

# IGBT - Field Stop

## 600 V, 40 A

# FGH40N60UF

### Description

Using novel field stop IGBT technology, onsemi's field stop IGBTs offer the optimum performance for solar inverter, UPS, welder and PFC applications where low conduction and switch-ing losses are essential.

### Features

- High Current Capability
- Low Saturation Voltage:  $V_{CE(sat)} = 1.8\text{ V @ } I_C = 40\text{ A}$
- High Input Impedance
- Fast Switching
- These Device is Pb-Free and is RoHS Compliant

### Applications

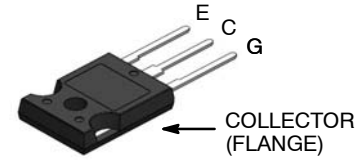
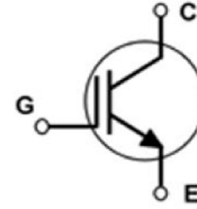
- Solar Inverter, UPS, Welder, PFC

### ABSOLUTE MAXIMUM RATINGS

Description	Symbol	Value	Unit
Collector to Emitter Voltage	$V_{CES}$	600	V
Gate to Emitter Voltage	$V_{GES}$	$\pm 20$	V
Transient Gate to Emitter Voltage		$\pm 30$	
Collector Current	$I_C$	$T_C = 25^\circ\text{C}$	A
Collector Current		$T_C = 100^\circ\text{C}$	
Pulsed Collector Current (Note 1)	$I_{CM}$	$T_C = 25^\circ\text{C}$	A
Maximum Power Dissipation	$P_D$	$T_C = 25^\circ\text{C}$	W
Maximum Power Dissipation		$T_C = 100^\circ\text{C}$	W
Operating Junction Temperature	$T_J$	-55 to +150	$^\circ\text{C}$
Storage Temperature Range	$T_{stg}$	-55to +150	$^\circ\text{C}$
Maximum Lead Temp. for Soldering Purposes, 1/8" from Case for 5 Seconds	$T_L$	300	$^\circ\text{C}$

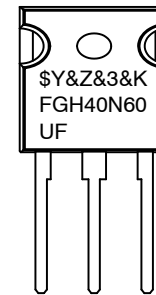
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. Repetitive rating: Pulse width limited by max. junction temperature.



TO-247-3LD  
CASE 340CK

### MARKING DIAGRAMS



\$Y = onsemi Logo  
&Z = Assembly Plant Code  
&3 = Numeric Date Code  
&K = Lot Code  
FGH40N60UF = Specific Device Code

### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 2 of this data sheet.

# FGH40N60UF

## THERMAL CHARACTERISTICS

Parameter	Symbol	Typ	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}(IGBT)$	-	0.43	$^{\circ}C/W$
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	-	40	$^{\circ}C/W$

## PACKAGE MARKING AND ORDERING INFORMATION

Part Number	Top Mark	Package	Packing Method	Reel Size	Tape Width	Quantity
FGH40N60UFTU	FGH40N60UF	TO-247-3	Tube	N/A	N/A	30

## ELECTRICAL CHARACTERISTICS OF THE IGBT ( $T_C = 25^{\circ}C$ unless otherwise noted)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
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### Off Characteristics

Collector to Emitter Breakdown Voltage	$BV_{CES}$	$V_{GE} = 0 V, I_C = 250 \mu A$	600	-	-	V
Temperature Coefficient of Breakdown Voltage	$\Delta BV_{CES}/\Delta T_J$	$V_{GE} = 0 V, I_C = 250 \mu A$		0.6		$V/^{\circ}C$
Collector Cut-Off Current	$I_{CES}$	$V_{CE} = V_{CES}, V_{GE} = 0 V$	-	-	250	$\mu A$
G-E Leakage Current	$I_{GES}$	$V_{GE} = V_{GES}, V_{CE} = 0 V$	-	-	$\pm 400$	nA

### On Characteristics

G-E Threshold Voltage	$V_{GE(th)}$	$I_C = 250 \mu A, V_{CE} = V_{GE}$	4.0	5.0	6.5	V
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C = 40 A, V_{GE} = 15 V$	-	1.8	2.4	V
		$I_C = 40 A, V_{GE} = 15 V, T_C = 125^{\circ}C$	-	2.0	-	V

### Dynamic Characteristics

Input Capacitance	$C_{ies}$	$V_{CE} = 30 V, V_{GE} = 0 V, f = 1 MHz$	-	2110	-	pF
Output Capacitance	$C_{oes}$		-	200	-	pF
Reverse Transfer Capacitance	$C_{res}$		-	60	-	pF

### Switching Characteristics

Turn-On Delay Time	$t_{d(on)}$	$V_{CC} = 400 V, I_C = 40 A, R_G = 10 \Omega, V_{GE} = 15 V, \text{Inductive Load}, T_C = 25^{\circ}C$	-	24	-	ns
Rise Time	$t_r$		-	44	-	ns
Turn-Off Delay Time	$t_{d(off)}$		-	112	-	ns
Fall Time	$t_f$		-	30	60	ns
Turn-On Switching Loss	$E_{on}$		-	1.19	-	mJ
Turn-Off Switching Loss	$E_{off}$		-	0.46	-	mJ
Total Switching Loss	$E_{ts}$		-	1.65	-	mJ
Turn-On Delay Time	$t_{d(on)}$	$V_{CC} = 400 V, I_C = 40 A, R_G = 10 \Omega, V_{GE} = 15 V, \text{Inductive Load}, T_C = 125^{\circ}C$	-	24	-	ns
Rise Time	$t_r$		-	45	-	ns
Turn-Off Delay Time	$t_{d(off)}$		-	120	-	ns
Fall Time	$t_f$		-	40	-	ns
Turn-On Switching Loss	$E_{on}$		-	1.2	-	mJ
Turn-Off Switching Loss	$E_{off}$		-	0.69	-	mJ
Total Switching Loss	$E_{ts}$		-	1.89	-	mJ
Total Gate Charge	$Q_g$	$V_{CE} = 400 V, I_C = 40 A, V_{GE} = 15 V$	-	120	-	nC
Gate to Emitter Charge	$Q_{ge}$		-	14	-	nC
Gate to Collector Charge	$Q_{gc}$		-	58	-	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.

# FGH40N60UF

## TYPICAL PERFORMANCE CHARACTERISTICS

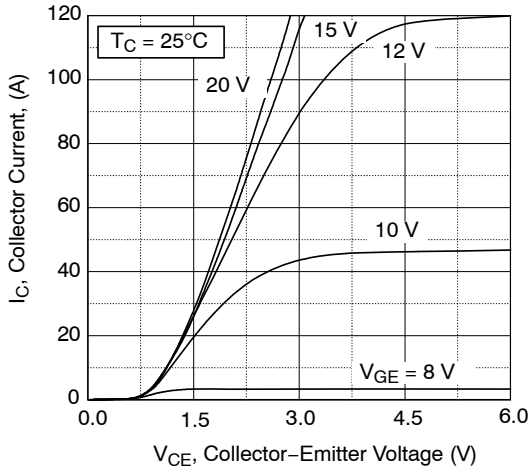


Figure 1. Typical Output Characteristics

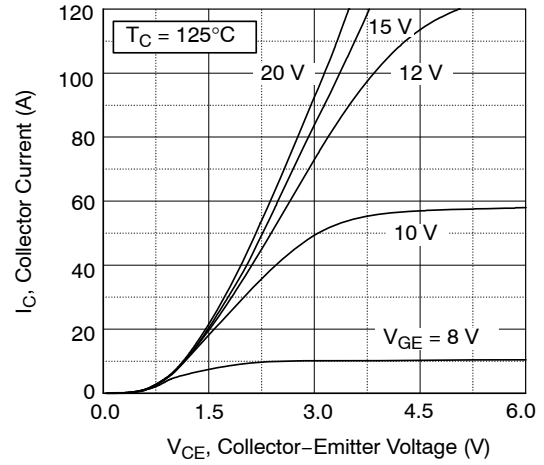


Figure 2. Typical Output Characteristics

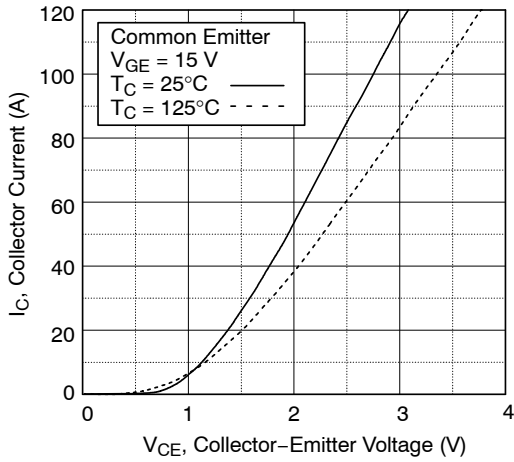


Figure 3. Typical Saturation Voltage Characteristics

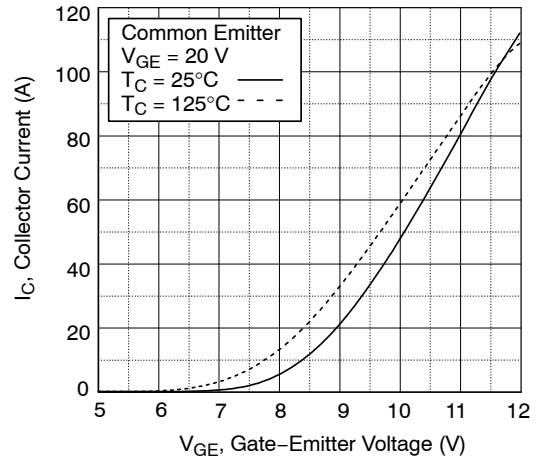


Figure 4. Transfer Characteristics

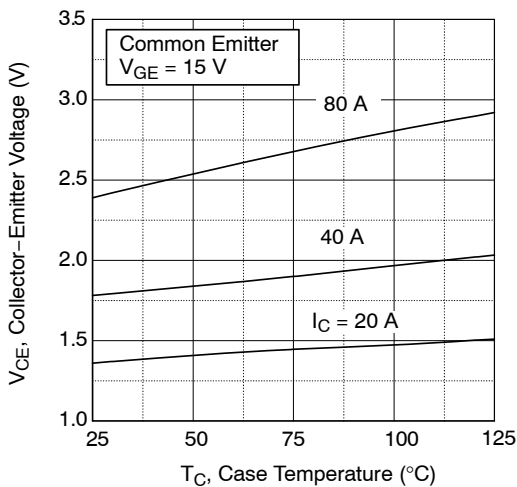


Figure 5. Saturation Voltage vs. Case Temperature at Variant Current Level

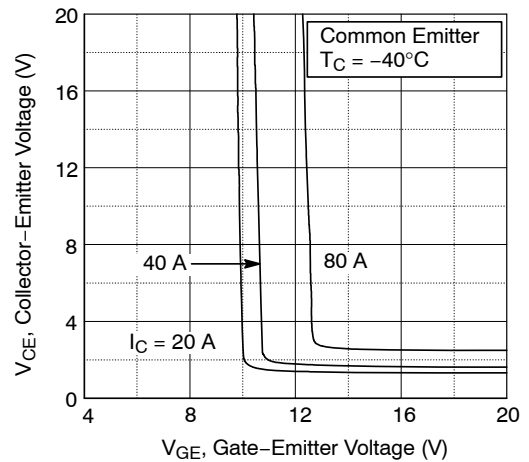


Figure 6. Saturation Voltage vs  $V_{GE}$

TYPICAL PERFORMANCE CHARACTERISTICS (CONTINUED)

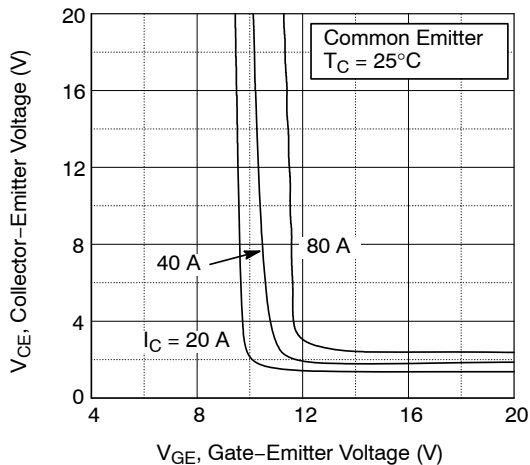


Figure 7. Saturation Voltage vs.  $V_{GE}$

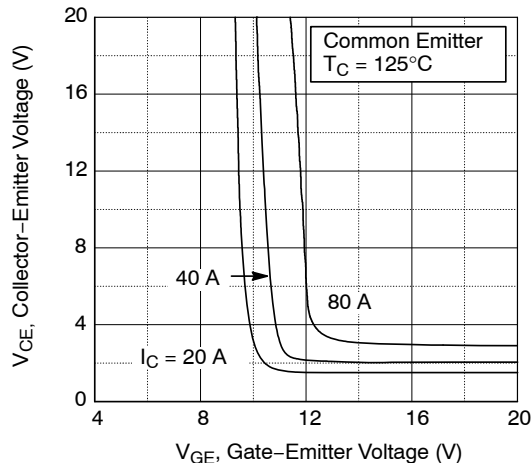


Figure 8. Saturation Voltage vs.  $V_{GE}$

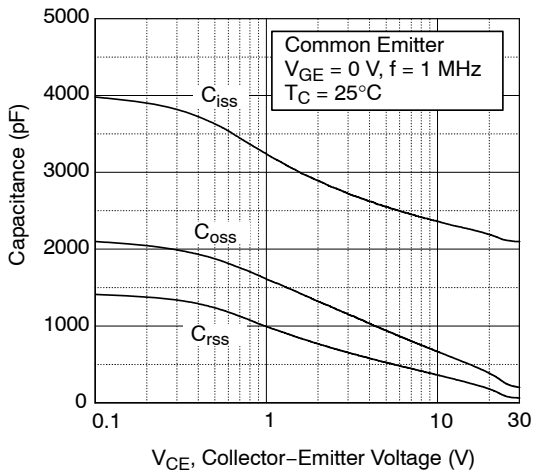


Figure 9. Capacitance Characteristics

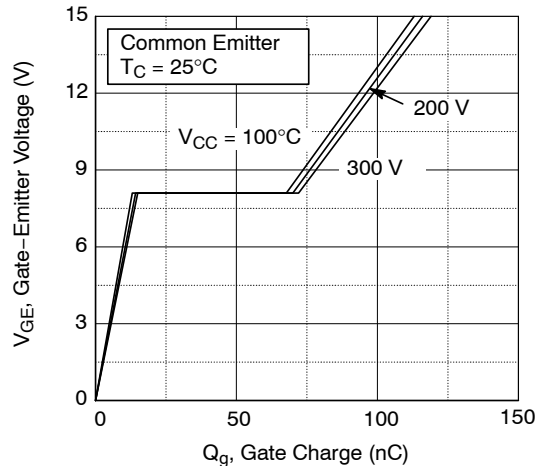


Figure 10. Gate Charge Characteristics

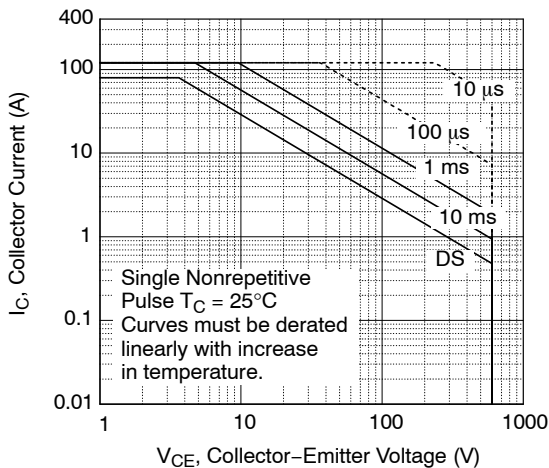


Figure 11. SOA Characteristics

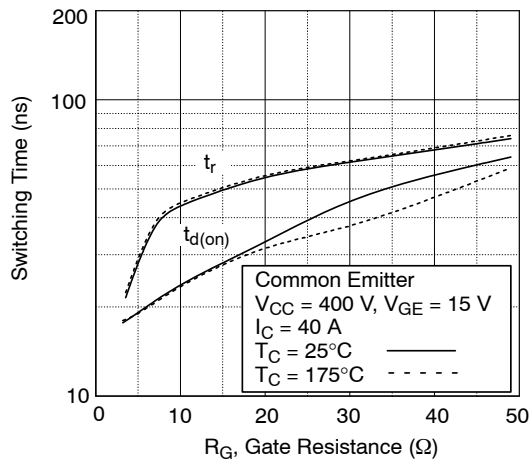


Figure 12. Turn-On Characteristics vs. Gate Resistance

TYPICAL PERFORMANCE CHARACTERISTICS (CONTINUED)

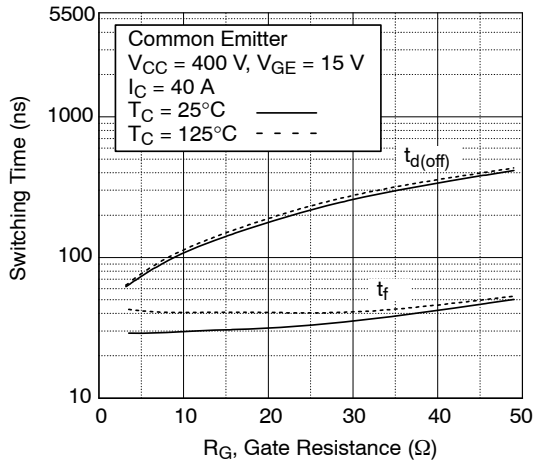


Figure 13. Turn-Off Characteristics vs. Gate Resistance

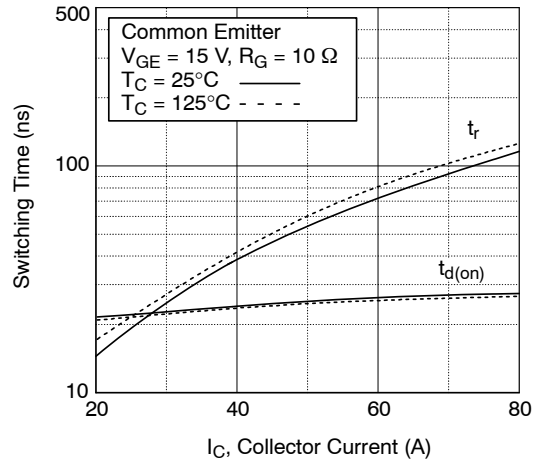


Figure 14. Turn-On Characteristics vs. Collector Current

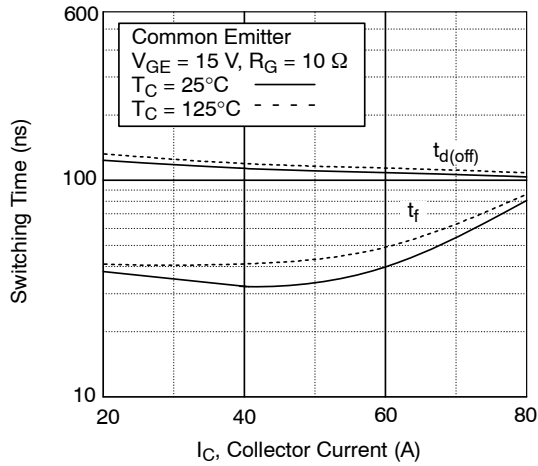


Figure 15. Turn-Off Characteristics vs. Collector Current

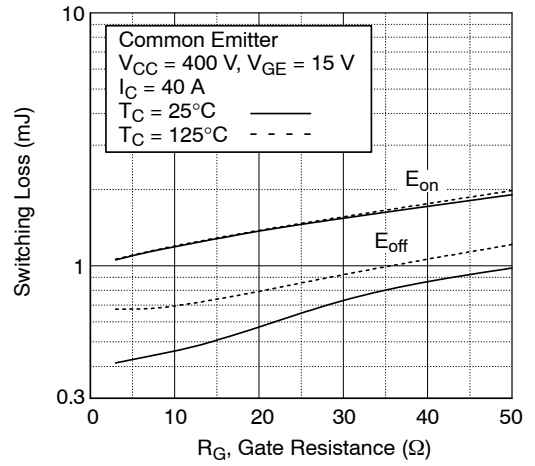


Figure 16. Switching Loss vs. Gate Resistance

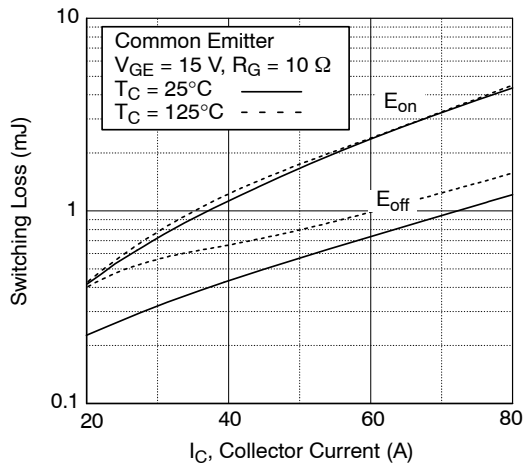


Figure 17. Switching Loss vs. Collector Current

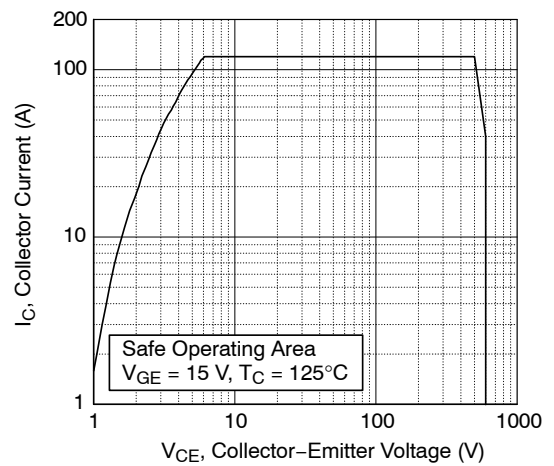


Figure 18. Turn-Off Switching SOA Characteristics

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## TYPICAL PERFORMANCE CHARACTERISTICS (CONTINUED)

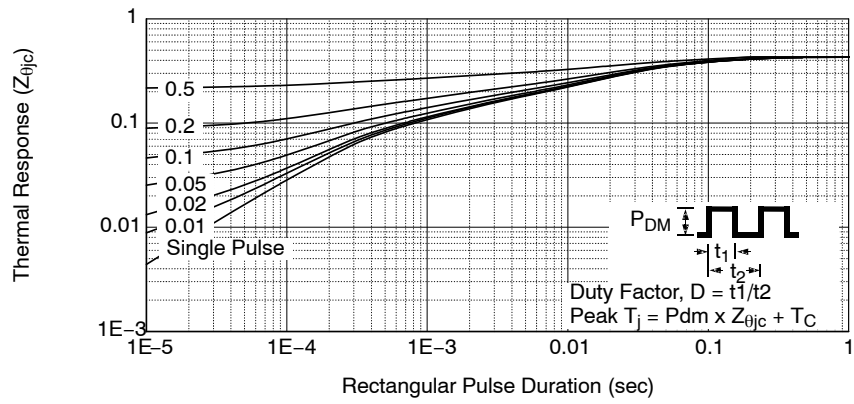


Figure 19. Transient Thermal Impedance of IGBT

**TO-247-3LD SHORT LEAD**  
**CASE 340CK**  
**ISSUE A**

DATE 31 JAN 2019



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\***



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.

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
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
D	20.32	20.57	20.82
D1	13.08	~	~
D2	0.51	0.93	1.35
E	15.37	15.62	15.87
E1	12.81	~	~
E2	4.96	5.08	5.20
e	~	5.56	~
L	15.75	16.00	16.25
L1	3.69	3.81	3.93
∅P	3.51	3.58	3.65
∅P1	6.60	6.80	7.00
Q	5.34	5.46	5.58
S	5.34	5.46	5.58

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