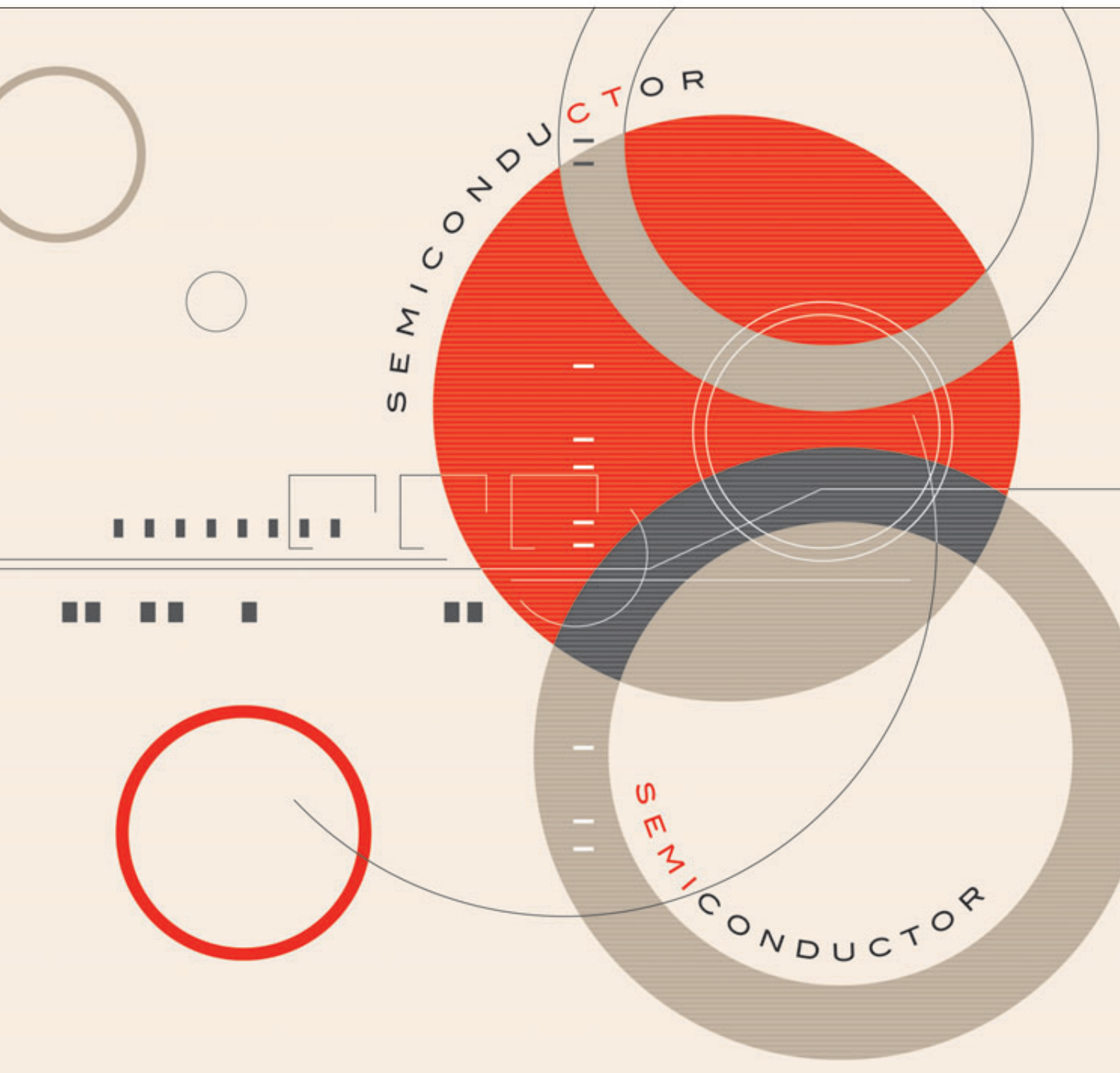


PRODUCT GUIDE

# Discrete IGBTs



# 1 Features and Structure

## IGBT: Insulated Gate Bipolar Transistor

IGBTs combine the MOSFET advantage of high input impedance with the bipolar transistor advantage of high-voltage drive.

The conductivity modulation characteristics of a bipolar transistor make it ideal for load control applications that require high breakdown voltage and high current.

Toshiba offers a family of fast switching IGBTs, which are low in carrier injection and recombination in carrier.

### Features of the Toshiba Discrete IGBTs

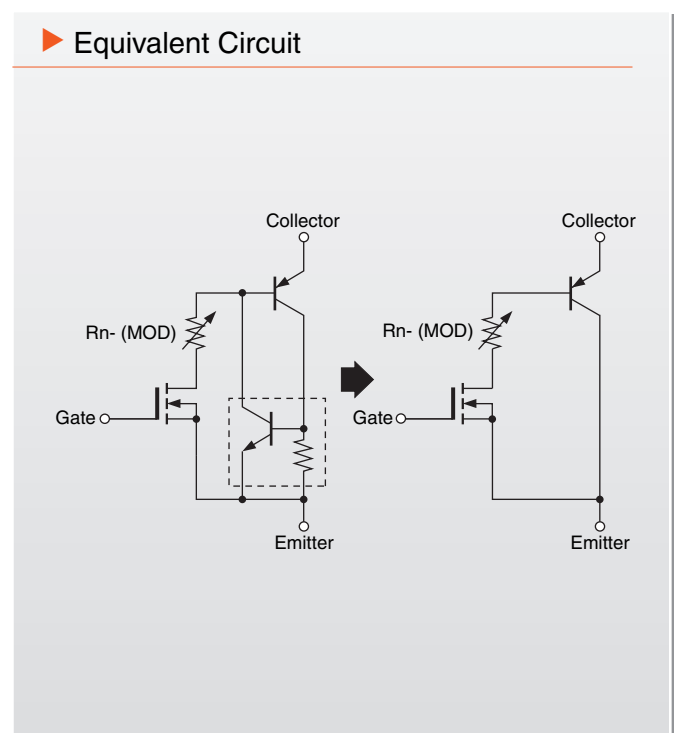
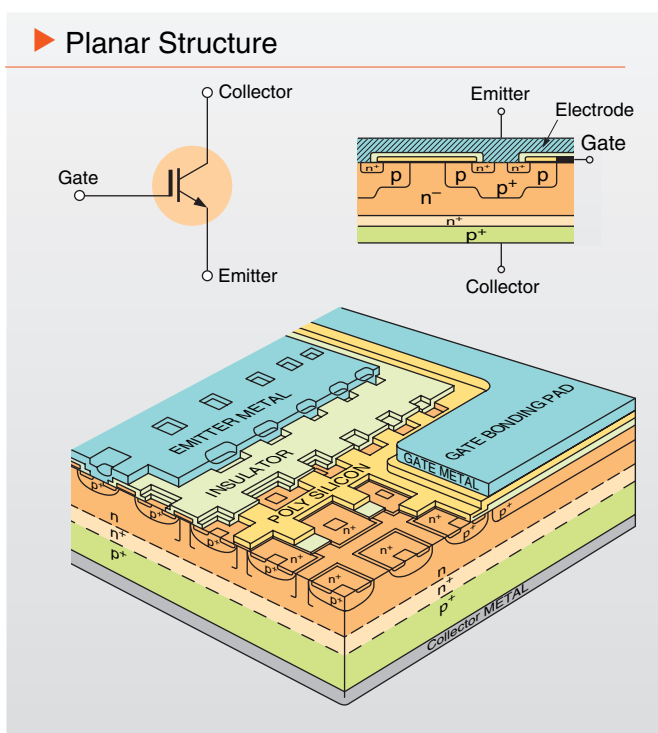
The Toshiba discrete IGBTs are available in high-voltage and high-current ratings. They are used in inverter and power conversion circuits for such diverse applications as motor drivers, uninterruptible power supply (UPS) systems, IH cookers, plasma display panels (PDPs), strobe flashes and so on.

- (1) IGBTs also featuring fast switching
- (2) Low collector-emitter saturation voltage even in the large current area
- (3) IGBTs featuring a built-in diode with optimal characteristics tailored to specific applications
- (4) High input impedance allows voltage drives
- (5) Available in a variety of packages

### Construction

The basic structure of the planar IGBT consists of four layers (pnpn), as shown in the following figure.

Low saturation voltage is achieved by using a pnp transistor to allow conductivity modulation during conduction.



# 2 IGBT Technical Overview

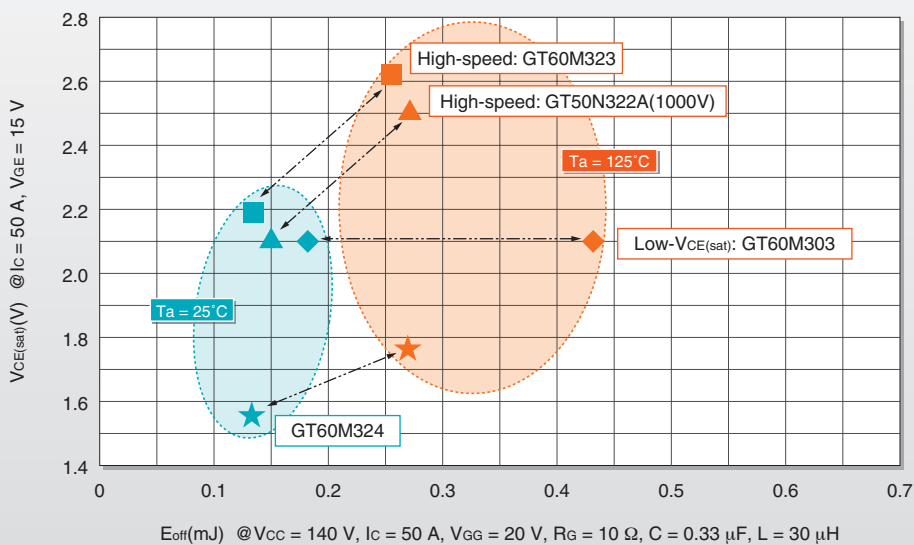
Prior to the development of IGBTs, power MOSFETs were used for power amplifier applications which require high input impedance and fast switching. However, at high voltages, the on-state resistance rapidly increases as the breakdown voltage increases. It is thus difficult to improve the conduction loss of power MOSFETs.

On the other hand, the IGBT structure consists of a pnp bipolar transistor and a collector contact made on the p<sup>+</sup> layer. The IGBT has a low on-state voltage drop due to conductivity modulation.

The following figure shows the  $V_{CE(sat)}$  curve of a soft-switching 900-V IGBT. Toshiba has offered IGBTs featuring fast switching by using carrier lifetime control techniques. Now, Toshiba offers even faster IGBTs with optimized carrier injection into the collector p<sup>+</sup> layer.

In the future, Toshiba will launch IGBTs with varied characteristics optimized for high-current-conduction and high-frequency-switching applications. The improvements in IGBTs will be spurred by optimized wafers, smaller pattern geometries and improved carrier lifetime control techniques.



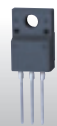




## ▶ 900-V IGBT for Soft-Switching



## Discrete IGBT Development Trends

1200 V	(1) High ruggedness (3rd gen): Low $V_{CE(sat)}$ and high ruggedness due to optimized carrier injection and thinner wafers			
	(2) Soft switching (5th gen): Low $V_{CE(sat)}$ due to trench gate structure			
	(3) Soft switching (6.5th gen): RC structure			
900 to 1500 V	(1) Soft switching (4th gen): Low $V_{CE(sat)}$ due to trench gate structure			
	(2) Soft switching (5th gen): Low $V_{CE(sat)}$ due to optimized carrier injection and trench gate structure			
	(3) Soft switching (6th gen): Thinner wafers and finer process geometries			
	(4) Soft switching (6.5th gen): RC structure			
600 V	(1) High ruggedness (3rd gen): Low $V_{CE(sat)}$ and high ruggedness due to optimized carrier injection and thinner wafers			
	(2) Fast switching (4th gen): High speedy $t_f$ due to optimized carrier injection			
	(4) Low $V_{CE(sat)}$ (6th gen): Thinner wafers and finer process geometries			
	(3) Soft switching (4th gen): Low $V_{CE(sat)}$ due to trench gate structure			
	(5) Soft switching (5th gen): Thinner wafers			
	(6) Soft switching (6th gen): Thinner wafers and finer process geometries			
400 V	(1) Strobe flashes (5th gen): Low $V_{CE(sat)}$ due to trench gate structure			
	(2) Strobe flashes (6th gen): High current due to trench gate structure and optimized wafers			
	(3) Strobe flashes (7th gen): High current due to optimized wafers and finer process geometries			
300 to 400 V	(1) Plasma displays (4th gen): Low $V_{CE(sat)}$ due to trench gate structure and high IC due to lifetime control			
	(2) Plasma displays (5th gen): Low turn-on loss due to finer process geometries			
	(3) Plasma displays (6th gen): Low turn-on loss due to optimized wafers and finer process geometries			
	(4) Plasma displays (7th gen): Thinner wafers and finer process geometries			
Year	2006	2008	2010	2012

# 3 Discrete IGBT Product Lineup

Applications and Features	Breakdown Voltage $V_{CES}$ (V) @ $T_a = 25^\circ\text{C}$	IGBT Current Rating $I_c$ (A) @ $T_a = 25^\circ\text{C}$		TSON-8	SOP-8	TO-220SIS	TO-220SM(MXN)	TO-3P(N)	TO-3P(N)IS	TO-3P(LH)		
		DC	Pulse									
General-purpose motors General-purpose inverters Hard switching fc: up to 20 kHz	600	10	20					GT10J301				
		20	40					GT20J301 GT20J101				
		30	60					GT30J301 GT30J101				
	High ruggedness Series	1200	50	100							GT50J102	
			10	20					GT10Q301 GT10Q101			
			15	30					GT15Q301 GT15Q102			
General-purpose inverters Fast switching Hard switching fc: up to 50 kHz	600	30	60					GT30J324 GT30J121	GT30J126			
		50	100							GT50J325 GT50J121		
Resonant switching Soft switching	600	30	100						GT30J322			
		37	100						GT35J321			
		40	100					GT40J321 GT40J322 GT40J323	GT40J325			
		50	100					GT50J327 GT50J341			GT50J322 GT50J322H	
			120					GT50J328				
		60	120								GT60J321 GT60J323 GT60J323H	
	Soft-Switching Series	900	15	30						GT15M321		
			35	100						GT35MR21		
			50	100					GT50MR21			
		1000	50	120					GT50M322 GT60M324			
			60	120					GT50N322A GT50N324			GT60N321
			1050	50	100				GT50NR21			
		1200	40	80					GT40QR21			
			1500	40	80					GT40T321		
				30	100					GT30J122A	GT30J122	
PFC	600	40	100						GT40J121			
		130		GT5G133								
Strobe flashes	400	150		GT8G151	GT8G132							
		200			GT10G131							
		200										
Plasma display panels	300	200				GT30F124 GT45F127						
	330	200				GT30F125 GT45F128						
	360	200					GT30F131					
	430	200				GT30G124 GT30G125 GT45G127 GT45G128						
	600	200				GT30J124						

  : New product

# 4 Part Numbering Scheme

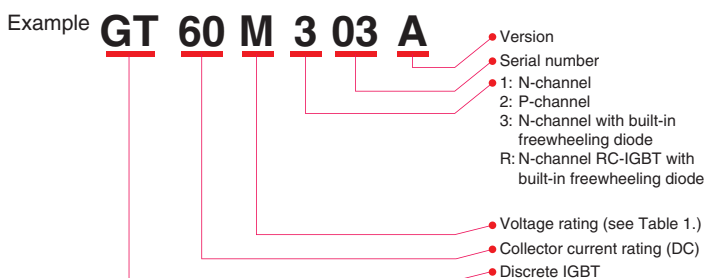


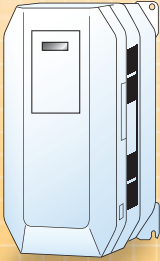
Table 1

Letter	Voltage (V)	Letter	Voltage (V)	Letter	Voltage (V)
C	150	J	600	Q	1200
D	200	K	700	R	1300
E	250	L	800	S	1400
F	300	M	900	T	1500
G	400	N	1000	U	1600
H	500	P	1100	V	1700

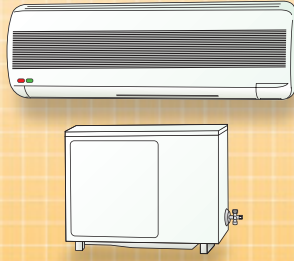
# 5-1 General-Purpose Inverter

The fast-switching (FS) series, a new addition to our third-generation IGBTs, features high ruggedness which helps to improve the energy efficiency of electronic equipment.

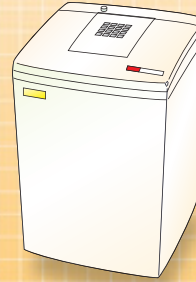
General-Purpose Inverters



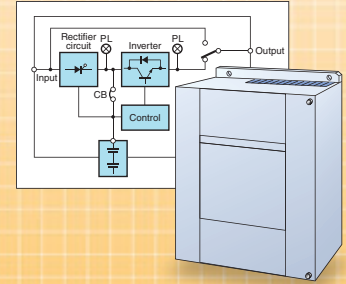
Inverter Air Conditioners



Inverter Washing Machines



UPS



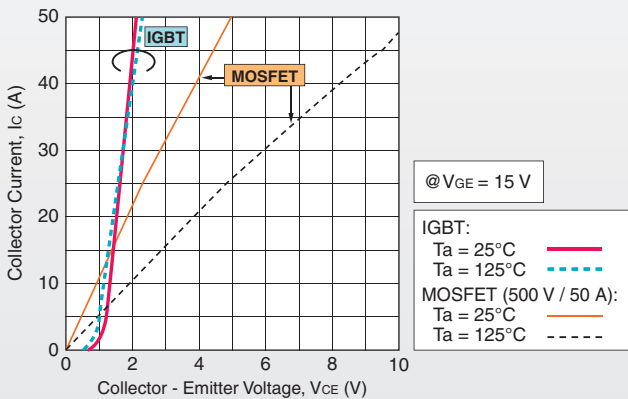
## Discrete IGBT Trend

► For general-purpose inverters

Our 3rd generation low-loss and low-noise IGBTs are ideal for inverter applications to reduce switching loss and thus improve energy efficiency. The following graphs compare the thermal and turn-on characteristics of our 3rd generation IGBTs and 500-V MOSFETs

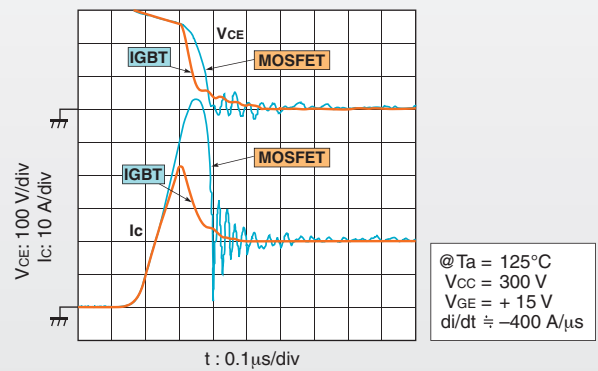
### ► IC - $V_{CE}$ Temperature Characteristics

Low saturation voltage with minimal temperature dependence



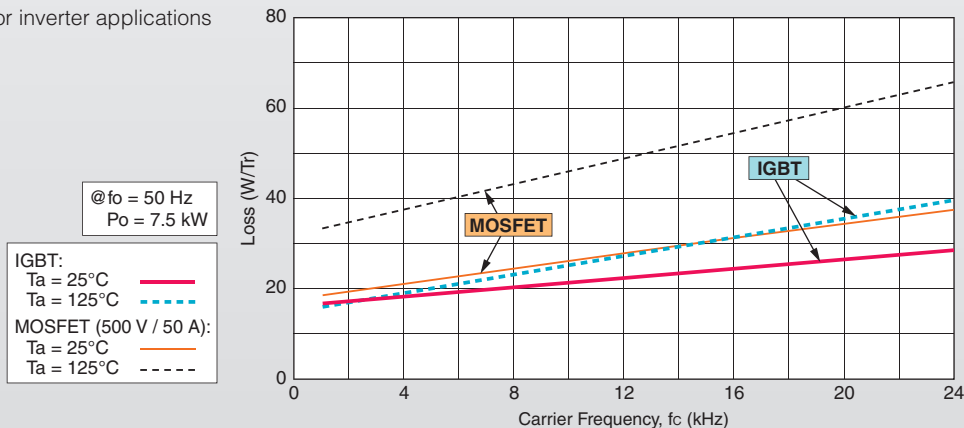
### ► Turn-On Waveform

Fast reverse-recovery characteristics due to built-in diode with optimal characteristics



### ► Power Loss vs. Carrier Frequency Characteristics

Simulation data for inverter applications

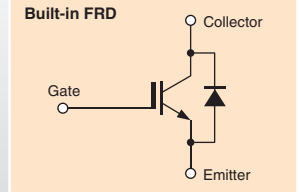
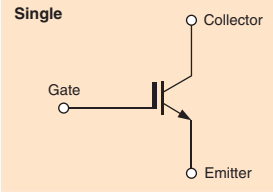


# 5-1 General-Purpose Inverter

## Product Lineup

► For general-purpose inverters

### ► Circuit Configurations



## 600-V and 1200-V IGBTs

Main Applications	Features	Part Number	Absolute Maximum Ratings				Package	Circuit Configuration (*1)	VCE(sat) Typ.			tr Typ.		Remarks
			VCES (V)	IC		Pc Tc = 25°C (W)			@ Ic (A)	@ VGE (V)	(μs)	Load (*2)		
				DC (A)	Pulsed (A)									
Motor driving (UPS/PFC)	High VCES (1200V)	GT10Q101	1200	10	20	140	TO-3P(N)	◆	2.1	10	15	0.16	L	
		GT10Q301	1200	10	20	140	TO-3P(N)	Built-in FRD	2.1	10	15	0.16	L	
		GT15Q102	1200	15	30	170	TO-3P(N)	◆	2.1	15	15	0.16	L	
		GT15Q301	1200	15	30	170	TO-3P(N)	Built-in FRD	2.1	15	15	0.16	L	
		GT25Q102	1200	25	50	200	TO-3P(LH)	◆	2.1	25	15	0.16	L	
		GT25Q301	1200	25	50	200	TO-3P(LH)	Built-in FRD	2.1	25	15	0.16	L	
	High VCES (600V)	GT10J301	600	10	20	90	TO-3P(N)	Built-in FRD	2.1	10	15	0.15	L	
		GT20J101	600	20	40	130	TO-3P(N)	◆	2.1	20	15	0.15	L	
		GT20J301	600	20	40	130	TO-3P(N)	Built-in FRD	2.1	20	15	0.15	L	
		GT30J101	600	30	60	155	TO-3P(N)	◆	2.1	30	15	0.15	L	
		GT30J301	600	30	60	155	TO-3P(N)	Built-in FRD	2.1	30	15	0.15	L	
GT50J102	600	50	100	200	TO-3P(LH)	◆	2.1	50	15	0.15	L			

## 600-V Fast IGBTs (4th Generation)

(FS: Fast Switching)

Main Applications	Features	Part Number	Absolute Maximum Ratings				Package	Circuit Configuration (*1)	VCE(sat) Typ.			tr Typ.		Remarks
			VCES (V)	IC		Pc Tc = 25°C (W)			@ Ic (A)	@ VGE (V)	(μs)	Load (*2)		
				DC (A)	Pulsed (A)									
Inverter power supplies (UPS/PFC/motor)	Fast switching	GT30J121	600	30	60	170	TO-3P(N)	◆	2.0	30	15	0.05	L	
		GT30J126	600	30	60	90	TO-3P(N)IS	◆	1.95	30	15	0.05	L	Isolation Package
		GT30J324	600	30	60	170	TO-3P(N)	Built-in FRD	2.0	30	15	0.05	L	
		GT50J121	600	50	100	240	TO-3P(LH)	◆	2.0	50	15	0.05	L	
		GT50J325	600	50	100	240	TO-3P(LH)	Built-in FRD	2.0	50	15	0.05	L	

## 600-V IGBTs for Low Frequency Switching

Main Applications	Features	Part Number	Absolute Maximum Ratings				Package	Circuit Configuration (*1)	VCE(sat) Typ.			tr Typ.		Remarks
			VCES (V)	IC		Pc Tc = 25°C (W)			@ Ic (A)	@ VGE (V)	(μs)	Load (*2)		
				DC (A)	Pulsed (A)									
Power factor correction	Low-frequency switching	GT30J122	600	30	100	75	TO-3P(N)IS	◆	2.1	50	15	0.25	R	Partial Switching Converter
		GT30J122A	600	30	100	120	TO-3P(N)	◆	1.7	50	15	0.2	R	Partial Switching Converter
		GT40J121	600	40	100	80	TO-3P(N)IS	◆	1.45	40	15	0.2	R	Partial Switching Converter

\*1 ◆ : Single  
FRD: Fast Recovery Diode

\*2 R : Resistive load  
L : Inductive load

◆ : New product

# 5-2 Soft-Switching Applications

Static inverters in IH cooktops, IH rice cookers and microwave ovens utilize a soft-switching technique which exhibits low switching loss. Toshiba offers IGBTs suitable for soft-switching applications.

Microwave Ovens



IH Rice Cookers



IH Cookers



MFPs



AC Input Voltage	Circuit	Waveform	IGBT Rating
100 V to 120 V	<p>Voltage Resonance</p>	<p>Waveform</p>	<p><math>V_{CES} = 900 \text{ V to } 1050 \text{ V}</math>  <math>I_c = 15 \text{ A to } 60 \text{ A}</math></p>
200 V to 240 V			<p><math>V_{CES} = 1200 \text{ V to } 1500 \text{ V}</math>  <math>I_c = 40 \text{ A}</math></p>
100 V to 240 V	<p>Current Resonance</p>	<p>Waveform</p>	<p><math>V_{CES} = 600 \text{ V}</math>  <math>I_c = 30 \text{ A to } 60 \text{ A}</math></p>

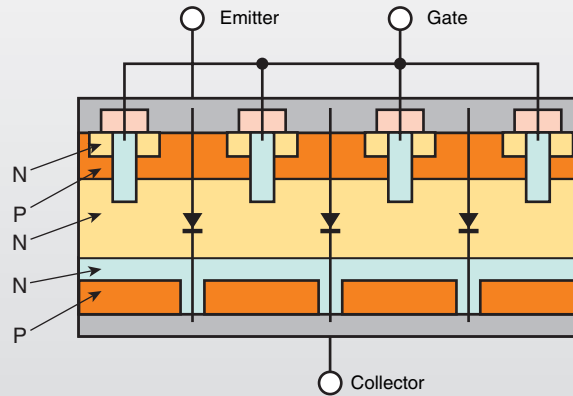
IH: Induction heating  
MFP: Multifunction Printer

# 5-2 Soft-Switching Applications

## 6.5th-Generation RC-IGBT Series (New Products)

The RC-IGBT (Reverse-Conducting IGBT) Series consists of a freewheeling diode monolithically integrated in an IGBT chip. This is realized by forming an N layer through the P layer on the collector side. The RC-IGBT Series is environmentally friendly since it eliminates the need for a separate diode. Additionally, it also features a reduced thermal resistance of the freewheeling diode.

### Cross-Sectional View of the RC-IGBT



### Product Lineup

► For soft switching

Main Applications	Features	Part Number	Absolute Maximum Ratings					Package	Circuit Configuration (*1)	V <sub>CE(sat)</sub> Typ. @ Ta = 25°C			t <sub>r</sub> Typ. @ Ta = 25°C		Remarks
			V <sub>CES</sub> (V)	I <sub>c</sub>		P <sub>c</sub>				I <sub>c</sub> (A)	V <sub>GE</sub> (V)	t <sub>r</sub> (μs)	Load (*2)		
				DC (A)	Pulsed (A)	T <sub>c</sub> = 25°C (W)	T <sub>j</sub> (°C)								
IH rice cookers and IH cooktops	Voltage resonance	GT35MR21	900	35	100	82	150	TO-3P(N)IS	Built-in FWD	1.6	35	15	0.2	R	6.5th generation
		GT50MR21	900	50	100	230	175	TO-3P(N)	Built-in FWD	1.7	50	15	0.18	R	6.5th generation T <sub>j</sub> = 175°C
		GT50NR21	1050	50	100	230	175	TO-3P(N)	Built-in FWD	1.8	50	15	0.2	R	6.5th generation T <sub>j</sub> = 175°C
		GT40QR21	1200	40	80	230	175	TO-3P(N)	Built-in FWD	1.9	40	15	0.2	R	6.5th generation T <sub>j</sub> = 175°C

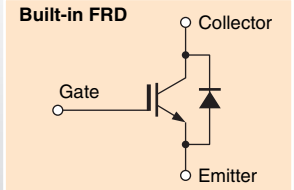
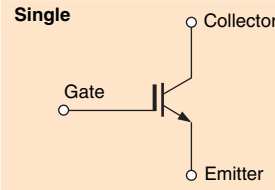
\*1 Abbreviation in the "Circuit Configuration" column  
FWD: Free-Wheeling Diode

\*2 Abbreviation in the "Load" column  
R : Resistive load

◻ : New product



► Circuit Configurations



IGBTs for Soft-Switching Applications

Main Applications	Features	Part Number	Absolute Maximum Ratings					Package	Circuit Configuration (*1)	V <sub>CE(sat)</sub> Typ.			t <sub>r</sub> Typ.		Remarks	
			V <sub>CE(s)</sub> (V)	I <sub>c</sub>		P <sub>c</sub> T <sub>c</sub> = 25°C (W)	T <sub>j</sub> (°C)			@ I <sub>c</sub> (A)	@ V <sub>GE</sub> (V)	tr (μs)	Load (*2)			
				DC (A)	Pulsed (A)											
IH rice cookers and IH cooktops	Current resonance	AC 200 V	GT30J322	600	30	100	75	150	TO-3P(N)IS	Built-in FRD	2.1	50	15	0.25	R	
		GT35J321	600	37	100	75	150	TO-3P(N)IS	Built-in FRD	1.9	50	15	0.19	R		
		GT40J321	600	40	100	120	150	TO-3P(N)	Built-in FRD	2.0	40	15	0.11	R	Fast switching	
		GT40J322	600	40	100	120	150	TO-3P(N)	Built-in FRD	1.7	40	15	0.2	R		
		GT40J323	600	40	100	170	150	TO-3P(N)	Built-in FRD	2.0	40	15	0.06	R	Fast switching	
		GT40J325	600	40	100	80	150	TO-3P(N)IS	Built-in FRD	1.45	40	15	0.2	R	6th generation	
		GT50J322	600	50	100	130	150	TO-3P(LH)	Built-in FRD	2.1	50	15	0.25	R		
		GT50J322H	600	50	100	130	150	TO-3P(LH)	Built-in FRD	2.2	50	15	0.11	R	Fast switching	
		GT50J327	600	50	100	140	150	TO-3P(N)	Built-in FRD	1.9	50	15	0.19	R		
		GT50J341	600	50	100	200	175	TO-3P(N)	Built-in FRD	1.6	50	15	0.15	R	6th generation T <sub>j</sub> = 175°C	
		GT50J328	600	50	120	140	150	TO-3P(N)	Built-in FRD	2.0	50	15	0.10	R	Fast switching	
		GT60J321	600	60	120	200	150	TO-3P(LH)	Built-in FRD	1.55	60	15	0.30	R		
		GT60J323	600	60	120	170	150	TO-3P(LH)	Built-in FRD	1.9	60	15	0.16	R		
		GT60J323H	600	60	120	170	150	TO-3P(LH)	Built-in FRD	2.1	60	15	0.12	R	Fast switching	
AC 100 V	Voltage resonance	GT15M321	900	15	30	55	150	TO-3P(N)IS	Built-in FWD	1.8	15	15	0.20	R		
		GT50M322	900	50	120	156	150	TO-3P(N)	Built-in FWD	2.1	60	15	0.25	R		
		GT60M324	900	60	120	254	175	TO-3P(N)	Built-in FWD	1.7	60	15	0.11	R	T <sub>j</sub> = 175°C	
		GT50N322A	1000	50	120	156	150	TO-3P(N)	Built-in FWD	2.2	60	15	0.10	R	Fast switching	
		GT50N324	1000	50	120	150	150	TO-3P(N)	Built-in FWD	1.9	60	15	0.11	R	6th generation	
		GT60N321	1000	60	120	170	150	TO-3P(LH)	Built-in FWD	2.3	60	15	0.25	R		
AC 200 V		GT40T321	1500	40	80	230	175	TO-3P(N)	Built-in FWD	2.15	40	15	0.24	R	T <sub>j</sub> = 175°C	

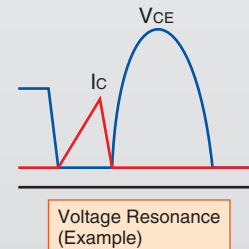
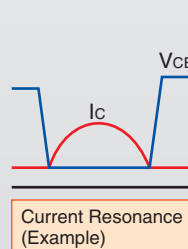
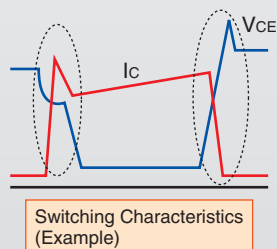
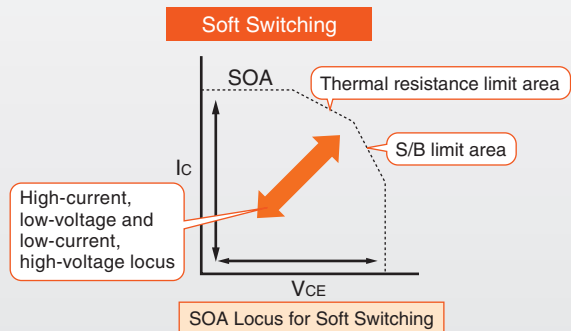
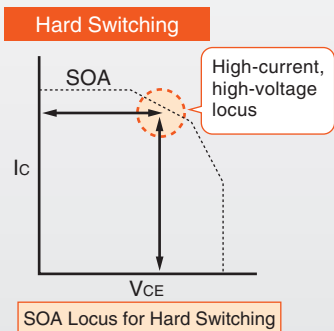
\*1 Abbreviations in the "Circuit Configuration" column  
FRD: Fast Recovery Diode, FWD: Free-Wheeling Diode

\*2 Abbreviation in the "Load" column  
R : Resistive load

: New product

## 5-2 Soft-Switching Applications

### ► Comparisons Between Hard and Soft Switching (diagrams shown only as a guide)

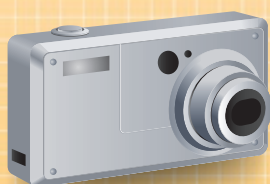


## 5-3 Strobe Flash Applications

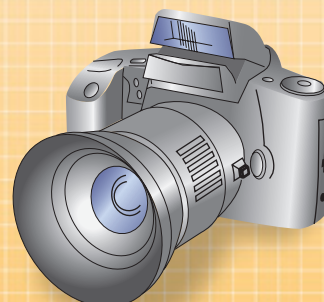
Strobe flash control is now prevalent in digital still cameras. Package sizes are getting smaller, and logic levels are increasingly used to represent the gate drive voltage. Toshiba offers compact IGBTs featuring low gate drive voltage.

- As a voltage-controlled device, the IGBT requires only a few components for drive circuit.
- IGBTs require fewer components for the strobe flash circuit (compared to SCRs).
- Strobe flash IGBTs are capable of switching large currents.

DSC, Compact Camera



Single-Lens Reflex Camera



# 5-3 Strobe Flash Applications

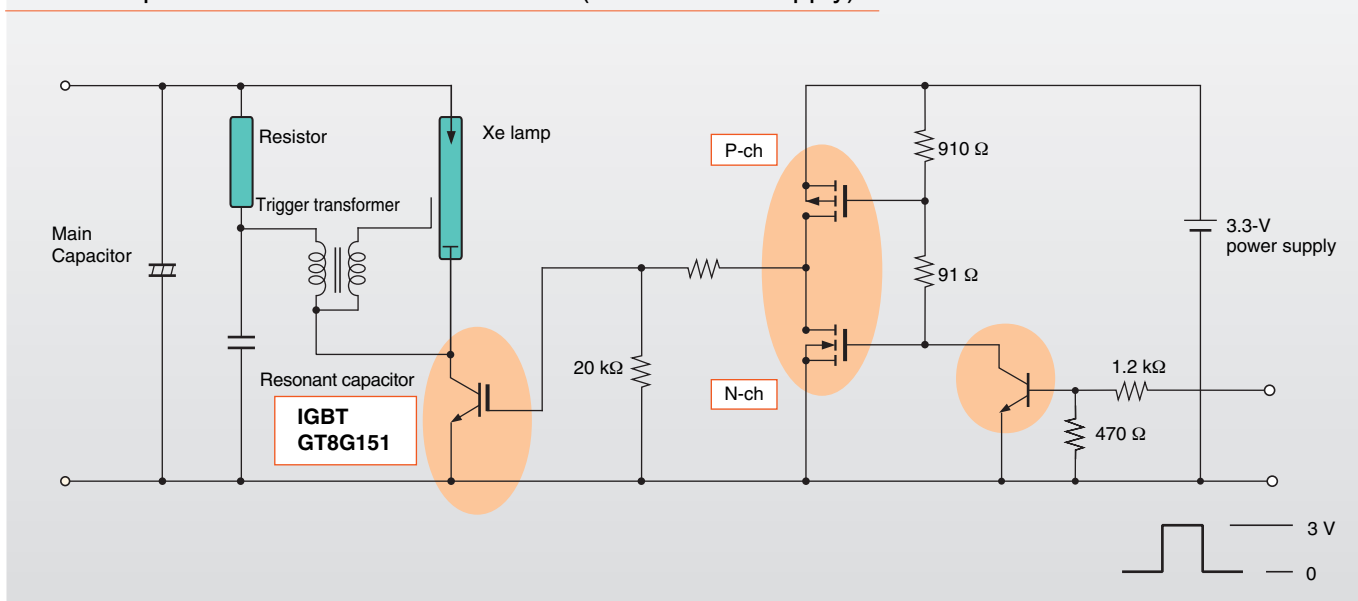
## Product Lineup

► For strobe flashes

### 2.5-V to 4.0-V Gate Drive Series

The IGBT can operate with a gate drive voltage of 2.5 V to 4.0 V. The common 3.3-V or 5-V internal power supply in a camera can be used as a gate drive power supply to simplify the power supply circuitry. A zener diode is included between the gate and emitter to provide ESD surge protection.

#### ► Example of an IGBT Gate Drive Circuit (3.3-V Power Supply)



### 3.3-V Power Supply

Part Number	V <sub>CE</sub> / I <sub>C</sub>	Gate Drive Voltage Min (V)	V <sub>CE(sat)</sub> (V)		P <sub>C</sub> (W) @ T <sub>a</sub> = 25°C	Package	Remarks
			Typ.	V <sub>GE</sub> / I <sub>C</sub>			
<b>GT5G133</b>	400 V / 130 A	2.5	3.0	2.5 V / 130 A	0.83	<b>TS0N-8</b>	7th generation
<b>GT8G151</b>	400 V / 150 A	2.5	2.65	2.5 V / 150 A	0.83	<b>TS0N-8</b>	7th generation

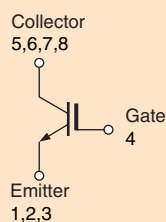
  : New product

### 5-V Power Supply

Part Number	V <sub>CE</sub> / I <sub>C</sub>	Gate Drive Voltage Min (V)	V <sub>CE(sat)</sub> (V)		P <sub>C</sub> (W) @ T <sub>a</sub> = 25°C	Package	Remarks
			Typ.	V <sub>GE</sub> / I <sub>C</sub>			
<b>GT8G132</b>	400 V / 150 A	4.0	2.3	4.0 V / 150 A	1.1	<b>SOP-8</b>	5th generation
<b>GT10G131</b>	400 V / 200 A	4.0	2.3	4.0 V / 200 A	1.9	<b>SOP-8</b>	5th generation

#### <Connection Examples>

Board connection example



All the emitter terminals should be connected together.

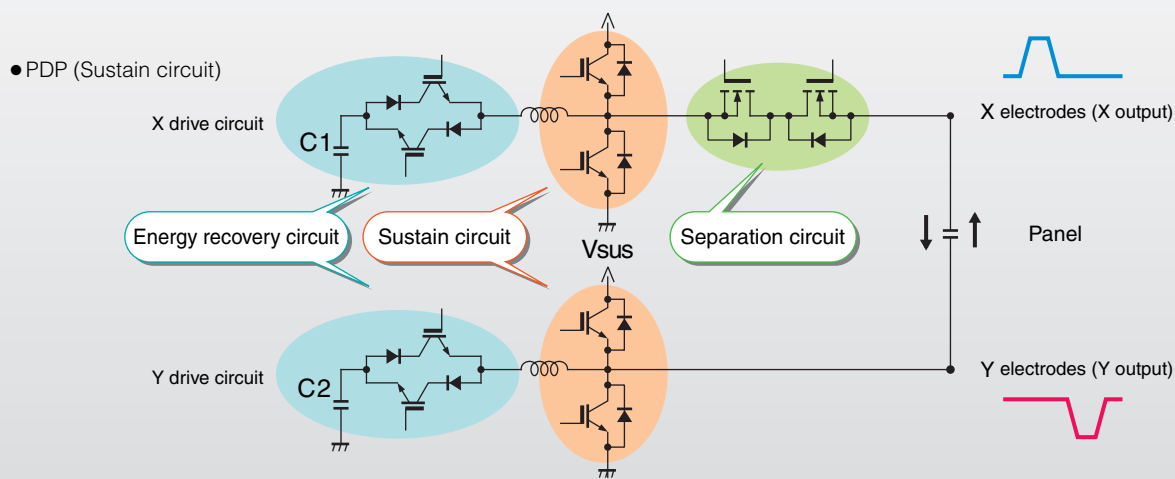
# 5-4 Plasma Display Panel Applications

## Plasma Displays

Parallel MOSFETs have been used for the drive circuitry of plasma display panels (PDPs). Recently, however, IGBTs are commonly used in large current applications due to their superior current conduction capability.



### ▶ Example of a Plasma Display Panel Drive Circuit



## Product Lineup

▶ For plasma display panels

### 300-V IGBTs

Part Number	$V_{CES} / I_{cp} @ 3 \mu s$	$V_{CE(sat)} (V) \text{ Typ. } @ 120 A$	$P_c (W) @ T_c = 25^\circ C$	Package	Remarks
GT30F124	300 V / 200 A	2.3	25	TO-220SIS	6th generation
GT30F125	330 V / 200 A	1.9	25	TO-220SIS	6th generation
GT45F127	300 V / 200 A	1.6	26	TO-220SIS	6th generation
GT45F128	330 V / 200 A	1.45	26	TO-220SIS	6th generation
GT30F131	360 V / 200 A	1.9	140	TO-220SM(MXN)	6th generation

  : New product

### 400-V IGBTs

Part Number	$V_{CES} / I_{cp} @ 3 \mu s$	$V_{CE(sat)} (V) \text{ Typ. } @ 120 A$	$P_c (W) @ T_c = 25^\circ C$	Package	Remarks
GT30G124	430 V / 200 A	2.5	25	TO-220SIS	6th generation
GT30G125	430 V / 200 A	2.1	25	TO-220SIS	6th generation
GT45G127	430 V / 200 A	1.7	26	TO-220SIS	6th generation
GT45G128	430 V / 200 A	1.55	26	TO-220SIS	6th generation

  : New product

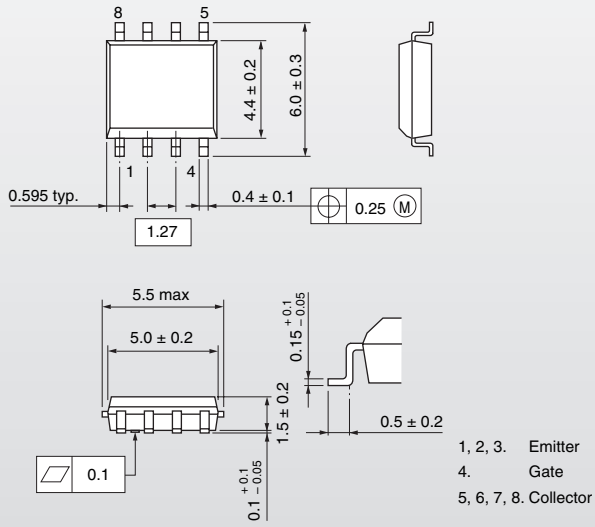
### 600-V IGBTs

Part Number	$V_{CES} / I_{cp} @ 3 \mu s$	$V_{CE(sat)} (V) \text{ Typ. } @ 120 A$	$P_c (W) @ T_c = 25^\circ C$	Package	Remarks
GT30J124	600 V / 200 A	2.4	26	TO-220SIS	5th generation

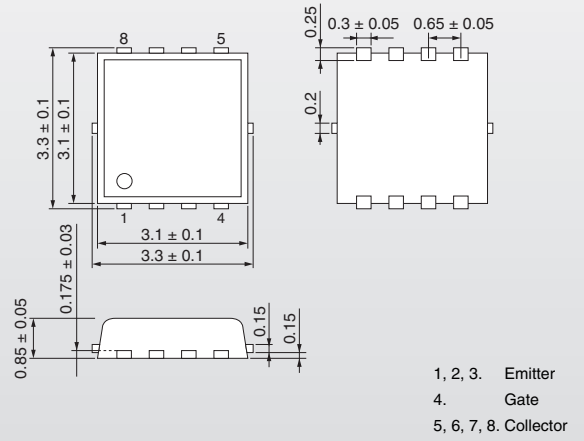
# 6 Package Dimensions

Unit: mm

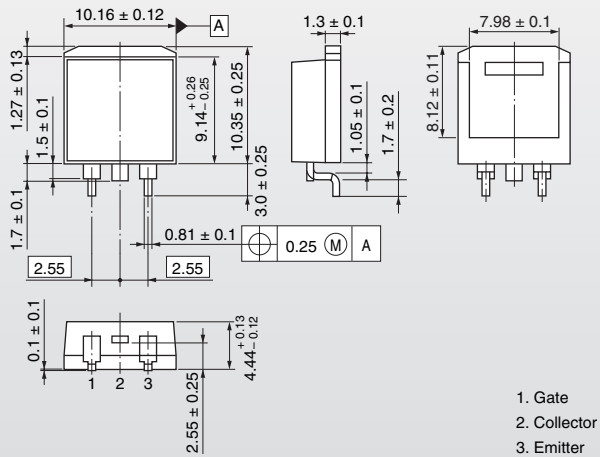
## ▶ SOP-8



## ▶ TSON-8



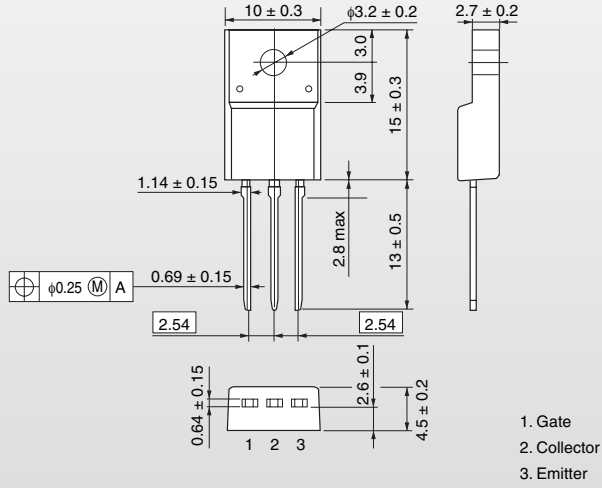
## ▶ TO-220SM(MXN)



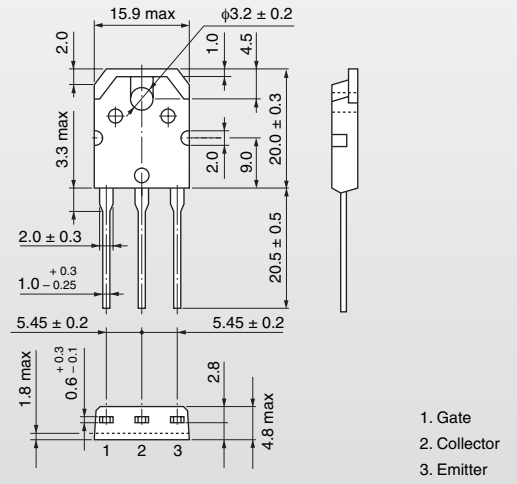
# 6 Package Dimensions

Unit: mm

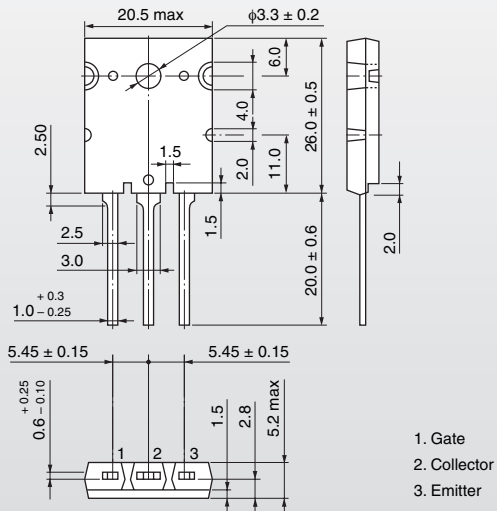
## ▶ TO-220SIS



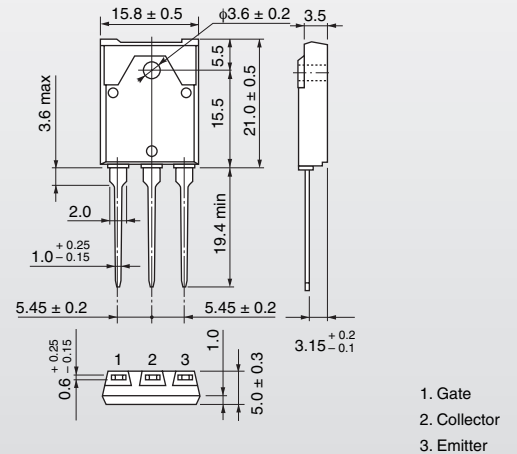
## ▶ TO-3P(N)



## ▶ TO-3P(LH)



## ▶ TO-3P(N)IS



# 7 Final-Phase and Obsolete Products

The following products are in stock but are being phased out of production. The recommended replacements that continue to be available are listed in the right-hand column. However, the characteristics of the recommended replacements may not be exactly the same as those of the final-phase and obsolete products. Before using a recommended replacement, be sure to check that it is suitable for use under the intended operating conditions.

Application	Final-Phase or Obsolete Product	Absolute Maximum Ratings		Package	Recommended Obsolete Replacements	Absolute Maximum Ratings		Package
		V <sub>CES</sub> (V)	I <sub>c</sub> (A) DC			V <sub>CES</sub> (V)	I <sub>c</sub> (A) DC	
Soft switching Resonant switching	<b>MG30T1AL1</b>	1500	30	<b>IH</b>	—	—	—	—
	<b>MG60M1AL1</b>	900	60	<b>IH</b>	—	—	—	—
	<b>GT40M101</b>	900	40	<b>TO-3P(N)IS</b>	—	—	—	—
	<b>GT40M301</b>	900	40	<b>TO-3P(LH)</b>	—	—	—	—
	<b>GT40Q322</b>	1200	39	<b>TO-3P(N)</b>	—	—	—	—
	<b>GT40Q323</b>	1200	39	<b>TO-3P(N)</b>	—	—	—	—
	<b>GT40T101</b>	1500	40	<b>TO-3P(LH)</b>	—	—	—	—
	<b>GT40T301</b>	1500	40	<b>TO-3P(LH)</b>	—	—	—	—
	<b>GT50L101</b>	800	50	<b>TO-3P(L)</b>	—	—	—	—
	<b>GT50M101</b>	900	50	<b>TO-3P(L)</b>	—	—	—	—
	<b>GT50Q101</b>	1200	50	<b>IH</b>	—	—	—	—
	<b>GT50S101</b>	1400	50	<b>IH</b>	—	—	—	—
	<b>GT50T101</b>	1500	50	<b>IH</b>	—	—	—	—
	<b>GT60J101</b>	600	60	<b>TO-3P(L)</b>	—	—	—	—
	<b>GT60J322</b>	600	60	<b>TO-3P(LH)</b>	—	—	—	—
	<b>GT60M101</b>	900	60	<b>TO-3P(L)</b>	—	—	—	—
	<b>GT60M102</b>	900	60	<b>TO-3P(L)</b>	—	—	—	—
	<b>GT60M103</b>	900	60	<b>TO-3P(L)</b>	—	—	—	—
	<b>GT60M104</b>	900	60	<b>TO-3P(L)</b>	—	—	—	—
	<b>GT60M105</b>	900	60	<b>TO-3P(L)</b>	—	—	—	—
	<b>GT60M301</b>	900	60	<b>TO-3P(LH)</b>	—	—	—	—
	<b>GT60M302</b>	900	60	<b>TO-3P(LH)</b>	—	—	—	—
	<b>GT60M305</b>	900	60	<b>TO-3P(LH)</b>	—	—	—	—
<b>GT60M322</b>	950	60	<b>TO-3P(LH)</b>	<b>GT60N321</b>	1000	60	<b>TO-3P(LH)</b>	
<b>GT60N323</b>	1050	60	<b>TO-3P(LH)</b>	—	—	—	—	
<b>GT80J101</b>	600	80	<b>TO-3P(L)</b>	—	—	—	—	
<b>GT80J101A</b>	600	80	<b>TO-3P(LH)</b>	—	—	—	—	
General-purpose motors General-purpose inverters	<b>GT8J101</b>	600	8	<b>TO-220NIS</b>	—	—	—	—
	<b>GT8J102</b>	600	8	<b>TO-220SM</b>	—	—	—	—
	<b>GT8N101</b>	1000	8	<b>TO-3P(N)</b>	<b>GT10Q101</b>	1200	10	<b>TO-3P(N)</b>
	<b>GT8Q101</b>	1200	8	<b>TO-3P(N)</b>	<b>GT10Q101</b>	1200	10	<b>TO-3P(N)</b>
	<b>GT8Q102</b>	1200	8	<b>TO-220SM</b>	—	—	—	—
	<b>GT10Q311</b>	1200	10	<b>TO-3P(SM)</b>	—	—	—	—
	<b>GT15J101</b>	600	15	<b>TO-3P(N)</b>	<b>GT20J101</b>	600	20	<b>TO-3P(N)</b>
	<b>GT15J102</b>	600	15	<b>TO-220NIS</b>	—	—	—	—
	<b>GT15J103</b>	600	15	<b>TO-220SM</b>	—	—	—	—
	<b>GT15N101</b>	1000	15	<b>TO-3P(N)</b>	<b>GT15Q102</b>	1200	15	<b>TO-3P(N)</b>
	<b>GT15Q101</b>	1200	15	<b>TO-3P(N)</b>	<b>GT15Q102</b>	1200	15	<b>TO-3P(N)</b>
	<b>GT15Q311</b>	1200	15	<b>TO-3P(SM)</b>	—	—	—	—
	<b>GT20J311</b>	600	20	<b>TO-3P(SM)</b>	—	—	—	—
	<b>GT25H101</b>	500	25	<b>TO-3P(N)</b>	<b>GT30J121</b>	600	30	<b>TO-3P(N)</b>
	<b>GT25J101</b>	600	25	<b>TO-3P(N)</b>	<b>GT30J121</b>	600	30	<b>TO-3P(N)</b>
	<b>GT25J102</b>	600	25	<b>TO-3P(N)IS</b>	<b>GT30J126</b>	600	30	<b>TO-3P(N)IS</b>
	<b>GT25Q101</b>	1200	25	<b>TO-3P(LH)</b>	<b>GT25Q102</b>	1200	25	<b>TO-3P(LH)</b>
	<b>GT30J311</b>	600	30	<b>TO-3P(SM)</b>	—	—	—	—
	<b>GT50J101</b>	600	50	<b>TO-3P(L)</b>	<b>GT50J121</b>	600	50	<b>TO-3P(LH)</b>
	Strobe flashes	<b>GT5G101</b>	400	130 (pulsed)	<b>NPM</b>	—	—	—
<b>GT5G102</b>		400	130 (pulsed)	<b>DP</b>	—	—	—	—
<b>GT5G103</b>		400	130 (pulsed)	<b>DP</b>	—	—	—	—
<b>GT8G101</b>		400	130 (pulsed)	<b>NPM</b>	—	—	—	—
<b>GT8G102</b>		400	150 (pulsed)	<b>NPM</b>	—	—	—	—
<b>GT8G103</b>		400	150 (pulsed)	<b>DP</b>	—	—	—	—
<b>GT8G121</b>		400	150 (pulsed)	<b>DP</b>	—	—	—	—
<b>GT10G101</b>		400	130 (pulsed)	<b>TO-220NIS</b>	—	—	—	—
<b>GT10G102</b>		400	130 (pulsed)	<b>TO-220NIS</b>	—	—	—	—
<b>GT15G101</b>		400	170 (pulsed)	<b>TO-220NIS</b>	—	—	—	—
<b>GT20G101</b>		400	130 (pulsed)	<b>TO-220FL</b>	—	—	—	—
<b>GT20G102</b>		400	130 (pulsed)	<b>TO-220FL</b>	—	—	—	—
<b>GT25G101</b>		400	170 (pulsed)	<b>TO-220FL</b>	—	—	—	—
<b>GT25G102</b>		400	150 (pulsed)	<b>TO-220FL</b>	—	—	—	—
<b>GT50G101</b>		400	100 (pulsed)	<b>TO-3P(N)</b>	—	—	—	—
<b>GT50G102</b>		400	100 (pulsed)	<b>TO-3P(N)</b>	—	—	—	—
<b>GT75G101</b>		400	150 (pulsed)	<b>TO-3P(N)</b>	—	—	—	—
Audio amps	<b>GT20D101</b>	250	20	<b>TO-3P(L)</b>	—	—	—	—
	<b>GT20D201</b>	-250	-20	<b>TO-3P(L)</b>	—	—	—	—

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