

Dual MOSFET Gate Driver, High Performance

NCP81075

Introduction

The NCP81075 is a high performance dual MOSFET gate driver optimized to drive the gates of both high and low side power MOSFETs in a synchronous buck converter. The NCP81075 uses an on-chip bootstrap diode to eliminate the external discrete diode. A high floating top driver design can accommodate HB voltage as high as 180 V. The low-side and high-side are independently controlled and match to 4 ns between the turn-on and turn-off of each other. Independent Under-Voltage lockout is provided for the high side and low side driver forcing the output low when the drive voltage is below a specific threshold.

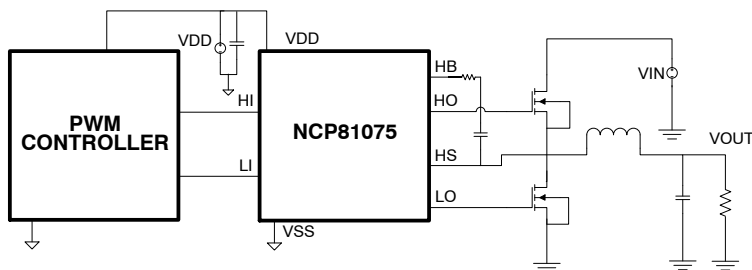
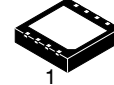
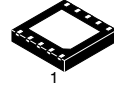
Features

- Drives Two N-Channel MOSFETs in High-Side and Low-Side Configuration
- Floating Top Driver Accommodates Boost Voltage up to 180 V
- Switching Frequency up to 1 MHz
- 20 ns Propagation Delay Times
- 4 A Sink, 4 A Source Output Currents
- 8 ns Rise / 7 ns Fall Times with 1000 pF Load
- UVLO Protection
- Specified from -40°C to 140°C
- Offered in SOIC-8 (D), DFN8 (MN), WDFN10 (MT) Packages
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

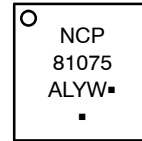
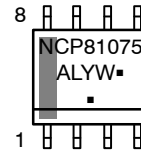
Applications

- Telecom and Datacom
- Isolated Non-Isolated Power Supply Architectures
- Class D Audio Amplifiers
- Two Switch and Active Clamp Forward Converters

Simplified Application Diagram


SOIC-8 NB
CASE 751-07

DFN8
CASE 506CY

WDFN10
CASE 511CE

MARKING DIAGRAMS



NCP81075 = Specific Device Code

A = Assembly Location

L = Wafer Lot

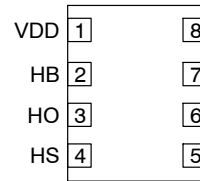
Y = Year

W = Work Week

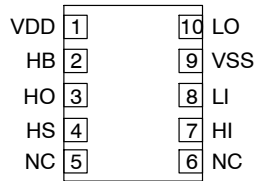
■ = Pb-Free Package

(Note: Microdot may be in either location)

PINOUT DIAGRAMS



SOIC/DFN8



WDFN10

NCP81075
(top views)

ORDERING INFORMATION

Device	Package	Shipping [†]
NCP81075DR2G	SOIC8 (Pb-Free)	2500 / Tape & Reel
NCP81075MNTXG	DFN8 (Pb-Free)	4000 / Tape & Reel
NCP81075MTTXG	WDFN10 (Pb-Free)	4000 / Tape & Reel

[†]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.

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Table 1. PIN DESCRIPTION

Pin No. SOIC/DFN8	Pin No. WDFN10	Symbol	Description
1	1	VDD	Positive Supply to the Lower Gate Driver
2	2	HB	High Side Bootstrap Supply
3	3	HO	High Side Output
4	4	HS	High-Side Source
5	7	HI	High-Side Input
6	8	LI	Low-Side Input
7	9	VSS	Negative Supply Return
8	10	LO	Low-Side Output
–	5,6	NC	No Connect

Table 2. MAXIMUM RATINGS

Parameter		Value	Units
VDD		–0.3 to 24	V
V _{HB}		–0.3 to 200	V
V _{HO}	DC	V _{HS} – 0.3 to V _{HB} + 0.3	V
	Repetitive Pulse < 100 ns	V _{HS} – 2 to V _{HB} + 0.3, (V _{HB} – V _{HS} < 24)	
V _{HS}	DC	–20 to 200 – VDD	V
V _{LO}	DC	–0.3 to VDD + 0.3	V
	Repetitive pulse < 100 ns	–2 to VDD + 0.3	
V _{HI} , V _{LI}		–10 to 24	V
V _{HB} – HS		–0.3 to 24	V
Operating Junction Temperature Range, T _J		–40 to 170	°C
Storage Temperature, T _{STG}		–65 to 150	°C
Lead Temperature (Soldering, 10 sec)		+300	°C
HBM		1000	V
CDM		2000	V

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. V_{HB} – V_{HS} should be in the range of –0.3 V to +20 V.

Table 3. RECOMMENDED OPERATING CONDITIONS

Parameter		Min	Nom	Max	Units
V _{DD}	Supply Voltage Range	8.5	12	20	V
V _{HS}	Voltage on HS (DC)	–10		180 – VDD	
V _{HB}	Voltage on HB	V _{HS} + 8, V _{DD} – 1		V _{HS} + 20, 180	
	Voltage Slew Rate on HS			50	V / ns
T _J	Operating Junction Temperature Range	–40		+140	°C
V _{HO}		V _{HS} – 0.3		V _{HB} + 0.3	V
V _{LO}		–0.3		V _{DD} + 0.3	V

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.

ABSOLUTE MAXIMUM RATINGS

Table 4. ELECTRICAL/THERMAL INFORMATION (All signals referenced to GND unless noted otherwise, Note 2)

Thermal Characteristic	SOIC	DFN8	DFN10	Unit
θ_{JA} Junction to Ambient thermal resistance	116	36	35	°C/W
$\theta_{JC(top)}$ Junction to case (Top) thermal resistance	98	42	32	
θ_{JB} Junction to Board thermal resistance	52	19.1	12	
$\theta_{JC(Bottom)}$ Junction to case (Bottom) thermal resistance	40	4	1.3	
ψ_{JT} Junction to top characterization parameter	14	0.6	0.2	
ψ_{JB} Junction to board characterization parameter	39	19.3	12.2	
Moisture Sensitivity Level (MSL) QFN Package	1			

2. This data was taken using the JEDEC proposed High-K Test PCB.

Table 5. ELECTRICAL CHARACTERISTICS

Unless otherwise stated: $T_A = T_J = -40^{\circ}\text{C}$ to 140°C ; $V_{DD} = V_{HB} = 12\text{ V}$, $V_{HS} = V_{SS} = 0\text{ V}$, No load on LO or HO

Parameter	Test Condition	Min	Typ	Max	Units	
SUPPLY CURRENTS						
I _{DD}	VDD quiescent current	V _{LI} = V _{HI} = 0		0.85	1.8	mA
I _{DDO}	VDD operating current	f = 500 kHz, C _{LOAD} = 0		7.3	15	
		f = 300 kHz, C _{LOAD} = 0		4.9	11	
I _{HB}	Boot voltage quiescent current	V _{LI} = V _{HI} = 0 V		0.92	1.8	
I _{HBO}	Boot voltage operating current	f = 500 kHz, C _{LOAD} = 0		6.55	12	
		f = 300 kHz, C _{LOAD} = 0		4.5	7.0	
I _{HBS}	HB to V _{SS} quiescent current	V _{HS} = V _{HB} = 110 V		5.0	25	μA
I _{HBSO}	HB to V _{SS} operating current	f = 500 kHz, C _{LOAD} = 0		0.1		mA
INPUT						
V _{HIH} , V _{LIH}	Input rising threshold		2.7			V
V _{HIL} , V _{LIL}	Input falling threshold				0.8	
R _{IN}	Input Pulldown Resistance		100	170	350	kΩ
UNDERVOLTAGE PROTECTION (UVLO)						
	VDD rising threshold		6.2	7.1	8.0	V
	VDD threshold hysteresis			0.58		
	VHB rising threshold		5.5	6.5	7.5	
	VHB threshold hysteresis			0.5		
BOOTSTRAP DIODE						
V _F	Low-current forward voltage	I _{VDD} – HB = 100 μA		0.59	0.95	V
V _{FI}	High-current forward voltage	I _{VDD} – HB = 100 mA		0.85	1.1	
R _D	Dynamic resistance, ΔVF/ΔI	I _{VDD} – HB = 100 mA and 80 mA		0.94	2.0	Ω
LO GATE DRIVER						
V _{LOL}	Low level output voltage	I _{LO} = 100 mA		0.1	0.40	V
V _{LOH}	High level output voltage	I _{LO} = -100 mA, V _{LOH} = V _{DD} – V _{LO}		0.15	0.40	
	Peak pull-up current	V _{LO} = 0 V		4		A
	Peak pull-down current	V _{LO} = 12 V		4		

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Table 5. ELECTRICAL CHARACTERISTICS

Unless otherwise stated: $T_A = T_J = -40^{\circ}\text{C}$ to 140°C ; $V_{DD} = V_{HB} = 12\text{ V}$, $V_{HS} = V_{SS} = 0\text{ V}$, No load on LO or HO

Parameter	Test Condition	Min	Typ	Max	Units
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HO GATE DRIVER

V_{HOL}	Low level output voltage	$I_{HO} = 100\text{ mA}$		0.1	0.40	V
V_{HOH}	High level output voltage	$I_{HO} = -100\text{ mA}$, $V_{HOH} = V_{HB} - V_{HO}$		0.15	0.40	
	Peak pull-up current	$V_{LO} = 0\text{ V}$		4		A
	Peak pull-down current	$V_{LO} = 12\text{ V}$		4		

PROPAGATION DELAYS

t_{DLFF}	V_{LI} falling to V_{LO} falling	$C_{LOAD} = 0$ (-40 to 140°C)	14	20.6	30	ns
t_{DHFF}	V_{HI} falling to V_{HO} falling	$C_{LOAD} = 0$ (-40 to 140°C)	14	20.6	30	
t_{DLRR}	V_{LI} rising to V_{LO} rising	$C_{LOAD} = 0$ (-40 to 140°C)	12	18.8	28	
t_{DHRR}	V_{HI} rising to V_{HO} rising	$C_{LOAD} = 0$ (-40 to 140°C)	12	18.8	28	

DELAY MATCHING

t_{MON}	LI ON, HI OFF		-10	-1.4	6	ns
t_{MOFF}	LI OFF, HI ON		-10	-2.4	6	

OUTPUT RISE AND FALL TIME

t_R	LO, HO	$C_{LOAD} = 1000\text{ pF}$		8		ns
t_F	LO, HO	$C_{LOAD} = 1000\text{ pF}$		7		
t_R	LO, HO (3 V to 9 V)	$C_{LOAD} = 0.1\text{ }\mu\text{F}$		0.2	0.55	μs
t_F	LO, HO (3 V to 9 V)	$C_{LOAD} = 0.1\text{ }\mu\text{F}$		0.25	0.45	

MISCELLANEOUS

t_1	Minimum input pulse width that changes the output			30		ns
t_2	Bootstrap diode turn-off time	$I_F = 100\text{ mA}$, $I_{REV} = -100\text{ mA}$ (Notes 3 and 4)		50		

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.

3. Typical values for $T_A = 25^{\circ}\text{C}$

4. I_F : Forward current applied to bootstrap diode, I_{REV} : Reverse current applied to bootstrap diode.

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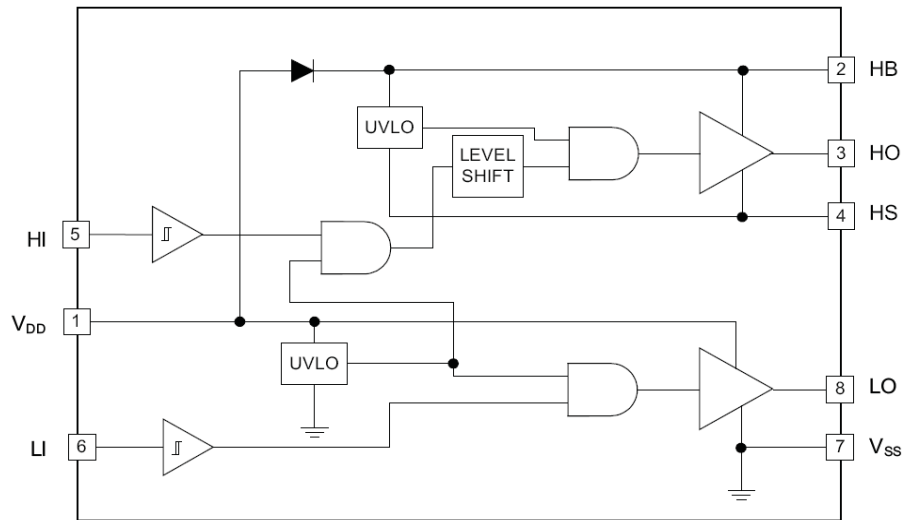
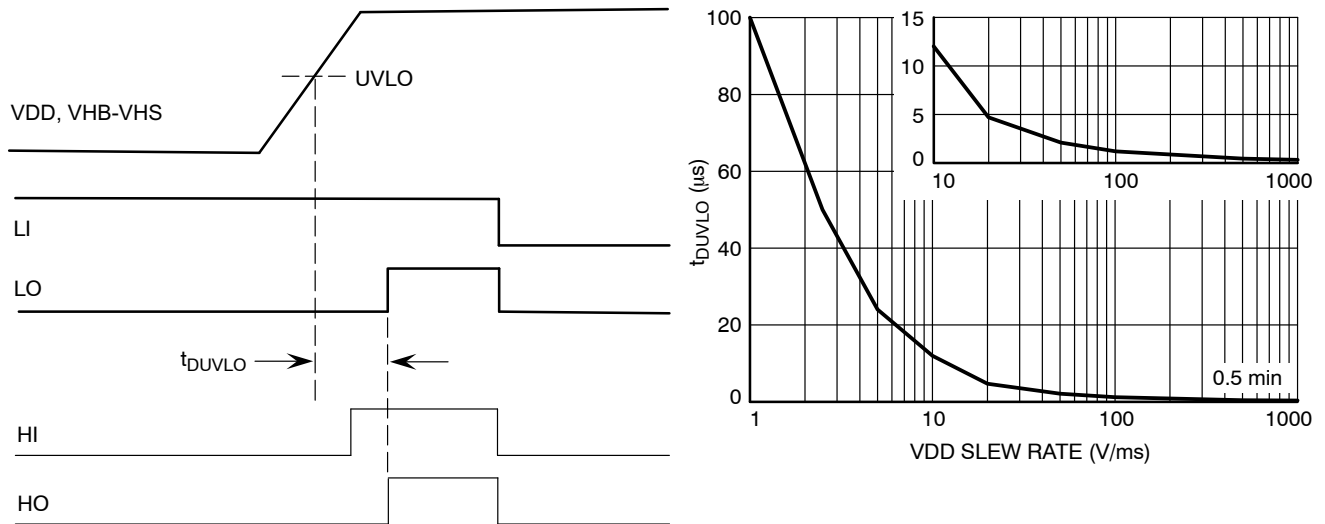


Figure 1. Internal Block Diagram

Timing Diagrams



Notes:

If HI is set and the High-Side driver (VHB-VHS) crosses its UVLO threshold after the VDD UVLO, then another rising HI edge is required to force the HO output high as shown above.

For the case UVLOs are coincident or VDD UVLO occurs last, the HI, HO response will mimic the LI, LO response shown above.

Figure 2. UVLO

NCP81075

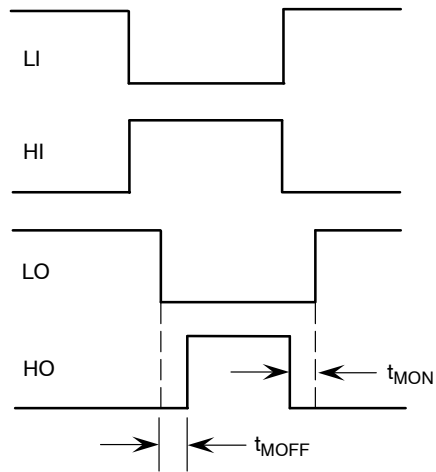


Figure 3. TMON and TMOFF

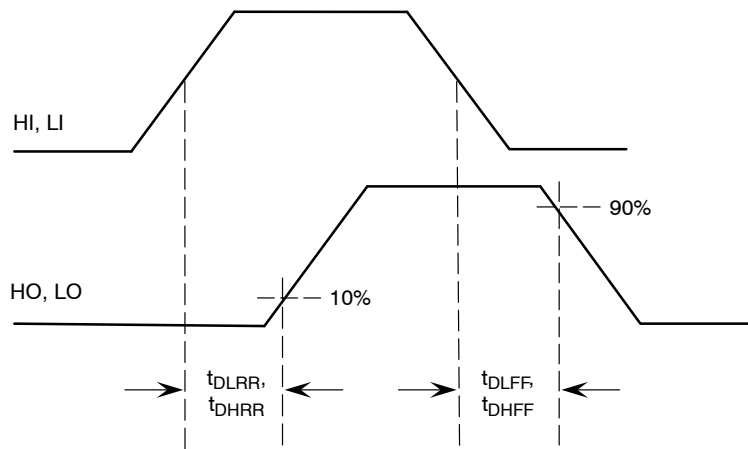


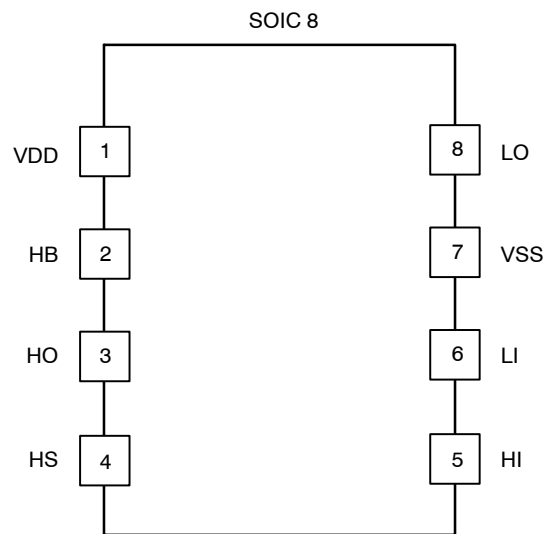
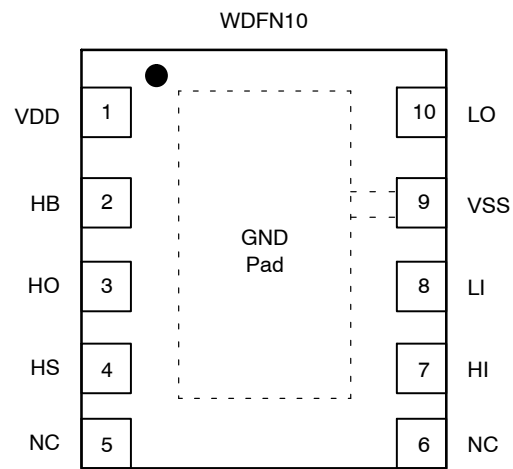
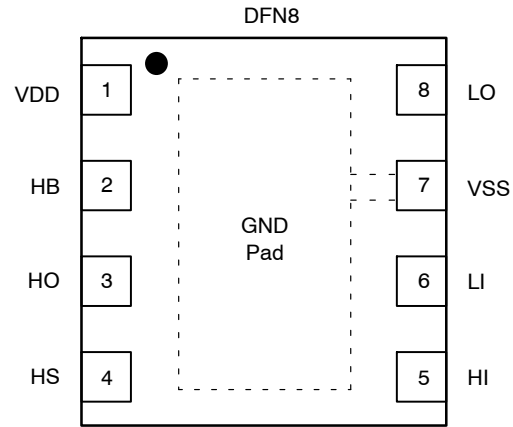
Figure 4. Propagation Delays

LOGIC TABLE

HI	LI	HO	LO
L	L	L	L
L	H	L	H
H	L	H	L
H	H	H	H

NCP81075

PINOUT DIAGRAMS



Note: The V_{SS} Pin and the GND Pad are internally connected.

Figure 5. NCP81075 Top View

TYPICAL CHARACTERISTICS

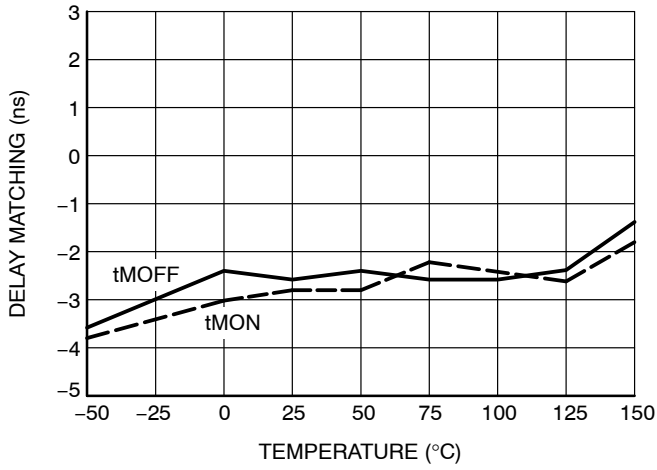


Figure 6. Delay Matching vs. Temperature

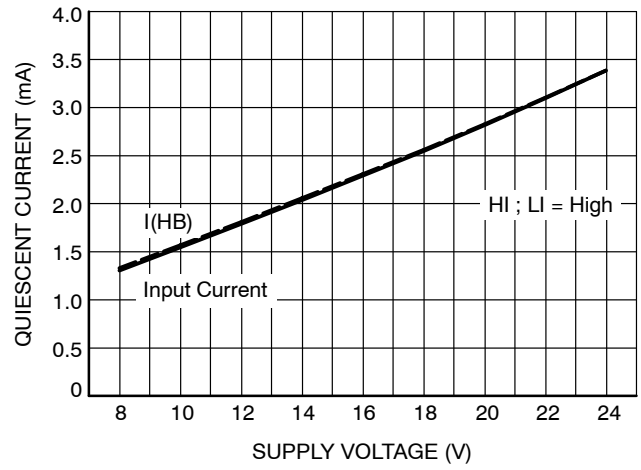


Figure 7. Quiescent Current vs. Supply Voltage High

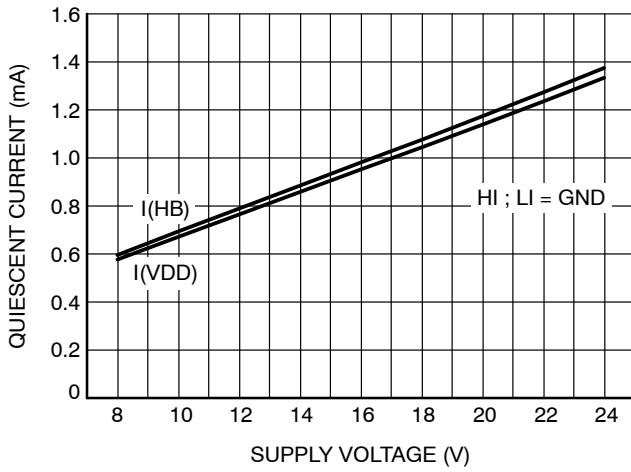


Figure 8. Quiescent Current vs. Supply Voltage Low

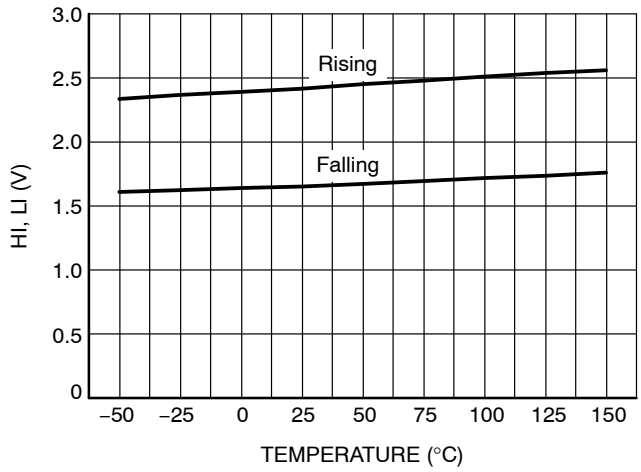


Figure 9. Input Threshold vs. Temperature

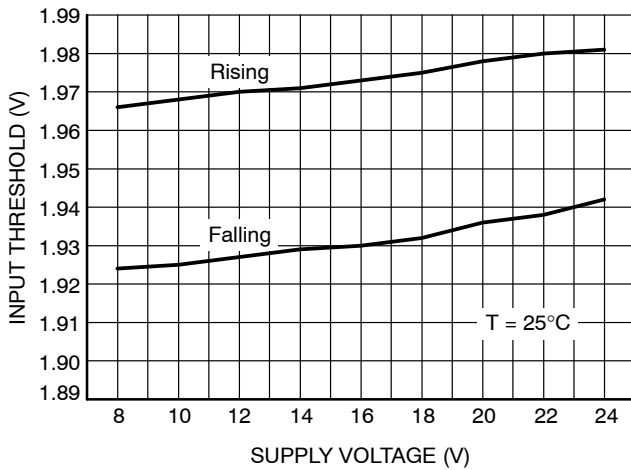


Figure 10. Input Threshold vs. Supply Voltage

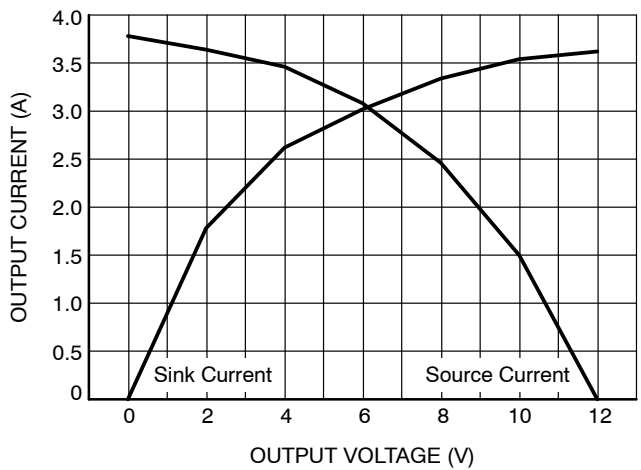


Figure 11. Output Current vs. Output Voltage

TYPICAL CHARACTERISTICS

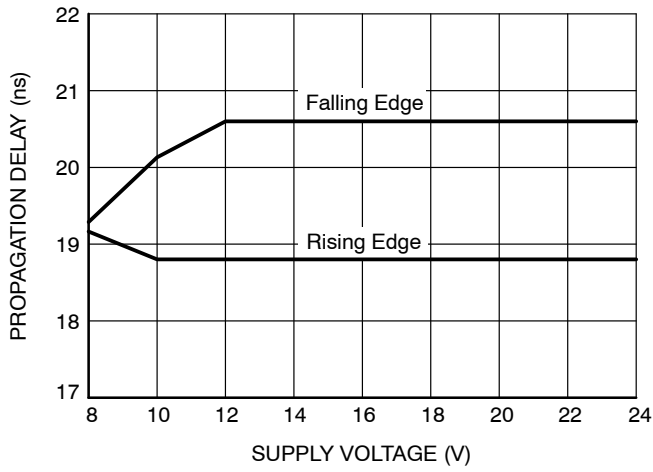


Figure 12. Propagation Delay vs. Supply Voltage

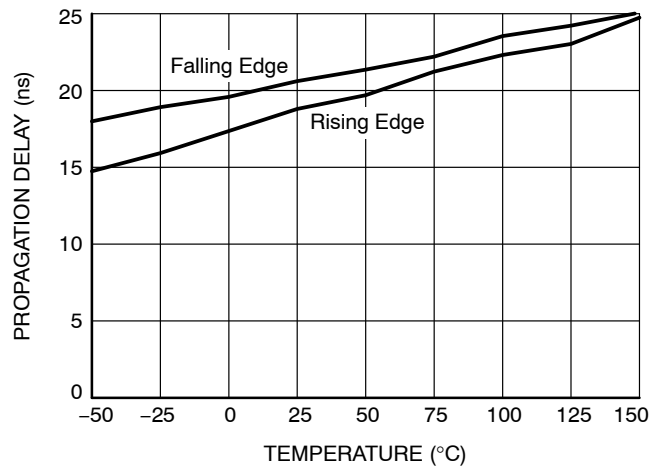


Figure 13. Propagation Delay vs. Temperature

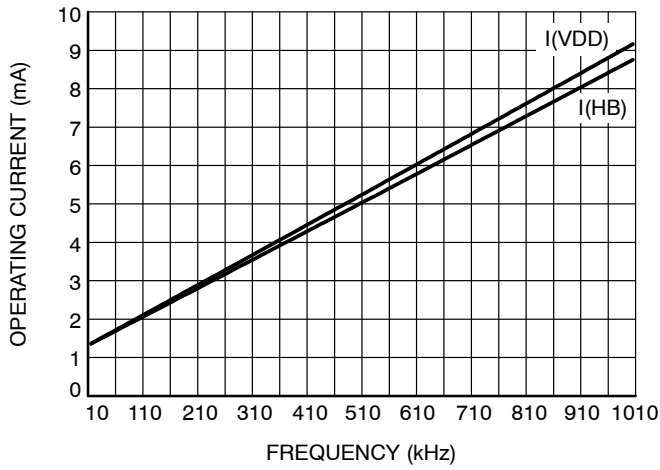


Figure 14. Operating Current vs. Frequency

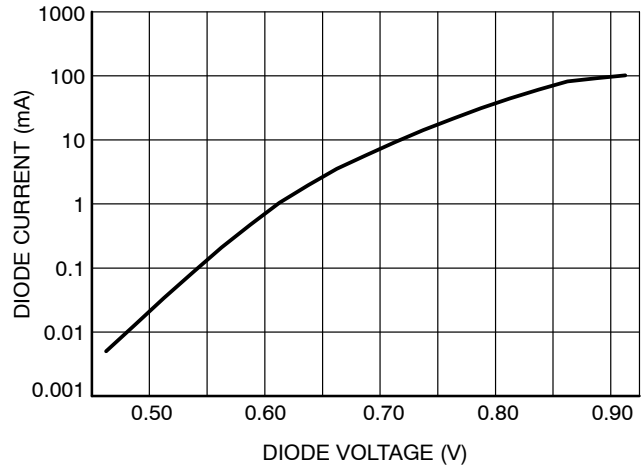


Figure 15. Diode Current vs. Diode Voltage

APPLICATION INFORMATION

The NCP81075 is a high performance dual MOSFET gate driver optimized for driving the gates of both high side and low side power MOSFETs in a synchronous buck converter topology. A high and a Low input signals are all that is required to properly drive the high side and low side MOSFETs.

Low-Side Driver

The low side driver is designed to drive low $R_{DS(on)}$ N-channel MOSFETs. The typical output resistances for the driver are 1.5 ohms for sourcing and 1 ohm for sinking gate current. Due to the parasitic inductances of the packages, drive circuits and the nonlinearity of the MOSFETs output resistances the recorded peak current is close to 4 A.

The low output resistances allow the driver to have 8 ns rise and 7 ns fall times into a 1 nF load. When the driver is enabled, the driver's output is in phase with LI. When the NCP81075 is disabled, the low side gate is held low.

High-Side Driver

The high side driver is designed to drive a floating low $R_{DS(on)}$ N-channel MOSFET. The output resistances for the driver are 1.5 ohms for sourcing and 1 ohm for sinking gate current. The bias voltage for the high side driver is realized by an external bootstrap supply circuit which is connected between the HB and HS Pins.

The bootstrap circuit is comprised of only the bootstrap capacitor since the bootstrap diode is internal. When the NCP81075 is starting up, the HS Pin is at ground, the bootstrap capacitor will charge up to VDD through the internal diode. When the HI goes high, the high side driver will begin to turn the high side MOSFET on by pulling charge out of the bootstrap capacitor. As the external MOSFET turns on, the HS Pin will rise up to VIN, forcing the HB Pin to $V_{IN} + V_{BstCap}$ which is enough gate to source voltage to hold the switch on. To complete the cycle, the MOSFET is switched off by pulling the gate down to the voltage at the HS Pin. When the low side MOSFET turns on, the HS Pin is pulled to ground. This allows the bootstrap capacitor to charge up to VDD again. The high-side driver's output is in phase with the HI input. When the driver is disabled, the high side gate is held low.

Unlike a Buck regulator at power-up, Boost regulators typically require starting when the HS pin is at the V_{IN} level, instead of GND or the prevailing V_{OUT} . Care should be

taken by the system designer to pre-charge the bootstrap capacitor (C_{BST}) to ensure sufficient voltage levels for proper operation. If the capacitor is discharged, the high-side power MOSFET relies on the driver's internal 20 k Ω pull down resistor to prevent charge from building up across its V_{GS} during the initial low side FET turn on events. High dV/dt on HS, when turning on the low-side MOSFET, creates a capacitive divider across the high side FET gate, possibly resulting in cross-conduction. With proper biasing across C_{BST} ($V_{HB} - V_{HS}$), the internal low-impedance pull down at HO ensures the high-side FET remains off.

The external BST resistor, which connects HB pin and BST cap, should avoid excessive resistance. NCP81075 has high-side UVLO protection based on the voltage across HB and HS pins. High resistance on HB pin may falsely trigger UVLO protection at the moment when high-side MOSFET is turning on.

UVLO (Under Voltage Lockout)

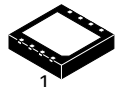
The bias supplies of the high-side and low-side drivers have UVLO protection. The VDD UVLO disables both drivers when the VDD voltage crosses the specified threshold. The typical rising threshold is 7.1 V with 0.58 V hysteresis. The VHB UVLO disables only the high-side driver when the VHB to VHS is below the specified threshold. The typical VHB UVLO rising threshold is 6.5 V with 0.5 V hysteresis. The designer must take into account a 40 μ s delay before the output channels can react to a logic input. (Refer to the UVLO Timing Diagram).

Input Stages

The input stage of the NCP81075 is TTL compatible. The logic rising threshold level is V_{HIH} , V_{LIH} and the logic falling threshold is V_{HIL} , V_{LIL} .

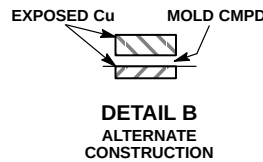
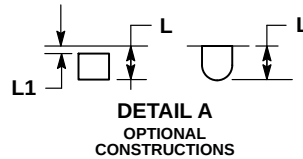
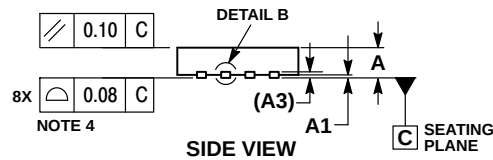
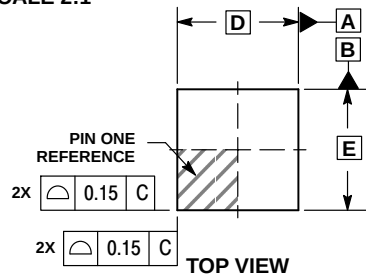
Layout Guidelines

Gate drivers experience high di/dt during the switching transitions. So, the inductance at the gate drive traces must be minimized to avoid excessive ringing on the switch node. Gate drive traces should be kept as short and wide (> 20 mil) as practical. The input capacitor must be placed as close as possible to the IC. Connect the VSS pin of the NCP81075 as close as possible to the source of the lower MOSFET. The use of vias is highly desirable to maximize thermal conduction away from driver.


1
SCALE 2:1

DFN8, 4x4, 0.8P
CASE 506CY
ISSUE O

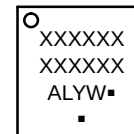
DATE 31 JUL 2014



NOTES:

1. DIMENSIONS AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.15 AND 0.30MM FROM TERMINAL TIP.
4. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.

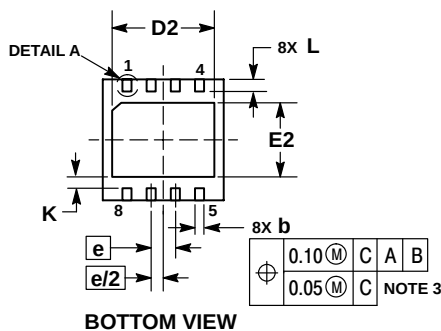
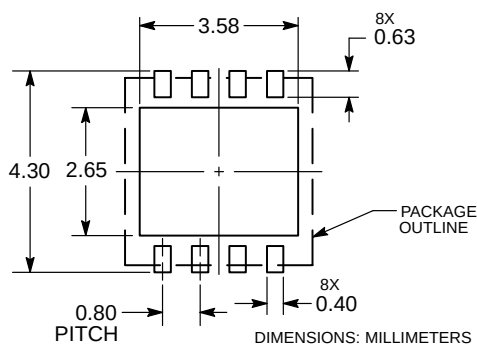
MILLIMETERS		
DIM	MIN	MAX
A	0.80	1.00
A1	0.00	0.05
A3	0.20	REF
b	0.25	0.35
D	4.00	BSC
D2	3.28	3.48
E	4.00	BSC
E2	2.35	2.55
e	0.80	BSC
K	0.375	REF
L	0.30	0.50
L1	---	0.15

**GENERIC
MARKING DIAGRAM***


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

(Note: Microdot may be in either location)

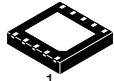
*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present.


**RECOMMENDED
SOLDERING FOOTPRINT***


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

DOCUMENT NUMBER:	98AON89300F	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
DESCRIPTION:	DFN8, 4X4, 0.8P	PAGE 1 OF 1

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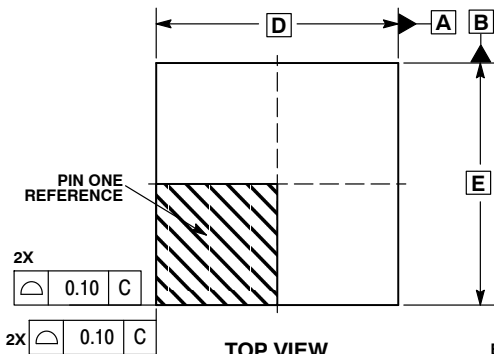
SCALE 2:1

WDFN10 4x4, 0.8P

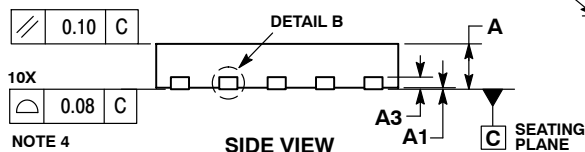
CASE 511CE

ISSUE O

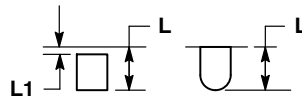
DATE 17 SEP 2014



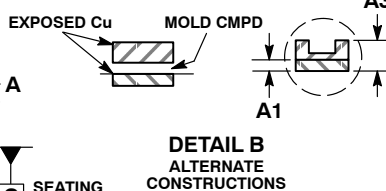
TOP VIEW



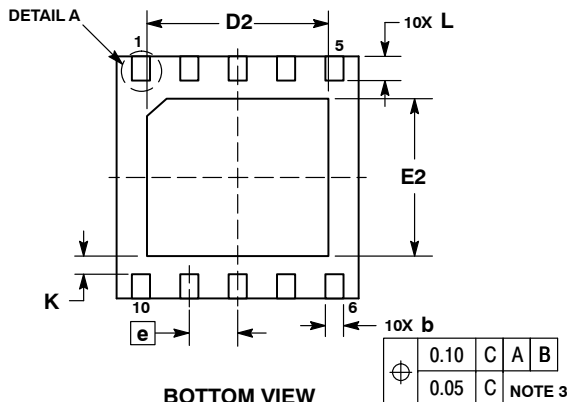
SIDE VIEW



DETAIL A
ALTERNATE TERMINAL
CONSTRUCTIONS

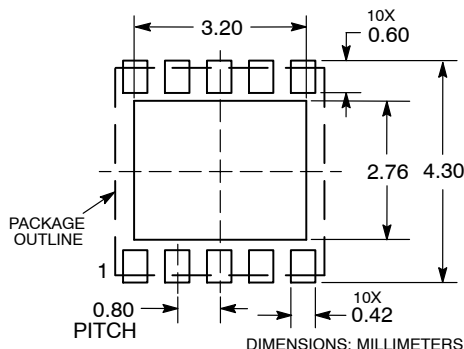


DETAIL B
ALTERNATE
CONSTRUCTIONS



BOTTOM VIEW

RECOMMENDED MOUNTING FOOTPRINT



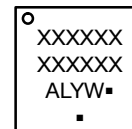
DIMENSIONS: MILLIMETERS

NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.25 AND 0.30 MM FROM THE TERMINAL TIP.
4. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.
5. DETAILS A AND B SHOW OPTIONAL VIEWS FOR END OF TERMINAL LEAD AT EDGE OF PACKAGE.
6. FOR DEVICE OPN CONTAINING W OPTION, DETAIL B ALTERNATE CONSTRUCTION IS NOT APPLICABLE.

DIM	MILLIMETERS	
	MIN	MAX
A	0.70	0.80
A1	0.00	0.05
A3	0.20	REF
b	0.25	0.35
D	4.00	BSC
D2	2.90	3.10
E	4.00	BSC
E2	2.50	2.70
e	0.80	BSC
K	0.30	REF
L	0.30	0.50
L1	0.00	0.15

GENERIC MARKING DIAGRAM*



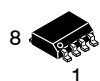
XXXXX = Specific Device Code
 A = Assembly Location
 L = Wafer Lot
 Y = Year
 W = Work Week
 ■ = Pb-Free Package

(Note: Microdot may be in either location)

*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G", may or not be present.

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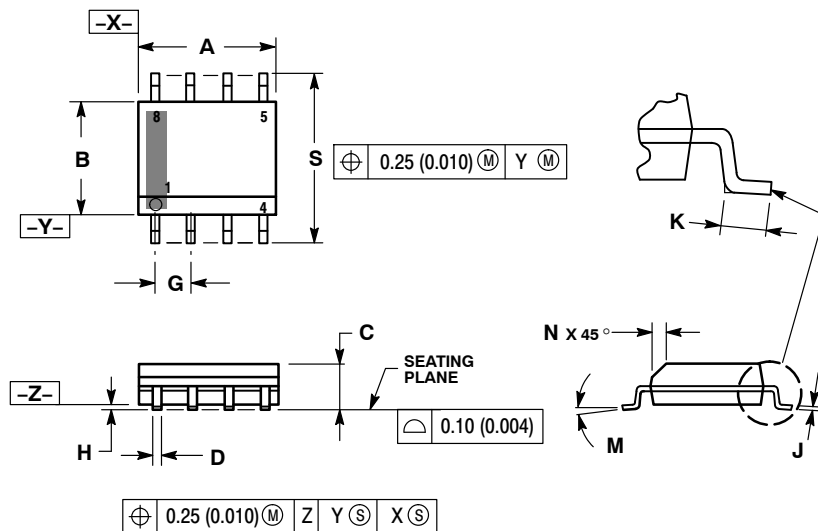
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SCALE 1:1

SOIC-8 NB
CASE 751-07
ISSUE AK

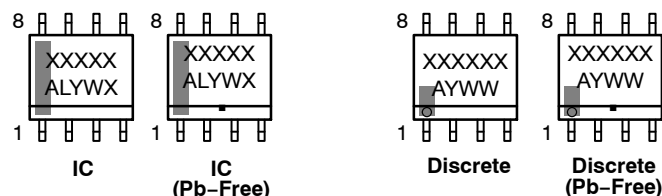
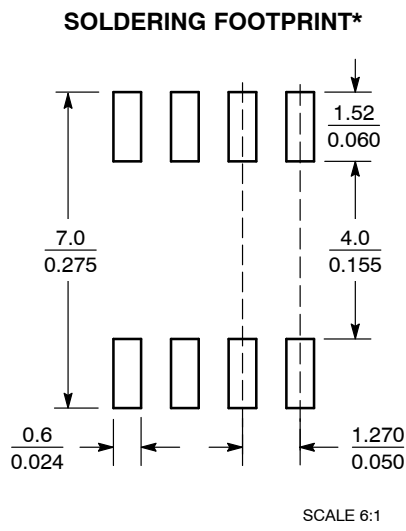
DATE 16 FEB 2011



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.

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

GENERIC
MARKING DIAGRAM*


XXXXXX = 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. 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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