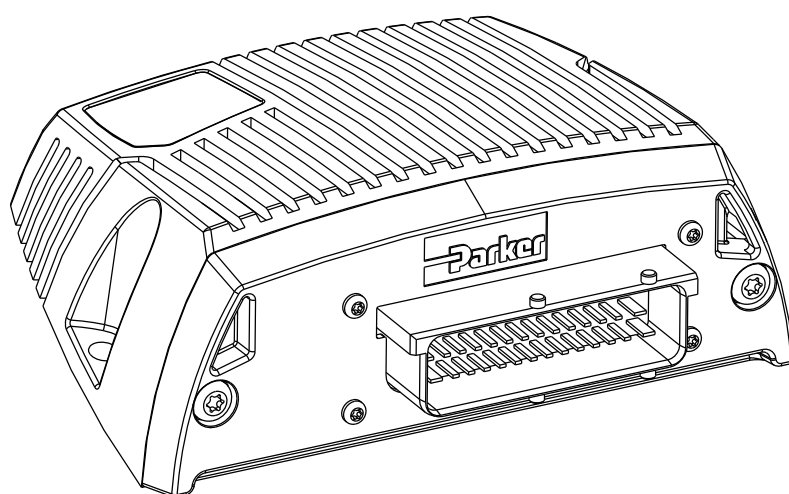


# IQAN-XS2

## Instruction book

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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.

Not all document sections that contain information about safety are marked with a warning symbol (there would be warnings everywhere). Failure to comply with the recommendations can cause unintentional, and unexpected behavior of the control system. This can potentially cause death, serious injury or property damage.



### **NOTICE**

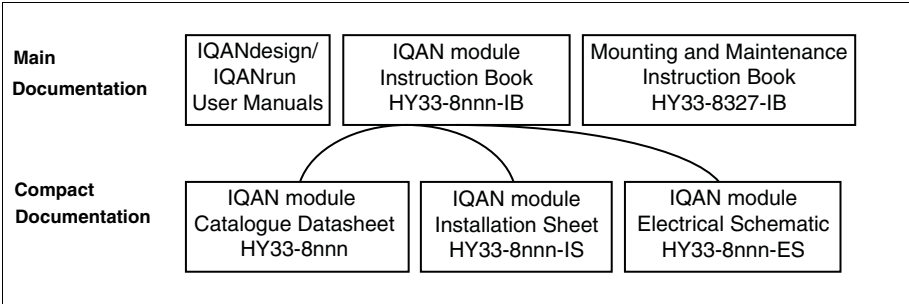
Sections labeled *NOTICE* with a notice symbol in the left margin, indicate there is important information about the product. Ignoring this could result in less than optimal performance, or damage to the product.

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**

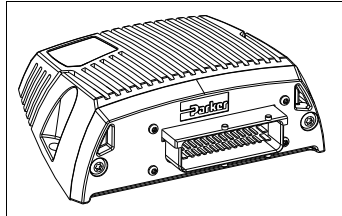
Read section "System diagnostics", and see "Appendix B", in this document.

Use the IQANrun software user manual as a reference.

## 3 Product description

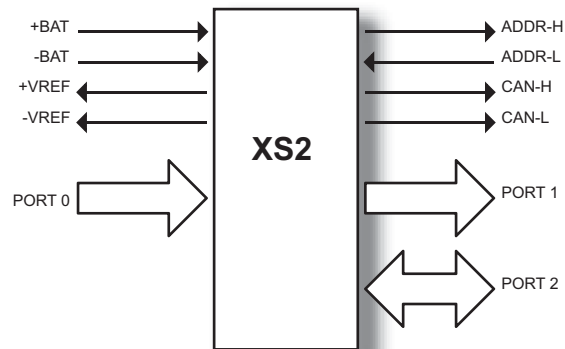
### **IQAN-XS2**

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



The IQAN-XS2 module.

### **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

(8) Digital inputs DIN-A, DIN-B.....DIN-H use positions VIN-A thru VIN-H.

---

**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.

### Current check

For the 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.

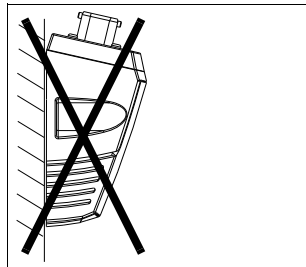
The emergency stop must be installed so that the risk of reverse feed of the module is avoided, see section "Supply voltage".

## 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 side load 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.



Non approved placing.



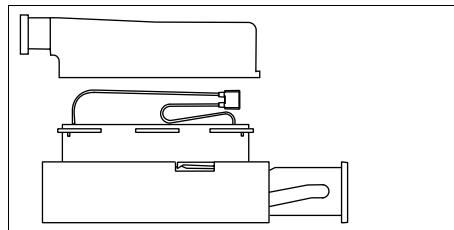
#### NOTICE

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 dependant. All IQAN expansion modules require an ID-tag, ref section "Addressing/terminating".

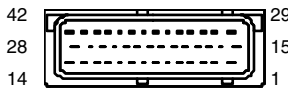
The ID-Tag will be mounted under the connector casing. Bend the ID-Tag's wires toward the opposite side of where the other wires enter the connector.



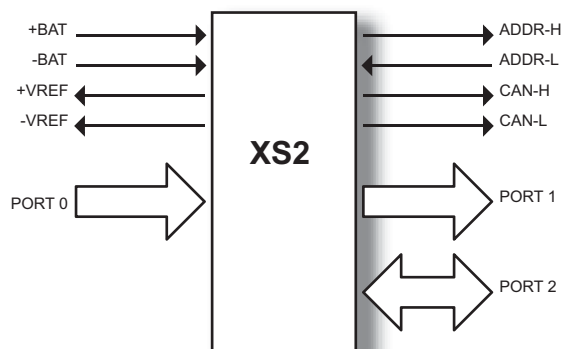
Assembling of the Id-Tag.

## 6 Installation

### Connector C1

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

### Connector pin assignments



Logical Symbol	Pin No.	(I)input or (O)utput	Function description and/or Signal name(s)
+BAT	28	-	Power supply, positive.
-BAT	15	-	Power supply, negative ground
+VREF	42	-	Voltage reference for external sensors. Sourcing +5V.
-VREF	29	-	Voltage reference for external sensors. Return (0V).
ADDR-H	1	-	High side to address tag. Sourcing +5V.
ADDR-L	14	-	Low side to address tag. Return (0V).
CAN-H	26 27	- -	CAN high voltage bus line, will be HIGH in dominant state.
CAN-L	40 41	- -	CAN low voltage bus line, will be LOW in dominant state.

Logical Symbol	Pin No.	(I)input or (O)utput	Function description and/or Signal name(s)	
P0			P0 is an 8 pin input port with alternate functions on four inputs.	
			<b>VIN</b>	<b>DIN</b>
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
			<i>Note: DIN-A to DIN-H have high impedance inputs (62K Ohm).</i>	
P1			P1 is an 6 pin output port.	
			<b>DOUT</b>	
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			P2 is an 18 pin input/output port.	
			<b>DIN</b>	<b>DOUT</b>
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	-
			<i>Notes:</i>	
			<i>DIN-I to DIN-T are equipped with clamping diode, risk for 'backending'. See section "Connecting switches to the digital inputs"</i>	

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 requisite 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. Expansion modules do not have +RTC.



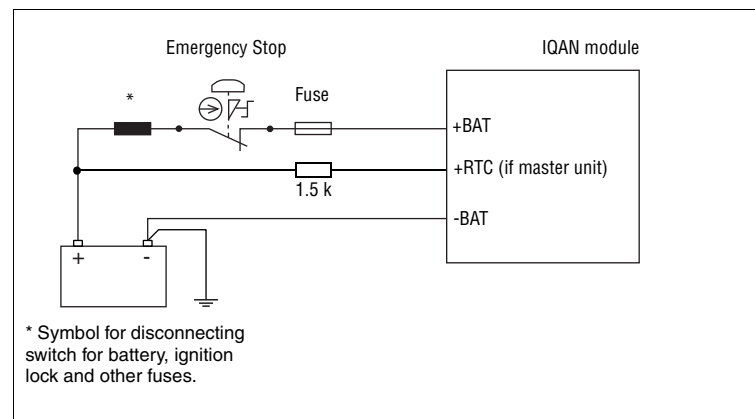
## WARNING

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. The same possibility exists from a short to CRET wires when they are used as digital inputs; refer to section "DIN that share pin with RET".



Connecting the emergency stop and voltage supply.



## 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

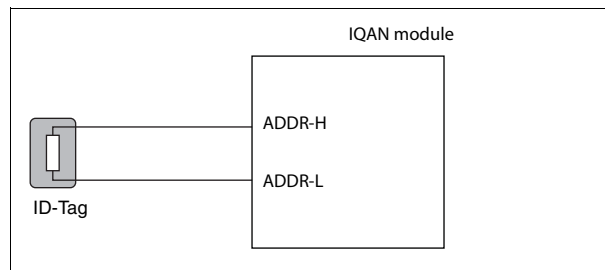
### Addressing

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.



Connecting of Id-Tag.

### 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".

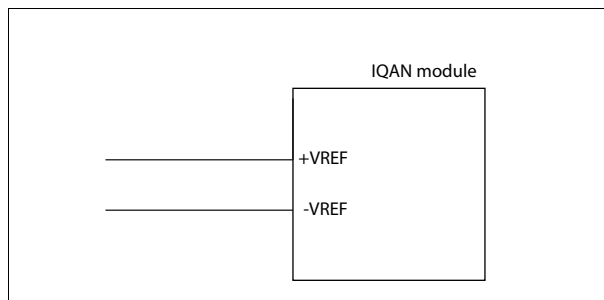


#### NOTICE

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, $V_{REF}$

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.



$V_{REF}$  positions.



### NOTICE

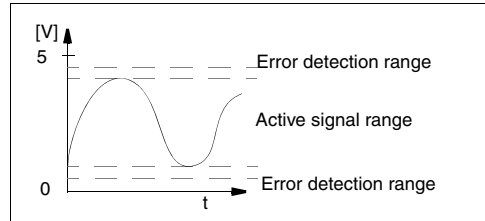
It is strongly recommended to use the module's  $-V_{REF}$  and  $+V_{REF}$  to all sensors and potentiometers that are connected to the module inputs. This will reduce bad measurement based on potential fault (i.e. different ground points for other supplies in relation to the IQAN module ground, -BAT).

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

## 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.



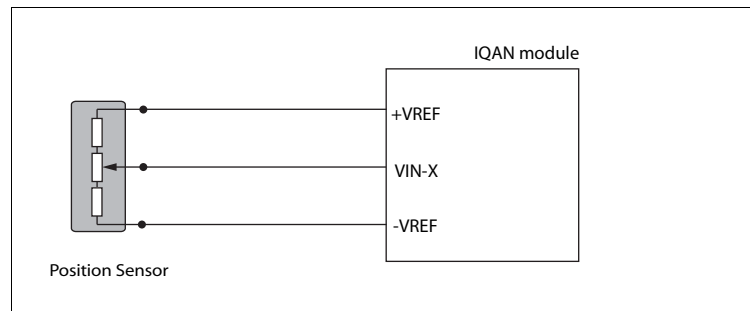
Active signal range.

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.



Connecting VREF and sensor signal VIN-X.



#### 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.

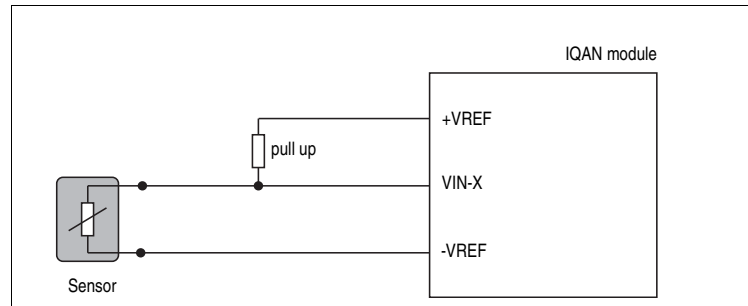


### Connecting a 2-wire temperature sensor to voltage in

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.

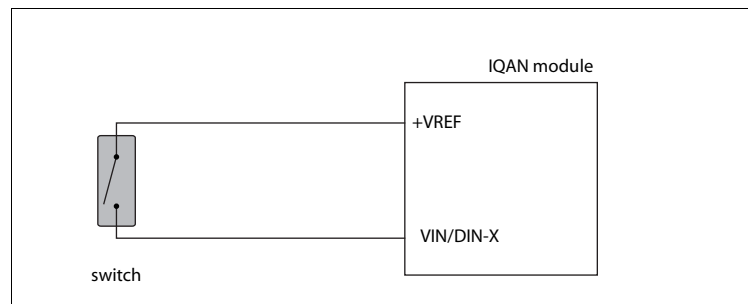
The pull up resistor value for a  $R_{25}=2000\Omega$ , PTC sensor is 4,7 K $\Omega$ .

### Connecting switches to the voltage inputs

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.



#### NOTICE

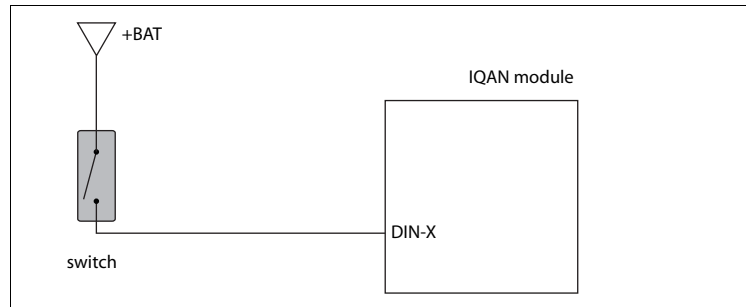
Maximum load for VREF position, see "Appendix A".

### Connecting switches to the voltage inputs

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.

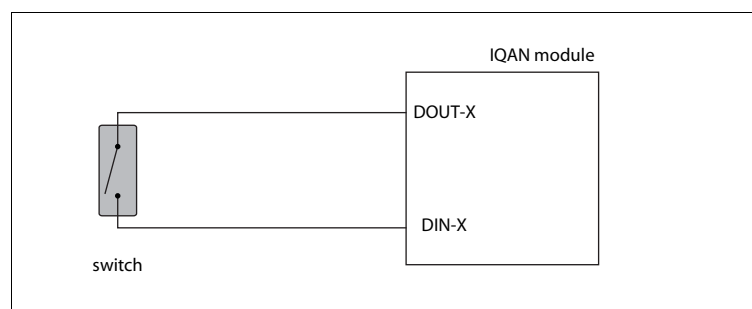
You can safely connect using +VREF for the supply, as shown in the preceding "Connecting switches to the voltage inputs" example.

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.

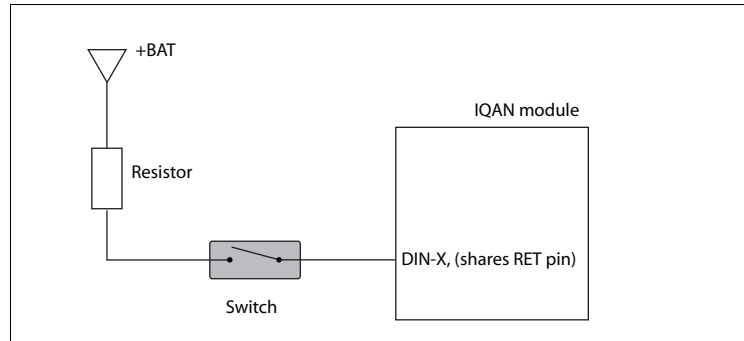


Connecting a switch to DOUT-X and DIN-X.

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.



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, VIN, DIN or DOUT-LS.

## 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.

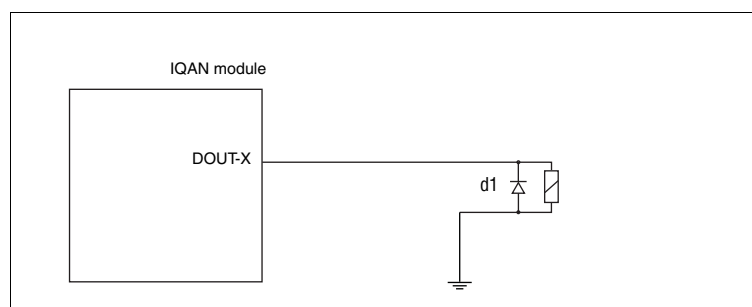
For example, use diode: 1N5408 (3A/1000V).

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.

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

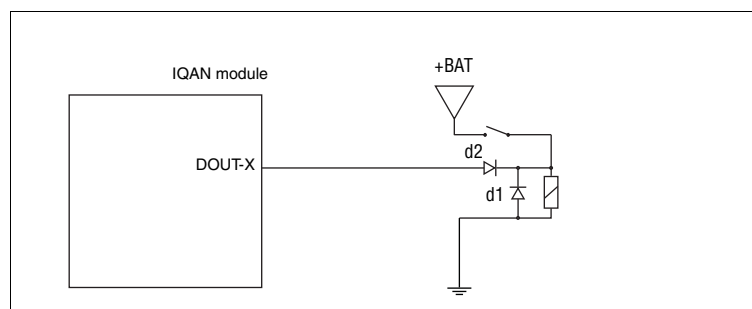


Connecting a load to the digital output.



#### NOTICE

If the load is controlled in parallel with another system, the digital output must be protected with a diode.



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:**

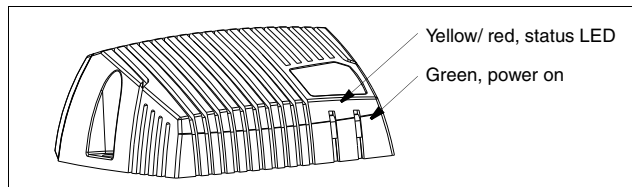
- Start the engine for the hydraulic system's pump, assuming that the above mentioned inspections have been carried out and shown correct values.

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 location of the LED indicators on the IQAN module.

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.

## Appendix A

### IQAN-XS2 Technical Overview

#### Absolute Maximum Ratings<sup>a</sup>

Parameter	Limit values			Unit	Remark
	min.	typ.	max.		
Ambient temperature, $T_A$ Storage temperature	- 40 - 40		+90 +100	°C	
Maximum voltage supply on +BAT			34	V	Reverse polarity protected with 20A fuse.
Voltage on any pin with respect to -BAT			34	V	
Maximum current into -VREF			2	A	
Maximum current sourced by all outputs			20	A	

- a. The “Absolute Maximum Ratings” table lists the maximum limits to which the device can be subjected without damage. **This doesn’t imply that the device will function at these extreme conditions**, only that, when these conditions are removed and the device operated within the “Recommended Operating Conditions”, it will still be functional and its useful life won’t have been shortened.

#### Environmental ratings

Parameter	Remark
EMI ISO 14982:1998, Radiated emission EN 55025:2003, Conducted emission ISO 11452-2:1995, Radiated Susceptibility ISO 11452-4:2001, Conducted Susceptibility ISO 7637-2:2004, Conducted transient susceptibility on power ISO 7637-3:1995, Conducted transient susceptibility on signal	30-1000 MHz 0.15-108 MHz, class 1 20-1000 MHz, 100V/m 1-200 MHz, 150mA 1,2a,2b,3a,3b,4, 5 80V
ESD ISO 10605:2001, ESD	15KV, air, 8 KV contact 4 KV handling
Mechanical environment IEC 60068-2-64:1993 Fh, Random vibration IEC 60068-2-29:1987 Eb, Bump	0.4 g <sup>2</sup> /Hz, 15- 250 Hz, 10 hours 40g, 6 ms,1000 in each direction
Climate environment IEC 60529:2001, Enclosure protection DIN 40050 Part 9:1993, Enclosure protection IEC 60068-2-30:1985 Db, Damp heat cyclic IEC 60068-2-78:2001, Damp heat, steady state IEC 60068-2-14:1984 Nb, Change of temperature	IP66: 100 l/min, 3min IP6K9K: 1000kPa, +80°C, 30sec 55°C, 6 cycles 40°C, 93% RH, 21 days -40°C to 70°C, 100 cycles
Chemical environment IEC 60068-2-52:1996 Kb, Salt mist	3 days



### Recommended Operating Conditions<sup>a</sup>

Parameter	Limit values			Unit	Remark
	min.	typ.	max.		
Ambient temperature, $T_A$	-40		+70	°C	
Voltage supply, $V_{BAT}$	11		32	V	
Total load on DOUT			20	A	

- a. Recommended operating conditions are given for maximum and minimum conditions where normal performance is still available from the device. Once the normal operating conditions are exceeded, the performance of the device may suffer.

### System

$T_A = +25\text{ °C}$  (unless otherwise specified)

Parameter	Limit values			Unit	Remark
	min.	typ.	max.		
Start-up delay		250		ms	Power to activated output
Sample rate local I/O		1000		Hz	
CAN message response time		1		ms	
Output voltage on VREF	4.9	5.0	5.1	V	load < 40mA
Maximum load current on VREF $V_{BAT}=11\text{V}$ to $32\text{V}$			40 100 150	mA	$V_{drop} < 25\text{mV}$ (0.5%) $V_{drop} < 50\text{mV}$ (1%) $V_{drop} < 100\text{mV}$ (2%)
Current supply $V_{BAT}=14\text{V}$ $V_{BAT}=28\text{V}$		95 75		mA	outputs = off no load on VREF

### I/O

$T_A = +25\text{ °C}$  (unless otherwise specified)

Parameter	Limit values			Unit	Remark
	min.	typ.	max.		
VIN (Voltage input)					
Signal range low		0	0.05	V	
Signal range high	4.9	5.0	5.1	V	
Input resistance		62		kΩ	
Signal resolution		5		mV	
Total unadjusted error	-35 -100		35 100	mV	VREF as source <40mA External source
DIN (On/off input)					
Input low			1.0	V	
Input high	4.0			V	
Trigg level, high level (1)		3.0 1.6 3.0 1.6		V	DIN-A to DIN-H DIN-I to DIN-N DIN-O to DIN-R DIN-S to DIN-T
Trigg level, low level (0)		2.5 1.2 2.5 1.2		V	DIN-A to DIN-H DIN-I to DIN-N DIN-O to DIN-R DIN-S to DIN-T
Input resistance		5.6 62		kΩ	DIN-A to DIN-L DIN-M to DIN-T

## I/O

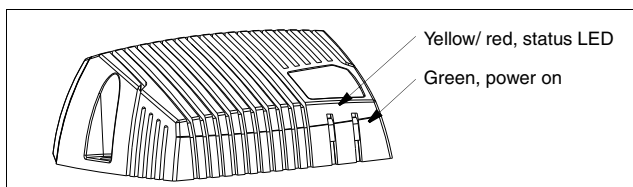
$T_A = +25\text{ }^{\circ}\text{C}$  (unless otherwise specified)

Parameter	Limit values			Unit	Remark
	min.	typ.	max.		
DOUT (on/off output)					
Load current			2	A	
Voltage drop ( $V_{BAT} - V_{DOUT}$ ) load $I_L = 0.5A$ load $I_L = 2A$		0.2 0.8		V	
Off-State output current:			10 1.8	uA mA	DOUT-A to DOUT-F DOUT-G to DOUT-L
Max load inductance:			200 1000	mH	@ 2A @ 1A
Short Circuit current limit		6		A	

## 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

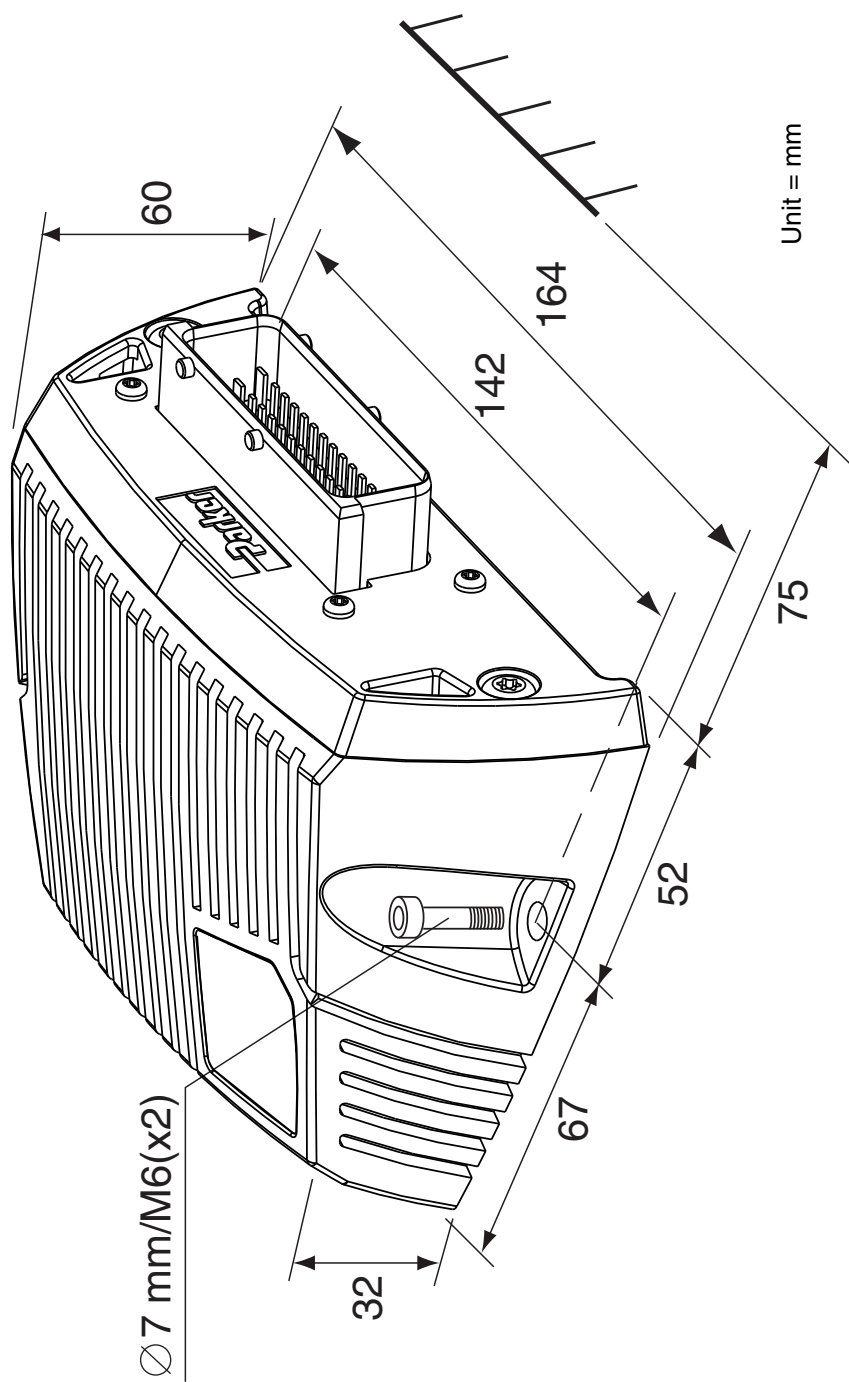
Status	Flash		
Normal operation (yellow)			
Error code	Error	Primary Flash (red) Error category	Secondary Flash (yellow) Error description
1:n	See note <sup>a</sup>		
2:n	See note <sup>a</sup>		
3:1	CAN error		
3:2	Address error		
4:1	Memory error <sup>b</sup>		
FE	Fatal error		

a. Error groups 1:n and 2:n are controlled by the master.

b. FRAM memory error.

Appendix C

Dimensioning of the IQAN module



## 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

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

#### Failure modes for VREF

Failure mode		Effect
1	+VREF Open	VIN out of range, will create a VIN error => VIN=Predefined error value. <sup>a</sup>
2	-VREF Open	VIN out of range, will create a VIN error => VIN=Predefined error value. <sup>a</sup>
3	+VREF Short-circuit to -VREF	VREF error => VIN out of range, will create a VIN error => VIN=Predefined error value. <sup>a</sup>
4	+VREF Short-circuited to +BAT	VREF error => VIN out of range, will create a VIN error => VIN=Predefined error value. <sup>a</sup>
5	+VREF Short-circuited to -BAT	VREF error => VIN out of range, will create a VIN error => VIN=Predefined error value. <sup>a</sup>
6	-VREF Short-circuited to +BAT	External fuse (if <7.5A) on +BAT blows.
7	-VREF Short-circuited to -BAT	Not detected.

- 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

Failure mode		Effect
1	VIN Open	VIN out of range, will create a VIN error => VIN=Predefined error value <sup>a</sup>
2	VIN Short-circuited to +BAT	VIN out of range, will create a VIN error => VIN=Predefined error value <sup>a</sup>
3	VIN Short-circuited to -BAT	VIN out of range, will create a VIN error => VIN=Predefined error value <sup>a</sup>

- 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

Failure mode		Effect
1	DIN Open	No effect on module, not detected
2	DIN Short-circuited to +BAT	No effect on module, not detected
3	DIN Short-circuited to -BAT	No effect on module, not detected