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MC2 MATCHING NETWORK CONTROLLER

OPERATOR'S MANUAL

Revision: 1.01
Standard Configuration

Document Number 6200070000

Introduction

Thank you for acquiring your new KJLC 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

For technical questions, application assistance, or additional information, contact our customer service department or nearest customer service representative.

Service

Customer Service Representatives are available to answer your technical questions. Should your KJLC product require service, contact the nearest KJLC service representative for a Return Materials Authorization Number. Any returned equipment should be sent freight prepaid.

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. Office hours are Monday through Friday, 8:00am to 8:00pm, United States Eastern Time

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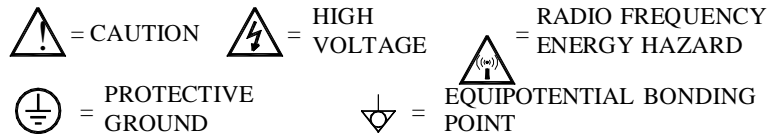
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Safety Notes

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.

Safety Symbols:



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.**

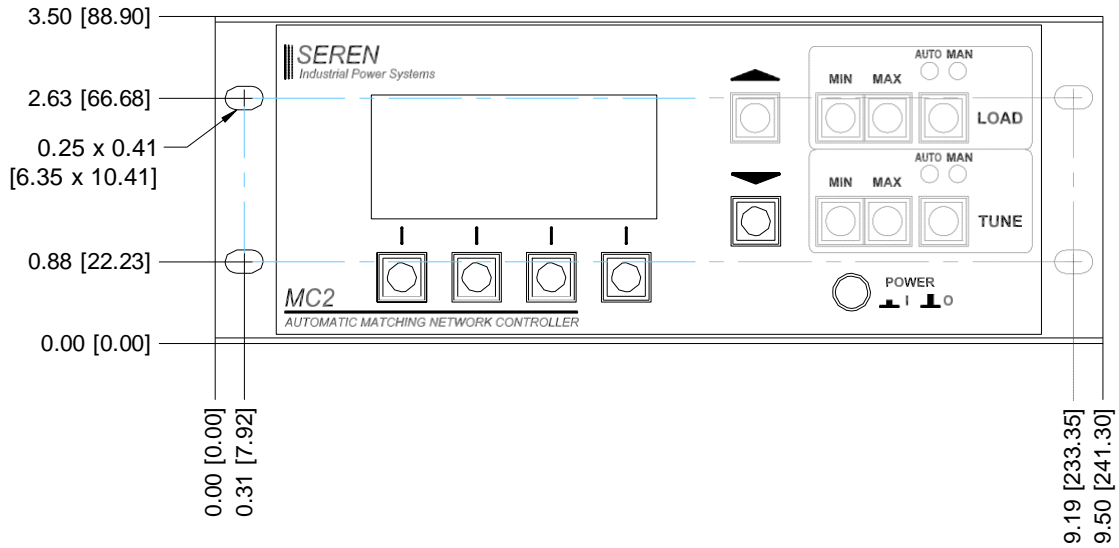
MC2 Matching Network Controller Features

The MC2 Matching Network Controller is intended for use with KJLC AT-Series Automatic Impedance Matching Networks.

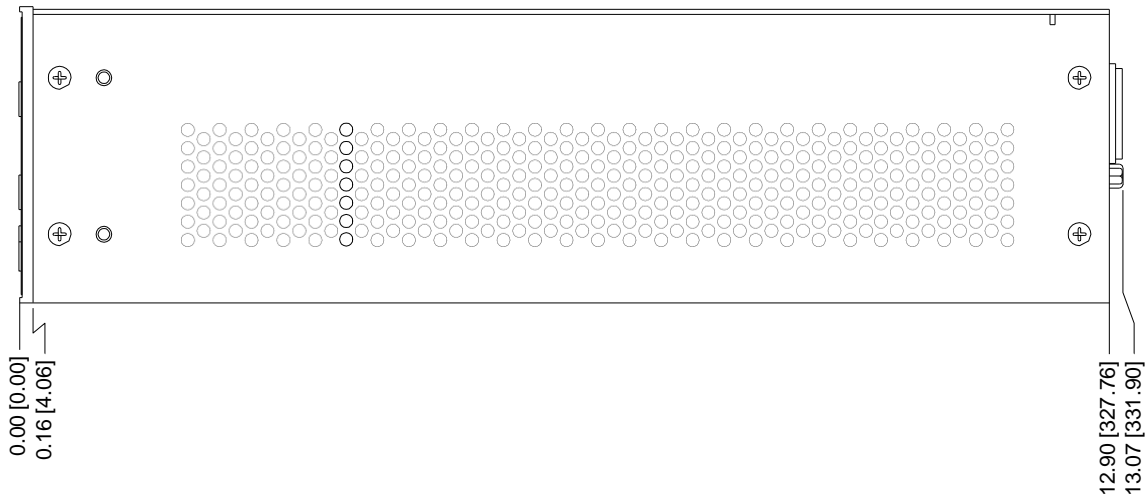
The MC2 Matching Network Controller powers and controls the operation of the KJLC AT-Series Automatic Impedance Matching Networks, provides operator- accessible controls, a visual display of matching network status, and a control interface to the user's processing system. Other MC2 features are listed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

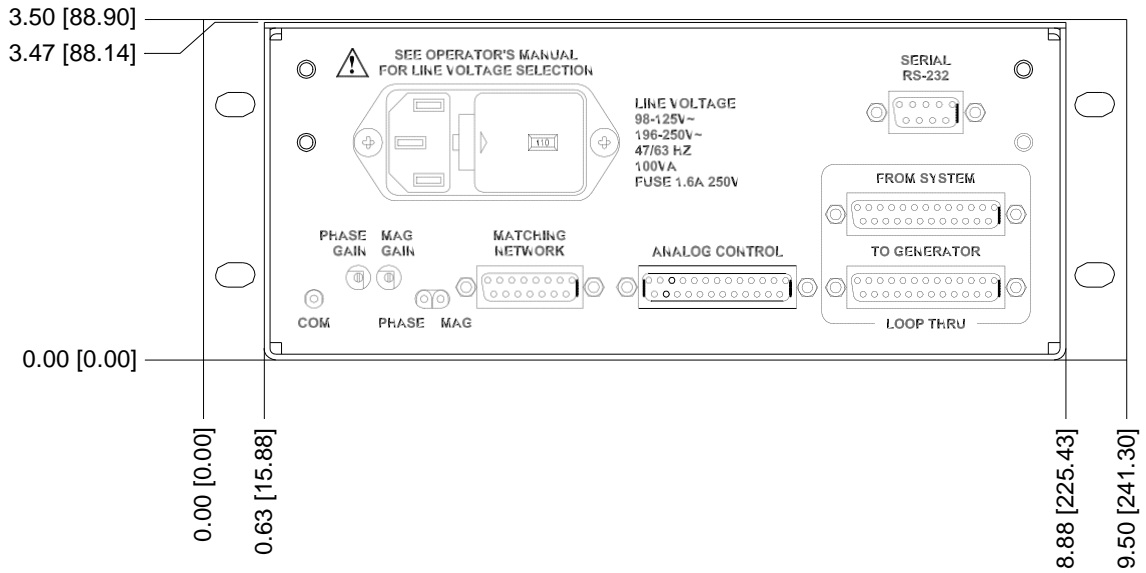


Front View, MC2 Matching Network Controller
 Dimensions in Inch [mm]



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

MC2 MATCHING NETWORK CONTROLLER OPERATOR'S MANUAL



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, KJLC 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, KJLC Part Number 7300070000. The equipment rack must be capable of supporting the full weight of two (2) MC2 units.

Supplied Accessories:

Description	Quantity	KJLC 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 KJLC 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) connectors 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 KJLC customer service department if you require assistance with interface connections. A brief summary of the connectors is listed below.

“Analog Control” Connector

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

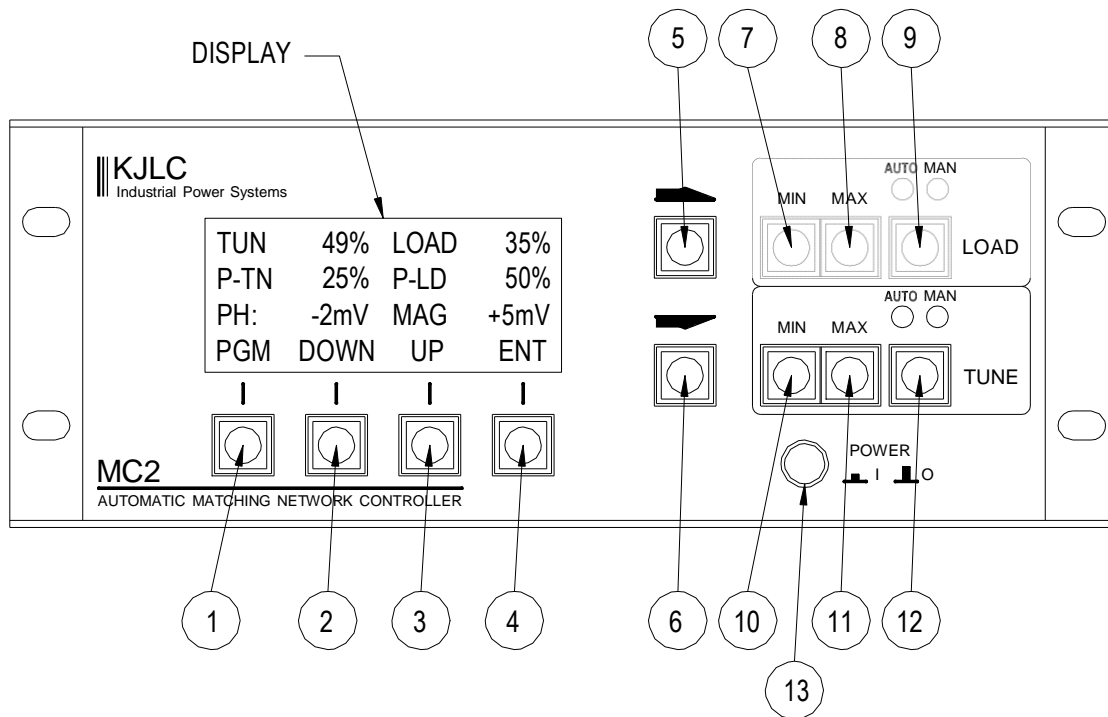
“Loop-Through” Connectors

Designed to simplify system cabling – most signals are passed through unmodified. The DC Probe and RF Probe signals are routed to the generator and the MC2 Controller can monitor generator status signals.

“Serial RS-232” Connector

Reserved for future use.

Front Panel Controls and Display:



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.

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.

Basic 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 either the "UP" or "DOWN" buttons saves the programmable parameter. Pressing the "ENT" button (item 4) also saves the programmable parameter. The programmable parameters are saved in the MC2 Controller's memory and are recalled upon power-on

PROGRAMABLE PARAMETER REFERENCE:

LEVEL	PARAMETER	DISPLAY LINE 3	OPTION
1	Strike Preset	RECORD STRIKE PRESET	<ENT>
2	Internal Load Preset Enable/Disable	LOAD PRESET	ON / OFF
3	Internal Tune Preset Enable/Disable	TUNE PRESET	ON / OFF
4	Internal Load Preset Position	SET LOAD PRESET	XX%
5	Internal Tune Preset Position	SET TUNE PRESET	XX%
6	Probe Select	PROBE SELECTED	DCV/RFV
7	DC Voltage Probe Attenuation Factor (XXXX:1)	DC PROBE ATTEN	XXXX
8	RF Voltage Probe Attenuation Factor (XXXX:1)	RF PROBE ATTEN	XXXX
9	Display Load and Tune Capacitor preset	LD/TN DISPLAY	ON / OFF
10	Display Phase and MAGNitude sensor error signal	PH/MAG DISPLAY	ON / OFF
11	Display Forward and Reflected power (Requires interfacing to RF Generator)	FWD/REF DISPLAY	ON / OFF

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LEVEL	PARAMETER	DISPLAY LINE 3	OPTION
12	Display RF or DC Voltage Probe (Displays Probe selected at level 6)	RF/DCV DISPLAY	ON / OFF
13	Forward Power Full Scale Wattage. Assumes generator's Forward power monitor signal is set for 5.00V at full scale. Instructs the MC2 Controller to display 0-9999 Watts for a 5.00VDC signal. (Requires interfacing to RF Generator)	FORWARD F.S.	0-9999
14	Reflected Power Full Scale Wattage. Assumes generator's Reflected power monitor signal is set for 5.00V at full scale. Instructs the MC2 Controller to display 0-9999 Watts for a 5.00VDC signal. (Requires interfacing to RF Generator)	REFLECTED F.S.	0-9999
15	Load Capacitor Programmable High Limit (Factory Default: 98%)	LOAD LIMIT HIGH	2-98%
16	Load Capacitor Programmable Low Limit (Factory Default 2%)	LOAD LIMIT LOW	2-98%
17	Tune Capacitor Programmable High Limit (Factory Default: 98%)	TUNE LIMIT HIGH	2-98%
18	Tune Capacitor Low Limit (Factory Default: 2%)	TUNE LIMIT LOW	2-98%
19	BACKOUT feature Enable / Disable (Factory Default: Enabled)	BACKOUT	ENABLED / DISABLED
20	RFON Signal Polarity Used to select RF Generator RF ON and RF OFF states for displaying Forward setpoint or Forward Power (Requires interfacing to RF Generator) Low Input = Active Low RF ON polarity (default) High Input = Active High RF ON polarity	RFON =	LOW INPUT / HIGH INPUT
21	Factory Settings – Enter secure setup menu. Enter passcode. No User Adjustments	ENT SECURE SETUP	XXX

PROGRAMMABLE PARAMETER DETAILS:

1. Record Strike Preset

Used in conjunction with LOAD and TUNE presets – records the current capacitor positions for use with the preset feature.

The third line of the front panel display changes to “RECORD STRIKE PRESET”.

Position the Load and Tune capacitors to the desired position for striking a plasma.

Press the Enter “ENT” button (item 4) on the front panel. The current load and tune capacitor positions are recorded as the strike preset and saved in non-volatile storage.

Use the UP or DOWN buttons to select another parameter, or press the RUN button return to normal operation.

2. Internal Load Preset Enable/Disable

Selects the source of the Load Capacitor preset position. The MC2 Controller will position the Load Capacitor to the selected preset when the Analog Control connector PRELOAD signal (pin 2) is activated.

The LOAD PRESET ON state instructs the MC2 Controller to position the Load Capacitor to the Load Preset value stored in the MC2 Controller's memory.

The LOAD PRESET OFF state instructs the MC2 Controller to position the Load Capacitor to the preset position value present at the Analog Control connector LOADPSETV signal (pin 13).

Use the VALUE UP button (item 5) or VALUE DOWN button (item 6) to select the desired LOAD PRESET state.

Press the Enter “ENT” button (item 4) on the front panel. The displayed Load Preset status is saved in non-volatile storage.

Use the UP or DOWN buttons to select another parameter, or press the RUN button return to normal operation.

3. Internal Tune Preset Enable/Disable

Selects the source of the Tune Capacitor preset position. The MC2 Controller will position the Tune Capacitor to the selected preset when the Analog Control connector PRETUNE signal (pin 5) is activated.

The TUNE PRESET ON state instructs the MC2 Controller to position the Tune Capacitor to the Tune Preset value stored in the MC2 Controller's memory.

The TUNE PRESET OFF state instructs the MC2 Controller to position the Tune Capacitor to the preset position value present at the Analog Control connector TUNEPSETV signal (pin 12).

Use the VALUE UP button (item 5) or VALUE DOWN button (item 6) to select the desired TUNE PRESET state.

Press the Enter "ENT" button (item 4) on the front panel. The displayed Tune Preset status is saved in non-volatile storage.

Use the UP or DOWN buttons to select another parameter, or press the RUN button return to normal operation.

4. Internal Load Preset Position

Sets the MC2 Controller's internal Load Capacitor preset position. Settable position range is from 2% (minimum) to 98% (maximum).

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.

Use the UP or DOWN buttons to select another parameter, or press the RUN button return to normal operation.

5. Internal Tune Preset Position

Sets the MC2 Controller's internal Tune Capacitor preset position. Settable position range is from 2% (minimum) to 98% (maximum).

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.

Use the UP or DOWN buttons to select another parameter, or press the RUN button return to normal operation.

6. Probe Select

Selects which matching network voltage probe signal, DC Voltage or RF Voltage, is routed to the RF Generator. Factory default is DC Voltage (DCV).

Note: DC Voltage probes are standard equipment on KJLC AT- Series Matching Networks. RF Voltage Probes are optional. Interfacing from the MC2 Controller to the RF Generator is required for the generator to use the Voltage Probe signal.

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.

Use the UP or DOWN buttons to select another parameter, or press the RUN button return to normal operation.

Related Menu Level: 7 DC Voltage Probe Attenuation Factor

Related Menu Level: 8 RF Voltage Probe Attenuation Factor

Related Menu Level: 12 Display RF or DC Probe

7. 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 9999:1. Factory default is 200:1

Note: The standard DC Voltage Probe attenuation factor for KJLC AT- Series matching networks is 200:1

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.

Use the UP or DOWN buttons to select another parameter, or press the RUN button return to normal operation.

Related Menu Level: 6 Probe Select

Related Menu Level: 12 Display RF or DC Probe

8. 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 9999:1.

Note: RF Voltage probes are optional on KJLC AT-Series matching networks

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.

Use the UP or DOWN buttons to select another parameter, or press the RUN button return to normal operation.

9. 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).

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.

Use the UP or DOWN buttons to select another parameter, or press the RUN button return to normal operation.

10. 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).

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.

Use the UP or DOWN buttons to select another parameter, or press the RUN button return to normal operation.

11. 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). This feature requires an interface connection from the MC2 Controller's "TO GENERATOR" connector to the RF Generator.

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.

Use the UP or DOWN buttons to select another parameter, or press the RUN button return to normal operation.

Related Menu Level: 13 Forward Power Full Scale Wattage
Related Menu Level: 14 Reflected Power Full Scale Wattage
Related Menu Level: 20 RFON Signal Polarity

12. Display RF or DC Probe

Enables/disables the display of the matching networks RF Voltage probe signal or DC Voltage probe signal, in Volts, on one of the two user-configurable front panel display lines (lines 2 and 3). The displayed probe is selected at menu level 6 - Probe Select.

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.

Use the UP or DOWN buttons to select another parameter, or press the RUN button return to normal operation.

Related Menu Level: 6 Probe Select

Related Menu Level: 7 DC Voltage Probe Attenuation Factor

Related Menu Level: 8 RF Voltage Probe Attenuation Factor

13. Forward Power Full Scale Wattage

Adjusts the MC2 Controller's forward power scaling factor. The MC2 Controller assumes the RF Generator's full-scale forward power monitor output voltage is +5.00VDC. Range is 1 Watt to 9999 Watts.

This feature requires an interface connection from the MC2 Controller's “TO GENERATOR” connector to the RF Generator.

Use the VALUE UP button (item 5) or the VALUE DOWN button (item 6) to set the FORWARD F.S. to the desired full-scale wattage.

Press the Enter “ENT” button (item 4) on the front panel. The displayed FORWARD F.S. value is saved in non-volatile storage.

Use the UP or DOWN buttons to select another parameter, or press the RUN button return to normal operation.

Related Menu Level: 11 Display Forward and Reflected Power

14. 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 9999 Watts.

This feature requires an interface connection from the MC2 Controller's “TO GENERATOR” connector to the RF Generator.

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.

Press the Enter “ENT” button (item 4) on the front panel. The displayed REFLECTED F.S. value is saved in non-volatile storage.

Use the UP or DOWN buttons to select another parameter, or press the RUN button return to normal operation.

Related Menu Level: 11 Display Forward and Reflected Power

15. 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 MAX" will be displayed on the front panel.

Range is 2% to 98%. Factory default is 98%.

Use the VALUE UP button (item 5) or the VALUE DOWN button (item 6) 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.

Use the UP or DOWN buttons to select another parameter, or press the RUN button return to normal operation.

16. 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 MIN" will be displayed on the front panel.

Range is 2% to 98%. Factory default is 2%.

Use the VALUE UP button (item 5) or the VALUE DOWN button (item 6) 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.

Use the UP or DOWN buttons to select another parameter, or press the RUN button return to normal operation.

17. 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 MAX" will be displayed on the front panel.

Range is 2% to 98%. Factory default is 98%.

Use the VALUE UP button (item 5) or the VALUE DOWN button (item 6) 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.

Use the UP or DOWN buttons to select another parameter, or press the RUN button return to normal operation.

18. 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 MIN" Will be displayed on the front panel.

Range is 2% to 98%. Factory default is 2%.

Use the VALUE UP button (item 5) or the VALUE DOWN button (item 6) 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.

Use the UP or DOWN buttons to select another parameter, or press the RUN button return to normal operation.

19. 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 VALUE UP button (item 5) to set BACKOUT to ENABLED. Use the 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.

Use the UP or DOWN buttons to select another parameter, or press the RUN button return to normal operation.

20. RFON Signal Polarity

Matches the MC2 Controller's “TO GENERATOR” and “FROM SYSTEM” connectors RFON signal (pin 3) polarity to the polarity of the RF Generator's RFON signal.

This feature requires an interface connection from the MC2 Controller's “TO GENERATOR” connector to the RF Generator, and an interface connection from the MC2 Controller's “FROM SYSTEM” to the user's system controller.

The MC2 Controller uses this signal to determine when to display the forward power setpoint from the user's system controller (when RF is Off), or the actual forward power from the RF Generator (when RF is On). Proper polarity is required to correctly detect the RF Generator's RF ON/OFF state.

Note: An interface connection from the MC2 Controller's “TO GENERATOR” connector to the RF Generator is required to obtain the forward and reflected power signals.

Use the VALUE UP button (item 5) to set RFON = LOW INPUT. Use the VALUE DOWN button (item 6) to set RFON = HIGH INPUT.

Press the Enter “ENT” button (item 4) on the front panel. The displayed RFON = setting is saved in non-volatile storage.

Use the UP or DOWN buttons to select another parameter, or press the RUN button return to normal operation.

Related Menu Level: 11 Display Forward and Reflected Power

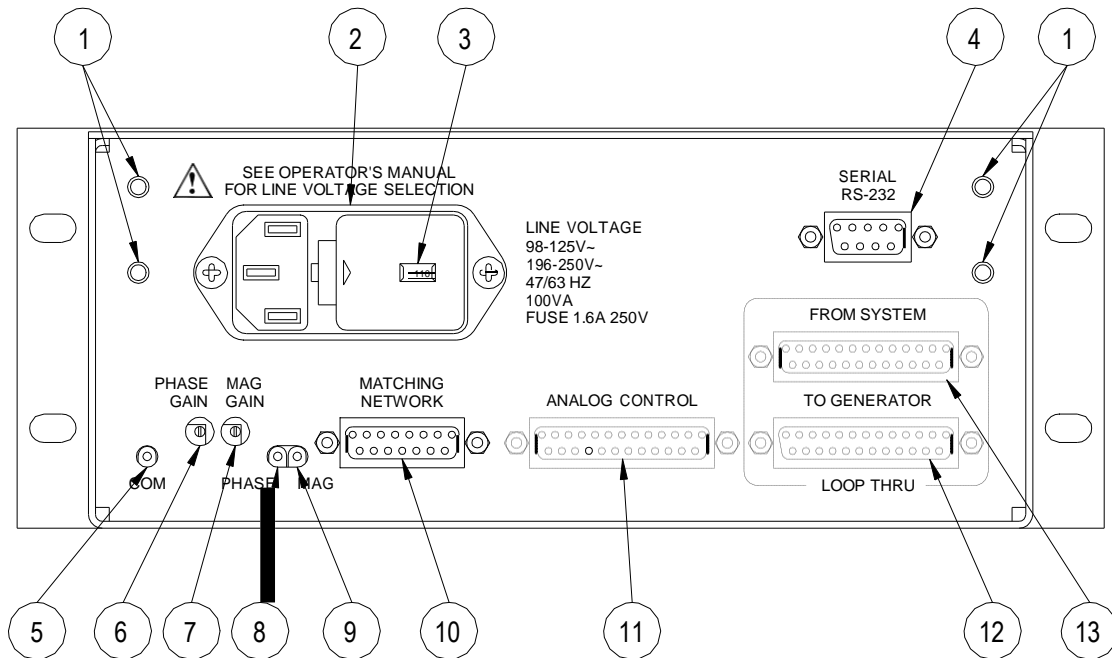
21. Factory Settings

Used by factory technicians to program and calibrate the MC2 Controller. There are no user adjustments.

Use the VALUE UP button (item 5) or the VALUE DOWN button (item 6) to set the desired ENT SECURE SETUP passcode value.

Press the Enter "ENT" button (item 4) on the front panel. If the displayed passcode is correct, factory settings are available by using the UP or DOWN buttons, or press the RUN button return to normal operation.

Rear Panel Controls and Connections



1. Threaded inserts

For dual rack-mount brackets (optional accessory).

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.

4. RS-232 Serial Interface Connector

Allows remote control and monitoring of the matching network and generator parameters (monitoring of generator requires use of the FROM SYSTEM/TO GENERATOR Loop-Thru connectors). Connector Type: 9 pin “D” female

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

Pin	Signal	Description
1	No Connection	No Connection
2	TXB	Transmit Data
3	RXB	Receive Data

Pin	Signal	Description
4	No Connection	No Connection
5	No Connection	No Connection
6	No Connection	No Connection
7	CTS	Clear To Send
8	RTS	Request To Send
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

7. MAG Gain Adjustment

Adjusts the gain (sensitivity) of the Magnitude Error Amplifier. The Magnitude error amplifier drives the matching network's LOAD capacitor

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. Connector Type: 15 pin "D" female. Connect to the matching network's "CONTROL" connector with a shielded cable (purchased separately).

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
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, -10VDC to +10VDC range
14	RF-PROBE	DC Probe signal input. Analog, -10VDC to +10VDC range
15	GROUND	Internally connected to chassis ground.

11. Analog Control Connector

Analog control signals for system interfacing. Connector Type: 25 pin "D" female. Use shielded cable for making connections to system controller or external equipment.

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.
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.

Pin	Signal	Description
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.
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.

Pin	Signal	Description
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 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 KJLC R/L20XX/30XX/50XX series of RF generators. Other RF generators can be connected with external cabling - contact KJLC customer service department for assistance.

12. "TO GENERATOR" Connector:

Connects to the RF Generator's analog interface or control connector. Connector type: 25 pin "D" female. Use shielded cable to make connections to the RF Generator.

Pin	Signal	Description
1	Loop-Thru	Connected to pin 1 of SYSTEM connector
2	Loop-Thru	Connected to pin 2 of SYSTEM connector
3	RFON1	RFON signal output. TTL/HCMOS compatible logic output, active low. The logic state is the same as the pin 3 of the SYSTEM connector
4	Loop-Thru	Connected to pin 4 of SYSTEM connector
5	Loop-Thru	Connected to pin 5 of SYSTEM connector
6	Loop-Thru	Connected to pin 6 of SYSTEM connector
7	Loop-Thru	Connected to pin 7 of SYSTEM connector
8	Loop-Thru	Connected to pin 8 of SYSTEM connector
9	Loop-Thru	Connected to pin 9 of SYSTEM connector
10	FORWARD	Forward Power monitor signal. Analog loop-thru, 0.00VDC to +5.00VDC. Connected to pin 10 of SYSTEM connector.
11	REFLECTED	Reflected Power monitor signal. Analog loop-thru, 0.00VDC to +5.00VDC. Connected to pin

Pin	Signal	Description
		11 of SYSTEM connector.
12	PROBE	RF or DC probe signal (from matching network controller, derived from the matching network). Analog, -10VDC to +10VDC. Connected to pin 12 of SYSTEM connector.
13	SETPOINT	Forward Power Setpoint signal. Analog loop-thru, -10VDC to +10VDC, single-ended. Connected to pin 13 of SYSTEM connector.
14	Loop-Thru	Connected to pin 14 of SYSTEM connector.
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	Loop-Thru	Connected to pin 19 of SYSTEM connector.
20	Loop-Thru	Connected to pin 20 of SYSTEM connector.
21	Loop-Thru	Connected to pin 21 of SYSTEM connector.
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	FBRET	External Feedback (Probe) return signal. Internally connected to chassis ground.
25	SETRET	Forward Power Setpoint return signal. Internally connected to chassis ground. Note: KJLC RF generators use a differential setpoint input. To prevent erratic operation, this signal <u>must</u> be connected to the generator's setpoint return terminal.

13. "FROM SYSTEM" Connector

Connects to the user's system controller or external equipment. Connector type: 25 pin "D" male. Use shielded cable to make connections to system controller or external equipment.

Pin	Signal	Description
1	Loop-Thru	Connected to pin 1 of GENERATOR connector
2	Loop-Thru	Connected to pin 2 of GENERATOR connector
3	RFON	RFON signal input. TTL/HCMOS compatible logic input, active low. Internally pulled up to +5VDC.
4	Loop-Thru	Connected to pin 4 of GENERATOR connector
5	Loop-Thru	Connected to pin 5 of GENERATOR connector
6	Loop-Thru	Connected to pin 6 of GENERATOR connector
7	Loop-Thru	Connected to pin 7 of GENERATOR connector
8	Loop-Thru	Connected to pin 8 of GENERATOR connector
9	Loop-Thru	Connected to pin 9 of GENERATOR connector
10	FORWARD	Forward Power monitor signal. Analog loop-thru, 0.00VDC to +5.00VDC. Connected to pin 10 of GENERATOR connector.
11	REFLECTED	Reflected Power monitor signal. Analog loop-thru, 0.00VDC to +5.00VDC. Connected to pin 11 of GENERATOR connector.
12	PROBE	RF or DC probe signal (from matching network controller). Analog, -10VDC to +10VDC. Connected to pin 12 of GENERATOR connector.
13	SETPOINT	Forward Power Setpoint signal. Analog loop-thru, -10VDC to +10VDC, single-ended. Connected to pin 13 of GENERATOR connector.
14	Loop-Thru	Connected to pin 14 of GENERATOR connector.
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	Loop-Thru	Connected to pin 19 of GENERATOR connector.
20	Loop-Thru	Connected to pin 20 of GENERATOR connector.

Pin	Signal	Description
21	Loop-Thru	Connected to pin 21 of GENERATOR connector.
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	FBRET	External Feedback (Probe) return signal. Internally connected to chassis ground.
25	SETRET	Forward Power Setpoint return signal. Internally connected to chassis ground.

TYPICAL INTERFACE CONNECTIONS

Analog Control

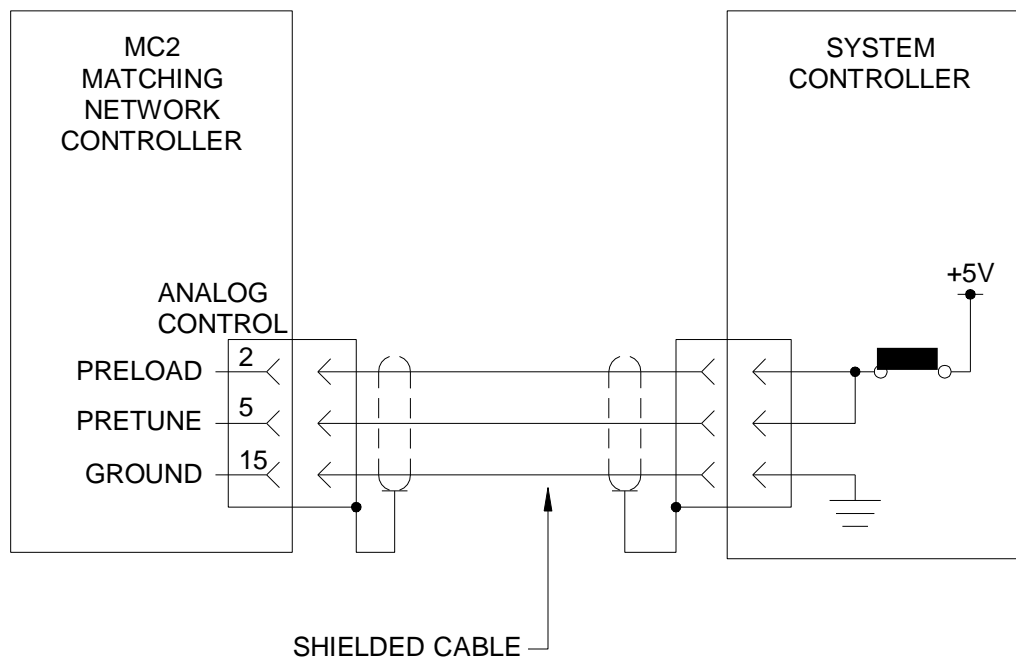
There are many possible analog control wiring schemes. The basic schemes shown below can be combined to make more sophisticated analog control schemes. Refer to the Analog Control connector pin list in the Rear Panel Controls and Connections section for signal details. Use shielded cable for all interconnections.

Basic Preset Operation

Simultaneously presets the matching network's Load and Tune capacitors to the positions internally stored within the MC2 controller (Programming Menu levels 4 and 5).

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.

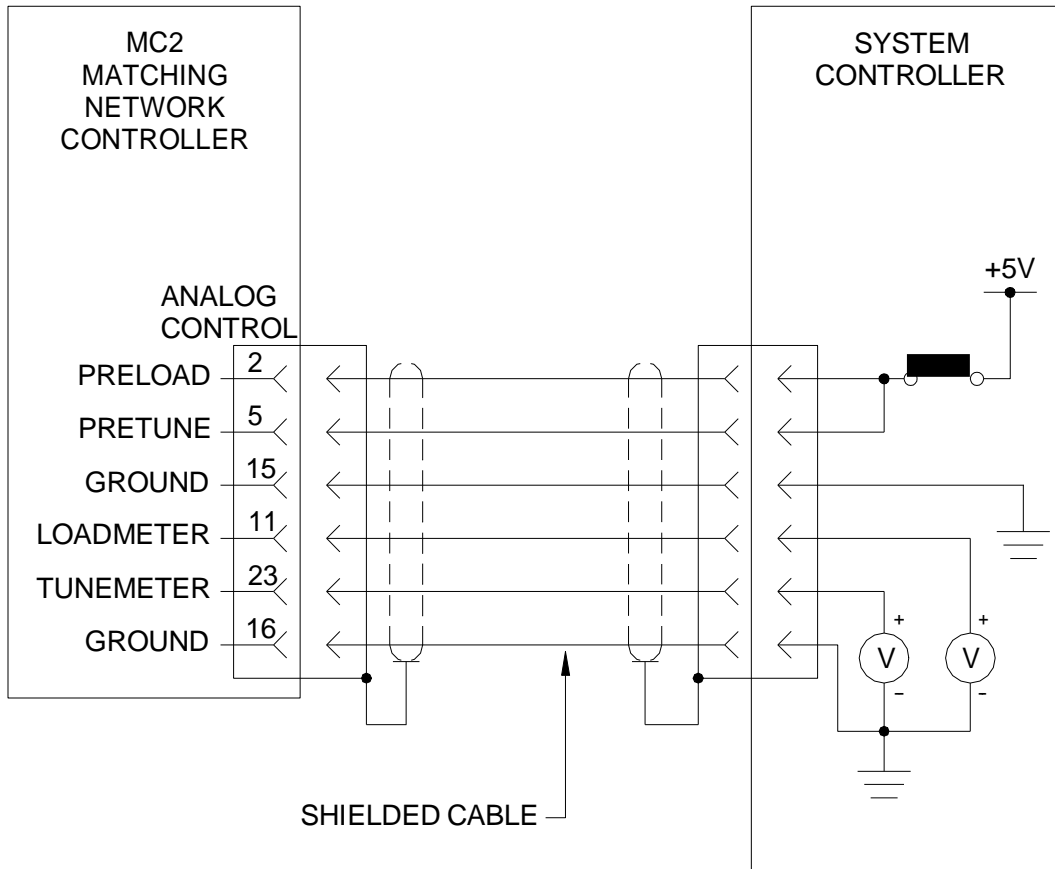
Requires Internal Load Preset and Internal Tune Preset (Programming Menu levels 2 and 3) set to "Enabled"



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.



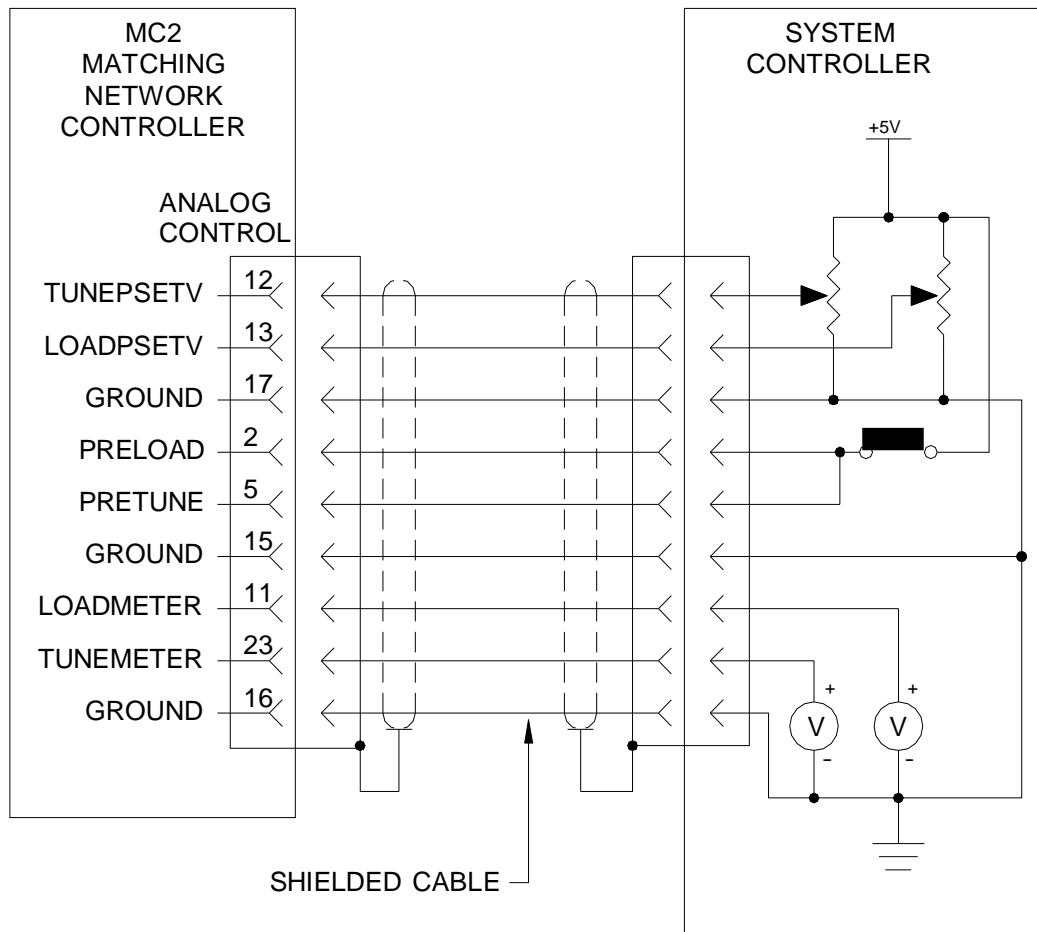
Basic Preset with Feedback

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 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 Internal Load Preset and Internal Tune Preset (Programming Menu levels 2 and 3) set to "Disabled"



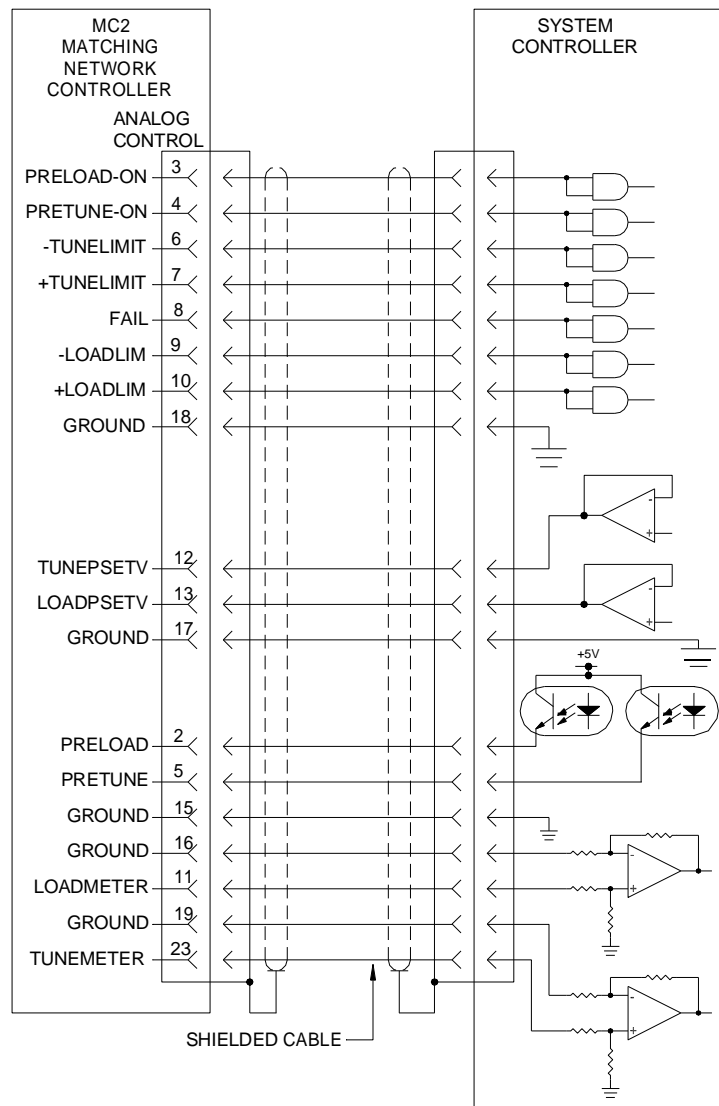
External Preset

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 Internal Load Preset and Internal Tune Preset (Programming Menu levels 2 and 3) set to "Disabled"



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 other control signals are passed from the "FROM SYSTEM" connector to the "TO GENERATOR" connector without modification.

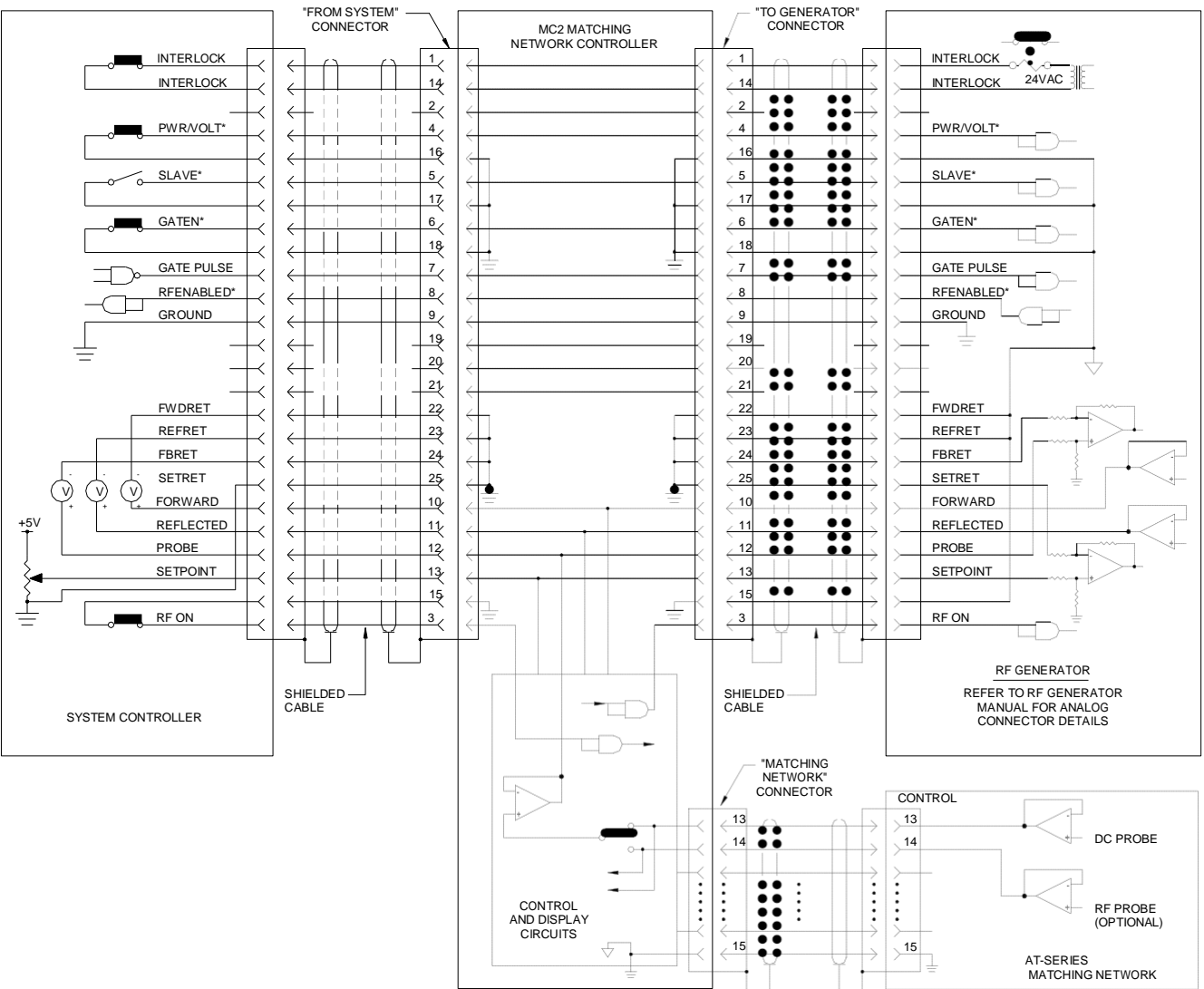
The RF Generator analog connections shown below are generic. The actual analog interface connection wiring depends on the RF Generator model. Consult the RF Generator's instruction manual for appropriate analog connector pin-outs or contact a customer service representative for wiring assistance and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

MC2 Controller Programming Notes:

1. Set the RFON Signal polarity (Programming Menu, level 20) to match the RF Generator's RFON signal polarity.
2. Select the desired Voltage Probe (Programming Menu, level 6)
3. Set the Voltage Probe's attenuation factor (Programming Menu, levels 7 and 8)
4. Set the Forward and Reflected Power full-scale wattage (Programming Menu, levels 13 and 14) to match the RF Generator's scaling.
5. Set the FWD/REF DISPLAY (Programming Menu, level 11) to "ON".
6. Set the RF/DCV DISPLAY (Programming Menu, level 12) 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.



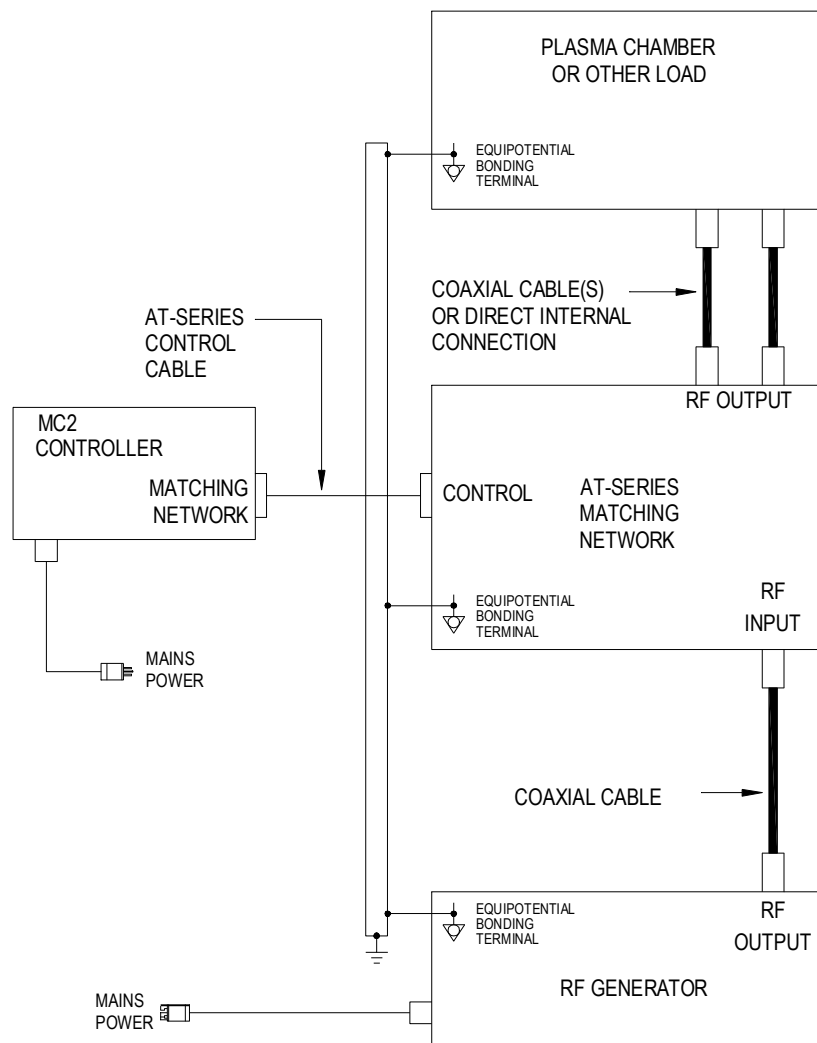
Loop-Thru Connector Interfacing

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 KJLC customer 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.

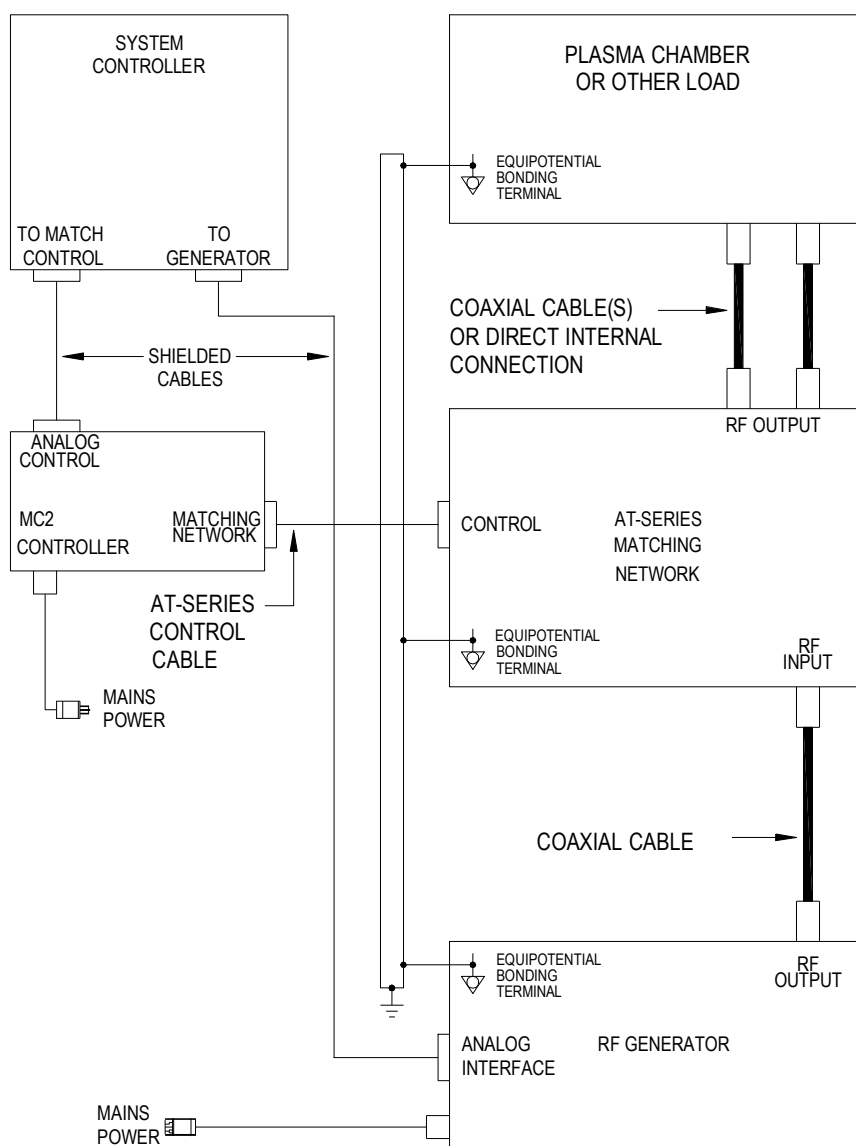


Basic Configuration

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.



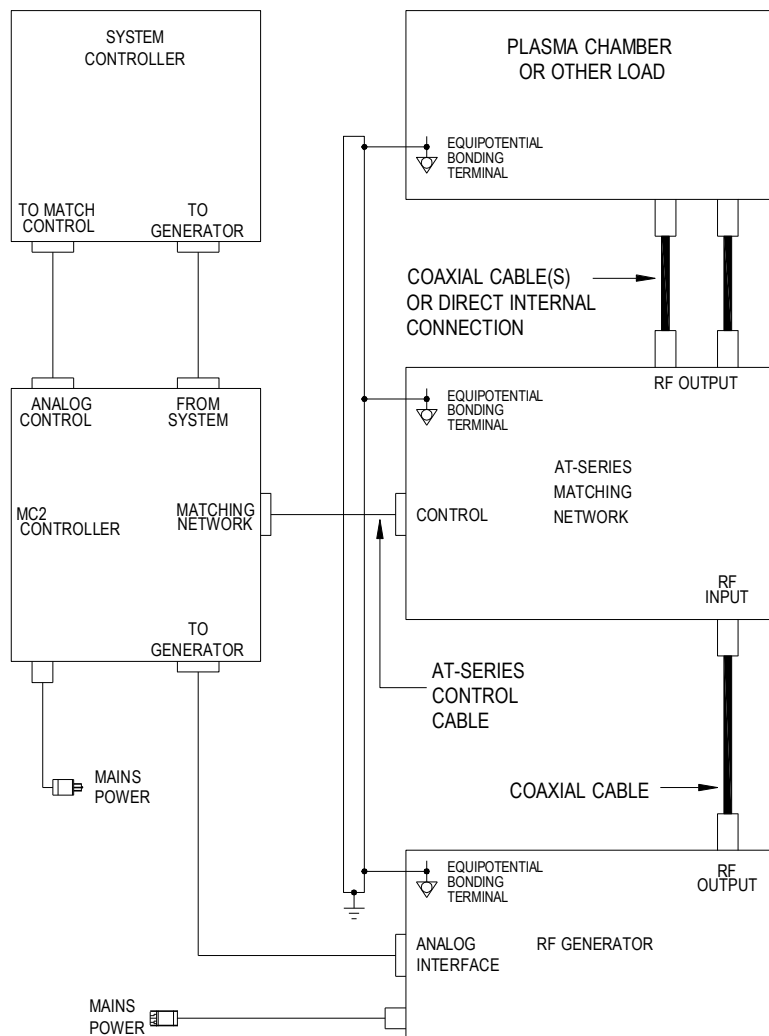
Basic Analog System Configuration

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.

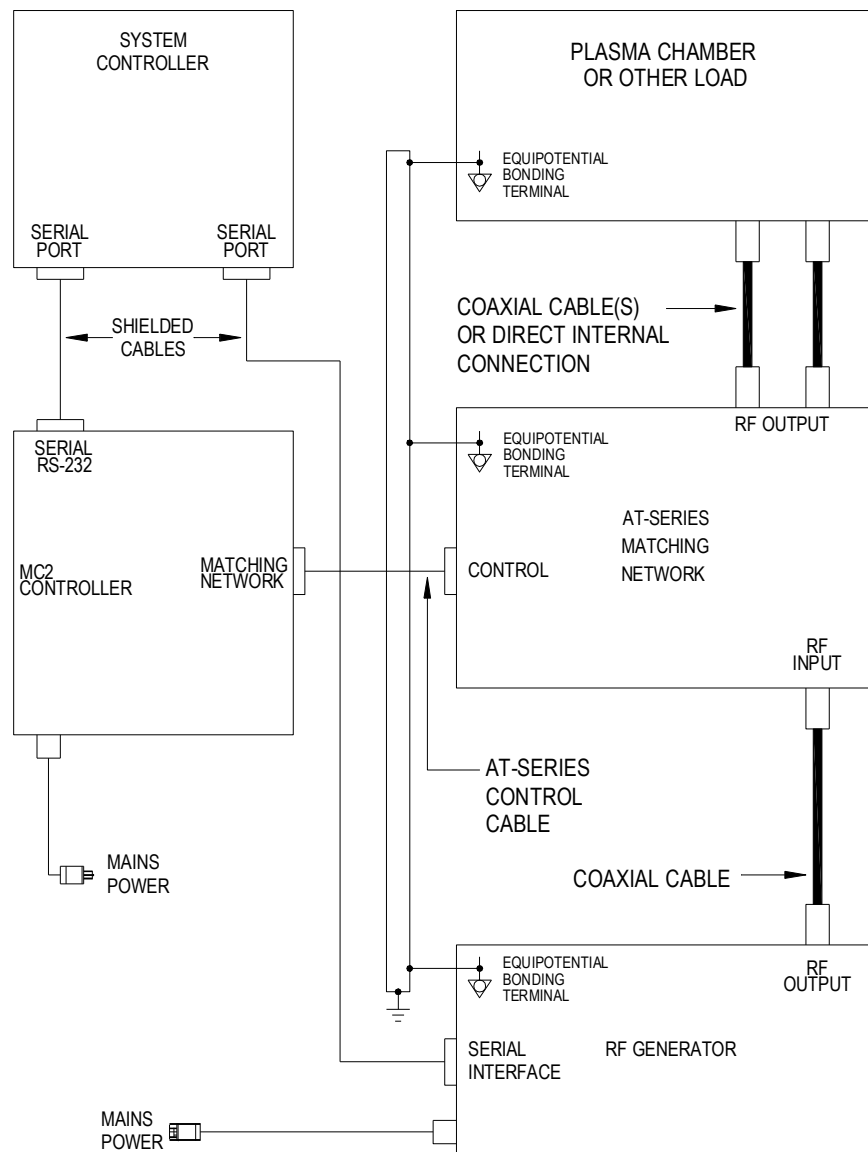


Full Analog System

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.

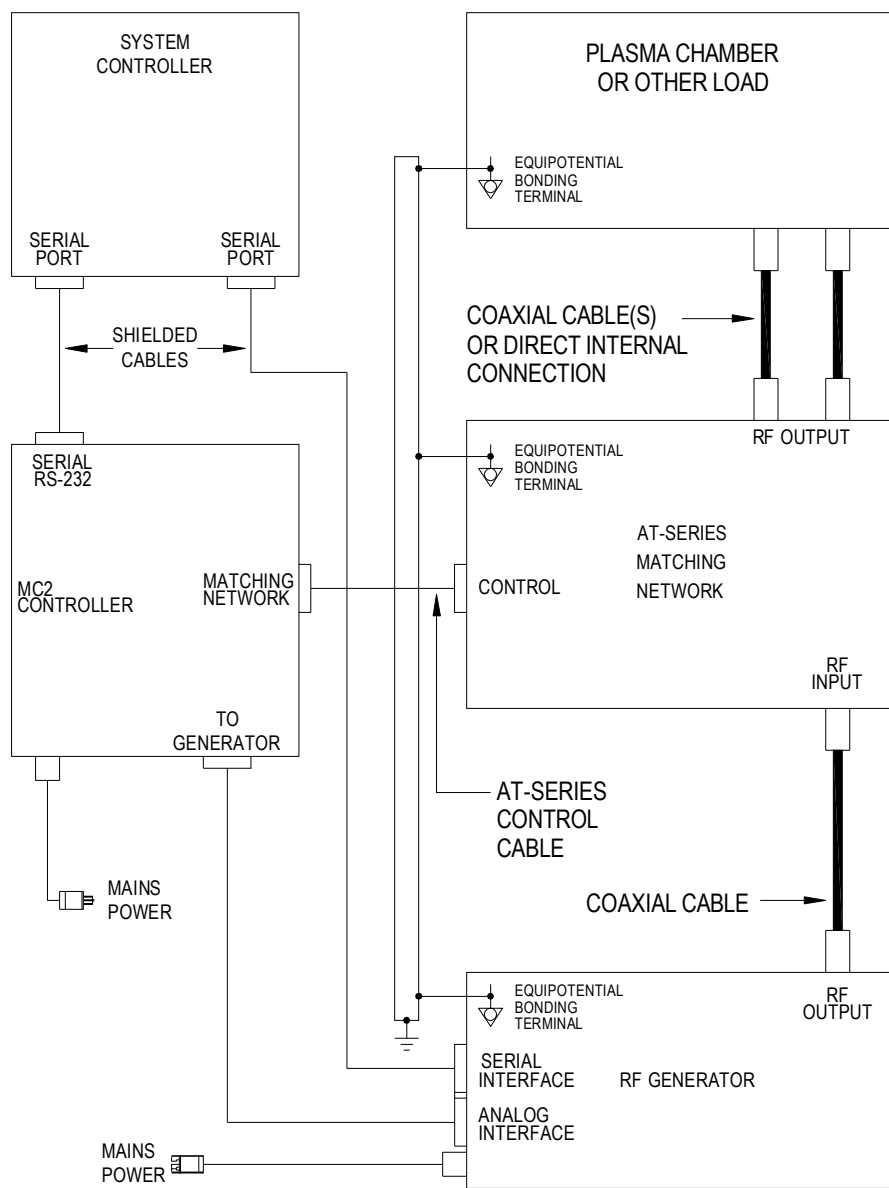


Basic Serial System

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.



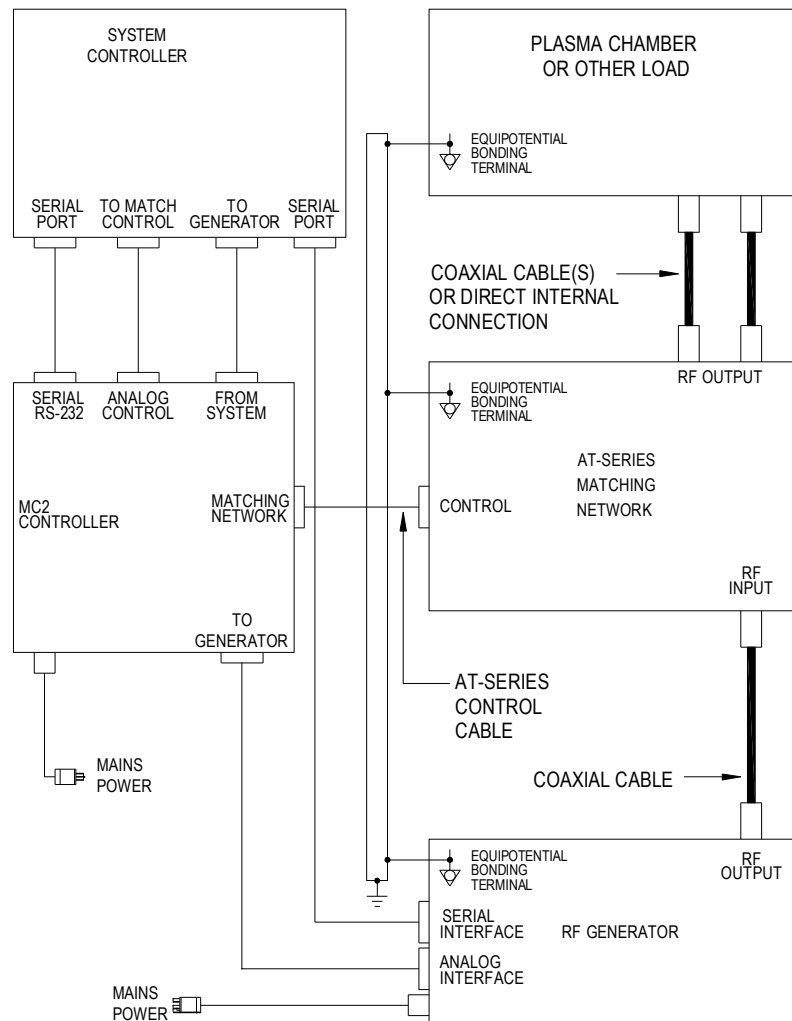
Serial System with Voltage Control

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 KJLC customer service.

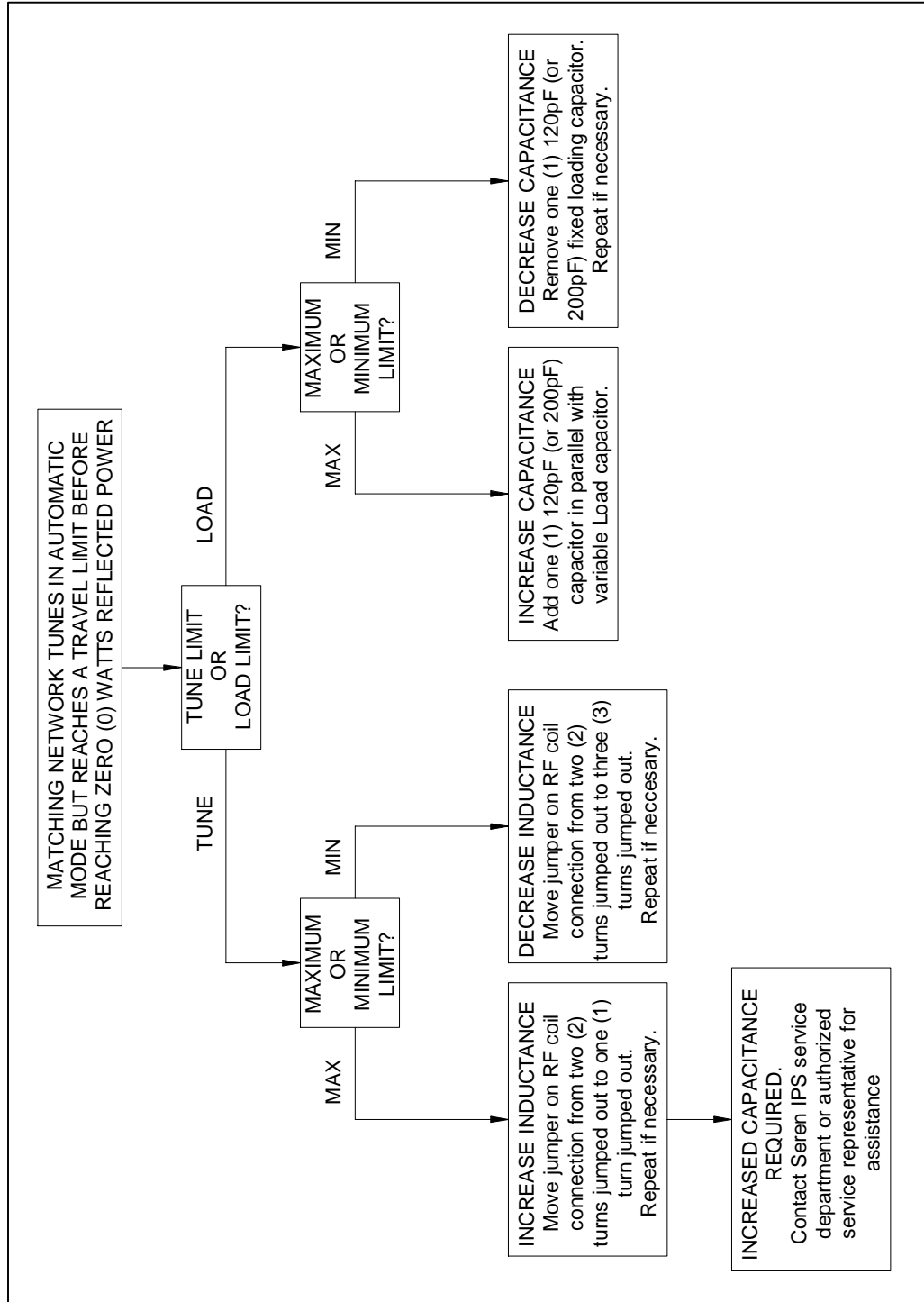
Condition	Suggested Solution
The matching network motors do not turn	<p>Verify the AT-Series Control cable is properly mated to the Matching network's "CONTROL" connector.</p> <p>Verify the AT-Series Control cable is properly mated to the MC2 Controller's "MATCHING NETWORK" connector.</p> <p>Make sure the MC2 controller's power switch is in the "ON" position and the power cord is properly mated to the rear panel inlet.</p> <p>Make sure AC Mains power is applied to the MC2 Controller</p>
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)	<p>Verify the AT-Series Control cable is properly mated to the Matching network's "CONTROL" connector.</p> <p>Verify the AT-Series Control cable is properly mated to the MC2 Controller's "MATCHING NETWORK" connector.</p> <p>The capacitor feedback signal from both capacitors may have failed. Contact the nearest KJLC service representative or factory service department for assistance.</p>
The top line of the MC2 Controller displays "CABL FAIL CABL FAIL" (Software Version 9D or earlier)	<p>Verify the AT-Series Control cable is properly mated to the Matching network's "CONTROL" connector.</p> <p>Verify the AT-Series Control cable is properly mated to the MC2 Controller's "MATCHING NETWORK" connector.</p> <p>The capacitor feedback signal from both capacitors may have failed. Contact the nearest KJLC service representative for assistance.</p>

Condition	Suggested Solution
<p>The top line of the MC2 Controller displays "LOAD 0% TUNE XX%" or "LOAD XX% TUNE 0%" (Software Version 9E or later)</p>	<p>One of the internal capacitor position feedback signals may have failed. Contact KJLC Customer service for assistance</p>
<p>The top line of the MC2 Controller displays "CABL FAIL TUNE XX%" or "LOAD XX% CABL FAIL" (Software version 9D or earlier)</p>	<p>One of the internal capacitor position feedback signals may have failed. Contact KJLC Customer service for assistance</p>
<p>The Load and/or Tune capacitor travels to a limit and "chatters" or "oscillates" in automatic mode when RF power is applied</p>	<p>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 from 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 "Range Configuration" heading in the Problem Solving section</p>
<p>"LOAD MAX" is displayed on the front panel during automatic operation.</p>	<p>The matching network's range configuration may need adjustment. See the "Range Configuration" heading in the Problem Solving section</p>
<p>"LOAD MIN" is displayed on the front panel during automatic operation.</p>	<p>The matching network's range configuration may need adjustment. See the "Range Configuration" heading in the Problem Solving section</p>
<p>"TUNE MAX" is displayed on the front panel during automatic operation.</p>	<p>The matching network's range configuration may need adjustment. See the "Range Configuration" heading in the Problem Solving section</p>
<p>"LOAD MIN" is displayed on the front panel during automatic operation.</p>	<p>The matching network's range configuration may need adjustment. See the "Range Configuration" heading in the Problem Solving section</p>
<p>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.</p>	<p>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.</p>

Condition	Suggested Solution
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.

Range Configuration

Unless otherwise specified at the time of order, KJLC 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 KJLC 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 (KJLC 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 (-) multimeter test lead into the "COM" test point on the rear panel of the MC2 Controller.
4. Insert the positive (+) multimeter 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 (+) multimeter test lead from the MC2 Controller's rear panel "PHASE" test point.
7. Insert the positive (+) multimeter 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

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 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:	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
Matching Network Motor Voltage:	12VDC Nominal
Overall Dimensions inch (mm):	3.47 (88.14) High x 9.50 (241.30) Wide x 13.03 (330.86) Deep. Width includes ½ Rack Mounting Brackets
Weight:	7.5 Lbs (3.2Kg)

KJLC 1 Year Limited Warranty

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

KJLC 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 KJLC and does not cover equipment damage or malfunction from misuse, abuse, accident, act of God, non-KJLC modification or upgrade. Improper return shipping, packaging, or shipping damage is not covered. KJLC 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. 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
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 known 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: <ol style="list-style-type: none">1. "Cable Fail" messages removed2. End-of-travel limits no longer disable the RF Power source's output (when MC2 is interfaced to the user's system <u>and</u> the RF power source)