

FGW40XS120C

Discrete IGBT

Discrete IGBT (XS-series) 1200V/40A

■ Features

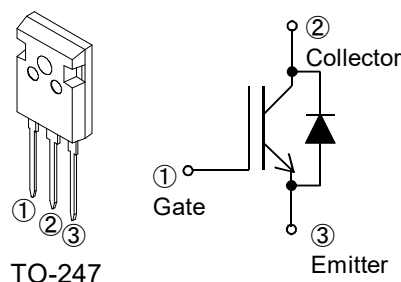
Pb-free lead terminal ;RoHS compliant
Helogen-free molding compound

■ Applications

Uninterruptible Power Supply, PV Power Conditioner,
Inverter welding machine



■ Equivalent Circuit



■ Maximum ratings and characteristics

●Absolute maximum ratings at $T_{vj}=25^{\circ}\text{C}$ (unless otherwise specified)

| Parameter | Symbol | Value | Unit | Remarks |
|--------------------------------|-----------------|-----------------|--------------------|--|
| Collector-Emitter voltage | V_{CES} | 1200 | V | |
| Gate-Emitter voltage | V_{GES} | ± 20 | V | $t_p < 1\mu\text{s}$ |
| Transient Gate-Emitter voltage | | ± 30 | | |
| DC collector current | $I_{C@25}$ | 63 | A | $T_c=25^{\circ}\text{C}$ |
| | $I_{C@100}$ | 40 | A | $T_c=100^{\circ}\text{C}$ |
| Pulsed collector current | I_{CP} | 160 | A | Note*1 |
| Turn-off safe operating area | - | 160 | A | $V_{CE} \leq 1200\text{ V}, T_{vj} \leq 175^{\circ}\text{C}$ |
| Diode forward current | $I_{F@25}$ | 63 | A | |
| | $I_{F@100}$ | 40 | A | |
| Diode pulsed current | I_{FP} | 160 | A | Note*1 |
| IGBT max. power dissipation | P_{tot_IGBT} | 351 | W | $T_c=25^{\circ}\text{C}$ |
| FWD max. power dissipation | P_{tot_FWD} | 127 | W | $T_c=25^{\circ}\text{C}$ |
| Operating junction temperature | T_{vj} | $-40 \sim +175$ | $^{\circ}\text{C}$ | |
| Storage temperature | T_{stg} | $-55 \sim +175$ | $^{\circ}\text{C}$ | |

Note*1 : Pulse width limited by T_{vjmax}

FGW40XS120C

Discrete IGBT

● **Electrical characteristics (at $T_{vj} = 25^{\circ}\text{C}$ unless otherwise specified)**

| Parameter | Symbol | Conditions | Min. | Typ. | Max. | Unit |
|--------------------------------------|---------------|--|---|------|------|----------|
| Zero-gate voltage collector current | I_{CES} | $V_{CE}=1200\text{V}$ $V_{GE}=0\text{V}$ | $T_{vj}=25^{\circ}\text{C}$ $T_{vj}=175^{\circ}\text{C}$ | - | - | 250 2 |
| | | | | | | mA |
| Gate-Emitter leakage current | I_{GES} | $V_{CE}=0\text{V}$ $V_{GE}=\pm 20\text{V}$ | - | - | 200 | nA |
| Gate-Emitter threshold voltage | $V_{GE(th)}$ | $V_{CE}=20\text{V}$ $I_C=40\text{mA}$ | 4.9 | 5.5 | 6.1 | V |
| Collector-Emitter saturation voltage | $V_{CE(sat)}$ | $V_{GE}=15\text{V}$ $I_C=40\text{A}$ | $T_{vj}=25^{\circ}\text{C}$ | 1.3 | 1.6 | 1.9 |
| | | | $T_{vj}=125^{\circ}\text{C}$ | - | 2.05 | - |
| | | | $T_{vj}=175^{\circ}\text{C}$ | - | 2.15 | - |
| Input capacitance | C_{ies} | $V_{CE}=25\text{V}$ | 2350 | 4700 | 7050 | pF |
| Ooutput capacitance | C_{oes} | $V_{GE}=0\text{V}$ | 33 | 66 | 100 | |
| Reverse transfer capacitance | C_{res} | $f = 1\text{MHz}$ | 19 | 38 | 60 | |
| Gate charge | Q_G | $V_{CC}=600\text{V}, I_C=40\text{A}, V_{GE}=15\text{V}$ | 125 | 250 | 380 | nC |
| Turn-on delay time | $t_{d(on)}$ | $T_{vj}=25^{\circ}\text{C}, V_{CC}=600\text{V}, I_C=40\text{A}$ | 22 | 45 | 70 | ns |
| Rise time | t_r | $V_{GE}=15\text{V}, R_G=10\Omega$ | 16 | 32 | 50 | |
| Turn-off delay time | $t_{d(off)}$ | Energy loss include "tail" and FWD reverse recovery. | 125 | 250 | 380 | |
| Fall time | t_f | | 30 | 60 | 90 | |
| Turn-on energy | E_{on} | $T_{vj}=175^{\circ}\text{C}, V_{CC}=600\text{V}, I_C=40\text{A}$ $V_{GE}=15\text{V}, R_G=10\Omega$ Energy loss include "tail" and FWD reverse recovery. | 0.7 | 1.4 | 2.1 | mJ |
| Turn-off energy | E_{off} | | 0.85 | 1.7 | 2.6 | |
| Turn-on delay time | $t_{d(on)}$ | | 22 | 44 | 66 | ns |
| Rise time | t_r | | 13 | 26 | 39 | |
| Turn-off delay time | $t_{d(off)}$ | | 140 | 280 | 420 | |
| Fall time | t_f | Energy loss include "tail" and FWD reverse recovery. | 65 | 130 | 195 | mJ |
| Turn-on energy | E_{on} | | 1.1 | 2.2 | 3.3 | |
| Turn-off energy | E_{off} | | 1.0 | 2.0 | 3.0 | |

※ Recommended external R_G value range is from 5.1Ω to 51Ω.

● **FWD characteristics**

| Parameter | Symbol | Conditions | Min. | Typ. | Max. | Unit |
|-------------------------------|----------|--|------------------------------|------|------|------|
| Forward voltage drop | V_F | $I_F=40\text{A}$ | $T_{vj}=25^{\circ}\text{C}$ | 2.5 | 2.9 | 3.3 |
| | | | $T_{vj}=125^{\circ}\text{C}$ | - | 3.2 | - |
| | | | $T_{vj}=175^{\circ}\text{C}$ | - | 3.2 | - |
| Diode reverse recovery time | t_{rr} | $V_{CC}=600\text{V}, I_F=40\text{A}$ | 115 | 230 | 345 | ns |
| Diode reverse recovery charge | Q_{rr} | $-di_F/dt=300\text{A}/\mu\text{s}, T_{vj}=25^{\circ}\text{C}$ | 0.55 | 1.10 | 1.65 | μC |
| Diode reverse recovery time | t_{rr} | $V_{CC}=600\text{V}, I_F=40\text{A}$ | 250 | 500 | 750 | ns |
| Diode reverse recovery charge | Q_{rr} | $-di_F/dt=300\text{A}/\mu\text{s}, T_{vj}=175^{\circ}\text{C}$ | 1.15 | 2.30 | 3.45 | μC |

■ **Thermal resistance**

| Parameter | Symbol | Min. | Typ. | Max. | Unit |
|---|----------------------|------|------|-------|-----------------------------|
| Thermal resistance, junction-ambient | $R_{th(j-a)}$ | - | - | 50 | $^{\circ}\text{C}/\text{W}$ |
| Thermal resistance, IGBT junction to case | $R_{th(j-c)}_{IGBT}$ | - | - | 0.427 | $^{\circ}\text{C}/\text{W}$ |
| Thermal resistance, FWD junction to case | $R_{th(j-c)}_{FWD}$ | - | - | 1.176 | $^{\circ}\text{C}/\text{W}$ |

FGW40XS120C

Discrete IGBT

Figure 1.
IGBT power dissipation vs T_c
 $T_{vj} \leq 175^\circ\text{C}$

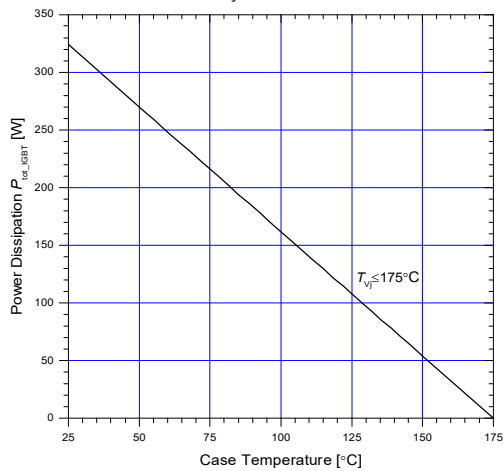


Figure 2.
DC collector current vs T_c
 $V_{GE} \geq +15\text{ V}, T_{vj} \leq 175^\circ\text{C}$

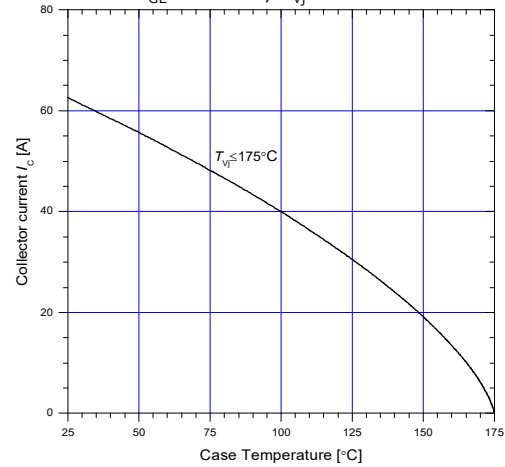


Figure 3.
Typical output characteristics
 $T_{vj} = 25^\circ\text{C}$

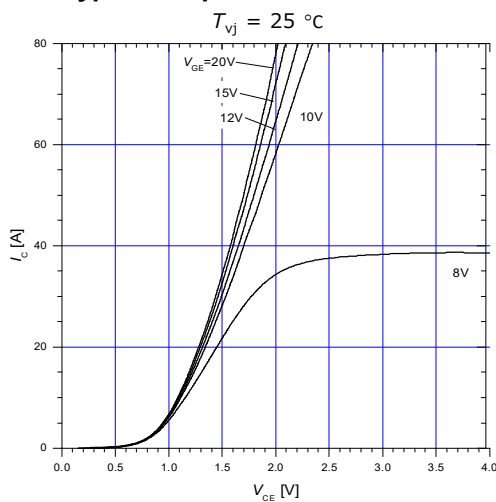


Figure 4.
Typical output characteristics
 $T_{vj} = 175^\circ\text{C}$

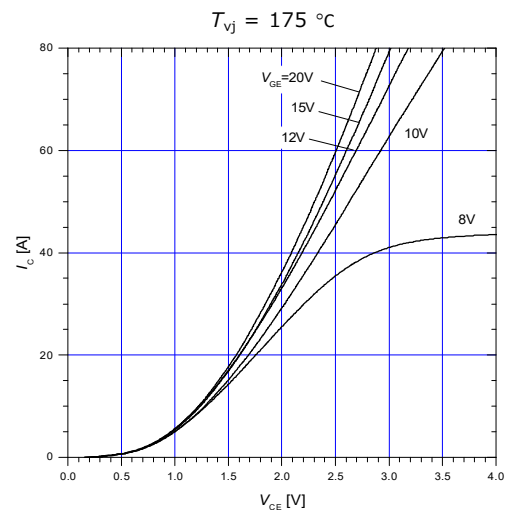


Figure 5.
Typical transfer characteristics
 $V_{CE} = 20\text{ V}$

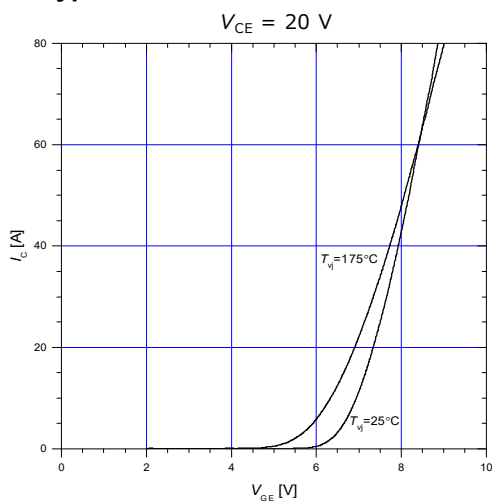
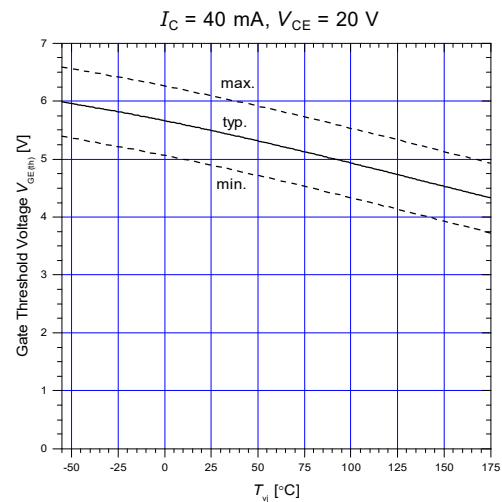


Figure 6.
Gate threshold voltage
 $I_C = 40\text{ mA}, V_{CE} = 20\text{ V}$



FGW40XS120C

Discrete IGBT

Figure 7.
Typical capacitance

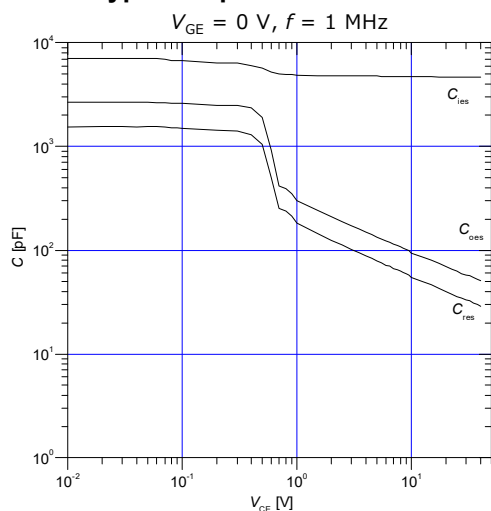


Figure 8.
Typical gate charge

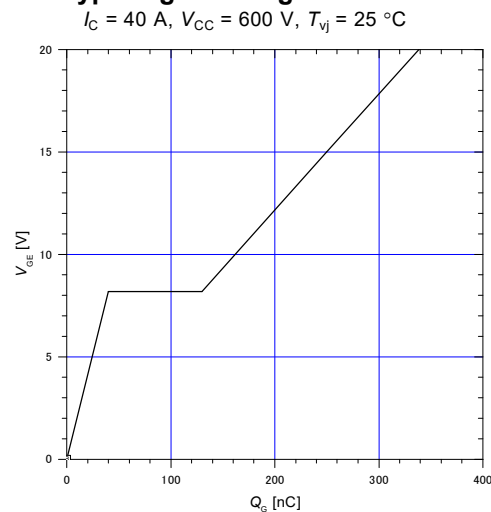


Figure 9.
Typical switching times vs. I_C

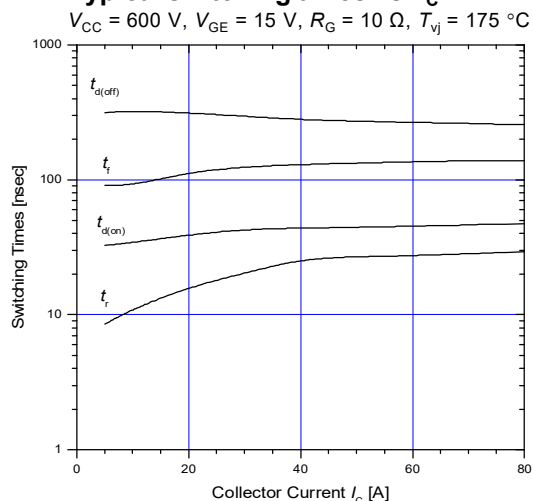


Figure 10.
Typical switching times vs. R_G

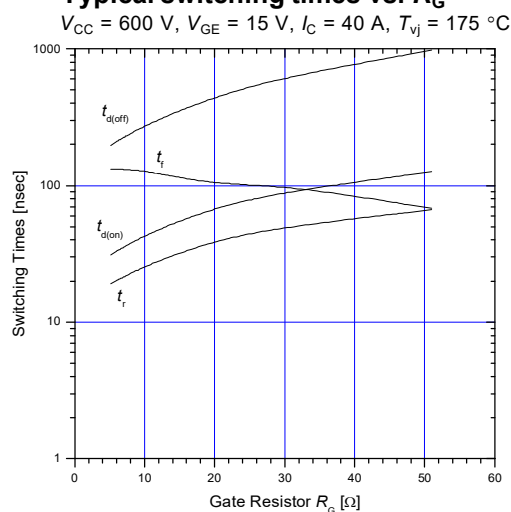


Figure 11.
Typical switching losses vs. I_C

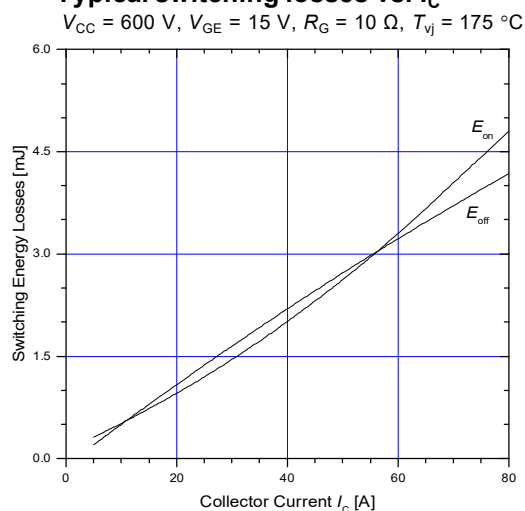
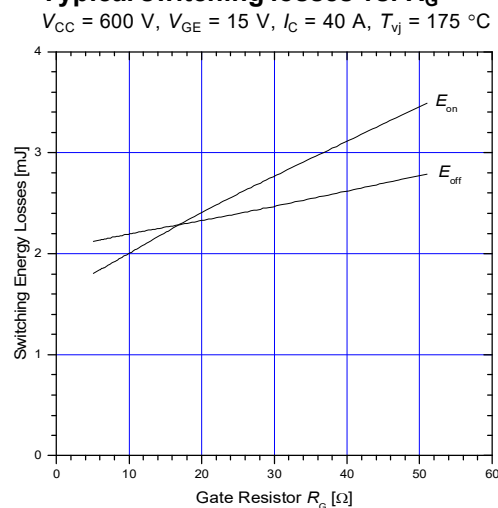


Figure 12.
Typical switching losses vs. R_G



FGW40XS120C

Discrete IGBT

Figure 13.
Typical forward characteristics of FWD

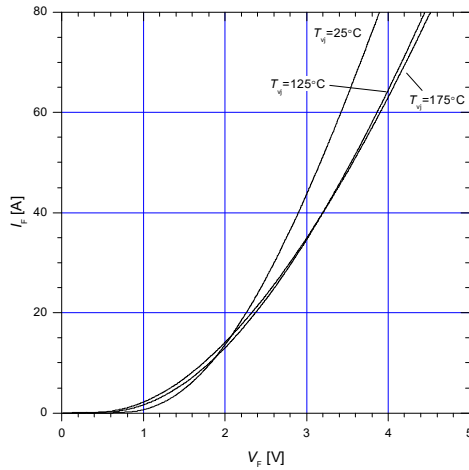


Figure 14.
Typical reverse recovery characteristics vs. I_F
 $V_{CC} = 600 \text{ V}$, $V_{GE} = 15 \text{ V}$, $R_G = 10 \Omega$, $T_{vj} = 175^\circ \text{C}$

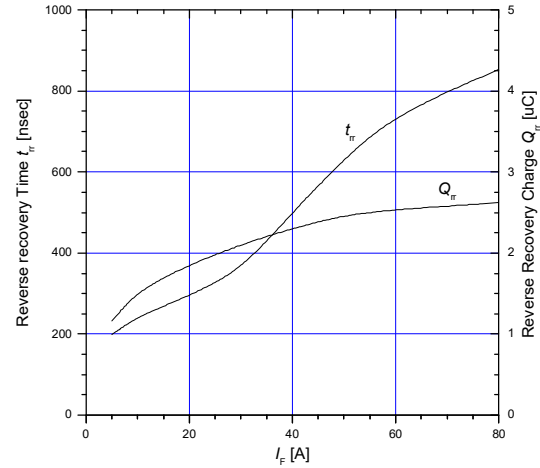


Figure 15.
Typical reverse recovery loss vs. I_F
 $V_{CC} = 600 \text{ V}$, $V_{GE} = 15 \text{ V}$, $R_G = 10 \Omega$, $T_{vj} = 175^\circ \text{C}$

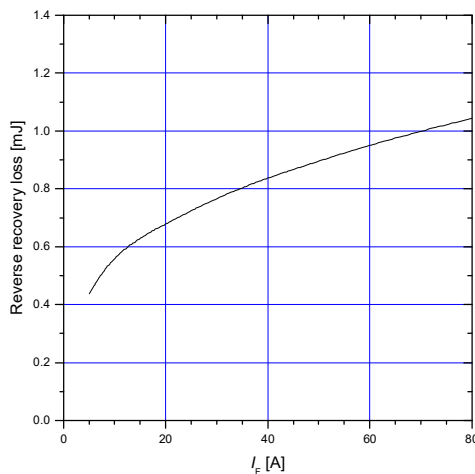


Figure 16.
Reverse biased safe operating area
 $V_{GE} = 10 \text{ V}$, $T_{vj} \leq 175^\circ \text{C}$

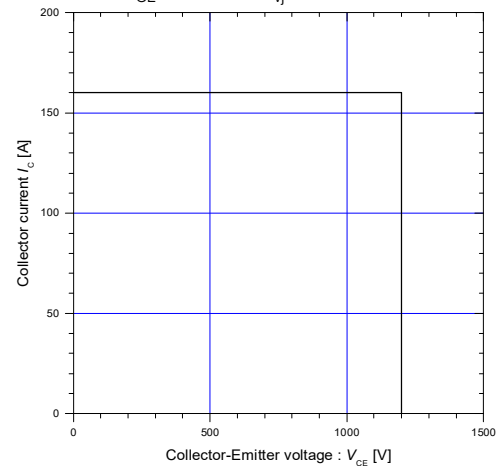


Figure 17.
Transient Thermal Impedance of IGBT
 $D = 0$

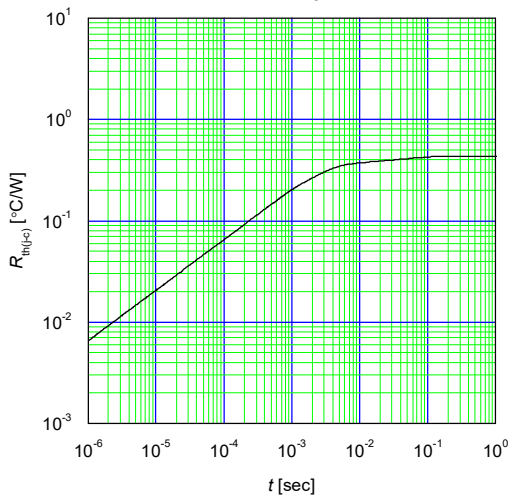
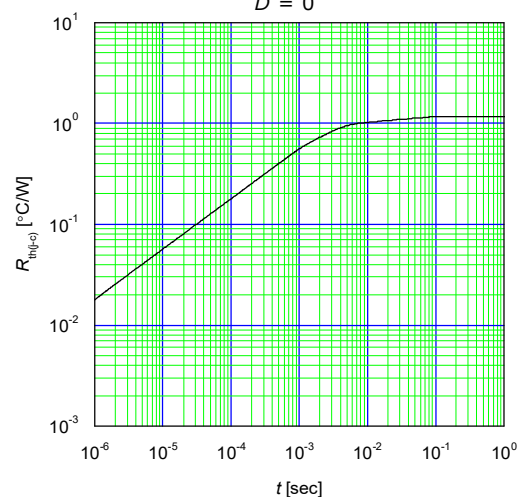


Figure 18.
Transient Thermal Impedance of FWD
 $D = 0$

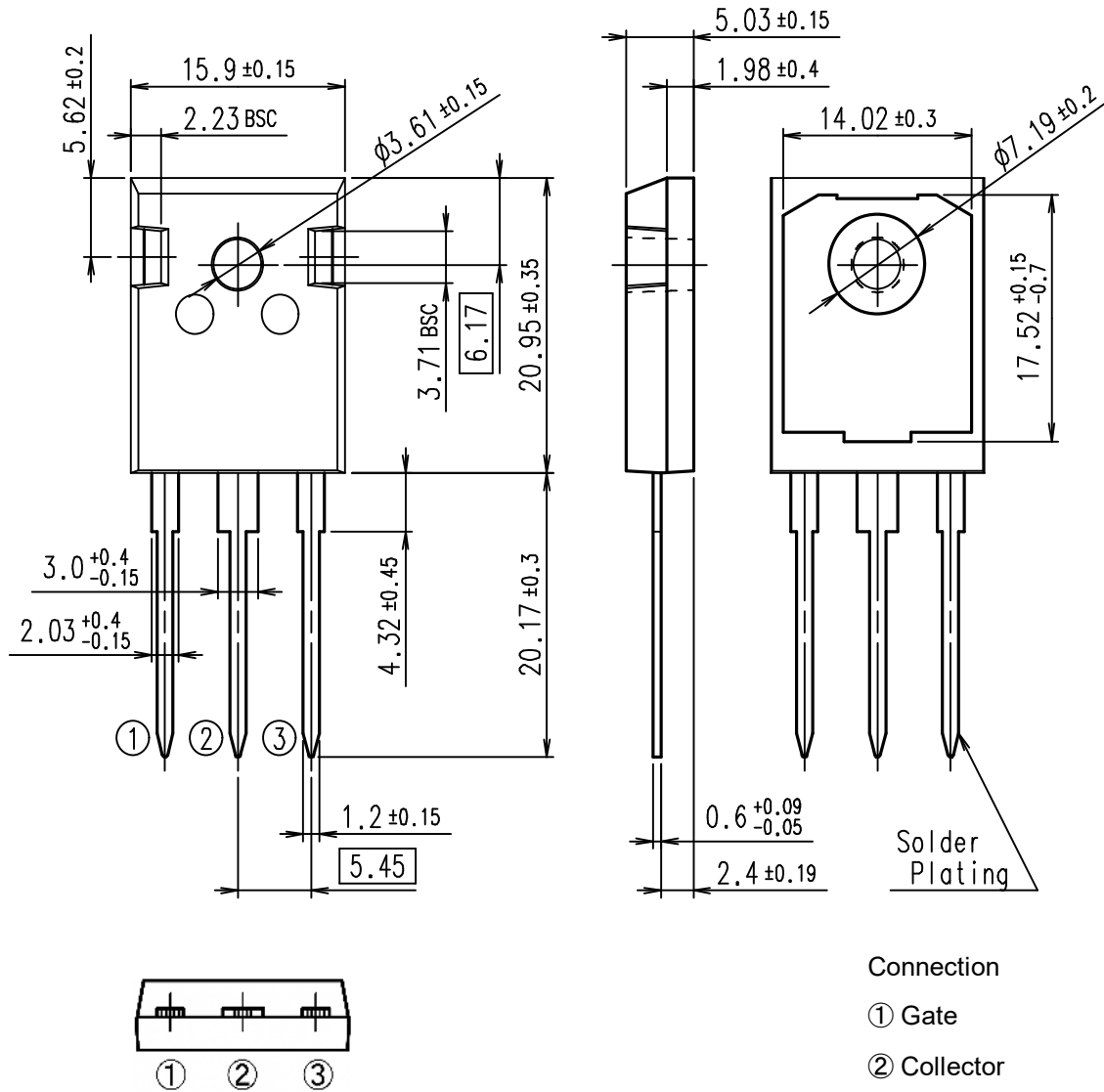


FGW40XS120C

Discrete IGBT

■ Outline drawings,mm

Outview : TO-247 package



Connection

- ① Gate
- ② Collector
- ③ Emitter

Dimensions are in millimeters.

Warnings

1. This Catalog contains the product specifications, characteristics, data, materials, and structures as of 10/2024.
The contents are subject to change without notice for specification changes or other reasons. When using a product listed in this Catalog, be sure to obtain the latest specifications.
2. All applications described in this Catalog exemplify the use of Fuji Electric's products for your reference only. No right or license, either express or implied, under any patent, copyright, trade secret or other intellectual property right owned by Fuji Electric Co., Ltd. is (or shall be deemed) granted. Fuji Electric Co., Ltd. makes no representation or warranty, whether express or implied, relating to the infringement or alleged infringement of other's intellectual property rights which may arise from the use of the applications described herein.
3. Although Fuji Electric Co., Ltd. is enhancing product quality and reliability, a small percentage of semiconductor products may become faulty. When using Fuji Electric semiconductor products in your equipment, you are requested to take adequate safety measures to prevent the equipment from causing a physical injury, fire, or other problem if any of the products become faulty. It is recommended to make your design fail-safe, flame retardant, and free of malfunction.
4. The products introduced in this Catalog are intended for use in the following electronic and electrical equipment which has normal reliability requirements.
 - Computers · OA equipment · Communications equipment (terminal devices) · Measurement equipment
 - Machine tools · Audiovisual equipment · Electrical home appliances · Personal equipment · Industrial robots etc.
5. If you need to use a product in this Catalog for equipment requiring higher reliability than normal, such as for the equipment listed below, it is imperative to contact Fuji Electric Co., Ltd. to obtain prior approval. When using these products for such equipment, take adequate measures such as a backup system to prevent the equipment from malfunctioning even if a Fuji Electric's product incorporated in the equipment becomes faulty.
 - Transportation equipment (mounted on cars and ships) · Trunk communications equipment
 - Traffic-signal control equipment · Gas leakage detectors with an auto-shut-off feature
 - Emergency equipment for responding to disasters and anti-burglary devices · Safety devices · Medical equipment
6. Do not use products in this Catalog for the equipment requiring strict reliability such as the following and equivalents to strategic equipment (without limitation).
 - Space equipment · Aeronautic equipment · Nuclear control equipment · Submarine repeater equipment
7. Copyright (c)1996-2024 by Fuji Electric Co., Ltd. All rights reserved.
No part of this Catalog may be reproduced in any form or by any means without the express permission of Fuji Electric Co., Ltd.
8. If you have any question about any portion in this Catalog, ask Fuji Electric Co., Ltd. or its sales agents before using the product. Neither Fuji Electric Co., Ltd. nor its agents shall be liable for any injury caused by any use of the products not in accordance with instructions set forth herein.

Technical Information

IGBT Modules

- Please refer to URLs below for further information about products, application manuals and design support.
- 关于本规格书中没有记载的产品信息，应用手册，技术信息等，请参考以下链接。
- 本データシートに記載されていない製品情報，アプリケーションマニュアル，デザインサポートは以下の URL をご参照下さい。

FUJI ELECTRIC Power Semiconductor WEB site

| | |
|---------------|--|
| 日本 | www.fujielectric.co.jp/products/semiconductor/ |
| Global | www.fujielectric.com/products/semiconductor/ |
| 中国 | www.fujielectric.com/products/semiconductor/cn/ |
| Europe | www.fujielectric-europe.com/products/semiconductors/ |
| North America | www.americas.fujielectric.com/products/semiconductors/ |

Information

日本

| | |
|----------------------|--|
| 1 半導体総合カタログ | www.fujielectric.co.jp/products/semiconductor/catalog/ |
| 2 製品情報 | www.fujielectric.co.jp/products/semiconductor/model/ |
| 3 アプリケーションマニュアル | www.fujielectric.co.jp/products/semiconductor/model/igbt/application/ |
| 4 デザインサポート | www.fujielectric.co.jp/products/semiconductor/model/igbt/technical/ |
| 5 マウンティングインストラクション | www.fujielectric.co.jp/products/semiconductor/model/igbt/mounting/ |
| 6 IGBT 損失シミュレーションソフト | www.fujielectric.co.jp/products/semiconductor/model/igbt/simulation/ |
| 7 富士電機技報 | www.fujielectric.co.jp/products/semiconductor/journal/ |
| 8 製品のお問い合わせ | www.fujielectric.co.jp/products/semiconductor/contact/ |

Global

| | |
|----------------------------------|--|
| 1 Semiconductors General Catalog | www.fujielectric.com/products/semiconductor/catalog/ |
| 2 Product Information | www.fujielectric.com/products/semiconductor/model/ |
| 3 Application Manuals | www.fujielectric.com/products/semiconductor/model/igbt/application/ |
| 4 Design Support | www.fujielectric.com/products/semiconductor/model/igbt/technical/ |
| 5 Mounting Instructions | www.fujielectric.com/products/semiconductor/model/igbt/mounting/ |
| 6 IGBT Loss Simulation Software | www.fujielectric.com/products/semiconductor/model/igbt/simulation/ |
| 7 Fuji Electric Journal | www.fujielectric.com/products/semiconductor/journal/ |
| 8 Contact | www.fujielectric.com/contact/ |

中国

| | |
|---------------|--|
| 1 半导体综合目录 | www.fujielectric.com/products/semiconductor/cn/catalog/ |
| 2 产品信息 | www.fujielectric.com/products/semiconductor/cn/model/ |
| 3 应用手册 | www.fujielectric.com/products/semiconductor/cn/model/igbt/application/ |
| 4 技术信息 | www.fujielectric.com/products/semiconductor/cn/model/igbt/technical/ |
| 5 安装说明书 | www.fujielectric.com/products/semiconductor/cn/model/igbt/mounting/ |
| 6 IGBT 损耗模拟软件 | www.fujielectric.com/products/semiconductor/cn/model/igbt/simulation/ |
| 7 富士电机技报 | www.fujielectric.com/products/semiconductor/cn/journal/ |
| 8 产品咨询 | www.fujielectric.com/contact/ |