Vincotech

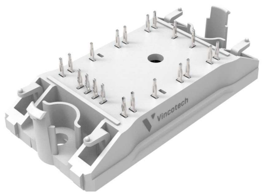
# 10-PF12NMA080SH08-M260F98T
datasheet

***flow*MNPC 0** | **1200 V / 80 A**

### Features

- Three-level MNPC topology
- High reactive power capability
- Low inductive layout
- Improved LVRT capability
- Enhanced thermal performance

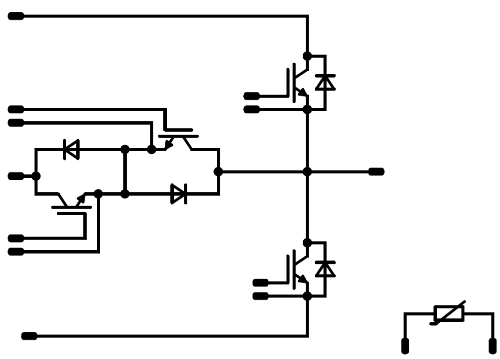
### *flow* 0 12 mm housing



### Target applications

- Industrial Drives
- Solar Inverters
- UPS

### Schematic



### Types

- 10-PF12NMA080SH08-M260F98T

## Maximum Ratings

$T_j$ = 25 °C, unless otherwise specified

| Parameter | Symbol | Condition | Value | Unit |
|---|---|---|---|---|
| **Boost Switch** | | | | |
| Collector-emitter voltage | $V_{CES}$ | | 650 | V |
| Collector current | $I_C$ | $T_j = T_{jmax}$ $T_s$ = 80 °C | 62 | A |
| Repetitive peak collector current | $I_{CRM}$ | $t_p$ limited by $T_{jmax}$ | 320 | A |
| Total power dissipation | $P_{tot}$ | $T_j = T_{jmax}$ $T_s$ = 80 °C | 101 | W |
| Gate-emitter voltage | $V_{GES}$ | | ±30 | V |
| Short circuit ratings | $t_{SC}$ | $V_{GE}$ = 15 V $V_{cc} \le 360$ V $T_j$ = 25 °C | 2 | μs |
| Maximum junction temperature | $T_{jmax}$ | | 175 | °C |



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# Maximum Ratings

$T_j$ = 25 °C, unless otherwise specified

| Parameter | Symbol | Condition | | | Value | Unit |
|---|---|---|---|---|---|---|
| **Boost Diode** | | | | | | |
| Peak repetitive reverse voltage | $V_{RRM}$ | | | | 1200 | V |
| Continuous (direct) forward current | $I_F$ | $T_j = T_{jmax}$ | | $T_s$ = 80 °C | 49 | A |
| Repetitive peak forward current | $I_{FRM}$ | $t_p$ limited by $T_{jmax}$ | | | 100 | A |
| Total power dissipation | $P_{tot}$ | $T_j = T_{jmax}$ | | $T_s$ = 80 °C | 87 | W |
| Maximum junction temperature | $T_{jmax}$ | | | | 175 | °C |
| **Buck Switch** | | | | | | |
| Collector-emitter voltage | $V_{CES}$ | | | | 1200 | V |
| Collector current | $I_C$ | $T_j = T_{jmax}$ | | $T_s$ = 80 °C | 77 | A |
| Repetitive peak collector current | $I_{CRM}$ | $t_p$ limited by $T_{jmax}$ | | | 240 | A |
| Total power dissipation | $P_{tot}$ | $T_j = T_{jmax}$ | | $T_s$ = 80 °C | 192 | W |
| Gate-emitter voltage | $V_{GES}$ | | | | ±20 | V |
| Short circuit ratings | $t_{SC}$ | $V_{GE}$ = 15 V | $V_{cc}$ = 800 V | $T_j$ = 150 °C | 10 | µs |
| Maximum junction temperature | $T_{jmax}$ | | | | 175 | °C |
| **Buck Diode** | | | | | | |
| Peak repetitive reverse voltage | $V_{RRM}$ | | | | 650 | V |
| Continuous (direct) forward current | $I_F$ | $T_j = T_{jmax}$ | | $T_s$ = 80 °C | 58 | A |
| Repetitive peak forward current | $I_{FRM}$ | | | | 320 | A |
| Total power dissipation | $P_{tot}$ | $T_j = T_{jmax}$ | | $T_s$ = 80 °C | 82 | W |
| Maximum junction temperature | $T_{jmax}$ | | | | 175 | °C |



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# Maximum Ratings

$T_j$ = 25 °C, unless otherwise specified

| Parameter | Symbol | Condition | | Value | Unit |
|---|---|---|---|---|---|
| **Module Properties** | | | | | |
| **Thermal Properties** | | | | | |
| Storage temperature | $T_{stg}$ | | | -40…+125 | °C |
| Operation temperature under switching condition | $T_{jop}$ | | | -40…($T_{jmax}$ - 25) | °C |
| **Isolation Properties** | | | | | |
| Isolation voltage | $V_{isol}$ | DC Test Voltage* | $t_p$ = 2 s | 6000 | V |
| | | AC Voltage | $t_p$ = 1 min | 2500 | V |
| Creepage distance | | | | min. 12,7 | mm |
| Clearance | | | | 8,75 | mm |
| Comparative Tracking Index | CTI | | | > 200 | |

*100 % tested in production



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# Characteristic Values

| Parameter | Symbol | Conditions | $V_{GE}$ [V]<br>$V_{GS}$ [V] | $V_{CE}$ [V]<br>$V_{DS}$ [V]<br>$V_F$ [V] | $I_C$ [A]<br>$I_D$ [A]<br>$I_F$ [A] | $T_j$ [°C] | Value Min | Value Typ | Value Max | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| **Boost Switch** | | | | | | | | | | |
| **Static** | | | | | | | | | | |
| Gate-emitter threshold voltage | $V_{GE(th)}$ | | | 5 | 0,0571 | 25 | 5 | 6 | 7 | V |
| Collector-emitter saturation voltage | $V_{CEsat}$ | | 15 | | 80 | 25<br>125<br>150 | | 1,65<br>1,69<br>1,75 | 1,9 | V |
| Collector-emitter cut-off current | $I_{CES}$ | | 0 | 650 | | 25 | | | 10 | µA |
| Gate-emitter leakage current | $I_{GES}$ | | 30 | 0 | | 25 | | | 200 | nA |
| Internal gate resistance | $r_g$ | | | | | | | none | | Ω |
| Input capacitance | $C_{ies}$ | $f$ = 1 Mhz | 0 | 30 | | 25 | | 4810 | | pF |
| Output capacitance | $C_{oes}$ | | | | | | | 184 | | |
| Reverse transfer capacitance | $C_{res}$ | | | | | | | 79 | | |
| Gate charge | $Q_g$ | | 15 | 400 | 80 | 25 | | 171 | | nC |
| **Thermal** | | | | | | | | | | |
| Thermal resistance junction to sink | $R_{th(j-s)}$ | $\lambda_{paste}$ = 3,4 W/mK (PSX) | | | | | | 0,94 | | K/W |
| **Dynamic** | | | | | | | | | | |
| Turn-on delay time | $t_{d(on)}$ | $R_{gon}$ = 4 Ω<br>$R_{goff}$ = 4 Ω | ±15 | 350 | 55 | 25<br>125<br>150 | | 56<br>58<br>58 | | ns |
| Rise time | $t_r$ | | | | | 25<br>125<br>150 | | 5<br>5<br>6 | | |
| Turn-off delay time | $t_{d(off)}$ | | | | | 25<br>125<br>150 | | 76<br>89<br>92 | | |
| Fall time | $t_f$ | | | | | 25<br>125<br>150 | | 47<br>44<br>54 | | |
| Turn-on energy (per pulse) | $E_{on}$ | $Q_{rFWD}$ = 5,6 µC<br>$Q_{rFWD}$ = 7,6 µC<br>$Q_{rFWD}$ = 8,4 µC | | | | 25<br>125<br>150 | | 0,263<br>0,368<br>0,420 | | mWs |
| Turn-off energy (per pulse) | $E_{off}$ | | | | | 25<br>125<br>150 | | 0,758<br>1,22<br>1,33 | | |



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# Characteristic Values

| Parameter | Symbol | Conditions | | | | | Value | | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | $V_{GE}$ [V] $V_{GS}$ [V] | $V_{CE}$ [V] $V_{DS}$ [V] $V_F$ [V] | $I_C$ [A] $I_D$ [A] $I_F$ [A] | $T_j$ [°C] | Min | Typ | Max | |
| **Boost Diode** | | | | | | | | | | |
| **fStatic** | | | | | | | | | | |
| Forward voltage | $V_F$ | | | | 50 | 25<br>125<br>150 | | 1,66<br>1,78<br>1,79 | 2,1 | V |
| Reverse leakage current | $I_R$ | | | 1200 | | 25 | | | 40 | µA |
| **Thermal** | | | | | | | | | | |
| Thermal resistance junction to sink | $R_{th(j-s)}$ | $\lambda_{paste}$ = 3,4 W/mK (PSX) | | | | | | 1,09 | | K/W |
| **Dynamic** | | | | | | | | | | |
| Peak recovery current | $I_{RRM}$ | $di/dt$ = 15050 A/µs<br>$di/dt$ = 12587 A/µs<br>$di/dt$ = 12212 A/µs | ±15 | 350 | 55 | 25<br>125<br>150 | | 150<br>149<br>154 | | A |
| Reverse recovery time | $t_{rr}$ | | | | | 25<br>125<br>150 | | 34<br>112<br>115 | | ns |
| Recovered charge | $Q_r$ | | | | | 25<br>125<br>150 | | 5,62<br>7,56<br>8,39 | | µC |
| Reverse recovered energy | $E_{rec}$ | | | | | 25<br>125<br>150 | | 1,51<br>2,08<br>2,31 | | mWs |
| Peak rate of fall of recovery current | $(di_{rf}/dt)_{max}$ | | | | | 25<br>125<br>150 | | 10000<br>9986<br>9495 | | A/µs |



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# Characteristic Values

| Parameter | Symbol | Conditions | | | | | Value | | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | $V_{GE}$ [V]<br>$V_{GS}$ [V] | $V_{CE}$ [V]<br>$V_{DS}$ [V]<br>$V_F$ [V] | $I_C$ [A]<br>$I_D$ [A]<br>$I_F$ [A] | $T_j$ [°C] | Min | Typ | Max | |
| **Buck Switch** | | | | | | | | | | |
| **Static** | | | | | | | | | | |
| Gate-emitter threshold voltage | $V_{GE(th)}$ | $V_{GE} = V_{CE}$ | | | 0,003 | 25 | 5,2 | 5,8 | 6,4 | V |
| Collector-emitter saturation voltage | $V_{CEsat}$ | | 15 | | 80 | 25<br>125<br>150 | 1,7 | 1,99<br>2,33<br>2,41 | 2,4 | V |
| Collector-emitter cut-off current | $I_{CES}$ | | 0 | 1200 | | 25 | | | 10 | µA |
| Gate-emitter leakage current | $I_{GES}$ | | 20 | 0 | | 25 | | | 240 | nA |
| Internal gate resistance | $r_g$ | | | | | | | none | | Ω |
| Input capacitance | $C_{ies}$ | $f$ = 1 Mhz | 0 | 25 | | 25 | | 4660 | | pF |
| Output capacitance | $C_{oes}$ | | | | | | | 300 | | |
| Reverse transfer capacitance | $C_{res}$ | | | | | | | 260 | | |
| Gate charge | $Q_g$ | | 15 | 960 | 80 | 25 | | 370 | | nC |
| **Thermal** | | | | | | | | | | |
| Thermal resistance junction to sink | $R_{th(j-s)}$ | $\lambda_{paste}$ = 3,4 W/mK (PSX) | | | | | | 0,50 | | K/W |
| **Dynamic** | | | | | | | | | | |
| Turn-on delay time | $t_{d(on)}$ | $R_{gon}$ = 4 Ω<br>$R_{goff}$ = 4 Ω | ±15 | 350 | 55 | 25<br>125<br>150 | | 78<br>78<br>78 | | ns |
| Rise time | $t_r$ | | | | | 25<br>125<br>150 | | 12<br>15<br>15 | | |
| Turn-off delay time | $t_{d(off)}$ | | | | | 25<br>125<br>150 | | 179<br>235<br>248 | | |
| Fall time | $t_f$ | | | | | 25<br>125<br>150 | | 54<br>89<br>107 | | |
| Turn-on energy (per pulse) | $E_{on}$ | $Q_{rFWD}$ = 2 µC<br>$Q_{rFWD}$ = 3,6 µC<br>$Q_{rFWD}$ = 4,2 µC | | | | 25<br>125<br>150 | | 0,806<br>1,35<br>1,38 | | mWs |
| Turn-off energy (per pulse) | $E_{off}$ | | | | | 25<br>125<br>150 | | 1,47<br>2,71<br>2,73 | | |



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# Characteristic Values

| Parameter | Symbol | Conditions | | | | | Value | | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | $V_{GE}$ [V] $V_{GS}$ [V] | $V_{CE}$ [V] $V_{DS}$ [V] $V_F$ [V] | $I_C$ [A] $I_D$ [A] $I_F$ [A] | $T_j$ [°C] | Min | Typ | Max | |
| **Buck Diode** | | | | | | | | | | |
| **Static** | | | | | | | | | | |
| Forward voltage | $V_F$ | | | | 80 | 25<br>125<br>150 | | 1,55<br>1,62<br>1,62 | 1,9 | V |
| Reverse leakage current | $I_R$ | | | 650 | | 25 | | | 10 | µA |
| **Thermal** | | | | | | | | | | |
| Thermal resistance junction to sink | $R_{th(j-s)}$ | $\lambda_{paste}$ = 3,4 W/mK (PSX) | | | | | | 1,15 | | K/W |
| **Dynamic** | | | | | | | | | | |
| Peak recovery current | $I_{RRM}$ | $di/dt$ = 3491 A/µs<br>$di/dt$ = 3563 A/µs<br>$di/dt$ = 3610 A/µs | ±15 | 350 | 55 | 25<br>125<br>150 | | 82<br>84<br>86 | | A |
| Reverse recovery time | $t_{rr}$ | | | | | 25<br>125<br>150 | | 42<br>109<br>125 | | ns |
| Recovered charge | $Q_r$ | | | | | 25<br>125<br>150 | | 2,04<br>3,64<br>4,16 | | µC |
| Reverse recovered energy | $E_{rec}$ | | | | | 25<br>125<br>150 | | 0,314<br>0,665<br>0,771 | | mWs |
| Peak rate of fall of recovery current | $(di_{rf}/dt)_{max}$ | | | | | 25<br>125<br>150 | | 6568<br>4238<br>3040 | | A/µs |
| **Thermistor** | | | | | | | | | | |
| Rated resistance | $R$ | | | | | 25 | | 22 | | kΩ |
| Deviation of $R_{100}$ | $\Delta_{R/R}$ | $R_{100}$ = 1484 Ω | | | | 100 | -5 | | 5 | % |
| Power dissipation | $P$ | | | | | 25 | | 5 | | mW |
| Power dissipation constant | | | | | | 25 | | 1,5 | | mW/K |
| B-value | $B_{(25/50)}$ | Tol. ±1 % | | | | 25 | | 3962 | | K |
| B-value | $B_{(25/100)}$ | Tol. ±1 % | | | | 25 | | 4000 | | K |
| Vincotech NTC Reference | | | | | | | | | I | |



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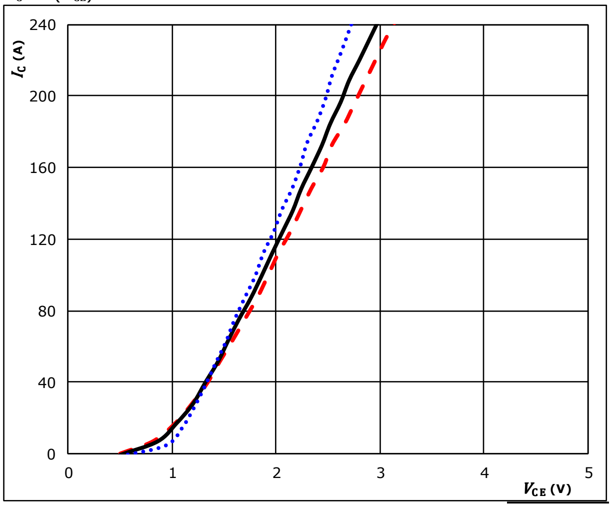
**10-PF12NMA080SH08-M260F98T**
datasheet

# Boost Switch Characteristics

**figure 1.** **IGBT**

**Typical output characteristics**

$I_C = f(V_{CE})$

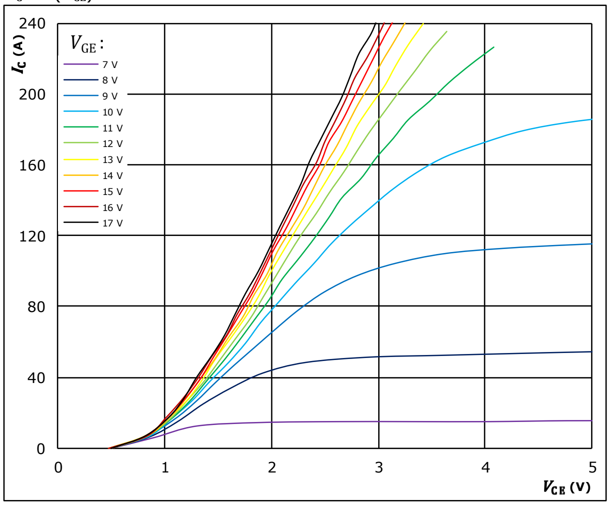



| | | | | | |
|---|---|---|---|---|---|
| $t_p$ = | 250 | μs | | 25 | °C |
| $V_{GE}$ = | 15 | V | $T_j$: | 125 | °C |
| | | | | 150 | °C |

**figure 2.** **IGBT**

**Typical output characteristics**

$I_C = f(V_{CE})$

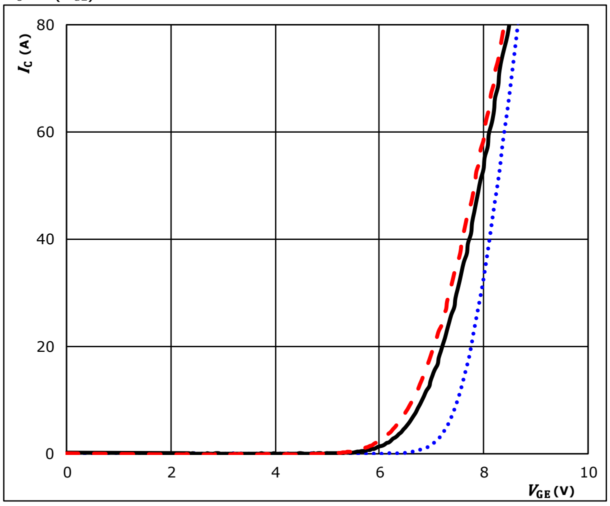



| | | |
|---|---|---|
| $t_p$ = | 250 | μs |
| $T_j$ = | 150 | °C |
| $V_{GE}$ from | 7 V to 17 V in steps of 1 V | |

**figure 3.** **IGBT**

**Typical transfer characteristics**

$I_C = f(V_{GE})$

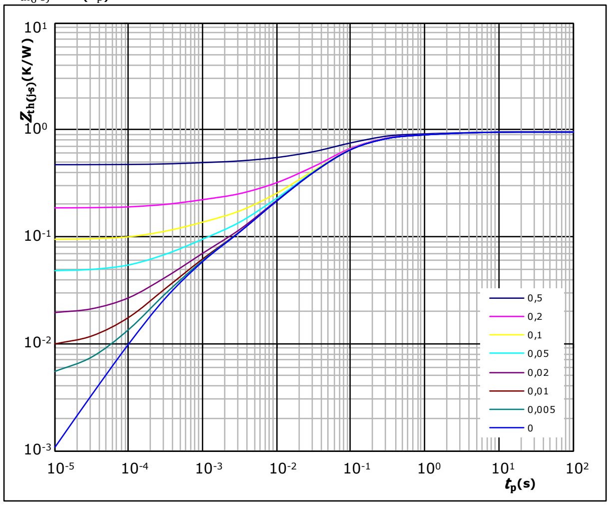



| | | | | | |
|---|---|---|---|---|---|
| $t_p$ = | 100 | μs | | 25 | °C |
| $V_{CE}$ = | 10 | V | $T_j$: | 125 | °C |
| | | | | 150 | °C |

**figure 4.** **IGBT**

**Transient thermal impedance as function of pulse duration**

$Z_{th(j-s)} = f(t_p)$




$D$ = $t_p$ / $T$

$R_{th(j-s)}$ = 0,94 K/W

IGBT thermal model values

| $R$ (K/W) | $\tau$ (s) |
|---|---|
| 6,31E-02 | 2,59E+00 |
| 1,02E-01 | 4,41E-01 |
| 4,73E-01 | 8,37E-02 |
| 1,96E-01 | 2,52E-02 |
| 6,91E-02 | 4,70E-03 |
| 3,59E-02 | 4,42E-04 |

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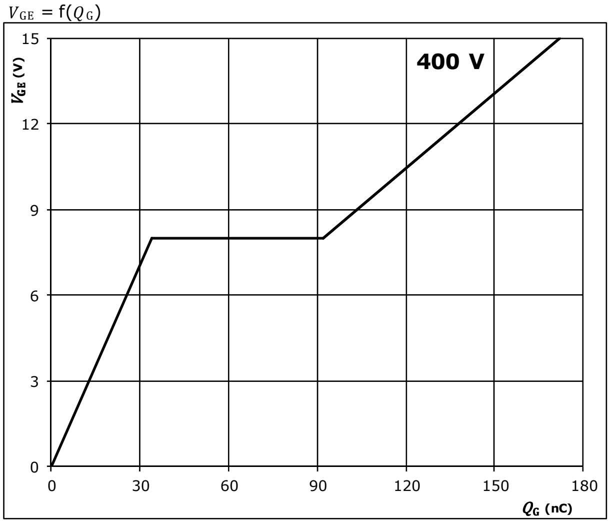
# Boost Switch Characteristics

| figure 5. | IGBT |
|---|---|

**Gate voltage vs gate charge**

$V_{GE} = f(Q_G)$

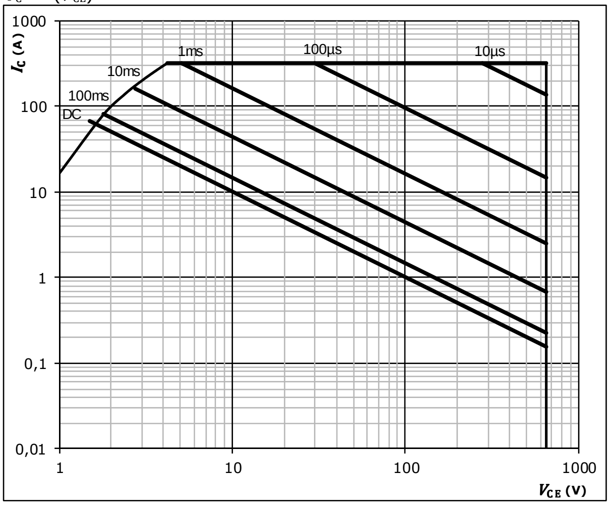



| | | |
|---|---|---|
| $I_C$ = | 80 | A |
| $T_j$ = | 25 | ºC |

| figure 6. | IGBT |
|---|---|

**Safe operating area**

$I_C = f(V_{CE})$




| | | |
|---|---|---|
| $D$ = | single pulse | |
| $T_s$ = | 80 | ºC |
| $V_{GE}$ = | ±15 | V |
| $T_j$ = | $T_{jmax}$ | |



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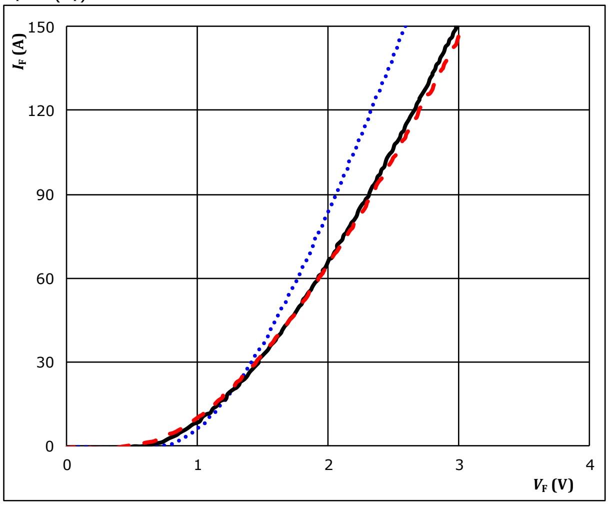
# Boost Diode Characteristics

**figure 1.** **FWD**

**Typical forward characteristics**

$I_F = f(V_F)$



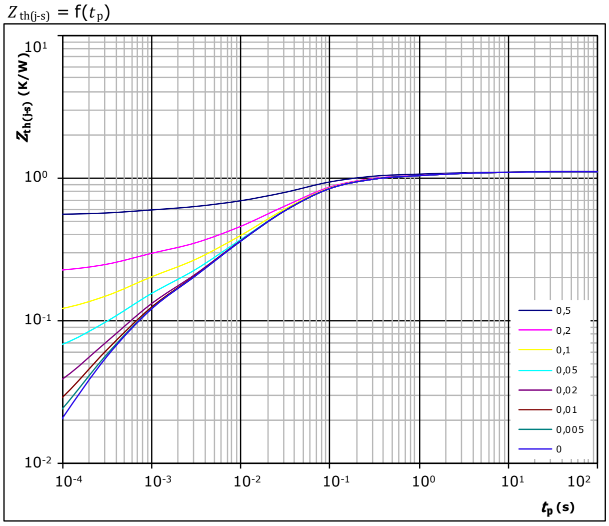

$t_p$ = 250 µs

$T_j$: 25 °C
125 °C
150 °C

**figure 2.** **FWD**

**Transient thermal impedance as a function of pulse width**

$Z_{th(j-s)} = f(t_p)$




$D = t_p / T$

$R_{th(j-s)}$ = 1,09 K/W

FWD thermal model values

| $R$ (K/W) | $\tau$ (s) |
|---|---|
| 4,05E-02 | 7,09E+00 |
| 8,82E-02 | 9,93E-01 |
| 2,80E-01 | 1,18E-01 |
| 4,48E-01 | 3,26E-02 |
| 1,45E-01 | 5,44E-03 |
| 9,23E-02 | 5,22E-04 |



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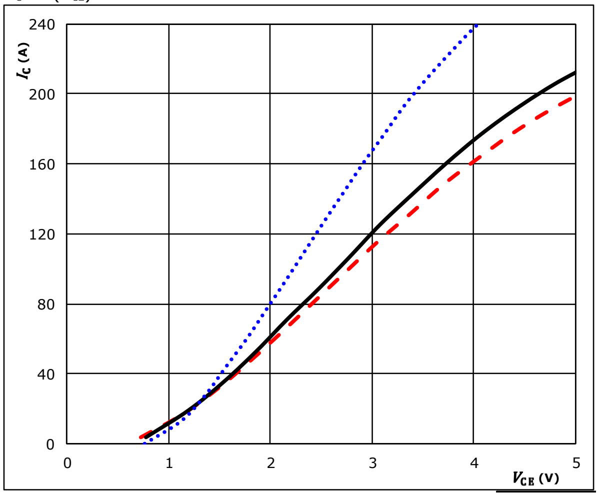
# Buck Switch Characteristics

**figure 1.** **IGBT**

**Typical output characteristics**

$I_C = f(V_{CE})$

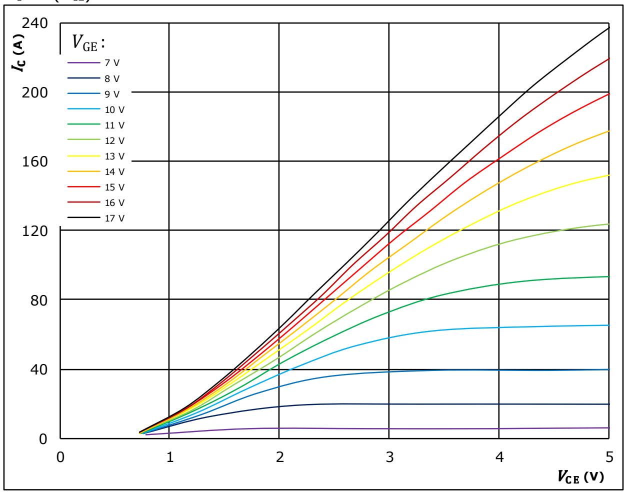



| | | | | | |
|---|---|---|---|---|---|
| $t_p$ = | 250 | µs | | 25 °C | ··········· |
| $V_{GE}$ = | 15 | V | $T_j$: | 125 °C | ——— |
| | | | | 150 °C | – – – |

**figure 2.** **IGBT**

**Typical output characteristics**

$I_C = f(V_{CE})$

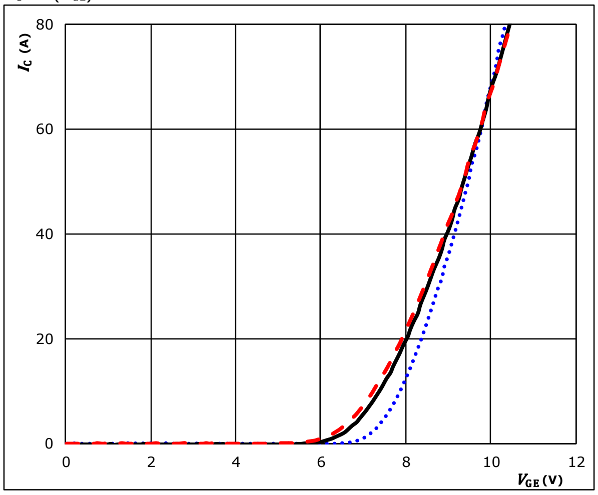



| | | |
|---|---|---|
| $t_p$ = | 250 | µs |
| $T_j$ = | 150 | °C |
| $V_{GE}$ from | 7 V to 17 V in steps of 1 V | |

**figure 3.** **IGBT**

**Typical transfer characteristics**

$I_C = f(V_{GE})$

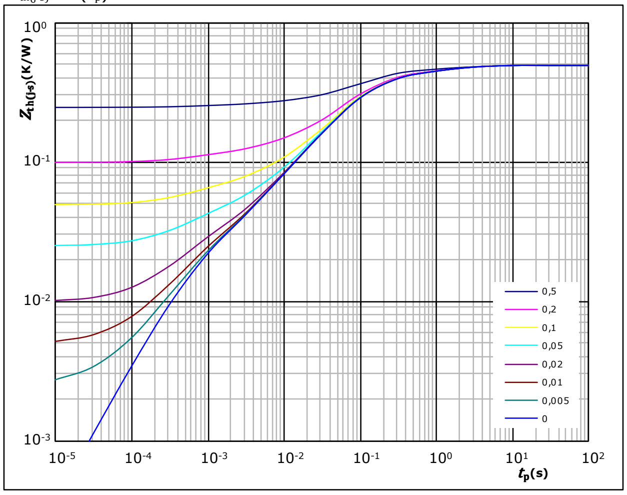



| | | | | | |
|---|---|---|---|---|---|
| $t_p$ = | 100 | µs | | 25 °C | ··········· |
| $V_{CE}$ = | 10 | V | $T_j$: | 125 °C | ——— |
| | | | | 150 °C | – – – |

**figure 4.** **IGBT**

**Transient thermal impedance as function of pulse duration**

$Z_{th(j\text{-}s)} = f(t_p)$




| | | |
|---|---|---|
| $D$ = | $t_p$ / $T$ | |
| $R_{th(j\text{-}s)}$ = | 0,50 | K/W |

IGBT thermal model values

| $R$ (K/W) | $\tau$ (s) |
|---|---|
| 6,04E-02 | 2,14E+00 |
| 7,39E-02 | 4,50E-01 |
| 2,54E-01 | 9,48E-02 |
| 6,61E-02 | 3,38E-02 |
| 2,51E-02 | 5,63E-03 |
| 1,59E-02 | 6,08E-04 |



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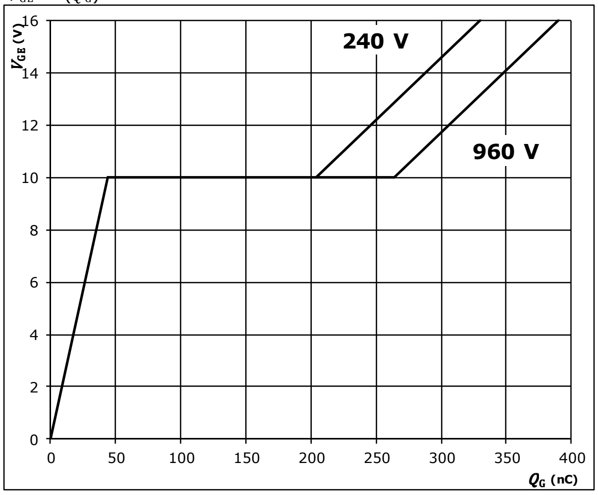
# Buck Switch Characteristics

**figure 5.** **IGBT**

**Gate voltage vs gate charge**

$V_{GE} = f(Q_G)$

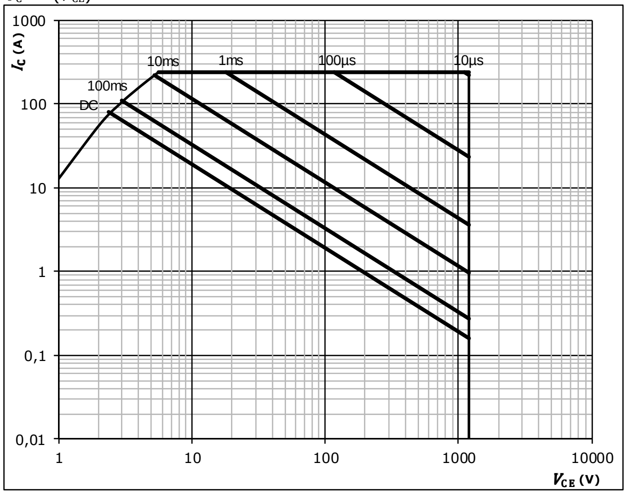



$I_C$ = 80 A

**figure 6.** **IGBT**

**Safe operating area**

$I_C = f(V_{CE})$

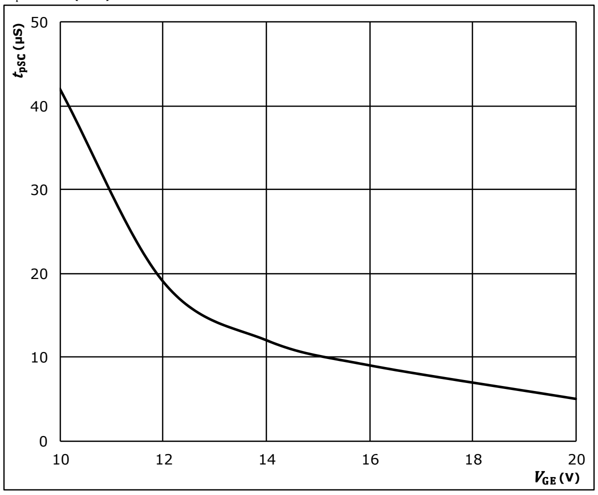



| | | |
|---|---|---|
| $D$ = | single pulse | |
| $T_s$ = | 80 | ºC |
| $V_{GE}$ = | ±15 | V |
| $T_j$ = | $T_{jmax}$ | |

**figure 7.** **IGBT**

**Short circuit duration as a function of $V_{GE}$**

$t_{pSC} = f(V_{GE})$

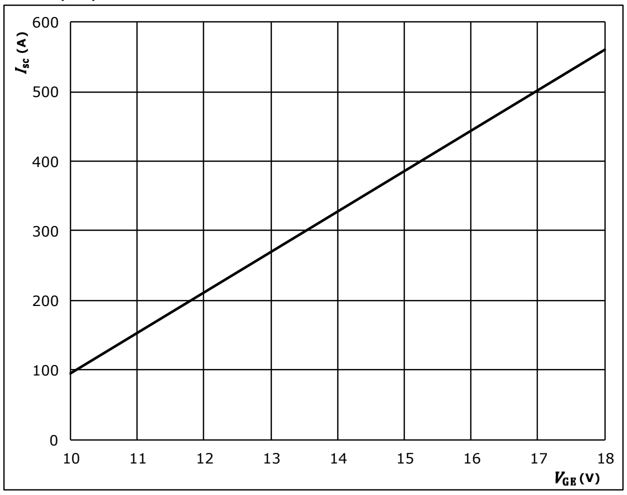



| | | |
|---|---|---|
| $V_{CE}$ = | 600 | V |
| $T_j$ ≤ | 150 | ºC |

**figure 8.** **IGBT**

**Typical short circuit current as a function of $V_{GE}$**

$I_{SC} = f(V_{GE})$




| | | |
|---|---|---|
| $V_{CE}$ ≤ | 600 | V |
| $T_j$ ≤ | 25 | ºC |



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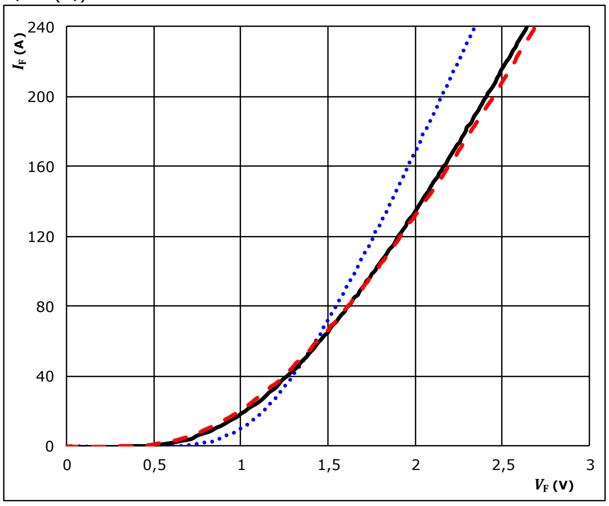
# Buck Diode Characteristics

| **figure 1.** | **FWD** |
|---|---|

**Typical forward characteristics**

$I_F = f(V_F)$



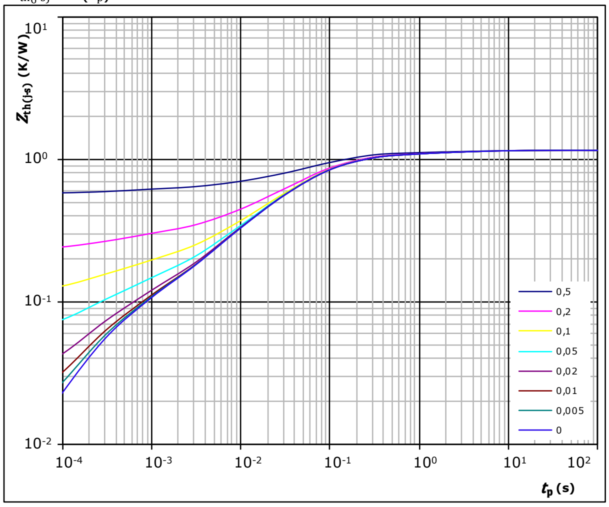

$t_p$ = 250 µs

| | | |
|---|---|---|
| $T_j$: | 25 °C | dotted |
| | 125 °C | solid |
| | 150 °C | dashed |

| **figure 2.** | **FWD** |
|---|---|

**Transient thermal impedance as a function of pulse width**

$Z_{th(j\text{-}s)} = f(t_p)$




$D$ = $t_p / T$

$R_{th(j\text{-}s)}$ = 1,15 K/W

FWD thermal model values

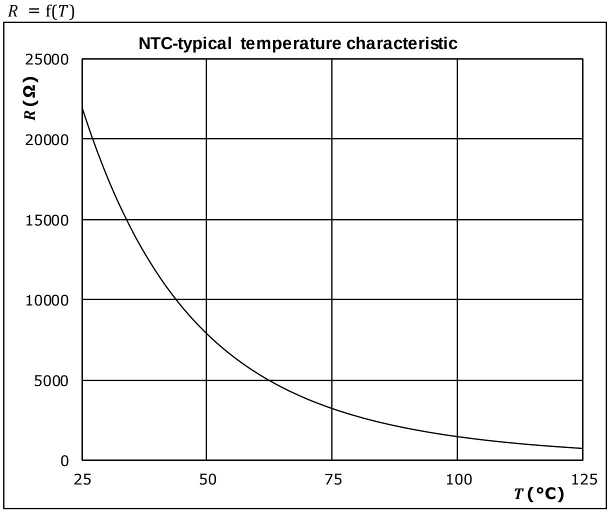
| $R$ (K/W) | $\tau$ (s) |
|---|---|
| 5,84E-02 | 4,16E+00 |
| 1,14E-01 | 5,35E-01 |
| 5,44E-01 | 8,00E-02 |
| 2,68E-01 | 2,04E-02 |
| 9,87E-02 | 4,10E-03 |
| 6,88E-02 | 3,19E-04 |

# Thermistor Characteristics

| **figure 1.** | **Thermistor** |
|---|---|

**Typical NTC characteristic as a function of temperature**

$R = f(T)$



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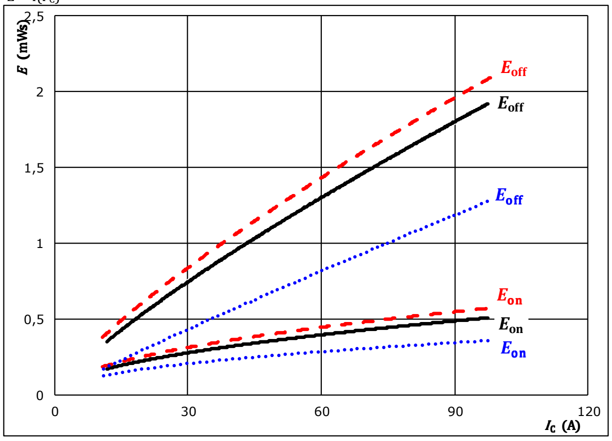
# Boost Switching Characteristics

**figure 1.** IGBT

Typical switching energy losses as a function of collector current

$E = f(I_C)$



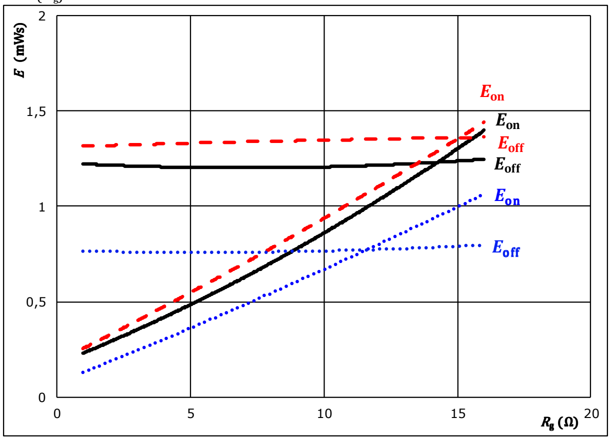

With an inductive load at

| | | | | | |
|---|---|---|---|---|---|
| $V_{CE}$ = | 350 | V | $T_j$: | 25 °C | dotted |
| $V_{GE}$ = | ±15 | V | | 125 °C | solid |
| $R_{gon}$ = | 4 | Ω | | 150 °C | dashed |
| $R_{goff}$ = | 4 | Ω | | | |

**figure 2.** IGBT

Typical switching energy losses as a function of gate resistor

$E = f(R_g)$



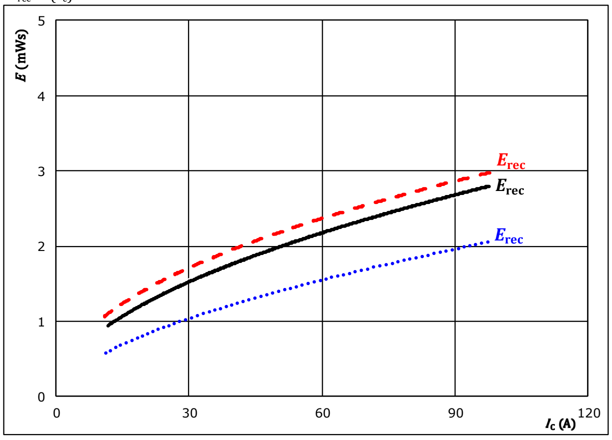

With an inductive load at

| | | | | | |
|---|---|---|---|---|---|
| $V_{CE}$ = | 350 | V | $T_j$: | 25 °C | dotted |
| $V_{GE}$ = | ±15 | V | | 125 °C | solid |
| $I_C$ = | 55 | A | | 150 °C | dashed |

**figure 3.** FWD

Typical reverse recovered energy loss as a function of collector current

$E_{rec} = f(I_c)$



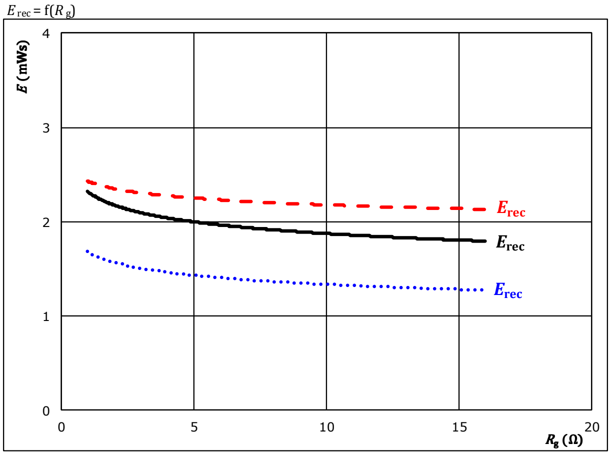

With an inductive load at

| | | | | | |
|---|---|---|---|---|---|
| $V_{CE}$ = | 350 | V | $T_j$: | 25 °C | dotted |
| $V_{GE}$ = | ±15 | V | | 125 °C | solid |
| $R_{gon}$ = | 4 | Ω | | 150 °C | dashed |

**figure 4.** FWD

Typical reverse recovered energy loss as a function of gate resistor

$E_{rec} = f(R_g)$




With an inductive load at

| | | | | | |
|---|---|---|---|---|---|
| $V_{CE}$ = | 350 | V | $T_j$: | 25 °C | dotted |
| $V_{GE}$ = | ±15 | V | | 125 °C | solid |
| $I_C$ = | 55 | A | | 150 °C | dashed |



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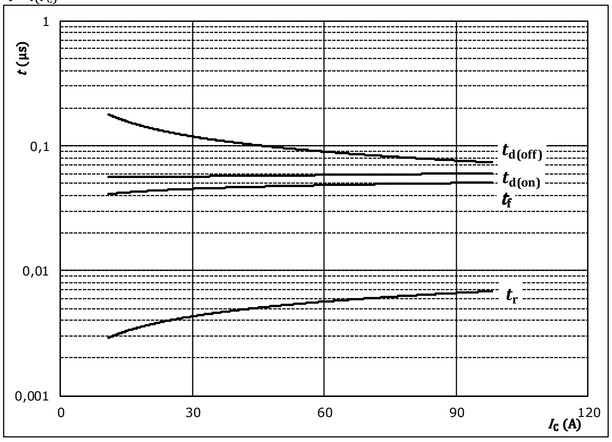
# Boost Switching Characteristics

**figure 5.** **IGBT**

Typical switching times as a function of collector current

$t = f(I_C)$



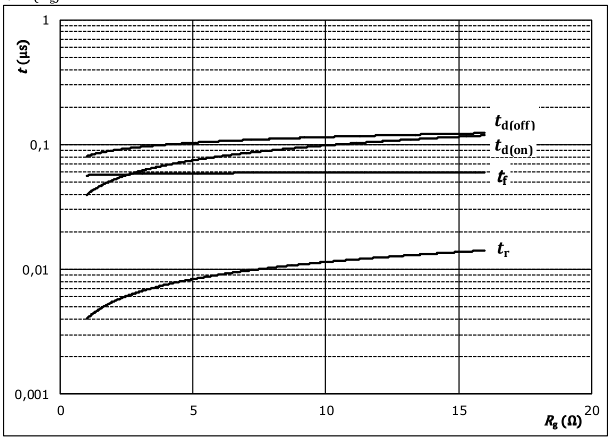

With an inductive load at

| | | |
|---|---|---|
| $T_j$ = | 150 | °C |
| $V_{CE}$ = | 350 | V |
| $V_{GE}$ = | ±15 | V |
| $R_{gon}$ = | 4 | Ω |
| $R_{goff}$ = | 4 | Ω |

**figure 6.** **IGBT**

Typical switching times as a function of gate resistor

$t = f(R_g)$



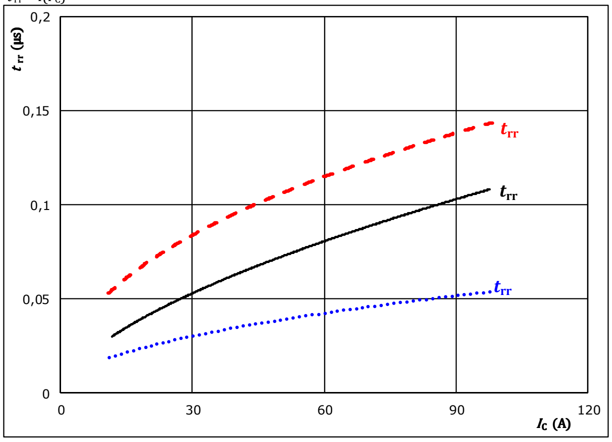

With an inductive load at

| | | |
|---|---|---|
| $T_j$ = | 150 | °C |
| $V_{CE}$ = | 350 | V |
| $V_{GE}$ = | ±15 | V |
| $I_C$ = | 55 | A |

**figure 7.** **FWD**

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$



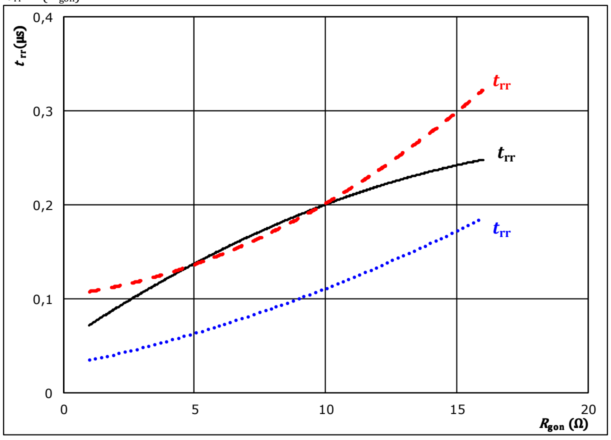

With an inductive load at

| | | | | |
|---|---|---|---|---|
| $V_{CE}$= | 350 | V | $T_j$: | 25 °C |
| $V_{GE}$ = | ±15 | V | | 125 °C |
| $R_{gon}$ = | 4 | Ω | | 150 °C |

**figure 8.** **FWD**

Typical reverse recovery time as a function of IGBT turn on gate resistor

$t_{rr} = f(R_{gon})$




With an inductive load at

| | | | | |
|---|---|---|---|---|
| $V_{CE}$ = | 350 | V | $T_j$: | 25 °C |
| $V_{GE}$ = | ±15 | V | | 125 °C |
| $I_C$ = | 55 | A | | 150 °C |



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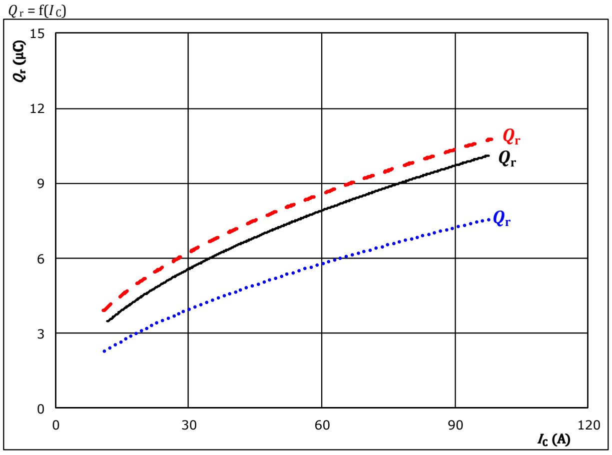
# Boost Switching Characteristics

**figure 9.** FWD

Typical recovered charge as a function of collector current

$Q_r = f(I_C)$



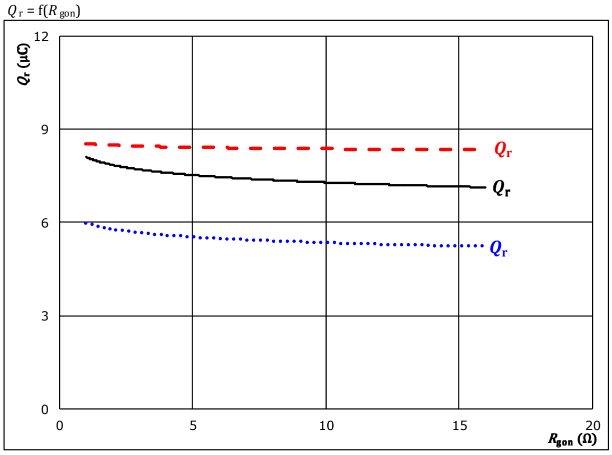

With an inductive load at

| | | | | | |
|---|---|---|---|---|---|
| $V_{CE}$ = | 350 | V | $T_j$: | 25 °C | dotted |
| $V_{GE}$ = | ±15 | V | | 125 °C | solid |
| $R_{gon}$ = | 4 | Ω | | 150 °C | dashed |

**figure 10.** FWD

Typical recovered charge as a function of IGBT turn on gate resistor

$Q_r = f(R_{gon})$



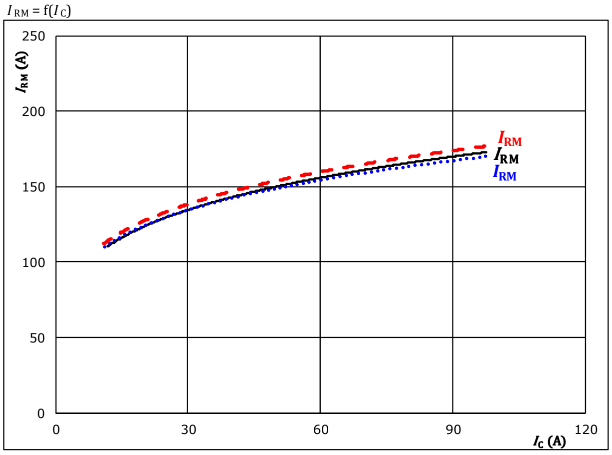

With an inductive load at

| | | | | | |
|---|---|---|---|---|---|
| $V_{CE}$= | 350 | V | $T_j$: | 25 °C | dotted |
| $V_{GE}$ = | ±15 | V | | 125 °C | solid |
| $I_C$= | 55 | A | | 150 °C | dashed |

**figure 11.** FWD

Typical peak reverse recovery current current as a function of collector current

$I_{RM} = f(I_C)$



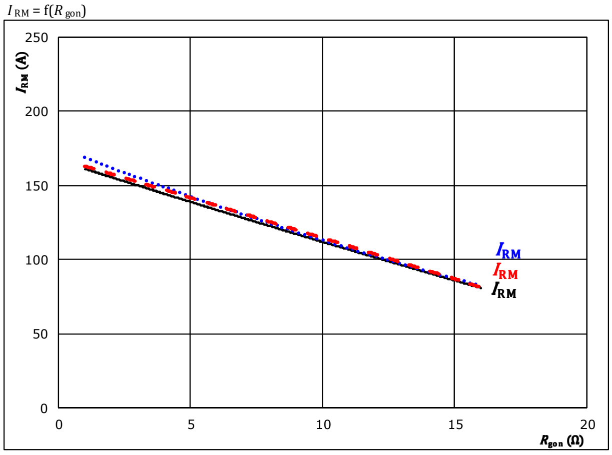

With an inductive load at

| | | | | | |
|---|---|---|---|---|---|
| $V_{CE}$ = | 350 | V | $T_j$: | 25 °C | dotted |
| $V_{GE}$ = | ±15 | V | | 125 °C | solid |
| $R_{gon}$ = | 4 | Ω | | 150 °C | dashed |

**figure 12.** FWD

Typical peak reverse recovery current as a function of IGBT turn on gate resistor

$I_{RM} = f(R_{gon})$




With an inductive load at

| | | | | | |
|---|---|---|---|---|---|
| $V_{CE}$ = | 350 | V | $T_j$: | 25 °C | dotted |
| $V_{GE}$ = | ±15 | V | | 125 °C | solid |
| $I_C$ = | 55 | A | | 150 °C | dashed |



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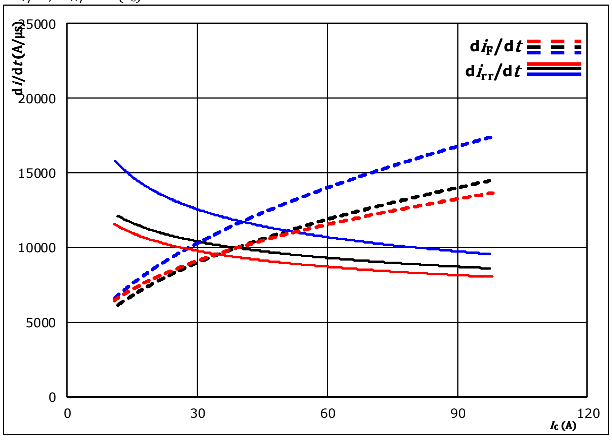
# Boost Switching Characteristics

**figure 13.** **FWD**

**Typical rate of fall of forward and reverse recovery current as a function of collector current**

$di_F/dt$, $di_{rr}/dt$ = f($I_C$)



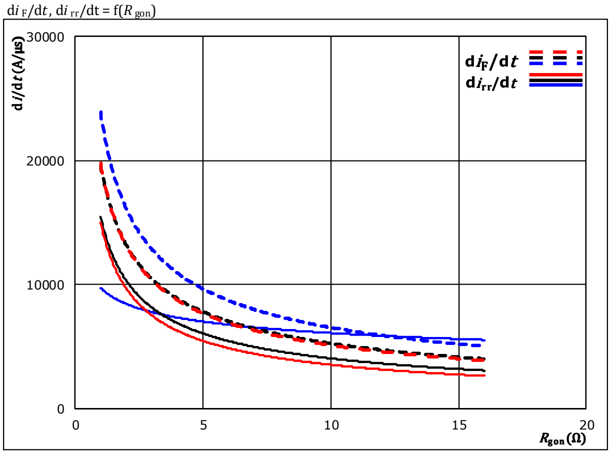

With an inductive load at

| | | | | |
|---|---|---|---|---|
| $V_{CE}$ = | 350 | V | $T_j$: | 25 °C |
| $V_{GE}$ = | ±15 | V | | 125 °C |
| $R_{gon}$ = | 4 | Ω | | 150 °C |

**figure 14.** **FWD**

**Typical rate of fall of forward and reverse recovery current as a function of IGBT turn on gate resistor**

$di_F/dt$, $di_{rr}/dt$ = f($R_{gon}$)



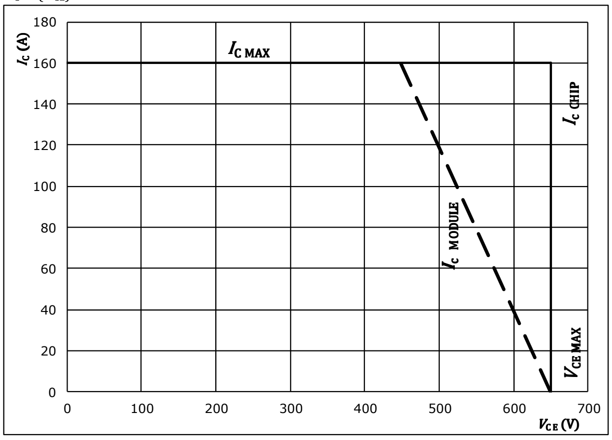

With an inductive load at

| | | | | |
|---|---|---|---|---|
| $V_{CE}$ = | 350 | V | $T_j$: | 25 °C |
| $V_{GE}$ = | ±15 | V | | 125 °C |
| $I_C$= | 55 | A | | 150 °C |

**figure 15.** **IGBT**

**Reverse bias safe operating area**

$I_C$ = f($V_{CE}$)




**At**

| | | |
|---|---|---|
| $T_j$ = | 125 | °C |
| $R_{gon}$ = | 4 | Ω |
| $R_{goff}$ = | 4 | Ω |



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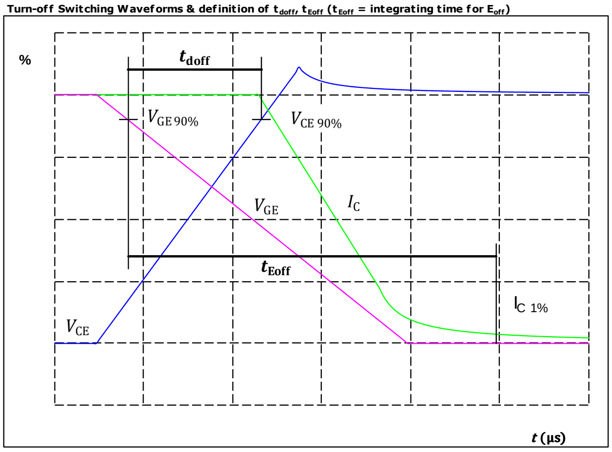
# Boost Switching Definitions

| General conditions | | |
|---|---|---|
| $T_j$ | = | 125 °C |
| $R_{gon}$ | = | 4 Ω |
| $R_{goff}$ | = | 4 Ω |

**figure 1.** **IGBT**

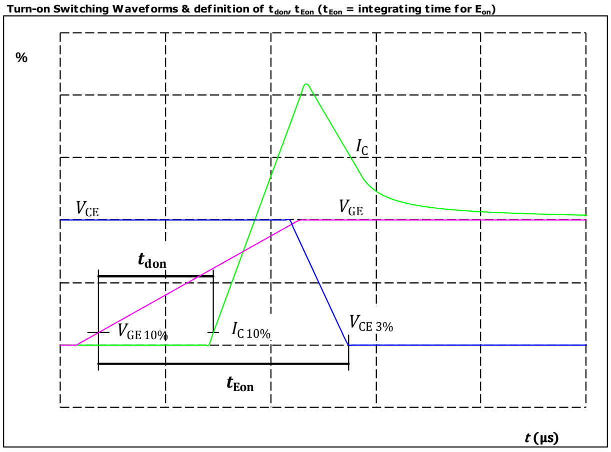
Turn-off Switching Waveforms & definition of $t_{doff}$, $t_{Eoff}$ ($t_{Eoff}$ = integrating time for $E_{off}$)




| | | |
|---|---|---|
| $V_{GE}$(0%) = | -15 | V |
| $V_{GE}$(100%) = | 15 | V |
| $V_C$(100%) = | 350 | V |
| $I_C$(100%) = | 55 | A |
| $t_{doff}$ = | 89 | ns |

**figure 2.** **IGBT**

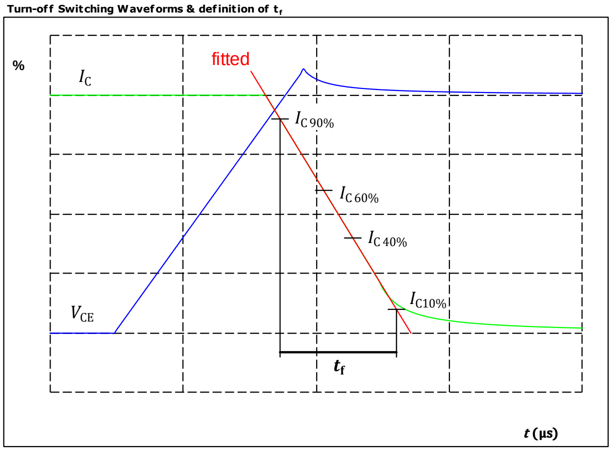
Turn-on Switching Waveforms & definition of $t_{don}$, $t_{Eon}$ ($t_{Eon}$ = integrating time for $E_{on}$)




| | | |
|---|---|---|
| $V_{GE}$(0%) = | -15 | V |
| $V_{GE}$(100%) = | 15 | V |
| $V_C$(100%) = | 350 | V |
| $I_C$(100%) = | 55 | A |
| $t_{don}$ = | 58 | ns |

**figure 3.** **IGBT**

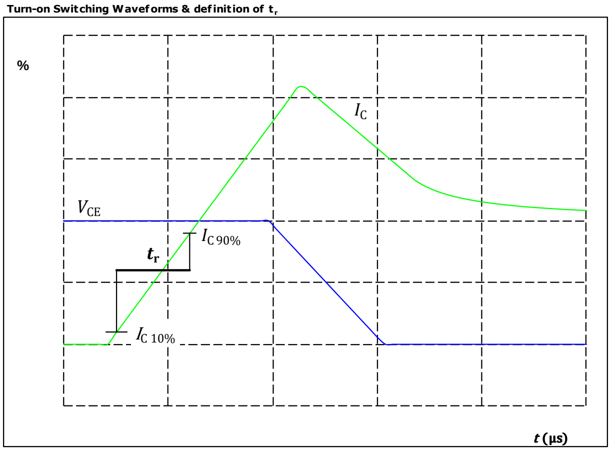
Turn-off Switching Waveforms & definition of $t_f$




| | | |
|---|---|---|
| $V_C$(100%) = | 350 | V |
| $I_C$(100%) = | 55 | A |
| $t_f$ = | 44 | ns |

**figure 4.** **IGBT**

Turn-on Switching Waveforms & definition of $t_r$




| | | |
|---|---|---|
| $V_C$(100%) = | 350 | V |
| $I_C$(100%) = | 55 | A |
| $t_r$ = | 5 | ns |



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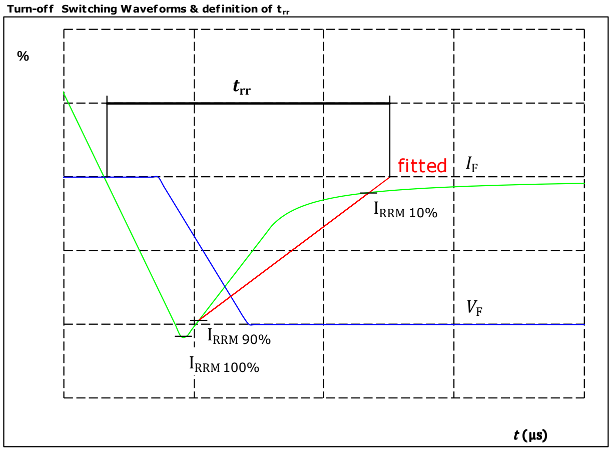
# Boost Switching Characteristics

**figure 5.** **FWD**

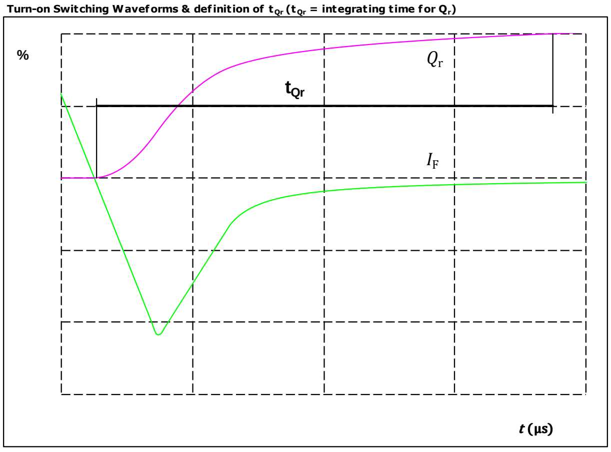
**Turn-off Switching Waveforms & definition of $t_{rr}$**




| | | |
|---|---|---|
| $V_F$ (100%) = | 350 | V |
| $I_F$ (100%) = | 55 | A |
| $I_{RRM}$ (100%) = | 149 | A |
| $t_{rr}$ = | 112 | ns |

**figure 6.** **FWD**

**Turn-on Switching Waveforms & definition of $t_{Qr}$ ($t_{Qr}$ = integrating time for $Q_r$)**




| | | |
|---|---|---|
| $I_F$ (100%) = | 55 | A |
| $Q_r$ (100%) = | 0 | µC |



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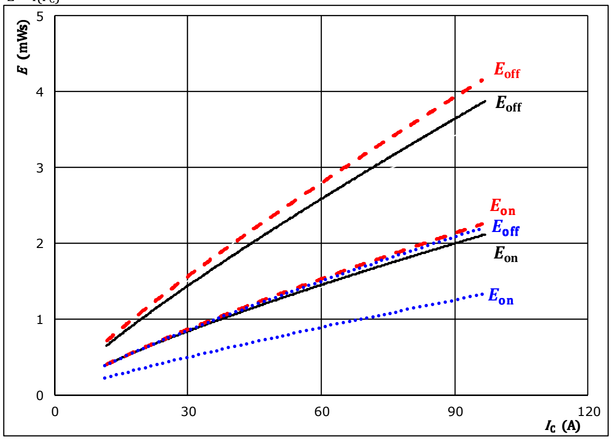
# Buck Switching Characteristics

**figure 1.** **IGBT**

Typical switching energy losses as a function of collector current

$E = f(I_C)$



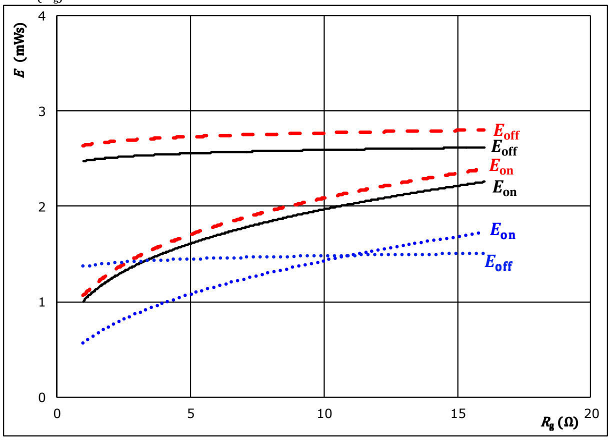

With an inductive load at

| | | | | | |
|---|---|---|---|---|---|
| $V_{CE}$ = | 350 | V | $T_j$: | 25 °C | ··········· |
| $V_{GE}$ = | ±15 | V | | 125 °C | ——— |
| $R_{gon}$ = | 4 | Ω | | 150 °C | – – – |
| $R_{goff}$ = | 4 | Ω | | | |

**figure 2.** **IGBT**

Typical switching energy losses as a function of gate resistor

$E = f(R_g)$



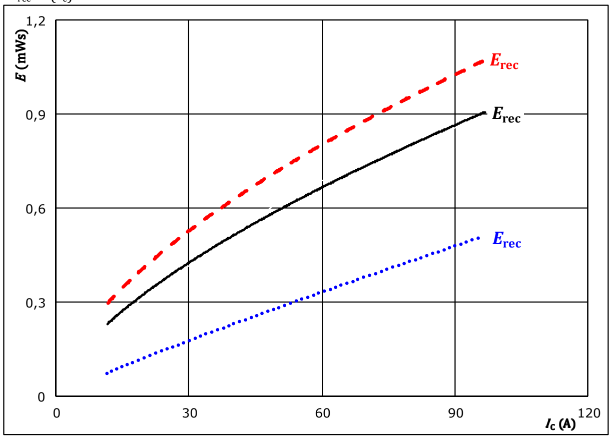

With an inductive load at

| | | | | | |
|---|---|---|---|---|---|
| $V_{CE}$ = | 350 | V | $T_j$: | 25 °C | ··········· |
| $V_{GE}$ = | ±15 | V | | 125 °C | ——— |
| $I_C$ = | 55 | A | | 150 °C | – – – |

**figure 3.** **FWD**

Typical reverse recovered energy loss as a function of collector current

$E_{rec} = f(I_C)$



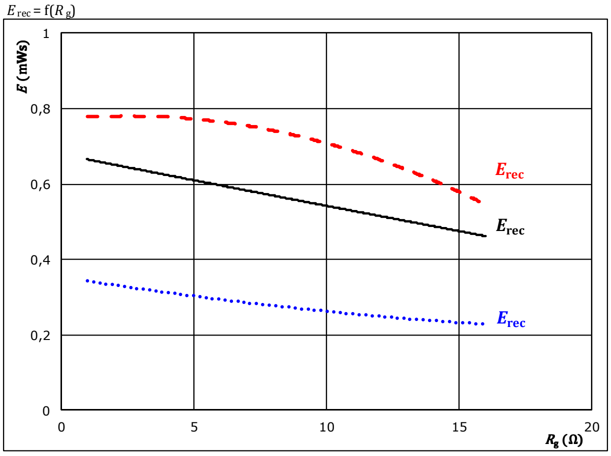

With an inductive load at

| | | | | | |
|---|---|---|---|---|---|
| $V_{CE}$ = | 350 | V | $T_j$: | 25 °C | ··········· |
| $V_{GE}$ = | ±15 | V | | 125 °C | ——— |
| $R_{gon}$ = | 4 | Ω | | 150 °C | – – – |

**figure 4.** **FWD**

Typical reverse recovered energy loss as a function of gate resistor

$E_{rec} = f(R_g)$




With an inductive load at

| | | | | | |
|---|---|---|---|---|---|
| $V_{CE}$ = | 350 | V | $T_j$: | 25 °C | ··········· |
| $V_{GE}$ = | ±15 | V | | 125 °C | ——— |
| $I_C$ = | 55 | A | | 150 °C | – – – |



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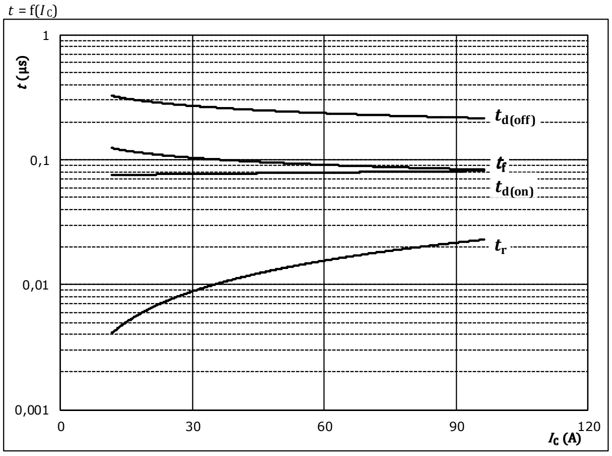
# Buck Switching Characteristics

**figure 5.** **IGBT**

Typical switching times as a function of collector current

$t = f(I_C)$



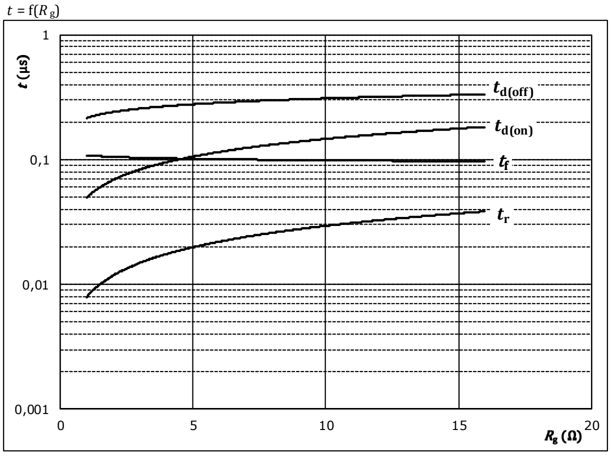

With an inductive load at

| | | |
|---|---|---|
| $T_j$ = | 150 | °C |
| $V_{CE}$ = | 350 | V |
| $V_{GE}$ = | ±15 | V |
| $R_{gon}$ = | 4 | Ω |
| $R_{goff}$ = | 4 | Ω |

**figure 6.** **IGBT**

Typical switching times as a function of gate resistor

$t = f(R_g)$



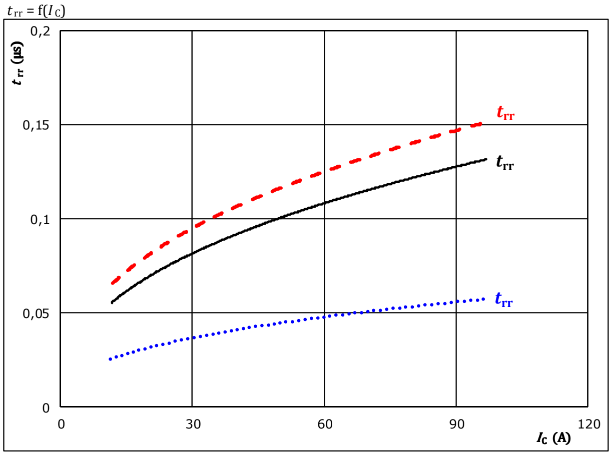

With an inductive load at

| | | |
|---|---|---|
| $T_j$ = | 150 | °C |
| $V_{CE}$ = | 350 | V |
| $V_{GE}$ = | ±15 | V |
| $I_C$ = | 55 | A |

**figure 7.** **FWD**

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$



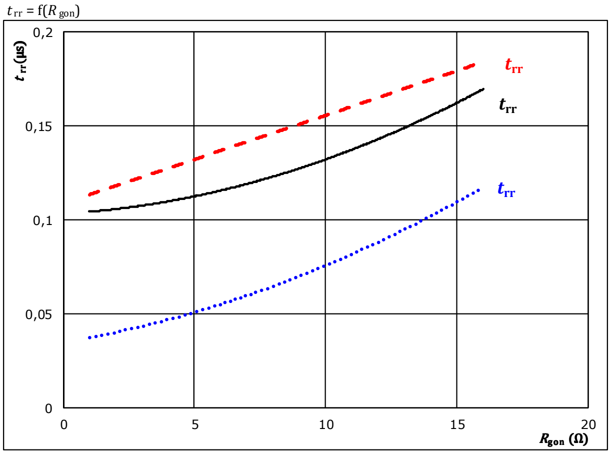

With an inductive load at

| | | | | | |
|---|---|---|---|---|---|
| $V_{CE}$= | 350 | V | $T_j$: | 25 °C | |
| $V_{GE}$ = | ±15 | V | | 125 °C | |
| $R_{gon}$ = | 4 | Ω | | 150 °C | |

**figure 8.** **FWD**

Typical reverse recovery time as a function of IGBT turn on gate resistor

$t_{rr} = f(R_{gon})$




With an inductive load at

| | | | | | |
|---|---|---|---|---|---|
| $V_{CE}$ = | 350 | V | $T_j$: | 25 °C | |
| $V_{GE}$ = | ±15 | V | | 125 °C | |
| $I_C$ = | 55 | A | | 150 °C | |

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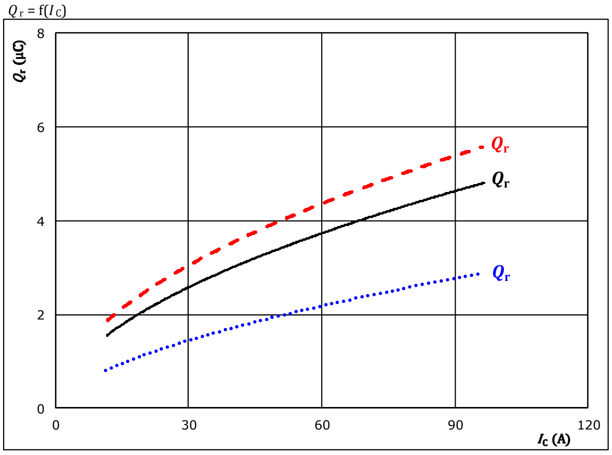
# Buck Switching Characteristics

**figure 9.** **FWD**

**Typical recovered charge as a function of collector current**

$Q_r = f(I_C)$



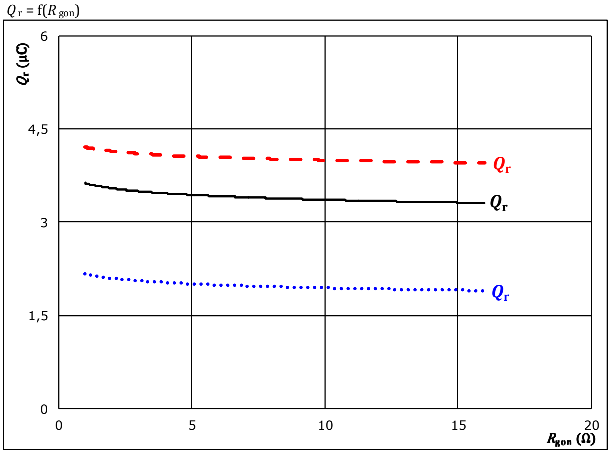

With an inductive load at

| | | | | | |
|---|---|---|---|---|---|
| $V_{CE}$ = | 350 | V | $T_j$: | 25 °C | dotted |
| $V_{GE}$ = | ±15 | V | | 125 °C | solid |
| $R_{gon}$ = | 4 | Ω | | 150 °C | dashed |

**figure 10.** **FWD**

**Typical recovered charge as a function of IGBT turn on gate resistor**

$Q_r = f(R_{gon})$



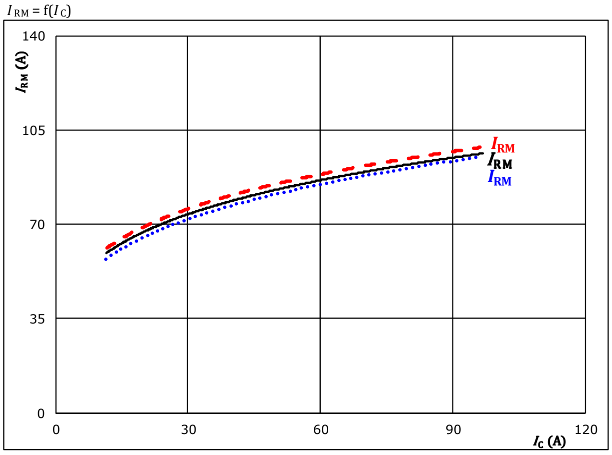

With an inductive load at

| | | | | | |
|---|---|---|---|---|---|
| $V_{CE}$= | 350 | V | $T_j$: | 25 °C | dotted |
| $V_{GE}$ = | ±15 | V | | 125 °C | solid |
| $I_C$= | 55 | A | | 150 °C | dashed |

**figure 11.** **FWD**

**Typical peak reverse recovery current current as a function of collector current**

$I_{RM} = f(I_C)$



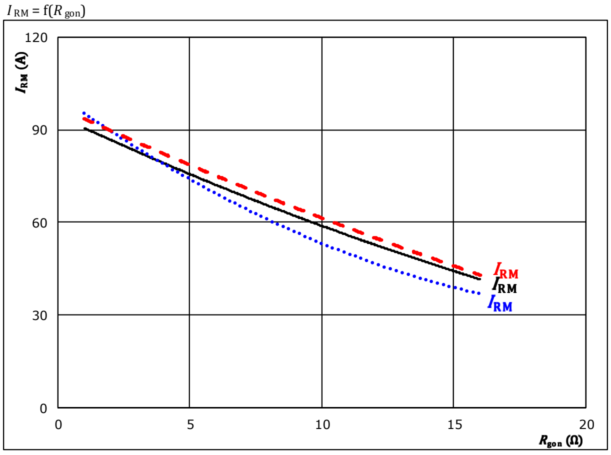

With an inductive load at

| | | | | | |
|---|---|---|---|---|---|
| $V_{CE}$ = | 350 | V | $T_j$: | 25 °C | dotted |
| $V_{GE}$ = | ±15 | V | | 125 °C | solid |
| $R_{gon}$ = | 4 | Ω | | 150 °C | dashed |

**figure 12.** **FWD**

**Typical peak reverse recovery current as a function of IGBT turn on gate resistor**

$I_{RM} = f(R_{gon})$




With an inductive load at

| | | | | | |
|---|---|---|---|---|---|
| $V_{CE}$= | 350 | V | $T_j$: | 25 °C | dotted |
| $V_{GE}$ = | ±15 | V | | 125 °C | solid |
| $I_C$= | 55 | A | | 150 °C | dashed |



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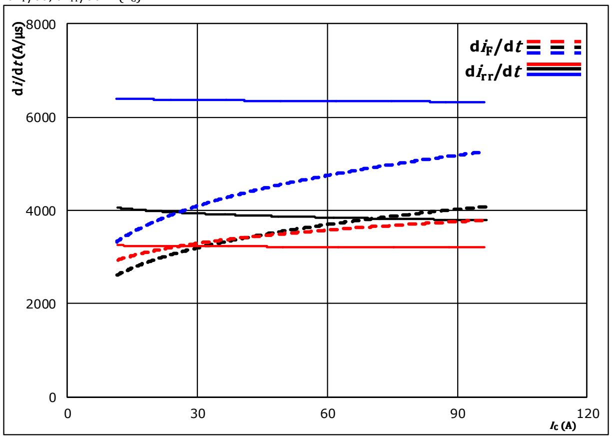
# Buck Switching Characteristics

**figure 13.** **FWD**

Typical rate of fall of forward and reverse recovery current as a function of collector current

$di_F/dt, di_{rr}/dt = f(I_C)$



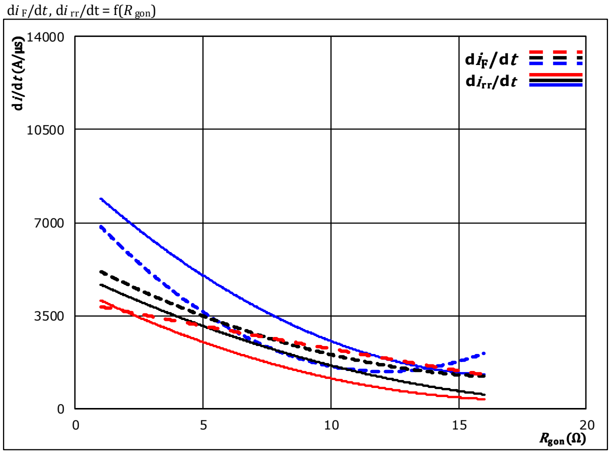

With an inductive load at

| | | | | |
|---|---|---|---|---|
| $V_{CE}$ = | 350 | V | $T_j$: | 25 °C |
| $V_{GE}$ = | ±15 | V | | 125 °C |
| $R_{gon}$ = | 4 | Ω | | 150 °C |

**figure 14.** **FWD**

Typical rate of fall of forward and reverse recovery current as a function of IGBT turn on gate resistor

$di_F/dt, di_{rr}/dt = f(R_{gon})$



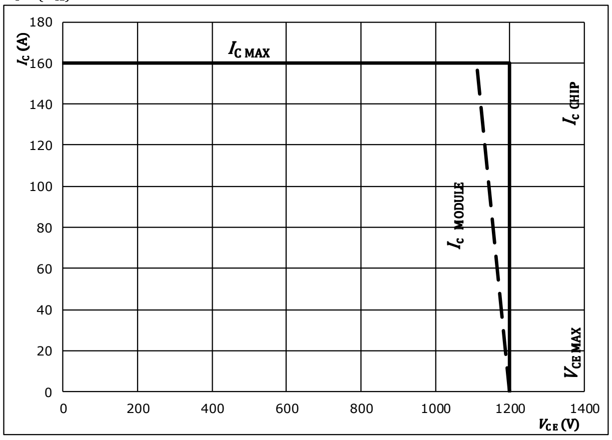

With an inductive load at

| | | | | |
|---|---|---|---|---|
| $V_{CE}$ = | 350 | V | $T_j$: | 25 °C |
| $V_{GE}$ = | ±15 | V | | 125 °C |
| $I_C$ = | 55 | A | | 150 °C |

**figure 15.** **IGBT**

Reverse bias safe operating area

$I_C = f(V_{CE})$




At

| | | |
|---|---|---|
| $T_j$ = | 125 | °C |
| $R_{gon}$ = | 4 | Ω |
| $R_{goff}$ = | 4 | Ω |



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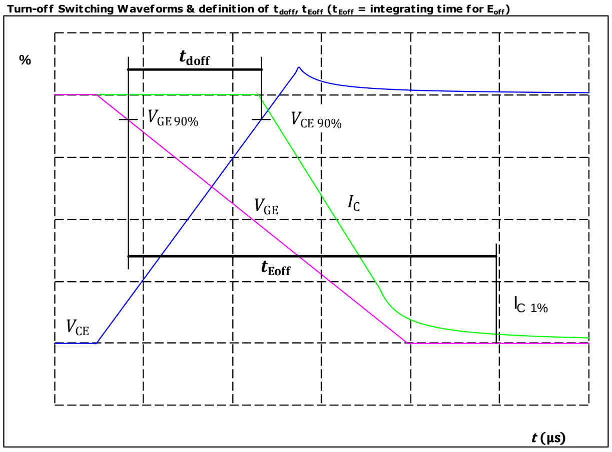
# Buck Switching Definitions

| General conditions | | |
|---|---|---|
| $T_j$ | = | 125 °C |
| $R_{gon}$ | = | 4 Ω |
| $R_{goff}$ | = | 4 Ω |

**figure 1.** IGBT

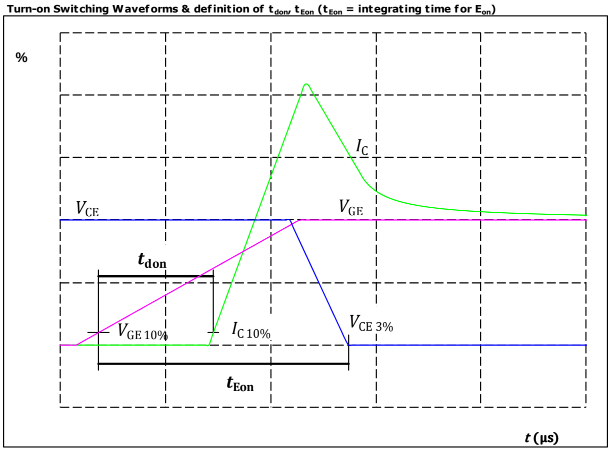
Turn-off Switching Waveforms & definition of $t_{doff}$, $t_{Eoff}$ ($t_{Eoff}$ = integrating time for $E_{off}$)




| | | |
|---|---|---|
| $V_{GE}(0\%)$ = | -15 | V |
| $V_{GE}(100\%)$ = | 15 | V |
| $V_C(100\%)$ = | 350 | V |
| $I_C(100\%)$ = | 55 | A |
| $t_{doff}$ = | 235 | ns |

**figure 2.** IGBT

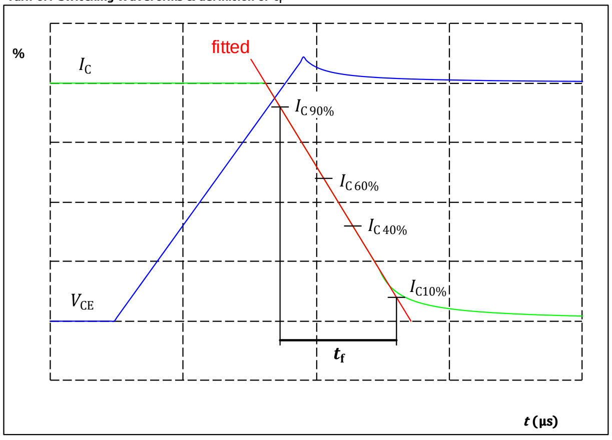
Turn-on Switching Waveforms & definition of $t_{don}$, $t_{Eon}$ ($t_{Eon}$ = integrating time for $E_{on}$)




| | | |
|---|---|---|
| $V_{GE}(0\%)$ = | -15 | V |
| $V_{GE}(100\%)$ = | 15 | V |
| $V_C(100\%)$ = | 350 | V |
| $I_C(100\%)$ = | 55 | A |
| $t_{don}$ = | 78 | ns |

**figure 3.** IGBT

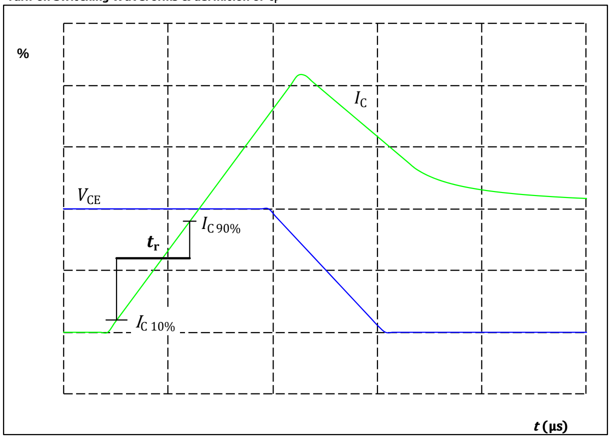
Turn-off Switching Waveforms & definition of $t_f$




| | | |
|---|---|---|
| $V_C(100\%)$ = | 350 | V |
| $I_C(100\%)$ = | 55 | A |
| $t_f$ = | 89 | ns |

**figure 4.** IGBT

Turn-on Switching Waveforms & definition of $t_r$




| | | |
|---|---|---|
| $V_C(100\%)$ = | 350 | V |
| $I_C(100\%)$ = | 55 | A |
| $t_r$ = | 15 | ns |



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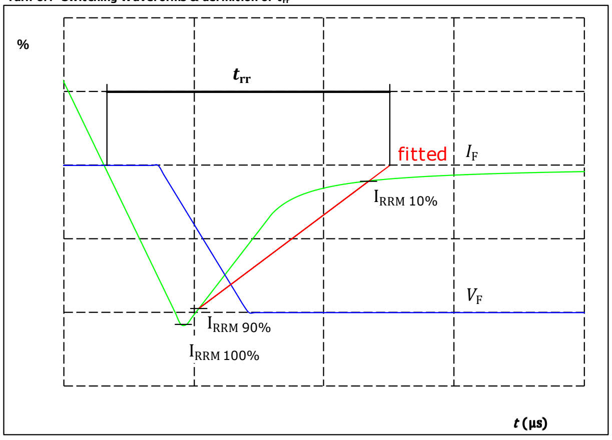
# Buck Switching Characteristics

**figure 5.** **FWD**

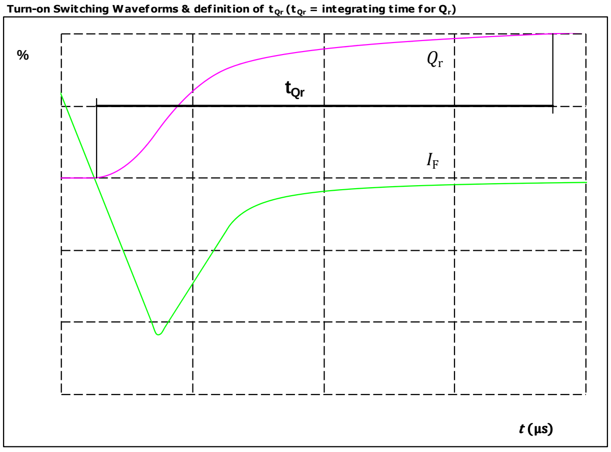
Turn-off Switching Waveforms & definition of $t_{rr}$




| | | |
|---|---|---|
| $V_F$ (100%) = | 350 | V |
| $I_F$ (100%) = | 55 | A |
| $I_{RRM}$ (100%) = | 84 | A |
| $t_{rr}$ = | 109 | ns |

**figure 6.** **FWD**

Turn-on Switching Waveforms & definition of $t_{Qr}$ ($t_{Qr}$ = integrating time for $Q_r$)




| | | |
|---|---|---|
| $I_F$ (100%) = | 55 | A |
| $Q_r$ (100%) = | 0 | µC |



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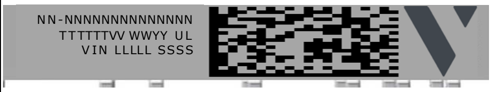
## Ordering Code & Marking

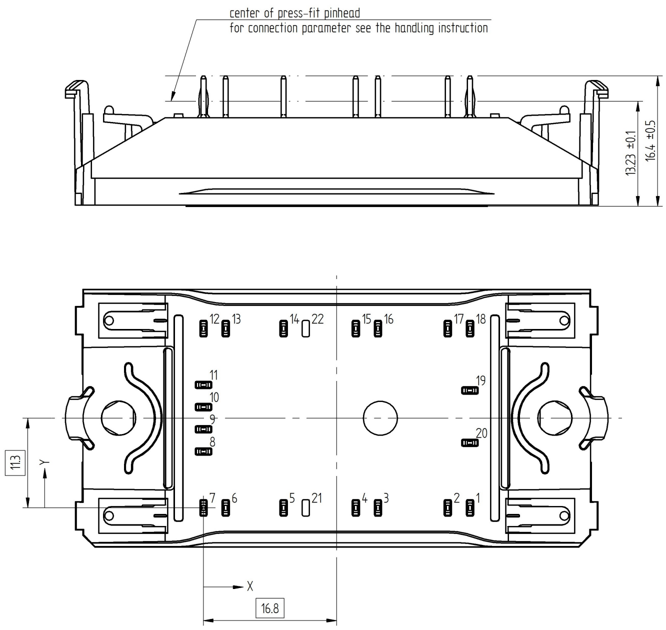
| Version | Ordering Code |
|---|---|
| without thermal paste 12mm housing with press-fit pins | 10-PF12NMA080SH08-M260F98T |
| | |
| | |
| | |




| | | | | | |
|---|---|---|---|---|---|
| **Text** | **Name** | **Date code** | **UL & VIN** | **Lot** | **Serial** |
| | NN-NNNNNNNNNNNNNN-TTTTTTVV | WWYY | UL VIN | LLLLL | SSSS |
| **Datamatrix** | **Type&Ver** | **Lot number** | **Serial** | **Date code** | |
| | TTTTTTVV | LLLLL | SSSS | WWYY | |

## Outline

| Pin | X | Y | Function |
|---|---|---|---|
| 1 | 33,6 | 0 | S2 |
| 2 | 30,8 | 0 | G2 |
| 3 | 22 | 0 | -DC |
| 4 | 19,2 | 0 | -DC |
| 5 | 10,1 | 0 | GND |
| 6 | 2,8 | 0 | S4 |
| 7 | 0 | 0 | G4 |
| 8 | 0 | 7,1 | Line |
| 9 | 0 | 9,9 | Line |
| 10 | 0 | 12,7 | Line |
| 11 | 0 | 15,5 | Line |
| 12 | 0 | 22,6 | G3 |
| 13 | 2,8 | 22,6 | S3 |
| 14 | 10,1 | 22,6 | GND |
| 15 | 19,2 | 22,6 | +DC |
| 16 | 22 | 22,6 | +DC |
| 17 | 30,8 | 22,6 | G1 |
| 18 | 33,6 | 22,6 | S1 |
| 19 | 33,6 | 14,8 | NTC1 |
| 20 | 33,6 | 8,2 | NTC2 |
| 21 | Not assembled | | |
| 22 | Not assembled | | |




Tolerance of pinpositions: ±0,5mm at the end of pins
Dimension of coordinate axis is only offset without tolerance



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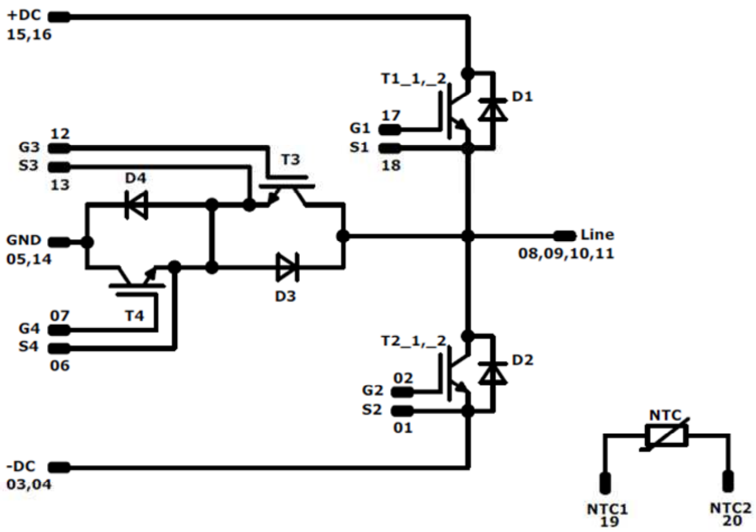
## Pinout




## Identification

| ID | Component | Voltage | Current | Function | Comment |
|---|---|---|---|---|---|
| T3, T4 | IGBT | 650 V | 80 A | Boost Switch | |
| D1, D2 | FWD | 1200 V | 50 A | Boost Diode | |
| T1, T2 | IGBT | 1200 V | 80 A | Buck Switch | |
| D4, D3 | FWD | 650 V | 80 A | Buck Diode | |
| NTC | Thermistor | | | Thermistor | |



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| Packaging instruction | | | | |
|---|---|---|---|---|
| Standard packaging quantity (SPQ) 135 | >SPQ | Standard | <SPQ | Sample |

| Handling instruction |
|---|
| Handling instructions for *flow* 0 packages see vincotech.com website. |

| Package data |
|---|
| Package data for *flow* 0 packages see vincotech.com website. |

| UL recognition and file number |
|---|
| This device is certified according to UL 1557 standard, UL file number E192116. For more information see vincotech.com website. |

| Document No.: | Date: | Modification: | Pages |
|---|---|---|---|
| 10-PF12NMA080SH08-M260F98T-D1-14 | 09 Jan. 2019 | | |

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