Vincotech

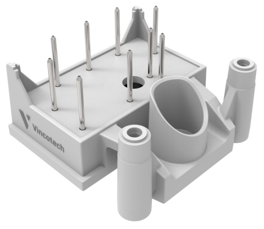
10-0B166BA028SC-M989G09
datasheet

***flow*CON 0B** | **1600 V / 28 A**

Features

- 3 phase rectifier bridge
- Brake chopper
- Single screw mounting

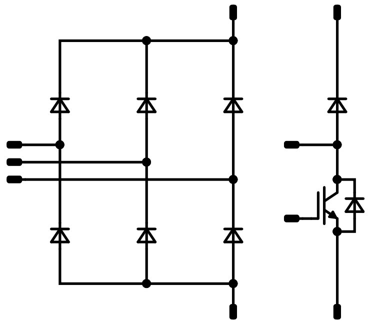
flow 0B 17 mm housing



Target applications

- Industrial Drives

Schematic



Types

- 10-0B166BA028SC-M989G09

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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	I_C	$T_j = T_{jmax}$	T_s = 80 °C	38	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	96	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
Brake Diode					
Peak repetitive reverse voltage	V_{RRM}			1200	V
Continuous (direct) forward current	I_F	$T_j = T_{jmax}$	T_s = 80 °C	21	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}		30	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	47	W
Maximum junction temperature	T_{jmax}			175	°C
Brake Sw. Protection Diode					
Peak repetitive reverse voltage	V_{RRM}			1200	V
Continuous (direct) forward current	I_F	$T_j = T_{jmax}$	T_s = 80 °C	4	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}		6	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	24	W
Maximum junction temperature	T_{jmax}			150	°C

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 average current	I_{FAV}	$T_j = T_{jmax}$	T_s = 80 °C	39	A
Surge (non-repetitive) forward current	I_{FSM}	Single Half Sine Wave, t_p = 10 ms	T_j = 150 °C	270	A
Surge current capability	I^2t			370	A^2s
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	48	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
Creepage distance				min. 12,7	mm
Clearance				min, 12,7	mm
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]	Values Min	Values Typ	Values Max	Unit
Brake Switch										
Static										
Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$			0,0012	25	5,3	5,8	6,3	V
Collector-emitter saturation voltage	V_{CEsat}		15		35	25 125 150	1,58	1,93 2,19 2,29	2,07(1)	V
Collector-emitter cut-off current	I_{CES}		0	1200		25			5	µA
Gate-emitter leakage current	I_{GES}		20	0		25			120	nA
Internal gate resistance	r_g							None		Ω
Input capacitance	C_{ies}	f = 1 Mhz	0	25		25		2000		pF
Reverse transfer capacitance	C_{res}							70		pF
Gate charge	Q_g		15		0	25		270		nC
Thermal										
Thermal resistance junction to sink (2)	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						0,99		K/W
Dynamic										
Turn-on delay time	$t_{d(on)}$	R_{gon} = 16 Ω R_{goff} = 16 Ω	0/15	700	35	25 125 150		33,6 32,2 32,4		ns
Rise time	t_r					25 125 150		42,2 44 43,2		ns
Turn-off delay time	$t_{d(off)}$					25 125 150		315 384 403,2		ns
Fall time	t_f					25 125 150		61,72 115,43 142,53		ns
Turn-on energy (per pulse)	E_{on}	Q_{rFWD}=2,53 µC Q_{rFWD}=3,56 µC Q_{rFWD}=3,83 µC				25 125 150		3,39 4 4,13		mWs
Turn-off energy (per pulse)	E_{off}					25 125 150		2,55 4,14 4,67		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				15	25 125 150		1,62 1,73 1,73	2,1(1)	V
Reverse leakage current	I_R	V_r = 1200 V				25			30	µA
Thermal										
Thermal resistance junction to sink (2)	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						2,03		K/W
Dynamic										
Peak recovery current	I_{RRM}	d*i*/d*t*=747 A/µs d*i*/d*t*=532 A/µs d*i*/d*t*=581 A/µs	0/15	700	35	25 125 150		17,16 18,08 18,46		A
Reverse recovery time	t_{rr}					25 125 150		285,46 396,71 430,44		ns
Recovered charge	Q_r					25 125 150		2,53 3,56 3,83		µC
Reverse recovered energy	E_{rec}					25 125 150		1,06 1,58 1,72		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125 150		58,78 46,85 48,97		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				3	25 125	1,23	1,74 1,64	1,97[1]	V
Reverse leakage current	I_R	V_r = 1200 V				25			27	µA
Thermal										
Thermal resistance junction to sink [2]	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						2,96		K/W
Rectifier Diode										
Static										
Forward voltage	V_F				28	25 125		1,15 1,1	1,5[1]	V
Reverse leakage current	I_R	V_r = 1600 V				25 150			100 1000	µA
Thermal										
Thermal resistance junction to sink [2]	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						1,47		K/W

[1] Value at chip level

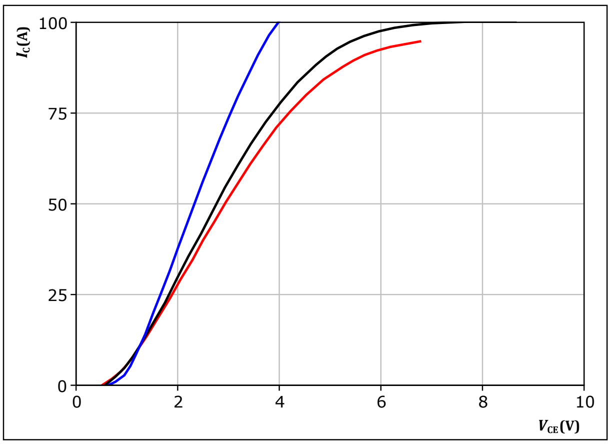
[2] Only valid with pre-applied Vincotech thermal interface material.

Brake Switch Characteristics

figure 1. IGBT

Typical output characteristics

I_C = f(V_{CE})

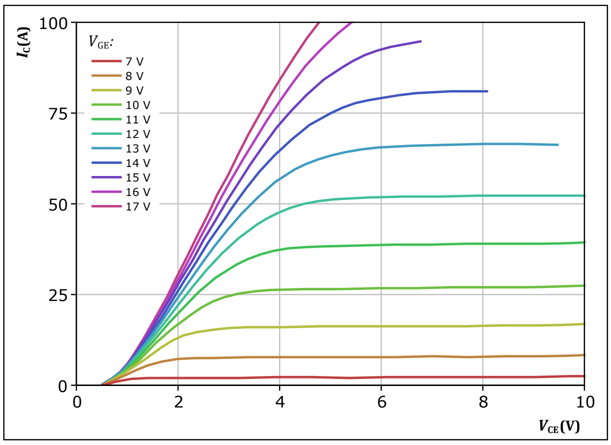


t_p = 250 µs
V_{GE} = 15 V
T_j: 25 °C, 125 °C, 150 °C

figure 2. IGBT

Typical output characteristics

I_C = f(V_{CE})

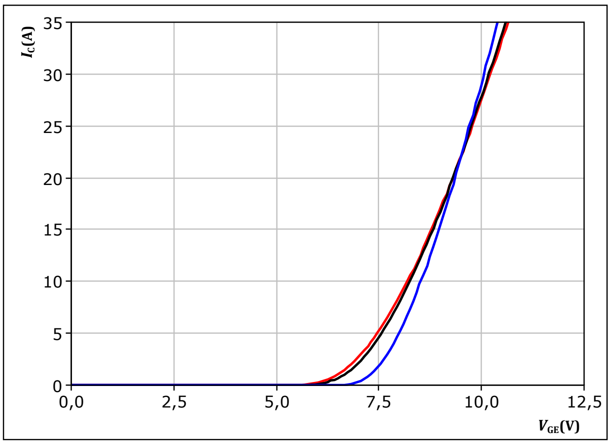


t_p = 250 µs
T_j = 150 °C
V_{GE} from 7 V to 17 V in steps of 1 V

figure 3. IGBT

Typical transfer characteristics

I_C = f(V_{GE})

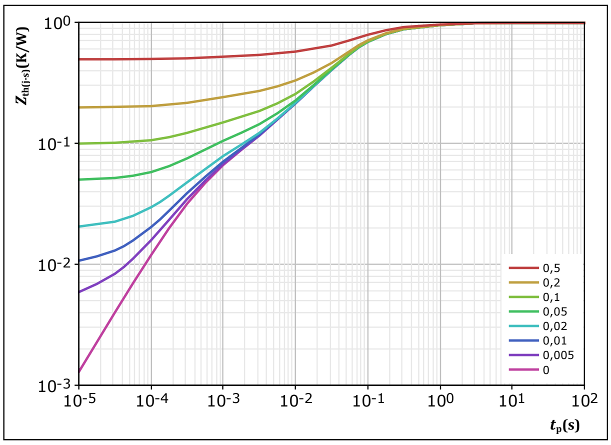


t_p = 250 µs
V_{CE} = 10 V
T_j: 25 °C, 125 °C, 150 °C

figure 4. IGBT

Transient thermal impedance as a function of pulse width

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



D = t_p / T
$R_{th(j-s)}$ = 0,989 K/W

IGBT thermal model values

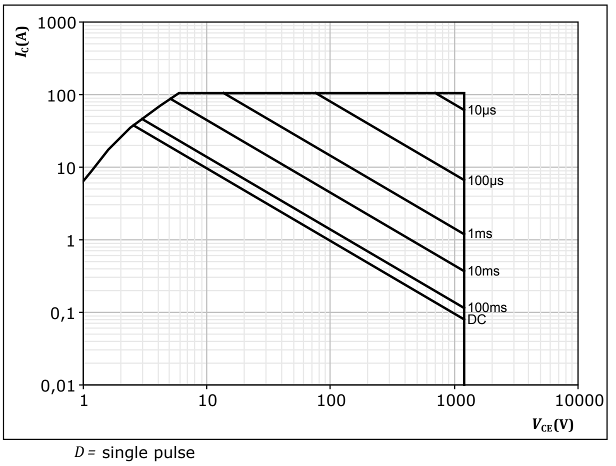
R (K/W)	τ (s)
1,08E-01	1,01E+00
3,09E-01	1,38E-01
4,67E-01	4,59E-02
5,88E-02	4,18E-03
4,64E-02	4,47E-04

Brake Switch Characteristics

figure 5.	IGBT

Safe operating area

$I_C = f(V_{CE})$



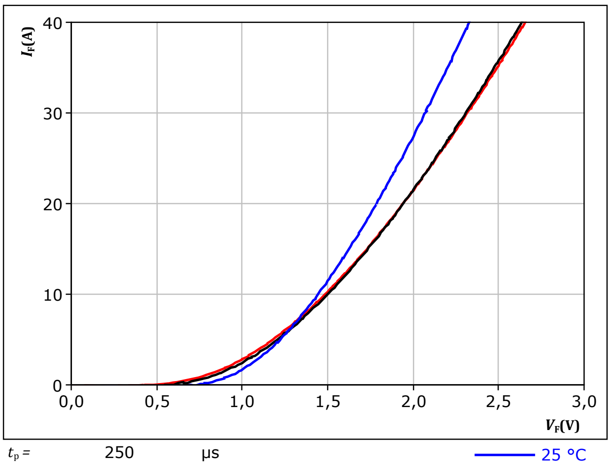
D =	single pulse	
T_s =	80	°C
V_{GE} =	15	V
T_j =	T_{jmax}	

Brake Diode Characteristics

figure 6. **FWD**

Typical forward characteristics

$I_F = f(V_F)$



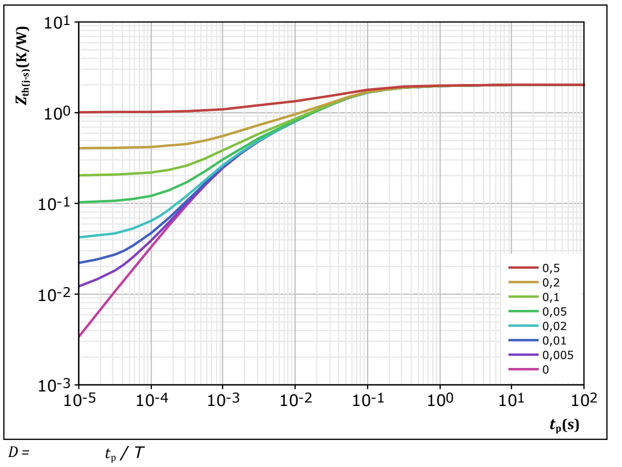
t_p = 250 µs

T_j: 25 °C, 125 °C, 150 °C

figure 7. **FWD**

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$

$R_{th(j-s)}$ = 2,03 K/W

FWD thermal model values

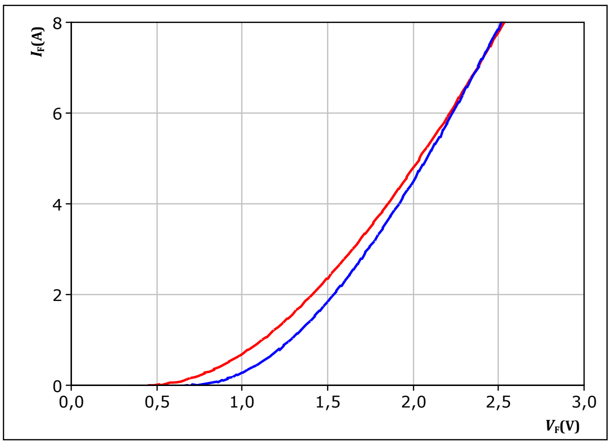
R (K/W)	τ (s)
7,11E-02	2,74E+00
2,03E-01	2,92E-01
9,95E-01	5,10E-02
4,55E-01	8,39E-03
3,03E-01	1,14E-03

Brake Sw. Protection Diode Characteristics

figure 8. **FWD**

Typical forward characteristics

I_F = f(V_F)



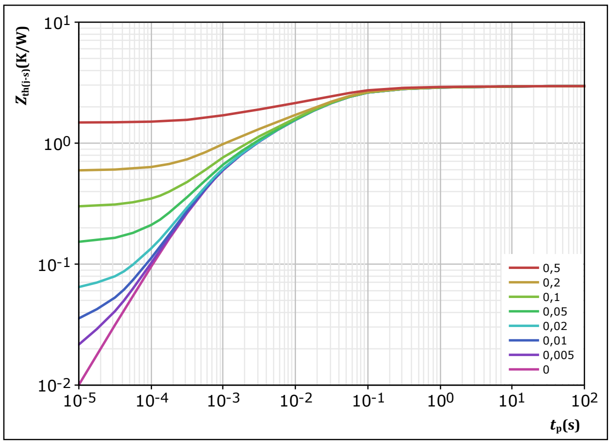
t_p = 250 µs

T_j: 25 °C, 125 °C

figure 9. **FWD**

Transient thermal impedance as a function of pulse width

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



D = t_p / T

$R_{th(j-s)}$ = 2,961 K/W

FWD thermal model values

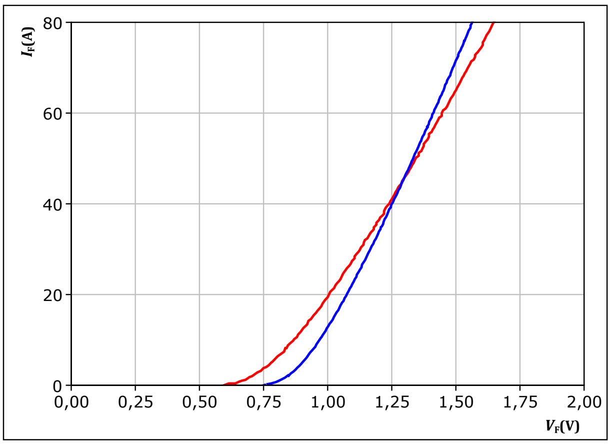
R (K/W)	τ (s)
6,59E-02	8,32E+00
1,92E-01	4,17E-01
8,46E-01	5,17E-02
8,02E-01	1,60E-02
5,87E-01	3,15E-03
4,68E-01	6,17E-04

Rectifier Diode Characteristics

figure 10. **Rectifier**

Typical forward characteristics

$I_F = f(V_F)$



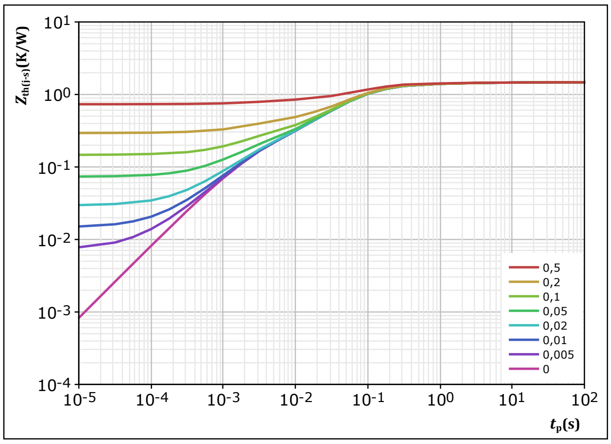
t_p = 250 µs

T_j: 25 °C, 125 °C

figure 11. **Rectifier**

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$

$R_{th(j-s)}$ = 1,47 K/W

Rectifier thermal model values

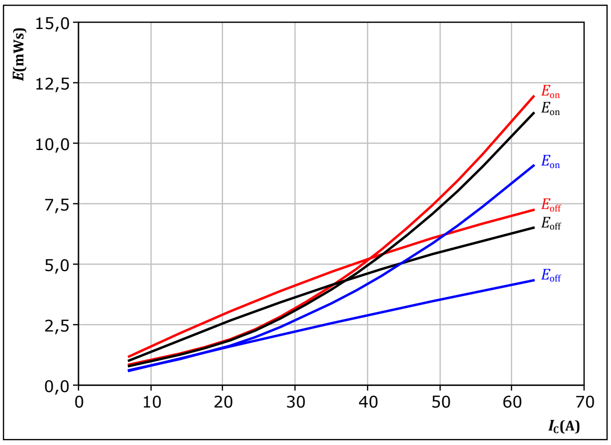
R (K/W)	τ (s)
5,46E-02	4,88E+00
1,41E-01	5,73E-01
8,54E-01	8,60E-02
2,84E-01	2,74E-02
1,34E-01	2,14E-03

Brake Switching Characteristics

figure 12. **IGBT**

Typical switching energy losses as a function of collector current

E = f(I_C)



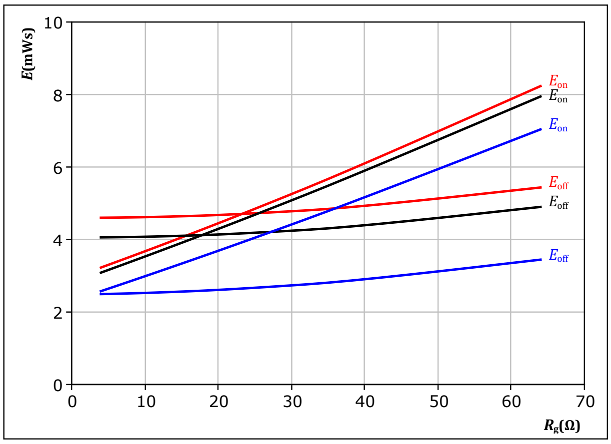
With an inductive load at

V_{CE} =	700	V	T_j: 25 °C / 125 °C / 150 °C
V_{GE} =	0/15	V	
R_{gon} =	16	Ω	
R_{goff} =	16	Ω	

figure 13. **IGBT**

Typical switching energy losses as a function of gate resistor

E = f(R_g)



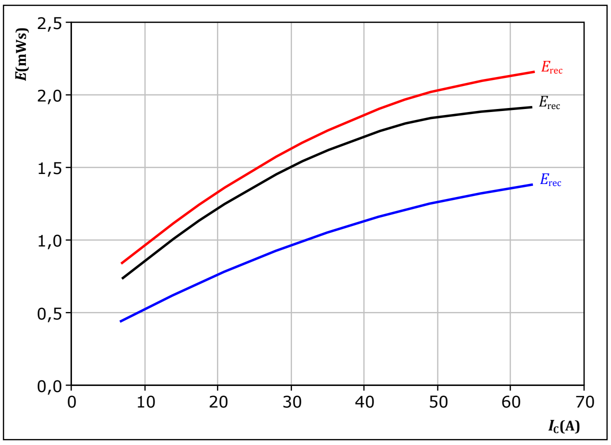
With an inductive load at

V_{CE} =	700	V	T_j: 25 °C / 125 °C / 150 °C
V_{GE} =	0/15	V	
I_C =	35	A	

figure 14. **FWD**

Typical reverse recovered energy loss as a function of collector current

E_{rec} = f(I_C)



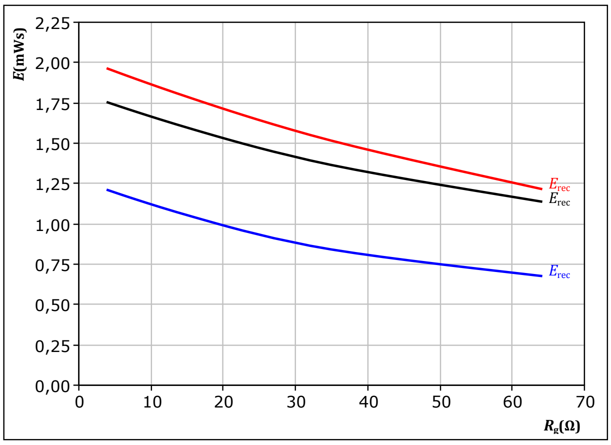
With an inductive load at

V_{CE} =	700	V	T_j: 25 °C / 125 °C / 150 °C
V_{GE} =	0/15	V	
R_{gon} =	16	Ω	

figure 15. **FWD**

Typical reverse recovered energy loss as a function of gate resistor

E_{rec} = f(R_g)



With an inductive load at

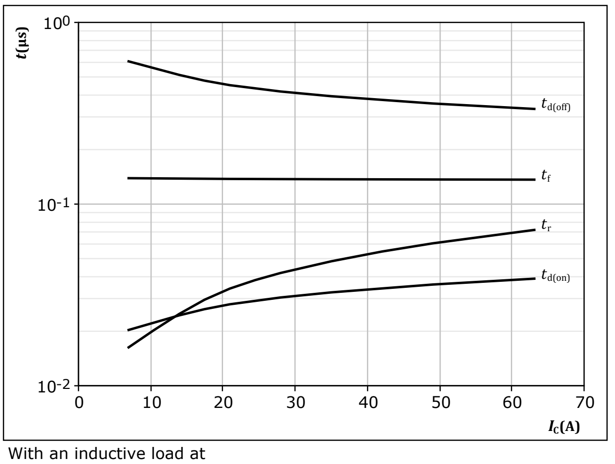
V_{CE} =	700	V	T_j: 25 °C / 125 °C / 150 °C
V_{GE} =	0/15	V	
I_C =	35	A	

Brake Switching Characteristics

figure 16. **IGBT**

Typical switching times as a function of collector current

$t = f(I_C)$



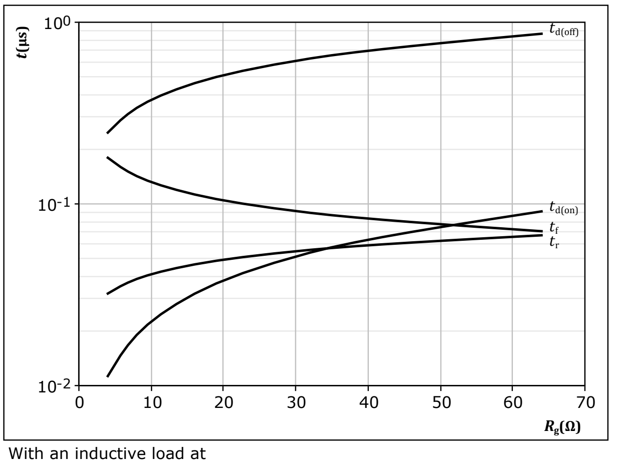
With an inductive load at

T_j =	150	°C
V_{CE} =	700	V
V_{GE} =	0/15	V
R_{gon} =	16	Ω
R_{goff} =	16	Ω

figure 17. **IGBT**

Typical switching times as a function of gate resistor

$t = f(R_g)$



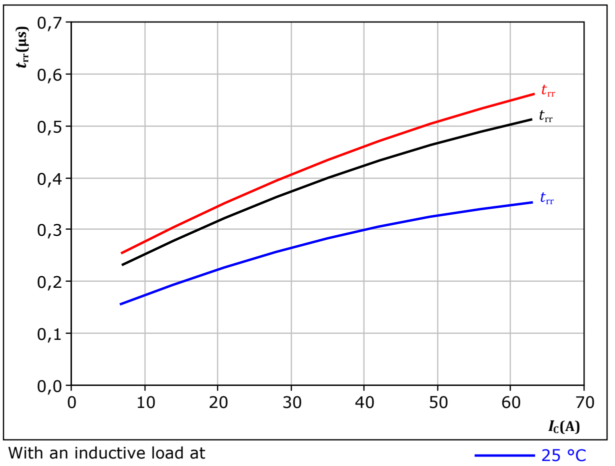
With an inductive load at

T_j =	150	°C
V_{CE} =	700	V
V_{GE} =	0/15	V
I_C =	35	A

figure 18. **FWD**

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$



With an inductive load at

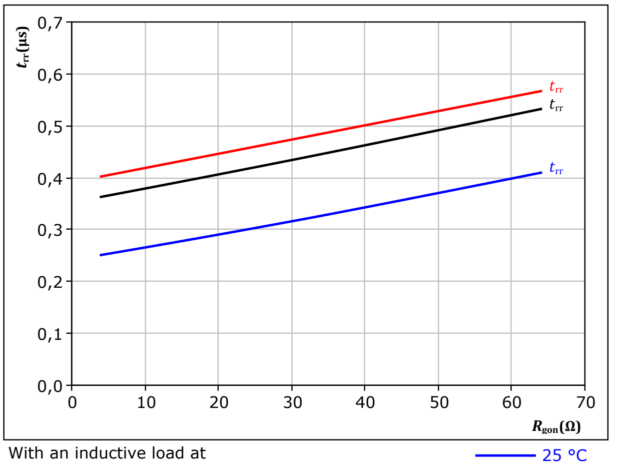
V_{CE} =	700	V
V_{GE} =	0/15	V
R_{gon} =	16	Ω

T_j: 25 °C, 125 °C, 150 °C

figure 19. **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 =	35	A

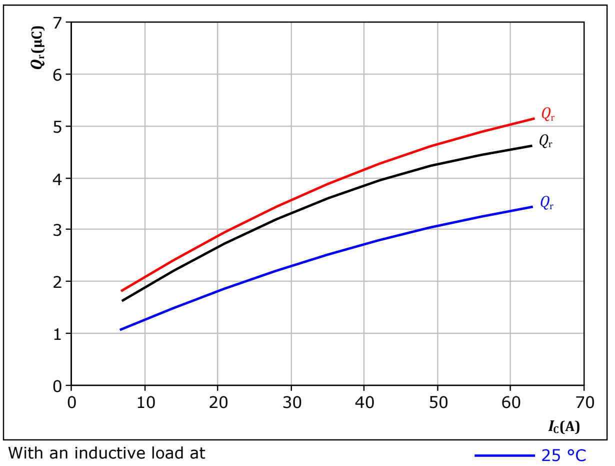
T_j: 25 °C, 125 °C, 150 °C

Brake Switching Characteristics

figure 20. FWD

Typical recovered charge as a function of collector current

Q_r = f(I_C)



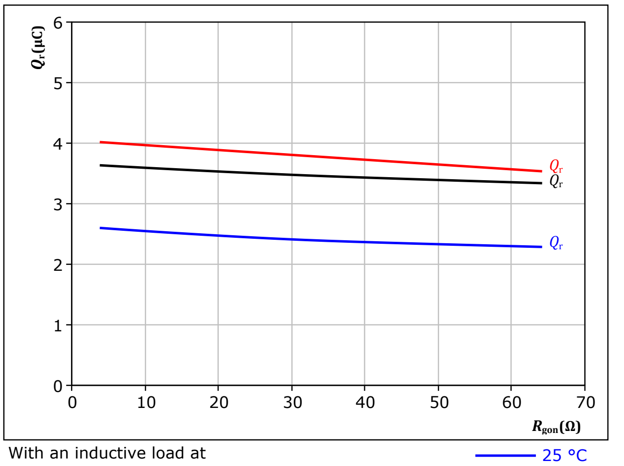
With an inductive load at

V_{CE} =	700	V	T_j:	25 °C
V_{GE} =	0/15	V		125 °C
R_{gon} =	16	Ω		150 °C

figure 21. FWD

Typical recovered charge as a function of turn on gate resistor

Q_r = f(R_{gon})



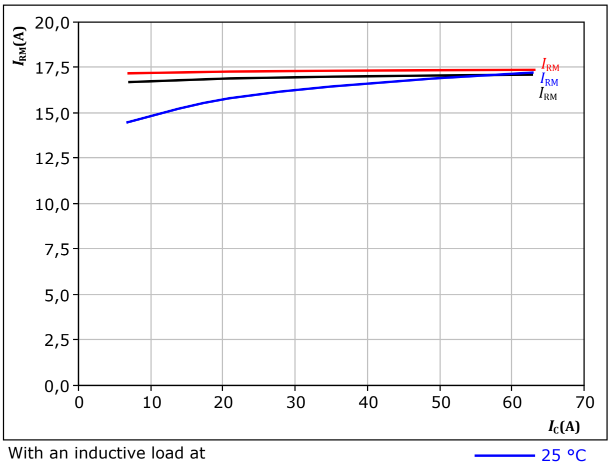
With an inductive load at

V_{CE} =	700	V	T_j:	25 °C
V_{GE} =	0/15	V		125 °C
I_C =	35	A		150 °C

figure 22. FWD

Typical peak reverse recovery current as a function of collector current

I_{RM} = f(I_C)



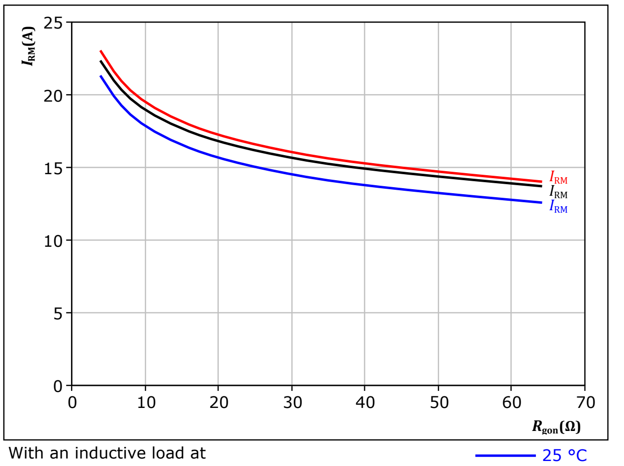
With an inductive load at

V_{CE} =	700	V	T_j:	25 °C
V_{GE} =	0/15	V		125 °C
R_{gon} =	16	Ω		150 °C

figure 23. FWD

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

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



With an inductive load at

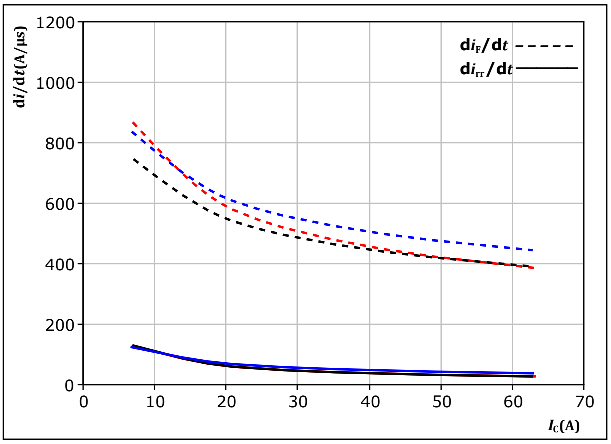
V_{CE} =	700	V	T_j:	25 °C
V_{GE} =	0/15	V		125 °C
I_C =	35	A		150 °C

Brake Switching Characteristics

figure 24. **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)



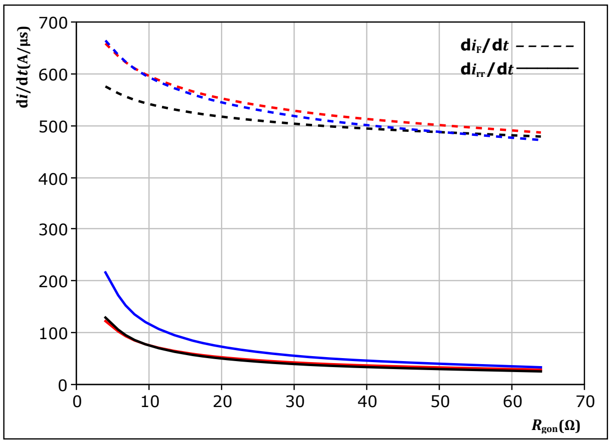
With an inductive load at

V_{CE} =	700	V	T_j:	25 °C
V_{GE} =	0/15	V		125 °C
R_{gon} =	16	Ω		150 °C

figure 25. **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})



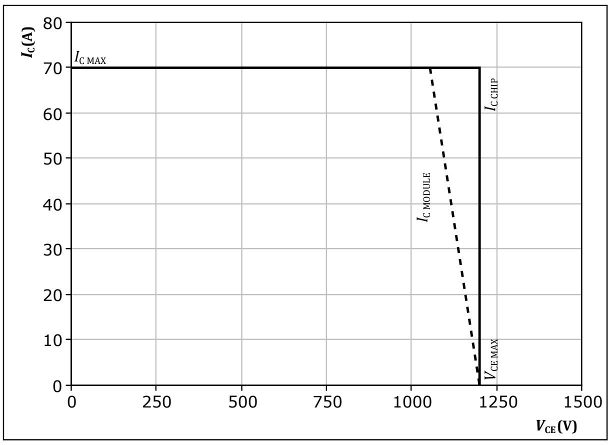
With an inductive load at

V_{CE} =	700	V	T_j:	25 °C
V_{GE} =	0/15	V		125 °C
I_C =	35	A		150 °C

figure 26. **IGBT**

Reverse bias safe operating area

I_C = f(V_{CE})



At	T_j =	150	°C
	R_{gon} =	16	Ω
	R_{goff} =	16	Ω

Brake Switching Definitions

figure 27. **IGBT**

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

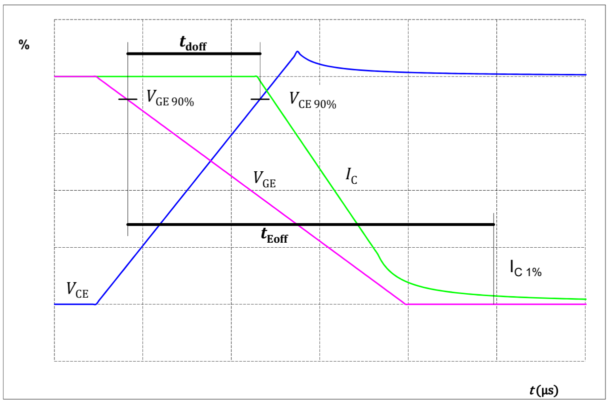


figure 28. **IGBT**

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

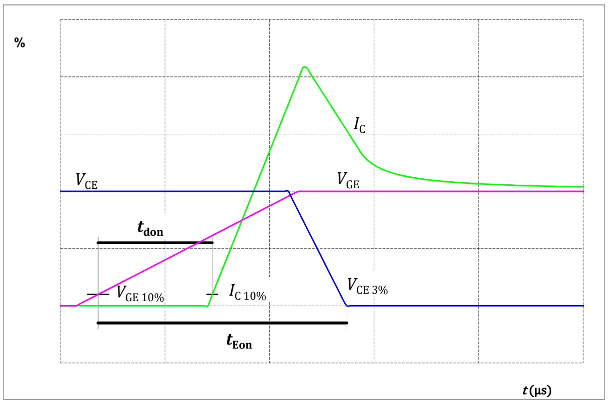


figure 29. **IGBT**

Turn-off Switching Waveforms & definition of t_f

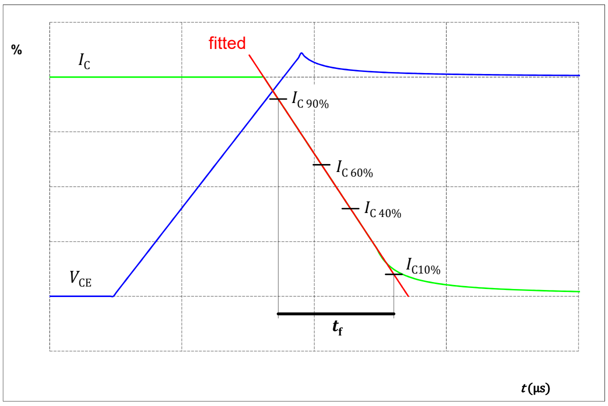
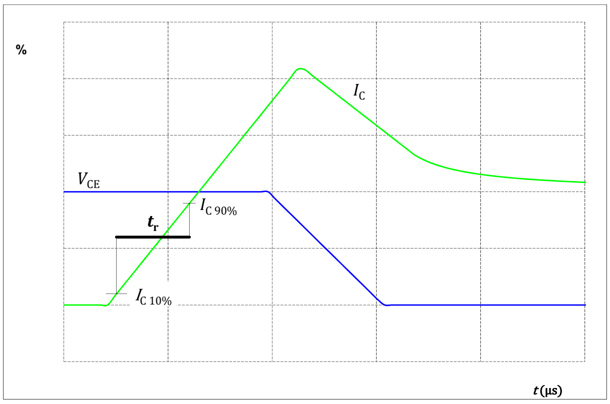


figure 30. **IGBT**

Turn-on Switching Waveforms & definition of t_r



Brake Switching Definitions

figure 31. **FWD**

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

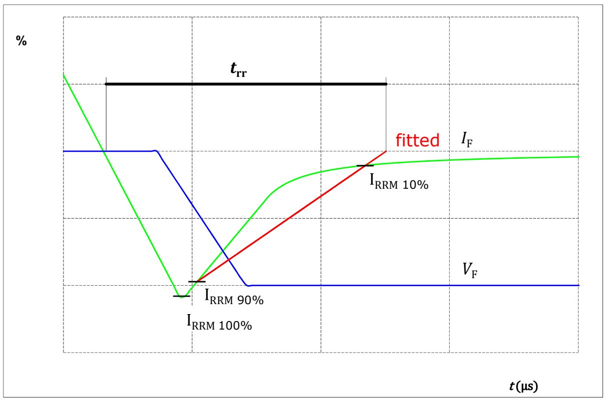
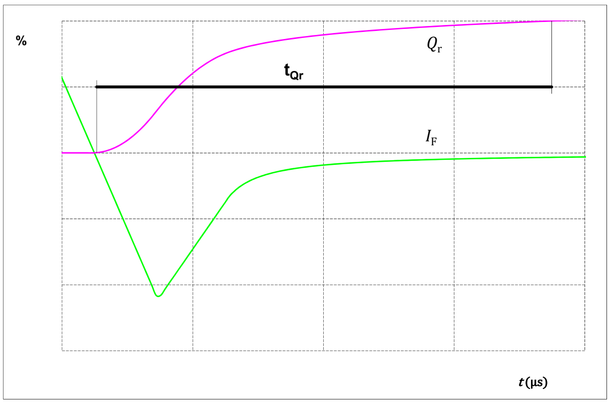


figure 32. **FWD**

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



Ordering Code

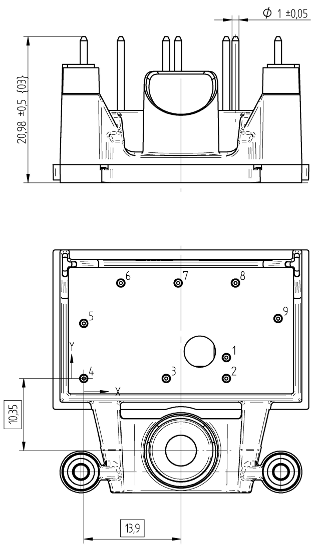
Version	Ordering Code
Without thermal paste	10-0B166BA028SC-M989G09
With thermal paste	10-0B166BA028SC-M989G09-/3/

Marking

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

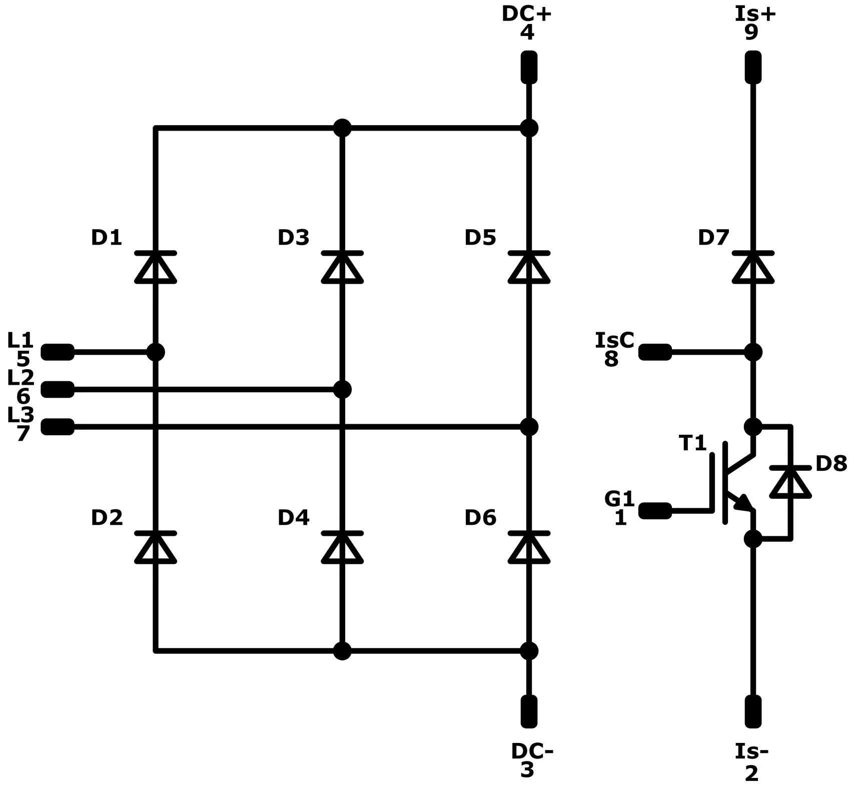
Outline

Pin table [mm]			
Pin	X	Y	Function
1	20,4	3	G1
2	20,4	0	Is-
3	11,8	0	DC-
4	0	0	DC+
5	0	7,9	L1
6	5,3	13,7	L2
7	13,5	13,7	L3
8	21,7	13,7	IsC
9	27,8	8,6	Is+
10	20,4	3	G1
11	20,4	0	Is-
12	11,8	0	DC-
13	0	0	DC+
14	0	7,9	L1
15	5,3	13,7	L2
16	13,5	13,7	L3
17	21,7	13,7	IsC
18	27,8	8,6	Is+



Tolerance of pinpositions: ±0,5mm at the end of pins
Dimension of coordinate axis is only offset without tolerance
PCB cutouts and holes see in handling instruction document

Pinout



Identification

ID	Component	Voltage	Current	Function	Comment
T1	IGBT	1200 V	35 A	Brake Switch	
D7	FWD	1200 V	15 A	Brake Diode	
D8	FWD	1200 V	3 A	Brake Sw. Protection Diode	
D2, D1, D4, D3, D6, D5	Rectifier	1600 V	28 A	Rectifier Diode	

Packaging instruction				
Standard packaging quantity (SPQ) 160	>SPQ	Standard	<SPQ	Sample

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

Package data
Package data for *flow* 0B 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
10-0B166BA028SC-M989G09-D2-14	25 Jun. 2020	Adjust rated current of the module to the nominal current of the Rectifer	1

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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.