BRADSHAW
COMMUNICATION
SYSTEMS

MODEL MCU3
MOTOR CONTROL UNIT
INSTALLATION & MAINTENANCE MANUAL

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INTRODUCTION

A. MANUAL PURPOSE

This manual contains installation and maintenance instructions for the Bradshaw Communication Systems MCU3 Motor Control Unit. The instructions herein are provided for personnel responsible for installing and maintaining the MCU3. A nameplate label located on the inside cover door of the MCU3 identifies the units' model number, part number, revision, and serial number. The serial number is used by Bradshaw Communication Systems (BCS) to identify the units' particular configuration of options.

This manual does not provide information pertaining to the operation of the MCU3. Information pertaining to operation of the MCU3 is found only in the MCU3 Operators Manual. It is required that a installation and/or service technician have a thorough understanding of the operation of the MCU3 prior to any attempts to install or service the unit. Any required internal repairs to the MCU3 should be referred to qualified service personnel.

B. MANUAL ORGANIZATION

This manual is organized into the following three sections:

"Introduction" – This section provides manual purpose, manual organization, required installation/ setup equipment, unit specifications, and customer support information.

"MCU3 Installation" – This section provides safety precautions, typical system configuration, MCU3 Mounting, and interface wiring information.

"MCU3 Maintenance" – This section provides information pertaining to preventative maintenance and troubleshooting of the MCU3.

C. REQUIRED INSTALLATION / SETUP TOOLS & EQUIPMENT

1 EACH	Medium Phillips Screwdriver
1 EACH	Medium Flat-blade Screwdriver
1 EACH	Adjustable Wrench
1 EACH	Socket Wrench Set
1 EACH	Multi-meter (capable of direct current voltage measurement)
MISC.	Multi-meter Test Leads

D. UNIT SPECIFICATIONS

Dimensions:	18" (45.7cm) high x 16" (40.6cm) wide x 10" (25.4cm) deep
Weight:	33 LBS (15 Kg)
Power Requirements:	1 or 3 Phase Power - Voltage & Current Dependent on Motor Sizes
Environmental:	-40° to 50°Celsius (-40° to 122° Fahrenheit) Operational 100% Relative Humidity
Enclosure:	Wall Mounted Weatherproof NEMA 4X Enclosure with Hinged Cover with Pad-Lockable Quick Release Latches.
Enclosure Finish:	Fiberglass Polyester
Enclosure Color:	Light Gray

E. CUSTOMER SUPPORT

Customer support, replacement parts, and repair are available 8AM – 5PM EST M-F by contacting Bradshaw Communication Systems at 770-844-9704 or by fax at 770-886-0205. Additional support may be obtained from our website at http://www.bcstech.com

MCU3 INSTALLATION

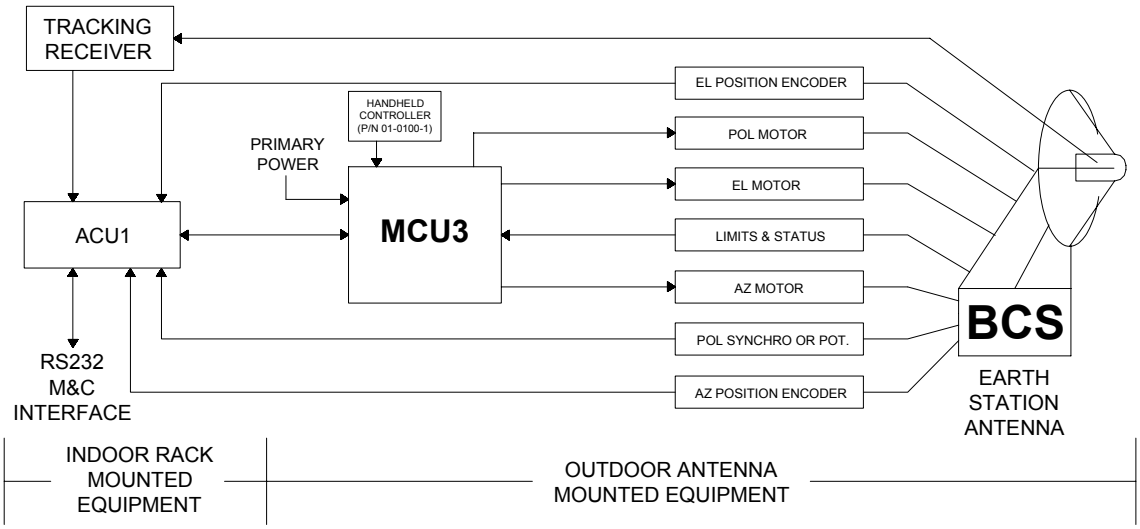
A. SAFETY PRECAUTIONS

Lethal voltages are present inside the MCU3. Emergency Stop switches and other interlocks will disable the system, but do not disconnect the MCU3 from primary power. Refer all troubleshooting and repair to qualified service personnel. The MCU3 contains no operator serviceable parts.

B. INTRODUCTION

Typical System Configuration

The MCU3 is designed to allow automatic control via an Antenna Control Unit (ACU1) or local manual positioning of an earth station antenna. Operators may use the controls on the MCU Handheld Controller to provide control at the antenna structure. The MCU3 is normally only a part of the complete antenna control system, however, the MCU3 used in conjunction with the MCU Handheld Controller has all controls necessary to allow positioning of the earth station antenna. This redundancy is extremely useful in the unlikely event of an Antenna Control Unit failure or if local positioning is required for antenna maintenance or other. A typical antenna control system configuration using the MCU3 is depicted in Figure 1. Note that the addition of the motors and limit switches are all that is required to allow local positioning of the earth station antenna.



TYPICAL SYSTEM CONFIGURATION
FIGURE 1

The ACU1 is the main system component and contains the control logic electronics to generate motor drive commands. The motor control commands are produced in response to inputs from the position encoders, limit and status switches, front panel controls, and R.F. signal receiving equipment. Control may also be accomplished via the RS-232 monitor & control port.

The angular position of each axis is reported by synchro based position encoders that are mounted on their corresponding axes of the earth station antenna. The signal from these position encoders is converted in the ACU1 to provide an angular display on the front panel display as well as being used for automatic positioning modes.

For automatic satellite tracking operation (Steptrack), a D.C. signal proportional to signal strength is connected to the ACU1. This signal is then used by the ACU1 to optimize the antenna position when in Steptrack mode.

The ACU1 is connected to the MCU3, which produces the high voltage required to start and stop the earth station antennas' motors. Each axis has a motor that allows electrical control of the

mechanical movement of each antenna axis. The MCU3 is a variable frequency drive (VFD) based unit allowing adjustable speed control of the azimuth and elevation motors. This variable speed is implemented via two adjustable speed ranges, "Track" speed and "Slew" speed. Each axis speed (on both azimuth and elevation axes) is independently adjustable to match the MCU3 drive speed commands to the antenna characteristics. By matching these drive commands to the antenna, optimal satellite tracking performance as well as a high slew rate for fast maneuvering may be obtained. The polarization speed is fixed and is directly proportional to the antenna polarization gearing. The MCU3 allows for simultaneous control of the three axis motors including the polarization axis if the antenna is equipped with a motorized polarization axis.

If the earth station antenna being controlled by the ACU1 has a linearly polarized feed, the ACU1 polarization option is employed. This option allows the ACU1 to receive a signal from an additional position encoder (either a synchro transmitter or potentiometer depending upon configuration) and to control an additional motor via the MCU3. By adding the additional position encoder and motor the ACU1 can remotely control the rotation of the earth station antenna polarization feed horn.

The ACU1 is generally rack mounted and located in the control room area, while the position encoders, limit switches, MCU3, and motors are generally located on the earth station antenna structure. The R.F. tracking equipment is generally located in the control room area with the ACU1.

C. MCU3 MOUNTING

The MCU3 design provides for mounting the unit via four tabs. Two tabs at the top of the unit and two at the bottom. These tabs are provided loose inside the MCU3 and alternately may not be installed to allow rear mounting using the MCU3 enclosure's four captive 10-32 threaded inserts. Standard ¼ inch hardware may be used for mounting through the mounting tabs to the appropriate mounting location. Due to the variety of antennae the MCU3 may be used with, mounting specific instructions cannot be provided. For unit mounting and dimensional data assistance, please contact Bradshaw Communication Systems.

D. INTERFACE WIRING CHARTS

1. Termination Notes

NOTE 1: Limit switch contacts must be closed for a non-limit condition. All limit switch contacts must be isolated.

NOTE 2: Jumper wires are installed on TB-3 and TB-4 to "jumper" the auxiliary Azimuth, Elevation, & Polarization Interlock connections as well as the auxiliary Emergency Stop connection. These jumper wires may be removed to allow the insertion of additional safety interlock switches as required. The switches must be normally closed and may be connected in series to provide multiple interlock points as required.

Pre-installed Jumpers:

Emergency Stop	TB3-1 to TB3-2
Azimuth Interlock	TB3-3 to TB3-4
Elevation Interlock	TB3-9 to TB4-1
Polarization Interlock	TB4-6 to TB4-7

2. MCU3 to Azimuth Track Motor

Azimuth Motor Cable

FROM MCU3 (EURO Terminal Block)			TO AZIMUTH TRACK MOTOR (Wire Leads)			
TERMINATION	TYPE	NOTES	TERMINATION	TYPE	NOTES	FUNCTION
TB2-1	Stripped Wire		MOTOR L1	Wire-Nut		Motor Phase A
TB2-2	Stripped Wire		MOTOR L2	Wire-Nut		Motor Phase B
TB2-3	Stripped Wire		MOTOR L3	Wire-Nut		Motor Phase C
GROUND BAR	Stripped Wire		MOTOR CASE	#10 Ring Terminal		Safety Ground

3. MCU3 to Elevation Track Motor

Elevation Motor Cable

FROM MCU3 (EURO Terminal Block)			TO ELEVATION TRACK MOTOR (Wire Leads)			
TERMINATION	TYPE	NOTES	TERMINATION	TYPE	NOTES	FUNCTION
TB3-1	Stripped Wire		MOTOR L1	Wire-Nut		Motor Phase A
TB3-2	Stripped Wire		MOTOR L2	Wire-Nut		Motor Phase B
TB3-3	Stripped Wire		MOTOR L3	Wire-Nut		Motor Phase C
GROUND BAR	Stripped Wire		MOTOR CASE	#10 Ring Terminal		Safety Ground

4. MCU3 to Polarization Motor (Optional)

Polarization Motor Cable

FROM MCU3 (EURO Terminal Block)			TO POLARIZATION MOTOR (Wire Leads)			
TERMINATION	TYPE	NOTES	TERMINATION	TYPE	NOTES	FUNCTION
TB4-1	Stripped Wire		MOTOR CCW LEAD	Wire-Nut		MOTOR CCW
TB4-2	Stripped Wire		MOTOR COMMON LEAD	Wire-Nut		MOTOR COMMON
TB4-3	Stripped Wire		MOTOR CW LEAD	Wire-Nut		MOTOR CW
GROUND BAR	Stripped Wire		MOTOR CASE	#10 Ring Terminal		Safety Ground

5. MCU3 to Azimuth Limit Switch/s

Azimuth Limit Switch/s Cable

FROM MCU3 CTL PWA (Pluggable Terminal Block) TO AZIMUTH LIMIT SWITCH/S (#6 Screws)

TERMINATION	TYPE	NOTES	TERMINATION	TYPE	NOTES	FUNCTION
PWA TB3-8	Stripped Wire		CLOCKWISE N.C.	#6 Ring Terminal	NOTE 1	CW Status
PWA TB3-7	Stripped Wire		CLOCKWISE COMMON	#6 Ring Terminal	NOTE 1	CW Return
PWA TB3-6	Stripped Wire		COUNTER-CLOCKWISE N.C.	#6 Ring Terminal	NOTE 1	CCW Status
PWA TB3-5	Stripped Wire		COUNTER-CLOCKWISE COMMON	#6 Ring Terminal	NOTE1	CCW Return

6. MCU3 to Elevation Limit Switch/s

Elevation Limit Switch/s Cable

FROM MCU3 CTL PWA (Pluggable Terminal Block) TO ELEVATION LIMIT SWITCH/S (#6 Screws)

TERMINATION	TYPE	NOTES	TERMINATION	TYPE	NOTES	FUNCTION
PWA TB4-5	Stripped Wire		UP N.C.	#6 Ring Terminal	NOTE 1	UP Status
PWA TB4-4	Stripped Wire		UP COMMON	#6 Ring Terminal	NOTE 1	UP Return
PWA TB4-3	Stripped Wire		DOWN N.C.	#6 Ring Terminal	NOTE 1	DOWN Status
PWA TB4-2	Stripped Wire		DOWN COMMON	#6 Ring Terminal	NOTE1	DOWN Return

7. MCU3 to Polarization Limit Switch/s (Optional)

Polarization Limit Switch/s Cable

FROM MCU3 CTL PWA (Pluggable Term. Block) TO POLARIZATION LIMIT SWITCH/S (#6 Screws)

TERMINATION	TYPE	NOTES	TERMINATION	TYPE	NOTES	FUNCTION
PWA TB4-11	Stripped Wire		CLOCKWISE N.C.	#6 Ring Terminal	NOTE 1	CW Status
PWA TB4-10	Stripped Wire		CLOCKWISE COMMON	#6 Ring Terminal	NOTE 1	CW Return
PWA TB4-9	Stripped Wire		COUNTER-CLOCKWISE N.C.	#6 Ring Terminal	NOTE 1	CCW Status
PWA TB4-8	Stripped Wire		COUNTER-CLOCKWISE COMMON	#6 Ring Terminal	NOTE1	CCW Return

8. MCU3 to Auxiliary Emergency Stop Limit Switch/s (Optional)

Auxiliary Emergency Stop Limit Switch/s Cable

FROM MCU3 CTL PWA (Pluggable Terminal Block) TO EMERG. STOP LMT SWITCH/S (#6 Screws)

TERMINATION	TYPE	NOTES	TERMINATION	TYPE	NOTES	FUNCTION
TB3-2	Stripped Wire	NOTES 1 & 2	STOP SWITCH N.C.			Emergency Stop (N.C.)
TB3-1	Stripped Wire	NOTES 1 & 2	STOP SWITCH COMMON			Emergency Stop (COM)

9. MCU3 to Primary Input Power

Primary Input Power Cable

FROM MCU3 (EURO Terminal Block) **TO PRIMARY INPUT POWER**

TERMINATION	TYPE	NOTES	TERMINATION	TYPE	NOTES	FUNCTION
TB1-1	Stripped Wire		PHASE A			Phase A
TB1-2	Stripped Wire		PHASE B			Phase B
TB1-3	Stripped Wire		PHASE C			Phase C
TB1-4	Stripped Wire		NEUTRAL			Neutral
GROUND BAR	Stripped Wire		SAFETY GROUND			Safety Ground

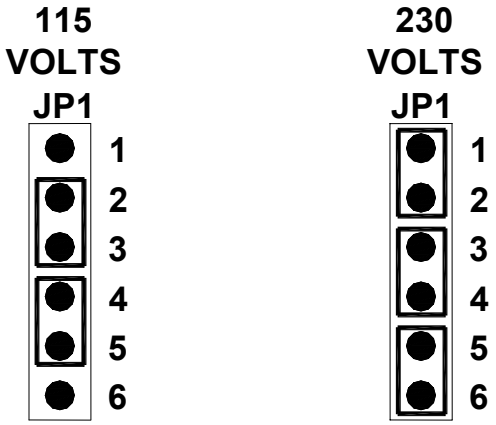
10. MCU3 Logic Control PWA Input Power Configuration

Logic Control PWA Input Power Configuration

WARNING: FAILURE TO PROPERLY JUMPER THE LOGIC CONTROL PWA COULD RESULT IN PERSONAL INJURY AND/OR PERMANENT MCU3 DAMAGE!

Prior to applying power to the MCU3, configure jumper block J1 on the MCU3 Logic Control PWA for the appropriate input voltage as follows:

Voltage Present Between TB5 Terminals 1 & 2 (L1 to Neutral Voltage Value)



E. INSTALLATION INSTRUCTIONS

1. Wiring/Pre Power-up Verification

Prior to application of power, verify the following:

a. Proper input voltage and wiring.

b. Use a multi-meter on ohm scale to verify high impedance between each motor connection and safety ground. This step is crucial to avoid damage to the MCU3.

c. Check continuity of all wiring to ensure proper wiring per the installation wiring charts.

2. Motor Phasing, Track Speed Setting & Limit Switch Testing

a. Plug in the MCU Handheld Controller to the handheld connector on the bottom of the MCU3.

b. Verify the Emergency Stop Switch/s is in the normal operation position (pulled out).

c. Turn ON the MCU3 control, azimuth, elevation, and polarization (optional) power circuit breakers.

d. Set the SLEW/NORMAL Switch on the MCU Handheld to the NORMAL position.

e. Using the MCU Handheld Axis Jog Switch for Azimuth, command the CW direction. The antenna should rotate in the CW direction. If the antenna rotates CCW, turn off all power to the MCU3 and switch any two motor wires to change phasing to obtain the proper direction of rotation. If the antenna rotates CW, but the antenna velocity is incorrect or doesn't move, adjust the NORMAL speed velocity trimmer potentiometer (VR1 for Azimuth and VR2 for Elevation) on the MCU3 Logic Control PWA until the proper NORMAL (tracking) velocity is obtained. The velocity of the azimuth and elevation antenna axes should be set to produce a velocity, in degrees per second, in the range of 0.5/(D)(F) to 1.5/(D)(F) where "D" is the reflector diameter in meters and "F" is the receive frequency in gigahertz. It is desirable for both axis velocities to be set as closely as possible to each other and in the range described above for optimum tracking performance.

f. While commanding the CW direction, manually activate the CW Limit Switch. Verify antenna motion is stopped in the CW direction. Verify that axis movement in the CCW direction is still functional even though the CW Limit Switch is still manually activated.

g. Repeat steps "e" & "f" for the remaining axes and directions as follows:

Azimuth CCW
Elevation UP
Elevation DOWN
⊗ Polarization CW
⊗ Polarization CCW

⊗ Switch forward and reverse motor leads to change polarization motor rotation.

h. After all axes limit switch functionality and directions have been checked by manually activating the various limit switches, verify proper limit operation and adjustment by commanding the antenna into each limit. The MCU3 should be able to drive out of each limit, but not further into the limit. Check at both NORMAL and SLEW speeds starting with NORMAL.

3. Slew Speed Setting & Testing

a. Set the SLEW/NORMAL Switch on the MCU Handheld to the SLEW position.

b. Using the MCU Handheld Axis Jog Switch for Azimuth, command the CW direction. The antenna should rotate in the CW direction. Verify the antenna moves in the commanded direction at a much higher velocity than when set to NORMAL speed. If the antenna SLEW velocity is not set as desired, adjust the Frequency MAX and Frequency MAX–Voltage Point parameters in the Azimuth VFD until the proper SLEW (fast) velocity is obtained. SLEW (fast) speed is set at each VFD unit via parameters and may be altered as required to provide the desired SLEW velocity in each axis. The SLEW velocity has no affect on tracking performance. SLEW speed is primarily used to move the antenna from one satellite to another rapidly when the SLEW mode is selected at either the ACU or the MCU Handheld. Consult the VFD Technical Manual and Default VFD Parameter List for the VFD model employed for instructions on changing drive parameters and prior to attempting reprogramming of the VFD drive/s. VFD Technical Manuals and Default VFD Parameter Lists are available for download at http://www.bcstech.com under the Support Documentation Section.

c. Repeat step “b” for the remaining axes and directions as follows:

Azimuth CCW
Elevation UP
Elevation DOWN

MCU3 MAINTENANCE

A. MAINTENANCE

At six-month intervals, inspect the interior of the MCU3 for excessive dust, dirt, and/or moisture. Remove any such accumulations with a damp cloth only after ensuring all input power has been removed.

Add desiccant packets inside the bottom of the MCU3 if the unit is opened frequently or if the MCU3 is located in a heavy humidity environment.

B. TROUBLESHOOTING

In the event a motor does not turn in the proper direction, reverse any two phases at the motor to obtain proper rotation. If a limit switch does not properly stop antenna motion in a given direction, reverse the limit switch wiring to ensure proper antenna motion direction to proper limit switch orientation.

If the antenna does not respond to MCU Handheld Controller Axis Jog commands, verify the following:

1. Proper input power is applied
2. Power Circuit Breaker is in the “up” (ON) position
3. MCU Handheld is properly plugged in
4. All Motor Power Circuit Breakers are in the “up” (ON) position
5. MCU3 Logic Power PWA red power supply ON LED is illuminated
6. Emergency Stop Switch/s is not depressed (pull to reset)

If the antenna does not respond to ACU1 commands, verify the following:

1. Proper MCU3 input power is applied
2. Power Circuit Breaker is in the “up” (ON) position
3. MCU Handheld is NOT plugged in disabling ACU control (LOCAL)
4. All Motor Power Circuit Breakers are in the “up” (ON) position
5. MCU3 Logic Power PWA red power supply ON LED is illuminated
6. Emergency Stop Switch/s is not depressed (pull to reset)
7. ACU1 to MCU3 Control & Status Cables are properly secured and in good condition.