



Vincotech

# 30-EP12NIA600H703-PM00F83T

datasheet

flowNPC E3BP

1200 V / 600 A

## Topology features

- Low side Kelvin Emitter for improved switching performance
- Neutral Point Clamped Topology (I-Type)
- Split topology
- Temperature sensor

## Component features

- High speed switching
- Low collector emitter saturation voltage
- Low turn-off losses
- Optimized for hard switching topologies
- Positive temperature coefficient

## Housing features

- Base isolation: Al<sub>2</sub>O<sub>3</sub>
- Cu baseplate
- Convex shaped baseplate for superior thermal contact
- CTI600 housing material
- Baseplate with rough surface
- Press-fit pin
- Reliable cold welding connection
- Thermo-mechanical push-and-pull force relief

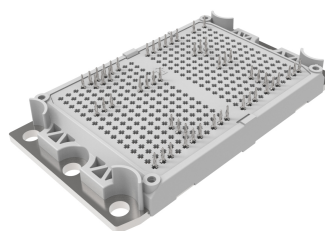
## Target applications

- Solar Inverters

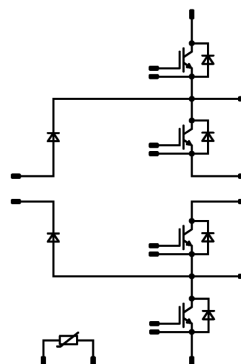
## Types

- 30-EP12NIA600H703-PM00F83T

## flow E3BP 12 mm housing



## Schematic





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## Maximum Ratings

$T_j = 25\text{ °C}$ , unless otherwise specified

| Parameter | Symbol | Conditions | Value | Unit |
|-----------|--------|------------|-------|------|
|-----------|--------|------------|-------|------|

### Buck Switch

|                                   |            |                                                  |          |    |
|-----------------------------------|------------|--------------------------------------------------|----------|----|
| Collector-emitter voltage         | $V_{CES}$  |                                                  | 1200     | V  |
| Collector current (DC current)    | $I_C$      | $T_j = T_{jmax}$ $T_a = 80\text{ °C}$            | 375      | A  |
| Repetitive peak collector current | $I_{CRM}$  | $t_p$ limited by $T_{jmax}$                      | 1800     | A  |
| Turn off safe operating area      |            | $T_j = 150\text{ °C}$ , $V_{CE} = 1200\text{ V}$ | 1800     | A  |
| Total power dissipation           | $P_{tot}$  | $T_j = T_{jmax}$ $T_a = 80\text{ °C}$            | 708      | W  |
| Gate-emitter voltage              | $V_{GES}$  |                                                  | $\pm 20$ | V  |
| Maximum junction temperature      | $T_{jmax}$ |                                                  | 175      | °C |

### Buck Diode

|                                        |            |                                                                     |      |    |
|----------------------------------------|------------|---------------------------------------------------------------------|------|----|
| Peak repetitive reverse voltage        | $V_{RRM}$  |                                                                     | 1200 | V  |
| Forward current (DC current)           | $I_F$      | $T_j = T_{jmax}$ $T_a = 80\text{ °C}$                               | 174  | A  |
| Repetitive peak forward current        | $I_{FRM}$  | $t_p$ limited by $T_{jmax}$                                         | 320  | A  |
| Surge (non-repetitive) forward current | $I_{FSM}$  | Single Half Sine Wave,<br>$t_p = 10\text{ ms}$ $T_j = 25\text{ °C}$ | 1280 | A  |
| Total power dissipation                | $P_{tot}$  | $T_j = T_{jmax}$ $T_a = 80\text{ °C}$                               | 365  | W  |
| Maximum junction temperature           | $T_{jmax}$ |                                                                     | 175  | °C |

### Boost Switch

|                                   |            |                                                                        |          |               |
|-----------------------------------|------------|------------------------------------------------------------------------|----------|---------------|
| Collector-emitter voltage         | $V_{CES}$  |                                                                        | 1200     | V             |
| Collector current (DC current)    | $I_C$      | $T_j = T_{jmax}$ $T_a = 80\text{ °C}$                                  | 298      | A             |
| Repetitive peak collector current | $I_{CRM}$  | $t_p$ limited by $T_{jmax}$                                            | 800      | A             |
| Total power dissipation           | $P_{tot}$  | $T_j = T_{jmax}$ $T_a = 80\text{ °C}$                                  | 551      | W             |
| Gate-emitter voltage              | $V_{GES}$  |                                                                        | $\pm 20$ | V             |
| Short circuit ratings             | $t_{SC}$   | $V_{GE} = 15\text{ V}$ , $V_{CC} = 800\text{ V}$ $T_j = 150\text{ °C}$ | 9,5      | $\mu\text{s}$ |
| Maximum junction temperature      | $T_{jmax}$ |                                                                        | 175      | °C            |



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## Maximum Ratings

$T_j = 25\text{ °C}$ , unless otherwise specified

| Parameter                       | Symbol     | Conditions                            | Value | Unit |
|---------------------------------|------------|---------------------------------------|-------|------|
| <b>Boost Diode</b>              |            |                                       |       |      |
| Peak repetitive reverse voltage | $V_{RRM}$  |                                       | 1200  | V    |
| Forward current (DC current)    | $I_F$      | $T_j = T_{jmax}$ $T_s = 80\text{ °C}$ | 110   | A    |
| Repetitive peak forward current | $I_{FRM}$  | $t_p$ limited by $T_{jmax}$           | 600   | A    |
| Total power dissipation         | $P_{tot}$  | $T_j = T_{jmax}$ $T_s = 80\text{ °C}$ | 196   | W    |
| Maximum junction temperature    | $T_{jmax}$ |                                       | 175   | °C   |

## Boost Sw. Inv. Diode

|                                 |            |                                       |      |    |
|---------------------------------|------------|---------------------------------------|------|----|
| Peak repetitive reverse voltage | $V_{RRM}$  |                                       | 1200 | V  |
| Forward current (DC current)    | $I_F$      | $T_j = T_{jmax}$ $T_s = 80\text{ °C}$ | 110  | A  |
| Repetitive peak forward current | $I_{FRM}$  | $t_p$ limited by $T_{jmax}$           | 600  | A  |
| Total power dissipation         | $P_{tot}$  | $T_j = T_{jmax}$ $T_s = 80\text{ °C}$ | 196  | W  |
| Maximum junction temperature    | $T_{jmax}$ |                                       | 175  | °C |

## 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* $t_p = 2\text{ s}$ | 6000  | V  |
| Creepage distance          |            |                                     | >12,7 | mm |
| Clearance                  |            |                                     | >12,7 | mm |
| Comparative Tracking Index | CTI        |                                     | ≥ 600 |    |

\*100 % tested in production



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## Characteristic Values

| Parameter | Symbol | Conditions |                              |                                           |                                     |            | Values |     |     | 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       | $V_{GE(th)}$  | $V_{CE} = V_{GE}$        |      |      | 0,0096 | 25               | 4,7 | 5,5                 | 6,2                 | V  |
| Collector-emitter saturation voltage | $V_{CE(sat)}$ |                          | 15   |      | 600    | 25<br>125<br>150 |     | 1,84<br>2,12<br>2,2 | 2,15 <sup>(1)</sup> | V  |
| Collector-emitter cut-off current    | $I_{CES}$     |                          | 0    | 1200 |        | 25               |     |                     | 32                  | μA |
| Gate-emitter leakage current         | $I_{GES}$     |                          | 20   | 0    |        | 25               |     |                     | 800                 | nA |
| Internal gate resistance             | $r_g$         |                          |      |      |        |                  |     | None                |                     | Ω  |
| Input capacitance                    | $C_{ies}$     | $f = 100 \text{ kHz}$    | 0    | 25   |        | 25               |     | 76800               |                     | pF |
| Output capacitance                   | $C_{oes}$     |                          |      |      |        |                  |     | 1472                |                     | pF |
| Reverse transfer capacitance         | $C_{res}$     |                          |      |      |        |                  |     | 432                 |                     | pF |
| Gate charge                          | $Q_g$         | $V_{CC} = 960 \text{ V}$ | 0/15 |      | 600    | 25               |     | 4400                |                     | nC |

### Thermal

|                                                    |               |                                               |  |  |  |  |  |      |  |     |
|----------------------------------------------------|---------------|-----------------------------------------------|--|--|--|--|--|------|--|-----|
| Thermal resistance junction to sink <sup>(2)</sup> | $R_{th(j-s)}$ | $\lambda_{paste} = 5,2 \text{ W/mK}$<br>(PTM) |  |  |  |  |  | 0,13 |  | K/W |
|----------------------------------------------------|---------------|-----------------------------------------------|--|--|--|--|--|------|--|-----|

### Dynamic

|                             |              |                                                                                                |          |     |     |                  |  |                            |  |     |
|-----------------------------|--------------|------------------------------------------------------------------------------------------------|----------|-----|-----|------------------|--|----------------------------|--|-----|
| Turn-on delay time          | $t_{d(on)}$  | $R_{gon} = 2 \Omega$<br>$R_{goff} = 2 \Omega$                                                  | $\pm 15$ | 600 | 600 | 25<br>125<br>150 |  | 448,53<br>454,88<br>454,49 |  | ns  |
| Rise time                   | $t_r$        |                                                                                                |          |     |     | 25<br>125<br>150 |  | 40<br>41,16<br>41,75       |  | ns  |
| Turn-off delay time         | $t_{d(off)}$ |                                                                                                |          |     |     | 25<br>125<br>150 |  | 354,82<br>392,1<br>400,56  |  | ns  |
| Fall time                   | $t_f$        |                                                                                                |          |     |     | 25<br>125<br>150 |  | 29,48<br>49,9<br>56,18     |  | ns  |
| Turn-on energy (per pulse)  | $E_{on}$     | $Q_{tFWD} = 1,2 \mu\text{C}$<br>$Q_{tFWD} = 1,19 \mu\text{C}$<br>$Q_{tFWD} = 1,16 \mu\text{C}$ |          |     |     | 25<br>125<br>150 |  | 23,89<br>24,75<br>24,23    |  | mWs |
| Turn-off energy (per pulse) | $E_{off}$    |                                                                                                |          |     |     | 25<br>125<br>150 |  | 15,12<br>24,13<br>29,41    |  | mWs |



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## Characteristic Values

| Parameter | Symbol | Conditions |                              |                                           |                                     |            | Values |     |     | 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 Diode

#### Static

|                         |       |                |  |  |     |                  |  |                      |                                           |    |
|-------------------------|-------|----------------|--|--|-----|------------------|--|----------------------|-------------------------------------------|----|
| Forward voltage         | $V_F$ |                |  |  | 160 | 25<br>125<br>150 |  | 1,49<br>1,82<br>1,94 | 1,65 <sup>(1)</sup><br>2,3 <sup>(1)</sup> | V  |
| Reverse leakage current | $I_R$ | $V_r = 1200$ V |  |  |     | 25               |  | 8                    | 800                                       | µA |

#### Thermal

|                                                    |               |                                       |  |  |  |  |  |      |  |     |
|----------------------------------------------------|---------------|---------------------------------------|--|--|--|--|--|------|--|-----|
| Thermal resistance junction to sink <sup>(2)</sup> | $R_{th(j-s)}$ | $\lambda_{paste} = 5,2$ W/mK<br>(PTM) |  |  |  |  |  | 0,26 |  | K/W |
|----------------------------------------------------|---------------|---------------------------------------|--|--|--|--|--|------|--|-----|

#### Dynamic

|                                       |                      |                                                                |          |     |     |                  |  |                                  |  |      |
|---------------------------------------|----------------------|----------------------------------------------------------------|----------|-----|-----|------------------|--|----------------------------------|--|------|
| Peak recovery current                 | $I_{RM}$             | $di/dt=17031$ A/µs<br>$di/dt=16259$ A/µs<br>$di/dt=15648$ A/µs | $\pm 15$ | 600 | 600 | 25<br>125<br>150 |  | 126,58<br>124,27<br>120,66       |  | A    |
| Reverse recovery time                 | $t_{rr}$             |                                                                |          |     |     | 25<br>125<br>150 |  | 16,88<br>16,78<br>16,49          |  | ns   |
| Recovered charge                      | $Q_r$                |                                                                |          |     |     | 25<br>125<br>150 |  | 1,2<br>1,19<br>1,16              |  | µC   |
| Reverse recovered energy              | $E_{rec}$            |                                                                |          |     |     | 25<br>125<br>150 |  | 0,136<br>0,138<br>0,132          |  | mWs  |
| Peak rate of fall of recovery current | $(di_{rr}/dt)_{max}$ |                                                                |          |     |     | 25<br>125<br>150 |  | 19015,73<br>24651,94<br>22411,45 |  | A/µs |



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## Characteristic Values

| Parameter | Symbol | Conditions |                              |                                           |                                     |            | Values |     |     | 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 |      |

### Boost Switch

#### Static

|                                      |              |                  |      |      |      |                  |     |                      |                     |    |
|--------------------------------------|--------------|------------------|------|------|------|------------------|-----|----------------------|---------------------|----|
| Gate-emitter threshold voltage       | $V_{GE(th)}$ |                  |      | 10   | 0,04 | 25               | 5,4 | 6                    | 6,6                 | V  |
| Collector-emitter saturation voltage | $V_{CEsat}$  |                  | 15   |      | 400  | 25<br>125<br>150 |     | 1,74<br>2,01<br>2,08 | 1,85 <sup>(1)</sup> | V  |
| Collector-emitter cut-off current    | $I_{CES}$    |                  | 0    | 1200 |      | 25               |     |                      | 200                 | µA |
| Gate-emitter leakage current         | $I_{GES}$    |                  | 20   | 0    |      | 25               |     |                      | 1000                | nA |
| Internal gate resistance             | $r_g$        |                  |      |      |      |                  |     | 1                    |                     | Ω  |
| Input capacitance                    | $C_{ies}$    | 0                | 10   |      | 25   |                  |     | 74000                |                     | pF |
| Output capacitance                   | $C_{oes}$    |                  |      |      |      |                  |     | 2200                 |                     | pF |
| Reverse transfer capacitance         | $C_{res}$    |                  |      |      |      |                  |     | 840                  |                     | pF |
| Gate charge                          | $Q_g$        | $V_{CC} = 600$ V | 0/15 |      | 400  | 25               |     | 2400                 |                     | nC |

#### Thermal

|                                                    |               |                                       |  |  |  |  |  |      |  |     |
|----------------------------------------------------|---------------|---------------------------------------|--|--|--|--|--|------|--|-----|
| Thermal resistance junction to sink <sup>(2)</sup> | $R_{th(j-s)}$ | $\lambda_{paste} = 5,2$ W/mK<br>(PTM) |  |  |  |  |  | 0,17 |  | K/W |
|----------------------------------------------------|---------------|---------------------------------------|--|--|--|--|--|------|--|-----|

#### Dynamic

|                             |              |                                                                        |     |     |     |                  |  |                            |  |     |
|-----------------------------|--------------|------------------------------------------------------------------------|-----|-----|-----|------------------|--|----------------------------|--|-----|
| Turn-on delay time          | $t_{d(on)}$  | $R_{gon} = 2$ Ω<br>$R_{goff} = 2$ Ω                                    | ±15 | 600 | 400 | 25<br>125<br>150 |  | 428,28<br>435,05<br>436,05 |  | ns  |
| Rise time                   | $t_r$        |                                                                        |     |     |     | 25<br>125<br>150 |  | 103,05<br>115,9<br>120,93  |  | ns  |
| Turn-off delay time         | $t_{d(off)}$ |                                                                        |     |     |     | 25<br>125<br>150 |  | 283,52<br>320,34<br>331,2  |  | ns  |
| Fall time                   | $t_f$        |                                                                        |     |     |     | 25<br>125<br>150 |  | 67,91<br>89,59<br>96,53    |  | ns  |
| Turn-on energy (per pulse)  | $E_{on}$     | $Q_{tFWD} = 5,97$ µC<br>$Q_{tFWD} = 13,28$ µC<br>$Q_{tFWD} = 15,74$ µC |     |     |     | 25<br>125<br>150 |  | 34,02<br>44,84<br>47,91    |  | mWs |
| Turn-off energy (per pulse) | $E_{off}$    |                                                                        |     |     |     | 25<br>125<br>150 |  | 30,36<br>41,66<br>44,65    |  | mWs |



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## Characteristic Values

| Parameter | Symbol | Conditions |                              |                                           |                                     |            | Values |     |     | 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 |      |

### Boost Diode

#### Static

|                         |       |                |  |  |     |                  |  |                      |                  |    |
|-------------------------|-------|----------------|--|--|-----|------------------|--|----------------------|------------------|----|
| Forward voltage         | $V_F$ |                |  |  | 200 | 25<br>125<br>150 |  | 2,72<br>2,42<br>2,34 | 3 <sup>(1)</sup> | V  |
| Reverse leakage current | $I_R$ | $V_r = 1200$ V |  |  |     | 25               |  |                      | 8                | µA |

#### Thermal

|                                                    |               |                                       |  |  |  |  |  |      |  |     |
|----------------------------------------------------|---------------|---------------------------------------|--|--|--|--|--|------|--|-----|
| Thermal resistance junction to sink <sup>(2)</sup> | $R_{th(j-s)}$ | $\lambda_{paste} = 5,2$ W/mK<br>(PTM) |  |  |  |  |  | 0,48 |  | K/W |
|----------------------------------------------------|---------------|---------------------------------------|--|--|--|--|--|------|--|-----|

#### Dynamic

|                                       |                      |                                                             |          |     |     |                  |  |                            |  |      |
|---------------------------------------|----------------------|-------------------------------------------------------------|----------|-----|-----|------------------|--|----------------------------|--|------|
| Peak recovery current                 | $I_{RM}$             | $di/dt=3256$ A/µs<br>$di/dt=3499$ A/µs<br>$di/dt=2911$ A/µs | $\pm 15$ | 600 | 400 | 25<br>125<br>150 |  | 96,99<br>113,85<br>119,02  |  | A    |
| Reverse recovery time                 | $t_{rr}$             |                                                             |          |     |     | 25<br>125<br>150 |  | 157,94<br>255,7<br>291,62  |  | ns   |
| Recovered charge                      | $Q_r$                |                                                             |          |     |     | 25<br>125<br>150 |  | 5,97<br>13,28<br>15,74     |  | µC   |
| Reverse recovered energy              | $E_{rec}$            |                                                             |          |     |     | 25<br>125<br>150 |  | 1,11<br>2,95<br>3,62       |  | mWs  |
| Peak rate of fall of recovery current | $(di_{rr}/dt)_{max}$ |                                                             |          |     |     | 25<br>125<br>150 |  | 3387,9<br>943,29<br>472,79 |  | A/µs |



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### Characteristic Values

| Parameter | Symbol | Conditions |                              |                                           |                                     |            |  | Values |     |     | 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 |      |

#### Boost Sw. Inv. Diode

##### Static

|                         |       |                |  |  |     |                  |  |                      |                  |  |    |
|-------------------------|-------|----------------|--|--|-----|------------------|--|----------------------|------------------|--|----|
| Forward voltage         | $V_F$ |                |  |  | 200 | 25<br>125<br>150 |  | 2,72<br>2,42<br>2,34 | 3 <sup>(1)</sup> |  | V  |
| Reverse leakage current | $I_R$ | $V_i = 1200$ V |  |  |     | 25               |  |                      | 8                |  | µA |

##### Thermal

|                                                    |               |                                       |  |  |  |  |  |      |  |  |     |
|----------------------------------------------------|---------------|---------------------------------------|--|--|--|--|--|------|--|--|-----|
| Thermal resistance junction to sink <sup>(2)</sup> | $R_{th(j-s)}$ | $\lambda_{paste} = 5,2$ W/mK<br>(PTM) |  |  |  |  |  | 0,48 |  |  | K/W |
|----------------------------------------------------|---------------|---------------------------------------|--|--|--|--|--|------|--|--|-----|

#### Thermistor

##### Static

|                                |                |                    |  |  |  |     |    |      |   |  |      |
|--------------------------------|----------------|--------------------|--|--|--|-----|----|------|---|--|------|
| Rated resistance               | $R$            |                    |  |  |  | 25  |    | 22   |   |  | kΩ   |
| Deviation of R100              | $\Delta_{R/R}$ | $R_{100} = 1484$ Ω |  |  |  | 100 | -5 |      | 5 |  | %    |
| Power dissipation              | $P$            |                    |  |  |  | 25  |    | 130  |   |  | mW   |
| Power dissipation constant     | $d$            |                    |  |  |  | 25  |    | 1,5  |   |  | mW/K |
| B-value                        | $B_{(25/50)}$  | Tol. ±1 %          |  |  |  |     |    | 3962 |   |  | K    |
| B-value                        | $B_{(25/100)}$ | Tol. ±1 %          |  |  |  |     |    | 4000 |   |  | K    |
| Vincotech Thermistor Reference |                |                    |  |  |  |     |    |      | I |  |      |

<sup>(1)</sup> Value at chip level

<sup>(2)</sup> Only valid with pre-applied Vincotech thermal interface material.



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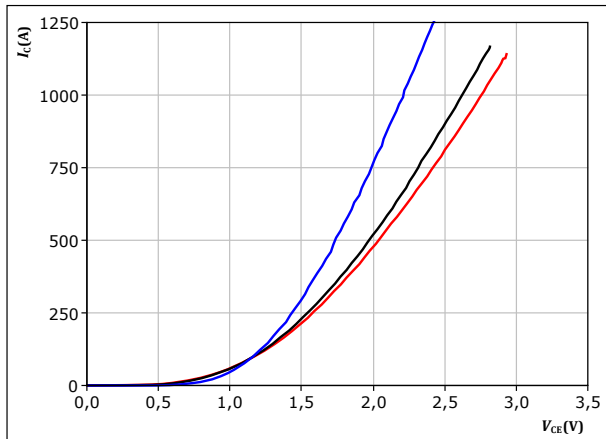
datasheet

## Buck Switch Characteristics

figure 1. IGBT

Typical output characteristics

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



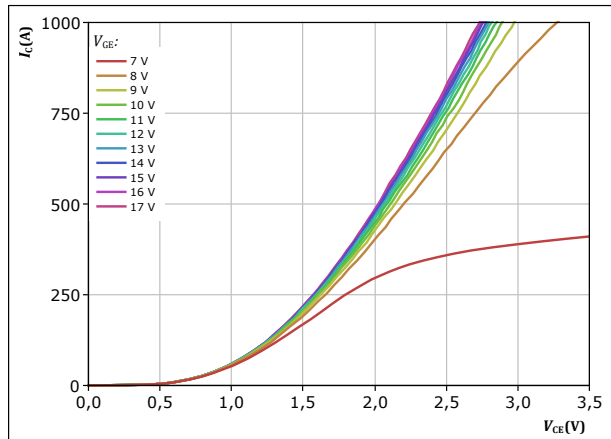
$t_p = 250 \mu s$   
 $V_{GE} = 15 V$

$T_j$ :  
— 25 °C  
— 125 °C  
— 150 °C

figure 2. IGBT

Typical output characteristics

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

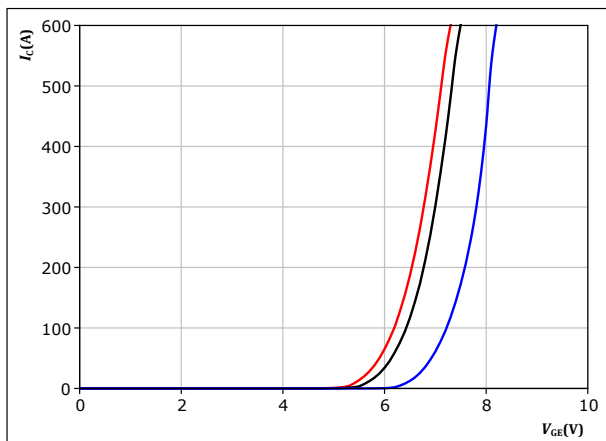


$t_p = 250 \mu s$   
 $T_j = 150 ^\circ C$   
 $V_{GE}$  from 7 V to 17 V in steps of 1 V

figure 3. IGBT

Typical transfer characteristics

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



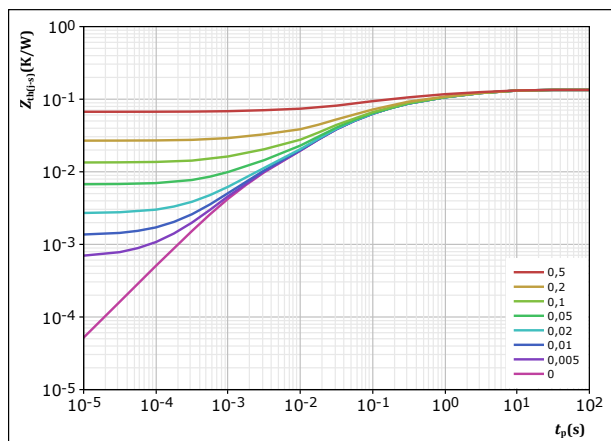
$t_p = 250 \mu s$   
 $V_{CE} = 10 V$

$T_j$ :  
— 25 °C  
— 125 °C  
— 150 °C

figure 4. IGBT

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$   
 $R_{th(j-s)} = 0,134 K/W$   
IGBT thermal model values  

| $R (K/W)$ | $\tau (s)$ |
|-----------|------------|
| 1,79E-02  | 5,14E+00   |
| 2,60E-02  | 1,43E+00   |
| 4,74E-02  | 1,95E-01   |
| 3,68E-02  | 2,86E-02   |
| 6,13E-03  | 1,70E-03   |



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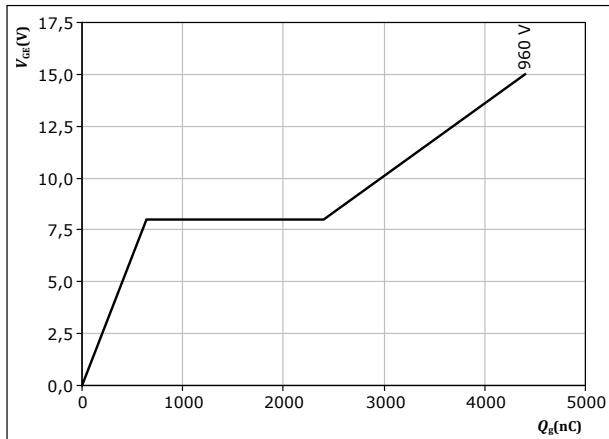
## Buck Switch Characteristics

figure 5.

IGBT

Gate voltage vs gate charge

$$V_{GE} = f(Q_g)$$



$I_C = 600$  A  
 $T_j = 25$  °C



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## Buck Diode Characteristics

figure 6. FWD

Typical forward characteristics

$$I_F = f(V_F)$$

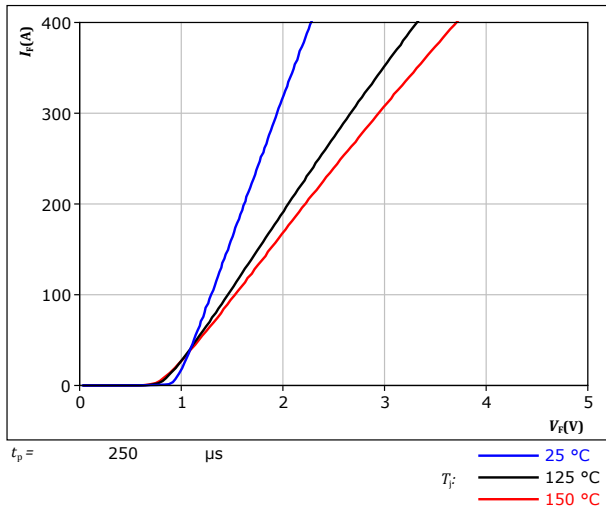
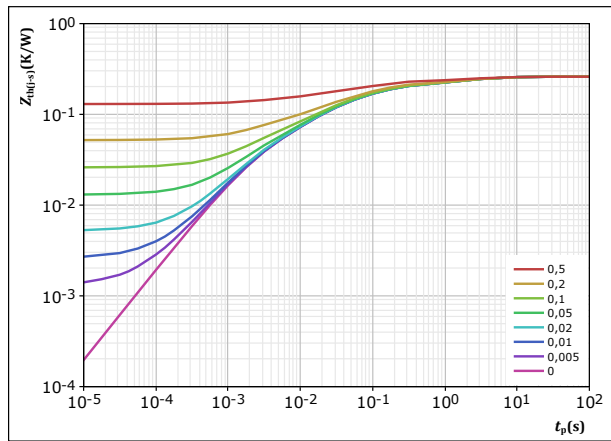


figure 7. FWD

Transient thermal impedance as a function of pulse width

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



|                          |            |     |
|--------------------------|------------|-----|
| $D =$                    | $t_p / T$  |     |
| $R_{th(j-s)} =$          | 0,26       | K/W |
| FWD thermal model values |            |     |
| $R$ (K/W)                | $\tau$ (s) |     |
| 2,45E-02                 | 4,55E+00   |     |
| 3,89E-02                 | 1,09E+00   |     |
| 1,02E-01                 | 8,48E-02   |     |
| 6,60E-02                 | 1,47E-02   |     |
| 2,83E-02                 | 2,05E-03   |     |



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datasheet

## Boost Switch Characteristics

figure 8. IGBT

Typical output characteristics

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

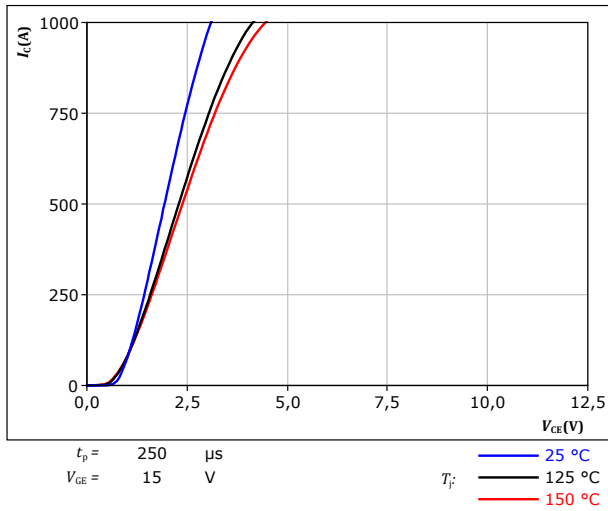


figure 9. IGBT

Typical output characteristics

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

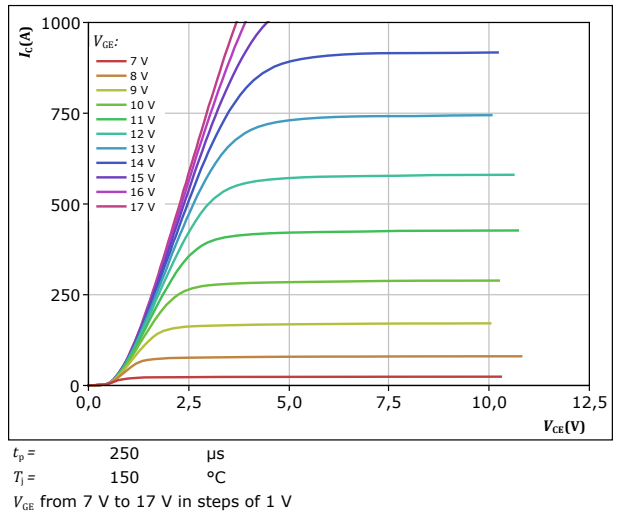


figure 10. IGBT

Typical transfer characteristics

$$I_c = f(V_{GE})$$

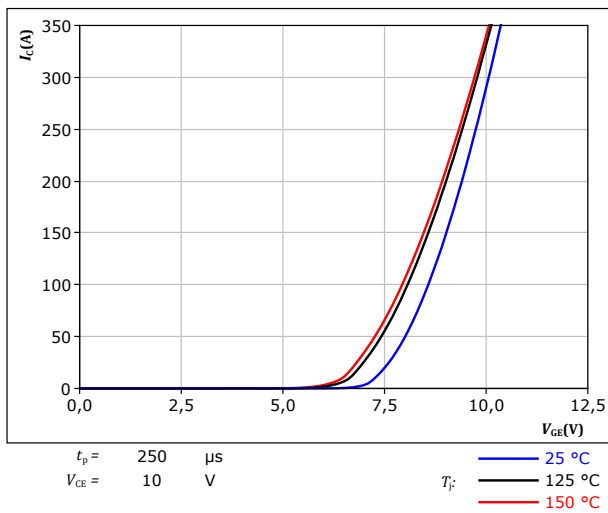
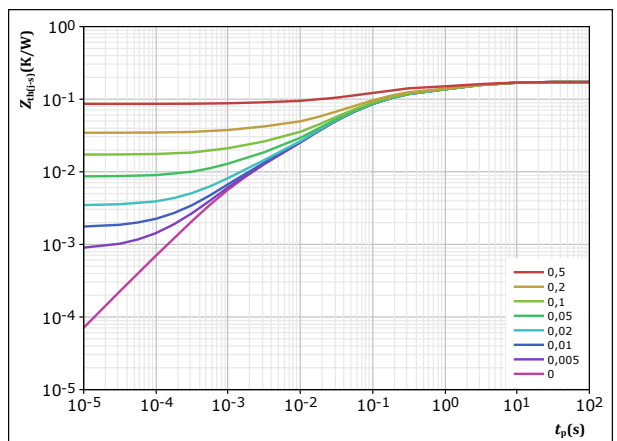


figure 11. IGBT

Transient thermal impedance as a function of pulse width

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



| IGBT thermal model values |            |
|---------------------------|------------|
| $R$ (K/W)                 | $\tau$ (s) |
| 2,18E-02                  | 5,31E+00   |
| 3,84E-02                  | 1,27E+00   |
| 7,42E-02                  | 1,08E-01   |
| 3,10E-02                  | 2,16E-02   |
| 6,97E-03                  | 1,39E-03   |



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datasheet

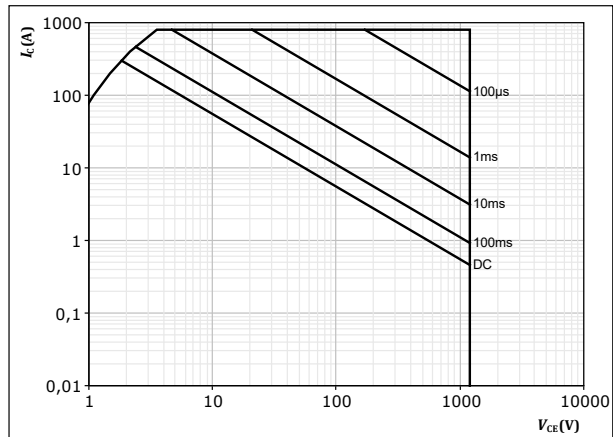
## Boost Switch Characteristics

figure 12.

IGBT

Safe operating area

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



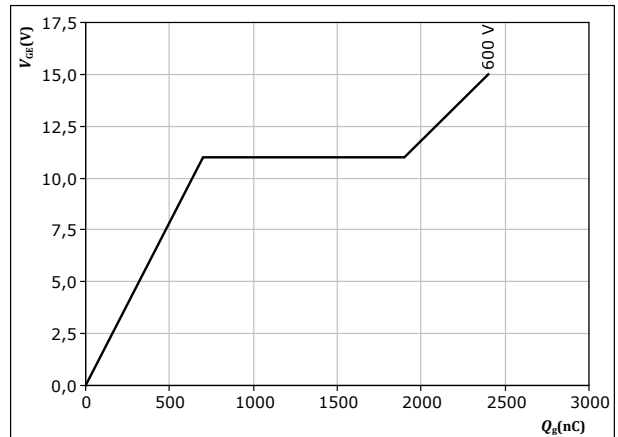
$D =$  single pulse  
 $T_s = 80$  °C  
 $V_{GE} = 15$  V  
 $T_j = T_{jmax}$

figure 13.

IGBT

Gate voltage vs gate charge

$$V_{GE} = f(Q_g)$$



$I_C = 400$  A  
 $T_j = 25$  °C



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## Boost Diode Characteristics

figure 14.

FWD

Typical forward characteristics

$$I_F = f(V_F)$$

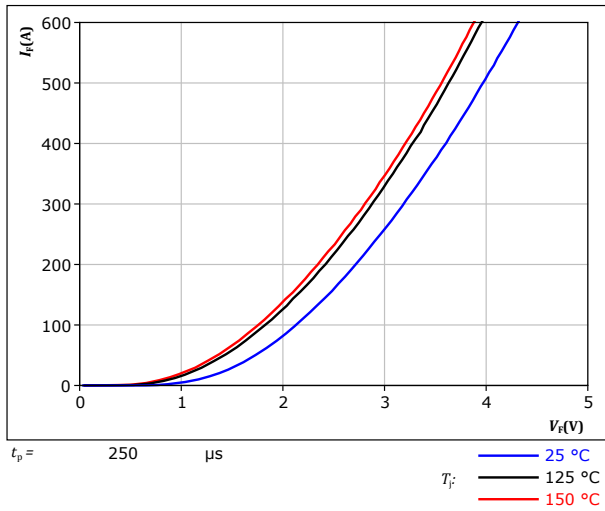
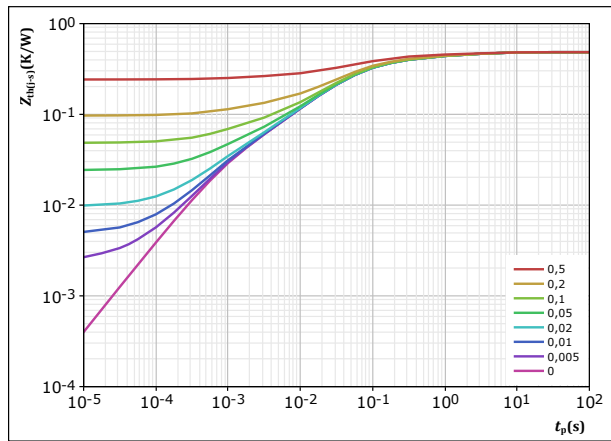


figure 15.

FWD

Transient thermal impedance as a function of pulse width

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



|                          |            |
|--------------------------|------------|
| $D =$                    | $t_p / T$  |
| $R_{th(j-s)} =$          | 0,484 K/W  |
| FWD thermal model values |            |
| $R$ (K/W)                | $\tau$ (s) |
| 4,96E-02                 | 3,28E+00   |
| 7,95E-02                 | 4,30E-01   |
| 2,38E-01                 | 6,16E-02   |
| 8,86E-02                 | 1,21E-02   |
| 2,86E-02                 | 9,94E-04   |



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## Boost Sw. Inv. Diode Characteristics

figure 16. FWD

Typical forward characteristics

$$I_F = f(V_F)$$

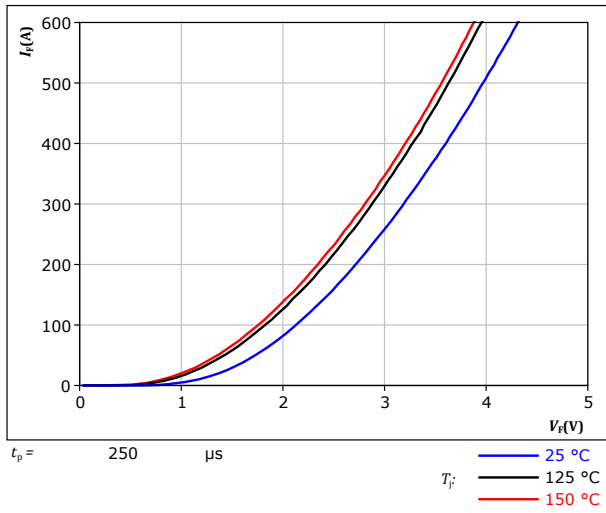
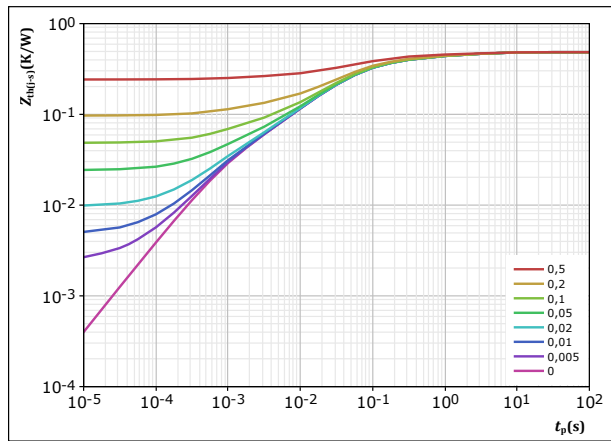


figure 17. FWD

Transient thermal impedance as a function of pulse width

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



|                          |            |
|--------------------------|------------|
| $D =$                    | $t_p / T$  |
| $R_{th(j-s)} =$          | 0,484 K/W  |
| FWD thermal model values |            |
| $R$ (K/W)                | $\tau$ (s) |
| 4,96E-02                 | 3,28E+00   |
| 7,95E-02                 | 4,30E-01   |
| 2,38E-01                 | 6,16E-02   |
| 8,86E-02                 | 1,21E-02   |
| 2,86E-02                 | 9,94E-04   |



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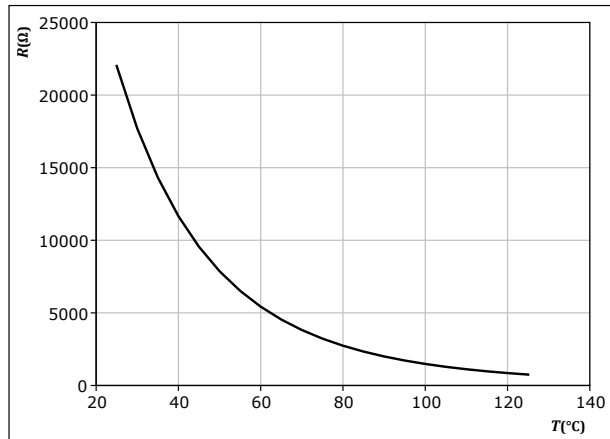
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datasheet

## Thermistor Characteristics

**figure 18.** Thermistor

Typical NTC characteristic as function of temperature

$$R_T = f(T)$$





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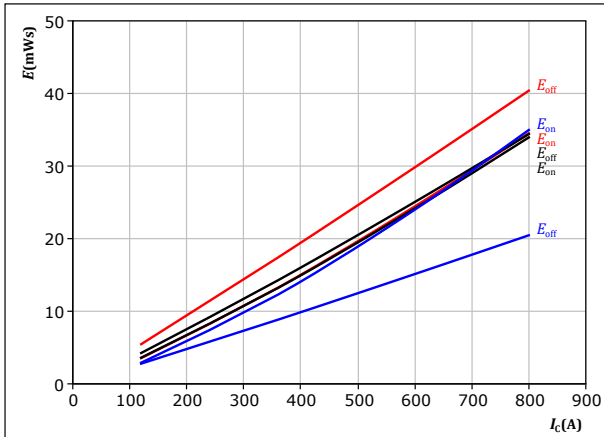
## Buck Switching Characteristics

figure 19.

IGBT

Typical switching energy losses as a function of collector current

$$E = f(I_C)$$



With an inductive load at

$V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $R_{gon} = 2 \text{ } \Omega$   
 $R_{goff} = 2 \text{ } \Omega$

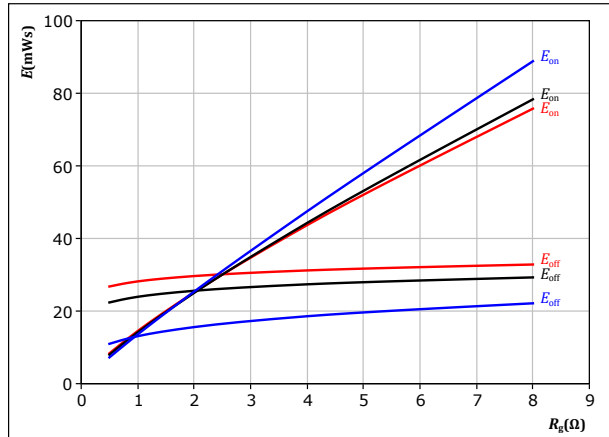
$T_j$ :  $25 \text{ } ^\circ\text{C}$  (blue)  
 $125 \text{ } ^\circ\text{C}$  (black)  
 $150 \text{ } ^\circ\text{C}$  (red)

figure 20.

IGBT

Typical switching energy losses as a function of IGBT turn on gate resistor

$$E = f(R_g)$$



With an inductive load at

$V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $I_C = 600 \text{ A}$

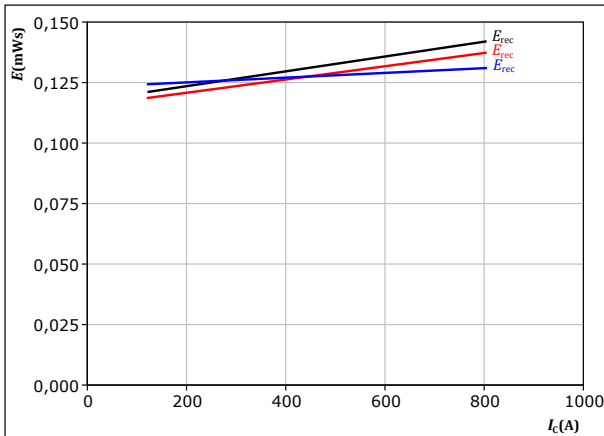
$T_j$ :  $25 \text{ } ^\circ\text{C}$  (blue)  
 $125 \text{ } ^\circ\text{C}$  (black)  
 $150 \text{ } ^\circ\text{C}$  (red)

figure 21.

FWD

Typical reverse recovered energy loss as a function of collector current

$$E_{rec} = f(I_C)$$



With an inductive load at

$V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $R_{gon} = 2 \text{ } \Omega$

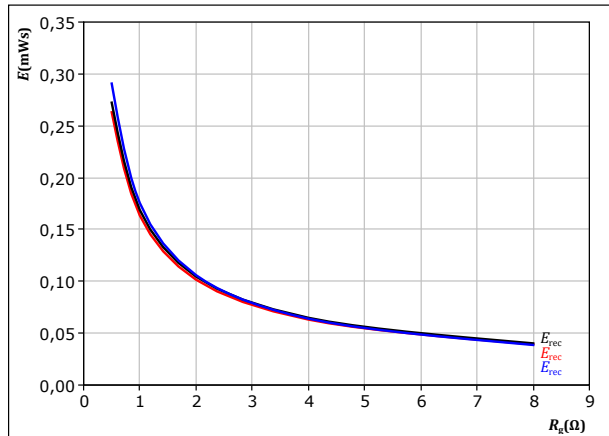
$T_j$ :  $25 \text{ } ^\circ\text{C}$  (blue)  
 $125 \text{ } ^\circ\text{C}$  (black)  
 $150 \text{ } ^\circ\text{C}$  (red)

figure 22.

FWD

Typical reverse recovered energy loss as a function of IGBT turn on gate resistor

$$E_{rec} = f(R_g)$$



With an inductive load at

$V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $I_C = 600 \text{ A}$

$T_j$ :  $25 \text{ } ^\circ\text{C}$  (blue)  
 $125 \text{ } ^\circ\text{C}$  (black)  
 $150 \text{ } ^\circ\text{C}$  (red)



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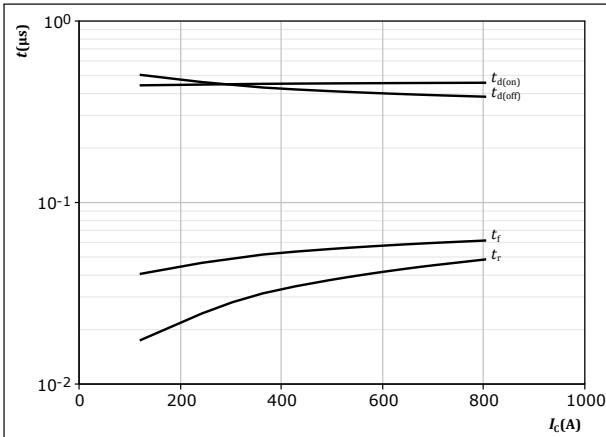
datasheet

## Buck Switching Characteristics

figure 23.

IGBT

Typical switching times as a function of collector current  
 $t = f(I_C)$



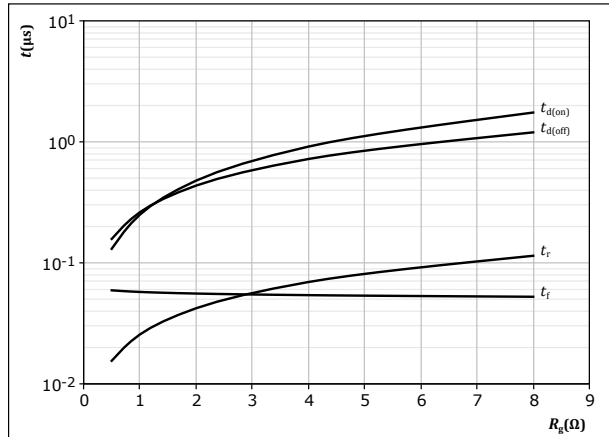
With an inductive load at

$T_j = 150$  °C  
 $V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $R_{gon} = 2$   $\Omega$   
 $R_{goff} = 2$   $\Omega$

figure 24.

IGBT

Typical switching times as a function of IGBT turn on gate resistor  
 $t = f(R_g)$



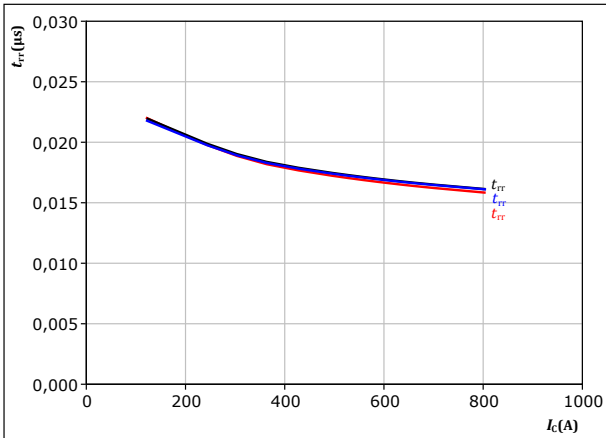
With an inductive load at

$T_j = 150$  °C  
 $V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $I_C = 600$  A

figure 25.

FWD

Typical reverse recovery time as a function of collector current  
 $t_{rr} = f(I_C)$



With an inductive load at

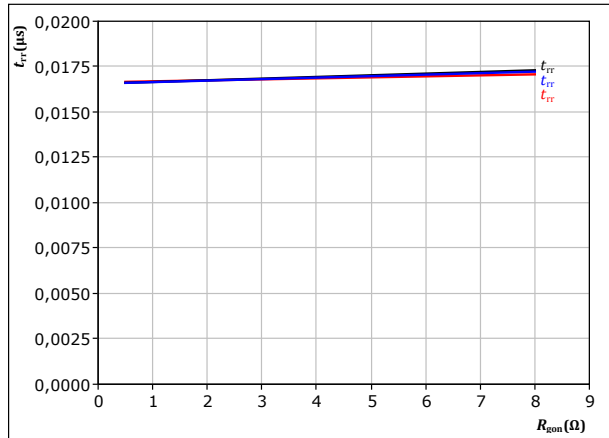
$V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $R_{gon} = 2$   $\Omega$

$T_j$ : 25 °C  
125 °C  
150 °C

figure 26.

FWD

Typical reverse recovery time as a function of IGBT turn on gate resistor  
 $t_{rr} = f(R_{gon})$



With an inductive load at

$V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $I_C = 600$  A

$T_j$ : 25 °C  
125 °C  
150 °C



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datasheet

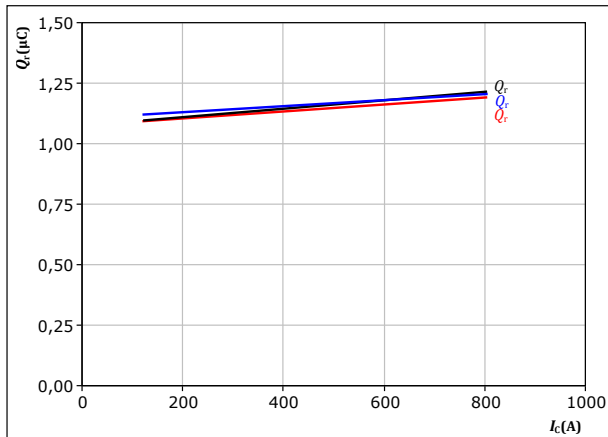
## Buck Switching Characteristics

figure 27.

FWD

Typical recovered charge as a function of collector current

$$Q_r = f(I_c)$$



With an inductive load at

$V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $R_{gon} = 2$  Ω

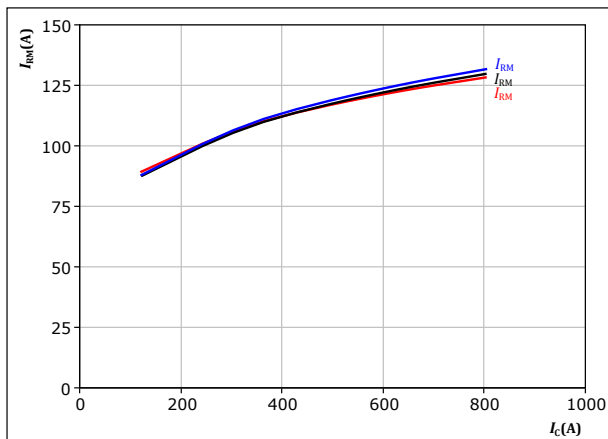
$T_j$ : — 25 °C  
— 125 °C  
— 150 °C

figure 29.

FWD

Typical peak reverse recovery current as a function of collector current

$$I_{RM} = f(I_c)$$



With an inductive load at

$V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $R_{gon} = 2$  Ω

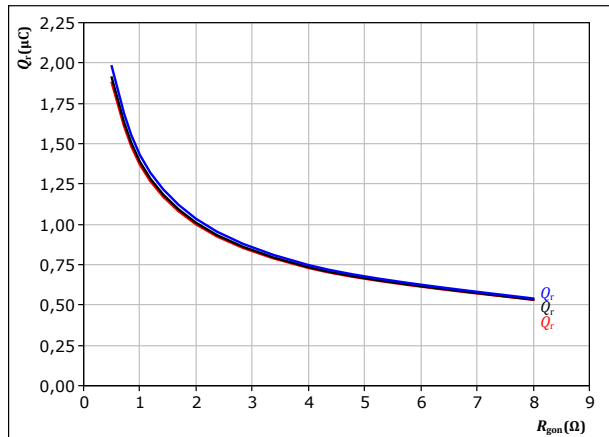
$T_j$ : — 25 °C  
— 125 °C  
— 150 °C

figure 28.

FWD

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

$$Q_r = f(R_{gon})$$



With an inductive load at

$V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $I_c = 600$  A

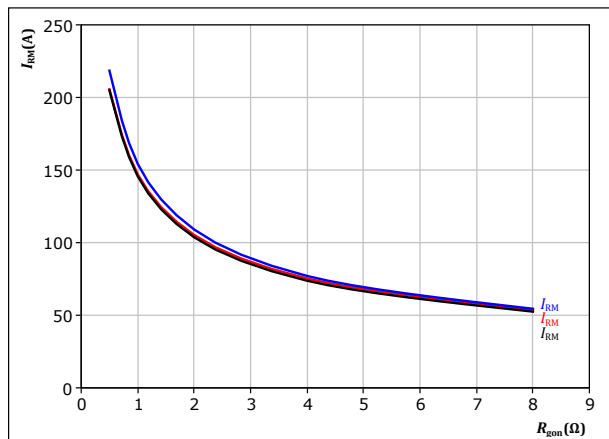
$T_j$ : — 25 °C  
— 125 °C  
— 150 °C

figure 30.

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

$V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $I_c = 600$  A

$T_j$ : — 25 °C  
— 125 °C  
— 150 °C



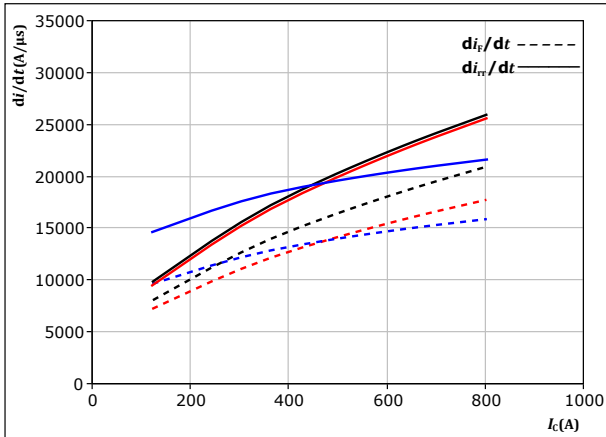
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datasheet

## Buck Switching Characteristics

**figure 31.** FWD

Typical rate of fall of forward and reverse recovery current as a function of collector current  
 $di_f/dt, di_r/dt = f(I_C)$



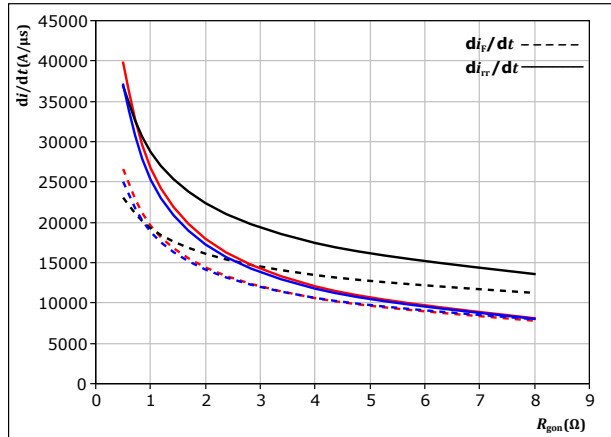
With an inductive load at

$V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $R_{gon} = 2 \text{ } \Omega$

$T_j:$  — 25 °C  
— 125 °C  
— 150 °C

**figure 32.** FWD

Typical rate of fall of forward and reverse recovery current as a function of turn on gate resistor  
 $di_f/dt, di_r/dt = f(R_{gon})$



With an inductive load at

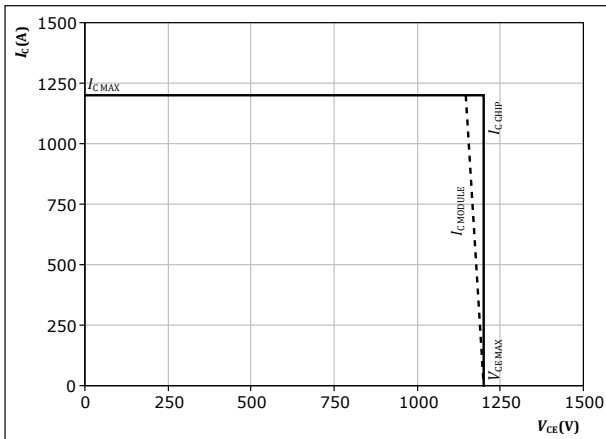
$V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $I_C = 600 \text{ A}$

$T_j:$  — 25 °C  
— 125 °C  
— 150 °C

**figure 33.** IGBT

Reverse bias safe operating area

$I_C = f(V_{CE})$



At  $T_j = 150 \text{ } ^\circ\text{C}$   
 $R_{gon} = 2 \text{ } \Omega$   
 $R_{goff} = 2 \text{ } \Omega$



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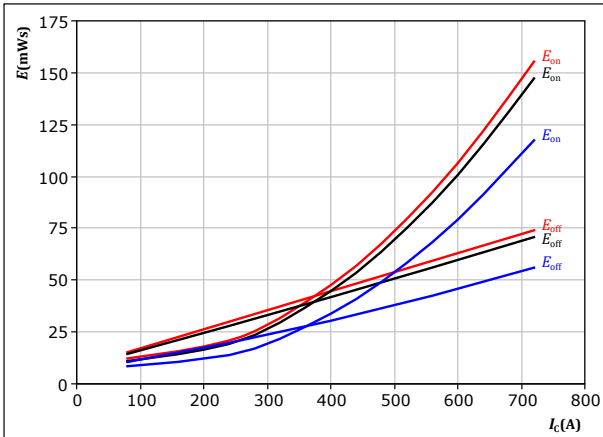
## Boost Switching Characteristics

figure 34.

IGBT

Typical switching energy losses as a function of collector current

$$E = f(I_c)$$



With an inductive load at

$V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $R_{gon} = 2$   $\Omega$   
 $R_{goff} = 2$   $\Omega$

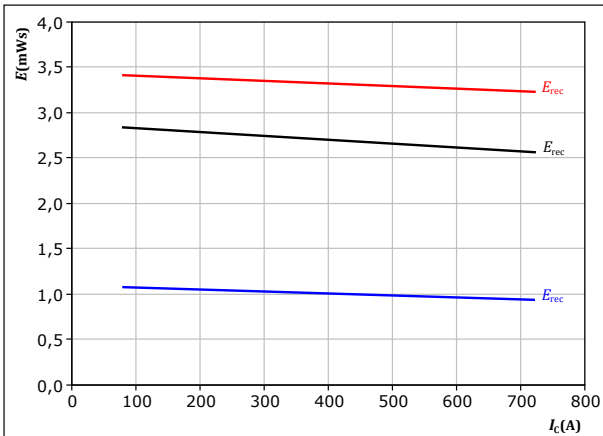
$T_j$ : — 25 °C  
— 125 °C  
— 150 °C

figure 36.

FWD

Typical reverse recovered energy loss as a function of collector current

$$E_{rec} = f(I_c)$$



With an inductive load at

$V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $R_{gon} = 2$   $\Omega$

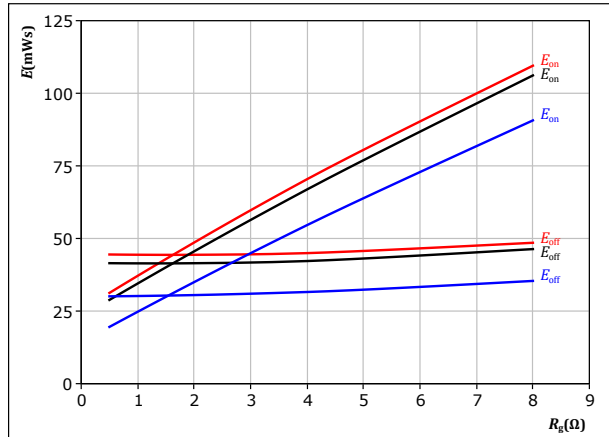
$T_j$ : — 25 °C  
— 125 °C  
— 150 °C

figure 35.

IGBT

Typical switching energy losses as a function of IGBT turn on gate resistor

$$E = f(R_g)$$



With an inductive load at

$V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $I_c = 400$  A

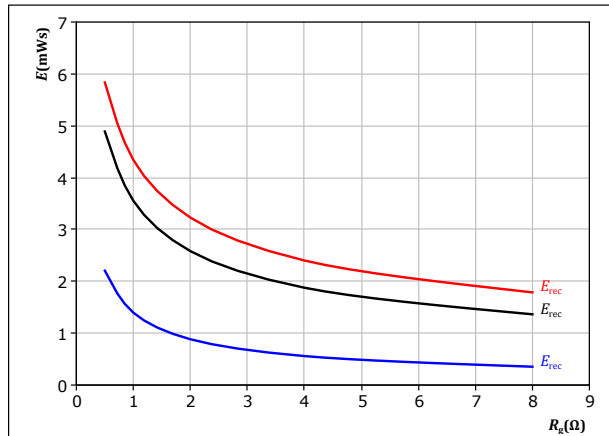
$T_j$ : — 25 °C  
— 125 °C  
— 150 °C

figure 37.

FWD

Typical reverse recovered energy loss as a function of IGBT turn on gate resistor

$$E_{rec} = f(R_g)$$



With an inductive load at

$V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $I_c = 400$  A

$T_j$ : — 25 °C  
— 125 °C  
— 150 °C



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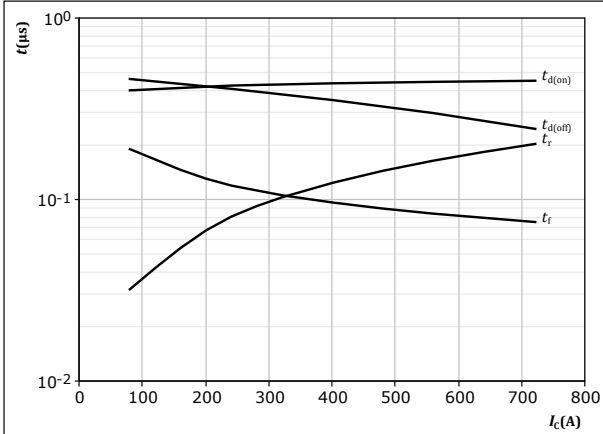
# 30-EP12NIA600H703-PM00F83T datasheet

## Boost Switching Characteristics

figure 38.

IGBT

Typical switching times as a function of collector current  
 $t = f(I_C)$



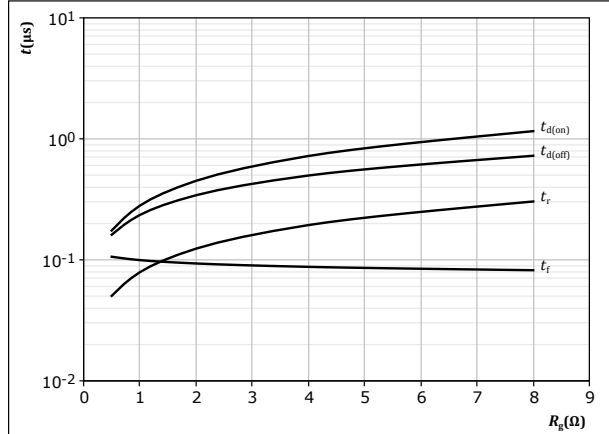
With an inductive load at

$T_j = 150$  °C  
 $V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $R_{gon} = 2$   $\Omega$   
 $R_{goff} = 2$   $\Omega$

figure 39.

IGBT

Typical switching times as a function of IGBT turn on gate resistor  
 $t = f(R_g)$



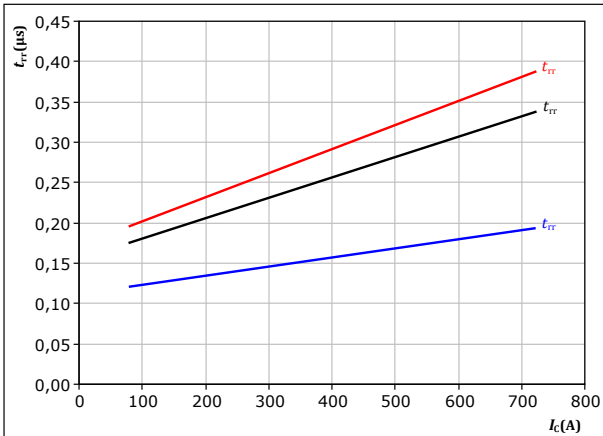
With an inductive load at

$T_j = 150$  °C  
 $V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $I_C = 400$  A

figure 40.

FWD

Typical reverse recovery time as a function of collector current  
 $t_{rr} = f(I_C)$



With an inductive load at

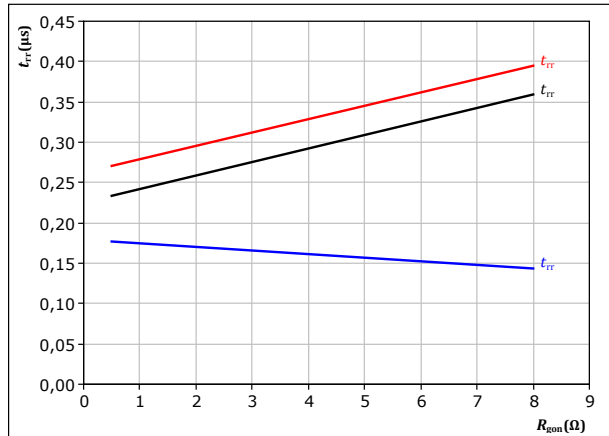
$V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $R_{gon} = 2$   $\Omega$

$T_j$ : 25 °C  
125 °C  
150 °C

figure 41.

FWD

Typical reverse recovery time as a function of IGBT turn on gate resistor  
 $t_{rr} = f(R_{gon})$



With an inductive load at

$V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $I_C = 400$  A

$T_j$ : 25 °C  
125 °C  
150 °C



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datasheet

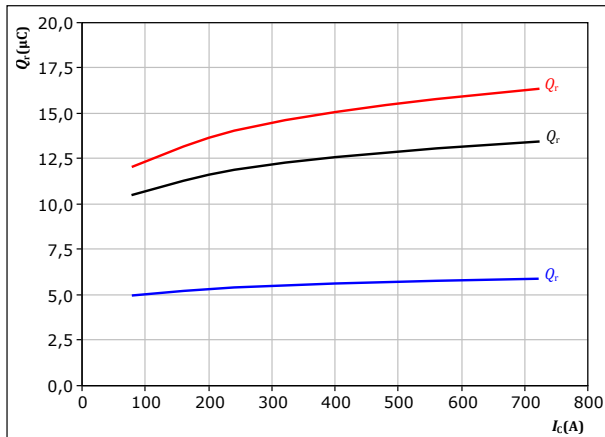
## Boost Switching Characteristics

figure 42.

FWD

Typical recovered charge as a function of collector current

$$Q_r = f(I_c)$$



With an inductive load at

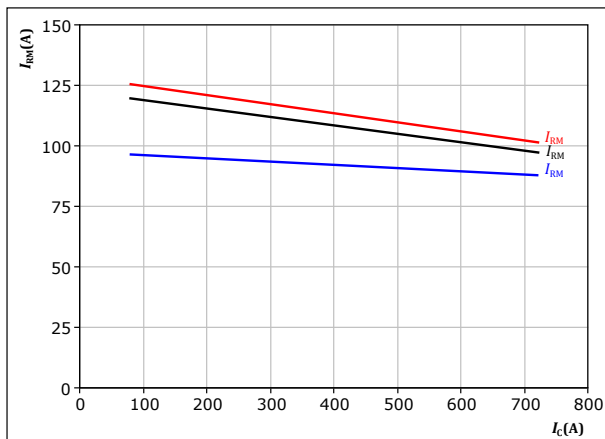
$V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $R_{gon} = 2$  Ω  
 $T_j:$  25 °C (blue), 125 °C (black), 150 °C (red)

figure 44.

FWD

Typical peak reverse recovery current as a function of collector current

$$I_{RM} = f(I_c)$$



With an inductive load at

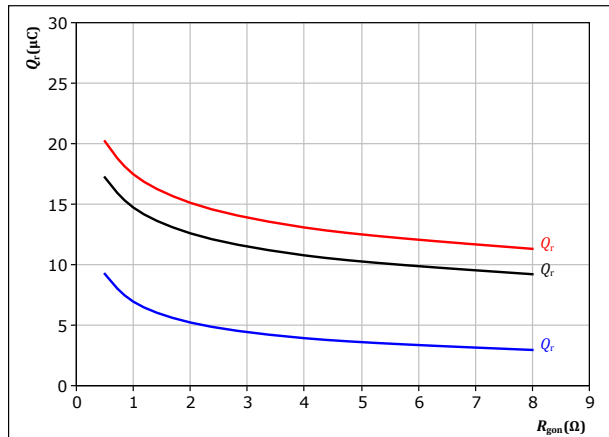
$V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $R_{gon} = 2$  Ω  
 $T_j:$  25 °C (blue), 125 °C (black), 150 °C (red)

figure 43.

FWD

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

$$Q_r = f(R_{gon})$$



With an inductive load at

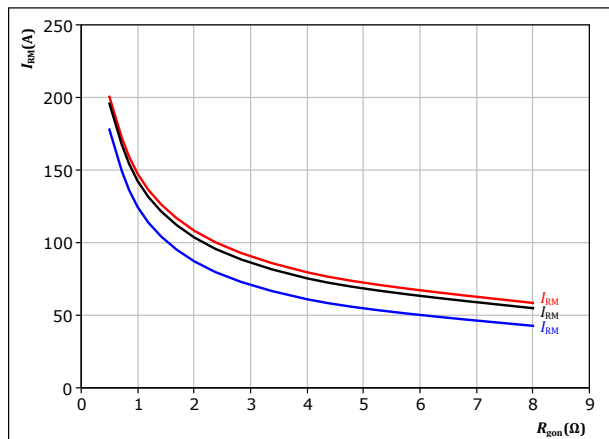
$V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $I_c = 400$  A  
 $T_j:$  25 °C (blue), 125 °C (black), 150 °C (red)

figure 45.

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

$V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $I_c = 400$  A  
 $T_j:$  25 °C (blue), 125 °C (black), 150 °C (red)



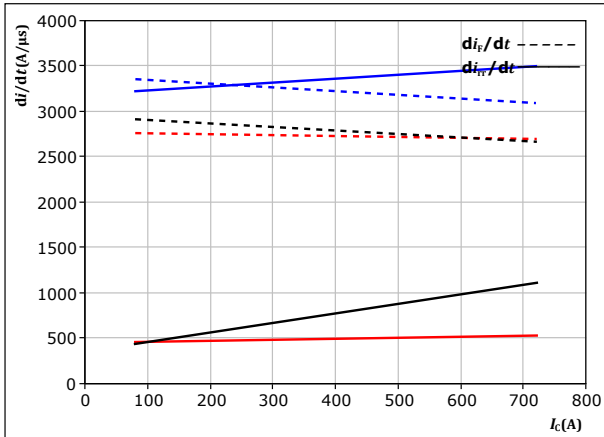
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## Boost Switching Characteristics

figure 46. FWD

Typical rate of fall of forward and reverse recovery current as a function of collector current  
 $di_f/dt, di_r/dt = f(I_C)$



With an inductive load at

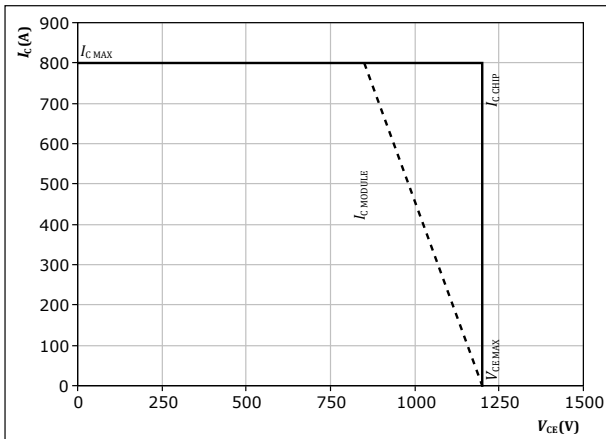
$V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $R_{gon} = 2$   $\Omega$

$T_j$ :  
— 25 °C  
— 125 °C  
— 150 °C

figure 48. IGBT

Reverse bias safe operating area

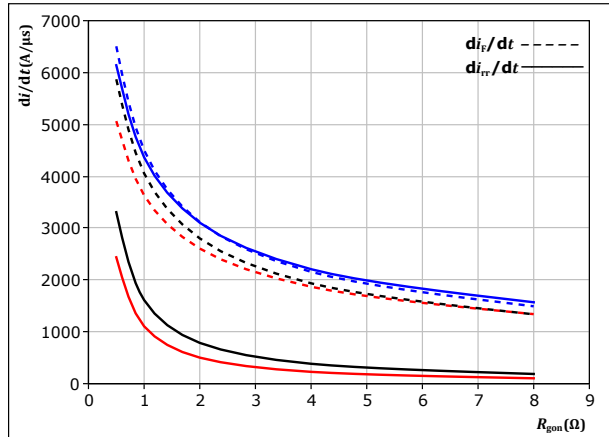
$I_C = f(V_{CE})$



At  $T_j = 150$  °C  
 $R_{gon} = 2$   $\Omega$   
 $R_{goff} = 2$   $\Omega$

figure 47. FWD

Typical rate of fall of forward and reverse recovery current as a function of turn on gate resistor  
 $di_f/dt, di_r/dt = f(R_{gon})$



With an inductive load at

$V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $I_C = 400$  A

$T_j$ :  
— 25 °C  
— 125 °C  
— 150 °C



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## Switching Definitions

figure 49. IGBT

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

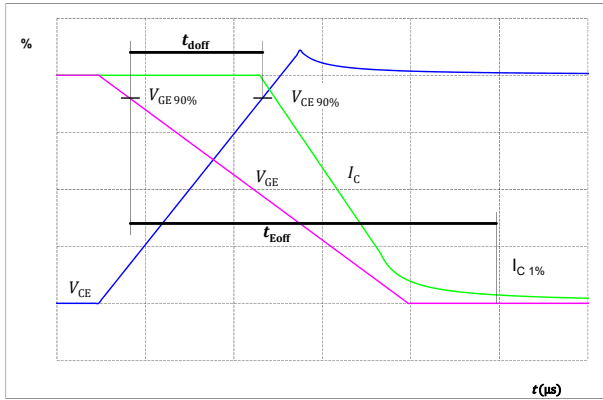


figure 50. IGBT

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

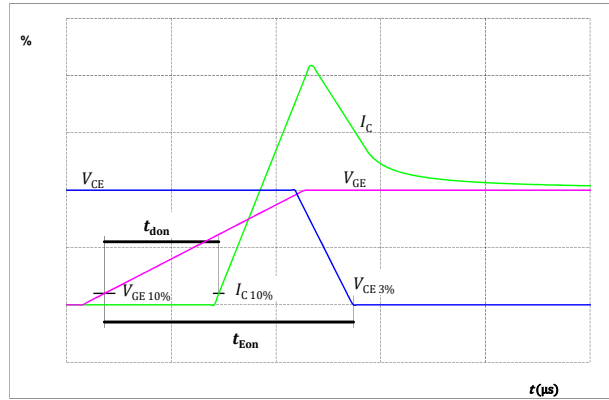


figure 51. IGBT

Turn-off Switching Waveforms & definition of  $t_f$

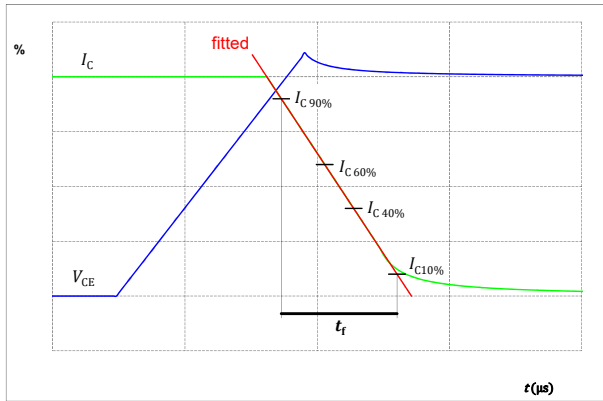
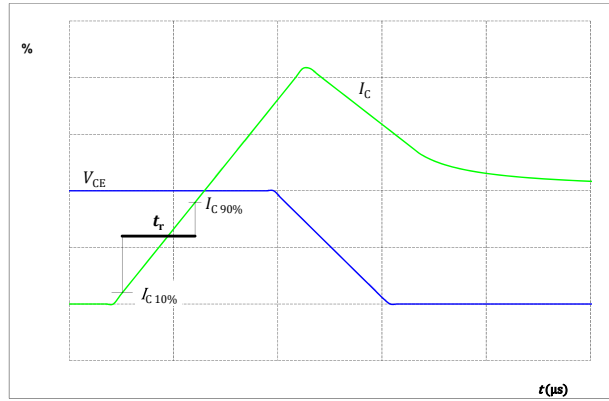


figure 52. IGBT

Turn-on Switching Waveforms & definition of  $t_r$





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## Switching Definitions

figure 53.

FWD

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

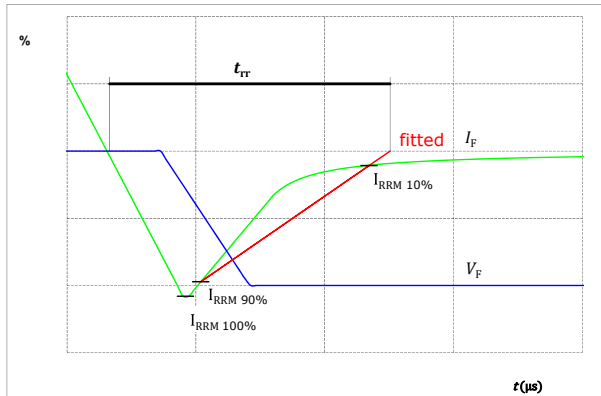
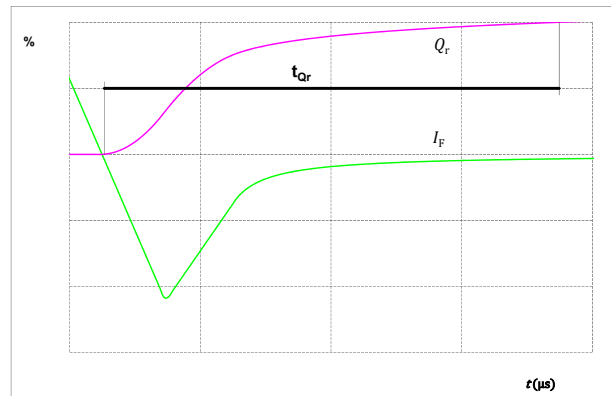


figure 54.

FWD

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





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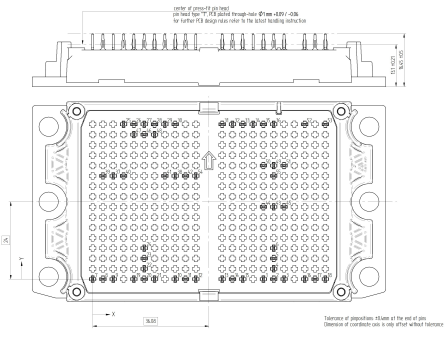
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| Ordering Code                            |                                |
|------------------------------------------|--------------------------------|
| Version                                  | Ordering Code                  |
| Without thermal paste                    | 30-EP12NIA600H703-PM00F83T     |
| With thermal paste (5,2 W/mK, PTM6000HV) | 30-EP12NIA600H703-PM00F83T-/7/ |

| Marking                                                                           |            |                               |            |          |           |        |
|-----------------------------------------------------------------------------------|------------|-------------------------------|------------|----------|-----------|--------|
|  | Text       | Name                          | Date code  | UL & VIN | Lot       | Serial |
|                                                                                   |            | NN-NNNNNNNNNNNNNN-<br>TTTTTVV | WWYY       | UL VIN   | LLLL      | SSSS   |
|                                                                                   | Datamatrix | Type&Ver                      | Lot number | Serial   | Date code |        |
|                                                                                   |            | TTTTTVV                       | LLLL       | SSSS     | WWYY      |        |

| Outline        |       |     |          |    |       |      |        |  |
|----------------|-------|-----|----------|----|-------|------|--------|--|
| Pin table [mm] |       |     |          |    |       |      |        |  |
| Pin            | X     | Y   | Function | 29 | 22,4  | 48   | Ph12   |  |
| 1              | 52,96 | 0   | DC-      | 30 | 25,6  | 48   | Ph12   |  |
| 2              | 56,16 | 0   | DC-      | 31 | 40,16 | 48   | Ph11   |  |
| 3              | 59,36 | 0   | DC-      | 32 | 43,36 | 48   | Ph11   |  |
| 4              | 56,16 | 3,2 | DC-      | 33 | 46,56 | 48   | Ph11   |  |
| 5              | 56,16 | 6,4 | DC-      | 34 | 49,76 | 48   | Ph11   |  |
| 6              | 56,16 | 9,6 | DC-      | 35 | 52,96 | 48   | Ph11   |  |
| 7              | 0     | 0   | GND21    | 36 | 56,16 | 48   | Ph11   |  |
| 8              | 3,2   | 0   | GND21    | 37 | 6,4   | 32   | G11-1  |  |
| 9              | 6,4   | 0   | GND21    | 38 | 25,6  | 32   | G11-2  |  |
| 10             | 25,6  | 0   | GND22    | 39 | 3,2   | 32   | S11    |  |
| 11             | 28,8  | 0   | GND22    | 40 | 9,6   | 32   | S11    |  |
| 12             | 32    | 0   | GND22    | 41 | 22,4  | 32   | S11    |  |
| 13             | 40,16 | 0   | GND12    | 42 | 28,8  | 32   | S11    |  |
| 14             | 43,36 | 0   | GND12    | 43 | 56,16 | 22,4 | G12    |  |
| 15             | 46,56 | 0   | GND12    | 44 | 52,96 | 22,4 | S12    |  |
| 16             | 65,76 | 0   | GND11    | 45 | 59,36 | 22,4 | S12    |  |
| 17             | 68,96 | 0   | GND11    | 46 | 16    | 44,8 | S13    |  |
| 18             | 72,16 | 0   | GND11    | 47 | 12,8  | 44,8 | G13-1  |  |
| 19             | 12,8  | 0   | DC+      | 48 | 19,2  | 44,8 | G13-2  |  |
| 20             | 16    | 0   | DC+      | 49 | 56,16 | 35,2 | S14    |  |
| 21             | 19,2  | 0   | DC+      | 50 | 52,96 | 35,2 | G14-2  |  |
| 22             | 16    | 3,2 | DC+      | 51 | 59,36 | 35,2 | G14-1  |  |
| 23             | 16    | 6,4 | DC+      | 52 | 65,76 | 48   | Therm1 |  |
| 24             | 16    | 9,6 | DC+      | 53 | 72,16 | 48   | Therm2 |  |
| 25             | 9,6   | 48  | Ph12     | 54 | 32    | 32   | P      |  |
| 26             | 12,8  | 48  | Ph12     | 55 | 56,16 | 32   | N      |  |
| 27             | 16    | 48  | Ph12     |    |       |      |        |  |
| 28             | 19,2  | 48  | Ph12     |    |       |      |        |  |



Outline drawing of the 30-EP12NIA600H703-PM00F83T package. The drawing shows the package from the top and side views. The top view shows the pin locations and the package dimensions. The side view shows the package height and the pin pitch. The package is a square package with a central square area containing the pins. The pins are arranged in a grid pattern. The package dimensions are 72,16 mm by 72,16 mm. The pin pitch is 1,27 mm. The package height is 1,27 mm. The package is marked with the Vincotech logo and the part number 30-EP12NIA600H703-PM00F83T.

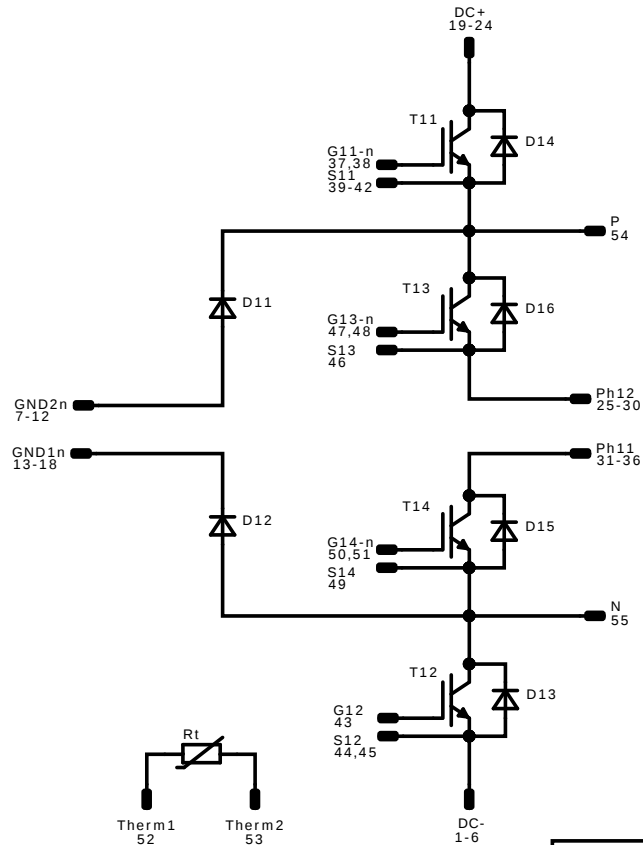


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## Pinout



n=1-2 See exact Pin numbers and Pin functions on Outline

## Identification

| ID       | Component  | Voltage | Current | Function             | Comment                                                                  |
|----------|------------|---------|---------|----------------------|--------------------------------------------------------------------------|
| T11, T12 | IGBT       | 1200 V  | 600 A   | Buck Switch          | Parallel devices with separate control. Values apply to complete device. |
| D11, D12 | FWD        | 1200 V  | 160 A   | Buck Diode           | Parallel devices. Values apply to complete device.                       |
| T13, T14 | IGBT       | 1200 V  | 400 A   | Boost Switch         | Parallel devices with separate control. Values apply to complete device. |
| D13, D14 | FWD        | 1200 V  | 200 A   | Boost Diode          | Parallel devices. Values apply to complete device.                       |
| D16, D15 | FWD        | 1200 V  | 200 A   | Boost Sw. Inv. Diode | Parallel devices. Values apply to complete device.                       |
| Rt       | Thermistor |         |         | Thermistor           |                                                                          |



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| Packaging instruction                                                                                                                                                                                                           |      |          |      |                                                                                     |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------|------|-------------------------------------------------------------------------------------|
| Standard packaging quantity (SPQ) 24                                                                                                                                                                                            | >SPQ | Standard | <SPQ | Sample                                                                              |
| Handling instruction                                                                                                                                                                                                            |      |          |      |                                                                                     |
| Handling instructions for <i>flow</i> E3BP packages see vincotech.com website.                                                                                                                                                  |      |          |      |                                                                                     |
| Package data                                                                                                                                                                                                                    |      |          |      |                                                                                     |
| Package data for <i>flow</i> E3BP packages see vincotech.com website.                                                                                                                                                           |      |          |      |                                                                                     |
| Vincotech thermistor reference                                                                                                                                                                                                  |      |          |      |                                                                                     |
| See Vincotech thermistor reference table at vincotech.com website.                                                                                                                                                              |      |          |      |                                                                                     |
| UL recognition and file number                                                                                                                                                                                                  |      |          |      |                                                                                     |
| This device is UL 1557 recognized under E192116 up to a junction temperature under switching condition $T_{j,op}=175^{\circ}\text{C}$ and up to 4000VAC/1min isolation voltage. For more information see vincotech.com website. |      |          |      |  |

| Document No.:                    | Date:        | Modification:               | Pages |
|----------------------------------|--------------|-----------------------------|-------|
| 30-EP12NIA600H703-PM00F83T-D1-14 | 18 Dec. 2024 | Initial Release             |       |
| 30-EP12NIA600H703-PM00F83T-D2-14 | 7 May. 2025  | Correct Erec of Boost Diode |       |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
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