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1 Introduction

These instructions are to be used as a reference tool for the vehicle manufacturer’s design, production, and service personnel. The user of these instructions should have basic knowledge in the handling of electronic equipment.

Warnings
Sections marked with a symbol in the left margin, must be read and understood by everyone using the system, carrying out service work, or making changes to hardware and software. The different symbols used in this manual are defined below.

WARNING
Sections labeled WARNING with a caution symbol in the left margin, indicate that a hazardous situation exists. We use warnings, marked with the warning symbol, in two ways.
• As a strong recommendation about work practices when using the product in the machine (e.g. routines when updating an application). This use is common to the term 'hazardous situation', that a person is exposed to a hazard.
• As a way of pointing out important information for the machine designer that in some way relates to safety. This includes the design of the physical machine, and also the application program being developed for the control system.

NOTICE
Sections labeled NOTICE with a notice symbol in the left margin, indicate there is important information about the product. Ignoring this could result in less than optimal performance, or damage to the product.

Contact the manufacturer if there is anything you are not sure about or if you have any questions regarding the product and its handling or maintenance. The term "manufacturer" refers to Parker Hannifin Corporation.
Overview of relevant documentation

The following publications are relevant for users of this product.

The main documentation contains information that is not found elsewhere. The additional documentation contains product information in a compact format, for details on the information found in those documents, consult this manual.

The IQAN module documentation system.
2 Precautions

Work on the hydraulics control electronics may only be carried out by trained personnel who are well-acquainted with the control system, the machine and its safety regulations.

**WARNING**
Make sure that you have sufficient knowledge before designing, modifying or servicing the control system.
Read the relevant sections of this document before conducting any work on the control system.

**WARNING**
This product is not field repairable.

**NOTICE**
As much as possible of the welding work on the chassis should be done before the installation of the system. If welding has to be done afterwards, the electrical connections on the system must be disconnected from other equipment. The negative cable must always be disconnected from the battery before disconnecting the positive cable. The ground wire of the welder shall be positioned as close as possible to the place of the welding. The cables on the welding unit shall never be placed near the electrical wires of the control system.

**Read This**

**Design of control system**

**WARNING**
Risk of injury may be introduced by design of control system!
This product is designed to control hydraulic outputs. The control application must be designed using basic safety principles so that unintentional movement is avoided. The machine must be equipped with an emergency stop that stops all movement. Please refer to section "Supply voltage".

**Before you start**
Read this document.
Read the IQANdesign software user manual section on 'application safety'.
Start-up, maintenance, and diagnostics
For all personnel carrying out installation, commissioning, maintenance or troubleshooting.

WARNING
Work on the hydraulics control electronics may only be carried out by trained personnel who are well-acquainted with the control system, the machine and its safety regulations.

Before you start,
Read section "Start-up".

Additional information for service
Mounting and maintenance instruction book.

Additional information for diagnosing the system
Read section "System diagnostics", and see "Appendix B", in this document.
Use the IQANrun software user manual as a reference.
3 Product description

IQAN-XS2
The IQAN-XS2 is a flexible expansion module designed for controlling hydraulic systems in vehicles and machinery, using 12/24 Vdc power supply.

I/O overview

Inputs
The IQAN-XS2 module has eight (8) voltage inputs VIN-A thru VIN-H for connection of 0-5 Vdc signals. The inputs may be configured as digital inputs DIN-A thru DIN-H. Voltage inputs and digital inputs share positions, see below.

(8) Voltage inputs VIN-A, VIN-B, VIN-C, VIN-D.....VIN-H
or
Digital inputs and outputs
The XS2 module has six (6) digital outputs for controlling on/off valves and twelve (12) on/off inputs for switch inputs.

(6) on/off outputs, DOUT-G thru DOUT-L
(12) on/off inputs, DIN-I thru DIN-T.

High power On/Off outputs
The XS2 module has six (6) on/off outputs that are high-side power outputs.

(6) On/off outputs, DOUT-A thru DOUT-F

CAN related functions
The master uses the CAN-bus (CAN = Controller Area Network) to communicate with the modules. The CAN-bus is a robust communication protocol that is widely used and well proven within the automotive industry.
4 Safety

Internal diagnostics
The module performs a number of self-checks that improve safety. Checks include monitoring of voltage supplies, checksums on memory and a watchdog that monitors software execution. The module is using a real time operating system which supervises software execution.
If a critical error is detected, the module is stopped, with CAN-bus and outputs off.

CAN-bus interruption
The IQAN modules communicate on a CAN-bus. Both the master module and expansion modules check for any interruptions in CAN-bus communication. If an error occurs the master will use zero or an application defined error value for the module inputs, and the module outputs will be off.
The error will be presented on the master/display module, if there is one, and with a related blink code on the IQAN module status LEDs, see Appendix B.

Current check
For modules with proportional outputs, when used in current mode a current check is performed. If an error is detected, this will be indicated on the master module, and the output will shut off.
The module can detect open-circuit, short-circuit to +BAT/-BAT or short-circuit to other proportional output and return pins.

Emergency stop
WARNING
Risk of injury!
The emergency stop must disconnect the power supply to the module; do not connect the emergency stop as a signal input only.
The emergency stop must be installed so that the risk of reverse feed of the module is avoided, see section "Supply voltage". 
5 Mounting

Mounting the module

The IQAN module should be mounted according to the following instructions:

- Locate the module eliminating the risk for the cabling to be folded, crushed or damaged in any way. Ensure the cabling cannot pull, twist or induce sideload on the connector.
- Locate the module so that severe physical impact is avoided, e.g. impact from falling objects or the module being used as a step.
- Locate the module so that air can circulate to eliminate excess heat. Ensure that no external heat, e.g. from the engine or heater, is transferred to the module.
- Locate the module to protect it from high pressure washing or similar.
- Locate the module so that the cable connector is facing down.
- Locate the module so that the LEDs are visible.

**NOTICE**

The IQAN module must not be placed in any marine related or similar continuously damp, salt-spray environment without external protection.

Assembling of the ID-Tag

The ID-Tag will be placed in the connector in order to address/terminate the module. For IQAN master modules, the use of an ID-tag is application dependent. All IQAN expansion modules require an ID-tag, ref section "Addressing/terminating".

The ID-Tag will be mounted under the connector casing. Bend the ID-Tag’s wires toward the opposite side of where the other wires enter the connector.
6 Installation

Connector C1

<table>
<thead>
<tr>
<th>Connector kit</th>
<th>Parker no. 5031063</th>
</tr>
</thead>
<tbody>
<tr>
<td>Housing</td>
<td>Amp no. 1-963226-1</td>
</tr>
<tr>
<td>Casing</td>
<td>Amp no. 0-965643-1</td>
</tr>
<tr>
<td>Plane sealing, 42 p installed in module</td>
<td></td>
</tr>
<tr>
<td>Pin types*</td>
<td>Amp no. 963711-2 (MT) Amp no. 929938-1 (JPT)</td>
</tr>
<tr>
<td>Cables</td>
<td>0,75-1,0 mm² (MT) 1,5-2,5 mm² (JPT)</td>
</tr>
<tr>
<td>Seals</td>
<td>Amp no. 963530-1 (MT) Amp no. 828905-1 (JPT)</td>
</tr>
<tr>
<td>Plugs (empty pos.)</td>
<td>Amp no. 963531-1 (MT) Amp no. 828922 (JPT)</td>
</tr>
<tr>
<td>IQAN crimping tool references</td>
<td>Blue handle, pos. A use blue extraction tool Red handle, pos. B use yellow extraction tool</td>
</tr>
<tr>
<td>IQAN tool kit</td>
<td>Parker no. 5031061</td>
</tr>
</tbody>
</table>

Connector pin assignments

<table>
<thead>
<tr>
<th>Logical Symbol</th>
<th>Pin No.</th>
<th>(I)output</th>
<th>Function description and/or Signal name(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>+BAT</td>
<td>28</td>
<td>-</td>
<td>Power supply, positive.</td>
</tr>
<tr>
<td>-BAT</td>
<td>15</td>
<td>-</td>
<td>Power supply, negative ground</td>
</tr>
<tr>
<td>+VREF</td>
<td>42</td>
<td>-</td>
<td>Voltage reference for external sensors. Sourcing +5V.</td>
</tr>
<tr>
<td>-VREF</td>
<td>29</td>
<td>-</td>
<td>Voltage reference for external sensors. Return (0V).</td>
</tr>
<tr>
<td>ADDR-H</td>
<td>1</td>
<td>-</td>
<td>High side to address tag. Sourcing +5V.</td>
</tr>
<tr>
<td>ADDR-L</td>
<td>14</td>
<td>-</td>
<td>Low side to address tag. Return (0V).</td>
</tr>
<tr>
<td>CAN-H</td>
<td>26</td>
<td>-</td>
<td>CAN high voltage bus line, will be HIGH in dominant state.</td>
</tr>
<tr>
<td></td>
<td>27</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>CAN-L</td>
<td>40</td>
<td>-</td>
<td>CAN low voltage bus line, will be LOW in dominant state.</td>
</tr>
<tr>
<td></td>
<td>41</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>
### Logical Symbol | Pin No. | Input or Output | Function description and/or Signal name(s) | Notes
---|---|---|---|---
**P0** | # | I/O | P0 is an 8 pin input port with alternate functions on four inputs. VIN | DIN
P0.0 | 10 | I | VIN-A | DIN-A
P0.1 | 11 | I | VIN-B | DIN-B
P0.2 | 12 | I | VIN-C | DIN-C
P0.3 | 13 | I | VIN-D | DIN-D
P0.4 | 24 | I | VIN-E | DIN-E
P0.5 | 25 | I | VIN-F | DIN-F
P0.6 | 38 | I | VIN-G | DIN-G
P0.7 | 39 | I | VIN-H | DIN-H

Note: DIN-A to DIN-H have high impedance inputs (62K Ohm).

**P1** | # | O | P1 is an 6 pin output port. DOUT
P1.0 | 8 | O | DOUT-A
P1.1 | 9 | O | DOUT-B
P1.2 | 22 | O | DOUT-C
P1.3 | 23 | O | DOUT-D
P1.4 | 36 | O | DOUT-E
P1.5 | 37 | O | DOUT-F

**P2** | # | O/I | P2 is an 18 pin input/output port. DIN | DOUT
P2.0 | 2 | O | - | DOUT-G
P2.1 | 16 | O/I | DIN-I | -
P2.2 | 30 | O/I | DIN-J | -
P2.3 | 3 | O | - | DOUT-H
P2.4 | 17 | O/I | DIN-K | -
P2.5 | 31 | O/I | DIN-L | -
P2.6 | 4 | O | - | DOUT-I
P2.7 | 18 | O/I | DIN-M | -
P2.8 | 32 | O/I | DIN-N | -
P2.9 | 5 | O | - | DOUT-J
P2.10 | 19 | O/I | DIN-O | -
P2.11 | 33 | O/I | DIN-P | -
P2.12 | 6 | O | - | DOUT-K
P2.13 | 20 | O/I | DIN-Q | -
P2.14 | 34 | O/I | DIN-R | -
P2.15 | 7 | O | - | DOUT-L
P2.16 | 21 | O/I | DIN-S | -
P2.17 | 35 | O/I | DIN-T | -

Notes:
- DIN-I to DIN-T are equipped with clamping diode, risk for 'backending'. See section "Connecting switches to the digital inputs"
- Shaded positions are Junior Power Timer pins. Unshaded positions are Micro Timer II pins. See above for wire, seal, pin number and crimping tool information. The IQAN tool kit is found in the "IQAN accessories" datasheet.
Supply voltage
Before any installation of the IQAN system can take place, make sure the ignition lock is turned off and the battery is disconnected.

Emergency stop
Make sure an *Emergency Stop* disconnecting the power supply, is easily accessible at any time. The figure below shows how to connect the emergency stop.

Connecting of Supply Voltage
The supply voltage, should be within the operating interval, see Appendix A. Connect the supply voltage to +BAT and -BAT. Protect the module by using a fuse. For recommended fuse level, see Appendix A.

RTC supply
IQAN master modules have a clock that is used for date/time stamping when logging data. The *real time clock*, +RTC, requires a separate positive power connection. Connect the supply voltage to +RTC through a 1.5K ohm resistor. The resistor should be as close to the battery as possible for safety. IQAN expansion modules do not have +RTC.

**WARNING**
Risk of injury!
To reduce the risk for uncontrolled supply of an IQAN master module, i.e., a short circuit between the +RTC cable and +BAT, a resistor must be connected between the battery and the +RTC input. This is important as this line is not controlled by an emergency stop.
The resistor should be placed close to the battery, as the 'protected' part is the cable between the resistor and the unit.
This will prevent the +RTC wire from powering up the unit if shorted to +BAT.

![Connecting the emergency stop and voltage supply.](image)

**NOTICE**
Do not use the chassis as the negative terminal.

Polarity reversal
The module is protected against power supply polarity reversal and over-voltage, provided an external fuse is being used.
If this fuse is not used, polarity reversal can damage the unit.
Addressing/terminating

Addressing
Each IQAN expansion module will have a specific address, enabling the master module to communicate with the modules through the CAN-bus. When operating, the system distinguishes between different modules by first verifying the module type and secondly, through the modules having unique addresses.

EXAMPLE
If having an expansion module with address 0, the system will denote this one as [module type]-A0, The letter "A" in the example refers to CAN-bus A.

The maximum number of similar modules in a system is four or eight depending on the master module, denoted in the first case as addresses 0, 1, 2, 3 respectively. In order to assign any IQAN module a unique CAN-address, an ID-Tag will have to be connected to the positions ADDR-H and ADDR-L.

Terminating
To eliminate interference in the communications through the CAN-bus, the CAN-bus must be terminated at both ends. By default, if no ID-tag is installed in an IQAN master, it will be terminated internally to be the Bus master and will have no special configuration. When an IQAN expansion module is located at the end of the CAN-bus, then you would use an ID-tag having a combined addressing and terminating function. This is denoted with a "T" for terminating, after the appropriate address such as; 0T, 1T, 2T... etc. In the application, the same address value as the non-terminated ID-Tag with equivalent number will be transferred to the application.

Selecting appropriate ID-Tag
• Check the address number of the module assigned in the application.
• If the module is located at the end of the CAN-bus, then select the appropriate ID-Tag denoted with a "T".

NOTICE
The CAN-bus must not be terminated at the module using an external regular terminating resistor, due to the fact that terminating is made from within the module by default or in conjunction with the ID-Tag.
Reference voltage, VREF
The IQAN module is internally equipped with a voltage regulator to generate the reference voltage $V_{REF}$. The standard reference voltage will feed different kinds of sensors and potentiometers.

- VREF positions.

**NOTICE**
It is strongly recommended to use the module’s -$V_{REF}$ and $+V_{REF}$ to all sensors and potentiometers that are connected to the module inputs. This will reduce bad measurement based on potential fault (i.e. different ground points for other supplies in relation to the IQAN module ground, -$BAT$).

Maximum load for the $V_{REF}$ is different according to 12/24 Vdc power supply, see "Appendix A".

Instruction book, IQAN
Voltage inputs

Connecting sensors to the voltage inputs
The sensor signal range must be 0-5 Vdc. To detect signal errors such as short circuits or interruptions the active signal range be within 0.5-4.5 Vdc.

![Graph showing error detection and active signal ranges](image)

The current consumption related to the voltage input is negligible. The positive terminal of the sensor is connected to the +VREF position and the corresponding negative terminal to the -VREF position. The sensor signal is connected to appropriate VIN position.

**EXAMPLE**
Connect the positive and negative terminals of the position sensor to +VREF, and -VREF, respectively. Then connect the sensor signal to VIN-X.

![Diagram of IQAN module and sensor connections](image)

NOTICE
The negative terminal of the sensor must not be connected to the chassis. Maximum load for VREF position: see Appendix A.

Connecting other 3 wire sensors
The same type of connection shown for potentiometers is used for other 3 wire sensors supplied with power from the regulated 5VDC supply, VREF. This includes active temperature sensor IQAN-ST, pressure sensor IQAN-SP and Hall-effect levers IQAN-LST or IQAN-LSL.
Connecting a 2-wire temperature sensor to voltage in
When you connect a PTC (positive temperature coefficient) temperature sensor you may need to use a pull up resistor on the input signal. Please check the technical data for your specific temperature sensor.

**EXAMPLE**
Connect the negative terminal of the temperature sensor to -VREF, and the signal to VIN-X. The pull up resistor will be connected between VIN-X, and +VREF.

![Connecting -VREF and temperature sensor signal VIN-X.](image)

The pull up resistor value for a $R_{25}=2000\, \Omega$, PTC sensor is 4.7 KΩ.

Connecting switches to the voltage inputs using VREF
Switches could be connected to the voltage inputs, to create a digital on/off signal. The switches should be connected to +VREF and VIN/DIN respectively for 5V signal. The current consumption for the input is negligible.

**EXAMPLE**
Connect the positive and negative terminals of the switch to +VREF, and VIN-X, respectively.

![Connecting a switch to VIN-X and VREF.](image)

NOTICE
Maximum load for VREF position, see "Appendix A".
Connecting switches to the voltage inputs using +BAT

It is recommended to connect system voltage +BAT to the input through a switch in order to reserve 5Vdc VREF for sensors and potentiometers.

EXAMPLE

Connect the positive and negative terminals of the switch to supply or the unit’s +BAT, and DIN-X, respectively.

Connecting a switch to DIN-X and +BAT.
Digital inputs

DIN that share pins with VIN
These digital inputs share pins with the module voltage inputs and have high impedance characteristics. The preceding switch examples apply to these inputs.

DIN that share pins with CRET
These digital inputs share pins with the return pins of the proportional output channels, e.g. CRET and PWMRET. These pins have an internal power clamping diode. If used as inputs they must be connected in a way that prevents 'backending', that is, supplying power to the module from a source other than its power pin (+BAT). Carefully read the following section for more information.

Connecting switches to the digital inputs
When connecting switches to the digital inputs, DIN, that share pins with CRET, extra precautions should be taken.

WARNING
The DIN that share pins with the CRET positions of the proportional outputs have a possibility of 'backending' the IQAN module when using those pins as digital inputs. The internal circuitry has power clamping diodes between CRET pins and the internal power supply. This arrangement creates a risk of inadvertently supplying power to the unit.

You can safely connect using +VREF for the supply, as shown in the preceding "Connecting switches to the voltage inputs" example.

If you would like to preserve +VREF for sensors and joysticks, then there are two additional methods:

1. The switches could be powered by one of the module’s DOUT pins.

EXAMPLE
Connect the supply of the switch to DOUT-X, and the signal to DIN-X, respectively.

![Diagram](connecting-to-dout-x-and-din-x.png)
2 The switch supply could be connected through a high impedance resistor.

**EXAMPLE**

Connect the supply of the switch to +BAT through a high impedance resistor, and the signal to DIN-X, respectively.

![Diagram of switch supply connection](image)

Connecting a switch to DIN-X and supply through a resistor.

**WARNING**

Do not exceed 35Kohm for 12 Vdc systems and 50Kohm for 24 Vdc systems!
The DIN signal will not be detected by the module.
Remember that these flexible I/O pins must be configured in pairs of the same type.
**Digital outputs**
The digital outputs control relays and on/off valves. For the maximum load per output see Appendix A.

**Connecting loads to digital outputs**
Connecting of loads to the digital outputs such as on/off valves is done by using the DOUT positions and the negative battery terminal as ground.

**Protection against voltage transients**
A clamping diode must be placed between the digital output and ground, as close to the load as possible. This protects the output against high voltage transients. For example, use diode: 1N5408 (3A/1000V). Depending on the load, other clamping diodes might be used instead.

**EXAMPLE**
Connect the on/off valve to the digital output using the DOUT-X, and the negative battery terminal as ground.

**NOTICE**
A clamping diode must be placed as close to the load as possible

**EXAMPLE**
Connecting a load to the digital output.

**NOTICE**
If the load is controlled in parallel with another system, the digital output pin must also be protected with a second diode.

**EXAMPLE**
Digital output protected with a diode.
7 Start-up

Start-up procedures
This chapter contains instructions for action to be taken in connection with the initial start.

WARNING
Risk of injury!
If the control system is not fitted properly, the machine could move uncontrollably. The machine’s engine shall not be started before the control system is completely fitted and its signals are verified.

Starting the control system

Start the control system as follows:
• Prior to start, all modules and cables are to be fitted correctly.
• Check fuses, i.e. make sure that the supply voltage to the modules is equipped with the correct fuse.
• Make sure that connections for supply voltage and return lines are correct in the cable’s conductor joint.
• Make sure an emergency stop is installed.
  The emergency stop should disconnect the supply voltage to all modules. Alternatively, the emergency stop may also shut off the diesel engine or a dump valve, and with that, depressurize the hydraulic system.

Prepare for system start

WARNING
Make sure no one is in dangerous proximity to the vehicle to avoid injuries when it starts.

Prepare for the initial system start as follows:
• The engine for the hydraulic system’s pump shall be in off position.
• Make sure that all connectors are properly connected.
• Turn on the control system.
• Make sure that voltage is being supplied to all modules; the power/status diode shall be illuminated on all modules. Also, make sure that the master is in contact with all modules by reading the master’s display.
• Make sure the emergency stop is functioning properly.

Start the system

Start the system as follows:
• Start the engine for the hydraulic system’s pump, assuming that the above mentioned inspections have been carried out and shown correct values. Calibrate and adjust input and output signals according to the instructions related to the master menu system and check each and every output function carefully.
8 System Diagnostics

The yellow blinking LED on the top of the module indicates normal status. If there is an error detected, the IQAN module will indicate error status through the red blinking LED. This gives an immediate diagnosis as to the nature of the error that has occurred.

The green LED indicates power on. The yellow/red LED, will be blinking red when an error has been detected. To get further information about the error messages, see Appendix B.
### IQAN-XS2 Technical Overview

#### System

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td></td>
</tr>
<tr>
<td>Operating temperature</td>
<td>-40 to 70 °C</td>
</tr>
<tr>
<td>Absolute maximum temperature</td>
<td>-40 to 85 °C</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>-40 to 100 °C</td>
</tr>
<tr>
<td>Voltage supply</td>
<td></td>
</tr>
<tr>
<td>Power on threshold</td>
<td>9-32 V</td>
</tr>
<tr>
<td>Over voltage on any pin</td>
<td>6.2 V</td>
</tr>
<tr>
<td>Reverse polarity protection on +BAT</td>
<td>34 V with respect to -BAT</td>
</tr>
<tr>
<td></td>
<td>with external 20A fuse.</td>
</tr>
<tr>
<td>-VREF load</td>
<td>2A</td>
</tr>
<tr>
<td>Power driver load</td>
<td>total load on power drivers &lt; 20 A</td>
</tr>
<tr>
<td>Current supply</td>
<td></td>
</tr>
<tr>
<td>$V_{BAT} = 14$ V</td>
<td>typ. 95 mA</td>
</tr>
<tr>
<td>$V_{BAT} = 28$ V</td>
<td>typ. 75 mA</td>
</tr>
<tr>
<td>Start-up time</td>
<td>typ. 250 ms</td>
</tr>
<tr>
<td>Weight</td>
<td>750 grams</td>
</tr>
</tbody>
</table>

#### Environmental ratings

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMI</td>
<td></td>
</tr>
<tr>
<td>ISO 13766:2010/ISO 14982:2009, Radiated emission EN 55022:2003, Conducted emission ISO 11452-2:1995, Radiated Susceptibility ISO 11452-4:2001, Conducted Susceptibility ISO 7637-2:1990, Conducted transient susceptibility</td>
<td>30-1000 MHz, 0.15-108 MHz, Class 1 200-2000 MHz, 1 kHz, 80% AM, 100V/m 1-200 MHz, 1 kHz, 80% AM, 150mA Pulse 1,2,2a,2b,2c, Level 3; Pulse 5, Level 1</td>
</tr>
<tr>
<td>ESD</td>
<td></td>
</tr>
<tr>
<td>ISO 10605:2001, ESD, operation</td>
<td></td>
</tr>
<tr>
<td>ISO 10605:2001, ESD, handling</td>
<td></td>
</tr>
<tr>
<td>Mechanical environment</td>
<td></td>
</tr>
<tr>
<td>IEC 60068-2-64:2008 Fh, Random vibration IEC 60068-2-27:2008 Ea, Shock</td>
<td>15K, air, 8 KV contact 4 KV contact 15- 250 Hz, 9.7 Grms, 3 x 10 hrs 40g, 6 ms,1000 x 6 directions</td>
</tr>
<tr>
<td>Climate environment</td>
<td></td>
</tr>
</tbody>
</table>

#### Sensor supply, VREF

$T_J = -40 °C$ to $+70 °C$ (unless otherwise specified)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of VREF</td>
<td>1</td>
</tr>
<tr>
<td>Output voltage</td>
<td>5 V ±150 mV</td>
</tr>
<tr>
<td>Temperature drift</td>
<td>25 mV/°C</td>
</tr>
<tr>
<td>Maximum load current</td>
<td>150 mA</td>
</tr>
<tr>
<td>Protection</td>
<td>overload, SCB, SCG</td>
</tr>
</tbody>
</table>
### Sensor supply, VREF

\( T_A = -40 \, ^\circ\text{C} \) to \(+70 \, ^\circ\text{C}\) (unless otherwise specified)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diagnostics</td>
<td>under/over voltage</td>
</tr>
<tr>
<td>Under/over voltage threshold</td>
<td>±250 mV from nominal value</td>
</tr>
</tbody>
</table>

### I/O

\( T_A = +25 \, ^\circ\text{C}\) (unless otherwise specified)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>VIN (Voltage input)</strong></td>
<td></td>
</tr>
<tr>
<td>Signal range, full scale</td>
<td>5000 mV ±100 mV</td>
</tr>
<tr>
<td>Signal resolution</td>
<td>100 bits = 5 mV</td>
</tr>
<tr>
<td>Input impedance</td>
<td>62 kΩ</td>
</tr>
<tr>
<td>Accuracy</td>
<td>35 mV, VREF as source</td>
</tr>
<tr>
<td></td>
<td>100 mV, External source</td>
</tr>
<tr>
<td>Protection</td>
<td>SCB, SCG</td>
</tr>
<tr>
<td>Diagnostics</td>
<td>defined in application</td>
</tr>
<tr>
<td><strong>DIN (On/off input)</strong></td>
<td></td>
</tr>
<tr>
<td>Input low</td>
<td>&lt;1.0 V</td>
</tr>
<tr>
<td>Input high</td>
<td>&gt;4.0 V</td>
</tr>
<tr>
<td>Input hysteresis</td>
<td>1.0 V, DIN-A to DIN-H</td>
</tr>
<tr>
<td></td>
<td>0.5 V, DIN-H to DIN-T</td>
</tr>
<tr>
<td>Input impedance</td>
<td>62 kΩ, DIN-A to DIN-H</td>
</tr>
<tr>
<td></td>
<td>5.6 kΩ, DIN-I to DIN-T</td>
</tr>
<tr>
<td>Diagnostics</td>
<td>defined in application</td>
</tr>
<tr>
<td><strong>Power driver, DOUT (on/off output)</strong></td>
<td></td>
</tr>
<tr>
<td>Number of DOUT</td>
<td>12</td>
</tr>
<tr>
<td>Maximum load</td>
<td>2 A</td>
</tr>
<tr>
<td>Power driver voltage drop</td>
<td>typ. 0.30 V @ 1.5 A load</td>
</tr>
<tr>
<td>Leakage current in OFF state</td>
<td></td>
</tr>
<tr>
<td>DOUT-A to DOUT-F</td>
<td>&lt;100 µA</td>
</tr>
<tr>
<td>DOUT-G to DOUT-L</td>
<td>&lt;1 mA</td>
</tr>
<tr>
<td>Maximum load inductance</td>
<td></td>
</tr>
<tr>
<td>( V_{\text{BAT}} = 14 , \text{V} ), single pulse</td>
<td>14 Ohm / 366 mH, 9.3 ohm / 126 mH, 7 ohm / 50 mH</td>
</tr>
<tr>
<td>( V_{\text{BAT}} = 28 , \text{V} ), single pulse</td>
<td>28 Ohm / 334 mH, 19 ohm / 114 mH, 14 ohm / 46 mH</td>
</tr>
<tr>
<td>Protection</td>
<td>over load, SCB, SCG</td>
</tr>
<tr>
<td>Diagnostics</td>
<td>no</td>
</tr>
</tbody>
</table>

### CAN

\( T_A = -40 \, ^\circ\text{C} \) to \(+70 \, ^\circ\text{C}\) (unless otherwise specified)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of CAN buses</td>
<td>1</td>
</tr>
<tr>
<td>CAN specification</td>
<td>2.0A and 2.0B</td>
</tr>
<tr>
<td>CAN bus speed</td>
<td>250 kbits</td>
</tr>
<tr>
<td>Protection</td>
<td>SCB, SCG</td>
</tr>
</tbody>
</table>
Appendix B

Error codes, messages and actions

If one of the following error is detected, a message will be presented on the display together with an error code on the module. In some cases, the module will turn off or at least shut down the outputs, to increase safety.

The location of the LED indicators on the IQAN-XS2 module.

**WARNING**

Don’t use the machine if an error message or error code is activated. The following sections will present what measures to take for different error situations put into appropriate context.

**LED indicator showing different XS2 modes**

<table>
<thead>
<tr>
<th>Status</th>
<th>Flash</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal operation (yellow)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Error code</th>
<th>Error</th>
<th>Primary Flash (red)</th>
<th>Secondary Flash (yellow)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3:1</td>
<td>CAN error</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3:2</td>
<td>Address error</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4:1</td>
<td>Memory error&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FE</td>
<td>Fatal error</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup> FRAM memory error.
Appendix C

Dimensioning of the IQAN module

![Diagram of IQAN module with dimensions]

Unit = mm

- 60 mm
- 164 mm
- 75 mm
- 52 mm
- 67 mm
- 32 mm
- $\varnothing 7 \text{ mm/M6(x2)}$
Appendix D

Failure Modes
The following tables contain information about the different possible failures that could occur for each module subsystem. In most cases when an error is detected, a message will be presented on the master display together with an error code on the module. In some cases, the module will turn off or at least shut down the outputs, to increase safety.

Failure modes for CAN interface

<table>
<thead>
<tr>
<th>Failure mode</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 CAN-H to -BAT</td>
<td>No CAN communication. All output turned off.</td>
</tr>
<tr>
<td>2 CAN-L to -BAT</td>
<td>No CAN communication. All output turned off.</td>
</tr>
<tr>
<td>3 CAN-H to +BAT</td>
<td>No CAN communication. All output turned off.</td>
</tr>
<tr>
<td>4 CAN-L to +BAT</td>
<td>No CAN communication. All output turned off.</td>
</tr>
<tr>
<td>5 CAN-L open circuit</td>
<td>No CAN communication. All output turned off.</td>
</tr>
<tr>
<td>6 CAN-H open circuit</td>
<td>No CAN communication. All output turned off.</td>
</tr>
<tr>
<td>7 CAN-L to CAN-H</td>
<td>No CAN communication. All output turned off.</td>
</tr>
<tr>
<td>8 CAN-termination failure, termination on</td>
<td>No effect</td>
</tr>
<tr>
<td>9 CAN-termination failure, termination off</td>
<td>Dependent on CAN size and number of CAN nodes.</td>
</tr>
</tbody>
</table>

Failure modes for VREF

<table>
<thead>
<tr>
<th>Failure mode</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>+VREF Open</td>
<td>VIN out of range, will create a VIN error =&gt; VIN=Predefined error value.a</td>
</tr>
<tr>
<td>-VREF Open</td>
<td>VIN out of range, will create a VIN error =&gt; VIN=Predefined error value.a</td>
</tr>
<tr>
<td>+VREF Short-circuit to +VREF</td>
<td>VREF error =&gt; VIN out of range, will create a VIN error =&gt; VIN=Predefined error value.a</td>
</tr>
<tr>
<td>+VREF Short-circuited to +BAT</td>
<td>VREF error =&gt; VIN out of range, will create a VIN error =&gt; VIN=Predefined error value.a</td>
</tr>
<tr>
<td>+VREF Short-circuited to +BAT</td>
<td>VREF error =&gt; VIN out of range, will create a VIN error =&gt; VIN=Predefined error value.a</td>
</tr>
<tr>
<td>-VREF Short-circuited to +BAT</td>
<td>External fuse (if &lt;7.5A) on +BAT blows.</td>
</tr>
<tr>
<td>-VREF Short-circuited to -BAT</td>
<td>Not detected.</td>
</tr>
</tbody>
</table>

a. Measure is controlled by CAN master and application as a result from the CAN error message. Turning outputs off is controlled by CAN master unit and therefore delayed maximum 2 bus cycles.
Failure modes for VIN

<table>
<thead>
<tr>
<th>Failure mode</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 VIN Open</td>
<td>VIN out of range, will create a VIN error =&gt; VIN=Predefined error value</td>
</tr>
<tr>
<td>2 VIN Short-circuited to +BAT</td>
<td>VIN out of range, will create a VIN error =&gt; VIN=Predefined error value</td>
</tr>
<tr>
<td>3 VIN Short-circuited to -BAT</td>
<td>VIN out of range, will create a VIN error =&gt; VIN=Predefined error value</td>
</tr>
</tbody>
</table>

a. Measure is controlled by CAN master and application as a result from the CAN error message. Turning outputs off is controlled by CAN master unit and therefore delayed maximum 2 bus cycles.

Failure modes for DIN

<table>
<thead>
<tr>
<th>Failure mode</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 DIN Open</td>
<td>No effect on module, not detected</td>
</tr>
<tr>
<td>2 DIN Short-circuited to +BAT</td>
<td>No effect on module, not detected</td>
</tr>
<tr>
<td>3 DIN Short-circuited to -BAT</td>
<td>No effect on module, not detected</td>
</tr>
</tbody>
</table>