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FAIRCHILD

SEMICONDUCTOR®

FGL40N120AND
1200V NPT IGBT

Features

- High speed switching
- Low saturation voltage : $V_{CE(sat)}$ = 2.6 V @ I_C = 40A
- High input impedance
- CO-PAK, IGBT with FRD : t_{rr} = 75ns (typ.)

Applications

Induction Heating, UPS, AC & DC motor controls and general purpose inverters.

Description

Employing NPT technology, Fairchild's AND series of IGBTs provides low conduction and switching losses. The AND series offers an solution for application such as induction heating (IH), motor control, general purpose inverters and uninterruptible power supplies (UPS).

TO-264

G C E

C

G

E
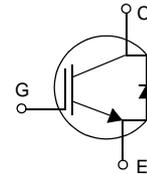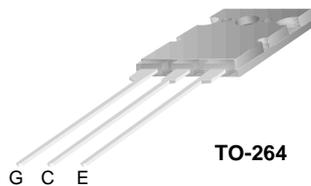
Absolute Maximum Ratings

Symbol	Parameter		FGL40N120AND	Units
V_{CES}	Collector-Emitter Voltage		1200	V
V_{GES}	Gate-Emitter Voltage		±25	V
I_C	Collector Current	@T_C = 25°C	64	A
	Collector Current	@T_C = 100°C	40	A
$I_{CM(1)}$	Pulsed Collector Current		160	A
I_F	Diode Continuous Forward Current	@T_C = 100°C	40	A
I_{FM}	Diode Maximum Forward Current		240	A
P_D	Maximum Power Dissipation	@T_C = 25°C	500	W
	Maximum Power Dissipation	@T_C = 100°C	200	W
SCWT	Short Circuit Withstand Time, V_{CE} = 600V, V_{GE} = 15V, T_C = 125°C		10	μs
T_J	Operating Junction Temperature		-55 to +150	°C
T_{STG}	Storage Temperature Range		-55 to +150	°C
T_L	Maximum Lead Temp. for Soldering Purposes, 1/8" from Case for 5 seconds		300	°C

Notes:
(1) Pulse width limited by max. junction temperature

Thermal Characteristics

Symbol	Parameter	Typ.	Max.	Units
$R_{\theta JC}$(IGBT)	Thermal Resistance, Junction-to-Case	--	0.25	°C/W
$R_{\theta JC}$(DIODE)	Thermal Resistance, Junction-to-Case	--	0.7	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	--	25	°C/W

Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FGL40N120AND	FGL40N120AND	TO-264	-	-	25

Electrical Characteristics of the IGBT T_C = 25°C unless otherwise noted

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
Off Characteristics						
BV_{CES}	Collector-Emitter Breakdown Voltage	V_{GE} = 0V, I_C = 1mA	1200	--	--	V
$BV_{CES}/\Delta T_J$	Temperature Coefficient of Breakdown Voltage	V_{GE} = 0V, I_C = 1mA	--	0.6	--	V/°C
I_{CES}	Collector Cut-Off Current	V_{CE} = V_{CES}, V_{GE} = 0V	--	--	1	mA
I_{GES}	G-E Leakage Current	V_{GE} = V_{GES}, V_{CE} = 0V	--	--	±250	nA
On Characteristics						
$V_{GE(th)}$	G-E Threshold Voltage	I_C = 250µA, V_{CE} = V_{GE}	3.5	5.5	7.5	V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	I_C = 40A, V_{GE} = 15V	--	2.6	3.2	V
		I_C = 40A, V_{GE} = 15V, T_C = 125°C	--	2.9	--	V
		I_C = 64A, V_{GE} = 15V	--	3.15	--	V
Dynamic Characteristics						
C_{ies}	Input Capacitance	V_{CE} = 30V, V_{GE} = 0V f = 1MHz	--	3200	--	pF
C_{oes}	Output Capacitance		--	370	--	pF
c_{res}	Reverse Transfer Capacitance		--	125	--	pF
Switching Characteristics						
$t_{d(on)}$	Turn-On Delay Time	V_{CC} = 600V, I_C = 40A, R_G = 5Ω, V_{GE} = 15V, Inductive Load, T_C = 25°C	--	15	--	ns
t_r	Rise Time		--	20	--	ns
$t_{d(off)}$	Turn-Off Delay Time		--	110	--	ns
t_f	Fall Time		--	40	80	ns
E_{on}	Turn-On Switching Loss		--	2.3	3.45	mJ
E_{off}	Turn-Off Switching Loss		--	1.1	1.65	mJ
E_{ts}	Total Switching Loss		--	3.4	5.1	mJ
$t_{d(on)}$	Turn-On Delay Time	V_{CC} = 600V, I_C = 40A, R_G = 5Ω, V_{GE} = 15V, Inductive Load, T_C = 125°C	--	20	--	ns
t_r	Rise Time		--	25	--	ns
$t_{d(off)}$	Turn-Off Delay Time		--	120	--	ns
t_f	Fall Time		--	45	--	ns
E_{on}	Turn-On Switching Loss		--	2.5	--	mJ
E_{off}	Turn-Off Switching Loss		--	1.8	--	mJ
E_{ts}	Total Switching Loss		--	4.3	--	mJ
Q_g	Total Gate charge	V_{CE} = 600V, I_C = 40A, V_{GE} = 15V	--	220	330	nC
Q_{ge}	Gate-Emitter Charge		--	25	38	nC
Q_{gc}	Gate-Collector Charge		--	130	195	nC

Electrical Characteristics of DIODE $T_C = 25°C$ unless otherwise noted

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Units
V_{FM}	Diode Forward Voltage	$I_F = 40A$	$T_C = 25°C$	--	3.2	4.0	V
			$T_C = 125°C$	--	2.7	--	
t_{rr}	Diode Reverse Recovery Time		$T_C = 25°C$	--	75	112	nS
			$T_C = 125°C$	--	130	--	
I_{rr}	Diode Peak Reverse Recovery Current	$I_F = 40A$, di/dt = 200A/μs	$T_C = 25°C$	--	8	12	A
			$T_C = 125°C$	--	13	--	
Q_{rr}	Diode Reverse Recovery Charge		$T_C = 25°C$	--	300	450	nC
			$T_C = 125°C$	--	845	--	

Typical Performance Characteristics

Figure 1. Typical Output Characteristics
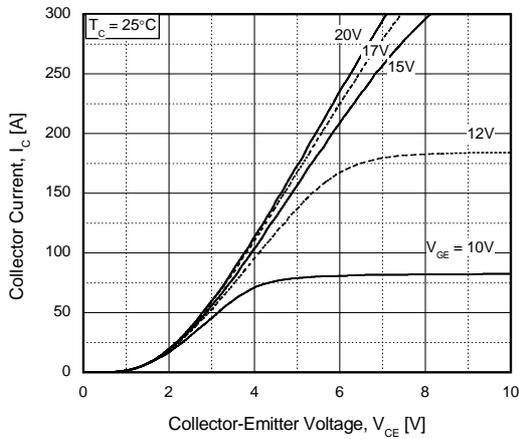
Figure 2. Typical Saturation Voltage Characteristics
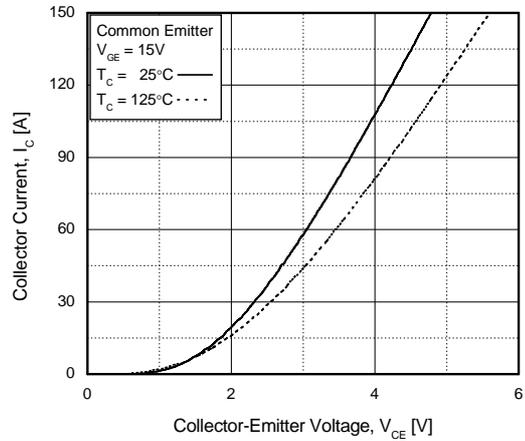
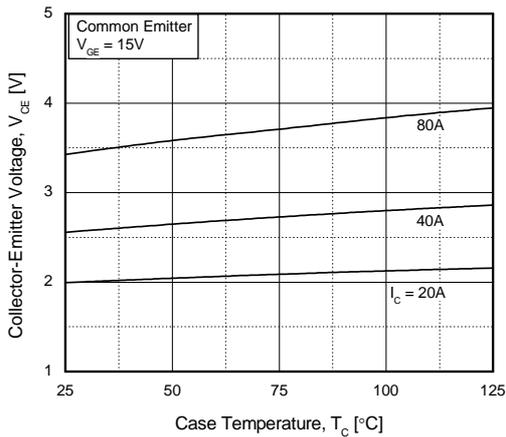## Figure 3. Saturation Voltage vs. Case Temperature at Variant Current Level

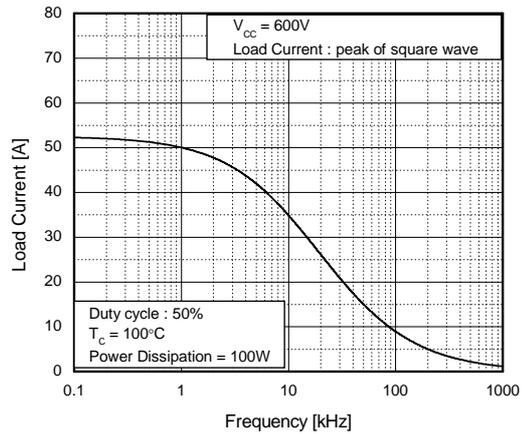

Figure 4. Load Current vs. Frequency
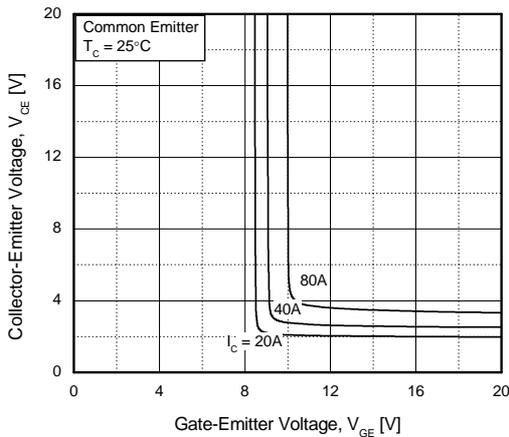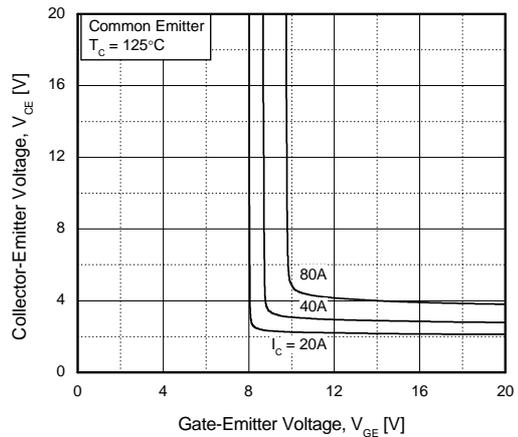

Figure 5. Saturation Voltage vs. V_{GE}

Figure 6. Saturation Voltage vs. V_{GE}

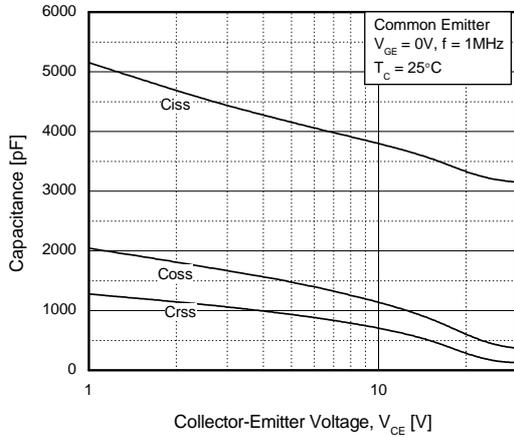## Typical Performance Characteristics (Continued)

Figure 7. Capacitance Characteristics

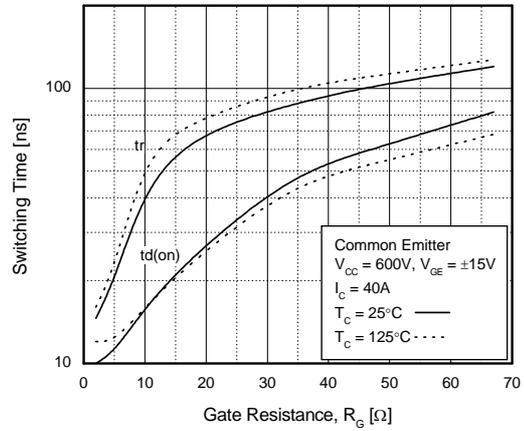### Figure 8. Turn-On Characteristics vs. Gate Resistance

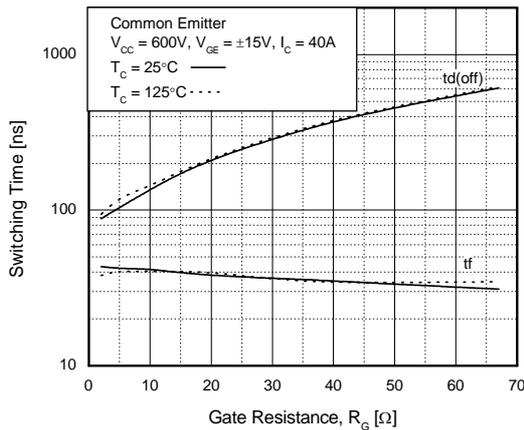### Figure 9. Turn-Off Characteristics vs. Gate Resistance

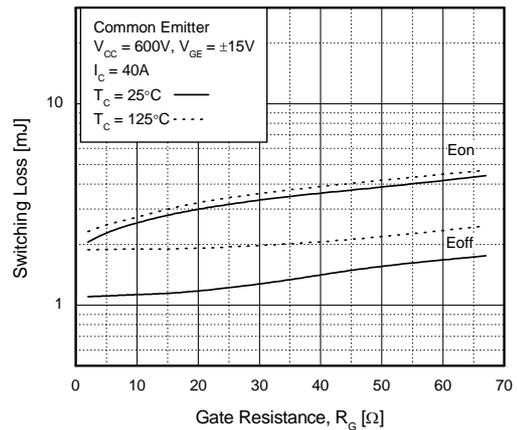### Figure 10. Switching Loss vs. Gate Resistance

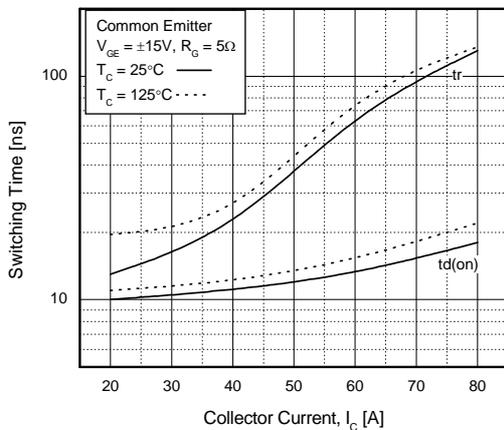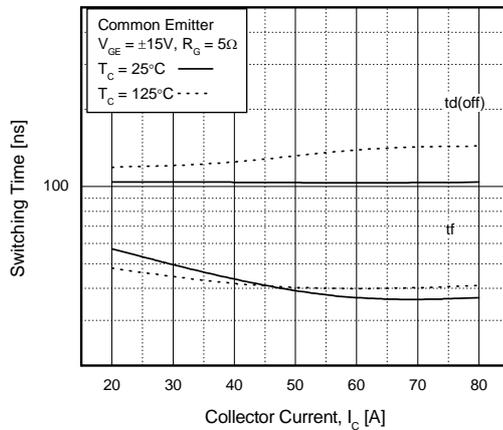### Figure 11. Turn-On Characteristics vs. Collector Current

Figure 12. Turn-Off Characteristics vs. Collector Current

Typical Performance Characteristics (Continued)
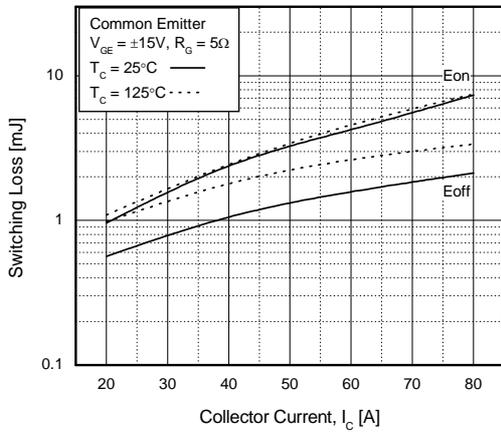
Figure 13. Switching Loss vs. Collector Current

Common Emitter
$V_{GE} = \pm15V$, $R_G = 5\Omega$
$T_C = 25°C$ ——
$T_C = 125°C$ ····

Switching Loss [mJ] vs. Collector Current, I_C [A]

Eon
Eoff

Figure 14. Gate Charge Characteristics

Common Emitter
$R_L = 15\Omega$
$T_C = 25°C$

Vcc = 200V
600V
400V

Gate-Emitter Voltage, V_{GE} [V] vs. Gate Charge, Q_g [nC]
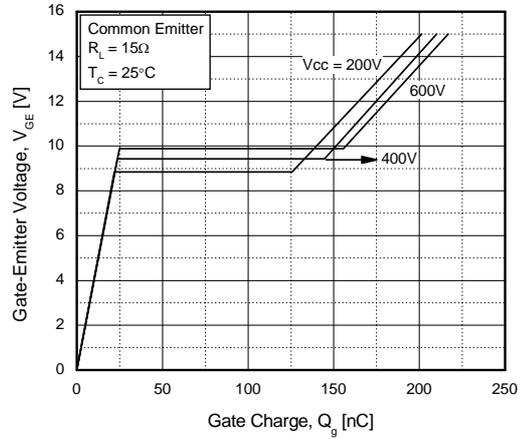
Figure 15. SOA Characteristics

Ic MAX (Pulsed)
Ic MAX (Continuous)
50µs
100µs
1ms
DC Operation

Single Nonrepetitive
Pulse Tc = 25°C
Curves must be derated
linearly with increase
in temperature

Collector Current, Ic [A] vs. Collector - Emitter Voltage, V_{CE} [V]

Figure 16. Turn-Off SOA

Safe Operating Area
$V_{GE} = 15V$, $T_C = 125°C$

Collector Current, I_C [A] vs. Collector-Emitter Voltage, V_{CE} [V]
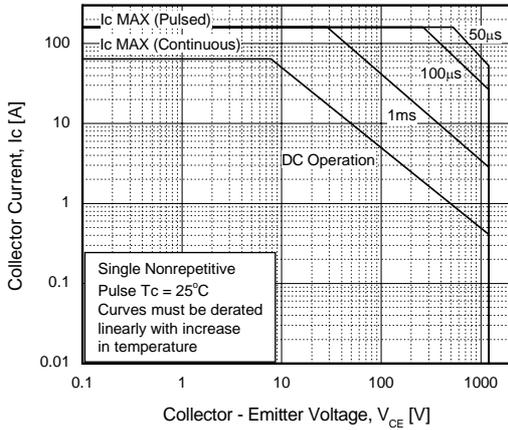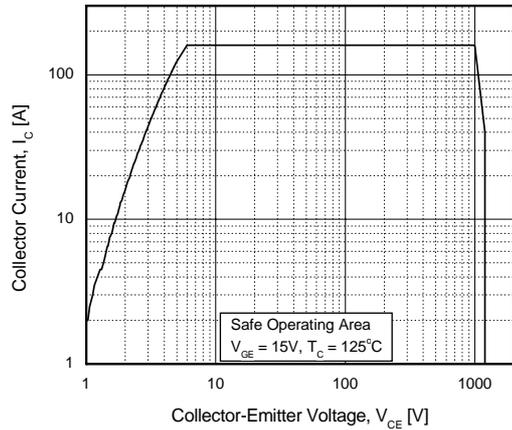
Figure 17. Forward Characteristics

$T_J = 125°C$
$T_J = 25°C$

$T_C = 125°C$ ····
$T_C = 25°C$ ——

Forward Current , I_F [A] vs. Forward Voltage , V_F [V]
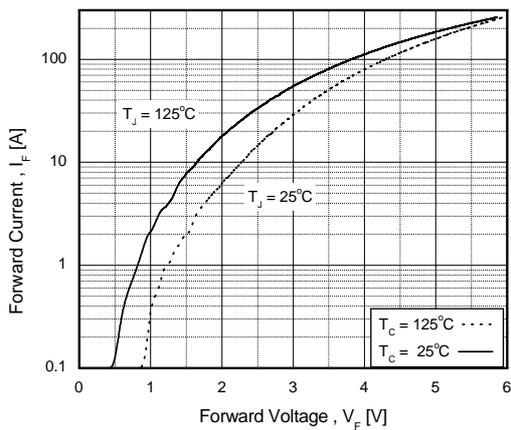
Figure 18. Reverse Recovery Current

di/dt = 200A/µs
di/dt = 100A/µs

Reverse Recovery Curret, I_{rr} [A] vs. Forward Current , I_F [A]
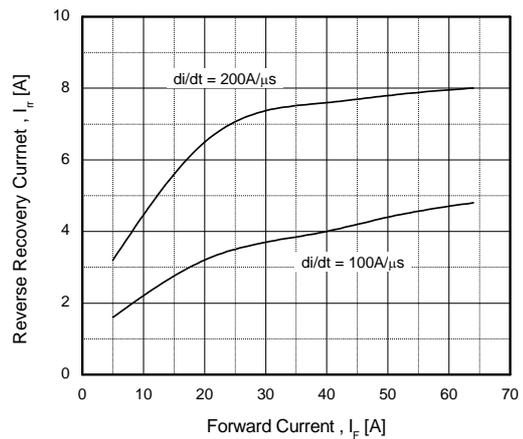
Typical Performance Characteristics (Continued)

Figure 19. Stored Charge

di/dt = 200A/μs

di/dt = 100A/μs

Reverse Recovery Time , t_{rr} [ns] vs Forward Current , I_F [A]
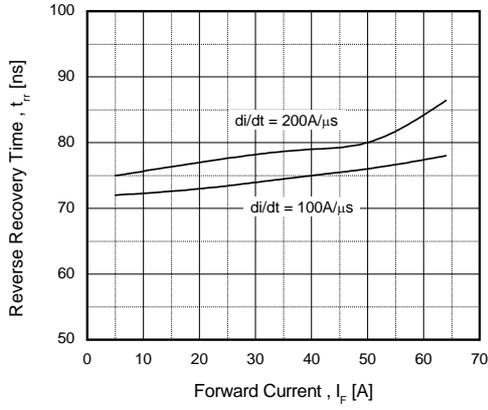
Figure 20. Reverse Recovery Time

di/dt = 200A/μs

di/dt = 100A/μs

Stored Recovery Charge , Q_{rr} [nC] vs Forward Current , I_F [A]
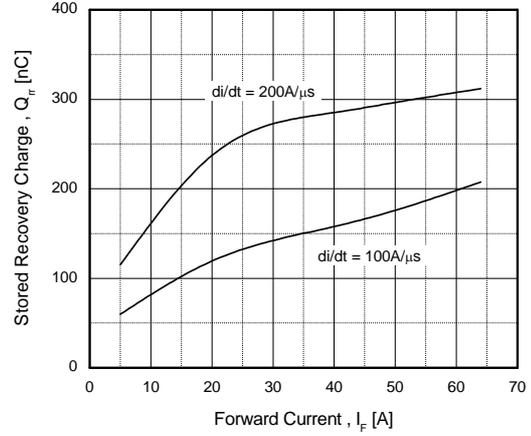
Figure 21. Transient Thermal Impedance of IGBT

0.5
0.2
0.1
0.05
0.02
0.01
single pulse

Thermal Response [Zthjc] vs Rectangular Pulse Duration [sec]

Duty factor D = t1 / t2
Peak Tj = Pdm × Zthjc + T_C

FGL40N120AND Rev. A2
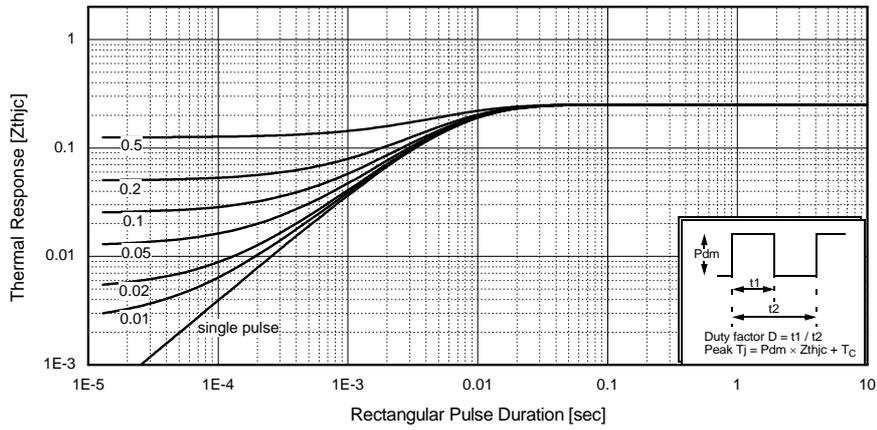
Mechanical Dimensions

TO-264
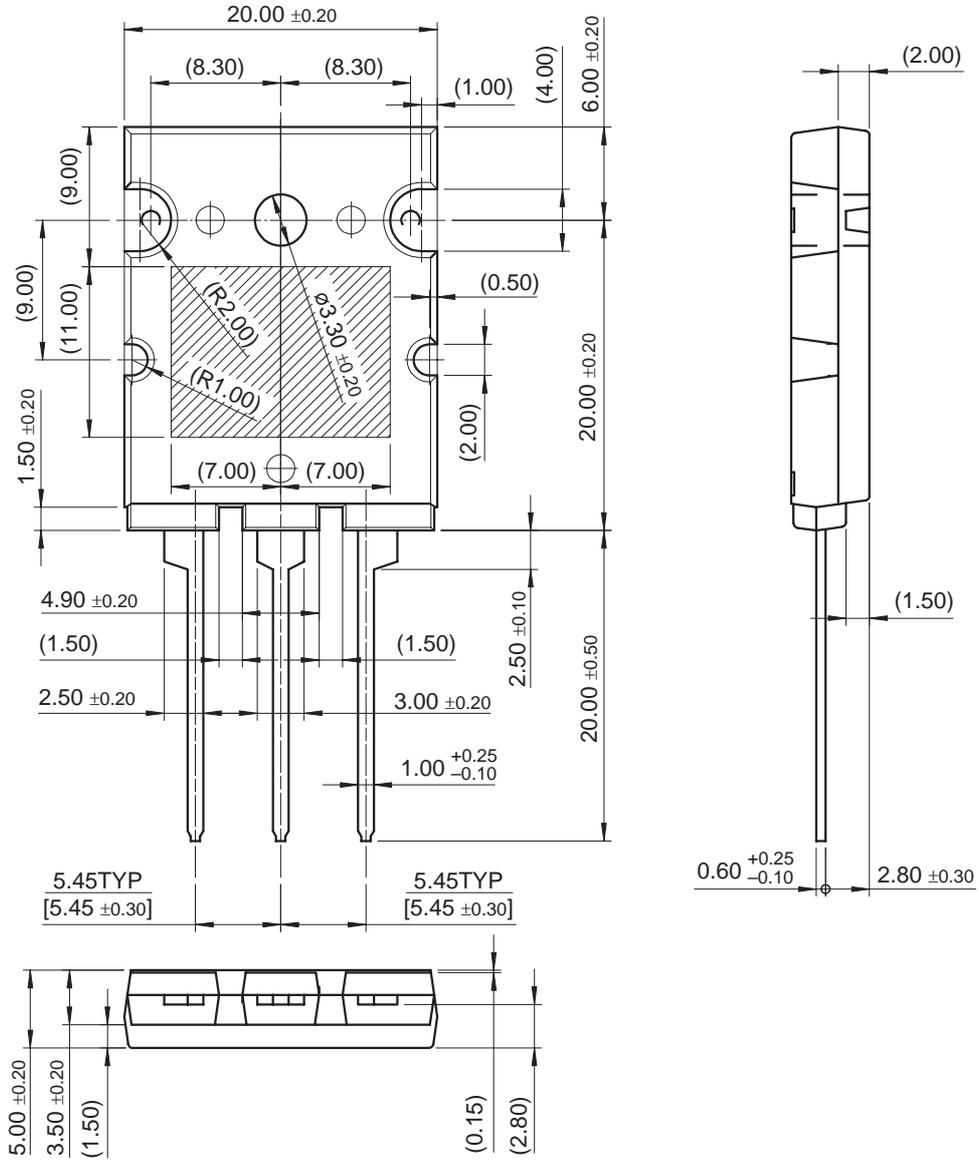
Dimensions in Millimeters

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