MANUAL FOR COOLING SYSTEM QDC006

Parker

WARNING — USER RESPONSIBILITY

FAILURE OR IMPROPER SELECTION OR IMPROPER USE OF THE PRODUCTS DESCRIBED HEREIN OR RELATED ITEMS CAN CAUSE DEATH, PERSONAL INJURY AND PROPERTY DAMAGE.

- This document and other information from Parker-Hannifin Corporation, its subsidiaries and authorized distributors provide product or system options for further investigation by users having technical expertise.
- The user, through its own analysis and testing, is solely responsible for making the final selection of the system and components and assuring that all performance, endurance, maintenance, safety and warning requirements of the application are met. The user must analyze all aspects of the application, follow applicable industry standards, and follow the information concerning the product in the current product catalog and in any other materials provided from Parker or its subsidiaries or authorized distributors.
- To the extent that Parker or its subsidiaries or authorized distributors provide component or system options based upon data or specifications provided by the user, the user is responsible for determining that such data and specifications are suitable and sufficient for all applications and reasonably foreseeable uses of the components or systems.

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Introduction / Safety Instructions

Introduction

The purpose of this manual is to serve as a reference guide for installation, maintenance and operation of the QDC 006 series of air fluid coolers.
Keep the manual at hand. A lost manual should be replaced as soon as possible.
For optimum performance and in order to prevent incorrect use, please read this manual carefully and observe all safety precautions prior to putting the air fluid cooler into service. Installation and maintenance work should only be carried out by qualified personnel.
Parker reserve the right to make technical alternations without notice.

Use

The QDC 006 series of air fluid coolers is designed to cool liquids in systems for mobile applications.

Warranty and Claims

In the event of breakdown, consult your local Parker office. Parker shall not be held responsible for any consequences due to modifi - caution and/or variation made by the customer.

Safety Instructions

The installation contractor as well as the user should be aware of understand and observe all safety precautions in this manual, including any information mentioned on labels fixed to the product.

Definition of Safety Warning Levels…

…concerning personal safety
All precautions concerning personal safety are classified as per below, depending on how severe the consequences of an incident could be.

Danger: This alerts you to an action or procedure that, if performed improperly, will produce bodily harm or death.

Caution: This alerts you to an action or procedure that, if performed improperly, is likely to produce bodily harm or death.

Precaution: This alerts you to an action or procedure that, if performed improperly, is likely to cause an accident with physical harm.

…concerning other safety issues:
Notifications concerning other safety issues (property, process or environment) and maintenance work are classified as follows:
Important: This alerts you to an action or procedure that, if performed improperly, is likely to result in damages to the property, process or environment.
…concerning additional information:
Additional information is marked as follows:
Note! This alerts you to important information related to the text in a paragraph.

Overall Instructions

Handling, Operation and Maintenance

Risk of bodily injury. To prevent physical harm when lifting the unit, use the correct lifting technique. Make sure that all lifting devices are free from damage and approved for the weight of the air oil cooler.

Risk of bodily injury. Disconnect the motor power supply prior to maintenance.

Risk of bodily injury. Before disconnecting hydraulic connections and hoses make sure the system is depressurized.

Risk of severe burns. The oil cooler could become extremely hot during operation. Always make sure the cooler is cool before touching.

Risk of bodily injury. If the air oil cooler is fitted with a thermo contact, the fan will start automatically when the preset temperature has been reached. Be careful when standing close to rotating units.

This indicates a toxic hazard. To prevent bodily injury, damage to property or environment, used fluid should be collected and taken to a special depot.

Important! Static electricity. Fans generate static electricity. Do not put sensitive devices (electronics etc.) in the immediate vicinity of the air oil cooler.

Note! Use hearing protection when standing close to an operating air oil cooler for long periods of time.

Warning Label

The warning label shown below is fitted to the air oil cooler at delivery. Always replace a damaged or missing label.

High temperature surface! Use hearing protection! Rotating fan!

Identification Plate

The identification plate of the air fluid cooler is fitted on the fan housing and contains the following information: See Figure 2. A – Part number. B – Designation. C – Serial number. D – Date of delivery (year and week, e.g. 1018, i.e. year 2010 and week 18).
Replace a damaged or missing identification plate as soon as possible.

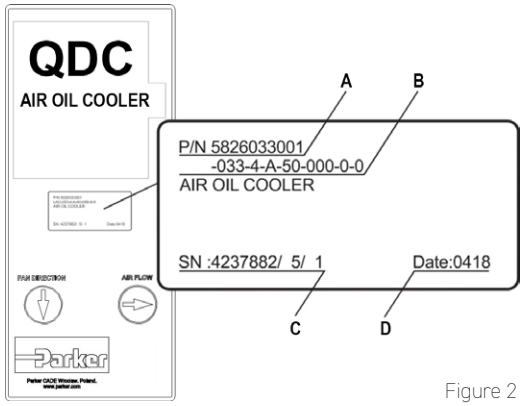


Figure 2

Acoustic Pressure Level

could reach 50-78 dB(A) at 1 m distance depending on air fluid cooler size and rotation speed under normal operating conditions.
An inappropriate location or operation under extreme conditions could cause an increase in acoustic pressure level and a decrease in cooling capacity.

The direct or indirect influence of the air flow can cause reflections or vibrations on components. This can increase the noise level.

Fluids

Water: add corrosion inhibitors to the water to avoid corrosion. All materials included in the cooling circuit must be considered for choice of correct inhibitor.
Glycol: Mix glycol and water in a ratio of 50 % / 50 % before filling! Never mix different types and different brands of glycol. We recommend the use of demineralized or osmosis water.

Additives like Glysantin G48 or TYFOCOR have demonstrated their ability to prevent corrosion in a closed cooling circuit. See supplier information regarding water quality, additive quantity and periodic replacements.
Caution: Follow material safety data sheets (MSDS) of glycol manufacturers! Please note that the coolant is considered hazardous waste and needs to be disposed accordingly.

Filtration

The use of a filter allows reducing the presence of impurities or chips in the liquid circuit in order to prevent any obstruction. Check the contamination with particles and biological changes, the composition of the water-glycol mixture and the current possible temperature range in which it can be operated at regular intervals. Change the filter elements if the values deviate from the values at initial start-up. Follow the filter manufacturer's instructions and the fluid manufacturer's MSDS.

Lifting

Caution: Risk of bodily injury. To prevent physical harm when lifting the unit, use the correct lifting technique. Make sure that all lifting devices are free from damage and approved for the weight of the air fluid cooler

General Electrical Connection

Precaution: Prior to connecting the DC motor to the supply system, make sure the information on the motor label corresponds to specified direct current. The DC motor must only be installed according to general and electrical safety rules.

Precaution: Be careful when connecting. Improperly made connections, damaged cables, etc. could cause components to become live or result in the incorrect direction of rotation of the DC motor and fan.
Note! A motor overload protection is recommended.

Prior to Start-up

Precaution: Do not start the air fluid cooler/system if there is a risk of damage to person, property or environment. Check that:

- All parts from the System are free from damage
- The System is correctly connected
- The fan rotates freely (use hand force)
- All liquid connections are tight
- The Pump turn in the correct direction
- The inside of the fan housing is free from objects that could be thrown around and cause bodily injury or damage to property
- The direction of rotation of the fan and the air flow corresponds to indications on the fan housing
- The System is free from abnormal noise and vibrations.
- The System is free from leaks
- The coolant and the system are free from air

During Operation

Caution risk of severe burns. The air fluid cooler could become extremely hot during operation. Make sure that the air fluid cooler is cool before touching.
Maximum permitted fluid temperature in the cooler matrix is 120 °C. The cooler matrix is designed for maximum allowed dynamic working pressure of 14 bar. Do not overload the DC motor, see identification plate.
Note! Use hearing protection when standing in the immediate vicinity of an operating air fluid cooler for long periods of time.

Preventive Maintenance

Preventive maintenance work must be carried out at regular intervals. Make sure that:

- There is no abnormal noise or vibrations.
- Air fluid cooler/system is securely fixed.
- The cooler matrix is clean - debris will reduce the cooling capacity.
- The air fluid cooler/system is free from damage, replace damaged components.
- The air fluid cooler/system is free from leaks, take appropriate measures.
- The coolant is on the correct level.
- The coolant is clean and free from air.
- Warning labels are in good condition, replace any damaged/ missing label immediately.
- Hose and Cable are not brittle or cracked on the outside,
- The rubber dampers are not hardened or embrittled and have their function.
- The finger guard is not damaged or extended so that fingers can get into the fan.
- Regularly changing the coolant is necessary every three to four years, depending on the product used and the vehicle manufacturer's recommendations. This is important because the protective additives such as the corrosion protection contained in the coolant degrade over time.

Annually: Check the electrical installation.

Cleaning

Precaution: Risk of bodily injury. Prior to cleaning, disconnect all motor power supplies.

Caution: Risk of severe burns. The air fluid cooler could become extremely hot during operation. Make sure the air fluid cooler is cool before touching.

Air fluid cooler/system: When cleaning the exterior of the cooler/system, for instance using water, disconnect all power supplies. Be aware of the DC motor protection standard.
Cooler matrix: The air fins of the matrix can be cleaned by blowing through with compressed air. If necessary a high-pressure water system can be used. When using a high-pressure water system point the jet parallel to the air fins.
Fan housing: Remove the cooler matrix when cleaning the inside of the fan housing. To clean the inside of the fan housing, use compressed air. If necessary suitable cleaning agents can be used. Blow with compressed air from the electric motor side through the fan guard.

Precaution: Risk of bodily injury. When using compressed air, ensure that you use personal protective equipment in accordance with the occupational health and safety regulations of your country.

Tank

Precaution: Risk of bodily injury. Before opening the tank filler cap, remove any dirt in the area with compressed air or suitable means. When using compressed air, ensure that you use personal protective equipment in accordance with the occupational health and safety regulations of your country.

Product Description

The QDC is an active air-fluid cooling system composed of a cooling matrix and a fan.
The QDC series brushless DC motor driving the fan provides a higher power density than classical DC motors, offering a suitable solution for the electrified mobile applications.
The QDC size 006 is a very compact solution and can be provided with an embedded expansion tank along with a pump, in 24 V or 12 V version.

Intended Use

The QDC 006 is used mostly in mobile, electrified applications with higher compacity requirements. The cooler can be used with both water-glycol mixture and oil. The optional pumps are not suitable for mineral oil and is permissible only after consultation with Parker.

Scope of Delivery

The QDC 006 includes:

- Cooling matrix size 006 (2xG3/4" for outlet/inlet, 2x G1/2" for sensors, 3x G1/4" for sensors ,venting and draining, grounding screw M8),
- Brushless DC fan,
- Fan drive with integrated Inverter for RPM control
- Fastening bracket,
- Finger guard.

The fan drive can be ordered in 12V DC or 24V DC version.
The following embedded features can be ordered:

- 30L/min pump for water/glycol mixtures (standard size)
- 70L/min pump for water/glycol mixtures (lLarge size)
- 6.1L expansion tank

The optional tank includes a breather, a G¼" port with a plug (stainless steel, EPDM sealing), a water level eye/window.
The optional pumps are delivered along with a tank and a mounted hose connecting the matrix outlet to the pumps inlet port. The standard pump size is available in both 12 V and 24 V input voltage. The Large pump is 24 V only. The pump and hose position change according to the pump size.

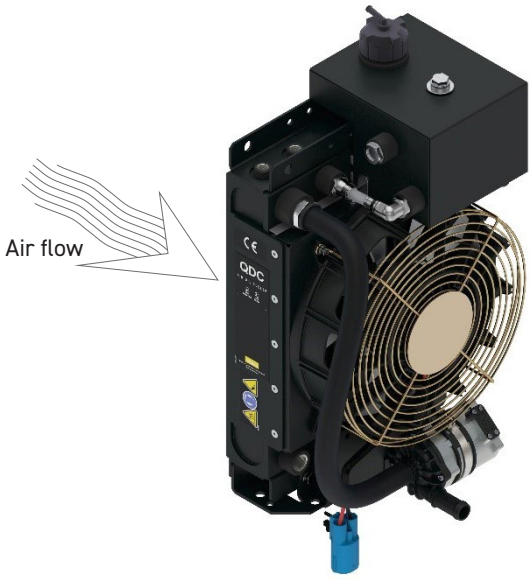
See below the part numbers for each available assembly:

Part #	Input voltage	Tank	Pump
5847006001	24V	–	–
5847006502	24V	✓	–
5847006500	24V	✓	Standard
5847006501	24V	✓	Large
5847006002	12V	–	–
5847006522	12V	✓	–
5847006520	12V	✓	Standard

5847006001 / 5847006002

5847006502 / 5847006522

5847006500 / 5847006520



5847006501

Technical Data

		5847006001	5847006002	5847006500	5847006520
Pressure drop	[bar]	0.18 at 100 l/min water Glycol 50 % at 30 °C	0.18 at 100 l/min water Glycol 50 % at 30 °C	0.04 at 40 l/min water glycol 50 % at 30 °C	0.18 at 100 l/min water Glycol 50 % at 30 °C
Max. cooling capacity	[kW/°C]	0,29 with water glycol mix 50 % at 4300 rpm at 100 l/min	0,255 with water glycol mix 50 % at 4000 rpm at 100 l/min	0.277 with water glycol mix 50 % at 4300 rpm at 40 l/min	0,24 with water glycol mix 50 % at 4000 rpm at 100 l/min
Connection thread size		G 1/2 and G1/4 Sensoric, G 3/4 Inlet and Outlet, G1/4 bleed port			
Configuration		QDC liquid cooler	QDC liquid cooler	With tank and pump	With tank and pump
Size		006			
Input voltage	[VDC]	24	12	24	12
Product type		QDC-006-B-0-00-01X-F-0-0-0-0	QDC-006-A-0-00-01X-F-0-0-0-0	QDC-006-B-0-ST-01X-F-0-0-0-2	QDC-006-A-0-ST-01X-F-0-0-0-2
For fluid type		Water Glycol Mix 35 % - 50 %			
Maximum flow rate	[l/min]	100	100	40	40
Minimum flow rate	[l/min]	5	5	6.7	6.7
Max. operating pressure	[bar]	14	14	1.0	1.0
Min. operating pressure	[bar]	0.05			
Max. operating tempe-rature	[°C]	95	95	85	85
Min. operating tempe-rature	[°C]	-40			
Volume	[L]	1.2 matrix	1.2 matrix	4.1 QDC006 system	3,7L QDC006 system
Power supply voltage	[VDC]	16 .. 30	9 .. 16	16 .. 30	9 .. 16
Signal input	[VDC]	PWM or 0 - 10			
Maximum noise level	[dB(A)]	78 at 1 meter at 4300 rpm	76 at 1 meter at 4000 rpm	78 at 1 meter at 4300 rpm	76 at 1 meter at 4000 rpm
Fan rated speed	[rpm]	1100 - 4300	100 - 4000	1100 - 4300	100 - 4000
Current	[A]	15.3 at 4300 rpm	27 at 4000 rpm	15.3 at 4300 rpm	27 at 4000 rpm
Height / length / width	[mm]	450 / 281 / 190	450 / 281 / 190	550 / 281 / 210	552 / 283 / 212
Weight	[kg]	10	10	14	14

		5847006501	5847006502	5847006522
Pressure drop	[bar]	0.1 at 70 l/min water glycol 50 % at 30 °C	0.18 at 100 l/min water glycol 50 % at 30 °C	0.18 at 100 l/min water glycol 50 % at 30 °C
Max. cooling capacity	[kW/°C]	0,29 with water glycol mix 50 % at 4300 rpm at 70 l/min	0,29 with water glycol mix 50 % at 4300 rpm at 100 l/min	0,255 with water glycol mix 50 % at 4000 rpm at 100 l/min
Connection thread size		G 1/2 and G1/4 Sensoric, G 3/4 Inlet and Outlet, G1/4 bleed port		
Configuration		With tank and pump	With tank	With tank
Size		006		
Input voltage	[VDC]	24	24	12
Product type		QDC-006-B-0-ST-01X-F-0-0-0-3	QDC-006-B-0-ST-01X-F-0-0-0-1	QDC-006-A-0-ST-01X-F-0-0-0-1
For fluid type		Water Glycol Mix 35 % - 50 %		
Maximum flow rate	[l/min]	70	100	100
Minimum flow rate	[l/min]	10	5	5
Max. operating pressure	[bar]	1.8	14	14
Min. operating pressure	[bar]	0.05		
Max. operating temperature	[°C]	85	85	85
Min. operating temperature	[°C]	-40		
Volume	[L]	4.2 L QDC006 system	7.3 L QDC006 system	3,7L QDC006 system
Power supply voltage	[VDC]	16 .. 30	16 .. 30	9 .. 16
Signal input	[VDC]	PWM or 0 - 10		
Maximum noise level	[dB(A)]	78 at 1 meter at 4300 rpm	78 at 1 meter at 4300 rpm	76 at 1 meter at 4000 rpm
Fan rated speed	[rpm]	1100 - 4300	1100 - 4300	100 - 4000
Current	[A]	15.3 at 4300 rpm	15.3 at 4300 rpm	27 at 4000 rpm
Height / length / width	[mm]	550 / 281 /300	550 / 281 / 210	553 / 284 / 213
Weight	[kg]	16	12	12

System Installation

Positioning

The installation of the air-water cooler 5847006001/ 5847006002 is basically possible in all orientations, but certain requirements must be fulfilled:

- Air reflection
- Air restriction
- Air free coolant

The installation of the air-water/Glycol cooler system 5847006500 up to 5847006522 is basically possible in vertical orientations and certain requirements must be fulfilled:

- Air reflection
- Air restriction
- Air free coolant
- Water Glycol Tank – highest position in the system*
- Water Glycol Pump – in the lowest position in the system*

* If this is not possible, ensure that the system is sufficiently vented.

Air Reflection

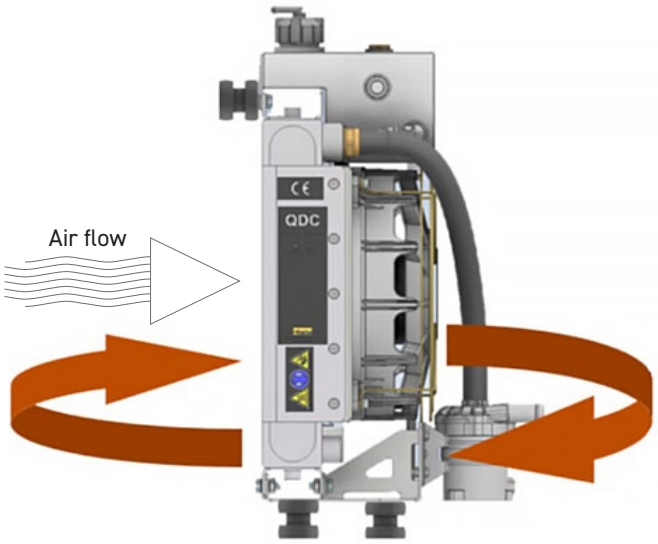
The cooling system should be placed in a vented environment. Hot air from the cooling matrix should be blown away outside to avoid recirculation to the intake side of the fan.
Failure to meet this requirement could lead to an increase in the air inlet temperature of the and reduce the cooling efficiency. In the most critical case, it can lead to the required cooling capacity not being achieved.

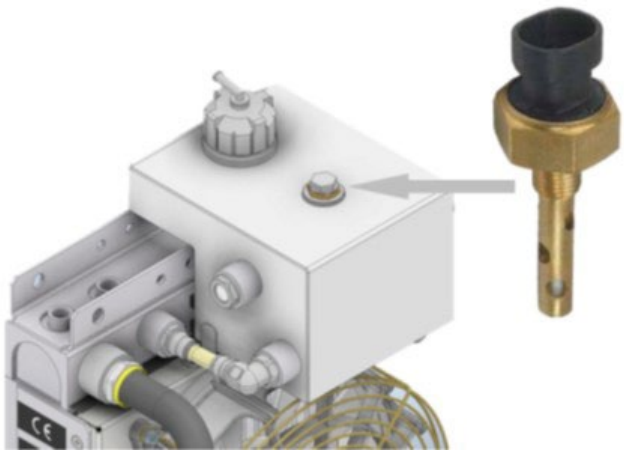
Air Restriction

The matrix requires an air supply and should not be placed too close to an obstacle. The distance from to cooler to nearest obstacle should be superior or equal to half the height of the cooler matrix. Failure to meet this requirement could lead to increase in the current consumption and a decrease of the system efficiency.

Air Extraction / Water Filling

The pump used is a centrifugal pump which requires pre-filling. The pump should be installed in the lowest position of the system. To ensure that the impeller is always filled with liquid.
The water glycol pump should not be running dry. The pump can dry-run for a period (refer to the datasheet), after this period the internal control will automatically stop the pump.
Please make sure to pre-fill the pump before starting the system. We recommend using a vacuum filling device.
Make sure that the coolant used is free of impurities and that no impurity enter the cooling system. Failure to meet this requirement will reduce the cooling capacity and the service life of the individual components. Use filter systems if necessary.
The Parker CLS 46 level sensor can be used in the connection provided in the tank to detect when the water glycol level in the tank falls below the minimum.
The final level depends on the total volume of coolant in the system and must be determined by a thermal expansion calculation.





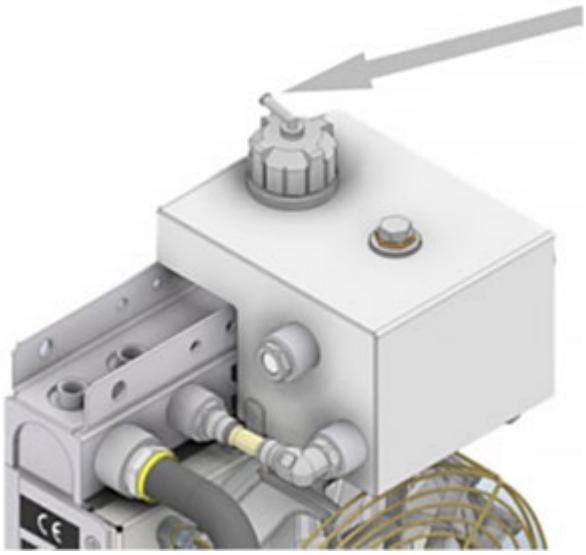
When filling the system, use pre-mixed water glycol with a minimum of 20 % and a maximum of 50 % ethylene-glycol content. Fill the water-glycol mixture at temperatures between 15 and 25 °C. The correct filling amount is achieved as follows:

Step: Vacuum fill the entire cooling system.

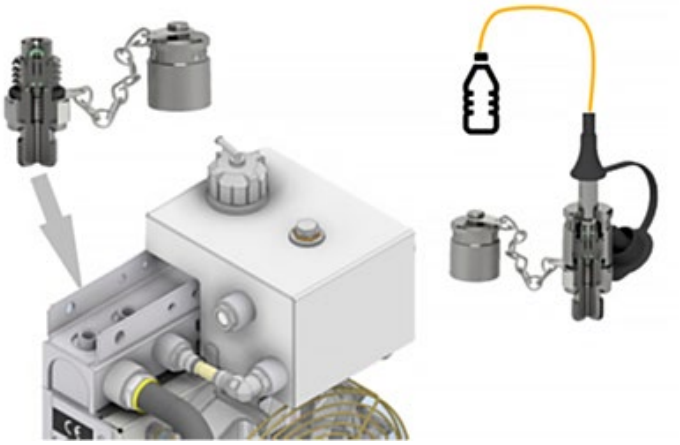
Step: Fill the expansion tank to the upper edge of the optical level indicator.

Step: Add an additional 200 ml to the expansion tank.
If the water-glycol level in the expansion tank drops due to leaks or the ingress/egress of air, this will be visible in the optical level indicator.

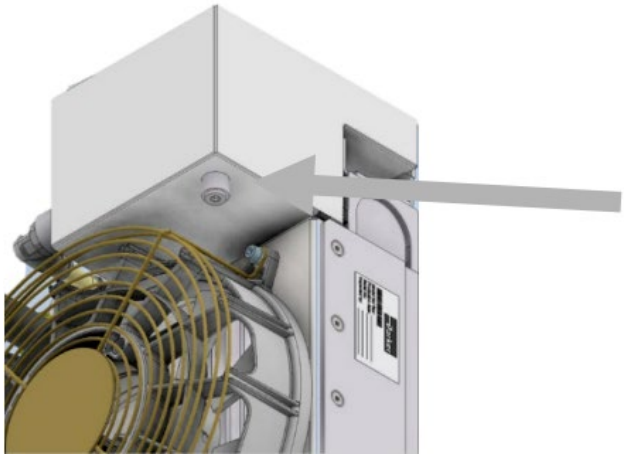
When installing the level sensor CLS 46, it will trigger a signal shortly before the level becomes visible in the optical level indicator.
For an air free system, you could vent the system when you use a mechanical valve, to avoid contact with the coolant. A hose can be used for draining into a bottle or back to the tank.



A blind plug is available at the bottom of the tank for emptying, please check it regularly for leaks.



Make sure that there is enough space for opening and filling the tank so that there is no risk of injury during operation. Use a suitable hose to connect the pressure relief valve connection to an area in your vehicle where the coolant coming out of the pressure relief valve can be drained without hazard to people, animals, or the environment.

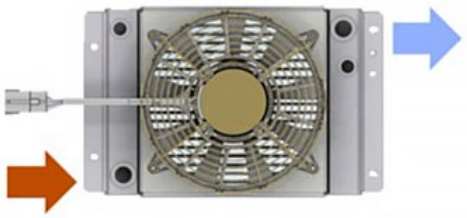


To completely empty the tank, there is an additional connection at the bottom, sealed with a blind plug. Please check this regularly for any leaks.

Installation

Coolant Flow

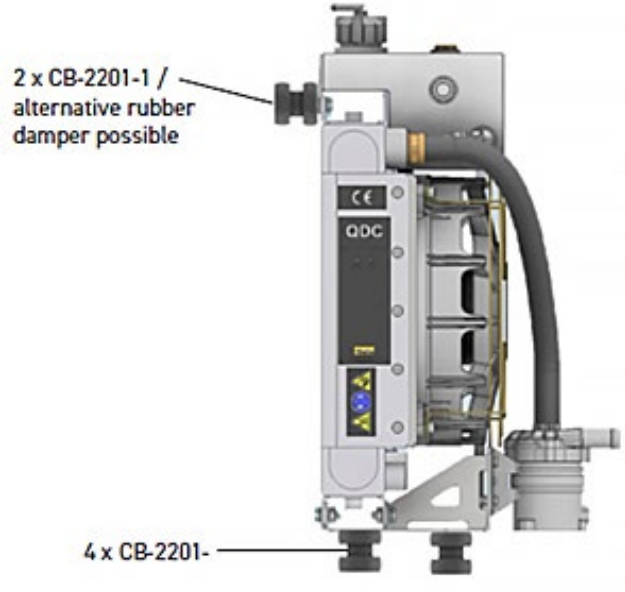
The cooler matrix should be placed either vertically or horizontally, so that the inlet is lower than the outlet.

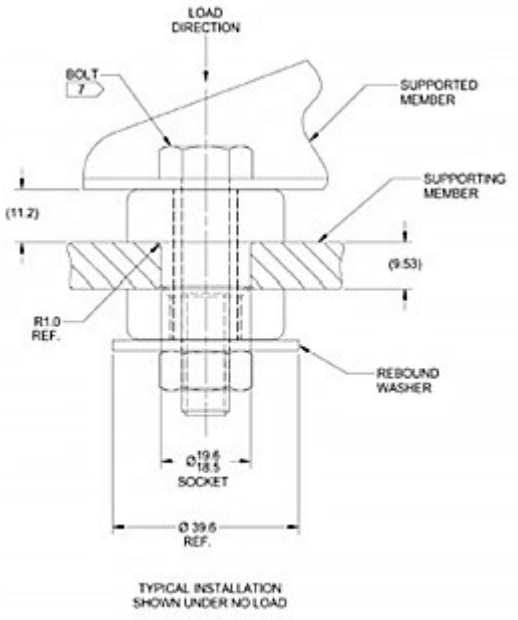


The tank, either separated or embedded, should be placed at the highest point of the cooling circuit. If some components / lines are mounted higher than the tank level a venting option should be provided at the highest point. The pump should be installed at the lowest point of the circuit.

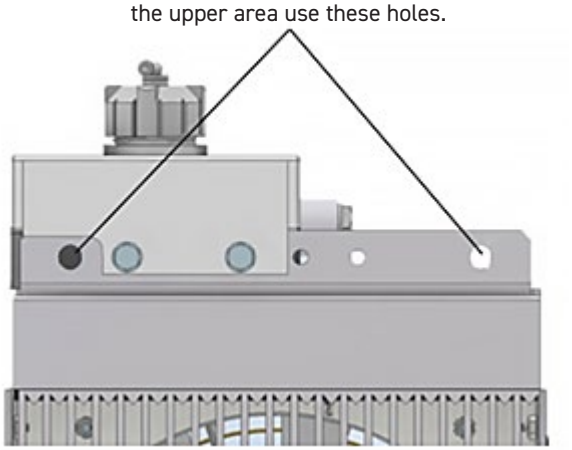
Vibrations

In order to isolate the structure from excessive vibrations, two rubber dampers should be installed in the upper part and four others under the system.





To mount the vibration damper in the upper area use these holes.



The hose from the heat exchanger to the pump should be secured to a solid structure with a suitable rubberized clamp to avoid chafing or flapping which will limit service life and can lead to failure.

Detailed Pump Positioning

The QPMDC centrifugal type of low-pressure pump is equipped with electric high efficiency brushless direct current (DC) motor, magnetic force transmission, Inverter with PWM signal rotation speed controlling and protection from reverse polarity, dry running, over voltage and current, overload and over-temperature.
The QPMDC centrifugal type of low-pressure pump is available in 12 and 24 VDC and different flow rates,
The centrifugal principle involves imparting energy to the liquid by means of a centrifugal force developed by the rotation of an impeller that has several blades or vanes.
QPMDC series pumps are centrifugal pumps which require pre-filling.

Do not step on the unit! High temperature surfaces!

To avoid the dry-running (air getting stuck in impeller), pump outlet port should be vertical or in the upper of the impeller (Figure 1).
Make sure that the outlet port level is always above the pump axis (Figure 1b).
Connected Hose should be vertically mounted (or no elbow in 20cm) to make the air discharged easily, the outlet pipe should not be used less than 90 degrees elbow (figure 2).
Can't use the seawater or other heavy pollution with big grain impurity liquid as the liquid medium.

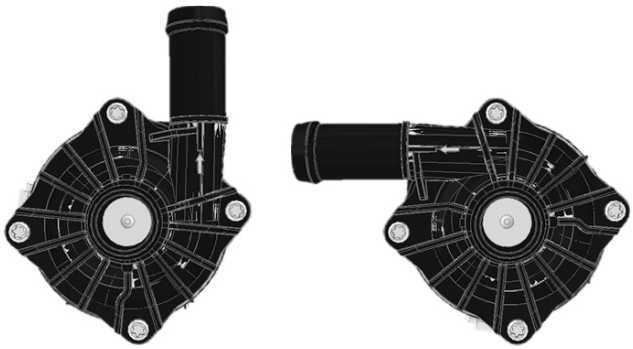


Figure 1

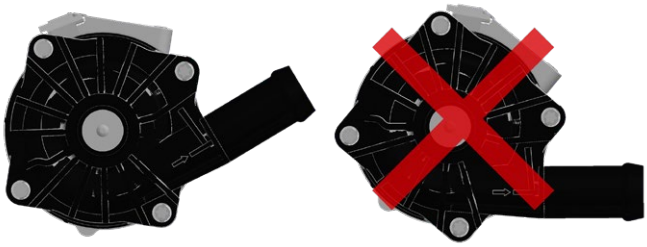


Figure 1b

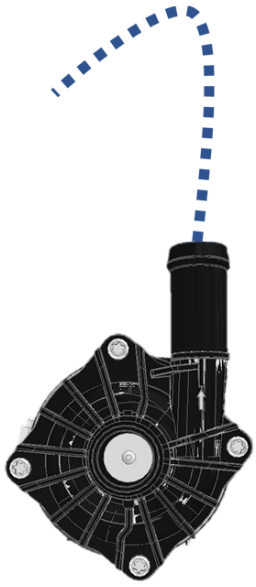


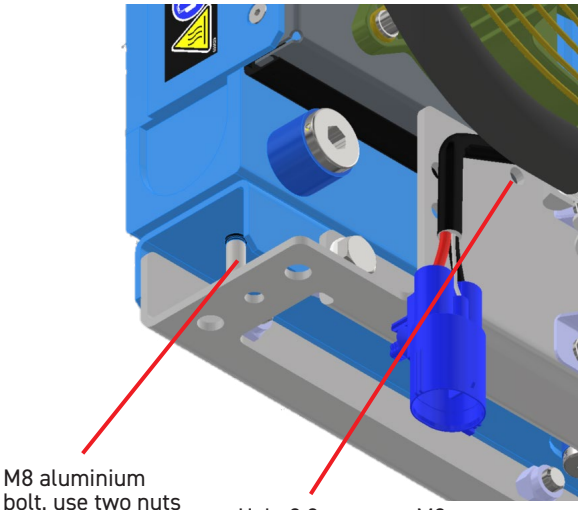
Figure 2

To maintain cooling efficiency, it is crucial to prevent the formation of insulating deposits in the cooling circuit. Electrochemical reactions can lead to deposit formation and degradation of the cooling fluid's properties, resulting in reduced thermal conductivity in the heat exchanger and the components being cooled. Therefore, selecting the right metallic connection components is a critical decision. It is essential to avoid galvanized connecting elements.

Ground Connection

Connect a ground strap of sufficient size between the ground connection and the vehicle chassis. The connection point for the ground strap on the vehicle chassis shall be bare metal and be coated in dielectric grease to prevent corrosion. The electrical resistance between the ground strap and the chassis must be less than 40 mΩ.

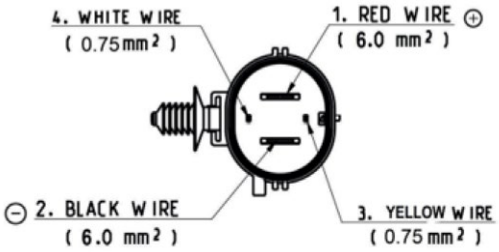
In every country, you must respect all the local electrical installation regulations and standards to determine the vehicle chassis (ground) cable size.



Electrical Connections

See below the connections for the fan and the optional pump (QPMDC). For specific information please refer to the fan drive and pump manual.
Appropriate wire section and fuse should be implemented to meet safety requirements.

Fan Drive



Identification	+D	-D	A	PWM* / E*
Pin number	1	2	3	4
Wire colour	Red	Black	Yellow	White
Sealing P/N	7158-3035	7158-3035	7158-3031-90	7158-3031-90
Pin P/N	7114-3250	7114-3250	7114-4103-02	7114-4103-02
Section (mm²)	6.0	6.0	0.75	0.75

The electrical drive interface consists of 4 pins:

Power pins:
- supply voltage plus: +D
- supply voltage minus: -D

Signal pins:

1. Input: digital PWM input / active low: PWM* / E*
2. Input: analog input: A

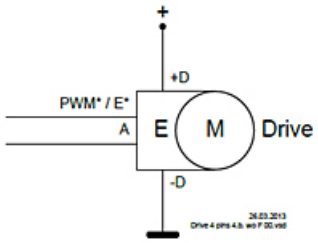
The signal pin PWM*/E* is used to control the drive mode, it is the control input. The signal pin A can be used to control the speed of the drive. Here are the mating parts for this connector:

Description	Part number
Housing	7283-8497-90
4.0mm² wire sealing	7157-3582-90
4.0mm² wire socket	7116-3251
0.5mm² wire sealing	7158-3030-50
0.5mm² wire socket	7116-4102-02
0.5mm² blanking plug	7158-3032-60

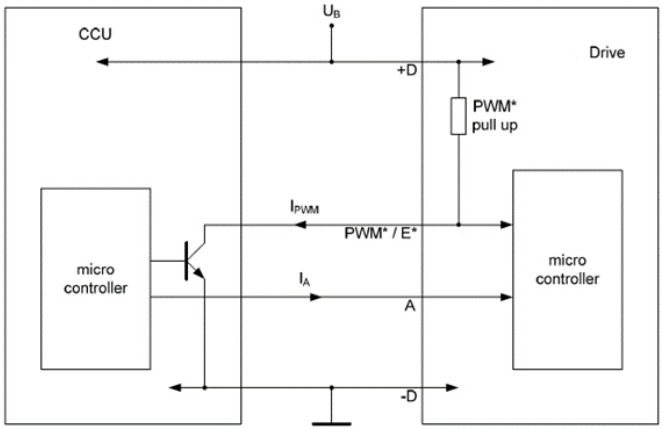
Notice: Sealing plugs must be used in all open pin positions. Failure to follow this instruction will cause the module to not meet the environmental specification.

Drive Interface

In the following figure the drive diagram is shown. E stands for integrated electronics. M stands for motor. Drive stands for motor with axial integrated electronics.



The Drive interface, i.e. the connections between the CCU (Custom Control Unit) and the drive, is depicted in the following picture.



The CCU electronics and the drive electronics are connected via two unidirectional lines.

The PWM signal for the input PWM*/E* comes from the CCU electronics and uses a pull up resistor (PWM*/E* pull up) located in the drive electronics to determine the recessive level.

This pull up resistor is connected to the supply voltage plus: +D / UB. The dominant level on the input PWM*/E* is low level, provided by the switching to ground stage depicted in above figure. as a bipolar npn transistor in the CCU.

Operating Modes

The drive interface (the connection between the drive and the user system) can be done in 8 ways (see table) depending on if and how the two signal inputs PWM*/E* and A are used:

Mode description	Mode	+D	-D	PWM* / E*	A	Pins
On / off to minus	1	+	+ -D	–	+	4
On / off to plus	2	+ +D	-	–	+	4
On / off with enable low	3	+	-	+ E*	+	4
Analogue control 1	4	+	+ -D	–	ana-logue	4
Analogue control 2	5	+ +D	-	–	ana-logue	4
Analogue control with enable low	6	+	-	+ E*	ana-logue	4
Digital control	7	+	-	PWM	n.c.	3
Mixed analogue / digital control	8	+	-	PWM	ana-logue	4

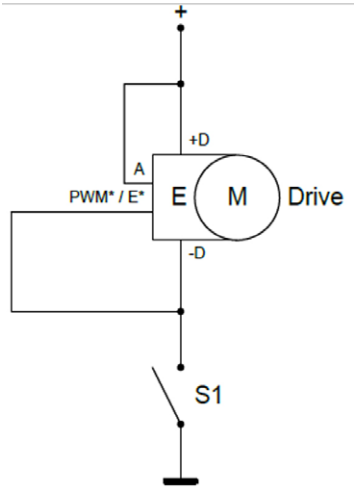
Key word	Description
+D	Drive positive supply
-D	Drive negative supply
PWM* / E*	PWM input / low active enable input
A	Analogue input
+	connected to plus
-	connected to minus
analogue	analogue voltage signal
PWM	PWM signal
n.c.	not connected
+ +D	switch of the drive positive supply to plus
+ -D	switch of the drive negative supply to minus / GND
+ E*	switch active low enable input to minus / GND

Interface Mode 1: On/off to minus

To realize the mode on/off to minus with the drive interface for catalogue product it is necessary to put

- A to +D and
- PWM*/E* to -D.

When the switch S1 is switched on, the drive goes after the initialization of the electronics to full speed. This mode can be used if the CCU which controls the drive has limited capabilities or does not even exist. The drive is just switched on and off via any power switch like a relay, MOS FET or even just a switch.
The appropriate current rating for this “switch” has to be dimensioned according to the current consumption of the drive.

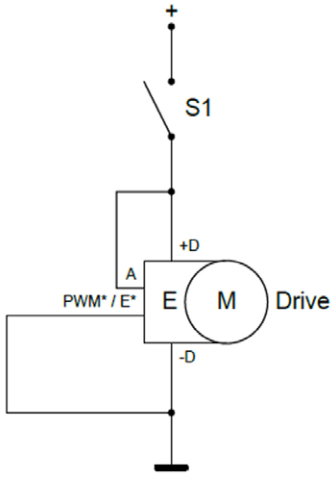


Interface Mode 2: On/off to plus

To realize the mode on/off to plus with the drive interface for catalogue product it is necessary to put

- A to +D and
- PWM*/E* to -D.

When the switch S1 is switched on, the drive goes after the initialization of the electronics to full speed. This mode can be used if the CCU which controls the drive has limited capabilities or does not even exist. The drive is just switched on and off via any power switch like a relay, MOS FET or even just a switch.
The appropriate current rating for this “switch” has to be dimensioned according to the current consumption of the drive.

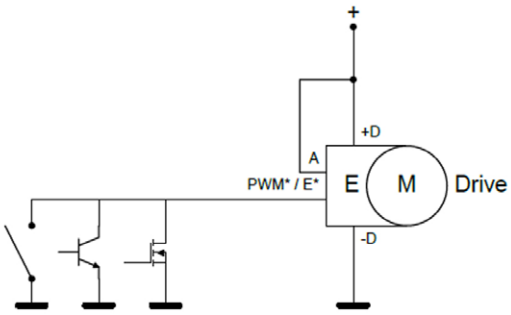


Interface Mode 3: On/off with enable low

To realize the mode on/off with enable low with the drive interface for catalogue product it is necessary

- A to +D and
- to use PWM*/E* as a low active enable.

In mode 3 the drive can stay always on supply voltage and is controlled by a low current input which can be driven by simple low cost low side signal driver in the CCU. When the enable input PWM*/E* goes to high, the drive goes after a short time into the quiescent current mode.
When the enable pin PWM*/E* is driven low, the drive goes to full speed after the initialization of the electronics. This mode can be used if the CCU which controls the drive has limited capabilities or does not even exist
The appropriate sink current rating of the driver for the enable pin PWM*/E* has to be dimensioned according to the current consumption of the pin PWM*/E*.
The circuit structure to drive the pin PWM*/E* can be any active low “open collector” typical circuitry as depicted in the figure below.

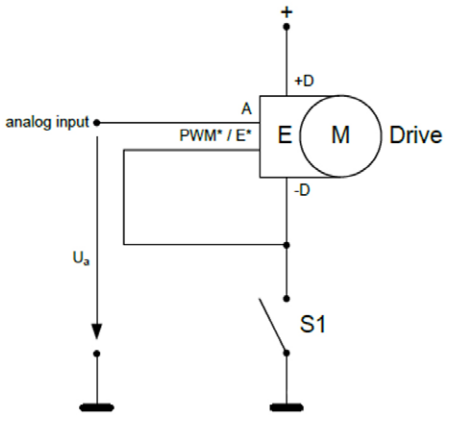


Interface Mode 4: Analogue Control 1

To realize the mode on/off to plus with the drive interface for catalogue product it is necessary to put

- to use A as an analogue input and
- to put PWM*/E* to -D.

When the switch S1 is switched on the drive goes after the initialization of the electronics to the speed requested by the analogue input A. The appropriate current rating for this “switch” has to be dimensioned according to the current consumption of the drive.

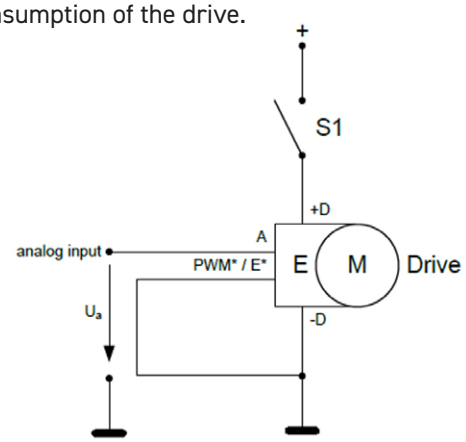


Interface Mode 5: Analogue Control 2

To realize the mode analogue control 2 with the drive interface for catalogue product it is necessary

- to use A as an analogue input and
- to put PWM*/E* to -D.

When the switch S1 is switched on the drive goes after the initialization of the electronics to the speed requested by the analogue input A. The appropriate current rating for this “switch” has to be dimensioned according to the current consumption of the drive.



Interface Mode 6: Analogue Control with enable low

To realize the mode analogue control with enable low with the drive interface for catalogue product it is necessary

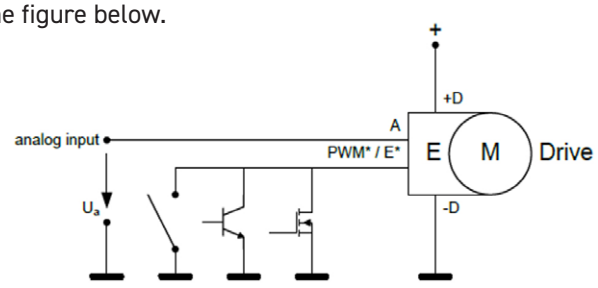
- to use A as an analogue input and
- to use PWM*/E* as a low active enable.

In mode 6 the drive can stay always on supply voltage and is controlled by a low current enable input which can be driven by simple low cost low side signal driver in the CCU. When the enable input PWM*/E* goes to high, the drive goes after a short time into the quiescent current mode.

When the enable pin PWM*/E* is driven low, the drive goes to the speed requested by the analogue input A after the initialization of the electronics.

The appropriate sink current rating of the driver for the enable pin PWM*/E* has to be dimensioned according to the current consumption of the pin PWM*/E*.

The circuit structure to drive the pin PWM*/E* can be any active low “open collector” typical circuitry as depicted in the figure below.



In this operating mode the sopply voltage plus is usually connected permanently. To run the drive first the pin PWM*/E* has to be connected to supply voltage minus and afterwards the drive speed can be then controlled with an analogue voltage on the pin A.

Interface Mode 7: Digital Control

To realize the mode digital control with the drive interface for catalogue product it is necessary

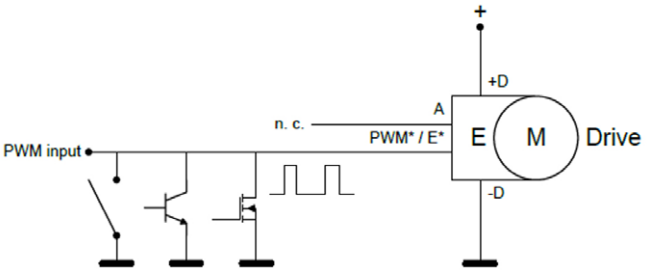
- to apply a PWM signal to the pin PWM*/E*.

In mode 7 the drive can stay always on supply voltage and is controlled by a low current PWM and enable PWM*/E* input which can be driven by a simple low cost low side signal driver in the CCU. When the enable input PWM*/E* goes to high, the drive goes after a short time into the quiescent current mode.

When the enable pin PWM*/E* is driven with PWM, the drive goes to the speed requested by the duty cycle after the initialization of the electronics.

The appropriate sink current rating of the driver for the enable pin PWM*/E* has to be dimensioned according to the current consumption of the pin PWM*/E*.

The circuit structure to drive the pin PWM*/E* can be any active low “open collector” typical circuitry as depicted in the figure below.



In this operating mode the supply voltage plus is usually connected permanently. To run the drive on the pin PWM*/E* a PWM signal has to be applied and with the duty cycle of the PWM signal the drive speed can be then controlled.

Interface Mode 8: Mixed Analogue / Digital Control

To realize the mode mixed analogue/digital control with the drive interface for catalogue product it is necessary

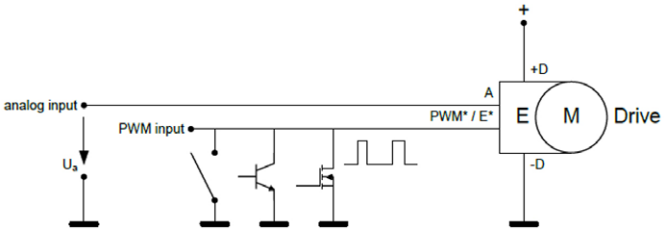
- to use A as an analogue input and
- to apply a PWM signal to the pin PWM*/E*.

In mode 8 the drive can stay always on supply voltage and is controlled by a low current PWM and enable PWM*/E* input which can be driven by a simple low cost low side signal driver in the CCU. When the enable input PWM*/E* goes to high, the drive goes after a short time into the quiescent current mode.

When the enable pin PWM*/E* is driven with PWM, the drive goes to the speed requested by the duty cycle after the initialization of the electronics (if the electronics is not already activated).

The appropriate sink current rating of the driver for the enable pin PWM*/E* has to be dimensioned according to the current consumption of the pin PWM*/E*.

The circuit structure to drive the pin PWM*/E* can be any active low “open collector” typical circuitry as depicted in the figure below.



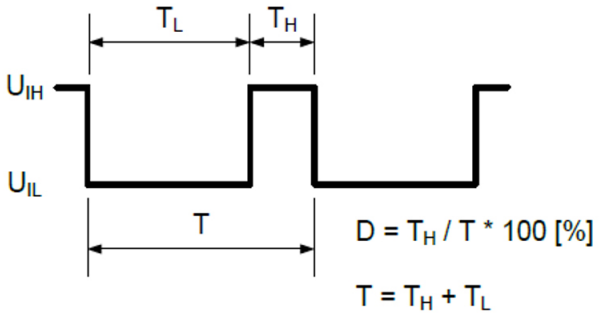
In this operating mode the supply voltage plus is usually connected permanently. To run the drive on the pin PWM*/E* a PWM signal has to be applied and with the duty cycle of the PWM signal the drive speed can be then controlled.

If the pin PWM*/E* is switched to supply voltage minus the drive speed can be then controlled with an analogue voltage on the pin A. So a mixed control with either digital or analogue input is possible. The priority has the digital PWM signal.

Digital Control: Transfer Function PWM Input

The transfer function PWM input is the relation between the drive speed and the duty cycle on the pin digital PWM input / active low: PWM*/E*.

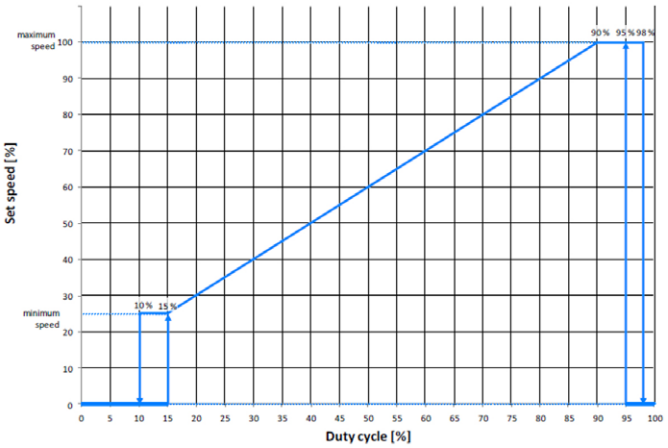
The duty cycle is defined according to so called “positive logic duty cycle definition”.



Considering this definition:

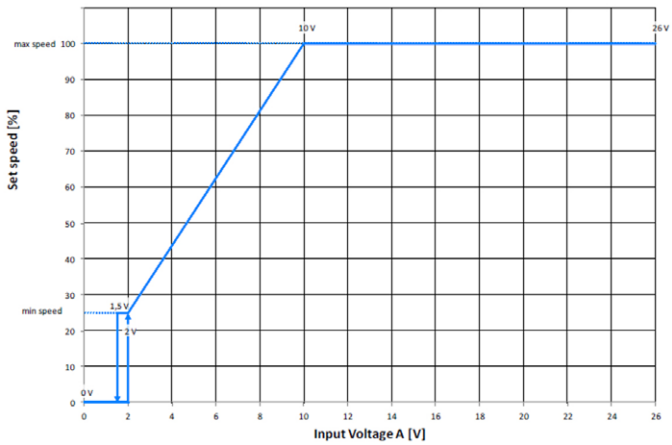
- continuous low voltage is 0 % duty cycle (dominant level)
- continuous high voltage is 100 % duty cycle (recessive level)

Based on this duty cycle definition the transfer function PWM input is shown below.



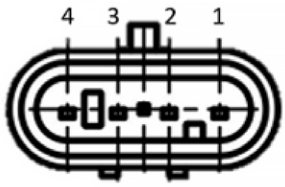
Analog Control: Transfer Function Analog Input

The transfer function analog input is the relation between the Drive speed and the duty cycle on the pin analog input A (see following figure).



Water Pump Connector and Wires

Connector: AMP282106-1 / Mating connector: AMP282088-1



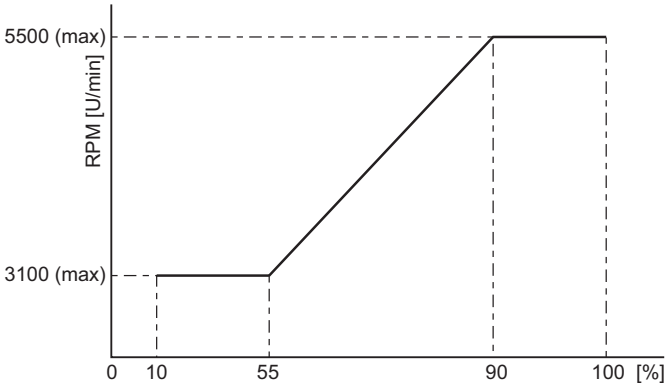
Pin number	1	2	3	4
Identification	GND	Fault feedback	PWM	+12 V / 24 V
Wire color	Black	Yellow	Blue	Red

See below the mating parts for the pump connector:

Description	AMP Part number
Housing	282088-1
Sealing	281934-4
Socket	282110-1
Blanking plug	282081-1

Notice: Sealing plugs must be used in all open pin positions. Failure to follow this instruction will cause the module to not meet the environmental specification.

PWM Transfer Function



Duty cycle	PWM mode
0 % ⩽ duty ⩽ 10 %	Stop
11 % ⩽ duty ⩽55 %	Minimum speed
56 % ⩽duty ⩽90 %	Linear speed control range
90 % ⩽duty ⩽100 %	Maximum speed

Remarks:

- PWM duty cycle metrical error +/-2 %
- PWM voltage 24 VDC/12 VDC (same as pump voltage)
- Frequency 50-1000 Hz
- Recommended duty cycle for stop: 10 %, so 0 % remains for disconnection issue.

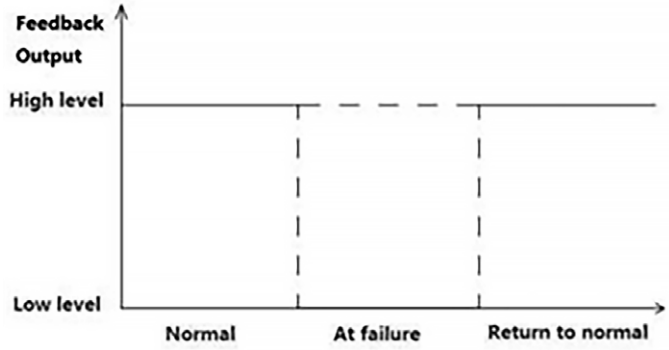
The pump could also be driven in start/stop mode simply by bridging PWM and voltage supply.

Fault Feedback Signal

The fault feedback signal gives information on whether the pump is in error state or not. The signal is high when running normally, otherwise it is low.

- High level is equal to supply voltage.
- Low level is GND.

Error Feedback State Chart



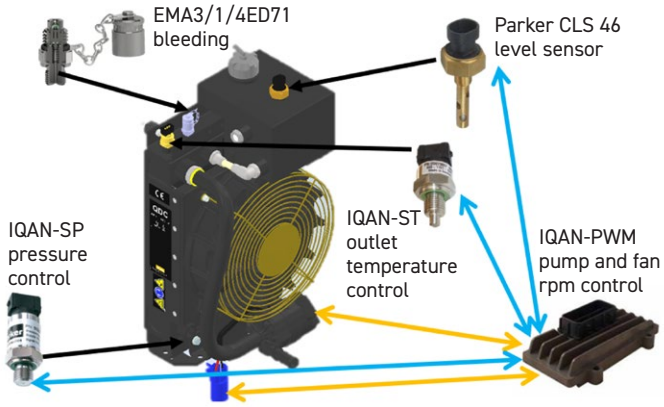
Controlling the Cooling System with an IQAN-MC4x

The IQAN-MC4x controller family can be used to control and monitor a cooling system. The following section describe a typical solution using an IQAN-MC41. This suggestion is not mandatory and stands for example purpose. The user is free to design any original solution.

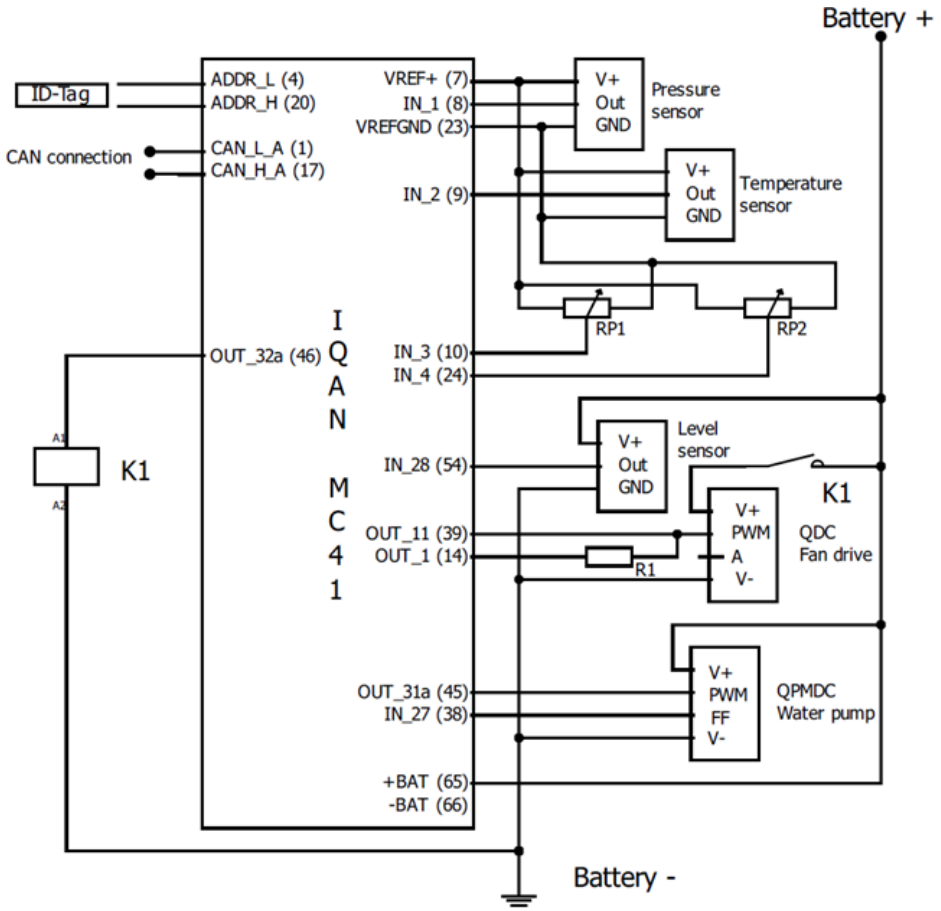
Hardware

Overall System

The cooling system is a QDC 006 assembly from Parker (P/N: 5847006500), including a tank and QPMDC water pump. The system is monitored via a level sensor (CLS46), an IQAN-SP pressure sensor (P/N: 5020026) and an IQAN-ST temperature sensor (P/N: 20073657). The controller is an IQAN-MC41 (P/N: 20085111).



Connections and Wires



Pump and Fan Speed Control

In this suggestion we use simple potentiometers to drive separately the fan drive and the pump. The user is free to use any command solution. The IQAN controller software provides various tools to program automated behaviors. For a display function, we recommend the IQAN-MD4 product range which provides programmable Human-Machine Interfaces.

The fan PWM command signal needs to be adapted to the PWM output. To match the requirements, a resistor must be connected between the IQAN PWM LS and HS pins. See below the adapted resistance value:

- 24 V fan: 10 k - 22 kOhm
- 12 V fan: 5.6 k- 12 kOhm

Also, a normally open relay must be implemented between the Battery + and the + pin from the fan, and controlled with one of the IQAN's DOUT digital output. There should be no voltage on the PWM HS+LS pins when powering on. Otherwise - the PWM pull-up resistor in the fan drive being connected to the battery potential - the IQAN will return a critical error and will not run.

ID-Tag

The IQAN-MC41 controller requires an ID-Tag between its address pins (4 and 20). It will give the IQAN an identification address and allow communication on the CAN bus. Without an ID-Tag the controller will not run.

The address units from Parker such as product N°20085130 will fit and can be found in the catalogue: IQAN Accessories Catalogue datasheet - Catalogue MSG17-8319/UK (parker.com), available on the Parker website.

Pump: The pumps + and – pins should be permanently wired to the power supply. An adapted switch can be implemented for safety stop. The PWM pin should be wired to a OUT_31a pin of the IQAN (45).

The FF (fault feedback) pin of the pump should be wired to a IN_27 pin of the IQAN (38). This pin returns supply voltage when no error on the pump, 0 V otherwise.

Fan drive side: The D+ / D- wires from the fan drive should be wired to the power supply. The user is free to use various operation modes, please refer to the QDC fan drive operation modes sections. In this example we use the interface mode n°7 (PWM command). Connect the fan drive white wire PWM*/E* to pin OUT_11 (39).

IQAN-MC41 controller side: To handle the fan's low current PWM signal, OUT_1 (14) and OUT_11 (39) shall be paired with a resistor as detailed in the previous section.

The +BAT and -BAT pins should be permanently wired to the power supply. An adapted switch can be implemented for safety stop.

An ID-Tag (Parker reference: 20085130) must be plugged between ADDR_L and ADDR_H (4 and 20). This tag is mandatory, otherwise the IQAN-MC41 will return an error and won't proceed.

CAN_L_A (1) and CAN_H_A (17) shall be used for program upload, diagnostics, and CAN communication with other devices. A second CAN channel is available on CAN_L_B (2) and CAN_H_B (18).

The two potentiometers for speed control can be between VREF+_A (pin 7) which supplies +5Vdc and VREF_GND (pin 23). One will have to be connected to IN_3 (pin n°10), the other to IN_4 (24). The fan relay's coil must be connected to OUT_32a (46) and to the ground.

IQAN-SP pressure sensor: The sensor can be supplied with VREF+_A (pin 7) and VREF_GND (pin 23). The output can be connected to IN_1 (8).

IQAN-SP temperature sensor: The sensor can be supplied with VREF+_A (pin 7) and VREF_GND (pin 23). The output can be connected to IN_2 (9).

CLS level sensor: This sensor needs to be supplied 7 to 40Vdc. The output must be connected to a 0-32Vdc IQAN input IN_28 (54).

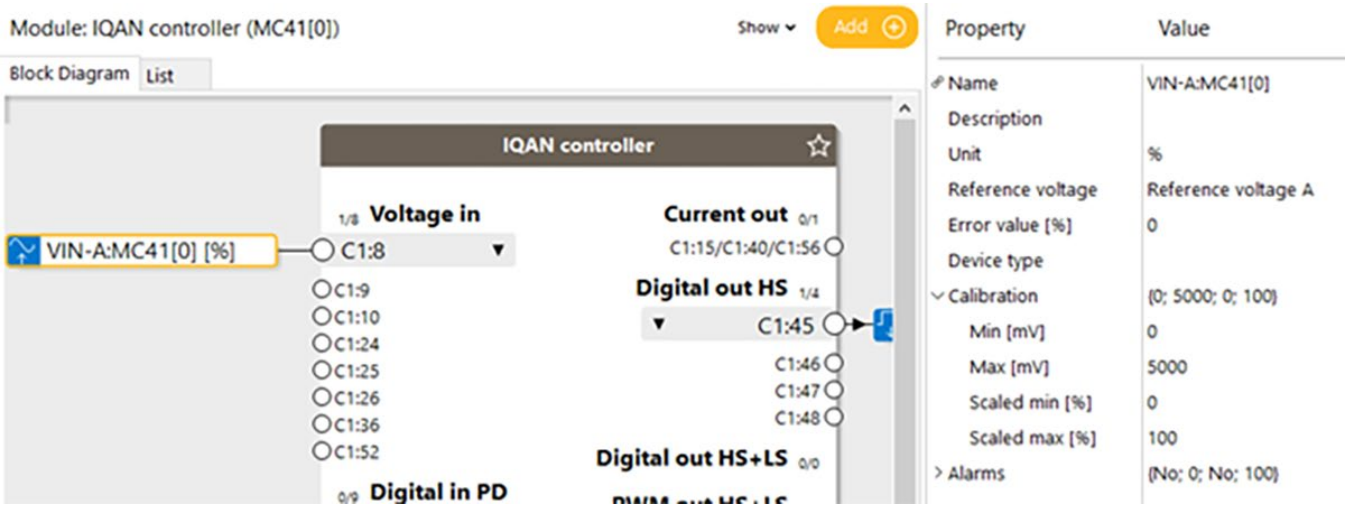
Software

This section details how to handle the IQANDesign software to build a simple algorithm able to control the pump and fan speed via potentiometers.

Creating Project and Setting-up Channels

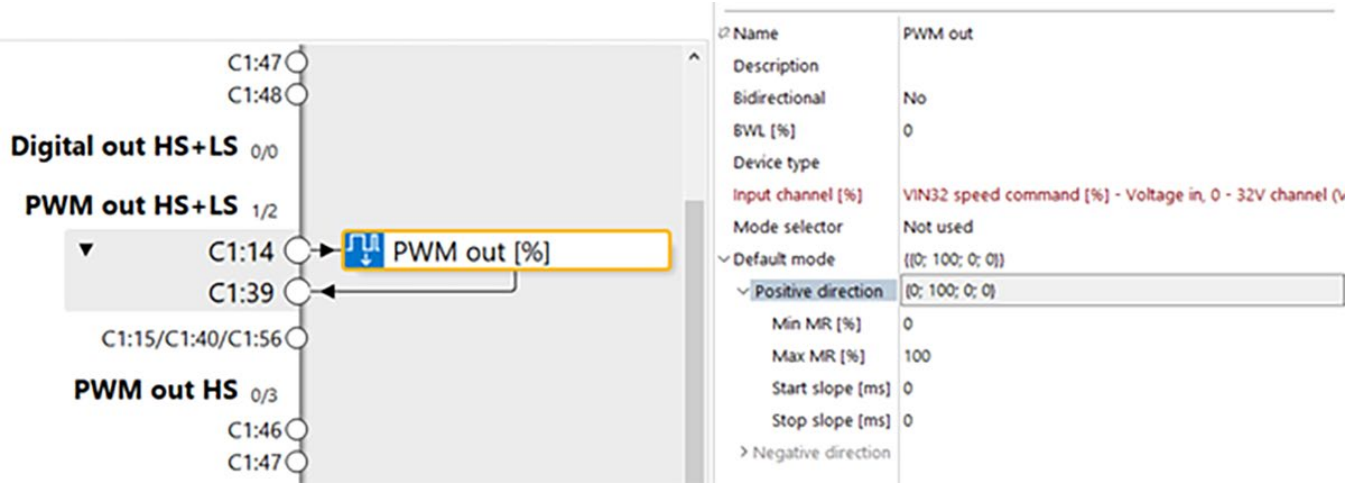
Create a new project on IQANDesign. Select MC41 as controller. Click the master controller in System Layout and set the address to the Id-Tag value.

Double-click the IQAN controller in system layout. Right-click on “Voltage in” pin 8 and add a channel. This will be the input for the potentiometer controlling the fan speed. Set calibration to 0-5000 mV / 0-100 %. Repeat to add the potentiometer controlling the pump speed (0-5000 mV / 0-100 %), the pressure sensor signal (500-4500 mV / 0-30 bar), and the temperature sensor signal (250-4750 mV / -50-150 °C). Repeat to add a “Voltage In 32 V” channel for the Fault feedback of the pump, and another one for the level sensor (0-32000 mV / 0-100 %). Set a low-level alarm below 10 % for the level sensor.



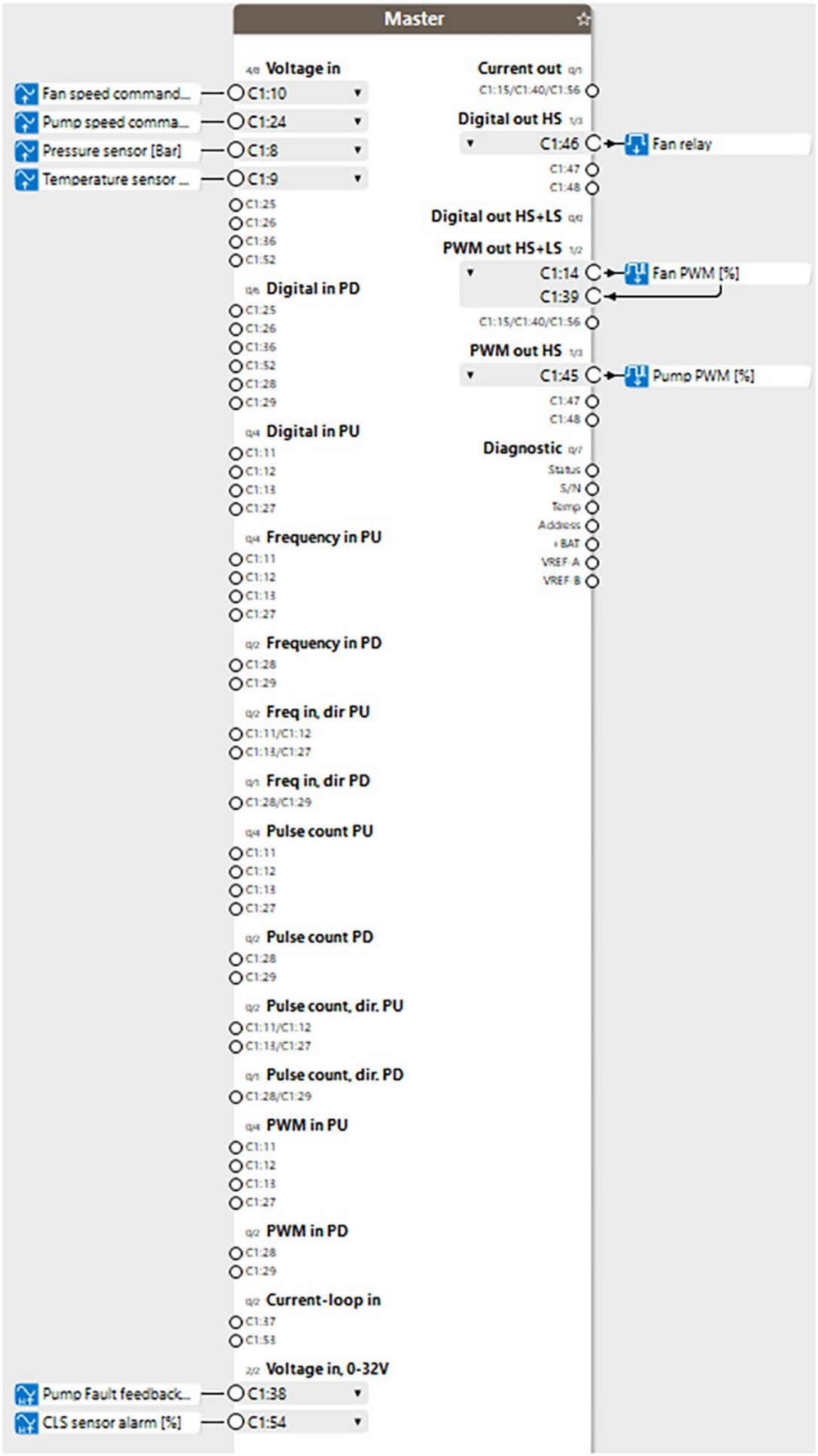
Add a channel on PWM out HS+LS C:14/C:39/C:55. Fill in the properties of the PWM channel. Make it unidirectional, set the input as the Fan speed command signal.

MR is the modulation ratio, set the range as [0 %;100 %]. Also click on the now greyed part written C1:14 and C1:39 (see below) and set the PWM frequency to 100 Hz.



Repeat to add a PWM out HS channel for the pump. Also add pin 46 as Digital out HS to control the fan relay.

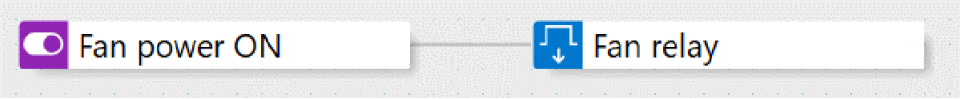
System Layout Setting Suggestion



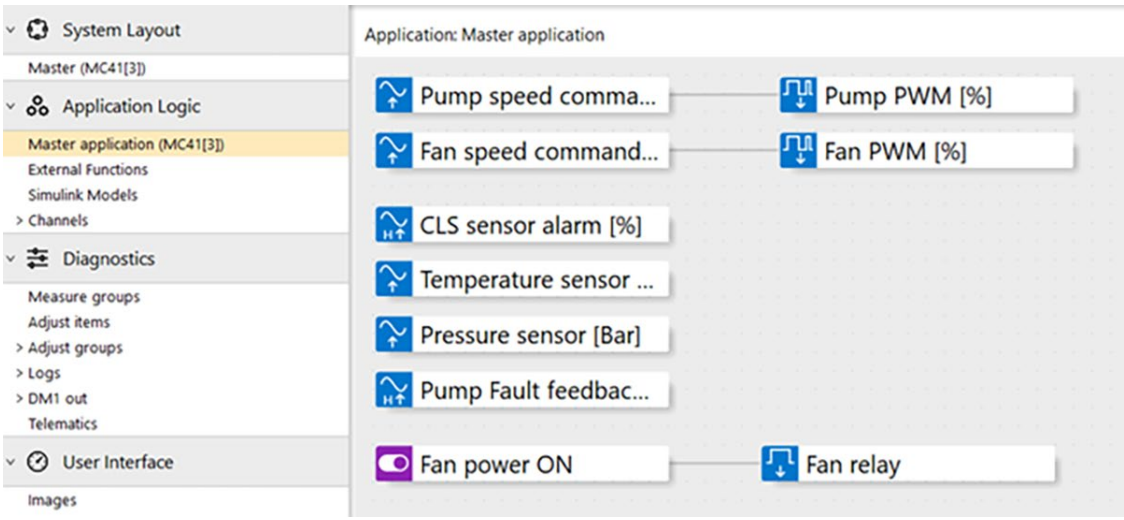
Application Logic Configuration

Go to application logic in the left-hand side of the window and double-click on the “New master module application” box.
Every channel created before should be visible. Click the Pump PWM channel and add Pump Speed Command as input channel. Set positive direction to (0;100;0;0).
Repeat similar operation for Fan PWM and Fan Speed Command.

Create a “digital parameter” and set “True” as default value. Set it as an input for the “fan relay” digital output. The IQAN will close the relay as long as it is running. It is recommended to open the fan relay as soon as the fan is stopped, to save the relay lifetime and current consumption.



If some wires turn red, right-click on the background -> calculation order -> auto order
-> OK.



This is the minimum set up. The application logic provides various tools to program any kind of behavior. According to the customer application, one could build a temperature regulation with the temperature sensor as an input, an emergency stop button if the level is too low, display an emergency message, or communicate the sensors data to the operator.

Upload

The IQAN MC41 only supports uploading by CAN communication. The CAN communication between the controller and the PC shall be provided by the user. Once the IQAN is plugged to the computer, go to the upper menu “Communication” -> “Send project”.

Troubleshooting

Issue	Plausible cause	Solution
The IQAN controller blinks 3 times red and twice orange	IdTag error. The address detected between pin 20 and 4 is wrong.	Check if the IdTag is correctly plugged. Check if the address of the plugged IdTag correctly matches the address entered in the software. (Right-click on the controller block in System layout)
Can't send project into the IQAN		
The IQAN returns a critical error on start	Voltage on PWM HS+LS on start	Be sure to implement a normally open relay on between the battery the + pin of the fan drive.
When the motor is expected to start, the IQAN starts blinking 1 red / 1 orange.	If you are using a digital output, it may be detecting under current or an open load.	Make sure the under current / open load detection is turned OFF.

In case of issue with the IQAN controller, watching the LED can provide information on its state. For more details please the IQAN-MC4x-XC4x Controller Family Instruction Book. The software IQANrun is available to have a live diagnostic of the application.

Technical Data

Voltage supply	24 V version: 16 to 32 Vdc	
	12 V version: 9 to 16V dc	
Fan rated current	15.3 A @24 V / 27 A @12 V	
Fan signal input	PWM (5 - 5000 Hz) or 0 – 10 V	
Rated speed	1100 to 4300 RPM	
Pump rated current	Standard: 4.2 A @ 24 V / 8.4 A @ 12 V Large: 10 A @ 24 V	
Pump signal input	PWM (50 – 1000Hz)	
Pump rated flowrate	Standard: 30 L/min @ 0.9 bar Large: 40 L/min @ 1.7 bar	
Pump features	B rushless DC motor Reverse polarity protection Dry running protection Over voltage, over current protection Overload, over temperature protection EMC: grade 3	
Weight	No option: 10 kg With tank: 12 kg With tank and pump (S): 14 kg With tank and pump (L): 16 kg	
Coolant type	Water-glycol mixture 20 % to 50 %	
Materials in contact with the coolant	Matrix: Hose: Pump:	Aluminum Rubber NBR or EPDM Pump head housing: Die casting aluminum alloys Impeller: PPS+GF Shield cavity: PPS+GF Shaft sleeve: carborundum composite materials Shaft: stainless steel(3CR14) shaft Magnet housing: PPS plastic capsulation Seal ring: EPDM
Operating pressure	Without pump: 0.05 to 14 bar With pump: 0.05 to 2.5 bar	
Maximum flowrate:	100 L/min	
Minimum flowrate:	5 L/min	
Maximum operating temperature:	+85 °C	
Minimum operating temperature:	-40 °C	
Volume	Matrix: 1.2 L With tank: 7.3 L	
Maximum noise level	76 dB	

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