SEREN

INDUSTRIAL POWER SYSTEMS INC.

MC2
MATCHING NETWORK CONTROLLER

OPERATOR'S MANUAL

Revision: 2.03
Standard Configuration

Document Number 6200070000

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Introduction

Thank you for acquiring your new SEREN IPS product. The MC2 Matching Network Controller has been designed to provide the best value, ease of operation, and reliability for plasma and processing systems. This manual covers specifications, installation, and operation of the MC2 Matching Network Controller.

Information

To get answers for any questions you might have regarding your plasma or processing system, please contact your system vendor first. Your system vendor knows the intimate details of how your equipment interfaces and operates with the MC2 Matching Network Controller and can efficiently resolve system related problems.

For questions directly related to the MC2 Matching Network Controller, you may call us, Monday through Friday, 8:00am to 5:00pm, United States Eastern Time, at:

1-856-205-1131

Service

For Matching Network Controllers purchased with a processing system, or covered under a service contract from your system vendor, please contact the system vendor to arrange for service.

For after-market or end user customers, a SEREN IPS customer service representative will arrange for service. Call us, Monday through Friday, 8:00am to 5:00pm, United States Eastern Time, at: **1-856-205-1131**

Please note: Equipment returned to us without prior authorization or without a Return Materials Authorization (RMA) number visible on the outside of the package will be refused.

How to Contact Us

Our address, telephone, and fax numbers are listed below.

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Proprietary Information Notice

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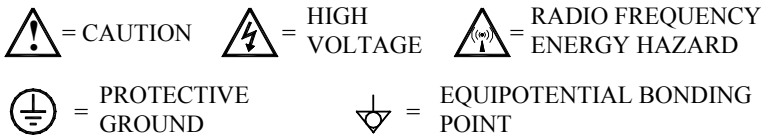
Safety Notes

The MC2 Matching Network Controller has been designed and tested to meet strict safety requirements. These include independent lab examination and approval, and compliance to established standards. Please read the following instructions carefully before operating the Matching Network Controller and refer to them as needed to ensure the continued safe operation of the Matching Network Controller.

Follow all warnings and instructions marked on or supplied with the product.

Symbology:



Unplug or disconnect this equipment from the power source before cleaning or re-configuring the AC mains voltage.

Do not use this equipment near water, wet locations, or outdoors.

Do not place this equipment on an unstable cart, stand, or table. The MC2 Matching Network Controller may fall, causing personal injury or damage to the Matching Network Controller.

This product is equipped with a 3-wire power cord and grounding type plug. This is a safety feature. To avoid electric shock, this unit must be connected to the power source in compliance with the National Electrical Code ANSI C1 and/or any other codes applicable to the user. Improper installation may result in a shock or fire hazard.

It is the responsibility of the installer to provide a proper protective ground from the Matching Network Controller to earth ground, in accordance with local and national electrical codes, and any other codes applicable to the user.

The Matching Network Controller should be operated from the type of power source indicated by the rear panel voltage selector. If you are not sure of the type of power available, consult an electrician or your local power company.

The power supply cord and plug is the disconnect device for this equipment. If the plug is removed from the cord and the power cord is hard wired to the power source, it is the responsibility of the installer to provide a disconnect device.

Do not allow anything to rest on the power cord or interconnecting cables. Do not locate the Matching Network Controller where persons will step on the power or interconnecting cables.

Slots and Openings in the equipment's chassis are provided for ventilation. To ensure reliable operation of the MC2 Matching Network Controller, these openings must not be blocked, covered, or restricted. Restricting the air inlets or exhaust will cause the unit to overheat. Sustained over temperature conditions may degrade or damage the unit.

Never push objects of any kind into the slots and openings of the Matching Network Controller's enclosure. They may touch dangerous voltage points or short out parts, which could result in a fire or electric shock.

Never spill liquid of any kind on or into the Matching Network Controller.

Never remove covers or guards that require a tool for removal. There are no operator serviceable areas within these covers. Refer servicing to qualified service personnel.

CAUTION!

ELECTRICAL SHOCK HAZARD PRESENT INSIDE UNIT AND AT THE MAINS INPUT CONNECTOR .
DO NOT REMOVE COVERS.
REFER SERVICING TO QUALIFIED SERVICE PERSONNEL.

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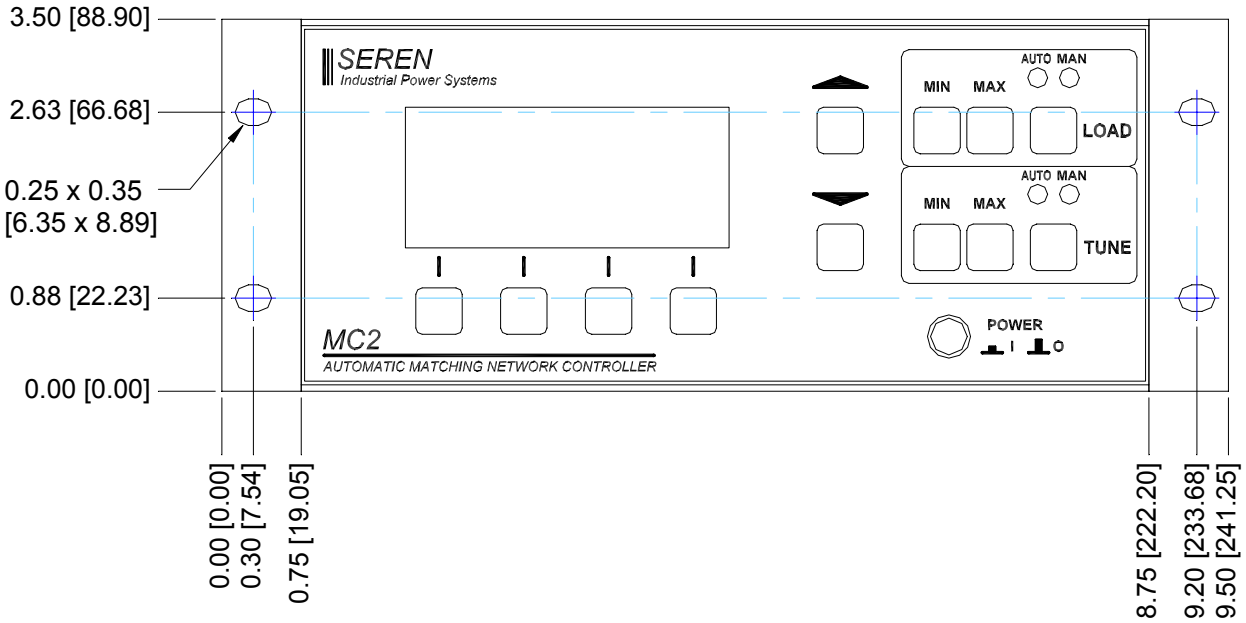
MC2 Matching Network Controller Features

The MC2 Matching Network Controller is designed and intended for use with Seren IPS Inc. AT-Series Automatic Impedance Matching Networks.

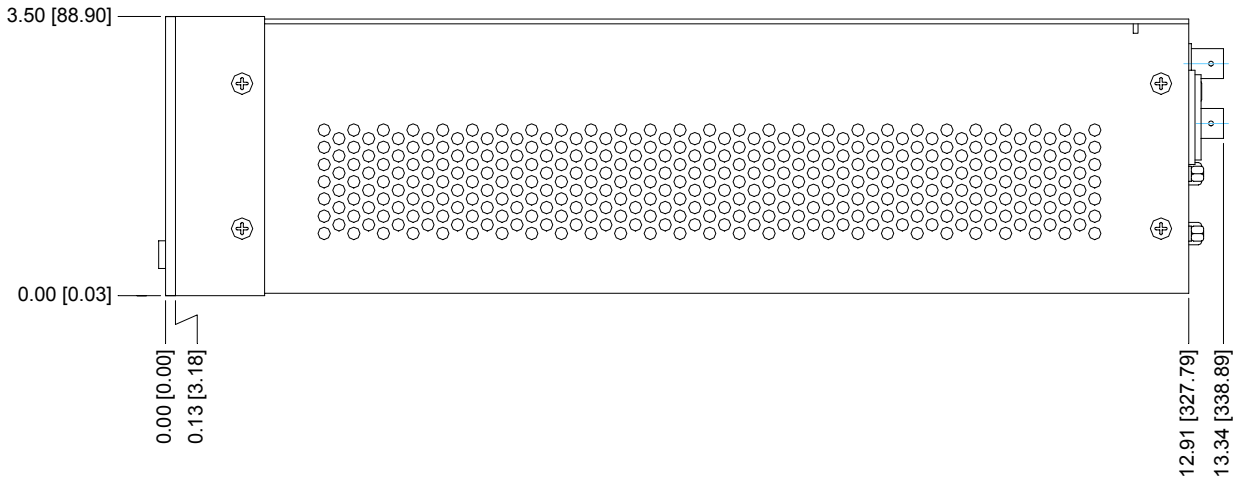
The MC2 Matching Network Controller powers and controls the operation of the Seren IPS Inc. AT-Series Automatic Impedance Matching Networks, provides operator-accessible controls, a visual display of matching network status, and a control interface to the user's processing system. Other MC2 features are listed below:

- ½ Rack 2U High Package
- 110VAC or 220VAC AC Mains, field selectable
- Bright, easy to read 4 Line Vacuum Fluorescent Display, capable of displaying matching network status, RF Power Supply Status, RF or DC Probe Voltage, Phase and magnitude error signals
- Front panel controls for capacitor positioning, mode selection, and programming
- Scalable Forward and Reflected power metering (requires interface connection to RF Power Supply)
- Scalable RF and DC Probe display
- Programmable capacitor position presets
- Programmable capacitor position limits
- Remote controlled via analog system interface connector
- Monitoring and control via serial interface or *optional* DeviceNet™ or PROFIBUS interface
- Matching network capacitors can be manually positioned from front panel controls while unit is in "Automatic" mode
- Loop-through control connectors for the RF Power Supply – simplifies connection of RF and DC Probes, provides forward power, reflected power, and power setpoint monitoring
- Adjustable error amplifier gain
- Rear panel Phase and Magnitude error signal test points
- Limit Condition Backout: The MC2 Controller reverses the matching network's motors for a brief interval when a minimum or maximum position limit condition has been reached, allowing the matching network to re-tune, thus minimizing "stuck" network conditions. The limit condition feature can be enabled/disabled from the front panel.

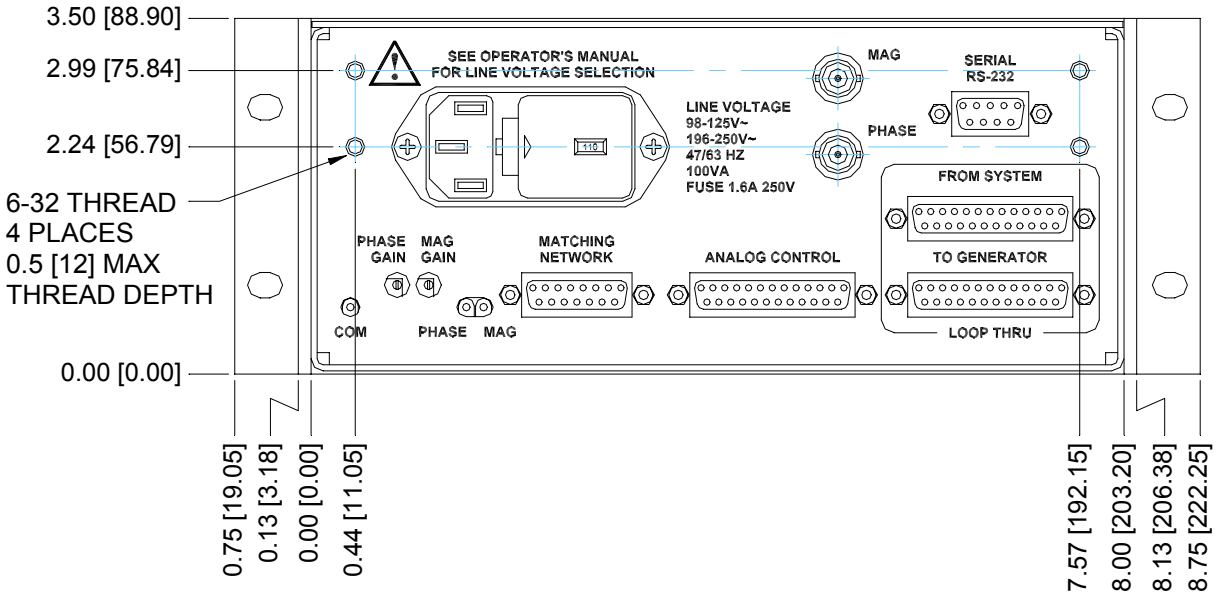
Physical Dimensions



Front View, MC2 Matching Network Controller
Dimensions in Inch [mm]



Side View, MC2 Matching Network Controller
Dimensions in Inch [mm]



Rear View, MC2 Matching Network Controller
Dimensions in Inch [mm]

Installation:

Recommended mounting:

The MC2 Matching Network Controller is designed for placement on a tabletop or within an equipment rack, with another ½ Rack 2U piece of equipment, in a clean environment. The table or equipment rack must be capable of supporting the full weight of the unit. The MC2 Controller is supplied with an integral ½ Rack Mounting Bracket. The user is responsible for providing mounting hardware.

Note: the weight of the MC2 Matching Network Controller is 7.5 pounds (3.2 kg)

Optional Mounting:

One (1) MC2 Controller may be mounted in a 19" equipment rack with the use of the optional single rack mount kit, Seren IPS Inc. Part Number 7300080000. The equipment rack must be capable of supporting the full weight of the unit.

Two (2) MC2 Controllers may be mounted in a 19" equipment rack with the use of the dual rack mount kit, Seren IPS Inc. Part Number 7300070000. The equipment rack must be capable of supporting the full weight of two (2) MC2 units.

Rack mount kits for mounting the MC2 Matching Network Controller in a 19" rack with Seren IPS Inc. 1/2-rack RF Power supplies are available. Consult your Seren IPS sales representative for additional information.

Supplied Accessories:

Description	Quantity	Seren Part Number
½ Rack Mount Bracket Kit (2 brackets and 4 screws)	1	7300120000
Power Cord (for 110V models) IEC320-13 Receptacle to NEMA 5-15 Plug	*	4500680000
Power Cord (for 220V models) IEC320-13 Receptacle to un-terminated wires	*	4500730000

* Only 1 power cord is supplied with the MC2 Matching Network Controller. The power cord type depends on the line voltage ordered.

Connection to AC Mains:

BEFORE connecting the MC2 Controller to the AC mains, inspect the voltage displayed in the window of the fuse drawer, located next to the power inlet on the rear panel. If needed, reconfigure the AC Mains voltage selection to match your AC mains Voltage. Refer to the **Rear Panel Controls and Connections** section for detailed instructions.

Note: Incorrect Mains Voltage selection may damage the MC2 Matching Network Controller.

Connection To AT-Series Matching Network:

Connect the MC2 Controller to the AT-Series matching network via a 15 conductor shielded cable (purchased separately). Several cable lengths and configurations are available – consult with the Seren IPS Inc. sales or customer service departments to select the cable appropriate to your installation.

Connect the matching network control cable to the "MATCHING NETWORK" connector on the rear panel of the MC2 Controller to the "CONTROL" connector on the AT-Series matching network.

System Interfacing:

The MC2 Controller can be used "stand-alone" or can be interfaced with a processing system. There are four (4) standard connectors and one optional connector on the rear panel dedicated to system interfacing. Refer to the Rear Panel Controls and Connections for detailed pin lists and signal descriptions. There are many possible interface schemes – a full discussion of interface schemes is beyond the scope of this document. Contact the Seren IPS Inc. customer service department if you require assistance with interface connections. A brief summary of the connectors is listed below.

"Analog Control" Connector

Provides analog status signals and allows an external system controller to position the matching network's capacitors.

"Loop-Through" Connectors

Designed to simplify system cabling – most signals are passed through unmodified. The DC Probe and RF Probe signals from the Seren IPS Inc. AT-Series matching network are routed to the RF generator and the MC2 Controller can monitor RF generator status signals.

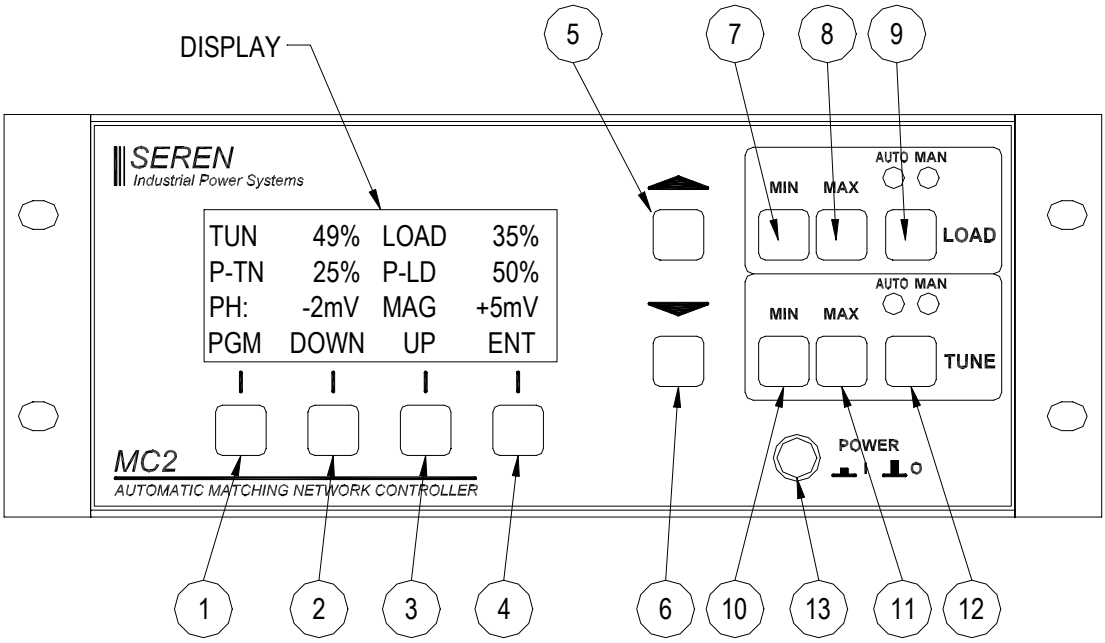
"Serial RS-232" Connector

Facilitates computer control & monitoring of matching network controller functions via RS-232, RS-422, RS-485, and MOSBUS protocols

"DeviceNet" Connector

Facilitates computer control and monitoring of matching network controller functions via optional DEVICENET communications interface.

Front Panel Controls and Display:



Front Panel Buttons		
Item	**Name**	**Description**
1	Program/Run	Toggles the MC2 Controller between the RUN mode and PROGRAM mode. In Program mode, display line 3 changes to show Programmable Menu Entry Options. The button legend changes from "PGM" to "RUN" when in the Program mode.
2	Down	Moves down the programming menu
3	Up	Moves up the programming menu
4	Enter	Programs (saves) changes made to a parameter
5	Value Up	Changes Parameter Value - Increment
6	Value Down	Changes Parameter Value - Decrement
7	Load Min	Manually positions Load cap towards minimum capacitance
8	Load Max	Manually positions Load cap towards maximum capacitance
9	Load Mode	Selects Load capacitor automatic or manual mode
10	Tune Min	Manually moves Tune cap to minimum capacitance
11	Tune Max	Manually moves Tune cap to maximum capacitance
12	Tune Mode	Selects Tune capacitor automatic or manual mode
13	Power	Enables / Disables Mains Power

Display

The front panel display shows status of the matching network capacitor positions and provides legends for the keypad. Two of the four display lines are user configurable.
There are four (4) display items available for the user configurable display lines, but only two (2) display items can be shown at one time.

Front Panel Display Lines	
Line	**Description**
1	Tune and Load Capacitor positions 1 to 100%, or 0% if matching network control cable has been disconnected or capacitor position feedback signal is missing.
2	User Configurable Display Line Displays Tune Capacitor Preset Point, Load Capacitor Preset Point (User enabled or disabled) Displays Phase and MAGnitude error signal Voltage (User enabled or disabled) Displays Generator's Forward power setpoint and Reflected power (RF OFF condition) or Actual Forward power and reflected power (RF ON condition). (User enabled or disabled) Displays DC Voltage Probe or RF Voltage Probe output (User enabled or disabled)
3	User Configurable Display Line In RUN mode: Displays Tune Capacitor Preset Point, Load Capacitor Preset Point (User enabled or disabled) Displays Phase and MAGnitude error signal Voltage (User enabled or disabled) Displays Generator's Forward power setpoint and Reflected power (RF Off condition) or Actual Forward power and reflected power (RF ON condition). (User enabled or disabled) Displays DC Voltage Probe or RF Voltage Probe output (User enabled or disabled) In PROGRAM mode: Displays a programmable parameter and its current setting.
4	Keypad Menu – button legends change depending on mode

Operation

Front panel operation of the MC2 Matching Network Controller is simple. This section describes the use and operation of the front panel controls in a "how to…" manner. Refer to the front panel illustration on the previous page for item references.

Front Panel Operation

Mains Power On/Off
Press the POWER button (item 13) to enable mains power – the front panel display will illuminate and momentarily display the firmware revision and copyright. Press the POWER button again to disable mains power.

To Select CAPACITOR MODE:
The MC2 Controller has two (2) capacitor control modes: Automatic (AUTO) and Manual (MAN). The Load and Tune capacitor control modes are independent of each other.

The Automatic mode responds to an error signal from the matching network's Phase and Magnitude sensor, automatically adjusting the associated matching network capacitor to minimize reflected power to the RF generator. The MIN and MAX capacitor positioning buttons are active in Automatic mode – this is useful for system set-up.

The automatic mode will only respond when an RF signal is applied to the matching network.

The Manual mode disables automatic operation of the respective matching network capacitor. The MIN and MAX capacitor positioning buttons may be used to manually position the matching network capacitor.

LOAD:
To change the mode of the Load capacitor, press the LOAD mode select button (item 9) on the front panel. The indicator lamp above the button will change to show the current operational mode.

TUNE:
To change the mode of the Tune capacitor, press the TUNE mode select button (item 12) on the front panel. The indicator lamp above the button will change to show the current operational mode.

Note: The mode selection is saved when the MC2 Controller is powered down – it will power-up in the same mode.

Manually Positioning Matching Network Capacitors:

Use the MIN and MAX Positioning Buttons. The Load and Tune capacitor positioning buttons operate independently of each other and are active in the AUTOmatic and MANual modes.

The LOAD capacitor MIN button (item 7) moves the LOAD capacitor towards minimum capacitance. Depress the button until the desired position is reached and then release – the capacitor will stop.

The LOAD capacitor MAX button (item 8) moves the LOAD capacitor towards maximum capacitance. Depress the button until the desired position is reached and then release – the capacitor will stop.

The TUNE capacitor MIN button (item 10) moves the TUNE capacitor towards minimum capacitance. Depress the button until the desired position is reached and then release – the capacitor will stop.

The TUNE capacitor MAX button (item 11) moves the TUNE capacitor towards maximum capacitance. Depress the button until the desired position is reached and then release – the capacitor will stop.

Configuring Programmable Parameters

The MC2 Matching Network Controller's programmable parameters allow you to select options to customize the controller to fit your application needs. A summary of the programmable parameters is listed in the table below, followed by detailed descriptions of each parameter.

Navigating the Programming Menu

TO ENTER the programming mode, press the "PGM" button (Program/Run button – item 1) on the front panel. The legend above the button will change from "PGM" to "RUN".

TO EXIT the programming mode, press the "RUN" button (Program/Run button – item 1) on the front panel. The legend above the button will change from "RUN" to "PGM".

Pressing the "DOWN" button (item 2) moves down the programming menu levels.

Pressing the "UP" button (item 3) moves up the programming menu levels.

Pressing the "ENT" button (item 4) saves the programmable parameter setting. The programmable parameters are saved in the MC2 Controller's memory and are recalled upon power-on

PROGRAMABLE PARAMAETER REFERENCE CHART:

Factory settings are noted in the option column by an asterisk (*) or the term "Default:"

PROGRAMMABLE PARAMETER REFERENCE CHART		
PARAMETER	**DISPLAY LINE 3**	**OPTION**
Set Strike Preset	RECORD STRIKE PRESET or WAITING FOR DC BIAS	<ENT>
Internal Load Capacitor Preset Position	SET LOAD PRESET XX%	2% to 98% Default: 50%
Internal Tune Capacitor Preset Position	SET TUNE PRESET XX%	2% to 98% Default: 50%
Preset Source	PRESETS - OFF	EXT SOURCE INT SOURCE OFF *
Preset Trigger	RF-OFF TRIGGER or ANALOG TRIGGER	RF-OFF* ANALOG
RF On/Off Detection	RF DETECT: GENERATOR	GENERATOR* RF PROBE
Feedback Source (Probe) Select	DCV PROBE SELECTED	DCV PROBE* RFV PROBE
DC Voltage Probe Attenuation Factor (XXXX:1)	DC PROBE ATTEN XXXX	0 to 4095 Default: 200

PROGRAMMABLE PARAMETER REFERENCE CHART		
PARAMETER	**DISPLAY LINE 3**	**OPTION**
RF Voltage Probe Attenuation Factor (XXXX:1)	RF PROBE ATTEN XXXX	0 to 4095 Default: 1000
RF On/Off Detect Threshold	RF-ON PRB THR: XXXXXV	0 to 32000V Default 0V
Display Load and Tune Capacitor Preset	LD/TN DISPLAY OFF	ON OFF*
Display Phase and Magnitude Sensor Error Signal	PH/MAG DISPLAY OFF	ON* OFF
Display Forward and Reflected Power (Requires interfacing to RF Generator)	FWD/REF DISPLAY OFF	ON OFF*
Display RF or DC Voltage Probe (Displays selected Feedback Probe's Voltage)	RF/DCV DISPLAY OFF	ON OFF*
Magnitude Error Signal Offset	MAG ERROR ADJ XXX	-4095 to 4095 Default: 0
Phase Error Signal Offset	PHASE ERROR ADJ XXX	-4095 to 4095 Default: 0
Forward Power Full Scale Wattage Assumes RF Power Supply's Forward power monitor signal is set for 5.00V at full scale. Instructs the MC2 Controller to display 1-10,000 Watts for a 5.00VDC signal.	FORWARD F.S. XXXXX	1-10000 Default: 600
Reflected Power Full Scale Wattage Assumes RF Power Supply's Reflected power monitor signal is set for 5.00V at full scale. Instructs the MC2 Controller to display 1-4095 Watts for a 5.00VDC signal.	REFLECTED F.S. XXXX	1-4095 Default: 150
Load Capacitor Programmable High Limit	LOAD LIMIT HIGH XX%	2-98% Default: 98%
Load Capacitor Programmable Low Limit	LOAD LIMIT LOW XX%	2-98% Default: 2%
Tune Capacitor Programmable High Limit	TUNE LIMIT HIGH XX%	2-98% Default 98%
Tune Capacitor Low Limit	TUNE LIMIT LOW XX%	2-98% Default: 2%
BACKOUT feature Enable / Disable	BACKOUT ENABLED	ENABLED* DISABLED

PROGRAMMABLE PARAMETER REFERENCE CHART		
PARAMETER	**DISPLAY LINE 3**	**OPTION**
Communication Protocol Select	RS232	PROFIBUS DEVICENET MODBUS 2W RTU MODBUS 4W RTU RS485-2 RS485-4 RS422 RS232*
Address ID number Applies to all Communication Protocols.	ADDRESS # XX	0 to 99 Default: 99
Data Rate DeviceNet Protocol: 500, 250, 125 KBPS RS232, RS422, RS485, Modbus Protocols: 115200, 57600, 38400, 19200, 9600 4800, 2400 BAUD PROFIBUS Protocol: Data rate is detected automatically and set to match the PROFIBUS Master.	DATA RATE XXX KBPS XXXXX BAUD	500 KBPS* 250 KBPS 125 KBPS 115200 BAUD 57600 BAUD 38400 BAUD 19200 BAUD* 9600 BAUD 4800 BAUD 2400 BAUD
Communications ECHO	ECHO: DISABLED	Disabled* Enabled
Load Capacitor Deadband	LOAD DEADBAND XX mV	0mV to 999mV Default: 1mV
Load Capacitor High Threshold	LOAD HI THRSH XXX mV	0mV to 999mV Default: 700mV
Load Capacitor Medium Threshold	LOAD MED THRSH XXX mV	0 mV to 999 mV Default: 710mV
Load Capacitor Low Threshold	LOAD LOW THRSH XXX mV	0 mV to 999 mV Default: 720mV
Tune Capacitor Deadband	TUNE DEADBAND XXX mV	0mV to 999mV Default: 1mV
Tune Capacitor High Threshold	TUNE HI THRSH XXX mV	0mV to 999mV Default: 700mV
Tune Capacitor Medium Threshold	TUNE MED THRSH XXX mV	0 mV to 999 mV Default: 710mV
Tune Capacitor Low Threshold	TUNE LOW THRSH XXX mV	0 mV to 999 mV Default: 720mV
Factory Settings – Enter passcode. No User Adjustments	PCB SETUP-OUT	XXX

PROGRAMMABLE PARAMETER DETAILS:

Programmable parameters are discussed in detail below. Factory settings are noted by an asterisk (*) or the term "Default:".

PROGRAMMABLE PARAMETER DETAILS	
PARAMETER	**PARAMETER DETAIL**
Set Strike Preset	Used in conjunction with LOAD and TUNE presets – detects the point where DC bias is first developed ("strike point") and records the current capacitor positions for use with the preset feature. Requires an AT-Series Matching Network with a DC Probe installed. 1. Configure the matching network and RF power supply and initiate sequence to ignite a plasma. The third line of the front panel display changes to "WAITING FOR DC BIAS". 2. As a plasma is developed and DC Bias is detected, the third line of the front panel changes to "RECORD STRIKE PRESET" 3. Press the Enter "ENT" button (item 4) on the front panel to save the Load and Tune capacitor positions at the strike point into preset memory. Related Parameters: Preset Source, Preset Trigger
Internal Load Capacitor Preset Position	Sets the MC2 Controller's internal Load Capacitor preset position. Settable position range is from 2% (minimum) to 98% (maximum). Factory Default setting: 50%. Use the VALUE UP button (item 5) or VALUE DOWN button (item 6) to select the desired LOAD PRESET position. Press the Enter "ENT" button (item 4) on the front panel. The displayed LOAD PRESET value is saved in non-volatile storage. Related Parameters: Preset Source, Preset Trigger Related Serial Command: MPL
Internal Tune Capacitor Preset Position	Sets the MC2 Controller's internal Tune Capacitor preset position. Settable position range is from 2% (minimum) to 98% (maximum). Factory Default Setting: 50%. Use the VALUE UP button (item 5) or VALUE DOWN button (item 6) to select the desired TUNE PRESET position. Press the Enter "ENT" button (item 4) on the front panel. The displayed TUNE PRESET value is saved in non-volatile storage. Related Parameters: Preset Source, Preset Trigger Related Serial Command: MPT

PROGRAMMABLE PARAMETER DETAILS	
PARAMETER	**PARAMETER DETAIL**
Preset Source	Enables/Disables presets and selects the preset position source. Available selections are: PRESETS OFF PRESETS-INT SOURCE PRESETS-EXT SOURCE Factory Default setting: PRESETS OFF PRESETS OFF: Preset function is completely disabled. Presets function will not respond to any trigger source. PRESETS –INT SOURCE: Selects the Load and Tune Capacitor Preset values internally stored in the MC2 controller. Preset function is enabled. The MC2 Controller positions the Load and Tune Capacitors to the internally stored positions when a preset trigger event occurs. PRESETS-EXT SOURCE: Selects the Load and Tune Capacitor Preset values applied to the MC2 Controller's rear panel "ANALOG CONTROL" connector. Preset function is enabled. The MC2 Controller positions the Load and Tune Capacitors to the preset position values present at the rear panel "ANALOG CONTROL" connector when a preset trigger event occurs Apply the Load Capacitor preset position value to the "ANALOG CONTROL" connector LOADPSETV signal (pin 13). Apply the Tune Capacitor preset position value to the "ANALOG CONTROL" connector TUNEPSETV signal (pin 12) when Use the VALUE UP button (item 5) or VALUE DOWN button (item 6) to select the desired Preset Source. Press the Enter "ENT" button (item 4) on the front panel. The displayed Preset Source is saved in non-volatile storage. Note: The preset source can be set by serial command or by the front panel programming menu. Related Parameters: Internal Load Capacitor Preset Position Internal Tune Capacitor Preset Position Preset Trigger Related Serial Commands: OFF, INT, EXT

PROGRAMMABLE PARAMETER DETAILS	
PARAMETER	**PARAMETER DETAIL**
Preset Trigger	Selects the control source used to trigger (activate) presets. Note: A Preset Source must be selected in order to use presets. Available selections are: RF-OFF ANALOG Factory Default setting: RF-OFF RF-OFF: Uses the user-configurable RF On/Off detection method to trigger presets. If the RF Power Supply is in an "RF OFF" state, the MC2 Controller positions the Load and Tune Capacitors to the internal preset positions stored in the MC2's memory. If the RF Power Supply is in an "RF ON" state, the MC2 controller adjusts the Load and Tune Capacitors to minimize reflected power. ANALOG: Uses the state of the PRELOAD and PRETUNE signals on the rear panel "ANALOG CONTROL" connector to trigger presets. An interface connection from the rear panel "ANALOG CONTROL" connector to the user's system or user-supplied external control is required. The PRELOAD and PRETUNE signals operate independently of each other, allowing external activation of the Load Capacitor Preset, Tune Capacitor Preset or both presets, at the user's discretion. The MC2 Controller will position the Load Capacitor to the selected preset (internal or external) when the "ANALOG CONTROL" connector PRELOAD signal (pin 2) is activated. The Load Capacitor will be held at the preset position until the PRELOAD signal is de-activated. The MC2 Controller will position the Tune Capacitor to the selected preset (internal or external) when the "ANALOG CONTROL" connector PRETUNE signal (pin 5) is activated. The Tune Capacitor will be held at the preset position until the PRETUNE signal is de-activated. Use the VALUE UP button (item 5) or VALUE DOWN button (item 6) to select the desired Preset Trigger Source. Press the Enter "ENT" button (item 4) on the front panel. The displayed Preset Trigger source is saved in non-volatile storage. Note: The preset trigger can be set by serial command or by the front panel programming menu. Related Parameters: Internal Load Capacitor Preset Position Internal Tune Capacitor Preset Position Preset Source RF On/Off Detection RF On/Off Detect Threshold Related Serial Commands: TRGX, TRGR

PROGRAMMABLE PARAMETER DETAILS	
PARAMETER	**PARAMETER DETAIL**
RF On/Off Detection	Selects the method used to determine if the RF Power Supply is in an "RF ON" or "RF OFF" state. Available Selections are: GENERATOR RF PROBE Factory default setting: GENERATOR GENERATOR: Uses the RFENABLED signal from the rear panel "From System" and "To Generator" connectors to determine RF On/Off status. If the RFENABLED signal is at a TTL "High" state, the RF power supply is assumed to be in an "RF OFF" condition; If the RFENABLED signal is at a TTL "Low" state, the RF power supply is assumed to be in an "RF ON" condition. **Note:** the RFENABLED signal states listed above are for Seren IPS Inc. RLX01-Series RF Power Supplies. Other RF Power Supplies may have different signal states. Consult your RF Power Supply's operator manual or an authorized Seren IPS Inc. service depot for detailed application assistance. RF PROBE: Utilizes an *optional* RF probe in a Seren IPS Inc. AT-Series matching network in conjunction with the RF On/Off Detect Threshold parameter to sense the presence of RF voltage and determine if the RF power supply is in an "RF ON" condition. If the sensed RF voltage is less than the voltage specified by the RF On/Off Detect Threshold parameter, the RF power supply is assumed to be in a "RF OFF" state. If the sensed RF voltage is equal to or greater than the voltage specified by the RF On/Off Detect Threshold parameter, the RF power supply is assumed to be in a "RF ON" state Use the VALUE UP button (item 5) or VALUE DOWN button (item 6) to select the desired RF On/Off detection method. Press the Enter "ENT" button (item 4) on the front panel. The displayed RF On/Off detection method is saved in non-volatile storage. Related Parameters: Preset Source Preset Trigger RF Voltage Probe Attenuation Factor RF On/Off Detect Threshold

PROGRAMMABLE PARAMETER DETAILS	
PARAMETER	**PARAMETER DETAIL**
Feedback Source (Probe) Select	Selects the matching network voltage probe signal, DC Voltage or RF Voltage, to be routed to the RF Power Supply. Available Selections are: DCV PROBE RFV PROBE Factory default setting: DCV PROBE (DC Voltage Probe). DCV PROBE: The voltage present at the MC2 Controller's rear panel "MATCHING NETWORK" connector DC-PROBE signal (pin 13) is routed to the PROBE signal (pin 12) of the "FROM SYSTEM" connector *and* to the PROBE signal (pin 12) of the "TO GENERATOR" connector. RFV PROBE: The voltage present at the MC2 Controller's rear panel "MATCHING NETWORK" connector RF-PROBE signal (pin 14) is routed to the PROBE signal (pin 12) of the "FROM SYSTEM" connector *and* to the PROBE signal (pin 12) of the "TO GENERATOR" connector. **Note:** Interfacing from the MC2 Controller to the RF Power Supply is required for the RF Power Supply to use the Voltage Probe signal. **Note:** DC Voltage probes are standard equipment on most Seren IPS Inc. AT-Series Matching Networks. RF Voltage Probes are optional. Probes on custom-configured AT-Series Matching networks may vary. Use the VALUE UP button (item 5) or VALUE DOWN button (item 6) to select the desired Voltage Probe. Press the Enter "ENT" button (item 4) on the front panel. The displayed Voltage PROBE SELECTED value is saved in non-volatile storage. Note: The Feedback Source (Probe Select) can be set by serial command or by the front panel programming menu. Related Parameters: DC Voltage Probe Attenuation Factor RF Voltage Probe Attenuation Factor Display RF or DC Voltage Probe Related Serial Commands: PRB0, PRB1

PROGRAMMABLE PARAMETER DETAILS	
PARAMETER	**PARAMETER DETAIL**
DC Voltage Probe Attenuation Factor	Sets the DC Voltage probe's attenuation factor, in the form of XXXX: 1. Set the attenuation factor to match the matching network's DC Voltage Probe attenuation factor. Attenuation factor range is 1:1 to 4095:1 Factory default setting: 200:1 **Note:** The standard DC Voltage Probe attenuation factor for Seren IPS Inc. AT-Series matching networks is 200:1. DC Voltage probes are standard on most Seren AT-Series matching networks. Custom-configured matching networks may vary. Use the VALUE UP button (item 5) or VALUE DOWN button (item 6) to select the desired DC PROBE ATTEN factor. Press the Enter "ENT" button (item 4) on the front panel. The displayed DC PROBE ATTEN factor value is saved in non-volatile storage. Related Parameters: Feedback Source (Probe) Select Display RF or DC Voltage Probe
RF Voltage Probe Attenuation Factor	Sets the RF Voltage probe's attenuation factor, in the form of XXXX: 1. Set the attenuation factor to match the matching network's RF Voltage Probe attenuation factor. Attenuation factor range is 1:1 to 4095:1. Factory default setting: 1000:1 **Note:** The standard RF Voltage Probe attenuation factor for Seren IPS Inc. AT-Series matching networks is 1000:1. RF Voltage probes are ***optional*** on most Seren AT-Series matching networks. Custom-configured matching networks may vary. Use the VALUE UP button (item 5) or VALUE DOWN button (item 6) to select the desired RF PROBE ATTEN factor. Press the Enter "ENT" button (item 4) on the front panel. The displayed RF PROBE ATTEN factor value is saved in non-volatile storage. Related Parameters: Feedback Source (Probe) Select Display RF or DC Voltage Probe RF On/Off Detect Threshold

PROGRAMMABLE PARAMETER DETAILS	
PARAMETER	**PARAMETER DETAIL**
RF On/Off Detect Threshold	Sets the threshold above which the voltage measured from the AT-Series Matching networks' *optional* RF Voltage Probe indicates the RF Power Supply is in the "RF ON" state. Threshold range is 0V to 32000V Factory default setting: 0V **Note:** The threshold value represents the voltage from the RF Probe *after* the RF Probe Attenuation Factor has been applied. **Note:** The RF On/Off Detect Threshold parameter is active only if the RF On/Off Detection parameter is set to "RF PROBE". Use the VALUE UP button (item 5) or VALUE DOWN button (item 6) to select the desired RF On/Off Detect Threshold voltage. Press the Enter "ENT" button (item 4) on the front panel. The displayed RF On/Off Detect Threshold voltage is saved in non-volatile storage. Related parameters: Preset Trigger RF On/Off Detection RF Voltage Probe Attenuation Factor
Display Load and Tune Capacitor Preset	Enables/disables the display of the Load and Tune Capacitor Preset values on one of the two user-configurable front panel display lines (lines 2 and 3). The preset value displayed is controlled by the Preset Source parameter. Available selections: LD/TN DISPLAY ON LD/TN DISPLAY OFF Factory default setting: LD/TN DISPLAY OFF **Note:** There are 4 items that can be enabled for display on the front panel; however, there are only 2 user-configurable display lines available. Select a maximum of 2 display line items. Use the VALUE UP button (item 5) to set LD/TN DISPLAY to ON. Use the VALUE DOWN button (item 6) to set LD/TN DISPLAY to OFF. Press the Enter "ENT" button (item 4) on the front panel. The displayed LD/TN DISPLAY mode is saved in non-volatile storage. Related Parameters: Internal Load Capacitor Preset Position Internal Tune Capacitor Preset Position Preset Source

PROGRAMMABLE PARAMETER DETAILS	
PARAMETER	**PARAMETER DETAIL**
Display Phase and Magnitude Sensor Error Signal	Enables/disables the display of the Phase and Magnitude sensor error signal values, in milli-Volts, on one of the two user-configurable front panel display lines (lines 2 and 3). Available selections: PH/MAG DISPLAY ON PH/MAG DISPLAY OFF Factory default setting: PH/MAG DISPLAY ON **Note:** There are 4 items that can be enabled for display on the front panel; however, there are only 2 user-configurable display lines available. Select a maximum of 2 display line items. Use the VALUE UP button (item 5) to set PH/MAG DISPLAY to ON. Use the VALUE DOWN button (item 6) to set PH/MAG DISPLAY to OFF. Press the Enter "ENT" button (item 4) on the front panel. The displayed PH/MAG DISPLAY mode is saved in non-volatile storage. Note: The Phase and magnitude error signals can be queried by serial commands. Related Serial Commands: PHS, MAG
Display Forward and Reflected Power	Enables/disables the display of the RF Generator's Forward and Reflected Power monitor signal, in Watts, on one of the two user-configurable front panel display lines (lines 2 and 3). **Note:** This feature requires an interface connection from the MC2 Controller's "TO GENERATOR" connector to the RF Power Supply. Available selections: FWD/REF DISPLAY ON FWD/REF DISPLAY OFF Factory default setting: FWD/REF DISPLAY OFF **Note:** There are 4 items that can be enabled for display on the front panel; however, there are only 2 user-configurable display lines available. Select a maximum of 2 display line items. Use the VALUE UP button (item 5) to set FWD/REF DISPLAY to ON. Use the VALUE DOWN button (item 6) to set FWD/REF DISPLAY to OFF. Press the Enter "ENT" button (item 4) on the front panel. The displayed PH/MAG DISPLAY mode is saved in non-volatile storage. Related Parameters: Forward Power Full Scale Wattage Reflected Power Full Scale Wattage

PROGRAMMABLE PARAMETER DETAILS	
PARAMETER	**PARAMETER DETAIL**
Display RF or DC Voltage Probe	Enables/disables the display of the matching network's DC Voltage Probe signal *or* RF Voltage Probe signal, in Volts, on one of the two user-configurable front panel display lines (lines 2 and 3). The displayed probe voltage is controlled by the Feedback Source (Probe) Select parameter. Available selections: RF/DCV DISPLAY ON RF/DCV DISPLAY OFF Factory default setting: RF/DCV DISPLAY OFF **Note:** The DC Probe voltage is shown to the left of the display line "DC: XXXV" and the RF Probe voltage is shown to the right of the display line "RF: XXXXV". If the Feedback Source (Probe) Select parameter is set to "DC PROBE" and the RF On/Off Detection parameter is set to "RF PROBE", both probe voltages will be shown on the display line. Example: "DC: 100V RF: 2000V" **Note:** There are 4 items that can be enabled for display on the front panel; however, there are only 2 user-configurable display lines available. Select a maximum of 2 display line items. Use the VALUE UP button (item 5) to set RF/DCV DISPLAY to ON. Use the VALUE DOWN button (item 6) to set RF/DCV DISPLAY to OFF. Press the Enter "ENT" button (item 4) on the front panel. The displayed RF/DCV DISPLAY mode is saved in non-volatile storage. Related Parameters: Feedback Source (Probe) Select DC Voltage Probe Attenuation Factor RF Voltage Probe Attenuation Factor
Magnitude Error Signal Offset	Used to compensate for an inadequately nulled Magnitude error signal. Similar in function the "MAG" adjustment on an AT-Series matching network, however it is not a substitute or a remote control for the AT-Series matching network's "MAG" adjustment. Intended for use when the MAG error null needs only a minor adjustment and the AT-Series matching network is installed in such a manner that the MAG adjustment is inaccessible. Adjustment Range: -4095 to 4095 mV Factory default setting: 0
Phase Error Signal Offset	Used to compensate for an inadequately nulled Phase error signal. Similar in function the "PHASE" adjustment on an AT-Series matching network, however it is not a substitute or a remote control for the AT-Series matching network's "PHASE" adjustment. Intended for use when the PHASE error null needs only a minor adjustment and the AT-Series matching network is installed in such a manner that the PHASE adjustment is inaccessible. Adjustment Range: -4095 to 4095 mV Factory default setting: 0

PROGRAMMABLE PARAMETER DETAILS	
PARAMETER	**PARAMETER DETAIL**
Forward Power Full Scale Wattage	Adjusts the MC2 Controller's forward power scaling factor. The MC2 Controller assumes the RF Power Supply's full-scale forward power monitor output voltage is +5.00VDC. Range is 1 Watt to 10,000 Watts. Factory default setting: 600 Watts **Note:** This feature requires an interface connection from the MC2 Controller's "TO GENERATOR" connector to the RF Power Supply. Use the VALUE UP button (item 5) or the VALUE DOWN button (item 6) to set the FORWARD F.S. value to match the RF Power Supply's full-scale Wattage. **Note:** If the RF Power Supply's full-scale forward power monitor output voltage is +10.00VDC, set the FORWARD F.S. value to one-half (1/2) the RF Power Supply's full-scale forward power Wattage. Press the Enter "ENT" button (item 4) on the front panel. The displayed FORWARD F.S. value is saved in non-volatile storage. Related Parameter: Display Forward and Reflected Power
Reflected Power Full Scale Wattage	Adjusts the MC2 Controller's forward power scaling factor. The MC2 Controller assumes the RF Generator's full-scale reflected power monitor output voltage is +5.00VDC. Range is 1 Watt to 4095 Watts. Factory default setting: 150 Watts **Note:** This feature requires an interface connection from the MC2 Controller's "TO GENERATOR" connector to the RF Power Supply. Use the VALUE UP button (item 5) or the VALUE DOWN button (item 6) to set the REFLECTED F.S. to the desired full-scale wattage. **Note:** If the RF Power Supply's full-scale reflected power monitor output voltage is +10.00VDC, set the REFLECTED F.S. value to one-half (1/2) the RF Power Supply's full-scale reflected power Wattage. Press the Enter "ENT" button (item 4) on the front panel. The displayed REFLECTED F.S. value is saved in non-volatile storage. Related Parameter: Display Forward and Reflected Power
Load Capacitor Programmable High Limit	Sets the Load Capacitor's maximum position limit to a value less than the absolute maximum. The Load Capacitor's motor will stop when this limit is reached, regardless of the Magnitude error signal, preset signal, or front panel positioning controls. "LOAD LIMIT HIGH XXX" will be displayed on the front panel, where "XX" is the limit value. Range is 2% to 98%. Factory default setting: 98%. Use the VALUE UP button (item 5) or the VALUE DOWN button (item 6) on the front panel to set the desired LOAD LIMIT HIGH value. Press the Enter "ENT" button (item 4) on the front panel. The displayed LOAD LIMIT HIGH value is saved in non-volatile storage.

PROGRAMMABLE PARAMETER DETAILS	
PARAMETER	**PARAMETER DETAIL**
Load Capacitor Programmable Low Limit	Sets the Load Capacitor's minimum position limit to a value greater than the absolute minimum. The Load Capacitor's motor will stop when this limit is reached, regardless of the Magnitude error signal, preset signal, or front panel positioning controls. "LOAD LIMIT LOW XX%" will be displayed on the front panel, where "XX is the limit value. Range is 2% to 98%. Factory default settings: 2%. Use the VALUE UP button (item 5) or the VALUE DOWN button (item 6) on the front panel to set the desired LOAD LIMIT LOW value. Press the Enter "ENT" button (item 4) on the front panel. The displayed LOAD LIMIT LOW value is saved in non-volatile storage.
Tune Capacitor Programmable High Limit	Sets the Tune Capacitor's maximum position limit to a value less than the absolute maximum. The Tune Capacitor's motor will stop when this limit is reached, regardless of the Phase error signal, preset signal, or front panel positioning controls. "TUNE LIMIT HIGH XX%" will be displayed on the front panel, where "XX" is the limit value. Range is 2% to 98%. Factory default setting: 98%. Use the VALUE UP button (item 5) or the VALUE DOWN button (item 6) on the front panel to set the desired TUNE LIMIT HIGH value. Press the Enter "ENT" button (item 4) on the front panel. The displayed TUNE LIMIT HIGH value is saved in non-volatile storage.
Tune Capacitor Programmable Low Limit	Sets the Tune Capacitor's minimum position limit to a value greater than the absolute minimum. The Tune Capacitor's motor will stop when this limit is reached, regardless of the Phase error signal, preset signal, or front panel positioning controls. "TUNE LIMIT LOW XX%" will be displayed on the front panel, where "XX" is the limit value. Range is 2% to 98%. Factory default setting: 2%. Use the VALUE UP button (item 5) or the VALUE DOWN button (item 6) on the front panel to set the desired TUNE LIMIT LOW value. Press the Enter "ENT" button (item 4) on the front panel. The displayed TUNE LIMIT LOW value is saved in non-volatile storage.

PROGRAMMABLE PARAMETER DETAILS	
PARAMETER	**PARAMETER DETAIL**
Backout Feature Enable/Disable	Enables or disables the MC2 Controller's Limit Condition Backout feature. Factory Default: Enabled With the limit condition BACKOUT feature enabled, the MC2 Controller reverses the matching network's motors for a brief interval when a minimum or maximum position limit condition has been reached, allowing the matching network to re-tune, thus minimizing "stuck" network conditions. This feature is useful for processing systems or plasmas that are difficult to start or ignite. **Note:** When installing a MC2 Controller and matching network on a new system, or when calibrating a matching network, it is recommended the BACKOUT feature be disabled. Enabling the BACKOUT feature during set-up can lead to "oscillation" of the motors, making set-up very difficult. Use the front panel VALUE UP button (item 5) to set BACKOUT to ENABLED. Use the front panel VALUE DOWN button (item 6) to set BACKOUT to DISABLED. Press the Enter "ENT" button (item 4) on the front panel. The displayed BACKOUT mode is saved in non-volatile storage.

PROGRAMMABLE PARAMETER DETAILS	
PARAMETER	**PARAMETER DETAIL**
Communications Protocol Select	Selects the communications interface protocol. Available selections: PROFIBUS (requires *optional* factory-installed PROFIBUS Interface) DEVICENET (requires *optional* factory-installed DeviceNet Interface) MODBUS 2W RTU (ModBus 2-Wire) MODBUS 4W RTU (ModBus 4-wire) RS485-2 (RS-485 2-Wire) RS485-4 (RS-485 4-Wire) RS422 RS232 Factory default setting: RS232 Use the VALUE UP button (item 5) or the VALUE DOWN button (item 6) on the front panel to set the desired communications protocol. Press the Enter "ENT" button (item 4) on the front panel. The displayed communications protocol is saved in non-volatile storage. **Note:** Connections for MODBUS, RS485, RS422, and RS232 communications are made via the rear panel "SERIAL RS232" connector. Refer to the Rear Panel Controls And Connections section for interface wiring details. **Note:** Connections for *optional* DEVICENET communications are made via the rear panel "DEVICENET" connector. Refer to the Rear Panel Controls And Connections section for DEVICENET interface wiring details. **Note:** Connections for the *optional* PROFIBUS interface are made via the rear panel 9-pin "PROFIBUS" connector. If the *optional* PROFIBUS interface is installed, none of the other communications protocols/interfaces are available. **Note:** When RS232 communications protocol is selected, the Address ID Number is ignored. Related Parameters: Address ID Number Data Rate Communications ECHO

PROGRAMMABLE PARAMETER DETAILS	
PARAMETER	**PARAMETER DETAIL**
Address ID Number	Selects the Address ID Number for RS-232, RS-422, RS-485, MODBUS, and DEVICENET communication protocols. "ADDRESS # XXX" will be displayed on the front panel, where "XXX" is the address value. Address ranges: RS422, RS485: 0 to 99 MODBUS: 1 to 247 DEVICENET: 0 to 64 PROFIBUS: 0 to 126 Factory default settings: RS-232, RS-422, RS-485, MODBUS: 99 DEVICENET: 63 PROFIBUS: 2 Use the VALUE UP button (item 5) or the VALUE DOWN button (item 6) on the front panel to set the desired Address ID Number. Press the Enter "ENT" button (item 4) on the front panel. The displayed Address ID Number is saved in non-volatile storage. **Note:** For RS232 operation, the Address ID Number is ignored. **Note:** If the *optional* PROFIBUS interface is installed, none of the other communications protocols are available. Related Parameters: Communications Protocol Select Data Rate Communications ECHO

PROGRAMMABLE PARAMETER DETAILS	
PARAMETER	**PARAMETER DETAIL**
Data Rate	Selects the Data Rate for RS-232, RS-422, RS-485, MODBUS, and DEVICENET communication protocols. Available data rates displayed depend on the currently selected communications protocol. Available Data Rates for DEVICENET protocol: 500KBPS 250KBPS 125KBPS **Note:** DeviceNet data rate selections are visible only when DeviceNet protocol is selected. DeviceNet data rate is set via the rear panel data rate switch. With the *optional* DeviceNet interface is installed, the DeviceNet interface reads the rear panel data rate switch, sets the data rate, and displays the data rate on the front panel display. When the *optional* DeviceNet interface is not installed, the data rate can be adjusted via the front panel, but it is ignored by the MC2 Controller. Available Data Rates for RS-232, RS-422, RS-485, and MODBUS protocols: 115200 BAUD 57600 BAUD 38400 BAUD 19200 BAUD 9600 BAUD 4800 BAUD 2400 BAUD **Note:** RS-232, RS-422, RS-485, and MODBUS protocols data rate selections are visible only when RS-232, RS-422, RS-485, or MODBUS communication protocols are selected. Available Data Rates for PROFIBUS Protocol: The PROFIBUS data rate is automatically detected and set to match the PROFIBUS Master. The data rate parameter is not configurable. If the PROFIBUS interface option is installed, the data rate is displayed as "DATA RATE: AUTOMATIC" Factory Default Setting: DEVICENET: 500KBPS RS232, RS422, RS485, and MODBUS: 19200 BAUD PROFIBUS: AUTOMATIC (not configurable) Use the VALUE UP button (item 5) or the VALUE DOWN button (item 6) on the front panel to set the desired Data Rate. Press the Enter "ENT" button (item 4) on the front panel. The displayed Data Rate is saved in non-volatile storage. Related Parameters: Communications Protocol Select Address ID Number Communications ECHO

PROGRAMMABLE PARAMETER DETAILS	
PARAMETER	**PARAMETER DETAIL**
Communications ECHO	Enables/Disables echoing of Serial, Modbus, or DeviceNet commands back to the originating communications device. Available settings: ENABLED DISBLED Factory Default setting: DISABLED Use the front panel VALUE UP button (item 5) or the VALUE DOWN button (item 6) on the front panel to Enable/Disable Communications ECHO. Press the Enter "ENT" button (item 4) on the front panel. The displayed Communications ECHO setting is saved in non-volatile storage. Note: Communications ECHO mode can be set by serial command or by the front panel programming menu. Related Parameters: Communications Protocol Select Address ID Number Data Rate Related Serial Commands: ECHO, NOECHO

PROGRAMMABLE PARAMETER DETAILS	
PARAMETER	**PARAMETER DETAIL**
Auto-Gain Feature	The Auto-Gain feature allows the operator to set up to 5 gain bands, tailoring the response of MC2 Controller to different levels of phase and magnitude error signals. This feature is useful when a process utilizes a wide range of RF power levels or the process tune point has a very high "Q" factor ("touchy"). The Auto-Gain feature operates on the premise that high-level error signals require a low gain, and low-level error signals require higher gain. Most processes will not require the use of all gain bands. Often, setting the Capacitor Deadbands is sufficient. Using the Auto-Gain feature requires operator experimentation to obtain the best results. To use the Auto-Gain feature, follow the procedure below: 1. Ensure the rear panel MAG GAIN and PHASE GAIN controls are set to their mid-points. The MAG GAIN and PHASE GAIN controls are factory pre-set to the mid-points. **Note:** The rear panel "MAG GAIN" and "PHASE GAIN" controls interact with the MC2's Auto Gain Feature. The rear-panel "MAG GAIN" and "PHASE GAIN" controls are a coarse adjustment. The recommended starting position of the MAG GAIN and PHASE GAIN controls is the mid-point. The MAG GAIN and PHASE GAIN controls are multi-turn potentiometers with 25 turns nominal. To set the MAG GAIN and PHASE GAIN controls to the mid-point, turn each set-screw counter-clockwise until a "clicking" sound is heard. Then turn each set-screw 12-1/2 turns clockwise. 2. Ensure the Capacitor Deadbands are set to 1mV (factory default) 3. Ensure the Capacitor High Thresholds are set to 700mV, the Capacitor Medium Thresholds are set to 710mV and the Capacitor Low Thresholds are set to 720mV (factory defaults) 4. Run the process. Obtain the best match possible – it may be necessary to optimize the matching network's range configuration or adjust the matching network's PHASE ZERO and MAG ZERO potentiometers. Refer to the Matching Network Range Configuration and Phase and Magnitude Sensor Adjustment Procedure sections for details. 5. If needed, adjust the rear panel MAG GAIN and PHASE GAIN controls to improve the match/obtain the best match possible. 6. Run the process, experimenting with adjusting the Capacitor Deadband settings, obtaining the best match possible. 7. Experiment with adjusting the Capacitor High, Medium and Low thresholds.

PROGRAMMABLE PARAMETER DETAILS	
PARAMETER	**PARAMETER DETAIL**
Auto Gain Feature — Load Capacitor Deadband	The Load Capacitor Deadband is a component setting of the MC2's Auto-Gain feature. When the absolute magnitude error signal level reaches the Load Capacitor Deadband setting, the load capacitor stops tuning. This setting allows the system operator to define when a match condition is "good enough", thus preventing the matching network from continuously "hunting" for a better match point. The Load Capacitor Deadband setting must be set lower than the Load Capacitor High, Medium, and Low thresholds. Deadband Range: 0mV to 999mV Factory default setting: 1mV **Example:** If the Load Capacitor Deadband is set to 10mV, the Load Capacitor will tune until the magnitude error signal reaches +/-10mV, and then it will stop. Related Parameters: Load Capacitor High Threshold Load Capacitor Medium Threshold Load Capacitor Low Threshold
Auto Gain Feature — Load Capacitor High Threshold	The Load Capacitor High Threshold is a component setting of the MC2's Auto-Gain feature. When the absolute magnitude error signal is greater than the Load Capacitor Deadband setting, but lower then Load Capacitor High Threshold, the Auto-Gain circuitry is at its maximum gain. Above this threshold setting, the gain will be one step lower. Threshold Range: 0mV to 999mV Factory default setting: 700mV **Note:** The magnitude error signal is internally clamped to 700mV, so any setting at 700mV or more effectively disables the threshold. **Note:** The Load Capacitor High Threshold should always be set to a level lower than the Load Capacitor Medium Threshold. Use the VALUE UP button (item 5) or the VALUE DOWN button (item 6) on the front panel to set the Load Capacitor High Threshold value. Press the Enter "ENT" button (item 4) on the front panel. The displayed Load Capacitor High Threshold value is saved in non-volatile storage. Related Parameters: Load Capacitor Deadband Load Capacitor Medium Threshold Load Capacitor Low Threshold

PROGRAMMABLE PARAMETER DETAILS	
PARAMETER	**PARAMETER DETAIL**
Auto Gain Feature — Load Capacitor Medium Threshold	The Load Capacitor Medium Threshold is a component setting of the MC2's Auto-Gain feature. When the absolute magnitude error signal is greater than the Load Capacitor Deadband setting, but lower then Load Capacitor Medium Threshold, the Auto-Gain circuitry's gain is one step lower than maximum gain. When the magnitude error signal is above this threshold setting, the gain will be one step lower. Threshold Range: 0mV to 999mV Factory default setting: 710mV **Note:** The magnitude error signal is internally clamped to 700mV, so any setting at 700mV or more effectively disables the threshold. **Note:** the Load Capacitor Medium threshold should always be set to a number higher than the Load Capacitor High Threshold. Use the VALUE UP button (item 5) or the VALUE DOWN button (item 6) on the front panel to set the Load Capacitor Medium Threshold value. Press the Enter "ENT" button (item 4) on the front panel. The displayed Load Capacitor Medium Threshold value is saved in non-volatile storage. Related Parameters: Load Capacitor Deadband Load Capacitor High Threshold Load Capacitor Low Threshold
Auto Gain Feature — Load Capacitor Low Threshold	The Load Capacitor Low Threshold is a component setting of the MC2's Auto-Gain feature. When the absolute magnitude error signal is greater than the Load Capacitor Deadband setting, but lower then Load Capacitor Low Threshold, the Auto-Gain circuitry's gain is two steps lower than maximum gain. When the magnitude error signal is above this threshold setting, the gain will be one step lower. Threshold Range: 0mV to 999mV Factory default setting: 720mV **Note:** The magnitude error signal is internally clamped to 700mV, so any setting at 700mV or more effectively disables the threshold. **Note:** the Load Capacitor Low threshold should always be set to a number higher than the Load Capacitor Medium Threshold. Use the VALUE UP button (item 5) or the VALUE DOWN button (item 6) on the front panel to set the Load Capacitor Low Threshold value. Press the Enter "ENT" button (item 4) on the front panel. The displayed Load Capacitor Low Threshold value is saved in non-volatile storage. Related Parameters: Load Capacitor Deadband Load Capacitor High Threshold Load Capacitor Medium Threshold

PROGRAMMABLE PARAMETER DETAILS	
PARAMETER	**PARAMETER DETAIL**
Auto Gain Feature — Tune Capacitor Deadband	The Tune Capacitor Deadband is a component setting of the MC2's Auto-Gain feature. When the absolute phase error signal level reaches the Tune Capacitor Deadband setting, the tune capacitor stops tuning. This setting allows the system operator to define when a match condition is "good enough", thus preventing the matching network from continuously "hunting" for a better match point. The Tune Capacitor Deadband setting must be set lower than the Tune Capacitor High, Medium, and Low thresholds. Deadband Range: 0mV to 999mV Factory default setting: 1mV **Example:** If the Tune Capacitor Deadband is set to 10mV, the Tune Capacitor will tune until the phase error signal reaches +/-10mV, and then it will stop. Related Parameters: Tune Capacitor High Threshold Tune Capacitor Medium Threshold Tune Capacitor Low Threshold
Auto Gain Feature — Tune Capacitor High Threshold	The Tune Capacitor High Threshold is a component setting of the MC2's Auto-Gain feature. When the absolute phase error signal is greater than the Tune Capacitor Deadband setting, but lower then Tune Capacitor High Threshold, the Auto-Gain circuitry is at its maximum gain. Above this threshold setting, the gain will be one step lower. Threshold Range: 0mV to 999mV Factory default setting: 700mV **Note:** The phase error signal is internally clamped to 700mV, so any setting at 700mV or more effectively disables the threshold. **Note:** The Tune Capacitor High Threshold should always be set to a level lower than the Tune Capacitor Medium Threshold. Use the VALUE UP button (item 5) or the VALUE DOWN button (item 6) on the front panel to set the Tune Capacitor High Threshold value. Press the Enter "ENT" button (item 4) on the front panel. The displayed Tune Capacitor High Threshold value is saved in non-volatile storage. Related Parameters: Tune Capacitor Deadband Tune Capacitor Medium Threshold Tune Capacitor Low Threshold

PROGRAMMABLE PARAMETER DETAILS	
PARAMETER	**PARAMETER DETAIL**
Auto Gain Feature — Tune Capacitor Medium Threshold	The Tune Capacitor Medium Threshold is a component setting of the MC2's Auto-Gain feature. When the absolute phase error signal is greater than the Tune Capacitor Deadband setting, but lower then Tune Capacitor Medium Threshold, the Auto-Gain circuitry's gain is one step lower than maximum gain. When the magnitude error signal is above this threshold setting, the gain will be one step lower. Threshold Range: 0mV to 999mV Factory default setting: 710mV **Note:** The phase error signal is internally clamped to 700mV, so any setting at 700mV or more effectively disables the threshold. **Note:** The Tune Capacitor Medium threshold should always be set to a number higher than the Tune Capacitor High Threshold. Use the VALUE UP button (item 5) or the VALUE DOWN button (item 6) on the front panel to set the Tune Capacitor Medium Threshold value. Press the Enter "ENT" button (item 4) on the front panel. The displayed Tune Capacitor Medium Threshold value is saved in non-volatile storage. Related Parameters: Tune Capacitor Deadband Tune Capacitor High Threshold Tune Capacitor Low Threshold
Auto Gain Feature — Tune Capacitor Low Threshold	The Tune Capacitor Low Threshold is a component setting of the MC2's Auto-Gain feature. When the absolute phase error signal is greater than the Tune Capacitor Deadband setting, but lower then Tune Capacitor Low Threshold, the Auto-Gain circuitry's gain is two steps lower than maximum gain. When the magnitude error signal is above this threshold setting, the gain will be one step lower. Threshold Range: 0mV to 999mV Factory default setting: 720mV **Note:** The phase error signal is internally clamped to 700mV, so any setting at 700mV or more effectively disables the threshold. **Note:** The Tune Capacitor Low threshold should always be set to a number higher than the Tune Capacitor Medium Threshold. Use the VALUE UP button (item 5) or the VALUE DOWN button (item 6) on the front panel to set the Tune Capacitor Low Threshold value. Press the Enter "ENT" button (item 4) on the front panel. The displayed Tune Capacitor Low Threshold value is saved in non-volatile storage. Related Parameters: Load Capacitor Deadband Load Capacitor High Threshold Load Capacitor Medium Threshold

PROGRAMMABLE PARAMETER DETAILS	
PARAMETER	**PARAMETER DETAIL**
Factory Settings	Used by factory technicians to program and calibrate the MC2 Controller. There are no user adjustments. Use the front panel VALUE UP button (item 5) or the VALUE DOWN button (item 6) to set the desired PCB SETUP-OUT pass-code value. Press the Enter "ENT" button (item 4) on the front panel. If the displayed pass-code is correct, factory settings are available by using the UP or DOWN buttons, or press the RUN button return to normal operation.

Serial Communications

The Seren IPS Inc. model MC2 Matching Network Controller supports several serial communications modes and interfaces. The communications mode and corresponding interface is configured from the front-panel programming menu. Available communications modes are: RS-232, RS-422, RS-485 4 Wire, RS-485 2 Wire, MODBUS 4 Wire RTU, MODBUS 2 Wire RTU, DeviceNet, and PROFIBUS. ***DeviceNet and PROFIBUS are optional interfaces***, and are not field-installable.

This section describes the usage and commands applicable to RS232, RS422, RS485-4 and RS-485-2 serial protocols. DeviceNet communications is discussed in its own section, MODBUS and PROFIBUS communications are described separate documents. Selecting and configuring the serial interface is discussed later in this section.

The serial interface connector (labeled "SERIAL RS232"), located on the rear panel of the MC2 controller, is used for RS232, RS422, RS485-4, and RS485-2 communications. The serial interface connector is detailed in the Rear Panel Controls And Connections section.

RS232, RS422, RS485-4, and RS485-2 modes share a common command set. The differences between the serial interface modes are related to the physical connection type and usage. The serial modes and connections are described in the chart below.

IMPORTANT NOTE:

When communicating via the serial interface, the front panel controls remain active. Programmable parameters may be set via the front panel, the Load and Tune capacitors may be positioned via the front panel, and the Load and Tune capacitor position control mode may be changed via the front panel.

General Note:

Throughout this document, Hexadecimal numbers are preceded by "0x"
Example: 80 (decimal) = 0x50 (hexadecimal)

The following serial communication parameters are fixed and cannot be configured	
Parity:	NONE
Data Bits:	8
Stop Bits:	1

Serial Interface Modes and Connections	
Mode	**Description**
RS232	Single-Ended, point-to-point. Suitable for short distances (less than 30 meters) SERIAL RS232 Connector — Signal Function Pin 2 — Transmit Data (out) Pin 3 — Receive Data (in) Pin 9 — Common (ground)
RS422	Balanced, point-to-point. Suitable for longer distances (up to 1000 meters at 9600 BAUD) SERIAL RS232 Connector — Signal Function Pin 5 — Receive Data + (in) Pin 6 — Receive Data – (in) Pin 7 — Transmit Data + (out) Pin 8 — Transmit Data – (out) Pin 9 — Common (ground)
RS485-4	Balanced, multipoint addressable, up to 32 nodes. Full-Duplex SERIAL RS232 Connector — Signal Function Pin 5 — Receive Data + (in) Pin 6 — Receive Data – (in) Pin 7 — Transmit Data + (out) Pin 8 — Transmit Data – (out) Pin 9 — Common (ground)
RS485-2	Balanced, multipoint addressable, up to 32 nodes. Half-Duplex SERIAL RS232 Connector — Signal Function Pin 7 — Transmit / Receive Data + (out/in) Pin 8 — Transmit / Receive Data – (out/in) Pin 9 — Common (ground)

Serial Interface Address

When either of the multipoint communication modes (RS485-4, RS485-2) is used, each slave device (such as the MC2) is assigned a unique address so that only one device at a time will respond to commands. The MC2's address is set from the front panel using the menu screen immediately below the communication mode screen. The address can range from 0 to 99.

If the MC2's address is below 99, the MC2 will expect each command to be preceded by an address, and it will respond only to commands that follow an address that matches its address setting.

If the MC2's address is 99, the MC2 will assume that addressing is not used and will respond to every command. The factory default address for RS-232, RS-422, RS-485, and MODBUS serial communications mode is "99"

When addressing is used, each command must be preceded by a device's address, sent as follows:

@<address high digit><address low digit><CR>

Where: @ = the "at" character, ASCII value 0x40
<CR> = the "carriage return" character, ASCII value 0x0D
The address must always be sent as two decimal digits. For 4, send 04

After the address is sent, the MC2 will acknowledge by sending an "A" character. After that, the MC2 expects one of the serial commands described in the serial command chart. An example of a serial communications exchange is shown below.

Example 1: For an MC2 with an address of "46", set the load capacitor for manual operation.

Command	Response	Comments
@46<CR>	A	Send address 46, receive "A" as acknowledgment
MLD<CR>	<CR>	Send "load = manual" command

Example 2: For an MC2 with an address of "3", read the tune capacitor position.

Command	Response	Comments
@03<CR>	A	Send address 03 (must send 2 digits), receive "A" as acknowledgment
TPS?<CR>	44<CR>	Send "report tune position" command, receive position "44"

Serial Commands

RS-232, RS-422, RS-485-4 and RS-485-2 modes share a common command set. The commands are listed in the Serial Command Reference chart in a "how to" fashion. In the Serial Command Detail chart, serial commands are listed alphabetically and described in depth.

All of the following commands must be terminated with a CR (carriage return) character, ASCII value 0x0D. For commands that expect an input value, send the value first, then send a space, then send the command.

Symbology: @ = the "at" character, ASCII value 0x40
<CR> = the "carriage return" character, ASCII value 0x0D
<sp> = the "space" character, ASCII value 0x20
All examples are given with character echo disabled.

Serial Command Reference chart:

SERIAL COMMAND REFERENCE		
To	**Send**	**Description/Comment**
Set the Load capacitor position control mode to manual	MLD<CR>	Front panel Load "AUTO" LED extinguishes, front panel Load "MAN" led illuminates. Response: <CR>
Set the Load capacitor position control mode to automatic	ALD<CR>	Front panel Load "MAN" LED extinguishes, front panel Load "AUTO" led illuminates. Response: <CR>
Read the current Load capacitor control mode	QAML<CR>	Response if in automatic mode: A<CR> Response if in manual mode: M<CR>
Set the Tune capacitor position control mode to manual	MTN<CR>	Front panel Tune "AUTO" LED extinguishes, front panel Tune "MAN" LED illuminates. Response: <CR>
Set the Tune capacitor position control mode to automatic	ATN<CR>	Front panel Tune "MAN" LED extinguishes, front panel Tune "AUTO" LED illuminates. Response: <CR>
Read the current Tune capacitor control mode	QAMT<CR>	Response if in automatic mode: A<CR> Response if in manual mode: M<CR>
Read Load capacitor position	LPS?<CR>	Reports the current Load capacitor position Response: XX<CR> Where "XX" is the Load capacitor position, in percent.
Read Tune capacitor position	TPS?<CR>	Reports the current Tune capacitor position Response: XX<CR> Where "XX" is the Tune capacitor position, in percent.

SERIAL COMMAND REFERENCE		
To	**Send**	**Description/Comment**
Set the Load capacitor preset position	XX<sp>MPL<CR>	Where "XX" is the desired Load capacitor preset position, in percent. 2 digits, range: 02% to 98%. Response: <CR>
Read the current Load capacitor preset position	QPL<CR>	Response: XX<CR> Where "XX" is the current Load capacitor preset position, in percent. 2 digits, range: 02% to 98%.
Set the Tune capacitor preset position	XX<sp>MPT<CR>	Where "XX" is the desired Tune capacitor preset position, in percent. 2 digits, range: 02% to 98%. Response: <CR>
Read the current Load capacitor preset position	QPT<CR>	Response: XX<CR> Where "XX" is the current Tune capacitor preset position, in percent. 2 digits, range: 02% to 98%.
Enable character echo	ECHO<CR>	Response: <CR>
Disable character echo	NOECHO<CR>	Response: <CR>
Set preset mode to "off"	OFF<CR>	Disables preset mode. Response: <CR>
Set preset mode to "internal"	INT<CR>	Enables preset mode ***and*** instructs the MC2 to use the Load and Tune presets stored in internal memory. Response: <CR>
Set preset mode to "external":	EXT<CR>	Enables preset mode ***and*** instructs the MC2 to use the Load and Tune preset signals present at the rear panel ANALOG connector. Response: <CR>
Set preset trigger to "RFENABLED"	TRGR<CR>	Instructs the MC2 to go to the preset positions when the RF generator indicates an RF OFF condition. Response: <CR>
Set preset trigger to "ANALOG"	TRGX<CR>	Instructs the MC2 to go to the preset positions when the preset enable signals of the rear panel ANALOG connector are in an active state. Response: <CR>
Read the Phase error signal	PHS<CR>	Reports the current Phase error signal voltage. Response: -XX<CR> Where "-XX" is the Phase error voltage in milli-volts (mV). Note: Negative polarity is prefixed with a "-" sign, positive polarity is unsigned.

SERIAL COMMAND REFERENCE		
To	**Send**	**Description/Comment**
Read the Magnitude error signal	MAG<CR>	Reports the current Magnitude error signal voltage. Response: -XX<CR> Where "-XX" is the Magnitude error voltage in milli-volts (mV). Note: Negative polarity is prefixed with a "-" sign, positive polarity is unsigned.
Go to the preset position	GOTO<CR>	Executes only when capacitor position control is set to "manual". Response: <CR>
Select the DC probe	PRB0<CR>	Routes the matching network's DC probe to the RF generator's FEEDBACK signal, and selects the DC probe for display/reporting. Response: <CR>
Select the RF Probe	PRB1<CR>	Routes the matching network's RF probe to the RF generator's FEEDBACK signal, and selects the RF probe for display/reporting. Response: <CR>
Read the Voltage probe	V?<CR>	Reports the currently selected probe voltage. Response: XXX<CR> Where "XXX" is the probe voltage, in Volts. Note: Same as the "0?" command
Read the Voltage probe	0?<CR>	Reports the currently selected probe voltage. Response: XXX<CR> Where "XXX" is the probe voltage, in Volts. Note: Same as the "V?" command

Serial Command Details:

All of the following commands must be terminated with a CR (carriage return) character, ASCII value 0x0D. For commands that expect an input value, send the value first, then send a space, then send the command.

Symbology: @ = the "at" character, ASCII value 0x40

<CR> = the "carriage return" character, ASCII value 0x0D

<sp> = the "space" character, ASCII value 0x20

All examples are given with character echo disabled.

General Note:

Throughout this document, Hexadecimal numbers are preceded by "0x"
Example: 80 (decimal) = 0x50 (hexadecimal)

Serial Command Detail chart:

SERIAL COMMAND DETAILS	
COMMAND	**COMMAND DETAIL**
0?	Query the currently selected probe's voltage. Responds with the value of the external feedback (DC Bias or RF Volts) Voltage, with Probe Attenuation and scaling factors applied. Note: The "0?" command is the same as the "V?" command. Related Serial Commands: PRB0, PRB1, V? In the example below, assume the Voltage reading is 250V: ASCII / HEX BYTES Command: 0?<CR> / 30 3F 0D Response: 250<CR> / 32 35 30 0D
ALD	Set the Load capacitor position control mode to "automatic". The front panel Load "MAN" LED extinguishes, and front panel Load "AUTO" LED illuminates. The MC2 controller responds to the matching network's Magnitude error signal and automatically positions the Load capacitor. Note: The Tune capacitor position control mode can be set by serial command or the front panel programming menu. Related Serial Commands: MLD, GOTO ASCII / HEX BYTES Command ALD<CR> / 41 4C 44 0D Response: <CR> / 0D

SERIAL COMMAND DETAILS

COMMAND	COMMAND DETAIL

ATN

Set the Tune capacitor position control mode to "automatic".

The front panel Tune "MAN" LED extinguishes, and front panel Tune "AUTO" LED illuminates. The MC2 controller responds to the matching network's Phase error signal and automatically positions the tune capacitor.

Note: The Tune capacitor position control mode can be set by serial command or the front panel programming menu.

Related Serial Commands: MTN, GOTO

	ASCII	HEX BYTES
Command	ATN<CR>	41 54 4E 0D
Response:	<CR>	0D

ECHO

Enable character echo.

Enables echoing of command characters back to the sending source. Character echo is often enabled when communicating with the MC2 controller via a data terminal or terminal emulation software.

Note: Character ECHO mode can be set by serial command or by the front panel programming menu.

Related Serial Commands: NOECHO

	ASCII	HEX BYTES
Command	ECHO<CR>	45 43 48 4F 0D
Response:	<CR>	0D

EXT

Set preset mode to "external".

Enables preset mode *and* instructs the MC2 to use the Load and Tune preset signals present at the rear panel "Analog" connector.

Note: The preset mode can be set by serial command or by the front panel programming menu.

Related Serial Commands: INT, OFF, TRGX, TRGR

	ASCII	HEX BYTES
Command	EXT<CR>	45 58 54 0D
Response:	<CR>	0D

SERIAL COMMAND DETAILS

COMMAND	COMMAND DETAIL
GOTO	Go To the preset position. Moves the Load and Tune capacitors to the preset position, internal or external, as specified by the programming menu's Preset Source parameter or by the INT/EXT serial commands. Note: Executes only when the capacitor position control is set to "manual". If the capacitor position control is set to "auto", the GOTO command is ignored. Note: The GOTO command is ignored if the preset mode is set to "off" by the front panel programming menu or the "OFF" serial command. Related Serial Commands: MTN, MLD, ATN, ALD, INT, EXT, OFF Command: GOTO<CR> — 47 4F 54 4F 0D Response: <CR> — 0D
INT	Set preset mode to "internal". Enables preset mode *and* instructs the MC2 to use the Load and Tune presets stored in internal memory. Note: The preset mode can be set by serial command or by the front panel programming menu. Related Serial Commands: EXT, OFF, TRGR, TRGX Command: INT<CR> — 46 4E 54 0D Response: <CR> — 0D
LPS?	Query the current Load capacitor position. Reports the current Load capacitor position, in percent, range 2% to 98% In the example below, the Load capacitor position is 43% Command: LPS?<CR> — 4C 50 53 3F 0D Response: 43<CR> — 34 33 0D
MAG	Query the current Magnitude error signal voltage. Reports the current Magnitude error signal voltage, in milli-Volts (mV). Negative polarity is prefixed with a "-" sign (0x2D), positive polarity is unsigned. In the example below, assume the Magnitude error signal is 137 mV Command: MAG<CR> — 4D 41 47 0D Response: 137<CR> — 31 33 37 0D

SERIAL COMMAND DETAILS	
COMMAND	**COMMAND DETAIL**
MLD	Set the Load capacitor position control mode to "manual". The front panel Load "AUTO" LED extinguishes, and front panel Load "MAN" LED illuminates. The MC2 controller ignores the matching network's Magnitude error signal and *does not* automatically position the Load capacitor. Note: The Tune capacitor position control mode can be set by serial command or the front panel programming menu. Related Serial Commands: ALD, GOTO ASCII / HEX BYTES Command: MLD<CR> / 4D 4C 44 0D Response: <CR> / 0D
MPL	Modify/Set the internal Load capacitor preset position. The internal Load capacitor preset position is modified/set by sending the desired position, followed by the space character, followed by "MPL", then followed by the carriage return character. Command syntax: XX<sp>MPL<CR> Where: "XX" is the desired Tune capacitor preset position, in percent. 2 digits, range: 02% to 98%. Note: The internal Load capacitor preset position can be set by serial command or the front panel programming menu. In the example below, the Load capacitor preset position is set to 56% ASCII / HEX BYTES Command: 56<sp>MPL<CR> / 35 36 20 4D 50 4C 0D Response: <CR> / 0D
MPT	Modify/Set the internal Tune capacitor preset position. The internal Tune capacitor preset position is modified/set by sending the desired position, followed by the space character, followed by "MPT", then followed by the carriage return character. Command syntax: XX<sp>MPT<CR> Where: "XX" is the desired Tune capacitor preset position, in percent. 2 digits, range: 02% to 98%. Note: The internal Tune capacitor preset position can be set by serial command or the front panel programming menu In the example below, the Tune capacitor preset position is set to 22% ASCII / HEX BYTES Command: 22<sp>MPT<CR> / 32 32 20 4D 50 54 0D Response: <CR> / 0D

SERIAL COMMAND DETAILS

COMMAND	COMMAND DETAIL

MTN

Set the Tune capacitor position control mode to "manual".

The front panel Tune "AUTO" LED extinguishes, and front panel Tune "MAN" LED illuminates. The MC2 controller ignores the matching network's Phase error signal and *does not* automatically position the tune capacitor.

Note: The Tune capacitor position control mode can be set by serial command or the front panel programming menu.

Related Serial Commands: ATN, GOTO

	ASCII	HEX BYTES
Command	MTN<CR>	4D 54 4E 0D
Response:	<CR>	0D

NOECHO

Disable character echo.

Disables echoing of command characters back to the sending source. When communicating with the MC2 via a system controller computer or a PLC, character echo is usually not required and set to "disabled".

Note: Character ECHO mode can be set by serial command or by the front panel programming menu.

Related Serial Command: ECHO

	ASCII	HEX BYTES
Command	NOECHO<CR>	4E 4F 45 43 48 4F 0D
Response:	<CR>	0D

OFF

Set preset mode to "off"

Disables preset mode. When preset mode is set to off, the MC2 controller will not respond to any preset trigger source and the GOTO serial command is ignored.

Note: The preset mode can be set by serial command or by the front panel programming menu.

Related Serial Commands: INT, EXT, TRGR, TRGX,

	ASCII	HEX BYTES
Command	OFF<CR>	4F 46 46 0D
Response:	<CR>	0D

PHS

Query the current Phase error signal voltage.

Reports the current Phase error signal voltage, in milli-Volts (mV). Negative polarity is prefixed with a "-" sign (0x2D), positive polarity is unsigned.

In the example below, assume the Phase error signal is -44 mV

	ASCII	HEX BYTES
Command	PHS<CR>	50 48 53 0D
Response:	-44<CR>	2D 34 34 0D

SERIAL COMMAND DETAILS

COMMAND	COMMAND DETAIL

PRB0

Select the DC Probe.

Selects the DC PROBE signal (rear panel "Match Network" connector pin 13) for display/reporting and routes the DC PROBE signal to pin 12 of the "To Generator" connector and to pin 12 of the "From System" connector (FEEDBACK signal).

Note: The DC Probe can be selected by serial command or by the front panel programming menu.

Related Serial Commands: 0?, PRB1, V?

	ASCII	HEX BYTES
Command	PRB0<CR>	50 52 42 30 0D
Response:	<CR>	0D

PRB1

Select the RF Probe.

Selects the RF PROBE signal (rear panel "Match Network" connector pin 14) for display/reporting and routes the RF PROBE signal to pin 12 of the "To Generator" connector and to pin 12 of the "From System" connector (FEEDBACK signal).

Note: The RF Probe can be selected by serial command or by the front panel programming menu.

Related Serial Commands: 0?, PRB0, V?

	ASCII	HEX BYTES
Command	PRB1<CR>	50 52 42 31 0D
Response:	<CR>	0D

QAML

Query the current control mode of the Load Capacitor.

Reports the current control mode of the Load capacitor.

Firmware: Version 12.8D and up.

	ASCII	HEX BYTES
Command:	QPL<CR>	51 50 4C 0D
Response: (If Automatic Mode)	A<CR>	41 0D
Response: (If Manual Mode)	M<CR>	4D 0D

QAMT

Query the current control mode of the Tune Capacitor.

Reports the current control mode of the Tune capacitor.

Firmware: Version 12.8D and up.

	ASCII	HEX BYTES
Command:	QPL<CR>	51 50 4C 0D
Response: (If Automatic Mode)	A<CR>	41 0D
Response: (If Manual Mode)	M<CR>	4D 0D

SERIAL COMMAND DETAILS	
COMMAND	**COMMAND DETAIL**
QPL	Query the current Load capacitor preset position. Reports the current Load capacitor preset position, in percent, range 2% to 98% Firmware: Version 12.8D and up. In the example below, the Load capacitor position is 33% ASCII / HEX BYTES Command: QPL<CR> / 51 50 4C 0D Response: 33<CR> / 33 33 0D
QPT	Query the current Tune capacitor preset position. Reports the current Tune capacitor preset position, in percent, range 2% to 98% Firmware: Version 12.8D and up. In the example below, the Load capacitor position is 66 ASCII / HEX BYTES Command QPT<CR> / 51 50 54 0D Response: 66<CR> / 36 36 0D
TPS?	Query the current Tune capacitor position. Reports the current Tune capacitor position, in percent, range 2% to 98% In the example below, the Tune capacitor position is 75% ASCII / HEX BYTES Command TPS?<CR> / 54 50 53 3F 0D Response: 75<CR> / 37 35 0D
TRGR	Set the Preset Trigger to "RFENABLED" Instructs the MC2 to go to the preset positions when pin 8 of the rear panel "To Generator" connector or pin 8 of the rear panel "To System" connector when the RF generator indicates an RF OFF condition. Note: The preset trigger mode can be set by serial command or by the front panel programming menu. Related Serial Commands: TRGX, OFF, INT, EXT ASCII / HEX BYTES Command TRGR<CR> / 54 52 47 52 0D Response: <CR> / 0D

SERIAL COMMAND DETAILS	
COMMAND	**COMMAND DETAIL**
TRGX	Set the Preset Trigger to "ANALOG" Instructs the MC2 to go to the preset positions when the preset enable signals of the rear panel "Analog" connector are in an active state. Note: The preset trigger mode can be set by serial command or by the front panel programming menu. Related Serial Commands: TRGR, OFF, INT, EXT ASCII / HEX BYTES Command: TRGX<CR> / 54 52 47 58 0D Response: <CR> / 0D
V?	Query the currently selected probe's voltage. Responds with the value of the external feedback (DC Bias or RF Volts) Voltage, with Probe Attenuation and scaling factors applied. Note: The "V?" command is the same as the "0?" command. Related Serial Commands: 0?, PRB0, PRB1 In the example below, assume the probe Voltage reading is 250V: ASCII / HEX BYTES Command: 0?<CR> / 30 3F 0D Response: 250<CR> / 32 35 30 0D

Configuring the MC2 for Serial Communications

The steps below detail how to configure the MC2 Matching Network Controller for serial communications. Once the MC2 is configured for the desired serial communications protocol, connect the MC2 to the serial communications device. The serial interface wiring depends on the selected serial communications mode. Refer to the **Serial Interface Modes and Connections** chart and the **SERIAL RS232** connector pin list in the Rear Panel Controls and Connections section for serial interface wiring details.

Note: DeviceNet is an *optional* communications interface. If the DeviceNet interface is not installed and is selected as the interface protocol, serial commands sent to the MC2 via the SERIAL RS232 connector will be ignored.

Serial Communication Configuration Steps	
STEP	**ACTION**
1.	Enter programming menu - press the PRG button (item 1) on the front panel.
2.	Press the DOWN button (item 2) on the front panel until the third display line indicates one of the following communications protocols: RS232 RS422 RS485-4 RS485-2 MODBUS 4W RTU MODBUS 2W RTU DEVICENET
3.	Use the VALUE UP button (item 5) or the VALUE DOWN button (item 6) on the front panel to select the desired communications protocol. The MC2 Controller will re-start. After the re-start, enter the programming menu and return to this screen.
4.	Press the Enter "ENT" button (item 4) on the front panel. The displayed serial communications protocol selection is saved in non-volatile storage.
5.	Press the DOWN button (item 2) on the front panel once. The display's third line should look like: ADDRESS # XX (Where "XX" = the current serial address, "0" to "99") Note: Ensure the selected serial address is valid for the selected serial communications protocol.
6.	Use the VALUE UP button (item 5) or the VALUE DOWN button (item 6) on the front panel to select the desired serial address.
7.	Press the Enter "ENT" button (item 4) on the front panel. The displayed serial communications address selection is saved in non-volatile storage.

Serial Communication Configuration Steps		
STEP	**ACTION**	
8.	Press the DOWN button (item 2) on the front panel once. The display's third line should display one of the following data rates:	
	500KBPS 250KBPS 125KBPS	Data rates for DeviceNet. Displayed if DeviceNet protocol is selected.
	115200 BAUD 57600 BAUD 38400 BAUD 19200 BAUD 9600 BAUD 4800 BAUD 2400 BAUD	Data rates for RS-232,RS-422, RS-485, and Modbus. Displayed if DeviceNet protocol is not selected.
9.	Use the VALUE UP button (item 5) or the VALUE DOWN button (item 6) on the front panel to select the desired data rate.	
10.	Press the Enter "ENT" button (item 4) on the front panel. The displayed serial communications data rate selection is saved in non-volatile storage.	
11.	Press the DOWN button (item 2) on the front panel once. The display's third line should display one of the following echo modes: ECHO: DISABLED ECHO: ENABLED	
12.	Use the VALUE UP button (item 5) or the VALUE DOWN button (item 6) on the front panel to select the desired echo mode.	
13.	Press the Enter "ENT" button (item 4) on the front panel. The displayed serial communications echo mode selection is saved in non-volatile storage.	
14.	Press the RUN button. Serial communications configuration is complete.	

The following serial communication parameters are fixed and cannot be configured	
Parity:	NONE
Data Bits:	8
Stop Bits:	1

DeviceNet ™ Communications

The Seren IPS Inc. model MC2 Matching Network Controller supports several serial communications modes and interfaces. The communications mode is configured from the front-panel programming menu. Available communications modes are: RS-232, RS-422, RS-485 4 Wire, RS-485 2 Wire, MODBUS 4 Wire RTU, MODBUS 2 Wire RTU, and DeviceNet. ***DeviceNet is an optional interface***, and is not field-installable.

This section describes the usage and commands applicable to DeviceNet. RS-232, RS-422, and RS-485 serial protocols are discussed in its own section, and MODBUS communications are described in a separate document.

The DeviceNet interface connector, located on the rear panel of the MC2 controller, is detailed in the Rear Panel Controls And Connections section.

DeviceNet Communications Model:

Group 2 Only Server
Predefined Master/Slave Connection Set supported

DeviceNet Connections:

Connection Instance 1: Explicit
Connection Instance 2: Polled I/O

DeviceNet Specifications:

Vendor ID: 946 (3B2 hex)
Message Body Format: DeviceNet 8/8
Minimum Time Between I/O Poll Commands: 50ms

DeviceNet Physical Layer:

Philips PCA82C250 CAN controller, optically isolated

MC2 DeviceNet Operation:

When the MC2 is powered up it runs through a self-test, sends two "Duplicate MAC ID check" messages, and waits for a Master to establish a connection. To set up a connection, a Master should send "Allocate Master/Slave Connection Set" followed by "Set Single Attribute - Expected Packet Rate". After the connection is established, the Master may issue I/O Poll Command messages and the MC2 will respond with I/O Poll Response messages.

In the following examples, the Master's MAC ID is 01, and the Slave's (MC2's) MAC ID is 3F. Values are in hexadecimal.

Example 1: Allocate Master/Slave Connection Set

CAN ID:	5FE	Group 2, Destination MAC ID 3F, Message ID 6
Data Byte Count:	6	
Data:	01	Message header - source ID = 01
	4B	Service code = Allocate M/S Connection Set
	03	Class ID = DeviceNet
	01	Instance ID = 01
	03	Allocation choice = Polled + Explicit
	01	Allocator's MAC ID = 01

Example 2: Set Expected Packet Rate for the I/O Poll Connection

CAN ID:	5FC	Group 2, Destination MAC ID 3F, Message ID 4
Data Byte Count:	7	
Data:	01	Message header - source ID = 01
	10	Service code = Set Attribute Single
	05	Class ID = Connection
	02	Instance ID = I/O Poll
	09	Attribute = Expected Packet Rate
	00	Value LSB
	04	Value MSB (Value = 0400 = 1024_{10} ms)

DeviceNet Commands:

I/O Poll Command Format - Assembly ID 64hex

Assembly ID 64hex: From Fieldbus To MC2

BYTE	7	6	5	4	3	2	1	0
0	Load Preset							
1	Tune Preset							
2	Not Used							
3	Not Used							
4			LoadMd	TuneMd		TrigMd	Preset Control	
5	GoTo	Strike						IGNORE

DeviceNet I/O Poll Command Data Structure	
Data Field	**Description**
Byte 0	LoadPres - Load Preset Value in percent, min = 2, max = 98
Byte 1	TunePres - Tune Preset Value in percent, min = 2, max = 98
Byte 4 bit 5	LoadMd - Load Mode 0 = Auto Load, 1 = Manual Load
Byte 4 bit 4	TuneMd - Tune Mode 0 = Auto Tune, 1 = Manual Tune
Byte 4 bit 2	TrigMd - Trigger Mode 0 = RF On/Off, 1 = External
Byte 4 bit 4	TuneMd - Tune Mode 0 = Auto Tune, 1 = Manual Tune
Byte 4 bit 2	TrigMd - Trigger Mode 0 = RF On/Off, 1 = External
Byte 4 bits 1,0	PresCtrl - Preset Control 0 = Off, 1 = Internal, 2 = External
Byte 5 bit 7	GoTo - Go To Preset Load and Tune Positions Transition from 0 to 1 causes move to Load and Tune preset positions
Byte 5 bit 6	Strike Transition from 0 to 1 causes current Load and Tune positions to be saved as Presets
Byte 5 bit 0	IGNORE While set, the MC2 will ignore all other settings

I/O Poll Response Format - Assembly ID 65hex

Assembly ID 65hex: To Fieldbus From MC2

BYTE	7	6	5	4	3	2	1	0
0	Load Preset							
1	Tune Preset							
2	Not Used							
3	Not Used							
4			LoadMd	TuneMd		Trigger	Preset Control	
5								IGNORE
6	Magnitude LSB							
7	Magnitude MSB							
8	Phase LSB							
9	Phase MSB							
10	Load Position							
11	Tune Position							

DeviceNet I/O Poll Response Command Data Structure	
Data Field	**Description**
Byte 0	LoadPres - Load Preset Value in percent
Byte 1	TunePres - Tune Preset Value in percent
Byte 4 bit 5	LoadMd - Load Mode 0 = Auto Load, 1 = Manual Load
Byte 4 bit 4	TuneMd - Tune Mode 0 = Auto Tune, 1 = Manual Tune
Byte 4 bit 2	TrigMd - Trigger Mode 0 = RF On/Off, 1 = External
Byte 4 bits 1,0	PresCtrl - Preset Control 0 = Off, 1 = Internal, 2 = External
Byte 5 bit 0	IGNORE If set, ignore all other data reported by the MC2
Bytes 6,7	Mag - Magnitude
Bytes 8,9	Phs - Phase
Byte 10	LoadPos - Current Load Position
Byte 11	TunePos - Current Tune Position

Configuring the MC2 for DeviceNet Communications

The steps below detail how to configure the MC2 Matching Network Controller for DeviceNet communications. Once the MC2 is configured for the DeviceNet communications protocol, connect the MC2 to the DeviceNet network or DeviceNet communications device. Refer to the **DeviceNet** connector pin list in the Rear Panel Controls and Connections section for serial interface wiring details.

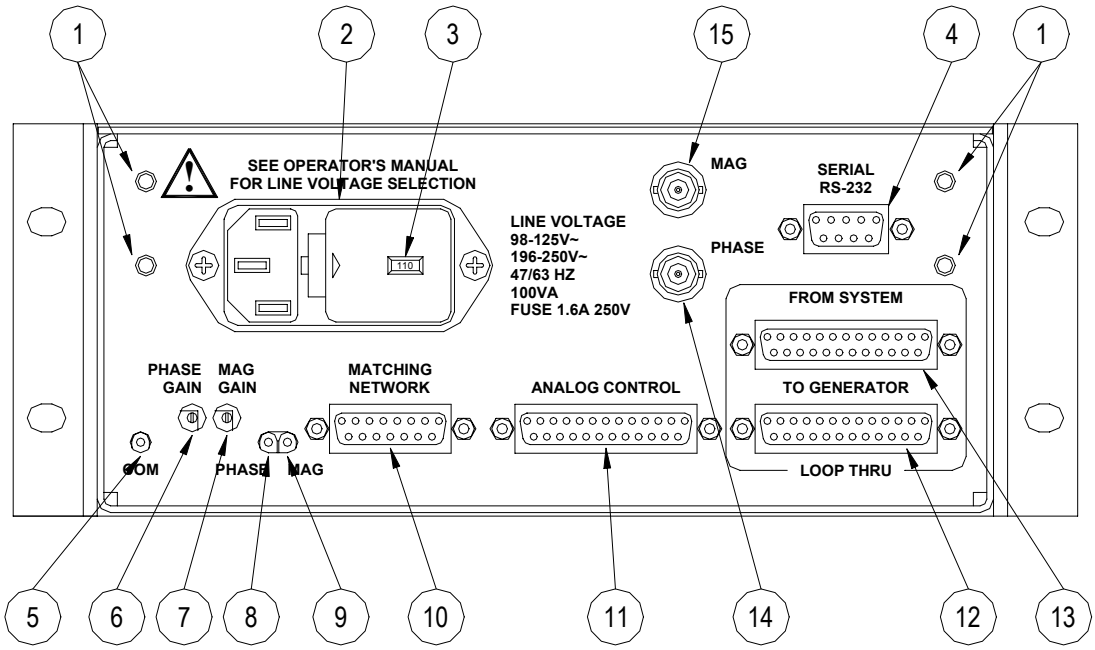
Note: DeviceNet is an *optional* communications interface. If the DeviceNet interface is not installed and DeviceNet is selected as the communications protocol, serial commands sent to the MC2 via the SERIAL RS232 connector will be ignored.

DeviceNet Communication Configuration Steps	
STEP	**ACTION**
1.	Turn the MC2 Matching Network Controller off and disconnect the power cord. Look at the rear panel.
2.	If the MC2 unit does not have switches and indicator LEDs on the rear panel, proceed to step 4.
3.	If the MC2 unit has rear panel switches and indicator LEDs: a. Set the RATE switch to the desired data rate 1 = 125Kb, 2 = 250Kb, 5 = 500Kb, P = set by programming menu b. Set the DeviceNet address, "00" to "63", using the MSD and LSD switches. MSD = Most Significant Digit (10's column) LSD = Least Significant Digit (1's column) Factory default setting is "63"
4.	Connect the power cord to the MC2 Matching Network Controller and enable mains power.
5.	Enter the programming menu - press the PRG button (item 1) on the front panel.
6.	Press the DOWN button (item 2) on the front panel until the third display line indicates one of the following communications protocols: RS232 RS422 RS485-4 RS485-2 MODBUS 4W RTU MODBUS 2W RTU DEVICENET
7.	Use the VALUE UP button (item 5) or the VALUE DOWN button (item 6) on the front panel to select "DEVICENET" communications protocol.
8.	Press the Enter "ENT" button (item 4) on the front panel. The displayed communications protocol selection is saved in non-volatile storage ant the MC2 controller will re-start. After the re-start, enter the programming menu and return to this screen.

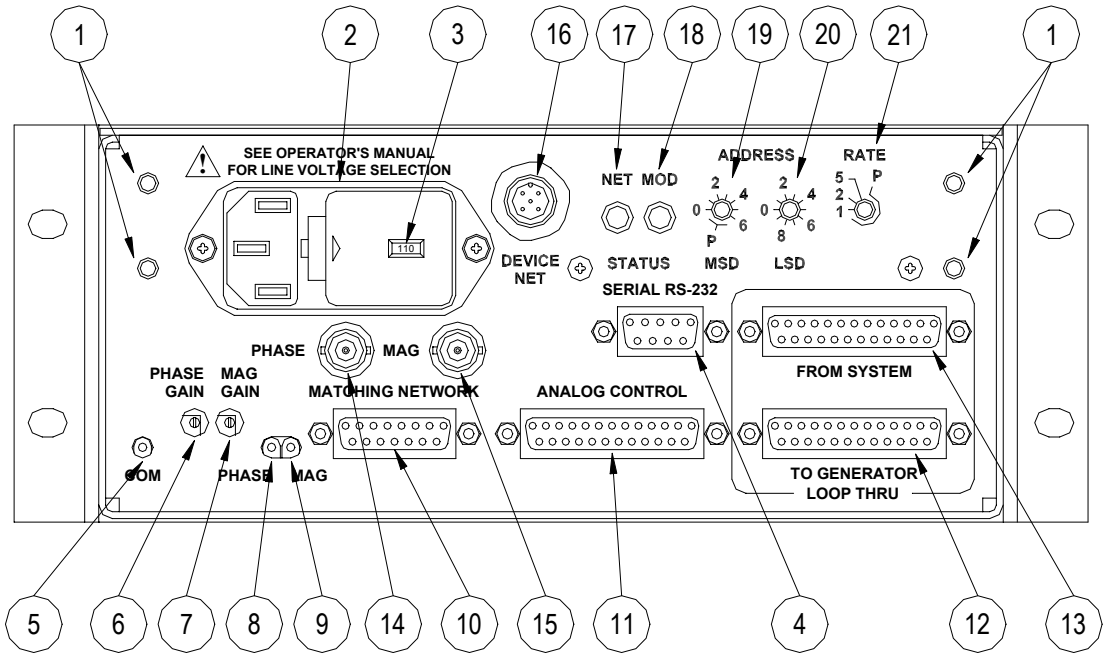
<table>
<tr><th colspan="3">DeviceNet Communication Configuration Steps</th></tr>
<tr><th>STEP</th><th colspan="2">ACTION</th></tr>
<tr><td>9.</td><td colspan="2">Press the DOWN button (item 2) on the front panel once. The display's third line should look like:
ADDRESS # XX
(Where "XX" = the current serial address, "0" to "99")
<u>Note:</u> Ensure the selected serial address is valid for the selected communications protocol. Valid DeviceNet address range is "0" to "64"
<u>Address Selection Notes:</u>
a. If the MC2's rear panel DeviceNet MSD address switch is set for "0", "1", "2", "3", "4", "5", or "6" any address selection made via the front panel programming menu will be ignored.
b. If the MC2's rear panel DeviceNet MSD address switch is set to "P", the front panel programming menu's address selection is used.
c. It is good practice to ensure the front panel programming menu's address selection is set to match the rear panel switch settings</td></tr>
<tr><td>10.</td><td colspan="2">Use the VALUE UP button (item 5) or the VALUE DOWN button (item 6) on the front panel to select the desired DeviceNet address.</td></tr>
<tr><td>11.</td><td colspan="2">Press the Enter "ENT" button (item 4) on the front panel. The displayed DeviceNet address selection is saved in non-volatile storage.</td></tr>
<tr><td>12.</td><td colspan="2">Press the DOWN button (item 2) on the front panel once. The display's third line should display one of the following data rates:</td></tr>
<tr><td></td><td>500KBPS
250KBPS
125KBPS</td><td>Data rates for DeviceNet.
Displayed if DeviceNet protocol is selected.
<u>Data Rate Selection Notes:</u>
a. The MC2's DeviceNet data rate is determined by the rear panel DeviceNet RATE switch.
b. Set the rear panel RATE switch for the desired DeviceNet data rate:
5 = 500KBPS
2 = 250KBPS
1 = 125KBPS
It is good practice to ensure the front panel programming menu data rate is set to match the rear panel switch settings.</td></tr>
<tr><td>13.</td><td colspan="2">Use the VALUE UP button (item 5) or the VALUE DOWN button (item 6) on the front panel to select the desired DeviceNet data rate.</td></tr>
<tr><td>14.</td><td colspan="2">Press the Enter "ENT" button (item 4) on the front panel. The displayed DeviceNet communications data rate selection is saved in non-volatile storage.</td></tr>
<tr><td>15.</td><td colspan="2">Press the RUN button.</td></tr>
<tr><td>16.</td><td colspan="2">Disable the MC2 Matching Network Controller's mains power.</td></tr>
<tr><td>17.</td><td colspan="2">Connect the DeviceNet cable to the rear panel DeviceNet connector.</td></tr>
<tr><td>18.</td><td colspan="2">Enable the MC2's mains power.</td></tr>
</table>

DeviceNet Communication Configuration Steps	
STEP	**ACTION**
19.	If the MC2 controller has status indicator LEDs on the rear panel, they should light up in the following sequence: NET and MOD both flash green briefly (normal turn-on behavior) NET off MOD green NET off MOD red NET green MOD green NET red MOD green NET off MOD off NET amber MOD amber NET off MOD off
20.	Once the power-on sequence is complete, the MOD indicator should stay off. The NET indicator should either be flashing green (waiting for a connection) or solid green (connection established). If the NET indicator is red, check the following: a. Ensure power is available on the DeviceNet network. b. Ensure the DeviceNet network is properly terminated. c. Ensure the MC2's address is valid. d. Ensure the MC2's data rate is set to match the DeviceNet network data rate. If the DeviceNet status indicator LEDs remain amber color: Check the Communications Protocol Selection (front panel programming menu) – ensure the communications protocol is set to "DEVICENET"
21.	DeviceNet setup complete

Rear Panel Controls and Connections



Rear View, MC2 Standard Configuration
Optional Phase/Mag BNC connectors shown
DeviceNet option *not installed*



Rear View, MC2 DeviceNet Configuration
Optional Phase/Mag BNC connectors shown

1. Threaded inserts

   For use with dual rack-mount brackets (optional accessory). 6-32 thread, 0.5" [12mm] maximum thread depth.

2. Power Inlet and Fuse Holder Drawer

   Power Inlet Connector: IEC320 type male, filtered
   Mating Cord Connector: IEC320-C13
   Fuses: 1.6A 250V Time Delay, 5mm x 20mm

   Fuse Replacement Procedure:

   1. Disable AC mains power and disconnect the power cord from the MC2 Matching Network Controller.
   2. Insert a small, flat blade screwdriver into the slot next to the power cord connector and press the fuse drawer's retaining clip away from the power cord connector. The fuse drawer will eject from the power inlet.
   3. Replace the fuses and slide the fuse drawer into the power inlet.
   4. Press the fuse drawer firmly into the power inlet – the retainer clip will engage and hold the drawer in place.

3. Voltage Selector (part of Power Inlet)

CAUTION: UNLESS OTHERWISE SPECIFIED, THE MC2 CONTROLLER IS SHIPPED FROM THE FACTORY WITH THE LINE VOLTAGE SELECTOR SET FOR 110 VOLT OPERATION.

CHECK YOUR LINE VOLTAGE OR CONSULT A QUALIFIED ELECTRICIAN BEFORE CONNECTING THE MC2 CONTROLLER TO MAINS POWER. SELECTING THE WRONG LINE VOLTAGE MAY DAMAGE THE MC2 CONTROLLER AND VOID THE WARRANTY.

The MC2 Matching network controller has 2 mains voltage settings.
Use the "110" voltage setting for 100 to 125V 50/60 Hz AC Mains
Use the "220" voltage setting for 198 to 250V 50/60 Hz AC Mains

The mains voltage is displayed in the window in the fuse drawer.

AC Mains Voltage Change Procedure:

1. Disable AC mains power and disconnect the power cord from the MC2 Matching Network Controller.
2. Insert a small, flat blade screwdriver into the slot next to the power cord connector and press the fuse drawer's retaining clip away from the power cord connector. The fuse drawer will eject from the power inlet. Set the fuse drawer aside.
3. Remove the gray power selector from the power inlet housing
4. Rotate the power selector until the desired voltage is facing you.
5. Re-insert the voltage selector into the power inlet housing.
6. Place the fuse drawer back into the power inlet.
7. Press the fuse drawer firmly into the power inlet – the retainer clip will engage and hold the drawer in place.
8. Connect the MC2 Matching Network Controller to the AC mains with a power cord suitable for your location.

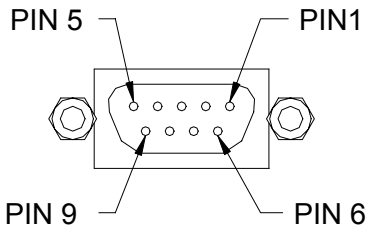
4a. Serial RS-232 Interface Connector

Allows remote computer control and monitoring of the matching network and generator parameters (monitoring of the RF generator requires use of the FROM SYSTEM/TO GENERATOR Loop-Thru connectors and an interface connection to the RF generator).

Supported serial interface protocols: RS-232, RS-422 2-Wire, RS-422 4 Wire, RS-485 2-Wire, RS-485 4 Wire, MODBUS 2 Wire RTU, MODBUS 4 Wire RTU. Serial interface protocol type and data rate can be selected via the front-panel programming menu.

Fixed Serial Parameters: Parity: None
Number of data bits: 8
Number of stop bits: 1

Connector Type: 9 pin "D" female



Serial RS-232 Connector

For serial operation details, see the Serial Commands section of this manual.

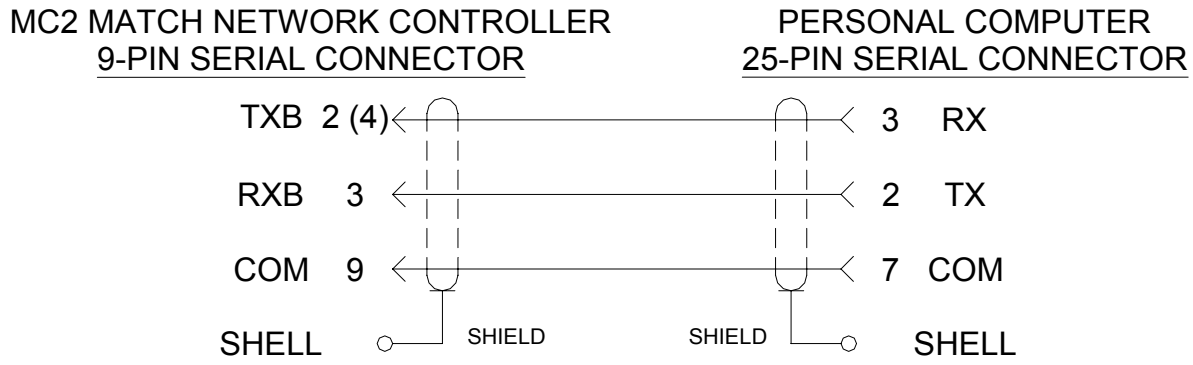
SERIAL RS232 Connector Pin List		
Pin	**Signal**	**Description**
1	No Connection	No Connection
2	TXB-232	RS-232 Transmit Data (internally connected to pin 4)
3	RXB-232	RS-232 Receive Data
4	TXB-232	RS-232 Transmit Data (internally connected to pin 2) [1]
5	+RCV	RS-422/485–4 +RCV
6	-RCV	RS-422/485-4 -RCV
7	+XMIT	RS-422/485-4 +XMIT (RS-485-2 +RCV/XMIT)
8	-XMIT	RS-422/485-4 –XMIT (RS-485-2 -RCV/XMIT) [2]
9	COMMON	Common Return (internally connected to chassis ground)

Notes:

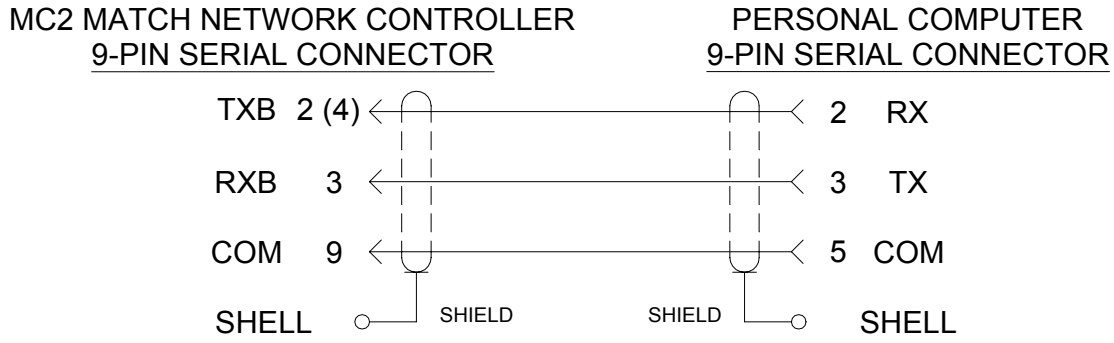
1. Standard configuration. May be custom configured for non-standard applications. Consult factory for details.
2. Standard configuration. May be custom configured for non-standard applications. RS-422/485 functionality is not available for non-standard configuration. Consult factory for details.

RS-232 Serial Interface Wiring

Wiring for RS-232 serial interface connections to a personal computer are shown below. RS-422, RS-485, and MODBUS interface connections are not standardized. Consult your interface device's manual for connection details. The use of shielded cable for serial interface connections is strongly recommended.



RS-232 Serial Interface Connections to Personal Computer, DB25 Connector



RS-232 Serial Interface Connections to Personal Computer, DB9 Connector

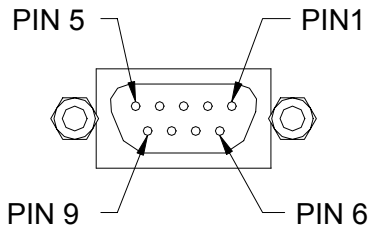
4b. PROFIBUS Interface Connector ***(Optional)***

Allows remote computer control and monitoring of the matching network and generator parameters (monitoring of the RF generator requires use of the FROM SYSTEM/TO GENERATOR Loop-Thru connectors and an interface connection to the RF generator).

With the *optional* PROFIBUS interface installed, the rear panel 9-pin "D" female connector is re-labeled as "PROFIBUS". RS-232, RS-422 2-Wire, RS-422 4 Wire, RS-485 2-Wire, RS-485 4 Wire, MODBUS 2 Wire RTU, MODBUS 4 Wire RTU, and DeviceNet protocols/interfaces are not available.

The PROFIBUS data rate is automatically detected and set to match the PROFIBUS Master. The PROFIBUS address is set via the front-panel programming menu. PROFIBUS commands and communications protocol details are discussed in a separate document.

Connector Type: 9 pin "D" female



PROFIBUS Connector

PROFIBUS operation details are described in a separate document.
Consult the factory for assistance.

PROFIBUS Connector Pin List		
Pin	**Signal**	**Description**
1	No Connection	No Connection
2	No Connection	No Connection
3	+DATA	PROFIBUS Data, positive (+)
4	DIRECTION	Direction Control
5	GNDISO	Isolated Ground
6	TERM	Termination Voltage
7	No Connection	No Connection
8	-DATA	PROFIBUS Data, negative (-)
9	No Connection	No Connection

5. "COM" Test Point

Common return (negative) test point for the PHASE and MAG test points. Internally connected to chassis ground. Used when making direct measurements of Phase and Magnitude error signals during matching network set-up. Accepts 0.080" [2.03mm] diameter test probe.

6. PHASE Gain Adjustment

Adjusts the gain (sensitivity) of the Phase Error Amplifier. The Phase error amplifier drives the matching network's TUNE capacitor. 25 turn (nominal) potentiometer, factory pre-set to mid-range position.

Turning the potentiometer counter-clockwise (CCW) decreases Phase Gain.
Turning the potentiometer clockwise (CW) increases Phase Gain.

7. MAG Gain Adjustment

Adjusts the gain (sensitivity) of the Magnitude Error Amplifier. The Magnitude error amplifier drives the matching network's LOAD capacitor. 25 turn (nominal) potentiometer, factory pre-set to mid-range position.

Turning the potentiometer counter-clockwise (CCW) decreases Mag Gain.
Turning the potentiometer clockwise (CW) increases Mag Gain.

8. "PHASE" Test Point

PHASE error signal test point. Buffered PHASE detector output from the matching network. Used when making direct measurements of the Phase error signal and when nulling (calibrating) the matching network's phase detector during matching network set-up. See Troubleshooting instructions for details. Accepts 0.080" [2.03mm] diameter test probe.

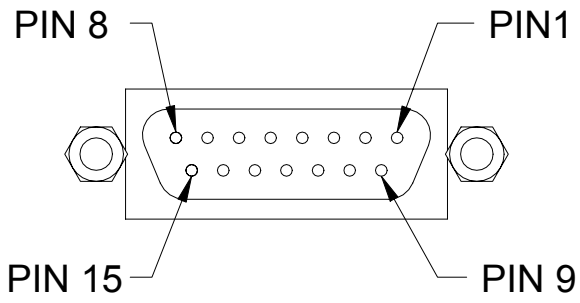
9. "MAG" Test Point

MAGnitude error signal test point. Buffered Magnitude detector output from the matching network. Used when making direct measurements of the Magnitude error signal and while nulling (calibrating) the matching network's magnitude detector during matching network set-up. See Troubleshooting instructions for details. Accepts 0.080" [2.03mm] diameter test probe.

10. Matching Network Connector

Control signals and motor drive for matching network. Connect to the Seren IPS Inc. AT-Series matching network's "CONTROL" connector with a shielded cable (purchased separately).

Connector Type: 15 pin "D" female



Matching Network Connector
15 Pin "D" Female

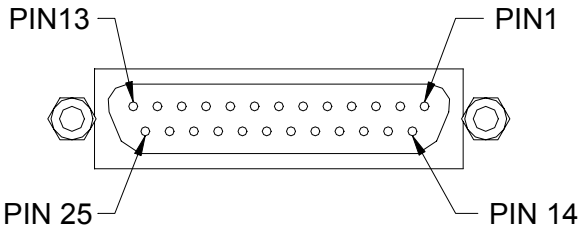
MATCHING NETWORK Connector Pin List		
Pin	**Signal**	**Description**
1	TUNEMOTOR	Drive voltage output for tune capacitor motor –15VDC to +15VDC
2	GROUND	Return for load capacitor motor. Internally connected to chassis ground.
3	TUNEPOS	Tune capacitor position feedback input. Analog signal, 0.00VDC = minimum capacitance, 5.00VDC = maximum capacitance.
4	+5.25VREF	Current limited +5.25VDC reference voltage output for capacitor feedback signals. Do not connect external equipment to this pin.
5	-0.25VREF	Current limited -0.25VDC reference voltage output for capacitor feedback signals. Do not connect external equipment to this pin.
6	+12V	Current limited +12VDC output for operation of control circuits within the matching network. Do not connect other equipment to this pin.
7	PHASE	Phase (tune) error signal input. Analog input, -10VDC to +10VDC range.
8	MAG	Magnitude (load) error signal input. Analog input, -10VDC to +10VDC range
9	LOADMOTOR	Drive voltage output for load capacitor motor –15VDC to +15VDC

MATCHING NETWORK Connector Pin List		
Pin	**Signal**	**Description**
10	GROUND	Return for tune capacitor motor. Internally connected to chassis ground.
11	LOADPOS	Load capacitor position feedback input. Analog signal, 0.00VDC = minimum capacitance, 5.00VDC = maximum capacitance.
12	GROUND	Internally connected to chassis ground.
13	DC-PROBE	DC Probe signal input. Analog, 0VDC to +10VDC range
14	RF-PROBE	DC Probe signal input. Analog, 0VDC to +10VDC range
15	GROUND	Internally connected to chassis ground.

11. Analog Control Connector

Analog control signals for system interfacing. Use shielded cable for making connections to system controller or external equipment.

Connector Type: 25 pin "D" female



Analog Control Connector
25 Pin "D" Female

ANALOG CONTROL Connector Pin List		
Pin	**Signal**	**Description**
1	No Connection	No connection
2	PRELOAD	Load capacitor preset enable input. TTL/HCMOS compatible logic input, active high internally pulled down to 0V. Apply a logic high signal to enable preset, apply a logic low signal to disable preset.
3	PRELOAD-ON	Load capacitor preset active output. TTL/HCMOS compatible logic output, active low. Internally pulled up to +5VDC. Logic low when controller is presetting the load capacitor, logic high when the load capacitor is not being pre-set.

ANALOG CONTROL Connector Pin List		
Pin	**Signal**	**Description**
4	PRETUNE-ON	Tune capacitor preset active output. TTL/HCMOS compatible logic output, active low. Internally pulled up to +5VDC. Logic low when controller is presetting capacitors, logic high when the tune capacitor is not being pre-set.
5	PRETUNE	Tune capacitor preset enable input. TTL/HCMOS compatible logic input, active high, internally pulled down 0V. Apply a logic high signal to enable preset, apply a logic low signal to disable preset.
6	-TUNELIMIT	Tune capacitor minimum limit signal output. TTL/HCMOS compatible logic output, active high. Output is a logic high when the tune capacitor has reached its minimum limit. Output is a logic low when the tune capacitor is not at its minimum limit.
7	+TUNELIMIT	Tune capacitor maximum limit signal output. TTL/HCMOS compatible logic output, active high. Output is a logic high when the tune capacitor has reached its maximum limit. Output is a logic low when the tune capacitor is not at its maximum limit.
8	FAIL	General purpose fail condition signal output. TTL/HCMOS compatible logic output, active high. Output state is a logic high if a fail condition is detected (control cable disconnected or other software-determined condition), output state is a logic low if there is no fail condition.
9	-LOADLIM	Load capacitor minimum limit signal output. TTL/HCMOS compatible logic output, active high. Output is a logic high when the load capacitor has reached its minimum limit. Output is a logic low when the load capacitor is not at its minimum limit.
10	+LOADLIM	Load capacitor maximum limit signal output. TTL/HCMOS compatible logic output, active high. Output is a logic high when the load capacitor has reached its maximum limit. Output is a logic low when the load capacitor is not at its maximum limit.
11	LOADMETER	Load capacitor position output signal. Analog, 0.00VDC to +5.00VDC, linearly proportional 0 to 100% of load capacitor position. 0.00VDC = minimum capacitance, 5.00VDC = maximum capacitance.
12	TUNEPSETV	Tune capacitor position preset voltage input. Analog input, 0.00VDC to +5.00VDC. 0.00VDC = minimum capacitance, +5.00VDC = maximum capacitance.
13	LOADPSETV	Load capacitor position preset voltage input. Analog input, 0.00VDC to +5.00VDC. 0.00VDC = minimum capacitance, +5.00VDC = maximum capacitance.

ANALOG CONTROL Connector Pin List		
Pin	**Signal**	**Description**
14	No Connection	No Connection
15	Ground	Internally connected to chassis ground.
16	Ground	Internally connected to chassis ground.
17	Ground	Internally connected to chassis ground.
18	Ground	Internally connected to chassis ground.
19	Ground	Internally connected to chassis ground.
20	Ground	Internally connected to chassis ground.
21	Ground	Internally connected to chassis ground.
22	Ground	Internally connected to chassis ground.
23	TUNEMETER	Tune capacitor position output signal. Analog, 0.00VDC to +5.00VDC, linearly proportional 0 to 100% of tune capacitor position. 0.00VDC = minimum capacitance, 5.00VDC = maximum capacitance.
24	Ground	Internally connected to chassis ground.
25	Ground	Internally connected to chassis ground.

12 and 13: Loop-Thru Connectors

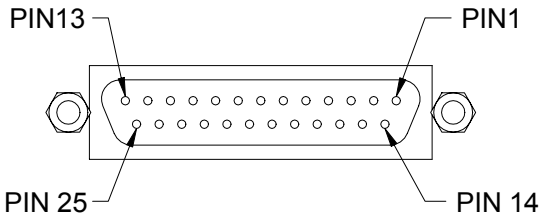
These connectors are provided to interface the MC2 matching network controller with an RF generator. This enables the MC2 to monitor and display the generator's setpoint, forward power, and reflected power, and supply the AT-Series matching network's RF or DC probe voltage signal to the RF generator (for voltage control). All other control signals are passed from the "FROM SYSTEM" connector to the "TO GENERATOR" connector without modification.

The Loop-Thru connectors are designed to be plug-compatible with the Seren IPS Inc. R/L20XX/30XX/50XX/100XX series of RF generators. The signal names show in the pin list charts below correspond to Seren IPS Inc. RF generator interface signals. Other RF generators can be connected with external cabling - contact Seren IPS Inc. customer service department or service depot for assistance.

12. "TO GENERATOR" Connector:

Connects to the RF Generator's analog interface or control connector. Use shielded cable to make connections to the RF Generator. Interface cables are available from Seren IPS Inc., Seren IPS representatives, and service depots.

Connector type: 25 pin "D" female.



"TO GENERATOR" Connector
25 Pin "D" Female

TO GENERATOR Connector Pin List		
Pin	**Signal**	**Description**
1	MAINS INTERLOCK or PSYNC	Loop-Thru. Connected to pin 1 of the FROM SYSTEM connector. No internal connection to MC2 circuitry.
2	INTERLOCK	Loop-Thru. Connected to pin 2 of the FROM SYSTEM connector. No internal connection to MC2 circuitry.
3	RFON	Loop-Thru. Connected to pin3 of the FROM SYSTEM connector. The MC2 Controller monitors the RFON signal to control preset operation.

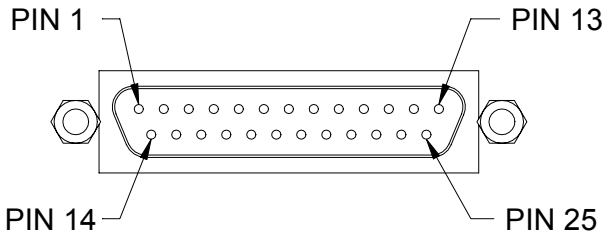
TO GENERATOR Connector Pin List		
Pin	**Signal**	**Description**
4	PWR/VLT*	Loop-Thru. Connected to pin 4 of the FROM SYSTEM connector. No internal connection to MC2 circuitry.
5	SLAVE*	Loop-Thru. Connected to pin 5 of the FROM SYSTEM connector. No internal connection to MC2 circuitry.
6	GATEN*	Loop-Thru. Connected to pin 6 of the FROM SYSTEM connector. No internal connection to MC2 circuitry.
7	GATE	Loop-Thru. Connected to pin 7 of the FROM SYSTEM connector. No internal connection to MC2 circuitry.
8	RFENABLED	Loop-Thru. Connected to pin 8 of the FROM SYSTEM connector. The MC2 Controller monitors the RFENABLED signal to control preset operation. Internally pulled-up to +5VDC (factory default), can be configured for no pull-up - consult factory for details.
9	GND	Internally connected to chassis ground.
10	FWD MON	Forward Power monitor signal. Analog input, looped-thru, 0.00VDC to +5.00VDC. Connected to pin 10 of the FROM SYSTEM connector. The MC2 Controller monitors this signal – used for displaying forward power on the front panel.
11	REFP MON	Reflected Power monitor signal. Analog input, looped-thru, 0.00VDC to +5.00VDC. Connected to pin 11 of the FROM SYSTEM connector. The MC2 Controller monitors this signal – used for displaying reflected power on the front panel.
12	FEEDBACK	The DC or RF probe signal from the MATCHING NETWORK connector is routed to this pin, selected via the front panel, the serial interface or the optional DeviceNet interface. Analog Output, 0.0VDC to +10.00VDC. Connected to pin 12 of the FROM SYSTEM connector.
13	SETPOINT	Forward Power Setpoint signal. Analog input, looped-thru, 0.0VDC to +10.00VDC, single-ended. Connected to pin 13 of the FROM SYSTEM connector. The MC2 Controller can monitor this signal if the RF generator is configured for single-ended setpoint operation. Consult factory for details..
14	MAINS INTERLOCK	Loop-Thru. Connected to pin 14 of the FROM SYSTEM connector. No internal connection to MC2 circuitry.
15	INTERLOCK-RTN	Internally connected to chassis ground.
16	GNDI	Internally connected to chassis ground.
17	GNDI	Internally connected to chassis ground.

TO GENERATOR Connector Pin List		
Pin	**Signal**	**Description**
18	GNDI	Internally connected to chassis ground.
19	RL-IN	Loop-Thru. Connected to pin 19 of the FROM SYSTEM connector. No internal connection to MC2 circuitry.
20	RL-OUT	Loop-Thru. Connected to pin 20 of the FROM SYSTEM connector. No internal connection to MC2 circuitry.
21	PHASE	Loop-Thru. Connected to pin 21 of the FROM SYSTEM connector. No internal connection to MC2 circuitry.
22	FWDRET	Forward Power Monitor return signal. Internally connected to chassis ground.
23	REFRET	Reflected Power Monitor return signal. Internally connected to chassis ground.
24	RESERVED	Loop-Thru. Connected to pin 24 of the FROM SYSTEM connector. No internal connection to MC2 circuitry.
25	SETRET	Forward Power Setpoint return signal. Loop-Thru. Connected to pin 25 of the FROM SYSTEM connector. No internal connection to MC2 circuitry. **Note**: Seren IPS Inc. RF generators use a differential setpoint input. To prevent erratic operation, this signal ***must*** be connected to the generator's setpoint return terminal.

13. "FROM SYSTEM" Connector

Connects to the user's system controller or external equipment. Use shielded cable to make connections to system controller or external equipment.

Connector type: 25 pin "D" male



"FROM SYSTEM" Connector
25 Pin "D" Male

FROM SYSTEM Connector Pin List		
Pin	**Signal**	**Description**
1	MAINS INTERLOCK1 or PSYNC	Loop-Thru. Connected to pin 1 of the TO GENERATOR connector. No internal connection to MC2 circuitry.
2	INTERLOCK	Loop-Thru. Connected to pin 2 of the TO GENERATOR connector. No internal connection to MC2 circuitry.
3	RFON	Loop-Thru. Connected to pin3 of the TO GENERATOR connector. The MC2 Controller monitors the RFON signal to control preset operation.
4	PWR/VLT*	Loop-Thru. Connected to pin 4 of the TO GENERATOR connector. No internal connection to MC2 circuitry.
5	SLAVE*	Loop-Thru. Connected to pin 5 of the TO GENERATOR connector. No internal connection to MC2 circuitry.
6	GATEN*	Loop-Thru. Connected to pin 7 of the TO GENERATOR connector. No internal connection to MC2 circuitry.
7	GATE	Loop-Thru. Connected to pin 7 of the TO GENERATOR connector. No internal connection to MC2 circuitry.
8	RFENABLED	Loop-Thru. Connected to pin 8 of the TO GENERATOR connector. The MC2 Controller monitors the RFENABLED signal to control preset operation. Internally pulled-up to +5VDC (factory default), can be configured for no pull-up - consult factory for details.
9	GND	Internally connected to chassis ground.

FROM SYSTEM Connector Pin List		
Pin	**Signal**	**Description**
10	FWD MON	Forward Power monitor signal. Analog input, looped-thru, 0.00VDC to +5.00VDC. Connected to pin 10 of the TO GENERATOR connector. The MC2 Controller monitors this signal – used for displaying forward power on the front panel.
11	REFP MON	Reflected Power monitor signal. Analog input, looped-thru, 0.00VDC to +5.00VDC. Connected to pin 11 of the TO GENERATOR connector. The MC2 Controller monitors this signal – used for displaying reflected power on the front panel.
12	FEEDBACK	The DC or RF probe signal from the MATCHING NETWORK connector is routed to this pin, selected via the front panel, the serial interface or the optional DeviceNet interface. Analog Output, 0.0VDC to +10.00VDC. Connected to pin 12 of the TO GENERATOR connector.
13	SETPOINT	Forward Power Setpoint signal. Analog input, looped-thru, 0.0VDC to +10.00VDC, single-ended. Connected to pin 13 of the TO GENERATOR connector. The MC2 Controller can monitor this signal if the RF generator is configured for single-ended setpoint operation. Consult factory for details..
14	MAINS INTERLOCK2	Loop-Thru. Connected to pin 14 of the TO GENERATOR connector. No internal connection to MC2 circuitry.
15	INTERLOCK-RTN	Internally connected to chassis ground.
16	GNDI	Internally connected to chassis ground.
17	GNDI	Internally connected to chassis ground.
18	GNDI	Internally connected to chassis ground.
19	RL-IN	Loop-Thru. Connected to pin 19 of the TO GENERATOR connector. No internal connection to MC2 circuitry.
20	RL-OUT	Loop-Thru. Connected to pin 20 of the TO GENERATOR connector. No internal connection to MC2 circuitry.
21	PHASE	Loop-Thru. Connected to pin 21 of the TO GENERATOR connector. No internal connection to MC2 circuitry.
22	FWDRET	Forward Power Monitor return signal. Internally connected to chassis ground.
23	REFRET	Reflected Power Monitor return signal. Internally connected to chassis ground.
24	RESERVED	Loop-Thru. Connected to pin 24 of the TO GENERATOR connector. No internal connection to MC2 circuitry.

FROM SYSTEM Connector Pin List		
Pin	**Signal**	**Description**
25	SETRET	Forward Power Setpoint return signal. Loop-Thru. Connected to pin 25 of the TO GENERATOR connector. No internal connection to MC2 circuitry. **Note**: Seren IPS Inc. RF generators use a differential setpoint input. To prevent erratic operation, this signal ***must*** be connected to the generator's setpoint return terminal.

14. Phase Connector (optional)

Phase error signal input, analog, -10VDC to +10VDC range. Internally connected to pin 7 of the MATCH NETWORK connector. Used for matching network configurations that do not support routing of the phase error signal through the matching network's CONTROL connector.

Connector Type: BNC Female
Center pin is "phase error signal hot", shell is connected to chassis ground.

Recommended Cable: Type RG-58/U 50 Ohm Coaxial Cable

15. Mag Connector (optional)

Magnitude error signal input, analog, -10VDC to +10VDC range. Internally connected to pin 8 of the MATCH NETWORK connector. Used for matching network configurations that do not support routing of the magnitude error signal through the matching network's CONTROL connector.

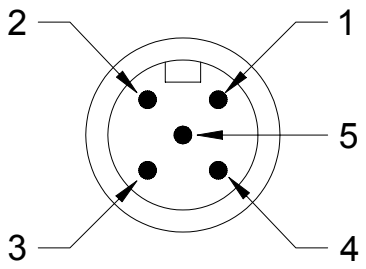
Connector Type: BNC Female
Center pin is "magnitude error signal hot", shell is connected to chassis ground.

Recommended Cable: Type RG-58/U 50 Ohm Coaxial Cable

16. DeviceNet Interface Connector (optional)

Permits remote computer control and monitoring of the matching network and generator parameters over the user's DeviceNet network. Use shielded cable to make DeviceNet interface connections.

Connector type: DeviceNet 5 pin Male micro-circular connector.



DeviceNet Connector

DeviceNet Connector Pin List		
Pin	**Signal**	**Description**
1	DRAIN	Shield drain connection. Internally connected to chassis ground
2	V+	DeviceNet termination power positive
3	V-	DeviceNet termination power negative
4	CAN_H	DeviceNet/CAN Bus data +
5	CAN_L	DeviceNet/CAN Bus data -

17. DeviceNet NET Status Indicator (optional)

After flashing during the power-up sequence, the Network (NET) status indicator shows the DeviceNet connection status, per the chart below: Additional details are explained in the DeviceNet communications section.

NET indicator	**Status**
Flashing Green	Waiting for connection
Solid Green	Connection Established
Solid Red	Problem with connection – check the following: 1. Ensure power is available on the DeviceNet Network. 2. Verify the DeviceNet network is properly terminated. 3. Verify the MC2's address is valid (0 to 63) 4. Ensure the MC2's data rate is appropriate for the DeviceNet network

18. DeviceNet MOD Status Indicator (optional)

After flashing during the power-up and connection sequence, the Module (MOD) status indicator should remain off. Additional details are explained in the DeviceNet communications section.

19. DeviceNet Address MSD Select Switch (Most Significant Digit) (optional)

Selects the most significant digit of the 2-digit DeviceNet address ("tens" column). Selection range is 0 to 6, and "P". The "P" position should not be used.

It is good practice to ensure the front panel programming menu address parameter is set to the same value indicated by the rear panel switches.

20. DeviceNet Address LSD Select Switch (Least Significant Digit) (optional)

Selects the least significant digit of the 2-digit DeviceNet address ("ones" column). Selection range is 0 to 9.

It is good practice to ensure the front panel programming menu address parameter is set to the same value indicated by the rear panel switches.

21. DeviceNet Data Rate Select Switch (optional)

Selects the DeviceNet network data rate. Data rate selections are listed below.

It is good practice to ensure the front panel programming menu data rate parameter is set to the same value indicated by the rear panel RATE switch.

RATE Switch Setting	DeviceNet Data Rate
1	125 KBPS
2	250 KBPS
5	500 KBPS
P	Not supported, do not use.

TYPICAL INTERFACE CONNECTIONS

Analog Control

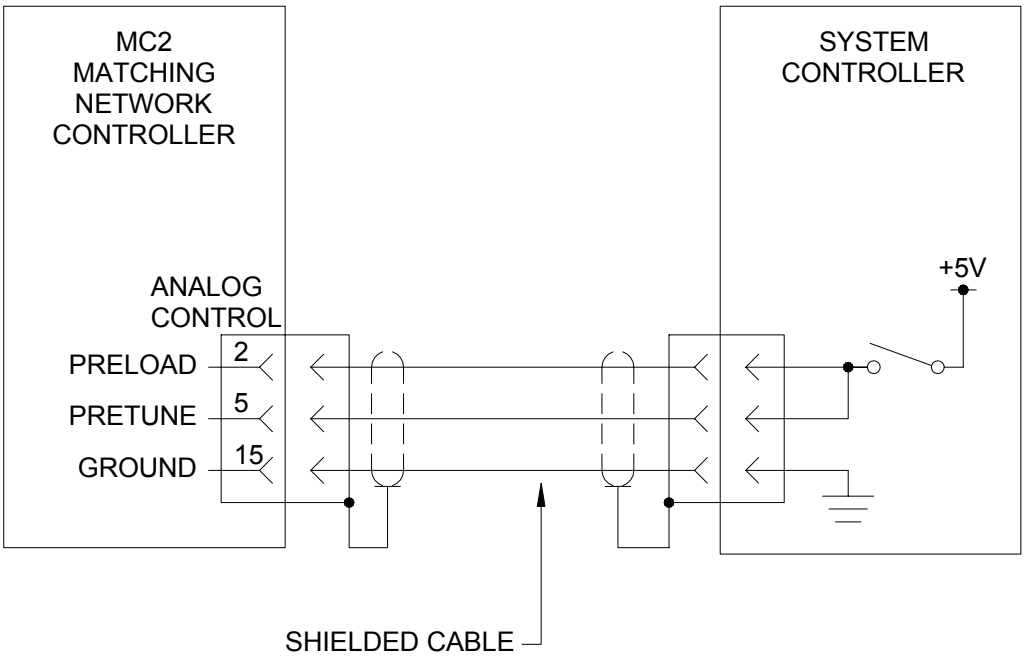
There are many possible analog control wiring schemes. The basic schemes shown below can be combined to make more sophisticated analog control schemes. Refer to the Analog Control connector pin list in the Rear Panel Controls and Connections section for signal details. Use shielded cable for all interconnections.

Basic Preset Operation

Simultaneously presets the matching network's Load and Tune capacitors to the positions internally stored within the MC2 controller (Programming Menu, Internal Load Capacitor Preset Position Parameter; Internal Tune Capacitor Preset Parameter).

Apply a TTL logic HIGH to the Analog Control Connector pins 2 and 5. Allow sufficient time for the capacitors to reach their preset point, then apply a TTL logic low (or open circuit) to pins 2 and 5. Once the capacitors are positioned, enable RF power.

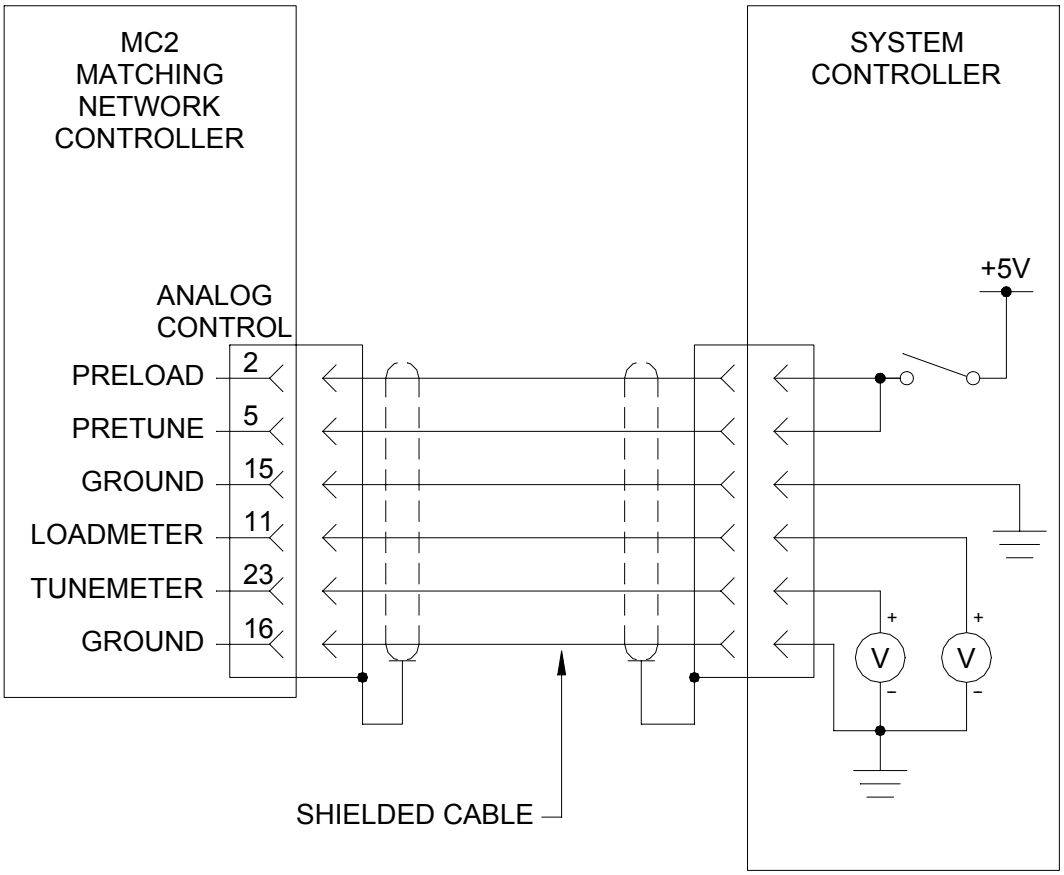
Requires setting of programming menu ***Preset Source*** parameter to "INT SOURCE" and programming menu parameter ***Preset Trigger*** to "ANALOG" trigger.



Basic Preset

Basic Preset With Feedback

Operates the same as the Basic Preset Scheme above, but the system controller can monitor capacitor positions during preset and normal operation.



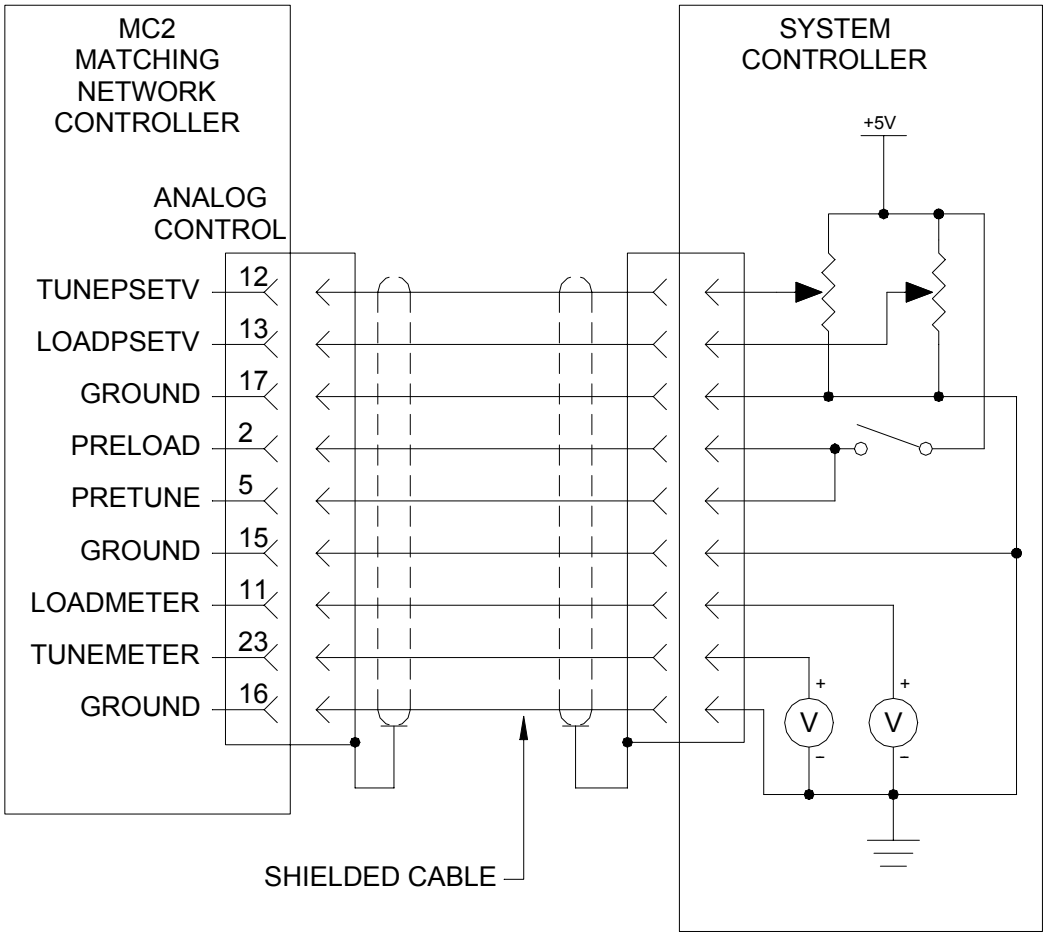
Basic Preset with Feedback

External Preset Operation

Simultaneously presets the matching network's Load and Tune capacitors to the positions requested by the system controller.

Apply a TTL logic HIGH to the Analog Control Connector pins 2 and 5. Allow sufficient time for the capacitors to reach their preset point, or monitor the capacitor position signals TUNEMETER and LOADMETER until the capacitors to reach their requested positions, then apply a TTL logic level LOW (or open circuit) to pins 2 and 5. Once the capacitors are positioned, enable RF power.

Requires setting the programming menu ***Preset Source*** parameter to "EXT SOURCE" and the programming menu ***Preset Trigger*** parameter to "ANALOG".



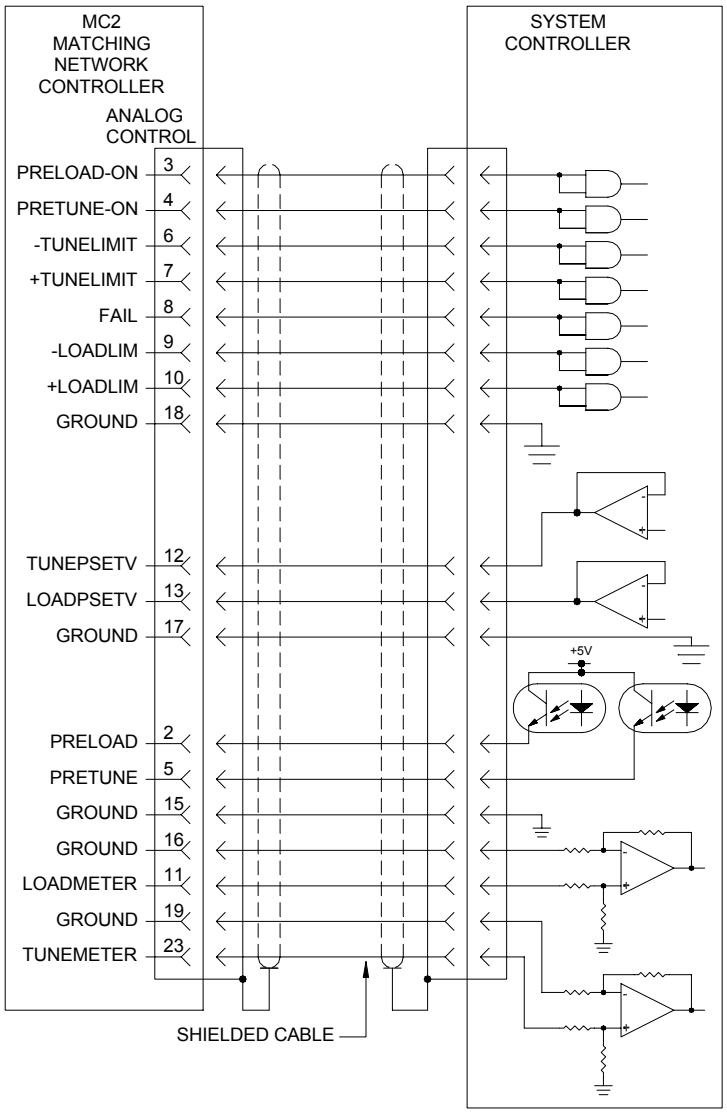
External Preset

Full Analog Control

The system controller can individually preset the matching network's Load and Tune capacitors, monitor the capacitor positions and monitor all status signals.

Make connections to the Analog Control Connector as shown below. Apply preset voltages to pins 12 and 13 and apply a TTL logic HIGH state to pin 2 and/or pin 5. Allow sufficient time for the capacitors to reach their preset point, or monitor the capacitor position signals TUNEMETER (pin23) and LOADMETER (pin 11) until the capacitors to reach their requested positions, then apply a TTL logic LOW signal to pins 2 and 5. Once the capacitors are positioned, enable RF power.

Requires setting the programming menu ***Preset Source*** parameter to "EXT SOURCE" and the programming menu ***Preset Trigger*** parameter to "ANALOG".



Full Analog Control

Loop Thru Connector Interfacing

The rear panel Loop-Thru connectors interface the MC2 Matching Network Controller to an RF Generator and your system controller. Using the Loop-Thru connectors can simplify system wiring when using RF or DC Voltage control modes.

The configuration diagrammed below allows the MC2 Matching Network Controller to monitor and display the RF Generator's setpoint, forward power, and reflected power and supply the AT-Series Matching Network's RF or DC probe voltage signal to the RF generator for voltage control operation.

All control signals are passed from the "FROM SYSTEM" connector to the "TO GENERATOR" connector without modification. The MC2 controller monitors some signals for display and preset control purposes.

The RF Generator analog connections shown below are generic. The actual analog interface connection wiring depends on the RF Generator model. Consult the RF Generator's instruction manual for appropriate analog connector pin-outs or contact a customer service representative for wiring assistance and available interface cables.

MC2 Controller Programming Notes:

1. Set the programming menu ***Preset Source*** and ***Preset Trigger*** parameters for desired mode of operation. Setting of ***Internal Load Capacitor Preset Position*** and ***Internal Tune Capacitor Preset Position*** parameters may be required.

2. Select the desired Voltage probe (Programming Menu ***Feedback Source*** parameter)

3. Set the Voltage Probe's attenuation factor (Programming Menu ***DC Voltage Probe Attenuation Factor*** or ***RF Voltage Probe Attenuation*** factor)

4. Set the Forward and Reflected Power full-scale wattage (Programming Menu, ***Forward Power Full Scale Wattage*** and ***Reflected Power Full Scale Wattage*** parameters) to match the RF Generator's scaling.

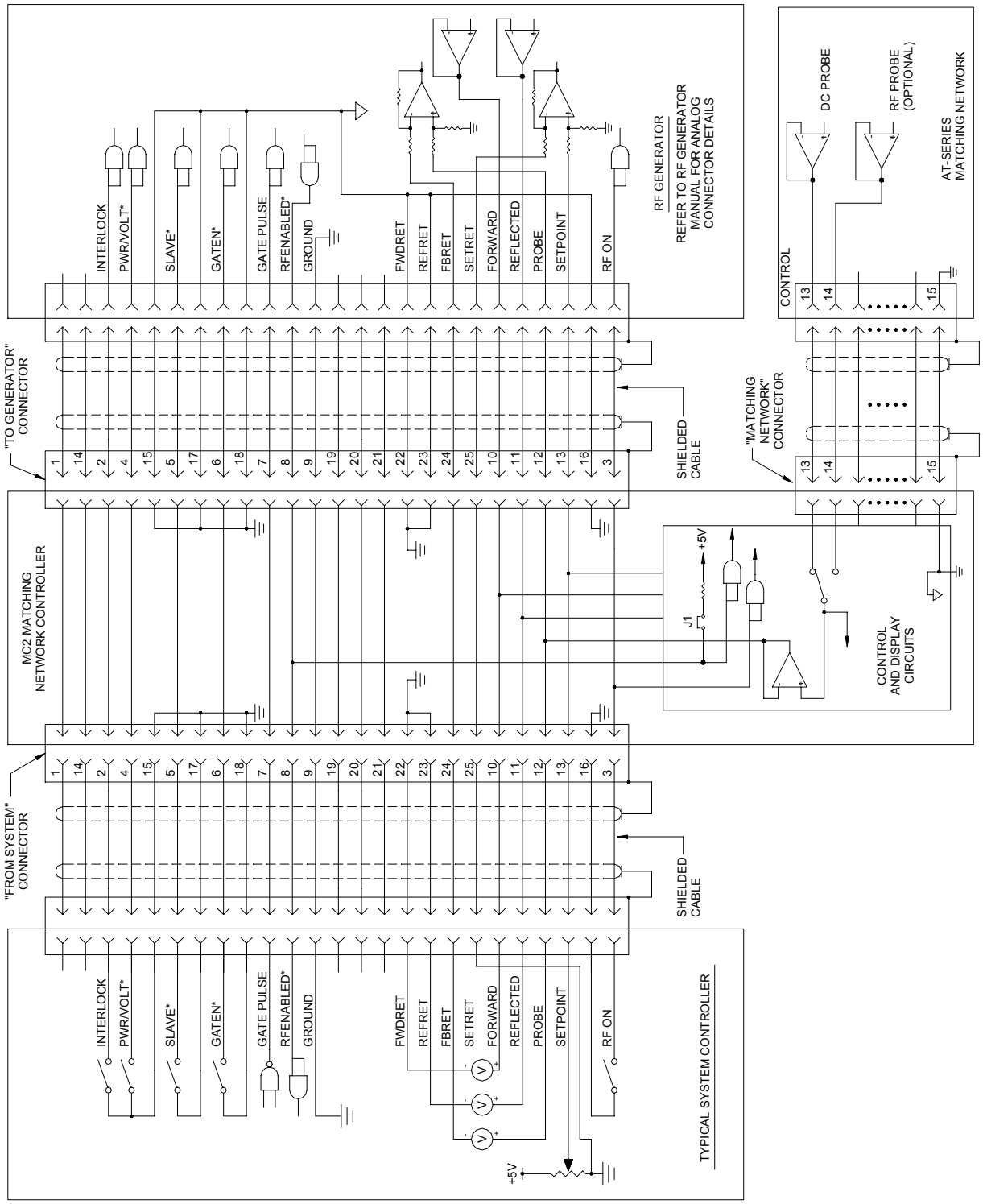
5. Set the programming menu ***Display Forward And Reflected Power*** parameter to "ON".

6. Set the programming menu ***Display RF or DC Voltage Probe*** parameter to "ON".

System Wiring Notes:

1. Use shielded cables for all interface wiring. Foil shielded cable with a drain wire is recommended.

2. Use connectors with metal shells and connect the cable shield (drain wire) to the connector's shell.



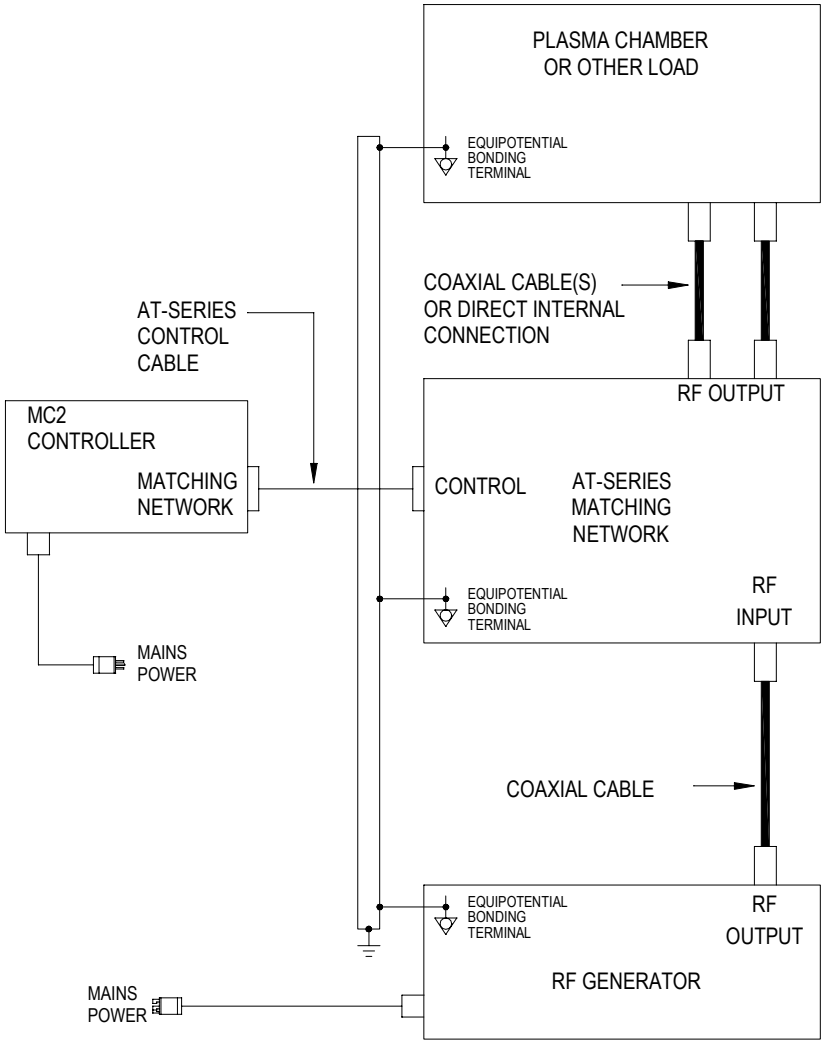
Loop-Thru Connector Interfacing

Typical Configurations

Popular configurations are depicted in this manual. Other configurations and wiring schemes are possible. For assistance with system wiring schemes, contact the customer service department or a Seren IPS Inc. service depot. Coaxial cables, control cables, matching networks, RF generators, and system equipment are not supplied with the MC2 Controller.

1. Basic Configuration

The basic configuration consists of the MC2 Controller, an AT-Series matching network, an RF Power source (generator), and a load. There are no control connections between the MC2 controller and the RF Power source and load/processing system. In this configuration, the MC2 and matching network operate independently from the RF power source and load/processing system.

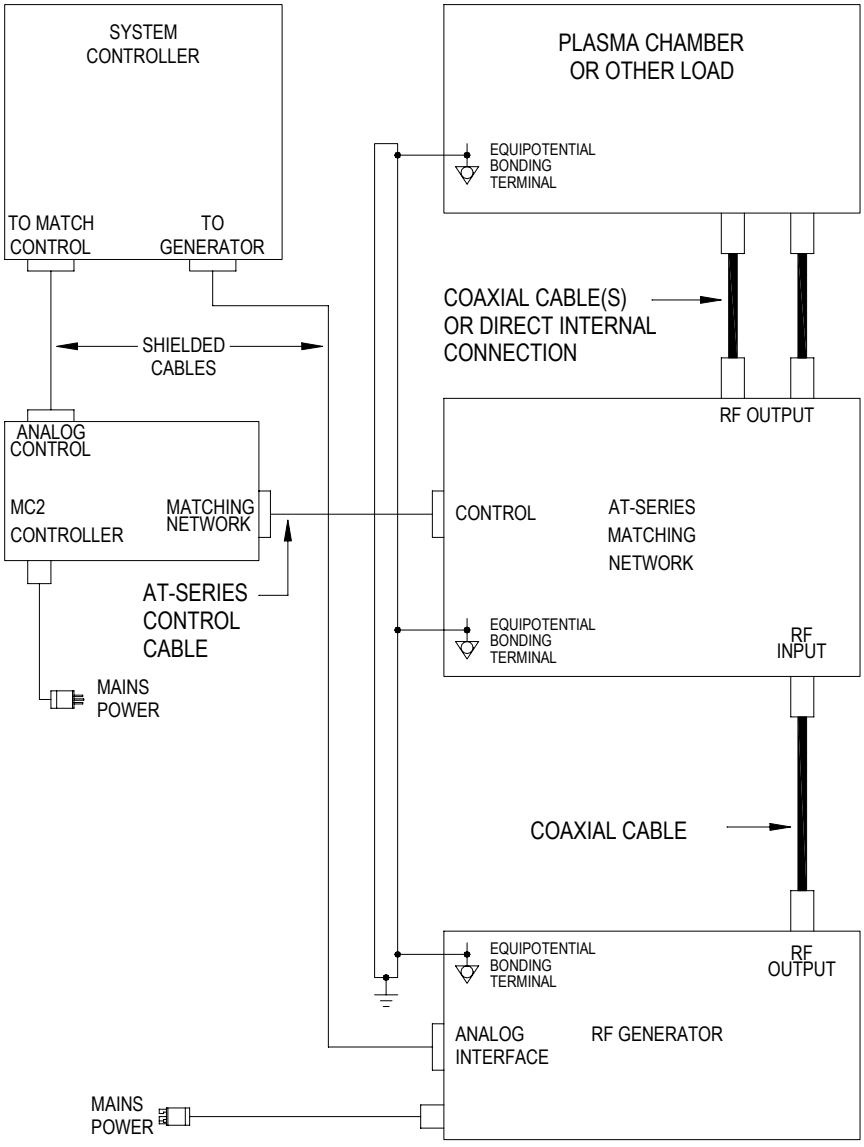


Basic Configuration

2. Basic Analog System

The Basic Analog System configuration consists of the MC2 Controller, an AT-Series matching network, and RF Power source (generator), system controller and a load. The system controller interfaces to the MC2 matching network controller and the RF generator. There are no control connections between the MC2 controller and the RF Power source.

In this configuration, the MC2 and matching network operate independently from the RF power source. The system controller controls the operation of the MC2 controller and the RF generator. Voltage control (a DC Probe or RF Probe within the matching network provides a feedback signal to the generator's power regulation circuits) of the RF generator is not available.



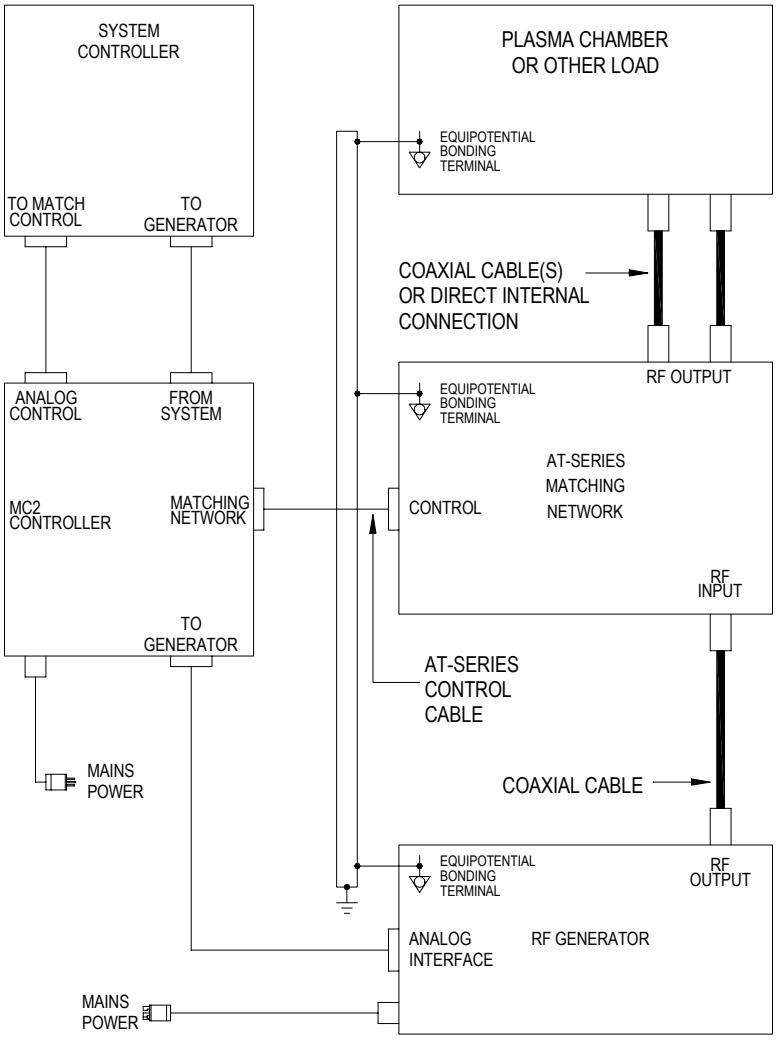
Basic Analog System Configuration

3. Full Analog System

The Full Analog System configuration consists of the MC2 Controller, an AT-Series matching network, and RF Power source (generator), system controller and a load. The system controller interfaces to the MC2 matching network controller and the RF generator with shielded analog control cables.

In this configuration, the MC2 and matching network operate independently from the RF power source. The system controller controls the operation of the MC2 controller and the RF generator. A voltage control signal (a DC Probe or RF Probe within the matching network provides a feedback signal to the generator's power regulation circuits) from the matching network is routed through the MC2 controller to the RF generator.

The system controller controls RF enable/disable and other functions of the RF generator.

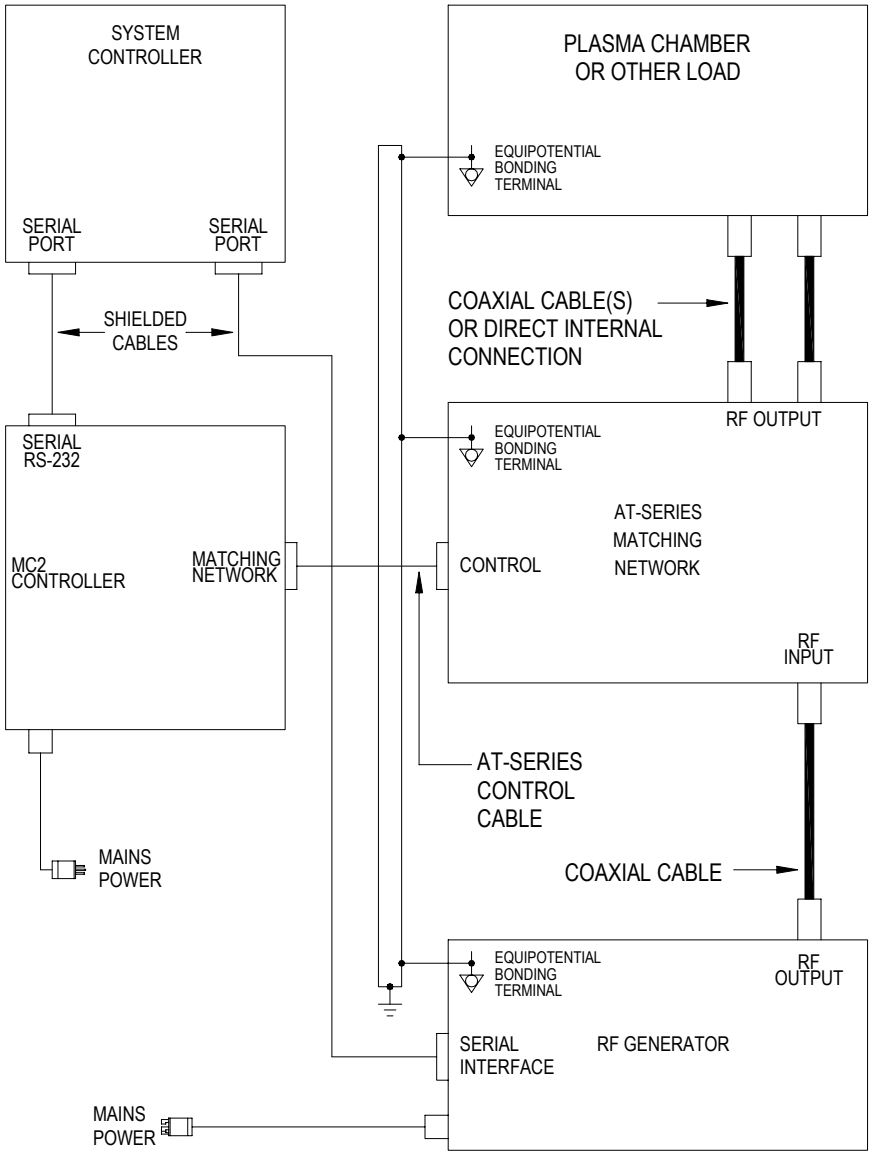


Full Analog System

4. Basic Serial System

The Basic Serial System configuration consists of the MC2 Controller, an AT-Series matching network, and RF Power source (generator), system controller and a load. The system controller interfaces to the MC2 matching network controller and the RF generator using RS232 serial interfaces. There are no control connections between the MC2 controller and the RF Power source.

In this configuration, the MC2 and matching network operate independently from the RF power source. The system controller controls the operation of the MC2 controller and the RF generator. Voltage control (a DC Probe or RF Probe within the matching network provides a feedback signal to the generator's power regulation circuits) of the generator is not available.

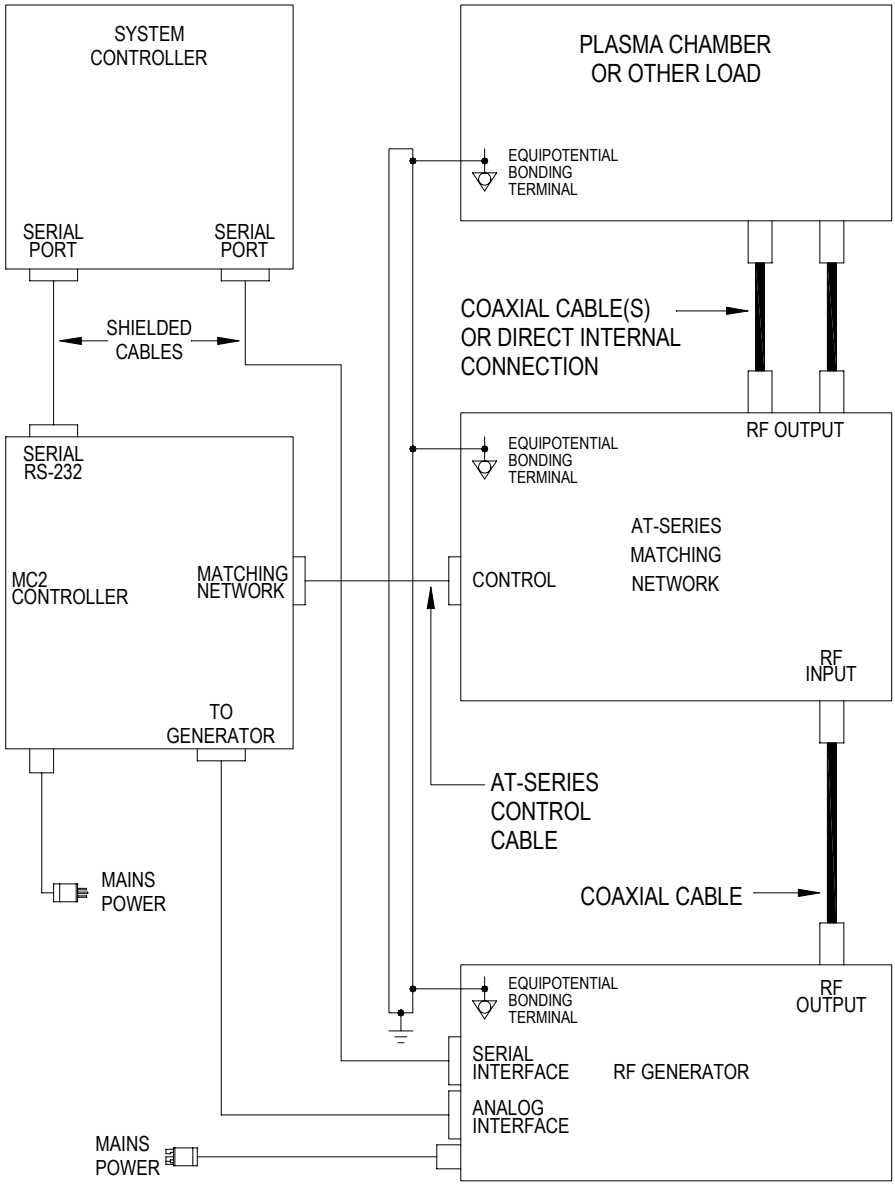


Basic Serial System

5. Serial System With Voltage Control

The Serial System with Voltage Control consists of the MC2 Controller, an AT-Series matching network, and RF Power source (generator), system controller and a load. The system controller interfaces to the MC2 matching network controller and the RF generator using RS232 serial interfaces. The MC2 routes the DC Probe signal (feedback signal) to the RF Power source.

In this configuration, the MC2 and matching network operate independently from the RF power source. The system controller controls the operation of the MC2 controller and the RF generator. Voltage control (a DC Probe or RF Probe within the matching network provides a feedback signal to the generator's power regulation circuits) of the generator is available.



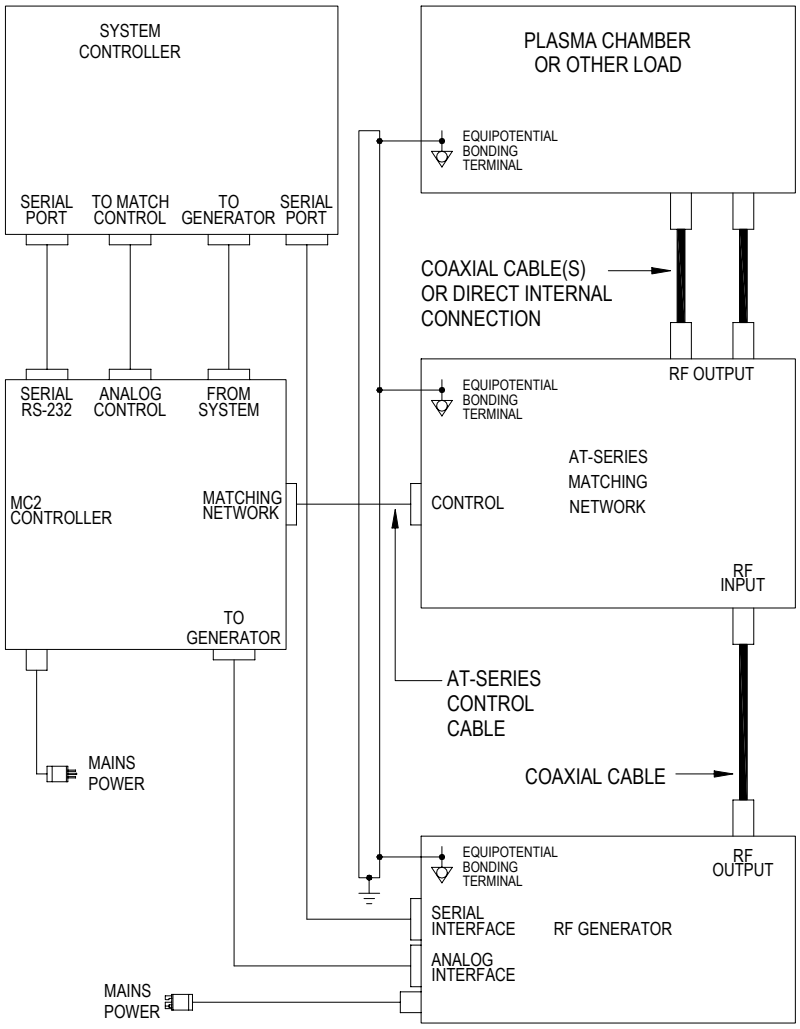
Serial System with Voltage Control

6. Fully Configured System

The Fully Configured System consists of the MC2 Controller, an AT-Series matching network, and RF Power source (generator), system controller and a load. The system controller interfaces to the MC2 matching network controller and the RF generator using RS232 Serial *and* Analog Control interfaces. The MC2 routes the DC Probe signal (feedback signal) to the RF Power source.

In this configuration, the MC2 and matching network operate independently from the RF power source. The system controller controls the operation of the MC2 controller and the RF generator. Voltage control (a DC Probe or RF Probe within the matching network provides a feedback signal to the generator's power regulation circuits) of the generator is available.

The system controller controls RF enable/disable and other functions of the RF generator.



Fully Configured System

Maintenance

The MC2 Automatic Matching Network Controller is designed to be maintenance free. There are no user maintainable assemblies inside the unit. The MC2 is designed for use in a clean environment. Periodically check the air vents for accumulation of dust and debris. Clean the air vents with a vacuum cleaner if they appear dirty or clogged.

Restricting the air vents or installing the MC2 Automatic Matching Network Controller in a dusty environment may impact the long-term reliability of the matching network controller.

Cleaning:

DO NOT clean the MC2 Automatic Matching Network Controller when RF power is applied to the matching network or when the unit is connected to the AC mains. The exterior of the matching network controller may be cleaned with a soft cloth, dampened with soap and water or a mild solvent, such as alcohol.

Problem Solving

Problem Solving Chart

The following chart lists some conditions that may occur and the recommended solutions. Follow the suggested solutions until the problem is corrected. If the problem persists, please contact Seren IPS Inc. customer service or a Seren IPS Inc. service representative.

MC2 Problem Solving Chart	
Condition	**Suggested Solution**
The matching network motors do not turn	Verify the AT-Series Control cable is properly mated to the Matching network's "CONTROL" connector. Verify the AT-Series Control cable is properly mated to the MC2 Controller's "MATCHING NETWORK" connector. Make sure the MC2 controller's power switch is in the "ON" position and the power cord is properly mated to the rear panel inlet. Make sure AC Mains power is applied to the MC2 Controller
The matching network does not tune when RF Power is applied to the matching network	Check the MC2 controller's load and tune capacitor's mode settings. Ensure both the Load and Tune capacitors are set to the "AUTO" (automatic) mode
The top line of the MC2 Controller displays "LOAD 0% TUNE 0%" (Software Version 9E or later)	Verify the AT-Series Control cable is properly mated to the Matching network's "CONTROL" connector. Verify the AT-Series Control cable is properly mated to the MC2 Controller's "MATCHING NETWORK" connector. The capacitor feedback signal from both capacitors may have failed. Contact the nearest Seren IPS Inc. service representative or factory service department for assistance.
The top line of the MC2 Controller displays "CABL FAIL CABL FAIL" (Software Version 9D or earlier)	Verify the AT-Series Control cable is properly mated to the Matching network's "CONTROL" connector. Verify the AT-Series Control cable is properly mated to the MC2 Controller's "MATCHING NETWORK" connector. The capacitor feedback signal from both capacitors may have failed. Contact the nearest Seren IPS Inc. service representative or factory service department for assistance.
The top line of the MC2 Controller displays "LOAD 0% TUNE XX%" or "LOAD XX% TUNE 0%" (Software Version 9E or later)	One of the internal capacitor position feedback signals may have failed. Contact the nearest Seren IPS Inc. service representative or factory service department for assistance

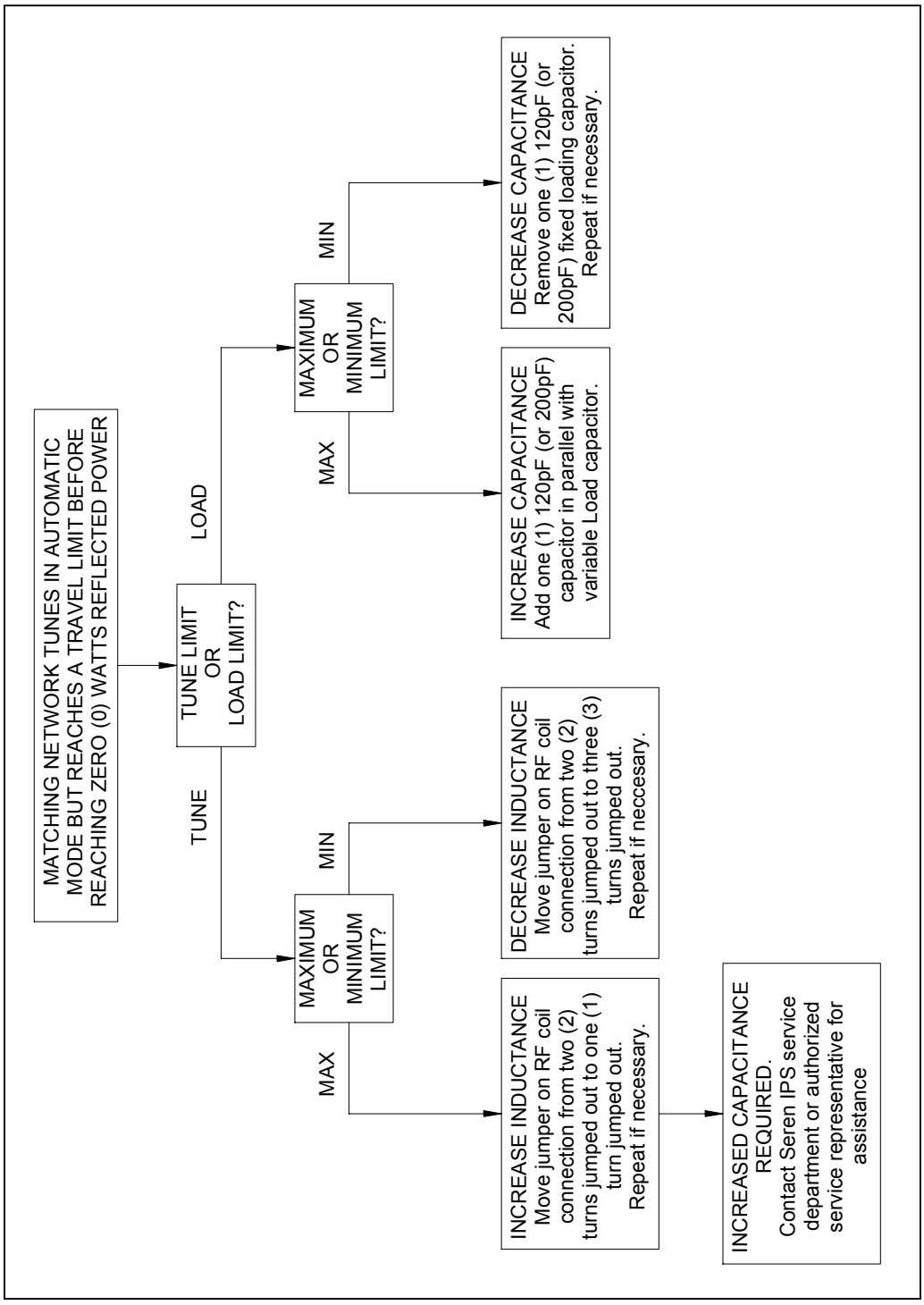
MC2 Problem Solving Chart	
Condition	**Suggested Solution**
The top line of the MC2 Controller displays "CABL FAIL TUNE XX%" or "LOAD XX% CABL FAIL" (Software version 9D or earlier)	One of the internal capacitor position feedback signals may have failed. Contact the nearest Seren IPS Inc. service representative or factory service department for assistance
The Load and/or Tune capacitor travels to a limit and "chatters" or "oscillates" in automatic mode when RF power is applied	The "chatter" is caused by the capacitor(s) being driven to the end-of-travel limit by the automatic mode and the "BACKOUT" feature is pushing the capacitor away form the end-of-travel limit. Temporarily switch to "MAN" (manual) mode to confirm – the "chatter" should stop. The matching network's range configuration may need adjustment. See the "Matching Network Range Configuration" heading in the Problem Solving section
"LOAD MAX" is displayed on the front panel during automatic operation.	The matching network's range configuration may need adjustment. See the "Matching Network Range Configuration" heading in the Problem Solving section
"LOAD MIN" is displayed on the front panel during automatic operation.	The matching network's range configuration may need adjustment. See the "Matching Network Range Configuration" heading in the Problem Solving section
"TUNE MAX" is displayed on the front panel during automatic operation.	The matching network's range configuration may need adjustment. See the "Matching Network Range Configuration" heading in the Problem Solving section
"LOAD MIN" is displayed on the front panel during automatic operation.	The matching network's range configuration may need adjustment. See the "Matching Network Range Configuration" heading in the Problem Solving section
The matching network tunes automatically, but reflected power is not Zero (0) Watts. Reflected power is less than 10 Watts and can be tuned to Zero (0) Watts in manual mode.	On some systems, a perfect (0W reflected power) may not be possible or a slight mis-match (1W to 5W of reflected power) may be considered tolerable due to process variations or a multi-process system configuration. If needed, the Phase and Magnitude sensor may be adjusted. Refer to the "Phase And Magnitude Sensor Adjustment Procedure" heading in the Problem Solving section.
The matching network tunes automatically, but reflected power is not Zero (0) Watts. Reflected power is greater than 10 Watts and can be tuned to Zero (0) Watts in manual mode.	The Phase and Magnitude sensor may require adjustment. Refer to the "Phase And Magnitude Sensor Adjustment Procedure" heading in the Problem Solving section.

MC2 Problem Solving Chart	
Condition	**Suggested Solution**
Cannot communicate with the MC2 via serial commands	1. Several front panel settings affect serial communications. Ensure the following programming menu parameters are set appropriately for your serial communications method: Communications Protocol Address ID Number Data Rate Communications ECHO 2. Ensure the system controller or data terminal emulation software is set for: No Parity, 8 Data Bits, 1 Stop Bit 3. Check the serial interface wiring. The MC2 uses a non-standard serial interface connector, and serial interface wiring depends on the serial communications protocol selected. Refer to the Serial Communications section for wiring details by protocol; refer to the Rear Panel Controls and Connections section for the serial connector pin list. 4. If DeviceNet communication protocol is selected, commands sent via the serial interface are ignored. 5. Ensure the serial cable from the system is connected to the MC2's rear panel SERIAL RS232 connector.
Cannot communicate with the MC2 via DeviceNet	1. Several front panel settings affect serial communications. Ensure the following programming menu parameters are set appropriately for your DeviceNet communications method: Ensure the MC2's Communications Protocol is set to "DEVICENET". Ensure the MC2's address ID number is between "00" and "63" – check rear panel switches *and* front panel programmable parameter settings. Ensure the selected Data Rate is correct for the DeviceNet network. 2. Ensure there are no duplicate address ID's on the DeviceNet network. 3. Ensure there is proper power available on the DeviceNet network. 4. Ensure the DeviceNet network is properly terminated. 5. Ensure the DeviceNet cable is connected to the rear panel DEVICENET connector.

MC2 Problem Solving Chart	
Condition	**Suggested Solution**
Cannot communicate with the MC2 via DeviceNet, The rear panel NET LED indicator is RED	1. Ensure the MC2's address ID number is between "00" and "63" – check rear panel switches *and* front panel programmable parameter settings. 2. Ensure the selected Data Rate is correct for the DeviceNet network. 3. Ensure there is proper power available on the DeviceNet network. 4. Ensure the DeviceNet network is properly terminated.
Cannot communicate with the MC2 via DeviceNet, The rear panel NET LED *and* MOD LED indicators are AMBER	The MC2 Matching Network controller's communications mode *is not* set to "DEVICENET". Enter the front panel programming menu and set the communications protocol to "DEVICENET".
The rear panel NET LED indicator is flashing GREEN (DeviceNet equipped MC2's only)	There is no fault with the MC2 Matching Network Controller. The MC2 is waiting for a DeviceNet host to establish a connection.

Matching Network Range Configuration

Unless otherwise specified at the time of order, Seren IPS Inc. Automatic Matching Networks are shipped with a "generic" range configuration. On some systems, the generic range configuration may be insufficient to obtain a matched (0 Watts Reflected power) condition. Refer to the chart below to adjust the matching network's range.



Phase and Magnitude Sensor Adjustment Procedure:

If your Seren IPS Inc. AT-Series Matching Network can optimally match to your plasma chamber in manual mode, but not in automatic mode, or your matching network's hardware configuration required changes to meet your process requirements, adjustment of the Phase and Magnitude error sensor may have to be performed. Use the following procedure to adjust the Phase and Magnitude Error Sensor.

Required test equipment: Digital Multimeter, Fluke Model 77 Type III or equivalent (Seren IPS Inc. recommends the Fluke digital multimeter because of its superior immunity to RF Interference)

1. At the MC2 Controller, set the Load and Tune capacitor modes to "MAN" (manual)
1. Set the RF Generator's power setpoint to 250 Watts and enable the RF output.
2. Manually adjust the matching network's Load and Tune capacitors for minimum reflected power at the RF Generator.
3. Insert the negative (-) miltimeter test lead into the "COM" test point on the rear panel of the MC2 Controller.
4. Insert the positive (+) miltimeter test lead into the "PHASE" test point on the rear panel of the MC2 Controller.
5. Adjust the "PHASE" potentiometer, located on the side panel of the AT-Series Matching Network for a 0.000VDC +/- 0.005VDC reading on the multimeter.
6. Remove the positive (+) miltimeter test lead from the MC2 Controller's rear panel "PHASE" test point.
7. Insert the positive (+) miltimeter test lead into the "MAG" test point on the rear panel of the MC2 Controller.
8. Adjust the "MAG" potentiometer, located on the side panel of the AT-Series Matching Network for a 0.000VDC +/- 0.005VDC reading on the multimeter.
9. Set the MC2 Controller Load and Tune capacitor modes to "AUTO" (automatic) and confirm the matching network tunes to zero (0) Watts reflected.
10. Increase the RF Generator's output power to the matching networks' rated input power (or maximum power if less than the matching network's rated input power).
11. Repeat steps 2 through 9.
12. Disconnect the multimeter from the MC2 Controller's rear panel test points.
13. Disable the RF generator's RF output.
14. End Of Procedure

Technical Data

MC2 Technical Data		
AC Mains Input Power	Voltage: 98-125V or 198-250V, selectable	
	Frequency: 47-63 HZ	
	Power required: 100VA Maximum	
	Overcurrent Protection: 1.6A 250V Time-Delay fuse, 5mm x 20mm	
	Power Inlet: IEC-320 Type	
Power Cord Supplied	98-125V Models: 18/3 Type SJT, 2m length, with IEC320-C13 female connector and NEMA 5-15P male plug.	
	198-250V Models: 18/3 Type SJT, 2m length, with IEC320-C13 female connector to un-terminated leads	
Environment:	Operating Temperature, Ambient: 0 to +40°C	
	Operating Relative Humidity: 10% to 90%, non-condensing	
Cooling:	Convection	
Interfaces & Connections:	Matching Network:	15 pin Female D-Sub Connector
	Serial RS-232:	9 pin Female D-Sub Connector
	Analog Control:	25 Pin Female D-Sub Connector
	Loop-Thru To Generator:	25 pin Female D-Sub Connector
	Loop-Thru From System:	25 pin Male D-Sub Connector
	DeviceNet (optional):	5-pin Male Micro-circular connector, with screw-on locking
	PROFIBUS (optional):	9 pin Female D-Sub Connector
	Phase Input (optional):	Type BNC Female
	Mag Input (optional):	Type BNC Female
DeviceNet Applicable Documents:	Title:	DeviceNet Specification Volume 1: DeviceNet Communication Model and Protocol
	Version:	Release 2.0, Errata5 March 31 2002
	Source:	ODVA
	Title:	DeviceNet Specification Volume II: DeviceNet Device Profiles and Object Library

MC2 Technical Data		
	Version:	Release 2.0, Errata 5 March 31, 2002
	Source:	ODVA
	Title:	Interface Guidelines for DeviceNet Devices On Semiconductor Manufacturing Tools
	Version:	Revision: 2.5 09-Sept-2005
	Source:	ODVA Semiconductor Special Interest Group (SIG)
DeviceNet Physical Layer:	Philips PCA82C250 CAN Controller, Optically Isolated	
Matching Network Motor Voltage:	+/- 12VDC Nominal	
Overall Dimensions inch (mm):	3.47 (88.14) High x 8.00 (203.20) Wide x 13.03 (330.86) Deep. Width with ½-Rack Mounting Brackets installed: 9.50 (241.30)	
Weight:	7.5 Lbs (3.2Kg)	

SEREN 1 Year Limited Warranty

SEREN IPS Inc. products are warranted to the original purchaser against defects in material and workmanship for a period of one year from the date of delivery.

SEREN IPS Inc. will repair or replace, at its option, all defective products returned freight prepaid during the warranty period, without charge, provided that there is no evidence the product has been mishandled, abused, or misapplied. Our liability under this warranty is limited to servicing, repairing, or replacing any defective products for a period of one year after delivery to the original purchaser.

If warranty service is required, the equipment must be returned, transportation charges prepaid, to our factory or authorized service depot. In the case of misuse, abnormal operating conditions, or other non-warranty work, a repair cost estimate will be submitted for approval before work is started.

WHAT THE WARRANTY DOES NOT COVER:

This warranty covers only defects in materials and workmanship provided by SEREN I.P.S. and does not cover equipment damage or malfunction from misuse, abuse, accident, act of God, non-SEREN I.P.S. modification or upgrade. Improper return shipping, packaging, or shipping damage is not covered. SEREN I.P.S. will not be liable for any incidental or consequential damages resulting from your use or inability to use your Matching Network Controller.

IF YOU HAVE A PROBLEM

The first step is to contact your system vendor. Consult with your system vendor to determine the nature of the problem. Your system vendor knows the intimate details of how your processing system interfaces and operates with the MC2 Matching Network Controller and can efficiently resolve system related problems.

If it is determined that the Matching Network Controller has a problem, contact our customer service department at **1-856-205-1131**. Before you call, please be ready to provide the model of your Matching Network Controller, its serial number, date of manufacture, a description of the problem, and the model and manufacturer of the processing system it is used on.

HOW IS WARRANTY SERVICE OBTAINED?

Our customer service representative will explain how to obtain service under this warranty. Please save the original packing materials in order to facilitate shipment.

Glossary of Terms

A	Amperes, a measurement unit of current
AC	Alternating Current
Chamber	Industry term for a vacuum chamber used in plasma processing equipment.
D-Sub	Industry term for D-Subminiature connector
DC	Direct Current
Equipotential Bond Equipotential Bonding	Equipotential bonding (often referred to as grounding) is used to control RF circulating currents within a system. For regulatory purposes, it is not a "Protective Earth" or "Safety Ground", even though it may be bonded to the "Protective Earth" or "Safety Ground" within the equipment or user's facility.
KHz	Kilo Hertz, a measurement unit of frequency (1000 Hertz)
KVA	Kilo Volt-Amperes
LED	Light-emitting diode. Used an indicator lamp to show status.
Load Capacitor	Industry term for a shunt capacitor in an "L" type impedance matching network. Can be fixed or variable type.
Matchbox	Industry term for an impedance matching network
MHz	Mega Hertz, a measurement unit of frequency (1,000,000 Hertz)
mV	Milli-Volts, a measurement unit of Voltage, equal to 1/1000 of a Volt.
Non-Volatile Storage	Also know as non-volatile memory. Computer memory that retains its data after power has been removed.
RF Generator	Industry term for Radio Frequency Power Supply
RF	Radio Frequency
Strike Preset	A pre-determined (usually empirically) starting positions for the matching network's capacitors – an aid for plasma ignition.
TTL	Transistor-Transistor Logic
Tune Capacitor	Industry term for the series capacitor in an "L" type impedance matching network. Can be fixed or variable type.
Tuner	Industry term for an impedance matching network
VAC	Volts, Alternating Current
VDC	Volts, Direct Current
W	Watts

Revision History:

Revision	Date	Revision Description
0.90	12/23/02	Preliminary
1.00	2/28/03	Issued
1.01	9/23/03	Updated illustrations; Incorporated Software Version 9E changes: 1. "Cable Fail" messages removed 2. End-of-travel limits no longer disable the RF Power source's output (when MC2 is interfaced to the user's system *and* the RF power source)
2.00	3/10/07	General revision - updated to include firmware revision 12.5B, updated illustrations, revised programming menu, revised serial interface pin list, revised Loop-Thru Connector Interfacing diagram, revised "From System" and "To Generator" pin lists; added serial interface commands, serial interface wiring, and DeviceNet interface.
2.01	5/4/07	Updated to include firmware revision 12.8A features and optional PROFIBUS interface – PROFIBUS protocol and commands are discussed in a separate document.
2.02	4/8/08	Added increase/decrease directions for Phase and Mag Gain adjustments.
2.03	11/22/10	Added serial commands QPL, QPT, QAML, QAMT (firmware versions 12.8D and later)

Notes: