Vincotech

10-F1166BA140RS01-M499G79
datasheet

***flow*CON 1** **1600 V / 140 A**

Topology features

- Three-phase Rectifier
- Brake Chopper

Component features

- High inrush current capability

Housing features

- Base isolation: Al_2O_3
- Convex shaped substrate for superior thermal contact
- Thermo-mechanical push-and-pull force relief
- Solder pin

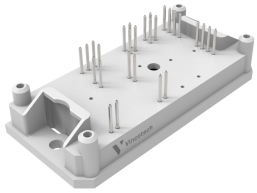
Target applications

- Embedded Drives
- Industrial Drives

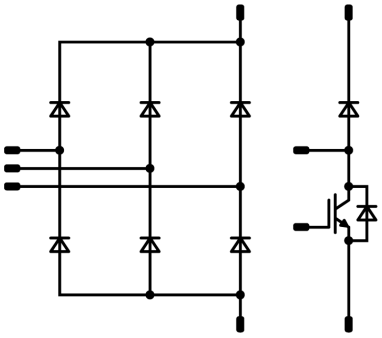
Types

- 10-F1166BA140RS01-M499G79

flow 1 17 mm housing



Schematic



Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Conditions	Value	Unit
Brake Switch				
Collector-emitter voltage	V_{CES}		1200	V
Collector current (DC current)	I_C	$T_j = T_{jmax}$ T_s = 80 °C	84	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}	150	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ T_s = 80 °C	160	W
Gate-emitter voltage	V_{GES}		±20	V
Maximum junction temperature	T_{jmax}		175	°C
Brake Diode				
Peak repetitive reverse voltage	V_{RRM}		1200	V
Forward current (DC current)	I_F	$T_j = T_{jmax}$ T_s = 80 °C	45	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}	100	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ T_s = 80 °C	78	W
Maximum junction temperature	T_{jmax}		175	°C
Brake Sw. Protection Diode				
Peak repetitive reverse voltage	V_{RRM}		1200	V
Forward current (DC current)	I_F	$T_j = T_{jmax}$ T_s <= 80 °C	20 (1)	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}	20	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ T_s = 80 °C	44	W
Maximum junction temperature	T_{jmax}		175	°C

(1) limited by I_{FRM}

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Conditions		Value	Unit
Rectifier Diode					
Peak repetitive reverse voltage	V_{RRM}			1600	V
Forward current (DC current)	I_F	$T_j = T_{jmax}$	T_s = 80 °C	105	A
Surge (non-repetitive) forward current	I_{FSM}	Single Half Sine Wave, t_p = 10 ms	T_j = 150 °C	1380	A
Surge current capability	I^2t			9520	A^2s
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	130	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 s	6000	V
Isolation voltage	V_{isol}	AC Voltage	t_p = 1 min	2500	V
Creepage distance				>12,7	mm
Clearance				>12,7	mm
Comparative Tracking Index	CTI			≥ 600	

*100 % tested in production

Characteristic Values

Parameter	Symbol	Conditions					Values			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	
Brake Switch										
Static										
Gate-emitter threshold voltage	$V_{GE(th)}$			10	0,0075	25	5,4	6	6,6	V
Collector-emitter saturation voltage	V_{CEsat}		15		75	25 125 150		1,55 1,7 1,75	1,9(2)	V
Collector-emitter cut-off current	I_{CES}		0	1200		25			100	µA
Gate-emitter leakage current	I_{GES}		20	0		25			500	nA
Internal gate resistance	r_g							4		Ω
Input capacitance	C_{ies}		0	10		25		16000		pF
Output capacitance	C_{oes}							480		pF
Reverse transfer capacitance	C_{res}							190		pF
Gate charge	Q_g	V_{CC} = 600 V	0/15		75	25		570		nC
Thermal										
Thermal resistance junction to sink(3)	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						0,6		K/W
Dynamic										
Turn-on delay time	$t_{d(on)}$	R_{gon} = 4 Ω R_{goff} = 4 Ω	0/15	700	75	25 125 150		112,32 111,68 111,04		ns
Rise time	t_r					25 125 150		37,76 45,76 47,04		ns
Turn-off delay time	$t_{d(off)}$					25 125 150		424 485,76 503,68		ns
Fall time	t_f					25 125 150		106,05 133,52 144,84		ns
Turn-on energy (per pulse)	E_{on}	Q_{rFWD}=6,08 µC Q_{rFWD}=9,32 µC Q_{rFWD}=10,48 µC				25 125 150		6,47 8,37 8,88		mWs
Turn-off energy (per pulse)	E_{off}					25 125 150		6,21 8,58 9,2		mWs

Characteristic Values

Parameter	Symbol	Conditions					Values			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	
Brake Diode										
Static										
Forward voltage	V_F				50	25 125 150		1,66 1,78 1,79	2,1[2]	V
Reverse leakage current	I_R	V_r = 1200 V				25			40	µA
Thermal										
Thermal resistance junction to sink[3]	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						1,22		K/W
Dynamic										
Peak recovery current	I_{RM}	di/dt=1883 A/µs di/dt=1356 A/µs di/dt=1465 A/µs	0/15	700	75	25 125 150		46,76 48,14 49,54		A
Reverse recovery time	t_{rr}					25 125 150		300,5 450,44 497,19		ns
Recovered charge	Q_r					25 125 150		6,08 9,32 10,48		µC
Reverse recovered energy	E_{rec}					25 125 150		2,61 4,28 4,86		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125 150		250,15 224,35 222,94		A/µs

Characteristic Values

Parameter	Symbol	Conditions					Values			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	
Brake Sw. Protection Diode										
Static										
Forward voltage	V_F				10	25 125 150		1,61 1,69 1,7	1,9(2)	V
Reverse leakage current	I_R	V_r = 1200 V				25			25	µA
Thermal										
Thermal resistance junction to sink(3)	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						2,16		K/W
Rectifier Diode										
Static										
Forward voltage	V_F				77	25 125		1,2 1,11	1,21(2) 1,1(2)	V
Reverse leakage current	I_R	V_r = 1600 V				25			50	µA
Thermal										
Thermal resistance junction to sink(3)	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						0,54		K/W

(2) Value at chip level

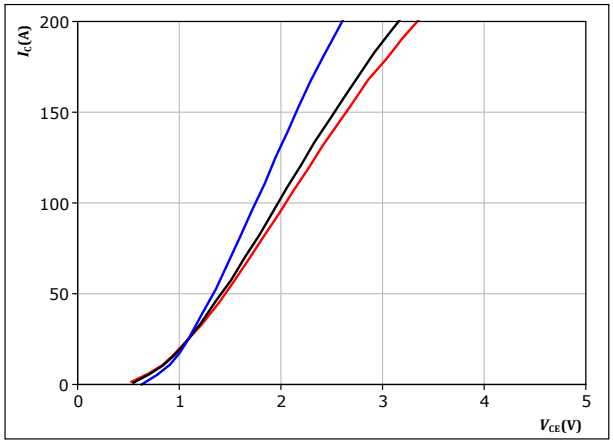
(3) Only valid with pre-applied Vincotech thermal interface material.

Brake Switch Characteristics

figure 1. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$

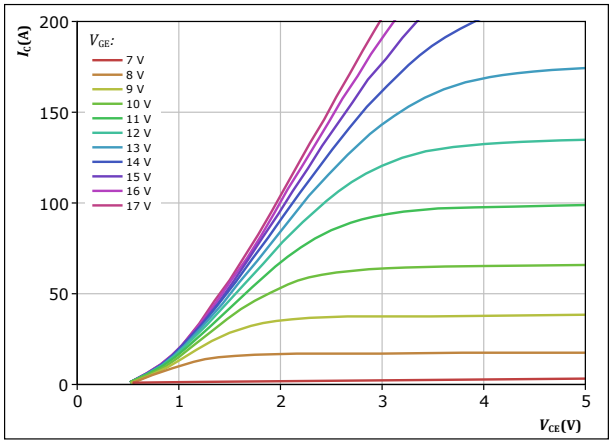


t_p =	250	µs		
V_{GE} =	15	V	T_j:	25 °C
				125 °C
				150 °C

figure 2. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$



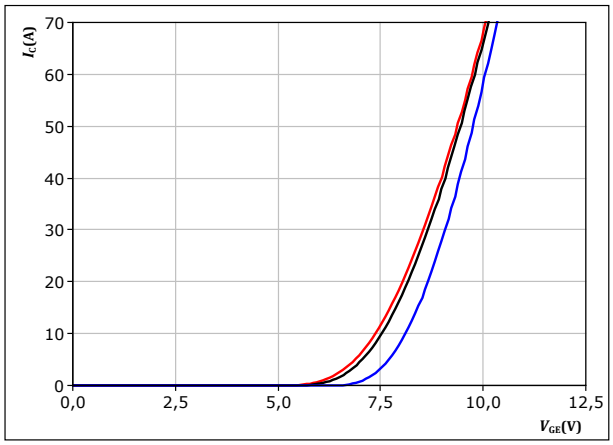
t_p =	250	µs
T_j =	150	°C

V_{GE} from 7 V to 17 V in steps of 1 V

figure 3. **IGBT**

Typical transfer characteristics

$I_C = f(V_{GE})$

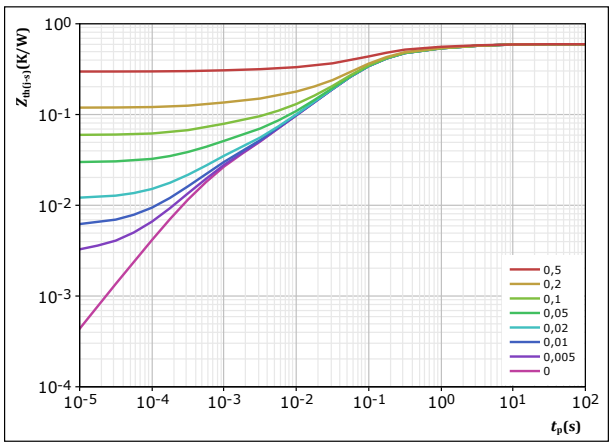


t_p =	250	µs		
V_{CE} =	10	V	T_j:	25 °C
				125 °C
				150 °C

figure 4. **IGBT**

Transient thermal impedance as a function of pulse width

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



D =	t_p / T	
$R_{th(j-s)}$ =	0,595	K/W

IGBT thermal model values

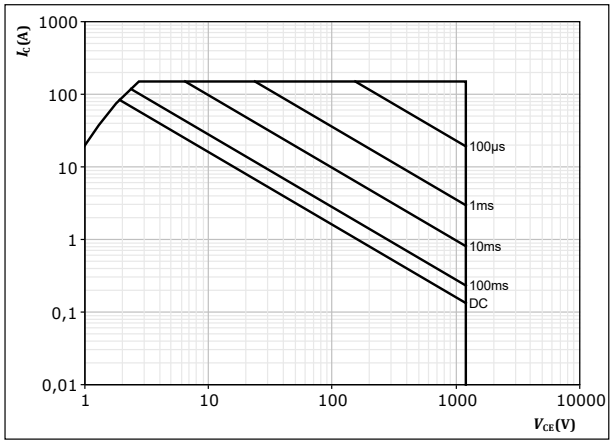
R (K/W)	τ (s)
4,72E-02	3,99E+00
6,97E-02	8,51E-01
2,23E-01	1,52E-01
1,98E-01	5,35E-02
3,69E-02	6,62E-03
2,04E-02	6,16E-04

Brake Switch Characteristics

figure 5. **IGBT**

Safe operating area

$I_C = f(V_{CE})$

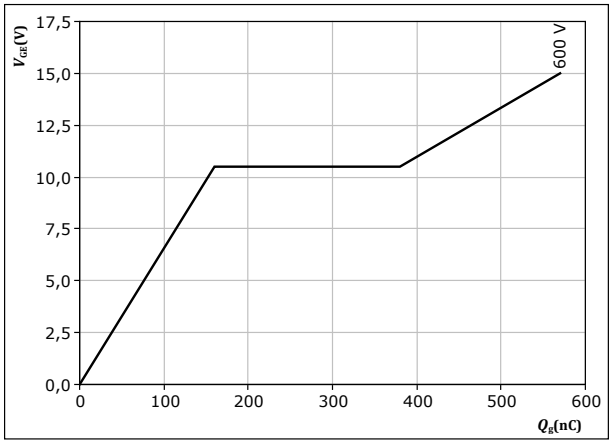


D = single pulse
T_s = 80 °C
V_{GE} = 15 V
T_j = T_{jmax}

figure 6. **IGBT**

Gate voltage vs gate charge

$V_{GE} = f(Q_g)$



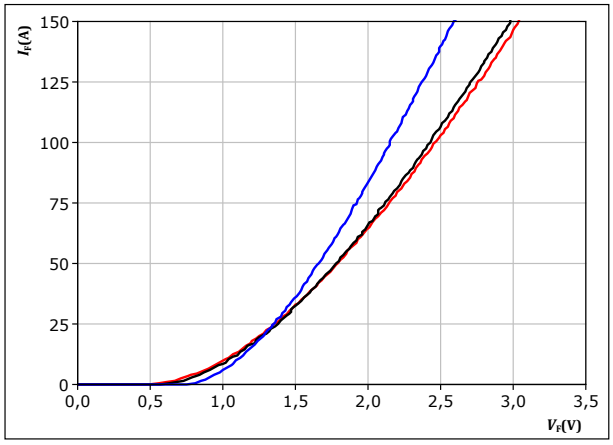
I_C = 75 A
T_j = 25 °C

Brake Diode Characteristics

figure 7. **FWD**

Typical forward characteristics

$I_F = f(V_F)$



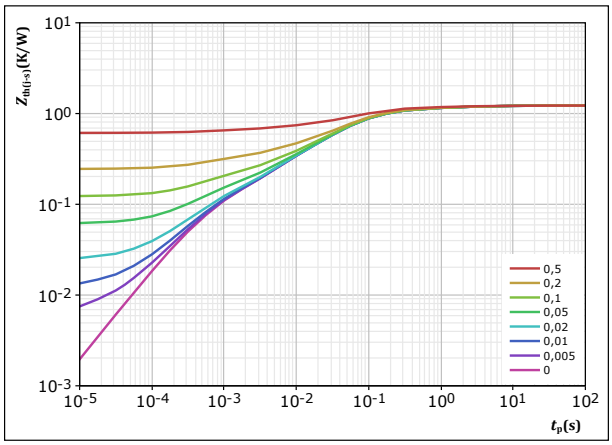
t_p = 250 µs

T_j: 25 °C, 125 °C, 150 °C

figure 8. **FWD**

Transient thermal impedance as a function of pulse width

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



D = t_p / T

$R_{th(j-s)}$ = 1,224 K/W

FWD thermal model values

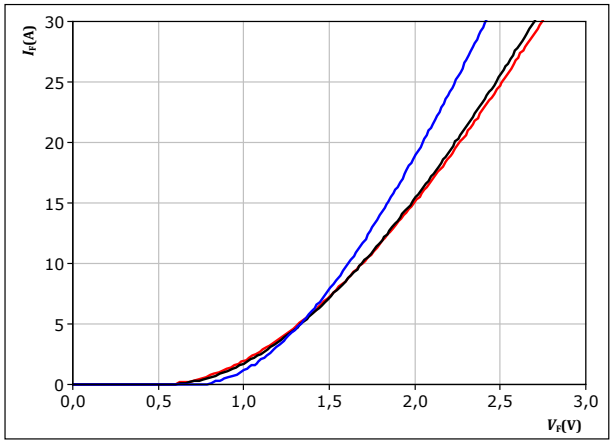
R (K/W)	τ (s)
3,84E-02	6,82E+00
9,89E-02	9,92E-01
3,93E-01	1,28E-01
4,67E-01	3,75E-02
1,41E-01	5,65E-03
8,52E-02	5,44E-04

Brake Sw. Protection Diode Characteristics

figure 9. **FWD**

Typical forward characteristics

$I_F = f(V_F)$



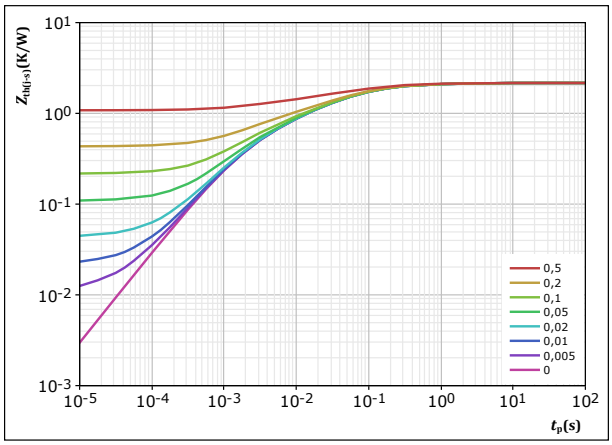
t_p = 250 µs

T_j: 25 °C, 125 °C, 150 °C

figure 10. **FWD**

Transient thermal impedance as a function of pulse width

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



D = t_p / T

$R_{th(j-s)}$ = 2,162 K/W

FWD thermal model values

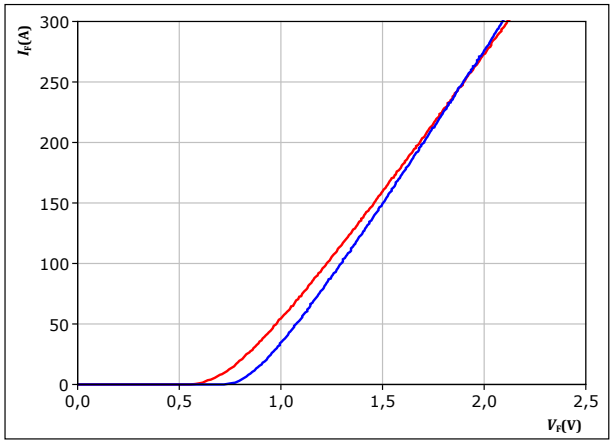
R (K/W)	τ (s)
9,29E-02	2,25E+00
3,88E-01	2,05E-01
7,75E-01	5,06E-02
5,89E-01	8,88E-03
3,17E-01	1,48E-03

Rectifier Diode Characteristics

figure 11. **Rectifier**

Typical forward characteristics

$I_F = f(V_F)$



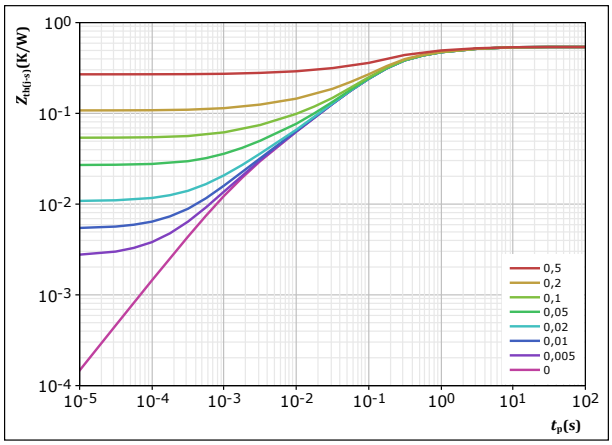
t_p = 250 µs

T_j: 25 °C, 125 °C

figure 12. **Rectifier**

Transient thermal impedance as a function of pulse width

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



D = t_p / T

$R_{th(j-s)}$ = 0,539 K/W

Rectifier thermal model values

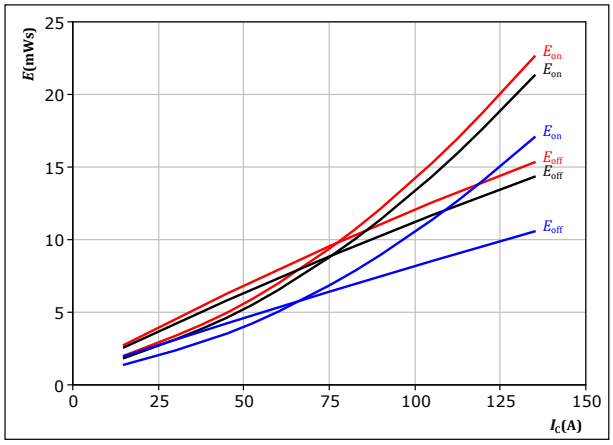
R (K/W)	τ (s)
5,60E-02	3,61E+00
1,44E-01	5,65E-01
2,80E-01	1,22E-01
4,46E-02	1,27E-02
1,39E-02	1,61E-03

Brake Switching Characteristics

figure 13. **IGBT**

Typical switching energy losses as a function of collector current

$E = f(I_C)$



With an inductive load at

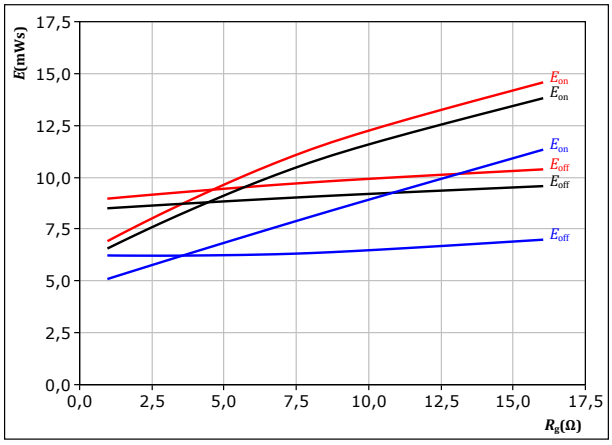
V_{CE} =	700	V
V_{GE} =	0/15	V
R_{gon} =	4	Ω
R_{goff} =	4	Ω

T_j: 25 °C, 125 °C, 150 °C

figure 14. **IGBT**

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

$E = f(R_g)$



With an inductive load at

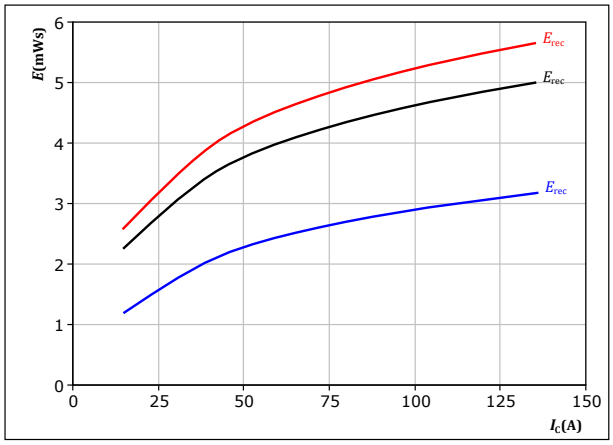
V_{CE} =	700	V
V_{GE} =	0/15	V
I_C =	75	A

T_j: 25 °C, 125 °C, 150 °C

figure 15. **FWD**

Typical reverse recovered energy loss as a function of collector current

$E_{rec} = f(I_C)$



With an inductive load at

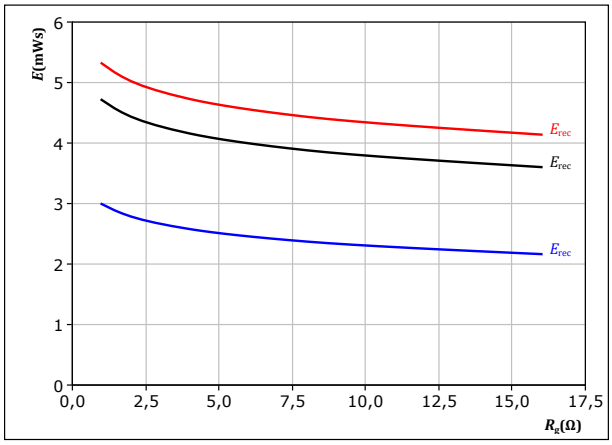
V_{CE} =	700	V
V_{GE} =	0/15	V
R_{gon} =	4	Ω

T_j: 25 °C, 125 °C, 150 °C

figure 16. **FWD**

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

$E_{rec} = f(R_g)$



With an inductive load at

V_{CE} =	700	V
V_{GE} =	0/15	V
I_C =	75	A

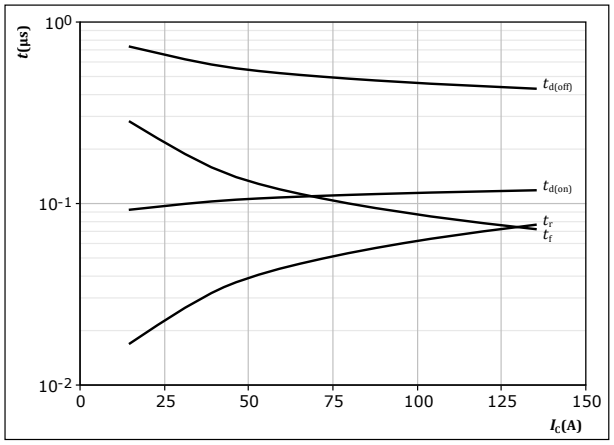
T_j: 25 °C, 125 °C, 150 °C

Brake Switching Characteristics

figure 17. **IGBT**

Typical switching times as a function of collector current

$t = f(I_C)$



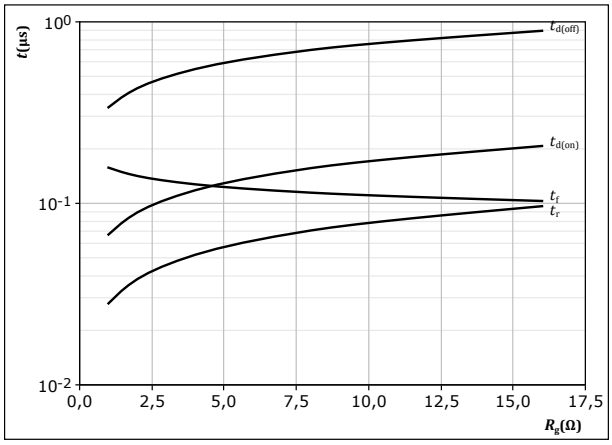
With an inductive load at

T_j =	150	°C
V_{CE} =	700	V
V_{GE} =	0/15	V
R_{gon} =	4	Ω
R_{goff} =	4	Ω

figure 18. **IGBT**

Typical switching times as a function of IGBT turn on gate resistor

$t = f(R_g)$



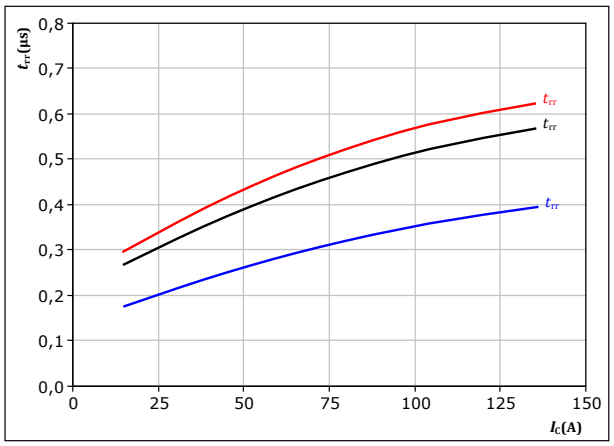
With an inductive load at

T_j =	150	°C
V_{CE} =	700	V
V_{GE} =	0/15	V
I_C =	75	A

figure 19. **FWD**

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$



With an inductive load at

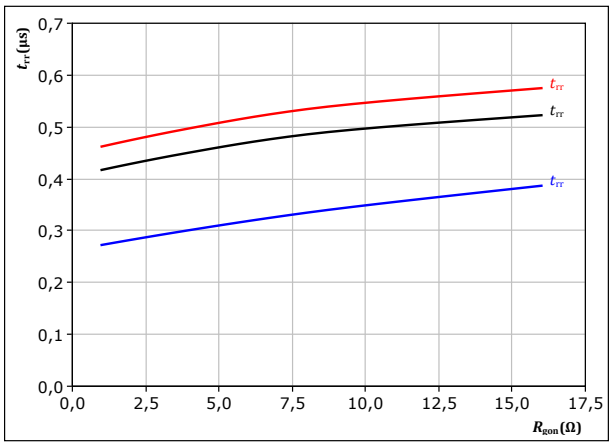
V_{CE} =	700	V
V_{GE} =	0/15	V
R_{gon} =	4	Ω

T_j: 25 °C, 125 °C, 150 °C

figure 20. **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} =	700	V
V_{GE} =	0/15	V
I_C =	75	A

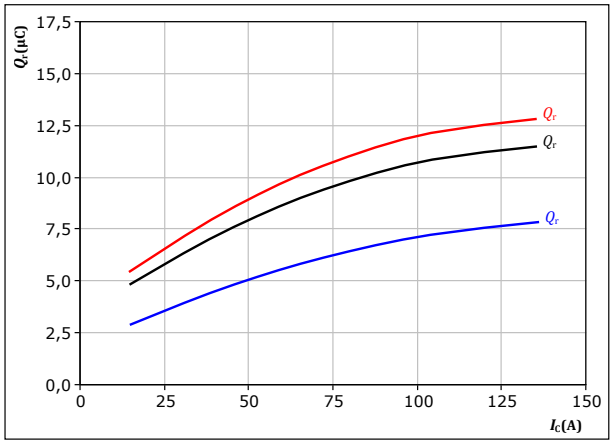
T_j: 25 °C, 125 °C, 150 °C

Brake Switching Characteristics

figure 21. **FWD**

Typical recovered charge as a function of collector current

$Q_r = f(I_C)$



With an inductive load at

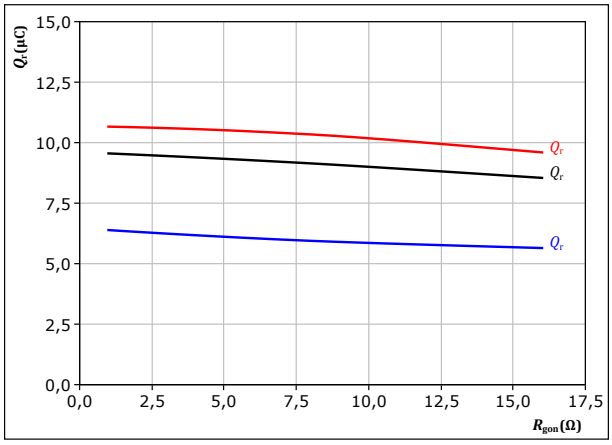
V_{CE} =	700	V
V_{GE} =	0/15	V
R_{gon} =	4	Ω

T_j: 25 °C, 125 °C, 150 °C

figure 22. **FWD**

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

$Q_r = f(R_{gon})$



With an inductive load at

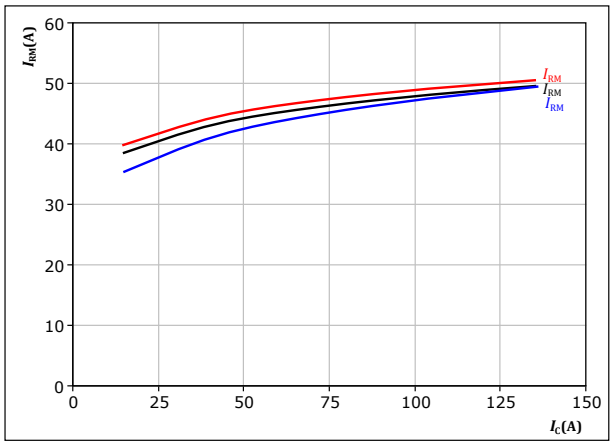
V_{CE} =	700	V
V_{GE} =	0/15	V
I_C =	75	A

T_j: 25 °C, 125 °C, 150 °C

figure 23. **FWD**

Typical peak reverse recovery current as a function of collector current

$I_{RM} = f(I_C)$



With an inductive load at

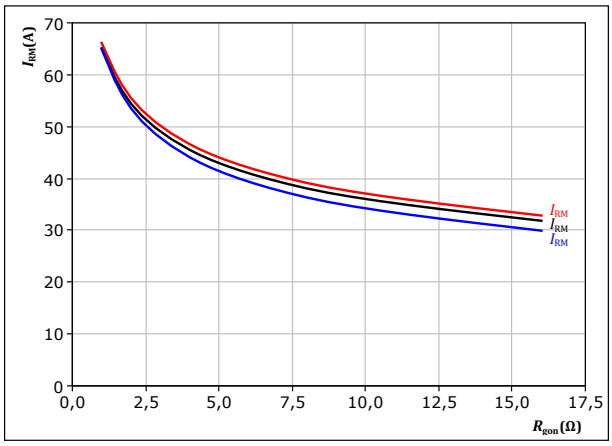
V_{CE} =	700	V
V_{GE} =	0/15	V
R_{gon} =	4	Ω

T_j: 25 °C, 125 °C, 150 °C

figure 24. **FWD**

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

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



With an inductive load at

V_{CE} =	700	V
V_{GE} =	0/15	V
I_C =	75	A

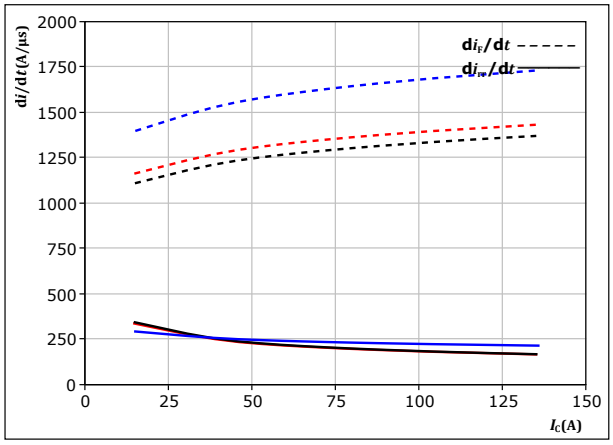
T_j: 25 °C, 125 °C, 150 °C

Brake Switching Characteristics

figure 25. **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)



With an inductive load at

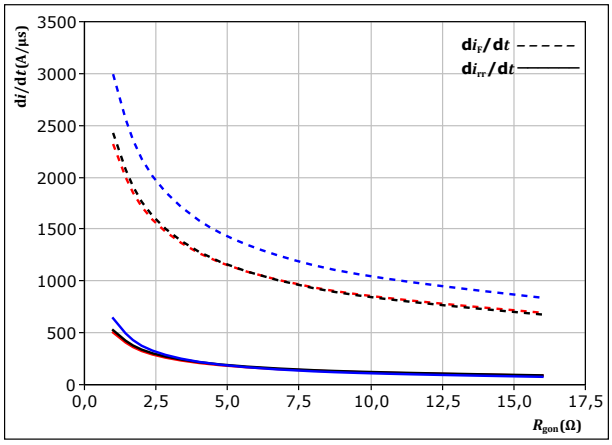
V_{CE} =	700	V
V_{GE} =	0/15	V
R_{gon} =	4	Ω

T_j: 25 °C, 125 °C, 150 °C

figure 26. **FWD**

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

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



With an inductive load at

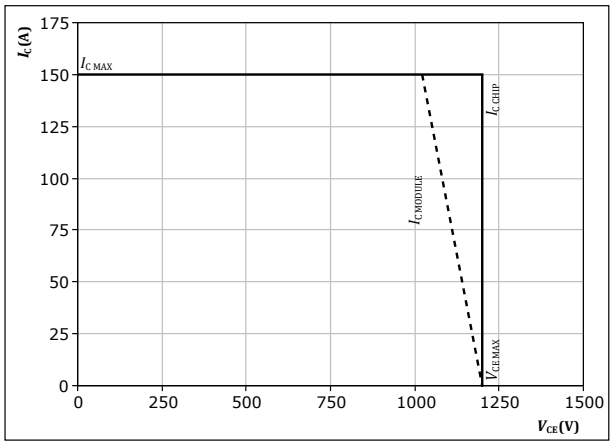
V_{CE} =	700	V
V_{GE} =	0/15	V
I_C =	75	A

T_j: 25 °C, 125 °C, 150 °C

figure 27. **IGBT**

Reverse bias safe operating area

I_C = f(V_{CE})



At

T_j =	150	°C
R_{gon} =	4	Ω
R_{goff} =	4	Ω

Brake Switching Definitions

figure 28. **IGBT**

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

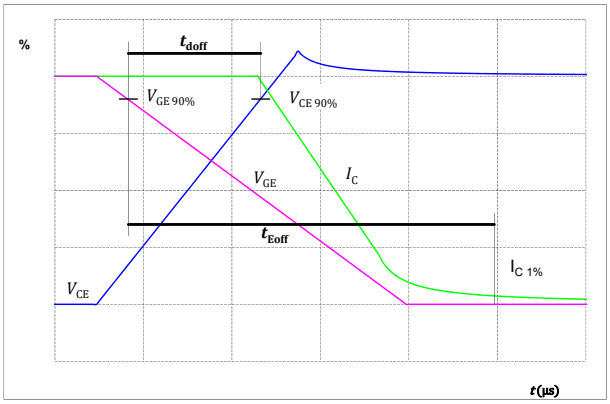


figure 29. **IGBT**

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

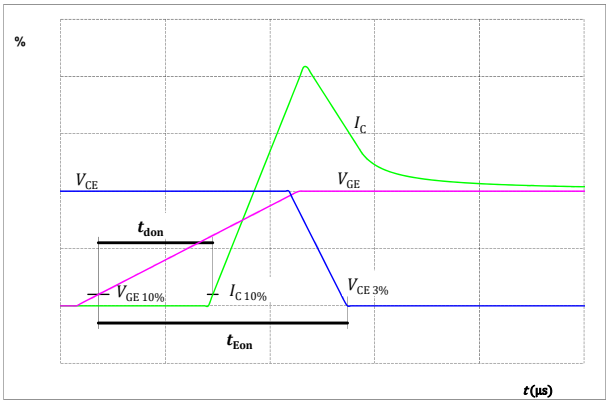


figure 30. **IGBT**

Turn-off Switching Waveforms & definition of t_f

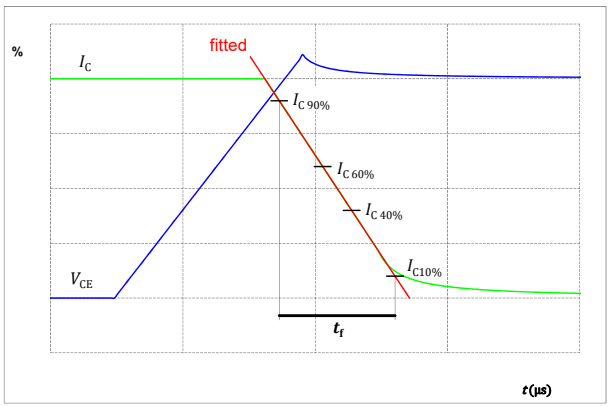
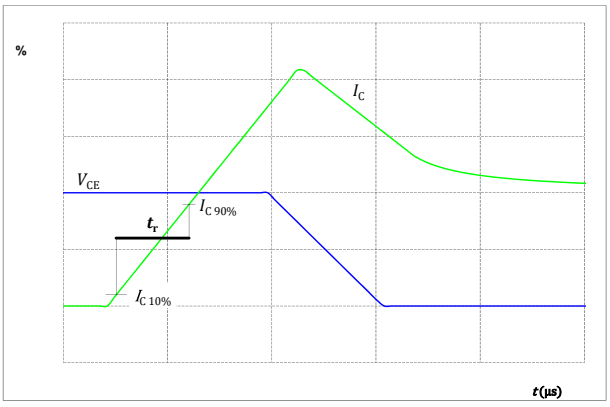


figure 31. **IGBT**

Turn-on Switching Waveforms & definition of t_r



Brake Switching Definitions

figure 32. **FWD**

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

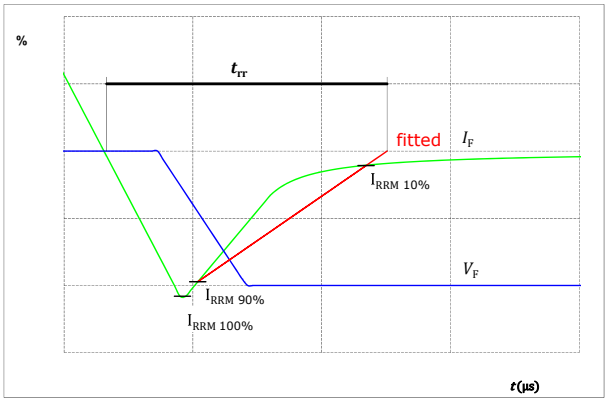
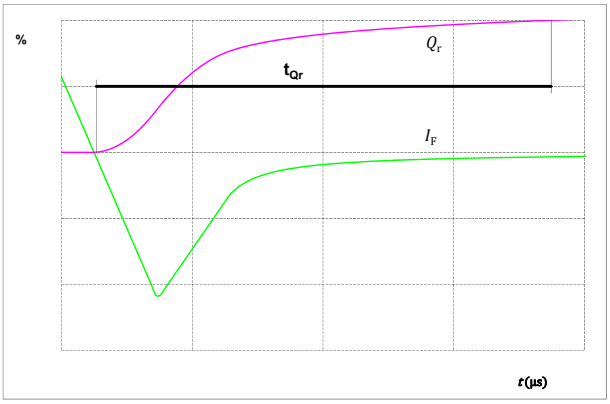


figure 33. **FWD**

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



Ordering Code

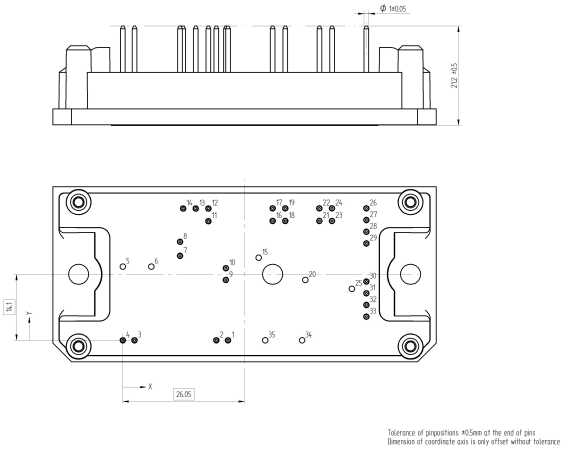
Version	Ordering Code
Without thermal paste	10-F1166BA140RS01-M499G79
With thermal paste (5,2 W/mK, PTM6000HV)	10-F1166BA140RS01-M499G79-/7/
With thermal paste (3,4 W/mK, PSX-P7)	10-F1166BA140RS01-M499G79-/3/

Marking

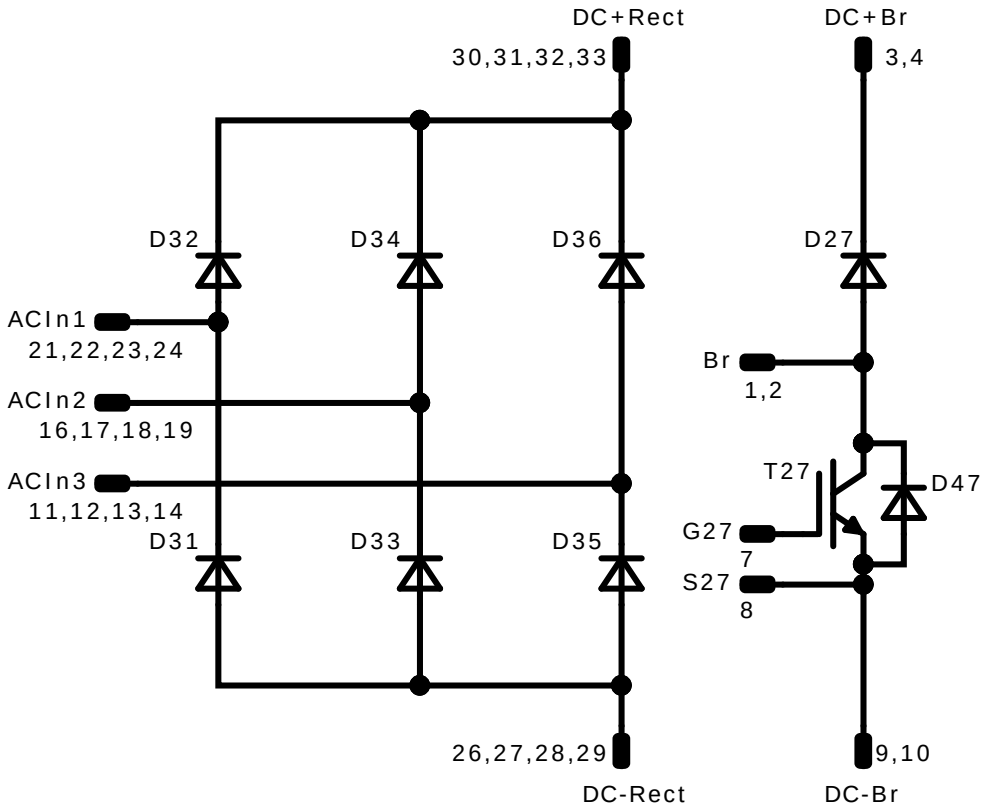
	Name		Date code	UL & VIN	Lot	Serial
Text	NN-NNNNNNNNNNNNN-TTTTTTVV		WWYY	UL VIN	LLLLL	SSSS
Datamatrix	**Type&Ver**	**Lot number**	**Serial**	**Date code**		
	TTTTTTTVV	LLLLL	SSSS	WWYY		

Outline

Pin table [mm]			
Pin	X	Y	Function
1	22,5	0	Br
2	20	0	Br
3	2,5	0	DC+Br
4	0	0	DC+Br
5	not assembled		
6	not assembled		
7	12,25	18,05	G27
8	12,25	21,05	S27
9	22,05	12,9	DC-Br
10	22,05	15,4	DC-Br
11	18,3	25,45	ACIn3
12	18,3	28,15	ACIn3
13	15,6	28,15	ACIn3
14	12,9	28,15	ACIn3
15	not assembled		
16	32,05	25,5	ACIn2
17	32,05	28,2	ACIn2
18	34,75	25,5	ACIn2
19	34,75	28,2	ACIn2
20	not assembled		
21	42,05	25,5	ACIn1
22	42,05	28,2	ACIn1
23	44,75	25,5	ACIn1
24	44,75	28,2	ACIn1
25	not assembled		
26	52,1	28,2	DC-Rect
27	52,1	25,7	DC-Rect
28	52,1	23,2	DC-Rect
29	52,1	20,7	DC-Rect
30	52,1	12,55	DC+Rect
31	52,1	10,05	DC+Rect
32	52,1	7,55	DC+Rect
33	52,1	5,05	DC+Rect
34	not assembled		
35	not assembled		



Pinout



Identification

ID	Component	Voltage	Current	Function	Comment
T27	IGBT	1200 V	75 A	Brake Switch	
D27	FWD	1200 V	50 A	Brake Diode	
D47	FWD	1200 V	10 A	Brake Sw. Protection Diode	
D31, D32, D33, D34, D35, D36	Rectifier	1600 V	140 A	Rectifier Diode	

Packaging instruction				
Standard packaging quantity (SPQ) 100	>SPQ	Standard	<SPQ	Sample

Handling instruction
Handling instructions for *flow* 1 packages see vincotech.com website.

Package data
Package data for *flow* 1 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
10-F1166BA140RS01-M499G79-D3-14	17 Jan. 2024	Correct Thermal characteristic of Rectifier Diode	