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XMC630 Series Ethernet Network Interface Cards

USER'S MANUAL

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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 – XMC Base Specification

ANSI/VITA 42.3 – XMC PCI Express Protocol Layer Standard

ANSI/VITA 42.6 – XMC 10 Gigabit Ethernet 4-Lane Protocol Layer Standard

IEEE 802.3 – 2008 IEEE Standard for Ethernet

IEEE 802.3ae – 2002 IEEE Amendment for 10 Gb/s Ethernet

SFF-8431 Enhanced Small Form Factor Pluggable Module SFP+

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 XMC630 series modules are XMC modules that use the Intel XL710 Ethernet Controller to provide up to four 10-Gigabit Ethernet interfaces. These modules interface with the PCIe bus via eight high-speed serial lanes on the XMC P15 connector. The aggregate data rate of the four Ethernet ports is limited by the PCIe host interface. A PCIe Gen3 x8 connection is necessary to achieve full 4 x 10G bandwidth.

The XMC631 provides four 10GbE interfaces via SFP+ connectors available on the front panel. The XMC632 provides two 10GbE XAUI interfaces 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. Each model is available with the standard VITA 42 (XMC1.0) connectors or the high-speed VITA 61 (XMC2.0) connectors.

MODELS	Description	OPERATING TEMPERATURE RANGE
XMC631-42-20	4-Port SFP+ 10GbE NIC XMC VITA 42 Style Connectors	0°C to +70°C[1,2]
XMC631-42-30	4-Port SFP+ 10GbE NIC XMC VITA 42 Style Connectors	-40°C to +85°C[1,2]
XMC631-61-20	4-Port SFP+ 10GbE NIC XMC VITA 61 Style Connectors	0°C to +70°C[1,2]
XMC631-61-30	4-Port SFP+ 10GbE NIC XMC VITA 61 Style Connectors	-40°C to +85°C[1,2]
XMC632-42-50	2-Port XAUI 10GbE NIC XMC VITA 42 Style Connectors	-40°C to +85°C
XMC632-61-50	2-Port XAUI 10GbE NIC XMC VITA 61 Style Connectors	-40°C to +85°C

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 3 interface operates at a bus speed of 8 Gbps per lane per direction. The XMC630 modules utilize a x8 PCIe interface.

SFP+ Connectivity – Supports SFP connections for 10GBASE-SR, 10GBASE-LR, 10GBASE-T, and 10GSFP+Cu Direct Attach Copper physical media.

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.

Intel Ethernet Flow Director – Advanced traffic steering capability that increases the number of transactions per second and reduces latency.

VMDq for Emulated Path – Virtual Machine Device Queues enable a hypervisor to represent a single network port as multiple network ports that can be assigned to individual VMs.

Dynamic Load Balancing – Increases performance by efficiently balancing loads across CPU cores when used with Receive-Side Scaling from Microsoft or scalable I/O in Linux.

Flexible Port Partitioning (PCI-SIG SR-IOV) – Up to 128 Virtual Functions (VFs) appear as Ethernet Controllers in Linux OSes that can be assigned to VMs, Kernel processes, or teamed using Linux Bonding Drivers.

Tx/Rx IP, TCP/UDP/SCTP, IPv4/IPv6 Checksum Offloads – Enables lower processor usage. Checksum and segmentation capability extended to new standard packet type.

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

2.6 Software Support

The XMC630 series products require support drivers specific to your operating system. Supported operating systems include: Linux, Windows.

Windows®

Acromag does not provide a custom Windows driver for these products. The Windows driver for the Intel XL710 Ethernet Controller is available at www.intel.com.

Linux®

Acromag does not provide a custom Linux driver for these products. The Linux driver for the Intel XL710 Ethernet Controller is available at www.intel.com.

2.7 Block Diagrams

Figure 2.7.1: XMC631 Block Diagram

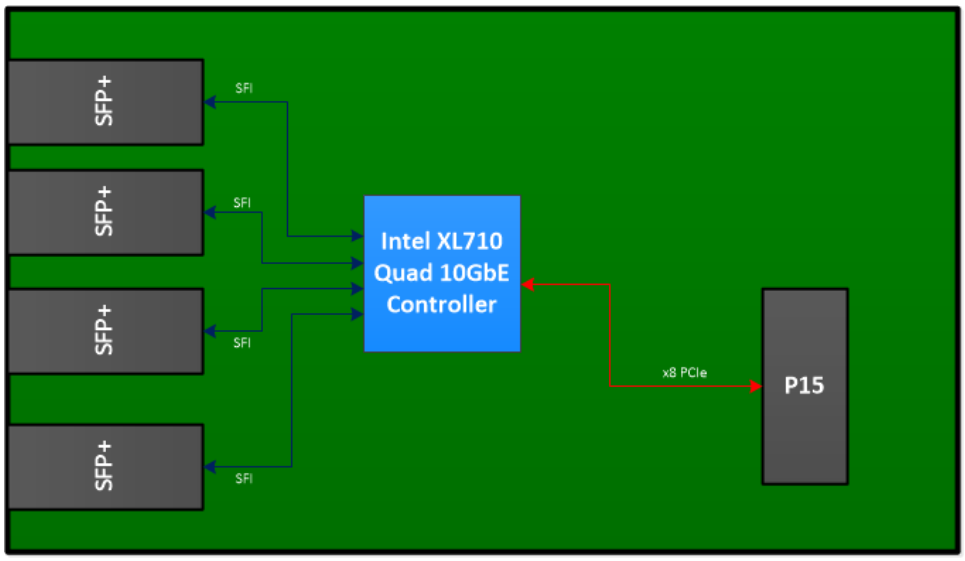
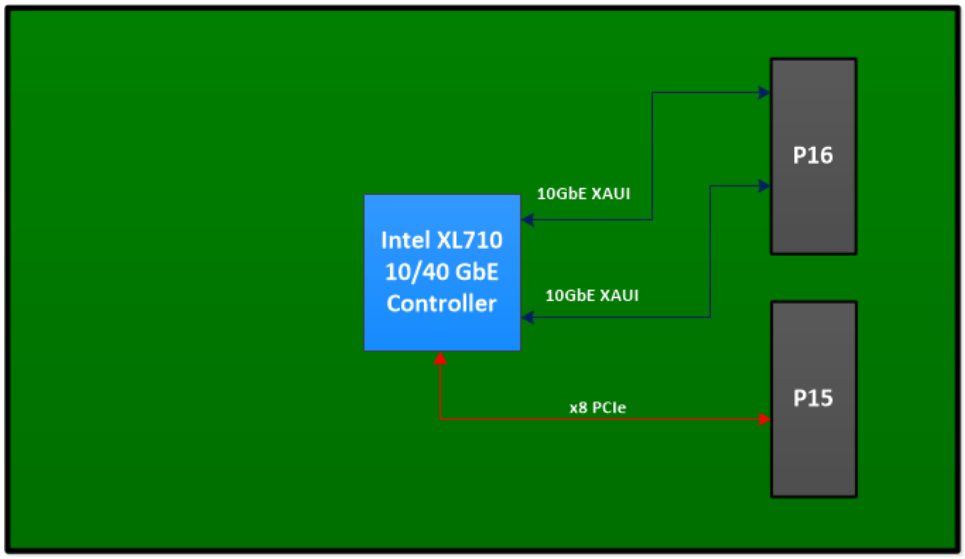
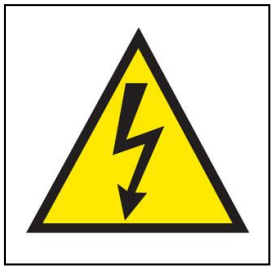


Figure 2.7.2: XMC632 Block Diagram



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 eight lanes of PCI Express to the Intel Ethernet 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	PET04+	PET04-	+3.3V	PET05+	PET05-	N.C.
6	GND	GND	TMS	GND	GND	N.C.
7	PET06+	PET06-	+3.3V	PET07+	PET07-	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	PER04+	PER04-	N.C.	PER05+	PER05-	N.C.
16	GND	GND	MVMRO	GND	GND	MSCL
17	PER06+	PER06-	N.C.	PER07+	PER07-	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 (XMC632 Only)

The P16 connector is used to provide Rear network I/O support and thus will only be populated on the XMC632 conduction-cooled model. The P16 secondary XMC connector connects the two 10GbE XAUI interfaces as shown in Table 4.1.2. The XAUI interfaces are connected per the VITA 42.6 standard.

Table 4.1.2: Secondary XMC Connector P16

Pin	A	B	C	D	E	F
1	X0_TX0_P	X0_TX0_N	NC	X0_TX1_P	X0_TX1_N	NC
2	GND	GND	NC	GND	GND	NC
3	X0_TX2_P	X0_TX2_N	NC	X0_TX3_P	X0_TX3_N	NC
4	GND	GND	NC	GND	GND	NC
5	X1_TX0_P	X1_TX0_N	NC	X1_TX1_P	X1_TX1_N	NC
6	GND	GND	NC	GND	GND	NC
7	X1_TX2_P	X1_TX2_N	NC	X1_TX3_P	X1_TX3_N	NC
8	GND	GND	NC	GND	GND	NC
9	NC	NC	NC	NC	NC	NC
10	GND	GND	NC	GND	GND	NC
11	X0_RX0_P	X0_RX0_N	NC	X0_RX1_P	X0_RX1_N	NC
12	GND	GND	NC	GND	GND	NC
13	X0_RX2_P	X0_RX2_N	NC	X0_RX3_P	X0_RX3_N	NC
14	GND	GND	NC	GND	GND	NC
15	X1_RX0_P	X1_RX0_N	NC	X1_RX1_P	X1_RX1_N	NC
16	GND	GND	NC	GND	GND	NC
17	X1_RX2_P	X1_RX2_N	NC	X1_RX3_P	X1_RX3_N	NC
18	GND	GND	NC	GND	GND	NC
19	NC	NC	NC	NC	NC	NC

4.1.3 SFP+ Connectors (XMC631 Only)

On the XMC631 model, the four 10-Gigabit Ethernet interfaces are available via standard SFP+ connectors. The XMC631 is fully compliant with the SFF-8431 Specifications for Enhanced Small Form Factor Pluggable Module SFP+. All SFF-8431 compliant SFP+ modules are supported.

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

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 the problem persists, the next step should be to visit the Acromag worldwide web site at http://www.acromag.com. Our web site contains the most up-to-date product and software information.

Go to the "Support" tab to access:

- Application Notes
- Frequently Asked Questions (FAQ's)
- Product Knowledge Base
- Tutorials
- Software Updates/Drivers

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 XMC631:	104.2 g
Weight XMC632:	76.9 g

Unit weight does not include shipping materials.

6.2 Power Requirements

The XMC630 boards are powered by the 3.3V supply and the 5V/12V VPWR supply present on the XMC P15 connectors. Both 5V and 12V are supported as VPWR from the XMC carrier board. The optional auxiliary 3.3V supply on the P15 connector can be used to power the IPMI FRU EEPROM device.

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.

XMC631

	3.3V (mA)	5V/12V (mA)	Total Power (W)
Typical Idle[1]	250	467/219	2.98
Typical Active[2]	250	565/260	3.49
Maximum[3]	400	1098/482	6.20

XMC632

	3.3V (mA)	5V/12V (mA)	Total Power (W)
Typical Idle[1]	220	448/211	2.77
Typical Active[2]	220	498/232	3.04
Maximum[3]	330	1024/451	5.63

1. Idle is defined as typical conditions, T_j = 80°C, nominal voltages, and no traffic.
2. Active is defined as typical conditions, T_j = 80°C, nominal voltages, and continuous network traffic at link speed on all ports.
3. Maximum is defined as maximum conditions, max operating temperature (T_j = 110°C), nominal voltages, and continuous network traffic at link speed on all ports.

6.3 Environmental Considerations

Summarized below are the operating temperature range, airflow and other environmental requirements and applicable standards for the XMC630 Series modules.

6.3.1 Operating Temperature

Table 6.3.1: Operating Temperature

MODELS	DESCRIPTION	OPERATING TEMPERATURE RANGE
XMC631-XX-20	4-Port SFP+ 10GbE NIC XMC	0°C to +70°C[1,2]
XMC631-XX-30	4-Port SFP+ 10GbE NIC XMC	-40°C to +85°C[1,2]
XMC632-XX-50	2-Port XAUI 10GbE NIC XMC	-40°C to +85°C[3]

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.
3. For conduction-cooled applications, adequate thermal conduction must be provided to prevent a temperature rise above the maximum operating temperature.

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 XMC630 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

The XMC630 family is designed to comply with EMC Directive 2004/108/EC.

- **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

6.4 Reliability Prediction

Table 6.4.1: XMC631 MTBF Predictions

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

Temperature	MTBF (Hours)	MTBF (Years)	Failure Rate (FIT[1])
25°C	1,412,382	161.2	708.0
40°C	846,375	96.6	1,181.5

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

Table 6.4.2: XMC632 MTBF Predictions

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

Temperature	MTBF (Hours)	MTBF (Years)	Failure Rate (FIT[1])
25°C	1,485,286	169.6	673.3
40°C	894,775	102.1	1,117.6

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

7.0 Certificate of Volatility

Certificate of Volatility				
Acromag Models: XMC631-42-20 XMC631-42-30 XMC631-61-20 XMC631-61-30 XMC632-42-50 XMC632-61-50	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.) Flash	Size: 128 Mbit	User Modifiable □ Yes ■ No	Function: XL710 Configuration Data	Process to Sanitize: Clear Flash 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
21 NOV 2018	Preliminary	MDW/ARP	Internal Release.
12 MAR 2019	A	MDW/MJO	Rev A Release

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