

PIM IGBT Module

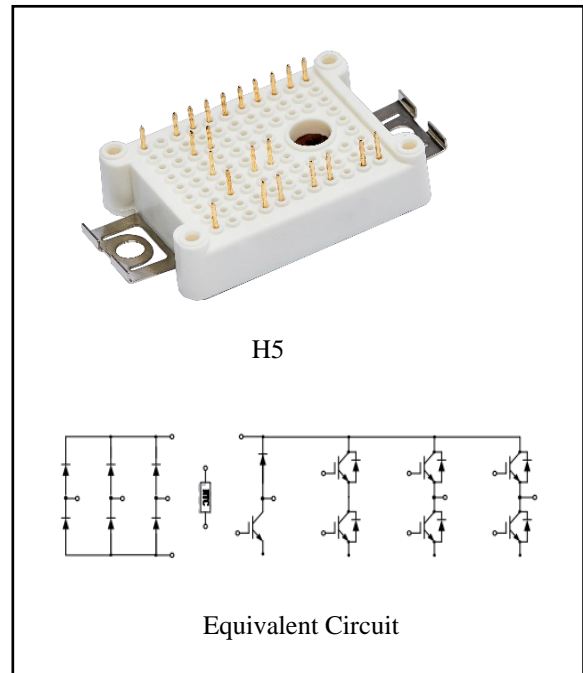
$V_{CES} = 1200V$, $I_{C\ nom} = 15A$ / $I_{CRM} = 30A$

Features :

- 1200V Trench /Field Stop process
- Low switching losses
- V_{cesat} has a positive temperature coefficient

Applications:

- Variable Frequency Drive
- Servo drive
- Inverter



IGBT, Inverter

Maximum Ratings

Parameter	Conditions	Symbol	Value	Unit
Collector-Emitter voltage	$T_{vj} = 25^{\circ}C$	V_{CES}	1200	V
Continuous DC collector current	$T_C = 100^{\circ}C$, $T_{vj\ max} = 175^{\circ}C$	$I_{C\ nom}$	15	A
Repetitive peak collector current	$t_p = 1\ ms$	I_{CRM}	30	A
Total power dissipation	$T_C = 25^{\circ}C$, $T_{vj\ max} = 175^{\circ}C$	P_{tot}	130	W
Gate emitter voltage		V_{GE}	± 20	V

Characteristic Values

Parameter	Conditions	Symbol	Value			Unit
			Min.	Typ.	Max.	
Collector-Emitter saturation voltage	$V_{GE} = 15V$, $I_C = 15A$ $T_{vj} = 25^{\circ}C$ $V_{GE} = 15V$, $I_C = 15A$ $T_{vj} = 125^{\circ}C$ $V_{GE} = 15V$, $I_C = 15A$ $T_{vj} = 150^{\circ}C$	V_{CEsat}		1.95 2.46 2.54	2.40	V
Gate-Emitter threshold voltage	$I_C = 0.48mA$, $V_{GE} = V_{CE}$ $T_{vj} = 25^{\circ}C$	$V_{GE(th)}$	5.10	5.70	6.30	
Internal gate resistor		R_{Gint}		None		Ω

Gate charge	$V_{GE} = -15V \dots +15V$	Q_G		0.10		μC
Input capacitance	$f = 1MHz, V_{CE} = 25V, V_{GE} = 0V \quad T_{vj} = 25^\circ C$	C_{ies}		0.88		nF
Reverse transfer capacitance		C_{res}		0.04		
Collector-emitter cut-off current	$V_{CE} = 1200V, V_{GE} = 0V \quad T_{vj} = 25^\circ C$	I_{CES}			1	mA
Gate-emitter leakage current	$V_{CE} = 0V, V_{GE} = 20V \quad T_{vj} = 25^\circ C$	I_{GES}			100	nA
Turn-on delay time	$I_C = 15A, V_{CE} = 600V$ $V_{GE} = \pm 15V, R_G = 40\Omega$ (inductive load)	$T_{vj} = 25^\circ C$ $T_{vj} = 125^\circ C$ $T_{vj} = 150^\circ C$	$t_{d\ on}$		46	
					42	
					44	
Rise time	$I_C = 15A, V_{CE} = 600V$ $V_{GE} = \pm 15V, R_G = 40\Omega$ (inductive load)	$T_{vj} = 25^\circ C$ $T_{vj} = 125^\circ C$ $T_{vj} = 150^\circ C$	t_r		38	
					41	
					39	
Turn-off delay time	$I_C = 15A, V_{CE} = 600V$ $V_{GE} = \pm 15V, R_G = 40\Omega$ (inductive load)	$T_{vj} = 25^\circ C$ $T_{vj} = 125^\circ C$ $T_{vj} = 150^\circ C$	$t_{d\ off}$		215	ns
					249	
					259	
Fall time	$I_C = 15A, V_{CE} = 600V$ $V_{GE} = \pm 15V, R_G = 40\Omega$ (inductive load)	$T_{vj} = 25^\circ C$ $T_{vj} = 125^\circ C$ $T_{vj} = 150^\circ C$	t_f		196	
					221	
					203	
Turn-on energy loss per pulse	$I_C = 15A, V_{CE} = 600V$ $V_{GE} = \pm 15V, R_G = 40\Omega$ (inductive load)	$T_{vj} = 25^\circ C$ $T_{vj} = 125^\circ C$ $T_{vj} = 150^\circ C$	E_{on}		1.57	mJ
					2.12	
					2.25	
Turn-off energy loss per pulse	$I_C = 15A, V_{CE} = 600V$ $V_{GE} = \pm 15V, R_G = 40\Omega$ (inductive load)	$T_{vj} = 25^\circ C$ $T_{vj} = 125^\circ C$ $T_{vj} = 150^\circ C$	E_{off}		0.89	
					1.07	
					1.16	
SC data	$V_{GE} \leq 15V, V_{cc} = 800V$ $V_{CEmax} = V_{CES} - L_{sCE} \cdot di/dt \quad t_p \leq 8\mu s, T_{vj} = 25^\circ C$	I_{sc}		71		A
Thermal resistance, junction to case	per IGBT	R_{thJC}		1.05	1.15	K/W
Temperature under switching conditions		$T_{vj\ op}$	-40		150	$^\circ C$

Diode, Inverter

Maximum Ratings

Parameter	Conditions	Symbol	Value	Unit
Repetitive peak reverse voltage	$T_{vj} = 25^\circ C$	V_{RRM}	1200	V
Continuous DC forward current		I_F	15	A
Repetitive peak forward current	$t_p = 1ms$	I_{FRM}	30	A
I^2t -value	$t_p = 10ms, \sin 180^\circ, T_{vj} = 125^\circ C$	I^2t	136	A^2s

Characteristic Values

Parameter	Conditions	Symbol	Value			Unit
			Min.	Typ.	Max.	
Forward voltage	$I_F=15A, V_{GE}=0V$ $T_{vj}=25^{\circ}C$	V_F		1.60	2.10	V
	$I_F=15A, V_{GE}=0V$ $T_{vj}=125^{\circ}C$			1.75		
	$I_F=15A, V_{GE}=0V$ $T_{vj}=150^{\circ}C$			1.78		
Peak reverse recovery current	$I_F=15A,$ $-di_F/dt=251A/\mu s(T_{vj}=150^{\circ}C)$ $V_R=600V, V_{GE}=-15V$ $T_{vj}=25^{\circ}C$	I_{RM}		13		A
	$T_{vj}=125^{\circ}C$			15		
	$T_{vj}=150^{\circ}C$			17		
Recovered charge	$I_F=15A,$ $-di_F/dt=251A/\mu s(T_{vj}=150^{\circ}C)$ $V_R=600V, V_{GE}=-15V$ $T_{vj}=25^{\circ}C$	Q_r		1.87		μC
	$T_{vj}=125^{\circ}C$			3.33		
	$T_{vj}=150^{\circ}C$			3.82		
Reverse recovered energy	$I_F=15A,$ $-di_F/dt=251A/\mu s(T_{vj}=150^{\circ}C)$ $V_R=600V, V_{GE}=-15V$ $T_{vj}=25^{\circ}C$	E_{rec}		0.70		mJ
	$T_{vj}=125^{\circ}C$			1.28		
	$T_{vj}=150^{\circ}C$			1.45		
Thermal resistance, junction to case	per diode	R_{thJC}		1.75	1.90	K/W
Temperature under switching conditions		$T_{vj op}$	-40		150	$^{\circ}C$

Diode, Rectifier
Maximum Ratings

Parameter	Conditions	Symbol	Value	Unit
Repetitive peak reverse voltage	$T_{vj}=25^{\circ}C$	V_{RRM}	1600	V
Non-Repetitive peak reverse voltage	$T_{vj}=25^{\circ}C$	V_{RSM}	1800	V
Maximum Average Forward Current		$I_{F(AV)}$	16	A
Surge forward current	$t_p=10ms, \sin 180^{\circ}, T_{vj}=25^{\circ}C$	I_{FSM}	190	A
I^2t -value	$t_p=10ms, \sin 180^{\circ}, T_{vj}=125^{\circ}C$	I^2t	381	A^2s

Characteristic Values

Parameter	Conditions	Symbol	Value			Unit
			Min.	Typ.	Max.	
Forward voltage	$I_F=16A, T_j=25^{\circ}C$	V_F		0.95		V

Reverse current	$V_R=V_{RRM}$	$T_{vj}=25^{\circ}\text{C}$	I_R			5	μA
Temperature under switching conditions			$T_{vj\text{ op}}$	-40		150	$^{\circ}\text{C}$

IGBT, Brake-Chopper

Maximum Ratings

Parameter	Conditions	Symbol	Value	Unit
Collector-Emitter voltage	$T_{vj}=25^{\circ}\text{C}$	V_{CES}	1200	V
Continuous DC collector current	$T_C=100^{\circ}\text{C}$, $T_{vj\text{ max}}=175^{\circ}\text{C}$	$I_{C\text{ nom}}$	15	A
Repetitive peak collector current	$t_p=1\text{ ms}$	I_{CRM}	30	A
Total power dissipation	$T_C = 25^{\circ}\text{C}$, $T_{vj\text{ max}} = 175^{\circ}\text{C}$	P_{tot}	130	W
Gate emitter voltage		V_{GE}	± 20	V

Characteristic Values

Parameter	Conditions	Symbol	Value			Unit	
			Min.	Typ.	Max.		
Collector-Emitter saturation voltage	$V_{GE}=15\text{V}$, $I_C=15\text{A}$ $V_{GE}=15\text{V}$, $I_C=15\text{A}$ $V_{GE}=15\text{V}$, $I_C=15\text{A}$	$T_{vj}=25^{\circ}\text{C}$ $T_{vj}=125^{\circ}\text{C}$ $T_{vj}=150^{\circ}\text{C}$	$V_{C\text{esat}}$		2.08 2.37 2.45	2.50	V
Gate-Emitter threshold voltage	$I_C=0.48\text{mA}$, $V_{GE}=V_{CE}$	$T_{vj}=25^{\circ}\text{C}$	$V_{GE(\text{th})}$	5.10	5.70	6.30	
Gate charge	$V_{GE}=-15\text{V}\dots+15\text{V}$		Q_G		0.11		μC
Internal gate resistor			$R_{G\text{int}}$		None		Ω
Input capacitance	$f=1\text{MHz}$, $V_{CE}=25\text{ V}$, $V_{GE}=0\text{ V}$	$T_{vj}=25^{\circ}\text{C}$	C_{ies}		0.86		nF
Reverse transfer capacitance			C_{res}		0.02		
Collector-emitter cut-off current	$V_{CE}=1200\text{ V}$, $V_{GE}=0\text{ V}$	$T_{vj}=25^{\circ}\text{C}$	I_{CES}			1	mA
Gate-emitter leakage current	$V_{CE}=0\text{ V}$, $V_{GE}=20\text{ V}$	$T_{vj}=25^{\circ}\text{C}$	I_{GES}			100	nA
Turn-on delay time	$I_C=15$, $V_{CE}=600\text{ V}$ $V_{GE}=\pm 15\text{ V}$, $R_G=40\Omega$ (inductive load)	$T_{vj}=25^{\circ}\text{C}$	$t_{d\text{ on}}$		51		ns
		$T_{vj}=125^{\circ}\text{C}$			47		
		$T_{vj}=150^{\circ}\text{C}$			40		
Rise time	$I_C=15\text{A}$, $V_{CE}=600\text{ V}$ $V_{GE}=\pm 15\text{ V}$, $R_G=40\Omega$ (inductive load)	$T_{vj}=25^{\circ}\text{C}$	t_r		44		ns
		$T_{vj}=125^{\circ}\text{C}$			48		
		$T_{vj}=150^{\circ}\text{C}$			56		

Turn-off delay time	I _C =15A, V _{CE} =600 V V _{GE} =±15 V, R _G =40Ω (inductive load)	T _{vj} =25°C	t _{d off}		216		
		T _{vj} =125°C			254		
		T _{vj} =150°C			262		
Fall time	I _C =15A, V _{CE} =600 V V _{GE} =±15 V, R _G =40Ω (inductive load)	T _{vj} =25°C	t _r		194		
		T _{vj} =125°C			213		
		T _{vj} =150°C			219		
Turn-on energy loss per pulse	I _C =15A, V _{CE} =600 V V _{GE} =±15 V, R _G =40Ω (inductive load)	T _{vj} =25°C	E _{on}		0.92		mJ
		T _{vj} =125°C			1.21		
		T _{vj} =150°C			1.31		
Turn-off energy loss per pulse	I _C =15A, V _{CE} =600 V V _{GE} =±15 V, R _G =40Ω (inductive load)	T _{vj} =25°C	E _{off}		0.88		
		T _{vj} =125°C			1.11		
		T _{vj} =150°C			1.15		
Thermal resistance, junction to case	per IGBT		R _{thJC}		1.05	1.15	K/W
Temperature under switching conditions			T _{vj op}	-40		150	°C

Diode, Brake-Chopper

Maximum Ratings

Parameter	Conditions	Symbol	Value	Unit
Repetitive peak reverse voltage	T _{vj} =25°C	V _{RRM}	1200	V
Continuous DC forward current		I _F	8	A
Repetitive peak forward current	t _p =1ms	I _{FRM}	16	A
I ² t-value	V _R =0V, t _p =10ms, T _{vj} =125°C	I ² t	25	A ² t

Characteristic Values

Parameter	Conditions	Symbol	Value			Unit		
			Min.	Typ.	Max.			
Forward voltage	I _F =8A, V _{GE} =0V	V _F			1.88	2.4	V	
					T _{vj} =125°C			1.96
					T _{vj} =150°C			1.90
Peak reverse recovery current	I _F =8A, -di _F /dt=203A/μs(T _{vj} =150°C) V _R =600V, V _{GE} =-15V	I _{RM}			6		A	
					T _{vj} =25°C			7
					T _{vj} =150°C			8
Recovered charge	I _F =8A, -di _F /dt=203A/μs(T _{vj} =150°C) V _R =600V, V _{GE} =-15V	Q _r			0.68		μC	
					T _{vj} =25°C			1.22
					T _{vj} =150°C			1.32
Reverse recovered energy	I _F =8A, -di _F /dt=203A/μs(T _{vj} =150°C) V _R =600V, V _{GE} =-15V	E _{rec}			0.27		mJ	
					T _{vj} =25°C			0.49
					T _{vj} =150°C			0.53
Thermal resistance, junction to case	per diode		R _{thJC}		1.75	1.90	K/W	

Temperature under switching conditions		$T_{vj\ op}$	-40		150	°C
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NTC-Thermistor

Characteristic Values

Parameter	Conditions	Symbol	Value			Unit
			Min.	Typ.	Max.	
Rated resistances	$T_c=25^\circ\text{C}, \pm 5\%$	R_{25}		5.0		k Ω
B-value	$\pm 1\%$	$B_{25/50}$		3380		K

Module

Parameter	Conditions	Symbol	Value			Unit
Isolation test voltage	RMS, $f=50\text{Hz}, t=1\text{min}$	V_{ISOL}	2500			V
Internal isolation			Al_2O_3			
Storage temperature		T_{stg}	-40		125	°C
Mounting torque for modul mounting		M	3.0		6.0	Nm
Weight		W		23		g

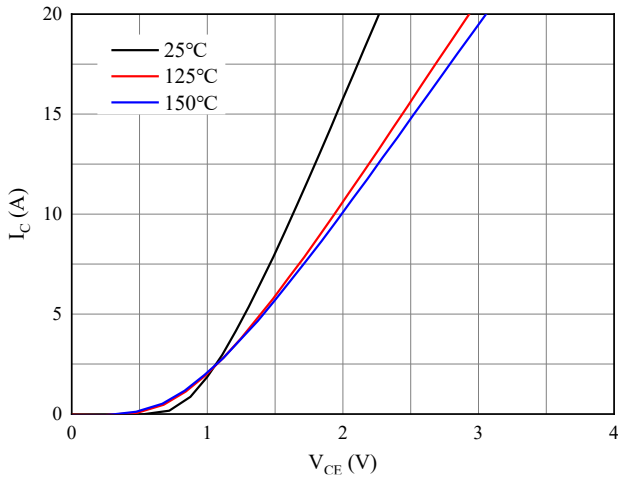


Fig 1. Typical output characteristics ($V_{GE}=15V$)

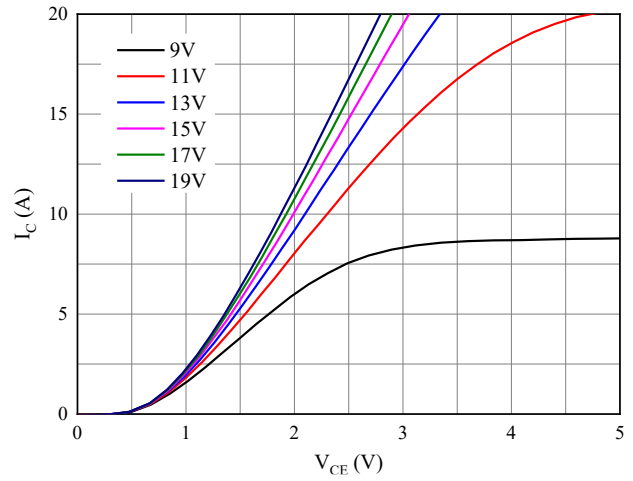


Fig 2. Typical output characteristics ($T_{vj}=150^{\circ}C$)

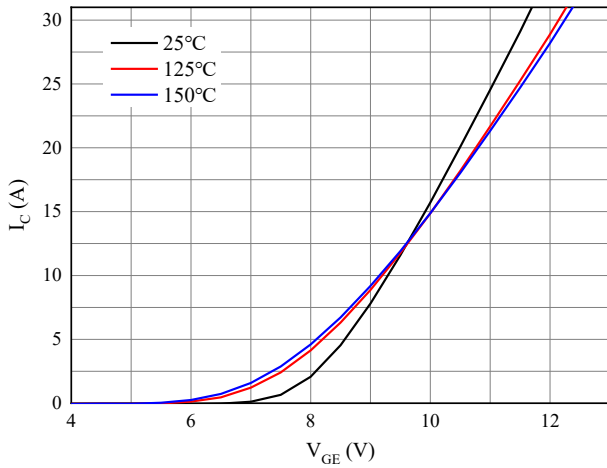


Fig 3. Typical transfer characteristic ($V_{CE}=20V$)

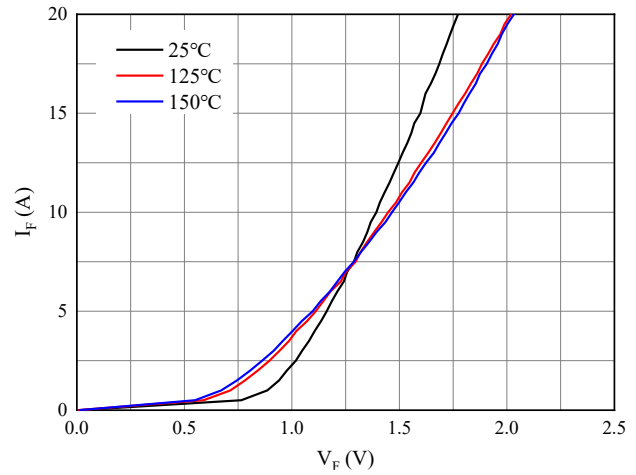


Fig 4. Forward characteristic of Diode

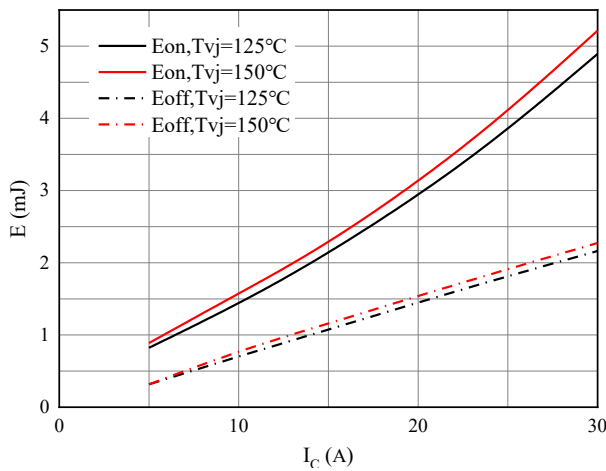


Fig 5. Switching losses of IGBT
 $V_{GE}=\pm 15V$, $R_{Gon}=40\Omega$, $R_{Goff}=40\Omega$, $V_{CE}=600V$

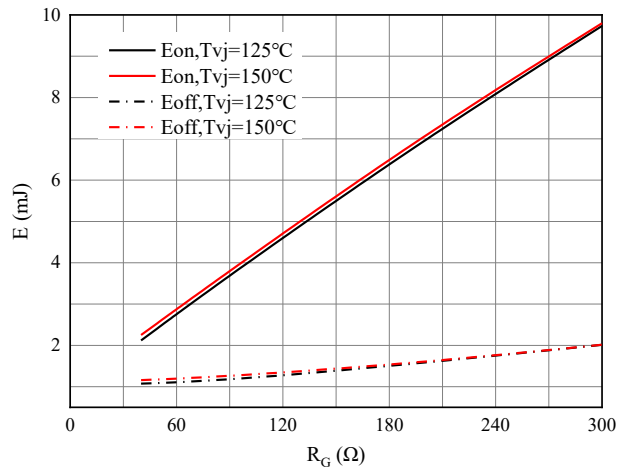


Fig 6. Switching losses of IGBT
 $V_{GE}=\pm 15V$, $I_C=15A$, $V_{CE}=600V$

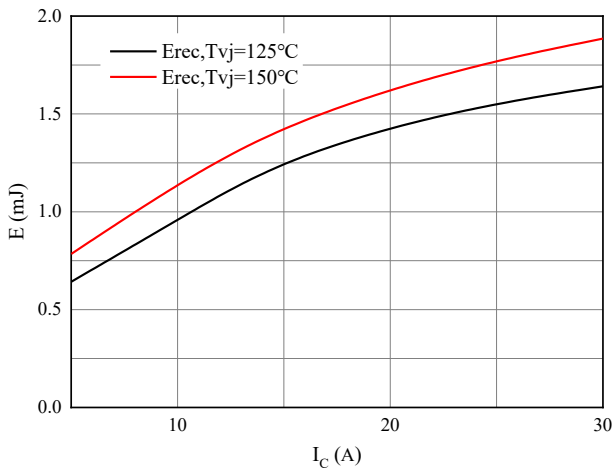


Fig 7. Switching losses of Diode
RGon=40Ω, VCE=600V

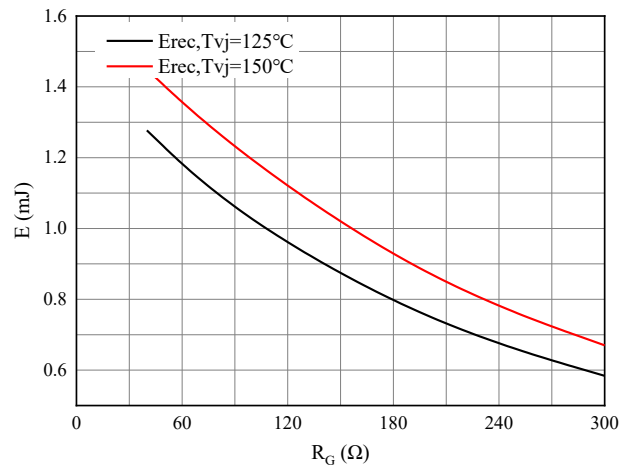


Fig 8. Switching losses of Diode
IF=15A, VCE=600V

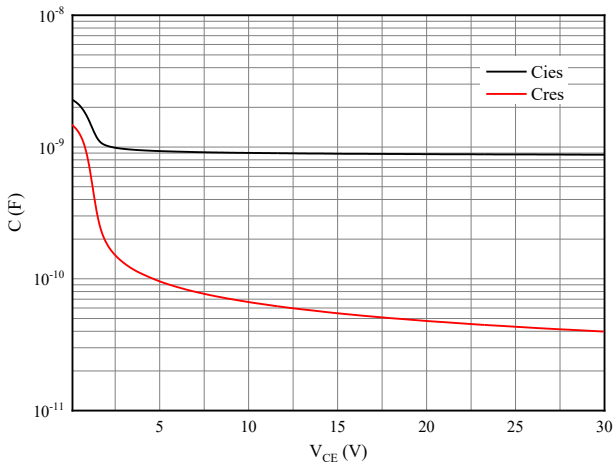


Fig 9. Capacitance characteristic

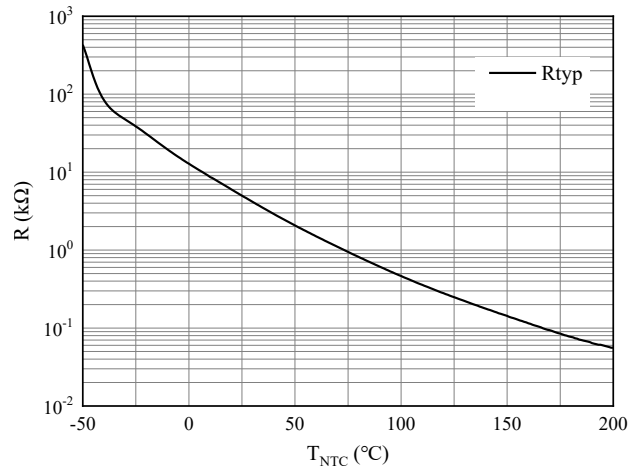
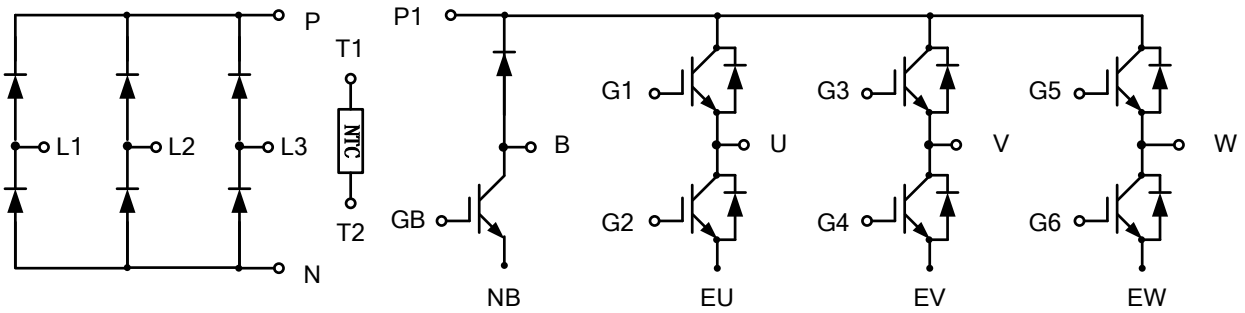


Fig 10. NTC-Themistor-temperature characteristic

Circuit diagram



Package outlines

