

IRG4PH40UD2-EP

International
IR Rectifier

Electrical Characteristics @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)CES}$	Collector-to-Emitter Breakdown Voltage ③	1200	—	—	V $V_{GE} = 0V, I_C = 250\mu A$
$V_{(BR)ECS}$	Emitter-to-Collector Breakdown Voltage	18	—	—	V $V_{GE} = 0V, I_C = 1.0A$
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	—	0.43	—	V/ $^\circ\text{C}$ $V_{GE} = 0V, I_C = 1mA$
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage	—	2.43	3.1	V $I_C = 21A, V_{GE} = 15V$
		—	2.97	—	$I_C = 41A$ See Fig.2, 5
		—	2.47	—	$I_C = 21A, T_J = 150^\circ\text{C}$
$V_{GE(th)}$	Gate Threshold Voltage	3.0	—	6.0	V $V_{CE} = V_{GE}, I_C = 250\mu A$
$\Delta V_{GE(th)}/\Delta T_J$	Threshold Voltage temp. coefficient	—	-11	—	mV/ $^\circ\text{C}$ $V_{CE} = V_{GE}, I_C = 250\mu A$
g_{fe}	Forward Transconductance ④	16	24	—	S $V_{CE} = 100V, I_C = 21A$
I_{CES}	Zero Gate Voltage Collector Current	—	—	250	μA $V_{GE} = 0V, V_{CE} = 1200V$
		—	—	5000	$V_{GE} = 0V, V_{CE} = 1200V, T_J = 150^\circ\text{C}$
V_{FM}	Diode Forward Voltage Drop	—	3.4	3.8	V $I_F = 10A$ See Fig.13
		—	3.3	3.7	$I_F = 10A, T_J = 150^\circ\text{C}$
I_{GES}	Gate-to-Emitter Leakage Current	—	—	± 100	nA $V_{GE} = \pm 20V$

Switching Characteristics @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

Parameter	Min.	Typ.	Max.	Units	Conditions
Q_g	Total Gate Charge (turn-on)	—	100	150	$I_C = 21A$
Q_{ge}	Gate-to-Emitter Charge (turn-on)	—	18	24	$V_{CC} = 400V$ See Fig.8
Q_{gc}	Gate-to-Collector Charge (turn-on)	—	34	50	$V_{GE} = 15V$
$t_{d(on)}$	Turn-On delay time	—	22	—	ns $I_C = 21A, V_{CC} = 800V$ $V_{GE} = 15V, R_G = 10\Omega$ Energy losses include "tail" and diode reverse recovery. See Fig. 9, 10, 11, 18
t_r	Rise time	—	26	—	
$t_{d(off)}$	Turn-Off delay time	—	100	140	
t_f	Fall time	—	200	300	
E_{on}	Turn-On Switching Loss	—	1950	—	μJ $T_J = 150^\circ\text{C}$, See Fig. 9, 10, 11, 18 $I_C = 21A, V_{CC} = 800V$ $V_{GE} = 15V, R_G = 10\Omega$ Energy losses include "tail" and diode reverse recovery.
E_{off}	Turn-Off Switching Loss	—	1710	—	
E_{tot}	Total Switching Loss	—	3660	4490	
$t_{d(on)}$	Turn-On delay time	—	21	—	ns $T_J = 150^\circ\text{C}$, See Fig. 9, 10, 11, 18 $I_C = 21A, V_{CC} = 800V$ $V_{GE} = 15V, R_G = 10\Omega$ Energy losses include "tail" and diode reverse recovery.
t_r	Rise time	—	25	—	
$t_{d(off)}$	Turn-Off delay time	—	220	—	
t_f	Fall time	—	380	—	
E_{TS}	Total Switching Loss	—	6220	—	μJ Measured 5mm from package
L_E	Internal Emitter Inductance	—	13	—	nH
C_{ies}	Input Capacitance	—	2100	—	pF $V_{GE} = 0V$
C_{oes}	Output Capacitance	—	99	—	pF $V_{CC} = 30V$, See Fig.7 $f = 1.0MHz$
C_{res}	Reverse Transfer Capacitance	—	12	—	
t_{rr}	Diode Reverse Recovery Time	—	50	76	ns $T_J = 25^\circ\text{C}$ See Fig. 14
		—	72	110	$T_J = 125^\circ\text{C}$ 15
I_{rr}	Diode Peak Reverse Recovery Current	—	4.4	7.0	A $T_J = 25^\circ\text{C}$ See Fig. 15
		—	5.9	8.8	$T_J = 125^\circ\text{C}$ 16
Q_{rr}	Diode Reverse Recovery Charge	—	130	200	nC $T_J = 25^\circ\text{C}$ See Fig. 17
		—	250	380	$T_J = 125^\circ\text{C}$ 17
$di_{(rec)M}/dt$	Diode Peak Rate of Fall of Recovery During t_b	—	210	—	A/ μs $T_J = 25^\circ\text{C}$ See Fig. 17
		—	180	—	$T_J = 125^\circ\text{C}$ 17

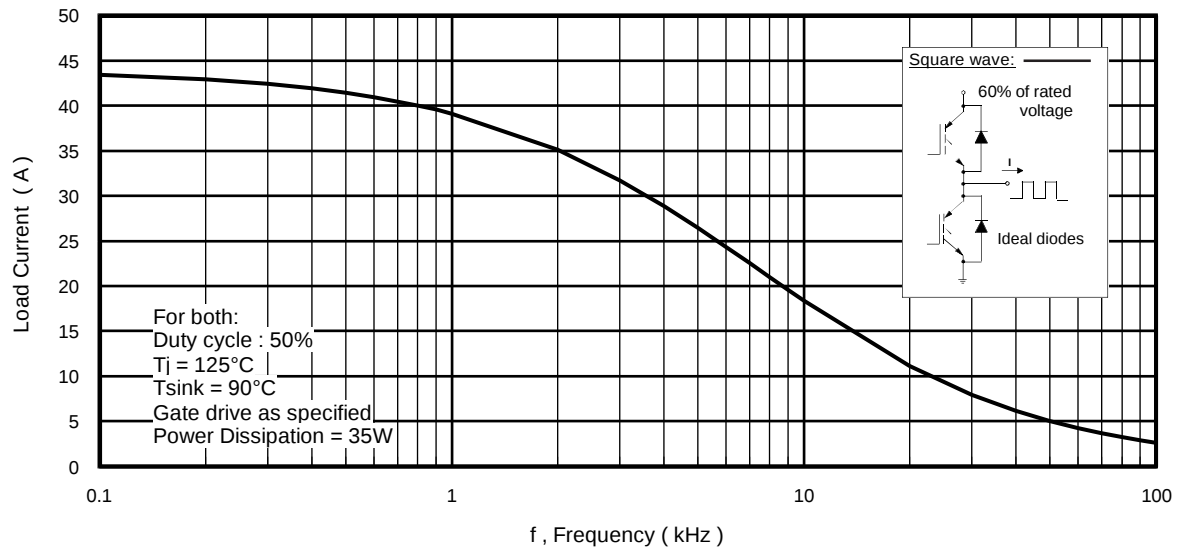


Fig. 1 - Typical Load Current vs. Frequency
(Load Current = I_{RMS} of fundamental)

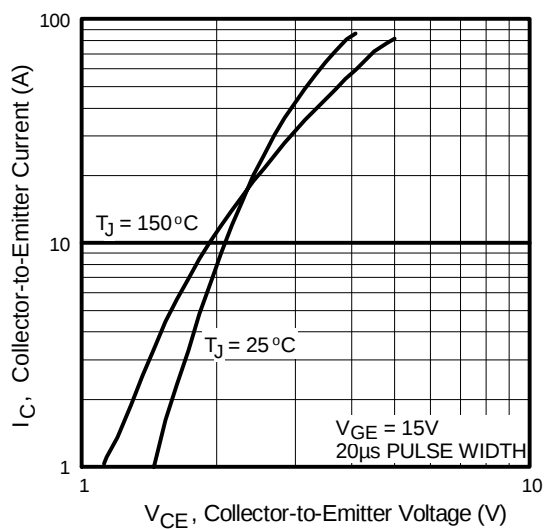


Fig. 2 - Typical Output Characteristics
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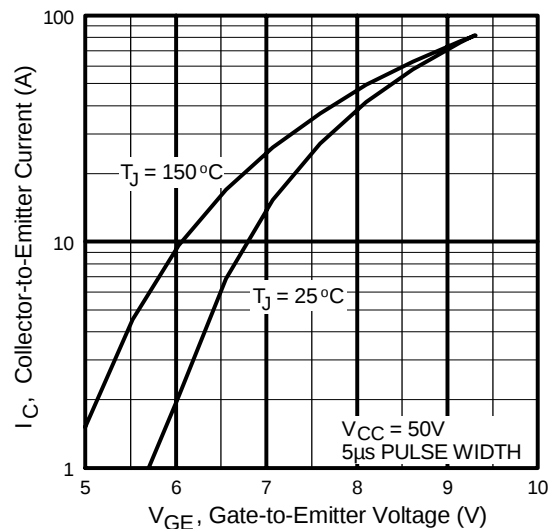


Fig. 3 - Typical Transfer Characteristics
3

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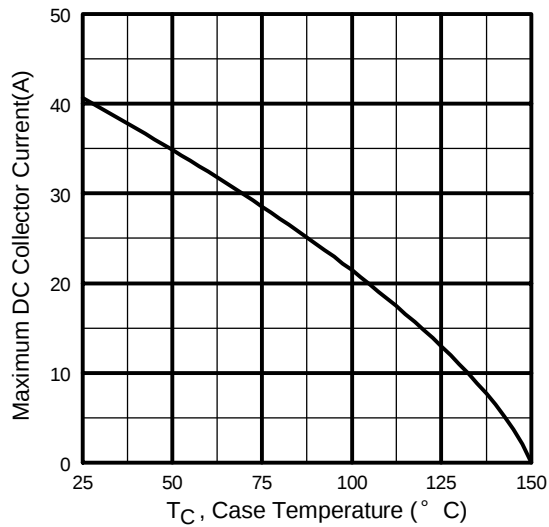


Fig. 4 - Maximum Collector Current vs. Case Temperature

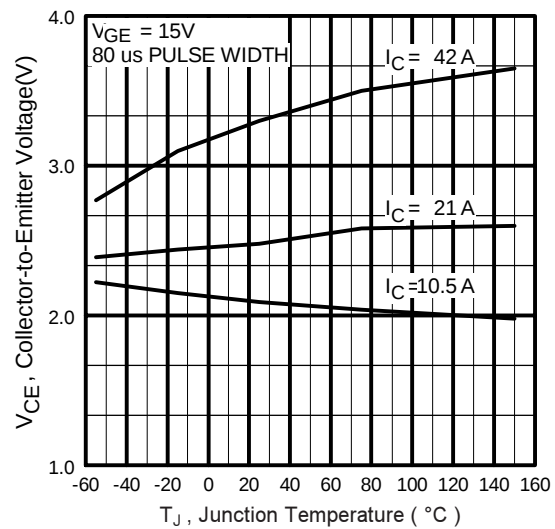


Fig. 5 - Typical Collector-to-Emitter Voltage vs. Junction Temperature

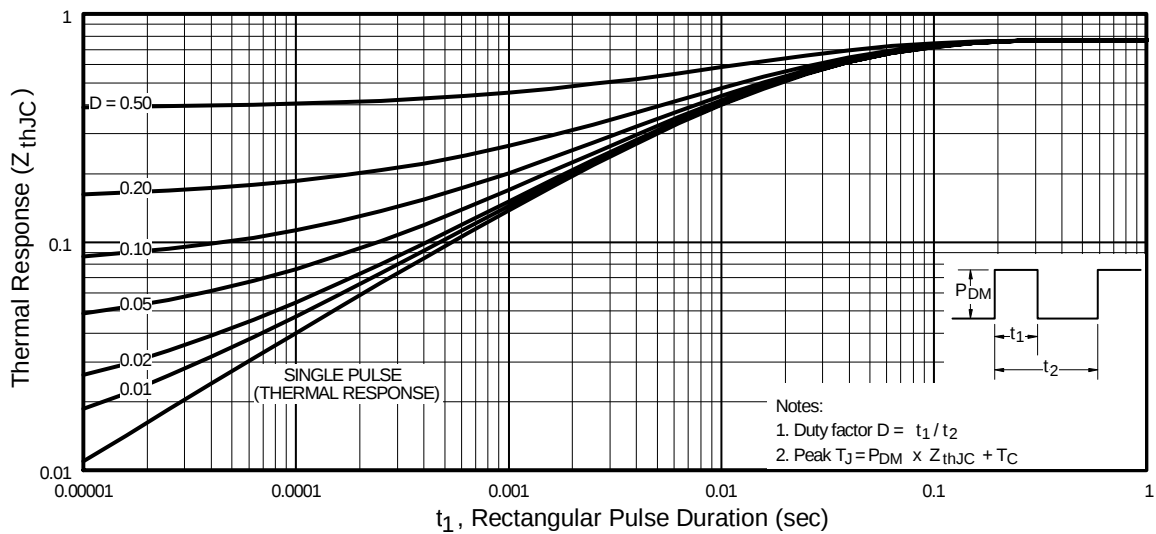


Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

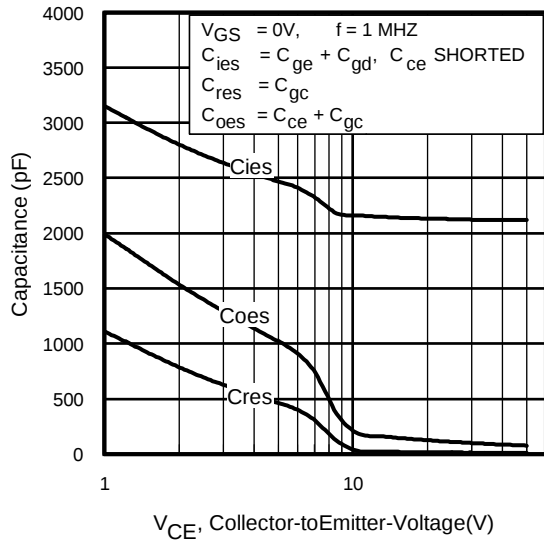


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

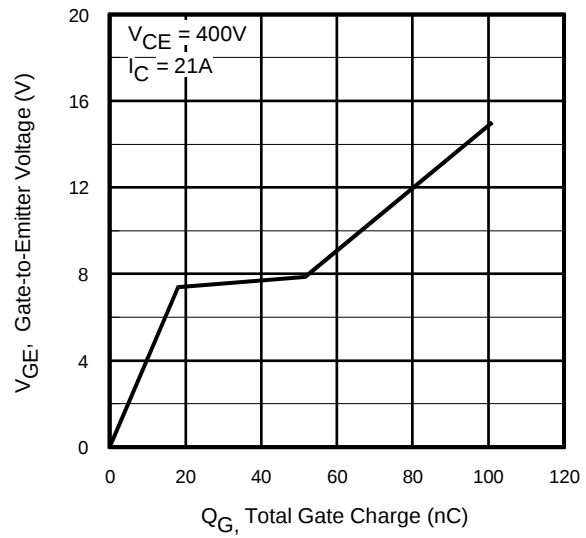


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

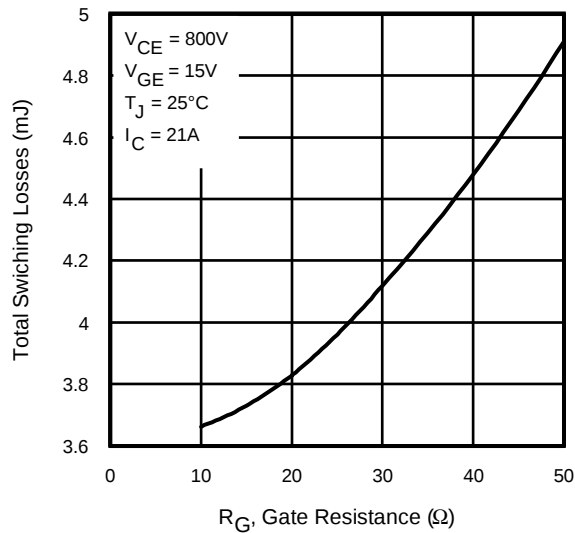


Fig. 9 - Typical Switching Losses vs. Gate Resistance

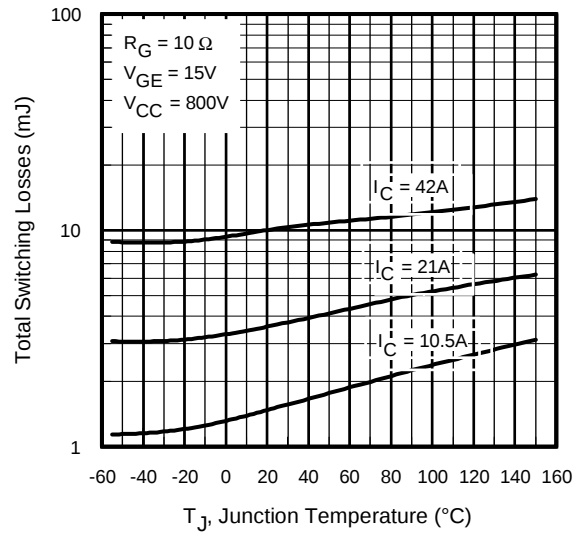


Fig. 10 - Typical Switching Losses vs. Junction Temperature

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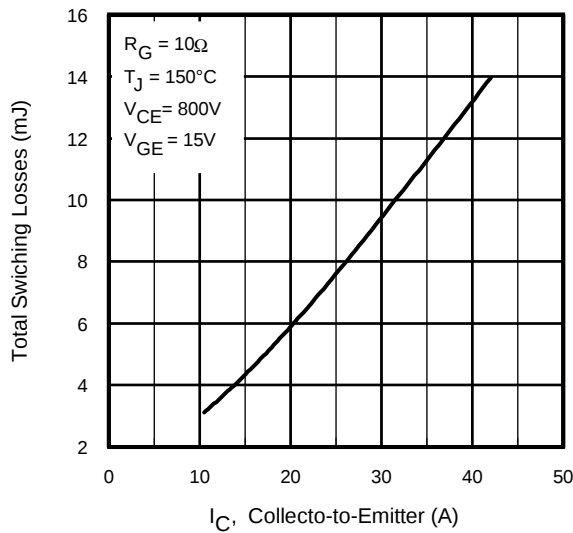


Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

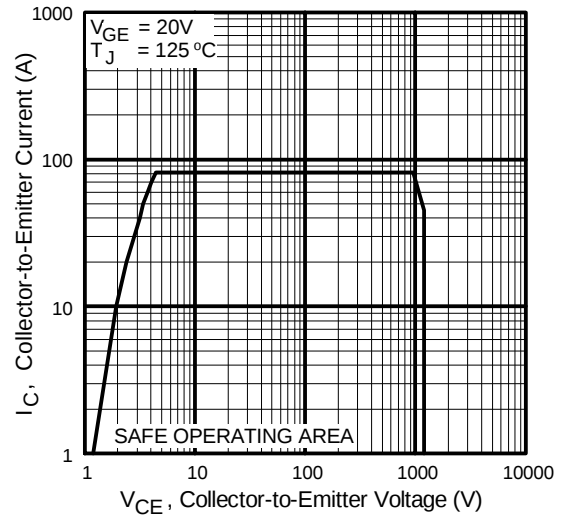


Fig. 12 - Turn-Off SOA

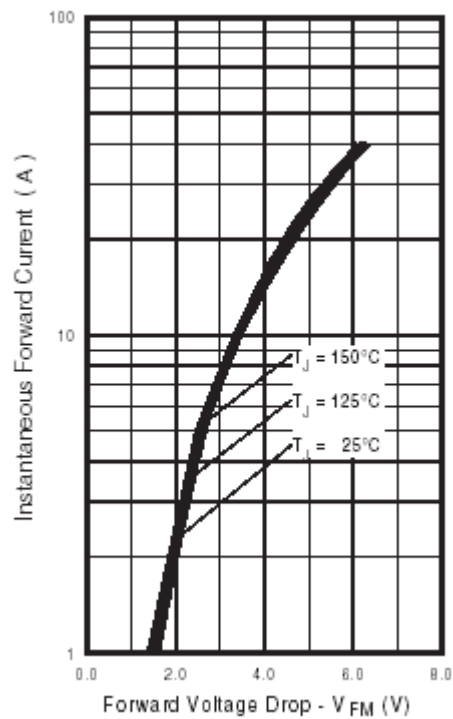


Fig. 13 - Maximum Forward Voltage Drop vs. Instantaneous Forward Current

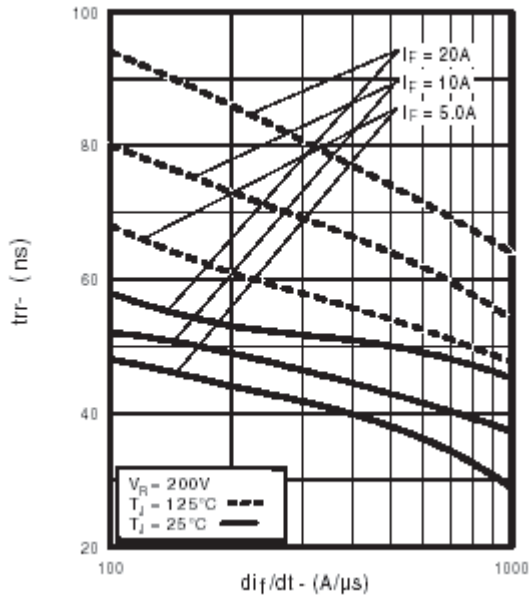


Fig. 14 - Typical Reverse Recovery vs. di_f/dt

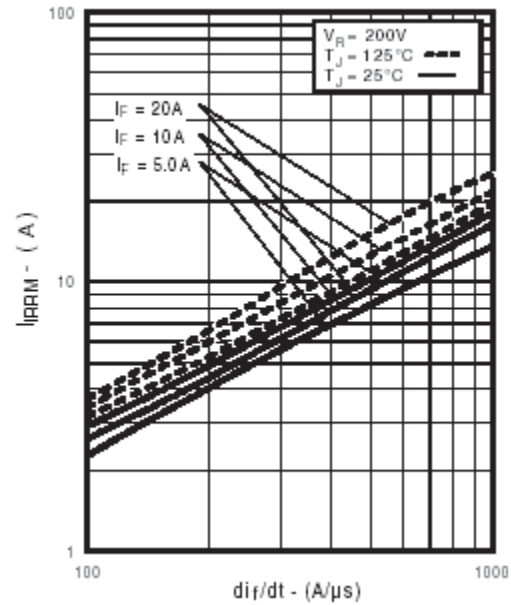


Fig. 15 - Typical Recovery Current vs. di_f/dt

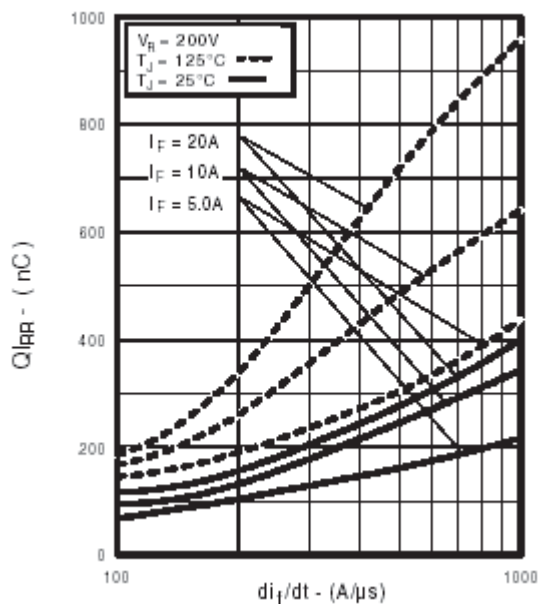


Fig. 16 - Typical Stored Charge vs. di_f/dt
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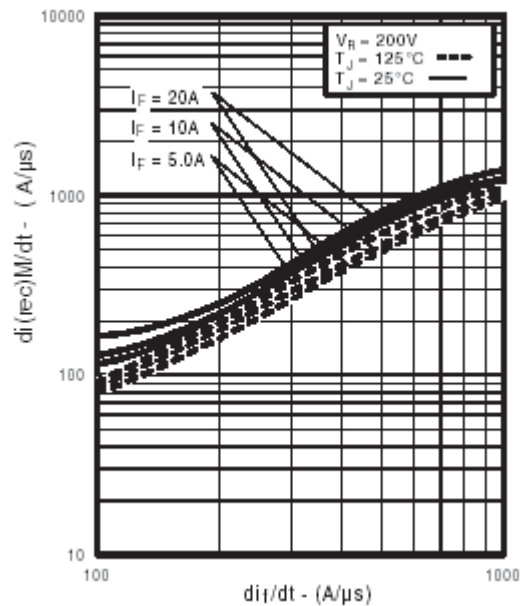


Fig. 17 - Typical $di_{(rec)}M/dt$ vs. di_f/dt

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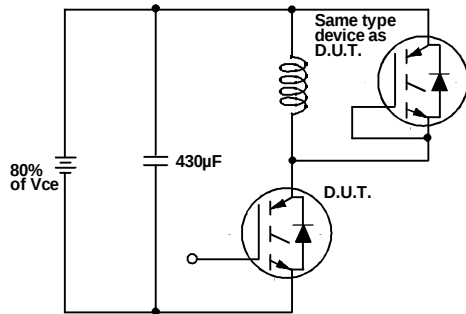


Fig. 18a - Test Circuit for Measurement of I_{LM} , E_{on} , $E_{off}(\text{diode})$, t_{rr} , Q_{rr} , I_{rr} , $t_{d(on)}$, t_r , $t_{d(off)}$, t_f

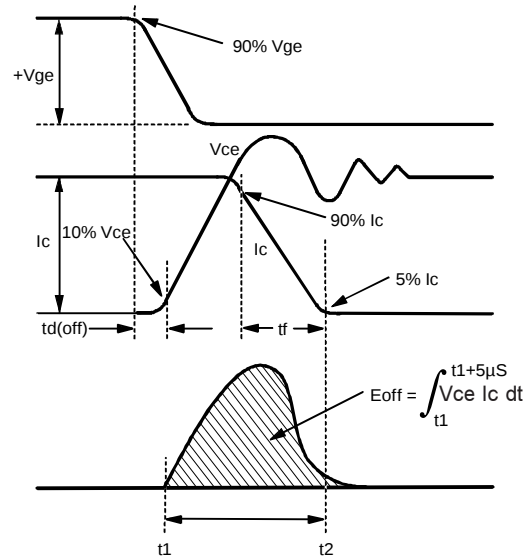


Fig. 18b - Test Waveforms for Circuit of Fig. 18a, Defining E_{off} , $t_{d(off)}$, t_f

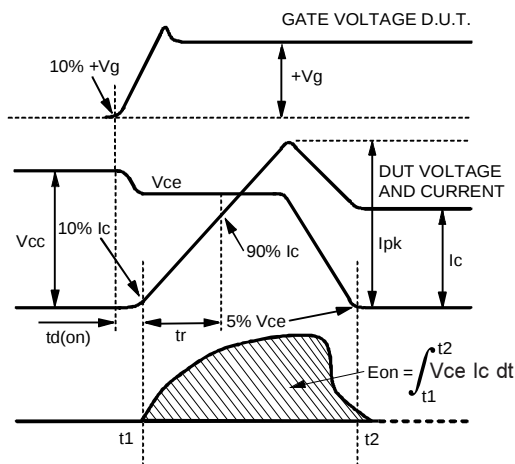


Fig. 18c - Test Waveforms for Circuit of Fig. 18a, Defining E_{on} , $t_{d(on)}$, t_r

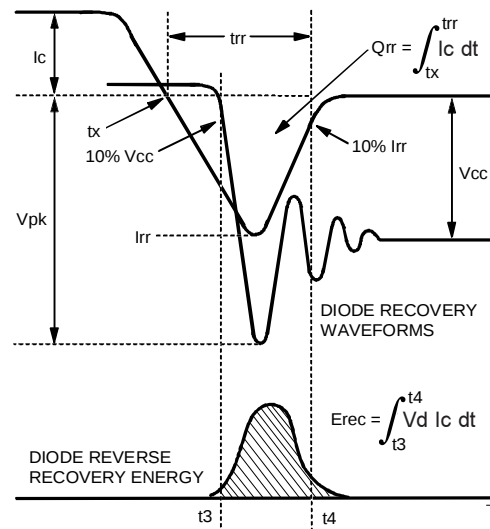


Fig. 18d - Test Waveforms for Circuit of Fig. 18a, Defining E_{rec} , t_{rr} , Q_{rr} , I_{rr}

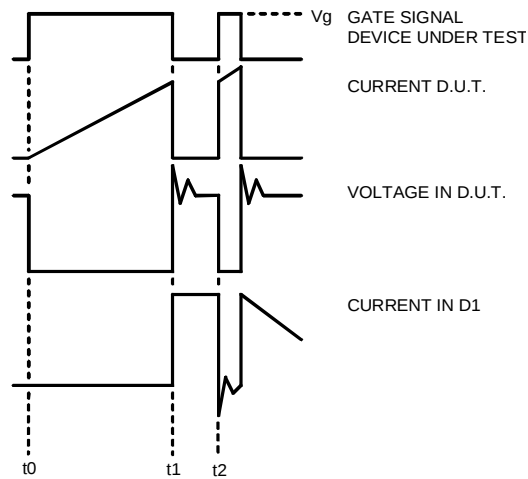


Figure 18e. Macro Waveforms for Figure 18a's Test Circuit

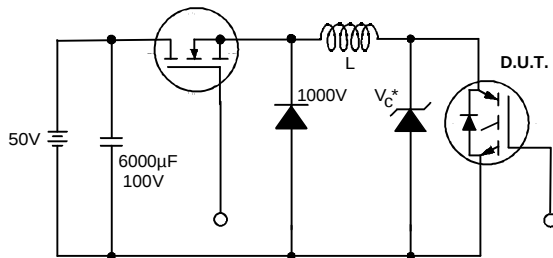


Figure 19. Clamped Inductive Load Test Circuit

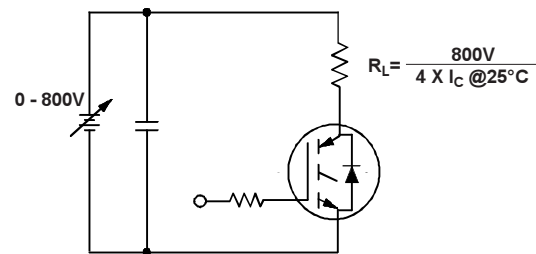


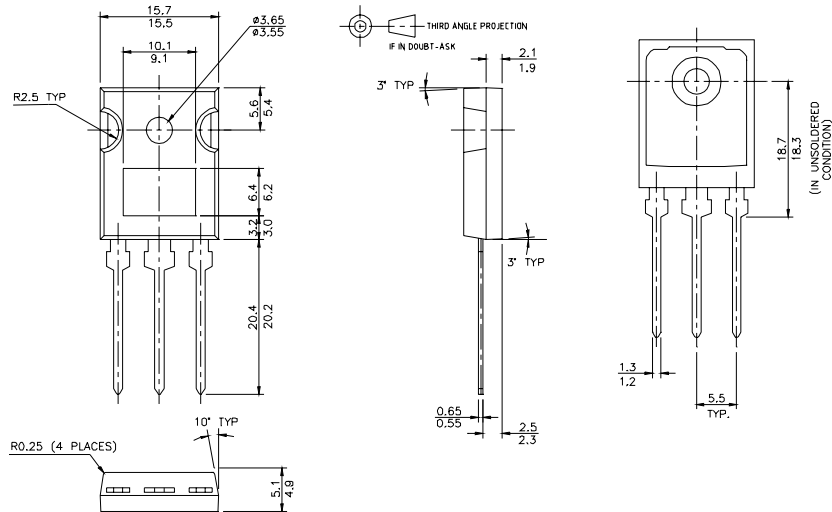
Figure 20. Pulsed Collector Current Test Circuit

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TO-247AD Package Outline

Dimensions are shown in millimeters (inches)

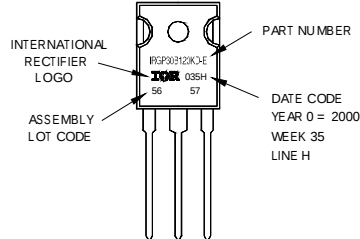
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TO-247AD Part Marking Information

EXAMPLE: THIS IS AN IRGP30B120KD-E
WITH ASSEMBLY
LOT CODE 5657
ASSEMBLED ON WW 35, 2000
IN THE ASSEMBLY LINE "H"

Note: "P" in assembly line position
indicates "Lead-Free"



Notes:

- ① Repetitive rating: $V_{GE}=20V$; pulse width limited by maximum junction temperature (figure 20)
- ② $V_{CC}=80\%(V_{CES})$, $V_{GE}=20V$, $L=10\mu H$, $R_G=10\Omega$ (figure 19)
- ③ Pulse width $\leq 80\mu s$; duty factor $\leq 0.1\%$.
- ④ Pulse width 5.0 μs , single shot.

TO-247AD package is not recommended for Surface Mount Application.

Data and specifications subject to change without notice.
This product has been designed and qualified for Industrial market.
Qualification Standards can be found on IR's Web site.

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Note: For the most current drawings please refer to the IR website at:
<http://www.irf.com/package/>