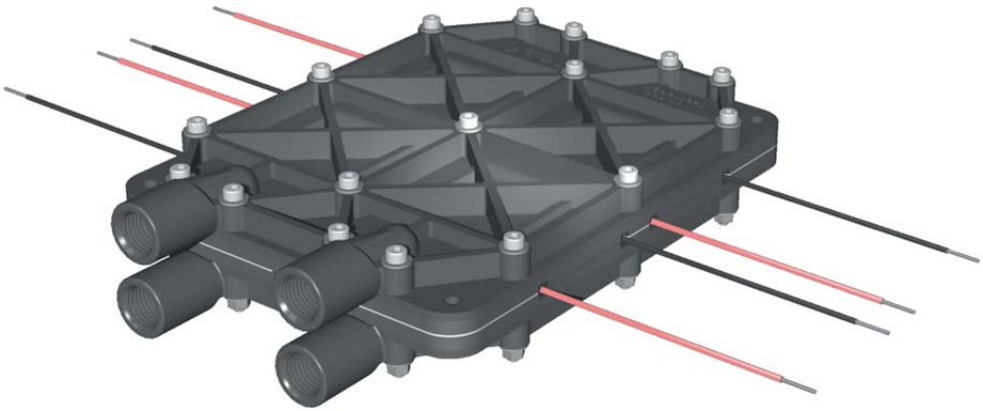
USER MANUAL

TCT 4 POWER PACK SERIES



 www.top-cool.eu

CONTENTS

Thank you for purchasing a TCT 4 Power Pack. Please read this manual carefully before installing and/or operating the product. Always keep it on hand for quick reference.

GENERAL

The cooling engine from the Power Pack series has 4 Peltier elements working together for producing a top level cooling performance for many applications. The 2 liquid circuits have patented direct surface contact with the Peltier elements. Together with the internal tabulators they create an optimal heat transfer from the element to the liquid to create maximum cooling performance. In a good operating and configured system, the power pack series can reach a coefficient of performance (COP) between one and three.

NAMING OF THE TCT4 POWER PACK SERIES

To determine what TCT unit you received/ordered, the unit has given an article code. The article code is build up as followed:

For example:

Type	Peltier type	Elec. Connection	Special features
TCT 4 -PP -	24V13A	- 4P	- TW.HT.NT

Type	TCT	Stands for patented Top-Cool Technology
Type number	4	Number of Peltier elements
Series name	PP	Power Pack series
Special versions	PPC	Power Pack Combi, 2 TCT's stacked together
	PPT	Power Pack Triple, 3 TCT's stacked together
	PPQ	Power Pack Quatro, 4 TCT's stacked together
Peltier type	..V..A	Maximum voltage and amperes of the TEC's
Electric connection	4P, 2P2S, 4S..	If the wires of the unit are already connected together, this section stands for the electric connection. Details under the electric connection section
Special features	TW	Means the TCT is twisted
	HT	Means the TCT is sealed for higher operating temperatures
	NT	Means there is no thread inside the nozzles
	HP	Means the TCT unit can handle higher pressures
	ST	TCT unit has special thread setup
	CT	Cascade TEC, means the TCT can reach a higher temperature difference.
	*	Others

PRECAUTIONS

WARNINGS FOR USE

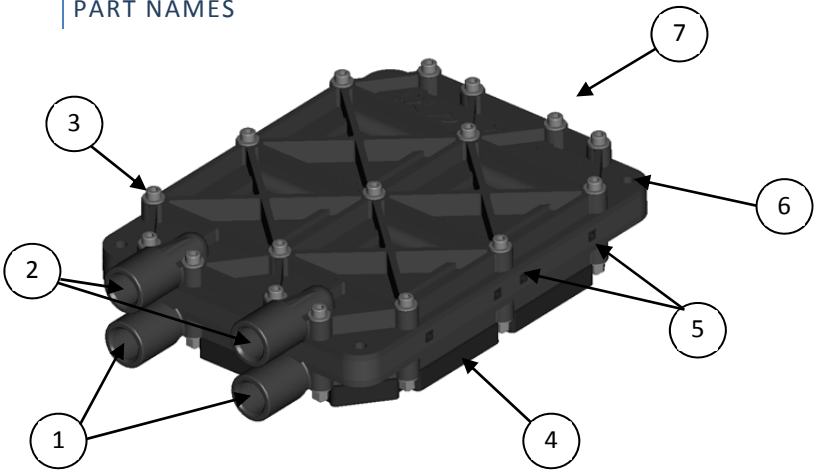
1. **<u>Do not use the TCT without active liquid flow on both sides</u>, <u>without active flow the unit will be damaged in seconds.</u>**
2. **Use the TCT-unit with a recommended liquid without contamination.**
3. **Before assembly and operating make sure you have read the manual.**
4. **Make sure the liquid temperatures stay in the recommended temperature range, make sure you remove enough heat in the warm loop!**
5. **Do not use the TCT on a higher voltage as recommended.**
6. **Do not use the TCT under higher pressures as recommended.**
7. **NEVER untighten the M3 fasteners or disassemble the unit.**
8. **Do not use a flow less than 1,5 L/min.**

ADDITIONAL NOTES

1. To make sure the TCT reaches his performance as showed on the datasheets there must be a 2 liter/min flow at both sides. With lower flow the performance can drop significant.
2. <u>Removing heat</u> out of the warm loop is important, if not enough heat is removed the performance will drop and you risk getting out of the recommended temperature range!

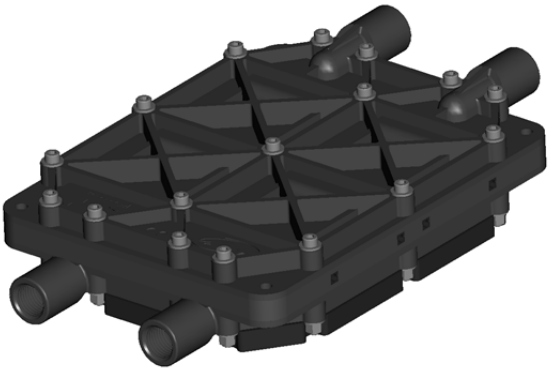
INSTALLATION INSTRUCTIONS

PART NAMES



1. Nominal cold side TCT (¼" BSP female ≈ G ¼)
2. Nominal hot side TCT (¼" BSP female ≈ G ¼)
3. M3 fasteners
4. Insulation pad on cold side (optional)
5. Wiring Peltier
6. M4 openings for attachment
7. Top-Cool label on the back

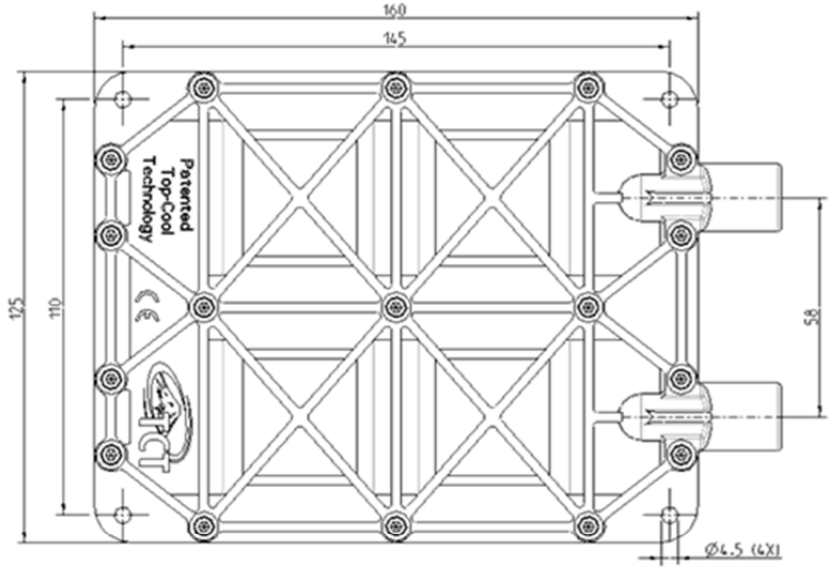
Twisted TCT unit:



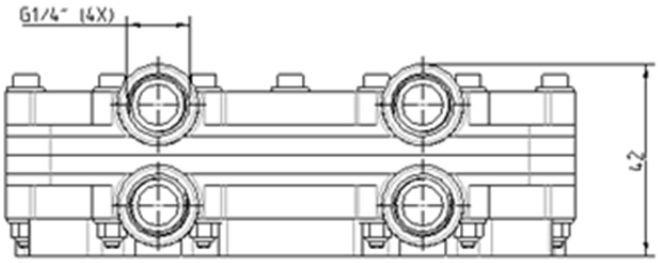
DIMENSIONS

Dimensions: 160 x 125 x 40mm
Weight: +/- 500 grams – Base Material: PP

Top & Side (dimensions in mm):



Front:

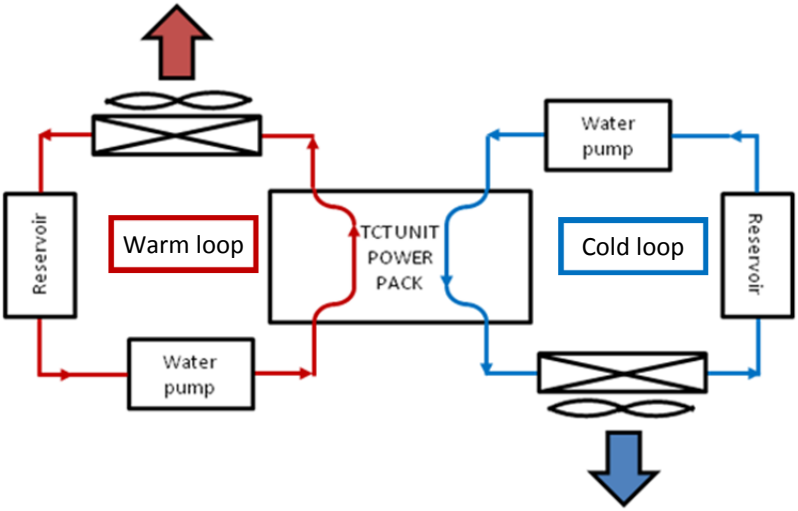


ITEMS PACKED WITH THIS TCT UNIT

1. This manual
2. Insulation Pad

BASIC USE TCT UNIT

The use of a TCT-unit inside a basic operating system works as follow. On both flows (hot & cold) the needed components: Radiator with fans, water pump and a reservoir. A sufficient power supply is needed for all the components especially the TCT unit, as



it consumes the most power.

Strongly recommended are the following recommended components that should be added on both liquid flows:

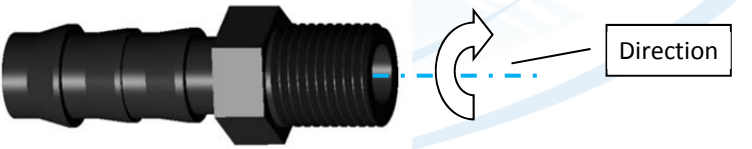
A. A flow switch that should turn of the power supply if there is no active liquid flow.
B. A temperature switch that turns of the power supply when the temperature gets outside its range.
C. A filter that can filter out small parts to make sure the liquid flow is free of contamination.

COMPONENTS RECOMMENDED FOR ASSEMBLY

1. Reservoir
2. Temperature controller
   Recommended security components:
3. Flow switch
4. Temperature switch
5. Filter, to filter out contamination in the flow.

ASSEMBLY

1. Caution: When BSPT couplings are used only hand tighten otherwise you risk breaking the nozzles of the TCT unit. BSPT couplings are tapered / conic!
2. For male BSP couplings its strongly advised to use a sealing cord and place it inside the thread. The sealing cord gives protection against cold and hot liquids. We recommend using Loctite 55, make 2-4 full loops and hand tighten the couplings (the nozzles can break when applied with too much force). When applied properly, this is leak proof at 1,5 bar pressure.



Example proper use of the sealing cord:

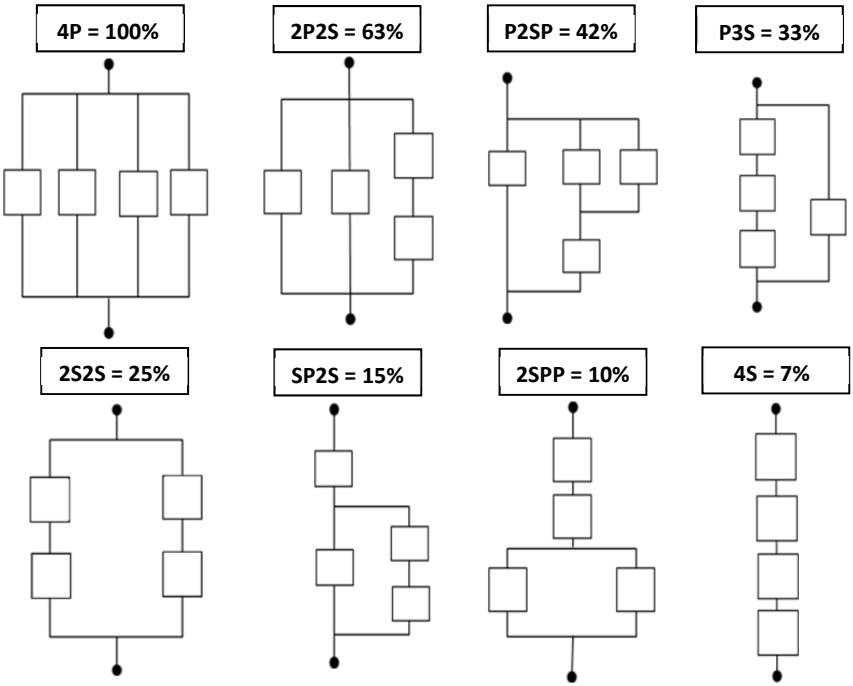
3. Use the M4 attachment holes for mounting the unit.
4. When using O-ring couplings, use at least a distance of 8mm of the thread to ensure the thread inside the TCT can handle the clamping force.
5. Mounting sets for (multiple) TCT-units available at Top-Cool.

ELECTRIC CONNECTION

The Peltier elements of a TCT-unit can be connected in different ways. This makes it possible to modify the characteristics of the unit in cooling power and COP without a adjustable power supply.

Cooling power of the TCT is maximum with highest power (4 parallel TEC's). Maximum coefficient of performance line (COP-line) is highest with the lowest power (4 serial TEC's). Below the theoretical percentages electric power compared to the maximum power line.

Electric input compared to the maximum input line (4P):

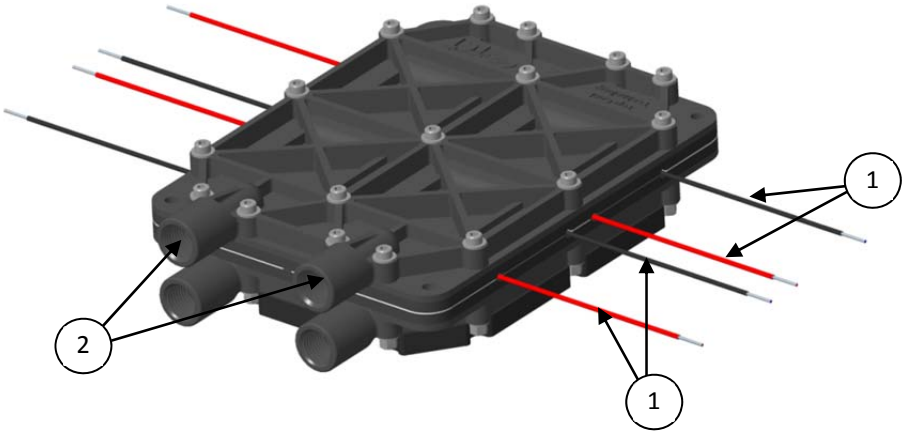


Influence of the electric power on the performance of the TCT can be found on the datasheets on the website: www.top-cool.eu.

ELECTRIC WIRING

The following information is very important for a good and safe working system. Electrical work should be performed by a qualified operator, always observe applicable codes or regulations.

The wires of the TCT should be connected as followed, the red wire is positive (+), the black wire is the neutral conductor / negative (-). When connected correctly the top side of the TCT will be the hot side. The top side is on top when all the black wires of the peltier are right from the red wire (also notice the red sticker on this side):



1. Red wire is on the left, black wire on the right.
2. Conclusion: Top is nominal hot side.

For a good electric connection please make sure the wires are attached properly. Cable eyes in combination with heat shrinks is an example for a good and save electric connection.

Connecting a lot of peltier's together may result in a high current, make sure you use the proper diameter for wiring (higher amperes means higher heat loss in the wiring, this can damage the wiring).

OPERATING INSTRUCTIONS

OPERATING TEMPERATURE CONDITION

Recommended operating temperature range:

	Water (˚C)	MEG 40% -26 (˚C)	MPG 40% -22 (˚C)
Hot side out	50	50	50
Cold side out	5	-21	-17
Hot side out (high temperature TCT)	70	70	70

OPERATING ELECTRIC POWER

Recommended operating electric output for cooling purpose:

	Max Voltage	Max Power TCT
4x Peltier 24V	18	750
4x Peltier 15,6V	12	500

OPERATING PRESSURE

Do not use the TCT-unit in an operation system where the pressure is higher than 1 bar in the unit. The units get tested at a pressure of 2,5 bar but it's not advised to constantly use the unit at this pressure.

OPERATING LIQUIDS

Only use the following liquids with the flow of the TCT. Top-Cool doesn't support or give warranty if any other liquid is used as stated below.

- Clean water / demineralised water
- Mono ethylene glycol (MEG), till 50% MEG / 50% water (-37˚C)
- Mono propylene glycol (MPG), till 50% MPG / 50% water (-34˚C)

The cold-side can freeze if the liquid used is operating near its freezing temperature. The peltier surface at the cold side is colder than the liquid: the liquid will always freeze inside the unit first! This may damage the TCT-unit and will void warranty! Please make sure you always use the liquid with at least 5 degree difference from its freezing temperature.

Observe the viscosity of the liquid, at low temperatures viscosity of the advised coolants can be very high which results in an increased flow resistance and need for a higher pump head of the pump to reach the same flow.

Observe if the flow is clear of air, air bubbles in the flow can influence performance of the TCT.

OPERATING UNDER ATEX

When operating under ATEX guidelines please make sure you have ordered the unit with an ATEX label from Top-Cool. (For equipment and protective systems intended for use in potentially explosive atmospheres).

MAINTENANCE

The TCT-unit does not require any maintenance at short terms.

When operating the TCT-unit with high fluctuations of temperature and/or pressure a risk occurs that the fasteners loose it's formal tension. It's advised to use a TCT-unit with special features, or retighten the fasteners with 1,1 Nm torque when needed.

When the unit is polluted, clean outer surface with a water wedded cloth. Do not use other fluids or solvents.

Basic maintenance on system components:

1. Make sure the level of the water inside the reservoir is between min and max level.
2. Make sure there is no contamination is inside the liquid.
3. From time to time check if the recommended security components are still working properly.
4. If you are using a filter, make sure you clean/replace the filter from time to time, polluted filters can slow down the flow dramatically.

TROUBLESHOOTING

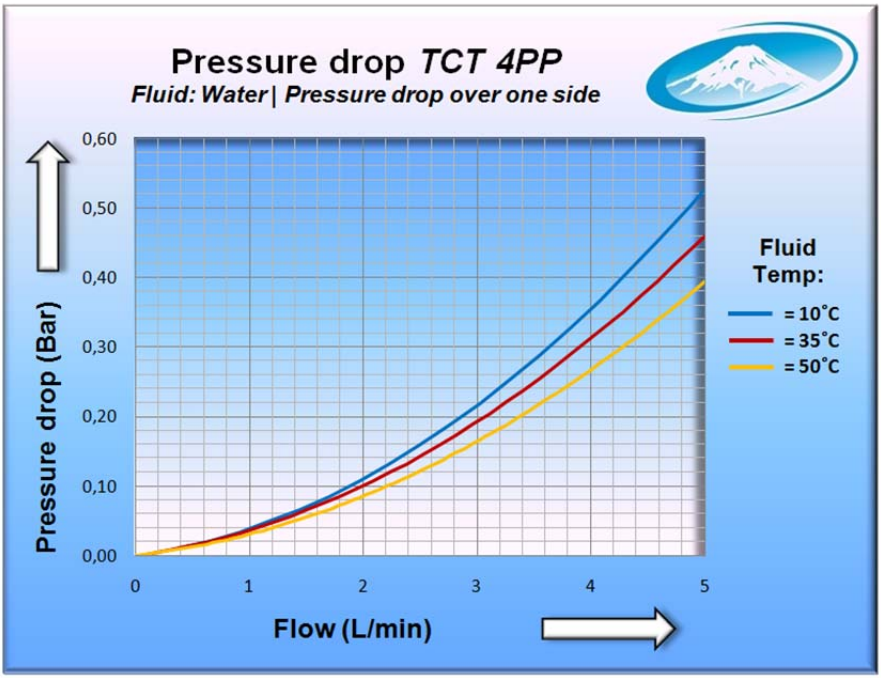
Please try to following instructions before calling for service:

States	Possible cause	Instruction
TCT-unit is not heating / cooling correctly	Wrong wiring	Inspect wiring
	Power capacity shortage	Check if the TCT-unit receives enough electric power from the power supply
	Not enough flow	Measure the flow with a flow meter, flow needs to be at least 1,5 L/min
TCT-unit is not heating / cooling	The peltier elements are broken	Check if the peltier elements are still working by measuring their electrical resistance
	No electric power	Inspect power supply
	Wrong wiring	Inspect wiring
TCT-unit leakage	Fasteners are loose	Tighten the fasteners with 1,1Nm torque
	Power was on without a flow on both sides	The unit is permanently damaged

DATASHEETS

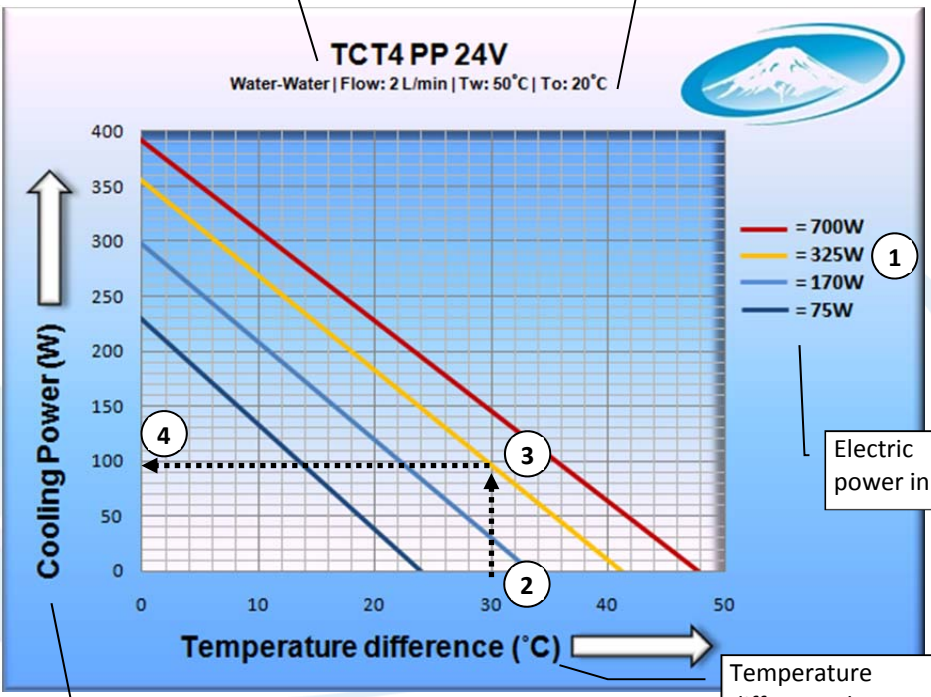
This section contain some datasheets of the TCT4 power pack. The datasheet given in the 'how to read a performance sheet' section is an example only, and probably won't be equivalent to the performance sheet of your TCT-unit. The specific performance datasheets of your unit can be found on the website: www.top-cool.eu.

PRESSURE DROP



The pressure drop over the TCT against the flow in liter/minute trough one side, at 10, 35 and 50 degrees Celsius.

HOW TO READ A PERFORMANCE SHEET



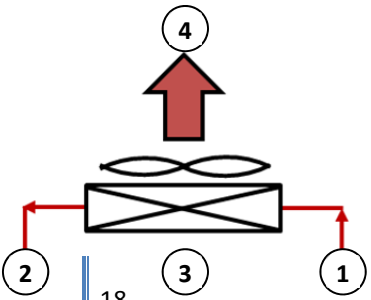
A basic example: We have the basic operation system (p.8) with both flows 2L/min, ambient temperature of 20 degrees. The hot side of the TCT on 50 degrees and the TCT working on 325W electric power (1). We want to stay top cool at 20 degrees Celsius. We have a temperature difference between both flows of 30 (50-20) degrees Celsius (2). At the graph we can see our work point (3) and on the vertical axis we can read that we can have around 100W (cooling power) load on the cool side with this type of TCT (4).

More advanced example: We have the basic operation system (p.8) with both flows 2L/min, an ambient temperature of 20 degrees. The hot side of the TCT on 50 degrees. There is an electric car battery pack to be top cooled (the battery pack must stay below 30 degrees), with these conditions it requires 600W cooling power to do this. How many electric input is needed to reach the conditions?
As seen in the sheet one TCT-unit cannot reach the requirements, but stacking of TCT's can. As the TCT's have linear behavior you can just add up the cooling power. So at a temperature difference of 10 degrees and a cooling power of 300W we need , as we can see in the graph, between 325 and 700W electric input, so around 500W of electric input. When we use two we can add up the cooling and electric power and reach 600W cooling with 1kW electric input and the battery pack can be cooled with two TCT's of this type.

HOW TO DESIGN A BASIC OPERATING SYSTEM

This example is based on a basic system like on page 8 of this manual.
We have the basic system with the radiator and fan combination to remove the heat from the cooling system. If we take the same data from the basic example on previous page, we have a hot side of the TCT of 50 degrees Celsius (1), electric power of 325W, around 100W cooling power, an ambient temperature of 20 degrees (3) and a flow of 2 liters/min.

To ensure the temperature of the cold side of the system, and thus the cooling power of the system, we need enough heat removal. The heat to be removed equals the electric power added and the cooling power (325W + 100W). What we need is a radiator + fan combination that can remove 425W from the flow at a temperature difference between the liquid (pos. 1) and the ambient temperature (pos. 3), 30 degrees Celsius (50-20). If the specific radiator + fan combination is placed and operating, pos. 2 will have a temperature around 47 degrees. The temperature of pos. 4 after the radiator + fan will be higher than the ambient temperature.



Using this specific radiator makes sure the cool loop of the TCT runs, with the

operating specifications, at 20 degrees Celsius (With the specs. the unit can create a temperature difference of 30 degrees).

ADDITIONAL INFORMATION

TIPS

1. If there is doubt about a (sufficient) flow, you can use a flow switch, a flow meter or a flow indicator (like a propeller) in the flow to visually check if there is still a flow in the system.
2. You can use the TCT-unit for cooling but also for heating! It is possible to combine these two options in one application.
3. If any doubts occur how to use the unit otherwise as listed in this manual, contact Top-Cool for instructions or confirmation.

SAFETY INSTRUCTIONS

1. Before making any modifications in your operation system, or disconnecting the TCT-unit, turn off the electric power of all system components.
2. Make absolutely sure the electric power to the TCT is off BEFORE you shut down the pump(s).
3. Always follow the instructions and regulations conform this manual.

TECHNICAL SPECIFICATIONS

Base material	Polypropylene (PP)
Material fasteners and bolts	Stainless steel
Connection size normal unit	¼" BSP ≈ G ¼
Testing pressure	2,5 bar
Testing pressure high pressure unit	5,0 bar
Noise level	0 dB(A)
Outside dimensions normal TCT-unit	182 x 125 x 40mm
Outside dimensions twisted TCT-unit	202 x 125 x 40mm
Electric voltage range single TEC 24V	0-18VDC
Electric voltage range single TEC 15V	0-12VDC

MARKS USED

Caution: Read these chapters very carefully, the information given is very important for security, installation and operating.

Important information: concerning the electric wiring and power.

Important information: concerning assembling the unit and maintenance to a total system.

Important tips

ENVIRONMENTAL

For disposal of any damaged or used TCT-unit, dispose accordance local regulations.

The TCT-unit does not contain any of the 'restriction of hazardous substances' (RoHS) listed substances.

CERTIFICATIONS

The TCT-unit is in conformity with the following guidelines:


TOP-COOL

CE

EC DECLARATION OF CONFORMITY

We: Top-Cool Products B.V.
Groeneweg 37B
5993 NN Maasbree
The Netherlands

Hereby declare in our sole responsibility that the product:

TCT cool-unit TCT4 Power Pack series

According to the requirements of the Directive
ATEX Directive 94/9/EG
Equipment and protective systems intended for use in potentially explosive atmospheres

Ex II, 3 G/D, Eex nC, IIC, T6, IP54 (Standard version)
Ex II, 3 G/D, Eex nC, IIC, T6, IP67 (Sealed version)

Which is the subject of this declaration, is in conformity with the following standards or normative documents.

NEN-EN-IEC 60079-14
NEN-EN-IEC 60079-15
NEN-EN-IEC 60529

Maasbree, 12 September 2011 Ing. Marc Zelissen (Director)

Top-Cool Products B.V. Groeneweg 37B 5993 NN Maasbree E-Mail: info@top-cool.eu Tel.: +31 077 465 0142 Fax: +31 077 465 0143 Web: www.top-cool.eu CoC no.: 14105220 VAT no.: NL8195.78.633.B01 TOP-COOL

CE

<u>CE, declaration of conformity</u>

The product is in conformity with the essential requirements of the applicable EC directives.

NEN-EN-IEC 60079-14
NEN-EN-IEC 60079-15
NEN-EN-IEC 60529

Ex

<u>ATEX directive</u>

This equipment is suitable for operating in potential explosive atmospheres (zone 2 and zone 22, potential gas and dust explosions).

According to the requirements of the Directive: ATEX Directive 94/9/EG.
The products are in conformity with ATEX under the following guidelines:
Ex II, 3 G/D, Eex nC, IIC, T6, IP54 (Standard version)
Ex II, 3 G/D, Eex nC, IIC, T6, IP67 (Sealed version)

IP

<u>IP-classification (International Protection)</u>

IP54: protection against dust and splash proof.
IP67: dust-tight and protection against submersion for 30 minutes long.

<u>Mechanical impact</u>
The unit has undergone vertical drop tests, from 2 meters in vertical and horizontal orientation with maximum impact to solid ground, and successfully passed.

RoHS

The TCT-unit does not contain any of the 'restriction of hazardous substances' (RoHS) listed substances.

Common used materials for food applications

The parts of the unit contains the following common used materials in food applications:

- Polypropylene (PP)
- Ceramic material
- Thermoplastic elastomers (TPE)
- Stainless steel fasteners

DISCLAIMER AND WARRANTY

DISCLAIMER

This manual should be kept in a safe place for handy reference. All efforts have been made to provide the most comprehensive manual possible, though everything without prejudice. Top-Cool is never responsible for any kind of damage to persons, products, systems, the unit itself or whatsoever due to the unit. Top-Cool assumes no liability expressed or implied for any damage(s) occurring to any component as result of using products of Top-Cool. The user or purchaser of this product will confirm to the general Terms of Delivery of Top-Cool.

WARRANTY

TCT4 Power Pack series are guaranteed for 12 months from the date of purchase. The purchaser should register within 30 days after purchase with Top-Cool to ensure warranty. During the warranty period, warranty is given to the TCT4 Power Pack only for defects in material and workmanship, under condition that:

1. All the precautions, installation, operation and security instructions are strictly followed.
2. The TCT-unit does not show any signs of damaging as a result of not following instructions, handling or negligence.
3. The TCT-unit does not show any sign of modifications, demounts, adjustments or whatsoever.
4. All labels are present, unaffected and clearly readable.
5. The unit does not show any signs of excessive wear
6. User can show the original invoice with date and place of purchase.

Normal wear is excluded from warranty.
After receiving the unit, the RMA report and original invoice, Top-Cool will examine if warranty is applicable. Only when warranty is applicable Top-Cool is obliged to repair/replace components or replace the whole unit, with the same or nearest equivalent unit. Top-Cool reserves the right to reject or determine the RMA-procedure when warranty is void.

Inventors of the Top-Cool Technology

Top-Cool Products B.V.
Groesweg 37B
Maasbree
The Netherlands
Tel. +31 - 77 - 465 01 42
Fax +31 - 77 - 465 01 43
Web: www.top-cool.eu
Email: info@top-cool.eu