Vincotech

| flowPIM 0 | 600V/15A |

Features

- Vincotech clip-in housing
- Trench Fieldstop IGBT's for low saturation losses
- Optional w/o BRC

Target Applications

- Industrial drives
- Embedded drives

Types

- V23990-P544-A28-PM
- V23990-P544-A29-PM
- V23990-P544-C28-PM
- V23990-P544-C29-PM

flowPIM 0 housing

12mm housing   17mm housing

Schematic

Maximum Ratings

T_j=25°C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Input Rectifier Diode					
Repetitive peak reverse voltage	V_{RRM}			1600	V
DC forward current	I_{FAV}	$T_j=T_j$max	T_h=80°C	28	A
			T_c=80°C	37	
Surge forward current	I_{FSM}	t_p=10ms	T_j=25°C	200	A
I2t-value	I^2t	50 Hz half sine wave		200	A^2s
Power dissipation per Diode	P_{tot}	$T_j=T_j$max	T_h=80°C	33	W
			T_c=80°C	50	
Maximum Junction Temperature	$T_j$max			150	°C
Inverter Transistor					
Collector-emitter break down voltage	V_{CE}			600	V
DC collector current	I_C	$T_j=T_j$max	T_h=80°C	20	A
			T_c=80°C	25	
Repetitive peak collector current	I_{Cpulse}	t_p limited by $T_j$max		45	A
Turn off safe operating area		VCE ≤ 1200V, Tj ≤ Top max		45	A
Power dissipation per IGBT	P_{tot}	$T_j=T_j$max	T_h=80°C	45	W
			T_c=80°C	69	
Gate-emitter peak voltage	V_{GE}			±20	V
Short circuit ratings	t_{SC}	T_j≤150°C		6	µs
	V_{CC}	V_{GE}=15V		360	V
Maximum Junction Temperature	$T_j$max			175	°C

Maximum Ratings

T_j=25℃, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Inverter Diode					
Peak Repetitive Reverse Voltage	V_{RRM}			600	V
DC forward current	I_F	T_j=$T_j$max	T_h=80℃ T_c=80℃	18 23	A
Repetitive peak forward current	I_{FRM}	t_p limited by $T_j$max		30	A
Power dissipation per Diode	P_{tot}	T_j=$T_j$max	T_h=80℃ T_c=80℃	35 52	W
Maximum Junction Temperature	$T_j$max			175	℃
Brake Transistor					
Collector-emitter break down voltage	V_{CE}			600	V
DC collector current	I_C	T_j=$T_j$max	T_h=80℃ T_c=80℃	14 18	A
Repetitive peak collector current	I_{Cpuls}	t_p limited by $T_j$max		30	A
Turn off safe operating area		VCE ≤ 1200V, Tj ≤ Top max		30	A
Power dissipation per IGBT	P_{tot}	T_j=$T_j$max	T_h=80℃ T_c=80℃	36 55	W
Gate-emitter peak voltage	V_{GE}			±20	V
Short circuit ratings	t_{SC} V_{CC}	T_j≤150℃ V_{GE}=15V		10 360	µs V
Maximum Junction Temperature	$T_j$max			175	℃
Brake Diode					
Peak Repetitive Reverse Voltage	V_{RRM}			600	V
DC forward current	I_F	T_j=$T_j$max	T_h=80℃ T_c=80℃	14 19	A
Repetitive peak forward current	I_{FRM}	t_p limited by $T_j$max		20	A
Power dissipation per Diode	P_{tot}	T_j=$T_j$max	T_h=80℃ T_c=80℃	27 41	W
Maximum Junction Temperature	$T_j$max			175	℃
Thermal Properties					
Storage temperature	T_{stg}			-40…+125	℃
Operation temperature under switching condition	T_{op}			-40…+(Tjmax - 25)	℃
Insulation Properties					
Insulation voltage	V_{is}	t=2s DC voltage		4000	V
Creepage distance				min 12,7	mm
Clearance				min 12,7	mm
Comparative tracking index	CTI			>200	

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Characteristic Values

Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V] or V_{GS} [V]	V_r [V] or V_{CE} [V] or V_{DS} [V]	I_C [A] or I_F [A] or I_D [A]	T_j	Min	Typ	Max	
Input Rectifier Diode										
Forward voltage	V_F				30	Tj=25℃ Tj=125℃	0,8	1,26 1,24	1,45	V
Threshold voltage (for power loss calc. only)	V_{to}				30	Tj=25℃ Tj=125℃		0,92 0,82		V
Slope resistance (for power loss calc. only)	r_t				30	Tj=25℃ Tj=125℃		11 14		mΩ
Reverse current	I_r			1500		Tj=25℃ Tj=145℃			1,1	mA
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50µm λ = 1 W/mK						2,10		K/W
Inverter Transistor										
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE}=V_{GE}$			0,00021	Tj=25℃ Tj=150℃	5	5,8	6,5	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		15	Tj=25℃ Tj=150℃	1,1	1,61 1,81	1,9	V
Collector-emitter cut-off current incl. Diode	I_{CES}		0	600		Tj=25℃ Tj=150℃			0,00085	mA
Gate-emitter leakage current	I_{GES}		20	0		Tj=25℃ Tj=150℃			300	nA
Integrated Gate resistor	R_{gint}							none		Ω
Turn-on delay time	$t_{d(on)}$					Tj=25℃ Tj=150℃		14 13		ns
Rise time	t_r					Tj=25℃ Tj=150℃		11 13		
Turn-off delay time	$t_{d(off)}$	Rgoff=8 Ω Rgon=16 Ω	±15	300	15	Tj=25℃ Tj=150℃		127 146		
Fall time	t_f					Tj=25℃ Tj=150℃		86 86		
Turn-on energy loss per pulse	E_{on}					Tj=25℃ Tj=150℃		0,19 0,26		mWs
Turn-off energy loss per pulse	E_{off}					Tj=25℃ Tj=150℃		0,31 0,39		
Input capacitance	C_{ies}							860		
Output capacitance	C_{oss}	f=1MHz	0	25		Tj=25℃		55		pF
Reverse transfer capacitance	C_{rss}							24		
Gate charge	Q_{Gate}		±15	480	15	Tj=25℃		87		nC
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50µm λ = 1 W/mK						2,10		K/W
Inverter Diode										
Diode forward voltage	V_F				15	Tj=25℃ Tj=150℃	1,25	1,79 1,67	1,95	V
Peak reverse recovery current	I_{RRM}					Tj=25℃ Tj=150℃		15 17		A
Reverse recovery time	t_{rr}					Tj=25℃ Tj=150℃		100 184		ns
Reverse recovered charge	Q_{rr}	Rgon=16 Ω	±15	300	15	Tj=25℃ Tj=150℃		0,52 1,01		µC
Peak rate of fall of recovery current	di(rec)max /dt					Tj=25℃ Tj=150℃		1448 773		A/µs
Reverse recovered energy	Erec					Tj=25℃ Tj=150℃		0,10 0,21		mWs
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50µm λ = 1 W/mK						2,75		K/W

Characteristic Values

Parameter	Symbol	Conditions				Value			Unit
		V_{GE} [V] or V_{GS} [V]	V_r [V] or V_{CE} [V] or V_{DS} [V]	I_C [A] or I_F [A] or I_D [A]	T_j	Min	Typ	Max	
Brake Transistor									
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE}=V_{GE}$		0,00015	Tj=25℃ Tj=150℃	5	5,8	6,5	V
Collector-emitter saturation voltage	$V_{CE(sat)}$	15		10	Tj=25℃ Tj=150℃	1,1	1,66 1,87	1,9	V
Collector-emitter cut-off incl diode	I_{CES}	0	600		Tj=25℃ Tj=150℃			0,0006	mA
Gate-emitter leakage current	I_{GES}	20	0		Tj=25℃ Tj=150℃			300	nA
Integrated Gate resistor	R_{gint}						none		Ω
Turn-on delay time	$t_{d(on)}$	Rgoff=16 Ω Rgon=32 Ω	±15	300	10	Tj=25℃ Tj=150℃	15 15		ns
Rise time	t_r					Tj=25℃ Tj=150℃	11 14		
Turn-off delay time	$t_{d(off)}$					Tj=25℃ Tj=150℃	147 163		
Fall time	t_f					Tj=25℃ Tj=150℃	101 97		
Turn-on energy loss per pulse	E_{on}					Tj=25℃ Tj=150℃	0,16 0,22		mWs
Turn-off energy loss per pulse	E_{off}					Tj=25℃ Tj=150℃	0,23 0,27		
Input capacitance	C_{ies}	f=1MHz	0	25		Tj=25℃	551		pF
Output capacitance	C_{oss}						40		
Reverse transfer capacitance	C_{rss}						17		
Gate charge	Q_{Gate}		±15	480	10	Tj=25℃	62		nC
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50µm λ = 1 W/mK					2,61		K/W
Brake Diode									
Diode forward voltage	V_F			10	Tj=25℃ Tj=150℃	1,25	1,67 1,61	1,95	V
Reverse leakage current	I_r	Rgon=32 Ω	600		Tj=25℃ Tj=150℃			27	µA
Peak reverse recovery current	I_{RRM}	Rgon=32 Ω Rgon=32 Ω	±15	300	10	Tj=25℃ Tj=150℃	10 10		A
Reverse recovery time	t_{rr}					Tj=25℃ Tj=150℃	149 208		ns
Reverse recovered charge	Q_{rr}					Tj=25℃ Tj=150℃	0,46 0,46		µC
Peak rate of fall of recovery current	di(rec)max/dt					Tj=25℃ Tj=150℃	620 340		A/µs
Reverse recovery energy	E_{rec}					Tj=25℃ Tj=150℃	0,09 0,16		mWs
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50µm λ = 1 W/mK					3,53		K/W
Thermistor									
Rated resistance	R				Tj=25℃		22000		Ω
Deviation of R100	ΔR/R	R100=1486 Ω			Tc=100℃	-5		5	%
Power dissipation	P				Tc=100℃		210		mW
Power dissipation constant					Tj=25℃		3,5		mW/K
B-value	$B_{(25/50)}$	Tol. ±3%			Tj=25℃				K
B-value	$B_{(25/100)}$	Tol. ±3%			Tj=25℃		4000		K
Vincotech NTC Reference					Tj=25℃			A	

Output Inverter

Figure 1	Output inverter IGBT

Typical output characteristics

$I_C = f(V_{CE})$

At

t_p =	250	µs
T_j =	25	℃
V_{GE} from	7 V to 17 V in steps of 1 V	

Figure 2	Output inverter IGBT

Typical output characteristics

$I_C = f(V_{CE})$

At

t_p =	250	µs
T_j =	125	℃
V_{GE} from	7 V to 17 V in steps of 1 V	

Figure 3	Output inverter IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$

At

t_p =	250	µs
V_{CE} =	10	V

Figure 4	Output inverter FWD

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$

At

t_p =	250	µs

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Output Inverter

Figure 5 — Output inverter IGBT

**Typical switching energy losses
as a function of collector current**

$E = f(I_C)$

With an inductive load at

$T_j =$	25/125	℃
$V_{CE} =$	300	V
$V_{GE} =$	15	V
$R_{gon} =$	16	Ω
$R_{goff} =$	8	Ω

Figure 6 — Output inverter IGBT

**Typical switching energy losses
as a function of gate resistor**

$E = f(R_G)$

With an inductive load at

$T_j =$	25/125	℃
$V_{CE} =$	300	V
$V_{GE} =$	15	V
$I_C =$	15	A

Figure 7 — Output inverter FWD

**Typical reverse recovery energy loss
as a function of collector current**

$E_{rec} = f(I_C)$

With an inductive load at

$T_j =$	25/125	℃
$V_{CE} =$	300	V
$V_{GE} =$	15	V
$R_{gon} =$	16	Ω

Figure 8 — Output inverter FWD

**Typical reverse recovery energy loss
as a function of gate resistor**

$E_{rec} = f(R_G)$

With an inductive load at

$T_j =$	25/125	℃
$V_{CE} =$	300	V
$V_{GE} =$	15	V
$I_C =$	15	A

Output Inverter

Figure 9	Output inverter IGBT

Typical switching times as a function of collector current

$t = f(I_C)$

With an inductive load at

$T_j =$	125	℃
$V_{CE} =$	300	V
$V_{GE} =$	15	V
$R_{gon} =$	16	Ω
$R_{goff} =$	8	Ω

Figure 10	Output inverter IGBT

Typical switching times as a function of gate resistor

$t = f(R_G)$

With an inductive load at

$T_j =$	125	℃
$V_{CE} =$	300	V
$V_{GE} =$	15	V
$I_C =$	15	A

Figure 11	Output inverter FWD

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$

At

$T_j =$	25/125	℃
$V_{CE} =$	300	V
$V_{GE} =$	15	V
$R_{gon} =$	16	Ω

Figure 12	Output inverter FWD

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

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

At

$T_j =$	25/125	℃
$V_R =$	300	V
$I_F =$	15	A
$V_{GE} =$	15	V

Output Inverter

Figure 13	Output inverter FWD

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

$Q_{rr} = f(I_C)$

At

$T_j =$	25/125	℃
$V_{CE} =$	300	V
$V_{GE} =$	15	V
$R_{gon} =$	16	Ω

Figure 14	Output inverter FWD

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

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

At

$T_j =$	25/125	℃
$V_R =$	300	V
$I_F =$	15	A
$V_{GE} =$	15	V

Figure 15	Output inverter FWD

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

$I_{RRM} = f(I_C)$

At

$T_j =$	25/125	℃
$V_{CE} =$	300	V
$V_{GE} =$	15	V
$R_{gon} =$	16	Ω

Figure 16	Output inverter FWD

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

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

At

$T_j =$	25/125	℃
$V_R =$	300	V
$I_F =$	15	A
$V_{GE} =$	15	V

Output Inverter

Figure 17 — Output inverter FWD

Typical rate of fall of forward and reverse recovery current as a function of collector current
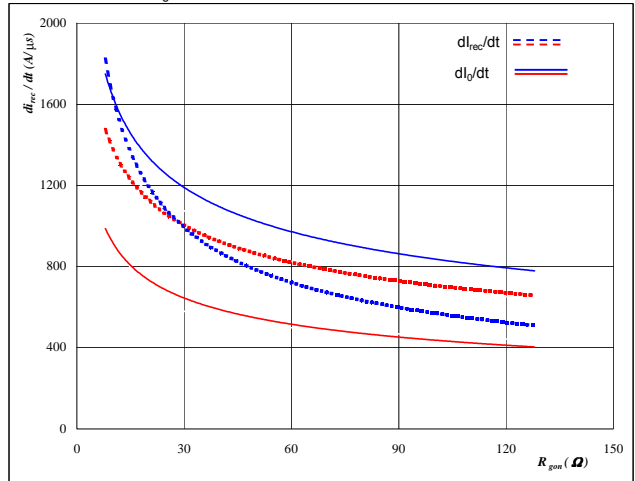
$dI_0/dt, dI_{rec}/dt = f(I_C)$

At

T_j =	25/125	°C
V_{CE} =	300	V
V_{GE} =	15	V
R_{gon} =	16	Ω

Figure 18 — Output inverter FWD

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

$dI_0/dt, dI_{rec}/dt = f(R_{gon})$

At

T_j =	25/125	°C
V_R =	300	V
I_F =	15	A
V_{GE} =	15	V

Figure 19 — Output inverter IGBT

IGBT transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$

At

D =	t_p / T	
R_{thJH} =	2,10	K/W

IGBT thermal model values

Thermal grease		Phase change interface	
R (C/W)	Tau (s)	R (C/W)	Tau (s)
0,07	3,4E+00	0,06	2,8E+00
0,25	3,7E-01	0,20	3,0E-01
0,98	7,6E-02	0,79	6,2E-02
0,42	1,4E-02	0,34	1,1E-02
0,19	2,5E-03	0,16	2,1E-03
0,19	3,0E-04	0,15	2,4E-04

Figure 20 — Output inverter FWD

FWD transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$

At

D =	t_p / T	
R_{thJH} =	2,75	K/W

FWD thermal model values

Thermal grease		Phase change interface	
R (C/W)	Tau (s)	R (C/W)	Tau (s)
0,05	8,2E+00	0,04	6,6E+00
0,17	7,4E-01	0,14	6,0E-01
0,78	1,1E-01	0,64	8,7E-02
0,74	3,1E-02	0,60	2,5E-02
0,48	5,4E-03	0,39	4,4E-03
0,24	8,5E-04	0,19	6,9E-04

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Output Inverter

Figure 21	Output inverter IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$

At

$T_j =$ 175 ℃

Figure 22	Output inverter IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_h)$

At

$T_j =$ 175 ℃
$V_{GE} =$ 15 V

Figure 23	Output inverter FWD

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$

At

$T_j =$ 175 ℃

Figure 24	Output inverter FWD

Forward current as a function of heatsink temperature

$I_F = f(T_h)$

At

$T_j =$ 175 ℃

Output Inverter

Figure 25	Output inverter IGBT

**Safe operating area as a function
of collector-emitter voltage**

$I_C = f(V_{CE})$

At

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

Figure 26	Output inverter IGBT

Gate voltage vs Gate charge

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

At

I_C =	15	A

Figure 27	Output inverter IGBT

**Short circuit withstand time as a function of
gate-emitter voltage**

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

At

V_{CE} =	600	V
$T_j \leq$	175	°C

Figure 28	Output inverter IGBT

**Typical short circuit collector current as a function of
gate-emitter voltage**

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

At

$V_{CE} \leq$	600	V
T_j =	175	°C

Figure 29	IGBT

Reverse bias safe operating area

$I_C = f(V_{CE})$

At

$T_j =$ T_{jmax}-25 °C

$U_{ccminus} = U_{ccplus}$

Switching mode : 3 level switching

Brake

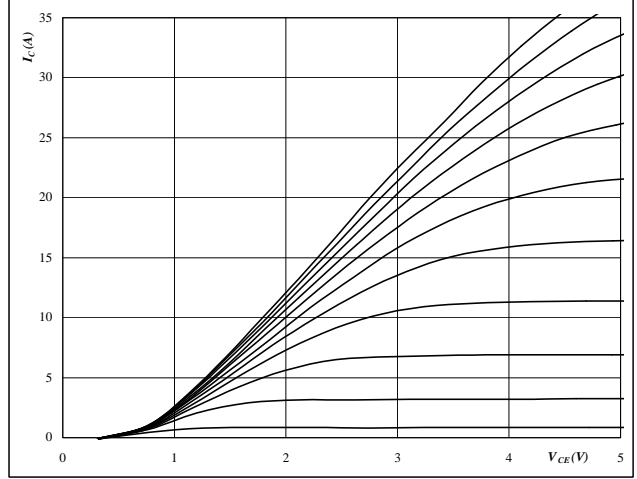| Figure 1	Brake IGBT

Typical output characteristics
$I_C = f(V_{CE})$

At

$t_p =$	250	µs
$T_j =$	25	℃
V_{GE} from	7 V to 17 V in steps of 1 V	

Figure 2	Brake IGBT

Typical output characteristics
$I_C = f(V_{CE})$

At

$t_p =$	250	µs
$T_j =$	125	℃
V_{GE} from	7 V to 17 V in steps of 1 V	

Figure 3	Brake IGBT

Typical transfer characteristics
$I_C = f(V_{GE})$

$T_j = T_{jmax}-25℃$ $T_j = 25℃$

At

$t_p =$	250	µs
$V_{CE} =$	10	V

Figure 4	Brake FWD

**Typical diode forward current as
a function of forward voltage**
$I_F = f(V_F)$

$T_j = T_{jmax}-25℃$ $T_j = 25℃$

At

$t_p =$	250	µs

Brake

Figure 5	Brake IGBT

Typical switching energy losses
as a function of collector current

$E = f(I_C)$

With an inductive load at

$T_j =$	25/125	℃
$V_{CE} =$	300	V
$V_{GE} =$	15	V
$R_{gon} =$	32	Ω
$R_{goff} =$	16	Ω

Figure 6	Brake IGBT

Typical switching energy losses
as a function of gate resistor

$E = f(R_G)$

With an inductive load at

$T_j =$	25/125	℃
$V_{CE} =$	300	V
$V_{GE} =$	15	V
$I_C =$	10	A

Figure 7	Brake FWD

Typical reverse recovery energy loss
as a function of collector current

$E_{rec} = f(I_C)$

With an inductive load at

$T_j =$	25/125	℃
$V_{CE} =$	300	V
$V_{GE} =$	15	V
$R_{gon} =$	32	Ω

Figure 8	Brake FWD

Typical reverse recovery energy loss
as a function of gate resistor

$E_{rec} = f(R_G)$

With an inductive load at

$T_j =$	25/125	℃
$V_{CE} =$	300	V
$V_{GE} =$	15	V
$I_C =$	10	A

Brake

Figure 9	Brake IGBT

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

With an inductive load at

T$_j$ =	25/125	℃
V$_{CE}$ =	300	V
V$_{GE}$ =	15	V
R$_{gon}$ =	32	Ω
R$_{goff}$ =	16	Ω

Figure 10	Brake IGBT

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

With an inductive load at

T$_j$ =	25/125	℃
V$_{CE}$ =	300	V
V$_{GE}$ =	15	V
I$_C$ =	10	A

Figure 11	Brake IGBT

IGBT transient thermal impedance
as a function of pulse width
Z$_{thJH}$ = f(t$_p$)

At	D =	tp / T
Thermal grease		Phase change interface
R$_{thJH}$ = 2,61 K/W		R$_{thJH}$ = 0,60 K/W

Figure 12	Brake FWD

FWD transient thermal impedance
as a function of pulse width
Z$_{thJH}$ = f(t$_p$)

At	D =	tp / T
Thermal grease		Phase change interface
R$_{thJH}$ = 3,53 K/W		R$_{thJH}$ = 1,27 K/W

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Brake

Figure 13	Brake IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$

At

T_j = 175 ºC

Figure 14	Brake IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_h)$

At

T_j = 175 ºC

V_{GE} = 15 V

Figure 15	Brake FWD

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$

At

T_j = 175 ºC

Figure 16	Brake FWD

Forward current as a function of heatsink temperature

$I_F = f(T_h)$

At

T_j = 175 ºC

Input Rectifier Bridge

Typical diode forward current as
a function of forward voltage
$I_F = f(V_F)$

At

$t_p =$ 250   µs

Diode transient thermal impedance
as a function of pulse width
$Z_{thJH} = f(t_p)$

At

$D =$ t_p / T

$R_{thJH} =$ 2,1   K/W

Power dissipation as a
function of heatsink temperature
$P_{tot} = f(T_h)$

At

$T_j =$ 150   ºC

Forward current as a
function of heatsink temperature
$I_F = f(T_h)$

At

$T_j =$ 150   ºC

Thermistor

Figure 1	Thermistor

Typical NTC characteristic

as a function of temperature

$R_T = f(T)$

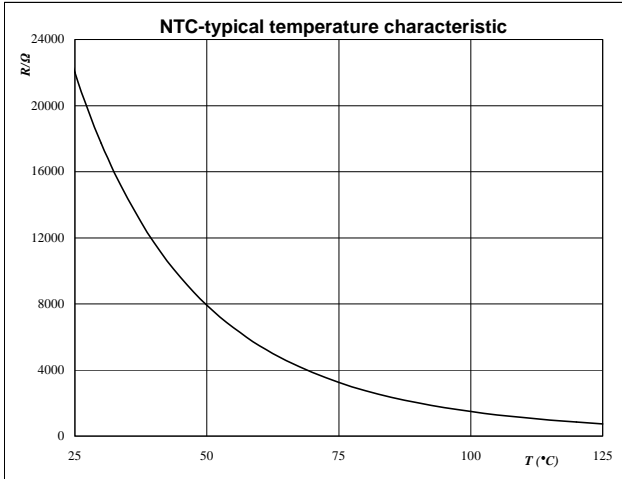NTC-typical temperature characteristic

Figure 2	Thermistor

Typical NTC resistance values

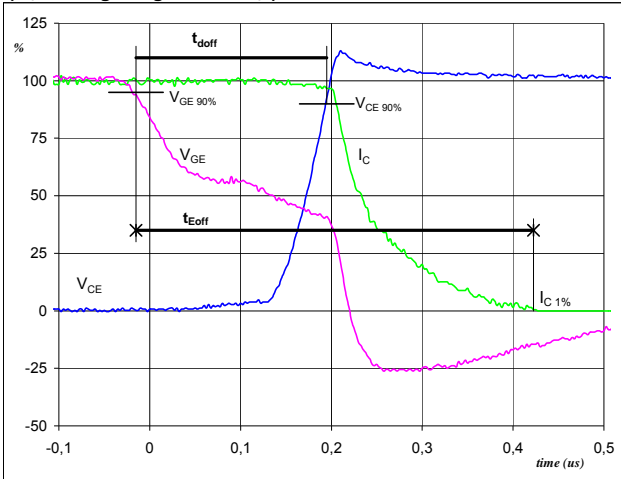$$R(T) = R_{25} \cdot e^{\left(B_{25/100} \left(\frac{1}{T} - \frac{1}{T_{25}} \right) \right)} \quad [\Omega]$$

T [°C]	R_nom [Ω]	R_min [Ω]	R_max [Ω]	△R/R [±%]
-55	2089434,5	1506495,4	2672373,6	27,9
0	71804,2	59724,4	83884	16,8
10	43780,4	37094,4	50466,5	15,3
20	27484,6	23684,6	31284,7	13,8
25	22000	19109,3	24890,7	13,1
30	17723,3	15512,2	19934,4	12,5
60	5467,9	4980,6	5955,1	8,9
70	3848,6	3546	4151,1	7,9
80	2757,7	2568,2	2947,1	6,9
90	2008,9	1889,7	2128,2	5,9
100	**1486,1**	**1411,8**	**1560,4**	**5**
150	400,2	364,8	435,7	8,8

Switching Definitions Output Inverter

General conditions

T_j	=	125 °C
R_{gon}	=	32 Ω
R_{goff}	=	16 Ω

Figure 1 — Output inverter IGBT

Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff}

(t_{Eoff} = integrating time for E_{off})

V_{GE} (0%) =	0	V
V_{GE} (100%) =	15	V
V_C (100%) =	300	V
I_C (100%) =	15	A
t_{doff} =	0,21	µs
t_{Eoff} =	0,44	µs

Figure 2 — Output inverter IGBT

Turn-on Switching Waveforms & definition of tdon, t_{Eon}

(t_{Eon} = integrating time for E_{on})

V_{GE} (0%) =	0	V
V_{GE} (100%) =	15	V
V_C (100%) =	300	V
I_C (100%) =	15	A
t_{don} =	0,02	µs
t_{Eon} =	0,20	µs

Figure 3 — Output inverter IGBT

Turn-off Switching Waveforms & definition of t_f

V_C (100%) =	300	V
I_C (100%) =	15	A
t_f =	0,09	µs

Figure 4 — Output inverter IGBT

Turn-on Switching Waveforms & definition of t_r

V_C (100%) =	300	V
I_C (100%) =	15	A
t_r =	0,02	µs

Switching Definitions Output Inverter

Figure 5	Output inverter IGBT

Turn-off Switching Waveforms & definition of t$_{Eoff}$

P$_{off}$ (100%) =	4,47	kW
E$_{off}$ (100%) =	0,40	mJ
t$_{Eoff}$ =	0,44	μs

Figure 6	Output inverter IGBT

Turn-on Switching Waveforms & definition of t$_{Eon}$

P$_{on}$ (100%) =	4,47	kW
E$_{on}$ (100%) =	0,34	mJ
t$_{Eon}$ =	0,20	μs

Figure 7	Output inverter FWD

Gate voltage vs Gate charge (measured)

V$_{GEoff}$ =	0	V
V$_{GEon}$ =	15	V
V$_C$ (100%) =	300	V
I$_C$ (100%) =	15	A
Q$_g$ =	105,74	nC

Figure 8	Output inverter IGBT

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

V$_d$ (100%) =	300	V
I$_d$ (100%) =	15	A
I$_{RRM}$ (100%) =	14	A
t$_{rr}$ =	0,21	μs

Switching Definitions Output Inverter

Figure 9	Output inverter FWD

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

I_d (100%) =	15	A
Q_{rr} (100%) =	1,01	µC
t_{Qrr} =	0,49	µs

Figure 10	Output inverter FWD

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

P_{rec} (100%) =	4,47	kW
E_{rec} (100%) =	0,20	mJ
t_{Erec} =	0,49	µs

Ordering Code and Marking - Outline - Pinout

Ordering Code & Marking

Version	Ordering Code	in DataMatrix as	in packaging barcode as
without thermal paste 12mm 2 clips housing	V23990-P544-A28-PM	P544-A28	P544-A28
without thermal paste 17mm 2 clips housing	V23990-P544-A29-PM	P544-A29	P544-A29
without thermal paste 12mm 2 clips housing	V23990-P544-C28-PM	P544-C28	P544-C28
without thermal paste 17mm 2 clips housing	V23990-P544-C29-PM	P544-C29	P544-C29

7	10.8	0
8	8.1	0
9	5.4	0
10	2.7	0
11	0	0
12	0	19.8
13	0	22.5
14	7.5	19.8
15	7.5	22.5
16	15	19.8
17	15	22.5
18	22.8	22.5
19	25.5	22.5
20	33.5	22.5
21	33.5	15
22	33.5	7.5
23	33.5	0

Pinout

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