Single Channel 10A High Speed Low-Side MOSFET Driver

NCP81074A, NCP81074B

The NCP81074 is a single channel, low−side MOSFET driver. It is capable of providing large peak currents into capacitive loads. This driver can deliver a 7 A peak current at the Miller plateau region to help reduce the Miller effect during MOSFETs switching transitions. It exhibits a split output configuration allowing the user to control the turn on and turn off slew rates. This part is available in SOIC−8 and DFN8 2x2 mm packages.

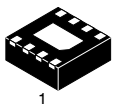
Features

- High Current Drive Capability ±10 A
- TTL/CMOS Compatible Inputs Independent of Supply Voltage
- High Reverse Current Capability (10 A) Peak
- 4 ns Typical Rise and 4 ns Typical Fall Times with 1.8 nF Load
- Fast Propagation Delay Times of 15 ns with Input Falling and 15 ns with Input Rising
- Input Voltage Range from 4.5 V to 20 V
- Split Output Configuration
- Dual Input Design Offering Drive Flexibility
- These Devices are Pb−Free, Halogen Free/BFR Free and are RoHS Compliant

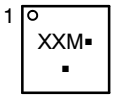
Applications

- Server Power
- Telecommunication, Datacenter Power
- Synchronous Rectifier
- Switch Mode Power Supply
- DC/DC Converter
- Power Factor Correction
- Motor Drive
- Renewable Energy, Solar Inverter

MARKING DIAGRAMS

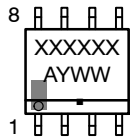


DFN8
MN SUFFIX
CASE 506AA



XX = Specific Device Code
M = Date Code
▪ = Pb−Free Device
(Note: Microdot may be in either location)

SOIC−8
CASE 751



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

ORDERING INFORMATION

See detailed ordering, marking and shipping information on page 2 of this data sheet.

ORDERING INFORMATION

Device	Temperature Range (°C)	Marking	Input Type	Package Type	Shipping†
NCP81074AMNTBG	−40 to +140	CL	Fixed Digital Threshold	DFN8 2x2 (Pb−Free)	3000 / Tape & Reel
NCP81074BMNTBG	−40 to +140	CM	VDD Based Threshold	DFN8 2x2 (Pb−Free)	3000 / Tape & Reel
NCP81074ADR2G	−40 to +140	NCP81074A	Fixed Digital Threshold	SOIC−8 (Pb−Free)	2500 / Tape & Reel
NCP81074BDR2G	−40 to +140	NCP81074B	VDD Based Threshold	SOIC−8 (Pb−Free)	2500 / 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.

BLOCK DIAGRAM

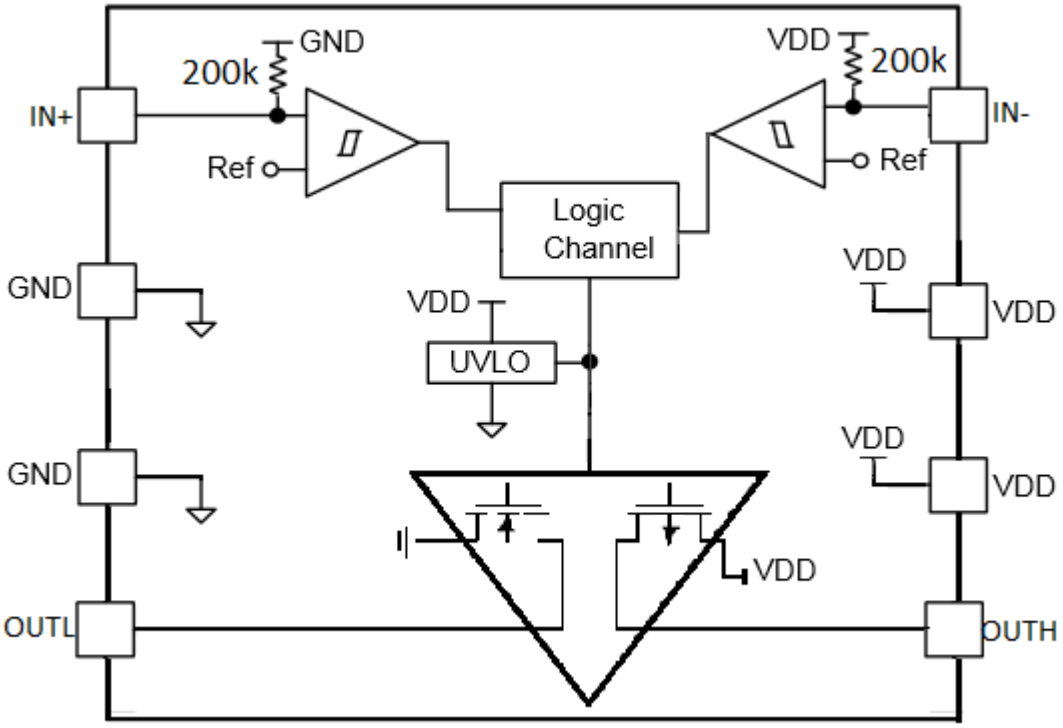


Figure 1. NCP81074 Block Diagram

PIN DESCRIPTION

Pin No.	Symbol	Description
1	IN+	Non−Inverting Input which has logic compatible threshold and hysteresis. If not used, this pin should be connected to VDD. It should not be left unconnected.
2	GND	Common ground. This ground should be connected very closely to the source of the power MOSFET.
3	GND	Common ground. This ground should be connected very closely to the source of the power MOSFET.
4	OUTL	Sink pin. Connect to Gate of MOSFET.
5	OUTH	Source Pin. Connect to Gate of MOSFET.
6	VDD	Power Supply Input Pin.
7	VDD	Power supply Input Pin.
8	IN−	Inverting Input which has logic compatible threshold and hysteresis. If not used, this pin should be connected to GND. It should not be left unconnected.

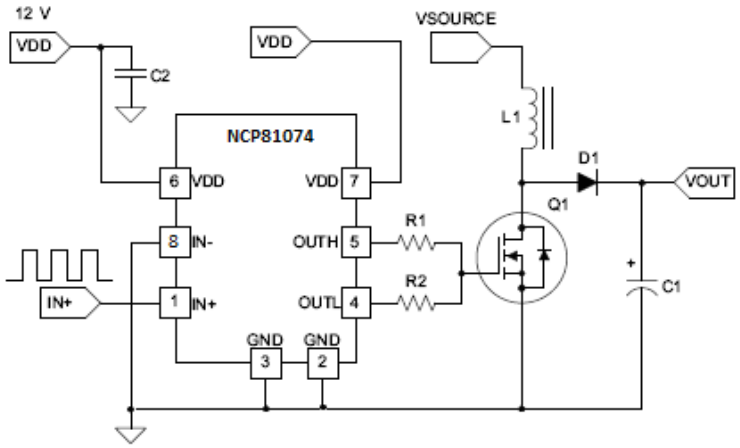


Figure 2. TYPICAL APPLICATION CIRCUIT

ABSOLUTE MAXIMUM RATINGS

Parameter		Value		Unit
		Min	Max	
Supply Voltage	VDD	−0.3	24	V
Output Current (DC)	Iout_dc	0.6		A
Reverse Current (Pulse<1 μs)			10	A
Output Current (Pulse<0.5 μs)	Iout_pulse	10		A
Input Voltage	IN+, IN−	−6	24	V
Output Voltages	OUTH, OUTL	−0.3	VDD + 0.3	V
Output Voltages (Pulse<0.5 μs)	OUTH, OUTL	−3.0	VDD + 3.0	V
Junction Operation Temperature	T_J	−40	150	°C
Storage Temperature	T_{stg}	−65	160	
Electrostatic Discharge	Human body model, HBM	4000		V
	Charge device model, CDM	1000		
OUT Latch−up Protection		500		mA
Moisture Sensitivity Level (MSL)		MSL1		

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.

RECOMMENDED OPERATING CONDITIONS

Parameter	Rating	Unit
VDD supply Voltage	4.5 to 20	V
IN+, IN− input voltages	−5 to 20	V
Junction Temperature Range	−40 to +140	°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.

Table 1. THERMAL INFORMATION

Package	Theta JA (°C/W)	Theta JC (°C/W)
DFN−8 2x2	80.3	11.9
SOIC−8	115	50

Table 2. ELECTRICAL CHARACTERISTICS (Note 1) **(Typical values: V_{DD} =12V, 1uF from VDD to GND,TA = TJ = −40°C to 140°C, typical at T_{AMB} = 25°C, unless otherwise specified)**

Parameter	SYMBOL	Test Conditions	MIN	TYP	MAX	Unit
SUPPLY VOLTAGE						
VDD Under Voltage Lockout (rising)	V_{CCR}	VDD rising	3.7	3.9	4.1	V
VDD Under Voltage Lockout (Falling)	V_{CCF}	VDD falling	3.4	3.6	3.8	V
VDD Under Voltage Lockout (hysteresis)	V_{CCH}			300		mV
Operating Current (no switching)	I_{DD}			1.2	2	mA
VDD Under Voltage Lockout to Output Delay (Note 1)		VDD rising		10		μs
INPUTS						
NCP81074A High Threshold	V_{thH}	Input rising from logic low	1.9	2.1	2.3	V
NCP81074A Low Threshold	V_{thL}	Input falling from logic high	1.1	1.3	1.5	V
VIN_HYS	Input Signal Hysteresis			0.8		V
NCP81074B High Threshold	V_{thH}	Input rising from logic low (VDD = 8 V to 12 V)	VDD −3.5	VDD −3.1	VDD −2.7	V
NCP81074B Low Threshold	V_{thL}	Input falling from logic high (VDD = 8 V to 12 V)	GND +2.6	GND +2.9	GND +3.2	V
IN− Pull−up Resistor	R_{in-}			200		kΩ
IN+ Pull−Down Resistor	R_{in+}			200		kΩ
OUTPUTS						
Output Resistance High	R_{OH}	IOUT = −10 mA		0.4	0.8	Ω
Output Resistance Low	R_{OL}	IOUT = +10 mA		0.4	0.8	Ω
Peak Source Current(2)	I_{Source}	OUT = GND 200 ns Pulse		10		A
Miller Plateau Source Current(2)	I_{Source}	OUT = 5.0 V 200 ns Pulse		7		A
Peak Sink Current(2)	I_{Sink}	OUT = VDD 200 ns Pulse		10		A
Miller Plateau Sink Current(2)	I_{Sink}	OUT = 5.0 V 200 ns Pulse		7		A
SWITCHING CHARACTERISTICS						
Propagation Delay Time Low to High, IN Rising (IN to OUT) (Note 2)	t_{d1}	C_{Load} = 1.8 nF		15	27	ns

Table 2. ELECTRICAL CHARACTERISTICS (Note 1) **(Typical values: V_{DD} =12V, 1uF from VDD to GND,TA = TJ = −40°C to 140°C, typical at T_{AMB} = 25°C, unless otherwise specified)**

Parameter	SYMBOL	Test Conditions	MIN	TYP	MAX	Unit
SWITCHING CHARACTERISTICS						
Propagation Delay Time High to Low, IN Falling (IN to OUT) (Note 2)	t_{d2}	C_{Load} = 1.8 nF		15	27	ns
Rise Time (Note 2)	t_r	C_{Load} = 1.8 nF		4	7	ns
Fall Time (Note 2)	t_f	C_{Load} = 1.8 nF		4	7	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.

1. All Limits are 100% tested at TAMB = 25 °C and guaranteed across temperature by design and statistical analysis.
2. Guaranteed by characterization. *See timing Waveforms.

Table 3. LOGIC TRUTH TABLE

IN+	IN−	OUTH	OUTL	OUT (OUTH & OUTL CONNECTED TOGETHER)
L	L	HIGH−Z	L	L
L	H	HIGH−Z	L	L
H	L	H	HIGH−Z	H
H	H	HIGH−Z	L	L

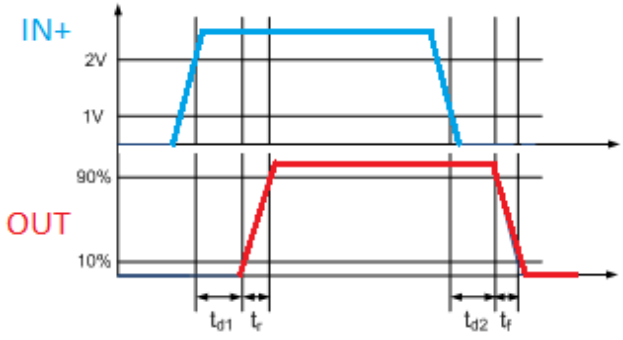


Figure 3. Non−inverting Input Driver Operation

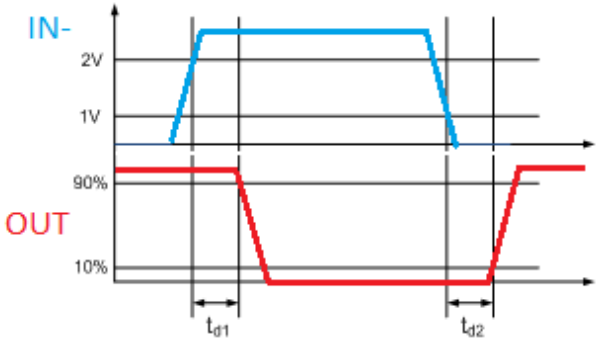


Figure 4. Inverting Input Driver Operation

TYPICAL CHARACTERISTICS

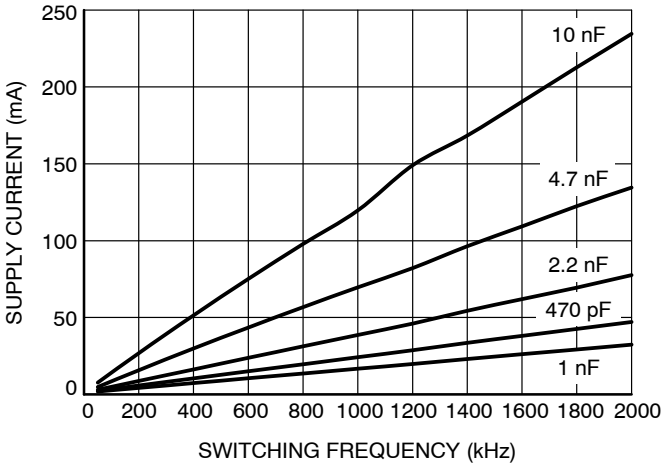


Figure 5. Supply Current vs. Switching Frequency, V_{DD} = 12 V

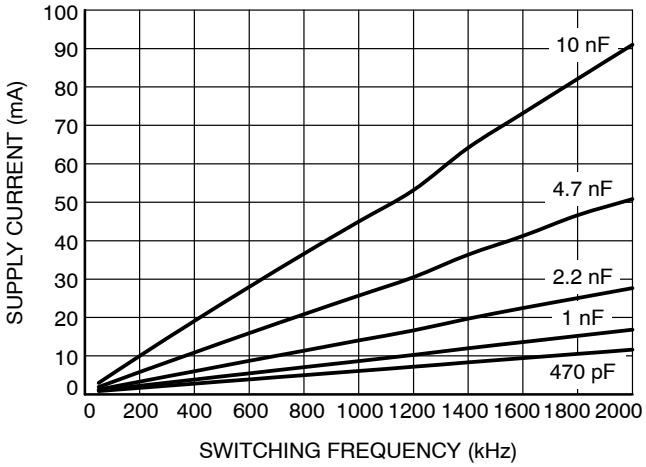


Figure 6. Supply Current vs. Switching Frequency, V_{DD} = 4.5 V

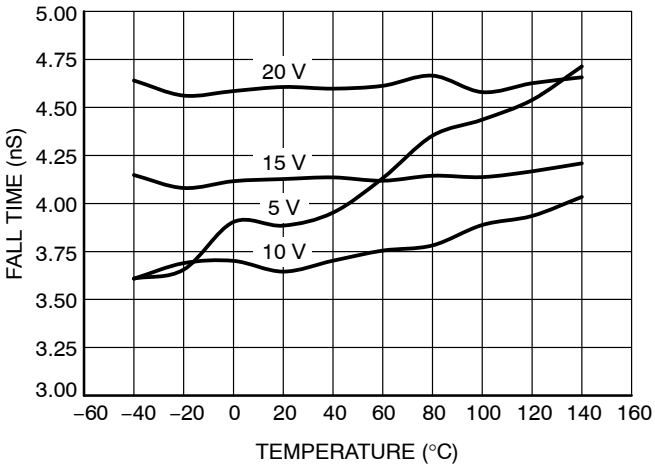


Figure 7. Fall Time vs. Temperature C_{LOAD} = 1.8 nF

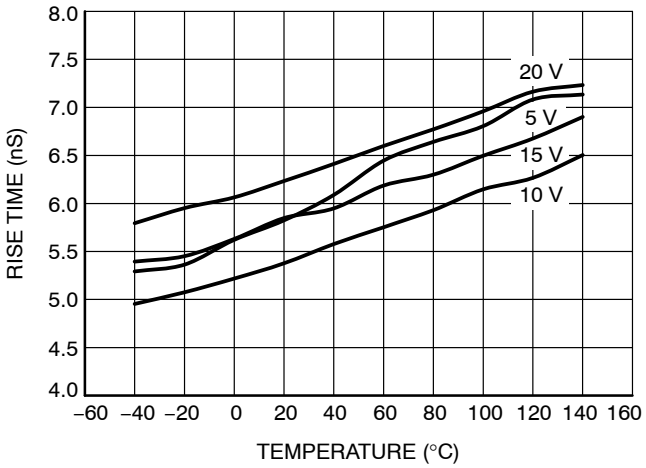


Figure 8. Rise Time vs. Temperature C_{load} = 1.8 nF

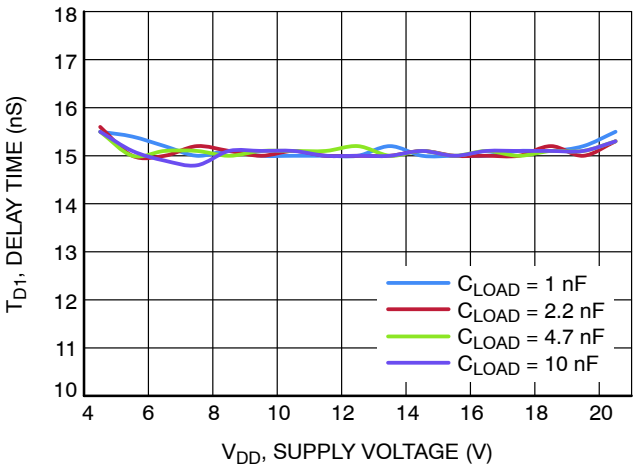


Figure 9. Propagation Delay T_{D1} vs. Supply Voltage

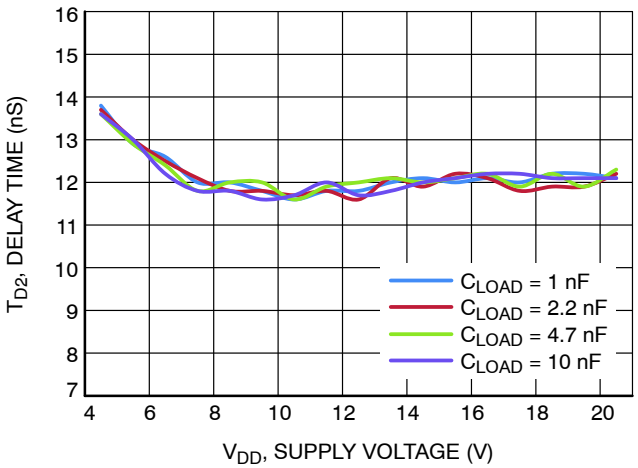


Figure 10. Propagation Delay T_{D2} vs. Supply Voltage

TYPICAL CHARACTERISTICS

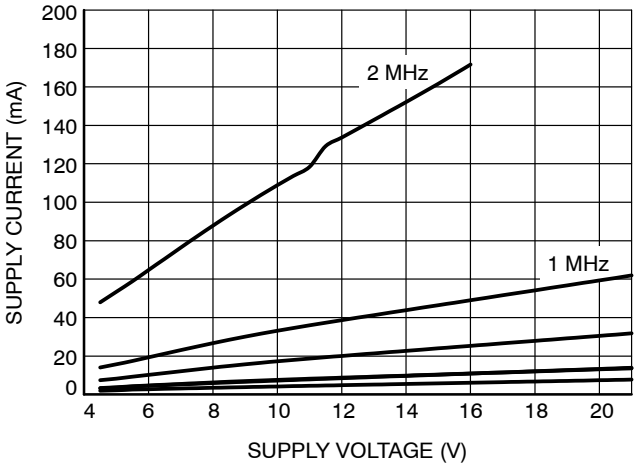


Figure 11. Supply Current vs. Supply Voltage C_{LOAD} = 2.2 nF

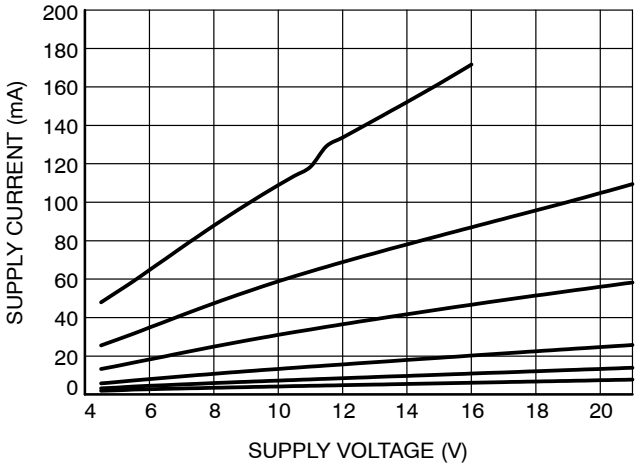


Figure 12. Supply Current vs. Supply Voltage C_{LOAD} = 4.7 nF

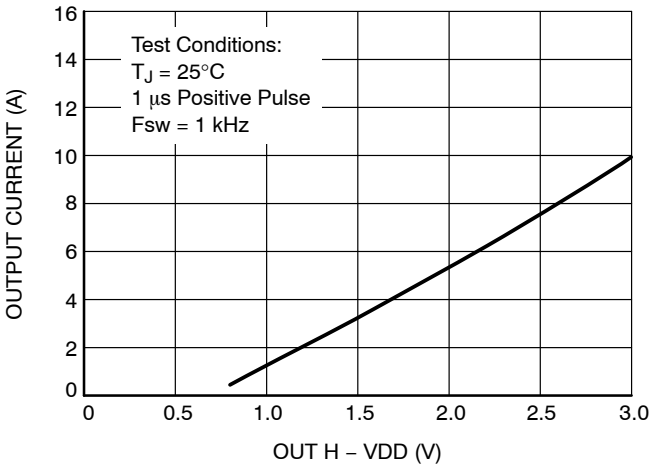


Figure 13. Reverse Current, $P_{MOS(on)}$, $P_{MOS(off)}$

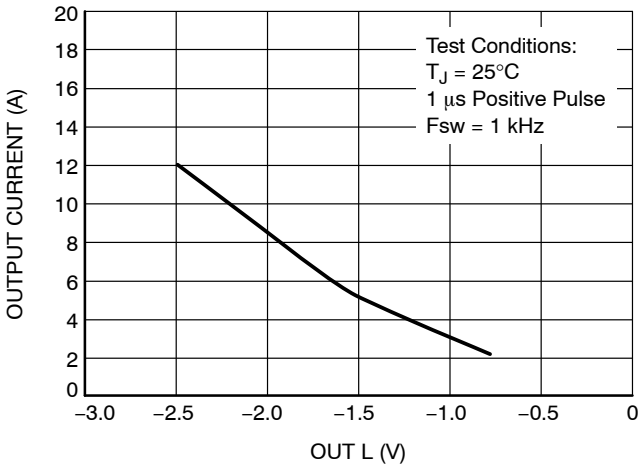


Figure 14. Reverse Current, $P_{MOS(off)}$, $P_{MOS(on)}$

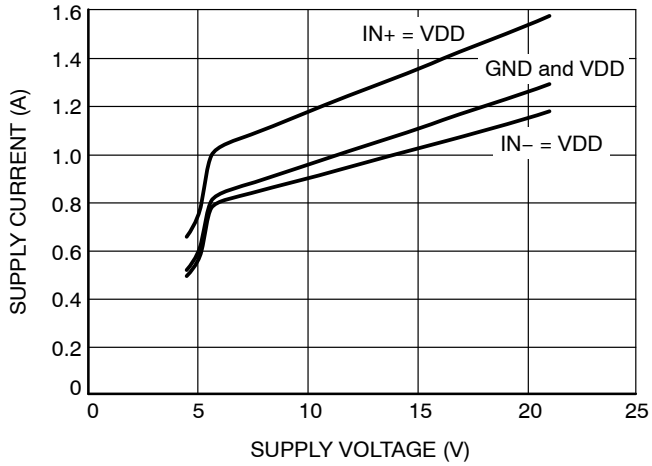


Figure 15. Supply Current vs. Supply Voltage

BENCH WAVEFORMS – NON−INVERTING INPUT

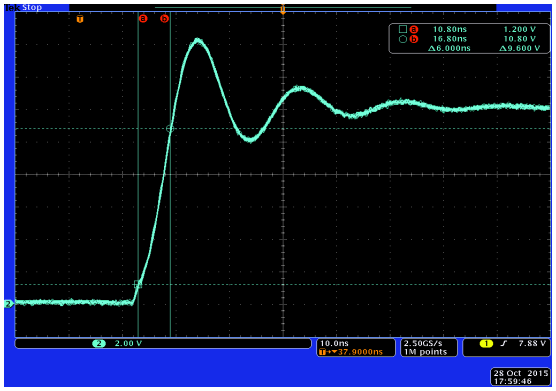


Figure 16. Rise Time with 1.8 nF Load

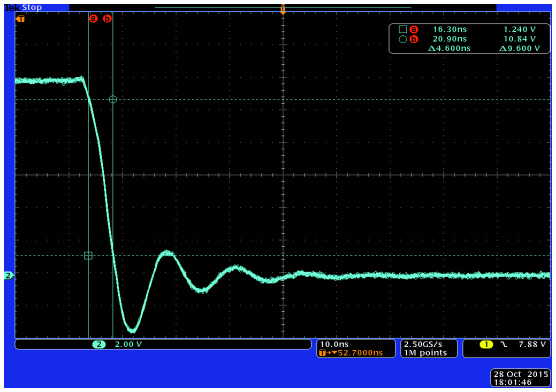


Figure 17. Fall Time with 1.8 nF Load

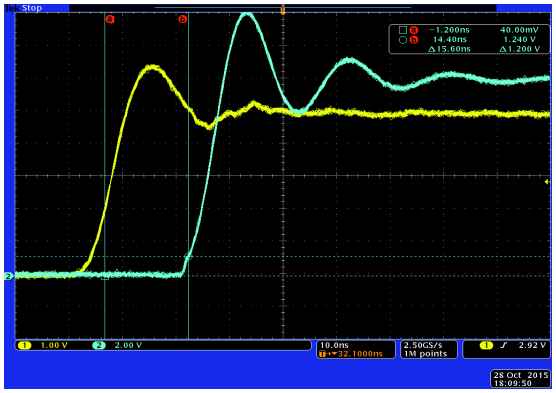


Figure 18. Propagation Delays with 1.8 nF Load

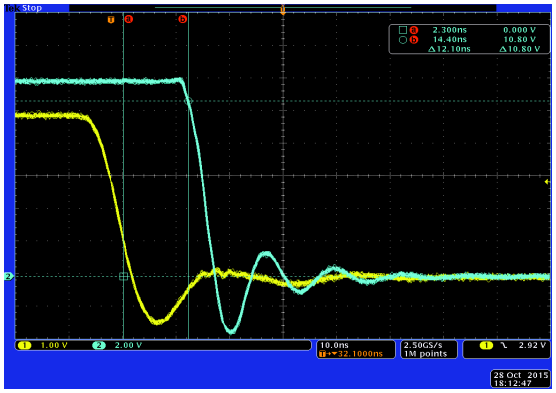


Figure 19. Propagation Delays with 1.8 nF Load

BENCH WAVEFORMS – INVERTING INPUT

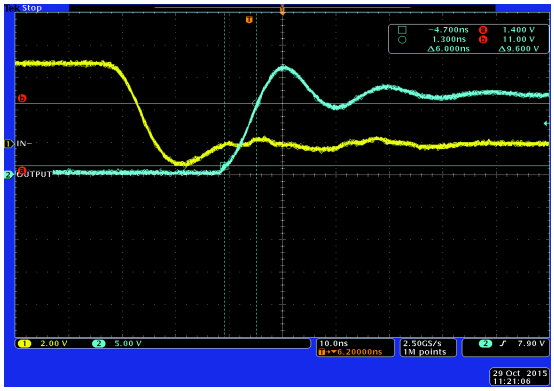


Figure 20. Rise Time with 1.8 nF Load

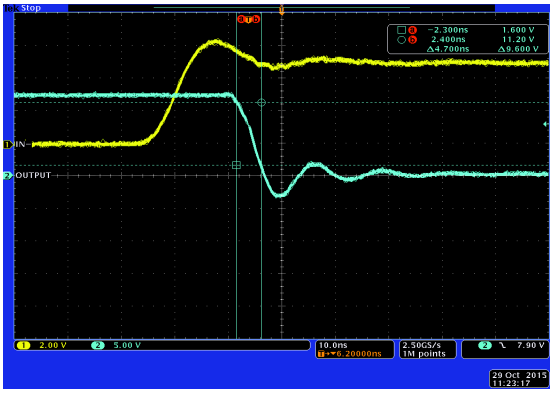


Figure 21. Fall Time with 1.8 nF Load

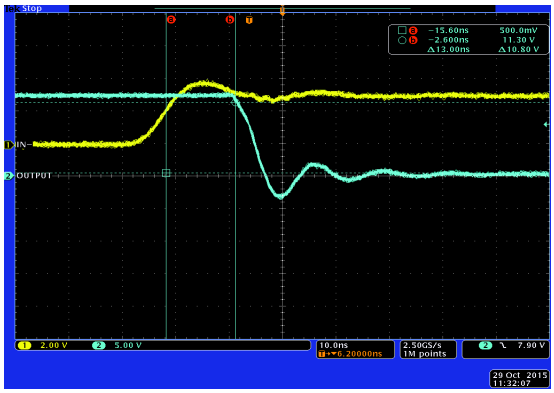


Figure 22. Propagation Delays with 1.8 nF Load

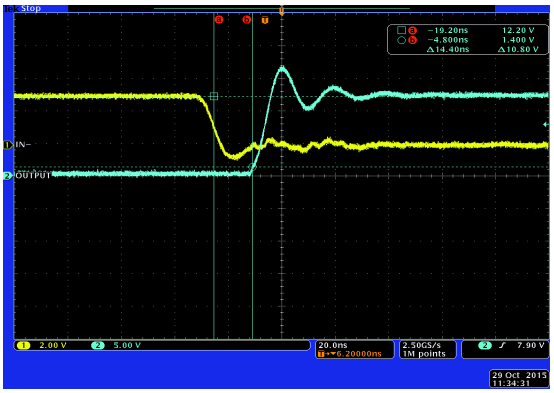


Figure 23. Propagation Delays with 1.8 nF Load

PCB LAYOUT RECOMMENDATION

Proper component placement is extremely important in high current, fast switching applications to provide appropriate device operation and design robustness. The NCP81074 gate driver exhibits a powerful output stage enabling large peak currents with fast rise and fall times. Eventhough the NCP81074 provides a split output configuration for slew rate control, a proper PCB layout is crucial to ensure maximum performance. The following circuit layout guidelines are strongly recommended when designing with the NCP81074.

- Place the driver close to the power MOSFET in order to have a low impedance path between the output pins and the gate. Keep the traces short and wide to minimize the parasitic inductance and accommodate for high peak currents.
- Place the decoupling capacitor close to the gate drive IC. Placing the VDD capacitor close to the pin and ground improves noise filtering. This capacitor supplies high peak currents during the turn−on transition of the MOSFET. Using a low ESL chip capacitor is highly recommended.
- Keep a tight turn−on turn−off current loop paths to minimize parastic inductance. High di/dt will induce voltage spikes on the output pin and the MOSFET gate. Parallel the source and return signals taking advantage of flux cancellation.
- Since the NCP81074 is a 2x2mm package driving high peak currents into capacitive loads, adding a shielding ground plane helps in power dissipation and noise blocking. The ground plane should not be a current carrying path to any of the current loops.
- Any unused pin, should be pulled to either rail depending on the functionality of the pin to avoid any malfunction on the output. Please refer to the pin description table for more information.

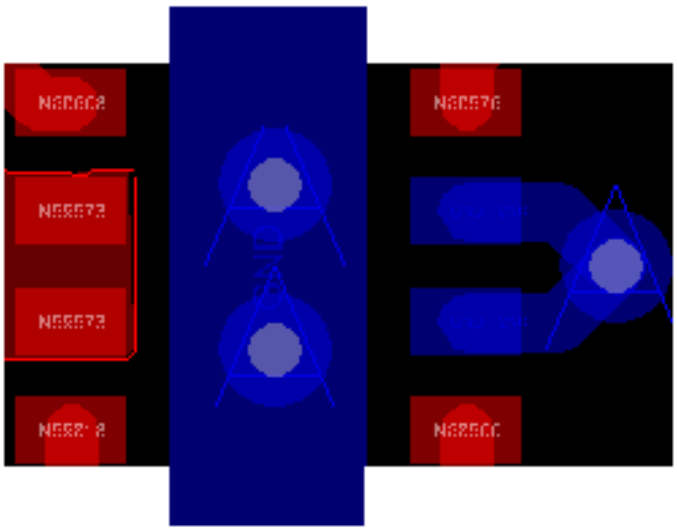
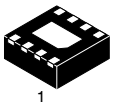


Figure 24.

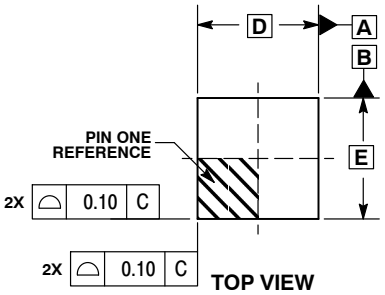
MECHANICAL CASE OUTLINE
PACKAGE DIMENSIONS

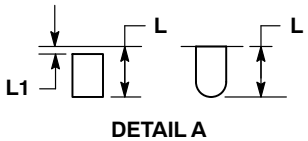


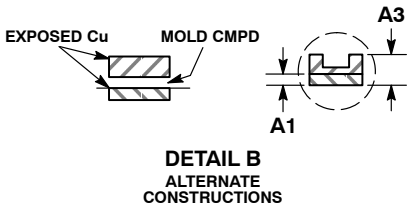
SCALE 4:1

DFN8 2x2, 0.5P
CASE 506AA
ISSUE F

DATE 04 MAY 2016

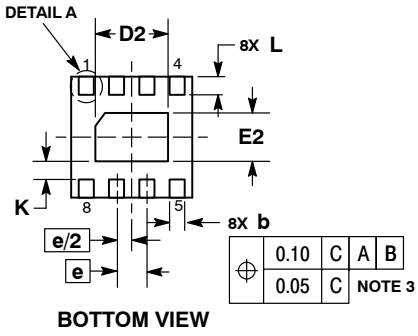




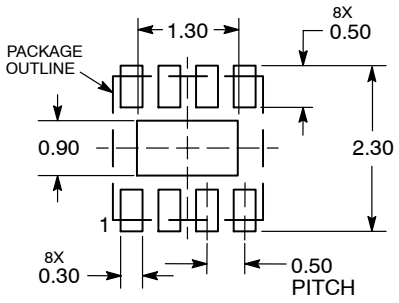


NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994 .
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.15 AND 0.20 MM FROM TERMINAL TIP.
4. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.

	MILLIMETERS	
DIM	MIN	MAX
A	0.80	1.00
A1	0.00	0.05
A3	0.20 REF	
b	0.20	0.30
D	2.00 BSC	
D2	1.10	1.30
E	2.00 BSC	
E2	0.70	0.90
e	0.50 BSC	
K	0.30 REF	
L	0.25	0.35
L1	---	0.10



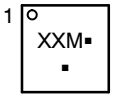
RECOMMENDED SOLDERING FOOTPRINT*



DIMENSIONS: MILLIMETERS

*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*



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M = Date Code
▪ = Pb−Free Device

*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.

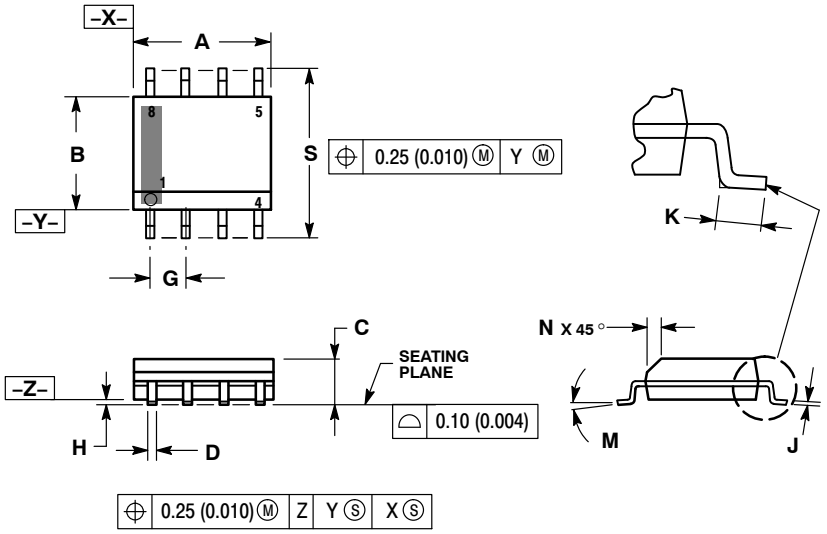
DOCUMENT NUMBER:	**98AON18658D**	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped “CONTROLLED COPY” in red.
DESCRIPTION:	**DFN8, 2.0X2.0, 0.5MM PITCH**	**PAGE 1 OF 1**

MECHANICAL CASE OUTLINE
PACKAGE DIMENSIONS

SCALE 1:1

SOIC−8 NB
CASE 751−07
ISSUE AK

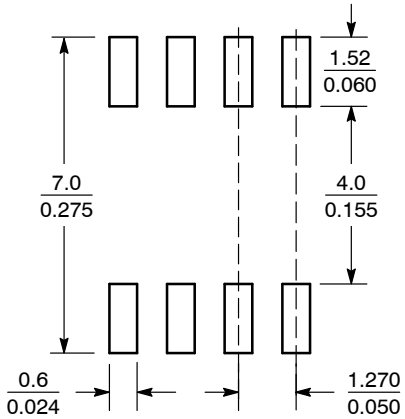
DATE 16 FEB 2011



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

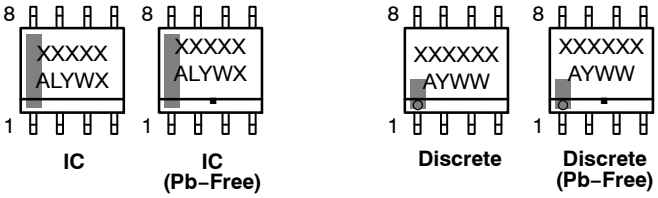
SOLDERING FOOTPRINT*



SCALE 6:1 (mm / inches)

*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*



IC | IC (Pb−Free) | Discrete | Discrete (Pb−Free)

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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DESCRIPTION:	**SOIC−8 NB**		**PAGE 2 OF 2**

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