# Digital FET, Dual N & P Channel

## FDG6320C

## **General Description**

These dual N & P-Channel logic level enhancement mode field effect transistors are produced using ON Semiconductor's proprietary, high cell density, DMOS technology, this very high density process is especially tailored to minimize on-state resistance. This device has been designed especially for low voltage applications as a replacement for bipolar digital transistors and small signal MOSFETS. Since bias resistors are not required, this dual digital FET can replace several different digital transistors, with different bias resistor values.

## Features

- N-Ch 0.22 A, 0.25 V
  - $R_{DS(ON)} = 4.0 \Omega @ V_{GS} = 4.5 V$
  - $R_{DS(ON)} = 5.0 \Omega @ V_{GS} = 2.7 V$
- P-Ch -0.14 A, -25 V
  - $R_{DS(ON)} = 10 \Omega @ V_{GS} = -4.5 V$
  - $R_{DS(ON)} = 13 \ \Omega @ V_{GS} = -2.7 \ V$
- Very Small Package Outline SC70–6
- Very Low Level Gate Drive Requirements Allowing Direct Operation in 3 V Circuits (V<sub>GS(th)</sub> < 1.5 V)
- Gate–Source Zener for ESD Ruggedness (>6 kV Human Body Model)
- These Devices are Pb-Free and are RoHS Compliant

Symbol	Param	neter 🗸 😏	N-Channel	P-Channel	Units
V <sub>DSS</sub>	Drain-Source Voltage		25	-25	V
V <sub>GSS</sub>	Gate-Source V	oltage	8	-8	V
I <sub>D</sub>	Drain Current	Continuous	0.22	-0.14	А
<	HIS	Pulsed	0.65	-0.4	
P <sub>D</sub>	Maximum Powe (Note 1)	er Dissipation	0.3		W
T <sub>J</sub> , T <sub>STG</sub>		Operating and Storage Temperature Range		–55 to 150	
ESD	Electrostatic Discharge Rating MIL–STD–883D Human Body Model (100 pF / 1500 Ω)		6		kV

## ABSOLUTE MAXIMUM RATINGS (TA = 25°C unless otherwise noted)

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.



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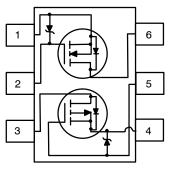


20M

= Specific Device Code = Assembly Operation Month

## PIN CONNECTIONS

M



## **ORDERING INFORMATION**

See detailed ordering and shipping information on page 8 of this data sheet.

## **THERMAL CHARACTERISTICS**

Symbol	Parameter	Ratings	Unit
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient (Note 1)	415	°C/W

R<sub>θJA</sub> is the sum of the junction-to-case and case-to-ambient thermal resistance where the case thermal reference is defined as the solder mounting surface of the drain pins. R<sub>θJC</sub> is guaranteed by design while R<sub>θCA</sub> is determined by the user's board design. R<sub>θJA</sub> = 415°C/W on minimum pad mounting on FR-4 board in still air.

#### ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 25°C unless otherwise noted)

Symbol	Parameter	Conditions	Туре	Min	Тур	Max	Unit	
OFF CHARACTERISTICS								
BV <sub>DSS</sub>	Drain-Source Breakdown Voltage	$V_{GS}$ = 0 V, $I_D$ = 250 $\mu$ A	N-Ch	25	-	-	V	
		$V_{GS}$ = 0 V, $I_D$ = –250 $\mu$ A	P-Ch	-25	-	-		
$\Delta \text{BV}_{\text{DSS}} / \Delta \text{T}_{\text{J}}$	Breakdown Voltage Temperature	$I_D$ = 250 $\mu$ A, Referenced to 25°C	N-Ch	-	25	-	mV/°C	
	Coefficient	$I_D = -250 \ \mu\text{A}$ , Referenced to $25^{\circ}\text{C}$	P-Ch	1 (	-19	-		
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	$V_{DS} = 20 \text{ V}, V_{GS} = 0 \text{ V}$	N-Ch	F	-	. C.	μA	
		$V_{DS}$ = 20 V, $V_{GS}$ = 0 V, $T_{J}$ = 55 $^{\circ}C$		- /	-20	10		
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	$V_{DS} = -20 \text{ V}, V_{GS} = 0 \text{ V}$	P-Ch	-	$\Theta^{\vee}$	-1	μA	
		$V_{DS}$ = -20 V, $V_{GS}$ = 0 V, $T_{J}$ = 55°C		(SV	_	-10		
I <sub>GSS</sub>	Gate-Body Leakage Current	$V_{GS}$ = 8 V, $V_{DS}$ = 0 V	N-Ch	<u> 1-</u>	-	100	nA	
		$V_{GS} = -8 \text{ V}, V_{DS} = 0 \text{ V}$	P-Ch	1	4	-100		
N CHARACTERISTICS (Note 2)								

#### **ON CHARACTERISTICS** (Note 2)

V <sub>GS(th)</sub>	Gate Threshold Voltage	$V_{DS} = V_{GS}$ , $I_D = 250 \ \mu A$	N-Ch	0.65	0.85	1.5	V
		$V_{DS} = V_{GS}, I_D = -250 \mu A$	P-Ch	-0.65	-0.82	-1.5	
$\Delta V_{GS(th)}/\Delta T_J$	Gate Threshold Voltage	$I_D = 250 \ \mu A$ , Referenced to $25^{\circ}C$	N-Ch	-	-2.1	-	mV/°C
	Temperature Coefficient	$I_D = -250 \ \mu A$ , Referenced to 25°C	P-Ch	-	2.1	-	
R <sub>DS(ON)</sub>	Static Drain-Source	$V_{GS} = 4.5 \text{ V}, I_D = 0.22 \text{ A}$	N-Ch	-	2.6	4	Ω
	On-Resistance	V <sub>GS</sub> = 4.5 V, I <sub>D</sub> = 0.22 A, T <sub>J</sub> = 125°C		-	5.3	7	
	S'S	V <sub>GS</sub> = 2.7 V, I <sub>D</sub> = 0.19 A		-	3.7	5	
	CE EAS	V <sub>GS</sub> = -4.5 V, I <sub>D</sub> = -0.14 A	P-Ch	-	7.3	10	
	DEVIC PLEES	V <sub>GS</sub> = -4.5 V, I <sub>D</sub> = -0.14 A, T <sub>J</sub> = 125°C		-	11	17	
	S DEF.	$V_{GS}$ = -2.7 V, $I_D$ = -0.05 A		-	10.4	13	
I <sub>D(ON)</sub>	On-State Drain Current	$V_{GS}$ = 4.5 V, $V_{DS}$ = 5 V	N-Ch	0.22	-	-	А
Ÿ		$V_{GS}$ = -4.5 V, $V_{DS}$ = -5 V	P-Ch	-0.14	-	-	]
<b>9</b> FS	Forward Transconductance	$V_{DS} = 5 \text{ V}, \text{ I}_{D} = 0.22 \text{ A}$	N-Ch	-	0.2	-	S
		$V_{DS} = -5 \text{ V}, \text{ I}_{D} = -0.14 \text{ A}$	P-Ch	-	0.12	_	]

## DYNAMIC CHARACTERISTICS

C <sub>iss</sub>	Input Capacitance	N-Channel	N-Ch	-	9.5	_	pF
		$V_{DS} = 10 \text{ V}, V_{GS} = 0 \text{ V}, \text{ f} = 1.0 \text{ MHz}$	P-Ch	-	12	_	
C <sub>oss</sub>	Output Capacitance	P–Channel V <sub>DS</sub> = −10 V, V <sub>GS</sub> = 0 V,	N-Ch	-	6	_	
			P-Ch	-	7	-	
C <sub>rss</sub>	Reverse Transfer Capacitance		N-Ch	-	1.3	_	
			P-Ch	1	1.5	-	

## **ELECTRICAL CHARACTERISTICS** ( $T_A = 25^{\circ}C$ unless otherwise noted) (continued)

Symbol	Parameter	Conditions	Туре	Min	Тур	Max	Unit			
SWITCHING C	WITCHING CHARACTERISTICS (Note 2)									
t <sub>D(on)</sub>	Turn-On Delay Time	N-Channel	N-Ch	-	5	12	ns			
		$V_{DD}$ = 5 V, I <sub>D</sub> = 0.5 A, V <sub>GS</sub> = 4.5 V, R <sub>GEN</sub> = 50 $\Omega$	P-Ch	-	5	12				
t <sub>r</sub>	Turn-On Rise Time	P-Channel	N-Ch	-	4.5	10	ns			
		$V_{DD} = -5 V$ , $I_D = -0.5 A$ , $V_{CS} = -4.5 V$ , $R_{CEN} = 50 \Omega$	P-Ch	-	8	16				
t <sub>D(off)</sub>	Turn-Off Delay Time	$V_{GS} = -4.5 \text{ V}, \text{ n}_{GEN} = 50 \text{ s}_2$	N-Ch	-	4	8	ns			
			P-Ch	-	9	18				
t <sub>f</sub>	Turn-Off Fall Time		N-Ch	-	3.2	7	ns			
			P-Ch	-	5	12				
Qg	Total Gate Charge	N-Channel	N-Ch	-	0.29	0.4	nC			
		$V_{DS} = 5 V, I_D = 0.22 A, V_{GS} = 4.5 V$	P-Ch		0.22	0.31				
Q <sub>gs</sub>	Gate-Source Charge	P-Channel	N-Ch	-	0.12	<u>(</u> ()	nC			
		V <sub>DS</sub> = -5 V, I <sub>D</sub> =-0.14 A, V <sub>GS</sub> = -4.5 V	P-Ch		0.12	P'_				
Q <sub>gd</sub>	Gate-Drain Charge	VGS	N-Ch		0.03	-	nC			
			P-Ch	JE.	0.05	-				

#### DRAIN-SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS

ſ	I <sub>S</sub>	Maximum Continuous Source Current N-Ch - 0.25	А
		P-Gh0.25	
	V <sub>SD</sub>	Drain–Source Diode Forward $V_{GS} = 0 V$ , $I_S = 0.5 A$ (Note 2) N–Ch – 0.8 1.2	V
		Voltage V <sub>GS</sub> = 0 V, I <sub>S</sub> = -0.5 A (Note 2) P-Ch0.8 -1.2	

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions performance may not be indicated by the Electrical Characteristics if operated under different conditions. 2. Pulse Test: Pulse Width ≤ 300 µs, Duty Cycle ≤ 2.0% Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product

## **TYPICAL PERFORMANCE CHARACTERISTICS: N-CHANNEL**

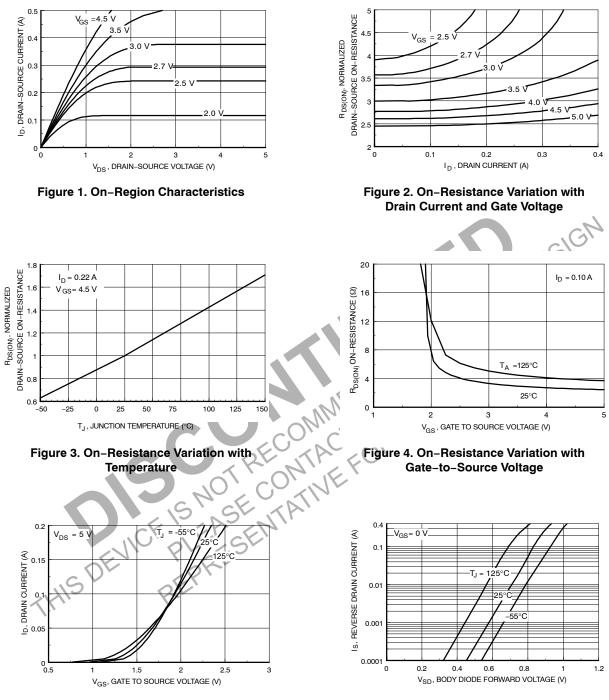
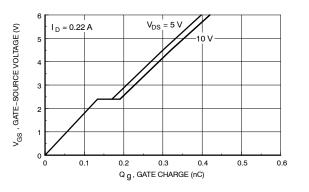


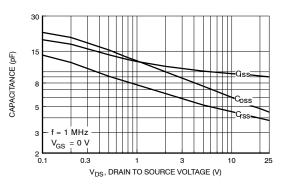


Figure 6. Body Diode Forward Voltage Variation with Source Current and Temperature

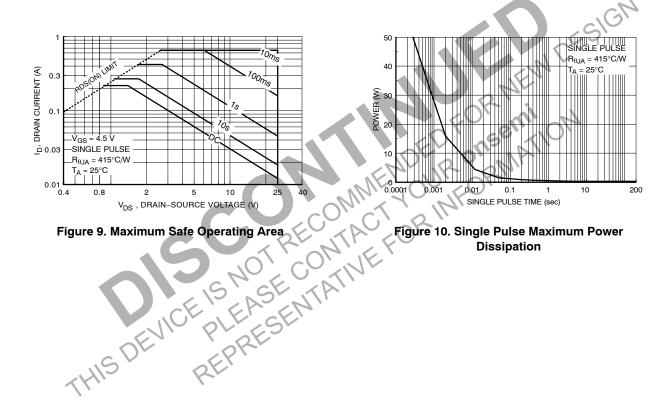
## TYPICAL PERFORMANCE CHARACTERISTICS: N-CHANNEL (continued)











## **TYPICAL PERFORMANCE CHARACTERISTICS: P-CHANNEL**

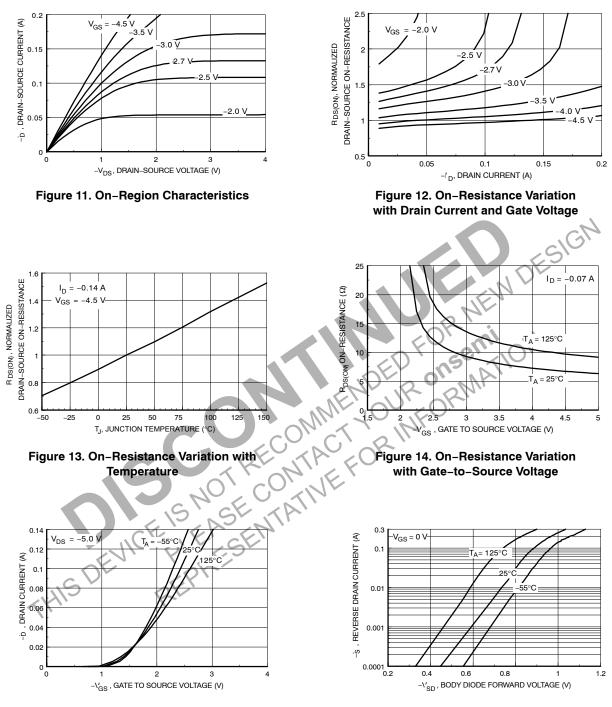




Figure 16. Body Diode Forward Voltage Variation with Source Current and Temperature

## TYPICAL PERFORMANCE CHARACTERISTICS: P-CHANNEL (continued)

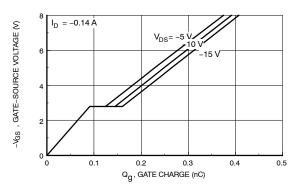


Figure 17. Gate Charge Characteristics

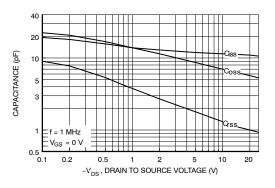
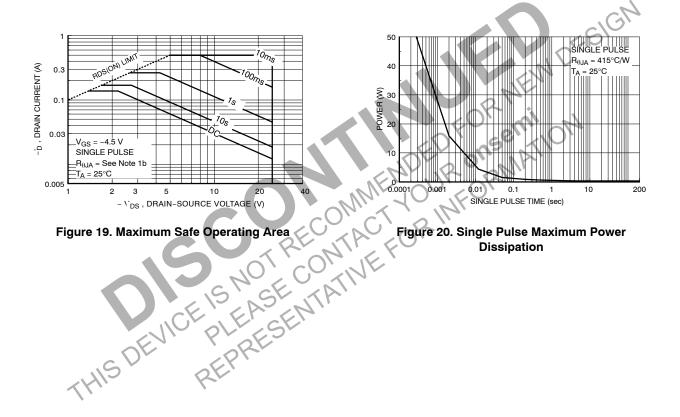
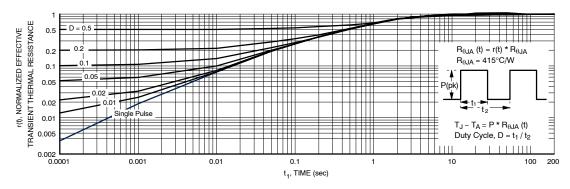


Figure 18. Capacitance Characteristics



## **TYPICAL PERFORMANCE CHARACTERISTICS: N & P-CHANNEL**



Thermal characterization performed using the conditions described in Note 1. Transient thermal response will change depending on the circuit board design.

### Figure 21. Transient Thermal Response Curve

#### **ORDERING INFORMATION**

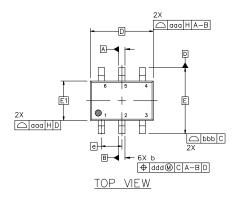
Transient thermal response will change depending on the circuit board design. Figure 21. Transient Thermal Response Curve						
ORDERING INFORMATION Device Order Number	Device Marking	Package Type	Shipping <sup>†</sup>			
FDG6320C	20	SC-88/SC70-6/SOT-363 (Pb-Free)	3000 / Tape & Reel			

Pb-Free) tFor information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

# semi

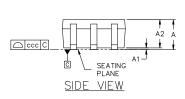
#### SC-88 2.00x1.25x0.90, 0.65P CASE 419B-02 **ISSUE Z**

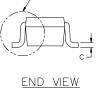
DATE 18 APR 2024



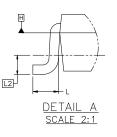


- DIMENSIONING AND TOLERANCING CONFORM TO ASME 1. Y14.5-2018.
- 2.
- ALL DIMENSION ARE IN MILLIMETERS. DIMENSIONS D AND E1 DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS. MOLD FLASH, PROTRUSIONS, OR GATE BURRS SHALL NOT EXCEED 0.20 3. PER END.
- 4. DIMENSIONS D AND E1 AT THE OUTERMOST EXTREMES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





DETAIL A



	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		
С	0.08	0.15	0.22		
D		2.00 BSC	;		
E	2.10 BSC				
E1		1.25 BSC	;		
е		0.65 BSC	)		
L	0.26	0.36	0.46		
L2		0.15 BSC			
aaa	0.15				
bbb	0.30				
ссс	0.10				
ddd		0.10			

6X 0.66 6X 0.30-2.50 0.65 PITCH

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.

XXX = Specific Device Code = Date Code\* Μ

GENERIC **MARKING DIAGRAM\*** 

XXXM-

. 0

6

= 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:	STYLE 14:	STYLE 15:	STYLE 16:	STYLE 17:	STYLE 18:
PIN 1. ANODE	PIN 1. VREF	PIN 1. ANODE 1	PIN 1. BASE 1	PIN 1. BASE 1	PIN 1. VIN1
2. N/C	2. GND	2. ANODE 2	2. EMITTER 2	2. EMITTER 1	2. VCC
3. COLLECTOR	3. GND	3. ANODE 3	3. COLLECTOR 2	3. COLLECTOR 2	3. VOUT2
4. EMITTER	4. IOUT	4. CATHODE 3	4. BASE 2	4. BASE 2	4. VIN2
5. BASE	5. VEN	5. CATHODE 2	5. EMITTER 1	5. EMITTER 2	5. GND
6. CATHODE	6. VCC	6. CATHODE 1	6. COLLECTOR 1	6. COLLECTOR 1	6. VOUT1
STYLE 19:	STYLE 20:	STYLE 21:	STYLE 22:	STYLE 23:	STYLE 24:
PIN 1. I OUT	PIN 1. COLLECTOR	PIN 1. ANODE 1	PIN 1. D1 (i)	PIN 1. Vn	PIN 1. CATHODE
2. GND	2. COLLECTOR	2. N/C	2. GND	2. CH1	2. ANODE
3. GND	3. BASE	3. ANODE 2	3. D2 (i)	3. Vp	3. CATHODE
4. V CC	4. EMITTER	4. CATHODE 2	4. D2 (c)	4. N/C	4. CATHODE
5. V EN	5. COLLECTOR	5. N/C	5. VBUS	5. CH2	5. CATHODE
6. V REF	6. COLLECTOR	6. CATHODE 1	6. D1 (c)	6. N/C	6. CATHODE
STYLE 25:	STYLE 26:	STYLE 27:	STYLE 28:	STYLE 29:	STYLE 30:
PIN 1. BASE 1	PIN 1. SOURCE 1	PIN 1. BASE 2	PIN 1. DRAIN	PIN 1. ANODE	PIN 1. SOURCE 1
2. CATHODE	2. GATE 1	2. BASE 1	2. DRAIN	2. ANODE	2. DRAIN 2
3. COLLECTOR 2	3. DRAIN 2	3. COLLECTOR 1	3. GATE	3. COLLECTOR	3. DRAIN 2
4. BASE 2	4. SOURCE 2	4. EMITTER 1	4. SOURCE	4. EMITTER	4. SOURCE 2
5. EMITTER	5. GATE 2	5. EMITTER 2	5. DRAIN	5. BASE/ANODE	5. GATE 1
6. COLLECTOR 1	6. DRAIN 1	6. COLLECTOR 2	6. DRAIN	6. CATHODE	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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