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**CHT-NEPTUNE-1210  
PRELIMINARY DATASHEET**Version: 4.3  
(see note 1)**High Temperature  
1200V/10A Silicon Carbide MOSFET**

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**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.

This new version D (PLA8543D), replacing obsolete version C (PLA8543C), offers lower On-Resistance with equivalent switching energies.

**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  $T_C \leq 210^\circ\text{C}$
  - 8.7A at  $T_C = 215^\circ\text{C}$
- Typical On-resistance
  - $R_{DSon} = 40\text{ m}\Omega @ 25^\circ\text{C}$
  - $R_{DSon} = 120\text{ m}\Omega @ 225^\circ\text{C}$
- Low Switching Energy
  - $E_{on} = 240\mu\text{J}$
  - $E_{off} = 140\mu\text{J}$
- Voltage control:  $V_{GS} = -4V/20V$
- Gate charge:  $Q_{GS} = 22\text{nC}$
- Low capacitance:  $C_{OSS} = 76\text{ pF}$
- Package: TO-257
- Thermal Safe Operation Area model

**Applications**

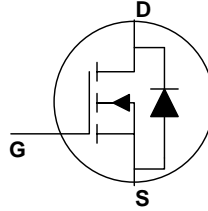
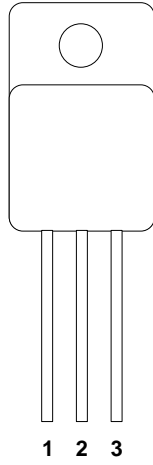
- High Temperature, High Power Density and Extended Lifetime Power Converters
- DC-AC Converters for motor drives & actuator controls
- DC-DC converters
- AC-DC converters and battery chargers

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1 Please always refer to the latest datasheet version available at <http://www.cissoid.com/files/files/products/planet/cht-neptune-1210.pdf>

## Package Configuration

FRONT VIEW



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

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**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

**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 $T_C \leq 210^\circ\text{C}$	10A
Max DC drain current $I_{DS}$ at $T_C = 215^\circ\text{C}$	8.7A
Max pulsed drain current	10A
Junction temperature	-55°C to +225°C

**ESD Rating** (expected)

Human Body Model	>1kV
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(\*): including switching losses

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PRELIMINARY

## Electrical characteristics

Unless otherwise stated,  $T_j = 25^\circ\text{C}$ . **Bold** figures point out values valid over the whole temperature range ( $T_j = -55^\circ\text{C}$  to  $+225^\circ\text{C}$ ).

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Threshold voltage	$V_{TH}$	$T_j = 25^\circ\text{C}$ ; $I_D = 1\text{mA}$ ; $V_{DS} = 20\text{V}$		4.45		V
		$T_j = 225^\circ\text{C}$ ; $I_D = 1\text{mA}$ ; $V_{DS} = 20\text{V}$		3.28		V
Drain cut-off current	$I_{DSS}$	$V_{GS} = 0\text{V}$ , $V_{DS} = 1200\text{V}$ , $T_j = 25^\circ\text{C}$		20		nA
		$V_{GS} = 0\text{V}$ , $V_{DS} = 1200\text{V}$ , $T_j = 225^\circ\text{C}$		10		$\mu\text{A}$
		$V_{GS} = -5\text{V}$ , $V_{DS} = 1200\text{V}$ , $T_j = 225^\circ\text{C}$		0.5		$\mu\text{A}$
Gate leakage current	$I_{GSS}$	$V_{GS} = 20\text{V}$ , $V_{DS} = 0\text{V}$ , $T_j = 25^\circ\text{C}$		5		nA
		$V_{GS} = 20\text{V}$ , $V_{DS} = 0\text{V}$ , $T_j = 225^\circ\text{C}$		20		nA
Static drain-to-source resistance	$R_{DS(on)}$	$V_{GS} = 20\text{V}$ , $I_D = 10\text{A}$ , $T_j = 25^\circ\text{C}$		40		$\text{m}\Omega$
		$V_{GS} = 20\text{V}$ , $I_D = 10\text{A}$ , $T_j = 225^\circ\text{C}$		120		$\text{m}\Omega$
Breakdown drain-to-source voltage (DC characterization)	$V_{BRDS}$	$V_{GS} = 0\text{V}$ ; $I_D = 100 \mu\text{A}$	<b>1200</b>			V
Input capacitance	$C_{ISS}$	$V_{GS} = 0\text{V}_{DC}$ , $V_{DS} = 600\text{V}_{DC}$ $f = 1 \text{MHz}$		1337		pF
Output capacitance	$C_{OSS}$	$V_{AC} = 25\text{mV}$		76		pF
Feedback capacitance	$C_{RSS}$			30		pF
Turn-on delay time	$T_{d(ON)}$	$V_{DS} = 600\text{V}$ ; $V_{GS} = -4/20\text{V}$ ; $I_D = 10\text{A}$ ; $R_G = 6.8\Omega$ ; $L = 856\mu\text{H}$		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		$\mu\text{J}$
Turn-Off Switching Loss	$E_{off}$			140		$\mu\text{J}$
Internal gate resistance	$R_G$		$V_{GS} = 0\text{V}_{DC}$ ; $f = 1 \text{MHz}$ ; $V_{AC} = 25\text{mV}$		7	
Gate to Source Charge	$Q_{GS}$	$T_j = 25^\circ\text{C}$ ; $V_{DS} = 600\text{V}$ ; $I_D = 10\text{A}$ ; $V_{GS} = -4/20\text{V}$		22		nC
Gate to Drain Charge	$Q_{GD}$			41		nC
Total Gate Charge	$Q_G$			107		nC

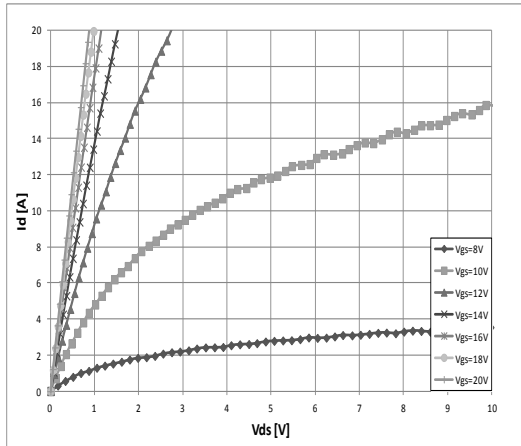
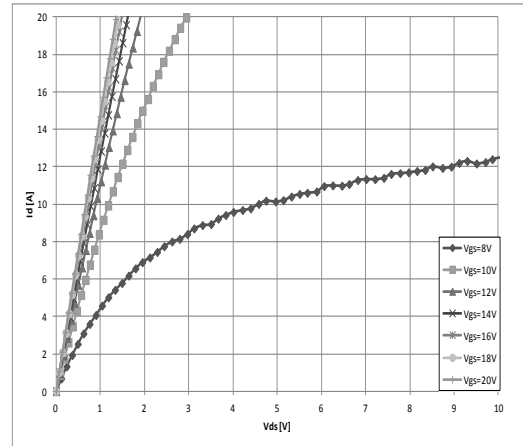
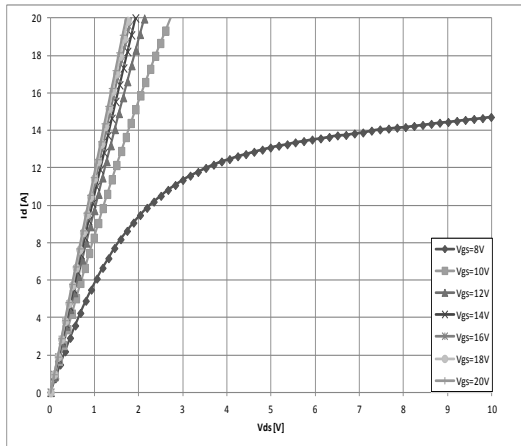
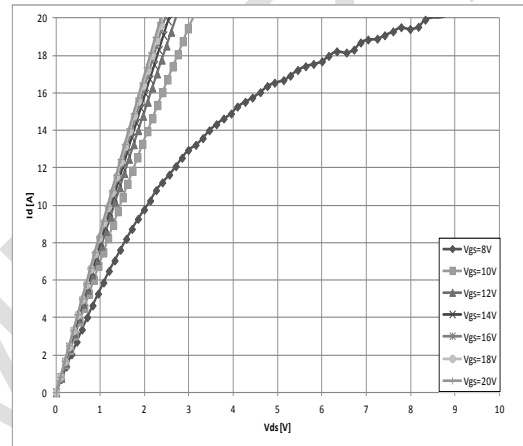
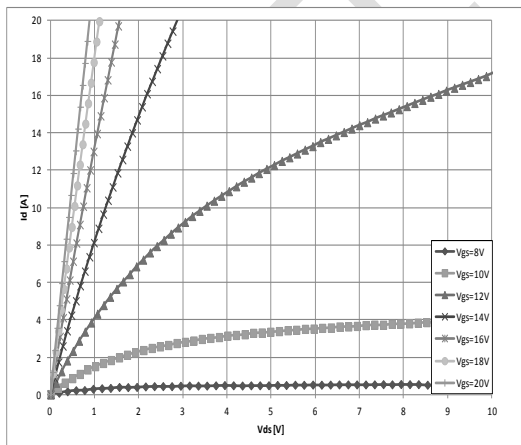
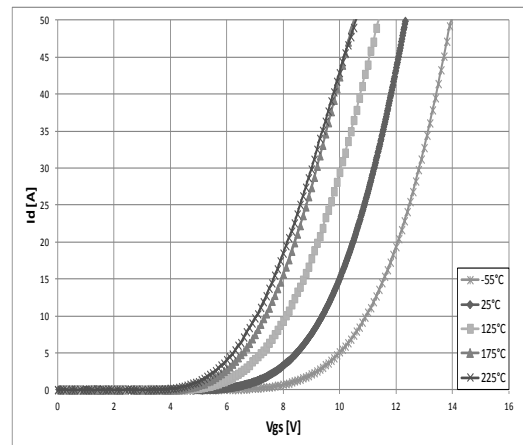
## Thermal Characteristics

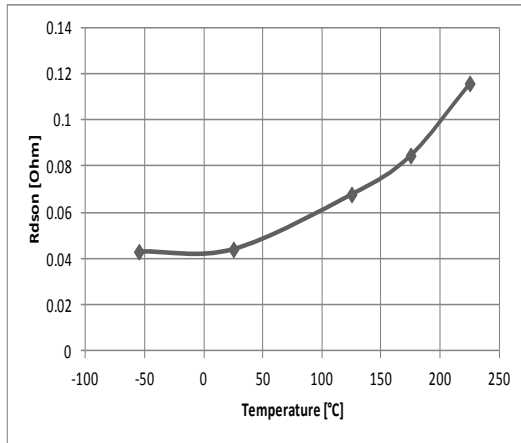
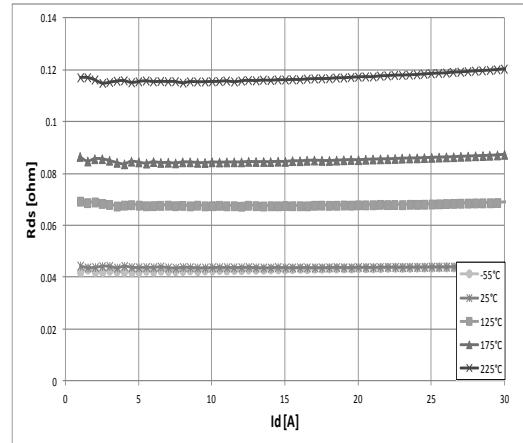
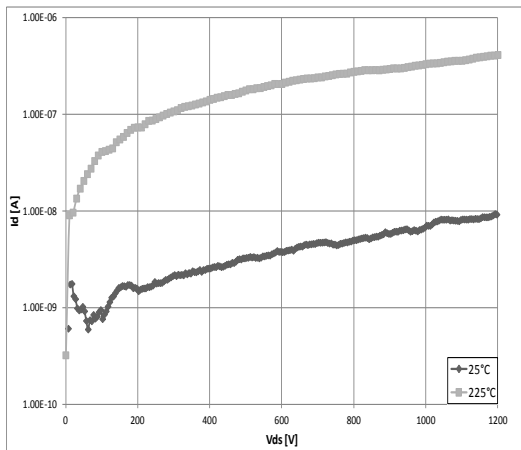
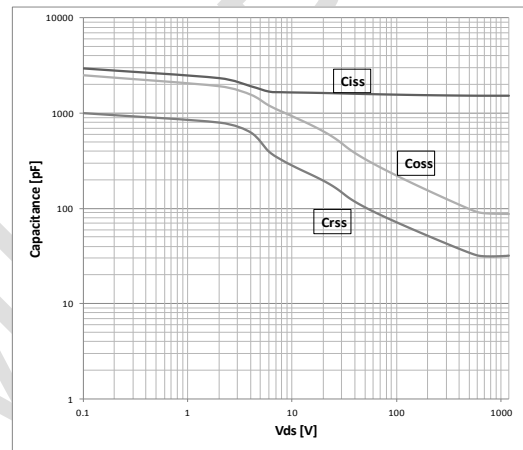
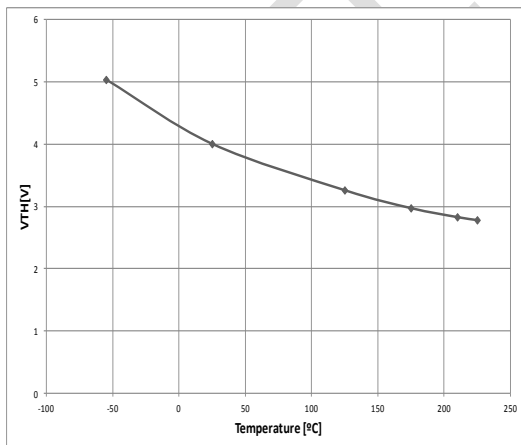
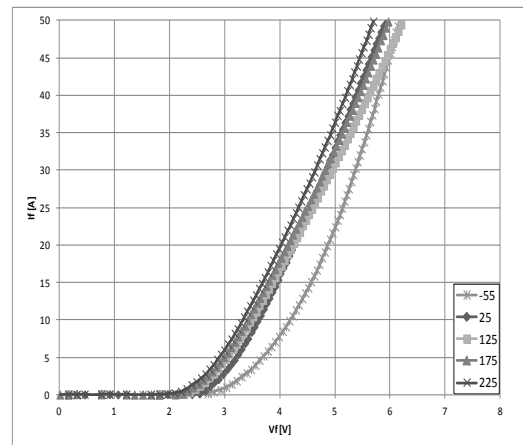
Parameter	Symbol	Condition	Min	Typ	Max	Unit
Junction-to-Case Thermal resistance	$R_{\theta_{JC}}$			0.95		$^\circ\text{C/W}$

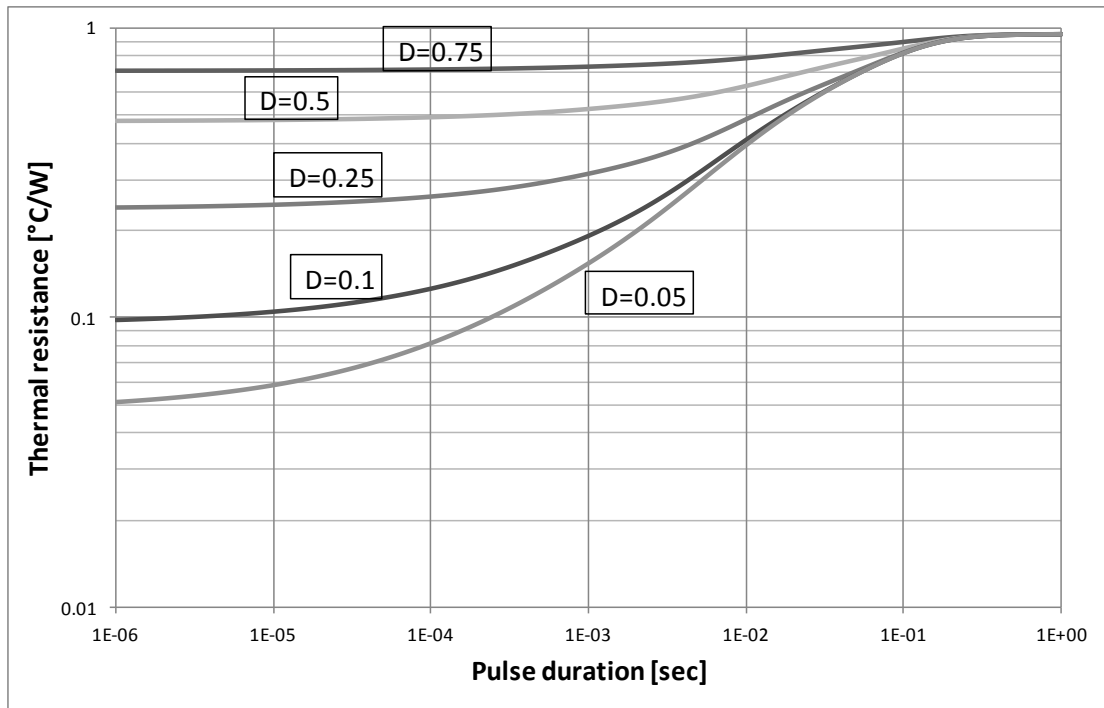
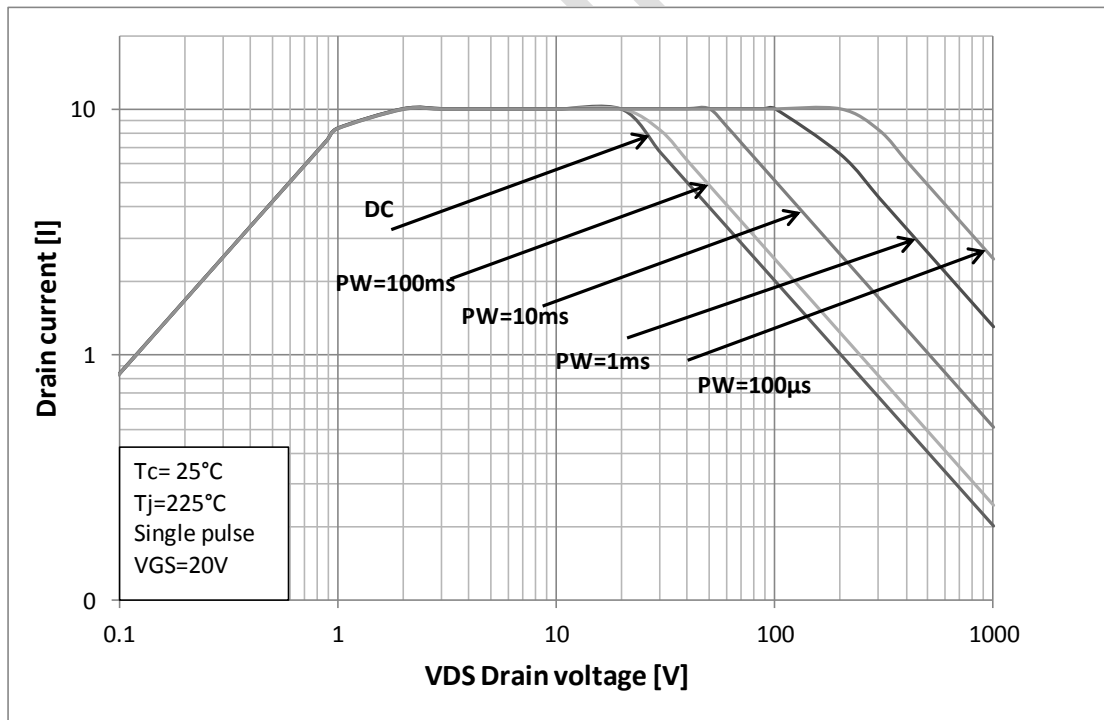
## Reverse Diode Characteristics

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

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Diode forward voltage	$V_F$	$T_j = 25^\circ\text{C}$ ; $V_{GS} = -5\text{V}$ ; $I_F = 10\text{A}$		3.6		V
		$T_j = 25^\circ\text{C}$ ; $V_{GS} = 0\text{V}$ ; $I_F = 10\text{A}$		2.7		V
Reverse recovery time	$T_{rr}$	$T_j = 25^\circ\text{C}$ ; $V_{DS} = 600\text{V}$ ;		25		ns
Peak reverse recovery current	$I_{pr}$	$I_F = 20\text{A}$ ; $di_F/dt = 1100\text{A}/\mu\text{S}$		9		A

**Typical Performance Characteristics**

**Figure 1:** Drain current vs  $V_{DS}$  ( $T_j=25^\circ\text{C}$ )

**Figure 2:** Drain current vs  $V_{DS}$  ( $T_j=125^\circ\text{C}$ )

**Figure 3:** Drain current vs  $V_{DS}$  ( $T_j=175^\circ\text{C}$ )

**Figure 4:** Drain current vs  $V_{DS}$  ( $T_j=225^\circ\text{C}$ )

**Figure 5:** Drain current vs  $V_{DS}$  ( $T_j=-55^\circ\text{C}$ )

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

**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  $V_{DS}$  ( $T_j = 25^\circ C$ )

**Figure 11:** Threshold voltage vs temperature

**Figure 12:** Diode  $I_F$  vs  $V_F$  ( $V_{GS} = -5V$ )

**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 ( $0.95^{\circ}\text{C/W}$ ). 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.

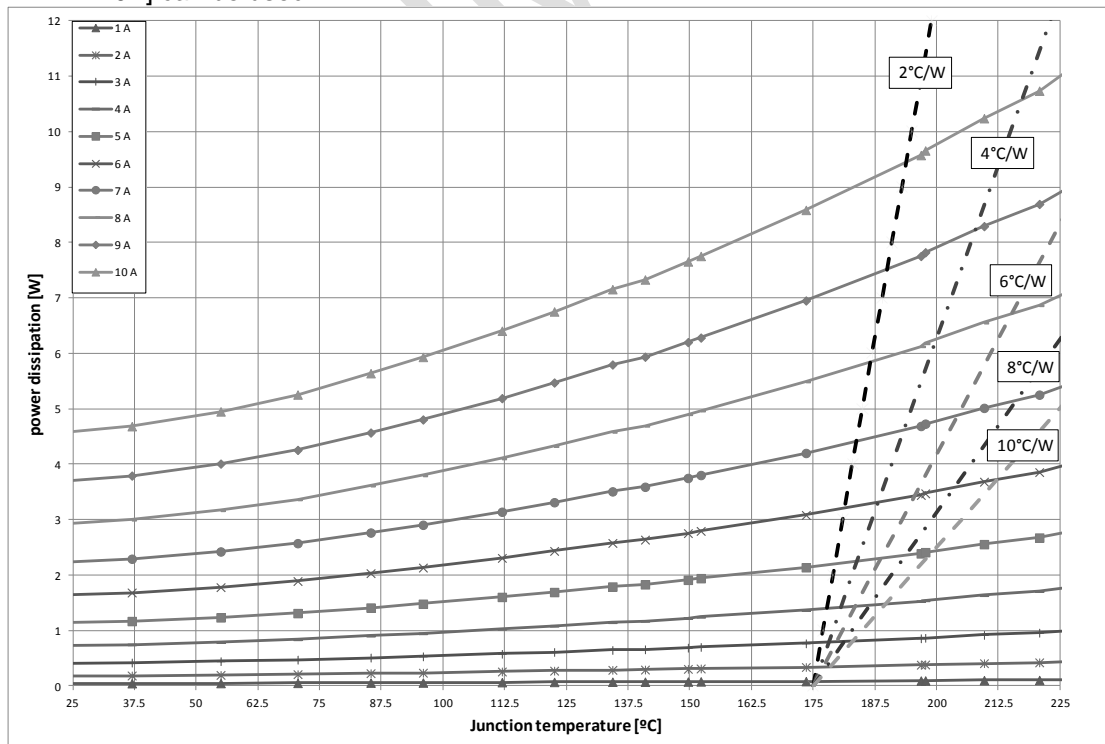
The graph below will help system designers to dimension their system properly. Firstly, it plots the device resistive losses as a function of temperature for different DC currents. Since  $R_{ds(on)}$  increases with temperature, power dissipation increases with temperature as well. The curves do not 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.  $T_a=175^{\circ}\text{C}$  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.

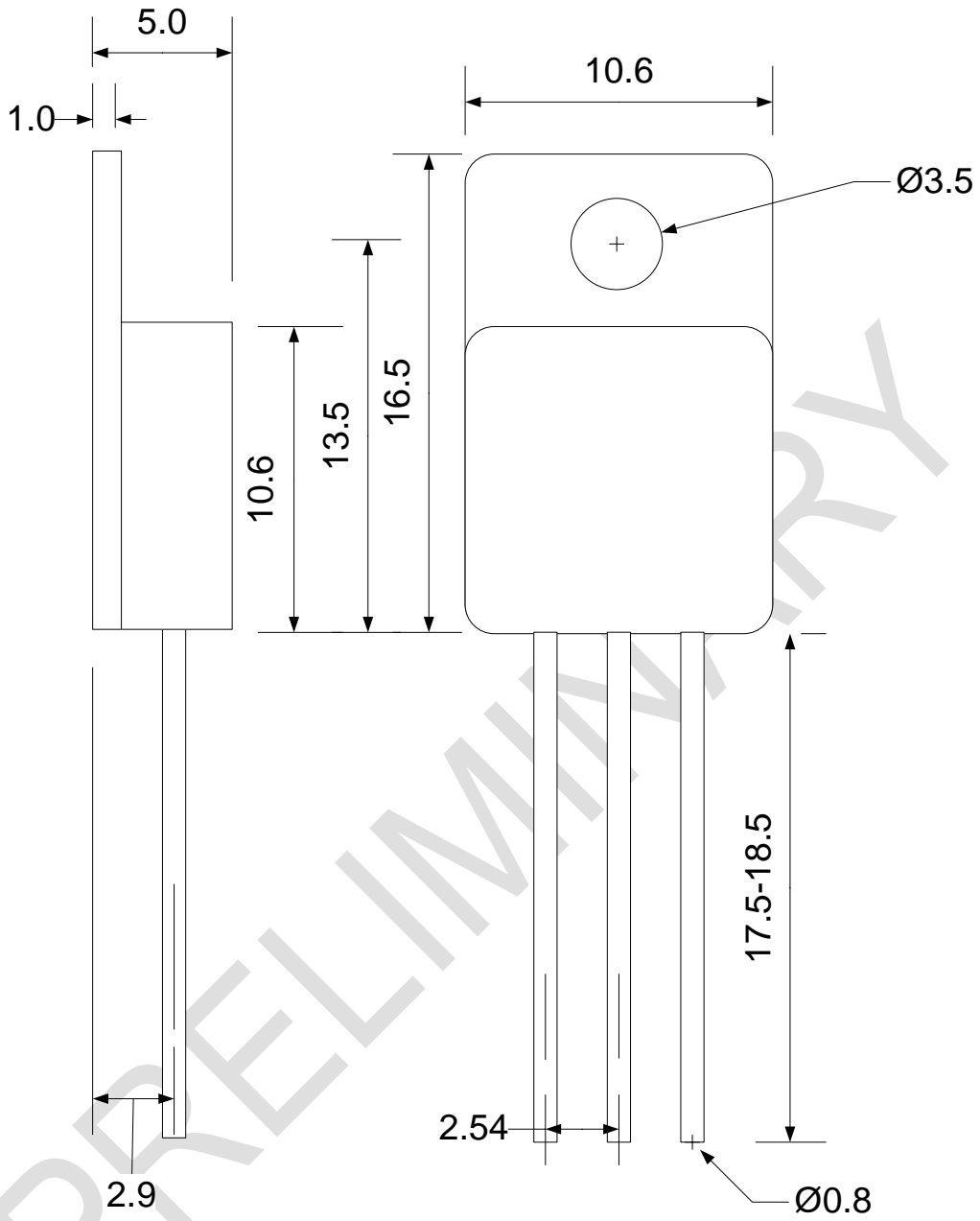
As examples:

- With a system thermal resistance of  $10^{\circ}\text{C/W}$ , 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  $2^{\circ}\text{C/W}$ , 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-PLA8543D-TO257-T	TO-257 metal can	CHT-PLA8543D

## Contact & Ordering

### CISSOID S.A.

<b>Headquarters and contact EMEA:</b>	CISSOID S.A. – Rue Francqui, 3 – 1435 Mont Saint Guibert - Belgium T : +32 10 48 92 10 – F : +32 10 88 98 75 Email : <a href="mailto:sales@cissoid.com">sales@cissoid.com</a>
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