

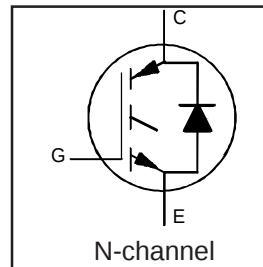
IRGPS60B120KDP

INSULATED GATE BIPOLAR TRANSISTOR WITH
ULTRAFAST SOFT RECOVERY DIODE

Motor Control Co-Pack IGBT

Features

- Low VCE (on) Non Punch Through IGBT Technology.
- Low Diode VF.
- 10µs Short Circuit Capability.
- Square RBSOA.
- Ultrasoft Diode Reverse Recovery Characteristics.
- Positive VCE (on) Temperature Coefficient.
- Super-247 Package.
- Lead-Free



$V_{CES} = 1200V$
 $V_{CE(on)} \text{ typ.} = 2.50V$
@ $V_{GE} = 15V$,
 $I_{CE} = 60A, T_j = 25^\circ C$

Benefits

- Benchmark Efficiency for Motor Control.
- Rugged Transient Performance.
- Low EMI.
- Significantly Less Snubber Required
- Excellent Current Sharing in Parallel Operation.



Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Voltage	1200	V
$I_C @ T_C = 25^\circ C$	Continuous Collector Current	105②	A
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	60	
I_{CM}	Pulsed Collector Current	240	
I_{LM}	Clamped Inductive Load Current ①	240	
$I_F @ T_C = 25^\circ C$	Diode Continuous Forward Current	120	
$I_F @ T_C = 100^\circ C$	Diode Continuous Forward Current	60	
I_{FM}	Diode Maximum Forward Current	240	
V_{GE}	Gate-to-Emitter Voltage	± 20	V
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	595	W
$P_D @ T_C = 100^\circ C$	Maximum Power Dissipation	238	
T_J	Operating Junction and	-55 to +150	$^\circ C$
T_{STG}	Storage Temperature Range		
	Soldering Temperature, for 10 sec.	300 (0.063 in. (1.6mm) from case)	

Thermal Resistance

	Parameter	Min.	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case - IGBT	—	—	0.20	$^\circ C/W$
$R_{\theta JC}$	Junction-to-Case - Diode	—	—	0.41	
$R_{\theta CS}$	Case-to-Sink, flat, greased surface	—	0.24	—	
$R_{\theta JA}$	Junction-to-Ambient, typical socket mount	—	—	40	
	Recommended Clip Force	20 (2)	—	—	N(kgf)
Wt	Weight	—	6.0 (0.21)	—	g (oz)
Le	Internal Emitter Inductance (5mm from package)	—	13	—	nH

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

	Parameter	Min.	Typ.	Max.	Units	Conditions	Ref.Fig.
$V_{(BR)CES}$	Collector-to-Emitter Breakdown Voltage	1200	—	—	V	$V_{GE} = 0V, I_C = 500\mu A$	
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	—	0.40	—	V/ $^\circ\text{C}$	$V_{GE} = 0V, I_C = 1.0mA, (25^\circ\text{C}-125^\circ\text{C})$	
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage	—	2.33	2.50	V	$I_C = 50A, V_{GE} = 15V$	5, 6
		—	2.50	2.75		$I_C = 60A$	7, 9
		—	2.79	3.1		$I_C = 50A, T_J = 125^\circ\text{C}$	10
		—	3.04	3.5		$I_C = 60A, T_J = 125^\circ\text{C}$	11
$V_{GE(th)}$	Gate Threshold Voltage	4.0	5.0	6.0		$V_{CE} = V_{GE}, I_C = 250\mu A$	9,10
$\Delta V_{GE(th)}/\Delta T_J$	Temperature Coeff. of Threshold Voltage	—	-12	—	mV/ $^\circ\text{C}$	$V_{CE} = V_{GE}, I_C = 1.0mA, (25^\circ\text{C}-125^\circ\text{C})$	11, 12
g_{fe}	Forward Transconductance	—	34.4	—	S	$V_{CE} = 50V, I_C = 60A, PW=80\mu s$	
I_{CES}	Zero Gate Voltage Collector Current	—	—	500	μA	$V_{GE} = 0V, V_{CE} = 1200V$	
		—	650	1350		$V_{GE} = 0V, V_{CE} = 1200V, T_J = 125^\circ\text{C}$	
V_{FM}	Diode Forward Voltage Drop	—	1.82	2.10	V	$I_C = 50A$	8
		—	1.93	2.20		$I_C = 60A$	
		—	1.96	2.20		$I_C = 50A, T_J = 125^\circ\text{C}$	
		—	2.13	2.40		$I_C = 60A, T_J = 125^\circ\text{C}$	
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	Ref.Fig.
Qg	Total Gate Charge (turn-on)	—	340	510	nC	Ic = 60A	23
Qge	Gate - Emitter Charge (turn-on)	—	40	60		VCC = 600V	CT1
Qgc	Gate - Collector Charge (turn-on)	—	165	248		VGE = 15V	
Eon	Turn-On Switching Loss	—	3214	4870	μJ	Ic = 60A, VCC = 600V	CT4
Eoff	Turn-Off Switching Loss	—	4783	5450		VGE = 15V,RG = 4.7Ω, L =200μH	WF1
Etot	Total Switching Loss	—	8000	10320		LS = 150nH Tj = 25°C	WF2
Eon	Turn-On Switching Loss	—	5032	6890	μJ	Tj = 125°C	13,15
Eoff	Turn-Off Switching Loss	—	7457	8385		Energy losses include "tail" and diode reverse recovery.	
Etot	Total Switching Loss	—	12500	15275			
td(on)	Turn-On Delay Time	—	72	94	ns	Ic = 15A, VCC = 600V	14, 16
tr	Rise Time	—	32	45		VGE = 15V, RG = 4.7Ω L =200μH	CT4
td(off)	Turn-Off Delay Time	—	366	400		LS = 150nH, Tj = 125°C	WF1
tf	Fall Time	—	45	58			WF2
Cies	Input Capacitance	—	4300	—	pF	VGE = 0V	22
Coes	Output Capacitance	—	395	—		VCC = 30V	
Cres	Reverse Transfer Capacitance	—	160	—		f = 1.0MHz	
RBSOA	Reverse Bias Safe Operting Area	FULL SQUARE				Tj = 150°C, Ic = 240A, Vp =1200V VCC = 1000V, VGE = +15V to 0V RG = 4.7Ω	4 CT2
SCSOA	Short Circuit Safe Operting Area	10	—	—	μs	Tj = 150°C, Vp =1200V VCC = 900V, VGE = +15V to 0V, RG = 4.7Ω	CT3 WF4
Erec	Reverse Recovery energy of the diode	—	3346	—	μJ	Tj = 125°C	17,18,19
trr	Diode Reverse Recovery time	—	180	—	ns	VCC = 600V, If = 60A, L =200μH	20, 21
Irr	Diode Peak Reverse Recovery Current	—	50	—	A	VGE = 15V,RG = 4.7Ω, LS = 150nH	CT4,WF3

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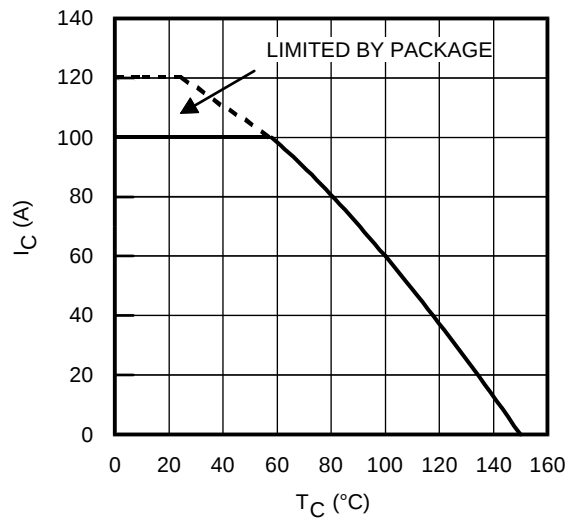


Fig. 1 - Maximum DC Collector Current vs. Case Temperature®

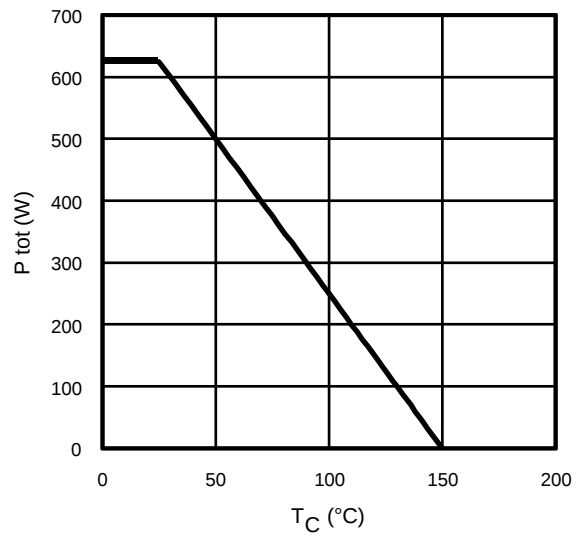


Fig. 2 - Power Dissipation vs. Case Temperature

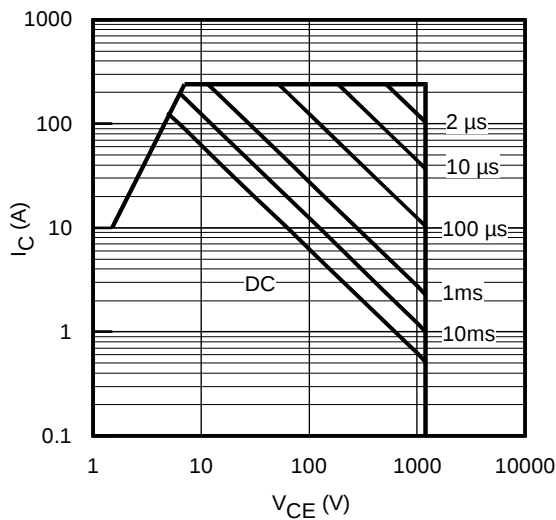


Fig. 3 - Forward SOA
 $T_C = 25^\circ\text{C}$; $T_{JS} \leq 150^\circ\text{C}$

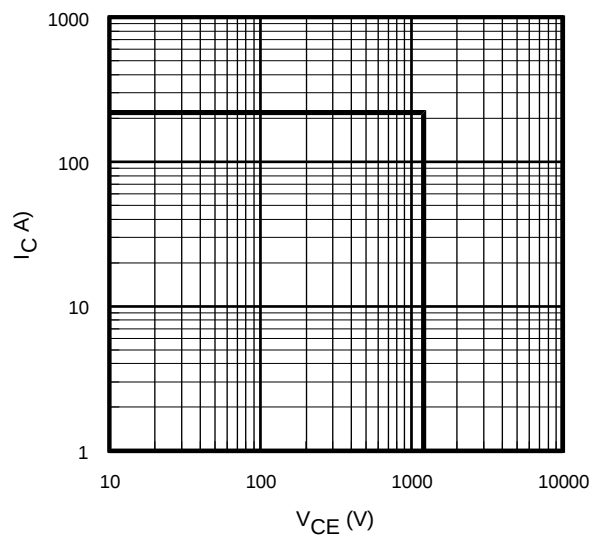


Fig. 4 - Reverse Bias SOA
 $T_J = 150^\circ\text{C}$; $V_{GE} = 15\text{V}$

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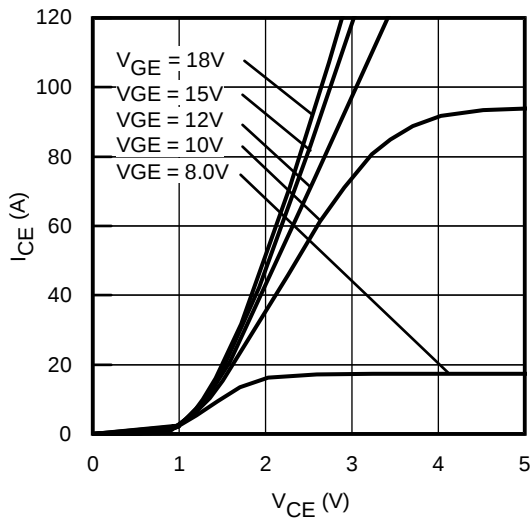


Fig. 5 - Typ. IGBT Output Characteristics
 $T_j = -40^\circ\text{C}$; $t_p = 80\mu\text{s}$

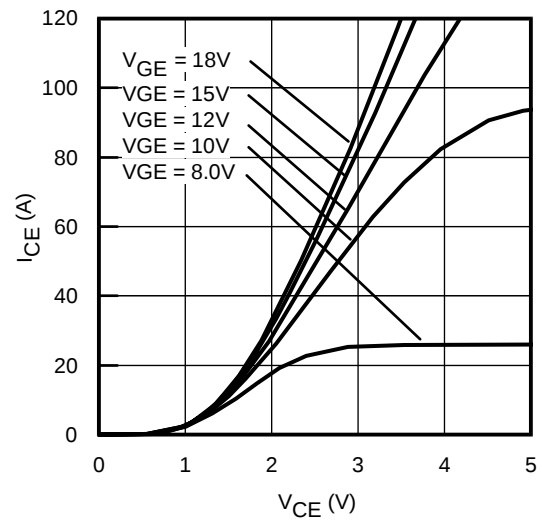


Fig. 6 - Typ. IGBT Output Characteristics
 $T_j = 25^\circ\text{C}$; $t_p = 80\mu\text{s}$

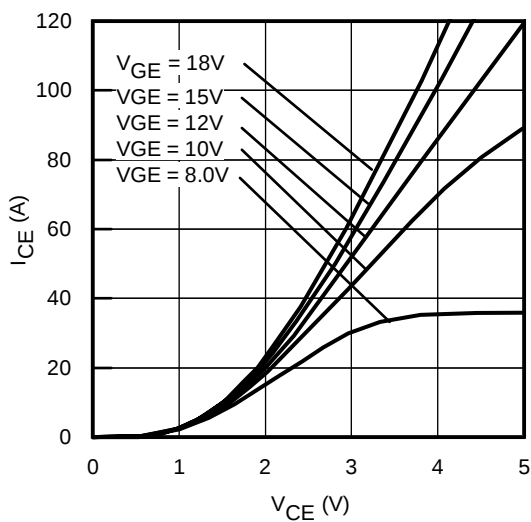


Fig. 7 - Typ. IGBT Output Characteristics
 $T_j = 125^\circ\text{C}$; $t_p = 80\mu\text{s}$

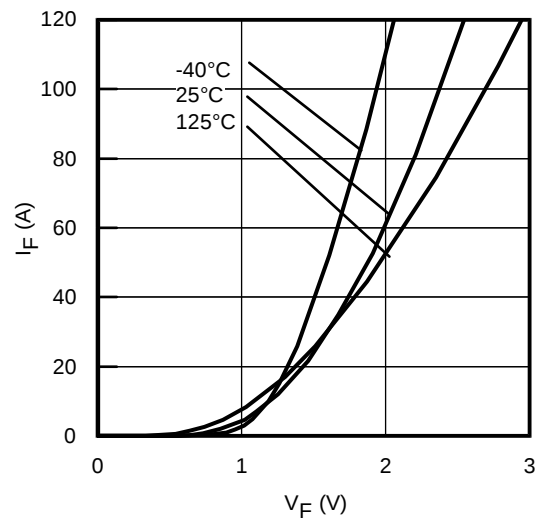


Fig. 8 - Typ. Diode Forward Characteristics
 $t_p = 80\mu\text{s}$

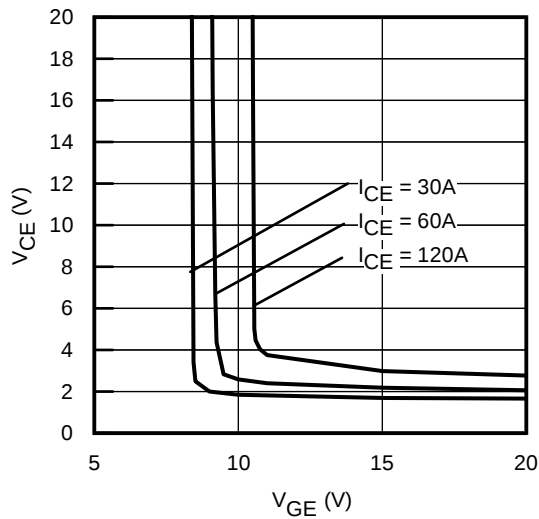


Fig. 9 - Typical V_{CE} vs. V_{GE}
 $T_J = -40^\circ\text{C}$

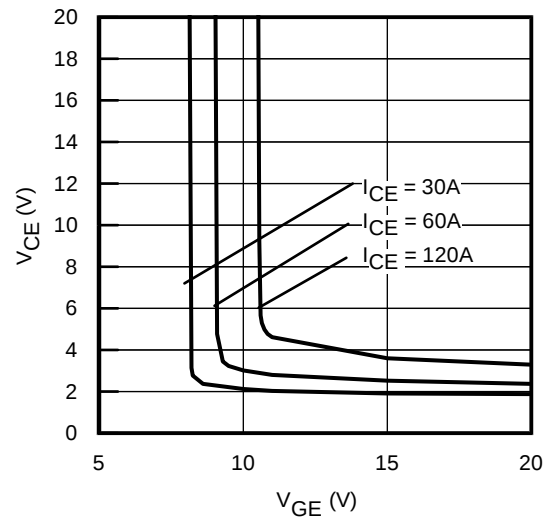


Fig. 10 - Typical V_{CE} vs. V_{GE}
 $T_J = 25^\circ\text{C}$

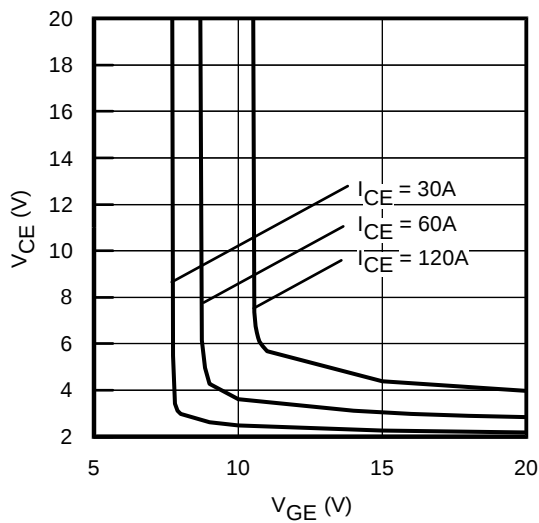


Fig. 11 - Typical V_{CE} vs. V_{GE}
 $T_J = 125^\circ\text{C}$

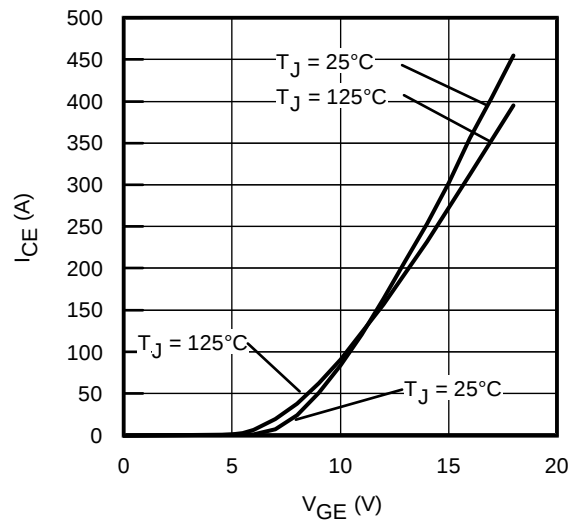


Fig. 12 - Typ. Transfer Characteristics
 $V_{CE} = 50\text{V}$; $t_p = 10\mu\text{s}$

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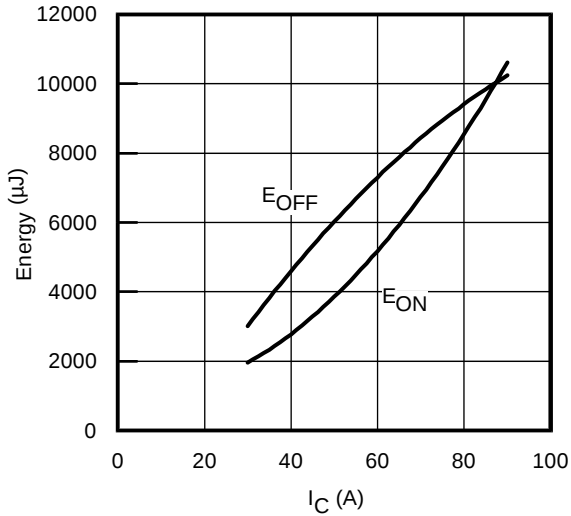


Fig. 13 - Typ. Energy Loss vs. I_C
 $T_J = 125^\circ\text{C}$; $L=200\mu\text{H}$; $V_{CE}=600\text{V}$
 $R_G=4.7\Omega$; $V_{GE}=15\text{V}$

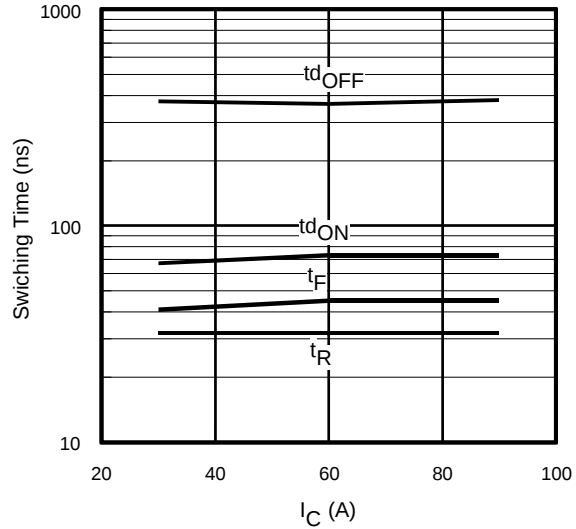


Fig. 14 - Typ. Switching Time vs. I_C
 $T_J = 125^\circ\text{C}$; $L=200\mu\text{H}$; $V_{CE}=600\text{V}$
 $R_G=4.7\Omega$; $V_{GE}=15\text{V}$

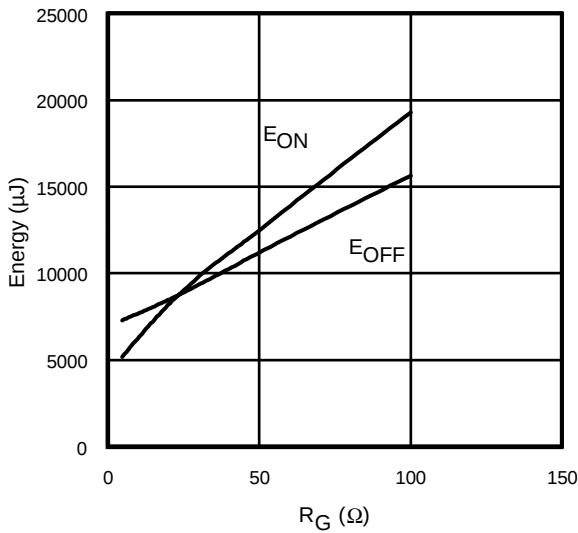


Fig. 15 - Typ. Energy Loss vs. R_G
 $T_J = 125^\circ\text{C}$; $L=200\mu\text{H}$; $V_{CE}=600\text{V}$
 $I_{CE}=60\text{A}$; $V_{GE}=15\text{V}$

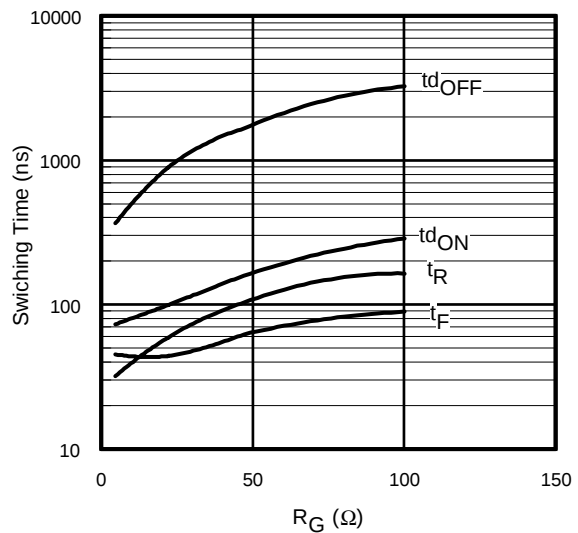


Fig. 16 - Typ. Switching Time vs. R_G
 $T_J = 125^\circ\text{C}$; $L=200\mu\text{H}$; $V_{CE}=600\text{V}$
 $I_{CE}=60\text{A}$; $V_{GE}=15\text{V}$

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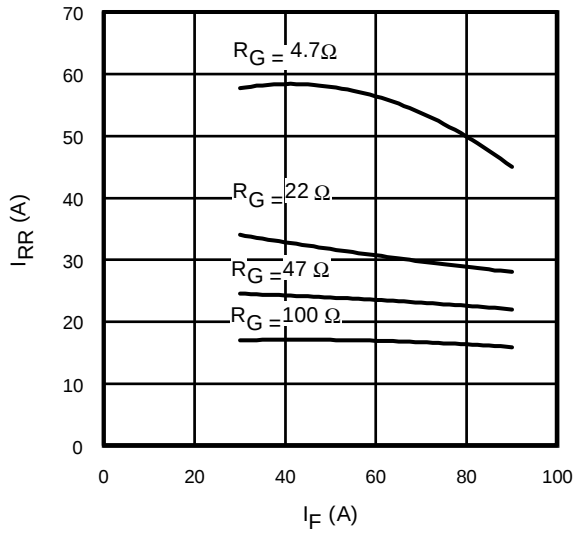


Fig. 17 - Typical Diode I_{RR} vs. I_F
 $T_J = 125^\circ\text{C}$

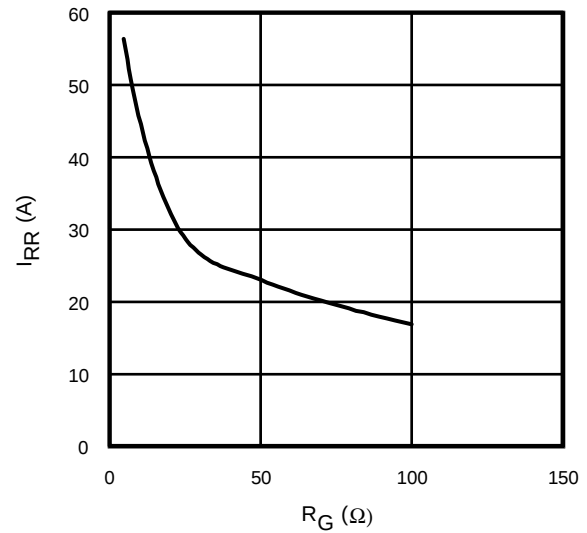


Fig. 18 - Typical Diode I_{RR} vs. R_G
 $T_J = 125^\circ\text{C}; I_F = 60\text{A}$

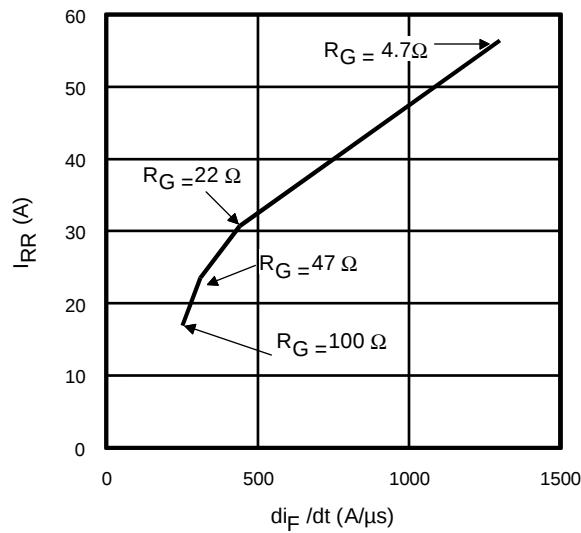


Fig. 19 - Typical Diode I_{RR} vs. di_F/dt
 $V_{CC} = 600\text{V}; V_{GE} = 15\text{V};$
 $I_{CE} = 60\text{A}; T_J = 125^\circ\text{C}$

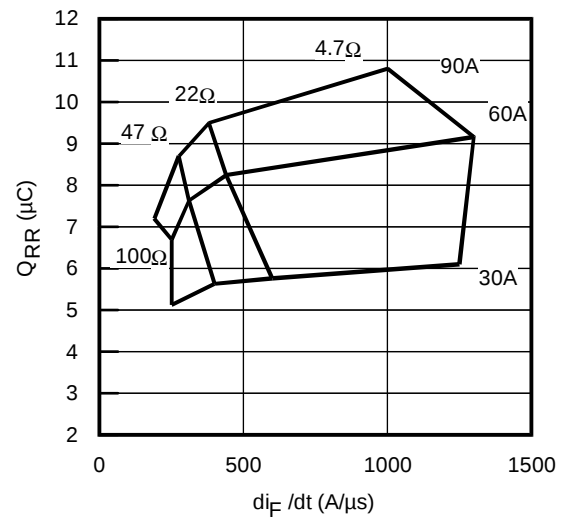


Fig. 20 - Typical Diode Q_{RR}
 $V_{CC} = 600\text{V}; V_{GE} = 15\text{V}; T_J = 125^\circ\text{C}$

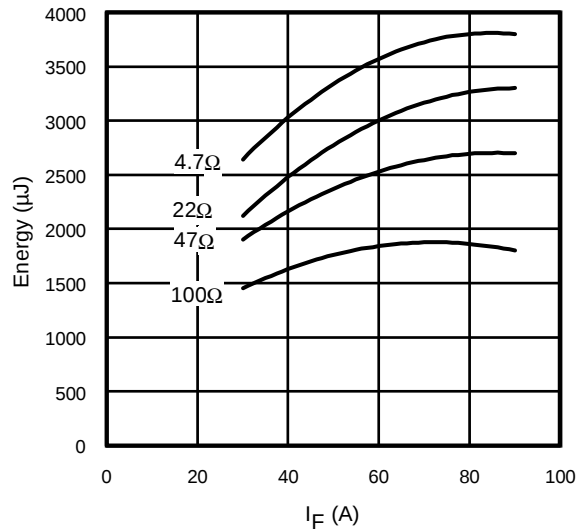


Fig. 21 - Typical Diode E_{RR} vs. I_F
 $T_J = 125^\circ\text{C}$

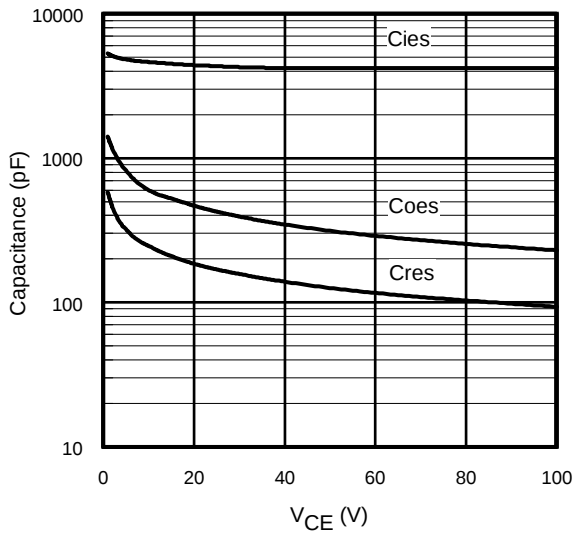


Fig. 22- Typ. Capacitance vs. V_{CE}
 $V_{GE} = 0\text{V}$; $f = 1\text{MHz}$

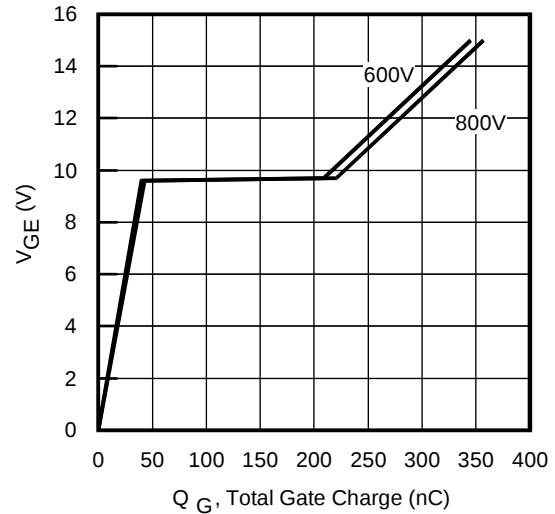


Fig. 23 - Typical Gate Charge vs. V_{GE}
 $I_{CE} = 60\text{A}$; $L = 600\mu\text{H}$

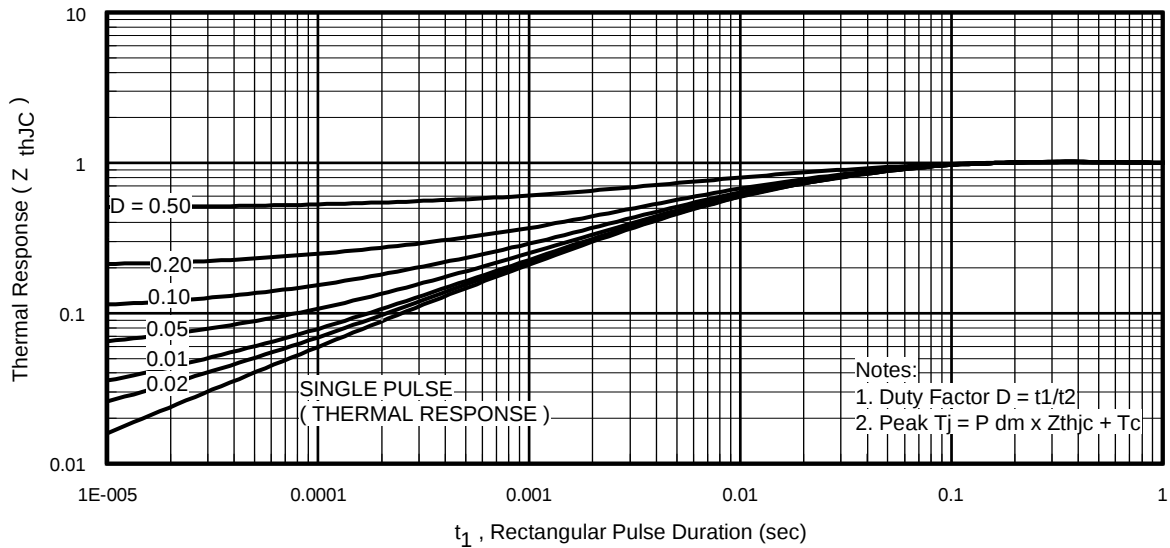


Fig 24. Normalized Transient Thermal Impedance, Junction-to-Case (IGBT)

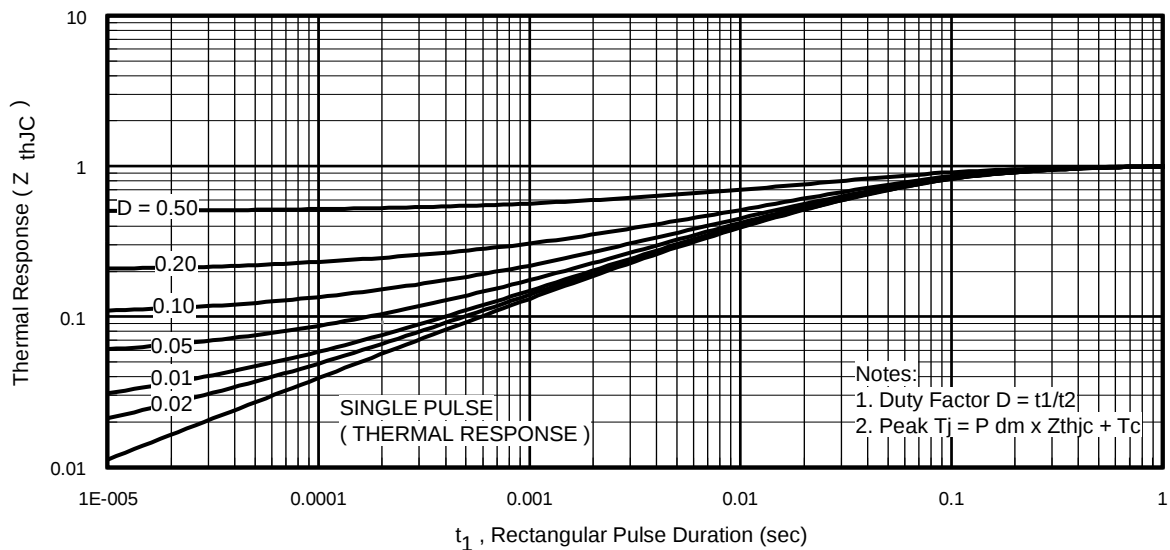


Fig 25. Normalized Transient Thermal Impedance, Junction-to-Case (DIODE)

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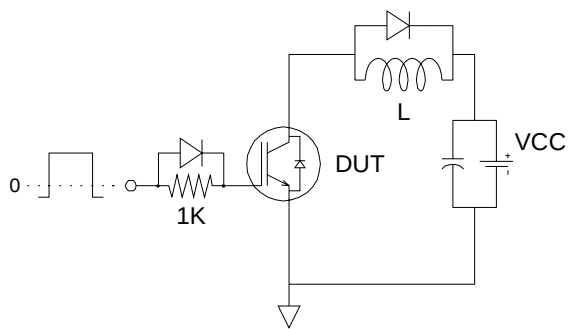


Fig.C.T.1 - Gate Charge Circuit (turn-on)

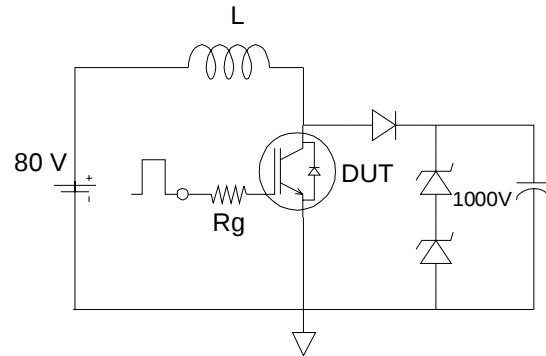


Fig.C.T.2 - RBSOA Circuit

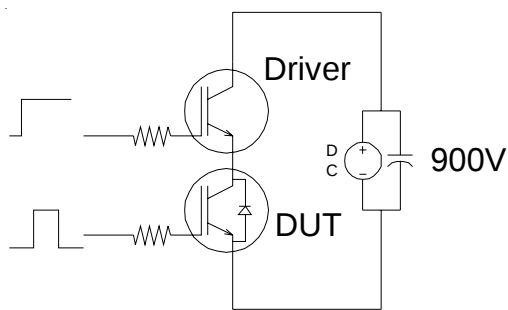


Fig.C.T.3 - RBSOA Circuit

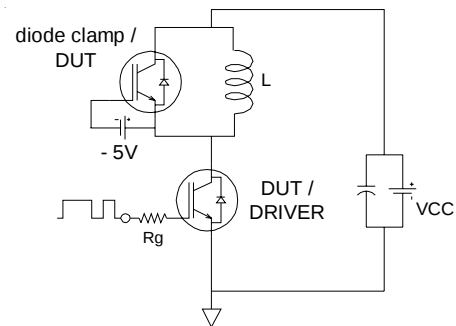


Fig.C.T.4 - RBSOA Circuit

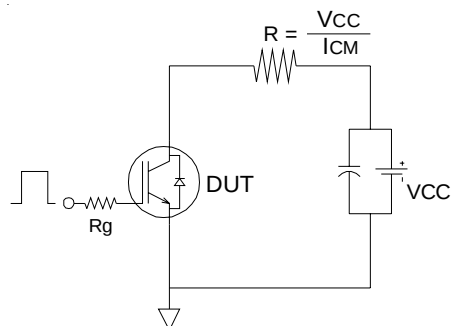


Fig.C.T.5 - RBSOA Circuit

Fig. WF1 - Typ. Turn-off Loss Waveform
@ $T_j=125^\circ\text{C}$ using Fig. CT.4

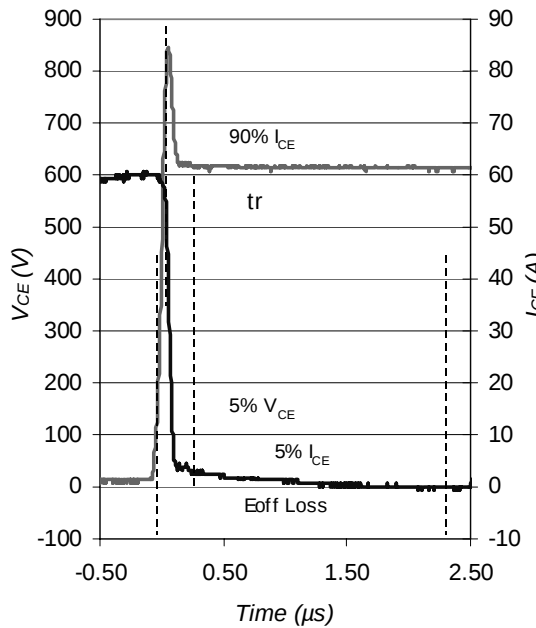


Fig. WF2 - Typ. Turn-On Loss Waveform
@ $T_j=125^\circ\text{C}$ using Fig. CT.4

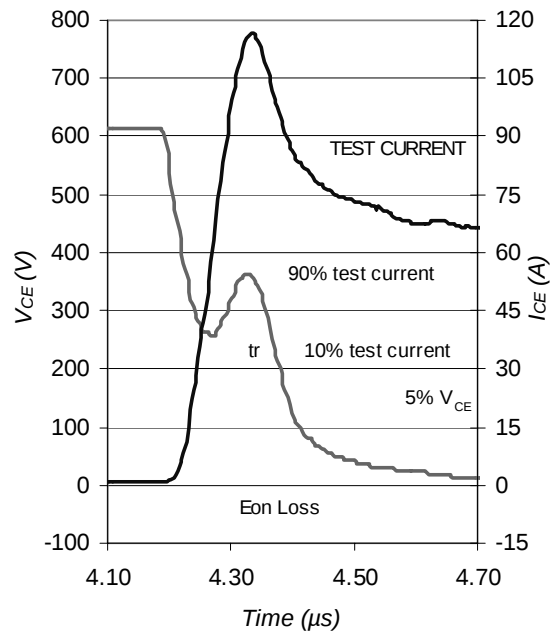


Fig. WF.3 - Typ. Diode Recovery
Waveform
@ $T_j=125^\circ\text{C}$ using Fig. CT.4

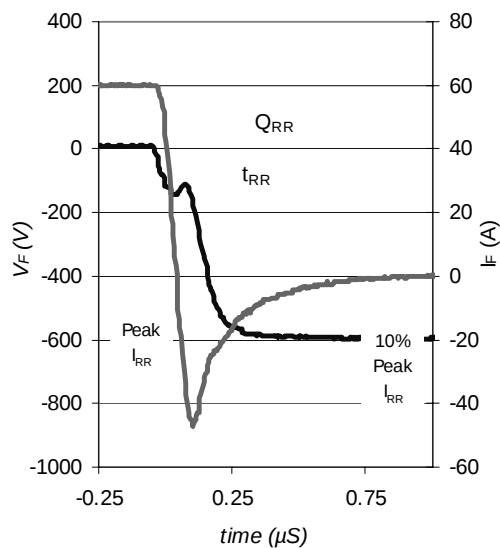
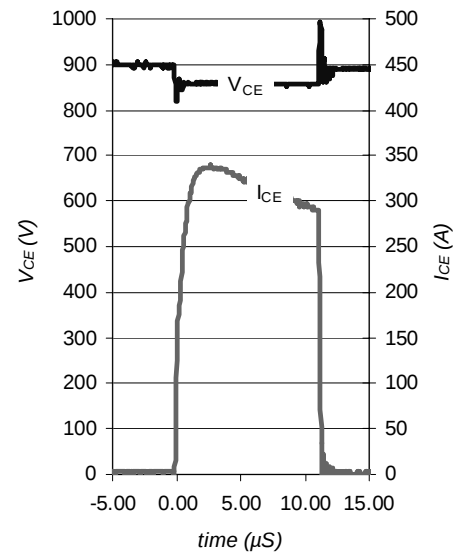


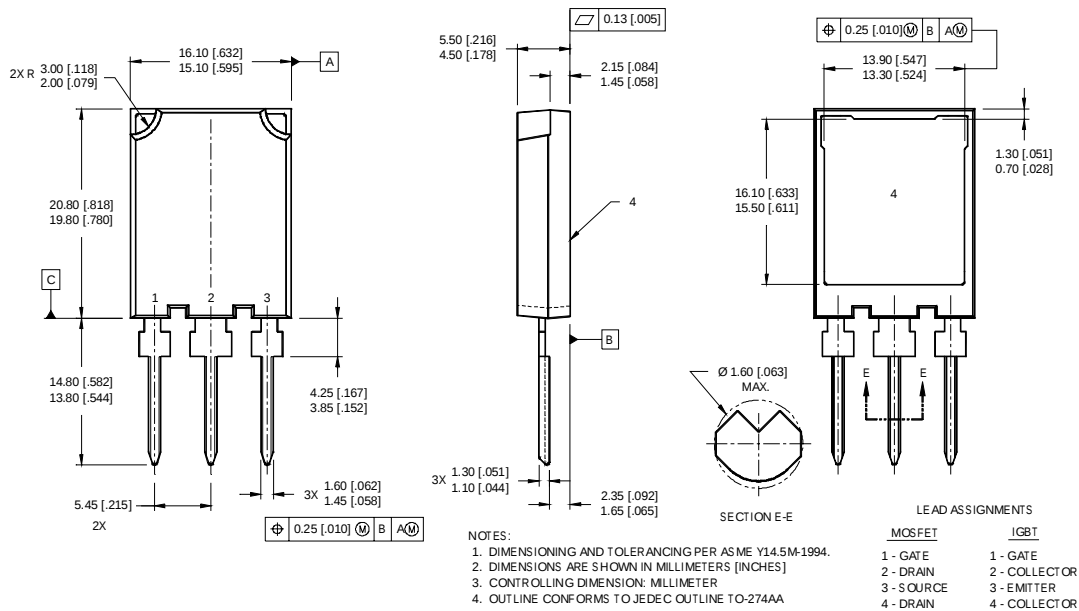
Fig. WF.4 - Typ. S.C. Waveform
@ $T_C=150^\circ\text{C}$ using Fig. CT.3



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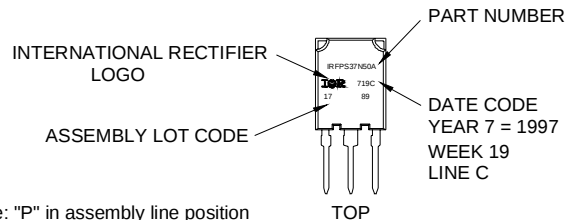
Super-247™ Package Outline

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Super-247 (TO-274AA) Part Marking Information

EXAMPLE: THIS IS AN IRFPS37N50A WITH
 ASSEMBLY LOT CODE 1789
 ASSEMBLED ON WW 19, 1997
 IN THE ASSEMBLY LINE "C"



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

Notes:

- $V_{CC} = 80\% (V_{CES})$, $V_{GE} = 20V$, $L = 100 \mu H$, $R_G = 4.7\Omega$.
- Calculated continuous current based on maximum allowable junction temperature. Package limitation current is 105A.

Data and specifications subject to change without notice.

This product has been designed and qualified for the industrial market.

Qualification Standards can be found on IR's Web site.

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