



**DR 6/11-135A and 135EC
1×N Frequency Diversity
Operation and Maintenance
Radio Transmitter
Test Procedures**

Contents	Page
1 Introduction	5
1.1 Safety Labels	5
1.2 Service Protection	5
1.3 Maintenance Philosophy	6
1.4 Test Equipment	6
1.5 Helpful Information	6
2 Flowcharts	7
2.1 Annual Tests (Flowchart 1)	8
2.2 Transmitter Alignment (Flowchart 2)	9
2.3 Unit Replacement and Alignment (Flowchart 3)	11
2.4 Where to Go From Here (Flowchart 4)	12
3 Alignment—Common Items	13
3.1 Voltage Checks	13
3.2 MWV GEN Power	14
3.3 MWV GEN Frequency (“Annual”)	16
3.4 IF Predistorter Input/Output Levels	23

AT&T— PROPRIETARY

This document contains proprietary information of AT&T and is not to be disclosed or used except in accordance with applicable agreements

Copyright © 1996 AT&T
Unpublished and Not for Publication
All Rights Reserved
Printed in U. S. A.

Contents	Page
4 Alignment—TWT	28
4.1 Helix and Beam Current (TWT)	28
4.2 Initial Output Power (TWT)	30
4.3 Linearization (TWT)	33
5 Alignment—Solid State	49
5.1 Up-Converter IF Input Level (Solid State)	49
5.2 Initial Output Power (Solid State)	52
5.3 Linearization (Solid State)	55
6 Unit Tests—Common	70
6.1 ALC Voltage ("Annual")	70
6.2 Up-Converter Gain	72
6.3 Slope and Frequency Response	76
6.4 Intermodulation Isolation	87
7 Unit Tests—TWT	101
7.1 RF MON Calibration (TWT)	101
7.2 Amplifier Gain (TWT)	107
7.3 Power Supply and Amplifier Evaluation (TWT)	111
8 Unit Tests—Solid State	118
8.1 RF MON Calibration (Solid State)	118
8.2 Amplifier Gain (Solid State)	124

Contents	Page
Figures	
1 MWV GEN Power Check	15
2 MWV GEN Frequency Check	17
3 IF Predistorter Input Level Check	25
4 IF Predistorter Output Level Check	27
5 RF MON Power Measurement—TWT	31
6 Establish 3-Tone Test Signal Level	35
7 RF MON Power Measurement (with 3-Tone Test Signal Applied)	37
8 Measuring Linearity at RF MON (with Predistorter)	39
9 Spectrum Display Example	41
10 IF Predistorter Output Level Check	43
11 RF MON Power Measurement—TWT	45
12 Up-Converter Input Level Check	51
13 RF MON Power Measurement—Solid State	53
14 Establish 3-Tone Test Signal Level	57
15 RF MON Power Measurement (with 3-Tone Test Signal Applied)—Solid State	59
16 Measuring Linearity at RF MON (with Predistorter)	61
17 Spectrum Display Example	63
18 IF Predistorter Output Level Check	65
19 RF MON Power Measurement	67
20 Up-Converter Gain Check	73
21 Establish IF Test Signal Level and Center Frequency	77
22 Calibrate Test Equipment Back-to-Back	81
23 Measure Amplitude vs. Frequency Response—TWT	83
24 Measure Amplitude vs. Frequency Response—Solid State	85
25 Establish 3-Tone Test Signal Level	89

Contents	Page
Figures	
26 Measuring Linearity at RF MON (Predistorter Bypassed)—TWT	91
27 Measuring Linearity at RF MON (Predistorter Bypassed)—Solid State	93
28 Establish 3-Tone Test Signal Level at Predistorter Output	97
29 Measure IF Predistorter Linearity and Adjust Distortion Level	99
30 RF OUT Power Measurement—TWT	103
31 RF MON Power Measurement—TWT	105
32 TWT Amplifier Gain Check	109
33 RF OUT Power Measurement—Solid State	119
34 RF MON Power Measurement—Solid State	121
35 328A Amplifier Gain Check	125
Flowcharts	
1 Annual Tests	8
2 Transmitter Alignment (Sheet 1 of 2)	9
3 Unit Replacement and Alignment	11
4 Where to Go From Here	12
Tables	
A 6-GHz Regular Frequency Plan	19
B 6-GHz Staggered Frequency Plan	20
C 11-GHz Regular Frequency Plan	21
D 11-GHz Alternate Frequency Plan	22
E Intermodulation Requirements	95
F Watts-to-dBm Conversions—TWT and Solid State	106
G Dummy Load Requirements	114
H Watts-to-dBm Conversions—Solid State	123

1 Introduction

Procedures for testing and adjusting a DR 6/11-135 radio transmitter are included in this tab. These procedures may be referenced from any of these other tabs:

- ANNUAL TESTS
- TROUBLE ISOLATION
- DEGRADED PERFORMANCE.

1.1 Safety Labels

Safety labels are strategically-placed symbols and messages that will alert you to potential risks. There are three types of safety labels.



DANGER:

DANGER indicates the presence of a hazard that **will** cause death or severe personal injury if the hazard is not avoided.



WARNING:

WARNING indicates the presence of a hazard that **can** cause death or severe personal injury if the hazard is not avoided.



CAUTION:

CAUTION indicates the presence of a hazard that **will** or **can** cause minor personal injury or property damage if the hazard is not avoided.

Within the **CAUTION** safety label, the term "property damage" refers also to possible service interruption or impairment.

Please refer to the Safety Labels heading in the **START HERE** tab for additional information about, and examples of, safety labels.

1.2 Service Protection

With no exceptions, service must be protected before any out-of-service tests are performed.

Service protection generally consists of:

- Regular Channel, manually line-switch service to Protection
- Protection Channel, manually lock out the Protection channel.

Please refer to the **SERVICE PROTECTION** tab for details on service protection.

1.3 Maintenance Philosophy

This section is made up of individual radio transmitter test procedures. Very few of the procedures, however, stand alone. Each unit in a DR 6/11 radio transmitter interacts very closely with all the other units. As a result, almost any adjustment you make will require a Transmitter Alignment. The only "stand-alone" tests you will perform are those associated with the annual tests, and they are "stand-alone" only if no adjustments are made.

Which of the procedures you will perform depends on the "event" that brought you to this section.

There are only two events that initiate digital radio maintenance:

- Annual tests, listed in the **ANNUAL TESTS** tab
- Trouble, in either of two categories;
 - Equipment Alarms
 - Degraded Performance.

To perform maintenance, start at the **START HERE** tab where a flowchart will direct you to the **ANNUAL TESTS** tab, **DEGRADED PERFORMANCE** tab, or appropriate **TROUBLE ISOLATION** tab.

After the maintenance has been completed, go to the **END HERE** tab to return the equipment and station to normal operation.

1.4 Test Equipment

You will use the Digital Radio Test System (DRTS) for all maintenance procedures in this section. Refer to the **DRTS** tab for:

- Operating instructions
- Accessory Kit parts (item) list
- Accessory Kit item location.

1.5 Helpful Information

Several methods have been used to make this version of documentation easier and more convenient to use.

- a. Most steps and instructions are short, concise statements.
- b. In longer procedures, brief summary statements, called comments, are provided to tell you what you are about to do, or have just done. *They are in oblique type like this* and are information only, no action required.
- c. Your attention will be directed to specific items of test equipment and/or operating units using UPPERCASE type.

- d. In every procedure that requires the use of the POWER METER, the first appearance includes the statement:

“Calibrate the POWER METER, if necessary.”

Power meter calibration is required only when the test set is first turned on, before testing is started each day, or if the display flashes a “PLEASE ZERO” message.

Bypass the calibration if you have already calibrated it.

Within that procedure, any following uses of the power meter will refer only to entering the required OFFSET value.

- e. Test setups (figures) use graphic representations of the test set, each test item and the involved portion of the equipment bay. Circles or rectangles around numbers and letters identify the location of the test item in the DRTS accessory case. Additional test items shown in the figures, but not part of the DRTS, are listed in the **TEST EQUIPMENT** and **ACCESSORIES** tab.
- f. In some procedures, you may be instructed to **record** a value on the RADIO DATA CARD. You may also be asked to **note** a level for use in a later step. A note is a temporary reminder and should not be recorded on the RADIO DATA CARD.
- g. When you complete a procedure, look ahead to the test setup figure in the next procedure you are going to do. You will often be able to save time by reusing many of the same connections and test items.

2 Flowcharts

Three flowcharts are provided to direct you through the transmitter procedures.

a. Annual Tests

This is the “flow” you will perform most often. There are two required radio transmitter procedures;

- ALC Voltage
- MWV GEN Frequency.

If both requirements are met, you are done with this transmitter.

b. Transmitter Alignment

Transmitter Alignment is the process of performing all the tests necessary to ensure correct signal levels and linearity within the radio transmitter.

While performing a transmitter alignment, you will not need to work directly from the flowchart. All the “flow” information and possible variations from the direct path are written into the individual procedures. A shaded instruction block will direct you to the next procedure in the Transmitter Alignment Flowchart. For abnormal conditions you will be directed to other flowcharts.

c. Unit Replacement and Alignment.

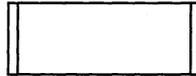
After most units are replaced, you will be directed to the Transmitter Alignment Flowchart.

If a Transmitter Alignment is required after replacing a unit, you may bypass any steps in the Transmitter Alignment Flowchart that you have already performed if:

- The requirements were met.
- Nothing has been done that would change the earlier results.

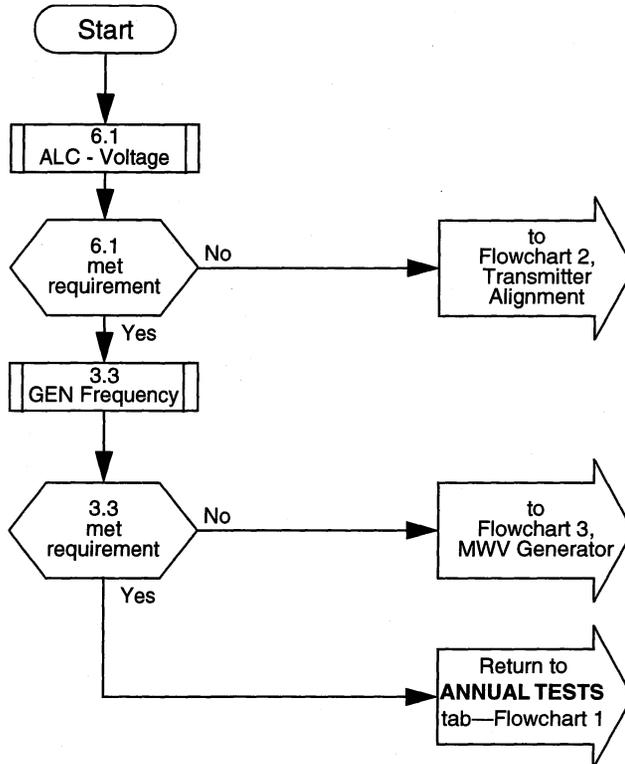
A fourth flowchart, (Flowchart 4) will guide you to what needs to be done next.

Flowchart instructions and symbol explanations can be found in the **START HERE** tab. An important flowchart symbol is this "return to" symbol,



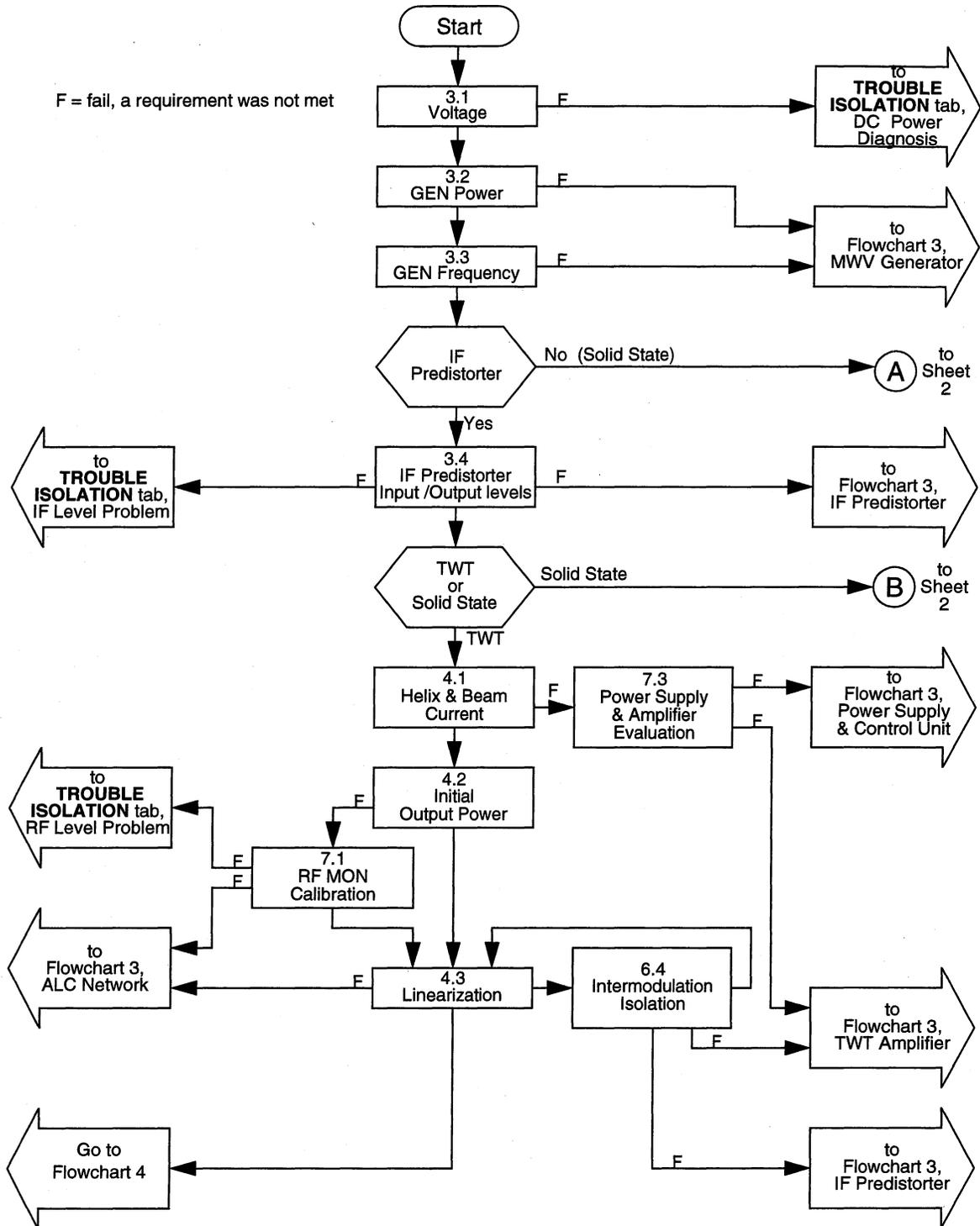
(a rectangle with double vertical side lines). It means, "return to this point in the flowchart after you complete the instruction or procedure described within the rectangle".

2.1 Annual Tests (Flowchart 1)

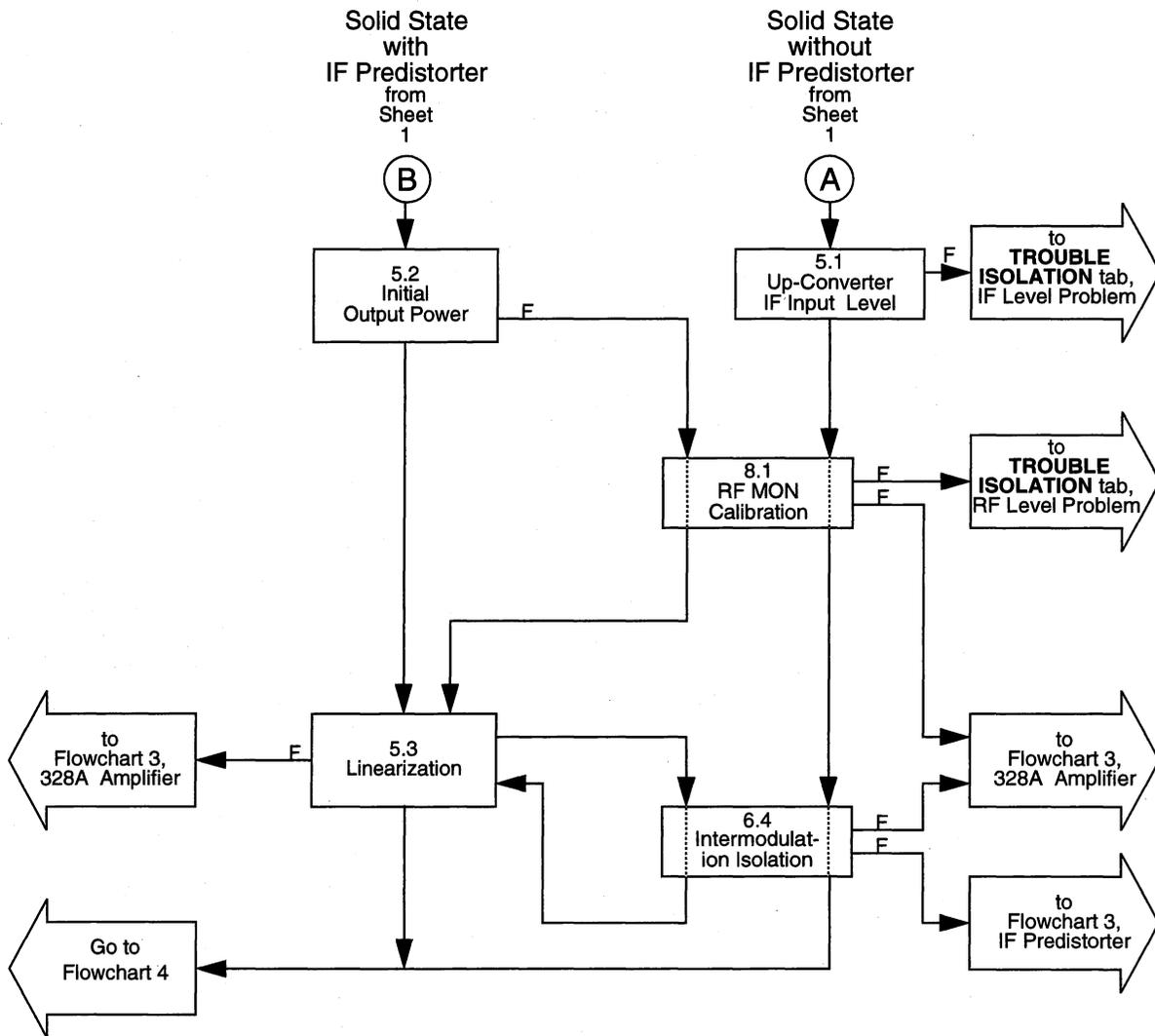


Flowchart 1. Annual Tests

2.2 Transmitter Alignment (Flowchart 2)



Flowchart 2. Transmitter Alignment (Sheet 1 of 2)

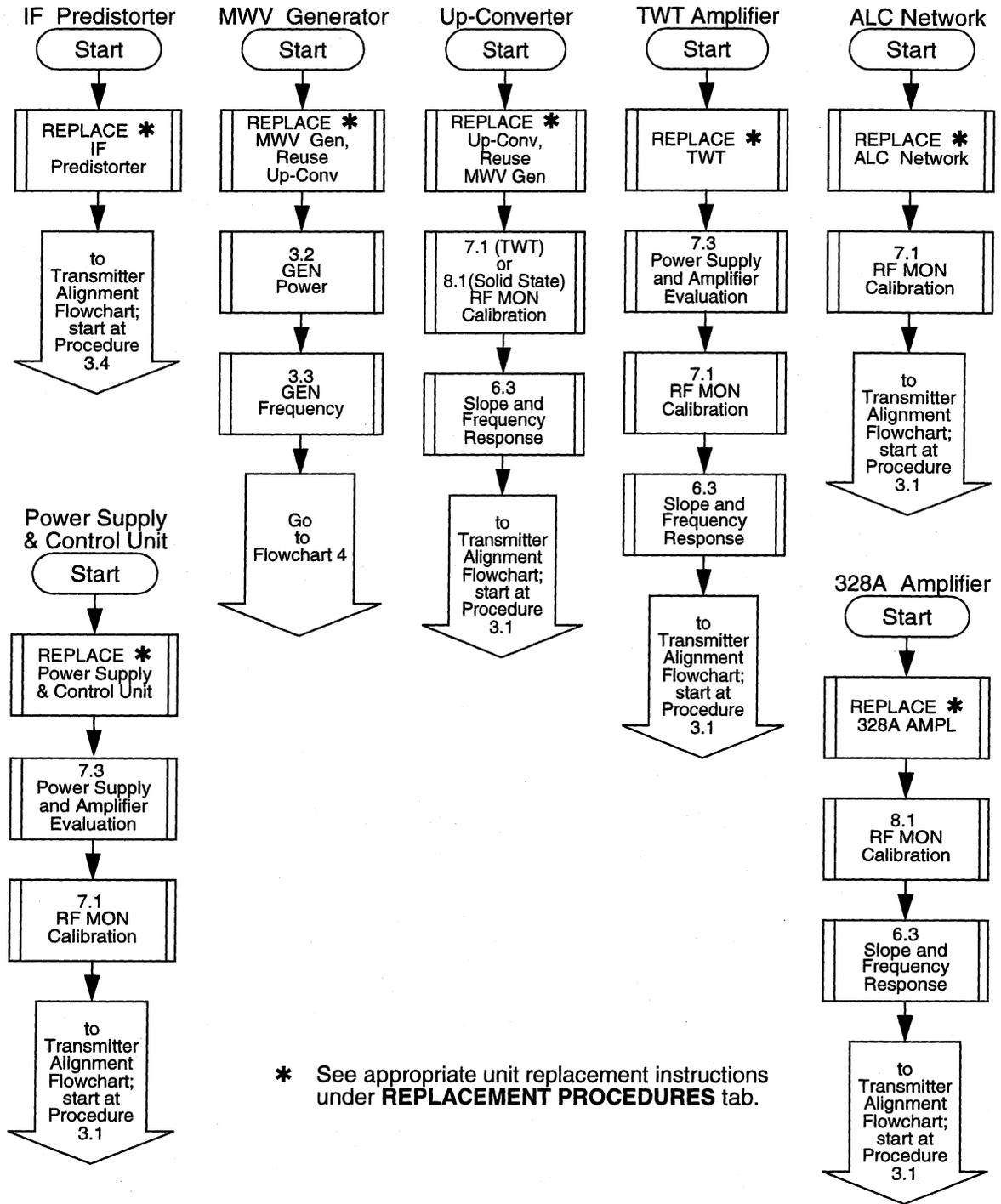


F = fail, a requirement was not met

Flowchart 2. Transmitter Alignment (Sheet 2 of 2)

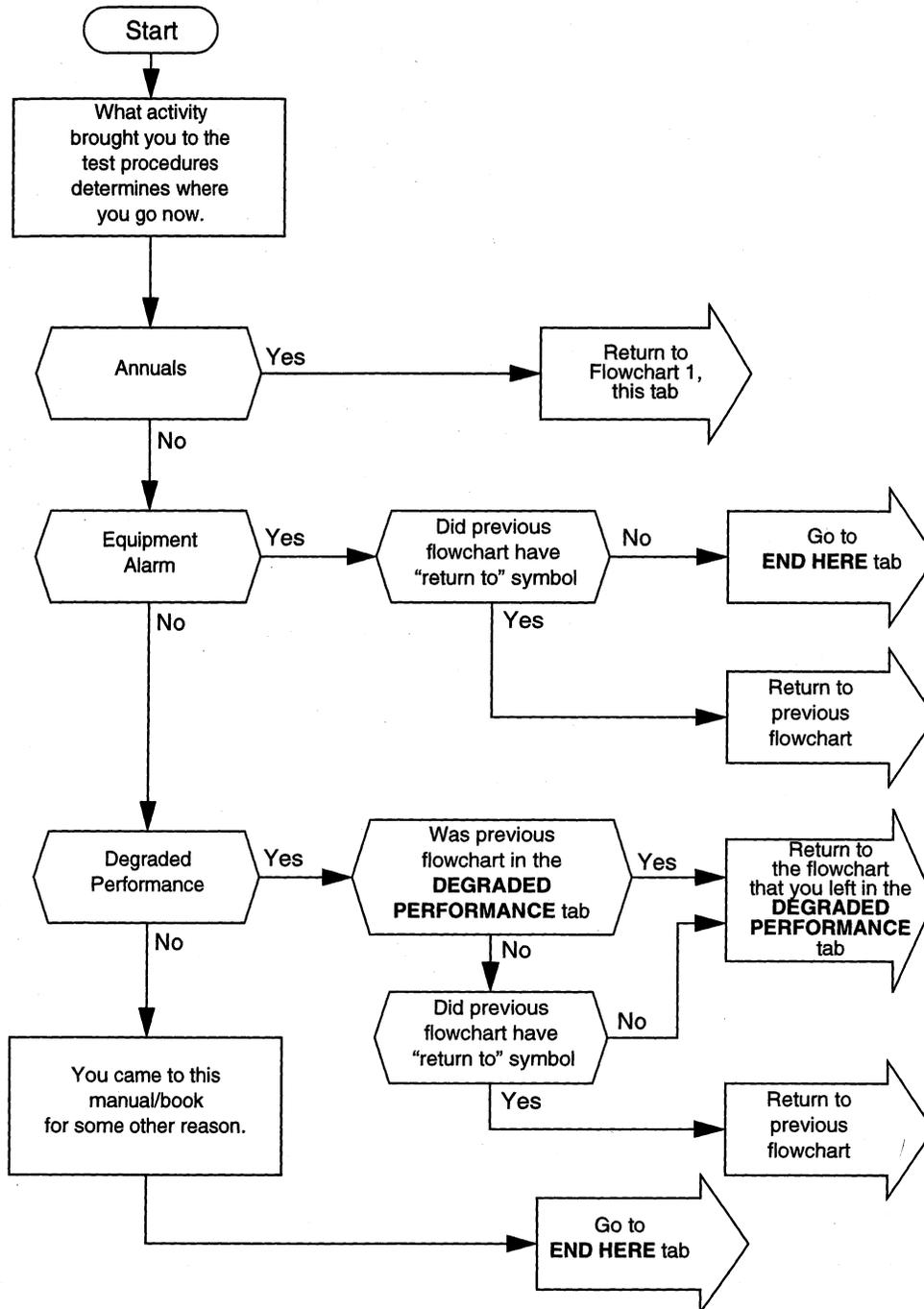
AT&T— PROPRIETARY
See notice on first page

2.3 Unit Replacement and Alignment (Flowchart 3)



Flowchart 3. Unit Replacement and Alignment

2.4 Where to Go From Here (Flowchart 4)



Flowchart 4. Where to Go From Here

AT&T— PROPRIETARY
See notice on first page

3 Alignment—Common Items

3.1 Voltage Checks



CAUTION:

Service will be interrupted or impaired if you operate the ALC ON/OFF switch or make an adjustment on an in-service radio bay.

Step	Procedure
1	<p>On the ALARM AND METER unit:</p> <p>a. Operate the selector switch to TRMTR +5V.</p> <p><i>Requirement:</i> Display indicates 5.00 ±0.30.</p> <p>b. Operate the selector switch to TRMTR +15V.</p> <p><i>Requirement:</i> Display indicates 15.00 ±0.40.</p> <p>c. Operate the selector switch to TRMTR -15V.</p> <p><i>Requirement:</i> Display indicates -15.00 ±0.40.</p>
2	<p>Is this a SOLID STATE transmitter?</p> <p>YES - Go to Step 3.</p> <p>NO - Go to Step 4.</p>
3	<p>On the ALARM AND METER unit,</p> <p>operate the selector switch to TRMTR +10V.</p> <p><i>Requirement:</i> Display indicates 10.00 ±0.30.</p>
4	<p>On the ALARM AND METER unit,</p> <p>operate the selector switch to TRMTR OFF.</p> <p>Were all requirements met?</p> <p>NO - Go to the TROUBLE ISOLATION tab, 2.1 DC Power Diagnosis.</p> <p>YES - Test completed.</p> <p><i>Transmitter Alignment path</i></p> <div style="border: 1px solid black; padding: 2px; text-align: center;"> <p>Go to Procedure 3.2, MWV GEN Power.</p> </div>

End of Procedure

AT&T— PROPRIETARY
See notice on first page

3.2 MWV GEN Power

This procedure is used to test the output power of the microwave generator portion of the TRANSMITTER UP CONV & MWV GEN unit.



CAUTION:

This is an Out-of-Service procedure. Service will be interrupted or impaired unless you apply Service Protection measures.

Step	Procedure
1	<p>On the TEST SET:</p> <p>a. Calibrate the POWER METER, if necessary.</p> <p style="padding-left: 40px;">Reference: DRTS tab, 2.2 Calibration.</p> <p>b. Enter the OFFSET (as shown on the POWER SENSOR) for measurement of RF between -30 dBm and +10 dBm (about 30 dB).</p> <p style="padding-left: 40px;">Reference: DRTS tab, 2.3 Entering Offset.</p>
2	<p>On the TRANSMITTER UP CONV & MWV GEN,</p> <p style="padding-left: 40px;">remove the termination from the GEN MON jack.</p>
3	<p>Connect the test equipment as shown in Figure 1.</p> <p>Requirement:</p> <ul style="list-style-type: none"> ■ 0 dBm \pm 3 dB on the power meter display ■ TRMTR—GEN OVEN indicator not lighted on the ALARM AND METER unit. <p>Are the requirements met?</p> <p>NO - Go to Flowchart 3, Unit Replacement and Alignment—MWV Generator.</p> <p>YES - Update the RADIO DATA CARD—TRMTR “GEN MON PWR”, if necessary.</p>
4	<p>Return to the flowchart or procedure that sent you here.</p> <p style="text-align: center;"><i>Transmitter Alignment path</i></p> <div style="border: 1px solid black; padding: 5px; text-align: center;"> <p>Go to Procedure 3.3, MWV GEN Frequency.</p> </div>

End of Procedure

AT&T— PROPRIETARY
See notice on first page

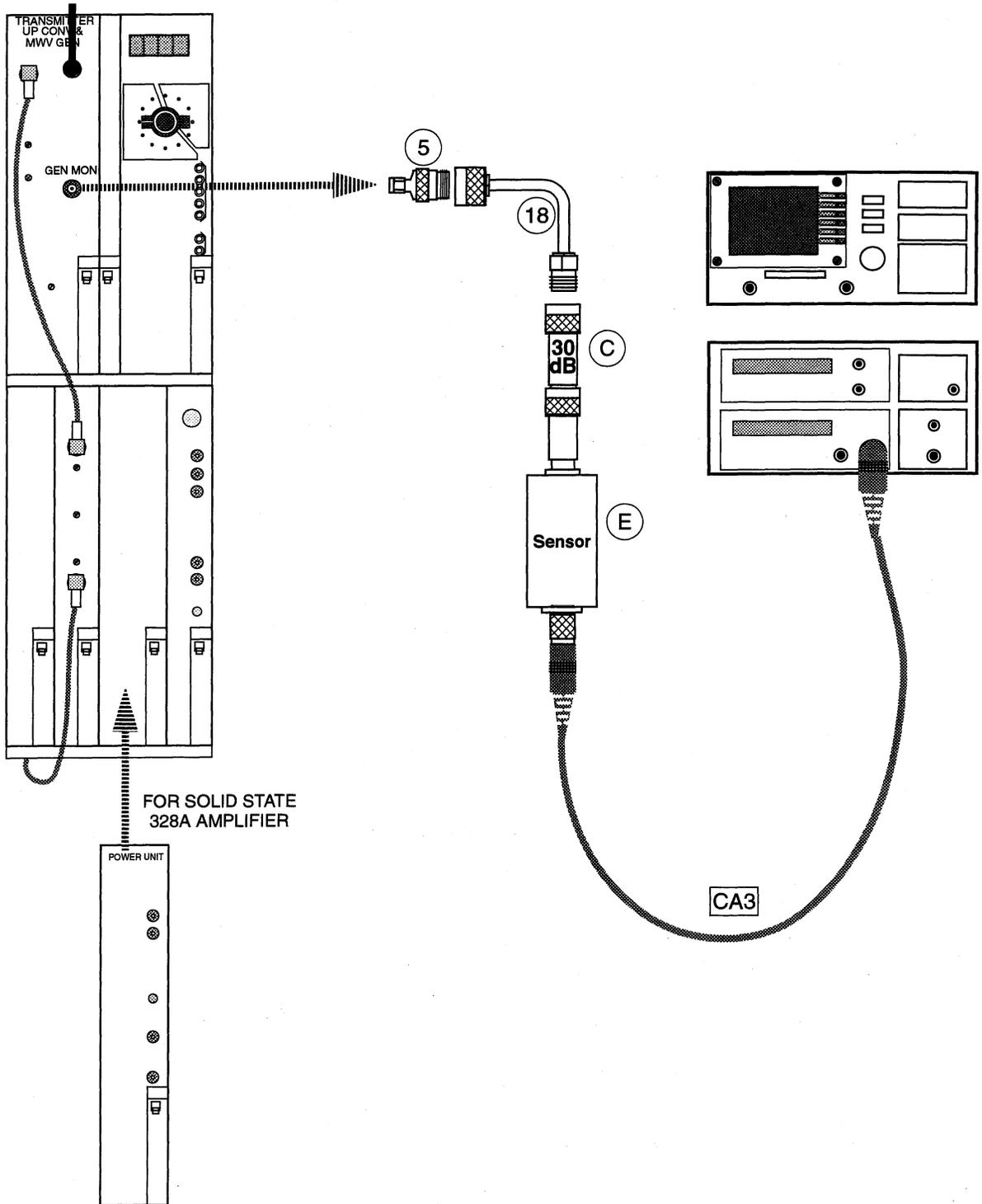


Figure 1. MWV GEN Power Check

AT&T— PROPRIETARY
See notice on first page

3.3 MWV GEN Frequency ("Annual")

This procedure is used to check and adjust the output frequency of the microwave generator portion of the TRANSMITTER UP CONV & MWV GEN unit.

Prerequisite: TRMTR—GEN OVEN indicator not lighted on the ALARM AND METER unit.



CAUTION:

This is an Out-of-Service procedure. Service will be interrupted or impaired unless you apply Service Protection measures.



NOTE:

For an accurate measurement, the microwave generator must be warmed up at least 1 hour before making any frequency measurements.

Step	Procedure
1	Connect the test equipment as shown in Figure 2.
2	On the SPECTRUM ANALYZER: <ol style="list-style-type: none"> a. Press the green PRESET key. <p><i>Comment: FREQ COUNTER softkey should be displayed on screen; if it is not, load "GROUP 1" menu.</i></p> <p style="text-align: center;">Reference: DRTS tab, 1.6 Downloading User Programs.</p> <ol style="list-style-type: none"> b. Press FREQ COUNTER softkey. c. Press FREQ softkey to select (underline) 22. d. Press Resoln softkey. e. Press 1 KHz softkey. f. Read the frequency. <p>To determine the Oscillator Frequency (f_o) of the microwave generator being tested, match the letter designation on the latch label of the TRANSMITTER UP CONV & MWV GEN with the Latch Label Code column of Table A, B, C, or D and read the frequency from the Oscillator Frequency column.</p>

Requirement: For FCC

- 6 GHz: frequency within ± 120 kHz (± 0.120 MHz) of f_o
- 11 GHz: frequency within ± 240 kHz (± 0.240 MHz) of f_o .

AT&T— PROPRIETARY
See notice on first page

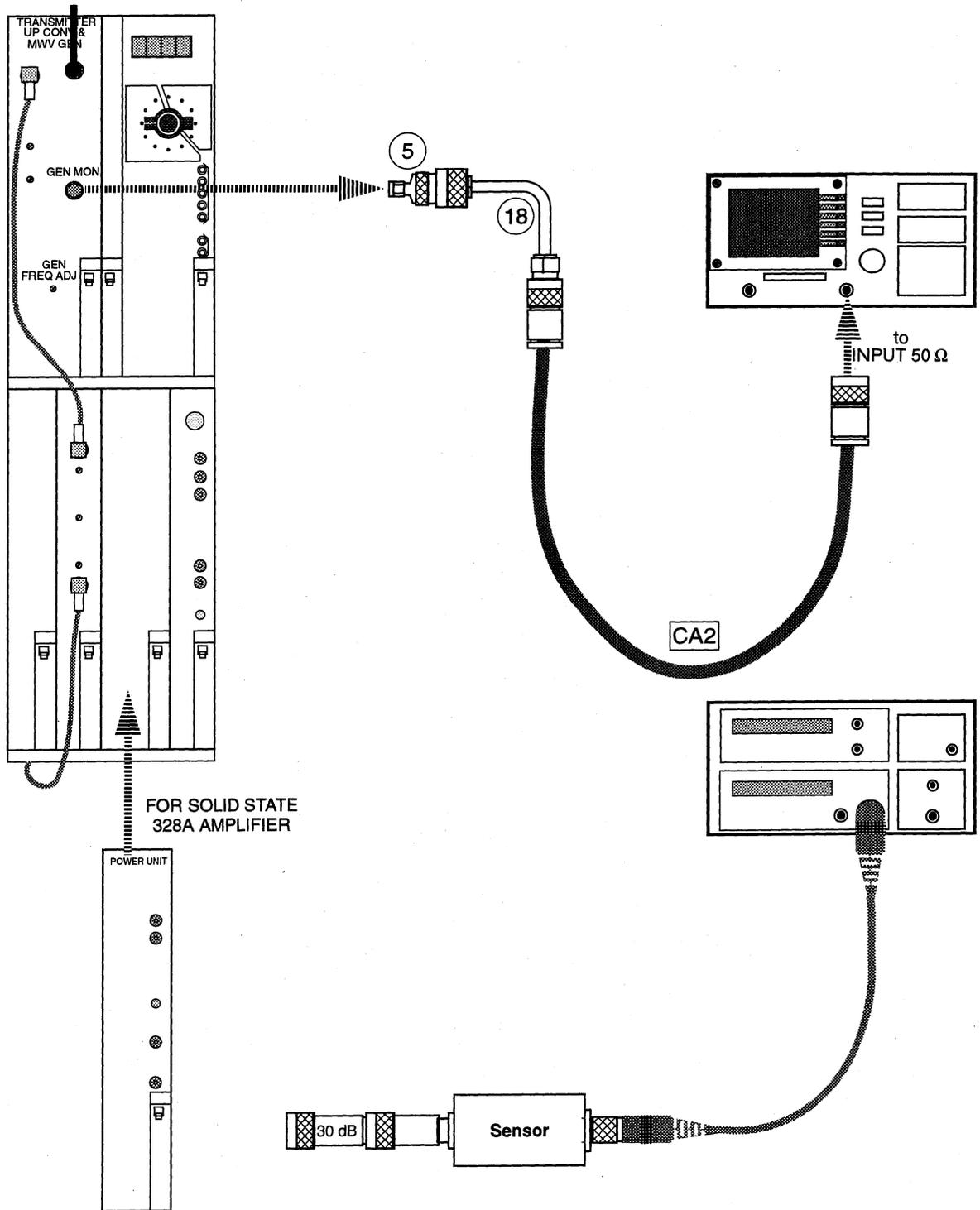


Figure 2. MWV GEN Frequency Check

AT&T— PROPRIETARY
See notice on first page

- 3 Apply the following requirement to determine if adjustment is necessary.

Requirement:

- 6 GHz: frequency within ± 15 kHz of f_o
- 11 GHz: frequency within ± 30 kHz of f_o .

Was the requirement met?

YES - No adjustment is required.

- Go to Step 5.

NO - Go to Step 4.

- 4 On the TRANSMITTER UP CONV & MWV GEN,
adjust the GEN FREQ ADJ control for the following requirement:

Requirement:

- 6 GHz: frequency within ± 3 kHz of f_o
- 11 GHz: frequency within ± 5 kHz of f_o .

Was the requirement met?

YES - Go to Step 5

NO - Go to Flowchart 3, Unit Replacement and
Alignment—MWV Generator.

- 5 Disconnect the test equipment.
- 6 On the TRANSMITTER UP CONV & MWV GEN,
replace the termination on the GEN MON jack.
- 7 Update the RADIO DATA CARD—TRMTR “GEN MON FREQ”, if necessary.
- 8 Return to the flowchart or procedure that sent you here.

Transmitter Alignment path

With an IF Predistorter,
go to Procedure 3.4, IF Predistorter Input/Output Levels.

Without an IF Predistorter,
go to Procedure 5.1, Up-Converter IF Input Level.

End of Procedure

Table A. 6-GHz Regular Frequency Plan

Channel			Up-Converter, Down-Converter, and Microwave Generator		
Number	Center Frequency f_c (kHz)	Sideband	1502() RF Filter, Latch Label, and 141() Gen Code	1503() RF Filter Code	Oscillator Frequency f_o (kHz)
11T	5,945,198	Lower	B	CB	6,015,198
12T	5,974,850	Lower	D	CD	6,044,850
13T	6,004,502	Lower	F	CF	6,074,502
14T	6,034,154	Lower	H	CH	6,104,154
15T	6,063,805	Upper	K	CK	5,993,805
16T	6,093,457	Upper	M	CM	6,023,457
17T	6,123,109	Upper	P	CP	6,053,109
18T	6,152,761	Upper	S	CS	6,082,761
21T	6,197,239	Lower	AB	DB	6,267,239
22T	6,226,891	Lower	AD	DD	6,296,891
23T	6,256,542	Lower	AF	DF	6,326,542
24T	6,286,194	Lower	AH	DH	6,356,194
25T	6,315,846	Upper	AK	DK	6,245,846
26T	6,345,498	Upper	AM	DM	6,275,498
27T	6,375,150	Upper	AP	DP	6,305,150
28T	6,404,802	Upper	AS	DS	6,334,802

Table B. 6-GHz Staggered Frequency Plan

Channel			Up-Converter, Down-Converter, and Microwave Generator		
Number	Center Frequency f_c (kHz)	Sideband	1502() RF Filter, Latch Label, and 141() Gen Code	1503() RF Filter Code	Oscillator Frequency f_o (kHz)
11S	5,960,024	Lower	C	CC	6,030,024
12S	5,989,676	Lower	E	CE	6,059,676
13S	6,019,328	Lower	G	CG	6,089,328
14S	6,048,979	Upper	J	CJ	5,978,979
15S	6,078,631	Upper	L	CL	6,008,631
16S	6,108,283	Upper	N	CN	6,038,283
17S	6,137,935	Upper	R	CR	6,067,935
18S	6,167,587	Upper	T	CT	6,097,587
20S	6,182,413	Lower	AA	DA	6,252,413
21S	6,212,065	Lower	AC	DC	6,282,065
22S	6,241,717	Lower	AE	DE	6,311,717
23S	6,271,368	Lower	AG	DG	6,341,368
24S	6,301,020	Upper	AJ	DJ	6,231,020
25S	6,330,672	Upper	AL	DL	6,260,672
26S	6,360,324	Upper	AN	DN	6,290,324
27S	6,389,976	Upper	AR	DR	6,319,976

AT&T— PROPRIETARY
See notice on first page

Table C. 11-GHz Regular Frequency Plan

Radio Channel			Up-Converter, Down-Converter, and Microwave Generator	
Number	Center Frequency f_c (kHz)	Sideband	RF Filter, Latch Label, and 142() Gen Code	Oscillator Frequency f_o (kHz)
1P	10,755,000	Upper	PB	10,685,000
10P	10,795,000	Upper	PC	10,725,000
11P	10,835,000	Upper	PD	10,765,000
6P	10,875,000	Upper	PE	10,805,000
7P	10,915,000	Upper	PF	10,845,000
2P	10,955,000	Upper	PG	10,885,000
3P	10,995,000	Upper	PH	10,925,000
12P	11,035,000	Upper	PJ	10,965,000
9P	11,075,000	Upper	PK	11,005,000
8P	11,115,000	Upper	PL	11,045,000
5P	11,155,000	Upper	PM	11,085,000
9J	11,245,000	Lower	JA	11,315,000
12J	11,285,000	Lower	JB	11,355,000
5J	11,325,000	Lower	JC	11,395,000
8J	11,365,000	Upper	JD	11,295,000
1J	11,405,000	Upper	JE	11,335,000
4J	11,445,000	Upper	JF	11,375,000
11J	11,485,000	Upper	JG	11,415,000
10J	11,525,000	Upper	JH	11,455,000
7J	11,565,000	Upper	JJ	11,495,000
6J	11,605,000	Upper	JK	11,535,000
3J	11,645,000	Upper	JL	11,575,000

Table D. 11-GHz Alternate Frequency Plan

Radio Channel			Up-Converter, Down-Converter, and Microwave Generator	
Number	Center Frequency f_c (kHz)	Sideband	RF Filter, Latch Label, and 142() Gen Code	Oscillator Frequency f_o (kHz)
4E	10,735,000	Upper	EA	10,665,000
1E	10,775,000	Upper	EB	10,705,000
10E	10,815,000	Upper	EC	10,745,000
11E	10,855,000	Upper	ED	10,785,000
6E	10,895,000	Upper	EE	10,825,000
7E	10,935,000	Upper	EF	10,865,000
2E	10,975,000	Upper	EG	10,905,000
3E	11,015,000	Upper	EH	10,945,000
12E	11,055,000	Upper	EJ	10,985,000
9E	11,095,000	Upper	EK	11,025,000
8E	11,135,000	Upper	EL	11,065,000
12D	11,265,000	Lower	DB	11,335,000
5D	11,305,000	Lower	DC	11,375,000
8D	11,345,000	Lower	DD	11,415,000
1D	11,385,000	Upper	DE	11,315,000
4D	11,425,000	Upper	DF	11,355,000
11D	11,465,000	Upper	DG	11,395,000
10D	11,505,000	Upper	DH	11,435,000
7D	11,545,000	Upper	DJ	11,475,000
6D	11,585,000	Upper	DK	11,515,000
3D	11,625,000	Upper	DL	11,555,000
2D	11,665,000	Upper	DM	11,595,000

AT&T— PROPRIETARY
See notice on first page

3.4 IF Predistorter Input/Output Levels

This procedure is used to measure the 64 Quadrature Amplitude Modulation (QAM) signal level applied to IF IN jack of the IF Predistorter and to measure and adjust the predistorter IF OUT signal level.

**CAUTION:**

This is an Out-of-Service procedure. Service will be interrupted or impaired unless you apply Service Protection measures.

Step	Procedure
1	On the TEST SET: <ul style="list-style-type: none">a. Calibrate the POWER METER, if necessary. Reference: DRTS tab, 2.2 Calibration.b. Enter the OFFSET (as shown on the POWER SENSOR) for measurement of IF between -30 dBm and +10 dBm (about 35.7 dB).c. Add an additional 0.25 dB to the OFFSET to compensate for loss in the 8-foot BNC - BNC test cable. Reference: DRTS tab, 2.3 Entering Offset.
2	On the ALC NETWORK or 328A AMPL, operate the ALC ON/OFF switch to OFF .
3	On the IF PREDISTORTER, remove the cable from the IF IN jack.

- 4 Connect the test equipment as shown in Figure 3.
- 5 On the POWER METER,
observe the display.

Requirement:

- $-8.2 \text{ dBm} \pm 1.2 \text{ dB}$
for a 50-foot IF interconnect cable
- $-8.2 \text{ dBm} \pm 1.7 \text{ dB}$
for an IF interconnect cable longer than 50 feet.

Reference: Determine cable length by checking the type of 64-QAM MOD card in the connected terminal-transmitter or regenerator shelf.

- AMR 27/27B 64-QAM MOD cards
use 50-foot cables.
- AMR 28/28B 64-QAM MOD cards
use cables longer than 50 feet.

Comment: This level is recorded on the RADIO DATA CARD as TRMTR "IF IN LEVEL (J4)".

Is the requirement met?

- YES - Disconnect the test equipment from the IF IN cable.
- Update the RADIO DATA CARD—
TRMTR "IF IN LEVEL (J4)", if necessary.
 - Go to Step 6.
- NO - Go to **TROUBLE ISOLATION** tab,
3.2 IF Level Problem.

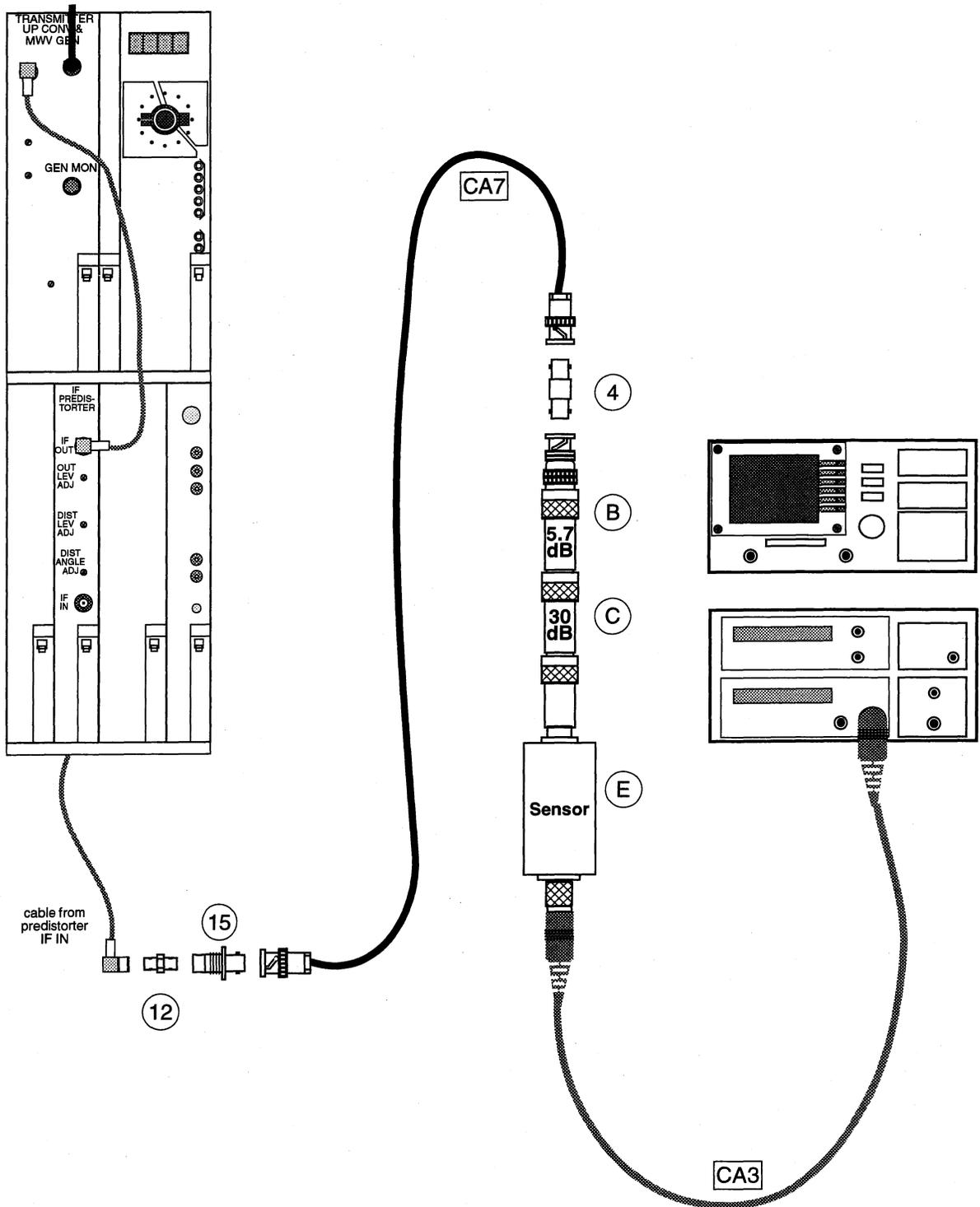


Figure 3. IF Predistorter Input Level Check

AT&T— PROPRIETARY
See notice on first page

- 6 On the IF PREDISTORTER:
- a. Remove the cable from the IF OUT jack.
 - b. Reconnect the bay cable (64-QAM) to the IF IN jack.
- 7 Connect the test equipment as shown in Figure 4.
- 8 On the IF PREDISTORTER,
- adjust the OUT LEV ADJ control to meet the following requirement:
- Requirement:** $-8.2 \text{ dBm} \pm 0.05 \text{ dB}$ on the power meter display.
- Was the requirement met?
- YES - Disconnect the test equipment from the radio bay.
- Go to Step 9.
- NO - Go to Flowchart 3, Unit Replacement and Alignment—IF Predistorter.
- 9 On the IF PREDISTORTER,
- reconnect the cable to the IF OUT jack.
- 10 On the ALC NETWORK or 328A AMPL,
- operate the **ALC ON/OFF** switch to **ON**.
- 11 Return to the flowchart or procedure that sent you here.

Transmitter Alignment path

TWT Amplifier,
go to Procedure 4.1, Helix and Beam Current.

Solid State Amplifier,
go to Procedure 5.2, Initial Output Power

End of Procedure

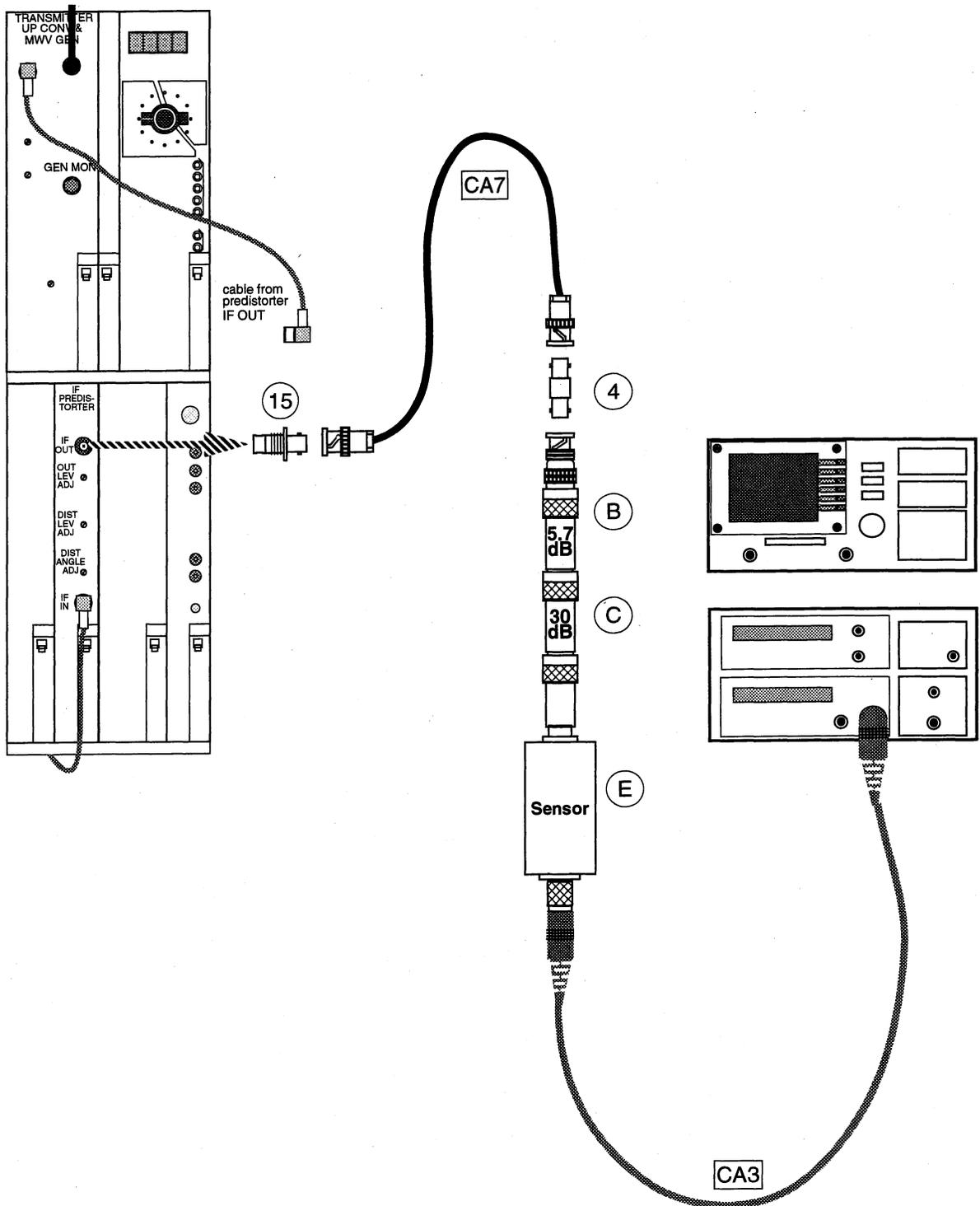


Figure 4. IF Predistorter Output Level Check

AT&T— PROPRIETARY
See notice on first page

4 Alignment—TWT

4.1 Helix and Beam Current (TWT)

This procedure is used to measure the beam current (IK) and helix current (IH) of the TWT Amplifier and to adjust the beam current (IK), if necessary.



CAUTION:

This is an Out-of-Service procedure. Service will be interrupted or impaired unless you apply Service Protection measures.



CAUTION:

Meter probe tips longer than 1/2 inch may short and damage the power supply. Use meter probes with tips shorter than 1/2 inch.



NOTE:

If the TWT Power Supply Control has been turned off or power has been removed, allow a 5-minute warm-up period before proceeding.

Step	Procedure
1	On the POWER SUPPLY CONTROL unit, verify that: <ol style="list-style-type: none"> The ON/OFF switch is set to ON. The TRANS/STBY switch is set to TRANS.
2	On a digital MULTIMETER, condition it for a 20-volt, DC measurement.
3	On the POWER SUPPLY CONTROL unit, connect the multimeter between the I _K jack and the GND jack.
4	On the MULTIMETER, multiply the indicated voltage by ten to the beam current (IK) in milliamperes.
	<i>Comment: At the I_K jack, beam current (mA) equals voltage times ten (1 V=10 mA).</i>
	Requirement: ±2 mA of the IK value recorded on the RADIO DATA CARD as TRMTR "IK".
	<i>Comment: The IK value recorded on the RADIO DATA CARD should be the same as the IK stamped value on the TWT identification plate (on the side or front of the TWT Amplifier).</i>

AT&T— PROPRIETARY

See notice on first page

Was the requirement met?

YES - Go to Step 6.

NO - Go to Step 5.

- 5 On the AMPLIFIER ASSEMBLY,
adjust the BEAM ADJ control to the recorded value ± 2 mA.

Did the adjusted value meet the requirement?

YES - Go to Step 6.

NO - Go to Procedure 7.3,
Power Supply and Amplifier Evaluation.

- 6 On the POWER SUPPLY CONTROL unit,
connect the multimeter between the I_H jack and the GND jack.

Requirement: Measured helix current (IH) shall be 2.2 mA or less.

Comment: At the IH jack, measured voltage equals helix current in mA
(1 V=1 mA).

Was the requirement met?

YES - Go to Step 7.

NO - Go to Procedure 7.3,
Power Supply and Amplifier Evaluation.

- 7 On the Power Supply Control unit,
verify the following requirement.

Requirement: The PREAL indicator is not lighted.

Was the requirement met:

YES - Go to Step 8.

NO - Go to Flowchart 3, Unit Replacement and
Alignment—Power Supply and Control Unit.

- 8 Disconnect the MULTIMETER.
- 9 If you are not performing a Transmitter Alignment, go to the **END HERE** tab.

Transmitter Alignment path

Go to Procedure 4.2, Initial Output Power.

End of Procedure

4.2 Initial Output Power (TWT)

Use this procedure to check the transmitter output power with ALC OFF.



WARNING:

RF radiation in excess of 1 milliwatt may cause bodily harm. Do not open any radio transmitter RF connection until the IF drive signal has been removed.



CAUTION:

This is an Out-of-Service procedure. Service will be interrupted or impaired unless you apply Service Protection measures.



CAUTION:

SMA connectors damage easily. Finger-start SMA connections for several turns, then use only a torque wrench to tighten.

Step	Procedure
1	On the ALC NETWORK, operate the ALC ON/OFF switch to OFF .
2	On the TRANSMITTER UP CONV & MWV GEN, remove the cable from the IF IN jack.
3	On the ALC NETWORK, remove the termination from the RF MON jack.
4	On the TEST SET: <ol style="list-style-type: none"> a. Calibrate the POWER METER, if necessary. Reference: DRTS tab, 2.2 Calibration. b. Enter the OFFSET (as shown on the POWER SENSOR) for measurement of RF between 0 dBm and +40 dBm (about 60 dB). Reference: DRTS tab, 2.3 Entering Offset.
5	Connect the test equipment as shown in Figure 5.
6	On the TRANSMITTER UP CONV & MWV GEN, reconnect the cable to the IF IN jack.

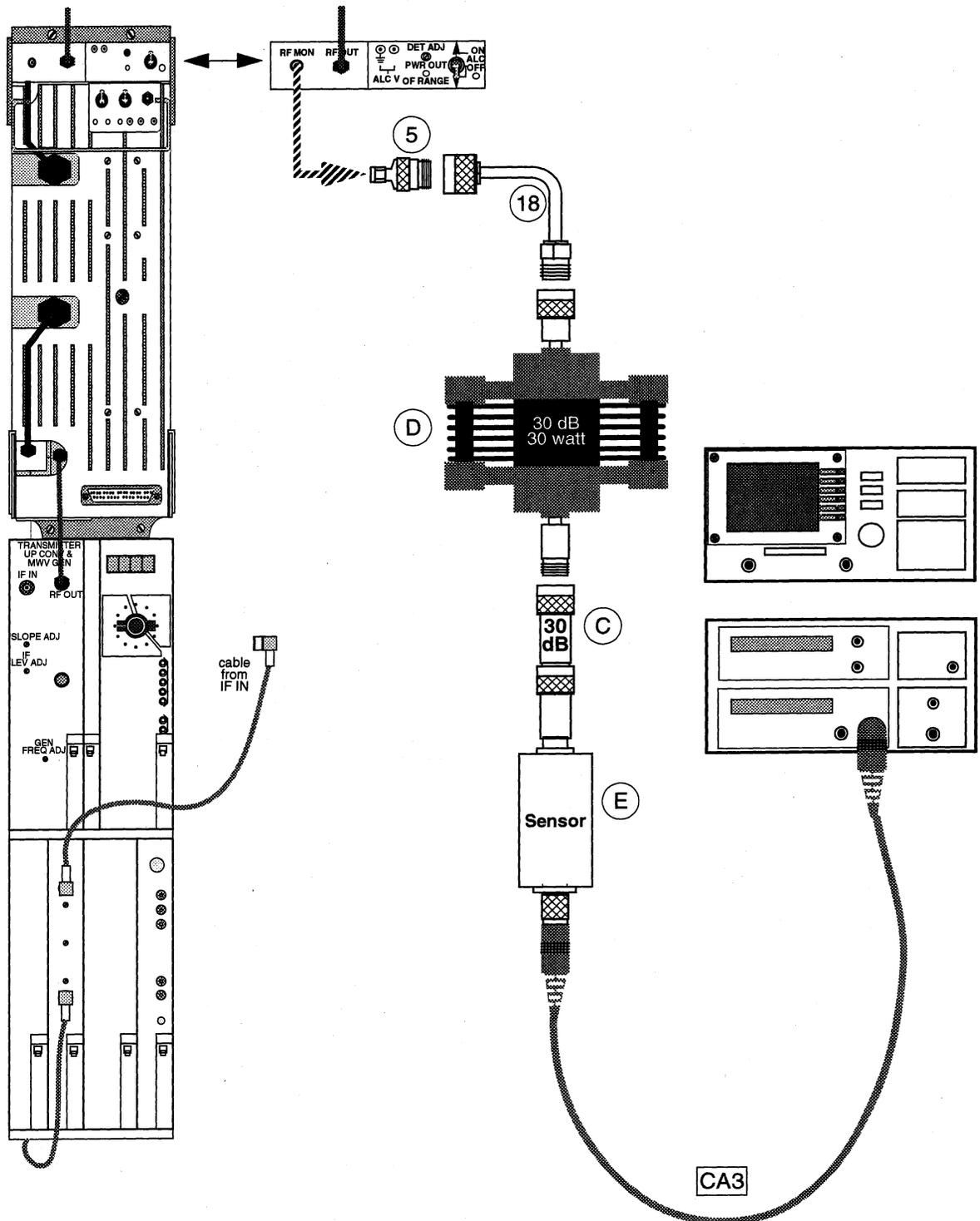


Figure 5. RF MON Power Measurement—TWT

AT&T— PROPRIETARY
See notice on first page

- 7 On the POWER METER,
observe the display.

Requirement: ± 0.5 dB of the TRMTR "RF MON OUT" level recorded on the RADIO DATA CARD.

Was the requirement met?

YES - Go to Step 13.

NO - Go to Step 8.
(suspect a level problem; will check RF MON calibration).

- 8 On the TRANSMITTER UP CONV & MWV GEN,
remove the cable from the IF IN jack.

- 9 Disconnect test equipment from the radio bay.

- 10 On the ALC NETWORK,
reconnect the termination to the RF MON jack.

- 11 On the TRANSMITTER UP CONV & MWV GEN,
reconnect the cable to the IF IN jack.

- 12 On the ALC NETWORK:
a. Operate the **ALC ON/OFF** switch to **ON**.

Transmitter Alignment path

b. Go to Procedure 7.1, RF MON Calibration.

- 13 On the TRANSMITTER UP CONV & MWV GEN,
adjust the IF LEV ADJ control for ± 0.1 dB of the TRMTR
"RF MON" level recorded on the RADIO DATA CARD.

- 14 Disconnect test equipment from the radio bay at items C & D, leaving items
5, 18, and D (30-dB, 30-watt attenuator) connected to the RF MON jack.

- 15 On the ALC NETWORK,
a. Operate the **ALC ON/OFF** switch to **ON**.

Transmitter Alignment path

b. Go to Procedure 4.3, Linearization.

End of Procedure

4.3 Linearization (TWT)

This procedure is used to measure and then minimize, by adjustment, the third-order products generated in the transmitter with a 3-tone IF test signal input. It then checks the output power of the transmitter in the manual mode (ALC OFF) and then in the automatic mode (ALC ON) using the normal 64-QAM signal.

Prerequisite: The IF and RF power levels meet requirements of Procedures 3.4 and either 4.2 or 7.1.



WARNING:

RF radiation in excess of 1 milliwatt may cause bodily harm. Do not open any radio transmitter RF connection until the IF drive signal has been removed.



CAUTION:

This is an Out-of-Service procedure. Service will be interrupted or impaired unless you apply Service Protection measures.



CAUTION:

SMA connectors damage easily. Finger-start SMA connections for several turns, then use only a torque wrench to tighten.

Step	Procedure
1	On the ALC NETWORK, operate the ALC ON/OFF switch to OFF .
2	On the IF PREDISTORTER: a. Remove the cable from the IF IN jack. b. Remove the cable from the IF OUT jack. <i>Comment: Steps 3 through 9 establish the 3-tone test signal level.</i>
3	On the TEST SET: a. Calibrate the POWER METER, if necessary. Reference: DRTS tab, 2.2 Calibration. b. Enter the OFFSET (as shown on the POWER SENSOR) for measurement of IF between -30 dBm and +10 dBm (about 35.7 dB). c. Add an additional 0.25 dB to the OFFSET to compensate for loss in the 8-foot BNC - BNC test cable. Reference: DRTS tab, 2.3 Entering Offset.

AT&T— PROPRIETARY
See notice on first page

- 4 On the 3 TONE SOURCE,
operate all tone switches (67, 70, and 75 MHz) to ON (lighted).
- 5 On the MULTIPATH FADING SIMULATOR (MFS):
 - a. Press the green PRESET/LOCAL key.
 - b. Press the ENTER key.
 - c. Press the blue SHIFT key to select functions labeled above keys.
Verify that the SHIFT annunciator arrow is indicated in the display window.
 - d. Press the green PRESET/LOCAL key to select MORE (shifted-PRESET/LOCAL).
 - e. Press the \uparrow key to display 6 3TONE READ.
 - f. Press the ENTER key.
- 6 On the 3 TONE SOURCE:
 - a. Use OFFSET FREQ to adjust the offset frequency to 0.0 MHz as read on the MFS display.
 - b. Set the TOTAL POWER OUT control to midposition (-8 dBm).
- 7 Connect the test equipment as shown in Figure 6.
- 8 On the POWER METER,
observe the power meter indication as you perform the next step.
- 9 On the 3 TONE SOURCE,
adjust TOTAL POWER OUT for $-8.2 \text{ dBm} \pm 0.05 \text{ dB}$ on the power meter display.

Comment: Steps 10 through 17 adjust transmitter gain (ALC ON and OFF) with a 3-tone test signal.
- 10 On the IF PREDISTORTER:
 - a. Remove the test connection from the IF OUT jack.
 - b. Leave the IF OUT jack open until a later step (to prevent possible RF radiation).
- 11 On the POWER METER,
enter the OFFSET for RF between 0 dBm and +40 dBm (about 60 dB).
- 12 On the ALC NETWORK,
remove the termination from the RF MON jack, unless it is still off from Procedure 4.2.

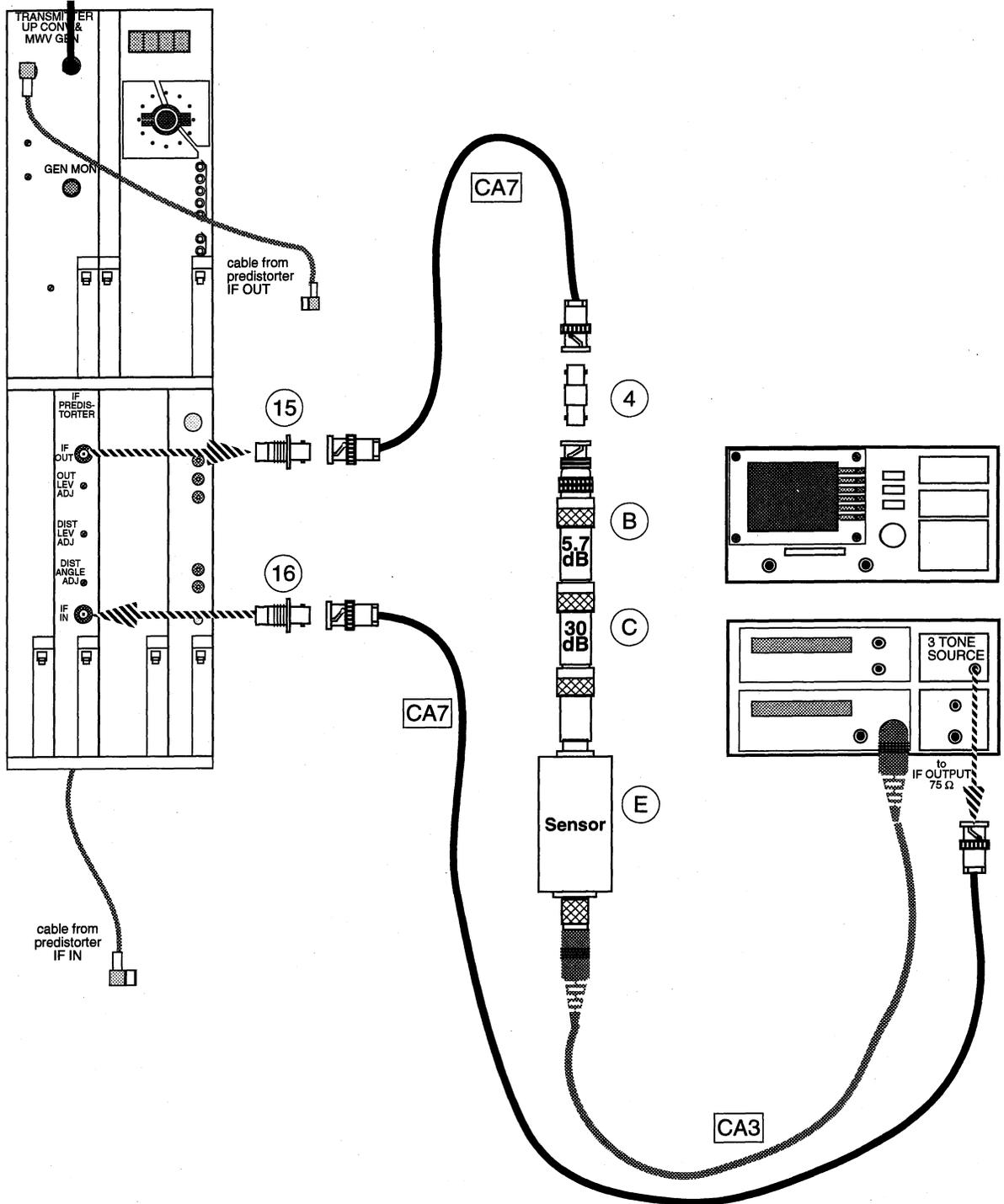


Figure 6. Establish 3-Tone Test Signal Level

AT&T— PROPRIETARY
See notice on first page

- 13 Connect the test equipment as shown in Figure 7.
- 14 On the IF PREDISTORTER,
reconnect the cable between the IF OUT jack and the IF IN jack
on the TRANSMITTER UP CONV & MWV GEN.
- 15 On the TRANSMITTER UP CONV & MWV GEN,
adjust the IF LEV ADJ control for a power meter reading ± 0.1 dB of
the TRMTR "RF MON" level recorded on the RADIO DATA CARD
(very little or no adjustment should be necessary).
- 16 On the ALARM AND METER unit:
a. Set the selector switch to TRMTR ALC V.
b. Observe the ALC indication as you perform the following step.
- 17 On the ALC NETWORK:
a. **Exercise** the ALC ON/OFF switch by operating the **ALC ON/OFF**
switch to **ON**, then to **OFF** five times (ending in OFF position).
b. Adjust the DET ADJ control for 0.00 ALC V.
c. Operate the **ALC ON/OFF** switch to **ON**.

Requirement: ALC V must be 0.00.

Was the requirement met?

YES - Go to Step 18.

NO - Go to Flowchart 3, Unit Replacement and
Alignment—ALC Network.

- 18 On the ALC NETWORK unit, and while observing the power meter display,
operate the **ALC ON/OFF** switch to **OFF**, then to **ON**.

Requirement:

- In both switch positions, ALC OFF and ALC ON, power level indications must be within 0.03 dB of each other.
- Each indication must be within ± 0.1 dB of the TRMTR "RF MON" value recorded on the RADIO DATA CARD.

Were the requirements met?

YES - Go to Step 19.

NO - Go to Flowchart 3, Unit Replacement and
Alignment —ALC Network

AT&T— PROPRIETARY
See notice on first page

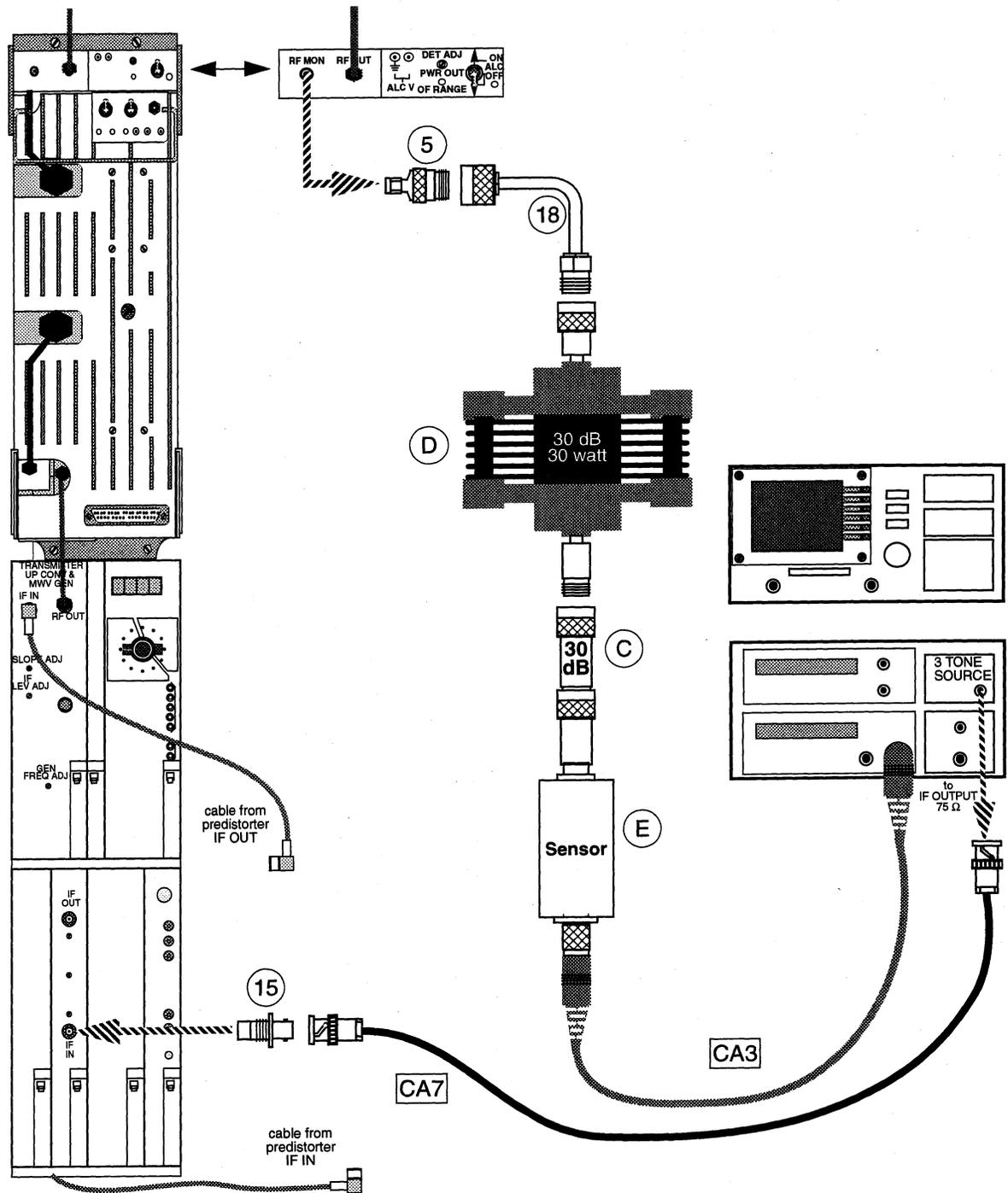


Figure 7. RF MON Power Measurement (with 3-Tone Test Signal Applied)

AT&T— PROPRIETARY
See notice on first page

19 On the ALC NETWORK,
operate the **ALC ON/OFF** switch to **OFF**.

20 On the TRANSMITTER UP CONV & MWV GEN,
remove the cable from the IF IN jack.

Comment: Step 21 prepares the spectrum analyzer to display the transmitter RF output spectrum.

21 On the SPECTRUM ANALYZER:

- a. Press the green PRESET key.
- b. Press the FREQUENCY key.
- c. Use the DATA keys to enter the transmit channel center frequency (fc).

Reference: Obtain Center Frequency
from Tables A, B, C, or D.

Verify that correct center frequency is displayed in the **active function block**.

Reference: **DRTS** tab, 3.2.2 Active Function Block.

- d. Press the SPAN key.
- e. Use the DATA keys to enter 30 MHz.
Verify that SPAN 30.00 MHz is displayed in the active function block.
- f. Press the BW key.
- g. Press the RES BW AUTO MAN softkey to underline MAN.
- h. Use the DATA keys to enter 100 kHz.
Verify that RES BW 100 KHz is displayed in the active function block.
- i. Press the VID BW AUTO MAN softkey twice to underline MAN.
- j. Use the DATA keys to enter 3 kHz.
Verify that VIDEO BW 3 KHz is displayed in the active function block.

- k. Press HOLD key to close the active function block.

22 Connect the test equipment as shown in Figure 8.

23 On the TRANSMITTER UP CONV & MWV GEN,
reconnect the cable to the IF IN jack.

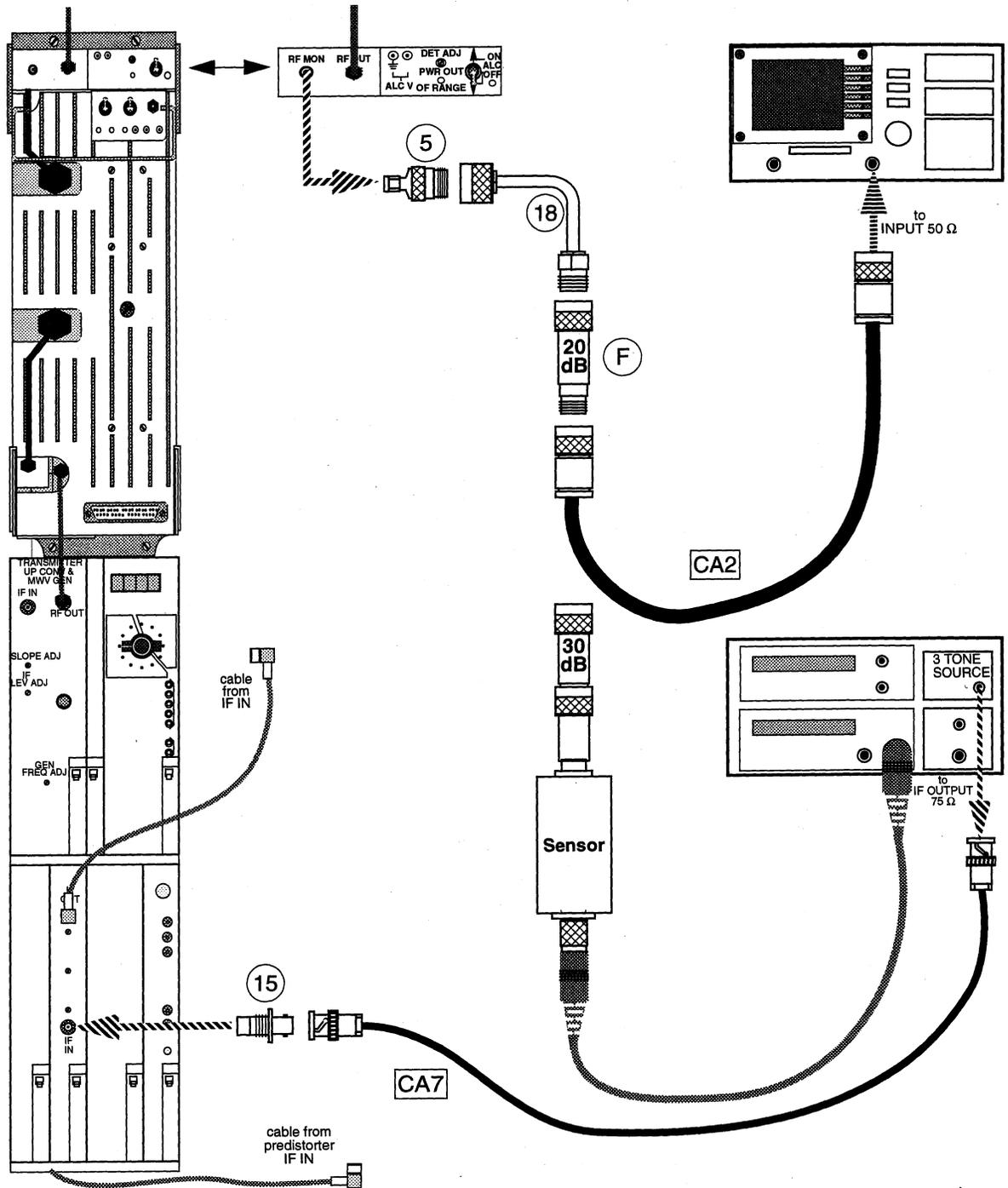


Figure 8. Measuring Linearity at RF MON (with Predistorer)

AT&T— PROPRIETARY
See notice on first page

24 On the SPECTRUM ANALYZER:

- a. Press the AMPLITUDE key.

Verify that REF LEVEL .0 dBm is displayed in the active function block.

- b. Use the data KNOB to position the fundamental tone peaks at the top graticule line (approximate REF LEVEL -20.0 dBm).
- c. Press HOLD key to close the active function block.

Requirement: Minimum separation between the fundamental tones and the modulation products must be at least 47 dB.

Reference: Figure 9, Spectrum Display Example.

Comment: *In Step 25, you will adjust the DIST LEV ADJ (distortion level adjustment) and the DIST ANGLE ADJ (distortion angle adjustment) controls for maximum separation. Because these adjustments affect IF Predistorter gain, you will also maintain constant gain by adjusting the OUT LEV ADJ (output level adjustment) to keep ALC V at 0.00 ± 0.05 volts.*

25 On the IF PREDISTORTER:

- a. Alternately adjust the DIST ANGLE ADJ and the DIST LEVEL ADJ controls for maximum separation between the fundamental tones and the modulation products.
- b. Adjust the OUT LEV ADJ control to maintain the ALC V at 0.00 ± 0.05 .
- c. Repeat sub-steps a. and b. until separation is maximum and ALC V is 0.00 ± 0.05 .

26 On the ALC NETWORK,

operate the **ALC ON/OFF** switch to **ON**.

Requirement: 47 dB or more separation between fundamental tones and modulation products.

Was the requirement met?

YES - Go to Step 27.

NO - See Table A, TWT Gas Burn Off Time (421-500-124)

- Go to Procedure 6.4,
Intermodulation Isolation.

AT&T— PROPRIETARY
See notice on first page

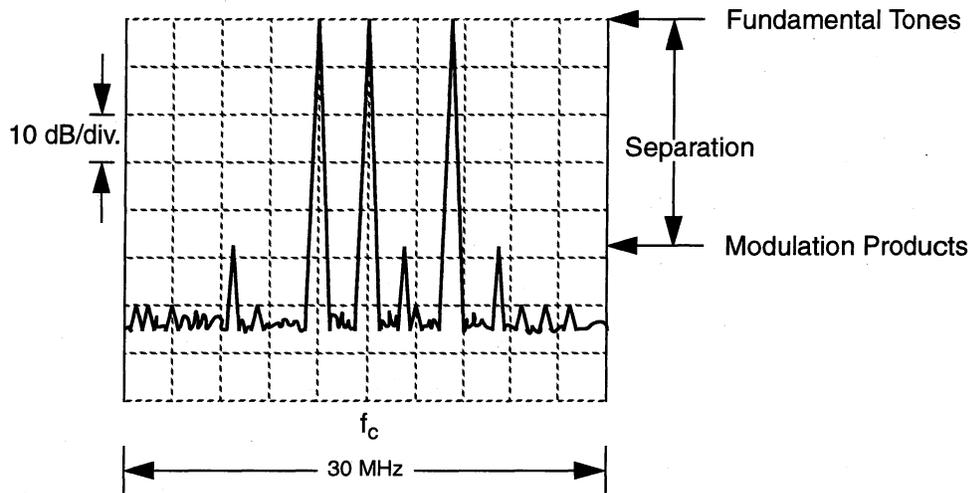


Figure 9. Spectrum Display Example

AT&T— PROPRIETARY
See notice on first page

- 27 On the ALC NETWORK,
operate the **ALC ON/OFF** switch to **OFF**.
- 28 On the IF PREDISTORTER:
a. Disconnect the 3-tone test signal from the IF IN jack.
b. Disconnect the cable from the IF OUT jack.
- 29 On the POWER METER,
enter the OFFSET for IF between -30 dBm and $+10$ dBm
(about 35.7 dB), plus an additional 0.25 dB to compensate
for loss in the test cable.
- 30 Connect the test equipment as shown in Figure 10.
- 31 On the IF PREDISTORTER,
connect the bay cable (64-QAM) to the IF IN jack.
- 32 On the POWER METER,
observe the display.

Requirement: -8.2 dBm ± 0.2 dB.

Is the requirement met?

YES - Go to Step 33.

NO - Repeat from Step 2.

(Only an error or defective test equipment would cause the
requirement not to be met.)

- 33 On the IF PREDISTORTER:
a. Adjust the OUT LEV ADJ control for -8.2 dBm ± 0.05 dB on the
power meter display.
b. Remove the test connection from the IF OUT jack.
c. Leave the IF OUT jack open until a later step.
- 34 On the POWER METER,
enter the correct OFFSET for RF between 0 dBm and $+40$ dBm
(about 60 dB).

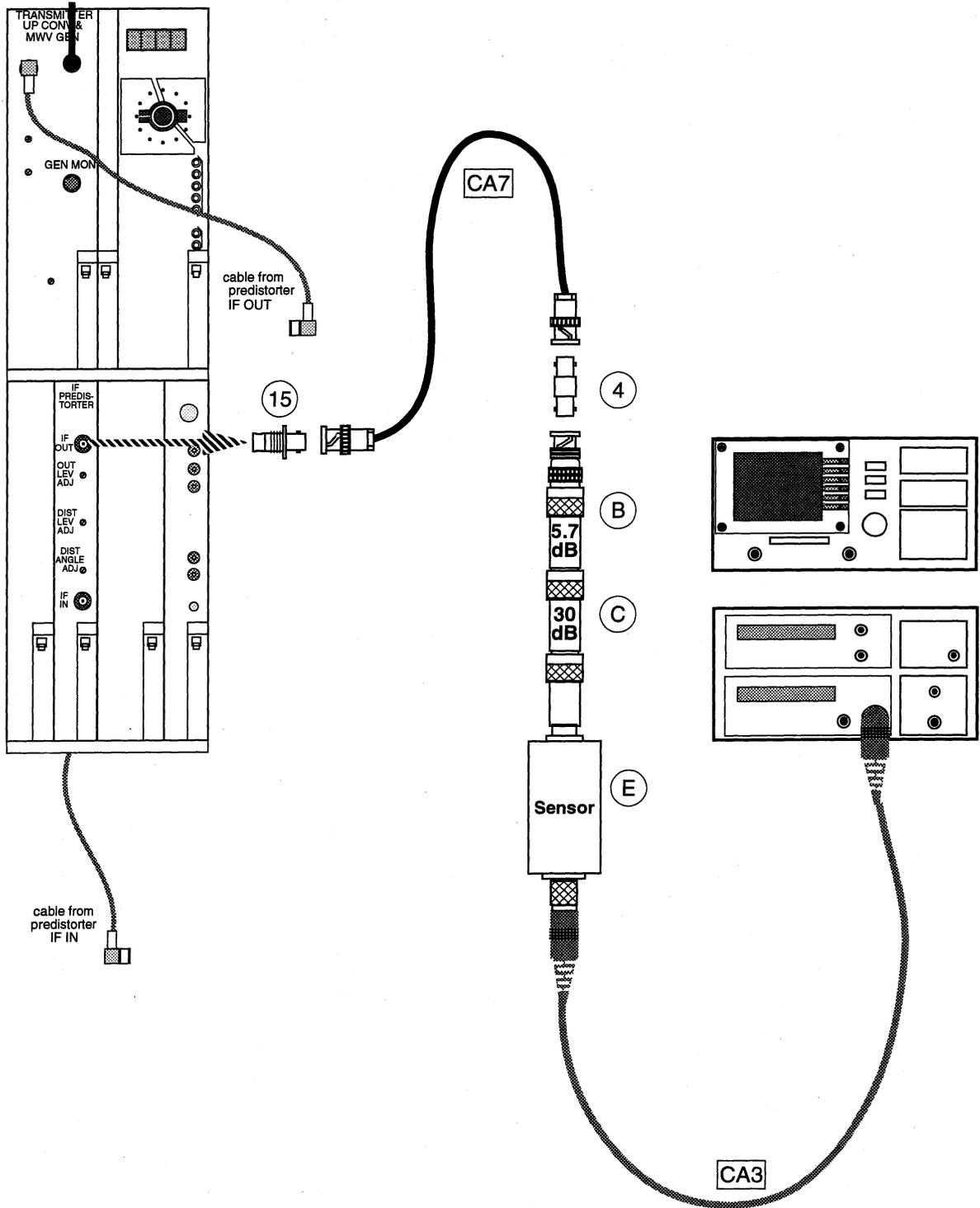


Figure 10. IF Predistorter Output Level Check

AT&T— PROPRIETARY
See notice on first page

- 35 Disconnect the 20 dB attenuator (item F) from the right angle adapter (item 18) and connect the test equipment as shown in Figure 11.
- 36 On the IF PREDISTORTER,
reconnect the cable between the IF OUT jack and the IF IN jack on the TRANSMITTER UP CONV & MWV GEN.
- 37 On the POWER METER:
- a. Compare the power meter display to the TRMTR "RF MON" level recorded on the RADIO DATA CARD.
 - b. Match the difference to one of the following:
 - ± 0.1 dB:
Go to Step 38.
 - Greater than ± 0.1 dB and does not exceed ± 0.5 dB:
 1. Adjust the IF LEV ADJ control on the TRANSMITTER UP CONV & MWV GEN for a power meter display within ± 0.1 dB of the RF MON level recorded on the RADIO DATA CARD.
 2. Go to Step 38.
 - Greater than ± 0.5 dB:
Repeat the Transmitter Alignment, starting at Procedure 3.4, IF Predistorter Input/Output Levels. (It appears that you have made a mistake.)
- 38 On the ALARM AND METER unit,
turn the selector switch to TRMTR ALC V.
- 39 On the ALC NETWORK,
adjust the DET ADJ control to meet the following requirement.

Requirement: An ALC V indication of 0.00 ± 0.01 volts.

Was the requirement met?

YES - Go to Step 40.

NO - Go to Flowchart 3, Unit Replacement and Alignment—ALC Network.

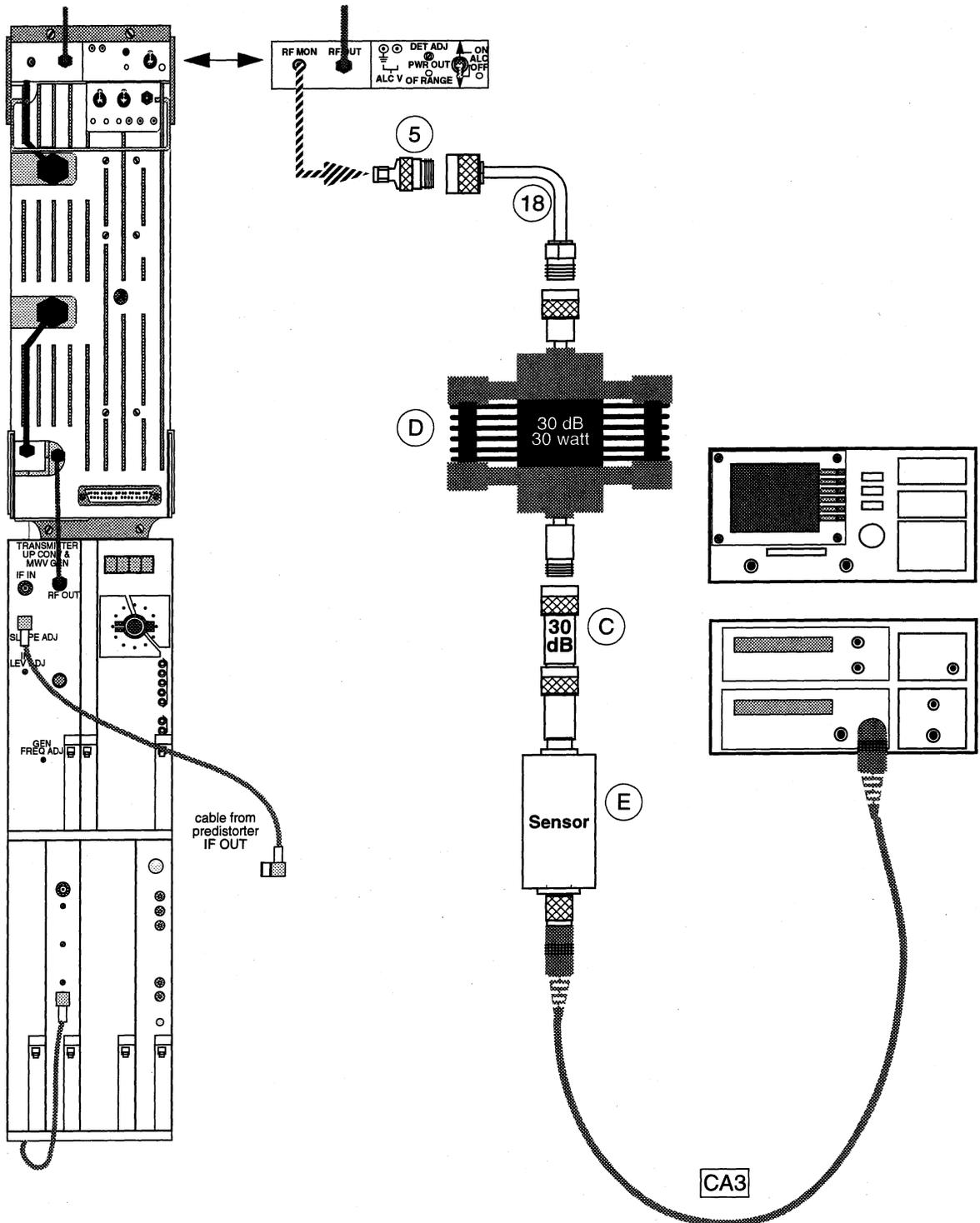


Figure 11. RF MON Power Measurement—TWT

AT&T— PROPRIETARY
See notice on first page

40

On the ALC NETWORK:

- a. Operate the **ALC ON/OFF** switch to **ON**, then to **OFF** while observing the power meter display.

Requirement:

- In both switch positions, ALC ON and ALC OFF, power level indications must be within 0.03 dB of each other.
- Each indication must be within ± 0.1 dB of the TRMTR "RF MON" value recorded on the RADIO DATA CARD.

- b. Operate the **ALC ON/OFF** switch to **ON**.

Requirement:

- ALC V indication of 0.00 ± 0.00 volts on the ALARM AND METER unit.
- PWR OUT OF RANGE indicator is OFF on the ALC Network.

Were all the requirements met?

YES - Go to Step 41.

NO - Perform sub-Steps 1 through 5.

1. **Exercise** the ALC ON/OFF switch by operating the **ALC ON/OFF** switch to **OFF**, then to **ON**, five times.
2. Operate the **ALC ON/OFF** switch to **OFF**.
3. If you have already completed sub-Step 4 once, go to sub-Step 5.
4. Return to Step 39 and repeat.
5. Go to Flowchart 3, Unit Replacement and Alignment—ALC Network.

41

On the ALC NETWORK,

operate the **ALC ON/OFF** switch to **OFF**.

42

On the TRANSMITTER UP CONV & MWV GEN,

remove the cable from the IF IN jack.

43

Disconnect the test equipment from the radio bay.

44

On the ALC NETWORK,

install the termination on the RF MON jack.

- 45 On the TRANSMITTER UP CONV & MWV GEN,
reconnect the cable to the IF IN jack.
- 46 On the ALC NETWORK,
operate the **ALC ON/OFF** switch to **ON**.
- 47 On the ALARM AND METER unit,
set the selector switch to TRMTR OFF.
- 48 Go to Flowchart 4 (this tab).

Transmitter Alignment path

TWT Transmitter Alignment completed.

End of Procedure

This page has intentionally been left blank.

AT&T— PROPRIETARY
See notice on first page

5 Alignment—Solid State

5.1 Up-Converter IF Input Level (Solid State)

This procedure is used to measure the normal 64-QAM signal applied to the IF IN jack of the up-converter when an IF Predistorter is not being used.



CAUTION:

This is an Out-of-Service procedure. Service will be interrupted or impaired unless you apply Service Protection measures.

Step	Procedure
1	On the 328A AMPL, operate the ALC ON/OFF switch to OFF .
2	On the TRANSMITTER UP CONV & MWV GEN, remove the cable from the IF IN jack.
3	On the TEST SET: <ol style="list-style-type: none"> Calibrate the POWER METER, if necessary. Reference: DRTS tab, 2.2 Calibration. Enter the OFFSET (as shown on the POWER SENSOR) for measurement of IF between -30 dBm and $+10$ dBm (about 35.7 dB). Add an additional 0.25 dB to the OFFSET to compensate for loss in the 8-foot BNC - BNC test cable. Reference: DRTS tab, 2.3 Entering Offset.

- 4 Connect the test equipment as shown in Figure 12.
- 5 On the POWER METER,
observe the display.

Requirement:

- $-8.2 \text{ dBm} \pm 1.2 \text{ dB}$
for a 50-foot IF interconnect cable
- $-8.2 \text{ dBm} \pm 1.7 \text{ dB}$
for an IF interconnect cable longer than 50 feet.

Reference: Determine cable length by checking the type of 64-QAM MOD card in the connected terminal-transmitter or regenerator shelf.

- AMR 27/27B 64-QAM MOD cards use 50-foot cable.
- AMR 28/28B 64-QAM MOD cards use cables longer than 50 feet.

Comment: This level is recorded on the RADIO DATA CARD as TRMTR "IF IN LEVEL (J4)".

Is the requirement met?

YES - Update the RADIO DATA CARD—
TRMTR "IF IN LEVEL (J4)", if necessary.

- Go to Step 6.

NO - Go to **TROUBLE ISOLATION** tab,
3.2 IF Level Problem.

- 6 Remove the test equipment connections from the radio bay.
- 7 On the TRANSMITTER UP CONV & MWV GEN,
reconnect the cable to the IF IN jack.
- 8 On the 328A AMPL,
operate the **ALC ON/OFF** switch to **ON**.
- 9 Return to the procedure or flowchart that sent you here.

Transmitter Alignment path

Go to Procedure 8.1,
RF MON Calibration.

End of Procedure

AT&T— PROPRIETARY
See notice on first page

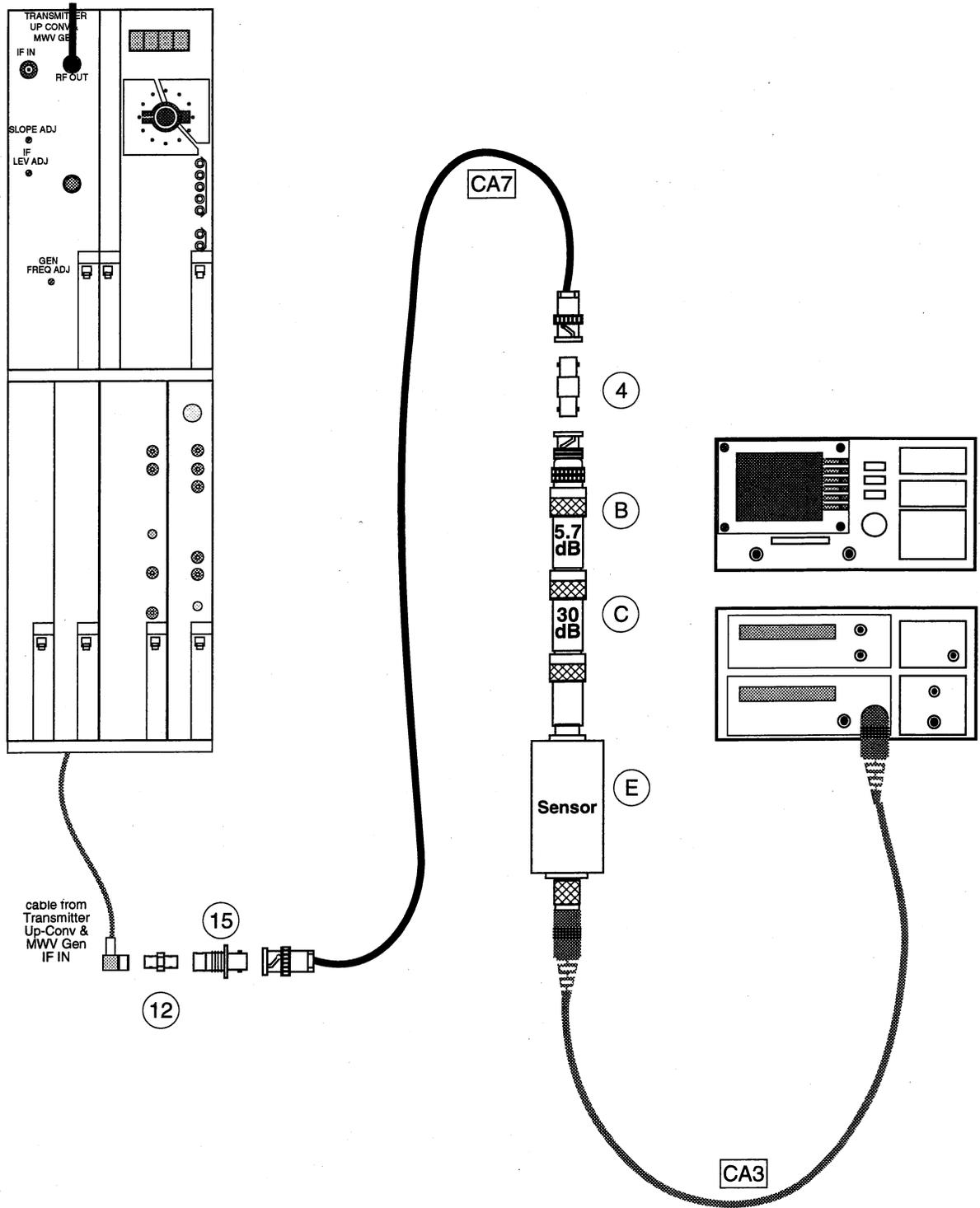


Figure 12. Up-Converter Input Level Check

AT&T— PROPRIETARY
See notice on first page

5.2 Initial Output Power (Solid State)

Use this procedure to check the transmitter output power with ALC OFF.



WARNING:

RF radiation in excess of 1 milliwatt may cause bodily harm. Do not open any radio transmitter RF connection until the IF drive signal has been removed.



CAUTION:

This is an Out-of-Service procedure. Service will be interrupted or impaired unless you apply Service Protection measures.



CAUTION:

SMA connectors damage easily. Finger-start SMA connections for several turns, then use only a torque wrench to tighten.

Step	Procedure
1	On the 328A AMPL, operate the ALC ON/OFF switch to OFF .
2	On the TRANSMITTER UP CONV & MWV GEN, remove the cable from the IF IN jack.
3	On the 328A AMPL, remove the termination from the RF MON jack.
4	On the TEST SET: a. Calibrate the POWER METER, if necessary. Reference: DRTS tab, 2.2 Calibration. b. Enter the OFFSET (as shown on the POWER SENSOR) for measurement of RF between -30 dBm and +10 dBm (about 30 dB). Reference: DRTS tab, 2.3 Entering Offset.
5	Connect the test equipment as shown in Figure 13.
6	On the TRANSMITTER UP CONV & MWV GEN, reconnect the cable to the IF IN jack.

AT&T— PROPRIETARY

See notice on first page

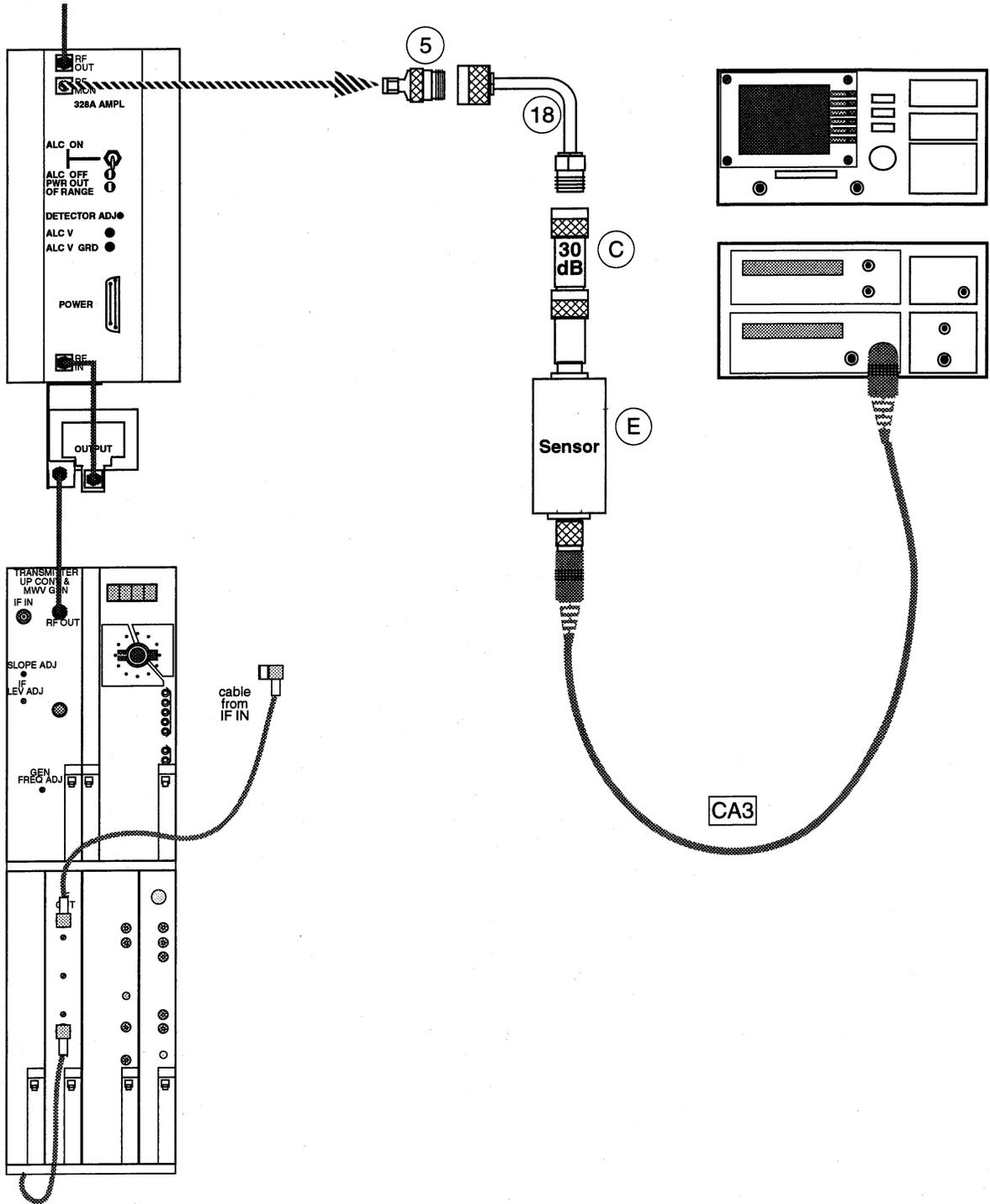


Figure 13. RF MON Power Measurement—Solid State

AT&T— PROPRIETARY
See notice on first page

- 7 On the POWER METER,
observe the display.

Requirement: ± 0.5 dB of the TRMTR "RF MON" level recorded on the RADIO DATA CARD.

Was the requirement met?

YES - Go to step 13.

NO - Go to Step 8
(suspect a level problem; will check RF MON calibration).

- 8 On the TRANSMITTER UP CONV & MWV GEN,
remove the cable from the IF IN jack.

- 9 Disconnect test equipment from the radio bay.

- 10 On the 328A AMPL,
reconnect the termination to the RF MON jack.

- 11 On the TRANSMITTER UP CONV & MWV GEN,
reconnect the cable to the IF IN jack.

- 12 On the 328A AMPL:
a. Operate the **ALC ON/OFF** switch to **ON**.

Transmitter Alignment path

- b. Go to Procedure 8.1,
RF MON Calibration.

- 13 On the TRANSMITTER UP CONV & MWV GEN,
adjust the IF LEV ADJ control for ± 0.1 dB of the TRMTR "RF MON"
level recorded on the RADIO DATA CARD.

- 14 Disconnect test equipment from the radio bay at item C, leaving items 5, 18,
and C (30-dB attenuator) connected to the RF MON jack.

- 15 On the 328A AMPL:
a. Operate the **ALC ON/OFF** switch to **ON**.

Transmitter Alignment path

- b. Go to Procedure 5.3,
Linearization.

End of Procedure

5.3 Linearization (Solid State)

This procedure is used to measure and then minimize, by adjustment, the third-order products generated in the transmitter with a 3-tone IF test signal input. It then checks the output power of the transmitter in the manual mode (ALC OFF) and then in the automatic mode (ALC ON) using the normal 64-QAM signal.

Prerequisite: The IF and RF power levels meet requirements of Procedures 3.4 and either 5.2 or 8.1.



WARNING:

RF radiation in excess of 1 milliwatt may cause bodily harm. Do not open any radio transmitter RF connection until the IF drive signal has been removed.



CAUTION:

This is an Out-of-Service procedure. Service will be interrupted or impaired unless you apply Service Protection measures.



CAUTION:

SMA connectors damage easily. Finger-start SMA connections for several turns, then use only a torque wrench to tighten.

Step	Procedure
1	On the 328A AMPL, operate the ALC ON/OFF switch to OFF .
2	On the IF PREDISTORTER: a. Remove the cable from the IF IN jack. b. Remove the cable from the IF OUT jack.
	<i>Comment: Steps 3 through 9 establish the 3-tone test signal level.</i>
3	On the TEST SET: a. Calibrate the POWER METER, if necessary. Reference: DRTS tab, 2.2 Calibration. b. Enter the OFFSET (as shown on the POWER SENSOR) for measurement of IF between -30 dBm and + 10 dBm (about 35.7 dB). c. Add an additional 0.25 dB to the OFFSET to compensate for loss in the 8-foot BNC - BNC cable.

Reference: **DRTS** tab, 2.3 Entering Offset.

AT&T— PROPRIETARY

See notice on first page

- 4 On the 3 TONE SOURCE,
operate the three tone switches (67, 70, & 75 MHz) to ON (lighted).
- 5 On the MULTIPATH FADING SIMULATOR (MFS):
- Press the green PRESET/LOCAL key.
 - Press the ENTER key.
 - Press the blue SHIFT key to select functions labeled above keys.
Verify that the SHIFT annunciator arrow is indicated in the display window.
 - Press the green PRESET/LOCAL key to select MORE (shifted-PRESET/LOCAL).
 - Press the \uparrow key to display 6 3TONE READ.
 - Press the ENTER key.
- 6 On the 3 TONE SOURCE:
- Use OFFSET FREQ to adjust the offset frequency to 0.0 MHz as read on the MFS display.
 - Set the TOTAL POWER OUT control to midposition (-8 dBm).
- 7 Connect the test equipment as shown in Figure 14.
(You may have to get the 30-dB attenuator from the RF MON connection.)
- 8 On the POWER METER,
observe the power meter indication as you perform the next step.
- 9 On the 3 TONE SOURCE,
adjust TOTAL POWER OUT for -8.2 dBm ± 0.05 dB on the power meter display.
- Comment: Steps 10 through 17 adjust transmitter gain (ALC ON and OFF) with a 3-tone test signal.*
- 10 On the IF PREDISTORTER;
- Remove the test connection from the IF OUT jack.
 - Leave the IF OUT jack open until a later step (to prevent possible RF radiation).
- 11 On the 328A AMPL,
remove the termination from the RF MON jack, unless it is still off from Procedure 5.2.
- 12 On the POWER METER,
enter the OFFSET for RF between -30 dBm and $+10$ dBm (about 30 dB).

AT&T— PROPRIETARY
See notice on first page

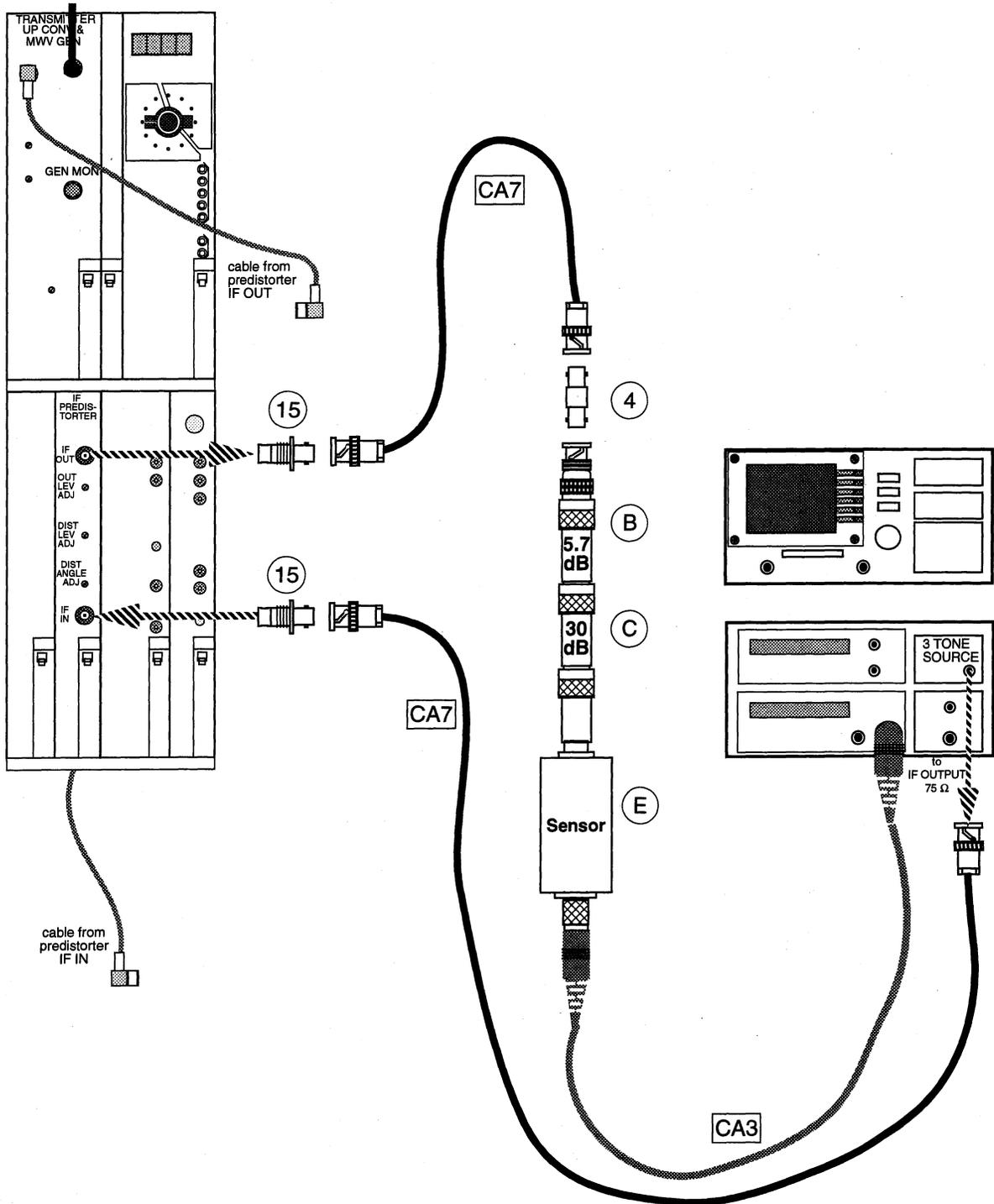


Figure 14. Establish 3-Tone Test Signal Level

AT&T— PROPRIETARY
See notice on first page

- 13 Connect the test equipment as shown in Figure 15.
- 14 On the IF PREDISTORTER,
reconnect the cable between the IF OUT jack and the IF IN jack on the TRANSMITTER UP CONV & MWV GEN.
- 15 On the TRANSMITTER UP CONV & MWV GEN,
adjust the IF LEV ADJ control for a power meter display ± 0.1 dB of the TRMTR "RF MON" level recorded on the RADIO DATA CARD (very little or no adjustment should be necessary).
- 16 On the ALARM AND METER unit:
a. Set the selector switch to TRMTR ALC V.
b. Observe the ALC indication as you perform the following step.
- 17 On the 328A AMPL:
a. **Exercise** the ALC ON/OFF switch by operating the **ALC ON/OFF** switch to **ON**, then to **OFF**, five times (ending in OFF position).
b. Adjust the DET ADJ control for 0.00 ALC V.
c. Operate the **ALC ON/OFF** switch to **ON**.

Requirement: ALC V must be 0.00.

Was the requirement met?

YES - Go to Step 18.

NO - Go to Flowchart 3, Unit Replacement and Alignment—328A Amplifier.

- 18 On the 328A AMPL, and while observing the power meter display,
operate the **ALC ON/OFF** switch to **OFF**, then to **ON**.

Requirement:

- In each switch position, ALC OFF and ALC ON, power level indications must be within 0.03 dB of each other.
- Each indication must be within ± 0.1 dB of the TRMTR "RF MON" value recorded on the RADIO DATA CARD.

Were the requirements met?

YES - Go to Step 19.

NO - Go to Flowchart 3, Unit Replacement and Alignment—328A Amplifier.

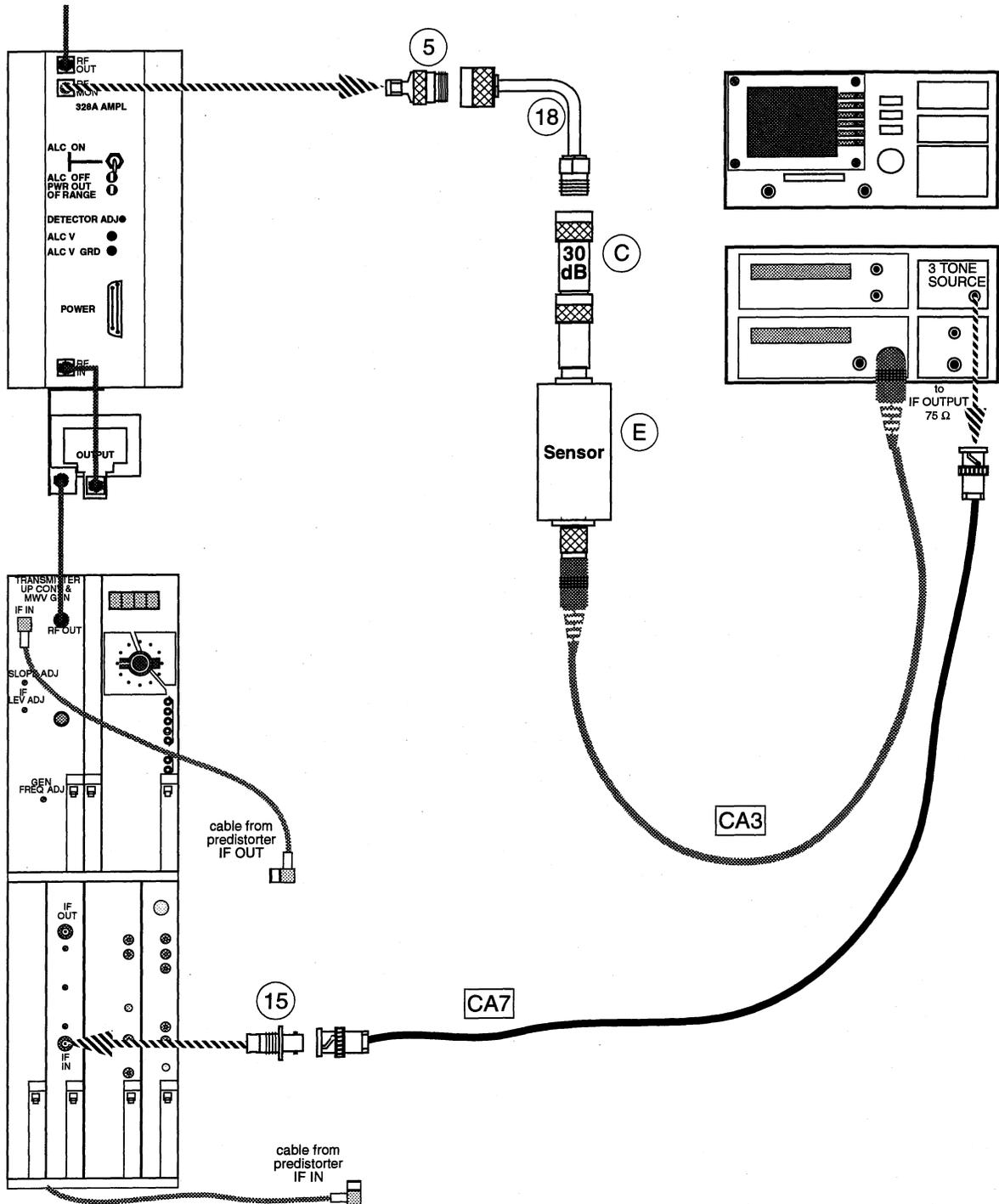


Figure 15. RF MON Power Measurement (with 3-Tone Test Signal Applied)—
Solid State

AT&T— PROPRIETARY
See notice on first page

19 On the 328A AMPL,
operate the ALC ON/OFF switch to OFF.

20 On the TRANSMITTER UP CONV & MWV GEN,
remove the cable from the IF IN jack.

Comment: Step 21 prepares the spectrum analyzer to display the transmitter RF output spectrum.

21 On the SPECTRUM ANALYZER:
a. Press the green PRESET key.
b. Press the FREQUENCY key.
c. Use the DATA keys to enter the transmit channel center frequency (fc).

Reference: Obtain Center Frequency from
Tables A, B, C, or D.

Verify that the correct center frequency is displayed in the
active function block.

Reference: **DRTS** tab, 3.2.2 Active Function Block.

- d. Press the SPAN key.
- e. Use the DATA keys to enter 30 MHz.
Verify that SPAN 30.00 MHz is displayed in the active
function block.
- f. Press the BW key.
- g. Press the RES BW AUTO MAN softkey to underline MAN.
- h. Use the DATA keys to enter 100 kHz.
Verify that RES BW 100 KHz is displayed in the active
function block.
- i. Press the VID BW AUTO MAN softkey twice to underline MAN.
- j. Use the DATA keys to enter 3 kHz.
Verify that VIDEO BW 3 KHz is displayed in the active
function block.
- k. Press the HOLD key to close the active function block.

22 Connect the test equipment as shown in Figure 16.

23 On the TRANSMITTER UP CONV & MWV GEN,
reconnect the cable to the IF IN jack.

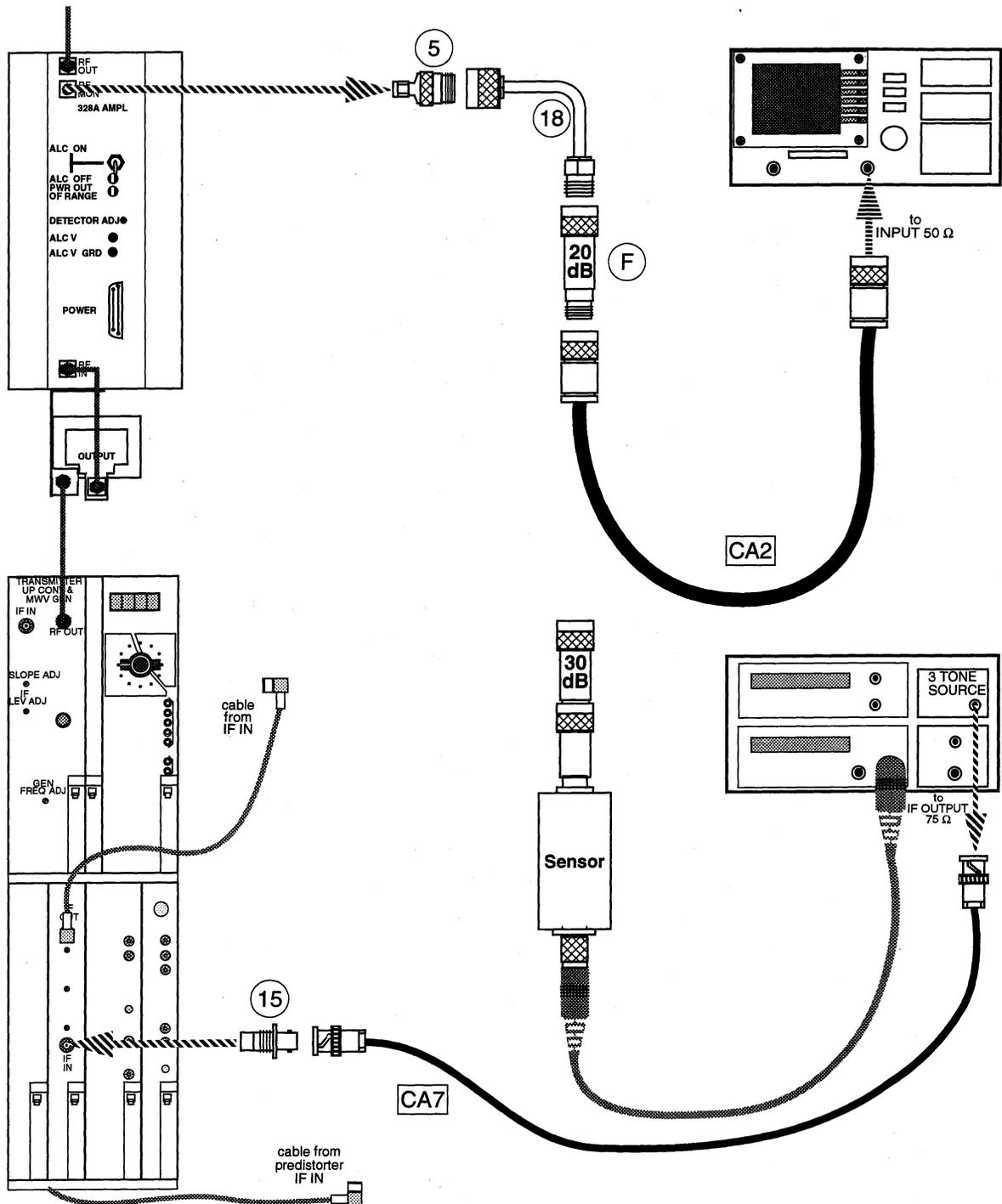


Figure 16. Measuring Linearity at RF MON (with Predistorter)

AT&T— PROPRIETARY
See notice on first page

24

On the SPECTRUM ANALYZER:

- a. Press the AMPLITUDE key.

Verify that REF LEVEL.0 dBm is displayed in the active function block.

- b. Use the data KNOB to position the fundamental tone peaks at the top graticule line (approximate REF LEVEL -26.0 dBm).
- c. Press HOLD key to close the active function block.

Requirement: Minimum separation between the fundamental tones and the modulation products must be at least 47 dB.

Reference: Figure 17, Spectrum Display Example.

Comment: In Step 25, you will adjust the DIST LEV ADJ (distortion level adjustment) and the DIST ANGLE ADJ (distortion angle adjustment) controls for maximum separation. Because these adjustments affect IF Predistorter gain, you will also maintain constant gain by adjusting the OUT LEV ADJ (output level adjustment) to keep ALC V at 0.00 ± 0.05 volts.

25

On the IF PREDISTORTER:

- a. Alternately adjust the DIST ANGLE ADJ and the DIST LEVEL ADJ controls for maximum separation between the fundamental tones and the modulation products.
- b. Adjust the OUT LEV ADJ control to maintain the ALC V at 0.00 ± 0.05 .
- c. Repeat sub-steps a. and b. until separation is maximum and ALC V is 0.00 ± 0.05 .

26

On the 328A AMPL,

operate the **ALC ON/OFF** switch to **ON**.

Requirement: 47dB or more separation between fundamental tones and modulation products.

Was the requirement met?

- YES - Go to Step 27.
NO - Go to Procedure 6.4,
Intermodulation Isolation.

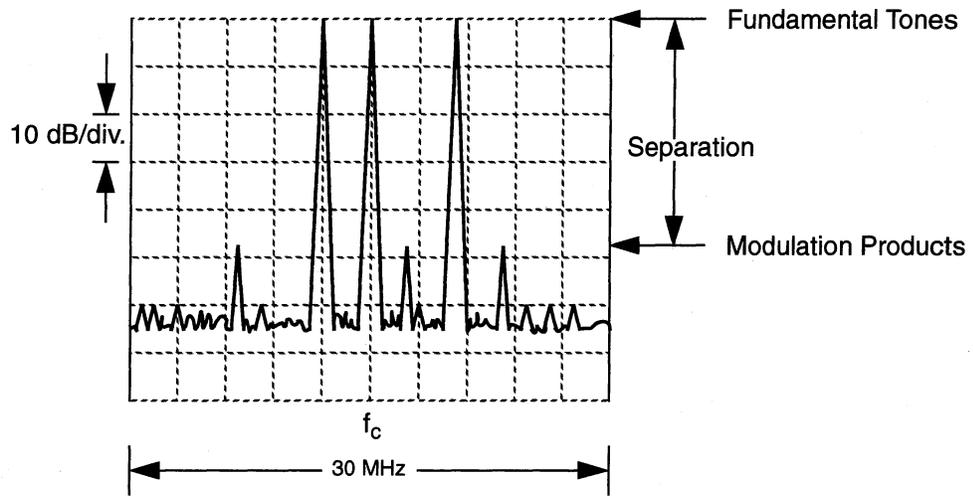


Figure 17. Spectrum Display Example

AT&T— PROPRIETARY
See notice on first page

- 27 On the 328A AMPL,
operate the **ALC ON/OFF** switch to **OFF**.
- 28 On the IF PREDISTORTER:
a. Disconnect the 3-tone test signal from the IF IN jack.
b. Disconnect the cable from the IF OUT jack.
- 29 On the POWER METER,
enter the OFFSET for IF between -30 dBm and $+10$ dBm
(about 35.7 dB), plus an additional 0.25 dB to compensate for loss
in the test cable.
- 30 Connect the test equipment as shown in Figure 18.
- 31 On the IF PREDISTORTER,
connect the bay cable (64-QAM) to the IF IN jack.
- 32 On the POWER METER,
observe the display.
- Requirement:** -8.2 dBm ± 0.2 dB
- Is the requirement met?
- YES - Go to Step 33.
- NO - Repeat from Step 2.
(Only an error or defective test equipment would cause the
requirement not to be met.)
- 33 On the IF PREDISTORTER:
a. Adjust the OUT LEV ADJ control for -8.2 dBm ± 0.05 dB on the
power meter display.
b. Remove the test connection from the IF OUT jack.
c. Leave the IF OUT jack open until a later step.
- 34 On the TEST SET,
enter the correct OFFSET for RF between -30 dBm and $+10$ dBm
(about 30 dB).

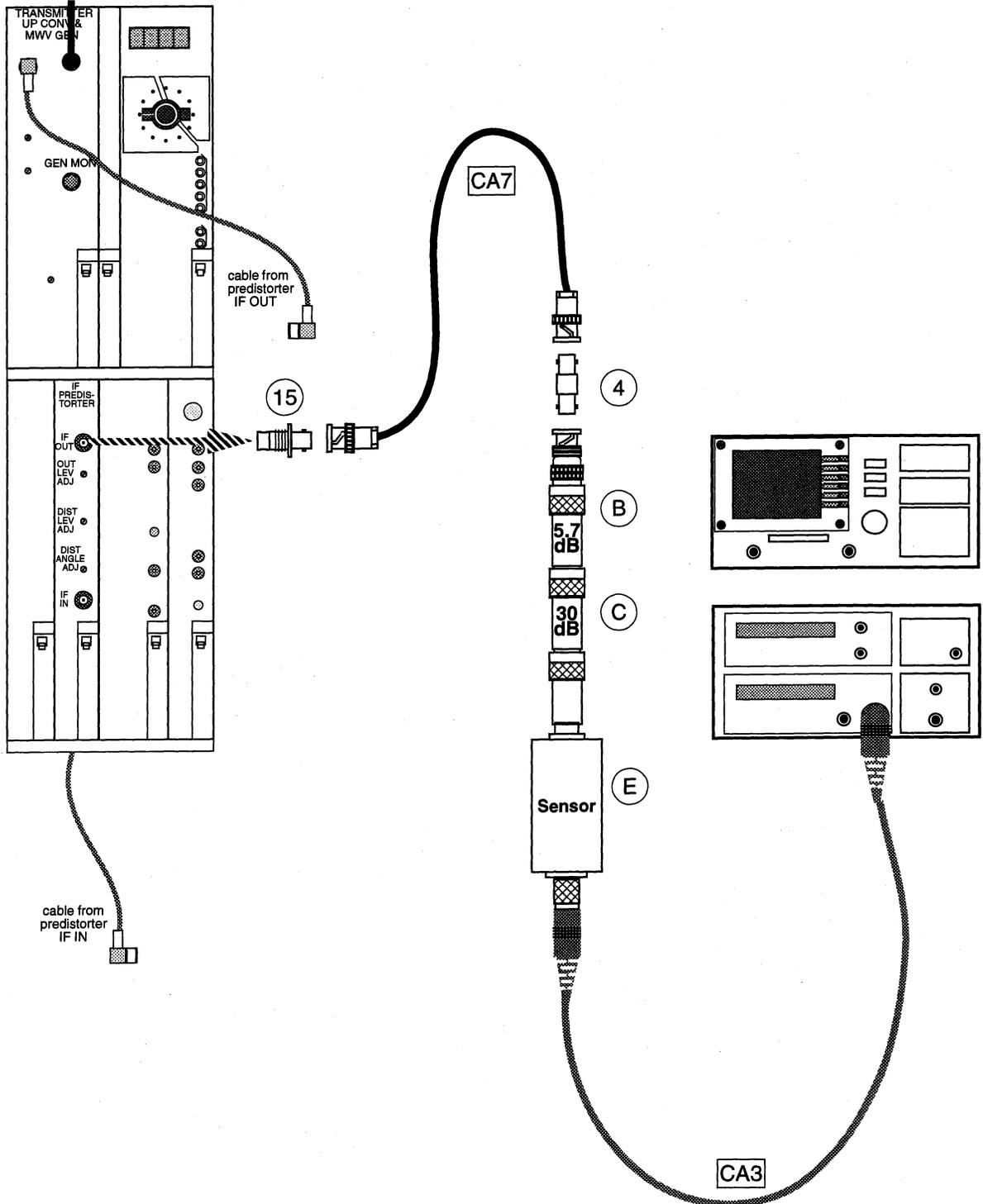


Figure 18. IF Predistorter Output Level Check

AT&T— PROPRIETARY
See notice on first page

- 35 Disconnect the 20 dB attenuator (item F) from the right angle adapter (item 18) and connect the test equipment as shown in Figure 19.
- 36 On the IF PREDISTORTER,
reconnect the cable between the IF OUT jack and the IF IN jack on the TRANSMITTER UP CONV & MWV GEN.
- 37 On the POWER METER:
- a. Compare the power meter display to the TRMTR "RF MON" level recorded on the RADIO DATA CARD and note the difference.
 - b. Match the difference to one of the following:
 - ± 0.1 dB:
Go to Step 38.
 - Greater than ± 0.1 dB and does not exceed ± 0.5 dB:
 1. Adjust the IF LEV ADJ control on the TRANSMITTER UP CONV & MWV GEN for a power meter display within ± 0.1 dB of the RF MON level recorded on the RADIO DATA CARD.
 2. Go to Step 38.
 - Greater than ± 0.5 dB:
Repeat the Transmitter Alignment, starting at Procedure 3.4, IF Predistorter Input/Output Levels. (It appears that you have made a mistake.)
- 38 On the ALARM AND METER unit,
turn the selector switch to TRMTR ALC V.
- 39 On the 328A AMPL,
adjust the DET ADJ control to meet the following requirement.

Requirement: An ALC V indication of 0.00 ± 0.01 volts.

Was the requirement met?

YES - Go to Step 40.

NO - Go to Flowchart 3, Unit Replacement and Alignment—328A Amplifier.

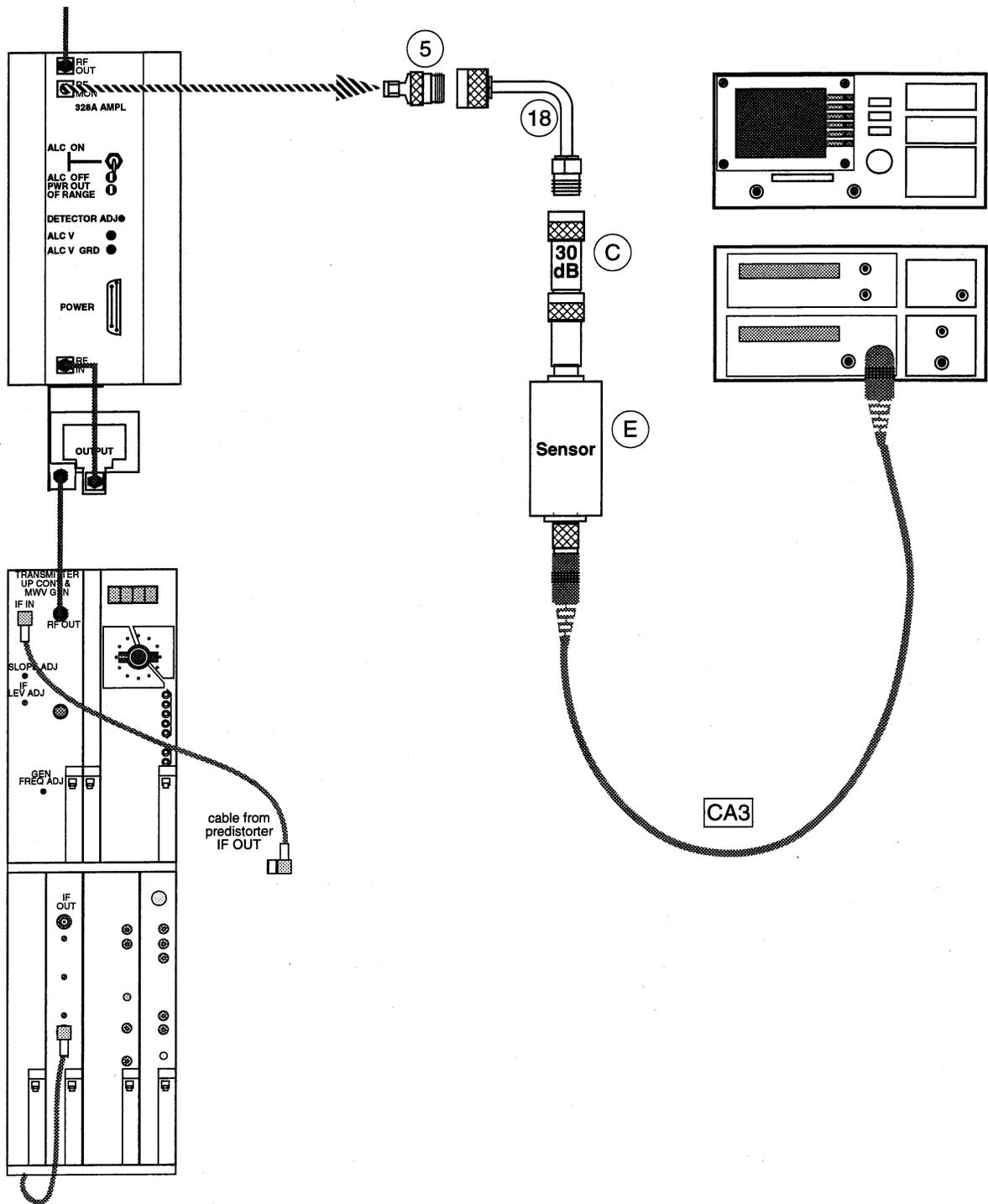


Figure 19. RF MON Power Measurement

AT&T— PROPRIETARY
See notice on first page

40

On the 328A AMPL:

- a. Operate the **ALC ON/OFF** switch to **ON**, then to **OFF** while observing the power meter display.

Requirement:

- In both switch positions, ALC ON and ALC OFF, power meter indications must be within 0.03 dB of each other.
- Each power indication must be within ± 0.1 dB of the TRMTR "RF MON" value recorded on the RADIO DATA CARD.

- b. Operate the **ALC ON/OFF** switch to **ON**.

Requirement:

- An ALC V indication of 0.00 ± 0.00 volts on the ALARM AND METER unit.
- The PWR OUT OF RANGE indicator is OFF on the 328A Amplifier.

Were all the requirements met?

YES - Go to Step 41.

NO - Perform sub-Steps 1 through 5.

1. **Exercise** the ALC ON/OFF switch by operating the **ALC ON/OFF** switch to **OFF**, then to **ON**, five times.
2. Operate the **ALC ON/OFF** switch to **OFF**.
3. If you have already completed sub-Step 4 once, go to sub-Step 5.
4. Return to Step 39 and repeat.
5. Go to Flowchart 3, Unit Replacement and Alignment—ALC Network.

41

On the 328A AMPL,

operate the **ALC ON/OFF** switch to **OFF**.

42

On the TRANSMITTER UP CONV & MWV GEN,

remove the cable from the IF IN jack.

43

Disconnect the test equipment from the radio bay.

44

On the 328A AMPL,

install the termination on the RF MON jack.

- 45 On the TRANSMITTER UP CONV & MWV GEN,
reconnect the cable to the IF IN jack.
- 46 On the 328A AMPL,
operate the **ALC ON/OFF** switch to **ON**.
- 47 On the ALARM AND METER unit,
set the selector switch to TRMTR OFF.
- 48 Go to Flowchart 4 (this tab).

Transmitter Alignment path

Solid State Transmitter Alignment completed.

End of Procedure

6 Unit Tests—Common

6.1 ALC Voltage (“Annual”)

This procedure checks the RF output power by measuring the ALC voltage. If the ALC voltage (ALC ON) has changed less than ± 0.03 volts since the last alignment or annual test, the RF output power is still within limits for the Annual Tests requirement.



CAUTION:

Service will be interrupted or impaired if you operate the ALC ON/OFF switch or make an adjustment on an in-service radio bay.

Step	Procedure
1	<p>On the ALARM AND METER unit, turn the selector switch to TRMTR ALC V.</p> <p><i>Requirement:</i> An ALC V indication of 0.00 ± 0.03 volts.</p> <p>Was the requirement met?</p> <p>YES - Go to Step 2.</p> <p>NO - A Transmitter Alignment is required.</p>
2	<p>On the ALARM AND METER unit, turn the selector switch to TRMTR OFF.</p>
3	<p>Return to the flowchart or procedure that sent you here.</p>

End of Procedure

This page has intentionally been left blank.

6.2 Up-Converter Gain

Use this procedure to check the gain of the up-converter.

Prerequisite: The microwave generator output level and the IF input level to the up-converter meet requirements of Procedures 3.2, 3.3, and either 3.4 or 5.1.



CAUTION:

This is an Out-of-Service procedure. Service will be interrupted or impaired unless you apply Service Protection measures.



CAUTION:

SMA connectors damage easily. Finger-start SMA connections for several turns, then use only a torque wrench to tighten.

Step	Procedure
1	On the ALC NETWORK or 328A AMPL, operate the ALC ON/OFF switch to OFF .
2	On the TRANSMITTER UP CONV & MWV GEN: a. Remove the cable from the IF IN jack. b. Remove the semirigid cable between the RF OUT jack and the RF FL IN jack on the Amplifier Assembly.
3	On the TEST SET: a. Calibrate the POWER METER, if necessary. Reference: DRTS tab, 2.2 Calibration. b. Enter the OFFSET (as shown on the POWER SENSOR) for measurement of RF between -30 dBm and +10 dBm (about 30 dB). Reference: DRTS tab, 2.3 Entering Offset.
4	Connect the test equipment as shown in Figure 20.
5	On the TRANSMITTER UP CONV & MWV GEN, reconnect the cable to the IF IN jack.
6	On the POWER METER, note the power level for later reference.

AT&T— PROPRIETARY
See notice on first page

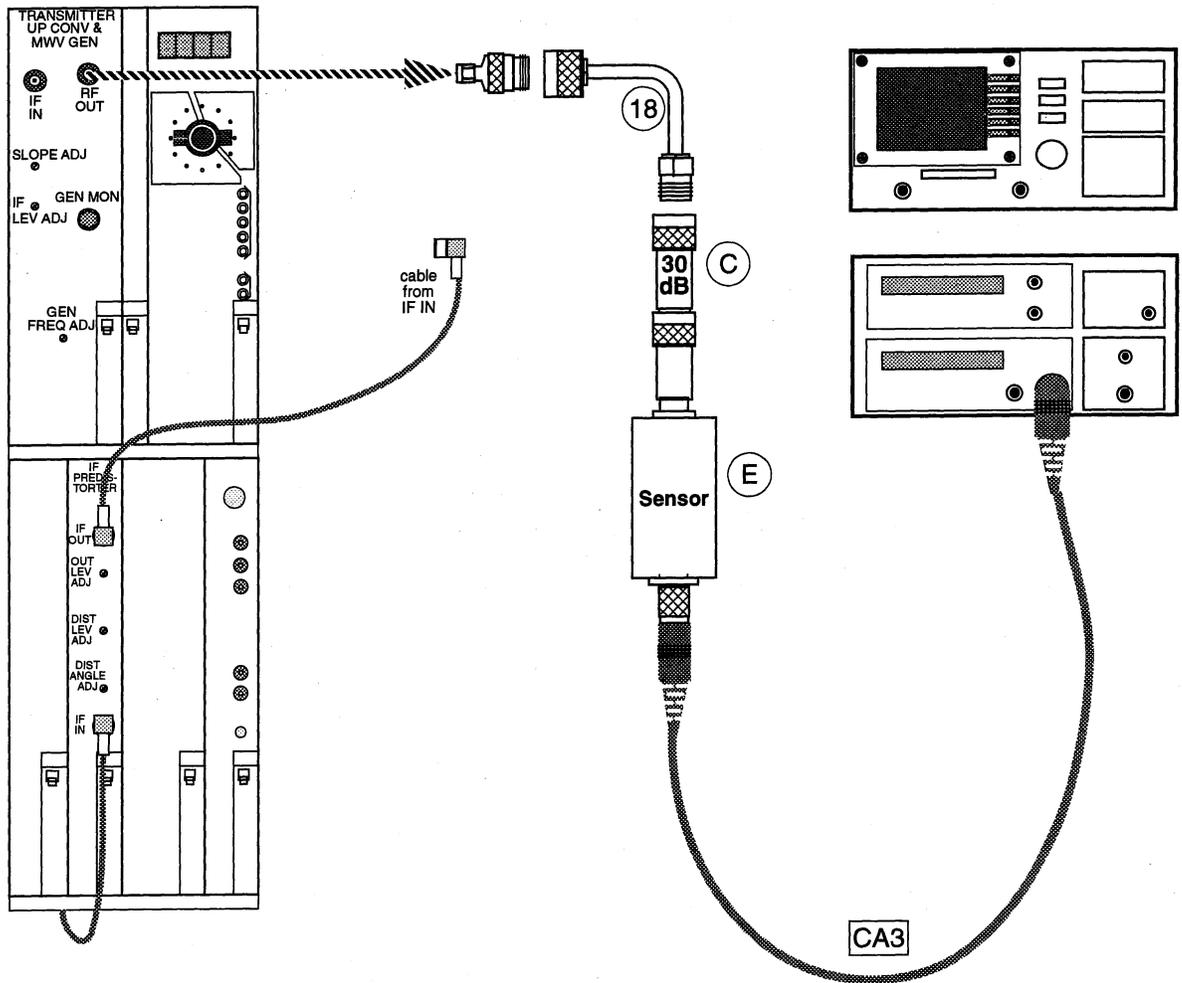


Figure 20. Up-Converter Gain Check

AT&T— PROPRIETARY
See notice on first page

- 7 On the TRANSMITTER UP CONV & MWV GEN,
adjust the IF LEV ADJ control for a maximum power meter display.

Requirement: -2.0 dBm or greater.

Example: Both -1.0 dBm and +0.5 dBm are greater than -2.0 dBm.

Was the requirement met?

YES - Go to Step 8.

NO - Go to Flowchart 3, Unit Replacement and
Alignment—Up-Converter.

- 8 On the TRANSMITTER UP CONV & MWV GEN:
- a. Adjust the IF LEV ADJ control to the same power level noted in Step 6.
 - b. Remove the cable from the IF IN jack.
 - c. Remove the test connection from the RF OUT jack.
 - d. Reconnect the semirigid cable between the RF OUT jack and the RF FL IN jack on the Amplifier Assembly.
 - e. Reconnect the cable to the IF IN jack.
- 9 On the ALC NETWORK or 328A AMPL,
operate the **ALC ON/OFF** switch to **ON**.
- 10 Return to the flowchart or procedure that sent you here.

End of Procedure

This page has intentionally been left blank.

6.3 Slope and Frequency Response

This procedure checks the amplitude vs. frequency response of the up-converter and RF Amplifier (TWT or Solid State) combination. Steps are included to adjust the slope component, if necessary.



WARNING:

RF radiation in excess of 1 milliwatt may cause bodily harm. Do not open any radio transmitter RF connection until the IF drive signal has been removed.



CAUTION:

This is an Out-of-Service procedure. Service will be interrupted or impaired unless you apply Service Protection measures.



CAUTION:

SMA connectors damage easily. Finger-start SMA connections for several turns, then use only a torque wrench to tighten.

Step	Procedure
1	On the ALC NETWORK or 328A AMPL, operate the ALC ON/OFF switch to OFF .
2	On the TEST SET: a. Calibrate the POWER METER, if necessary. Reference: DRTS tab, 2.2 Calibration. b. Enter the OFFSET (as shown on the power sensor) for measurement of IF between -30 dBm and +10 dBm (about 35.7 dB). Reference: DRTS tab, 2.3 Entering Offset.
<i>Comment: Steps 3 through 7 establish the level of the IF test signal.</i>	
3	Connect the test equipment as shown in Figure 21.

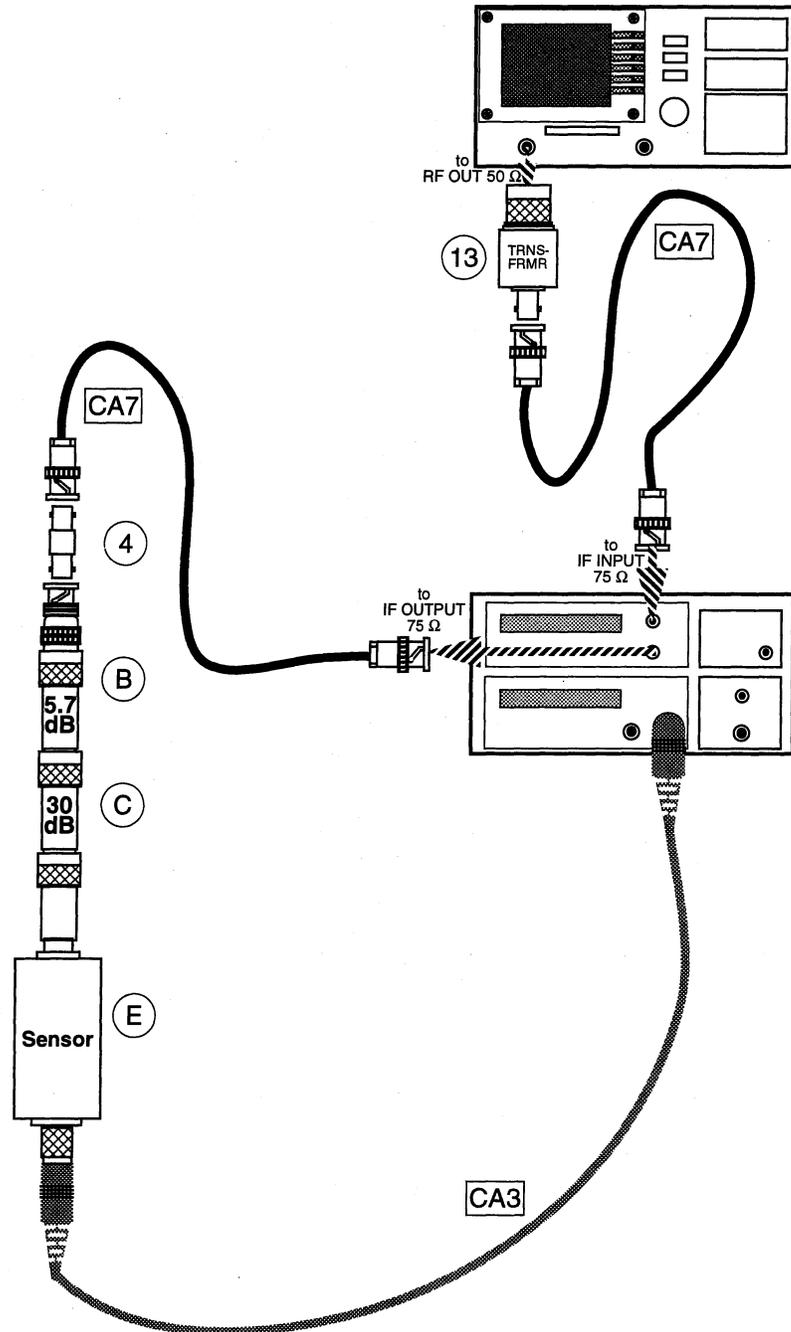


Figure 21. Establish IF Test Signal Level and Center Frequency

AT&T— PROPRIETARY
See notice on first page

4 On the SPECTRUM ANALYZER:

- a. Press the green PRESET key.
- b. Press the FLATNESS & SOURCES softkey.
- c. Press the Sources softkey.

Verify that IF SOURCE PWR .0 dBm is displayed in the **active function block** (default value).

Reference: **DRTS** tab, 3.2.2 Active Function Block.

- d. Press the CENTER FREQ softkey.

Verify that CENTER 70.00 MHz is displayed in the active function block (default value).

- e. Press the SPAN softkey.
- f. Use the DATA keys to enter 0 Hz.

Verify that 0 Hz is displayed in the active function block.

- g. Press the SRC PWR ON OFF softkey to select source power (SRC PWR highlighted).

If SRC PWR softkey was not displayed, you probably pressed the SPAN key rather than the SPAN softkey. If this is the case, press the MODE key two times to return to the FLATNESS & SOURCES main menu; then press the Sources softkey (SRC PWR will be highlighted) and proceed to sub-step h..

- h. Press the SRC PWR ON OFF softkey to underline ON.
- i. Press HOLD key to close the active function block.

5 On the MULTIPATH FADING SIMULATOR (MFS):

- a. Press the green PRESET/LOCAL key.
- b. Press the ENTER key.
- c. Press the ATTEN key (you now have a variable attenuator).

- 6 On the POWER METER,
observe the power meter indication as you perform the next step.

**CAUTION:**

If Step 7 a. is not performed correctly, excessive power may damage the radio transmitter. Be sure you observe the POWER METER display as you perform the adjustment in Step 7 a..

- 7 On the MULTIPATH FADING SIMULATOR:
- a. Use the arrow keys to adjust ATTEN (dB) for a **power meter** display of -8.2 dBm, ± 0.1 dB.
 - b. Press the ENTER key (on MFS) to lock in the attenuator value.
 - c. Verify that the MFS display indicates a positive ATTEN (dB) value (about 07.6 ± 1.0).

Comment: We should never have a negative ATTEN (dB) value because a negative value indicates gain, not loss.

Comment: Steps 8 and 9 calibrate the back-to-back amplitude response of the test equipment and cables.

- 8 Change test connections to those shown in Figure 22.
- 9 On the SPECTRUM ANALYZER:
 - a. Press the SPAN softkey.
 - b. Use the DATA keys to enter 24 MHz.
Verify that 24 MHz is displayed in the active function block.
 - c. Press the Main Menu softkey.
If Main Menu softkey was not displayed, you probably pressed the SPAN key rather than the SPAN softkey. If this is the case, press the MODE key two times to return to the FLATNESS & SOURCES main menu; then proceed to d..
 - d. Press the Cal softkey.
 - e. Press the CAL TRANS softkey.
Wait for
Connect THRU, Store when ready
to be displayed in the active function block.
 - f. Press the STORE THRU softkey.
Wait for
THRU cal stored, Normalization ON
to appear in the active function block.
 - g. Press the Main Menu softkey.
 - h. Press the Meas softkey.
 - i. Press the AMPL TRK ON OFF softkey to underline ON.
 - j. Press the SCALE LOG softkey.
 - k. Use the DATA keys to enter 0.2 dB (per div).
Verify that .2 dB/ is displayed in the active function block.
 - l. Press HOLD key to close the active function block.

Requirement: A *flat* response should be observed on the screen display.

If the requirement is not met, recheck the test setup.

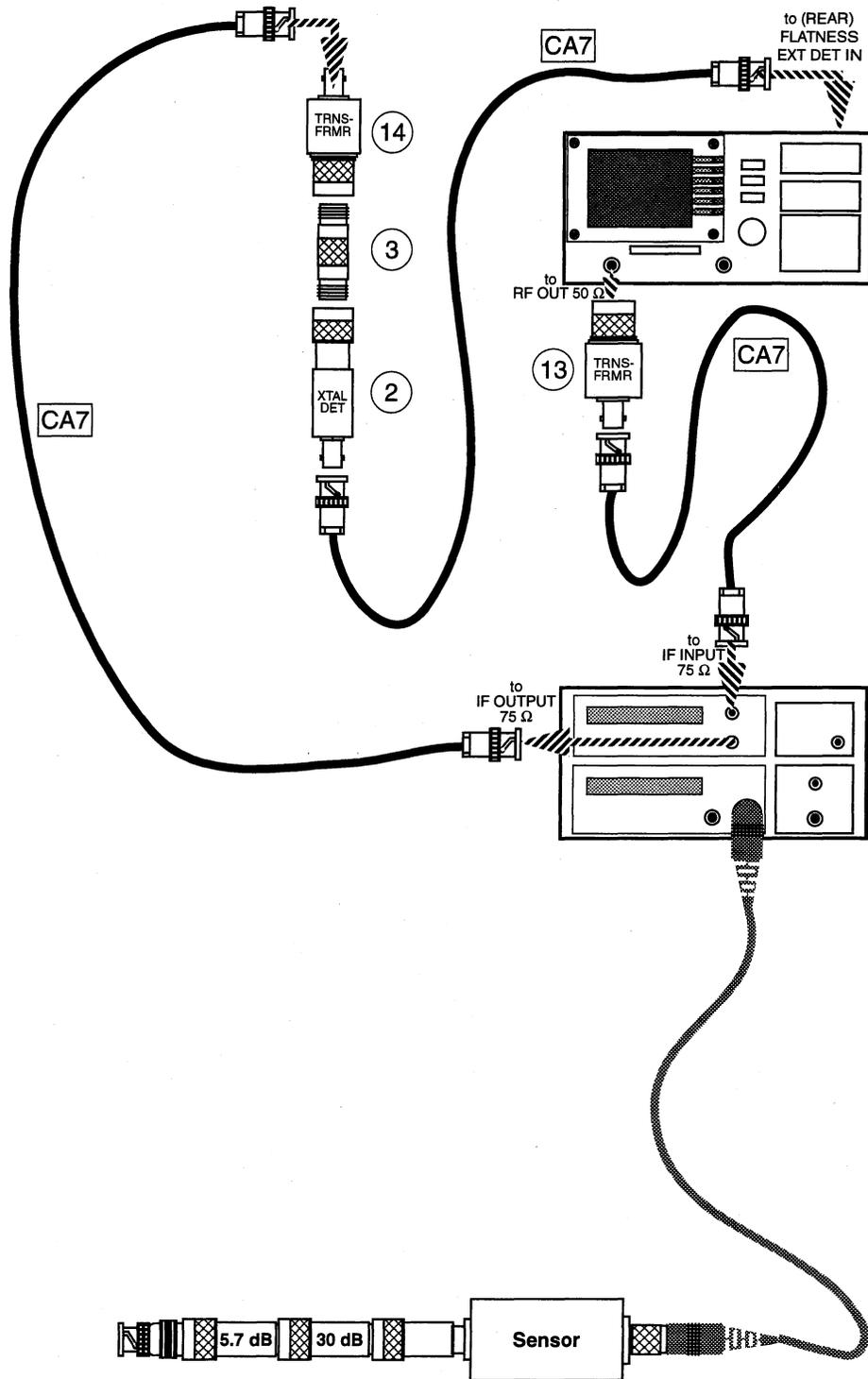


Figure 22. Calibrate Test Equipment Back-to-Back

AT&T— PROPRIETARY
See notice on first page

10 On the TRANSMITTER UP CONV & MWV GEN,
remove the cable from the IF IN jack.

11 On the ALC NETWORK or 328A AMPL,
remove the termination from the RF MON jack.

Comment: In Steps 12 through 15, you will measure and evaluate the amplitude response of the radio transmitter.

12 Connect the test equipment as shown in Figure 23 (TWT) or Figure 24 (Solid State) in the following sequence:

- First, make the connection to the RF MON jack.
- Second, connect the test signal to the IF IN jack of the TRANSMITTER UP CONV & MWV GEN.

13 On the SPECTRUM ANALYZER,
observe the +12 and -12 MHz end points on the display.

Requirement: Amplitude at the end points must be equal, within ± 0.1 dB.

Is the requirement met?

YES - Go to Step 15.

NO - Go to Step 14.

14 On the TRANSMITTER UP CONV & MWV GEN,
adjust the SLOPE ADJ to meet the requirement of Step 13.

Is the requirement met?

YES - Go to Step 15.

NO - Leave the test arrangement intact.

- Go to **TROUBLE ISOLATION** Tab,
3.3 Slope and Frequency Response Problem.

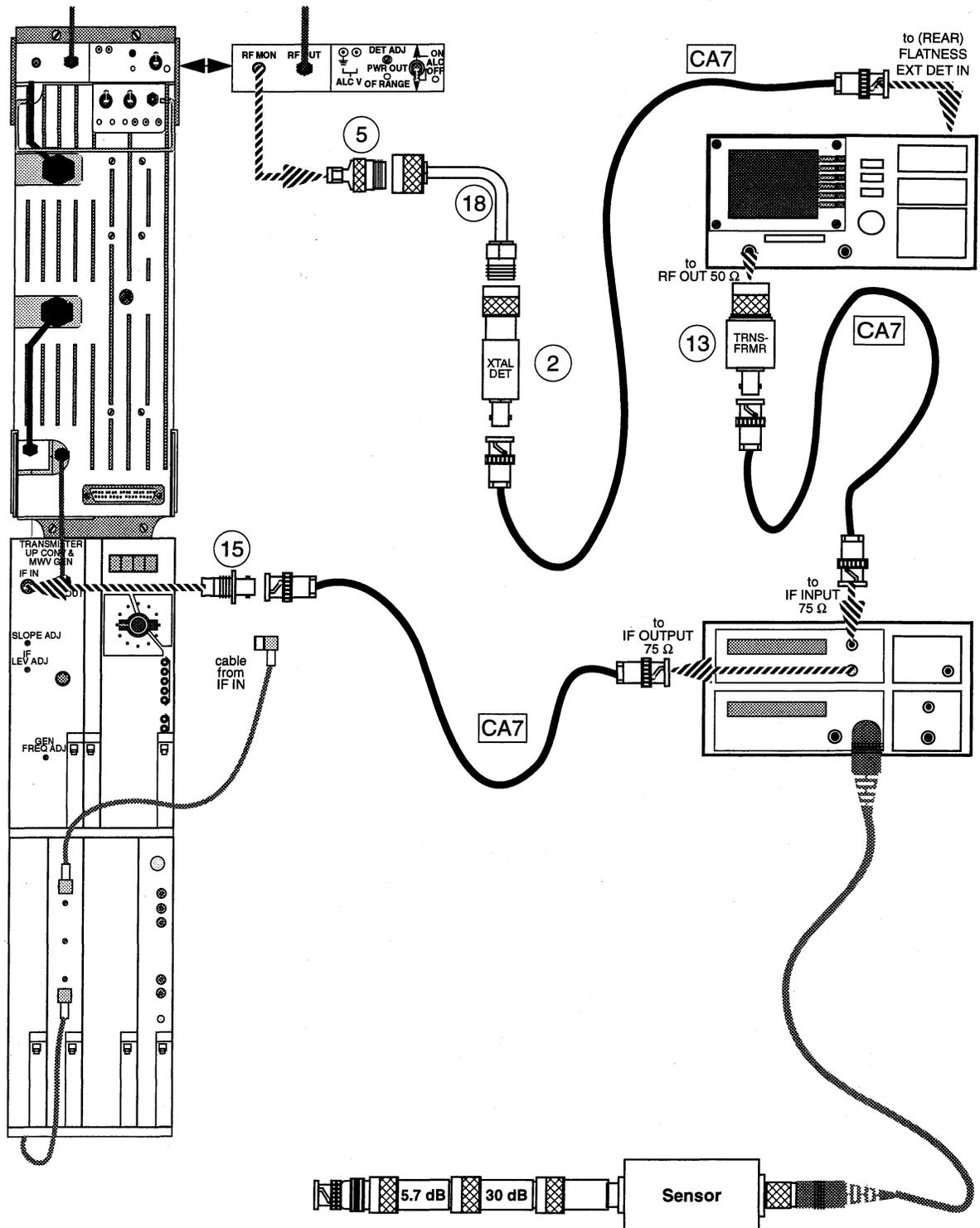


Figure 23. Measure Amplitude vs. Frequency Response—TWT

AT&T— PROPRIETARY
See notice on first page

This page has intentionally been left blank.

- 15 On the SPECTRUM ANALYZER,
observe the amplitude variations of the display between
the +12 and -12 MHz end points.

Requirement:

- Amplitude variation (peak-to-peak) must be within a 1-dB response window.
- There shall be no abrupt discontinuities.

Are the requirements met?

YES - Go to Step 16.

NO - Leave the test arrangement intact.

- Go to **TROUBLE ISOLATION** Tab,
3.3 Slope and Frequency Response Problem.

- 16 On the TRANSMITTER UP CONV & MWV GEN,
remove the test cable from the IF IN jack.
- 17 Disconnect the rest of the test equipment from the radio bay.
- 18 On the ALC NETWORK or 328A AMPL,
reconnect the termination to the RF MON jack.
- 19 On the TRANSMITTER UP CONV & MWV GEN,
reconnect the cable to the IF IN jack.
- 20 On the ALC NETWORK,
operate the **ALC ON/OFF** switch to **ON**.
- 21 Return to the flowchart or procedure that sent you here.

End of Procedure

6.4 Intermodulation Isolation

This is a trouble-isolation procedure to determine whether the up-converter and transmitter amplifier combination is producing more intermodulation than can be cancelled by the IF Predistorter. It also includes preliminary adjustment of the IF Predistorter distortion level control to match the level of the transmitter-produced intermodulation.

This procedure is also used to measure the linearity of a Solid State transmitter that is not equipped with an IF Predistorter.

Prerequisite: If the transmitter is equipped with an IF Predistorter, the input and output levels of the IF Predistorter must meet the requirements of Procedure 3.4 IF Predistorter Input/Output Levels.



WARNING:

RF radiation in excess of 1 milliwatt may cause bodily harm. Do not open any radio transmitter RF connection until the IF drive signal has been removed.



CAUTION:

This is an Out-of-Service procedure. Service will be interrupted or impaired unless you apply Service Protection measures.



CAUTION:

SMA connectors damage easily. Finger-start SMA connections for several turns, then use only a torque wrench to tighten.

Step	Procedure
1	On the ALC NETWORK or 328A AMPL, operate the ALC ON/OFF switch to OFF .
2	Remove the IF Predistorter (if equipped). Reference: REPLACEMENT PROCEDURES tab. a. Verify that the slide switch on the side of the unit is in the correct position. Reference: See the REPLACEMENT PROCEDURES tab for the correct switch position. b. Reinstall the IF Predistorter.

Comment: Steps 3 through 8 calibrate the 3-tone test signal.

- 3 On the TEST SET:
 - a. Calibrate the POWER METER, if necessary.

Reference: **DRTS** tab, 2.2 Calibration.
 - b. Enter the OFFSET (as shown on the POWER SENSOR) for measurement of IF between -30 dBm and +10 dBm (about 35.7 dB).

Reference: **DRTS** tab, 2.3 Entering Offset.
- 4 On the 3 TONE SOURCE,
operate the tone switches (67, 70, and 75 MHz) to ON (lighted).
- 5 On the MULTIPATH FADING SIMULATOR (MFS):
 - a. Press the green PRESET/LOCAL key.
 - b. Press the ENTER key.
 - c. Press the blue SHIFT key to select functions labeled above keys.

Verify that the SHIFT annunciator arrow is indicated in the display window.
 - d. Press the green PRESET/LOCAL key to select MORE (shifted-PRESET/LOCAL).
 - e. Press the \uparrow key to display 6 3TONE READ.
 - f. Press the ENTER key.
- 6 On the 3 TONE SOURCE:
 - a. Use the OFFSET FREQ control to adjust the offset frequency to 0.0 MHz on the MFS display.
 - b. Set the TOTAL POWER OUT control to midposition (-8 dBm).
- 7 Connect the test equipment as shown in Figure 25.
- 8 On the 3 TONE SOURCE, and while observing the power meter display,
adjust the TOTAL POWER OUT control for -8.2 dBm \pm 0.05 dB.
- 9 On the TRANSMITTER UP CONV & MWV GEN,
remove the cable from the IF IN jack.
- 10 On the ALC NETWORK or 328A AMPL,
remove the termination from the RF MON jack.

AT&T— PROPRIETARY
See notice on first page

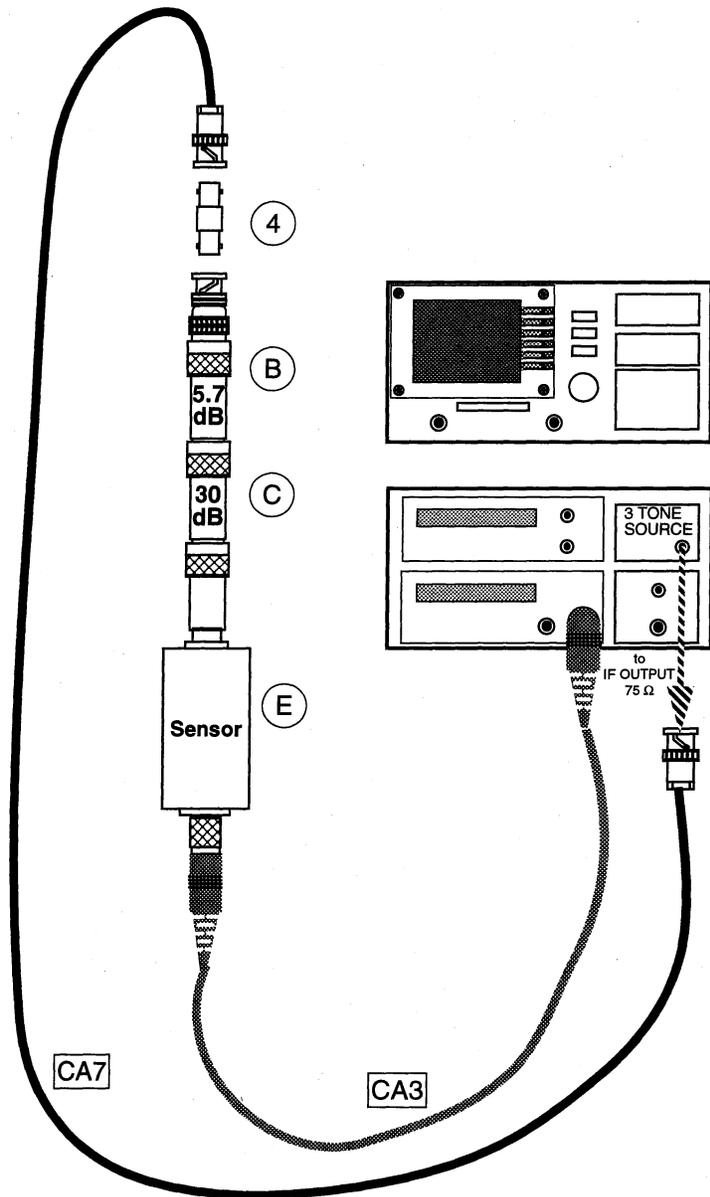


Figure 25. Establish 3-Tone Test Signal Level

AT&T— PROPRIETARY
See notice on first page

- 11 Connect the test equipment as shown in Figure 26 (TWT) or Figure 27 (Solid State) in the following sequence:
- First, make the connection to the RF MON jack.
 - Second, connect the 3-tone test signal to the IF IN jack of the TRANSMITTER UP CONV & MWV GEN.

Comment: Step 12 prepares the spectrum analyzer for an RF spectrum display.

- 12 On the SPECTRUM ANALYZER:
- Press the green PRESET key.
 - Press the FREQUENCY key.
 - Use the DATA keys to enter the transmit channel center frequency (fc).

Reference: Obtain Center Frequency from Tables A, B, C, or D.

Verify that the correct center frequency is displayed in the active function block.

Reference: **DRTS** tab, 3.2.2 Active Function Block.

- Press the SPAN key.
- Use the DATA keys to enter 30 MHz.
Verify that SPAN 30.00 MHz is displayed in the active function block.
- Press the BW key.
- Press the RES BW AUTO MAN softkey to underline MAN.
- Use the DATA keys to enter 100 kHz.
Verify that RES BW 100 KHz is displayed in the active function block.
- Press the VID BW AUTO MAN softkey to underline MAN.
- Use the DATA keys to enter 3 kHz.
Verify that VIDEO BW 3 KHz is displayed in the active function block.
- Press HOLD key to close the active function block.

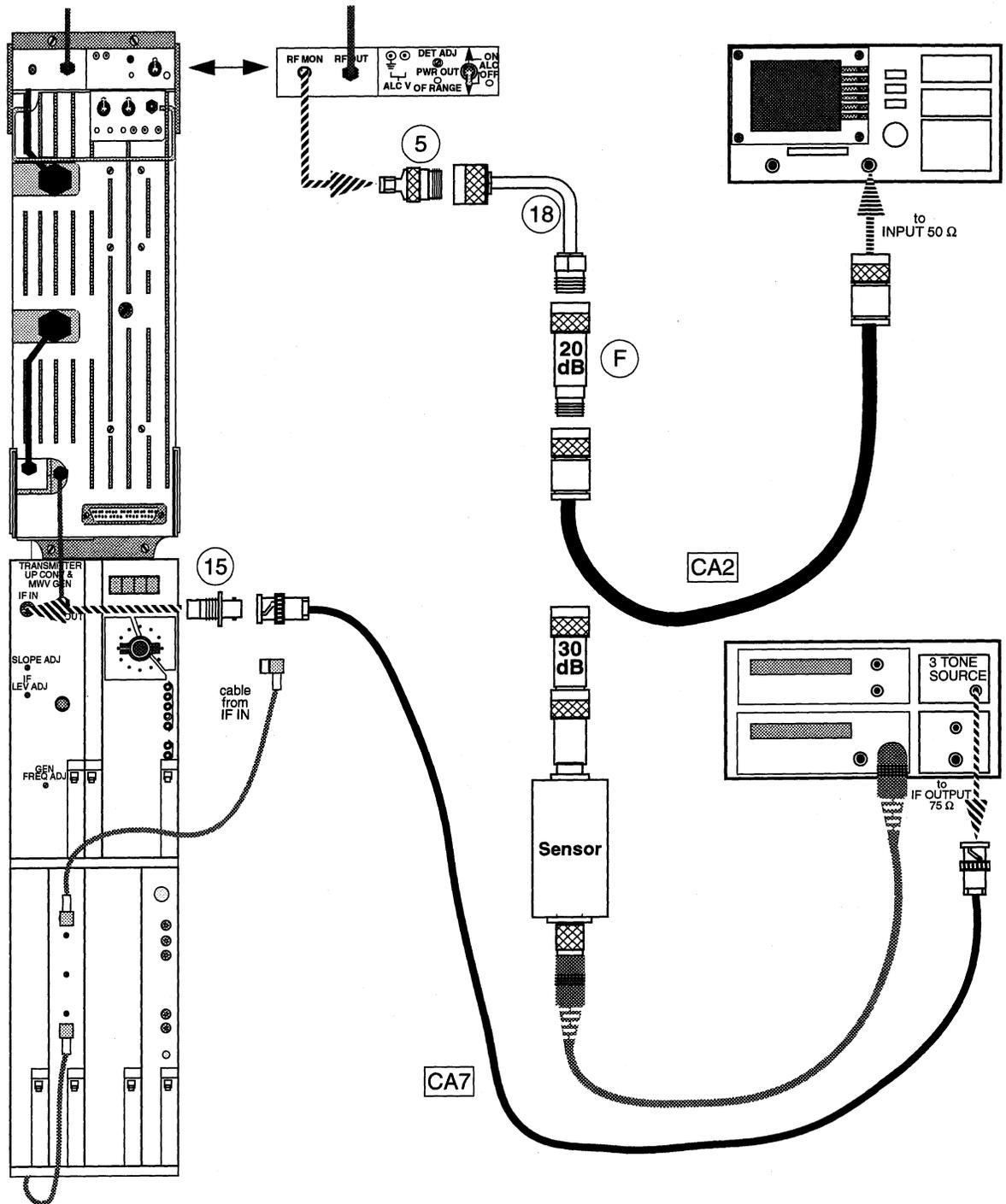


Figure 26. Measuring Linearity at RF MON (Predistorter Bypassed)—TWT

AT&T— PROPRIETARY
See notice on first page

This page has intentionally been left blank.

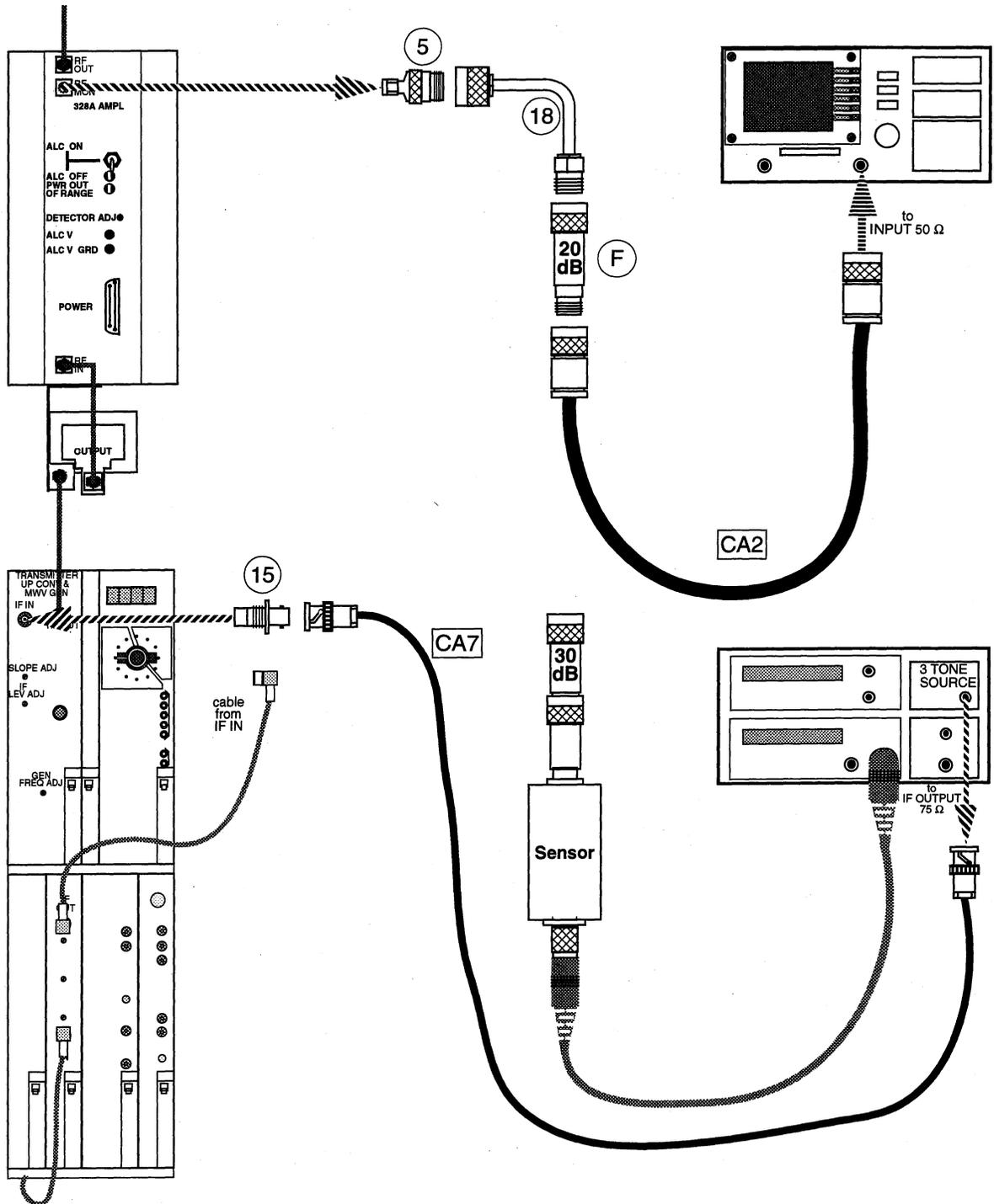


Figure 27. Measuring Linearity at RF MON (Predistorter Bypassed)—Solid State

AT&T— PROPRIETARY
See notice on first page

Comment: Step 13 measures the amplifier intermodulation.

- 13 On the SPECTRUM ANALYZER:
- a. Press the AMPLITUDE key.
 - b. Use the data KNOB to position the fundamental tone peaks at the top graticule line.
 - c. Press HOLD key to close the active function block.
 - d. Observe the spectrum display.

Requirement: Minimum separation between the fundamental tones and the modulation products must be at least 29 dB for a TWT transmitter power of +36.9 dBm. For transmitters with other output power levels, see Table E.

Was the requirement met?

YES - If this is a Solid State transmitter without an IF Predistorter, go to Step 14.

- For transmitters equipped with an IF Predistorter, make a note of the exact separation, in dB, and call it TWT (or Solid State) separation for use in a later step.

- Go to Step 15.

NO - Go to Flowchart 3, Unit Replacement and Alignment—TWT Amplifier, or 328A Amplifier.

- 14 For Solid State transmitters *not equipped* with an IF Predistorter:
- a. Remove all test set connections from the radio bay.
 - b. Reconnect the termination to the RF MON jack.
 - c. Reconnect the IF IN cable to the Up-Converter.
 - d. Operate the **ALC ON/OFF** switch to **ON**.
 - e. End of Procedure. Go to Flowchart 4 (this tab).

Transmitter Alignment path (Solid State without IF Predistorter)

Solid State Transmitter Alignment completed.

- 15 On the TRANSMITTER UP CONV & MWV GEN:
- a. Remove the 3-tone source from the IF IN jack.
 - b. Reconnect the normal bay cable to the IF IN jack.
- 16 On the IF PREDISTORTER:
- a. Remove the cable from the IF IN jack.
 - b. Remove the cable from the IF OUT jack.

Table E. Intermodulation Requirements

Transmitter Power at RF OUT Jack	Minimum Separation Between Fundamental Tones and Modulation Products	
	TWT (dB)	Solid State (dB)
+36.9	29.0	
+36.5	29.8	
+35.9	31.0	
+35.5	31.8	
+35.2	32.4	
+34.7	33.4	
+34.2	34.4	
+33.7	35.4	
+33.2	36.4	
+32.7	37.4	
+32.2	38.4	
+31.7	39.4	
+31.2	40.4	
+31.0	40.8	34.0
+30.7	41.4	35.1
+30.2	42.4	36.9
+29.7	43.4	38.8
+29.2	44.4	40.6
+28.9	45.0	41.7
+28.7		42.4
+28.2		44.3
+28.0		45.0

- 17 Connect the test equipment as shown in Figure 28.
- 18 On the POWER METER:
 - a. Enter the OFFSET for IF between -30 dBm and $+10$ dBm (about 35.7 dB).
 - b. Add an additional 0.25 dB to the OFFSET to compensate for loss in the 8-foot BNC - BNC test cable.
- 19 On the 3 TONE SOURCE, and while observing the power meter display, adjust the TOTAL POWER OUT control for -8.2 dBm ± 0.05 dB.

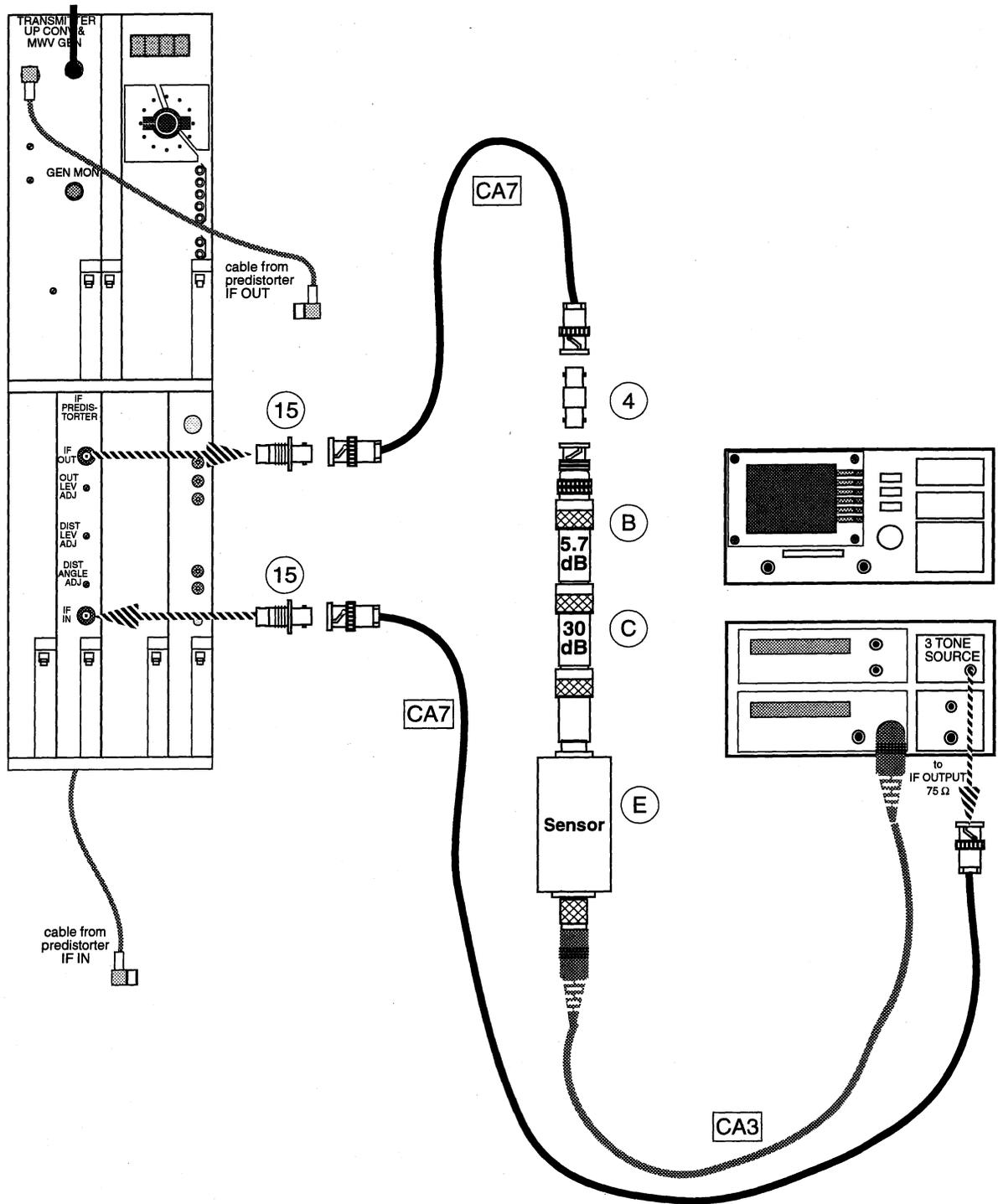


Figure 28. Establish 3-Tone Test Signal Level at Predistorter Output

AT&T— PROPRIETARY
See notice on first page

20 Connect the test equipment as shown in Figure 29.

21 On the SPECTRUM ANALYZER:

- a. Press the FREQUENCY key.
- b. Use the DATA keys to enter 70 MHz.

Verify that CENTER 70.00 MHz is displayed in the active function block.

- c. Press HOLD key to close the active function block.

Comment: The spectrum analyzer is already set with:

- SPAN 30.00 MHz
- RES BW 100 KHz
- VIDEO BW 3 KHz.

- d. Press the AMPLITUDE key.
- e. Use the data KNOB to position the fundamental tone peaks at the top graticule line.
- f. Press the HOLD key to close the active function block.

22 On the IF PREDISTORTER,

adjust the DIST LEV ADJ control for the following requirement (while viewing the spectrum analyzer display).

Requirement: The same separation (± 1 dB) noted in Step 13 as TWT (or Solid State) separation.

Was the requirement met?

YES - Go to Step 23.

NO - Go to Flowchart 3, Unit Replacement and Alignment— IF Predistorter.

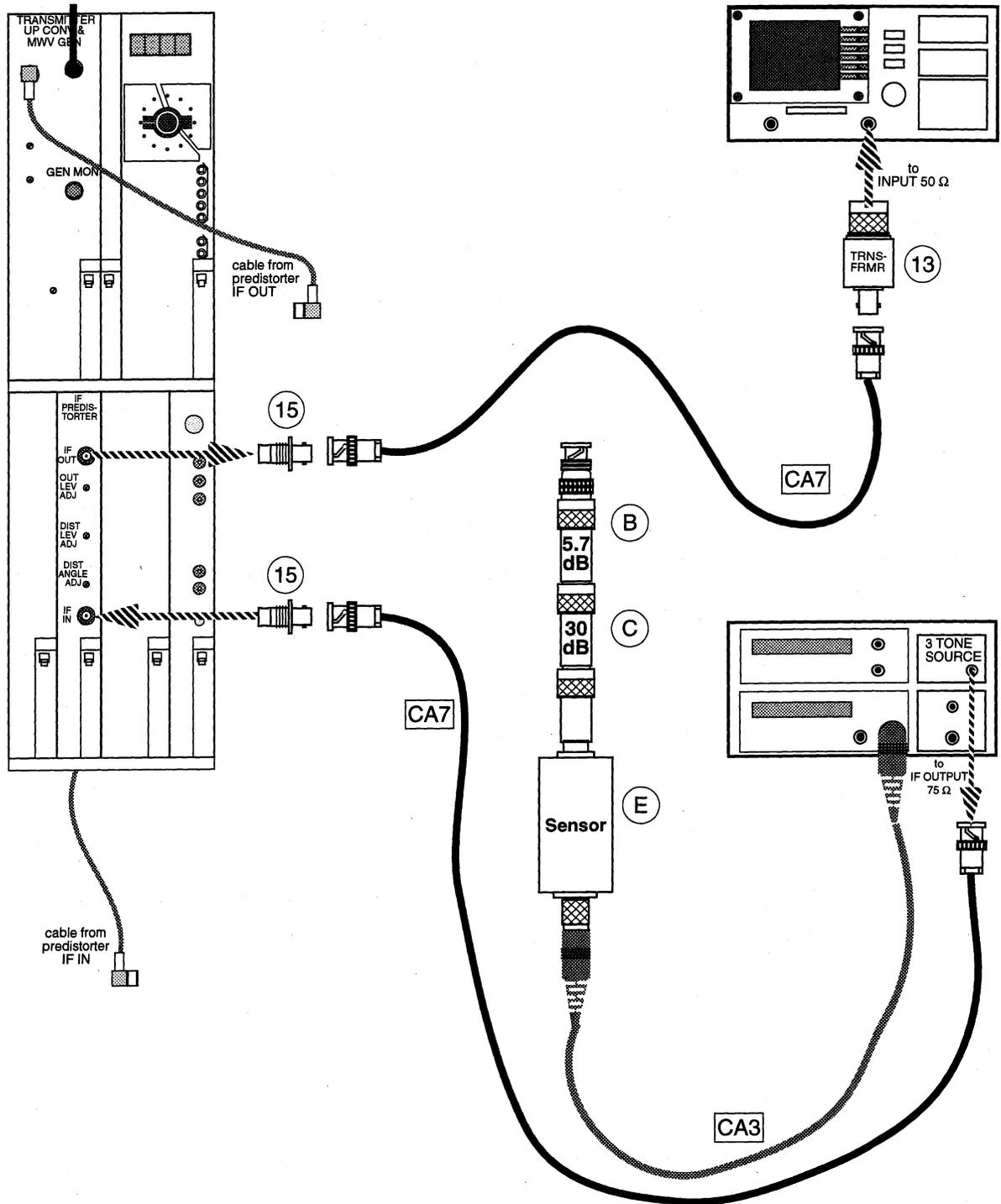


Figure 29. Measure IF Predistorter Linearity and Adjust Distortion Level

AT&T— PROPRIETARY
See notice on first page

Comment: The up-converter/transmitter amplifier combination and the IF Predistorter both have acceptable levels of intermodulation and the preliminary adjustment of the IF Predistorter distortion level has been made.

23 On the IF PREDISTORTER:

- a. Remove test connections, but leave the 3-tone source intact.
- b. Reconnect the cable from the TRANSMITTER UP CONV & MWV GEN to the IF OUT jack.

24 On the TRANSMITTER UP CONV & MWV GEN,
disconnect the cable from the IF IN jack.

Comment: Step 25 conditions the Spectrum Analyzer for returning to the linearization adjustment procedure where you will reuse much of this test arrangement.

25 On the SPECTRUM ANALYZER:

- a. Press the FREQUENCY key.
- b. Use the DATA keys to enter the transmit channel center frequency (fc).

Reference: Obtain Center Frequency from
Tables A, B, C, or D.

Verify that the correct center frequency is displayed in the active function block.

- c. Press HOLD key to close the active function block.

Transmitter Alignment path

TWT Amplifier,
go to Procedure 4.3,
Linearization, Step 22.

Solid State Amplifier,
go to Procedure 5.3,
Linearization, Step 22.

End of Procedure

7 Unit Tests—TWT

7.1 RF MON Calibration (TWT)

This procedure adjusts transmitter output power at the RF OUT jack, then calibrates the RF MON jack by determining the coupler loss (isolation) between the RF OUT jack and the RF MON jack.

Prerequisite: Procedure 3.4, IF Predistorter Input/Output Levels, if performing a Transmitter Alignment.

None, if performing either of the following:

- Radio Transmitter—**Trouble Isolation** tab, 2.3 RF Power Alarm Diagnosis—TWT, ALC Network replacement path
- Radio Receiver—**Trouble Isolation** tab, 3.1 RF Input Level Problem (Receiver).



WARNING:

RF radiation in excess of 1 milliwatt may cause bodily harm. Do not open any radio transmitter RF connection until the IF drive signal has been removed.



CAUTION:

This is an Out-of-Service procedure. Service will be interrupted or impaired unless you apply Service Protection measures.



CAUTION:

SMA connectors damage easily. Finger-start SMA connections for several turns, then use only a torque wrench to tighten.

Step	Procedure
	<i>Comment: Steps 1 through 7 adjust the transmitter RF output power.</i>
1	On the ALC NETWORK, operate the ALC ON/OFF switch to OFF .
2	On the TRANSMITTER UP CONV & MWV GEN, remove the cable from the IF IN jack.
3	On the AMPLIFIER ASSEMBLY, remove the semirigid cable between the RF OUT jack on the ALC Network and the INPUT jack on the Isolator/Transducer.
4	On the TEST SET: a. Calibrate the POWER METER, if necessary.

Reference: **DRTS** tab, 2.2 Calibration.

AT&T— PROPRIETARY

See notice on first page

- b. Enter the OFFSET (as shown on the POWER SENSOR) for measurement of RF between 0 dBm and +40 dBm (about 60 dB).

Reference: **DRTS** tab, 2.3 Entering Offset.

- 5 Connect the test equipment as shown in Figure 30.
- 6 On the TRANSMITTER UP CONV & MWV GEN:
 - a. Reconnect the cable to the IF IN jack.
 - b. Adjust the IF LEV ADJ control to meet the following requirement.

*Comment: These requirements are normal maximum operating power levels. Some transmitters are licensed to operate at lower output power. To verify correct output power, contact your TSG representative or check your station license. Power levels listed on the station license are at the output of the channel combining network; they will be 1.2 dB (6 GHz) and 1.8 dB (11 GHz) below levels measured at the RF OUT jack.
(Table F lists Watts-to-dBm conversions.)*

Requirement: A power meter display of:

- 6 GHz: +36.9 dBm \pm 0.1 dB
- 11 GHz: +36.5 dBm \pm 0.1 dB.

Was the requirement met?

YES - Go to Step 7.

NO - Go to **TROUBLE ISOLATION** tab,
3.1 RF Level Problem (Transmitter).

- 7 On the RADIO DATA CARD,
record the measured value on the TRMTR "RF OUT" line.

Comment: Steps 8 through 13 measure transmitter output power at the RF MON jack. The difference between the level here and at the RF OUT jack is the coupler loss for the RF MON jack.

- 8 On the TRANSMITTER UP CONV & MWV GEN,
remove the cable from the IF IN jack.
- 9 On the ALC NETWORK:
 - a. Remove the test equipment from the RF OUT jack.
 - b. Reconnect the semirigid cable between the RF OUT jack and the Isolator/Transducer INPUT jack.
 - c. Remove the termination from the RF MON jack.

AT&T— PROPRIETARY
See notice on first page

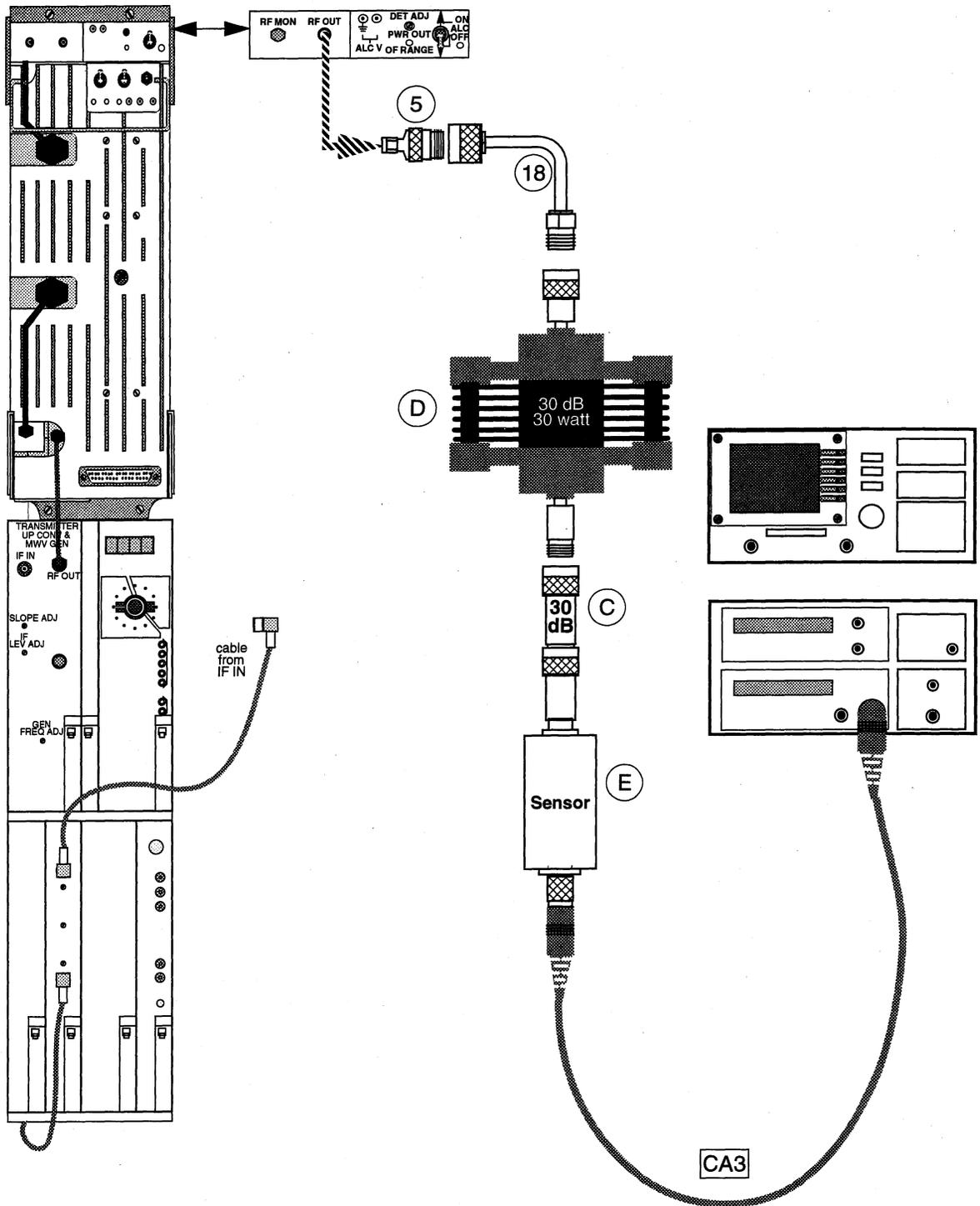


Figure 30. RF OUT Power Measurement—TWT

AT&T— PROPRIETARY
See notice on first page

- 10 Connect the test equipment as shown in Figure 31.
- 11 On the TRANSMITTER UP CONV & MWV GEN,
reconnect the cable to the IF IN jack.
- 12 On the POWER METER, after waiting 1 minute for thermal stabilization:
 - a. Observe the display.
 - b. Subtract this power level from the value measured and recorded in Step 7 to obtain the RF MON jack coupler loss.

Requirement: Coupler loss of:

- 6 GHz: 28 ± 4 dB
- 11 GHz: 30 ± 4 dB.

Was the requirement met?

Yes - Go to Step 13.

No - Go to Flowchart 3, Unit Replacement and Alignment—ALC Network.

- 13 On the RADIO DATA CARD,
record the measured power level on the TRMTR "RF MON OUT" line.
- 14 On the TRANSMITTER UP CONV & MWV GEN,
remove the cable from the IF IN jack.
- 15 Disconnect all test equipment from the radio bay.
- 16 On the ALC NETWORK,
install the termination on the RF MON jack.
- 17 On the TRANSMITTER UP CONV & MWV GEN,
reconnect the cable to the IF IN jack.
- 18 On the ALC NETWORK,
operate the **ALC ON/OFF** switch to **ON**.
- 19 Return to the flowchart or procedure that sent you here.

Transmitter Alignment path

Go to Procedure 4.3, Linearization.

End of Procedure

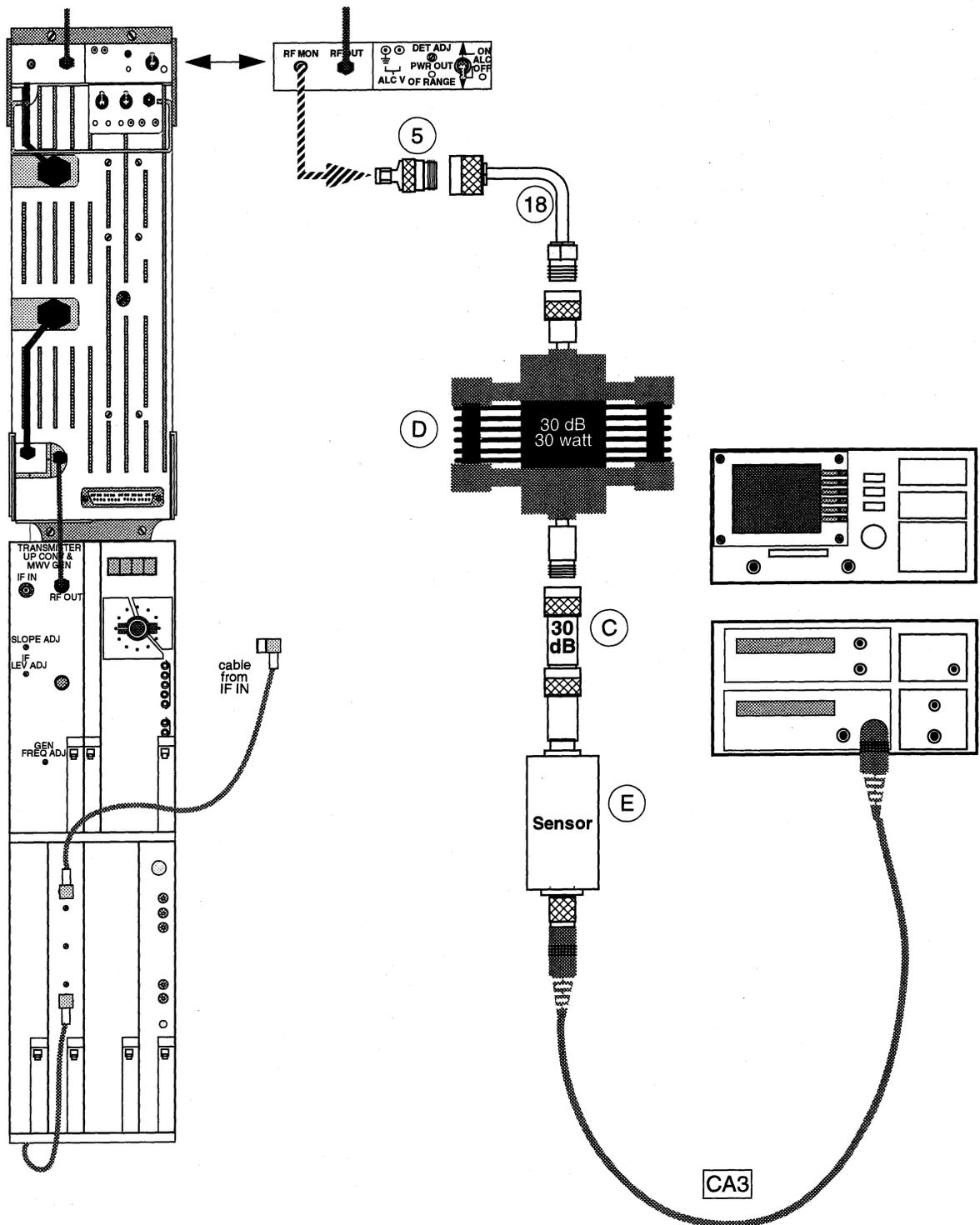


Figure 31. RF MON Power Measurement—TWT

AT&T— PROPRIETARY
See notice on first page

Table F. Watts-to-dBm Conversions—TWT and Solid State

Licensed Power		Transmitter Power at RF OUT Jack	
(Watts)	(dBm)	6 GHz (Licensed + 1.2 dB) (dBm)	11 GHz (Licensed + 1.8 dB) (dBm)
3.72	+35.7	+36.9	
3.39	+35.3	+36.5	
2.95	+34.7	+35.9	+36.5
2.69	+34.3	+35.5	+36.1
2.51	+34.0	+35.2	+35.8
2.24	+33.5	+34.7	+35.3
2.00	+33.0	+34.2	+34.8
1.78	+32.5	+33.7	+34.3
1.59	+32.0	+33.2	+33.8
1.41	+31.5	+32.7	+33.3
1.26	+31.0	+32.2	+32.8
1.12	+30.5	+31.7	+32.3
1.00	+30.0	+31.2	+31.8
0.96	+29.8	+31.0	
0.89	+29.5	+30.7	
0.79	+29.0	+30.2	
0.71	+28.5	+29.7	
0.63	+28.0	+29.2	
0.59	+27.7	+28.9	
0.56	+27.5	+28.7	
0.50	+27.0	+28.2	
0.48	+26.8	+28.0	

AT&T— PROPRIETARY
See notice on first page

7.2 Amplifier Gain (TWT)

This procedure measures the RF output level of the TWT Amplifier.

Prerequisite: Procedure 6.2, Up-Converter Gain.



WARNING:

RF radiation in excess of 1 milliwatt may cause bodily harm. Do not open any radio transmitter RF connection until the IF drive signal has been removed.



CAUTION:

This is an Out-of-Service procedure. Service will be interrupted or impaired unless you apply Service Protection measures.



CAUTION:

SMA connectors damage easily. Finger-start SMA connections for several turns, then use only a torque wrench to tighten.

Step	Procedure
1	On the ALC NETWORK, operate the ALC ON/OFF switch to OFF .
2	On the TRANSMITTER UP CONV & MWV GEN, remove the cable from the IF IN jack. <i>Comment: Steps 3, 4, and 5 provide access to the RF OUT jack on the TWT. Access depends on the type of network.</i> <i>4388A (11 GHz) and 4389A (6 GHz) ALC Networks have the RF IN jack located internally, not visible from the front.</i> <i>4411B (6 GHz) and 4411C (11 GHz) ALC Networks have the RF IN jack mounted on the front faceplate of the network.</i>
3	On the ALC NETWORK: Is the RF IN jack located on the front of the unit? YES - Go to Step 4. NO - Go to Step 5.
4	On the AMPLIFIER ASSEMBLY: a. Remove the semirigid cable between the RF OUT jack on the TWT and the RF IN jack of the ALC Network. b. Go to Step 6.

- 5 On the ALC NETWORK:
- Remove the semirigid cable between the RF OUT jack on the ALC Network and the INPUT jack on the Isolator/Transducer.
 - Loosen the holding tab in the center of the unit.
 - Gently pull the ALC Network forward about 1/2 inch as you loosen the N-type connector (6 GHz) or SMA connector (11 GHz) on the RF OUT jack on the TWT.

Comment: An N-type torque wrench was provided as part of the DR6 tools.

- When the semirigid cable clears the heat fin, the connector will flex enough to provide access to the RF OUT jack on the TWT.

- 6 On the TEST SET:

- Calibrate the POWER METER, if necessary.

Reference: **DRTS** tab, 2.2 Calibration.

- Enter the OFFSET (as shown on the POWER SENSOR) for measurement of RF between 0 dBm and +40 dBm (about 60 dB).

Reference: **DRTS** tab, 2.3 Entering Offset.

Comment: Steps 7 through 10 measure the output power of the TWT Amplifier.

- 7 Connect the test equipment as shown in Figure 32.

- 8 On the TRANSMITTER UP CONV & MWV GEN,
reconnect the cable to the IF IN jack.

- 9 On the POWER METER:

- Observe the display.
- Note the power level for later reference.

Requirement: +38.0 dBm or greater.

Was the requirement met?

YES - Go to Step 11.

NO - Go to Step 10.

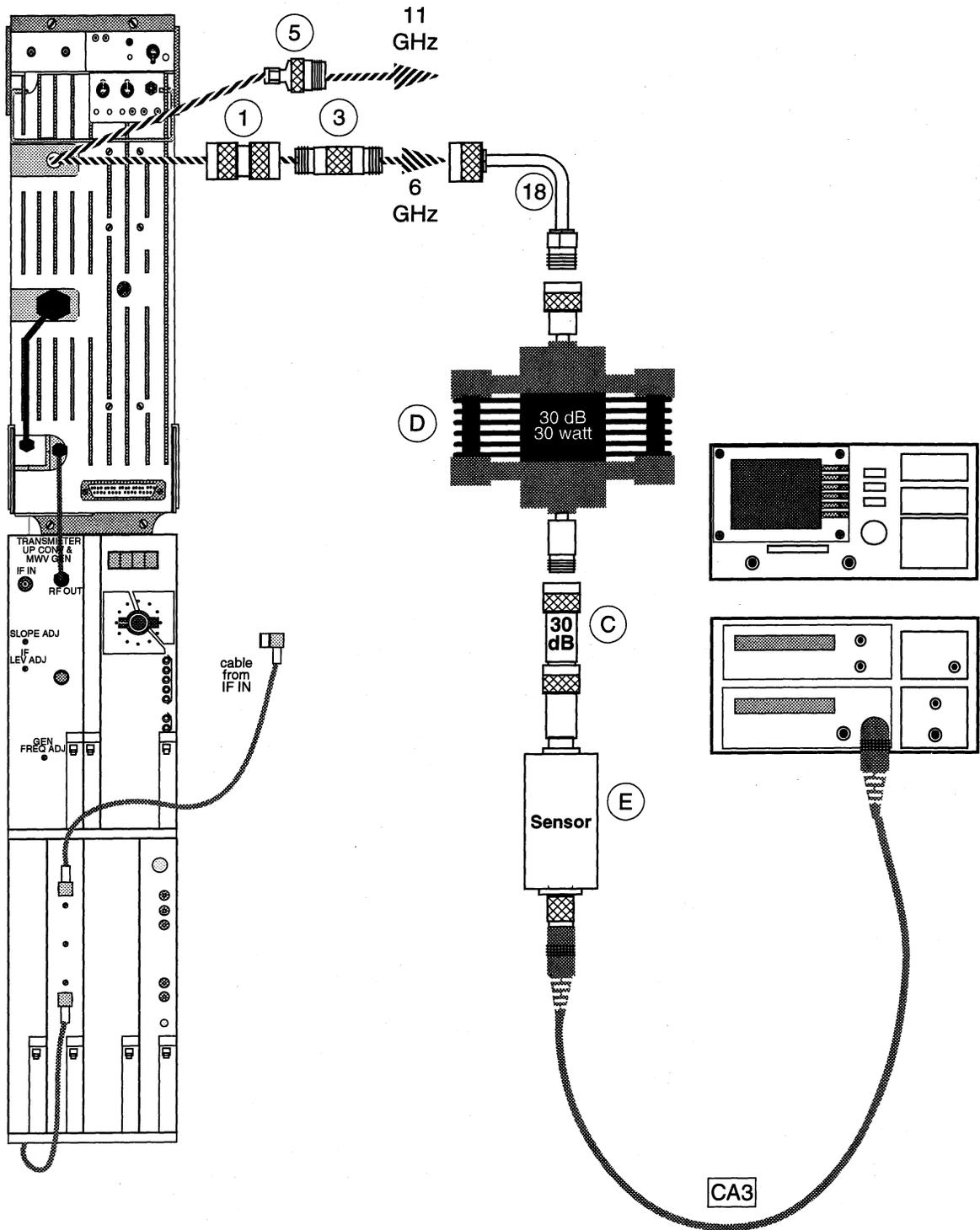


Figure 32. TWT Amplifier Gain Check

AT&T— PROPRIETARY
See notice on first page

- 10 On the TRANSMITTER UP CONV & MWV GEN,
adjust IF LEV ADJ for a power meter display of
+38 dBm or greater.
- Was the adjustment successful?
- YES - Go to Step 11.
- NO - Suspect a faulty TWT Amplifier or TWT Power Supply.
- Go to Procedure 7.3, Power Supply and
Amplifier Evaluation.

Comment: The remaining steps put the transmitter back together.

- 11 On the TRANSMITTER UP CONV & MWV GEN:
- If you made an adjustment in Step 10, adjust the IF LEV ADJ control to the same power level noted in Step 9.
 - Remove the cable from the IF IN jack.

- 12 Did you have to loosen the ALC Network in Step 5?

YES - Go to Step 13.

NO - Go to Step 14.

- 13 On the ALC NETWORK:

- Gently slide the ALC Network back into position as you finger-tighten the connector at the RF OUT jack on the TWT.

Comment: Tighten all connections (N-type and SMA) with the appropriate torque wrench.

- Reconnect the semirigid cable between the RF OUT jack on the ALC Network and the INPUT jack of the Isolator/Transducer.

- Go to Step 15.

- 14 On the AMPLIFIER ASSEMBLY,

reconnect the semirigid cable between the RF OUT jack on the TWT and the RF IN jack on the ALC Network.

- 15 On the TRANSMITTER UP CONV & MWV GEN,

reconnect the cable to the IF IN jack.

- 16 On the ALC NETWORK,

operate the **ALC ON/OFF** switch to **ON**.

- 17 Return to the procedure or flowchart that sent you here.

End of Procedure

AT&T— PROPRIETARY
See notice on first page

7.3 Power Supply and Amplifier Evaluation (TWT)

Use this procedure to isolate a suspected trouble to either the TWT Power Supply or the TWT Amplifier. You will test the TWT Power Supply by connecting it to a dummy load, then you will test the TWT Amplifier by connecting it to the tested TWT Power Supply.

You will also use this procedure to verify that a replacement TWT Amplifier or TWT Power Supply is good.



WARNING:

RF radiation in excess of 1 milliwatt may cause bodily harm. Do not open any radio transmitter RF connection until the IF drive signal has been removed.



CAUTION:

This is an Out-of-Service procedure. Service will be interrupted or impaired unless you apply Service Protection measures.



CAUTION:

SMA connectors damage easily. Finger-start SMA connections for several turns, then use only a torque wrench to tighten.



NOTE:

This test requires a SIEMENS DUMMY LOAD test set (Model DL100 or DL120) and a DLZ 102 test cable which was provided with the test set and which might not be labeled.*

Step	Procedure
1	Is the Amplifier Assembly removed from the bay? YES - Go to Step 5. NO - Go to Step 2.
2	On the ALC NETWORK, operate the ALC ON/OFF switch to OFF .
3	On the TRANSMITTER UP CONV & MWV GEN, remove the cable from the IF IN jack.
4	Remove the AMPLIFIER ASSEMBLY from the radio bay.

Reference: **REPLACEMENT PROCEDURES** tab.

*Registered Trademark of Siemens Aktiengesellschaft.

AT&T— PROPRIETARY

See notice on first page

- 5 Place the AMPLIFIER ASSEMBLY on its back (controls up).
- Comment: Step 6 verifies that the beam current (IK) value as stamped on the TWT Amplifier Identification label is the same value recorded on the RADIO DATA CARD. The RADIO DATA CARD value should not be changed unless the TWT Amplifier is replaced.*
- 6 On the TWT Amplifier label (on the side or front of the TWT Amplifier), compare the IK **stamped value** with the IK value written on the RADIO DATA CARD as TRMTR "IK".
- Are the IK values the same?
- YES - Go to Step 7.
- NO - Record the **stamped value** (IK) on the RADIO DATA CARD as TRMTR "IK".
- Go to Step 7.
- 7 On the lower end (RF FL IN end) of the AMPLIFIER ASSEMBLY:
- Remove the multipin TWT power cable from the output connector of the TWT Power Supply.
 - Connect one end of the dummy load test cable (DLZ 102) to the output connector of the TWT Power Supply and finger-tighten the holding screws.
- 8 Route the free ends of both cables to the lower front, clear of the Amplifier Assembly.
-  **CAUTION:**
Service on adjacent channels may be interrupted as you perform Step 9 unless you visually verify that the power cables on the transmitters on either side are locked to their connectors so you will not cause them to loosen. Watch closely for any wires or cables that might be snagged or pinched as you slide the assembly into the bay.
- 9 Temporarily install the AMPLIFIER ASSEMBLY into the radio frame while carefully routing the free end of the two cables under the right-front heat sink of the assembly.
- 10 On the AMPLIFIER ASSEMBLY,
lock the four captive screws into place.

Comment: Steps 11 through 16 connect the TWT Power Supply to the dummy load. Because the TWT Amplifier is not powered, no signal connections are needed for this part of the test.

- 11 On the POWER SUPPLY CONTROL unit:
- a. Verify that the TRANS/STBY switch is set to STBY.
 - b. Verify that the ON/OFF switch is set to OFF.



NOTE:

If you have just replaced the TWT and have already tested the TWT Power Supply with the dummy load, you can skip to Step 23.

- 12 On the DUMMY LOAD:
- a. Connect the free end of the DLZ 102 test cable.
 - b. Connect an external ground between the DUMMY LOAD and the bay framework.
- 13 Which model DUMMY LOAD do you have?
- DL 120, go to Step 14.
 - DL 100, go to Step 15.
- 14 On the DUMMY LOAD, model DL120:
- a. Operate the CODE switch to the OUT: HIGH-LIN position.
 - b. Go to Step 16.
- 15 On the DUMMY LOAD, model DL 100:
- a. Position the code block (with letters upright) to select High Linearity.
 - b. Operate the tk ON/OFF switch to the OFF position.
 - c. Go to Step 16.
- 16 On the AMPLIFIER ASSEMBLY,
- reconnect the bay power cable to the P12 connector (lower right corner).

Comment: In Steps 17 through 21, output voltages from the TWT Power Supply are evaluated by the dummy load.

- 17 On the POWER SUPPLY CONTROL unit:
- a. Operate the ON/OFF switch to ON.

Requirement: The ON indicator will light.

If this requirement, or any requirement in Steps 18 through 20, is not met, go directly to Step 21.

- b. Operate the TRANS/STBY switch to TRANS.

- 18 On the DUMMY LOAD,
compare the indicated voltages with Table G.
Grid 2 voltage will be indicated after a 1-minute delay.

Table G. Dummy Load Requirements

	HELIX	GRID 2	COLL 1	COLL 2	HEATER
6 GHz	4.00 ±0.15 kV	2.6 to 3.3 kV	2.00 ±0.10 kV (1) or 2.40 ±0.10 kV (2)	0.33 ±0.05 kV (1) or 0.40 ±0.05 kV (2)	6.3 ±0.2 V
11 GHz	5.10 ±0.15 kV	3.4 to 4.3 kV	2.40 ±0.10 kV	0.40 ±0.05 kV	6.3 ±0.2 V

Note: There are different tables, use the one attached to the individual power supply.

- (1) Power Supply strapping table shows collector voltage switch 1-2 closed, 3 open.
(2) Power Supply strapping table shows collector voltage switch 1-2-3 closed.

Requirement: All voltages must meet the values shown in Table G.

- 19 On the DUMMY LOAD:
- Press and hold the HELIX OVLD button.
 - Hold the HELIX OVLD button until the requirement is met, but **no longer than** 10 seconds.

Requirement:

- After eight on-off cycles, the power supply will shut off.
- The AL and PREAL indicators on the Power Supply Control unit will light.

- 20 On the POWER SUPPLY CONTROL unit,
press the RESET button.

Requirement:

- The ON indicator will light.
- The AL and PREAL indicators will extinguish.

- 21 On the POWER SUPPLY CONTROL unit:
- Operate the TRANS/STBY switch to STBY.
 - Operate the ON/OFF switch to OFF.
- Were all requirements in Steps 17 through 20 met?

YES - Go to Step 22.

NO - Go to Flowchart 3, Unit Replacement and Alignment—Power Supply & Control Unit.

AT&T— PROPRIETARY
See notice on first page

Comment: The TWT Power Supply and Control Unit has met its requirements. In Steps 22 through 25, you will prepare to test the TWT Amplifier by using the DLZ 102 test cable to temporarily connect the TWT Amplifier to the TWT Power Supply. You will also have to reconnect semirigid cable input and output connections.

- 22 On the DUMMY LOAD,
remove the DLZ 102 test cable from the test set.
- 23 On the AMPLIFIER ASSEMBLY,
connect the free end of the DLZ 102 cable to the TWT power cable.
- 24 On the ALC NETWORK:
a. Verify that the **ALC ON/OFF** switch is set to **OFF**.
b. Install the semirigid cable from the RF OUT jack to the INPUT jack on the Isolator/Transducer.
- 25 On the TRANSMITTER UP CONV & MWV GEN:
a. Install the semirigid cable between the RF OUT jack and the RF FL IN on the Amplifier Assembly.
b. Connect the normal bay cable to the IF IN jack.

Comment: The TWT Amplifier is now connected to the TWT Power Supply through the DLZ 102 test cable and all normal bay cables have been reconnected. In Steps 26 through 31, you will test the TWT Amplifier.

- 26 On the POWER SUPPLY CONTROL unit:
a. Operate the ON/OFF switch to ON.
Verify that the AL indicator lights.
b. Operate the TRANS/STBY switch to TRANS.

Comment: Allow up to 10 minutes for transmitter stabilization and for meeting these requirements.

Requirement:

- The ON indicator will light.
- The AL indicator will extinguish.
- The PREAL indicator will not be lighted.

Were the requirements met?

YES - Go to Step 27.

NO - Go to Flowchart 3, Unit Replacement and Alignment—TWT Amplifier.

AT&T— PROPRIETARY
See notice on first page

27

On a digital MULTIMETER,
condition it for a 20-volt, DC measurement.

28

On the POWER SUPPLY CONTROL unit,
connect the multimeter between the I_K jack and the GND jack.

29

On the MULTIMETER,
multiply the indicated voltage by ten to obtain the beam current (IK)
in milliamperes (mA).

Comment: At the I_K jack, beam current (mA) equals voltage times ten
(1 V=10 mA).

30

On the AMPLIFIER ASSEMBLY,
adjust the BEAM ADJ control to the IK value recorded on the
RADIO DATA CARD as TRMTR "IK".

Requirement: ± 2 mA of the IK value recorded on the RADIO DATA CARD.

Comment: The IK value recorded on the RADIO DATA CARD must also be
the same as the IK value stamped on the TWT identification plate
(on the side or front of the TWT Amplifier).

Was the requirement met?

YES - Go to Step 31.

NO - Go to Flowchart 3, Unit Replacement and
Alignment—TWT Amplifier.

31

On the POWER SUPPLY CONTROL unit,
connect the multimeter between the I_H jack and the GND jack.

Requirement:

- Measured helix current (I_H) shall be 2.2 mA or less.

Comment: At the I_H jack, measured voltage equals helix current in mA
(1 V=1 mA).

- PREAL indicator is not lighted.

Were both requirements met?

YES - Go to Step 32.

NO - Go to Flowchart 3, Unit Replacement and
Alignment—TWT Amplifier.

32

Disconnect the multimeter and ground strap (dummy load) from the bay.

AT&T— PROPRIETARY
See notice on first page

Comment: The TWT Power Supply and the TWT Amplifier have both been evaluated. The remaining steps return the Amplifier Assembly to its normal operating condition.

- 33 On the ALC NETWORK,
verify that the **ALC ON/OFF** switch is set to **OFF**.
- 34 On the POWER SUPPLY CONTROL unit:
a. Operate the TRANS/STBY switch to STBY.
b. Operate the ON/OFF switch to OFF.
- 35 On the TRANSMITTER UP CONV & MWV GEN:
a. Remove the cable from the IF IN jack.
b. Remove the semirigid cable from between the RF OUT jack and the RF FL IN jack on the Amplifier Assembly.
- 36 On the ALC NETWORK,
remove the semirigid cable from between the RF OUT jack and the INPUT jack on the Isolator/Transducer.
- 37 On the AMPLIFIER ASSEMBLY:
a. Remove the bay power cable from the P12 connector (lower right corner).
b. Loosen the four captive screws holding the assembly to the framework.
- 38 Remove the AMPLIFIER ASSEMBLY from the radio frame.
- 39 Place the AMPLIFIER ASSEMBLY on its back (controls up).
- 40 On the bottom (lower end) of the AMPLIFIER ASSEMBLY:
a. Remove the DLZ 102 test cable.
b. Connect the TWT Amplifier power cable to the TWT Power Supply output connector.
- 41 Reinstall the AMPLIFIER ASSEMBLY in the radio bay.
- Reference: **REPLACEMENT PROCEDURES** tab
- 42 Return to the flowchart or procedure that sent you here.

End of Procedure

8 Unit Tests—Solid State

8.1 RF MON Calibration (Solid State)

This procedure adjusts transmitter output power at the RF OUT jack, then calibrates the RF MON jack by determining the coupler loss (isolation) between the RF OUT jack and the RF MON jack.



WARNING:

RF radiation in excess of 1 milliwatt may cause bodily harm. Do not open any radio transmitter RF connection until the IF drive signal has been removed.



CAUTION:

This is an Out-of-Service procedure. Service will be interrupted or impaired unless you apply Service Protection measures.



CAUTION:

SMA connectors damage easily. Finger-start SMA connections for several turns, then use only a torque wrench to tighten.

Step	Procedure
	<i>Comment: Steps 1 through 7 adjust the transmitter RF output power.</i>
1	On the 328A AMPL, operate the ALC ON/OFF switch to OFF .
2	On the TRANSMITTER UP CONV & MWV GEN, remove the cable from the IF IN jack.
3	On the 328A AMPL, remove the semirigid cable between the RF OUT jack and the INPUT jack on the Isolator/Transducer.
4	On the TEST SET: <ol style="list-style-type: none"> Calibrate the POWER METER, if necessary. Reference: DRTS tab, 2.2 Calibration. Enter the OFFSET (as shown on the POWER SENSOR) for measurement of RF between 0 dBm and +40 dBm (about 60 dB). Reference: DRTS tab, 2.3 Entering Offset.
5	Connect the test equipment as shown in Figure 33.

AT&T— PROPRIETARY

See notice on first page

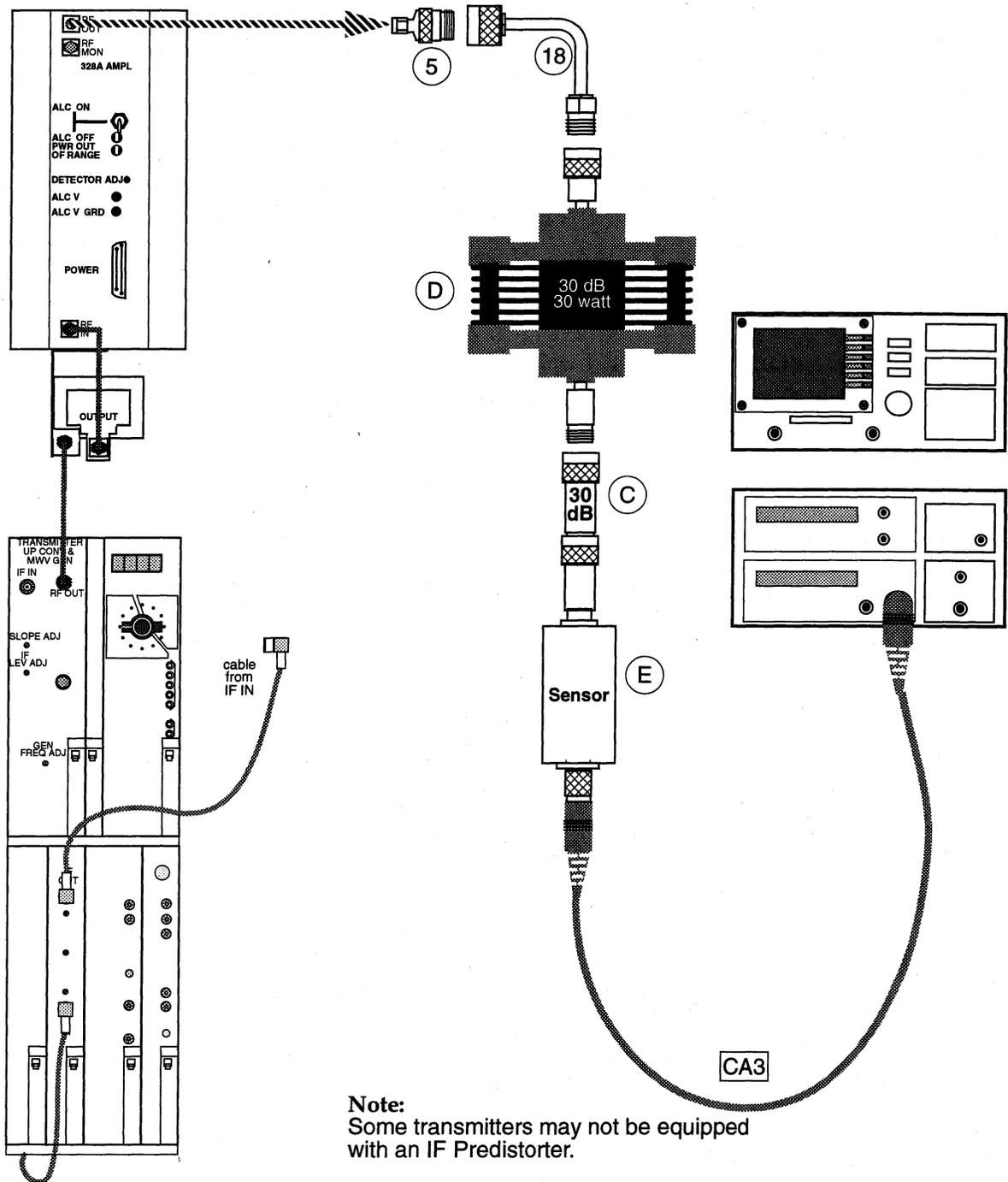


Figure 33. RF OUT Power Measurement—Solid State

AT&T— PROPRIETARY
See notice on first page

- 6 On the TRANSMITTER UP CONV & MWV GEN:
- Reconnect the cable to the IF IN jack.
 - Adjust the IF LEV ADJ control to meet the following requirement.
- Comment: These requirements are normal maximum operating power levels. Some transmitters are licensed to operate at lower output power. To verify correct output power, contact your TSG representative or check your station license. Power levels listed on the station license are at the output of the channel combining network; they will be 1.2 dB below levels measured at the RF OUT jack. (Table H lists Watts-to-dBm conversions.)*
- Requirement:** A power meter display of:
- +31.0 dBm \pm 0.1 dB (with IF predistorter)
 - +28.2 dBm \pm 0.1 dB (without IF predistorter).
- Was the requirement met?
- YES - Go to Step 7.
- NO - Go to **TROUBLE ISOLATION** tab,
3.1 RF Level Problem (Transmitter).
- 7 On the RADIO DATA CARD,
record the measured value on the TRMTR "RF OUT" line.
- Comment: Steps 8 through 14 measure transmitter output power at the RF MON jack. The difference between the level here and at the RF OUT jack is the coupler loss for the RF MON jack.*
- 8 On the TRANSMITTER UP CONV & MWV GEN,
remove the cable from the IF IN jack.
- 9 On the 328A AMPL:
- Remove test connection from RF OUT jack.
 - Reconnect the semirigid cable between the RF OUT jack and the INPUT jack on the Isolator/Transducer.
 - Remove the termination from the RF MON jack.
- 10 Connect the test equipment as shown in Figure 34.
(The 30-dB, 30-watt attenuator is not used.)
- 11 On the POWER METER,
enter the OFFSET for RF between -30 dBm and +10 dBm
(about 30 dB).

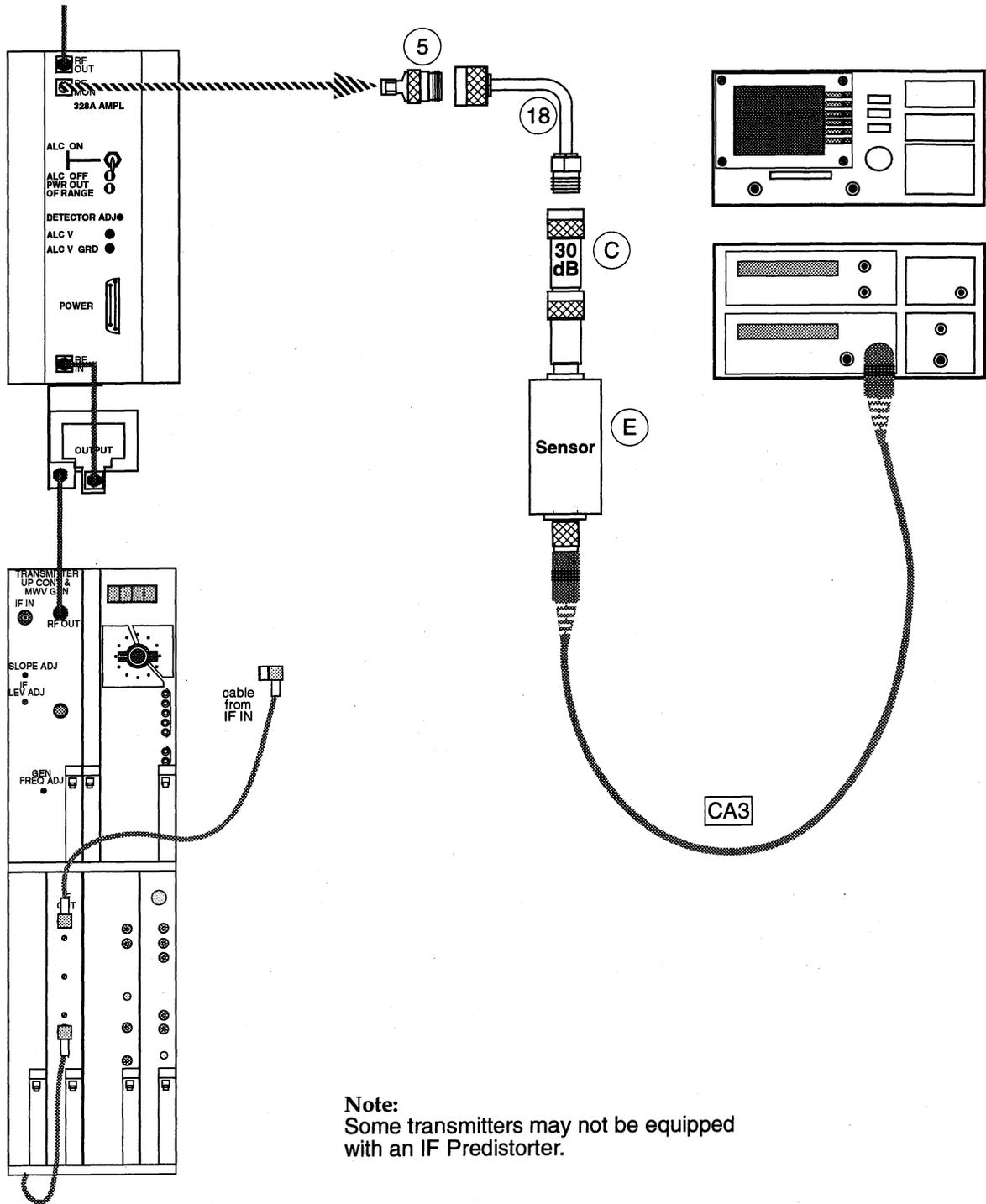


Figure 34. RF MON Power Measurement—Solid State

AT&T— PROPRIETARY
See notice on first page

- 12 On the TRANSMITTER UP CONV & MWV GEN,
reconnect the cable to the IF IN jack.
- 13 On the POWER METER:
- a. Observe the display.
 - b. Subtract this power level from the value measured and recorded in Step 7 to obtain the RF MON coupler loss.

Requirement: 28 ± 4 dB

Was the requirement met?

Yes - Go to Step 14.

No - Go to Flowchart 3, Unit Replacement and Alignment—328A Amplifier.

- 14 On the RADIO DATA CARD,
record the measured power level on the TRMTR "RF MON OUT" line.
- 15 On the TRANSMITTER UP CONV & MWV GEN,
remove the cable from the IF IN jack.
- 16 Disconnect all test equipment from the radio bay.
- 17 On the 328A AMPL,
install the termination on the RF MON jack.
- 18 On the TRANSMITTER UP CONV & MWV GEN,
reconnect the cable to the IF IN jack.
- 19 On the 328A AMPL,
operate the **ALC ON/OFF** switch to **ON**.
- 20 Return to the flowchart or procedure that sent you here.

Transmitter Alignment path

Transmitter **equipped** with an IF predistorter;
go to Procedure 5.3,
Linearization.

Transmitter **not equipped** with an IF predistorter;
go to Procedure 6.4,
Intermodulation.

End of Procedure

AT&T— PROPRIETARY
See notice on first page

Table H. Watts-to-dBm Conversions—Solid State

Licensed Power		Transmitter Power at RF OUT Jack (Licensed + 1.2 dB)
(Watts)	(dBm)	(dBm)
1.00	+30.0	+31.2
0.96	+29.8	+31.0
0.89	+29.5	+30.7
0.79	+29.0	+30.2
0.71	+28.5	+29.7
0.63	+28.0	+29.2
0.59	+27.7	+28.9
0.56	+27.5	+28.7
0.50	+27.0	+28.2
0.48	+26.8	+28.0

8.2 Amplifier Gain (Solid State)

This procedure measures the RF output level of the Solid State Amplifier.

Prerequisite: Procedure 6.2, Up-Converter Gain.



WARNING:

RF radiation in excess of 1 milliwatt may cause bodily harm. Do not open any radio transmitter RF connection until the IF drive signal has been removed.



CAUTION:

This is an Out-of-Service procedure. Service will be interrupted or impaired unless you apply Service Protection measures.



CAUTION:

SMA connectors damage easily. Finger-start SMA connections for several turns, then use only a torque wrench to tighten.

Step	Procedure
1	On the 328A AMPL, operate the ALC ON/OFF switch to OFF .
2	On the TRANSMITTER UP CONV & MWV GEN, remove the cable from the IF IN jack.
3	On the 328A AMPL, remove the semirigid cable between the RF OUT jack and the INPUT jack on the Isolator/Transducer.
4	On the TEST SET: <ol style="list-style-type: none"> a. Calibrate the POWER METER, if necessary. Reference: DRTS tab, 2.2 Calibration. b. Enter the OFFSET (as shown on the POWER SENSOR) for measurement of RF between 0 dBm and +40 dBm (about 60 dB). Reference: DRTS tab, 2.3 Entering Offset.
5	Connect the test equipment as shown in Figure 35.
6	On the TRANSMITTER UP CONV & MWV GEN, reconnect the cable to the IF IN jack.

AT&T— PROPRIETARY
See notice on first page

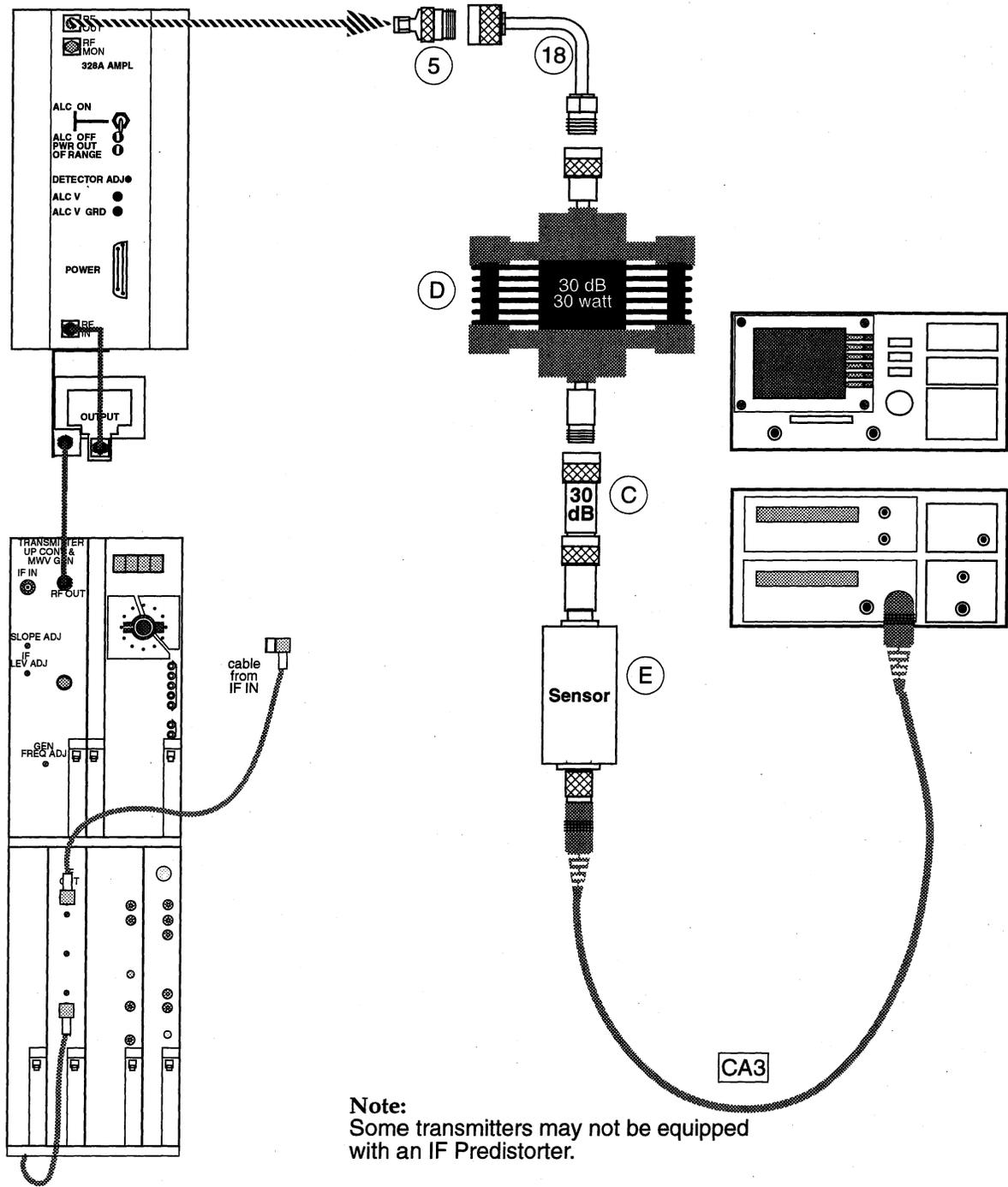


Figure 35. 328A Amplifier Gain Check

AT&T— PROPRIETARY
See notice on first page

- 7 On the POWER METER:
- Observe the display.
 - Note the power level for later reference.

Requirement:

- +31.0 dBm \pm 0.1 dB (with IF Predistorter)
- +28.2 dBm \pm 0.1 dB (without IF Predistorter).

Was the requirement met?

YES - Go to Step 9.

NO - Go to Step 8.

- 8 On the TRANSMITTER UP CONV & MWV GEN,
- adjust IF LEV ADJ for a power meter display of:
- +31.0 dBm \pm 0.1 dB (with IF predistorter)
 - +28.2 dBm \pm 0.1 dB (without IF Predistorter).

Was the adjustment successful?

YES - Go to Step 9.

NO - Go to Flowchart 3, Unit Replacement and Alignment—328A Amplifier.

- 9 On the TRANSMITTER UP CONV & MWV GEN:
- If you adjusted the IF LEV ADJ control in Step 8, readjust the IF LEV ADJ control to the same power level noted in Step 7.
 - Remove the cable from the IF IN jack.

- 10 Disconnect all test equipment from the radio bay.

- 11 On the 328A AMPL,
- reconnect the semirigid cable between the RF OUT jack and the INPUT jack on the Isolator/Transducer.

- 12 On the TRANSMITTER UP CONV & MWV GEN,
- reconnect the cable to the IF IN jack.

- 13 On the 328A AMPL,
- operate the **ALC ON/OFF** switch to **ON**.

- 14 Return to the flowchart or procedure that sent you here.

End of Procedure

AT&T— PROPRIETARY
See notice on first page