J94027F P/AR TRANSMITTER/RECEIVER
DESCRIPTION, OPERATION, AND MAINTENANCE

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1. GENERAL INFORMATION

1.01 This section covers the description, operation, and maintenance of the J94027F P/AR transmitter/receiver. The J94027F (27F) replaces the J94027A, J94027C, J94027E P/AR generators and the J94027B P/AR receiver which are manufacture discontinued. The 27F transmitter/receiver is designed to provide a rating of some of the more important characteristics that affect the capability of a transmission facility to handle voiceband data signals. The P/AR rating is a measure of simultaneous effects caused by amplitude and/or envelope delay distortions, bandwidth reduction, and poor return loss present in the facility under test. Characteristics of the 27F transmitter/receiver are shown in Table A.

1.02 When this section is reissued, the reason for reissue will be given this paragraph.

A. General Description

1.03 The P/AR test system was developed to quickly identify data quality voice-frequency (VF) channels due to increased demand for data services on VF channels. As a single-weighted value, the P/AR unit rating can be used for the following functions.

(a) Characterize the combined effect of envelope delay distortion, bandwidth reduction, and low return loss evidenced by gain and phase ripples.

(b) Locate the L-multiplex trunks assigned to channels 1 and/or 12 by looking for the low P/AR reading caused by the envelope delay distortion (EDD) of the group filter on frequencies near the band edges.

(c) Screen private line facilities for approximate compliance to tariffed envelope delay distortion conditioning requirements. The P/AR spectrum and the tariffs give heaviest weighting to the envelope delay distortion in the center of the voiceband.

(d) Establish a benchmark type of measurement for a hardwire looped private line facility during circuit-order testing. P/AR test signal measurements made after the circuit has been turned up for service will determine the amount of parameter change and the general condition of the circuit.

1.04 The P/AR measurement requires a P/AR transmitter at one end of the VF channel under test and a P/AR receiver at the other end.

TABLE A

CHARACTERISTIC	27F P/AR TEST SET	
	TRANSMITTER	RECEIVER
Impedance (Balanced)	600 Ohms or 900 Ohms	600 Ohms or 900 Ohms
Number of Outputs	Two	Two (Input)
Pulse Repetition Freq	64 ms	
Pulse Polarity	Bilateral (Bipolar)	
True RMS Power Output Peak Power Output Average Power Output	True RMS Power Output Variable from 0 dBm to -41 dBm True RMS plus 10 dB RMS minus 5dB	
Input Attenuator Range		−2 dBm to −41 dBm
Power Supply	**(AC Line) 105 to 125 Vdc**	
Set Type	**Portable**	
Operating Temperature	0—50° C	
Overall Dimensions (Approximate, in inches)	17 Long 15 Wide 6 High	
Weight	18 Pounds	
Accuracy	±2 P/AR Units	
Resolution	1 P/AR Unit	
Measurement Ranges	0 to 199 P/AR Units	

The equipment may be used to test customer-to-customer connections, single trunks or loops, portions of trunks or loops (such as a channel of a carrier facility), or the voice transmission path through a signaling unit or other equipment.

1.05 While the primary purpose of the P/AR transmitter/receiver is to check for data-handling capability, it can also be useful in indicating the general transmission quality of a voiceband channel whether it is to be used for speech or for data.

1.06 The P/AR system will respond to a limited degree to other impairments such as noise, harmonic distortion, gain-slope distortion, phase jitter, repeater clipping, and compression. The 27F P/AR test system is superior to its predecessors because it is less sensitive to these impairments and unaffected by impulse noise and frequency shift.

1.07 On long-haul systems employing single sideband transmission, the 27F transmitter/receiver overcomes the problem of frequency shift by transmitting pulses made up of 16 frequency components from 125 + 15.625 Hz to 3875 + 15.625 Hz. [fn = (2n-1) 125 + 15.625 Hz, n = 1, 2, 3, ...16]. Without the 15.625-Hz offset, each spectral line is an odd harmonic of 125 Hz. Half-wave symmetry is produced by the absence of even harmonics, minimizing the influence of system intermodulation (nonlinear) distortion on the P/AR measurement.

1.08 The P/AR system responds to the ratio of the peak and full-wave rectified average values of a low duty-cycle test pulse transmitted over a trunk or circuit. This ratio is indicated on a zero-suppressed percentage basis relative to the undistorted test signal. That is, if the pulse is received undistorted, the P/AR meter receiver indicates 100. Distortion normally causes the peak-to-average ratio to be reduced, producing a reading lower than 100. For example, if the pulse is distorted so that the peak-to-average ratio is decreased 22 percent, the P/AR meter reading will be depressed 44 units from 100 to a P/AR reading of 56 since the actual P/AR indication decreases twice as fast as the percentage decrease in the ratio. A low value for this P/AR reading indicates that the test pulse has been dispersed or spread out in time as a result of the line distortion. These same effects cause intersymbol interference in a data signal.

1.09 A P/AR reading of 100 might be obtained on local facilities, but is not probable when testing over a carrier facility. Two main unavoidable impairments of a normal carrier channel are bandwidth restriction (due to the channel filters) and envelope delay distortion introduced at the band edges. However, the influence of strong echoes or high background noise can cause the P/AR reading to be above 100 and should be considered as carefully as the previously mentioned impairments that create very low P/AR readings.

1.10 Two common kinds of nonlinear distortion are clipping and compression. Clipping usually occurs as a nonsymmetrical distortion. That is, either the positive or the negative peaks of the transmitted signal are clipped. This kind of distortion frequently occurs in compandored carrier systems. When the 27F transmitter/receiver is used, clipping will be identical, independent of tip and ring, since the bilateral pulse alternates the sequence of polarity applied, and the peak-to-average ratios will be the same.

1.11 Symmetrical nonlinear distortions which affect the positive and negative portions of the test signal equally will not cause a polarity turnover effect. However, if the peaks of the P/AR test signal are compressed by the nonlinearity, the peak-to-average ratio will be reduced.

B. 27F P/AR Transmitter/Receiver Unit Description

1.12 The 27F P/AR transmitter/receiver is shown in Fig. 1. A block diagram of the 27F transmitter and receiver is shown in Fig. 2 and 3, respectively. The 27F equipment, unlike the other 27-type equipment, combines both the transmitter and receiver into a single unit.

> ***Note:*** The 27F test set is not compatible for use with any of the other 27-type units due to transmitter circuit changes and different signal processing methods used in the receiver of the 27F test set even though the envelope of the recovered test signal and the frequency spectrum are similar to those in the earlier P/AR units.

1.13 In addition to measuring P/AR values, the 27F test set measures the full-wave average and displays the rms level in dBm of the received P/AR line signal. Both the P/AR value and the rms level are displayed on a digital readout.

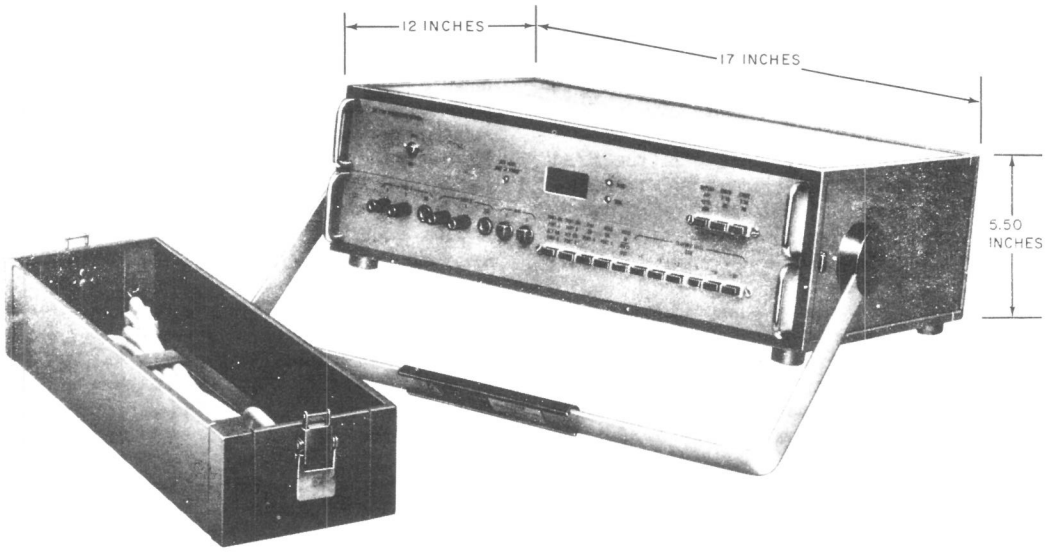


Fig. 1—J94027F P/AR Transmitter/Receiver

Indicator lights next to the readout indicate the measurement being displayed.

1.14 The 27F transmitter/receiver chassis is composed of two frame sections which are hinged together at the rear and opened at the front. The two frame sections are locked together in the close position using quarter turn fasteners. A large printed wiring board (PWB) and associated electronic components of the P/AR transmitter are contained by the lower frame, while a large PWB and associated electronic components of the P/AR receiver are contained by the upper frame. (See Fig. 4 and 5). This arrangement provides easy access and convenience during checking, adjusting, etc, and controls can be operated in the same manner as they are normally without any modification.

1.15 The 27F P/AR system is a portable transmitter/receiver that operates on a 105- to 125-volt, 60-Hz ac source. The ac power is converted to ±15 Vdc and +5 Vdc for use in both the transmitter and receiver circuits. Power is applied to the set through the male power cord receptacle located on the rear of the test set. The ac line is fused by a 1/2-ampere fuse located next to the power cord receptacle. A spare fuse is located next to the line fuse holder.

1.16 The 27F transmitter/receiver front panel and controls are shown in Fig. 6. Two pushbutton switches (TRMT ON PORT A RCV ON PORT B and TRMT ON PORT B RCV ON PORT A) are used for selection of PORT A and PORT B jack fields. The switches are interlocked to prevent simultaneous operations. When the TRMT ON PORT A RCV ON PORT B pushbutton is depressed, the tip (T) and ring (R) jacks of PORT A are used for transmission of the P/AR line signal and the T and R jacks of PORT B are used for receiving the line signal. When the TRMT ON PORT B RCV ON PORT A pushbutton is depressed, the T and R jacks of PORT B are used for transmission and the T and R jacks of PORT A, for receiving.

1.17 In addition to connections for routine P/AR testing, PORT A jacks should always be used when conducting P/AR tests on transmit and receive modes of a 2-wire wet connection. This type of connection requires a constant holding current for supervision which is supplied to the tip

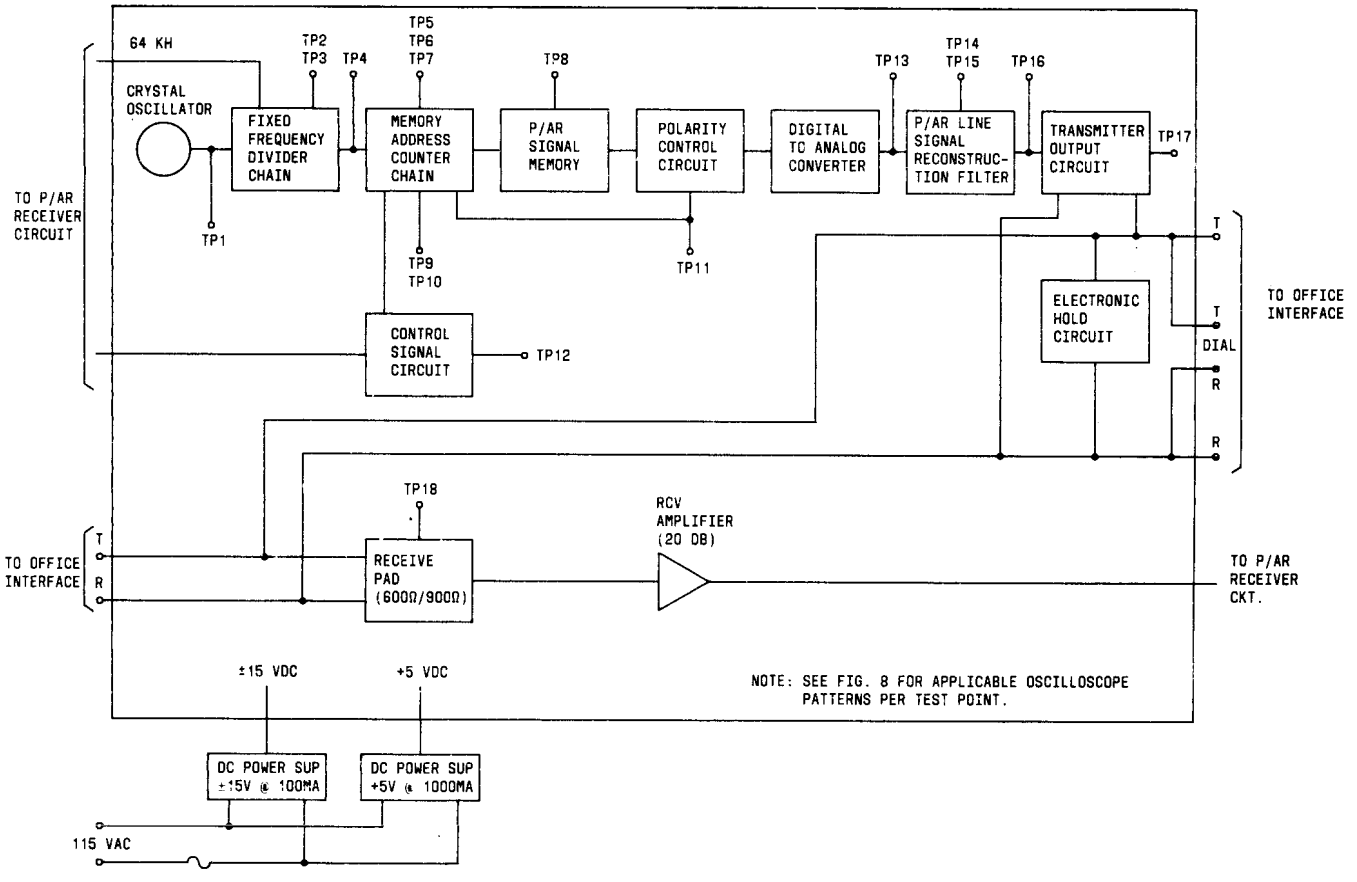
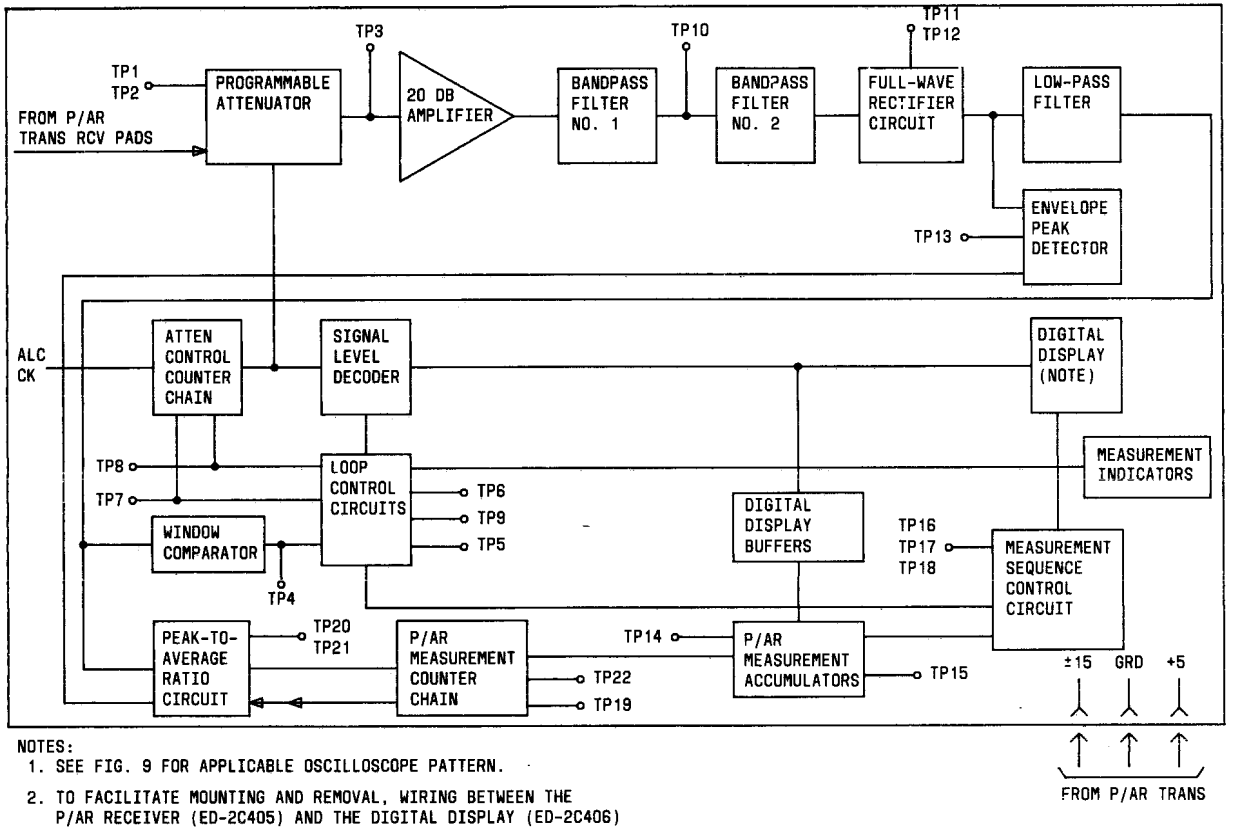


Fig. 2—27F P/AR Transmitter—Block Diagram



NOTES:
1. SEE FIG. 9 FOR APPLICABLE OSCILLOSCOPE PATTERN.
2. TO FACILITATE MOUNTING AND REMOVAL, WIRING BETWEEN THE P/AR RECEIVER (ED-2C405) AND THE DIGITAL DISPLAY (ED-2C406) HAS BEEN CONNECTORIZED.

Fig. 3—27F P/AR Receiver—Block Diagram

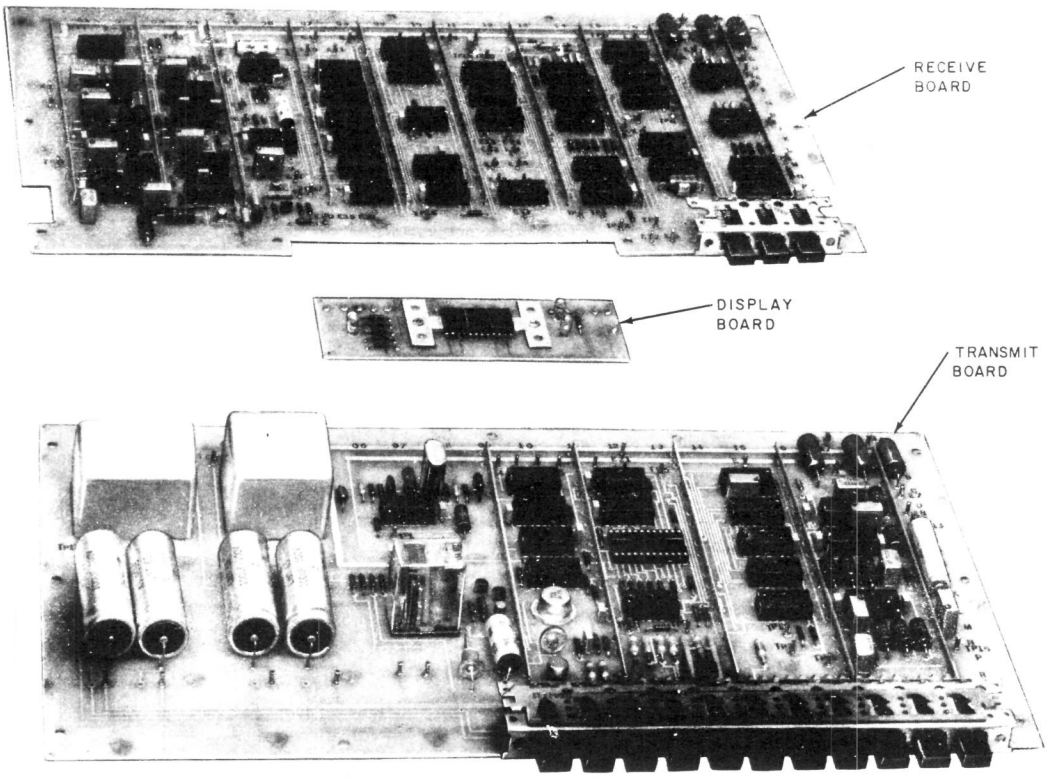


Fig. 5—27F Circuit Boards

When the pushbutton is released (out), a 600-ohm impedance is provided by a resistor pad within the 27F test set to match the impedance of the line under test during transmission and reception of the P/AR signal. When the pushbutton is depressed (in), a 900-ohm impedance is provided by a resistor pad for the transmission and reception of the P/AR signal input/output mode.

1.20 The TRANSMIT LEVEL DBM pushbutton switches select the output level of the P/AR signal in the transmit mode. The output level is selectable in 1-dB increments from 0 to -41 dBm (true rms) by depressing one or a combination of the six pushbuttons provided. The output level is equal to the sum of the values associated with each depressed pushbutton (eg, if -1, -3, -5, and -20 pushbuttons are depressed, the output level of the P/AR signal in the transmit mode is -29 dBm). When all six pushbuttons are released, the nominal transmit level is 0 dBm (true rms). Each switch operates independently, ie, push-to-actuate/push-to-release.

1.21 The 3-digit display and measurement indicator is used to display the P/AR rating of the received P/AR test signal over the range from 100 to 0 and the RMS value of the received signal from -2 dBm to -41 dBm. The display also indicates when the received signal level is either above or below the allowable range by displaying a plus (+) sign only for above range and a minus (-) sign only for below range in the P/AR rating measurement mode. In the RMS value measurement mode (range -2 dBm to -41 dBm), the digital disply will indicate -2 dBm for signal levels received above -2 dBm

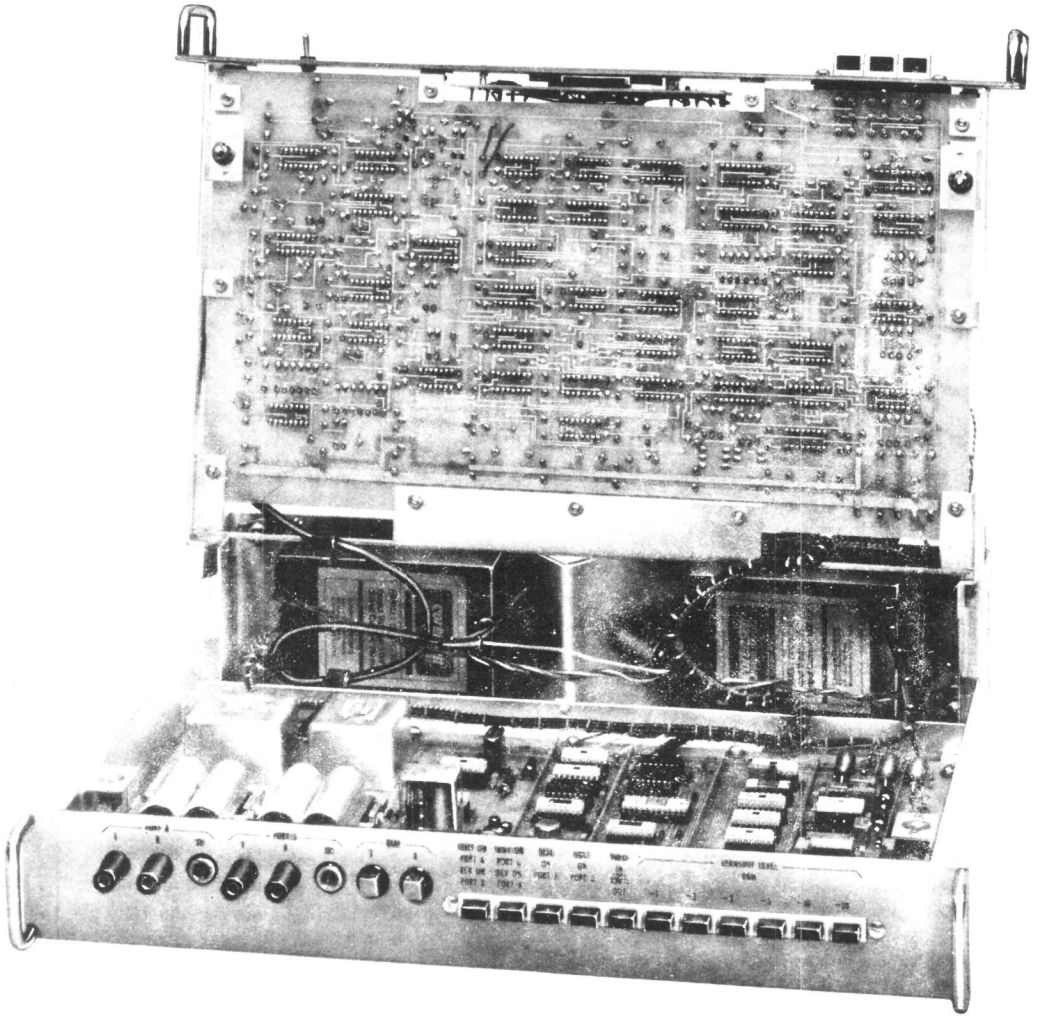


Fig. 4—27F Chassis Hinged Open for Service

and ring jacks of PORT A when the HOLD ON PORT A pushbutton is depressed.

1.18 The DIAL ON PORT A pushbutton, when depressed, connects the PORT A, T and R jacks to the DIAL T and R "cufflink" posts and disconnects the PORT A jacks from the internal transmission and receive circuits of the 27F test set. Dialing is accomplished through a maintenance handset connected to the DIAL T and R "cufflink" posts.

1.19 The 900Ω IN/600Ω OUT pushbutton serves a dual purpose by matching the 27F test set impedance to the characteristic impedance of the line under test in the transmit and receive modes.

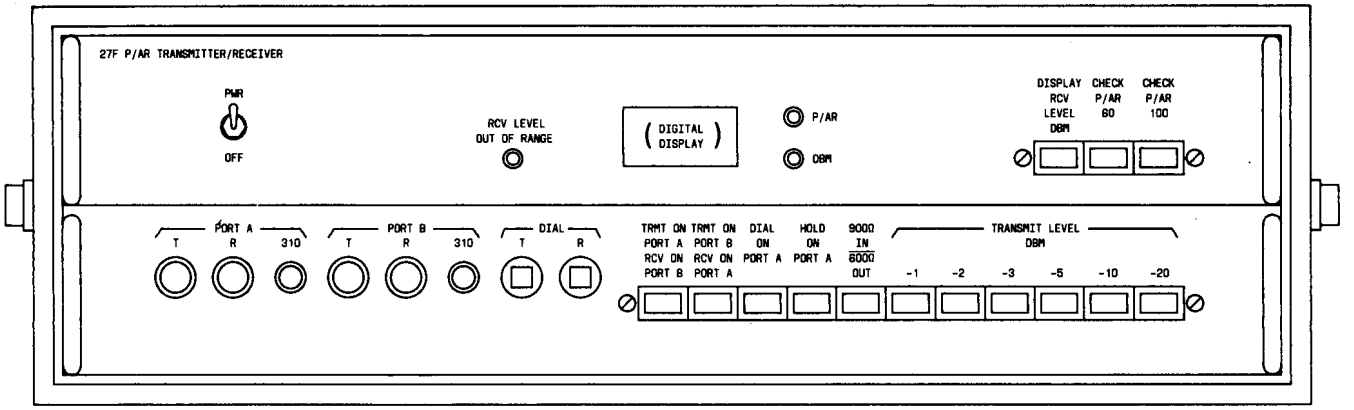


Fig. 6—27F P/AR Transmitter/Receiver Front Panel and Controls

and a -41 dBm for signal levels received below -41 dBm.

1.22 The three measurement indicators (P/AR, DBM, and RCV LEVEL OUT OF RANGE) are light-emitting diodes (LEDs) that are visible on the 27F test set front panel and indicate the status of the measurement shown on the digital display. When the P/AR rating is being measured, the P/AR LED is activated. When the RMS value in dBm of the received signal is being measured, the DBM LED is activated and, if the received signal level is not in the allowable range, the RCV LEVEL OUT OF RANGE LED is activated.

1.23 The DISPLAY RCV LEVEL DBM pushbutton switch, when depressed (in), causes the digital display and measurement indicator to show the received rms level of the P/AR test signal. Values ranging from -2 dBm to -41 dBm are displayed. Values greater than -2 dBm or less than -41 dBm are above or below range, respectively. When the pushbutton switch is released, the P/AR receiver reverts back to its normal measurement mode displaying P/AR rating units.

1.24 The 27F P/AR line signal transmission output can be checked by depressing (in) the CHECK P/AR 100 pushbutton which connects the transmitter circuit output internally to the receiver input and terminates PORT A and B jacks in 600 ohms. Result of the check is shown on the digital display in a P/AR rating unit. Releasing the pushbutton reestablishes the 27F transmitter/receiver to normal operation.

1.25 An operational check of the P/AR system is provided by operating the CHECK P/AR 60 pushbutton and observing the digital display for a P/AR rating of 60. When depressed, internal circuits simulating a VF channel with a P/AR rating of 60 shape a lower peak-to-average ratio signal output. Also, depressing the pushbutton connects the generator output internally to the receiver input and terminates the jacks of PORT A and PORT B in 600 ohms. Releasing the pushbutton reestablishes the 27F transmitter/receiver to normal operation.

1.26 The jacks of PORT A and PORT B accommodate 310-type plugs. The jacks are wired in parallel with binding-post-type terminals to accommodate spade clips. These access arrangements permit use of a variety of standard telephone test cords.

2. OPERATING INSTRUCTIONS

A. 27F Transmitter/Receiver—Calibration Check

2.01 The 27F transmitter/receiver calibration check should be performed periodically to verify the performance of the test set. The calibration check may be performed when the test set is connected or disconnected from on-line testing. The procedure is as follows.

STEP	PROCEDURE
1	Connect power cord to receptacle on rear of set to 115 volts, 60-Hz ac power line.
2	Operate PWR/OFF switch to PWR position.
3	Set the transmit level to -20 dBm by depressing the appropriate TRANSMIT LEVEL DBM pushbutton.
4	Depress and hold the CHECK P/AR 100 pushbutton.
5	Verify a P/AR reading on the digital display of 100±1 P/AR units.
	Note: When either the CHECK P/AR 100 or the CHECK P/AR 60 pushbutton is depressed, the digital readout (initially blank) will be displayed in approximately 4 seconds.

STEP	PROCEDURE
6	With the CHECK P/AR 100 pushbutton depressed, depress and hold the DISPLAY RCV LEVEL DBM pushbutton.
7	Verify that the receive level reading on the digital display is -20 dBm±1 dB.
8	Release the CHECK P/AR 100 and DISPLAY RCV LEVEL DBM pushbuttons.
9	Depress and hold the P/AR CHECK 60 pushbutton.
10	Verify a P/AR reading on the digital display of 60±1 P/AR units.
11	Release the P/AR CHECK 60 pushbutton.

B. 27F Transmitter/Receiver Setup and Measurement Procedures

2.02 In the following procedures, Procedure 1 is applicable to all facilities except P/AR tests conducted on 2-wire facilities requiring wet (battery and ground applied) off-hook connections for supervision. Procedure 2 lists the steps required for the setup and measurement of a 2-wire wet connection.

STEP	PROCEDURE 1
1	At the office testboard or equivalent, verify that circuit to be tested has been turned down from service.
2	Connect power cord to receptacle on rear of 27F test set to 115 volts, 60-Hz ac power line and operate PWR/OFF switch on front of test set to PWR position.
3	Select correct impedance to match impedance of line under test by operating the 900Ω IN/600Ω OUT pushbutton.
4	Select appropriate port (PORT A or PORT B) for transmitting (or receiving) by depressing TRMT ON PORT A RCV ON PORT B or TRMT ON PORT B RCV ON PORT A pushbutton.
5	Connect the 27F transmitter/receiver to line under test using appropriate test cords.
6	Verify that appropriate 27F test setup has been initiated at other end of line under test.
7	Read the P/AR measurement or the rms value of the received signal.

STEP	PROCEDURE 2
1	Perform Steps 1 through 3 of Procedure 1.

STEP	PROCEDURE
2	Depress TRMT ON PORT B RCV ON PORT A pushbutton.
3	Connect maintenance handset to T and R posts of DIAL function.
4	Depress DIAL ON PORT A pushbutton. ***Note:*** In the dial position (switch in), PORT A jacks are connected to the dial posts and disconnected from the internal circuitry.
5	Dial up the 107 test line. ***Note:*** The 107 test line transmits the P/AR signal along with other types of test signals. The 107 test line P/AR signal is compatible with the 27F P/AR transmitter/receiver. See Section 660-440-107 for additional 107 test line information including access procedures.
6	After 107 test line connection has been confirmed, depress HOLD ON PORT A pushbutton and release DIAL ON PORT A pushbutton. ***Note:*** Releasing the DIAL ON PORT A pushbutton sets the 27F in the measurement mode. The HOLD ON PORT A pushbutton must be fully locked in to prevent the dialup connection from being dropped.
7	Observe the P/AR measurement in P/AR rating units on the digital display. ***Note:*** The digital display will indicate the received level in dBm (true rms) when the DISPLAY RCV LEVEL DBM pushbutton is depressed.
8	To monitor test signals using a maintenance handset, depress DIAL ON PORT A pushbutton after test is in progress. Releasing the pushbutton reinstates the measurement mode on the test set.

3. CHECKS, ADJUSTMENTS, AND MAINTENANCE

A. General

3.01 It is recommended that all checks, adjustments, and/or maintenance be made as often as convenience permits and no less than once annually. In the event of a component failure or abnormal condition in the 27F P/AR test set, the test set should be sent to the appropriate service center for repair.

3.02 As an aid to checks, adjustments, and/or maintenance, typical 27F P/AR test set waveforms are shown in Fig. 7 through 9. The testpoints (TPs) correspond to those on the SD drawings and block diagrams.

3.03 The equipment required for checks, adjustments, or maintenance covering the 27F P/AR transmitter/receiver are as follows:

(a) 1 — RMS Voltmeter (Hewlett-Packard 3400A)

(b) 1 — DC Power Supply (Hewlett-Packard 6206B)

(c) 1 — Oscilloscope (Tektronix 549)

(d) 1 — Electronic Counter (Hewlett-Packard 5245L)

(e) 1 — Time Interval Unit (Hewlett-Packard 5262A)

(f) 1 — Multimeter (Triplett, KS-14510 L1)

(g) 1 — Digital Multimeter (Hewlett-Packard 3490A)

(h) 1 — Resistor, 600 ohms ±1% tolerance, 1/2 watt

(i) 1 — Resistor, 100 ohms ±1% tolerance, 1/2 watt

(j) 1 — Resistor, 900 ohms ±1% tolerance, 1/2 watt

(k) 1 — Attenuator (Daven, VT-795-G).

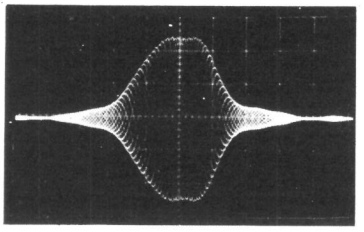
B. 27F Transmitter

3.04 The 27F line signal waveform check is as follows.

STEP	PROCEDURE
1	Connect external power (115 Vac, 60 Hz) to the 27F P/AR test set and operate PWR/OFF switch to PWR position.
2	Depress TRMT ON PORT A RCV ON PORT B pushbutton.
3	Set impedance to 600Ω by operating the 900Ω IN/600Ω OUT pushbutton.
4	Set TRANSMIT LEVEL DBM function to 0 dBm (all pushbuttons out).
5	Connect 600-ohm resistor between T and R jacks of PORT A.
6	Connect oscilloscope to T and R jacks of PORT A.
7	Set oscilloscope time base to 0.2 msec/cm.
8	Set the oscilloscope time base to the variable mode, and adjust control until the observed waveform has a single stationary lobe.
9	The observed waveform envelope should appear similar to Fig. 7A.
10	Disconnect oscilloscope and 600-ohm resistor from T and R jacks.

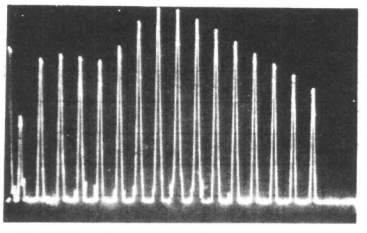
3.05 The 27F line signal spectrum check is as follows.

STEP	PROCEDURE
1	Perform Steps 1 through 5 of 3.04.
2	Connect spectrum analyzer to T and R jacks of PORT A.
3	Set analyzer controls as follows: FREQ SPAN — .5 kHz/DIV RESOLUTION BANDWIDTH — 10 Hz DISPLAY SMOOTHING — MIN SWEEP TIME — 10 SEC/DIV SWEEP MODE — REP AMPLITUDE MODE — 10 dB/DIV
4	At 1891-Hz frequency component of P/AR test signal (8th frequency component from 0 Hz, see 1.07), adjust input sensitivity and amplitude for peak value of 0 dB.
5	Adjust ADAPTIVE SWEEP to -55 dB level.
6	The observed spectrum should appear with 16 frequency components as shown in Fig. 7B. ***Note:*** All other spurious tones should be at least 50 dB below the 0-dB reference.
7	Verify that the 16 frequency components are separated by 250 Hz between each component.
8	See Table B for amplitude values of the 16 frequency components.
9	Disconnect spectrum analyzer and 600-ohm resistor from T and R jacks.



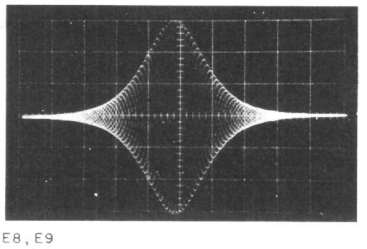
P/AR LINE SIGNAL ENVELOPE (T-R)
V = 1.0V
H = UNCALIBRATED
(TRANSMIT LEVEL = 0 DBM, AT 600 OHMS,
T-R TERMINATED WITH 600 OHMS)

A



P/AR LINE SIGNAL SPECTRUM (T-R)
V = 10 DB/DIV
H = 500 HZ/DIV
(REF: 1891 HZ COMPONENT = 0 DB)

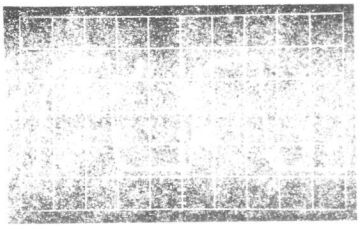
B



E8, E9
V = 0.5 V
H = UNCAL/.2 MS
(P/AR TEST SIGNAL
WITH P/AR = 100 — OUTPUT OF RECEIVER
SHAPING FILTER)

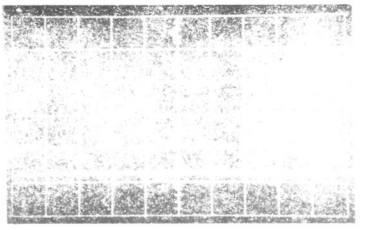
C

Fig. 7—Oscilloscope Patterns—27F Transmitter/Receiver



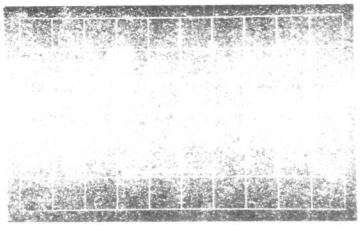
TP1
V = 1V
H = 0.2 μSEC
(CRYSTAL OSC OUTPUT – 1.024 MHZ)

A



TP7
V = 1V
H = 5 MSEC
(62.5-HZ PULSE WAVEFORM, 16 MSEC PERIOD,
PULSE WIDTH = 62.5 μSEC)

D

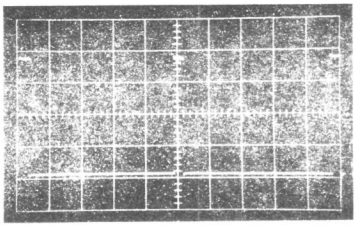


TP4
V = 1V
H = 10 μSEC
(SAMPLING FREQUENCY = 16.00 KHZ)

B

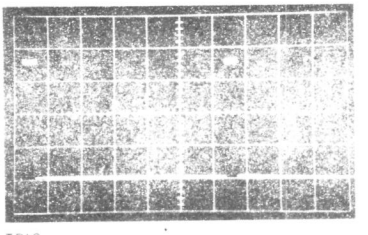
TP11
V = 1V
H = 10 MSEC
(15.625-HZ SQUARE WAVE
PERIOD = 64 MSEC)

E



TP5
V = 1V
H = 0.2 MSEC
(1.0-KHZ PULSE WAVEFORM,
PULSE WIDTH = 62.5 μSEC)

C



TP12
V = 1V
H = 10 MSEC
(15.625-HZ PULSE WAVEFORM,
PULSE WIDTH = 4.0 MSEC)

F

Fig. 8—Oscilloscope Patterns—27F Transmitter Circuits (Sheet 1 of 3)

TP13
V=2V
H=UNCAL
(D/A CONVERTER OUTPUT)

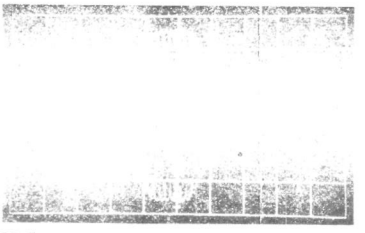
G

TP16
V=5V
H=UNCAL
(RECONSTRUCTION FILTER OUTPUT-
P/AR LINE SIGNAL)

J

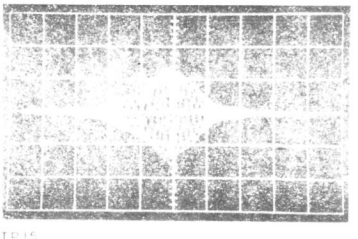
TP14
V=5V
H=UNCAL
(OUTPUT OF FIRST-ORDER SECTION
OF P/AR RECONSTRUCTION FILTER)

H



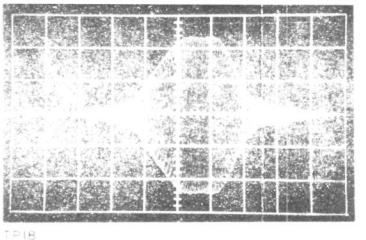
TP17
V=1V
H=UNCAL
(UNBALANCED SIDE OF TRANSFORMER T1-
P/AR LINE SIGNAL, 0 DBM, 600 OHMS)

K



TP15
V=5V
H=UNCAL

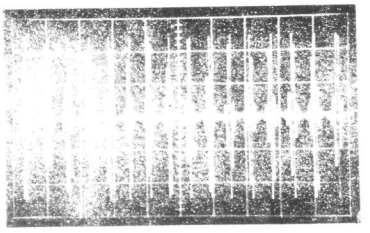
I



TP18
V=1V
H=UNCAL
(UNBALANCED SIDE OF TRANSFORMER T2-
RECEIVED P/AR SIGNAL, PAR=100,
0 DBM, 600-OHM TRANSMISSION)

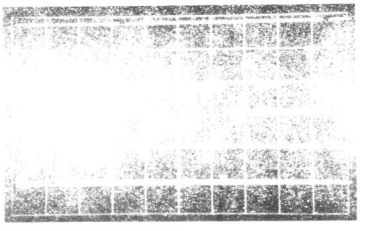
L

Fig. 8—Oscilloscope Patterns—27F Transmitter Circuits (Sheet 2 of 3)



P/AR LINE [illegible]
V=1.2V
H=6.4 MSEC
(TRANSMIT LEVEL [illegible] DBM AT 600 OHMS,
T-R TERMINATED IN 600 OHMS)

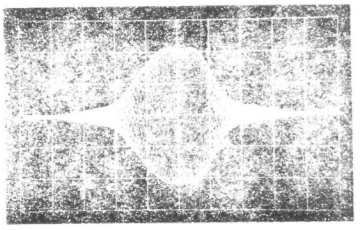
M



E3, E4 (E5, E6
V=5V
H=20 MSEC
(E3 (P/AR CLK)-SQUARE WAVE,
PERIOD=1.28 MSEC)
(E4 (PK RESET)-RETANGULAR PULSE
PULSE WIDTH=4 MSEC)
(E5 (CLEAR)-RECTANGULAR PULSE,
PULSE WIDTH=4 MSEC)
(E6 (ALCCK)-PULSE WAVEFORM,
PULSE WIDTH=62.5 μSEC)

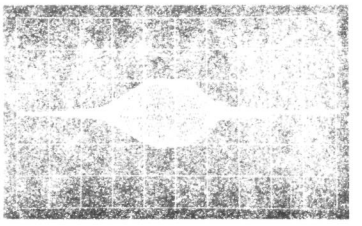
N

Fig. 8—Oscilloscope Patterns—27F Transmitter Circuits (Sheet 3 of 3)



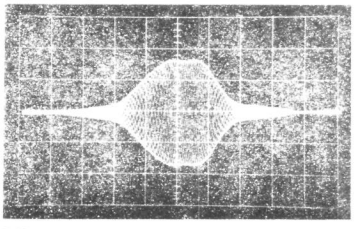
E1
V = 1.0V
H = UNCAL / .2 MS
(INPUT TO AUTOMATIC LEVEL CONTROL)

A



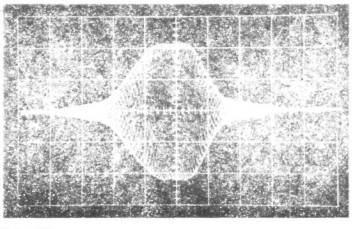
TP3
V = 0.1 V
H = UNCAL / .2 MS
(OUTPUT OF STAGE 3 OF PROGRAMMABLE ATTENUATOR)

D



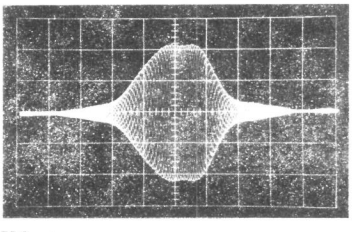
TP1
V = 1V
H = UNCAL / .2 MS
(OUTPUT OF STAGE 1 OF PROGRAMMABLE ATTENUATOR)

B



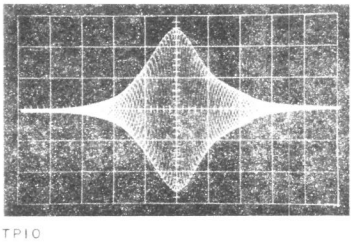
E6, E7
V = 0.5V
H = UNCAL / .2 MS
(INPUT TO RECEIVER SHAPING FILTER)

E



TP2
V = 0.5V
H = UNCAL / .2 MS
(OUTPUT OF STAGE 2 OF PROGRAMMABLE ATTENUATOR)

C



TP10
V = 0.5V
H = UNCAL / .2 MS
(OUTPUT OF BANDPASS FILTER NO. 1)

F

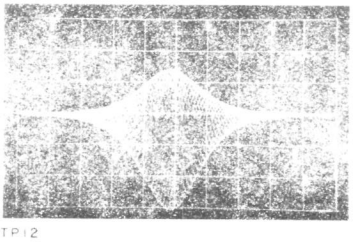
Fig. 9—Oscilloscope Patterns—27F Receiver Circuits (Sheet 1 of 3)

TP11
V = 2V
H = UNCAL/.2 MS
(OUTPUT SIGNAL OF INVERTING HALF-WAVE RECTIFIER)

G

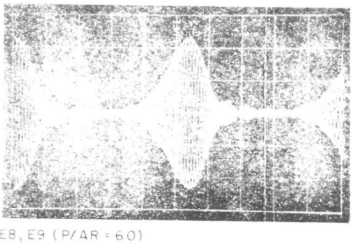
E1 (PAR = 60)
V = 1.0V
H = UNCAL/0.5 MS
(RECIVED P/AR SIGNAL AT INPUT TO AUTOMATIC LEVEL CONTROL)

J (NOTE 2)



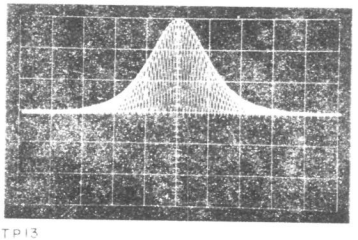
TP12
V = 1.0V
H = UNCAL/.2 MS
(OUTPUT SIGNAL OF NON-INVERTING RECTIFIER)

H



E8, E9 (P/AR = 60)
V = 0.5V
H = UNCAL/.5 MS
(P/AR TEST SIGNAL FOR SELF-TEST PAR = 60)

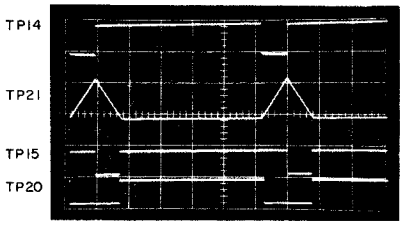
K (NOTE 2)



TP13
V = 1.0V
H = UNCAL/.2 MS
(FULL-WAVE RECTIFIED P/AR TEST SIGNAL)

I

Fig. 9—Oscilloscope Patterns—27F Receiver Circuits (Sheet 2 of 3)



TP14, 15, 20, 21
V = 5.0V
H = 20 MS
(TP14 PULSE SIGNAL THAT DRIVES RATIO CIRCUIT FET SWITCH, PERIOD = 128 MSEC, PULSE WIDTH = 16 MSEC)
(TP15 ENABLE SIGNAL FOR P/AR ACCUMULATOR, PERIOD = 128 MSEC, PULSE WIDTH = 16 MSEC)
(TP20 OUTPUT OF A RATIO CIRCUIT THRESHOLD COMPARATOR, PERIOD = 128 MSEC, PULSE WIDTH = 32 MSEC)
(TP21 OUTPUT OF RATIO CIRCUIT INTEGRATOR, PERIOD = 128 MSEC, PULSE WIDTH = 32 MSEC)

L

NOTES:
1. ALL CPS 2 OSCILLOSCOPE PATTERNS SHOWN WERE OBTAINED WITH TRANSMITTER AND RECEIVER CONNECTED BACK-TO-BACK (P/AR = 100). TRANSMIT LEVEL = −15 DBM AT 600 OHMS.
2. THE P/AR 60 SELF TEST SIGNAL MAY BE GENERATED CONTINUOUSLY BY GROUNDING TERMINAL E1 ON CP1.

Fig. 9—Oscilloscope Patterns—27F Receiver Circuits (Sheet 3 of 3)

NOTES

TABLE B

COMPONENT NO.	FREQUENCY (Hz)	AMPLITUDE (dB)
1	141	−34.0 ± 2.0
2	391	−16.0 ± 0.5
3	641	−14.6 ± 0.4
4	891	−15.2 ± 0.4
5	1141	−16.3 ± 0.3
6	1391	−11.9 ± 0.2
7	1641	−4.1 ± 0.2
8	1891	0.0 ± 0.05
9	2141	−0.43 ± 0.2
10	2391	−3.2 ± 0.2
11	2641	−6.7 ± 0.3
12	2891	−10.0 ± 0.3
13	3141	−13.7 ± 0.4
14	3391	−17.3 ± 0.5
15	3641	−21.0 ± 0.5
16	3891	−24.9 ± 0.8

3.06 The 27F output level and impedance check is as follows.

STEP	PROCEDURE
1	Perform Steps 1 through 5 of 3.04.
2	Connect the rms voltmeter between the T and R jacks of PORT A.
3	Verify rms voltmeter reading of 0.0±1.0 dBm.

STEP	PROCEDURE

4 Verify the following rms voltmeter values when the appropriate TRANSMIT LEVEL DBM pushbuttons are depressed to obtain the listed output level for the 27F:

OUTPUT TRANSMIT LEVEL SETTING (dBm) OF 27F TRANSMITTER	RMS VOLTMETER MEASUREMENT (dBm)
0	0.0 ± 1.0 = REF LEV*
−1	−1.0 ± 0.2 + REF LEV
−2	−2.0 ± 0.2 + REF LEV
−3	−3.0 ± 0.2 + REF LEV
−5	−5.0 ± 0.2 + REF LEV
−10	−10.0 ± 0.2 + REF LEV
−20	−20.0 ± 0.2 + REF LEV

* REF LEV is actual value shown on the RMS VM at TRANSMIT LEVEL 0 which may be a small deviation from the 0 value up to ±1.0 dBm. To obtain a true measurement with the RMS VM, meter readings must be adjusted to include the deviation.

5 Readjust TRANSMIT LEVEL DBM function to 0 dBm (all pushbuttons out).

6 Disconnect 600-ohm resistor from T and R jacks of PORT A of the 27F transmitter.

7 Set impedance to 900Ω by operating the 900Ω IN/600Ω OUT pushbutton.

8 Connect a 900-ohm resistor between the T and R jacks of PORT A.

9 Connect the rms voltmeter between the T and R jacks of PORT A.

10 A reading of REF LEV + 1.8±0.2 dBm should be indicated on the rms voltmeter.

Note: Readings for the 27F output signal in the 900-ohm mode will be 1.8±0.2 dBm higher on the rms voltmeter due to an impedance mismatch. The rms voltmeter input impedance is 600 ohms.

11 Repeat Step 4. The rms voltmeter will reflect the listed measurement result plus 1.8±0.2 dBm setting for each output level setting.

12 Disconnect the rms voltmeter and 900-ohm resistor from T and R jacks of PORT A.

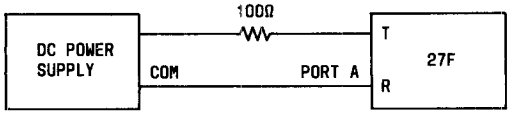
STEP	PROCEDURE
13	Readjust TRANSMIT LEVEL DBM function to 0 dBm.
14	Depress TRMT ON PORT B RCV ON PORT A pushbutton.
15	Set impedance to 600Ω by operating the 900Ω IN/600Ω OUT pushbutton.
16	Connect 600-ohm resistor between T and R jacks of PORT B.
17	Connect the rms voltmeter between T and R jacks of PORT B.
18	Repeat Steps 3 through 12 using T and R jacks of PORT B for P/AR signal transmission check.

3.07 The 27F dial control check is as follows.

STEP	PROCEDURE
1	Set PWR/OFF switch to OFF position and release DIAL ON PORT A pushbutton.
2	Set the multimeter (Triplett, KS-14510, L1) to test for continuity.
3	Connect the multimeter between tip jack (T) of PORT A and tip jack (T) of DIAL.
4	An "open" (no continuity) reading should be indicated.
5	Depress DIAL ON PORT A pushbutton and observe multimeter reading.
6	Meter should indicate continuity.
7	Release DIAL ON PORT A pushbutton and connect the multimeter between ring (R) jack of PORT A and ring (R) jack of DIAL.
8	The multimeter should indicate an "open" circuit.
9	Depress DIAL ON PORT A pushbutton and observe multimeter.
10	The multimeter should indicate continuity.
11	Release DIAL ON PORT A pushbutton and disconnect test equipment from the P/AR unit.

3.08 The 27F holding function check is as follows.

STEP	PROCEDURE
1	Set PWR/OFF switch to OFF position.
2	Prepare the following test setup:



3	Depress HOLD ON PORT A pushbutton.
4	Connect the dc voltmeter (H-P 3490A) between T and R jacks of PORT A.
5	Adjust the dc power supply to obtain the voltages indicated in Table C (V_{TR}) for the T and R jacks of PORT A.

TABLE C

VOLTAGE MEASURED BETWEEN T AND R JACKS OF PORT A (V_{TR})	$V_{PS} - V_{TR}$
50.0 ± 0.1	2.6 ± 0.3
40.0 ± 0.1	2.6 ± 0.3
30.0 ± 0.1	2.6 ± 0.3
20.0 ± 0.1	2.5 ± 0.3
10.0 ± 0.1	2.4 ± 0.3

6	Measure the corresponding power supply voltage and subtract the T and R voltage (V_{TR}) from the power supply voltage (V_{PS}).
7	The difference voltage (V_{PS}-V_{TR}) should be as specified in Table C.
8	Reverse connections shown in Step 2 to T and R jacks of PORT A and repeat Steps 4 through 7.
9	Release HOLD ON PORT A pushbutton and disconnect test setup.

C. 27F Receiver

3.09 The 27F receiver detector null adjustment is as follows.

STEP	PROCEDURE
	Note: SD-1C167-01 will be required for reference in the following steps.
1	Perform Steps 1 through 3 of 3.04.
2	Depress TRANSMIT LEVEL DBM -10 pushbutton.
3	Remove 27F cover for circuit access of CP2 (see 1.14 and Fig. 4 and 5).
4	Connect E7 on CP2 to circuit ground using clip leads.
5	Connect the digital multimeter (H-P 3490A) to terminal E14 on CP2 and adjust multimeter to read dc volts.
6	Adjust variable resistor R67 on CP2 until meter indication is 0.000±0.002 volts.
7	Disconnect multimeter.
8	Connect E19 on CP2 to circuit ground using clip leads.
9	Connect digital multimeter to terminal E12 on CP2.
10	Adjust variable resistor R72 on CP2 until meter indication is 0.000±0.002 volts.
11	Disconnect multimeter.
12	Remove clip leads connecting E7 and E19 to circuit ground and replace cover.

3.10 The 27F receiver P/AR ratio circuit adjustment is as follows.

STEP	PROCEDURE
1	Perform Steps 1 through 3 of 3.04.
2	Depress TRANSMIT LEVEL DBM -10 pushbutton.
3	Depress CHECK P/AR 100 pushbutton and observe digital display.

STEP	PROCEDURE
4	Display indication should be in the range from 90 to 110.
5	Adjust electronic counter (H-P 5245L) to measure time interval using time interval unit (H-P 5262A).
6	Adjust controls on time interval unit as follows: START, STOP TRIGGER LEVELS to +2 START, STOP MULT to 1 MODE function set to COM START SLOPE to "-" STOP SLOPE to "+"
7	Remove 27F cover necessary for circuit access of CP2 (see 1.14 and Fig. 4 and 5).
8	Connect START input of time interval unit between TP15 on CP2 and circuit ground (E38).
9	Adjust variable resistor R85 on CP2 until counter indicates 15.600±0.02 msec.
10	The 27F digital display should indicate a P/AR rating of 100.
11	Disconnect time interval unit.
12	Connect oscilloscope to terminal E8 on CP2 and set time base to 0.2 msec/cm.
13	Place time base generator on oscilloscope in variable mode and vary time base control until the observed waveform appears stationary.
14	The observed waveform should appear similar to Fig. 7C.

3.11 The 27F receiver autoranging and level measurement check is as follows.

STEP	PROCEDURE
1	Perform Steps 1 through 4 of 3.04.
2	Connect T and R jacks of PORT A to attenuator (Daven, VT-795-G or equivalent) input and T and R jacks of PORT B to attenuator output.

STEP	PROCEDURE
3	Set the attenuator controls and the 27F DISPLAY RCV LEVEL DBM pushbutton as indicated in Table D.
4	Verify that the corresponding 27F digital display reading and measurement indicators (LED) are as shown in Table D for each setting.
5	Disconnect the attenuator.

TABLE D

ATTENUATOR SETTING (dB)	27F DISPLAY RCV LEVEL DBM PUSHBUTTON POSITION	27F DIGITAL DISPLAY READOUT	MEASUREMENT INDICATORS (LED)		
			RCV LEVEL OUT OF RANGE	P/AR	DBM
43	OUT	—	ON	ON	OFF
	IN	−41	ON	OFF	ON
40	OUT	100 ± 1	OFF	ON	OFF
	IN	−40 ± 1	OFF	OFF	ON
30	OUT	100 ± 1	OFF	ON	OFF
	IN	−30 ± 1	OFF	OFF	ON
20	OUT	100 ± 1	OFF	ON	OFF
	IN	−20 ± 1	OFF	OFF	ON
10	OUT	100 ± 1	OFF	ON	OFF
	IN	−10 ± 1	OFF	OFF	ON
3	OUT	100 ± 1	OFF	ON	OFF
	IN	−3 ± 1	OFF	OFF	ON
0	OUT	+	ON	ON	OFF
	IN	−2	ON	OFF	ON

4. REFERENCES

4.01 The following references contain additional information.

NUMBER	TITLE
660-440-107	107-Type Test Line for Data Transmission Description
SD-1C167-01	27F P/AR Transmitter/Receiver
CD-1C167-01	27F P/AR Transmitter/Receiver Circuit
801-250-162	J94027-Type P/AR Meter Equipment Design Requirements—Common Systems