

MOSFET – Power, N-Channel, SUPERFET III, Easy Drive

650 V, 19 A, 165 mΩ

FCP165N65S3R0

Description

SUPERFET III MOSFET is onsemi's brand-new high voltage super-junction (SJ) MOSFET family that is utilizing charge balance technology for outstanding low on-resistance and lower gate charge performance. This advanced technology is tailored to minimize conduction loss, provide superior switching performance, and withstand extreme dv/dt rate.

Consequently, SUPERFET III MOSFET Easy drive series helps manage EMI issues and allows for easier design implementation.

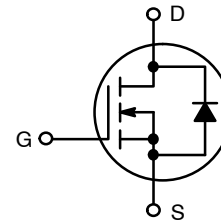
Features

- 700 V @ $T_J = 150^{\circ}\text{C}$
- Typ. $R_{DS(on)} = 140\text{ m}\Omega$
- Ultra Low Gate Charge (Typ. $Q_g = 39\text{ nC}$)
- Low Effective Output Capacitance (Typ. $C_{oss(eff.)} = 341\text{ pF}$)
- 100% Avalanche Tested
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

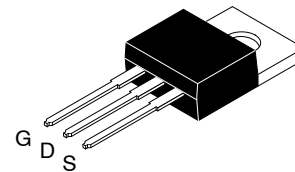
Applications

- Computing / Display Power Supplies
- Telecom / Server Power Supplies
- Industrial Power Supplies
- Lighting / Charger / Adapter

V_{DSS}	$R_{DS(on)}\text{ MAX}$	$I_D\text{ MAX}$
650 V	165 mΩ @ 10 V	19 A

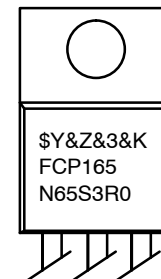


N-Channel MOSFET



TO-220-3LD
CASE 340AT

MARKING DIAGRAM



\$Y	= onsemi Logo
&Z	= Assembly Plant Code
&3	= Numeric Date Code
&K	= Lot Code
FCP165N65S3R0	= Specific Device Code

ORDERING INFORMATION

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

FCP165N65S3R0

ABSOLUTE MAXIMUM RATINGS ($T_C = 25^\circ\text{C}$, Unless otherwise specified)

Symbol	Parameter		Value	Unit
V_{DSS}	Drain to Source Voltage		650	V
V_{GSS}	Gate to Source Voltage	DC	± 30	V
		AC ($f > 1\text{ Hz}$)	± 30	V
I_D	Drain Current	Continuous ($T_C = 25^\circ\text{C}$)	19	A
		Continuous ($T_C = 100^\circ\text{C}$)	12.3	
I_{DM}	Drain Current	Pulsed (Note 1)	47.5	A
E_{AS}	Single Pulsed Avalanche Energy (Note 2)		87	mJ
I_{AS}	Avalanche Current (Note 2)		2.7	A
E_{AR}	Repetitive Avalanche Energy (Note 1)		1.54	mJ
dv/dt	MOSFET dv/dt		100	V/ns
	Peak Diode Recovery dv/dt (Note 3)		20	
P_D	Power Dissipation	($T_C = 25^\circ\text{C}$)	154	W
		Derate Above 25°C	1.23	W/ $^\circ\text{C}$
T_J, T_{STG}	Operating and Storage Temperature Range		-55 to +150	$^\circ\text{C}$
T_L	Maximum Lead Temperature for Soldering, 1/8" from Case for 5 s		300	$^\circ\text{C}$

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. Repetitive rating: pulse-width limited by maximum junction temperature.

2. $I_{AS} = 2.7\text{ A}$, $R_G = 25\ \Omega$, starting $T_J = 25^\circ\text{C}$.

3. $I_{SD} \leq 9.5\text{ A}$, $di/dt \leq 200\text{ A}/\mu\text{s}$, $V_{DD} \leq 400\text{ V}$, starting $T_J = 25^\circ\text{C}$.

THERMAL CHARACTERISTICS

Symbol	Parameter	Value	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case, Max.	0.81	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient, Max.	62.5	

PACKAGE MARKING AND ORDERING INFORMATION

Part Number	Top Marking	Package	Shipping
FCP165N65S3R0	FCP165N65S3R0	TO-220-3LD (Pb-Free / Halogen Free)	50 Units / Tube

FCP165N65S3R0

ELECTRICAL CHARACTERISTICS ($T_C = 25^\circ\text{C}$ unless otherwise noted)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
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OFF CHARACTERISTICS

BV _{DSS}	Drain to Source Breakdown Voltage	V _{GS} = 0 V, I _D = 1 mA, T _J = 25°C	650			V
		V _{GS} = 0 V, I _D = 1 mA, T _J = 150°C	700			V
ΔBV _{DSS} /ΔT _J	Breakdown Voltage Temperature Coefficient	I _D = 1 mA, Referenced to 25°C		0.64		V/°C
I _{DSS}	Zero Gate Voltage Drain Current	V _{DS} = 650 V, V _{GS} = 0 V			1	μA
		V _{DS} = 520 V, T _C = 125°C		0.85		
I _{GSS}	Gate to Body Leakage Current	V _{GS} = ±30 V, V _{DS} = 0 V			±100	nA

ON CHARACTERISTICS

V _{GS(th)}	Gate Threshold Voltage	V _{GS} = V _{DS} , I _D = 0.44 mA	2.5		4.5	V
R _{DS(on)}	Static Drain to Source On Resistance	V _{GS} = 10 V, I _D = 9.5 A		140	165	mΩ
g _{FS}	Forward Transconductance	V _{DS} = 20 V, I _D = 9.5 A		12		S

DYNAMIC CHARACTERISTICS

C _{iss}	Input Capacitance	V _{DS} = 400 V, V _{GS} = 0 V, f = 1 MHz		1500		pF
C _{oss}	Output Capacitance			35		pF
C _{oss(eff.)}	Effective Output Capacitance	V _{DS} = 0 V to 400 V, V _{GS} = 0 V		341		pF
C _{oss(er.)}	Energy Related Output Capacitance	V _{DS} = 0 V to 400 V, V _{GS} = 0 V		49		pF
Q _{g(tot)}	Total Gate Charge at 10 V	V _{DS} = 400 V, I _D = 9.5 A, V _{GS} = 10 V (Note 4)		39		nC
Q _{gs}	Gate to Source Gate Charge			11		nC
Q _{gd}	Gate to Drain "Miller" Charge			16		nC
ESR	Equivalent Series Resistance	f = 1 MHz		0.5		Ω

SWITCHING CHARACTERISTICS

t _{d(on)}	Turn-On Delay Time	V _{DD} = 400 V, I _D = 9.5 A, V _{GS} = 10 V, R _g = 4.7 Ω (Note 4)		17		ns
t _r	Turn-On Rise Time			15		ns
t _{d(off)}	Turn-Off Delay Time			44		ns
t _f	Turn-Off Fall Time			5		ns

SOURCE-DRAIN DIODE CHARACTERISTICS

I _S	Maximum Continuous Source to Drain Diode Forward Current			19	A
I _{SM}	Maximum Pulsed Source to Drain Diode Forward Current			47.5	A
V _{SD}	Source to Drain Diode Forward Voltage	V _{GS} = 0 V, I _{SD} = 9.5 A		1.2	V
t _{rr}	Reverse Recovery Time	V _{DD} = 400 V, I _{SD} = 9.5 A, dI _F /dt = 100 A/μs		339	ns
Q _{rr}	Reverse Recovery Charge			5.8	μC

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.

4. Essentially independent of operating temperature typical characteristics.

TYPICAL PERFORMANCE CHARACTERISTICS

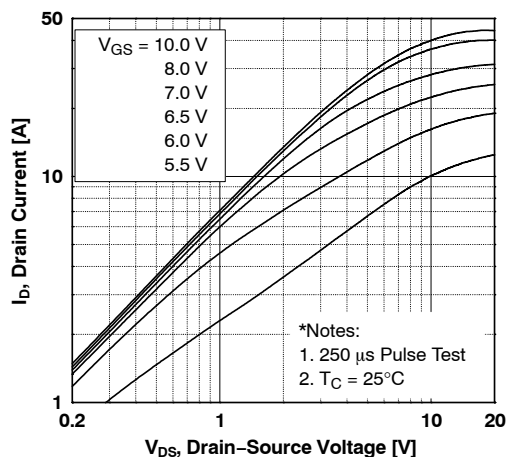


Figure 1. On-Region Characteristics

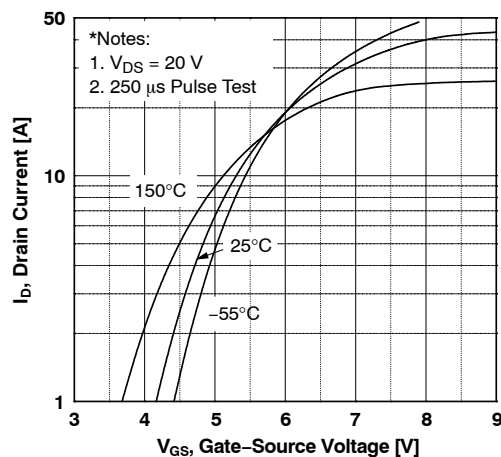


Figure 2. Transfer Characteristics

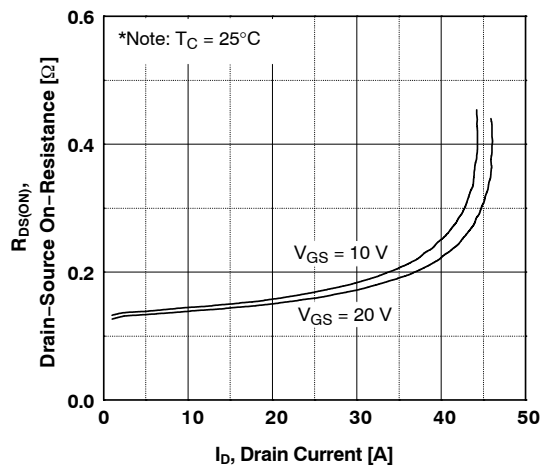


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

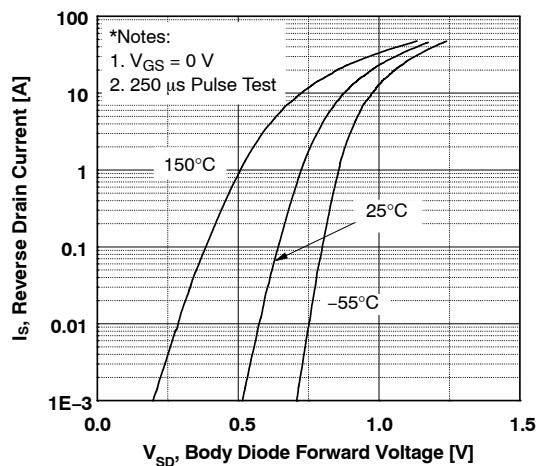


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

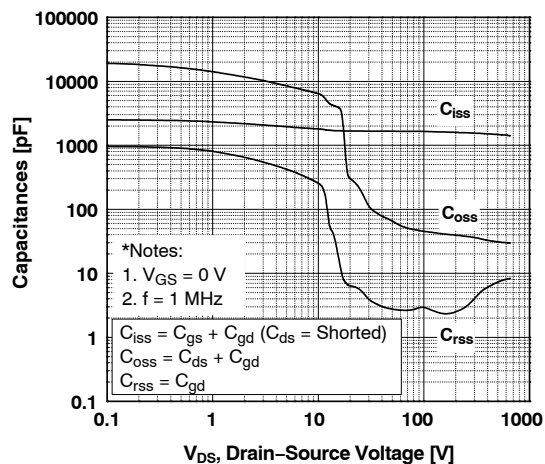


Figure 5. Capacitance Characteristics

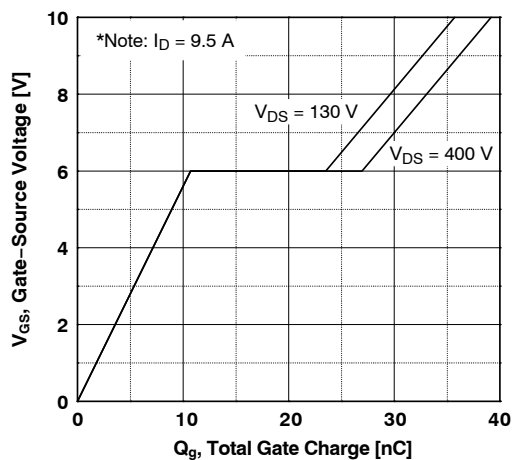


Figure 6. Gate Charge Characteristics

TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

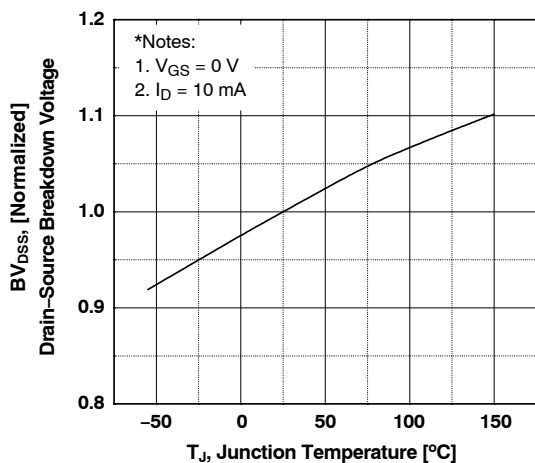


Figure 7. Breakdown Voltage Variation vs. Temperature

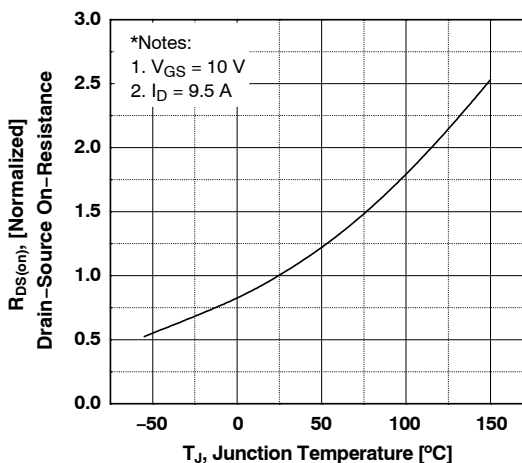


Figure 8. On-Resistance Variant vs. Temperature

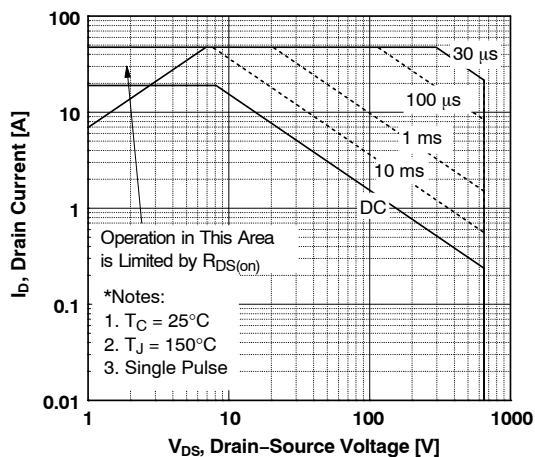


Figure 9. Maximum Safe Operation Area

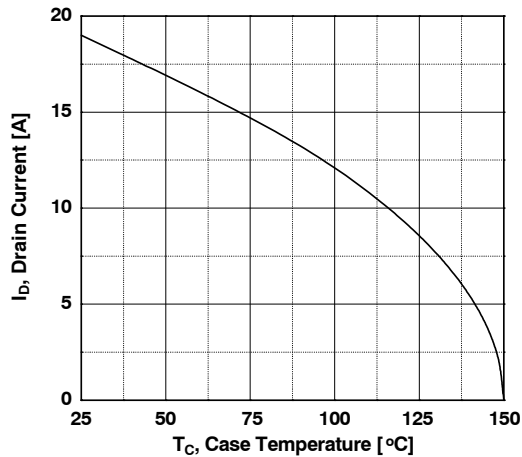
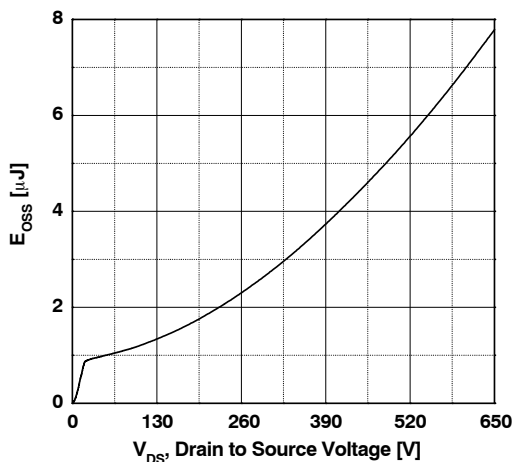


Figure 10. Maximum Drain Current vs. Case Temperature

Figure 11. E_{OSS} vs. Drain to Source Voltage

TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

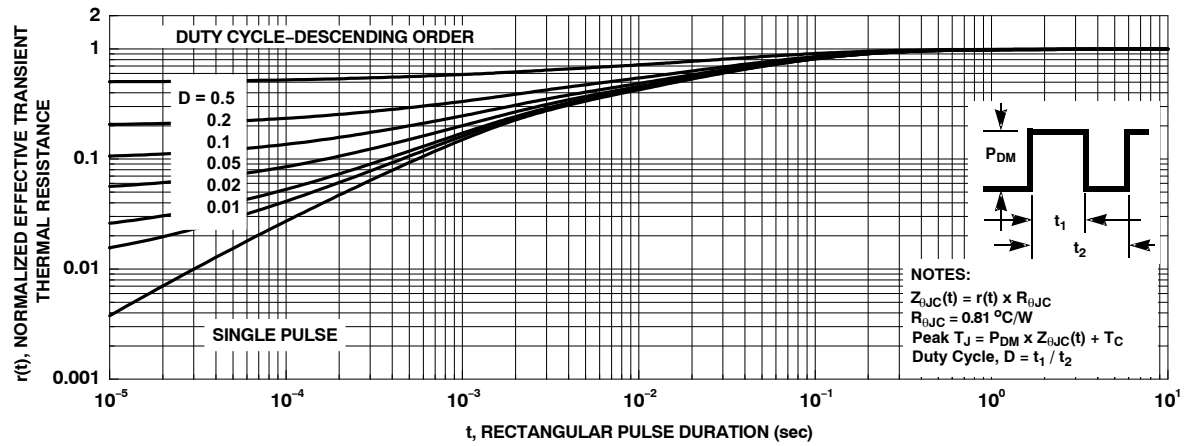


Figure 12. Transient Thermal Response Curve

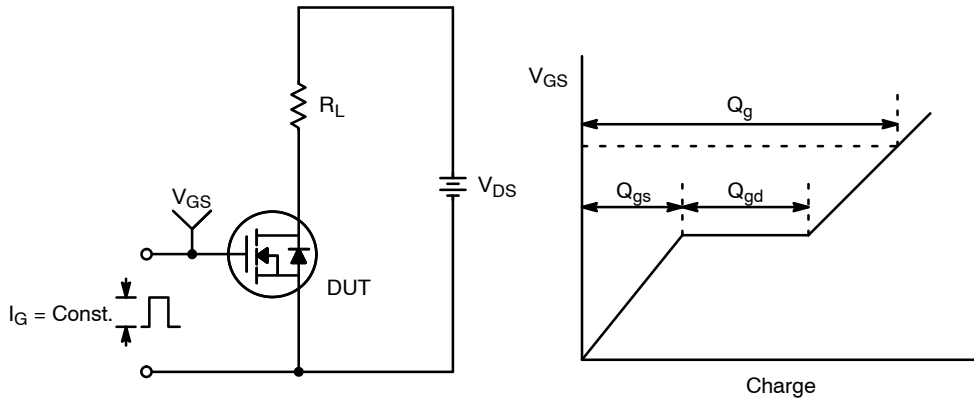


Figure 13. Gate Charge Test Circuit & Waveform

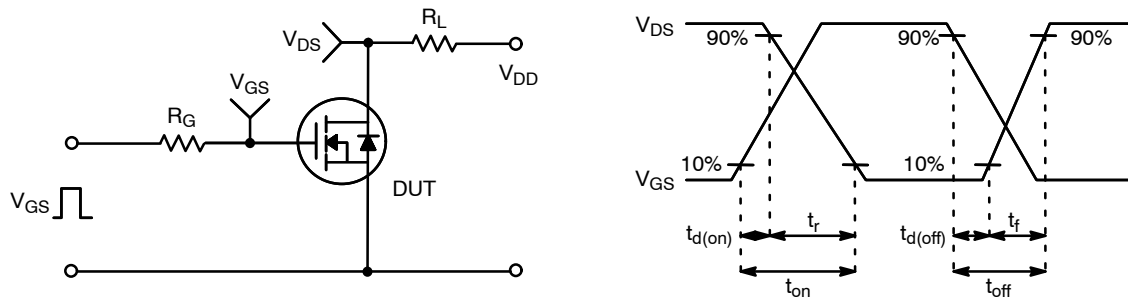


Figure 14. Resistive Switching Test Circuit & Waveforms

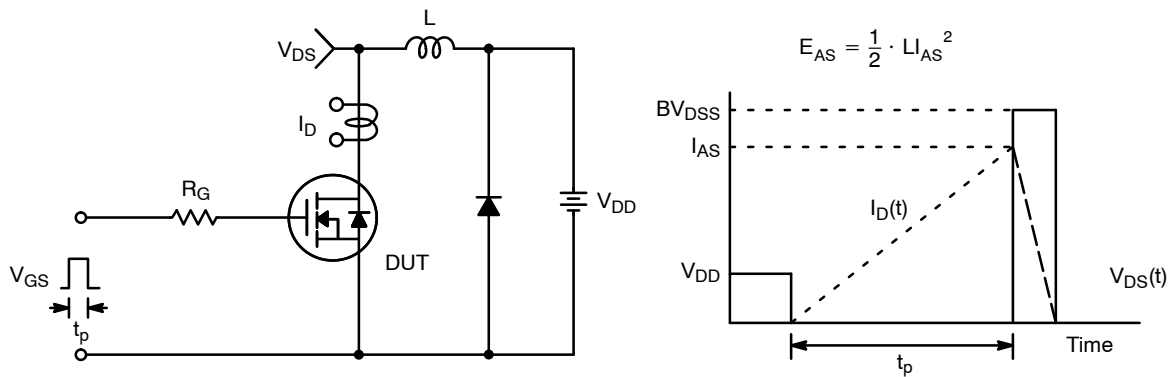


Figure 15. Unclamped Inductive Switching Test Circuit & Waveforms

The diagram shows a switching circuit. A MOSFET labeled "DUT" has its gate connected to its drain. The source of the DUT is connected to the drain of a second MOSFET labeled "Driver". The gate of the Driver MOSFET is connected to a pulse voltage source V_{GS} through a resistor R_G . The source of the Driver MOSFET is connected to ground. The drain of the Driver MOSFET is connected to the source of the DUT and to one end of an inductor L . The other end of the inductor L is connected to a positive supply voltage V_{DD} . The DUT's drain is also connected to V_{DD} . The DUT's source is labeled V_{SD} and the current through it is I_{SD} . The Driver MOSFET is noted as being "Same Type as DUT".

- dv/dt controlled by R_G
- I_{SD} controlled by pulse period





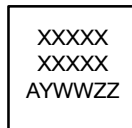
TO-220-3LD
CASE 340AT
ISSUE B

DATE 08 AUG 2022

DIM	MILLIMETERS		
	MIN.	NOM.	MAX.
A	4.00	--	4.70
A1	SEE NOTE "F"		
A2	2.10	--	2.85
b	0.55	--	1.00
b2	1.10	--	1.62
b4	1.42	--	1.62
c	0.36	--	0.60
D	13.90	--	16.30
D1	8.13	--	9.40
D2	11.50	--	14.30
D3	15.42	--	16.51
E	9.65	--	10.67
E1	7.59	--	8.65
e	2.40	--	2.67
H1	6.06	--	6.69
L	12.70	--	14.04
L1	2.70	--	4.10
P	3.50	--	4.00
Q	2.50	--	3.40
z	2.13 REF		
z1	2.06 REF		
θ	3°	--	5°

IF PRESENT, SEE NOTE "D"

GENERIC
MARKING DIAGRAM*



XXXX = Specific Device Code
A = Assembly Location
Y = Year
WW = Work Week
ZZ = Assembly Lot Code

*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.



NOTES:

- A) REFERENCE JEDEC, TO-220, VARIATION AB
- B) ALL DIMENSIONS ARE IN MILLIMETERS.
- C) DIMENSIONS COMMON TO ALL PACKAGE SUPPLIERS EXCEPT WHERE NOTED [].
- D) LOCATION OF MOLDED FEATURE MAY VARY (LOWER LEFT CORNER, LOWER CENTER AND CENTER OF THE PACKAGE)
- △ DOES NOT COMPLY JEDEC STANDARD VALUE.
- F) "A1" DIMENSIONS AS BELOW:
SINGLE GAUGE = 0.51 - 0.61
DUAL GAUGE = 1.10 - 1.45
- △ PRESENCE IS SUPPLIER DEPENDENT
- H) SUPPLIER DEPENDENT MOLD LOCKING HOLES IN HEATSINK.

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DESCRIPTION:	TO-220-3LD	PAGE 1 OF 1

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