CISSOID
POWER SEMICONDUCTORS

CHT-NEPTUNE-1210 DATASHEET

Version: 4.9
14-Dec-23
(Last Modification Date)

High Temperature 1200V/10A Silicon Carbide MOSFET

General description

CHT-NEPTUNE-1210 is a High Temperature, High Voltage, Silicon Carbide MOSFET switch. It is available in a metal TO-257 package – the metal case being electrically isolated from the switch terminals. The product is guaranteed for normal operation on the full range -55°C to +225°C (Tj). The device has a breakdown voltage in excess of 1200V and is capable of switching currents up to 10A. The device features a body diode that can be used as free-wheeling diode.

Benefits

- High Temperature Operation
- Extended lifetime and high reliability
- Low Switching Energy enabling High Frequency Switching
- Pins electrically isolated from the case easing mechanical and thermal integration
- Seamless driving with HADES® gate driver solutions

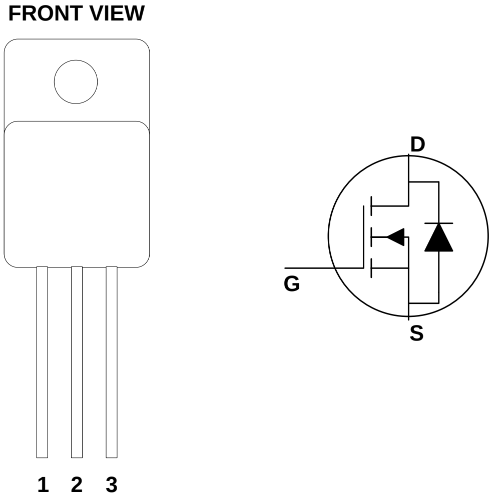
Features

- Specified from -55 to +225°C (Tj)
- V_{DS} Max: 1200V
- I_{DS} Max Continuous Current
  - 10A at T_C≤210°C
  - 8.7A at T_C=215°C
- Typical On-resistance
  - R_{DSon}= 40 mΩ @ 25°C
  - R_{DSon}= 120 mΩ @ 225°C
- Low Switching Energy
  - Eon= 240µJ
  - Eoff= 140µJ
- Voltage control: V_{GS}=-4V/20V
- Gate charge: Q_{GS}=22nC
- Low capacitance: C_{OSS}=76 pF
- Package: TO-257
- Thermal Safe Operation Area model
- Validated at 225°C for 1000 hours

Applications

- High Temperature, High Power Density and Extended Lifetime Power Converters
- DC-AC Converters for motor drives & actuator controls
- DC-DC converters
- AC-DC converters and battery chargers

Package Configuration



TO-257 (Pin1= Drain; Pin2= Source; Pin3= Gate)

Case isolated from pins 1/2/3

Case cannot be left floating in the application

Absolute Maximum Ratings

Gate-to-Source voltage V_{GS}	-5V to 22V
Drain-to-Source voltage V_{DS}	-0.5V to 1200V
Max DC Drain current I_{DS}	12A
Max pulsed drain current	12A
Max Junction temperature T_{jmax}	225°C
Power dissipation (*)	30W

ESD Rating (expected)

Human Body Model	>1kV

Operating Conditions

Gate-to-Source voltage V_{GS}	-4V to 20V
Drain-to-Source voltage V_{DS}	-0.5V to 1200V
Max DC drain current I_{DS} at $T_C \leq 210°C$	10A
Max DC drain current I_{DS} at $T_C = 215°C$	8.7A
Max pulsed drain current	10A
Junction temperature	-55°C to +225°C

(*): including switching losses

Electrical characteristics

Unless otherwise stated, T_j =25°C. **Bold** figures point out values valid over the whole temperature range (T_j =-55°C to +225°C).

Parameter	**Symbol**	**Condition**	**Min**	**Typ**	**Max**	**Unit**
Threshold voltage	V_{TH}	T_j=25°C ; I_D = 1mA; V_{DS} =20V		4.45		V
		T_j=225°C ; I_D = 1mA; V_{DS} =20V		3.28		V
Drain cut-off current	I_{DSS}	V_{GS} =0V, V_{DS}=1200V, T_j=25°C		20		nA
		V_{GS} =0V, V_{DS} =1200V, T_j=225°C		10		µA
		V_{GS} =-5V, V_{DS} =1200V, T_j=225°C		0.5		µA
Gate leakage current	I_{GSS}	V_{GS} =20V, V_{DS} =0V, T_j=25°C		5		nA
		V_{GS} =20V, V_{DS} =0V,T_j=225°C		20		nA
Static drain-to-source resistance	R_{DSon}	V_{GS} =20V, ID=10A, T_j=25°C		40		mΩ
		V_{GS} =20V, ID=10A, T_j=225°C		120		mΩ
Breakdown drain-to-source voltage (DC characterization)	V_{BRDS}	V_{GS} =0V; ID = 100 µA	**1200**			V
Input capacitance	C_{ISS}	V_{GS} =0V_{DC}, V_{DS} =600V_{DC} f = 1 MHz V_{AC} = 25mV		1337		pF
Output capacitance	C_{OSS}			76		pF
Feedback capacitance	C_{RSS}			30		pF
Turn-on delay time	$T_{d(ON)}$	VDS=600V; VGS= -4/20V; ID = 10A; RG= 6.8Ω; L = 856µH		21		ns
Rise time	T_r			39		ns
Turn-off delay time	$T_{d(OFF)}$			49		ns
Fall time	T_f			24		ns
Turn-On Switching Loss	E_{on}			240		µJ
Turn-Off Switching Loss	E_{off}			140		µJ
Internal gate resistance	R_G	V_{GS} =0$V_{DC;}$ f = 1 MHz; V_{AC} = 25mV		7		Ω
Gate to Source Charge	Q_{GS}	Tj=25°C ;VDS= 600V; ID = 10A; VGS = -4/20V		22		nC
Gate to Drain Charge	Q_{GD}			41		nC
Total Gate Charge	Q_G			107		nC

Thermal Characteristics

Parameter	**Symbol**	**Condition**	**Min**	**Typ**	**Max**	**Unit**
Junction-to-Case Thermal resistance	$R\Theta_{JC}$			0.95		°C/W

Reverse Diode Characteristics

Unless otherwise stated, T_j =25°C. **Bold** figures point out values valid over the whole temperature range (T_j =-55°C to +225°C). Timing definitions according to JEDEC 24 page 27

Parameter	**Symbol**	**Condition**	**Min**	**Typ**	**Max**	**Unit**
Diode forward voltage	V_F	Tj=25°C; VGS=-5V; IF=10A		3.6		V
		Tj=25°C; VGS=0V; IF=10A		2.7		V
Reverse recovery time	T_{rr}	Tj=25°C; VDS=600V; I_F=20A;dI_F/dt = 1100A/µS		25		ns
Peak reverse recovery current	I_{prr}			9		A

Typical Performance Characteristics

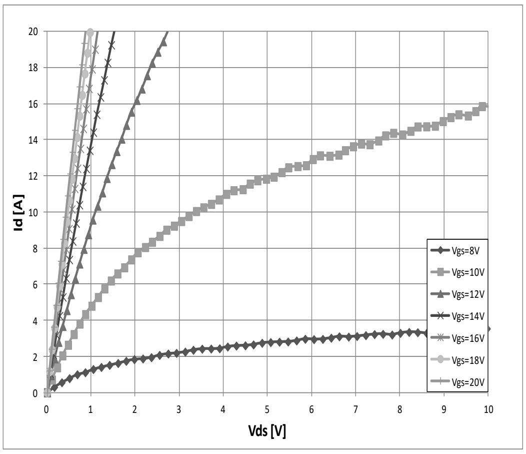


Figure 1: Drain current vs V_{DS} (T_j=25°C)

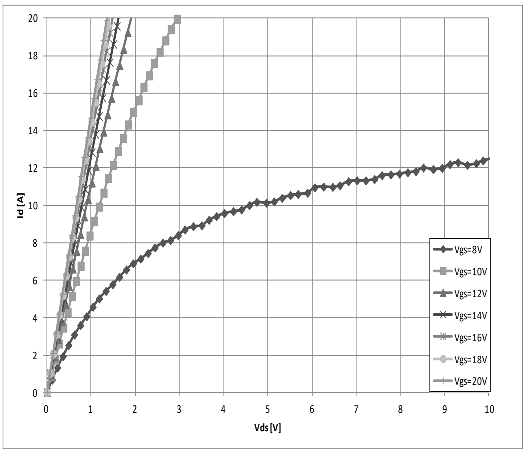


Figure 2: Drain current vs V_{DS} (T_j=125°C)

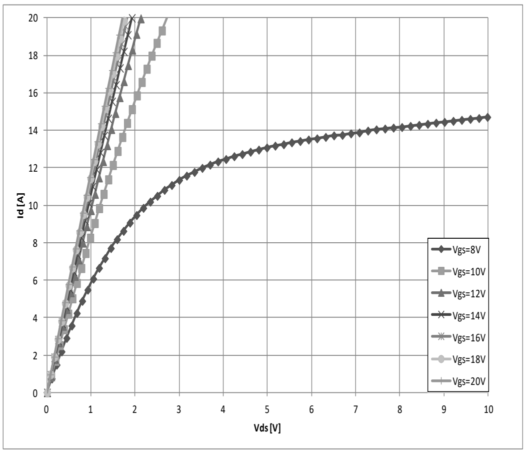


Figure 3: Drain current vs V_{DS} (T_j=175°C)

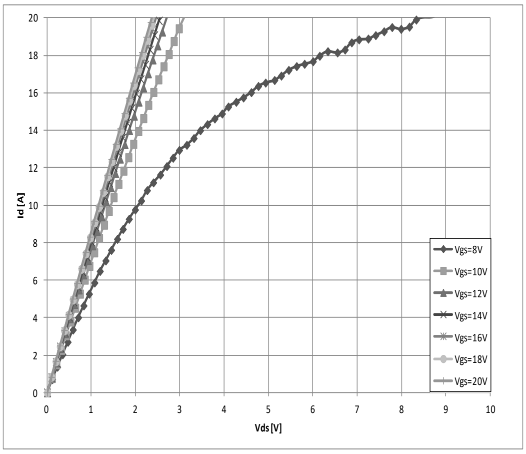


Figure 4: Drain current vs V_{DS} (T_j=225°C)

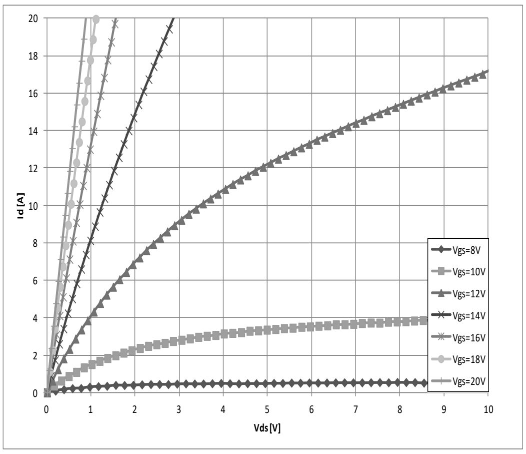


Figure 5: Drain current vs V_{DS} (T_j=-55°C)

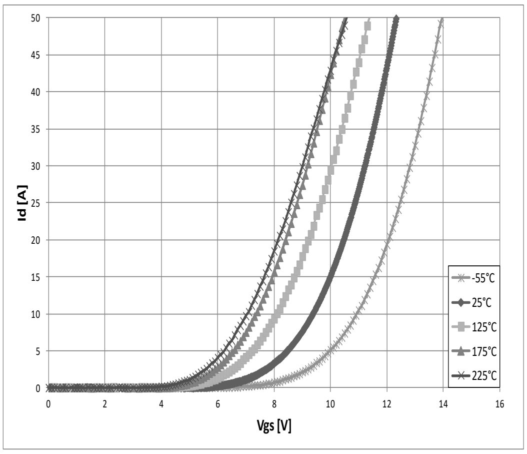


Figure 6: Drain current vs V_{GS} (V_{DS}= 10V)

Typical Performance Characteristics (cnt'd)

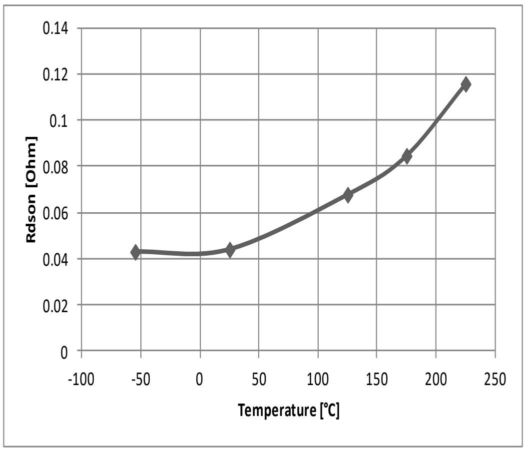


Figure 7: On-state drain source resistance vs. Temperature (V_{GS} =20V; I_{DS}=10A)

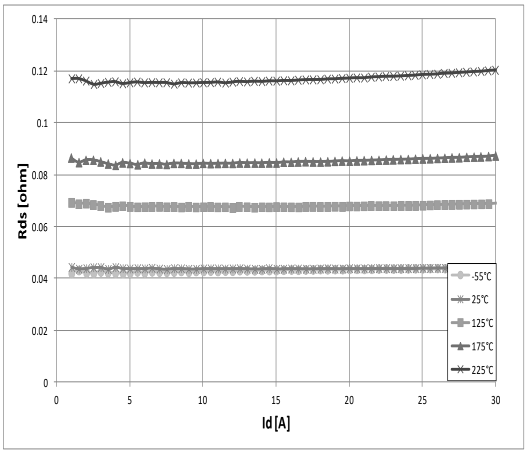


Figure 8: On-state drain source resistance vs. Drain current and temperature (V_{GS} =20V)

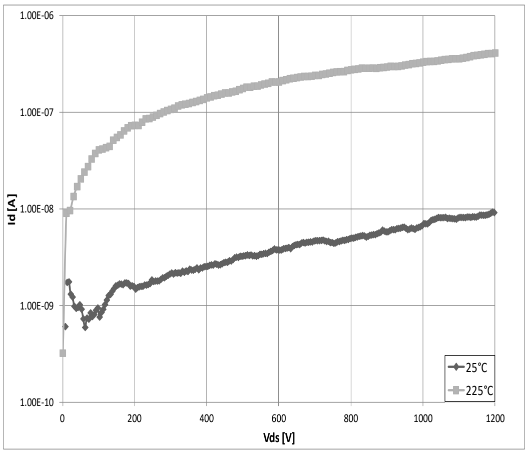


Figure 9: Drain current vs V_{DS} (V_{GS}= -5V)

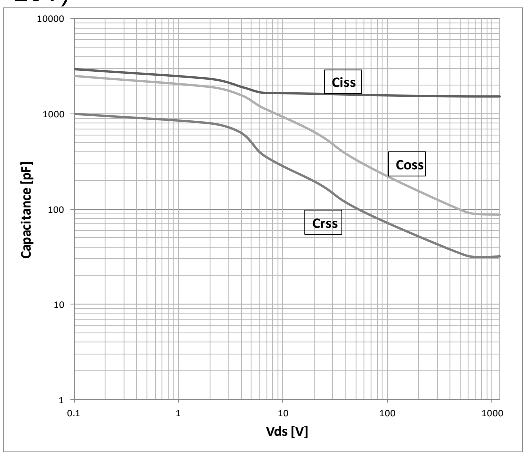


Figure 10:Capacitances vs V_{DS} (T_j=25°C)

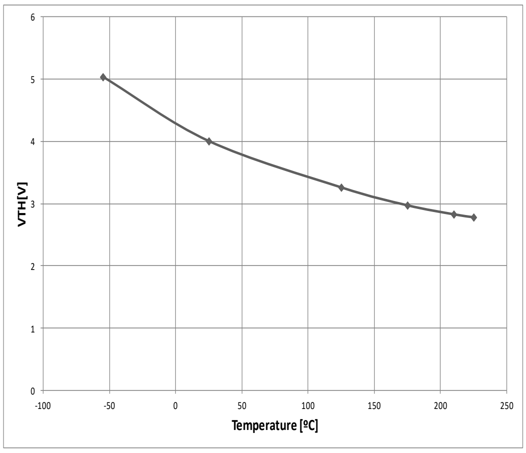


Figure 11: Threshold voltage vs temperature

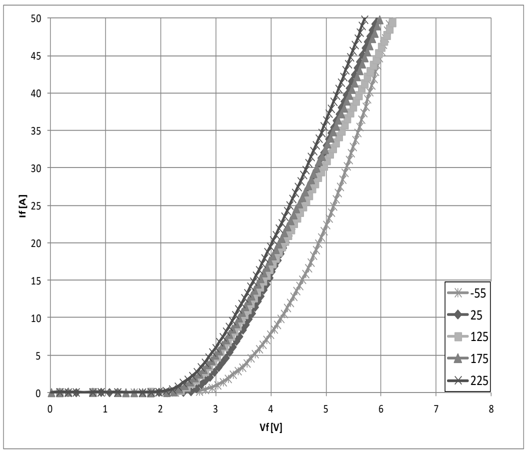


Figure 12: Diode I_F vs V_F (VGS=-5V)

Typical Performance Characteristics (cnt'd)

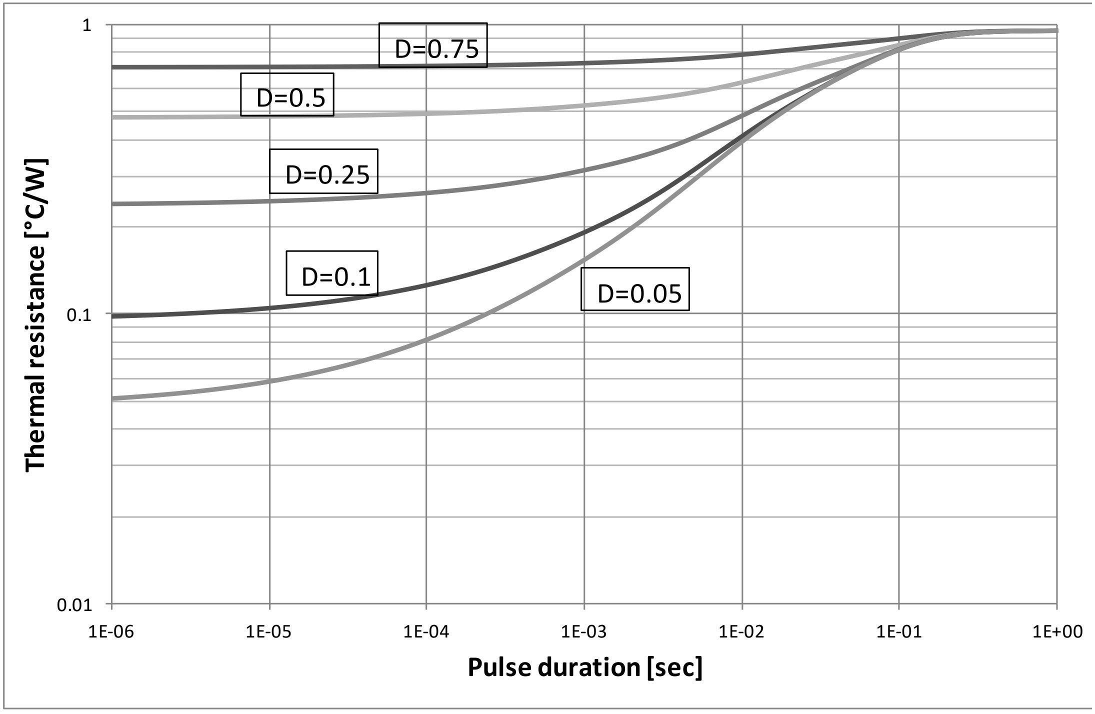


Figure 13: Transient thermal resistance

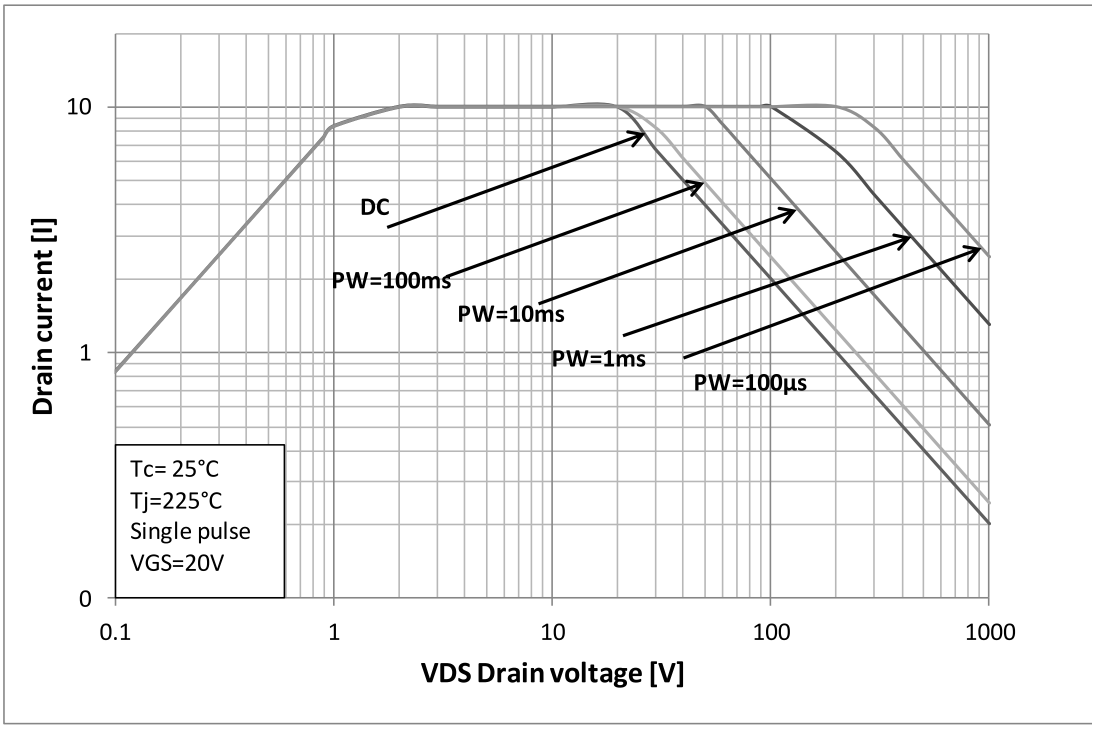


Figure 14: Safe Operating Area

Thermal Safe Operating Area

In power electronics, thermal design is an essential part of the design process. CHT-NEPTUNE-1210 device junction-to-case thermal resistance, R_{thJ-C} is very low (0.95°C/W). However, when designing the system, one needs to take into account the end-to-end junction-to-air thermal resistance which can be evaluated using FEA tools or physical measurements. With too high a thermal resistance, it is possible that any power device will experience thermal runaway. This situation should of course be avoided as it leads to the device destruction.

The graph below will help system designers to dimension their system properly. Firstly, it plots the device resistive losses as a function of temperature for different DC currents. Since Rdson increases with temperature, power dissipation increases with temperature as well. The curves do not include the dissipation due to switching losses which tends to be quite flat over the entire temperature range so therefore an offset may be applied to the curves to take it into account.
Secondly, it plots (in dotted lines) the behavior of the thermal system: the room temperature (point crossing the X-axis at zero power) at which the system operates (e.g. Ta=175°C in the graph example below) and the global junction-to-air thermal resistance (the slope of the straight lines).
To have a stable and healthy system, one needs to ensure that the dotted line (corresponding to the designed thermal system) and the relevant (function of the DC current flowing through the device) power dissipation line are crossing each other at a temperature point below the recommended maximum junction operating point of the device.

As examples:

- With a system thermal resistance of 10°C/W, using CHT-NEPTUNE-1210 with any DC current above 6A will lead a junction temperature outside of the recommended conditions.
- With a system thermal resistance of 2°C/W, the complete specified current range [0A-10A] can be used.

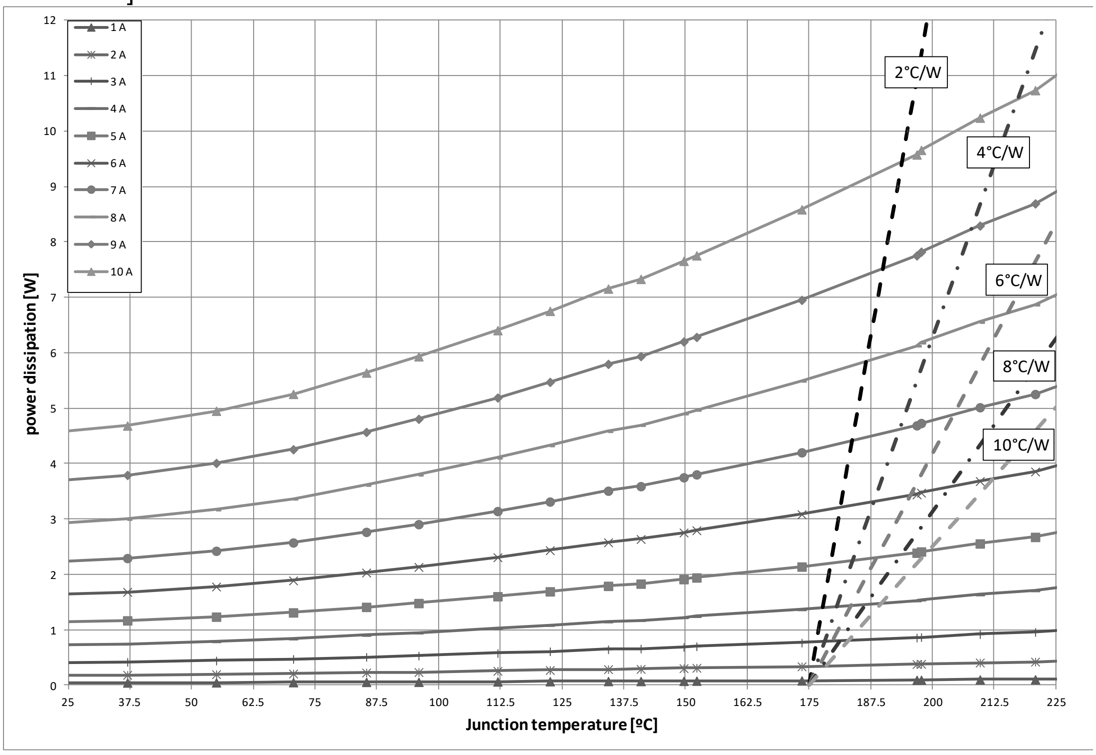
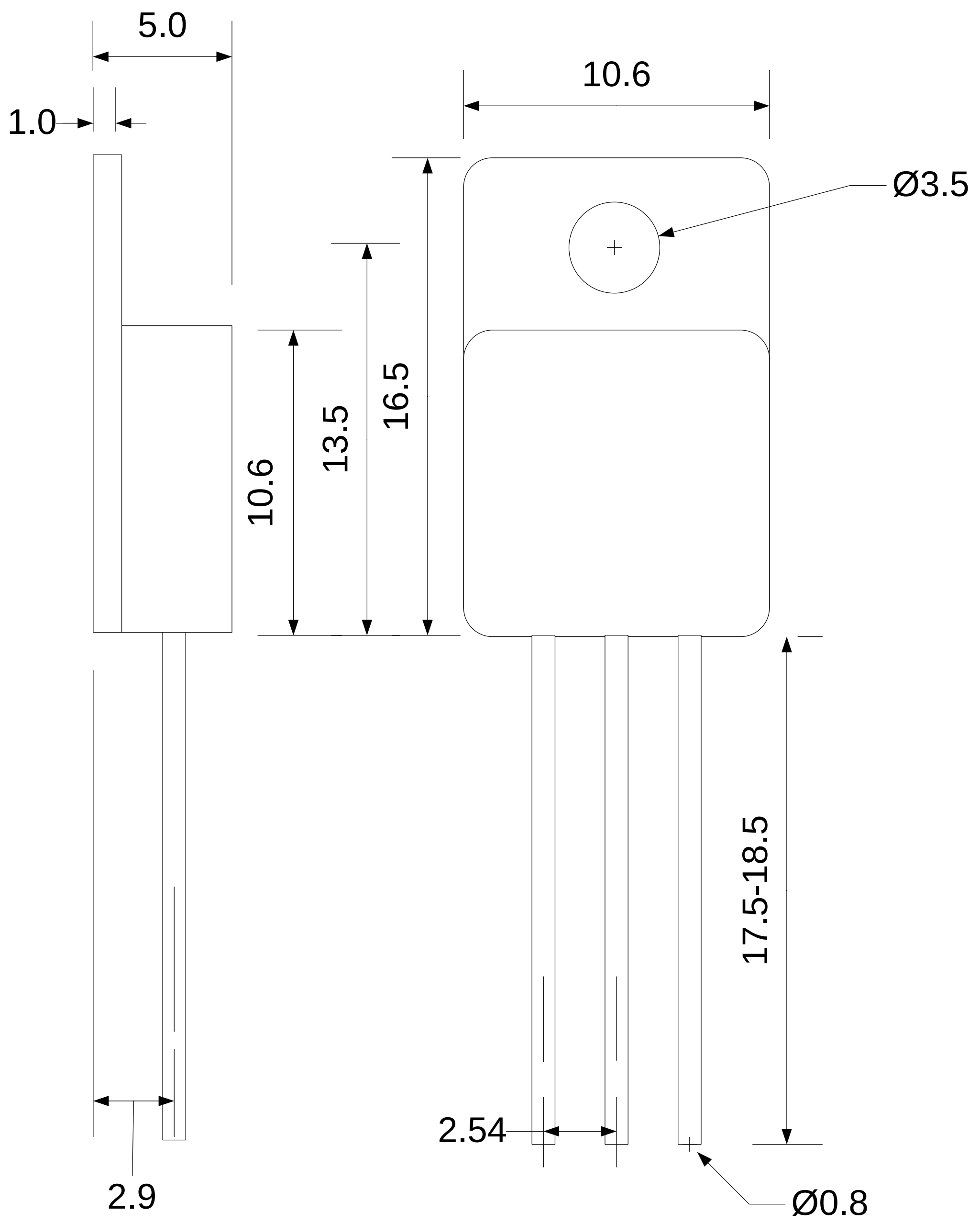


Figure 15: Thermal Safe Operating Area

Package Dimensions



Drawing TO257 (mm)

Ordering Information

Product Name	Ordering Reference	Package	Marking
CHT-NEPTUNE-1210	CHT-PLA8543E-TO257-T	TO-257 metal can	CHT-PLA8543E

Contact & Ordering

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