

INSTRUCTION MANUAL

DOVETRON MPC-1000C

MULTIPATH-DIVERSITY RTTY TERMINAL UNIT

E - SERIES

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

MPC-1000C.300 and up.

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THIS MANUAL IS COMPLETE WHEN SCHEMATIC DIAGRAM 75103E AND COMPONENT LOCATION PRINT 75100E ARE ATTACHED.

## PREFACE

Many schemes have been presented to improve the performance of RTTY Terminal Units in the presence of the anomalies of HF (3 to 30 MHz) radio propagation.

Most of them, with esoteric sounding names, like Automatic Threshold Corrector, Decision Threshold Computer, Axis Restorers, Hard Limiters and the like, addressed themselves to the problems of fading and noise.

It was reasoned that an FM discriminator with hard limiting would overcome the problems of AM noise pulses and fading. To a large extent, these designs were successful.

But too often, signals could still be heard, or seen in the various display units, and no copy could be had on the teleprinter.

Ingenuous circuits were devised that doubled (or quadrupled) the redundancy of the Baudot Code, and large capital investments were made in dual receiving installations that permitted Dual-Diversity operation, where two antennas, two receivers, and two terminal units with a combiner were used to drive a single teleprinter.

This approach certainly works better, as evidenced by the many Dual (polarization, frequency and space) Diversity systems in use today.

But little work was done in the area of In-Band Diversity, where the Mark and Space signals being transmitted by a single transmitter are received and treated as two independent AM stations operating a few hundred Hertz apart, both containing precisely the same information at the same time.

Systems that attempted such an AM Diversity approach, often called TTL, Two Tone Limiterless, usually ended up with a hard limiter to prevent hits from fast fades of the long marking pulses between the characters of keyboard signals.

Realizing that almost all terminal unit designs were adequate when operating with good signals, Dovetron initiated a program in 1971 to develop a terminal unit that would offer the best of both worlds: FM and its hard limiting, and Linear AM with its benefits of In-Band Diversity.

With the development of the AMTI-MARK/FADE circuit, it was possible to have all the advantages of AM Limiterless operation, taking full benefit of the independent action of the Mark and Space tone channels, and at the same time, not taking hits at slow keyboard speeds.

But it became obvious very early that another phenomena was present: Time and Frequency Dispersion of both the Mark and Space channels, i.e., Multipath Distortion.

Unlike Selective Fading, which is also a form of Multipath Distortion, the phenomena stretched and smeared the pulses in time and modulated each in frequency.

Dual trace oscilloscope analysis (using the computer designed Bessel Function filters in the Dovetron prototype) revealed that the information was there, but not in a form that a conventional FM terminal unit could copy.

Often considered a night-time phenomena on the lower frequencies, Multipath Distortion was also discovered to be present during the daylight hours on almost all signal paths in the HF spectrum. Conjecture led to the belief that this phenomena was probably caused by simultaneous auroral and/or equatorial side paths. The design goal was not to discover why it existed, but rather how to cope with it and demodulate the information available with the lowest possible error rate.

So in addition to designing a terminal unit that took advantage of selective fading as caused by Multipath Propagation, a design effort was made to cope with the smear and overlap of the alternating Mark and Space pulses.

The problem became more complex when it was determined that the strongest channel was not necessarily the wanted channel. The term MULTIPATH CORRECTOR<sup>TM</sup> was coined and Dovetron set out to develop one.

Many versions of Multipath Correction were developed. Some of them worked quite well. Some were very simple and others were very complicated. Some were asynchronous and had to be clocked at the incoming Baud rate, and others ran in an independent synchronous mode.

It was finally determined that a simpler asynchronous approach was feasible, was easy to manufacture, required no maintenance or adjustment, and produced the desired results.

Rather than quote error rate differentials, it is just simpler to say that if it can't be copied on the Dovetron MPC Series, it probably can't be copied.

To permit the MULTIPATH CORRECTOR<sup>TM</sup> to function properly, it was necessary to demodulate the Mark and Space channels without adding any significant perturbations. This was done with two identical VLF receivers, one tuned to the Mark frequency and the other tuned to the Space frequency. Their identicalness assured that any distortions or timing errors added to one channel would be added to the other in a like amount.

It worked. Multipath Correction became a reality without sacrificing the high performance of the Linear AM circuits.

The two identical receivers were incorporated into a single package with a common power supply. A CRT Cross Display was added for ease of tuning. Peripheral non-data circuits were added, and the Dovetron MPC-1000C became a finished product.

Needless to say, acceptance was immediate.

As feedback was collected from users in the field, additional features were incorporated into the design.

The culmination of this effort was realized with the sixth generation. Its designation is: E Series.

We sincerely hope you enjoy the performance of the E Series MPC-1000C as much as we enjoyed developing it.

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## SECTION I

### OPERATING HINTS

For the operator who prefers to turn on a new piece of equipment and read the manual later, the following is offered:

- 1) Attach power cord, teleprinter's loop line and audio line from receiver.
- 2) Set LOOP adjustment potentiometer on rear panel to full counter clockwise position (MIN).
- 3) Place all front panel toggle switches UP.
- 4) Set the LEVEL control at 9 o'clock.
- 5) Set the THRESHOLD control at 12 o'clock.
- 6) Set Mode switch to MS, which is the normal Mark-Space In-Band Diversity position.
- 7) Adjust Mark VFO to 2125 Hz.
- 8) Adjust Space VFO to desired space tone frequency:  
2295 Hz. for 170 Hz. shift.  
2975 Hz. for 850 Hz. shift.  
2550 Hz. is the proper space tone for 425 Hz. commercial shift.
- 9) Tune in a RTTY signal and start copying.
- 10) If garbled, reverse NORMAL/REVERSE switch.
- 11) Now sit back and read the rest of this manual and discover all the other things that the MPC-1000(C) can do.

If after reading the manual and studying the prints, should problems or questions persist, contact DOVETRON at 627 Fremont Avenue, South Pasadena, California, 91030, or call: 213-682-3705.

## SECTION II

### INSTALLATION INSTRUCTIONS

1. Observe the power-main requirements as marked on the rear panel just below the AC power cord receptacle.

The MPC-1000C may be internally strapped for 110 VAC or 220 VAC operation from single phase, 50 to 400 Hz power mains.

To change the AC input voltage range, remove the top and bottom covers and locate the voltage selection jumpers next to the wire leads of the power transformer. Two jumpers are required for 110 volt operation. Only one lead is required in the middle jumper holes for 220 volt operation.

2. A three-conductor power cord is supplied with the MPC-1000C. The third conductor in this cord should be connected to a good earth ground, both for safety and for high performance of the terminal unit.
3. The neutral high level (120 volt DC, 60 Ma.) output has its own internal loop supply. Do not attempt to use a teleprinter that has a wired-in internal loop supply. The loop supply is adjustable over the range of 40 to 70 milliamperes, and is fused at the rear panel with a 0.1 ampere fast blow fuse.
4. Connect the MPC-1000C to the power mains and connect teleprinter to appropriate high level loop jack or low level FSK output connector. Standard 2-way plugs will work in either loop jack, but a 3-way jack is provided should the teleprinter be wired with a tip/ring type plug.
5. Turn the MPC-1000C ON and observe that the front panel LOOP LED indicator is lit, indicating that the TU is turned on and that at least 50 Ma. of loop current is flowing thru the teleprinter.
6. If Autostart operation is desired, plug the power cord from the teleprinter's motor into the PRINTER power connector on the rear panel of the TU, place MOTOR switch in AUTOSTART and select either MARK or FSK Autostart control.

7. Place the mode switch in the MS-REV position. Teleprinter should print a continuous string of RYs. If not, consult SECTION VI (MODE SWITCH) and SECTION IX (RY GENERATOR).
8. Switch the mode switch to MS (Mark-Space Diversity) and connect audio input line from receiver to audio input connector on rear panel.

The MPC-1000C has a balanced and isolated 600 $\Omega$  input matching transformer and should be driven by a 500 to 600 $\Omega$  line for best performance. An unbalanced line may be used. The input impedance of the primary of this audio transformer may be changed to values lower than 600 $\Omega$  if required. Please refer to the LEVEL CONTROL portion of Section VI.

9. The MPC-1000C is now set up for basic operation and the additional front panel controls are self explanatory.

### SECTION III

#### GENERAL DESCRIPTION

The DOVETRON MPC-1000C Multipath-Diversity RTTY Terminal Unit is basically two identical low-frequency, single-conversion, solid-state receivers, whose outputs drive a MULTIPATH CORRECTOR<sup>TM</sup> circuit, which in turn, drives a high level keyer that outputs directly to a teleprinter.

Internal calibration adjustments permit the front panel VFOs to cover any 1900 Hz. segment between 100 Hz. and 4000 Hz.

An integral 2 inch CRT cross display indicates the Mark tone as a horizontal trace and the Space tone as a vertical trace. The selectivity of the channel filters and the scope amplifiers is such that time and frequency dispersions are readily apparent on the screen of the CRT.

The IN-BAND DIVERSITY mode of operation is automatic and single-channel (Mark-only or Space-only) copy is possible when one channel is lost due to deep selective fading or MAB (Make and Break) transmission modes as used in some satellite repeater operations.

In addition to Automatic Mark-Hold, Anti-Space and Anti-CW functions, the MPC-1000C also incorporates an ANTI-MARK-FADE (AMF) circuit that prevents false start pulses being generated by fast fades of the Marking pulse during slow speed (keyboard) operation.

A dual autostart circuit permits operator selection of auto-starting on a Marking carrier or on a signal with Mark-Space transitions. Neither mode responds to a continuous or keyed spacing carrier. The Mark mode does not respond to a spacing carrier, keyed or continuous.

Additional features provide for an external scope, external regeneration and code conversion, as well as diversity operation of two or more MPC-1000C terminal units without the use of a separate diversity combiner. The IN-BAND DIVERSITY capability of the MPC-1000C provides quad-diversity performance with only two terminal units, two receivers and two antennas.

The MULTIPATH-CORRECTOR<sup>TM</sup> circuit is an asynchronous regenerator that restores the proper Mark-Space transition points on RTTY signals that have been stretched or smeared by HF multipath propagation.

Capable of operating in excess of 50,000 baud, and taking its timing from the incoming signal, the MULTIPATH CORRECTOR™ circuit requires no internal or external clocks. No adjustments are required when changing speed.

Additional features include an internal high level loop supply (120 volts DC at .060 amps), two low level FSK voltage level outputs (EIA RS-232C and MIL STD 188C), and a phase-continuous sine-wave AFSK tone generator with an output of 60 Mv, peak to peak.

The Mark and Space tones of the AFSK tone generator are independently adjustable at the rear panel over the range of 1200 Hz. to 3100 Hz.

Other features include a front panel LED Signal Loss Indicator, remote controls for transmit, receive and standby functions, a LOCK line on transmit and two high level keyer output jacks.

The Signal Loss circuit is also buffered to the rear panel and may be used for system control or alarm circuits.

A proprietary Multipath Combiner circuit provides fully automatic operation of the MULTIPATH CORRECTOR™ under multipath signal conditions, as well as correlation and cancellation of noise.

Provision has also been made for the attachment of UART peripherals.

Normally wired for 110 volts, 40 Hz. to 400 Hz., single phase, simple internal jumper changes provide 220 volt operation.

Package size is 17" wide, 3.5" high and 9" deep. The cabinet is available in either a table-top or standard EIA 19" rack mounting configuration. Either unit weighs 11 pounds.

## SECTION IV

### SPECIFICATIONS

INPUT IMPEDANCE: 600 $\Omega$ , balanced and isolated. Adjustable to lower impedances.

INPUT LEVEL: 1 volt RMS Nominal. Useable from 5 millivolts to 25 volts RMS.

INPUT RATE: 45 to 75 baud. Field adjustable to other baud rates.

MARK-SPACE TONE FREQUENCIES: Variable from 1200 to 3100 Hz. with calibration points at 1275, 1360, 1445, 1575, 1700, 1870, 2000, 2125, 2295, 2425, 2550, 2775 and 2975 Hz.

OUTPUT CIRCUITS: High level solid-state neutral keyer with internal 120 volt DC loop supply. Current selectable and adjustable for 20, 40 and 60 mil operation.

Polar Keyer (PKC-100) option provides  $\pm 60$  VDC at 20 mils. Current range adjustable .

EIA RS-232C FSK voltage levels, 1K $\Omega$  output Z. Mark: -12vdc. Space: +12vdc.

MIL-STD-188C FSK voltage levels, 1K $\Omega$  output Z. Mark: +6vdc. Space: -6vdc.

Phase continuous, sine-wave AFSK tone generator. Output level: 60 millivolts with 470 $\Omega$  output Z. Tones independently adjustable at rear panel from 1200 Hz. to 3100 Hz. Balanced and isolated output option available.

Ext. scope connectors for dual-trace signal analysis.

Ext. connectors for regeneration, code conversion, crypto and speed changing peripherals.

Ext. connectors for dual-diversity use of two or more MPC-1000C terminal units without the need for an external diversity combiner.

Power connector for teleprinter's motor for autostart operation.

POWER REQUIREMENTS: 100 to 130 VAC or 200 to 260 VAC, internally selectable, 40 to 400 Hz., single phase, 25 watts.

POWER CORD: Standard detachable three-wire polarized cord.

TEMPERATURE RANGE: Operating: 0°C to 50°C.  
Storage: -55°C to +165°C.

#### PHYSICAL DESCRIPTION

DIMENSIONS: Table-top: 17" wide, 3.5" high and 9" deep.  
Rackmount: 19" wide, 3.5" high and 9" deep.

WEIGHT: 11 pounds operating.

SERVICING: The top and bottom covers are removable for maintenance. All internal adjustments are available from the top.

MAINTENANCE: Scheduled maintenance required: None.

KNOBS: Black insulated plastic.

RACKMOUNT: Standard EIA with mounting holds on 3.0" centers.

