Vincotech

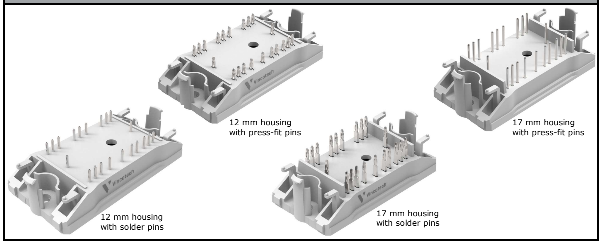
# V23990-P860-F48
# V23990-P860-F48Y
# V23990-P860-F49
# V23990-P860-F49Y
datasheet

***flow*PACK 0** **1200 V / 35 A**

### Features

- 2 clip housing in 12 mm and 17 mm height
- Trench Fieldstop IGBT4 technology
- Compact and low inductance design
- Built-in NTC

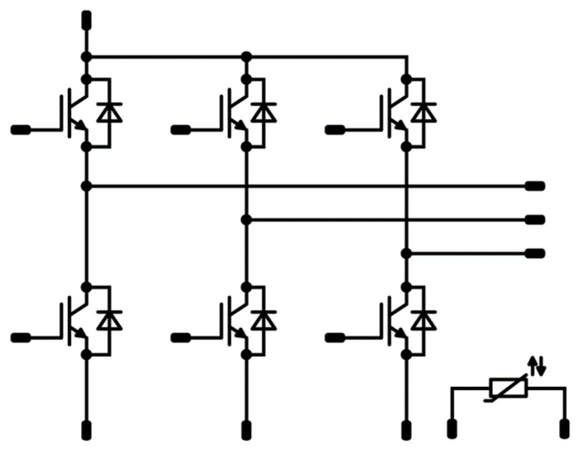
### *flow* 0 housing




### Target applications

- Motor Drives
- Power Generation
- UPS

### Schematic



### Types

- V23990-P860-F48-PM
- V23990-P860-F48Y-PM
- V23990-P860-F49-PM
- V23990-P860-F49Y-PM

# Maximum Ratings

$T_j$ = 25 °C, unless otherwise specified

| Parameter | Symbol | Condition | Value | Unit |
|---|---|---|---|---|
| **Inverter Switch** | | | | |
| Collector-emitter voltage | $V_{CES}$ | | 1200 | V |
| Collector current | $I_C$ | $T_j = T_{jmax}$ $T_s$ = 80 °C | 34 | A |
| Repetitive peak collector current | $I_{CRM}$ | $t_p$ limited by $T_{jmax}$ | 105 | A |
| Total power dissipation | $P_{tot}$ | $T_j = T_{jmax}$ $T_s$ = 80 °C | 80 | W |
| Gate-emitter voltage | $V_{GES}$ | | ±20 | V |
| Short circuit ratings | $t_{SC}$ | $V_{GE}$ = 15 V $V_{cc}$ = 800 V $T_j$ = 150 °C | 10 | μs |
| Maximum junction temperature | $T_{jmax}$ | | 175 | °C |

# Maximum Ratings

$T_j$ = 25 °C, unless otherwise specified

| Parameter | Symbol | Condition | | Value | Unit |
|---|---|---|---|---|---|
| **Inverter Diode** | | | | | |
| Peak repetitive reverse voltage | $V_{RRM}$ | | | 1200 | V |
| Continuous (direct) forward current | $I_F$ | $T_j = T_{jmax}$ | $T_s$ = 80 °C | 35 | A |
| Repetitive peak forward current | $I_{FRM}$ | | | 70 | A |
| Total power dissipation | $P_{tot}$ | $T_j = T_{jmax}$ | $T_s$ = 80 °C | 61 | W |
| Maximum junction temperature | $T_{jmax}$ | | | 175 | °C |

## Module Properties

### Thermal Properties

| Parameter | Symbol | Condition | | Value | Unit |
|---|---|---|---|---|---|
| Storage temperature | $T_{stg}$ | | | -40…+125 | °C |
| Operation temperature under switching condition | $T_{jop}$ | | | -40…($T_{jmax}$ - 25) | °C |

### Isolation Properties

| Parameter | Symbol | Condition | | Value | Unit |
|---|---|---|---|---|---|
| Isolation voltage | $V_{isol}$ | DC Test Voltage* | $t_p$ = 2 s | 6000 | V |
| | | AC Voltage | $t_p$ = 1 min | 2500 | V |
| Creepage distance | | | | min. 12,7 | mm |
| Clearance | | Solder pins | 12 mm / 17 mm | 9,22 / min. 12,7 | mm |
| | | Press-fit pins | 12 mm / 17 mm | 9,24 / min. 12,7 | |
| Comparative Tracking Index | CTI | | | > 200 | |

*100% tested in production

# Characteristic Values

| Parameter | Symbol | Conditions | $V_{GE}$ [V] $V_{GS}$ [V] | $V_{CE}$ [V] $V_{DS}$ [V] $V_F$ [V] | $I_C$ [A] $I_D$ [A] $I_F$ [A] | $T_j$ [°C] | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| **Inverter Switch** | | | | | | | | | | |
| **Static** | | | | | | | | | | |
| Gate-emitter threshold voltage | $V_{GE(th)}$ | $V_{GE} = V_{CE}$ | | | 0,0012 | 25 | 5 | 5,8 | 6,5 | V |
| Collector-emitter saturation voltage | $V_{CEsat}$ | | 15 | | 35 | 25<br>150 | | 1,9<br>2,33 | 2,3 | V |
| Collector-emitter cut-off current | $I_{CES}$ | | 0 | 1200 | | 25 | | | 15 | µA |
| Gate-emitter leakage current | $I_{GES}$ | | 20 | 0 | | 25 | | | 200 | nA |
| Internal gate resistance | $r_g$ | | | | | | | none | | Ω |
| Input capacitance | $C_{ies}$ | $f$ = 1 Mhz | 0 | 25 | | 25 | | 1950 | | pF |
| Output capacitance | $C_{oes}$ | | | | | | | 155 | | |
| Reverse transfer capacitance | $C_{res}$ | | | | | | | 115 | | |
| Gate charge | $Q_g$ | | ±15 | 960 | 35 | 25 | | 197 | | nC |
| **Thermal** | | | | | | | | | | |
| Thermal resistance junction to sink | $R_{th(j-s)}$ | $\lambda_{paste}$ = 0,8 W/mK (P12) | | | | | | 1,19 | | K/W |
| **Dynamic** | | | | | | | | | | |
| Turn-on delay time | $t_{d(on)}$ | $R_{gon}$ = 16 Ω<br>$R_{goff}$ = 16 Ω | ±15 | 600 | 35 | 25<br>150 | | 85<br>89 | | ns |
| Rise time | $t_r$ | | | | | 25<br>150 | | 22<br>26 | | |
| Turn-off delay time | $t_{d(off)}$ | | | | | 25<br>150 | | 199<br>259 | | |
| Fall time | $t_f$ | | | | | 25<br>150 | | 73<br>115 | | |
| Turn-on energy (per pulse) | $E_{on}$ | $Q_{rFWD}$ = 3,8 µC<br>$Q_{rFWD}$ = 7 µC | | | | 25<br>150 | | 2,48<br>3,71 | | mWs |
| Turn-off energy (per pulse) | $E_{off}$ | | | | | 25<br>150 | | 1,84<br>2,91 | | |

# Characteristic Values

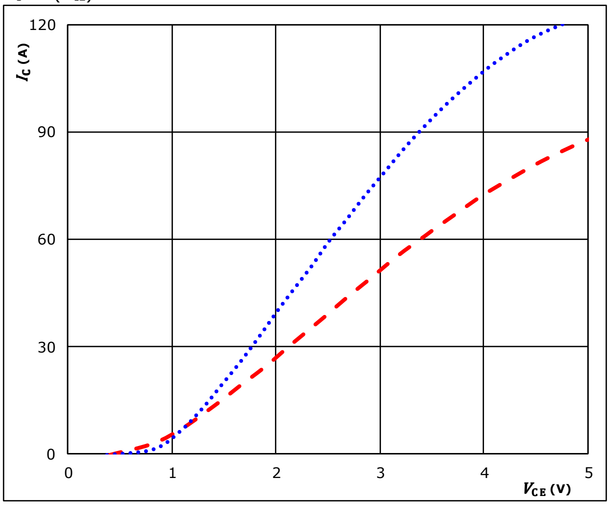
| Parameter | Symbol | Conditions | | | | | Value | | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | $V_{GE}$ [V] $V_{GS}$ [V] | $V_{CE}$ [V] $V_{DS}$ [V] $V_{F}$ [V] | $I_{C}$ [A] $I_{D}$ [A] $I_{F}$ [A] | $T_{j}$ [°C] | Min | Typ | Max | |
| **Inverter Diode** | | | | | | | | | | |
| **Static** | | | | | | | | | | |
| Forward voltage | $V_{F}$ | | | | 35 | 25<br>150 | | 1,79<br>1,76 | 2,3 | V |
| Reverse leakage current | $I_{R}$ | | | 1200 | | 25 | | | 7,7 | µA |
| **Thermal** | | | | | | | | | | |
| Thermal resistance junction to sink | $R_{th(j-s)}$ | $\lambda_{paste}$ = 0,8 W/mK (P12) | | | | | | 1,55 | | K/W |
| **Dynamic** | | | | | | | | | | |
| Peak recovery current | $I_{RRM}$ | d$i$/d$t$ = 1463 A/µs<br>d$i$/d$t$ = 1493 A/µs | ±15 | 600 | 35 | 25<br>150 | | 30<br>34 | | A |
| Reverse recovery time | $t_{rr}$ | | | | | 25<br>150 | | 298<br>493 | | ns |
| Recovered charge | $Q_{r}$ | | | | | 25<br>150 | | 3,79<br>7,00 | | µC |
| Reverse recovered energy | $E_{rec}$ | | | | | 25<br>150 | | 1,48<br>2,81 | | mWs |
| Peak rate of fall of recovery current | $(di_{rf}/dt)_{max}$ | | | | | 25<br>150 | | 122<br>105 | | A/µs |
| **Thermistor** | | | | | | | | | | |
| Rated resistance | $R$ | | | | | 25 | | 22 | | kΩ |
| Deviation of $R_{100}$ | $\Delta_{R/R}$ | $R_{100}$ = 1484 Ω | | | | 100 | -5 | | 5 | % |
| Power dissipation | $P$ | | | | | 25 | | 5 | | mW |
| Power dissipation constant | | | | | | 25 | | 1,5 | | mW/K |
| B-value | $B_{(25/50)}$ | Tol. ±1 % | | | | 25 | | 3962 | | K |
| B-value | $B_{(25/100)}$ | Tol. ±1 % | | | | 25 | | 4000 | | K |
| Vincotech NTC Reference | | | | | | | | | I | |

# Inverter Switch Characteristics

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

**Typical output characteristics**

$I_C = f(V_{CE})$

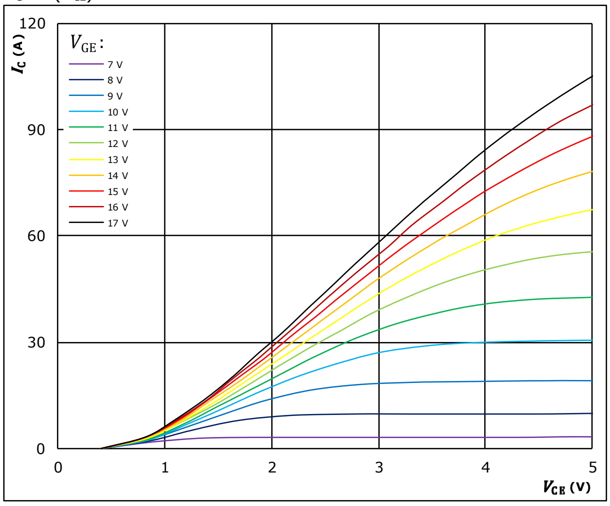



| | | | | | |
|---|---|---|---|---|---|
| $t_p$ = | 250 | µs | $T_j$: | 25 °C | ·········· |
| $V_{GE}$ = | 15 | V | | 150 °C | – – – |

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

**Typical output characteristics**

$I_C = f(V_{CE})$

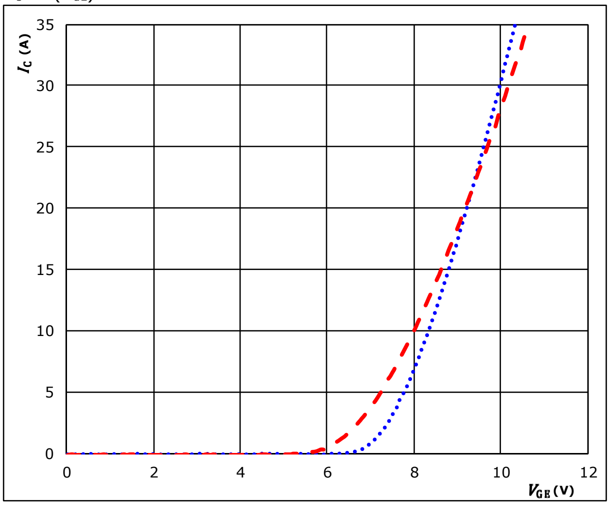



| | | |
|---|---|---|
| $t_p$ = | 250 | µs |
| $T_j$ = | 150 | °C |
| $V_{GE}$ from | 7 V to 17 V in steps of 1 V | |

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

**Typical transfer characteristics**

$I_C = f(V_{GE})$

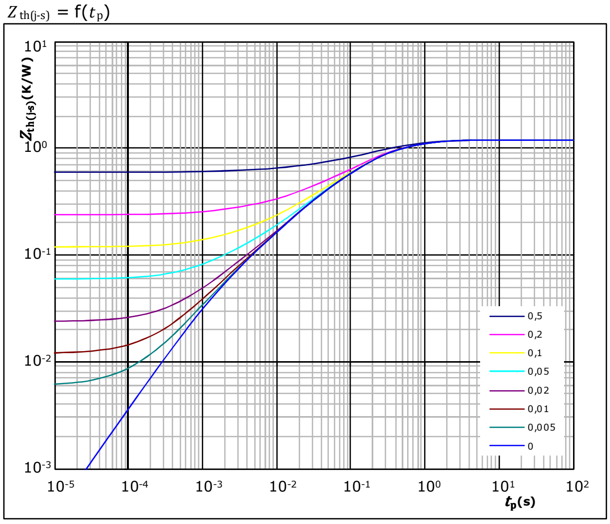



| | | | | | |
|---|---|---|---|---|---|
| $t_p$ = | 100 | µs | $T_j$: | 25 °C | ·········· |
| $V_{CE}$ = | 10 | V | | 150 °C | – – – |

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

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

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




$D$ = $t_p / T$

$R_{th(j\text{-}s)}$ = 1,19 K/W

IGBT thermal model values

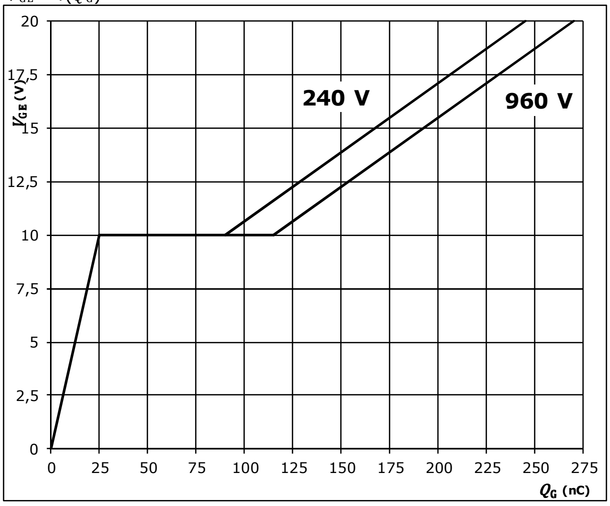
| $R$ (K/W) | $\tau$ (s) |
|---|---|
| 2,33E-01 | 1,13E+00 |
| 5,75E-01 | 2,43E-01 |
| 2,19E-01 | 7,16E-02 |
| 1,27E-01 | 1,64E-02 |
| 3,55E-02 | 1,94E-03 |

# Inverter Switch Characteristics

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

**Gate voltage vs gate charge**

$V_{GE} = f(Q_G)$

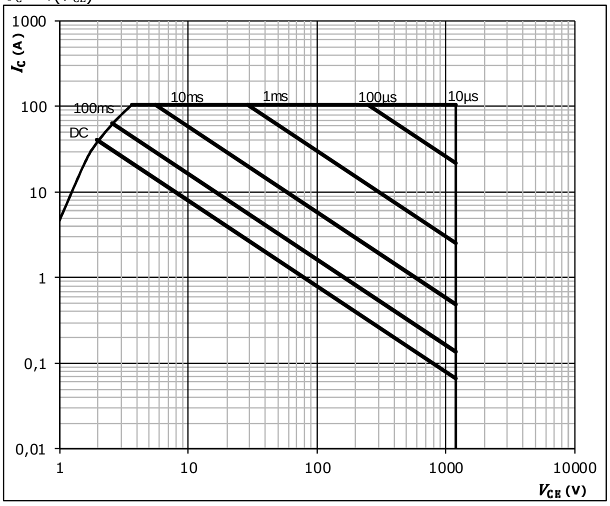



$I_C$ = 35 A

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

**Safe operating area**

$I_C = f(V_{CE})$



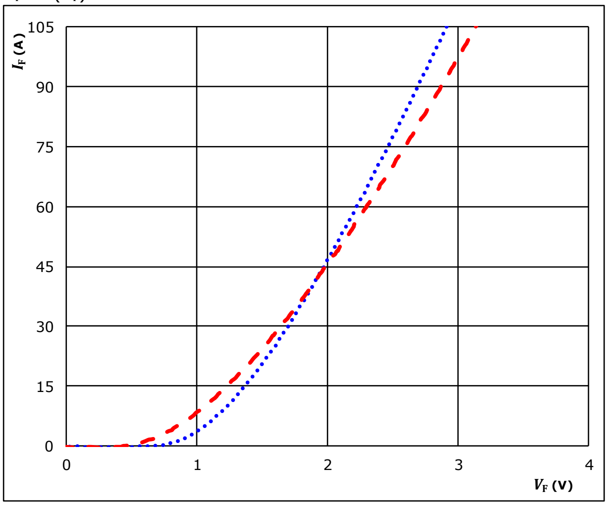

$D$ = single pulse
$T_s$ = 80 ºC
$V_{GE}$ = ±15 V
$T_j$ = $T_{jmax}$

# Inverter Diode Characteristics

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

**Typical forward characteristics**

$I_F = f(V_F)$



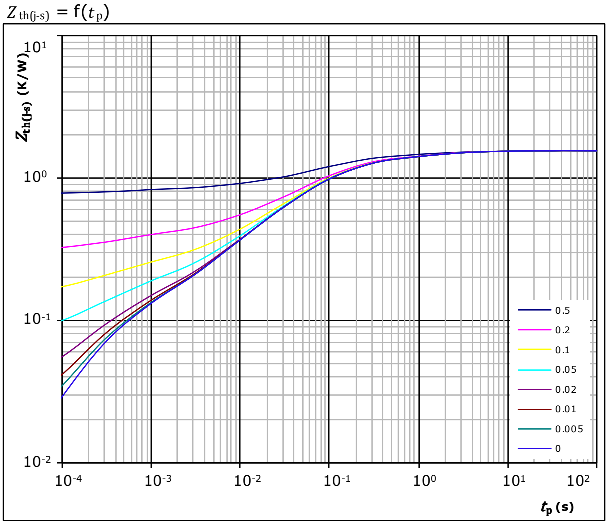

$t_p$ = 250 µs

$T_j$: 25 °C (dotted), 150 °C (dashed)

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

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

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




$D = t_p / T$

$R_{th(j-s)}$ = 1,55 K/W

FWD thermal model values

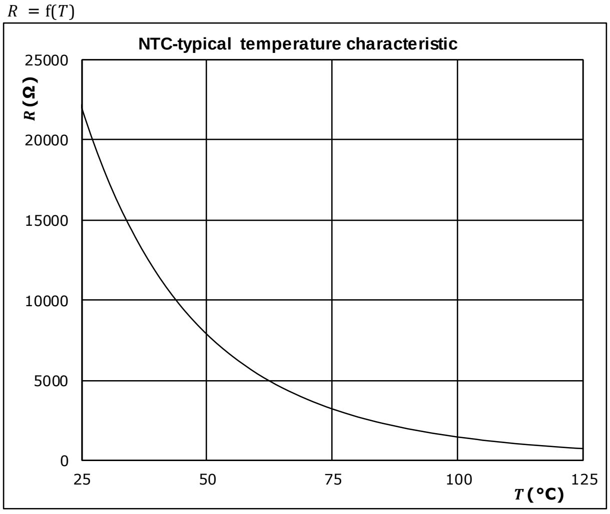
| $R$ (K/W) | $\tau$ (s) |
|---|---|
| 4,55E-02 | 1,03E+01 |
| 2,26E-01 | 1,43E+00 |
| 6,16E-01 | 1,57E-01 |
| 4,43E-01 | 3,74E-02 |
| 1,25E-01 | 5,48E-03 |
| 9,34E-02 | 3,86E-04 |

# Thermistor Characteristics

**figure 1.** **Thermistor**

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

$R = f(T)$

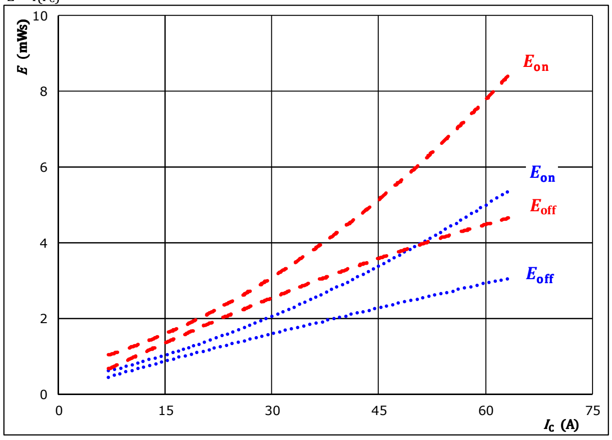


# Inverter Switching Characteristics

**figure 1.** IGBT

Typical switching energy losses as a function of collector current

$E = f(I_C)$



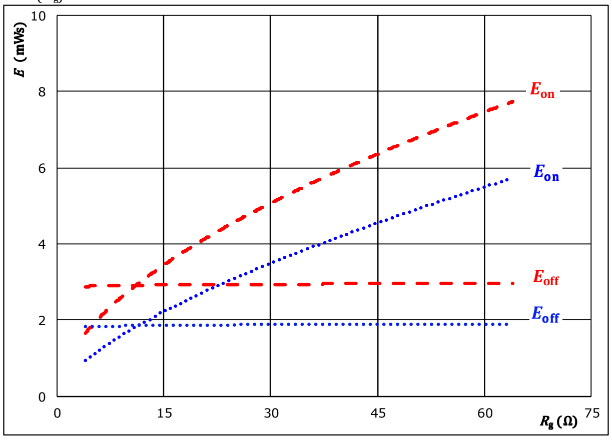

With an inductive load at

| | | | | | |
|---|---|---|---|---|---|
| $V_{CE}$ = | 600 | V | $T_j$: | 25 °C | ············ |
| $V_{GE}$ = | ±15 | V | | 150 °C | – – – – |
| $R_{gon}$ = | 16 | Ω | | | |
| $R_{goff}$ = | 16 | Ω | | | |

**figure 2.** IGBT

Typical switching energy losses as a function of gate resistor

$E = f(R_g)$



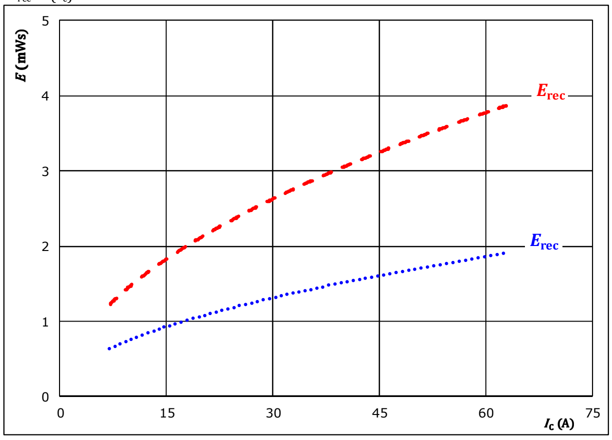

With an inductive load at

| | | | | | |
|---|---|---|---|---|---|
| $V_{CE}$ = | 600 | V | $T_j$: | 25 °C | ············ |
| $V_{GE}$ = | ±15 | V | | 150 °C | – – – – |
| $I_C$ = | 35 | A | | | |

**figure 3.** FWD

Typical reverse recovered energy loss as a function of collector current

$E_{rec} = f(I_c)$



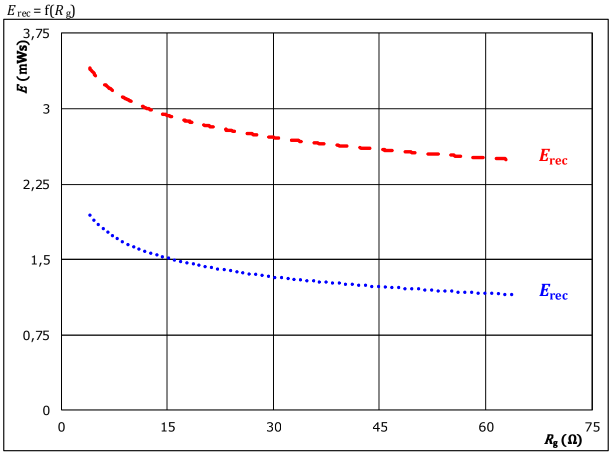

With an inductive load at

| | | | | | |
|---|---|---|---|---|---|
| $V_{CE}$ = | 600 | V | $T_j$: | 25 °C | ············ |
| $V_{GE}$ = | ±15 | V | | 150 °C | – – – – |
| $R_{gon}$ = | 16 | Ω | | | |

**figure 4.** FWD

Typical reverse recovered energy loss as a function of gate resistor

$E_{rec} = f(R_g)$




With an inductive load at

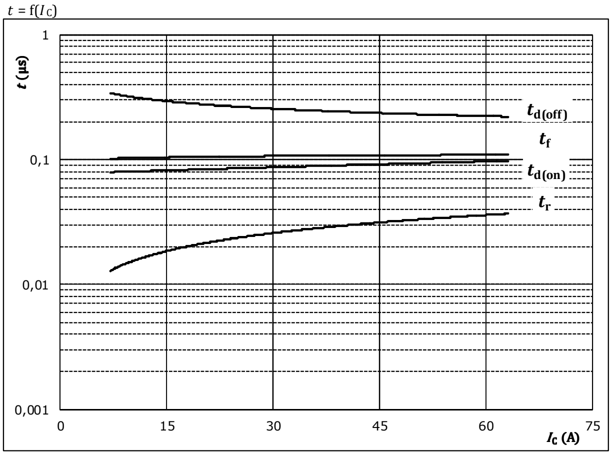
| | | | | | |
|---|---|---|---|---|---|
| $V_{CE}$ = | 600 | V | $T_j$: | 25 °C | ············ |
| $V_{GE}$ = | ±15 | V | | 150 °C | – – – – |
| $I_C$ = | 35 | A | | | |

# Inverter Switching Characteristics

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

**Typical switching times as a function of collector current**

$t = f(I_C)$



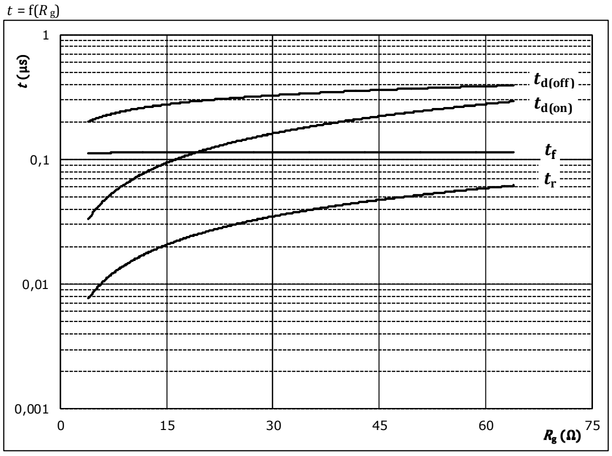

With an inductive load at

| | | |
|---|---|---|
| $T_j$ = | 150 | °C |
| $V_{CE}$ = | 600 | V |
| $V_{GE}$ = | ±15 | V |
| $R_{gon}$ = | 16 | Ω |
| $R_{goff}$ = | 16 | Ω |

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

**Typical switching times as a function of gate resistor**

$t = f(R_g)$



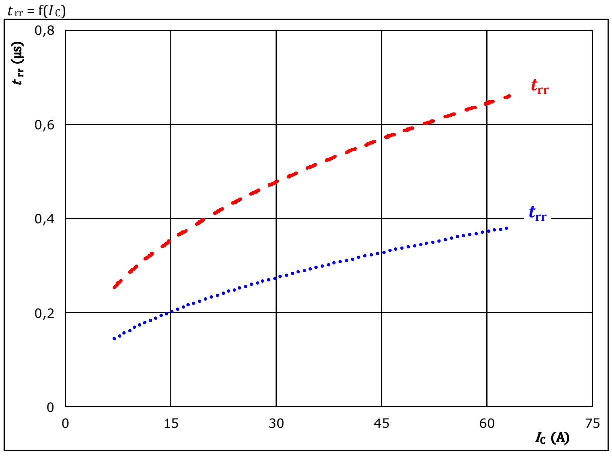

With an inductive load at

| | | |
|---|---|---|
| $T_j$ = | 150 | °C |
| $V_{CE}$ = | 600 | V |
| $V_{GE}$ = | ±15 | V |
| $I_C$ = | 35 | A |

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

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

$t_{rr} = f(I_C)$



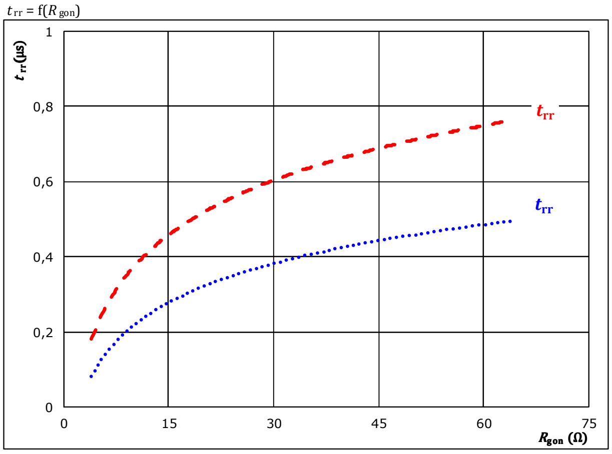

At

| | | | | |
|---|---|---|---|---|
| $V_{CE}$ = | 600 | V | $T_j$: | 25 °C (dotted) |
| $V_{GE}$ = | ±15 | V | | 150 °C (dashed) |
| $R_{gon}$ = | 16 | Ω | | |

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

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

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




At

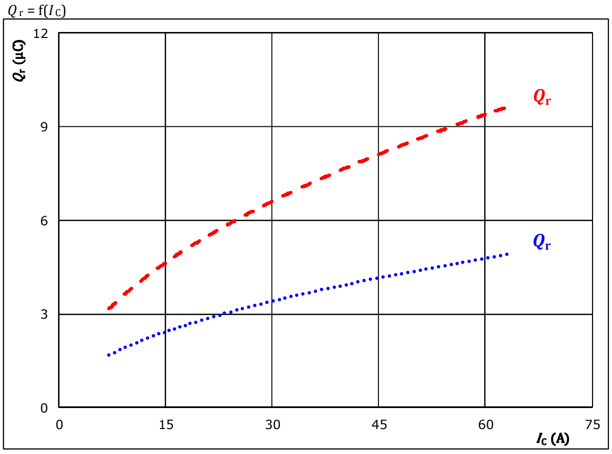
| | | | | |
|---|---|---|---|---|
| $V_{CE}$ = | 600 | V | $T_j$: | 25 °C (dotted) |
| $V_{GE}$ = | ±15 | V | | 150 °C (dashed) |
| $I_C$ = | 35 | A | | |

# Inverter Switching Characteristics

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

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

$Q_r = f(I_C)$

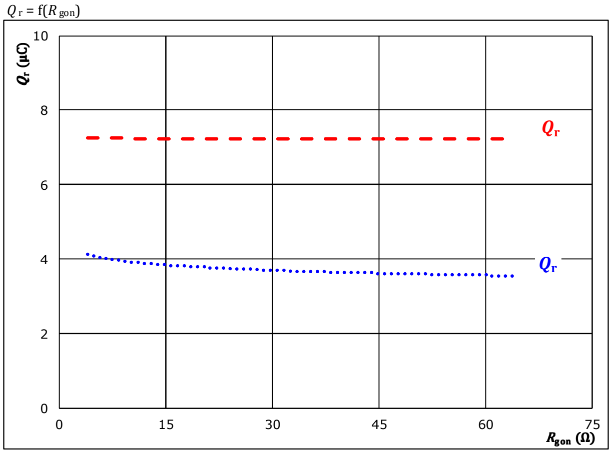



| | | | | | | |
|---|---|---|---|---|---|---|
| **At** | $V_{CE}$ = | 600 | V | $T_j$: | 25 °C | ··········· |
| | $V_{GE}$ = | ±15 | V | | 150 °C | – – – – |
| | $R_{gon}$ = | 16 | Ω | | | |

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

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

$Q_r = f(R_{gon})$

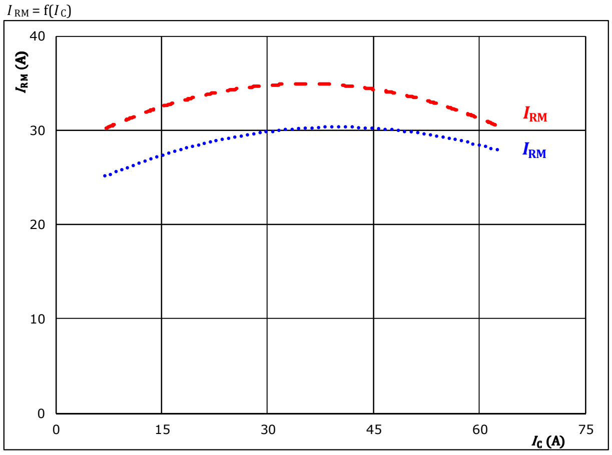



| | | | | | | |
|---|---|---|---|---|---|---|
| **At** | $V_{CE}$= | 600 | V | $T_j$: | 25 °C | ··········· |
| | $V_{GE}$ = | ±15 | V | | 150 °C | – – – – |
| | $I_C$= | 35 | A | | | |

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

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

$I_{RM} = f(I_C)$

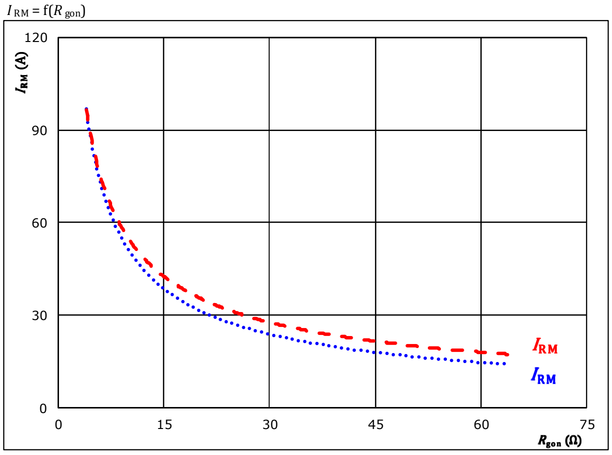



| | | | | | | |
|---|---|---|---|---|---|---|
| **At** | $V_{CE}$: | 600 | V | $T_j$: | 25 °C | ··········· |
| | $V_{GE}$ = | ±15 | V | | 150 °C | – – – – |
| | $R_{gon}$ = | 16 | Ω | | | |

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

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

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



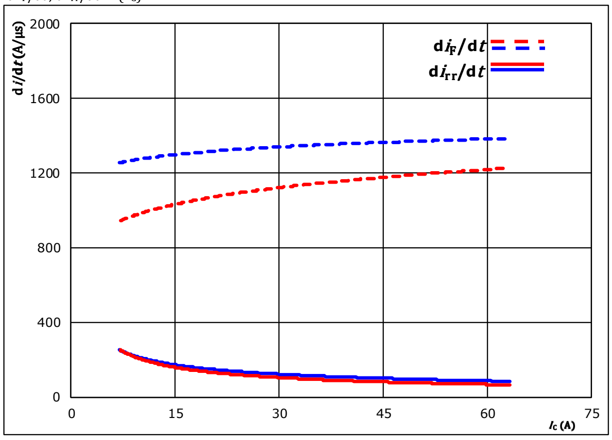

| | | | | | | |
|---|---|---|---|---|---|---|
| **At** | $V_{CE}$ = | 600 | V | $T_j$: | 25 °C | ··········· |
| | $V_{GE}$ = | ±15 | V | | 150 °C | – – – – |
| | $I_C$ = | 35 | A | | | |

# Inverter Switching Characteristics

**figure 13.** FWD

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

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

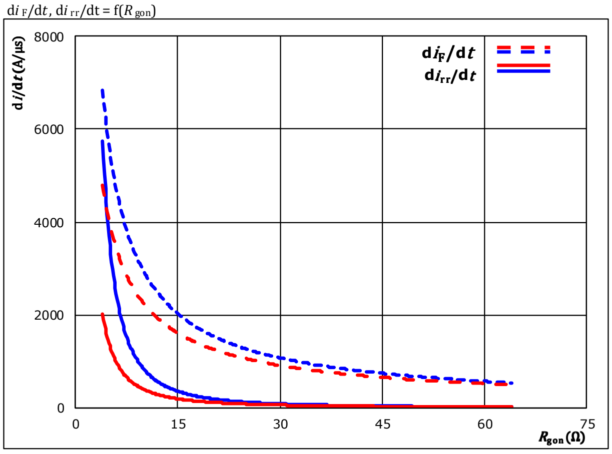



| At | | | | |
|---|---|---|---|---|
| $V_{CE}$ = | 600 | V | $T_j$: | 25 °C |
| $V_{GE}$ = | ±15 | V | | 150 °C |
| $R_{gon}$ = | 16 | Ω | | |

**figure 14.** FWD

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

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

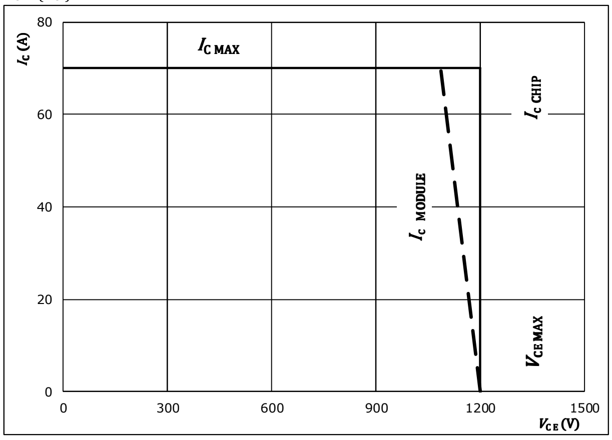



| At | | | | |
|---|---|---|---|---|
| $V_{CE}$ = | 600 | V | $T_j$: | 25 °C |
| $V_{GE}$ = | ±15 | V | | 150 °C |
| $I_C$ = | 35 | A | | |

**figure 15.** IGBT

**Reverse bias safe operating area**

$I_C = f(V_{CE})$




| At | | |
|---|---|---|
| $T_j$ = | 175 | °C |
| $R_{gon}$ = | 16 | Ω |
| $R_{goff}$ = | 16 | Ω |

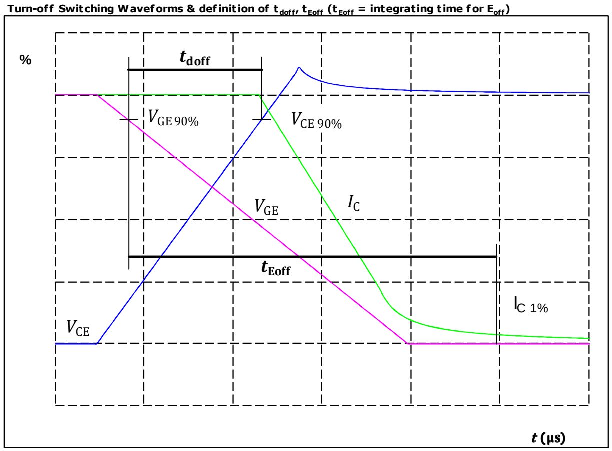
# Inverter Switching Definitions

**General conditions**

| | | |
|---|---|---|
| $T_j$ | = | **125 °C** |
| $R_{gon}$ | = | **16 Ω** |
| $R_{goff}$ | = | **16 Ω** |

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

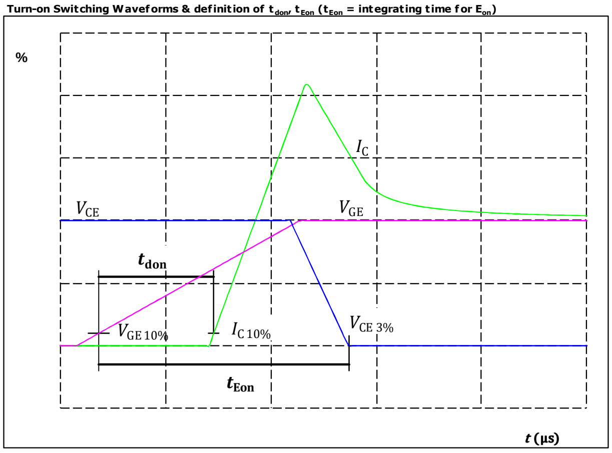
Turn-off Switching Waveforms & definition of $t_{doff}$, $t_{Eoff}$ ($t_{Eoff}$ = integrating time for $E_{off}$)




| | | |
|---|---|---|
| $V_{GE}(0\%)$ = | -15 | V |
| $V_{GE}(100\%)$ = | 15 | V |
| $V_C(100\%)$ = | 600 | V |
| $I_C(100\%)$ = | 35 | A |
| $t_{doff}$ = | 259 | ns |

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

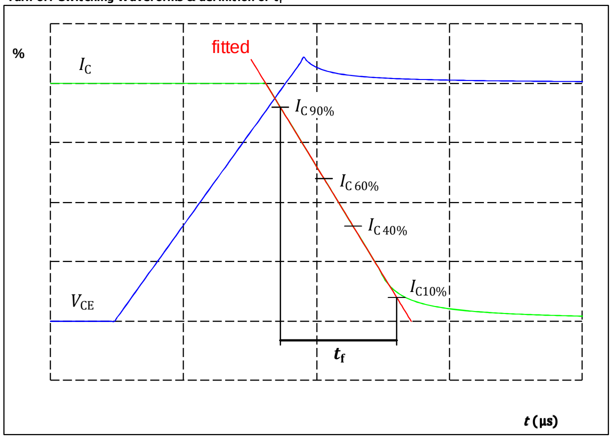
Turn-on Switching Waveforms & definition of $t_{don}$, $t_{Eon}$ ($t_{Eon}$ = integrating time for $E_{on}$)




| | | |
|---|---|---|
| $V_{GE}(0\%)$ = | -15 | V |
| $V_{GE}(100\%)$ = | 15 | V |
| $V_C(100\%)$ = | 600 | V |
| $I_C(100\%)$ = | 35 | A |
| $t_{don}$ = | 89 | ns |

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

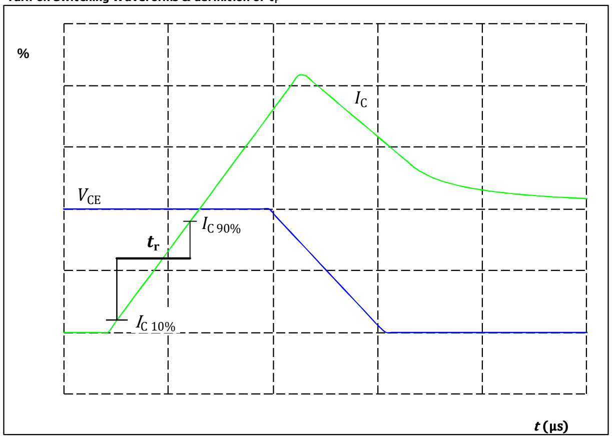
Turn-off Switching Waveforms & definition of $t_f$




| | | |
|---|---|---|
| $V_C(100\%)$ = | 600 | V |
| $I_C(100\%)$ = | 35 | A |
| $t_f$ = | 115 | ns |

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

Turn-on Switching Waveforms & definition of $t_r$

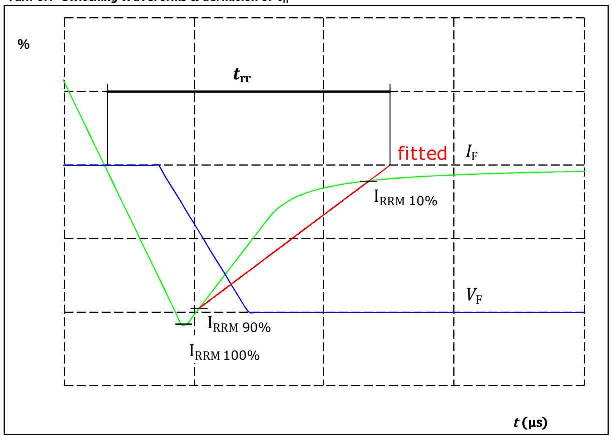



| | | |
|---|---|---|
| $V_C(100\%)$ = | 600 | V |
| $I_C(100\%)$ = | 35 | A |
| $t_r$ = | 26 | ns |

# Inverter Switching Characteristics

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

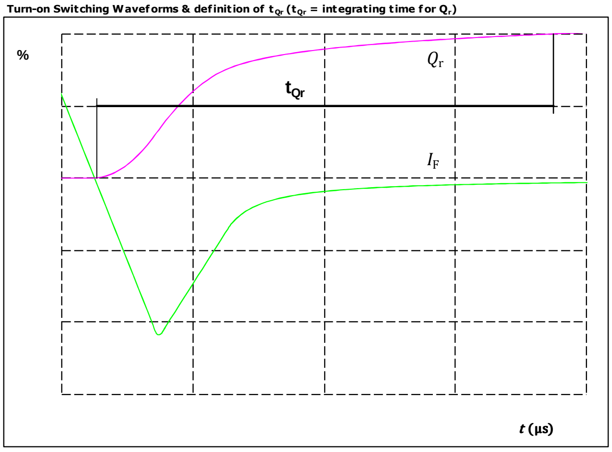
Turn-off Switching Waveforms & definition of $t_{rr}$




| | | |
|---|---|---|
| $V_F$ (100%) = | 600 | V |
| $I_F$ (100%) = | 35 | A |
| $I_{RRM}$ (100%) = | 34 | A |
| $t_{rr}$ = | 493 | ns |

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

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




| | | |
|---|---|---|
| $I_F$ (100%) = | 35 | A |
| $Q_r$ (100%) = | 7,00 | µC |

# V23990-P860-F48
# V23990-P860-F48Y
# V23990-P860-F49
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## Ordering Code & Marking

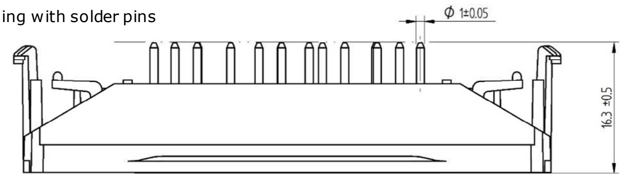
| Version | Ordering Code |
|---|---|
| without thermal paste 12 mm housing with solder pins | V23990-P860-F48-PM |
| with thermal paste 12 mm housing with solder pins | V23990-P860-F48-/3/-PM |
| without thermal paste 12 mm housing with press-fit pins | V23990-P860-F48Y-PM |
| with thermal paste 12 mm housing with press-fit pins | V23990-P860-F48Y-/3/-PM |
| without thermal paste 17 mm housing with solder pins | V23990-P860-F49-PM |
| with thermal paste 17 mm housing with solder pins | V23990-P860-F49-/3/-PM |
| without thermal paste 17 mm housing with press-fit pins | V23990-P860-F49Y-PM |
| with thermal paste 17 mm housing with press-fit pins | V23990-P860-F49Y-/3/-PM |


| | | | | | | |
|---|---|---|---|---|---|---|
| Text | VIN | | Name&Ver | UL | Lot | Serial |
| | VIN | | NNNNNNNNVV | UL | LLLLL | SSSS |
| Datamatrix | Type&Ver | Lot number | Serial | Date code | | |
| | NNNNNNNNVV | LLLLL | SSSS | WWYY | | |

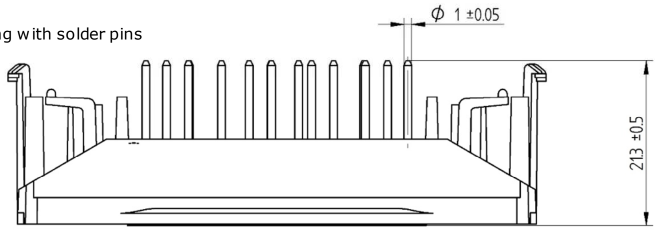
## Outline

| Pin table | | | |
|---|---|---|---|
| Pin | X | Y | Function |
| 1 | 33,3 | 0 | DC- |
| 2 | 30,7 | 0 | S15 |
| 3 | 27,9 | 0 | G15 |
| 4 | 23,85 | 0 | S13 |
| 5 | 21,05 | 0 | G13 |
| 6 | 15,95 | 0 | Therm2 |
| 7 | 9,6 | 0 | Therm1 |
| 8 | 5,4 | 0 | G11 |
| 9 | 2,6 | 0 | S11 |
| 10 | 0 | 0 | DC- |
| 11 | 0 | 11,15 | DC+ |
| 12 | 0 | 22,3 | Ph1 |
| 13 | 2,6 | 22,3 | Ph1 |
| 14 | 5,5 | 22,3 | G12 |
| 15 | 13,1 | 22,3 | G14 |
| 16 | 15,9 | 22,3 | Ph2 |
| 17 | 19,4 | 22,3 | Ph2 |
| 18 | 27,7 | 22,3 | G16 |
| 19 | 30,7 | 22,3 | Ph3 |
| 20 | 33,3 | 22,3 | Ph3 |
| 21 | 33,3 | 11,15 | DC+ |

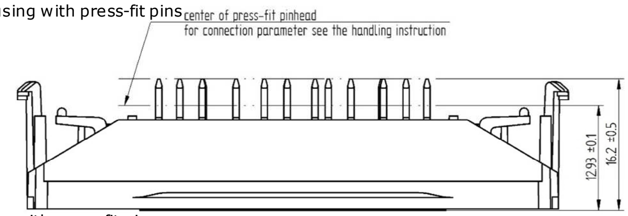
12 mm housing with solder pins



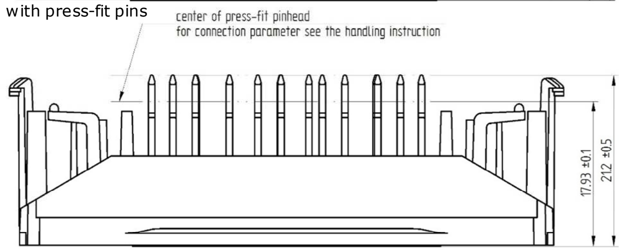

17 mm housing with solder pins

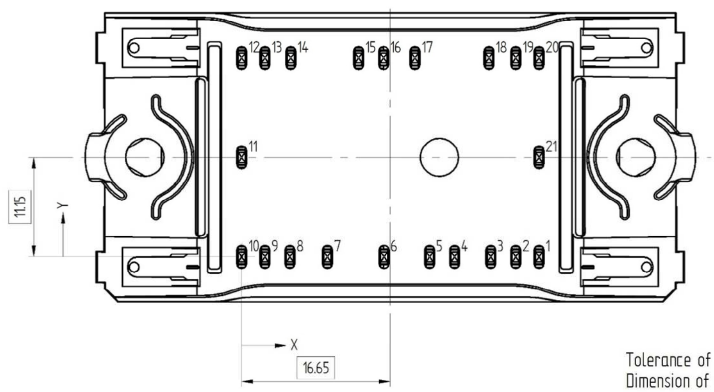



12 mm housing with press-fit pins




17 mm housing with press-fit pins




Tolerance of pinpositions: ±0.5mm at the end of pins
Dimension of coordinate axis is only offset without tolerance

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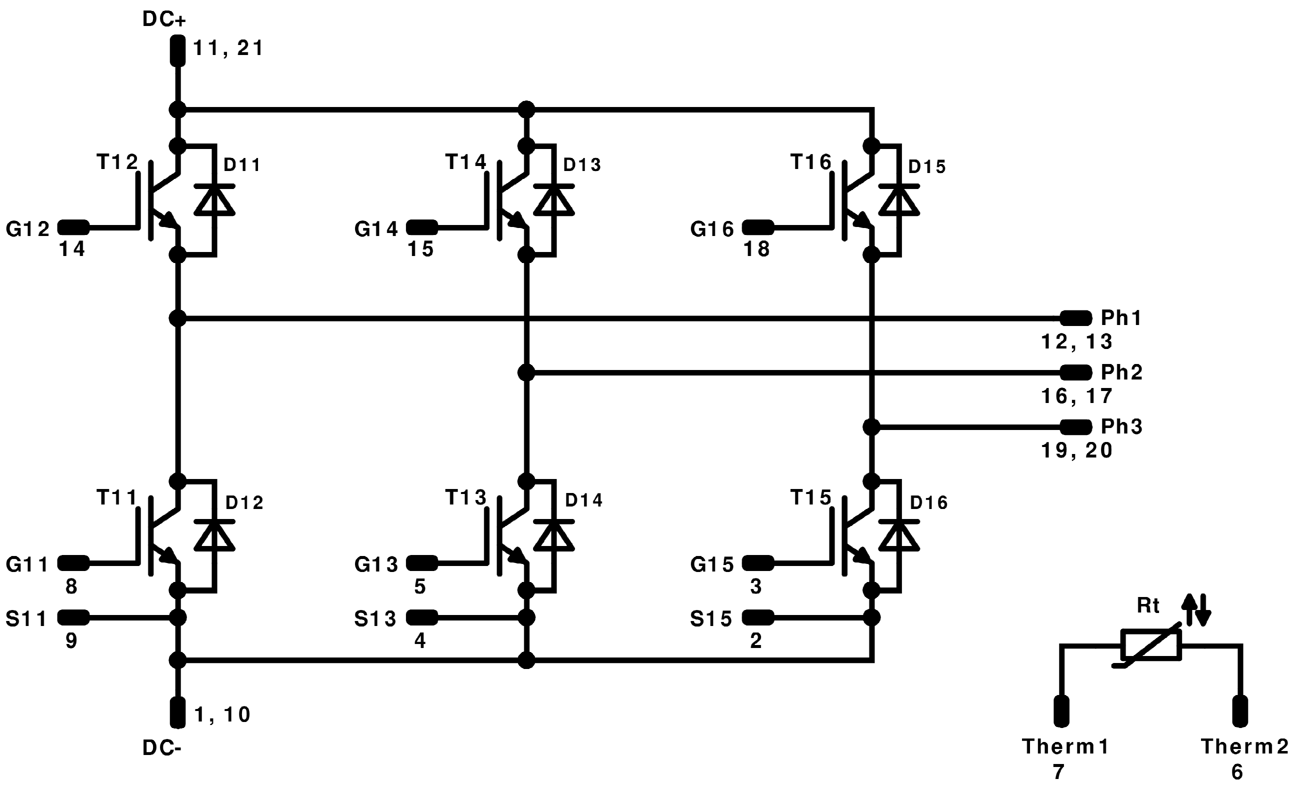
## Pinout




## Identification

| ID | Component | Voltage | Current | Function | Comment |
|---|---|---|---|---|---|
| T11, T12, T13, T14, T15, T16 | IGBT | 1200 V | 35 A | Inverter Switch | |
| D11, D12, D13, D14, D15, D16 | FWD | 1200 V | 35 A | Inverter Diode | |
| Rt | NTC | | | Thermistor | |

Vincotech

# V23990-P860-F48
# V23990-P860-F48Y
# V23990-P860-F49
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| Packaging instruction | | | | |
|---|---|---|---|---|
| Standard packaging quantity (SPQ) 135 | >SPQ | Standard | <SPQ | Sample |

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

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

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

| Document No.: | Date: | Modification: | Pages |
|---|---|---|---|
| V23990-P860-F4xx-D4-14 | 15 May. 2018 | New format | All |