Universal M-7000

Version 2

Owner's Manual

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&
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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 to be 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-7000 in normal operating situations. Additional information on specific operating and installation situations may be obtained by contacting your dealer.

This manual reflects all the enhancements of the M-7000 version 2 but will refer to the device simply as the "M-7000".

Listeners are reminded that the unauthorized interception of private non-broadcast radio or satellite communications may violate federal or state law.

GENERAL DESCRIPTION

The UNIVERSAL M-7000 provides video display output of Morse, Baudot, ASCII, Packet, ARQ (TDM Moore), Simplex Telex Over Radio (SITOR) codes and facsimile images (optional) when attached to a communications receiver and a video monitor. A variety of 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 SITOR codes (modes A and B).
- Decoding of ARQ (TDM Moore) codes.
- Decoding of ARQ-E and ARQ-E3 codes.
- Decoding Packet 300 baud and 1200 baud (AX.25).
- Decoding of three shift Russian Cyrillic to video.
- Literal display mode.
- Databit code analysis mode.
- A unique screen-print feature allows the user to obtain hard copy of received data as displayed on the screen.
- Crystal controlled tone filters with frequency and bandwidth optimized, to the selected shift and speed, by the internal microprocessor.
- Remote terminal or computer control of operation.
- User programmable Sel-Cal codes.
- Automatic filter tuning by microprocessor.
- VFT (FDM) demodulator operation.
- Eleven, user programmable, recallable operating memories.

INSTALLATION

LINE VOLTAGE SELECTION

Before connecting the M-7000 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.

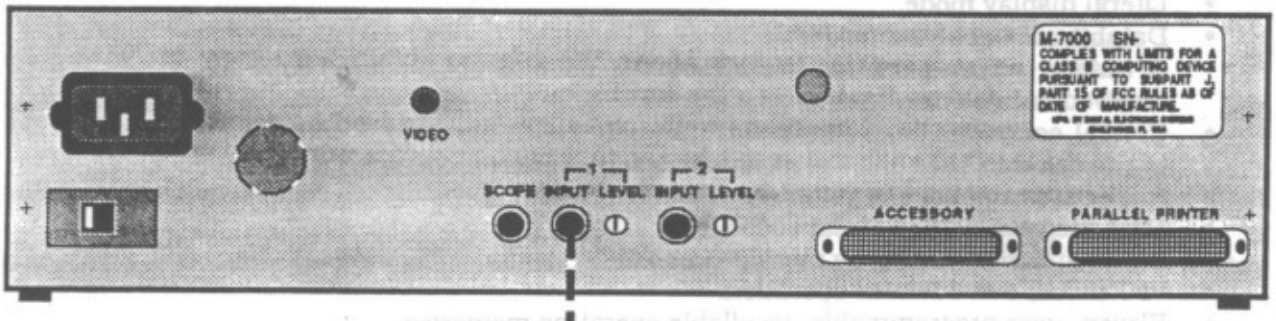
WARNING

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.

RECEIVER CONNECTION

Any good quality communications receiver will suffice for use with the M-7000. However stability, sensitivity, and selectivity are the most important attributes of a good RTTY communications receiver. Examples of suitable receivers would include: Japan Radio NRD-515, Japan Radio NRD-525, Kenwood R-1000, Kenwood R-2000, Kenwood R-5000, Icom R-70, Icom R-71A, Yaesu FRG-7000, Yaesu FRG-7700, and Yaesu FRG-8800.

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-7000 "INPUT" to the earphone or speaker outputs using the 2 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.

RECEIVER INPUT LEVEL ADJUSTMENT

The M-7000 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-7000 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-7000.
2 Turn on the M-7000 and receiver.
3 Tune in a fairly strong RTTY signal (precise tuning is not important at this point).
4 Set the front-panel GAIN control to mid-range.
5 With the keyboard switch in the NORM position, press the 9 key on the right keyboard (R9n). Repeat until " 1" appears at the left end of the status line.
6 Adjust the 1 LEVEL control so that the first orange LED is lit on the front panel AUDIO INPUT LEVEL indicator. This is the fourth LED segment from the right. A small flat-blade screwdriver should be used to adjust the LEVEL control.

If two receivers are to be used, repeat the above procedure, using INPUT 2, LEVEL 2 and "2" on the status line. When two receivers are used it is best to leave both connected, and select between the two using keyboard commands.

NOTE: Do not over-drive the input stages of the M-7000. If the front panel GAIN control must be set lower than the 9:00 position in order to bring the AUDIO INPUT LEVEL out of the red range (rightmost two segments), proper unit performance will be seriously impaired.

VIDEO MONITOR CONNECTION

The M-7000 generates composite video designed to work with nearly all monochromatic (ie. black & white) monitors. As the video display output is a fairly wide band signal, it is recommended that a 12" high quality green, amber or black and white video monitor be used with the M-7000.

A monitor whose specifications indicate that it will display a 22 line x 80 character display, with RS-170 or equivalent input, will perform properly.

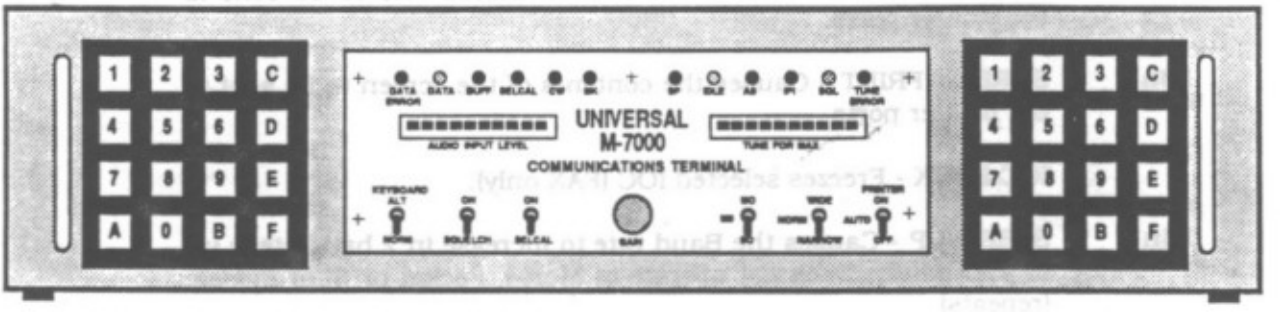
Video monitors that are known to work well with the M-7000 are the Zenith ZVM-121, ZVM-122, ZVM-123, ZVM-1220A, ZVM-1230A, Sanyo VM-4512, Koyo TVM-96-2, Magnavox BM7622, BM7652 and the Samsung MD-1255H. Monitors that would not be suitable would include color monitors, RGB monitors and TTL monitors.

The use of a converted television is not recommended because of the inherently poor bandwidth of the TV and the potential for shock hazards with a non-transformer isolated TV. The use of an RF modulator will also give poor results.

The video monitor is connected to the "VIDEO" jack on the rear panel using the RCA type pin plug supplied. Be sure that your cable to the video monitor is a good quality,

well shielded RG58, RG59 coax. The use of double shielded coax (RG-232/U, RG71B/U, RG62B/U, RG55/U) will further reduce any video hash radiation.

OPERATING CONTROLS



KEYPAD FUNCTIONS

The M-7000 uses two keypads to control the majority of operating functions.

In addition, a toggle switch labeled "NORM/ALT" allows each of the two keypads to have two sets of functions.

A prompt card, furnished with the M-7000 provides the user with help when operating the M-7000.

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 enable or disabled by the user in the PROGRAM function.

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

The convention used in this manual to specify a particular key is:

```
Lln
^^^
|||
||└── n = NORMal keyboard    a = ALTernate keyboard
|└─── key number or letter
└──── L = left keyboard      R = right keyboard
```

The following is a list of the keypad functions in both the NORMal and ALTernate modes:

Left Keypad NORMal Mode

L1n SRO (Speed Read Out) - Initiates the speed reading function in the RTTY Modes, or switches between Line and Gray formats when in the FAX mode.

L2n STATUS PRINT - Causes the current status line to be sent to the printer ports.

L3n SCREEN PRINT - Causes the contents of the screen to be sent to the printer ports.

IOC LOCK - Freezes selected IOC (FAX only).

L4n SPEED UP - Causes the Baud rate to increase in 2 baud steps up to 250 baud. Does not operate in Morse, Packet or Sitor modes. (repeats)

L5n SCROLL UP - Causes the display to scroll upwards on the screen. Inoperative if the screen is split. (repeats)

L6n UOS/PAR/IOC

UOS Switches the Unshift On Space function on and off. Operates in all Baudot based modes.

PAR When in the ASCII mode, steps through the available PARity selections.

IOC When in the FAX mode this key steps through the various Indices Of Cooperation (IOC's).

L7n SPEED DOWN - Causes the Baud rate to decrease in 2 baud steps down to 30 baud. Does not operate in Morse, Packet or Sitor modes. (repeats)

L8n SCROLL DOWN - Causes the display to scroll down (inoperative in split screen). (repeats)

L9n CASE CHANGE - Manually steps through the cases for Baudot based RTTY modes: Figures, Letters and National. (National only in three shift alphabets).

L0n SCREEN CLEAR - Clears video screen and printer buffer.

LAn ASCII MODE - Places M-7000 in ASCII mode and steps through the eight (8) pre-set Baud rates.

LBn BAUDOT MODE - Places the M-7000 in the Baudot mode and steps through the five (5) pre-set Baud rates.

LCn CW - Places the M-7000 in the Morse mode and steps through the three (3) speed ranges.

LDn SITOR - Places the M-7000 in the SITOR mode and steps through SITOR A (ARQ), SITOR B (FEC) and AUTOR modes.

LEn ARQ - Places the M-7000 in an ARQ mode and steps between ARQ 2 channel (ARQ-M2) and ARQ 4 channel (ARQ-M4) at three (3) Baud rates each.

LFn PACKET - Selects packet mode and changes packet speed.

Right Keypad NORMal Mode

R1n NORMAL/REVERSE - Changes the sense of the signal in Baudot and ASCII modes. Selects positive or negative polarity in FAX mode.

R2n FILTER TUNE - Allows automatic tuning of channel filters to the tone pair being received when the received audio tones are between 1200 and 3000 Hz. Operates in all RTTY modes.

R3n START/STOP - Starts and stops the data stream in the FAX or Databit modes.

R4n SHIFT UP - Increases the frequency spacing (shift) of the channel filters in 5 Hz. steps. Operates in all RTTY modes unless modem or VFT tones are used. (repeats)

R5n VFT GROUP - Selects the VFT demodulator mode and steps through the four (4) VFT channelization schemes. (repeats)

R6n ATC - Turns the Automatic Threshold Control circuit on and off.

R7n SHIFT DOWN - Decreases the frequency spacing (shift) of the channel filters in 5 Hz. steps. Operates in all RTTY modes unless modem or VFT tones are used. (repeats)

R8n SHIFT - Steps through the six (6) pre-set shifts of the high or low tone sets or through the seven (7) pre-set tone pairs in the modem mode. In the VFT mode, steps through the available tone pairs of the selected channelization scheme. (repeats)

R9n INPUT SELECT - Selects either one of the two audio inputs or places the system in the Diversity input mode.

R0n DEMODULATOR MODE - Selects the high tone set (Mark = 2125 Hz.), low tone set (Mark = 1275 Hz.) or the modem tone sets. (repeats)

RAn ALPHABET - Selects the various alphabets available in the Baudot based RTTY modes and in Morse mode.

RBn AGC - Turns the Automatic Gain Control circuit on and off.

RCn MEMORY SELECT - Enables the operator to select one of the eleven (11) user programmable operating memories.

RDn ARQ CHANNEL - Selects which of the two (2) or four (4) ARQ channels will be directed to the video display and/or printer.

REn AUTO TUNE - Selects proper shift, speed and sense of Baudot signals.

RFn FAX - Places the M-7000 in FAX mode and steps through the four (4) standard Drum Speeds.

Left Keypad	ALTernate Mode
L1a	BIT INVERSION (Manual) - Manually steps through the thirty two (32) possible Baudot bit inversion combinations. Operates on Baudot based codes only. (repeats)
L2a	FRAME LEFT - Shifts framing left in FAX and synchronous DATABIT modes. In ARQ mode it enables automatic framing.
L3a	FRAME RIGHT - Shifts framing right in FAX and synchronous DATABIT modes. In ARQ mode it is used for manual framing.
L4a	BIT INVERSION (Automatic) - Automatically steps through the thirty two (32) possible Baudot bit inversion combinations. Operates on Baudot based codes only.
L5a	BITS/CHARACTER UP - Used in DATABIT mode only. Increases the number of bits per character.
L6a	Reserved for future use.
L7a	SPLIT SCREEN - Turns the split screen video mode on and off. When the video screen is split, two independent data streams may be viewed on the screen at the same time. Operates in AR2 mode only.
L8a	BITS/CHARACTER DOWN - Used in DATABIT mode only. Decreases the number of bits per character.
L9a	Reserved for future use.
L0a	LITERAL MODE - Causes all received characters (including non-printing and control characters) to be displayed on the screen. Operates in RTTY text modes only.
LAa	DATABIT MODE - An advanced code analysis mode that displays received data as bit patterns of 1's and 0's.
LBa	PROGRAM - Selects a menu-based program that allows the user to customize certain of the unit's operations for their particular installation.
LCa	ARQ-E3 - Places the M-7000 in the ARQ-E3 mode and steps through the eight (8) pre-set baud rates.
LDa	Reserved for future use.
LEa	ARQ-E - Places the M-7000 in the ARQ-E mode and steps through the seven (7) pre-set baud rates.
LFa	HELP - Displays the keypad function layout on screen.

Right Keypad ALTernate Mode

R1a	Numerical Entry 1.
R2a	Numerical Entry 2.
R3a	Numerical Entry 3.
R4a	Numerical Entry 4.
R5a	Numerical Entry 5.
R6a	Numerical Entry 6.
R7a	Numerical Entry 7.
R8a	Numerical Entry 8.
R9a	Numerical Entry 9.
R0a	Numerical Entry 0.
RAa	Reserved for future use.
RBa	BAUD - For discrete Baud rate setting.
RCa	MARK FREQUENCY - For discrete Mark frequency.
RDa	SPACE FREQUENCY - For discrete Space frequency.
REa	SHIFT - For discrete Shift frequency.
RFa	Reserved for future use.

TOGGLE SWITCH FUNCTIONS

POWER

This toggle switch (located behind the right hand rack handle). Switches power to the M-7000. Up is on; down is off.

KEYBOARD NORM/ALT toggle switch

This switch determines whether the NORmal or ALTernate set of keyboard functions is selected.

SQUELCH toggle switch

This switch controls the operation of the print inhibiting squelch circuit. This switch must be "ON" in order for the squelch circuits to inhibit printing on weak signals.

SELCAL toggle switch

When this switch is ON, only data received after one of the programmed Sel-Cal codes will be sent to the printer, if the printer switch is in the AUTO position.

MO/MS/SO toggle switch

Selects the Mark filter Only, Space filter Only, or both Mark and Space filter operation of the RTTY demodulator.

WIDE/NORM/NARROW toggle switch

Increases (WIDE) or decreases (NARROW) the bandwidth of the demodulator filters from a pre-determined normal (NORM) operating point.

PRINTER ON/AUTO/OFF toggle switch

This switch determines when data will be sent to the printer ports (both parallel & serial).

INDICATORS

LED INDICATORS

DATA ERROR	Data being received by microprocessor does not meet the specification selected by the mode and speed controls.
DATA	Indicates that data is being received by the M-7000.
BUFF	Indicates a buffer overflow.
SELCAL	Indicates reception of a user-programmed Sel-Cal.
CW	Indicates when a "key down" Morse code signal is received.
MK	Indicates reception of a MARK tone.
SP	Indicates reception of a SPACE Tone.
IDLE	When receiving synchronous codes, this LED turns on when idle or phasing signals are being received.
AS	Indicates that the Auto-Start output is turned on. This shows that data is being transferred to the printer output.
IPI	Indicates activity on the Intelligent Peripheral Interface.
SQL	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.
TUNE ERROR	Indicates improper tuning or reception.
AUDIO INPUT LEVEL	A solid state tri-color LED meter which indicates the strength (loudness) of the signal being fed to the selected input of the M-7000. The three colors of this display and their indicated level ranges are:
	Green (low to usable)
	Orange (ideal)

	Red	(limiting; maximum to excessive).
TUNE FOR MAX >	A solid state LED tuning meter. Tune signal for maximum rightward deflection. This display indicates the average level of the filter output.	

THE STATUS LINE

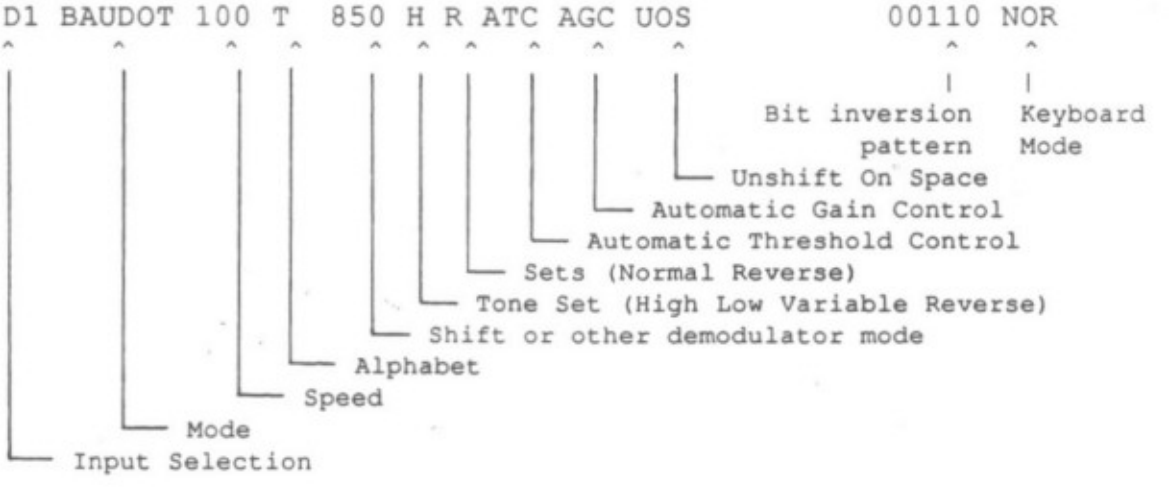
ON SCREEN TUNE INDICATOR

Functions similarly to the LED TUNE FOR MAX > indicator, except this is a peak-reading indicator.

This indicator displays ---- TUNE ----> to the immediate left of the status line. As the tuning level is increased, the highlighted video portion of this section moves toward the right.

The bottom line of the video display is used as a status line. The status line is a visible indicator of operations selected by the keypads.

A typical status line is shown below:



OPERATING THE M-7000

After you have connected the receiver, and the video monitor, turn on the M-7000 power switch, located directly behind the right hand rack handle, by placing this switch in the up position. This applies power to the M-7000.

The words UNIVERSAL M-7000 should appear (in reverse video) 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-7000 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-7000 version number. Please indicate this number when corresponding with the factory or your dealer regarding your M-7000. The status line will appear at the bottom. You may need to adjust your monitor (vertical and horizontal) to center the screen and ensure the total visibility of the status line. 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.

MORSE CODE (CW)

To copy Morse Code (CW) press the LCn key. Your M-7000 is now in the Morse (CW) mode at MEDium speed (10-40 words per minute).

In the Morse mode the R0n key will select the audio tone frequency that the M-7000 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.).

For applications where neither of these frequencies can be used, the R4n and R7n keys mad be used to vary the Morse operating frequency up and down from 500 Hz to 2500 Hz in 25 Hz steps.

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 and the TUNE FOR MAX > display is indicating maximum movement to the right.

Care should be taken that you do not over-drive the M-7000 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-7000 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 short-wave. For reception of code slower than 10 w.p.m. you can press the LCn key until SLOW appears on the status line. For reception of code faster than 40 w.p.m. you should press the LCn key until FAST appears on the status line.

The M-7000 Morse section will decode CW only when it is properly sent, with reasonably constant speed and character spacing.

Two alphabets are available in the Morse mode, standard and international. These alphabets are selected with the RAn key, and are indicated on the status line to the right of the speed indication. The standard alphabet is indicated by leaving this position blank, while the international selection will show an "I" in this position. Special Morse international characters include:

Ä .-.- Ĥ ---- É ..-.. Ö ---. Ü ..-- Ñ --.--

RTTY OPERATION

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 loop 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.

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-7000, 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 megacycles (millions of cycles per second) separated by only a few hundred cycles. This separation between the mark and space frequencies is referred to as the shift.

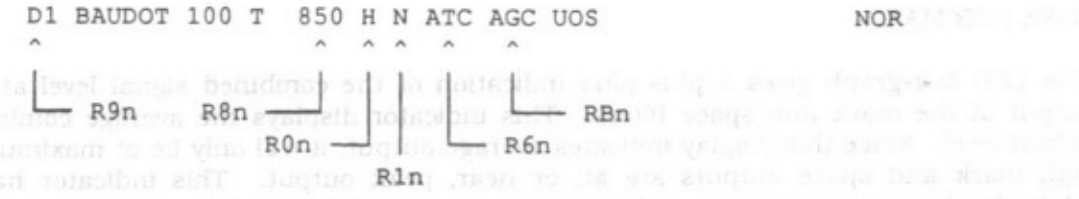
It is the responsibility of the short-wave receiver to convert these radio frequency signals down to audio tones. While the frequency difference, or shift, between the two tones will remain constant, the actual tone frequencies are dependent upon the receiver tuning. In this respect, the receiver becomes 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 will 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-7000, 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 4 configurations)
AUTOMATIC + variable shift
DIRECT ENTRY + variable shift

All of the demodulator controls to accomplish this are located on the right keyboard.



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 accurately 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 in 10 Hz. steps or less, then the Delta F, RIT, BFO, or similar fine-tuning control must be used to tune RTTY signals.

TUNING INDICATORS

While tuning the RTTY demodulator, there are several indicators that should be observed to make the process much easier:

AUDIO INPUT LEVEL

While this indicator need not be monitored closely while tuning a signal, it should be checked before tuning to ensure that there is neither too much, nor too little, signal for proper RTTY operation. Any indication above the third (from the left) Green segment, but less than full-scale (extreme right) should prove adequate for most operations. Ideal signal level, though will illuminate one or both of the Orange segments (3rd and 4th from right).

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 Ø Hz shift neither LED will ever turn on.

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. When fine tuning a signal (after all other indicators have been peaked), this LED can be used as a tune for minimum. This indicator has a very sharp null, that is, any variation from precise tuning will cause this indicator to turn on. As a result, in normal operation some flicker of this LED may be experienced.

TUNE FOR MAX >

This LED bar-graph gives a plus-plus indication of the combined signal level at the output of the mark and space filters. This indicator displays the average combined output level. Since this display indicates average output, it will only be at maximum if both mark and space outputs are at, or near, peak output. This indicator has a relatively slow response time, and so is not as susceptible to false indications from noise bursts. The average indication, combined with the slow response time causes this display to never show maximum reading on pulsed signals (CW., SITOR A, etc.).

TUNE (on screen)

This indicator operates similarly to the front panel LED display, except that this indicator shows peak value outputs. Since the on screen indicator shows peak value, it will deflect to the far right if either of the filters has maximum output. This indicator has a fairly fast response time, and so can indicate rapid changes in tuning when first approaching a signal.

INPUT SELECTION

Before any tuning can commence, however, the receiver must be connected to the input to the M-7000 that is selected by the R9n key, as indicated at the left end of the status line.

With respect to input selection, refer also the section on DIVERSITY RECEPTION on page 52.

DEMODULATOR MODE SELECTION

The HIGH, LOW, and MODEM tone sets are selected by stepping through these options using the R0n 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.. With either High or Low tone sets, the R8n 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 R4n key to move up and the R7n key to move down.

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-7000 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 MK and SP front panel LEDs.
3. Set the receiver to the setting that produced the second peak in the brightness of the MK LED. (If the SP LED is also flashing, tuning is completed.)
4. If the SP LED experienced a peak during step 2 then the received shift is wider than that set on the demodulator. If there was no flashing of the SP LED then the received shift is narrower than the demodulator setting.
5. Increase or decrease the shift as indicated by step 4 until the SP LED is flashing brightly. The shift may be changed in large steps by using the R8n key (this will be faster if a standard shift is being used), or in very fine steps by using the R4n key to increase or the R7n key to decrease the shift.

The RTTY station must be active, that is, sending traffic, in order to properly tune. If we are receiving a constant tone frequency, we have no way of knowing if that tone is the higher or lower of the two tones the station will send. What we have done, then, is to 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 MK LED is 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 MK LED is observed, the lower of the received tones (mark) is matched to the demodulator mark filter. [step 3]

If the SP LED started flashing and then stopped during this tuning, that means that the higher of the two received tones matched and then surpassed the frequency of the demodulator space filter. Therefor the received shift is wider (higher) than that set. If there was no flashing of the SP LED, then the higher of the two received tones has not reached the demodulator space filter. Therefor the received shift is narrower that 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.

MODEM

When the modem demodulator has been selected by the R0n key, the R8n 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

```
D1 ASCII  110  103 A N ATC AGC ODD NOR
```

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 so that MK and SP LEDs are both flashing or for maximum indications on both tuning 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 RTTY tuning scope.

```
D1 BAUDOT 100 T B 12   N ATC AGC UOS                NOR
                  ^   ^
VFT MODE  R5n ____|   |____ R8n  VFT TONE PAIR (channel)
```

The VFT demodulator mode is selected by pressing the R5n key. Each subsequent press of the R5n key steps through the 4 VFT channelization modes (A, B, C, D). When in a VFT mode, the R8n key steps through the various channels available in the selected mode:

MODE	A	B	C	D
CHANNELS	01-24	01-16	01-12	01-08

Refer to Appendix 1 for a listing of the frequencies for each channel of the four VFT modes.

AUTOMATIC

The automatic filter tuning allows the M-7000 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-7000 is also capable of feedback to the operator indicating the results of the request to automatic tune.

```
D1 BAUDOT 100 T  850 H N ATC AGC UOS      TUNE        NOR
```

Tune to an active RTTY signal. Press the R2n key, TUNE will appear on the status line. If you are tuned at least "in the ball park", the M-7000 will tune the mark, the space and TUNE on the status line will change to TUNED. The approximate shift will also be displayed.

Once the M-7000 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 R8n or the variable keys). This is indicated on the status line by the letter "V" following the shift indication.

```
D1 BAUDOT 100 T  375 V N ATC AGC UOS      TUNED       NOR
```

A single press of the R0n key, when a Variable tone set is in effect will restore the standard tone pair that was in effect at the time the unit was auto-tuned.

If you tuned too low on the signal the display will indicate "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).

```
D1 BAUDOT 100 T  850 H N ATC AGC UOS      TONES HIGH NOR
```

If you tuned too high on the signal the display will indicate "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 indicate "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 (ie. is on hold), then wait for it to begin sending traffic before pressing the R2n 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-7000 to copy, or it may be necessary to attempt to tune the station manually.

```
D1 BAUDOT 100 T  850 H N ATC AGC UOS      CAN'T TUNE NOR
```

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'.

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. This mode may be quasi-used, however, to verify or ascertain the frequency that the filters are set to.

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

RCa MARK FREQUENCY

RDa SPACE FREQUENCY

REa SHIFT FREQUENCY

These three commands operate similarly, so RCa will be used as an example. When the RCa key is pressed, the status line is replaced with the prompt:

```
ENTER THE DESIRED 4 DIGIT MARK FREQUENCY _ _ _ _   NOW = 2125
```

The four digit value of the new mark frequency may now be entered 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. If any of the letter keys on the right keyboard are pressed, the direct entry function is canceled. This can be used to check the current value of any of these three frequencies by simply pressing the appropriate key (C, D, or E) twice; once to turn on the prompt (which indicates the current value) and again to cancel the command.

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.

After a direct entry demodulator frequency (mark or space) has been successfully entered, the status line will indicate "V" for Variable after the shift indication.

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 space frequency also changes, the shift value 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.

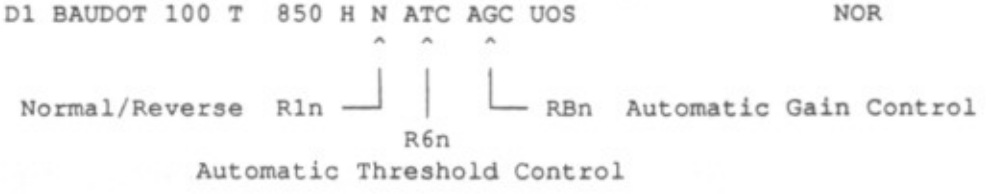
Due to the intentionally loose restrictions on the direct entry values, the following should be well noted when using this mode of operation:

- 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. When this is done, the shift indication on the status line will still indicate the difference between the mark and space frequencies, but the indicator that follows will change from "V" to "R" for Reversed. This Reverse is still in addition to the Normal/Reverse status indicator.

OTHER RTTY DEMODULATOR CONTROLS

In addition to the essential filter tuning, there are several other controls that affect the operation of the RTTY demodulator. The three additional keys are:



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 R1n key will change the sense of the demodulator from Normal to Reverse. The status line will indicate N or R respectively.

The Decoder section of the M-7000 is capable of detecting whether the demodulated signal is of the proper polarity when operating in the SITOR and ARQ modes, and automatically correcting the signal if it is inverted. Therefor in these modes the R1n key does not function, and the status line position for the N/R indication will remain blank.

ATC

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

The M-7000 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.

Two toggle switches that affect demodulator operation are:

WIDE/NORM/NARROW SWITCH

This switch allows adjustment of the bandwidth of the Mark and Space Tone filters.

The NORMal (center) position of this switch allows the microprocessor to control the bandwidth of the filters automatically, depending on the tone set, shift, and speed selected by the operator.

The WIDE and NARROW positions permit the operator to select a bandwidth that is wider or narrower than the pre-selected normal value.

A selection in the Programming SYSTEM sub-menu allows the user to select steps that are approximately 15% or 30% wider or narrower than the microprocessor's selection.

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

The WIDE position 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.

MO/MS/SO SWITCH

This three position toggle switch selects the demodulator filters to be used.

In the MO position the Mark filter Only is selected.

In the SO position the Space filter Only is selected.

In the MS position both the Mark and Space filters are selected.

The preferred position is MS. However, there may be occasions where only a single filter will give you better reception - (adjacent channel interference, etc.).

When the position of this switch is changed, it will take a few seconds for the filters to stabilize at the new setting. During this time, errors in the received signal may occur. Any time the MO or SO operation is selected the ATC must be turned on.It may also be necessary to turn off the AGC during MO or SO operation.

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 below concerns interpreting that digital signal into intelligible text.

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-7000, be equipped to properly interpret the demodulated signal. While the M-7000 is more versatile in this respect than any other 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-7000 will successfully decode, there are only two variables that must be determined and set to achieve proper RTTY operation: Mode and Speed

The M-7000 will decode the following RTTY codes:

BAUDOT, SITOR, ARQ, ASCII, and PACKET

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-7000 expresses speed in Baud. Use the following table to convert Baudot (only) transmission speeds:

WPM	BAUD
60	45
66 or 67	50
75	57
100	75
132	100

SPEED READ-OUT

```
D1 BAUDOT 100 T  850 H N ATC AGC UOS     BAUD =       NOR
```

Pressing the L1n key enables the Speed Read-Out function. The indication BAUD = will appear on the status line. The decoder will analyze the input data stream, and after a short delay, indicate after the = the data rate in baud that the received signal appears to be.

If not enough samples are obtained within 10 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.

AUTO TUNE

```
D1 BAUDOT 100 T  850 H N ATC AGC UOS     AUTO TUNE    NOR
```

Pressing the REn key invokes the Auto Tune function. The M-7000 first performs the demodulator filter tuning function. If the first attempt at Filter Tuning is unsuccessful, the unit will automatically re-try up to two more times before indicating a CAN'T TUNE condition. After the demodulator filters are tuned, the unit goes directly to:

```
D1 BAUDOT 100 T  850 H N ATC AGC UOS     AUTO BAUD    NOR
```

The procedure here is very similar to the SRO function, except many more samples are taken in this operation. The baud rate is determined, but instead of simply displaying the result of the evaluation, the unit is set to that speed without further operator intervention. If the signature, or the bit pattern is such that the mode of operation can also be determined, the unit will be set to that mode. Further, if the bit pattern allows the sense (Normal or Reverse) of the received signal to be resolved, then that also will be set.

At this time the only modes clearly discernible are true Baudot signals, identified by their 1.5 bit time stop bits. Noise distortion and Baudot signals using other than 1.5 stop bits may cause erroneous results.

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, ASCII and Databit 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

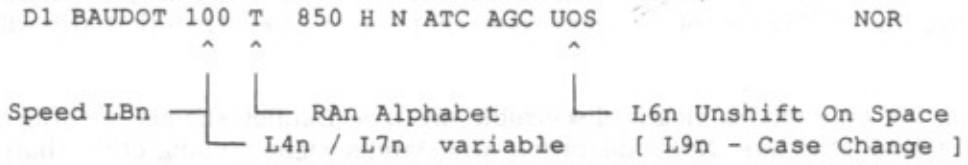
This LED will turn on whenever the decoder receives a bit pattern that does not conform to the specifications of the selected mode. In asynchronous codes (Baudot and ASCII) this may indicate an invalid start bit, missing or invalid stop bit, or parity error. With synchronous codes, this will generally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

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.

IDLE

When operating in synchronous modes which 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.

BAUDOT



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 Baudot mode is selected by pressing the LBn key. Each subsequent press of this key will step through the standard Baudot speeds of:

45, 50, 57, 75 and 100 baud.

In addition to these, the speed may be increased or decreased in 2 baud steps from 30 to 250 baud by pressing the L4n key (up) or the L7n key (down).

While 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 L1n key.

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. These alphabets may be selected by pressing the RAn key until the desired symbol is indicated on the status line after the speed indication.

I = ITA2
T = TELEX
M = MIL
C = Cyrillic (discussed below)

The character tables of these various alphabets may be found in Appendix 2.

There are also in use alphabets which are permutations or combinations of these alphabets. It is the responsibility of the user to determine and select the alphabet that best matches the alphabet used by the received station.

UNSHIFT ON SPACE

As mentioned above, 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-7000 provides this function on a user-selected basis. Each press of the L6n 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:

CASE CHANGE

As was explained above, the reception of the Baudot code can inadvertently fall into the wrong case. (It can also falsely switch to LTRS from the FIGS case.) The M-7000 will allow the user to manually toggle between, or step through, the cases appropriate to the selected Baudot alphabet. This is done by pressing the L9n key. The case that is selected at any given time may be determined by observing the displayed print.

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, a "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.

RUSSIAN THREE SHIFT CYRILLIC

```
D1 BAUDOT 100 C  850 H N ATC AGC UOS                    NOR
```

The M-7000 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 RAn key until a "C" appears on the status line after the speed indication. In this mode, the L9n 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 accidentally selected on a non-Russian signal, Cyrillic characters may appear on the video that are spurious.

BIT INVERTED BAUDOT

```
D1 BAUDOT 100 T  850 H N ATC AGC UOS          01101 ALT
                                                  ^
                                                  |
                Bit Inversion Pattern  L1a  /  L4a ---┘
```

The M-7000 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-7000 allows you to re-invert (or "flip-back") the necessary bit or bits in order to read the message properly. The M-7000 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! The sequence search is controlled by keys L1a and L4a. In order to try the bit-inversion feature you must be properly tuned to an active Baudot RTTY signal.

L4a — This key starts the auto-sequencing mode. Pressing this key once starts the M-7000 inverting the bits. You will see the bits being

"flipped" on the bottom right of the status line. (If you wish to exit the auto-sequencing mode press L4a again). Watch the screen very carefully. When the incoming text turns from "garbage" to readable text, you must quickly press the L1a key to stop the sequencing. You may wish to note the inversion pattern (e.g. 00110). The auto-sequencing may be resumed by pressing L4a again once, or the Bit Inversion mode may be exited by pressing L4a twice. If you are unsuccessful you may wish to try again using the opposite sense (R1n).

If you want to manually step through the 32 different patterns you must press the L1a key.

L1a — If you are not in the bit inversion (BI) mode pressing this key once will give you to the first BI pattern. Each successive press will advance you to the next BI pattern. Note again the status line. If you wish to escape bit inversion from here, press L4a twice.

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, therefor, the Baudot functions of alphabet selection, Unshift On Space, case selection, and Bit Inversion (RAn , L6n , L9n , R1a , R4a), operate just as in the true Baudot mode, even three shift operation.

Some of these Baudot based codes are SITOR (all sub-modes) ARQ Moore, ARQ-E and ARQ-E3.

SITOR

```
D1 SITORA 100 T  170 H   ATC    UOS                NOR
          ^
          └── LDn  SITOR mode
```

The Simplex Telex Over Radio (SITOR) code (aka. SPECTOR, AMTOR) is a 7 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. Therefor when selecting any of the SITOR modes, 100 baud and 170 Hz. shift will automatically be selected by the M-7000.

The phasing circuits in the M-7000 automatically detect and set the proper sense (Normal or Reverse) of the received SITOR signal, so the user need not be concerned with this critical setting. The "N"/"R" indication is removed from the status line, and the R1n key does not function in these modes. Also, since all SITOR is 100 baud, the variable speed controls (L4n and L7n) do not operate in these modes.

SITOR Mode A (ARQ) and Mode B (FEC selective and collective) are all decoded by the M-7000.

Pressing the LDn key steps through the SITOR modes of:

SITORA	(mode A)
SITORB	(mode B)
AUTOR	(automatic selection of modes A or B)

SITOR MODE A

Mode A transmissions are characterized by the chirp, chirp, chirp sound of two stations interchanging data.

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-7000 cannot request repetition, error free copy cannot be expected in the reception of these stations.

The mode 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-7000 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 therefor do not print.

Due to the keyed nature of the mode A signal it is recommended that the AGC on your receiver and on the M-7000 be turned off.

Once a mode B signal is properly tuned, within a few seconds the M-7000 should sync to the signal (DATA LED will turn on), and start printing, IF actual data is being transmitted. With practice, you will be able to distinguish by ear the difference between ARQ text transmission and ARQ acknowledgment pulses (which neither display nor light the DATA LED).

SITOR MODE B

Mode 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 by coastal maritime stations.

Mode B actually consists of two formats - Collective and Selective. The difference between these two is that Selective is sent inverted as compared to Collective, and a different signal is used for idle periods. The M-7000 automatically adjusts for the normal and inverted signals of this mode so that both can be received without further adjustment.

To receive the SITOR mode B toggle the LDn key until SITORB appears on the status line. This will permit reception of either Collective or Selective mode B transmissions.In mode 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, should 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 mode B, the phasing signals are sent ONLY at the beginning of a transmission. If you miss these phasing signals you will not be able to snyc on the transmission. Or if sync is lost during the transmission you will not able to read the transmission. (CCIR 476 intended it this way.)

The error correction of the mode 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.

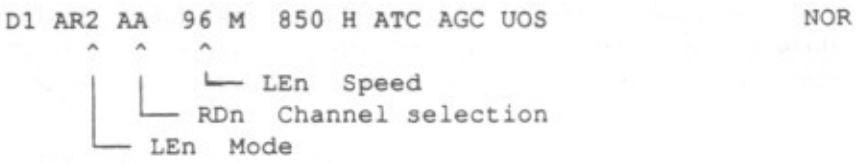
AUTOR MODE

Maritime stations may switch from mode A to mode B very suddenly. If you are not at the M-7000 to change modes immediately, this can lead to lost data. Therefore the M-7000 features a special AUtomatic sITOR that automatically selects between mode A and mode B without operator intervention.

In the AUTOR mode, the unit will attempt to synchronize to either mode A or mode B. When synchronization occurs, the indication on the status line will change from AUTOR to SITORA or SITORB, 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-7000 to occasionally mis-read a mode B signal as being mode A. When this occurs, this error will be readily noted and the unit will automatically return to AUTOR to resume its search for the mode B phasing signal.

ARQ-M2 / ARQ-M4 (MOORE)



The M-7000 is capable of receiving ARQ (TDM Moore) signals based upon CCIR recommendation 342.

Pressing the LEn key steps through the ARQ modes/speed of:

AR2	86	(two channel, 86 baud)
AR2	96	(two channel, 96 baud)
AR2	100	(two channel, 100 baud)
AR4	172	(four channel, 172 baud)
AR4	192	(four channel, 192 baud)
AR4	200	(four channel, 200 baud)

The L4n and L7n keys may be used to select variable non-standard speeds from 30 to 250 bauds.

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 2 or 4 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 run synchronization pulses only for several hours, followed by brief traffic. Keep this in mind.

A channel may switch back and forth from receiving to sending or from idling to sending. Also on a 2 channel TDM signal one, both, or neither channel may be sending text at any given time.

When the TDM mode is selected, the M-7000 will automatically attempt to synchronize on the received signal. When the unit establishes sync., the DATA LED will light.

Due to the nature of some of the bit patterns used during TDM idling, and the lack of periodic fail-safe synchronizing, it is possible for the unit to synchronize incorrectly.

Should this occur, pressing the L2a key will initialize another attempt at automatic synchronization. This re-synchronization should also be used (pressing L2a key) when changing frequencies to tune a different ARQ station. The M-7000 will only auto sync

on idle stations (no traffic either channel). If the station is sending traffic, manual synchronization must be used.

When attempting auto-sync (keypad L2a) on an ARQ signal, if the DATA LED turns on and the DATA ERROR LED turns off, you are properly synchronized. If the unit does not sync. within 10-15 seconds with the DATA LED on and the DATA ERROR LED off, then you are either on an active signal or the signal is not ARQ.

If several attempts to auto-sync. the signal fail, manual synchronization should be attempted.

Manual synchronization is accomplished by using keypad L3a as follows:

1. Press the L3a key.
2. The DATA 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 L3a key again.
4. Check the screen, if one to three characters are displayed repeatedly, the unit is still not framed properly. Press L3a again.
5. If manual framing is tried a total of 7 times then give up and find another station.

Once proper sync. and framing have been established, the desired channel may be selected with the use of the RDn key. The M-7000 allows the selection of the ARQ channel to be manual or semi-automatic.

Pressing the RDn key steps through the following sequence in AR2 (2 channel):

AR2 A - channel A manual
AR2 AA - channel A automatic
AR2 B - channel B manual
AR2 BB - channel B automatic

If AR4 (4 channel) is selected the following sequence is added:

AR4 C - channel C manual
AR4 CC - channel C automatic
AR4 D - channel D manual
AR4 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: AR2 AB. When channel B returns to idle, or if channel A should become active while B is still active the display would change to AR2 AA.

AR2 SPLIT SCREEN

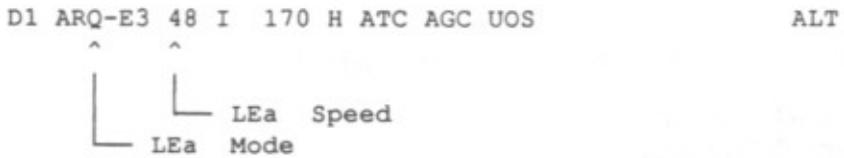
The video display output of the M-7000 may be split when operating in the ARQ 2 channel mode. When this is done the status line moves from the bottom of the screen to approximately mid-screen. Data received on channel A is displayed on the top half of the screen, while channel B data is displayed on the bottom half.

When the screen is split, the channel selection still controls the data fed to the printers and accessory functions such as sel-cal decoders, bell sounders, etc..

The screen may be toggled into and out of split mode by pressing the L7a key. The unit must be in AR2 mode for this key to function. When the AR2 mode is exited (another mode selected) the screen split is automatically disabled.

When the screen is split, the scroll up, scroll down, and screen print functions are disabled. Also, when split, there will be two cursors on the screen, one for top and one for bottom halves. It is normal for these twin cursors to have a slight flicker.

ARQ-E3



This synchronous, single channel, full duplex transmission mode uses the seven-bit error-detecting ITA3 (Moore) code. Operation in this mode is very similar to the ARQ-M2 and ARQ-M4 modes described above, except that the data stream contains only a single channel of text. Synchronization, both automatic and manual, is accomplished by following the procedures described for the ARQ-M2 and ARQ-M4 modes.

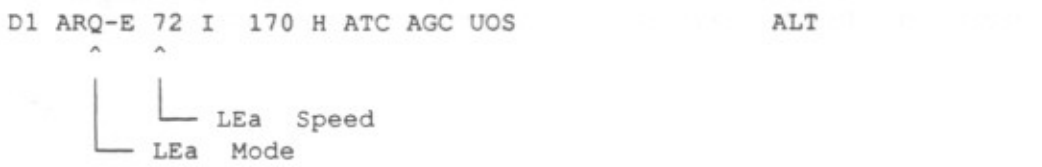
The M-7000 identifies whether the received station is utilizing a 4 or 8 character repetition cycle, and automatically adjusts itself for proper decoding.

To select ARQ-E3 mode press the LCa key. Subsequent presses of this key will step through the standard ARQ-E3 speeds of:

48, 64, 72, 86, 96, 100, 192 and 200 baud.

The L4n and L7n keys may be used to select variable non-standard speeds from 30 to 250 bauds.

ARQ-E



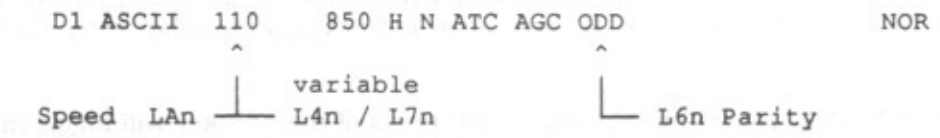
This synchronous, single channel, full duplex mode is similar in operation to the ARQ-E3 mode described above. Automatic and manual synchronization is identical to that in the above ARQ modes. ARQ-E is a super-set of the ITA2 (Baudot) code and contains error detection. When the ARQ-E station is idling it has the familiar 'sing' of other synchronous codes (due to the bit pattern of the idle character). When text is sent, however, the 'sing' disappears, and the signal sounds nearly identical to an asynchronous (Baudot) transmission at the given baud rate.

The ARQ-E mode is selected by pressing the LEa key. Subsequent presses of this key step through the standard ARQ-E speeds of:

48, 64, 72, 86, 96, 144 and 192 baud.

The L4n and L7n keys may be used to select variable non-standard speeds from 30 to 250 baud.

ASCII



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 high speed ASCII is used extensively on satellite downlinks.

The ASCII mode is selected by pressing the LAn key. Each subsequent press of this key will step through the standard ASCII speeds of:

75, 110, 150, 300, 600, 1050, 1200 and 1800 baud

The L4n and L7n keys may be used to select variable non-standard speeds from 30 to 250 bauds. Speeds from 250 to 1800 bauds may be selected by stepping to a higher speed and using the L7n key to vary the speed down to the desired point.

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-7000 tests for is selected by the L6n 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.

PACKET OPERATION

The M-7000 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.

To select the Packet mode, press the LFn key. Each press of the LFn key will toggle the unit between 300 and 1200 baud Packet operation. Packet mode is tuned in the same manner as Baudot mode.

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 R8n and/or R0n keys can be used to select other demodulator settings. In 1200 baud Packet the AGC and ATC should be off.

In the Packet mode, the NORMal/REVerse key (R1n) has no effect, the ATC circuit is always disabled, and the Speed Up (L4n) and Speed Down (L47) keys do not operate.

As packets are received, they are stored in memory until the entire packet has been received. 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.

The bandwidth (actually the audio frequency rolloff) on some VHF receivers is such that the higher of the Bell 202 audio tones is severely attenuated, hindering reliable operation. This condition can be compensated for by operating the audio input in the 'limiting' level range.

LITERAL DISPLAY

```
D1 BAUDOT 100 T  850 H N ATC AGC LITERAL              ALT
```

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 as shown in Appendix 2.

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-7000.

The Literal Display feature may be invoked while in any RTTY mode, either before or after selecting the actual mode and speed of main operation.

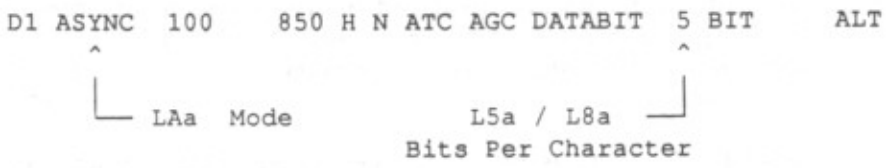
To toggle into and out of the Literal Display Mode, press the L0a key. This feature is available in ASCII, Baudot, SITOR and ARQ modes at all speeds available in these modes. See Appendix 2 for illustration of Literal characters.

UOS will automatically be disabled, and LITERAL will appear on the Status Line whenever the Literal Display function is in operation. 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.

DATABIT DISPLAY MODE



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.

To enable this mode press the LAa key. When this mode is selected, UOS is disabled, as it is meaningless in this mode, and the word DATABIT will appear on the status line. Each subsequent press of the LAa key will toggle between SYNC and ASYNC modes. The mode of operation SYNC or ASYNC, is displayed on the left side of the status line, while the number of bits per group is displayed on the right side as N BIT.

When in this mode, six of the keys are assigned special functions:

L2a — Each press of this key shifts the bit pattern left by one bit. This key operates in the SYNC mode only.

L3a — Each press of this key shifts the bit pattern right by one bit. This key operates in the SYNC mode only.

L5a — Each press of this key increases the number of bits per character group up to a maximum of 8 bits in the ASYNC mode or 13 bits in the SYNC mode.

L8a — Each press of this key decreases the number of bits per group, down to a minimum of 5 bits.

Note: When the number of bits per group or bit pattern position is changed, the column alignment of the display may be momentarily disturbed.

R3n — 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.

The speed (baud rate) of operation may be set prior to entering the DATABIT mode, or may be selected with the Speed Up/Speed Down keys (L4n and L7n) after selecting this mode, however the maximum speed allowed in this mode is 251 baud.

Databits 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. 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 indicates if invalid start bits, or framing errors are detected. The DATA LED indicate 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 R3n 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. If there are more than 9 marking bits in a character (not normally encountered on valid signals) then the following coding will apply: 10=: 11=; 12=< 13==.

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. As in all modes, the data on the screen may also be viewed on a printer.

DIRECT RTTY SPEED ENTRY

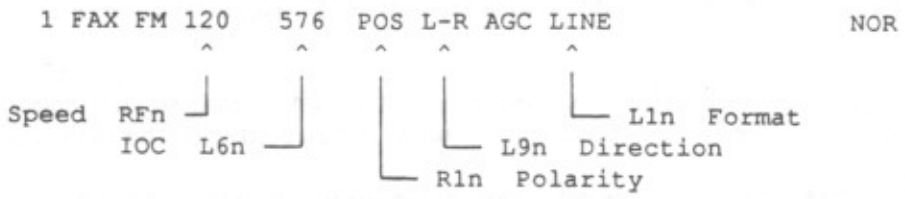
When operating in any of the RTTY modes, the data speed (baud rate) may be directly programmed by keyboard entry, similarly to the direct entry of the demodulator filter parameters. To directly enter a baud rate, press the RBa key. The status line will be replaced with the prompt:

```
ENTER THE DESIRED 4 DIGIT BAUD RATE _ _ _ _   NOW =  75
```

The desired value must be entered as a four digit number, using the right keyboard. As each digit is pressed, the value of the digit is displayed in the corresponding blank. If any of the letter keys on the right keyboard are pressed, the direct entry function is canceled.

If the entered baud rate is within the allowed limits, the unit will be set to that speed as soon as the fourth digit is entered. If the value is outside these limits, the entry function is cancelled. The entered value may not be below 30 baud, nor above 1200 baud.

FAX



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 pin or 24 pin) must be specified in PROGRAMMING mode under the PRINTERS sub-menu. (See page 65 for details)
- When the FAX mode is selected, the video screen will be cleared and will remain blank (except for the status line), unless the VIDEO FAX OPTION has been installed.
- The screen print function is disabled in this mode.

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 between machines:

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.

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.

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-7000 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 R0n key.

Since the M-7000 presents the recovered video image on a dot matrix printer, 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 (excluding ribbon wear).

The M-7000 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-7000 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 on, and reduce ribbon wear while copying, satellite visual images.

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.

FAX INDICATORS

In the FAX mode the SQL and DATA LEDs operate as follows:

The SQL 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-7000 is actually running in the FAX mode.

FAX TUNING

When the FAX mode is selected, the on-screen tuning indicator changes from a tune-for-max indicator to:

```
< W --+-- B >
```

The "W" and "B" correspond to the White and Black FAX image levels. When the highlighted section remains near the left side, the demodulated signal is mainly white. As the light bar moves to the right, more black information is present. While the on-screen display is relatively fast for RTTY tuning, it is quite slow with respect to the extremely high data rate of the FAX signal. As a result, this indicator will show the average level (black or white) of the signal.

For most weather charts, the indicator should be in the left 1/3 of the scale. On wirephotos and satellite images the indicator will tend to swing about the center of the scale.

AM TUNING

To tune an AM signal, reduce the output of the receiver, or the setting of the front-panel gain control. Slowly increase the output or gain control until the SQL LED just turns on (the FAX station must be sending an image). 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, as well as the TUNE FOR MAX > indicator 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. Please note that AM Fax is <u>not</u> used on shortwave, but only on certain satellite FAX feeds.

FM TUNING

The FAX signal has a wide bandwidth, therefor 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 SQL LED on the front panel just lights steadily. 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. The TUNE FOR MAX > indicator can be used for proper tuning.

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 charts, the SP LED will be mostly on, with the MK only flickering occasionally.

The TUNE ERROR LED may also be used, but on LINE type signals (charts, maps) only. On gray images (wirephotos, satellite images, etc.) the TUNE ERROR LED may be on almost constantly. This is normal when receiving these types of images.

Due to the wide-band characteristic of radio noise, the SQL LED may stay lit when the receiver is tuned off-station. This is normal. If the DATA LED is on, it may be necessary to manually stop the unit using the R3n key.

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 RFn key to select the drum speed, and the L6n 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 R3n 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.

After a few inches of the image have been printed, 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.

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.

To change the format, press the L1n key.

The direction selection is determined by the operation of the sending station equipment. Most, if not all, weather charts, as well as visible satellite images, are sent from left to right (L-R), while most, if not all, wire photos are sent from right to left (R-L).

Each press of the L9n key will change the direction from the current selection to the opposite selection. Reversing the direction will not affect the framing of the received image and, like the format control, may be done at any time.

The polarity selection, like the direction, is also to a large degree determined by the sending station. While the weather is sent POSitive, the wire photos are sent as NEGatives. It is also possible to save on ribbon wear, retain spatial resolution and increase clarity by reversing cloud cover satellite images. This prints the clouds as black rather than white, but can save a lot of wear and tear on the equipment.

Each press of the R1n key changes the selection from POSitive to NEGative or vice versa. The polarity may be changed at any time without affecting the framing of the received image.

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 L2a key to move the IMAGE to the left, or the L3a key to move the IMAGE to the right. Each press of these keys will move the image APPROXIMATELY 1/2 inch.

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 will be one print cycle every 12 seconds (for less than an eight of an inch of paper). It will take 113 seconds for every inch of image that you receive. With most of the images averaging seven inches that's 791 seconds, or 13 minutes for the reception of the average image.

AUTOMATIC OPERATION

Once a FAX station has been properly tuned, much of the operation of the M-7000 becomes automatic.

The weather charts and satellite images from the NWS (National Weather Service) are preceded by a signal that indicates the IOC of the FAX image to be sent. The M-7000 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 the image on the paper. The M-7000 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-7000 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 R3n key should be pressed to stop the conversion process.

Appendix C has a listing of a few FAX frequencies to get you started.

IOC LOCK

Some services preface their transmitted images with signaling tones that are not compatible with the established standards for automatic IOC selection. When

encountering these stations it has been necessary to manually re-set the IOC to the proper setting at the beginning of each image.

The M-7000 FAX operation has a feature that will cause the unit to ignore the IOC signaling that is sent before each image. This IOC lock is toggled on and off with the L3n key. When the IOC is locked, the IOC value on the status line is enclosed in brackets [_], For example: [288], [576] or [440].

When the IOC is locked, this refers only to the automatic IOC selection, the L6n key will change the IOC setting, whether it is in the locked mode or not.

FAX PRINTER SELECTION

When operating in the FAX mode, the PRINTER switch will control the flow of FAX data to the printer. If this switch is in the OFF position, no FAX data will flow to the printer. When this switch is in the AUTO or ON positions, received FAX data will be sent to the printer. The image portion received while this switch is off will not be stored, but will be lost. this switch should be used to stop the FAX printout, rather than turning the printer off, or setting it "off line". The setting of this switch will not affect the video FAX operation of units so equipped.

FAX BUFFER OVERFLOW

The received FAX data to be sent to the printer is entered into the printer buffer, just as any other printed data is. Due to the nature of the printer pin-graphics operation, if any data is lost (even one byte), unpredictable operation may result. If the printer buffer becomes full, some of this graphics data will certainly be lost. The M-7000 prevents the resultant erratic operation as follows:

If a printer buffer overflow occurs, the BUFF LED will turn on, and all FAX processing into and out of the printer buffer will immediately cease. To clear this overflow condition, first correct the condition that caused the overflow to occur, then clear the printer buffer (and video screen) using the L0n key.

Please note that this overflow 'lock up' condition will only occur in a system error environment, and is intentionally provided to prevent the type of erratic printer operation that would result if the overflow were not arrested. To recover from a lock-up condition turn the M-7000 off, then on.

Some of the causes for a buffer overflow are: Printer turned off or 'off line'. (Use M-700 PRINTER switch). Printer too slow for the speed/IOC of image being received. Improper printer cable connections.

ABOUT FACSIMILE RECEPTION

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.

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. On teletype signals this causes pulse stretching that can introduce errors in the received text. In FAX reception the image is made up of pulses, and multipath distortion stretches these pulses also, smearing fine vertical lines and blurring fine detail.

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.

VIDEO FAX

The M-7000 has an option available which will display the received facsimile image on the video monitor screen. The following section will describe the operation of this option if it is installed in your unit. This option may be factory-installed in any M-7000. Contact your dealer for details and shipping instructions.

The video FAX operates identically to the printer FAX with the following exceptions:

NOTE: The M-7000 WILL provide simultaneous FAX outputs to the printer and to the video screen.

The standard FAX printer output holds 960 dots per line, while the video screen has only 720 dots per line, and only 640 of these dots are active. As a result, the video screen displays only 75% of the width of the printed image. Due to the character generator type of video output, there is a fine vertical dark line between each of the 80 character segments in each line. On most normal charts these fine lines are not visible, and on other images tend not to be objectionable.

Due to the inherent lack of resolution on standard scan video monitors, the video image will NOT show nearly as much detail as is seen on the printed image.

In view of this already limited resolution, it was decided to not further reduce resolution to show gray images. All video FAX images will be displayed in LINE mode, regardless of the setting of the printer format. (Printed images will still be in gray format when so selected.)

The scroll up and scroll down limits in this mode are expanded to allow the scrolling of up to 165 lines. Remember though, that these are scan lines, not lines of text, so the scrolling will be in very fine steps.

Since the video FAX does not need to store 24 lines of dots prior to a display cycle (as to the printer), the received image becomes visible much more quickly that with the printer.

The polarity (positive-negative) of the video FAX image will be the opposite of the printer FAX image in line mode only.

DIVERSITY RECEPTION

```
D1 BAUDOT 100 T  850 H N ATC AGC UOS                    NOR
^^
||
|└── Indicates Input Currently Fed to Demodulator
└─── "D" Indicates Diversity Operation Selected
```

Diversity reception is used to reduce the effects of 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 automatically feeding, to the demodulator, the signal which is strongest at a 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-7000 has two audio inputs which allow the user to connect two receiver systems to the M-7000 to allow diversity reception.

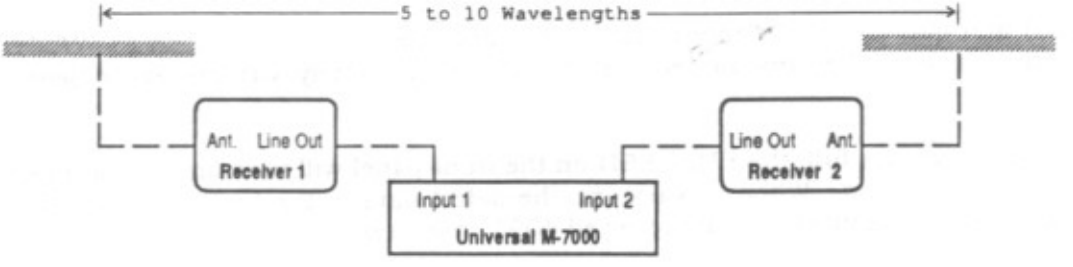
The M-7000 internal circuitry senses the strength of the two inputs and when one input becomes approximately 3 Db stronger that the other, the demodulator is switched to the stronger input. switching time is on the order of 20 milliseconds thus very little data is lost during the transition.

The diversity reception feature is automatically DISABLED on CW.

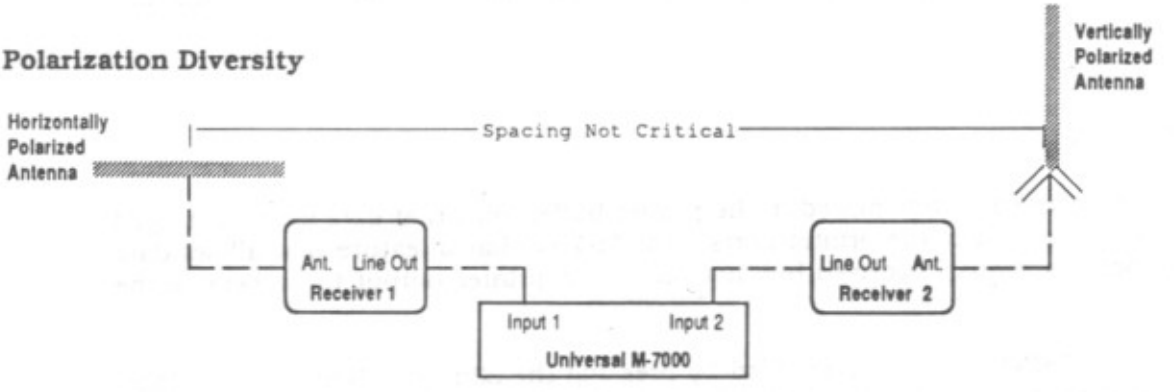
To set up the total system one should have two receivers with similar specifications as to stability, bandwidth, and sensitivity, and tuned for frequency diversity or with their antennas connected as space or polarization diversity.

The output levels of each receiver should be the same, and the input level controls of the M-7000 adjusted to provide equal levels when each receiver is tuned to the same, non fading, signal with the AGC of each receiver turned off.

Space Diversity (Both antennas with the same polarization)



Polarization Diversity



Adjustment of input levels for diversity reception

1. Connect the receivers as shown in either of the above configurations.
2. Tune both receivers to a stable, non fading, signal (one that gives a steady "S" meter reading).
3. Select no. 1 receiver by pressing R9n.
4. With the front panel gain control set to mid range adjust the no. 1 input level control on the rear panel to illuminate the first orange LED on the audio input level bargraph.
5. Select the no. 2 receiver by pressing R9n.
6. Adjust the no. 2 input level control to illuminate the first orange LED on the audio input level bargraph.
7. Select diversity mode by pressing R9n.
8. Tune both receivers to the RTTY station of your choice and automatic diversity operation will commence.

MISCELLANEOUS FEATURES

PRINTER BUFFER

All printable data (this does not include idle or phasing characters) received by the M-7000 is 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 L0n key, the printer buffers are also cleared.

SCREEN 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-7000 has a feature that allows data that has been previously received but not tagged for printer output to be sent to the printer.

This SCREEN PRINT function is enabled by pressing the L3n key. When this is done, the contents of the printer buffer, starting with the text on the top line of the video display are transferred to the printer ports. All of the text on the video screen will be printed as though it were tagged for output.

Data that is subsequently received will also be directed to the printer output until the screen print is disabled by again pressing the L3n key. Do not disable the screen print until all of the desired text has been printed.

It is possible to begin the screen print prior to the current page of video text by using the scroll up key to place the first line of the desired text at the top of the screen prior to pressing the L3n key. This method is subject to the limitations of the printer buffer. (It is possible to view further back than the printer buffer remembers)

SELCAL

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 does 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 useless traffic.

The M-7000 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-7000 provides three separate ON codes and one common OFF code.

With your radio, M-7000 and printer left on, the M-7000 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 hard-copy only 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-7000, 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.

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-7000 will also sound a four-tone 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.

PRINTER CONTROL SWITCH

The PRINTER control switch 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 switch is in the ON (up) position, all received data is tagged for output. When this switch is in the OFF (down) position, no data is tagged for output. [1]

When this switch is in the AUTO (center) position, the operation is determined by the setting of the SELCAL switch:

If the SELCAL switch is ON, only data received when a sel-cal is active (SELCAL LED on) will be tagged for output. [1] [2]

If the SELCAL switch is OFF, then the space character printer control will take effect: Any character 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. [1] [2]

NOTES:

[1] The screen print operation over rides the PRINTER toggle switch. If the screen print command has been invoked, by pressing (L3n), then the data that appears on screen, along with any data received after the invocation, will be sent to the printer. To remove this over ride, L3n must be pressed again.

[2] Unless the PRINTER toggle switch is in the ON position or a screen print is in progress, the squelch circuit can inhibit any data from being tagged for the printer. The printer squelch must be enabled at the PROGRAM level and by the front panel switch in order to inhibit data that would otherwise be printed.

AUTO START

When data (that is tagged for the printers) appears at the printer buffer output, the auto start circuit is turned on: The AS LED lights and the auto start output transistor turns on. After this occurs, there is a brief delay before the printer data actually begins to be output at the printer ports. This delay allows time for the printers to fully turn on and become ready before data is sent to them.

A short while after no data is being output at either printer port, the auto start circuit will turn off. The stopping of data may be as a result of the printer buffer empty, or the printers being busy. Remember that the autostart output is common to both printers.

Tip: If you are not getting any output on your printer, first check the AS LED. If this is not ON, then no data is going to your printer! Check the setting of the PRINTER switch (try ON), and the handshake lines or cables to your printer.

PRINTER SQUELCH

A squelch circuit is one that mutes or turns off an output under weak signal conditions. The M-7000 has such a circuit to inhibit the flow (tagging) of data to the printer under weak signal conditions.

The squelch circuit in the M-7000 opens when the on-screen tuning indicator reaches 80% of full scale. The squelch circuit closes when this indicator falls below 60% of full scale. When the squelch circuit is open, that is, there is enough signal to unmute the printer, the SQL LED will turn on.

In order for the squelch circuit to inhibit the flow of data to the printer, the SQL LED must be OFF, the SQUELCH toggle switch must be ON, and the printer squelch function must be enabled (ON) in the PRINTER sub-menu of the PROGRAMMING mode.

VIDEO SQUELCH

The same squelch circuit as described above for the printer also functions to inhibit the flow of data to the video display screen.

In order for the squelch circuit to inhibit the flow of data to the video display, the SQL LED must be OFF, the SQUELCH toggle switch must be ON, and the video squelch function must be enabled (ON) in the VIDEO sub-menu of the PROGRAMMING mode.

VIDEO SCROLL (PAGES)

The video display of the M-7000 has 22 lines (including the status line) of 80 characters each on screen at any one time.

The video refresh memory is capable of storing 96 such lines of text, which equals over four pages of video.

The video screen uses what is known as a scrolling display: New information is always presented on the bottom line, and when this line is full (or completed) all of the displayed lines move up, making more room on the bottom. When this happens, the oldest information is scrolled off the top of the screen and disappears.

The M-7000 has two keys that control access to this text that has scrolled off the top of the screen: Scroll up (L5n) and scroll down (L8n).

Each press of the L8n key will cause the displayed lines to move down on the screen by one line. If this key is pressed and held, the lines will scroll down at a fairly quick pace. The lines will not scroll down any further once they have been offset by 74 lines.

Note: Even though the display is offset, received data will continue to be posted on the display (in its proper place, beyond the bottom of the screen), and the entire display will continue to scroll up at the end of each received line of text.

Each press of the L5n key will cause the displayed lines to move back up on the screen by one line. Just as the scroll down key, pressing and holding this key will cause the scroll to repeat.

The scroll up limit is reached when the video display is restored to it normal condition, that is, when the display has been scrolled up a number equal to that scrolled down. No, we cannot scroll up any further to look into the future, we can view only the past.

CLOCK

The M-7000 features a real-time clock / calendar. The time and/or date from this clock will be displayed on the extreme right hand side of the status line. This will be displayed, however, only if the clock has been set.

If the REAL TIME CLOCK option has been installed in the unit, the time need be set only when first installed, when changing batteries, or when the time changes. If this option is not installed, then the time must be set every time that the unit is turned on in order to obtain the time display or to include the time / date in the status printout. Under normal use the lithium battery included with the real-time clock should last in excess of three years. The battery may be changed by the user without special tools or skills (CR 2430 or LF 1/2W or DL2430).

This RTC option can be installed only at the factory. Contact your dealer for more information and shipping instructions.

Refer to the CLOCK sub-menu of the PROGRAMMING mode for instructions on setting the clock.

HELP

The LFa key turns on and off the Help display. This is a video representation of the keyboard command layout. Before this display is presented, the video screen is scrolled down so that it is offset by 50 lines. This is done to preserve the integrity of the recently received information on the screen. Pressing the LFa key again will scroll the display back to the normal position (zero offset).

While the help display is on the screen, scrolling is inhibited. It is possible for the normal video processing (which continues during this display) to cause a video wrap-around (new text will begin to appear at the top of the screen). As a result, the help display should not be left on the screen any longer that needed to ascertain the desired command key.

IPI

The Intelligent Peripheral Interface allows the M-7000 to interface with various smart accessory units (yet to be announced). The IPI LED on the front panel will indicate activity or operation of these peripherals. Unless one or more of these units are connected to the M-7000, this LED will remain off.

RECALLABLE OPERATING MEMORIES

The M-7000 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.).

To recall one of these memories, that is, restore the operation of the unit to the parameters stored in a memory press the RCn key. When this is done, the normal status line is replaced with the prompt:

PRESS THE DIGIT FOR THE DESIRED OPERATING MEMORY [0-9 OR A]

At this time 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.

If you do not wish to select a recallable memory, simply press the RCn key again (or press B, D, E or F on the right keyboard). Any entries on the left keyboard will be ignored.

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.

PROGRAMMING OPERATIONS

Pressing the LBa key 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.

Once the Programming mode has been entered, the keys on the two keyboards are identical, and the NORM/ALT keyboard switch is ignored. Entering the Programming mode will cause the on-screen tuning indicator to be replaced with "-PROGRAMMING-" and the following Main Programming Menu will appear:

```
MAIN MENU

1 SYSTEM
2 VIDEO
3 PRINTERS
4 CLOCK
5 BEEPER
6 SEL-CAL
7 MEMORIES
8 CALIBRATE
D DIAGNOSTIC
E EXIT
```

When a selection from the Main Menu leads to a sub-menu, Exiting or Canceling the selected sub-menu will return you to the Main Menu. In all cases (except 8 CALIBRATE) you will have the option of returning to the Main Menu from any sub-menu without affecting the unit's operation: On each of these sub-menus that have the two selections of C CANCEL and E ENTER options, no changes are actually stored in the units functional memory until the E ENTER selection is made. Any programming changes that are made up until that time may be discarded by selecting C CANCEL.

Selections from the Main Menu are:

1 SYSTEM (sub-menu)

```
SYSTEM MENU
1 REMOTE BAUD   = 4800
2 SERIAL    HS  = ON
3 PARALLEL HS   = ON
4 WIDE BW STEP = OFF
C CANCEL
E ENTER
```

1 REMOTE BAUD

Selects 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 & 3 HANDSHAKING

When this option is OFF, the printer handshake input is ignored during printer operations. In most cases, this option should be left ON. 2) Controls the handshake override for the Serial Printer while 3) controls the Parallel Printer Handshake.

4 WIDE BW STEP

This option controls whether the front panel WIDE/NORM/NARROW switch controlling the bandwidth of the demodulator filters changes the bandwidth in normal or wide STEPS. This option does not change the NORMal bandwidth setting. On=30% change. Off=15% change.

2 VIDEO (sub-menu)

```
VIDEO MENU

1 60 HZ REFRESH  = ON
2 INTERLACE      = ON
3 VIDEO MSI      = ON
4 VIDEO SQUELCH  = OFF
5 SCREEN SAVER   = OFF

C CANCEL
E ENTER
```

1 60 HZ REFRESH

ON selects 60 Hz. vertical refresh rate. OFF selects 50 Hz. vertical. The vertical refresh rate should be chosen to match the power line frequency where the unit is installed.

2 INTERLACE

This selects whether the video display is interlaced or not. Interlacing gives a smoother appearance to the characters on the screen, but can result in an apparent jitter on some monitors that may be annoying. If this is the case, select this option OFF.

3 VIDEO MSI

MSI (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.

4 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 front panel SQUELCH switch is also ON. If this option is OFF the print to the video screen will never be squelched.

5 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.

3 PRINTERS (sub-menu)

```
1 PRINTER SQUELCH   = OFF
2 PRINTER M.S.I.    = ON
3 PRINTER ACR-LF    = OFF
4 PRINTER OPI       = ON
5 AUTO - STATUS     = OFF
6 AUTO FORM FEED    = OFF

7 SERIAL MODE       = ASCII
8 SERIAL BAUDS      = 110
9 SERIAL BIT 7      = ON

0 PARALLEL BIT 7    = OFF
A PARALLEL 24 PIN   = OFF
B WIDE CARRIAGE     = OFF

C CANCEL
E ENTER
```

1 PRINTER SQUELCH — This option functions just as the Video Squelch described above, except that it enables the squelch circuit operation on the printers.

2 PRINTER M.S.I. — Again, just as the Video MSI described above, but with respect to the printer outputs.

3 PRINTER ACR-LF — If this option is ON, the unit will Automatically send a Carriage Return and Line Feed to the printer if 82 characters have been sent to the printer since the last carriage return.

4 PRINTER O.P.I. — This 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 in the data to both printer outputs. A Line-Feed will also be added if a hit causes a Carriage-Return to be received in error (*without* a Line-Feed). This option will not cause the printer to double space received text.

5 AUTO - STATUS — 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 FORM FEED

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.

7 SERIAL MODE

Selects the serial printer mode as either BAUDOT or ASCII.

8 SERIAL BAUDS

Selects the baud rate of the serial printer. If Baudot: 45, 50, 57 or 75 bauds.

If ASCII: 110, 150, 300 or 600 bauds.

9 SERIAL BIT 7

This selects the polarity of the 8th bit (data bit 7) in the serial printer output.

ON = Mark OFF = Space.

0 PARALLEL BIT 7

This selects the polarity of the 8th bit (data bit 7) of the parallel printer output.

ON = High OFF = Low.

A PARALLEL 24 PIN

This option concerns the parallel printer output during FAX mode operation. ON indicates that the parallel printer has a 24 pin print head [Epson LQ-800/LQ-850]. OFF indicates that the FAX printer has an 8 or 9 pin head, or uses 8 pin graphic addressing.

B WIDE CARRIAGE

This option permits the use of a wide carriage printer in Facsimile mode. This is a FAX only control. This feature does not support 240 LPM. The Manual Framing button will yield 3/4" rather than 1/2" increments. At press time this feature has been certified only for the Star NR-15. Other similarly configured printers will likely work, but have not been tested. All wide carriage printers will not work however as the C/R increment and pin spacing may not be compatible.

The NR-15 has two 8 position DIP switches. The factory settings are for all positions on

both switches to be ON. For use with the M-7000 all positions will remain on except the 4th position on switch 2 should be OFF. That is to say: All ON except 2-4 OFF. (Significant switches: 1-5, 2-2, 2-3, 2-4).

4 CLOCK (sub-menu)

```
CLOCK MENU

1 SET TIME
2 SET DATE

3 STATUS TIME  = OFF
4 STATUS DATE  = OFF
5 ALTERNATE    = ON

C CANCEL
E ENTER
```

1 & 2 SET TIME/DATE

These two selections provide for the setting of the Time and Date in the system clock.

When either one is selected another sub-menu appears:

```
SET TIME   (or   SET DATE)

ENTER THE DESIRED FOUR DIGIT VALUE
OBSERVE ENTRY AT STATUS LINE CLOCK
```

C CANCEL

The far right side of the status line will display the time or date as it is currently set. The new time or date may now be entered as a four-digit value. As each digit is entered, its value will appear in the appropriate position of the status line indication.

After the fourth digit has been entered, the value is tested for a valid time or date. If an invalid entry has been made, the previously set time or date will return and re-entry may be attempted. At any time in the process, the C CANCEL selection can be made, and you will return to the CLOCK MENU.

After a successful entry has been made the menu selection line of:

E ENTER — Will be added to the menu. At this point you have the option of entering the displayed time into the system clock and, if the RTC option is installed, into the Real Time Clock module. Or you may still at this point C CANCEL the operation. Unless the RTC option is installed, however, the Status Line clock will not be displayed unless the time OR date is successfully ENTERed.

3/4/5 Display — These three selections determine whether the status line display shows the TIME continuously, the DATE continuously, or ALTERNATES between time and date, displaying each in turn for one second. These three choices are mutually exclusive. When any one of the three is selected ON the other two are automatically turned OFF. Therefor there will always be one ON and two OFF displayed.

5 BEEPER (sub-menu)

```
BEEP MENU

1 KEYPRESS  = ON
2 BELL      = ON
3 SEL-CAL   = ON

C CANCEL
E ENTER
```

This sub menu allows the user to control the conditions under which the beep annunciator is activated. Each of the three conditions has a unique tone signal. 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 two-tone signal will sound: 1000 Hz. followed by 650 Hz.

3 SEL-CAL — When a valid sel-cal on code is detected, a four-tone sequence will sound: 850 Hz., 650 Hz., 850 Hz., and 650 Hz.

6 SEL-CAL (sub-menu)

```
SEL-CAL MENU

1 SEL-CAL 1 ON    _ _ _ _ _ _ _ _
2 SEL-CAL 2 ON    _ _ _ _ _ _ _ _
3 SEL-CAL 3 ON    _ _ _ _ _ _ _ _
4 SEL-CALS OFF    _ _ _ _ _ _ _ _

C CANCEL
E ENTER
```

Programming a Sel-Cal code is done by first pressing the key that corresponds to the Sel-Cal (1, 2, 3, or 4) to be programmed, then entering the sequence of (up to eight) two-digit numbers that correspond to the letters to be programmed, followed by the E key. The Sel-Cal look-up table following, shows the two digit number associated with each possible character. Any keys pressed (except C or E), after the eighth number has been entered, will be ignored. Any number entered, that is outside of the range of numbers listed in the Table, will be ignored. Each number entered must be a two-digit number, numbers less than ten must be preceded by a 0.

The following examples will demonstrate the programming of Sel-Cal codes:

1. To program Sel-Cal one with ZCZCABC:
   a. Press <1>. The entry line for Sel-Cal 1 will highlight.

   b. Press 26, 03, 26, 03, 01, 02, 03

   c. If you have made an error press <C> and start again from step a.

   d. If the desired Sel-Cal letters appear on the screen at SC-1, press <E> and the Sel-Cal is entered.

2. To enter NNNN as the Sel-Cal OFF code:
   a. Press <4>. The entry line for Sel-Cals Off will highlight.

   b. Press 14, 14, 14, 14. Four "N"s should appear on the line for Sel-Cals Off.

   c. Press <E> to enter the Sel-Cals in memory.

3. The <C> key may be pressed at any stage of the Sel-Cal entry process to cancel the entry. When an entry is canceled, the Sel-Cal data that was programmed prior to the re-programming attempt will be restored (as long as the E key in not pressed first).

4. To erase a Sel-Cal that has already been programmed, press the key for the desired sel-cal and then press <E>. This is NOT required prior to re-programming a Sel-Cal. Use this procedure only to erase and leave the Sel-Cal blank.

5. To return to the Main Menu press the <C> key.

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..

SEL-CAL LOOK-UP TABLE

01	A	22	V	43	+	
02	B	23	W	44	,	
03	C	24	X	45	-	
04	D	25	Y	46	.	
05	E	26	Z	47	/	
06	F	27	[	48	0	
07	G	28	\	49	1	
08	H	29	]	50	2	
09	I	30	^	51	3	
10	J	31	__	52	4	
11	K	32	spc	53	5	
12	L	33	!	54	6	
13	M	34	"	55	7	
14	N	35	#	56	8	
15	O	36	$	57	9	
16	P	37	%	58	:	
17	Q	38	&	59	;	
18	R	39	'	60	<	(C/R)
19	S	40	(	61	=	(L/F)
20	T	41	)	62	>	
21	U	42	*	63	?	

7 MEMORIES (sub-menu)

```
                    MEMORY PROGRAMMING

0    1 MORSE MED   I 1000          AGC
1   D1 BAUDOT  45 T  170 H N ATC AGC UOS
2   D2 AR2 AA  96 M  170 L           UOS
3   D1 SITORA 100 C  170 H   ATC     LITERAL
4    2 SITORB 100 I  170 H       AGC
5   D1 ASCII  300    103 A N ATC AGC ODD
6   D1 BAUDOT  50 M  B 13  N     AGC
7   D2 ASYNC   45    634 V N     AGC DATABIT  5 BIT
8    1 FAX FM 120   576  POS L-R AGC LINE
9    1 BAUDOT  62 T  205 V N     AGC UOS          00101
A    2 PAKET 1200    B 202

                      C CANCEL
                      E PRINT
```

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

Also on screen, in reverse video, 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 <C> to return to the main program menu. Or if you wish a printout of your memory list press <E>. Be sure your printer is turned on, and on-line. The E PRINT selection will automatically take you completely out of the Programming Mode.

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 (N or R)
- Input selection
- Literal sub-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-7000 power is applied. This allows the user to control how the unit will operate when it is turned on.

8 CALIBRATE (sub-menu)

This selection immediately begins the calibration procedure. The M-7000 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.

Other than selecting this menu item, the user need do nothing to prepare for, or during the calibration process. The unit will indicate at the top of the screen:

```
CALIBRATION IN PROGRESS
```

When the unit has calibrated itself, a beep will be heard and the screen will display:

```
CALIBRATION COMPLETE
```

After a brief delay, you will be returned to the Main Menu. The entire process only takes about two seconds.

D DIAGNOSTIC (sub-menu)

```
DIAGNOSTIC MENU

1 BAUDOT TEST
2 MORSE  TEST

C CANCEL
```

The diagnostic operation will check the operation of all the internal circuits of the M-7000. The Baudot test operates at 75 baud, 170 Hz High tone. The Morse test operates at MEDium speed and 1000 Hz tone. In either mode, the test message, that will repeat over and over again is:

```
THE QUICK BROWN FOX JUMPED OVER THE LAZY DOG'S BACK 1234567890
M-7000 TEST O K.
```

While in the Diagnostic operation, the keyboard status will indicate

DIG — This is similar to the NORMal keyboard selection except commands that would change the mode, speed, shift or sense of operation are disabled. To terminate the diagnostic operation simply select the NORMal keyboard operation.

M-7000 REMOTE TERMINAL CONTROL

The M-7000 has the capability of being controlled by a remote ASCII terminal or computer via a 3 wire bi-directional control system.

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

The following are the specifications for the control interface:

Data protocol: ASCII
1 start bit
8 data bits
no parity
2 stop bits.

Data Levels (RS-232 compatible):
Mark = -2.5 to -15 V
Space = +2.5 to +15 V

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

Note: Handshake line must be high to enable data flow from the M-7000 to the remote terminal.

CONNECTIONS TO THE M-7000

J2- 6 Handshake from terminal
J2- 4 Data from terminal
J2- 5 Data from M-7000
J2-16 Signal ground

To operate the M-7000 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.

REMOTE TERMINAL OPERATIONS

Remote operation is accomplished by sending ASCII characters to the M-7000 remote terminal input (J2-4). The M-7000 interprets each character (in some cases, a group of characters) as a command corresponding to the press of a front-panel key or the toggle of one of the front-panel switches.

These ASCII characters may be sent to the M-7000 by simply typing on the keyboard of a 'dumb' ASCII terminal, or they may be generated within a program running on a personal computer.

The latter method my be implemented with simple Basic output statements such as:

```
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-7000. The statement must direct the output of the CHR$(n) or "c" to the serial output port that is connected to the M-7000 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 list the decimal value of the character code.

KEYPAD

When any of the following codes are received at the remote input, the M-7000 will respond in the same manner as if the corresponding keypad button were pressed:

In each section of the table below, the first column represents the ASCII character to be typed on the terminal keyboard; the second column is the value to be used in a BASIC: PRINT CHR$(value) statement; the third column shows the notation for the front panel key which will be effectively pressed by sending either of these to the M-7000.

For example: Sending the ASCII character A (capital A) or in BASIC sending CHR$(65) will have the same effect as pressing the 1 key on the normal left keypad (L1n).

@	64	L0n	L	76	LCn	X	88	R8n	d	100	L4a
A	65	L1n	M	77	LDn	Y	89	R9n	e	101	L5a
B	66	L2n	N	78	LEn	Z	90	RAn	f	102	L6a
C	67	L3n	O	79	LFn	[	91	RBn	g	103	L7a
D	68	L4n	P	80	R0n	\	92	RCn	h	104	L8a
E	69	L5n	Q	81	R1n	]	93	RDn	i	105	L9a
F	70	L6n	R	82	R2n	^	94	REn	j	106	LAa
G	71	L7n	S	83	R3n	_	95	RFn	k	107	LBa
H	72	L8n	T	84	R4n	`	96	L0a	l	108	LCa
I	73	L9n	U	85	R5n	a	97	L1a	m	109	LDa
J	74	LAn	V	86	R6n	b	98	L2a	n	110	LEa
K	75	LBn	W	87	R7n	c	99	L3a	o	111	LFa

FRONT PANEL SWITCHES

Fourteen command characters affect the operation of the unit as though a switch on the front panel had been thrown. In the table below, the first column indicates the abbreviation for the ASCII character to be sent (Note: These are all control codes which are not marked on most terminal keyboards, but may sent using 'control' or 'shift-

control' expansions of standard keys. Refer to your terminal manual for information on generating these characters.) The second column shows the value to be used in BASIC PRINT CHR$(value) statements. The third column indicates which front panel switch will controlled. The fourth column shows which position the command will effectively select.

ASCII	code	places switch	in this position
DLE	16	SQUELCH	ON
DC1	17	SQUELCH	OFF
DC2	18	SELCAL	ON
DC3	19	SELCAL	OFF
DC4	20	MO/MS/SO	MO
NAK	21	MO/MS/SO	MS
SYN	22	MO/MS/SO	SO
ETB	23	WIDE/NORM/NARROW	WIDE
CAN	24	WIDE/NORM/NARROW	NORM
EM	25	WIDE/NORM/NARROW	NARROW
SUB	26	PRINTER	ON
ESC	27	PRINTER	AUTO
FS	28	PRINTER	OFF
GS	29	ALL -- restore to panel switch setting --	

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-7000.

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.

(01)nnnn = Set Mark frequency to nnnn Hz.
(02)nnnn = Set Space frequency to nnnn Hz.
(03)nnnn = Sets Shift frequency to nnnn Hz.
(04)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.:

```
Use:          10 LPRINT CHR$(01);"1750"          or
              10 LPRINT CHR$(01);STR$(1750)

Do Not Use:       10 LPRINT CHR$(01),1750              or
                  10 LPRINT CHR$(01):LPRINT 1750
```

The extra characters, from the tab, in the third example, or the C/R L/F in the fourth, would result in command cancellation.

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

REMOTE RECEIVING OF DATA FROM THE M-7000

Data received by the M-7000 may be transferred to the remote terminal as it is received. To enable this data flow, send the character code (30). To turn off this data flow, send the character code (31).

A "retro-print" to the remote terminal may be initiated by sending the character code (33). 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 (34) is sent by the remote terminal, the M-7000 responds by sending the Status Line, as it appears at the bottom of the screen. This status does not include the on-screen tuning bar.

If receive data was being transferred to the remote terminal when the (34) command is detected, the transfer will be suspended until the status transfer has been completed. Data transfer will then resume.

ACCESSORY FUNCTIONS / CONNECTIONS

AUXILIARY TUNING SCOPE OUTPUT

A jack labeled SCOPE is provided on the rear panel for attachment of an external oscilloscope for RTTY tuning. This three circuit 1/4 inch jack has the Space filter output on the tip, the Mark filter output connected to the ring, and common (ground) on the shell (sleeve).

For proper hook-up the RING should be connected to the horizontal input of the scope, the TIP should be connected to the vertical input, and the SHELL connected to the scope ground.

RTTY AUXILIARY INPUT/OUTPUT

J2- 8 is the RTTY Auxiliary input/output port. This connection provides a TTL level output from the demodulator or a TTL level input into the microprocessor. This I/O enables the M-7000 to be used with a keyboard or external demodulator.

No level greater than +5.0 volts or less than 0 volts, may be connected to this point without possible damage to the M-7000, or the connected equipment.

MORSE AUXILIARY INPUT/OUTPUT

J2- 7 is the Morse Auxiliary input/output. This connection is the same as the RTTY Aux. port above, except for the Morse (CW) circuits.

PRINTER CONNECTIONS

A parallel ASCII printer output is also available as a standard output. It conforms to the Centronics 8 bit ASCII standard.

SERIAL PRINTER OUTPUT SELECTION

The M-7000 offers three different serial printer output levels:

J2- 1	Mil-188	Mark = +5V, Space = -5V
J2- 3	EIA	Mark = -7V, Space = +7V
J2-15	High voltage, open collector transistor for 20 or 60 MA. current loop circuits, Mark = on (conducting).	

Note: An external current loop power supply must be used. Maximum open circuit voltage that may be applied to this output is 175 V.D.C., maximum current is 70 ma. and must be resistively current limited.

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 J2-17.

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-7000 will accommodate serial printers that require handshaking.

A high signal (+3V to +15V), from your printer, applied to J2- 2 will indicate to the M-7000 that the printer is not ready to accept data.

If this handshake line is not connected, then the M-7000 assumes that the printer is ready to accept data at all times.

PARALLEL PRINTER

The M-7000 will drive any parallel printer that conforms to the Centronics, 8 bit, parallel standard.

The cable used between the M-7000 and the printer should be well shielded to minimize RFI/EMI radiation. Suitable parallel printer cables are available from your dealer.

Pinout information on the parallel printer connector can be found in Figure 10 of the Schematics section for those wishing to construct their own printer cable.

AUTO-START OUTPUT

An open collector output is provided at J2-14 to drive an external relay for the purpose of switching power to a teleprinter.

The circuit is intended to turn on the teleprinter after valid data is received and keep the printer's motor running for a few seconds after the data has stopped.

The maximum ratings for this output is 24VDC @60 ma. (NOT for directly switching 120VAC).

APPENDIX 1

VFT FREQUENCY TABLE

CHAN	MODE A		MODE B		MODE C		MODE D	
	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 2

BAUDOT ALPHABET TABLE

ALL LETTERS	ITA2 <I> FIGURES	TELEX<T> FIGURES	MIL <M> FIGURES	CYR <C> FIGURES	CYR <C> 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	--	--	--	--	--
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	Ү	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	Ш	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	&	&	Щ	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 WRU SPACE BETA ALPHA

RQ IDLE ERROR ITA2-U1 ITA-U2 ITA-U3 (U=undefined)

APPENDIX 3

J-2 PINOUTS & FUNCTIONS

Pin	Function
1	MIL serial printer data
2	Serial printer handshake
3	EIA serial printer data
4	Remote control data from terminal to M-7000
5	Remote control data from M-7000 to terminal
6	Remote control handshake line to M-7000
7	Morse (CW) auxiliary input / output
8	RTTY auxiliary input / output
9	IPI - DCD
10	IPI - CTS
11	IPI - RxD
12	Spare
13	IPI - TxD
14	Auto start
15	Current loop serial printer data
16	Signal ground
17	Signal ground
18	Signal ground
19	Signal ground
20	Opt. clk A *
21	Opt. clk B *
22	Opt. +13 V *
23	Opt. +13 V *
24	Ground *
25	Ground *

* Make no connection to these terminals.

APPENDIX 4

ADDITIONAL REFERENCES

Users seeking more detailed information on the various codes that the M-7000 receives should consult the following publications:

Getting Started With the Universal M-7000	Universal Radio Res.
Reference Data for Engineers: Radio, Electronics, Computer and Communications 7th Edition	Howard Sams
RTTY Code Manual	J. Klingenfuss
Guide to Utility Stations	J. Klingenfuss
RTTY Today	Universal Electronics
RTTY Press 2nd Edition	Universal Electronics
Hidden Signals on Satl. TV	Universal Electronics
Worldwide Marine Facsimile	Universal Electronics
SW FAX Frequency Guide	Universal Electronics
Antenna Systems AF Manual	Dept. of Air Force
Mariner's Guide to Radiofacsimile Weather Charts	

APPENDIX 5

RTTY RECEPTION PROBLEMS

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

Multipath Distortion	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 overlapped to the extent that they are decoded improperly.
Fading and Selective Fading	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: 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. Once the signal is properly tuned, there are three variables in the reception of RTTY that must be determined and their determination is simply a matter of quick trial and error.

APPENDIX 6

M-7000 SEMI-CONDUCTOR LIST

MAIN BOARD & FRONT PANEL BOARD	
IC 1, 3	4520
IC 2, 4	4046
IC 5 - 10	5620
IC 11, 12, 19	4741
IC 20, 21, 24	4741
IC 13, 14	4051
IC 17, 27	4051
IC 15	MC1413
IC 16	4070
IC 18	MF4CN50
IC 22, 28	1458
IC 25	MC3340
IC 26	LM2907
IC 29	1496P
IC 30	567
IC 31, 32	8036
IC 33	8030
IC 34	8800
IC 35	74HC373
IC 36	27256
IC 37, 38	2064 or 6264
IC 39	8582
IC 40	74HC04
IC 41	74HC00
IC 42	74HC42
IC 43	DS1215 *
IC 44	TL072
IC 45	145406
IC 46	ADC0844
IC 47	NSM39158
IC 48	NSM3914
VR 1	7808
VR 2	7908
VR 3	LM309K
Q1, Q6	MPSA14
Q2	MPSA42
Q3, Q4, Q5	MPS5172 or 4124
BATTERY	CR 2430 or LF 1/2W or DL 2430 *
	* Used with RTC option ONLY

VIDEO BOARD	
IC 1	2674
IC 2, 11	74HC174
IC 3	2064 or
video FAX	43256
IC 4, 5	74HC374
IC 6	27C128
IC 7	74HC166
IC 8	74HC163
IC 9	74HC86
IC 10	74HC04
IC 12	74HC32
IC 13	74HC00
VR	7805
Q1	MPS5172 or 4124

All diodes are 1N914 unless otherwise specified.

APPENDIX 7

M-7000 ALIGNMENT

The following adjustments are the only alignment needed for the M-7000. The alignment has been done at the factory and will NOT be required again under normal conditions!

Filter Offset Adjustment	Using high impedance dc voltmeter set on a 10 volt scale connected between pin 1 of IC-19 and ground, adjust control "4" for 0 volts. This adjustment must be made with the AGC off and no audio input to the M-7000. Note: This reading may go negative prior to final adjustment of this control.
Morse Detector Adjustment	Using an accurate frequency counter connected to test point "M", adjust control "1" for a reading of 8500 Hz. on the frequency counter.
Audio Input Level Adjustment	With the M-7000 in the Baudot diagnostic mode, adjust control "2" so that the two Orange LED segments (third and fourth from the right) are equally lit.
On Screen Bar-Graph Adj.	With the M-7000 in Baudot diagnostic mode, adjust control "3" for full scale illumination of the on screen ---- TUNE ----> status indicator.
Master Time Base Adjustment	Connect the high impedance probe of an accurate frequency counter to pin 20 of IC 33. Adjust C-V for a reading of 6.000000 MHz.

APPENDIX 8

SPECIFICATIONS

Modes & Speeds:

ASCII	75, 110, 150, 300, 600, 1050, 1200 & 1800 Baud Plus variable non-standard rates from 30 to 251 Baud in 2 baud increments.
Packet	300 & 1200 Baud (AX.25)
Baudot	45, 50, 57, 75 & 100 Baud Plus variable non-standard rates from 30 to 251 Baud in 2 baud increments.
Sitor	Mode A (ARQ) and Modes B (FEC collective and selective) - 100 Baud (with AUTOR automatic feature)
ARQ Moore	2 channel TDM 86, 96 & 100 Baud 4 channel TDM 172, 192 & 200 Baud
ARQ-E	ARQ-E 48, 64, 72, 86, 96, 144 and 192 Baud.
ARQ-E3	ARQ-E3 48, 64, 72, 86, 96, 100, 192 and 200 Baud.
Morse	5 to 120 wpm auto ranging (in 3 ranges)
Bit Inversion	Baudot based codes only - decodes any combination of bit inversions.
Three Shift Cyrillic	Available in Baudot and Baudot-based codes (video display only).
Literal Display Mode	ASCII, Baudot, SITOR and ARQ in all speeds available in these modes (video display)
Databit Display Mode	Synchronous and Asynchronous from 30 to 251 bauds.
Filter Tones	High tone (mark = 2125), Low tone (mark = 1275) fixed shifts of 60, 85, 170, 425, 850, and 1200 Hz. are provided, plus a variable function

which allows shifts of 30 to 1800 Hz in 5 Hz. steps. Modem tones (Seven standard modem tone pairs). VFT (Four standard FDM channelization schemes)

Inputs

Audio	Two independent input channels each: 4 to 600 ohms .25V p-p nominal.
Aux	TTL Levels (mark = +5V). May be used as an output from the demodulator or as an input to the microprocessor system.

Outputs

Video	Composite video, 75 ohm, 1.5v p-p, negative sync, 7x9 dot matrix, 22 lines of 80 characters each (including status line). Scrolling display, 50 or 60 Hz. vertical refresh rate.
Printer	Drives - Loop (20 or 60 ma.), MIL, or EIA levels and parallel ASCII, all with handshaking.

Printer Modes & Speeds

Serial:	Baudot 45, 50, 57, 75 Baud ASCII 110, 150, 300, 600 Baud
Parallel:	(ASCII 8 bit Centronics standard)

Demodulators

RTTY	Microprocessor controlled, switched capacitor filters comprise the pre-filters, channel filters, and post detector low pass filter for exceptional control and flexibility.
Morse	A PLL, superheterodyne demodulator centered on 750 Hz., 1000 Hz.(or variable) exhibits excellent dynamic range and tracking ability.

Rear Panel Jacks

Power
Video Output
Tuning Scope
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.

WARNING

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/U or RG-213/U, 92% shield 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.

DIGITAL ELECTRONIC SYSTEMS, INC.

Englewood, Florida
(813) 474-9518

LIMITED WARRANTY M-7000

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 defective in either workmanship or materials, within a period of six months 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 7 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 born 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 (with 2" of padding) 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-7000 uses semi-conductors which are rated for the commercial temperature range (0-70°C.). Operating the M-7000 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-7000 has been thoroughly tested and found to perform according to the M-7000 specifications.

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

APPENDIX 9

PARTS LOCATION AND SCHEMATICS

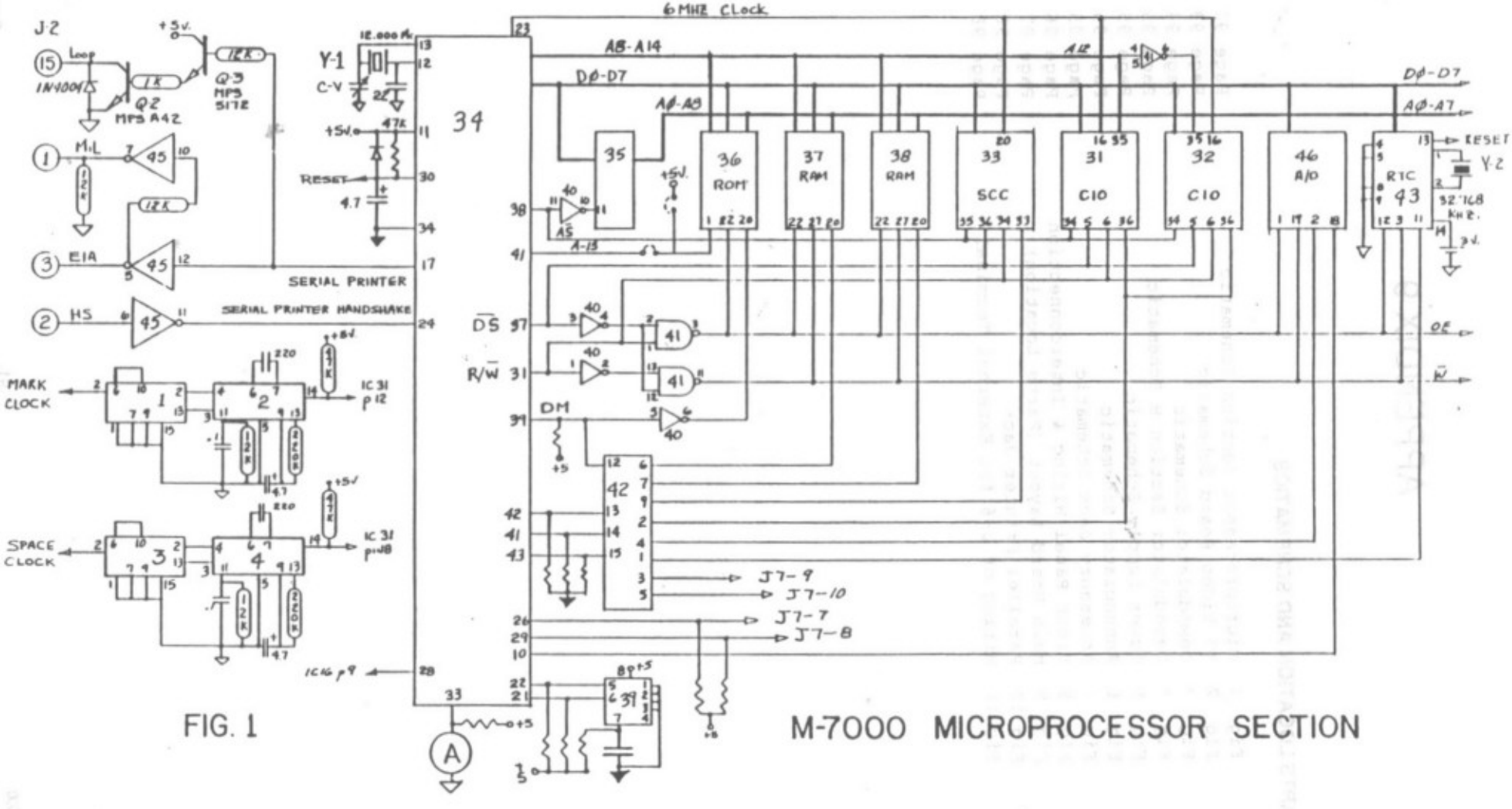


FIG. 1

M-7000 MICROPROCESSOR SECTION

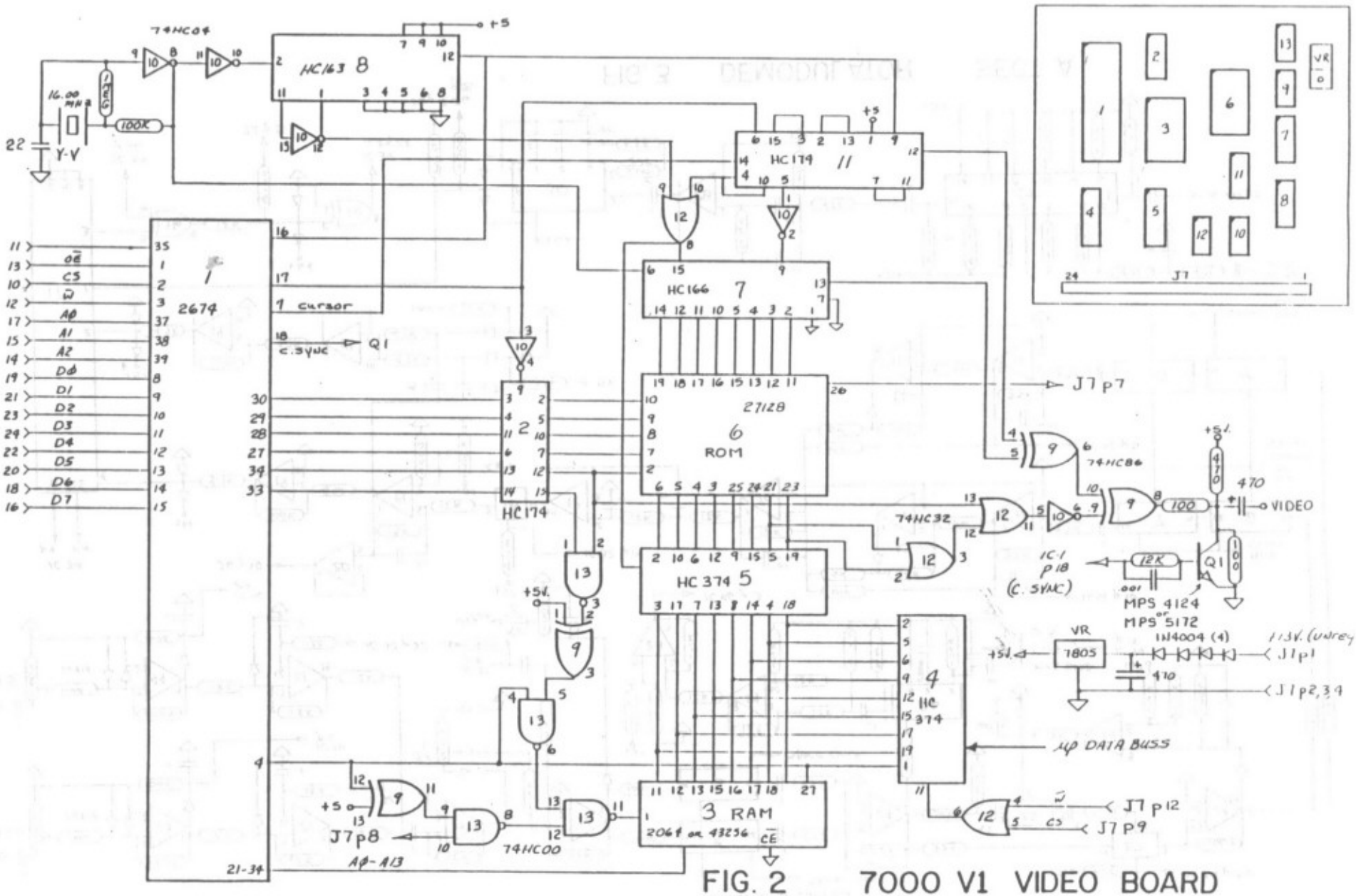


FIG. 2 7000 V1 VIDEO BOARD

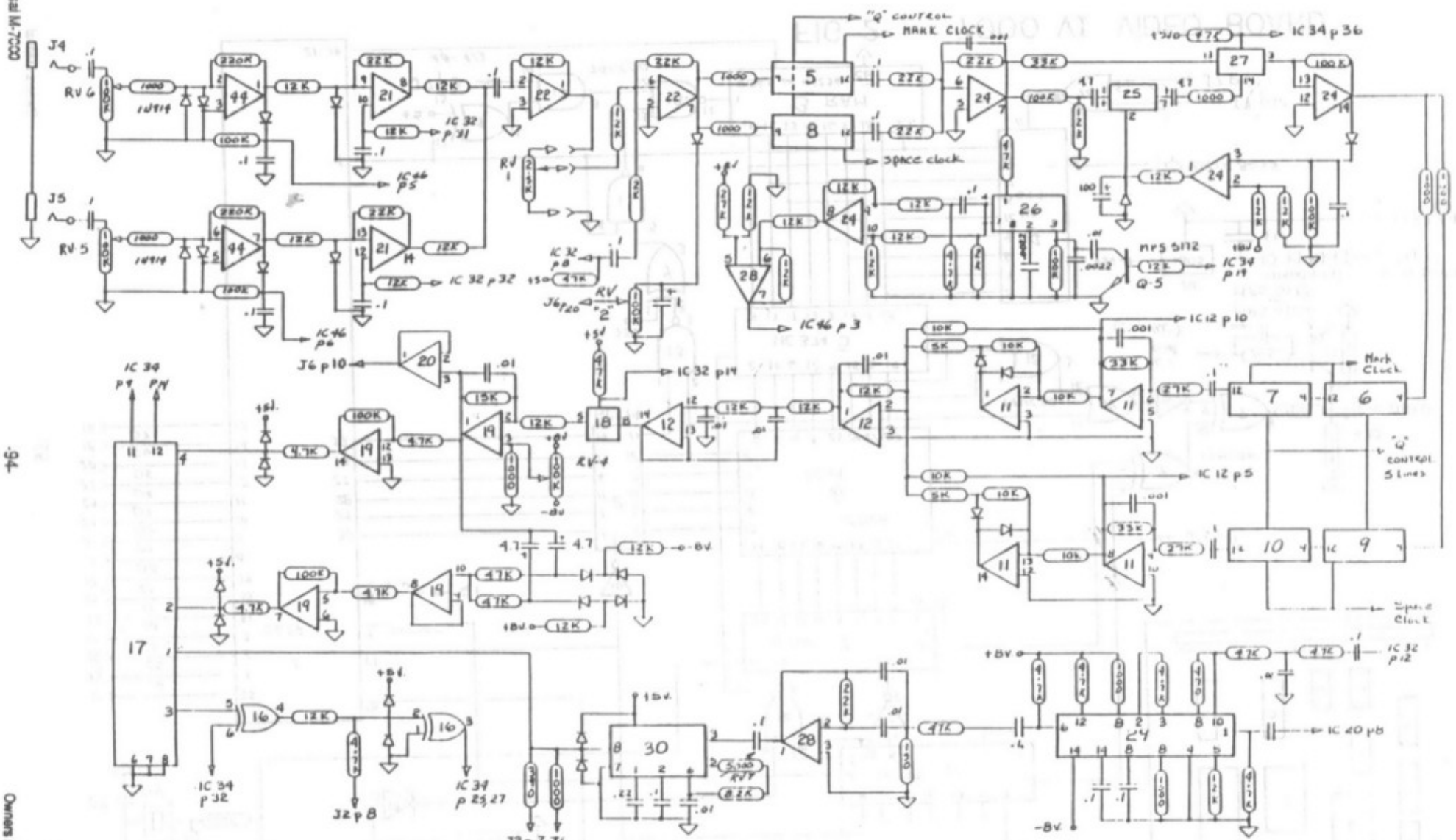


FIG. 3 DEMODULATOR SECT. A

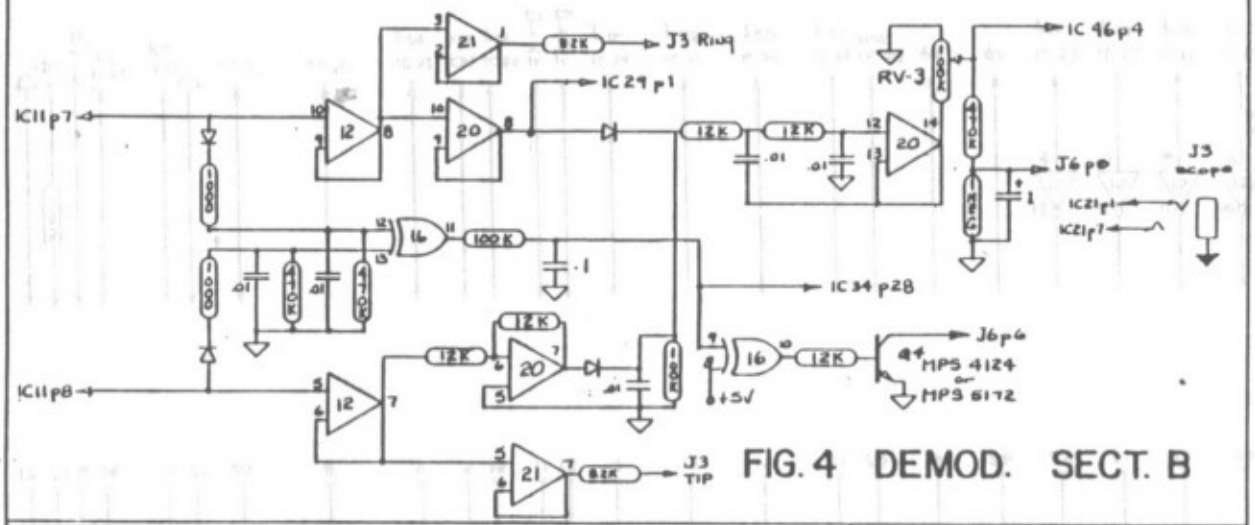


FIG. 4 DEMOD. SECT. B

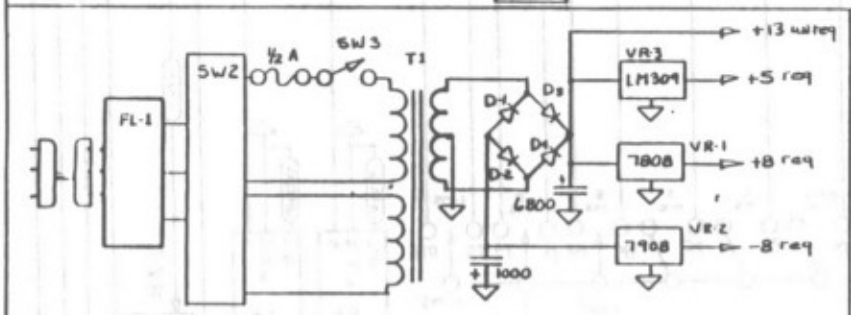
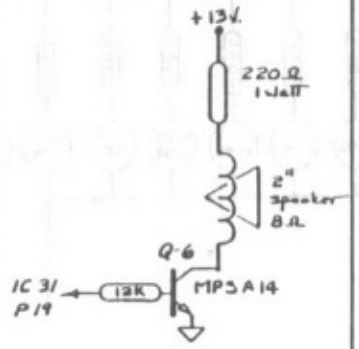


FIG. 5 POWER SUPPLY

FIG.6 ANNUNCIATOR



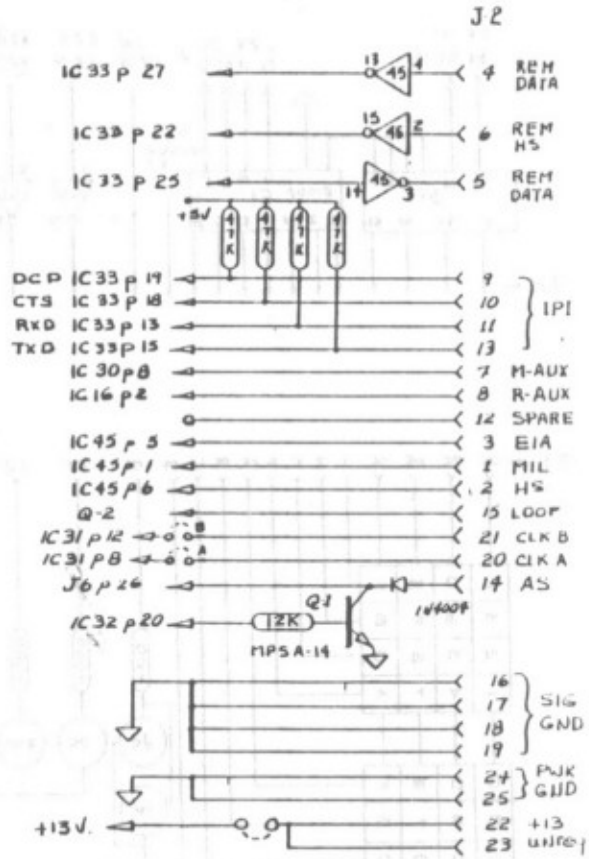


FIG. 7 ACCESSORY JACK (J-2)

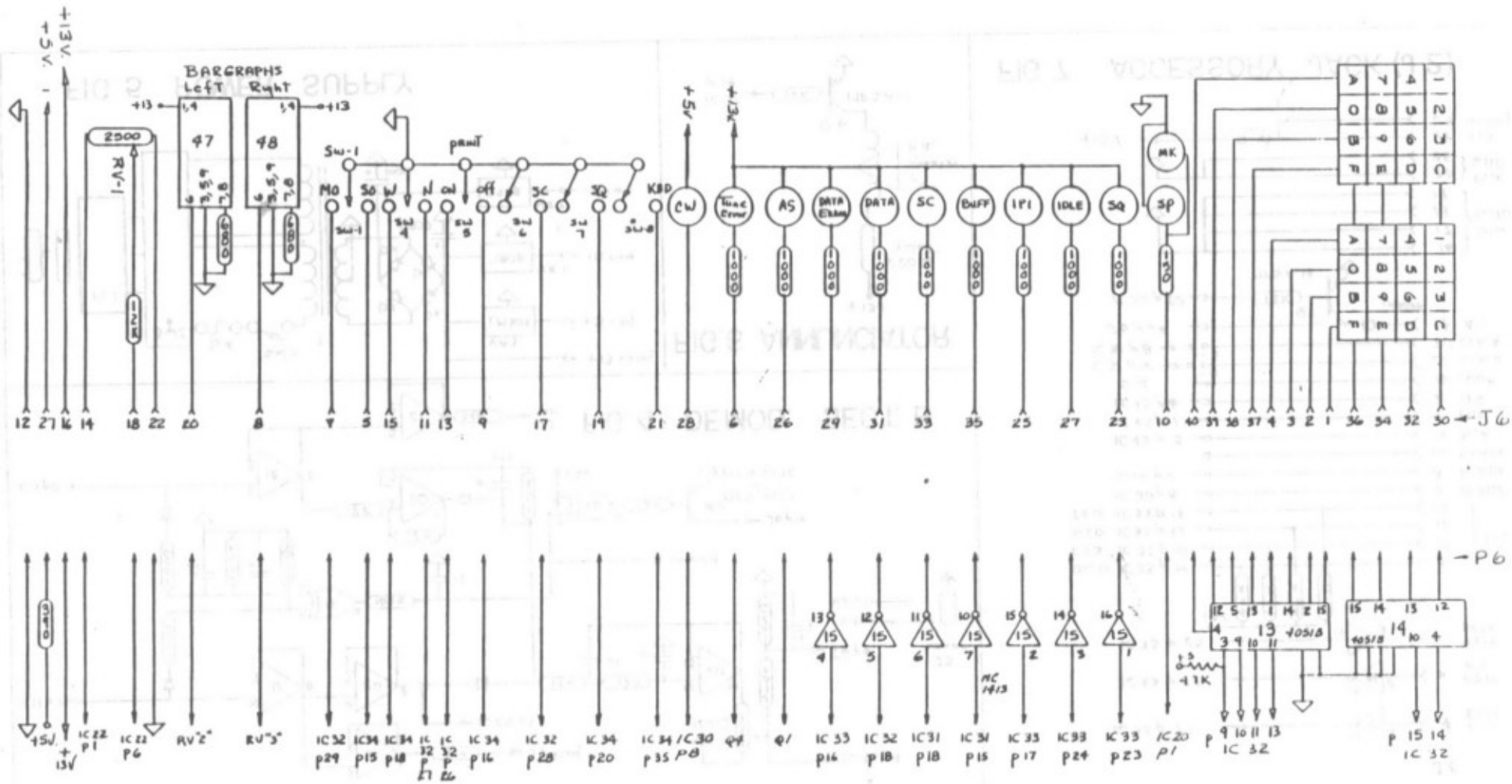


FIG. 8 FRONT PANEL WIRING & INTERCONNECTION

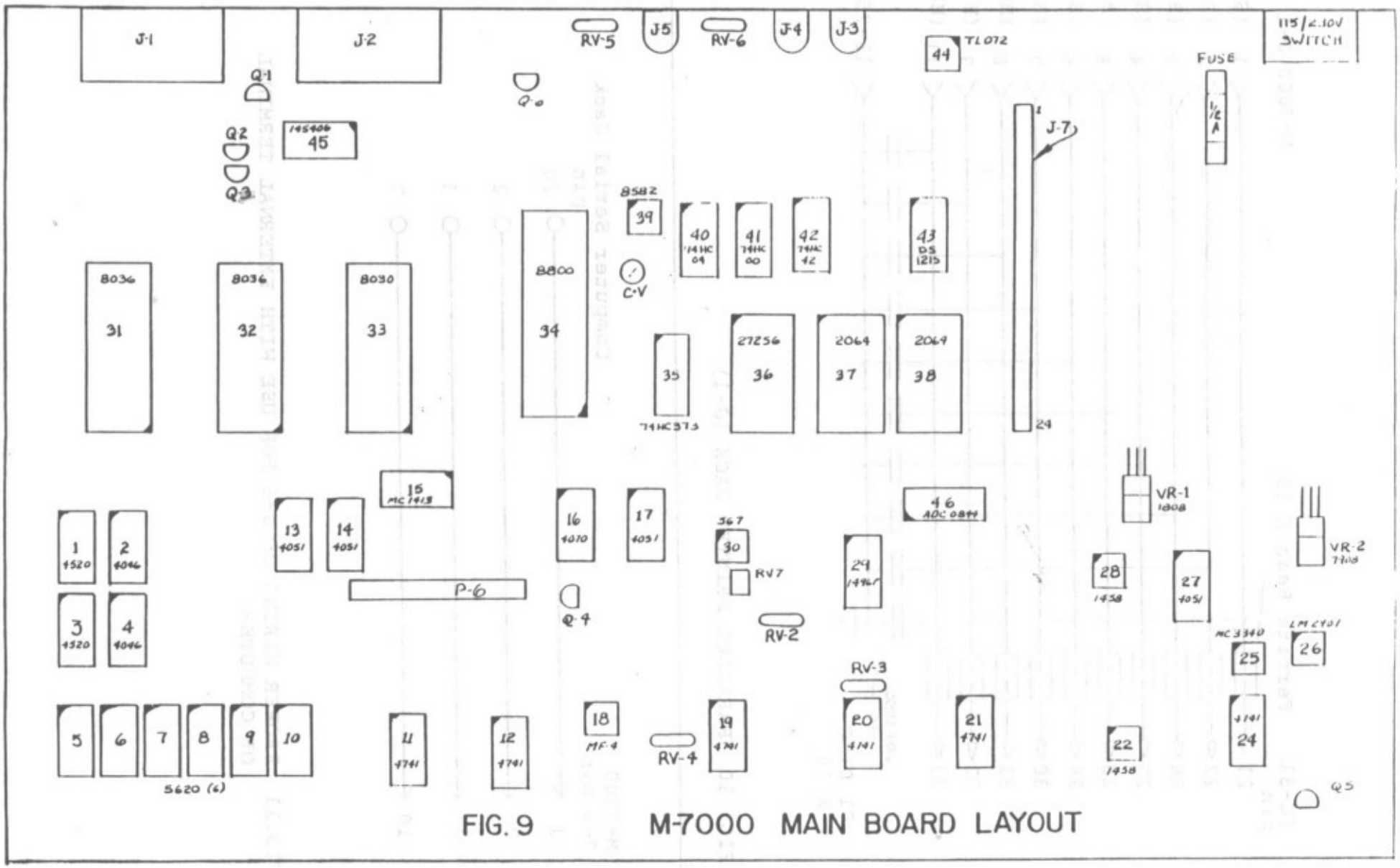


FIG. 9 M-7000 MAIN BOARD LAYOUT

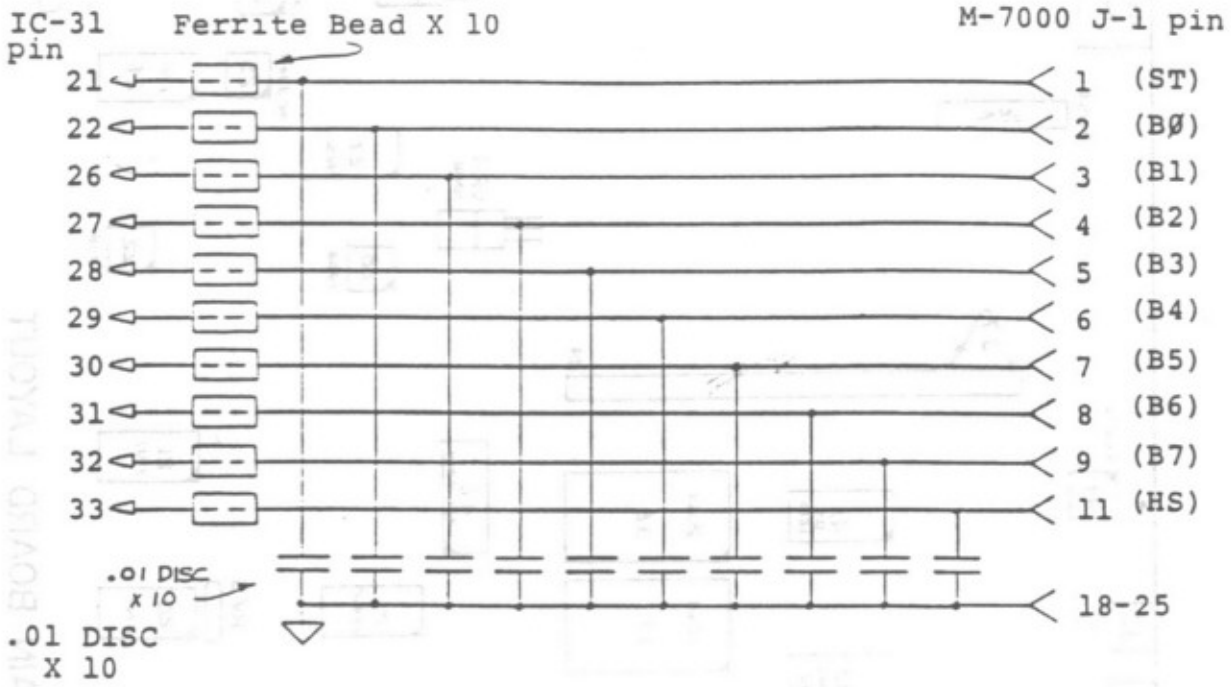


FIG. 10 PARALLEL PRINTER JACK (J-1)

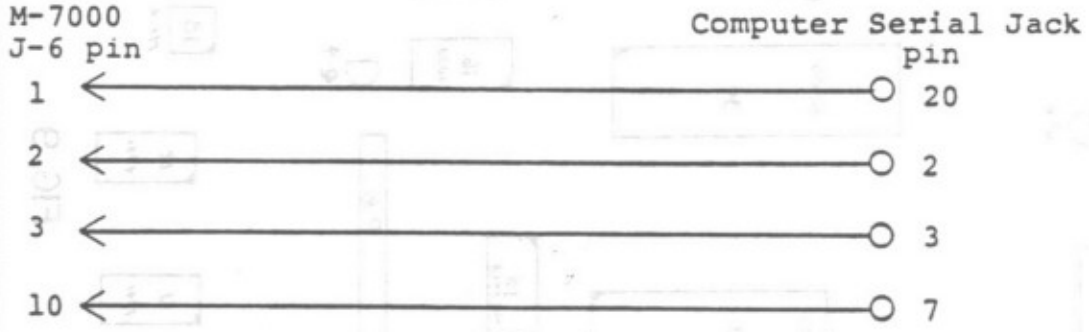


FIG.11 PROPER WIRING OF J-6 FOR USE WITH EXTERNAL TERMINAL OR COMPUTER

APPENDIX 10

FACSIMILE FREQUENCIES

KEY:

		Recommended Settings			
WX	Weather charts	120 / 576	LINE	L-R	POS
SI	Satellite image	120 / 576	GRAY	L-R	POS
	or	120 / 576	LINE	L-R	NEG
WP	Wire photo	60 / 288	GRAY	R-L	NEG

HF / USB / BW = 2000 - 3000 Hz :

Frequency	Mode	Key	Notes
3357	FM	WX SI	NAM Mostly WX occasional SI
8080	FM	WX SI	NAM " "
10865	FM	WX SI	NAM " "
10680	FM	WP	
17069	FM	WP	
17670	FM	WP	
18433	FM	WP	
20736	FM	WP	
22542	FM	WP	

Westar V Transponder 17 video subcarriers FM

1927.5	AM	SI	GOES 1 visible and infrared
1882.0	AM	SI	GOES 2 " "
1569.0	AM	WX	NAFAX

Special Note: Unauthorized reception of satellite signals may violate federal and international law.