



**10Mbps SPREAD SPECTRUM
WIRELESS TRANSCEIVERS**

M10 Series User's Manual

Rev. 1

NOTICES

FCC

Models, JX-4000F-A, JX4000F-C, JX4000W-A and JX4000W-C comply with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) This device must accept any interference received, including interference that may cause undesired operation.

Removing covers from of the radio(s) nullifies the FCC compliance and can be the cause of spurious transmission, RF noise and out of band transmission levels above FCC regulations.

Warning

The manufacturer assumes no responsibility for damage caused by interference due to this equipment.

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Patent

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1. INTRODUCTION

1.1 Welcome

Welcome to Clarion's world of wireless LAN (Local Area Network) products. The M10 family of products currently include the M10 (Models JX-4000FA, JX-4000F-C and JX-4000F-S), and the M10II (Models JX-4000W-A, JX-4000W-C, and JX4000W-S).

The **M10** is a wireless multi-point modem, the **M10II** is an extension of this multi-point modem to multi-source address situations, it can accommodate up to 200 NICs (Network Interface Cards) per network segment, and maintains its own internal tables.

1.1.1 M10

The M10 is a robust, 10 Mbps (Megabits Per Second) wireless single address, multi-point modem designed to support wireless connections across town, across the street or just across the hall for IEEE 802.3 and Ethernet II (TCP/IP) LANs. It provides all the functionality of a wired LAN, without the physical constraints of the wire.

The M10 uses state-of-the-art spread spectrum technology, which provides secure, long-range radio link operations for reliable transmission.

The M10 is compatible with all computer platforms, operating systems and network protocols. It is pre-configured to operate right out of the box, just connect the M10 to your existing Ethernet card and use your existing network software. The M10 functions as an Ethernet Medium Attachment Unit (MAU) encapsulating the Medium Access Control (MAC) frames from a standard Auxiliary Unit Interface (AUI) port to form a Radio Frequency (RF) MAC frame.

The M10 can be connected to a computer, hub or router and can be used to create innovative LANs by combining existing wired devices with the M10 units without sacrificing speed or accuracy.

1.1.2 M10II

The M10II is the second generation Clarion product in the M10 family. The M10II offers all the functions and features of the original M10 modem, as well as providing an important additional advantage to customers. The

upgraded feature of the M10II is the extension of retransmission protocol to multi-source address situations.

This key new feature of the M10II required substantial development. In wired communications frames are lost mainly by collisions. However, in wireless communications frames can be lost by fading, weak signals or interference. Thus, all radio modems require lower level retransmission of frames to provide adequate reliability and throughput. The original M10 was designed for connection to a single Ethernet card, either in a workstation or a router. Both the workstation and the router employ a single 802.3 source address that the M10 learns and uses for the retransmission protocol. Thus, when the M10 receives a frame with the destination address equal to the address of the attached Ethernet card, the M10 sends the RF acknowledgment frame to the source modem. The M10II can do this for multiple Ethernet source addresses.

There are two important situations in which the above single-source-address constraint is violated: 802 MAC (media access control) level bridging and wireless interconnection of 10BaseT hubs. Each of these is important for general networking, and each presents the modem with multiple source addresses from the wired side. The M10II maintains a list of its wired side source addresses, and will acknowledge RF frames addressed to these. Thus, the key new feature of the M10II is extension of the retransmission protocol to multi-source-address configurations.

The M10II maintains acknowledgment-address tables, however, it is not a bridge. For 802-compliant bridging the M10II can be connected to a MAC bridge, with the MAC bridge providing address tables obtained via the spanning-tree algorithm.

1.2 Summary of Features

1.2.1 FEATURES OF ALL M10 MODEMS

- **10 Mbps Wireless Multi-Point Modem**
- **Plugs into AUI port of a hub, media converter or router**
- **Simple to install**
- **Adapts immediately without user intervention**
- **High Throughput at the MAC (Media Access Control) layer**
- **Compatible with all IEEE 802.3 and Ethernet II LAN devices, all operating systems and all protocol stacks**
- **Completely transparent to the network operating system**
- **Secure Direct Sequence Spread Spectrum (DSSS) Technology**
- **Provides all the functionality of wired LANs without the wire**
- **No FCC License is required**

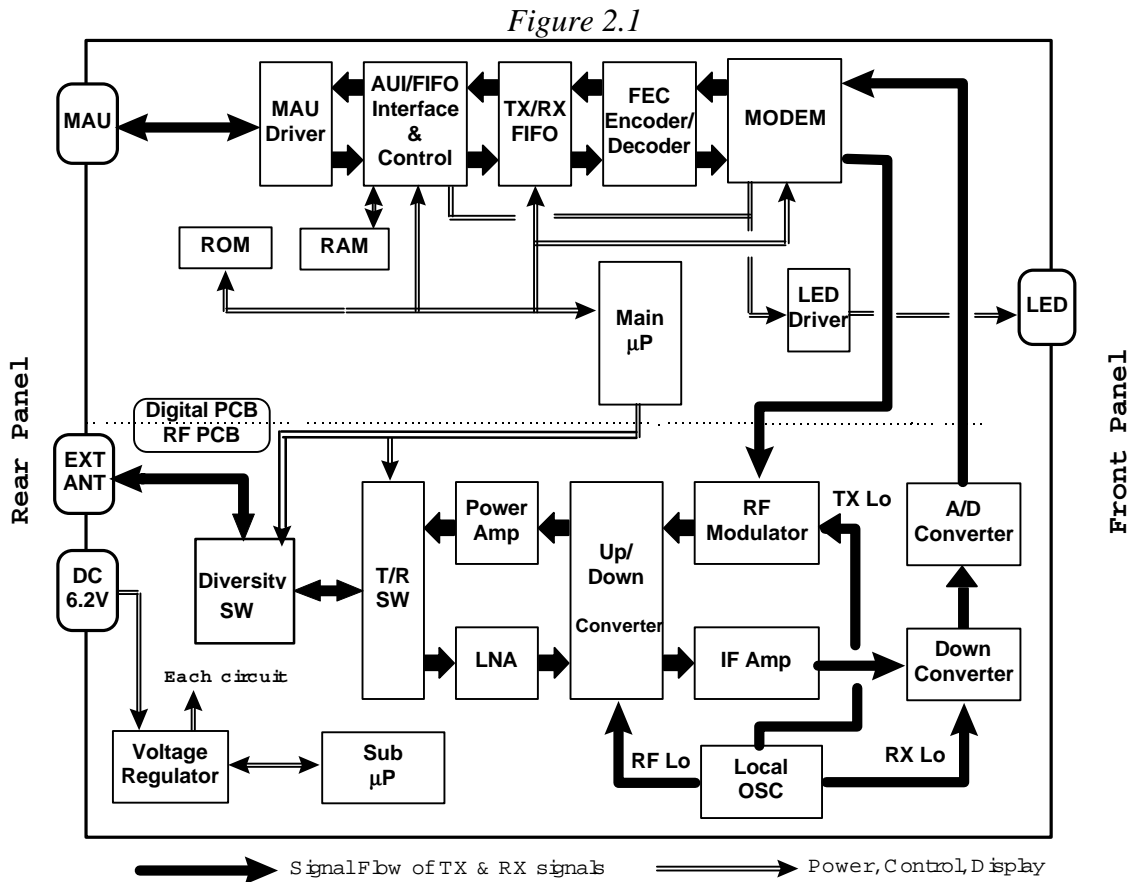
1.2.2 ADDITIONAL FEATURES OF THE M10II

- **Automatically senses local traffic, builds internal tables and operates re-transmission and packet filtering protocols**
- **Accommodates up to 200 NICs per network segment**

2. STRUCTURE

2.1 Block Diagram

The following is a block diagram of the M10.



2.2 Description of Block Diagram

MAU port: The AUI port of an Ethernet device connects to the MAU port of the M10 through a transceiver cable (AUI cable). The connector type is physically the same as for a standard MAU.

MAU Driver: Bi-directional driver to the MAU port.

AUI/FIFO Interface & Control: provides fast-in-fast-out buffer management using *TX/RX FIFO* to minimize the degradation of the throughput.

TX/RX FIFO: FIFO RAM managed by *AUI/FIFO Interface & Control*.

FEC Encoder/Decoder: Encoder and a decoder for efficient forward error correction.

MODEM: generates baseband transmission signals corresponding to the uploaded data stream or a control data generated by the *Main mP*. It also regenerates the received data bit stream corresponding to the output of an *A/D Converter*.

RF Modulator: modulates the IF (Intermediate Frequency) carrier by the output of the *MODEM*.

Up/Down Converter: up-converts the modulated RF signal of the *RF Modulator* to radio transmission signals in the 2.4 GHz band. It also down-converts incoming RF signals of the 2.4 GHz band to IF signals.

Power Amp: amplifies the 2.4 GHz band signals up to transmit power.

RF SW: switches the signal flow from an antenna to a receiver or from the *Power Amp* to the antenna.

Diversity SW: switches the antenna to use the internal antenna or the external antenna, controlled by the *Main mP* to improve the reception under the extreme fading environment.

Ext. Ant. port: The external antenna connects to this port. RF signals of 2436 MHz are transmitted or received. The connector type is a SMA female.

LNA (Low Noise Amplifier): reduces the noise figure of the receiver to obtain sufficient sensitivity.

Local OSC: provides local signals fed to the *Up/Down Converter*, to the *RF Modulator* and to the *Down Converter*.

IF Amp: amplifies the IF (Intermediate Frequency) signal of 487 MHz, enough to be handled by the *A/D Converter*.

Down Converter: regenerates baseband signals from IF signals fed to the *A/D Converter*.

A/D Converter: converts analog baseband signals to digital signal stream for the *MODEM*.

Main mP (Microprocessor): controls the signal flow, hardware functions, and the protocol.

DC 6.2V port: The output of the AC adapter connects to this port. This voltage is tightly specified. Please contact to Clarion, if you want to use alternate power sources.

LED: indicates operating situations of the M10. Please refer to specifications for details.

Sub mP: controls power fed to each circuit of the M10.

2.3 Principles of Operation

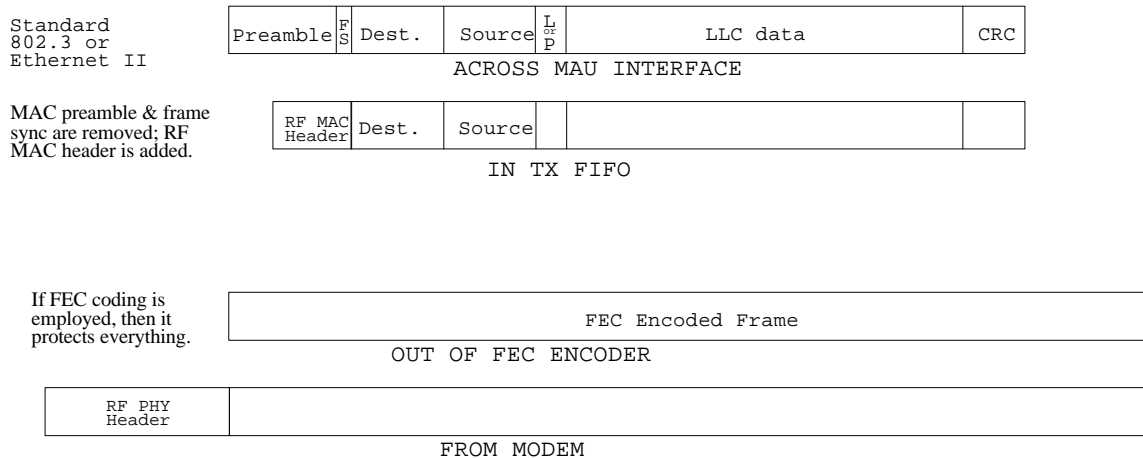
2.3.1 UPLOAD PROCESS

The *Upload* is defined as a data flow from an Ethernet device to the M10. During *Upload*, it provides the following:

- Detection of preamble of the Ethernet frame followed by the frame sync pattern.
- Suppression of the Ethernet preamble and frame sync for RF transmission. (These portions of the frame are meaningless for wireless transmission).
- Generation of a **Collision** signal if an *Upload* commences while the AUI interface is busy; generation of the busy **Collision** is selected through configuration setup. This enables the M10 to force the Ethernet card into its exponential back-off algorithm for flow control. If generation of the **Collision** is not selected, then no **Collision** is generated but *Uploads* are ignored.
- Generation, when enabled through the configuration setup, of the **SQE** (Signal Quality Error) test signal toward the MAU port.
- FEC-encoding, when FEC is enabled through configuration setup.
- Generation of header information (RF MAC and RF physical layer).
- Spread-spectrum carrier sense before transmission, with preference given to reception. The M10 senses signals after correlation, meaning that interference, such as microwave ovens and different kinds of wireless LAN systems, cannot be sensed.
- Data and spread-spectrum modulation onto a carrier of 2.4 GHz and RF transmission.

Figure 2.3.1 shows the encapsulation process described above.

Figure 2.3.1



2.3.2 DOWNLOAD PROCESS

The **Download** is defined as a data flow from the M10 to an Ethernet device. During **Download**, it provides the following:

- Detection of and time alignment to received radio signal.
- Demodulation of PHY header and MAC frame.
- FEC decoding when the M10 recognizes that the received frame is FEC encoded by reading PHY header.
- Checking of 32-bit CRC (generated by an Ethernet card that **Uploaded** the frame).
- Conversion of serial stream to bytes for storing in FIFO.
- Regeneration of the Ethernet preamble and frame sync.

- Detection of any collision condition for avoiding collision of the **Download** to the **Upload** and signaling of such to the AUI interface and to the CPU.

2.3.3 BUFFER MEMORY

A data transfer is called an **Upload** when the Ethernet device conveys a frame to the buffer memory, and a **Download** when a frame is conveyed from the buffer memory to the Ethernet device. The buffer memory is organized as 16 2-Kbytes FIFOs, each FIFO being independently employed and capable of storing a maximum-length Ethernet frame of 1518-bytes.

When all buffers are consumed, a **Collision** signal is generated to force the Ethernet card into its exponential back-off algorithm for flow control. If generation of the **Collision** is not selected, then no **Collision** is generated but **Upload(s)** are ignored.

2.3.4 FORWARD ERROR CORRECTION (FEC)

The nominal transmission mode (uncoded mode) employs modulation without FEC. The enhanced-robustness mode (coded mode) employs FEC to overcome irreducible errors due to multi-path propagation condition. The coded mode and/or selection of a diversity antenna can be selected by the RF-MAC-level re-transmission protocol.

2.3.5 RE-TRANSMISSION

A re-transmission protocol at the RF MAC layer provides enhanced reliability. The 32-bit CRC, checked by the 802.3 MAC layer to provide ultimate data reliability, is also used to support the re-transmission protocol. Figure 2.3.5 shows a conceptual signal flow diagram of the re-transmission.

The use of MAC-level re-transmission protocol, recommended by 802.11 draft standard, is important for high throughput. Re-transmission via the level-four transport protocol must be avoided because of the long time-out typically employed.

Prior to the re-transmission, the M10 recognizes and memorizes the source MAC address of an Ethernet device connected to the M10 through the MAU port. The **Download** occurs only when the M10 recognizes complete matching of the memorized source MAC address and destination MAC address written in a received radio frame. Once the M10 memorizes the source MAC address, no update of the source MAC address is performed in the M10 unless the power turns off. That is, applications that lead to frequent changing of the source MAC address of the Ethernet frame coming from plural Ethernet devices through the MAU interface are not suitable for making the re-transmission effective. In case of such applications, we recommend the M10 be configured without re-transmission.

The re-transmission protocol is based on the recognition of acknowledgment generated by a M10 that received a radio data frame from another. A radio frame that carries the acknowledgment is called an **Ack**-frame and effects only the RF MAC level protocol. Contents of the **Ack**-frame never appear at the MAU port. The **Ack**-frame is transmitted immediately after the completion of receiving.

The re-transmission is not available for Broadcast-frames because no Ack-frame can be transmitted for Broadcast-frames (it contains a destination address of all 1 bits).

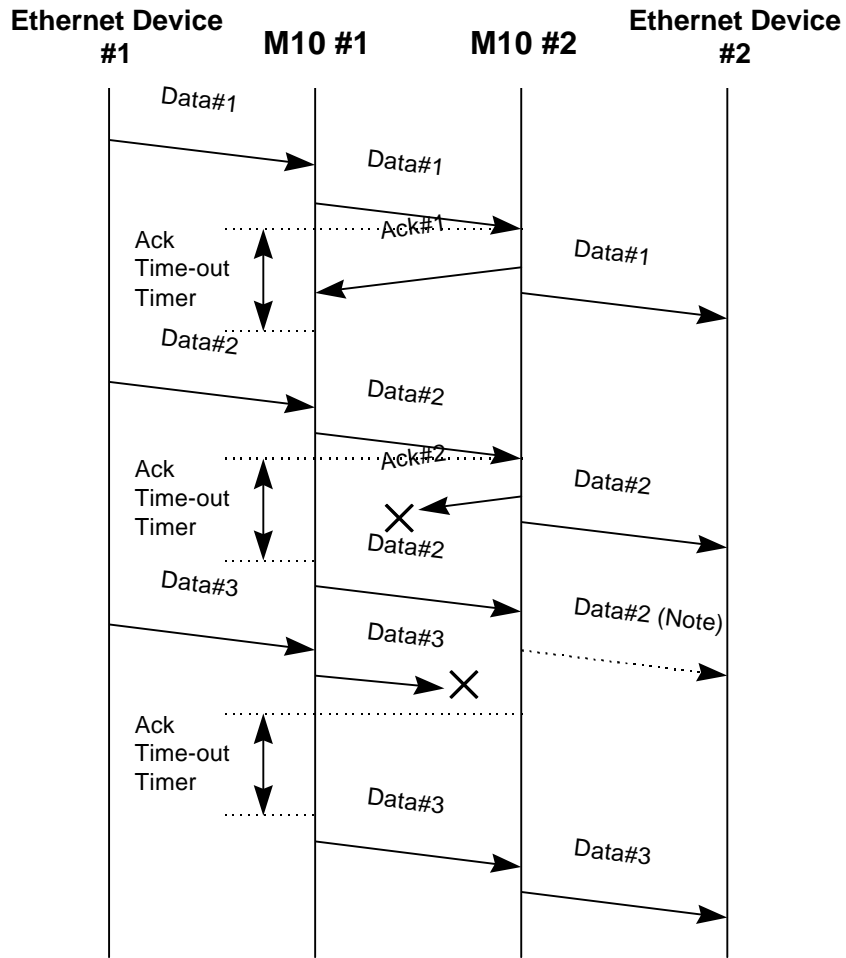
Figure 2.3.5 shows two different causes of re-transmission. One is missing of **Ack**-frame (Ack #2) and another is missing data-frame (Data #3). In each case, the M10 #1 recognizes no return of the **Ack**-frame from M10 #2, then M10 #1 initiates re-transmission. The M10 #1 recognizes that a duplicate frame has been received, then M10 #1 filters it out (i.e. download does not occur). This function is called **Duplicate filter**.

The duplicate filter is functional only in case a single Ethernet device is connected to the M10. The function will be updated in the future to make it available for multiple Ethernet devices.

Duplicate frames that the M10 has not filtered out will be removed by a function of **NOS** (Network Operating System). The number of re-transmissions is limited to seven (i.e. eight transmission totally). Accordingly, if no transmission of a frame was successful by the seventh re-transmission, the successful transmission will depend on the another re-transmission function provided by the **NOS** protocol.

The value of the time-out is currently fixed to 300 msec. It will be updated in the future to a user-definable variable to support a range of wireless links.

Figure 2.3.5



⊗ indicates missing of radio frames.

Note: No duplicate frame is downloaded in case of single Ethernet device is connected to the M10.

2.3.6 SECURITY

Security is a great concern with any data transmission system. Security in wireless data systems may be of even greater concern because of the leakage of transmitter waveforms beyond the intended receiver sites. The M10 offers excellent security without incorporating conventional cryptography. Of course, the user always has the option to add conventional data encryption technology to the most critical applications.

Most commercial spread spectrum manufacturers use fixed spreading codes in their products. The M10 radio, with Direct Sequence Spread Spectrum (DSSS), uses continuously changing, pseudo-random spreading codes, in which each symbol is encoded with a different spreading code. Furthermore, the user may select from 2^{16} (64k) different sequences to determine the order in which the spreading codes are used; this provides excellent security against eavesdropping by unintended parties.

The sequences can be selected through configuration procedure provided by the M10.

2.3.7 ANTENNA DIVERSITY

The M10 also offers additional robustness via the ***Antenna-selection diversity*** upon re-transmission.

The M10 (models JX4000F-A and JX4000W-A) is equipped with an internal antenna and an external antenna port for the attachment of your FCC approved antenna for longer distance links. The external antenna port uses a standard female SMA connector with Antenna Sense Circuit for use with a FCC approved antenna. The user can purchase FCC approved antennas kits from HyperLink (see section **8. Customer Assistance** for contact information).

If the user selects ***Enable*** of the diversity in the configuration setup, the M10 selects the antenna for each transmission. The antenna used for the transmission is memorized and used for the next transmission of a new uploaded frame.

2.3.8 ANTENNA RECOGNITION (ANTENNA SENSE CIRCUIT)

M10 uses a standard SMA connector for the attachment of external antennas. Although there is a standard SMA connector **only Clarion approved antennas will work** due to the Antenna Sense Circuit.

Antenna Sense Circuit is an electrical verification that the attached antenna is FCC approved for use with the M10. If another antenna is attached the M10 will not transmit.

IMPORTANT

Antenna Sense Circuit activates only at POWER UP

The antenna sense circuit electronically senses the attached antenna when the M10 is first turned on. If an antenna is attached after the M10 has already powered up the antenna will not be recognized. You must switch the M10 off and back on to activate the antenna.



WARNING! The external antenna port outputs dc voltage up to +5 Volts for antenna recognition. If using measuring equipment, please check allowed dc input voltage of the equipment.

2.3.9 ANTENNA POINTING

It is important to properly point external directional antennas at the time of installation. We suggest that the user employ the Traffic program (included in the Software Utility Kit Diskette) to assist in the installation of directional antennas.

We suggest that the installer follow these steps as part the external directional antenna set-up process:

1. Connect a laptop computer to the MAU port of the M10. An active IPX/SPX stack is required on the computer.
2. Install the Traffic Program (from Utility Software Kit Diskette).
3. Point both directional antennas in the general direction of each other.
4. Initiate network data traffic between the 2 sites.
5. Alternatively at both antenna sites, dither the pointing of the directional antennas until maximums in network traffic throughput are observed.
6. As a final step, find the angular range (both horizontally and vertically) over which the maximum traffic throughput can be maintained for the first antenna. Once this angular range is obtained, lock the position of the first antenna in the center of this range. Then repeat this process at the other antenna site, and lock that antenna in position.

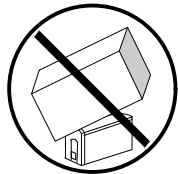
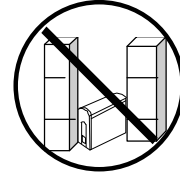
2.3.10 RANGE OF OPERATION

Using the internal antenna (models JX4000F-A and JX4000W-A only) the operating range is 100-200 meters of coverage. The range of operation will decrease if the M10 is positioned behind large metal objects, such as file cabinets, safes, storage cabinets, metal walls or walls containing foil-backed insulation.

The outdoor operating range with high gain antennas in line-of-sight operation is up to 5 miles. With special amplifiers purchased from HyperLink (see section 8. **Customer Assistance** for contact information) the user may reach up to 20 miles in line-of-sight operation.

2.3.11 POSITIONING

Proper positioning of the M10 units will increase the range of operation and the ability of the units to communicate. It is important to position the M10 units out in the open and away from any large metal objects such as file cabinets, safes, storage cabinets, metal walls or walls containing foil-backed insulation.



To reduce the risk of the unit overheating, do not place the M10 under boxes, papers or anything that may reduce airflow.

If you are using the units in an office with metal cubicle walls it will increase operating range if the units are placed above the cubicle wall height.

The use of microwave ovens during transmission may reduce data throughput by as much as a factor of two.

2.3.11.1 Co-Location of M10 Units

If two or more M10 units are co-located at one site, maximum traffic throughput rates to remote sites may be reduced, especially if the user is relying on the internal antennas.

The M10 units operate on a single frequency channel. If one M10 unit is transmitting to a remote site while a second M10 is attempting to receive data from a second remote unit, the transmitting M10 will normally block receipt of messages by the receiving M10.

Traffic throughput rates can be improved by providing enhanced RF isolation between the co-located units at a site. This is best accomplished by using correctly orientated directional antennas at each site. Further improvement in throughput can be expected if the external directional antennas can be further isolated to reduce RF leakage. This can be accomplished by increasing the physical separation between the antennas or by locating the antennas in such

a manner that direct RF leakage between the two antennas is reduced by an intervening metal object or shielding wall.

2.3.12 CHANNEL ACCESS PROTOCOL

The M10 provides for adaptive P-CSMA¹ by using a sequence of P values. These are loosely tied to the transmission attempts, in that the P values in the sequence correspond to the attempt number, but any successful receive resets to P0 for the next attempt; if that attempt fails, the sequence of P values is resumed according to which attempt is in progress. (P is a power of two, up to 256.)

¹ **On Ethernet both carrier sensing and collision detection are simple processes. For any radio channel the ability to detect collisions is lost; in addition, for a spread-spectrum system with changing codes (for security) the ability to perform carrier sensing is limited to acquisition of the preamble portion of a transmission. The channel-access protocol (CAP) employed in the M10 is called P-persistent CSMA.**

When an M10 has scheduled a transmission, the start time of that transmission is selected randomly from a grid of P possible start times, these being separated by the slot time. The slot time is somewhat larger than the one-way propagation time; this ensures that if only one transmission is started at a slot boundary, then all other M10s can detect that transmission and cancel any other pending transmissions. Of course, there remains the probability 1/P that any two radios might select the same slot boundary on which to transmit, and then the two transmissions will collide. In dense environments selecting a large value for P keeps the network from collapsing, while in less-dense environments a small P gives higher throughput. With P as a configurable parameter (in fact, dynamically configurable) the M10 supports a variety of user-controlled CAP strategies.

3. APPEARANCE

3.1 Dimensions

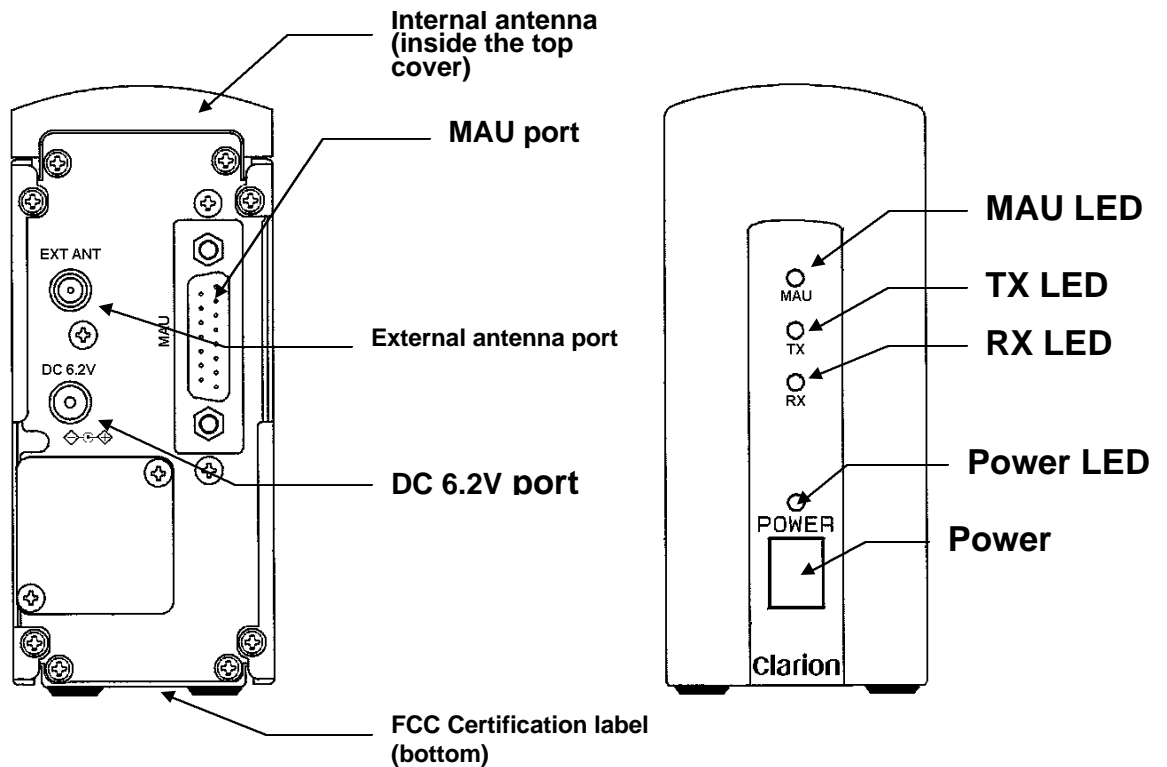
2 inches (W) x 4.7 inches (H) x 6.5 inches (D)

3.2 Weight

14 ounces

3.3 Front and Rear Panel

Figure 3.3



4. SPECIFICATIONS

4.1 General

Frequency Range	: 2400-2483.5 MHz ISM band
Carrier Frequency	: 2436.07 MHz
Type of Emission	: Direct Sequence Spread Spectrum
Chip Modulation	: BPSK, 32 Mcps
Processing Gain	: 12dB (Nominal)
Communication Method	: Half Duplex
Channel Access Method	: SS-P-CSMA ²
Type of Interface	: MAU (driven by AUI)
Datalink Interface	: IEEE802.3 or Ethernet II MAC
Network Addressing	: derived from attached NIC (<i>Note-1</i>)
RF MAC Protocol	: Radio encapsulation of IEEE802.3 or Ethernet II MAC frame.
Network Topology	: Peer to peer

Note 1 JX-4000F-S has own MAC address for configuration of operating parameters. JX-4000F-S also memorizes single MAC address of attached Network Interface Card(s) for re-transmission protocol.

² Spread Spectrum p-persistent CSMA

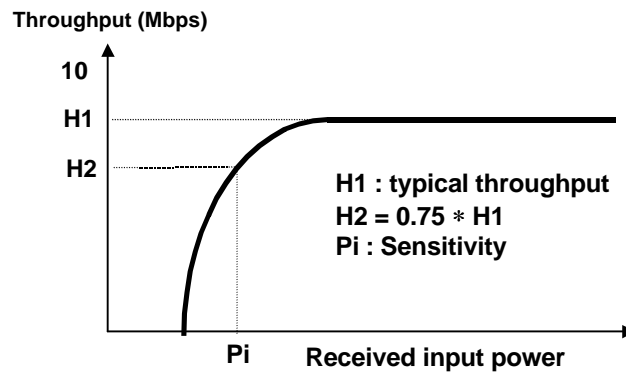
4.2 Radio

Table 4.2

Parameter		Min.	Typ.	Max.	Unit	Note
Carrier Frequency Stability		-10		+10	PPM	
Peak Power Density		-6	-2	+1.0	dBm/MHz	1
Data Rate			10		Mbps	
Sensitivity			-85	-81	dBm	2
VSWR	2436MHz		1.4	2.3	V/V	3
	2436MHz±10MHz		1.9	3.2		
	2436MHz±20MHz		2.2	3.9		
	2436MHz±30MHz		2.6	4.1		

1. Measured by spectrum analyzer with RBW=1MHz, VBW=10Hz. Total transmit power can be calculated by adding 16.0 ± 0.6 dB to the Peak Power Density. Accordingly, typical total transmit power is 14 dBm.
2. Input power at which the throughput without re-transmission degrades to 75% of typical throughput (See Figure 4.2).
3. For receive and transmission.

Figure 4.2



4.3 Network

Table 4.3

Parameter	Min.	Typ.	Max.	Unit	Note
Throughput without Re-transmission	7.9	8.8		Mbps	1
Throughput with Re-transmission	6.8	7.6		Mbps	1
Boot up Time			5.5	sec	2

- 1 10 (Mbps) × Measured Average Utilization (%) under the condition of two units connected by cable through 60 dB attenuator and uni-directional data flow.
- 2 Time for self checking and stabilization of radio operating point. If AC power is switched, additional time must be considered because of its time constant.

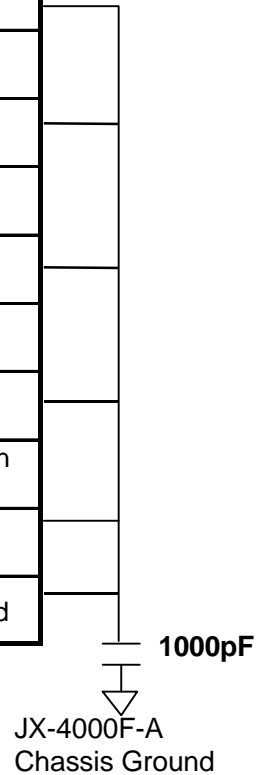
4.4 Port

4.4.1 MAU PORT

4.4.1.1 Pin Assignment

Table 4.4.1.1

DTE (AUI)		M 10 (M AU)	
PIN	Data Flow	PIN	
3 Data out+	→ 2	3 Data in+	
10 Data out-		10 Data in-	
11 Shield	← 1	11 Shield	
5 Data in+	← 2	5 Data out+	
12 Data in-		12 Data out-	
4 Shield	← 1	4 Shield	
7 Control out+	NC	7 Control in+	
15 Control out-		15 Control in-	
8 Shield	← 1	8 Shield	
2 Control in+	← 2	2 Control out+	
9 Control in-		9 Control out-	
1 Shield	← 1	1 Shield	
6 Voltage common	NC	6 Voltage common	
13 Voltage+		13 Voltage+	
14 Shield	← 1	14 Shield	
Shield Protective Ground		Shield Protective Ground	



4.4.1.2 Absolute Maximum Ratings of the Driver (An7992B)**Table 4.4.1.2**

Parameter	Min.	Typ.	Max.	Unit	Note
DC Voltage Applied to Outputs	- 0.5		+ 5.0	V	
DC Voltage Applied to Inputs	- 6.0		+ 12.0	V	
DC Logic Input Voltage			+ 5.5	V	
DC Output Current, into Outputs			100	mA	
DC Input Current (Logic)			± 30	mA	

4.4.1.3 Transformer (ST7032)**Table 4.4.1.3**

Parameter	Min.	Typ.	Max.	Unit	Note
Common Mode Standoff			2000	Vrms	
Rise Time			3.0	ns	

4.4.2 DC 6.2V PORT

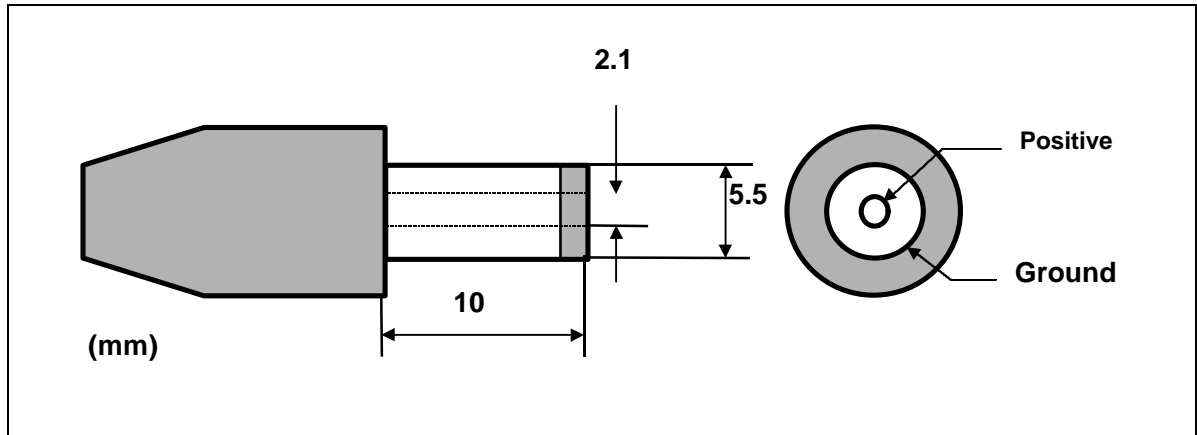
4.4.2.1 Power Requirement**Table 4.4.2.1**

Parameter	Min.	Typ.	Max.	Unit	Note
Supplied DC Voltage	6.00	6.20	6.85	Vdc	1
Ripple and Spurious		30	100	mVp-p	1
Current Consumption (TX)		1.6	2.0	A	
Current Consumption (RX)		1.1			

1. Measured at current draw of 1.8 A.

4.4.2.2 Power Jack Requirement

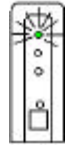
Ground	:	5.5 mm outer diameter
Positive pin	:	2.1 mm inner diameter
Pin length	:	10 mm

*Figure 4.4.2.2*

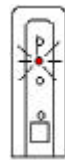
Note *Ground is connected to a chassis of the M10.*

4.5 LED Display

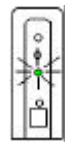
There are four LED indicator lights on the front panel of the M10 (Figure 3.3). These lights help the user to understand the status of the M10. The Lights are as follows:



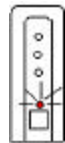
MAU -Flickers for Upload or Download of a Connected AUI.



TX - Flickers whenever a frame is RF transmitted



RX - Flickers whenever a frame is RF received



POWER - Indicates the M10 is turned on

Table 4.5

Label	Color	Description
MAU	Green	Indicates MAU signal (upload or download) is active. (Note-1)
TX	Red	<ol style="list-style-type: none"> 1. During the power-up cycle, it blinks on and off slowly five times in approximately one second to indicate that the firmware has passed its integrity 2. After normal power-up cycle, it indicates radio transmission. (Note-1) 3. During the firmware-upload cycle ; refer description attached on the new firmware.
RX	Green	<ol style="list-style-type: none"> 1. Indicates radio signal detection. (Note-1) 2. Sometimes flashes even if no true signal is received, because of optimized false alarm rate.
Power	Red	<ol style="list-style-type: none"> 1. It turns on just after applying the power to indicate activation of the unit. 2. It will not illuminate continuously if there is unsuitable supply voltage.

Note-1 : The turn-on period is very brief. The intensity of the flickering is proportional to the throughput of traffic.

4.6 Emissions

Non-intentional	:	FCC part 15 (Radio Frequency Devices) Subpart B (Unintentional Radiator) Class A digital devices & peripherals
Intentional	:	FCC part 15 (Radio Frequency Devices) Subpart C (Intentional Radiator)

4.7 Environmental

Operating Temperature Range	
Specification Guaranteed	: 0°C ~ +40°C
Operation Guaranteed	: -10°C~+50°C
Storage Temperature Range	: -20°C ~ +60°C
Humidity	: 0% ~ 90%
Vibration	: 0.4 G (peak to peak)

4.8 Spectrum Mask

Spectrum of transmission signal from external antenna port of JX-4000F-S complies with spectrum mask shown in Figure 4.8. The example shows acceptable spectrum. This specification is applied at room temperature.

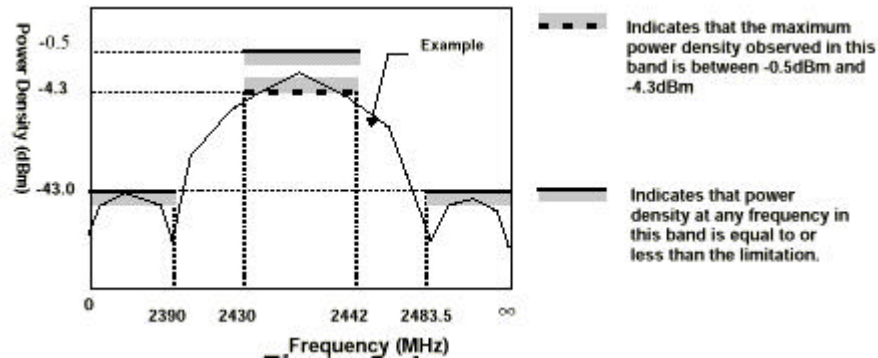


Figure 4.8

Measurement conditions of the spectrum:

1. Using spectrum analyzer connected directly to external port of JX-4000F-S.
2. Spectrum Analyzer Settings
 - Center Frequency : 2436.070 MHz
 - Span : 150 MHz
 - Reference Level : 20 dBm
 - Detection : Sample
 - RBW : 1MHz
 - VBW : 10Hz
 - Scale : 10 dB/div
 - Sweep Time : Auto
3. Using unit of dBm/MHz for power density.
4. Using continuous spreading transmission with pseudo-random data initiated by sending special command to the M10 through MAU port³.

³ Stream of Ethernet frames does not meet the requirement even if the inter-frame-gap is set to the minimum value.

5. CONFIGURATION

The M10II units are pre-configured to operate right out of the box. There are also a variety of options that the user can change to adapt the M10II to a specific situation.

The configuration software is pre-loaded into an internal EEPROM (Electrically Erasable Programmable Read-Only Memory) in the M10II. For updates to this software please see section **8. Technical Information**.

5.1 Default Settings

The default settings that the M10II is shipped with are as follows:

- Acknowledging is enabled (one ACK per packet)
- Transmit filtering is turned on
- Download filtering is turned on
- Aging time is set to 5 minutes
- Loop Detection is on
- Static Table is uploading is set to off
- Professional Addressing Mode is off

5.2 Configuration Commands

Included with the radio is a diskette that contains MIIImqry.exe and Tmshow.bat. MIIImqry is like M10query but includes the M10II settings of filtering and aging. Tmshow.bat allows the user to read the table that is stored internally in the M10II at the time of issuing the command. They both keep log files. Both of these programs can be issued remotely. By using these the complete configuration and stored table of any radio in the network can be read from any location in the network. You only need to know the MAC ID of the radio you are trying to query. Both commands continue to issue once per second until there is a response or until a key is hit.

The following utilities will be included on diskette for the M10II. Typing the name followed by a question mark will show the usage syntax.

- MIIImqry.exe allows monitoring of the configuration.

- Tmshow.exe will read out the table that is stored in the M10II at the time of issue.

The new configuration commands for controlling the M10II are as follows (can use with the send or sendm10 commands):

CONFigFe1, CONFigFe0 turns M10II mode on/off respectively. When M10II is off the radio does not operate. This command is stored in non-volatile memory and takes immediate effect.

CONFigFt1, CONFigFt0 turns transmit filtering on/off. (Default is on) This command is stored in non-volatile memory and takes immediate effect.

CONFigFd1, CONFigFd0 turns download filtering on/off. (Default is on). This command is stored in non-volatile memory and takes immediate effect.

CONFigFaxx, xx== 0 to 60, sets aging value. xx=0 turns aging off. (Default is 5 min.) This command is stored in non-volatile memory and takes immediate effect.

CONFigFr1, CONFigFr0 turns remote commands on/off respectively (Default is off). This command is stored in non-volatile memory and takes immediate effect.

CONFigFs1, CONFigFs0 (Static table command) turns table maintenance on or off respectively; default is on. Table maintenance is defined as table insertions, deletions, and aging. This command is used if the OEM is using an 802.1d bridge or other table-building device that they prefer over our automatic table-building protocol. The OEM must upload the table into the M10II using the CONFigFw command followed by packets containing the table in the format described below. Then the data-link-level acknowledgment protocol will operate with the microsecond-scale response that only the radio itself can provide, but based on the tables provided by the user. All filtering can still be optionally applied. This command is currently volatile and should be issued after each power cycle or prior to each table revision. When using this, the OEM can shut off the M10II loop sense protocol since the table generation device will have that built in. An ANSI C program

that will convert an ASCII address list to the proper internal format is available from the web site. Also, the required format is available if you want to generate your own program to do this. In order to keep remote commands enabled when the OEM is uploading a table, the MAC ID of the radio must be included in the uploaded table, since the remote commands rely on having it there.

CONFigF11, CONFigF10 Turn the proprietary loop-sense/blocking function on or off respectively (Default is on). If the static table command is used, the loop-sense/blocking feature is not generally needed because this function is accomplished in the device generating the table. This command is stored in non-volatile memory and takes immediate effect. (Even though the static-table command is volatile and must be re-issued upon power-cycling).

CONFigFw prepares the M10II to receive a table to use in place of its own. The table maintenance will continue to operate on the uploaded table, adding to it and deleting from it unless the static table command is issued. The format used for the packets containing the table is available from the web site. In order to keep remote commands enabled when the OEM is uploading a table, the MAC ID of the radio must be included in the table, since the remote commands rely on having it there. (The radio MAC ID is normally entered into the table when the radio is turned on).

CONFigFpXX, where XX is a decimal value 0-32. If 00 is entered, professional mode is turned off. There are 32 possible addresses. The default is that this mode is off. This command is stored in non-volatile memory and takes immediate effect. Example: send CONFigFp10 00606f01E765.

CONFigFn1, CONFigFn0 selects 802.3/802.2 respectively as the packet response for configuration frames. CONFigFn1 is the default as it was in the M10.

5.3 Configuration Parameters

The following is a list of the configurable parameters of the M10:

Table 5.3 Configurable Parameters

Parameters	Possible Values		Default	Remarks
AUI Busy Collision	1/0 (i.e. On/Off)		On	Used for flow control on wired side. ON causes assertion of collision signal if a frame upload is attempted when all 8 upload buffers are full.
				OFF means do not assert collisions if 8 packet upload buffers are full.
SQE Test	1/0 (i.e. On/Off)		Off	ON means there is a brief assertion of collision signal after frame ends.
				OFF means no signal after frame
Download with CRC error	1/0 (i.e. On/Off)		Off	If "Download with CRC error" is ON, M10II downloads all frames regardless of CRC check.
				OFF means block CRC failures.
FEC Sequence on re-tries	Try #	Available configuration	FE	The FEC mode is selected as 1/0 (i.e. On/Off) for a particular transmission attempt. (There are a maximum of 8 tries per packet. The first transmission and up to 7 re-transmissions).
	1	FEC on or off for each trial	Off	
	2		On	
	3		On	
	4		On	
	5		On	
	6		On	
	7		On	
	8		On	
P-CSMA slots	Try #	Available configuration	23456788	The number of ~15us slots that are used as the range of the uniformly distributed wait interval before transmitting in a CSMA protocol. This is commonly known as the backoff but in actuality, is only the range of the possible backoffs. The number set in config is the binary exponent.
	1	P-CSMA slot-number P of 1 to 8 for each trial.	2	

Parameters	Possible Values	Default	Remarks
P-CSMA slots (continued)	2	3	For example, a value of 3 means there are 8 possible slots that a queued transmission can begin in as measured from the end of the previous transmission. The transmission has a 1/8 probability of occurring in any of those slots.
	3	4	
	4	5	
	5	6	
	6	7	
	7	8	
	8	8	
Number of tries of transmission	1 – 8	8	“1” means no re-transmission
Hardware Address Checking	1/0 (On/Off)	Off	Acknowledgments are sent for received frames with matched destination address only when this is On, and are not dependent on the address when this is Off. The hardware register is loaded with the address of either the first source it sees on the wired side after connection, or, an address that can be manually set.
Security Code Channel	00001h ~ FFFFh	2D1Bh	Spreading code changes pseudo randomly by a sequence defined by this code channel.
Duplicate Filter	1/0 (On/Off)	On	If this switch turns on, received duplicate frames are discarded ⁴ . If it is Off, duplicate will not prevent a download.
Search Code	44BCh, A0DCh, D223h, 0A76h, 425Ch, 23A4h, 245Ch, A243h	44BCh	Search Code is a PN code used for initial acquisition. They are chosen for good performance and provide
Antenna Diversity	1/0 (On/Off)	Off	OFF means that the antenna first “Antenna Selection” setting chooses a particular antenna. ON means that the “Antenna Selection” setting toggles the antenna choice or leaves it alone based on the setting for any particular transmission attempt for a packet.

⁴ Duplicate filter function is available in case of one to one connection only. It means that if two or more modems are connected to a modem, duplication cannot be avoided.

Parameters	Possible Values	Default	Remarks
Antenna Selection	1/0 (External/Internal)	FF (= External with Diversity set to OFF)	This parameter must be set to 'External' absolutely because no internal antenna is provided with JX-4000. Otherwise it behaves similar to the FEC mode where a 1 toggles the antenna choice and a 0 leaves the choice for a transmission attempt.
RF Address	Derived from attached NIC Or set manually with CONFigRf command.		RF address is used on RF reception by the JX-4000 determine whether to send ACK, and at the transmitter to recognize its ACK. It is not used if 'Address Checking' is off.
Use default MAC ID	MAC Address (00606FXXXXXX) or Clarion Null Address (00606F000000)	Null Address	Upload address is used for configuration and firmware upgrade only. Each JX-4000 has its own unique 12-hex-digit MAC ID that is used as default Upload Address. However, one can select Clarion Null Address '00606F000000' as Upload Address for convenience.
ACK time-out	0xx6E to 0xxFE	0xx6E (~330us)	Can be selected by steps for various environments of applications. The longer link range requires the longer ACK time-out. Three (3) microsecond time resolution.

6. COMPLIANCE WITH STANDARDS

6.1 MAU

While the M10 has been designed to appear electrically as a standard MAU, it is executing a medium-access protocol appropriate for the wireless medium. As a result, some of its behaviors are not reflected in a wired-medium MAU, and the transparency to the wired-medium MAC in the attached computer or bridging device cannot be absolute. MAUs for wired networks have no internal storage; they operate with negligible delay relative to the signals at the AUI/MAU interface.

Because the MAC software in the attached computer is executing a protocol appropriate for the wired medium, and the M10 must employ a protocol appropriate for the wireless medium, the M10 stores frames in buffers in order to isolate the (wired and wireless) media.

This results in important differences from conventional 802.3 MAUs; these include buffer delay as well as the need for RF re-transmissions and for flow control.

6.1.1 BUFFER DELAY

The protocol operating over a M10 link must anticipate a delay of two frames in each direction. When a frame is offered from the AUI port, first it is saved in a buffer; subsequently the frame is transferred over the RF channel to a receive buffer in the destination M10; only then is the frame downloaded to the destination AUI port.

This need not limit throughput if the transport protocol properly anticipates the delay. If the protocol waits for each frame to be acknowledged, then the throughput achieved will be very low due to the excess delay. However, if a burst mode is used, then the effect of the delay can be made negligible. This effect can be readily demonstrated using, for example, Perform 3®.

6.1.2 FLOW CONTROL

When no buffers are available for **UPLOAD** of AUI frames to the M10, some action is required. The M10 may:

1. Invoke flow control (default for the M10 connected to an AUI port), by using the ***COLLISION*** signal to force the Ethernet card into its exponential back-off algorithm. Because there are eight ***UPLOAD*** buffers, this flow control can always maximize RF throughput even though the attached device may delay re-offering of frames.
2. Ignore ***UPLOAD*** frames when no ***UPLOAD*** buffer is available, this may be required when the M10 is connected to multiple computers (e.g., via a hub) which might be disrupted by excessive collision indications. However, ignored frames will incur a large delay for retransmission by the level-4 transport protocol (TCP, IPX), or may not be re-offered at all for datagrams (UDP, SPX). Although using the ***COLLISION*** signal for flow control is the default, the user must make an informed selection between these two possibilities based upon network topology, acceptable link behavior, and the requirements of the application software.

7. RECOMMENDED TEST PROCEDURE

7.1 Testing Procedure

To test the units connect two M10s (or two M10IIs), one to each of two previously isolated network segments, leaving all settings at the factory default values.

1. Make an inter-segment file transfer and observe the LEDs on the M10II units. The upload (MAU) and transmit (TX) lights on the sending unit will turn on brightly. The receive (RX) and download (MAU) light on the receiving unit will also turn on brightly. The transmit light (TX) on the receiving radio and the receive light (RX) on the sending radio will turn on dimly due to the acknowledgments. If other combinations of LEDs occur, there may be something wrong. There should be expected, bursts of traffic and dead time in any network file transfer and this should not indicate a problem.
2. Next make a local file transfer between NICs on a single segment. You will see the upload light (MAU) come on but not the transmit light (TX) on the sending unit, and you should see no receive lights on the other unit. You can simultaneously do a local file transfer on each segment and if you attach LAN analyzers to each, you will see that each unit simultaneously achieves wired speed.
3. Now attach a third segment with a third M10II. When you do an inter-segment file transfer, the LEDs will be the same as before for the intended receiver, but the third M10II will show only a receive light, not a download light nor a dim transmit light. In this case, the M10II that has the intended NIC attached will acknowledge and download the packets. The other M10II will receive the packets but will not respond with acknowledgments, and not download. You can also try three simultaneous local file transfers, and you will see that each achieves wired speed. You may also wish to try an inter-segment file transfer between two of the segments and a simultaneous local file transfer on the third segment.

7.2 SPECIAL FEATURES OF THE M10II

7.2.1 INTRODUCTION TO TESTING THE M10II

The standard **M10** is a single address wireless modem, the **M10II** has been expanded to accommodate multi-address situations. The M10II maintains internal acknowledgment-address tables. This extension of retransmission protocol to multi-source address situations requires further information to understand the operation of the M10II:

1. To test the M10II it is suggested that you connect two M10II units, one to each of two previously isolated network segments. As the normal traffic is generated on each segment the internal M10II table is automatically built up on the packet transmissions of each NIC. Only one transmission is required to create a table entry for a NIC. The source addresses of the traffic are used to build and maintain the table and the tables are referenced by the destination addresses of the traffic to determine whether or not the intended receiving NICs are attached to a particular M10II. The M10II units are shipped with the following defaults: acknowledgment is enabled, transmit filtering is turned on, download filtering is turned on, aging time is set to 5 minutes, loop-sense is on, and professional addressing mode is off. The following is a brief description of these features.
 - a) M10II acknowledging enabled. This is the main M10II feature, it refers to the data-link level re-transmission protocol. It means that if a destination address of an intended NIC is in the local table of the M10II, that radio will acknowledge the packet from within the radio firmware with microsecond response time. This feature creates a reliable link out of a wireless connection. Without it, the burden on common transport-level protocols would be too great to obtain substantial throughput.
 - b) Transmit filtering on. When this feature is activated local traffic will remain local. If a packet generated on a segment is addressed to a NIC on the same segment, the M10II will not transmit that packet. The result is that local bandwidth is preserved and the radio must only support the total inter-segment bandwidth. Therefore many segments, each with 10 Mbps local

bandwidth, can be connected with a 10 Mbps backbone since each packet is not necessarily transmitted. Without it turned on, the bandwidth of any local segments is shared by the NICs on other remote segments, since each packet that is generated on another segment is transferred to the local segment and vice versa. Transmit filtering also provides added security because local server traffic is not exposed to other segments.

- c) Download filtering on: This feature can be thought of as the converse of transmit filtering. The M10II with this enabled will not download to its network segment, a packet that it receives if the destination is not on its local segment. Of course, all packets on the same code channel will be received by the M10II, and their CRC will be checked, prior to the address being examined.
- d) Aging = 5 minutes. This default value is the same as in most bridges. If a NIC is shut down, the aging setting is the time that it takes to passively decide to remove the entry from the local table. As long as a packet is sent from a NIC more often than this setting, the entry will remain in the table. Most network operating systems will normally send out keep-alive or sense packets more often than once per minute. The penalty for being deleted from the table is minimal; it takes about 20 ms (milliseconds) after a packet is transmitted for the entry to be placed into the table. Also, if a NIC is moved to another segment, the transmissions that it generates from another M10II will force the instant deletion of the NIC address from the table of the first M10II. If transmissions from the moved NIC are not received, the aging will cause the NIC to be deleted after the aging time as measured from the last packet that the NIC generated while it was still local. The table is volatile and cycling the power will delete the table.
- e) Loop detection. The M10II has an optional capability for detecting and blocking network loops. A loop is a network connection that allows a packet to be regenerated, and can occur with any wired or wireless network device. An example of a loop is when two radios are inadvertently connected to the same network segment, and they are on the same code channel, then a packet that is uploaded and transmitted by one radio, is received and downloaded by the second radio, which creates a packet to

be uploaded by the first one again. If the loop is allowed to persist, the packet will be regenerated indefinitely. Instead of allowing this to happen, all M10IIs will first start in the blocking mode when they are powered on (if loop detection is enabled). The blocking mode prevents any packets to be transmitted and only loop-sense packets to be downloaded. If a loop is detected, the M10II will block traffic until the loop is eliminated. If after trying for a few seconds, the radio does not sense a loop, it will exit blocking mode and proceed with a normal boot cycle. After that, an attempt to sense loops will be made at 3 second intervals, and steals 2ms of traffic time each 3 seconds in order to operate. Since a loop can be created while reconfiguring the wired network the detection process will occur indefinitely. After the initial boot, there will be 2 one-second intervals, each signaled by a pair of LED flashes, and then 5 LED flashes if there is no loop found. If there is a loop, then the radio will enter a blocking state where no packets will be transmitted or downloaded, and the radio will continue to sense the loop at 3-second intervals. After 4 intervals without seeing a loop, the blocking state will be terminated, the LED will indicate this by flashing 5 times. There may be additional delays in high traffic conditions (i.e. > 65% wired side utilization, continuously over the 3 second time periods).

When in the blocking state, a blocking-message packet is downloaded to the wired side just prior to the loop test packet. The blocking message is addressed to broadcast (all Fs), and the source address is the active address. The loop test packet is addressed to the sensing M10II's own MAC_ID independent of the active address. The source address is the active address. Therefore, it will have the same source and destination address if the CONFigAs1 command has been issued.

If you power-up with loop-sense turned off, the power-on blocking state is not entered and the normal LED flash sequence is observed. If you power-up with it turned on, the blocking state is entered upon power-up and must be exited for radio operation. If CONFigF10 is issued remotely to a radio that is blocking, the blocking state is not exited. The radio will suspend any check for loops and will remain in the blocking state. A remote CONFigF11 will put the blocking radio back into normal periodic

loop-sense operation. To exit a blocking state after issuing CONFigF10 to a blocking radio, the radio must be power cycled. A radio is not forced out of blocking if the loop sensing has determined that it should be blocking. The user can issue a PN code change (locally or remotely) that will accomplish this on the next 4 loop sense cycles.

While blocking, no AUI commands can be issued. The radio cannot be queried from the AUI. But commands can be issued remotely, although the responses will NOT be sent back since transmits are blocked (as are downloads, other than the loop-sense packet itself). Acknowledgments are not blocked so re-transmission of the remote command will not occur if it is a good RF link.

If turning on a radio will cause a loop, then the last radio powered up is guaranteed to go into blocking state. If the loop is made with a wire connecting two radios already powered up, one of the radios will enter blocking but there is no telling which one it will be.

- f) Professional Addressing Mode. This mode allows improved duplicate packet filtering in the case of a poor link. It keeps track of the last packet sent from each of the other M10IIs in the network (up to 32 M10IIs can be supported in this version). Normally, when this mode is not used, duplicate filtering operates on the last packet received. If there are several radios with a poor link, there is some probability that the normal duplicate filtering will be inadequate. In this case the professional addressing mode can be used. This operation requires that RF IDs (1-32) be entered for all the M10IIs in a network. The IDs are entered using configuration frames. Therefore it is considered the “professional mode” because a professional installer is more likely to use it.

- 2. An additional feature is the ability to turn off the AUI-port flow control if the RF link deteriorates. This way, a bad RF connection (for example, if someone should shut off the remote M10II) will not reduce the throughput on the local segment. This setting is a ratio of good transmissions to bad transmissions that the user sets. If the user sets the

ratio to 0.5, then when half of the packets are bad over a specified averaging interval, as determined by not receiving acknowledgments, the source radio will no longer use collisions to back off the source channel. The switching from using flow control to not using flow control and vice versa is an immediate action. Uploaded packets will be transmitted even if flow control is off. If a high percentage of these get through then the flow control is immediately turned back on. If they start failing again, the flow control is immediately turned off again. There is no user intervention here once the ratio is set. Setting the ratio enables this operation. Use the send.exe command to send `CONFigGbxxyyFFFF` command where `xx` is the number of good packets to be required and `yy` is the number of bad (unacknowledged) packets to be tolerated. Whichever threshold is reached first will reset the count of both good and bad packets and will take an action: either to turn off collisions, leave them off, turn on collisions or leave them on. So if the following entry is made: `send CONFigGb0F1dFFFF <ret>` then when 15 good packets are reached before 30 bad packets, the collisions will remain on. If not they are turned off. The ratio is 0.5 and the absolute numbers used reflects the reaction time. In this example, 15 packets are the minimum time to make a determination. The four `0xFs` at the end of the command allow the user to have hysteresis. Unless the user fully understands the use of this part of the command, it is recommended that these be left as `0xF` (they must be entered). In the case of entering `CONFigGbxxyywwzz`, `xx` is only the number of good packets required to reset the bad-packet count that turns the collisions off. And `yy` is the number of bad packets required to turn the collisions off. `ww` is the number of good packets required to turn the collisions back on and `zz` is the number of bad packets required to reset the good-packet count that would be used to turn the collisions back on. By making these four parameters independent, the user can set one ratio for the collisions to turn off (`xx/yy`) and another for the collisions to turn back on (`ww/zz`) with the absolute values of each setting the approximate reaction time measured in packets. Resetting the good and bad values to `0xFF` (i.e. `CONFigGbFFFFFFFF`) turns the function off, which will leave flow control always on (assuming that the configuration bit for AUI collisions is set).

3. Another feature of the M10II is the use of remote commands. A M10II will respond to most configuration commands over the air. Use the `SendM10` utility but address the destination of the command to the MAC ID of the remote M10II (i.e. `00606Fxxxxxx`). Even if the remote

radio is set to use the Clarion null address instead of its own MAC ID, the radio's MAC ID must be used for remote access. To allow a broadcast address to be used over the air would require handling multiple responses, which is not possible. The command will automatically flow through the sending M10II to the remote M10II and the response will occur back throughout the sending M10II. The retransmission protocol will also work as in the case of any normal packet. Remote M10IIs can be queried, and reconfigured. Using Tmshow, you can view the remote M10II's table entries. For security purposes, the remote configuration is disabled by default. If you want it on, you must enable it locally through the AUI port only. Once enabled, all activity can be controlled remotely but this way the configuration can only be changed after someone within the user's facility has allowed it. Commands that cannot operate remotely include: firmware upgrade, enabling M10II mode/licensing, and enabling remote commands.

7.3 Testing Throughput

The M10 family of products offers true 10 Mbps RF transmission. However, the real measure of network performance is the average throughput. This requires not only high-data-rate modem transmission, but also efficient utilization of frame buffers and coordination of RF and wired-interface traffic. The M10's throughput is greater than or equal to 6.8 Mbps with the re-transmission and 7.9 Mbps without the re-transmission under the definition and specified measurement described below.

7.3.1 DEFINITION OF THROUGHPUT

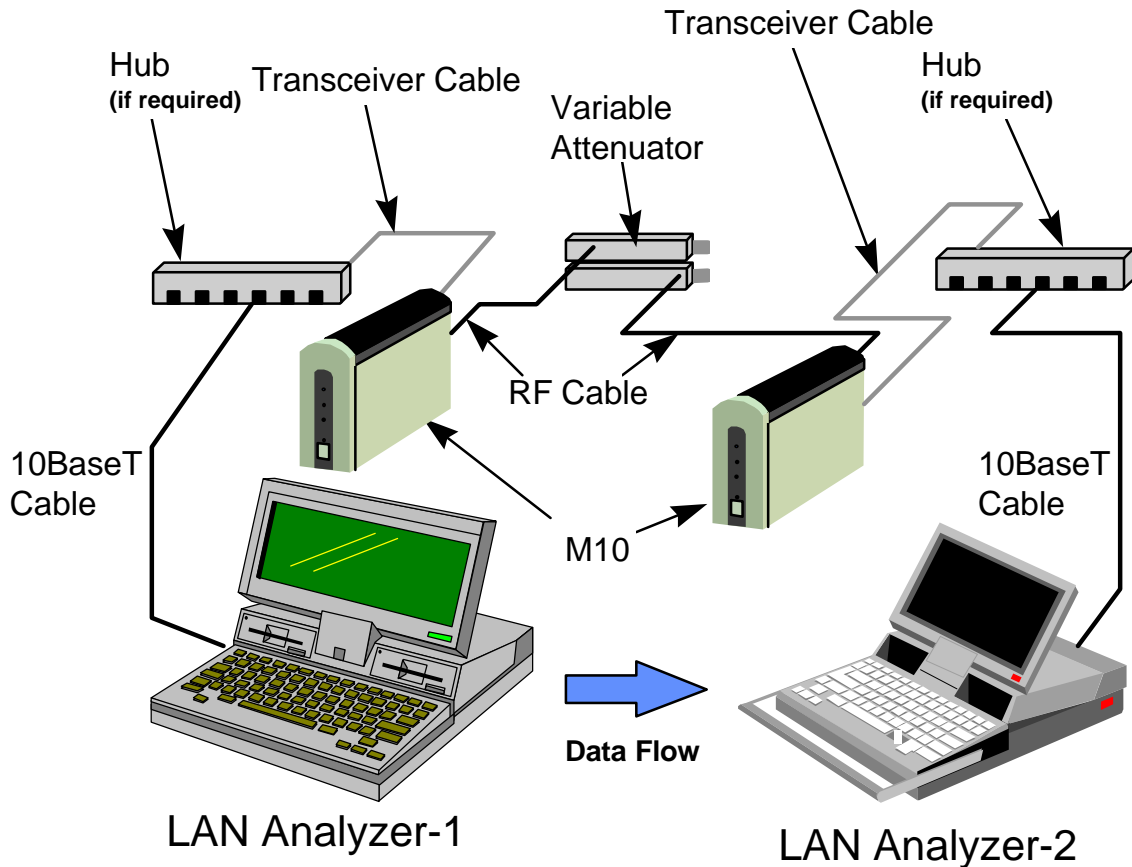
The throughput of the M10 is defined as the average transmitted bits per second from one M10 to another (as described in the following test procedure).

7.3.2 SETUP FOR MEASURING THE THROUGHPUT

Figure 7.3.2 shows recommended setup for measuring the throughput. We recommend characteristics for each device as follows:

- **LAN analyzer-1:** HP's J2S22B or equivalent.
- **LAN analyzer-2:** HP's J2S22B or equivalent or a PC with a installed NIC and Novell's "LANalyzer".
- **Hub:** HP's J2610A or equivalent. This works as a converter of the interface from which the LAN analyzer has to the AUI. If the LAN analyzer has an AUI port, then this hub is not required.
- **Attenuator:** HP's 8494A (0 - 11dB; 1dB step) and 8496A (0 - 110dB; 10dB step) or equivalent. Two attenuators are connected to provide wide variable range and precise adjustment.

Figure 7.3.2



7.3.3 MEASURING PROCEDURE OF THROUGHPUT

1. Setup as shown in Figure 7.3.2. The power sources of the M10s must also be connected (not shown in the figure).
2. Power on the M10s
3. Initiate hubs and LAN analyzers.

4. Transmit frames from LAN analyzer-1 by conditions in the following table (Table 7.3.3).

Table 7.3.3

Average Utilization (%)	98
Average Frame Rate (fr/sec)	Note-1
Inter-frame spacing (ms)	Note-1
Times to send	Continuous
Activate message	✓
Message #	1
Message Type	802.3 Fox Message
Frame length (bytes)	1500
Source address	Note-2
Destination address	Note-3
FCS type	Good

Note-1: This value is determined indirectly.

Note-2: Source address varies depending on the products. If the MSB is set to 1, then the re-transmission is suspended.

Note-3: Destination address does nothing with this measurement.

5. Observe average utilization by LAN analyzer-2.
6. The average throughput can be calculated as (average utilization observed by LAN analyzer-2) * 10 Mbps.

8. CUSTOMER ASSISTANCE

For more information please refer to any of the following documents:

- M10 Getting Started Guide
- M10II Getting Started Guide
- JX-4000F-S Specifications
- M10 Frame Types – OEM Customer Version
- M10 Service Manual

Authorized users can obtain these documents by calling the Clarion Sales Office (listed below).

A Software Utility Kit Diskette is included with your M10 product, the software contained in the utility kit is also available from the Clarion Sales Office or Micrilor's home page: www.micrilor.com. For access the user name is M10, and the user password is M10. The kit contains:

- A software query program
- A traffic program
- An electronic version of this M10 Series User Manual
- The latest software upgrades

Sales & Support:

Phil Van Wattering Jr.
Wireless LAN Business Group
Clarion Corporation of America
115 Franklin Tpke, Suite 242
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Telephone: (201) 818-8889
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E-mail: pvwjr@compuserve.com

Technical Information

Moto Gochi/M10 Product
Telephone: (781) 246-0103
FAX: (781) 246-0157
Website: www.micrilor.com

Marketing Corporate Support

M10 Product
Wireless LAN Business Group
Clarion Corporation of America
8001 Irvine Center Drive, Suite 800
Irvine, California 92618

Telephone: (714) 790-3500
FAX: (714) 790-3599
Website: www.clarionwireless.com

Antenna Kit Support

Hyperlink Technologies
1201 Clint Moore Road
Boca Raton, Florida 33487

Telephone: (561) 995-2256
FAX: (561) 995-2432
Website: www.hyperlinktech.com

9. GLOSSARY

AUI - Auxiliary Unit Interface: The standard hardware interface used to connect a device to a 10base5 transceiver. It uses a DB-15 connector.

Bridge: A device that connects different networks together allowing them to communicate with each other.

BPSK - Binary Phase Shift Key

CSMA - Carrier Sense Multiple Access: A method for controlling the transfer of information on an Ethernet network.

DES - Data Encryption Standard: The standard cryptographic algorithm, designed by the National Bureau of Standards, used to transform (encrypt and decrypt) information using a 64-bit key.

DSSS - Direct Sequence Spread Spectrum: A highly secure and reliable technology which spreads data over a broad frequency range requiring receiving and sending devices to use specific coding and decoding algorithms

EPROM - Erasable Programmable Read-Only Memory

Ethernet: Trademark of Xerox. A 10 Megabit per second (Mbps) standard for Local Area Networks (LANs) in which all nodes are connected usually with a coaxial cable where they contend for network access using Carrier Sense Multiple Access (CSMA).

FCC - Federal Communications Commission

GHz - gigahertz: A measure of the number of cycles per second of a signal. One GHz is one billion cycles per second.

Hz - Hertz: A measure of the number of cycles per second of a signal. One Hz is one cycle per second.

Hub: A network central controlling device.

IEEE - Institute of Electrical and Electronics Engineers

IEEE 802.x: The set of Institute of Electrical and Electronic Engineers standards for the definition of Local Area Network protocols.

LAN - Local Area Network: A data communications system which interconnects computer systems at various different sites within a few square kilometers, or less, in order to share resources and communicate with each other.

MAU - Medium Access Unit: A concentrator that allows multiple network nodes to access a Local Area Network (LAN) through a single device.

MAC - Media Access Control: The lower datalink sublayer defined in IEEE standards for each particular medium.

Mbps - Megabits per second

NICs - Network Interface Cards: A device that joins a cable to a computer. It is usually installed inside the computer with an access port for plugging in a network cable.

Node: Any device that is connected to a network.

PC - Personal Computer

RF - Radio Frequency: The frequency at which electromagnetic energy may be made to radiate coherently.

TCP/IP - Transmission Control Protocol/Internet Protocol: The suite of transport and application layer protocols that operate over the Internet Protocol.

Throughput – A way of measuring the speed at which a system or link can accept, handle and output information. The amount of data that a communications channel can carry, usually in bits per second.