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AN/UYA-7 INTERFACE FOR USAF HF AERONAUTICAL STATIONS.(U)
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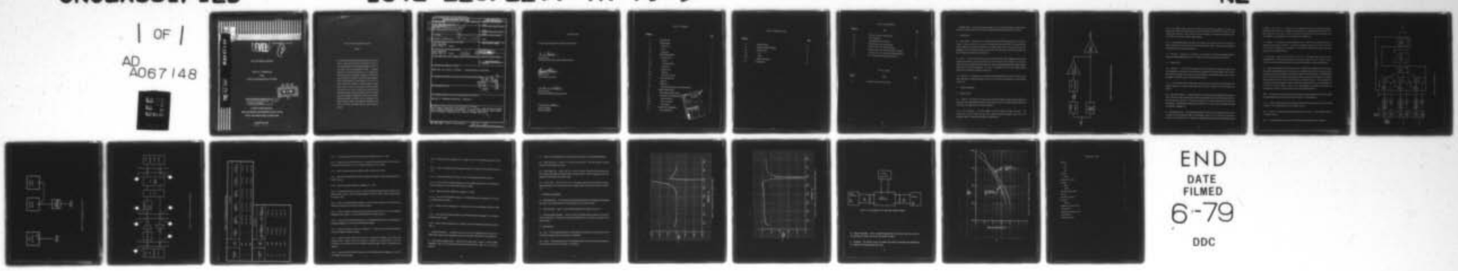

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AFCS TECHNICAL REPORT

AN/UYA-7 INTERFACE
FOR
USAF HF AERONAUTICAL STATIONS

RADIO SYSTEMS BRANCH
1842 ELECTRONICS ENGINEERING GROUP (AFCS)
SCOTT AIR FORCE BASE, ILLINOIS 62225

30 MARCH 1979

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1842 ELECTRONICS ENGINEERING GROUP

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This report describes the design of a circuit card which provides an interface between an AN/UYA-7, Digital Data Group, and a USAF high frequency aeronautical station (Scope Control).

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1. INTRODUCTION. This report describes the design of a circuit card which provides an interface between an AN/UYA-7, Digital Data Group and a USAF high frequency (HF) aeronautical station (Scope Control).

2. BACKGROUND.

2.1 Scope Control. Scope Control is a worldwide network of HF/SSB aeronautical stations. Each station consists of a transmitter site, receiver site, and a communications relay center (CRC). The transmitter and receiver equipments are remotely controlled from an operator console (part of the CRC) using in-band FSK signalling on the A1 channel (upper sideband) of each radio. Each station has at least four radio levels; each level consisting of one transmitter and one receiver.

2.2 UYA-7. The UYA-7, Digital Data Group is a miniaturized modular system capable of secure data rates of digital communication at 50 or 75 bits per second. Input to the system is from a keyboard. At the output, Quantized Frequency Modulation (QFM) techniques are used to provide multipath protection, doppler frequency shift rejection, and data processing gain. The UYA-7 is compatible with 3 kHz voice channels including HF/SSB, VHF-UHF/AM/FM, or satellite communication.

2.3 Requirement. The requirement is to interface a remotely located UYA-7 with up to two Scope Control station radio levels. The design and operation of the UYA-7 is such that the transmitter key must be controlled by the UYA-7.

3. SYSTEM DESCRIPTION.

3.1 Interface Circuit.

3.1.1 Location. The interface is a printed circuit card which will directly replace the audio amplifier card (Collins part number 564-9583-004) in positions 3A7A5, 3A7A6 and 3A7A7 of the Data Intercept Console (part of the CRC). No modifications to the console are required.

3.1.2 Circuit Description. The audio amplifier card being replaced provides unity gain. The interface card will also provide unity gain and, in addition, provide the necessary circuitry for UYA-7 operation. Figure 3-1 shows the basic design of the interface card.

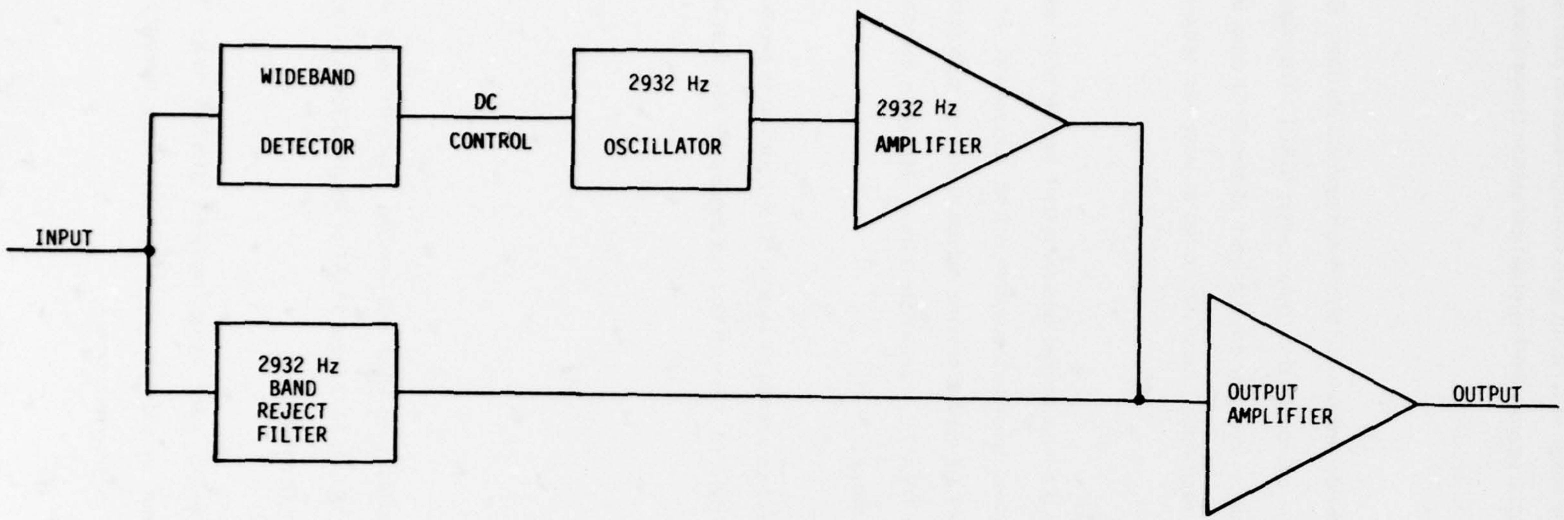

Figure 3-1. Interface Circuit Card-Block Diagram

3.1.2.1 The wideband detector monitors the power level of the QFM signal applied to the input of the interface card. When the power level exceeds -10 dBm, the detector turns the 2932 Hz Oscillator off. When the power level is less than -10 dBm, the detector turns the oscillator on. The output of the oscillator is routed to the 2932 Hz Amplifier which feeds the output amplifier.

3.1.2.2 The QFM signal applied to the input of the interface card is routed to the band reject filter where 2932 Hz is removed. The output of the filter is then fed to the output amplifier. Both the output amplifier and 2932 amplifier have continuously adjustable gain.

3.1.3 Fabrication. Fabrication of the interface card is specified in HQ AFCS Engineering-Installation Standard Drawing LDBWS01204AD000, "UYA-7 Interface Circuit Card (Scope Control), Fabrication of".

3.2 Transmitter Key.

3.2.1 Operation. A 3 kHz channel is required for the UYA-7 QFM signal. Therefore, the Scope Control station equipment must be placed in a "data hold" mode to provide the full 3 kHz bandwidth. While in the data hold mode, the transmitter must receive, on the 3 kHz channel for the QFM signal, a 2932 Hz tone for unkey. The absence of the 2932 Hz tone will cause the transmitter to key.

3.2.1.1 The QFM signal contains enough energy at 2932 Hz to cause the transmitter to intermittently unkey during a transmission. The 2932 Hz band reject filter of the UYA-7 Interface Circuit Card eliminates this problem.

3.2.2 Data Unkey Detectors. For the interface card to operate properly, the applicable Receive Network cards, FSK Receiver cards, and Logic Relay Card(s) must be installed in the Transmitter Jackfield/CDF Rack FSK card cage (rack position A21). These cards are necessary for transmitter key/unkey control during data hold operation. The data bypass operational tests can be found in T. O. 31W2-4-157-2, "Transmitter Jackfield and CDF Rack", paragraph 5-19.

3.3 Interconnecting Lines. The telephone line connecting the UYA-7 to an aeronautical station must be "S3" grade to minimize differential delay of the QFM signal. Table 1-4 of T. O. 12R-2 UYA7-1 recommends the RF circuit connected to the UYA-7 should have a differential delay of less than 500 milliseconds from 600 to 2800 Hz. When the UYA-7 is interfaced with an aeronautical station, the interconnecting lines are considered a part of the RF circuit. Although no DCA grade lines meet the differential delay requirements, S3 grade provides the minimum delay. Table II of DCAC 300-175-9 describes the S3 circuit parameters. Only minor degradation of the QFM signal occurs when operated with S3 grade lines.

3.4 Orderwire. An orderwire is required between the UYA-7 location and an aeronautical station for operations and maintenance coordination. The orderwire can possibly terminate at the CRC on one of the 15-line Cordless Switchboard lines. Reference T. O. 31R2-4-363-2, "Data Intercept Console", for further information on the cordless switchboard.

3.5 Signal Flow. Figure 3-2 shows the flow of the UYA-7 QFM Signal through the CRC from the Jackfield/CDF Rack to the Data Intercept Console. The interface concept is for the UYA-7 signal to connect to one (or two) of the special data subscriber patch intercept modules (PIMs) in the data intercept console.

3.5.1 Special Data Subscriber Lines Performance Test. The special data subscribers (UYA-7) access the switchboard through amplifier/equalizers and amplifiers in the jackfield rack and PIMs in the operators console. The subscriber access is accomplished when two PIMs are placed in the PATCH condition. The amplifier/equalizer in the transmit line from the special data subscriber is used to compensate for line losses and the frequency response of the intersite line. Connect the test equipment as illustrated in Figure 3-3. The following performance test procedure lists the steps to be taken in testing special data subscriber line 1 to the switchboard with the interface circuit card installed. Figure 3-4 is a block diagram of the special data subscriber line performance test. Table 3-1 lists the test points for each special data subscriber line.

NOTE: The lines must not be in use by a special data subscriber during the performance of this test. Special data subscriber's signals may enter the site at more or less than a -13 dbm signal level.

3.5.1.1 Connect an audio oscillator and a matching transformer-precision voltmeter to test point 1 as listed in Table 3-1. Set the matching transformer to the 10KΩ position.

3.5.1.2 Connect a matching transformer-precision voltmeter to test point 2. Set the matching transformer to the 600 Ω position.

3.5.1.3 Set the audio oscillator at a level of -13 dbm and sweep the frequency from 300 to 3000 Hz.

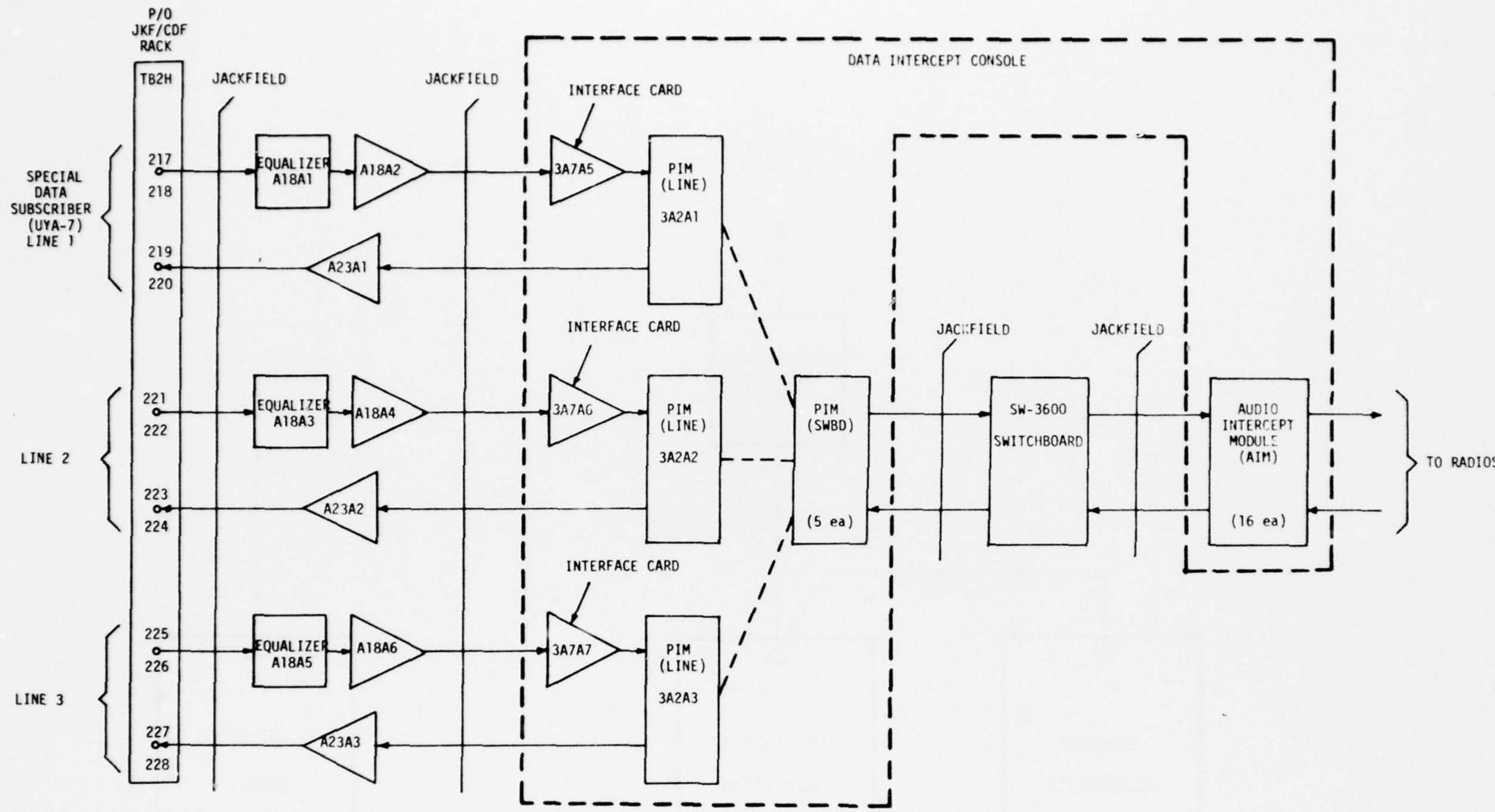

Figure 3-2. System Signal Flow

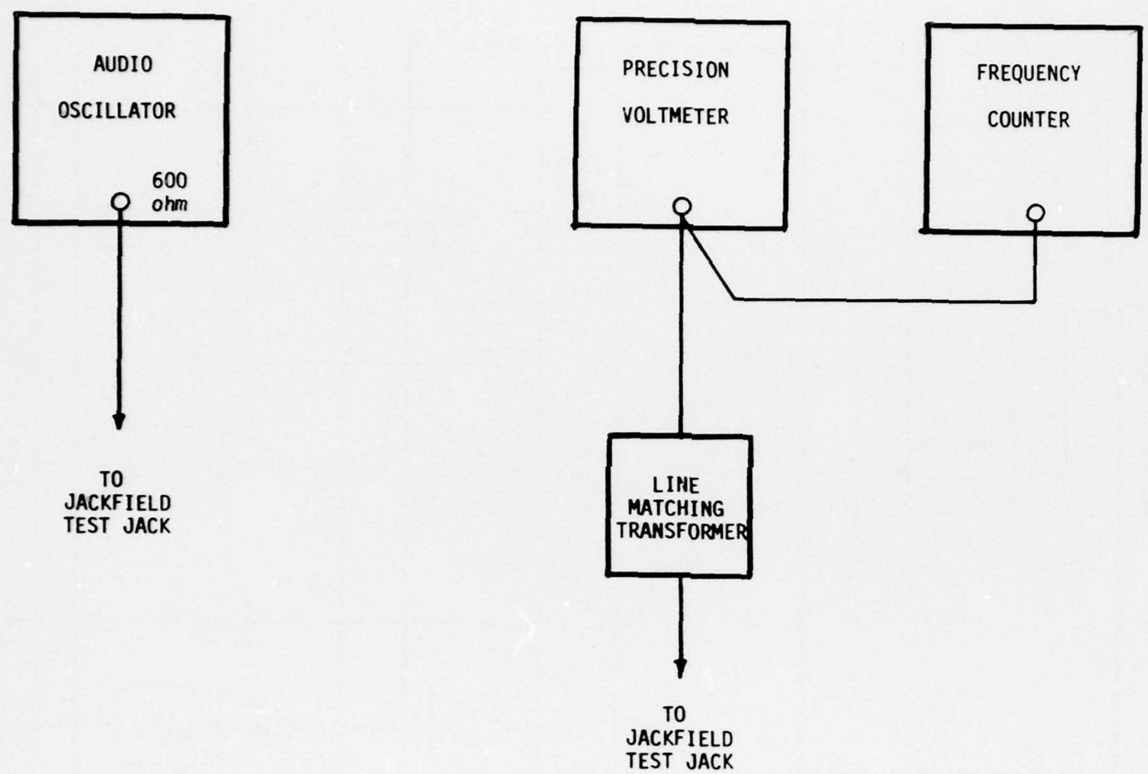

Figure 3-3. Test Equipment Set Up--PIM Test

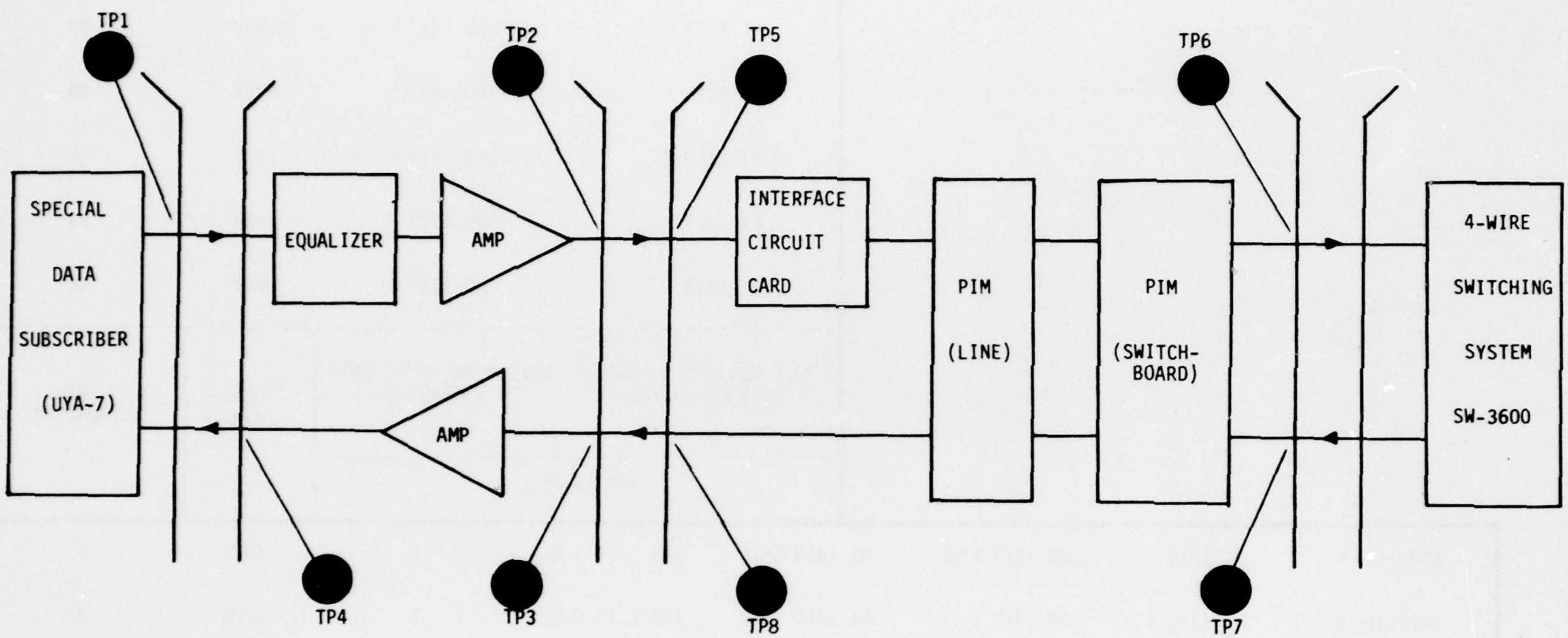

Figure 3-4. PIM Performance Test--Block Diagram

Table 3-1. PIM Performance Test and Test Points

SUBSCRIBER LINE	PIM (LINE)	TEST POINTS					
		1 SUBSCRIBER LINES	2 AMPL/EQ-CONSOLE SIDE	3 AMPL/EQ-CONSOLE SIDE	4 AMPL/EQ-LINE SIDE	5 DATA SUBS. L.U.-LINE SIDE	8 DATA SUBS. L.U.-LINE SIDE
1	A2A1	1	18-2 LIFT OUT	23-1 LIFT IN	23-1 LIFT OUT	1 LIFT IN	1 LIFT OUT
2	A2A2	2	18-4 LIFT OUT	21-2 LIFT IN	21-2 LIFT OUT	2 LIFT IN	2 LIFT OUT
3	A2A3	3	18-6 LIFT OUT	21-3 LIFT IN	21-3 LIFT OUT	3 LIFT IN	3 LIFT OUT

SWITCHBOARD LINE	PIM (SWBD)	TEST POINTS	
		6 DATA CONSOLE NO.1 SUBS. L.U.-SWBD SIDE	7 DATA CONSOLE NO.1 SUBS. L.U.-SWBD SIDE
65	A2A6	1 LIFT OUT	1 LIFT IN
66	A2A7	2 LIFT OUT	2 LIFT IN
67	A2A8	3 LIFT OUT	3 LIFT IN
68	A2A9	4 LIFT OUT	4 LIFT IN
69	A2A10	5 LIFT OUT	5 LIFT IN

3.5.1.4 At test point 2, observe that the precision voltmeter indicates a level of -6 ± 1 dbm.

3.5.1.5 Connect the audio oscillator to test point 3. Connect the matching transformer-precision voltmeter to the MON jack above test point 3. Set the matching transformer to the 10 Ω position.

3.5.1.6 Adjust the audio oscillator for a frequency of 1000 Hz and a level of -6 dbm.

3.5.1.7 Move the matching transformer-precision voltmeter to test point 4. Set the matching transformer to the 600 Ω position.

3.5.1.8 Observe the precision voltmeter for a reading of -13 ± 1 dbm.

3.5.1.9 Move the audio oscillator to test point 5. Move the matching transformer-precision voltmeter to the MON jack above test point 5. Set the matching transformer to the 10K Ω position. Adjust the audio oscillator for a level of -6 dbm.

3.5.1.10 Press the PATCH-STANDBY pushbutton on the PIM (LINE) associated with the special data subscriber line under test so that the PATCH indicator is lighted.

3.5.1.11 Move the matching transformer-precision voltmeter to test point 6 of one of the switchboard (SWBD) lines listed in Table 3-1. Set the matching transformer to the 600 Ω position.

3.5.1.12 Press the PATCH-STANDBY pushbutton on the PIM (SWBD) associated with the switchboard line selected in paragraph 3.5.1.11 so that the PATCH indicator is lighted.

3.5.1.13 Observe the precision voltmeter for a reading of -6 ± 1 dbm. R14, OUT control, on the interface circuit card is adjusted to obtain this reading.

3.5.1.14 Remove the audio oscillator from test point 5. This causes the interface circuit card 2932 Hz oscillator to turn on. Observe the precision voltmeter for a reading of -18 ± 1 dbm at 2932.5 ± 3 Hz. R29, 2932 control, on the interface circuit card is adjusted to obtain this reading. There is no adjustment for the frequency.

3.5.1.15 Press the PATCH-STANDBY pushbutton on the PIM (SWBD) selected in paragraph 3.5.1.12 so that the STANDBY indicator is lighted.

3.5.1.16 Repeat the steps in paragraphs 3.5.1.11 through 3.5.1.15 for each switchboard line listed in Table 3-1.

3.5.1.17 Move the matching transformer-precision voltmeter to test point 8 for the subscriber line under test.

3.5.1.18 Move the audio oscillator to test point 7 of one of the switchboard lines listed in Table 3-1.

3.5.1.19 Press the PATCH-STANDBY pushbutton on the PIM (SWBD) associated with the switchboard line selected in paragraph 3.5.1.18 so that the PATCH indicator is lighted.

3.5.1.20 Observe the precision voltmeter for a reading of -6 ± 1 dbm.

3.5.1.21 Press the PATCH-STANDBY pushbutton on the PIM (SWBD) selected in paragraph 3.5.1.19 so that the STANDBY indicator is lighted.

3.5.1.22 Repeat the steps in paragraphs 3.5.1.18 through 3.5.1.21 for each switchboard line listed in Table 3-1.

3.5.1.23 Press the PATCH-STANDBY pushbutton on the PIM (LINE) selected in paragraph 3.5.1.10 so that the STANDBY indicator is lighted.

3.5.1.24 Repeat the steps in paragraphs 3.5.1.1 through 3.5.1.23 for each special data subscriber line listed in Table 3-1.

4. OTHER APPLICATIONS. Although the interface circuit card was designed specifically for use in the Scope Control console, several strapping options and a relay were added to facilitate use in other applications.

4.1 Power Supply Strapping Options. Reference power supply block of Figure 1, Drawing LDBWS-01204AD000. Strap A to B for 28 volt DC operation (for Scope Control use). Strap A to C for 24 volt DC operation.

4.2 Transmitter Key Strapping Options. Reference relay block of Figure 1, Drawing LDBWS01204AD000.

4.2.1 Scope Control Key. Strap F to D for Scope Control operation. This strap enables the wideband detector to control the 2932 Hz oscillator.

4.2.2 Relay Contact Key. Strap D to K, F to G, and I to H. Strap D to K turns the 2932 Hz oscillator off. The remaining straps enable the wideband detector to control relay K1. Relay K1 energizes when the QFM signal input to the interface card exceeds -10 dbm.

4.2.3 DC Key Input. Strap D to E and I to H. This enables external control of the 2932 Hz oscillator. Applying a ground at pin "U" of the interface card will energize relay K1 which will turn the 2932 Hz oscillator off.

5. ELECTRICAL PARAMETERS.

5.1 Power Requirements. The interface circuit card requires 24 or 28 volts DC (± 1 V) depending on the strapping option used. Current requirements are 100 mA using relay K1 or 70 mA without the relay.

5.2 Differential Delay. Figure 5-1 shows the differential delay of the interface circuit card.

5.3 Amplitude Frequency Response. Figure 5-2 shows the amplitude frequency response of the interface circuit card and Figure 5-3 shows the test equipment configuration used. For the test, the input level to the card was -6 dBm.

5.4 Switching Times.

5.4.1 Key. The time between application of a QFM signal to the interface circuit card input and removal of the 2932 Hz tone from the circuit card output is 7 milliseconds.

5.4.2 Unkey. The time between removal of a QFM signal at the interface circuit card input and application of the 2932 Hz tone to the circuit card output is 5 milliseconds.

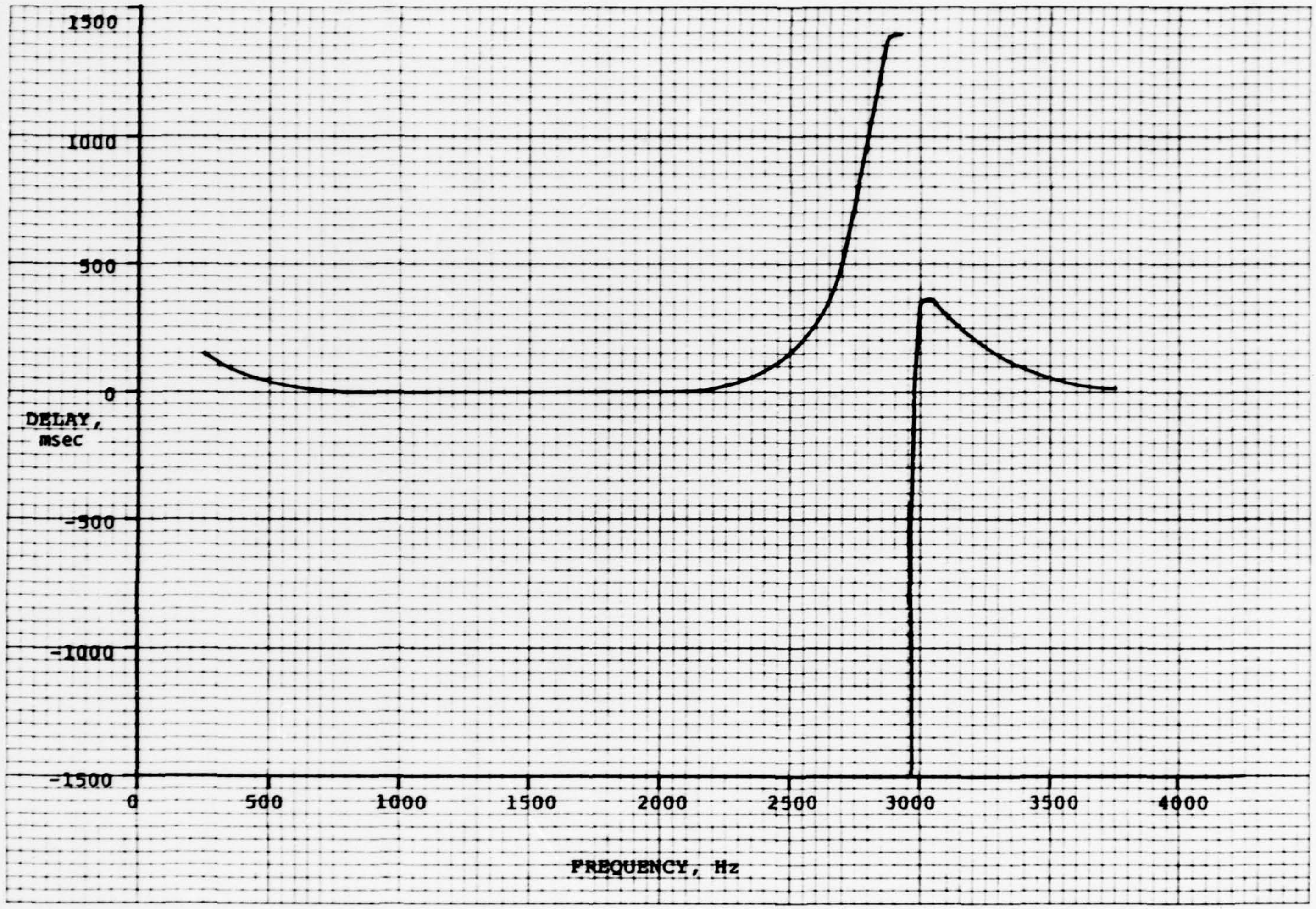

Figure 5-1. Interface Circuit Card--Differential Delay

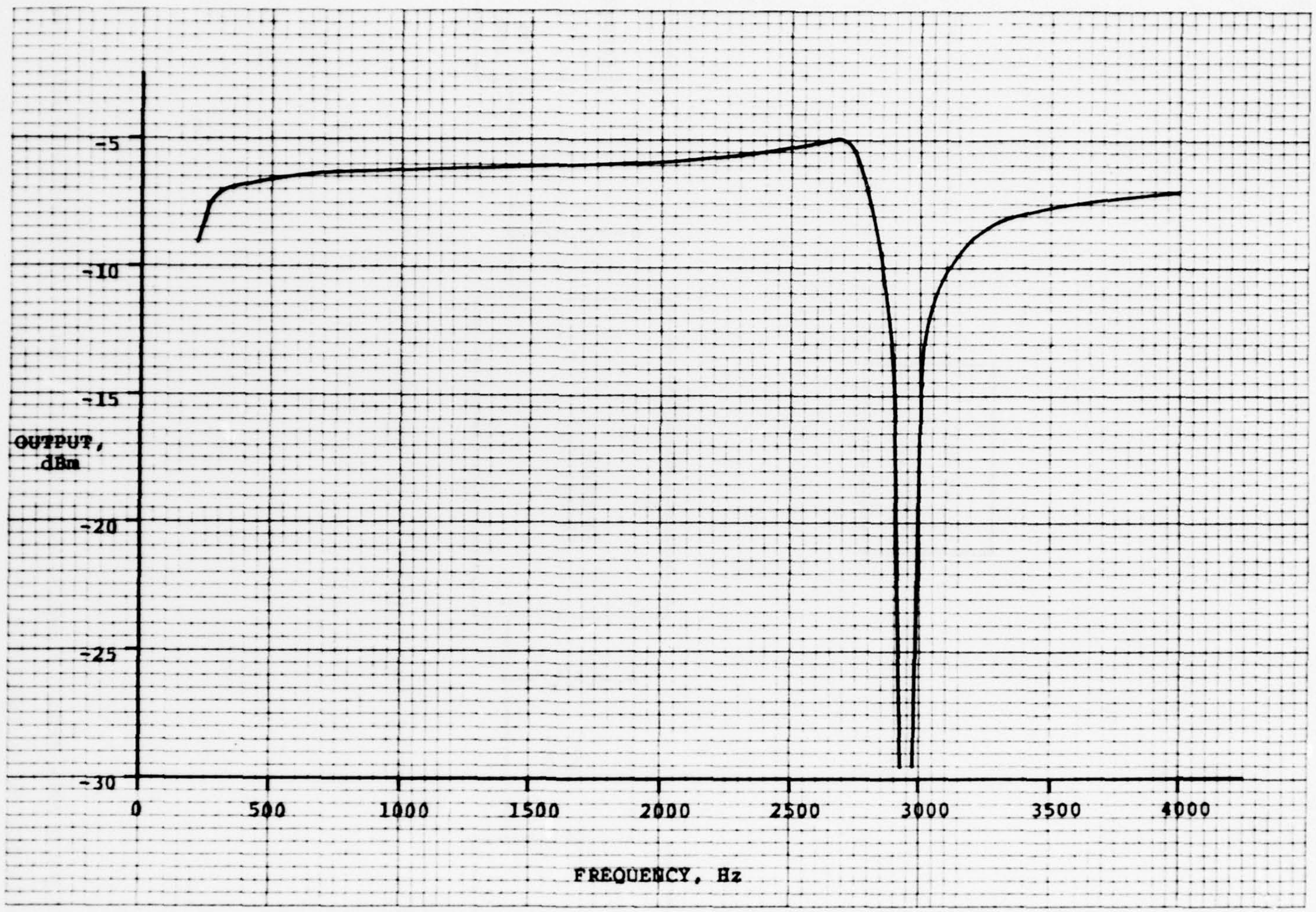

Figure 5-2. Interface Circuit Card--Amplitude Frequency Response

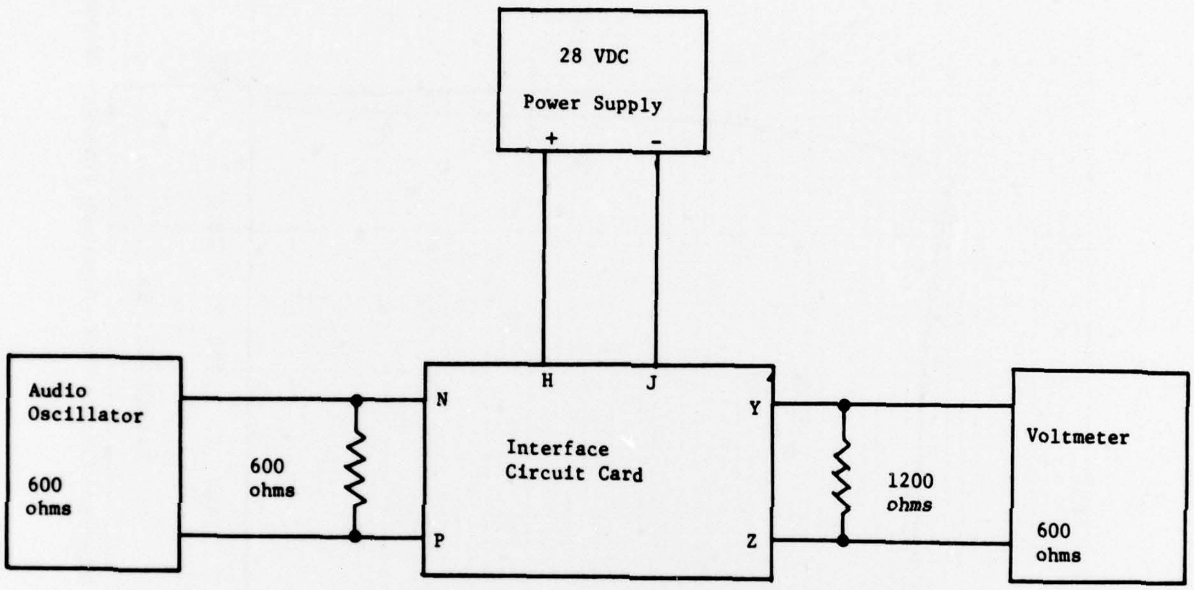

Figure 5-3. Test Equipment Set Up--Amplitude Frequency Response

5.5 Signal to Noise Ratio. Figure 5-4 shows the signal to noise ratio versus bit error rate of the UYA-7 with and without the interface circuit card in the transmit circuit path.

6. Conclusions. The interface circuit card satisfies the interface requirements while degrading the UYA-7 signal to noise ratio by approximately .75 dB.

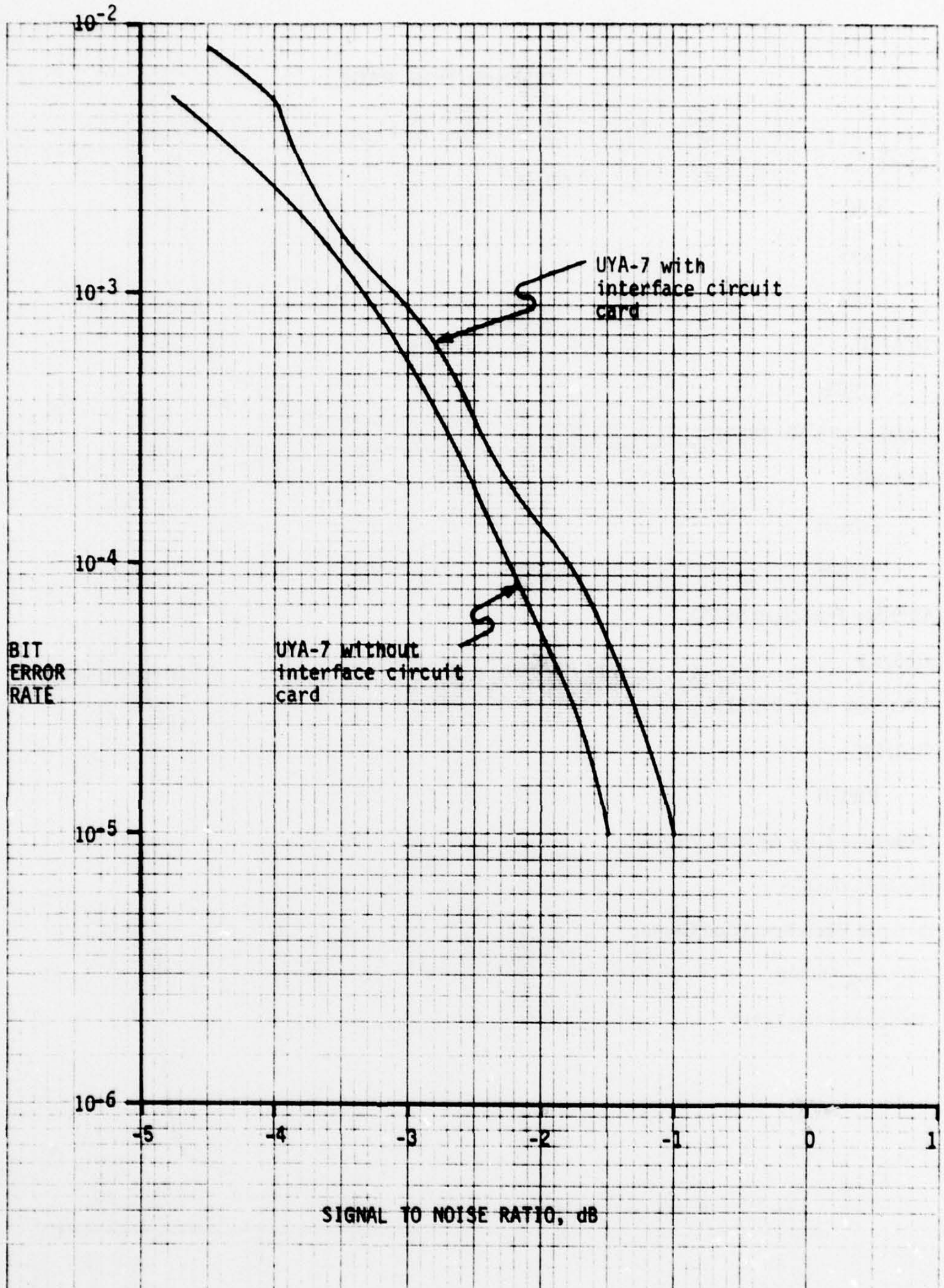

Figure 5-4. UYA-7, Signal to Noise Ratio vs Bit Error Rate

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