20-1B12IPA015SC-L579F09
datasheet

***flow*IPM 1B** — **1200 V / 15 A**

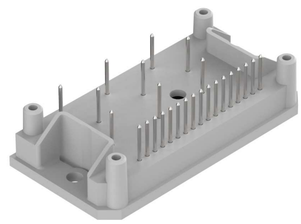
Features

Power
- Three Phase Inverter
- Emitter Shunts

Gate Driver
- Booststrap circuit
- Overcurrent protection
- Undervoltage lockout

NTC
- Temperature sensor

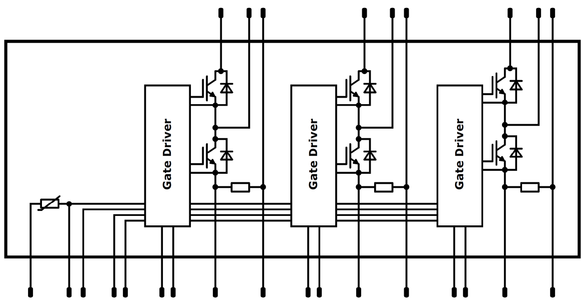
*flow*IPM 1B 17 mm housing



Target applications

- Embedded Drives
- Industrial Drives

Schematic



Types

- 20-1B12IPA015SC-L579F09

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	12	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}	45	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ T_s = 80 °C	31	W
Gate-emitter voltage	V_{GES}		±20	V
Short circuit ratings	t_{SC}	V_{GE} = 15 V Vcc = 800 V $T_j \leq$ 150 °C	10	μs
Maximum junction temperature	T_{jmax}		175	°C

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Inverter Diode					
Peak repetitive reverse voltage	V_{RRM}			1200	V
Continuous (direct) forward current	I_F	$T_j = T_{jmax}$	T_s = 80 °C	11	A
Repetitive peak forward current	I_{FRM}			30	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	19	W
Maximum junction temperature	T_{jmax}			175	°C
Gate Driver					
Supply voltage	V_{CC}			-0,5…+24	V
Logic input voltage	V_{in}	UH, UL, VH, VL, WH, WL, FO, RST		-0,5…V_{cc}+0,5	V
Internal current limit	I_{MAX}			16,7	A
Junction Temperature	T_{jmax}			125	°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
		AC Voltage	t_p = 1 min	2500	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					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 Switch										
Static										
Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{GE} = V_{CE}$			0,0005	25	5,3	5,8	6,3	V
Collector-emitter saturation voltage	V_{CEsat}		15		12	25 125 150		2,10 2,28 2,46	2,3	V
Collector-emitter cut-off current	I_{CES}		0	1200		25			10	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		890		pF
Reverse transfer capacitance	C_{res}	f = 1 Mhz	0	25		25		30		pF
Gate charge	Q_g		20			25		0,12		nC
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						3,07		K/W
Dynamic										
Turn-on delay time	$t_{d(on)}$	R_{gon} = 16 Ω R_{goff} = 32 Ω	0 / 15	600	11	25 125 150		1480 1912 2007		ns
Rise time	t_r	R_{gon} = 16 Ω R_{goff} = 32 Ω	0 / 15	600	11	25 125 150		19 23 24		ns
Turn-off delay time	$t_{d(off)}$	R_{gon} = 16 Ω R_{goff} = 32 Ω	0 / 15	600	11	25 125 150		1508 2011 2119		ns
Fall time	t_f	R_{gon} = 16 Ω R_{goff} = 32 Ω	0 / 15	600	11	25 125 150		79 133 159		ns
Turn-on energy (per pulse)	E_{on}	Q_{rFWD} = 1,2 µC Q_{rFWD} = 2,2 µC Q_{rFWD} = 2,6 µC	0 / 15	600	11	25 125 150		0,676 1,107 1,240		mWs
Turn-off energy (per pulse)	E_{off}		0 / 15	600	11	25 125 150		0,879 1,440 1,600		mWs

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				12	25 125 150		1,93 1,91 1,90	2,3	V
Reverse leakage current	I_R			1200		25			3,5	µA
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						4,92		K/W
Dynamic										
Peak recovery current	I_{RRM}	di/dt = 730 A/µs di/dt = 539 A/µs di/dt = 478 A/µs	0 / 15	600	11	25 125 150		12 13 14		A
Reverse recovery time	t_{rr}					25 125 150		245 394 437		ns
Recovered charge	Q_r					25 125 150		1,226 2,228 2,557		µC
Reverse recovered energy	E_{rec}					25 125 150		0,453 0,829 0,965		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125 150		80 42 39		A/µs

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]	Min	Typ	Max	Unit
Gate Driver										
Static										
Recommended supply voltage	V_{cc}						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}	UH, UL, VH, VL, WH, WL, RST					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*	$V_{outFAULTH}$	I_{FAULT} = 1 mA							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

* FAULT pin is inverse logic with open drain output for more information see Mitshubishi's M81738FP datasheet

Characteristic Values

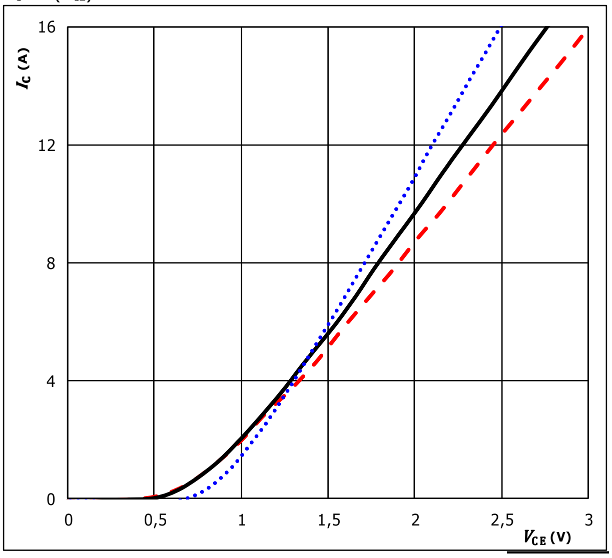
Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V] V_{GS} [V]	V_{CE} [V] V_{DS} [V] V_F [V]	I_C [A] I_D [A] I_F [A]	T_j [°C]	Min	Typ	Max	
Thermistor										
Rated resistance	R					25		22		kΩ
Deviation of R_{100}	$\Delta_{R/R}$	R_{100} = 1486 Ω				100	-12		+14	%
Power dissipation	P					25		200		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	

Inverter Switch Characteristics

figure 1. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$

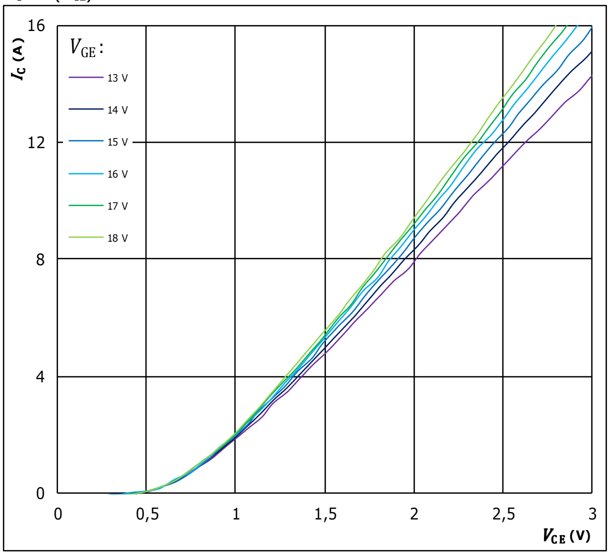


t_p =	250	µs		25 °C	············
V_{GE} =	15	V	T_j:	125 °C	———
				150 °C	– – – –

figure 2. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$

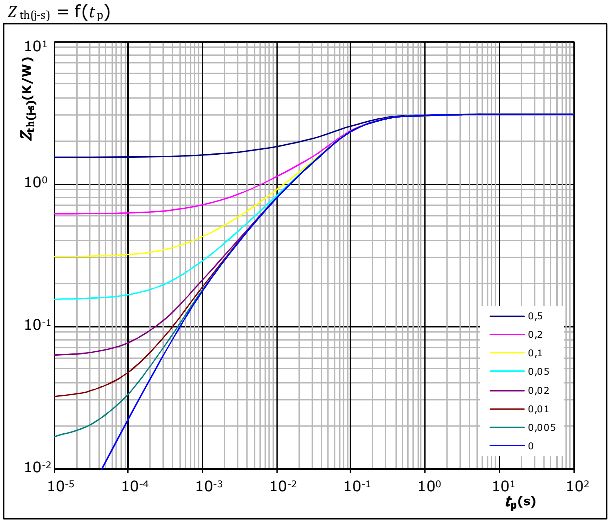


t_p =	250	µs
T_j =	150	°C
V_{GE} from	13 V to 18 V in steps of 1 V	

figure 3. **IGBT**

Transient thermal impedance as function of pulse duration

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



D =	t_p / T	
$R_{th(j\text{-}s)}$ =	3,07	K/W

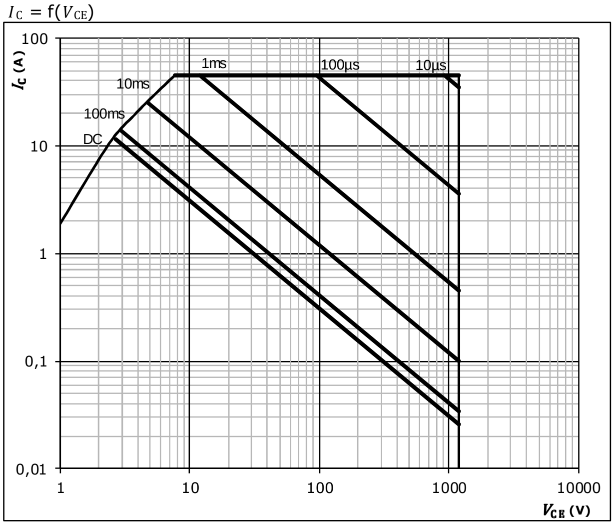
IGBT thermal model values

R (K/W)	τ (s)
1,26E-01	1,14E+00
4,34E-01	2,04E-01
1,94E+00	6,00E-02
4,50E-01	6,48E-03
1,19E-01	9,59E-04

figure 4. **IGBT**

Safe operating area

$I_C = f(V_{CE})$



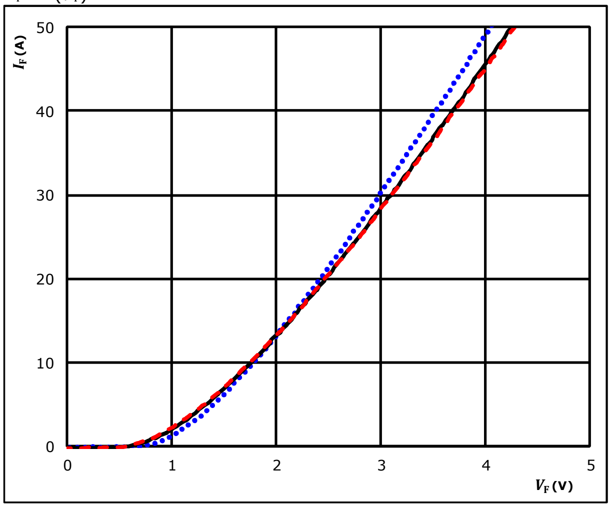
D =	single pulse	
T_s =	80	ºC
V_{GE} =	±15	V
T_j =	T_{jmax}	

Inverter Diode Characteristics

figure 1. **FWD**

Typical forward characteristics

$I_F = f(V_F)$

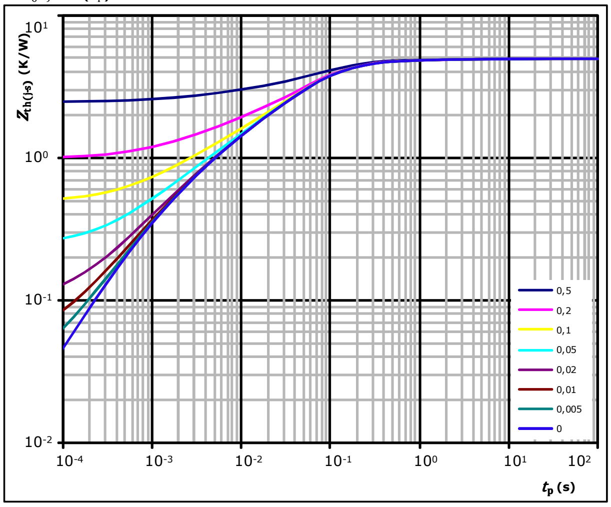


t_p =	250	μs	T_j:	25 °C
				125 °C
				150 °C

figure 2. **FWD**

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$

$R_{th(j-s)}$ = 4,92 K/W

FWD thermal model values

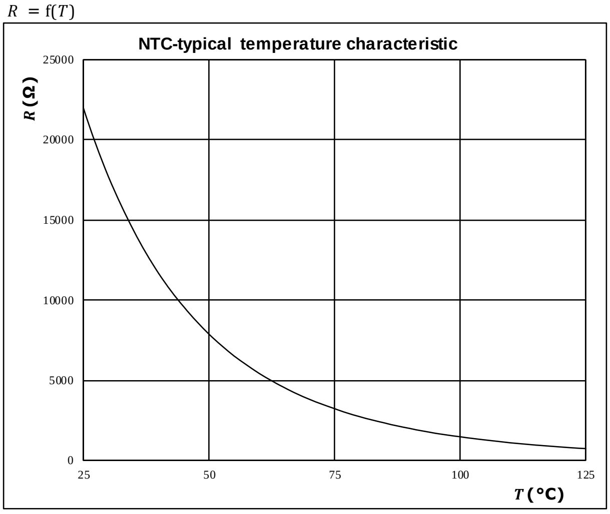
R (K/W)	τ (s)
1,83E-01	2,10E+00
4,86E-01	2,84E-01
2,86E+00	6,82E-02
7,18E-01	1,40E-02
5,14E-01	3,30E-03
1,52E-01	6,79E-04

Thermistor Characteristics

figure 1. **Thermistor**

Typical NTC characteristic as a function of temperature

$R = f(T)$

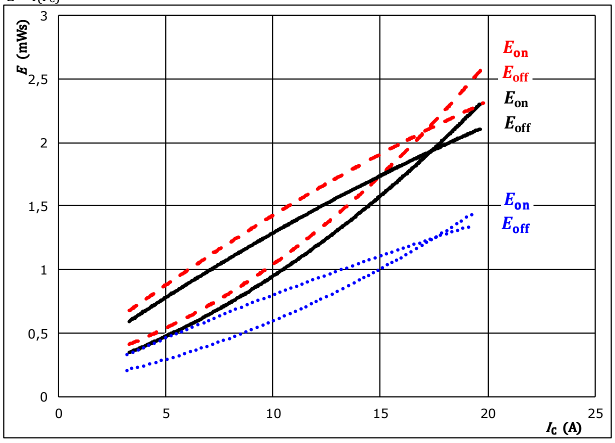


Inverter Switching Characteristics

figure 1. IGBT

Typical switching energy losses as a function of collector current

$E = f(I_C)$



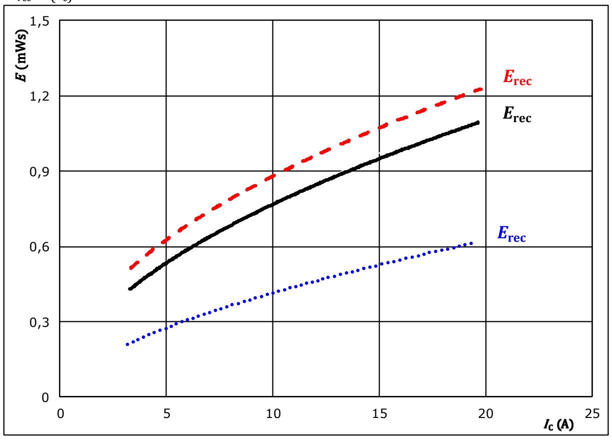
With an inductive load at

V_{CE} =	600	V	T_j:	25 °C
V_{GE} =	0 / 15	V		125 °C
R_{gon} =	16,0	Ω		150 °C
R_{goff} =	32,0	Ω		

figure 2. FWD

Typical reverse recovered energy loss as a function of collector current

$E_{rec} = f(I_C)$



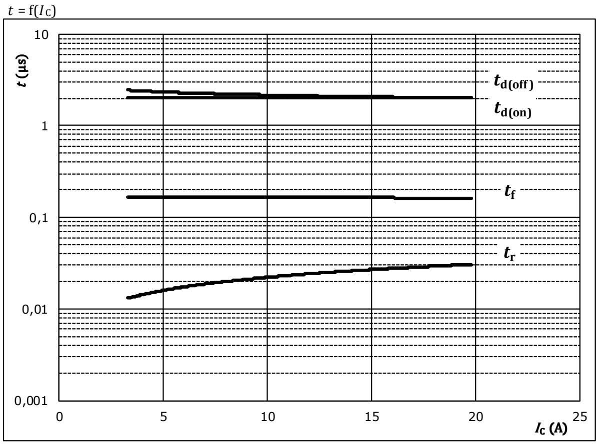
With an inductive load at

V_{CE} =	600	V	T_j:	25 °C
V_{GE} =	0 / 15	V		125 °C
R_{gon} =	16,0	Ω		150 °C

figure 3. IGBT

Typical switching times as a function of collector current

$t = f(I_C)$



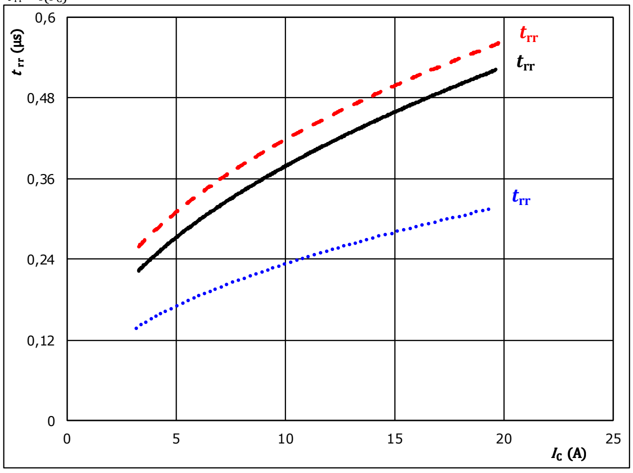
With an inductive load at

T_j =	150	°C
V_{CE} =	600	V
V_{GE} =	0 / 15	V
R_{gon} =	16,0	Ω
R_{goff} =	32,0	Ω

figure 4. FWD

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$



At	V_{CE}=	600	V	T_j:	25 °C
	V_{GE} =	0 / 15	V		125 °C
	R_{gon} =	16,0	Ω		150 °C

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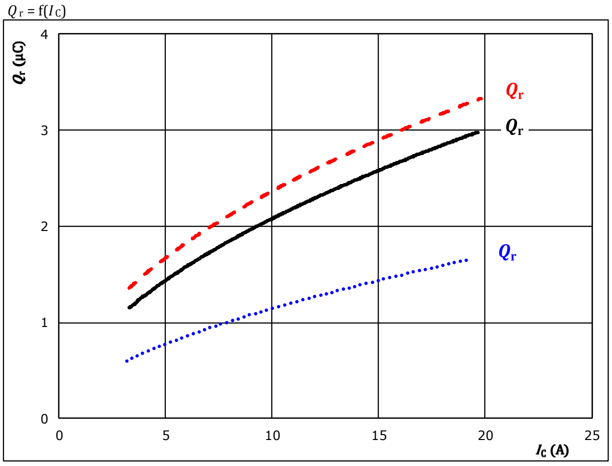
Inverter Switching Characteristics

figure 5. **FWD**

Typical recovered charge as a function of collector current

$Q_r = f(I_C)$

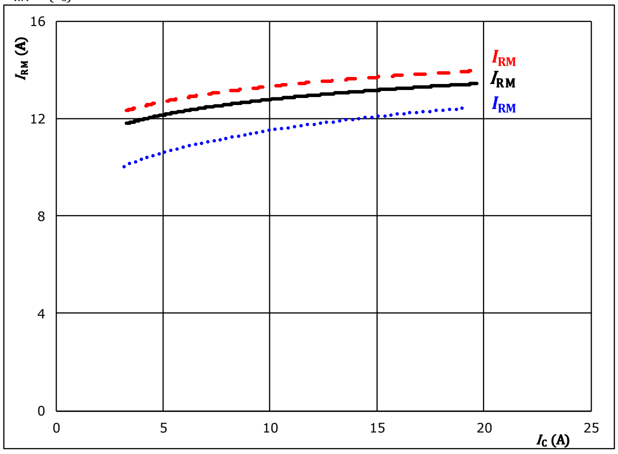


At					
V_{CE} =	600	V	T_j:	25 °C	dotted
V_{GE} =	0 / 15	V		125 °C	solid
R_{gon} =	16,0	Ω		150 °C	dashed

figure 6. **FWD**

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

$I_{RM} = f(I_C)$

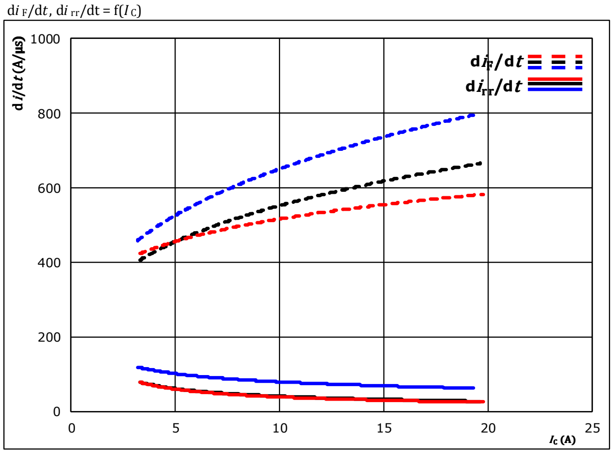


At					
V_{CE} =	600	V	T_j:	25 °C	dotted
V_{GE} =	0 / 15	V		125 °C	solid
R_{gon} =	16,0	Ω		150 °C	dashed

figure 7. **FWD**

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

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

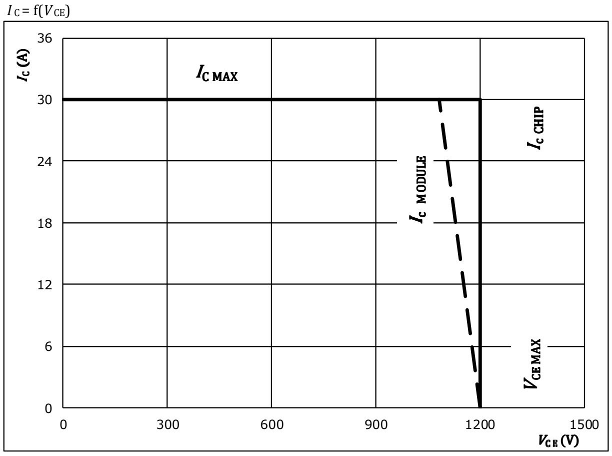


At					
V_{CE} =	600	V	T_j:	25 °C	
V_{GE} =	0 / 15	V		125 °C	
R_{gon} =	16,0	Ω		150 °C	

figure 8. **IGBT**

Reverse bias safe operating area

$I_C = f(V_{CE})$



At		
T_j =	175	°C
R_{gon} =	16,0	Ω
R_{goff} =	32,0	Ω

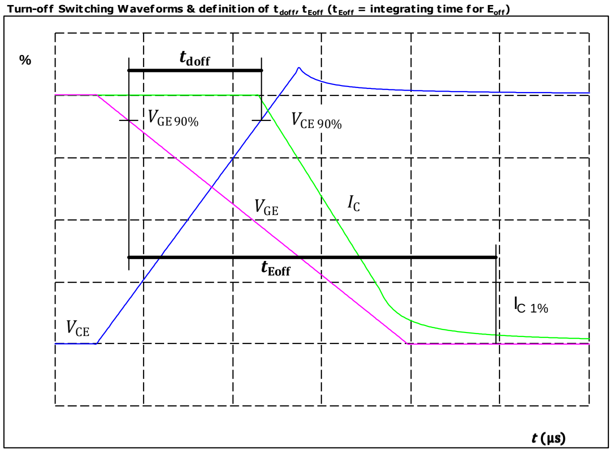
Inverter Switching Definitions

General conditions

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

figure 1. **IGBT**

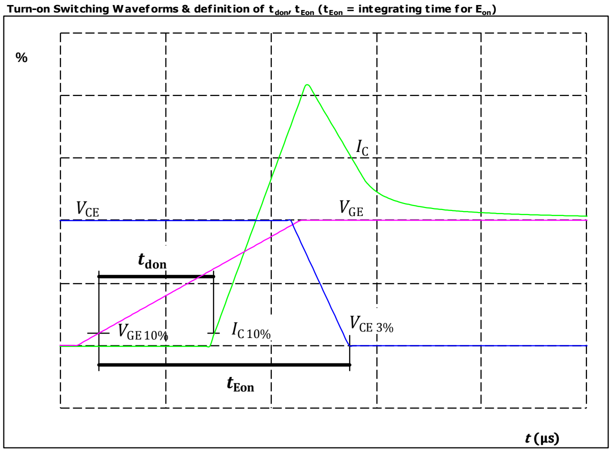
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff} (t_{Eoff} = integrating time for E_{off})



$V_{GE}(0\%)$ =	0	V
$V_{GE}(100\%)$ =	15	V
$V_C(100\%)$ =	600	V
$I_C(100\%)$ =	11	A
t_{doff} =	2011	ns

figure 2. **IGBT**

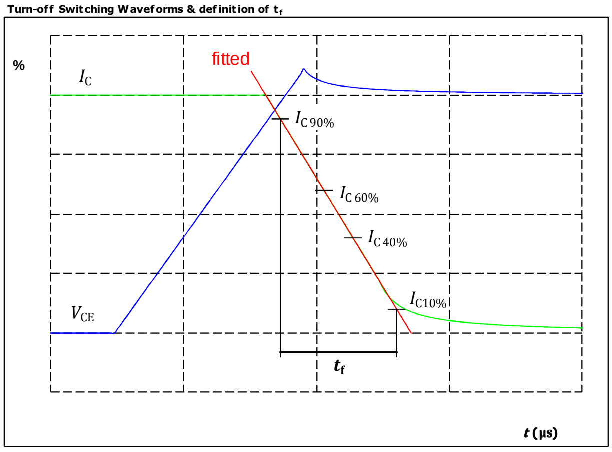
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon} (t_{Eon} = integrating time for E_{on})



$V_{GE}(0\%)$ =	0	V
$V_{GE}(100\%)$ =	15	V
$V_C(100\%)$ =	600	V
$I_C(100\%)$ =	11	A
t_{don} =	1912	ns

figure 3. **IGBT**

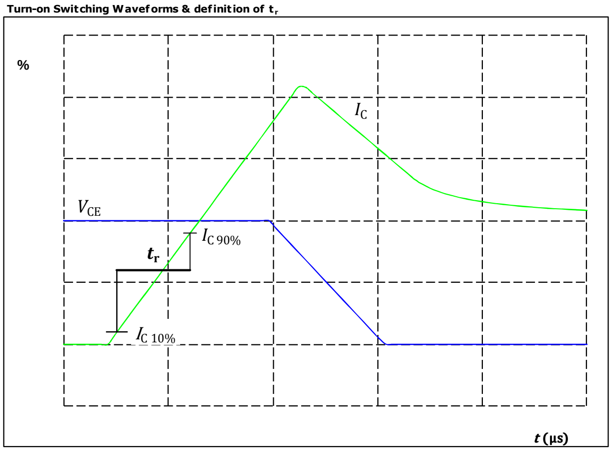
Turn-off Switching Waveforms & definition of t_f



$V_C(100\%)$ =	600	V
$I_C(100\%)$ =	11	A
t_f =	133	ns

figure 4. **IGBT**

Turn-on Switching Waveforms & definition of t_r



$V_C(100\%)$ =	600	V
$I_C(100\%)$ =	11	A
t_r =	23	ns

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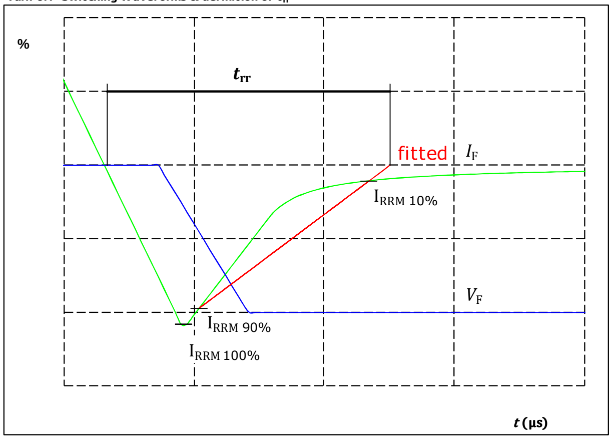
Inverter Switching Characteristics

figure 5. **FWD**

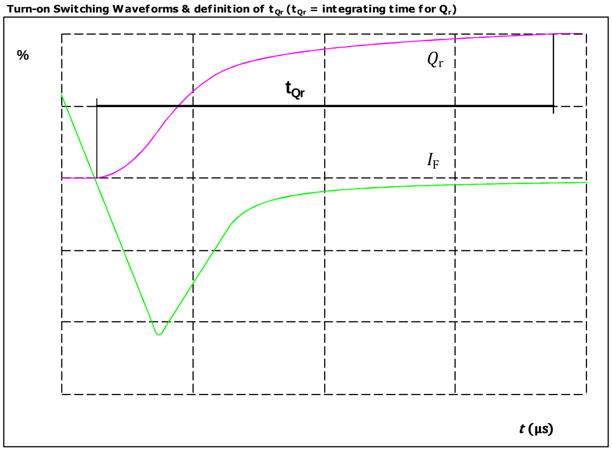
Turn-off Switching Waveforms & definition of t_{rr}



V_F (100%) =	600	V
I_F (100%) =	11	A
I_{RRM} (100%) =	13	A
t_{rr} =	394	ns

figure 6. **FWD**

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



I_F (100%) =	11	A
Q_r (100%) =	2,23	µC

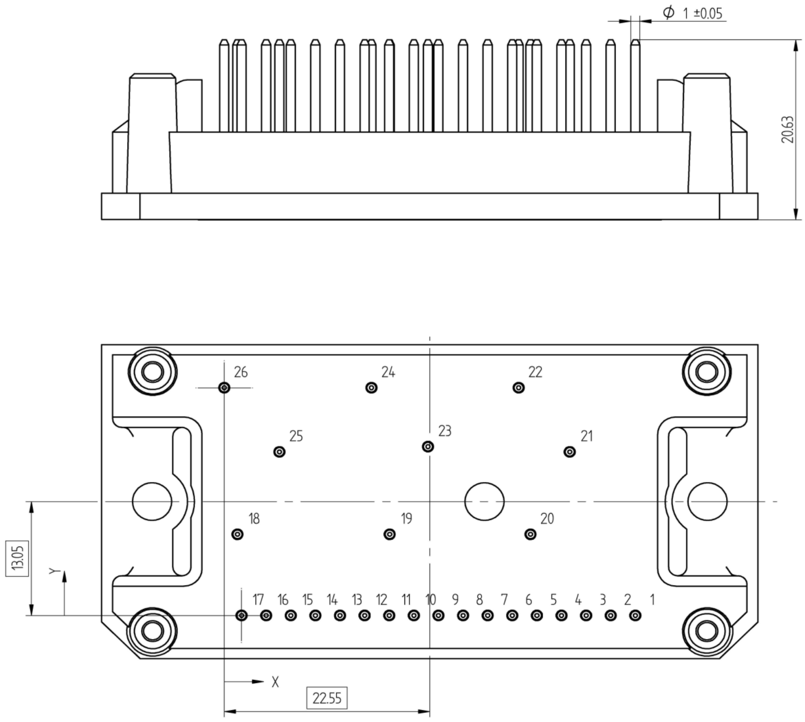
Ordering Code & Marking

Version	Ordering Code
without thermal paste 17 mm housing with solder pins	20-1B12IPA015SC-L579F09
with thermal paste 17 mm housing with solder pins	20-1B12IPA015SC-L579F09-/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		
		TTTTTTTVV	LLLLL	SSSS	WWYY		

Outline

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	RST
12	15,4	0	FO
13	12,7	0	UH
14	10	0	UL
15	7,3	0	RU+
16	4,6	0	RU-
17	1,9	0	THERM1
18	1,45	9,3	EU
19	18,15	9,3	EV
20	33,6	9,3	EW
21	37,9	18,75	DC+3
22	32,3	26,1	W
23	22,35	19,35	DC+2
24	16,15	26,1	V
25	6,05	18,75	DC+1
26	0	26,1	U



Tolerance of pinpositions: ±0,5mm at the end of pins
Dimension of coordinate axis is only offset without tolerance

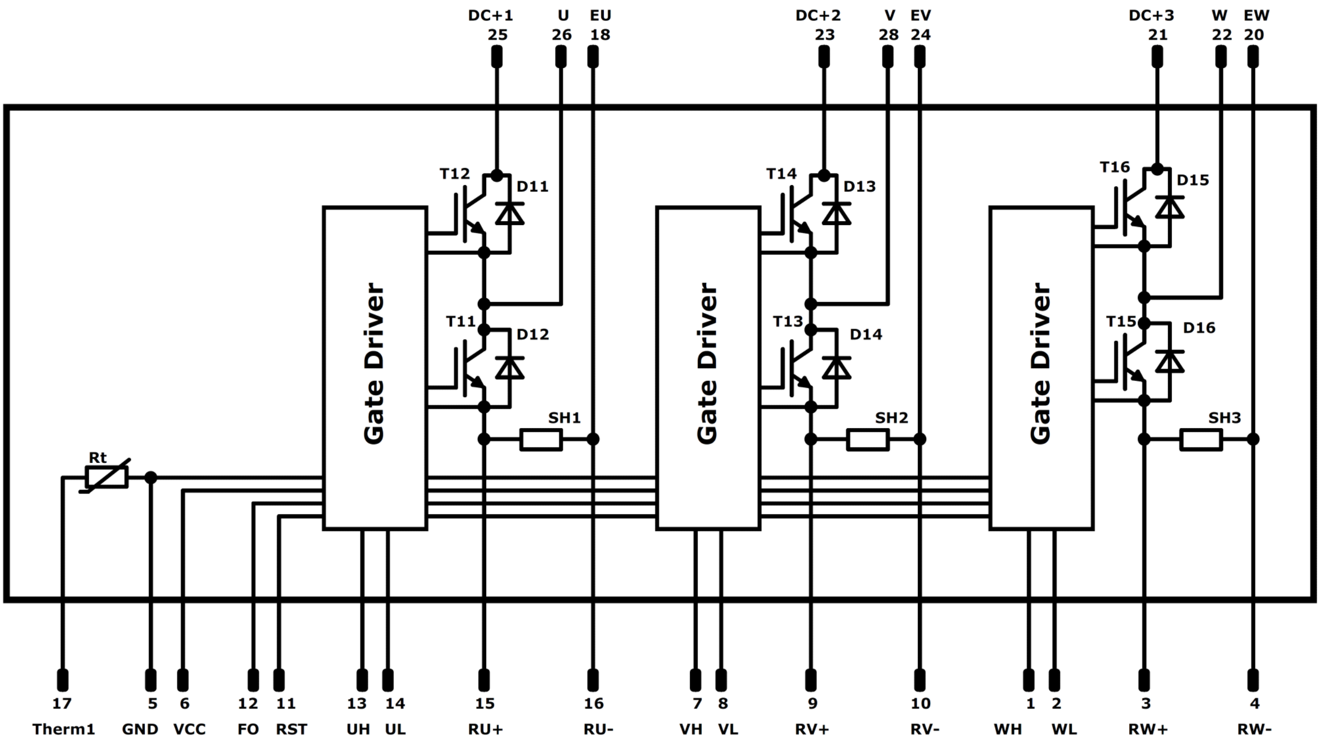
Pin Descriptions

Pin	Function	Description
1	WH	Signal input for high-side W phase
2	WL	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	VH	Signal input for high-side V phase
8	VL	Signal input for low-side V phase
9	RV+	V phase shunt +
10	RV-	V phase shunt -
11	RST	Fault latch reset (min. 500ns pulse)
12	FO	Fault latch input/output (negative logic, open drain)
13	UH	Signal input for high-side U phase
14	UL	Signal input for low-side U phase
15	RU+	U phase shunt +
16	RU-	U phase shunt -
17	THERM1	Temperature sensor connector

Power pin descriptions

Pin	Function	Description
18	EU	Open emitter U phase
19	EV	Open emitter V phase
20	EW	Open emitter W phase
21	DC+3	Inverter input DC+
22	W	Output W phase
23	DC+2	Inverter input DC+
24	V	Output V phase
25	DC+1	Inverter input DC+
26	U	Output U phase

Pinout



Identification

ID	Component	Voltage	Current	Function	Comment
T11, T12, T13, T14, T15, T16	IGBT	1200 V	15 A	Inverter Switch	
D11, D12, D13, D14, D15, D16	FWD	1200 V	15 A	Inverter Diode	
Rt	NTC			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
20-1B12IPA015SC-L579F09-D1-14	20 Mar. 2018		

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