NORTHCOMM TECHNOLOGIES
WE MAKE THE CONNECTION

QUANTAR EXTERNAL CONTROL MODULE

DEVICE OVERVIEW AND THEORY OF OPERATION

The QUANTAR External Control Module (Quantar ECM) is a microprocessor-based, DTMF enabled controller that is designed specifically for the Motorola QUANTAR/QUANTRO platform. The base controller module is a multilayer FR4 PCB. The form factor is that of a daughter card insomuch as the device is connected directly to the station backplane. Once connected, the Quantar ECM will receive and process DTMF data from the station receiver, and provide up to five logical inputs to the QUANTAR/QUANTRO. In addition, the Quantar ECM provides courtesy tones and error beeps by injecting those tones directly into the Aux-TX audio path.

The physical function of the five logical inputs is assignable through the QUANTAR/QUANTRO Wildcard Table(s) via RSS. More detail on the use and programming of the wildcard system will be covered later in this manual. However, the Quantar ECM/Wildcard combination provides an immense set of station control options that are controllable through off-air DTMF signaling as well as the Quantar ECM serial console.

The Quantar ECM is simple to install and specialized test equipment is not needed. Unlike traditional controllers, the ECM does not re-route the station audio. Rather, the ECM samples the receiver audio path for the purpose of DTMF decoding. The injection of user selectable courtesy tones and error beeps is accomplished through the Aux-TX audio port. The Repeater audio path, however, remains internal to the QUANTAR/QUANTRO station. Therefore, as long as your station alignment is current and valid, your station will not need re-alignment after the addition of this device. Traditional controller architecture removes and reinserts the repeat audio. This more invasive approach requires station and controller alignment using a communications service monitor.

QUANTAR ECM – LIMITATIONS OF LIABILITY

1: Proper and safe installation of the Quantar ECM product is the sole responsibility of the installer. We recommend that this device is installed by a professional technician with any and all appropriate certifications, credentials and training. Improper installation, poor wire management or deviations from industry best practice may lead to an unreliable operation, injury or death.

2: The Quantar ECM is an accessory product that is designed and intended for external station control. Any device, including the Quantar ECM, that asserts external control capabilities has the potential to inhibit the proper function of your station / communications system. There is always the potential that a malfunction of the Quantar ECM would render the station unusable. Therefore, we DO NOT recommend or intend for this item to be used in an environment where the sudden and unexpected loss of communications, or harm to a communications channel, would present a danger to life, property or an undue burden of any kind. The customer and end user are ultimately responsible for determining whether or not this product is appropriate for their needs. **Northcomm Technologies Group, Ltd. including its agents, owners, partners, and shareholders are not responsible for any type of loss, damage or harm, whether actual or perceived, that may be caused by the use of this product.**

3: By installing this device you acknowledge and agree to the following:

- This product shall be used in accordance with all federal, state and local laws
- You or your agency accept full and sole responsibility for the installation, use, and integration of this equipment
- Should you or your agency elect to install this product you, agree to hold harmless and indemnify Northcomm Technologies Group, Ltd, its agents, owners, and partners against any and all harm or liability, actual or perceived that might arise out of the use or installation of this equipment

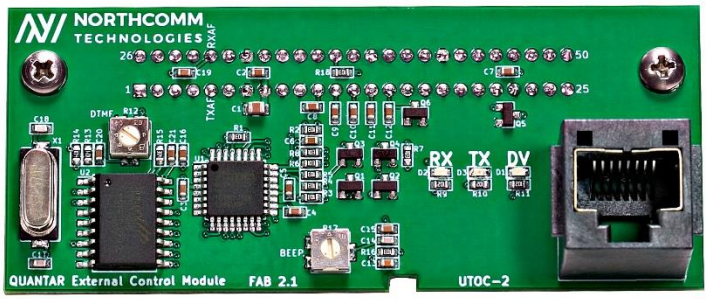
4: Additional limitations of liability are discussed within our “Invoice term and conditions”. By purchasing and installing this product you further agree to and are bound by these additional limitations.

5: If you do not agree to these terms and conditions, do not use this product.

QUANTAR ECM – KIT CONTENTS

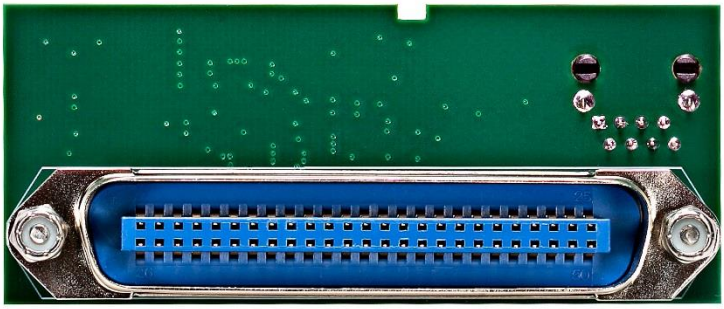
QUANTAR ECM – Base Module

PN: NC-03-QPCEMC-2 (front view)



QUANTAR ECM – Base Module

PN: NC-03-QPCEMC-2 (back view)



NOTICE:

A serial number and firmware revision ID plate will be affixed to any shipped device. The Serial number, password and customer data will be maintained in our database. Passwords will only be released to persons or agencies associated with the product serial number listed in our records.

QUANTAR ECM – QUANTAR SETTINGS

PROGRAMING THE QUANTAR REPEATER

Before installing the Quantar ECM, you must first make the required programming changes to the QUANTAR's codeplug using QUANTAR RSS. If these changes are not programmed, the Quantar ECM will be unable to decode DTMF, nor will it have control access to the station. Connecting the board to the QUANTAR prior to programming the station WILL NOT damage the Quantar ECM.

1: Read your station with QUANTAR RSS. Customer programming software is available from Motorola Solutions, Inc. ©. Northcomm Technologies does not supply, sell or furnish this software.

2: Select the "Hardware Configuration" tab

- Once in Hardware Configuration set the **"Wireline"** tab to **"8-Wireline"**
    - Please note – you MUST have a working wireline card; however, you will only require the 4-wire card. Regardless of which card you have, 4 or 8-wire, you MUST tell the station that it is an 8-wireline card.
- Locate the **"Wildcard"** tab and select **"ENHANCED"**

3: Select the **"Wireline Configuration"** tab

- Locate "**Wireline Operation"** and select **"4 WIRE FULL DUPLEX"**
- Within **"Wireline Configuration"** select the **"Astro"** tab, then locate the **"Wireline Interface"** menu and select **"V.24 HYBRID"**
- All other settings in the Astro tab may remain at their defaulted position

QUANTAR ECM – QUANTAR SETTINGS (CONT.)

4: Select the **“Channel Information”** Tab

- You may create up to 15 channels (The 16th can’t be used here). Each channel may contain the same frequencies or they may be different. This determination is dependent upon your use case. However, you might elect to have three channels that are all identical except that each one uses different TX or RX PL’s, DPL’s etc.

- You might decide to create channels with:

    - Different power levels
    - Individual and unique CW ID’s
    - Longer or shorter hang timers
    - Analog or Mixed-Mode (P25-Phase 1 CAI) operation
    - Unique PL or DCS settings per channel for receive, transmit or both
    - Different TX and RX frequencies

- The Quantar ECM can change the station selectively and determinatively between channels 1-15 remotely using DTMF tones or serial console. How these channels are configured are entirely up to the user and will be determined by the system requirements

5: Remaining within the **“Channel Information”** Tab

- Set **“Analog RX Activation”** to **“S=Carrier Squelch”**

    - **“Analog Rprt Activation”** can be set based upon your requirements

NOTICE:

Please ensure that your station squelch settings are adjusted for the noise-floor at the installation location. If your receiver locks open due to a maladjusted squelch setting, DTMF commands sent to the station will keep the station keyed until the receiver closes. This loop can be avoided by proper squelch settings.

QUANTAR ECM – QUANTAR SETTINGS (CONT.)

- In the “Advanced” tab of “Channel Information” ensure that:
    - **“Compander”** and **“Noise Canceller”** are *disabled*
    - **“Rcv Signal Inversion”** is *disabled*
    - **“PTT Priority”** is R>W>L>M>D
    - **“Analog Repeater Boost”** is *enabled*

NOTICE:

It is a best-practice, and we **STRONGLY** recommend, that you set time out timers of at least 180 seconds for “Wireline” “Repeater” and “Local.” These timers ensure that your repeater won’t stay keyed beyond the time allotted in the timer no matter what the keying source point. A time out time of “0” (zero) means that the timer is inactive and that the station would potentially remain keyed infinitely from that PTT source.

6: Select the **“RF Configuration”** Tab

- Locate the **“Repeater Operation”** tab and select **“REPEATER”**
    - The remaining requirements on this tab may be left as default or per your system requirements

7: Select the **“Wildcard Input”** Tab and press the **“Set to Default”** button

8: Select the **“Wildcard Output”** Tab and press the **“Set to Default”** button

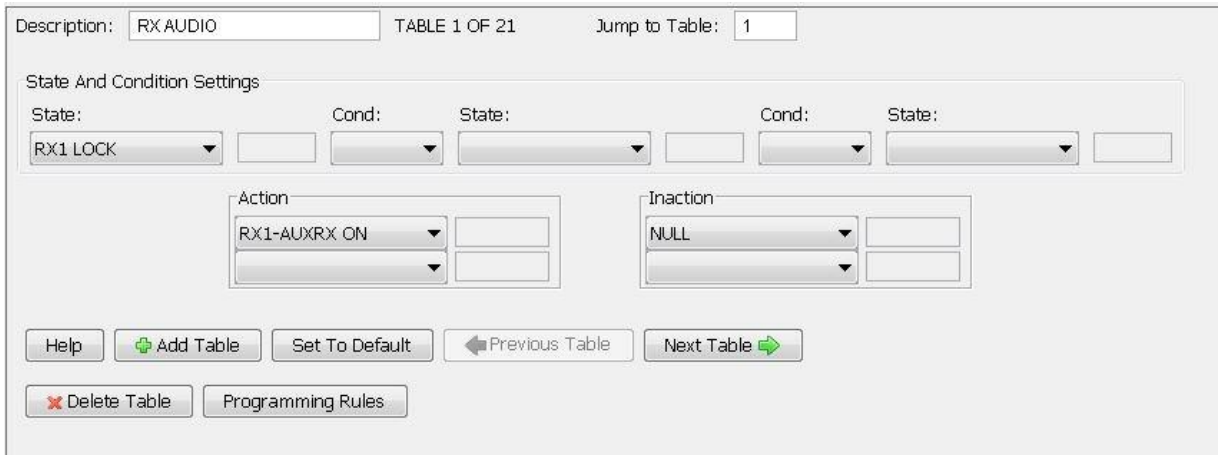
The next section contains screen shots of the required wildcard tables. The proper operation of your Quantar ECM is dependent upon recreating these tables correctly. Please follow the instructions exactly. If you need additional assistance, please do not hesitate to contact us a info@northcommtechnologies.com or 1-866-858-1745.

QUANTAR ECM – QUANTAR WILDCARD

PROGRAMING THE WILDCARD TABLES

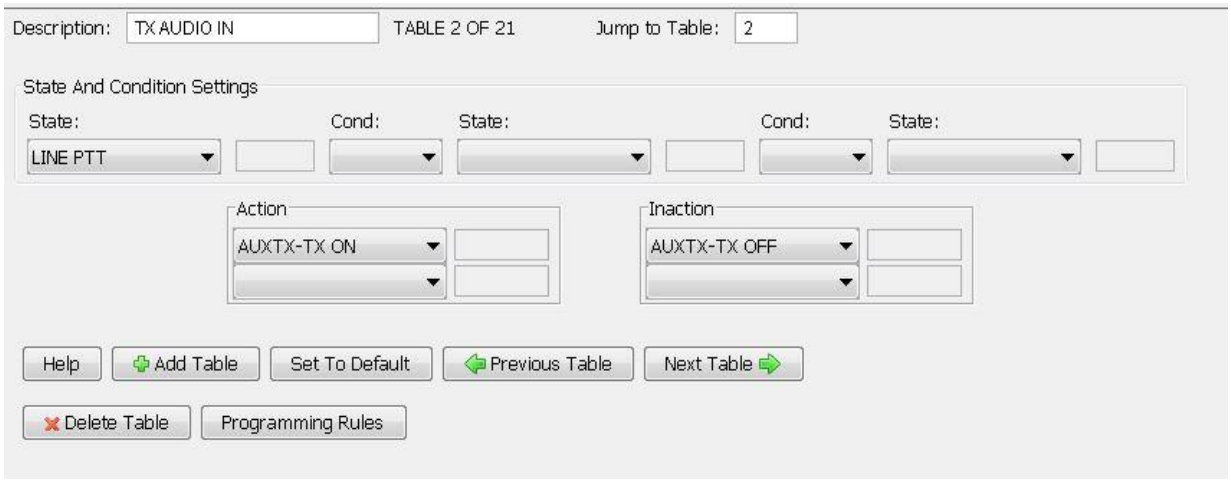
1: Receiver Audio Routing Wildcard Table

- This table routes receiver audio from the QUANTAR receiver to the Quantar ECM



2: Transmit Audio Routing Wildcard Table

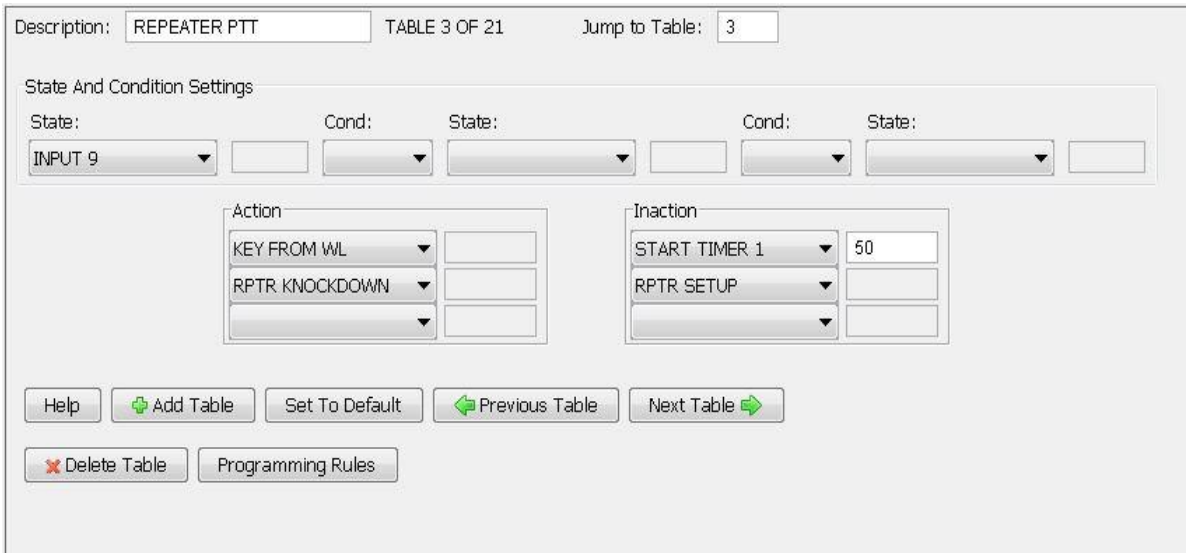
- This table routes Quantar ECM audio to the QUANTAR



QUANTAR ECM – QUANTAR WILDCARD (CONT.)

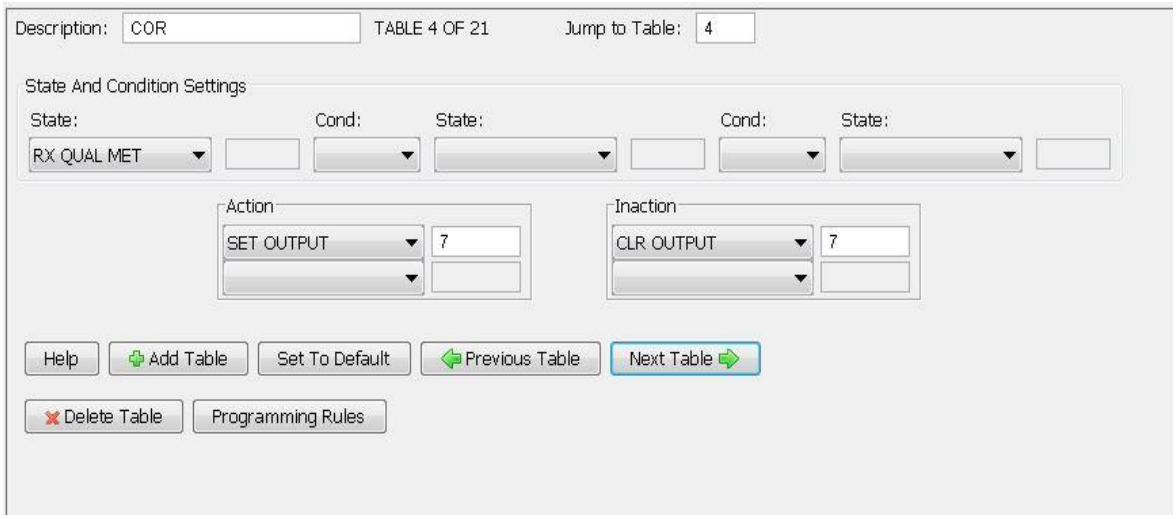
3: External PTT Routing Wildcard Table

- This table allows the Quantar ECM to key the transmitter for the transmission of courtesy beeps, error tones and DTMF acknowledgement tones



4: COR Detect Routing Wildcard Table

- This table signals the Quantar ECM that COR is present. COR detect qualification is determined by the receiver qualification requirements previously set as “S-Carrier Squelch”



QUANTAR ECM – QUANTAR WILDCARD (CONT.)

The Quantar ECM firmware is coded so that predetermined DTMF codes or serial console commands steer the station from one channel to another. For example, entering a DTMF code of "*301" will cause the station to set CH 1 as the active channel. Sending the DTMF code of "*302" would steer the station to CH 2. This logic continues all the way to the command "*315", which ultimately steers the station to CH 15.

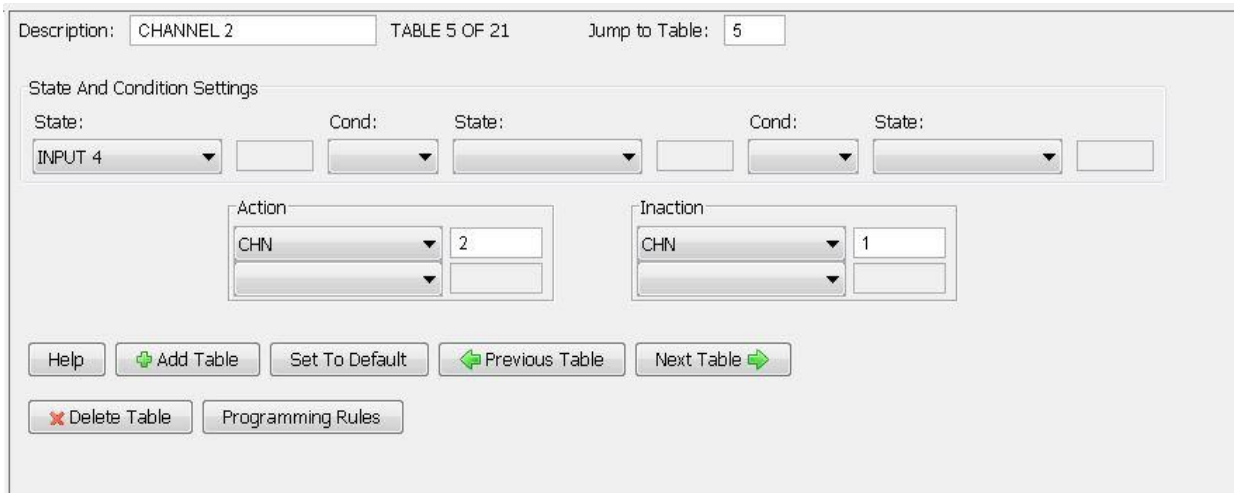
This channel steering is accomplished by setting QUANTAR logic inputs 1, 2, 3 and 4 low at various times and in various combinations as defined in wildcard tables (below).

Please note, that for the purposes of this manual, we are demonstrating a single use case where one may use the channel steering commands of "*301" through to "*315" to set channels. However, the Quantar ECM is simply setting binary bits. These bits may be used for purposes other than setting a channel. This document is simply a "starting off" point. Once you are more familiar with the wildcard structure, you can adapt these suggestions however you might need.

A complete list of all DTMF commands and the programming structure will be provided later on.

5: Channel Select Wildcard Table

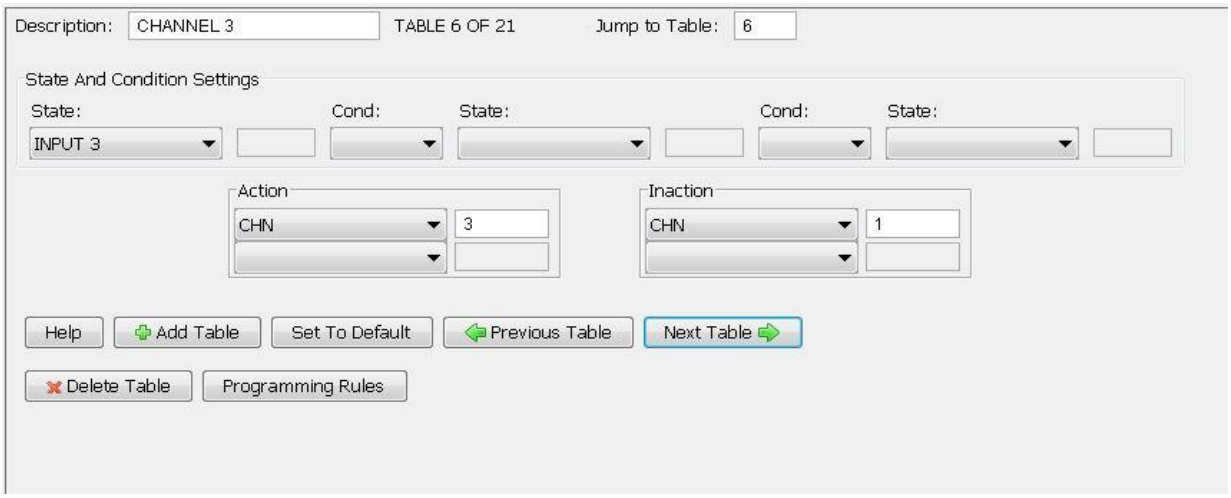
- This table selects the channel 2 as the active channel.



QUANTAR ECM – QUANTAR WILDCARD (CONT.)

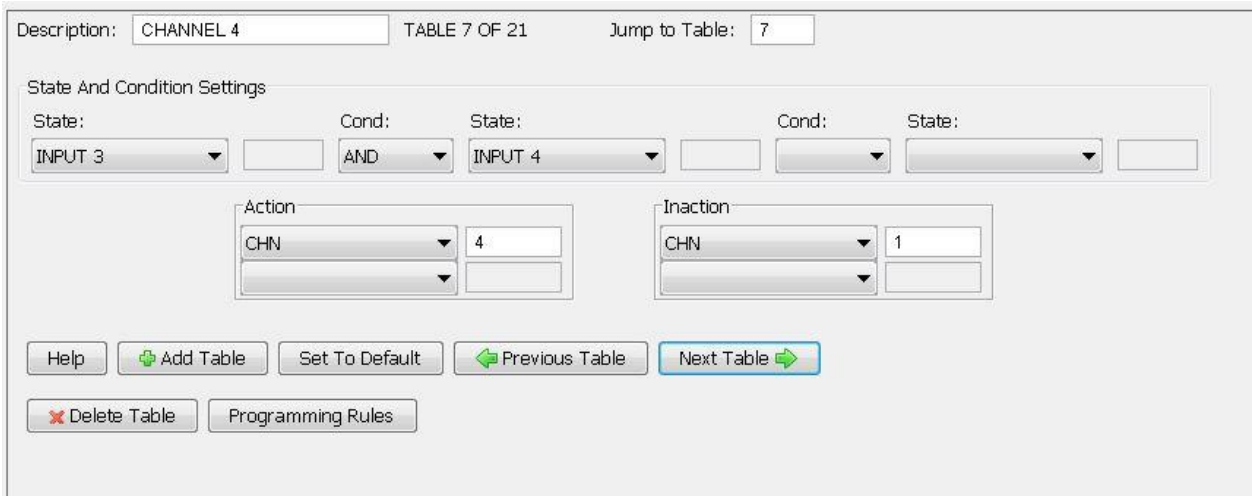
6: Channel Select Wildcard Table

- This table selects the channel 3 as the active channel.



7: Channel Select Wildcard Table

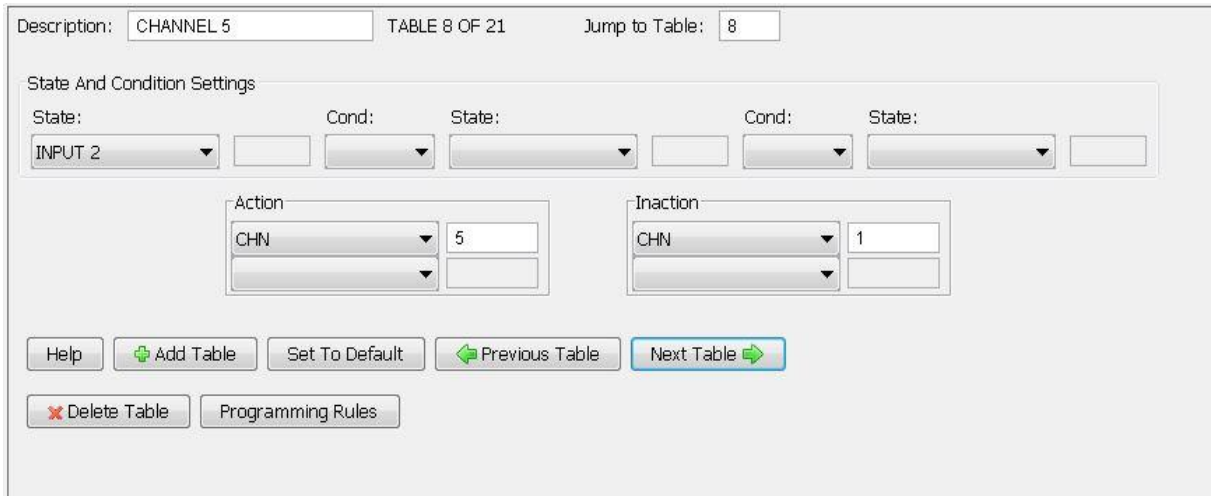
- This table selects the channel 4 as the active channel.



QUANTAR ECM – QUANTAR WILDCARD (CONT.)

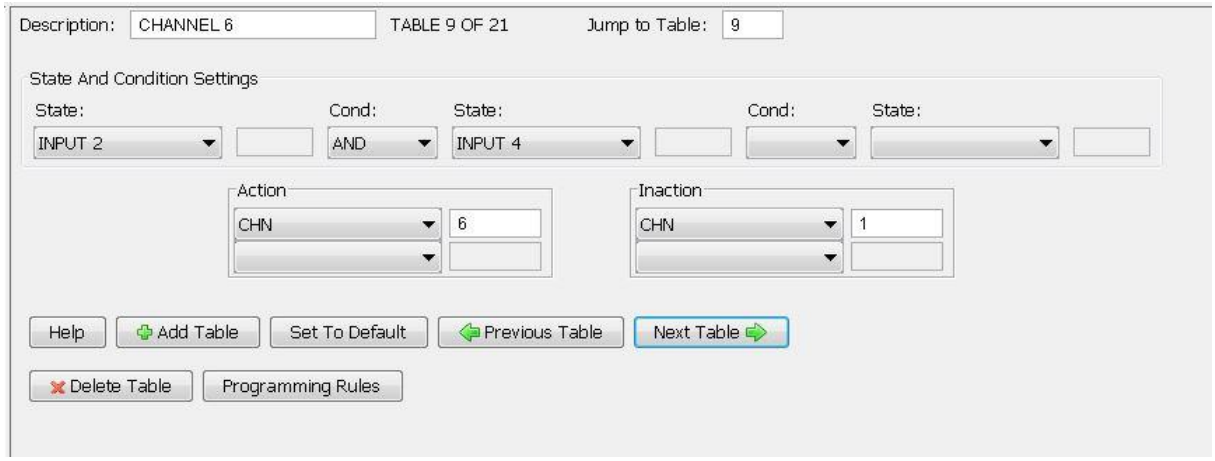
8: Channel Select Wildcard Table

- This table selects the channel 5 as the active channel.



9: Channel Select Wildcard Table

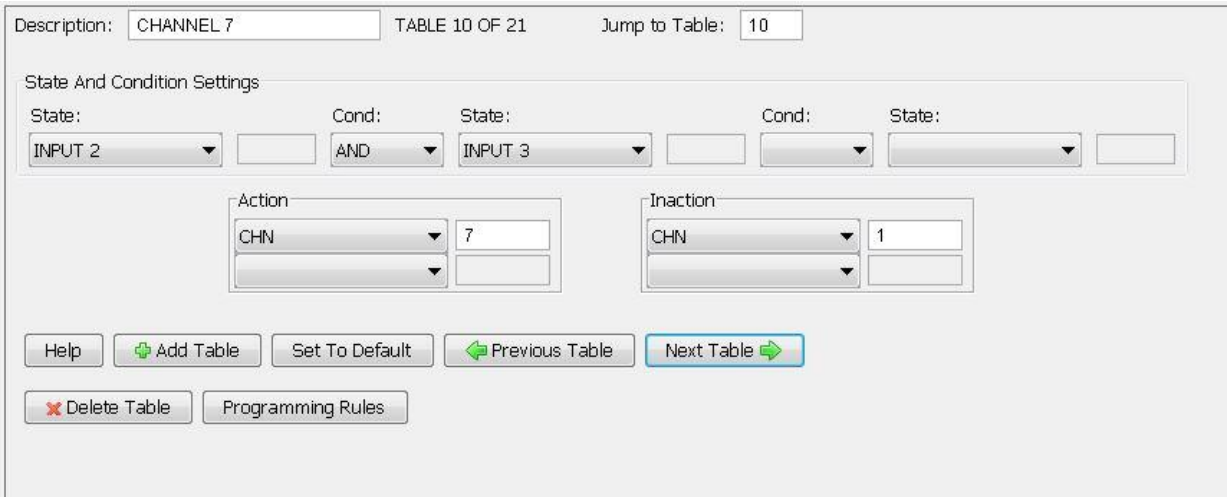
- This table selects the channel 6 as the active channel.



QUANTAR ECM – QUANTAR WILDCARD (CONT.)

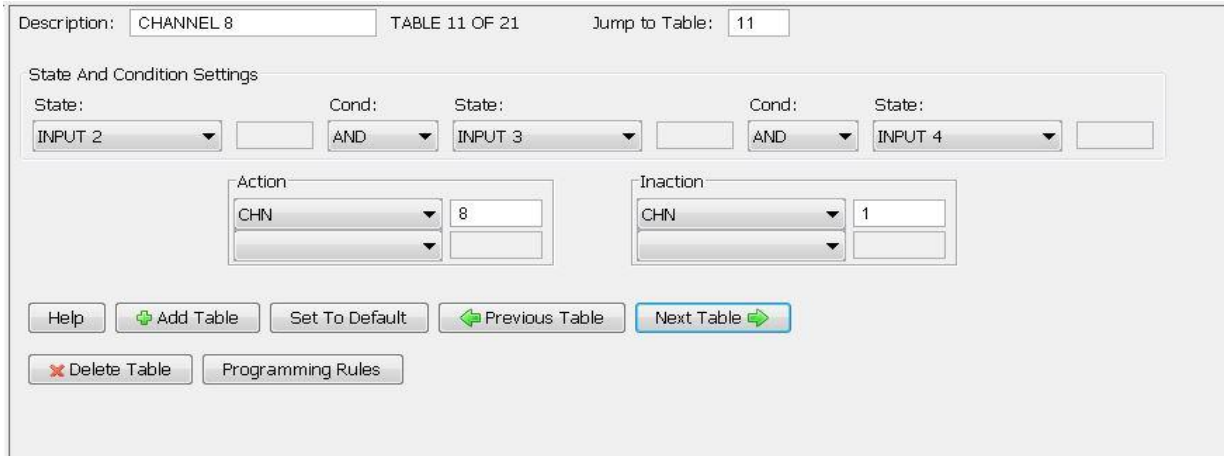
10: Channel Select Wildcard Table

- This table selects the channel 7 as the active channel.



11: Channel Select Wildcard Table

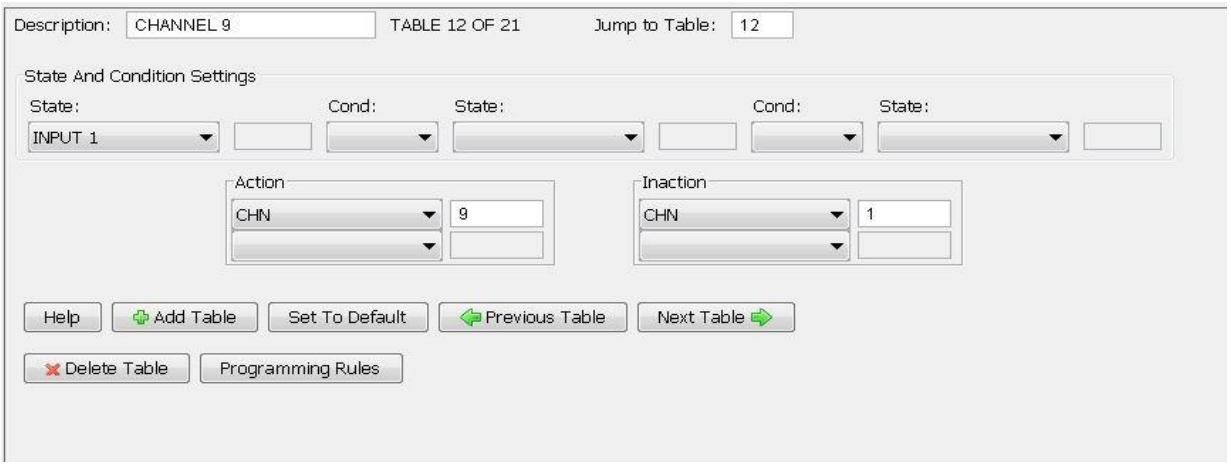
- This table selects the channel 8 as the active channel.



QUANTAR ECM – QUANTAR WILDCARD (CONT.)

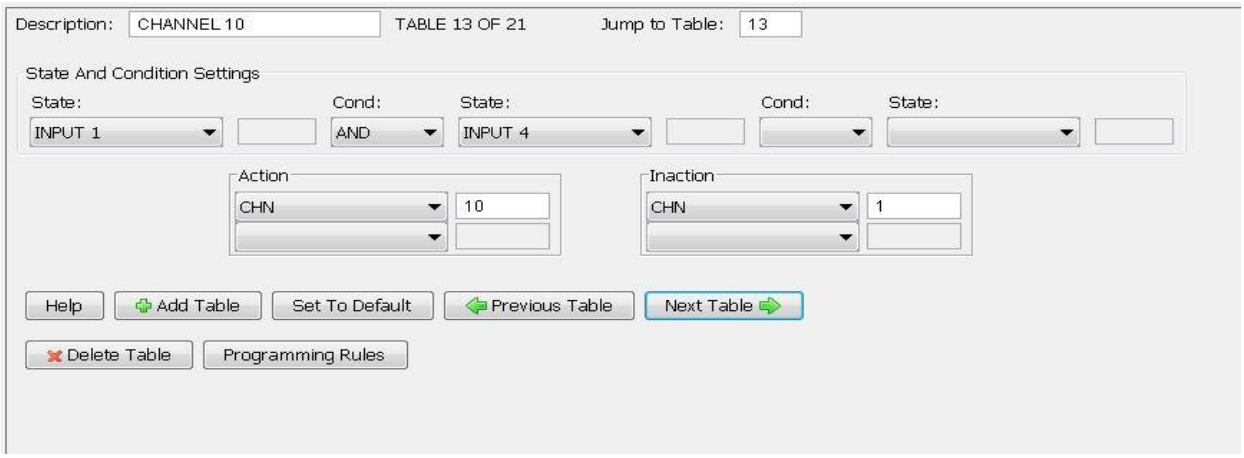
12: Channel Select Wildcard Table

- This table selects the channel 9 as the active channel.



13: Channel Select Wildcard Table

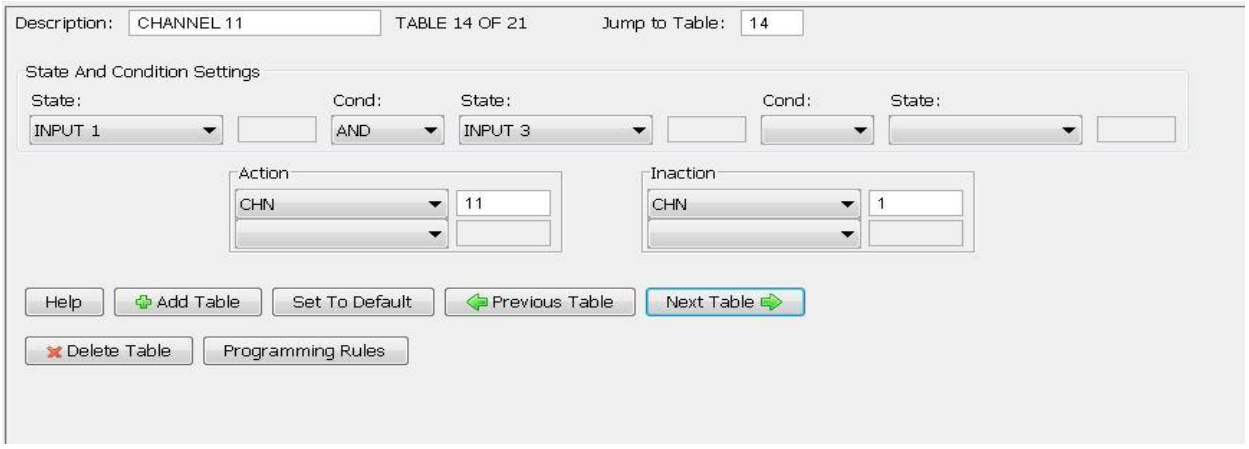
- This table selects the channel 10 as the active channel.



QUANTAR ECM – QUANTAR WILDCARD (CONT.)

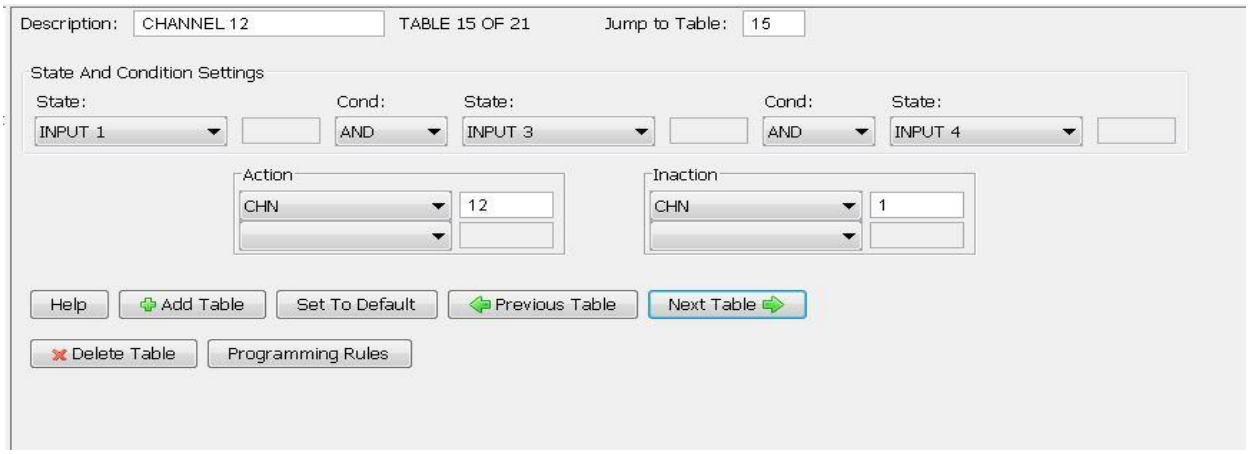
14: Channel Select Wildcard Table

- This table selects the channel 11 as the active channel.



15: Channel Select Wildcard Table

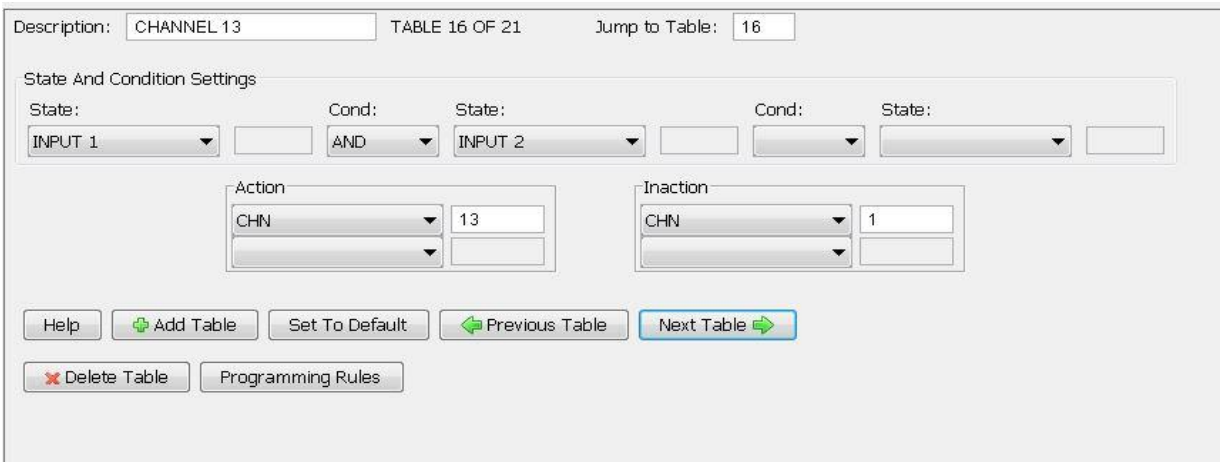
- This table selects the channel 12 as the active channel.



QUANTAR ECM – QUANTAR WILDCARD (CONT.)

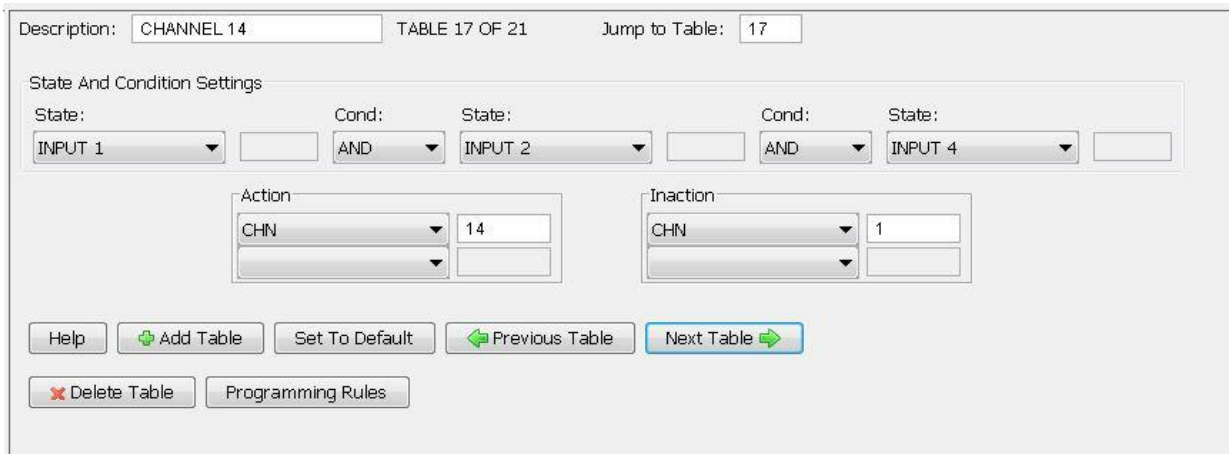
16: Channel Select Wildcard Table

- This table selects the channel 13 as the active channel.



17: Channel Select Wildcard Table

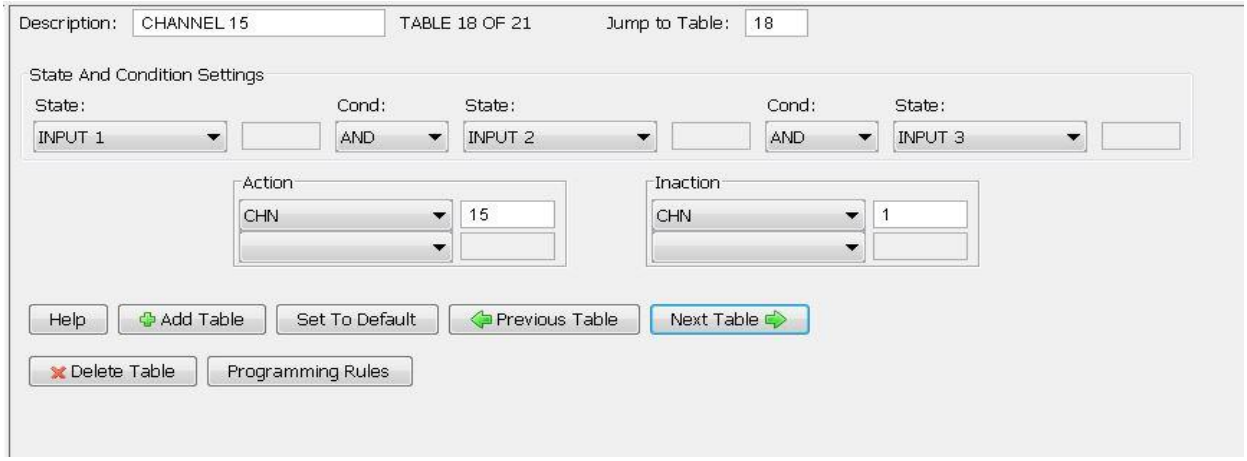
- This table selects the channel 14 as the active channel.



QUANTAR ECM – QUANTAR WILDCARD (CONT.)

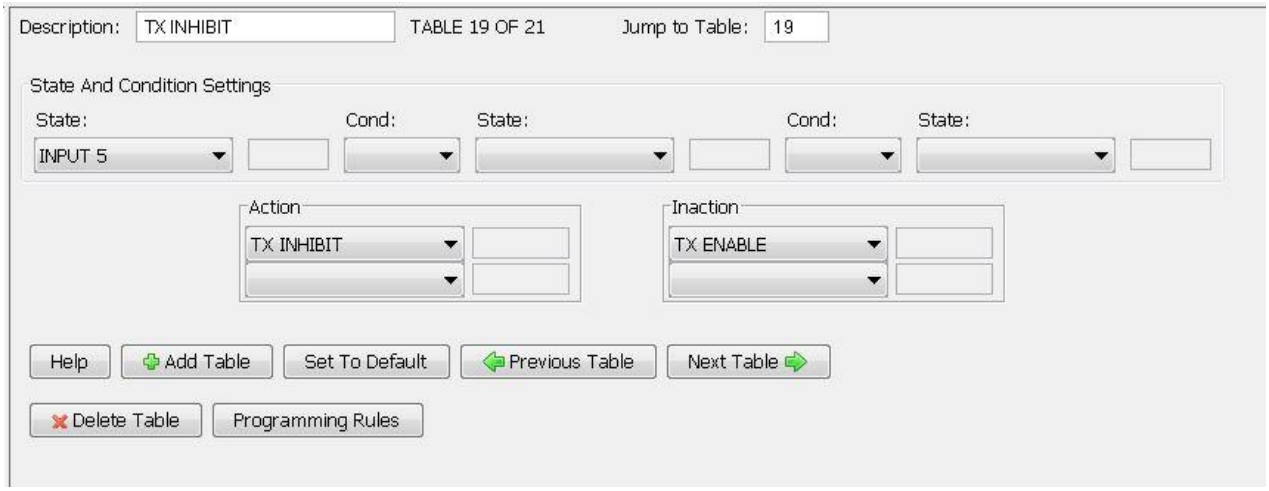
18: Channel Select Wildcard Table

- This table selects the channel 15 as the active channel



19: Transmitter Inhibit Wildcard Table

- This table will allow the Quantar ECM to inhibit both analog and P25 Transmit functions, also known as “Repeater Knockdown”



QUANTAR ECM – QUANTAR WILDCARD (CONT.)

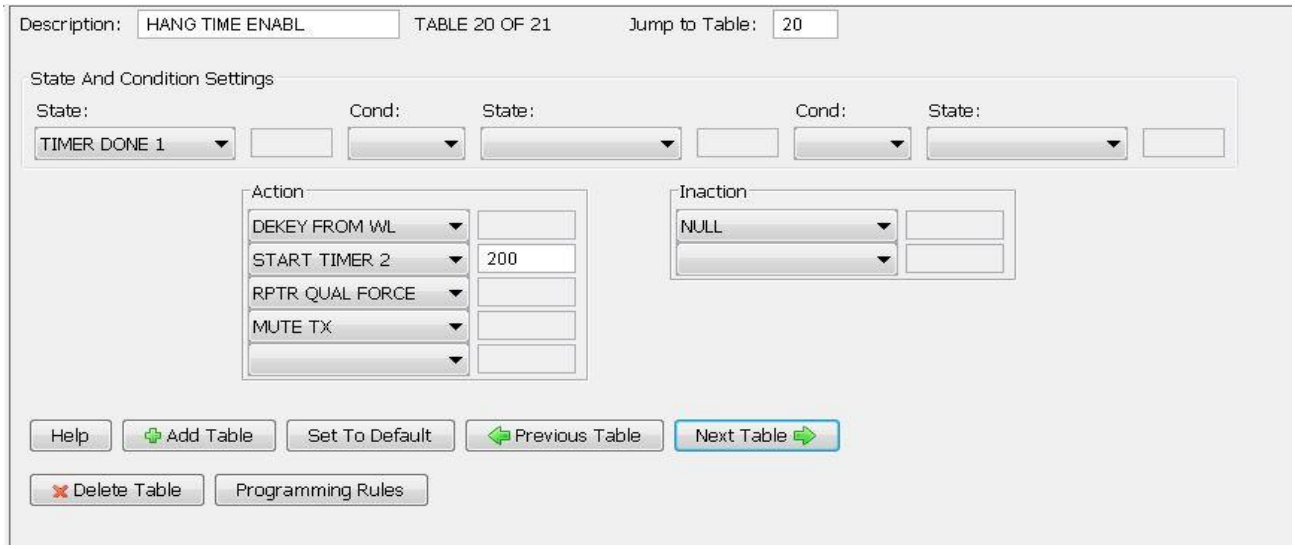
The preceding wildcard table will ensure that you have a Transmitter Inhibit function.

- DTMF code “*32812731” will cause input 5 to go low and thereby inhibit the transmitter
- DTMF code “*32812730” will cause input 5 to go high and thereby enable the transmitter

The proceeding wildcard tables will ensure that channel specific hang timers function correctly. Finally, we have to use wildcard audio routing to selectively muted TX audio so the DTMF tones are muted and not rebroadcast.

20: Transmitter Hang Time Wildcard Enable

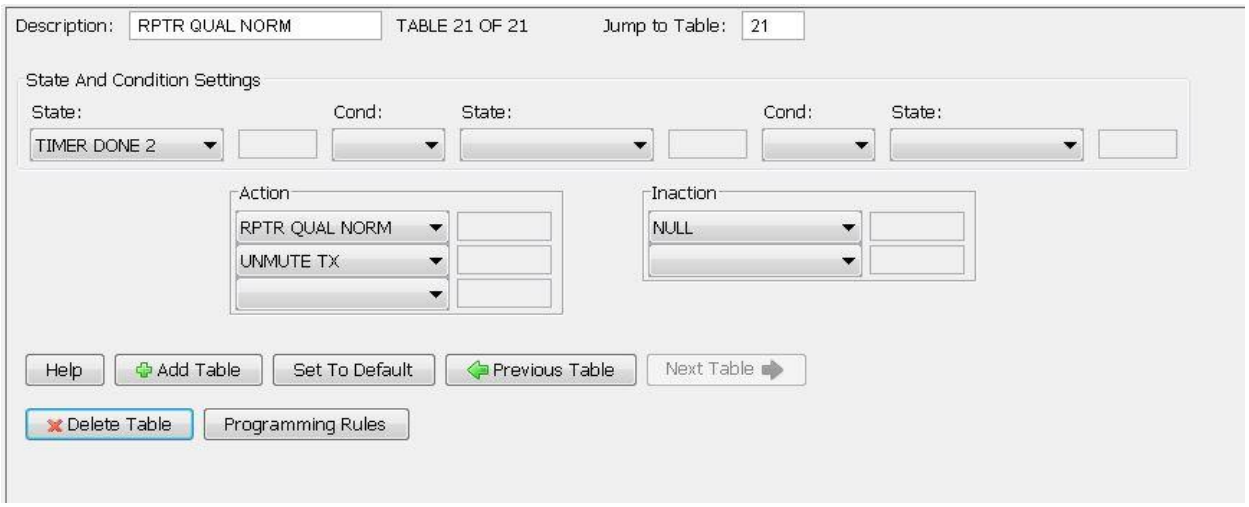
- This table will allow the Quantar ECM provide a courtesy tone and DTMF confirmation beep while still preserving the per-channel hang timer settings



QUANTAR ECM – QUANTAR WILDCARD (CONT.)

21: Repeater Normal Operation After Hangtime

- This table will allow the QUANTAR to resume normal repeater operation after hangtime



Once you have successfully written your wildcard tables, please take a moment to check your work. It is necessary to recreate the wildcard structure exactly as we have shown above. Deviations from our recommended codeplug may cause undesirable operational conditions, poor audio quality or both. If you require additional assistance, please contact us directly.

Please proceed to the next section, Controller Installation.

QUANTAR ECM – PRODUCT INSTALLATION

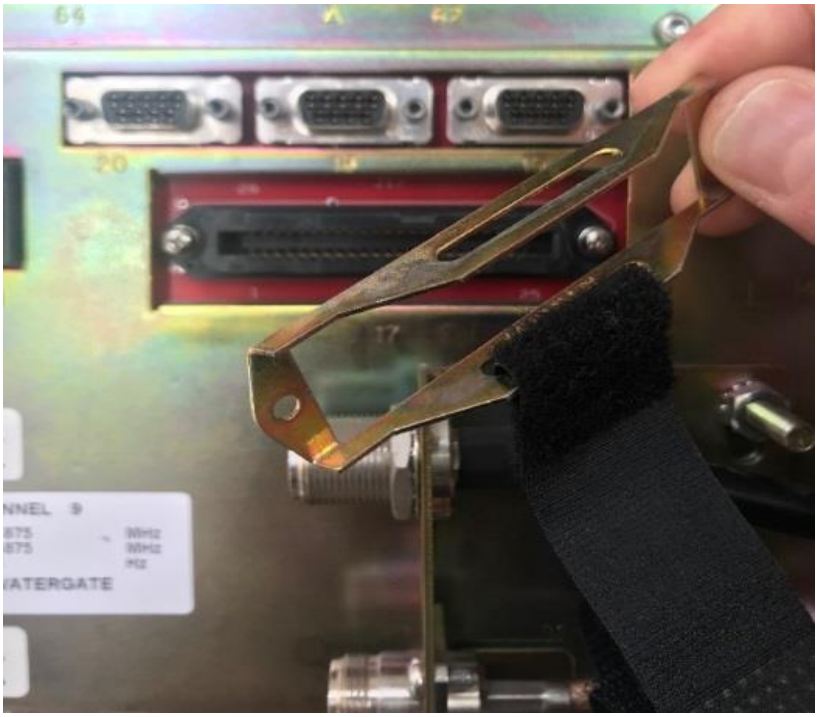
DEVICE INSTALLATION

The QUANTAR External Control Module (Quantar ECM) is installed by attaching the device to QUANTAR backplane connector J17. Prior to making the connection, it may be necessary to modify the antenna connector and removed the Velcro shroud surrounding the J17 connector housing (pictured below).

Before you begin your installation, please ensure that your station is powered down and that you have removed the AC and / or DC mains connection.

1: Using a small Philips head screwdriver, remove the J17 Velcro retainer clip as pictured here. One removed, reinstall the screws and washers into the connector housing. Set the retaining clip aside. It will no longer be used

- BRACKET REMOVAL: Remove and discard this bracket and reinstall the screws

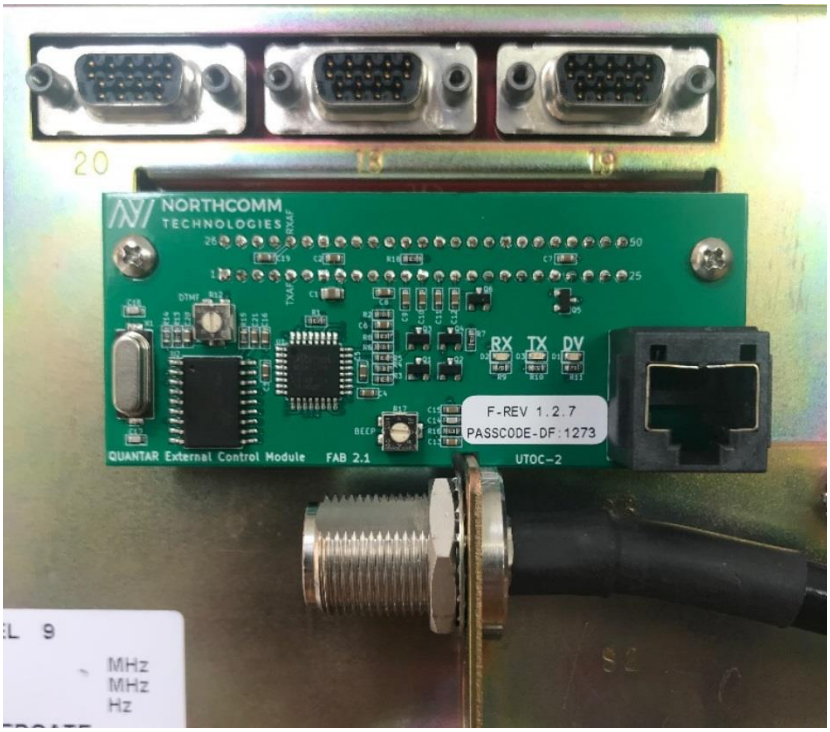


QUANTAR ECM – PRODUCT INSTALLATION (CONT.)

2: Remove both the TX and RX antenna connections

3: The QUANTAR antenna connector bracket may either be configured to the left, or it may be oriented facing down. This decision is based upon your rack layout. Our recommendation is that the antenna connectors face down as it moves the TX connector away from the Quantar ECM. See the examples pictured below.

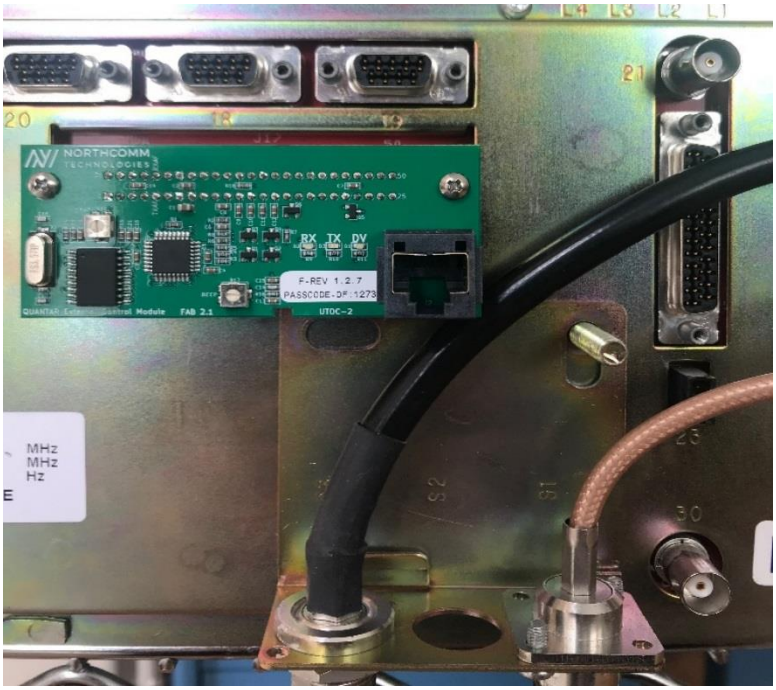
- OPTION A: Left facing connectors are shown below



QUANTAR ECM – PRODUCT INSTALLATION (CONT.)

If you elect to install the antenna bracket as pictured below, you will need to remove the zip ties that secure the TX cable to the chassis backplane. Once removed, loosen the ground bolt, and relocate the bracket as shown herein. Once you are satisfied with your installation, replace the previously removed zip ties with new zip ties. DO NOT overtighten these zip ties, and DO NOT leave this cable unsecured. Reinstall your chassis ground wire and secure the ground nut.

- OPTION B: Down facing connectors are shown below



QUANTAR ECM – PRODUCT INSTALLATION (CONT.)

4: Before reconnecting the station power, reconnect the transmitter, as required, either to the system combiner / duplexer / antenna, or a dummy-load

5: Reconnect station power.

6: There are only two physical audio adjustment points on the Quantar ECM. These adjustment points are the DTMF audio gain potentiometer, R12 and the BEEP tone output potentiometer, R17.

The DTMF gain pot (R12) adjusts the audio level provided to the DTMF resonator U2. Proper adjustment of this resistor is critical for reliable DTMF decode performance. Adjustment is a straightforward process:

- Key up a DTMF enabled radio on the repeater's receive channel
- Enter random DTMF tones and observe the status of D1, the DV (data valid) status LED
- Rotate R12 clockwise until **D1 lights fully and consistently** with the press of every single DTMF digit. A D1 LED that flickers during the steady press of a DTMF button indicates that the R12 level is low. Increase the gain at R12 until this condition is eliminated
- Rotate R12 10-20 degrees beyond the position observed in the previous step

7: The beep tone adjustment will be set to whatever level is determined appropriate by you, the installer.

On initial powerup, the QUANTAR station (NON-UHSO) will require approximately 45 seconds to boot. Stations' with internal UHSO's such as narrow banded 800 and 900 MHz stations may take up to 10-minutes to complete the boot cycle. In all cases, the station fail light will be lit until the boot cycle has completed.

The Quantar ECM will complete its own boot cycle within 60 seconds of station powerup as it waits for the QUANTAR to become ready. The ECM status can be monitored on the serial port. Serial port programming and configuration will be discussed in the next section. Once active, the control will emit a dual beep over the air to indicate that the MCU is active and that the station is ready in all regards.

QUANTAR ECM – INSTALLATION VERIFICATION

INSTALLATION VERIFICATION

If your Quantar ECM is installed correctly, you should hear a courtesy beep every time you key the station with an on-channel signal. The default courtesy beep is the NASA Quindar outro beep with a 25 mS duration.

Receiver status will be indicated by the green RX activity LED (D2) located on the Quantar ECM. Loss of COR should immediately cause TX LED (D3) to light as the courtesy beep is sent.

When a valid DTMF tone is sent to the QUANTAR receiver, all three LED's (RX, TX and DV) will light simultaneously. You may check the operation of the controller's DTMF circuit by entering the following command:

- *399

This command will cause the Quantar ECM to transmit all currently active courtesy and error beeps that are loaded in memory.

Installation is now complete in all respects.

The following sections will provide guidance on the DTMF and Serial Command structure of the Quantar ECM.

QUANTAR ECM – COMMAND STRUCTURE

DTMF AND SERIAL TERMINAL COMMAND SYSTEM

Motorola Quantar Repeater External Control Module Command Structure

The External Control Module (ECM) adds functions to a Motorola QUANTAR repeater for external DTMF controls. This section identifies the Quantar ECM command structure.

The ECM also has a serial control console for local configuration/control. This console is discussed in the next section.

DTMF Commands:

Multiple controllers can operate on the same frequency.

The targeted controller is addressed by its "ID".

DTMF commands with the prefix (*), and match the controllers ID will execute. The default address is “3” Therefor a valid command begins with “*3”.

All DTMF Base commands are 4 digits, a prefix (*), an ID (0 to 7), and 2 digits command. Incomplete 4-digit DTMF Base command will result in an error.

Command 00 is invalid and will error.

Commands 01 to 15 are channel commands, they set the channel directly.

Commands 16 to 27 (and 98 & 99) are controller commands.
Any other commands are also invalid, and will error.

- DTMF Example: Set Channel 05 at a controller with an ID 3 = "*305"
- DTMF Example: Courtesy Response select 16 on a controller with an ID 3 = "*32216"

QUANTAR ECM – COMMAND STRUCTURE (CONT.)

DTMF Commands:

00
Invalid command
Will Error

01 to 15
Channel Command (sets directly to the channel)
01 to 15

16
TX re-enable with passcode
PPPP (passcode)

17
Quindar enable
0 or 1

18
Quindar Intro Enable
0 or 1

19
Courtesy Enable
0 or 1

20
Confirmation Enable
0 or 1

21
Error Enable
0 or 1

22
Select Courtesy Response
01 to 23

23
Select Confirmation Response
01 to 23

24
Select Error response
01 to 23

QUANTAR ECM – COMMAND STRUCTURE (CONT.)

25
DTMF Re-Enable With Passcode
PPPP (passcode)

26
Change DTMF Passcode
OOOONNNN
O = Old Passcode
N = New Passcode

27
TX Inhibit Timer Enable
PPPPE
PPPP = Passcode
E = 0 or 1

28
TX Inhibit
PPPPE
PPPP = Passcode
E = 0 or 1

98
Command 98 is send enabled responses
No Argument

99
Command 99 is send selected responses
No Argument

QUANTAR ECM – COMMAND STRUCTURE (CONT.)

SERIAL TERMINAL COMMAND SYSTEM

The Quantar ECM has a powerful serial console that includes a “Print Screen” as well as live station status updates. Any command that can be executed through DTMF may also be executed through terminal. In fact, it is possible to disable DTMF entirely and retain full station control from a dedicated terminal.

A simple terminal program may be used to access the Quantar ECM. The ECM module requires the use of a USB to TTL serial cable. Northcomm Technologies manufactures these cables, pre-terminated with the RJ45 male plug. Please contact us to purchase the console cable. Under no circumstance should you use a D-Sub style or EIA serial connection; doing so may destroy the microprocessor.

The screen shots below will provide guidance and help you configure your terminal. These screens were taken in TeraTerm.

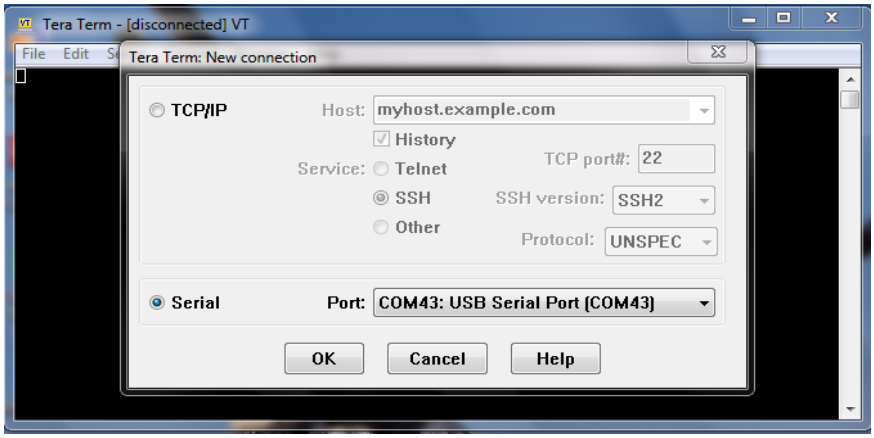
TeraTerm may be downloaded here: https://osdn.net/projects/ttssh2/releases/

QUANTAR ECM – COMMAND STRUCTURE

SERIAL TERMINAL SETUP

1: Connect the Northcomm Technologies TTL/USB serial cable to your computer. Please allow Windows © to configure the USB device. Our cable uses the FTDI chipset. If required, drivers are available from FTDI

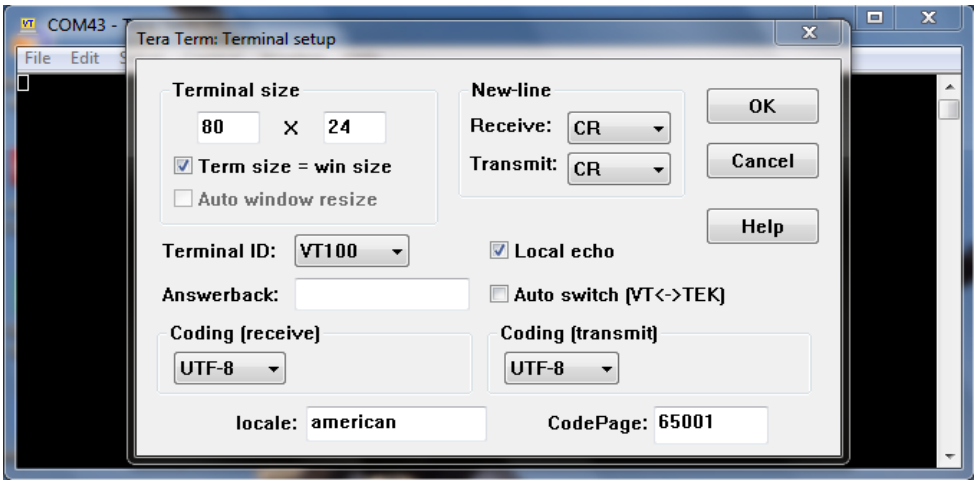
2: Once you have completed step one, you may open TeraTerm. Once open. you should see the following screen:



3: Select the “Serial” button and choose the correct COM port for your USB/Serial cable. In this case our computer used COM 43. Your computer may assign a different COM port.

QUANTAR ECM – COMMAND STRUCTURE

4: Select “Local Echo”. All other functions may be left as default.



5: Finally, connect the console cable to the RJ45 located on the Quantar ECM. Verify the connection by entering in the “PS” command (all caps) and press the enter key. If you are connected you will see the following screen

QUANTAR ECM – COMMAND STRUCTURE

Serial Commands:

Serial commands are a command, and an optional argument separated by a space.

All serial commands are in UPPER CASE.

Most serial commands without an argument will simply display the current setting for the command.

Examples of a few serial commands include:

- Serial Example: Set Channel 5, type: "CH 5" (and press the enter key)
- Serial Example: Courtesy Response Select 16, type: "CR 16" (and press the enter key)
- Serial Example: Enable Timer 1, type: "TIE 1" (and press the enter key)

Serial Example No Argument:

- Serial Example: Query Current Courtesy Response, type: "CR" (and press the enter key)
    - Terminal Reply: "CR=16" indicating Courtesy Response is currently 16

QUANTAR ECM – COMMAND STRUCTURE (CONT.)

SERIAL TERMINAL COMMANDS

Commands:

CD
NO-PTT To Chan Set Delay mS
0 to 3000 mS

CH
Channel
1 to 15

CM
Confirmation Response
0 to 23

CR
Courtesy Response
0 to 23

DI
DTMF Inhibit
0 or 1

EEPROM
Reload Parameters From EEPROM
0 to 23

ER
Error Response
0 to 23

HT
Hang Time mS
0 to 3000

ID
DTMF Command ID
0 to 9

PCCE
Remote Passcode Change Enable
OOOONNNNE
O = Old passcode
N = New Passcode
E = 0 or 1

QUANTAR ECM – COMMAND STRUCTURE (CONT.)

PQ
PTT To Quindar Delay mS
0 to 3000

PS
Print Settings
No Argument

PV
Print Version
No Argument

QE
Quindar Enable
0 or 1

QI
Quindar Intro Enable
0 or 1

RQ
Response to Quindar (Quindar is the Default Courtsey Tone) Delay mS
0 to 3000

SETDEFAULTS
Set EEPROM & Perimeters to Defaults
No Argument

SP
Set DTMF Passcode
1000 to 9999

SR
Squelch Closed to Response Delay mS
0 to 3000

TID
Timer 1 Duration Minuets
0 to 60

TIE
Timer 1 Enable
0 or 1

QUANTAR ECM – COMMAND STRUCTURE (CONT.)

T2D
Timer 2 Duration Minuets
0 to 60

T2E
Timer 2 Enable
0 or 1

T3D
Timer 3 Duration Seconds
0 to 180

T3E
Timer 3 Enable
0 or 1

T4D
Timer 4 Duration Minuets
0 to 60

T4E
Timer 4 Enable
0 or 1

TI
TX Inhibit
0 or 1

VB
Serial Verbosity Level
0 to 2

QUANTAR ECM – INSTALLATION COMPLETION

Installation is now complete in all respects.

Any questions or concerns regarding the use, installation or repair of this product can be directed to info@northcommtechnologies.com. Technical support is also available by phone Monday through Friday 0830-1630 CST at 1-866-858-1745.

The Quantar ECM is a highly adaptable and versatile product. If you have any suggestions, ideas or special requirements please do not hesitate to contact us. Individually tailored wildcard tables, firmware loads and programming typologies are available. Please inquiring about these additional services.

Email inquiries can be directed to info@northcommtechnologies.com. We will typically respond within two hours or less. More urgent matters will be handled via telephone.