Vincotech

20-1B12IPA008SC-L239C09
20-FB12IPA008SC-L239C08Y
datasheet

flow IPM 1B-CI — **1200 V / 8 A**

Features

Power
- 3 Phase Inverter
- 3 Phase Input Rectifier
- Open emitter or Emitter Shunt

Gate Driver
- Booststrap circuit
- Overcurrent protection
- Undervoltage lockout

NTC
- Temperature sensor

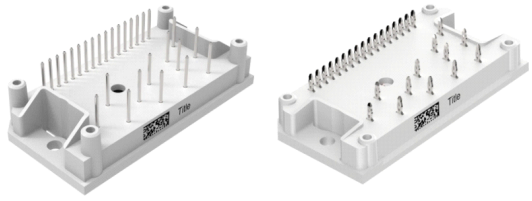
Target applications

- Embedded Drives
- Industrial Drives

Types

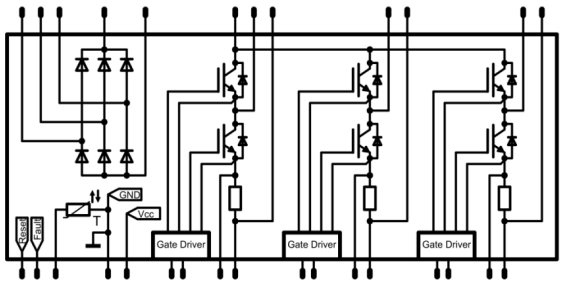
- 20-1B12IPA008SC-L239C09
- 20-FB12IPA008SC-L239C08Y

flow 1B 17 mm and 12 mm housing



with solder pins 17 mm with Press-fit pins 12mm

Schematic



Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
Rectifier Diode				
Peak Repetitive Reverse Voltage	V_{RRM}		1600	V
Continuous (direct) forward current	I_F	$T_j = T_{jmax}$ T_s = 80 °C	13	A
Surge (non-repetitive) forward current	I_{FSM}	50 Hz Single Half Sine Wave T_j = 45 °C, t_p = 10 ms	150	A
Surge current capability	I^2t		110	A^2s
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ T_s = 80 °C	15	W
Maximum Junction Temperature	T_{jmax}		150	°C

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	9	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}	24	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ T_s = 80 °C	23	W
Gate-emitter voltage	V_{GES}		±20	V
Short circuit ratings	t_{SC} V_{CC}	$T_j \leq$ 150 °C V_{GE} = 15 V	10 800	µs V
Maximum Junction Temperature	T_{jmax}		175	°C
Inverter Diode				
Peak Repetitive Reverse Voltage	V_{RRM}		1200	V
Continuous (direct) forward current	I_F	$T_j = T_{jmax}$ T_s = 80 °C	8	A
Repetitive peak forward current	I_{FRM}		15	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ T_s = 80 °C	12	W
Maximum Junction Temperature	T_{jmax}		150	°C
Gate Driver				
Supply voltage	V_{CC}		24	V
Logic input voltage	V_{in}	U-Hin, U-Lin, V-Hin, V-Lin, W-Hin, W-Lin FAULT, RESET	-0,5...V_{cc}+0,5	V
Internal current limit	I_{MAX}		5	A
Junction Temperature	T_{jmax}		125	°C

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
Inverter Shunt				
DC forward current	I_F		9	A
Power dissipation	P_{tot}		2,43	W
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	4000	V
Creepage distance			min. 12,7	mm
Clearance		Press-fit pins / solder pins	min. 12,7 / 12,69	mm
Comparative Tracking Index	CTI		> 200	

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	
Rectifier Diode										
Static										
Forward voltage	V_F				7	25 125		1,04 0,97	1,11	V
Reverse leakage current	I_r			1600		25			10	µA
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	phase-change material λ = 3,4 W/mK						4,56		K/W
Inverter Switch										
Static										
Gate-emitter threshold voltage	$V_{GE(th)}$	V_{GE} = V_{CE}			0,00015	25	5,3	5,8	6,3	V
Collector-emitter saturation voltage	V_{CEsat}		15		8	25 150	1,58	1,85 2,25	2,07	V
Collector-emitter cut-off current	I_{CES}		0	1200		25			1	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		490		pF
Reverse transfer capacitance	C_{res}							30		
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	phase-change material λ = 3,4 W/mK						4,22		K/W
Dynamic										
Turn-on delay time*	$t_{d(on)}$	V_{cc} = 15 V		600	8	25 125		1484 1909		ns
Rise time	t_r					25 125		12 16		
Turn-off delay time*	$t_{d(off)}$					25 125		1436 1916		
Fall time	t_f					25 125		77 136		
Turn-on energy (per pulse)	E_{on}	Q_{rFWD} = 1 µC Q_{rFWD} = 1,7 µC				25 125		0,399 0,630		mWs
Turn-off energy (per pulse)	E_{off}					25 125		0,520 0,844		

* times include gate driver deadtime

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				7,5	25 125		1,65 1,61		V
Reverse leakage current	I_r			1200		25			250	µA
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	phase-change material λ = 3,4 W/mK						5,69		K/W
Dynamic										
Peak recovery current	I_{RRM}	di/dt = 336 A/µs di/dt = 481 A/µs	15	600	8	25 125		8 8		A
Reverse recovery time	t_{rr}					25 125		320 514		ns
Recovered charge	Q_r					25 125		0,975 1,748		µC
Reverse recovered energy	E_{rec}					25 125		0,433 0,785		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125		56 37		A/µs
Inverter Shunt										
Resistance	R							30		mΩ

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	
Gate Driver*										
Static										
Recommended supply voltage	Vcc						13,5	15	20	V
Power on reset trip voltage	V_{POR}						4,0	5,5	7,5	V
Internal current limit	I_{MAX}						13,3	16,7	20	A
Quiescent supply current	I_q							3	4,5	mA
Logic "1" input voltage	V_{IH}	UH, UL, VH, VL, WH, WL, RST					2,2	3	4	V
Logic "0" input voltage	V_{IL}						0,6	1,5	2,1	V
Logic "1" input current	I_{inH}	V_{in} = 5 V					0,6	1	1,4	mA
Logic "0" input current	I_{inL}	V_{in} = 0 V					0	0	0,01	mA
Input signal filter time	t_{Filt}	UH, UL, VH, VL, WH, WL, FO (in), RST (pulse)					80	200	500	ns
Logic "1" FAULT output**	$V_{outFAULTH}$								0,95	V
Logic "1" FAULT input treshold voltage**	$V_{inFAULTH}$						0,6	1,5	2,1	V
Logic "0" FAULT input treshold voltage**	$V_{inFAULTL}$						2,2	3	4	V
Under voltage reset voltage	$V_{UVreset}$						10	10,8	11,6	V
Under voltage trip voltage	V_{UVtrip}						10,5	11,3	12,1	V
Under voltage hysteresis voltage	$V_{UVhysteresis}$						0,2	0,5	0,8	V
Under voltage filter time	t_{UVfilt}						4	8	16	µs
Internal dead time	t_{UVfilt}	Delay matching, high side turn-on and low side turn off					-100	80	300	ns
Internal dead time	t_{UVfilt}	Delay matching, low side turn-on and high side turn off					-20	180	400	ns

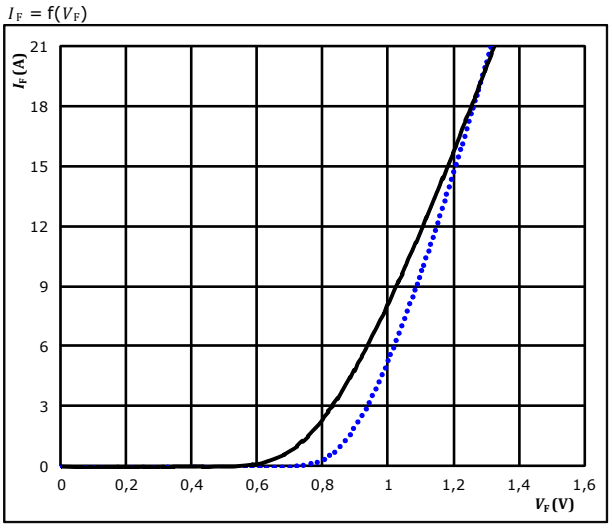
* For more information see Mitshubishi's M81738FP datasheet. The recommended minimum input pulse width is 2 µs.
** FAULT active low with pull up resistor to Vcc.

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	
Thermistor										
Rated resistance	R					25		22		kΩ
Deviation of R_{100}	$\Delta_{R/R}$	R_{100} = 1486 Ω				100	-12		+14	%
Power dissipation	P					25		200		mW
Power dissipation constant						25		2		mW/K
B-value	$B_{(25/50)}$	Tol. ±3%				25		3950		K
B-value	$B_{(25/100)}$	Tol. ±3%				25		3998		K
Vincotech NTC Reference									B	

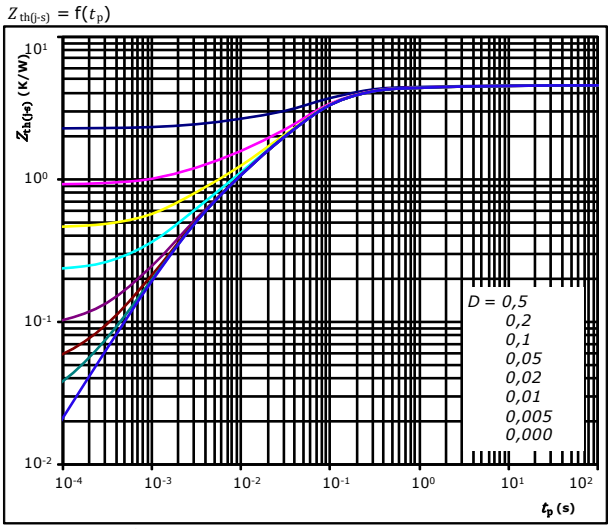
Rectifier Diode Characteristics

figure 1. **Rectifier Diode**
Typical forward characteristics



t_p = 250 µs 25 °C
T_j: 125 °C

figure 2. **Rectifier Diode**
Transient thermal impedance as a function of pulse width



D = t_p / T
$R_{th(j-s)}$ = 4,56 K/W

Diode thermal model values

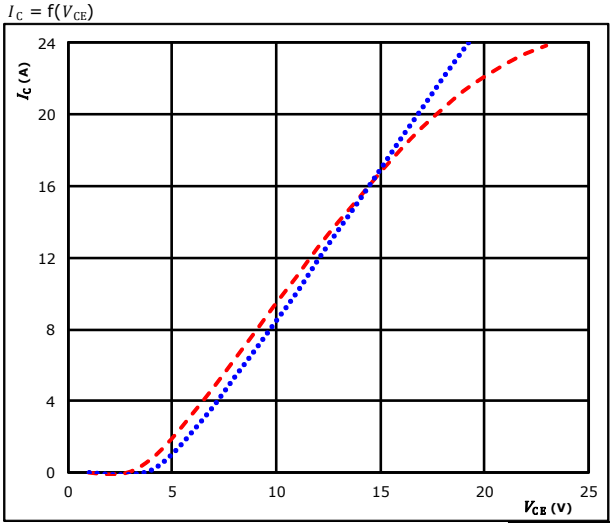
R (K/W)	τ (s)
1,1300E-01	8,9590E+00
2,5930E-01	8,4330E-01
1,9540E+00	1,0960E-01
1,7280E+00	3,6370E-02
5,0510E-01	3,4450E-03

Inverter Switch Characteristics

figure 1. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$

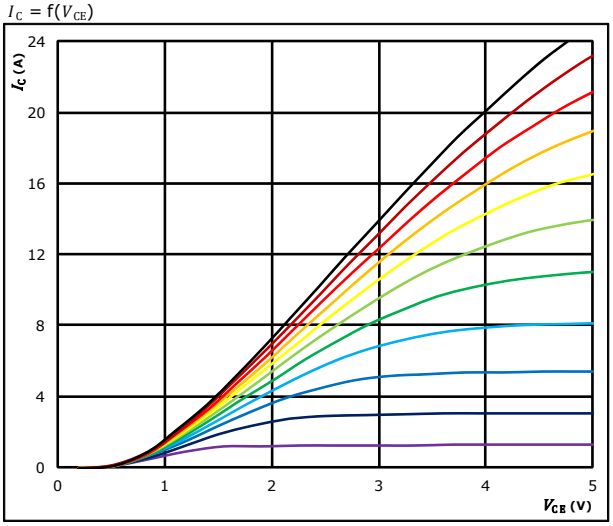


t_p =	250	µs		25 °C	
V_{GE} =	15	V	T_j:	150 °C	

figure 2. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$

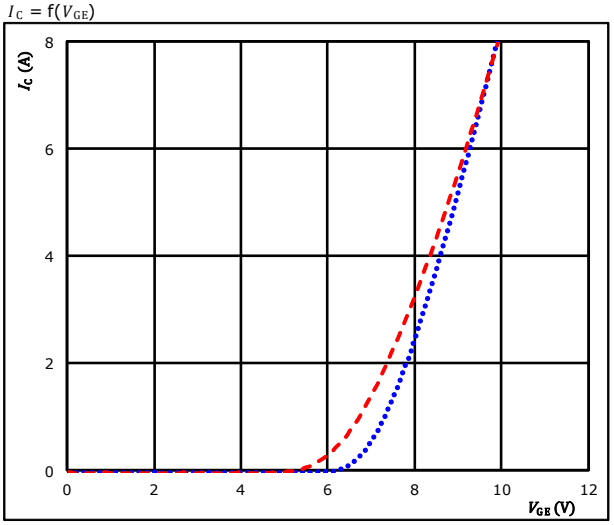


t_p =	250	µs
T_j =	150	°C
V_{GE} from	7 V to 17 V in steps of 1 V	

figure 3. **IGBT**

Typical transfer characteristics

$I_C = f(V_{GE})$

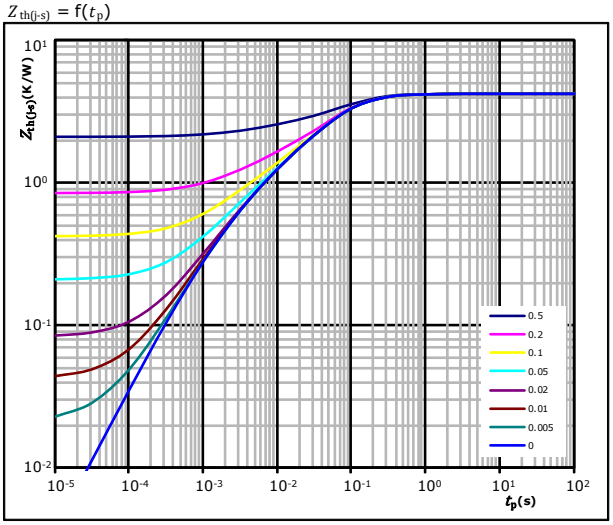


t_p =	100	µs		25 °C	
V_{CE} =	10	V	T_j:	150 °C	

figure 4. **IGBT**

Transient Thermal Impedance as function of Pulse duration

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



D =	t_p / T	
$R_{th(j-s)}$ =	4,22	K/W

IGBT thermal model values

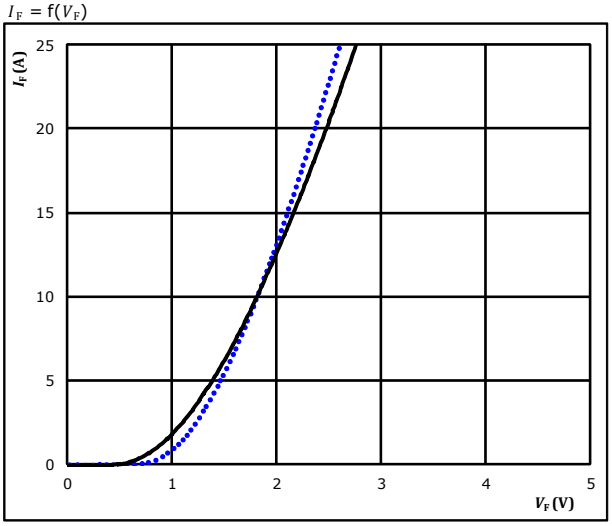
R (K/W)	τ (s)
2,57E+00	6,96E-02
7,15E-01	1,68E-02
5,14E-01	3,47E-03
9,91E-02	7,30E-04

Inverter Diode Characteristics

figure 1. **FWD**

Typical forward characteristics

$I_F = f(V_F)$



t_p = 250 µs

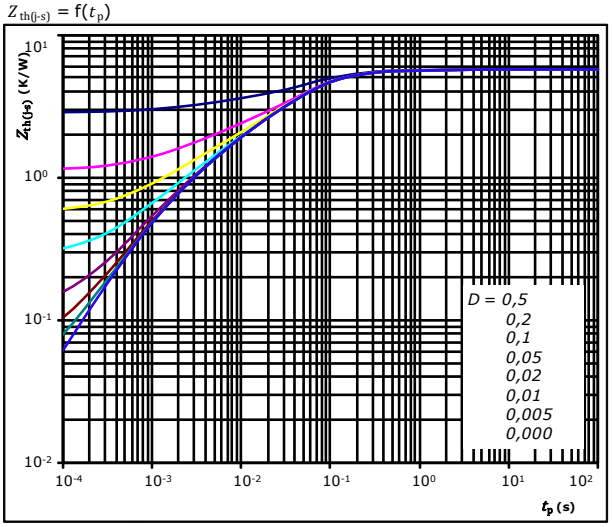
T_j: 25 °C

T_j: 125 °C

figure 2. **FWD**

Transient thermal impedance as a function of pulse width

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



D = t_p / T

$R_{th(j-s)}$ = 5,69 K/W

FWD thermal model values

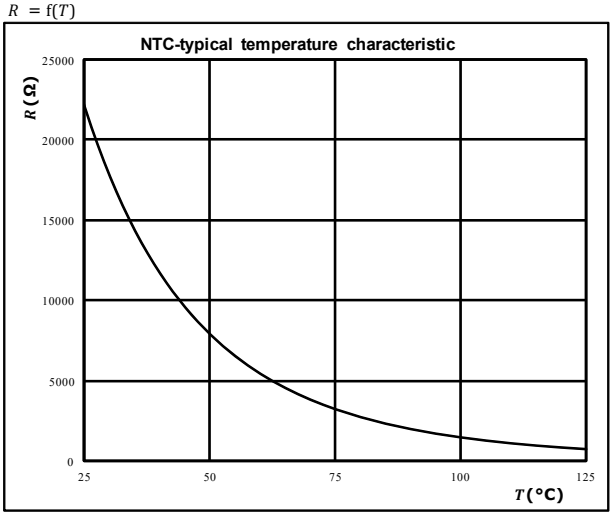
R (K/W)	τ (s)
1,733E-01	2,116E+00
1,301E+00	1,400E-01
2,883E+00	4,111E-02
9,535E-01	5,372E-03
3,778E-01	1,029E-03

Thermistor Characteristics

figure 1. **Thermistor**

Typical NTC characteristic
as a function of temperature

$R = f(T)$

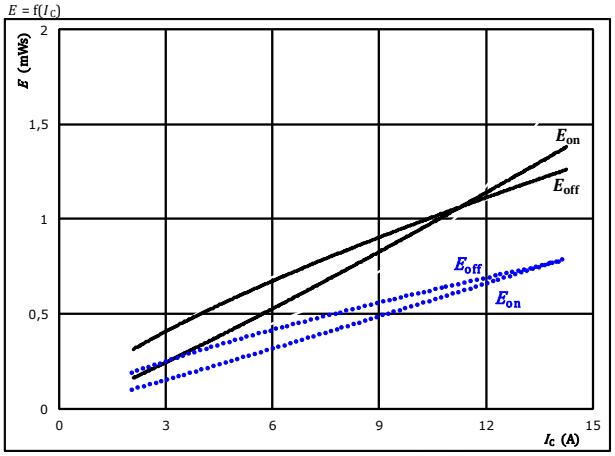


Inverter Switching Characteristics

figure 1. **IGBT**

Typical switching energy losses as a function of collector current

$E = f(I_C)$



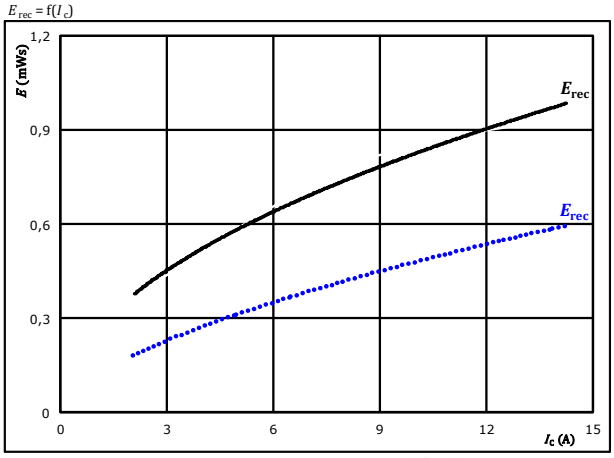
With an inductive load at

V_{CE} =	600	V	T_j:	**25 °C**
V_{CC} =	15	V		**125 °C**
V_{IN} =	5	V		

figure 2. **FWD**

Typical reverse recovered energy loss as a function of collector current

$E_{rec} = f(I_C)$



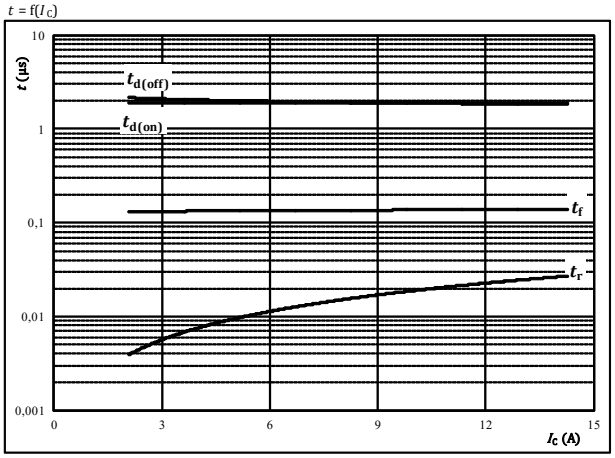
With an inductive load at

V_{CE} =	600	V	T_j:	25 °C
V_{CC} =	15	V		125 °C
V_{IN} =	5	V		

figure 3. **IGBT**

Typical switching times as a function of collector current

$t = f(I_C)$



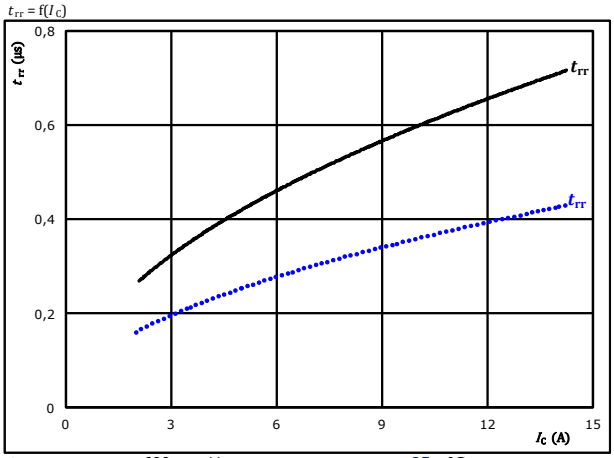
With an inductive load at

T_j =	125	°C
V_{CE} =	600	V
V_{CC} =	15	V
V_{IN} =	5	V

figure 4. **FWD**

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$



At

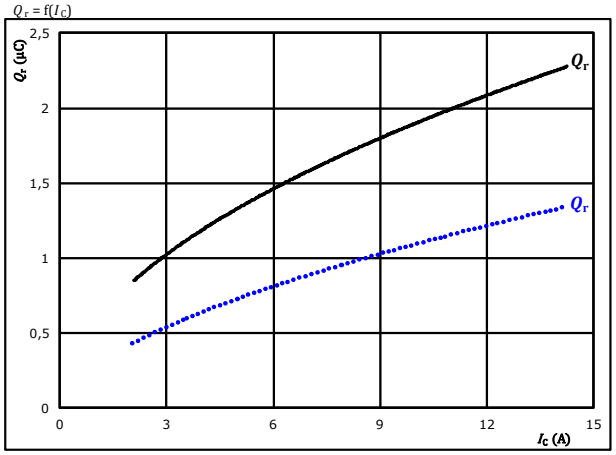
V_{CE} =	600	V		25 °C
V_{CC} =	15	V	T_j:	125 °C
V_{IN} =	5	V		
I_C =	8	A		

Inverter Switching Characteristics

figure 5. FWD

Typical recovered charge as a function of collector current

$Q_r = f(I_C)$

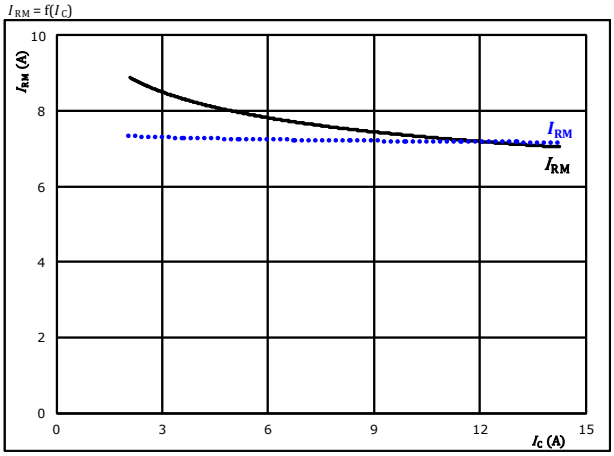


At						
	V_{CE} =	600	V		25 °C	
	V_{CC} =	15	V	T_j:	125 °C	
	V_{IN} =	5	V			

figure 6. FWD

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

$I_{RM} = f(I_C)$

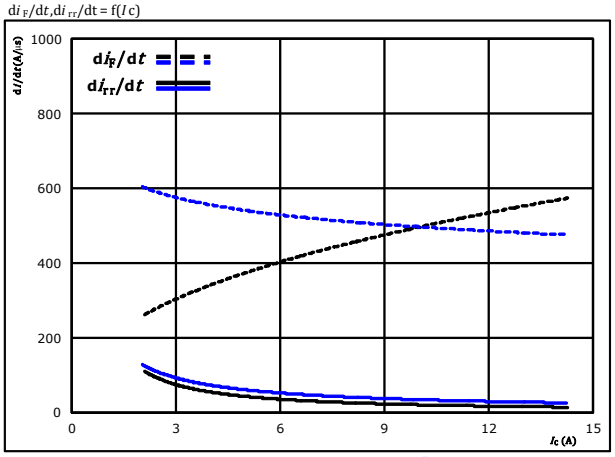


At						
	V_{CE} =	600	V		25 °C	
	V_{CC} =	15	V	T_j:	125 °C	
	V_{IN} =	5	V			
	V_{GE} =	15	V			
	I_C =	8	A			

figure 7. FWD

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

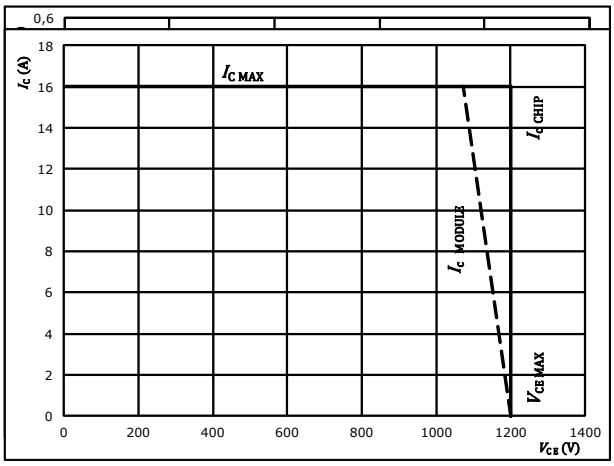
$di_F/dt, di_{rr}/dt = f(I_C)$



At						
	V_{CE} =	600	V		25 °C	
	V_{CC} =	15	V	T_j:	125 °C	
	V_{IN} =	5	V			

figure 8. IGBT

Reverse bias safe operating area



At			
	T_j =	175	°C

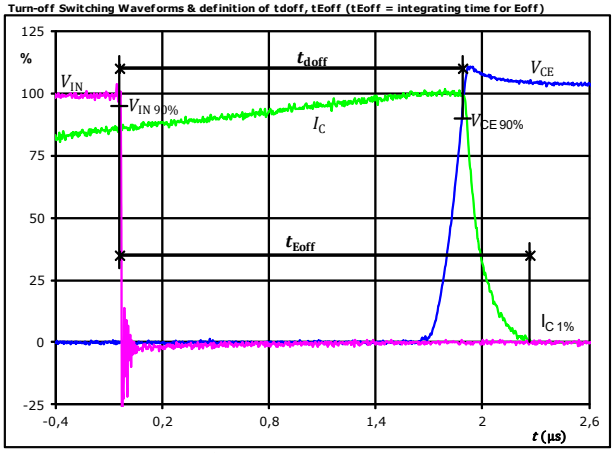
Inverter Switching Characteristics

General conditions

T_j	=	125 °C
V_{CC}	=	15 V

Figure 1. IGBT

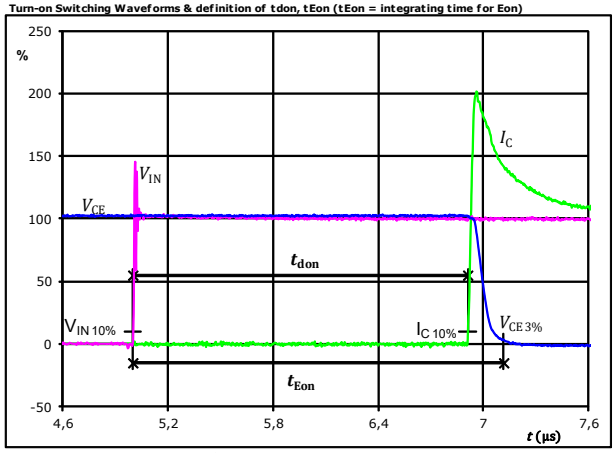
Turn-off Switching Waveforms & definition of tdoff, tEoff (tEoff = integrating time for Eoff)



V_{IN} (0%) =	0	V
V_{IN} (100%) =	15	V
V_C(100%) =	600	V
I_C(100%) =	8	A
t_{doff} =	1,916	µs
t_{Eoff} =	2,308	µs

Figure 2. IGBT

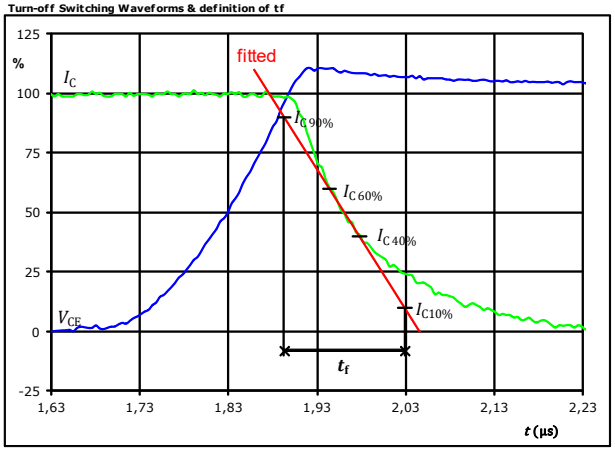
Turn-on Switching Waveforms & definition of tdon, tEon (tEon = integrating time for Eon)



V_{IN} (0%) =	0	V
V_{IN} (100%) =	15	V
V_C(100%) =	600	V
I_C(100%) =	8	A
t_{don} =	1,909	µs
t_{Eon} =	2,116	µs

Figure 3. IGBT

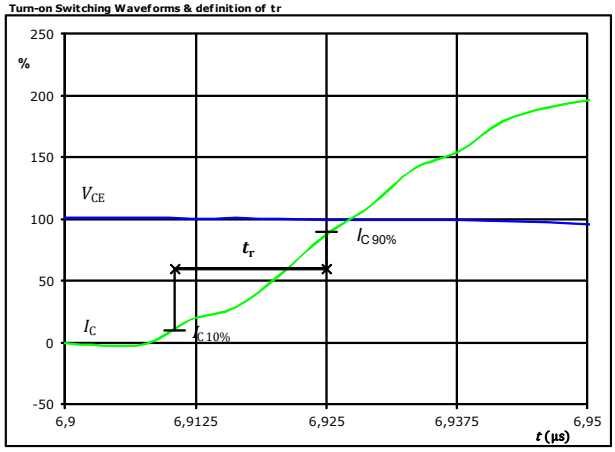
Turn-off Switching Waveforms & definition of tf



V_C(100%) =	600	V
I_C(100%) =	8	A
t_f =	0,136	µs

Figure 4. IGBT

Turn-on Switching Waveforms & definition of tr

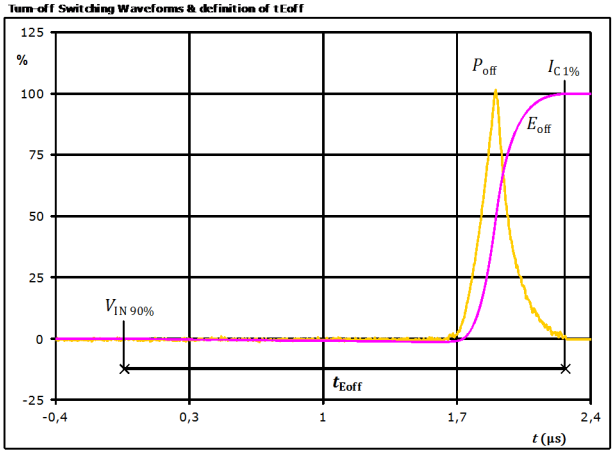


V_C(100%) =	600	V
I_C(100%) =	8	A
t_r =	0,016	µs

Inverter Switching Characteristics

Figure 5. **IGBT**

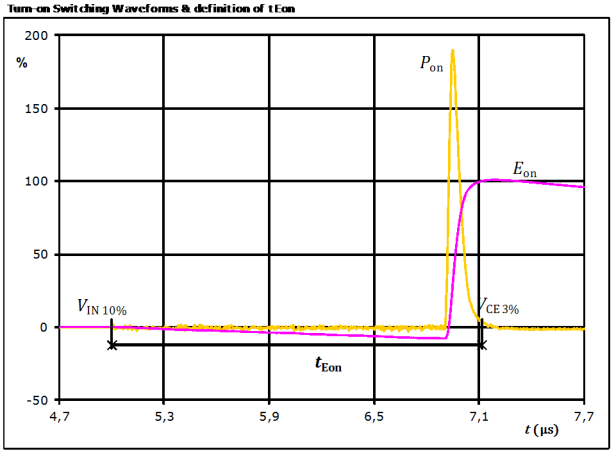
Turn-off Switching Waveforms & definition of tEoff



P_{off} (100%) =	4,85	kW
E_{off} (100%) =	0,84	mJ
t_{Eoff} =	2,31	µs

Figure 6. **IGBT**

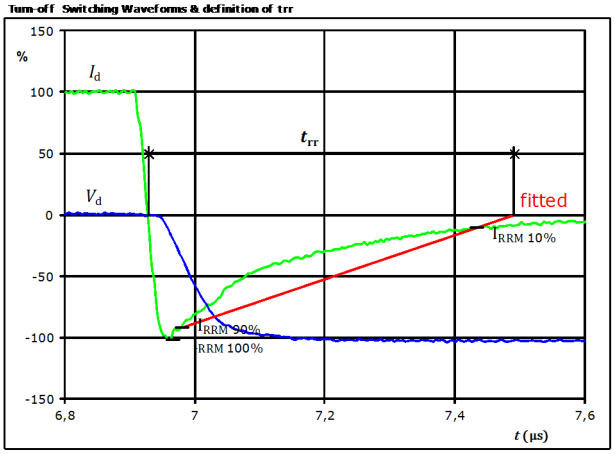
Turn-on Switching Waveforms & definition of tEon



P_{on} (100%) =	4,85	kW
E_{on} (100%) =	0,63	mJ
t_{Eon} =	2,12	µs

Figure 7. **FWD**

Turn-off Switching Waveforms & definition of trr

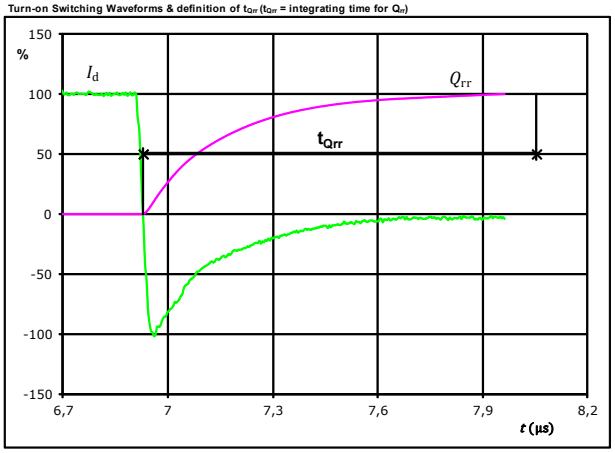


V_d (100%) =	600	V
I_d (100%) =	8	A
I_{RRM} (100%) =	-8	A
t_{rr} =	0,514	µs

Inverter Switching Characteristics

Figure 8. **FWD**

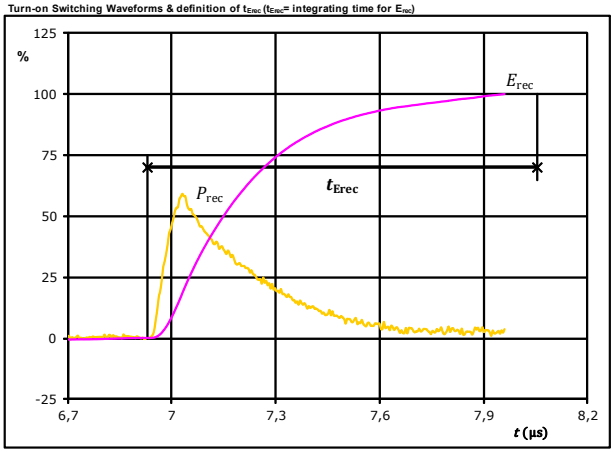
Turn-on Switching Waveforms & definition of t_{Qrr} (t_{Qrr} = integrating time for Q_{rr})



I_d (100%) =	8	A
Q_{rr} (100%) =	1,75	µC
t_{Qrr} =	1,13	µs

Figure 9. **FWD**

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



P_{rec} (100%) =	4,85	kW
E_{rec} (100%) =	0,79	mJ
t_{Erec} =	1,13	µs

Vincotech

20-1B12IPA008SC-L239C09
20-FB12IPA008SC-L239C08Y
datasheet

Ordering Code & Marking

Version	Ordering Code
without thermal paste 17 mm housing with solder pins	20-1B12IPA008SC-L239C09
without thermal paste 12 mm housing with press-fit pins	20-FB12IPA008SC-L239C08Y
with thermal paste 17 mm housing with solder pins	20-1B12IPA008SC-L239C09-/3/
with thermal paste 12 mm housing with press-fit pins	20-FB12IPA008SC-L239C08Y-/3/

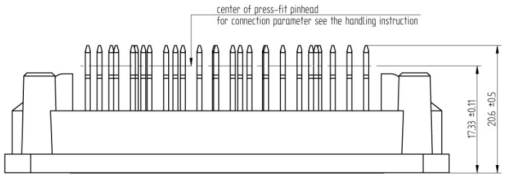
Text	Name	Date code	UL & VIN	Lot	Serial
	NN-NNNNNNNNNNNNNN-TTTTTTVV	WWYY	UL VIN	LLLLL	SSSS

Datamatrix	Type&Ver	Lot number	Serial	Date code		
	TTTTTTVV	LLLLL	SSSS	WWYY		

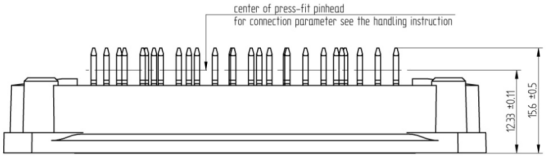
Outline

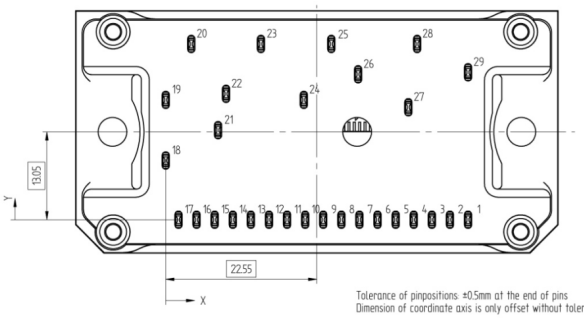
Pin table [mm]			
Pin	X	Y	Function
1	45,1	0	WH
2	42,4	0	WL
3	39,7	0	RW+
4	37	0	RW-
5	34,3	0	GND
6	31,6	0	VCC
7	28,9	0	VH
8	26,2	0	VL
9	23,5	0	RV+
10	20,8	0	RV-
11	18,1	0	UH
12	15,4	0	UL
13	12,7	0	RU+
14	10	0	RU-
15	7,3	0	RST
16	4,6	0	FO
17	1,9	0	NTC
18	0	8,8	L3
19	0	17,8	L2
20	3,8	26,1	L1
21	7,8	13,3	EU
22	9	18,7	DC1-
23	14,2	26,1	DC1+
24	20,6	17,8	EV
25	24,7	26,1	U
26	28,7	21,6	DC2+
27	36,2	16,7	EW
28	37,5	26,1	V
29	45,1	21,9	W

17 mm Solder pin



12 mm Press-fit



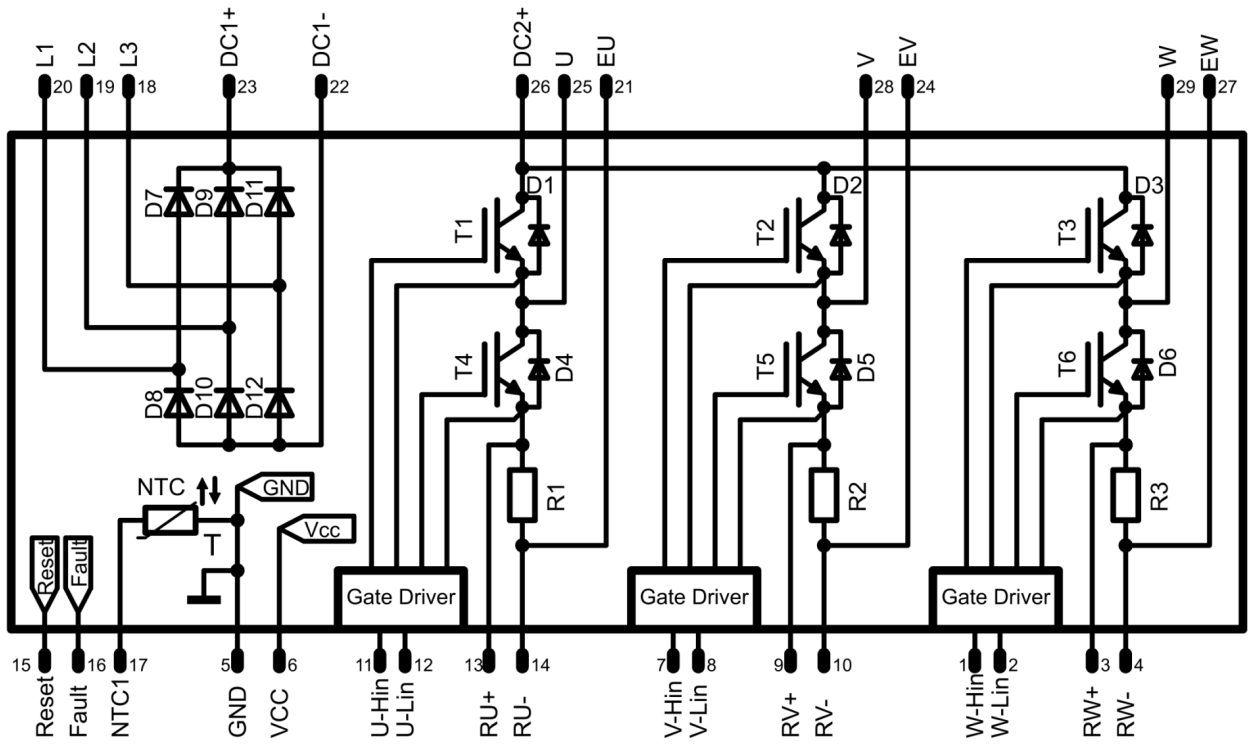


Pin Descriptions

Pin	Function	Description
1	W-HIN	Signal input for high-side W phase
2	W-LIN	Signal input for low-side W phase
3	RW+	W phase shunt +
4	RW-	W phase shunt -
5	GND	Signal ground
6	VCC	Driver circuit supply voltage
7	V-HIN	Signal input for high-side V phase
8	V-LIN	Signal input for low-side V phase
9	RV+	V phase shunt +
10	RV-	V phase shunt -
11	U-HIN	Signal input for high-side U phase
12	U-LIN	Signal input for low-side U phase
13	RU+	U phase shunt +
14	RU-	U phase shunt -
15	RESET	Fault latch reset (min. 500ns pulse)
16	¬FAULT	Fault latch input/output (negative logic, open drain)
17	NTC	Temperature sensor connector

Power pin descriptions		
Pin	Function	Description
18	L3	Rectifier input L3
19	L2	Rectifier input L2
20	L1	Rectifier input L1
21	EU	Open emitter U phase
22	DC1-	Rectifier output DC-
23	DC1+	Rectifier output DC+
24	EV	Open emitter V phase
25	U	Output U phase
26	DC2+	Inverter input DC+
27	EW	Open emitter W phase
28	V	Output V phase
29	W	Output W phase

Pinout



Identification

ID	Component	Voltage	Current	Function	Comment
D7-D12	FWD	1600 V	12 A	Rectifier Diode	
T1-T6	IGBT	1200 V	8 A	Inverter Switch	
D1-D6	FWD	1200 V	7,5 A	Inverter Diode	
R1-R3	Resistor			Inverter Shunt	
NTC	Thermistor			Thermistor	

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

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

Package data
Package data for *flow* 1B 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
20-xB12IPA008SC-L239C0xx-D2-14	26 July. 2019	Modified remark on Gate Driver, $V_{outFAULTH}$ condition	6