MAQ®20

Industrial Data Acquisition and Control System

MA1062

MAQ20-ISOMV
MAQ20-ISOVx
MAQ20-ISOI
Hardware User Manual

DATAFORTH®

MAQ20-ISOMV/-ISOV/-ISOI Hardware User Manual
MA1062 Rev. B – March 2024

ISO9001:2015-Registered QMS

Table of Contents

About Dataforth Corporation

"Our passion at Dataforth Corporation is designing, manufacturing, and marketing the best possible signal conditioning, data acquisition, and data communication products. Our mission is to set new standards of product quality, performance, and customer service." Dataforth Corporation, with more than a quarter century of experience, is the worldwide leader in Instrument Class® Industrial Electronics – rugged, high performance signal conditioning, data acquisition, and data communication products that play a vital role in maintaining the integrity of industrial automation, data acquisition, and quality assurance systems. Our products directly connect to most industrial sensors and protect valuable measurement and control signals and equipment from the dangerous and degrading effects of noise, transient power surges, internal ground loops, and other hazards present in industrial environments.

Dataforth spans the globe with more than 50 International Distributors and US Representative Companies. Our customers benefit from a team of over 130 salespeople highly trained in the application of precision products for industrial markets. In addition, we have a team of application engineers in our Tucson factory ready to solve any in-depth application questions. Upon receipt of an RFQ or order, our Customer Service Department provides fast one-day delivery information turnaround. We maintain an ample inventory that allows small quantity orders to be shipped from stock.

Dataforth operates under an ISO9001:2015 quality management system.

Contacting Dataforth Corporation

Contact Method	Contact Information
E-Mail: Technical Support	support@dataforth.com
Website:	www.dataforth.com
Phone:	+1-520-741-1404 and toll free +1-800-444-7644
Fax:	+1-520-741-0762
Mail:	Dataforth Corporation 3331 E. Hemisphere Loop Tucson, AZ 85706 USA

Errata Sheets

Refer to the Technical Support area of Dataforth's website (www.dataforth.com) for any errata information on this product.

1.0 System Features

The MAQ20 Data Acquisition System encompasses more than 35 years of design excellence in the process control industry. It is a family of high performance, DIN rail mounted, programmable, multi-channel, industrially rugged signal conditioning I/O and communications modules.

Instrument Class Performance

- ±0.035% Accuracy
- Industry leading ±0.3°C CJC Accuracy over full operating temperature range
- Ultra-low Zero and Span Tempco
- Over-range on one channel does not affect other channels
- 1500Vrms Channel-to-Bus Isolation
- 240Vrms Continuous Field I/O Protection
- ANSI/IEEE C37.90.1 Transient Protection
- Ventilated Communications and I/O Modules
- Industrial Operating Temperature of -40°C to +85°C
- Wide Power Supply Range of 7-34VDC
- CE Compliant
- UL/cUL (Class I, Div 2, Groups A, B, C, D) Compliant, file E232858
- ATEX Compliance pending

Industry Leading Functionality

- The system is a Modbus Server and can be operated remotely with no local PC
- Up to 8GB of logged data can be transferred via FTP during real-time acquisition
- Up to 24 I/O modules, or 384 analog or 480 digital channels, per system, 19" rack width
- Per-channel configurable for range, alarms, and other functions
- Backbone mounts within DIN rail and distributes power and communications
- System firmware automatically registers the installation and removal of I/O modules
- I/O modules can be mounted remotely from the Communications Module
- Equal load sharing power supply modules allow for system expansion
- Hot Swappable I/O modules with Field-side pluggable terminal blocks on most models
- Sophisticated package enables high density mounting in 3U increments
- DIN Rail can be mounted on a continuous flat panel or plate

Distributed Processing Enables Even More Functionality

- Output modules are programmable for user-defined waveforms
- Discrete I/O modules have seven high level functions:
  - ➢ Pulse Counter
  - ➢ Frequency Counter
  - ➢ Waveform Measurement
  - ➢ Time Between Events
  - ➢ Frequency Generator
  - ➢ PWM Generator
  - ➢ One-Shot Pulse Generator

Multiple Software Options

- Free Configuration Software
  - ➢ ReDAQ Shape Graphical HMI Design & Runtime Solution
- Intuitive Graphical Control Software
  - ➢ ReDAQ Shape Graphical HMI Design & Runtime Solution
  - ➢ Phyton API
  - ➢ OPC Server
  - ➢ Programming examples and LabVIEW Vis

2.0 System Description and Documentation

A MAQ®20 Data Acquisition System must have as a minimum a Communications Module, a Backbone, and one I/O Module. Examples include but are not limited to:

- MAQ20-COMx Communications Module with Ethernet, USB and RS-232 or RS-485 Interface
- MAQ20-DIOx Discrete Input / Output Module
- MAQ20-xTC Type x Thermocouple Input Module
- MAQ20-mVxN, -VxN Voltage Input Module
- MAQ20-IxN Process Current Input Module
- MAQ20-IO, -VO Process Current Output and Process Voltage Output Module
- MAQ20-BKPLx x Channel System Backbone

Refer to https://www.dataforth.com/maq20 for a complete listing of available modules and accessories.

System power is connected to the Communications Module, which in turn powers the I/O modules. For systems with power supply requirements exceeding what the Communications Module can provide, the *MAQ20-PWR3* Load Share Power Supply module is used to provide additional power. When a MAQ20 I/O module is inserted into a system, module registration occurs automatically, data acquisition starts, and data is stored locally in the module. The system is based on a Modbus compatible memory map for easy access to acquired data, configuration settings, and alarm limits. Information is stored in consistent locations in module memory for ease of use and system design.

MAQ20 modules are designed for installation in Class I, Division 2 hazardous locations and have a high level of immunity to environmental noise commonly present in heavy industrial environments.

The **MAQ20-ISOMV and MAQ20-ISOVx voltage input modules and MAQ20-ISOI current input modules** interface to wide ranges of voltage and current signals. Each have eight input channels that are isolated channel-to-channel to 300Vrms continuous. Signal bandwidth of 1kHz captures valuable signal components. Burst scan mode allows up to 5kS/s per channel to be captured simultaneously. All channels are individually configurable for range, alarm, and averaging to match the most demanding applications. High, Low, High-High and Low-Low alarms provide essential monitoring and warning functions to ensure optimum process flow and fail-safe applications. Hardware low-pass filtering in each channel provides anti-aliasing and rejection of spurious signals. Field I/O connections are made through a pluggable terminal block with positions designated for the termination of wiring shields.

Input-to-Bus isolation is a robust 1500Vrms and each individual channel is protected up to 240Vrms continuous overload in the case of inadvertent wiring errors. Overloaded channels do not adversely affect other channels in the module which preserves data integrity.

For details on installation, configuration, and system operation, refer to the manuals and software available for download from www.dataforth.com. This includes, but is not limited to:

MA1036 MAQ®20 Quick Start Guide

MA1040 MAQ®20 Communications Module Hardware User Manual

MA1041 MAQ®20 milliVolt, Volt, and Current Input Module Hardware User Manual

MA1037 MAQ®20 Configuration Software Tool User Manual

MA1038 MAQ®20 ReDAQ Shape for MAQ®20 User Manual

MAQ20-940 ReDAQ Shape Software for MAQ®20 – Developer Version

MAQ20-941 ReDAQ Shape Software for MAQ®20 – User Version

MAQ20-945 MAQ®20 Configuration Software Tool

MAQ20-952 IPEMotion Software for MAQ®20

3.0 Specifications

ANALOG INPUT MODULE Typical at T_A = +25°C and +24V system power

Model Number, Sensor Type & Input Range	
MAQ20-ISOMV1	0 to +100mV, ±100mV (default)
MAQ20-ISOV1	0 to +1V, ±1V (default)
MAQ20-ISOV2	0 to +10V, ±10V (default)
MAQ20-ISOV3	0 to +20V, ±20V (default)
MAQ20-ISOV4	0 to +40V, ±40V (default)
MAQ20-ISOV5	0 to +60V, ±60V (default)
MAQ20-ISOI1	0-20mA (default), 4-20mA, ±20mA
Per Channel Setup	Individually configurable for range, alarms, averaging, burst scan
Input Protection	
Continuous	240Vrms max
Transient	ANSI/IEEE C37.90.1
CMV	
Channel-to-Bus	1500Vrms, 1 min
Channel-to-Channel	300Vrms, 425VDC
Transient	ANSI/IEEE C37.90.1
CMR	100dB @ 50/60 Hz
NMR	20dB/decade
Accuracy(1)	±0.035% span
Linearity / Conformity	±0.02% span
Resolution	0.0015% span
Stability	
Zero	15ppm/C
Span	35ppm/C
Bandwidth	1kHz
Scan Rate(2)	
Module Poll Rate (Channel Data from Module Memory)	6ms/Poll & 8-Ch/Poll, 167S/s per Channel, 1333 S/s Total
Burst Poll Rate (Internal Scan to Module Memory)	5kS/s per channel
Alarms	High / High-High / Low / Low-Low
Open Input Response (mV Input Only)	Upscale
Detection Time	<5s
Power Supply Current	270mA
Dimensions (h)(w)(d)	4.51" x 0.60" x 3.26" (114.6mm x 15.3mm x 82.8mm)
Environmental	
Operating Temperature	-40°C to +85°C
Storage Temperature	-40°C to +85°C
Relative Humidity	0 to 95%, non-condensing
Emissions, EN61000-6-4	ISM Group 1
Radiated, Conducted	Class A
Immunity EN61000-6-2	ISM Group 1
RF	Performance A +/- 0.5% Span Error
ESD, EFT	Performance B
Certifications	Heavy Industrial CE
	UL/cUL (Class I, Div 2, Groups A, B, C, D) file E232858
	ATEX Pending

(1) Includes linearity/conformity, hysteresis and repeatability.
(2) See *Channel Scan Rate, System Throughput & Module Mux*

4.0 Unpacking

Each MAQ20 Data Acquisition System component is shipped in electro-static discharge (ESD) protective packaging. Use appropriate ESD protection measures while unpacking. Check visually for physical damage. If physical damage is noted, file a claim with the shipping carrier and contact the factory.

5.0 Module Dimensions and Input Connections

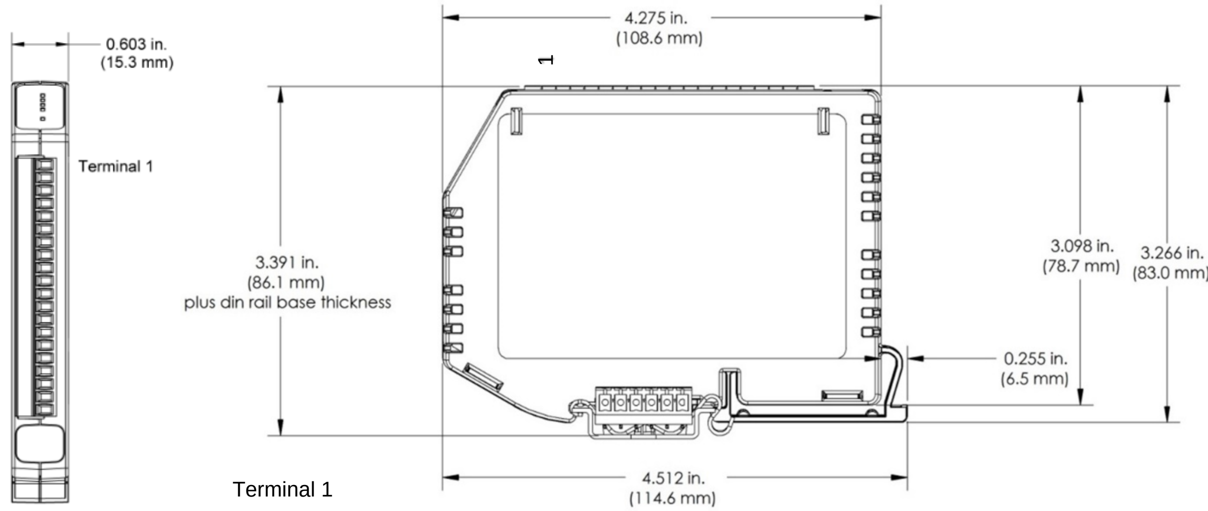


Figure 1: Module Dimensions

Table 1: Millivolt, Volt & Milliamp Input Module Input Terminal Block Connections

TERMINAL BLOCK POSITION (TOP TO BOTTOM)	MAQ20-ISOMV INPUT CONNECTIONS	MAQ20-ISOVx INPUT CONNECTIONS	MAQ20-ISOI INPUT CONNECTIONS
1	CH0 +IN	CH0 +IN	CH0 +IN
2	CH0 -IN	CH0 -IN	CH0 -IN
3	SHIELD	SHIELD	SHIELD
4	CH1 +IN	CH1 +IN	CH1 +IN
5	CH1 -IN	CH1 -IN	CH1 -IN
6	CH2 +IN	CH2 +IN	CH2 +IN
7	CH2 -IN	CH2 -IN	CH2 -IN
8	SHIELD	SHIELD	SHIELD
9	CH3 +IN	CH3 +IN	CH3 +IN
10	CH3 -IN	CH3 -IN	CH3 -IN
11	CH4 +IN	CH4 +IN	CH4 +IN
12	CH4 -IN	CH4 -IN	CH4 -IN
13	SHIELD	SHIELD	SHIELD
14	CH5 +IN	CH5 +IN	CH5 +IN
15	CH5 -IN	CH5 -IN	CH5 -IN
16	CH6 +IN	CH6 +IN	CH6 +IN
17	CH6 -IN	CH6 -IN	CH6 -IN
18	SHIELD	SHIELD	SHIELD
19	CH7 +IN	CH7 +IN	CH7 +IN
20	CH7 -IN	CH7 -IN	CH7 -IN

The terminal blocks can accept the following wire sizes:

Solid Wire	AWG 26 to AWG 16
Stranded Wire	AWG 26 to AWG 16

6.0 Module Installation and Removal

The MAQ20 I/O module package has been designed for easy insertion into and removal from a system and can mate with DIN rails mounted flush on continuous panels or plates.

To install a module:

1. Orient the module with the field connector facing away from the DIN rail.
2. Align the angled surface on the top rear corner with panel or plate the DIN rail is mounted to.
3. Slide the module down to capture the DIN rail with the hook on the module.
4. Rotate the module and snap in place.

To remove a module, reverse the steps in the installation process. If space is available, the clip at the bottom of the module can be squeezed by hand to release. For tight installations, insert a flat blade screwdriver into the recess in the clip (5), place the shaft of the screwdriver against the curved part of the clip and gently pry the clip to release (6) as shown below.

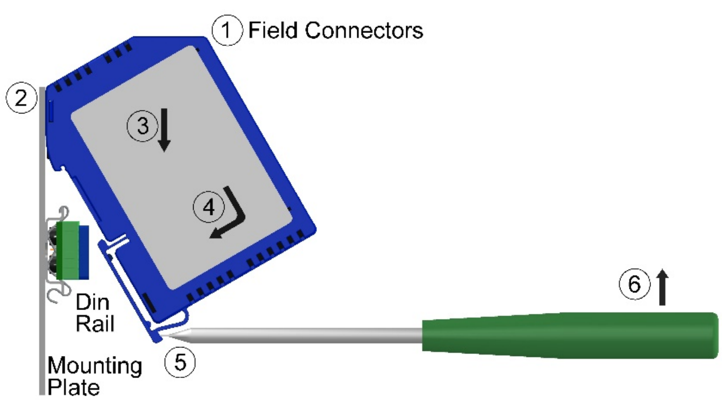


Figure 2: Module Installation and Removal

Multiple rows of MAQ20 modules can be mounted at a 3U vertical spacing interval. Backbones can be combined to add I/O modules to a system. A system is only allowed to have one MAQ20-COMx module. Some possible configurations in a 19" rack are shown in below.

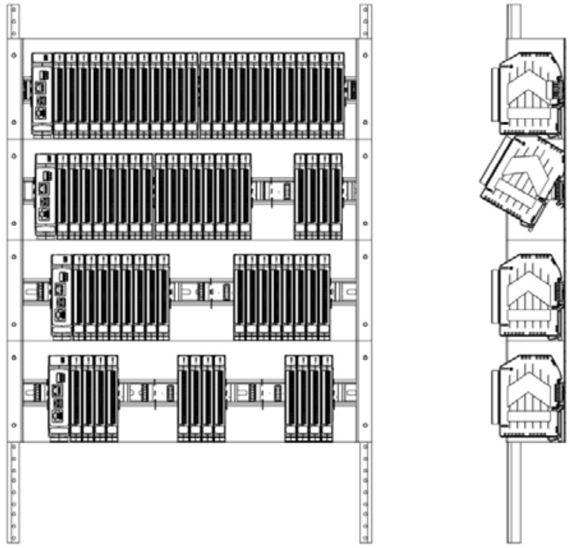


Figure 3: Possible System Configurations

7.0 LED Indicators

A set of 5 LEDs on the top panel of the MAQ20 I/O modules indicate module power, operation, communication, and alarm status.

Figure 4: LED Indicators

LED Function and Troubleshooting Tips:

PWR

Normal operation: BLUE, solid lit

LED Off: Abnormal power situation

- Verify that a MAQ20-COMx is present in the system.
- Verify that the MAQ20-COMx module has 7-34VDC power connected and turned on.
- Determine if the module is communicating by observing the TX and RX LEDs.

STAT

Normal operation: GREEN, 1 Hz blinking

Module Detect: A write to the Module Detect Register will force this LED to blink at 5Hz rate for 5 seconds so the module location in a system can be visually identified. Referring to the Address Map, this module register is at address 98, offset from the module base address.

LED Constant On or Constant Off: Abnormal operation

- Remove and reinstall module to force a reset.
- Remove and reinstall module into another backbone position.
- Determine if the module is communicating by observing the TX and RX LEDs

RX, TX

Normal Operation – YELLOW, rapid blinking during communication with MAQ20-COMx module

LED Constant Off: Abnormal operation or no communications to MAQ20-COMx module

- Verify communications by sending a request for data. Note that the fast communications rate used on the system backbone will result in the LED appearing dim due to short blinking cycle.
- Verify that the PWR and STAT LED indicate normal operation.
- Verify that there is only one MAQ20-COMx module installed in the system.

ALM

Normal operation: Off

Alarm Condition Detected: RED, solid lit.

- One or more alarms have been tripped.
- Read module Alarm Registers based on Alarm Configuration to determine system status.

The following troubleshooting tips can be used to further diagnose and fix system problems:

- Remove and reinstall MAQ20 I/O module and/or MAQ20-COMx module to verify proper insertion into Backbone.
- Remove and reinstall MAQ20 I/O module into another backbone position.
- If a Backbone extension cable is used, ensure that the connections are made correctly.

8.0 Module Identification and Status Registers

Module identification including model number, serial number, date code and firmware revision are stored in module registers starting at address 0.

I/O modules in a system are identified in general by their model number (MAQ20-ISOV2, MAQ20-KTC, etc.) and uniquely by their Serial Number printed on the side label (1234567-89). When I/O modules are installed in the system, only a general identifier is visible on the front of the module (ISOV, TC, etc.). Wire tags or additional labeling applied to the module terminal block may be used for visible unique identification in an installed system. Additionally, the system has a utility to provide a visual indication of module response for identification. Any write to address 98 plus the offset based on the Registration Number will blink the STATUS LED on the top angled surface of the module at a 5Hz rate for 5 seconds.

The MAQ20-ISOMV, MAQ20-ISOVx & MAQ20-ISOI Address Map is found at the end of this manual. An excerpt from the Address Map is shown below. Module identification is stored starting at module register address 0, which is system register address 2000*R+100, where R is the module Registration Number. Refer to the MAQ20 I/O Module Registration section for further details.

Table 2: MAQ20-ISOMV, MAQ20-ISOV, & MAQ20-ISOI Address Map Excerpt – Module Information

Address Range 0 - 99: Module Information						
Start Address	**Read/ Write**	**Number of Registers**	**Contents**	**Description**	**Data Range**	**Data type**
0	R	15	Device Description	MAQ20-ISOMV1 MAQ20-ISOV1 MAQ20-ISOV2 MAQ20-ISOV3 MAQ20-ISOV4 MAQ20-ISOV5 MAQ20-ISOI1	Characters, Numbers, "-" and Space	ASCII
19	R	11	Serial Number	S1234567-89	Characters, Numbers, "-" and Space	ASCII
30	R	5	Date Code	D0622 (D<month><year>)	Characters, Numbers	ASCII
35	R	5	Firmware Rev	Fx.xx	Characters, Numbers and "."	ASCII
40	R	1	Input Channels	8 Input Channels	8	ASCII
41	R	1	Output Channels	0 Output Channels	0	ASCII

For troubleshooting purposes, reset status, communications errors, and invalid data written to a module are monitored and made available to the user. Module diagnostic registers starting at module register address 1900 hold this information.

Table 3: MAQ20-ISOMV, MAQ20-ISOVx, & MAQ20-ISOI Address Map Excerpt – Status Registers

Address Range 1900 - 1999 : Status Registers						
Start Address	**Read/ Write**	**Number of Registers**	**Contents**	**Description**	**Data Range**	**Data type**
1900	R/W	1	Watchdog Flag	1 = Watchdog Reset, 0 = Normal	0 or 1	INT16
1901	R/W	1	Brownout Flag	1 = Brownout Reset, 0 = Normal	0 or 1	INT16
1906	R/W	1	Numeric Error	Increments when a value received is outside of the allowed range	0 to 65,535	INT16
1908	R/W	1	UART RX Error	UART RX Error Counter Command Too Short	0 to 65,535	INT16
1909	R/W	1	UART RX Error	UART RX Error Counter Command Too Long	0 to 65,535	INT16
1910	R/W	1	UART RX Error	UART RX Error Counter Command received in invalid state	0 to 65,535	INT16

9.0 Building a System

An automated I/O module registration process reduces system setup to three basic steps:

STANDARD SETUP PROCESS

1.) Install a MAQ20-BKPLx backbone in a DIN rail then insert a MAQ20-COMx module in the left-most position and apply power.

2.) Install any MAQ20 I/O Module in any vacant local or remote backbone position. Observe that the green Power LED is on, and communications activity is seen on the TX and RX LEDs. Allow 1 second for registration. This module has now been assigned Registration Number 1.

    Label and connect field wiring to the I/O Module. If desired, record module physical position in the system.

3.) Repeat Step 2 for all remaining MAQ20 I/O modules in the system. Subsequent modules installed are assigned Registration Number 2, 3, etc., allowing 1 second for registration. The Registration Number sequence matches the physical sequence of module installation.

ALTERNATE SETUP PROCESS

1.) Do not apply power. Install a MAQ20-BKPLx backbone in a DIN rail then insert a MAQ20-COMx module in the left-most position and install all required MAQ20 I/O modules in any vacant local or remote backbone position. Label and connect field wiring to the I/O Module and if desired record physical position in the system.

2.) Apply system power and observe that each module has the green Power LED on and communications activity is seen on the TX and RX LEDs. Registration is complete when module TX and RX LEDs all have a repeating blink pattern. All modules have now been assigned Registration Numbers, but in a random sequence not associated with the physical position on the backbone.

NOTES:

Once the registration process is complete, Registration Numbers are permanent as long as I/O modules are not removed from or added to a system. When system power is cycled or the system is reset, I/O module Registration Numbers will always remain the same. If I/O modules are removed while the system is powered, they will be unregistered, and the slots or registration numbers become available to register new modules once inserted. If I/O modules are removed while the system is powered and then the power is cycled, the remaining modules will remain registered with their originally assigned Registration Numbers.

I/O modules in a system are identified in general by their model number (MAQ20-RTD31, MAQ20-VDN, etc.) and uniquely by their Serial Number printed on the side label (i.e. 1234567-89). When I/O modules are installed in the system, only a general identifier is visible on the front of the module (RTD, V, TC, etc.). Wire tags or additional labeling applied to the module terminal block may be used for visible unique identification in an installed system.

MAQ20-940 ReDAQ Shape Software for MAQ20 automatically assigns tag names to each input and output channel. These can be changed by the customer to associate channels with input wiring or parameters measured and controlled.

The system does not identify I/O modules by physical position on a backbone, only by registration sequence. MAQ20-940 ReDAQ Shape Software for MAQ20 provided by Dataforth shows a graphical representation of a system based on registration sequence and not by physical position. Tools within the software package allow the user to reassign and save Registration Numbers thereby making graphical representations match physical location for a single, local backbone and retain permanence. Refer to the *MAQ20 I/O Module Registration* section for further details.

Module Detect: A write to the Module Detect register at I/O module register address 98 plus the module offset based on Registration Number will blink the STAT LED on the top angled surface of the module at a 5Hz rate for 5 seconds so the module location in a system can be visually identified.

10.0 Maintaining a System

The MAQ20-COMx Communications Module periodically scans the system and will detect if a MAQ20 I/O module has been removed from the system or has lost communications. When this happens the module Registration Number will be released and available for reassignment.

Standard system maintenance involves a simple three step process:

STANDARD MAINTENANCE PROCESS

1.) Turn system power on and observe communications activity on the I/O modules.

2.) **CASE 1:** I/O module is replaced with one having a different model number or serial number: Remove a single MAQ20 I/O module from any local or remote backbone position. Replace the module with another having a different model number. This module can be installed in any vacant local or remote backbone position. Observe that the green Power LED is on and that there is communications activity on the TX and RX LEDs. Allow 1 second for registration. **This module now has the same Registration Number as the one removed.**

   CASE 2: I/O module is suspected faulty and is to be replaced with the same model number: Remove a single MAQ20 I/O module from any local or remote backbone position. Replace the module with another of the same model number. This module can be installed in any vacant local or remote backbone position. Observe that the green Power LED is on and communications activity is seen on the TX and RX LEDs. Allow 1 second for registration. **This module now has the same Registration Number as the one removed.**

   Label and connect input/output wiring to the I/O module and if desired record physical position in the system.

3.) Repeat Step 2 for any remaining MAQ20 I/O modules in the system requiring maintenance.

ALTERNATE MAINTENANCE PROCESS

1.) With system power off, remove any I/O modules which are to be replaced. Replace the modules with others of the same or different model numbers. Modules can be installed in any vacant local or remote backbone position.

   Label and connect input/output wiring to the I/O module and if desired record physical position in the system.

2.) Apply system power and observe that each module has the green Power LED on and communications activity is seen on the TX and RX LEDs. Registration is complete when module TX and RX LEDs all have a repeating blink pattern. Replaced modules have now been assigned the Registration Numbers of those removed, but in a random sequence not associated with the physical position on the backbone. Modules which were not replaced retain their assigned Registration Numbers.

NOTES:

Once the registration process is complete, Registration Numbers are permanent as long as I/O modules are not removed from or added to a system. When system power is cycled or the system is reset, I/O module Registration Numbers will always remain the same. Tools within MAQ20-940 ReDAQ Shape Software for MAQ20 allow the user to reassign and save Registration Numbers. Refer to the MAQ20 I/O Module Registration section for further details.

Module Detect: A write to the Module Detect register at I/O module register address 98 plus the module offset based on Registration Number will blink the STAT LED on the top angled surface of the module at a 5Hz rate for 5 seconds so the module location in a system can be visually identified.

11.0 Expanding a System

The MAQ20-COMx Communications Module periodically scans the system and will detect if a MAQ20 I/O module has been added. When this happens the next available sequential Registration Number is assigned to the module.

Standard system expansion involves a simple three step process:

STANDARD EXPANSION PROCESS

1.) Turn system power on and observe communications activity on the I/O modules.

2.) Add a single MAQ20 I/O module in any local or remote backbone position. Observe that the green Power LED is on and communications activity is seen on the TX and RX LEDs. Allow 1 second for registration. This module has now been assigned the next available sequential Registration Number.

   Label and connect input/output wiring to the I/O module and if desired record physical position in the system.

3.) Repeat Step 2 for all remaining MAQ20 I/O modules to be added to the system. Subsequent modules installed are assigned the next sequential Registration Number.

ALTERNATE EXPANSION PROCESS

1.) With system power off, install all additional MAQ20 I/O modules in any vacant local or remote backbone positions. Label and connect field wiring to the I/O module and if desired record physical position in the system. Do not apply power.

2.) Apply system power and observe that each module has the green Power LED on and communications activity is seen on the TX and RX LEDs. Registration is complete when module TX and RX LEDs all have a repeating blink pattern. Added modules have now been assigned the next available sequential Registration Numbers, but in a random sequence not associated with the physical position on the backbone. Modules previously installed and registered in the system retain their assigned Registration Numbers.

NOTES:

Once the registration process is complete Registration Numbers are permanent as long as I/O modules are not removed from or added to a system. When system power is cycled or the system is reset, I/O module Registration Numbers will always remain the same. If I/O modules are removed while the system is powered, they will be unregistered, and the slots or registration numbers become available to register modules once inserted. If I/O modules are removed while the system is powered and then the power is cycled, the remaining modules will remain registered with their assigned Registration Numbers. Tools within MAQ20-940 ReDAQ Shape Software for MAQ20 allow the user to reassign and save Registration Numbers. Refer to the MAQ20 I/O Module Registration section for further details.

Module Detect: A write to the Module Detect register at I/O module register address 98 plus the module offset based on Registration Number will blink the STAT LED on the top angled surface of the module at a 5Hz rate for 5 seconds so the module location in a system can be visually identified.

12.0 MAQ20 I/O Module Registration and Reading Input Signals

The MAQ20 Data Acquisition System uses an automated registration process which periodically scans the system and will detect when MAQ20 I/O modules are added and removed. Modules are assigned a sequential Registration Number based on the order in which they are detected. This order can be forced to occur in a given sequence by adding modules one at a time or it can be allowed to happen randomly. Refer to the *Building a System*, *Maintaining a System*, and *Expanding a System* sections of this manual.

The system does not identify I/O modules by physical position on a backbone, only by registration sequence. MAQ20-940 ReDAQ Shape Software for MAQ20 provided by Dataforth shows a graphical representation of a system based on registration sequence and not by physical position.

Tools within the software package allow the user to reassign Registration Numbers thereby making graphical representations match physical location for a single, local backbone.

Module Detect: A write to the Module Detect register at I/O module register address 98 plus the module offset based on Registration Number will blink the STAT LED on the top angled surface of the module at a 5Hz rate for 5 seconds so the module location in a system can be visually identified.

Each module is assigned an address space of 2000 addresses based on the Registration Number and starting at address 2000. I/O module with Registration Number 1 is assigned address space 2000 – 3999, I/O module with Registration Number 2 is assigned address space 4000 – 5999 and so on. The starting address for the module is very important because this is the offset address that must be added to the addresses listed in the I/O module register address map to know where data for that module is located within the system level address map. The MAQ20-COMx Communication Module is always assigned a Registration Number of 0 and cannot be re-sequenced.

Table 4: MAQ20 System Register Address Range & Module Register Address Range

Registration Number	System Register Address Range	Module Register Address Range	Register Address Offset
0	0 to 1999	0 to 1999	0
1	2000 to 3999	0 to 1999	2000
2	4000 to 5999	0 to 1999	4000
3	6000 to 7999	0 to 1999	6000
…	…	…	…
24	48000 to 49999	0 to 1999	24000

The automated registration process can be disabled, and I/O modules can be registered using a manual process if required by an application. Refer to the MAQ20 I/O Module Registration section of the *MA1040 MAQ20 Communications Module Hardware User Manual* for details.

The standard mode of operation is called Continuous Scan Mode. All channels are enabled, and input readings are taken by sending a read request command to the module. In Burst Scan Mode, channels can be selectively enabled.

The MAQ20-ISOMV, MAQ20-ISOVx & MAQ20-ISOI Address Map is found at the end of this manual. An excerpt from the Address Map is shown below. Channel Data is stored starting at module register address 1000, which is system register address 2000*R+1000, where R is the module Registration Number. Refer to the *MAQ20 I/O Module Registration* section for further details.

Table 5: MAQ20-ISOMV, MAQ20-ISOVx, & MAQ20-ISOI Address Map Excerpt – Module Data

Address Range 1000 - 1699: Module Data						
Start Address	**Read/ Write**	**Number of Registers**	**Contents**	**Description**	**Data Range**	**Data type**
1000	R	8	Channel Data	Data for each of 8 Channels	-32,768 to 32,767	INT16

Example: A MAQ20-ISOV2 module with serial number 1234567-89 is installed in a system and has been assigned a Registration Number of 6. Read Current Data from Channels 0-7.

The MAQ20-ISOV2 module with s/n 1234567-89 has an address offset of 2000*6 = 12000

Read from register addresses 12000+1000 to 1007 = 13000 to 13007 the Current Data from Channels 0-7

The MAQ20-940 ReDAQ Shape Software for MAQ20 has a utility which allows the user to reassign Registration Numbers to I/O Modules in a system. This can be used to rearrange the way I/O modules are displayed in the software if the Alternate Registration Processes have been used instead of the Standard Registration Processes. Refer to the Building a System, Maintaining a System, and Expanding a System sections for further details.

ReDAQ Shape Software for MAQ20 presents a graphical representation of the system on the Acquire panel as shown in Figure 9. I/O modules are displayed sequentially left to right in the order they were registered. The display does not represent physical position and will not show physical vacant positions between I/O modules. The system graphic shows a 24-position backbone regardless of the backbone or combination of backbones used in a system.

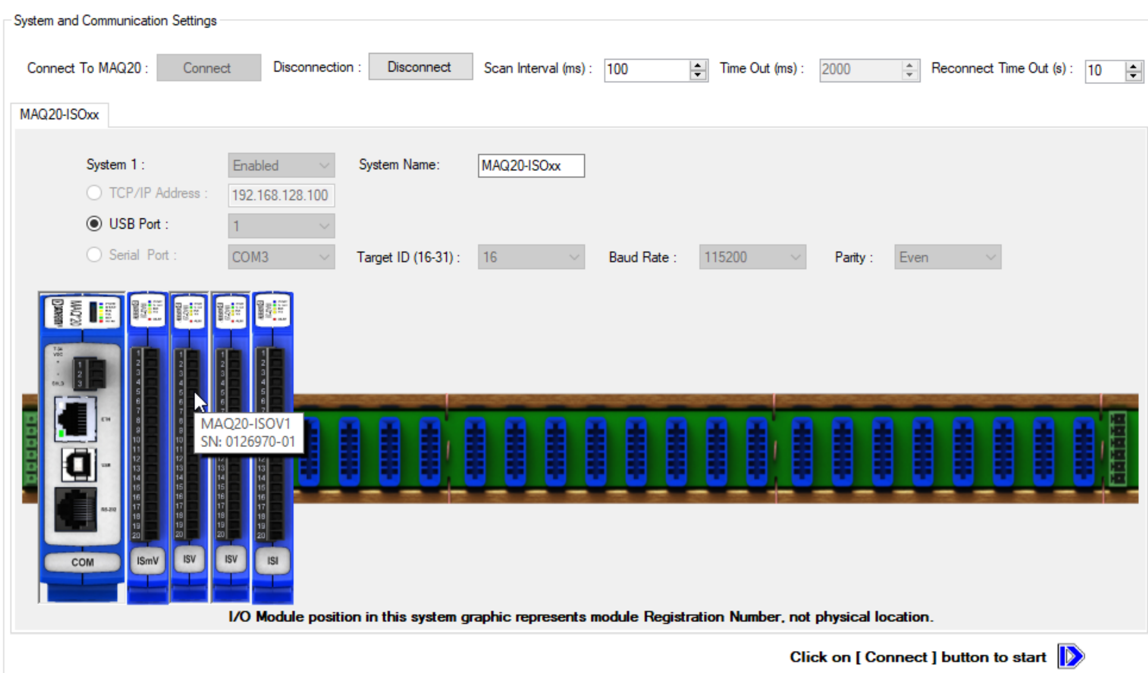


Figure 5: MAQ20-940 ReDAQ Shape for MAQ20 Main Configuration Screen with Graphical System Representation

To view the registration sequence, double-click on the MAQ20-COMx graphic to obtain the system panel shown in Figure 6.

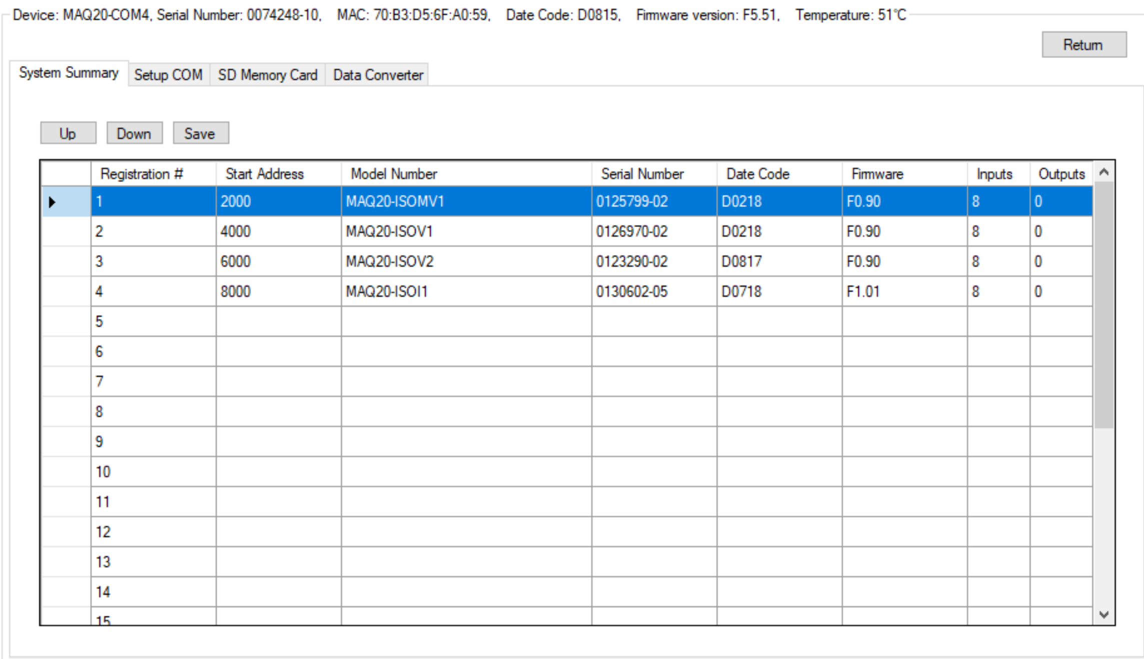


Figure 6: Module Registration using MAQ20-940 ReDAQ Shape for MAQ20

Registration Numbers listed in the left column refer to the position where the software has registered the I/O module. Registration Number will not necessarily be the same as the physical position of the module in the system. To change the Registration Number of an I/O module, click the box in the left column next to the Registration Number, then use the Up and Down buttons to move the module within the sequence. The system automatically reassigns the I/O modules above and below the one moved. Repeat for other modules if desired. The MAQ20-COMx module always has Registration Number 0 and cannot be moved. Press 'Save' to save the new configuration. The new registration sequence is permanent across power cycles and any other system configuration if I/O modules are not removed from or added to a system.

13.0 Range Selection, Channel Enable & Reading Signals

The MAQ20-ISOMV, MAQ20-ISOVx and MAQ20-ISI modules have two user selectable input ranges. Input ranges are selectable on a per-channel basis. Over-range and Under-range up to 10% beyond the standard input values will be measured. The published accuracy is guaranteed over the standard input ranges. The Range Table following the Address Map for each module at the end of this manual shows the input ranges for each module and the input to counts mapping. The Range Table is shown below for reference.

Table 6: MAQ20-ISOMV, MAQ20-ISOVx, & MAQ20-ISOI Input Ranges

	Range	Input	Equivalent Counts	Over/Under Range	Equivalent Counts
MAQ20-ISOMV1	0	-100mV to +100mV (Default)	-28671 to 28671	-110mV to +110mV	-31538 to 31538
	1	0V to +100mV	0 to 28671	-10mV to +110mV	-2867 to 31538
MAQ20-ISOV1	0	-1V to +1V (Default)	-28671 to 28671	-1.1V to +1.1V	-31538 to 31538
	1	0V to +1V	0 to 28671	-0.1V to +1.1V	-2867 to 31538
MAQ20-ISOV2	0	-10V to +10V (Default)	-28671 to 28671	-11V to +11V	-31538 to 31538
	1	0V to +10V	0 to 28671	-1V to +11V	-2867 to 31538
MAQ20-ISOV3	0	-20V to +20V (Default)	-28671 to 28671	-22V to +22V	-31538 to 31538
	1	0V to +20V	0 to 28671	-2V to +22V	-2867 to 31538
MAQ20-ISOV4	0	-40V to +40V (Default)	-28671 to 28671	-44V to +44V	-31538 to 31538
	1	0V to +40V	0 to 28671	-4V to +44V	-2867 to 31538
MAQ20-ISOV5	0	-60V to +60V (Default)	-28671 to 28671	-66V to +66V	-31538 to 31538
	1	0V to +60V	0 to 28671	-6V to +66V	-2867 to 31538
MAQ20-ISOI1	0	0mA to 20mA (Default)	0 to 28671	-2mA to +22mA	-2867 to 31538
	1	4mA to 20mA	5734 to 28671	2mA to 22mA	2867 to 31538
	2	-20mA to +20mA	-28671 to 28671	-22mA to +22mA	-31538 to 31538

The MAQ20-ISOMV, MAQ20-ISOVx & MAQ20-ISOI Address Map is found at the end of this manual. An excerpt from the Address Map is shown below. Input Range is stored starting at module register address 0, which is system register address 2000*R+100, where R is the module Registration Number. Refer to the *MAQ20 I/O Module Registration* section for further details.

Table 7: MAQ20-ISOMV, MAQ20-ISOVx, & MAQ20-ISOI Address Map Excerpt – Module Configuration

Address Range 100 - 699: Module Configuration						
Start Address	**Read/ Write**	**Number of Registers**	**Contents**	**Description**	**Data Range**	**Data type**
100	R/W	8	Input Range	Range for each of 8 channels	0 to 2	INT16

Table 8: MAQ20-ISOMV, MAQ20-ISOVx, & MAQ20-ISOI Address Map Excerpt – Module Data

Address Range 1000 - 1699: Module Data						
Start Address	**Read/ Write**	**Number of Registers**	**Contents**	**Description**	**Data Range**	**Data type**
1000	R	8	Channel Data	Data for each of 8 Channels	-32,768 to 32,767	INT16

To change the input range, write the appropriate range code to Address 1000+2000*R.

Once a range selection is made it can be saved to EEPROM by writing a 0 to register 119. Standard Reset does not affect the setting in volatile memory. Reset-to-Default will clear the setting in volatile memory and reset the ranges to the default values. Settings stored to EEPROM are not affected by Standard Reset or Reset-to-Default. Module power cycle will restore range settings from EEPROM.

Example: A MAQ20-ISOV2 module with serial number 1234567-89 is installed in a system and has been assigned a Registration Number of 2. Set channels 0 and 1 to measure ±10V, channels 4 and 5 to measure 0 to +10V. Obtain the current readings in counts and convert these to Engineering units.

The MAQ20-ISOV2 module with s/n 1234567-89 has an address offset of 2000*2 = 4000

The Range Table shows that Range 0 is ±10V and Range 1 is 0V to +10V. Range information is also stored in registers at Addresses 1700 – 1800 for user read back if desired.

1.) Write to register address 4000+100 = 4100 a data value of 0 to set Ch 0 input range to ±10V
2.) Write to register address 4000+101 = 4101 a data value of 0 to set Ch 1 input range to ±10V
3.) Write to register address 4000+104 = 4104 a data value of 1 to set Ch 4 input range to 0V to +10V
4.) Write to register address 4000+105 = 4105 a data value of 1 to set Ch 5 input range to 0V to +10V

5.) Read from register address 4000+1000 = 5000 the data from Channel 0

6.) Read from register address 4000+1001 = 5001 the data from Channel 1

7.) Read from register address 4000+1004 = 5004 the data from Channel 4

8.) Read from register address 4000+1005 = 5005 the data from Channel 5

If the data read from Channel 0 is -14336 counts and the data read from Channel 4 is 21503 counts, the input signals are:

Ch 0: -14336 counts * (10V - -10V) /(28671 counts - -28671 counts) = -5.000V
Ch 4: 21503 counts * (10V - 0V) /(28671 counts - 0 counts) = 2.500V

14.0 Channel Scan Rate & System Throughput

MAQ20-ISOxx modules have eight isolated analog-to-digital converters which continuously scan the input channels and store the data in local memory. As new data is acquired, previous sampled data is continuously overwritten such that local memory always has the most recent data. Sample rate is fixed at 5kS/s. When a channel data read command is received, data for all channels is retrieved from local memory and returned in a single response. A standard command-response cycle takes 6ms. Channel scan rate at the system level depends on the number of MAQ20 I/O modules installed in a system. As more modules are added to a system, each is scanned sequentially, therefore the scan rate for an individual module and for the channels within that module decreases.

The following calculation is used to determine channel scan rate for each of the 8 input channels in a MAQ20-ISOxx input module operating in a system of modules.

Command-response cycle = 6ms

Module Scan Rate = Number of MAQ20 I/O modules in a system/6ms Scans/s

During each command/response cycle, 8 channels of data are acquired. The net scan rate is then:

Net Scan Rate = Module Scan Rate * Number of channels

Example: Determine the MAQ20-ISOV2 per channel scan rate for the following system:
MAQ20-COM4
MAQ20-ISOV2

The scan rate for each of the input channels is the same as the scan rate for the module in the system:

Scan Rate, Channels 0 through 7 = 1/6ms = 167 Scans/s = 167Hz

During each command/response cycle, 8 channels of data are acquired. The net scan rate is then:

Net Scan Rate = 167Hz * 8 channels = 1333 Ch/s

Example: Determine the MAQ20-ISOV1 per channel scan rate for the following system:

MAQ20-COM4	
MAQ20-ISOV1	*(8 channels)*
MAQ20-ISOV2	*(8 channels)*
MAQ20-VDN	*(8 channels)*
MAQ20-ISOI1	*(8 channels)*
MAQ20-ISOMV1	*(8 channels)*

The scan rate for each of the input channels is the same as the scan rate for the module in the system:

Scan Rate, Channels 0 through 7 = 1/(6ms * 5 modules) = 33 Scans/s = 33 Hz

During each system command/response cycle, 8 channels of data are acquired from the MAQ20-ISOV1 module. The net scan rate is then:

Net Scan Rate, MAQ20-ISOV1 = 33 Hz * 8 channels = 264 Ch/s
Net Scan Rate, entire system = 33 Hz * (8+8+8+8+8) channels = 1320 Ch/s

15.0 Burst Scan Mode

MAQ20-ISOxx modules have a dedicated data converter on each isolated channel, enabling input signal sampling of up to 5kS/s per channel. Burst Scan Mode stores all samples acquired in internal volatile memory. Data is then transferred to the host computer in a separate operation. All stored burst scan data is erased upon power cycle or reset,

Burst Scan Mode user settable parameters are Burst Enable per channel, Burst Size (Number of Samples), and Burst Scan Rate. Burst Read, Burst Status and Burst Index are used for data transfer operations.

The MAQ20-ISOMV, MAQ20-ISOVx & MAQ20-ISOI Address Map is found at the end of this manual. An excerpt from the Address Map is shown below. Burst Scan Mode settings are stored starting at module register address 660, which is system register address 2000*R+ 660, where R is the module Registration Number. Refer to the MAQ20 I/O Module Registration section for further details on Registration Number.

Address Range 100 - 699: Module Configuration						
Start Address	**Read/ Write**	**Number of Registers**	**Contents**	**Description**	**Data Range**	**Data type**
660	R/W	8	Burst Scan Channel Enable	Burst Scan Mode Channel Enable. 0 = Disable 1 = Enable Default = 0.	0 or 1	INT16
670	R/W	1	Burst Scan Size MSB (4,000,000 max)	Size of burst scan to capture, MSB. Number of samples per channel * number of channels. Default = 0.	0 to 61	INT16
671	R/W	1	Burst Scan Size LSB (4,000,000 max)	Size of burst scan to capture, LSB. Number of samples per channel * number of channels. Default = 0.	0 to 65,535	INT16
672	W	1	Save Burst Scan Parameters to Memory	Save Burst Scan Mode Parameters to Module Memory. Write 1 to save.	1	INT16
675	R/W	2	Burst Scan Rate	Scan Rate in microseconds (us). MSB = 675, LSB = 676	0 to 65,535	INT16

Address Range 1000 - 1699: Module Data						
Start Address	**Read/ Write**	**Number of Registers**	**Contents**	**Description**	**Data Range**	**Data type**
1200	W	1	Burst Enable	1 = Enable 0 = Disable	0 or 1	INT16
1201	R	100	Burst Read	Read burst samples in a block of 1 to 100	1 to 100	INT16
1202	R	1	Burst Status	1 = Burst Ongoing 0 = Burst Complete or Inactive	0 or 1	INT16
1203	R/W	2	Burst Read Index	Returns the index of the next Burst Sample MSB = 1203, LSB = 1204	1 to 4000000	INT16

To configure burst scan mode, write to module register addresses 660 to 675. Note that these addresses are offset by 2000*R. Once burst scan settings are made, they can be saved to local memory by writing a 1 to module register 672.

Retrieve burst scan data by reading the data stored in module memory starting at module register address 1201. Data is read in blocks from 1 to 100 samples. A block size of 80 is recommended for optimal system and module internal data processing. During data retrieval, module register address 1202 can be polled to check if a burst capture is active. A user application should keep track of the amount of data retrieved from a module. Comparing this value to the Burst Read Index at module register address 1203 will verify that the quantity of data sent matches the quantity of data received.

If there is a mismatch, write to the Burst Read Index to set the index back and read any missing data.

Burst scan mode channel data stored in the module is circular. If all eight module channels are enabled for burst capture, Channel 0 data will be stored at indices 0, 8, 16…, Channel 1 data at indices 1, 9, 17…, Channel 2 data at indices 2, 10, 18… A user application retrieving data must use this storage sequence to assemble captured data correctly upon retrieval.

Example: A MAQ20-ISOV1 module with serial number 1234567-89 is installed in a system and has been assigned a Registration Number of 2. Set the burst scan rate to 1ms. Configure and run a burst scan of 10,000 samples (10 seconds) on Channel 0 and 10,000 samples (10 seconds) on Channel 1. Retrieve the data from module memory.

The MAQ20-ISOV1 module with s/n 1234567-89 has an address offset of 2000*2 = 4000

1.) Write to system register address 4000+675 = 4675 a data value of 1000 to set the scan rate
2.) Write to system register address 4000+671 = 4671 a data value of 10000 samples * 2 channels = 20000 to set the burst scan size
3.) Write to system register address 4000+660 = 4660 a data value of 1 to enable capture on Channel 0
4.) Write to system register address 4000+661 = 4661 a data value of 1 to enable capture on Channel 1
5.) Write to system register address 4000+1200 = 5200 a data value of 1 to start the burst scan

Monitor system register address 4000+1202 = 5202 during the scan to check status

Wait 10 seconds for the burst scan to complete.

1.) Write to system register address 4000+1107 = 5107 a data value of 0 to initialize the data read counter.
2.) Read from system register address block 4000+1110 to 4000+1210 = 5110 to 5210 the first 100 samples.
3.) Read from system register address 4000+1107 = 5107 a data value of 100 which indicates read success.
4.) Save the samples to a file.
5.) Repeat the block read from 5110 to 5210 a total of 100 times to retrieve the 10000 samples.
6.) After each block is read, append the samples to the saved file.

The consolidated saved data can then be reviewed, plotted, analyzed, and used for any purpose.

The captured data will remain in the MAQ20-BRDG1 module memory and can be retrieved again using the steps above. Data is volatile and will be erased upon module power cycle or reset command.

To capture a new set of data, write a 1 to module register 1100.

To post process the data using the FIR filter function, write a 1 to register 1096.

To post process the data using the V/V Calculation function, write a 1 to register 1097. When V/V Calculation is enabled, data retrieved will be in Float32 format with integer part at register 1xxx and fractional part at register 1xxx+1.

16.0 Alarm Functions

The powerful alarm functions in the MAQ20 Data Acquisition System provide essential monitoring and warnings to ensure optimum process flow and fail-safe applications. Alarms have the following parameters which can be configured:

Alarm Enable

Enables the Alarm on a given channel provided that the Alarm Configuration Register has a valid configuration. Set the bit corresponding to the given channel to a 1 to enable the alarm. If the Alarm Configuration register for the given channel does not have a valid value, the write will be ignored and the Alarm Enable bit will remain 0. Write a 0 to the bit corresponding to the given channel to disable the alarm and clear any alarms that have tripped.

Alarm Configuration

Selects Tracking or Latching alarms for a given channel and selects which limits trip the alarm - High, Low, High-High or Low-Low. There is a register for each channel. The value written to this register is the sum of the codes for the Alarm Type and Alarm Limits. Reference Section 12.0 for the specific codes. If an invalid value is written to this register, the value will be ignored and the last valid value that the register contained will be kept. If a 0 is written to the register, the Alarm Enable register for the channel will be set to 0 and alarms that the channel has tripped will be cleared.

Tracking alarms follow the value of the input signal and reset automatically when the signal comes back into the valid range specified by the limit and deadband. Latching alarms trip when the signal exceeds the alarm condition and remain set until reset by the user.

High Limit

Sets the value for the High limit in counts. Alarm status is stored in a register.

Low Limit

Sets the value for the Low limit in counts. Alarm status is stored in a register.

High Low Deadband

Used for the High and/or Low limits to prevent false tripping or alarm chatter for noisy signals. Deadband is the region less than the High limit or greater than the Low limit, measured in counts, which the signal must traverse through before the alarm is reset after being tripped.

High-High Limit

Sets the value for the High-High limit in counts. Alarm status is stored in a register.

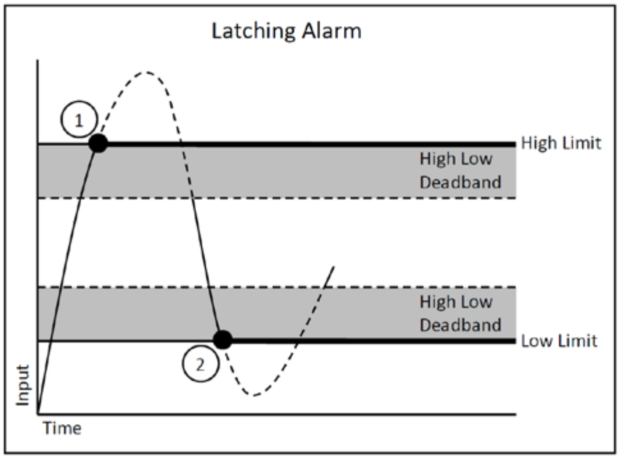
Low-Low Limit

Sets the value for the Low-Low limit in counts. Alarm status is stored in a register.

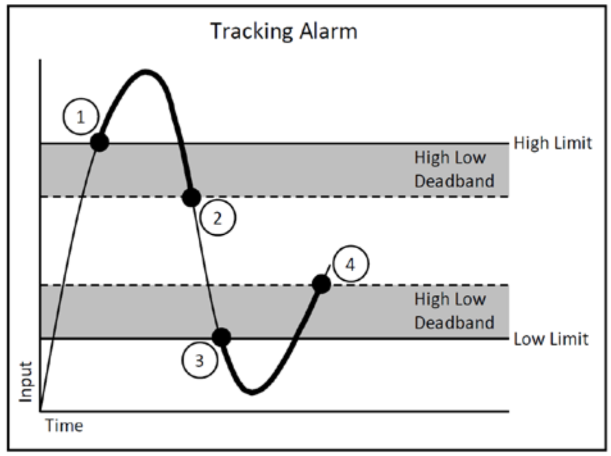
High-High Low-Low Deadband

Used for the High-High and/or Low-Low limits to prevent false tripping or alarm chatter for noisy signals. Deadband is the region less than the High-High limit or greater than the Low-Low limit, measured in counts, which the signal must traverse through before the alarm is reset after being tripped.

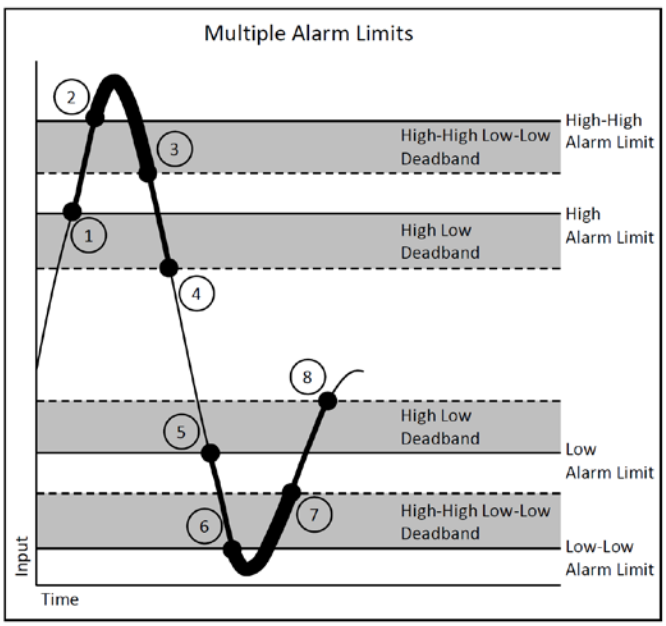
See Figure 6 below for graphical representations of alarm parameters and functionality.



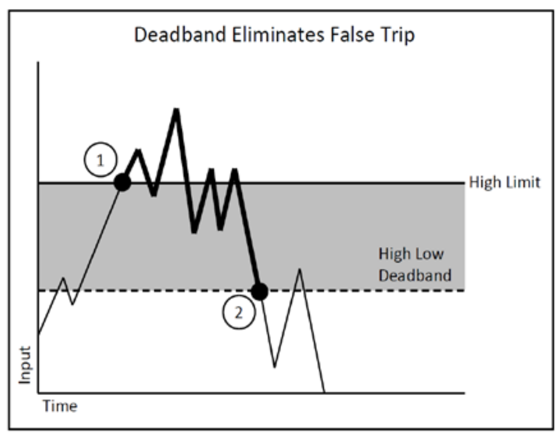
1. High Alarm Tripped
2. Low Alarm Tripped



1. High Alarm Tripped
2. High Alarm Reset
3. Low Alarm Tripped
4. Low Alarm Reset



1. High Alarm Trip
2. High-High Alarm Trip
3. High-High Alarm Reset
4. High Alarm Reset
5. Low Alarm trip
6. Low-Low Alarm Trip
7. Low-Low Alarm Reset
8. Low Alarm Reset



1. High Alarm Trip
2. High Alarm Reset

Figure 6: Alarm Parameters and Functionality

17.0 Setting and Monitoring Alarms

The *MAQ20-ISOMV, MAQ20-ISOVx & MAQ20-ISOI Address Map* is found at the end of this manual. An excerpt from the Address Map is shown below. Alarm Parameters are stored starting at module register address 700, which is system register address 2000*R+700, where R is the module Registration Number. Refer to the *MAQ20 I/O Module Registration* section for further details.

Address Range 700 - 999: Alarm Configuration						
Start Address	**Read/ Write**	**Number of Registers**	**Contents**	**Description**	**Data Range**	**Data type**
700	R/W	1	Alarm Status, Low-Low	Write 0 to the corresponding channel bit to clear a Latched Alarm	0 to 65,535	INT16
701	R/W	1	Alarm Status, Low	Write 0 to the corresponding channel bit to clear a Latched Alarm	0 to 65,535	INT16
702	R/W	1	Alarm Status, High	Write 0 to the corresponding channel bit to clear a Latched Alarm	0 to 65,535	INT16
703	R/W	1	Alarm Status, High-High	Write 0 to the corresponding channel bit to clear a Latched Alarm	0 to 65,535	INT16
704	R/W	1	Alarm Enable	1 = Enabled 0 = Disabled	See Section 12.0	INT16
709	W	1	Save Alarm Parmeters to Module Memory	Writing 1 saves the Alarm Configuration, High Limit, Low Limit, High-Low Deadband, High-High Limit, Low-Low Limit and HHLL Deadband to local non-volatile memory.	1	INT16
710	R/W	8	Alarm Configuration	Alarm Configuration	See Section 12.0	INT16
730	R/W	8	High Limit	High Alarm Limit	See Table 4	INT16
750	R/W	8	Low Limit	Low Alarm Limit	See Table 4	INT16
770	R/W	8	High Low Deadband	Deadband for High Low Alarm	See Table 4	INT16
790	R/W	8	High-High Limit	High-High Alarm Limit	See Table 4	INT16
810	R/W	8	Low-Low Limit	Low-Low Alarm Limit	See Table 4	INT16
830	R/W	8	High-High Low-Low Deadband	Deadband for High-High Low-Low Alarm	See Table 4	INT16

Alarms are configured by writing a code to the register at address 710+2000*R and then enabled and disabled by writing a 1 or 0 to the register at address 704+2000*R. Alarm Status is stored in registers at address range 700–703, offset by 2000*R. The code written to address 710+2000*R is the sum of a number representing the type of alarm and a number representing the alarm limits to be monitored.

Alarm Configuration Value = Alarm Type Code + Alarm Limit Code

Alarm Type	Code
Tracking	1000
Latching	2000

Alarm Limit	Code
Low Limit	100
High Limit	200
High Low Limits	300
Low-Low Limit	400
High-High Limit	500
High-High Low-Low Limits	600

Once alarm configuration is complete, store the data to module non-volatile memory by writing a 1 to register 709. If the Alarm Configuration Value = 0, the Alarm is Off (Disabled). The Alarm for a given channel cannot be turned On (Enabled) until a valid, non-zero value is written to the Alarm Configuration register.

Example: A MAQ20-ISOV2 module with serial number 1234567-89 is installed in a system and has been assigned a Registration Number of 3. Set up the module to have a Tracking Alarm on Channel 1 with a High limit of 3000 counts, a Low limit of 500 counts and a Deadband of 100 counts.

The MAQ20-ISOV2 module with s/n 1234567-89 has an address offset of 2000*3 = 6000

1.) Write to register address 6000+711 = 6711 a value of 2000+300 = 2300 to set a Latching Alarm with High Low limit on Channel 1
2.) Write to register address 6000+731 = 6731 a data value of 3000 to set the High limit on Channel 1
3.) Write to register address 6000+751 = 6751 a data value of 500 to set the Low limit on Channel 1
4.) Write to register address 6000+771 = 6711 a data value of 100 to set the Deadband for the High and Low limits on Channel 1
5.) Write to register address 6000+704 = 6704 the equivalent of bit code 0000 0010 = 3 to enable Channel 1
6.) Write to register address 6000+709 = 6709 a data value of 1 to save the configuration to memory

When an alarm condition is reached as specified by the above parameters, the Alarm Status registers are updated in response to the events and the red LED on the module is lit.

7.) Read register address 6000+702 = 6702 to view the status of the Low Alarm.
If bit code 0000 0010 = 3 is read, a Low Alarm has occurred on Channel 1.

8.) Write to register address 6000+702 = 6702 the equivalent of bit code 0000 0000 = 0 to clear the Channel 1 latched alarm.

18.0 Signal Average, Minimum & Maximum

Signal averaging can be set on a per-channel basis by configuring the Average Weight. Average Weight is calculated as 2^x where x = 0 to 15 and the default value is x = 0. The running average is then calculated as follows:

$$\text{Average} = \text{Average} + \frac{\text{Sampled Value} - \text{Average}}{\text{Average Weight}}$$

The *MAQ20-ISOMV, MAQ20-ISOVx & MAQ20-ISOI Address Map is* found at the end of this manual. An excerpt from the Address Map is shown below. Signal Average and related parameters are stored starting at module register address 120, which is system register address 2000*R+120, where R is the module Registration Number. Refer to the *MAQ20 I/O Module Registration* section for further details.

Address Range 100 - 699: Module Configuration						
Start Address	**Read/ Write**	**Number of Registers**	**Contents**	**Description**	**Data Range**	**Data type**
120	R/W	8	Average Weight	Weight for Average Calculation	0 to 15	INT16

Address Range 1000 - 1699: Module Data						
Start Address	**Read/ Write**	**Number of Registers**	**Contents**	**Description**	**Data Range**	**Data type**
1000	R	8	Channel Data	Data for all 8 Channels	See Table 4	INT16
1016	R	1	Alarm Status	Status of Low-Low Alarm	0 to 65,535	INT16
1017	R	1	Alarm Status	Status of Low Alarm	0 to 65,535	INT16
1018	R	1	Alarm Status	Status of High Alarm	0 to 65,535	INT16
1019	R	1	Alarm Status	Status of High-High Alarm	0 to 65,535	INT16
1030	R/W	8	Data Minimum	Minimum for each of 8 Channels	See Table 4	INT16
1050	R/W	8	Data Maximum	Maximum for each of 8 Channels	See Table 4	INT16
1070	R/W	8	Data Average	Average for each of 8 Channels	See Table 4	INT16
1090	R	8	Channel 0 Data	Last 8 readings for Channel 0	See Table 4	INT16
1100	R	8	Channel 1 Data	Last 8 readings for Channel 1	See Table 4	INT16
1110	R	8	Channel 2 Data	Last 8 readings for Channel 2	See Table 4	INT16
1120	R	8	Channel 3 Data	Last 8 readings for Channel 3	See Table 4	INT16
1130	R	8	Channel 4 Data	Last 8 readings for Channel 4	See Table 4	INT16
1140	R	8	Channel 5 Data	Last 8 readings for Channel 5	See Table 4	INT16
1150	R	8	Channel 6 Data	Last 8 readings for Channel 6	See Table 4	INT16
1160	R	8	Channel 7 Data	Last 8 readings for Channel 7	See Table 4	INT16

Example: A MAQ20-ISOV2 module with serial number 1234567-89 is installed in a system and has been assigned a Registration Number of 4. Set the Average Weight of Channel 4 to 8, then read the following parameters for Channel 4: Current Data, Min Data, Max Data, Average Data and the last 8 readings.

The MAQ20-ISOV2 module with s/n 1234567-89 has an address offset of 2000*4 = 8000

1.) Write to register address 8000+124 = 8124 a data value of 8 to set the Average Weight

2.) Read from register address 8000+1034 = 9034 the min data from Channel 4
3.) Read from register address 8000+1054 = 9054 the max data from Channel 4
4.) Read from register address 8000+1074 = 9074 the average data from Channel 4 with weight 8
5.) Read from register address 8000+1130 to 1138 = 9130 to 9138 the last 8 readings from Channel 4

19.0 Reset Functions

Two types of firmware reset are supported in the MAQ20 I/O modules:

Standard Reset is used to put the module in a user-defined state. The parameters listed below will be set to the last state saved to module memory. Parameters stored in memory are not affected.

Reset-to-Default reverts the module to the settings used at the factory during manufacture. It performs the standard reset actions plus resets most non-volatile parameters to default settings. Parameters stored in module memory are not affected.

The table below shows what parameters are affected for each reset.

Table 2: Parameters Affected by Standard Reset and Reset-to-Default

RESET TYPE	PARAMETERS
Standard Reset	Disables all Alarms, Clears Alarm Status Resets Alarm Configuration, Limits, and Deadbands to values stored in module memory. Resets Data Minimum to –f.s., Data Maximum to +f.s. and Average Data to 0 Resets Input Range, Average Weight, Burst Scan List, Burst Channel Enable, Burst Size, to values stored in module memory. Resets Burst Enable and Burst Read to values stored in module memory. Clears all Status and Diagnostic registers
Reset-to-Default	Disables all Alarms, Clears Alarm Status Resets Alarm Configuration, Limits, and Deadbands to factory default Resets Data Minimum to –f.s., Data Maximum to +f.s. and Average Data to 0 Resets Input Range, Average Weight, Burst Scan List, Burst Channel Enable, Burst Size, to factory default. Resets Burst Enable and Burst Read to values stored in module memory. Clears all Status and Diagnostic registers

Reset Registers

Writing a valid data value to the Reset Register will force the module to perform a specified reset. Write 0 to perform Standard Reset and write 255 to perform Reset-to-Default.

NOTE:

The MAQ20 I/O modules send a response to the reset register write before carrying out the reset. This means the module will be unresponsive to commands for approximately 3 seconds.

Power-On-Reset (POR) and Brownout

MAQ20 I/O modules utilize a brown-out detect circuit and watchdog timer to ensure reliable and predictable operation under all conditions. Upon power cycle, brown-out detect or any extreme circumstance under which the watchdog timer expires, a Standard Reset is performed, and parameters stored in module memory are loaded to the appropriate registers.

20.0 MAQ20-ISOMV, MAQ20-ISOV2 & MAQ20-ISOI Address Map and Range Table

The table in this section outlines the MAQ20-ISOMV, MAQ20-ISOV2 and MAQ20-ISOI address space. Data in these registers contains all permanent and user settable information for module configuration, status, operation of all functions, data read/write, and data storage. Table columns list the following information:

Start Address: Start address for the specified quantity of addresses. The start address is offset by 2000*R where R is the module Registration Number.

Read/Write: Indicates whether data at the address is Read, Write or both.

Number of Registers: The number of 16-bit registers reserved for the specified contents.

Contents: Parameter stored at the specified address.

Description: Details, examples, limits, and default values for the parameter stored at the specified address.

Data Range: Valid data read from or written to an address range. Data not in this range which is written to an address may return a Modus Exception 3, Illegal Data, or may be ignored.

Data Type: The type of data stored at the specified address.

ASCII 0123456789ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz, **-**, " "
INT16 16-bit integer value, 0 to 65535, unless otherwise indicated. Stored at a single address.
INT32 32-bit integer value, 0 to 4294967295, unless otherwise indicated. Stored at two 16-bit addresses. MSB is stored at address N, LSB is stored at address N+1.

Module register addresses 0 to 1999 in the table below are system register addresses 2000*R+0 to 1999, where R is the module Registration Number. Refer to the MAQ20 I/O Module Registration section for further details.

Table 3: MAQ20-ISOMV, MAQ20-ISOV, & MAQ20-ISOI Address Map

Address Range 0 - 99 : Module Information						
Start Address	**Read/ Write**	**Number of Registers**	**Contents**	**Description**	**Data Range**	**Data type**
0	R	15	Device Description	MAQ20-ISOMV1 MAQ20-ISOV1 MAQ20-ISOV2 MAQ20-ISOV3 MAQ20-ISOV4 MAQ20-ISOV5 MAQ20-ISOI1	Characters, Numbers, "-" and Space	ASCII
19	R	11	Serial Number	S1234567-89	Characters, Numbers, "-" and Space	ASCII
30	R	5	Date Code	D0622 (D<month><year>)	Characters, Numbers	ASCII
35	R	5	Firmware Rev	Fx.xx	Characters, Numbers and "."	ASCII
40	R	1	Input Channels	8 Input Channels	8	ASCII
41	R	1	Output Channels	0 Output Channels	0	ASCII
98	W	1	Module Detect	Any write will blink Status LED at 5Hz for 5 seconds	0 to 65,535	INT16
99	W	1	Reset Register	0 = Standard Reset 255 = Reset to Default	0, 255	INT16

Address Range 100 - 699: Module Configuration						
Start Address	**Read/ Write**	**Number of Registers**	**Contents**	**Description**	**Data Range**	**Data type**
100	R/W	8	Input Range	Range for each of 8 channels	0 to 2	INT16
119	W	1	Save to Module Memory	0 = Range, Average Weight	0	INT16
120	R/W	8	Average Weight	Weight for Average Calculation. Default = 0.	0 to 15	INT16
660	R/W	8	Burst Scan Channel Enable	Burst Scan Mode Channel Enable. 0 = Disable 1 = Enable Default = 0.	0 or 1	INT16
670	R/W	1	Burst Scan Size MSB (4,000,000 max)	Size of burst scan to capture, MSB. Number of samples per channel * number of channels. Default = 0.	0 to 61	INT16
671	R/W	1	Burst Scan Size LSB (4,000,000 max)	Size of burst scan to capture, LSB. Number of samples per channel * number of channels. Default = 0.	0 to 65,535	INT16
672	W	1	Save Burst Scan Parameters to Memory	Save Burst Scan Mode Parameters to Module Memory. Write 1 to save.	1	INT16
675	R/W	2	Burst Scan Rate	Scan Rate in microseconds (us). MSB = 675, LSB = 676	0 to 65,535	INT16

Address Range 700 - 999: Alarm Configuration						
Start Address	**Read/ Write**	**Number of Registers**	**Contents**	**Description**	**Data Range**	**Data type**
700	R/W	1	Alarm Status, Low-Low	Write 0 to the corresponding channel bit to clear a Latched Alarm. Default = 0.	0 to 255	INT16
701	R/W	1	Alarm Status, Low	Write 0 to the corresponding channel bit to clear a Latched Alarm. Default = 0.	0 to 255	INT16
702	R/W	1	Alarm Status, High	Write 0 to the corresponding channel bit to clear a Latched Alarm. Default = 0.	0 to 255	INT16
703	R/W	1	Alarm Status, High-High	Write 0 to the corresponding channel bit to clear a Latched Alarm. Default = 0.	0 to 255	INT16
704	R/W	1	Alarm Enable	1 = Enabled 0 = Disabled	0 or 1	INT16
709	W	1	Save Alarm Parmeters to Module Memory	Writing 1 saves the Alarm Configuration, High Limit, Low Limit, High-Low Deadband, High-High Limit, Low-Low Limit and HHLL Deadband to local non-volatile memory.	1	INT16
710	R/W	8	Alarm Configuration	Alarm Configuration. Default = 0.	0 to 2600	INT16
730	R/W	8	High Limit	High Alarm Limit Default = +f.s.	-32,768 to 32,767	INT16
750	R/W	8	Low Limit	Low Alarm Limit. Default = -f.s.	-32,768 to 32,767	INT16
770	R/W	8	High Low Deadband	Deadband for High Low Alarm. Default = 0.	-32,768 to 32,767	INT16
790	R/W	8	High-High Limit	High-High Alarm Limit Default = +f.s.	-32,768 to 32,767	INT16
810	R/W	8	Low-Low Limit	Low-Low Alarm Limit Default = -f.s.	-32,768 to 32,767	INT16
830	R/W	8	High-High Low-Low Deadband	Deadband for High-High Low-Low Alarm. Default = 0.	-32,768 to 32,767	INT16

Address Range 1000 - 1699: Module Data						
Start Address	**Read/ Write**	**Number of Registers**	**Contents**	**Description**	**Data Range**	**Data type**
1000	R	8	Channel Data	Data for each of 8 Channels	-32,768 to 32,767	INT16
1016	R	1	Alarm Status	Status of Low-Low Alarm Default = 0	0 to 255	INT16
1017	R	1	Alarm Status	Status of Low Alarm. Default = 0.	0 to 225	INT16
1018	R	1	Alarm Status	Status of High Alarm Default = 0	0 to 255	INT16
1019	R	1	Alarm Status	Status of High-High Alarm Default = 0	0 to 255	INT16
1030	R/W	8	Data Minimum	Minimum for each of 8 Channels. Default = –f.s.	-32,768 to 32,767	INT16
1050	R/W	8	Data Maximum	Maximum for each of 8 Channels. Default = +f.s.	-32,768 to 32,767	INT16
1070	R/W	8	Data Average	Average for each of 8 Channels Default = 0	-32,768 to 32,767	INT16
1090	R	8	Channel 0 Data	Last 8 readings for Ch 0	-32,768 to 32,767	INT16
1100	R	8	Channel 1 Data	Last 8 readings for Ch 1	-32,768 to 32,767	INT16
1110	R	8	Channel 2 Data	Last 8 readings for Ch 2	-32,768 to 32,767	INT16
1120	R	8	Channel 3 Data	Last 8 readings for Ch 3	-32,768 to 32,767	INT16
1130	R	8	Channel 4 Data	Last 8 readings for Ch 4	-32,768 to 32,767	INT16

Address Range 1000 - 1699: Module Data						
Start Address	**Read/ Write**	**Number of Registers**	**Contents**	**Description**	**Data Range**	**Data type**
1140	R	8	Channel 5 Data	Last 8 readings for Ch 5	-32,768 to 32,767	INT16
1150	R	8	Channel 6 Data	Last 8 readings for Ch 6	-32,768 to 32,767	INT16
1160	R	8	Channel 7 Data	Last 8 readings for Ch 7	-32,768 to 32,767	INT16
1200	W	1	Burst Enable	1 = Enable 0 = Disable	0 or 1	INT16
1201	R	100	Burst Read	Read burst samples in a block of 1 to 100	1 to 100	INT16
1202	R	1	Burst Status	1 = Burst Ongoing 0 = Burst Complete or Inactive	0 or 1	INT16
1203	R/W	2	Burst Read Index	Returns the index of the next Burst Sample MSB = 1203, LSB = 1204	1 to 4000000	INT16

Address Range 1700 - 1899: Input Ranges						
Start Address	**Read/ Write**	**Number of Registers**	**Contents**	**Description**	**Data Range**	**Data type**
1700	**R**	**1**	**Range Count**	**Number of ranges supported**	**3**	**INT16**
1710	**R**	**1**	**Range 0**	**Engineering -fs.**	**-32,768 to 32,767**	**INT16**
1711	R	1	Range 0	Future Use	-32,768 to 32,767	INT16
1712	R	1	Range 0	Engineering +fs	-32,768 to 32,767	INT16
1713	R	1	Range 0	Future Use	-32,768 to 32,767	INT16
1714	R	1	Range 0	+fs & -fs multiplier Factor 10^X	-32,768 to 32,767	INT16
1715	R	1	Range 0	Engineering Units ("C", "V", etc)	A to Z	ASCII
1716	R	1	Range 0	Engineering Units ("C", "V", etc)	A to Z	ASCII
1717	R	1	Range 0	Future Use	-32,768 to 32,767	INT16
1718	R	1	Range 0	Count Value of -fs.	-32,768 to 32,767	INT16
1719	R	1	Range 0	Future Use	-32,768 to 32,767	INT16
1720	R	1	Range 0	Count Value of +fs.	-32,768 to 32,767	INT16
1730	**R**	**1**	**Range 1**	**Engineering -fs.**	**-32,768 to 32,767**	**INT16**
1731	R	1	Range 1	Future Use	-32,768 to 32,767	INT16
1732	R	1	Range 1	Engineering +fs	-32,768 to 32,767	INT16
1733	R	1	Range 1	Future Use	-32,768 to 32,767	INT16
1734	R	1	Range 1	+fs & -fs multiplier Factor 10^X	-32,768 to 32,767	INT16
1735	R	1	Range 1	Engineering Units ("C", "V", etc)	A to Z	ASCII
1736	R	1	Range 1	Engineering Units ("C", "V", etc)	A to Z	ASCII
1737	R	1	Range 1	Future Use	-32,768 to 32,767	INT16
1738	R	1	Range 1	Count Value of -fs.	-32,768 to 32,767	INT16
1739	R	1	Range 1	Future Use	-32,768 to 32,767	INT16
1740	R	1	Range 1	Count Value of +fs.	-32,768 to 32,767	INT16
1750	**R**	**1**	**Range 2**	**Engineering -fs.**	**-32,768 to 32,767**	**INT16**
1751	R	1	Range 2	Future Use	-32,768 to 32,767	INT16
1752	R	1	Range 2	Engineering +fs	-32,768 to 32,767	INT16
1753	R	1	Range 2	Future Use	-32,768 to 32,767	INT16
1754	R	1	Range 2	+fs & -fs multiplier Factor 10^X	-32,768 to 32,767	INT16
1755	R	1	Range 2	Engineering Units ("C", "V", etc)	A to Z	ASCII
1756	R	1	Range 2	Engineering Units ("C", "V", etc)	A to Z	ASCII
1757	R	1	Range 2	Future Use	-32,768 to 32,767	INT16
1758	R	1	Range 2	Count Value of -fs.	-32,768 to 32,767	INT16
1759	R	1	Range 2	Future Use	-32,768 to 32,767	INT16
1760	R	1	Range 2	Count Value of +fs.	-32,768 to 32,767	INT16

Address Range 1900 - 1999: Status Registers						
Start Address	**Read/ Write**	**Number of Registers**	**Contents**	**Description**	**Data Range**	**Data type**
1900	R/W	1	Watchdog Flag	1 = Watchdog Reset, 0 = Normal	0 or 1	INT16
1901	R/W	1	Brownout Flag	1 = Brownout Reset, 0 = Normal	0 or 1	INT16
1906	R/W	1	Numeric Error	Increments when a value received is outside of the allowed range	0 to 65,535	INT16
1908	R/W	1	UART RX Error	UART RX Error Counter Command Too Short	0 to 65,535	INT16
1909	R/W	1	UART RX Error	UART RX Error Counter Command Too Long	0 to 65,535	INT16
1910	R/W	1	UART RX Error	UART RX Error Counter Command received in invalid state	0 to 65,535	INT16

Table 4: MAQ20-ISOMV, MAQ20-ISOVx, MAQ20-ISOI Range Table

	Range	Input	Equivalent Counts	Over/Under Range	Equivalent Counts
MAQ20-ISOMV1	0	-100mV to +100mV (Default)	-28671 to 28671	-110mV to +110mV	-31538 to 31538
	1	0V to +100mV	0 to 28671	-10mV to +110mV	-2867 to 31538
MAQ20-ISOV1	0	-1V to +1V (Default)	-28671 to 28671	-1.1V to +1.1V	-31538 to 31538
	1	0V to +1V	0 to 28671	-0.1V to +1.1V	-2867 to 31538
MAQ20-ISOV2	0	-10V to +10V (Default)	-28671 to 28671	-11V to +11V	-31538 to 31538
	1	0V to +10V	0 to 28671	-1V to +11V	-2867 to 31538
MAQ20-ISOV3	0	-20V to +20V (Default)	-28671 to 28671	-22V to +22V	-31538 to 31538
	1	0V to +20V	0 to 28671	-2V to +22V	-2867 to 31538
MAQ20-ISOV4	0	-40V to +40V (Default)	-28671 to 28671	-44V to +44V	-31538 to 31538
	1	0V to +40V	0 to 28671	-4V to +44V	-2867 to 31538
MAQ20-ISOV5	0	-60V to +60V (Default)	-28671 to 28671	-66V to +66V	-31538 to 31538
	1	0V to +60V	0 to 28671	-6V to +66V	-2867 to 31538
MAQ20-ISOI1	0	0mA to 20mA (Default)	0 to 28671	-2mA to +22mA	-2867 to 31538
	1	4mA to 20mA	5734 to 28671	2mA to 22mA	2867 to 31538
	2	-20mA to +20mA	-28671 to 28671	-22mA to +22mA	-31538 to 31538

Table 5: MAQ20-ISOMV, MAQ20-ISOVx, MAQ20-ISOI Special Count Readings

Reading	Condition
32001	Positive Differential Input Exceeded
-32001	Negative Differential Input Exceeded

DATAFORTH WARRANTY

To view the current Dataforth Corporation Warranty, please click on the link below for the Dataforth Standard Terms and Conditions of Sale Applying to Products Sold by Dataforth Corporation. The Warranty in its entirety is Section 3. Please check this link periodically for updates.

https://www.dataforth.com/terms-and-conditions-sale

APPLICATION SUPPORT

Dataforth provides timely, high-quality product support. Send an email to support@dataforth.com or call **+1-800-444-7644 TOLL-FREE.**

Returns/Repair Policy

All warranty and repair requests should be directed to the Dataforth Customer Service Department at +1-520-741-1404 or **+1-800-444-7644 TOLL-FREE.**

If a product return is required, submit a Return Material Authorization (RMA) request by visiting https://www.dataforth.com.

The information provided herein is believed to be reliable; however, DATAFORTH assumes no responsibility for inaccuracies or omissions. DATAFORTH assumes no responsibility for the use of this information, and all use of such information shall be entirely at the user's own risk. Application information is intended as suggestions for possible use of the products and not as explicit performance in a specific application. Prices and specifications are subject to change without notice. No patent rights or licenses to any of the circuits described herein are implied or granted to any third party. DATAFORTH does not authorize or warrant any DATAFORTH product for use in life support devices and/or systems.

MAQ20-ISOMV/-ISOV/-ISOI Hardware User Manual
MA1062 Rev. B – March 2024

ISO9001:2015-Registered QMS