

# NTD20P06L, NTDV20P06L

## MOSFET – Power, Single, P-Channel, DPAK –60 V, –15.5 A

### Features

- Withstands High Energy in Avalanche and Commutation Modes
- Low Gate Charge for Fast Switching
- AEC Q101 Qualified – NTDV20P06L
- These Devices are Pb-Free and are RoHS Compliant

### Applications

- Bridge Circuits
- Power Supplies, Power Motor Controls
- DC-DC Conversion

### MAXIMUM RATINGS (T<sub>J</sub> = 25°C unless otherwise noted)

Parameter	Symbol	Value	Unit	
Drain-to-Source Voltage	V <sub>DSS</sub>	-60	V	
Gate-to-Source Voltage	Continuous	V <sub>GS</sub>	± 20 V	
	Non-Repetitive	t <sub>p</sub> ≤ 10 ms	V <sub>GSM</sub>	± 30
Continuous Drain Current	Steady State	T <sub>C</sub> = 25°C	I <sub>D</sub>	-15.5 A
Power Dissipation	Steady State	T <sub>C</sub> = 25°C	P <sub>D</sub>	65 W
Pulsed Drain Current	t <sub>p</sub> = 10 μs	I <sub>DM</sub>	± 50 A	
Operating Junction and Storage Temperature	T <sub>J</sub> , T <sub>STG</sub>	-55 to 175	°C	
Single Pulse Drain-to-Source Avalanche Energy (V <sub>DD</sub> = 25 V, V <sub>GS</sub> = 5 V, I <sub>PK</sub> = 15 A, L = 2.7 mH, R <sub>G</sub> = 25 Ω)	E <sub>AS</sub>	304	mJ	
Lead Temperature for Soldering Purposes (1/8" from case for 10 s)	T <sub>L</sub>	260	°C	

### THERMAL RESISTANCE RATINGS

Parameter	Symbol	Max	Unit
Junction-to-Case (Drain)	R <sub>θJC</sub>	2.3	°C/W
Junction-to-Ambient – Steady State (Note 1)	R <sub>θJA</sub>	80	
Junction-to-Ambient – Steady State (Note 2)	R <sub>θJA</sub>	110	

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.

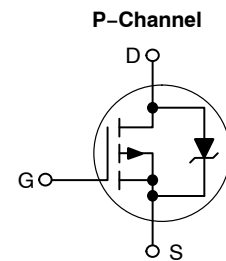
1. Surface-mounted on FR4 board using 1 in sq. pad size (Cu area = 1.127 in sq. [1 oz] including traces)
2. Surface-mounted on FR4 board using the minimum recommended pad size (Cu area = 0.412 in sq.)



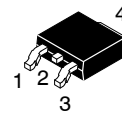
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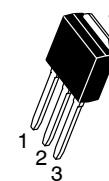
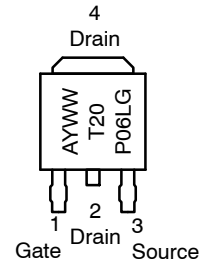
V <sub>(BR)DSS</sub>	R <sub>DS(on)</sub> TYP	I <sub>D</sub> MAX (Note 1)
-60 V	130 mΩ @ -5.0 V	-15.5 A



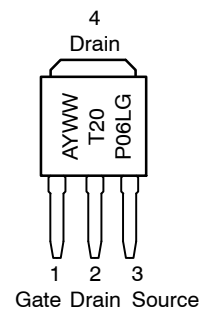
### MARKING DIAGRAMS



DPAK CASE 369C STYLE 2



IPAK/DPAK CASE 369D STYLE 2



20P06L Device Code  
 A = Assembly Location  
 Y = Year  
 WW = Work Week  
 G = Pb-Free Package

### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 5 of this data sheet.

# NTD20P06L, NTDV20P06L

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

Parameter	Symbol	Test Condition	Min	Typ	Max	Units
<b>OFF CHARACTERISTICS</b>						
Drain-to-Source Breakdown Voltage	V <sub>(BR)DSS</sub>	V <sub>GS</sub> = 0 V, I <sub>D</sub> = -250 μA	-60	-74		V
Drain-to-Source Breakdown Voltage Temperature Coefficient	V <sub>(BR)DSS</sub> /T <sub>J</sub>			-64		mV/°C
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	V <sub>GS</sub> = 0 V, V <sub>DS</sub> = -60 V	T <sub>J</sub> = 25°C		-1.0	μA
			T <sub>J</sub> = 150°C		-10	
Gate-to-Source Leakage Current	I <sub>GSS</sub>	V <sub>DS</sub> = 0 V, V <sub>GS</sub> = ±20 V			±100	nA

## ON CHARACTERISTICS (Note 3)

Gate Threshold Voltage	V <sub>GS(TH)</sub>	V <sub>GS</sub> = V <sub>DS</sub> , I <sub>D</sub> = -250 μA	-1.0	-1.5	-2.0	V
Gate Threshold Temperature Coefficient	V <sub>GS(TH)</sub> /T <sub>J</sub>			3.1		mV/°C
Drain-to-Source On Resistance	R <sub>DS(on)</sub>	V <sub>GS</sub> = -5.0 V, I <sub>D</sub> = -7.5 A		0.130	0.150	Ω
		V <sub>GS</sub> = -5.0 V, I <sub>D</sub> = -15 A		0.143		
Forward Transconductance	g <sub>FS</sub>	V <sub>DS</sub> = -10 V, I <sub>D</sub> = -7.5 A		11		S
Drain-to-Source On-Voltage	V <sub>DS(on)</sub>	V <sub>GS</sub> = -5.0 V, I <sub>D</sub> = -7.5 A	T <sub>J</sub> = 25°C		-1.2	V
			T <sub>J</sub> = 150°C		-1.9	

## CHARGES AND CAPACITANCES

Input Capacitance	C <sub>ISS</sub>	V <sub>GS</sub> = 0 V, f = 1 MHz, V <sub>DS</sub> = -25 V		740	1190	pF
Output Capacitance	C <sub>OSS</sub>			207	300	
Reverse Transfer Capacitance	C <sub>RSS</sub>			66	120	
Total Gate Charge	Q <sub>G(TOT)</sub>	V <sub>GS</sub> = -5.0 V, V <sub>DS</sub> = -48 V, I <sub>D</sub> = -18 A		15	26	nC
Gate-to-Source Charge	Q <sub>GS</sub>			4.0		
Gate-to-Drain Charge	Q <sub>GD</sub>			7.0		

## SWITCHING CHARACTERISTICS (Note 4)

Turn-On Delay Time	t <sub>d(ON)</sub>	V <sub>GS</sub> = -5.0 V, V <sub>DD</sub> = -30 V, I <sub>D</sub> = -15 A, R <sub>G</sub> = 9.1 Ω		11	20	ns
Rise Time	t <sub>r</sub>			90	180	
Turn-Off Delay Time	t <sub>d(OFF)</sub>			28	50	
Fall Time	t <sub>f</sub>			70	135	

## DRAIN-SOURCE DIODE CHARACTERISTICS

Forward Diode Voltage	V <sub>SD</sub>	V <sub>GS</sub> = 0 V, I <sub>S</sub> = -15 A	T <sub>J</sub> = 25°C	1.5	2.5	V
			T <sub>J</sub> = 150°C	1.3		
Reverse Recovery Time	t <sub>RR</sub>	V <sub>GS</sub> = 0 V, d <sub>I</sub> S/d <sub>t</sub> = 100 A/μs, I <sub>S</sub> = -12 A		60		ns
Charge Time	t <sub>a</sub>			39		
Discharge Time	t <sub>b</sub>			21		
Reverse Recovery Charge	Q <sub>RR</sub>			0.13		

3. Pulse Test: pulse width ≤ 300 μs, duty cycle ≤ 2%

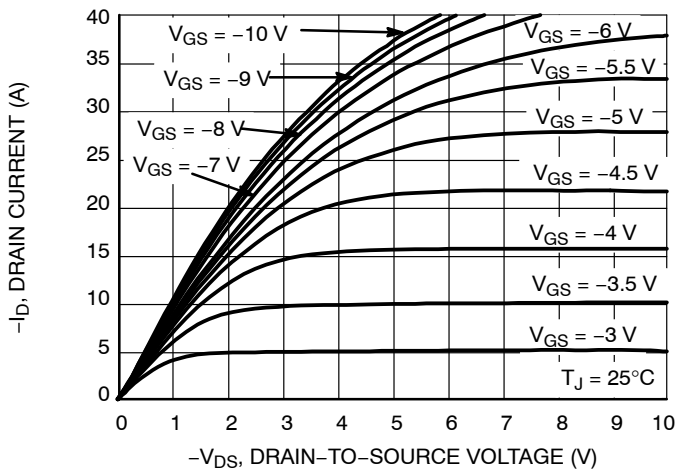
4. Switching characteristics are independent of operating junction temperatures

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.

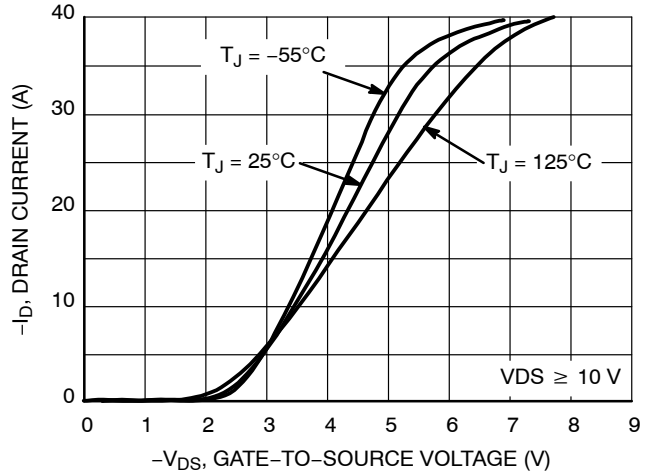
# NTD20P06L, NTDV20P06L

## TYPICAL PERFORMANCE CURVES

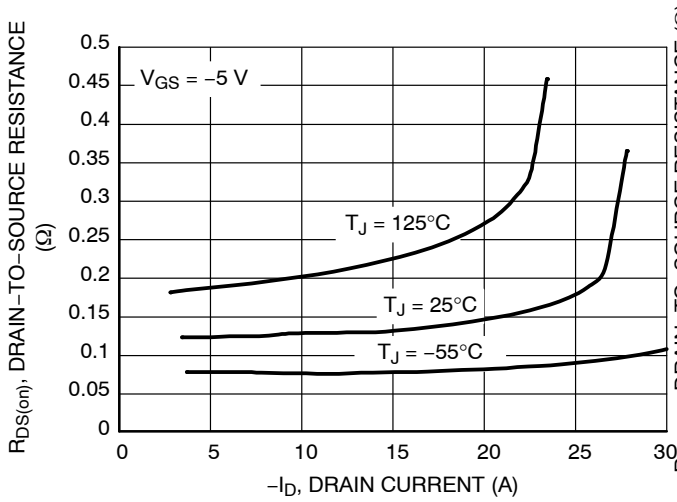
( $T_J = 25^\circ\text{C}$  unless otherwise noted)



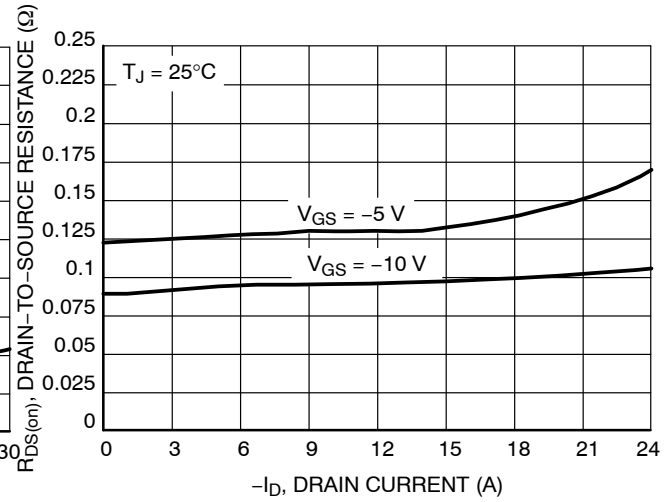
**Figure 1. On-Region Characteristics**



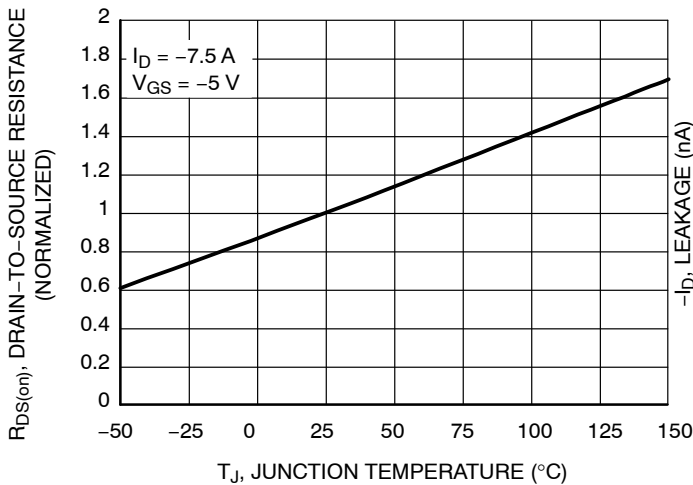
**Figure 2. Transfer Characteristics**



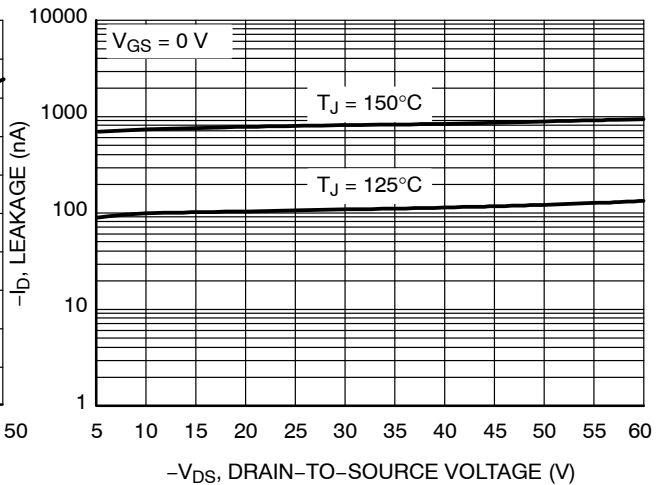
**Figure 3. On-Resistance versus Drain Current and Temperature**



**Figure 4. On-Resistance versus Drain Current and Gate Voltage**



**Figure 5. On-Resistance Variation with Temperature**



**Figure 6. Drain-to-Source Leakage Current versus Voltage**

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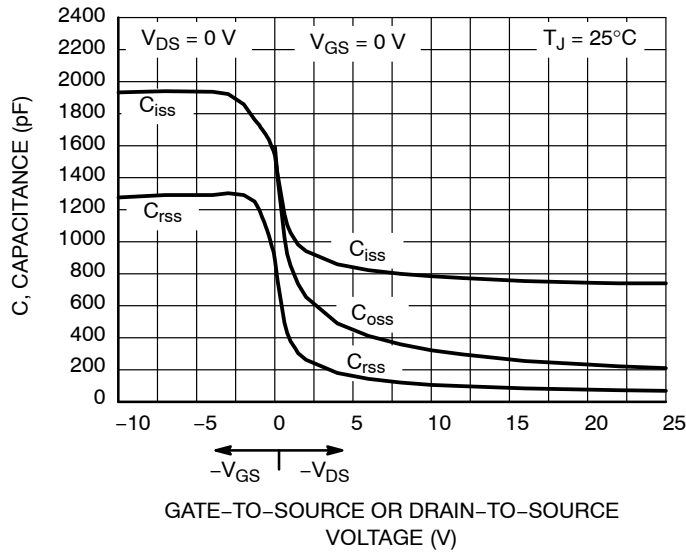


Figure 7. Capacitance Variation

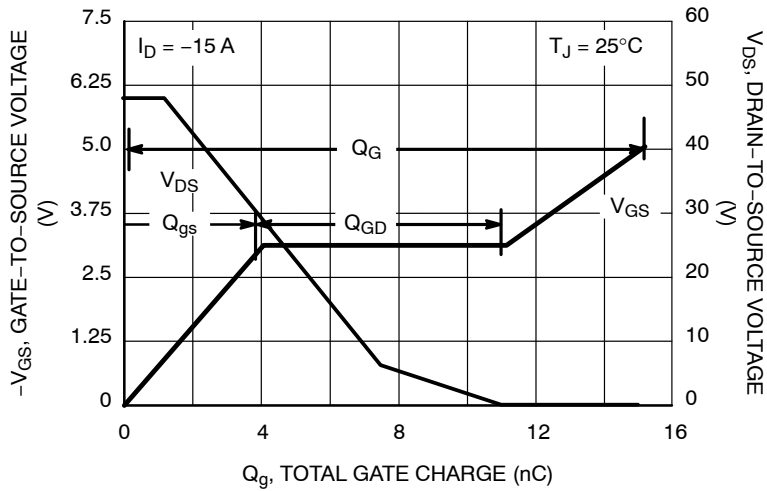


Figure 8. Gate-to-Source and Drain-to-Source Voltage versus Total Charge

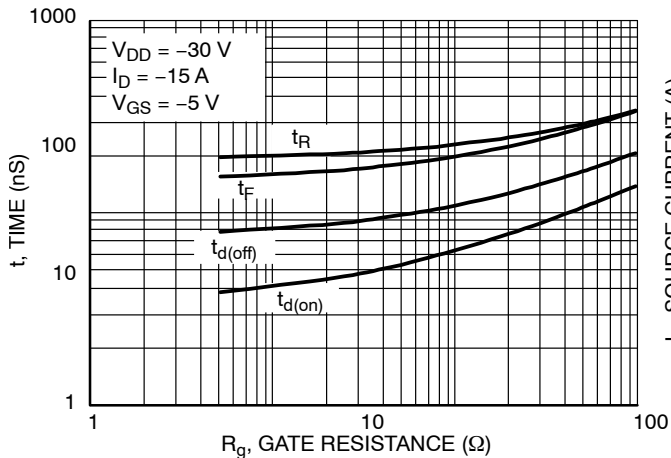


Figure 9. Resistive Switching Time Variation versus Gate Resistance

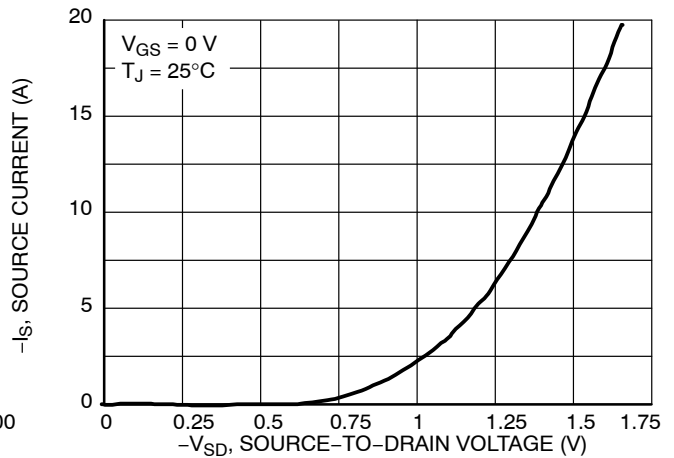
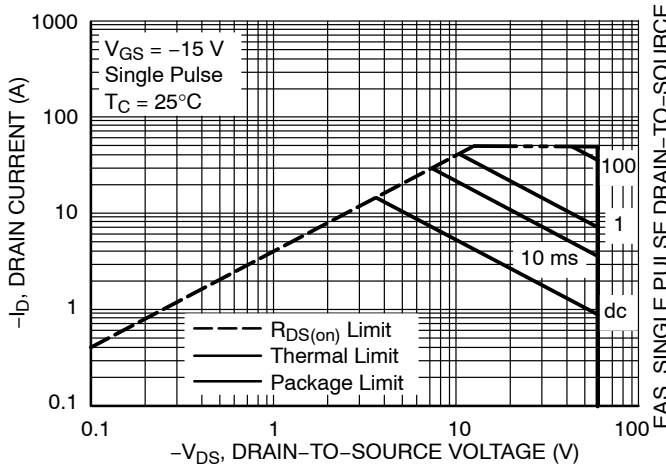
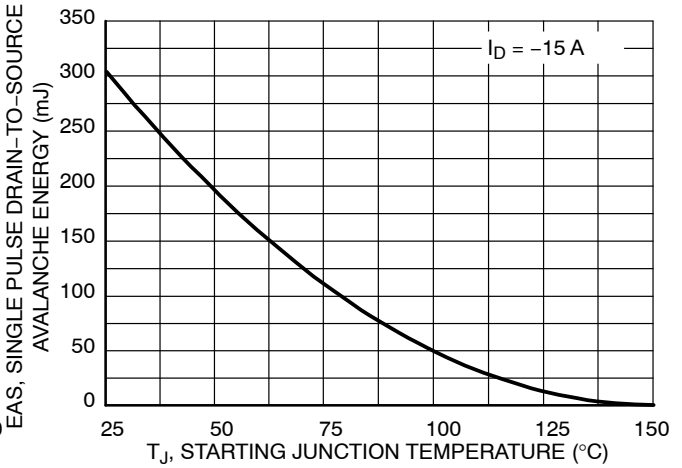


Figure 10. Diode Forward Voltage versus Current

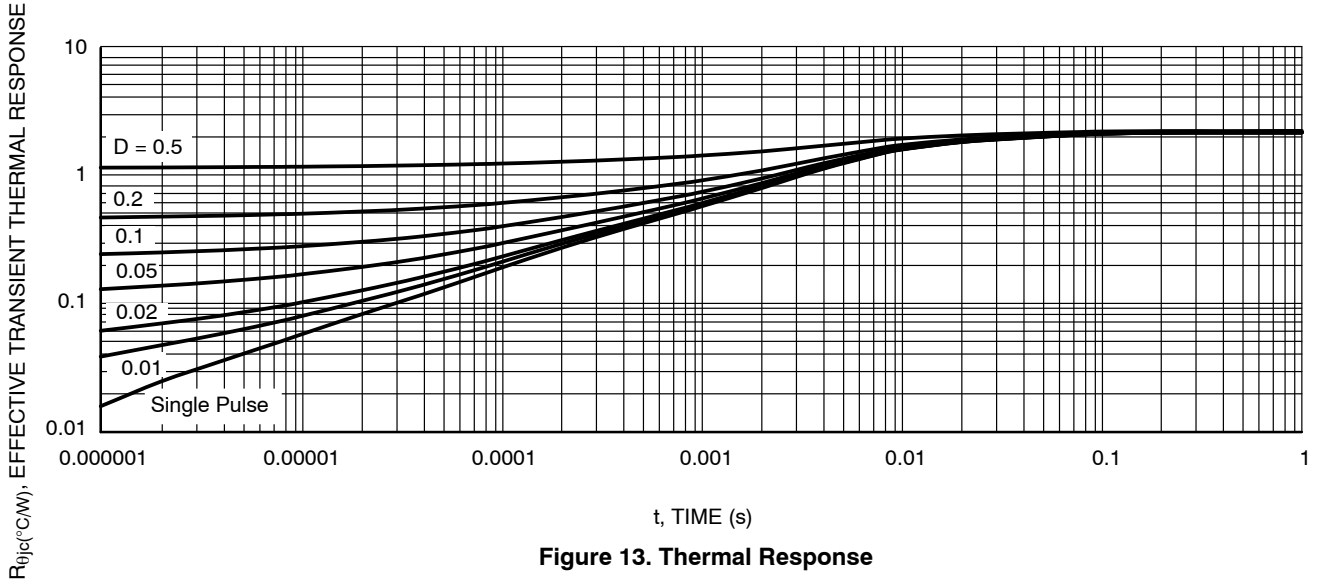
# NTD20P06L, NTDV20P06L



**Figure 11. Maximum Rated Forward Biased Safe Operating Area**



**Figure 12. Maximum Avalanche Energy versus Starting Junction Temperature**



**Figure 13. Thermal Response**

## ORDERING INFORMATION

Device	Package	Shipping <sup>†</sup>
NTD20P06LG	DPAK (Pb-Free)	75 Units / Rail
NTD20P06LT4G		2500 / Tape & Reel
NTDV20P06LT4G		2500 / Tape & Reel
NTDV20P06LT4G-VF01		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.

# MECHANICAL CASE OUTLINE

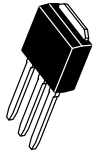
## PACKAGE DIMENSIONS

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### IPAK CASE 369D-01 ISSUE C

DATE 15 DEC 2010



SCALE 1:1



- NOTES:
- DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  - CONTROLLING DIMENSION: INCH.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.235	0.245	5.97	6.35
B	0.250	0.265	6.35	6.73
C	0.086	0.094	2.19	2.38
D	0.027	0.035	0.69	0.88
E	0.018	0.023	0.46	0.58
F	0.037	0.045	0.94	1.14
G	0.090	BSC	2.29	BSC
H	0.034	0.040	0.87	1.01
J	0.018	0.023	0.46	0.58
K	0.350	0.380	8.89	9.65
R	0.180	0.215	4.45	5.45
S	0.025	0.040	0.63	1.01
V	0.035	0.050	0.89	1.27
Z	0.155	---	3.93	---

- |  |   |  |  |
|--|---|--|--|
| <p>STYLE 1:<br/>PIN 1. BASE<br/>2. COLLECTOR<br/>3. EMITTER<br/>4. COLLECTOR</p> | <p>STYLE 2:<br/>PIN 1. GATE<br/>2. DRAIN<br/>3. SOURCE<br/>4. DRAIN</p> | <p>STYLE 3:<br/>PIN 1. ANODE<br/>2. CATHODE<br/>3. ANODE<br/>4. CATHODE</p>      | <p>STYLE 4:<br/>PIN 1. CATHODE<br/>2. ANODE<br/>3. GATE<br/>4. ANODE</p> |
| <p>STYLE 5:<br/>PIN 1. GATE<br/>2. ANODE<br/>3. CATHODE<br/>4. ANODE</p>         | <p>STYLE 6:<br/>PIN 1. MT1<br/>2. MT2<br/>3. GATE<br/>4. MT2</p>        | <p>STYLE 7:<br/>PIN 1. GATE<br/>2. COLLECTOR<br/>3. EMITTER<br/>4. COLLECTOR</p> |  |

### MARKING DIAGRAMS



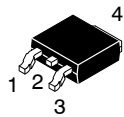
- xxxxxxxx = Device Code  
A = Assembly Location  
IL = Wafer Lot  
Y = Year  
WW = Work Week

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# MECHANICAL CASE OUTLINE

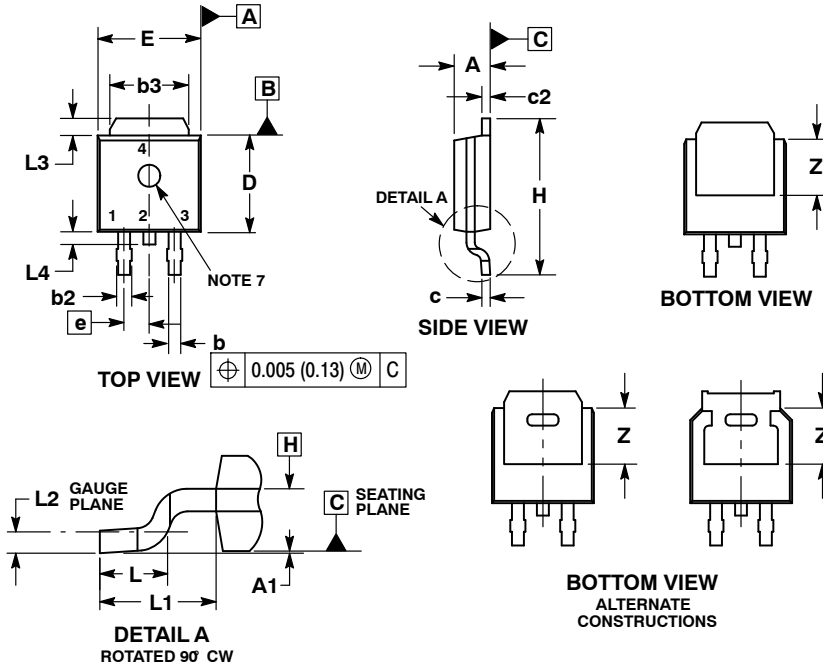
## PACKAGE DIMENSIONS



### DPAK (SINGLE GAUGE) CASE 369C ISSUE F

DATE 21 JUL 2015

SCALE 1:1



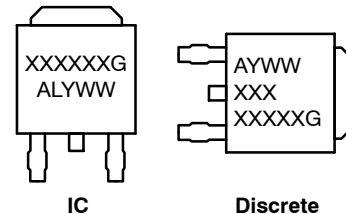
NOTES:

- DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
- CONTROLLING DIMENSION: INCHES.
- THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSIONS b3, L3 and Z.
- DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR BURRS. MOLD FLASH, PROTRUSIONS, OR GATE BURRS SHALL NOT EXCEED 0.006 INCHES PER SIDE.
- DIMENSIONS D AND E ARE DETERMINED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY.
- DATUMS A AND B ARE DETERMINED AT DATUM PLANE H.
- OPTIONAL MOLD FEATURE.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.086	0.094	2.18	2.38
A1	0.000	0.005	0.00	0.13
b	0.025	0.035	0.63	0.89
b2	0.028	0.045	0.72	1.14
b3	0.180	0.215	4.57	5.46
c	0.018	0.024	0.46	0.61
c2	0.018	0.024	0.46	0.61
D	0.235	0.245	5.97	6.22
E	0.250	0.265	6.35	6.73
e	0.090	BSC	2.29	BSC
H	0.370	0.410	9.40	10.41
L	0.055	0.070	1.40	1.78
L1	0.114	REF	2.90	REF
L2	0.020	BSC	0.51	BSC
L3	0.035	0.050	0.89	1.27
L4	---	0.040	---	1.01
Z	0.155	---	3.93	---

### GENERIC MARKING DIAGRAM\*

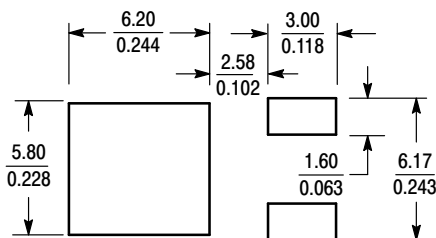
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|--|--|---|---|--|
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| <p>STYLE 6:<br/>PIN 1. MT1<br/>2. MT2<br/>3. GATE<br/>4. MT2</p>                 | <p>STYLE 7:<br/>PIN 1. GATE<br/>2. COLLECTOR<br/>3. EMITTER<br/>4. COLLECTOR</p> | <p>STYLE 8:<br/>PIN 1. N/C<br/>2. CATHODE<br/>3. ANODE<br/>4. CATHODE</p>   | <p>STYLE 9:<br/>PIN 1. ANODE<br/>2. CATHODE<br/>3. RESISTOR ADJUST<br/>4. CATHODE</p> | <p>STYLE 10:<br/>PIN 1. CATHODE<br/>2. ANODE<br/>3. CATHODE<br/>4. ANODE</p> |



- XXXXXX = Device Code
- A = Assembly Location
- L = Wafer Lot
- Y = Year
- WW = Work Week
- G = 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.

### SOLDERING FOOTPRINT\*



SCALE 3:1 (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.

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