Vincotech

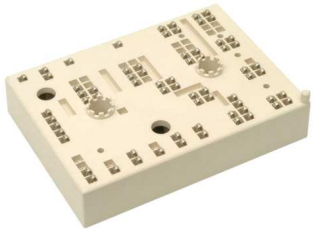
V23990-K430-F60-PM
datasheet

MiniSkiiP®PACK 3 — 1200 V / 150 A

Features

- Solderless interconnection
- Mitsubishi Generation 6.1 technology

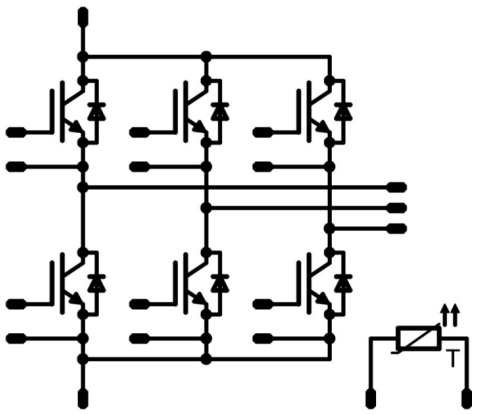
MiniSkiiP® 3 housing



Target applications

- Servo Drives
- Industrial Motor Drives
- UPS

Schematic



Types

- V23990-K430-F60

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	$T_j = T_j$max	T_S=80 °C	114	A
Repetitive peak collector current	I_{CRM}	t_p limited by $T_j$max		600	A
Turn off safe operating area		T_j ≤ 125°C, V_{CE} ≤ 1200 V		600	A
Total power dissipation	P_{tot}	$T_j = T_j$max	T_S=80 °C	212	W
Gate-emitter voltage	V_{GES}			±20	V
Maximum Junction Temperature	T_{jmax}			175	°C

Parameter	Symbol	Conditions		Value	Unit
Inverter Diode					
Peak Repetitive Reverse Voltage	V_{RRM}			1200	V
Continuous (direct) forward current	I_F	$T_j = T_{jmax}$	T_h = 80°C	95	A
Repetitive peak forward current	I_{FRM}			300	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_h = 80°C	160	W
Maximum Junction Temperature	T_{jmax}			175	°C

Parameter	Symbol	Conditions	Value	Unit
Module Properties				
Thermal Properties				
Storage temperature	T_{stg}		-40…+125	°C
Operation Junction Temperature	T_{jop}		-40…+(T_{jmax} - 25)	°C

Isolation Properties					
Isolation voltage	V_{isol}	DC voltage	t_p=2s	4000	V
Creepage distance				min 12,7	mm
Clearance				min 12,7	mm
Comparative Tracking Index	CTI			>200	

Characteristic Values

Parameter	Symbol	Conditions					Value			Unit
Inverter Switch			V_{GE} [V]	V_{CE} [V]	I_C [A]	T_j[°C]	Min	Typ	Max	
Static										
Gate-emitter threshold voltage	$V_{GE(th)}$	V_{GE}=V_{CE}			0,003	25 125	5,4	6	6,6	V
Collector-emitter saturation voltage	V_{CEsat}		15		150	25 125 150	1,35	1,73 2,01 2,07	2,15	V
Collector-emitter cut-off current	I_{CES}		0	1200		25 125			0,86	µA
Gate-emitter leakage current	I_{GES}		20	0		25 125			1000	nA
Internal gate resistance	r_g							6,5		Ω
Input capacitance	C_{ies}	f=1 MHz	0	25		25		30000		pF
Output capacitance	C_{oes}							6000		
Reverse transfer capacitance	C_{res}							500		
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	Thermal grease thickness≤50um λ = 1 W/mK						0,45		K/W
IGBT Switching										
Turn-on delay time	$t_{d(on)}$	R_{goff} = 2 Ω R_{gon} = 2 Ω	±15	600	150	25 125 150		77 77 77		ns
Rise time	t_r					25 125 150		8 10 10		
Turn-off delay time	$t_{d(off)}$					25 125 150		154 188 200		
Fall time	t_f					25 125 150		44 75 95		
Turn-on energy (per pulse)	E_{on}	Q_{rFWD} = 11,3 µC Q_{rFWD} = 24,6 µC Q_{rFWD} = 28,2 µC				25 125 150		3,327 6,444 7,460		mWs
Turn-off energy (per pulse)	E_{off}					25 125 150		7,912 11,452 12,488		

Parameter	Symbol	Conditions					Value			Unit
Inverter Diode				V_r [V]	I_F [A]	T_j [°C]	Min	Typ	Max	
Static										
Forward voltage	V_F				150	25 125 150		2,65 2,33 2,21	3,3	V
Reverse leakage current	I_r			1200		25 150			50	µA
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	Thermal grease thickness≤50um λ = 1 W/mK						0,60		K/W
FWD Switching										
Peak recovery current	I_{RRM}	di/dt = 12743 A/µ di/dt = 10162 A/µ di/dt = 10901 A/µ	±15	600	150	25 125 150		184 211 216		A
Reverse recovery time	t_{rr}					25 125 150		119 156 299		ns
Recovered charge	Q_r					25 125 150		11,286 24,605 28,238		µC
Reverse recovered energy	E_{rec}					25 125 150		5,194 11,661 13,292		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125 150		10342 4683 3106		A/µs

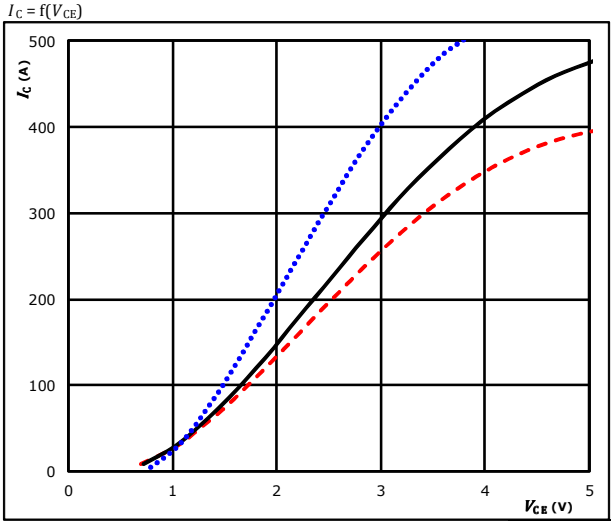
Thermistor

Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V]	V_{CE} [V]	I_C [A]	T_j [°C]	Min	Typ	Max	
Rated resistance	R					25		1		kΩ
Deviation of R100	$\Delta_{R/R}$	R100=1670 Ω				100	-2		+2	%
R100	R					100		1670		Ω
Power dissipation constant						25		0,76		mW/K
A-value	$A_{(25/50)}$					25		$7,635*10^{-3}$		1/K
B-value	$B_{(25/100)}$					25		$1,731*10^{-5}$		1/K²
Vincotech NTC Reference									E	

Inverter Switch Characteristics

Typical output characteristics **IGBT**

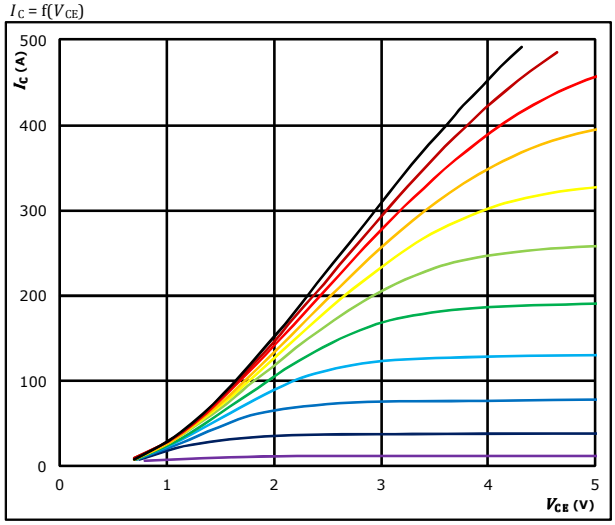
$I_C = f(V_{CE})$



t_p =	250	µs	25 °C	
V_{GE} =	15	V	125 °C	
			150 °C	

Typical output characteristics **IGBT**

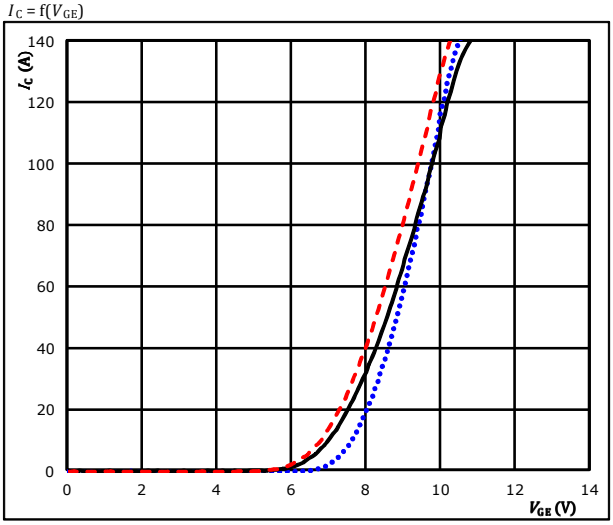
$I_C = f(V_{CE})$



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

Typical transfer characteristics **IGBT**

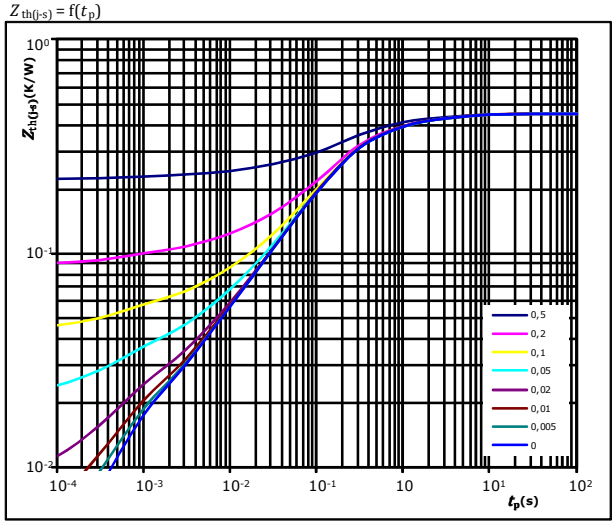
$I_C = f(V_{GE})$



t_p =	100	µs	25 °C	
V_{CE} =	10	V	125 °C	
			150 °C	

Transient Thermal Impedance as function of Pulse duration **IGBT**

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



D =	t_p / T	
$R_{th(j-s)}$ =	0,45	K/W

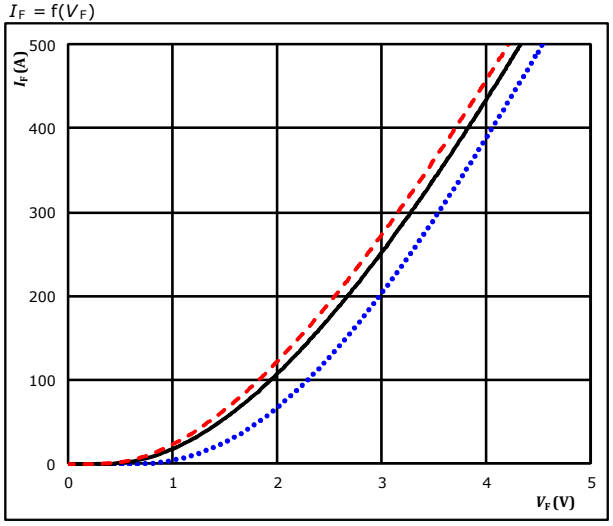
IGBT thermal model values

R_{th} (K/W)	τ (s)
4,18E-02	3,98E+00
8,71E-02	7,83E-01
2,37E-01	1,78E-01
4,05E-02	4,41E-02
2,78E-02	8,73E-03
1,47E-02	5,82E-04

Inverter Diode Characteristics

Typical forward characteristics **FWD**

$I_F = f(V_F)$

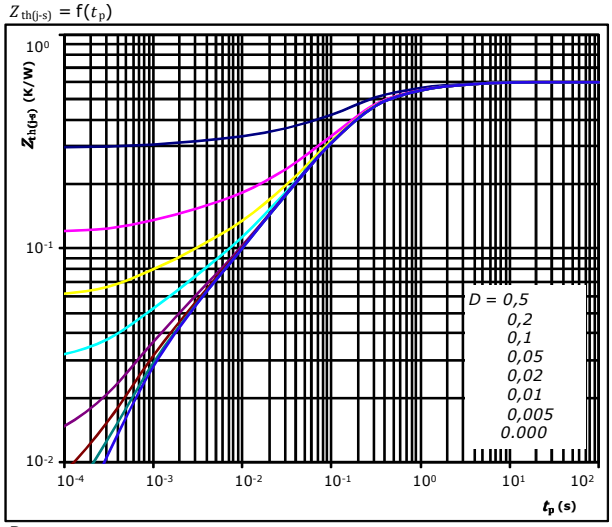


t_p = 250 µs

T_j: 25 °C, 125 °C, 150 °C

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

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



D = t_p / T

$R_{th(j-s)}$ = 0,60 K/W

FWD thermal model values

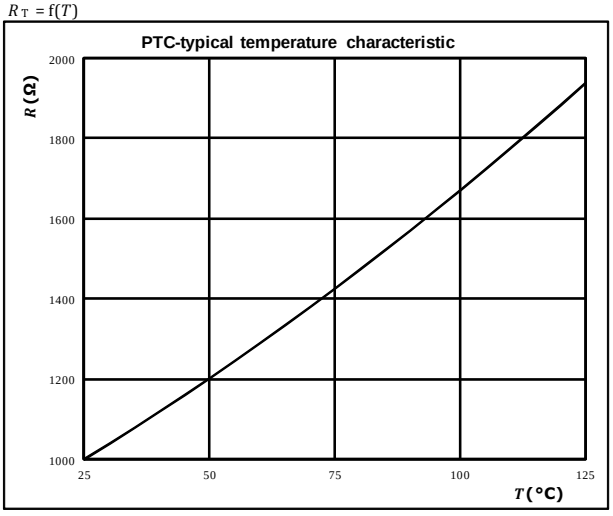
R (K/W)	τ (s)
5,21E-02	2,54E+00
1,12E-01	4,98E-01
3,08E-01	1,31E-01
6,85E-02	2,35E-02
2,79E-02	5,39E-03
2,69E-02	9,57E-04

Thermistor Characteristics

Thermistor typical temperature characteristic

Typical PTC characteristic as a function of temperature

$R_T = f(T)$

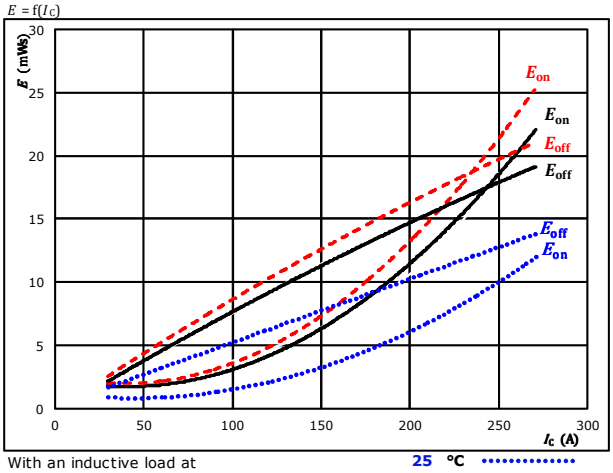


Inverter Switching Characteristics

Figure 1. **IGBT**

Typical switching energy losses as a function of collector current

$E = f(I_C)$



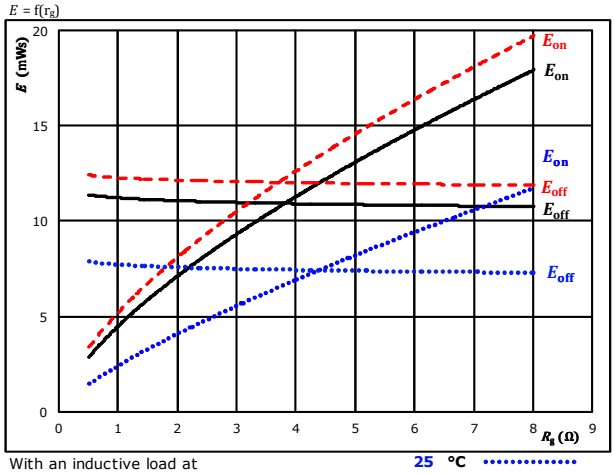
With an inductive load at

V_{CE} =	600	V	T_j:	25 °C
V_{GE} =	±15	V		125 °C
R_{gon} =	2	Ω		150 °C
R_{goff} =	2	Ω		

Figure 2. **IGBT**

Typical switching energy losses as a function of gate resistor

$E = f(r_g)$



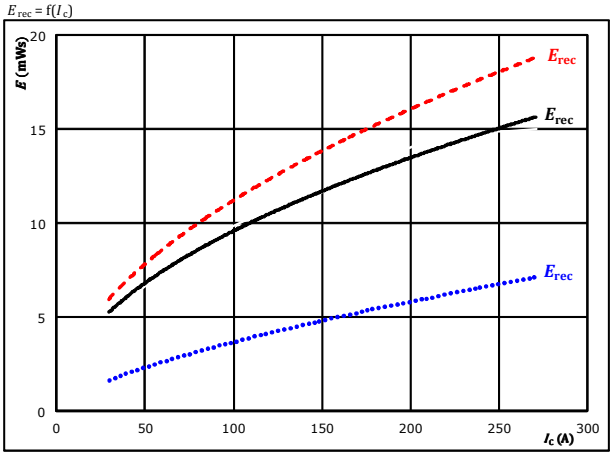
With an inductive load at

V_{CE} =	600	V	T_j:	25 °C
V_{GE} =	±15	V		125 °C
I_C =	150	A		150 °C

Figure 3. **FWD**

Typical reverse recovered energy loss as a function of collector current

$E_{rec} = f(I_c)$



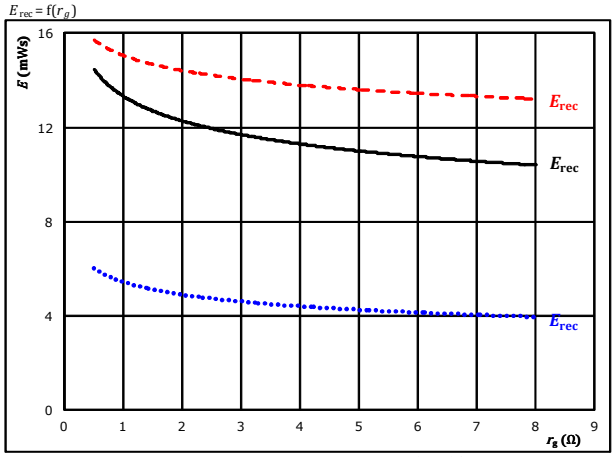
With an inductive load at

V_{CE} =	600	V	T_j:	25 °C
V_{GE} =	±15	V		125 °C
R_{gon} =	2	Ω		150 °C

Figure 4. **FWD**

Typical reverse recovered energy loss as a function of gate resistor

$E_{rec} = f(r_g)$



With an inductive load at

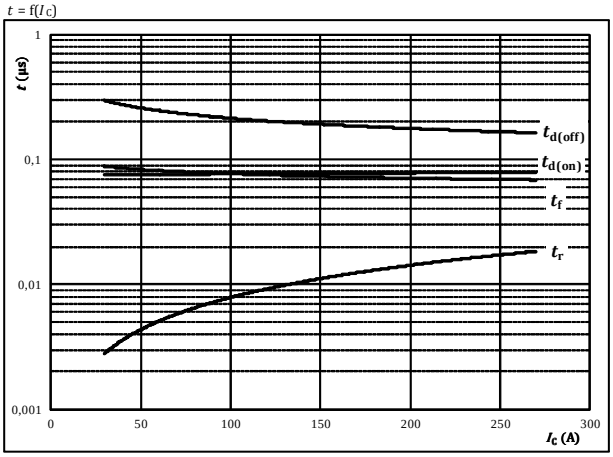
V_{CE} =	600	V	T_j:	25 °C
V_{GE} =	±15	V		125 °C
I_C =	150	A		150 °C

Inverter Switching Characteristics

Figure 5. **IGBT**

Typical switching times as a function of collector current

$t = f(I_C)$



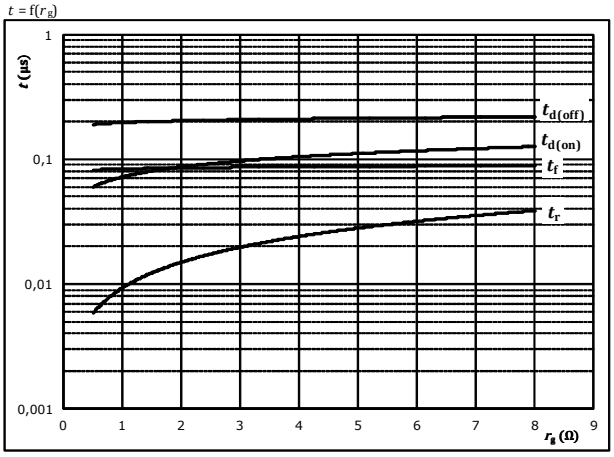
With an inductive load at

T_j =	150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	2	Ω
R_{goff} =	2	Ω

Figure 6. **IGBT**

Typical switching times as a function of gate resistor

$t = f(r_g)$



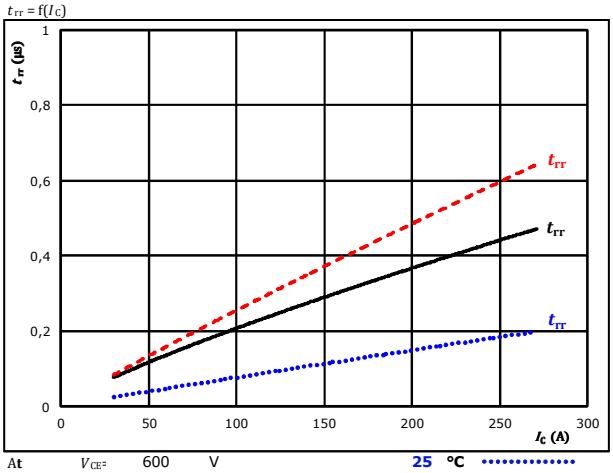
With an inductive load at

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

Figure 7. **FWD**

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$



At

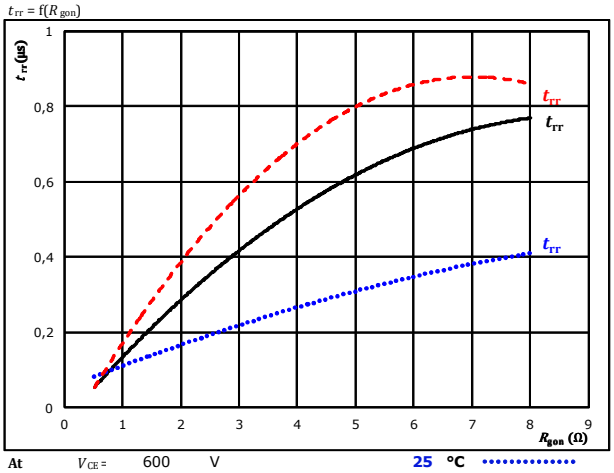
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	2	Ω

T_j: 25 °C, 125 °C, 150 °C

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
V_{GE} =	±15	V
I_C =	150	A

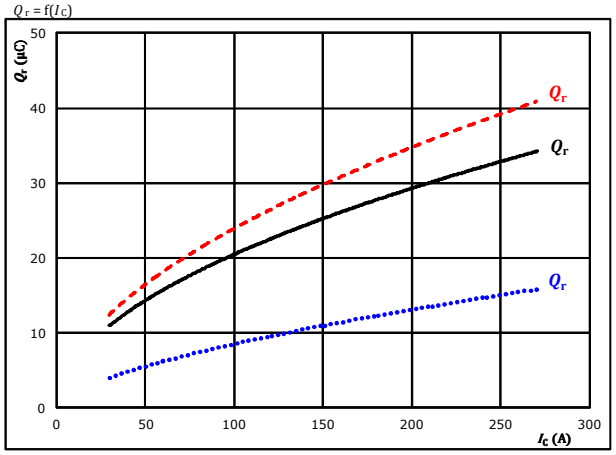
T_j: 25 °C, 125 °C, 150 °C

Inverter Switching Characteristics

Figure 9. **FWD**

Typical recovered charge as a function of collector current

$Q_r = f(I_C)$

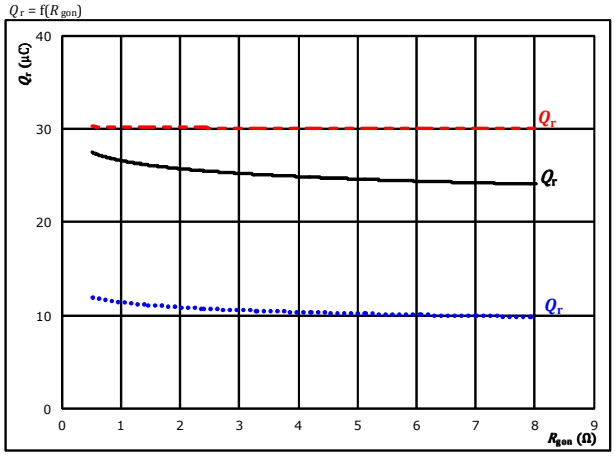


At	V_{CE} =	600	V		25 °C	
	V_{GE} =	±15	V	T_j:	125 °C	
	R_{gon} =	2	Ω		150 °C	

Figure 10. **FWD**

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

$Q_r = f(R_{gon})$

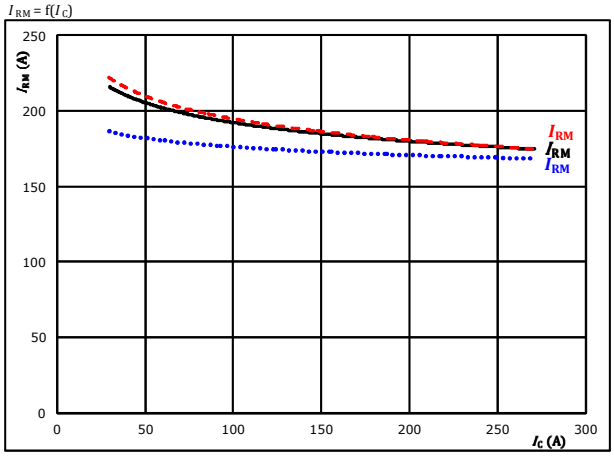


At	V_{CE}=	600	V		25 °C	
	V_{GE} =	±15	V	T_j:	125 °C	
	I_C=	150	A		150 °C	

Figure 11. **FWD**

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

$I_{RM} = f(I_C)$

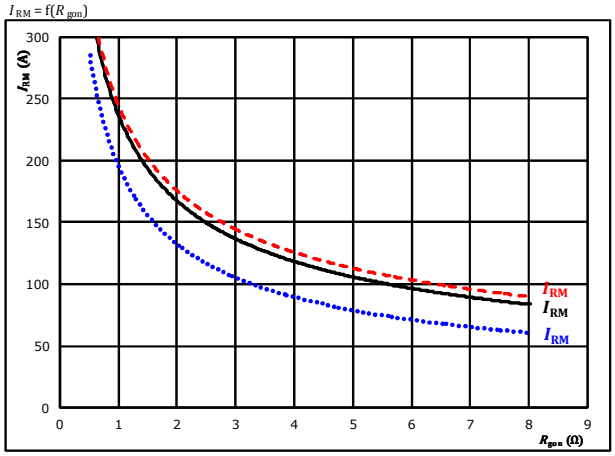


At	V_{CE} =	600	V		25 °C	
	V_{GE} =	±15	V	T_j:	125 °C	
	R_{gon} =	2	Ω		150 °C	

Figure 12. **FWD**

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

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



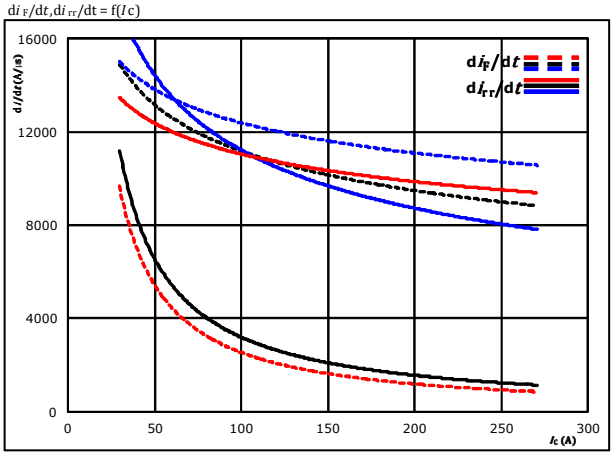
At	V_{CE} =	600	V		25 °C	
	V_{GE} =	±15	V	T_j:	125 °C	
	I_C =	150	A		150 °C	

Inverter Switching Characteristics

Figure 13. **FWD**

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

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

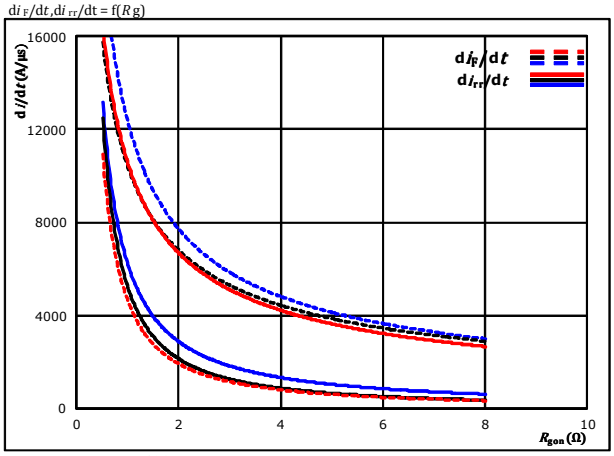


At					
V_{CE}:	600	V	T_j:	25 °C	
V_{GE} =	±15	V		125 °C	
R_{gon} =	2	Ω		150 °C	

Figure 14. **FWD**

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

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

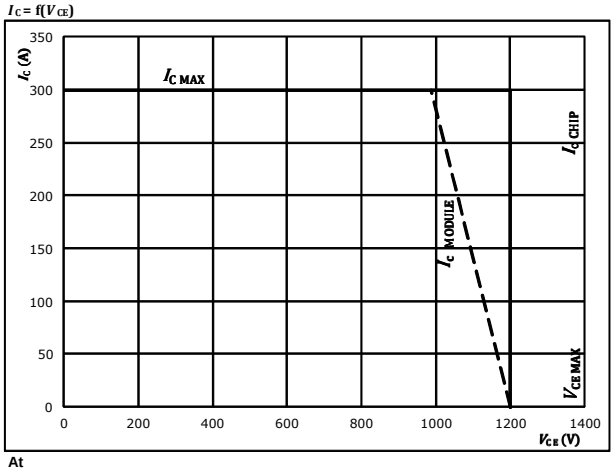


At			
V_{CE} =	600	V	
V_{GE} =	±15	V	
I_C =	150	A	

Figure 15. **IGBT**

Reverse bias safe operating area

$I_C = f(V_{CE})$



At

T_j =	175	°C
R_{gon} =	2	Ω
R_{goff} =	2	Ω

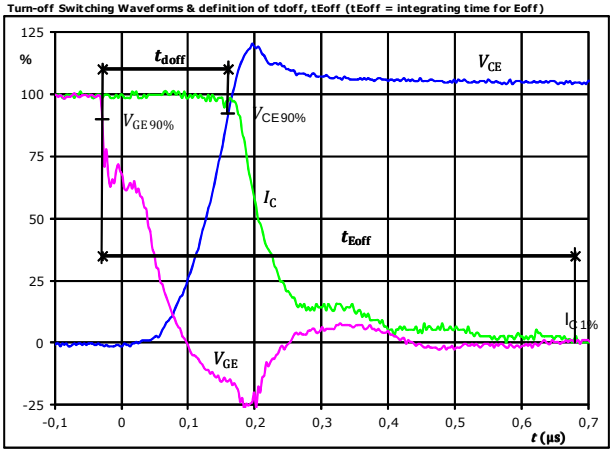
Inverter Switching Definitions

General conditions

T_j	=	**125 °C**
R_{gon}	=	**2 Ω**
R_{goff}	=	**2 Ω**

Figure 1. IGBT

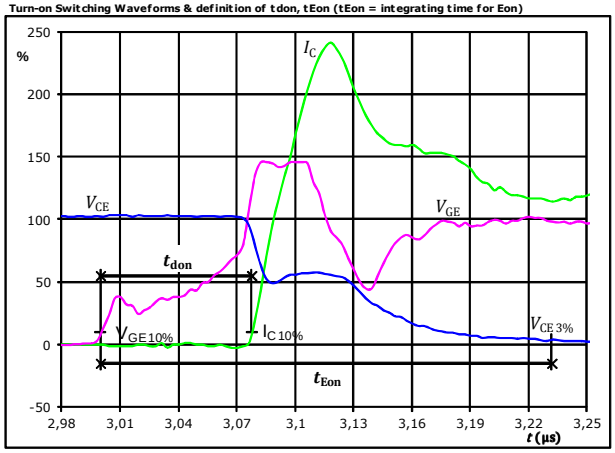
Turn-off Switching Waveforms & definition of tdoff, tEoff (tEoff = integrating time for Eoff)



$V_{GE}(0\%)$ =	-15	V
$V_{GE}(100\%)$ =	15	V
$V_C(100\%)$ =	600	V
$I_C(100\%)$ =	150	A
t_{doff} =	0,188	µs
t_{Eoff} =	0,710	µs

Figure 2. IGBT

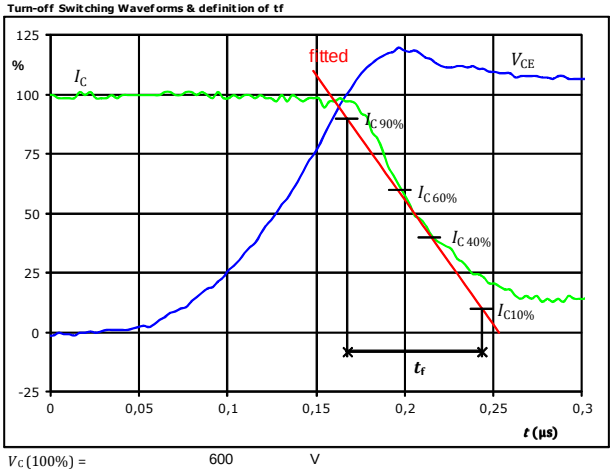
Turn-on Switching Waveforms & definition of tdon, tEon (tEon = integrating time for Eon)



$V_{GE}(0\%)$ =	-15	V
$V_{GE}(100\%)$ =	15	V
$V_C(100\%)$ =	600	V
$I_C(100\%)$ =	150	A
t_{don} =	0,077	µs
t_{Eon} =	0,232	µs

Figure 3. IGBT

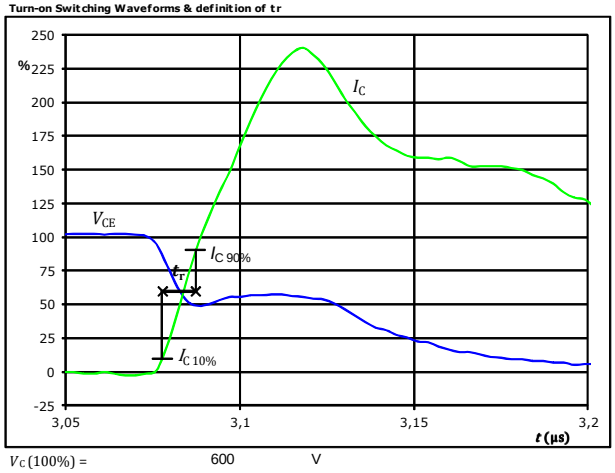
Turn-off Switching Waveforms & definition of tf



$V_C(100\%)$ =	600	V
$I_C(100\%)$ =	150	A
t_f =	0,075	µs

Figure 4. IGBT

Turn-on Switching Waveforms & definition of tr

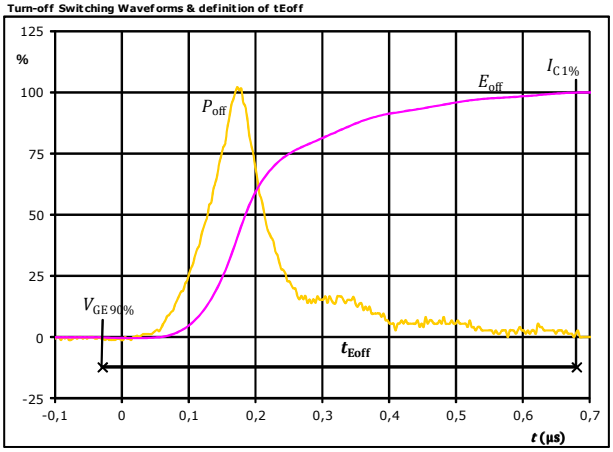


$V_C(100\%)$ =	600	V
$I_C(100\%)$ =	150	A
t_r =	0,010	µs

Inverter Switching Definitions

Figure 5. **IGBT**

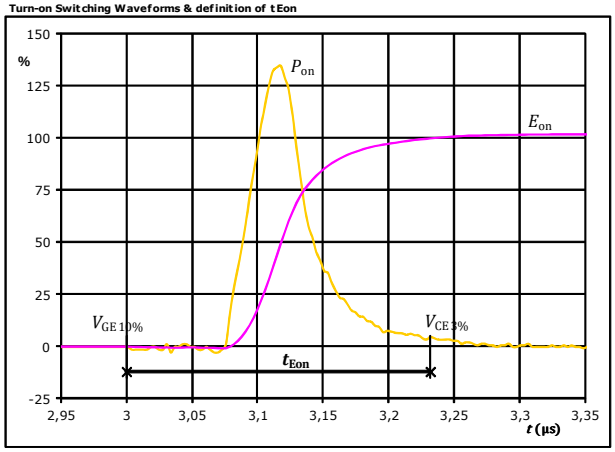
Turn-off Switching Waveforms & definition of tEoff



$P_{off}(100\%) =$	89,99	kW
$E_{off}(100\%) =$	11,45	mJ
$t_{Eoff} =$	0,71	µs

Figure 6. **IGBT**

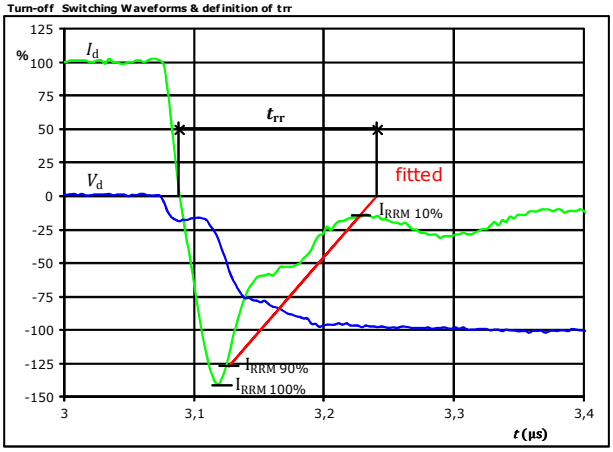
Turn-on Switching Waveforms & definition of tEon



$P_{on}(100\%) =$	89,99	kW
$E_{on}(100\%) =$	6,44	mJ
$t_{Eon} =$	0,23	µs

Figure 7. **FWD**

Turn-off Switching Waveforms & definition of trr

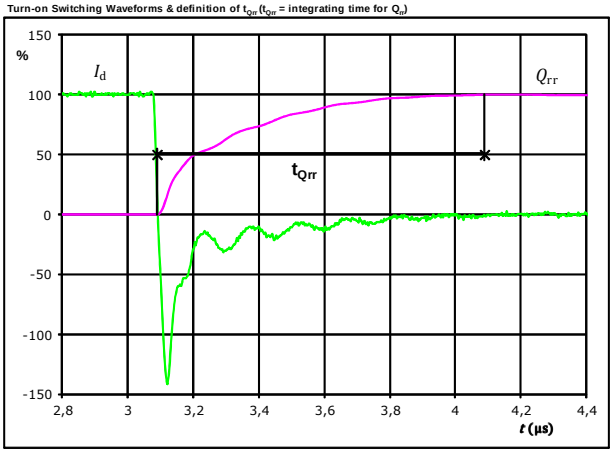


$V_d(100\%) =$	600	V
$I_d(100\%) =$	150	A
$I_{RRM}(100\%) =$	-211	A
$t_{rr} =$	0,156	µs

Inverter Switching Definitions

Figure 8. **FWD**

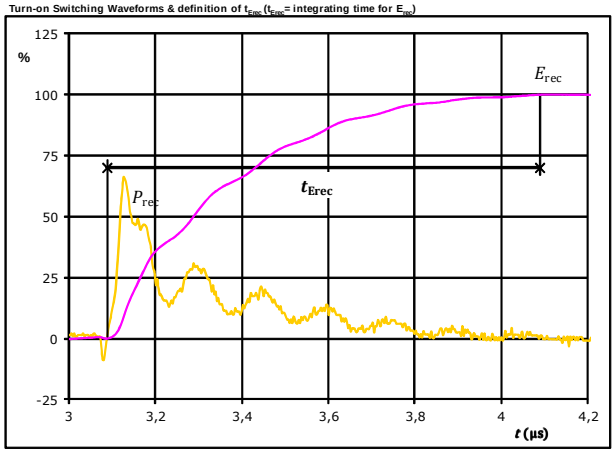
Turn-on Switching Waveforms & definition of t_{Qrr} (t_{Qrr} = integrating time for Q_{rr})



I_d (100%) =	150	A
Q_{rr} (100%) =	24,61	µC
t_{Qrr} =	1,00	µs

Figure 9. **FWD**

Turn-on Switching Waveforms & definition of t_{Erec} (t_{Erec} = integrating time for E_{rec})



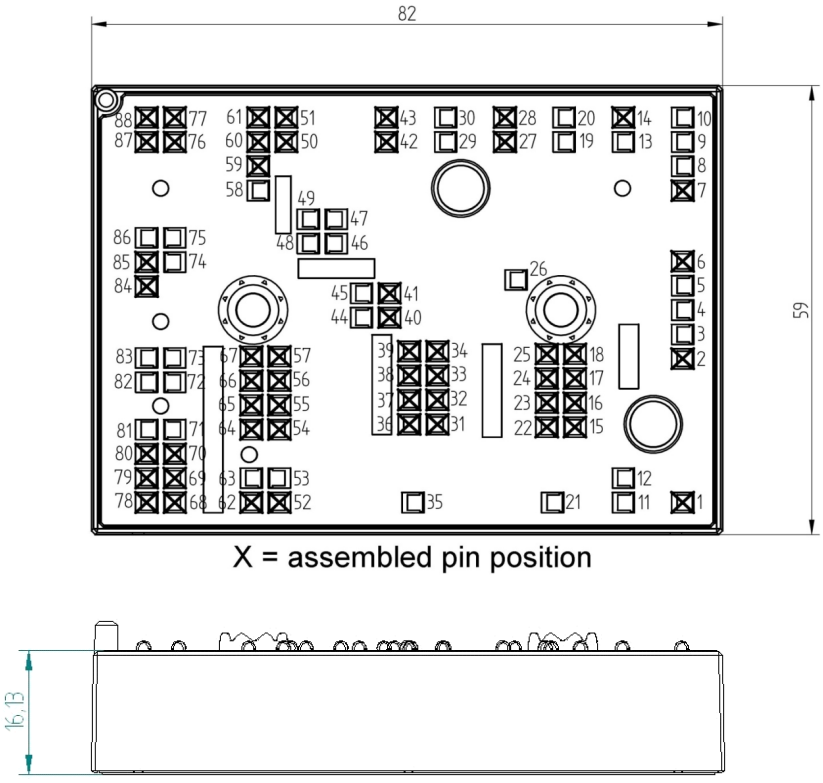
P_{rec} (100%) =	89,99	kW
E_{rec} (100%) =	11,66	mJ
t_{Erec} =	1,00	µs

Ordering Code & Marking

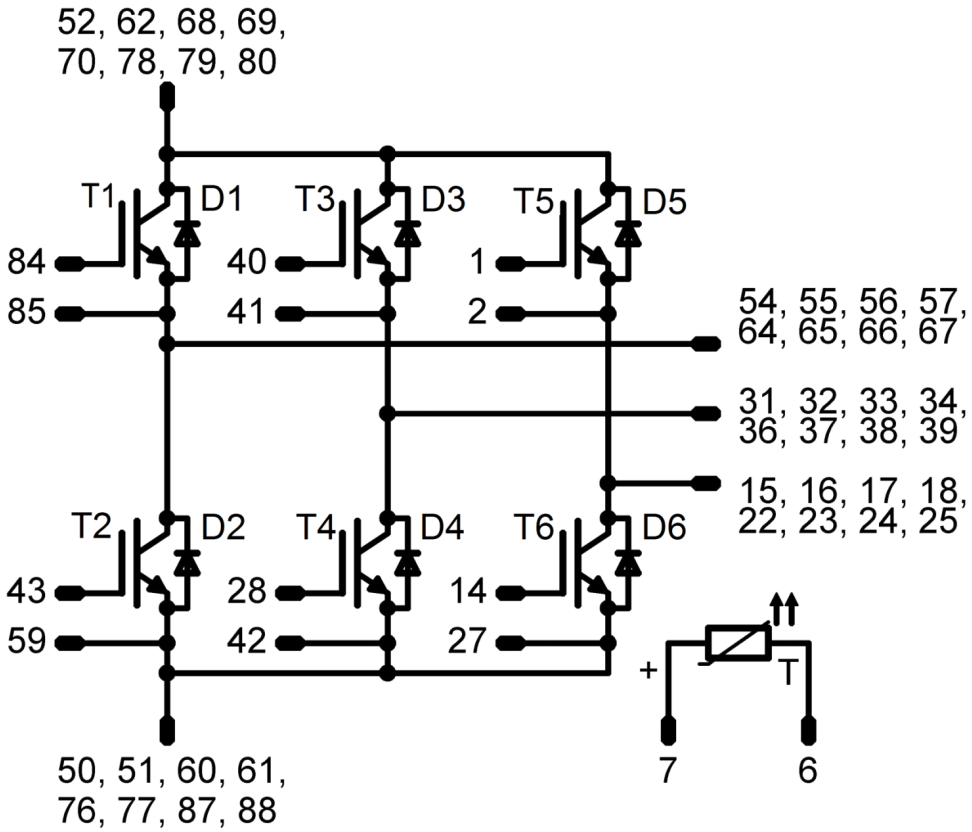
Version	Ordering Code	in DataMatrix as	in packaging barcode as
with std lid (black V23990-K32-T-PM)	V23990-K430-F60-/0A/-PM	K430F60	K430F60-/0A/
with std lid (black V23990-K32-T-PM) and P12	V23990-K430-F60-/1A/-PM	K430F60	K430F60-/1A/
with thin lid (white V23990-K33-T-PM)	V23990-K430-F60-/0B/-PM	K430F60	K430F60-/0B/
with thin lid (white V23990-K33-T-PM) and P12	V23990-K430-F60-/1B/-PM	K430F60	K430F60-/1B/

	Name		Type&Ver	Date code	Vinco&Lot	Serial&UL
Text	NN-NNNNNNNNNNNNN		TTTTTTTVV	WWYY	Vinco LLLLL	SSSS UL
	Type&Ver	**Lot number**	**Serial**	**Date code**		
Datamatrix	TTTTTTTVV	LLLLL	SSSS	WWYY		

Outline



Pinout



Identification

ID	Component	Voltage	Current	Function	Comment
T1-T6	IGBT	1200V	150A	Inverter Switch	
D1-D6	FWD	1200V	150A	Inverter Diode	
T	PTC	-	-	Thermistor	

Packaging instruction					
Standard packaging quantity (SPQ)	48	>SPQ	Standard	<SPQ	Sample

Handling instruction
Handling instructions for MiniSkiiP® 3 packages see vincotech.com website.

General datasheet
General datasheet for MiniSkiiP® 3 packages see vincotech.com website.

Document No.:	Date:	Modification:	Pages
V23990-K430-F60-D1-14	10 Jul. 2015		

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2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.