STGW40NC60V

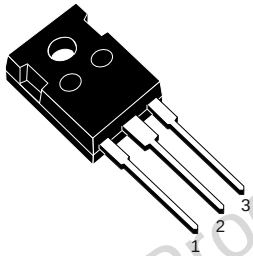
N-CHANNEL 50A - 600V - TO-247
Very Fast PowerMESH™ IGBT

Table 1: General Features

TYPE	V_{CES}	$V_{CE(sat)}$ (Max) @25°C	I_C @100°C
STGW40NC60V	600 V	< 2.5 V	50 A

- HIGH CURRENT CAPABILITY
- HIGH FREQUENCY OPERATION UP TO 50 KHz
- LOSSES INCLUDE DIODE RECOVERY ENERGY
- OFF LOSSES INCLUDE TAIL CURRENT
- LOWER C_{RES} / C_{IES} RATIO
- NEW GENERATION PRODUCTS WITH TIGHTER PARAMETER DISTRUBUTION

Figure 1: Package



TO-247

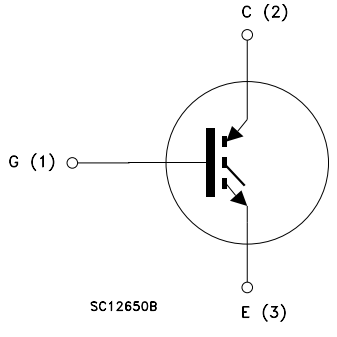
Weight: 4.41gr ± 0.01

Max Clip Pressure: 150 N/mm^2

DESCRIPTION

Using the latest high voltage technology based on a patented strip layout, STMicroelectronics has designed an advanced family of IGBTs, the PowerMESH™ IGBTs, with outstanding performances. The suffix “V” identifies a family optimized for high frequency.

Figure 2: Internal Schematic Diagram



APPLICATIONS

- HIGH FREQUENCY INVERTERS
- SMPS and PFC IN BOTH HARD SWITCH AND RESONANT TOPOLOGIES
- UPS
- MOTOR DRIVERS

Obsolete Product(s) - Obsolete Product(s)

Table 2: Order Codes

SALES TYPE	MARKING	PACKAGE	PACKAGING
STGW40NC60V	GW40NC60V	TO-247	TUBE

Table 3: Absolute Maximum ratings

Symbol	Parameter	Value	Symbol
V_{CES}	Collector-Emitter Voltage (V_{GS} = 0)	600	V
V_{ECR}	Reverse Battery Protection	20	V
V_{GE}	Gate-Emitter Voltage	± 20	V
I_C	Collector Current (continuous) at 25°C (#)	80	A
I_C	Collector Current (continuous) at 100°C (#)	50	A
I_{CM} (1)	Collector Current (pulsed)	200	A
P_{TOT}	Total Dissipation at T_C = 25°C	260	W
	Derating Factor	2.08	W/°C
T_{stg}	Storage Temperature	– 55 to 150	°C
T_j	Operating Junction Temperature		

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

Table 4: Thermal Data

		Min.	Typ.	Max.	Unit
Rthj-case	Thermal Resistance Junction-case			0.48	°C/W
Rthj-amb	Thermal Resistance Junction-ambient			50	°C/W
T_L	Maximum Lead Temperature for Soldering Purpose (1.6 mm from case, for 10 sec.)		300		°C

ELECTRICAL CHARACTERISTICS (T_{CASE} =25°C UNLESS OTHERWISE SPECIFIED)

Table 5: Off

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{BR(CES)}$	Collectro-Emitter Breakdown Voltage	I_C = 1 mA, V_{GE} = 0	600			V
I_{CES}	Collector-Emitter Leakage Current (V_{CE} = 0)	V_{GE} = Max Rating Tc=25°C Tc=125°C			 10 1	 µA mA
I_{GES}	Gate-Emitter Leakage Current (V_{CE} = 0)	V_{GE} = ± 20 V , V_{CE} = 0			± 100	nA

Table 6: On

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{GE(th)}$	Gate Threshold Voltage	V_{CE}= V_{GE}, I_C= 250 µA	3.75		5.75	V
$V_{CE(SAT)}$	Collector-Emitter Saturation Voltage	V_{GE}= 15 V, I_C= 40A, Tj= 25°C V_{GE}= 15 V, I_C= 40A, Tj= 125°C		1.9 1.7	2.5	V V

(#) Calculated according to the iterative formula:

$$I_C(T_C) = \frac{T_{JMAX} - T_C}{R_{THJ-C} \times V_{CESAT(MAX)}(T_C, I_C)}$$

Obsolete Product(s) - Obsolete Product(s)

ELECTRICAL CHARACTERISTICS (CONTINUED)

Table 7: Dynamic

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
g_{fs}(1)	Forward Transconductance	V_{CE} = 15 V, I_C= 20 A		20		S
C_{ies} C_{oes} C_{res}	Input Capacitance Output Capacitance Reverse Transfer Capacitance	V_{CE} = 25V, f = 1 MHz, V_{GE} = 0		4550 350 105		pF pF pF
Q_g Q_{ge} Q_{gc}	Total Gate Charge Gate-Emitter Charge Gate-Collector Charge	V_{CE} = 390 V, I_C = 40 A, V_{GE} = 15V, (see Figure 20)		214 30 96		nC nC nC
I_{CL}	Turn-Off SOA Minimum Current	V_{clamp} = 480 V , Tj = 150°C R_G = 100 Ω, V_{GE}= 15V	200			A

Table 8: Switching On

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$ t_r $(di/dt)_{on}$ Eon (2)	Turn-on Delay Time Current Rise Time Turn-on Current Slope Turn-on Switching Losses	V_{CC} = 390 V, I_C = 40 A R_G= 3.3Ω, V_{GE}= 15V, Tj= 25°C (see Figure 18)		43 17 2060 330	 450	ns ns A/µs µJ
$t_{d(on)}$ t_r $(di/dt)_{on}$ Eon (2)	Turn-on Delay Time Current Rise Time Turn-on Current Slope Turn-on Switching Losses	V_{CC} = 390 V, I_C = 40 A R_G= 3.3Ω, V_{GE}= 15V, Tj= 125°C (see Figure 18)		42 19 1900 640		ns ns A/µs µJ

2) Eon is the turn-on losses when a typical diode is used in the test circuit in figure 2. If the IGBT is offered in a package with a co-pack diode, the co-pack diode is used as external diode. IGBTs & DIODE are at the same temperature (25°C and 125°C)

Table 9: Switching Off

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_r(V_{off})$	Off Voltage Rise Time	V_{cc} = 390 V, I_C = 40 A, R_{GE} = 3.3 Ω , V_{GE} = 15 V T_J = 25 °C (see Figure 18)		25		ns
$t_{d(off)}$	Turn-off Delay Time			140		ns
t_f	Current Fall Time			45		ns
E_{off} (3)	Turn-off Switching Loss			720	970	µJ
E_{ts}	Total Switching Loss			1050	1420	µJ
$t_r(V_{off})$	Off Voltage Rise Time	V_{cc} = 390 V, I_C = 40 A, R_{GE} = 3.3 Ω , V_{GE} = 15 V Tj = 125 °C (see Figure 18)		60		ns
$t_{d(off)}$	Turn-off Delay Time			170		ns
t_f	Current Fall Time			77		ns
E_{off} (3)	Turn-off Switching Loss			1400		µJ
E_{ts}	Total Switching Loss			2040		µJ

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

Obsolete Product(s) - Obsolete Product(s)

Figure 3: Output Characteristics

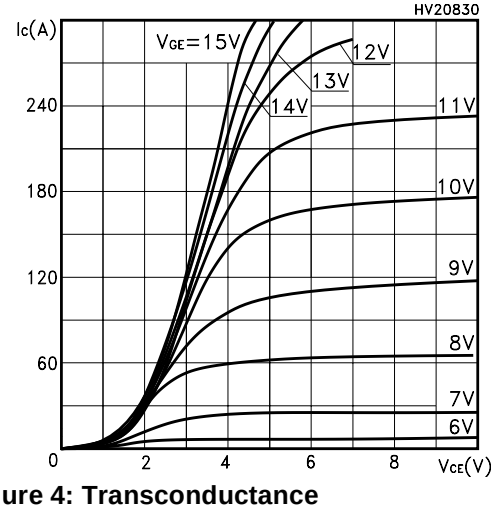


Figure 4: Transconductance

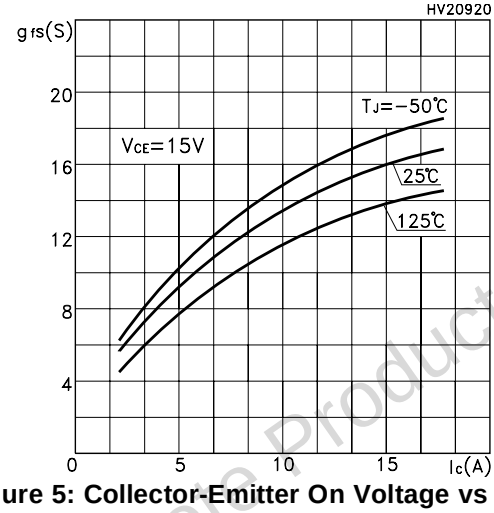


Figure 5: Collector-Emitter On Voltage vs Collector Current

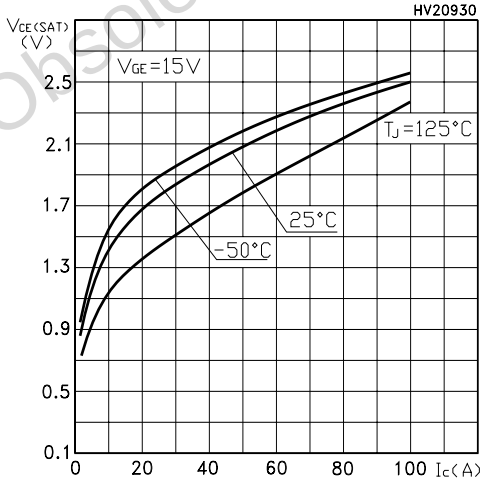


Figure 6: Transfer Characteristics

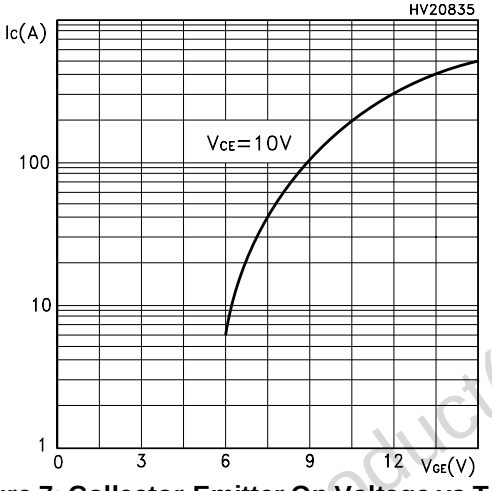


Figure 7: Collector-Emitter On Voltage vs Temperature

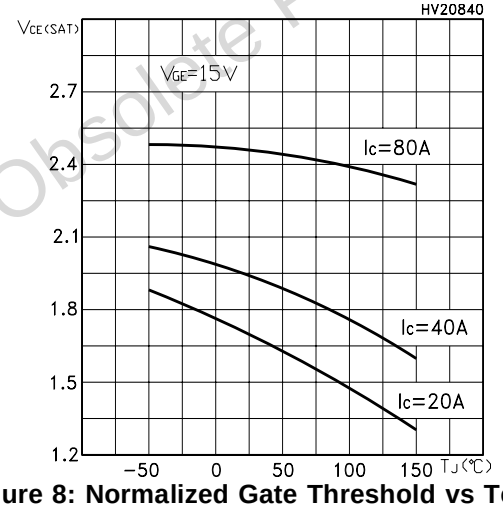
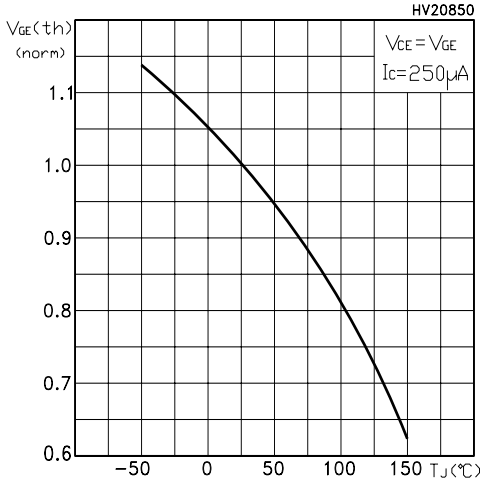


Figure 8: Normalized Gate Threshold vs Temperature



Obsolete Product(s) - Obsolete Product(s)

Figure 9: Normalized Breakdown Voltage vs Temperature

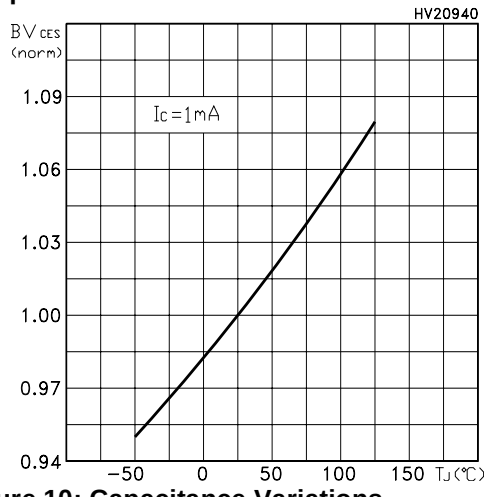


Figure 10: Capacitance Variations

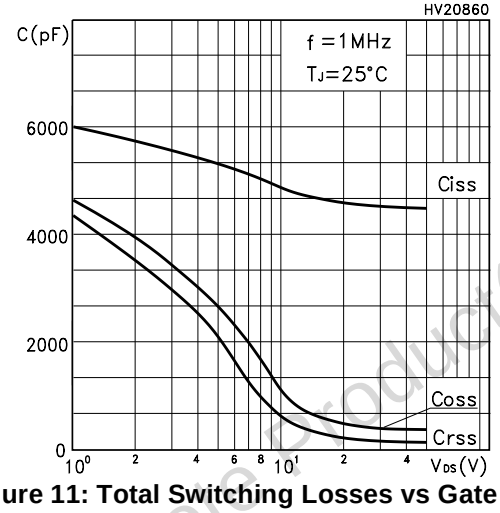


Figure 11: Total Switching Losses vs Gate Resistance

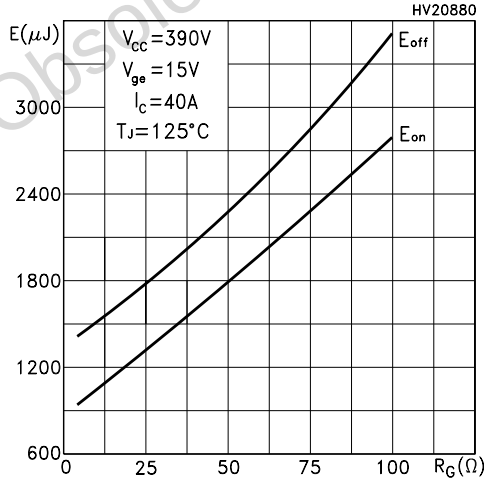


Figure 12: Gate Charge vs Gate-Emitter Voltage

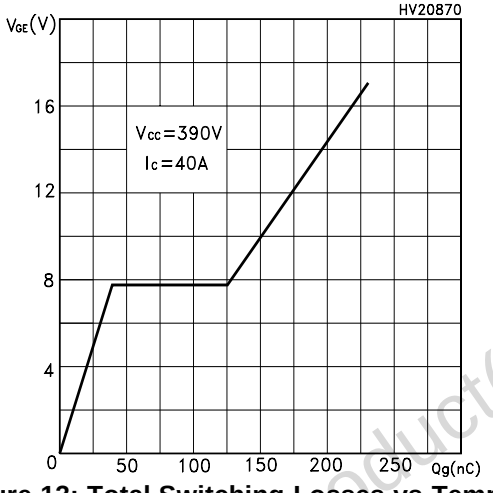


Figure 13: Total Switching Losses vs Temperature

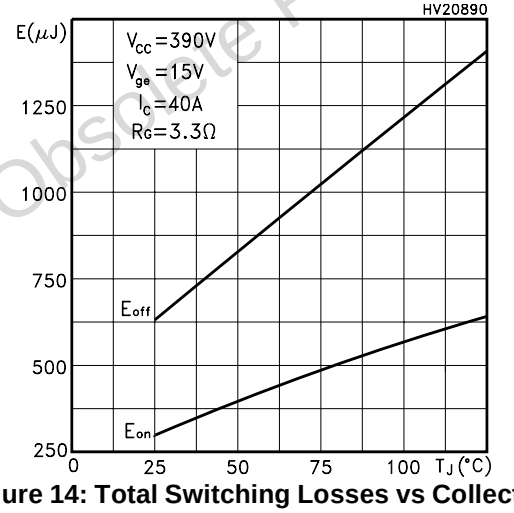
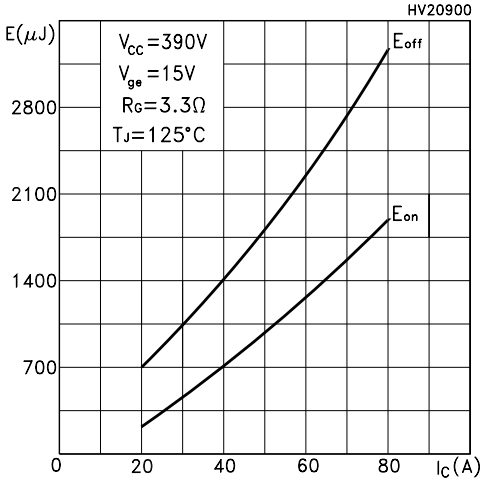


Figure 14: Total Switching Losses vs Collector Current



Obsolete Product(s) - Obsolete Product(s)

Figure 15: Thermal Impedance

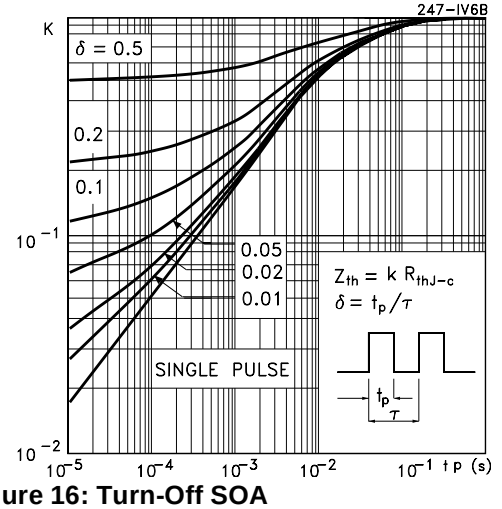


Figure 16: Turn-Off SOA

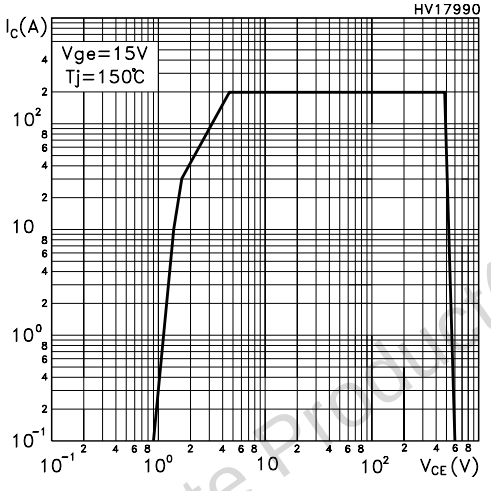
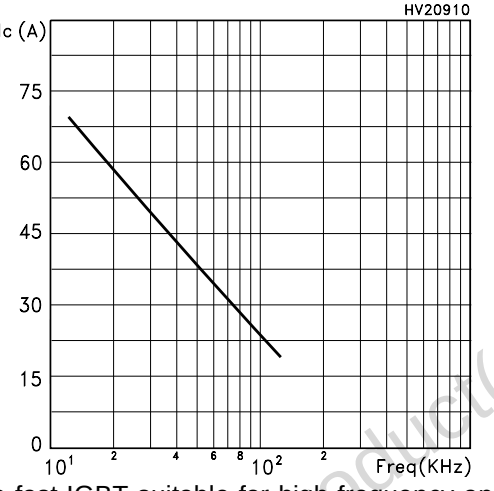


Figure 17: Ic vs Frequency



For a fast IGBT suitable for high frequency applications, the typical collector current vs. maximum operating frequency curve is reported. That frequency is defined as follows:

$$f_{MAX} = (P_D - P_C) / (E_{ON} + E_{OFF})$$

1) The maximum power dissipation is limited by maximum junction to case thermal resistance:

$$P_D = \Delta T / R_{THJ\text{-}C}$$

considering $\Delta T = T_J - T_C = 125\ °C - 75\ °C = 50°C$

2) The conduction losses are:

$$P_C = I_C * V_{CE(SAT)} * \delta$$

with 50% of duty cycle, V_{CESAT} typical value @125°C.

3) Power dissipation during ON & OFF commutations is due to the switching frequency:

$$P_{SW} = (E_{ON} + E_{OFF}) * freq.$$

4) Typical values @ 125°C for switching losses are used (test conditions: V_{CE} = 390V, V_{GE} = 15V, R_G = 3.3 Ohm). Furthermore, diode recovery energy is included in the E_{ON} (see note 2), while the tail of the collector current is included in the E_{OFF} measurements (see note 3).

Obsolete Product(s) - Obsolete Product(s)

Figure 18: Test Circuit for Inductive Load Switching

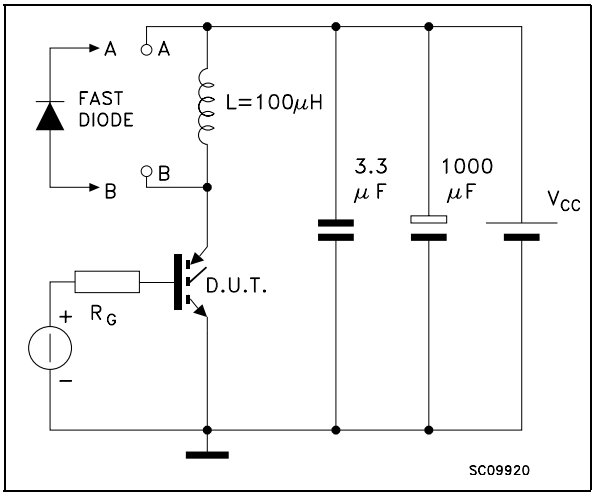


Figure 19: Switching Waveforms

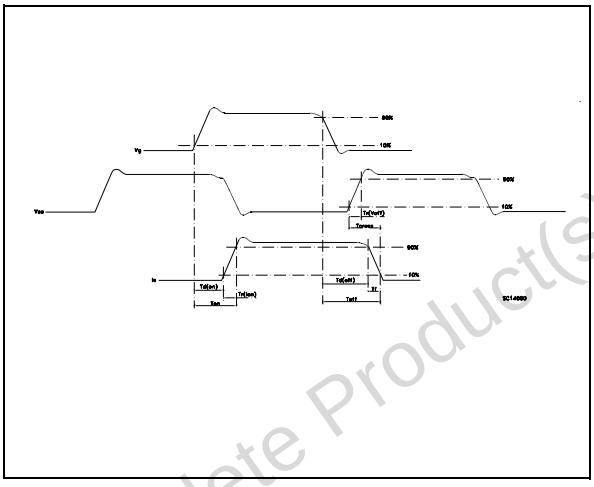
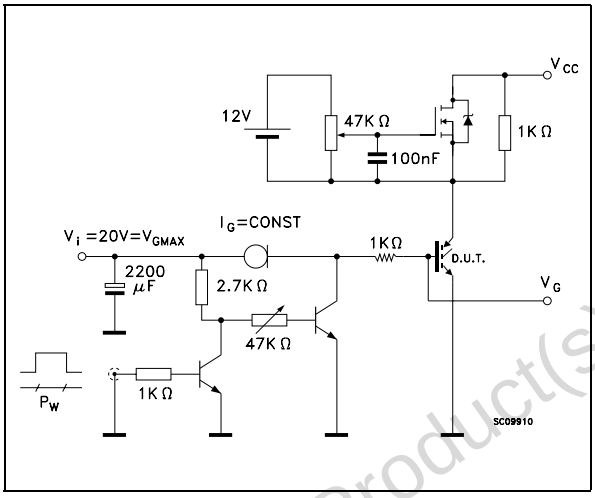


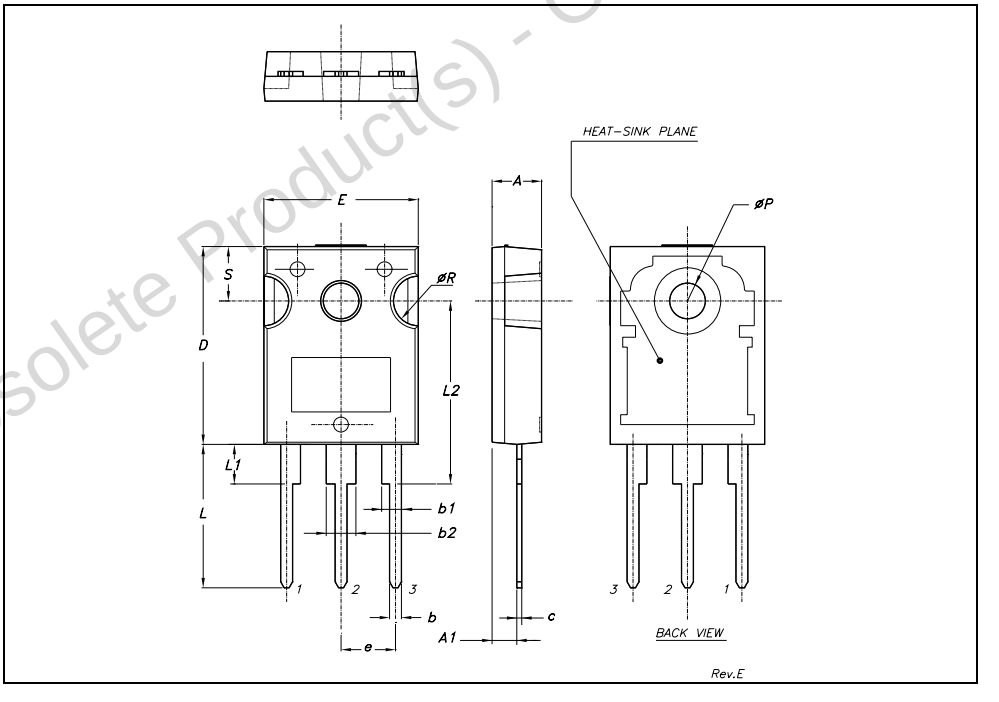
Figure 20: Gate Charge Test Circuit



Obsolete Product(s) - Obsolete Product(s)

TO-247 MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	4.85		5.15	0.19		0.20
A1	2.20		2.60	0.086		0.102
b	1.0		1.40	0.039		0.055
b1	2.0		2.40	0.079		0.094
b2	3.0		3.40	0.118		0.134
c	0.40		0.80	0.015		0.03
D	19.85		20.15	0.781		0.793
E	15.45		15.75	0.608		0.620
e		5.45			0.214	
L	14.20		14.80	0.560		0.582
L1	3.70		4.30	0.14		0.17
L2		18.50			0.728	
øP	3.55		3.65	0.140		0.143
øR	4.50		5.50	0.177		0.216
S		5.50			0.216	



Obsolete Product(s) - Obsolete Product(s)

Table 10: Revision History

Date	Revision	Description of Changes
13-Jul-2004	9	Stylesheet update. No content change
14-Jul-2004	10	Some datas have been updated

Obsolete Product(s) - Obsolete Product(s)

Obsolete Product(s) - Obsolete Product(s)

Information furnished is believed to be accurate and reliable. However, STMicroelectronics assumes no responsibility for the consequences of use of such information nor for any infringement of patents or other rights of third parties which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of STMicroelectronics. Specifications mentioned in this publication are subject to change without notice. This publication supersedes and replaces all information previously supplied. STMicroelectronics products are not authorized for use as critical components in life support devices or systems without express written approval of STMicroelectronics.

The ST logo is a registered trademark of STMicroelectronics

All other names are the property of their respective owners

© 2004 STMicroelectronics - All Rights Reserved

STMicroelectronics GROUP OF COMPANIES

Australia - Belgium - Brazil - Canada - China - Czech Republic - Finland - France - Germany - Hong Kong - India - Israel - Italy - Japan - Malaysia - Malta - Morocco - Singapore - Spain - Sweden - Switzerland - United Kingdom - United States.