UNIVERSAL M-8000

Version 5

Owner's Manual

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&
Universal Radio Research

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1.0 INTRODUCTION

You are now the owner of the most versatile communications terminal available. This state-of-the-art device offers a host of features and capabilities never before offered in a unit of this class.

This unit was designed as a commercial grade piece of equipment, with the professional operator in mind. Of course it is also more than suitable for the advanced hobbyist.

We recommend that you read this manual thoroughly in order to obtain the full performance capability engineered into this product. This manual provides users with information necessary for proper installation and operation of the Universal M-8000v5 in normal operating situations. Additional information on specific operating and installation situations may be obtained by contacting your dealer.

Important Note: Listeners are reminded that the unauthorized interception and/or divulgence of private non-broadcast radio or satellite communications may violate federal and/or state laws.

2.0 GENERAL DESCRIPTION

The Universal M-8000v5 provides video output of Morse, Baudot, ASCII, Packet, PACTOR, Simplex Telex Over Radio (SITOR), a variety of both simplex and duplex ARQ and FEC codes, PICCOLO code, ACARS and POCSAG and GOLAY paging codes and Facsimile images when attached to a communications receiver and a color VGA monitor. A variety of matrix and laser printers may also be added.

This converter includes capabilities and features usually not found on other units of its kind. Key advanced features include:

- Bit inversion decoding of Baudot codes.
- Decoding of the SITOR codes (modes A and B).
- Decoding of the ARQ (TDM Moore) codes.
- Decoding Packet 300 baud and 1200 baud (AX.25).
- Decoding PACTOR
- Decoding of three shift Russian Cyrillic to video.
- Decoding of PICCOLO multi-tone signals.
- Decoding of POCSAG and GOLAY pager signals.
- Decoding of the ACARS VHF radioteletype mode.
- Literal display mode.
- Databit code analysis mode.
- A unique retro-print feature allows the user to obtain hard copy of received data after reception.
- Crystal controlled tone filters with frequency and bandwidth optimized, to the selected shift and speed, by the internal microprocessor.
- Remote computer, or terminal, control of operation.
- User programmable initialization and Sel-Cal codes.
- Automatic filter tuning by microprocessor.
- VFT (FDM) demodulator operation.
- Eleven, user programmable, recallable operating memories.
- Full-color on-screen tuning aids including input and tone filter levels, x-y tuning 'scope' and spectral display.

3.0 INSTALLATION

3.1 LINE VOLTAGE SELECTION

Before connecting the M-8000 to the power mains, check that the voltage selection switch on the rear panel is set to the proper voltage. This switch is located directly below the power cord connector. If you are connecting the unit to 110-120 V.A.C. mains, the switch must be set so that "115V" is visible. For connection to 220-230 V.A.C. power, the switch must be set so that "230V" is visible.

The switch setting may be changed by using a small screwdriver, paper clip, or fingernail. Make certain that the selector switch is set fully to the proper side before connecting the power cable. Do not change the setting of this switch unless the power cord is unplugged from the mains outlet.

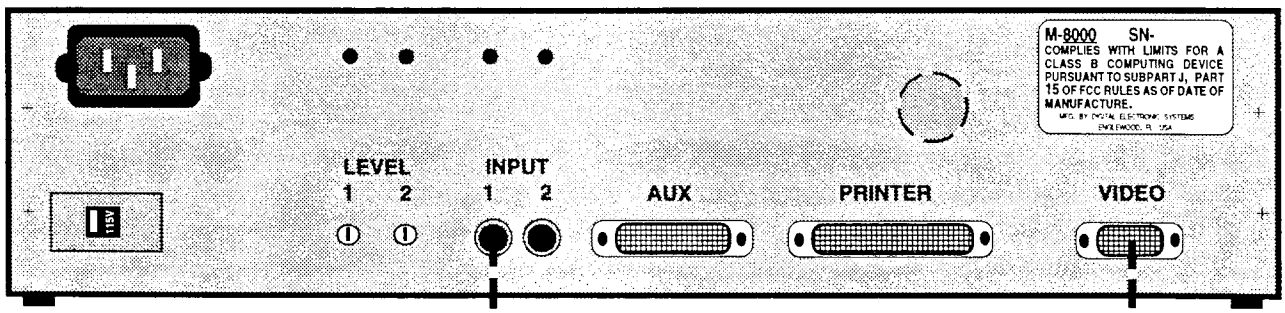
Warning: Attempting to operate the unit with the voltage selection switch improperly set may result in serious permanent damage to the equipment and/or serious personal injury.

3.2 RECEIVER CONNECTION

Any good quality communications receiver will suffice for use with the M-8000. However stability, sensitivity and selectivity are the most important attributes of a good RTTY communications receiver. Examples of suitable shortwave receivers would include:

• Kenwood R-1000	• Yaesu FRG-7000	• Icom R-70	• Lowe HF-150
• Kenwood R-2000	• Yaesu FRG-7700	• Icom R-71A	• Lowe HF-225
• Kenwood R-5000	• Yaesu FRG-8800	• Icom R-72	• Lowe HF-235
• Drake R-8	• Yaesu FRG-100	• Icom R-9000	• W-J HF1000
• Drake SW-8	• JRC NRD-515	• JRC NRD-525	• JRC NRD-535/D

The best point of connection to your receiver would be the Record or Line output. If your receiver does not provide such outputs, then you may connect the M-8000 "INPUT" to the earphone or speaker outputs using the two conductor phone plug (supplied) and an appropriate length of two conductor wire. Shielded wire should be used for this cable.



Connect to *Record Output* of your communications receiver.

Connect to your VGA video monitor.

■ RECEIVER INPUT LEVEL ADJUSTMENT

The M-8000 provides for a wide range of audio input levels from receivers. For proper operation of the unit, however, it is imperative that the input level of the M-8000 be set to correctly match the receiver to be used. This is quite simply done as follows:

1. Connect the audio output (record, line, speaker, phones, etc.) from your receiver to the 1 INPUT of the M-8000.
2. Turn on the M-8000 and receiver.
3. Tune in a fairly strong RTTY signal (precise tuning is not important at this point).
4. Adjust the LEVEL 1 control on the rear panel while observing the on-screen "INPUT 1" level display bar. The level control should be set so that the displayed level is at the border between the two green segments on the level bar. A small flat-blade screwdriver should be used to adjust the LEVEL control.
5. Repeat the above procedure for the second input by using INPUT 2 and LEVEL 2 and observing the "INPUT 2" level bar.

NOTE: Do not over-drive the input stages of the M-8000. Input levels which cause an input bar level to light the bright red segment (at the extreme right of the bar) may degrade the performance of the unit.

3.3 VIDEO MONITOR CONNECTION

The most important consideration is selecting a video monitor is to ensure that it is compatible with the M-8000 output. The M-8000 generates a full 640 x 480 16 color analog VGA graphics display with a nominal horizontal frequency of 31.5 kHz. and a vertical frequency of 60 Hz. The M-8000 employs the widely-used 15 pin mini-D for the video output connector.

The quality and sharpness of the displayed image depends upon the resolution of the video monitor. This resolution is controlled by two factors: video bandwidth and phosphor dot pitch. With bandwidth (measured in megahertz (MHz.)) the higher the number, the better the performance. When comparing dot pitch, however, the lower (smaller) the number is the better the quality will be. A dot pitch of 0.31 millimeters (mm) will give good results.

When selecting a video monitor for use with the M-8000, remember that monitors with an FCC Part 15 class "B" certification have been tested to tighter EMI and RFI emission standards than those with a class "A" emission rating, and as such radiate less interference to short-wave radio signals.

You may want to consider investing in a multi-sync monitor at this point. While these sophisticated monitors command a premium price, their flexibility may prove worthwhile as higher resolution displays become more prevalent.

The video monitor is connected to the "VIDEO" jack on the rear panel. If your video monitor is equipped with a connector other than the 15 pin mini-D, then an adapter must be used to mate your connector with the M-8000. These adapters are often available at local computer stores.

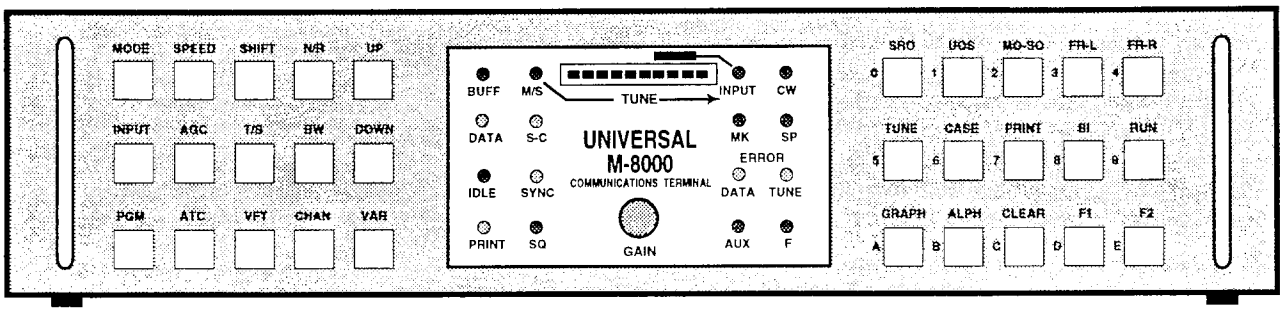
■ THE VIDEO SCREEN

The top 26 rows of the screen are reserved for displaying received text. Below this area is a graphics tuning indicator section. In modes where these tuning indicators are not usable (Morse, DataBit, FAX or Paging modes), this section of the screen is automatically converted for use as displaying additional text (graphics in FAX mode). This conversion to text may also be initiated manually, by user command, to provide a 30 line by 80 character display in any text mode, if the tuning aids are not needed. The bottom two lines of the screen are used as status lines to display the setting of the various operating parameters affected by the control keys.

4.0 OPERATING CONTROLS

4.1 POWER SWITCH

The power to the M-8000 is controlled by a toggle switch located behind the right hand rack handle. Up is *ON*, down is *OFF*.



4.2 KEYPAD FUNCTIONS

The M-8000 uses 30 push-button keys to control the majority of operating functions. Some of these keys are capable of providing more than one function by using them in conjunction with the **F1** or **F2** keys. These alternate functions are activated by pressing the **F1** or **F2** key and then pressing the appropriate multi-function key. When one of the alternate functions (F1 or F2) is active, the F LED will blink and the appropriate F on the status line will also blink. The alternate function enable will turn off as soon as any control key is pressed. To disable the alternate selection without performing an alternate function, simply press the appropriate **F** key a second time.

Whenever a key is pressed, a short beep tone (1000 Hz.) will be heard. If the pressed key has no function in the selected mode of operation, or if the limits to the function of that key have already been reached, then a lower frequency tone (500 Hz.) will be heard. These tones can be enabled or disabled by the user in the PROGRAM function.

Pressing and holding certain keys will cause the function of that key to repeat, just as if the key were pressed and released multiple times. Keys that do this are noted below by the {repeats} indication after the function description.

The functions associated with several of the keys have 'variable' capabilities. When these keys are pressed, in addition to performing the indicated operation, the status line indicator for that function will be highlighted. When a status line function is highlighted, the **UP** and **DOWN** keys may be used to step through the available values or vary the value of that function. The selected function will remain highlighted until another control key with variable capability is pressed or the **VAR** key is used to select another variable function. Keys that operate in this manner are noted below by the {variable} indication after the function description.

LEFT HAND KEY ARRAY

MODE	Steps through the available operating modes in the following sequence: Baudot, ASCII, Packet, PACTOR, Sitor-A, Sitor-B, Autor, FEC-A, FEC-S, ARQ-M2, ARQ-M4, ARQ-E, ARQ-E3, ARQ-S, SWED, ARQ6-90, ASYNC, SYNC, ACARS, POCSAG, GOLAY, PICCOLO, FAX and Morse. {repeats} {var.}
F1+ MODE	Direct entry of mode.
F2+ MODE	Short-cut, expert mode.
SPEED	Steps through the available standard speeds of operation for the selected mode. {repeats} {variable}
F2+ SPEED	Direct entry of speed.
SHIFT	Steps through the six pre-set shifts of the high or low tone sets or through the seven pre-set tone pairs in the modem mode. {repeats} {variable}
F2+ SHIFT	Direct entry of shift.
N/R	Selects between Normal and Reverse sense of the demodulator.
UP	Increases the value of the currently selected variable parameter. {repeats}
INPUT	Switches between audio input 1 and input 2.
F1+ INPUT	Turns the DIVersity function on or off.
AGC	Selects AGC off, AGC on or LIMiter.
T/S	Selects the demodulator Tone Set as high tones, low tones or modem tones.
F1+ T/S	Selects external demodulators.
F2+ T/S	Direct entry of Mark tone frequency.
BW	Modifies the BandWidth of the demodulator filters from the NOMinal value in steps ranging from -3 (narrowest) to +3 (widest). {variable}
DOWN	Decreases the value of the currently selected variable parameter. {repeats}
F2+ PGM	Accesses the menu-driven programming function of the M-8000.
ATC	Turns the Automatic Threshold Circuit on or off.
VFT	Selects the Voice Frequency Telegraph demodulator mode (FDM).
F2+ VFT	Direct entry of Space tone frequency.
CHAN	Steps through the available VFT tone channels within the selected channelization mode. If VFT demodulator is not in use, CHAN selects the desired ARQ-M2 or ARQ-M4 channel to monitor.
F1+ CHAN	Selects the desired ARQ-M2 or ARQ-M4 channel to monitor.
VAR	Steps through the various operating parameters which are capable of variable operation: MODE, SPEED, SHIFT, BW or no variable functions.

RIGHT HAND KEY ARRAY

SRO (Speed Read Out) Initiates the speed evaluation function.

UOS (Unshift On Space) Turns the UOS function on or off in all Baudot based codes. In ASCII mode selects parity operation.

MO-SO (Mark Only - Space Only) Enables the Mark filter or Space filter to operate alone or both filters to operate simultaneously.

FR-L (FRame Left)

FR-R (FRame Right)

TUNE Activates the automatic demodulator filter tuning function.

F2+ TUNE Activates the automatic filter tuning and speed setting function.

CASE Manually steps through the cases for Baudot-based RTTY modes: Figures, Letters and National. (National in three-shift alphabets only).

PRINT Selects the printer output mode to be:
OFF, ON, SPC (space character), S-C (sel-cal) or SQU (squelch).

F1+ PRINT Causes the indications on the status lines to be sent to the printer.

F2+ PRINT Activates the retro-print function. The last 2048 characters received are placed in the printer output buffer and a printer selection of ON is assumed. The retro-print function will turn off when the printer buffer empties. While retro-print is active, the status line will indicate "PRN=RET".

F1/F2+ BI Control the operation of the Baudot-based Bit Inversion decoding function.

RUN Starts or stops the transfer of received data to the video screen and printers. This function operates only in the following modes: SYNC (databit) and FAX.

GRAPH Sets the front panel LED bar-graph to indicate either the audio level to the tone filters or the output of the Mark / Space filters.

F2+ GRAPH Controls whether the video display will be 80 x 26 text characters with graphic tuning aids or 80 x 30 text with status lines only. When the display is switched from one format to another, the screen is automatically cleared.

ALPH Selects the desired Baudot or Baudot-based code ALPHabets of:
ITA (ITA-2), TLX (Telex), MIL (Military) and CYR (Cyrillic).

F1+ ALPH Switches the Literal code conversion option on or off.

CLEAR Clears the video display screen.

F1+ CLEAR Clears the printer buffers (except in FAX mode it clears the screen).

F2+ CLEAR Clears the spectral display.

In addition to the above functions, each of the right-hand control keys is labeled with a number (0-9) or letter (A-E). These keys are also used for numeric entry and/or programming functions.

5.0 LED INDICATORS

BUFF	Indicates a printer buffer overflow condition.
DATA	Indicates that data is being received by the M-8000.
IDLE	When receiving synchronous codes, this LED turns on when idle or phasing signals are being received.
PRINT	Indicates when data is being transferred to one or both of the printer outputs.
M/S	Indicates that the LED bar-graph is displaying the tuning level of the Mark and Space filters. The signal should be tuned for maximum deflection to the right.
SC	Indicates reception of a user-programmed Sel-Cal.
SYNC	When receiving synchronous codes, this LED indicates the unit has acquired the proper phasing and sync to decode the signal.
SQ	When this LED is on it indicates that the squelch circuit is open, that is, sufficient signal is detected to allow data to flow to the video and printers.
INPUT	Indicates that the LED bar-graph is displaying the received audio level present at the input to the unit's pre-filters. Best operation is normally obtained when one of the LED's under the white block is illuminated.
MK	Indicates reception of a MARK tone.
DATA ERROR	Data being received by microprocessor does not meet specification selected by mode and speed controls.
AUX	Reserved for future use.
CW	Indicates when a "key down" Morse code signal is detected.
SP	Indicates reception of a SPACE Tone.
TUNE ERROR	Indicates improper tuning or reception.
F	This LED will blink when either the F1 or F2 function keys are active.

6.0 SCREEN INDICATORS

6.1 STATUS LINES

The bottom two display lines on the M-8000 are used to display the status of the various operating parameters which are controlled by the operating keys, as well as other pertinent operating information. Each portion of these status lines is dedicated to displaying a specific type of indicator as shown in the example below:

```
DIV   IN-1 AGC    HIGH  NOM  M+S UOS              F1 MK=2125
BAUDOT     75     170  NOR  ATC ITA  PRN=ON      F2 SP=2295 12/25 14:36
```

6.2 TUNING BARS

At the left side of the tuning graphics section of the screen are five bar-graph type indicators. These are 128 step multi-colored bars with a gray background. The top two bars indicate the level of the audio input to the unit. The indication on these bars is affected by the output of the receiver connected to the input and the setting of the input level controls at the rear panel. The rightmost color displayed corresponds to the following input conditions:

ALL GRAY	virtually no audio input
RED	extremely low input level
BROWN	low input level
BLUE	slightly low input level
GREEN	proper input level (low range)
LT GREEN	proper input level (high range)
YELLOW	slight limiting of input signal
LT RED	full limiting of input signal

These input level tuning bars may be removed from the display with option four under the Video menu in the programming mode.

The lower three bars serve to assist in tuning the received signal by indicating the output level of the Mark filter, Space filter and an average of the combined Mark and Space filters. These bars, labeled as MARK, SPACE and MK + SP respectively, indicate the tuning status as follows:

ALL GRAY	virtually no filter output
RED	extremely poor signal or tuning
BROWN	poor signal tuning
YELLOW	fair signal tuning
LT BLUE	good signal tuning
LT GREEN	optimum signal tuning

6.3 SPECTRUM DISPLAY

The middle area of the tuning graphics section is occupied by a frequency spectral display. This display gives a visual indication of the frequency spectrum applied to the demodulator filter inputs. The analysis covers the frequency range of approximately 1000 Hz at the left end to 3000 Hz at the right end of the graph. At the bottom of the display are two reference marks. The one on the left corresponds to the low tone mark frequency of 1275 while the right one corresponds to the high tone mark of 2125. The position of these reference indicators are approximate locations only and should not be used for fine tuning a signal.

A light red bar will appear against the gray background at a position corresponding to the received audio frequency. The height of the bar will correspond to the amount of time a signal of that frequency is present. The display does not present any signal amplitude information and as such is not a true spectral analysis. The display is weighted so that signals of relatively brief duration are suppressed. In order to obtain substantial frequency peaks, the duty cycle of each displayed tone must be in the range of 35% to 45% minimum. As a result, signals such as Sitor-A and SWED-ARQ will not produce a usable spectral display because these signals have an inherent transmit duty cycle of 50% or less, allowing an average of 25% or less per tone.

In normal RTTY operation there will be two distinct peaks on the display. The location and separation of these two vertical bars will indicate the approximate frequency and shift of the received signal. The closer the two bars are, the narrower the received shift is. The farther a bar is to the right, the higher the tone frequency is.

As you slowly tune your receiver across an RTTY signal, the bars of the Mark and Space tones will move across the display. Large or sudden changes, however, may take a few seconds to register. Additionally, it will take several seconds for the display to decay after leaving the signal. If you wish to *immediately* clear the spectral display press **F2** then the **CLEAR** button.

Remember the height of the bar is independent of the demodulator filter output and does not indicate proper tuning of the signal.

6.4 X-Y TUNING SCOPE

The right side of the tuning graphics section is used for a simulated X-Y RTTY tuning scope display. This square green box has two display lines which indicate the output amplitude of the demodulator tone filters: A horizontal line for the Mark tone and a vertical line for the Space tone.

Proper tuning is indicated by the horizontal and vertical lines being at maximum length and perpendicular to each other. As with the other graphic displays, large and/or sudden changes in tuning may not be immediately reflected in the display.

The X/Y display uses both averaged and instantaneous demodulator filter output signals to derive the displayed pattern. As a result of the averaged signal factor, pulsed or keyed signals, such as SITOR-A, Packet and SWED-ARQ may result in a distorted or erratic scope pattern.

7.0 RTTY OPERATION

7.1 POWERING UP

After you have connected the receiver, and the video monitor, turn on the M-8000 power switch, located directly behind the right hand rack handle, by placing this switch in the up position. This applies power to the M-8000.

The words UNIVERSAL M-8000 should appear near the center of the screen. If this does not occur (within a few seconds) then turn the unit off and recheck your power and video connections to the M-8000 and the video monitor. It may be necessary to adjust the brightness and/or contrast controls on the video monitor to make this "sign on" visible.

Below this model number will appear the M-8000 version number. Please indicate this number when corresponding with the factory or your dealer regarding your M-8000. Please note and report the full number, including the revision number which appears after the period following the major version digit. (E.g. "2.17", not simply "version two".)

The status lines should appear at the bottom of the screen. You may need to adjust your monitor (vertical and horizontal) to center the screen and ensure the total visibility of the status lines. In some cases it may be necessary to adjust the vertical height and/or linearity of your video monitor. Consult the manual for your monitor for the proper procedure of these adjustments.

7.2 RTTY THEORY

RTTY, which stands for Radio TeleTYpe, is a term used to cover a wide variety of radio communications codes. What they all have in common is that they are based on teletype operation. Tele (far away, or remote) type (typing, or printing) originally used wires to connect the teletyping machines together, utilizing a 60 milliamp current that was turned on and off to signal characters from one machine to others. This on and off keying is called a binary, or two state code.

All of the RTTY codes that we will deal with are still binary codes (two states only), but since it is impossible to key a 60 milliamp current on and off over the air waves, another method must be used. The method that is used is to represent the two states (on and off) with two distinct tones, or frequencies (mark and space).

Now that all these RTTY codes have this in common, what makes the various signals unique are:

1. The particular two tones or frequencies that are used to signal the on and off states of the code. This is the concern of the ***DEMODULATOR*** section of the terminal.

2. The manner in which the on and off keying is used to represent each character. This is the concern of the ***DECODER*** portion of the terminal.

7.3 RTTY DEMODULATOR TUNING

As mentioned above, it is the responsibility of the demodulator to convert the two signaling tones or frequencies of mark and space into an on and off keying (current or voltage) that will be fed to the decoder for further processing.

The demodulator in the M-8000, as with nearly all RTTY demodulators, deals with audio tones or frequencies. Most, if not all HF RTTY is sent via FSK (Frequency Shift Keying), where the mark and space frequencies are RF (Radio Frequency) frequencies. These two radio frequencies may be many megahertz (millions of cycles per second) separated by only a few hundred Hertz. This separation between the mark and space frequencies is referred to as the shift.

It is the responsibility of the short-wave receiver to convert these radio frequency signals down to audio tones. While the frequency difference, or shift, between the two tones will remain constant, the actual tone frequencies are dependent upon the receiver tuning. In this respect, the receiver becomes an integral component of the demodulating system. Any instability or drift in the short-wave receiver will be reflected in the apparent loss of performance of the demodulator. The receiver must also be capable of providing the demodulator with the complete signal to be demodulated. While narrow filters may be desirable in certain cases, in other instances they serve to prevent needed portions of the signal from reaching the demodulator. Special care of this needs to be taken in the VFT mode and when using any shift of 400 Hz. or more.

The RTTY demodulator in the M-8000, while remaining in a fixed circuit configuration, is capable of operating, under microcomputer control, in six different modes, with a variable shift option available on four of these:

HIGH TONE SET	+ variable shift
LOW TONE SET	+ variable shift
MODEM	
VFT	(with four configurations)
AUTOMATIC	+ variable shift
DIRECT ENTRY	+ variable shift

Simply stated, the object of RTTY tuning is to match the mark and space tones coming from the receiver to the same frequencies as the mark and space filters in the demodulator.

In order to match these tones, the receiver must be capable of changing its tuning in very fine increments. If the main tuning of the receiver is not capable of varying the frequency by 10 Hz. or less then the delta f, RIT, BFO, or similar fine-tuning control must be used to tune RTTY signals.

NOTE The *normal* setting is: **HIGH** TONE SET

7.4 TUNING INDICATORS

While tuning the RTTY demodulator, there are several indicators that should be observed to make the process much easier. The M-8000 front panel features a ten segment red LED bargraph directly above the GAIN knob. This tuning aid can be used as a *tune bar graph* or *audio input level.* The **GRAPH** button will toggle you between these two choices.

TUNE BAR GRAPH
When the M/S LED is on, the front panel LED bar graph indicates the combined average output of the Mark and Space tone filters. Optimum tuning coincides with maximum deflection of this LED to the right.

AUDIO INPUT LEVEL
To check your input level on this same front panel LED indicator, the **GRAPH** key may need to be pressed so that the INPUT LED is on. While this indicator need not be monitored closely while tuning a signal, it should be checked prior to tuning to ensure that there is neither too much, nor too little, signal for proper RTTY operation. The receiver output and rear panel input level control should be set so that the on-screen input bar for the input in use is in the green range. The front panel gain control should be adjusted so that the LED input indicator illuminates an LED beneath the white bar. This level will normally be achieved with the gain control set at the 12:00 position if the input bar is in the green range.

MK and **SP**
The MarK and SPace LEDs on the front panel will glow in proportion to the signal level present at the output of the respective demodulator filter. The more closely tuned the received signal is to the frequency of the filter, the brighter the corresponding LED will glow.

Note: There is a certain amount of cancellation effect on very narrow shifts, to the extent that at 0 Hz shift neither LED will ever turn on.

NOTE In *normal* RTTY tuning, the use of the MK&SP LEDs is best.

TUNE ERROR
This LED indicator is useful (through 300 baud) for precise tuning of RTTY signals. This LED will indicate improper tuning, multipath distortion, or selective fading of the received signal. Proper tuning, without fading, or multi-path distortion, will be indicated by the LED being off. In normal operation some flicker of this LED will be experienced.

MARK, SPACE and **MARK + SPACE BARS** (ON SCREEN)
These on screen tuning aids indicate the output level of the demodulator filters. The received signal and/or the M-8000 should be adjusted so that each of these three bars are illuminated to the extreme right (light blue or light green).

7.5 INPUT SELECTION

Before any tuning can commence, the receiver must be connected to the input of the M-8000 that is selected by the **INPUT** key, as indicated at the left side of the top status line. Please note that if DIVersity operation is enabled and a signal is present on only one of the inputs, it will not be possible to select the input with no signal applied to it. (With respect to input selection, refer also to the section on *DIVERSITY RECEPTION* on page 67).

The HIGH, LOW and MODEM Tone Sets are selected by stepping through these options using the **T/S** key.

HIGH TONE / LOW TONE
When the High tones are used, the mark frequency is 2125 Hz., the Low tones use a mark of 1275 Hz. If your receiver has a *RTTY* operating mode, use the *RTTY* mode and select the High tone set on the M-8000. If your receiver is limited to operation on *USB* or *LSB* modes, the Low tone set will be preferred, particularly on wider shifts, due to the lower frequency bandwidth of the sideband receiver filters. In either High or Low tone sets, the **SHIFT** key steps through the following selections of shift frequencies:

60, 85, 170, 425, 850 and 1200 Hz.

In addition to these fixed shifts, the shift may be varied up or down in 5 Hz. increments from 30 to 1800 Hz., using the **UP** key to increase and the **DOWN** key to decrease the shift when the shift indication on the status line is highlighted.

When dealing with HIGH tone or LOW tone signals, the procedure for tuning and determining and setting the shift is quite simply done using only the indicators on the M-8000 as follows:

1. After locating an active RTTY signal, adjust the receiver so that the audio tones are fairly low in frequency.
2. Slowly adjust the receiver to increase the audio frequency of the tones while observing the Mark and Space tone indicators (MK and SP LEDs, MARK and SPACE graphic bars and the X/Y graphic scope).
3. Set the receiver to the setting that produced the second peak in the strength of the Mark indicators. (If the Space indicators are also at peak, tuning is completed.)
4. If the Space indicators experienced a peak during step 2 then the received shift is wider than that set on the demodulator. If there was no indication of a strong Space signal then the received shift is narrower than the demodulator setting.
5. Increase or decrease the shift as indicated by step 4 until there is a maximum signal displayed on the Space indicators. The shift may be changed in large steps by using the **SHIFT** key (this will be faster if a standard shift is being used), or in very fine steps by using the **UP** key to increase or the **DOWN** key to decrease the shift.

The RTTY station must be active (sending traffic) in order to properly tune. If a constant tone frequency is being received, there is no way of knowing if that received tone is the higher or lower of the two tones the station will send.

What the tuning method described above does, is place both tones of the unknown pair well below the mark tone filter frequency [step 1].

As we increase the frequency of the audio tones, these tones begin to approach the demodulator filter frequency. The first peak that we observe on the Mark indicators occurs when the higher of the two received tones (space) matches the lower of the two demodulator filters (mark) [step 2].

We must continue to increase the tone frequencies. When the second peak of the Mark indicator is observed, the lower of the received tones (mark) is matched to the demodulator mark filter [step 3].

If the Space indicators increased and then decreased during this tuning, that means that the higher of the two received tones matched and then surpassed the frequency of the demodulator space filter. Therefore the received shift is wider (higher) than that set. If there was no significant response noted on the Space indicators, then the higher of the two received tones has not reached the demodulator space filter. Therefore the received shift is narrower than the demodulator setting. [step 4]

When tuning the demodulator, use the receiver controls to set the mark tone, then use the demodulator controls to set the shift to match the space tone.

Practice this tuning method on several strong, known signals until you are very familiar with this simple process. Once this method becomes second nature, tuning any signal with this easy five step system will be a simple matter.

MODEM

When monitoring VHF, UHF or satellite traffic, you may need to select this feature. When the modem demodulator has been selected by the **T/S** key, the **SHIFT** key is used to step through the available modem tone sets of:

Status	Modem Standard	Mark	Space
103 O	Bell 103 Originate	1270	1070
103 A	Bell 103 Answer	2225	2025
C21 O	CCITT V.21 Originate	980	1180
C21 A	CCITT V.21 Answer	1650	1850
C23 1	CCITT V.23 Mode 1	1300	1700
C23 2	CCITT V.23 Mode 2	1300	2100
B 202	Bell 202	1200	2200

When using the Modem demodulator mode, tuning becomes very simple, but the modem tones that are used must be known in advance. Once this in known, it is simply a matter of selecting the proper tone set and adjusting the receiver to obtain maximum signal level on the Mark and Space indicators.

VFT

Tuning in the VFT (Voice Frequency Telegraphy) mode (aka FDM (Frequency Division Multiplex)) is quite challenging and often requires the use of an external RTTY tuning scope.

The VFT demodulator mode is selected by pressing the **VFT** key. Subsequent presses of the **VFT** key will step through the four VFT channelization modes (A, B, C, D). When in the VFT mode, the **CHAN** key steps through the various channels available in the selected mode. The **UP** and **DOWN** keys may also be used to select the desired channel when the channel status indicator is highlighted. The four VFT modes are described below:

MODE	A	B	C	D
CHANNELS	01-24	01-16	01-12	01-08
SPACING	120	170	240	340
M/S SHIFT	60	85	120	170

Refer to Chapter 26 for more information on tuning VFT signals.

NOTE **Mode B** is the most common VFT format on shortwave.

7.6 AUTOMATIC

The automatic filter tuning allows the M-8000 to examine the pair of tones coming from the receiver, determine the frequency of those tones, and set the demodulator filters to match those tones. The M-8000 is also capable of feedback to the operator indicating the results of the request to automatically tune.

Tune to an active RTTY signal. Press the **TUNE** key. The word "TUNE" will blink on the status line. If you are tuned at least "in the ball park", the M-8000 will tune the mark, the space and "TUNE" on the status line will change to a constant "TUNED". The approximate shift will also be displayed in the shift status area.

Once the M-8000 has selected Mark and Space frequencies as a result of an automatic tuning operation, the Mark tone may not be at one of the standard (high tone / low tone) frequencies. This non-standard Mark frequency will remain in effect through subsequent demodulator parameter changes (changes in Space or Shift frequency by means of the **SHIFT** key or the variable keys).
If you tuned too low on the signal the display will blink "TONES LOW" on the status line. In this case, the receiver should be adjusted to increase the frequency of the tones (...make them a higher pitch).

If you tuned too high on the signal the display will blink "TONES HIGH" on the status line. In this case, the receiver should be adjusted to decrease the frequency of the tones (...make them a lower pitch).

If the separation between the two received tones (the shift) is too narrow, the display will blink "CAN'T TUNE". This indication may also result from the reception of only a single tone (mark hold). If the station you are tuned to is not sending (i.e. is on hold), then wait for it to begin sending traffic before pressing the **TUNE** again. If repeated attempts to auto-tune an active station result in the "CAN'T TUNE" indication, the transmission may be too narrow for the M-8000 to copy, or it may be necessary to attempt to tune the station manually.

Just as it is possible for the automatic tuning circuit to be fooled by excessive noise or momentary deep fades, the status line indication of the tuning results may not always be a correct indication of the proper tuning action, but will in most cases be of some help in proper tuning, particularly for the novice or the 'tone deaf'.

NOTE *Manual* tuning is more work, but is intrinsically more accurate.

7.7 DIRECT ENTRY

This method allows the user to directly program (by keyboard entry) the mark frequency, space frequency, or shift frequency of the demodulator. Tuning by this method will generally be limited to situations where the exact mark and space or shift frequencies are known in advance. Under *normal* circumstances this would not be the most efficient way to set the mark and space!

Because the direct entry uses a portion of the graphics tuning screen, this function will not operate if the video screen is used for a full 30x80 text display.

The three keys that enable direct entry of the demodulator filter frequencies are:

```
F2+ SHIFT = Shift entry
F2+ T/S   = Mark  entry
F2+ VFT   = Space entry
```

(The decoder speed may also be set by direct entry using the same procedure after pressing the **F2** then the **SPEED** key). After the desired parameter is selected, using the **F2** function key, the name of the parameter will flash to the left of the X/Y tuning scope and "__ __ __ __" will appear below the flashing prompt. You may now enter the new parameter value by using the number keys on the right keyboard. As each digit key is pressed, the value of that digit is displayed in the corresponding blank. The entered value must be a four digit number entered on the right keyboard. For example, the value "170" would have to be entered as "0170". To cancel the entry, simply press the **CLEAR** key before entering the fourth digit.

As soon as the fourth digit is entered, the new value is tested to see if it is within the allowed range for that variable. If it is, then that value is immediately loaded into that parameter. If the entered value is outside the allowed range, then the entire command is discarded.

In order to provide maximum flexibility to the advanced users, the only restrictions to the direct entry values are:

- Neither mark nor space frequency may be below 300 Hz.
- Neither mark nor space frequency may be above 3500 Hz.
- The entered shift may be no greater than 1500 Hz.

Since the mark / space / shift parameters are inter-related (form a triangle) it is not possible to change one without changing at least one of the other parameters. When a change is made by the above direct method, the following rules apply:

* If the mark frequency is changed, the shift also changes, the space frequency remains the same.

* If the space frequency is changed, the shift value also changes, the mark frequency remains the same.

* If the shift value is changed, the space frequency also changes, the mark frequency remains the same.

Due to the intentionally loose restrictions on the direct entry values, the following should be noted when using this mode of operation:

* It is possible to select shift values that may be lower than the demodulator is capable of detecting. (00 Hz. shift CAN be selected).

* It is also possible to set the mark frequency higher than the space frequency.

7.8 OTHER RTTY DEMODULATOR CONTROLS

In addition to the essential filter tuning, there are several other control keys that affect the operation of the RTTY demodulator. These five additional keys are:

N/R (Normal/Reverse)
After the filters have been tuned, the received tones may be matched mark to mark and space to space, or they may be reversed (mark to space and space to mark). Proper decoding of the teletype codes requires that the demodulated polarity of the on and off keying be the same as at the sending end. To accommodate this possible inversion of the keying signal the demodulator can, without re-tuning, invert the polarity of the cross-demodulated signal to restore proper demodulation.

Each press of the **N/R** key will change the sense of the demodulator from Normal to Reverse. The status line will indicate NOR or REV respectively.

The Decoder section of the M-8000 is capable of detecting whether the demodulated signal is of the proper polarity when operating in any of the *synchronous* RTTY modes, and automatically correcting the signal if it is inverted. Therefore in these modes the **N/R** key does not function and the status line position for the NOR/REV indication will remain blank.

ATC (Automatic Threshold Control)
The ATC (Automatic Threshold Control) circuit is designed to provide for correction of bias distortion which may be caused by the propagation of the HF signal. It will attempt to correct for some differential fading and may be used at all times. In the case of hand-typed RTTY it should be turned off as the character rate will generally be too slow for proper correction. Little hand-typed RTTY is encountered except on the Amateur bands. It is therefore advisable to leave the ATC on at all times.

AGC (Automatic Gain Control)
The M-8000 demodulator has an Automatic Gain Control circuit located between the pre-filters and the main mark and space filters. This circuit serves to provide the main filters with a constant input signal level.

There may be cases where the demodulator will perform better with this AGC circuit off, and the signal level to the main filters adjusted indirectly by the front panel GAIN control. Due to the time constant of the AGC circuit it may be best to turn it off when receiving signals that are experiencing very rapid and deep fading, or flutter.

The AGC circuit may also be set to operate at maximum gain to provide a full limiting signal to the tone filters. This selection is indicated by LIM on the status line. This hard-limiting of the signal may provide improved performance on VHF Packet.

MO-SO (Mark Only Space Only)
The **MO-SO** key selects demodulator operation using either the Mark filter only (status=M/O), Space filter only (Status=S/O), or both Mark and Space filters (status=M+S).

The preferred setting is to use both Mark and Space filters (M+S). However, there may be rare occasions when a single filter may provide better reception - (adjacent channel interference, etc.).

NOTE The *normal* setting is: M+S

BW (BandWidth)
The bandwidth of the demodulator's active filters may be varied by pressing the **BW** key. Each press of this key steps through the available settings of:

```
NOM  (nominal)
-1   (15% narrower)
-2   (30% narrower)
-3   (45% narrower)
+3   (45% wider)
+2   (30% wider)
+1   (15% wider)
```

The percentage variations from nominal shown above are average approximations of the bandwidth variation. Actual variation step size will depend upon the nominal bandwidth and the frequency of operation.

A narrower than nominal selection would normally be called for only during conditions of extreme interference (adjacent signals), or for more precise indications when tuning in a signal.

A wider setting may be used to make tuning somewhat less critical when checking a number of signals around the band or when using a receiver with some drift.

NOTE The *normal* setting is: NOM

■ EXTERNAL DEMODULATORS

For very special applications, it is possible to bypass the demodulator built into the M-8000 and feed the decoder section directly from an external demodulator. The external demodulators are selected by pressing the **T/S** key with F1 active. Each press of the **F1** then **T/S** key will toggle between the two external demodulators of EIA (J3-15) and TTL (J3-14). To resume operation with the internal demodulator, press the **T/S** or **VFT** key as appropriate for the desired internal demodulator.

SUMMARY

It is important to realize that while there may be many standard conventions linking certain demodulator modes with certain data types, any of the above modes may be used with any of the RTTY codes listed below. Everything that was dealt with in the *demodulator* section deals strictly with converting audio tones into a digital binary signal. Everything that will be dealt with in the *decoder* section that follows, concerns interpreting that digital signal into intelligible text.

7.9 DECODER

Once the demodulator has reduced the received signal down to simple binary keying, the decoder must attempt to convert this digital signal into intelligent text. The most obvious prerequisite to accomplishing this task is that the decoder, in this case the M-8000, be equipped to properly interpret the demodulated signal. While the M-8000 is more versatile in this respect than any unit in its class, there are still a large number of RTTY signals that this device is not prepared to decode. Many of these are encrypted transmissions from military or government sources which we, of course, were not intended to intercept.

Of those many signals that the M-8000 will successfully decode, there are only two variables that must be determined and set to achieve proper RTTY operation: Mode and Speed.

Please note that some publications list transmission speeds in WPM (Words Per Minute), and others use Baud. It is rather like yards and meters. The Universal M-8000 expresses speed in Baud. Use the following table to convert:

WPM	BAUD
60	45
66 or 67	50
75	57
100	75
133	100

The **SPEED** key will step through the standard or commonly used speeds for the selected mode of operation. In modes where there is only one standard speed (such as SITOR) the **SPEED** key will have no effect (except to highlight the SPEED status indicator).

When the SPEED is the variable (highlighted) parameter, the **UP** and **DOWN** keys will vary the speed in 1 baud steps, permitting very fine adjustment of the decoder's data rate. If the **UP** or **DOWN** key is held in to activate the {repeat} function, the speed will increase or decrease in 3 baud increments permitting a more expeditious approach to the desired speed. If the key is then released, subsequent presses of the **UP** or **DOWN** key will return to a 1 baud change for each press.

The desired speed may also be set by using the direct-entry method (see page 16).

SPEED READ-OUT

Pressing the **SRO** key enables the Speed Read-Out function. The indication BAUD= will blink on the status line. The decoder will analyze the input data stream, and after a short delay indicate the data rate in baud that the received signal appears to be.

If not enough samples are obtained within ten seconds, or if the baud rate cannot be determined from the received samples the unit will display BAUD=???. In this case, check your tuning and try again. If a reasonable speed is indicated, then half of the questions about the signal are answered.

The SRO function requires the filter bandwidth to be significantly altered for reliable results. As a result, the line slope of the X/Y tuning scope display is suppressed during speed analysis.

AUTO TUNE
Pressing the **F2** key and then the **TUNE** key invokes the Auto Tune function. The M-8000 first performs the Filter Tuning function. If the first attempt at Filter Tuning is unsuccessful, the unit will automatically re-try two more times before indicating a CAN'T TUNE condition. If the demodulator filters are successfully tuned then the unit will proceed to determine and set the proper speed of operation.

The procedure here is very similar to the SRO function. The baud rate is determined, but instead of displaying the result of the evaluation, the unit is set to that speed without further operator intervention.

NOTE The *AUTO TUNE feature will not work during poor reception.*

7.10 DECODER INDICATORS

There are three front panel indicators that can assist in determining if the proper mode and speed have been selected:

DATA
This LED will turn on when the decoder is receiving valid data from the demodulator. In Baudot and ASCII modes, this indicates no more than transitions from mark to space. In the remaining modes, however, this LED will only turn on if the decoder is in sync with the demodulated signal, and is a much more specific indicator of proper mode and speed.

DATA ERROR
This LED will turn on whenever the decoder receives a bit pattern that does not conform to the specifications of the selected mode. In asynchronous codes (Baudot and ASCII) this may indicate an invalid start bit, missing or invalid stop bit, or parity error. With synchronous codes, this will generally indicate a received character error (most sync codes are error-checking), or a sync or framing error.

IMPORTANT NOTE: When the DATA LED is on and the DATA ERROR LED remains off (at least most of the time), it can generally be safely assumed that the mode and speed of the decoder (and the sense of the demodulator) have been properly set. If, under these circumstances, plain text is not displayed, the received signal is probably encoded or encrypted. If you are receiving text with the DATA LED consistently *on*, and the DATA ERROR LED consistently *off*, you are in fact receiving exactly what has been sent, regardless if it "makes sense".

IDLE
When operating in synchronous modes that have idle or phasing signals, this LED will turn on when those idle or phasing signals are being received. No printable information is contained in these signals, so there is no indication on the video screen that characters are being received.

7.11 MODE SELECTION

All of the various modes of M-8000 operation are selected by pressing the **MODE** key, or using the **UP** or **DOWN** key when the mode status is highlighted, until the desired mode of operation appears on the status line.

When changing among the various modes of operation, the function of the status lines and the graphic tuning area operation must be reconfigured. In order to facilitate changing from one mode to another without the need to re-configure these parameters to each of the interposed modes, the actual change in the mode of operation is delayed until the mode selection has been stable for a few moments.

After a new mode has been selected, the unit concentrates on system reconfiguration to the new mode to the exclusion of all other operations. During this brief period there will be no response to any command keys.

The sequence of selected modes is as follows:

> MORSE, BAUDOT, ASCII, PACKET, PACTOR, SITOR-A, SITOR-B, AUTOR, FEC-A, FEC-S, ARQ-M2, ARQ-M4, ARQ-E, ARQ-E3, ARQ-S, SWED (arq), ARQ6-90, ASYNC (databit), SYNC (databit), ACARS, POCSAG (pager), GOLAY (pager), PICCOLO and FAX.

The mode of operation may also be selected via a short-cut or 'expert' entry method. Each of the 24 modes of operation is assigned a number from 0 through 23. This direct-entry method requires the user to enter the two-digit number which corresponds to the desired mode of operation. There are two variations of this direct mode entry. They are described below:

F1+ MODE
This method will function regardless of the screen configuration. As soon as this key combination is pressed, reception is suspended and the display screen is filled with a selection menu which lists the 24 operating modes along with their assigned numbers (see table to the left). Simply enter the two digit number corresponding to the desired mode. As each digit is entered, the entered digit will appear on the screen below the menu.

F2+ MODE
This method may be invoked only if the tuning graphics segment of the screen is enabled. In this 'expert' direct entry method, reception in the current mode continues while the user is prompted by a flashing "MODE" to the left of the X/Y tuning scope. By this time the 'expert' operator will have hopefully committed to memory, the proper number of the desired mode of operation and will simply key in the appropriate two-digit number. The entered digits will be displayed directly below the "MODE" prompt. To cancel the expert entry simply press the **CLEAR** key prior to entering the second mode digit.

00 = MORSE
01 = BAUDOT
02 = ASCII
03 = PACKET
04 = PACTOR
05 = SITOR A
06 = SITOR B
07 = AUTOR
08 = FEC-A
09 = FEC-S
10 = ARQ-M2
11 = ARQ-M4
12 = ARQ-E
13 = ARQ-E3
14 = ARQ-S
15 = SWED
16 = ARQ6-90
17 = ASYNC DATABIT
18 = SYNC DATABIT
19 = ACARS
20 = POCSAG PAGER
21 = GOLAY PAGER
22 = PICCOLO
23 = FAX

8.0 MORSE CODE (CW)

EXPERT MODE
00

Morse code was the first radio transmission mode. It still remains a popular form of text transmission on shortwave today. Morse (also called CW) is in wide use by maritime coastal stations, ships at sea and amateur radio operators.

In the Morse mode the **SHIFT** key will select the audio tone frequency that the M-8000 wants to "hear" to detect the Morse keying. This frequency will be displayed near the center of the status line as either 1000 or 750 (Hz.). While in Morse Code, the M-8000 will be in the 80 character by 30 line format. The simulated CRT and spectral display will not be shown as they are not applicable.

Set your receiver for CW operation, tune in a CW signal and adjust your BFO or fine tune your receiver until the "CW" LED is flashing in time with the incoming code. When tuning Morse code, look at the red "CW" LED indicator only! It should flicker in perfect unison with the signal. The M/S tuning indicator should be indicating as far to the right as possible during key-down periods while returning to the extreme left when the sending station's key is up.

Care should be taken to **not** over-drive the M-8000 with too much audio signal. Best reception is often obtained by reducing the RF gain control on the receiver to the point where there is no flicker on the CW LED during key-up periods. Some experimentation with input level may be required.

The M-8000 will take a short time (3-8 characters) to lock onto the code being sent and after it is locked you should see printing on your screen.

The MORSE MED (Morse MEDium speed) position will copy 95% of the CW sent on shortwave. For reception of code slower than 10 w.p.m. you can press the **SPEED** key until SLOW appears on the status line. For reception of code faster than 40 w.p.m. you should press the **SPEED** key until FAST appears on the status line.

The M-8000 Morse section will decode CW only when it is properly sent, with reasonably constant speed and character spacing.

Three alphabets are available in the Morse mode, standard, international and Cyrillic. These alphabets are selected with the **ALPH** key, and are indicated on the status line to the right of the tone indication as follows:

```
STD = standard
ITA = international
CYR = Cyrillic
```

NOTE
For *normal* Morse reception select the ITA alphabet.

The special ITA international Morse characters are:

Å	·--·-	Ó	---·
Ç	-·-··	Ü	··--
É	··-··	Ñ	--·--

Morse code transmissions may seem at first baffling to the radio listener. Morse code operators use many abbreviations. A typical CW maritime transmission may look like:

```
CQ CQ CQ DE WCC WCC WCC QSX 6 8 12 MHZ
CHNL 5/6/11 RTTY SITOR 1.0 AMVER OBS? K
```

In "English" this means: Calling all stations. This is coastal station WCC. I am listening on 6, 8 and 12 MHz. and channels 5, 6 and 11 in Sitor radioteletype. I await your Automated Mutual Assistance Vessel Rescue System observations. End.

The best sent Morse code can be found in the international maritime bands. Coastal station operators send high quality code on these frequencies:

DAYS
12660 - 13070 kHz.
16905 - 17240 kHz.
22445 - 22695 kHz.

EVENINGS
6335 - 6500 kHz.
8440 - 8705 kHz.
12660 - 13070 kHz.

Morse code can also be found on the lower portion of each HF ham band on these frequencies:

3500 - 3750 kHz.
7000 - 7150 kHz.
14000 - 14150 kHz.
21000 - 21200 kHz.
28000 - 28300 kHz.

Morse reception quality on the amateur bands will be a function of the skill of the individual ham operator.

9.0 BAUDOT

EXPERT MODE 01

The Baudot, or Murray, code is the most common type of RTTY code in use today. Baudot is a five data bit per character code, providing 32 possible bit combinations. This does not provide enough unique characters for the 26 letters, 10 digits, and punctuation used in the English language, so this code uses two sets of characters, or cases. One case (letters or LTRS) contains the letters of the alphabet, while the other case (figures or FIGS) holds the numbers and punctuation. The control codes for space, carriage return, line feed, and for switching back and forth between the two cases are repeated in both cases.

The standard Baudot speeds which the **SPEED** key will step through are: 45, 50, 57, 75 and 100 baud. In addition to these, the speed may be increased or decreased in 1 baud steps from 30 to 250 baud by pressing the **UP** key or the **DOWN** key when the speed status is highlighted. Please note that such non-standard speeds are very rare.

While this is a demodulator function, it is important to note here that in order to obtain proper Baudot reception, the sense of the signal (NORmal or REVerse) must be manually selected by the user with the **N/R** key.

9.1 BAUDOT ALPHABETS

While the standard Baudot alphabets are all the same with respect to their lower (LTRS) case, the representations of the various upper (FIGS) case characters vary among the various alphabets. The most common alphabets in use today are the ITA2, TELEX and MIL. To select these alphabets press the **ALPH** key until the desired abbreviation is indicated on the status line after the ATC indication.

```
ITA = ITA2
TLX = TELEX
MIL = MIL
CYR = Cyrillic (discussed later)
```

The character tables of these various alphabets may be found in *Appendix B.*

There are also alphabets in use which are permutations or combinations of these standard alphabets. It is the responsibility of the user to determine and select the alphabet that best matches the alphabet used by the received station. Failure to select the correct alphabet (not including CYR) will provide properly printing letters and numbers, but may yield incorrect punctuation.

9.2 UNSHIFT ON SPACE

As mentioned previously, there are two cases in the Baudot code. Normally, the control codes to select a case are only sent when there is actually a change in the case of the transmitted text, or, in some services, at the end of every line. Normal text contains mostly lower case characters. If an error occurs in the reception of a character, there is a one in thirty-one chance that the resulting error will cause a shift into the upper case. If this occurs, the upper case representation of the following text will be displayed (numbers, punctuation, bells, etc.), until the sending station again sends the lower case (LTRS) control code.

To circumvent this 'problem', teletype machines were equipped with unshift on space functions. These served to force the receiving machine into the lower (LTRS) case each time the space character was received. At the end of every word, then, the lower case operation was restored, and the most that would be lost to gibberish in the event of a false FIGS, was one word.

The M-8000 provides this function on a user-selected basis. Each press of the **UOS** key toggles this function on and off. Why would we want to turn off such a marvelous invention? Certain stations, particularly weather transmissions, send columns of numbers. With the UOS *on*, each time a space is received to place the numbers (FIGS) in column form the unit will switch to LTRS and you will see a column of numbers followed by several columns of letters that make no sense at all.

Also the date of MARCH 12, 1987 (of no particular significance) would appear as MARCH 12, QOIU (of no significance at all), if the UOS were enabled.

To a large degree, UOS on or off is one of user preference, also depending upon the station being received, signal conditions, etc., however there is an option:

9.3 CASE CHANGE

As was explained above, the reception of the Baudot alphabet can inadvertently fall into the wrong case. (It can also falsely switch to LTRS from the FIGS case.) The M-8000 will allow the user to manually toggle between, or step through, the cases appropriate to the Baudot selected alphabet. This is done by pressing the **CASE** key. The case that is selected at any given time may be determined by observing the displayed text.

9.4 THREE SHIFT BAUDOT CODES

There are cases where there are not enough symbols in the Baudot alphabet to satisfy the needs of a particular language. In these situations, a third shift, or case, is added to the basic Baudot code. These are usually referred to as the "NATIONAL" case. The control code that would normally be the 'BLANK' character (basically a useless code) is used to select this National case, with FIGS and LTRS still operating as in standard Baudot.

It is important to realize that these Three Shift codes are still Baudot codes, and the controls that function for Baudot, as described above, operate identically in these Three Shift modes also.

9.5 RUSSIAN THREE SHIFT CYRILLIC

The M-8000 is capable of displaying, on the video screen, the reception of Russian third shift Cyrillic characters. This unique feature will be of keen interest to anyone interested in monitoring the extensive Soviet maritime RTTY traffic.

Three shift Cyrillic operation may be obtained by simply selecting the Cyrillic alphabet while in a Baudot based code. This is done by pressing the **ALPH** key until CYR appears on the status line after the ATC indication. In this mode, the **CASE** key will step through the three shifts; figures, letters and national.

It is up to the user to detect Russian RTTY transmissions. If the Cyrillic alphabet is inadvertently selected while receiving a non-Russian signal, Cyrillic characters may appear on the video that are spurious.

Russian Cyrillic maritime traffic can often be found on these bands:

```
 6263 -  6314 kHz.
 8373 -  8412 kHz.
12553 - 12575 kHz.
16796 - 16804 kHz.
22350 - 22373 kHz.
25193 - 25208 kHz.
```

Two useful references on this topic are available from Universal and other radio dealers:

The Soviet Maritime RTTY Dictionary
by Gary Gorka and Fred Osterman

The U.S.S.R. Merchant Ship List
by Jason Berri.

We are now ready to tune a Baudot RTTY station. As a beginner, it would be advisable to seek a known RTTY station rather than to start randomly tuning around the bands. If you start blindly tuning RTTY stations it is likely that you will encounter mostly unreadable signals. These signals will produce characters on your video screen but they will likely be "garbage", or at least appear to be garbage. Regardless of what audio signal you feed into the M-8000, it will **try** to decode it. If it is not a valid RTTY signal, or if any of your M-8000 settings are incorrect, you will not obtain readable copy. Also keep in mind that the considerable Arabic and Russian RTTY traffic may also appear as "garbage" at least until you become more knowledgeable in these areas.

So our first job is to try to find a published RTTY station that we know is transmitting readable RTTY. The following table will list some stations to try for. You certainly will not be able to hear them all. At least not all at once. A published RTTY station may not be receivable for several reasons:

- Many frequencies are seasonal and only in use during certain months.
- Most RTTY stations transmit in a directional pattern, and therefore may not be audible in your area.
- Propagation may not permit reception at a given time.
- Like other shortwave stations, RTTY stations do change frequencies at will to avoid interference or to improve their signal coverage.
- Some stations only transmit on certain days, many with reduced weekend schedules.

Reminders ...

• When looking for a specific RTTY station, always try the listed frequency plus or minus 3 KHz. The station may not appear exactly on your receiver's digital readout as it is published.

• When successfully tuning any RTTY mode, the DATA ERROR LED should be totally off or nearly always off! The TUNE ERROR will still keep blinking, on all but the very strongest signals. This is normal.

• It is generally advisable to leave the following options ***on*** : ATC AGC UOS

Now that you have found a known signal let's check the receiver. It should be set in the RTTY mode. If your receiver does not have a RTTY mode select, LSB or CW. Your selectivity should be set for a value between 1.5 and 3.0 kHz. Filter selectivity below 1.5 may be too narrow for RTTY signals with an 850 Hz shift.

Check the M-8000 status line. It should say BAUDOT followed by the correct speed and shift. Now slowly adjust the tuning (or BFO) of your receiver until you are able to light the MK and the SP LEDs on the M-8000. The object is to illuminate these two LEDs equally and obtain maximum rightward deflection of the TUNE bargraph. Do not concern yourself with the other LEDs ... just watch the MK and the SP LEDs. With the MK and SP LEDs flashing, you are now tuned to the signal. Look at the screen. If the text is still not readable, you should change the "Sense" from Normal to Reverse. Readable print should follow.

BAUDOT FREQUENCIES

TIME (GMT)	kHz.	Baud	Shift	Station
0000	6848	50	425	PAP press also 11497
0000-0200	11012	75	850	DYN Spanish press
0030	7806	50	400	TANJUG English press
0100	10515	50	170	SRI press
0100	11065	75	475	XINHUA English press
0114	7996	50	400	TANJUG English press
0300	4004	50	425	TELAM press also 7428
0400-0415	11478	50	425	KCNA English press
0500	16135	75	425	APN press
0600	17468	50	425	MTI English press
0700	9187	50	425	AFP French press
0700	9830	50	425	SPK English press
0800	8140	50	425	PL press
0801	9133	50	425	ATA English press
0945	14568	50	425	KCNA press also 10580
1000	15632	50	230	KCNA English press
1120	13440	50	425	TANJUG press
1120	17470	75	425	XINHUA English press
1220	18039	50	850	AA press also 19040
1300	13580	50	250	KCNA English press
1300	13371	50	425	INA English press
1330	13113	75	365	XINHUA English press
1340	14800	50	600	TAP French press
1350	16224	50	425	CNA press also 13563
1400	18055	75	425	MFA/TANJUG Press
1400	14373	50	425	INA English press
1400	13648	50	425	CTK English press
1400	16302	75	425	TANJUG English press
1400	7695	50	850	CNA press also 9090
1400	5097	50	425	JIJI press also 8175
1430	16117	50	425	PANA English press
1500	5195	50	425	ADN press
1500	9051	50	425	ANSA English press
1500-	9430	50	425	ATA English press
1500	7800	50	425	IRNA English press
1500	9395	50	425	KCNA press also 10580
1500	9331	50	425	VNA press also 10599
1500	19980	50	600	IRNA press also 20085
1500	24102	75	400	TANJUG English press
1540	14764	75	350	GNA English press
1545	20085	50	425	ANSA English press
1600	20560	50	425	JANA English Press
1600	10920	50	425	ADN press also 11123
1630	19171	50	425	MAP French/Spanish press
1700	10920	50	425	ADN press
1800	8020	50	425	KCNA press
1830	16265	50	425	ANSA English press
2100	11430	50	250	KCNA French press
	6496	75	850	CFH Weather (also FAX)
	10535	75	850	CFH Weather (also FAX)
	13510	75	850	CFH Weather (also FAX)
	14356	50	425	GFL24 Weather

10.0 BIT INVERTED BAUDOT

The M-8000 is capable of receiving bit-inverted Baudot transmissions. Every normal Baudot character is sent as a combination of five bits (a bit is either a Mark or a Space). In order to discourage the casual interception of messages, some RTTY stations will invert ("flip") one or more of these five bits. This will cause standard demodulators to print "garbage". The M-8000 allows you to re-invert (or "flip-back") the necessary bit or bits in order to read the message properly. The M-8000 contains a decoding system that will search and try each of the possible bit inversion (BI) patterns. (There are 32 possible patterns since 2 to the fifth power is 32). It is up to the user to stop the searching sequence when the correct bit inversion pattern is reached! In order to try the bit-inversion feature you must be properly tuned to an active Baudot RTTY signal.

Bit inverted Baudot is no longer in wide use. Randomly testing Baudot-type signals for bit inversion will therefore be long, tedious and probably unproductive. It may be more rewarding to occasionally check known BI frequencies for occasional reactivation.

F1+ BI Manual BI Sampling
Pressing the **BI** key with F1 active will enable the manual bit inversion function. Each subsequent press of the BI key will advance the inversion pattern through the various possible combinations. To change from manual to automatic bit inversion sampling (starting from the present manual setting) press **BI** with F2 active.

F2+ BI Automatic BI Sampling
Pressing the **BI** key with F2 active starts the auto-sequencing mode. This starts the M-8000 inverting the bits of each character as indicated by the bit pattern shown on the status line. You will see the bits being "flipped" on the bottom right of the status line. To stop the automatic sequencing (freeze the currently displayed inversion pattern) press **BI** again. This places the unit in the manual bit inversion mode.

To disable the bit inversion function simply press **BI** with either F1 or F2 active while the bit inversion function is active. (F2 will disable only if automatic sampling.) After the last inversion pattern has been selected (11111) the next pattern step, either manual or automatic will then disable the bit inversion function.

A few BI frequencies to watch are: 10902, 13830, 23035 (45 baud / 425 shift).

NOTE Bit Inversion is currently **very** rare on H.F. Novices should avoid it.

11.0 OTHER BAUDOT BASED CODES

While the Three Shift codes are actually expanded Baudot codes, there are a number of other codes that are Baudot code based. These codes use a completely different method of character transmission, but their characters are a super-set of the Baudot alphabet. Transmissions in these codes begin with input in the form of a Baudot message. Each Baudot character in the message is converted to its matching character within the particular code being used. These super-sets also include several special codes that have no equivalent in the Baudot code, which are used for control functions only. At the receiving end, the reverse process is used, where every non-control character is converted into its direct Baudot equivalent, and then processing continues as though operation were in the Baudot mode.

When operating in these modes, therefore, the Baudot type functions of alphabet selection, Unshift On Space, case selection, and Bit Inversion (ALPH, UOS, CASE, and BI), operate just as in the true Baudot mode, even three shift operation.

Some of these Baudot based codes are SITOR (all sub-modes) and essentially all of the synchronous FEC and ARQ modes.

12.0 ASCII

EXPERT MODE 02

ASCII stands for *American Standard Code for Information Interchange*. The ASCII code is similar to the Baudot code except its character is composed of 7 data bits and so the ASCII character set is broader than the Baudot character set, even with Baudot's two cases. The penalty to be paid for this expanded set (one forth of which are non-printing control codes, and another one forth are the lower case (typeset) doubles for the upper case alphabet) is that it takes more than 40% longer to transmit each typical ASCII character than its Baudot counterpart (when there is one), given identical baud rates.

As a result, ASCII is not generally used on the HF bands except by *W1AW*, a few amateurs, and then usually at 110 Baud. High speed ASCII can occasionally be found on VHF/UHF. Low speed and medium speed ASCII is used occasionally on satellite downlinks.

PARITY

The ASCII code has the option of including an error detecting bit in each character. This bit is set such that each character sent always has an odd number of marking bits, or that each has an even number of mark bits. If the character is distorted in reception such that an odd number of bits are changed in polarity, the parity test will reveal that an error has occurred.

The type of parity that the M-8000 tests for is selected by the **UOS** key as either odd "ODD", even "EVN", or none "___". If either Odd or Even is selected, then the DATA ERROR LED will come on each time a character is received that does not have the appropriate number of marking bits. If *none* is selected, then no parity test is performed on received characters.

The one station with regular ASCII transmissions is *W1AW*, the master station of the *American Radio Relay League* located in Newington, CT. They transmit bulletins daily for radio amateurs in the following modes:

- Baudot 45
- ASCII 110
- Sitor B 100

The W1AW teletype schedule:

DAILY	MONDAY - FRIDAY
0100, 0400, 2200 UTC	1500 UTC
Frequencies for all teleprinter transmissions: 3625, 7095, 14095, 21095 & 28095 kHz	

Other frequencies where ASCII has occasionally been observed:

110 baud: 1743, 13401, 20610, and 20876 kHz
75 baud: 6623 and 15853 kHz

NOTE ASCII is currently **very** rare on H.F.

13.0 PACKET

EXPERT MODE 03

The M-8000 will permit the monitoring of packet transmissions using AX.25 protocol at 300 and 1200 bauds. Packet mode is becoming increasingly popular with radio amateurs.

When the 1200 baud Packet operation is selected, the demodulator is set to the Bell 202 standard (B 202). When 300 baud Packet is selected, the Bell 103 Originate standard (103 O) is used. The **T/S** or **SHIFT** keys can be used to select other demodulator settings.

In the Packet mode, the **N/R** key (normal/reverse) has no effect and the NOR/REV selection does not appear on the status line.

As packet characters are received, they are stored in memory until the entire packet has been assembled. At the end of the packet, the frame check sequence (FCS), a two byte cyclic redundancy check (CRC), is tested to determine if there were any errors in the received packet. If any error is detected, the entire packet is discarded and not displayed at all. If the packet was received error-free, then it will be displayed on the video screen and/or passed to the printer outputs.

The type of packet is also monitored and Information and Unnumbered Information packets only are processed. Control type packets are discarded.

The display format of the received packet is as follows:

1. Call sign of the sender of the packet.
2. Call sign of addressee (the intended recipient of the packet).
3. Call sign(s) of the digipeater station(s), if any, requested to repeat the packet.
4. The text or data in the packet.

The DATA LED will turn on when a packet is in the process of being received. The DATA ERROR LED will turn on whenever an error in the FCS of a packet is detected.

Only 300 baud is used on shortwave. The 1200 baud setting is used for VHF work (most commonly on the *2 meter* Ham band at 144.9 - 145.1 MHz).

Again, the tuning is the same. Slowly tune your shortwave receivers until you get both the MK and SP LEDs to flash. One of the challenges to tuning this mode is that the Packet transmissions can be very short. Many transmissions are only 1 or 2 seconds long. Therefore, it may take a bit of patience to get the hang of it. Eventually you will get more dexterous at this and develop an "ear" for what the Packet tones should sound like.

The best spot on shortwave is about 14090 kHz (±20 kHz). It is especially active on weekend afternoons. Also try 7080 kHz (±10 kHz). Packet has been noted outside the ham bands at 13994, 14374 and 14933 kHz (M.A.R.S. traffic).

Be advised that much Packet traffic is very cryptic in nature. Not only do you have to deal with radio abbreviations, but also computer abbreviations are heavily used. To add to the confusion, packet messages are broken up into several 'packets' and transmitted in little pieces. The monitoring station will receive and display a kaleidoscope of these message fragments from any stations sharing the monitored frequency. Some of these fragments may be repeated several times while others may be missing entirely. Extracting an intelligible conversation in the Packet monitor mode can be challenging.

14.0 SYNCHRONOUS TELEPRINTER CODES

The following group of codes are all synchronous teleprinter codes (SITOR-A, SITOR-B, FEC-A, FEC-S, ARQ-M2, ARQ-M4, ARQ-E, ARQ-E3, ARQ-S, ARQ6-90, PACTOR and SWED). The phasing circuits in the M-8000 automatically detect and set the proper sense (Normal or Reverse) of these transmissions, so the user need not be concerned with this critical setting. The "NOR"/ "REV" indication is removed from the status line and the **N/R** key does not function in these modes.

AUTOMATIC SYNCHRONIZING
When any of these modes are selected, the M-8000 automatically begins searching for the particular synchronization pattern unique to that mode. When the pattern characteristic of that mode is detected, the phasing, framing and sense parameters are set and decoding of the signal begins. At this point the SYNC LED will turn on.

AUTOMATIC RE-SYNC
If sync or framing is lost during the transmission, as indicated by an excessive number of data errors, the M-8000 will cease decoding the signal and return to the standby mode, again searching for the unique sync pattern. When this occurs, the SYNC LED will turn off.

MANUAL RE-SYNC
It is possible, under some circumstances, for the M-8000 to loose sync, but due to the received bit pattern, not register enough data errors to force an automatic re-sync cycle. In these cases the user may manually force an automatic re-sync by pressing the **FR-R** key. This will turn the SYNC LED off and cause the M-8000 to resume the search for the sync pattern.

MANUAL SYNCHRONIZATION
The automatic sync function will only operate in the following codes if the signal is idling (no text information): ARQ-M2, ARQ-M4, ARQ-E and ARQ-E3.

If you are receiving one of these signals which is in the process of sending text then the signal must be synchronized manually by using the following procedure:

1. Press the **FR-L** key.
2. The SYNC LED will come on if you have synchronized.
3. Check the DATA ERROR LED - if it is on or blinks in rhythm then press the **FR-L** key again.
4. Check the screen, if one to three characters are displayed repeatedly, the unit is still not framed properly. Press **FR-L** again.
5. If manual framing is tried a total of 7 times then give up and find another station.

The M-8000 is capable of automatically synchronizing to the other teleprinter codes whether they are idling or sending text, so the manual framing key **FR-L** does not function in those modes.

15.0 SITOR MODE A

EXPERT MODE
05

The SImplex Telex Over Radio (SITOR) code (aka. AMTOR) is a seven bit synchronous error correction code based on CCIR 476. It is used extensively in maritime and diplomatic communications. The SITOR signals are always sent at 100 baud and usually 170 Hz. shift[1]. Therefore when selecting any of the SITOR modes, 100 baud and 170 Hz. shift will automatically be selected by the M-8000. SITOR Mode A (ARQ) and Mode B (FEC selective and collective) are all decoded by the M-8000.

SITOR A is one of the easiest RTTY modes to find and tune. It is easy to find because of the unique *chirp, chirp, chirp* sound of two stations interchanging data. It is easy to tune because the baud rate is fixed at 100, the shift usually at 170 and the M-8000 automatically determines the correct "sense" (that is, Normal or Reverse).

The actual SITOR mode A transmission is no less susceptible to errors than any other 100 baud signal. It is by virtue of its error detecting capability, coupled with the ability to demand repetition, that the mode A link, between two stations, becomes error free. The third party listener, (you!), retains the ability to test for errors, but since the M-8000 cannot request repetition, error free copy cannot be expected in the reception of these stations. A SITOR A link can be established between two and only two SITOR stations.

Data received in ARQ mode will be that sent by the ISS (Information Sending Station) as the M-8000 is not programmed to receive the response signals of the IRS (Information Receiving Station). ARQ IRS signals are simply acknowledgment pulses (ACK's) which would be of no use and little interest to the listener, and therefore do not print.

Using the frequency chart below, listen for the distinctive *chirp, chirp* sound. Once again, the idea will be to tune the radio receiver in such a manner as to get both the MK and SP LEDs to flicker on the M-8000. Don't worry about all the other LEDs for the moment! Now that you have both Mark and Space you may or may not be getting text on your screen. When you tune to a Sitor A station, the chirps you hear may be the three character groups being sent, or they may be nothing more than the ARQ acknowledgment pulses from the receiving station (which neither display nor light the DATA LED). Or in "computer" terms ... you may be merely listening to the "handshaking". The sound is quite similar. However, in time you will be able to tell the difference by "ear". Until then, be patient. Understand that when the receiving station is done receiving he will probably start transmitting text back to the original transmitting station.

DAYS
12465 - 13070 kHz.
16860 - 17225 kHz.
22315 - 22555 kHz.

EVENINGS
6325 - 6490 kHz.
8435 - 8700 kHz.
12465 - 13070 kHz.

[1]By definition a SITOR-A signal must have a 170 Hz shift. However there is a growing trend among non-maritime SITOR-A stations (especially in S. America) to transmit with shifts of: 400, 425, 740, 850 Hz. The M-8000 will decode these.

NOTE
For SITOR A, the AGC on your M-8000 and receiver should be off.

16.0 SITOR MODE B

EXPERT MODE 06

SITOR B consists of a continuous data stream of 100 baud data bits characterized by its "singing" sound. It does not have the distinctive "chirp-chirp" sound of mode A, and is not as commonly used. Mode B is generally used as a broadcast mode to ships by coastal maritime stations.

SITOR B actually consists of two formats - Collective and Selective. The difference is that Selective is sent inverted as compared to Collective and a different signal is used for idle periods. The M-8000 automatically adjusts for the normal and inverted signals of this mode so that both can be received without further adjustment.

In SITOR B, synchronization only occurs on the special phasing signal which is sent at the beginning of each transmission, after the carriage return and line feed at the end of each line of text, and during idle periods of the transmission. As a result, synchronizing in the B mode may take longer than in the A mode and in the event that sync be lost due to hits or fading it will automatically re-sync but will be subject to possible delay.

Note: In the Selective SITOR B, the phasing signals are sent ONLY at the beginning of a transmission. No unit will sync onto these transmissions once they have begun, or if sync is lost during the transmission. (CCIR 476 intended it this way.)

The error correction of the SITOR B signal results from each character in a message being sent twice with four other characters occurring between the first and second transmission of a character. Both occurrences of each character are tested for proper reception. If only one occurrence tests bad, the good character is printed. If neither test good, or if both test good but do not match, then a space character is printed to indicate a non-correctable error.

The B mode assumes a continuous data stream. If no signal is present, most, if not all, of the received characters will be errors and will be displayed as spaces.

When you request a Speed Readout on a maritime frequency, and the result is BAUD 100, this usually indicates a Sitor B station.

SITOR-B may also be used for the reception of the NAVTEX signal at 518 kHz.

Here are some frequencies to try:

DAYS
12630 - 12715 kHz
16860 - 17025 kHz.
19680 - 19710 kHz.
22375 - 22445 kHz.

EVENINGS
4210 - 4270 kHz.
6314 - 6345 kHz.
8415 - 8435 kHz.
12630 - 12715 kHz.

Watch for diplomatic Sitor B on:

9117, 11423, 11494, 13602, 13791, 14362, 15637, 15647, 18993, 20055, 20156, 20491 and 20596 kHz.

17.0 AUTOR FEATURE

Maritime stations may switch from mode A to mode B very suddenly. If you are not at the M-8000 to change modes immediately, this can lead to lost data. Therefore the M-8000 features a special AUtomatic siTOR that automatically selects between SITOR-A and SITOR-B without operator intervention.

In the AUTOR mode, the unit will attempt to synchronize to either SITOR-A or SITOR-B. When synchronization occurs, the indication on the status line will change from AUTOR to AUTOR-A or AUTOR-B, depending on which mode is being received. Upon losing sync, normally at the end of traffic, the status indication will return to AUTOR.

It is not unusual for the M-8000 to occasionally mis-read a mode B signal as being mode A. When this occurs, the error will be readily noted and the unit will automatically return to the AUTOR mode to resume its search for the SITOR-B phasing signal.

18.0 FEC-A

EXPERT MODE 08

FEC-A is a synchronous bit-interleaved convolutional error-correcting code utilizing an expanded version of the five unit Baudot alphabet. The M-8000 will automatically synchronize to an FEC-A station that is sending text. The idling signal of this code cannot be synchronized to. The polarity (Normal or Reverse) is automatically determined by the M-8000.

When selecting FEC-A the M-8000 will take you to the most common setting of 96 baud. Subsequent presses of the **SPEED** key will step you through the other FEC-A standard speeds of 144 and 192 baud.

The error-correcting process of this code involves a delay of up to five seconds between the reception and display of each received character. Once the DATA LED turns on, stop tuning and wait for the results to appear on the screen. Again, the received data is not lost, it is simply delayed by the error-correcting process. You will note that if the signal is lost, characters will continue to print on the screen for a time equal to the start-up delay. A final error checking of each character is performed after the error-correcting process so the DATA ERROR LED will only turn on if a non-correctable error in the received signal has occurred. If the received signal is experiencing an excessive number of character errors, the DATA LED will turn off and M-8000 will attempt to automatically re-sync to the signal. The user may manually initiate an automatic re-sync by pressing the **FR-R** key. The **UP** and **DOWN** keys may be used to select variable non-standard speeds from 20 to 250 baud. However, such non-standard speeds have not been reported to date.

FEC-A FREQUENCIES

Baud	Shift	kHz	Call	Location
96	850	123	DCF42	Bonn, Germany
96		10217	9VF59	Singapore (Bonn relay)
144		10802		Belgrade, Yugoslavia
96		11060	9VF67	Singapore (Bonn relay)
144		11483		Paris, France
144	368	13427		Belgrade, Yugoslavia
144		13464	TAD	Ankara, Turkey
144	378	13539	'U3H'	Moscow, Russia (Fr.Emb.)
96	403	13570	DFN57	Bonn, Germany
144		13837	TAD	Ankara, Turkey
96	425	13927	DFN92	Bonn, Germany
144	812	13982	TAD	Ankara, Turkey
192	403	14975	'RFGW'	Paris, France
144		15794	TAD	Ankara, Turkey
144		18202	TAD	Ankara, Turkey
144	820	18964	TAD	Ankara, Turkey
96		19535	9VC91	Singapore (Bonn relay)
96	425	19644		Lagos, Nigeria
192	388	19872	'RFGW'	Paris, France
96	395	20022	DFU23	Bonn, Germany
96		23355		Lagos, Nigeria
96	425	23545	DFX54	Bonn, Germany
96	425	23697	DFX69H6	Bonn, Germany
96	395	25320	DFZ32	Bonn, Germany
96	425	26441	DFZ64	Bonn, Germany

19.0 FEC-S

EXPERT MODE
09

FEC-S is a simplex error-detecting and correcting code which is similar to Sitor-B. The FEC-S signal does not rely on special phasing signals to achieve synchronization. The M-8000 will sync on the FEC-S signal during either text or idling periods. Selecting FEC-S will take you to the most common setting of 96 baud. Subsequent presses of the SPEED key will step you through the various FEC-S standard speeds of 96, 100, 144, 192 and 200 Baud. The **UP** and **DOWN** keys may be used to select variable non-standard speeds from 20 to 250 baud. However, such non-standard speeds have not been reported.

To achieve greater reliability, each character is actually sent twice, although it will only be displayed once on your M-8000. The DATA ERROR LED will indicate an error in either the first or second transmission of the received characters. Since the correct reception of either character will provide error-free display, it is possible to get perfect copy even when the DATA LED is indicating errors. As with other error detecting codes, re-synchronization will occur as a result of excessive errors or pressing **FR-R**.

(Note: FEC-S is referred to as SI-FEC in some publications.)

FEC-S FREQUENCIES

Baud	Shift	kHz	Call	Location
96		19756		Jakarta, Indonesia
96		20952		

20.0 ARQ-M2/M4 (MOORE)

EXPERT MODE 10

The M-8000 is capable of receiving ARQ (TDM-Moore) signals based upon CCIR recommendation 342. There are two separate formats for this mode of operation ARQ-M2 (two traffic channels) and ARQ-M4 (four traffic channels). To select the ARQ mode, press the **MODE** key until the desired format (ARQ-M2 or ARQ-M4) appears on the status line.

These ARQ signals use the seven bit synchronous error-detecting MOORE code which functions similarly to the code used for SITOR transmissions. ARQ operation however uses a full duplex system which interleaves two or four separate RTTY data channels on a single carrier.

This mode of operation provides for ARQ (Automatic ReQuest) error correction. While a channel is sending data at one end of the RF link, the corresponding "receiving" channel is transmitting control information, indicating whether the data was received correctly or if errors were detected. Since the system is full duplex, these signals are transmitted on separate frequencies.

It is important to note, that when searching for ARQ signals it is possible to be correctly tuned and phased to the signal and still obtain no print. This may be because the station is idling (just maintaining synchronization with the other end of the link) or it may be a "receiving" channel, transmitting only control information. It is not uncommon for an ARQ station to send nothing but synchronization pulses for several hours, followed by brief very periods of traffic. Keep this in mind.

A channel may switch back and forth from receiving to sending or from idling to sending. Also on a ARQ-M2 signal one, both, or neither channel may be sending text at any given time.

Pressing the **CHAN** key steps through the following sequence in ARQ-M2 (two channel):

A	channel A manual
AA	channel A automatic
B	channel B manual
BB	channel B automatic

EXPERT MODE 11

If ARQ-M4 (four channel) is selected, the following sequence is added:

C	channel C manual
CC	channel C automatic
D	channel D manual
DD	channel D automatic

If a channel is selected in manual mode, then that channel and ONLY that channel will be monitored. If an automatic channel mode is selected, then the following rules apply:

* If there is traffic on the selected channel then that channel will be displayed.
* If there is no traffic on the selected channel, then all other channels will be monitored, and if another channel has traffic on it, then that channel will be displayed.
* If more than one non-selected channel is active, the active channel that appears first on the following list will be displayed: A, B, C, D.

When in the automatic mode, the selected (or priority) channel will be displayed first on the status line, followed by the channel that is actually being printed to the screen. If all channels are idle, or if the selected channel is active, both channel indicators will be the same (AA, BB, etc.).

If channel A is selected, but idle, and channel B is active, then the status line will display: ARQ-M2 AB. When channel B returns to idle, or if channel A should become active while B is still active the display would change to ARQ-M2 AA.

The most common ARQ-M2 speed is 96 baud. The following standard speeds are also available: 100 and 86 baud.

ARQ-M2 at 200 baud (400 Hz shift) has recently become a popular format with the French military network. The M-8000 can receive this. After selecting ARQ-M2, press the **SPEED** button. Then press the **UP** button until you get to 200 baud. Frequencies to watch for ARQ-M2 200 baud / 400 Hz are:

- Paris: 5396, 6836, 8094, 10400, 10467, 10950, 12136, 13101, 13615, 13840, 13978, 16147, 16165,16278, 16306, 17368, 17426, 17462, 19063, 19675, 20845, 20865, 20995, 23234 and 23867 kHz.
- Jibuti: 5832, 10638, 10814, 13654, 13830, 13901, 16125, 16193, 19385, 19386, 20805 and 2305 kHz.
- N'djamena: 10468, 14585, 18033, 18447, 21857 and 23245 kHz.

The above information courtesy of Fred B. Hetherington.

The most common ARQ-M4 speed is 192 baud. The following standard speeds are also available: 200 and 172 baud.

Note: If the VFT demodulator is in use, the **CHAN** key selects the VFT channel. Use the F1 + **CHAN** key to select the ARQ data channel. (F1+ **CHAN** may be used for ARQ channel selection at any time.)

ARQ M-2 FREQUENCIES

Baud	Shift	kHz.	Call	Location
96	850	5098	'RFTJ'	Dakar, Senegal (FN)
96	425	5160	CLN21	Bauta, Cuba
86	425	5219	VKD	Australia
96	425	5222	TYE	Cotonou, Benin
96	425	5730	5UA	Niamey, Niger
96	425	5807	XTU7	Ouagadougou, Bkino.Faso
86	850	5938	VLS	Sydney, Australia
96	850	6770	'RFLI'	Ft.of France, Mart.(FN)
96	425	6770	WKA46	New Orleans, USA
96	850	6883	FUX	Le Port, Reunion Is(FN)
96	850	6900	'RFTJ'	Dakar, Senegal (FN)
96	425	6941	TRK	Libreville, Gabon
96	425	7483	'RFTJ'	Dakar, Senegal (FN)
96	850	7605	'RFHI'	Noumea, New Caledonia
96	380	7922	5UA79	Niamey, Niger
96	425	7923	BZG41	Beijing, China (Xinhua)
96	425	8107	'RFQP'	Djibouti, Djibouti (FN)
96	850	9260	'HCS'	Ho Chi Minh, Vietnam
96	850	9980	'RFFA'	Paris, France
96	850	10176	'RFFA'	Paris, France
96	850	10520	'RFLI'	Ft.of France, Mart.(FN)
96	60	10729		Hong Kong (to VTN)
96	60	10754		Hong Kong (to VTN)
96	425	10813	'RFQP'	Djibouti, Djibouti (FN)
96	425	11060	TZH	Bamako, Mali
96	850	11108	'RFLI'	Ft.of France, Mart.(FN)
96	425	11445	CUA68	Lisbon, Portugal
96	425	11685	HVH	Vatican City
96	850	13592	'RFFA'	Paris, France
96	425	13649	'RFFA'	Paris, France
96	325	13678	MSS	Belize (RN)
96	850	13928		Buenos Aires, Argentina
96	850	14625	'RFLI'	Ft.of France, Mart.(FN)
96	850	14925	'RFTJ'	Dakar, Senegal (FN)
96	425	15696	CLN484	Havana, Cuba
96	850	15960	'RFLI'	Ft.of France, Mart.(FN)
96	850	16142	'RFLI'	Ft.of France, Mart.(FN)
96	170	17382	'KMS'	Karachi, Pakistan
96	425	18295	SDN10	Stockholm, Sweden
96	850	18520	'HOS'	Ho Chi Minh, Vietnam
96	850	18933	'HOS'	Ho Chi Minh, Vietnam
96	850	19100	'RFLI'	Ft.of France, Mart.(FN)
96	850	19203	'RFLI'	Ft.of France, Mart.(FN)
96	340	19496	9RE394	Kinshasa, Zaire
96	360	19576	ORI49	Brussels, Belgium
96	360	19679	7OB93	Aden, Yemen
96	850	23715	'RFLI'	Ft.of France, Mart.(FN)
96	850	24870	'RFHJ'	Papeete, Tahiti (FN)

21.0 ARQ-E

EXPERT MODE 12

ARQ-E is a relatively new mode. It is a synchronous, single-channel, full-duplex mode.

The most common ARQ-E speed is 72 baud. The following standard speeds are also available: 86, 96, 144, 192, 48 and 64 baud.

The **UP** and **DOWN** keys may be used to select variable non-standard speeds from 20 to 250 baud. However, such non-standard speeds have not been reported to date.

It is common for ARQ-E channels to be inactive (idle) for hours at a time! During these idle periods, the signal will have the familiar 'sing' sound to it. During the actual transmission of traffic the signal will sound very much like regular Baudot.

ARQ-E FREQUENCIES

Baud	Shift	kHz.	Call	Location
96	330	5357	'RFFF'	Lyon, France
72	400	9337		Bangui, Cent.Afr.Rep.
72	390	10120	'RFFX'	Versailles, France
72	850	10169	'RFTJD'	Libreville, Gabon (FN)
72	425	10415	'RFFXL'	Beirut, Lebanon
72	425	10665	'RFTJD'	Libreville, Gabon (FN)
72	425	10858	'RFFX'	Versailles, France
192	425	11111	'RFLI'	Ft.of France, Mart.
72	850	12063	'RFLIG'	Cayenne, French Guiana
72	400	13572	'RFFX'	Versailles, France
72	850	13732	'RFLIC'	Ft.of France, Mart.
72	425	13980	'RFFXL'	Beirut, Lebanon
72	396	14412	'RFFXQA'	Paris, France
48	120	14663	DMK	Bonn, Germany
72	425	14666		Port Bouet, Ivory Coast
96	425	14845	'RFVITT'	Dzaoudzi, Comoro Island
72	425	14960	'RFFXL'	Beirut, Lebanon
72	425	15860	TLO	Bangui, Cent.Afr.Rep.
96	170	18289	DMK	Bonn, Germany
96	170	19884	DMK	Bonn, Germany
72	390	20268	TLO	Bangui, Cent.Afr.Rep.
96	170	20418		Managua, Nic. (Ger.Emb)
72	400	20822	'RFFXI'	Bangui, Cent.Afr.Rep.
96	120	22905	DMK	Bonn, Germany
96	170	29460	DMK	Bonn, Germany

22.0 ARQ-E3

EXPERT MODE 13

ARQ-E3 is a synchronous, single channel, full duplex transmission mode using seven-bit error detecting ITA-3 (Moore) code. The M-8000 will automatically adjust for either four or eight character repetition cycles.

The most common ARQ-E3 speed is 48 baud. The following standard speeds are also available: 64, 72, 86, 96, 100, 192 and 200 baud.

The **UP** and **DOWN** keys may be used to select variable non-standard speeds from 20 to 250 baud. However, such non-standard speeds have not been reported to date.

It is common for ARQ-E3 channels to be inactive (idle) for hours at a time!

ARQ-E3 FREQUENCIES

Baud	Shift	kHz.	Call	Location
48	850	4056	TJK	Douala, Cameroon
48	950	9125	'RFTJD'	Libreville, Gabon
48	700	10102	'RFLIRT	Ft.of France, Mart.
48	425	10283	'RFLI'	Ft.of France, Mart.
48	850	10800	'RFLI'	Ft.of France, Mart.
48	800	11190	'RFTJF'	Port Bouet, Ivory Coast
48	850	11575	'RFTJF'	Port Bouet, Ivory Coast
100	400	12190	'RFVI'	Reunion Island
48	850	13542	'RFTJD'	Libreville, Gabon
48	850	13683	'RFFI'	Paris, France
48	170	14484	FZC44	Cayenne, Fr. Guiana
192	375	14759	'RFQP'	Djibouti
48	850	14925	'RFTJ'	Dakar, Senegal
48	850	16260	'RFTJD'	Libreville, Gabon
96	425	17379	'RFTJ'	Dakar, Senegal
96	425	19048	'RFFA'	Paris, France
192	385	19101	'RFLIF'	Ft.of France, Mart.
48	850	19417	FUB	Paris, France
100	390	20633	'RFVI'	Reunion Island
48	840	20715	'RFFI'	Paris, France
48	850	20812	'RFTJD'	Libreville, Gabon
192	390	20856	'RFQP'	Djibouti
72	850	23520	'RFVI'	Reunion Island
192	425	23716	'RFLI'	Ft.of France, Mart.
192	395	24868	'FUM'	Papeete, Tahiti
100	390	26241	'RFVI'	Reunion Island

23.0 ARQ-S

EXPERT MODE 14

ARQ-S is a simplex error-detecting and correcting code which is similar to Sitor-A. The ARQ-S code may use a character block of 4, 5, 6, or 7 characters. The idle (receiving) time between successive blocks is always the same length of time as the transmit block. It is during this idle period that the receiving station transmits a single character (regardless of transmit block size) which indicates whether a block was received correctly or requests a repetition of the block. It is by virtue of this request for repetition by the receiving station that this mode becomes error-free. The monitoring station (you!) does not have this capability.

Pressing the **FR-L** key will step you through the group sizes of 4, 5, 6 and 7 characters. The group size must be manually set by the user in order for the M-8000 to sync to the received signals. The group size may be determined aurally by the duration of the character bursts. If the group size is correctly set the M-8000 will synchronize to either text or idle signals. When sync occurs, the DATA LED will turn on. When an error in the received signal is detected, the DATA ERROR LED will turn on. If an excessive number of errors are detected, the DATA LED will turn off and the unit will automatically attempt to re-sync. Pressing the **FR-R** will manually force an automatic re-sync to the signal.

The **UP** and **DOWN** keys may be used to select variable non-standard speeds from 20 to 250 baud. However, such non-standard ARQ-S speeds have not been reported to date.

ARQ-S FREQUENCIES

Baud	Shift	kHz.	Call	Location
96-6	170	10420	OEC	Vienna, Austria
96-5	170	11076	OEC	Moscow, (Austrian Emb.)
96-		13441		
96-6	170	14478	OEC	Vienna, Austria
96-5	170	14520	OEC	Vienna, Austria
96-5		15420	OEC	Vienna, Austria
96-6	195	17458	OEC	Vienna, Austria
96-5		19756	DMA	Jakarta, Indonesia
96-5	170	19810	OEC	Vienna, Austria
96-6	170	19928	OEC	Vienna, Austria
96-5	210	20494	OEC	Vienna, Austria
96-5	170	20750	OEC	Vienna, Austria

24.0 ARQ6-90

EXPERT MODE 16

ARQ6-90 is a very new and increasing popular French diplomatic mode. It is similar to SITOR A, but at a faster baud rate. The observed transmission rate so far, has always been 200 baud.

ARQ6-90 SAMPLE FREQUENCIES

Baud	Shift	kHz	Call	Location
200	400	15801	A1D	Ft.of France, Mart.
200	400	17455		
200	400	18033		
200		18744		Riyadh, Saudi Arabia (Fr.Emb.)
200	400	19932	'RFGW'	Paris, France
200		20153	'DKR'	Dakar, Sengal (Fr.Emb.)
200	400	20095	'KHSA'	Kinshasa, Zaire (Fr.Emb.)
200		20550	'KWIT'	Safat, Kuwait (Fr.Emb.)
200	400	20612		
200		20910		Riyadh, Saudi Arabia (Fr.Emb.)
200	400	22854		
200	400	25401	'TNNR'	Antananarivo, Malagasy (Fr.Emb.)

25.0 SWED-ARQ

EXPERT MODE 15

SWED-ARQ is another simplex error-detecting and correcting code which is similar to SITOR-A, but with one very significant difference. The SWED-ARQ has the capability of changing the size of the transmit character group during a transmission. Three group sizes are supported: 3, 9 and 22 characters. In all cases the acknowledgment from the receiving station is a single character and the idle time between character groups remains nearly the same. The received group size is indicated on the status line as **S** for short (3 characters), **M** for medium (9 characters) and **L** for long (22 characters). As the sending station changes from one size to another, the M-8000 will track these changes unless received errors occur at the change-over time. In order for the synchronization to occur when first tuning a signal, or if group size coordination is lost during an errored change, the M-8000 must be manually set to the same group size that the station is sending. The determination of group size may be determined aurally with little difficulty. The small group size sounds like SITOR-A. The medium group will have a cadence of about one block per second while the long group will take nearly two seconds for each transmit block. These times are based upon a 100 baud transmit speed which is the standard for this mode.

Pressing the **FR-L** key will step you through the group sizes of S, M and L. Pressing the **FR-R** will manually force an automatic re-sync to the signal.

The **UP** and **DOWN** keys may be used to select variable non-standard speeds from 20 to 250 baud. However, such non-standard SWED-ARQ speeds have not been reported to date.

Note: Some SWED-ARQ stations have been observed switching to SITOR-B for sending broadcast traffic.

SWED-ARQ FREQUENCIES

Baud	Shift	kHz.	Call	Location
100	170	12103	SAM	Stockholm, Sweden
100	425	13862	SAM	Stockholm, Sweden
100	170	14406	SAM	Stockholm, Sweden
100	370	14523	SAM	Stockholm, Sweden
100	425	14814	SAM	Stockholm, Sweden
100	400	14878	SAM	Stockholm, Sweden
100	385	14970	SAM	Stockholm, Sweden
100	425	18033		
100	170	18810	SAM	Stockholm, Sweden
100		18947	SAM	Stockholm, Sweden
100	395	20699	SAM	Lisbon, Portugal
100	170	20960	SAM	Stockholm, Sweden
100	425	20986	SAM	Stockholm, Sweden
100		23505	SAM	Stockholm, Sweden
100	400	23593	SAM	Stockholm, Sweden

26.0 V.F.T. (F.D.M.)

One of the more unusual forms of teletype is Frequency Division Multiplex (also called Voice Frequency Telegraphy). VFT is more a grouping of signals than a discreet "mode". Simply stated, the VFT signal is composed of several narrow shifted Baudot (or other mode) channels. Most VFT on shortwave is 16 channel. This is what we call mode B. The various channels may be operating at different baud rates (or even different modes). One common format is 50 baud press on channel one, 75 baud weather on channels 2 and 3, with channels 4 to 16 encrypted. VFT signals can be spotted by their obnoxious droning sound, not unlike a buzz saw or a swarm of bees.

There are several challenges to tuning VFT. The first is tuning the signal for correct channelization. Let's assume you are trying for the press channel of the 13553 logging below. First set the M-8000 for Baudot 50 baud. Then press the **VFT** button. This will put you at the most common VFT mode which is **B.** Below the "VFT-B" indication on the status line is "01". This indicates you are on channel 1. Set your shortwave receiver to LSB with a bandwidth 4 to 6 kHz selected. Very slowly tune up to the signal (from lowest to highest). *If* channel 1 is active the MK and SP LEDs should be flashing. As with all Baudot, signals you must try Normal and Reverse. Readable text should follow. Due to the large number of individual tone pairs in the VFT mode, the spectral display will not give an accurate representation of the received signal.

Please note that of the 16 mode B channels, at most only 1, 2 or 3 will be readable Baudot. Channels may be inactive for long periods. VFT stations change frequencies often. Tuning VFT requires very slow tuning with a stable receiver capable of tuning in 10 Hz or less steps. This is not a mode for the beginner or the impatient! Tuning your *first* readable VFT signal may take several hours. Be sure to write all the M-8000 and receiver settings down! Retuning the signal in the future will then only require a few minutes.

VFT (F.D.M.) FREQUENCIES

Mode	Ch.	kHz.	Baud	Service
B	09	4446	50	Press (AP-UPI)
B	04	**5159**	75	Press (AP)
B	01	6793	75	Press (AP-UPI)
B	01	6993	50	Press (AP-UPI)
B	05	**7871**	75	Press (AP)
B	03	7994	75	NLX RY test
B	01	8032	50	Press (AP-UPI)
B	01	**9961**	50	Press (AP-UPI)
B	02	**9961**	75	Aviation Weather
B	03	**9961**	75	Aviation Weather
B	02	10258	50	Press (AP-UPI)
B	03	10258	75	Aviation Weather
B	01	**11007**	50	Press (AP)
B	01	**13553**	50	Press (AP-UPI)
B	02	**13553**	75	Aviation Weather
B	03	**13553**	75	Aviation Weather
B	01	14386	50	Press (AP-UPI)
B	01	**14418**	75	Press (AP)
B	01	**14522**	50	Press (AP)
B	01	**16141**	75	Press (AP)
D	01	15788	75	RVK88 Russia

27.0 PICCOLO

EXPERT MODE 22

Piccolo is like a telegraph code, in that it uses the Baudot character set as its basis, but it is not like a telegraph code because it does not use binary (on/off) keying. The Piccolo signal is comprised of six tones (as opposed to the binary telegraph's two tones) with only one of the six tones transmitted at any given instant. A Piccolo character is sent as a sequence of two tones, each tone lasting 50 milliseconds. A pair of two tones out of a field of six frequencies yields 36 possible combinations of tones. Of these 36 combinations, 32 correspond directly to the 32 binary combinations of the Baudot code, one is reserved as an idle signal and the remaining 3 are not used as valid combinations. There being no start or stop pulses, Piccolo is a synchronous code. Since Piccolo is a super-set of the Baudot code the controls for UOS, ALPHabet and CASE will function just as in the other Baudot-based modes.

PICCOLO TUNING

Since there are six tones involved, all previous discussions on RTTY tuning (except for input level considerations) are rendered invalid. When the Piccolo mode is selected on the M-8000, the frequency spectrum graphic tuning aid is reconfigured specifically for Piccolo tuning. Superimposed on the spectrum display are six vertical green reference lines. These lines correspond to the optimum detection points for the six Piccolo tones of 460, 480, 500, 520, 540 and 560 Hz.

Look again at the list of Piccolo tones. Note that they are all much lower in frequency than we are used to using for normal RTTY, and the tones are only 20 Hz. apart. In order to receive a Piccolo signal the receiver will have to be set to either USB or LSB mode. In order to successfully tune a Piccolo station, the receiver must have the capability of changing the tuned frequency in very fine steps. The receiver must also be extremely stable to keep the station tuned once the receiver is set.

After locating an active Piccolo station, adjust the receiver so that there are six peaks in the graphics spectrum tuning display. Carefully adjust the receiver tuning so that these six peaks coincide with the six reference lines. If your receiver tuning is in steps too coarse to make these line up, use a setting which places the peaks as close as possible to the reference lines and then use the **FR-L** and **FR-R** keys to fine tune the M-8000 to match the received tones. The **FR-L** and **FR-R** keys will fine tune the received signal in 1 Hz. steps up to a maximum variation of plus or minus 50 Hz. The **FR-L** and **FR-R** keys will repeat if they are held down.

Once the receiver and/or M-8000 have been tuned so that the six spectrum peaks coincide with (or are as close as possible to) the six reference lines, there are two other considerations to properly decoding the Piccolo signal. The polarity and phasing of the M-8000 must match that at the sending station.

PICCOLO POLARITY

In standard RTTY the Mark and Space tones may be reversed. A similar situation can occur with Piccolo signals. It is possible for tone 1 to be received as tone 6, tone 2 as tone 5 and tone 3 as tone 4. In order to correct for this inversion of the six tones, the M-8000 **N/R** key can invert the order of all six Piccolo tones, just as it does for the Mark and Space tones in RTTY.

PICCOLO PHASING

Each Piccolo character is sent using two tones; the first tone followed by the second tone. As the string of tones is decoded, there is no way for the M-8000 to positively know whether any two sequential tones are the first and second tones of a character, or if the two tones are the last tone of one character followed by the first tone of the next character. Pressing the **TUNE** key will cause the M-8000 to offset the received string by one tone thus reversing the first tone/second tone sequence.

The simplest means to resolve the polarity and phasing dilemma is to try both normal and then reverse settings, then pressing the **TUNE** key and again trying both reverse and normal positions. You would, of course stop the trial process once the unit is properly set. Much of what is sent by piccolo is also encrypted, so using the trial method until plain text is observed may prove futile. Since there are three unused, and hence invalid, tone combinations, the DATA ERROR LED may be used to set the piccolo polarity and phasing. Simply perform the above trial and error method where a minimum number of DATA ERROR indications will reflect proper settings.

Please note that for a given station and receiver setting, the proper polarity setting NOR or REV will remain constant for that signal. The phasing, having to do with the relative timing of the sending and receiving unit, is a random factor. There is a 50/50 chance that the phasing for a given signal will be correct when tuned. It is also possible for the M-8000 to loose phasing synchronization due to interference fading or noise. If this does occur, the **TUNE** key (one press only) should restore proper phasing.

It is normal for the MK and SP LEDs to blink during piccolo reception but these indicators should not be relied upon for tuning. The MK LED will light when the 460 Hz. tone is received while the 560 Hz. tone will turn on the SP LED.

The 'idle' character for piccolo is represented by the 500 Hz. tone followed by the 520 Hz. tone (the middle two tones). An idling Piccolo signal then is a repeated transition between these two tones. As a result there are two settings of the N/R and phasing which will produce no DATA ERRORs. There is no way, however, to determine which setting is the correct one.

Continuous Piccolo traffic is usually encrypted, but long idles are often interrupted by short clear traffic and ID's. Often Piccolo is two channel in VFT with one crypto channel and the other being the "order-wire" with occasional clear traffic.

We would like to acknowledge the assistance provided by Dr. Dave Wilson in providing the conversion tables for the Piccolo mode.

PICCOLO FREQUENCIES

kHz.	Call	Location	Transmit To
9053	MKK	London, UK	MSS
10760	MKK	London, UK	MSS
13445	MKK	London, UK	MSS
14473	MKK	London, UK	MSS
16344	MKK	London, UK	MSS
17515	MKK	London, UK	MSS

PICCOLO FREQUENCIES continued

kHz.	Call	Location	Transmit To
18512	MKK	London, UK	MSS
18525	MKK	London, UK	MSS
19810	MKK	London, UK	MSS
19915	MKK	London, UK	MSS
20170	MKK	London, UK	MSS
23761	MKK	London, UK	MSS
11584	MKK	London, UK	MTS
13580	MKK	London, UK	MTS
14510	MKK	London, UK	MTS
16205	MKK	London, UK	MTS
18057	MKK	London, UK	MTS
18750	MKK	London, UK	MTS
20265	MKK	London, UK	MTS
20436	MKK	London, UK	MTS
22890	MKK	London, UK	MTS
7822	MSS	Belize, Belize	MKK
12270	MSS	Belize, Belize	MKK
14496	MSS	Belize, Belize	MKK
14710	MSS	Belize, Belize	MKK
14828	MSS	Belize, Belize	MKK
15815	MSS	Belize, Belize	MKK
16270	MSS	Belize, Belize	MKK
18420	MSS	Belize, Belize	MKK
18941	MSS	Belize, Belize	MKK
19005	MSS	Belize, Belize	MKK
20285	MSS	Belize, Belize	MKK
22922	MSS	Belize, Belize	MKK
24333	MSS	Belize, Belize	MKK
9265	MTS	Pt.Stanley, Falkland I.	MKK
14593	MTS	Pt.Stanley, Falkland I.	MKK
15855	MTS	Pt.Stanley, Falkland I.	MKK
16390	MTS	Pt.Stanley, Falkland I.	MKK
18879	MTS	Pt.Stanley, Falkland I.	MKK
20308	MTS	Pt.Stanley, Falkland I.	MKK
6844	MKD	Akrotiri, Cyprus	MUH8
10249	MKD	Akrotiri, Cyprus	MUH8
11465	MKD	Akrotiri, Cyprus	MUH8
13968	MKD	Akrotiri, Cyprus	MUH8
16233	MKD	Akrotiri, Cyprus	MUH8
19056	MKD	Akrotiri, Cyprus	MUH8
20124	MKD	Akrotiri, Cyprus	MUH8
20600	MKD	Akrotiri, Cyprus	MUH8
23374	MKD	Akrotiri, Cyprus	MUH8
24654	MKD	Akrotiri, Cyprus	MUH8
10854	MUH8	Nanyuki, Kenya	MKD
16254	MUH8	Nanyuki, Kenya	MKD
23794	MUH8	Nanyuki, Kenya	MKD
14853	GEC	???	???
15780	GYU	Gibraltar	???
18704		???	???
16319		???	???

28.0 PACTOR

EXPERT MODE 04

PACTOR is a combination of AMTOR and PACKET modes, and is most closely related to AMTOR (SITOR). The sound of PACTOR is very similar to that of SWED-ARQ in the long (22 character) operating mode. The PACTOR packets are approximately one second long and are repeated at a rate of about four packets every five seconds. In between the data packets, the receiving station responds with a single acknowledgment code which indicates if the previous packet was received correctly. As with all other such 'ARQ' codes, the only station entitled to error-free reception is the one receiving station which responds with these control signals.

Just like Packet radio, PACTOR uses a sixteen bit cyclic redundancy check (CRC) to verify the accuracy of the received data. This type of error check is essentially fool-proof in detecting any received data errors. PACTOR is also similar to Packet in that a count of transmitted packets is maintained and sent with each packet. Any packet which does not pass the CRC error test is discarded, ensuring that only error-free packets are presented and the packet count is used to prevent any repeated packets from being displayed (except as noted below).

The data within each packet may be sent at either 100 or 200 bauds, depending upon the propagation characteristics between the two communicating stations. The speed is set and/or changed automatically by the PACTOR system so that no user intervention is required. Regardless of actual packet data speed, the status line will indicate **PACTOR 200**.

Because of this dual-speed capability, it is possible that during a reducing speed change, a monitoring station may have a certain number of characters, which were in both the 200 and 100 baud packets, displayed more than once (repeated text characters). This is an inherent idiosyncrasy of the PACTOR system which has yet to be addressed by the designers.

The fact that only error-free packets are displayed does not, in itself, ensure error-free reception. It is possible, and to be expected, that the monitoring station will completely miss entire packets of any given transmission. This will occur whenever the monitoring station detects an error in the received packet while the intended recipient captures the packet without error. Conversely, repeated characters will occur when the monitoring station correctly receives a 200 baud packet which the intended recipient cannot recover and subsequently requests a change to 100 bauds.

Operation

To select PACTOR press the **MODE** key until **PACTOR** appears in the mode position of the status line.

To select Long Path **(LP)** or Short Path **(SP)**, use the **FR-L** key. (For 99% of the time SP would be the desired setting).

29.0 LITERAL DISPLAY

The Literal Display feature is actually a sub-mode of the various RTTY modes. Basic operation in this mode is the same as for normal operation in the main mode being literally displayed.

The Literal Display provides limited diagnostic or analysis capability by displaying ALL received characters on the video screen. These include character codes that would not normally be displayed, such as carriage return, line feed, figures shift, letters shift, blank character, who-are-you, bell and other control and phasing signals. These special symbols are shown on page 92.

This feature can be extremely useful for those studious listeners wishing to better understand transmission modes and protocols. It can even be used in a limited fashion to identify or classify certain transmissions. However, the RTTY neophyte should avoid this mode at first as they might find it confusing. It should be engaged only after the user has a solid understanding of the M-8000.

The Literal Display feature may be invoked while in any Baudot-based RTTY mode, either before or after selecting the actual mode and speed of main operation. To toggle into and out of the Literal Display Mode, press the **ALPH** key with F1 active. This feature is available in Baudot, SITOR and all FEC and ARQ modes at all speeds available in these modes.

The UOS status line indicator will be replaced with LIT when the Literal Display function is in operation. The state of the UOS function will remain as it was set when entering the LITeral display, and the **UOS** key will still toggle the UOS function *on* and *off*, but there will be no status line indicator of this.

When the LITeral display is enabled, the only control codes that will retain their controlling functions are the FIGS and LTRS case shift codes, and any phasing control patterns. All other codes will be displayed ONLY. That is, a carriage return or line feed will not result in a new line on the video monitor.

This mode is truly literal, in that all characters are displayed exactly as they are received:

* During SITOR reception all groups from the ISS are displayed, including repetitions, request for repetition and idles. Errors are displayed.

* During SITOR mode B operation all phasing signals are displayed and the character stream is displayed in received format (character interleaved). Errors are displayed.

* During ARQ reception, the full data stream (all channels, and all characters (idle, RQ, etc.)) are shown exactly as they are received.

30.0 DATABIT DISPLAY MODEs (SYNC/ASYNC)

The Databit Display Mode is an advanced code analysis mode for the seasoned data investigator. Once again ... novice RTTY listeners should avoid this mode! In this mode the actual data bit stream of the received signal is displayed on the video screen. This can be done in either synchronous or asynchronous modes. The screen will be in the 80x30 text format only.

The **SPEED** key will step through the following speeds in either SYNC or ASYNC modes:
50, 75, 100, 150, 200 and 250.

The number of bits per each received group is displayed to the right of the Mode indication. When in this mode, four of the keys are assigned special functions:

FR-L Each press of this key shifts the bit pattern left by one bit. This key operates in the SYNC mode only.

FR-R Each press of this key shifts the bit pattern right by one bit. This key operates in the SYNC mode only.

BI Each press of this key steps through the various number of data bits per group (4-9). Note: When the number of bits per group or bit pattern position is changed, the column alignment of the display may be momentarily disturbed.

RUN Pressing this key toggles between the display and halt display. This key will stop the incoming display, then if pressed again the display will resume. The transfer of data to the screen may be halted to assist in examining a number of bit groups. The start/stop is synchronized to the beginning of each group, so that full groups will be displayed. Internal processing continues during the halt period, so sync with incoming signal will not be lost. This key operates in SYNC mode only. In order to halt the screen display in the ASYNC mode simply turn the GAIN control fully counter-clockwise.

Data bits are displayed on the screen with the first received bit at the left of each group, and the last received bit to the right.

In the ASYNC mode, a group of bits will only be displayed if a valid start pulse is detected for the group, and only data bits are displayed, start and stop bits are stripped away. These start and stop bits are tested however, and the DATA ERROR LED will indicate if invalid start bits, or framing errors are detected. The DATA LED indicates when bit groups are being received.

Since so many have asked: No, there is no advantage in displaying the start and stop bits in the ASYNC mode. Since the polarity and position of all start bits and all stop bits is the same for all asynchronous characters, their presence on the screen would only clutter the display.

In the SYNC mode, bit groups will be continuously displayed unless halted by the **RUN** key. The DATA LED will indicate if the input bit stream is active (as opposed to steady Mark or Space). As an additional diagnostic tool in the SYNC mode, each bit group is followed by a number indicating the number of 1 bits in each group.

In either mode, the bit groups will be spaced apart and arranged in as many columns as will fit on the screen for the number of bits per group selected.

31.0 PAGER CODES

In an attempt to help satisfy modern man's insatiable need to remain constantly 'in touch', the pocket pager was developed. These handy little receivers have been developed using a variety of different integral signal decoding methods. Some of these include two-tone sequential and DTMF. These signals could simply cause the pager to beep, or they could then be followed by a voice message which would be heard only on the pager whose code had been sent. This allowed a large number of customers to be placed on the same frequency without interfering with one another.

While tone only and voice pagers are still in common use, the trend is toward digital pager signaling and message delivery. The M-8000 is capable of decoding two of the most widely used digital paging codes: POCSAG and GOLAY. These codes do not use tones to signal the pager, but rather transmit digital data which directly modulates the RF carrier. These codes can be used to address a specific pager to simply beep, to enable the transmission of a voice message, or to directly enter a message into the pager which may then be read by the user.

These digital messages fall into two categories, numeric only and alpha-numeric. The numeric only messages require considerably less data, hence air-time, than do the alpha-numeric messages. The alpha-numeric can actually spell out a message to the pager, while the numeric only is limited to sending a series of digits (usually the telephone number the paged person is to call). Both digital pager formats have the capability of simply signaling the pager to beep, with no data message at all, or in conjunction with an audio voice message.

Every pager has a unique address which identifies it from other pagers sharing a common frequency. This address is digitized and transmitted to the pager. The address that the M-8000 displays is a representation of this digitized information and not the address as would be entered on a paging terminal. This address information is presented as incidental information for the listener to analyze repetitions of a signal to a specific pager. It is not intended to be a means of determining the identity of the paged individual, or for any other investigative purpose.

Many of the paging services in operation today use a combination of several different signaling formats. It is not unusual to hear a two-tone sequential voice page followed by a GOLAY signal followed by a DTMF and then a POCSAG page. The M-8000 will filter out only those pages which are in the format that the mode is set to.

31.1 PAGER RECEIVER HOOKUP

The M-8000 has a separate demodulator for the pager codes (and ACARS). Your scanner or VHF/UHF receiver must be connected to Audio Input #2 in a special way. Audio Input #2 is actually a stereo 1/4" phone jack. Pager data must be connected using a three conductor 1/4" phone plug to the RING and SLEEVE.

31.2 PAGER CODE RECEPTION

The M-8000 receives 24 different modes in order to satisfy the needs of hobby, government and military users. The interception of pager modes *by private individuals* may be forbidden in certain areas. Check with your local authorities. The misuse, recording or publication of such traffic would certainly be prohibited anywhere.

31.3 PAGER TRAFFIC

The vast majority of digital paging messages consist of telephone numbers. Some of these will appear in the standard "555-1234" format, but there are many variations on this. Sometimes the hyphen is left out ("18005554578") or an extension number is added ("5557382-438"). A limited number of alpha characters are included in the 'numeric only' pager formats. This allows for a designation of an urgent message or call by adding an R or UR after the phone number. Other times the extension will be used to indicate priority ("555-4821 911"). Not all pages are composed of telephone numbers. The digital page may also be used to send authorization codes, part numbers or any other type of numerical message.

31.4 PAGER TUNING

Perhaps the most important thing to be said about tuning a digital pager station is that the M-8000 does not have a pager signal demodulator! The 'audio' signal coming out of your receiver, scanner or whatever is the raw binary pager data. This fact comes as a mixed blessing: Tuning is a simple matter of setting your receiver to the proper frequency and the only adjustment is to set the audio output to the proper level. The down side to this is that the proper level must be determined by trial and error.

The other factor is that the audio circuits in most scanners are designed to handle and reproduce voice signals, not digital data. The data rates of the pager signals (500 to 600 bps) result in fundamental frequencies at 300 Hz. and below. A string of 10 to 15 consecutive 1's or 0's results in an equivalent frequency of 20 to 30 Hz., far below the optimum response of the typical scanner audio output circuit.

The polarity of the pager signal is also of critical importance. As a result, the N/R key is still used to invert the digital signal, if necessary. The setting of the sense to NOR or REV is a function of the sending station's equipment and the receiver's discriminator and audio circuits.

There is one indicator on the M-8000 that can assist in setting the proper receiver level: The DATA LED will indicate when detectable data transitions are present at the pager input. Optimum reception of pager signals is usually obtained by increasing the radio output level just past the point where the DATA LED stays on nearly flicker-free during digital pages.

Note that this LED will also turn on during voice and tone pages. It does not indicate valid data; it merely indicates that the radio output is sufficient to trigger the M-8000 pager data input. Obviously, there must be enough level from the radio to do this, but there should not be such an excessive level as to distort the signal.

32.0 POCSAG

EXPERT MODE 20

This code was developed by a British communications committee called the Post Office Code Standardisation Advisory Group. This code is transmitted at a data rate of 512 bits per second. The transmit format is as follows: A preamble of at least 576 bits of 1 / 0 reversals (this is essentially a 288 Hz. tone lasting at least 1 1/8 seconds). This preamble is followed by the address and then message information, if any message is sent.

A POCSAG page signal is displayed on the screen by showing the six digit address indicator followed by and equal sign (=) and then a letter indicating the type of page:

B indicates a beep only
indicates a numeric message
A indicates an alpha-numeric message

In the case of the numeric and alpha-numeric pages, the type indicator is followed by the page information. It is possible to have a data page with the information fields empty.

33.0 GOLAY

EXPERT MODE 21

The Golay, or more properly Golay sequential code, is another commonly used pager signaling system. This page format is:

A preamble of 28 bits of 1/0 reversals at 600 bits per second, followed by a preamble word repeated 18 times at 300 bits per second, then a sync and address at 300 bits per second. If the page includes digital data (numeric or alpha-numeric) that data is then sent at 600 bits per second.

The Golay pages are displayed on the screen by printing the eight digit address. If the page is beep only there is no indication other than the address. A numeric page address is followed by an equal sign (=) and then the numeric data. Alpha-numeric page addresses are followed by a colon (:) and then the page information on the following line. Again, it is possible to have a numeric or alpha-numeric page with an empty data field.

34.0 ACARS

EXPERT MODE 19

ACARS stands for *Aircraft Communications Addressing and Reporting System* . It was developed to reduce the flight crew's workload by using computers on the ground and in the aircraft to exchange many routine reports and messages that enhance the safety and efficiency of modern air travel.

ACARS is a transmission mode, somewhat like Packet radio, which is sent in short bursts at 2400 baud. A typical ACARS transmission lasts well under ½ a second. Consequently you must leave our receivers **Squelch open (OFF) to copy ACARS**. ACARS uses AM (amplitude modulated) aircraft radios. ACARS transmissions may be heard on:

131.550 MHz primary USA and Canada
130.025 MHz secondary USA
129.125 MHz tertiary USA

131.725 MHz primary Europe
131.475 MHz private *Air Canada*
129.125 MHz (in some areas only)

These VHF communications are generally "line of sight" where one of the radio antennas (usually the one on the airplane) is several thousand feet high. Unless you are located fairly near to a major airport, it is not likely that you will receive any ground to air ACARS traffic. However, air to ground transmissions can typically be heard over hundred of miles. Therefore, certain ACARS traffic can be monitored virtually anywhere in the U.S.

The ACARS system has fairly sophisticated error detecting capabilities with positive control over message integrity. The receiving station will respond with a signal indicating whether or not each transmission was received correctly. If a message is found to contain errors the receiving station demands a repetition of the same transmission until it is correctly received.

In the full ACARS implementation there are three distinct levels of detecting a reception error: at the individual bit level, the character level and the message level. When absolute accuracy is essential (on an airliner) an error at any level will cause the received message to be scrapped and will trigger a request for repetition. The M-8000 tests for errors at the bit level and will decode and display the ACARS message until either a bit error is detected or the message is completed. This format permits you to monitor the greatest amount of ACARS traffic with the least amount of displayed garble. You will note that some ACARS messages will not be displayed in their entirety. You will also find that the unit will occasionally print a line of gibberish. The system that the M-8000 uses is the best compromise in terms of percentage of valid data presented. It would be very nice for us (and you) if the Universal M-8000 could request a repetition when an error was detected, but this feature would likely upset the major air carriers!

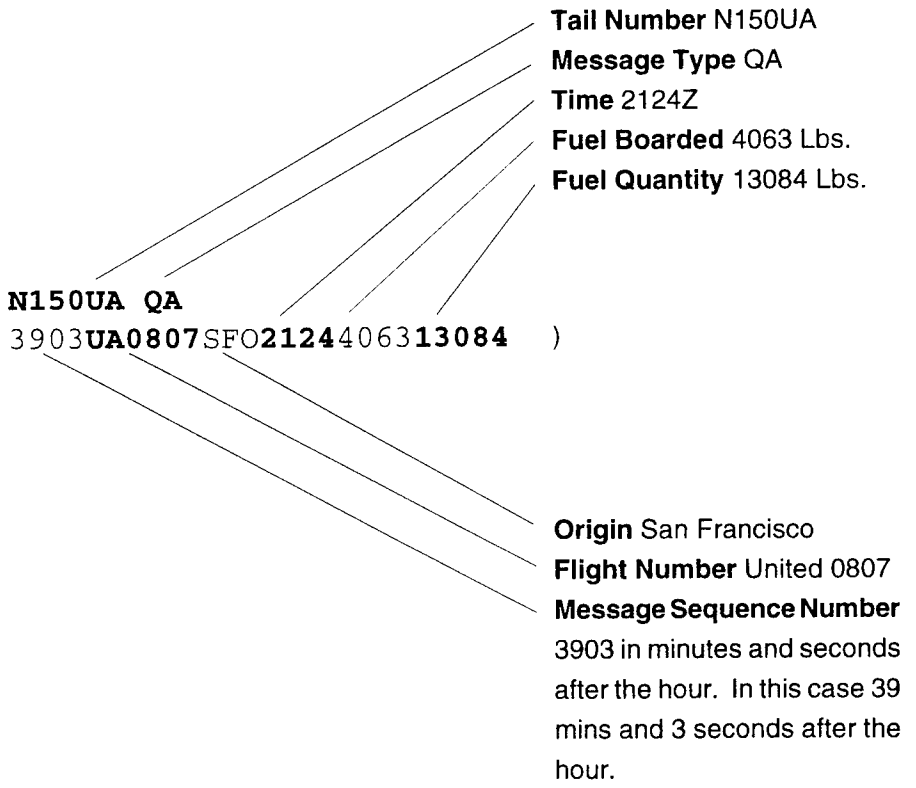
34.1 ACARS RECEIVER HOOKUP

The M-8000 has a separate demodulator for ACARS (and the pager codes). See Chapter 31.1. Your scanner or VHF/UHF receiver must be connected to Audio Input #2 in a special way. Audio Input #2 is actually a stereo 1/4" phone jack. Pager data must be connected using a three conductor 1/4" phone plug to the RING and SLEEVE.

ACARS transmissions are usually very cryptic and highly abbreviated. They will, at first glance, seem indecipherable, even to those with an understanding of aviation. Over thirty ACARS message types are utilized. A typical message is shown below with an analysis of its meaning.

OUT/FUEL REPORT (QA)

The "QA" or OUT/FUEL report, indicates total fuel boarded (in pounds) and total fuel on board as the plane leaves the gate. (*Not* fuel at takeoff).



For detailed information on interpreting this format we recommend:

Understanding ACARS
by Ed Flynn.

This affordable and informative title is available from Universal Radio and other dealers.

35.0 FAX

EXPERT MODE
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Before attempting to operate in the FAX mode, please note:

* The FAX printer output is generated on the parallel printer output only. During FAX operation, the serial printer is completely disabled.
* For proper operation, the type of printer (8/9 pin, 24 pin or LASER) must be specified in the PROGRAMMING mode under the PRINTERS sub-menu. (See Page 87 for details)

Facsimile or 'FAX' is a transferring of a visible image on paper from one location to another by means of electrical signals. At the sending location, each spot of the image is sampled to determine its intensity (light to dark), using an optic sensor. The intensity is then converted to an electrical signal proportional to the lightness or darkness of the spot. The spots are sampled horizontally across the image, forming lines. When one horizontal line has been completely scanned, the sensor is moved to the first dot of the next line to be scanned. This process is repeated until the entire image has been sampled. In practice, this is accomplished by placing the original image on a rotating drum, while the optic sensor is moved along the axis of the drum at a much slower rate. This is why the speed is referred to as 'drum speed'.

At the receiving location(s), the electrical signal is used to impress the sampled image, spot by spot and line by line until the entire image is re-created. This is usually done by applying the electrical signal to one or more stylus which contacts the receiver's paper. Either the paper is attached to a rotating drum while the stylus slowly moves along the axis of the drum (similar to the sending process), or the stylus moves across the paper as the paper is fed from a roll in the receiving machine. There are two modulation methods used for sending these FAX signals:

FM (Frequency Modulation)
In this method, the sending unit converts the electrical signal from the image sensor to a tone whose frequency is determined by the spot intensity. Standards have been established which set the tone frequency for black to 1500 Hz and white to 2300 Hz., with the tones for the gray levels proportional. Forall shortwave FAX the FM FAX mode should be selected.

AM (Amplitude Modulation)
In this mode, the sending unit sends a tone of constant frequency. The amplitude, or loudness, of the tone is proportional to the intensity of the spot, with the highest amplitude (loudest) corresponding to black. AM FAX is not used on shortwave.

Please note: The above nomenclature (AM / FM) refers ONLY to the audio signal from the sending machine, NOT to the method of transmission, which for either type could be telephone line, FM transmitter, AM transmitter or SSB transmitter, terrestrial or satellite. The M-8000 demodulators are capable of decoding either AM or FM, so that signals in either format may be received. The demodulator mode is selected with the **T/S** key.

The FAX mode on the M-8000 is used for receiving broadcast facsimile images from shortwave or satellite stations. The M-8000 will not receive or display signals from an "office" telefax machine.

35.1 FAX RECEPTION CONTROLS

The **SPEED** key selects the LPM (lines per minute) of the FAX signal. The available speeds are 120, 240, 60 and 90 LPM. On most shortwave weather FAX signals 120 LPM is used. 60 LPM is often used for press FAX photos. 240 LPM is not used on shortwave, but can be found on some satellite frequencies. The speed of 90 LPM is rarely used.

The **N/R** key is used to reverse the polarity of the received signal. If the received image appears as a negative (black and white reversed), press the **N/R** key. This will affect only subsequently received image information and will not alter the appearance of the image which has already been displayed.

The **SHIFT** key selects the IOC. The IOC (Index Of Cooperation) of a FAX image indicates the relationship between the width of the image and the number of lines per inch that make up the image. The IOC is defined as the width of the image multiplied by the number of lines per inch and divided by *pi*. The IOC determines the aspect ratio of the image, that is the ratio of height to width. After a small amount of the image has been displayed, it should become apparent if the IOC selection is correct or not. If 288 is selected on a 576 signal, the image will be stretched out vertically. If 576 is selected on a 288 signal, the image will be compressed in the vertical dimension. Most shortwave FAX is at IOC 576. The values of 288 and 440 may also be selected using the **SHIFT** key. **SHIFT** with F1 active toggles IOC lock. This insures the IOC will not accidently change during marginal reception conditions. A locked IOC is shown in brackets such as **[576]**. A locked IOC may be *manually* changed. The **T/S** key is used to select AM or FM FAX.

Press **[F1+CLEAR]** to clear the current FAX image from the screen. To prevent an *accidental* press of the **CLEAR** key from erasing a received FAX image, the screen clear function in the FAX mode must be invoked by first press the **F1** key, *then* the **CLEAR** key. Pressing the **CLEAR** key by itself will have no effect when the M-8000 is operating in the FAX mode.

35.2 FAX INDICATORS

SQ and DATA LEDs

The SQ LED will turn on when the demodulated signal is correct for good FAX reproduction. The DATA LED will be on only while the FAX conversion is in process, that is, when the M-8000 is actually running in the FAX mode.

B + W STATUS LINE INDICATOR

When the FAX mode is selected, the right end of the top status line is used to present a FAX tuning aid. The "W" and "B" correspond to the White and Black FAX image levels. The highlighted portion of the display will extend outward from the center to indicate the amount of black and white image information. Proper tuning is indicated by the highlighted area filling as much of the indicator as possible.

35.3 AM TUNING

To select between AM and FM FAX detection press the **T/S** key. Some satellite FAX transmissions are amplitude modulated (AM) FAX. To tune an AM FAX signal, reduce the output of the receiver, or the setting of the front-panel gain control. This should produce a maximum indication toward the White and no illumination toward the Black. Slowly increase the output or gain control until the highlighted bar approaches the Black reference. This should provide nearly optimum tuning. Slight adjustment may be made while observing the on-screen indicator and the displayed image.

When using the AM demodulator, the MK, SP and TUNE ERROR LEDs should be ignored. The AUDIO INPUT LEVEL will give some indication of the received FAX signal level, but should not be relied upon for tuning. In the AM mode, the AGC circuit must be turned off.

35.4 FM TUNING

To select between AM and FM FAX detection press the **T/S** key. The FM FAX signal has a wide bandwidth, therefore use the USB setting of your receiver with a bandwidth of 2000 to 3000 Hz. Adjust the tuning (BFO) so that the FAX tones are at a fairly high audio frequency. Slowly decrease the frequency of the FAX audio tones until the highlighted bars are nearly equal and maximum. This setting should give reasonable image reproduction.

In the FM mode, the MK LED will indicate the black level and the SP LED will indicate white. While the MK and SP LEDs operate in the FM mode, the high switching rate of the FAX signal may keep these LEDs from both lighting. On weather charts, the SP LED will be mostly on, with the MK only flickering occasionally.

35.5 MANUAL OPERATION

Once the FAX signal has been properly tuned in, the speed and IOC of the received signal must be selected. This is done by pressing the **SPEED** key to select the drum speed, and the **SHIFT** key to select the IOC. The speed of the received FAX signal can be determined aurally. In listening to the FAX signal, a definite cadence can be detected. The rate of this cadence signals the drum speed: A cadence of one beat per second would indicate 60 lpm; one and a half per second 90; two per second 120; and four per second 240.

Once the speed has been determined and set, the unit should be started by pressing the **RUN** key. The DATA LED should light. If the tuning is very far off from proper, or if the sending station is at idle (constant level or frequency tone signal) the automatic shut-off circuit in the unit may keep the DATA LED from coming on. An active FAX signal must be properly tuned.

When a FAX signal is manually started it will not, in most cases, be properly synchronized or phased to the converter. In these cases (where the image is not centered on the page), the image must be manually framed. This is done by pressing the **FR-L** key to move the IMAGE to the left, or the **FR-R** key to move the *image* to the right. Each press of these keys will move the image APPROXIMATELY 1/2 inch.

35.6 MANUAL OPERATION WITH LOCK

There are occasions when, due to either the received signal conditions *or* the content of the received FAX image, the M-8000 will falsely sense that the end of an image has been reached and automatically stop the facsimile processing. If the FAX reception is manually started by pressing the **F1** *and* **RUN** keys, the M-8000 will continue FAX processing until the unit is manually stopped by again pressing the **RUN** key.

Note: When using this method, just as with any manual image start, the received image may need to be manually framed.

35.7 AUTOMATIC OPERATION

Once a FAX station has been **properly** tuned in, much of the operation of the M-8000 becomes automatic. The weather charts and satellite images from the NWS are preceded by a signal that indicates the IOC of the FAX image to be sent. The M-8000 recognizes this signal and automatically sets the IOC to the indicated value. FAX transmissions begin with a phasing (sync) signal that indicates the speed of the following transmission and also frames (centers) the image. The M-8000 recognizes these signals and automatically sets the unit to the indicated speed, synchronizes the internal timers to the incoming signal and starts the conversion process (the DATA LED will turn on).

While some transmissions use a stop signal, the characteristics of the stop signal vary enough that detection is at best difficult. However, all transmissions end with an idle pause. The M-8000 interprets this idle pause as a stop signal and automatically stops the conversion process (the DATA LED turns off). On very noisy signals, the random noise signal may prevent this function from operating, and the **RUN** key should be pressed to stop the conversion process.

35.8 VIDEO FAX DISPLAY

The received FAX image is displayed on the video screen in full VGA format of 640 x 480 x 16 colors. The image may be displayed using any of the five color palettes: MONO, B&W, COL1, COL2 or CGA. Pressing the **ALPH** key steps through these various palettes and the palette may be changed at any time whether an image is being received or not.

The MONO (monochrome) palette is a linear 16 shade gray scale. For most images this selection provides the nearest approximation to the transmitted image. The B&W (black & white) palette provides a high-contrast display which can improve the sharpness of some line charts or may clear up a dull or dirty background at the expense of some loss of detail.

The remaining three palettes are 'false color' selections. COL1 and COL2 (colors 1 and 2) may be used on visible or infra-red satellite images to enhance cloud cover depth or storm intensity. The CGA palette uses the standard CGA default color palette. The palette selection does not affect the FAX image sent to the printer.

35.9 FAX DOT MATRIX PRINTING

When a dot matrix printer is used to display the received FAX image, some of the inherent limitations of the printer are conveyed to the converter. Primary among these limitations is the fact that there is no intensity control on the matrix dot. A printhead pin may either be fired or not, but there is no control over the intensity with which the pin strikes the paper, or how dark the spot is made.

The M-8000 copes with this limitation by converting clusters of 16 spots to a single 'pixel' composed of a 4 X 4 array of pins. The number of pins in this array which are printed in any pixel is a function of the average intensity of the 16 corresponding spots. This provides an apparent gray shading, not unlike the way that images are reproduced in a magazine or newspaper, where the size of each dot corresponds to the gray level. Unfortunately, it is not possible to get something for nothing, and there is a trade off to be made. In providing the gray shading (tonal or depth resolution), there is a corresponding loss in detail (spatial resolution). Each 'spot' on the paper is now 4 times as wide and 4 times as high as the transmitted spot.

The M-8000 provides the user with two modes (formats) of operation. In the Line format, spatial resolution is maximized, providing great detail. This mode is used for weather charts (there are no gray levels in these images, so nothing is lost), or for obtaining maximum detail in other images. The Gray format provides a pleasant compromise between spatial and depth resolution for copying wire photos and may be used to give depth to cloud cover and reduce ribbon wear while copying satellite visual images. Press the **UOS** key to change from LINE format to GRAY format.

The format selection can be one of personal preference. However, unless a signal is known to contain gray information (in short order the ear will be able to differentiate the line from the gray FAX signals), the LINE selection is usually preferred until the content of the image can be determined. As mentioned earlier, weather charts require the fine detail of the LINE format, while wirephotos require the depth provided by the GRAY format. The selection between LINE and GRAY may be made 'on the fly', that is, in the midst of an image, without affecting the synchronization of the image on the paper. Bear in mind that the change will not become apparent until subsequent print cycles and it is possible for several print lines to be disturbed by the change in format.

35.10 FAX LASER PRINTING

The M-8000 supports FAX image output to laser printers which are fully compatible with the *HP II* raster graphics format and operate using the *HP II* escape sequences. Laser printers which do not meet these specifications will NOT operate with the M-8000 to produce FAX images. No matter how wonderful your new laser printer is in all other respects, if it is not *HP II* compatible, it will NOT work properly!

— KEEP YOUR LASER PRINTER POWERED UP AND ON LINE —

Before entering the FAX mode make certain that your laser printer is turned on and is ON LINE. If, like most printers, your printer performs a lengthy self-test when turned on, make sure that this procedure is completed and the printer is ready to accept commands and data prior to selecting the FAX mode on the M-8000. Do not take your laser printer OFF LINE while the M-8000 is in the FAX mode.

If you forget the above warnings and take the printer off line or if the printer takes itself off line due to a paper jam, runs out of paper or experiences some other malfunction, the M-8000 will likely hang up (stop working). If this occurs, simply turn off the M-8000 (power switch down), correct the problem with the laser printer and then turn the M-8000 back on.

If you are using a laser printer, the printer control functions are synchronized to the FAX line timer. When pressing the PRINT key there may be a noticeable delay before observing the PRN= status change. This is normal and necessary in order to keep your printer happy.

■ HIGH-RES LASER FAX

The M-8000 will send the received FAX image to the laser printer as the image is received. In this mode the printer will produce a 300 dot-per-inch (dpi) image on a 1:1 ratio with the sampled FAX signal. This results in a maximum resolution printed image which is 6.4 inches wide. The image produced in this mode is strictly black and white (no gray scale). To enable this mode simply turn the M-8000 printer output on (PRN=ON). The received image will be printed either when the paper page is full or at the end of a FAX image if the paper is at least half full and the auto page eject option of the printer options menu is turned on.

■ VGA-RES LASER FAX (SCREEN PRINT)

The M-8000 can also transfer the VGA image from the display screen to a laser printer. To activate this feature press the **PRINT** key with F2 active once the desired image appears on the video screen. When this is done the status line will change to PRN=SCR and the M-8000 will begin transferring the image from the screen to the printer. During this process all other operations are suspended. FAX image reception will stop but framing with the received signal will be kept in sync. If the FAX reception had stopped when the screen print was initiated and a new FAX image starts during the print process, the new image will be recognized and properly framed and will begin to display as soon as the screen print is complete.

It is possible to invoke the screen print while the M-8000 is processing a high-res image to the printer. If there is enough room left on the current page, the screen print will be placed after the high-res image. If there is not sufficient space on the current printer page, then the pending image will be printed and that page ejected prior to the screen print transfer. The screen print maintains the same spatial and depth resolution as the VGA screen. It does this by converting each VGA pixel into a 4x4 dot array to provide 16 levels of gray shading on the printed page, again using the 300 dpi printer mode. Due to this variety of image printing methods, the mode (LINE/GRAY) selection is not necessary if a laser printer is used.

35.11 FAX RECEPTION

It is important to note that with FAX reception, patience is a key. For most of what you will be receiving the rate of display is such that an average image will take in the range of 10 to 15 minutes to be completely sent. The fact that it may take 13 minutes or more to receive a complete image may tend to obscure the fact that FAX is a very high data rate mode of communication. Remember that each line of the image contains 960 dots or bits of information, and there are up to 226 of these lines per inch. That places the data rate of the FAX signal (at 120 lpm) in the neighborhood of 2000 bits per second. FAX transmissions on HF frequencies are subject to the same limitations and problems as any other signal. Some of the problems and their indications are:

■ FADING and NOISE

Most interference to the FAX signal is observed as bands or streaks across the width of the image. These can range from narrow speckled lines to broad dark bands, depending upon the strength and duration of the interference. Every 1/2 second of interference will obliterate one full line of the image at 120 lpm. Deep fading or selective fading (affecting the black tone frequencies) will result in light bands, again running horizontally across the image.

Excessive noise can also prevent the automatic shut-off circuit from operating properly. If the conversion process is not terminated at the end of an image, the turn-on circuit will not operate at the beginning of the next one. It is this turn-on circuit that properly frames the following image, so high levels of noise may cause mis-framed images.

Additional noise can be introduced when using active antennas or preamps. While these devices may not effect voice or RTTY, they can potentially degrade the quality of FAX images.

■ MULTI-PATH DISTORTION

Multi-path distortion occurs when the radio signal reaches the receiving antenna via two or more paths of different lengths. The signals, then arrive at the receiver at different times. This difference in time is manifested in the FAX image as jagged vertical lines. The signals representing the vertical line which arrive at the receiver via the shorter path appear to the left of the line which takes the longer path. While the jagged vertical line is an excellent indication of the existence of multipath distortion, this phenomenon affects the clarity of the entire image, blurring fine details and causing a general 'out of focus' appearance. Blurring of detail can also be caused by tuning the FM signal tones too low in frequency. Setting the receiver bandwidth too narrow can also blur fine detail due to ringing in the IF circuits.

■ INSUFFICIENT BANDWIDTH

Some of the FAX signals on the satellite video sub-carriers utilize a fairly wide bandwidth. In this mode of transmission the AM tone signal from the FAX machine is used to frequency modulate the RF carrier which becomes the sub-carrier to the video baseband signal. The black level corresponds to the loudest tone and hence the widest bandwidth. (In an FM transmission the bandwidth is a function of the AMPLITUDE of the modulating signal.) The level of the tone coming from the FAX machine, can vary from image to image. On those images where the transmitted bandwidth exceeds that of the receiver, the resulting signal loss causes a reduction of the black level intensity. This can be verified by the signal strength meter on the receiver dropping noticeably during black periods, particularly during the sync signal at the beginning of the image.

FACSIMILE FREQUENCIES

TIME (GMT)	kHz.	LPM	IOC	Station	
evenings	3357	120	576	NAM Norfolk, VA	WX
evenings	4296	120	576	NOJ Kodiak, AK	WX
evenings	4704	120	576	AOK Rota, Spain	WX
evenings	4853	120	576	NPM Pearl Harbor,HI	WX
	5768	120	576	JBK3 Tokyo, Japan	Press
evenings	6496	120	576	CFH Halifax, NS	WX
evenings	6850	120	576	WLO Mobile, AL	WX
	6872	60	288	LRB79 B.Aires, Arg.	Press
	6900	120	576	SMA6 Norrköping,Sw.	WX
evenings	6944	120	576	CKN Vancouver, BC	WX
	7475	60	576	RXB72 Khabarovsk,CIS	WX
	7530	120	576	NMF Boston, MA	WX
	7993	120	576	NPM Pearl Harbor,HI	WX
	7710	120	576	VFF Frobisher Bay	WX
	8000	120	576	GXH Thurso, Greenl.	WX
24 hours	8080	120	576	NAM Norfolk, VA	WX
2300	8167	60	288	LQB9 B.Aires, Arg.	Press
evenings	8185	120	576	FPI88 Paris, France	WX
evenings	8459	120	576	NOJ Kodiak, AK	WX
	8467	60	576	JJC Tokyo, Japan	Press
	8492	120	576	NPM Pearl Harbor,HI	WX
	8617	60	576	JJC Tokyo, Japan	Press
	8646	120	576	WWD LaJolla, CA	WX
	8682	120	576	NMC San Fran., CA	WX
	9060	90	576	RCU73 Nov. C.I.S.	WX
	9157	120	576	WLO Mobile, AL	WX
2300	9241	60	288	LRO64 B.Aires, Arg.	Press
	9318	120	576	NRK Keflavik,Iceland	WX
	9383	120	576	NPN Apra, Guam	WX
	9395	120	576	NPM Pearl Harbor,HI	WX
	9438	120	576	JMJ3 Tokyo, Japan	WX
	10535	120	576	CFH Halifax, NS	WX
	10555	120	576	AX134 Darwin, Aus.	WX
	10677	60	288	LRN2 B.Aires, Arg.	Press
24 hours	10863	120	576	NAM Norfolk, VA	WX
2300	11480	60	288	AZG641 B.Aires, Arg.	Press
	12728	120	576	USN Point Reyes, CA	WX
	14570			RVM44 Tashkent, Uzb.	WX
	14828	120	576	NPM Pearl Harbor,HI	WX
days	16410	120	576	NAM Norfolk, VA	WX
	17069	60	576	JJC Tokyo, Japan	Press
	17151	120	576	NMC San Fran., CA	WX
	17405	120	576	WWD LaJolla, CA	WX
	17585	120	576	AOK Rota, Spain	WX
	18060	120	576	AX136 Darwin, Aus.	WX
	18093	120	576	LRO84 B.Aires, Arg.	WX
	18130	120	576	JMJ5 Tokyo, Japan	WX
	18245	120	576	GXH Thurso, Greenl.	WX
	18431	60	288	LRO83 B.Aires, Arg.	Press
mornings	19862	120	576	NPN Apra Harbor,Guam	WX
	20736	60	288	LSA600 B.Aires, Arg	Press
	21037	120	576	NPM Pearl Harbor,HI	WX
	22542	120	576	JJC Tokyo, Japan	Press

36.0 DIVERSITY RECEPTION

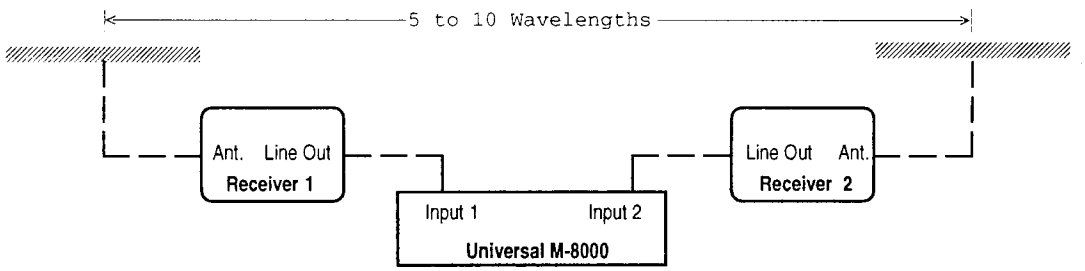
Diversity reception is used to reduce the effects of radio signal fading. There are several systems of diversity reception in current use. All of these operate on the simple principle of providing two input signal channels, both of which may fade independently of each other, then of automatically feeding to the demodulator the signal which is stronger at that given moment.

In the frequency diversity method, transmissions are radiated on two different frequencies. The diversity receiver has two input circuits or two receivers are used which are tuned to the different frequencies. The signal that has the greatest amplitude at any given instant feeds into the remaining receiver circuits to produce the useful output.

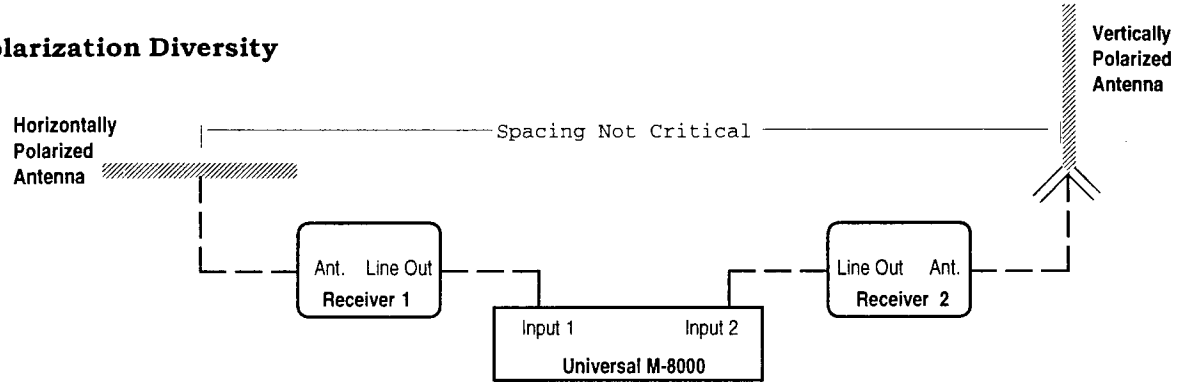
In the space diversity system, two separate receiving antennas are connected to separate receivers or input circuits, the output of which are suitably combined. If these antennas are widely separated, chances are good that the signals received in each antenna will fade independently of each other. The stronger signal is then used to produce an output. When space limitations do not permit obtaining the separation referred to above, a polarization diversity system can be used. This is based on the observation that the vertical and horizontal polarization components of a received signal usually do not fade simultaneously. Thus, diversity reception can be obtained from two antennas, one responsive to horizontally polarized waves and the other to vertically polarized waves.

The M-8000 has two audio inputs which allow the user to connect two receiver systems to the M-8000 providing diversity reception. The M-8000 internal circuitry senses the strength of the two inputs and when one input becomes approximately 3 dB stronger than the other, the demodulator is switched to the stronger input. Switching time is on the order of 28 milliseconds thus very little data is lost during the transition.

Space Diversity (Both antennas with the same polarization)



Polarization Diversity



To set up the total system one should have two receivers which are identical, or which at least have similar specifications as to stability, bandwidth, and sensitivity, and tuned for frequency diversity or with their antennas connected as space or polarization diversity.

The output levels of each receiver should be the same, and the input level controls of the M-8000 adjusted to provide equal levels when each receiver is tuned to the same, non-fading, signal with the AGC of each receiver turned off.

The rear panel input LEVEL controls should be adjusted so that both INPUT 1 and INPUT 2 tuning bars indicate the same level when both receivers are tuned to the same signal (same frequency) and using the same antenna.

The diversity reception feature is automatically *disabled* when CW, SITOR-A, ARQ-S, ARQ6-90, PACTOR or SWED-ARQ mode of operation are selected. Diversity reception should not be used on signals of a keyed or pulsed nature such as Morse, SITOR-A, ARQ-S, ARQ6-90, PACTOR or SWED-ARQ due to the unpredictable results during the transmitter idle or key-up time. As a result, the diversity function is disabled in these modes. Diversity operation is also not available in the FAX mode.

37.0 OTHER FEATURES

37.1 SEL-CALs

An RTTY station will often send traffic on a circuit or frequency that is connected to, or monitored by, a large number of receiving stations. Not all of the voluminous traffic on these circuits is of interest to all of the monitoring stations. In order that each station did not print every item of traffic and then throw away all of the unwanted paper, SELective CALling codes were developed.

By prefacing each item of traffic, or traffic destined for a particular station or group of stations, with a specific group of characters, the receiving equipment could distinguish between information that was intended for it, and unwanted traffic.

The M-8000 user programmable sel-cals represent exciting opportunities for the user. By programming appropriate selcal codes into the unit, you also can monitor only that traffic directed to, or if interest to, you. The M-8000 provides three separate ON codes and one common OFF code. With your radio, M-8000 and printer left on, the M-8000 will print the message prefaced with a selcal. It will print this message ONLY, and will then turn off!

You can use this feature to selectively print press stories of interest to you! If for example, you left your receiver tuned to an English press service, and wanted the printer to only hard-copy stories related to the space shuttle, you might put *SHUTTLE* in selcal 1, and *NASA* in selcal 2. If either of these words is detected by the M-8000, the printer will engage and print the balance of the story! Most RTTY press stories and weather broadcasts end with *NNNN* so you may want to store this in the selcal off code to terminate the print job.

Refer to the SEL-CAL sub menu section of the PROGRAMMING mode for instructions on programming your custom selective calling codes. This is on page 81.

SELCAL LED
This front panel LED will turn on whenever a valid selcal ON code is received. This LED will remain ON until the OFF code is received.

SELCAL BEEP
The M-8000 will also sound a beep signal upon receiving one of the three selcal on codes. This beep can be enabled and disabled in the BEEPER sub-menu of the PROGRAMMING mode. This is shown on page 78.

37.2 VIDEO SQUELCH

It is possible to inhibit the transfer of received characters to the video screen unless the SQU LED is on. This may prevent weak or improperly tuned signals from filling the screen with invalid information. To enable this function set the VIDEO SQUELCH to ON in the VIDEO menu of the PROGRAMMING mode. This is on page 73.

37.3 CLOCK

The M-8000 features a real-time clock/calendar. The time and date from this clock will be displayed on the extreme right hand side of the lower status line. There is a built in lithium energy cell which maintains power to the clock circuit when the power to the M-8000 is turned off or disconnected. As a result, the time does not need to be set except when changing batteries, or when the time changes. Refer to the CLOCK sub-menu of the PROGRAMMING mode for instructions on setting the clock. This is on page 79.

37.4 PRINTER BUFFER

All printable data (this does not include idle or phasing characters) received by the M-8000 are transferred into the printer buffer. This buffer has a capacity of 4095 characters. Both serial and parallel printers share this buffer and the data contained in it. While the two printers share the same buffer, they are treated separately with respect to being full or empty.

If either buffer becomes full, the BUFF LED on the front panel will turn on, indicating a buffer overflow condition. When this occurs, the oldest data in the buffer is lost. The buffer always holds the most recently received 4095 characters.

Whenever the video screen is cleared by use of the **CLEAR** key, the printer buffers are also cleared. The printer buffers may be cleared independently of the video screen by pressing the **CLEAR** key with F1 active.

37.5 RETRO PRINT

Although all received data is placed in the printer buffer, only that data which is tagged for output will be sent to the printer ports. The M-8000 has a feature that allows data that has been previously received but not tagged for printer output to be sent to the printer.

This RETRO PRINT function is enabled by pressing the **PRINT** key with F2 active. This will cause the most recently received 2048 characters to be sent to the printer outputs. Data that is subsequently received will also be directed to the printer output until the retro print is disabled either automatically when the printer buffer becomes empty or manually by again pressing **F2** then the **PRINT** key. When ever the retro print is active, the status line will indicate "PRN=RET".

37.6 PRINTER CONTROL SELECTION

Pressing the PRINT key steps through the various selections for the printer control setting. The printer control setting (PRN=) determines whether the received data that is entered into the printer buffer will be tagged for output to the printer ports or not. When this control is set = ON, all received data is tagged for output. When this setting = OFF, no data is tagged for output.

If PRN=SPC then any characters occurring within 16 characters of the last received space character will be tagged for output. If more that 16 characters have been received since the last space character, then they will not be tagged.

If the printer is set for sel-cal reception (PRN=S-C), only data received when a sel-cal is active (SELCAL LED on) will be tagged for output.

If PRN=SQU then characters will be tagged for output to the printer only if the SQ LED is on, indicating that the received signal is strong enough and tuned well enough to produce a usable output.

A retro-print may be selected by pressing **F2** and then **PRINT** key. This will temporarily over ride the current printer selection and result in a status of PRN=RET. The most recently received 2048 characters will be sent to the printer output whether they were previously tagged for printing or not. The retro print feature will remain active, printing the buffer contents and any subsequently received characters until both printer buffers are empty. When the printer buffers are empty, the retro-print will be disabled and the status will return to indicate the printer selection in effect when the retro-print was turned on.

37.7 RECALLABLE OPERATING MEMORIES

The M-8000 has eleven recallable operating memories numbered 0 through 9 and A. These memories store the operating mode, speed, sense, demodulator tone frequencies and other pertinent operating parameters (ATC, AGC, UOS, BI pattern, etc.).

Refer to the MEMORIES sub-menu of the PROGRAMMING mode for instructions on setting the memories. This is on page 83.

To recall one of these memories, that is, restore the operation of the unit to the parameters stored in a memory press the **PGM** key with F1 active. When this is done the prompt "MEMORY" will flash above the printer status indication. If you do not want to recall a memory then press the B, C, D or E keys. Pressing a key (0 through 9 or A) on the right keyboard will recall the operating memory corresponding to that number. Operation at the stored mode, speed etc. begins immediately.

After an operating memory has been recalled, changes to the operating parameters may still be made by simply using the keypads to change the speed, shift etc.

38.0 PROGRAMMING OPERATIONS

Pressing the **PGM** key with F2 active will transfer operation to the Programming mode. Here the user is taken, menu by menu, through the various system programming modes available.

The menus in this Programming mode tend to be self-explanatory. The following will give a brief description of the various functions to be programmed. Menu selections are made by simply pressing the key corresponding to the number that appears to the left of the menu item to be activated or selected. This will generally select a sub-menu, turn an option ON and OFF, or step thorough a variable list. In some cases, the selection will immediately cause some action to be taken. Again, in all cases, to operate the Programming mode, simply press the key corresponding to the number of the menu item desired.

Most of the programming input will utilize inputs from the numbered keys on the right key array. The **UP** and **DOWN** keys in the left array are used for some functions, and in most cases the **PGM** key, also in the left array, is used to select the previous menu. From the main, or starting, menu the **PGM** key will exit the PROGRAMMING mode and return the unit to normal operation.

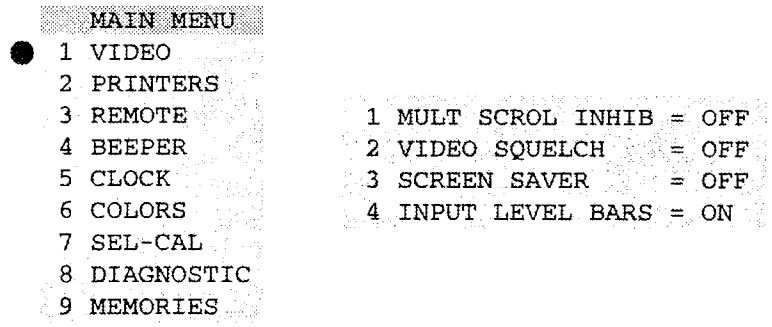
```
  MAIN MENU
1 VIDEO
2 PRINTERS
3 REMOTE
4 BEEPER
5 CLOCK
6 COLORS
7 SEL-CAL
8 DIAGNOSTIC
9 MEMORIES

PGM = EXIT PROGRAMMING MODE
```

When a selection is made from the Main Menu or from an intermediate menu, a yellow spot will appear in front of the main or intermediate menu item which was selected to activate the current operating menu.

The first selection from the MAIN MENU is 1 VIDEO

38.1 VIDEO



1 MULTiple SCROLl INHIBit - prevents the unit from scrolling text off the video screen upon the reception of more that one line feed at the end of a line. Some services send as many as ten sets of carriage return and line feed at the end of traffic, sending the message off of the screen. When MSI is ON the video will scroll (move up a line) only if the bottom line is not blank when a line feed is received.

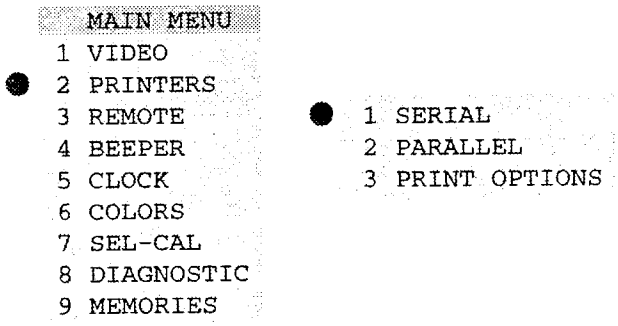
2 VIDEO SQUELCH - The squelch circuit can inhibit print to the video screen during weak signal reception (noise) if this option is set ON and the SQ LED is off. If this option is OFF the print to the video screen will never be squelched.

3 SCREEN SAVER - When this option is ON, the video screen will go completely blank after 15 minutes of inactivity (no received data to the screen and no keys on the unit pressed). Pressing any key, or the reception of data to be printed on the screen will restore the video display just as it was prior to the blanking. This is to prevent a fixed video display from burning a pattern in the face of the video monitor's CRT.

Note: The screen saver's timer does not operate while in the PROGRAM mode.

4 INPUT LEVEL BARS - If this selection is ON, then the input level bars for inputs 1 and 2 will be present in the graphic tuning aid section of the screen. If this selection is OFF, these tuning aids will not appear.

38.2 PRINTERS



1 SERIAL

If the serial printer is disabled, the only option to appear under this menu will be:

```
1 PRINTER DISABLED
```

The only available function on this menu is to enable the printer by pressing the 1 key. *If* the serial printer is enabled, then the following sub-menu will appear:

```
1 PRINTER  ENABLED
2 MODE   =  ASCII
3 SPEED =    300
4 DATA BIT 7 = MK
5 HANDSHAKE  = ON
```

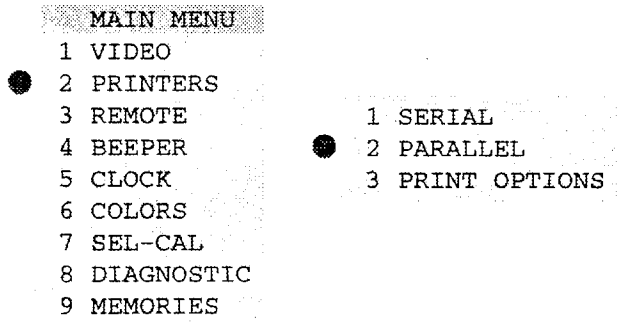
1 PRINTER ENABLED - The serial printer output will not function unless it is enabled under this menu. There is no danger of damaging the unit by leaving the serial printer enabled in the absence of a serial printer. If you do not expect to connect a serial printer to the unit, however, there may be an advantage to disabling this output. Both the BUFF LED and the retro print auto-disable functions consider the status of both the serial and parallel printer buffer conditions. Disabling the unused printer output will essentially eliminate improper indication or function of these features. If the printer output is disabled under this menu, no settings of any other controls or keys will make the printer output work.

2 MODE - This sets the mode of the serial output as either Baudot or ASCII.

3 SPEED - This steps through the available speeds for the selected mode of serial printer operation. In Baudot mode the speeds are: 45, 50, 57 and 75.
When ASCII is selected the speeds are: 110, 300, 600 and 1200.

4 DATA BIT 7 - This sets the polarity of data bit 7 (the eighth data bit) of the serial printer output character to either Mark or Space. On certain printers this setting can affect whether the printer types in a normal or italic font or prints graphic symbols. If the output is Baudot, this setting has no effect on the output.

5 HANDSHAKE - The flow of data to the printer output can be controlled by a signal from the printer indicating when the printer is ready to accept data. This is referred to as handshaking. If the unit is connected to a printer which is not capable of supporting this type of handshake operation, then it may be necessary to turn the handshake off. With the handshake off, data will be transferred to the serial output at the maximum rate possible without regard for the ability of the printer to accept that data. Disabling the handshake when using a printer which relies upon this interaction may result in erratic printer behavior, particularly when receiving high speed data such as PACKET or burst character modes such as SITOR-A, ARQ-S or SWED.



2 PARALLEL

If the parallel printer is disabled, the only option to appear under this menu will be:

```
1 PRINTER DISABLED
```

The only available function on this menu is to enable the printer by pressing the 1 key. *If* the parallel printer is enabled, the following menu will appear:

```
1 PRINTER  ENABLED
2 PRINTER =  8 PIN
3 NORMAL CARRIAGE
4 DATA BIT 7 = LOW
5 HANDSHAKE  = ON
```

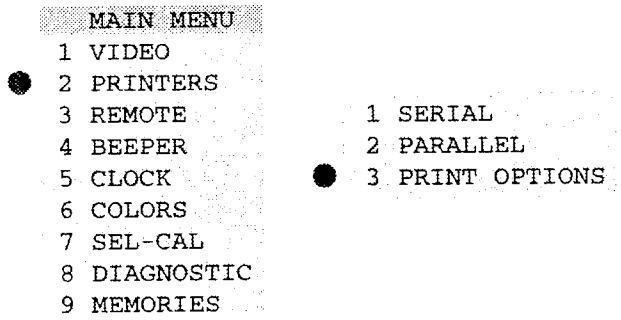
1 PRINTER ENABLED - The parallel printer output will not function unless it is enabled under this menu. There is no danger of damaging the unit by leaving the parallel printer enabled in the absence of a parallel printer. If you do not expect to connect a parallel printer to the unit, however, there may be an advantage to disabling this output. Both the BUFF LED and the retro print auto-disable functions consider the status of both the serial and parallel printer buffer conditions. Disabling the unused printer output will essentially eliminate improper indication or function of these features. If the printer output is disabled under this menu, no settings of any other controls or keys will make the printer output work.

2 PRINTER - This option must be set to match the type of parallel printer connected to the M-8000 in order to obtain proper operation in the FAX mode. The available selections are: 8 PIN, 24 PIN or LASER. If you have a 9 pin matrix printer set the selection on 8PIN. The setting of this option will not affect the parallel printer output in text modes.

3 CARRIAGE - This option also affects only FAX operation and should be set to match the carriage width of the parallel printer used for FAX reception. The possible settings are NORMAL CARRIAGE or WIDE CARRIAGE. The NORMAL setting should be selected for 8 inch wide printers, while the WIDE setting should be used for printers which can handle and are loaded with 15 inch wide paper.

4 DATA BIT 7 - This sets the polarity of data bit 7 (the eighth data bit) of the parallel printer output character as either high or low. On certain printers this setting can affect whether the printer types in a normal or italic font or prints graphic symbols.

5 HANDSHAKE - The flow of data to the printer output can be controlled by a signal from the printer indicating when the printer is ready to accept data. This is referred to as handshaking. If the unit is connected to a printer which is not capable of supporting this type of handshake operation, then it may be necessary to turn the handshake off. With the handshake off, data will be transferred to the parallel output at the maximum rate possible without regard for the ability of the printer to accept that data. Disabling the handshake when using a printer which relies upon this interaction may result in erratic printer behavior, particularly when receiving high speed data such as PACKET or FAX, or burst character modes such as SITOR-A, ARQ-S or SWED.



3 PRINT OPTIONS

This selection provides a menu of options which affect both the serial and parallel printer outputs.

```
1 AUTO C/R & L/F    = ON
2 OVER PRINT INHIB  = ON
3 MULT SCROL INHIB  = ON
4 SKIP OVER PERF    = OFF
5 AUTO STATUS LINE  = OFF
6 AUTO PAGE EJECT   = OFF
```

1 AUTO C/R & L/F - If this option is ON, the unit will Automatically send a Carriage Return and Line Feed to the serial and parallel printers if 82 characters have been sent to the printer since the last carriage return.

2 OVER PRINT INHIB - The Over Print Inhibit option, when turned on, will prevent one line of text from being printed on top of the previous line. If one or more Carriage-Returns are received without a corresponding Line-Feed, the missing Line-Feed will be automatically inserted into the data to both printer outputs. A Line-Feed will also be added if a Carriage-Return is detected due to a reception error. This option will not cause the printer to double-space received text.

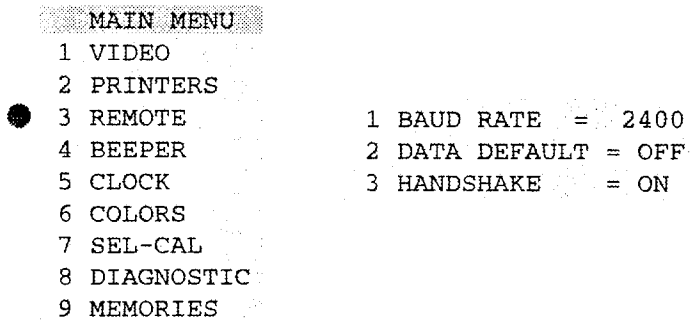
3 MULT SCROL INHIB - The Multiple Scroll Inhibit feature conserves printer paper by suppressing Line-Feeds in excess of one feed for every line of text. Some services send as many as ten Line-Feed signals at the end of each traffic item. This may be great for separating stories in the news room, but the SWL will wind up with many yards of blank printer paper at the end of the day. When the Mult Scrol Inhib option is turned on, a Line-Feed will be sent to the printer only if some text has been printed on the current printer line.

4 SKIP OVER PERF - This option allows printers connected to the M-8000 to skip over the perforation of fan-fold printer paper. When this option is ON, a form-feed command character will be sent to the printer output after every 60 lines of text. In order for this feature to operate properly, the paper in the printer must be set to print at the top of a page (approximately 1/2 inch below the perforation) when the printer is turned on. Failure to properly initialize the printer's paper position in this manner will result in the 'skip' not occurring at the perforation.

5 AUTO STATUS LINE - If this option is selected ON, and a SELective-CALling message is being received, the Print Status Line command will be assumed at the end of the message (when the SEL-CAL turns off). Sel-cal on and off codes must be programmed for this option to function in RTTY or Morse modes. This option will also function at the end of a FAX image (no need for selcals here).

6 AUTO PAGE EJECT - This option allows the unit to send a form-feed command to the printers under the same conditions as the Auto-Status, either separately or in conjunction with the Auto-Status. If both are enabled, the Status will precede the form-feed.

38.3 REMOTE



This selection presents a menu of options which control the operation of the remote terminal or computer interface.

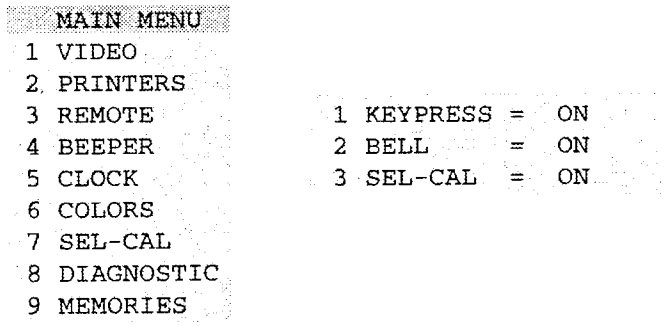
1 BAUD RATE - This selection determines the data rate (in bauds) of the remote control interface. The choices that are stepped through are:

110, 150, 300, 600, 1200, 1800, 2400 and 4800.

2 DATA DEFAULT - The M-8000 has the capability of transferring received data to the remote terminal. This transfer is turned on and off by commands from the remote terminal. The Data Default setting determines the initial setting of the transfer enable. If this option is ON, then the received data transfer from the M-8000 to the remote terminal output will be enabled automatically when the M-8000 is turned on. Otherwise data transfer will not occur until the transfer enable command is issued from the remote terminal.

3 HANDSHAKE - The transfer of characters from the M-8000 to the remote terminal may be controlled by a handshake line which allows the remote terminal to signal when it is ready to accept data. If the Handshake option is set ON, then characters will be sent to the remote terminal only when the handshake line is high. If this option is OFF, the M-8000 will transfer characters to the remote terminal without regard to the level on the handshake line.

38.4 BEEPER



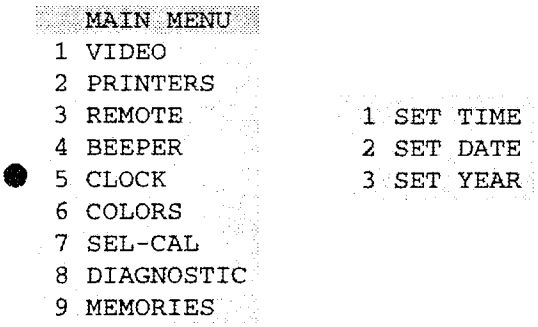
This selection allows the user to determine the conditions under which the beep annunciator is activated. If a selection is ON then the corresponding BEEP will sound under the following conditions:

1 KEYPRESS - Whenever a keyboard key is pressed a 1000 Hz. tone will sound, unless it is an undefined or invalid entry, in which case the tone will be 500 Hz.

2 BELL - Whenever the BELL character is received, a 1000 Hz. beep will be heard.

3 SEL-CAL - When a valid sel-cal on code is detected, a 500 Hz. beep will be heard.

38.5 CLOCK



This main menu selection presents a sub-menu that provides the ability to set the time and date on the M-8000's real-time clock.

Selecting any of these three options will cause a display showing the current setting of that value, along with a round 'cursor' which indicates the next digit to be programmed. To enter a new value, simply press the digit keys (0-9) corresponding to the desired value. As each new digit is entered, the cursor will advance to the next digit position. As each new value is entered, it will be tested for conformance with the allowable range of values for the programmed variable. If the new value is permissible, that value will be accepted. If it is outside the allowable range, the cursor will retreat to the first digit of the value to be entered.

At any point in this process, the **PGM** key may be used to abort the entry process for that value. The **CLEAR** key may be used to step the cursor back to a previous digit for correction. After the last digit has been entered, the entry cursor will disappear. At this point the **E** (Enter) key may be pressed to program the clock with the new value. The **PGM** or **CLEAR** keys may also be used to abort or to correct the displayed value prior to Entering.

1 SET TIME - The time is entered and displayed in 24 hour format. The allowable range for the time values are:

Hours	= 00 - 23
Minutes	= 00 - 59

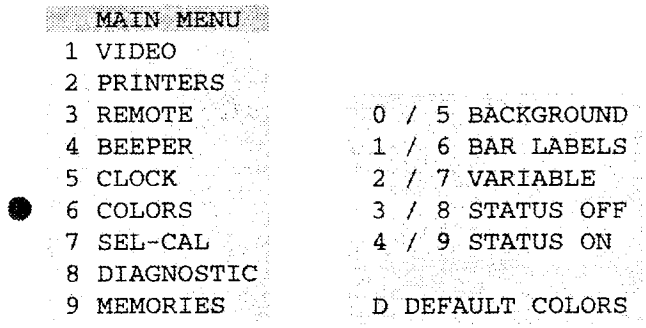
2 SET DATE - The allowable range of date values are:

Date	= 01 - 31
Month	= 01 - 12

Note that it is possible to program an 'illegal' date by entering a date of 31 for a month which has less than 31 days. While this practice is not harmful to the unit, it is not a recommended procedure.

3 SET YEAR - The allowable range of values for the year are from 00 through 99. The year is not displayed on the status line and there are, in effect, no invalid values, so the programming of this value is optional. The sole function of programming the year into the time-keeping circuit is so that the clock will know when it is a 'leap year' so it can add the extra day in February.

38.6 COLORS



This selection permits the user to customize the video screen by changing the colors of the various components of the status lines. Along with the Colors selection menu, a sample status line is shown along with a block which identifies the various components of the status area.

This menu is operated by pressing the appropriate digit keys for the status area color to be changed. The keys are paired to step forward and backward through the 16 standard VGA (actually CGA) colors of:

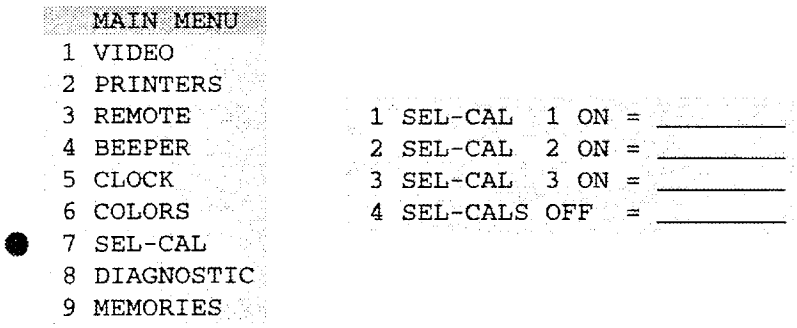
> BLACK, BLUE, GREEN, CYAN, RED, MAGENTA, BROWN, WHITE, GRAY, LIGHT BLUE, LIGHT GREEN, LIGHT CYAN, LIGHT RED, LIGHT MAGENTA, YELLOW and BRIGHT WHITE.

Note that some combinations may be difficult to see, and others, such as when the selected foreground and background colors are the same, are impossible to see. Pressing the **D** key will restore all color values to the factory default settings. After all of the colors are set to your satisfaction, press the **E** (Enter) key to store the customized values.

Before entering the new values, check to see that each of the three status line items (VARIABLE, ON and OFF) are set to different values. After the new values have been stored the unit will return to the MAIN MENU. At any point in the process, you may press the **PGM** key to return to the main menu and the previously stored colors will remain unchanged.

0 / 5 BACKGROUND	These keys set the background color of the status lines.
1 / 6 BAR LABELS	These keys set the color of the labels on the five input and tuning bars.
2 / 7 VARIABLE	These keys set the color of the status item which is 'highlighted' indicating that it is active for variable (UP / DOWN) operation.
3 / 8 STATUS OFF	These keys set the color of a status line item to indicate that the status item is turned OFF.
4 / 9 STATUS ON	These keys set the color of a status line item which is active or ON.

38.7 SEL-CAL



This selection provides the means to program the SELective CALling codes. To program a Sel-Cal code, first press the key that corresponds to the sel-cal to be programmed. When this has been done, the appropriate sel-cal field will be @_____ in black letters. Pressing the **UP** or **DOWN** key will change the @ symbol to various letters and symbols in the following sequence:

```
                    <- DOWN START  UP ->
                                  |
!"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_
```

In the sel-cal detector, the symbols "<" and "=" have special meanings: "<" represents a Carriage Return code and "=" represents a Line Feed character.

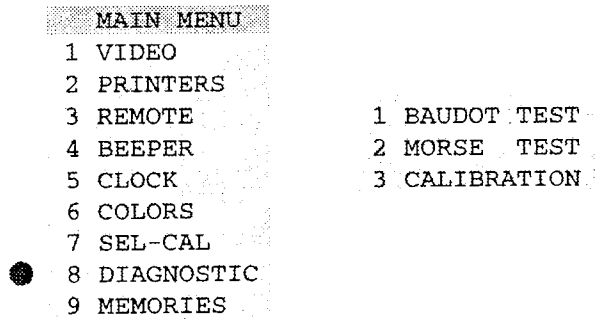
Continue pressing the **UP** or **DOWN** key until the desired letter or symbol appears. If additional letters are needed, press the **E** (Enter) key to temporarily store the displayed letter. The following entry space will be replaced by the @ symbol and the selection process may continue for subsequent letters. After the last letter for the desired sel-cal has been selected, do not press the **E** key, but rather use the **PGM** key to program the displayed sel-cal code into semi-permanent storage. (If you already pressed the **E** key after selecting the last character, just press the **C** key, then the **PGM** key.)

During entry, prior to pressing the **PGM** key, the **CLEAR** key may be used to step back and correct previously Entered characters, or the **F1** key may be used to abort the entry for the sel-cal and leave the previous setting unchanged. To eliminate a sel-cal, simply program the first (and only) character of that sel-cal code as a "_" symbol (the extreme UP direction).

To exit the sel-cal menu, press the **PGM** key when no sel-cal entry is in progress.

Remember when selecting sel-cal codes that the decoder looks only for that sequence of characters, without regard to context. A selcal programmed to respond to "IN" will respond to all of the following: IN PIN WING THIN INDIGO SEWING SPLINTER etc. If there is sufficient space in the sel-cal storage, space characters may be used as part of the sel-cal code to limit the extent of this type of aliasing. (The space character is at the extreme DOWN setting.) Using this method to define the sel-cal code as a whole word (bounded by space characters) will eliminate or at least reduce false detection as in the above example. If the sel-cal code appears as the first or last word in a line of text, however, it is not likely that a space will precede and follow the word, so the code will most probably go undetected.

38.8 DIAGNOSTIC



This selection provides diagnostic self-test functions in either Baudot or Morse code modes or self-calibration for the auto-tune function.

1 BAUDOT TEST - Performs an operational test of the RTTY demodulator and decoder. This test is performed at 75 baud and 170 Hz. shift.

2 MORSE TEST - Performs an operational test of the Morse demodulator and decoder. This test is performed at approximately 25 words per minute.

In either the Baudot or Morse diagnostic operation:

The test message, repeated indefinitely is:

THE QUICK BROWN FOX JUMPED OVER THE LAZY DOG'S BACK 1234567890 M-8000 TEST O K.

When in the diagnostic mode, both audio inputs are disabled and the input and diversity segments of the status line are replaced with the indicator "DIAGNOSTIC". When running diagnostics, key commands which would change the mode, speed, shift or other critical operating parameters are disabled. To exit either diagnostic mode, press the **PGM** key.

3 CALIBRATION - Activates the tuning calibration procedure. The M-8000 relies on an internal calibration to perform the Automatic Filter Tuning function. If difficulty is experienced while attempting to Auto Tune on reasonably strong and stable signals, the unit should be re-calibrated.

To calibrate the M-8000 Automatic Filter Tuning, simply select this menu item. As soon as the calibration has been completed, the Diagnostics menu will disappear.

38.9 MEMORIES

This selection allows the user to store a set of operating parameters into a recallable non-volatile memory for later use.

Displayed on the screen are the 11 "status lines" for the recallable operating memories. Each line is labeled with the number of the memory (0 through 9 and A).

Also on screen is the status line as it was set just prior to entering the programming mode. This is the mode of operation that will be stored into one of the recallable operating memories. To store the current status line in a memory simply press the key **0** through **9** or **A** corresponding to the memory location used to store the memory. You will see the memory change. Press **PGM** to return to the main program menu.

The following information is stored in each operating memory:

* Mode
* Speed
* Shift
* ATC on/off
* AGC on/off
* UOS on/off
* Demodulator Mode
* Alphabet
* Sense (NOR or REV)
* Input selection
* Literal translation mode on/off
* Bit inversion pattern if any

All of these parameters will be restored when the corresponding operating memory is recalled from the keypad. These memories are useful for storing operating parameters of frequently monitored signals.

While any of the memories may be selected during operation, memory **A** is the initialization memory that is automatically loaded when the M-8000 power is applied. This allows the user to control how the unit will be configured when it is turned on.

39.0 REMOTE TERMINAL CONTROL

The M-8000 has the capability of being controlled by a remote ASCII terminal or computer via a three wire bi-directional control system.

All front panel control functions except power on/off and the Programming Mode functions may be controlled remotely.

39.1 CONTROL INTERFACE SPECIFICATIONS

```
Data protocol:  ASCII          Data Levels  (RS-232 compatible):
Start bits:       1               Mark  = -2.5 to -15 V
Data bits:        8               Space = +2.5 to +15 V
Parity:        None
Stop bits:        2

Handshake from computer:
High = +2.5 to +15 V
Low  =   -0 to -15 V
```

Note: If handshaking is enabled, this line must be high to enable data to flow from the M-8000 to the remote terminal.

39.2 CONNECTIONS TO THE M-8000

```
J3-6  Handshake from terminal
J3-4  Data from terminal
J3-5  Data from M-8000
J3-12 Signal ground
```

To operate the M-8000 with a computer you must be using a terminal program that enables your computer to perform as a terminal to receive and transmit standard ASCII characters.

Function	M-8000 J-3 Accs. Jack Pin No.		Computer DB-25 Pin No.	Signal Name
Data to M-8000	4	←	2	TD Transmit Data
Data from M-8000	5	→	3	RD Receive Data
Handshake	6	—	20	DTR Data Terminal Ready
Ground	12	—	7	SG Signal Ground or Logic Ground

This table may be used for wiring the remote terminal connections on J-3 of the M-8000 to the standard 25 pin D RS-232 connector of a remote terminal or computer configured as DTE.

The M-8000 does not support the full compliment of RS-232 signals. In order for your terminal to interface with the M-8000 it may be necessary to artificially complete the RS-232 environment. This is normally done by connecting the following signals *at the computer or terminal connector:* DTR connected to DSR (in addition to the DTR connection to the M-8000); RTS connected to CTS.

Most of the PC compatible computers use a 9 pin D connector which may be connected as follows:

Name	P.C. DB-9 Pin No.		M-8000 J-3 Jack Pin No.
Receive Data	2	←	5
Transmit Data	3	→	4
Data Term. Ready	4	→	6
Signal Ground	5	—	12
Data Set Ready	6	←	
Request To Send	7	→	
Clear To Send	8	←	

39.3 REMOTE TERMINAL OPERATIONS

Remote operation is accomplished by sending to the M-8000 character codes which the unit interprets as commands. These can be done from Basic type programs using statements along the following lines:

```
LPRINT CHR$(n)      LPRINT "c"
PRINT #N,CHR$(n)    PRINT #N,"c"
WRITE #N,CHR$(n)    WRITE #N,"c"
```

Where n represents the value of the command character, and c represents the actual character to be sent to the M-8000. The statement must direct the output of the CHR$(n) or "c" to the serial output port that is connected to the M-8000 remote interface.

If the system you are using will not permit the use of certain values of n, then 128 may be added to the listed number to obtain a usable value. The tables below will list the decimal value of the character code, and also the character.

39.4 KEYPAD

When any of the following codes are received at the remote input, the M-8000 will respond in the same manner as if the corresponding key were pressed:

A	MODE	Q	SRO
B	SPEED	R	UOS
C	SHIFT	S	MO-SO
D	N/R	T	FR-L
E	UP	U	FR-R
F	INPUT	V	TUNE
G	AGC	W	CASE
H	T/S	X	PRINT
I	BW	Y	BI
J	DOWN	Z	RUN
K	PGM	[	GRAPH
L	ATC	\	ALPH
M	VFT	]	CLEAR
N	CHAN	^	F1
O	VAR	_	F2

39.5 REMOTE PROGRAMMING OF DEMODULATOR FREQUENCIES & BAUD RATES

The remote terminal (computer) may directly load a mark frequency, space frequency, shift frequency or baud rate into the M-8000.

The format of the command to do this is a letter that determines the parameter to be affected, followed by four digits (ASCII digits) that provide the value to be set.

```
"a"nnnn = Set Mark   frequency to nnnn Hz.
"b"nnnn = Set Space  frequency to nnnn Hz.
"c"nnnn = Sets Shift frequency to nnnn Hz.
"d"nnnn = Set Speed to nnnn bauds.
```

If the four characters immediately following the command code are not ASCII digits, or if the value specified by the four digits is outside the permissible range of operation for the specified parameter, then the entire command is canceled.

For example, to set the Mark tone to 1750 Hz.: `LPRINT "a1750"`

The entries made in this fashion are subject to the same limitations and triangulation rules as direct entries from the front panel keyboards.

39.6 REMOTE RECEIVING OF DATA FROM THE M-8000

Data received by the M-8000 may be transferred to the remote terminal as it is received. To enable this data flow, send the character "e". To turn off this data flow, send the character code "f".

A "retro-print" to the remote terminal may be initiated by sending the character "g". This transfers the entire contents of the 4095 character printer buffer to the remote data output. This command does not affect the data flow to the printer.

When the character code "h" is sent by the remote terminal, the M-8000 responds by sending the Status Line, as it appears at the bottom of the screen. This status does not include the on-screen tuning indicators.

If receive data was being transferred to the remote terminal when the "h" command is detected, the transfer will be suspended until the status transfer has been completed. Data transfer will then resume.

Please also refer to Section 38.3 REMOTE on page 77. Be sure to review the 2 DATA DEFAULT setting.

39.7 REMOTE RECALL OF OPERATING MEMORIES

To recall an operating memory send the character "m", immediately followed by the ASCII character for the memory number to be recalled. For example; to recall memory #4, you would send the string "m4" to the M-8000.

40.0 PRINTER CONNECTIONS

40.1 PARALLEL PRINTER

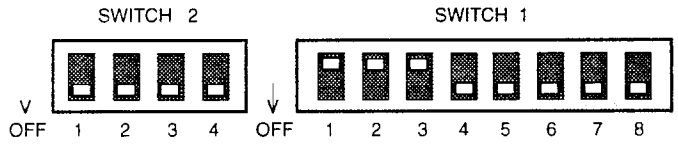
The M-8000 will drive any parallel printer that conforms to the Centronics, 8 bit ASCII, parallel standard.

The cable used between the M-8000 and the printer should be well shielded to minimize RFI/EMI radiation. Suitable parallel printer cables are available from your dealer.

The following tables show proper printer set-up for a variety of popular printers. Your exact printer may not be shown, but the following examples indicate proper function settings. Also refer to Chapter 38.2 on programming the M-8000 printer ports. This starts on page 74.

Mfg.: **Seikosha**
Model: **SP-1000A & SP-1200AI**
Type: 9 Pin Dot Matrix

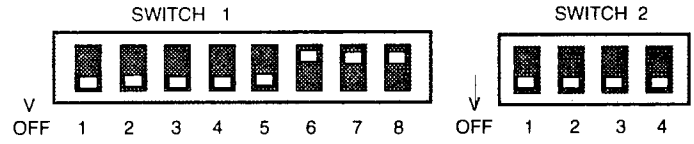
Printer DIP Switch Settings:



SW#	Function	Set
2-1	Italics on=on off=off	*OFF*
2-2	Print Mode -	*OFF*
2-3	Print Mode -	*OFF*
2-4	1.5K RAM on=download	*OFF*
1-1	Intl. Character USA=on	*ON*
1-2	Intl. Character USA=on	*ON*
1-3	Intl. Character USA=on	*ON*
1-4	Paper Detect on=on	*ON*
1-5	Slashed Zero on=yes off=no	*OFF*
1-6	Page Length on=12" off=11"	*OFF*
1-7	CR= on=CR+LF off=AUTOFEED	*OFF*
1-8	Skip 1" Perf on=on off=off	*OFF*

Mfg.: **Epson**
Model: **FX-86e / FX-286e**
Type: 9 Pin Dot Matrix

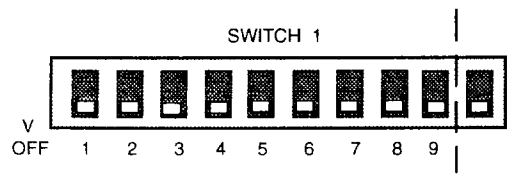
Printer DIP Switch Settings:



SW#	Function	Set
1-1	Condensed Print on=on	*OFF*
1-2	Slash Zero on=yes off=no	*OFF*
1-3	Char.Tbl.on=graph off=itl	*OFF*
1-4	Commands on=IBM off=ESC/P	*OFF*
1-5	Print on=NLQ off=Draft	*OFF*
1-6	Intl. Characters - on=USA	*ON*
1-7	Intl. Characters - on=USA	*ON*
1-8	Intl. Characters - on=USA	*ON*
2-1	Page Length on=12" off=11"	*OFF*
2-2	Auto Sheet Feeder on=active	*OFF*
2-3	Skip Perf on=on off=off	*OFF*
2-4	Auto LF on=CR+LF off=CR	*OFF*

Mfg.: **Diconix**
Model: **D150**
Type: Ink Jet

Printer DIP Switch Settings:

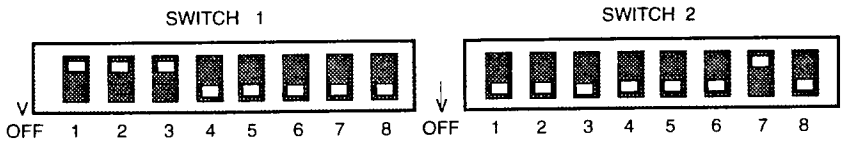


SW#	Function	Set
1-1	CR off=CR only on=CR+LF	*OFF*
1-2	LF off=CR+LF on=LF only	*OFF*
1-3	Perf Skip off=no on=yes 1"	*OFF*
1-4	Page Length on=12" off=11"	*OFF*
1-5	Font off=draft on=final	*OFF*
1-6	Mode off=Epson on=IBM	*OFF*
1-7	Intl. Characters -	*OFF*
1-8	Intl. Characters -	*OFF*
1-9	Intl. Characters -	*OFF*
1-10	DO NOT USE!	*OFF*

Mfg.: **Epson**
Model: **LQ-800 & LQ-1000**
Type: 24 Pin Dot Matrix

NOTE The LQ-1000 requires the M-8000 parallel port be set to **wide** carriage.

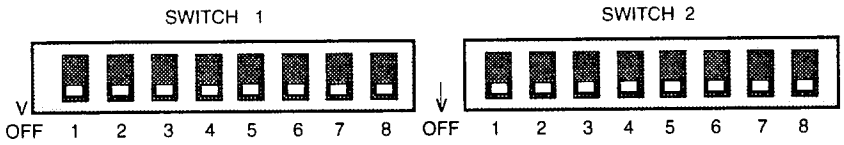
Printer DIP Switch Settings:



SW#	Function	Set
1-1	Intl. Characters -	*ON*
1-2	Intl. Characters -	*ON*
1-3	Intl. Characters -	*ON*
1-4	On=Large off=Small Buffer	*OFF*
1-5	off=Letter Quality on=draft	*OFF*
1-6	Condensed on=on off=off	*OFF*
1-7	Skip Perf on=on off=off	*OFF*
1-8	Cut Sheet Feeder on=active	*OFF*
2-1	Paper Size off=11" on=12"	*OFF*
2-2	Not used.	*OFF*
2-3	Serial Interface	*OFF*
2-4	Serial Interface	*OFF*
2-5	Serial Baud Rate	*OFF*
2-6	Serial Baud Rate	*OFF*
2-7	Printer Select Signal	*ON*
2-8	Auto LF on=CR+LF off=CR only	*OFF*

Mfg.: **Epson**
Model: **LQ-850**
Type: 24 Pin Dot Matrix

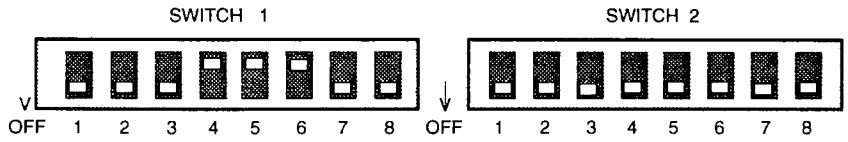
Printer DIP Switch Settings:



SW#	Function	Set
1-1	Intl. Characters -	*OFF*
1-2	Intl. Characters -	*OFF*
1-3	Intl. Characters -	*OFF*
1-4	Character Table on=graphics	*OFF*
1-5	Print Dir.on=bidir off=unidir	*OFF*
1-6	Not used.	*OFF*
1-7	Cut Sheet Feeder on=active	*OFF*
1-8	Receive Buffer on=0K off=6K	*OFF*
2-1	Paper Size off=11" on=12"	*OFF*
2-2	Skip Perf on=on off=off	*OFF*
2-3	Serial Interface	*OFF*
2-4	Serial Interface	*OFF*
2-5	Serial Baud Rate	*OFF*
2-6	Serial Baud Rate	*OFF*
2-7	Short tear-off mode on=on	*OFF*
2-8	Auto LF on=CR+LF off=CR only	*OFF*

Mfg.: **Seikosha**
Model: **SL-80AI**
Type: 24 Pin Dot Matrix

Printer DIP Switch Settings:

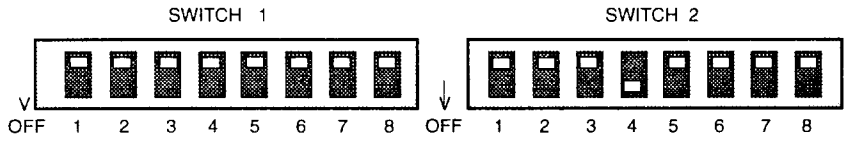


SW#	Function	Set
1-1	Not Used	*OFF*
1-2	Mode on=Standard off=IBM	*OFF*
1-3	Reserved	*OFF*
1-4	Intl. Characters -	*ON*
1-5	Intl. Characters -	*ON*
1-6	Intl. Characters -	*ON*
1-7	CR on=CR+LF off=Autofeed	*OFF*
1-8	If IBM,sel.1,2 or Download	*OFF*
2-1	CSF mode select on=selected	*OFF*
2-2	Paper Detect off=valid	*OFF*
2-3	Page Length on=12" off=11"	*OFF*
2-4	Skip Perf on=on off=off	*OFF*
2-5	Print Mode on=draft off=LQ	*OFF*
2-6	Slashed Zero off=no on=yes	*OFF*
2-7	CR IBM Mode on=CR+LF off=CR	*OFF*
2-8	Not used.	*OFF*

Mfg.: **Star**
Model: **NR-15**
Type: 24 Pin Dot Matrix- Wide Carriage

NOTE The NR-15 requires the M-8000 parallel port be set to **wide** carriage.

Printer DIP Switch Settings:



SW#	Function	Set
1-1	Paper Detect on=inactive	*ON*
1-2	On=Select IN Signal to Low	*ON*
1-3	On=Ignore Download Characters	*ON*
1-4	Linefeed on=1/6" off=1/8"	*ON*
1-5	On=LF from Host off=auto LF	*ON*
1-6	On=No Bottom Margin off=1"	*ON*
1-7	On=10CPI off=17CPI Condensed	*ON*
1-8	Slash Zero on=yes off=no	*ON*
2-1	Print on=Draft off=NLQ	*ON*
2-2	Mode on=Standard off=IBM	*ON*
2-3	On=IBM-P off=IBM-G	*ON*
2-4	On=1/216" C-1 off=1/144" C-2	*OFF*
2-5	Auto LF on=CR+LF off=CR only	*ON*
2-6	Intl. Characters -	*ON*
2-7	Intl. Characters -	*ON*
2-8	Intl. Characters -	*ON*

40.2 SERIAL PRINTER OUTPUT

Serial printer output is available on J3 (marked AUX, on the back of the M-8000). The M-8000 offers two different serial printer output levels:

```
J3-1    Mil-188 Mark = +5V, Space = -5V
J3-3    EIA     Mark = -7V, Space = +7V

J3-11   Common
```

Simply select the above signal level that is compatible with your serial printer and connect the appropriate pin to your printer input. Regardless of the level selected, the common (return) should be connected to J3-11.

As part of the serial printer installation, be sure to set the mode, speed, and any other pertinent variables for the serial printer output in the PRINTERS sub-menu of the PROGRAMMING mode.

SERIAL PRINTER HANDSHAKE

The M-8000 will accommodate serial printers that require handshaking.

A high signal (+3V to +15V), from your printer, applied to J3-2 would indicate to the M-8000 that the printer is not ready to accept data.

If this handshake line is not connected, then the M-8000 assumes that the printer is ready to accept data at all times.

APPENDIX A - VFT FREQUENCY TABLE

	MODE A		MODE B		MODE C		MODE D	
CH	**mark**	**space**	**mark**	**space**	**mark**	**space**	**mark**	**space**
1	390	450	382	467	420	540	450	630
2	510	570	552	637	660	780	810	990
3	630	690	722	807	900	1020	1170	1350
4	750	810	892	977	1140	1260	1530	1710
5	870	930	1062	1147	1380	1500	1890	2070
6	990	1050	1232	1317	1620	1740	2250	2430
7	1110	1170	1402	1487	1860	1980	2610	2790
8	1230	1290	1572	1657	2100	2220	2970	3150
9	1350	1410	1742	1827	2340	2460		
10	1470	1530	1912	1997	2580	2700		
11	1590	1650	2082	2167	2820	2940		
12	1710	1770	2252	2337	3060	3180		
13	1830	1890	2422	2507				
14	1950	2010	2592	2677				
15	2070	2130	2762	2847				
16	2190	2250	2932	3017				
17	2310	2370						
18	2430	2490						
19	2550	2610						
20	2670	2730						
21	2790	2850						
22	2910	2970						
23	3030	3090						
24	3150	3210						

APPENDIX B - BAUDOT ALPHABET TABLE

ALL LETTERS	**ITA2 FIGURES**	**TELEX FIGURES**	**MIL FIGURES**	**CYR FIGURES**	**CYR NATIONAL**
BLANK	BLANK	BLANK	BLANK	BLANK	BLANK
E	3	3	3	3	Е
L/F	L/F	L/F	L/F	L/F	L/F
A	-	-	-	-	**А**
SPACE	SPACE	SPACE	SPACE	SPACE	SPACE
S	'	'	BELL	'	С
I	8	8	8	8	**И**
U	7	7	7	7	**У**
C/R	C/R	C/R	C/R	C/R	C/R
D	WRU	WRU	$	WRU	**Д**
R	4	4	4	Y	**Р**
J	BELL	BELL	'	**Ю**	**Й**
N	,	,	,	,	**Н**
F	U-1	$	!	**Э**	**Ф**
C	:	:	:	:	**Ц**
K	(	(	(	(	**К**
T	5	5	5	5	**Т**
Z	+	"	"	+	**З**
L	)	)	)	)	**Л**
W	2	2	2	2	**В**
H	U-2	#	STOP	**Щ**	**Х**
Y	6	6	6	6	**Ы**
P	0	0	0	0	**П**
Q	1	1	1	1	**Я**
O	9	9	9	9	**О**
B	?	?	?	?	**Б**
G	U-3	&	&	**Ш**	**Г**
FIGS	FIGS	FIGS	FIGS	FIGS	FIGS
M	.	.	.	.	**М**
X	/	/	/	/	**Ь**
V	=	;	;	=	**Ж**
LTRS	LTRS	LTRS	LTRS	LTRS	LTRS

Note: BLANK, BELL, STOP, LTRS, FIGS, C/R, L/F, and WRU are control codes which are only displayed on the video screen when the LITERAL sub-mode is enabled as:

BELL	STOP	LTRS	FIGS	BLANK	C/R	L/F	IDLE	ALPHA
	⊕				⇐	≡	|	∝

BETA	ERROR	WRU	RQ	ITA U-1	ITA U-2	ITA U-3	(U=undefined)
ß	X						

APPENDIX C - REAR PANEL CONNECTORS

J-1 Audio Input #1

TIP - Audio input, channel 1.
SLEEVE - Ground

J-2 Audio Input #2

TIP - Audio input, channel 2.
RING - Pager and ACARS data input.
SLEEVE - Ground

J-3 Accessory

1	Serial printer output mil levels
2	Serial printer handshake
3	Serial printer output EIA (RS-232) levels
4	Remote terminal data into M-8000
5	Remote terminal data output from M-8000
6	Remote terminal handshake
7	Output for external tuning scope (mark)
8	Output for external tuning scope (space)
9	Spare to pad labeled "6"
10	Spare to pad labeled "7"
11	Ground
12	Ground
13	Ground
14	Aux data input TTL level
15	Aux data input EIA level

J-4 Printer

1	Strobe
2	B0
3	B1
4	B2
5	B3
6	B4
7	B5
8	B6
9	B7
11	Handshake
18-25	Ground

J-5 Video Output

1	Red
2	Green
3	Blue
4	N/C
5-10	Ground
11-12	N/C
13	H Sync
14	V Sync
15	N/C

APPENDIX D - ADDITIONAL REFERENCES

Users seeking more detailed information on the various codes that the M-8000 receives should consult the following publications:

GUIDE TO UTILITY STATIONS

By J. Klingenfuss. The very best guide to non-broadcast stations in the world. 19,549 frequencies and 3590 call signs. Aero, maritime, military, diplomatic, research, time stations and more. Covers SSB, CW AM and exhaustive RTTY with new modes. Includes *Guide to World RTTY Stations.* 537 p.

GUIDE TO FACSIMILE STATIONS

By J. Klingenfuss. The best book we have seen on the exciting world of FAX monitoring. It covers equipment, techniques, formats, frequencies, abbreviations and schedules. Very up to date and comprehensive. Also includes many interesting sample facsimile photos. © *Klingenfuss Publications.* 392 p.

MODULATION TYPES ON COMPACT DISK.

By J. Klingenfuss. Noted author Joerg Klingenfuss has brought forth his 25 years of monitoring experience to produce this audio CD set of 71 emission types. This 2½ hour, two CD set allows rapid access to the typical sound of all conventional and exotic shortwave transmission modes.

AIR & METEO CODE MANUAL

By J. Klingenfuss. Learn to decode content and origination points of the extensive RTTY meteorological broadcasts. Detailed descriptions of WMO GTS message formats with many decoding examples. 10,000 meteorological stations are listed in numerical order. © *Klingenfuss Publications.* 374 p.

RADIOTELETYPE CODE MANUAL

By J. Klingenfuss. A technical review of RTTY alphabets including: Arabic, Chinese, Korean, Japanese and Russian Cyrillic. Explains new RTTY transmission modes including ARQ, ARQ-E, FEC, VFT, Sitor, Piccolo plus major CW alphabets. For advanced RTTY enthusiasts. ©*Klingenfuss Publications.* 144 p.

WORLD PRESS SERVICES FREQUENCY LIST & MANUAL

By Thomas Harrington. Lists **English** RTTY press stations. Three different master frequency lists: by time, by frequency and by country. Chapters also review antennas, receivers and RTTY equipment. The original world press services book. Includes supplement. Fifth Edition ©1992 *Universal Electronics* 84 p.

THE HIDDEN SIGNALS ON SATELLITE TV

By Thomas P. Harrington. There is more than just TV signals coming from the domestic satellites! Read about the secret signals and hidden services on the 4 GHz satellites. For every TVRO owner or hobbyist wanting to learn more about communications satellites. Third Edition. ©1991 *Universal Elect.* 238 p.

THE U.S.S.R. MERCHANT SHIP LIST

By Jason Berri. This book list hundreds of recently monitored Soviet ships by callsign and name. Also provides information on decoding the header, and indicates ship type. An excellent secondary reference for the Soviet RTTY enthusiast. As useful before, as after the U.S.S.R. breakup. ©1991 *Universal Radio Res.* 72 p.

THE SOVIET MARITIME RTTY DICTIONARY

By Gary Gorka & Fred Osterman. The single largest user of Baudot RTTY on shortwave is the vast Soviet maritime fleet. Their RTTY transmissions can be monitored 24 hours a day! With this book you will be able to find, decode and understand this extensive traffic. ©1988 *Universal Radio Research* 102 p.

THE RTTY LISTENER RL 1 - 25

By Fred Osterman. This specialized book contains up-to-date, hard-to-find information on advanced RTTY and FAX monitoring techniques and frequencies. Shortwave and satellite topics are explored. An interesting secondary reference for the advanced radioteletype listener. ©1991 *Univ. Radio Res.* 222 p. 8½" x 11".

SHORTWAVE FACSIMILE FREQUENCY GUIDE

By Balneger & Schaay. A valuable reference for anyone involved in FAX. Includes a good station list organized by frequency. Also many FAX charts and photos are shown. Facsimile equipment is also briefly touched on. The book concludes with addresses for many FAX broadcasters. © *Universal Electronics.* 66 p.

RTTY TODAY

By D. Ingram. Covers the theory and equipment of amateur and SWL radioteletype. Understand how radioteletype works. Covers theory, methods, equipment and techniques. Good coverage of computers and RTTY. A readable book with photos, diagrams and station set ups. ©1984 *Universal Electronics.* 112 p.

THE RTTY LISTENER RL 26 - 30

Compiles Newsletters 26 to 30. ©1992 *Universal Radio Research.* 103 pages.

UNDERSTANDING ACARS

By Ed Flynn. Learn how to interpret the ACARS aviation mode. ©1993 *Universal Radio Research.*

TUNE SATELLITE RADIO ON YOUR SATELLITE SYSTEM

By T.P. Harrington. Receive audio programing on the satellites. Includes guide. ©1993 *Universal Elect.* 150 p.

APPENDIX E - RTTY RECEPTION PROBLEMS

Perfect copy of short-wave (HF) RTTY transmissions is not guaranteed. There are several "natural" obstructions to perfect copy. Basically these obstructions fall into the three following categories:

Multipath Distortion
Multipath Distortion is caused by the signal from the transmitter arriving at the receiving antenna via two different paths, at slightly different times, which causes the mark and space pulses to be smeared, stretched, or over-lapped to the extent that they are decoded improperly.

Fading and Selective Fading
Fading and Selective Fading is caused by the ionospheric propagation of H.F. signals. Naturally if the signal fades out completely the information not received during the fade will not be printed. Selective fading, wherein only the mark or space appear to fade out will also cause loss of intelligence in the receiving installation.

Noise
Large scale static crashes and impulse noise may both interfere with RTTY reception.

The large static crash can obliterate the signal and impulse noise, whose pulse width closely approximates the bit-width of the marks and spaces of the RTTY signal, can fool the demodulator system into printing errors. Note, that in all cases of the aforementioned disturbances, greater errors can occur when the transmission rate is faster. Thus, most H.F. RTTY occurs at 45 or 50 baud rather than 75 or 100 baud.

Experimentation with the demodulator controls will enable the user to partially overcome these propagation abnormalities.

APPENDIX F - M-8000 ALIGNMENT

⚠ WARNING ⚠

Lethal voltages are present inside the M-8000. Refer all maintenance and alignment to qualified service personnel.

The following adjustments are the only alignment needed for the M-8000. The alignment has been done at the factory and will NOT be required again under normal conditions!

1. **Master Time Base Adjustment**
   Connect the high impedance probe of an accurate frequency counter to Test Point 'Z'. Adjust C-1 for a reading of 9.000000 MHz.

2. **Filter Offset Adjustment**
   Using high impedance dc voltmeter set on a 5 volt scale or lower * connected between pin 7 of IC-67 and ground, adjust control "5" for 0 volts. This adjustment must be made with the AGC off and no audio input to the M-8000.
   Note: This reading may go negative prior to final adjustment of this control.

3. **M/S Tune Indicator Adjustment**
   With the M-8000 in the Baudot diagnostic mode and the front panel bar graph set to display M/S, adjust control "3" so that the front panel bar graph just illuminates the right-most LED segment.

4. **Audio Input Level Adjustment**
   With the M-8000 in the Baudot diagnostic mode and the front panel bar graph set to display INPUT, adjust control "4" so that the illuminated LED segments of the front panel bar graph are centered under the white INPUT target box.

5. **Spectrum Display Reference Adjustment**
   With the M-8000 in the Baudot diagnostic mode, adjust R-6 so that the left (Mark tone) display peak is positioned above the 2125 Hz (right) reference mark of the spectrum display.

   Note: There will be a brief delay between adjusting R-6 and observing the effect of the change in setting.

APPENDIX G - SPECIFICATIONS

Modes & Speeds:

MORSE	5 to 120 wpm auto ranging (in 3 ranges)
BAUDOT	45, 50, 57, 75 & 100 Baud + variable
ASCII	75, 110, 150, 300, 600, 1050, 1200 & 1800 Baud + variable
PACKET	300 & 1200 Baud (AX.25)
PACTOR	100 / 200 baud short and long path (as licensed by SCS).
SITOR	Mode A (ARQ) and Modes B (FEC collective and selective) - 100 Baud + variable
FEC-A	96, 144 & 192 Baud + variable
FEC-S	96, 100, 144, 192 & 200 Baud + variable
ARQ-M2	86, 96 & 100 Baud + variable
ARQ-M4	172, 192 & 200 Baud + variable
ARQ-E	48, 64, 72, 86, 96, 144 & 192 Baud + variable
ARQ-E3	48, 64, 72, 86, 96, 100, 192 & 200 Baud + variable
ARQ-S	86, 96, 100, 172, 192 & 200 Baud + variable 4, 5, 6 or 7 character groups
ARQ6-90	200 Baud + variable
SWED	100 Baud + variable

• DATABIT	Evaluation modes 4, 5, 6, 7, 8 or 9 bits per character Asynchronous and Synchronous
• BIT INVERSION	Baudot based codes only. Decodes any combination of bit inversions.
• THREE SHIFT CYRILLIC	Baudot based codes only. Video display only.
• LITERAL DISPLAY MODE	Baudot based codes only. Video display only.

PICCOLO	Multi-tone teleprinter code
POCSAG	Digital pager code
GOLAY	Digital pager code
ACARS	2400 Baud
FAX	60, 90, 120 & 240 LPM at 288, 440 & 576 IOC

Note: All 'variable' speeds range from 20 to 250 Baud in 1 Baud increments.

Filter Tones:

High tone (mark = 2125), Low tone (mark = 1275)
Fixed shifts of 60, 85, 170, 425, 850, and 1200 Hz. are provided, plus variable.
Variable shifts of 60 to 1250 Hz in 5 Hz. steps.
Modem tones (Seven standard modem tone pairs)
VFT (Four standard FDM channelization schemes)

Inputs:

Two independent audio input channels each: 4 to 600 ohms .25V p-p nominal.

Input for Pager/ACARS audio.

Aux input for external demodulator (TTL or EIA level).

Outputs:

Video VGA color, 26 lines of 80 characters each
(excluding status lines and graphic tuning displays).

Printer Drives - MIL, or EIA levels and parallel ASCII, all with handshaking.

External tuning scope.

Printer Modes & Speeds:

Serial: Baudot 45, 50, 57, 75 Baud
ASCII 110, 300, 600, 1200 Baud

Parallel: (ASCII 8 bit Centronics standard)

Rear Panel Jacks:

Power, Video Output, Audio Input 1, Audio Input 2, Accessory Jack, Parallel Printer.

Power Requirements:

115/230 VAC 50/60 Hz. 25 watts maximum

Size:

16-3/8" wide x 3-1/2" high x 10-3/4" deep exclusive of rubber feet and rack handles.

Weight:

9 lbs.

The operation of the M-8000 is primarily software controlled. As such, it has the capability of being modified to accept customized software to meet your special operating needs.

Contact Universal Radio for additional information on the availability and cost of custom applications.

APPENDIX H - R.F.I.

This equipment generates and uses radio frequency energy and, if not installed and used properly, that is, in strict accordance with the manufacturer's instruction, may cause interference with radio and television reception. It has been type tested and found to comply with the limits for a Class B computing device in accordance with the specifications in subpart J of Part 15 of FCC rules, which are designed to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference with radio or television reception, (which can be determined by turning the equipment off and on), the user is encouraged to try to correct the interference by one or more of the following measures:

a. Be sure the downlead from the radio's antenna is high quality shielded coaxial cable (RG-8/X, RG-8 or RG-213 or better).

b. Reorient the receiving antenna.

c. Relocate the converter with respect to the receiver.

d. Move the converter away from the receiver and/or antenna.

e. Be sure the radio receiver is grounded to earth ground.

f. Plug the converter power supply into a different outlet so the converter and receiver are on different branch circuits.

If necessary, the user should consult the dealer or an experienced radio-television technician for additional suggestions. The user may find the following booklet, prepared by the Federal Communications Commission, helpful:

How to Identify and Resolve Radio-TV Interference Problems This booklet is available from the U.S. Government Printing Office, Washington, DC 20402, Stock No. 004-000-00345-4.

APPENDIX I

DIGITAL ELECTRONIC SYSTEMS, INC.
565 Paul Morris Drive
Englewood, Florida 34223
(813) 474-9518

LIMITED WARRANTY M-8000

Digital Electronic Systems, Inc. (herein after referred to as "manufacturer") has tested and found each product to function properly, and within the specifications listed in the product's manual, before being shipped. Any of Manufacturer's product found to be defective in either workmanship or materials, within a period of one year from the date of purchase by the original owner, will be, at the option of the Manufacturer, repaired, replaced, or adjusted at no charge, to the original quality standard, if returned to the factory pre-paid, provided that the warranty card supplied with the product is completed and returned to the Manufacturer within 30 days from the date the system was purchased. If no warranty card is on file from the purchaser, then the warranty term, on that particular unit will terminate 3 months after the date of shipment from the factory.

This warranty term does not apply to semiconductors which are warranted for 90 days. This warranty does not cover products damaged through abuse, operation outside of limits specified in the operating manual, or modifications to the product made without the express written permission of the manufacturer.

All transportation charges on returned systems, whenever warranty does NOT apply, must be borne by the owner to and from the manufacturer. Transportation charges outside of the continental U.S., whether or not warranty is applicable, must be borne in both directions by the owner.

If service or repair becomes necessary following expiration of the warranty period, or whenever warranty does not apply due to the conditions stated above, write the Manufacturer, giving model and serial number and details of your problem, to obtain a returned material authorization (R.M.A.). Upon receipt of the R.M.A. you may carefully pack and ship the unit to the manufacturer, prepaid, preferably via UPS.

Should you desire, the Manufacturer will give you a guaranteed cost for the repair of your unit prior to repair. Otherwise the unit will be repaired and returned to you at the prevailing rates for parts and labor.

Upon receipt of equipment, the purchaser is responsible for checking the contents for damage. Any shipping damage should be referred to the carrier. Manufacturer is not responsible for any personal injury or property damage, or consequential damage resulting from improper or careless installation or for usage not intended by the manufacturer.

Digital Electronic Systems, Inc. reserves the right to change designs and specifications without notice and without the obligation to retrofit or upgrade previously manufactured merchandise to the new design or specifications.

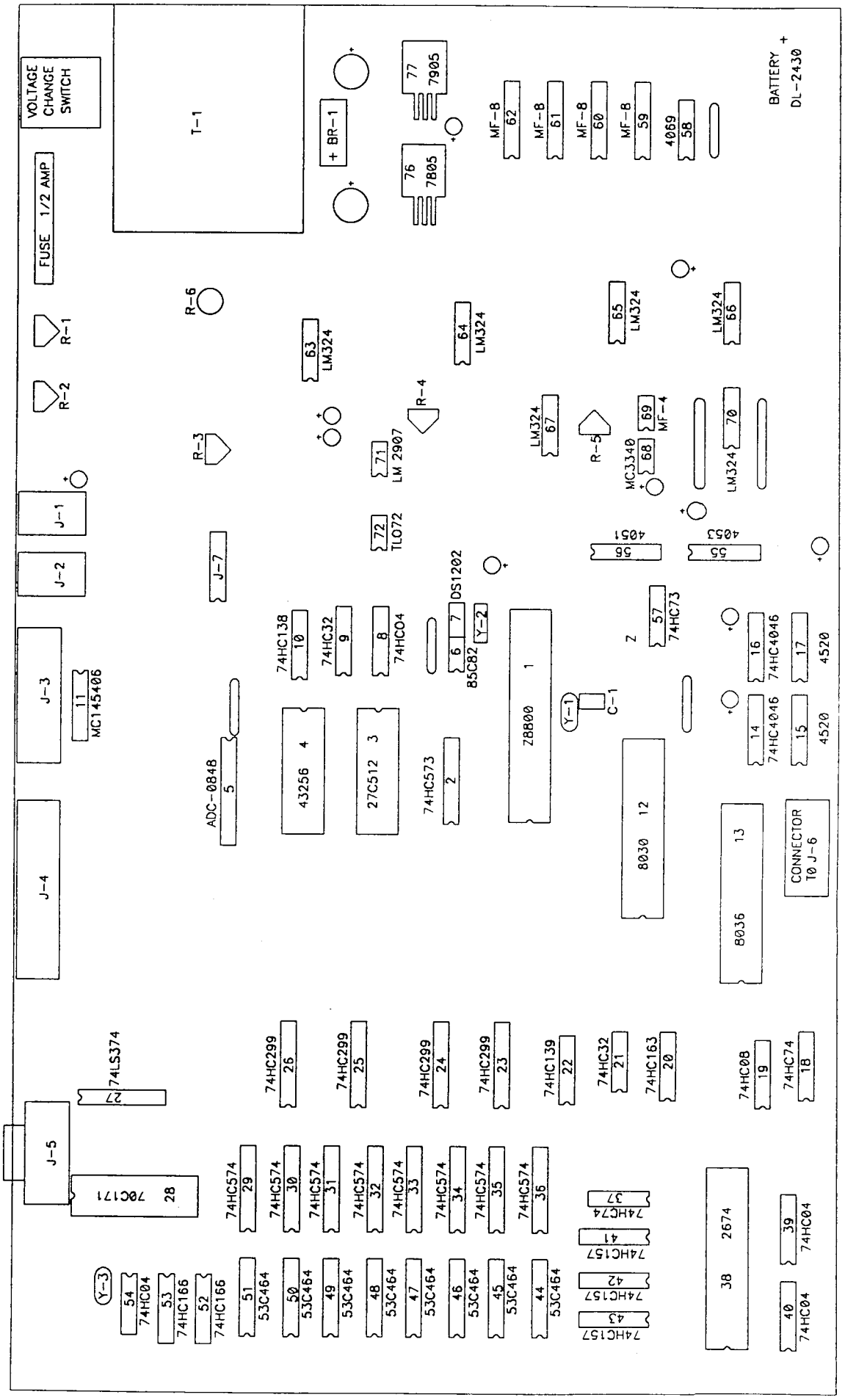
Special Notes to Warranty Statement:

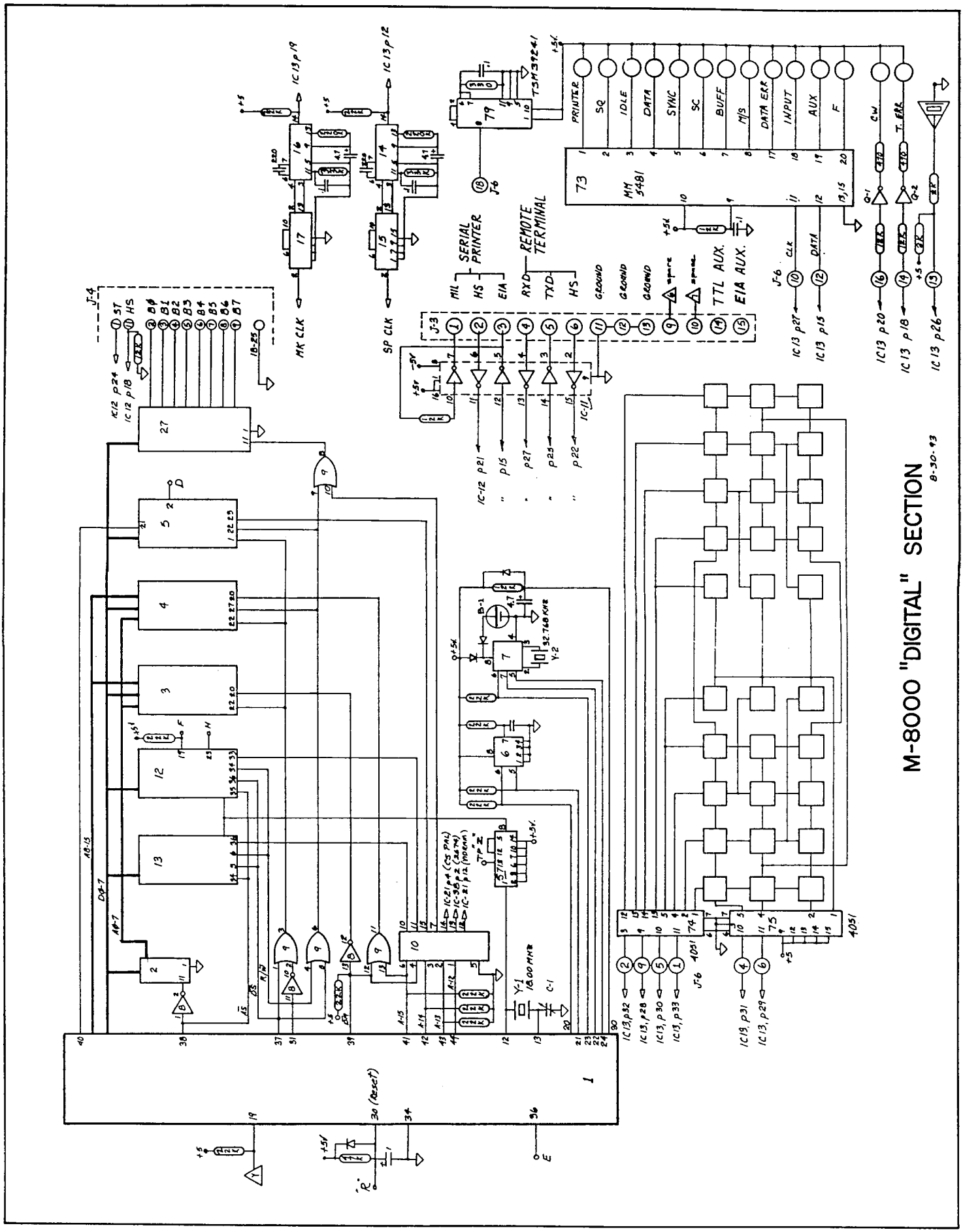
1. The M-8000 uses semi-conductors which are rated for the commercial temperature range (0-70°C.). Operating the M-8000 under conditions that cause the semi-conductors to exceed their temperature ratings may cause failure of these semi-conductors and will void the Limited Warranty.

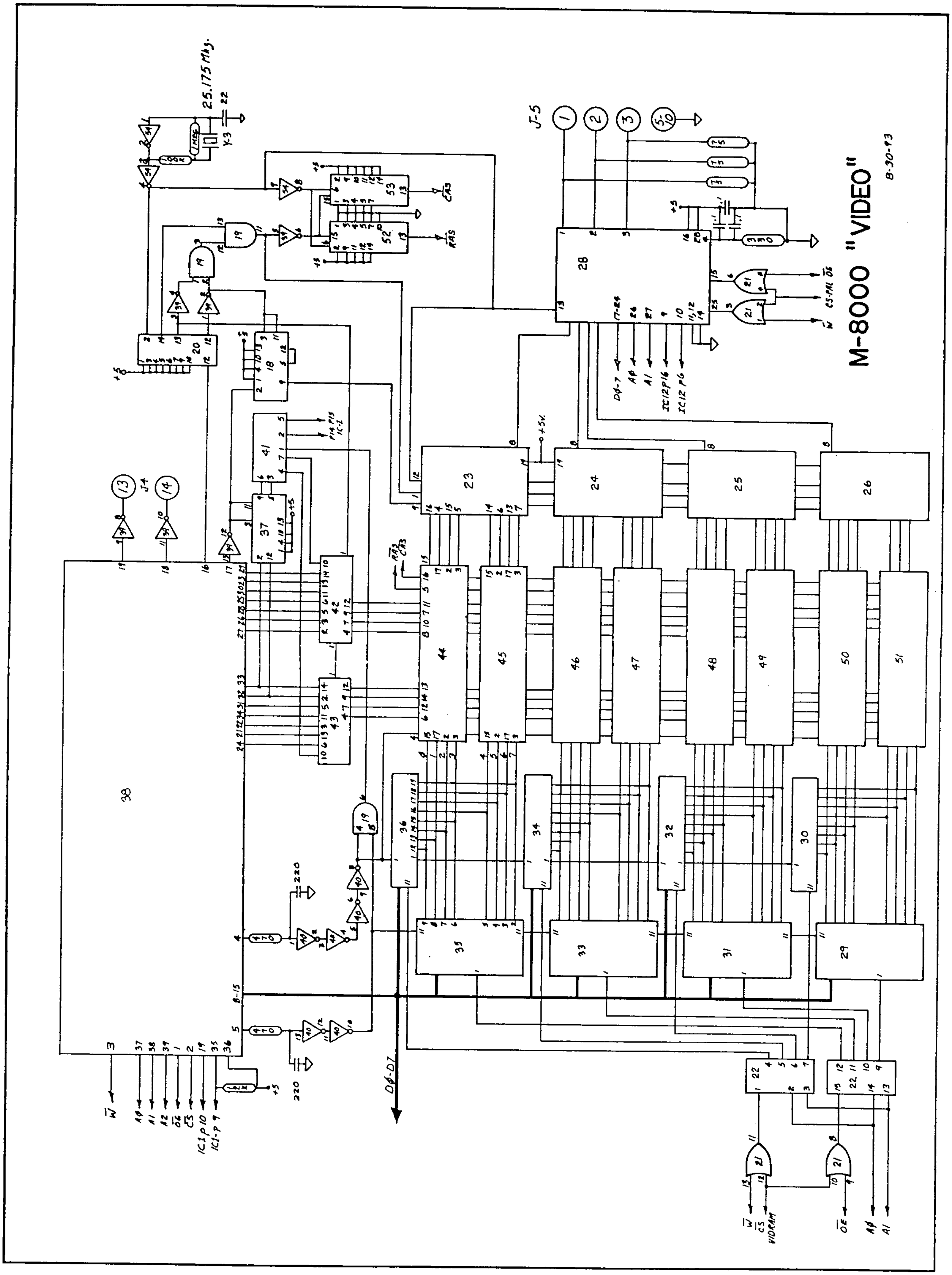
2. The software operating system furnished as an integral part of the M-8000 has been thoroughly tested and found to perform according to the M-8000 specifications.

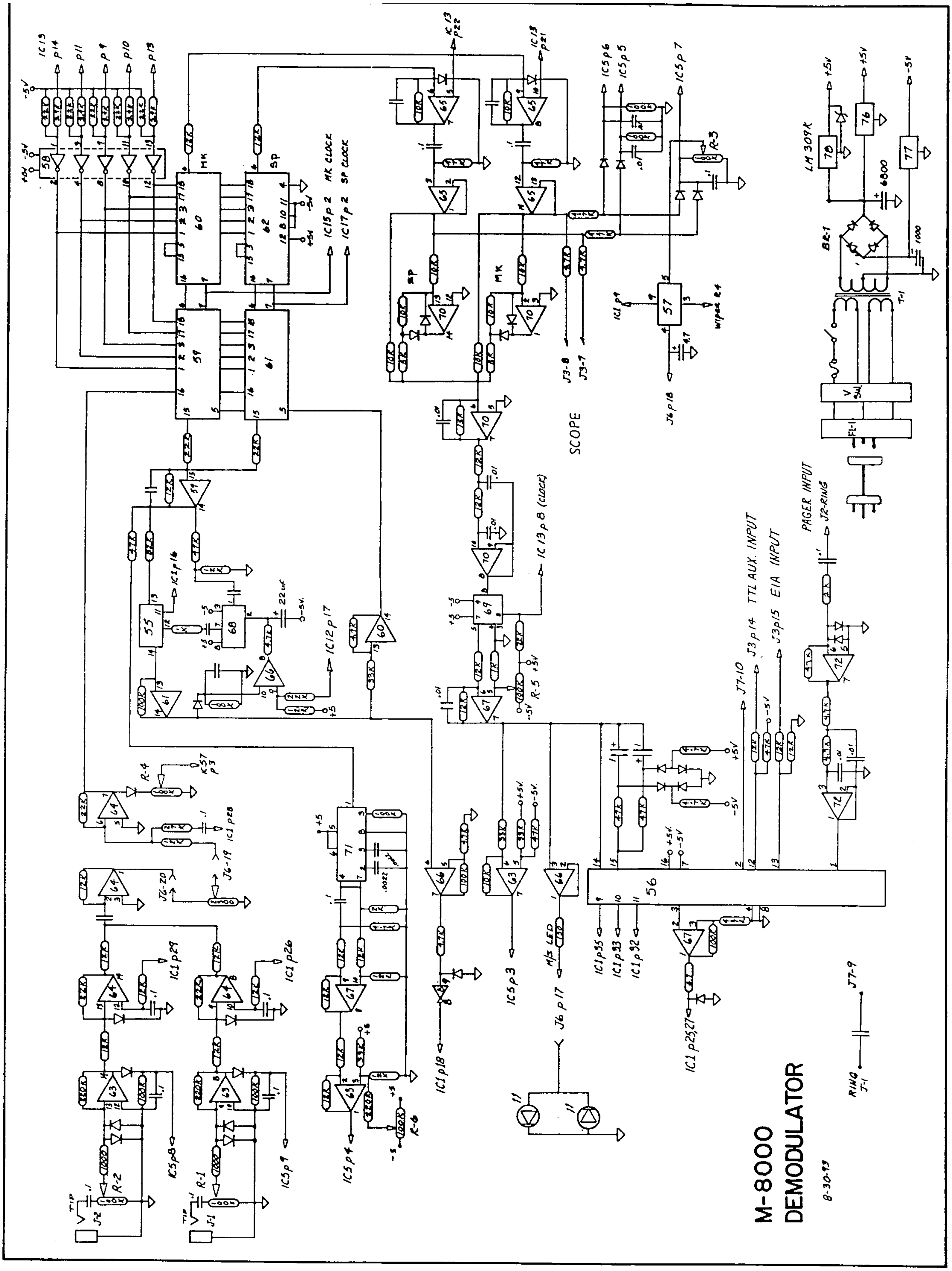
3. Software up-dates, improvements, or enhancements, should they be developed, will not be furnished free, but will be made available to the registered original purchaser at a reasonable cost.

APPENDIX J - PARTS LOCATIONS AND SCHEMATICS




M-8000 "DIGITAL" SECTION
8-30-93
SERIAL PRINTER
REMOTE TERMINAL
TTL AUX.
EIA AUX.
PRINTER
SQ
IDLE
DATA
SYNC
SC
BUFF
M/S
DATA ERR
INPUT
AUX
F
CW
T. ERR
MK CLK
SP CLK
32.768 KHz
16.00 MHz
(Reset)


M-8000 "VIDEO"
8-30-93
25.175 Mhz.
J-5
J-4
DØ-D7
RAS
CAS
+5
220


M-8000
DEMODULATOR
8-30-93
SCOPE
TTL AUX. INPUT
EIA INPUT
PAGER INPUT
MR CLOCK
SP CLOCK
LM 309K