ERICSSON

MAINTENANCE MANUAL
ALIGNMENT PROCEDURES
FOR
SIMULCAST

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INTRODUCTION

The following **SIMULCAST** equipment alignment procedures are with respect to each RF channel. To align the system properly, the adjustments should be completed in the following order. Read entire procedure before beginning.

1. Tektronix 2430A Digital Storage Oscilloscope **Start-up Procedure**
2. Tektronix 2430A Digital Storage Oscilloscope **Amplitude Measurement** From Test Receiver Start-up Procedure
3. Tektronix 2430A Digital Storage Oscilloscope **Phase Measurement** From Test Receiver Start-up Procedures
4. Exciter Deviation Adjustment
5. Audio Variable Delay/Audio Phase Amplitude Equalizer Pre-Alignment
6. Phase Equalization Adjustment
7. Amplitude Equalization Alignment
8. Analog Delay Check
9. Clock Reference Edge Check
10. 300 Hz Reference Polarity Check
11 Digital Delay Check

TOOLS AND TEST EQUIPMENT

1. Tektronix 2430A Digital Storage Oscilloscope with option 1R. Configure scope for rack mount. If a plotter is desired, the HP100 - color pin plotter and option 01 - GPIB cable is recommended.
2. Hewlett Packard HP3575A Gain/Phase Meter with options 001 Dual Readout/Dual Outputs and 908 rack flange kit.

3. Hewlett Packard 8116 Pulse/Function Generator with option 001 Burst and Logarithmic Sweep and HP5061-9672 rack mount kit.

4. Delay Line panel.

5. Balun Panel assembly.

6. IFR Systems Inc. - Communications Service Monitor FM/AM 1200S with Spectrum Analyzer.

7. Miscellaneous Test Leads:

Length	Connectors	Quantity
10-inch plus	BNC to BNC	4
13-inch plus	BNC to BNC	1
18-inch plus	BNC to BNC	2
40-inch plus	BNC to jack plug	2
10-inch plus	BNC to Banana	1
18-inch plus	BNC Male to Banana Female	2
40-inch plus	Banana to jack plug	1

TEKTRONIX 2430A DIGITAL STORAGE OSCILLOSCOPE START UP PROCEDURE

Refer to the TEK Operations Manual No. 070-6286-00, Product Group 37. Read Sections 1, 4 and 5 of the Tektronix manual.

NOTE

If this procedure has been performed at any time and the Tektronix 2430A Oscilloscope has "saved," then performing the following steps will not be necessary.

1. Perform all five steps of the Starting Setup procedures as outlined in Checks and Adjustments section of the Tektronix manual.

2. Press the **SETUP PRGM** front panel button.

3. Press the bezel button labeled **SAVE**.

4. Enter the word "**START**" using the menu buttons.

5. Press the bezel button labeled **SAVE**.

6. Press the **SETUP PRGM** front panel button. After the PRGM button is pressed, the **SET STEP ACTIONS** menu will be displayed.

7. Use the arrow labeled bezel buttons and the **Y:N** (yes:no) menu button select **<Y>** for the following labels: **SELF-CAL**, **SELF-TEST**, **BELL** and **PROTECT**. Set all others to **<N>**.

8. Select **SAVE SEQ** menu button.

TEKTRONIX 2430A DIGITAL STORAGE OSCILLOSCOPE AMPLITUDE MEASUREMENT FROM TEST RECEIVER START UP PROCEDURE

NOTE

If this procedure has been performed at any time and the Tektronix 2430A Oscilloscope set-up for amplitude has been "saved," then performing the following steps will not be necessary.

The required settings and adjustments when measuring and saving the amplitude signals from the test receiver are listed in the following pages. For additional information, refer to the TEK Operations Manual No. 070-6286-00, Product Group 37, Section 5, Table 5-2. Perform the start-up procedures if necessary as outlined in previous pages.

1. Set **VERTICAL** mode controls as follows:
   - **CH1 VOLTS/DIV** to 10 mV/div (approx. 1dB/div gain)
   - **CH2 VOLTS/DIV** to 5 V/div COUPLING (both) to DC
   - **50 Ω** to **OFF**
   - **INVERT** (both) to **OFF**
   - **POSITION** to mid screen
   - Display Mode to **YT**
   - Bandwidth to 20 MHz
   - **SMOOTH** to **ON**

2. Set **TRIGGER** controls as follows:
   - **AB TRIG** to **A**
   - **A TRIG MODE** to Normal
   - **SOURCE EXT** 1÷5
   - **COUPLING** (both) to **DC**
   - **SLOPE** (both) to - (minus)

- **TRIG POSITION** (both) to 1/4
- **LEVEL** (both) to 1.00V (trigger source = Ch 2)

3. Set **HORIZONTAL** controls as follows:
   - **MODE** to **A**
   - **A SEC/DIV** to 1 second
   - **POSITION REF** mode to trigger paint "**T**" is at the extreme left side of the screen.
4. Set **STORAGE** control as follows:
   - **ACQUIRE** to **ACQUIRE NORMAL**
   - **DISPLAY REF** in **YT** mode to **HORIZ POS REF**, then to **IND:LOCK**
5. Press **SETUP PRGM** button. Select **SAVE** menu button.
6. Use the menu buttons and arrow keys to enter name: **AMP**. Select **SAVE** menu button. Press **SETUP PRGM** button.
7. After the third-level menu appears, set **BELL**, and **PROTECT** to **<Y>** and set all others to **<N>**.
8. Select **SAVE SEQ** menu button.
9. **NOTE**: When recalling the program set-up, the vertical position is not recalled.

TEKTRONIX 2430A DIGITAL STORAGE OSCILLOSCOPE PHASE MEASUREMENT FROM TEST RECEIVER START UP PROCEDURE

NOTE

If this procedure has been performed at any time and/or the programmable Tektronix 2430A Oscilloscope set-up for phase measurement has been "saved," then performing the following steps will not be necessary.

The following steps outline the required settings and adjustments when measuring and saving the phase signals from the test receiver. For additional information, refer to the TEK Operations Manual No. 070-6286-00, Product Group 37. Perform the start-up procedures if necessary as outlined in previous pages.

1. Display the stored **AMP** signal as outlined in previous pages.
2. Change **CH1 VOLTS/DIV** from 10 mV/div to 500 mV/div.
3. Select **SAVE** menu button.
4. Use the menu buttons and arrow keys to enter name: **PHASE**.
5. Select **SAVE** menu button.
6. Press **SETUP PRGM**.
7. After the third-level menu appears, set **BELL** and **PROTECT** to **<Y>** and set all others to <N>.
8. Select **SAVE SEQ** menu button.
9. **NOTE**: When recalling the program set-up, the vertical position is not recalled.

EXCITER LEVEL ADJUSTMENT

Perform the steps in the order presented. A technician is required at both the control point and at the transmit site to perform this task. Establish a communication link between technicians before starting the procedures. Refer to Figure 1. It is important tht the same (or exactly matched) deviation measurement equipment be used at each site.

1. At the control point, perform the following:
   a. On the control panel, set the following switches:
      - Site 1, transmit control switch 1 (PTT) to **ON**.
      - Site 1, voice control switch 1 (A/D) to **ON**.
      - Site 2 switch 1 and site 3 switch 1, under both transmit control and voice control to **OFF**.
   b. On the 150 baud data select circuit card, set the **TEST ENABLE** switch (**SW2**) to **TEST**. This is the lower switch located on the front of the data selector; down is the **TEST** position.
2. At the transmit site:
   a. Set the communication service monitor to **FM NAR** operation and tune to receive the RF channel under test.

b. Observe modulation analog meter on service monitor and adjust R50 on the GE exciter for 0.75 kHz deviation (150 baud data), (.600 kHz if **NPSPAC**).

c. For checking after initial system installation, a 75 Hz, RS-232 level test signal may be injected on the GETC interface card of the station under test. Remove J4 and inject on Pin 1 (Rev. D or later). Key station manually. The test switch on the 150 baud data selector remains in th "**Normal**" position, allowing normal system operation on the other channels.

3. At the control point (for the site being tested):

a. Set the pulse/function generator for a -10 dBm, 1 kHz tone (system test tone level).

b. Insert the -10 dBm signal into the A60X jackfield Tx V audio channel 1 (line) circuit.

c. Return the test enable switch on the 150 baud data selector to the normal operating position.

4. At the transmit site:

a. Remove the **FSK** modem from sync unit D100 assembly. This removes the low speed data from all channels.

b. Remove 16 dB (minimum) of attenuation, on the Receiver end Mux card, for the channel under test.

c. Set communication service monitor to **FM MID** and observe the display while adjusting R52 in the GE exciter for 3.75 kHz deviation (3.0 kHz if **NPSPAC**).

d. Replace attenuation removed in (**b**.).

e. Observe the deviation with the communication service monitor; reading should be 3.0 kHz (±.05) (2.4 kHz if **NPSPAC**). Adjust the equalizer level control for this site to achieve 3.0 kHz (**FM NAR**) (2.4 kHz if **NPSPAC**). **Note**: Mux attenuation removed is nominally set to produce -17 dBm for MII with -10 dBm system level. This normally provides the correct deviation.

f. Replace the FSK modem.

5. At the control point:

a. On the control panel, set the site 1 transmit (PTT) control and voice control (A/D) switches to **OFF**.

b. Remove inhibit lead clips to prevent control channel from moving.

c. At jackfield D601, patch the control channel data into the channel being set.

6. At the transmit site:

Adjust R31 on the **GETC** circuit card assembly for 3.0 kHz deviation as observed on the communication service monitor display (2.4 kHz if **NPSPAC**).

7. Repeat procedures for each channel and site. After exciter adjustments have been performed, return all switches on the control panel to the system position.

9.6 kHz CLOCK EDGE REFERENCE CHECK

This checks the 9.6 kHz clock polarity relative to the rising edge of the 300 Hz signal and must be checked at each site. This test determines if Universal Sync card jumpers P8, P12, P16 and P20 are in the correct position. These jumpers must be positioned the same on all Universal Resync cards at a given site. It is possible that their position at one site may be different from their position at another site.

Procedure:

1. At the remote site, remove a Resync card and reinstall it on an extender card. There is less disruption to an operating system if it is not the Master Resync card.

2. Using a dual trace scope:

a. Channel 1 - probe U32, Pin 1 - 300 Hz reference signal

b. Channel 2 - probe U12, Pin 16 - 9.6 kHz clock out

c. Trigger on channel 1

3. The 9.6 kHz clock out polarity is chosen (using the jumpers) so that the rising edge of the 9.6 kHz clock is as close as possible to the rising edge of the 300 Hz signal. Note that there are only two choices. The four jumpers are one for each channel and all four (P8,P12, P16, & P20) must be installed in the same position on every card at this site.

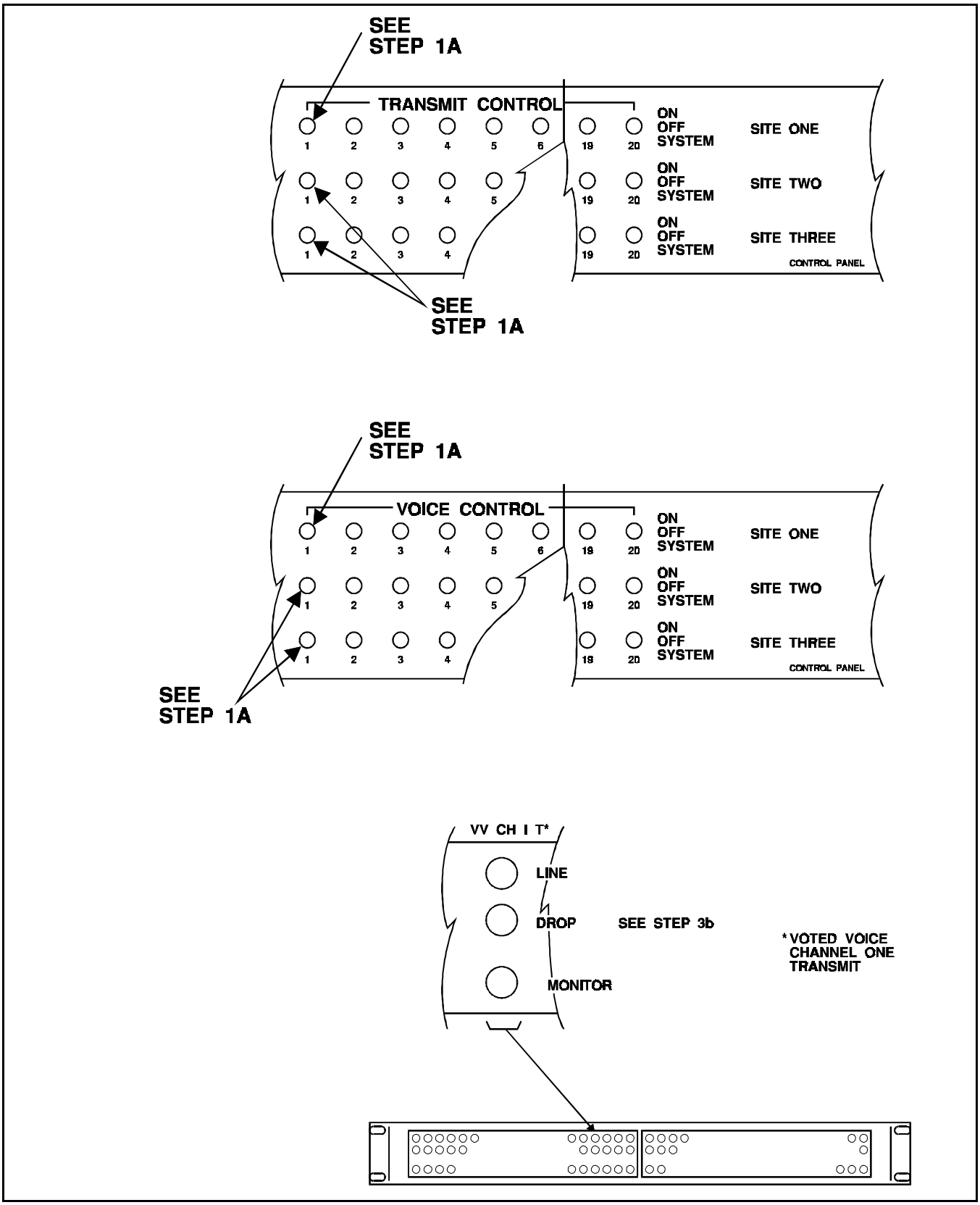

Figure 1 - Exciter Level Adjustment

300 Hz REFERENCE POLARITY CHECK

The polarity of the 300 Hz timing reference must arrive at the transmit site Master Universal Resync Card without an inadvertent inversion in the balanced audio lines. If the following check indicates this reference to a site is inverted from proper polarity, the condition can be corrected by either (1) "flipping" the balanced pair line at either the control end or the transmit end (not both) or (2) moving the position of jumper "J3" on the Tone Interface card at the transmit site in question.

Test Procedure:

1. Connect the Test Delay in series with the Tx modem audio going to the site under test on the Control Channel as shown in Figure 2.

> **NOTE**
>
> The Control Channel data can be patched to a "**Disabled**" channel at the Tx 9.6 data jackfield to minimizes system interruption and the "**Disabled**" channel used for this test.

2. With the test delay at zero (**0**), use delayed sweep on the oscilloscope to display the "**dotting/barker**" region of the Control Channel data (External trigger on **FSL**, discriminator output of the Test Radio set to the proper RF channel). On the test panel only the site under test should have PTT (See Figure 3 for "**dotting/barker**" region and oscilloscope connections. The scope setup may be stored under "DIGTME").

3. Set one cursor at the reference edge, the other cursor 3.3 milliseconds later (allow sufficient time for Resync (up to 56 seconds)).

4. Add one (1) millisecond of delay on the test delay; the edge will reappear after the modem retrains at some random point. Wait for Resync. The reference edge should come back to the first cursor.

5. Increase the delay to 2.5 milliseconds. After retraining and Resync, the reference edge should be at the second cursor. If the reference edge "**Resyncs**" to the first cursor the 300 Hz polarity is inverted going to the site and must be changed.

6. Repeat this test for all sites.

DIGITAL DELAY ADJUSTMENT

Perform the steps in the order presented. Refer to the Figure 3 and Delay Unit Shelf Assembly Maintenance Manual LBI-38941.

1. Connect the test equipment as shown in Figure 3. Patch data from Control Channel to the Test Channel.

2. Starting with the transmit site furthest from the Control Point, on the Control Panel, set the following switches.
   - Furthest site transmit control **ON**.
   - Furthest site voice control **OFF**.
   - All other sites transmit control **OFF**.
   - All other sites voice control **ON**.

> **NOTE**
>
> The different equiment delays may cause the geographically most distant site NOT to be electronically the farthest. It is acceptable to start with any site; it is the relative time between sites that must be correct once finished.

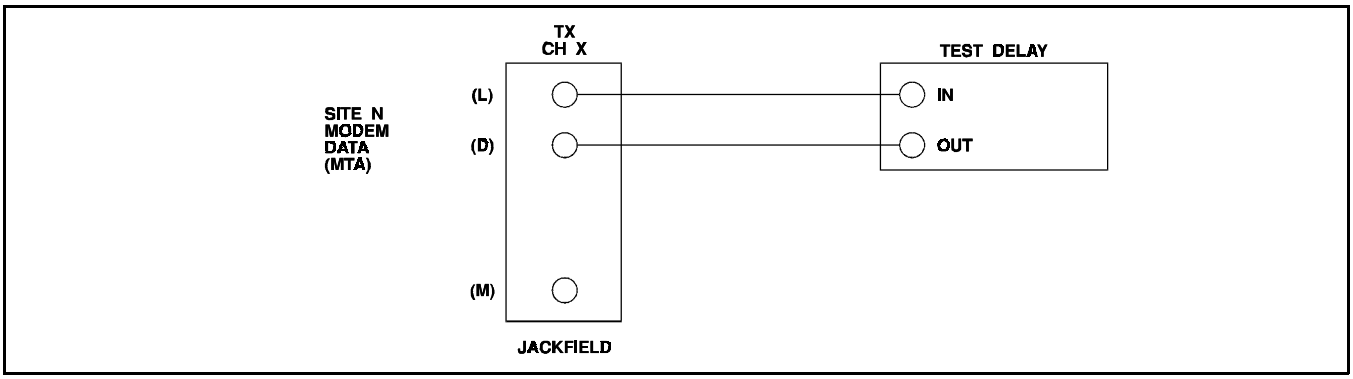

Figure 2 - Test Hook-Up

3. Set the oscilloscope to view the first "dotting/ barker" region of data after the scope triggers using delayed sweep. Record the time from trigger to a uniquely identifiable zero crossing of data.

4. Set the switches at the control point control Panel as follows:

   - Next site transmit control **ON**.
   - Next site voice control **OFF**.
   - All other sites voice control **ON**, transmit control **OFF**.

5. Observe the oscilloscope display. This site should arrive "**earlier**" than the prior site. Adjust digital delay for this site to move the identified data point out to the time recorded for the prior site.

6. Continue with the remaining sites per procedure.

7. Digital delays are set/adjusted on the Digital Delay Cards. Two sites are on each card. The setting is on a binary weighted dip switch (1.0 µS/bit). Refer to Digital Delay Card adjustment document.

8. These settings must be offset to compensate for the geographic difference in location of the overlap regions and the monitor receiver.

9. It is advisable to patch the Control Channel data to each channel for the site and verify that each "**Resyncs**" to the same place in time.

AUDIO PHASE AMPLITUDE EQUALIZER PRE-ALIGNMENT

NOTE

Convex equalizers are factory pre-adjusted for a FLAT response. Do Not pre-adjust. The following pre-adjustment procedures are applicable to Tellabs equalizers only.

Perform the steps in the order presented. Refer to delay/amplitude equalizer document.

1. At the control point, perform the following:

   a. Preset all controls per manufacturer's instructions.

   b. Mechanically preadjust all 13 Amplitude and all 13 Delay Pots as follows:

      1. Rotate Pot counterclockwise 15 turns.

      2. Rotate Pot clockwise 4 turns.

      This mechanical adjustment "presets" all cards alike and gives a starting point to work from.

2. Repeat for each site on channel 1.

3. Repeat for each channel.

AMPLITUDE EQUALIZATION ALIGNMENT

Perform the steps in the order presented. Refer to the Figure 4. For each site, the amplitude and phase must be iterated until no further adjustment is required. It may be desirable to sweep at a 5 second rate and decrease vertical sensitivity by one position for initial iterations.

1. Perform the digital oscilloscope start-up and amplitude measurement procedures as outlined on previous pages or recall **AMP** (refer to the **Table Of Contents** for the correct page number).

2. Turn off the compressor for the channel being tested (Bypass Gain and Compression).

3. Pulse/Function Generator:

   a. Set the pulse/function generator marker output signal to sweep from 300 Hz and 3.0 kHz (10 sec. sweep time marker at 1 kHz).

   b. Set the pulse/function generator output signal for approximately -20 dBm. Set Gain Phase meter to amplitude.

4. On the control panel, set the following switches:

   - Site 1, transmit control switch 1 to **ON**.
   - Site 1, voice control switch 1 to **ON**.
   - Remaining sites switch 1, both transmit and voice control to **OFF**.

5. Sweep Set Up:

   a. Insert this signal into the jackfield for site 1, channel 1 transmit audio drop circuit. Adjust amplitude to provide 2 to 2.5 kHz deviation, at 1 kHz, from the station. Establish a reference based on a single exciter's characteristic without equalization. The test Rx output may need to be adjusted (R2 on the Bridge card in the Alignment Receiver unit) to approximately match the reference level (can precisely match at 1 kHz as gain set procedure).

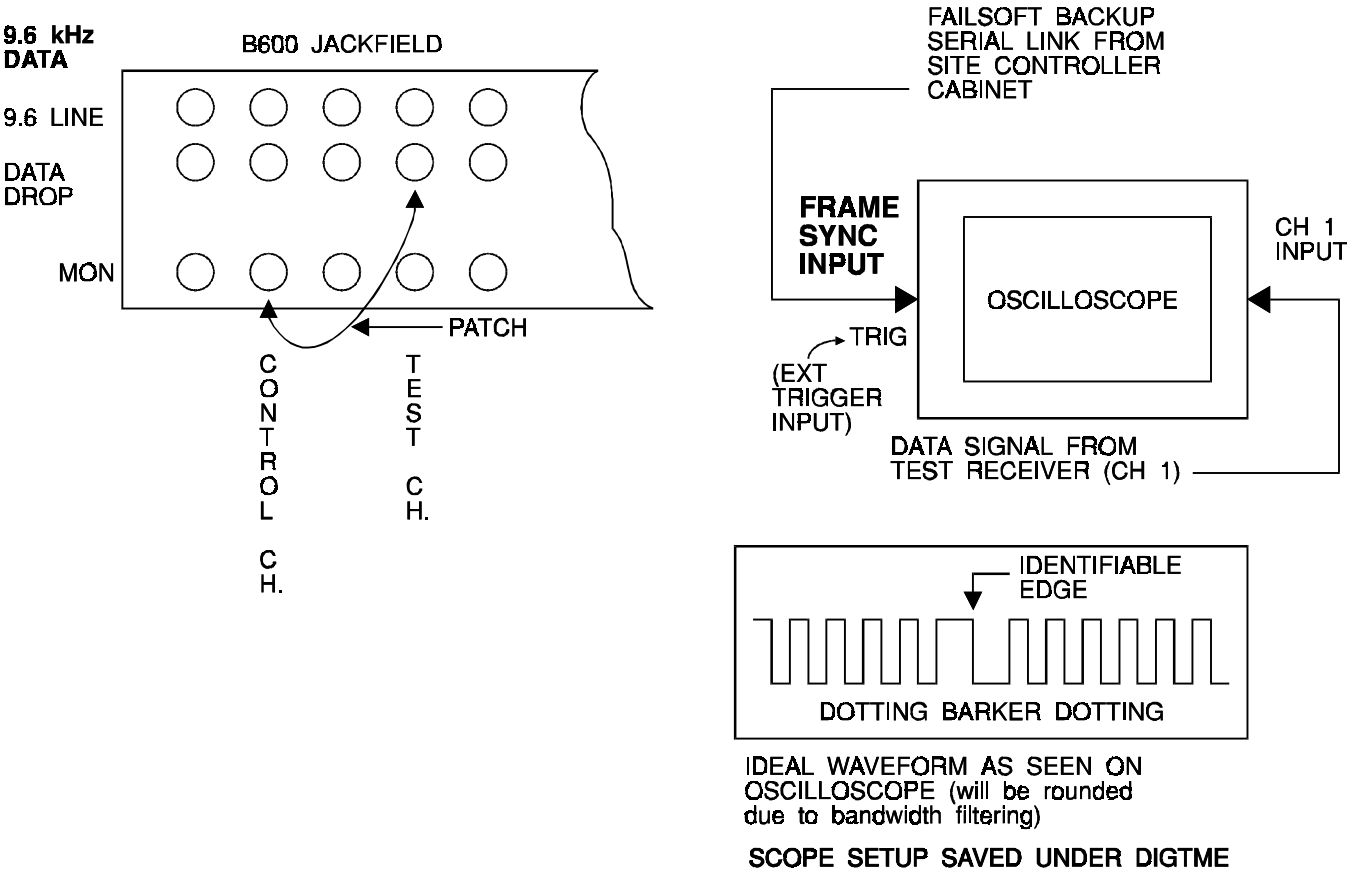

Figure 3 - Digital Delay Adjustment

b. Save the exciter only waveform in the oscilloscope as **CH1** memory location **REF1**.

6. a. Remove the signal from Site 1, channel 1 and insert into Jackfield Voted Audio Channel 1 drop circuit.

   b. Turn on transmit for each site, one at a time and note weakest RF site (Test Rx meter). Close attention is necessary to pad each site down to the weakest site signal using the RF attenuator on the alignment receiver.

7. Sweep site 1, channel 1 and adjust the amplitude pots on the equalizer to within ± 0.1 dB of the reference signal as saved in step 5b. . Repeat as necessary to obtain results.

8. On the control panel, set the following switches:
   - Site 2, transmit control switch 1 to **ON**.
   - Site 2, voice control switch 1 to **ON**.
   - Site 1 switch 1 and sites 3 - 8 both transmit and voice control to **OFF**.

9. Sweep site 2 channel 1 and adjust the amplitude pots on the equalizer to ± 0.1 dB of the reference signal as saved in step **5b**. Save the final adjusted waveform in the oscilloscope as **CH1** memory location **REF2**.

10. Remaining Sites:

    a. Continue the method for these sites, i.e., site being tested has transmit and voice control switches on; all other sites have transmit and voice control switches off.

    b. Sweep remaining sites and adjust corresponding amplitude pots on equalizer for the site and channel being tested to ±0.1 dB of the reference signal as saved in step **5b**.

    c. It may be necessary for some sites to use a remote test receiver to receive a distant site. Use a previously adjusted site that is strong enough for the remote test receiver to use as a reference. Store this new reference signal from the remote test receiver.

11. Compare all waveforms for each test receiver. The waveforms should remain within ±0.20 dB to assure proper long term operation.

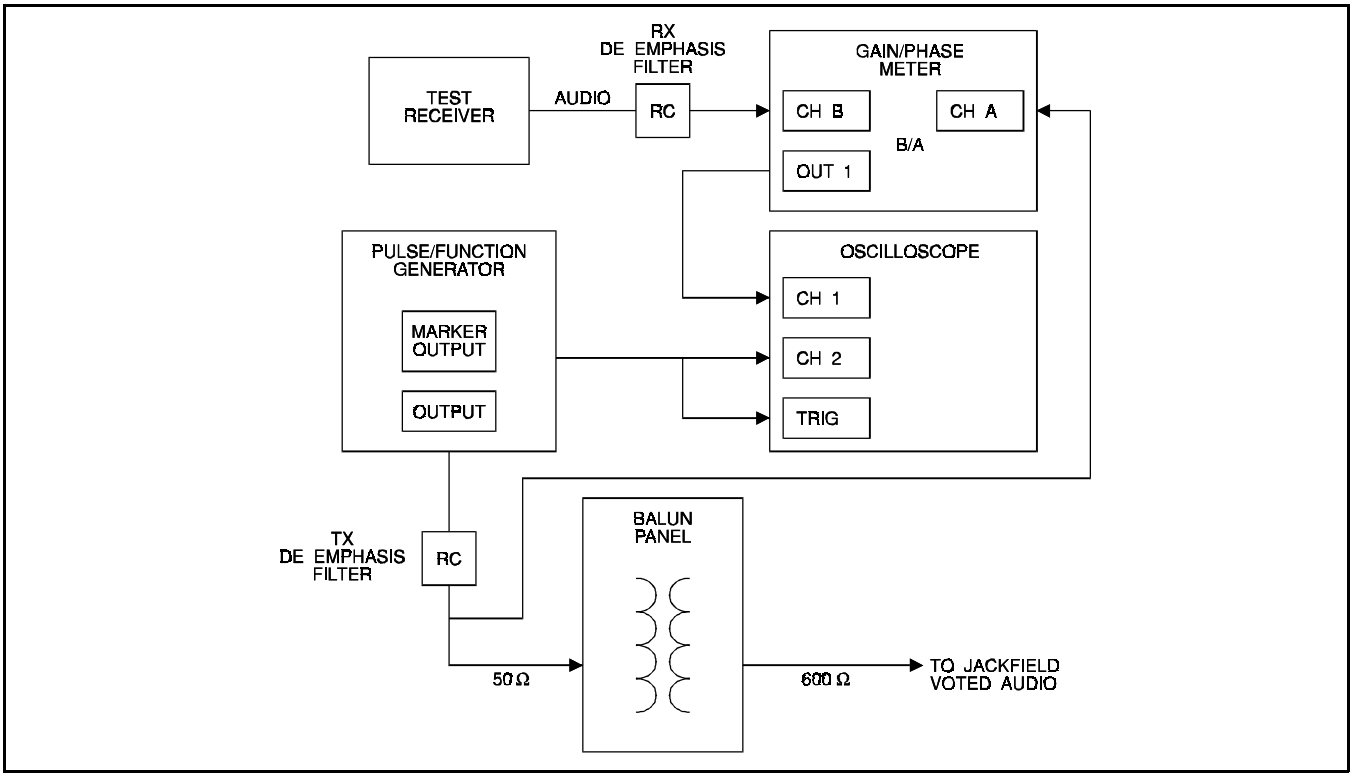

Figure 4 - Amplitude Equalization Alignment

12. When finished sweeping a channel, restore the compressor switches to normal.

PHASE EQUALIZATION ALIGNMENT

Perform the steps in the order presented. Refer to figure 5 to set up the equipment and to the waveforms of figures 6 and 7.

1. Perform the digital oscilloscope start-up and phase measurement procedures as outlined on previous pages or recall phase.

2. Starting with the site that is the greatest distance from the control point, on the control panel, set the following switches:
   - Transmit control switch 1 to **ON**.
   - Voice control switch 1 to **ON**.
   - All other sites switch 1 transmit control and voice control to **OFF**.

3. Pulse/Function Generator:
   a. Set the pulse/function generator output to provide 2 to 2.5 kHz deviation at 1 kHz (as for amplitude equalization).
   b. Set the pulse/function generator to sweep between 300 Hz and 3.0 kHz, and sweep the signal for channel 1.

4. a. Set the gain/phase meter to measure phase. If required to move the Ch1 oscilloscope cable to "**OUT 2**" on the gain/phase meter.
   b. Observe the waveforms on the oscilloscope. The waveforms may show insufficient, excessive or optimum reference delay (see Figure 8).
   c. Adjust the delay controls on the delay line panel to obtain an optimum reference delay.
   d. Save the adjusted waveform in the oscilloscope as **REF3** memory location **CH1**.

NOTE

To obtain optimum delay, the following method may help send a band of tones (sweep) through the system to the site: Feed the monitor receiver output to the oscilloscope. Route the same tone through test delay and also to the scope. Using dual trace, adjust time delay to get both "in phase" at "all" frequencies. "In phase" will have some flutter because delays have not been equalized.

5. On the control panel, set the following switches for the next site:
   - Transmit control switch 1 to **ON**.
   - Voice control switch 1 to **ON**.
   - All other sites switch 1 transmit and voice control to **OFF**.

6. Adjust the delay line panel for site reference setting.
   a. Sweep site, channel 1 and observe the phase difference between the previous site channel 1 (channel reference) and this sweep.
   b. Adjust the delay pots on the equalizer until the site 2 channel 1 waveform is within ±10 degrees between a frequency range of 600 Hz and 2800 Hz.

NOTE

The delay pots of the equalizer change the time delay in a band centered at the corresponding frequency. Since phase, which is a function of both time and frequency, is displayed, the major effect of adjustment is to "**rotate**" the phase curve and change the slope rather than simply raise or lower the curve. Experiment with one of the controls to get a feel for the effect.

7. Continue the method for sites 6 - 1, i.e., site being tested has transmit and voice control switches **ON**; all other sites have transmit and voice control switches **OFF**.

NOTE

The sequence in which sites are aligned is not critical; any convent sequence is acceptable.

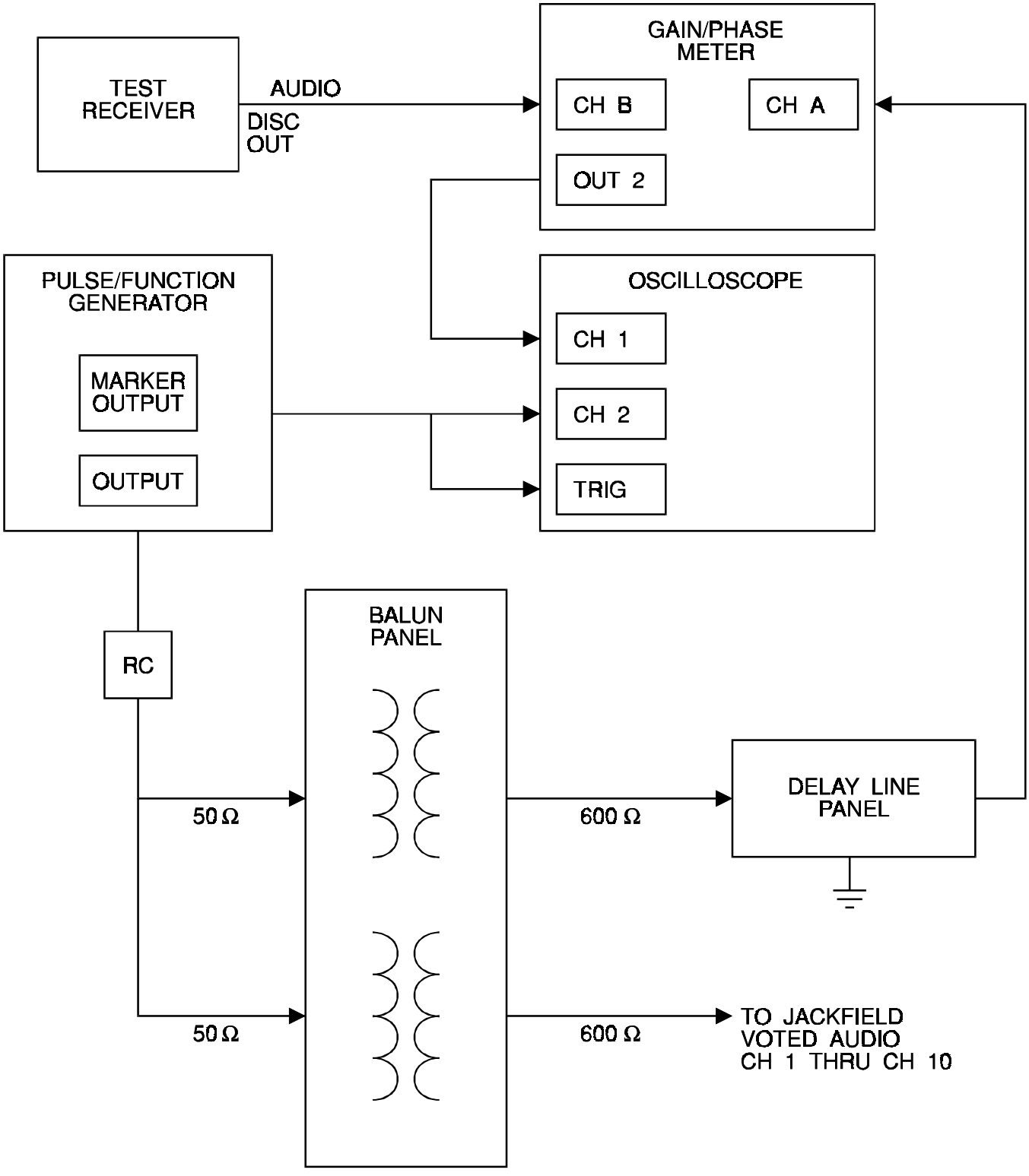

Figure 5 - Phase Equalization Alignment
(Amplitude and Phase Alignment is repeated for all channels.)

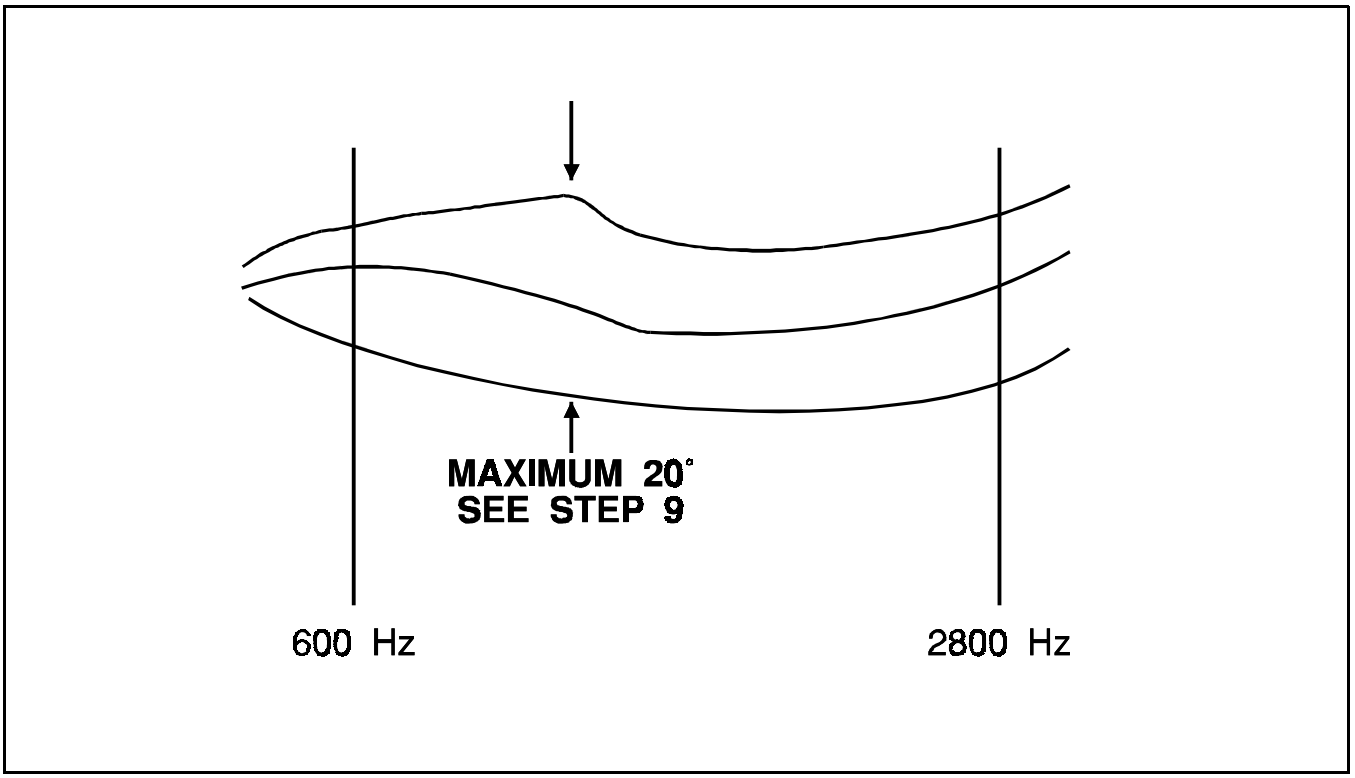

Figure 6 - Phase Equalization Alignment Waveforms

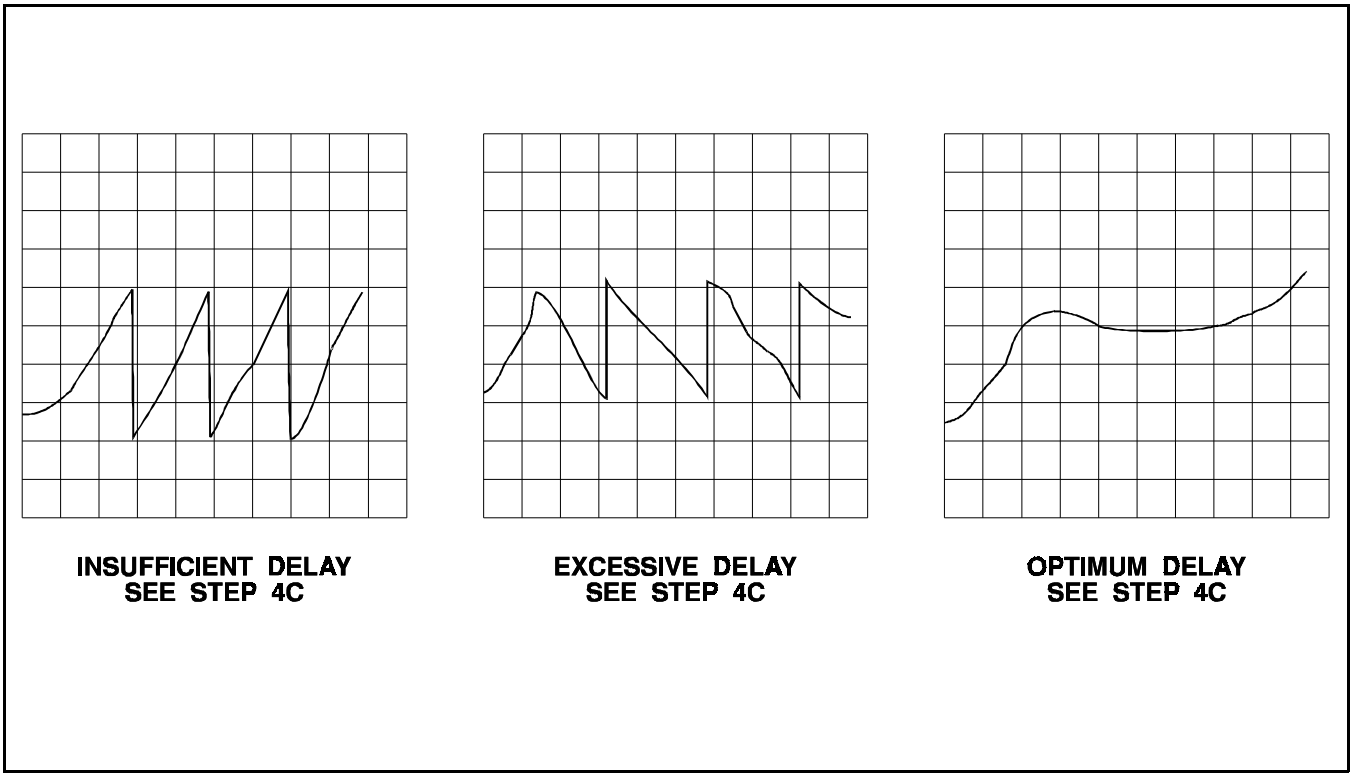

Figure 7 - Delay Waveforms

8. Sweep remaining sites and adjust corresponding phase delay pots on equalizer for the site and channel being tested to ±10 degrees over a frequency range of 600 Hz and 2800 Hz.

   It may be necessary for some sites to use a remote test receiver to receive a distant site. Use a previously adjusted site that is strong enough for the remote test receiver to use as a reference. Adjust delay line panel to obtain a similar pattern as originally displayed for the reference. Store this new reference signal from the remote test receiver.

9. Compare all waveforms from each test receiver. The waveforms should be within ±30 degrees or less.

ANALOG DELAY ADJUSTMENT

Perform the steps in the order presented. Refer to Figure 6 and Analog Delay Assembly Maintenance Manual LBI-38477.

1. Send a swept tone over a channel to all sites.

2. As was done in delay equalizing, route this signal through the test delay and adjust so that this matches the signal monitored from the farthest site (use dual trace on oscilloscopes.) This will become the "**farthest site**" time reference.

3. Adjust the Analog Delay for each site to match (in phase) this reference using the same procedure (If the **A/-A** Phase reference must be moved, the audio pairs polarity to this site must be reversed).

4. Offset these delays to compensate for the difference in location of the overlap region and the monitor receiver.

5. These differences can be included in the test delay, creating a differnt test delay for each site. This is preferable for future alignment checking and should be recorded.

COMPRESSION SETTING PROCEDURE

Compression will be set with 5 dB of gain when 10 dB below test tone (System Test Tone is typically -10 dBm).

1. Input a 1 kHz tone, 10 dB below test tone, into compressor being set (typically -20 dBm).

2. With **GAIN = NORMAL** and **COMP = OFF**, set gain to achieve 5 dB below test tone (typically -15 dBm) out of compressor.

3. Increase input of 1 kHz tone level to 5 dB above test tone (typically - 5 dBm).

4. With **GAIN = NORMAL** and **COMP = NORMAL**, set compression to achieve System Test Tone (typically -10 dBm).

5. Repeat for each channel compressor.

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Mountain View Road • Lynchburg, Virginia 24502

Printed in U.S.A.