



Vincotech

# 30-FT10NIA400S702-LP59F04

datasheet

flowNPC 2

1500 V / 400 A

## Features

- High speed IGBT
- Ultra-fast SiC diodes
- Three-level high efficient topology
- Integrated NTC
- Enhanced thermal performance

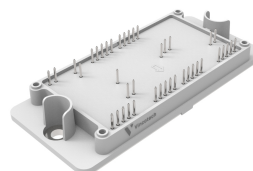
## Target applications

- Solar Inverters

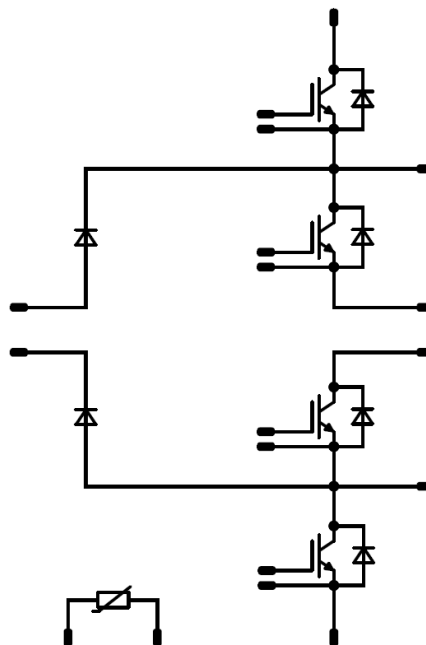
## Types

- 30-FT10NIA400S702-LP59F04

## flow 2 13 mm housing



## Schematic





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**30-FT10NIA400S702-LP59F04**  
datasheet

## Maximum Ratings

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

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

### Buck Switch

|                                   |            |                                       |          |    |
|-----------------------------------|------------|---------------------------------------|----------|----|
| Collector-emitter voltage         | $V_{CES}$  |                                       | 950      | V  |
| Collector current                 | $I_C$      | $T_j = T_{jmax}$ $T_s = 80\text{ °C}$ | 318      | A  |
| Repetitive peak collector current | $I_{CRM}$  | $t_p$ limited by $T_{jmax}$           | 800      | A  |
| Total power dissipation           | $P_{tot}$  | $T_j = T_{jmax}$ $T_s = 80\text{ °C}$ | 595      | 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  |
| Continuous (direct) forward current    | $I_F$      | $T_j = T_{jmax}$ $T_s = 80\text{ °C}$          | 126  | A  |
| Repetitive peak forward current        | $I_{FRM}$  | $t_p$ limited by $T_{jmax}$                    | 305  | A  |
| Surge (non-repetitive) forward current | $I_{FSM}$  | Single Half Sine Wave,<br>$t_p = 10\text{ ms}$ | 550  | A  |
| Total power dissipation                | $P_{tot}$  | $T_j = T_{jmax}$ $T_s = 80\text{ °C}$          | 305  | W  |
| Maximum junction temperature           | $T_{jmax}$ |                                                | 175  | °C |

### Boost Switch

|                                   |            |                                       |          |    |
|-----------------------------------|------------|---------------------------------------|----------|----|
| Collector-emitter voltage         | $V_{CES}$  |                                       | 950      | V  |
| Collector current                 | $I_C$      | $T_j = T_{jmax}$ $T_s = 80\text{ °C}$ | 391      | A  |
| Repetitive peak collector current | $I_{CRM}$  | $t_p$ limited by $T_{jmax}$           | 800      | A  |
| Total power dissipation           | $P_{tot}$  | $T_j = T_{jmax}$ $T_s = 80\text{ °C}$ | 483      | W  |
| Gate-emitter voltage              | $V_{GES}$  |                                       | $\pm 20$ | V  |
| 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     | $V_{RRM}$  |                                       | 950   | V    |
| Continuous (direct) forward current | $I_F$      | $T_j = T_{jmax}$ $T_a = 80\text{ °C}$ | 104   | A    |
| Total power dissipation             | $P_{tot}$  | $T_j = T_{jmax}$ $T_a = 80\text{ °C}$ | 186   | W    |
| Maximum junction temperature        | $T_{jmax}$ |                                       | 150   | °C   |

## Boost Sw. Inv. Diode

|                                     |            |                                       |     |    |
|-------------------------------------|------------|---------------------------------------|-----|----|
| Peak repetitive reverse voltage     | $V_{RRM}$  |                                       | 950 | V  |
| Continuous (direct) forward current | $I_F$      | $T_j = T_{jmax}$ $T_a = 80\text{ °C}$ | 104 | A  |
| Total power dissipation             | $P_{tot}$  | $T_j = T_{jmax}$ $T_a = 80\text{ °C}$ | 186 | W  |
| Maximum junction temperature        | $T_{jmax}$ |                                       | 150 | °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* $t_p = 2\text{ s}$ | 4000      | V  |
| Creepage distance          |            |                                     | min. 12,7 | mm |
| Clearance                  |            |                                     | min. 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       | $V_{GE(th)}$  | $V_{CE} = V_{GE}$     |    |     | 0,00668 | 25               | 4,35 | 5,1               | 5,85                | V  |
| Collector-emitter saturation voltage | $V_{CE(sat)}$ |                       | 15 |     | 400     | 25<br>125<br>150 |      | 1,67<br>1,95<br>2 | 2,35 <sup>(1)</sup> | V  |
| Collector-emitter cut-off current    | $I_{CES}$     |                       | 0  | 950 |         | 25               |      |                   | 8                   | μA |
| Gate-emitter leakage current         | $I_{GES}$     |                       | 20 | 0   |         | 25               |      |                   | 400                 | nA |
| Internal gate resistance             | $r_g$         |                       |    |     |         |                  |      | 0,375             |                     | Ω  |
| Input capacitance                    | $C_{ies}$     | $f = 100 \text{ kHz}$ | 0  | 25  |         | 25               |      | 26000             |                     | pF |
| Output capacitance                   | $C_{oes}$     |                       |    |     |         |                  |      | 556               |                     | pF |
| Reverse transfer capacitance         | $C_{res}$     |                       |    |     |         |                  |      | 80                |                     | pF |
| Gate charge                          | $Q_g$         |                       | 15 |     | 0       | 25               |      | 920               |                     | nC |

#### Thermal

|                                                    |               |                                               |  |  |  |  |  |      |  |     |
|----------------------------------------------------|---------------|-----------------------------------------------|--|--|--|--|--|------|--|-----|
| Thermal resistance junction to sink <sup>(2)</sup> | $R_{th(j-s)}$ | $\lambda_{paste} = 3,4 \text{ W/mK}$<br>(PSX) |  |  |  |  |  | 0,16 |  | K/W |
|----------------------------------------------------|---------------|-----------------------------------------------|--|--|--|--|--|------|--|-----|

#### Dynamic

|                             |              |                                                                 |          |     |     |                  |  |                         |  |     |
|-----------------------------|--------------|-----------------------------------------------------------------|----------|-----|-----|------------------|--|-------------------------|--|-----|
| Turn-on delay time          | $t_{d(on)}$  | $R_{gon} = 2 \text{ } \Omega$<br>$R_{goff} = 2 \text{ } \Omega$ | $\pm 15$ | 600 | 150 | 25<br>125<br>150 |  | 144,6<br>145<br>145,4   |  | ns  |
| Rise time                   | $t_r$        |                                                                 |          |     |     | 25<br>125<br>150 |  | 18,8<br>19,6<br>20      |  | ns  |
| Turn-off delay time         | $t_{d(off)}$ |                                                                 |          |     |     | 25<br>125<br>150 |  | 154,4<br>199,8<br>210,6 |  | ns  |
| Fall time                   | $t_f$        |                                                                 |          |     |     | 25<br>125<br>150 |  | 19,3<br>27,62<br>28,91  |  | ns  |
| Turn-on energy (per pulse)  | $E_{on}$     |                                                                 |          |     |     | 25<br>125<br>150 |  | 2,12<br>2,16<br>2,24    |  | mWs |
| Turn-off energy (per pulse) | $E_{off}$    |                                                                 |          |     |     | 25<br>125<br>150 |  | 4,64<br>6,88<br>7,46    |  | 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         | $V_F$ |                |  |  | 100 | 25<br>125<br>150 |  | 1,51<br>1,77<br>1,91 | 1,8 <sup>(1)</sup> | V  |
| Reverse leakage current | $I_R$ | $V_r = 1200$ V |  |  |     | 25               |  | 175                  | 1000               | µA |

#### Thermal

|                                                    |               |                                       |  |  |  |  |  |      |  |     |
|----------------------------------------------------|---------------|---------------------------------------|--|--|--|--|--|------|--|-----|
| Thermal resistance junction to sink <sup>(2)</sup> | $R_{th(j-s)}$ | $\lambda_{paste} = 3,4$ W/mK<br>(PSX) |  |  |  |  |  | 0,31 |  | K/W |
|----------------------------------------------------|---------------|---------------------------------------|--|--|--|--|--|------|--|-----|

#### Dynamic

|                                       |                      |                                                             |          |     |     |                  |  |                           |  |      |
|---------------------------------------|----------------------|-------------------------------------------------------------|----------|-----|-----|------------------|--|---------------------------|--|------|
| Peak recovery current                 | $I_{RRM}$            | $di/dt=9061$ A/µs<br>$di/dt=8999$ A/µs<br>$di/dt=8575$ A/µs | $\pm 15$ | 600 | 150 | 25<br>125<br>150 |  | 105,42<br>114,1<br>115,58 |  | A    |
| Reverse recovery time                 | $t_{rr}$             |                                                             |          |     |     | 25<br>125<br>150 |  | 40,16<br>41,08<br>41,49   |  | ns   |
| Recovered charge                      | $Q_r$                |                                                             |          |     |     | 25<br>125<br>150 |  | 1,2<br>1,56<br>1,61       |  | µC   |
| Reverse recovered energy              | $E_{rec}$            |                                                             |          |     |     | 25<br>125<br>150 |  | 0,174<br>0,318<br>0,338   |  | mWs  |
| Peak rate of fall of recovery current | $(di_{rr}/dt)_{max}$ |                                                             |          |     |     | 25<br>125<br>150 |  | 7251<br>6840<br>6589      |  | A/µs |



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datasheet

## 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       | $V_{GE(th)}$  | $V_{CE} = V_{GE}$     |    |     | 0,0065 | 25               | 4,15 | 4,85                | 5,65               | V  |
| Collector-emitter saturation voltage | $V_{CE(sat)}$ |                       | 15 |     | 400    | 25<br>125<br>150 |      | 1,2<br>1,23<br>1,24 | 1,4 <sup>(1)</sup> | V  |
| Collector-emitter cut-off current    | $I_{CES}$     |                       | 0  | 950 |        | 25               |      |                     | 8                  | µA |
| Gate-emitter leakage current         | $I_{GES}$     |                       | 20 | 0   |        | 25               |      |                     | 200                | nA |
| Internal gate resistance             | $r_g$         |                       |    |     |        |                  |      | 0,75                |                    | Ω  |
| Input capacitance                    | $C_{ies}$     | $f = 100 \text{ kHz}$ | 0  | 25  |        | 25               |      | 49200               |                    | pF |
| Output capacitance                   | $C_{oes}$     |                       |    |     |        |                  |      | 530                 |                    | pF |
| Reverse transfer capacitance         | $C_{res}$     |                       |    |     |        |                  |      | 220                 |                    | pF |
| Gate charge                          | $Q_g$         |                       | 15 |     | 0      | 25               |      | 4100                |                    | nC |

#### Thermal

|                                                    |               |                                               |  |  |  |  |  |     |  |     |
|----------------------------------------------------|---------------|-----------------------------------------------|--|--|--|--|--|-----|--|-----|
| Thermal resistance junction to sink <sup>(2)</sup> | $R_{th(j-s)}$ | $\lambda_{paste} = 3,4 \text{ W/mK}$<br>(PSX) |  |  |  |  |  | 0,2 |  | K/W |
|----------------------------------------------------|---------------|-----------------------------------------------|--|--|--|--|--|-----|--|-----|

#### Dynamic

|                             |              |                                                                                                   |          |     |     |                  |  |                           |  |     |
|-----------------------------|--------------|---------------------------------------------------------------------------------------------------|----------|-----|-----|------------------|--|---------------------------|--|-----|
| Turn-on delay time          | $t_{d(on)}$  | $R_{gon} = 2 \Omega$<br>$R_{goff} = 2 \Omega$                                                     | $\pm 15$ | 600 | 150 | 25<br>125<br>150 |  | 359,8<br>365,6<br>368,4   |  | ns  |
| Rise time                   | $t_r$        |                                                                                                   |          |     |     | 25<br>125<br>150 |  | 20<br>24,2<br>24,2        |  | ns  |
| Turn-off delay time         | $t_{d(off)}$ |                                                                                                   |          |     |     | 25<br>125<br>150 |  | 507,8<br>593,4<br>619,2   |  | ns  |
| Fall time                   | $t_f$        |                                                                                                   |          |     |     | 25<br>125<br>150 |  | 56,15<br>325,53<br>468,38 |  | ns  |
| Turn-on energy (per pulse)  | $E_{on}$     |                                                                                                   |          |     |     | 25<br>125<br>150 |  | 2,74<br>3,7<br>3,98       |  | mWs |
| Turn-off energy (per pulse) | $E_{off}$    | $Q_{tFWD} = 6,05 \mu\text{C}$<br>$Q_{tFWD} = 11,62 \mu\text{C}$<br>$Q_{tFWD} = 13,74 \mu\text{C}$ |          |     |     | 25<br>125<br>150 |  | 25,76<br>40,03<br>42,73   |  | 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 | 2,1 | 2,65<br>2,44<br>2,36 | 2,8 <sup>(1)</sup> | V  |
| Reverse leakage current | $I_R$ | $V_i = 950$ V |  |  |     | 25               |     |                      | 8                  | µA |

#### Thermal

|                                                    |               |                                       |  |  |  |  |  |      |  |     |
|----------------------------------------------------|---------------|---------------------------------------|--|--|--|--|--|------|--|-----|
| Thermal resistance junction to sink <sup>(2)</sup> | $R_{th(j-s)}$ | $\lambda_{paste} = 3,4$ W/mK<br>(PSX) |  |  |  |  |  | 0,38 |  | K/W |
|----------------------------------------------------|---------------|---------------------------------------|--|--|--|--|--|------|--|-----|

#### Dynamic

|                                       |                      |                                                             |          |     |     |                  |  |                            |  |      |
|---------------------------------------|----------------------|-------------------------------------------------------------|----------|-----|-----|------------------|--|----------------------------|--|------|
| Peak recovery current                 | $I_{RRM}$            | $di/dt=7523$ A/µs<br>$di/dt=6747$ A/µs<br>$di/dt=6754$ A/µs | $\pm 15$ | 600 | 150 | 25<br>125<br>150 |  | 160,09<br>204,77<br>218,18 |  | A    |
| Reverse recovery time                 | $t_{rr}$             |                                                             |          |     |     | 25<br>125<br>150 |  | 69,76<br>133,88<br>151,09  |  | ns   |
| Recovered charge                      | $Q_r$                |                                                             |          |     |     | 25<br>125<br>150 |  | 6,05<br>11,62<br>13,74     |  | µC   |
| Reverse recovered energy              | $E_{rec}$            |                                                             |          |     |     | 25<br>125<br>150 |  | 2,2<br>4,61<br>5,51        |  | mWs  |
| Peak rate of fall of recovery current | $(di_{rr}/dt)_{max}$ |                                                             |          |     |     | 25<br>125<br>150 |  | 5242<br>4762<br>4633       |  | 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 | 2,1 | 2,65<br>2,44<br>2,36 | 2,8 <sup>(1)</sup> | V  |
| Reverse leakage current | $I_R$ | $V_i = 950$ V |  |  |     | 25               |     |                      | 8                  | μA |

#### Thermal

|                                                    |               |                                       |  |  |  |  |  |      |  |     |
|----------------------------------------------------|---------------|---------------------------------------|--|--|--|--|--|------|--|-----|
| Thermal resistance junction to sink <sup>(2)</sup> | $R_{th(j-s)}$ | $\lambda_{paste} = 3,4$ W/mK<br>(PSX) |  |  |  |  |  | 0,38 |  | K/W |
|----------------------------------------------------|---------------|---------------------------------------|--|--|--|--|--|------|--|-----|

### Thermistor

#### Static

|                                |                |                    |  |  |  |     |    |      |   |      |
|--------------------------------|----------------|--------------------|--|--|--|-----|----|------|---|------|
| Rated resistance               | $R$            |                    |  |  |  | 25  |    | 22   |   | kΩ   |
| Deviation of $R_{100}$         | $\Delta_{R/R}$ | $R_{100} = 1484$ Ω |  |  |  | 100 | -5 |      | 5 | %    |
| Power dissipation              | $P$            |                    |  |  |  |     |    | 5    |   | mW   |
| Power dissipation constant     | $d$            |                    |  |  |  | 25  |    | 1,5  |   | mW/K |
| B-value                        | $B_{(25/50)}$  | Tol. $\pm 1$ %     |  |  |  |     |    | 3962 |   | K    |
| B-value                        | $B_{(25/100)}$ | Tol. $\pm 1$ %     |  |  |  |     |    | 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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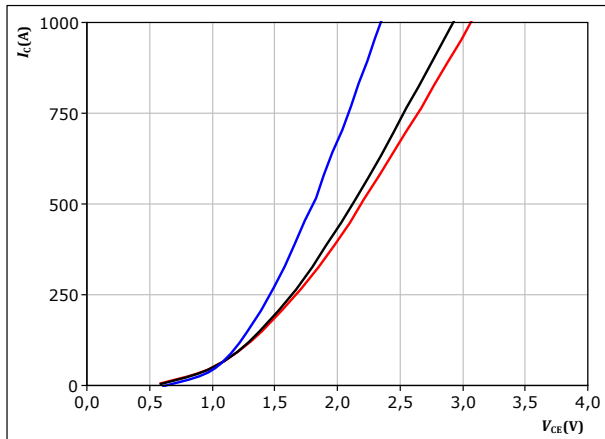
## 30-FT10NIA400S702-LP59F04 datasheet

### Buck Switch Characteristics

figure 1. IGBT

Typical output characteristics

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

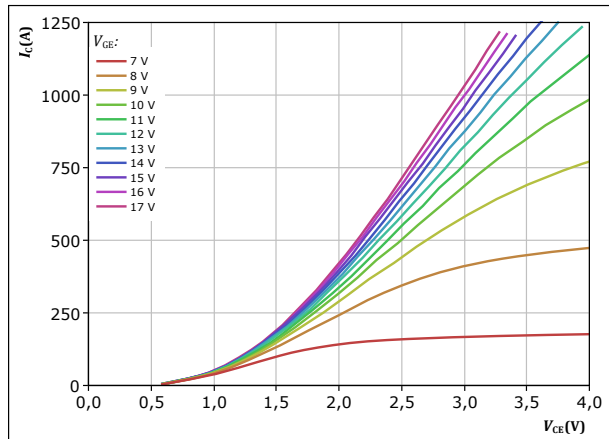


$t_p = 250 \mu s$   
 $V_{GE} = 15 V$   
 $T_j:$  25 °C, 125 °C, 150 °C

figure 2. IGBT

Typical output characteristics

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

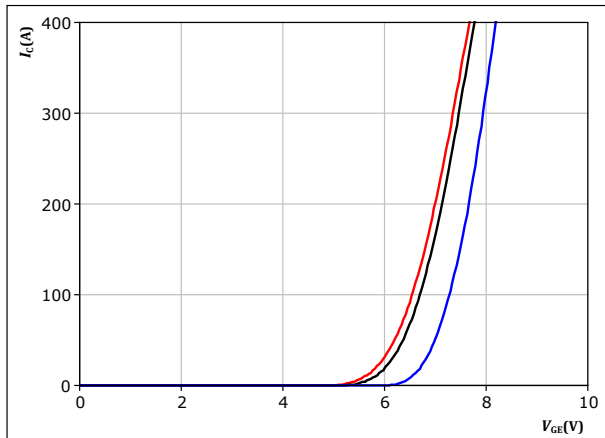


$t_p = 250 \mu s$   
 $T_j = 150 ^\circ C$   
 $V_{GE}$  from 7 V to 17 V in steps of 1 V

figure 3. IGBT

Typical transfer characteristics

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

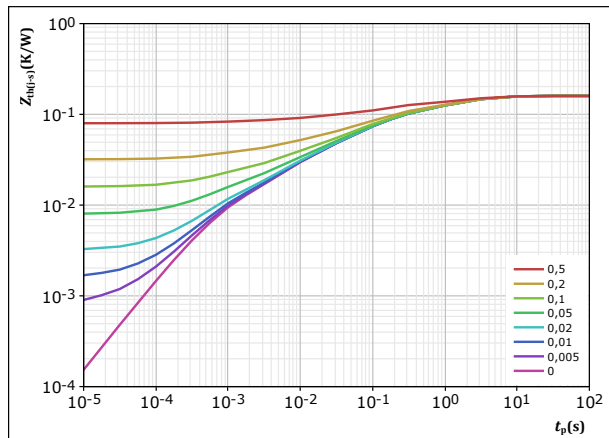


$t_p = 250 \mu s$   
 $V_{CE} = 10 V$   
 $T_j:$  25 °C, 125 °C, 150 °C

figure 4. IGBT

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$   
 $R_{th(j-s)} = 0,16 K/W$   
IGBT thermal model values  

| $R (K/W)$ | $\tau (s)$ |
|-----------|------------|
| 2,78E-02  | 3,63E+00   |
| 4,33E-02  | 8,40E-01   |
| 5,78E-02  | 9,61E-02   |
| 2,24E-02  | 8,88E-03   |
| 8,34E-03  | 6,81E-04   |



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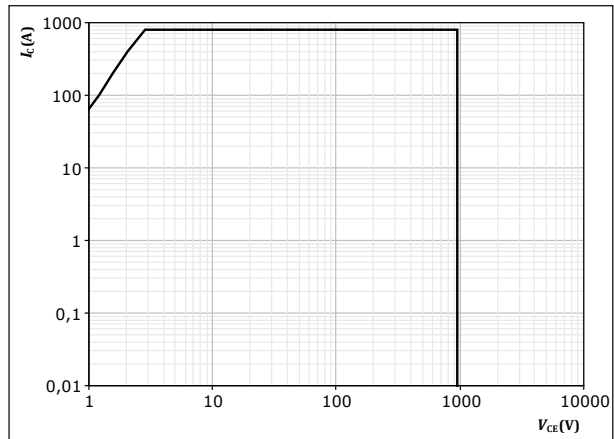
**30-FT10NIA400S702-LP59F04**  
datasheet

## Buck Switch Characteristics

**figure 5.** IGBT

Safe operating area

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



$D = \text{single pulse}$

$T_s = 80 \text{ } ^\circ\text{C}$   
 $V_{GE} = 15 \text{ V}$   
 $T_j = T_{jmax}$



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**30-FT10NIA400S702-LP59F04**  
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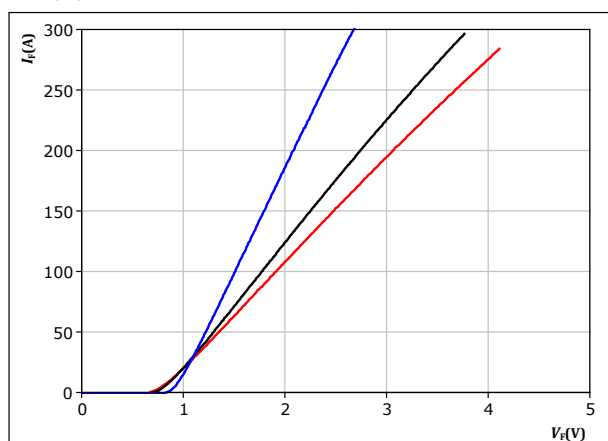
## Buck Diode Characteristics

figure 6.

FWD

Typical forward characteristics

$$I_F = f(V_F)$$



$t_p = 250 \mu s$

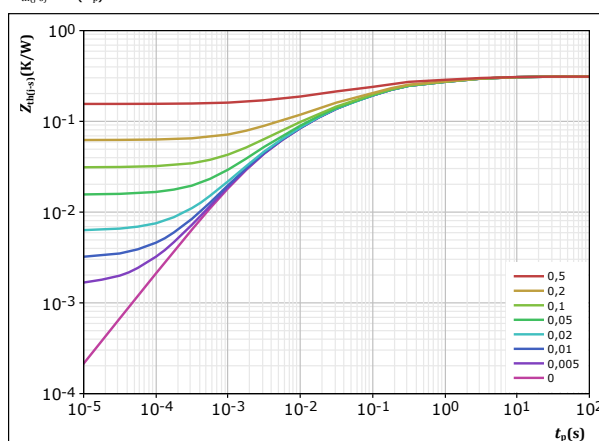
$T_j$ :  
25 °C  
125 °C  
150 °C

figure 7.

FWD

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$   
 $R_{th(j-s)} = 0,311 \text{ K/W}$   
 FWD thermal model values  

| $R$ (K/W) | $\tau$ (s) |
|-----------|------------|
| 1,70E-02  | 6,92E+00   |
| 5,16E-02  | 1,30E+00   |
| 1,30E-01  | 1,14E-01   |
| 8,31E-02  | 1,37E-02   |
| 3,01E-02  | 2,13E-03   |



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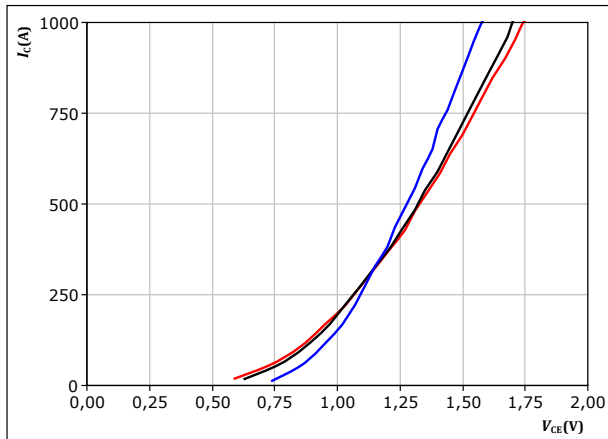
## Boost Switch Characteristics

figure 8.

IGBT

Typical output characteristics

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



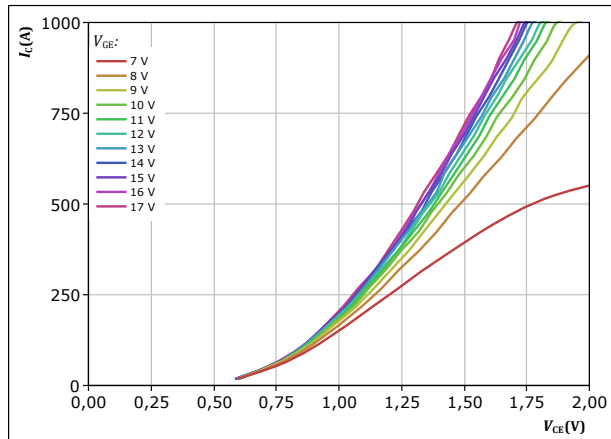
$t_p = 250 \mu s$   
 $V_{GE} = 15 V$   
 $T_j:$  25 °C, 125 °C, 150 °C

figure 9.

IGBT

Typical output characteristics

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



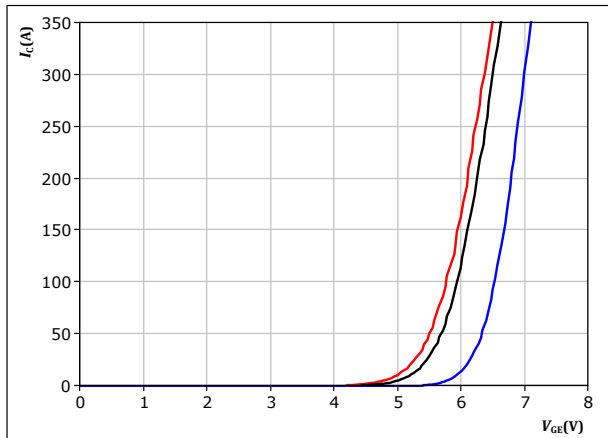
$t_p = 250 \mu s$   
 $T_j = 150 \text{ } ^\circ\text{C}$   
 $V_{GE}$  from 7 V to 17 V in steps of 1 V

figure 10.

IGBT

Typical transfer characteristics

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



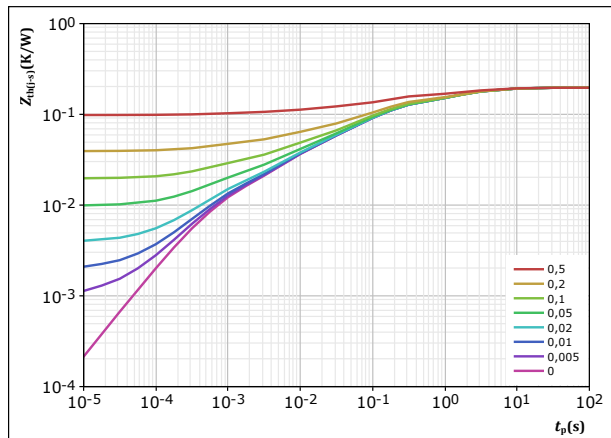
$t_p = 250 \mu s$   
 $V_{CE} = 11 V$   
 $T_j:$  25 °C, 125 °C, 150 °C

figure 11.

IGBT

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$   
 $R_{th(j-s)} = 0,196 \text{ K/W}$   
IGBT thermal model values  

| $R \text{ (K/W)}$ | $\tau \text{ (s)}$ |
|-------------------|--------------------|
| 1,70E-02          | 6,58E+00           |
| 5,92E-02          | 1,50E+00           |
| 8,39E-02          | 1,08E-01           |
| 2,62E-02          | 8,19E-03           |
| 1,02E-02          | 5,83E-04           |





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datasheet

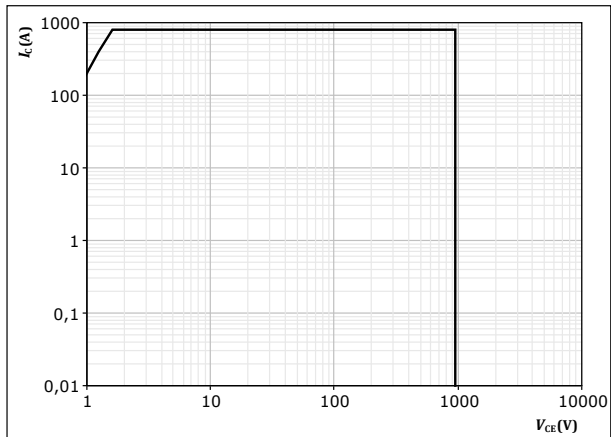
## Boost Switch Characteristics

figure 12.

IGBT

Safe operating area

$I_C = f(V_{CE})$



$D = \text{single pulse}$

$T_s = 80 \text{ } ^\circ\text{C}$

$V_{GE} = 15 \text{ V}$

$T_j = T_{jmax}$



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# 30-FT10NIA400S702-LP59F04 datasheet

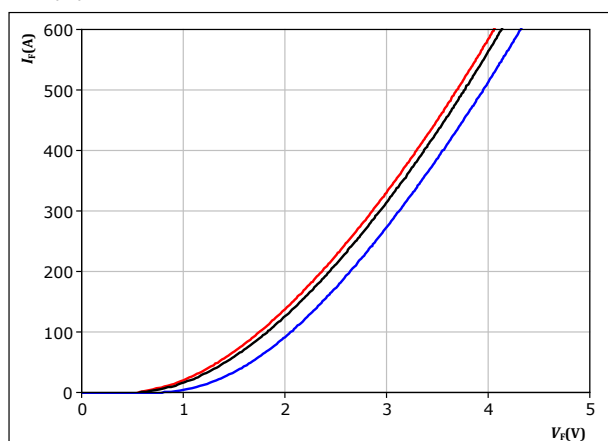
## Boost Diode Characteristics

figure 13.

FWD

Typical forward characteristics

$$I_F = f(V_F)$$



$t_p = 250 \mu s$

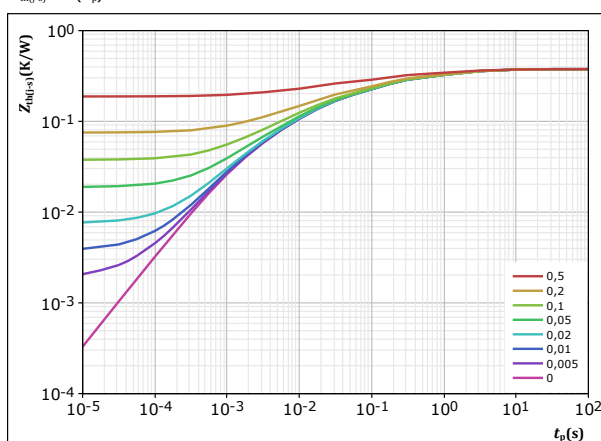
$T_j$ :  
— 25 °C  
— 125 °C  
— 150 °C

figure 14.

FWD

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$   
 $R_{th(j-s)} = 0,376 \text{ K/W}$   
FWD thermal model values  

| $R \text{ (K/W)}$ | $\tau \text{ (s)}$ |
|-------------------|--------------------|
| 2,41E-02          | 5,52E+00           |
| 7,30E-02          | 1,14E+00           |
| 1,38E-01          | 1,19E-01           |
| 1,11E-01          | 1,15E-02           |
| 3,09E-02          | 1,39E-03           |



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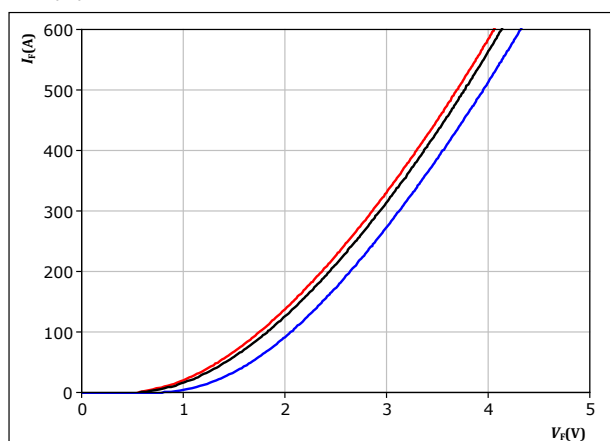
# 30-FT10NIA400S702-LP59F04 datasheet

## Boost Sw. Inv. Diode Characteristics

figure 15. FWD

Typical forward characteristics

$$I_F = f(V_F)$$



$t_p = 250 \mu s$

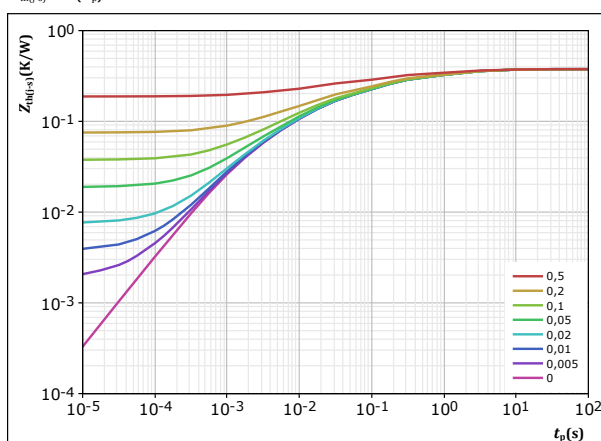
$T_j:$

- 25 °C
- 125 °C
- 150 °C

figure 16. FWD

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$

$R_{th(j-s)} = 0,376 \text{ K/W}$

FWD thermal model values

| $R$ (K/W)  | $\tau$ (s) |
|------------|------------|
| $2,41E-02$ | $5,52E+00$ |
| $7,30E-02$ | $1,14E+00$ |
| $1,38E-01$ | $1,19E-01$ |
| $1,11E-01$ | $1,15E-02$ |
| $3,09E-02$ | $1,39E-03$ |



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**30-FT10NIA400S702-LP59F04**  
datasheet

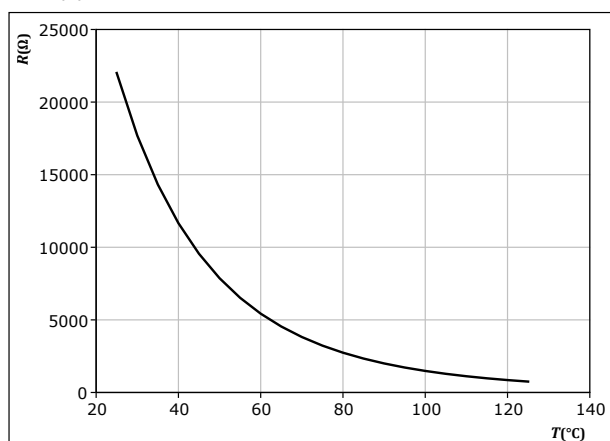
## Thermistor Characteristics

figure 17.

Thermistor

Typical NTC characteristic as function of temperature

$$R_T = f(T)$$





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datasheet

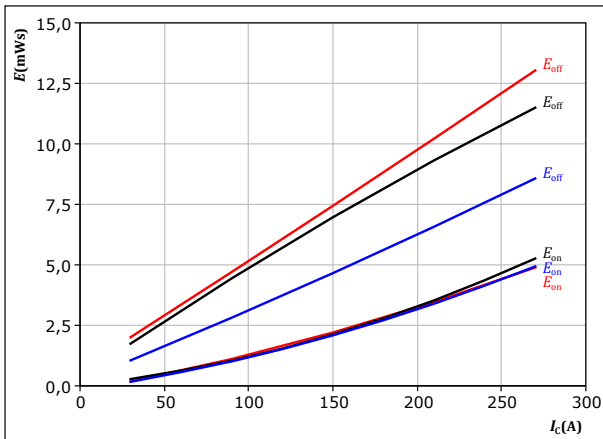
## Buck Switching Characteristics

figure 18.

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  
 $R_{gon} = 2$   $\Omega$   
 $R_{goff} = 2$   $\Omega$

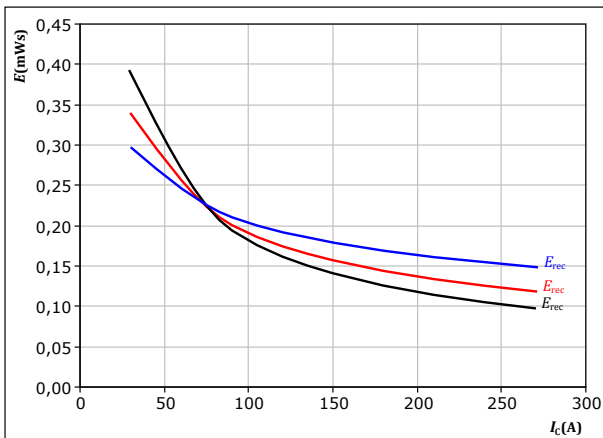
$T_j$ : 25 °C  
125 °C  
150 °C

figure 20.

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  
 $R_{gon} = 2$   $\Omega$

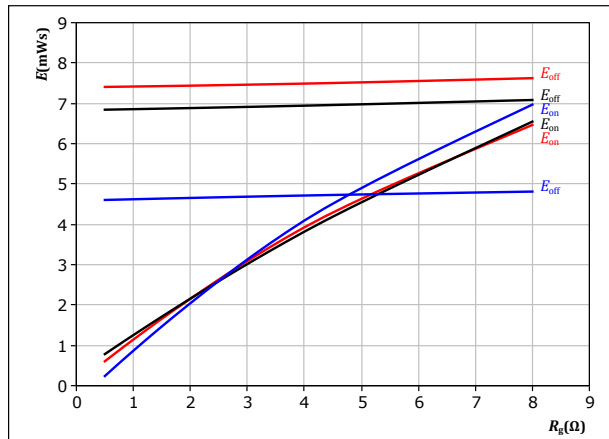
$T_j$ : 25 °C  
125 °C  
150 °C

figure 19.

IGBT

Typical switching energy losses as a function of gate resistor

$$E = f(R_g)$$



With an inductive load at

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

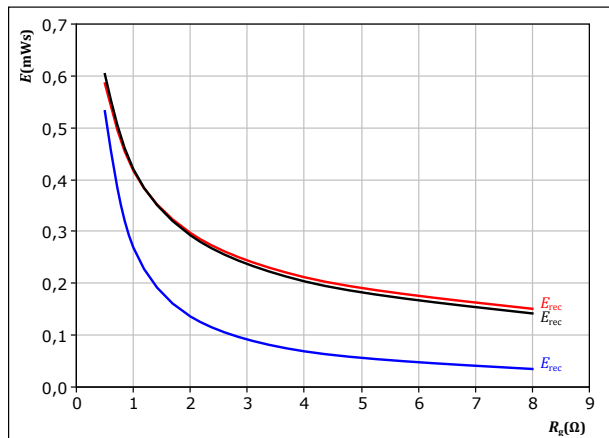
$T_j$ : 25 °C  
125 °C  
150 °C

figure 21.

FWD

Typical reverse recovered energy loss as a function of gate resistor

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



With an inductive load at

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

$T_j$ : 25 °C  
125 °C  
150 °C



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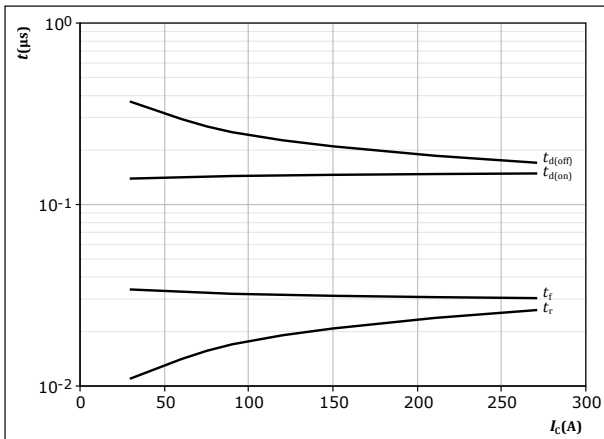
30-FT10NIA400S702-LP59F04  
datasheet

## Buck Switching Characteristics

figure 22.

IGBT

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



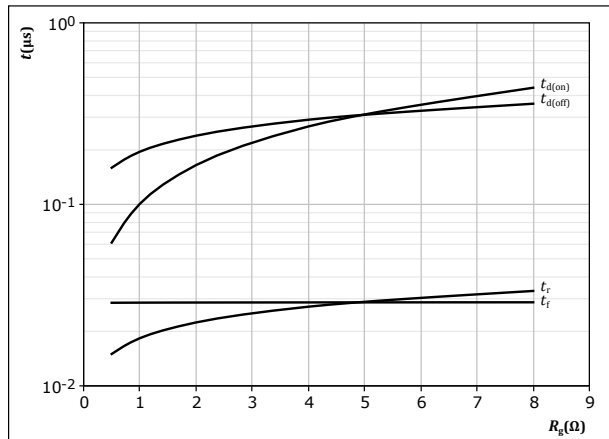
With an inductive load at

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

figure 23.

IGBT

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



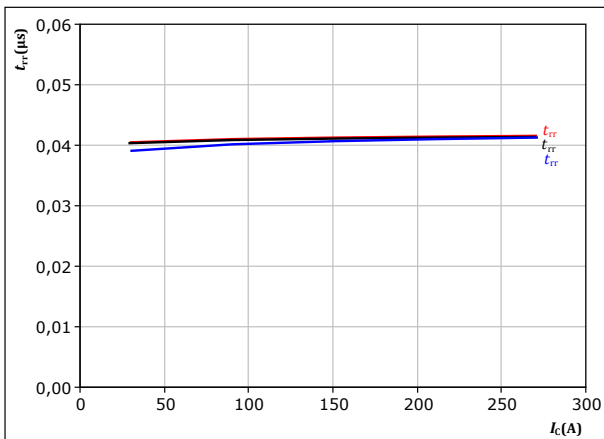
With an inductive load at

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

figure 24.

FWD

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



With an inductive load at

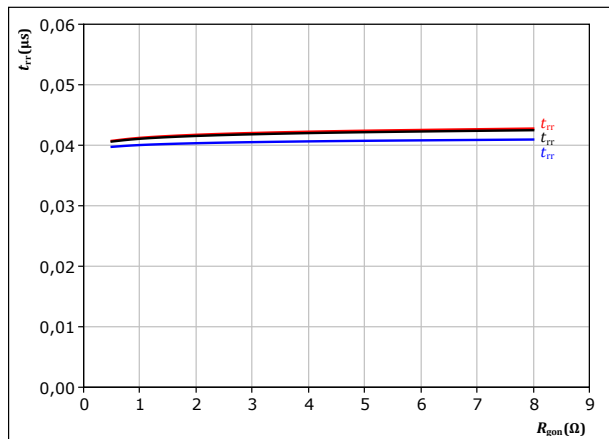
$V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $R_{gon} = 2$   $\Omega$

$T_j$ : 25 °C  
125 °C  
150 °C

figure 25.

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  
 $I_C = 150$  A

$T_j$ : 25 °C  
125 °C  
150 °C



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datasheet

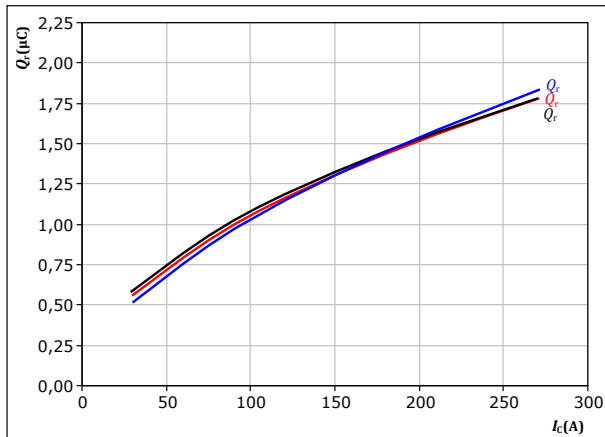
## Buck Switching Characteristics

figure 26.

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  
 $R_{gon} = 2$   $\Omega$

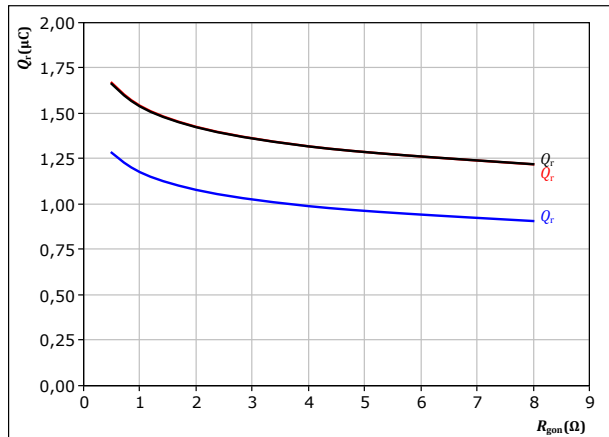
$T_j$ :  
— 25 °C  
— 125 °C  
— 150 °C

figure 27.

FWD

Typical recovered charge as a function of turn on gate resistor

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



With an inductive load at

$V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $I_c = 150$  A

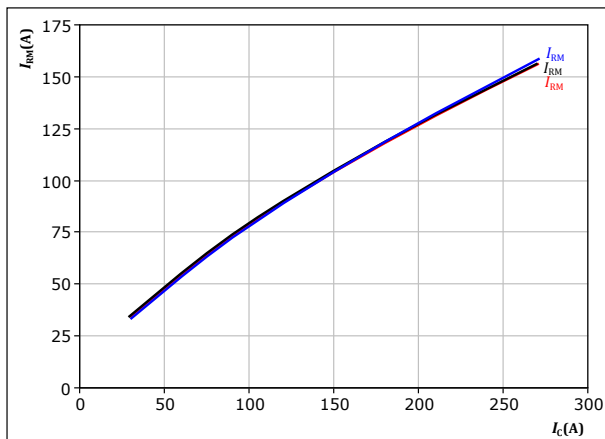
$T_j$ :  
— 25 °C  
— 125 °C  
— 150 °C

figure 28.

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  
 $R_{gon} = 2$   $\Omega$

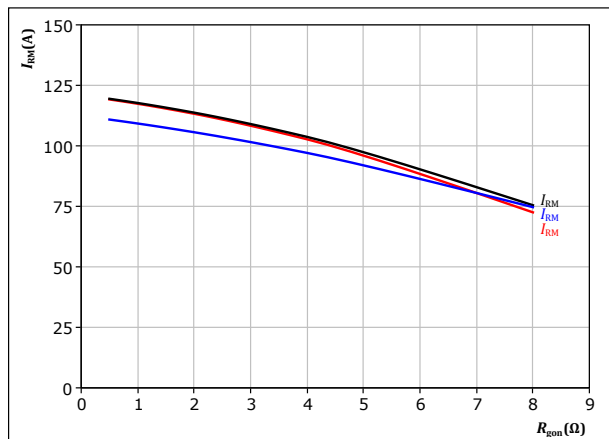
$T_j$ :  
— 25 °C  
— 125 °C  
— 150 °C

figure 29.

FWD

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

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



With an inductive load at

$V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $I_c = 150$  A

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



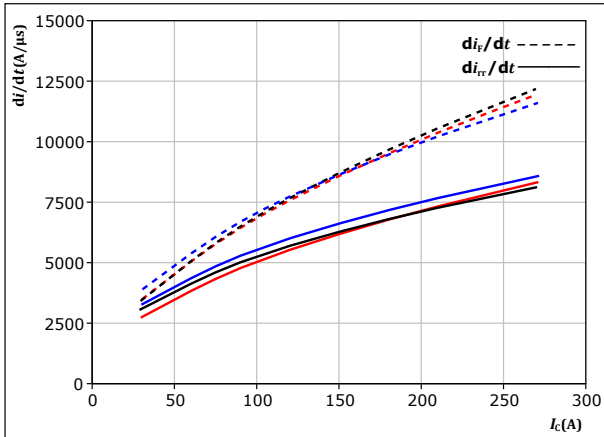
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datasheet

## Buck Switching Characteristics

**figure 30.** 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

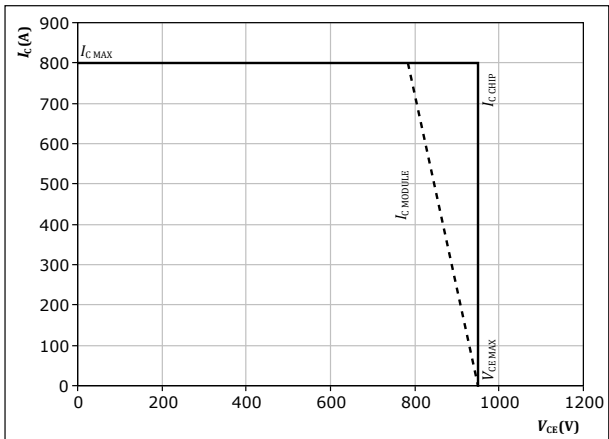
$V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $R_{gon} = 2 \text{ } \Omega$

$T_j:$  — 25 °C  
— 125 °C  
— 150 °C

**figure 31.** FWD

Reverse bias safe operating area

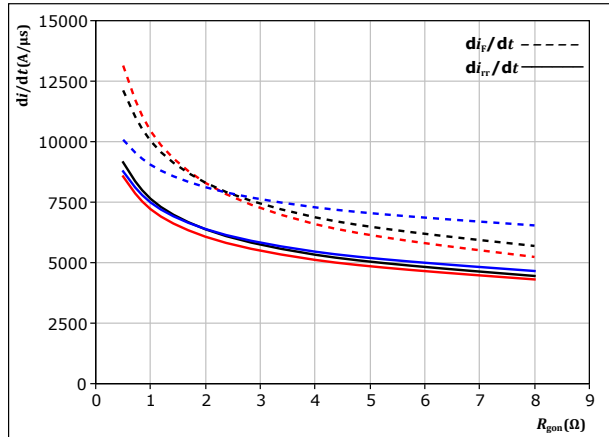
$I_C = f(V_{CE})$



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

**figure 31.** 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

$V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $I_C = 150 \text{ A}$

$T_j:$  — 25 °C  
— 125 °C  
— 150 °C





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## 30-FT10NIA400S702-LP59F04 datasheet

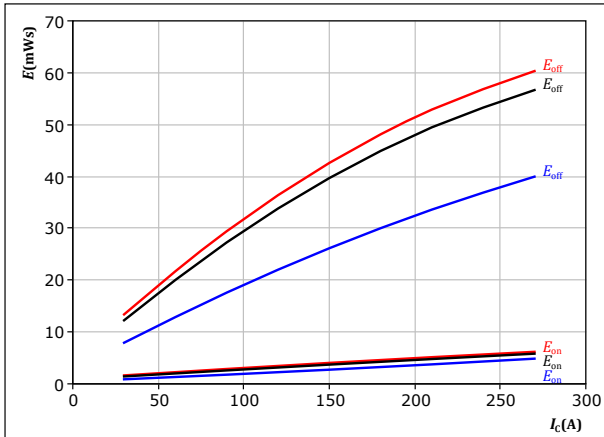
### Boost Switching Characteristics

figure 33.

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  
 $R_{gon} = 2$   $\Omega$   
 $R_{goff} = 2$   $\Omega$

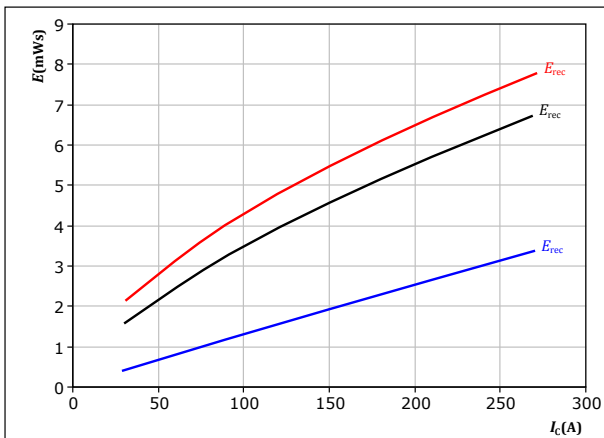
$T_j$ :  
— 25 °C  
— 125 °C  
— 150 °C

figure 35.

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  
 $R_{gon} = 2$   $\Omega$

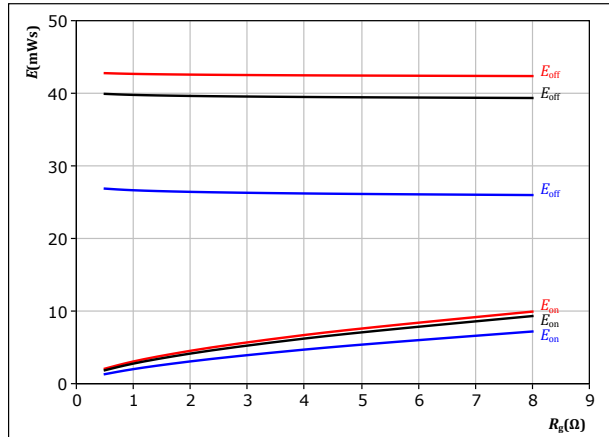
$T_j$ :  
— 25 °C  
— 125 °C  
— 150 °C

figure 34.

IGBT

Typical switching energy losses as a function of gate resistor

$$E = f(R_g)$$



With an inductive load at

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

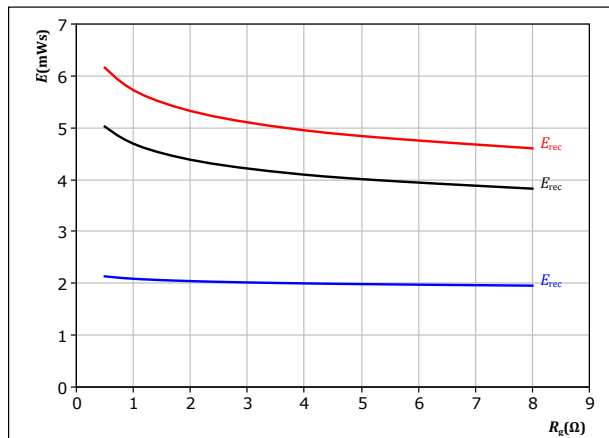
$T_j$ :  
— 25 °C  
— 125 °C  
— 150 °C

figure 36.

FWD

Typical reverse recovered energy loss as a function of gate resistor

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



With an inductive load at

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

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



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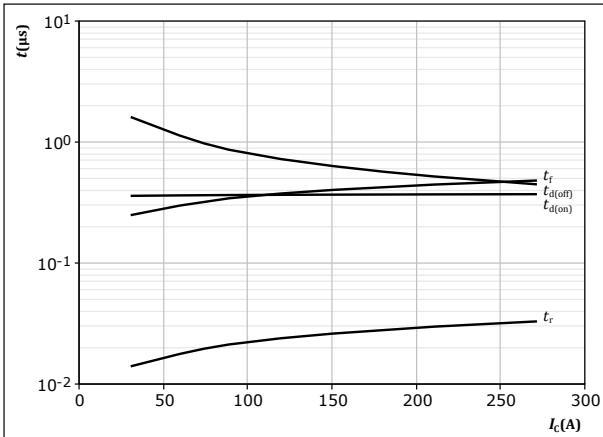
30-FT10NIA400S702-LP59F04  
datasheet

## Boost Switching Characteristics

figure 37.

IGBT

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



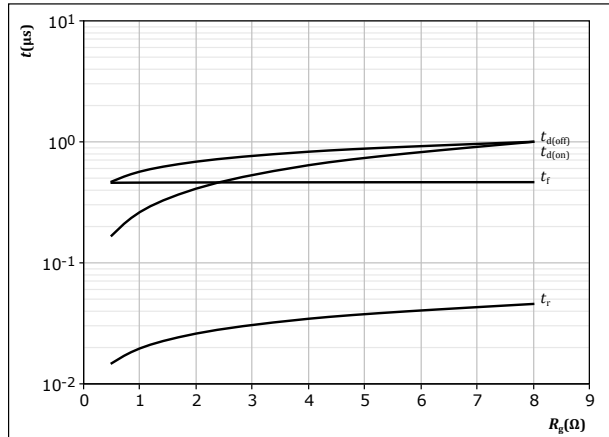
With an inductive load at

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

figure 38.

IGBT

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



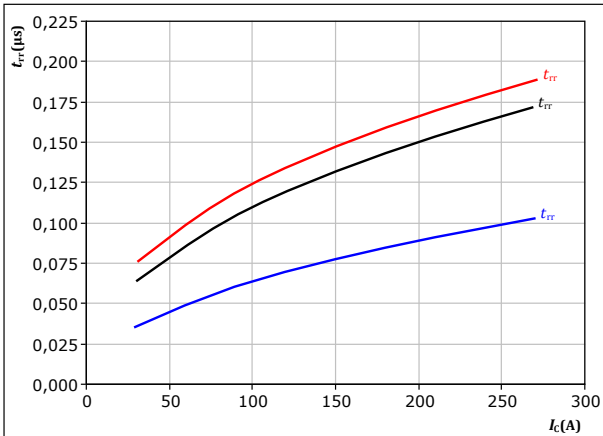
With an inductive load at

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

figure 39.

FWD

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



With an inductive load at

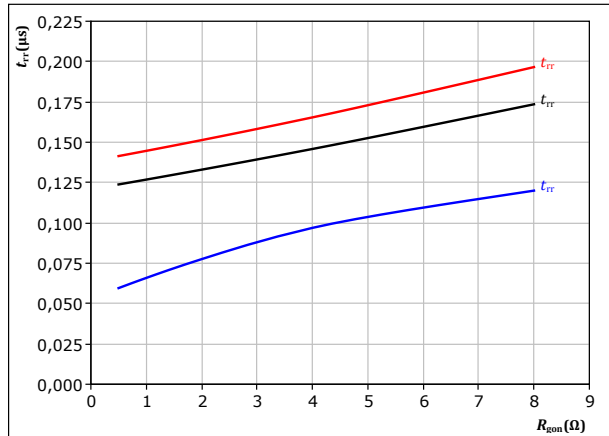
$V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $R_{gon} = 2 \text{ } \Omega$

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

figure 40.

FWD

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



With an inductive load at

$V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $I_C = 150 \text{ A}$

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



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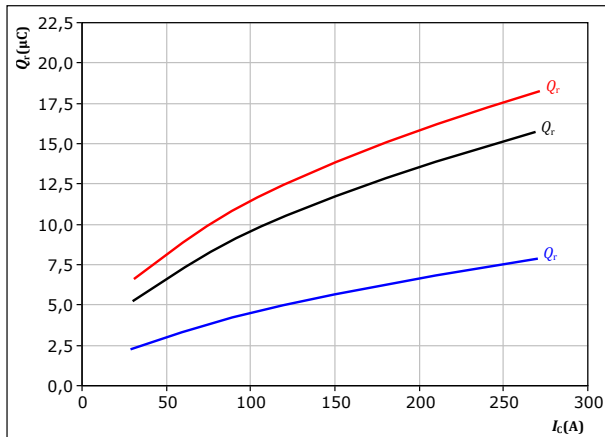
# 30-FT10NIA400S702-LP59F04 datasheet

## Boost Switching Characteristics

figure 41. FWD

Typical recovered charge as a function of collector current

$$Q_r = f(I_c)$$



With an inductive load at

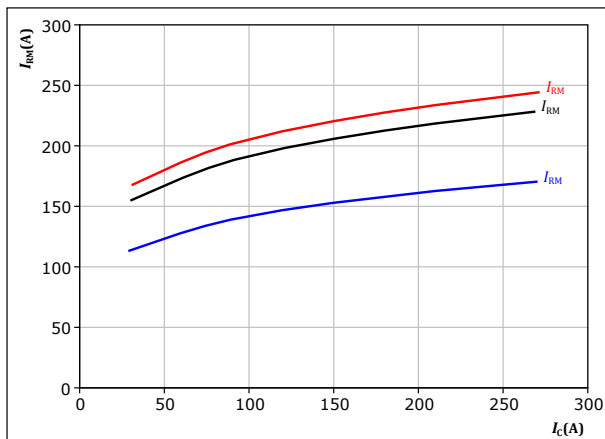
$V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $R_{gon} = 2$   $\Omega$

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

figure 43. FWD

Typical peak reverse recovery current as a function of collector current

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



With an inductive load at

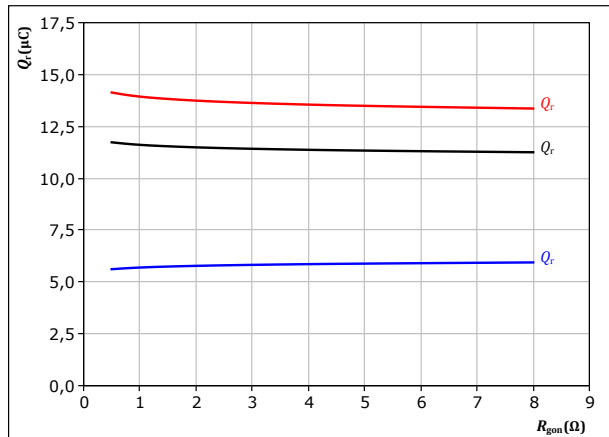
$V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $R_{gon} = 2$   $\Omega$

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

figure 42. FWD

Typical recovered charge as a function of turn on gate resistor

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



With an inductive load at

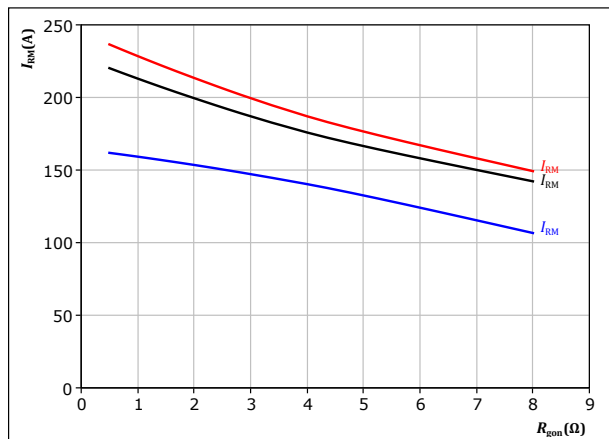
$V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $I_c = 150$  A

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

figure 44. FWD

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

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



With an inductive load at

$V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $I_c = 150$  A

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



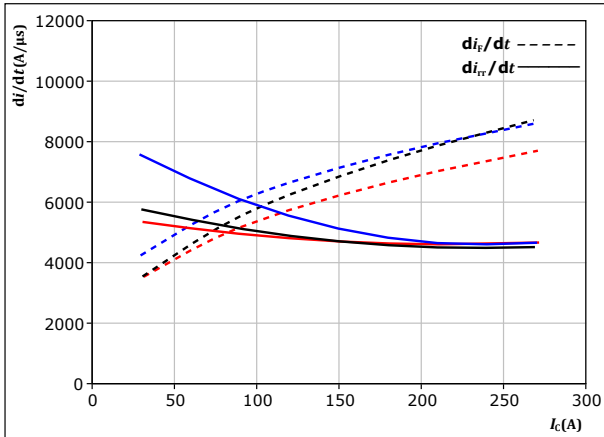
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datasheet

## Boost Switching Characteristics

**figure 45.** 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

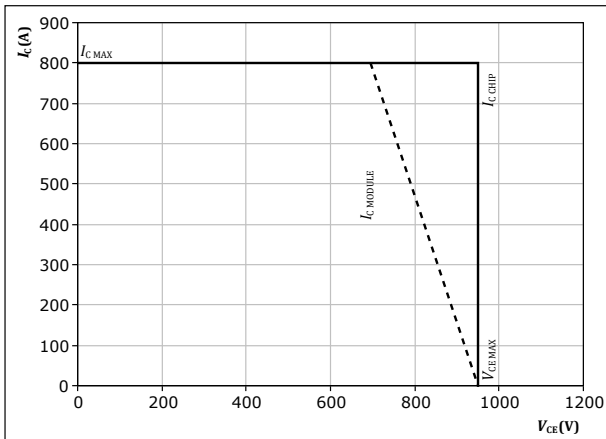
$V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $R_{gon} = 2 \text{ } \Omega$

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

**figure 47.** IGBT

Reverse bias safe operating area

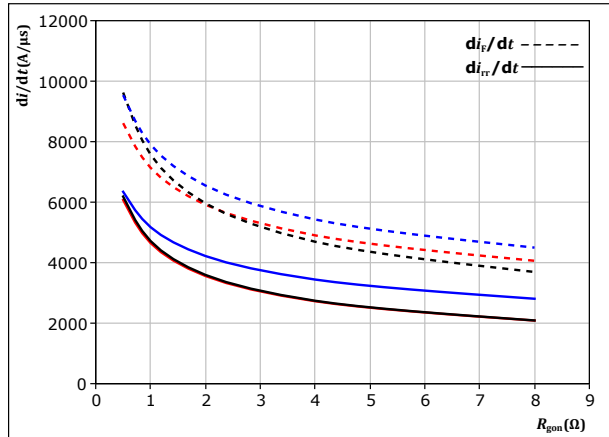
$I_C = f(V_{CE})$



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

**figure 46.** 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

$V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $I_C = 150 \text{ A}$

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



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# 30-FT10NIA400S702-LP59F04 datasheet

## Switching Definitions

figure 48. IGBT

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

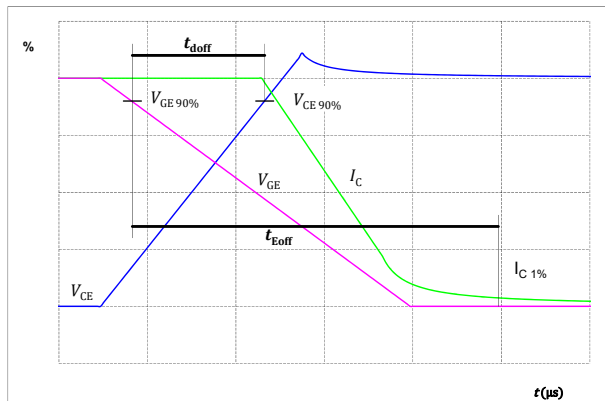


figure 49. IGBT

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

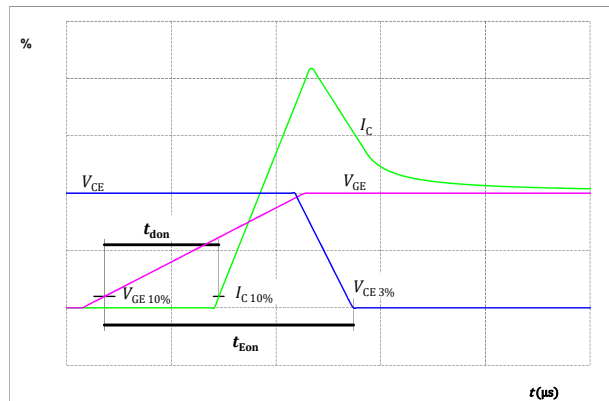


figure 50. IGBT

Turn-off Switching Waveforms & definition of  $t_f$

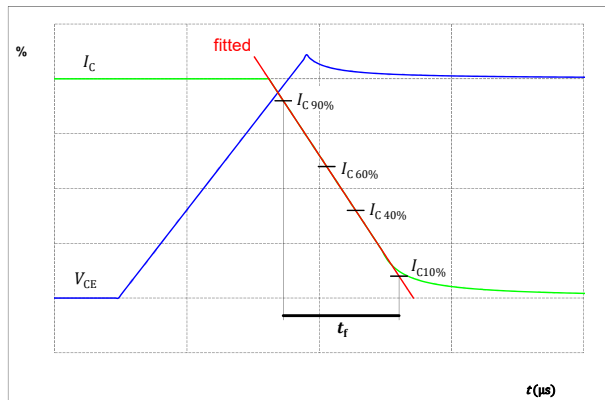
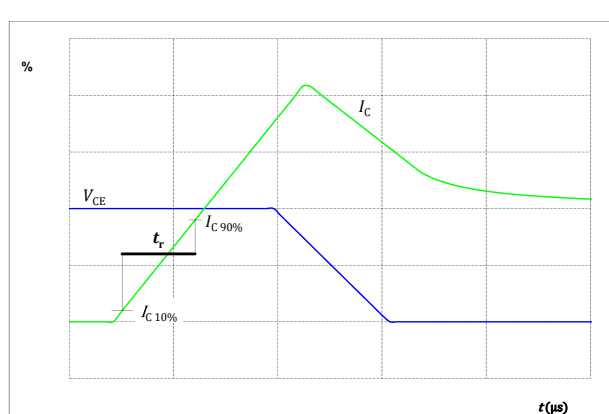


figure 51. IGBT

Turn-on Switching Waveforms & definition of  $t_r$





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# 30-FT10NIA400S702-LP59F04 datasheet

## Switching Definitions

figure 52. FWD

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

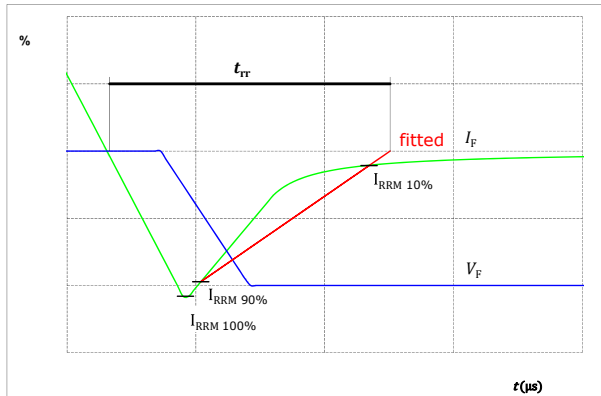
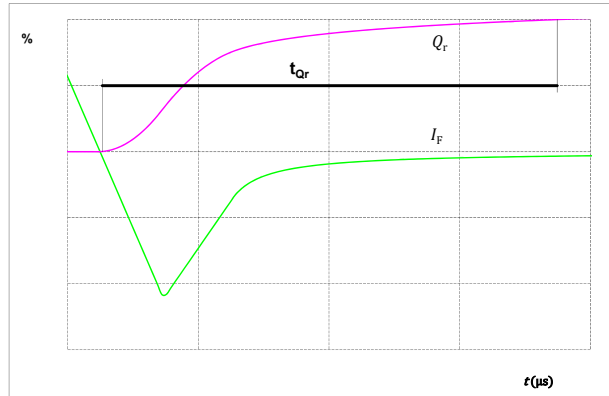


figure 53. FWD

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





datasheet

| Ordering Code         |                               |
|-----------------------|-------------------------------|
| Version               | Ordering Code                 |
| Without thermal paste | 30-FT10NIA400S702-LP59F04     |
| With thermal paste    | 30-FT10NIA400S702-LP59F04-/3/ |

| Marking                                                                           |                                                                                   |                               |          |            |          |           |        |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------|----------|------------|----------|-----------|--------|
|  | Text                                                                              | Name                          |          | Date code  | UL & VIN | Lot       | Serial |
|                                                                                   |                                                                                   | NN-NNNNNNNNNNNNN-<br>TTTTTIVV |          | WWYY       | UL VIN   | LLLLL     | SSSS   |
|                                                                                   |  | Datamatrix                    | Type&Ver | Lot number | Serial   | Date code |        |
| TTTTTIVV                                                                          |                                                                                   |                               | LLLLL    | SSSS       | WWYY     |           |        |

| Pin table [mm] |       |       |          |
|----------------|-------|-------|----------|
| Pin            | X     | Y     | Function |
| 1              | 70,9  | 0     | DC-      |
| 2              | 68,2  | 0     | DC-      |
| 3              | 65,5  | 0     | DC-      |
| 4              | 62,8  | 0     | DC-      |
| 5              | 60,1  | 0     | DC-      |
| 6              | 70,9  | 10,8  | S12      |
| 7              | 67,85 | 10,8  | G12      |
| 8              | 48,8  | 0     | GND1     |
| 9              | 46,1  | 0     | GND1     |
| 10             | 43,4  | 0     | GND1     |
| 11             | 40,7  | 0     | GND1     |
| 12             | 38    | 0     | GND1     |
| 13             | 32,9  | 0     | GND2     |
| 14             | 30,2  | 0     | GND2     |
| 15             | 27,5  | 0     | GND2     |
| 16             | 24,8  | 0     | GND2     |
| 17             | 22,1  | 0     | GND2     |
| 18             | 19,35 | 9,1   | S11      |
| 19             | 16,3  | 9,1   | G11      |
| 20             | 10,8  | 0     | DC+      |
| 21             | 8,1   | 0     | DC+      |
| 22             | 5,4   | 0     | DC+      |
| 23             | 2,7   | 0     | DC+      |
| 24             | 0     | 0     | DC+      |
| 25             | 19,75 | 18,7  | P        |
| 26             | 0     | 36,9  | Therm1   |
| 27             | 3     | 36,9  | Therm2   |
| 28             | 12,2  | 35,95 | S13      |
| 29             | 12,15 | 32,35 | G13      |
| 30             | 22,2  | 36,9  | Ph2      |
| 31             | 24,9  | 36,9  | Ph2      |
| 32             | 27,6  | 36,9  | Ph2      |
| 33             | 30,3  | 36,9  | Ph2      |
| 34             | 33    | 36,9  | Ph2      |
| 35             | 37,9  | 36,9  | Ph1      |
| 36             | 40,6  | 36,9  | Ph1      |
| 37             | 43,3  | 36,9  | Ph1      |
| 38             | 46    | 36,9  | Ph1      |
| 39             | 48,7  | 36,9  | Ph1      |
| 40             | 52,3  | 20,7  | G14      |
| 41             | 49,1  | 20,7  | S14      |
| 42             | 45,55 | 19,35 | N        |

The technical drawing shows the sensor module from two perspectives. The top view is a rectangular layout with dimensions 84,5 mm by 38,45 mm. It features four mounting holes at the corners and a central pin header. Pins are numbered 1 through 42, with some pins (1-17) grouped on the left side and others (18-42) on the right. A coordinate system (X, Y) is shown with the origin at the bottom-left corner. The side view shows the module's profile with a height of 17,2 mm and a pin diameter of 1,40 mm. A note indicates a tolerance of ±0,5 mm for the end of the pins.

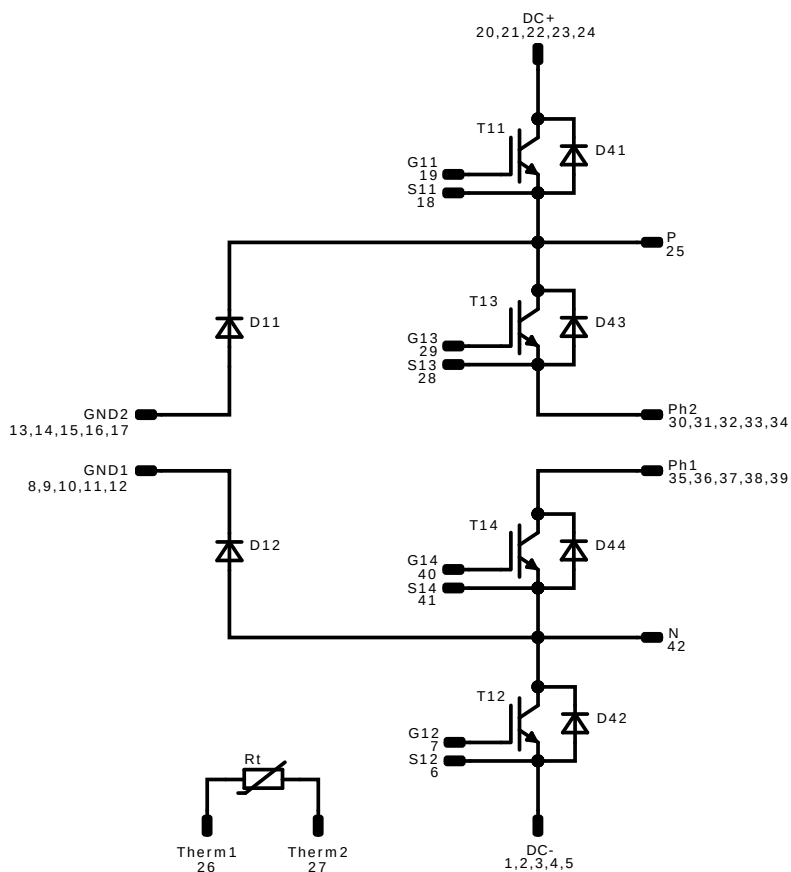


Vincotech

# 30-FT10NIA400S702-LP59F04

datasheet

## Pinout



## Identification

| ID       | Component | Voltage | Current | Function             | Comment |
|----------|-----------|---------|---------|----------------------|---------|
| T11, T12 | IGBT      | 950 V   | 400 A   | Buck Switch          |         |
| D11, D12 | FWD       | 1200 V  | 100 A   | Buck Diode           |         |
| T13, T16 | IGBT      | 950 V   | 400 A   | Boost Switch         |         |
| D41, D42 | FWD       | 950 V   | 200 A   | Boost Diode          |         |
| D43, D44 | FWD       | 950 V   | 200 A   | Boost Sw. Inv. Diode |         |
| Rt       | NTC       |         |         | Thermistor           |         |





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**30-FT10NIA400S702-LP59F04**  
datasheet

| Packaging instruction                                                                                                           |      |          |      |                                                                                     |
|---------------------------------------------------------------------------------------------------------------------------------|------|----------|------|-------------------------------------------------------------------------------------|
| Standard packaging quantity (SPQ) 36                                                                                            | >SPQ | Standard | <SPQ | Sample                                                                              |
| Handling instruction                                                                                                            |      |          |      |                                                                                     |
| Handling instructions for <i>flow 2</i> packages see vincotech.com website.                                                     |      |          |      |                                                                                     |
| Package data                                                                                                                    |      |          |      |                                                                                     |
| Package data for <i>flow 2</i> 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 certified according to UL 1557 standard, UL file number E192116. For more information see vincotech.com website. |      |          |      |  |

| Document No.:                   | Date:        | Modification: | Pages |
|---------------------------------|--------------|---------------|-------|
| 30-FT10NIA400S702-LP59F04-D1-14 | 27 Aug. 2020 |               |       |

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