

# IGBT for PFC Applications 650 V, 50 A, TO-247-3L

## FGHL50T65SQ

### Features

- Maximum Junction Temperature:  $T_J = 175^{\circ}\text{C}$
- Positive Temperature Co-efficient for Easy Parallel Operating
- High Current Capability
- Low Saturation Voltage:  $V_{CE(sat)} = 1.6\text{ V (Typ.) @ } I_C = 50\text{ A}$
- 100% of the Parts Tested for ILM (Note 1)
- High Input Impedance
- Fast Switching
- Tighten Parameter Distribution
- RoHS Compliant

### Typical Applications

- Solar Inverter, UPS, Welder, Telecom, ESS, PFC

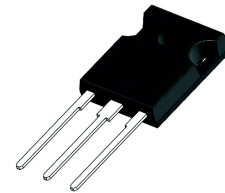
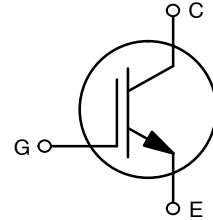
### MAXIMUM RATINGS ( $T_C = 25^{\circ}\text{C}$ unless otherwise noted)

Parameter	Symbol	Value	Unit
Collector-to-Emitter Voltage	$V_{CES}$	650	V
Gate-to-Emitter Voltage	$V_{GES}$	$\pm 20$	V
Transient Gate-to-Emitter Voltage	$V_{GES}$	$\pm 30$	V
Collector Current	$I_C$	$T_C = 25^{\circ}\text{C}$	A
		$T_C = 100^{\circ}\text{C}$	
Pulsed Collector Current (Note 2)	$I_{CM}$	$T_C = 25^{\circ}\text{C}$	A
Maximum Power Dissipation	$P_D$	$T_C = 25^{\circ}\text{C}$	W
		$T_C = 100^{\circ}\text{C}$	
Operating Junction and Storage Temperature Range	$T_J, T_{stg}$	$-55$ to $+175$	$^{\circ}\text{C}$
Maximum Lead Temperature for Soldering Purposes (1/8" from case for 5 s)	$T_L$	260	$^{\circ}\text{C}$

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.

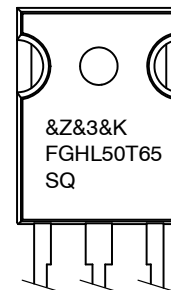
1.  $V_{CC} = 400\text{ V}$ ,  $V_{GE} = 15\text{ V}$ ,  $I_C = 200\text{ A}$ , Inductive Load
2. Repetitive rating: Pulse width limited by max. Junction temperature
3. The entire application environment impacts the thermal resistance values shown, they are not constants and are only valid for the particular conditions noted

$BV_{CES}$	$V_{CE(sat)}$ TYP	$I_C$ MAX
650 V	1.6 V	200 A



TO-247 LONG LEADS  
CASE 340CX

### MARKING DIAGRAM



&Z = Assembly Plant Code  
 &3 = 3-Digit Date Code  
 &K = 2-Digit Lot Traceability Code  
 FGHL50T65SQ = Specific Device Code

### ORDERING INFORMATION

Device	Package	Shipping
FGHL50T65SQ	TO-247-3L	30 Units / Rail

# FGHL50T65SQ

**Table 1. THERMAL RESISTANCE RATINGS**

Parameter	Symbol	Max	Unit
Junction-to-Case – Steady State	$R_{\theta JC}$	0.56	°C/W
Junction-to-Ambient – Steady State (Note 4)	$R_{\theta JA}$	40	

4. Repetitive rating: Pulse width limited by max. Junction temperature

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

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
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### OFF CHARACTERISTICS

Collector to Emitter Breakdown Voltage	$BV_{CES}$	$V_{GE} = 0\text{ V}, I_C = 1\text{ mA}$	650			V
Temperature Coefficient of Breakdown Voltage	$\Delta V_{CES} / \Delta T_J$	$V_{GE} = 0\text{ V}, I_C = 1\text{ mA}$		0.6		V/°C
Collector Cut-Off Current	$I_{CES}$	$V_{CE} = V_{CES}, V_{GE} = 0\text{ V}$			250	μA
G-E Leakage Current	$I_{GES}$	$V_{GE} = V_{GES}, V_{CE} = 0\text{ V}$			±400	nA

### ON CHARACTERISTICS

Gate Threshold Voltage	$V_{GE(th)}$	$V_{GE} = V_{CE}, I_C = 50\text{ mA}$	2.6	4.5	6.4	V
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C = 50\text{ A}, V_{GE} = 15\text{ V } T_C = 25^\circ\text{C}$		1.6	2.1	V
		$I_C = 50\text{ A}, V_{GE} = 15\text{ V } T_C = 175^\circ\text{C}$		1.92		V

### DYNAMIC CHARACTERISTIC

Input Capacitance	$C_{ies}$	$V_{CE} = 30\text{ V}, V_{GE} = 0\text{ V}, f = 1\text{ MHz}$		3209		pF
Output Capacitance	$C_{oes}$			42		
Reverse Transfer Capacitance	$C_{res}$			12		

### SWITCHING CHARACTERISTIC

Turn-On Delay Time	$t_{d(on)}$	$V_{CC} = 400\text{ V}, I_C = 25\text{ A},$ $R_G = 4.7\ \Omega, V_{GE} = 15\text{ V},$ Inductive Load, $T_C = 25^\circ\text{C}$  FWD: FGH50T65SQD		19		ns
Rise Time	$t_r$			13		ns
Turn-Off Delay Time	$t_{d(off)}$			93		ns
Fall Time	$t_f$			6.4		ns
Turn-On Switching Loss	$E_{on}$			410		μJ
Turn-Off Switching Loss	$E_{off}$			88		μJ
Total Switching Loss	$E_{ts}$			498		μJ
Turn-On Delay Time	$t_{d(on)}$	$V_{CC} = 400\text{ V}, I_C = 25\text{ A},$ $R_G = 4.7\ \Omega, V_{GE} = 15\text{ V},$ Inductive Load, $T_C = 175^\circ\text{C}$  FWD: FGH50T65SQD		18		ns
Rise Time	$t_r$			15		ns
Turn-Off Delay Time	$t_{d(off)}$			102		ns
Fall Time	$t_f$			8		ns
Turn-On Switching Loss	$E_{on}$			641		μJ
Turn-Off Switching Loss	$E_{off}$			203		μJ
Total Switching Loss	$E_{ts}$			844		μJ
Total Gate Charge	$Q_g$	$V_{CE} = 400\text{ V}, I_C = 50\text{ A},$ $V_{GE} = 15\text{ V}$		99		nC
Gate-to-Emitter Charge	$Q_{ge}$			17		nC
Gate-to-Collector Charge	$Q_{gc}$			23		nC

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.

TYPICAL CHARACTERISTICS

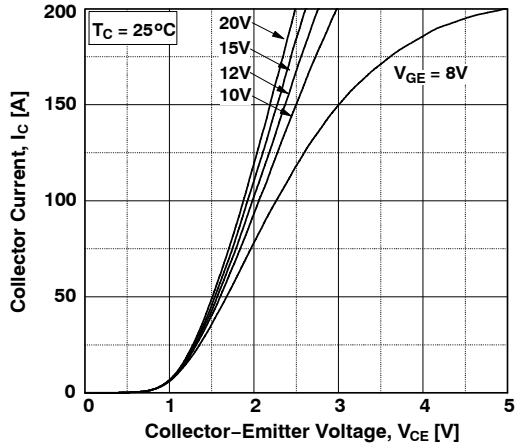


Figure 1. Typical Output Characteristics

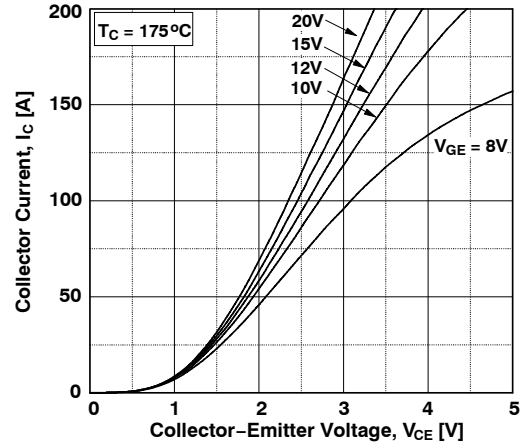


Figure 2. Typical Output Characteristics

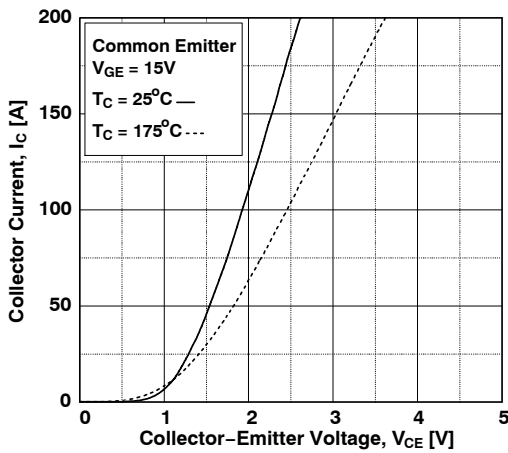


Figure 3. Typical Saturation Voltage Characteristics

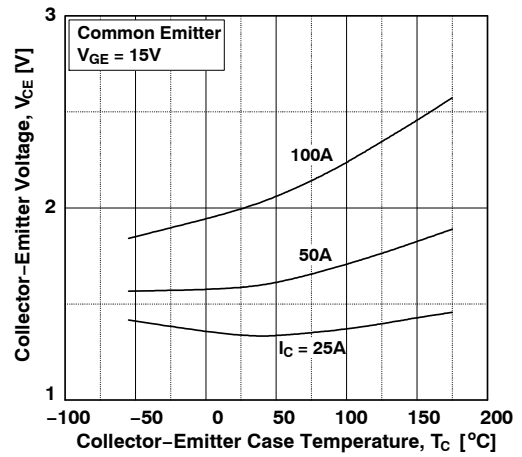


Figure 4. Saturation Voltage vs. Case Temperature at Variant Current Level

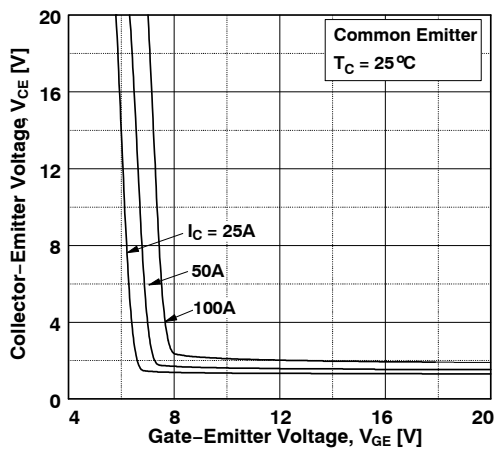


Figure 5. Saturation Voltage vs.  $V_{GE}$

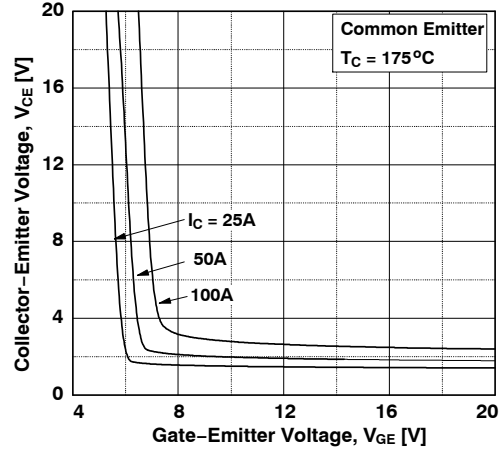


Figure 6. Saturation Voltage vs.  $V_{GE}$

TYPICAL CHARACTERISTICS

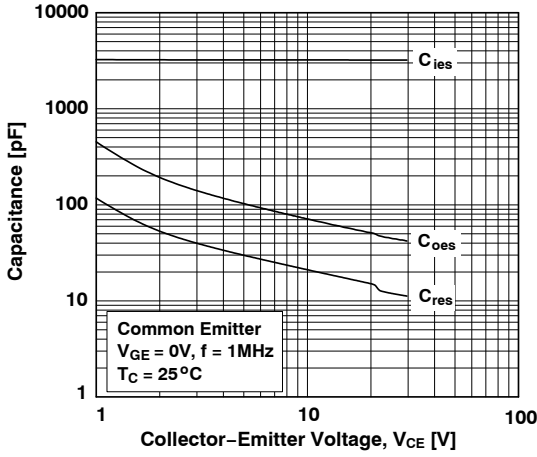


Figure 7. Capacitance Characteristics

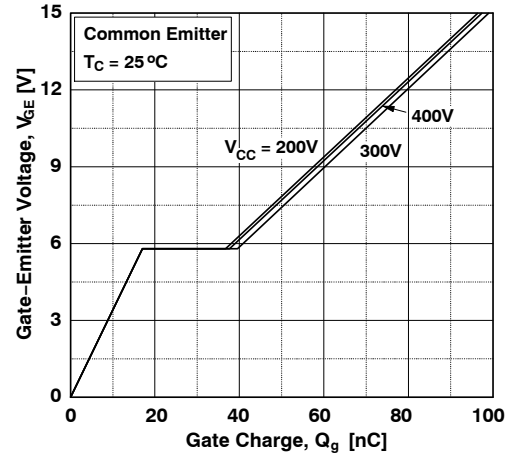


Figure 8. Gate Charge Characteristics

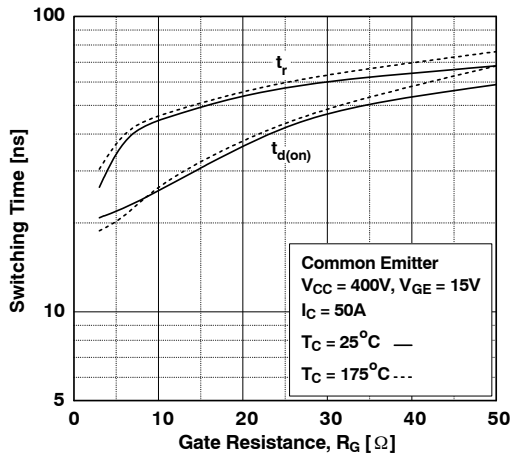


Figure 9. Turn-on Characteristics vs. Gate Resistance

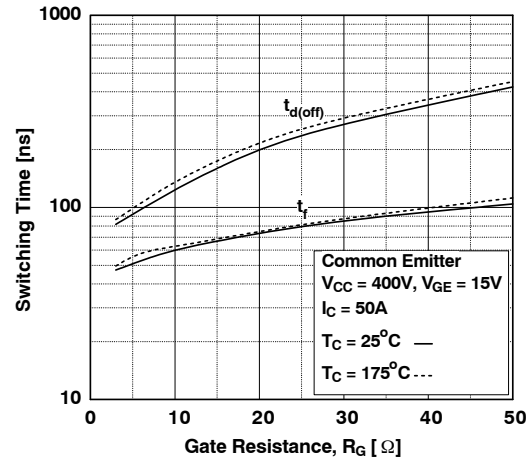


Figure 10. Turn-off Characteristics vs. Gate Resistance

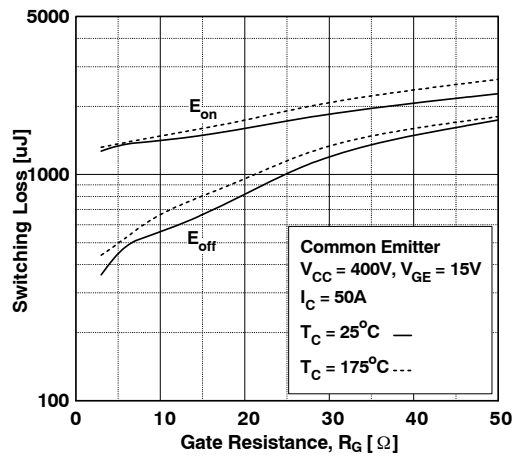


Figure 11. Switching Loss vs. Gate Resistance

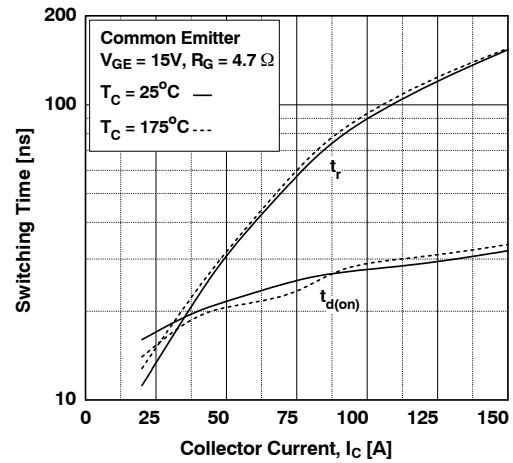


Figure 12. Turn-on Characteristics vs. Collector Current

TYPICAL CHARACTERISTICS

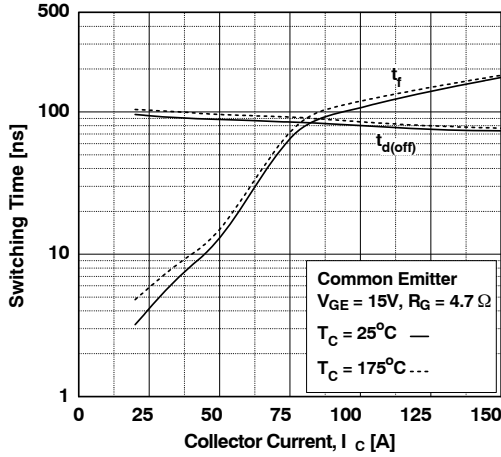


Figure 13. Turn-off Characteristics vs. Collector Current

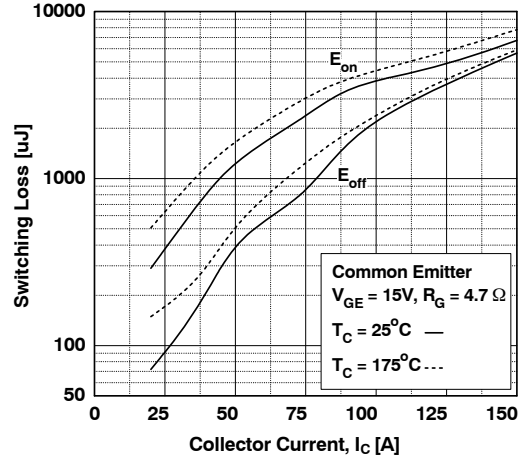


Figure 14. Switching Loss vs. Collector Current

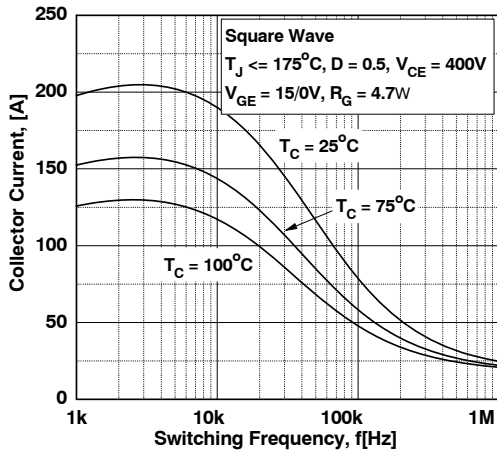


Figure 15. Load Current vs. Frequency

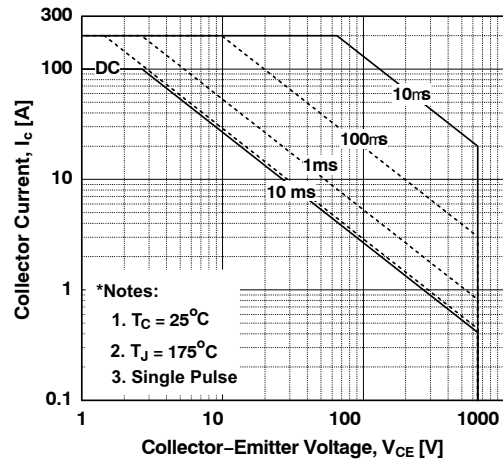


Figure 16. SOA Characteristics

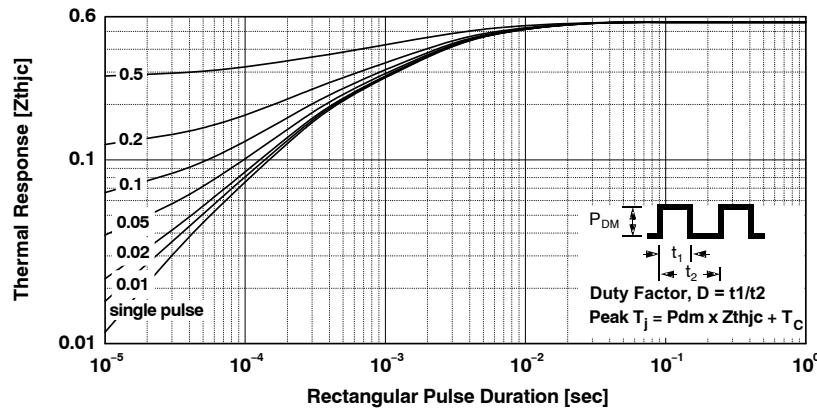
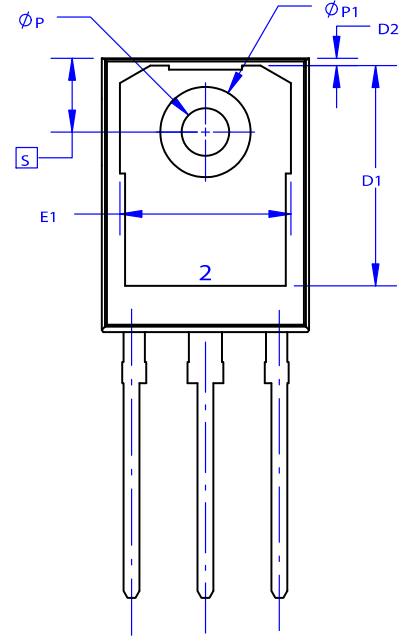
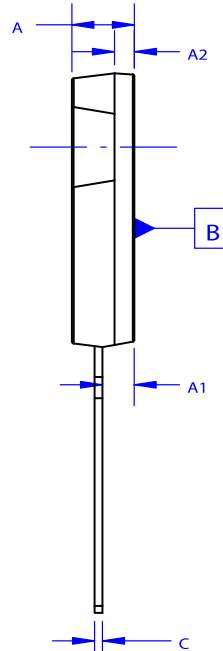
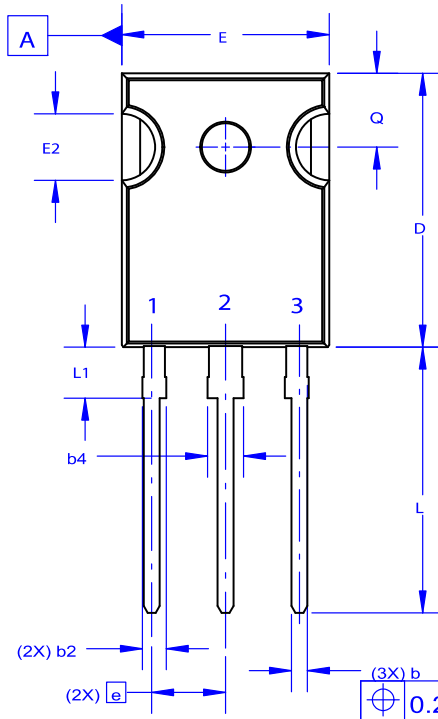
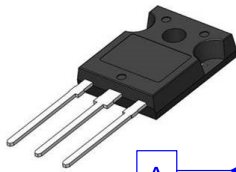


Figure 17. Transient Thermal Impedance of IGBT

**TO-247-3LD**  
**CASE 340CX**  
**ISSUE A**

DATE 06 JUL 2020



NOTES: UNLESS OTHERWISE SPECIFIED.

- A. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.  
B. ALL DIMENSIONS ARE IN MILLIMETERS.  
C. DRAWING CONFORMS TO ASME Y14.5 - 2009.  
D. DIMENSION A1 TO BE MEASURED IN THE REGION DEFINED BY L1.  
E. LEAD FINISH IS UNCONTROLLED IN THE REGION DEFINED BY L1.

**GENERIC**  
**MARKING DIAGRAM\***


XXXXX = Specific Device Code  
A = Assembly Location  
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.

DIM	MILLIMETERS		
	MIN	NOM	MAX
A	4.58	4.70	4.82
A1	2.20	2.40	2.60
A2	1.40	1.50	1.60
D	20.32	20.57	20.82
E	15.37	15.62	15.87
E2	4.96	5.08	5.20
e	~	5.56	~
L	19.75	20.00	20.25
L1	3.69	3.81	3.93
ØP	3.51	3.58	3.65
Q	5.34	5.46	5.58
S	5.34	5.46	5.58
b	1.17	1.26	1.35
b2	1.53	1.65	1.77
b4	2.42	2.54	2.66
c	0.51	0.61	0.71
D1	13.08	~	~
D2	0.51	0.93	1.35
E1	12.81	~	~
ØP1	6.60	6.80	7.00

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