RGW60TS65CHR

650V 30A Hybrid IGBT with Built-In SiC-SBD

Datasheet

V _{CES}	650V
I _{C (100°C)}	30A
V _{CE(sat) (Typ.)}	1.5V
P_D	178W

Outline TO-247N (1) (2)(3)

Features

- 1) AEC-Q101 Qualified
- 2) Low Collector Emitter Saturation Voltage
- 3) Low Switching Loss & Soft Switching
- 4) Built in No Recovery Silicon Carbide SBD
- 5) Pb free Lead Plating; RoHS Compliant

Application

Automotive

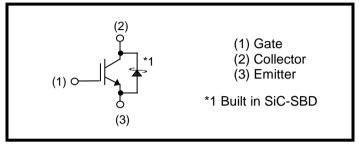
On & Off Board Chargers

DC-DC Converters

PFC

Industrial Inverter

●Inner Circuit



Packaging Specifications

or ackaging opeomeations					
	Packaging	Tube			
	Reel Size (mm)	-			
Tuno	Tape Width (mm)	-			
Туре	Basic Ordering Unit (pcs)	450			
	Packing Code	C11			
	Marking	RGW60TS65C			

● **Absolute Maximum Ratings** (at T_C = 25°C unless otherwise specified)

Parameter		Symbol	Value	Unit
Collector - Emitter Voltage		V _{CES}	650	V
Gate - Emitter Voltage		V_{GES}	±30	V
Collector Current	T _C = 25°C	I _C	64	А
Collector Current	T _C = 100°C	I _C	39	А
Pulsed Collector Current		I _{CP} *1	120	А
Diode Forward Current	T _C = 25°C	I _F	39	А
	T _C = 100°C	I _F	25	А
Diode Pulsed Forward Current		I _{FP} *1	100	А
Power Dissipation	T _C = 25°C	P _D	178	W
	T _C = 100°C	P _D	89	W
Operating Junction Temperature		T _j	-40 to +175	°C
Storage Temperature		T _{stg}	-55 to +175	°C

^{*1} Pulse width limited by T_{jmax.}

●Thermal Resistance

Parameter	Symbol	Values			Unit
raiailletei	Symbol	Min.	Тур.	Max.	Offic
Thermal Resistance IGBT Junction - Case	$R_{\theta(j-c)}$	-	-	0.84	°C/W
Thermal Resistance Diode Junction - Case	$R_{\theta(j-c)}$	-	-	1.34	°C/W

●IGBT Electrical Characteristics (at T_i = 25°C unless otherwise specified)

Parameter	Symbol	Conditions	Values			Unit
r arameter	Symbol	Conditions	Min.	Тур.	Max.	Offic
Collector - Emitter Breakdown Voltage	BV _{CES}	$I_C = 5mA$, $V_{GE} = 0V$	650	ı	ı	V
Collector Cut - off Current	I _{CES}	$V_{CE} = 650V, V_{GE} = 0V$	ı	1	5	mA
Gate - Emitter Leakage Current	I _{GES}	$V_{GE} = \pm 30V, V_{CE} = 0V$	ı	ı	±200	nA
Gate - Emitter Threshold Voltage	$V_{GE(th)}$	$V_{CE} = 5V, I_{C} = 20.0 \text{mA}$	5.0	6.0	7.0	V
Collector - Emitter Saturation Voltage	V _{CE(sat)}	$I_{C} = 30A, V_{GE} = 15V,$ $T_{j} = 25^{\circ}C$ $T_{j} = 175^{\circ}C$	-	1.5 1.85	1.9 -	V

•IGBT Electrical Characteristics (at $T_j = 25$ °C unless otherwise specified)

Parameter	Symbol	Conditions	Values			Unit
Parameter	Symbol	Conditions	Min.	Тур.	Max.	Offic
Input Capacitance	C _{ies}	$V_{CE} = 30V$,	-	2530	-	
Output Capacitance	C _{oes}	$V_{GE} = 0V$,	-	65	-	pF
Reverse transfer Capacitance	C_{res}	f = 1MHz	-	46	-	
Total Gate Charge	Q_g	V _{CE} = 400V,	-	84	-	_
Gate - Emitter Charge	Q_{ge}	$I_{\rm C} = 30A,$	-	17	-	nC
Gate - Collector Charge	Q_{gc}	$V_{GE} = 15V$	1	31	1	
Turn - on Delay Time	t _{d(on)}		•	37	ı	
Rise Time	t _r	$I_C = 15A, V_{CC} = 400V,$ $V_{GF} = 15V, R_G = 10\Omega,$	ı	8	ı	ns
Turn - off Delay Time	t _{d(off)}	$T_j = 25^{\circ}C$	•	91	ı	
Fall Time	t _f	Inductive Load	ı	70	ı	
Turn - on Switching Loss	E _{on}	*E _{on} include diode reverse recovery	1	0.07	ı	mJ
Turn - off Switching Loss	E _{off}		ı	0.22	ı	1110
Turn - on Delay Time	t _{d(on)}		ı	34	ı	
Rise Time	t _r	$I_C = 15A, V_{CC} = 400V,$ $V_{GE} = 15V, R_G = 10\Omega,$	ı	9	ı	ns
Turn - off Delay Time	t _{d(off)}	$T_j = 175^{\circ}C$	ı	134	ı	113
Fall Time	t _f	Inductive Load	1	86	ı	
Turn - on Switching Loss	E _{on}	*E _{on} include diode reverse recovery	1	0.07	-	mJ
Turn - off Switching Loss	E _{off}		1	0.33	ı	1110
Reverse Bias Safe Operating Area	RBSOA	$I_C = 120A$, $V_{CC} = 520V$, $V_P = 650V$, $V_{GE} = 15V$,	FU	LL SQUA	RE	-
		$R_G = 100\Omega, T_j = 175^{\circ}C$				

●SiC-SBD Electrical Characteristics (at T_j = 25°C unless otherwise specified)

Parameter	Symbol	Conditions	Values			Unit
Parameter			Min.	Тур.	Max.	Offic
Diode Forward Voltage	V _F	$I_F = 20A,$ $T_j = 25^{\circ}C$ $T_j = 175^{\circ}C$	-	1.35 1.63	1.55 -	V
Diode Reverse Recovery Time	t _{rr}		-	34	-	ns
Diode Peak Reverse Recovery Current	I _{rr}	I _F = 15A, V _{CC} = 400V,	-	2.5	-	А
Diode Reverse Recovery Charge	Q _{rr}	di _F /dt = 200A/μs, Τ _j = 25°C	-	49	-	nC
Diode Reverse Recovery Energy	E _{rr}		-	1.2	-	μJ
Diode Reverse Recovery Time	t _{rr}	$I_F = 15A,$ $V_{CC} = 400V,$ $di_F/dt = 200A/\mu s,$ $T_j = 175^{\circ}C$	-	37	-	ns
Diode Peak Reverse Recovery Current	I _{rr}		-	2.5	-	А
Diode Reverse Recovery Charge	Q _{rr}		-	55	-	nC
Diode Reverse Recovery Energy	E _{rr}		-	1.6	-	μJ
Total Capacitance	С	$V_R = 1V, f=1MHz$ $V_R = 600V, f=1MHz$	-	730 74	-	pF

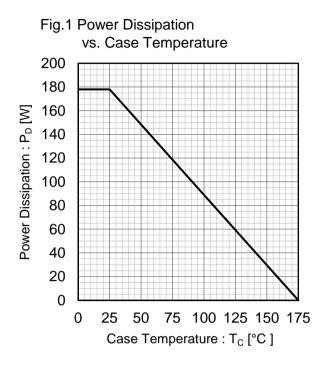


Fig.2 Collector Current vs. Case Temperature 70 60 Collector Current: Ic [A] 50 40 30 20 10 T_j ≤ 175°C V_{GE} ≥ 15V 0 25 50 75 100 125 150 175 Case Temperature : T_C [°C]

Fig.3 Forward Bias Safe Operating Area 1000 1µs

100 Collector Current : I_C [A] 10µs 10 100µs 1 0.1 $T_{\rm C} = 25^{\circ}{\rm C}$ Single Pulse 0.01 10 100 1000 Collector To Emitter Voltage : V_{CE} [V]

160 140 Collector Current : Ic [A] 120 100 80 60 40 20 $T_i \le 175^{\circ}C$ V_{GF} = 15V 0 200 400 600 800 Collector To Emitter Voltage: V_{CE} [V]

Fig.4 Reverse Bias Safe Operating Area

2021.03 - Rev.A

Fig.5 Typical Output Characteristics

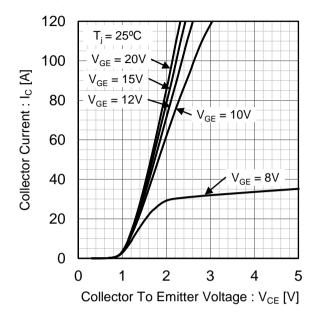


Fig.6 Typical Output Characteristics

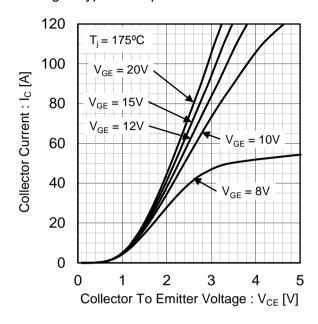


Fig.7 Typical Transfer Characteristics

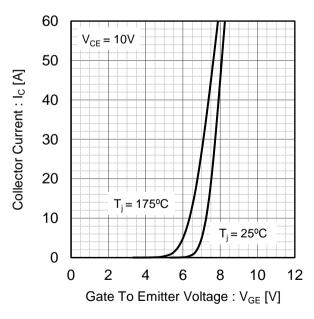
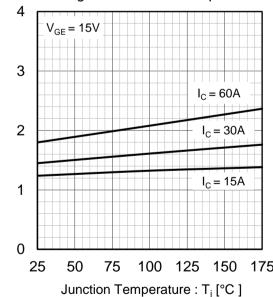


Fig.8 Typical Collector to Emitter Saturation Voltage vs. Junction Temperature



Collector To Emitter Saturation

Voltage: V_{CE(sat)} [V]

5

• Electrical Characteristic Curves

10

15

Gate To Emitter Voltage: V_{GE} [V]

Fig.9 Typical Collector to Emitter Saturation

Fig.10 Typical Collector to Emitter Saturation Voltage vs. Gate to Emitter Voltage

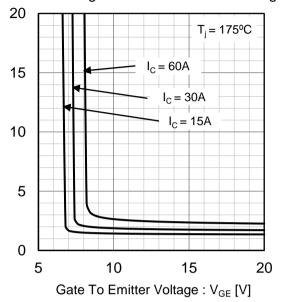
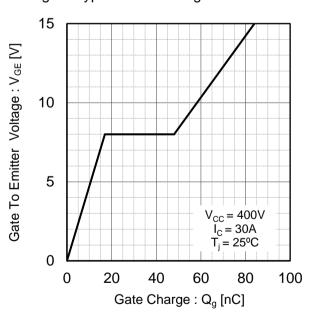


Fig.11 Typical Capacitance vs. Collector to Emitter Voltage 10000 Cies 1000 Capacitance [pF] C_{oes} 100 C_{res} 10 f = 1MHz $V_{GE} = 0V$ = 25°C 0.01 0.1 1 10 100 Collector To Emitter Voltage: V_{CE} [V]

Fig.12 Typical Gate Charge



Collector To Emitter Saturation

20

Voltage: V_{CE(sat)} [V]

Fig.13 Typical Switching Time vs. Collector Current 1000 Switching Time [ns] $t_{d(off)}$ 100 t_f $t_{d(on)}$ 10 $V_{CC} = 400V, V_{GE} = 15V,$ $R_{G} = 10\Omega, T_{j} = 25^{\circ}C$ Inductive load 1 0 10 20 30 40 50 60 Collecter Current : I_C [A]

vs. Gate Resistance 1000 $t_{d(off)}$ Switching Time [ns] 100 t_f $t_{d(on)}$ 10 $V_{CC} = 400V, V_{GE} = 15V,$ $I_{C} = 15A, T_{j} = 25^{\circ}C$ Inductive load 1 0 10 20 30 50 Gate Resistance : $R_G[\Omega]$

Fig.14 Typical Switching Time

Fig.15 Typical Switching Energy Losses vs. Collector Current 10 Switching Energy Losses [mJ] 1 $\mathsf{E}_{\mathsf{off}}$ 0.1 V_{CC} = 400V, V_{GE} = 15V, R_G = 10 Ω , T_j = 25°C Inductive load 0.01 0 10 20 30 40 50 60 Collecter Current : I_C [A]

vs. Gate Resistance

10

See Storm 1

Eoff

V_{CC} = 400V, V_{GE} = 15V,
I_C = 15A, T_j = 25°C
Inductive load

0.01

0 10 20 30 40 50

Gate Resistance : $R_G[\Omega]$

Fig.16 Typocal Switching Energy Losses

Fig.17 Typical Switching Time vs. Collector Current 1000 $t_{d(off)}$ Switching Time [ns] 100 $t_{d(on)}$ 10 $V_{CC} = 400V, V_{GE} = 15V,$ $R_G = 10\Omega, T_j = 175^{\circ}C$ Inductive load 1 0 10 20 30 40 50 60 Collecter Current : I_C [A]

vs. Gate Resistance $\begin{array}{c} \text{1000} \\ \text{ } \\$

Fig.18 Typical Switching Time

Fig.19 Typical Switching Energy Losses vs. Collector Current 10 Switching Energy Losses [mJ] 1 $\mathsf{E}_{\mathsf{off}}$ 0.1 $V_{CC} = 400V, V_{GE} = 15V,$ $R_G = 10\Omega, T_j = 175^{\circ}C$ E_{on} Inductive load 0.01 10 20 30 40 50 60 Collecter Current : I_C [A]

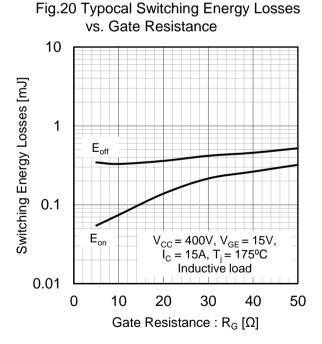


Fig.21 Typical Diode Forward Current vs. Forward Voltage

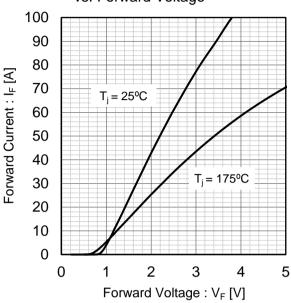


Fig.22 Typical Diode Revese Recovery Time vs. Forward Current

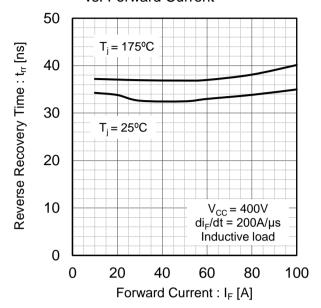


Fig.23 Typical Diode Reverse Recovery Current vs. Forward Current

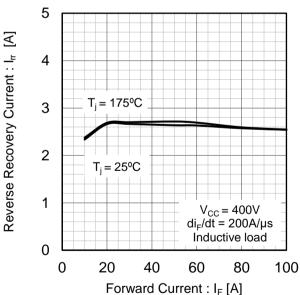
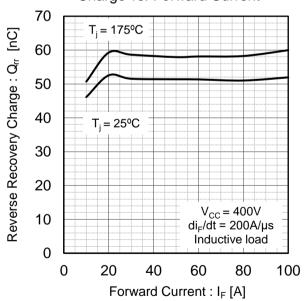
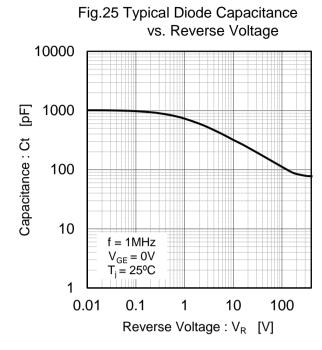


Fig.24 Typical Diode Rrverse Recovery Charge vs. Forward Current



2021.03 - Rev.A



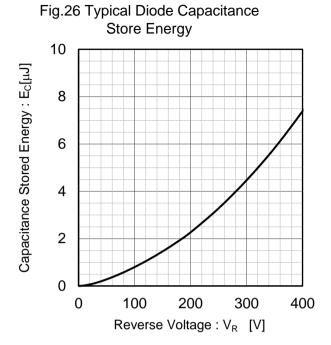


Fig.27 Typical IGBT Transient Thermal Impedance

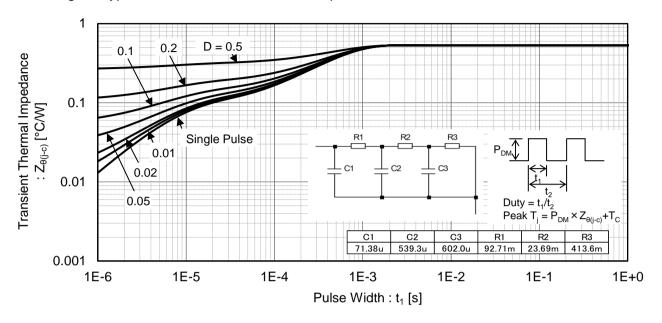
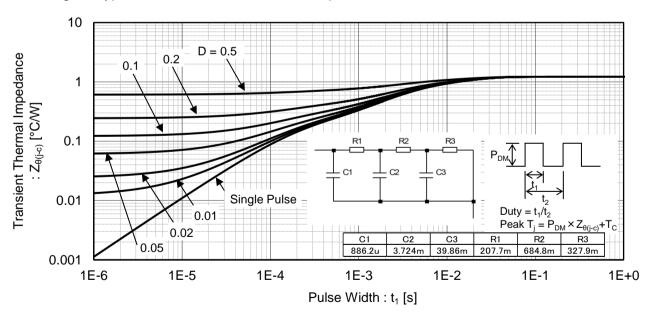


Fig.28 Typical Diode Transient Thermal Impedance



●Inductive Load Switching Circuit and Waveform

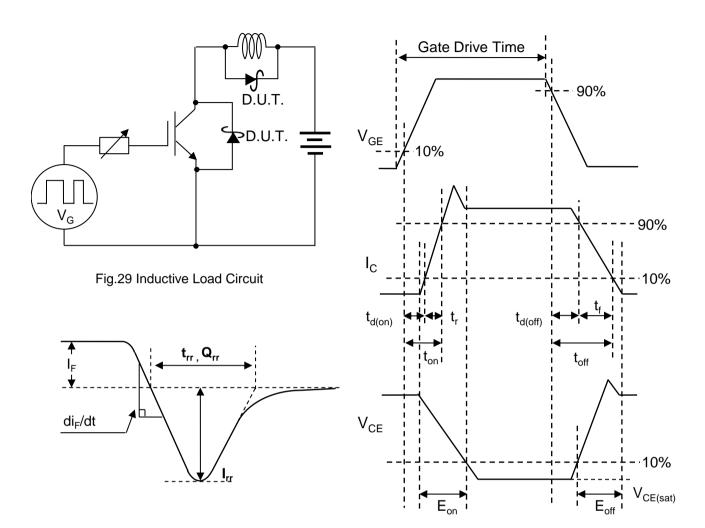


Fig.31 Diode Reverse Recovery Waveform

Fig.30 Inductive Load Waveform

Notes

- 1) The information contained herein is subject to change without notice.
- Before you use our Products, please contact our sales representative and verify the latest specifications.
- 3) Although ROHM is continuously working to improve product reliability and quality, semiconductors can break down and malfunction due to various factors.

 Therefore, in order to prevent personal injury or fire arising from failure, please take safety measures such as complying with the derating characteristics, implementing redundant and fire prevention designs, and utilizing backups and fail-safe procedures. ROHM shall have no responsibility for any damages arising out of the use of our Poducts beyond the rating specified by ROHM.
- 4) Examples of application circuits, circuit constants and any other information contained herein are provided only to illustrate the standard usage and operations of the Products. The peripheral conditions must be taken into account when designing circuits for mass production.
- 5) The technical information specified herein is intended only to show the typical functions of and examples of application circuits for the Products. ROHM does not grant you, explicitly or implicitly, any license to use or exercise intellectual property or other rights held by ROHM or any other parties. ROHM shall have no responsibility whatsoever for any dispute arising out of the use of such technical information.
- 6) The Products specified in this document are not designed to be radiation tolerant.
- 7) For use of our Products in applications requiring a high degree of reliability (as exemplified below), please contact and consult with a ROHM representative: transportation equipment (i.e. cars, ships, trains), primary communication equipment, traffic lights, fire/crime prevention, safety equipment, medical systems, and power transmission systems.
- 8) Do not use our Products in applications requiring extremely high reliability, such as aerospace equipment, nuclear power control systems, and submarine repeaters.
- 9) ROHM shall have no responsibility for any damages or injury arising from non-compliance with the recommended usage conditions and specifications contained herein.
- 10) ROHM has used reasonable care to ensure the accuracy of the information contained in this document. However, ROHM does not warrants that such information is error-free, and ROHM shall have no responsibility for any damages arising from any inaccuracy or misprint of such information.
- 11) Please use the Products in accordance with any applicable environmental laws and regulations, such as the RoHS Directive. For more details, including RoHS compatibility, please contact a ROHM sales office. ROHM shall have no responsibility for any damages or losses resulting non-compliance with any applicable laws or regulations.
- 12) When providing our Products and technologies contained in this document to other countries, you must abide by the procedures and provisions stipulated in all applicable export laws and regulations, including without limitation the US Export Administration Regulations and the Foreign Exchange and Foreign Trade Act.
- This document, in part or in whole, may not be reprinted or reproduced without prior consent of ROHM.



Thank you for your accessing to ROHM product informations. More detail product informations and catalogs are available, please contact us.

ROHM Customer Support System

http://www.rohm.com/contact/

General Precaution

- 1. Before you use our Products, you are requested to care fully read this document and fully understand its contents. ROHM shall not be in an y way responsible or liable for failure, malfunction or accident arising from the use of a ny ROHM's Products against warning, caution or note contained in this document.
- 2. All information contained in this docume nt is current as of the issuing date and subject to change without any prior notice. Before purchasing or using ROHM's Products, please confirm the latest information with a ROHM sale s representative.
- 3. The information contained in this doc ument is provided on an "as is" basis and ROHM does not warrant that all information contained in this document is accurate an d/or error-free. ROHM shall not be in an y way responsible or liable for any damages, expenses or losses incurred by you or third parties resulting from inaccuracy or errors of or concerning such information.

Notice – WE © 2015 ROHM Co., Ltd. All rights reserved. Rev.001