LIQUID REFRIGERATION CHARACTERISTICS

APPLICATION NOTE



BACKGROUND

Nowadays is increasing the number of applications with high power semiconductors, so it's required high capacity cooling systems, based on the liquids circulation inside the heat sinks, with different shapes and materials.

Because of this, appears lots of questions in reference to which type or quality liquid coolant must be used.

COOLING LIQUID SELECTION.

Pure deionized water is the best cooling method for closed systems, always if the temperature keeps over the freezing level.

Also it's common to use the combination of water-ethyleneglycol in different proportions, using the ethyleneglycol as anti-corrosive and antifreeze.

The performance of the heat sinks using water-ethyleneglycol decreases respect of pure deionized water in different degrees according to the mixed liquid proportion. Referenced proportions are 30% and 50% ethyleneglycol in water.

There is the possibility to use other liquids as refrigerants, and also formulated products specially for this application, but being so specific and limited makes them not profitable in this application note.

Many industrial systems also use tap water due to is low initial cost, and in case of not keeping a strict quality control of the water, this is the starting point of numerous failures, in some cases catastrophic failures.

RECOMMENDED APPLICATIONS RESPECT TO THE HEATSINK.

Depending on the heat sink material (Aluminum, Copper or Stainless Steel) its recommended to use one liquid or another liquid, with the target to reduce corrosion at medium an large term. The table below offers an orientation of the possible combinations.

Heat sink material	Tap water	Water-glycol mixtrures	Deionized water	Oil	Dielectric fluids
COPPER	OK	OK	OK	OK	OK
ALUMINUM	NO OK	OK	NO OK	OK	OK
STAINLESS STEEL	OK	OK	OK	OK	OK

160527 Rev.:1

RECTIFICADORES GUASCH, S.A.
Ciutat de Granada, 80
08005 BARCELONA
SPAIN

Se reserva el derecho de cambiar los límites, las condiciones de prueba y dimensiones indicadas en esta hoja sin previo aviso.
Reserves the right to change limits, test conditions and dimensions given in this data sheet at any time without previous notice.

Tel.: +34 93 309 88 91
Fax.: +34 93 300 18 41
e-mail: info@e-guasch.com
www.e-guasch.com

APPLICATION NOTE

CHARACTERISTICS OF TAP WATER.

If it's desirable to use tap water as a cooler it is recommended at least to keep some minimum requirements of quality, see at the table below.

Minimum quality values for water	min.	max
pH value	7.0	9.0
Clhoride	0	20 p.p.m.
Nitrate	0	10 p.p.m.
Sulphate	0	100 p.p.m.
Total solids	0	250 p.p.m.
Calcium carbonate	0	250 p.p.m.

In most cases it's not possible to have a chemical analysis, but it's possible to have a resistivity measure of the water, so will be possible to see the amount of dissolved solids.

For a coolant liquid it's acceptable to have a minimum value of 2500 Ohm/cm @ 25ºC.

The approximated content of dissolved solids can be calculated by the formula:

Solid (p.p.m.) = 640000 / Specific Resistivity (Ohm/cm)



Unless the circuit is electrically isolated, the hydraulic connections between heat sinks and ground (or between themselves) must have enough length to keep acceptable leakage current losses, otherwise, the electrolytic effects will produce a quick corrosion of the heat sinks, especially in the connection points.

The recommended minimum length is about 600mm for applications at 400 V_{RMS}.

Obviously, conductive tubes must be made with insulated materials and it must be checked, since unfortunately, it's common to find plants with black electrical conductive rubber tubes.

HABITUAL COOLING LIQUIDS CHARACTERISTICS

LIQUID	Thermal conductivitty (**k**)	Specific hot (C_p)	Dinamic viscosity (**μ**)	Density (**ρ**)	Prandtl number (**Pr**)
Water	0.61 W/mK	4072.71 J/kg K	0.000868 Pa s	996.58 kg/m^3	5.78
Water-ethyleneglycol 30%	0.49 W/mK	3729.95 J/kg K	0.001864 Pa s	1035.02 kg/m^3	14.29
Water-ethyleneglycol 50%	0.43 W/mK	3297.63 J/kg K	0.003367 Pa s	1053.25 kg/m^3	25.82
Ethyleneglycol	0.25 W/mK	2408.62 J/kg K	0.017195 Pa s	1112.13 kg/m^3	164.58

160527 Rev.:1

RECTIFICADORES GUASCH, S.A.
Ciutat de Granada, 80
08005 BARCELONA
SPAIN

Se reserva el derecho de cambiar los límites, las condiciones de prueba y dimensiones indicadas en esta hoja sin previo aviso.
Reserves the right to change limits, test conditions and dimensions given in this data sheet at any time without previous notice.

Tel.: +34 93 309 88 91
Fax.: +34 93 300 18 41
e-mail: info@e-guasch.com
www.e-guasch.com

ANOTACIONES EN LA NOTA DE APLICACIÓN:

RECTIFICADORES GUASCH, S.A. utiliza la siguiente anotación para identificar el documento, en el lado izquierdo de la primera página:

APPLICATION NOTE: La información contenida en esta publicación se refiere a aplicaciones de dispositivos y se proporciona solo para su conveniencia y puede ser sustituida por actualizaciones de la misma. Es su responsabilidad asegurar que su aplicación cumple con sus especificaciones.

Los datos indicados en esta publicación pueden corresponder a especificaciones de producto, queda excluida cualquier garantía expresa o implícita sobre sus propiedades o su aplicación, así como cualquier responsabilidad sobre daños directos o indirectos producidos por los materiales o resultantes de su aplicación. La empresa se reserva el derecho de realizar cambios en las especificaciones de los productos sin previo aviso. La información respecto a métodos de uso y aplicaciones se indica sólo como guía y no constituye garantía alguna de funcionamiento satisfactorio en un determinado equipo o aplicación. Es responsabilidad del usuario determinar la idoneidad del producto para su aplicación utilizando la información disponible y asegurarse de que la misma esta actualizada.
Cualquier nombre de producto o marca usada en esta publicación corresponde a marcas depositadas, marcas registradas o nombres protegidos por sus respectivos propietarios.

APLICATION NOTE ANNOTATIONS:

RECTIFICADORES GUASCH, S.A. annotate in the left corner of the front page to indicate the type of document:

APPLICATION NOTE: Information contained in this publication regarding device applications and the like is provided only for your convenience and may be superseded by updates. It is your responsibility to ensure that your application meets with your specifications.

The technical data are to specify components, not to guarantee their properties. No warranty or guarantee expressed or implied is made regarding delivery or performance. The Company reserves the right to alter without prior notice the specification of any product. Information concerning possible methods of use is provided as a guide only and does not constitute any guarantee that such methods of use will be satisfactory in a specific piece of equipment. It is the user's responsibility to fully determine the performance and suitability of any equipment using such information and to ensure that any publication or data used is up to date.
All brand names and product names used in this publication are trademarks, registered trademarks or trade names of their respective owners.

© RECTIFICADORES GUASCH, S.A.
DOCUMENTACION TECNICA, TECHNICAL DOCUMENTATION, DOCUMENTATION TECHNIQUE
PRODUCIDO EN ESPAÑA, PRODUCED IN SPAIN, PRODUIT EN ESPAGNA
PROHIBIDA SU VENTA, NOT FOR SALE, PAS A VENDRE

Your Needs, Our Solutions

160527 Rev.:1

RECTIFICADORES GUASCH, S.A.
Ciutat de Granada, 80
08005 BARCELONA
SPAIN

Se reserva el derecho de cambiar los límites, las condiciones de prueba y dimensiones indicadas en esta hoja sin previo aviso.
Reserves the right to change limits, test conditions and dimensions given in this data sheet at any time without previous notice.

Tel.: +34 93 309 88 91
Fax.: +34 93 300 18 41
e-mail: info@e-guasch.com
www.e-guasch.com