QX400FS65HP1 is 650V/400A IGBT Power Module HP1

General Description

KunSemi Technology QX400FS65HP1 400A, 650V IGBT Power Module provides ultra low conduction loss as well as short circuit ruggedness. They are designed for the applications such as motor drive and solar energy.

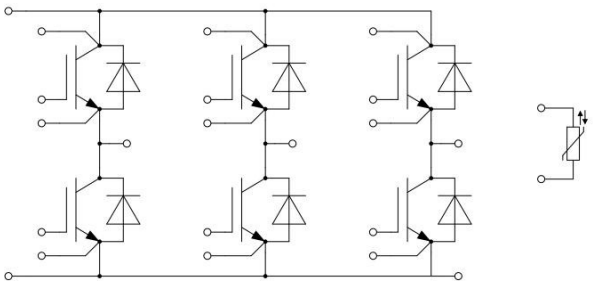
QX400FS65HP1 Summary

Symbol	Value
V_{CES}	650V
I_C@T_C = 85℃	400A

Features

- Low $V_{CE(sat)}$ Trench IGBT technology
- 10μs Short circuit capability
- $V_{CE(sat)}$ with positive temperature coefficient
- Maximum junction temperature 175℃
- Low inductance case
- Isolated copper baseplate using DBC technology

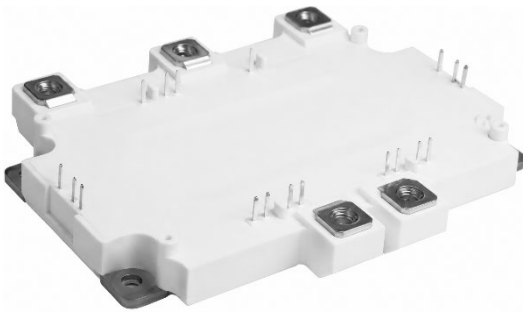
Equivalent Schematic



Applications

- Solar energy application
- Inverter for motor drive
- Uninterruptible power supply
- Hybrid and electric vehicle

Package



Package Marking

Product#	Marking	Package
QX400FS65HP1	QX400FS65HP1	HP1

Maximum Ratings (T_C = 25℃ unless otherwise specified)

Symbol	Description		Value	Unit
IGBT				
V_{CES}	Collector-Emitter Voltage		650	V
V_{GES}	Gate-Emitter Voltage		±20	V
I_C	Collector Current	@ T_C = 25℃	500	A
		@ T_C = 85℃	400	A
I_{CM}	Pulsed Collector Current t_p = 1ms		800	A
P_D	Maximum Power Dissipation @ T_j = 175℃		3261	W
Diode				
V_{RRM}	Repetitive Peak Reverse Voltage		650	V
I_F	Diode Continuous Forward Current		400	A
I_{FM}	Diode Maximum Forward Current t_p = 1ms		800	A
Module				
T_{jmax}	Maximum Junction Temperature		175	℃
T_{jop}	Operating Junction Temperature		-40 to +150	℃
T_{STG}	Storage Temperature Range		-40 to +125	℃
V_{ISO}	Isolation Voltage RMS, f = 50Hz, t = 1min		2500	V

Electrical Characteristics (T_C = 25℃ unless otherwise specified)

Symbol	Description	Conditions	Min	Typ	Max	Unit
IGBT						
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	I_C = 400A, V_{GE} = 15V, T_j = 25℃		1.63	1.75	V
		I_C = 400A, V_{GE} = 15V, T_j = 125℃		1.78		
		I_C = 400A, V_{GE} = 15V, T_j = 150℃		1.83		
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	I_C = 3.2mA, V_{CE} = V_{GE}, T_j = 25℃		5.52		V
I_{CES}	Collector Cut-Off Current	V_{CE} = V_{CES}, V_{GE} = 0V, T_j = 25℃			1	mA
I_{GES}	Gate-Emitter Leakage Current	V_{GE} = V_{GES}, V_{CE} = 0V, T_j = 25℃			400	nA
R_{Gint}	Internal Gate Resistance			1.37		Ω
C_{ies}	Input Capacitance	V_{CE} = 25V, f = 1MHz, V_{GE} = 0V		34.2		nF
C_{res}	Reverse Transfer Capacitance			4.31		nF
Q_G	Gate Charge	V_{GE} = -15…+15V		1.66		μC
$t_{d(on)}$	Turn-On Delay Time	V_{CC} = 300V, I_C = 400A, R_G = 3.3Ω, V_{GE} = ±15V, L_S = 7μH, T_j = 25℃		141		ns
t_r	Rise Time			101		ns
$t_{d(off)}$	Turn-Off Delay Time			197		ns
t_f	Fall Time			137		ns
E_{on}	Turn-On Switching Loss			5.78		mJ
E_{off}	Turn-Off Switching Loss			15.89		mJ
$t_{d(on)}$	Turn-On Delay Time	V_{CC} = 300V, I_C = 400A, R_G = 3.3Ω, V_{GE} = ±15V, L_S = 7μH, T_j = 125℃		145		ns
t_r	Rise Time			106		ns
$t_{d(off)}$	Turn-Off Delay Time			219		ns
t_f	Fall Time			221		ns
E_{on}	Turn-On Switching Loss			8.08		mJ
E_{off}	Turn-Off Switching Loss			18.83		mJ
$t_{d(on)}$	Turn-On Delay Time	V_{CC} = 300V, I_C = 400A, R_G = 3.3Ω, V_{GE} = ±15V, L_S = 7μH, T_j = 150℃		148		ns
t_r	Rise Time			108		ns
$t_{d(off)}$	Turn-Off Delay Time			226		ns
t_f	Fall Time			247		ns
E_{on}	Turn-On Switching Loss			9.21		mJ
E_{off}	Turn-Off Switching Loss			19.77		mJ
I_{SC}	SC Data	$t_P \leq 10\mu s$, V_{GE} = 15V, T_j = 150℃, V_{CC} = 360V, $V_{CEM} \leq 650V$		1950		A

Symbol	Description	Conditions	Min	Typ	Max	Unit
Diode						
V_F	Diode Forward Voltage	I_F = 400A, V_{GE} = 0V, T_j = 25℃		3.01		V
		I_F = 400A, V_{GE} = 0V, T_j = 125℃		2.44		
		I_F = 400A, V_{GE} = 0V, T_j = 150℃		2.28		
Q_r	Recovered Charge	V_{CC} = 300V, I_F = 400A, -di/dt = 3070A/μs, L_S = 7μH, V_{GE} = -15V, T_j = 25℃		1.71		μC
I_{RM}	Peak Reverse Recovery Current			59		A
E_{rec}	Reverse Recovery Energy			0.45		mJ
Q_r	Recovered Charge	V_{CC} = 300V, I_F = 400A, -di/dt = 3010A/μs, L_S = 7μH, V_{GE} = -15V, T_j = 125℃		6.07		μC
I_{RM}	Peak Reverse Recovery Current			105		A
E_{rec}	Reverse Recovery Energy			1.33		mJ
Q_r	Recovered Charge	V_{CC} = 300V, I_F = 400A, -di/dt =2930A/μs, L_S = 7μH, V_{GE} = -15V, T_j = 150℃		8.78		μC
I_{RM}	Peak Reverse Recovery Current			124		A
E_{rec}	Reverse Recovery Energy			1.86		mJ
NTC						
R_{25}	Rated Resistance			5.0		kΩ
ΔR/R	Deviation of R_{100}	T_C = 100℃, R_{100} = 493.3Ω	-5		5	%
P_{25}	Power Dissipation				20.0	mW
$B_{25/50}$	B-value	$R_2 = R_{25}\exp[B_{25/50}(1/T_2-1/(298.15K))]$		3375		K
$B_{25/80}$	B-value	$R_2 = R_{25}\exp[B_{25/80}(1/T_2-1/(298.15K))]$		3411		K
$B_{25/100}$	B-value	$R_2 = R_{25}\exp[B_{25/100}(1/T_2-1/(298.15K))]$		3433		K
Module						
L_{CE}	Stray Inductance			25		nH
$R_{CC'+EE'}$	Module Lead Resistance, Terminal to Chip			1.00		mΩ
R_{thJC}	Junction-to-Case (per IGBT)				0.046	K/W
	Junction-to-Case (per Diode)				0.146	
R_{thCH}	Case-to-Heatsink (per IGBT)			0.134		K/W
	Case-to-Heatsink (per Diode)			0.089		
	Case-to-Heatsink (per Module)			0.009		
M	Terminal Connection Torque: Screw M6 Mounting Torque: Screw M5		3.0 3.0		6.0 6.0	N.m
G	Weight of Module			470		g

Typical Performance

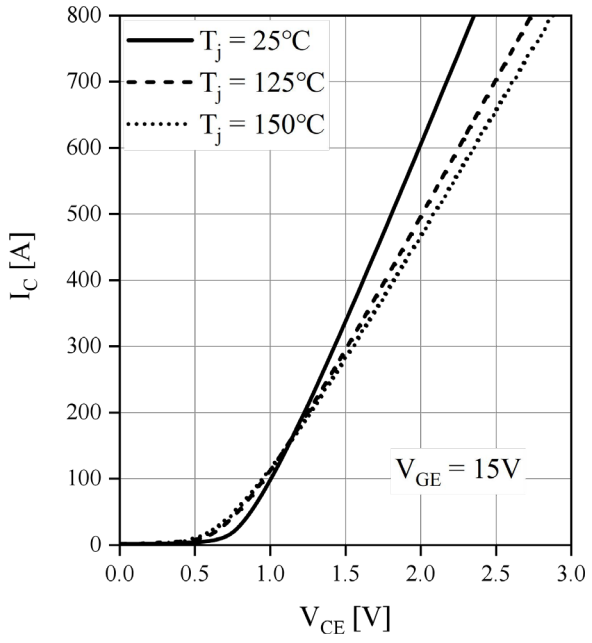


Figure 1: IGBT Output Characteristics

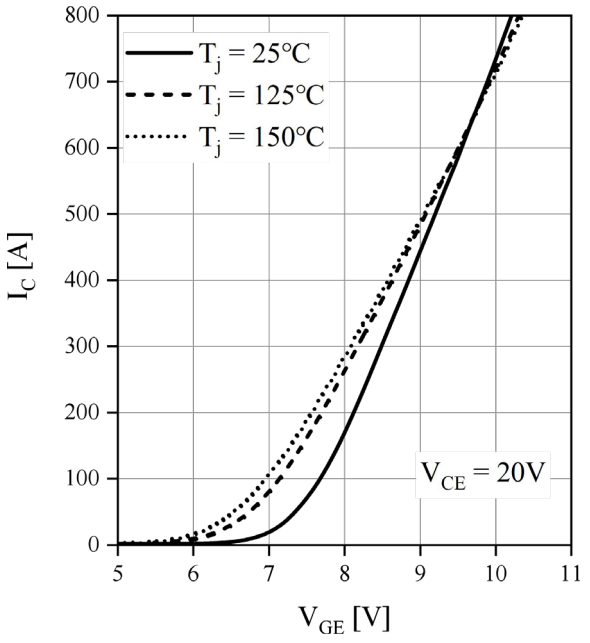


Figure 2: IGBT Transfer Characteristics

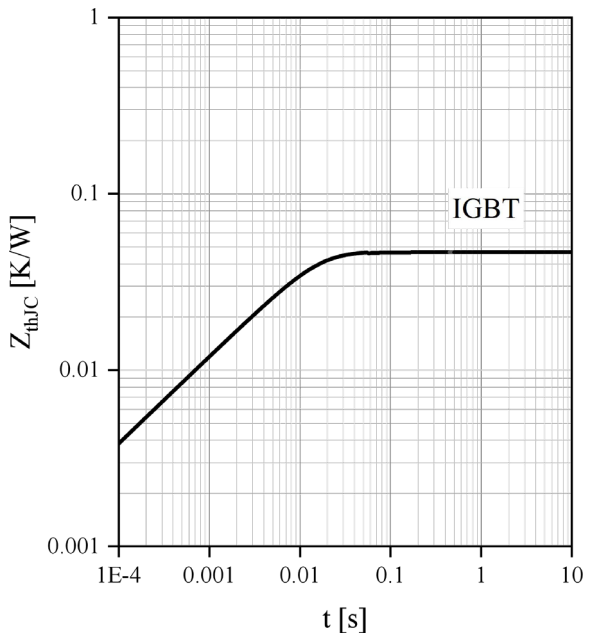


Figure 3: IGBT Transient Thermal Impedance

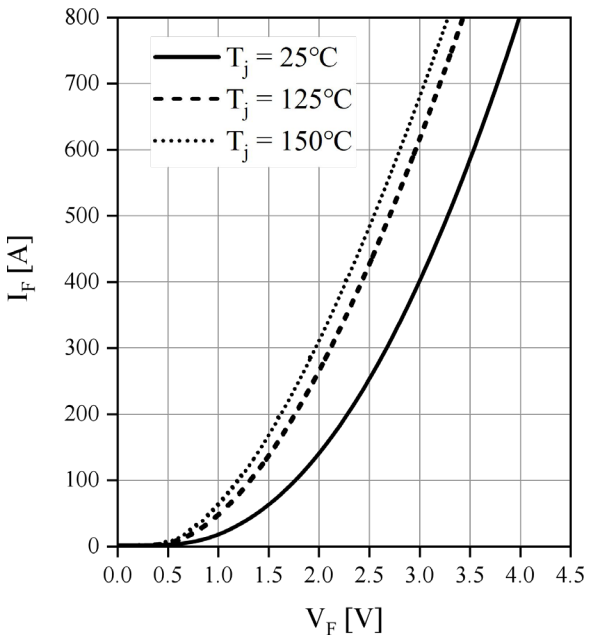


Figure 4: Diode Forward Characteristics

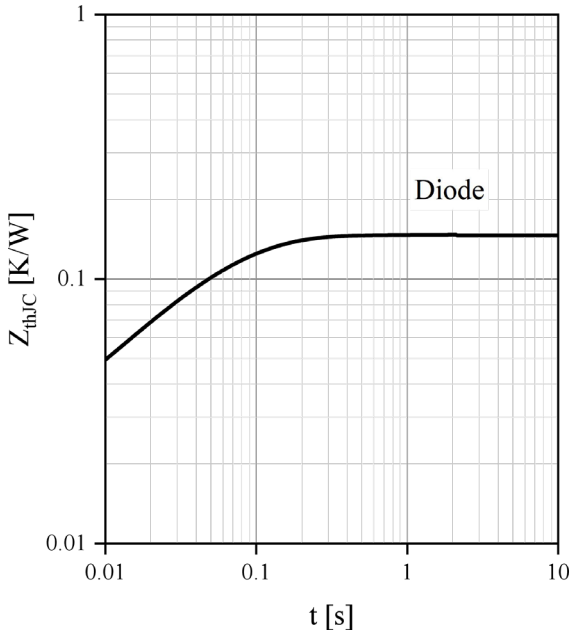


Figure 5: Diode Transient Thermal Impedance

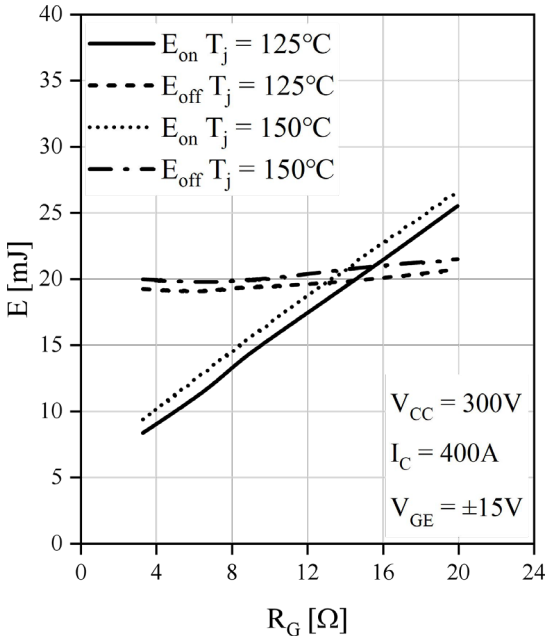


Figure 6: IGBT Switching Loss vs. R_G

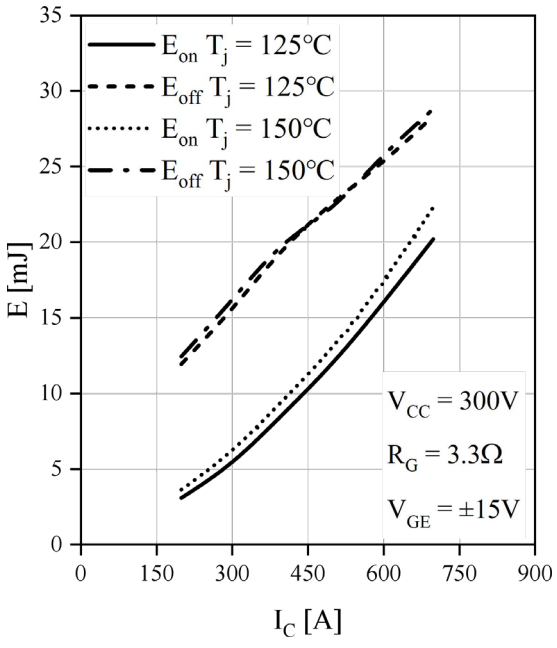


Figure 7: IGBT Switching Loss vs. I_C

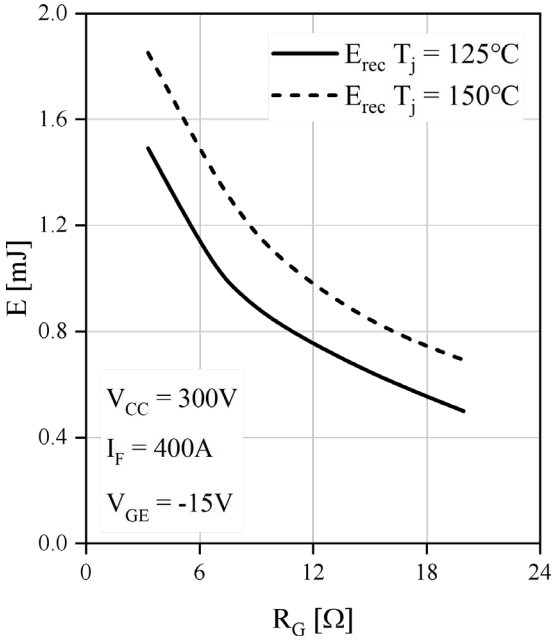


Figure 8: Diode Switching Loss vs. R_G

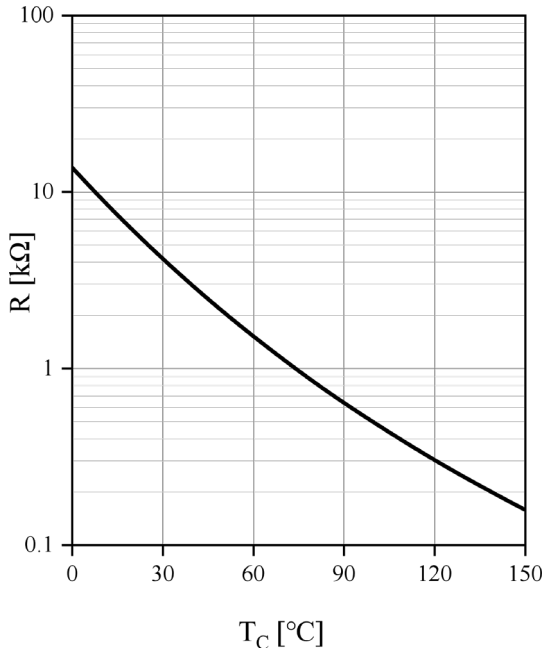
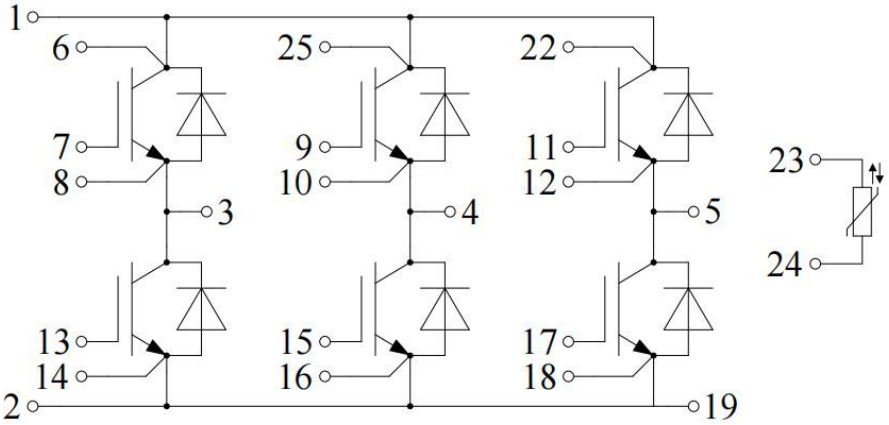
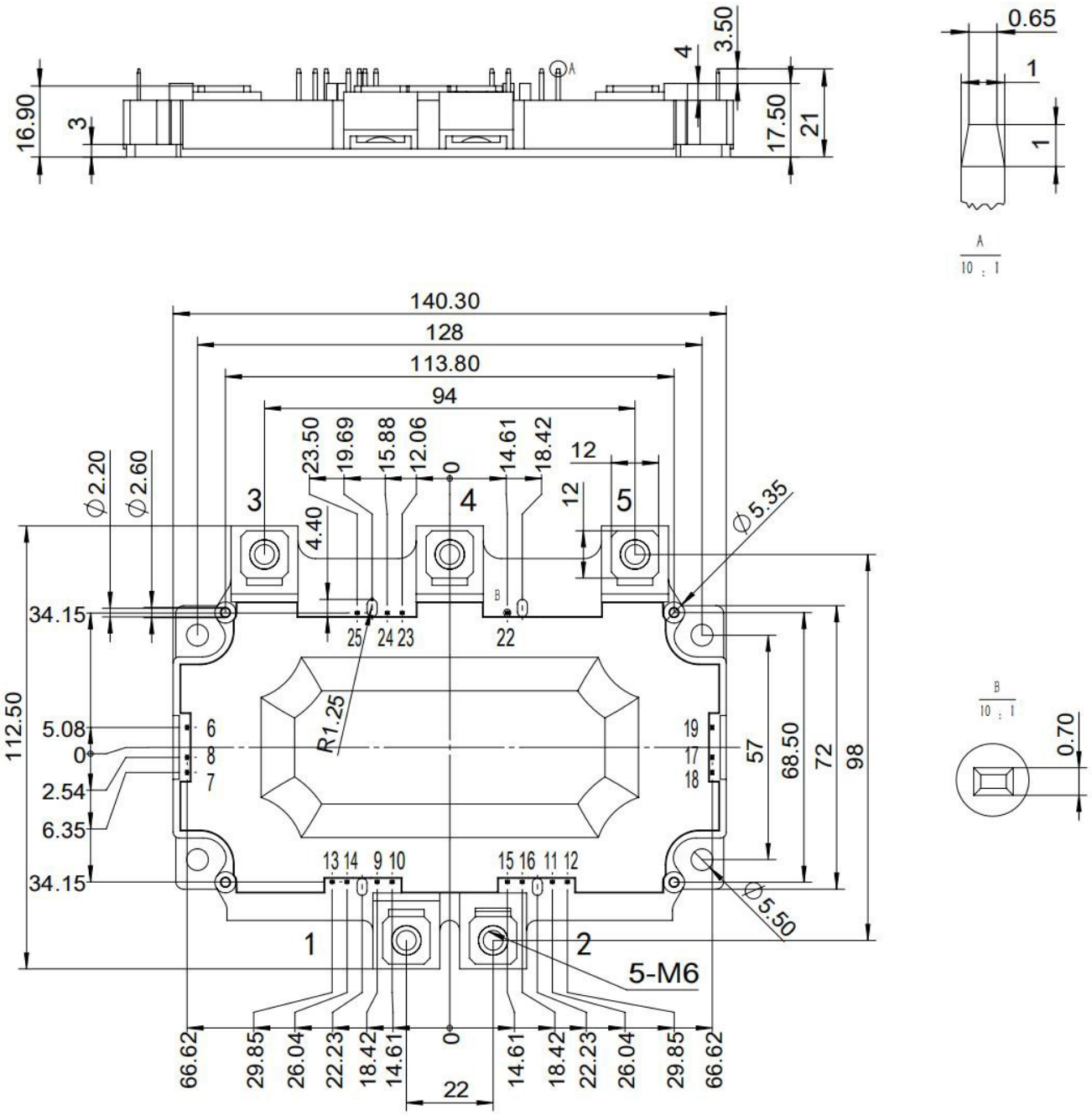


Figure 9: NTC Temperature Characteristic

Circuit Schematic



Package Dimensions



UNIT:mm