AREA CODE 408
TELEPHONE 291-4915

CXR Problems or

F. A. JONES, JR. TRANSMISSION, CALIBRATION
SENIOR ENGINEER
TBL

CHIEF ENGINEER'S DEPARTMENT
TRANSMISSION ENGINEERING
PACIFIC TELEPHONE
111 NORTH MARKET STREET, ROOM 604
SAN JOSE, CALIFORNIA 95113

Private Line

TELEPHONE HANDBOOK

SLO-TOLL

AT&T Long Lines

AREA CODE 408
TELEPHONE 291-4817

CXR Problems or

J. M. BASSETT TRANS
ENGINEER
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CHIEF ENGINEER'S DEPARTMENT
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PRIVATE LINE TELEPHONE HANDBOOK

PLANT
TESTROOMS

OFFICE _____

BOOK NO. _____

ASSIGNED TO _____

JA # 9

PREFACE

This Private Line Telephone Handbook is issued by the Director-Staff Operations for use by plant testrooms.

The handbook is designed as a handy reference source for the private line telephone testboardman to aid in sectionalizing and clearing private line telephone troubles. This handbook includes helpful technical and operational information with BSP references. When a more thorough source is required refer to BSP reference.

Revisions will be issued as required, by the Director-Staff Operations, to all Areas. These would include new equipment items or types of central office configurations. Corrections or suggestions should be submitted to the Director-Staff Operation's, Room 2408, 32 Avenue of the Americas; New York, N.Y. 10013.

Space has been provided for inserting local procedures or instructions by the individual office this handbook.

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Types of Carrier Systems

1. BN . . . . . Cable
2. BX . . . . . Cable
3. C . . . . . Open wire
4. J . . . . . Open wire
5. K . . . . . Cable
6. L . . . . . Coax
7. KL . . . . . Cable and coax
8. R . . . . . Radio
9. LR . . . . . Coax and radio
10. N . . . . . Cable
11. O . . . . . Open wire
12. ON . . . . . Cable and open wire
13. T . . . . . Cable time division multiplex

METHOD FOR CALCULATING RETURN LOSS (ERL) & (SP)

The return loss at a given frequency is the measured transmission loss across the hybrid coil at that frequency less the fixed losses due to the characteristics of the coil itself.

First find out loss of the hybrid itself.

Method 1 – Measure from the receive leg to the line and then measure from the line to the transmit leg.

Method 2 – Short (or open) circuit on 2–wire line, the trans–hybrid loss would be the difference between the OSC level and the TMS receive level (usually 6.5 DB) unless there are transmit or receive pads in the hybrid circuit.

Example:

20.5 DB – Difference between OSC and TMS
–6.5 DB – Trans hybrid loss
14.0 DB – return loss

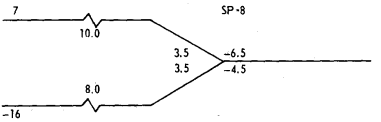
Formular for return loss.

$$R.L. - 20 \log \frac{ZN+ZL}{10}$$

$$R.L. - 20 \log \frac{ZN-ZL}{600+900}{600-900}$$

$$- 20\ 5-20 \times .7-14\ DB$$

HOW TO COMPUTE RETURN LOSS



The return loss at a given frequency is the measured transmission loss across the hybrid coil at that frequency less the fixed losses due to the characteristics of the coil itself.

Make sure the customer is giving a good off-hook (this is important)

1. Send tone back towards our sub at a +7 point.
2. Assume there is a direct short across the 2W side of the hyp.
3. If the tone level at 2W rec point is a −6.5, that tone will swing around on the Trans. side of the hyp. at a −6.5. The level coming back on the Trans. side will be 2 DB longer than the actual circuit level, and you will see a −18 dB at the −16 point. This is the zero balance level.
4. Add the singing point that is required (in this case it is 8) and you come up with a −2dB. This is the highest level that you should receive.

   (−26, −27, −28 GOOD!)
   (−25, −24, −23 BAD!)

ECHO RETURN LOSS AND SINGING POINT TEST

This test is made to determine echo return loss (ERL) and singing point (SP). When repairman is located near hybrid.

Step 1 – On 4–wire terminating set, connect a shorting cord across 2 wire terminals:
(on 173 types, 7 and 4 of "A" repeat coil)
(on 120 types, pins 1 and 4 of "A" repeat coil)
(on 1 type term sets pins 12 and 13)
(or insert shorting plug into 2–wire in jack).

Step 2 – Measure and record the db loss or SP.

Step 3 – Remove shorting cord from the 2–wire terminal or the shorting plug from the 2–wire in jack.

Step 4 – Measure and record the db loss or SP.

Step 5 – Subtract the db loss obtained in Step 2 from Step 4, this gives the actual SP in dB or the ERL directly in dB.

Echo return loss: echo return loss is a weighted average (on a power basis) of the return losses at all frequencies in the echo range (500 to 2500 HZ). This weighting may be accomplished automatically by networks in the testing equipment.

201B

Return loss — using 201A noise generator.

Test Equipment — 201A Noise Generator (201A NG) equipped with a 455B network and a 3A noise measurement set (3A NMS) with "C" message network.

Step A — Patch out of 201A NG to 4–W in jack. Patch in of 3A NMS to 4–W out jack.

Step B — On 3A NMS, set function switch to 600 OHMS and use "C" message network.

Step C — On 201A NG, with 455B network installed, adjust ADJ level knob for +15 on meter. Set output atten knob to 15 DB.

Step D — On 3A NMS measure dBrn reading.

Step E — Convert dBrn reading dB loss. dB loss 90= dBrn reading.

SINGING POINT—USING 2D SINGING POINT TEST SET

Test equipment – 2D singing point set
– 207G filter

Step A – Patch OUT of 2D to 4–wire IN. Patch IN of 2D to 4–wire OUT. Insert an operators TEL–SET in MON jack. Turn both dB dials to 0. Operate poling key to normal and filter key to in.

Step B – Slowly turn 50 dB dial clockwise until singing is heard in the TELSET Receiver. Turn dial back one step. Singing should stop. If not turn back a second step.

Step C – Slowly turn 10 dB dial clockwise until a sustained singing begins. If singing does not start before 6 is reached, turn 10 dB dial back to 1 and increase the 50 dB dial by 5 dB. Again in turn the 10 dB dial clockwise for a sustained singing.

Step D – Operate poling key to reversed and repeat Step B and C.

Step E – The smaller dB value (sum of 50 dB and 10 dB dials) obtained with poling normal or reversed is the measurement to be used.

Step F – Subtract the 4–wire loss of the hybrid from the measurement in Step E. This is the measurement to be used.

Example – The measured singing point is 26 dB
The 4–wire loss is 18 dB
The singing point measured is 8

BALANCE TESTS

A 4-wire carrier or cable facility reduced to a 2-wire loop or cable creates a return path for current power and therefore requires a balance between the two facilities. (A pure 4-wire circuit has no return path).

Prior to making the balance tests the facilities should be checked for irregularities, such as defective loading, net loss requirements, incorrect impedance compensation and repeater strapping; which may adversely affect terminal balance.

The purpose of balance tests is to adjust the network impedance so as to reduce the power returned to the originating end to a minimum by matching the office impedance to that of the loop and station.

Singing Point: A singing point is an expression of the degree of balance existing between a line and its balancing network. The higher this singing point is maintained, the higher the repeater gain can be operated and the lower the overall net loss of the trunk can be adjusted. A singing point is in effect a measure of the loss across a hybrid transformer (minus the actual transmission loss) due to the difference in impedance at various frequencies presented by the line and balancing circuits connected to this hybrid transformer. A singing point is established by increasing the gain of an amplifier, connected from the hybrid transformer output to input until the circuit just starts a sustained sing.

MESSAGE CIRCUIT NOISE

Message Circuit noise is any extraneous sound that interferes with voice or date transmission, usually 200 milliseconds or longer duration. It is caused by audio frequency voltages other than voice or data signals. Grounds, x–talk & inter-modulation, x–mod, unsoldered splices, open wire, or power induction can be some of the causes of noise.

The effects of noise can be annoying to the customer and in the case of data it can cause errors in transmission when the limits are exceeded.

The **3A Noise Measuring Set** is used to check the amount of steady state noise in a circuit. The 3A N.M.S. consists of an input circuit, attenuator, two amplifiers, calibration oscillator, freq. weighting nets, a detector and a meter. It can be used with externally connected meters or recorders and features two monitor jacks (AC & DC). FUNCTION switch: OFF: BAT (should read above red line); CAL (connects 1000 cycle osc and should adj. to red line with attenuator set on 85); NG (noise to gnd); BRDG; 600 ohm. DBRN attenuator 0–85 in 5dB steps. Normal–Damp switch is used for measuring gradual or rapidly varying noise. WTNG nets weights freq. in proportion to their interfering effects. Weightings are C-MSG (used on PL testing), 3 KC Flat. PGM, and 15 KC Flat. The 3A set reads directly in dBrn (dB above reference).

Noise requirements are found in table II of B.S.P. 314-410-500, Table 1 of B.S.P. 972-055-100 or in B.S.P. 310-300-500, Table II.

NOTE: Always keep set in OFF position when not in use because set is powered by an internal battery.

NOISE CONVERSION CHART

dBm	dBrn	dBa
0	+90	+85
–10	+80	+75
–20	+70	+65
–30	+60	+55
–40	+50	+45
–50	+40	+35
–60	+30	+25
–70	+20	+15
–80	+10	+ 5
–90	0	0

MESSAGE CIRCUIT NOISE

Use 3A Noise Measuring set with C message weighting measured at 600 OHM input.

NOTE: Limits are in reference to 0 TPL (corrected to "0" test point).

TWO POINT TELEPHONE CIRCUITS BSP 310–300–500

Circuits Length (Miles)	Noise Measurement Not exceeding (dBrnCO)
0– 15	27
15– 50	30
50– 100	33
100– 200	36
200– 400	38
400–1000	40
1000–1500	42
1500–2500	43
2500–4000	45

NOTE: When a circuit is made up of conpandored facilities, a combination of compandored facilities or two or more compandored facilities in tandem, the above limits are lowered 5db. If a normally compandored system is used in the noncompandored mode, the limit becomes 50 dnrnc0 overall.

MULTI STATION TELEPHONE CIRCUITS BSP 310–405–500

Circuits Length* Miles	Noise measurement Not exceeding (dBrnCO)
0– 249	31
250– 299	34
300– 399	35
400– 499	36
500– 599	37
600– 799	38
800– 999	39
1000–1249	40
1250–1599	41
1600–1999	42
2000–2499	43
2500–3199	44
3200–3999	45
4000–over	46

*Total length of all circuits or legs contributing noise at point of measurement. **EXCLUDES DATA CIRCUITS**

IMPULSE NOISE

Impulse noise can be defined as random bursts of noise at short durations, usually a few milliseconds or less in duration. It has a negligible effect on voice transmission but on data it can cause errors depending on the magnitude and frequency of occurrence. Some causes of impulse noise are slow switching, sparking of contacts, ignition, pulling down patches (break before make), capacitor discharge, static charges, radar and loose connections.

6A IMPULSE NOISE COUNTER: Consists of an input filter section, attenuator section, amplifier, phase inverter rectifier, trigger ckt, counter ckt, and a timer. The timer can be set up to an hour or for indefinite period. It has 90dB of attenuation in 3dB steps.

Calibration of the 6A:

(a) Set switch S1 to either the "voice-band" or "Flat" position.
(b) Set REF LEV DBRN switches to indicate 90dBrn input leve (S2 to 'add 30', S3 to '60').
(c) Connect a quiet standard 1000 Hertz, 600 ohm, 1—milliwatt source to the input terminals of the 6A counter.
(d) Turn CAL control MAX clockwise.
(e) Turn CAL control counterclockwise until the counter just starts to operate.
CAUTION: Continued rotation of the CAL control in the counterclockwise direction will cause the counter to stop counting. This is not a point of calibration and must not be confused with that discussed in step (F).
(f) Turn the CAL control clockwise until the counter just stops.
(g) Set the REF LEV dBrn switches to 87. The counter should start to record. Reset to 90. The counter should stop counting.
(h) Set the REF LEV dBrn switches successively to 87, 84, 81 and 78. There should be no appreciable change in the counting rate.

WARNING: Never leave CAL control in full counterclockwise position. This will deplete battery supply. BSP 103-620-100 (Par. 2.08).

When a 6-type impulse counter is used the circuit or facility should never register more than 15 counts in 15 minutes. The impulse noise objective for 2 point voiceband data channels overall is measured at a threshold of 72 dBrn0 VB. For other section or facility thresholds refer to table IV and V BSP 314-410-500.

dB . . . . . RATIO BETWEEN TWO POWERS
MEASUREMENT OF LOSS OR GAIN

dBm . . . . . POWER LEVEL REFERRED TO IMW
OR ODBM

+dBm = POWER GREATER
THAN 1MW

–dBm = POWER LESS THAN
1MW

dBrn . . . . . dB ABOVE REFERENCE NOISE
(ABOVE – 90 dBm OF SINE WAVE
POWER) USING 3A NOISE MEASURING SET.

dBa . . . . . dB ABOVE REFERENCE NOISE
FIA WTG (ABOVE –85 aBrn OF
SINE WAVE POWER)

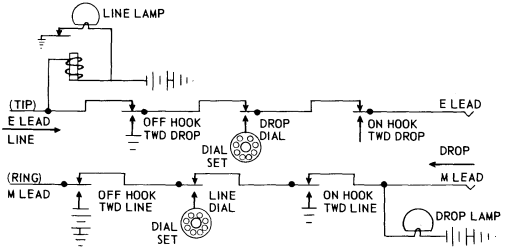
1 MW INTO 600 OHMS = 1.29 MA = .775V

CAPACITOR – CURRENT LEADS THE VOLTAGE
CURRENT INCREASES WITH
FREQUENCY.

INDUCTOR ––IMPEDANCE INCREASES WITH
FREQUENCY.

$E = IR \qquad R = \frac{E}{I} \qquad I = \frac{E}{R}$

$P = EI = I^2R = \frac{E^2}{R}$



BASIC SUPERVISION FEATURES OF 1A OR 2B
2B–1* TEST SET

E & M leads are used as a means of transferring signaling information from line equipment (such as an SF unit) to drop equipment (D1B, DOB, DX, and many others) and vice versa.

The E lead or the tip or the pair is always controlled by the line equipment and is either an open (idle condition) or a ground (busy condition).

The M lead or the ring of the pair is always controlled by the drop equipment and is either a ground (idle condition or battery (busy condition).

The 1A or 2B test set may be used as a means of monitoring the E & M leads with lamps used as visual aids. The LINE LAMP is associated with the E lead (tip). When an open is received from the line equipment, the lamp will be lit & is commonly referred to as an on hook or idle condition from the line. When the E lead is grounded, the lamp goes out & is referred to as off hook or seized condition.

The DROP LAMP or the lamp controlled by the M lead (ring) will be lit, again the idle or on hook condition, if there is a ground received from the drop equipment. In the seized or off hook condition there will be battery on the M lead (ring) and the lamp will be dark.

*2B Modified to 2B–1 Per Pem 9460 (Aug. 1965)

Always make sure that the switches on the test set are in a neutral position before monitoring a ckt. With the test set in the ckt you have full control of the signaling by throwing the switches.

TWD DROP SWITCH:

ON HOOK will furnish an open tip or E lead toward the drop regardless of the condition received from the line equip.

OFF HOOK will provide a ground on the tip or E lead.

TWD LINE SWITCH:

ON HOOK will furnish a ground on the M lead (ring) to the line equipment.

OFF HOOK will furnish battery on the M lead to the line equipment.

DIAL SWITCH:

DROP enables you to dial towards the drop. As the dial is released, a series of grounds & opens on the E lead to the drop pulse out the number.

LINE enables you to dial towards the line with a series of battery and grounds on the M lead toward the line equipment.

PULSE REPEATING

Adapter for 2B/2B1 signaling test set. Converts the pulses generated by the 2B–1 signaling test set to a form suitable for application at a loop testing point.

NOTE: The 2B signaling test set is not suitable for this purpose. Pulses received from the circuit being tested are also converted in the adapter and applied to a 2B or 2B–1 set for measuring percent break from the loop. (Reference 333–122–501).

2B SET – PULSING PROCEDURE & LIMITS

1. Plug –48 volt and the –24v, +130v cord (A & B) into battery supply on test board.

2. With dummy plug in P jack of 2B set PERCENT BREAK meter should read 0 on the red scale or 100 on the black scale. If not, adjust CAL % BK knob. Remove the plug.

3. SCALE SEL knob to PPS.

4. Adjust the ADJ PPS knob so that PULSES PER SECOND meter reads required pulses for test (on bottom scale.).

5. Adjust the ADJ % BK knob so that PERCENT BREAK meter reads required percent for test on black scale.

6. Patch from (TST 2) 'L' jack to E & M jacks of circuit under test.

TO SEND PULSES

1. TWD L key to OFF HOOK.
2. CONT PLS key to line (Percent BK meter should read 0 in black or 100 in red when key is thrown).

TO RECEIVE PULSES

1. TWD D key to ON HOOK.
2. MEAS % BK key to LINE or DROP.
3. Read RED scale for receiving pulses from line.

Procedure for testing toward the drop is the same except that the receive pulses are measured on the BLACK scale. Overall SIG ARGT and testing 333-122-501, FX & WATS 333-125-500, Dial Tie Lines 333-126-500, carrier (See BSP section for CXR) "N" "ON" "O" "T".

26B PULSING TEST SET

1. Set TEST–SEND key to "Send–Osc" position.
2. Set PULSES PER SEC switch to desired speed of pulses.
3. Set FUNCTION switch to "Cal Meter" position.
4. Adjust METER CAL control to set the meter pointer at 0 on the % Break meter scale.
5. Turn the Function Switch to the "Adj % Break" position.
6. Adjust the ADJ % Break control for the desired % break as indicated on the meter.
7. Turn the FUNCTION switch to "Send and Rec".

The tests listed below are the most common tests to be made with the 26B Sig. Test Set. For information on other tests, refer to instruction manual kept in test set cord compartment. On all tests below, the FUNCTION switch is in the "Send and Rec" position and the RECEIVE switch is in the "Send and Rec" (extreme right) position.

TEST	SEND SWITCH	JACK USED	METER CKT SW	TEST–SEND KEY	TWD–L KEY	TWD–D KEY
Monitor Working Circuit	Line (E=G&O M=B&G)	Line and Drop	% Break Direct	Test L&D	Thru&Meas	Thru&Meas
Send & Rec Twd Line	Line (E=G&O M=B&G)	Line and Drop	% Break Direct	Note 1	Thru&Meas	On Hook
Send & Rec Twd Drop	Drop (E=G&O M=B&G)	Line and Drop	% Break Direct	Note 1	On Hook	Thru&Meas
Send & Rec Loop (Open & Close Signals)	Snd Loop, Rec Loop	Rec to Rec Lp Trsg-send 1 or 2	% Break Thru Meter Rly	Note 1	Thru&Meas	Thru&Meas
Send & REc Loop (Trsg-Open & Close Rec-Bat & Gnd)	Snd Loop, Rec B&G	Rec to Rec B&G Trsg-Send 1 or 2	% Break Thru Meter Rly	Note 1	Thru&Meas	Thru&Meas

NOTE 1: To receive pulses put TEST-SEND key in "Send Dial" position, have distant end put "Off-Hook" toward line and adjust % Break Meter to 0 with CAL METER control. Leave TEST-SEND key in same position and read pulses. To TRANSIT pulses put TEST-SEND key in "Send Osc" position, and put FUNCTION switch to Send and Rec". You are now transmitting pulses.

TO MEASURE SPEED OF PULSES OR DIAL: Use same switch settings and jacks as above except METER CKT SW IS put on 0–25 PPS position. Read pulse speed on PPS scale. To check speed of dial, use same procedure and have a 0 dialed to obtain most accurate reading.

600/1500 SELECTIVE SIGNALING
(TWO TONE) BSP REF:
310-430-100
310-430-500

Consists Of . . . . .

1. Sending Unit SD61968-01
2. Receiving Unit . . . SD69168-01
3. Power Supply 110V 60CPS

Sending Unit . . . Generates 600 and 1500 CPS tones required for signaling and applies them alternately to the transmitting loop of the Private Line.

Receiving Unit . . Detects the 600 and 1500 CPS tones from the distant end and converts them into DC pulses which operates the 60 type selectors.

When dispatching a repairman to work on trouble in the receiving unit, have him take a DC milliammeter and make tests per (310-430-501 . . 4.58)

A two-tone arrangement is provided at the testboard. To use on a ckt throw "PL–LOC–OW" key to "PL" position and dial proper code, then release key.

Two Tone level should be (+–) 2 DB of voice.

Frequency Tolerances:

600 CPS (+–) 4 CPS
1500 CPS (+–)10 CPS

Adj Freq. per BSP: 310–430–501
Sect: 4.48

BSP 310-430-500 covers maintenance and trouble location tests for Central Office.

SS1 SELECTIVE SIGNALING CIRCUITS

The following covers general information and lineup procedure for SS1 Private Line Circuits.

Summary of Principal Features:

(A) SS1 signaling tones (2400-2600 cycles) are sent and received at a plurality of stations on a multipoint 4-wire private line circuit. No tone on the line in the idle condition.

(B) The system capacity is 81 two digit codes.

The basic decoder equipment is designed to decode nine codes in any one of nine tens digits (22, 23, 24, etc.) or four codes in each of two tens digits (22-25, 32-35). Additional tens digit relays may be supplied as needed on another unit to decode up to the full 81 codes.

To obtain reliable dialing, the SF receivers are shifted into the dialing or low guard condition upon receipt of the first pulse of 2600 cycles. This is accomplished by making the first pulse at least 100 milliseconds long to insure that it will operate the SF unit.

(C) Codes may be dialed in succession to establish conference calls.

(D) Master codes signal a number of points simultaneously. These points can also respond to individual codes.

(E) A privacy feature may be provided whereby all other points on a multipoint circuit are cut off from the line and a steady 2600 busy tone is fed to each station. When any code is dialed, all other stations are automatically cut off from the line. When the calling party disconnects, a spurt of 2600 tone (1 sec) is applied to the line automatically to restore all stations to the line.

(F) To prevent code mutilation, voice paths of all stations and signaling paths of all stations except the one sending are locked out and 2600 cycle busy tone is provide during the dialing interval.

(G) A 6 second time out restores the system to normal if only one digit is dialed. Dialing a digit 'one' causes immediate restoral.

(H) Provision is made for dialing into another SS1 system. This is accomplished by dialing a code to set up a transmission path to the other system. At the end of the conversation, a code is dialed to release the connection.

Signals 8db below voice level.
2400 hz is guard band.
2600 hz is intelligence band.

(I) The system will signal reliably in the presence of return looses as low as 10db.

Information on SF units.

As of June, 1962, the standard SF for use in the SS1 system is a E1B unit. This unit is stenciled J98613 List 1. E2B SF unit modified for SS1 per SD 98123–01 is rated MFG DISC. (P.I.B. 74).

If neither of the above units are available, the following units can be used with modification.

1. E1B per J9861D-1 List 2 (SD98085) modified by strapping punchings '3' and '6' on the printed circuit board.

2. E2B per SD98090-01 (rated MFG DISC) modified by strapping punchings '3' and '6' on the printed circuit board and opening the winding of 'HL' relay by disconnecting R106 (1100 OHMS) resistance from contact '12' of 'M' relay.

3. E3B per SD98124-01 modified by strapping '6' and '10' on printed circuit board.

SS1 Line-up Procedure

SS1 equipment at customer location should be retested per BSP 310-425-501 or the plant school practice.
Note: Tests per 310-425-501 are partially covered per section 5 of CD98093-01.

1. Measure cable pairs at 1000 and 2600 cycles.
   Reqd. 1000 cycle-loss on COLR + 2db (310-405-500)
   2600 cycle-1000 cycle loss + 1.0db

BSP 310-425-500 Paragraph 4.01 requires the measured loss of the cable pairs at 1000 and 2600 cycles to be within + 1db of value shown on the circuit order card or sketch. This value is unrealistic and cannot be met. The SF unit receiver sensitivity as adjusted per BSP A204.597 allows an operating margin of 15db. Even if the receive pair is 8db longer at 2600 as compared with 1000 cycles, this still leaves a 7db operating range.

2. Measure 2600 and 2400 cycle tone from customer.

Transmission man blocks ON1 relay operated to apply steady 2600 cycle tone to line. The addition of a open plug to the PB jack changes frequency to 2400 cycles.

Requirements = 2600 + 4 cycles –8db below circuit level. (ADJUST P1 POT) (A204.597) 2400 + 30 cycles –8 (+2db) below circuit level.

If level requirements are not met, proceed as follows:

A. Have man at customer connect transmission measuring set to OSC TST jack.
B. Turn LEV ADJ pontentiometer fully clockwise TMS reads +2dbm.
C. If requirement of step 'B' is not met:

   Unlock P1 potentiometer and adjust until TMS reads +2dbm. Lock P1 potentiometer.

D. Remove TSM from OSC TST jack.
E. Adjust LEV ADJ potentiometer for level of –8db below circuit level at 2600 cycles when measuring tone from customer at central office.

If frequency requirements are not met, proceed as follows:

To adjust frequency to 2600 + 4 cycles, man at customer straps capacitors C3 through C7 on Keyer circuit in or out of circuit.

Capacitor	Freq. Change In CPS
C3	−2
C4	−4
C5	−8
C6	−16
C7	−32

3. Setup of receive AMP & S.F. unit at 1000 cycles.

   A. Send 1000 cycles at proper level on receive pair.

   B. Remove SF UNIT from socket at customer location.

   C. Connect TMS set to terminals 12 & 41 of TS 'A' on Decoder Unit and adjust amplifier gains to read +7.0db.

   D. Disconnect TMS and install SF unit.

   E. Install correct 1C pad.

   F. Connect TMS to terminals 23 and 33 of TS 'A' on Decoder Unit.

   G. Adjust SF unit 'Rec' potentiometer to read +3.5 bridge level.

   H. Remove TMS from terminals.

4. SF Sensitivity Test

   A. Send 2600 cycles toward the customer at −27 below circuit level.

   B. Have transmission man insert 258C dummy plug in 'M' jack 'M' relay releases in SF unit. RG relay will operate if it was not operated.

   C. If 'RC' relay fails to operate, have man adjust 'SS' potentiometer on side of SF board until RG relay just operates.
   DO NOT TOUCH OR & RT POTENTIOMETERS!!!!!!!

   If above requirement can not be met, replace SF unit.

D. Remove 2600 cycles tone from circuit and dummy plug from 'M' jack. 'RG' relays release and 'M' relay operates.

5. Make transmission measurements to each station per BSP 310-405-500.

6. Operation Tests.

A. Loop back SS1 test circuit in PLBD through 15db test pad. Dial digits 2 through 0. Lamps on SS1 test panel should register same. Clear lamps by pressing restore button. This test clears checks that SS1 test circuit is working properly.

B. Patch SS1 test circuit to FP circuit to be tested. This test circuit is set up to transmit at a +7 (−1 SF TONE) level and receive at a −8db level. These levels can be reversed to a −8 transmit and a +7 receive by patching through 15db test pads in misc. strip in PL BD.

C. −1 Have telephone man at customer dial digits 2 through 0. From each station, lamps on SS1 test panels should register same.

C. −2 If privacy is provided, have men at customer dial two digit code and verify that spurt of 2600 cycle SF tone is sent out on line when he disconnects.

D. −1 At central office, dial from SS1 test circuit all codes for each station and verify with man at customer that incoming signal is received.

Dial digit 2 and have man at customer verify that 2600 cycle busy tone times out after 6 seconds. Dial code 21 and have man at customer verify that no 2600 cycle busy tone is on circuit.

D. −2 If privacy feature is provided, dial a wrong two digit code for each station and have telephone man verify that he is receiving 2600 busy tone at each station. To clear busy tone, depress clearing tone button on SS1 test panel for one-second.

Verify that upon completion of an incoming call no spurt of 2600 cycle is transmitted on line.

REFERENCES

CD 98093-01
CD 98124-01
982-325-100

NOTES ON TROUBLE REPORTS–

On troubles of one station having trouble dialing only one other station, raise or lower dialing level to check if trouble locates in called station if calling station levels are OK.

High level will cause chronic wrong numbers. Also, frequency out of limits or varying will cause problems in dialing.

Very low level will also cause problems in dialing.

A station "locked–up", unable to dial due to no disconnect tone from previous call or by failure to receive unlock tone on privacy arrangement, may be released with SSI test or a short period (6sec) of 2600 hz tone toward the station with trouble.

SF – SINGLE FREQUENCY

Types of SF Units

	Trans	REC.
X, Y*, B, E	2600 hz	2600 hz
X1	2600 hz	2400 hz
Xh	2400 hz	2600 hz
W, V, WM, VM, VMA	1600 hz	1600 hz
VLM, WLM, WL, VL	2000 hz	1600 hz
VHM, WH, VH	1600 hz	2000 hz

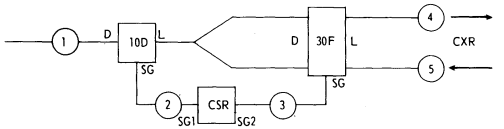
*Y type SF is modified WM to work 2600 hz

SF level is 20db below voice level in idle transmit condition. (–36db @ –16 point).

SF level is approx. 8db below voice level when pulsing out on line. (–24db @ –16 point).

	Tip E	Ring M	Rec	X–mit
Idle	open	gnd	SF	SF
Incoming Seizure	gnd	gnd	No SF	SF
Outgoing Seizure	open	gnd	SF	No SF

30F – 10D – CSR



BASIC RINGDOWN

	SG	LOOP OR DROP
Idle or Busy	GND	Nothing
Incoming Ring	–24V	20hz
Outgoing Ring	–24V	20hz

10D RINGER

Converts 20 cycles to DC and vice versa (1) 20 cycles from loop get –24 volt on SG (2) –24 volt on SG (2) get 20 cycles from 10D (1)

NOTE: Output of 10D is 105 volt AC (20 cycles associated with 420 cycle audible tone). It requires a minimum of 15 volt AC to operate.

CODE SELECTOR RINGER (CSR)

Used to select or count from 1 to 10 depending on what it is wired for. –24v DC to the SG2 lead (3) is actually counted and will pass –24v to SG1 (2) for a one second duration only if proper code is received. Process takes about two seconds.

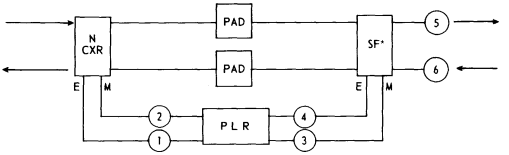
–24 volt DC SG1 (2) will be passed without interference to SG2 (3) (No codes necessary)

30F RINGER

Converts DC to 1000 cycle and ring and vice versa. –24 volt DC on SG lead (3) will cause 30F to transmit a 1000 cycle tone modulated by 20 cycles to be passed onto line facilities (4) (ring is –6DB from normal transmission). A 1000 cycle ring receive (5) will cause 30F to put out –24v DC on SG lead (3) Ring receive is also –6DB from normal transmission level.

	SG	REC LINE	XMIT LINE
Idle or Busy	GND	Nothing	Nothing
Incoming Ring	–24V	1000/20hz	Nothing
Outgoing Ring	–24V	Nothing	1000/20hz

PLR



* MAY BE "E–B" OR "F" TYPE SF UNIT.

PULSE LINK REPEATER

Used to interconnect E & M signaling between line facility signaling units. In example shown is N cxr signaling interconnected to SF signaling via E & M leads.

INCOMING SEIZURE FROM N CXR

Receive ground on E Lead (1) from N cxr (line lamp dark when signaling test set is inserted between PLR and N cxr).

PLR converts the E lead gnd from the N cxr to M lead (3) battery (drop lamp dark when monitoring between PLR and SF).

SF tone is then cut transmitting (5).

INCOMING SEIZURE FROM CXR (SF SIDE)

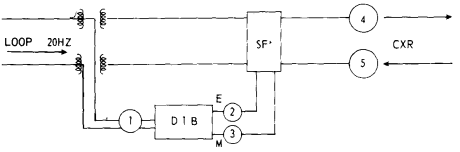
No SF tone receiving (6).

E lead (4) ground from SF unit (line lamp dark).

M lead (2) changes from ground to battery from PLR (drop dark when monitored between N chan & PLR).

In idle condition E lead open (1) or (4) get M lead ground from PLR (3) or (2).

D1B & DOB



* May be "E–B" or "F" Type SF Unit

DIB is used for 20 cycle ringdown.

NORMAL CONDITION LINE ● DROP ●

No SF tone transmitting (4) receiving (5) ground from SF on E lead (2) and (Line lamp dark). Battery from DIB on M lead (3) and drop lamp dark.

OUTGOING RING LINE ● DROP ○

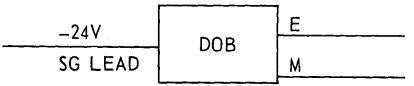
20 cycles AC from loop (1) (requires 15V AC min) M lead (3) changes from bat to gnd from DIB and drop lamp lit SF tone's now transmitting (4)
E lead (2) & receive from cxr unchanged (5) (no SF)
When 20 cycles is removed from loop see idle condition

INCOMING RING LINE ○ DROP ●

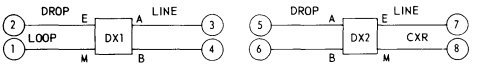
SF tone receiving (5)
E lead (2) changes from gnd to open from SF (line lamp lit)
20 cycles is applied by the DIB to the loop (1)
(output of DIB is 20 cycles at 105V AC)

DOB

The DOB operates in the same manner as the DIB with the exception that the DOB uses – 24V DC on the SG (1) in place of 20 cycles AC during the ringing cycle.



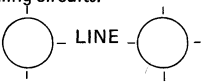
DX 1 & DX 2



DX1

Is used as a signal lead extension circuit for extending 'E' & 'M' leads from TRUNK CIRCUITS to signaling circuits.

IDLE CONDITION

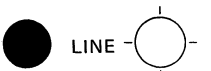


'A' lead (3) ground both ways.
'B' lead (4) –20 Volt DC both ways (never changes, used as a balance).
'E' lead (2) open from DX1.
Grounded 'M' lead (1) or on hook from drop into DX1.

BUSY CONDITION

'A' lead (3) –48Volt DC both ways.
'B' lead (4) –20Volt DC both ways (never changes; it is used as a balance.
'E' lead (2) ground from DX1.
–48 Volt batt on 'M' lead (1) or off hook from drop to DX1.

OUTGOING SEIZURE



–48 Volt batt on 'M' lead or off hook from drop to DX1.
'A' lead (3) changes to –48 Volt DC from the DX1 (ground from cable).

INCOMING SEIZURE

'A' lead (3) –48 Volt from simplex (from DX1 is a ground).
'E' lead (2) changes from open to a ground.

DX2

Designed to extend range of DC signal arrangements between a signal circuit and a trunk circuit when the distance is so great to connect them directly through 'E' & 'M' leads.

IDLE CONDITION LINE  DROP 

'A' lead (5) ground both directions
'B' lead (6) –20 Volt DC both directions (never changes; used as a balance)
'E' lead (7) open from SF (line lamp lit)
'M' lead (6) grounded from DX2 (drop lamp lit)

DX2 – Signals the same as SS1 procedure but watch the type of SF, if other than 2600hz use a 2B set to dial out.

BUSY CONDITION LINE  DROP 

'A' lead (5) –48 Volt DC both ways
'B' lead (6) –20 Volt DC both ways (never changes; used as a balance)
'E' lead (7) grounded from SF (line lamp dark)
'M' lead (8) –48 Volt DC from DX2 (drop lamp dark)

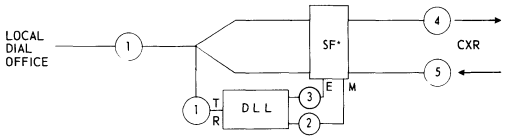
INCOMING SEIZURE LINE  DROP 

'E' lead (7) grounded from SF (line lamp dark)
'A' lead (5) –48 Volt DC from DX2 and ground from simplex

OUTGOING SEIZURE LINE  DROP 

–48 Volt from simplex on A lead (5); from DX2 remains grounded
'M' lead (8) changes from ground to –48 Volt DC

DLL SD96251 ("J" OPTION) Used on exchange end of circuit



* May be "E–B" or "F" type SF Unit.

IDLE CONDITION LINE – ◯ – DROP ●

There is SF receiving from the CXR (5).

(3) the 'E' will be open from the SF (line lamp lit).
(1) Between the 'T' & 'R' leads from the DLL there is an open.
(1) From the local dial office there is battery on the ring and ground on the tip.
(2) The 'M' lead will have battery from the DLL (drop lamp dark).
(4) No SF tone leaving on the carrier.

BUSY CONDITION LINE ● DROP ●

(5) No SF tone receiving from the carrier.
(3) The 'E' lead will have a ground from the SF (line lamp dark).
(1) The 'T' & 'R' lead from the DLL will be shorted.
(2) The 'M' lead will have batt from the DLL (drop lamp dark).
(4) No SF tone leaving on the carrier.

RINGING LINE – ◯ – DROP – ◯ –

(1) 20 cycles ringing current from the local dial office.
(2) The 'M' lead will follow the 20 cycles with a ground from the DLL (drop lamp lit).
(4) SF tone will leave on the carrier.

Ringing will stop when SF's cut receiving (see busy condition).

INCOMING CALLS

Spurts of SF tone following the digits dialed will be received from the carrier (5).

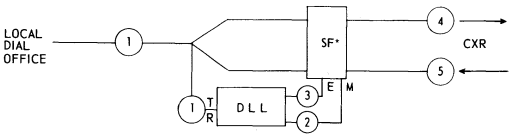
(3) The 'E' lead will follow the SF with opens (SF receiving) and grounds (no SF received).

(1) The 'TR' lead will follow the incoming pulse with opens (SF received) and shorts (no SF received) and will transmit dialing information to the local dial office.

NOTE: Above is one of various applications of a DLL used with a 2 wire circuit. The DLL can also be used in the voice path of a 2 wire circuit.* In a 4 wire circuit the 'TR' leads of the DLL may be simplexed across the transmit and receive pairs of a four wire circuit, or it may be located in the receive voice path of the loop. Also the line facilities may vary (different types of cxr or even cable pairs may be used), thus eliminating the use of the SF. However, the basic operation of the 'E' & 'M' leads and the 'TR' lead will remain the same. For wiring option refer to 'SD' drawing.

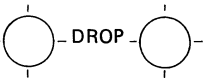
* When DLL is used in 2W path, incoming SF must be cut or an off hook thrown toward drop in order to pass tone through the DLL.

DLL SD96251 ("K" OPTION)



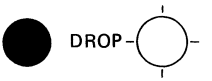
* May be "E–B" or "F" Type SF Unit

IDLE CONDITION



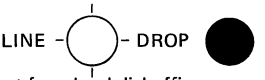
SF receiving from the carrier (5)
(3) The 'E' lead will be open from the SF (line lamp lit)
(1) The TR lead will be open
(1) From the local dial office there is ring batt and tip ground
(2) The 'M' lead will be grounded from the DLL (drop lamp lit)
(4) SF transmitting

BUSY CONDITION



No SF receiving (5)
(3) 'E' lead ground from SF (line lamp dark)
(1) TR lead shorted from DLL
(2) 'M' lead ground from DLL (drop lamp lit)
(4) SF tone transmitting

RINGING



(1) 20 cycle ringing current from local dial office
(2) 'M' lead will follow the 20 cycle ring with the batt from the DLL (drop lamp lit)
(4) SF tone will be cut trans during 20 cycle ring
Ringing will stop when incoming SF is cut receiving (see busy condition)

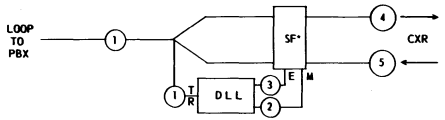
INCOMING CALLS

(5) No SF received (see busy condition)
As digits are dialed at far end (5) spurts of SF are received
(3) 'E' lead changes from grounds (no SF) to opens (SF received)

(1) TR lead follows 'E' lead grounds with shorts which in turn transmit dialing information

NOTE: DLL is used in 2W side of loop **there must be an incoming seizure** in order **to pass tone** through DLL. For wiring option refer to "SD" drawing.

DLL SD96252 or DLL03 Used on customer end of circuit.



*May be "E–B" or "F" Type SF Unit.

IDLE CONDITION LINE ● DROP –○–

(1) Looking toward PBX should see open between tip and ring of loop.
(2) Ground on 'M' lead from DLL (drop lamp lit)
(3) Ground on 'E' lead from SF (line lamp dark)
(4) SF tone transmitting
(5) No SF tone receiving

BUSY CONDITION LINE ● DROP ●

(1) Tip and ring short from customer on loop
(2) Batt on 'M' lead from DLL (drop lamp dark)
(3) Ground on 'E' lead from SF (line lamp dark)
(4) No SF tone transmitting
(5) No SF tone receiving

RINGING LINE –○– DROP –○–

(5) Spurts of SF incoming
(3) 'E' changes from grounds to opens with incoming SF tone (line lamp dark to lit)
(1) Spurts of 20 cycle from 'T' & 'R' of DLL going out on loop (when (3) 'E' lead open)
Ringing stops when customer answers call by a short being applied across 'T' & 'R' of loop (1) and circuit will be in busy condition.

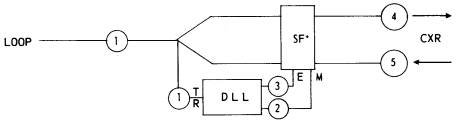
OUTGOING CALL FROM PBX

Customer seizes circuit (see busy condition)

(1) Tip and ring of loop will change shorts to opens as she dials number (circuit varies from idle to busy condition with the pulses).

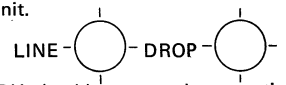
NOTE: Above is one of various applications of DLL used with 2 wire circuit. The DLL can also be used in voice path of a 2 wire or the 'T' & 'R' leads can be simplexed across a 4 wire loop. Also, the line facilities will vary (different types of carriers can be used) thus eliminating the use of SF units. However, the basic operation of the 'E' & 'M' leads (2) & (3) and the TR leads (1) will remain the same. For wiring option refer to "SD" drawing.

DLL SD96252 (H) OPTION



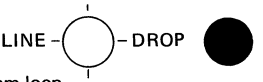
* May be "E–B" or "F" SF Unit.

IDLE CONDITION



(1) Looking toward PBX should see open between tip and ring of loop.
(2) Ground on 'M' lead from DLL (drop lamp lit).
(3) Open 'E' lead from SF (line lamp lit).
(4) SF tone transmitting.
(5) SF tone receiving.

BUSY CONDITION



(1) Tip and ring short from loop.
(2) Batt on 'M' lead from DLL (drop lamp dark).
(3) Open 'E' lead from SF (line lamp lit).
(4) No SF tone transmitting.
(5) SF tone receiving.

RINGING

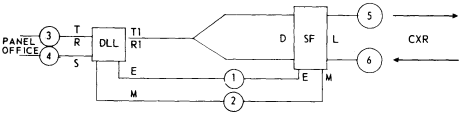
(5) Alternately changing from SF tone receiving to no SF tone receiving.
(3) 'E' lead changes from open to grounds (line lamp lit to dark), with changing condition of SF receive to no SF receive.
(1) 20 cycles will be applied to the loop from the DLL when the 'E' lead is grounded (line lamp dark) and 20 cycles will cease when 'E' lead is open (line lamp lit). When sub answers call (see busy condition), ringing will be tripped at far end and call will be completed.

OUTGOING CALL FROM PBX

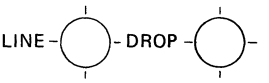
Customer seizes circuit (see busy condition) (1) Tip and ring of loop will change from shorts to opens as number is dialed. (Circuit will vary from busy to idle condition with the pulses.)

NOTE: Above is one of various applications of a DLL used with a 2 wire circuit. The DLL can also be used in the voice path of a 2 wire circuit. In a 4 wire circuit the 'T' & 'R' leads may be simplexed across a 4 wire loop or may be inserted in the received voice path of the loop. Also, the line facilities may vary (different types of carriers can be used), thus eliminating the use of the SF unit. However, the basic operation of the 'E' & 'M' leads (2) & (3) and the TR leads (1) will remain the same. For wiring option refer to "SD" drawing.

DLL 16 or ES65602 PANEL OFC



IDLE CONDITION



SF both ways (6) & (5)
E lead (1) open from SF (line lamp lit)
M lead (2) ground from ES (drop lamp lit)
TR (3) open from ES
Tip ground & ring batt from Panel ofc (3)
/Fig C/S lead (4) ground both ways
/Fig D/D lead (4) –48V batt both ways

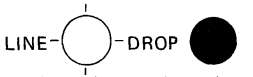
BUSY CONDITION

No SF transmitting (5) or receiving (6)
E lead (1) ground from SF (line lamp dark)
M lead (2) battery from ES (drop lamp dark)
TR (3) resistance short from ES
Tip ground & ring batt from Panel ofc (3)
/Fig C/S lead (4) –48V from Panel ofc and gnd from ES
/Fig D/S lead (4) from Panel ofc and –48V batt from ES

INCOMING CALLS

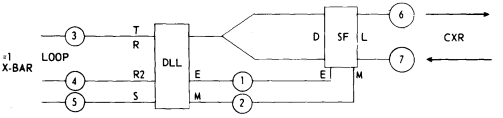
SF tone is cut receiving and E lead becomes ground from SF (line lamp goes dark). ES equipment puts a short across TR (3) two panel ofc and we get a ground/Fig D/ or Batt/Fig C/ on the S lead (4) from the Panel ofc. The ES recognized the gnd on the S lead and applies batt to the M lead (drop lamp goes dark) and SF tone is cut transmitting. As pulses are received, the E lead follows with opens and gnds and the ES opens and shorts the TR lead (3) twd the Panel ofc.

OUTGOING CALLS

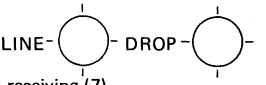


S lead (4) becomes grounded /Fig D/ or batt/Fig C/ from the panel ofc. The ES follows with ground applied to the M lead (drop lamp goes dark) which cuts transmitting SF. The ES recognizes the 20 cycles from the panel ofc on the TR lead (3) with a quick spurt of gnd on the M lead (drop lamp flashes) followed by the SF with a spurt of tone. This is known as **WINK** pulse. When cust answers phone at far end, see busy condition.

DLL 16 or ES65602 (Fig. F) #1 X–Bar



IDLE CONDITION



SF tone transmitting (6) & receiving (7)
E lead (1) open from SF (line lamp lit)
M lead (2) gnd from ES (drop lamp lit)
TR leads (3) open ES/ring batt and tip gnd from x-bar
R2 lead (4) open, from ES and batt from x-bar
S lead (5) batt from ES and gnd from x-bar

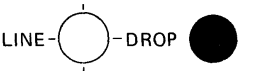
*** BUSY CONDITION**

No SF tone transmitting (6) or receiving (7)
E lead (1) gnd from SF (line lamp dark)
M lead (2) batt from ES (drop lamp dark)
TR lead (3) low resistance short from ES/ring batt and tip ground from x-bar
R2 lead (4) gnd from x-bar and gnd from ES
S lead (5) gnd from ES

INCOMING CALL

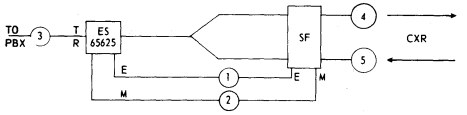
SF tone is seized receiving and E lead becomes ground (line lamp goes dark). ES puts a short across TR (3) and a gnd on the S lead (5) to the x-bar. The x-bar recognizes seizure with dial tone on TR and ground on T2 (5). In turn the ES applies batt to the M lead (drop lamp becomes dark) and SF tone is cut transmitting. As pulses of SF tone are received, the E lead follows the pulses with opens and grounds, and the ES opens and shorts the TR lead (3) twd the x-bar.

OUTGOING CALL

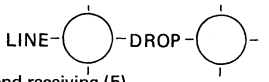


R2 lead (4) becomes grounded from x-bar. The ES recognizes the gnd and applies battery to the M lead (drop lamp becomes dark) and SF is seized transmitting. Also a ground is returned on the S lead (5) twd the x-bar. As 20 cycles are applied from the x-bar on the TR leads, the ES recognizes the ring with a spurt of gnd on the M lead, (drop lamp flashes) followed by a spurt of SF tone transmitting. See busy condition when call is completed.

ES65625



IDLE CONDITION



SF tone transmitting (4) and receiving (5)
E lead (1) open from SF (line lamp lit)
M lead (2) ground ES (drop lamp lit)
TR lead (3) from ES, tip open and ring batt
TR lead (3) from loop, ring open and tip batt

BUSY CONDITION

No SF tone transmitting (4) or receiving (5)
E lead (1) gnd from SF (line lamp dark)
M lead (2) batt from ES (drop lamp dark)
TR lead (3) from ES, tip gnd and ring batt
TR lead (3) from loop, tip batt & ring gnd

OUTGOING CALL FROM PBX

PBX trunk becomes seized and a gnd is placed on the ring of the loop (3). This ground is recognized by the ES & send out batt on the M lead (drop lamp goes dark) and SF is cut transmitting. When the line finder finds the line at the distant end, a seizure is sent back and SF is cut receiving (5). The E lead becomes gnd (line lamp goes dark) and the ES put a gnd on the tip (3) to the PBX. The PBX now dials and the ES follows the pulses alternately connecting batt and gnd to the M lead.

INCOMING CALLS FROM THE LINE

SF is cut receiving (5) and the E lead becomes gnd (line lamp dark). The ES then puts a gnd on the tip (3) to the PBX. When a spurt of SF is received (WINK pulse), the E lead goes open & the ES applies ring generator to the sub. When the PBX answers, a gnd comes up on the ring (3) from the loop & closes the connection (drop lamp goes dark).

E–B AND F SF UNITS

These SF units are used on 4 wire trunk circuits where E & M out of band signaling are used. The E & M from the SF unit must be converted to another form of signaling when applied to a customer service.

As noted in this handbook these units are used with pulse link repeaters DIB & DOB signal converters, LP1 signal converters, and Dial Long Lines units.

When used on a 4 wire CXR to 2W loop configuration a 4 wire term set must be used.

NOTE: The "F" type unit is a more advanced solid state version of the E–B unit and is compatible with another "F" type unit or a E-B unit. This unit will have, limited use at this publication as it is in the trial period. As the "F" type units become more available they will replace the E-B units.

E2S E2S–A AND E2L E2L–A

The E2L and E2S signaling units were designed and are used for Loop Start FX and OPX circuits. An auxiliary unit, E2LA and E2SA, may be used with the E2L and E2S unit to addapt for ground start application.

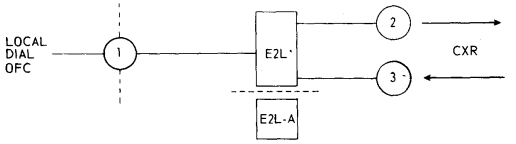
The E2L unit when received new has both "T" and "Y" options connected, requiring that option changes be made depending on the type of operation required. Notes on drawing SD-98137-02-2 specify options to be used. (NOTE: E1L units were designed for DTWX use and should not be used in voice circuits.)

Prior to placing in service, or replacing in service, each unit should be checked for proper options for the type of operation desired.

REFERENCE BSP's

E2L	179–328–501	E2S	179–330–501
E2L–A	179–328–502	E2S–A	179–330–502

The E2L is designed for use on the OPEN END of a FX or OPX circuit and the E2S is designed for use on the CLOSED END. The E2L will work with an E1R and the E2S will work with an E1P. The combination of these units are determined by the Engineer dependent on the loss of the loop the unit connects to.



* E2L operates at +7 receive and −16 transmit

E2L*

IDLE CONDITION SF tone receiving from carrier (3)
No SF tone leaving from E2L (2)
'T' & 'R' lead open from E2L (10
Tip ground and ring batt (−48v) from dial office (1)

BUSY CONDITION No SF receiving from carrier (3)
No SF tone trans from E2L (2)
'T' & 'R' lead short from E2L (1)

RINGING 20 cycles from local dial office (1)
SF tone released from E2L (2) as 20 cycles is applied (1)
Ringing cycle (2 seconds on and 4 off) stops when no SF received (3) and 'T' & 'R' lead is shorted from E2L (1)

INCOMING CALLS SF incoming is cut (3) and 'T' & 'R' short is applied from E2L (1) thus drawing dial tone from local dial office. SF pulse received makes and brakes short from E2L thus passing information to dial office.

E2L-A

IDLE SF tone transmitting (2) and receiving (3) 2W side of E2L (1) tip −48v and ring -48v; from local dial office (1) tip open and ring -48v

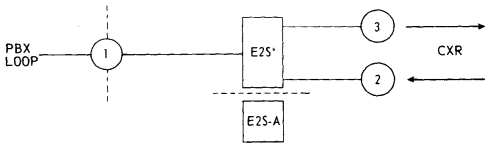
BUSY No SF transmitting (2) or receiving (3) 2W side of E2L (1) tip -48v and ground; from local dial ofc (1) tip ground and ring -48v

INCOMING CALL No SF receive (3)
2W side of E1L (1) tip -48v and ring ground
From local dial ofc (1) tip ground & ring -48v
SF tone is cut transmitting (2)
Dialing information is same as for E1L

OUTGOING RING As 20 cycles comes up from local dial ofc (1), the transmitting SF is modulated with 40 cycle wave.

***E2L OPTIONS** – When used as a ground start unit with a E2L-A remove the "Y" option.
"Y" option straps
Across pins 2 and 8 of GS plug
Across pins 3 and 7 of GS plug
Across pins 25 and 26 of printed CKT board
Open wire to plug 17 on E2L (no dash) or E2L-11
Open pins 10 and 11 on the "B" relay for E2L-20 units.

BALANCE THE E2L – By strapping from the common "26" terminal to "B", "C", "D" or "E" terminal for degree of balance required. Later manufactured units have balance punchings extended to screw type terminal on front of unit. The screw "in" contacts terminal "26" to designated terminal on front of unit.



* E2S operates at +7 receive and -16 transmit

E2S*

IDLE
(2) No SF receives
(3) SF tone transmitting
(1) 2W from loop is open between 'T' & 'R'

BUSY
(3) No SF transmitting
(2) No SF receiving
(1) 2W from loop is shorted between 'T' & 'R'

RINGING
(2) Spurts of SF tone receiving
(1) 2W side of E2S puts out 20 cycle ringing with each spurt of SF received.

DIALING
As circuit is seized from loop (see busy condition) dial tone is received from far end. 'T' & 'R' short makes and breaks with dialing pulses and information is sent out with spurts of SF for each digit dialed.

E2S–A

IDLE
SF transmitting (3) and receive (2)
(1) 2W side of E2S tip open and ring batt
(1) 2W from loop tip -48v and ring open

BUSY
No SF transmitting (3) and receive (2)
(1) 48V on tip and ground on ring of loop
(1) Gnd on tip and -48 on ring from E2S

DIALING

Customer seizes circuit with ring ground from loop, SF is cut trans and inturn it also becomes cut receiving. Dialing operation is now same as E2S.

RINGING

SF transmitting during ringing - - receiving is 2 second of 2600 cycles modulated with a 40 cycle wave followed 4 seconds of straight 2600 cycles. When modulated wave is received, the E2L passes 20 cycles ring to customer.

* **E2S OPTIONS** - When using the E2SA remove "Z" option and add "H" option.

"2" option straps

Across pins 1 and 2 of PLR jack
Across pins 3 and 4 of PLR jack
Across pins 6 and 7 of PLR jack

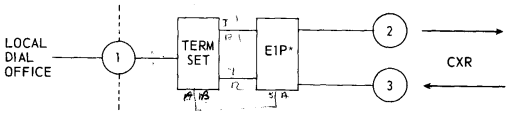
"H" option straps

From make contracts "RT" 5 to 2u of the "A" relay
The "H" option is automatically provided on the 98138–02 E2S.

Strap the 2 wire comp net to match the 2 wire pair.

BALANCE THE E2S - By strapping from the common "A" terminal to "B", "C", "D" or "E" for degree of balance required.

E1P



* E1P OPERATES AT + 7 RECEIVE AND -16 TRANSMIT

LOOP START

IDLE CONDITION SF tone receiving from carrier (3)
No SF tone leaving from E1P (2)
"T" & "R" leads open from E1P (1)
Tip Gnd and ring Batt (-48v) from dial office (1)

BUSY CONDITION No SF tone receiving from carrier (3)
No SF tone Trans from E1P (2)
"T" & "R" lead short from E1P (1)

RINGING 20 cycles from local dial office (1)
SF tone released from E1P (2) as 20 cycles is applied (1)
Ringing cycle (2 sec. on & 4 sec. off) stops when no SF received (3) and "T" & "R" lead is shorted from E1P (1).

INCOMING CALLS SF incoming is cut (3) and "T" & "R" short is applied from E1P (1) thus drawing dial tone from local dial office. SF pulse received (3) makes and breaks short from E1P (1) thus passing information to dial office.

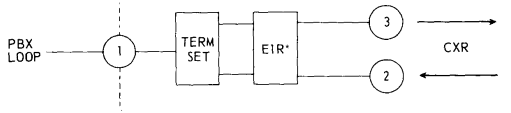
GROUND START E1P-A "OPTION A")

IDLE SF tone transmitting (2) and receiving (3). From E1p (1) "T" –48V & "R" –48V. From local dial office (1) "T" open & "R" –48V.

BUSY No SF transmitting (2) or receiving (3) from E1P (1) "T" -48V and "R" GND.
From local office (1) "T" GND & "R" -48V.

INCOMING CALL No SF receiving
From E1P (1) "T" – –48V & "R" GND.
From local dial office (1) "T" GND & "R" –48V
SF tone is cut transmitting (2)
Dialing information is same as for loop start.

OUTGOING RING As 20 cycles comes up from local dial office (1) the transmitting SF (2) is modulated with 40 cycles wave.



E1R

* E1R operates at +7 receive and -16 transmit

LOOP START

IDLE No SF receiving (2)
SF tone transmitting (3)
2W from loop is open "T" & "R"

BUSY No SF transmitting (3)
No SF receiving (2)
2W from loop is shorted "T" & "R" (1)

RINGING Spurts of SF tone receiving (2)
2W side of E1R (1) puts 20 cycle ringing with each spurt of SF received (2)

DIALING As circuit is seized from loop (1) (see busy condition) dial tone is received from far end (2) "T" & "R"
Short on loop (1) makes and breaks with dialing pulses and dial pulses are transmitted out with short spurts of SF for each digit dialed (3).

GROUND START (E1R-A "Option A")

IDLE SF transmitting (3) and receiving (2)
2W side of E1R (1) "T" open ring batt.
2W side of loop (1) "T" -48V & "R" open

BUSY No SF transmitting (3) or receiving (2)
2W side of loop (1) "T" -48V & "R" GND
2W side of E1R (1) "T" GND & "R" -48V

DIALING Customer seizes circuit with "R" GND from loop
(1). SF is cut transmitting (3) and inturn is also cut receiving (2).
Dialing operation is now same as for loop start.

RINGING SF transmitting during ringing (3). Receiving is 2 sec. of 2600 cycle modulated with a 40 cycle wave followed by 4 sec. of straight 2600 cycles (2). When modulated wave is received the E1R passes 20 cycles ring to customer (1).

E1P/E1R

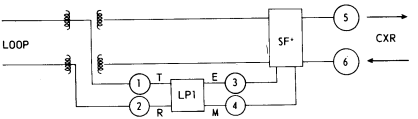
These units are used instead of E-L/E-S units where the customer loop is in excess of 1800 ohms (E-S) or 1200 ohms for office or exchange end (E-L).

The single unit may be used for either loop or GND start with internal strap change per SD99779-01 for E1P and SD99780 for E1R.

The E1P is compatible with a E1R, E2S and is used, when required in place of a E2L/E2LA.

The E1R is compatible with a E1P, E2L and is used when required in place of E2S/E2SA.

SD 95060 LP1 (Signaling Converter Circuit)



* May be "E–B" or "F" Type SF Unit.

Designed to connect a signal circuit (SF) and a trunk circuit (PBX type SD66039) for two way-auto or one way dial (from PBX) 1 way-auto.

IDLE CONDITION LINE – ○ – DROP – ○ –

SF tone BW (5) (6)
'E' lead (3) open from SF (line lamp lit)
'M' lead (4) ground from LP1 (drop lamp lit)
Battery on 'T' (1) LP1*
Ground on 'R' (2) from LP1*
High resistance short between 'T' (1) & 'R' (2) from loop

BUSY CONDITION LINE ● DROP ●

No SF tone (5) (6)
'E' lead (3) ground from SF (line lamp dark)
'M' lead (4) battery from LP1 (drop lamp dark)
Ground on 'T' from LP1*
Battery on 'R' (2) from LP1*
Low resistance short between 'T' (1) & 'R' (2) from loop

OUTGOING CALL LINE – ○ – DROP ●

Low resistance short between 'T' (1) & 'R' (2) from loop
'M' lead (4) changes from ground to battery from LP1 (drop lamp lit to dark)

SF tone will then be cut transmitting (5), 'T' (1) & 'R' (2) will remain unchanged from LP1 (IDLE condition until SF receive is cut see busy condition).

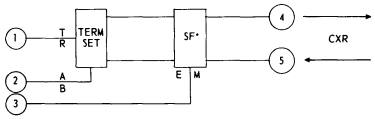
If it is a dial circuit pulses will be low to high resistance from loop and will be followed by 'M' lead battery to ground etc.

INCOMING CALL LINE  DROP - 

SF tone cut receiving (6)
'E' lead (3) changes from open to ground from SF (line lamp lit to dark)
'T' (1) lead changes from battery to ground from PL1
'R' (2) lead changes from ground to battery from PL1*
When sub answers high resistance short across 'T' (1) & (2) from loop will change to low resistance.

*Instructions written with 'G' Option used in LP1.
If 'H' Option is used reverse condition (ground to battery and vice versa) will be seen on both the 'T' (1) & 'R' (2) out of the LP1.

ONAL (Off Net Aux. Link)



*May be "E-B" or "F" Type SF Unit

The onal is used on exchange end of Foreign Exchange Services Associated with switched networks. The unit permits a network station to dial numbers accessed by the DDD Network. The basic onal unit is part of the local exchange equipment and presents a six lead configuration to the central office.

IDLE CONDITION LINE – ○ – DROP – ○ –

SF tone both ways (4) (5)
T & R (1) open from exchange, 48V on T and R open from term set
A & B (2) follows T & R
E lead open from TS
M lead GND from exchange

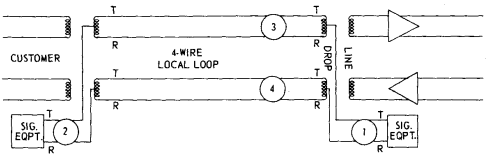
BUSY CONDITION LINE ● DROP ●

No SF either way (4) (5)
T & R (1) 48V
A & B (2) follows T & R
E lead GND
M lead 48V

DIALING & RINGING LINE ● DROP – ○ –

T & R (1) alternate 48V to open
A & B (2) follows T & R
E lead pulses open to GND
M lead GND to 48V when answer
SF REC (5) pulses
SF trans (4) on to off when answer

SIMPLEXING



Commonly on our circuits with 4W loops we use simplexing as a means of obtaining a third pair of wires for signaling purposes. It is also beneficial due to the fact that it decreases the resistance on the simplex pair to 1/2 that of the loop.

To obtain the third pair or signaling pair, a coil is used across the tip and ring of each individual pair. The coil is then center tapped at each end and brought out as one side of the simplex pair.

Generally the transmitting pair from the sub is used as the tip of the simplex and the receive pair the ring. If a ground were applied on the tip of the simplex from the far end (2) we would see the ground on both the tip and the ring (3) of the cable pair and also on the tip of our simplex pair (1). The same holds true for the ring, (ground on the ring (2), appears across T & R of the cable pair (4) and also on the ring (1) of the simplex pair).

To check for continuity of simplex in our office apply a ground to pair (3) toward the coil. With a voltmeter in (1) check either tip or ring for ground (will be on tip for our illustration) from the simplex. Then with a ground applied on pair (4) toward coil, it should be seen on opposite side of simplex pair (ring in illustration).

When we look out on the loop toward the customer with a voltmeter we should see a T & R short due to the coil across the pair.

TESTING INFORMATION FOR NON–DLL LOOPS

Ringdown with 20 cycle generator

WIRE LOOPS

Tip to ground and ring to ground - clear (capacity only).

Tip to ring - clear . . . (capacity only).

4 WIRE LOOPS

Generator applied to one pair only.

Tip to ground and ring to ground of both pairs - clear . . .(capacity only).

Tip to ring of pair generator is applied to, clear . . . (capacity only).

Tip to ring of the other pair, short . . .(due to the coil)

SIMPLEXED GENERATOR

Tip to ground and ring to ground on both pairs, clear . . .(capacity only).

Tip to ring on both pairs, short . . .(due to the coils).

SX leads, tip to ring toward the drop, clear (capacity only).

DIAL WITH DX2

4 wire loop simplexed to the DX2.

Customer receive pair . . .the tip & ring are grounded if the sub is on hook. The tip & ring have 48 volts if the sub is off the hook. The loop is simplexed to the tip of the DX2.

Customer transmit pair . . .the tip & ring have 18 volts in both on & off hook conditions. Loop is simplexed to ring DX2.

Tip to ring of both pairs, short . . .(due to coils).

BRIDGES

4-WIRE BRIDGES

The 4-wire bridge is used to interconnect four individual legs together. The legs may be carrier facilities or subscriber's loops. They are used in multipoint circuits. The 4-wire bridge has a configuration of transmit and receive legs connected through a resistance network to provide a transmission path from each receive leg to all other transmit legs. There are 4 WAY and 6 WAY 4-Wire bridges. These may be used individually or in combinations to provide the required number of legs for a multipoint circuit.

A Full duplex (simultaneous transmit and receive) arrangement (commonly called a split bridge) may be provided by utilizing two (2) bridges, one being a transmit bridge with one input and multiple outputs. The other bridge being a receive bridge with multiple inputs and one output.

2–WIRE BRIDGES

This type of bridge provides a configuration of one 2-Wire input with multiple 2-Wire outputs. This type of bridge is most commonly used on telephone/data and telephoto services provided for the press and new services but may be used on any multiple receive only type of voice service.

NOTE: TO PROVIDE A BALANCE between all legs of any bridge all legs must terminate in the same impedence (balance bridge). This requires unused legs to be terminated by means of a resistor in the impedence of the legs used. (This is normally 600 OHMS.)

REPEATING COILS

WHY USED

1. Matching impedances of facilities and equipment

2. Deriving phantom circuits

3. Deriving DC or low frequency (20 cycles) by simplex or composite

4. Isolation between
   A. Cable and equipment
   B. Balanced and unbalanced circuits to reduce noise

WHERE USED

1. Repeating coils are employed between lines and equipment of dissimilar impedances in order to reduce reflection effects at the mismatch point. Repeating coils are useful in minimizing reflection loss, cross-talk, echo, and reduced singing points.

2. Where it is desired to obtain phantom circuits.

3. Where a DC path is desired

The most common 2 wire repeating coils in use are 93, 62, and 120 type

COILS

93 type coils pass 20 cycle ringing

120 type coils do not pass 20 cycle ringing. Can be simplexed or composited.

Repeat or line coils are 2 wire to 2 wire

Hybrid coils are 4 wire to 2 wire

175A repeat coil (B1) will pass 20 cycles, has an associated retard coile and is adapted to pick DC off simplex lead. (Ref. to E43.120)

APPLICATIONS OF ECHO SUPPRESSORS (AB23.026)

The length of a circuit in circuit miles and the make-up of the overall facilities are the governing factors in the application of an echo suppressor to a circuit. The use of non-use is determined by the Engineer at the time the circuit is designed.

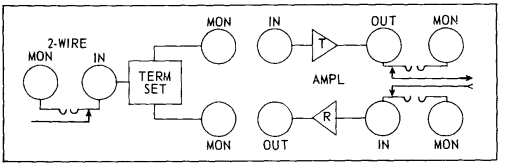
The echo suppressor is a voice sensing device which controls the two paths in a 4-Wire facility. The basic purpose of an echo suppressor is to provide a clear voice path for the speaker to the listener while blocking the voice path from the listener to the speaker. This eleminates a feedback to the speaker which would be of a delay or time lag represented as an echo or echos to the speaker.

The unit is adjustable for sensitivity to voice and noise and has an adjustment to control release time. Tests and Adjustments are in BSP 332-410-500 for 1A Echo Suppressors. All tests and adjustments are normally made at the time the echo suppressor is placed in the circuit for service and should not need any adjustments while in service in the circuit.

No circuit which has been designed to operate with an echo suppressor should ever be operated without one.

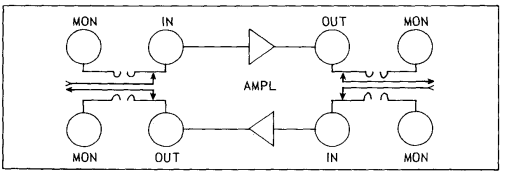
V4 TELEPHONE REPEATER
BSP 332–104–100

The 24V4 repeater is designed for use between 2 wire (900 or 600 OHM Central Office or PBX installations), and 4 wire loaded and non-loaded cable or the (4 wire terminals of inter-toll facilities).

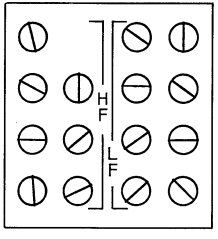


24V4 has jack access to plug in units and the ability to monitor them. When sending or receiving tones on monitor jack an open plug should be inserted in "in" or "out" jacks to eliminate bridging loss.
The sections describing V4 repeater equipment are–

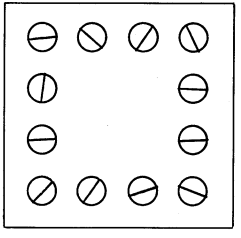
24V4 repeater mounting shelves 332-105
44V4 repeater mounting shelves 332-106
- 227 - type amplifiers 332-104
- 849 - type networks 332-115
- 359 - type equalizers 332-116
- 648 - type filter 332-117
- 1 type terminating sets 332-800
- 4066 type networks 332-852



The 44V4 Repeater (4-wire to 4-wire), can be placed between two lengths of loaded cable, non-loaded cable, 600 OHM lines or between a length of loaded and a length of non-loaded cable. The 44V4 Repeater consists of two 227 type amplifiers two 359 type equalizers and a jack field.



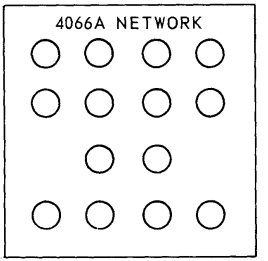
359 or D Equalizer



359G or H Equalizer

359 type equalizers are used on the line side of the terminal Repeater when gain or equalization is required.
Check section 332–104–500 for screw settings.

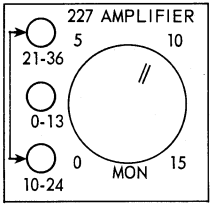
4066 Network is an adjustable 2 terminal network. Used for precision balancing to reduce the possibility of "singing" or oscillations in 4-wire loop.



4066A Net 332-852-101 used when 2-wire consists of 19,22 or 24 gauge high capacitance.
4066B Net 332-852-102 used when 2-wire consists of 26 gauge high and low capacitance.
4066C Net 332-852-103 used with older 4-wire terminating sets not equipped with comp. net. and BOC features.
4066D Net 332-852-104 used when 2-wire consists of 19 gauge H88 side or 19 gauge H50 phantom.
4066E Net 332-852-105 19 gauge H44 side.
4066F Net 332-852-106 24 gauge N.L. filter to prevent singing

BSP 332-117-101
648A filter is a balanced low pass filter with cutoff at 3150 HZ. It compensates for poor balance and prevents singing. When the filter is connected to a 600-OHM resistive termination screw down switch.

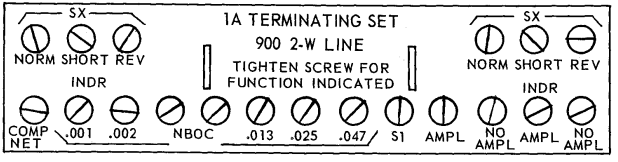
BSP 332-105-103
Page 2
Table A
434A plug provides circuit continuity for plug in filters and networks when circuit requires it.



227 type amplifiers are of the minature type employing transistors. 227A is designed for underground cable where no lightning protection required, 227B amplifier has built-in lightning protection. Provides either 600 or 1200 OHM impedances.
849 type networks can be used in place of 227 type amplifiers when gain is not required.

With the top and bottom screws turned in to make contact and the middle screw turned back out gain range is 21 to 36 DB.
With bottom screw only turned in the range is from 10 to 24 DB while with the middle screw only turned in, the range is from 0 to 13DB.

227 Type Amplifier



1A TERMINATING SET

1A Terminating Set consists of a 2–transformer hybrid comprise network adjustable building–out capacitor and simplex leads.

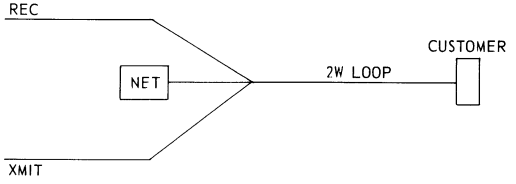
"S1" adjustment should be screwed out using with dail circuits having SD65718 or SD66799 equipment. As it will shunt 2DB switch pad if left in.

BALANCE NETWORKS

A Balance Network is a network of resistors and capacitors used to balance a 4-Wire hybrid to a 2-Wire line. For maximum transfer of power the characteristic impedence of the hybrid should be as near that of the line as possible. The more the impedences match the less power is returned through the hybrid to the transmit of the hybrid.

The Balance Network can be either an internal component of the 4-Wire Terminating Set or externally wired to the Terminating Set. The proper combination of settings or strappings on the network will provide a balance to the 2-Wire line.

BSP References - 310-350-100
310-350-500



DATA

Definitions

Analog Transmission — Two or more varying frequencies (600 series type sets).

Bias Distortion — 'Marks' or 'spaces' consistantly too long or too short.

Binary Data — Information in bit form.

Bi-polar Signals — Signals changing polarity from positive to negative.

Bit — A binary digit. A single basic unit of information. Either a 'Mark' or a 'space', also called a 'one' (1) or a 'zero' (O). Either a pulse or the absence of a pulse.

Bit Rate — Number of bits per second (bps).

Clock — A source of timing signals. The transmitting clock determines the bit rate of the system under test. The receiver clock must maintain a constant phase and frequency relationship with the transmitting clock.

Data — The transfer of information derived from the Greek word datam.

Debits — Two bits, side by side.

Error Rate — Ratio of the number of errors to the number of bits transmitted.

External Sync — An externally provided clock. Data receivers that contain a synchronization recovery circuit generally provides a timing signal which may be used to drive the local 903 test set.

Four Phase — Serial transmission where each dibit shifts in phase from the previous one.

DATA Continued

Parallel Transmission – Two or more serial data signals at the same time or in parallel (similar to MF key pulsing).

Peak Distortion – Summation of peak jitter an Bias Distortion.

Peak Jitter – Distortion caused by the maximum instantaneous time displacement of a transition.

Pulse – A short spurt of electrical energy.

Serial Data – Bits of information one after the other.

Synchronize –To make occur at the same time. To go on at the same rate and exactly together; to recur together.

Transition – The change is polarity occurring at the beginning or end of a pit.

Unipolar Signals – Signals changing from positive to zero, or negative to zero, but not both.

902B DATA TEST SET

BSP 107-300-100

The 902 is used for out of service tests, installation, routines, and troubles. Used with the 903 test set (also used to provide power to the 902), it compares the received signal with the locally generated signal. The 902 measures error rate and peak distortion.

Bit Rate selector switch ranges from 75 to 3000 bps. or can be externally driven (EXT SYNC).

Meter selection switch permits the meter to be connected to various test circuits (BIAS ADJ, DIST ADJ, VOLT ADJ, PHASE ADJ, and DIST ADJ).

Trigger (+ or -) determine whether the sampling interval for error detection is taken on the positive going or negative going transition of the timing signal.

Error Counter (seven lamps) count and record errors. The eighth lamp when lit indicates more than 127 errors and the counter must be reset.

Word Sync & Reset button when operated resets the counter to zero and syncs the receive signal with the locally generated signal.

903 DATA TEST SET

BSP 107-200-100

The 903 series test set is a test signal generator used to simulate the transmitting business machine and produces serial type data. Two types of test signal are available: a 63-bit random word or a dot signal. The 903 is used for out of service tests, installations, routines, and trouble investigation.

Bit Rate selector switch ranging from 75 to 3000 bps or can be externally driven up to 42000 bps (EXT SYNC).
The putput switch has two selections - RANDOM (puts out a repetitious 63-bit word) and a DOT (puts out a continuous mark-space, bi-polar square wave signal.

Word Sync terminal is used for synchronizing the oscilloscope display.

Calibration of the 902 is made using one 903 and one 902 as follows:

(1) Connect 903 and 902 together using the connector cord.
(2) Connect the SIG OUT terminals of the 903 to the DATA IN terminals of the 902.
(3) Plug in the 903 ac power cord and turn ON-OFF switch to ON.
(4) Set the RANDOM DOT switch of the 903 to DOT.
(5) Set the BIT RATE switches of both test set on a 2 to 1 speed ratio, eg, set 903 to 2000 bps and the 902 to 1000bps.
(6) Set the controls of the 902 set as follows:
    DISTORTION – Zero Adj.
    VOLTS – Zero Adj. } Set to approximate
    PHASE – Zero Adj. } center of rotation
    TRIGGER – Not required
(7) Set meter selection switch to DIST ADJ; wait until meter stabilizes before zeroing the meter with the DISTORTION knob.
(8) Set meter selection switch to VOLT ADJ and zero the meter by means of the VOLTS adjustment knob.
(9) Set the meter selection switch to PHASE ADJ and zero the meter by PHASE adjustment knob. (If meter will not zero, see BSP 107-300-100).

    NOTE: If the adjustment of the PHASE control knob has little or no effect on the meter reading, this could be an indication that the START button on the transmitting 903 has not been depressed or that the 903 signals are being improperly applied to the 902.

(10) Set the meter selection switch to DIST. MEAS.
(11) The meter should read 25 per cent + 3 percent.
(12) If the 902B is out of limits, adjust the CAL potentiometer, located on the face of the test set for meter reading of 25 percent.

The following test may be used to isolate a test set suspected by causing trouble. It requires two 903 and one 902 test sets and is made as follows:

(1) Connect the receiving 903 to the 902 using the connector cord.
(2) Connect the SIG OUT terminals of the transmitting 903 to the DATA IN terminals of the 902.
(3) Plug in AC power cord and turn ON-OFF switch of both 903 sets to ON. Set the controls of the transmitting 903 as follows:

BIT RATE – At desired bit rate for test
RANDOM DOT Switch – RANDOM
TRIGGER – Not required

(4) Set the controls for the receiving 903 as follows:

BIT RATE Switch – EXT CLOCK
RANDOM DOT Switch – RANDOM
TRIGGER Switch – (+)

(5) After both 903 sets are connected and switch settings adjusted, momentarily depress the START button of the transmitting 903.
(6) Set the controls of the 902 set as follows:
BIT RATE – To the same speed setting as the transmitting 903
DISTORTION – Zero Adj
VOLTS – Zero Adj — Set to approximate
PHASE – Zero Adj — center of rotation
TRIGGER – Not Required
(7) Set meter selection switch to DIST ADJ; wait until meter stabilizes before zeroing the meter with DISTORTION knob.
(8) Set meter selection switch to VOLT ADJ and zero the meter by means of the VOLTS adjustment.
(9) Set the meter selection switch to PHASE ADJ and zero the meter by PHASE adjustment knob. (If meter will not zero, see BSP.)
(10) Set the meter selection switch to DIST MEAS. Momentarily depress the WORD SYNC & RESET button. All the lamps should go out and the meter should not read more than 3 percent distortion.

With all three sets connected in this manner, the outputs of the two 903 test sets are being compared.

If there is more than a 3 percent distortion reading on the meter, it will not be caused by the receiving 903. Reversing the transmitting and receiving 903 sets should determine whether the trouble is in the 902 or the transmitting 903. If, after the set reversal, the reading is normal, the 903 that is now the receiving 903 is in trouble.

To further check that the 902 is working properly, momentarily depress the START button of either 903. This will throw the two words out of sychronization, and the lights on the 902 should start to flash. Repeating Steps 7, 8, 9 and 10 of above should cause the light to go out.

OVERALL DATA TESTS AND REQUIREMENTS

Voice band data on voice band channels for digital and analog transmission is covered by BSP 314-410-500. They can also be alternate voice operation if necessary (BSP 972-055-100), can be two point multi-point, or switched circuits. The sub sets can be customer provided equipment (CPE) or can be Telco's. All tests should be made on a matched impedence basis (supposedly 600 ohms). The STC or control office should co-ordinate all routines tests to keep out of service time down to a minimum.

PROCEDURES: Test line for presence of dc before using test equipment for leakage to ground (causes noise). Make net loss measurements station to station (1000 cycles). Net loss should be written + 4ab on ckt order.

Frequency response measured station to station should be made at every 100 cycles. The effects of noise would be errors in transmission when limits are exceeded. Make a separate check of compandored sections on A-1 digital systems. Measure noise station to station with 3A Noise Measuring Set. Use C-msg weighting, calibrate set and monitor ckt before using.

Impulse noise should be checked station to station with 6A Impulse Noise Counter. Check output level of data set at demarc strip and at STC.

Delay distortion is measured with a 25A envelope delay set.

BSP References:

Frequency response requirements	(314-410-500)
Steady state and impulse noise	(314-410-500) (972-055-100)
Intervals for routines	(314-410-500)

Envelope delay is found in frequency transmission. It is the lead or lag of some frequencies as opposed to other frequencies within a certain band width. It is caused by facility and equipment reactance which shifts the phase or changes the velocity. Minimum delay distortion is usually between 800 and 2000 cycles and the maximum delay is found at the lower and upper frequencies. This delay can be corrected by the insertion of delay equalizers which retard the leading frequencies.

Two hundred type equalizers are used to reduce delay distortion on special services to meet the requirements found in Table 1 of BSP 310-410-500. The equalizers are composed of inductors and capacitors. A small amount of attenuation loss not constant with frequency is presented by the equalizer but the amount of loss is negligible. They are designed for AC only and DC will cause magnetic saturation which may alter the delay characteristics.

A 25A Envelope Delay Test Set is used to measure envelope delay distortion.

PBX INFORMATION

STATION JACK

Positive Battery on Ring-
Ground on Tip } STN JACK PUTS OUT

20 Cycle Generator Ring

May be connected to another station jack, trunk jack, or 2 way manual ring down circuit.

Trunk Jack

Accepts incoming 20 cycle ring

Battery on ring - ground on tip. This may be furnished by:

1. C. O. trunk
2. LLE with battery TWDS trunk JK
3. PLE

With plug inserted in jack, trunk JK puts out short

May be connected only to station JKs or 2 wire manual ring down circuits.

Selector Levels For SD 65718-01

0 - Operator Level
1-2-3-4-5- Station Levels
6 - Station or Special Trunks
7 - Tie Trunks
8 - Foreign Exchange
9 - C. O. Trunks

The above combinations are those most commonly in use for private line applications. Variations are made with respect to customer requirements.

4A Transmission Test Set
(TTS4)
General Operation

Preparation

Step	Procedures
1.	Open lid. (May be removed by moving cover to the left.)
2.	Turn POWER switch ON.
3.	Wait 90 seconds for warm up.
4.	Set SEND LEVEL and REC LEVEL to O (cal).
5.	Set FUNCTION to CAL SEND.
6.	Set the SEND IMP to 600P.
7.	Adjust CAL SEND for odbm on meter.
8.	Set FUNCTION to CAL REC.
9.	Adjust CAL REC for Odbm on meter.
10.	Set FUNCTION to SEND REC.

General Operation Using Line Jack

Step	Procedure
1.	Complete all Steps under PREPARATION.
	TO TALK
2.	Connect line to be tested to line 310 or line 309 jack depending on type of plug available.
3.	Connect 52 or 53 type telephone set to TEL SET jk.
4.	Operate line key to TALK. This connects the telephone set to line.
	TO SEND TONE
2.	Set SEND FREQ. to desired frequency.
3.	Set SEND LEVEL to desired level.
4.	Set SEND IMP to desired sending impedance.
5.	Operate line key to SEND. This connects the output of the oscillator to the line.
6.	After a predetermined length of time. restore the LINE key to TALK.
	TO MEASURE TONE
2.	Set REC IMP to desired impedance.
3.	Request tone to be sent.
4.	When tone is heard in the telephone set, operate LINE key to REC.
5.	Turn REC LEVEL switch to obtain a convenient reading on the meter (between the -3 and +3 marks, if possible).

To monitor the tone being measured, turn the MONITOR key to ON.
When tone is removed, operate monitor key to HOLD and LINE key to TALK.
More information can be found in BSP 103-204-100.

Western Union

Circuit Requirements

1. Type of circuit furnished by the Telephone Company shall be suitable for a minimum of 12 channels of carrier telegraph. This does not mean that Western Union cannot attempt to increase the number of VF channels, but no guarantee is made that it will work.

   310-025-000

Frequency	Dev. from 1000 CPS
300 CPS	−5 to +5
500 CPS	−3 to +3
1000 CPS	0 to 0
1900 CPS	−3 to +3
2400 CPS	−3 to +3

Any equalization will be provided by Western Union.

Western Union may request additional equalization, but at an extra cost.

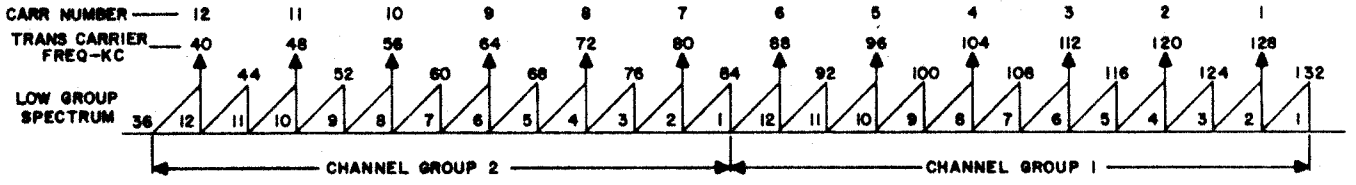
BSP REF: 660-450-300

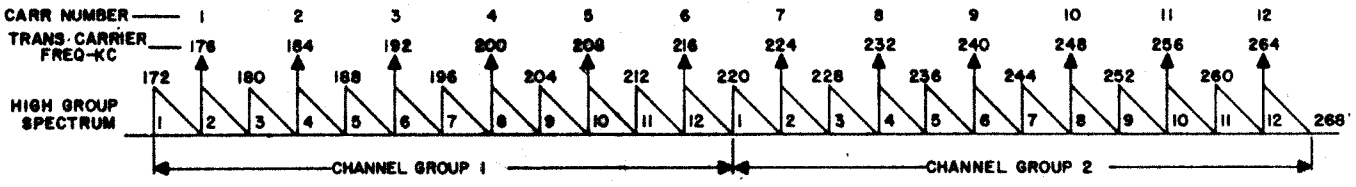
LOCAL PROCEDURES

This section may be used for local procedures, local instructions, special form instructions, EMC activation procedures, notification procedures, call-out directory and any other information applicable only to the individual office.

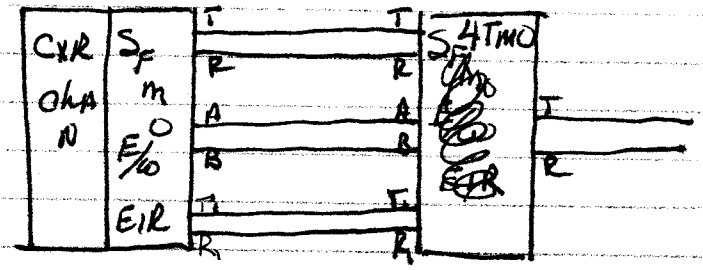
NOTES

TABLE A





Gnd Start- E-1-R Sig Unit SFXS50



Cust Seizures CKT and Gnd's B Lead or Ring Side which Removes SF TWD LINE

CKT Seized- From Line Removes SF TWD EIR - EIR Puts Gnd Back Twd- Cust which come Back on loop to EIR Cust CAN Remove Gnd & CKT will Hold -up-