Electronic Control Systems IQAN® System Products

Catalog HY33-1825/US

North American Product Offering

GS GLOBAL RESOURCES
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Electronic Controls Division
Elk Grove Village, IL 60007 USA

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Contents

When ordering IQAN Studios, the following items are included:

- IQAN Studio software (download from website)
- 1 licence

The user's manuals for IQAN software is provided in electronic format and is copied to your PC during installation. For a printed manual, contact Parker Catalog Services.

Communication cables are not included. Order the cables you need from the accessories section.

Requirements

CPU	PC compatible, Pentium® II 233 MHz or better
RAM	minimum 256 Mbyte (512 Mbyte recommended)
HD	100 Mbyte storage space available
Ports	serial port, RS232 or USB port
Display	XVGA (1280x1024 recommended)
Software	Windows® 7, 8, 10

Upgrade

It is always possible to download the latest version from our web site www.iqan.com.

Application

The IQAN software studios cover all phases of a machine's life cycle, from development through production to after sales. There are three different studios available; IQAN Creative Studio, IQAN Productive Studio and IQAN Active Studio.

IQAN Creative studio

IQAN Creative studio is a user-programmable software package for the R&D department. It includes tools for application development, simulation and initial setup.

- IQANdesign
- IQANsimulate
- IQANrun
- IQANanalyze

IQAN Productive studio

IQAN Productive studio is a software package for the manufacturing and service departments. It includes development tools for customization and automation of production and maintenance processes.

- IQANscript
- IQANcustomize
- IQANsimulate
- IQANrun

IQAN Active studio

IQAN Active studio is a software package for service and production personnel. It includes tools for machine diagnostics, setup and simulation.

- IQANrun
- IQANsimulate

IQAN Studios are used with the newest IQAN products including the IQAN-MD3 and IQAN-MD4 master/ display units and also with the IQAN-MC2, IQAN-MC3 and IQAN-MC4x controllers.

Description

IQAN Creative Studio
IQAN Productive Studio
IQAN Active Studio

Order on-line at store.iqan.se

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General

Weight (MD4-7)	0.93 kg
Weight (MD4-5)	0.67 kg
Weight (MD4-10)	1.5 kg
Operating temperature	-30 °C to 70 °C
Storage temperature	-40 °C to 85 °C
Protection	IP65
Voltage supply	9-32 Vdc
Current consumption (idle)	300 mA (28Vdc) 600 mA(14Vdc)
CE marking	2004/108/EC

Performance

Processor	ARM Cortex-A8, (800 MHz)
Memory	2 Gbyte Flash, 256 Mbyte SDRAM
Logging	64 Mb
Cycle time	10 to 100 ms
Software tools	IQANdesign platform

Communication interface

CAN (ISO 11898)	4 (2)[2]
Protocols	ICP, SAE J1939, generic
Ethernet 100Base-Tx	2 (1)[1, 2]

Display

Touch Interface	PCAP[2]
7” (18 cm) display	16:9, 800x480 pixels
5.7” (14 cm) display	4:3, 640x480 pixels
10.1” (26 cm) display	4:3, 800x600 pixels

Connection

Electrical connection	2x Deutsch DTM, 12 pos
Ethernet	2 x M12, D-code, 4 pos

Outputs

Digital outputs	4[3]
Type	Low side
Max load, 1 output	300 mA
Max load, all outputs	850 mA

Inputs

Voltage inputs	2[3]
Signal range	0 - 5 Vdc, 12 bit
Digital inputs	10[3]
Encoder input	1[3]
Signal range	0 - 500 Hz, 50/50 signal

1) Ethernet port A dedicated for PC diagnostics.
2) Depending on configuration.
3) The outputs and inputs share the same physical pins. The user defines the channels/pins with IQANdesign.

Application

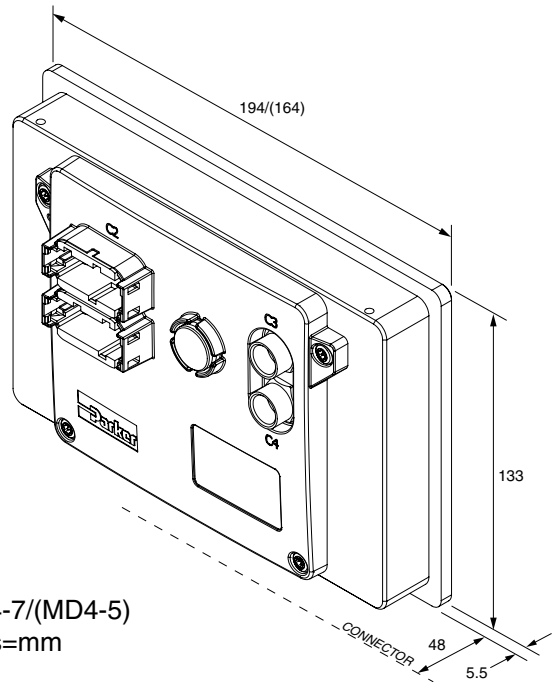
The IQAN-MD4 is a family of master display units, fully compliant with the IQANdesign platform system. The units have full graphical, diagnostic and CAN gateway capability and are used together with the easy to use IQAN programing tools.

IQAN-MD4-7 is offered with a 7” (18 cm) display with touch screen, IQAN-MD4-10 has a 10.4" (26 cm) display ith touch screen and the IQAN-MD4-5 has a 5.7” (14 cm) display with optional touchscreen. The IQAN-MD4 has a rugged mechanical design and is completely sealed. The use of optical bonded display glass improves the readability, avoids light refraction and also eliminates possible condensation.

The display units have a pleasing, aesthetic design that blends with modern cabins. A touchscreen interface is offered for interactive, intuitive HMI (code T1). The IQAN-MD4 also has IP-camera support (code E2). There is no need for separate camera monitors.

Mounting is easy, with steel clips for a well integrated, flush mount in cabin panels, or the back of the unit has an optional stand-alone bracket compatible with RAM™ mount components. The MD4 may be mounted in landscape or portrait orientation for easy integration of HMI or mechanics.

Description	**Ordering PN**
IQAN-MD4-7-T1E2	20077771
IQAN-MD4-5-T0E1	20077772
IQAN-MD4-5-T1E2	20077773
IQAN-MD4-10-T1E2	20077774



MD4-7/(MD4-5)
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General

Weight	0.3 Kg
Operating temperature	-30 to +60 °C -25>LCD off >+75 °C
Protection	outdoor use
Voltage supply	11- 32 Vdc
Current consumption (idle)	130 mA (28 Vdc) 190 mA (14 Vdc)

Performance

Processor	32-bit (144 MHz)
Logging	80K records
Sample time	min 10ms
Software tools	IQANdesign family

Communication interfaces

CAN (ISO 11898)	2
Protocols	ICP, SAE J1939, CANopen, etc
RS-232	1
Protocols	AT-Hayes,GSM07.07, GSM07.05, IDP
USB 2.0 (full speed)[1]	1

Outputs

Digital output	1
Type	high side switch
Max load	200 mA

Inputs

Voltage inputs	7
Signal range	0 - 5 Vdc
Resolution	1.2 mV
Digital inputs	(7)[2]
Signal high	4 Vdc
Signal low	1 Vdc

1) The USB driver circuit and LCD were updated on June 1, 2015
2) The voltage and digital inputs share the same physical pins. The user defines the channels/pins with IQANdesign.

Application

The IQAN-MD3 is a master/display unit that works with a variety of expansion modules in the IQANdesign platform. The MD3 is fully programmable for use in any machine application, as a graphical user interface and as a CAN gateway. The IQAN-MD3 is constructed to be weatherproof for outdoor use. The MD3 will display vehicle data and system information.

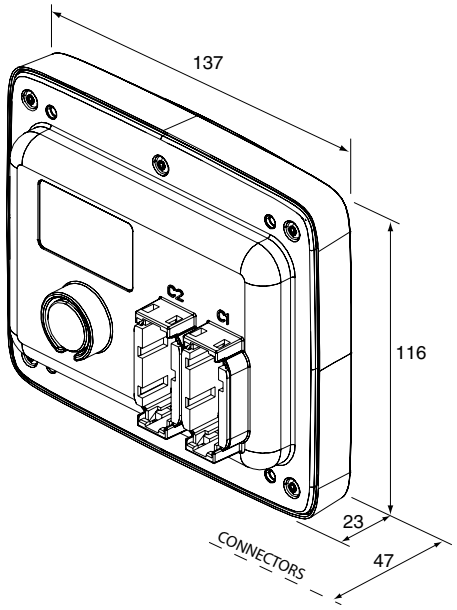
The IQAN-MD3 has a 3.5" transflective TFT color display. There are five navigation buttons and four 'soft' function buttons to make interaction with the control simple for the operator. The unit is designed to be easily mounted in a vehicle dashboard or exterior control panel. The unit has two sealed and keyed Deutsch DTM 12 position connectors.

The MD3 has a large internal memory for events and logging that is capable of storing 80,000 records. The analog inputs accept 0-5V signals from input devices or sensors. These inputs can also be set up as on-off inputs. A digital output is available and may be used for alarm or alert signals.

The MD3 is connected to other units by 3 CAN busses. All CAN busses may be configured as ICP (IQAN CAN Protocol), SAE J1939 or Generic CAN. The unit supports CAN connection and USB for communication with a PC.

Description	**Ordering PN**
IQAN-MD3-M15	20077793[3]
Phased-out part number	
IQAN-MD3	20072409[4]

3) This p/n is used after June 1, 2015 and requires software versions 2.63 and 3.17 or higher.
4) This p/n was used before June 1, 2015.



units=mm

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General

Weight	0.5 kg
Temperature range	-40 to +85 °C
Protection	outdoor, chassis
Voltage supply	9 - 32 Vdc
Current consumption (idle)	180 mA (24V) 250 mA (12V)

Communication interfaces

CAN buses	2
Protocols	ICP (IQAN CAN Protocol) SAE J1939, Generic CAN

Outputs

Max number of outputs	8
Proportional outputs	
Current output pairs	2
Type	current closed loop
Signal range	100 - 2500 mA
Dither frequency	70 - 1000 Hz
Resolution	1 mA
PWM outputs (HS)	4
Type	high side switch
Max load	2 A (single)
PWM outputs (LS)	4
Type	low side switch
Max load	2.5 A (single)

Inputs

Max number of inputs	18
Voltage inputs	10
Signal range	8 x 0 - 5 Vdc 2 x 0 - 32 Vdc
Resolution	12 bit
Current-loop inputs	2
Signal range	0 - 20 mA, 13 bit
Timer inputs:	
Frequency, PWM, Pulse	6
Signal high	4 Vdc - 32 Vdc
Signal low	0 - 1 Vdc
Range	0 - 50,000 Hz
Digital inputs	0 (up to 6)
Signal high	4 Vdc - 32 Vdc
Signal low	0 - 1 Vdc

Connector

Type	1 x Molex MX123, 66 pos.

Application

The IQAN-MC41 controller is the lowest I/O count module in the MC4 family. It is best for smaller applications such as task-oriented control, implementing single features on a vehicle (e.g. valve driver for auxiliary hydraulic function).

The IQAN-MC41 is designed to be either an IEC 61508 SIL2 Functional Safety (-FS) variant, or a performance optimized, standard controller.

The 3 core CPU architecture of the IQAN-MC41 provides computational power that allows it to perform high speed (ex. 1 ms) control loops for time critical functions. Lockstep CPU and hardware redundancy offers very high real-time performance in safety critical applications.

There are Voltage inputs in 2 different scales, Current loop inputs for 4-20 mA, Timer inputs (used for frequency, PWM and pulse devices) and Digital (on-off) inputs. Voltage and Timer inputs share pin positions with Digital inputs.

The IQAN-MC41 has 2 double proportional outputs for controlling valves. These outputs can control up to 2 bi-directional proportional valve sections or 2 single solenoid devices (ex. proportional cartridge valves).

The unit also has 4 high-side PWM outputs and 4 low-side PWM outputs.

The IQAN-MC41 footprint is small enough for any installation. The enclosure is rated IP66 + IP69K and is a rugged mechanical design, sealed for outdoor use.

To meet the environment found in mobile machines the MC41 uses a 66 position Molex MX123 high reliability connector, made for harsh environment and high vibration applications.

Description	Ordering PN
IQAN-MC41	20085111
IQAN-MC41-FS	20085121

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General

Weight	0.8 kg
Temperature range	-40 to +85 °C
Protection	outdoor, chassis
Voltage supply	9 - 32 Vdc
Current consumption (idle)	190 mA (24V) 320 mA (12V)

Communication interfaces

CAN buses	3
Protocols	ICP (IQAN CAN Protocol) SAE J1939, Generic CAN
Ethernet	10 base T

Outputs

Max number of outputs	16
Proportional outputs	
Current output pairs	6
Type	current closed loop
Signal range	100 - 2500 mA
Dither frequency	70 - 1000 Hz
Resolution	1 mA
PWM outputs (HS)	4
Type	high side switch
Max load	2 A (single)
PWM outputs (LS)	12
Type	low side switch
Max load	2.5 A (single)

Inputs

Max number of inputs	18
Voltage inputs	10
Signal range	8 x 0 - 5 Vdc 2 x 0 - 32 Vdc
Resolution	12 bit
Current-loop inputs	2
Signal range	0 - 20 mA, 13 bit
Timer inputs:	
Frequency, PWM, Pulse	6
Signal high	4 Vdc - 32 Vdc
Signal low	0 - 1 Vdc
Range	0 - 50,000 Hz
Digital inputs	0 (up to 6)
Signal high	4 Vdc - 32 Vdc
Signal low	0 - 1 Vdc

Connector

Type	1 x Molex MX123, 66 pos.

Application

The IQAN-MC42 controller is an intermediate I/O count module in the MC4 family. It is best for mid-size applications such as powertrain control (e.g. power shift transmissions) or distributing I/O on a vehicle (physically placed close to functions).

The IQAN-MC42 is designed to be either an IEC 61508 SIL2 Functional Safety (-FS) variant, or a performance optimized, standard controller.

The 3 core CPU architecture of the IQAN-MC42 provides computational power that allows it to perform high speed (ex. 1 ms) control loops for time critical functions. Lockstep CPU and hardware redundancy offers very high real-time performance in safety critical applications.

There are Voltage inputs in 2 different scales, Current loop inputs for 4-20 mA, Timer inputs (used for frequency, PWM and pulse devices) and Digital (on-off) inputs. Voltage and Timer inputs share pin positions with Digital inputs.

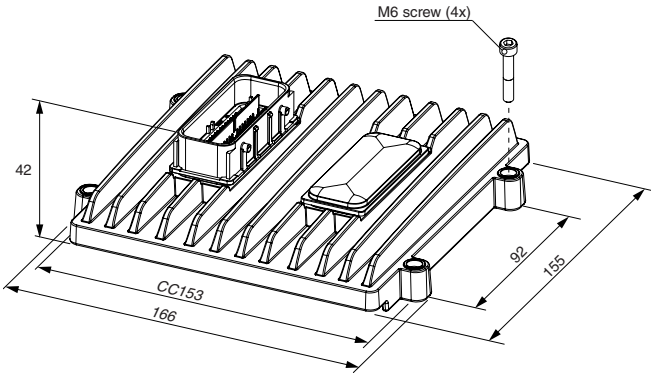
The IQAN-MC42 has 6 double proportional outputs for controlling valves. These outputs can control up to 6 bi-directional proportional valve sections or 6 single solenoid devices (ex. proportional cartridge valves).

The unit also has 4 high-side PWM outputs and 12 low-side PWM outputs.

The IQAN-MC42 footprint is small enough for any installation. The enclosure is rated IP66 + IP69K and is a rugged mechanical design, sealed for outdoor use.

To meet the environment found in mobile machines the MC42 uses a 66 position Molex MX123 high reliability connector, made for harsh environment and high vibration applications.

Description	Ordering PN
IQAN-MC42	20085112
IQAN-MC42-FS	20085122



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General

Weight	0.8 kg
Temperature range	-40 to +85 °C
Protection	outdoor, chassis
Voltage supply	9 - 32 Vdc
Current consumption (idle)	160 mA (24V) 240 mA (12V)

Communication interfaces

CAN buses	5
Protocols	ICP (IQAN CAN Protocol) SAE J1939, Generic CAN
Ethernet	10 base T

Outputs

Max number of outputs	36
Proportional outputs	
Current output pairs	10
Type	current closed loop
Signal range	100 - 2500 mA
Dither frequency	70 - 1000 Hz
Resolution	1 mA
PWM outputs (HS)	8
Type	high side switch
Max load	2 A (single)
PWM outputs (LS)	20
Type	low side switch
Max load	2.5 A (single)
PWM outputs (LS)	8
Type	low side switch
Max load	300 mA

Inputs

Max number of inputs	50
Voltage inputs	28
Signal range	26 x 0 - 5 Vdc 2 x 0 - 32 Vdc
Resolution	2 bit
Current-loop inputs	4
Signal range	13-bit, 0 - 25 mA
Timer inputs:	
Frequency, PWM, Pulse	6
Signal high	4 Vdc - 32 Vdc
Signal low	0 - 1 Vdc
Range	0 - 50,000 Hz
Digital inputs	12 (up to 18)
Signal high	4 Vdc - 32 Vdc
Signal low	0 - 1 Vdc

Connector

Type, C1	1 x Molex MX123, 66 pos.
Type, C2	1 x Molex MX123, 73 pos.

Application

The IQAN-MC43 controller is a large I/O count module in the MC4 family. It is best for bigger applications such as total vehicle control (all hydraulic functions) when it is desired to have the controller centrally located to save valuable space.

The IQAN-MC41 is designed to be either an IEC 61508 SIL2 Functional Safety (-FS) variant, or a performance optimized, standard controller.

The 3 core CPU architecture of the IQAN-MC43 provides computational power that allows it to perform high speed (ex. 1 ms) control loops for time critical functions. Lockstep CPU and hardware redundancy offers very high real-time performance in safety critical applications.

There are Voltage inputs in 2 different scales, Current loop inputs for 4-20 mA, Timer inputs (used for frequency, PWM and pulse devices) and Digital (on-off) inputs. Voltage and Timer inputs share pin positions with Digital inputs.

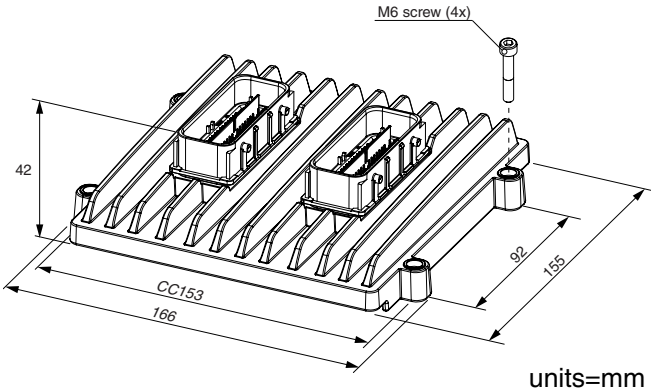
The IQAN-MC43 has 10 double proportional outputs for controlling valves. These outputs can control up to 5 bi-directional proportional valve sections or 5 single solenoid devices (ex. proportional cartridge valves).

The unit also has 8 high-side PWM outputs and 20 low-side PWM outputs.

The IQAN-MC43 footprint is small enough for any installation. The enclosure is rated IP66 + IP69K and is a rugged mechanical design, sealed for outdoor use.

To meet the environment found in mobile machines the MC43 uses 66 position and 73 position Molex MX123 high reliability connectors, made for harsh environment and high vibration applications.

Description	Ordering PN
IQAN-MC43	20085113
IQAN-MC43-FS	20085123



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Elk Grove Village, IL 60007 USA

General

Weight	1.1 kg
Temperature range	
Operating, ambient	-40 to +85 °C
Storage, ambient	-40 to +100 °C
Protection	outdoor, chassis
Voltage supply	9 - 32 Vdc
Current consumption (idle)	160 mA (24V) 240 mA (12V)
CAN buses	4[1]
Protocols	Parker ICP (IQAN CAN Protocol) SAE J1939, Generic CAN

1) It is recommended that one CAN bus is dedicated for diagnostic purposes (PC interface)

Safety

IEC 61508	Up to SIL2
EN ISO 13849-1	Up to PLd
PFHd	< 10^{-7}

Outputs

Proportional outputs	
Current output pairs	4
Type	current closed loop
Signal range	100-2000 mA
Dither frequency	70-333 Hz
Digital outputs	
Dedicated digital outputs	5
Type	hs+ls switch
Max load	3 x 3 A 2 x 1.5 A

Inputs

Max number of inputs	32
Voltage inputs	16
Signal range	0 - 5 Vdc
Frequency inputs	8
Signal high	4 Vdc - 32 Vdc
Signal low	0 - 1 Vdc
Alternative configuration	Quadrature in (4) Digital in (8)
Dedicated digital inputs	8
Signal high	4 Vdc - 32 Vdc
Signal low	0 - 1 Vdc

Connector

Type	4 x DT04-18P(key A-D)

Application

The IQAN-MC3 is a SIL2 rated master module in the IQANdesign platform. It can be used as a standalone controller, as a single bus master, or together with other IQAN master modules.

All IQAN modules are designed with the functional safety requirements of mobile machines in mind. The IQAN-MC3 is especially suited for applications with higher demands on functional safety, where there is a need to prove the safety integrity of each implemented safety function. It is designed in accordance with IEC 61508, and can be used to implement safety functions of up to SIL2. When applying EN ISO 13849-1 for safety functions, it can be used as a PLd subsystem.

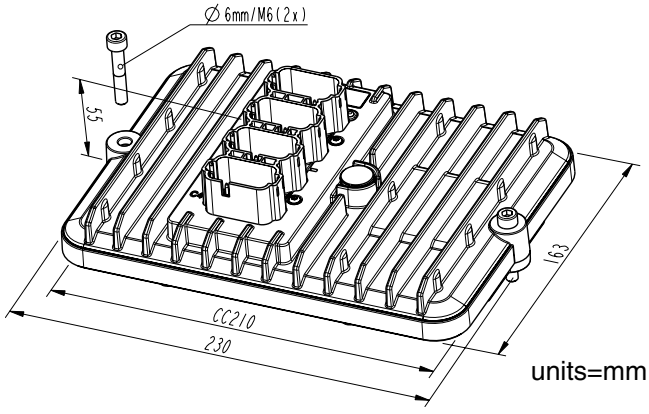
All of the 32 inputs on the IQAN-MC3 can be used for safety related signals, when the inputs are configured in pairs. On the unit there are analog inputs for 0-5 V signals from e.g. hall-effect or potentiometer sensors; digital inputs for e.g. switches; and frequency inputs. Frequency inputs can be configured to read signals from quadrature encoders, or alternatively to be used as digital inputs.

As a supply for sensors, it has two separately monitored 5 V reference signals.

All of the outputs on the IQAN-MC3 can be used for safety related signals. There are four proportional current outputs designed to drive proportional hydraulic valves, where each output controls one bi-directional valve section. The unit also has five digital outputs for driving on-off solenoids. Two of these are also intended to function as alarm outputs, for e.g. LED lamps.

The enclosure is designed to protect the electronics in a harsh environment on mobile machines. On the front of the unit, there are four sealed and individually keyed Deutsch DT connectors.

Description	**Ordering PN**
IQAN-MC3	20077717



units=mm

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General

Weight	1.1 kg
Temperature range	
Operating, ambient	-40 to +85 °C
Storage, ambient	-40 to +100 °C
Protection	outdoor, chassis
Voltage supply	9 - 32 Vdc
Current consumption (idle)	160 mA (24V) 240 mA (12V)
CE marking	2004/108/EC

Communication interfaces

CAN buses	4
Protocols	Parker ICP (IQAN CAN Protocol) SAE J1939, Generic CAN

Outputs

Proportional outputs	
Current output pairs	4
Type	current closed loop
Signal range	100-2000 mA
Dither frequency	70-333 Hz
Resolution	1 mA
Digital outputs	5
Type	high side switch
Max load	3 x 3 A 2 x 1.5 A
Digital outputs (LS)	5
Type	low side switch
Max load	3 x 3 A 2 x 1.5 A

Inputs

Max number of inputs	32
Voltage inputs	
Number	16
Signal range	0 - 5 Vdc
Resolution	1.2 mV
Frequency inputs	
Number	8 (0)
Signal high	4 Vdc - 32 Vdc
Signal low	0 - 1 Vdc
Alternative configurations	Quadrature in (4) Digital in (8)
Digital inputs	
Number	8
Signal high	4 Vdc - 32 Vdc
Signal low	0 - 1 Vdc

Connector

Type	4 x DT04-18P(key A-D)

Application

The IQAN-MC31 is a master module in the IQANdesign platform. It can be used as a standalone controller, as a single bus master, or together with other IQAN master modules.

The unit is based on the IQAN-MC3 SIL2 rated controller and uses the same hardware, but with software optimized for higher speed and lower memory consumption.

The 32 bit architecture of the IQAN-MC31 provides computational capacity that allows it to perform high speed (ex. 3 ms) control loops for time critical functions. The unit is equipped with a Real Time Clock and can perform data logging functions.

The IQAN-MC31 controller has 16 voltage inputs for connection of 0-5 Vdc signals and 8 frequency inputs for speed and position sensors.

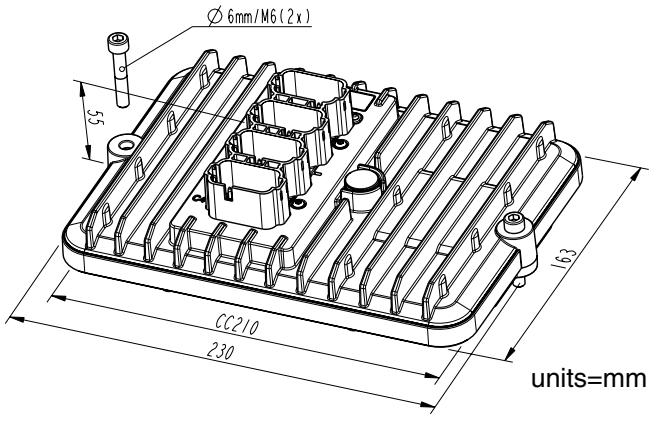
The IQAN-MC31 has 4 double proportional outputs for controlling valves. These outputs can control up to 4 bi-directional proportional valve sections or 4 single solenoid devices (ex. proportional cartridge valves).

The unit also has 5 dedicated on-off outputs that are high-side power outputs and 5 dedicated on-off outputs that are low-side outputs.

A bank of low-side, on-off outputs is typically connected to one or more of the high-side, on-off outputs and are used for low current functions.

The enclosure is designed to protect the electronics in a harsh environment on mobile machines. On the front of the unit, there are four sealed and individually keyed Deutsch DT connectors. The MC31 is designed for mounting outdoor on the chassis.

Description	**Ordering PN**
IQAN-MC31	20077786



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Parker Hannifin Corporation
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Elk Grove Village, IL 60007 USA

General

Weight	0.7 Kg
Temperature range	-40 to +70 °C
Protection	outdoor use
Voltage supply	11- 32 VDC
Current consumption (idle)	160 mA (28 VDC) 200 mA (14 VDC)
Data interface	
Type	Parker ICP (IQAN CAN Protocol) J1939, Generic CAN
Communication port	
Type	USB 1.1[1]

Outputs

Proportional outputs	8 double (max)[2]
Type current mode	current - closed-loop
PWM mode	voltage - open-loop
Signal range	100 - 2000 mA
Dither frequency	25 - 333 Hz
Resolution	0.1 mA
Digital outputs	24 (max)[2]
Type	high side switch
Total load (all outputs)	16 A

Inputs

Voltage inputs	13 (max)[2]
Signal range	0 - 5 VDC
Resolution	1.2 mV
Frequency inputs	5 (max)[2]
Signal range (speed mode)	2 - 20000 Hz
(position mode)	0 - 20000 Hz
Digital inputs	13 (max)[2]
Signal high	4 VDC - V_{BAT}
Signal low	0 - 1 VDC

1) the USB driver circuit was updated on January 1, 2015.
2) The flexible inputs and outputs share the same physical pins. The user defines the channels/pins with IQANdesign.

Application

The IQAN-MC2 is a flexible master unit that works with a variety of expansion modules in the IQANdesign platform control system. This unit is suitable for use as either a Bus master or standalone control. The IQAN-MC2 has new I/O flexibility that allows the user greater freedom in defining signals for both measurement and control.

The different input types are voltage, on/off, pulse and frequency. The outputs are proportional and on/off. The unit also has two CAN interfaces for bus communication using IQAN CAN Protocol (ICP) and SAE J1939 or Generic CAN.

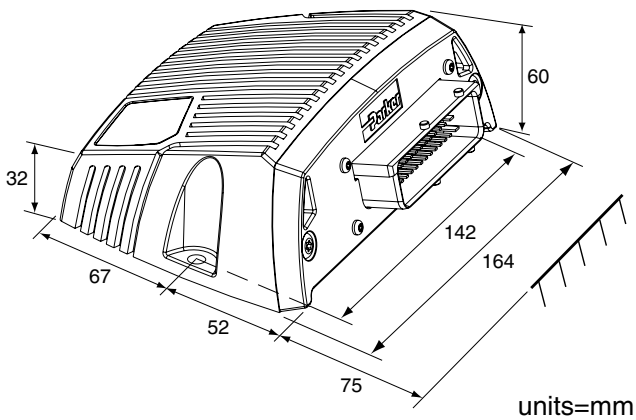
The MC2 is equipped with a Real Time Clock and can perform data logging functions.

The IQAN-MC2 can control proportional valves using current mode (current closed-loop) or PWM mode (voltage open-loop) signals. The analog inputs will accept 0-5V signals from input devices or sensors. The inputs can also be configured for 5 frequency inputs. Some outputs may alternatively be used as voltage inputs or digital inputs for switches. For communication and diagnostics the MC2 has a USB interface.

The aluminum housing is designed to be rugged, but light and has a sealed, automotive AMP/Tyco power timer connector. The IQAN-MC2 has a membrane to prevent condensation inside the housing. Additional protection allows the unit to be steam-cleaned. This controller is designed for the outdoor environment.

Description	**Ordering PN**
IQAN-MC2-M14	20077787[3]
Phased-out part number	
IQAN-MC2	20070899[4]

3) This p/n is used after January 1, 2015 and requires software versions 2.61 and 3.14 or higher.
4) This p/n was used before January 1, 2015.



units=mm

Parker Hannifin Corporation
Electronic Controls Division
Elk Grove Village, IL 60007 USA

General

Weight	1.2 kg
Temperature range	
Operating, ambient	-40 to +85 °C
Storage, ambient	-40 to +85 °C
Protection	IP66
Voltage supply	7.5 - 32 Vdc
Current consumption (idle)	60 mA (28 VDC) 70 mA (14 VDC)
Data interface	Parker ICP (IQAN CAN Protocol)

Outputs

Digital out high	16
Type	high-side switch
Max load	2.5 A
Max PWM frequency	500 Hz
Digital out low	4
Type	low-side switch
Max load	2.5 A

Inputs

Voltage inputs	10
Signal range	0 - 5 Vdc
Resolution	5 mV
Frequency inputs	4
Signal range	0 - 10000 Hz
Digital inputs	16
Signal high	3.65 Vdc - VBAT
Signal low	0 - 1.56 Vdc

Application

The IQAN-XC10 is an IQANdesign platform expansion module in the IQAN product group. This unit is designed to get a high digital I/O count in one module.

All IQAN expansion modules communicate with a master over a CAN bus, using the IQAN CAN protocol. The module has a large number of digital inputs for connection to switches. It also has analog inputs for connection to 0-5 Vdc sensors from resistive or Hall-effect sensors and joysticks. The sensors can be powered from the 5 V reference on the module. For flexibility, all of the analog voltage inputs can also be configured as digital inputs.

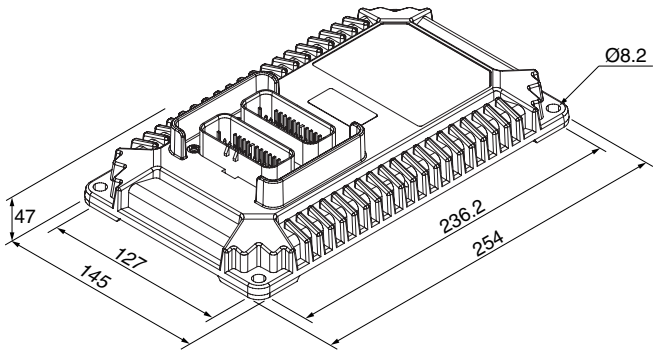
There are two types of frequency inputs, allowing for both active sensors, such as Hall effect sensors, and for inductive pickup sensors.

The module has a large number of digital outputs designed for driving on-off solenoids in a hydraulic system. The dedicated digital outputs can also be used for driving other types of loads, such as LEDs.

Some of the outputs can also be configured as PWM outputs, for less demanding proportional functions when temperature compensation is not needed. The PWM outputs are configured in pairs, where each pair is intended for one valve section. These outputs are monitored, and use a combination of high-side and low-side switches to make it possible to shut down in the event of wiring faults.

The IQAN-XC10 is designed for use on mobile machinery. It uses two keyed 35-pin Ampseal connectors. The unit also has two LEDs for aiding diagnostics when it is not connected to a master display.

Description	**Ordering PN**
IQAN-XC10	20077638ECD



units=mm

Parker Hannifin Corporation
Electronic Controls Division
Elk Grove Village, IL 60007 USA

General

Weight	0.7 Kg
Operating temperature	-40 to +70 °C
Protection	outdoor use
Voltage supply	11- 32 VDC
Current consumption (idle)	75 mA (28 VDC) 95 mA (14 VDC)
Data interface	Parker ICP (IQAN CAN Protocol)

Outputs

Proportional outputs	6 double (max)[1]
Type current mode	current - closed-loop
PWM mode	voltage - open-loop
Signal range	100 - 2000 mA
Dither frequency	25 - 333 Hz
Resolution	1 mA
Digital outputs	12 (max)[1]
Type	high side switch
Total load (all outputs)	20 A

Inputs

Voltage inputs	8 (max)[1]
Signal range	0 - 5 VDC
Resolution	5 mV
Frequency inputs	4 (max)[1]
Signal range (speed mode)	2 - 30000 Hz
(position mode)	0 - 30000 Hz
Quadrature inputs	2 (max)[1]
Signal range (speed mode)	2 - 30000 Hz
(position mode)	0 - 30000 Hz
Digital inputs	20 (max)[1]
Signal high	4 VDC - V_{BAT}
Signal low	0 - 1 VDC

1) The flexible inputs and outputs share the same physical pins. The user defines the channels/pins with IQANdesign.

Application

The IQAN-XA2 is an expansion module in the IQAN product group and is used with the IQANdesign platform. This unit is designed for high digital I/O count, weather resistance, and safety.

All IQAN expansion modules communicate with a master over a CAN bus. The XA2 module has new I/O flexibility that allows the user greater freedom in defining signals for measurement and control.

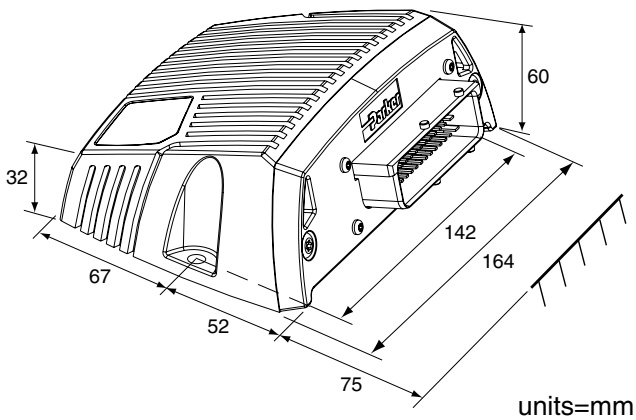
The IQAN-XA2 can control proportional valves using current mode (current closed-loop) or PWM mode (voltage open-loop) signals. The analog inputs accept 0-5V signals from input devices or sensors. These inputs can also be set up to accept 4 frequency or 2 directional frequency (quadrature) inputs. Many outputs may alternatively be used as digital inputs for switches. The XA2 also has a number of high power digital (on-off) outputs.

The aluminum housing is designed to be rugged, but light and has a sealed, automotive AMP/Tyco power timer connector. The XA2 has a membrane to prevent condensation inside the housing. This controller is designed for the outdoor environment.

The unit executes a self-test during start up and cyclic operation. An internal watch dog checks for software errors and will interrupt outputs if errors are detected. The IQAN-XA2 is made using selected components and conforms to strict international requirements.

Diagnostics: If an error is detected an LED on the top of the controller flashes a sequence to indicate the nature of the error.

Description	**Ordering PN**
IQAN-XA2	5010033



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Parker Hannifin Corporation
Electronic Controls Division
Elk Grove Village, IL 60007 USA

General

Weight	0.7 Kg
Operating temperature	-40 to +70 °C
Protection	outdoor use
Voltage supply	11- 32 VDC
Current consumption (idle)	75 mA (28 VDC) 95 mA (14 VDC)
Data interface	Parker ICP (IQAN CAN Protocol)

Outputs

Digital outputs	12
Type	high side switch
Total load (all outputs)	20 A

Inputs

Voltage inputs	8 (max)[1]
Signal range	0 - 5 VDC
Resolution	5 mV
Digital inputs	20 (max)[1]
Signal high	4 VDC - V_{BAT}
Signal low	0 - 1 VDC

1) The flexible inputs and outputs share the same physical pins. The user defines the channels/pins with IQANdesign.

Application

The IQAN-XS2 is an expansion module in the IQAN product group and is used with the IQANdesign platform. This unit is designed for high digital I/O count, weather resistance, and safety.

All IQAN expansion modules communicate with a master over a CAN bus. The XS2 module has a large number of inputs and outputs that allows the user to have fewer modules for digital signals.

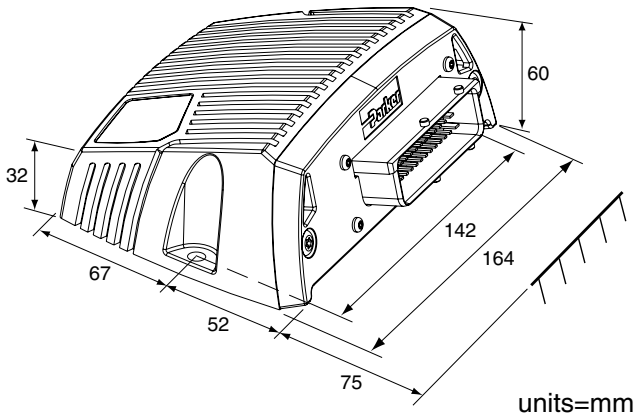
The IQAN-XS2 can control valves using digital (on-off) output signals. The analog inputs accept 0-5V signals from input devices or sensors. These analog inputs may alternatively be used as high impedance digital inputs for switches. The XS2 also has a number of dedicated digital (on-off) inputs.

The aluminum housing is designed to be rugged, but light and has a sealed, automotive AMP/Tyco power timer connector. The XS2 has a membrane to prevent condensation inside the housing. This controller is designed for the outdoor environment.

The unit executes a self-test during start up and cyclic operation. An internal watch dog checks for software errors and will interrupt outputs if errors are detected. The IQAN-XS2 is made using selected components and conforms to strict international requirements.

Diagnostics: If an error is detected an LED on the top of the controller flashes a sequence to indicate the nature of the error.

Description	**Ordering PN**
IQAN-XS2	5010017



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The IQAN-XC21 is an IQANdesign platform expansion module in the IQAN product group. This unit is a small dimension I/O module to be used as an expansion unit in an IQAN system. It is also useful as an interface with the IQAN-LC6-X05 joystick to provide CAN capability.

All IQAN expansion modules communicate with a master over a CAN bus, using the IQAN CAN protocol. The IQAN-XC21 module has I/O flexibility that allows the user freedom in defining signals for measurement and control.

The IQAN-XC21 has up to 20 digital inputs for connection to switches. Up to 8 of these inputs may be configured as voltage inputs for connection of 0-5 Vdc signals from resistive or Hall-effect sensors and joysticks. The sensors can be powered from one of the 5 Vdc reference voltages on the module.

The remaining 12 inputs can be configured as up to 10 frequency inputs and 1 encoder input for measuring speed and position.

The module's low power digital outputs are designed for driving low power loads such as relays, LEDs or alarm buzzers. The outputs share pins with the inputs and are configured using IQAN software.

The IQAN-XC21 is designed for in-cab use on mobile machinery. It uses four Molex Micro-fit connectors of varying pin density to prevent wiring mix-ups. The module has addressing in the wiring harness through use of an IDtag; the addressing of the IQAN-XC21 allows up to 8 modules of this type on the bus.

The housing is designed for stacking multiple modules, providing a high density of I/O in a small footprint. The module also has pins that allow 'daisy chaining' of power and CAN for simplified cable harness installation.

Description	**Ordering PN**
IQAN-XC21	20077775

General

Weight	0.1 kg
Temperature range	
Operating, ambient	-40 to +70 °C
Storage, ambient	-40 to +100 °C
Protection	IP32
Voltage supply	9 - 32 Vdc
Current consumption (idle)	20 mA (28 Vdc) 30 mA (14 Vdc)
CE marking	2004/108/EC
Data interface	Parker ICP (IQAN CAN Protocol)

Outputs

Digital out low	up to 8[1]
Type	low-side switch
Max load, 1 output	300 mA
Max load, all outputs	1700 mA

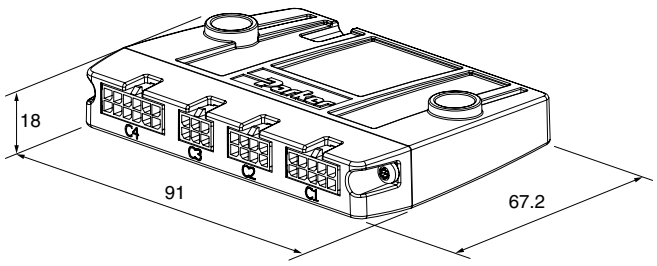
Inputs

Voltage inputs	up to 8[1]
Signal range	0 - 5 Vdc
Resolution	1.22 mV
Frequency inputs	up to 10[1]
Signal range (FIN-A to B)	1 - 20000 Hz
Signal range (FIN-C to J)	1 - 4000 Hz
Logic level high	>4 Vdc
Logic level low	<1 Vdc
Encoder inputs	up to 1[1]
Signal range	0 - 20000 Hz
Logic level high	>4 Vdc
Logic level low	<1 Vdc
Digital inputs	up to 20[1]
Signal high	>4 Vdc
Signal low	<1 Vdc

Sensor supplies

Voltage references	2
Supply range	5 Vdc ±100 mV
Max load C2 connector	70 mA (has 2 pins)
Max load C3 connector	70 mA (has 1 pin)

1) depending on configuration



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Elk Grove Village, IL 60007 USA

General

Weight	0.2 kg
Temperature range	
Operating, ambient	-40 to +70 °C
Storage, ambient	-40 to +100 °C
Protection	IP65, IP6K9K
Voltage supply	9 - 32 Vdc
Current consumption (idle)	20 mA (28 Vdc) 30 mA (14 Vdc)
CE marking	2004/108/EC
Data interface	Parker ICP (IQAN CAN Protocol)

Outputs

Digital out low	up to 8[1]
Type	low-side switch
Max load, 1 output	300 mA
Max load, all outputs	1700 mA

Inputs

Voltage inputs	up to 8[1, 2]
Signal range	0 - 5 Vdc
Resolution	1.22 mV
Frequency inputs	up to 10[1]
Signal range (FIN-A to B)	1 - 20000 Hz
Signal range (FIN-C to J)	1 - 4000 Hz
Logic level high	>4 Vdc
Logic level low	<1 Vdc
Encoder inputs	up to 1[1]
Signal range	0 - 20000 Hz
Logic level high	>4 Vdc
Logic level low	<1 Vdc
Digital inputs	up to 12[1] (20[1, 2])
Signal high	>4 Vdc
Signal low	<1 Vdc

1) depending on configuration
2) -XC23 only

The IQAN-XC22 and IQAN-XC23 are IQANdesign platform expansion modules in the IQAN system. This type of unit is a small dimension I/O module to be used as an expansion unit in an IQAN control system.

All IQAN expansion modules communicate with a master over a CAN bus, using the IQAN CAN protocol. The IQAN-XC22/23 modules have I/O flexibility that allows the user freedom in defining signals for measurement and control.

The IQAN-XC22 has up to 12 digital inputs for connection to switches. These inputs can be configured as up to 10 frequency inputs and 1 encoder input for measuring speed and position.

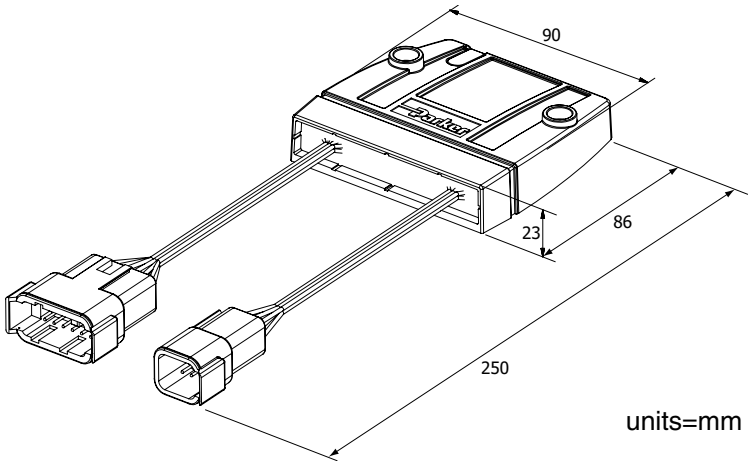
The IQAN-XC23 has up to 20 digital inputs for connection to switches. Up to 8 of these inputs may be configured as voltage inputs for connection of 0-5 Vdc signals from resistive or Hall-effect sensors and joysticks. The remaining 12 inputs can be configured as up to 10 frequency inputs and 1 encoder input for measuring speed and position.

The module's low power digital outputs are designed for driving low power loads such as relays, LEDs or alarm buzzers. The outputs share pins with the inputs and are configured using IQAN software.

The IQAN-XC22/23 is designed for outdoor use on mobile machinery. It uses 2 or 3 keyed Deutsch DTM connectors, depending on model, to prevent wiring mix-ups. The module has addressing in the wiring harness through use of an IDtag; the addressing of the IQAN-XC22/23 allows up to 8 modules of this type on the bus.

The housing is designed for stacking multiple modules, providing a high density of I/O in a small footprint.

Description	**Ordering PN**
IQAN-XC22	20077784
IQAN-XC23	20077792



units=mm

Parker Hannifin Corporation
Electronic Controls Division
Elk Grove Village, IL 60007 USA

General

Weight	0.7 Kg
Operating temperature	-40 to +70 °C
Protection	outdoor use
Voltage supply 9 - 34 VDC	
Current consumption (idle)	160 mA (28 VDC) 140 mA (14 VDC)
Data interface	Parker ICP (IQAN CAN Protocol)
Additional CAN hub	J1939 or other byte aligned CAN protocol

Outputs

Proportional current outputs	
Number	2 double
Signal range	60 - 1800 mA
Dither frequency	25 - 150 Hz
Dither amplitude	0 - 500 mA
Resolution	0.7 mA
Digital/ PWM (no current feedback)	
Number	6 / 3 double
Type	high side switch
Max load	3 A
PWM frequency	25 - 2000 Hz
E-gas/Servo motor output (PWM H-bridge)	
Number	1
Signal Range	0-100% rated power
Max load	2,5A
Total load (all outputs)	20 A

Inputs

Voltage/Frequency	
Number	10/3
Signal range	0 - 5 VDC
Resolution	5 mV
Frequency range	1-10 000 Hz

Application

IQAN-XT2 is a legacy unit from the IQANdevelop platform of IQAN expansion modules that is also supported in IQANdesign platform systems. Key features for this type of module are flexibility, weather resistance and safety.

All IQAN expansion modules communicate with a master over a CAN-BUS. The XT2 has an additional CAN hub designed to interface with J1939 diesel engines on mobile machinery and has a dedicated output for electronic throttle control, E-GAS.

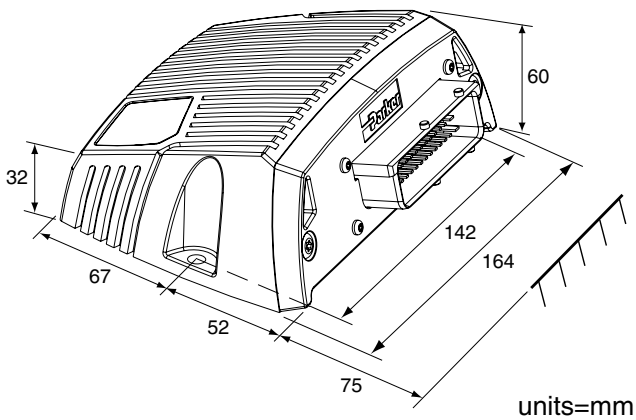
The IQAN-XT2 module has a flexible I/O interface which gives system designers increased options. The same physical pin can be used for different types of inputs or outputs. Types of I/O such as E-gas and PWM outputs increase the flexibility of the module. Digital outputs now have features such as softstart and peak & hold. The J1939 CAN hub allows the XT2 to communicate directly with an electronic engine control bus.

The aluminum housing is designed to be rugged, but light and has a sealed, automotive AMP/Tyco power timer connector. The XT2 has a membrane to prevent condensation inside the housing. This controller is designed for the outdoor environment.

The unit executes a self-test during start up and cyclic operation. An internal watch dog checks for software errors and will interrupt outputs if errors are detected. The IQAN-XT2 is made using selected components and conforms to strict international requirements.

Diagnostics: If an error is detected an LED on the top of the controller flashes a sequence to indicate the nature of the error.

Description	**Ordering PN**
IQAN-XT2	5010018



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Elk Grove Village, IL 60007 USA

General (Lever base)

Weight	.41 kg
Voltage supply	9 - 32 Vdc
Current consumption	45mA @ 14Vdc 30mA @ 28Vdc
CAN (ISO 11898)	CAN 2.0b
Protocol	ICP (IQAN Protocol)

Mechanical (Lever base)

Angle of movement	±18°
Expected life (full stroke cycles)	5 million
Lever force in neutral, XY	0.6 Nm
Full actuated, XY direction	1.4 Nm
One time loading (max.)	100 Nm

Environmental (Lever base)

Temperature range	
Operating, ambient	-40 to +85° C
Storage, ambient	-40 to +100° C
Sealing (above flange)	IP65

Connection

Electrical connection	Deutsch DTM, 2x 6 pos., 1x 12 pos.

Inputs

Voltage inputs[1]	8(1)
Signal range	0-5 Vdc
Resolution	1.2 mV
Digital inputs	5
Signal high	>4 Vdc
Signal low	<= 1 Vdc

1) The voltage inputs share the same physical pins. The user defines the channels/pins with IQAN software.

Outputs

Digital output	1
Type	high side switch Max load 200 mA

Application

The IQAN-LC5-C01 is a large, coordinate joystick that incorporates ruggedness, functionality, light weight with high flexibility for mobile market applications. The unit is extremely robust, able to withstand aggressive conditions during outdoor use and in outdoor installations, including EMI, vibrations and a wide temperature range. The IQAN-LC5-C01 has high I/O count and the ability to support up to 5 axes in IQANdesign platform applications.

Fourth generation IQAN-LL joysticks are easily replaced with the IQAN-LC5-C02/C03 versions. The U, N and G handles are offered.

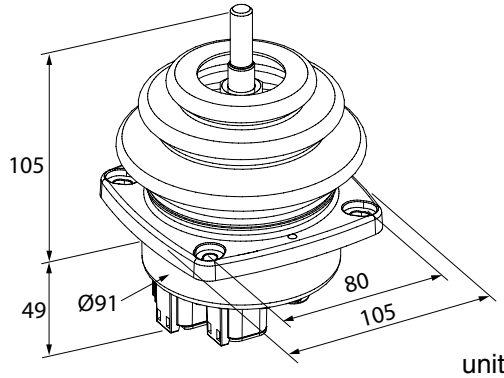
The IQAN-LC5 housing has integrated Deutsch transportation connectors. The handle cable may be routed completely through the main, non-corrosive housing. This makes field mounting of new handles or replacing a bellow very easy to accomplish.

All proportional inputs are of contactless Hall effect type with dual sensors to provide redundancy for high safety and reliability. This makes it easy for the application designer to meet high safety requirements on functions by using IQAN software.

The IQAN-LC5-C01/C02 CAN levers are connected to other modules through a CAN bus.

Description	Ordering PN
IQAN-LC5-C01-U1	20076330
IQAN-LC5-C01-U2	20076331
IQAN-LC5-C01-G	20077750
IQAN-LC5-C02-U1	20076333
IQAN-LC5-C02-U2	20076334
IQAN-LC5-C02-N2	20077690
IQAN-LC5-C02-N2E[1]	20077686
IQAN-LC5-C02-N2T	20077685
IQAN-LC5-C02-N4	20077688
IQAN-LC5-C03-G	20077752

1) wired to replace LL-E2 handle functionality



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Parker Hannifin Corporation
Electronic Controls Division
Elk Grove Village, IL 60007 USA

General (handle)

Weight	.25 kg
Temperature range	-40 to +85° C
Sealing	outdoor use

Buttons/Trigger

Expected life (electrical)	0.5 million
Expected life (mechanical)	1 million
Travel	1.5 mm
Actuating force	2 - 5 Nm
Switching current (max)	400 mA, 32 VAC, resistive load

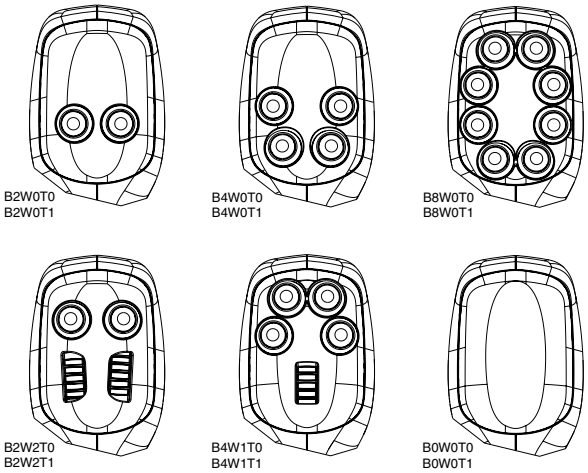
Thumb wheel

Rated power supply (Vs)	5 Vdc
Load resistive (min)	4.5 kΩ
Load capacitive (max)	1 uF
Current consumption (typ)	16 mA
Analog output active range	10%-90% Vs
Resolution	< 2 mV
Angle of movement	± 25 degrees
Expected life (operations)	5 million

Connection

B0W0T1 / B2W0T0 / B2W0T1 / B4W0T0	Deutsch DTM, 6 pos.
B4W0T1 / B4W1Tx / B2W2Tx / B8W0Tx	Deutsch DTM, 12 pos.

MP standard faceplate configurations



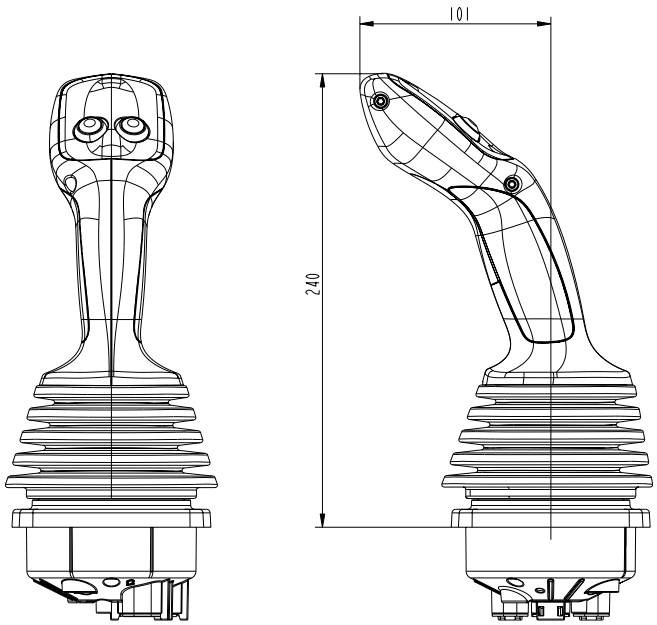
Application

The MP handle option provides a variety of control interfaces in an ergonomic, multi-function handle that comfortably fits your hand. The handle is a robust design, able to withstand heavy use in outdoor installations, including exposure to a wide range of automotive chemicals. The handle has the capability to have a maximum of 8 buttons or 2 proportional thumb wheels in the faceplate. Combinations of buttons, thumb wheels, and trigger are also possible. The MP handle will be assembled to the IQAN-LC5 base, and the cables are routed through the base. The push buttons and thumb wheel are easily connected to the joystick base by a Deutsch DTM connector.

The MP handle is made to fit either the right or left hand, reducing inventory part numbers. The buttons are large, and have a nice tactile feel. The proportional thumb wheel has dual sensors providing 2 crossed outputs that may be compared in IQAN modules for safe operation.

Description	Ordering PN
IQAN-LC5-C01-MPB2W0T0	20076996
IQAN-LC5-C01-MPB2W0T1	20076997
IQAN-LC5-C01-MPB2W2T1	20076999
IQAN-LC5-C01-MPB4W0T0	20077000
IQAN-LC5-C01-MPB4W0T1	20077001
IQAN-LC5-C01-MPB4W1T1	20077003
IQAN-LC5-C01-MPB8W0T1	20077005

Consult datasheet and pricelist for other IQAN-LC5-C01-MP options and ordering part numbers.



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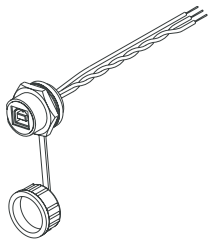
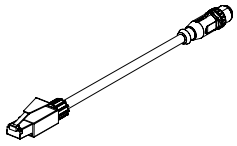
Elk Grove Village, IL 60007 USA

Communication cables

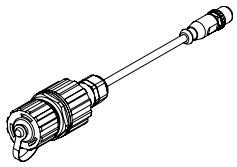
5030124
USB adapter-cable, panel mount
length: 0,4 meters
use with: IQAN-MC2, -MD3



20077780
Ethernet cable
length: 1,5 meters
use with: IQAN-MD4

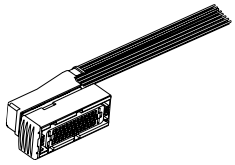


20077785
Ethernet cable, panel mount
length: 1,5 meters
use with: IQAN-MD4

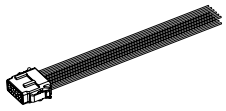


Prototype installation cables

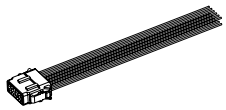
5030030
C1-cable, with seals
length: 2,5 meters
use with: IQAN-XA2, -XS2, -XT2, -MC2



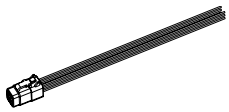
5030125
C1-cable, sealed
length: 2,5 meters
use with: IQAN-MD3, -MD4



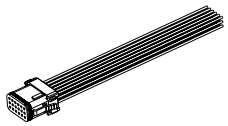
5030126
C2-cable, sealed
length: 2,5 meters
use with: IQAN-MD3, -MD4



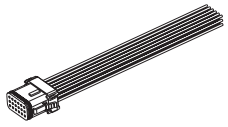
5030127[1]
C1-cable, sealed
length: 2,5 meters
use with: IQAN-LC5-C01, -C02
1) from catalog HY33-1800/US



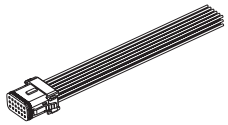
5030216
C1-cable, sealed, key A
length: 2,5 meters
use with: IQAN-MC3, -MC31



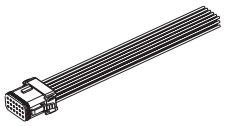
5030217
C2-cable, sealed, key B
length: 2,5 meters
use with: IQAN-MC3, -MC31



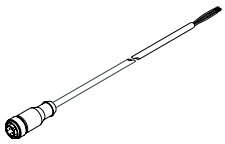
5030218
C3-cable, sealed, key C
length: 2,5 meters
use with: IQAN-MC3, -MC31



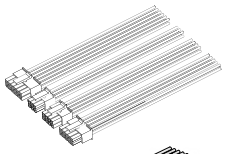
5030219
C4-cable, sealed, key D
length: 2,5 meters
use with: IQAN-MC3, -MC31



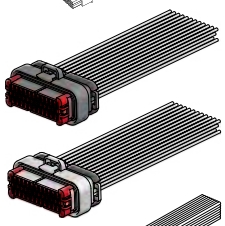
20077744
Power/CAN cable
length: 2,0 meters
use with: IQAN-G3



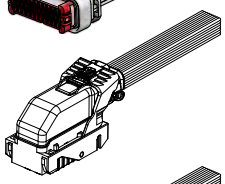
20077777
C1-C4 cables
length: 2,5 meters
use with: IQAN-XC21



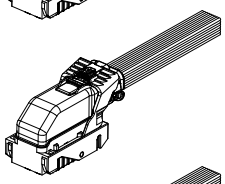
20085102
C1-C2 cables
length: 2,5 meters
use with: IQAN-XC10



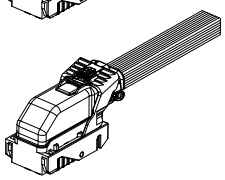
20085116
C1-cable
length: 2,5 meters
use with: IQAN-MC42, -MC43



20085117
C-2 cable
length: 2,5 meters
use with: IQAN-MC43



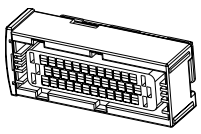
20085124
C-1 cable
length: 2,5 meters
use with: IQAN-MC41



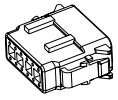
Connector kits

5031022
C1-connector, 6 position
use with: IQAN-LF1

5031063
C1-connector, 42 position
use with: IQAN-XA2, -XS2, -XT2, -MC2

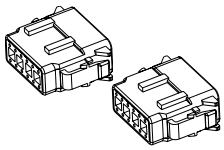


20072406
C1-connector (grey), 12 position
use with: IQAN-G1, -XC22

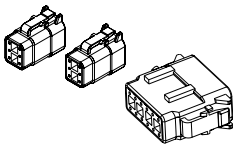


20072408[1]
C1-connector (grey), 6 position
use with: IQAN-XC22, -XC23
1) from catalog HY33-1800/US

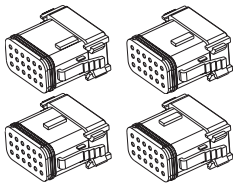
20073081
C1-connector (grey), 12 position
C2-connector (black), 12 position
use with: IQAN-MD3, -MD4, -XC23



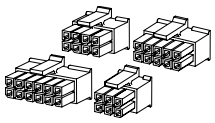
5035007
C1/C3-connector (grey), 6 pos.
C2-connector (grey), 12 position
use with: IQAN-LC5-C01, -C02/3



5035016
C1-connector (key A), 18 position
C2-connector (key B), 18 position
C3-connector (key C), 18 position
C4-connector (key D), 18 position
use with: IQAN-MC3, -MC31

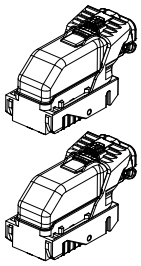


20077776
C1-connector, 12 position
C2-connector, 6 position
C3-connector, 8 position
C4-connector, 10 position
use with: IQAN-XC21



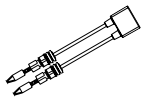
20085114
C1-connector, 66 position
use with: IQAN-MC4x

20085115
C2-connector, 73 position
use with: IQAN-MC43

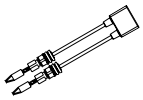


Address tags

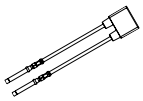
5030060 - 5030067
IQAN address tags 0-7 with AMP terminals.
Bag of 10 pcs.



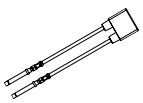
5030070 - 5030077
IQAN address/termination tags 0T-7T with AMP terminals.
Bag of 10 pcs.



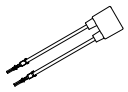
5030160 - 5030167
IQAN address tags 0-7 with Deutsch DTM terminals.
Bag of 10 pcs.



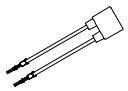
5030170 - 5030177
IQAN address/termination tags 0T-7T with Deutsch DTM terminals.
Bag of 10 pcs.



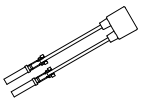
20085020 - 20085027
IQAN address tags 0-7 with Molex MicroFit terminals.
Bag of 10 pcs.



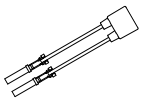
20085030 - 20085037
IQAN address/termination tags 0T-7T with Molex MicroFit terminals.
Bag of 10 pcs.



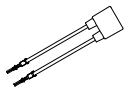
20085050 - 20085057
IQAN address tags 0-7 with Deutsch DT terminals.
Bag of 10 pcs.



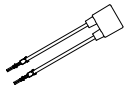
20085060 - 20085067
IQAN address/termination tags 0T-7T with Deutsch DT terminals.
Bag of 10 pcs.



20085130 - 20085133
IQAN address tags 0-3 with Molex MX64 terminals.
Bag of 10 pcs.



20085140 - 20085143
IQAN address/termination tags 0T-3T with Molex MX64 terminals.
Bag of 10 pcs.



Additional items

5010011
IQAN-LF1 electric speed/throttle pedal (legacy product).
use with: Engine ECUs, IQAN systems.

20085100
IQAN-G11 Bluetooth® gateway for remote diagnostics
use with: IQAN-MD3, -MD4, -MC2.

20085106
IQAN-SV hardened IP camera.
use with: IQAN-MD4 displays.

Consult "IQAN accessories" datasheet and pricelist for other accessory items and ordering part numbers.

Parker Hannifin Corporation
Electronic Controls Division
Elk Grove Village, IL 60007 USA

Terms of Sale with Warranty Limitations

Offer of Sale

The goods, services or work (referred to as the "Products") offered by Parker-Hannifin Corporation, its subsidiaries, groups, divisions, and authorized distributors ("Seller") are offered for sale at prices indicated in the offer, or as may be established by Seller. The offer to sell the Products and acceptance of Seller's offer by any customer ("Buyer") is contingent upon, and will be governed by all of the terms and conditions contained in this Offer of Sale. Buyer's order for any Products specified in Buyer's purchase document or Seller's offer, proposal or quote ("Quote") attached to the purchase order, when communicated to Seller verbally, or in writing, shall constitute acceptance of this offer.

1. Terms and Conditions. Seller's willingness to offer Products for sale or accept an order for Products is subject to the terms and conditions contained in this Offer of Sale or any newer version of the same, published by Seller electronically at www.parker.com/saleterms/. Seller objects to any contrary or additional terms or conditions of Buyer's order or any other document or other communication issued by Buyer.

2. Price; Payment. Prices stated on Seller's Quote are valid for thirty (30) days, except as explicitly otherwise stated therein, and do not include any sales, use, or other taxes or duties unless specifically stated. Seller reserves the right to modify prices to adjust for any raw material price fluctuations. Unless otherwise specified by Seller, all prices are F.C.A. Seller's facility (INCOTERMS 2010). Payment is subject to credit approval and payment for all purchases is due thirty (30) days from the date of invoice (or such date as may be specified by Seller's Credit Department). Unpaid invoices beyond the specified payment date incur interest at the rate of 1.5% per month or the maximum allowable rate under applicable law.

3. Shipment; Delivery; Title and Risk of Loss. All delivery dates are approximate. Seller is not responsible for damages resulting from any delay. Regardless of the manner of shipment, delivery occurs and title and risk of loss or damage pass to Buyer, upon placement of the Products with the shipment carrier at Seller's facility. Unless otherwise stated, Seller may exercise its judgment in choosing the carrier and means of delivery. No deferment of shipment at Buyers' request beyond the respective dates indicated will be made except on terms that will indemnify, defend and hold Seller harmless against all loss and additional expense. Buyer shall be responsible for any additional shipping charges incurred by Seller due to Buyer's acts or omissions.

4. Warranty. Seller warrants that the Products sold hereunder shall be free from defects in material or workmanship for a period of twelve (12) months from the date of delivery or 2,000 hours of normal use, whichever occurs first. All prices are based upon the exclusive limited warranty stated above, and upon the following disclaimer: DISCLAIMER OF WARRANTY: THIS WARRANTY IS THE SOLE AND ENTIRE WARRANTY PERTAINING TO PRODUCTS PROVIDED. SELLER DISCLAIMS ALL OTHER WARRANTIES, EXPRESS AND IMPLIED, INCLUDING DESIGN, MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

5. Claims; Commencement of Actions. Buyer shall promptly inspect all Products upon receipt. No claims for shortages will be allowed unless reported to the Seller within ten (10) days of delivery. No other claims against Seller will be allowed unless asserted in writing within thirty (30) days after delivery. Buyer shall notify Seller of any alleged breach of warranty within thirty (30) days after the date the defect is or should have been discovered by Buyer. Any claim or action against Seller based upon breach of contract or any other theory, including tort, negligence, or otherwise must be commenced within twelve (12) months from the date of the alleged breach or other alleged event, without regard to the date of discovery.

6. LIMITATION OF LIABILITY. IN THE EVENT OF A BREACH OF WARRANTY, SELLER WILL, AT ITS OPTION, REPAIR OR REPLACE A DEFECTIVE PRODUCT, OR REFUND THE PURCHASE PRICE WITHIN A REASONABLE PERIOD OF TIME. IN NO EVENT IS SELLER LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF, OR AS THE RESULT OF, THE SALE, DELIVERY, NON-DELIVERY, SERVICING, USE OR LOSS OF USE OF THE PRODUCTS OR ANY PART THEREOF, OR FOR ANY CHARGES OR EXPENSES OF ANY NATURE INCURRED WITHOUT SELLER'S WRITTEN CONSENT, WHETHER BASED IN CONTRACT, TORT OR OTHER LEGAL THEORY. IN NO EVENT SHALL SELLER'S LIABILITY UNDER ANY CLAIM MADE BY BUYER EXCEED THE PURCHASE PRICE OF THE PRODUCTS.

7. User Responsibility. The user, through its own analysis and testing, is solely responsible for making the final selection of the system and Product 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 and follow applicable industry standards and Product information. If Seller provides Product 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 Products or systems.

8. Loss to Buyer's Property. Any designs, tools, patterns, materials, drawings, confidential information or equipment furnished by Buyer or any other items which become Buyer's property, will be considered obsolete and may be destroyed by Seller after two (2) consecutive years have elapsed without Buyer ordering the items manufactured using such property. Seller shall not be responsible for any loss or damage to such property while it is in Seller's possession or control.

9. Special Tooling. A tooling charge may be imposed for any special tooling, including without limitation, dies, fixtures, molds and patterns, acquired to manufacture Products. Such special tooling shall be and remain Seller's property notwithstanding payment of any charges by Buyer. In no event will Buyer acquire any interest in apparatus belonging to Seller which is utilized in the manufacture of the Products, even if such apparatus has been specially converted or adapted for such manufacture and notwithstanding any charges paid by Buyer. Unless otherwise agreed, Seller has the right to alter, discard or otherwise dispose of any special tooling or other property in its sole discretion at any time.

10. Buyer's Obligation; Rights of Seller. To secure payment of all sums due or otherwise, Seller retains a security interest in all Products delivered to Buyer and this agreement is deemed to be a Security Agreement under the Uniform Commercial Code. Buyer authorizes Seller as its attorney to execute and file on Buyer's behalf all documents Seller deems necessary to perfect its security interest.

11. Improper Use and Indemnity. Buyer shall indemnify, defend, and hold Seller harmless from any losses, claims, liabilities, damages, lawsuits, judgments and costs (including attorney fees and defense costs), whether for personal injury, property damage, patent, trademark or copyright infringement or any other claim, brought by or incurred by Buyer, Buyer's employees, or any other person, arising out of: (a) improper selection, application, design, specification or other misuse of Products purchased by Buyer from Seller; (b) any act or omission, negligent or otherwise, of Buyer; (c) Seller's use of patterns, plans, drawings, or specifications furnished by Buyer to manufacture Products; or (d) Buyer's failure to comply with these terms and conditions. Seller shall not indemnify Buyer under any circumstance except as otherwise provided.

12. Cancellations and Changes. Buyer may not cancel or modify or cancel any order for any reason, except with Seller's written consent and upon terms that will indemnify, defend and hold Seller harmless against all direct, incidental and consequential loss or damage. Seller may change Product features, specifications, designs and availability.

13. Limitation on Assignment. Buyer may not assign its rights or obligations under this agreement without the prior written consent of Seller.

14. Force Majeure. Seller does not assume the risk and is not liable for delay or failure to perform any of Seller's obligations by reason of events or circumstances beyond its reasonable control (hereinafter "Events of Force Majeure"). Events of Force Majeure shall include without limitation: accidents, strikes or labor disputes, acts of any government or government agency, acts of nature, delays or failures in delivery from carriers or suppliers, shortages of materials, or any other cause beyond Seller's reasonable control.

15. Waiver and Severability. Failure to enforce any provision of this agreement will not invalidate that provision; nor will any such failure prejudice Seller's right to enforce that provision in the future. Invalidation of any provision of this agreement by legislation or other rule of law shall not invalidate any other provision herein. The remaining provisions of this agreement will remain in full force and effect.

16. Termination. Seller may terminate this agreement for any reason and at any time by giving Buyer thirty (30) days prior written notice. Seller may immediately terminate this agreement, in writing, if Buyer: (a) breaches any provision of this agreement (b) appoints a trustee, receiver or custodian for all or any part of Buyer's property (c) files a petition for relief in bankruptcy on its own behalf, or one if filed by a third party (d) makes an assignment for the benefit of creditors; or (e) dissolves its business or liquidates all or a majority of its assets.

17. Governing Law. This agreement and the sale and delivery of all Products are deemed to have taken place in, and shall be governed and construed in accordance with, the laws of the State of Ohio, as applicable to contracts executed and wholly performed therein and without regard to conflicts of laws principles. Buyer irrevocably agrees and consents to the exclusive jurisdiction and venue of the courts of Cuyahoga County, Ohio with respect to any dispute, controversy or claim arising out of or relating to this agreement.

18. Indemnity for Infringement of Intellectual Property Rights. Seller is not liable for infringement of any patents, trademarks, copyrights, trade dress, trade secrets or similar rights except as provided in this Section. Seller will defend and indemnify Buyer against allegations of infringement of U.S. patents, U.S. trademarks, copyrights, trade dress and trade secrets ("Intellectual Property Rights"). Seller will defend at its expense and will pay the cost of any settlement or damages awarded in an action brought against Buyer based on an allegation that a Product sold pursuant to this agreement infringes the Intellectual Property Rights of a third party. Seller's obligation to defend and indemnify Buyer is contingent on Buyer notifying Seller within ten (10) days after Buyer becomes aware of such allegations of infringement, and Seller having sole control over the defense of any allegations or actions including all negotiations for settlement or compromise. If a Product is subject to a claim that it infringes the Intellectual Property Rights of a third party, Seller may, at its sole expense and option, procure for Buyer the right to continue using the Product, replace or modify the Product so as to make it noninfringing, or offer to accept return of the Product and refund the purchase price less a reasonable allowance for depreciation. Notwithstanding the foregoing, Seller is not liable for claims of infringement based on information provided by Buyer, or directed to Products delivered hereunder for which the designs are specified in whole or part by Buyer, or infringements resulting from the modification, combination or use in a system of any Product sold hereunder. The foregoing provisions of this Section constitute Seller's sole and exclusive liability and Buyer's sole and exclusive remedy for infringement of Intellectual Property Rights.

19. Entire Agreement. This agreement contains the entire agreement between the Buyer and Seller and constitutes the final, complete and exclusive expression of the terms of sale. All prior or contemporaneous written or oral agreements or negotiations with respect to the subject matter are herein merged. The terms contained herein may not be modified unless in writing and signed by an authorized representative of Seller.

20. Compliance with Laws. Buyer agrees to comply with all applicable laws, regulations, and industry and professional standards of care, including those of the United Kingdom, the United States of America, and the country or countries in which Buyer may operate, including without limitation the U. K. Bribery Act, the U.S. Foreign Corrupt Practices Act ("FCPA"), the U.S. Anti-Kickback Act ("Anti-Kickback Act") and the U.S. Food Drug and Cosmetic Act ("FDCA"),each as currently amended, and the rules and regulations promulgated by the U.S. Food and Drug Administration ("FDA"), and agrees to indemnify and hold harmless Seller from the consequences of any violation of such provisions by Buyer, its employees or agents. Buyer acknowledges that it is familiar with the provisions of the U. K. Bribery Act, the FCPA, the FDA, and the Anti-Kickback Act, and certifies that Buyer will adhere to the requirements thereof. In particular, Buyer represents and agrees that Buyer will not make any payment or give anything of value, directly or indirectly to any governmental official, any foreign political party or official thereof, any candidate for foreign political office, or any commercial entity or person, for the purpose of influencing such person to purchase Products or otherwise benefit the business of Seller.

05/14

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Catalog HY33-1825/US 10/2016

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