorporates ESD protection and is tested by the following methods:  
ESD Human Body Model tested per AEC- Q100- 002 (EIA/JESD22- A114).  
ESD Charged Device Model tested per AEC- Q100- 011 (EIA/JESD22- C101).  
Latchup Current Maximum Rating:  $\leq 100$  mA per JEDEC standard: JESD78, 125°C.
3. For information, please refer to our Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

**Table 4. THERMAL CHARACTERISTICS**

Parameter	Symbol	Value	Unit
Thermal Characteristics, SOIC- 8 (Note 4) Thermal Resistance, Junction- to- Air (Note 5)	$R_{\theta JA}$	167	°C/W

4. Refer to ELECTRICAL CHARACTERISTICS and APPLICATION INFORMATION for Safe Operating Area.
5. Values based on copper area of 100 mm<sup>2</sup> (or 0.16 in<sup>2</sup>) of 1 oz copper thickness and FR4 PCB substrate.

**Table 5. RECOMMENDED OPERATING RANGES** (Note 6)

Parameter	Symbol	Min	Max	Unit
High- Side Floating Supply Voltage	$V_{BS}$	$V_S + UVLO2$	$V_S + 20$	V
High- Side Offset Voltage (see Figure 2)	$V_S$	- 800	800	V
High- Side Output Voltage (HO) (see Figure 2)	$V_{HO}$	$V_S$	$V_{BS}$	V
Low- Side Output Voltage (LO)	$V_{LO}$	GND	$V_{DD}$	V
Logic Input Voltage (HIN, LIN)	$V_{IN}$	GND	$V_{DD}$	V
Low- Side Supply Voltage	$V_{DD}$	UVLO1	20	V
Ambient Temperature	$T_A$	- 40	+125	°C

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

6. Refer to ELECTRICAL CHARACTERISTICS and APPLICATION INFORMATION for Safe Operating Area.

**Table 6. ELECTRICAL CHARACTERISTICS**  $V_{DD} = V_{BS} = 15$  V.For typical values  $T_A = 25^\circ\text{C}$ , for min/max values,  $T_A$  is the operating ambient temperature range that applies, unless otherwise noted.

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
<b>VOLTAGE SUPPLY</b>						
$V_{BS}$ Supply Under Voltage Output Enabled		$V_{UVLO2\text{-OUT-ON}}$	11	11.5	12	V
$V_{BS}$ Supply Under Voltage Output Disabled		$V_{UVLO2\text{-OUT-OFF}}$	10	10.5	11	V
$V_{BS}$ Supply Voltage Output Enabled/Disabled Hysteresis		$V_{UVLO2\text{-HYST}}$	0.5	1.0	1.2	V
$V_{DD}$ Supply Under Voltage Output Enabled		$V_{UVLO1\text{-OUT-ON}}$	12	12.5	13	V
$V_{DD}$ Supply Under Voltage Output Disabled		$V_{UVLO1\text{-OUT-OFF}}$	11	11.5	12	V
$V_{DD}$ Supply Voltage Output Enabled/Disabled Hysteresis		$V_{UVLO1\text{-HYST}}$	0.5	1.0	1.2	V
Leakage Current Between $V_S$ and GND	$V_S = \pm 800$ V, $T_A = 25^\circ\text{C}$ $V_S = \pm 800$ V, $T_A = -40^\circ\text{C}$ to $125^\circ\text{C}$	$I_{HV\text{-LEAK1}}$ $I_{HV\text{-LEAK2}}$		20	200 600	nA
Quiescent Current $V_{BS}$ Supply ( $V_B$ Only)	HO = Low	$I_{QBS1}$		260	325	$\mu\text{A}$
Quiescent Current $V_{BS}$ Supply ( $V_B$ Only)	HO = High	$I_{QBS2}$		330	440	$\mu\text{A}$
Quiescent Current $V_{DD}$ Supply ( $V_{DD}$ Only)	$V_{LIN} = \text{Float}$ , $V_{HIN} = 0$ V,	$I_{QDD1}$		380	440	$\mu\text{A}$
Quiescent Current $V_{DD}$ Supply ( $V_{DD}$ Only)	$V_{LIN} = 3.3$ V, $V_{HIN} = 0$ V,	$I_{QDD2}$		440	500	$\mu\text{A}$
Quiescent Current $V_{DD}$ Supply ( $V_{DD}$ Only)	$V_{LIN} = 0$ V, $V_{HIN} = 3.3$ V,	$I_{QDD3}$		2.4	3	mA
<b>LOGIC INPUT</b>						
Low Level Input Voltage		$V_{IL}$			0.9	V
High Level Input Voltage		$V_{IH}$	2.4			V
Logic "1" Input Bias Current	$V_{LIN} = 3.3$ V, $V_{HIN} = 3.3$ V	$I_{LIN1+}$ , $I_{HIN1+}$		25	50	$\mu\text{A}$
Logic "1" Input Bias Current	$V_{LIN} = 20$ V, $V_{HIN} = 20$ V, $V_{DD} = V_{BS} = 20$ V	$I_{LIN2+}$ , $I_{HIN2+}$		100	150	$\mu\text{A}$
Logic "0" Input Bias Current	$V_{LIN} = 0$ V, $V_{HIN} = 0$ V	$I_{LIN-}$ , $I_{HIN-}$		40	100	nA
<b>DRIVER OUTPUT</b>						
Output Low State	$I_{SINK} = 200$ mA, $T_A = 25^\circ\text{C}$	$V_{OL1}$		0.2	0.3	V
	$I_{SINK} = 200$ mA, $T_A = -40^\circ\text{C}$ to $125^\circ\text{C}$	$V_{OL2}$			0.5	
Output High State	$I_{SOURCE} = 200$ mA, $T_A = 25^\circ\text{C}$	$V_{OH1}$	14.4	14.5		V
	$I_{SOURCE} = 200$ mA, $T_A = -40^\circ\text{C}$ to $125^\circ\text{C}$	$V_{OH2}$	14			
Peak Driver Current, Sink (Note 7)	$V_{HO} = V_{LO} = 15$ V	$I_{PK\text{-SNK1}}$		2.3		A
	$V_{HO} = V_{LO} = 9$ V (near Miller Plateau)	$I_{PK\text{-SNK2}}$		2.1		
Peak Driver Current, Source (Note 7)	$V_{HO} = V_{LO} = 0$ V	$I_{PK\text{-SRC1}}$		1.9		A
	$V_{HO} = V_{LO} = 9$ V (near Miller Plateau)	$I_{PK\text{-SRC2}}$		1.5		

**Table 6. ELECTRICAL CHARACTERISTICS**  $V_{DD} = V_{BS} = 15$  V.For typical values  $T_A = 25^\circ\text{C}$ , for min/max values,  $T_A$  is the operating ambient temperature range that applies, unless otherwise noted.

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
<b>IGBT SHORT CIRCUIT CLAMPING</b>						
Clamping Voltage ( $V_{HO} - V_B$ ) / ( $V_{LO} - V_{DD}$ )	$I_{HO} = 100$ mA, $I_{LO} = 100$ mA (pulse test, $t_{CLPmax} = 10$ $\mu\text{s}$ )	$V_{CLAMP-OUT}$		0.8	1.3	V
<b>DYNAMIC CHARACTERISTIC</b>						
HO High Propagation Delay	$C_{LOAD} = 1$ nF, $V_{IH}$ to 10% of Output Change for PW > 150 ns	$t_{PD-ON-H}$	50	90	110	ns
HO Low Propagation Delay	$C_{LOAD} = 1$ nF, $V_{IL}$ to 90% of Output Change for PW > 150 ns	$t_{PD-OFF-H}$	50	90	110	ns
Propagation Delay Distortion(HS) (= $t_{PD-ON-H} - t_{PD-OFF-H}$ )	PW > 150 ns	$t_{DISTORT-H}$	-25	0	25	ns
LO High Propagation Delay	$C_{LOAD} = 1$ nF, $V_{IH}$ to 10% of Output Change for PW > 150 ns	$t_{PD-ON-L}$	50	90	110	ns
LO Low Propagation Delay	$C_{LOAD} = 1$ nF, $V_{IL}$ to 90% of Output Change for PW > 150 ns	$t_{PD-OFF-L}$	50	90	110	ns
Propagation Delay Distortion(LS) (= $t_{PD-ON-L} - t_{PD-OFF-L}$ )	PW > 150 ns	$t_{DISTORT-L}$	-25	0	25	ns
High Propagation Delay Distortion between High and Low Sides	PW > 150 ns	$t_{DISTORT-HL-H}$	-25	0	25	ns
Low Propagation Delay Distortion between High and Low Sides	PW > 150 ns	$t_{DISTORT-HL-L}$	-25	0	25	ns
Rise Time (HO) (see Figure 3)	$C_{LOAD} = 1$ nF, 10% to 90% of Output Change	$t_{RISE-H}$		13		ns
Fall Time (HO) (see Figure 3)	$C_{LOAD} = 1$ nF, 90% to 10% of Output Change	$t_{FALL-H}$		8		ns
Rise Time (LO) (see Figure 3)	$C_{LOAD} = 1$ nF, 10% to 90% of Output Change	$t_{RISE-L}$		13		ns
Fall Time (LO) (see Figure 3)	$C_{LOAD} = 1$ nF, 90% to 10% of Output Change	$t_{FALL-L}$		8		ns
Deadtime, HO Delays (see Figure 6)	$V_{LIN/HIN} = 0$ V and 3.3 V	$t_{DT1}$		340		ns
Deadtime, LO Delays (see Figure 6)	$V_{LIN/HIN} = 0$ V and 3.3 V	$t_{DT2}$		350		ns
Deadtime Matching		$t_{MDT}$		10		ns
Minimum Pulse Width Filtering Time (see Figure 3)	$T_A = 25^\circ\text{C}$	$t_{MIN1}, t_{MIN2}$	10		40	ns
UVLO Fall Delay (HO and LO)		$t_{UVF1}, t_{UVF2}$		1300		ns
UVLO Rise Delay (HO and LO)		$t_{UVR1}, t_{UVR2}$		1100		ns

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

7. Values based on design and/or characterization.

# NCD57200

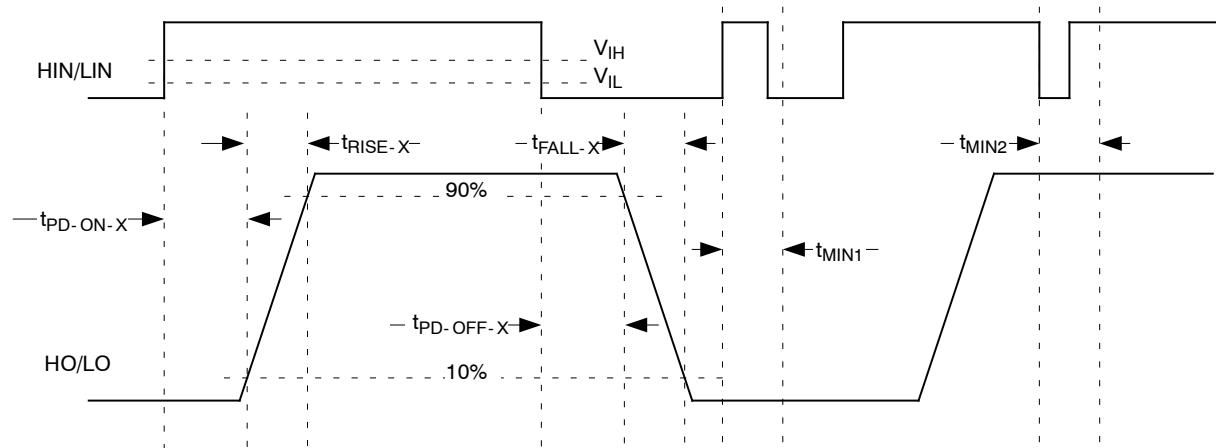


Figure 3. Propagation Delay, Rise and Fall Time

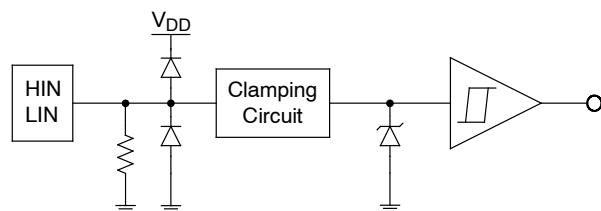


Figure 4. Input Pin Structure

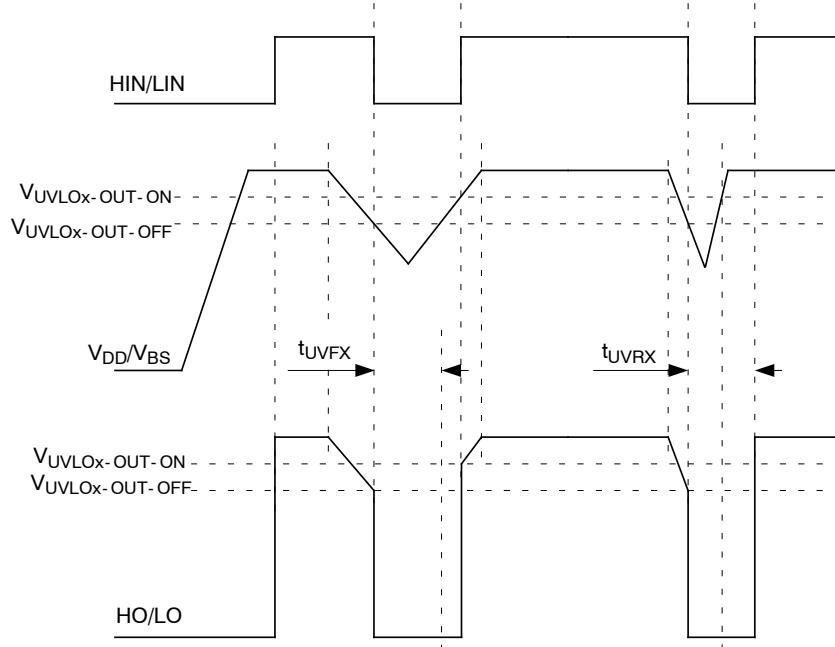


Figure 5. UVLO

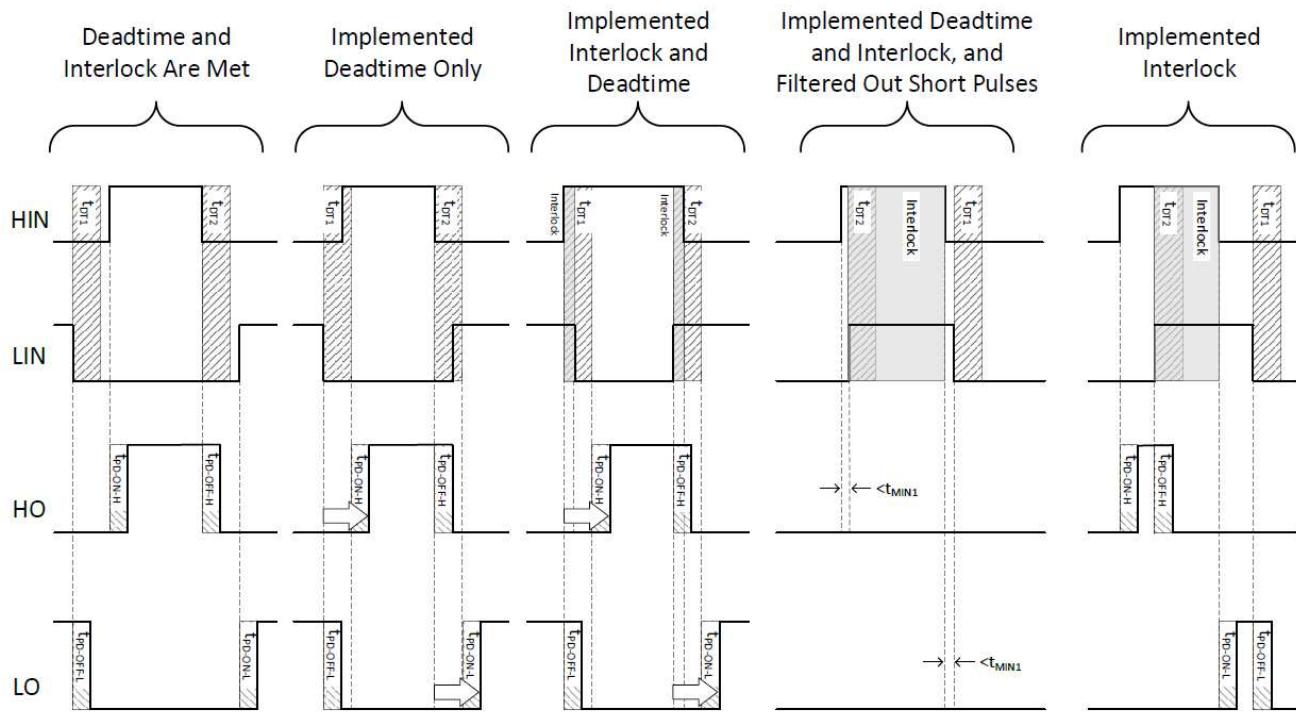


Figure 6. Deadtime, Interlock and Output Minimum Pulse Width

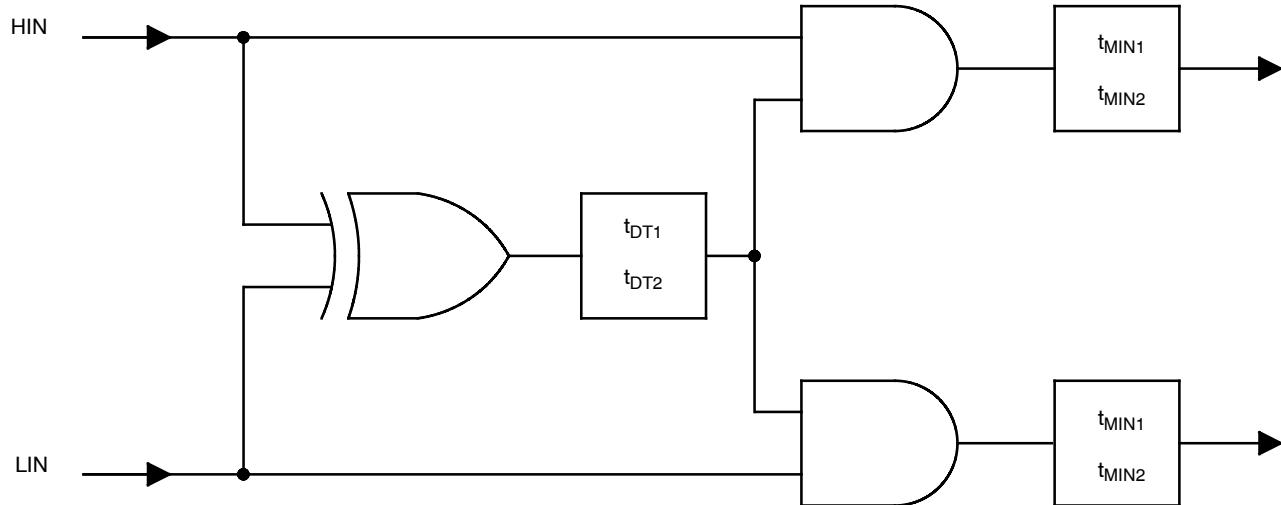
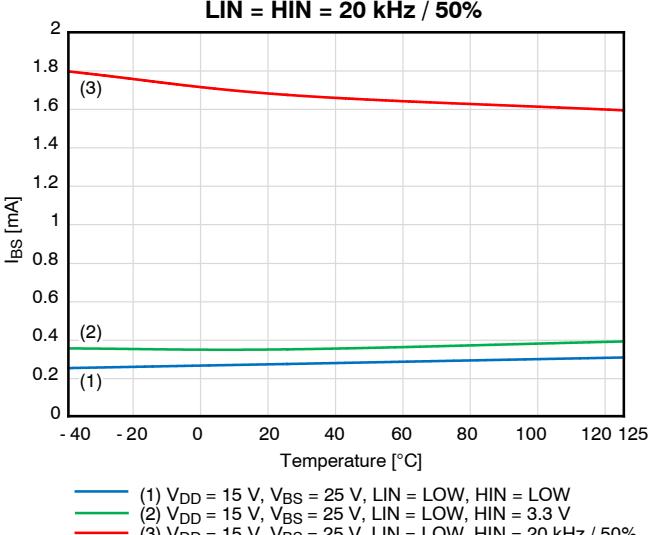
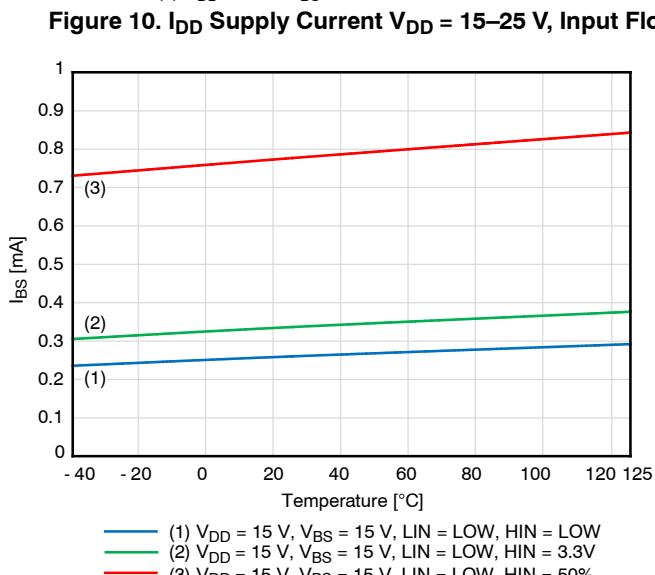
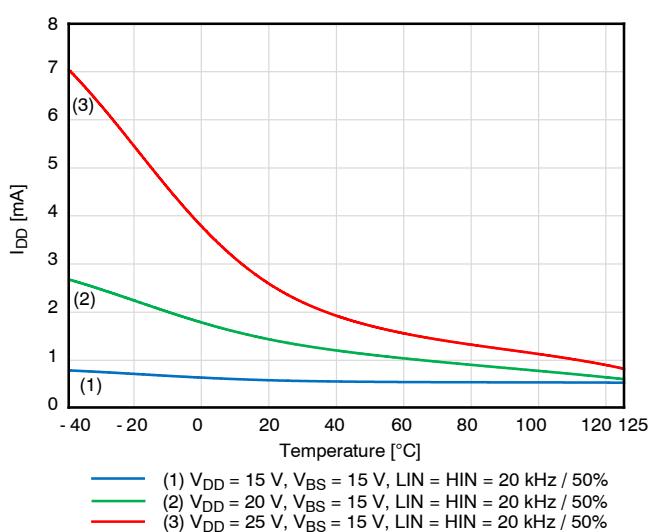
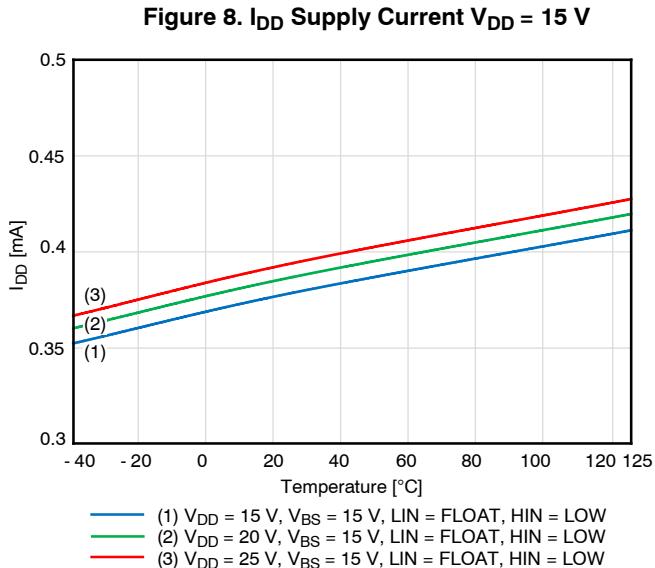
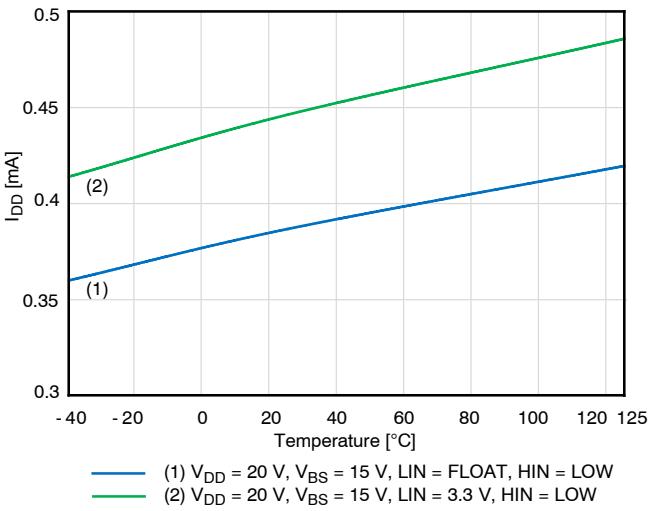
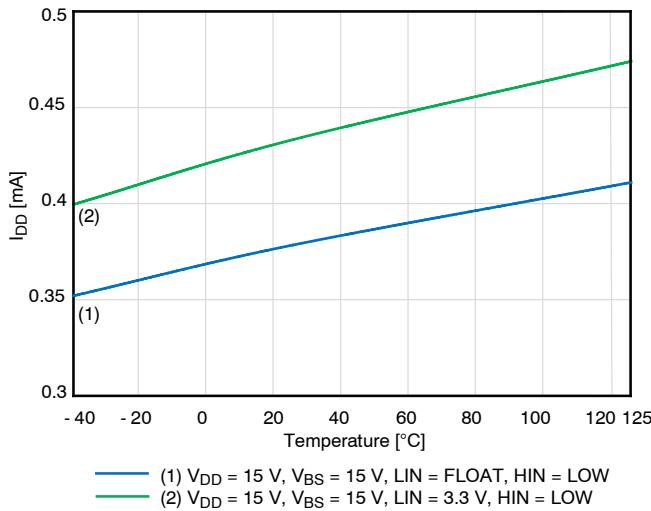


Figure 7. Input Circuit

## TYPICAL CHARACTERISTICS



## TYPICAL CHARACTERISTICS (continued)

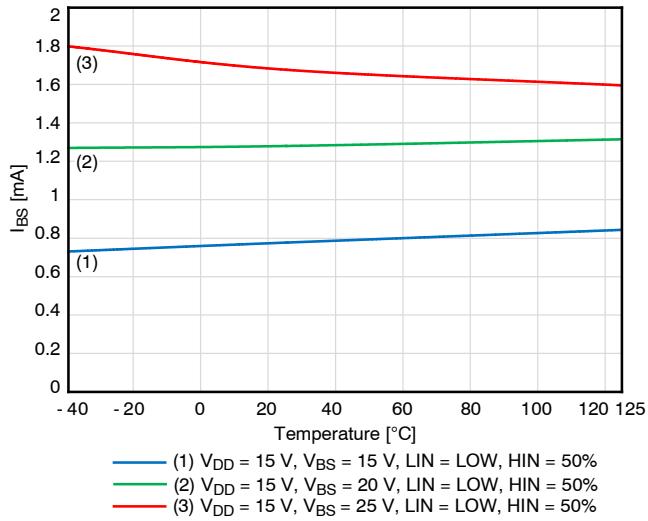


Figure 14.  $I_{BS}$  Supply Current  $V_{BS} = 15\text{--}25\text{ V}$ , HIN = 20 kHz / 50%

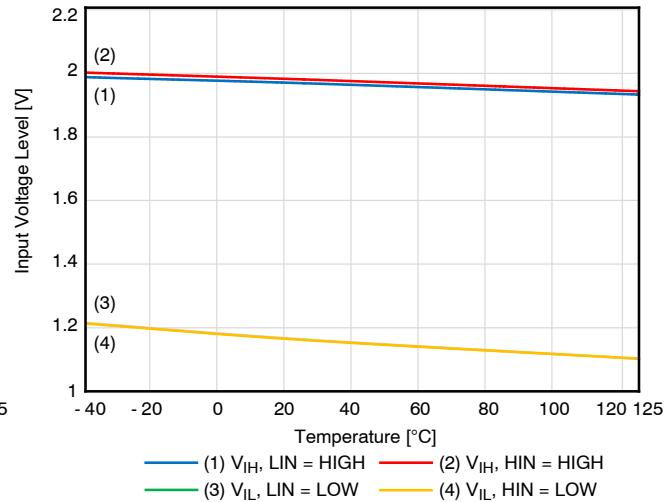


Figure 15. Input Voltage Level

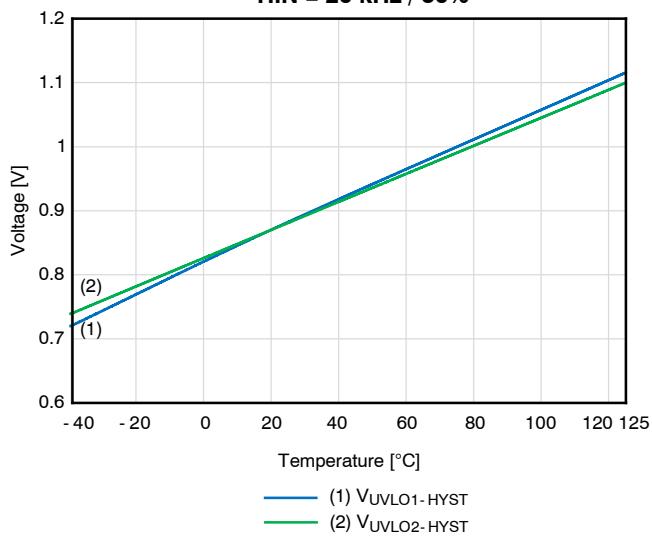


Figure 16. UVLO Hysteresis

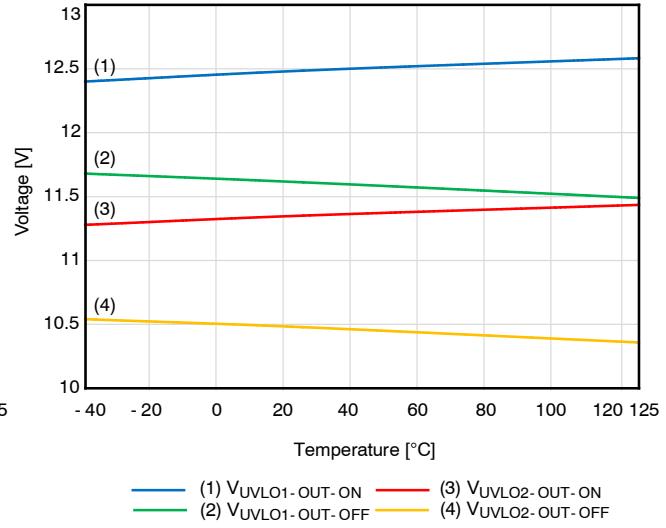


Figure 17. UVLO Threshold Voltage

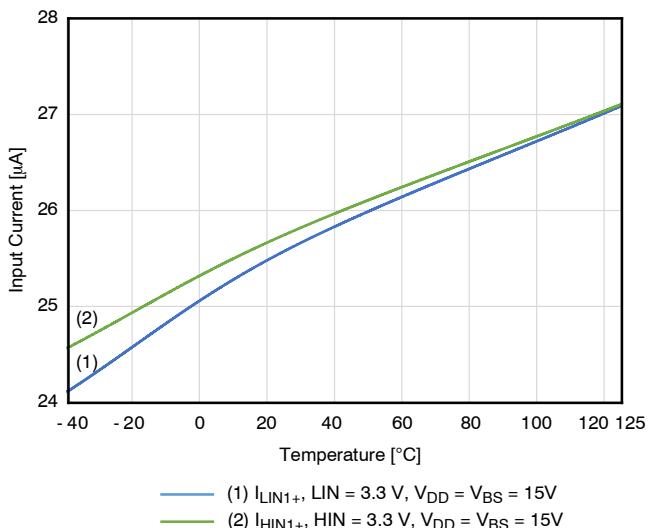


Figure 18. Input Current  $V_{DD} = V_{BS} = 15\text{ V}$

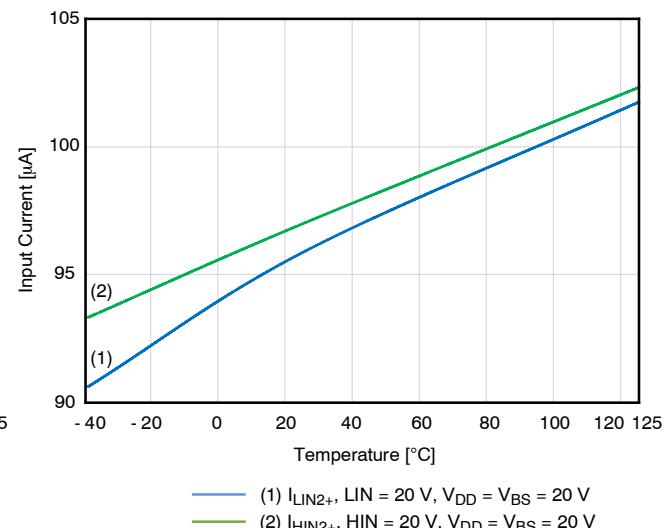
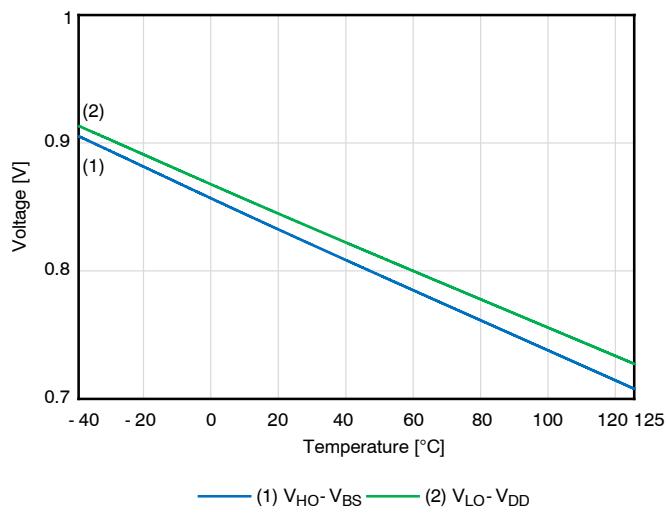
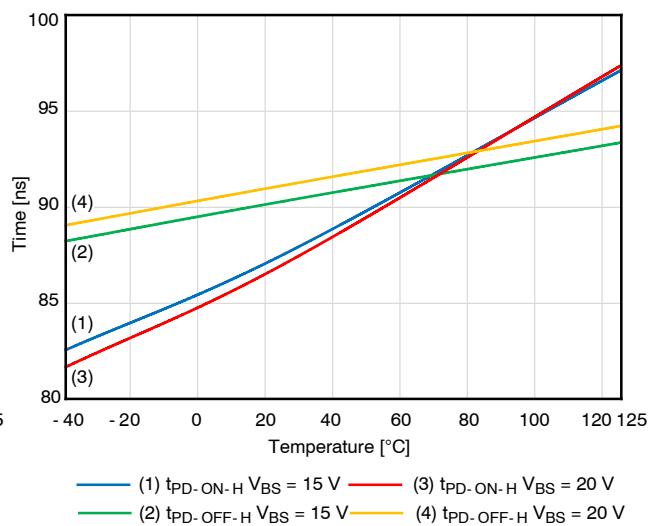


Figure 19. Input Current  $V_{DD} = V_{BS} = 20\text{ V}$

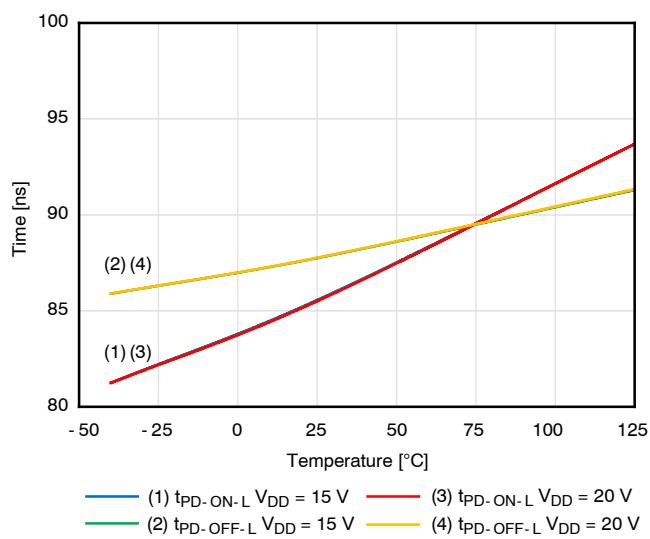
## TYPICAL CHARACTERISTICS (continued)



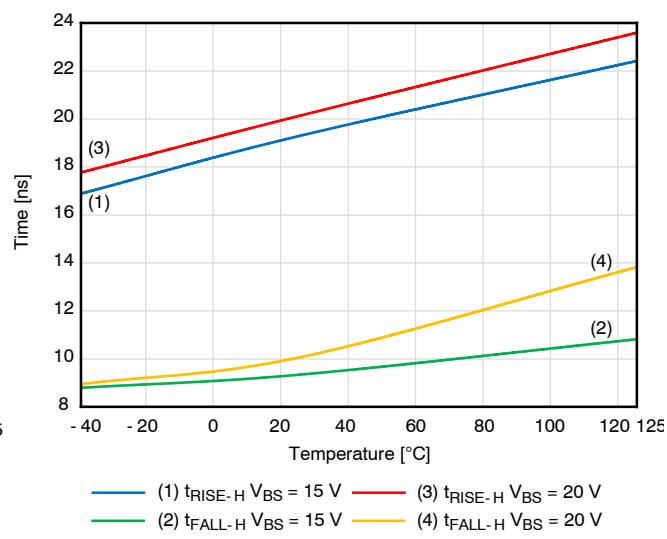
**Figure 20. IGBT Short Circuit CLAMP Voltage Drop**



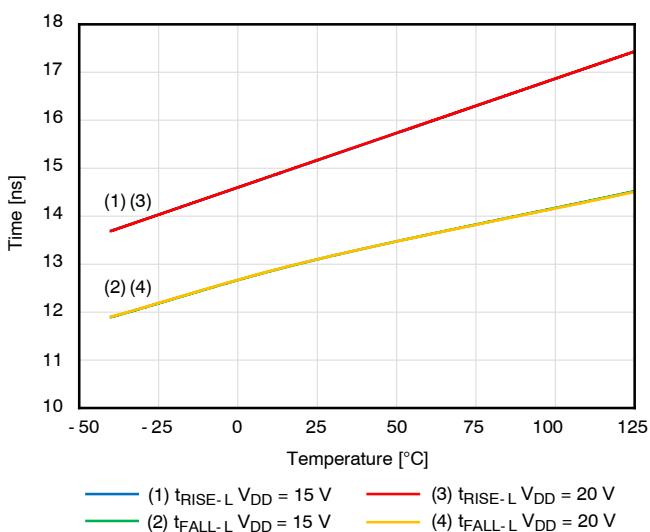
**Figure 21. HO Propagation Delay**



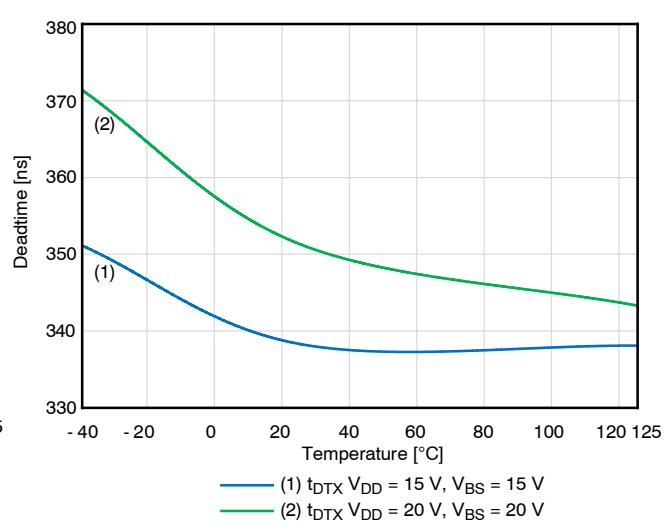
**Figure 22. LO Propagation Delay**



**Figure 23. HO Rise – Fall Time**

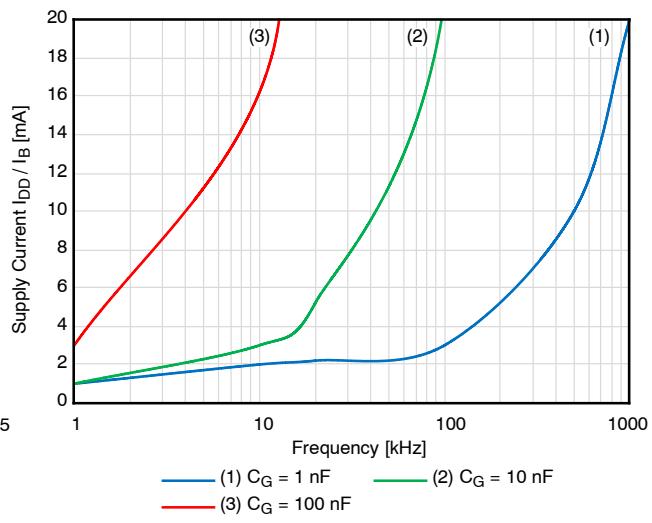
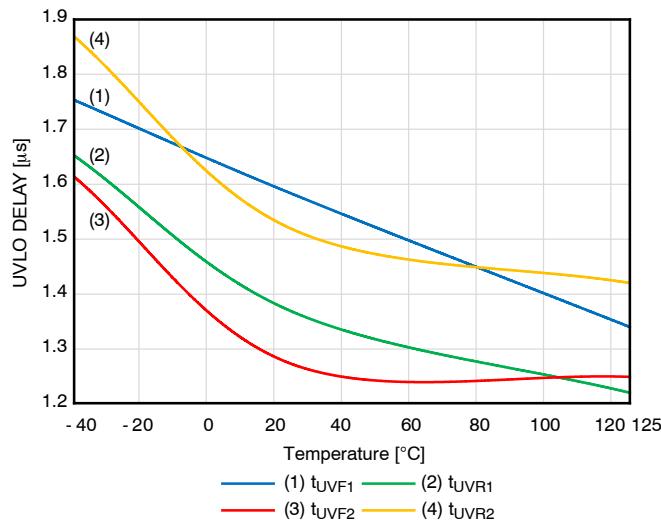
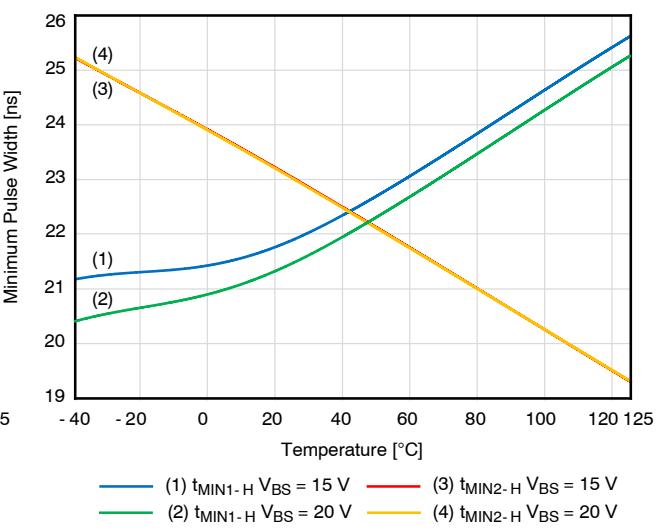
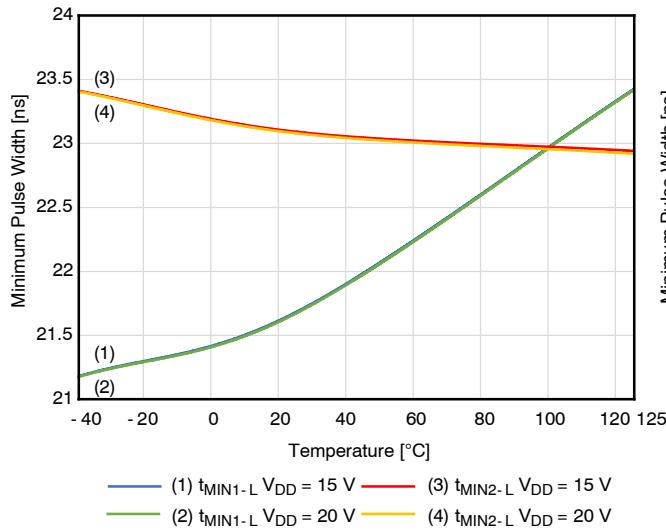


**Figure 24. LO Rise – Fall Time**



**Figure 25. Deadtime**

## TYPICAL CHARACTERISTICS (continued)



## Under Voltage Lockout (UVLO)

UVLO ensures correct switching of IGBT connected to the driver output.

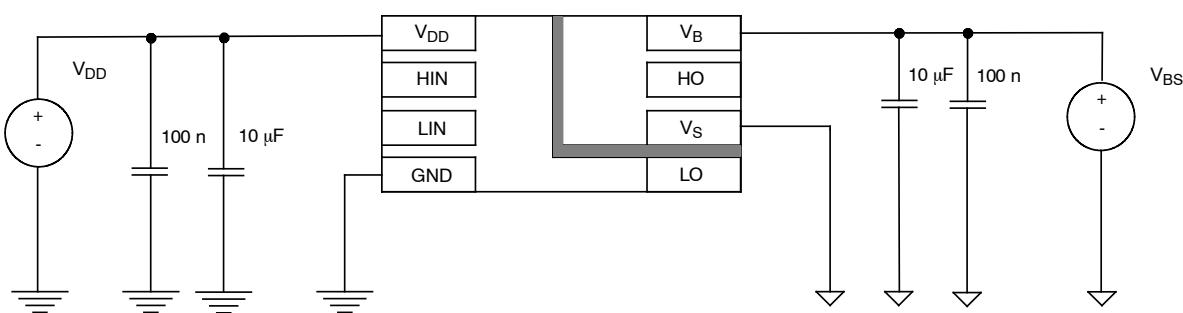
- The IGBT is turned-off, if the supply  $V_{DD}$  drops below  $V_{UVLO1-OUT-OFF}$  or  $V_{BS}$  drops below  $V_{UVLO2-OUT-OFF}$
- The driver output does not start to react to the input signal on HIN or LIN until the  $V_{DD}$  or  $V_{BS}$  rises above the  $V_{UVLOX-OUT-ON}$

## Power Supply ( $V_{DD}$ , $V_{BS}$ )

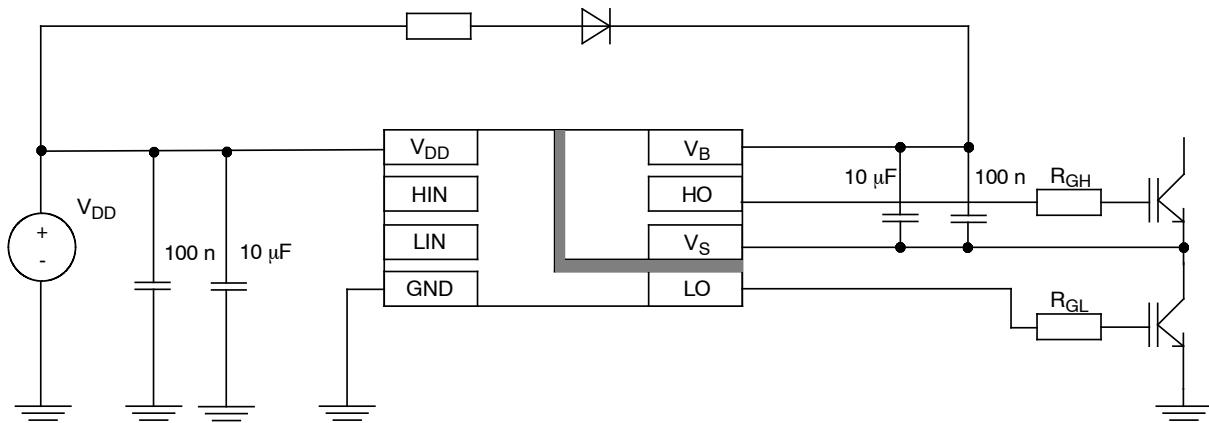
NCD57200 is designed to support unipolar power supply on both individual channels.

For reliable high output current suitable external power capacitors are required. Parallel combination of 100 nF + 4.7  $\mu$ F ceramic capacitors is optimal for a wide range of applications using IGBT. For reliable driving of IGBT modules (containing several parallel IGBTs) a higher capacitance is required (typically 100 nF + 10  $\mu$ F). Capacitors should be as close as possible to the driver's power pins.

Power supply of isolated (HO) channel can be provided by an external DC power supply or Bootstrap circuit.



**Figure 30. Unipolar Power Supply**



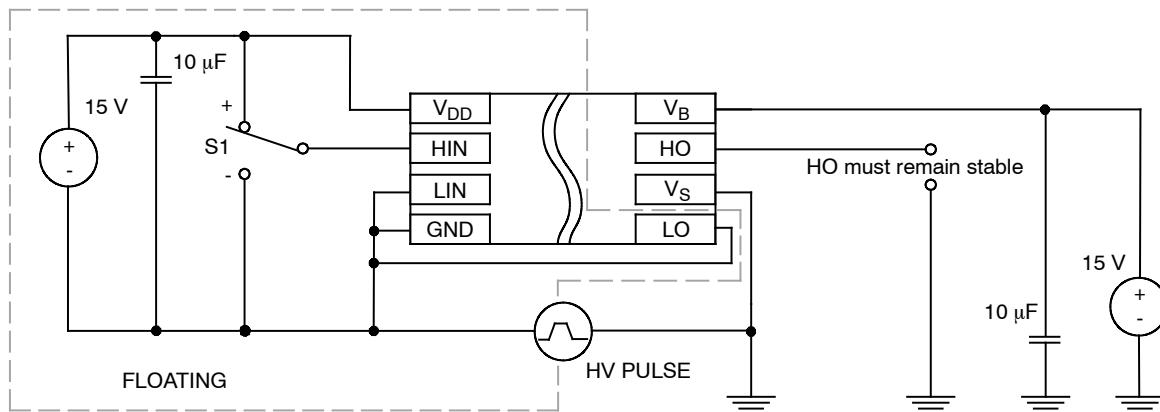
**Figure 31. Bootstrap Power Supply**

## Signal Inputs (HIN, LIN)

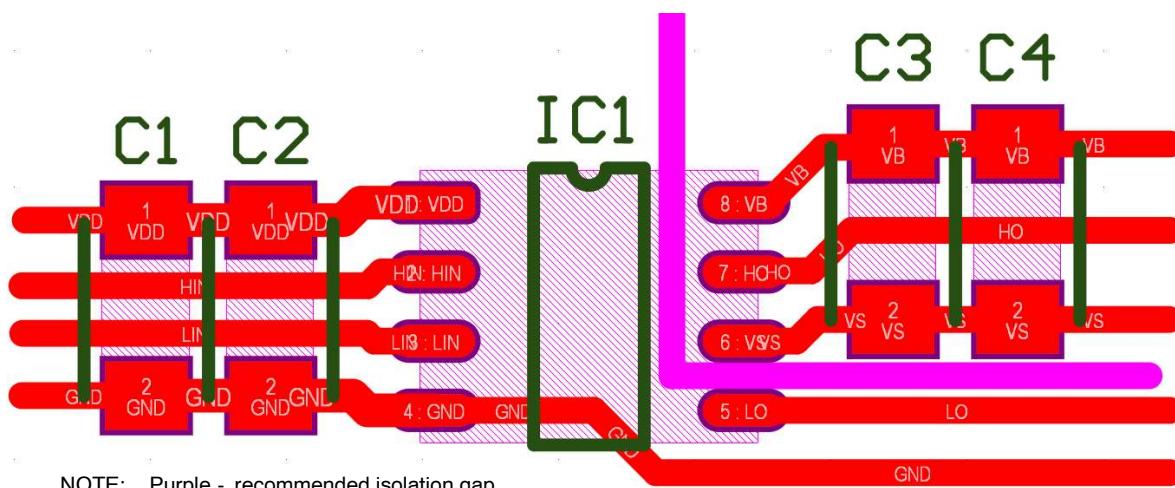
Inputs of NCD57200 are active high. Outputs are in phase with inputs signals respecting internal logic (see Figure 5, 6, 7).

**WARNING:** When the application uses an independent or separate power supply for the control unit on the input side of the driver, all inputs should be protected by a serial resistor (In case of a power failure of the driver, the driver may be damaged due to overloading of the input protection circuits).

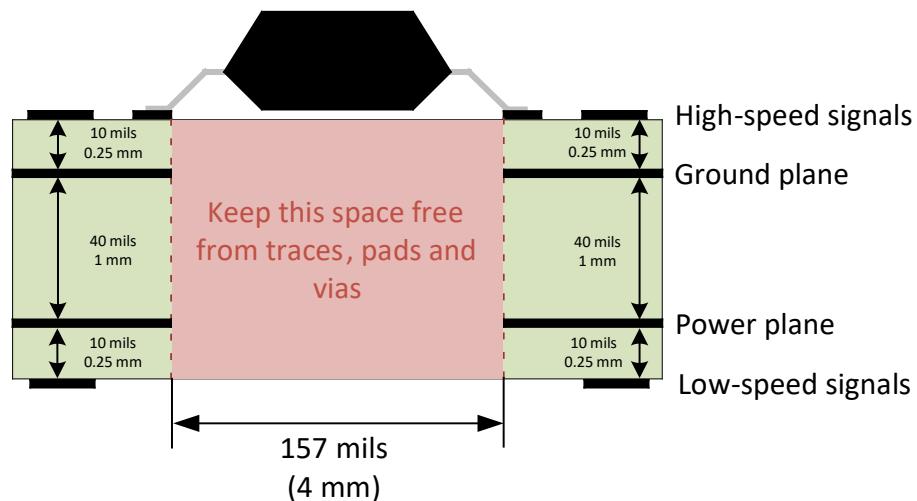
## Common Mode Transient Immunity (CMTI)



**Figure 32. CMTI Test Setup**  
(Test Conditions: HV PULSE =  $\pm 900$  V,  $dV/dt = 1 - 100$  V/ns,  $V_{DD} = 15$  V,  $V_B = 15$  V)



**Figure 33. Recommended Layout**



**Figure 34. Recommended Layer Stack**

# NCD57200

## ORDERING INFORMATION

Device	Package	Shipping <sup>†</sup>
NCD57200DR2G	SOIC- 8 (Pb- Free)	2500 / Tape & Reel

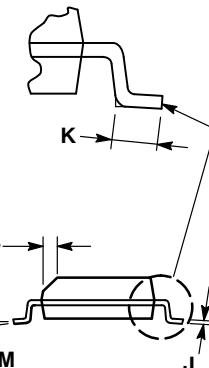
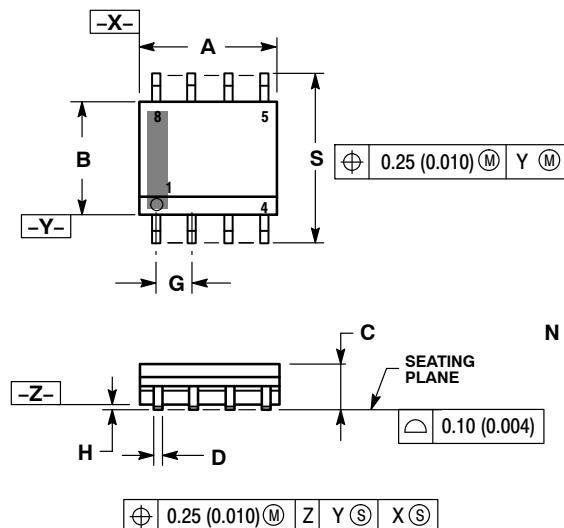
<sup>†</sup>For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.



SCALE 1:1

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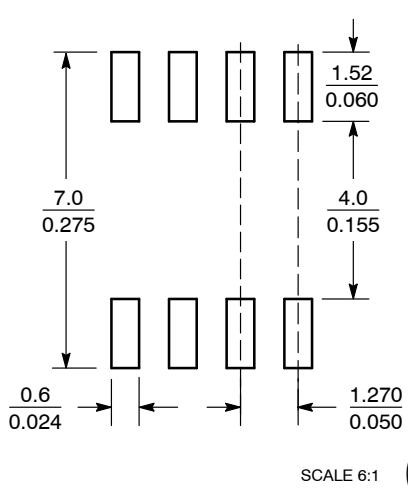


## NOTES:

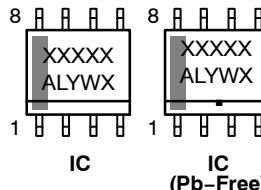
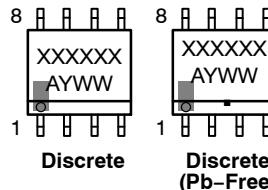
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL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

DIM	MILLIMETERS		INCHES	
	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\*



SCALE 6:1 (mm/inches)

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.

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

## STYLES ON PAGE 2

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**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. VBUCK 7. VBUCK 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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