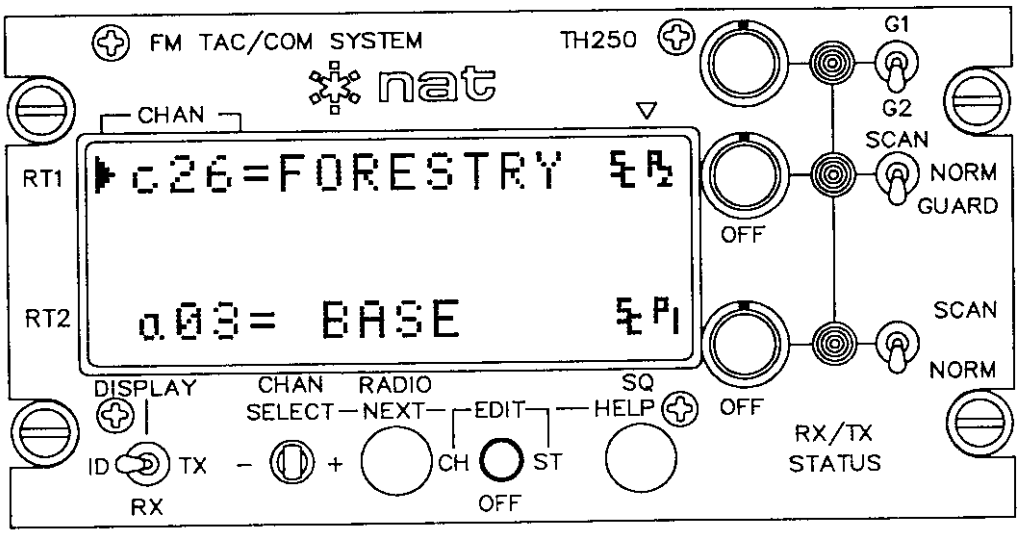
FCC ID: GOLNT030

TAC/COM SERIES
Control Head



OPERATION MANUAL

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Northern Airborne Technology Ltd.
#14-1925 Kirschner Road
Kelowna, B.C., Canada.
V1Y 4N7

Telephone (604) 763-2232
Facsimile (604) 762-3374

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Section 3.0 Operation

3.1 Introduction

Information in this section consists of the functional and operating procedures for the Tac/Com Control Heads.

3.2 General

To understand the operation of the Tac/Com control, a quick review of basic FM radio operation is helpful here. It is normally a requirement to carry out the following general operations on any FM radio system.

1. Turn the radio on and off.
2. Adjust the receive volume of the radio.
3. Select the required channel on the radio.
4. Optionally select/enable any special tones required for proper network or repeater operation.
5. Optionally select/enable any guard receive or transmit functions.

It is also helpful to show visually that the radio is transmitting or receiving, so that the pilot is assured of correct performance. If the radio is 'frequency agile' (i.e., the frequency of operation can be set directly by the operator) a method must also be provided to enter the specific frequency data, and identify and store the information.

Every manufacturer attacks these requirements in a different manner, and since the Tac/Com system provides the ability to interface with other manufacturer's equipment as well as NAT's own transceivers, a uniform method of operation must be provided. How each common operating function is accomplished in the Tac/Com system is described in the following sections. It is also possible to interrogate the control head itself for help in learning how to operate it, simply by pressing the **HELP** button during the first power-up screen or at any time while editing.

The on-line help function for the system is comprehensive enough to address most operational questions, and corrects a long standing problem in the cockpit relating to lost or missing operator's manuals. Every control function and valid editing choice is fully explained through this system, which can be activated by pressing the **HELP** button.

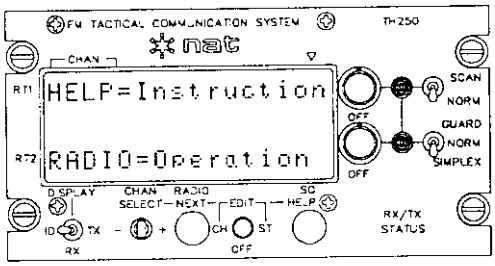
It is important to remember that the many radios simultaneously controlled by the Tac/Com system may have very different features and attributes as well as frequencies. If the radio was incapable of some functions prior to connection to the Tac/Com head, it will not suddenly acquire all the functions possible just by connection to the Tac/Com control. Crystal controlled radios, such as the FliteFone 40, for

example, do not suddenly become agile radios, and Flexcomm radios don't scan simply because they are connected to a Tac/Com control head. Only NAT's own radios offer full capability, which includes extended tones, DPL, encryption, scanning and variable transmit power.

3.3 Initial Operation

3.3.1 Power-up Help

Turn the Tac/Com system on by rotating any radio volume control away from the **OFF** detent position. The software revision number will be briefly displayed, followed by a screen presenting an option for use of the on-line **HELP** system, as shown below.

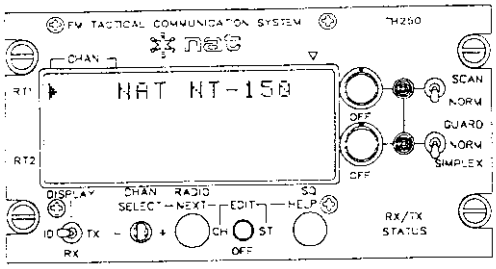


If help is selected (i.e., the **HELP** button is pushed), the control head will present a tutorial on the operation of each control head feature. To advance through the tutorial, press **HELP** after reading each screen. To exit this initial help function at any time press the **RADIO** button, and the control head will begin normal radio operation.

3.3.2 Initial Operating Display

If help is declined (by using the **RADIO** button as directed), the control head will display a summary of the installed functions and current settings for each radio (this feature can be disabled in the installation set-up for faster start-up). Once all of the functions have been displayed, the radio will be ready for normal operation.

Once you have selected normal control head operation, the display will install the radio and its settings as specified by the interface card and software set-up instructions. This will produce the following system message on the control head:



NAT NT-150 or **WULFS RT-7200** (etc.)

This is the radio type designated for that transceiver slot in the control head (RT1-4), and will change if either the interface card, the stored software set-up or hardware jumper selections are changed in the control head. This message is to advise you what the control head thinks should be in that interface slot.

Next, the status of the radio is presented which represents the state of its radio-wide functions such as transmit power, duplex operation or tones. A summary of all the selection options will be displayed, unless defeated in the installation software set-up to speed up turn-on of the control head. This display will produce messages such as those shown below, for each radio:

POWER=LO, TONES=OFF (etc.)

The control head will continue with each radio in sequence, and will finally position the cursor (arrow) by the selected radio when it has finished. You may also get messages such as those shown below, which are system error/alert messages reported by the Tac/Com control head:

NO I/F BOARD

There is no interface card installed in this specific slot (RT1-4) inside the Tac/Com control head. This message appears if you have empty slots in your control head, to warn that the panel controls are inactive.

-- NO RADIO --

No radio was found to be installed in this specific slot when tested by the Tac/Com control head. It may have been removed for service, used in another aircraft, or have the mating connector disconnected.

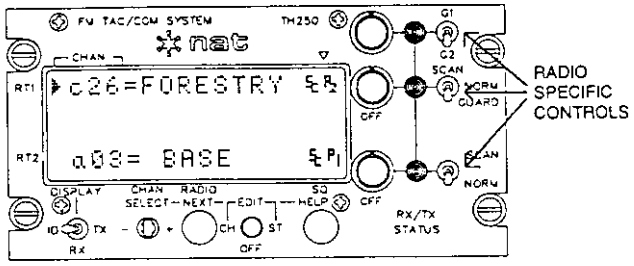
-- RADIO OFF --

The radio was found to be turned off or defective (if turned ON at the front panel) when checked by the Tac/Com control head. This message also appears for Flexcomm radios if they are removed from the aircraft, as they do not support the **-- NO RADIO --** function.

3.4 Front Panel Controls

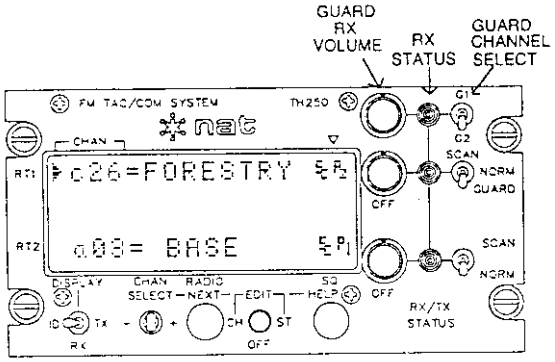
There are two main groups of controls, and a 2, 3 or 4 line by 16 character display on the Tac/Com control head. The first group of controls is "radio specific", and affects the operation of only a single radio (there can be up to four installed in a single control head). The second are general controls, which affect the over-all operation of the control head.
The function and relative location of these important groups is as follows:

3.4.1 Radio Specific Controls



Radio specific controls allow the general operation and function of each radio to be modified independently. The radios are identified as "RT1, RT2", etc. to the left of the display, and the line of text continues through the display to connect to the specific controls for that radio on the right hand side of the control head. The exact functions that are provided on the front panel via the radio function switch will vary with each radio type. Some radios support very few features, while others require both the front panel switch, and a number of status line functions to set all of the radio functions. Guard controls are not available on all units.

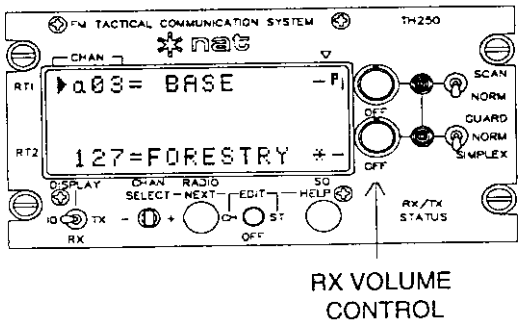
3.4.1.1 Guard Controls



In general, the **GUARD** volume control permits a zero volume level without turning the radio off, but in some instances, such as USFS GUARD RX controls, this will not be true. OAS government contracts require that this level not go to zero regardless of pot setting, with a minimum fixed output at all times.

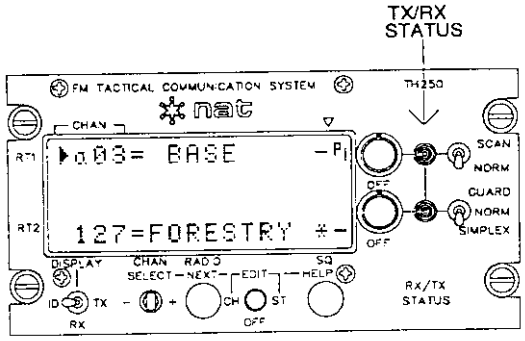
A second set of controls is provided for guard operation only when "H", "U" or "V" interface cards are installed. Note that the **GUARD** volume control has no OFF detent position. Forcing the control fully counter-clockwise may cause switch damage. The internal minimum guard volume adjustment is accessible through the right side of the control head. The additional guard controls provide selection of the guard 1 and guard 2 channels, plus a separate RX status indicator.

3.4.1.2 RX (Receive) Volume Control



The RX volume control is adjusted via the round knob for each radio. Rotating this control fully counter-clockwise to **OFF** turns the specific radio off. If all controls are **OFF**, then the control head itself turns off.

3.4.1.3 RX/TX Status Indicator

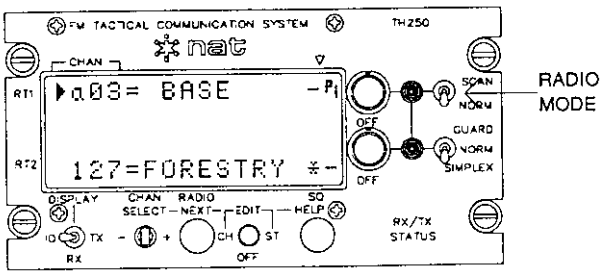


Next to the volume controls are bi-color indicators that display TX (Transmit) status or RX (Receive) status. If that specific radio is keyed to transmit, the LED will be green. If a signal is being received, the LED will be amber.

A radio which is receiving may still not produce any audio, if the tones or DPL codes for that channel do not match the tones or DPL codes set in the control head. If tones are set to ON for a given radio from the status line, then all data (frequency and tone/DPL code) must be correct to hear the receive audio. If tones are OFF, then all incoming transmissions are received. The indicator lights whether the logic is correct for audio or not, to warn the pilot that channel is active with radio traffic of some kind.

If the radio is idle (not receiving or transmitting), the LED will be off. The color coding used for these functions corresponds to the existing indications used in the FF40, C-62 and C-1000, for pilot familiarity. It is worth noting that these conventions are reversed from vehicular standards, and may be confusing for some emergency services staff used to land mobile equipment. When used with a Wulfsberg radio equipped with a guard channel, both the main and guard RX signal will illuminate the RX LED, unless equipped with separate guard controls.

3.4.1.4 Radio Mode Switch



The last radio specific control is the **MODE** or **FUNCTION** switch, which varies with the type of radio used. For NT-series transceivers, this selects either **NORM** or **SCAN** modes of operation, as specifically defined in the status line.

For NT-series transceivers scanning occurs at 90 channels/second/radio, and the following scan modes (defined in the status edit mode) are:

LIST (up to a block of 32 channels/list).
PRIORITY (up to 2 priority channels + active monitor channel).
LIST+PRIORITY (2 priority + 30 channels in a given block).

Priority monitoring is 3 times/second for a 10-15ms sample. The radio will re-channel to the priority channel if traffic is detected, and returns to the monitor channel (channel the radio was resting on when scanning was selected) after a 2 second latency. All CTCSS tones or DPL codes are inactive during scanning (due to lock delay).

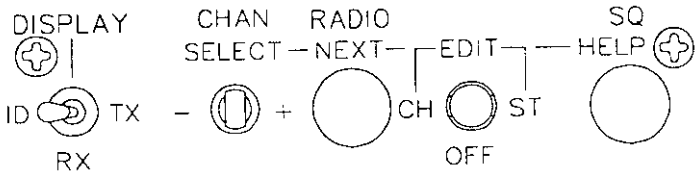
With some radios, this mode switch is reserved for **GUARD** or **MAIN** transmit selection, as scanning is not supported. It may also select **SIMPLEX** or direct (repeater talk-around) operation as opposed to **NORM** (Duplex) or repeater operation. Data for all channels is stored as individual TX and RX frequencies, which permits them to be entered and used in any way. The forced **SIMPLEX** function pushes the stored RX frequency into the TX slot temporarily to permit "talk-around" of an existing stored repeater frequency, and avoids having to store a separate channel with this information.

3.4.2 General Controls - NORMAL Operation

The general control head functions include the switches that effect the over-all operation of the control head. Some of these switches have dual functions depending on control head mode of operation. The two modes of operation are NORMAL and EDITING.

The TOP ROW is for NORMAL OPERATION.

CHAN RADIO SQ

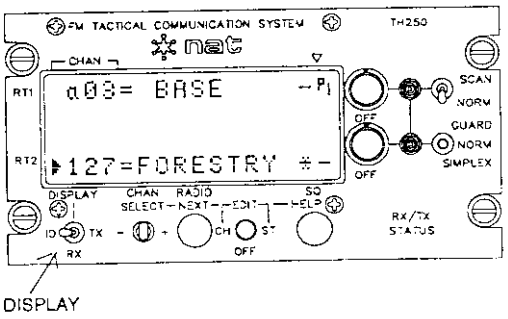


SELECT NEXT EDIT HELP

The BOTTOM ROW is for EDITING.

The EDITING functions are tied together by engraved panel lines to show that they are related. The alternate EDITING functions become active whenever the **EDIT** switch is in any position other than **OFF**.

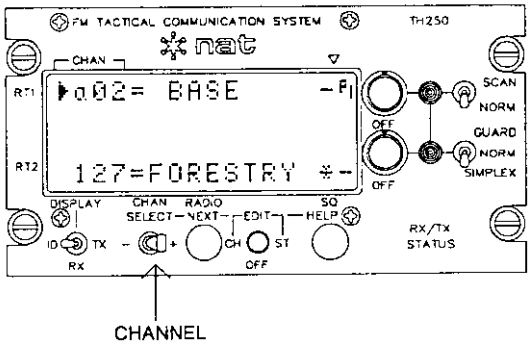
3.4.2.1 Display Switch



The **DISPLAY** switch works the same in both NORMAL and EDIT modes of operation.

The **DISPLAY** switch determines what data is shown on the individual channel presentations for each radio. Either the alphabetic channel name or identification (**ID** position), or the actual channel frequency (**RX** and **TX** positions) can be displayed. When editing, this also determines what will be edited. Whatever data is visible is the material that can be edited. During normal operation, the crew can select whatever presentation is the most helpful to them, which is generally the ID or channel name display. The cursor, or left hand arrow, shows which radio is set up for channeling or editing.

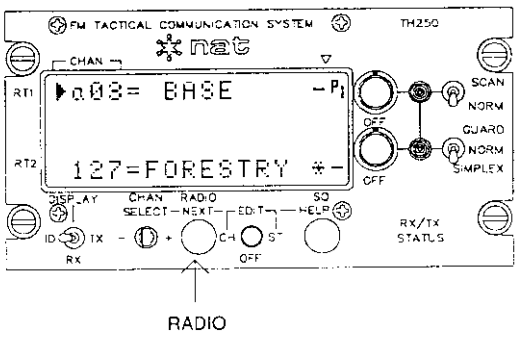
3.4.2.2 CHAN -/+ Toggle Switch - NORMAL Operation



To change channels, press the **CHAN** switch in the desired direction, either + or - for descending numbers. Channel selection can also be accomplished remotely if the remote channeling switch is installed. The radio that has the cursor in front of it is the one that will be channeled.

Channel numbers will increase from a02 upwards (a03, a04, etc.) with each press of the switch to "+" position. If the switch is held to either position, it will scroll rapidly, increasing in speed the longer you hold it down.

3.4.2.3 RADIO Push Button - NORMAL Operation



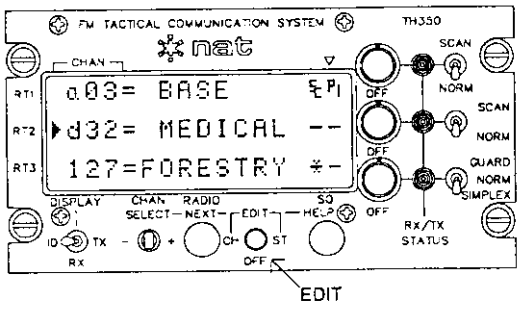
This push button switch picks the active radio selected for any operation. The radio selected is indicated by a triangular cursor to the left of the channel number (RT1 in this example). Cursor movement is from top to bottom, to the brightness screen and then returns back to the top again.

The radio that has the cursor in front of it is the one that will be channeled (RT1). To select RT2, press **RADIO**. If press a second time, the display brightness screen will be displayed.

When selected, a radio may be channeled, edited, or the manual squelch test operated. It has no bearing on transmit or receive capability, and only serves as an indication of which radio the control head is prepared to perform some operation on.

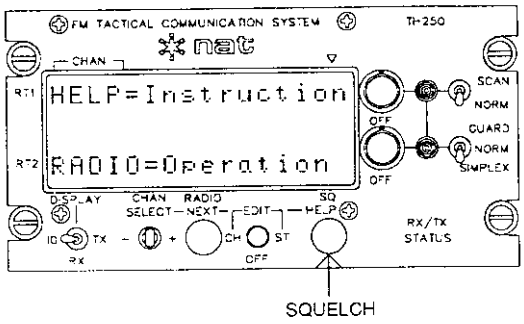
This selection works in increasing order only (1,2,3,4, display brightness), and then re-starts at the beginning.

3.4.2.4 **EDIT** Switch Function - NORMAL Operation



When the **EDIT** switch is in the center-off locked position, all editing functions are off, and the control is in normal operation. It the switch is set to any other position, then editing is active, and either radio or channel data can be altered by the operator.

3.4.2.5 Squelch Function - NORMAL Operation



Pressing this button during the power-up screen presentation (when the control head is first turned on) will take the operator through detailed help screens for each function of the control head. In the normal operation of the control head, this is the only access to help (on power-up), as this button is then the manual squelch (**SQ**) test button for the selected radio.

The squelch test function is useful for monitoring activity on a radio when tones prevent the squelch from opening normally, or to verify volume settings or radio function. Pressing **SQ** over-rides all squelch logic, and lets the radio's raw receive signal pass to the ship's audio system.

When the locking **EDIT** switch is in any position other than **OFF** (center), the **HELP** switch again becomes active, and provides context sensitive help for whatever function is being attempted, such as frequency entry, tones or labeling.

These two modes of help (power on and edit) provide assistance to the pilot/operator without interfering with the selected operation of the control head. If, basic help is required after the Tac/Com control head is already on, cycle the control head off again (turn all volume controls to OFF, or cycle the external breaker), and when powered up again, the option for comprehensive help will re-appear.

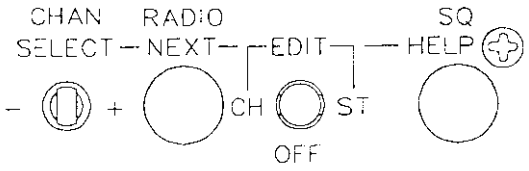
3.5 Editing

Editing is the general term for changing any information stored in the Tac/Com control head.

There are two basic types of editing that can be selected from the front panel of the control head. These are **CH**(channel) editing, and **ST**(status) editing. As the name implies, channel editing permits channel data to be controlled by the operator. This includes channel names, the transmit and receive frequencies and matching tones, scan flags (for list scan) and for some radios, channel discrete lines. To edit different channel information, such as frequency data or channel names, it is necessary to first select which information (**ID**, **RX**, or **TX**) will be edited via the **DISPLAY** switch.

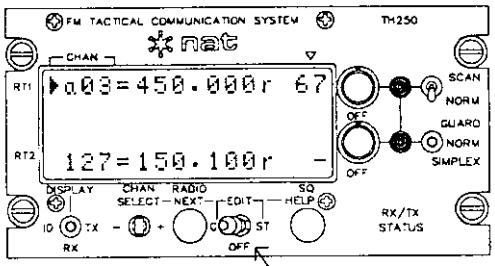
There is simply not enough room to fit every possible function switch that might be needed for a given radio on the front of a Tac/Com control. Some radios also have many more functions than others complicating this control arrangement. The solution for this clutter is the use of the status line to show features that are important, but not constantly in use on the front panel. Status functions can be as extensive as required for a given radio. The internal editor permits only valid choices at all times, so that the operator is not required to know a great deal about the specific radio in question, but only what he or she wants to accomplish.

Editing Controls:



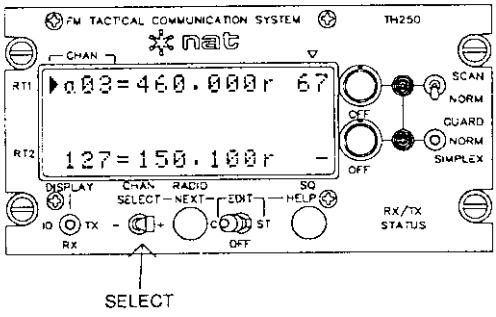
Two sets of legends exist for each of these switches. The bottom row (connected by lines) represents the function of the switches during the edit mode of operation. The dual nature of these switches takes some getting used to, but greatly reduces clutter on the front panel, and makes it possible to package all of the required functions into a size mechanically compatible with other systems.

3.5.1 Channel Editing



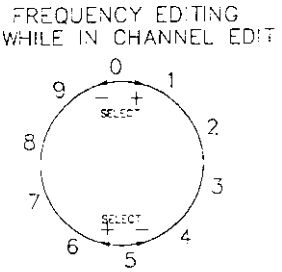
When the **EDIT** switch is in the **CH** position, the **ID**, **RX**, and **TX** information may be edited. The position or character to be edited will flash or blink on and off. When channel editing of data is in progress, operation of the radios is suspended, and the dual function edit switches work in the following way:

3.5.1.1 SELECT Switch



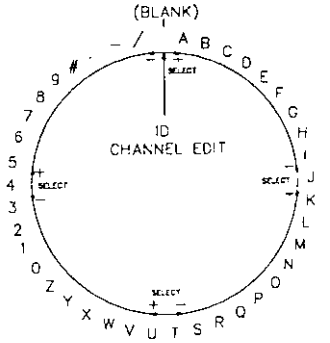
This switch is used to step the data entry up or down (**+/-**) on the currently marked radio. The character that will be selected flashes. This flashing character is referred to as the editing cursor, since it shows what you are about to change. The intelligent editor within the control head only permits a valid choice for every position you go to for data entry. This is to aid operators in reducing entry mistakes, particularly when busy with other flight procedures.

The selection choices are strung together in a circle, and you move through this circle with the **SELECT** switch as shown below in the diagram:

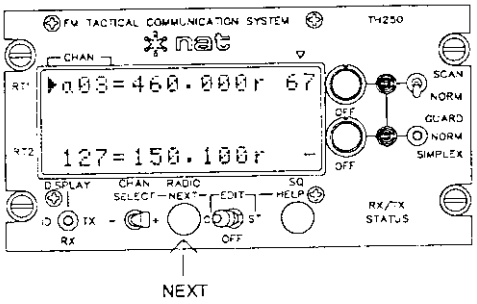


Depending on which way the **SELECT** switch is set (**+** or **-**), the choices will move around the circle in either direction. The editor removes numbers from this circle that don't apply to the particular cursor position (i.e., VHF High Band radios can only have a 3, 4, 5, 6 or 7 in the 10's of MHz position, so no other numbers are permitted during editing from the front panel in this location. Some radios do not channel below 150 MHz, so then the editor removes the 3 and 4, and so on through each position that can be edited.

When editing the channel ID label or name, the editor opens the circle to include all the alphabetic characters, and some frequently used symbols, like the blank (visible as a flashing underline "_" to show the cursor location), slash (/) and number sign (#). The choices for selection are shown below:



3.5.1.2 NEXT Switch



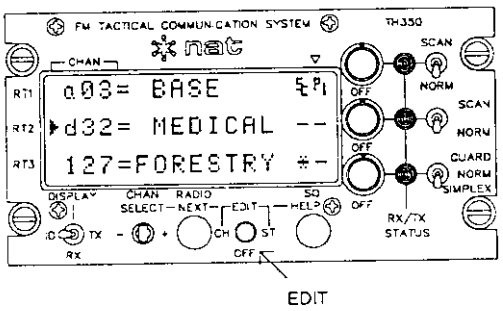
This push button switch cycles the editing cursor from left to right to the next character to edit. The editor will change what choices are valid as you move from one character to the next.

Sometimes more than one character will flash. This is because the only valid choices involve two characters, such as the fractional kHz entry for a channel frequency. This is also true for tone code entries. The **SELECT** switch will then scroll through the available entries from an internal table.

Note that a STAR appears at the right side of the RT #3 ID label in the diagram below. This means that the channel discrete line is enabled for that channel. This is a line to control external switching of a special function. It is programmed just like a scan flag,

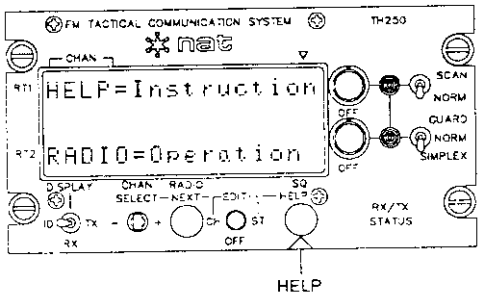
by advancing to that position with the **NEXT** button, and then toggling the entry with the **SELECT** switch. There is only one channel discrete line to set, and it appear only for the Flexcomm radios. This is a seldom used function, and is provided for compatibility reasons only.

3.5.1.3 EDIT Switch



This locking, center-off switch shifts the operation of the control head from editing back to the normal operating mode. For normal radio operation, it must be returned to the center or **OFF** position. No special activity is needed to store the data you have entered while editing. It is stored as soon as you enter it. When you are finished, set the **EDIT** switch back to **OFF**.

3.5.1.4 HELP Switch



The help screen may be accessed at any time, and for any function, while in the edit mode. Press the **HELP** button if the operation of any function is unclear during editing. Information will be provided for the edit function you wish to use, and if pressed while channel editing in the tone character position, will bring up the complete tone look up table for reference.

3.5.2 Summary of Channel Editing

For each channel stored in the control head, there are three possible data entries; identification label (ID), receive frequency (RX) and transmit frequency (TX). If equipped, the radio may also have tone and scan information associated with these entries. Note that non-agile radios can still have frequency data entered (for reference

only) in the master edit mode only, but changing this data will have no effect on the radio's performance.

The ID label or channel name has no effect on radio operation, and is provided for operator/pilot convenience in identifying the selected channel. Any alphabetical character, the numbers 0-9, and some punctuation (space # . - /) may be inserted in the ID label.

Help can be used at any time when editing, to give instruction for the operation you are performing. The exact data that pressing **HELP** provides depends on what you are doing, as it is context-sensitive. Editing tone locations and pressing **HELP** will bring up the tone look-up table. Editing channel frequencies will bring up frequency information, and so on.

It is important to remember that while frequency data may be edited, the radio itself must be an agile radio, with the AGILE MODE ENABLED on the interface card for any change to actually take place. Crystal controlled radios, or PROM coded radios which allow editing of this data in the master edit mode for reference only, will not change frequency after editing. Receive frequency editing is also allowed for guard channels (also crystal controlled) used in some radios, but again, this is for your reference only, and no change will take place in the operation of the radio.

When editing RX or TX frequency data, only those frequencies the control head recognizes as valid can be entered, and only in the fractional multiples allowed. If mismatched multiples occur when editing, a warning message, FREQ ERROR will appear, because the RX and TX frequencies must both be divisible by the same synthesizer interval.

The last positions (far right hand) on the RX and TX lines are for tone data (these locations have scan flags on the ID line). Depending on the type of radio installed, differing codes are possible here to represent the CTCSS (or sub-audible) tones used for repeater or squelch control. A different tone can be set for receive and transmit. the capability to have tones can also be enabled or disabled through the status lines, providing the radio will support this function. If the tones are enabled (via the status line), an "=" (equal sign) will be displayed between the channel number and following information on all three presentations. If the special function, DPL, or Digital Private Line as been enabled at installation time, then 83 different 3 digit DPL codes are available for use with NT-series radios.

3.5.3 Summary of Channel Labels

Tac/Com permits two kinds of channel numbers (set at installation time) for ease of use and to aid your memory. Block numbers begin with a letter, a-d, and have 32 channels per block. This lets you group channels together for convenience (i.e., all channels for forestry in one block, all EMS in another, all police in another, etc.), and also clearly shows you which channels can be scanned together as a group. NAT NT-series radios

hold 32 channels at one time for scanning, and they must be from the same block. Block numbers remind you which channels are grouped together.

Blocks:	a01-a32	Sequential Numbers:	001-032
	b01-b32		033-064
	c01-c32		065-096
	d01-d32		097-128

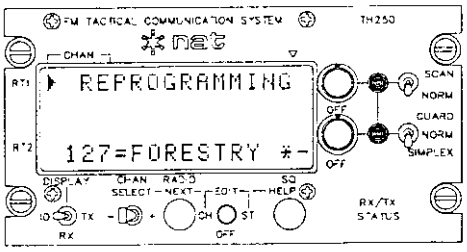
The control head can also be set to show 128 sequential channels (or some lesser number, if preferred, and have set it up that way at installation time). In this case, the channel numbers go 001 to 128. This is often used with Flexcomm radios, where there is no scan function.

There is also one additional mode, which is supported only on the NT136-PAS multi-mode transceiver. In this case, channel numbers are labeled A01 to A64 and F01 to F64. The "A" channels are AM, and the "F" channels are FM. You may scan within each 32 channel block within each bank (1-32 and 33-64), but all channels must be AM or FM within the scan group.

Blocks:	A01-A32	Sequential Numbers:	001-032
	A33-A64	(equivalent)	033-064
	F01-F32		065-096
	F33-F64		097-128

In addition to using the front panel channel and radio switches, you can also use the remote channel & radio switches, if installed. They work exactly the same way that the front panel switches work. A DTE12 or DP12 can also be used to directly access a channel by number. In this case, just key in the number (sequential number) and press the **ENTER** key on the DTE12.

It is important to understand how channel numbers work, because some things may occur on the display that won't make sense. A good example is shown below, as the control head is channeled below a01.



Note that the control displays a message REPROGRAMMING while it re-loads the next block of 32 channels into the NAT radio for scanning. This happens very quickly, but creates a short pause when scrolling through each block of 32 channels.

As soon as the data is loaded into the radio, the next channel in the next block appears (d32). Channels wrap around from highest to lowest, so that you can advance to any channel without ever having to reverse direction.

3.5.4 Summary of Subaudible Tones

Subaudible tones are sometimes used to screen unwanted transmissions on shared frequencies. They are often referred to as PL Tones or Private Line Tones. The correct name defined by Electronic Industries Association (EIA) is Continuous Tone Coded Squelch System (CTCSS).

Tac/Com has stored a useful tone look up table inside the help function. To get at it, edit a channel and move the editing cursor (flashing character) to the far right hand position where the tone should be. Pressing **HELP** there will allow the CTCSS tone table to be reviewed.

3.5.4.1 Methods of Tone Display

Over the years, many different codes have come into existence to describe these tone sub-audible tone frequencies and are listed below:

Tone Frequency (FREQ): - According to EIA, this is the only standard.

> This is a frequency below 300 Hz that uniquely identifies the tone key that is used to control the radio squelch (allows audio to be heard), or control a repeater function. We only have three digits available on the control head for this data, so any decimal fraction is omitted from the display (i.e., 103.5 Hz becomes 103). Although not displayed, the correct frequency is still used.

EIA Codes (1-32):

> This is a sequential number from 1-32 (or 38) that identifies the tone in order from lowest (67.0 Hz) to highest (203.5 Hz or 250.3 Hz)

Wulfsberg Codes (WCODES):

> These are sequential shifted OCTAL codes based on the thumbwheel design of the C-1000 control. Because they are missing numbers ending in 0 & 9, they often confuse people with the straight sequential number for the EIA tones.

Motorola Codes (MCODES):

> These are alphanumeric codes that seem largely random in assignment, but often appear in the land mobile business if Motorola equipment is used.

3.5.4.2 CTCSS or Subaudible Tone Table

The following table shows the relationship of the supported tone codes. All of these are available in the control head, and when editing, the **SELECT** slew switch (+/-) will bring up only valid choices for each type of code. Pressing **HELP** while editing these positions of the channel data will bring up the tone table for reference. The Frequency shown will have the decimal fraction truncated when displayed on the control head.

Tone Frequency	1-32 (1-38)	WCODE	MCODE
67.0 Hz	1	01	XZ
71.9 Hz	2	02	XA
74.4 Hz	3	03	WA
77.0 Hz	4	04	XB
79.7 Hz	5	05	SP
82.5 Hz	6	06	YZ
85.4 Hz	7	07	YA
88.5 Hz	8	08	YB
91.5 Hz	9	11	ZZ
94.8 Hz	10	12	ZA
97.4 Hz	11	13	ZB
100.0 Hz	12	14	1Z
103.5 Hz	13	15	1A
107.2 Hz	14	16	1B
110.9 Hz	15	17	2Z
114.8 Hz	16	18	2A
118.8 Hz	17	21	2B
123.0 Hz	18	22	3Z
127.3 Hz	19	23	3A
131.8 Hz	20	24	3B
136.5 Hz	21	25	4Z
141.3 Hz	22	26	4A
146.2 Hz	23	27	4B
151.4 Hz	24	28	5Z
156.7 Hz	25	31	5A
162.2 Hz	26	32	5B
167.9 Hz	27	33	6Z
173.8 Hz	28	34	6A
179.9 Hz	29	35	6B
186.2 Hz	30	36	7Z
192.8 Hz	31	37	7A
203.5 Hz	32	38	M1
210.7 Hz (NAT)	33 (NAT ONLY)	41 (NAT ONLY)	M2 (NAT ONLY)
218.1 Hz (NAT)	34 (NAT ONLY)	42 (NAT ONLY)	M3 (NAT ONLY)
225.7 Hz (NAT)	35 (NAT ONLY)	43 (NAT ONLY)	M4 (NAT ONLY)
233.6 Hz (NAT)	36 (NAT ONLY)	44 (NAT ONLY)	M5 (NAT ONLY)
241.8 Hz (NAT)	37 (NAT ONLY)	45 (NAT ONLY)	M6 (NAT ONLY)
250.3 Hz (NAT)	38 (NAT ONLY)	46 (NAT ONLY)	M7 (NAT ONLY)

The multiple codes shown are available on current generation Tac/Com II controls only. Previous generation Tac/Com I & II controls had only a single code, which was the WCODE, for compatibility with existing aircraft transceivers.
The additional codes and frequency display were added in 1991 for USFS/OAS contracts in the new control head software. Tone data, is often received in the EIA sequential number format, or as the raw frequency, and require additional tone support for ease of use. Controls with USFS interfaces (guard controls) are set for the EIA sequential tone code at the factory. Older controls (pre-1991 Tac/Com II) may upgrade to current generation software for this expanded tone display.

3.5.4.3 Using Help to Get the Table

The tone code table is accessed by pressing **HELP** while editing a tone location during channel editing. Scroll through the table by pressing **HELP** until you find the entry you want. Press **RADIO** to exit, or continue through the table by pressing **HELP** until you return to the data entry screen.

3.5.4.4 DPL Codes

NAT NT-series transceivers support 83 Digital Private Line Codes (DPL) in addition to the CTCSS or Private Line subaudible tones. This option must be enabled at installation time in the installation and configuration mode of operation. It is normally shipped set off by the factory to reduce confusion over tone codes.

DPL codes are three digit sequences that describe a digital code sent at low frequency in the background of regular transmissions. They are filtered out of normal receive audio and provide another method of signaling or squelch control.

Code numbers are arbitrary and are stored in an internal table. When in use, the control head finds the correct entries based on how the code is entered. The FREQ option for tone presentation is not available if DPL is enabled.

023	DPL Code	If you begin to edit the "0" position, the control head is programmed to select a 3-digit DPL code and bring up the table for the SELECT switch to choose from.
32	Tone Code	If you skip over the first digit position, the control head is tone code programmed to select a 2-digit tone code and bring up the table for selection.

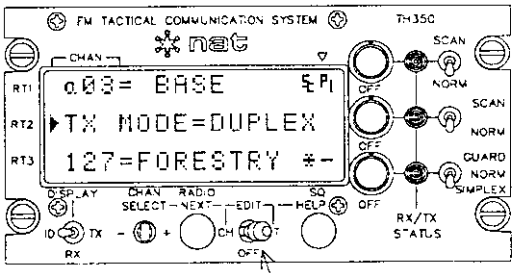
This arises ONLY if DPL is enabled. For most users, this selection will not be used because only subaudible tones are used.

3.6 Status Line Editing

The status lines for each radio contain all the extra functions supported by the radio. Because this is largely defined in software, it also provides a very cost-effective method of upgrading the system performance or features through simple software (EPROM) changes, rather than radical panel re-design. Some radios may have little or no function support (such as the FliteFone 40), others may have many features (such as NT-series RT's) including power level shift, scan, tones, and priority.

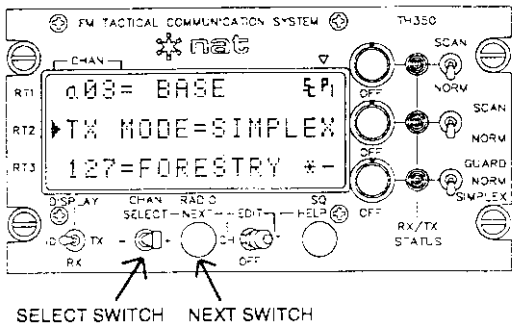
Like editing other data, only allowable options are presented, guided by the control head's reading of the interface card's capability and the stored software installation set up routines. This mode can also be used to display the status of the radio quickly, without editing any data.

To edit status line data, press the **RADIO** button until the triangular cursor appears to the left of the radio whose status you wish to edit or display. Once the radio is selected, you may then go into the **ST**(status) **EDIT** mode and change the information.



In this mode, each of the available functions for the radio can be set, or reviewed. Only valid functions and choices will be presented. Note that for this radio, the Tx mode function is set for DUPLEX operation. Pressing **NEXT** will advance to the next function, while pressing **SELECT** will select what choice is wanted for this function.

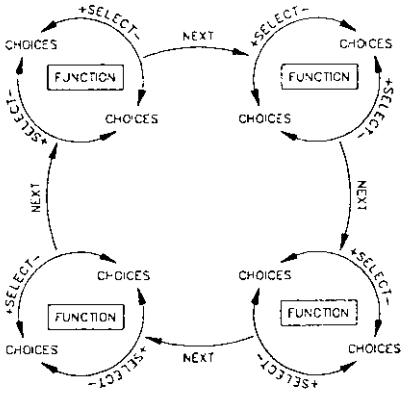
3.6.1 NEXT and SELECT Switch Use



SIMPLEX This choice will cycle with the SELECT switch.
TX MODE This function will cycle with the NEXT switch.

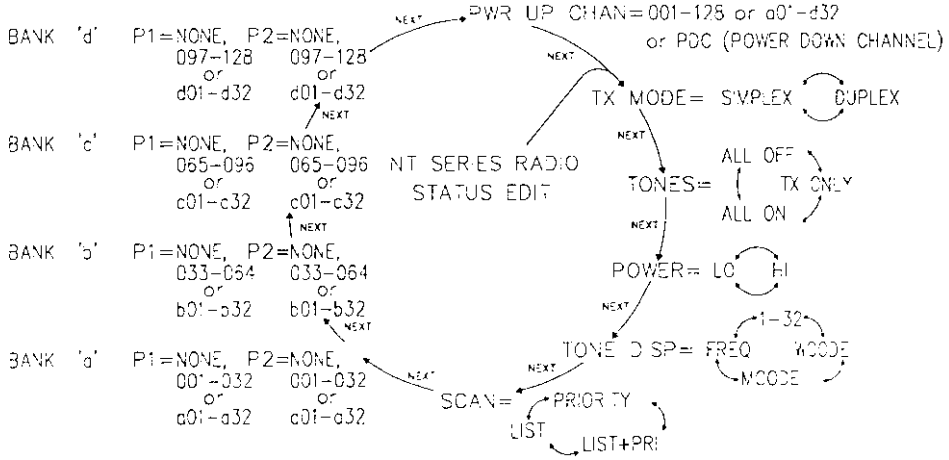
Cycling **SELECT** will change the choice displayed for any given function.

To advance to the next function, press **NEXT**, and it will appear. Use the **SELECT** switch to again insert the desired option, and continue in this manner until your radio status is correctly defined. If you continue pressing **NEXT**, you will cycle around again in a loop to allow you to correct any errors. The pattern of this selection is shown below to illustrate the flow of information:



The specific functions that appear in this general loop vary with each transceiver type, and to some extent, the version of the software. New generation Tac/Com II controls have three scan modes, while older ones have only two. This can be upgraded by replacing the EPROM in an older control head.

To illustrate the choices possible in the STATUS EDIT MODE, the following diagram shows all the current options and choices for an NT-series transceiver. While this appears complicated as a chart, it is very simple to use and just represents a sequence of clear choices that cycle around for user selection.



When you are finished editing, just return the **EDIT** switch to **OFF**, and the information will be stored. You do not have to go through the entire status listing and you can exit at any time. You may also use this feature to check how the radio is set up and do not have to make any changes.

3.6.2 Status Edit Features

The status edit features currently implemented in Tac/Com are as shown and explained below:

3.6.2.1 TX MODE=

There are two modes possible, either **DUPLEX** (REPEATER) operation, or **SIMPLEX** (DIRECT) operation. This determines whether a common frequency is used for RX and TX, or whether different frequencies will be used. This function over-rides what is stored in the individual channel data locations, and allows those stored channels to also be operated in SIMPLEX mode without taking up another storage location. Not all radios have this capability.

3.6.2.2 TONES=

Most radios have this capability. **TONES** can be set **ON** or **OFF** for the radio by this function, thus enabling or disabling any tones which may be set on a per channel basis through channel editing. NAT NT-series radios and the RT-96/7200 also support a tones mode of **TX ONLY**, which enables only the transmit tone, but not the receive tone. This is used where the tones are needed only to open the repeater and serve no RX squelch function.

3.6.2.3 POWER=

Some radios, such as NAT's NT-series and the RT-9600/7200 support a high and low power transmitter function. Many radio station licenses have power restrictions at altitude, and must be set to low TX power above 5,000' for legal operation. This may also be required to prevent repeater interference at altitude, or to permit secure operations.

3.6.2.4 TONE DISP=

New generation software now permits the user to define the tone presentation to suit local operations on a radio by radio basis. This selection can be set to the tone frequency referred to as FREQ, or to one of several codes. The sequential numbers for the first 32 EIA tones are referred to as 1-32. The alphanumeric codes for Motorola radios are referred to as MCODES. The shifted octal codes used by Wulfsberg are referred to as WCODES on the status line.
To select the desired tone display option from the list, chose the desired display mode with the **SELECT** switch. The options are **1-32**, **WCODE**, **MCODE** and **FREQ**. Note that

the **FREQ** option will not appear if the DPL tones have been selected ON in the IAC edit mode. Refer to Section 3.5.4.2 for more information.

3.6.2.5 SCAN=

For NAT series transceivers, the option of scanning a **LIST**, **PRIORITY** channels, or on newer generation control heads, **LIST + PRIORITY** is provided. The Scan List channels are edited in the second last digit on the ID line from normal channel edit mode. For more details on scanning refer to Section 3.7.

3.6.2.6 P1=, P2=

The Priority 1 and 2 channels are selected by toggling the **CHAN +/-** switch. Two channels are selected for each bank of channels (a through d). When the scan option is selected to List, the priority channels are not active but are retained in memory.

3.6.2.7 GUARD RCVR=

The RT-9600 guard functions can be from either the front panel (U interface), or the status line, depending on which type of interface has been installed in the control head. If the status line is used (R or P interface) the line appears as GUARD=0 (off), 1, or 2.

For Flexcomm, the guard RX may only be enabled or not from the status line, as only one channel exists. Front panel guard functions refer to guard transmit operation.

3.6.2.8 PWR-UP CHAN=

This is the channel the control head will go to when it is powered up. This may be set for each radio. On early Tac/Com I controls, only a specific channel could be set, but current generation Tac/Com I & II motherboards have additional non-volatile memory to remember the last channel used, and so can also provide an option of returning to the last channel set prior to power down. This channel is referred to as the PDC or Power Down Channel, and can be set as an option instead of any specific channel number.

3.6.2.9 ENCRYPTION=

NAT NTX138 radios are available with an encryption option. If installed in the radio the control head will include a status line to allow the selection of encryption "on" or "off".

3.7 Channel Display Summary

The NAT Tac/Com control heads provide three displays for each channel of stored radio information as set by the **DISPLAY** switch at the lower left side of the control head.

3.7.1 Display Switch Set to "ID"

ID or Channel Label Information. This is a name, such as FORESTRY, HOSPITAL or BASE 5. The display format shows the CHANNEL number, ID LABEL, and any SCAN FLAGS.

A typical ID Label might look like this:

a01= FORESTRY ^{S}c
Channel Label Scan Flag

The "=" indicates that TONES ARE ENABLED. This appears only once the tones are turned ON from the STATUS EDIT function. Tones can be stored, but not active, and can be activated for TX ONLY, or both TX and RX, as required. TX ONLY is the normal mode for forestry operations on USFS/OAS/BLM contracts. If all tones (both RX and TX) are activated, no audio may be heard in some simplex operations, as no tones may be present, and thus the radio squelch will not open.

SCAN FLAGS indicate which channels are flagged for monitoring during LIST SCAN. Another flag can appear here, the PRIORITY SCAN FLAG for the P1 and P2 channels, but this data is set from the STATUS EDIT function, as it can exist only once for each radio. Both list & priority scan are supported in NAT NT-series radios, and can be programmed by the operator. For Flexcomm radios, a CHANNEL DISCRETE flag ([) can also be programmed, to be used for special external switching. It appears in the same place as the SCAN FLAG on the display.

NAT NTX138 radios provide wide-band and narrow-band operation. The selected mode is indicated by the bandwidth flag. It indicates the current modulation acceptance and transmit deviation mode. When a W̲ character is displayed the channel is operating in wide-band mode. When a n̲ character is displayed the channel is operating in narrow-band mode

A typical NTX138 ID line might look like this

a01= FORESTRY n̲ ^{S}c P1

Channel Label Bandwidth Flag Scan Flags

3.7.2 Display Switch Set to "RX"

RX or Receive Frequency and Tone. This is the receive frequency of a given channel, plus its Receive Tone (if any), displayed in the format selected previously.

A typical RX frequency might look like this:

a01= 156.875r 91
Channel RX Freq. Tone

The "=" indicates that tones are enabled from the STATUS EDIT function. The small "r" indicates that the data displayed is a RECEIVE frequency. If the radio is put into the simplex mode, this will be replaced with an "s". In SIMPLEX or DIRECT operation, the radio's TX frequency is shifted to the previous RX frequency, to permit talk-around operation on repeaters. The old data remains in the control head, and the data displayed is for reference only.

3.7.3 Display Switch Set to "TX"

TX or Transmit Frequency and Tone. This is the transmit frequency of a given channel, plus its Transmit Tone (if any), in the format selected previously.

A typical TX frequency might look like this:

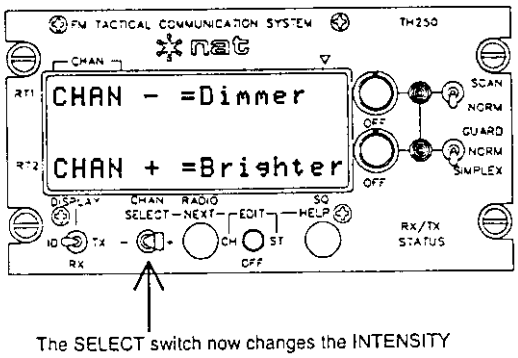
a01= 154.775t 100
Channel TX Freq. Tone

The "=" indicates that tones are enabled from the STATUS EDIT function. The small "t" indicates that the data displayed is a transmit frequency. If the radio is put into the simplex mode, this will be replaced with an "s", and the TX frequency cannot be edited. In SIMPLEX or DIRECT operation, the radio's TX frequency is shifted to the RX frequency, to permit talk-around operation on repeaters. The old data remains in the control head, and the data displayed is for reference only.

The Tac/Com Control Head has the ability to display the tone data in any of the formats in Section 3.5.2.4, plus 83 DPL or Digital Private Line identifiers.

3.8 Changing Display Brightness

There is one additional display function, which is the INTENSITY/CONTRAST setting. On LED controls, this is done by advancing the cursor past the bottom radio, and the screen on the next page will display. On a two radio control, simply press the **RADIO** button two times if the cursor is set to the top radio, or once if set to the bottom radio, and the screen below will appear. Press **RADIO** again to return to normal operation.



On LCD controls, there are two ways of making this adjustment, either by the screen described above, or by a **DISPLAY/CONTRAST** pot, if there is adequate room on the front panel. The Contrast control changes the contrast ratio and viewing angle of the LCD to suit varying light and position situations. If the display is subjected to dramatic temperature extremes (hot or cold), it will alter the chemical properties of the display, and may require an adjustment of this control to return the appearance to the desired presentation.

3.9 Scanning

Scanning is an automatic internal function that rapidly samples radio channels under operator control. The operator may select one of several predefined modes that control how the radio will carry out this function (via the STATUS EDIT function), and has a front panel switch to send the radio into this mode of operation.

Scanning is very useful for checking radio traffic on one or more channels, while working a "home" or monitor channel (the one the radio was on before scanning was selected). When scanning is active, All CTCSS/Subaudible Tone or DPL Functions are ignored, and the radio does not test for these conditions when determining that a channel has been found. Tones remain active for squelch control. This is because the delay to test for tones is so long compared to the radio lock-up time, that scanning would be seriously compromised. Tac/Com transceivers scan at rates of approximately 90 channels/second. It takes almost half a second to provide tone or DPL decoding, which would result in a virtually useless scan rate of 2 channels/second.

When Scanning is active, the front panel **CHAN** switch is inactive (for that radio), because channel control is taken over by the scanning logic in the control head. This may cause some operator confusion if the control head has acquired a channel (while scanning) and you then attempt to manually change channels for some reason. No change will occur, and the radio must be selected out of **SCAN** into **NORM** operation for manual channel changes to work from the panel control.

If the microphone for a transceiver is keyed while the control head is scanning, the radio will be rechanneled to the "home" or monitor channel for transmission.
When scanning, a signal needs to be slightly stronger than during normal operation because the time interval for detection is so short. No tones or DPL codes are taken

into account when scanning. The radio will stop on any scan designated channel that has an RF signal present, but received audio may not be heard if the tones are incorrectly set in the control head. To avoid any confusion, tones can be set to OFF (via the status edit function) during scanning so that all channels will be heard.

Any channel can be designated as both a PRIORITY channel and a LIST channel within the 4 banks of 32 channels supported by NAT NT-series transceivers. The appropriate scan flags will then appear after the channel name in the ID mode (P1, or P2, and/or SC). Any or all of the 32 channels in a bank can be in the list for LIST SCANNING, but only one channel each may be assigned the P1 and P2 Priority designation.

NOTE: NAT NTX138 radios provide 128 continous channels. Therefore only one pair of priority channels can be selected.

When scanning is selected by the front panel mode switch, a message will be displayed to indicate what the radio is doing. On earlier Tac/Com controls, this message was "SCANNING", but in new software revisions, the scan mode and bank are now displayed for better operator understanding. These messages are now as follows:

Display	Scan Mode
L -SCANNING 'a'	LIST SCANNING, bank 'a'
P -SCANNING 'b'	PRIORITY SCANNING bank 'b'
LP-SCANNING 'c'	LIST+PRIORITY bank 'c'

3.9.1 Scan Modes

If priority scan channels are enabled through the status editing mode, the channel label will then be followed by the ident: **P1** or **P2** viewed in the **ID** display mode, indicating priority status. If the channel was added to the list scan mode, the **SC** flag will also be displayed when viewing the channel label. Priority channels are selected by the status line, as is the **SCAN MODE** (list or priority). Channels are designated for list scanning in the **ID** label edit (**CH**) function. Current generation Tac/Com II software supports three scan modes as follows:

3.9.1.1 LIST Scanning

Channels are designated for **LIST** scanning by adding a scan flag (S_C) to the end of the **ID** line when in the channel editing mode. This space can be toggled to be either a dash (not flagged), or the (S_C) flag, showing that the channel is added to the scan list for that block of 32 channels.

Once scanning is active, the control will move through all the flagged channels in order until a carrier is detected, then it will remain on that channel until traffic stops, plus a 2-3 second latency period to permit you to reply to any incoming traffic. If there is no further activity, the control will continue through the list, and then start over. When scanning is de selected, the control head resumes normal operation and the radio will return to the "home" or monitor channel it was set to before scanning began.

3.9.1.2 PRIORITY Scanning

Because they can exist only once in each block of 32 channels and to avoid accidental duplication, priority channels are set via the status edit function. The same priority channels could be set for every block, but they must then be entered into channels within each block. The highest priority channel is designated **P1**, and the next priority P2; the lowest priority is the "home" or monitor channel. The P_1/ P_2 flags will appear after the channel names in the **ID** mode, once they are set. It is not necessary to have both P1 and P2 assigned, if they are not required.

If a transmission is received on the "home" channel, both **P1** and **P2** continue to be checked. If a transmission occurs on the P2 channel, the radio will continue to check for activity on **P1**. If a transmission occurs on the designated **P1** channel, the radio will rechannel to that frequency, regardless of activity on other channels. The check during priority is very fast, about every 1/3 second, and will sound like a faint tick when occurring during other reception. Whenever an incoming transmission is detected, the display will show the correct channel data corresponding to the display mode selected ("**ID**", "**RX**" or "**TX**").

3.9.1.3 LIST+PRIORITY Scanning

In this mode, both **LIST & PRIORITY** features are combined, so that a list can be checked while still periodically testing for activity on two priority channels. This is a new feature and only exists on software revisions 2.13 and later for Tac/Com II, and 1.45 and later for Tac/Com I controls. In this case, priority allocations remain per the normal priority mode, but list channels have a lower priority than the "home" channel, and are scanned only when there is not any activity on the other three.

3.9.1.4 AM Scanning

While this was not an original feature of Tac/Com and the NT136-PAS multi-mode transceiver, it is now fully implemented. Some hardware updates are required to the transceiver (below s/n 1018) to achieve the required sensitivity for fast-lock AM reception, but coupled with current software, it can provide scanning with AM levels down to 2.0 uV. Because of the electrically noisy environment aircraft present, squelch thresholds must be much higher for AM receivers than for FM (2-3.0 uV versus 0.5 uV). When scanning, the effective range of coverage will be smaller for AM than for FM signals of the same strength.

3.9.1.5 Scanning on other systems

On Midland Syn-Tech I radios, channels added to the scan list will have the letters "a" or "b" added to the end of the ID label display. The status line is used to select whether list b or both list a and b are used in the **SCAN** mode. Only list a channels are used in the priority mode. Scanning is not provided for Wulfsberg radios due to their very long synthesizer lock up times, which preclude scanning.

3.10 NAT NTX138 Wide-band/Narrow-band Operation

The NAT NTX138 radios are capable of operating in either a wideband mode (5.0 Khz modulation) or narrowband (2.5kHz modulation) mode. These modes are largely determined by the type of system the radio is operating with, and the associated channel spacing.