# Insulated Gate Bipolar Transistors (IGBTs)

### Milestones in IGBT Technology

In 1986, Toshiba started the production of its 1st Generation 1000V IGBTs. With the introduction of Toshiba's 2nd Generation in 1989, IGBTs were made available in High Speed and Low Saturation types for both a 600V and a 1200V series. Since then IGBTs have made their way into many applications such as inverters, servo drives, Uninterruptible Power Supplies (UPS), induction ovens and arc welding. Toshiba is now recognized as the market leader in IGBT technology.

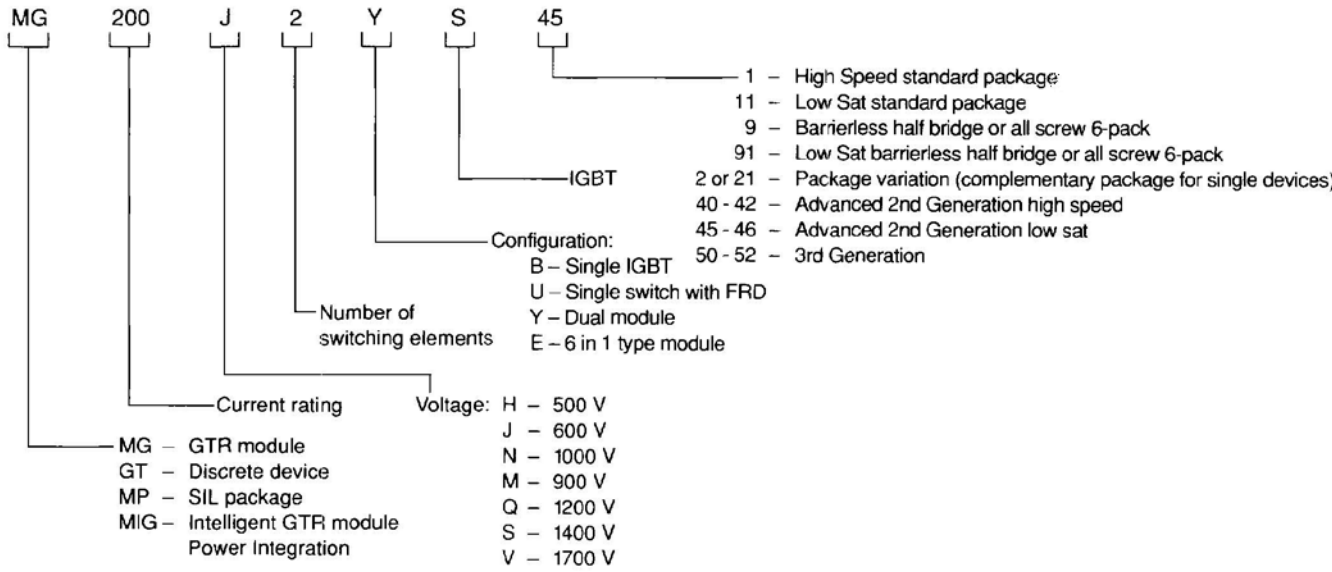
Today Toshiba is introducing the 600V 3rd Generation IGBT which uses a 1μm design rule. The new series combines low saturation and high speed in one device. In addition to the improvements in the IGBT chip, a new fast and soft recovery diode has been developed. With these improvements the total energy loss is 20% lower than the Advanced 2nd Generation devices. Another improvement in Toshiba's 3rd Generation IGBT is a square RBSOA at twice the rated current. A significant reduction of thermal impedance has been achieved by using a new AIN substrate.

Not only has Toshiba improved the IGBT, the FRD and the substrate, Toshiba has also improved the package layout. Two new low inductance packages are available with 50% lower internal inductance than conventional modules.

Beginning December, 1993 Toshiba will produce a full lineup of 1700V IGBT modules up to 360A. This series has been specially developed to meet the requirements of 575-600V AC lines as well as traction applications.

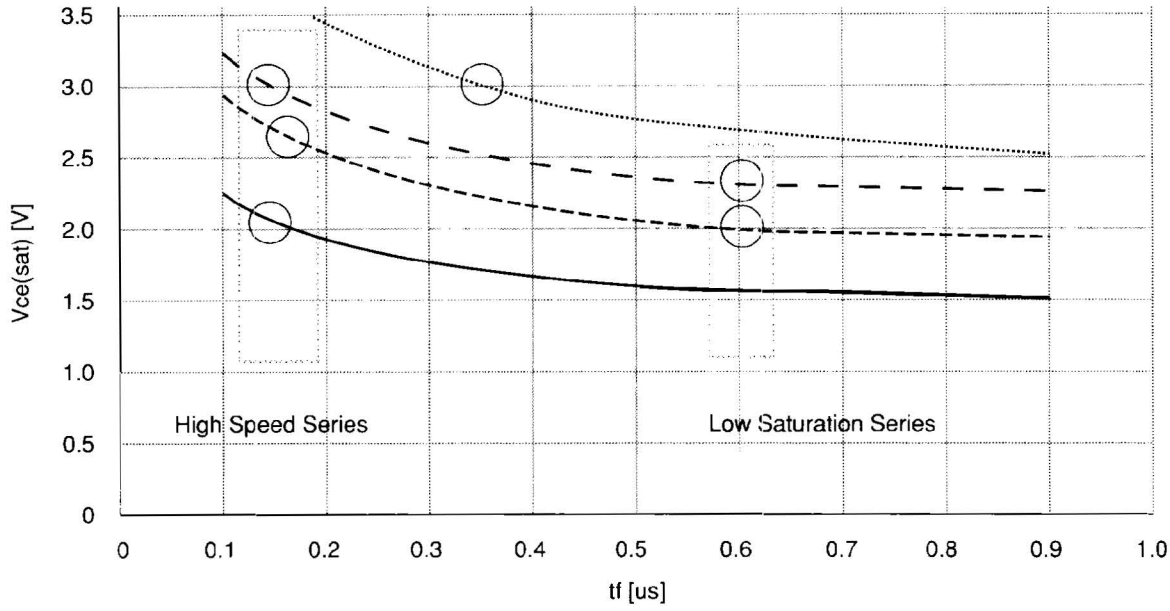
Power Integration (PI) devices combine all power elements of a 3-phase inverter (IGBTs, FRDs, rectifier and brake chopper) in one package. These devices are very small and eliminate component count to reduce system size of small drives. PIs have been available in 600V and 1200V since early 1993.

### IGBT Part Numbers



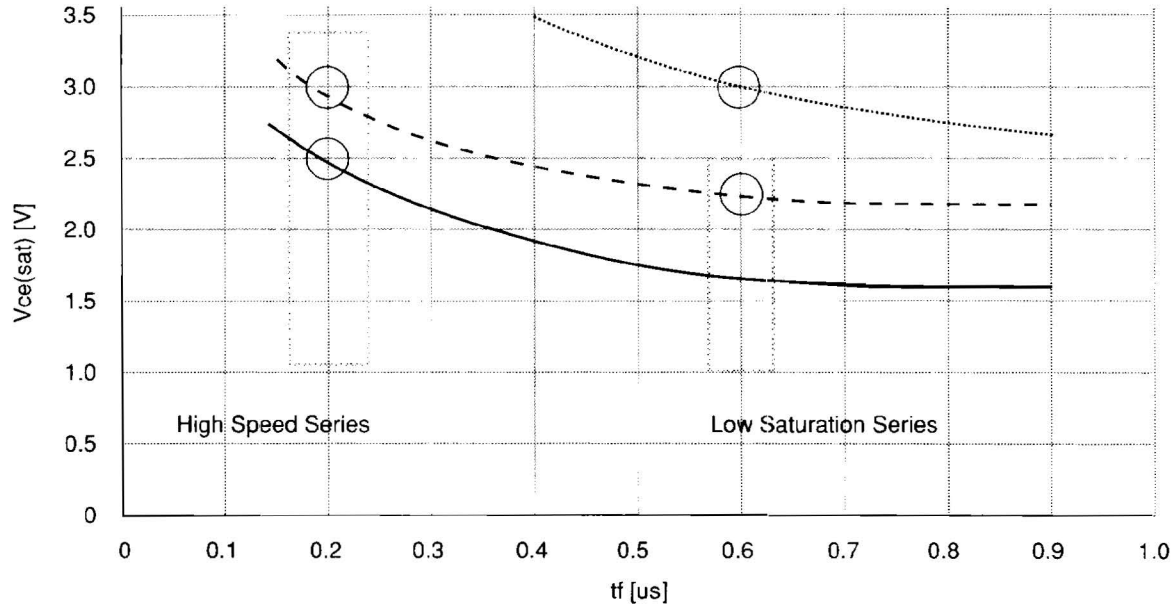
**Trade-Off Improvements**

## 600V IGBT




| 1st Generation 1985 | 2nd Generation 1989 | Advanced 2nd Generation 1991 | 3rd Generation 1993 |
|---|---|---|---|

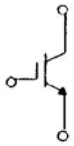
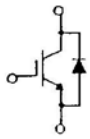
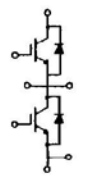
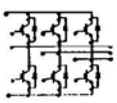
## 1200V IGBT




| 1st Generation 1985 | 2nd Generation 1989 | Advanced 2nd Generation 1991 | 4th Generation 1993 |
|---|---|---|---|

## High Speed Series

**(For fc > 5 kHz)**

| Circuit | $V_{CES}$ | Maximum Ratings Ic (A) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 8 | 15 | 25 | 50 | 60/200 | 80/300 | 400 | 500 | 600 | 800 |
|  BS | 600 | GT8J101 TO-220(IS)<br>GT8J102(SM) TO-220(SM) | GT15J101 @ TO-3P(N)<br>GT15J102 TO-220(IS)<br>GT15J103(SM) TO-220(SM)<br>S5J14M TO-220(SM) 20A FRD | GT25J101 @ TO-3P(N) | GT50J101 @ TO-3P(L)<br>S5978 2-33F1A 2 x 50 A FRD | GT60J101 @ TO-3P(L) (60 A)<br>GT60M301 TO-3P(LH) (60A/900V) | GT80J101 @ TO-3P(L) (80 A) | | | | |
| | 1200 | GT8Q101 @ TO-3P(N)<br>GT8Q102(SM) TO-220(SM) | GT15Q101 @ TO-3P(N)<br>S5J17M TO-220(SM) 15 A FRD | GT25Q101 @ TO-3P(L)<br>MG25Q1BS1 2-33F1A | GT50Q101 @ IH<br>MG50Q1BS1 2-33F1A<br>S5979 2-33F1A 2 x 50 A FRD | | | | | | |
|  US | 600 | | | | | | MG300J1US1 2-109A4A<br>MG300J1US51 2-109A4A | MG400J1US41 2-109A4A<br>MG400J1US51 2-109A4A | | MG600J1US51 2-109A4B | MG800J1US51 2-109A4B |
| | 1200 | | | | | MG200Q1US1 2-109A4A<br>MG200Q1US41 2-109A4A | MG300Q1US1 2-109A4A<br>MG300Q1US41 2-109A4A | MG400Q1US1 2-109A4A<br>MG400Q1US2 2-109A4B<br>MG400Q1US41 2-109A4A<br>MG400Q1US42 2-109A4B | MG500Q1US1 2-109A4A<br>MG500Q1US2 2-109A4B | MG600Q1US41 2-109A4B | |
| | 1700 | | | | | MG240V1US41 (240 A) 2-109A4A | | MG360V1US41 (360 A) 2-109A4B | | | |
| | | 8 | 15 | 25 | 50 | 75 | 100 | 150 | 200 | 300 | 400 |
|  YS | 600 | | | MG25J2YS40 2-94D1A | MG50J2YS40 2-94D1A<br>MG50J2YS50 2-94D1A | MG75J2YS40 2-94D1A<br>MG75J2YS50 2-94D1A | MG100J2YS40 2-94D1A<br>MG100J2YS50 2-94D1A | MG150J2YS40 2-95A1A<br>MG150J2YS50 2-95A1A | MG200J2YS40 2-95A1A<br>MG200J2YS50 2-95A1A | MG300J2YS40 2-109C1A<br>MG300J2YS50 2-109C1A | MG400J2YS40 2-109D1A<br>MG400J2YS50 2-109D1A |
| | 1200 | | | MG25Q2YS40 2-94D1A | MG50Q2YS40 2-94D1A | MG75Q2YS1 2-108A2A<br>MG75Q2YS40 2-94D1A | MG100Q2YS1 2-109B4A<br>MG100Q2YS9 2-109C1A<br>MG100Q2YS42 2-109C1A | MG150Q2YS1 2-109B4A<br>MG150Q2YS9 2-109C1A<br>MG150Q2YS40 2-109C1A | MG200Q2YS1 2-109B4A<br>MG200Q2YS9 2-109C1A<br>MG200Q2YS40 2-109C1A | MG300Q2YS40 2-109D1A | |
| | 1700 | | | MG30V2YS40 (30 A) 2-94D1A | | | MG90V2YS50 (90 A) 2-109C1A | MG180V2YS40 (180 A) 2-109D1A | | | |
|  ES | 600 | | MP6750 2-78A1A<br>MP6752 2-78A1A (20 A) | MG25J6ES40 2-72A5A<br>MG25J6ES42 2-93A2A | MG50J6ES40 2-94A2A<br>MG50J6ES50 2-94A2A | MG75J6ES40 2-94A2A<br>MG75J6ES50 2-94A2A | MG100J6ES40 2-94A2A<br>MG100J6ES50 2-94A2A | | | | |
| | 1200 | MG8Q6ES42 2-93A2A | MG15Q6ES42 2-93A2A | MG25Q6ES42 2-93A2A | MG50Q6ES1 2-94B1A<br>MG50Q6ES40 2-94B1A | | | | | | |

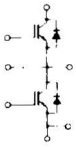
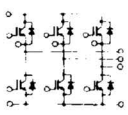
@ NON ISOLATED TYPE (TO-3P, TO-3P(L))

Red numbers indicate package codes pictured on pages 8-13.

# Insulated Gate Bipolar Transistors (IGBTs)

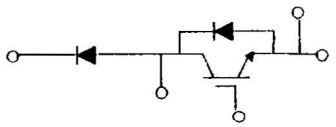
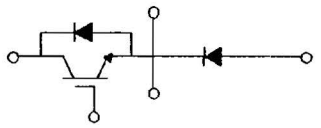
## Low Saturation Series

**(For fc < 5 kHz)**

| Circuit | $V_{CES}$ (V) | Maximum Ratings Ic (A) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 25 | 50 | 75 | 100 | 150 | 200 | 300 | 400 | 500 | 600 |
|  BS | 600 | MG25J1BS11 2-33F1A | MG50J1BS11 2-33F1A | MG75J1BS11 2-33F1A | MG100J1BS11 2-33F1A | MG150J1BS11 2-33F1A | | | | | |
| | 1200 | MG25Q1BS11 2-33D1A | MG50Q1BS11 2-33D1A | MG75Q1BS11 2-33D1A | | | | | | | |
|  US | 600 | | | | | | | | MG400J1US45 2-109A4A<br>MG400J1US51 2-109A4A | | |
| | 1200 | | | | | | MG200Q1US11 2-109A4A | MG300Q1US11 2-109A4A | MG400Q1US11 2-109A4A<br>MG400Q1US21 2-109A4B | MG500Q1US11 2-109A4A<br>MG500Q1US21 2-109A4B | MG600Q1US45 2-109A4B |
|  YS | 600 | MG25J2YS91 2-94A1A | MG50J2YS91 2-94A1A<br>MG50J2YS45 2-94D1A<br>MG50J2YS50 2-94D1A | MG75J2YS45 2-94D1A<br>MG75J2YS50 2-94D1A | MG100J2YS45 2-94D1A<br>MG100J2YS50 2-94D1A | MG150J2YS45 2-95A1A<br>MG150J2YS50 2-95A1A | MG200J2YS45 2-95A1A<br>MG200J2YS50 2-95A1A | MG300J2YS45 2-109C1A<br>MG300J2YS50 2-109C1A | MG400J2YS45 2-109D1A<br>MG400J2YS50 2-109D1A | | |
| | 1200 | MG25Q2YS91 2-94D1A | MG50Q2YS91 2-94D1A | MG75Q2YS11 2-108A2A | MG100Q2YS11 2-109B4A<br>MG100Q2YS91 2-109C1A | MG150Q2YS11 2-109B4A<br>MG150Q2YS91 2-109C1A | MG200Q2YS11 2-109B4A<br>MG200Q2YS91 2-109C1A | | | | |
|  ES | 600 | | MG50J6ES50 2-94A2A | MG75J6ES50 2-94A2A | MG100J6ES50 2-94A2A | | | | | | |
| | 1200 | | MG50Q6ES11 2-94A2A | | | | | | | | |

Red numbers indicate package codes pictured on pages 8-13.

## Chopper Circuits

| Circuit | $V_{CES}$ (V) | Maximum Ratings Ic (A) | | | | | |
|---|---|---|---|---|---|---|---|
| | | 25 | 50 | 75 | 100 | 150 | 200 |
|  ZS | 600 | | MG50J1ZS40 2-94D1A | MG75J1ZS40 2-94D1A | MG100J1ZS40 2-94D1A | | |
| | 1200 | | | | MG100Q1ZS9 2-109C1A | MG150Q1ZS9 2-109C1A | |
|  JS | HS 1200 | | | MG75Q1JS40 2-94D1A | MG100Q1JS9 2-109C1A | MG150Q1JS9 2-109C1A | MG200Q1JS9 2-109C1A |
| | LS | | | | | | |

Red numbers indicate package codes pictured on pages 8-13.

## Intelligent GTR Modules (IGM)

| Type Number | $V_{CES}$ (V) | $I_C$ (A) | $V_{CE(sat)}$ (MAX.) (V) | $I_C$ (A) | Switching Times (MAX.) $t_{on}$ (μs) | $t_{off}$ (μs) |
|---|---|---|---|---|---|---|
| MIG150J201H | 600 | 150 | 2.5 | 150 | 2.0 | 2.5 |
| MIG200J201H | 600 | 200 | 2.5 | 200 | 2.0 | 2.5 |
| MIG75Q201H | 1200 | 75 | 2.5 | 75 | 2.0 | 2.5 |
| MIG100Q201H | 1200 | 100 | 2.5 | 100 | 2.0 | 2.5 |