TinyLogic UHS 3-Input NAND Gate

NC7SZ10

Description

The NC7SZ10 is a single 3−Input NAND Gate from **onsemi**'s Ultra High Speed Series of TinyLogic. The device is fabricated with advanced CMOS technology to achieve ultra high speed with high output drive while maintaining low static power dissipation over a broad V_{CC} operating range. The device is specified to operate over the 1.65 V to 5.5 V V_{CC} operating range. The inputs and output are high impedance when V_{CC} is 0 V. Inputs tolerate voltages up to 5.5 V independent of V_{CC} operating voltage.

Features

- Space Saving SC88 6−Lead Package
- Ultra Small MicroPak™ Leadless Package
- Ultra High Speed: t_{PD} = 2.4 ns Typ into 50 pF at 5 V V_{CC}
- High Output Drive: ±24 mA at 3 V V_{CC}
- Broad V_{CC} Operating Range: 1.65 V – 5.5 V
- Power Down High Impedance Inputs / Output
- Overvoltage Tolerant Inputs Facilitate 5 V to 3 V Translation
- Patented Noise / EMI Reduction Circuitry Implemented
- These Devices are Pb−Free, Halogen Free/BFR Free and are RoHS Compliant

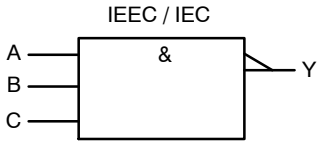
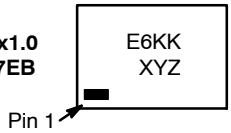


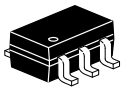
Figure 1. Logic Symbol

MARKING DIAGRAMS

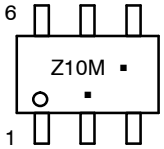


SIP6 1.45x1.0
CASE 127EB





SC−88
CASE 419B−02



E6, Z10	= Specific Device Code
KK	= 2−Digit Lot Run Traceability Code
XY	= 2−Digit Date Code Format
Z	= Assembly Plant Code
M	= Data Code*
▪	= Pb−Free Package

(Note: Microdot may be in either location)

* Date Code orientation and/or position may vary depending upon manufacturing location.

ORDERING INFORMATION

See detailed ordering, marking and shipping information in the package dimensions section on page 6 of this data sheet.

NOTE: Some of the devices on this data sheet have been **DISCONTINUED**. Please refer to the table on page 6.

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Connection Diagrams

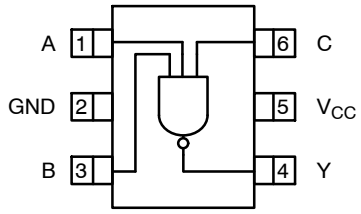


Figure 2. SC−88 (Top View)

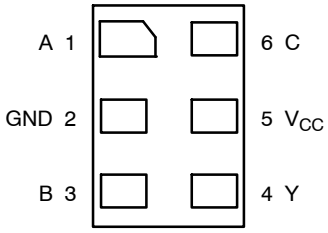
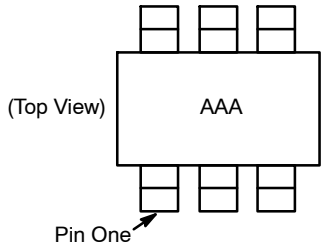


Figure 4. MicroPak (Top Through View)



AAA represents Product Code Top Mark − see ordering code.
NOTE: Orientation of Top Mark determines Pin One location. Read the Top Product Code Mark left to right, Pin One is the lower left pin (see diagram).

Figure 3. Pin 1 Orientation

PIN DESCRIPTIONS

Pin Name	Description
A, B, C	Inputs
Y	Output

FUNCTION TABLE (Y = $\overline{ABC}$)

Inputs			Output
A	**B**	**C**	**Y**
X	X	L	H
X	L	X	H
L	X	X	H
H	H	H	L

H = HIGH Logic Level
L = LOW Logic Level
X = Either LOW or HIGH Logic Level

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter		Min	Max	Unit
V_{CC}	Supply Voltage		−0.5	6.5	V
V_{IN}	DC Input Voltage		−0.5	6.5	V
V_{OUT}	DC Output Voltage		−0.5	6.5	V
I_{IK}	DC Input Diode Current	V_{IN} < 0 V	−	−50	mA
I_{OK}	DC Output Diode Current	V_{OUT} < 0 V	−	−50	mA
I_{OUT}	DC Output Current		−	±50	mA
I_{CC} / I_{GND}	DC V_{CC} / GND Current		−	±50	mA
T_{STG}	Storage Temperature		−65	+150	°C
T_J	Junction Temperature under Bias		−	+150	°C
T_L	Junction Lead Temperature (Soldering, 10 Seconds)		−	+260	°C

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P_D	Power Dissipation in Still Air	SC−88A	−	332	mW
		MicroPak−6	−	812	

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

Symbol	Parameter	Conditions	Min	Max	Unit
V_{CC}	Supply Voltage Operating		1.65	5.5	V
	Supply Voltage Data Retention		1.5	5.5	
V_{IN}	Input Voltage		0	5.5	V
V_{OUT}	Output Voltage		0	V_{CC}	V
T_A	Operating Temperature		−40	+85	°C
t_r, t_f	Input Rise and Fall Time	V_{CC} @ 1.8 V, 2.5 V ±0.2 V	0	20	ns/V
		V_{CC} @ 3.3 V ±0.3 V	0	10	
		V_{CC} @ 5.0 V ±0.5 V	0	5	
θ_{JA}	Thermal Resistance	SC70−5	−	377	°C/W
		MicroPak−6	−	154	

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.

1. Unused inputs must be held HIGH or LOW. They may not float.

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DC ELECTICAL CHARACTERISTICS

Symbol	Parameter	V_{CC} (V)	Conditions		T_A = +25°C			T_A = −40 to +85°C		Unit
					Min	Typ	Max	Min	Max	
V_{IH}	HIGH Level Input Voltage	1.65 to 1.95			0.65 V_{CC}	–	–	0.65 V_{CC}	–	V
		2.3 to 5.5			0.70 V_{CC}	–	–	0.70 V_{CC}	–	
V_{IL}	LOW Level Input Voltage	1.65 to 1.95			–	–	0.35 V_{CC}	–	0.35 V_{CC}	V
		2.3 to 5.5			–	–	0.30 V_{CC}	–	0.30 V_{CC}	
V_{OH}	HIGH Level Output Voltage	1.65	V_{IN} = V_{IH} or V_{IL}	I_{OH} = −100 μA	1.55	1.65	–	1.55	–	V
		2.3			2.2	2.3	–	2.2	–	
		3.0			2.9	3.0	–	2.9	–	
		4.5			4.4	4.5	–	4.4	–	
		1.65		I_{OH} = −4 mA	1.29	1.52	–	1.29	–	
		2.3		I_{OH} = −8 mA	1.9	2.15	–	1.9	–	
		3.0		I_{OH} = −16 mA	2.4	2.80	–	2.4	–	
		3.0		I_{OH} = −24 mA	2.3	2.68	–	2.3	–	
		4.5		I_{OH} = −32 mA	3.8	4.20	–	3.8	–	
V_{OL}	LOW Level Output Voltage	1.65	V_{IN} = V_{IH} or V_{IL}	I_{OL} = 100 μA	–	0.0	0.1	–	0.1	V
		2.3			–	0.0	0.1	–	0.1	
		3.0			–	0.0	0.1	–	0.1	
		4.5			–	0.0	0.1	–	0.1	
		1.65		I_{OL} = 4 mA	–	0.08	0.24	–	0.24	
		2.3		I_{OL} = 8 mA	–	0.10	0.3	–	0.3	
		3.0		I_{OL} = 16 mA	–	0.15	0.4	–	0.4	
		3.0		I_{OL} = 24 mA	–	0.22	0.55	–	0.55	
		4.5		I_{OL} = 32 mA	–	0.22	0.55	–	0.55	
I_{IN}	Input Leakage Current	1.65 to 5.5	V_{IN} = 5.5 V, GND		–	–	±1	–	±10	μA
I_{OFF}	Power Off Leakage Current	0.0	V_{IN} or V_{OUT} = 5.5 V		–	–	1	–	10	μA
I_{CC}	Quiescent Supply Current	1.65 to 5.5	V_{IN} = 5.5 V, GND		–	–	2.0	–	20	μA

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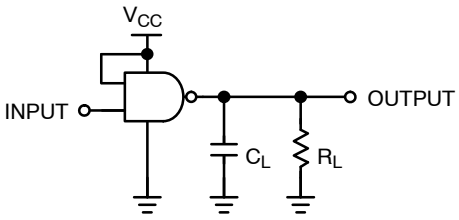
AC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	V_{CC} (V)	Conditions	T_A = +25°C			T_A = −40 to +85°C		Unit
				Min	Typ	Max	Min	Max	
t_{PLH}, t_{PHL}	Propagation Delay (Figure 5, 7)	1.8 ±0.15	C_L = 15 pF, R_L = 1 MΩ	–	7.0	17.5	–	18.0	ns
		2.5 ±0.2		–	3.0	10.5	–	11.0	
		3.3 ±0.3		–	2.4	7.5	–	8.0	
		5.0 ±0.5		–	2.0	5.5	–	6.0	
		3.3 ±0.3	C_L = 50 pF, R_L = 500 Ω	–	2.9	8.5	–	9.0	
		5.0 ±0.5		–	2.4	7.5	–	8.0	
C_{IN}	Input Capacitance	0		–	4	–	–	–	pF
C_{PD}	Power Dissipation Capacitance (Figure 6)	3.3	(Note 2)	–	24	–	–	–	pF
		5.0		–	30	–	–	–	

2. C_{PD} is defined as the value of the internal equivalent capacitance which is derived from dynamic operating current consumption (I_{CCD}) at no output loading and operating at 50% duty cycle.(See Figure 6) C_{PD} is related to I_{CCD} dynamic operating current by the expression: I_{CCD} = (C_{PD}) (V_{CC}) (f_{IN}) + (I_{CC}static).

AC Loading and Waveforms



C_L includes load and stray capacitance
Input PRR = 1.0 MHz, t_W = 500 ns.

Figure 5. AC Test Circuit

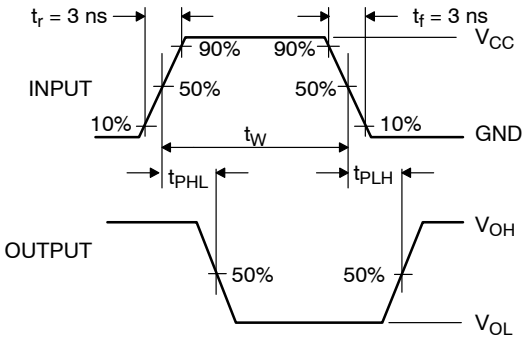
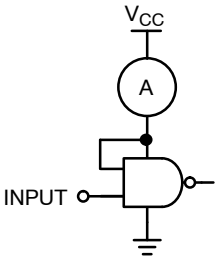


Figure 7. AC Waveforms



Input = AC Waveform; t_r = t_f = 1.8 ns;
PRR = 10 MHz; Duty Cycle = 50%.

Figure 6. I_{CCD} Test Circuit

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DEVICE ORDERING INFORMATION

Device	Top Mark	Packages	Shipping†
NC7SZ10P6X	Z10	6−Lead SC70, EIAJ SC88, 1.25 mm Wide	3000 / Tape & Reel

DISCONTINUED (Note 3)

NC7SZ10P6X−L22347	Z10	6−Lead SC70, EIAJ SC88, 1.25 mm Wide	3000 / Tape & Reel
NC7SZ10L6X	E6	6−Lead MicroPak, 1.00 mm Wide	5000 / 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.

3. **DISCONTINUED:** These devices are not available. Please contact your **onsemi** representative for information. The most current information on these devices may be available on www.onsemi.com.

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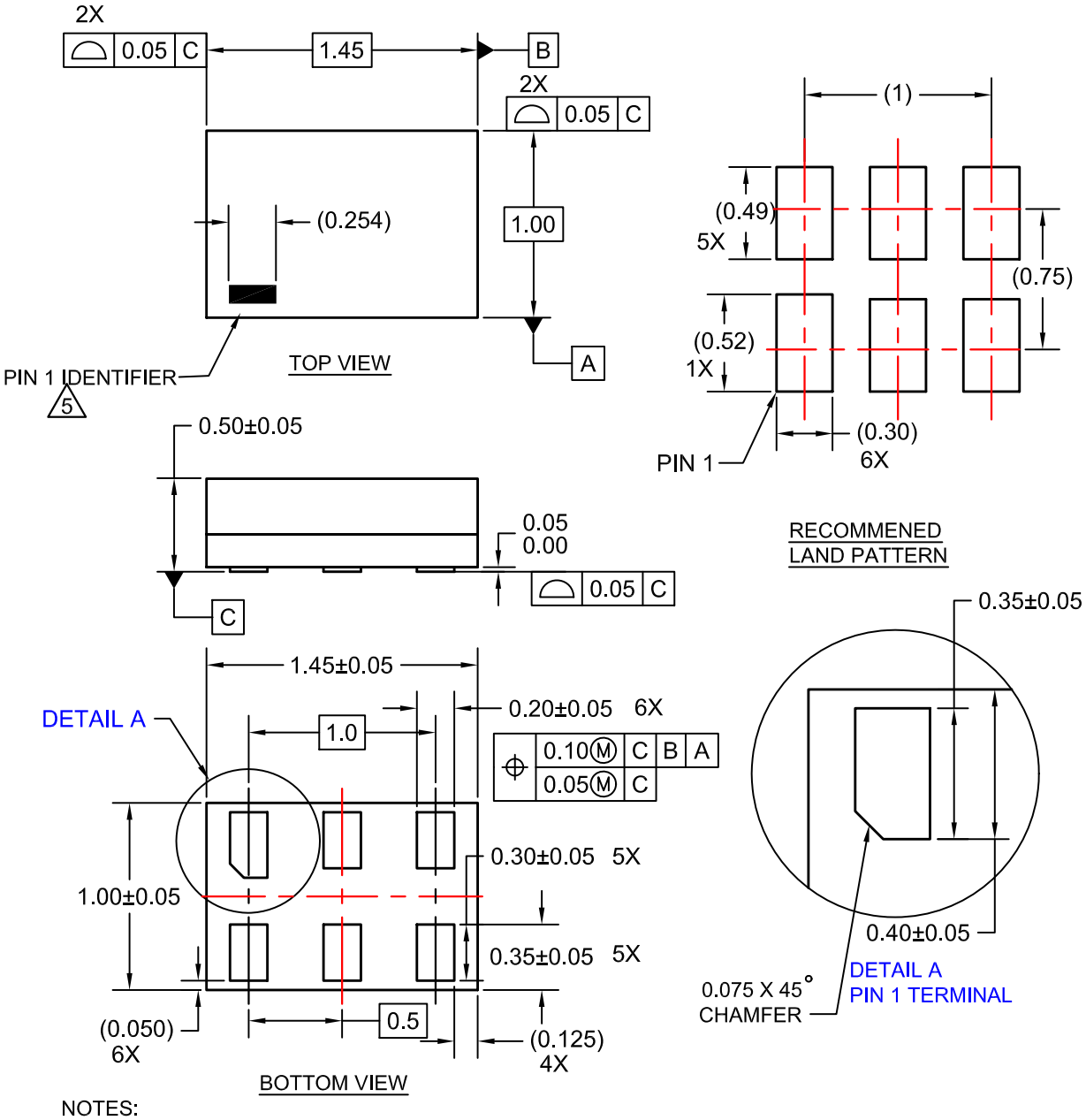
ISSUE O

DATE 31 AUG 2016



NOTES:

1. CONFORMS TO JEDEC STANDARD MO-252 VARIATION UAAD
2. DIMENSIONS ARE IN MILLIMETERS
3. DRAWING CONFORMS TO ASME Y14.5M-2009
4. PIN ONE IDENTIFIER IS 2X LENGTH OF ANY OTHER LINE IN THE MARK CODE LAYOUT.

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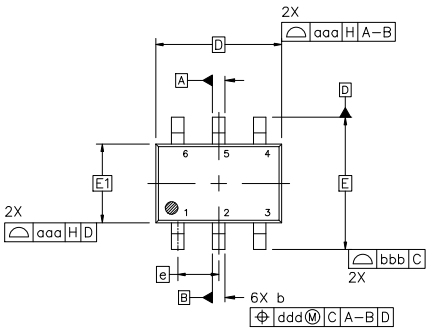
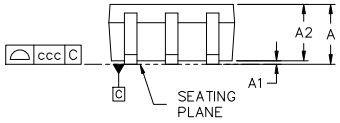
SC−88 2.00x1.25x0.90, 0.65P
CASE 419B−02
ISSUE Z

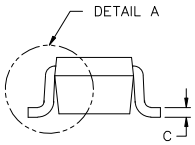
DATE 18 APR 2024



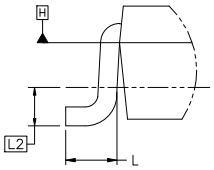
TOP VIEW



SIDE VIEW



END VIEW

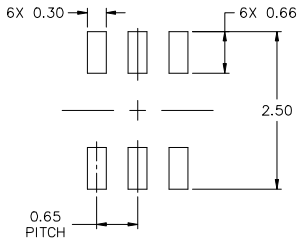


DETAIL A
SCALE 2:1

NOTES:

1. DIMENSIONING AND TOLERANCING CONFORM TO ASME Y14.5−2018.
2. ALL DIMENSION ARE IN MILLIMETERS.
3. DIMENSIONS D AND E1 DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS. MOLD FLASH, PROTRUSIONS, OR GATE BURRS SHALL NOT EXCEED 0.20 PER END.
4. DIMENSIONS D AND E1 AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY AND DATUM H.
5. DATUMS A AND B ARE DETERMINED AT DATUM H.
6. DIMENSIONS b AND c APPLY TO THE FLAT SECTION OF THE LEAD BETWEEN 0.08 AND 0.15 FROM THE TIP.
7. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 TOTAL IN EXCESS OF DIMENSION b AT MAXIMUM MATERIAL CONDITION. THE DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OF THE FOOT.

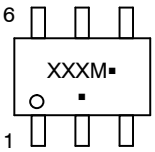
	MILLIMETERS		
DIM	MIN.	NOM.	MAX.
A	−−−	−−−	1.10
A1	0.00	−−−	0.10
A2	0.70	0.90	1.00
b	0.15	0.20	0.25
c	0.08	0.15	0.22
D	2.00 BSC		
E	2.10 BSC		
E1	1.25 BSC		
e	0.65 BSC		
L	0.26	0.36	0.46
L2	0.15 BSC		
aaa	0.15		
bbb	0.30		
ccc	0.10		
ddd	0.10		



RECOMMENDED MOUNTING FOOTPRINT*

* FOR ADDITIONAL INFORMATION ON OUR Pb−FREE STRATEGY AND SOLDERING DETAILS, PLEASE DOWNLOAD THE ONSEMI SOLDERING AND MOUNTING TECHNIQUES REFERENCE MANUAL, SOLDERRM/D.

GENERIC MARKING DIAGRAM*



XXX = Specific Device Code
M = Date Code*
▪ = Pb−Free Package

(Note: Microdot may be in either location)

*Date Code orientation and/or position may vary depending upon manufacturing 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. Some products may not follow the Generic Marking.

STYLES ON PAGE 2

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SC−88 2.00x1.25x0.90, 0.65P
CASE 419B−02
ISSUE Z

DATE 18 APR 2024

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

STYLE 2:
CANCELLED

STYLE 3:
CANCELLED

STYLE 4:
PIN 1. CATHODE
2. CATHODE
3. COLLECTOR
4. EMITTER
5. BASE
6. ANODE

STYLE 5:
PIN 1. ANODE
2. ANODE
3. COLLECTOR
4. EMITTER
5. BASE
6. CATHODE

STYLE 6:
PIN 1. ANODE 2
2. N/C
3. CATHODE 1
4. ANODE 1
5. N/C
6. CATHODE 2

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

STYLE 8:
CANCELLED

STYLE 9:
PIN 1. EMITTER 2
2. EMITTER 1
3. COLLECTOR 1
4. BASE 1
5. BASE 2
6. COLLECTOR 2

STYLE 10:
PIN 1. SOURCE 2
2. SOURCE 1
3. GATE 1
4. DRAIN 1
5. DRAIN 2
6. GATE 2

STYLE 11:
PIN 1. CATHODE 2
2. CATHODE 2
3. ANODE 1
4. CATHODE 1
5. CATHODE 1
6. ANODE 2

STYLE 12:
PIN 1. ANODE 2
2. ANODE 2
3. CATHODE 1
4. ANODE 1
5. ANODE 1
6. CATHODE 2

STYLE 13:
PIN 1. ANODE
2. N/C
3. COLLECTOR
4. EMITTER
5. BASE
6. CATHODE

STYLE 14:
PIN 1. VREF
2. GND
3. GND
4. IOUT
5. VEN
6. VCC

STYLE 15:
PIN 1. ANODE 1
2. ANODE 2
3. ANODE 3
4. CATHODE 3
5. CATHODE 2
6. CATHODE 1

STYLE 16:
PIN 1. BASE 1
2. EMITTER 2
3. COLLECTOR 2
4. BASE 2
5. EMITTER 1
6. COLLECTOR 1

STYLE 17:
PIN 1. BASE 1
2. EMITTER 1
3. COLLECTOR 2
4. BASE 2
5. EMITTER 2
6. COLLECTOR 1

STYLE 18:
PIN 1. VIN1
2. VCC
3. VOUT2
4. VIN2
5. GND
6. VOUT1

STYLE 19:
PIN 1. I OUT
2. GND
3. GND
4. V CC
5. V EN
6. V REF

STYLE 20:
PIN 1. COLLECTOR
2. COLLECTOR
3. BASE
4. EMITTER
5. COLLECTOR
6. COLLECTOR

STYLE 21:
PIN 1. ANODE 1
2. N/C
3. ANODE 2
4. CATHODE 2
5. N/C
6. CATHODE 1

STYLE 22:
PIN 1. D1 (i)
2. GND
3. D2 (i)
4. D2 (c)
5. VBUS
6. D1 (c)

STYLE 23:
PIN 1. Vn
2. CH1
3. Vp
4. N/C
5. CH2
6. N/C

STYLE 24:
PIN 1. CATHODE
2. ANODE
3. CATHODE
4. CATHODE
5. CATHODE
6. CATHODE

STYLE 25:
PIN 1. BASE 1
2. CATHODE
3. COLLECTOR 2
4. BASE 2
5. EMITTER
6. COLLECTOR 1

STYLE 26:
PIN 1. SOURCE 1
2. GATE 1
3. DRAIN 2
4. SOURCE 2
5. GATE 2
6. DRAIN 1

STYLE 27:
PIN 1. BASE 2
2. BASE 1
3. COLLECTOR 1
4. EMITTER 1
5. EMITTER 2
6. COLLECTOR 2

STYLE 28:
PIN 1. DRAIN
2. DRAIN
3. GATE
4. SOURCE
5. DRAIN
6. DRAIN

STYLE 29:
PIN 1. ANODE
2. ANODE
3. COLLECTOR
4. EMITTER
5. BASE/ANODE
6. CATHODE

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

Note: Please refer to datasheet for style callout. If style type is not called out in the datasheet refer to the device datasheet pinout or pin assignment.

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