950B-TYPE EQUALIZER
DESCRIPTION

CONTENTS PAGE

1. GENERAL

1.01 This section provides a description of the 950B-type (delay) equalizer, which is designed to plug into the J99347AA voice frequency amplitude and delay equalizer unit (hereafter referred to as the J-board). A description of the J-board is provided in the section entitled J99347 VF Amplitude and Delay Equalizer—Description (314-820-106). Complementary to the function of the 950B-type equalizer is the 950A-type (amplitude) equalizer, which is described in the section entitled 950A-type Equalizer—Description (314-820-107).

1.02 The 950B-type equalizer can be adjusted to compensate for envelope delay distortion in the voiceband. Its primary application is to equalize the delay distortion introduced by carrier facilities and/or loaded cable facilities. Each 950B-type delay equalizer will provide two adjustable delay bump shapes, one in the lower half and one in the upper half of the voiceband.

1.03 The locations of peak delay and the width of the delay bumps are independently adjustable. With this versatility, the 950B-type delay equalizers may be used to satisfy transmission requirements of basic and C1- through C5-conditioned lines to the limits specified in the section entitled Voice Bandwidth Private Line Data Circuits—Tests and Requirements (Section 314-410-500). Many facility arrangements will be satisfied with the operation of one 950B-type delay equalizer, but where necessary, more than one 950B-type may be connected in tandem to achieve the necessary requirements.

1.04 The 950B-type delay equalizer is a new product. When used with the 950A-type (amplitude) equalizer, if necessary, and connected onto a J-board equalizer unit, an effective replacement for many presently available equalizers can be realized.

2. PHYSICAL DESCRIPTION

2.01 The 950B-type delay equalizer (Fig. 1) is contained in a plastic box which measures approximately 3.7 inches long, 2.3 inches wide, and 1.0 inches thick. The bottom of the box is provided with pins which connect to the internal circuitry and are used for mounting it onto a J-board equalizer unit. Plastic spines on the box prevent the 950B-type equalizer from being mounted backwards. When necessary, up to five 950B-type (or combined with 950A-type) equalizers may be mounted on a J-board.

2.02 The 950B-type equalizer circuitry consists of two hybrid integrated circuits (HIC) plus capacitors which are mounted inside the box. The two HICs are identified as 556A and 556B. The 556A HIC provides delay shaping in the lower half of the voiceband spectrum, and the 556B HIC provides delay shaping in the upper half of the voiceband spectrum. On the top of the plastic box are eight 6-position slide switches. Contacts of the slide switches selectively short out thin film resistors on the two HIC substrates which permit adjustment of the equalizer.

2.03 Operating voltages for the 950B-type equalizer are normally provided by the J-board equalizer circuits. The amplifiers on the 556A and 556B HICs require a source of both +12 Vdc and −12 Vdc and appropriate ground returns.

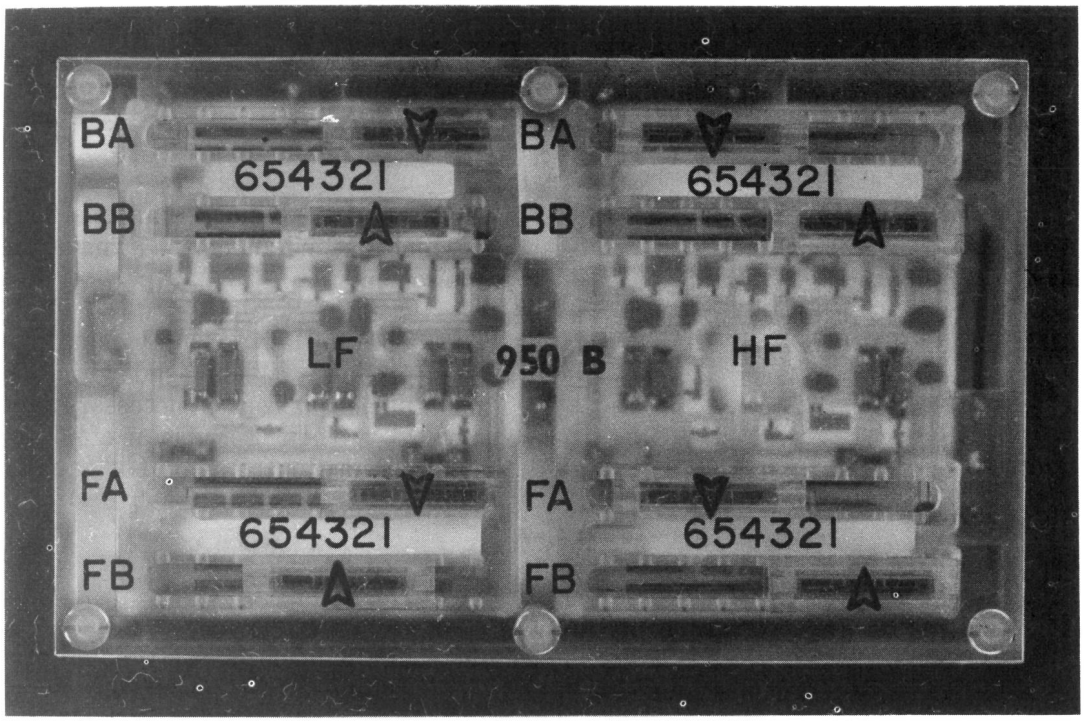
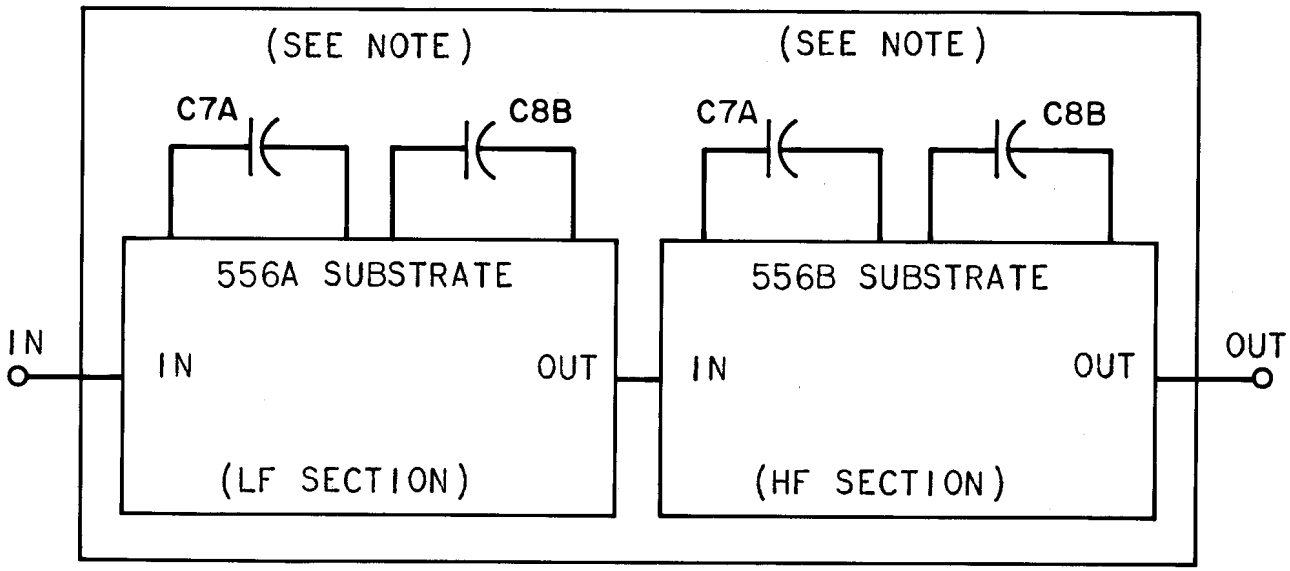


Fig. 1—950-Type Delay Equalizer—Top View

3. CIRCUIT DESCRIPTION

3.01 A block diagram of the 950B-type equalizer is shown in Fig. 2. A simplified diagram, applicable to either the 556A or 556B HIC is shown in Fig. 3 while a complete circuit diagram is shown in Fig. 4.

3.02 The three operational amplifiers on each HIC, plus associated resistors and capacitors, form a feedback loop which generates a resonance. The resonant frequency and the sharpness of the resonance are controlled by the resistors and capacitors in the feedback loop, and therefore, each is adjustable by the appropriate set of switched resistors. The input signal is applied, with proper weighting, to each of the operational amplifier inputs and thereby produces the desired delay equalization characteristics.



NOTES:

CAPACITORS C7 AND C8 ARE EXTERNAL TO THE HIC SUBSTRATE

Fig. 2—Block Diagram of the 950-Type Delay Equalizer

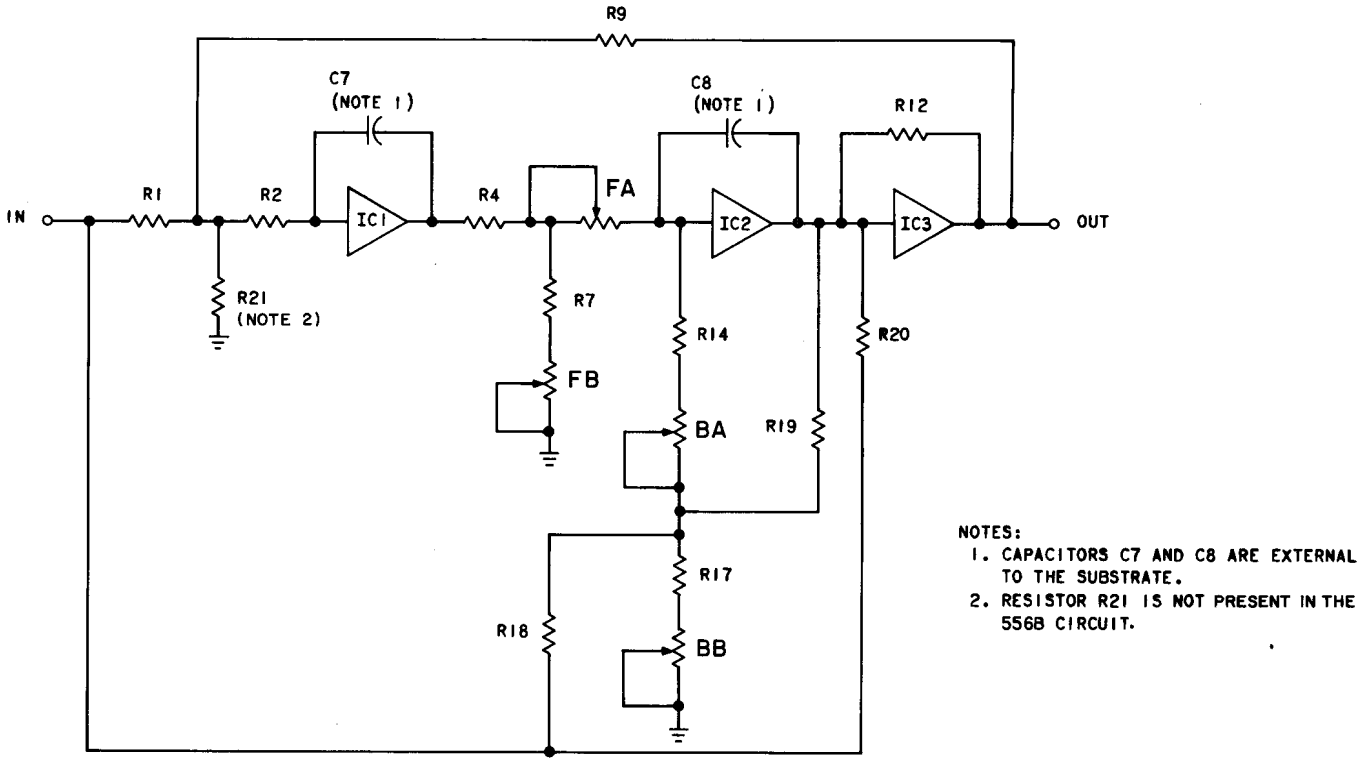
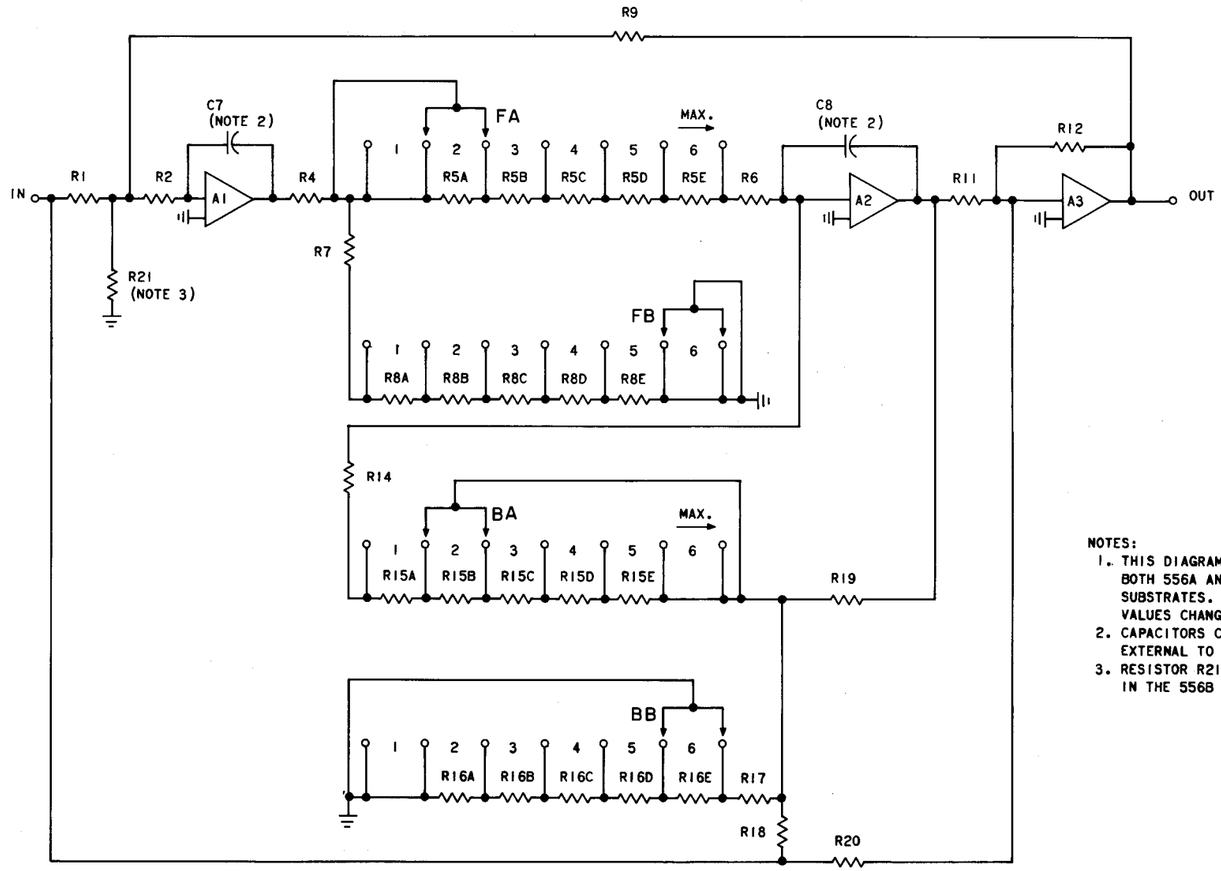


Fig. 3—Simplified Circuit Diagram of the 556A or 556B HIC Substrate



NOTES:
1. THIS DIAGRAM IS APPLICABLE TO BOTH 556A AND 556B HIC SUBSTRATES. ONLY COMPONENT VALUES CHANGE.
2. CAPACITORS C7 AND C8 ARE EXTERNAL TO THE SUBSTRATE.
3. RESISTOR R21 IS NOT PRESENT IN THE 556B CIRCUIT.

Fig. 4—Circuit Diagram of the 556A or 556B HIC Substrate

3.03 To illustrate how delay equalization is accomplished, consider the typical transmission function of the 950B-type equalizer as shown in Fig. 5. Two parameters characterize each of the basic delay bump shapes:

(a) The resonant frequency (F_0), which is approximately where the peak delay of that section occurs

(b) The bandwidth (BW), which is a measure of how wide the delay bump is.

Note: It is a property of the basic delay shapes used that the wider the bandwidth selected, the smaller the resulting peak delay.

3.04 These parameters of the 950B-type equalizer are independently adjustable by the operation of the eight 6-position slide switches. A description of the obtainable adjustments are as follows:

LF Section

(a) The resonant frequency can assume any of 36 discrete values between 750 Hz and 1799.7 Hz, as shown in Table A.

(b) The bandwidth can assume any of 36 distinct values in the range of 600.2 Hz and 1800.2 Hz, as shown in Table B.

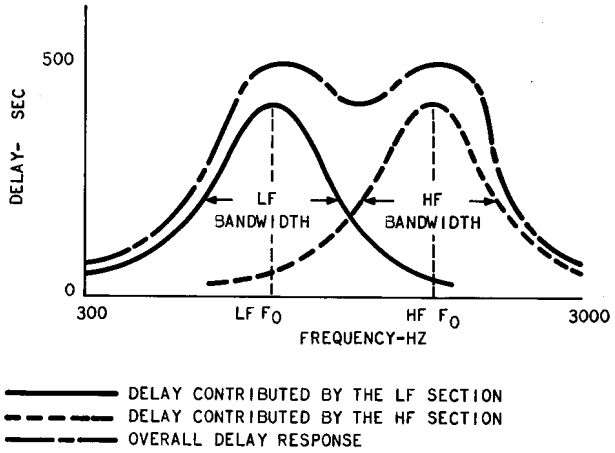


Fig. 5—Typical Delay Characteristics of the 950B-Type Equalizer

HF Section

(c) The resonant frequency can assume any of 36 discrete values between 1722 Hz and 3006 Hz, as shown in Table C.

TABLE A

CENTER FREQUENCY SETTINGS FOR THE 950B-TYPE DELAY EQUALIZER (LF SECTION: SWITCHES FA AND FB)

FA SWITCH POSITION	FB SWITCH POSITION	CENTER FREQUENCY (Hz)
1	1	750.0
1	2	776.2
1	3	803.0
1	4	830.4
1	5	858.5
1	6	887.2
2	1	916.4
2	2	946.2
2	3	976.5
2	4	1007.3
2	5	1038.6
2	6	1070.2
3	1	1102.2
3	2	1134.6
3	3	1167.2
3	4	1200.0
3	5	1232.9
3	6	1265.9
4	1	1299.0
4	2	1332.0
4	3	1364.8
4	4	1397.5
4	5	1429.9
4	6	1462.1
5	1	1493.6
5	2	1524.9
5	3	1554.8
5	4	1585.7
5	5	1615.1
5	6	1643.9
6	1	1671.9
6	2	1699.2
6	3	1725.6
6	4	1751.2
6	5	1775.9
6	6	1799.7

TABLE B

BANDWIDTH SETTINGS FOR THE 950B-TYPE DELAY EQUALIZER
(LF SECTION: SWITCHES BA AND BB)

BA SWITCH POSITION	BB SWITCH POSITION	BAND-WIDTH (Hz)
1	1	600.2
1	2	620.5
1	3	641.5
1	4	663.1
1	5	685.4
1	6	708.4
2	1	732.1
2	2	756.5
2	3	781.7
2	4	807.5
2	5	834.2
2	6	861.7
3	1	890.0
3	2	919.1
3	3	949.1
3	4	979.8
3	5	1011.5
3	6	1044.1
4	1	1077.5
4	2	1111.9
4	3	1147.3
4	4	1183.6
4	5	1220.9
4	6	1259.2
5	1	1289.4
5	2	1338.7
5	3	1380.1
5	4	1422.4
5	5	1465.8
5	6	1510.3
6	1	1556.0
6	2	1602.6
6	3	1650.4
6	4	1699.2
6	5	1749.2
6	6	1800.2

TABLE C

CENTER FREQUENCY SETTINGS FOR THE 950-TYPE DELAY EQUALIZER
(HF SECTION: SWITCHES FA AND FB)

FA SWITCH POSITION	FB SWITCH POSITION	CENTER FREQUENCY (Hz)
1	1	1722.0
1	2	1754.6
1	3	1787.5
1	4	1820.8
1	5	1855.0
1	6	1888.5
2	1	1923.0
2	2	1957.8
2	3	1992.9
2	4	2028.4
2	5	2064.6
2	6	2100.1
3	1	2136.5
3	2	2173.1
3	3	2210.0
3	4	2247.2
3	5	2284.9
3	6	2321.9
4	1	2359.6
4	2	2397.4
4	3	2435.5
4	4	2473.7
4	5	2512.3
4	6	2550.0
5	1	2588.4
5	2	2626.8
5	3	2665.1
5	4	2703.5
5	5	2742.2
5	6	2780.0
6	1	2818.0
6	2	2856.0
6	3	2893.9
6	4	2931.5
6	5	2969.4
6	6	3006.0

(d) The bandwidth can assume any of 36 distinct values in the range of 661 Hz and 1982.5 Hz, as shown in Table D.

3.05 Since each adjustable parameter can assume any one of 36 distinct values, the 950B delay equalizer can provide a total of 36^4 (or 1,679,616) distinct equalizing shapes. A computer program will be available to determine the number of equalizers needed, together with the correct switch settings. Instructions for this program will be found in the section entitled ADE 950 Equalizer Program (856-200-100).

3.06 The number of shapes available is so large that it is impossible to show meaningfully. A few selected examples are shown in Fig. 6 and Fig. 7 to illustrate some of the 950B-type equalizer operational capability. Figure 6 shows examples of equalizing the delay distortion of an A channel bank facility with increasing footage of H88 loaded cable. Figure 7 shows examples of a T1 carrier facility with increasing footage of H88 loaded cable.

3.07 Regardless of the switch position settings, the 950B-type delay equalizer introduces no amplitude distortion and has an insertion loss of 0 dB when used on the J-board equalizer unit which provides the proper input and output terminations.

3.08 The 950B-type delay equalizer uses active circuitry and is designed to be driven by a low source impedance (less than 100 ohms) and to drive a high output impedance (greater than 1200 ohms). The J-board normally provides for proper operation. The maximum signal output is approximately 10.0 Vac (peak), depending upon the switch settings.

TABLE D

BANDWIDTH SETTINGS FOR THE 950B-TYPE DELAY EQUALIZER
(HF SECTION: SWITCHES BA AND BB)

BA SWITCH POSITION	BB SWITCH POSITION	BAND-WIDTH (Hz)
1	1	661.0
1	2	683.4
1	3	706.5
1	4	730.3
1	5	754.8
1	6	780.2
2	1	806.2
2	2	833.1
2	3	860.8
2	4	889.3
2	5	918.7
2	6	949.0
3	1	980.1
3	2	1012.2
3	3	1045.2
3	4	1079.1
3	5	1114.0
3	6	1149.8
4	1	1186.7
4	2	1224.5
4	3	1263.5
4	4	1303.5
4	5	1344.5
4	6	1386.7
5	1	1429.9
5	2	1474.3
5	3	1519.8
5	4	1566.5
5	5	1614.3
5	6	1663.3
6	1	1713.5
6	2	1764.8
6	3	1817.5
6	4	1871.3
6	5	1926.3
6	6	1982.5

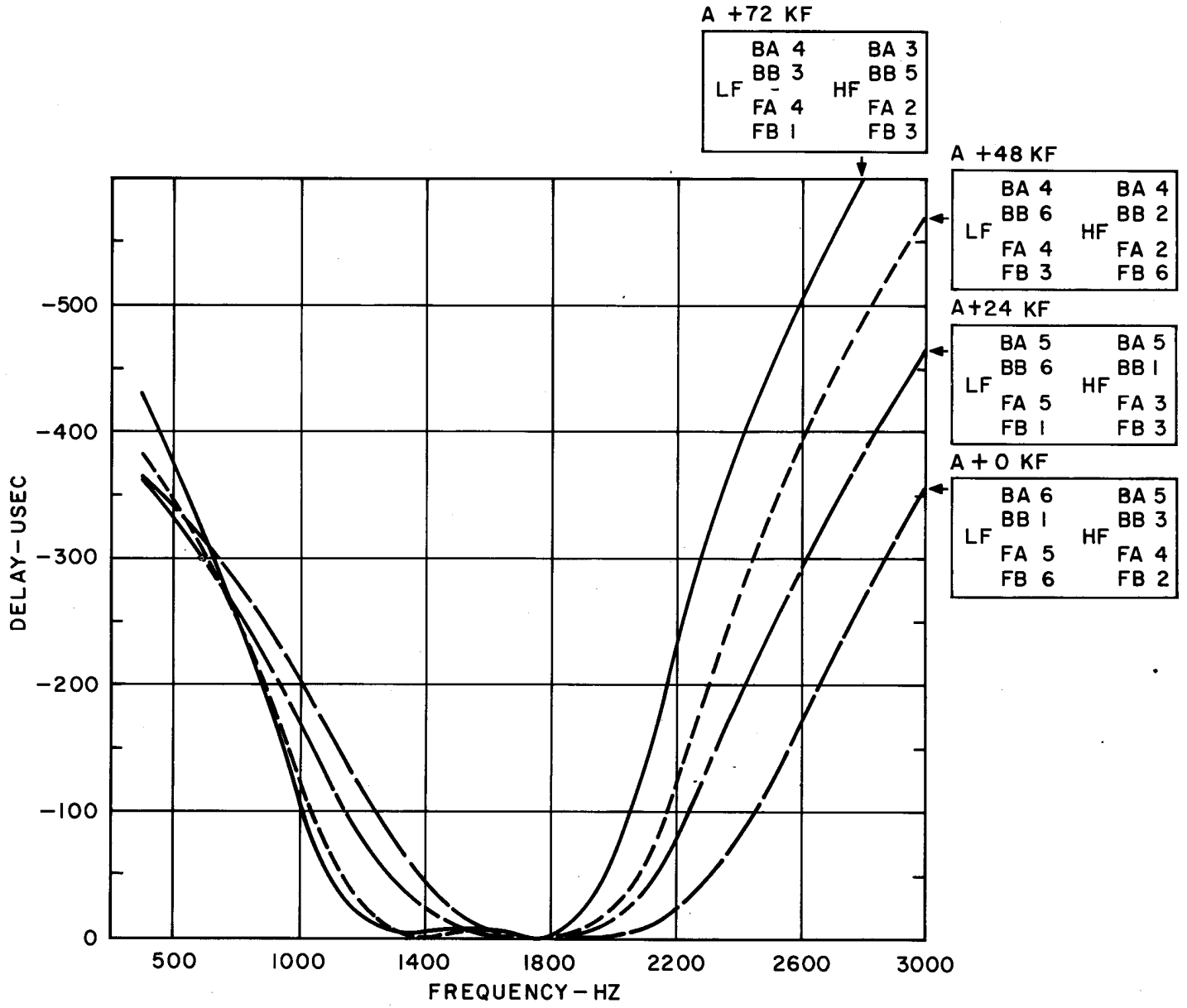


Fig. 6—Some Nominal 950B-Type Delay Equalizer Characteristic Curves Showing Compensation for the A Channel Bank and A Bank Plus H88 Loaded Cable

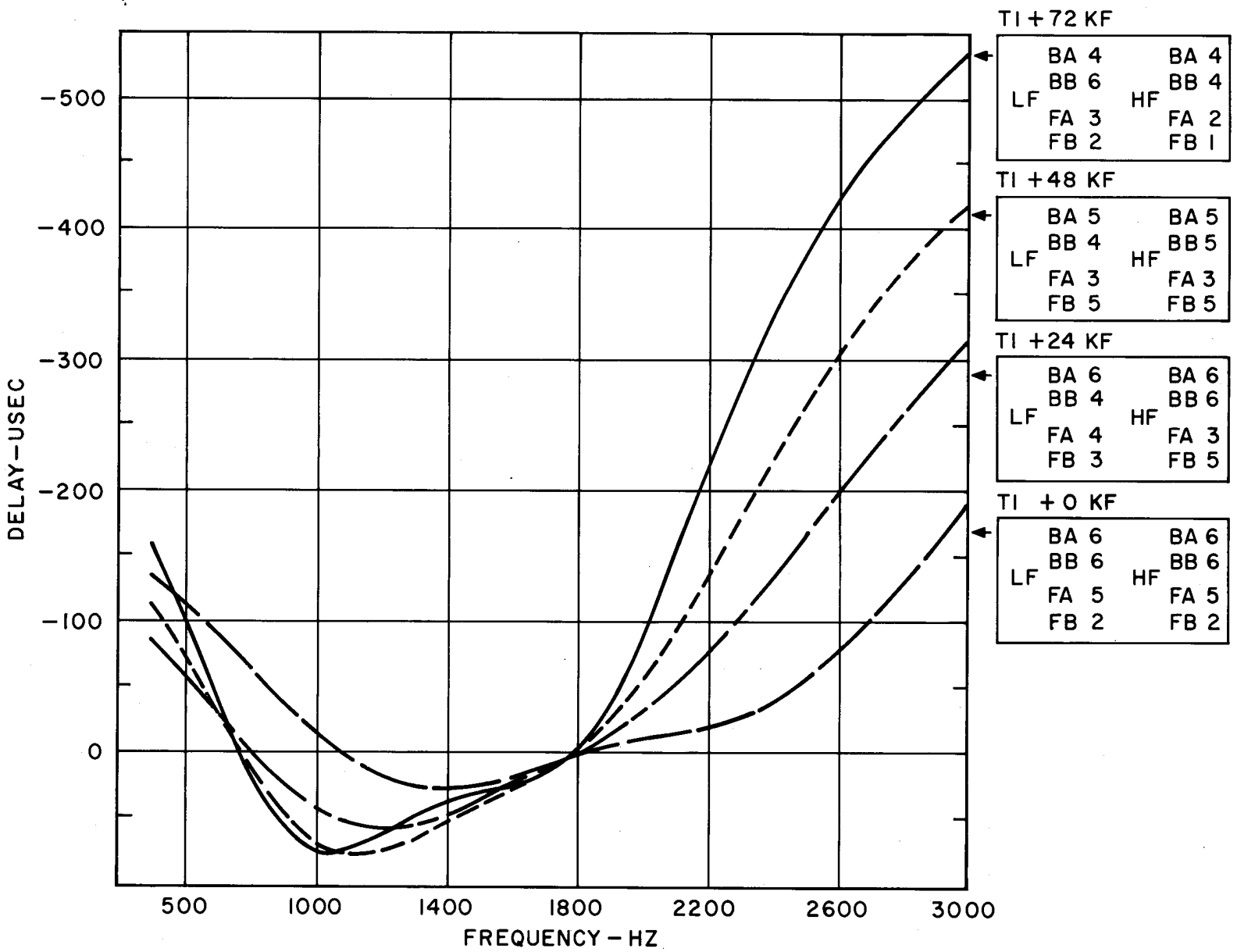


Fig. 7—Some Nominal 950B-Type Delay Equalizer Characteristic Curves Showing Compensation for T1 Carrier and Carrier Plus H88 Loaded Cable

4. REFERENCES

4.01 The following publication and document numbers are provided as a guide to supporting and supplementary information for this apparatus.

SECTION	TITLE
314-820-106	J99347 VF Amplitude and Delay Equalizing Units—Description
314-820-107	950A-Type Equalizer— Description
314-820-206	J99347 VF Amplitude and Delay Equalizing Equipment—Installation and Adjustment
314-820-506	J99347 VF Amplitude and Delay Equalizing Equipment—Maintenance Testing
332-414-105	4A Echo Suppressor—J68914TA Test Extender—Description
801-401-153	Equipment Specifications for the J99347 Equalizer Equipments
856-200-100	ADE 950 Equalizer Program

NUMBER	TITLE
SD-60069-01	4A Echo Suppressor Test Extender
SD-99559-01	Common Systems, VF Amplitude and Delay Equalizer Circuit