MAQ®20

Industrial Data Acquisition and Control System

MA1046

MAQ20-BRDG1
Hardware User Manual

DATAFORTH®

MAQ20-BRDG1 Hardware User Manual
MA1046 Rev. A – October 2015

ISO9001:2008-Registered QMS

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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 sales people 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 ISO9001:2008 quality management system.

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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 25 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 ±0.3C 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 Range 7-34VDC Power
- CE Compliant, UL/CUL Listing and ATEX Compliance pending

Industry Leading Functionality

- The system is a Modbus Server and can be operated remotely with no local PC
- Up to 4GB of logged data can be transferred via FTP during real-time acquisition
- Up to 24 I/O modules, or 384 channels, per system, per 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
- Intuitive Graphical Control Software
  - ReDAQ Shape Graphical HMI Design & Runtime Solution
  - IPEmotion Muli-Vendor and Multi-Language Solution
  - Programming examples and LabVIEW VIs
  - OPC Server

2.0 System Description and Documentation

A MAQ20 Data Acquisition System must have as a minimum a Communications Module, a Backbone, and one I/O Module. Examples include:

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 www.dataforth.com/maq20.aspx 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 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 strain gage input module has 4 input channels and can interface to full, half, and quarter bridge sensors using 4-wire or 6-wire connections. All channels are individually configurable for range, alarms, and averaging to match the most demanding applications. In addition, sampling rate, resolution, bandwidth, excitation voltage, and shunt calibration are user settable parameters. 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 rejection of unwanted frequencies. Field I/O connections are made through spring cage terminal blocks 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 30Vrms 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 hardware installation, configuration, and system operation, refer to the manuals and software available for download from www.dataforth.com/maq20_download.aspx This includes, but is not limited to:

MA1036 MAQ20 Quick Start Guide
MA1040 MAQ20 Communications Module Hardware User Manual
MA1041 MAQ20 milliVolt, Volt and Current Input Module Hardware User Manual
MA1037 MAQ20 Configuration Software Tool User Manual
MA1038 MAQ20 ReDAQ Shape for MAQ20 User Manual

MAQ20-940/-941 ReDAQ Shape Software for MAQ20 – Developer Version/User Version
MAQ20-945 MAQ20 Configuration Software Tool
MAQ20-951/-952 IPEMotion Software for MAQ20

3.0 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.

4.0 Module Dimensions and I/O Connections

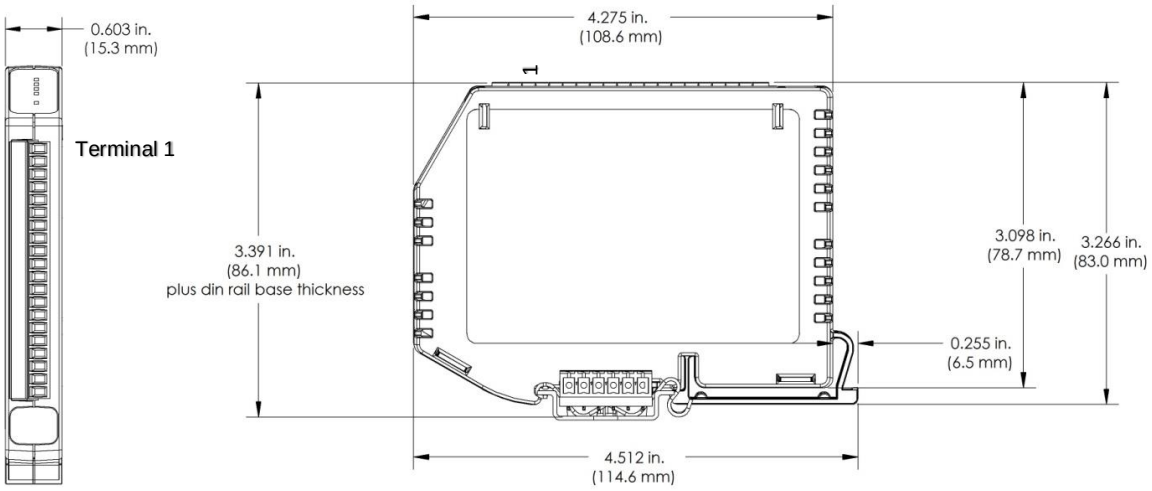
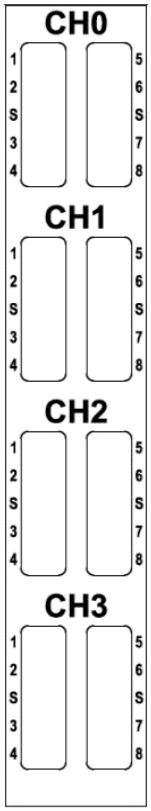


Figure 1: Module Dimensions

Table 1: I/O Terminal Block Connections



SENSOR CONNECTION	TERMINAL	TERMINAL	SENSOR CONNECTION
CH0			
+EXC	1	5	+REMOTE SENSE
-EXC	2	6	-REMOTE SENSE
SHIELD	S	S	SHIELD
+IN	3	7	+SHUNT CAL
-IN	4	8	-SHUNT CAL
CH1			
+EXC	1	5	+REMOTE SENSE
-EXC	2	6	-REMOTE SENSE
SHIELD	S	S	SHIELD
+IN	3	7	+SHUNT CAL
-IN	4	8	-SHUNT CAL
CH2			
+EXC	1	5	+REMOTE SENSE
-EXC	2	6	-REMOTE SENSE
SHIELD	S	S	SHIELD
+IN	3	7	+SHUNT CAL
-IN	4	8	-SHUNT CAL
CH3			
+EXC	1	5	+REMOTE SENSE
-EXC	2	6	-REMOTE SENSE
SHIELD	S	S	SHIELD
+IN	3	7	+SHUNT CAL
-IN	4	8	-SHUNT CAL

5.0 Installation

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 out.
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 in Figure 2 below.

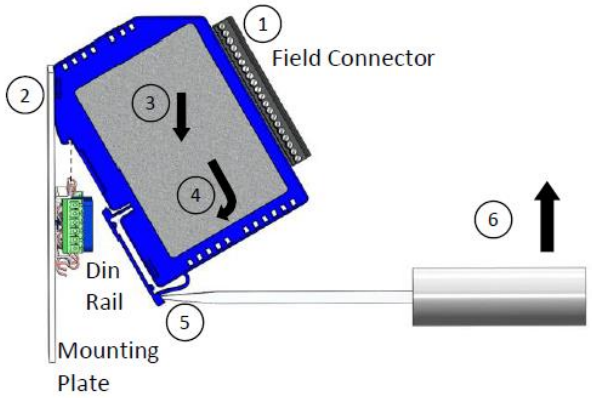


Figure 2: Installation and Removal

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 Figure 3 below.

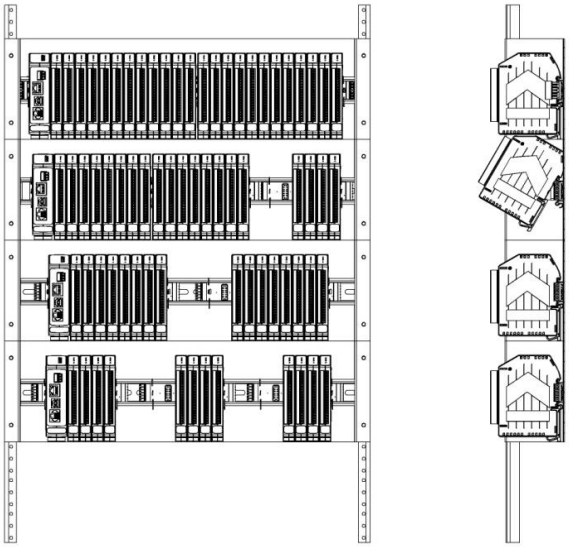


Figure 3: Possible System Configurations

6.0 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. 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. Allow 5 seconds for full system registration. 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.

I/O modules in a system are identified in general by their model number (MAQ20-VDN, MAQ20-JTC, 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 (V, I, TCPL, 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 and MAQ20-945 - MAQ20 Configuration Software Tool provided by Dataforth show a graphical representation of a system based on registration sequence and not by physical position. Tools within each software package allow the user to reassign Registration Numbers thereby making graphical representations match physical location for a single, local backbone. For further details, see Section 9.0.

Module Detect: A write to the Module Detect Register at I/O module 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.

7.0 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 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.

CASE 2: I/O module is to be replaced with another having a different model 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.

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. Allow 5 seconds for full system registration. 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 and MAQ20-945 - MAQ20 Configuration Software Tool allow the user to reassign Registration Numbers. For further details, see Section 9.0.

Module Detect: A write to the Module Detect Register at I/O module 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.

8.0 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. Allow 5 seconds for full system registration. 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. Tools within MAQ20-940 - ReDAQ Shape Software for MAQ20 and MAQ20-945 - MAQ20 Configuration Software Tool allow the user to reassign Registration Numbers. For further details, see Section 9.0.

Module Detect: A write to the Module Detect Register at I/O module 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.

9.0 MAQ20 I/O Module Registration and Reading the Input Signal

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. For further details, see Sections 6.0, 7.0 and 8.0.

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 and MAQ20-945 - MAQ20 Configuration Software Tool provided by Dataforth show a graphical representation of a system based on registration sequence and not by physical position. Tools within each 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 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 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.

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 has been used instead of the Standard Registration Processes. Registration is described in Sections 6.0, 7.0 and 8.0.

ReDAQ Shape provides a graphical representation of system which displays I/O modules sequentially in the order they were registered. The display does not represent physical position and will not show vacant positions between I/O modules. The graphic shows a 24 position backbone regardless of the backbone or combination of backbones used in a system.

The graphical representation of the system is presented on the Acquire panel as shown in Figure 4.

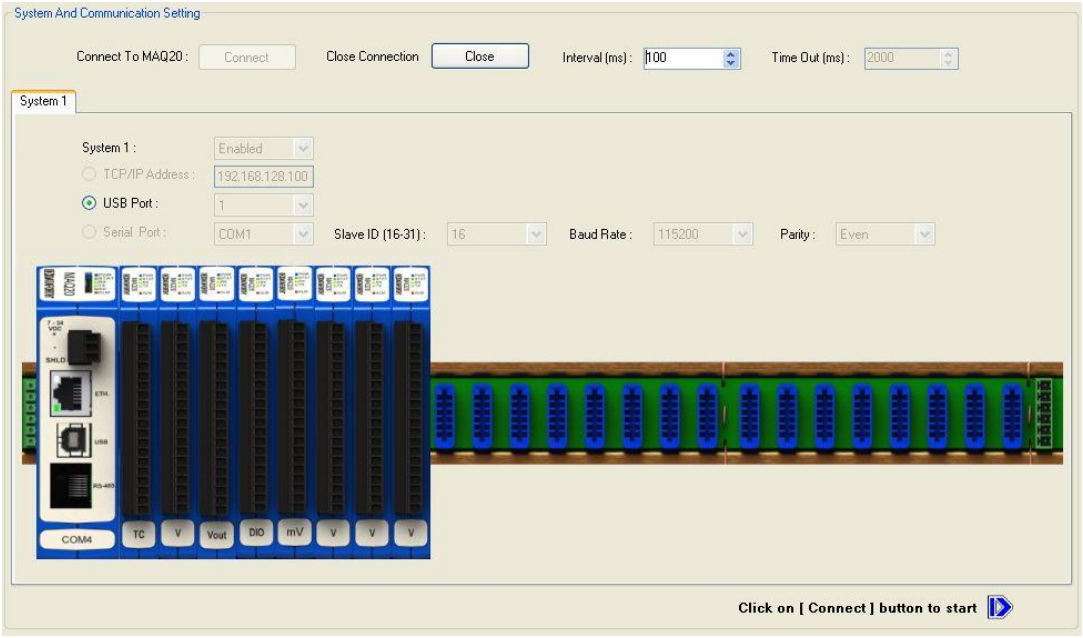
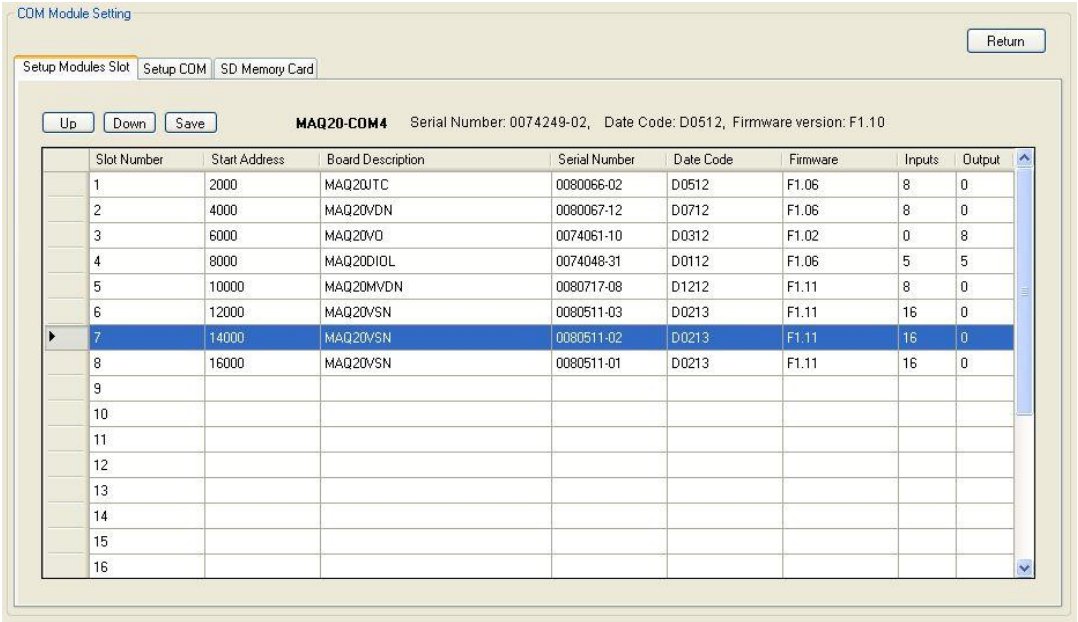


Figure 4: MAQ20-940 ReDAQ Shape for MAQ20 Main Configuration Screen

To view the registration sequence, double-click on the MAQ20-COMx graphic to obtain the system panel shown in Figure 5.



Slot Number	Start Address	Board Description	Serial Number	Date Code	Firmware	Inputs	Output
1	2000	MAQ20UTC	0080066-02	D0512	F1.06	8	0
2	4000	MAQ20VDN	0080067-12	D0712	F1.06	8	0
3	6000	MAQ20VO	0074061-10	D0312	F1.02	0	8
4	8000	MAQ20DIOL	0074048-31	D0112	F1.06	5	5
5	10000	MAQ20MVDN	0080717-08	D1212	F1.11	8	0
6	12000	MAQ20VSN	0080511-03	D0213	F1.11	16	0
7	14000	MAQ20VSN	0080511-02	D0213	F1.11	16	0
8	16000	MAQ20VSN	0080511-01	D0213	F1.11	16	0
9							
10							
11							
12							
13							
14							
15							
16							

Figure 5: Module Registration using MAQ20-940 ReDAQ Shape for MAQ20

Registration Numbers are listed in the left column. 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 as long as I/O modules are not removed from or added to a system.

The Address Map for the MAQ20-BRDG1 Bridge Input Module is found at the end of this manual. An excerpt from the Address Map is shown below. Channel Data is stored starting at address 1000.

NOTE: When a module is registered in a system, addresses are offset by 2000 * R, where R is the Registration Number.

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 4 Signal Channels. 24-bit data LSB at 100x, MSB at 100x+1. 16-bit data at 100x.	0 to 2^32-1 or 0 to 2^16-1	INT32 / INT16
1008	R	8	Excitation Data	Data for 4 Excitation Channels. 24-bit data LSB at 10xx, MSB at 10xx+1. 16-bit data at 10xx.	0 to 2^32-1 or 0 to 2^16-1	INT32 / INT16

Example: A MAQ20-BRDG1 module with serial number 1234567-89 is installed in a system and has been assigned a Registration Number of 6. Read Signal Data and Excitation Data for Channels 0 and 1 and convert these to Engineering units.

The MAQ20-BRDG1 module with s/n 1234567-89 has an address offset of 2000 * 6 = 12000

When signal sample rates of 1kS/s, 2kS/S, 4kS/s, 8kS/s and 16kS/s are used, sampled data will be 24 bits. LSB data is stored at the lower address and MSB data is stored at the higher address. For these data rates;

Read from register address 12000 + 1000 = 13000 the Channel 0 Signal Data LSB
Read from register address 12000 + 1001 = 13001 the Channel 0 Signal Data MSB
Read from register address 12000 + 1002 = 13002 the Channel 1 Signal Data LSB
Read from register address 12000 + 1003 = 13003 the Channel 1 Signal Data MSB

Read from register address 12000 + 1008 = 13008 the Channel 0 Excitation Data LSB
Read from register address 12000 + 1009 = 13009 the Channel 0 Excitation Data MSB
Read from register address 12000 + 1010 = 13010 the Channel 1 Excitation Data LSB
Read from register address 12000 + 1011 = 13011 the Channel 1 Excitation Data MSB

If the data read from Channel 0 LSB is 23154 counts and the data read from Channel 0 MSB is 106 counts, the input signal is:

Ch 0 LSB convert to binary	0101101001110010
Ch 0 MSB convert to binary	0000000001101010
Ch 0 24-bit representation	MSB + LSB = 011010100101101001110010
Ch 0 Decimal equivalent	6969970

6969970 counts * (+100mV - -100mV)/(2^23 counts - -2^23 counts) = 0.08475mV

When signal sample rates of 32kS/s and 64kS/s are used, sampled data will be 16 bits. For these data rates;

Read from register address 12000 + 1000 = 13000 the Channel 0 Signal Data
Read from register address 12000 + 1001 = 13001 the Channel 1 Signal Data

Read from register address 12000 + 1008 = 13008 the Channel 0 Excitation Data
Read from register address 12000 + 1009 = 13009 the Channel 1 Excitation Data

10.0 Signal Gain

The MAQ20-BRDG1 module has a factory default input signal range of -0.100V to +0.100V at the default signal gain setting of 1. 24-bit data conversion provides a high level of accuracy and resolution over this signal range and this setting should be sufficient for most applications. The signal gain setting can be changed independently for each channel to 1, 2, 4, 8, or 12 which changes the full scale input signal range to ±100mV, ±50mV, ±25mV, ±12.5mV and ±8.33mV respectively. Over-range and Under-range up to 2% beyond the specified input values will be measured.

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. Refer to Section 20.0 for details.

The Address Map for the MAQ20-BRDG1 Bridge Input Module is found at the end of this manual. An excerpt from the Address Map is shown below. Signal Gain is stored starting at Address 100.

NOTE: When a module is registered in a system, addresses are offset by 2000 * R, where R is the Registration Number. Refer to Section 9.0 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**
100	R/W	4	Signal Gain	0 = Do not use 1 = Signal Gain 1 2 = Signal Gain 2 3 = Do Not Use 4 = Signal Gain 4 5 = Signal Gain 8 6 = Signal Gain 12	1, 2, 4, 5, 6. Default = 1	INT16
119	W	1	Save to EEPROM	Writing 0 will save Signal Gain, Average Weight, Excitation V, HB, Shunt, and Data Rate settings.		INT16

To change the input range, write the appropriate range code to Address 100 + 2000 * R.

Once a Signal Gain 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-BRDG1 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 for a signal gain of 1 and channels 2 and 3 for a signal gain of 8.

The MAQ20-BRDG1 module with s/n 1234567-89 has an address offset of 2000 * 2 = 4000

Write to register address 4000 + 100 = 4100 a data value of 1 to set Ch 0 to signal gain = 1
Write to register address 4000 + 101 = 4101 a data value of 1 to set Ch 1 to signal gain = 1
Write to register address 4000 + 104 = 4104 a data value of 5 to set Ch 2 to signal gain = 8
Write to register address 4000 + 105 = 4105 a data value of 5 to set Ch 3 to signal gain = 8

11.0 Excitation

Content to be added.

12.0 Quarter Bridge, Half Bridge & Full Bridge Sensors

Content to be added.

13.0 Shunt Calibration

Content to be added.

14.0 Auto Zero

Content to be added.

15.0 Remote Sense

Content to be added.

16.0 Signal Sample Rate

Content to be added.

17.0 Signal Average, Minimum & Maximum

Content to be added.

18.0 V / V Signal Representation

Content to be added.

19.0 FIR Filter

Content to be added.

20.0 Burst Scan Mode

Content to be added.

21.0 Alarm Functions

Alarms in the MAQ20-BRDG1 module can be set for input signal or V/V measurements. Alarms have the following parameters which can be set to meet application requirements.

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. Refer to Section 14.0 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.

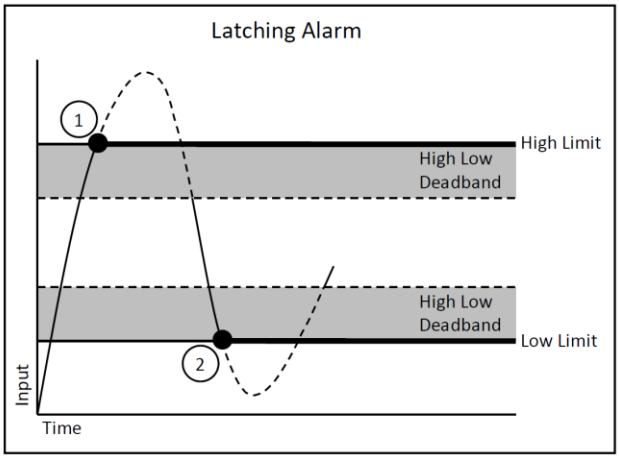
High Low Deadband
Used for the High and/or Low limits to prevent false tripping or alarm chatter for noisy signals. Deadband is the region less than the High limit or greater than the Low limit, measured in counts, which the signal must traverse through before the alarm is reset after being tripped.

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

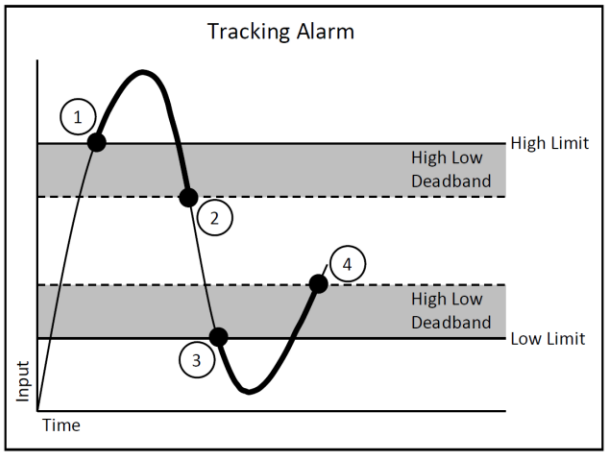
Low-Low Limit
Sets the value for the Low-Low limit in counts. Alarm status is stored in a register.

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.

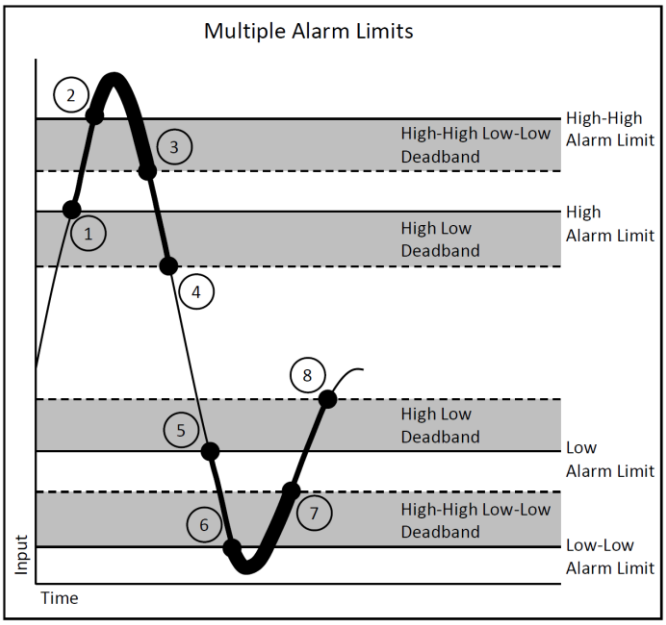
See Figure 6 below for graphical representations of alarm parameters and functionality keeping in mind that the parameters being monitored for alarms are event count, time between events, and event pair count.



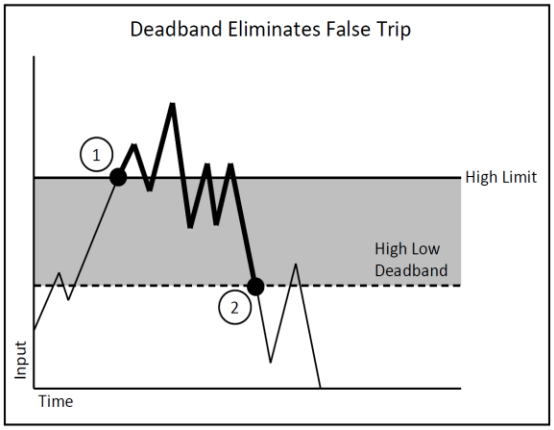
1. High Alarm Tripped
2. Low Alarm Tripped



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

22.0 Setting and Monitoring Alarms

When an alarm condition occurs, the appropriate register is written to show alarm status. This register can then be monitored by the host software for alarm detection. In addition, the MAQ20-BRDG1 module has the ability to map alarm events to other actions with the system.

Content to be added.

23.0 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 EEPROM. Parameters stored in EEPROM 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 EEPROM are not affected.

Table 2 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 Min, Max and Average registers to 0 Resets Signal Gain, Average Weight, Excitation Voltage, Bridge Configuration, Shunt Calibration, Auto Zero, Sampling Rate, FIR Filter Enable, V/V Calculation Enable, Burst Sample Count, Burst Channel Enable to values set in EEPROM Clears all Status and Diagnostic registers
Reset-to-Default	All parameters listed under Standard Reset, plus: Resets Signal Gain, Average Weight, Excitation Voltage, Bridge Configuration, Shunt Calibration, Auto Zero, Sampling Rate, FIR Filter Enable, V/V Calculation Enable, Burst Sample Count, Burst Channel Enable to values to factory default values Clears all Alarm Limits and Deadbands

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 or 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 EEPROM are loaded to the appropriate registers.

24.0 Module Identification and Status Registers

Module identification including model number, serial number, date code and firmware revision are stored in registers at addresses 0 – 41.

I/O modules in a system are identified in general by their model number (MAQ20-BRDG1, MAQ20-VDN, 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 (DIOH, V, 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.

For troubleshooting purposes, reset status, communications errors, and invalid data written to a module are monitored and made available to the user. Diagnostic registers at addresses 1900 – 1910 hold this information.

25.0 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.

LED Function and Troubleshooting Tips:

PWR
Normal operation: BLUE, solid lit

LED Off: Abnormal power situation
- Verify that a MAQ20-COMx is present in 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 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 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

26.0 Specifications

SPECIFICATIONS: STRAIN GAGE INPUT MODULE Typical at Ta = +25°C and +24V system power

Model Number, Sensor Type & Input Range MAQ20-BRDG1	 Full, Half, Quarter Bridge (with external bridge completion) 4-wire or 6-wire connection
Number of Channels	4
Per Channel Setup	Individually configurable for range, alarms, averaging
Input Range	+/-100mV at 0.8mV/V to 40mV/V Sensitivity
Input Protection	
Continuous Transient	30Vrms max ANSI/IEEE C37.90.1
Excitation Voltage	2.5V, 3.333V, 5.0V, 10.0V
Bridge Resistance	100ohm to 1kohm
Shunt Calibration	60kohm, 100kohm, 200kohm, External
Excitation Protection	
Continuous Transient	30Vrms max ANSI/IEEE C37.90.1
CMV	
Channel-to-Bus Channel-to-Channel Transient	1500Vrms, 1 min 3V ANSI/IEEE C37.90.1
CMR	100dB @ 50/60 Hz
NMR	60dB/decade
Accuracy(1)	±0.03% span
Linearity	±0.01% span
Resolution	0.0005% to 0.005% span
ADC Resolution	24-bit
Stability	
Zero Span	50ppm/C 75ppm/C
Bandwidth	Programmable to 17kHz
Sampling Rate, Simultaneous	1kS/s to 64kS/s burst
Alarms	High / High-High / Low / Low-Low
Power Supply Current	400mA
Dimensions (h)(w)(d)	3.27” x 4.51” x 0.60” (83.1mm x 114.6mm x 15.3mm)
Environmental	
Operating Temperature Storage Temperature Relative Humidity	-40°C to +85°C -40°C to +85°C 0 to 95%, non-condensing
Emissions, EN61000-6-4	ISM Group 1
Radiated, Conducted	Class A
Immunity EN61000-6-2	ISM Group 1
RF ESD, EFT Certifications	Performance A +/- 0.5% Span Error Performance B Heavy Industrial CE, ATEX Pending UL/CUL Class I, Division 2, Groups A, B, C, D Pending

(1) Includes linearity/conformity, hysteresis and repeatability.

27.0 MAQ20-BRDG1 Address Map

The table in this section outlines the MAQ20-BRDG1 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.

Table 3: MAQ20-BRDG1 Address Map

NOTE: When a module is registered in a system, addresses are offset by 2000 * R, where R is the Registration Number. Refer to Section 9.0 for further details on Registration Number.

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-BRDG1	Characters, Numbers, "-" and Space	ASCII
19	R	11	Serial Number	S1234567-89	Characters, Numbers, "-" and Space	ASCII
30	R	5	Date Code	D0915 (D<week><year>)	Characters, Numbers	ASCII
35	R	5	Firmware Rev	F1.00	Characters, 0-9 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	4	Signal Gain	0 = Do not use 1 = Signal Gain 1 2 = Signal Gain 2 3 = Do Not Use 4 = Signal Gain 4 5 = Signal Gain 8 6 = Signal Gain 12	1, 2, 4, 5, 6. Default = 1	INT16
119	W	1	Save to EEPROM	Writing 0 will save Signal Gain, Average Weight, Excitation V, HB, Shunt, and Data Rate settings.		INT16
120	R/W	8	Average Weight	Weight for Average Calculation	0-15	INT16
600	R/W	1	Excitation V	0 = 2.5V, 1 = 3.3V, 2 = 5V, 3 = 10V	0-3. Default = 0	INT16
610	R/W	4	4 channel HB	0 = Half Bridge, 1 = Full Bridge	0 or 1. Default = 1	INT16
620	R/W	4	4 channel Shunt	0 = 60kohm, 1 = 100kohm, 2 = 200kohm and 3 = External	0-3. Default = 0	INT16
624	R/W	1	Shunt Calibration On/Off	0 = On, 1 = Off	0 or 1. Default = 1	INT16
626	R/W	1	Auto Zero Ch 0 Enable	1 = Set new zero value, 0 = Clear zero	0 or 1	INT16
627	R/W	1	Auto Zero Ch 1 Enable	1 = Set new zero value, 0 = Clear zero	0 or 1	INT16
628	R/W	1	Auto Zero Ch 2 Enable	1 = Set new zero value, 0 = Clear zero	0 or 1	INT16
629	R/W	1	Auto Zero Ch 3 Enable	1 = Set new zero value, 0 = Clear zero	0 or 1	INT16
630	R/W	8	Auto Zero Values	4 channel Auto Zero values. 24-bit data LSB at 63x, MSB at 63x+1. 16-bit data at 63x.		INT32 / INT16
678	R/W	1	Sampling Rate	0 = 16bit, 64Ksps 1 = 16bit, 32Ksps 2 = 24bit, 16Ksps 3 = 24bit, 8Ksps 4 = 24bit, 4Ksps 5 = 24bit, 2Ksps 6 = 24bit, 1Ksps	0-6. Default = 4	INT16

Address Range 700 - 999 : Module Configuration						
Start Address	**Read/Write**	**Number of Registers**	**Contents**	**Description**	**Data Range**	**Data type**
700	R/W	1	Alarm Status, Low-Low	To clear a Latched alarm write a 0 to the corresponding channel bit.	0 to 65,535	INT16
701	R/W	1	Alarm Status, Low	To clear a Latched alarm write a 0 to the corresponding channel bit.	0 to 65,535	INT16
702	R/W	1	Alarm Status, High	To clear a Latched alarm write a 0 to the corresponding channel bit.	0 to 65,535	INT16
703	R/W	1	Alarm Status, High-High	To clear a Latched alarm write a 0 to the corresponding channel bit.	0 to 65,535	INT16
704	R/W	1	Alarm Enable	1 = Enabled 0 = Disabled	See Section x.xx	INT16
709	W	1	Save to EEPROM	Writing 1 will save the Alarm Configuration, High Limit, Low Limit, High-Low Deadband, High-High Limit, Low-Low Limit and HHLL Deadband.		
710	R/W	4	Alarm Configuration	Alarm Configuration	See Section x.xx	INT16
730	R/W	8	High Limit	High Alarm Limit. 24-bit data LSB at 7xx, MSB at 7xx+1. 16-bit data at 7xx.	0 to 2^32-1	INT32
750	R/W	8	Low Limit	Low Alarm Limit. 24-bit data LSB at 7xx, MSB at 7xx+1. 16-bit data at 7xx.	0 to 2^32-1	INT32
770	R/W	8	High Low Deadband	Deadband for High Low Alarm. 24-bit data LSB at 7xx, MSB at 7xx+1. 16-bit data at 7xx.	0 to 2^32-1	INT32
790	R/W	8	High-High Limit	High-High Alarm Limit. 24-bit data LSB at xxx, MSB at xxx+1. 16-bit data at xxx.	0 to 2^32-1	INT32
810	R/W	8	Low-Low Limit	Low-Low Alarm Limit. 24-bit data LSB at 8xx, MSB at 8xx+1. 16-bit data at 8xx.	0 to 2^32-1	INT32
830	R/W	8	High-High Low-Low Deadband	Deadband for High-High Low-Low Alarm. 24-bit data LSB at 8xx, MSB at 8xx+1. 16-bit data at 8xx.	0 to 2^32-1	INT32

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 4 Signal Channels. 24-bit data LSB at 100x, MSB at 100x+1. 16-bit data at 100x.	0 to 2^32-1 or 0 to 2^16-1	INT32 / INT16
1008	R	8	EXC Data	Data for 4 Excitation Channels. 24-bit data LSB at 10xx, MSB at 10xx+1. 16-bit data at 10xx.	0 to 2^32-1 or 0 to 2^16-1	INT32 / INT16
1016	R	1	Alarm Status	Status of Low-Low Alarm	0 to 65535	INT16
1017	R	1	Alarm Status	Status of Low Alarm	0 to 65535	INT16
1018	R	1	Alarm Status	Status of High Alarm	0 to 65535	INT16
1019	R	1	Alarm Status	Status of High-High Alarm	0 to 65535	INT16
1020	R/W	8	V/V output	4 channels V/V reading	-0.04 to +0.04	Float32
1030	R/W	8	Signal Data Minimum	Minimum value for each of 4 signal channels. 24-bit data LSB at 10xx, MSB at 10xx+1. 16-bit data at 10xx.	0 to 2^32-1 or 0 to 2^16-1	INT32 / INT16
1050	R/W	8	Signal Data Maximum	Maximum value for each of 4 signal channels. 24-bit data LSB at 10xx, MSB at 10xx+1. 16-bit data at 10xx.	0 to 2^32-1 or 0 to 2^16-1	INT32 / INT16
1070	R/W	8	Signal Data Average	Average value for each of 4 signal channels. 24-bit data LSB at 10xx, MSB at 10xx+1. 16-bit data at 10xx.	0 to 2^32-1 or 0 to 2^16-1	INT32 / INT16
1078	R/W	8	Excitation Data Average	Average value for each of 4 excitation channels. 24-bit data LSB at 10xx, MSB at 10xx+1. 16-bit data at 10xx.	0 to 2^32-1 or 0 to 2^16-1	INT32 / INT16
1096	R/W	1	FIR filter Enable	Burst Scan Mode only. 1 = Enabled 0 = Disabled	0 or 1. Default = 0	INT16
1097	R/W	1	V/V Calculation Enable	Burst Scan Mode only. 1 = Enabled 0 = Disabled	0 or 1. Default = 0	INT16
1098	R/W	2	Number of Samples to Read	Burst Scan Mode only. 24-bit data, 2M sample max. 16-bit data 4M sample max. LSB at 1098, MSB at 1099.	24-bit data 0 to 2000000, 16-bit data 0 to 4000000. Default = 1000000	INT32
1100	R/W	1	Scan Start	Burst Scan Mode Only. 1 = Start, 0 = Stop	0 or 1. Default = 0	INT16
1101	R/W	4	Channel Enable	Burst Scan Mode only. Channels to be included in Burst Scan. 1 = Enable, 0 = Disable	0 or 1. Default = 0	INT16

Address Range 1000 - 1699 : Module Data						
Start Address	**Read/Write**	**Number of Registers**	**Contents**	**Description**	**Data Range**	**Data type**
1105	R	2	Available Storage	Burst Scan Mode only. Storage space remaining, expressed in number of samples. 24-bit data, 2M sample max. 16-bit data 4M sample max. LSB at 1105, MSB at 1106.	24-bit data 0 to 2000000, 16-bit data 0 to 4000000. Default = 1000000	INT32
1107	R/W	2	Read Counter	Burst Scan Mode only. Sample read counter. 24-bit data, 2M sample max. 16-bit data 4M sample max. LSB at 1107, MSB at 1108.	24-bit data 0 to 2000000, 16-bit data 0 to 4000000. Default = 1000000	INT32
1110	R	100	Read Data Buffer	Burst Scan Mode only. Used for data transfer from internal memory. 24-bit data LSB at 1xxx, MSB at 1xxx+1. 16-bit data at 1xxx.	0 to 2^32-1 or 0 to 2^16-1 or -0.10 to +0.10	INT32 / INT16 / Float32

Address Range 1900 - 1999 : Status Registers						
Start Address	**Read/Write**	**Number of Registers**	**Type**	**Example**	**Range**	**Data type**
1900	R/W	1	Watchdog Reset	0 = Normal 1 = Watchdog Reset	0 or 1	INT16
1901	R/W	1	Brownout Flag	0 = Normal 1 = Brownout Reset	0 or 1	INT16
1902	R/W	1	I2C Error	I2C TX Error Counter	0 to 65,535	INT16
1903	R/W	1	I2C Error	I2C RX Error Counter	0 to 65,535	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

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BASED UPON WARRANTY, CONTRACT, TORT OR OTHERWISE, SHALL NOT EXCEED THE GREATER OF EITHER US$1000.00 (ONE THOUSAND DOLLARS U.S.A. CURRENCY) OR THE ACTUAL PURCHASE PRICE PAID BY BUYER FOR DATAFORTH'S PRODUCTS. DATAFORTH'S LIABILITY FOR ANY CLAIM OF ANY KIND SHALL IN NO CASE EXCEED THE OBLIGATION OR LIABILITY SPECIFIED IN THIS WARRANTY.

d. **Technical Assistance**. Dataforth 's Warranty as hereinabove set forth shall not be enlarged, diminished or affected by, and no obligation or liability shall arise or grow out of, Dataforth's rendering of technical advice, facilities or service in connection with buyer's order of the products furnished hereunder.

e. **Warranty Procedures**. Buyer shall notify Dataforth of any products which it believes to be defective during the applicable warranty period and which are covered by the Warranty set forth above. Buyer shall not return any products for any reason without the prior authorization of Dataforth and issuance of a Return Material Authorization ("RMA") number. After issuance of a RMA number, such products shall be promptly returned by buyer (and in no event later than thirty (30) days after the Warranty expiration date), transportation and insurance prepaid, to Dataforth's designated facility for examination and testing. Dataforth shall either repair or replace any such products found to be so defective and promptly return such products to buyer, transportation and insurance prepaid. Should Dataforth's examination and testing not disclose any defect covered by the foregoing Warranty, Dataforth shall so advise buyer and dispose of or return the products in accordance with buyer's instructions and at buyer's sole expense, and buyer shall reimburse Dataforth for testing expenses incurred at Dataforth's then current repair rates.

f. **Repair Warranty**. Dataforth warrants its repair work and/or replacement parts for a period of ninety (90) days from receipt by buyer of the repaired or replaced products or for the remainder of the warranty period for the initial delivery of such order as set forth in paragraph a above, whichever is greater.

g. **Critical Applications**. Certain applications using Dataforth's products may involve potential risks of death, personal injury, or severe property or environmental damage ("Critical Applications"). DATAFORTH'S PRODUCTS ARE NOT DESIGNED, INTENDED, AUTHORIZED, OR WARRANTED TO BE SUITABLE FOR USE IN LIFE-SUPPORT DEVICES OR SYSTEMS, SAFETY EQUIPMENT, NUCLEAR FACILITY APPLICATIONS OR OTHER CRITICAL APPLICATIONS WHERE MALFUNCTION OF THE PRODUCT CAN BE EXPECTED TO RESULT IN PERSONAL INJURY, DEATH OR SEVERE PROPERTY DAMAGE. BUYER USES OR SELLS SUCH PRODUCTS FOR USE IN SUCH CRITICAL APPLICATIONS AT BUYER'S OWN RISK AND AGREES TO DEFEND, INDEMNIFY AND HOLD HARMLESS DATAFORTH FROM ANY AND ALL DAMAGES, CLAIMS, PROCEEDINGS, SUITS OR EXPENSE RESULTING FROM SUCH USE.

h. **Static Sensitive**. Dataforth ships all product in anti-static packages. Dataforth's Warranty as hereinabove set forth shall not cover warranty repair, replacement, or refund on product or devices damaged by static due to buyer's failure to properly ground.

Application Support

Dataforth provides timely, high-quality product support. 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 (520) 741-1404. If a product return is required, request a Return Material Authorization (RMA) number. You should be ready to provide the following information:

1. Complete product model number.
2. Product serial number.
3. Name, address, and telephone number of person returning product.
4. Special repair instructions.
5. Purchase order number for out-of-warranty repairs.

The product should be carefully packaged, making sure the RMA number appears on the outside of the package, and ship prepaid to:

Dataforth Corporation
6230 S. Country Club
Tucson, AZ 85706 USA

An RMA Request Form and instructions for processing are also found at www.dataforth.com.

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ISO9001:2008-Registered QMS