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STGP30M65DF2

Trench gate field-stop IGBT, M series 650 V, 30 A low loss

Datasheet - production data

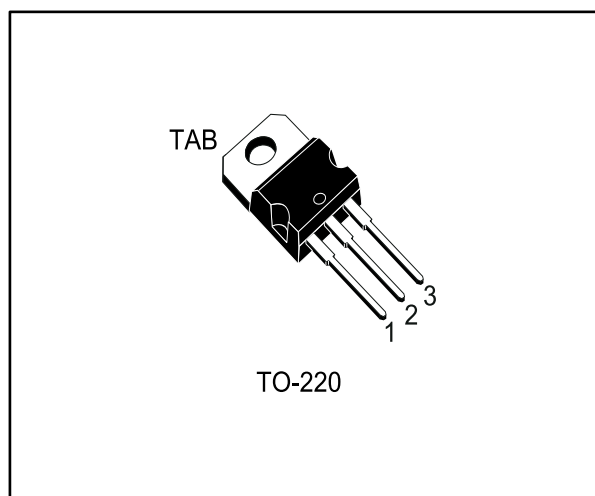
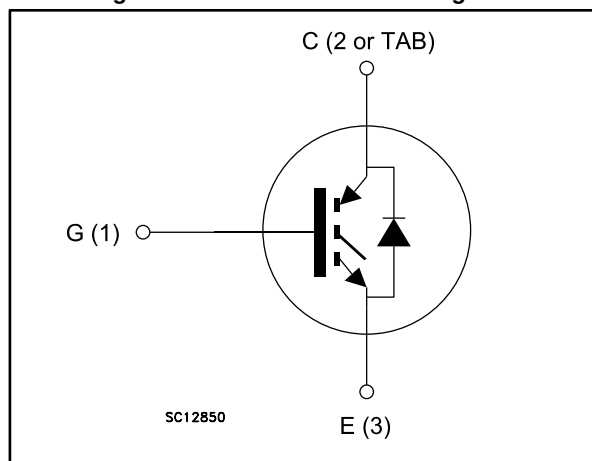


Figure 1: Internal schematic diagram



Features

- 6 μ s of short-circuit withstand time
- $V_{CE(sat)} = 1.55$ V (typ.) @ $I_C = 30$ A
- Tight parameters distribution
- Safer paralleling
- Low thermal resistance
- Soft and very fast recovery antiparallel diode

Applications

- Motor control
- UPS
- PFC

Description

This device is an IGBT developed using an advanced proprietary trench gate field-stop structure. The device is part of the M series of IGBTs, which represent an optimum compromise in performance to maximize the efficiency of inverter systems where low-loss and short-circuit capability are essential. Furthermore, a positive $V_{CE(sat)}$ temperature coefficient and tight parameter distribution result in safer paralleling operation.

Table 1: Device summary

Order code	Marking	Package	Packaging
STGP30M65DF2	G30M65DF2	TO-220	Tube

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Electrical ratings

1 Electrical ratings

Table 2: Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CES}	Collector-emitter voltage ($V_{GE} = 0$)	650	V
I_C	Continuous collector current at $T_C = 25\text{ }^{\circ}\text{C}$	60	A
I_C	Continuous collector current at $T_C = 100\text{ }^{\circ}\text{C}$	30	A
$I_{CP}^{(1)}$	Pulsed collector current	120	A
V_{GE}	Gate-emitter voltage	± 20	V
I_F	Continuous forward current at $T_C = 25\text{ }^{\circ}\text{C}$	60	A
I_F	Continuous forward current at $T_C = 100\text{ }^{\circ}\text{C}$	30	A
$I_{FP}^{(1)}$	Pulsed forward current	120	A
P_{TOT}	Total dissipation at $T_C = 25\text{ }^{\circ}\text{C}$	258	W
T_{STG}	Storage temperature range	- 55 to 150	$^{\circ}\text{C}$
T_J	Operating junction temperature	- 55 to 175	$^{\circ}\text{C}$

Notes:

⁽¹⁾ Pulse width limited by maximum junction temperature.

Table 3: Thermal data

Symbol	Parameter	Value	Unit
R_{thJC}	Thermal resistance junction-case IGBT	0.58	$^{\circ}\text{C/W}$
R_{thJC}	Thermal resistance junction-case diode	1.47	$^{\circ}\text{C/W}$
R_{thJA}	Thermal resistance junction-ambient	62.5	$^{\circ}\text{C/W}$

Electrical characteristics

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2 Electrical characteristics

$T_C = 25\text{ }^{\circ}\text{C}$ unless otherwise specified

Table 4: Static characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)CES}$	Collector-emitter breakdown voltage	$V_{GE} = 0\text{ V}$, $I_C = 2\text{ mA}$	650			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE} = 15\text{ V}$, $I_C = 30\text{ A}$		1.55	2.0	V
		$V_{GE} = 15\text{ V}$, $I_C = 30\text{ A}$, $T_J = 125\text{ }^{\circ}\text{C}$		1.95		
		$V_{GE} = 15\text{ V}$, $I_C = 30\text{ A}$, $T_J = 175\text{ }^{\circ}\text{C}$		2.1		
V_F	Forward on-voltage	$I_F = 30\text{ A}$		1.85		V
		$I_F = 30\text{ A}$, $T_J = 125\text{ }^{\circ}\text{C}$		1.6		
		$I_F = 30\text{ A}$, $T_J = 175\text{ }^{\circ}\text{C}$		1.5		
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}$, $I_C = 500\text{ }\mu\text{A}$	5	6	7	V
I_{CES}	Collector cut-off current	$V_{GE} = 0\text{ V}$, $V_{CE} = 650\text{ V}$			25	μA
I_{GES}	Gate-emitter leakage current	$V_{CE} = 0\text{ V}$, $V_{GE} = \pm 20\text{ V}$			250	μA

Table 5: Dynamic characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{ies}	Input capacitance	$V_{CE} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GE} = 0\text{ V}$	-	2490	-	pF
C_{oes}	Output capacitance		-	143	-	
C_{res}	Reverse transfer capacitance		-	46	-	
Q_g	Total gate charge	$V_{CC} = 520\text{ V}$, $I_C = 30\text{ A}$, $V_{GE} = 15\text{ V}$ (see Figure 30: "Gate charge test circuit")	-	80	-	nC
Q_{ge}	Gate-emitter charge		-	18	-	
Q_{gc}	Gate-collector charge		-	32	-	

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Table 6: IGBT switching characteristics (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{CE} = 400\text{ V}$, $I_C = 30\text{ A}$, $V_{GE} = 15\text{ V}$, $R_G = 10\ \Omega$ (see Figure 29: "Test circuit for inductive load switching")		31.6	-	ns
t_r	Current rise time			13.4	-	ns
$(di/dt)_{on}$	Turn-on current slope			1791	-	A/ μ s
$t_{d(off)}$	Turn-off-delay time			115	-	ns
t_f	Current fall time			110	-	ns
$E_{on}^{(1)}$	Turn-on switching losses			0.3	-	mJ
$E_{off}^{(2)}$	Turn-off switching losses			0.96	-	mJ
E_{ts}	Total switching losses			1.26	-	mJ
$t_{d(on)}$	Turn-on delay time	$V_{CE} = 400\text{ V}$, $I_C = 30\text{ A}$, $V_{GE} = 15\text{ V}$, $R_G = 10\ \Omega$ $T_J = 175\text{ }^\circ\text{C}$ (see Figure 29: "Test circuit for inductive load switching")		30	-	ns
t_r	Current rise time			17	-	ns
$(di/dt)_{on}$	Turn-on current slope			1435	-	A/ μ s
$t_{d(off)}$	Turn-off-delay time			116	-	ns
t_f	Current fall time			194	-	ns
E_{on}	Turn-on switching losses			0.67	-	mJ
E_{off}	Turn-off switching losses			1.36	-	mJ
E_{ts}	Total switching losses			2.03	-	mJ
t_{sc}	Short-circuit withstand time	$V_{CC} \leq 400\text{ V}$, $V_{GE} = 15\text{ V}$, $T_{Jstart} = 150\text{ }^\circ\text{C}$	6		-	μ s

Notes:

⁽¹⁾Energy losses include reverse recovery of the diode.

⁽²⁾Turn-off losses also include the tail of the collector current.

Table 7: Diode switching characteristics (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
t_{rr}	Reverse recovery time	$I_F = 30\text{ A}$, $V_R = 400\text{ V}$, $V_{GE} = 15\text{ V}$ (see Figure 29: "Test circuit for inductive load switching") $di/dt = 1000\text{ A}/\mu\text{s}$	-	140		ns
Q_{rr}	Reverse recovery charge		-	880		nC
I_{rrm}	Reverse recovery current		-	17		A
dl_{rr}/dt	Peak rate of fall of reverse recovery current during t_b		-	650		A/ μ s
E_{rr}	Reverse recovery energy		-	115		μ J
t_{rr}	Reverse recovery time	$I_F = 30\text{ A}$, $V_R = 400\text{ V}$, $V_{GE} = 15\text{ V}$ $T_J = 175\text{ }^\circ\text{C}$ (see Figure 29: "Test circuit for inductive load switching") $di/dt = 1000\text{ A}/\mu\text{s}$	-	244		ns
Q_{rr}	Reverse recovery charge		-	2743		nC
I_{rrm}	Reverse recovery current		-	25		A
dl_{rr}/dt	Peak rate of fall of reverse recovery current during t_b		-	220		A/ μ s
E_{rr}	Reverse recovery energy		-	320		μ J

Electrical characteristics

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2.1 Electrical characteristics (curves)

Figure 2: Power dissipation vs. case temperature

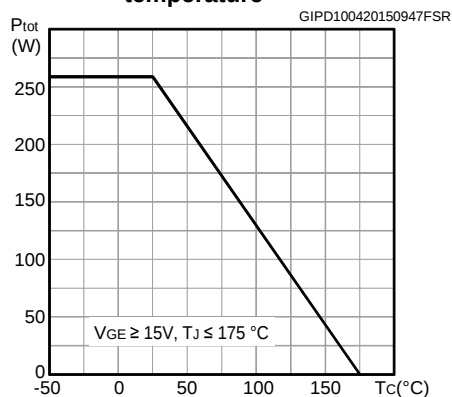


Figure 3: Collector current vs. case temperature

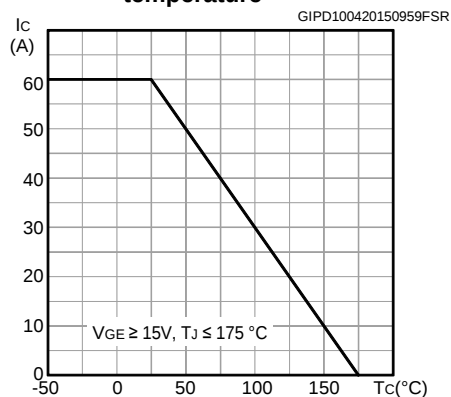


Figure 4: Output characteristics (TJ = 25 °C)

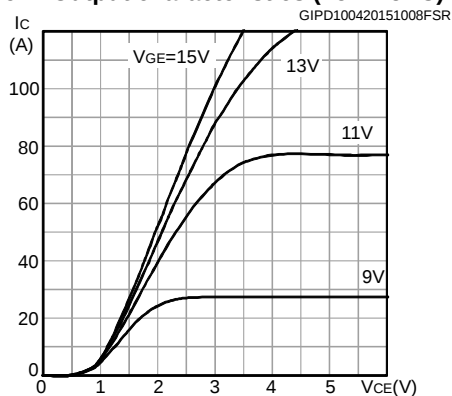


Figure 5: Output characteristics (TJ = 175 °C)

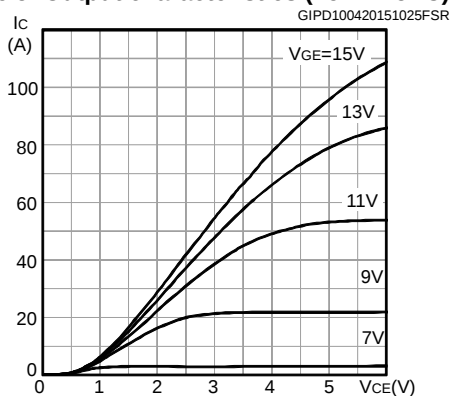


Figure 6: VCE(sat) vs. junction temperature

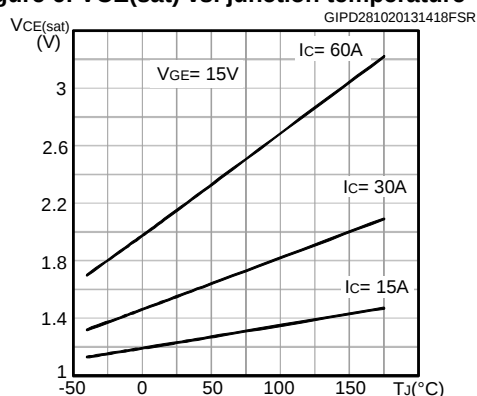
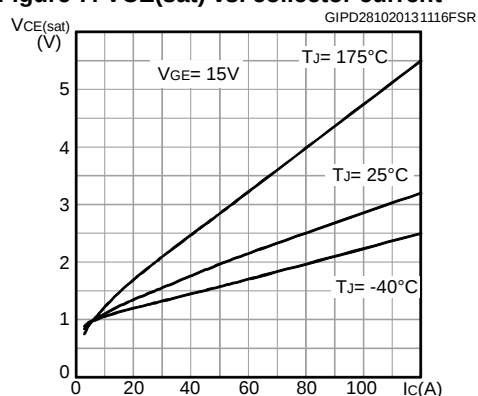


Figure 7: VCE(sat) vs. collector current



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Electrical characteristics

Figure 8: Collector current vs. switching frequency

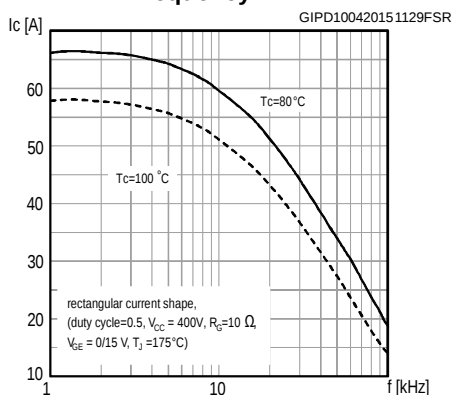


Figure 9: Forward bias safe operating area

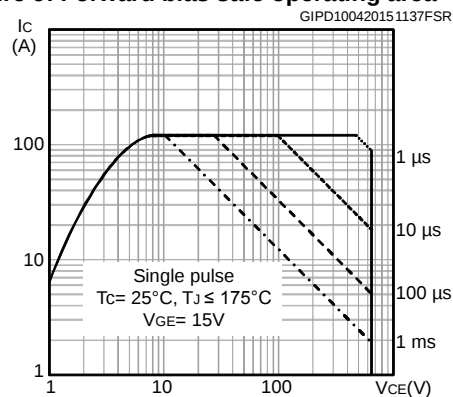


Figure 10: Transfer characteristics

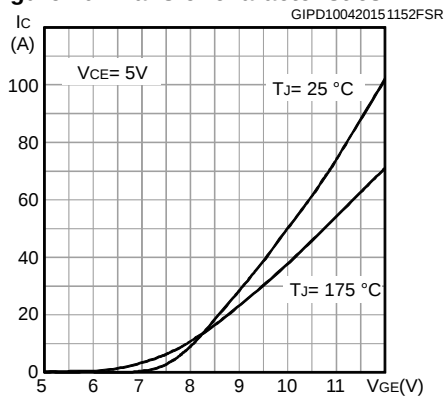


Figure 11: Diode VF vs. forward current

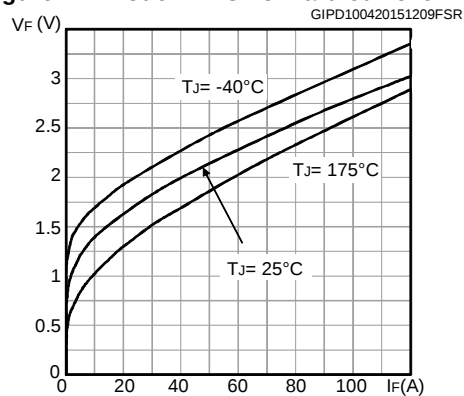


Figure 12: Normalized VGE(th) vs. junction temperature

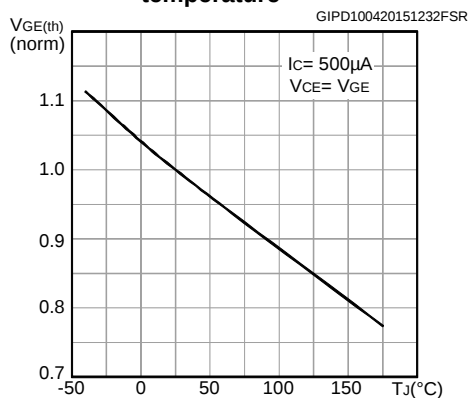
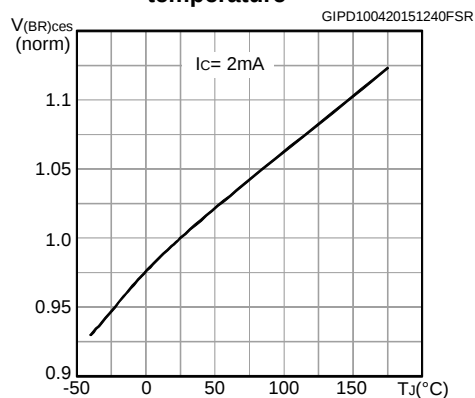


Figure 13: Normalized V(BR)CES vs. junction temperature



Electrical characteristics

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Figure 14: Capacitance variations

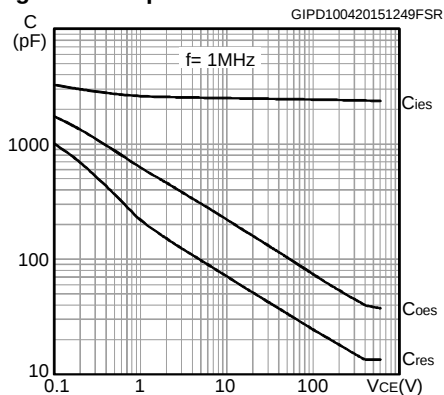


Figure 15: Gate charge vs. gate-emitter voltage

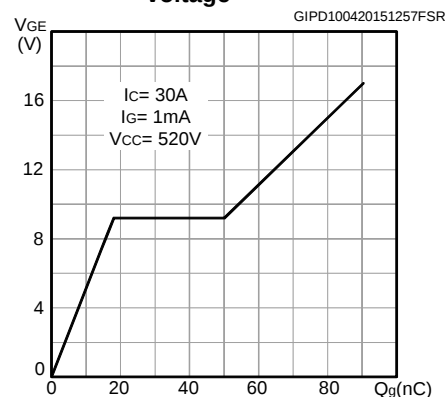


Figure 16: Switching loss vs. collector current

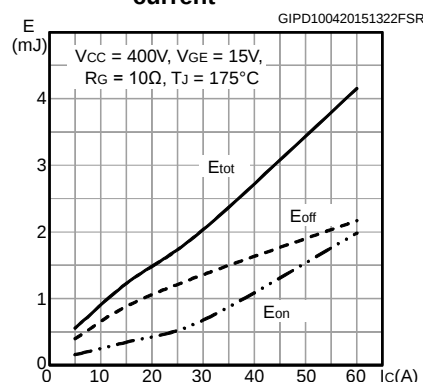


Figure 17: Switching loss vs. gate resistance

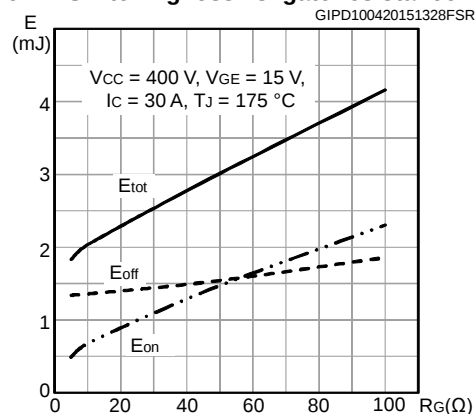


Figure 18: Switching loss vs. temperature

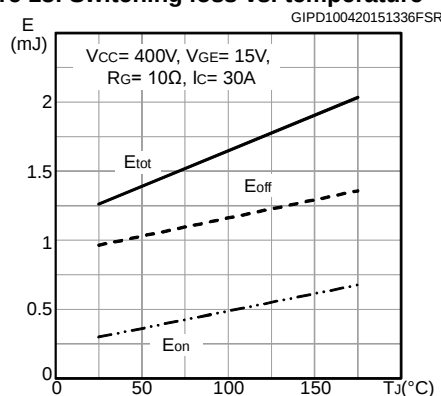
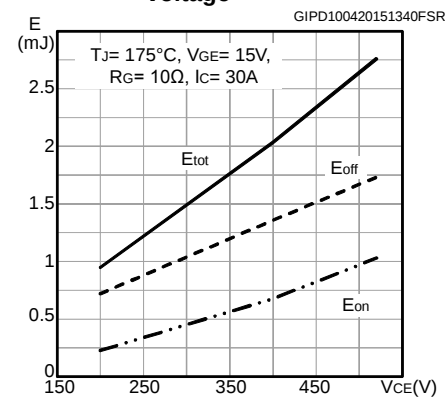


Figure 19: Switching loss vs. collector emitter voltage



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Figure 20: Short-circuit time and current vs. VGE

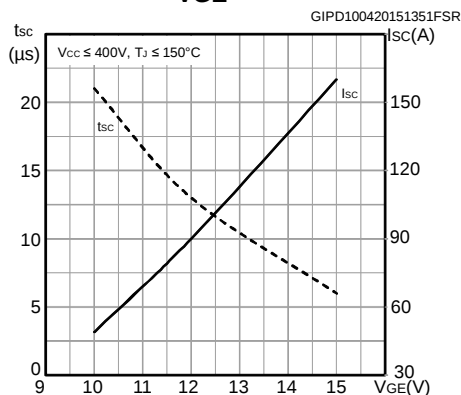


Figure 21: Switching times vs. collector current

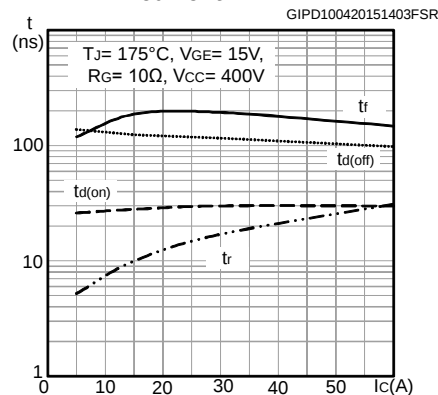


Figure 22: Switching times vs. gate resistance

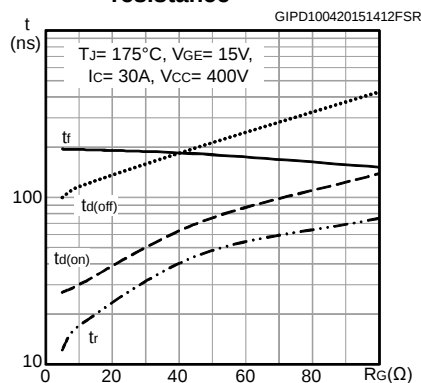


Figure 23: Reverse recovery current vs. diode current slope

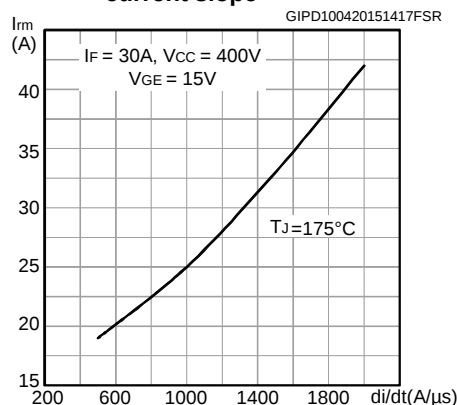


Figure 24: Reverse recovery time vs. diode current slope

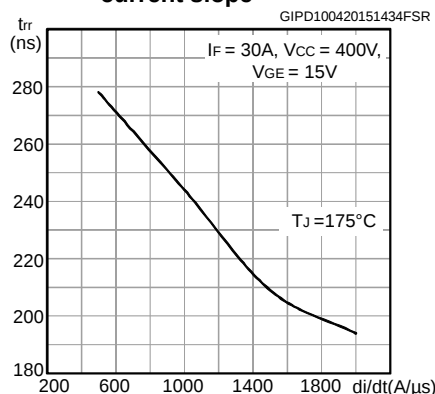
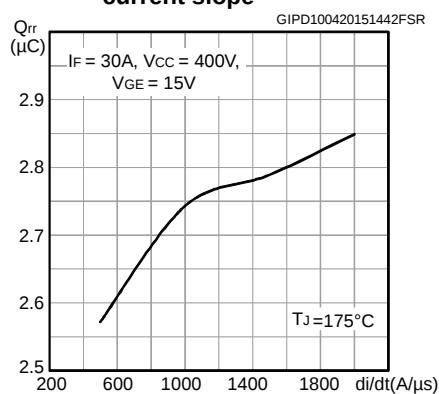


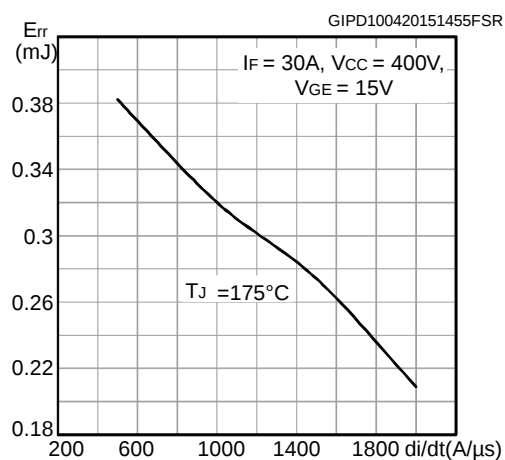
Figure 25: Reverse recovery charge vs. diode current slope



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Figure 26: Reverse recovery energy vs. diode current slope



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Electrical characteristics

Figure 27: Thermal impedance for IGBT

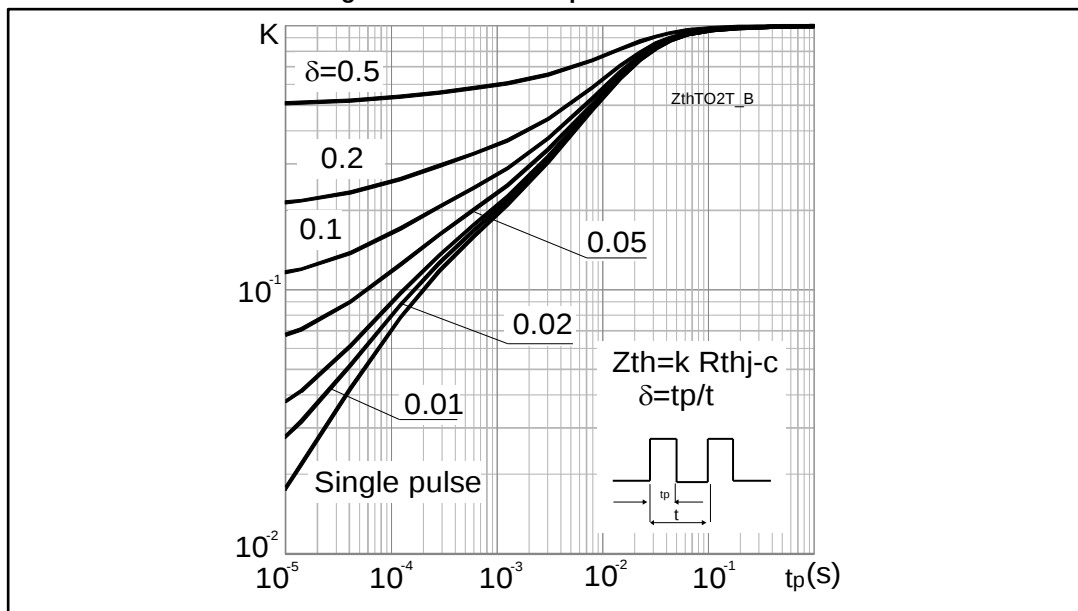
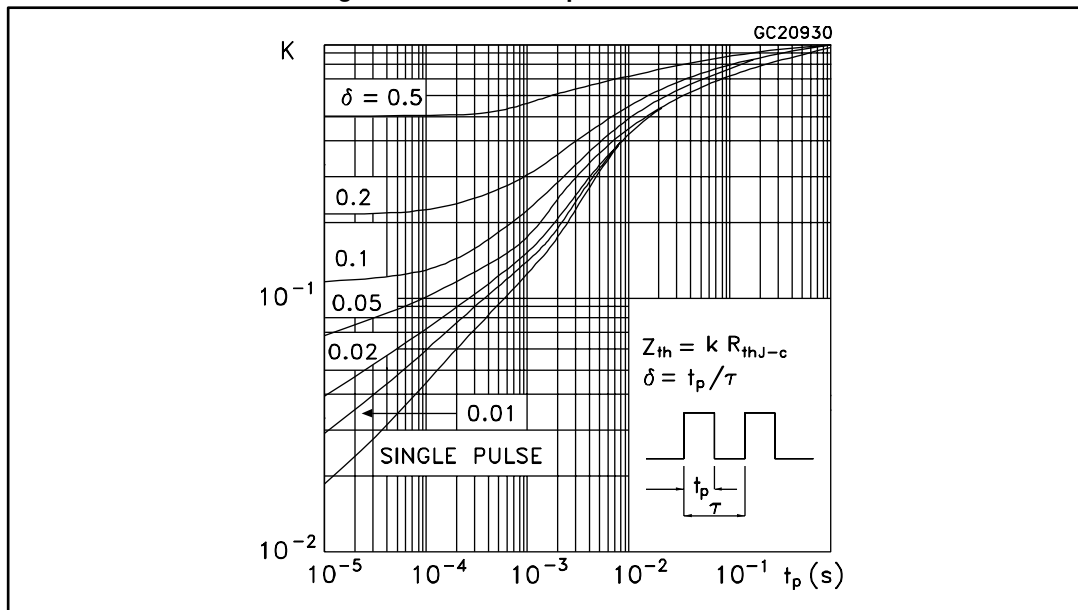
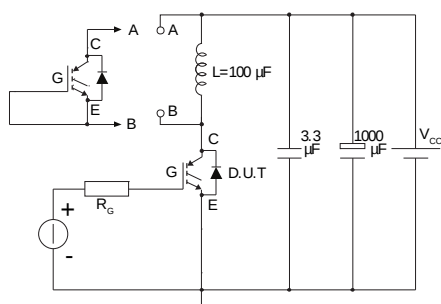


Figure 28: Thermal impedance for diode



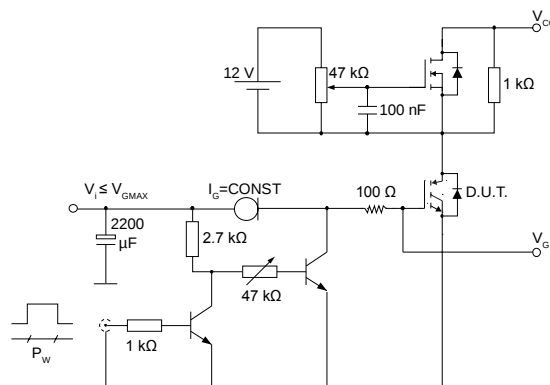
3 Test circuits

Figure 29: Test circuit for inductive load switching



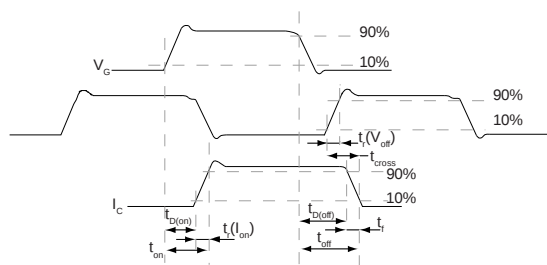
AM01504v1

Figure 30: Gate charge test circuit



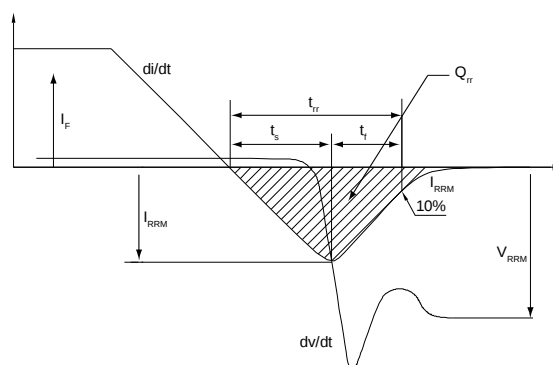
AM01505v1

Figure 31: Switching waveform



AM01506v1

Figure 32: Diode reverse recovery waveform



AM01507v1

4 Package mechanical data

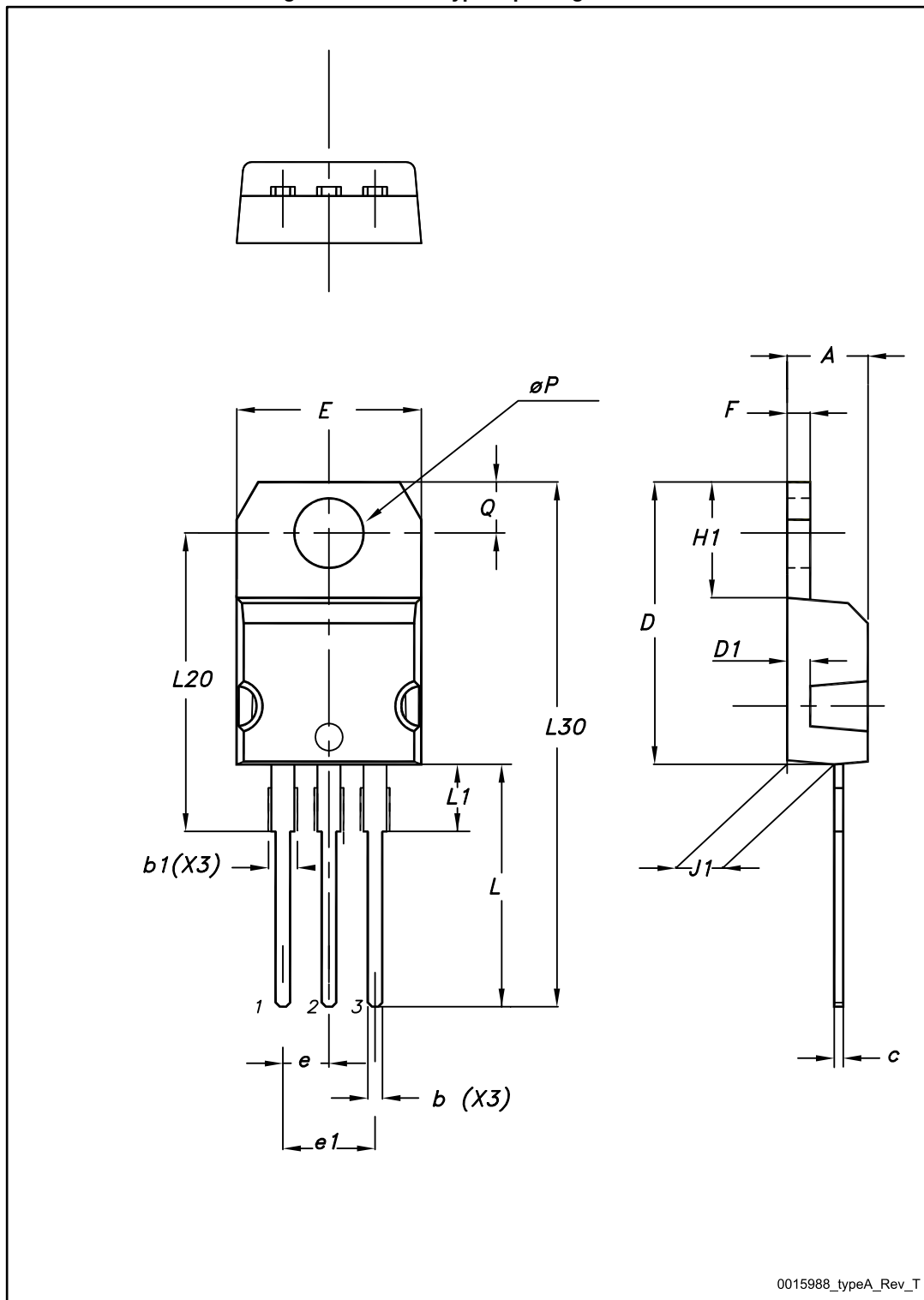
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Package mechanical data

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4.1 Package mechanical data

Figure 33: TO-220 type A package outline



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Package mechanical data

Table 8: TO-220 type A mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
b	0.61		0.88
b1	1.14		1.70
c	0.48		0.70
D	15.25		15.75
D1		1.27	
E	10		10.40
e	2.40		2.70
e1	4.95		5.15
F	1.23		1.32
H1	6.20		6.60
J1	2.40		2.72
L	13		14
L1	3.50		3.93
L20		16.40	
L30		28.90	
øP	3.75		3.85
Q	2.65		2.95

5 Revision history

Table 9: Document revision history

Date	Revision	Changes
10-Feb-2015	1	First release.
13-Apr-2015	2	Document status promoted from preliminary to production data. Updated features in cover page. Updated Section 2: "Electrical characteristics" Added Section 2.1: "Electrical characteristics (curves)"

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