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XMC610 Series Ethernet Network Interface Cards

USER'S MANUAL

ACROMAG INCORPORATED

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IMPORTANT SAFETY CONSIDERATIONS

It is very important for the user to consider the possible adverse effects of power, wiring, component, sensor, or software failures in designing any type of control or monitoring system. This is especially important where economic property loss or human life is involved. It is important that the user employ satisfactory overall system design. It is agreed between the Buyer and Acromag, that this is the Buyer's responsibility.

1.0 RELATED PUBLICATIONS

The following specifications provide necessary information for in depth understanding of this product and its use in a system architecture.

ANSI/VITA 42.0 – 2008 XMC Base Specification

ANSI/VITA 42.3 – 2006 XMC PCI Express Protocol Layer Standard

IEEE 802.3 – 2008 IEEE Standard for Ethernet

INF-8074i Specification for SFP Transceiver

SFF-8431 Enhanced Small Form Factor Pluggable Module

2.0 GENERAL INFORMATION

2.1 Intended Audience

This users' manual was written for technically qualified personnel who will be working with networking devices using this XMC module. It is not intended for a general, non-technical audience that is unfamiliar with XMC modules and their application.

2.2 Preface

The information contained in this manual is subject to change without notice, and Acromag, Inc. (Acromag) does not guarantee its accuracy. Acromag makes no warranty of any kind with regards to this material, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose. Further, Acromag assumes no responsibility for any errors that may appear in this manual and makes no commitment to update, or keep current, the information contained in this manual. No part of this manual may be copied or reproduced in any form, without the prior written consent of Acromag,

2.2.1 Trademark, Trade Name and Copyright Information

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All rights reserved. Acromag and Xembedded are registered trademarks of Acromag Incorporated. All other trademarks, registered trademarks, trade names, and service marks are the property of their respective owners.

2.2.2 Class A Product Warning

This is a Class A product. In a domestic environment this product may cause radio interference, in which case the user may find it necessary to take adequate corrective measures.

2.2.3 Environmental Protection Statement

This product has been manufactured to satisfy environmental protection requirements where possible. Many components used (structural parts, circuit boards, connectors, etc.) are capable of being recycled. Final disposition of this product after its service life must be conducted in accordance with applicable country, state, or local laws or regulations.

2.3 Product Overview

The XMC610 series modules are XMC modules that use the Intel I350 Ethernet Controller to provide four 1-Gigabit Ethernet interfaces. These modules interface with the PCIe bus via four high-speed serial lanes on the XMC P15 connector.

The XMC611 provides the interfaces via four RJ45 connectors available on the front panel. The XMC612 provides the interfaces via four SFP connectors available on the front panel. The XMC613 provides the interfaces as 1000BASE-T connections available as Rear I/O via the P16 connector.

2.4 Ordering Information

The following table lists the orderable models and their corresponding operating temperature range. All models support extended temperature operation.

MODELS	Description	OPERATING TEMPERATURE RANGE
XMC611	4-Port RJ45 1GbE NIC XMC	-40°C to +85°C[1]
XMC612	4-Port SFP 1GbE NIC XMC	-40°C to +85°C[1,2]
XMC613	4-Port Rear I/O 1GbE NIC XMC	-40°C to +85°C[1]

1. For applications requiring elevated operating temperatures, a minimum airflow of 200LFM is recommended.

2. The temperature rating does not apply to the SFP transceiver modules. Please consult the manufacturer's documentation of the SFP module to determine its operating temperature range.

2.5 Key Features

PCIe Bus – The PCI Express Gen 2 interface operates at a bus speed of 5 Gbps per lane per direction. The XMC610 modules utilize a x4 PCIe interface.

IEEE 802.3 Auto-negotiation – Automatic link configuration for speed, duplex, and flow control.

IEEE 1588 and 802.1AS Precision Timing – Time-stamping and synchronization of time sensitive applications. Distribute common time to connected devices.

IEEE 802.3az Energy Efficient Ethernet (EEE) – Power consumption is reduced by approximately 50% during idle state.

DMA Coalescing – Reduces platform power consumption by coalescing, aligning, and synchronizing DMA transfers. Enables synchronizing port activity and power management of memory, CPU, and other internal circuitry.

8 Tx and Rx Queue Pairs per Port – Supports VMware NetQueue and Microsoft VMQ.

Flexible Port Partitioning (PCI-SIG SR-IOV) – Up to 32 Virtual Functions (VFs) appear as Ethernet Controllers in Linux OSes that can be assigned to VMs, Kernel processes, or teamed using Linux Bonding Drivers.

TCP/UDP, IPv4/IPv6 Checksum Offloads – Extended Tx descriptors provide increased offload capabilities.

Jumbo Frame Packet Support – Improves system performance related to handling of network data on multiprocessor systems.

2.6 Software Support

The XMC610 series products require support drivers specific to your operating system. Supported operating systems include: Linux, Windows, and VxWorks.

Windows®

Acromag does not provide a custom Windows driver for these products. The Windows driver for the Intel I350 Ethernet Controller is available at www.intel.com.

VxWorks®

Acromag does not provide a custom VxWorks driver for these products. The VxWorks driver for the Intel I350 Ethernet Controller is available at www.intel.com. The Intel Ethernet driver is included in the default VxWorks 7.0 installation.

Linux®

Acromag does not provide a custom Linux driver for these products. The Linux driver for the Intel I350 Ethernet Controller is available at www.intel.com.

2.7 Block Diagrams

Figure 2.7.1: XMC611 Block Diagram

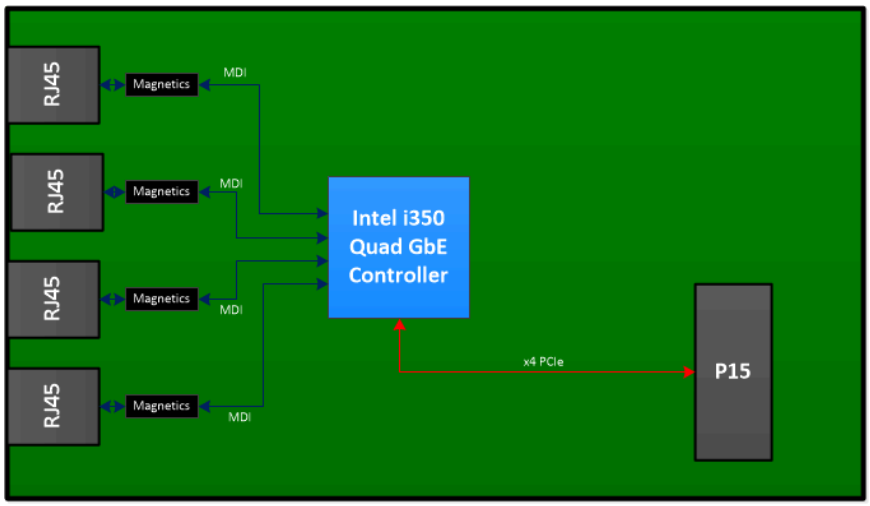


Figure 2.7.2: XMC612 Block Diagram

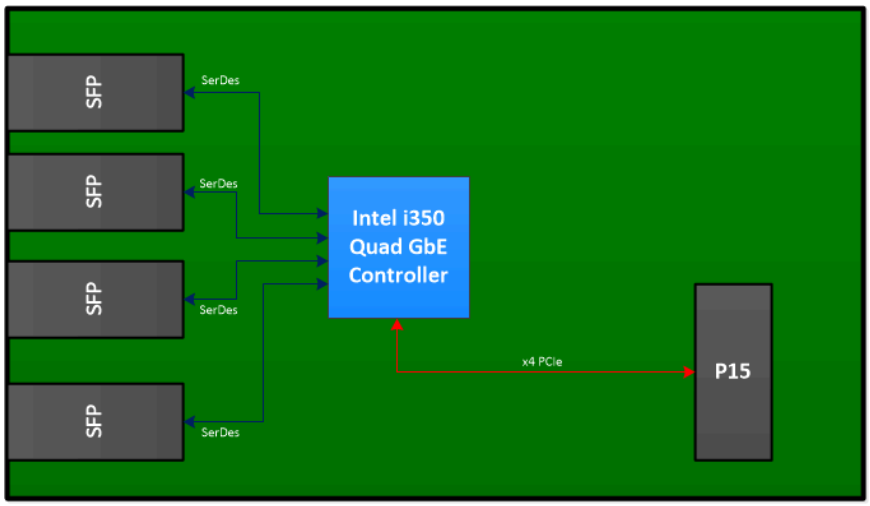
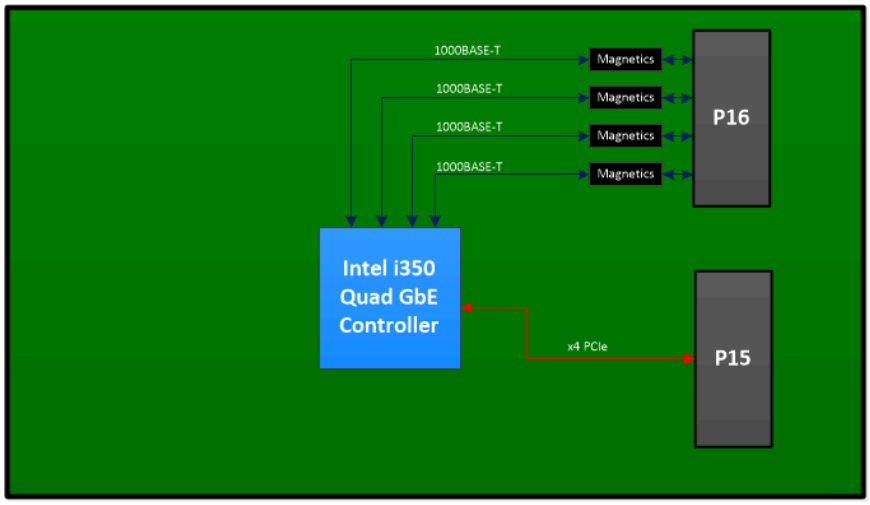
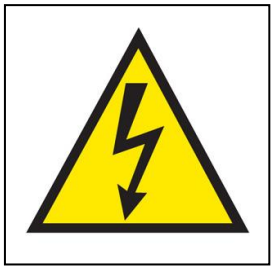


Figure 2.7.3: XMC613 Block Diagram



3.0 PREPARATION FOR USE

IMPORTANT PERSONAL AND PRODUCT SAFETY CONSIDERATIONS



It is very important for the user to consider the possible safety implications of power, wiring, component, sensor, or software failures in designing any type of control or monitoring system. This is especially important where personal injury or the loss of economic property or human life is possible. It is important that the user employ satisfactory overall system design. It is understood and agreed by the Buyer and Acromag that this is the Buyer's responsibility.



WARNING: This board utilizes static sensitive components and should only be handled at a static-safe workstation. This product is an electrostatic sensitive device and is packaged accordingly. Do not open or handle this product except at an electrostatic-free workstation. Additionally, do not ship or store this product near strong electrostatic, electromagnetic, magnetic, or radioactive fields unless the device is contained within its original manufacturer's packaging. Be aware that failure to comply with these guidelines will void the Acromag Limited Warranty.

3.1 Unpacking and Inspecting

Upon receipt of this product, inspect the shipping carton for evidence of mishandling during transit. If the shipping carton is badly damaged or water stained, request that the carrier's agent be present when the carton is opened. If the carrier's agent is absent when the carton is opened, and the contents of the carton are damaged, keep the carton and packing material for the agent's inspection.

For repairs to a product damaged in shipment, refer to the Acromag Service Policy to obtain return instructions. It is suggested that salvageable shipping cartons and packing material be saved for future use in the event the product must be shipped.

This board is physically protected with packing material and electrically protected with an anti-static bag during shipment. However, it is recommended that the board be visually inspected for evidence of mishandling prior to applying power.

The board utilizes static-sensitive components and should only be handled at a static-safe workstation.

3.2 Installation Considerations

IMPORTANT: Adequate air circulation must be provided to prevent a temperature rise above the maximum operating temperature.

Refer to the specifications for loading and power requirements. Be sure that the system power supplies can accommodate the power requirements of the carrier board, plus the installed XMC modules, within the voltage tolerances specified.

The dense packing of the XMC module to the carrier/CPU board restricts air flow within the card cage and is cause for concern. Adequate air circulation must be provided to prevent a temperature rise above the maximum operating temperature and to prolong the life of the electronics. If the installation is in an industrial environment and the board is exposed to environmental air, careful consideration should be given to air-filtering.

In a conduction cooled assembly, adequate thermal conduction must be provided to prevent a temperature rise above the maximum operating temperature.

3.3 Board Configuration

Power should be removed from the board when installing XMC modules, cables, termination panels, and field wiring.

4.0 HARDWARE INFORMATION

4.1 Connector Information

4.1.1 P15 Primary XMC Connector

The P15 XMC connector is wired per the VITA 42.0 standard. The P15 connector provides four lanes of PCI Express to the Intel Quad GbE Controller. The PCIe interface is connected per the VITA 42.3 standard.

Table 4.1.1: Primary XMC Connector P15

Pin	A	B	C	D	E	F
1	PET00+	PET00-	+3.3V	PET01+	PET01-	N.C.
2	GND	GND	TRST#	GND	GND	MRSTI#
3	PET02+	PET02-	+3.3V	PET03+	PET03-	N.C.
4	GND	GND	TCK	GND	GND	MRSTO#
5	N.C.	N.C.	+3.3V	N.C.	N.C.	N.C.
6	GND	GND	TMS	GND	GND	N.C.
7	N.C.	N.C.	+3.3V	N.C.	N.C.	N.C.
8	GND	GND	TDI	GND	GND	N.C.
9	N.C.	N.C.	N.C.	N.C.	N.C.	N.C.
10	GND	GND	TDO	GND	GND	GA0
11	PER00+	PER00-	MBIST#	PER01+	PER01-	N.C.
12	GND	GND	GA1	GND	GND	MPRSNT#
13	PER02+	PER02-	+3.3AUX	PER03+	PER03-	N.C.
14	GND	GND	GA2	GND	GND	MSDA
15	N.C.	N.C.	N.C.	N.C.	N.C.	N.C.
16	GND	GND	MVMRO	GND	GND	MSCL
17	N.C.	N.C.	N.C.	N.C.	N.C.	N.C.
18	GND	GND	N.C.	GND	GND	N.C.
19	REFCLK0_P	REFCLK0_N	N.C.	WAKE#	ROOT#	N.C.

4.1.2 P16 Secondary XMC Connector (XMC613 Only)

The P16 connector is used to provide Rear network I/O support and thus will only be populated on the XMC613 conduction-cooled model. The P16 secondary XMC connector connects the four 1000BASE-T Ethernet interfaces as shown in Table 4.1.2.

Table 4.1.2: Secondary XMC Connector P16

Pin	A	B	C	D	E	F
1	ENET0_P0_P	ENET0_P0_N	ENET3_ACT#	ENET0_P1_P	ENET0_P1_N	ENET3_LINK#
2	GND	GND	ENET2_ACT#	GND	GND	ENET2_LINK#
3	ENET0_P2_P	ENET0_P2_N	ENET1_ACT#	ENET0_P3_P	ENET0_P3_N	ENET1_LINK#
4	GND	GND	ENET0_ACT#	GND	GND	ENET0_LINK#
5	ENET1_P0_P	ENET1_P0_N	NC	ENET1_P1_P	ENET1_P1_N	NC
6	GND	GND	NC	GND	GND	NC
7	ENET1_P2_P	ENET1_P2_N	NC	ENET1_P3_P	ENET1_P3_N	NC
8	GND	GND	NC	GND	GND	NC
9	NC	NC	NC	NC	NC	NC
10	GND	GND	NC	GND	GND	NC
11	ENET2_P0_P	ENET2_P0_N	NC	ENET2_P1_P	ENET2_P1_N	NC
12	GND	GND	NC	GND	GND	NC
13	ENET2_P2_P	ENET2_P2_N	NC	ENET2_P3_P	ENET2_P3_N	NC
14	GND	GND	NC	GND	GND	NC
15	ENET3_P0_P	ENET3_P0_N	NC	ENET3_P1_P	ENET3_P1_N	NC
16	GND	GND	NC	GND	GND	NC
17	ENET3_P2_P	ENET3_P2_N	NC	ENET3_P3_P	ENET3_P3_N	NC
18	GND	GND	NC	GND	GND	NC
19	NC	NC	NC	NC	NC	NC

4.1.3 SFP Connectors (XMC612 Only)

On the XMC612 model, the four Gigabit Ethernet interfaces are available via standard SFP connectors. The XMC612 is fully compliant with the SFP Multi-Source Agreement and supports the use of all compliant SFP transceiver modules.

Table 4.1.3: SFP Connectors P1 – P4

11	VEER (GND)	VEER (GND)	10
12	RD-	RS1	9
13	RD+	RX_LOS	8
14	VEER (GND)	RS0	7
15	VCCR (+3.3V)	MOD_ABS	6
16	VCCT (+3.3V)	SCL	5
17	VEET (GND)	SDA	4
18	TD+	TX_DISABLE	3
19	TD-	TX_FAULT	2
20	VEET (GND)	VEET (GND)	1

4.1.4 RJ45 Connectors (XMC611 Only)

On the XMC611 model, the four Gigabit Ethernet interfaces are available via standard RJ45 connectors.

Table 4.1.4: RJ45 Connectors J1 – J4

Pin	Pin Description
1	TRD0+
2	TRD0-
3	TRD1+
6	TRD1-
4	TRD2+
5	TRD2-
7	TRD3+
8	TRD3-

5.0 SERVICE AND REPAIR

5.1 Service and Repair Assistance

Surface-Mounted Technology (SMT) are generally difficult to repair. It is highly recommended that a non-functioning board be returned to Acromag for repair. The board can be damaged unless special SMT repair and service tools are used. Further, Acromag has automated test equipment that thoroughly checks the performance of each board.

Please refer to Acromag's Service Policy Bulletin or contact Acromag for complete details on how to obtain parts and repair.

5.2 Preliminary Service Procedure

CAUTION: POWER MUST BE TURNED OFF BEFORE SERVICING BOARDS

Before beginning repair, be sure that all the procedures in the "Preparation for Use" section have been followed. Also, refer to the documentation of your carrier board to verify that it is correctly configured. Replacement of the board with one that is known to work correctly is a good technique for isolating a faulty part.

5.3 Where to Get Help

If you continue to have problems, your next step should be to visit the Acromag worldwide web site at https://www.acromag.com. Our web site contains the most up-to-date product and software information.

Go to the "Support" tab or your specific XMC model ordering page.

Acromag's application engineers can also be contacted directly for technical assistance via email, telephone, or FAX through the contact information listed below. Note that an email question can also be submitted from within the Knowledge Base or directly from the "Contact Us" tab. When needed, complete repair services are also available.

- Email: solutions@acromag.com
- Phone: 248-295-0310

6.0 SPECIFICATIONS

6.1 Physical

Length:	149.0 mm (5.866 in.)
Width:	74.0 mm (2.913 in.)
Stacking Height:	10.0 mm (0.394 in.)
Weight XMC611:	83.2 g
Weight XMC612:	98.5 g
Weight XMC613:	78.5 g

Unit weight does not include shipping materials.

6.2 Power Requirements

The XMC610 boards are powered entirely from the 3.3V supply present on the XMC P15 connector. The 5V/12V VPWR supply is not used on these boards.

The following power consumption values were measured with 2 ports utilized, 4 ports utilized, and with all ports idle or all ports active. Active ports were measured while operating with continuous network traffic at link speed at full duplex.

XMC611

	3.3V (mA)	Total Power (mW)
2 Ports Idle[1]	401	1323
2 Ports Active	885	2920
4 Ports Idle[1]	517	1706
4 Ports Active	1126	3717

XMC612

	3.3V (mA)	Total Power (mW)
2 Ports Idle	494	1630
2 Ports Active	554	1830
4 Ports Idle	585	1932
4 Ports Active	701	2313

XMC613

	3.3V (mA)	Total Power (mW)
2 Ports Idle[1]	401	1323
2 Ports Active	885	2920
4 Ports Idle[1]	517	1706
4 Ports Active	1126	3717

1. Energy Efficient Ethernet Enabled

6.3 Environmental Considerations

Summarized below are the operating temperature range, airflow and other environmental requirements and applicable standards for the XMC610 Series modules.

6.3.1 Operating Temperature

Table 6.3.1: Operating Temperature

MODELS	Description	OPERATING TEMPERATURE RANGE
XMC611	4-Port RJ45 1GbE NIC XMC	-40°C to +85°C[1]
XMC612	4-Port SFP 1GbE NIC XMC	-40°C to +85°C[1,2]
XMC613	4-Port Rear I/O 1GbE NIC XMC	-40°C to +85°C[1]

1. For applications requiring elevated operating temperatures, a minimum airflow of 200LFM is recommended.

2. The temperature rating does not apply to the SFP transceiver modules. Please consult the manufacturer's documentation of the SFP module to determine its operating temperature range.

6.3.2 Relative Humidity

The range of acceptable relative humidity is 5% to 95% non-condensing.

6.3.3 Vibration and Shock Standards

The XMC610 series products are designed to comply with the following Vibration and Shock standards.

Vibration, Random Operating: Designed to comply with VITA 47 Class V1. Shall withstand vibration from 5 to 100Hz. with Power Spectral Density (PSD) = $0.04g^2/Hz$, for 1 hour per axis. Testing shall be in accordance with MIL-STD-810, Method 514, Procedure 1

Shock, Operating: Designed to comply with VITA 47 Class OS1, 20g, 11ms half sine and terminal sawtooth shock pulses. 3 shock pulses in each direction along 3 axes (36 shocks, total). Testing shall be in accordance with MIL-STD-810, Method 516, Procedure 1.

6.3.4 EMC Directives

Electromagnetic Compatibility (EMC): CE Marked, per EMC Directive 2014/30/EU Class A.

The XMC610 family is designed to comply with EMC Directive 2014/30/EU.

- **Immunity per EN 61000-6-2:**
  Electrostatic Discharge Immunity (ESD), per IEC 61000-4-2.
  Radiated Field Immunity (RFI), per IEC 61000-4-3.
  Electrical Fast Transient Immunity (EFT), per IEC 61000-4-4.
  Surge Immunity, per IEC 61000-4-5.
  Conducted RF Immunity (CRFI), per IEC 61000-4-6.
- **Emissions per EN 61000-6-4:**
  Enclosure Port, per CISPR 16.
  Low Voltage AC Mains Port, per CISPR 16.
  Note: This is a Class A product

FCC Conformity: These devices comply with Part 15, Class A of the FCC rules. Operation is subject to the following two conditions: (1) These devices may not cause harmful interference, and (2) these devices must accept any interference received, including interference that may cause undesired operation.

6.4 Reliability Prediction

Table 6.4.1: XMC611 MTBF Predictions

MTBF (Mean Time Between Failure): MTBF in hours using MIL-HDBK-217F, FN2. *Per MIL-HDBK-217, Ground Benign, Controlled,* $G_B G_C$

Temperature	MTBF (Hours)	MTBF (Years)	Failure Rate (FIT[1])
25°C	1,506,982	172.0	663.6
40°C	1,089,482	124.4	917.9

[1] FIT is Failures in 10^9 hours.

Table 6.4.2: XMC612 MTBF Predictions

MTBF (Mean Time Between Failure): MTBF in hours using MIL-HDBK-217F, FN2. *Per MIL-HDBK-217, Ground Benign, Controlled,* $G_B G_C$

Temperature	MTBF (Hours)	MTBF (Years)	Failure Rate (FIT[1])
25°C	1,846,170	210.7	541.7
40°C	1,257,870	143.6	795.0

[1] FIT is Failures in 10^9 hours.

Table 6.4.3: XMC613 MTBF Predictions

MTBF (Mean Time Between Failure): MTBF in hours using MIL-HDBK-217F, FN2. *Per MIL-HDBK-217, Ground Benign, Controlled,* $G_B G_C$

Temperature	MTBF (Hours)	MTBF (Years)	Failure Rate (FIT[1])
25°C	1,527,620	174.4	654.6
40°C	1,109,159	126.6	901.6

[1] FIT is Failures in 10^9 hours.

7.0 Certificate of Volatility

Certificate of Volatility				
Acromag Models: XMC611 XMC612 XMC613	Manufacturer: Acromag, Inc. 30765 Wixom Rd Wixom, MI 48393			
Volatile Memory				
Does this product contain Volatile memory (i.e. Memory of whose contents are lost when power is removed)? □ Yes ■No				
Type (SRAM, SDRAM, etc.)	Size:	User Modifiable □ Yes □ No	Function:	Process to Sanitize:
Non-Volatile Memory				
Does this product contain Non-Volatile memory (i.e. Memory of whose contents is retained when power is removed)? ■ Yes □ No				
Type (EEPROM, Flash, etc.) EEPROM	Size: 2 Kbit	User Modifiable ■ Yes □ No	Function: FRU Records	Process to Sanitize: Clear EEPROM by erasing all bytes.
Type (EEPROM, Flash, etc.) EEPROM	Size: 128 Kbit	User Modifiable □ Yes ■ No	Function: I350 Configuration Data	Process to Sanitize: Clear EEPROM by erasing all bytes.

Acromag Representative				
Name: Russ Nieves	Title: Dir. of Sales and Marketing	Email: solutions@acromag.com	Office Phone: 248-295-0310	Office Fax: 248-624-9234

8.0 Revision History

The revision history for this document is summarized in the table below.

Release Date	Version	EGR/DOC	Description of Revision
18 MAY 2018	Preliminary	MDW/ARP	Internal Release.
07 JUN 2018	A	MDW/ARP	Rev A Release.
06 JUL 2018	B	MDW/ARP	Added minimum airflow requirements.
26 OCT 2018	C	CAP/ARP	Added CE and FCC statements.
03 MAY 2019	D	MDW/MJO	Added MTBF data.

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