INSTRUCTION MANUAL

DOVETRON MPC-1000T

TEMPEST

RTTY TERMINAL UNIT

E-SERIES

DOVETRON ⊥ 627 Fremont Avenue
So. Pasadena, California, 91030
⊥ P O Box 267 ⊥⊥ 213-682-3705 ⊥

MPC-1000T.200 and up.

Issue 3
July 1982

CONTENTS

MPC-1000T TEMPEST RTTY TERMINAL UNIT

* *

GENERAL DESCRIPTION

The DOVETRON MPC-1000T TEMPEST RTTY Terminal Unit is a complete FSK modem, designed for both SEND-RECEIVE and RECEIVE-ONLY modes of operation.

This unit meets the TEMPEST requirements of MIL STD 461 and NACSEM 5100 per testing done by a U. S. Government Agency.

The channel filters in the standard MPC-1000T are optimized for 150 baud operation and the standard tuning indicator is the Dovetron SSD-100 Solid State Cross Display. See NOTE page T-4.

Available options include channel filters optimized for other baud rates and internal signal regeneration/speed conversion assemblies.

The Dovetron BBP-100 Binary Bit Processor is an integral part of the MPC-1000T and is installed on the main board.

In addition to high performance axis-restoration, the BBP-100 also provides front panel selectable bandwidths and automatic Multipath Correction.

Five bandwidth modules are provided with each terminal unit. Two are stored on the BBP-100 assembly in storage sockets A and B. The other three are installed in active sockets: Wide, Medium and Narrow.

The active bandwidth modules are optimized for 50.00, 75.00

and 150 baud operation.

The stored bandwidth modules are optimized for 45.45 and 110 baud operation. See NOTE page T-4.

The Mark and Space input channels are continuously tuneable over the range of 1250 Hz. and 3100 Hz. and permit reception of shift widths up to 1850 Hz.

Shift widths down to approximately 35 Hz. may be copied using the standard in-band diversity dual channel mode.

For narrow shift, single channel operation is provided, which may also be used for MAB (Make and Break) type signals.

Internal calibration potentiometers permit shifting the range of the input channels to frequencies other than those screened on the front panel.

Three data outputs are available at the rear panel and all may be used simultaneously:

MIL STD 188C:	(+6 Mark, -6 Space).
EIA RS232C:	(-12 Mark, +12 Space).,
AFSK (Audio):	Ø dbm at 600 ohms, isolated. Sine wave - phase continuous.

The Mark and Space tones (AFSK) are internally adjustable over the range of 1200 Hz. and 3000 Hz.

A front panel switch permits these AFSK tones to be operator

enabled/disabled, providing simple control of VOX operated transmitters and tape recorders.

A second front panel switch selects FULL DUPLEX or HALF DUPLEX modes of operation.

In FULL DUPLEX, the AFSK tone keyer is keyed via the rear panel POLAR INPUT port, either MIL STD 188C or EIA RS232C.

In HALF DUPLEX, the AFSK tone keyer is keyed via the rear panel Polar Input when the terminal unit is in STANDBY (Send), and by the incoming signal when the terminal unit is in ON (Receive).

Audio input characteristics are Ø dbm, 600 ohm, isolated.

All signal input and output is at the rear panel via single-ended BNC connectors.

Power entry is thru a detachable power cable, which connects directly to an internally mounted EMI filter. The mating cable connector is an MS3106A-14S-7S.

Power requirements are 115/230 VAC ±25%, 40-400 Hz, 15 watts nominal.

The mains select switch and input power fuse are mounted internally and are available by removing the top lid.

Dimensions of the MPC-1000T are 17" wide, 3.5" high and 9" deep. With the rackmounting plates installed, width is 19".

Twelve inches of rack depth are required to accomodate the input power connector, allowing for normal cable bends.

Net weight is 10 pounds.

NOTE: When the MPC-1000T is supplied with channel filters optimized for other than 150 baud, the channel filter bandwidth is noted on a card affixed to the top panel of the unit. Bandwidth modules for 100 baud and 110 baud are identical, i.e., 330K.

INSTALLATION AND OPERATION

The MPC-1000T is normally shipped with the internal mains select switch set for 115 VAC, 40-500 Hz. operation.

If the unit is to be used on 230 VAC mains, remove the top cover and set the internal mains switch to 230 VAC and replace the 0.5 amp slo-blow fuse with a 0.25 amp slo-blow fuse.

A three conductor power cord is supplied with the MPC-1000T. The third conductor in the cord is power ground and for safety and optimum performance, should be terminated in a good earth ground.

A low level polar teleprinter should be connected to either of the FSK outputs, MIL or EIA. Since MIL and EIA have opposite polarities, a choice of polarities is available by selecting either one or the other.

The front panel Sense (NORMAL-REVERSE) switch may also be used to invert the FSK polarities in relation to the incoming signal.

The Audio Input port on the rear panel of the terminal unit should be connected to the audio output of the companion receiver, preferably a Ø dbm (600 ohm nominal) line.

With all front panel switches in the UP position, tune in an incoming RTTY (FSK) signal.

The Mark channel is normally displayed as the horizontal bar on the SSD display. The Space channel will then be displayed as the vertical bar.

If both channels are tuned to the same tone frequency, the two LEDS in the apex of the cross display will extinguish and the Signal Loss LED in the lower right quadrant will light.

At the same time, the Multipath Distortion LED in the upper left quadrant will flash, indicating signal energy is present in both channels simultaneously.

The LOOP LED is located in the upper right quadrant and will duplicate the indications of the front panel LOOP LED.

The LEVEL control is normally set at 9 o'clock.

This control is an attenuator and does not change the gain of the terminal unit. Set it for full deflection of the horizontal and vertical bars in the SSD with a Ø dbm input signal.

The THRESHOLD control is normally set at 12 o'clock.

If the SIGNAL LOSS LED flashes on weak signals, turn the THRESHOLD control CCW until the flashing stops.

The SIGNAL LOSS LED indicates that the terminal unit has gone to Markhold without a Marking signal in the Mark channel.

The LOOP LED is lit when the terminal unit is Marking and is extinguished when the terminal unit is Spacing. In normal operation, the LOOP LED with flash as the incoming signal switches between Mark and Space and indicates that the EIA and MIL FSK outputs are being keyed.

The MARK and SPACE LEDs are not normally used for tuning, but are provided as an emergency backup tuning indicator should the SSD display fail. They also provide a good indication of noise in the absence of a signal.

The MODE switch is normally operated in the MARK-SPACE (MS) position.

The MO (MARK ONLY) and SO (SPACE ONLY) positions may be selected if an interferring signal is present in one of the channels and for very narrow shifts or MAB (Make and Break) operation.

When tuning very narrow shifts (less than 100 Hz.), tune the Mark and Space VFOs for the maximum indentation at the sides of the cross display. Do not tune for maximum amplitude.

The DIV-OFF position of the MODE switch functions identically to the MS position in the MPC-1000T.

The MS-REV (Mark-Space Reversals) is a self test mode. In MS-REV, the AFSK tone keyer is keyed at a predetermined baud rate and the AFSK output is fed back into the front end of the terminal unit.

This is useful in setting the front panel VFOs exactly on the tone frequencies of the AFSK tone keyer, providing useful calibration check points for the VFOs.

It is also useful as a BITE self-test, since it will output FSK signals to the teleprinter and may also be used as a service tool when servicing the terminal unit.

Dovetron normally sets the AFSK tone frequencies to 2125 Hz. for Mark and 2550 Hz. for Space. See tag on top of unit for actual AFSK tone keyer frequencies.

THEORY OF OPERATION

The MPC-1000T TEMPEST RTTY Terminal Unit consists of two identical VLF (Very Low Frequency) AM superheterodyne receivers, in which the IF filters are analagous to the channel filters (Mark and Space) in conventional terminal units.

These Bessel function, 3 section channel filters are identical in all respects including center frequency (750 Hz.). The incoming Mark and Space tones are heterodyned into them thru full-wave J-Fet mixers.

In this way, both channels are subjected to the same amount of group delay, transient response and other anomalies, thus maintaining the signal information in the same form for eventual processing.

The SSD cross display derives its information from the buffer amplifiers following the channel filters and faithfully reproduces the actual signal content of the filters.

The Precision Detectors utilize active IC components which prevent thresholding effects and are also identical with the single exception that they are of opposite polarity.

This opposite polarity of the detected Mark and Space channels permits noise cancellation and correlation at the input of the summing amplifier on the BBP-100 Binary Bit Processor assembly.

After summing at the input of the BBP-100, the combined Mark and Space channel is passed thru a 2 section, four pole Bessel function low pass filter. This LPF has three bandwidths and each bandwidth may be selected from the front panel: Wide, Medium and Narrow.

The actual bandwidth configuration is determined by a four resistor network (using identical resistors) that plugs into one of three bandwidth sockets on the BBP-100 assembly.

Storage sockets are provided for two additional bandwidth modules on the BBP-100 and any three may be preselected for front panel selection.

As normally supplied by Dovetron, the Narrow position is set for 50 baud, the Medium position is set for 75 baud and the Wide position is set for 150 baud.

Bandwidth modules for 45.45 and 110 baud are stored in the A and B storage sockets at the left rear corner of the BBP-100 assembly.

The Mark and Space signals are stripped of their carrier component in the low pass filter and fed into a Track & Hold circuit that stores and holds the amplitude level of the sequential Mark and Space pulses. This Track & Hold circuit is controlled by a Track & Hold Logic Section. The Mark and Space information derived from the Track & Hold Section is also fed thru a pair of impedance buffers to a Common Mode Amplifier and to a Sum-

ming Amplifier. The output of the Common Mode Amplifier is inverted and provides the FSK Output from the BBP-100.

The purpose of the BBP-100 is to provide a very high performance axis-restoration to the Mark and Space signals as their amplitudes vary due to selective fading and other forms of multipath distortion.

The Summing Amplifier information working with the information from the Common Mode Amplifier automatically detects pulse stretching (overlapping) of the Mark and Space pulses in the Multipath Corrector circuit, which in turn, restores the proper zero crossing point.

A non-inverted FSK output is also provided to drive the Threshold and Mark Hold circuits on the main board.

The inverted FSK output drives the MIL STD 188C and EIA RS232C polar FSK buffer amplifiers, and their outputs are available at BNC connectors at the rear panel.

Other circuits on the main board provide an indication of Signal Loss and an automatic Threshold control after an RTTY signal has been acquired.

The SSD Intensity Control is provided by a light sensitive photocell mounted in the lower left quadrant of the SSD display.

The Signal Loss circuit lights a front panel LED whenever the

terminal unit goes into Mark-Hold without a Marking signal in the Mark channel.

The Autosensitivity circuit automatically lowers the threshold of the terminal unit when an input signal is detected, permitting the terminal to "track" the incoming signal thru deep flat fades. A variation of this circuit also reduces the Threshold requirement when the terminal unit is switched to either Mark-Only or Space-Only operation, since MO and SO operation (by definition) indicates that signal input power has been cut in half.

CIRCUIT DESCRIPTIONS

LEVEL CONTROL

The LEVEL control (R172) on the front panel is an attenuator that is used to set the audio input to the terminal unit at a convenient level after the desired audio level of the companion receiver has been selected. If the companion receiver has a 600 ohm Ø dbm output, the LEVEL control is nominally set at 9 o'clock.

INPUT IMPEDANCE

The input impedance of the MPC-1000T is single ended and isolated thru a transformer. This input may be balanced by replacing the single ended BNC audio input connector with a two-input connector.

INPUT AMPLIFIER

The input amplifier (Z2) is AC coupled from the output of the LEVEL pot at R172 and is protected from voltage transients by a pair of back-biased diodes, CR56 and CR57. This input may be driven to 50 volts without damage to the terminal unit.

The output of this amplifier drives one input of a full wave mixer in each channel and a unity gain inverter (Z3), which in turn, drives the other input of the full wave mixer in each channel.

MIXER STAGES

Each mixer consists of a pair of J-Fet transistors. Q1 and Q2 drive the Space channel thru buffer amplifier Z8. Q3 and Q4 drive the Mark channel thru the buffer amplifier Z9.

BUFFER AMPLIFIERS

The buffer amplifiers (Z8 and Z9) are set for a gain of ten and drive the channel filters.

VFO INJECTION OSCILLATORS AND INVERTERS

Both VFO oscillators are identical and consist of an oscillator stage and an inverter stage for full wave output to the mixer stages. A 5KΩ pot (R145 Mark and R147 Space) is mounted on the PC board directly behind its respective front panel VFO potentiometer and provide precise calibration for the front panel VFOs. The frequency of the oscillators is always 750 Hz. higher than the RTTY tone frequencies.

CHANNEL FILTERS

The Mark and Space channel filters are identical and consist of three section, six pole, active IC filters utilizing precision capacitors and resistors.

The center frequency of these filters is 750 Hz. with a 3 db bandwidth of 170 Hz. The filter design is linear phase (Bessel Function) with constant group delay, which prevents pulse dis-

tortion in the filters during periods of frequency dispersive multipath distortion.

These filters have been optimized for 150 baud operation by changing the standard 75 baud values, as shown in ( ) to those values as shown in (( )):

RESISTORS	75 Baud	150 Baud
R24/R49	(301K)	((147K))
R25/R50	(3.48K)	((5.9K))
R26/R51	(604K)	((365K))
R27/R52	(402K)	((162K))
R28/R53	(2.87K)	((4.32K))
R29/R54	(806K)	((422K))
R30/R55	(237K)	((169K))
R31/R56	(2.61K)	((6.65K))
R32/R57	(715K)	((442K))

SECTION	Q	CENTER FREQUENCY
1	4	750 Hz.
2	5	812 Hz.
3	4.5	700 Hz.

SSD-100 SOLID STATE CROSS DISPLAY

The SSD-100 is driven by the buffer amplifiers (Z13 and Z21) immediately following the channel filters.

The Signal Loss LED in the lower right quadrant duplicates the function of the Signal Loss LED on the front panel.

The two LEDs in the apex of the cross light when the Signal Loss LEDs are extinguished.

The LOOP LED in the upper right quadrant duplicates the function of the front panel LOOP LED.

The Multipath Distortion indicator (LED) in the upper left quadrant is lit whenever the Mark and Space channels contain a signal simultaneously.

The deflection width of the Mark and Space bars is determined by the setting of the Mark and Space gain pots (R17 and R18) on the SSD-100 assembly.

The Intensity pot at R11 sets the level at which the intensity level of the SSD is controlled by the photocell (PC1) and the ambient light conditions.

BUFFER AMPLIFIERS

The output of the channel filters is also routed to the output buffer amplifiers (Z13 and Z21), which drive the precision detectors thru the front panel Sense (Normal-Reverse) switch. Operating with a gain of 1.3, these buffer amplifiers also drive the LED drivers Z35 and Z48, which in turn drive the Mark and Space LEDs on the front panel.

LED DRIVERS

The drive signal on the front panel LEDs is AC and no consideration need be given to polarity if the LEDs should require replacement.

PRECISION DETECTORS

The Precision Detectors consist of two op-amps (Z14/Z15 Mark and Z22/Z23 Space), which provide full-wave envelope detection of the Mark and Space signals. The op-amps maintain the diodes conduction and no thresholding or cut-off occurs on weak signals.

The only exception to the rule of "identicalness" occurs in these precision detectors. The Mark and Space signals are detected such that the outputs have opposite polarities, which permits cancellation and correlation of noise and overlapping signals in the summing amplifier at the input of the BBP-100 Binary Bit Processor.

BINARY BIT PROCESSOR (BBP-100)

The Binary Bit Processor is a high performance axis-restoration circuit that incorporates selectable bandwidth and automatic Multipath Correction.

The selectable bandwidth feature permits the operator to optimize the signal-to-noise ratio of the terminal unit to the baud rate of the incoming signal.

Three standard bandwidths (baud rates) are selectable: 50, 74.2/75.0 and 150 baud. (Standard MPC-1000T).

Two spare bandwidth modules are stored on the BBP-100 assembly for 45.45 and 110 baud operation.

The input stage of the BBP-100 is a summing amplifier, which sums the outputs of the two precision detectors Z15 and Z23. The output of the summing amplifier is fed thru a two section, 4 pole linear phase Bessel function low pass filter, which strips the carrier information from the signal. The bandwidth of this low pass filter is front panel selectable as explained above.

The output of the low pass filter drives a pair of high impedance amplifiers, which in turn drive a common mode amplifier and a second summing amplifier.

The common mode amplifier drives a slicer circuit which provides the FSK output and an inverter slicer which provides the Inverted FSK output.

The summing amplifier drives the Multipath Corrector circuit which provides a hysteresis control to both of the FSK slicers.

The FSK output at TP16 drives Q6 (LOOP LED Driver) and the Signal Loss circuitry at Z37 on the main board.

The Inverted FSK Output at TP17 drives thru E56 (blue wire) on the main board to the MIL STD 188C and EIA RS232C output circuits at Z45 and Z46.

A third output from the BBP-100 (junction of R310 and R311) outputs to the main board thru header Z26, pin 6, and provides low pass filter information with a -400 millivolt offset to the Common Mode amplifier (Z38).

COMMON MODE AMPLIFIER (Z38)

The DC coupled common mode amplifier at Z38 provides signal status information to those circuits that are outside the main data string, such as Automatic Markhold, Anti-Space, Anti-CW and Anti-Mark/Fade.

The front panel THRESHOLD Pot R205 controls the sensitivity of Z38.

The time constant of the Pulse Width Discriminator at Z39 is determined by R119 (270K) and has been selected for optimum performance down to 45.45 baud.

LOW LEVEL POLAR (FSK) OUTPUTS

Both EIA RS232C and MIL STD 188C FSK outputs are available simultaneously.

The RS232C is generated by Z45: -12 volts Mark and +12 volts Space. Output impedance: 1KΩ.

The MIL 188C is generated simultaneously by Z46: +6 volts Mark and -6 volts Space. Output impedance: 1KΩ.

By definition, these two FSK outputs are of opposite polarities and the operator may choose the one that suits the polarity of the companion teleprinter.

AFSK TONE KEYER (AFSK)

An EXar XR2206C (Z43) monolithic function generator provides phase-continuous, sine-wave Mark and Space tone signals suitable for driving the audio input stage of SSB, PM, FM and AM transmitters, and for tape recording (magnetically) incoming signals.

The Mark and Space tone frequencies may be independently adjusted over the range of 1200 Hz. to 3000 Hz. by the PC board pots (R208 and R210) mounted at the rear of the MPC-1000T's main board.

The output of the AFSK tone keyer is isolated by a transformer with single ended output thru a BNC connector on the rear panel.

A front panel switch (AFSK ON/OFF) permits the tones at the

rear panel to be disabled by the operator, permitting easy turn-on/turn-off of a VOX operated tape recorder or SSB transmitter.

The output level is a nominal Ø dbm (600 ohms).

LOW VOLTAGE POWER SUPPLIES

The +15 and -15 volt power supplies are regulated with independent voltage regulators that have internal over-current and over-temperature protection circuits built-in (Q8 and Q9). In the event of a short circuit on either supply line, the effected regulator will shut down and stay down until the overload condition has been cleared.

POWER MAINS

The MPC-1000T has been designed to operate on either 115 or 230 VAC with a line frequency of 40 to 400 Hz. A mains select switch is mounted inside the terminal unit, available thru the top lid. Disconnect the detachable power cord before attempting to switch between 115 and 230 VAC operation. Although the terminal unit will operate satisfactorily at 50% voltage levels, the SSD probably will not have sufficient viewing intensity.

The third wire ground in the power cord should be tied to both peripheral equipment grounds and a good earth ground for optimum performance.

POWER FUSE

The power fuse is mounted in a plug-in fuse block on the top of

the main board, toward the right front corner. For 115 VAC operation, this fuse should be a 0.5 amp slo-blow. For 230 VAC operation, this fuse may be reduced to 0.25 amp, slow-blow.

THRESHOLD CONTROL

The front panel Threshold control sets the hysteresis level of the common mode amplifier (Z38) and the pulse width discriminator at Z39, permitting control of the automatic markhold circuitry.

The automatic markhold feature is defeated by rotating the THRESHOLD control to full counter clockwise (CCW), permitting the terminal unit to "run open on noise" when copying very weak signals.

The Signal Loss LED is a convenient indicator of the proper threshold setting. If this LED flickers while receiving an incoming signal, the Threshold control is set too high and should be turned CCW until the flickering stops.

SIGNAL LOSS INDICATOR

The logic of the Signal Loss Indicator is that it turns on the front panel LED whenever the terminal unit is in Markhold WITHOUT a marking signal in the Mark channel.

This information is also buffered to the rear panel thru a 1KΩ resistor and may be used to sound an alarm or provide other control functions.

This LED also lights whenever the terminal unit is put into the Standby condition.

MODE SWITCH

The front panel MODE SWITCH has five positions:

1) DIV OFF: Diversity off.
2) MO: Mark Only.
3) MS: Mark-Space (Normal).
4) SO: Space Only.
5) MS-REV: Mark-Space Reversals (RY).

The DIV OFF position is not normally used in the MPC-1000T, since no provision has been made on the standard MPC-1000T for rear panel interconnection of two units for Dual Diversity operation. In the DIV OFF position, the MPC-1000T will function as if it were in the MS position.

MO and SO permit either Mark Only or Space Only operation, by shutting down the local injection oscillator and inverter in the opposite channel.

MS is the normal operation mode and permits full In-Band Diversity operation of the MPC-1000T. If one channel should fade into the noise, the TU will automatically derive all of its data from the other channel.

The MS-REV position activates a square-wave generator that drives the AFSK tone keyer and routes the tones from the tone keyer into the front end of the terminal unit.

When the square-wave generator is set (in frequency) to one-

half of the baud rate of the companion teleprinter, the teleprinter will print a continuous string of RYs, provided no signal regeneration is taking place. If the teleprinter is using a digital regeneration technique (such as a UART), a continuous string of Ys will probably be generated. Since a UART always requires a Space pulse for Start, and Mark Space Reversals by definition, always provides a Mark pulse after a Space pulse, the character R cannot be derived from a string of Mark-Space reversals.

REAR PANEL PTT (J8)

With the ON-STANDBY switch in the ON position, the PTT circuit is open. With the switch in STANDBY, the PTT line is grounded and may be used to control a companion transmitter via its PTT (push to talk) line.

REAR PANEL LOCK (J5)

When the terminal unit is in STANDBY, the rear panel LOCK line is disconnected from the internal circuitry of the terminal unit.

A positive voltage (+5 to +15 VDC) may be applied to the rear panel LOCK (J5) connector when the terminal unit is in the ON position to remotely lock up the terminal unit, i.e., put it into Markhold.

POLAR INPUT (J6)

Either MIL STD 188C or EIA RS232C low level polar signals from

a teleprinter's keyboard may be inputted at J6.

With the terminal unit selected for FULL DUPLEX operation, and the Mode Switch in DIV-OFF, MO, MS or SO, the internal AFSK Tone Keyer will be driven directly by the Polar Input (J6).

In HALF DUPLEX, the AFSK Tone Keyer will be keyed by the Polar Input only when the ON-STANDBY switch is in the STANDBY position. In HALF DUPLEX, this switch functions as a RECEIVE-SEND switch.

When operating FULL DUPLEX, this switch must be left in the ON position.

SIGNAL LOSS (J7)

The rear panel Signal Loss line at J7 is buffered with a 1K resistor (R200). With no signal, this line sets high at approximately +12 volts. With signal, this line sets low at approximately -12 volts. A threshold detector may be installed on this line to provide an external indicator or alarm indicating "Signal Loss". For other buffering schemes, R200 may also be replaced with a silicon signal diode.

CALIBRATION PROCEDURES

VFO CALIBRATION

If a frequency counter is available, it may be connected directly to the wiper of the Mark or Space front panel VFO potentiometers, or to TP12 or TP13.

Set the front panel pot to 2000 Hz. and adjust the PC pot directly behind the pot being calibrated so the frequency counter indicates 2750 Hz.

If a frequency counter is not available, a rough calibration can be put on the terminal unit by setting the PC board fine calibration pots to approximately 2000 ohms, measured by a VOM with the power of the terminal unit turned off.

AFSK TONE KEYER ADJUSTMENT

The AFSK tone keyer is calibrated to the required tones by the two PC pots located at the rear of the main board.

These pots (R208 and R210) are labeled SPACE and MARK, but these markings are arbitrary, depending on whether the tones are to be calibrated Mark-high, Space-low, or vice versa, and whether the companion transmitter is to be used in upper sideband or lower sideband mode.

Dovetron (unless specified by the customer) calibrates the AFSK tone keyer in the following manner:

1) Switch DUPLEX switch on front panel to FULL DUPLEX (UP).

2) Connect frequency counter to TP10 on main board or to rear panel AFSK connector.

3) Apply +6 to +15 volts to rear panel POLAR INPUT connector.

4) Calibrate SPACE pot (R208) for 2125 Hz.

5) Apply -6 to -15 volts to rear panel POLAR INPUT connector.

6) Calibrate MARK pot (R210) for 2550 Hz.

7) Switch front panel DUPLEX switch to HALF DUPLEX. Frequency should read: 2125 Hz.

During the calibration procedure the front panel MODE switch must be in the MS position.

The +15 and -15 polar input voltages may be taken from the top of the BBP-100 assembly or from TP7 (-V) and TP9 (+V) on the main board.

This calibration will produce a MARK-Low, SPACE-High tone pair when injected into a SSB transmitter set for LSB operation and the Polar Input is driven by a MIL STD 188C configured signal. When driven by an EIA RS232C configured signal, the tone pair will be inverted, i.e., MARK-High, SPACE-Low (LSB).

Switching the transmitter from LSB to USB will also invert the sense of the Mark and Space tones.

MS-REV (RY) GENERATOR

When the mode switch is set to MS-REV, the AFSK tone keyer will output a continuous string of Mark-Space Reversals.

The frequency of this signal is set by a PC potentiometer at R163.

When adjusted for RY generation at one speed, RYs will not be printed at any other speed.

Select the most common speed that you intend to operate the companion teleprinter at, and adjust R163 until the teleprinter outputs RYs. If the teleprinter is a regenerating type unit, adjust for a string of Ys.

SERVICE INSTRUCTIONS

CAUTION: HIGH VOLTAGES ARE PRESENT IN THIS UNIT

BEFORE REMOVING THE TOP AND BOTTOM LIDS, REMOVE THE AC POWER CORD AT THE REAR PANEL AC CONNECTOR.

CAUTION: HIGH VOLTAGES ARE PRESENT IN THIS UNIT

The AC mains are exposed inside the MPC-1000T at the right side of the RFI line filter, on the rear of the front panel power switch and on the exposed clips of the fuse holder.

TEST POINTS (MAIN BOARD)

TP1 is the signal input line to input amplifier Z2. The amplitude of audio signals on this line is controlled by the front panel LEVEL control.

TP2 is the output of the input amplifier Z2.

TP3 is -400 MV output line from the BBP-100 assembly.

TP4 and TP5 is not used in the MPC-1000T.

TP6 is FSK output of the BBP-100 and may also be measured at TP16 on the BBP-100 assembly.

TP7 is the output of the -15 volt regulator.

TP8 is power ground, chassis ground and signal ground.

TP9 is the output of the +15 volt regulator.

TP10 is the output of the AFSK Tone Keyer (Z43).

TP11 is the output of the RY Generator (MS-REV).

TP12 is the output of the inverter (Z7) following the Space channel oscillator (Z6).

TP13 is the output of the inverter (Z5) following the Mark channel oscillator (Z4).

TP14 is the output of the Space channel oscillator.

TEST POINTS (BBP-100 ASSEMBLY)

TP15 is the output of the selectable bandwidth low pass filter.

TP16 is the non-inverted FSK output.

TP17 is the inverted FSK output.

E-POINT MPC: Grounding this point inhibits the automatic multipath correction section of the BBP-100. This point is also available in the header and socket at Z26, pin 5.

TROUBLE SHOOTING

The most common failure in a terminal unit with less than 1000 hours of operation is an op-amp.

A bad op-amp will usually short and run hot, split open and occasionally will burn.

All op-amps are plugged into sockets for ease of service and also to protect the PC board against damage from a hot or

burning op-amp.

The best way to find a shorted op-amp is to run the terminal unit for a few minutes and then feel the top of the op-amp's case. A shorted unit will run considerably hotter than normal.

If one of the low voltage power supplies is shorted, the regulator on that line will shut down. When the line is cleared of the short, and the regulator cools off, it will resume operation.

A blown power fuse is usually an indication of a problem in low voltage four-diode bridge.

When probing the pins on an op-amp, take care not to short Pin 6 (output) to pin 7 (±15 VDC).

All power diodes are 1N4007 and all silicon signal diodes are 1N914B.

MTBF (MEAN TIME BEFORE FAILURE)

An analysis of the MPC-1000C with CRT display indicates a failure rate of 89.42 failures per one million (1,000,000) hours of operation, or a MTBF of 6700 hours. Calculations were made per Mil Handbook 217. The MPC-1000T is similar to the MPC-1000C, but does not contain the high voltage supplies of the CRT or the high level neutral loop. The MTBF of the MPC-1000T with SSD-100 Solid State Cross Display is probably in excess of 7000 hours.

DOCUMENTATION

Six prints are supplied with the MPC-1000T:

75100 Printed Circuit Board Assembly-Control Board. MPC-1000 and MPC-1000C, E-Series.

75103 Schematic, Multipath Diversity RTTY Terminal Unit, Model MPC-1000 and MPC-1000C, E-Series.

75103T Schematic Addendum, MPC-1000T TEMPEST RTTY Terminal Unit.

75192 Assembly, BBP-100 Binary Bit Processor.

75195 Schematic, BBP-100 Binary Bit Processor.

75307 Assembly/Schematic, SSD-100 Solid State Display.

The MPC-1000T consists of a modified MPC-1000C and a BBP-100 Binary Bit Processor.

The BBP-100 plugs into the main board via six 8-pin headers and one interconnecting wire. This wire connects between E56 on the BBP-100 and E56 on the main board.

The front and rear panels are connected to the main board per print 75103T. The heavy lines on the print are PC board traces and the light lines are interconnecting wires.

A jumper is installed on the bottom of the main board between

the collector of location Q14 and the rear most end of location R217. Neither Q14 or R217 are installed in the MPC-1000T.

A jumper is also installed (on top of the main board) between locations B and C, directly underneath the CRT shield. No circuit traces are cut or removed.

White jumpers have been installed on the main board wherever necessary to utilize existing traces for circuit paths.

All original components that have been replaced by the circuitry of the BBP-100, the high level neutral loop keyer and power supply, and the autostart circuitry and relay have been left off the main board.

Consult Print 75192 for installation and removal instructions of the BBP-100 Binary Bit Processor assembly.

PARTS LIST - MPC-1000T TEMPEST

All MPC-1000T TEMPEST RTTY Terminal Units contain a Binary Bit Processor (BBP-100) and an SSD-100T Solid State Cross Display (U.S. Patent 4229698).

The Keyboard Operate Send (KOS-100T) is available as an option and included in this parts list.

The following parts list is separated into the following sections:

DESCRIPTION	DOVETRON PRINTS
Main Board:	75100E and 75103E
Front Panel:	75100E and 75103T
Rear Panel:	75103T
Cabinet parts:	No documentation
Binary Bit Processor BBP-100:	75192 and 75195
Solid State Cross Display SSD-100T:	75307

With the exception of the power transformer and the EMI optical filter, all components are available through normal commercial channels.

The power transformer is available from Dovetron or Wood Transformers, inc., 1301 Santa Fe Street, San Jacinto, CA 92383.

The EMI optical filter is available from Dovetron, Shielding Technology Inc., 120 Ethel Road West, Piscataway, NJ 08854, or Applied Shielding, 1997 Friendship Drive, El Cajon, CA 92020.

The function generator used in the AFSK tone keyer is an XR2206CP, and although available in commercial distribution, may be ordered from Dovetron or from EXAR Integrated Systems, Inc., 750 Palomar Avenue Sunnyvale, CA 94088.

MAINBOARD ASSEMBLY

ITEM	PART NUMBER	DESCRIPTION	MFRS ID	MANUFACTURER
1	CR5,6,7,8,9, 10,11,12,1,2, 3,4,56,57,32, 49,50,28,51	Diode, Silicon, Signal	1N914B	Fairchild
2	CR60,61,43A, 43B,43C,43D	Diode, Silicon, Power, 1 A, 1 KV	1N4007	General
3	R214	Resistor, 68Ω, 1/4W 5%, carbon film	R25AJ68	R-Ohm
4	R108,109	Res: 120 ohms	R25AJ120	R-Ohm
5	R199A,R300,R151	Res: 200 ohms	R25AJ200	R-Ohm
6	R153,219,121, 211,212	Res: 470 ohms	R25AJ470	R-Ohm
7	R216,158,159 200,213,220	Res: 1000 ohms	R25AJ1000	R-Ohm
8	R133	Res: 2000 ohms	R25AJ2000	R-Ohm
9	R43,68,134	Res: 4700 ohms	R25AJ4700	R-Ohm
10	R38,39,40,41, 42,63,64,65, 66,67,44,69, 3,4,5,6,7,8,9, 10,11,14A,14B, 19A,19B,115,116, 104,105,106,107, 138,142,164,166, 162,118,13,15,16, 21,20,156,157,154, 155,110	Res: 10K ohms	R25AJ10K	R-Ohm
11	R161	Res: 11K ohms	R25AJ11K	R-Ohm
12	R117,152,205	Res: 20K ohms	R25AJ20K	R-Ohm
13	R113,118,140	Res: 30K ohms	R25AJ30K	R-Ohm
14	R34,59	Res: 62K ohms	R25AJ62K	R-Ohm
15	R37,62,22,23, 35,60,111,112	Res: 100K ohms	R25AJ100K	R-Ohm
16	R36,61	Res: 130K ohms	R25AJ130K	R-Ohm

17	R1, 2 & 119	Res: 270K ohms	R25AJ270K	R-Ohm
18	R215	Res: 1 Megohm	R25AJ1M	R-Ohm
19	R31 & 56	Resistor, 2.61K, 1%, Metal Film	2611-55D	Dale
20	R28 & 53	Res: 2.87K-1%MF	2871-55D	Dale
21	R25 & 50	Res: 3.48K-1%MF	3481-55D	Dale
22	R30 & 55	Res: 237K-1%MF	2373-60D	Dale
23	R24 & 49	Res: 301K-1%MF	3013-60D	Dale
24	R27 & 52	Res: 402K-1%MF	4023-60D	Dale
25	R26 & 51	Res: 604K-1%MF	6043-60D	Dale
26	R32 & 57	Res: 715K-1%MF	7153-60D	Dale
27	R29 & 54	Res: 806K-1%MF	8063-60D	Dale
28	C77 & 79	Cap: .01 Mfd, 50 VDC, ceramic disc	UK50-103	Centralab
29	C63 & 64	Cap: 270 Pfd, 1 KV, ceramic disc	DD-271	Centralab
30	CR82, 83, 84, C54	Cap: 1 Mfd, 35 VDC, Tubular tantalum	150D105X-9035A2	Sprague
31	C56 & 57	Cap: 1000 Mfd, 35 VDC, Type TW	ECEA1YY102S	Panasonic
32	C6, 7, 8, 9, 10, 11, 21, 22, 23, 24, 25 & 26	Cap: 4700 Mfd, 630 VDC, 5%	.0047J630	Plessey
33	C12, 27, 3 & 46	Cap: 0.1 Mfd, 250 VDC, 5%	0.1J250	Plessey
34	C47, 45 & 55	Cap: 1 Mfd, 100 VDC, 5%	1.0J100	Plessey
35	Q6	Transistor, NPN, Silicon, Signal	2N697 or 2N2219A	Motorola or RCA
36	Q13	Transistor, JFET	2N4360	Motorola
37	Q8	Regulator, +15 VDC	MC7815CT	Motorola

38	Q9	Regulator, -15 VDC	MC7915CT	Motorola
39	Z2, 3, 5, 8, 9, 10, 11, 12, 13, 14, 15, 18, 19, 20, 21, 22, 23, 37, 38, 39, 35, 47, 48, 45 & 46	Integrated Circuit, Op-Amp, 8 pin, Mini-dip, plastic	UA/LM741CN	Signetics or Texas Instruments
40	Q1, 2, 3 & 4	Transistor, JFET	J111-18	Siliconix
41	R163	Potentiometer, PC mount, Vertical: 10K	X201R103B	C.T.S.
42	2 each	Socket, Regulator	1018-2031	Molex
43	R168	Resistor, Power, 75 ohms, 25 watts	0200E	Ohmite
44	T1	Transformer, Power	7827S	Dovetron/WTI
45	T2	Transformer, Audio	TY-34X	Dovetron or Triad/Utrad
46	3 each	Socket, transistor	3LPS-B	TWR/Cinch
47	26 each	Socket, 8 pin, low	CA-08SLP-TSD	Circuit Assy
48	8 each	Socket, 8 pin, high	CA-08SE-TSD	Circuit Assy
49	17 each	Wire Jumpers, 0.5 inch, 22 Ga., PVC	JO.5X0.25-PVC-22	Dovetron or Squires Elec.
50	1 each	Fuse Holder	357001	Littlefuse
51	F1	Fuse, 1/2 amp, S/B	313.500	Littlefuse
52	1 each	Cable, 8 wire	9160	Circuit Assy or Dovetron
53	1 each	Cable Clamp	CLN-1/8	Ico-Rally
54	1 each	Washer, No. 4	KWM-401	Waldom
55	1 each	Mainboard, P.C.	A75100-E	Dovetron
56	2 each	Support Bars	CS-1	Dovetron
57	1 each	Cabinet side plate Right side	SP/R	Dovetron
58	1 each	Cabinet side plate	SP/L	Dovetron
59	1 each	Cable, 14 wire	9130	Circuit Assy

60	R145,147,206,207	Potentiometer, PC Mount, Vertical, 5K	X201R502B	C.T.S.
61	1 each	Socket, 16 Pin, low profile	CA-16SLP-TSD	Circuit Assy.
62	Z43	I. C., Function Generator	XR2206CP	EXAR
63	R143,146	Resistor, Metal Film, 1%, 2.49K	2491-55D	Dale
64	C53	Capacitor, 0.1 MFD, 50 VDC, Polycarbonate	DP2B104X (+10%,-0%)	I.M.B. Inc.
65	Cspec	Capacitor, 100 Pfd, 1KV, ceramic disc.	DD-100	Centralab
66	C85	Capacitor, 0.1 Mfd, 250 VDC, polyester	.1J250	Plessey

FRONT PANEL COMPONENTS

1	1 each	Front Panel, Beauty	FP-1(T)	Dovetron
2	1 each	Front panel, Sub.	FP-2(T)	Dovetron
3	S1	Mode Switch	5P9959	C.T.S.
4	POWER, AFSK & DUPLEX (3)	Switch, Toggle, SPDT, miniature	MTA-106D	ALCO Switch
5	BANDWIDTH (1)	Switch, Toggle SPDT-CO, miniature	MTA-106E	ALCO Switch
6	NORMAL/REVERSE (1)	Switch, toggle, DPDT, miniature	MTA-206N	ALCO Switch
7	STANDBY (1)	Switch, toggle, 3PDT, miniature	MTA-306D	ALCO Switch
8	R172,205, 145,147	Potentiometer, 2K, Carbon Comp., linear	JA1N056S-202UA	Allen-Bradley
9	DS1,2,3,4	LED, light emitting diode, Red	MV5753	General Inst. (Monsanto)
10	1 each	Display Bezel with red optical filter	SSD-BZL	Dovetron
11	1 each	EMI Tempest Display Filter assembly	28817-09-0701-1183	Dovetron or Shielding Technology

The above item is also available (30-0501-5001) from Applied Shielding.

REAR PANEL

1	J1 - J8	Connector, BNC, Chassis Mount	31-221	Amphenol
2	1 each	Filter, Power, EMI-RFI	CGF20648	Genisco Technology
3	1 each	Panel, Rear, Tempest	RP-1(T)	Dovetron
4	T2	Transformer, Audio	TY34X	Dovetron or Triad
5	S8	Switch, Slide, DPDT, 115-230 VAC	46256LFE	Switchcraft
6	1 each	Connector, Power, AC mains	MS3106A-14S-7C	ITT-Cannon Amphenol

CABINET COMPONENTS

1	2 each	Handles, chrome	A2981-8	Unicorp, NJ
2	3 each	Knob, small	S1647-1L	Kurz-Kasch
3	2 each	Knob, large	S1653-1L	Kurz-Kasch
4	2 each	Washer, felt	FW-1	Dovetron
5	2 each	Lid, top/bottom	TP-179BLK	Intrafab
6	2 each	Rackmount side plate	SPHR-39BLK	Intrafab

BINARY BIT PROCESSOR (BBP-100) ASSEMBLY

1	1 each	Board, P.C.	75193	Dovetron
2	Z16, 24, 26, 27, 29, 36	Header, 8 pin	CA-08PF-11	Circuit Assy.
3	5 each	Bandwidth Modules	CA-08P-11	Circuit Assy.
4	U52, 53, 66, 67, 68, 69, 70, 71	I.C., Op-Amp, 8 pin, plastic DIP	UA/LM741CN	Signetics
5	U65	Integrated Circuit	MC14528B	Motorola
6	U57, 58, 59, 62, 64	I.C., Op-Amp, 8 pin, Plastic DIP	TL081CP	Texas Inst.
7	U54, 55, 56, 60, 61	Integrated Circuit	MC14066B	Motorola
8	U63	Integrated Circuit	CD4013AE	R.C.A.
9	R312, 313, 325, 326, 331	Res: 20K, 1%, Metal Film	2002-55D	Dale
10	R317, 350	Res: 9.1 Megohms, 1/4W, 5%, Carb.Comp.	RC07GF915J-OC99155	Ohmite
11	R337, 338	Res: 150K, 1/4W,	R25AJ150K	R-Ohm
12	R323, 324	Res: 100K	R25AJ100K	R-Ohm

13	R315, 316, 318 319, 343, 347	Res: 47K	R25AJ47K	R-Ohm
14	R332	Res: 4.7K	R25AJ4700	R-Ohm
15	R305, 311, 314, 321, 322, 327, 328, 329, 330, 335, 336, 339, 340, 342, 344, 351	Res: 20K	R25AJ20K	R-Ohm
16	R301, 302, 303, 304, 333, 341, 345, 346	Res: 10K	R25AJ10K	R-Ohm
17	R334	Res: 1K	R25AJ1000	R-Ohm
18	R310, 348, 349	Res: 470 Ohms	R25AJ470	R-Ohm
19	CR101, 102, 105, 106, 107, 108, 109, 110, 111, 112	Diode, Silicon, Signal	1N914B	Fairchild
20	CR113, 114	Diode, Zener, 7.5 VDC	1N755A	I.T.T.
21	C101, 103, 104	Cap: 4700 Mfd, 630 VDC, 5%	.0047J630	Plessey
22	C106	Cap: 2400 Mfd, Silver Mica	CM06FD-242J03	Arco Elect.
23	C105	Cap: 2000 Mfd, Silver Mica	CM06FD-202J03	Arco Elect.
24	C102	Cap: 390 Mfd, Silver Mica	CM05FD-391J03	Arco Elect.
25	C118, 119	Cap: 10 Mfd, 35 VDC, dipped Tant.	TAPS10M35	I.T.T.
26	C111	Cap: 1 Mfd, 35 VDC, Tubular tantalum	150D105X-9035A2	Sprague
27	C107, 108, 109 110	Cap: 0.1 Mfd, 250 VDC, 5%	0.1J250	Plessey
28	C112, 113, 114 115, 116, 117, 120	Cap: .01 Mfd, 50 VDC, Ceramic disc.	UK50-103	Centralab
29	12 each	Socket, 8 pin, low	CA-08SLP-TSD	Circuit Assy.
30	5 each	Socket, 8 pin, high	CA-08SE-TSD	Circuit Assy.
31	6 each	Socket, 14 pin, low	CA-14SLP-TSD	Circuit Assy.
32	1 each	Socket, 16 pin, low	CA-16SLP-TSD	Circuit Assy.

SOLID STATE DISPLAY (SSD-100) TEMPEST ASSEMBLY

1	1 each	Board, P.C.	75305	Dovetron
2	DS1/2	LED, Squire with PC assembly "D"	HLMP-2655	Dovetron
3	DS3,4,5	LED, Rectangular	MV57124	General Inst.
4	DS6,7,8,9	LED, Bargraph	MV57164F	General Inst.
5	CR5,6,7,8	Diode, Silicon	1N914B	Fairchild
6	CR1,2,3,4	Diode, Silicon	1N4007	General Inst.
7	Q1,2 & PC1	Socket, Transistor	3LPS-B	TRW/CINCH
8	Q1,2	Transistor, NPN	2N697 or 2N2219A	Motorola or R.C.A.
9	4 each	Socket, high, 20 pin for DS6 - DS9	CA-20S-TSD	Circuit Assy
10	U4	I.C., Op-Amp, 8 pin plastic, minidip	UA/LM741CN	Signetics
11	U3	Integrated Circuit	MC14011CP CD4011AE	Motorola or R.C.A.
12	U1,2	I.C., Bargraph Display Driver	LM3914N	National Semi.
13	5 each	Socket for DS1 thru DS5 LEDs	02STL-101WW	Circuit Assy
14	PC1	Photocell	VT841L	Vactec Corp.
15	R11,17,18	Potentiometer, P.C., Horizontal, 500K	U201R504B	C.T.S.
16	R1,6	Resistor, 1 Megohm 1/4W, 5%, Carb/film	R25AJ1MEG	R-Ohm
17	R13,23,24	Res: 30K	R25AJ30K	R-Ohm
18	R25,26	Res: 20K	R25AJ20K	R-Ohm
19	R12,14,15	Res. 4.7K	R25AJ4700	R-Ohm
20	R5,10	Res: 7.5K	R25AJ7500	R-Ohm
21	R2,7	Res: 2.7K	R25AJ2700	R-Ohm
22	R16	Res: 2K	R25AJ2000	R-Ohm
23	R4,9,19,20	Res: 1K	R25AJ1000	R-Ohm
24	R21,22,27	Res: 12 ohms	R25AJ12	R-Ohm
25	C1,2	Capacitor, 0.056 Mfd, 250 VDC	.056J250	Plessey
26	C3,4,5	Capacitor, .01 Mfd, 50 VDC, Disc Ceramic	UK50-103	Centralab
27	C6,7	Capacitor, 270 PFD, 1KV, Disc Ceramic	DD-271	Centralab

KEYBOARD OPERATE SEND (KOS-100T) TEMPEST ASSEMBLY

1	1 each	Board, P.C.	75175-2	Dovetron
2	U1,2,3,4	I.C., 8 pin, Plastic, DIP	UA/LM741CN	Signetics
3	U7	Integrated Circuit	MC14066B	Motorola
4	R28	Potentiometer, P.C., Horizontal, 500K	U201R504B	C.T.S.
5	R1	Resistor, 1 Megohm 1/4W, 5%, Carb/film	R25AJ1MEG	R-Ohm
6	R3,9	Res: 100K	R25AJ100K	R-Ohm
7	R20	Res: 47K	R25AJ47K	R-Ohm
8	R8,16,17,23	Res: 20K	R25AJ20K	R-Ohm
9	R4,5,6,10, 11,12,13,14, 15,18,19	Res: 10K	R25AJ10K	R-Ohm
10	R7,22,24	Res: 4.7K	R25AJ4700	R-Ohm
11	R27	Res: 1.5K	R25AJ1500	R-Ohm
12	R25	Res: 1.2K	R25AJ1200	R-Ohm
13	R2	Res: 1000 ohms	R25AJ1000	R-Ohm
14	Q3	Transistor, PNP, Silicon	2N5416	Motorola or R.C.A.
15	Q2	Transistor, NPN, Silicon	2N3439	Motorola or R.C.A.
16	Q1	Transistor, NPN,	2N697 or 2N2219A	Motorola or R.C.A.
17	DS2	LED, Rectangular, Red	MV57124	Gen. Inst.
18	DS1	LED, Round, Red	MV5753	Gen. Inst.
19	CR6,7	Diode, Silicon	1N4007	Gen. Inst.
20	CR1,2,3,4,5	Diode, Silicon	1N914B	Fairchild
21	C5	Capacitor, 10 Mfd, 35 VDC, dipped Tant.	TAPS10M35	I.T.T.
22	C1,2,3,4,7	Capacitor, 1 Mfd, 35 VDC, tubular tantalum	150D105X-9035A2	Sprague
23	C6	Capacitor, .01 Mfd, 50 VDC, ceramic disc.	UK50-103	Centralab