LOCAL CHANNEL
EQUALIZATION OF 5 OR 8 KHZ
PROGRAM AND WIRED MUSIC CIRCUITS

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1. GENERAL

1.01 This section outlines the equalization tests for 5 or 8 kHz local program and wired music circuits.

1.02 Whenever this section is reissued, the reason for reissue will be listed in this paragraph.

1.03 It is assumed that the circuit to be equalized has met all the requirements of the pre-equalization tests. ***IF THE PRE-EQUALIZATION REQUIREMENTS HAVE NOT BEEN MET, DON'T PROCEED WITH THESE TESTS!***

1.04 This practice includes a suggested form for recording the equalization data. It should be prepared locally. Such a form is helpful in following the test and behavior of the circuit for various equalizer adjustments.

1.05 When equalizing circuits more than one amplifier section in length, each section should be equalized separately. The section adjacent to the "sending end" should be equalized first. Each succeeding section should be equalized in tandem (series) with those previously equalized. This can be accomplished by moving the Transmission Measuring Set (TMS, eg, HP3552A) to the end of the next section. At intermediate amplifiers, the circuit should be equalized at the output terminals of each intermediate amplifier. This procedure should be followed through to the "receiving end" of the circuit.

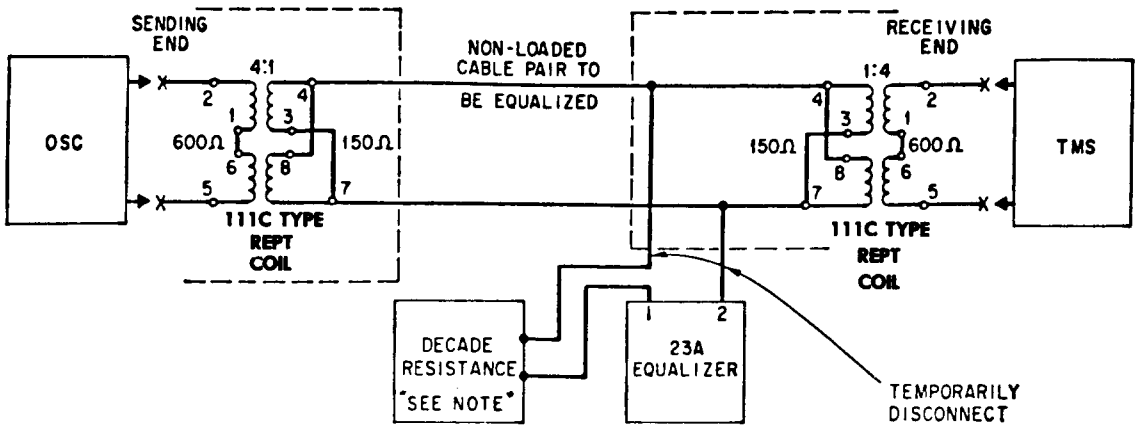
1.06 The gain of the intermediate amplifiers should be adjusted to compensate for the equalized loss of the cable at 1 kHz. The oscillator should remain at the "sending end" throughout the test in order to simplify the testing operations. Another reason for leaving the oscillator at the "sending end" is that slight irregularities in the previously equalized sections can be compensated for as each succeeding section is equalized.

1.07 In some instances, it may be necessary to make slight readjustments of intermediate equalizers in order to obtain the desired frequency response. All adjustments should be made in cooperation with the control office.

1.08 In order to make these tests, it will be necessary to establish a talking pair between both ends of the circuit. Any type circuit other than the circuit under test should be satisfactory.

2. EQUALIZATION TEST

2.01 Figure 1 shows the initial test setup for equalizing a single cable section to 5 or 8 kHz. This section may be part of a program circuit or the trunk portion of a wired music circuit. The 23A Equalizer is temporarily disconnected. If the receiving end of the program circuits is at the customer's premises, he will provide the amplifier. If the receiving end is at a Telephone Company office, such as a local loop connecting to a program network at a toll office or a section of the trunk for a wired music circuit, we will provide the amplifier, if required. Chart 1 gives the procedure to follow in making this test. During the equalizing procedure, a decade resistance may be used in place of the resistors normally provided with the 23A Equalizer. This will speed up the test.



NOTE:
WHEN USING DECADE RESISTANCE, STRAP TERMINALS 3 AND 4 OF 23A EQUALIZER

Fig. 1—Test Setup for Equalizing a Single Section Using 23A Equalizer

CHART I

STEP	PROCEDURE
1	Connect circuit as shown in Fig. 1 with equalizer disconnected.
2	Connect test equipment to ac power.
	Requirement: Allow ample warmup time.
3	Adjust OSC for 0 dBm output to the repeating coil.
4	Measure the 1-kHz loss.
	Requirement: The 1-kHz loss should be 18.5 dB or less with coils in circuit (12 dB without coils). If not met, the section may be too long to equalize.
5	Substitute decade resistance box in place of resistors normally used in equalizer.
	Requirement: Strap equalizer terminals No. 3 and No. 4. Insert decade in series with lead connected to equalizer terminal No. 1.
6	Connect equalizer with decade box to cable pair as shown in Fig. 1.
	Requirement: Adjust decade box for 100 ohms.
7	Measure the 100-Hz and 5-kHz or 50-Hz and 8-kHz loss. Adjust decade resistor until difference between 100-Hz and 5-kHz or 50-Hz and 8-kHz is 0.5 dB or less.
	Requirement: If 100- or 50-Hz loss is higher than 5- or 8-kHz loss, put in more resistance. If it is less, decrease the resistance.
8	Remove strap between terminals No. 3 and No. 4 of equalizer and disconnect decade box. Connect terminal No. 1 of equalizer to cable pair. Terminal No.2 is already connected.
9	Strap the resistance taps on the equalizer to agree as closely as possible to the final setting of the decade box obtained in Step 7.
10	Measure loss at the test frequencies shown on the attached form for a 5- or 8-kHz circuit.
	Requirement: If necessary, make minor changes in resistance strapping until all losses are within ±1.0 db of 1-kHz loss for single gauge or mixed gauge cable.
11	If requirements are met, solder resistance straps permanently.

2.02 When the KS-16816, L1 Equalizer is to be used instead of the 23A Equalizer, Chart II should be used. The advantage of the KS-16816, L1 Equalizer is that a circuit can be equalized much faster since soldering of resistances and L/C ratios is not necessary. Figure 2 shows the test setup for this equalizer.

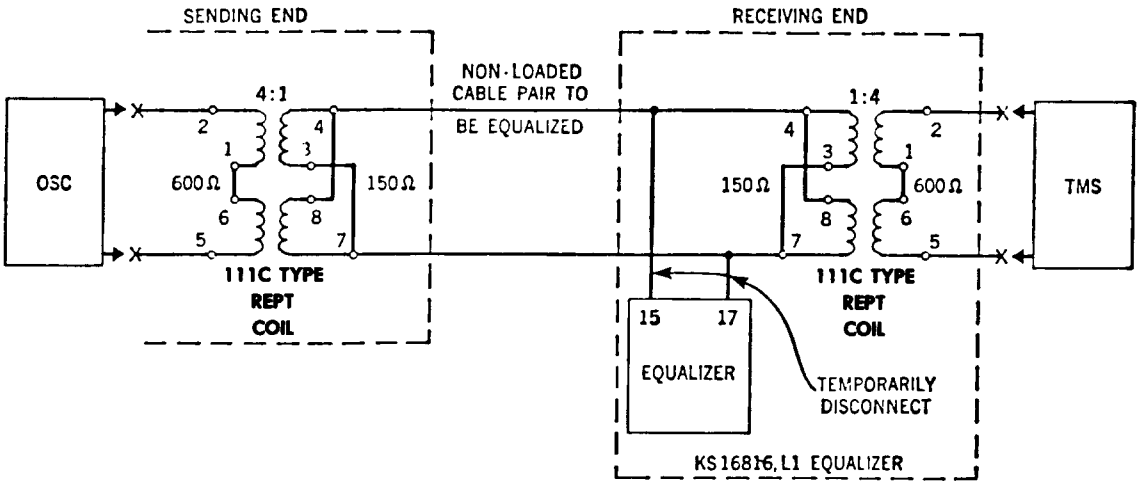


Fig. 2—Test Setup For Equalizing a Single Section Using the KS-16816,L1 Equalizer

CHART II

STEP	PROCEDURE
1	Connect circuit as shown in Fig. 2. Disconnect terminals 15 and 17 of equalizer from line.
	Requirement: Make sure terminals 19 and 20 of equalizer are disconnected.
2	Connect test equipment to ac power.
	Requirement: Allow ample warmup time.
3	Adjust OSC for 0 dbm output to the repeating coil.
4	Measure the 1-kHz loss.
	Requirement: The 1-kHz loss should be 18.5 dB or less with coils in circuit (12 dB without coils). If not met, the section may be too long to equalize.
5	Connect terminals 15 and 17 of equalizer to repeating coil as shown in Fig. 2.
6	Set selector switch of equalizer to 5- or 8-kHz position depending on frequencies to be equalized.
7	Set adjustable resistance to approximately 100 ohms.
	Note: The potentiometer shows actual resistance inserted.
8	Measure equalized loss at 100 Hz and 5 kHz or 50 Hz and 8 kHz.
	Requirement: If 100- or 50-Hz loss is higher than 5- or 8-kHz loss, put in more resistance. If it is less, decrease the resistance.
9	Adjust resistance until difference between 100 Hz and 5 kc or 50 Hz and 8 kHz is 0.5 dB or less.
10	Measure loss at test frequencies shown on the attached form for 5 or 8 kHz circuit.
	Requirement: All losses should be within ±1.0 dB of 1 kHz loss for single gauge or mixed gauge cable.
11	Strap terminals 20 to 10 and 19 to 9 of equalizer.
	Note: This should be done on 5-kHz circuit only to insert a series resonant circuit.
12	Repeat Step 10 for 5-kHz circuits only.
	Requirement: Loss between 7 and 8 kHz should increase to a peak of about 18 dB.
13	Clamp resistance by means of thumbscrew.

2.03 When equalizing loops for wired music circuits, equalizers are not generally provided at the station (restaurant, office building, etc). Experience indicates that with the 111C or equivalent repeating coil strapped for a 1:4 ratio at the station, an overall response of ±4 dB can be obtained. This is the ***REQUIREMENT*** for the frequency response from our customer's studio to his customer and includes the equalized response of the trunk, loop, and all Telephone Company equipment in the circuit.

2.04 When a Telephone Company amplifier is located at the receiving end of the section, the procedure for equalizing is the same as in Chart I or II with the following exception. The amplifier gain at 1 kHz should be adjusted to give 0 dBm output. This assumes a 0 dBm test tone is applied at the sending end. The TMS should be connected to the output terminals of the amplifier.

2.05 In those situations where the circuit is more than one amplifier section in length, each section should be equalized separately. The section adjacent to the "sending end" should be equalized first. Each succeeding section should be equalized in tandem (series) with those previously equalized. At intermediate amplifiers, the circuit should be equalized at the output terminals of each amplifier. This procedure should be followed to the "receiving end" of the circuit.

3. NOISE AND CROSSTALK TESTS

3.01 The circuit noise and crosstalk should be measured in accordance with Fig. 3 using program weighting and should not exceed 36 dBrn at the +8 VU volume level point. The noise should be measured during the heavy traffic period load. Occasional meter excursions which appear every few seconds, or less often, and go beyond the +1 mark on the meter should be ignored unless it is felt they are excessive. The DB dial of the 3C type NMS should be adjusted to 35 for this measurement.

3.02 If a noise measurement is made at other than the +8 VU volume level point (amplifier output), a correction should be made by adding the equalized loss to the 3C type NMS reading. The equalized loss is the 1 kc measured loss with all equalizers and amplifiers in place. For instance, if the equalized loss is 20 dB with the intermediate amplifiers adjusted to their proper levels and the 3C type NMS reads 15 dBrn at the −20 dB point, the corrected level at the +8 VU volume level point is 35 dBrn of noise (15 + 20).

3.03 The crosstalk should be observed with the monitoring receiver of the 3C type NMS. With the DB dial set at the same setting as for measuring noise, no intelligible words or syllables should be heard. The crosstalk should be observed during the heavy traffic period load for at least 10 minutes.

4. LEVEL MEASUREMENTS

4.01 When intermediate amplifiers are required, the equalized 1-kHz loss to the amplifier location should be used in adjusting the final gain of each amplifier. If the equalized loss, for example, is 20 dB at 1-kHz, the amplifier should be adjusted for 20-dB gain. Prior to equalization, the amplifier gain should be adjusted for the 1-kHz loss of the cable section. Each time the equalizer strapping is changed it may be necessary to readjust the amplifier gain.

4.02 The overall 1-kHz transmission should be measured from the "sending end" to the "receiving end" of the equalized circuit. This value should be recorded for future reference.

5. WORK FORM FOR RECORDING DATA

5.01 The work form, or one similar to it, should be prepared locally. (See Fig. 4.) Data obtained in the above tests should be recorded on this form, or one similar to it, for analysis of the equalization test. The final results of the test can be filed with the circuit order card if the Telephone Company wishes to do so. If the circuit consists of more than three sections, additional copies of the form should be used. The data should be recorded on the form by the tester at the receiving end of the circuit.

6. TROUBLE-HUNTING HINTS

6.01 The trouble-hunting hints outlined below give some idea as to where to look for specific troubles. All sources of troubles are not included in the following lists. Hence, other possibilities should not be overlooked.

6.02 *Circuit Is Noisy on Initial Noise Test*

Sources of Noise

(1) Induction from central office battery

(2) High resistance splices in cable

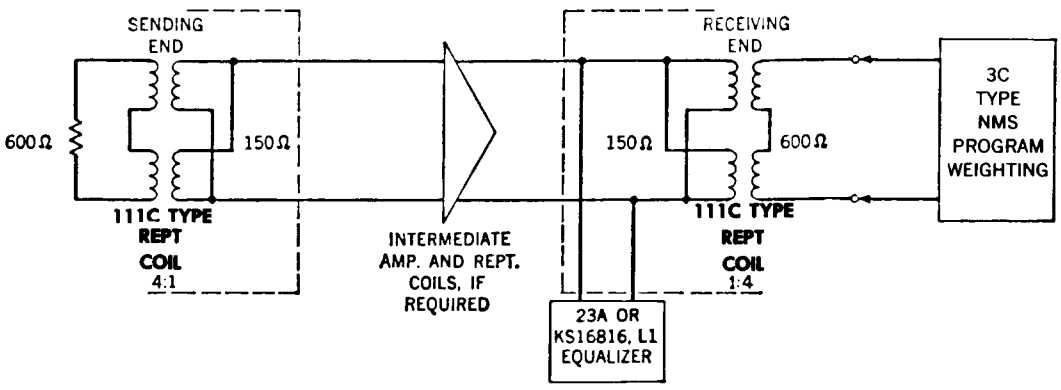


Fig. 3—Test Setup for Noise and Crosstalk

(3) Grounded tip or ring conductor

(4) Repeating coil missing

(5) Load coil on cable pair

(6) Protector carbons dirty

(7) Excessive power line induction

(8) Repeating coil shield may require grounding.

Remedial Measures

(1) Select another cable pair.

(2) Clean or replace carbons.

(3) If noise is due to excessive power line induction or central office battery, consult your supervisor.

6.03 *Circuit Losses Cannot Be Equalized Properly*

Sources of Trouble

(1) Bridged taps on loop

(2) Repeating coils improperly strapped or missing

(3) Equalizer located on wrong side of repeating coil

(4) Equalizer strapped incorrectly

(5) Presence of one or more load coils

(6) One side of circuit is open (will measure about 10-dB too long)

(7) Amplifier input and output impedances not correct.

Remedial Measures

(1) Consult cable assignment bureau for makeup of cable. If bridged taps are present, select another cable pair.

(2) Check repeating coils and equalizer.

SHEET_____OF_____SHEETS

PROGRAM CIRCUIT EQUALIZATION WORKSHEET – 8 OR 5 KHZ CIRCUITS

CIRCUIT NO._____ FROM_____ TO_____ ORDER NO. _____

DATE TESTED_____ TESTED BY_____ DATE SERV DUE_____

SENDING END ——— RECEIVING END

LOCATION_____ LOCATION_____

EQUIP._____ EQUIP._____

INSERT SYMBOL (▷) AND OFFICE WHERE INTERMEDIATE AMPLIFIER IS LOCATED

FIRST SECTION						FIRST AND SECOND SECTION						OVERALL CIRCUIT					
8 KHZ___DB INITIAL TRANS LOSS 5 KHZ___DB INITIAL TRANS LOSS 1 KHZ___DB DIFF___DB INITIAL TRIAL RES ___OHMS						8 KHZ___DB INITIAL TRANS LOSS 5 KHZ___DB INITIAL TRANS LOSS 1 KHZ___DB DIFF___DB INITIAL TRIAL RES ___OHMS						8 KHZ___DB INITIAL TRANS LOSS 5 KHZ___DB INITIAL TRANS LOSS 1 KHZ___DB DIFF___DB INITIAL TRIAL RES ___OHMS					
TEST FREQ		DB		DB		DB		DB		DB		DB		DB		DB	
8 KHZ	5 KHZ	LOSS	DEV	LOSS	DEV	LOSS	DEV	LOSS	DEV	LOSS	DEV	LOSS	DEV	LOSS	DEV	LOSS	DEV
1000	1000																
50																	
70																	
100	100																
250	250																
500	500																
1000	1000																
2000	2000																
3000	3000																
4000	4000																
	4500																
5000	5000																
6000																	
7000																	
8000																	
1000	1000																
EQL RES																	
*		*		*		*		*		*		*		*		*	

*INDICATE FINAL FREQUENCY RUN BY WRITING "FINAL" IN APPROPRIATE COLUMN.

AMP NO._____
AMP GAIN STEP_____
AMP LOC FIR___ RR___ BAY___
CIRCUIT LEVEL_____

AMP NO._____
AMP GAIN STEP_____
AMP LOC FIR___ RR___ BAY___
CIRCUIT LEVEL_____

METALLIC VARLEY_____
INSULATION RESISTANCE_____
CIRCUIT LEVEL_____

Fig. 4—Program Circuit Equalization Worksheet—8 or 5 kHz Circuits