BELL SYSTEM REFERENCE DOCUMENT
AT&T Co. Standard

JA-9

SPECIAL SERVICE TELEPHONE HANDBOOK

Select Code 418-294
Supply Service Center Order Number JA0900

REFERENCE MATERIAL
Issue 7, December, 1980

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AT&T Co. Standard

JA-9

C-TEK
235-3533

SPECIAL SERVICES TELEPHONE HANDBOOK

Development Sponsored By Bell System Operating Companies
Prepared By AT&T Co. – Long Lines

REFERENCE MATERIAL
Issue 7, December 1980

Issue 7
December 1980

PREFACE

This handbook is designed as a handy reference source for private line telephone testboard personnel to aid in their sectionalization and clearing of private line telephone and data troubles. This handbook includes helpful technical and operational information complete with BSP references. When more detailed information is required, refer to the appropriate BSP reference.

Designated NS-009, this handbook may be ordered from the Indiana Publication Center (IPC) of Western Electric on form SD-1-80.80 by its select code on the front cover.

This issue of the handbook has been prepared in order to delete the COLA/FOLA references and substitute instead the WORD document, add "G" type SF signaling unit information, delete information relative to Wide Band Data Services, and in general update the included information.

The continued usefulness and accuracy of this handbook will be dependent to a large extent upon your comments. If you find any inaccuracies in this handbook, of if you have any comments whatsoever, please send them to us or call:

SSS Course Developer - Room 329
800 North Pearl Street
Albany, New York 12204

Telephone: 518-471-6787

N O T I C E

Performance on the job requires the use of many types of test sets. Selection of the test sets to be included in this performance aid does not constitute endorsement to the exclusion of other test sets with similar functions but, rather, is a matter of practicality.

INDEX

GENERAL

INDEX - SECTION 1

BSP REFERENCES

PRIVATE LINE - GENERAL

NOTE: "X" indicates variable number.

PRIVATE LINE - DATA (VOICEBAND)

NOTE: "X" indicates variable number.

TEST SETS

Data Test Set, 902	107-300-100
Data Test Set, 913	107-401-100
Data Test Set, 914B	107-101-100
Data Test Set, 921	107-402-500
Delay Measuring Set, 25A	103-115-100
Delay Measuring Set, 25B	103-115-101
Gain and Phase Hit Counter (X75948)	103-125-000
Impulse Noise Counter 6A	103-620-100
Impulse Noise Counter 6H	103-620-101
Impulse Noise Counter 6F	103-620-102
Noise Measuring Set, 3A	103-611-100
Noise Measuring Set, 3C	103-611-101
Recorders	100-13X-XXX
Return Loss Test Set (KS20501)	103-106-115
Signaling Test Sets	100-26X-XXX
Transmission Measuring Sets	103-106-115

NOTE: "X" indicates variable number

In addition to the above test sets, the private line service group uses large numbers of sets manufactured by other companies. The manufacturers's manuals should be used for these sets.

ADMINISTRATIVE AND MISC.

NOTE: "X" indicates variable number.

BELL SYSTEM COMMON LANGUAGE

A system of codes, or abbreviated language, that is used by the Bell System to allow exchange of information between companies, or within a company, that is compatible to both personnel and computer. The Common Language system is basically divided into basic sections.

1. Common Language Location Identification (CLLI) - Reference 795-100-XXX.

2. Common Language Circuit Identification (CLCI) - Reference 795-402-100 for Private Line Services.

3. Common Language Equipment Identification (CLEI) - Reference 795-200-XXX.

4. Common Language Facility Identification (CLFI) - Reference 795-450-XXX.

This Job Aid covers only the basic format for COMMON LANGUAGE. For more detail, refer to the BSP's listed above or to TTC365 training course.

COMMON LANGUAGE LOCATION IDENTIFICATION (CLLI)

	CHARACTER POSITIONS AND CHARACTER SET			
	1-4	5-6	7-8	9-11
Place	AAAA			
State		AA		
Building			AA or NN	
Building Sub Division				XXX
Nonbuilding				
Customer			NANNN	
Other			ANNNN	

A = Alphabetical N = Numberical X = Either

Two types of CLLI are used

Building - Refers to a telephone building or a building housing telephone equipment.

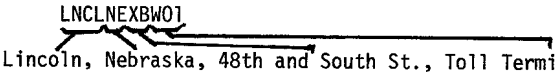
Non-Building - Covers other locations, such as manholes, poles, customer locations, etc.

Place - Town, city or community
State - State or Foreign country
Building - particular building within the Place location
Building Sub Division - Work location within the Building

NonBuilding - First six same as Building format. Specifies nonbuilding location within the Place location.

BSPs in 795-1 layer specify exact location. Different BSP for each state.

Example of a CLLI



COMMON LANGUAGE CIRCUIT IDENTIFICATION (CLCI)

Two formats used for private line services:

Telephone Number Format - used whenever the circuit can be identified by a particular telephone number and extension or Trunk code.

PREFIX	*	SERVICE CODE	MODIFIER	*	NPA CODE	*	CENTRAL OFFICE UNIT CODE	*	LINE NUMBER CODE	*	EXTENSION NUMBER OR TRUNK CODE	*	SEGMENT NUMBER
1 2		3 4	5 6		7 8 9		10 11 12		13 14 15 16		17 18 19 20 21		22 23 24

* When using the above format in a manual or mechanized system, it is recommended that certain data fields be separated for overall code readability.

Division	Character Position
Prefix	1 - 2
Service Code/Modifier	3 - 6
Number Plan Area (NPA) Code	7 - 9
Central Office Unit Code	10 - 12
Line Number Code	13 - 16
Extension Number/Trunk Code	17 - 21
Segment Number	22 - 24

Prefix - optional with issuing company. May be left blank.

Service Code/Modifier - See 1.9 for partial list.

NPA-CENTRAL OFFICE-Line Number - 10 digit telephone number.

Extension number or Trunk code - used when required to identify a particular station within a PBX group.

Segment number - used on multipoint circuits to identify the segment.

Example of a Telephone Number Format CLCI

/FXNT/301/340/8462/ /

Prefix - not used

Service code - FX (Foreign Exchange)

Modifier - NT (Non Data - all telco provided)

7 digit telephone number with no extension or Segment

EXAMPLES OF PRIVATE LINE SERVICE CODES

SERVICE	SERVICE CODE
Private Line Data	FD
Foreign Exchange Line	FX
LD Terminal Line	LL
LD Terminal Trunk	LT
NOn-tandem Tie Trunk	TL
WATS Line (In)	WX
WATS Line (Out)	WO
WATS Line (2 way)	WZ
Switched Service Access line	CA
Switched Service Network Trunk	CN
Switched Service Tie Trunk	CT
Switched Service Station Line	CE
Off Network Access Line	ON
Mobile Station	MS
Private Line Voice	PL
Radio Land Line	RT
Telephoto/Facsimile	TF

The Modifier (positions 5 & 6) information is shown below:

MODIFIER
CHARACTER POSITION 5

INTRASTATE CIRCUITS	INTERSTATE CIRCUITS	CODE DESCRIPTION
A	B	Alternate Data and Nondata
D	E	Data
N	L	Nondata Operation
P	—	Parameter Only Offering Under an Intrastate Restructured Private Line Tariff
S	T	Simultaneous Data and Non-data

MODIFIER
CHARACTER POSITION 6

BELL SYSTEM SERVICES		
ALL SERVICES EXCEPT U.S. GOVERNMENT	U.S. GOVERNMENT SERVICES (NOTE 1)	CODE DESCRIPTION
T	M	All facilities and electrically connected equipment are TELCO provided.
C (Note 4)	P	Part of the facilities and/or electrically connected equipment are customer provided.
A (Note 4)	J	All facilities are TELCO provided and all electrically connected equipment is customer provided.
S	S	Circuit terminates in an interface for connection to an Other Common Carrier (OCC) or connects to facilities provided to OCCs (Note 2).
V	V	Circuit terminates in an interface for connection to a Radio Common Carrier (RCC) (Note 2)
L	F	Circuit directly connects to a channel of a customer provided communication system. (TARIFF FCC No. 260) (Note 2)
Z	—	Official Service (Note 3)

Notes:

1. The implementation of codes in this column shall be the responsibility of the Long Lines or OTC Government Communications Manager (GCM). This not only involves including these codes in the CLCI on new services but also coordinating with the Company Common Language Coordinator for the inclusion of these codes on existing services as they are converted to Common Language.
2. OCC and RCC modifiers take priority over all other modifiers.
3. These modifiers are available for use only on Official Company Use circuits identified with tariff-defined services codes such as FX, PL, etc.
4. To determine the application of these modifiers codes, the following explanation applies. All terminating devices associated with design of the channel (Facilities) should be excluded from consideration. For example: 829As, 24Vs, Term. Sets, etc.

CLCI (Cont'd)

Serial Number Format - used whenever the Telephone Number Format does not apply.

PREFIX	*	SERVICE CODE	MODIFIER	*	SERIAL NUMBER	*	SUFFIX	*	COMPANY ASSIGNING CIRCUIT IDENTIFICATION (SEE NOTE)	*	SEGMENT NUMBER
1 2		3 4	5 6		7 8 9 10 11 12		13 14 15		16 17 18 19		20 21 22

* When using the above format in a manual or mechanized system, it is recommended that certain data fields be separated for overall code readability.

Division	Character Position
Prefix	1 - 2
Service Code	3 - 4
Modifier	5 - 6
Serial Number	7 - 12
Suffix	13 - 15
Company Assigning Circuit Identification	16 - 19
Segment Number	20 - 22

Prefix, Service Code, Modifier and Segment Number same as Telephone Number Format.

Serial number - 6 number character code assigned by the issuing company.

Company Assigning - Code for company making assignment.

Suffix - 3 number character code to allow circuits in a related group to be identified.

Example of a Serial Number Format CLCI

83/FDDT/201407/001/CD /

Prefix - 83
Service code - FD (Private Line Data)
Modifier - DT (Data - all Telco provided)
Serial Number - 201407
Suffix - 001 (1st circuit in a related group)
Assigning company - CD (Code for C&P of District of Columbia - Bell System companies have a 2 digit code. Independent companies use a 4 digit code. If the entire circuit is in the area of a single company, or Long Lines these spaces may be left blank.)
Segment number - not used on this circuit.

COMMON LANGUAGE EQUIPMENT IDENTIFICATION (CLEI)

A ten character Common Language Code providing feature oriented identification for hard wired and plug in equipment.

CLEI

CODING DATA	BASIC CODE	FEATURES	REFERENCE	SUPPLEMENTAL
Character Positions	1 - 4	5 to 7	8	9 and 10

Divisions	Character Positions
Basic Code	1 thru 4
Feature Codes	5 thru 7
Reference Code	8
Supplemental Identification	9 thru 10

Each Basic Code has its own BSP and is used to identify a specific type of equipment.

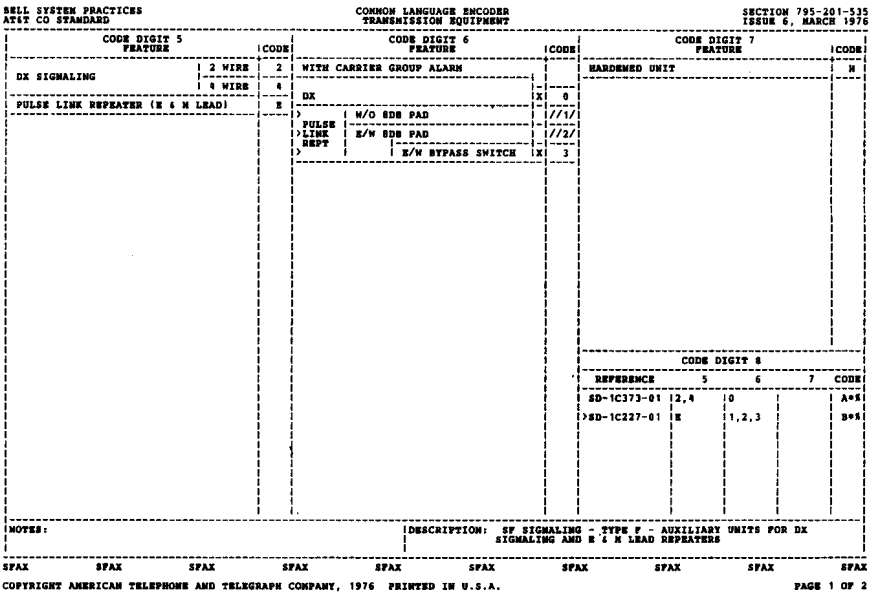
The Features characters identify the various component options of the Basic Code.

The Reference character identifies the schematic drawing, coded apparatus, or assembly.

The Supplemental Codes identify the specific wiring and equipment options and vintage. These codes are not always used and do not appear on the BSP for the Basic Code. A supplementary BSP, called a conversion section, lists these characters for each Basic Code.

An example of a CLEI BSP is shown on page 1.13.

A CLEI OF SFAXE1HBAA



BELL SYSTEM PRACTICES
AT&T CO STANDARD

COMMON LANGUAGE ENCODER
TRANSMISSION EQUIPMENT

SECTION 795-201-535
ISSUE 6, MARCH 1976

CODE DIGIT 5 FEATURE

FEATURE		CODE
DX SIGNALING	2 WIRE	2
	4 WIRE	4
PULSE LINK REPEATER (E & M LEAD)		E

CODE DIGIT 6 FEATURE

FEATURE		CODE
WITH CARRIER GROUP ALARM		
DX		X 0
PULSE LINK REPT	W/O BDB PAD	//1/
	E/W BDB PAD	//2/
	E/W BYPASS SWITCH	X 3

CODE DIGIT 7 FEATURE

FEATURE	CODE
HARDENED UNIT	H

CODE DIGIT 8

REFERENCE	5	6	7	CODE
SD-1C373-01	2,4	0		A*1
SD-1C227-01	E	1,2,3		B*1

NOTES:

DESCRIPTION: SF SIGNALING - TYPE F - AUXILIARY UNITS FOR DX SIGNALING AND E & M LEAD REPEATERS

SFAX SFAX SFAX SFAX SFAX SFAX SFAX SFAX SFAX SFAX

SFAX is the Basic Code. This BSP applies only to this code.

SF - Family of SF units
AX - "F" type Auxilary units
E - Pulse Link repeated E & M lead
1 - No carrier group alarm
H - No choice for this code digit
B - Drawing SD 1C 227-01
AA - Supplementary characters. To determine the meaning of these, reference must be made to the conversion BSP.

Any two equipments whose first seven characters are the same are interchangeable.

Whenever possible in JA9 the CLEI will be shown on the same page as the equipment being discussed.

COMMON LANGUAGE FACILITY IDENTIFICATION (CLFI)

	FACILITY DESIGNATION	FACILITY TYPE	CHANNEL/PAIR NUMBER	TERMINAL A	TERMINAL Z
Character Position	1 thru 5	6 thru 11	12 thru 16	17 thru 27	28 thru 38

Facility Designation	1 thru 5
Facility Type	6 thru 11
Channel/Pair Number	12 thru 16
Terminal A	17 thru 27
Terminal Z	28 thru 38

The Facility Designation is a code consisting of a maximum of 5 characters indicating the number of the facility.

The Facility Type is a code consisting of a maximum of 6 characters designating the type of facility.

The channel/pair is a code consisting of a maximum of 4 characters indicating the channel number of a carrier facility or the pair of a cable facility.

Terminal A is the CLLI for the "A" end of the facility.

Terminal Z is the CLLI for the "Z" end of the facility.

Example of a CLFI

2/A/6 /CHCGIL3604T /DNVRCOMAT10

2 - System #2
A - An Analog channel group other than "N", "O" or "ON"
6 - Channel 6 of the system
CHCGIL3604T - CLLI for Terminal "A"
DNVRCOMAT10 - CLLI for Terminal "Z"

The Facility types are listed in BSP 795-450-100.

The Common Language formats shown on pages 1.5 through 1.14 are used on various Bell System documents. Ability to read these Common Language codes is essential to the daily operation of the private line testroom.

WORK ORDER RECORDS AND DETAILS (WORD) DOCUMENTS

Two Basic types used for Private line maintenance.

1) CIRCUIT DESCRIPTION SHEETS AND 2) WORK AUTHORIZATION.

Make use of Common Language to provide documents on Private Line services. The Circuit Descriptions are a permanent record of each Private Line, and used as replacements for the older Circuit Order Layout Records (COLR) cards. The Work Authorizations are temporary and used only during preservice activities. BSPs 682-400-010 and 682-300-971LL cover these documents.

An example of a WORD CD is shown on page 1.17. The circled numbers are explained below.

1. The private line CLCI code
   - ON - Off Net Access Line
   - L - NonData operation
   - T - All Telco provided

2. Customer

3. Repeat of line 1 except written in English using abbreviations. This is a temporary entry used during conversion from COLA to WORD.

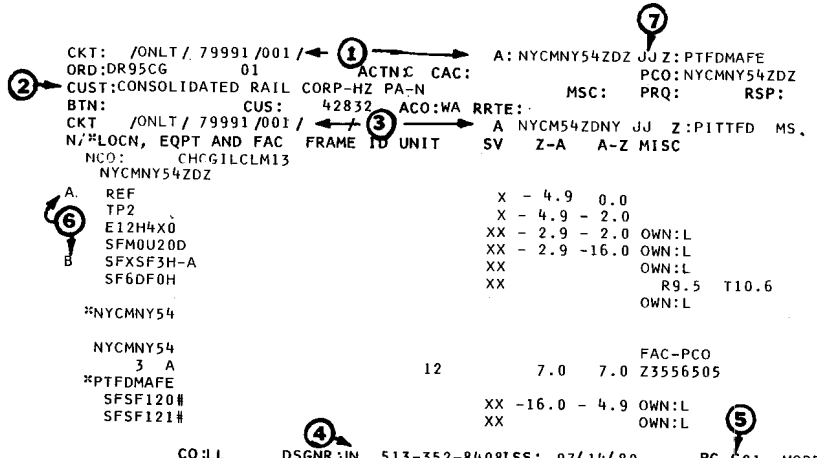
4. Design Engineer and phone number.

5. C indicates this is a circuit detail. 01 indicates page 1, More indicates that other pages follow.

6. Note (see page 1.20 for explanation.)

7. Indicates the type of signaling used. J is a code for Touchtone signaling (BSP 682-300-971LL, Appendix 1). The first "J" indicates the A-Z direction, the second the Z to A direction. Some of the more commonly used codes are shown below. For greater detail see the BSP.

   - A - Automatic Signaling
   - C - CCIS
   - D - Dial
   - F - Frequency Shift
   - J - Touchtone #12
   - K - Touchtone #16
   - M - Multifrequency
   - P - Panel Call Indicator
   - R - Ringdown
   - S - Straightforward
   - T - Dial Selective (Two tone)
   - V - Revertive
   - 5 - CCITT #5
   - 6 - CCITT #6
   - — - No Signaling




```
CKT:  /ONLT/ 79991/001/    /              A:NYCMNY54ZDZ JJ Z:PTFDMAFE
ORD: DR95CG       01        ACTN:C CAC:                  PCO:NYCMNY54ZDZ
N/*LOCN, EQPT AND FAC  FRAME ID UNIT    SV   Z-A   A-Z MISC
C   REF                                  X   0.0 - 4.9
    PHLAPALLA40
    FD DISTRIBUTION POINT

R N F RES ALBYNYSS     NYCMNY54    24  A          9  FR715900        08-
A   CKL 1-NEW YORK,NY
    NEW YORK TELCO #1 ESS
    2W & 4W CCSA
    811 10TH AVENUE
    17TH AND 18TH FLR
    TRM-A
    CKT TO BE ARRANGED IN ROTARY HUNT
    SEQUENCE WITH OTHER CKTS IN THIS GRP
    TERM EPSCS SWITCH
B   S/D GS1,GS2,M,R250,500,1000,2000
    A&B LEADS S/U./TO.4DB LS,R3.4DB LS/.
    CKL 2-PITTSFIELD,MS
    NEW ENGLAND TELCO
    CENTRAL OFFICE

         CO:LL     DSGNR:JN 513-352-8408 ISS:07/14/80      PG C02-MORE
NOTICE:  NOT FOR USE/DISCLOSURE OUTSIDE BELL SYS EXCEPT UNDER WRIT AGRMT
```

The WORD is repeated on page 1.19 for your convenience.

1. Control office

1A. Network control office

2. CLLI for "A"

3. CLLI for "Z"
Body of WORD lists all stations and equipment between A & Z in order. Stations are listed using the CLLI and equipment is listed using the CLEI. Except for "A" and "Z" all equipment will be preceded and followed by the CLLI when the equipment is located.

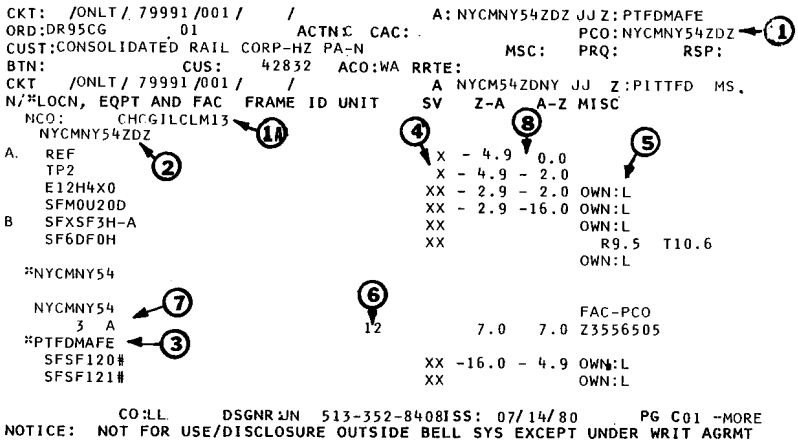
4. "S" stands for Signal path and "V" for Voice path. If the equipment shown on that line is in the signal path a "X" is shown under the "S". If it is in the voice path the "X" is under the "V".

5. This column lists Misc. information.

6. Channel numbers and pairs of cable facilities are shown under the "UNIT" column.

7. The facility is the CLFI in slightly different order than shown on page 1.14. The CLLI for "A" Terminal is shown first, then the facility designation, type, and number and finally the "Z" Terminal.

8. Test levels are shown. The Z-A column is read from the bottom of the card toward the top. The A-Z is top to bottom. All levels are at the output of the equipment of facility on that line.




```
CKT:  /ONLT/ 79991/001/     /              A:NYCMNY54ZDZ JJ Z:PTFDMAFE
ORD:DR95CG        01          ACTN:C CAC:                  PCO:NYCMNY54ZDZ
N/#LOCN, EQPT AND FAC  FRAME ID UNIT     SV   Z-A    A-Z MISC
C    REF                                  X   0.0 - 4.9
   PHLAPALLA40
    FD DISTRIBUTION POINT

R N F RES ALBYNYSS     NYCMNY54     24  A          9  FR715900        08-
A   CKL 1-NEW YORK,NY
    NEW YORK TELCO #1 ESS
    2W & 4W CCSA
    811 10TH AVENUE
    17TH AND 18TH FLR
    TRM-A
    CKT TO BE ARRANGED IN ROTARY HUNT
    SEQUENCE WITH OTHER CKTS IN THIS GRP
    TERM EPSCS SWITCH
B   S/D GS1,GS2,M,R250,500,1000,2000
    A&B LEADS S/U./TO.4DB LS,R3.4DB LS/.
    CKL 2-PITTSFIELD,MS
    NEW ENGLAND TELCO
    CENTRAL OFFICE

          CO:LL     DSGNR:JN  513-352-8408 ISS:07/14/80      PG C02-MORE
NOTICE:  NOT FOR USE/DISCLOSURE OUTSIDE BELL SYS EXCEPT UNDER WRIT AGRMT
```

Page 1.21 shows the last two cards of this WORD circuit description.

1. Notes: These notes are referenced in the main sequence of the document under the "N" column (See also 6 on 1.16). These notes give details as to Reference Levels, Equipment options, cable pair losses, etc. for the line where they appear. The explanation of the note referenced is always after the Z location on the document.

2. Under the preamble note a brief explanation of what the latest circuit order changed is shown.

3. Misc. information shows overall limits mileage, etc. (see BSP 682-300-971LL).

For more detailed explanation refer to the BSPs shown on page 1.16.

```
CKT:  /ONLT/ 79991/001/    /              A:NYCMNY54ZDZ JJZ:PTFDMAFE
ORD:DR95CG       01         ACTN:C CAC:                  PCO:NYCMNY54ZDZ
N/*LOCN, EQPT AND FAC  FRAME ID UNIT     SV   Z-A   A-Z MISC
C   REF                                   X  0.0 - 4.9
    PHLAPALLA40
    FD DISTRIBUTION POINT

R N F RES ALBYNYSS    NYCMNY54    24  A          9  FR715900       08-
A   CKL 1-NEW YORK,NY
    NEW YORK TELCO #1 ESS
    2W & 4W CCSA
    811 10TH AVENUE
    17TH AND 18TH FLR
    TRM-A
    CKT TO BE ARRANGED IN ROTARY HUNT
    SEQUENCE WITH OTHER CKTS IN THIS GRP
    TERM EPSCS SWITCH
B   S/D GS1,GS2,M,R250,500,1000,2000
    A&B LEADS S/U./TO.4DB LS,R3.4DB LS/.
    CKL 2-PITTSFIELD,MS
    NEW ENGLAND TELCO
    CENTRAL OFFICE

          CO:LL     DSGNR:JN  513-352-8408 ISS:07/14/80      PG C02-MORE
NOTICE:  NOT FOR USE/DISCLOSURE OUTSIDE BELL SYS EXCEPT UNDER WRIT AGRMT
```

(1)

```
CKT:  /ONLT/ 79991/001/    /              A:NYCMNY54ZDZ JJZ:PTFDMAFE
ORD:DR95CG       01         ACTN:C CAC:                  PCO:NYCMNY54ZDZ
N/*LOCN, EQPT AND FAC  FRAME ID UNIT     SV   Z-A   A-Z MISC
    TRM-A
    TERM IN NO. 5 CROSSBAR GROUNDSTART/
    TOUCHTONE. TN 413-499-2476
T N PREAMBLE:SPECIAL ROUTING RQMTS. PROC.DS
    REL:24-A-9 ALBYNYSS - NYCMNY54 AND RESV
    FOR FR7159 DUE 8-20-80.
    REL:10-1-9 ALBYNYSS - PTFDMAFE
    USE:3-A-12 NYCMNY54 - PTFDMAFE
    CSE:RWC 703-691-6269

MISC INFORMATION
    SWSYS A:4ES Z:25X  SWA A:TP2Z:       EML:  4.9  ALT EML:
    TST FQ:       NOISE A:      Z:       ICL:V2.9   ALT OPN:
    SF:    CLS:       CS:29-     GR CL:ON    MI: 193
    DD:08-20-80  SWC:          PTD:          RO:3281-     - -

COMPLETION DATE:   -   -       ASM ORD: D33GCD01
          CO:LL     DSGNR:JN  513-352-8408 ISS:07/14/80      PG C03-LAST
NOTICE:  NOT FOR USE/DISCLOSURE OUTSIDE BELL SYS EXCEPT UNDER WRIT AGRMT
```

(2)

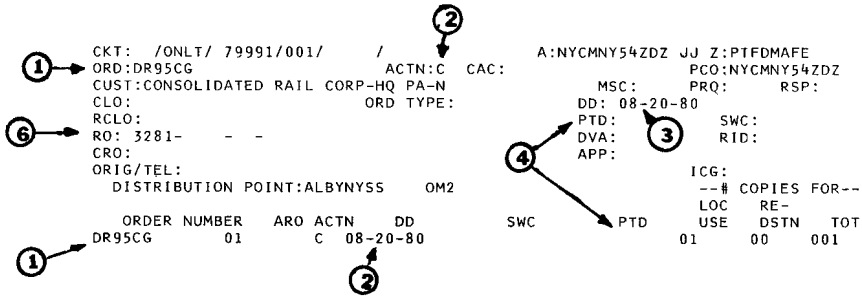
(3)

The Work Authorization WORD document for the service on pages 1.16 to 1.21 is shown on page 1.23.

No details are shown on the WORK Authorization ("W" instead of "C" in page number). It is necessary to refer to the "Preamble" note on the Circuit Detail for this information (page 1.20). However, the following information is available.

1) Circuit order number
2) Action (Add, change, disconnect, etc.)
3) Due date
4) Plant test date (when given)
5) Design engineer and Telephone number
6) Related circuit orders

In addition to the preamble note on the circuit description cards, offices involved in the work are marked with a * under that column on the circuit description cards (See COl on bottom of page 1.23).




```
          CO:LL     DSGNR:JN  513-352-8408 ISS:07/15/80     PG W01-LAST
NOTICE: NOT FOR USE/DISCLOSURE OUTSIDE BELL SYS EXCEPT UNDER WRIT AGRMT
```

```
CKT: /ONLT/ 79991/001/ /              A: NYCMNY54ZDZ JJ Z: PTFDMAFE
ORD:DR95CG      01          ACTN:C  CAC:                PCO:NYCMNY54ZDZ
CUST:CONSOLIDATED RAIL CORP-HZ PA-N              MSC:   PRQ:      RSP:
BTN:              CUS:    42832   ACO:WA RRTE:
CKT   /ONLT/ 79991/001/    /            A NYCM54ZDNY JJ  Z:PITTFD  MS.
N/*LOCN, EQPT AND FAC  FRAME ID UNIT    SV   Z-A    A-Z MISC
  NCO:     CHCGILCLM13
  NYCMNY54ZDZ
A.  REF                                  X  - 4.9    0.0
    TP2                                  X  - 4.9  - 2.0
    E12H4X0                             XX  - 2.9  - 2.0 OWN:L
    SFM0U20D                            XX  - 2.9 -16.0 OWN:L
B   SFXSF3H-A                           XX              OWN:L
    SF6DF0H                             XX                R9.5  T10.6
                                                        OWN:L
*NYCMNY54

  NYCMNY54                                              FAC-PCO
      3  A                        12        7.0    7.0 Z3556505
*PTFDMAFE
    SFSF120#                            XX -16.0  - 4.9 OWN:L
    SFSF121#                            XX              OWN:L

          CO:LL.     DSGNR:JN  513-352-8408ISS: 07/14/80      PG C01 -MORE
NOTICE:  NOT FOR USE/DISCLOSURE OUTSIDE BELL SYS EXCEPT UNDER WRIT AGRMT
```

Multipoint private line services are generally too large to include all necessary information on one WORD circuit description. As a result they are broken into segments. Each segment will then be documented on a WORD. To allow a look at the overall private line a special WORD document called a Information type is used. Page 1.25 illustrates this type of WORD.

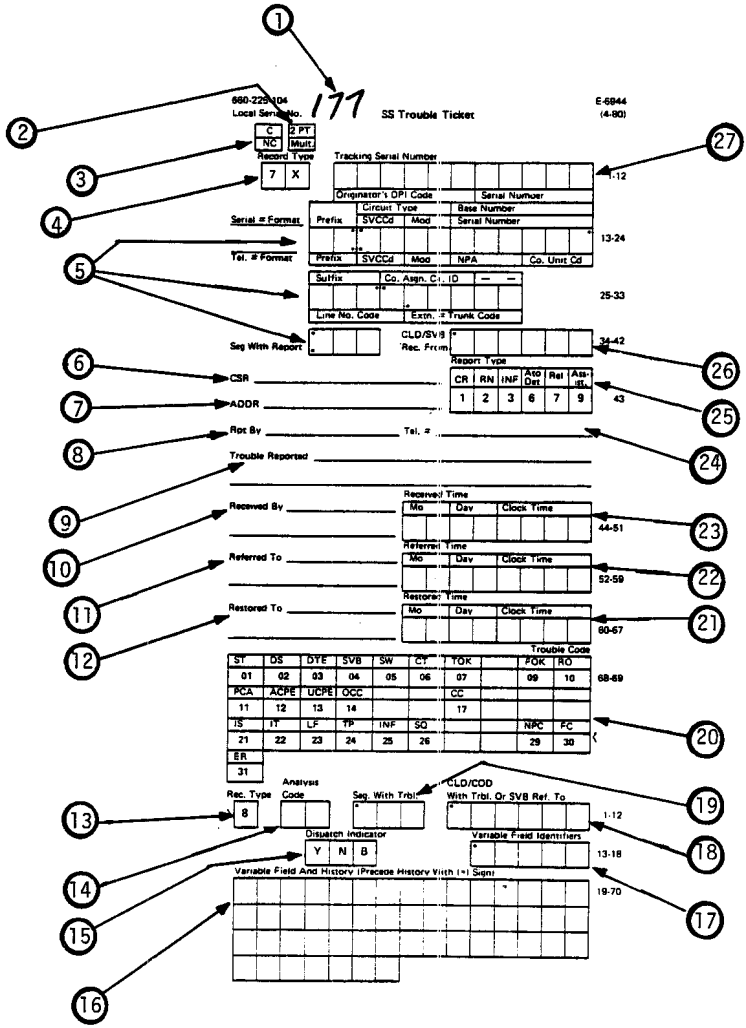
Card 1 is a list of all the segments and information concerning that segment.

1) Circuit order
2) due date
3) customer location address

Card 2 shows the circuit in outline form and refers to the segment (shown in brackets - ex /01/). All bridges and branches are shown. Two symbols are used to indicate continuity. The symbol "1" indicates a Vertical path read from top to bottom (Reference #1) and a "*" is used to indicate horizontal continuity (Reference #2). Horizontal continuity may be in either direction. For example, start at the Schenectady subscriber (Reference 3) read to left to the bridge. This shows a /01/ which indicates that this line is shown on segment 1. Reading down (Follow the "1" symbols) note that Segment /01/ is also shown for the feed to the other bridge. Thus Segment 1 covers all of the equipment and facilities between the Schenectady customer and the bridges. However each branch leg of the bridges has its own segment assigned.

```
  FDDC 73777                                    PCO: RUTLND  VT      FR286300
RUTLAND SAVINGS BANK                            NCO:
OPR: -- ALT OPR:       CL SVC: 50               PRI:                  DD: 090180
REF: JLB TEL NO: 914-320-2421            SPEC RFQ:VB
TOTAL SEGS: 05    MLG:                   ODS ISS:        CO: 1/
CKT NOTES:     SEG 01 MSTR STN


       CHANGE SEGMENT 06
SEG CKT ORD    DD     NAME ADDRESS-TERM                                  CITY     ST
01  FC013601 103079 FDS NORTHEAST 216 LAFAYYYETTE ST                    SCHEDY   NY
02  F4423301 111678 RUTLAND SAVINGS 104 MERCHANTS ROW                   RUTLND   VT
03  F4229307 062678 RUTLAND SAVINGS LUDLOW SHOPPING PLAZA               LUDLOW   VT
04  F4229308 062678 RUTLAND SAVINGS RTE 31 AND RTE 11                   MANCST   VT
05  F4106103 052579 RUTLAND SAVINGS WOODSTOCK AVE                       RUTLND   VT
06  FR286301 090180 RUTLAND SAVING & COCHNER DRIVE                      BENNTN   VT
      ①        ②            ③


CARD NO: 01  INFO TYPE: I     071480
 NOTICE: NOT FOR USE/DISCLOSURE OUTSIDE BELL SYS EXCEPT UNDER WRIT AGRMT


  FDDC 73777                                                          FR286300

WHITER  VT
BR1 BR2 /01/
/01/***5A6***ALBANY NY*203-T-15*SCHEDY NY 4LC
/02/***201R9***RUTLNDVT 4LC
/03/***116R8***BELLFLVT***208N11***LUDLOWVT 4LC
1           WHITER VT
1           BR3 BR4 /01/
/01/***IB***/01/
            /04/***106R11***MANCSTVT 4LC
            /05/***201R3***RUTLNDVT 4LC
            /06/**2A3**ALBANYNY*15-A-3*PITTFDMS--
             1 **203-D2-G**NADAMSMS**103-N-11**BENNTNVT 4LC


CARD NO: 02  INFO TYPE: L     071480
 NOTICE: NOT FOR USE/DISCLOSURE OUTSIDE BELL SYS EXCEPT UNDER WRIT AGRMT
```

SPECIAL SERVICES TROUBLE TICKET



Reference Number Code is on page 1.27.
Ticket reject codes may be found in BSP 660-225-104, Appendix 3.

1. Enter Local Serial Number (usually provided in advance)
2. Circle proper indicator (2 point or multipoint)
3. Circle proper indicator (control or noncontrol)
4. Circle "7" for a trouble; "X" for delete
5. Enter circuit ID as shown on circuit inventory. Top heading is for the Serial Number format, bottom for the Telephone Number format. Fill in unused spaces with dashes.
6. Enter customer identification.
7. Enter customer address.
8. Enter Reporting office or customer initials
9. Enter reported trouble, release or delete information.
10. Enter initials of person receiving report.
11. Enter office and initials to whom trouble is referred.
12. Enter initials of customer or office taking clearance.
13. Indicates Second Line continuation of report.
14. Enter Analysis Code (Table E, page 1.30)
15. Circle appropriate Dispatch indicator. (Y = Yes; N = No; B = Bulk)
16. Enter information relative to Variable Field indicators in same sequence. After this is complete enter "=" sign and plain language history.
17. Enter Variable Field indicators in any sequence (Table D, page 1.29)
18. Enter DPI code of District or SVB with trouble.
19. Enter segment number of serving link if applicable.
20. Circle appropriate trouble code (Table C, page 1.28)
21. Enter time service is restored.
22. Enter time referred. If not referred enter dashes.
23. Enter time report is received.
24. Enter customer's telephone number.
25. Enter appropriate report type (Table A, page 1.28)
26. Enter appropriate DBI code (Table B, page 1.28)
27. Enter tracking serial number.

The Tables in this Job Aid are for reference only. Complete information may be found in BSP 660-225-104.

Table A - Report Types

CR - Customer Report
RN - Referred In
INF - Information
ATO DET - Automatic Detect
REL - Release
Assist - Assistance required

Table B - CLD/SVB

CR - enter 6 Digit DPI for CLD (Customer Location District)
RN - enter DPI of SVB making referral
ATO DET - enter DPI of SVB making detect
INF or REL - enter DPI of SVB or dashes
Assist - enter the CLD code

Table C - Trouble Codes Maintained

ST (01) - Telco equipment at customer location
DS (02) - Dataspeed 40 equipment
DTE (03) - Telco provided data Terminal equipment
SVB (04) - equipment or activity in SVB
SW (05) - private line network Switching equipment
TOK (07) - Test OK
FOK (09) - Test OK after dispatch
RO (10) - Referred Out
PCA (11) - Protective connecting equipment
ACPE (12) - authorized customer provided equipment
UCPE (13) - unauthorized customer provided equipment
OCC (14) - OCC equipment or facilities
CC (17) - Came Clear
IS (21) - inter SVB facilities
IT (22) - interoffice toll facilities
LF (23) - nonrepeatered local loop
TF (24) - carrier or repeatered serving link facilities
INF (25) - Information
SQ (26) - Subsequent info on previous report
NPC (29) - non plan classified equip.
FC (30) - Foreign carrier (outside USA)
ER (31) - Existing report (Duplicate)

Table D - Variable Field Indicators

A. Delayed Maintenance

B. No Access Time

C. Pickup Time

D. Maintenance of Service Charge

E. Mutliple Circuit Troubles

F. Customer Credit Allowance

G. Called/Calling Numbers

H. Serving Bureau Study

J. Headquarters Study

K. Tested Time (Completed)

L. Dispatch Time

M. Trouble Reported *

N. 100-Hour Duration

* Refer to BSP 666-225-104, Appendix 2 for codes used for this indicator.

Table E - ANALYSIS CODES

00	General
01	Came Clear
02	Plant Activities
03	Improper Operation
04	Commercial Power
05	Test Access Arrangement
06	Order Release
07	Customer Release
08	Maintenance Release
10	Direct Distance Dialing (DDD)
11	Cable
12	Frame
13	Carbons - Heat Coils
14	Office Wiring
15	Common Equipment
16	Line Circuit
17	Trunk Circuit
18	Term Set
19	Bridge
20	Echo Suppressor
21	Repeater
22	Equalizer
23	Signaling Equipment
24	Relay Switch Arrangement
25	Loopback Key
26	Coupler
27	Testboard Jacks
28	Central Office
29	Switching Machine
30	Carrier Channel
31	Carrier System
32	Broadband Facility
33	Overseas Switcher
34	Beyond Overseas Switcher
35	Overseas Access Line
36	Overseas Cable (Not IRC)
40	Telco Power
41	Station Equipment
42	Private Branch Exchange (PBX) Equipment
43	Key Telephone System (KTS) Equipment
44	Multiplexer
45	Inside Wire
46	Telephone Set
47	Telementry Equipment
48	Recording Device
49	Computer
50	Radio Transmit and Receive Equipment
51	Alarm Equipment

52 Acoustically Coupled Device

53 Data Set

54 Data Auxiliary Set

55 Teletype Model Series 30

56 Teletype Model 43KSR

57 Teletype Model Other

58 DATASPEED® 40 Display Unit

59 DATASPEED 40 Keyboard

60 DATASPEED 40 Printer

61 DATASPEED 40 Logic and Other

62 DATASPEED 40/4 Controller

63 DATASPEED 50 Equipment

64 Cluster Arrangement

65 1A Data Station

66 Subset

67 Regenerative Repeater

68 Physical Conductors

69 Other

70 Independent Company Facilities

71 Independent Company Switcher

72 Independent Company Equipment

73 Independent Company Other

74 Beyond Telco/IRC Interface

75 Beyond Telco/OCC Interface

76 Beyond Telco/CPE Interface

77 Beyond Telco/Independent Company Interface

78 Company Provided Equipment (CPE) Release

79 Other Common Carrier (OCC) Release

80 Data Service Unit (DSU)

81 Channel Service Unit (CSU)

82 Office Channel Unit (OCU)

83 Multipoint Junction Unit (MJU)

84 Digital Data Group Unit (DDGT)

85 Timing

86 1A RDT

87 Keyboard Display Unit (Not DATASPEED 40)

88 Tape Drive

89 High Speed Printer

90 Customer Provided Equipment (CPE) (Nonverified)

91 Came Clear (CC) - Unsectionalized

92 CC - Partionally Sectionalized

93 Network Translations

94 Network Congestion

95 Network Control Feature

Note: Any analysis code may be used with any trouble code/class of service.

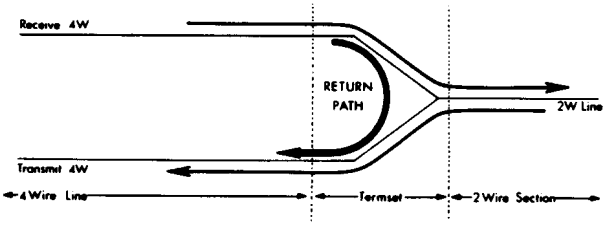
BALANCE AND NOISE

INDEX - SECTION 2

SINGING POINT & RETURN LOSS

Many circuits have 4-wire line facilities such as carrier channels and circuit units, which are reduced to 2-wire sections at the central office or customer location.

This change from 4-wire to 2-wire is accomplished with termsets (sometimes called hybrid coils). When converting from 4-wire to 2-wire, these devices create a *return path* as illustrated below.



As shown in the sketch, some of the receive signal is returned to originating end. If one end of the circuit is 2-wire, you will almost always find that the other end is also. In the sketch below you will see how a "singing path" is created. Each termset returns some of its received signal to the other termset.

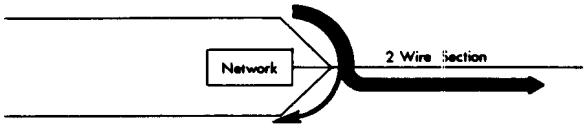
When the returned signal is of too high a level, it will be difficult or impossible to talk on the circuit. This condition may be reported by the customer as:

Loud echo
Hollow - "like talking in a barrel"

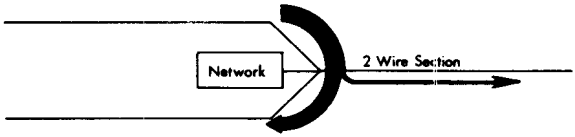
Whenever the returned signal overcomes the losses in the circuit a "sing" (howl) occurs. The frequency of this sing will be that frequency where the returned signal has its greatest power. The customer will probably report this condition as "howl" or "noisy"

CONTROL

We can control and measure the amount of signal power returned through a termset or hybrid coil. Termsets and hybrid coils are equipped with resistance and capacitive networks which can be adjusted to electrically match the 2-wire section. When the impedance of the network matches the impedance of the 2-wire line section, then the loss across the hybrid is maximum and maximum signal power is sent to the 2-wire section and mimimum power is returned to the originating end. This called a good balance.



A bad impedance mismatch between the network and the 2-wire section will allow a large amount of signal power to be returned to the originating end, causing the circuit to "sing" or sound "hollow".



MEASUREMENT

The degree of impedance balance between a 2-wire line and its network is called the "Singing Point". Since the balance introduces *loss* into the return path, we express it in dB. We can measure this loss by adding gain to the circuit and increasing the gain until it "sings". When we have added as much gain as there is loss, the circuit will sing and we have reached the "Singing Point". With some simple computations covered in another part of this section, we can determine the actual Singing Point in dB.

The engineer who designed the circuit will specify the Singing Points and will design circuit around these values. It is our job to make sure that the actual Singing Point is as high or higher than that specified on the WORD document, or in the BSP for the type of service involved.

There are three methods of measuring the Singing Point or balance on a circuit.

1) Singing Point is the measure of a single frequency (that with the lowest loss across the hybrid) in the band from 200Hz to 3200 Hz.

2) Singing Return Loss is the weighted average return loss in the singing bands (those bands most likely to contain the singing point frequency) between 200 to 500Hz and 2500Hz to 3200Hz.

3) Echo Return Loss is the power returned across the hybrid in the range from 500Hz to 2500Hz. This band of frequencies is most likely to cause echo to the talker.

While other methods for making these tests are available, it is recommended that a KS20501 Return Loss Measuring set be used whenever possible. Both SRL & ERL can be easily checked with this set. As you can see from the above both measurements are required if we are to accurately cover the frequency band used. Singing Point tests (BSP 103-106-105) could also be used in an emergency, however, the SRL-ERL combination is the recommended procedure.

Singing Point Tests or Return Loss Measurements may be made to either an "ON-Hook" (non-Terminated) or a "OFF-Hook" condition. The Terminations required for a "OFF-Hook" test vary with the type service and are too complex to state in this Job Aid. BSP's giving specific instructions are listed below:

2 point Private Line Service: 310-300-500
Multipoint Private Line Service: 310-405-500
Other Common Carrier Facilities: 471-210-020
Switched Services: 311-350-100 & 311-350-500
Other special services are covered in the maintenance BSP for the service.

Most requirements are based on "OFF-Hook" or Terminated conditions. To achieve this condition the BSPs should be followed explicitly. In some cases special procedures are required to hold the Termination in effect while the test is being conducted. Both ERL and SRL tests are required and different requirements are set for each in most cases. Page 2.5 outlines the general procedure for making these tests using a KS20501 Return Loss Measuring set (BSP 103-106-115).

ECHO RETURN LOSS (ERL) AND SINGING RETURN LOSS (SRL) USING THE KS20501 RETURN LOSS SET

The instructions listed here are general in nature. Exact BSP procedures should be followed for the service being tested. Test is assumed to be made from 4-wire side of terminating set.

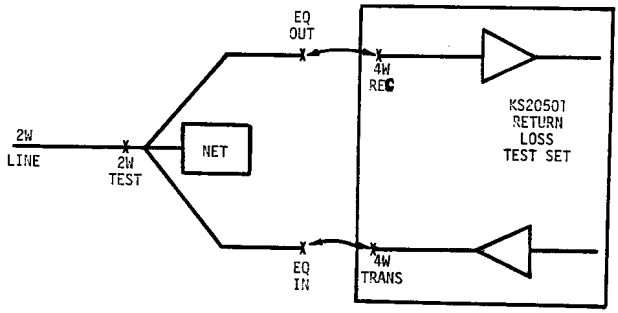
1 Turn on Set.

2 Establish the termination for the service being tested according to the BSP for that type service.

3 Make sure terminating set has the screw settings called for on the WORD.

4 Set the TEST Switch to "ERL", the TEST LOCATION Switch to the "+0" position, and the ADD DB switch to 0.

5 Connect the KS20501 Test set as shown below:



6 Short tip and ring on 2-wire side of Term Set (this can be done by inserting a S/C plug on the 2-wire test jack of the Term set if one is provided). This establishes a path across the terminating set for calibration of the test set.

7 Adjust the THL or ADD controls for a "0" DB indication on the meter. If "0" cannot be obtained, set ADD DB to "-10" and readjust to "0". Measurements must be reduced by 10dB if this is necessary. Set is now calibrated for the service to be tested.

8 Remove the short from the 2-wire side of the Term Set.

9 Adjust ADD DB switch for an on-scale reading. ERL equals sum of Meter reading and ADD DB setting. Compare with required ERL.

10 Set TEST switch to SRL and Adjust ADD DB for reading on meter. SRL equals sum of meter and ADD DB setting. Record SRL.

11 Set TEST switch to SRL-HI and Adjust ADD DB for reading on meter. SRL-HI equals sum of meter and ADD DB setting. Record SRL-HI.

12 Compare SRL & SRL-HI. The lowest reading is the corrected SRL and should be compared with the required SRL.

13 If either the ERL or SRL does not meet requirements the impedance balance should be improved if possible. If not possible, case should be referred to the engineer.

RETURN LOSS TESTS FOR OTHER COMMON CARRIERS

Return loss tests for services involving other common carriers follow special rules and must meet special requirements. BSP 471-210-020 lists these procedures and requirements and should be followed exactly on these services. Because of the variety of these services and the test procedures and requirements for each type, no attempt is made in this job aid to set forth more detail.

MESSAGE CIRCUIT NOISE

Message Circuit noise is any extraneous sound, of 200 milliseconds or longer in duration, that interferes with voice or data transmission. It is caused by voltage other than voice or data signals, such as grounds, x-talk & intermodulation, x-mod, unsoldered splices, open wire or power induction.

Noise can be annoying to the customer and in the case of data it can cause errors in transmission when certain 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 positions: OFF;BAT (should read above red line); CAL (connects 1000 HZ osc and should adj. to red line with attenuator set on 85); NG (measure noise to gnd); BRDG; 600 Ohm; DBRN attenuator 0-85 in 4dB steps. NORMAL-DAMP switch is used for measuring gradual or rapidly varying noise. WTNG network weights freq. in proportion to its interfering effects. Weightings are C-MSG (used on PL testing), 3KC Flat. PGM, and 15 KC Flat. The C-MSG weighting is used for private line telephone service since it most closely approximates the noise heard by the customer. The 3A set reads directly in dBrn (dB above reference noise).

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

NOISE CONVERSION CHART

dBm	dBrn
0	90
-10	80
-20	70
-30	60
-40	50
-50	40
-60	30
-70	20
-80	10
-90	0

MESSAGE CIRCUIT NOISE ("C" MESSAGE NOISE)

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

NOTE: Limits are in reference to 0 TLP (0 Transmission Level Point). Reading taken at other TLP's must be corrected as shown below:

dBrnC corrected to a "0" TLP is expressed as dBrnC0.

to correct dBrnC0 add or subtract the TLP from the dBrnC as shown in the examples,

1) +7 TLP read 37 dBrnC
   -7 -7
   0 TLP 30 dBrnC0

2) -16 TLP read 18 dBrnC
   +16 +16
   0 TLP 34 dBrnC0

3A NMS reads dBrnC directly when equipped with "C" message weighting filter.

Loss deviation tests should be made and requirements met before performing noise tests.

As circuit noise is in part a result of crosstalk and cross modulation, it should be measured during periods of normal to high traffic when possible.

TWO-POINT TELEPHONE CIRCUITS

2 Point Private Line Message Service Requirements are shown on page 2-10. If the service is used for Data transmission refer instead to Section 5.

Message circuit noise requirements are given in two parts:

(a) Overall message circuit noise requirements

(b) Loop message circuit noise requirements.

When overall noise requirements are met, the loop measurements may be omitted. The loop noise requirements are primarily for trouble location procedures.

TABLE "D"
MESSAGE CIRCUIT NOISE REQUIREMENTS

OVERALL CIRCUIT

CIRCUIT LENGTH MILES	NOISE (dBrncO)	
	OBJECTIVE	TROUBLE IF ABOVE
0-50	31	44
51-100	34	44
101-400	37	44
401-1000	41	50
1001-1500	43	50
1501-2500	45	50
2501-4000	47	50

LOOP NOISE (dBrncO)
NOISE MEASURED AT

	CENTRAL OFFICE		STATION
	STATION ON-HOOK	STATION OFF-HOOK	
Objective	10	5	20
Trouble If Above		15	30

MULTISTATION TELEPHONE CIRCUITS

Multipoint message service requirements are shown on page 2-11. If the service is used for Data Transmission refer instead to the requirements in Section 5.

MULTIPOINT TELEPHONE CIRCUITS
BSP 310-405-500

TABLE E

C-MESSAGE NOISE REQUIREMENTS

CIRCUIT LENGTH (MILES)	MAXIMUM NOISE (dBrnc0)
0- 50	31
51- 100	34
101- 400	37
401- 1000	41
1001- 1500	43
1501- 2500	45
2501- 4000	47
4001- 8000	50
8001-16000	53
Satellite Channel	44*

*Add this figure to land line requirement on a random power basis as described in BSP 314-410-102 to obtain the overall circuit requirement.

The circuit length in miles is the length of the link or links contributing noise at the point of measurement. The length in miles is given on the WORD Document.

IMPULSE NOISE

Impulse noise can be defined as random bursts of noise of short durations, usually a few milliseconds or less in duration. It has a negligible effect on voice transmission and is not a requirement for Private Line Voice Circuits unless Data is also transmitted. Impulse noise is covered in Section 5 for Data Services.

SIGNAL TO NOISE RATIO

The Signal to Noise ratio is the comparison of the relative power of the signal to the noise present.

It assumes that the noise weighting should be the same for both measurements and is expressed in dB.

The easiest way of checking this reading is to use a noise set with the required weighting network in place:

a) Measure the level of the test tone in dBrn.
b) Measure the level of the noise in dBrn.

Subtract "b" from "a". This is the signal to noise ratio.

If the noise set being used is not capable of reading the test tone directly, a TMS may be used and, using the chart on page 2.8 the dBm reading of the tone may be converted to dBrn. The noise reading is then taken and subtracted from the converted tone level. While this reading may not be completely accurate, it is approximately correct.

"C" NOTCHED NOISE

"C" notched noise is "C" message weighted noise that is taken in the presence of a holding tone. The noise set filters out the Holding tone and measures only the noise. These measurements are used mostly with data services (see Section 5).

Sig to noise with "C" notched noise is usually taken by shorting out the notch filter in the test set, thus measuring the signal level, and then reading the noise with the filter in.

FAA Services for Air-Ground Communications

Certain special voice-bandwidth channels used by the U. S. Government Federal Aviation Agency have special test parameters. These services and their parameters are covered by BSP 310-305-100 and 310-305-500. Care should be taken to insure that tests are not transmitted by the radio terminal.

The table below indicates the test required by these services.

TEST	CIRCUIT ORDER	ROUTINE
Net Loss (1004 Hz)	*	AR
Noise	*	*
Frequency Response	*	AR
DC Measurements (STC to Station)	*	AR
Customer Equipment Output Power	*	AR
Loopback Operation	*	AR
AC Switching	*	AR

All loss measurements are made at 8 dB below the TLP (example: send -24 dBM at a -16 TLP).

The AML (actual measured loss) is compared to the EML (expected measured loss) at 1004 Hz. The difference between the two is known as the loss deviation.

Requirement

Deviation = +0.0 dB to -1.00 dB on circuit order
+3.0 dB to -2.00 dB trouble or routine

Frequency Response (Attenuation Distortion)

Make frequency deviation tests at those frequencies shown on page 2.14. The requirements are shown in the two right columns.

(A) = CONTROL
(Z) = NONCONTROL

REMOTE CONTROL AIR GROUND CIRCUIT
TRANSMISSION HISTORY

310-305-500

CIRCUIT NUMBER _____

DATE											LIMITS (dB)	
FREQ (HZ)	RCV(A)	RCV(Z)	RCV(A)	RCV(Z)	RCV(A)	RCV(Z)	RCV(A)	RCV(Z)	RCV(A)	RCV(Z)	CO	ROUTINE
300											+6 TO -1	+9 TO -2
500											+3 TO -1	+6 TO -2
600											+3 TO -1	+6 TO -2
800											+3 TO -1	+6 TO -2
1000	0	0	0	0	0	3	0	0	0	0		
1200											+3 TO -1	+6 TO -2
1400											+3 TO -1	+6 TO -2
1600											+3 TO -1	+6 TO -2
1800											+3 TO -1	+6 TO -2
2000											+3 TO -1	+6 TO -2
2200											+3 TO -1	+6 TO -2
* 2400											+3 TO -1	+6 TO -2
2500											+5 TO -1	+8 TO -2
2600											+5 TO -1	+8 TO -2
2700											+5 TO -1	+8 TO -2
2800											+8 TO -1	+11 TO -2
3000											+8 TO -1	+11 TO -2

RECORD DEVIATIONS FROM 1000 HZ; PLUS SIGN INDICATES MORE LOSS AND MINUS SIGN INDICATES LESS LOSS.

NOTES:

* DAS 806A3 OPERATE FREQUENCY

Noise Measurements

Steady noise measurements should be made at the demarcation point (an NMS with C-message weighting should be used) by terminating the transmitting input to the circuit with 600-ohm impedance and by measuring the noise level at the receiving end. During each measurement the NMS should be used to monitor the circuit for intelligible crosstalk.

Requirements

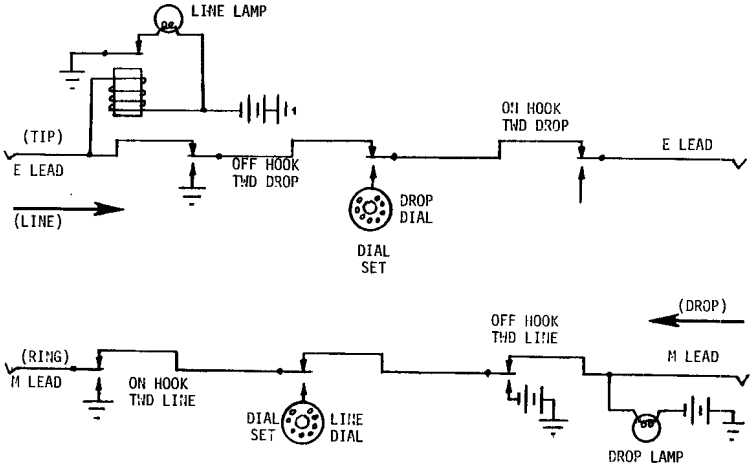
CIRCUIT LENGTH (MILES)	NOISE MEASUREMENT* AT OR BELOW (DBRNCO)
0- 50	31
51- 100	34
101- 400	37
401-1000	41
1001-1500	43
1501-2500	45
2501-4000	47

* Based on C-Message Weighting

When a circuit contains a compandored facility, the above limits are lowered 5dB for the compandored facility. A circuit made up of compandored and noncompandored facilities should use the limits above.

SIGNALING

INDEX - SECTION 3



BASIC SUPERVISION FEATURES OF 1A, 2B, 2B-1* AND 4A TEST SETS

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

The E lead or the tip of the pair is the receiving signaling lead and always controlled by the line equipment. It is either open (idle condition) or grounded (busy condition).

The M lead or the ring of the pair is the transmitting signaling lead and always controlled by the drop equipment. It is either grounded (idle condition) or battery (busy condition).

The 1A, 2B or 4A test set may be used as a means of monitoring the E & M leads with lamps 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 and is commonly referred to as an on hook condition from the line. When the E lead is grounded, the lamp goes out and is referred to as off hook condition.

The DROP LAMP or the lamp controlled by the M lead (ring) will be lit for the on hook condition if there is a ground received from the drop equipment. In the 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 keys.

TWD DROP KEY:

ON HOOK - will furnish an open on the E lead (tip) toward the drop regardless of the condition received from the line equip.
OFF HOOK - will provide a ground on the E lead (tip) toward the drop.

TWD LINE KEY:

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

DIAL KEY:

DROP - enables you to dial towards the drop. As the dial is released, a series of grounds & opens on the E lead toward 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/2B-1 signaling test set converts the pulses generated by the 2B-1 signaling test set to a form suitable for application to 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 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. PLS key to LINE (PERCENT BREAK meter should read 0 in BLACK or 100 RED when key is thrown).

TO RECEIVE PULSES

1. TWD D key to ON HOOK or OFF HOOK as required.

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.

TO SEND DIAL PULSES

1. DIAL PLS key to DIAL PLS.

2. PLS key to LINE or DROP (depending on direction you wish to dial).

3. Throw on off hook in direction you wish to dial.

4. Operate dial on test set.

BSP References:

100-262-101	1A Test Set
100-263-501	2B-2B1 Test Set
100-267-101	4A Test Set
333-122-501	Overall Signaling Arrangements and Testing
333-125-500	FX and WATS
333-126-500	Dial Tie Lines

4A SIGNALING TEST SET

MAIN MODULE CONTROLS:

SEND SWITCH: Connects the pulse generating circuit to the desire interface unit. The R position is a calibration position to permit adjusting the mercury relay output of the generator using the RELAY ADJ control.

PULSE MODE SWITCH: Permits the selection of the type of pulsing, either continuous pulsing or pulsing under the control of the keyset.

KEYSET: Allows outpulsing from one to ten pulses or a repeated discrete train of pulses with two choices of interdigital times.

PULSE WIDTH SWITCHES: Allow varying the pulse width from 1 to 998 ms in one ms intervals.

PULSE PERIOD SWITCHES: Allow varying the pulse period from 2 to 999 ms in one ms intervals.

GEN SUPV KEY: Determines steady-state output of test set.

(a) ON HK Position: The idle condition is on-hook and pulse type is make.

(b) OFF HK Position: The idle condition is off-hook and pulse type is break.

OPERATE-CLEAR KEY: Permits cutting off pulsing when operated to the clear (nonlighted) position. In the lighted position it starts the outpulsing when the PULSE MODE key is in the CONT position and prepares the circuit for outpulsing when the PULSE MODE key is in the KEYSET position.

Measurement and Display Circuit Controls

RECEIVE SWITCH: Connects the measurement and display circuit to the desired interface unit. The R position permits measurement of the mercury relay in the pulse generator for a shelf check and adjustment.

START-STOP KEY: Allows the measurement and display circuit to operate when operated to the lighted position. Release of the key to the lamp-extinguished position provides a manual stop.

MS RANGE SWITCH: Permits selection for two millisecond ranges.

(a) 99.9 Position: Allows measuring an interval equal to or less than 99.9 ms and positions a decimal on the NIXIE readout.

(b) 999 Position: Allows measuring an interval equal to or less than 999 ms but with less accuracy than the 99.9 position. This position also provides the split pulse cancellation feature.

FUNCTION SWITCH: Selects the type of measurement to be performed.

(a) NO. OF PULSES Position: Allows reading the number of pulses received.

(b) SPEED Position: Allows measuring the average speed of a train of pulses in pulses in second.

(c) % BK Position: Allows measuring the average percent break of a train of pulses.

(d) MK Position: Used in conjunction with the READ switch to display the maximum, minimum, or last make interval measured.

(e) BK Position: Used in conjunction with the READ switch to display the maximum, minimum, or last break interval measured.

(f) PER Position: Used in conjunction with the READ switch to display the maximum, minimum, or last period measured.

READ SWITCH: Allows selection for one of three types of displays:

(a) MIN Position: According to the setting of the FUNCTION switch, allows displaying the minimum make, break or period interval in a series of pulses.

(b) MAX Position: According to the setting of the FUNCTION switch, allows displaying the maximum make, break, or period interval in a series of pulses.

(c) UPDATE Position: According to the setting of the FUNCTION switch, allows displaying the last make, break, or period interval recorded by the test set.

SELECTOR SWITCH: Used to terminate a reading automatically by use of the STOP-START button, or when signals are no longer present.

(a) 1-9 Positions: Allow termination of a measurement after any one of the first nine pulses to which it is set when the FUNCTION switch is in the millisecond mode.

(b) NORM position: Allows termination of a measurement when the START-STOP button is operated for a manual stop (lamp extinguished) or when signals are no longer present.

E & M INTERFACE UNIT

TO MONITOR (HIGH IMPEDANCE):

1. Set "Twd Line" and "Twd Drop" to "Mon" and "Pulse/Meas" key to either "Line" or "Drop".

2. Set "E&M/cx-S/R" Switch to "E&M/cx". Patch "Drop/S" and "Line/R" Jacks to circuit under test.

TO PULSE AND MEASURE:

1. Set "Pulse/Meas" key to "Line" or "Drop" as required.

2. "Twd Line" and "Twd Drop" keys as required.

3. On the main module set the switches as required for the test being conducted.

SF INTERFACE UNIT

TO MONITOR (HIGH IMPEDANCE):

1. Operate "Twd Line" and Twd Eqpt" keys to "MON".

2. Set "Pulse/Meas" key to desired direction.

3. Patch Test Set to circuit under test, substituting the test set for the jack normals at the +7-16 TLP.

TO PULSE AND MEASURE:

1. Set "Pulse/Meas" key to "line" or "eqpt" as desired.

2. Set "Twd Line" and "Twd Eqpt" to "On Hk" or "Off Hk" as required.

3. Patch test set to "line" or "eqpt" jacks as required at +7-16 TLP.

4. On the main module set the switches as required for the test being conducted.

DX INTERFACE UNIT

To Monitor (High Impedance) and Measure:

1. Set double key to "Mon/Meas" position.

2. Set the "Bias" key to "Mon".

3. Patch DX interface to DX unit under test.

   a. For 2W facilities use "To Line" and "From Eqpt" jacks only.

   b. For 4W facilities "A" lead pair goes to "To Eqpt" and "From Line" and "B" lead pair goes to "From Eqpt" and "To Line" jacks.

4. To measure dial pulses operate "Bias" key to "On Hk" if Receiving DX is idle and "Off Hk" if it is off hook.

To Pulse:

1. Set Double key to either "pulse line" or "pulse eqpt" as required.

2. Set "Fac" key to "4W" or "2W" as required.

3. Set line resistance keys to simulate line resistance.

4. Set controls on main module as required for test in progress.

LOOP INTERFACE UNIT

Performs various loop signaling, pulsing and measuring functions. Because this unit is more complex than the other, refer to BSP 100-267-101 for instructions.

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-1 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 TRANSMIT 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)

310-430-100
310-430-500

Consists of . . .

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

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

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

When dispatching a craft to work on troubles in the receiving unit make sure the craft takes a DC millimeter and makes 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 level.

Frequency Tolerances:

600 HZ (±) 4HZ
1500 HZ (±) 10HZ

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

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

SS1, SS1-A, SS4 SELECTIVE SIGNALING CIRCUITS

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

SUMMARY OF PRINCIPAL FEATURES:

(A) SS signaling tones (2400-2600 HZ) are sent and received at all the station on a multipoint 4-wire private line circuit. No tone is on the line in the idle condition. The 2400HZ tone is used as a guard frequency, while the 2600HZ is used for signaling.

(B) System capacity is 81 two-digit codes.

To obtain reliable dialing, the SF receivers are shifted into the dialing or low guard condition upoin receipt of the first pulse of 2600 HZ. 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 HZ 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 HZ 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 HZ busy tone is provided 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 SS 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.

(I) General features:
Signaling level is 8 dB below voice level.
2400 HZ is the guard frequency.
2600 HZ is the signaling intelligence frequency.

(J) The system will signal reliably in the presence of return losses as great as 10 dB.

(K) Touchtone Frequencies may be used if desired. Interface equipment is necessary.

(L) Data may be transmitted over the private line by use of a locally provided data transfer circuit.

(M) All three SS systems (1, 1A and 4) are compatible, However, SS4 requires a much more accurate 2400 and 2600 frequency. Therefore when a SS4 is used with a SS1, or SS1A, the SS1, or 1A, requires accurate frequency adjustment.

Information on SF Units:

The standard SF for use in the SS systems is a FWA unit. The earlier E4B units are still used occasionally. The new GBA unit will probably be used when it becomes available.

SS Line-up Procedure:

SS1 equipment at customer location should be tested per BSP 480-621-50X, SS1A per BSP 480-622-50X; and SS4 per BSP 480-623-002.

Transmission Tests on Local Loops

Measure cable pairs in accordance with standard procedures as shown in BSP 310-405-500.

ADJUSTING 2600 AND 2400 HZ FROM CUSTOMER.

Tester applies 2600 Hz or 2400 Hz to the level as per appropriate BSP.

Requirements = SS1 or SS4 - 2600 HZ ±4 HZ, 2400 HZ ±30 HZ
SS1A - 2600 HZ ±8 HZ, 2400 HZ ±8 HZ.
Levels for both systems to be -8dBm 0 (8dB below TLP)
Level adjustments can be made by adjusting the LEV ADJ potentiometer.

If level requirements cannot be met proceed as follows:

SS1-SS1A

A. Have tester at customer connect TMS to OSC TST jack.
B. Turn LEV ADJ potentiometer fully clockwise, TMS reads 2dBm.
C. If requirement of "B" is not met:

Unlock P1 potentiometer and adjust until TMS reads 2dBm. Lock P1 potentiometer.

D. Remove the TMS from OSC TST jack.

E. Adjust LEV ADJ potentiometer for level 8dBm below circuit level at 2600 HZ when measuring tone from customer.

SS4

A. Place a Temporary Strap between Terminals 81 & 91 of TSB on the J1G033A panel.

B. Adj the LEV ADJ pot for -8dB below TLP.

If frequency requirements are not met proceed as follows:

To adjust frequency to ± limits for system (SS1, SS1A), tester at customer straps capacitors in or out of Keyer circuit.

SS1 per Table C of BSP 480-621-502
SS1A per Table C of BSP 480-622-502

SS4 Frequency is not adjustable.

MAKE TRANSMISSION MEASUREMENTS TO EACH STATION PER BSP 310-405-500.

OVERALL TESTS

Overall tests on SS systems should be made according to procedures in the BSPs listed below:

SS1 - 480-621-501
SS1A - 480-622-501
SS4 - 480-623-002

Installation, options and general information is available in:

SS1 - 480-621-200
SS1A - 480-622-200
SS4 - 480-623-001

Touchtone adaption for SS1 & SS1A information is available in BSP 480-621-503.

Trouble and sequence charts are also shown in BSPs as shown below:

SS1, 1A - 480-621-500
SS4 - 480-623-002

NOTES ON TROUBLE REPORTS- SS SYSTEMS

On troubles where one station is 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, if the frequency is out of limits or varying, it will cause problems in dialing.

Very low level will also cause problems in dialing.

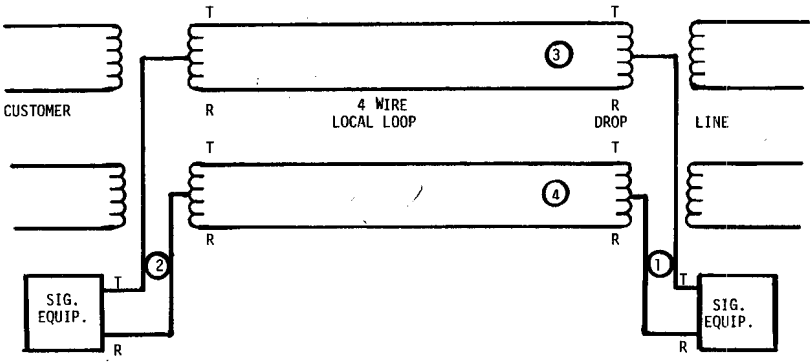
A station "locked-up", unable to dial due to no disconnect tone from previous call or by failure to receive unlock tone on privacy arrangement, may be released with SS test or a short period (6 sec) of 2600 HZ tone toward the station with trouble.

If an SS4 system is on the same service as an SS1 or SS1A, the frequency of the SS1 & 1A systems should be checked if dialing problems into the SS4 exist.

SS3 Selective Signaling System

SS3 is used on large network touchtone services. A maximum of 648 3-digit codes are available. While operation is similar to SS1, BSP 480-625-210 should be referred to when working on this sytem.

SIMPLEXING



Commonly on our circuits with 4-W 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.

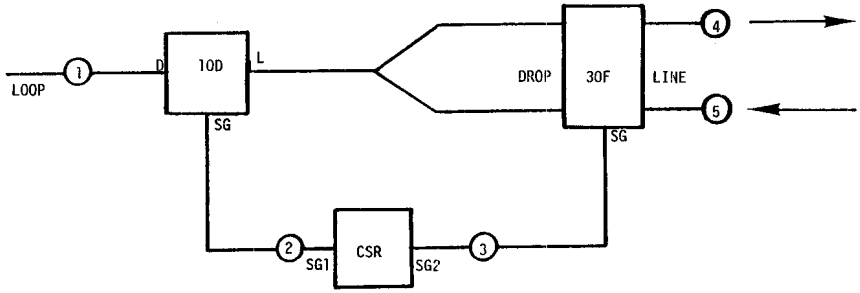
To obtain the third pair or simplex pair, a coil is used across the tip and ring of each individual pair. The coil is then tapped at each end and brought out as one side of the simplex pair.

Generally the transmitting pair from the sub is used as the tip of the simplex and the receive pair the ring of the simplex. 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 fo 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 at (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.

30F RD1D****
10D RD2D**0*
CSR MSCS100*



		SG	LOOP
BASIC	Idle or Busy	GND	No ringing
RINGDOWN	Incoming Ring	-24V	20 HZ toward loop
	Outgoing Ring	-24V	20 HZ from loop

10D RINGER

Converts 20 HZ to DC and vice versa (1) 20 HZ from the loop get -24 volts on SG (2).-24 volts on SG (2) get 20 HZ from 10 D (1) toward loop.

NOTE: 20 HZ output of 10D is 105 volts AC. It requires a minimum input of 15 volts AC to operate.

CODE SELECTOR RINGER (CSR)

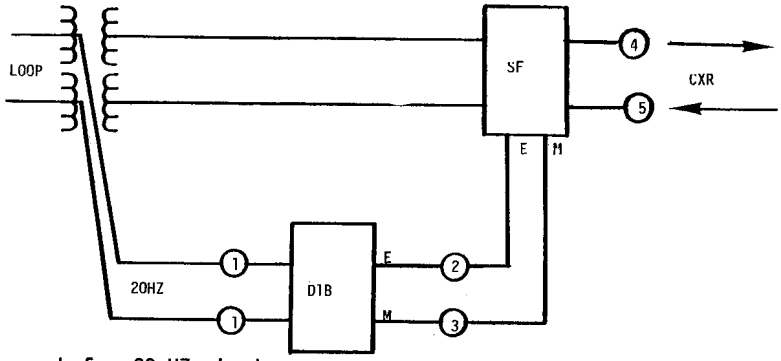
Used to select or count from 1 to 10 depending on what it is wired for. -24v DC pulses on the SG2 lead (3) are counted and will pass -24v to SG1 (2) for a one second duration only if proper code is received. Process takes about two seconds.

-24 volts DC SG1 (2) will be passed without interference to SG2 (3) (no codes necessary).

30 F RINGER

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

D1B SCE21**A
D0B SCED***



D1B is used for 20 HZ ringdown.

IDLE (NO RING) CONDITION

LINE ● DROP ●

No SF tone transmitting (4) or receiving (5). Ground from SF on E lead (2) and line lamp dark. Battery from D1B on M lead (3) and drop lamp dark.

OUTGOING RING

LINE ● DROP –○–

20 HZ AC from loop (1) (requires 15V AC min.). M lead (3) changes from bat to gnd from D1B and drop lamp lit. SF tone is now being transmitted (4).
E lead (2) and receive from cxr unchanged (5) (no SF).
When 20 HZ is removed from loop see idle condition.

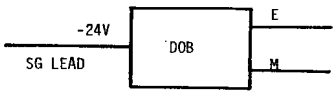
INCOMING RING

LINE –○– DROP ●

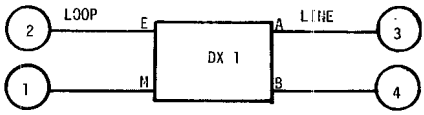
SF tone receiving (5)
E lead (2) changes from gnd to open from SF (line lamp lit) 20 HZ is applied by the D1B to the loop (1).
(output of D1B is 20 HZ at 105V AC)

D0B

The D0B operates in the same manner as the D1B with the exception that the D0B uses-24V DC on the SG (1) in place of 20 HZ AC during the ringing cycle.



DX 1 DXTO****



DX1

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

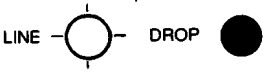
IDLE CONDTION

'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

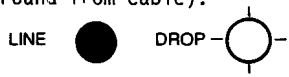
'A' lead (3) -48 Volt DC both ways.
'B' lead (4) -20 Volt both ways (never changes; it is used as a balance.)
'E' lead (2) ground from DX1.
-48 Volt batt on 'M' lead (1) or off hook from drop to DX1.

OUTGOING SEIZURE



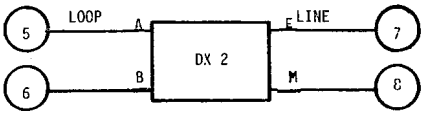
-48 Volt batt on 'M' lead or off hook from drop to DX1. 'A' lead (3) changes to -48 Volt DC from the DX1 (ground from cable).

INCOMING SEIZURE



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

DX 2 DXSO****



DX2

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

IDLE CONDITION

'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 (8) grounded from DX2 (drop lamp lit)

DX2 signals the same as DX1 but watch the type of SF. If other than 2600 HZ use a 2B set to dial out.

BUSY CONDITION

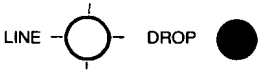
'A' lead (5) -48 Volt DC both ways
'B' lead (6) -20 Volt DC both ways (never changes; used as a balance)
'E' lead (7) grounded from SF (line lamp dark)
'M' lead (8) -48 Volt DC from DX2 (drop lamp dark)

INCOMING SEIZURE

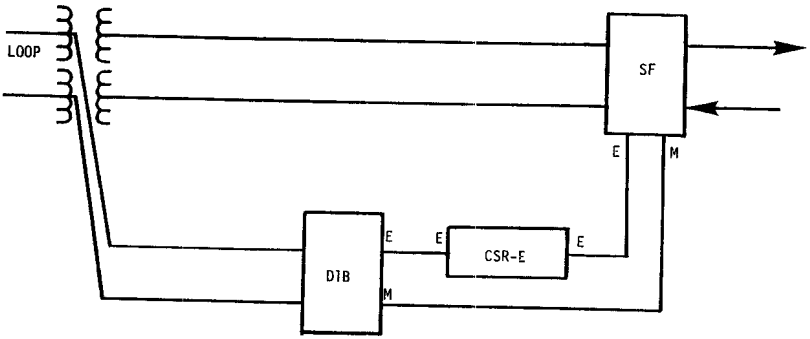
'E' lead (7) grounded from SF (line lamp dark)
'A' lead (5) -48 Volt DC from DX2 and ground from simplex

OUTGOING SEIZURE

'A' lead (5) -48 Volts DC from simplex and ground from DX2.
'M' lead (8) changes from ground to -48 Volt DC



D1B SCE21**A
CSR-E MSCS300*

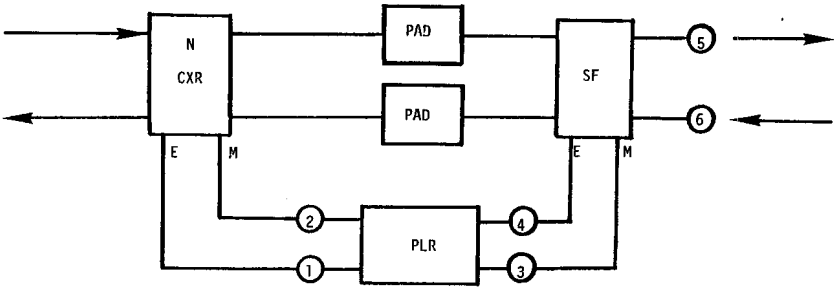


CODE SELECTOR RINGER (CSR-E)

Operations similar to CSR except that E & M leads are used rather than the SG lead. A CSR - E would normally be wired between SF and D1B as shown above.

The D1B and the SF act as shown on page 3.17.

PLR PLR0*00*



PULSE LINK REPEATER

Used to interconnect E & M signaling between line facility and signaling units. In example show N cxr signaling is 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).

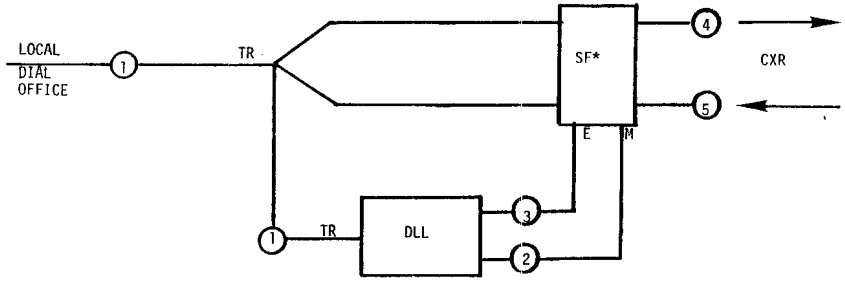
PLR converts the E lead gnd from the N cxr to M lead (3) battery (drop lamp dark when monitoring between PLR and SF).

Transmitting SF tone is cut (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).

DLL 01-J SD96251 ("J" OPTION) USED ON EXCHANGE END OF CIRCUIT DLOE****



*May be "X-T", E1P or "F" type SF units. E#B units are not compatible

IDLE CONDITION

LINE ○ DROP ●

There is SF receiving from the CXR (5).
(3) the 'E' lead 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 HZ ringing current from the local dial office.
(2) The 'M' lead will follow the 20 HZ 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).

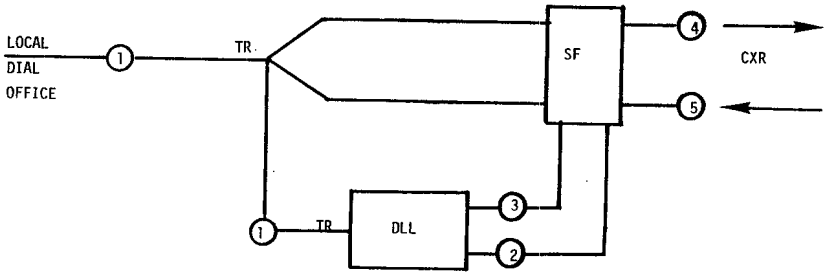
(3) The 'E' lead will follow the SF with opens (SF receiving) and grounds (no SF received)

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

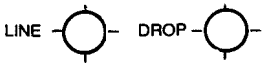
NOTE: Above is one of various applications of a DLL used with a 2-wire circuit. The DLL can also be used in the voice path of a 2-wire circuit.* In a 4-wire circuit the 'Tip' and 'Ring' leads of the DLL may be simplexed across the transmit and receive pairs of a four wire circuit, or it may be located 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 'Tip' and 'Ring' leads will remain the same. For wiring option refer to 'SD' drawing.

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

DLL01-K SD96251 ("K" OPTION)
DL0E****



IDLE CONDITION

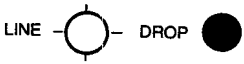


(5) SF receiving from the carrier
(3) The 'E' lead will be open from the SF (line lamp lit)
(1) The 'T' & 'R' leads will be open
(1) From the local dial office there is ring batt and tip ground
(2) The 'M' lead will be grounded from the DLL (drop lamp lit)
(4) SF transmitting

BUSY CONDITION

(5) No SF receiving
(3) 'E' lead ground from SF (line lamp dark)
(1) 'T' & 'R' leads shorted from DLL
(2) 'M' lead ground from DLL (drop lamp lit)
(4) SF tone transmitting

RINGING



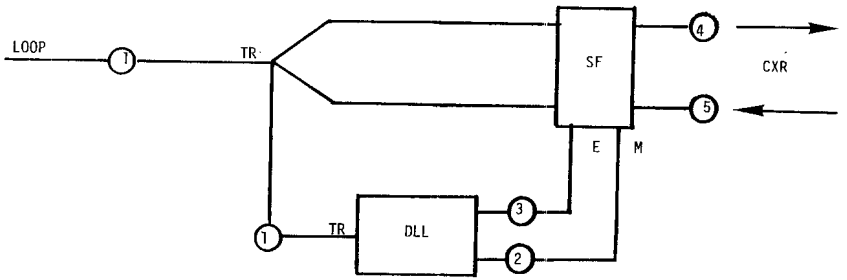
(1) 20 HZ ringing current from local dial office
(2) 'M' lead will follow the 20 HZ ring with the batt from the DLL (drop lamp lit)
(4) SF tone will cut trans during 20 HZ ring
Ringing will stop when incoming SF is cut receiving (see busy condition)

INCOMING CALLS

(5) No SF received (see busy condition)
(5) Spurts of SF are received as digits are dialed at far end
(3) 'E' lead changes from ground (no SF) to opens (SF received)
(1) 'T' & 'R' leads follow 'E' lead grounds with shorts which in turn transmit dialing information.

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

DLL03-J SD96252 USED ON CUSTOMER END OF CIRCUIT.
DLSE****



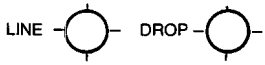
IDLE CONDITION

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

BUSY CONDITION

(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



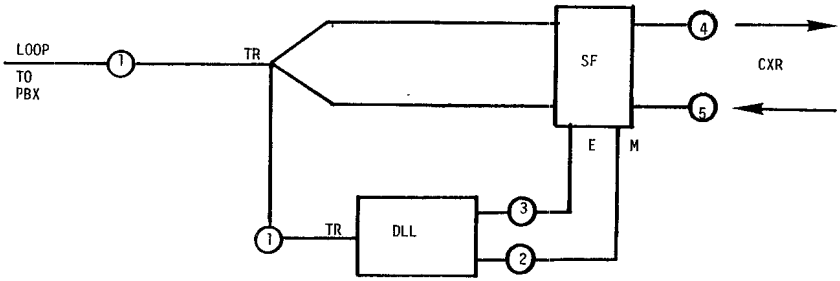
(5) Spurts of SF incoming
(3) 'E' lead changes from grounds to opens with incoming SF tone (line lamp dark to lit)
(1) Spurts of 20 HZ from 'T' & 'R' of DLL going out on loop when (3) 'E' lead open
Ringing stops, when customer answers call, by a short being applied across 'T' & 'R' of loop (1). Circuit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

OUTGOING CALL FROM PBX

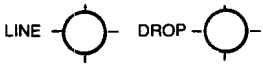
Customer seizes circuit (see busy condition)
(1) Tip and ring of loop will change shorts to opens as number is dialed. Circuit varies from idle to busy condition with the pulses.

NOTE: Above is one of various applications of DLL used with 2-wire circuit. The DLL can also be used in the voice path of a 2-wire loop 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 'T' & 'R' leads (1) will remain the same. For wiring option refer to "SD" drawing.

DLL03-H SD96252 (H) OPTION
DLSE****

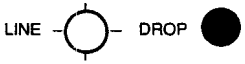


IDLE CONDITION



(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

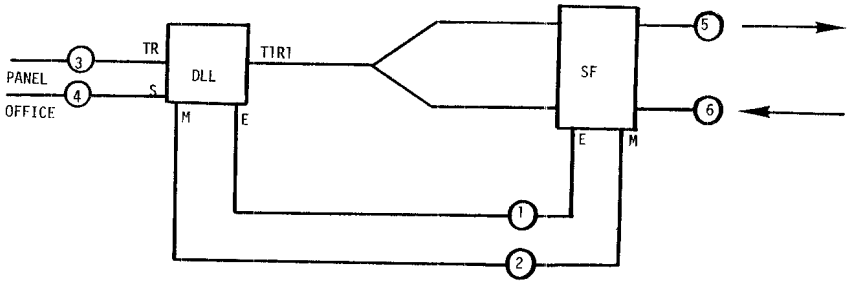
(5) Alternately changing from SF tone receiving to no SF tone receiving.
(3) 'E' lead changes from open to ground (line lamp lit to dark), with changing condition of SF receive to no SF receive.
(1) 20 HZ will be applied to the loop from the DLL when the 'E' lead is grounded (line lamp dark) and 20 HZ 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

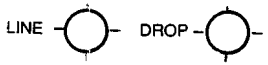
Customer seizes circuit (see busy condition) (1) Tip and ring of loop will change from short to open as number is dialed. (Circuit will vary from busy to idle condition with the pulses.)

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 'T' & 'R' leads (1) will remain the same. For wiring option refer to "SD" drawing.

DLL 16 OR ES65602-PANEL OFC
DLTE*00*



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)
T & R (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)
T & R (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

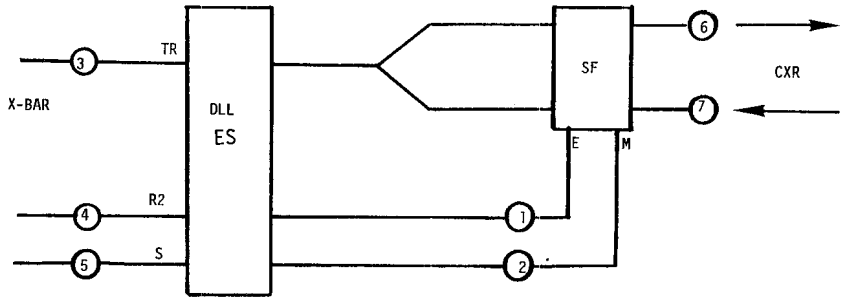
INCOMING CALLS

SF tone is cut receiving and E lead becomes ground from SF (line lamp goes dark). ES equipment puts a short across T & R (3) to panel ofc and we get a ground (Fig D) or Batt (Fig C) on the S lead (4) from the Panel ofc. The ES recognizes 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 open and gnd and the ES opens and shorts the T & R leads (3) twd the Panel ofc.

OUTGOING CALLS

S lead (4) becomes ground (Fig D) or batt (Fig C) from the panel ofc. The ES follows with BATTERY applied to the M lead (drop lamp goes dark) which cuts transmitting SF. The ES recognizes the 20 HZ from the panel ofc on the T & R leads (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 customer answers phone at far end, see busy condition.

DLL 19 OR ES65602 (FIG. F) - 1 X-BAR
DLTE*00 *



IDLE CONDITION

LINE ○ DROP ○

SF tone transmitting (6) & receiving (7)
E lead (1) open from SF (line lamp lit)
M lead (2) gnd from ES (drop lamp lit)
T & R leads (3) open ES. Batt on ring and gnd on tip 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

LINE ● DROP ●

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)
T & R lead (3) low resistance short from ES. Batt on ring and ground on tip from X-bar.
R2 lead (4) gnd from X-bar and gnd from ES
S lead (5) gnd from ES

INCOMING CALL

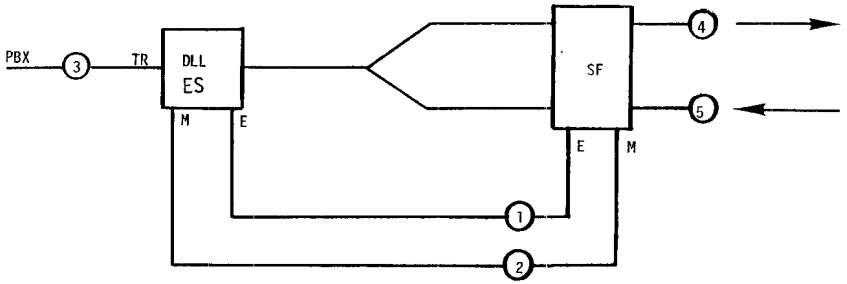
LINE ● DROP ●

SF tone is cut receiving and E lead becomes ground (line lamp goes dark). ES puts a short across T & R (3) and a gnd on the S lead (5) to the X-bar. The X-bar recognizes seizure with dial tone on T & R and ground on RD (4). 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 open and ground, and the ES opens and shorts the T & R leads (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 HZ are applied from the x-bar on the T & R 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.

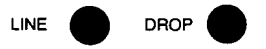
DLL20 ES65625 DLAT***A



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)
T & R leads (3) from ES tip open and ring batt
T & R leads (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)
T & R leads (3) from ES, tip gnd and ring batt)
T & R leads (3) from loop, tip & ring short

OUTGOING CALL FROM PBX

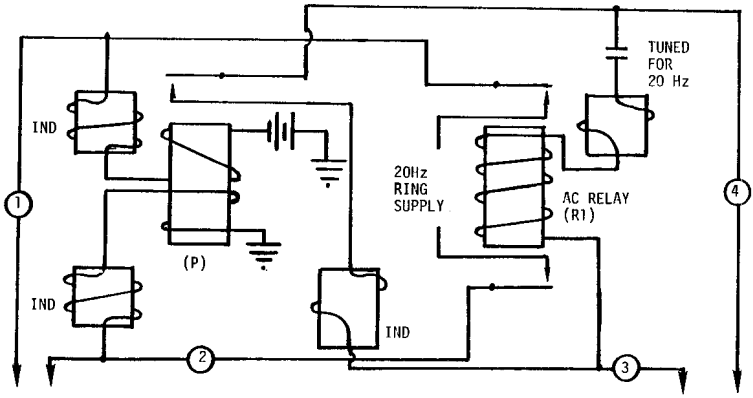
PBX trunk becomes seized and a gnd is placed on the ring of the loop (3). This ground is recognized by the ES and sends out batt on the M lead (drop lamp goes dark) and SF is cut transmitting. When the line finder finds the line at the distant end, a seizure is sent back and SF is cut receiving (5). 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 and the ES applies ring generator to the sub. When the PBX answers, gnd comes up on the ring (3) from the loop & closes the connection (drop lamp goes dark).

DIAL IMPULSE REPEATER

DLL61	SD96034-01	DLC1****
DLL62	SD96234-01	DLC2***A
DLL63	SD96555-01	DLC2***B



The DIR is used when signaling loop resistance exceeds normal operating limits.

It will repeat a short in one direction and a 20 HZ ring in the other direction, and can be used at either the open end or closed end of an FX or dial FP.

When used at the open end of FX or dial FP:

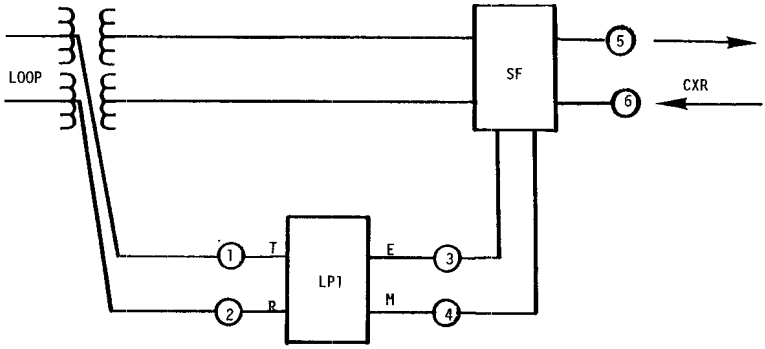
A 20 HZ ring from the local central office will cause the R1 relay to operate. This R1 relay, when operated, applies a new 20 HZ ring toward the SD96251 (1) and (2). A short from the SD96251 will cause the P relay to operate. The P relay, when operated, applies a new short toward the local central office (3) and (4).

When used at the closed end of an FX or dial FP:

A short from the station equipment will cause the P relay to operate. The P relay, when operated, applies a new short toward the SD96252 (3) and (4).

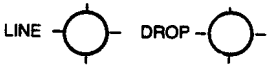
A 20 HZ ring from the SD96252 will cause the R1 relay to operate. The R1 relay, when operated, applies. a new 20 HZ ring toward the station equipment (1) & (2).

LP1 SIGNALING CONVERTER CIRCUIT SD 95060 SCLE****



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

IDLE CONDITION

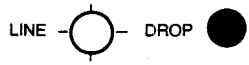


SF tone trans (5) and receiving (6)
'E' lead (3) open from SF (line lamp lit)
'M' lead (4) ground from LP1 (drop lamp lit)
Battery on 'T' (1) LP1*
Ground on 'R' (2) from LP1*
High resistance short between 'T' (1) & 'R' (2) from loop

BUSY CONDITION

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' (1) from LP1*
Battery on 'R' (2) from LP1*
Low resistance short between 'T' (1) & 'R' (2) from loop

OUTGOING CALL



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 receives is cut).

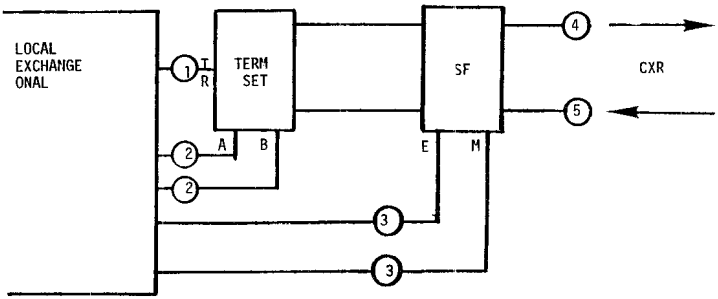
If it is a dial circuit pulses will be low to high resistance from loop and will be followed by 'M' lead battery to ground, etc.

INCOMING CALL

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 form LP1*
'R' (2) lead changes from ground to battery from LP1*
When sub answers high resistnace short across 'T' (1) & (2) from loop will change to low resistance.

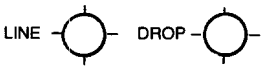
*Instructions written with 'G' Option used in LP1.
If 'H' Option is used reverse condition (ground to battery and vice versa) will be seen on both the 'T' (1) & 'R' (2) out of the LP1.

ONAL (OFF NET AUX. LINK)



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



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 SF
M lead GND from exchange

BUSY CONDITION

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

DIALING & RINGING

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 answered
SF rec (5) pulses
SF trans (4) on to off when answered

SF - SINGLE FREQUENCY

TYPES OF SF UNITS

	TRANS	REC
X, Y*, B, E, F, G	2600 HZ	2600 HZ
XL	2400 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. (-36dBm @ -16dBm point).

SF level is approx. 8dB below voice level when pulsing out on line. (-24dBm @ -16 dBm point)

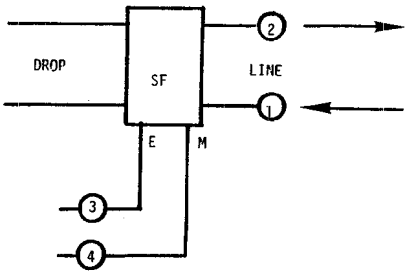
"E#B" SF UNITS

These SF units are used on 4-wire trunk circuits where E & M lead signaling is 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, D1B & D0B signal converters, LP1 signal converters, and Dial Long Lines units.

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

E1B	SF60**0L	FWA	SF60F*H*	GBA	SF60B00B
E3B	SF60*00M	FWC	SF60F4HF		
E4B	SF60****	FBA	SF60F*HA		
		FBB	SF60F*HA		



The above sketch shows a 4 wire SF used for "E" & "M" lead operation.

SF tone, 2600 Hz, should be 20 dB below TLP. Measure -13 dB at a +7 TLP, -36 dB at a -16 dB TLP.

The E lead is the receive lead and is on the Tip of the jack, the M lead is the transmit lead and is on the Ring side.

TONE ON FROM LINE (1)

SF applies an Open to the E lead (3)
A 2B set shows Line lamp lit.

NO TONE FROM LINE (1)

SF supplies Ground to the E lead (3)
A 2 B set show Line lamp dark.

TONE ON TOWARDS LINE (2)

Ground is being applied on the M lead towards the SF (4)
A 2B set shows Drop lamp lit.

NO TONE TOWARDS LINE (2)

Battery is being applied on the M lead towards the SF (4)
A 2B set shows Drop lamp dark.

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 adapt 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.

The E2L is designed for use on the OPEN END of either an 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. Combination of these units is determined by the loss of the loop that the units are connected to.

E1P/E1R

These units are essentially 4W loop versions of the E2S & E2L, but may be used on 2W loops if used in conjunction with a terminating set. This terminating set must be wired externally when so used.

The single unit may be used with LOOP or GND start by operating the LPGS switch on the front of the unit to LP or GS.

The BOR switch should be operated to the IN position only when the loop resistance is less than 520 ohms.

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

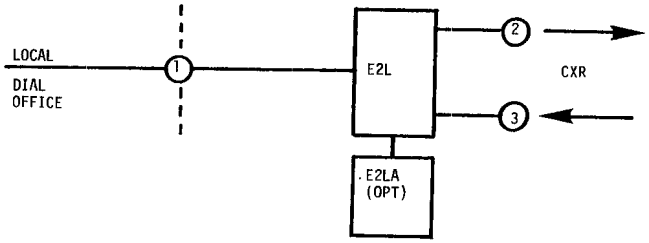
The E1R is compatible with a E1P or an E2L and is used, when required in place of a E2S/E2SA.

In the GS mode the units use the A and B leads for signaling between the connecting equipment, and in the LP mode either the A and B or E and M leads can be used.

E2L	179-328-501	E2S	179-330-501
E2L-A	179-328-502	E2S-A	179-330-502
E1P	179-331-101	E1R	179-332-101

A compatability chart for the various types of SF units may be found on page 3.96.

E2L SFXT*00M
E2LA SFAT*00M
E1L SFAT*00L



E2L (OR E1L)

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

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

RINGING (1) 20 HZ from local dial office
(2) SF tone transmitted from E2L as 20 HZ 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 breaks short from E2L thus passing information to dial office.

E2L-A

IDLE SF tone transmitting (2) and receiving (3).
(1) 2W side from E2L, tip -48V and ring -48V.
(1) 2W side from loop, tip open and ring -48V.

BUSY No SF tone transmitting (2) or receiving (3).
(1) 2W side from E2L, tip -48V and ring ground.
(1) 2W side from loop, tip ground and ring -48V.

*When a E2L is used to feed certain equipment, such as a 800A PBX, consisting of Solid State interfaces, the Tip will be +10V and the ring -20V.

INCOMING CALLS

(3) No SF receive
(1) 2-W side of E2L tip -48V and ring ground
(1) From local dial ofc tip ground and ring -48V
(2) SF tone is cut transmitting
Dialing information is same as for E2L

OUTGOING RING

As 20 HZ comes up from local dial ofc (1), the transmitting SF is modulated with 20 HZ wave.

E2L OPTIONS-

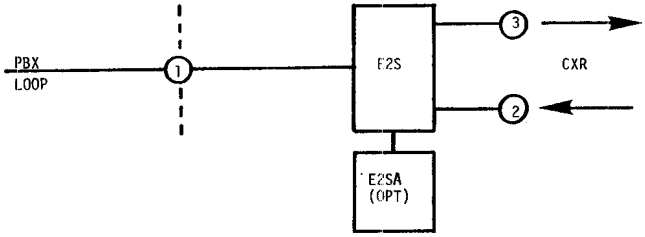
When used as a ground start unit with a E2L-A remove the "Y" option straps:
Across pins 2 and 8 of GS plug
Across pins 3 and 7 of GS plug
Across pins 25 and 26 of printed CKT board
Across pins 10 and 11 on the "B" relay for E2L-20
Open wire to plug 17 on E2L (no dash) or E2L-11 units. It is also necessary to cross connect TR of the E2LA to TR (4 wire trans) of E2L at the MDF. This is a multiple connection at the E2L.

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.

NOTE:
It may be necessary to use an external voltmeter to check for grounds on some equipment. If the ground is isolated through a diode the polarity of the testboard voltmeter may be wrong.

E1S SFXS*00L
E2S SFSX*0*M
E2SA SFAX*00*
E3S SFXS*00M



E2S (OR E1S, E3S)

IDLE
(2) No SF receiving
(3) SF tone transmitting
(1) 2-W from loop is open between 'T' & 'R'
(1) 2-W from E2S is tip gnd and ring -48V

BUSY
(3) No SF transmitting
(2) No SF receiving
(1) 2-W from loop is shorted between 'T' & 'R'
(1) 2-W from E2S is tip gnd and ring -48V

RINGING
(2) Spurts of SF tone receiving
(1) 2-W side of E2S puts out 20 HZ 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 receiving (2)
(1) 2-W side from E2S tip open and ring batt
(1) 2-W from loop tip -48v and ring open*

BUSY
No SF transmitting (3) and receiving (2)
(1) 2W side from E2S tip ground and -48v on ring
(1) 2W from loop -48v on tip and ground on ring

*In the idle condition it will not be possible to see the -48v on the tip of the loop using the testboard voltmeter. A ground present in the voltmeter will cause a relay to operate at the station removing the -48v.

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

RINGING SF tone transmitting: receiving is tone modulated at 20 HZ for 2 sec., no tone for 4 sec. When modulated tone is received the E2S passes 20 HZ ring to loop.

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

"Z" 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:

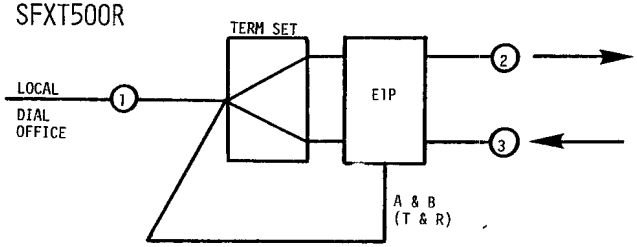
From make contact 5 of "RT" to 2U of the "A" relay.
The "H" option is automatically provided on the 98138-02 E2S.

Strap the 2-wire comp net to balance the 2-wire pair.

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

NOTE:
It may be necessary to use an external voltmeter to check for ground on some equipment. If the ground is isolated through a diode the polarity of the testboard voltmeter may be wrong.

E1P SFXT500R



E1P LOOP START

IDLE CONDITION
(3) SF tone receiving from carrier
(2) No SF tone leaving from E1P
(1) 'T' & 'R' leads high resistance short from E1P
(1) Tip Gnd and ring Batt (-48v) from dial office*

BUSY CONDITION
(3) No SF tone receiving from carrier
(2) No SF tone Trans from E1P
(1) 'T' & 'R' leads low resistance short from E1P

RINGING
(1) 20 HZ from local dial office
(2) SF tone transmitted from E1P as 20 HZ is applied
(1)
(1) Ring cycle (2 sec. on & 4 sec. off) stops when no SF received (3) and 'T' & 'R' lead is shorted from E1P

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.

E1P 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.

*When the E1P is used to feed certain equipment, such as 800A PBX, consisting of Solid State interfaces, the tip will be +10V adn the ring -20V.

INCOMING CALL

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

OUTGOING RING

As 20 HZ comes up from local dial office (1) the transmitting SF (2) is modulated with a 20 HZ wave.

OPTIONS

External loop loss greater than 520 ohms - BOR switch out
External loop less than 520 ohm - BOR switch in

4W LOOP

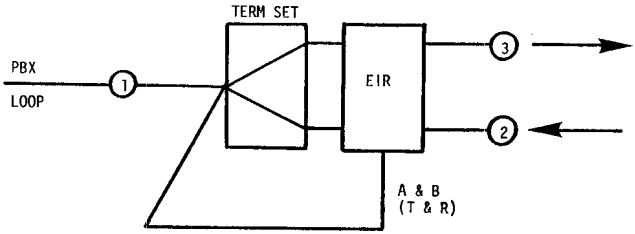
The E1P SF unit with a 4182 network in place of the Term set can also be used for 4W loop facilities When it is so used substitute "A" lead for tip and "B" for ring

NOTE:

It may be necessary to use an external voltmeter to check for grounds on some equipment. If the ground is isolated through a diode the polarity of the testboard voltmeter may be wrong.

To make transmission tests in the transmit direction, incoming SF tone has to be removed.

E1R SFXS500T



E1R LOOP START

IDLE
(2) No SF receiving
(3) SF tone transmitting
(1) 2-W from loop is open 'T' & 'R'
(1) 2-W from E1R is tip gnd and ring batt (-48V)

BUSY
(3) No SF transmitting
(2) No SF receiving
(1) 2-W from loop is shorted 'T' & 'R'
(1) 2-W from E1R is tip gnd and ring batt (48V)

BUSY
(2) Spurts of SF tone receiving
(1) 2-W side of E1R puts out 20 HZ 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).

E1R GROUND START (E1R-A "Option A")

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

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

*In the idle condition it will not be possible to see the -48v on the tip of the loop using the testboard voltmeter. A ground present in the voltmeter will cause a relay to operate at the station removing the -48v.

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

RINGING — SF tone transmitting (3). Receiving is tone modulated by 20 HZ for 2 seconds, followed by no tone for 2 seconds. When modulated tone is received the E1R passes 20 HZ ring to the loop (1).

OPTIONS — External loop resistance greater than 520 ohms - BOR Switch out.
External loop resistance less than 520 ohms - BOR Switch in

4W LOOP — The E1R SF unit, with a 4182 network in place of the Term set can also be used for 4W loop facilities. When it is so used substitute "A" lead for the tip and "B" lead for the ring.

NOTE: It may be necessary to use an external voltmeter to check for grounds on some equipment. If the ground is isolated through a diode the polarity of the testboard voltmeter may be wrong.

"F-" SF UNITS

These units replace the E & M type "E" type SF units. They would be FW, FA, FB, FC or FD types and are a more advanced version of the E-B type. The FW type occupy one mounting slot in the bay and are completely contained in one plug-in unit. The FA, FB, FC and FD types are made up of two plug in units. The first, FUA, or in some cases FUD, is common to all of these units. The FUA and FUD units are SF signaling converters which convert dc pulses to ac signals and vice versa. These units interface between the 4-wire transmission facility and auxiliary signaling unit. The FUA has active components and the FUD has integrated circuits. The FUD has a built-in gain transfer and line balancing network which allows for elimination of external repeaters and range extenders.

The other unit the FA, FB, FC and FD, etc. is an auxiliary unit that, when added to the FUA, or FUD, performs a specific function as shown below. Because two plug in units are required to make up a complete SF, the jack modules are referred to as "Double Module Mountings". The complete SF is referred to by the designation of the auxiliary unit:

FA ( ) 2W E&M lead
FB ( ) 4W E&M lead
FC ( ) Loop Reverse Battery - originating
FC ( ) Loop Reverse Battery - terminating

The FUD unit may not be used with either the FA or FB auxilaries.

A sketch of FB ( ) operation may be found on page 3.40.

Additional variations of the auxiliary mountings used for special purposes are covered on pages 3.52 thru 3.73. General notes for the special purposes may be found on page. 3.51. A compatability chart for the various types of SF's may be found on page 3.95. A complete list of "F" type units and their use may be found on page 3.96.

FM ( ) UNITS

These units provide no signalling function. They are intended primarily for level adjustments, impedance matching, balancing and other such functions. For information on these units see the BSP.

FL ( ) AND FS ( ) UNITS

The ( ) indicates possibility of more than one suffix, such as FLA & FLB. All FL & FS units are composed of two plug in units, the FUA or FUD* common to all. Variations are obtained by adding an auxiliary unit. The SF takes the name of the auxiliary unit. For this reason the mounting for these units is referred to as a "Double Unit Mounting".

*The FUD unit is not compatible with all auxiliary units. Those sketches that do not show the FUD cannot use it.

FL ( ) & FS ( ) are replacements for the E2L and E2S and serve the same basic functions.

The FL ( ) is designed for the open end of either a FX or OPX circuit and the FS ( ) is designed for the closed end. Either Loop Start or Ground Start is available (Note on some types. See notes on the individual unit pages).

FPA & FRA SF UNITS

These units are basically 4W versions of the FL ( ) and FS ( ) units. They replace the E1P and E1R units.

FPD & FRD UNITS

These units are used on FX type circuits at an intermediate office to connect a Digital "T" channel facility to an analog type channel, such as "L".

FGA & FHA UNITS

These units are basically a combination of a SF and a DX2 unit. The FGA is a 2 wire version and the FHA is a 4 wire.

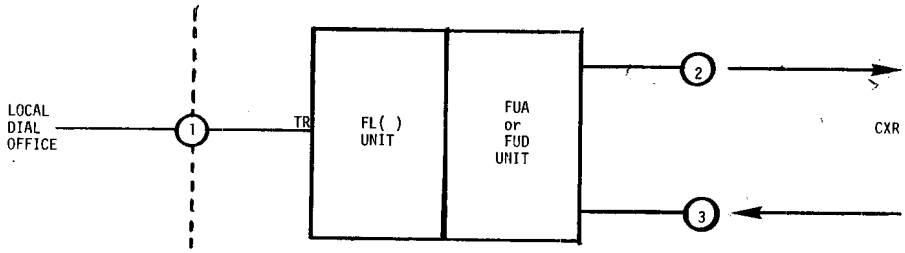
FGM, FGN, FHM AND FHN UNITS

These units are basically a combination of a SF and a D1B, D0B, or CSR. The FG ( ) units are 2 wire versions and the FH ( ) 4 wire.

REFERENCE BSP'S

FL ( ), FS ( ), FP ( ) and FRL ( )	179-365-101
FGA & FHA	179-367-101
FGM, FGN, FHM and FHN	179-368-101
FUA, FUD	179-363-101
FM ( )	179-366-101

FLA, FLB SFXTF*H* FLC, FLD SFXTL*HA



FL ( ) LOOP START OPTION (See note below)

IDLE
(3) SF Tone Receiving from carrier
(2) No SF tone transmitting from FL
(1) 'T' & 'R' leads high resistance short from FL
(1) Tip ground and ring batt (-48v) from dial office*

BUSY
(3) No SF receiving from carrier
(2) No SF tone trans from FL
(1) 'T' & 'R' lead closed from FL (Note 1, page 3.49)

RINGING
(1) 20 HZ from local dial office
(2) SF tone transmitted from FL as 20 HZ is applied
(1)
(1) Ring cycle (2 seconds on and 4 off) stops when no SF received (3) and 'T' & 'R' lead is closed from FL

INCOMING CALLS Loss of SF incoming (3) 'T' & 'R' closure is applied from FL (1) thus drawing dial tone from local dial office. SF pulse received makes and breaks closure from FL thus passing information to dial office.

FL ( ) GROUND START OPTION

IDLE
SF tone transmitting (2) and receiving (3).
(1) 2W side from FL, tip -48V and ring -48V.
(1) 2W side from loop, tip open and ring -48V.

BUSY
No SF tone transmitting (2) or receiving (3).
(1) 2W side from FL, tip -48V and ring ground.
(1) 2W side from loop, tip ground and ring -48V.

*When a FL ( ) is used to feed certain equipment, such as a 800A PBX, consisting of Solid State interfaces, the tip will be +10V and the ring -20V.

NOTE: In the Loop Start arrangement, E & M Lead operation may be used as an option when the Dial office equipment warrants.

INCOMING CALL (3) No SF receive
(1) 2-W side of FL tip -48V and ring ground
(1) From local dial ofc tip ground & ring -48v
(2) No SF tone
Dial information is same as for Loop option

OUTGOING RING (1) As 20 HZ comes up from local dial ofc, the transmitting SF is modulated with 20 HZ wave (2).

FL ( ) OPTIONS

Loop Start* - LP1 closed
LP2 closed
GS1 open
GS2 open
Ground Start*-LP1 open
LP2 open
GS1 closed
GS2 closed

Short Loop (less than 520) BOR1 open
BOR2 open

Long Loop (over 520) BOR 1 & 2 closed

BALANCE THE FL ( ) (Note 2)
Compromise network or external precision network

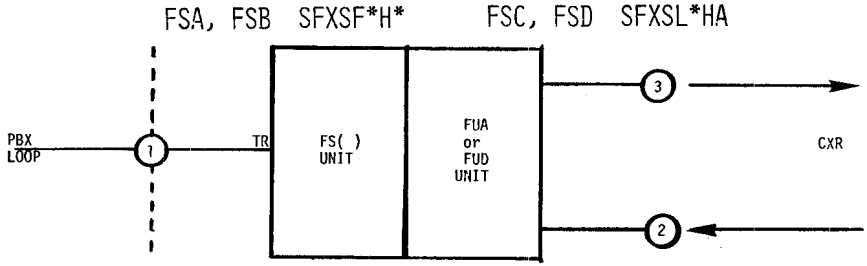
Compromise network - screw closed (comp net)
External network - screw open (comp net)

BOC on face of unit for either option

*Loop Start - Ground Start option available only on FLA & FLB units.
FLC & FLD available only in Loop Start.

TEST NOTE: It may be necessary to use an external voltmeter to check for grounds on some equipment. If the ground is isolated through a diode the polarity of the testboard voltmeter may be wrong.

Note 1: The term "closed" is used instead of "shorted". Actually a low resistance short.
Note 2: This information applies to an FL unit associated with a FUA. If a FUD is used see pages 3.68 and 3.69.



FS ( ) LOOP START OPTION (See note below)

IDLE
(2) No SF receiving
(3) SF tone transmitting
(1) 2-W from loop is open between 'T' & 'R'
(1) 2-W from FS is tip gnd and ring -48v (see note below)

BUSY
(3) No SF transmitting
(2) No SF receiving
(1) 2-W from loop is closed between 'T' & 'R' (Note 1, page 3.51)
(1) 2-W from FS is tip gnd and ring -48v

RINGING
(2) Spurts of SF tone receiving
(1) 2-W side of FS puts out 20 HZ 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' loop closure makes and breaks with dialing pulses and information is sent out with spurts of SF for each digit dialed.

FS ( ) GROUND START OPTION

IDLE
SF transmitting (3) and receiving (2)
(1) 2-W side from FS tip open and ring batt
(1) 2-W from loop tip -48v and ring open
See Note

BUSY
No SF transmitting (3) and receiving (2)
(1) 2W side from FS tip ground and -48v on ring
(1) 2W from loop -48v on tip and ground on ring

NOTES:
In the idle condition of the FS it will not be possible to see the -48v on the tip of the loop using the test-board voltmeter. A ground present in the voltmeter will cause a relay to operate at the station removing the -48v.

In the Loop Start arrangement, E & M lead operation may be used as an option when the PBX equipment warrants.

DIALING

Customer seizes circuit with ring ground from loop, SF is cut trans and in turn it also becomes cut receiving. Dialing operation is now same as for Loop Start option.

RINGING

SF tone transmitting. Receiving SF tone is modulated at 20 HZ for 2 sec., no tone for 4 sec. When modulated tone is received the FS passes 20 HZ ring to loop.

FS ( ) OPTIONS

Loop Start* - LP1 closed
GS1 open
GS2 open
Ground Start*-LP1 open
GS1 closed
GS1 closed

BALANCE THE FS ( ) (Note 2)

Compromise network - screw closed (comp net)
External network - screw open (comp net)

BOC on face of unit for either type network

General notes on FS ( ) units may be found on page 3.50.

*Loop Start - Ground Start option available only on FSA and FSB units. FSC and FSD are available only in loop start.

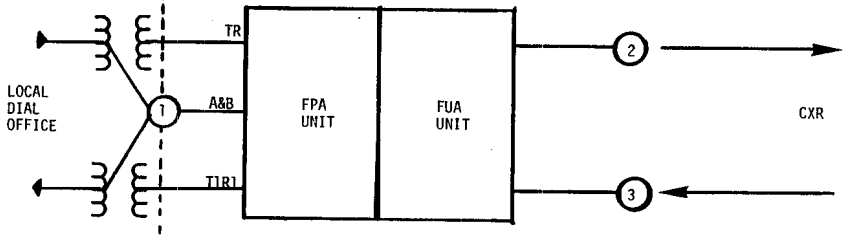
TEST NOTE:

It may be necessary to use an external voltmeter to check for grounds on some equipment. If the ground is isolated through a diode the polarity of the testboard voltmeter may be wrong.

Note 1: The term "closed" is used instead of "Shorted". Actually a low resistance short.

Note 2: This information applies to an FS unit associated with a FUA. If a FUD is used see pages 3.68 & 3.69.

FPA SFXTF*H*



FPA LOOP START OPTION (See Note, page 3.57)

IDLE CONDITION
(3) SF tone receiving from carrier
(2) No SF tone leaving from FPA
(1) 'A' & 'B' leads high resistance short from FPA
(1) "A" Gnd and "B" Batt (-48v) from dial office*

BUSY CONDITION
(3) No SF tone receiving from carrier
(2) No SF tone Trans from FPA
(1) 'A' & 'B' leads low resistance short from FPA

RINGING
(1) 20 HZ from local dial office over "A" & "B"
(2) SF tone transmitted from FPA as 20 HZ is applied
(1)
(1) Ringing cycle (2 sec. on & 4 sec. off) stops when no SF received (3) and 'A' & 'B' lead is shorted from FPA

INCOMING CALLS
SF incoming is cut (3) and 'A' & 'B' short is applied from FPA (1) thus drawing dial tone from local dial office. SF pulse received (3) makes and breaks short from FPA (1) thus passing information to dial office.

FPA GROUND START OPTION

IDLE
SF tone transmitting (2) and receiving (3). From FPA (1)
"A" & "B" -48V. From local dial office (1) "A" open & "B" -48V.

BUSY
No SF transmitting (2) or receiving (3). From FPA (1) "A" -48V and "B" GND.
From local office (1) "A" GND & "B" -48V.

*When a FPA is used to feed certain equipment, such as a 800A PBX, consisting of Solid State interfaces, the tip will be +10V and the ring -20V.

INCOMING CALL

(3) No SF receiving
(1) From FPA "A" -48V & "B" GND.
(1) From local dial office "A" GND & "B" -48V
(2) SF tone is cut transmitting
Dialing information is same as for loop start.

OUTGOING RING

As 20 HZ comes up from local dial office (1) the transmitting SF (2) is modulated with a 20 HZ wave.

FPA OPTIONS

Loop Start - LP1 closed
LP2 closed
GS1 open
GS2 open
Ground Start-LP1 open
LP2 open
GS1 closed
GS2 closed

Short Loop (less than 520) BOR1 open
BOR2 open
Long Loop (more than 520) BOR1 closed
BOR2 closed

Equalization per table "H" of BSP 179-365-101

Internal A&B leads - A&B closed
External A&B leads - A&B open

General notes on FPA units are on page 3.51

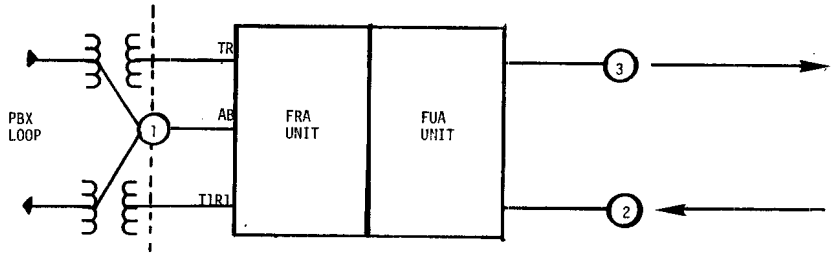
NOTES:

Sketch shows External lead option. In the internal option the coils and simplex are inside the FPA.

It may be necessary to use an external voltmeter to check for grounds on some equipment. If the ground is isolated through a diode the polarity of the testboard voltmeter may be wrong.

In the Loop Start arrangement, E & M lead operation may be used as an option when the Dial office equipment warrants.

FRA SFXSF*HA



FRA LOOP START OPTION (See NOTE, page 3.59)

IDLE
(2) No SF receiving
(3) SF tone transmitting
(1) Open "A" & "B" from PBX
(1) "A" ground "B" Battery (-48V) from FRA

BUSY
(3) No SF transmitting
(2) No SF receiving
(1) Shorted "A" & "B" from PBX
(1) "A" gnd and "B" -48V from FRA

RINGING
(2) Spurts of SF tone receiving
(1) FRA puts out 20 HZ 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)
"A" & "B" 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).

FRA GROUND START OPTION

IDLE
SF transmitting (3) receiving (2)
(1) "A" -48V & "B" open from Loop (See note on opposite page)
(1) "A" open & "B" -48V from FRA

BUSY
No SF transmitting (3) or receiving (2)
(1) "A" -48V "A" GND from loop
(1) "B" GND & "B" -48V from FRA

DIALING
(1) Customer seizes circuit with GND from loop on B.
(3) SF is cut transmitting and in turn is also cut receiving (2) when dial receiving equip is connected at Far End.
Dialing operations is now same as for loop start.

RINGING

(3) SF tone transmitting
(2) Receiving SF tone is modulated by 20 HZ for 2 seconds, followed by no tone for 2 seconds.
(1) When modulated tone is received the FRA passes 20 HZ ring to the loop.

FRA OPTIONS

Loop Start - LP1 closed
GS1 open
GS2 open
Ground Start - LP1 open
GS1 closed
GS2 closed

Equalization per Table "H" of BSP 170-365-101

Internal A&B leads - A&B closed
External A&B leads - A&B open

General notes on FRA units are on page 3.51.

NOTES:

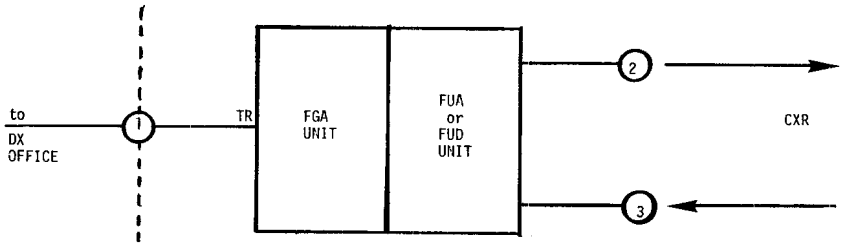
Sketch shows External A&B option. In the internal option the coils and simplex are inside the FRA.

In the idle condition (ground start) it will not be possible to see the -48v on the tip of the loop using the testboard voltmeter. A ground present in the voltmeter will cause a relay to operate at the station removing the -48v.

It may be necessary to use an external voltmeter to check for grounds on some equipment. If the ground is isolated through a diode the polarity of the testboard voltmeter may be wrong.

In the Loop start arrangement, E&M Lead operation may be used as an option when the PBX equipment warrants.

FGA SFAX20HA



FGA

IDLE CONDITION (3) SF Tone Receiving
(2) SF Tone Transmitting
(1) "T" Ground from FGA ("A" lead)
(1) "T" Ground from Station DX ("A" lead)

BUSY CONDITION (3) No SF Tone Receiving
(2) No SF Tone Transmitting
(1) "T" Battery (-48v) from FGA ("A" lead)

NOTE: "R" ("B") lead is always app. -20V from both the FGA and the Station DX. It is used for balance only.

OUTGOING CALLS -48V battery on Tip ("A" lead) (1) from Station DX. SF tone removed transmitting (2) Dial pulses alternate batt & ground from Station DX causing alternate SF tone off and on. When distant end answers, SF tone removed from receiving line (3) and battery on Tip from FGA (1).

INCOMING CALL Far end removes SF Tone receiving (3) causing -48V battery on Tip ("A" lead) from FGA (1). Far end dials causing alternate off and on SF tone receiving (3) and alternate grd and battery on Tip from FGA (1). When station answers station DX converts ground to battery on the tip toward the FGA (1).

BALANCE THE FGA (Note 1)
Compromise network - screw closed ("comp net")
External network - screw opened ("comp net")

BOC on face of FGA unit for either option

LR Resistors

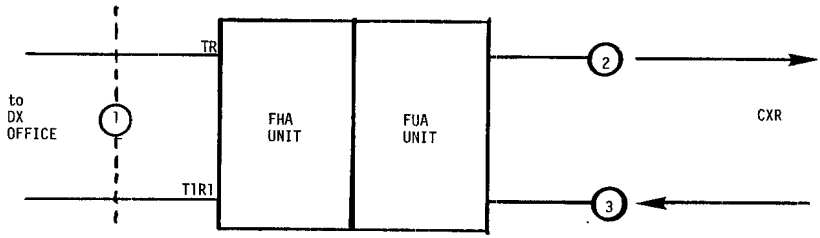
Adjusted to match line resistance as per Table A of BSP 179-367-101

This is a 2-wire SF-DX combination that effectively replaces the DX and SF combinations previously used.
"Test E" and "Test M" leads are sometimes brought out to allow checking conditions of the leads in the unit. See BSP 179-367-101, Table "C" for the indications on these leads.

TEST NOTE: It may be necessary to use an external voltmeter to check for grounds on some equipment. If the ground is isolated through a diode the polarity of the testboard voltmeter may be wrong.

NOTE 1: This information applies to a FGA unit associated with a FUA. If a FUD is used see pages 3.68 & 3.69.

FHA SFAX40HA



FHA

IDLE CONDITION
(3) SF Tone Receiving
(2) SF Tone Transmitting
(1) "T1R1" Ground from FHA (A lead)
(1) "T1R1" Ground from Station DX ("A" lead)

BUSY CONDITION
(3) No SF Tone Receiving
(2) No SF Tone Transmitting
(1) "T1R1" Battery (-48V) from FHA "A" lead)
(1) "T1R1" Battery (-48V) from Station DX ("A" lead)

NOTE:
"TR" ("B") lead is always app. -20V from both the FHA and the Station DX. It is used for balance only.

OUTGOING CALLS
-48V battery on "T1R1" ("A" lead) (1) from Station DX. SF tone removed transmitting (2) Dial pulses alternate batt & ground from Station DX causing alternate SF tone off and on. When distant end answers, SF tone removed from receiving line (3) and battery on "T1R1" from FHA (1).

INCOMING CALL
Far end removes SF Tone receiving (3) causing -48V battery on "T1R1" ("A" lead) from FHA (1). Far end dials causing alternate off and on SF tone receiving (3) and alternate grd and battery on "T1R1" from FHA (1). When station answers station DX converts ground to battery on the "T1R1" toward the FHA (1).

OPTIONS

LR Resistors

Adjusted to match line resistance as per Table A of BSP 179-367-101.

Equalization for 4 wire DX facilities

H88 or H44 Loading - H (1200)
Short Non-Loaded - M (600)
Long Non-Loaded - L (150)

These screw options are not available on face plate of unit. They are located on the printed board.

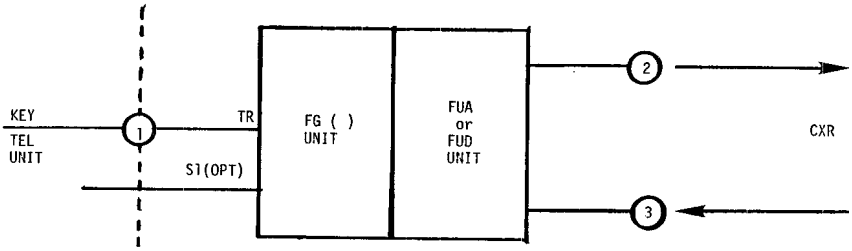
In addition for H88 loaded facilities only, face plate adjustments of "R" & "C" are available according to Tables "F" through "J" of BSP 179-367-101.

This is a 4-wire SF-DX combination that effectively replaces the DX and SF combinations previously used.

"Test E" and "Test M" leads are sometimes brought out to allow checking conditions on the leads in the unit. See BSP 179-367-101, Table "C" for the indications on these leads.

NOTE: It may be necessary to use an external voltmeter to check for grounds on some equipment. If the ground is isolated through a diode the polarity of the testboard voltmeter may be wrong.

FGM, FGN SFA2**HA



FGM, FGN

IDLE (2) SF Tone off Transmitting
(3) SF Tone off Receiving
(1) No ring from customer or FG ( )
(1) Grd on S1 lead from FG ( ); (This conditon on DC Ringing option only)

BUSY Same as Idle

OUTGOING CALL 20 HZ ringing burst from Station (1) causes corresponding SF Tone burst Transmitting (2); (in the case of the DC ringing option a -48V battery followed by an open from the station on the "S1" lead accomplishes the same thing).

INCOMING CALL SF Tone burst receiving (3) causes corresponding 20 HZ ring to be sent to Station over loop (AC ringing option) or -48V from the FG ( ) on the S1 lead (1) (DC ringing option). A "Code" Mode is available, also. This requires a specific number of SF bursts to be received before the AC or DC signal is sent to the station.

OPTIONS

AC Ringing - "A" & "B" Screws closed
DC Ringing - "A" & "B" Screws open
S2 lead internal Ground - Switch "S6" to "G"
S2 lead external ground - Switch "S6" to "L"
code receiver - Switch "S5" ("S2") to "C",
Switch "S7" ("S5") to "O"
no code receiver - Switch "S5" ("S2") to "NC",
Switch "S7" ("S5") to "O"
Ext. code receiver - Switch "S7" to EC

*unlimited pulse length - Switch ("S3") closed
*limited (2 sec.) pulse length _ Switch ("S3") open

(Switch numbers in parenthesis are the FGN unit. Switches without parenthesis are for the FGM unit.)

code mode number - Set switches for the desired code as shown in Tables A & B of BSP 179-368-101

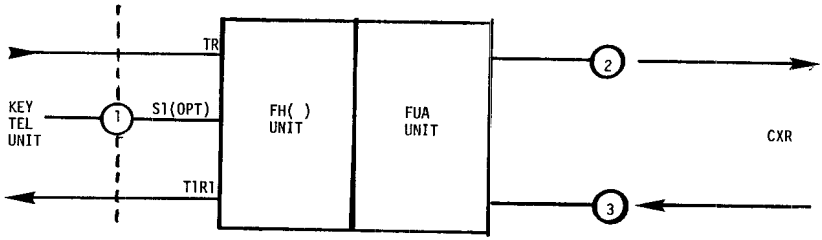
NOTE: All the above switches are located on the printed circuit boards of the units and are not available when the unit is in place in the mounting. For location of the switches on the boards refer to BSP 179-368-101, Figs. 6 & 8.

Compromise net - comp net Switch closed
External net - comp net Switch open

BALANCING THE FG ( ) BOC available on Face plate with comp. or external networks. However, when a FUD unit is used in place of the FUA, see pages 3.69 & 3.70.

*Available on FGN only

FHM, FHN SFA2**HA



FHM, FHN

IDLE

(2) SF Tone off Transmitting
(3) SF Tone off Receiving
(1) No ring from customer or FH ( ) on simplex of loop pairs
(1) Grd on S1 lead from FH ( ); (This condition on DC Ringing option only)

BUSY

Same as idle

OUTGOING CALL

20 HZ ringing burst from Station on simplex (1) causes corresponding SF Tone burst Transmitting (2); in the case of the DC ringing option a -48V battery followed by an open from the station on the "S1" lead accomplishes the same thing).

INCOMING CALL

SF Tone burst receiving (3) causes corresponding 20 HZ ring on simplex to be sent to Station over loop (AC ringing option) or -48V from the FH ( ) on the S1 lead (1) (DC ringing option). A "Code" Mode is available, also. This requires a specific number of SF bursts to be received before the AC or DC signal is sent to the station.

OPTIONS

AC Ringing - "A" & "B" Screws closed
DC Ringing - "A" & "B" Screws open
S2 lead internal Ground - Switch "S6" to "G"
S2 lead external Ground - Switch "S6" to "L"
code receiver - Switch "S5" ("S2") to "C";
Switch "S7" ("S5") to "O"
no code receiver - Switch "S5" ("S2") to "NC";
Switch "S7" ("S5") to "O"
Ext. code receiver - Switch "S7" to ("S5") to EC

*unlimited pulse length - Switch ("S3") closed
*limited (2 sec.) pulse length - Switch ("S3") open

(Switch numbers in parenthesis are for the FHN unit. Switches without parenthesis are for the FHM unit.)

code mode number - Set switches for the desired code as shown in Tables A & B of BSP 179-368-101

Impedance matching:

H88 Cable	H (1200)
Short Non-Loaded	M (600)
Long Non-Loaded	L (150)

NOTES:

All the above switches are located on the printed circuit boards of the unit and are not available when the unit is in place in the mounting. For location of the switches on the boards refer to BSP 179-368-101, Figs. 6 & 8.

When H88 Facility is used additional equalization is available on the faceplate of the unit according to Tables "D" through "H" of BSP 179-368-101.

When either non-loaded option is used the "IN" switch on the faceplate must be out and R250, 500, 1000 and 2000 must be in.

*Available on FHN only

FUA AND FUD UNITS
FUA SF6DF0H*
FUD SF6DF1HB

The FUA & FUD units are signal converters used with one of the auxiliary units. The are required with the auxiliary units to convert DC signal to AC tone signals & vice versa. The FUD unit is not compatible with all Aux units.

The FUA provides a zero loss transmission path with adjustable pads*. External echo suppressors, equalizers or other voice equipment may be used if required.

The FUD has variable gain circuits as part of the transmission path to provide gain transfer. Gain transfer is the amount of gain that the 2 wire part of a hybrid at the far end exceeds the gain of a 2 wire part at the near end. To achieve this a high degree of balance between the line and net is required. As a result the FUD unit uses precision networks, line build out capacitors and frequency slope controls. External echo suppressors and other equipments are not used with a FUD.

*The pads must be connected externally to the unit.

LEVEL ADJUSTMENTS

FUA - Adjust slide switches on Face of unit for required levels Transmitting and Receiving.

FUD - Adjust potentiometers on Face of unit for required levels. Pots calibrated to show actual gain or loss of units.

BALANCE (FUD ONLY)

Install Balance network for Loaded Cable; Set Sw5 to "L"
Install Balance network for Nonloaded cable; Set Sw5 to "N"
Follow procedures in BSP 179-363-301 and tables "C" through "M" in BSP 179-363-101.

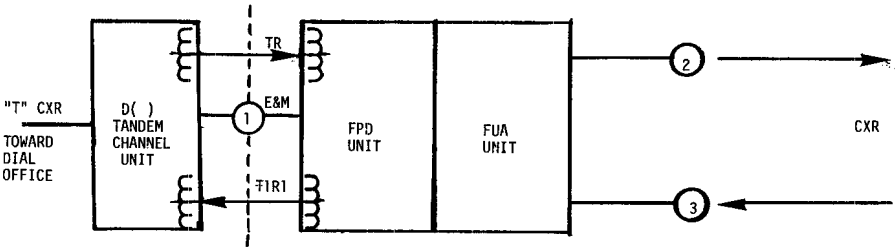
LINE BUILD OUT CAPACITORS (FUD ONLY)

Operate LBOC switch to open to remove capacitors

SLOPE CONTROL (FUD ONLY)

Adjust slope control switch as shown in Figures 10 through 12 of BSP 179-363-101.

FPD SFXTDOHB



FPD LOOP START OPTION

IDLE

(3) SF Tone Receiving from carrier
(2) No SF Tone leaving the FPD
(1) BATT & GRD on Loop Simplex from "D" unit open or high resistance short on simplex from FPD, "M" lead Battery, "E" lead open

BUSY

(3) No SF Tone Receiving from carrier
(2) No SF Tone Leaving the FPD
(1) BATT & GRD on Simplex for "D" unit closure on simplex from FPD, "M" lead Battery, "E" lead ground.

RINGING FROM DIAL OFFICE

(1) Alternate open (no ring) and ground (ring) on simplex on TIR1 from "D" unit. "M" lead grounded.
(2) Alternate no SF Tone and SF Tone leaving the FPD.
(3) SF Tone Receiving from carrier. When Station answers SF Tone is removed, the "E" lead is grounded toward the "D" unit, the "M" lead changes to Battery and the ringing stops.

CALLS FROM PBX

SF Tone incoming (3) is cut, Loop closure is sent from FPD unit to the "D" unit via the simplex (1) across TR & TIR1, which causes "D" unit to draw dial tone from the CO. SF pulses from the PBX transmits dialing information to the C.O. "E" lead alternate between the GRD and open with pulses. Simplex loop opens and closes with pulses.

FPD GROUND START OPTION

(E&M Leads not used with Ground Start)

IDLE

SF Tone transmitted from (2) and received to (3) the FUA unit.
(1) BATT and GRD from the D unit, open from the FPD unit on the TR - T1R1 simplex.

BUSY

No SF Tone either way (2 & 3) TR - T1R1 simplex loop.

RINGING FROM DIAL OFFICE

Alternate open (no ring) and Ground (ring) from "D" unit on simplex (1) of T1R1, causing alternate SF Tone OFF and ON leaving FPD unit (2). SF Tone receiving from carrier (3) is cut when Station answers. Removal of SF (3) causes a ground to be transmitted on the simplex of the TR from the FPD to the "D" unit, causing the ringing to stop.

CALLS FROM PBX

SF tone incoming (3) is cut, causing a ground to be transmitted from the FPD to the "D" unit over the simplex (1) on TR causing "D" unit to draw dial tone from the central office. This causes the "D" unit to ground the simplex on T1R1 to the FPD, and removes the SF tone transmitting (2). Dial pulses from the PBX are transmitted as SF pulses, which alternately opens and ground the simplex on TR toward the D unit (1).

FPD OPTIONS

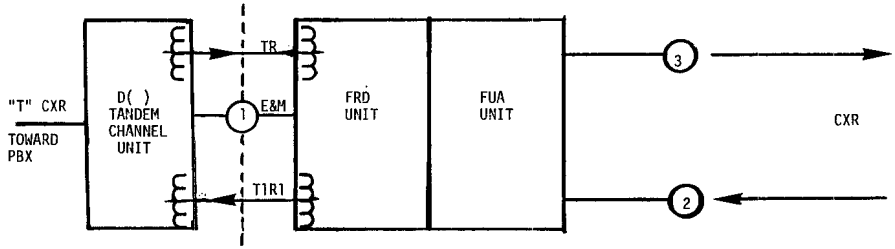
Loop Start - operate Switch to LS
Ground Start - operate Switch to GS
Alarm Make busy - ALB on
Alarm - ALM on
Alarm overside - ALO on
Operation with D1 Tandem Unit - LSRO on

NOTES:

The FPD unit is used on special services at an intermediate office when an Analog facility such as a "L" carrier channel works in tandem with a "T1" carrier channel. While this equipment is used in this configuration, it is included in this job aid since the private line group may have to test the unit. Reference point (1) on the sketch may not be readily available for testing in some offices. The "D" unit must be equipped with a 4 wire tandem plug-in unit optioned as per Table D or Table E of BSP 179-365-101.

When the FPD is used with an D3 or D4 tandem unit a SG lead is also required between the units.

FRD SFXSDOHB



FRD LOOP START OPTION

IDLE
(2) No SF Tone Receiving from CXR
(3) SF Tone Transmitting to CXR
(1) Open or high resistance short on Loop simplex from "D" unit. Batt & Grd on simplex from FRD. "E" lead Grd, "M" lead Grd.

BUSY
(2) No SF Tone Receiving
(3) No SF Tone Transmitting
(1) Closure on Simplex loop from "D" unit Batt & Grd a simplex from FRD. "E" lead Grd, "M" lead Batt.

RINGING FROM DIAL OFFICE
CO seizes circuit causing SF tone to be received by the FUA from the CXR (2) during ringing.
This opens the "E" lead to the "D" unit.

Alternate No SF Tone - Tone signals (Ring from CO) is received from the CXR (2) causing the FRD to send ringing signal over on TR (1) to the "D" unit. When PBX answers the "D" unit the Loop simplex provides a closure to the FRD unit and Batt is placed on the "M" lead (1). The SF Tone Transmitting to the Cxr is removed (3) and ringing stops.

CALLS FROM PBX

Seizure by PBX causes closure to the FRD unit over the loop simplex and Batt on the "M" lead (1). This removes the SF Tone transmitting to the CXR. When the CO answers, dial tone is returned to the PBX. Dialing then proceeds by alternate open-closures on the Loop Simplex to the FRD unit and alternate Grd-Battery on the M Lead.

FRD — GROUND START OPTION

(E&M leads not used with Ground Start)

IDLE — SF Tone on Transmitting (3) and Receiving (2) Simplex loop open or high resistnace short from "D" unit, Batt and Grd from FRD (1).

BUSY — No SF Tone transmitting (3) or Receiving (2) simplex loop closed from "D" unit.

RINGING FROM DIAL OFFICE — CO seizes circuits causing SF tone to be removed Receiving to SF (2). Loss of SF causes FRD to ground the TR simplex to the "D" unit (1). When the PBX answers, the "D" unit grounds the T1R1 simplex to the FRD (1) removing the SF Tone Transmitting (3) and ringing stops.

CALLS FROM PBX

When the PBX seizes the circuit the "D" unit grounds the T1R1 simplex (1) removing the SF Tone Transmitting (3). When the CO answers, SF Tone is removed receiving from the carrier (2) grounding the TR simplex to the "D" unit. Dial tone is provided to the PBX. Dialing consists of alternate simplex loop opens and closures (1) and SF Tone on and offs transmitting (3).

FRD OPTIONS

Loop Start - operate Switch to LS
Ground Start - operate Switch to GS
Alarm Make Busy - ALB on
Alarm - ALM on
Alarm Override - ALO on
Operation with D1 tandem unit - LSRO on

NOTES:

The FRD unit is used on special services at an intermediate office when an Analog facility such as an "L" carrier channel work in tandem with a "T1" carrier channel. While this equipment is used in this configuration, it is included in this job aid since the private line group may have to test the unit. Reference point (1) on the sketch may not be readily available for testing in some offices. The "D" unit must be equipped with a 4 wire tandem plug-in unit optioned as per Table D or Table E of BSP 179-365-101.

When the FRD is used with a D3 or D4 tandem unit a SG lead is also required between the units.

"G-" SG UNITS

The latest family of SF units. They electronically replace all previous types. The "G" family consists of plug-in units that fit into mountings of a "G" type bay. Each plug-in unit is a complete SF unit.

GA-, GB-, GC- UNITS

These units replace the E & M type "F" SF units. They are designated GA-, GB-, GC-, & GD- types. The G- type occupy one mounting slot in the "G" mounting bay and are completely contained in one plug-in unit. Some of the "G-" units have built in gain transfer and line balancing networks which allow the elimination of external repeaters and range extenders. A list of the units is shown below.

GAA - 900 ohm 2W E&M lead
GAB - 600 ohm 2W E&M lead
GBA - 600 ohm 4W E&M lead
GBM - Tandem application
GCA - Originating end Loop reverse battery
GCD - Terminating end Loop reverse battery

Additional variations of "G-" units used for special purposes are covered on pages 3.75 thru 3.93. General notes for the special purposes may be found on page 3.75. A compatability chart for the various types of SF's may be found on page 3.95. A complete list of "G" type units and their use may be found on page 3.94.

A sketch of GBA operations may be found on page 3.40.

GN- AND GM- UNITS

These units provide no signalling function. They are intended primarily for level adjustments, impedance matching, balancing and other such functions.

GL-, GP-, GR-, AND GS- UNITS:

These units are 2-wire 900 ohm or 4-wire 600 ohm, loop-start and ground-start special access SF units. The GL ( ) and GPA units are utilized at the central office end, and the GRA and GS( ) units are utilized at the station end of the special access line or trunk applications. The GLB and GSB units are similar to the GLA and GSA except the GLB and GSB units have gain transfer, precision balance networks, LBOC's, and equalizer features.

GE- AND GF- UNITS:

The GEA and GFA are private line automatic ringdown units and the GEB and GFB are 2- and 4-wire ringdown units. These units are intended for use on private line application which requires conversion from 20 Hz or dc to SF signaling and vice versa. The ringdown units have switches which allow for code selection of the ringing signal.

GHA UNIT:

This unit is a 4-wire, 600 ohm, DX-SF unit utilized on applications which require conversion from DX to SF signaling and vice versa.

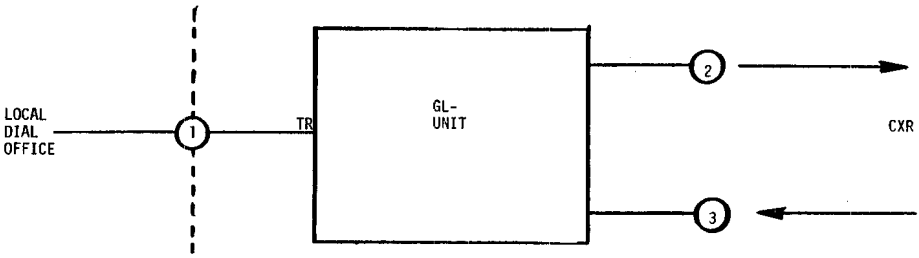
GPD UNIT:

This unit is used on FX type circuits at an intermediate office to connect a Digital "T" channel facility to an analog type channel, such as "L".

REFERENCE BSP'S

"G" SF Signaling - General	179-400-100
GA and GB types	179-405-100
GC and GD types	179-406-100
GL, GP, GR, GS types	179-407-100
GL, GP, GR, GS types	179-407-501 - Adj. proc.
GL, GP, GR, GS types	179-407-502 - Pres. settings

GLA SFXTA20C GLB SFXTV20E



GL- LOOP START OPTION

IDLE
(3) SF Tone Receiving from carrier
(2) No SF tone transmitting from GL-
(1) 'T' & 'R' leads° high resistance from GL-
(1) Tip ground and ring batt (-48v) from dial office*

BUSY
(3) No SF tone receiving from carrier
(2) No SF tone trans from GL-
(1) 'T' & 'R' lead closed from GL-(Note 1, page 3.77)

RINGING
(1) 20 HZ from local dial office
(2) SF tone transmitted from GL as 20 HZ is applied (1)
(1) Ring cycle (2 seconds on and 4 off) stops when no SF received (3) and 'T' & 'R' lead is closed from GL-

INCOMING CALLS Loss of SF incoming (3) 'T' & 'R' closure is applied from GL-(1) thus drawing dial tone from local dial office. SF pulse received makes and breaks closure from GL thus passing information to dial office.

GL- GROUND START OPTION

IDLE
SF tone transmitting (2) and receiving (3).
(1) 2W side from GL, tip -48V and ring -48V.
(1) 2W side from loop, tip open and ring -48V.

BUSY
No SF tone transmitting (2) or receiving (3).
(1) 2W side from GL, tip and ring low resistance.
(1) 2W side from loop, tip ground and ring -48V.

°These leads are also designated "A" & "B".

*When a GL- is used to feed certain equipment, such as a 800A PBX, consisting of Solid State interfaces, the tip will be +10V and the ring -20V.

INCOMING CALL — SF is removed receiving (3) causing 2W side of GL-(1) to ground the ring. Grounded ring causes local dial office to ground the tip toward the GL-(1) removing the transmitting SF tone (2).

OUTGOING RING — (1) As 20 HZ comes up from local dial ofc, the transmitting SF is modulated with 20 HZ wave (2).

GL- UNITS

OPTIONS (On Printed Board)

Loop Start - operate Switch to LS
Ground Start - operate Switch to GS
Alarm Make Busy - ALB on
Alarm - ALM on
Alarm Override - ALO on
Alarm Ring Ground - ARG on
Alarm Ring Ground Off - ARO on
Make Busy Ground - MBG on
Make Busy Ground Off - MBO on

GLB UNITS only (GLB units are equipped with variable gain circuits to allow Gain Transfer similar to the FUD unit)

Loaded cable - Switch S2 to "LC"
Non Loaded cable - Switch S2 to "NLC"
Normal operation - Switch S1 to "O"
Test Position - Switch S1 to "T"
Comp Net - Switch 4 to Comp
Bal Network - Switch 4 to BN

LEVEL ADJUSTMENTS

GLA - Adjust Transmit and Receive pads on Face of unit.

GLB - Adjust Transmit and Receive amplifier on Face of unit and attenuators on printed board. Slope adjustment is also available on the printed board. BSP 179-407-502 contains graphs that aid in setting the slope control.

BALANCE

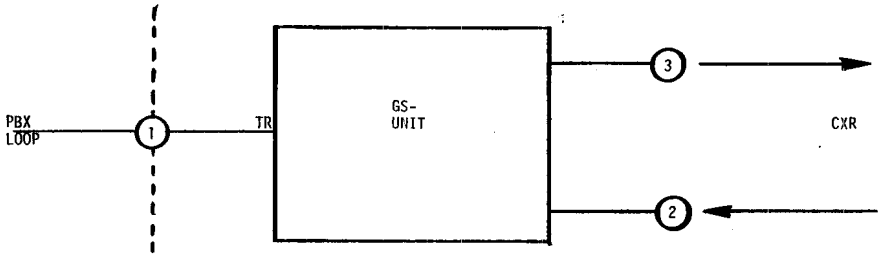
GLA - Adjust NBOC on printed board.

GLB - Adj. BOC on printed board in "COMP" position; Adj. Balance network in "BN" position. When Switch S2 is in the "LC" (Loaded Cable) position the BOC is across the line side of the hybrid and is used to build out the cable length.

*When red number is exposed the switch is closed, white indicates switch is open.

Note 1: - The term closed is used instead of Short. Actually a low resistance short.

GSA SFXSA20C GSB SFXSV20E



GS- LOOP START OPTION

IDLE
(2) No SF receiving
(3) SF tone transmitting
(1) 2-W from loop is open between 'T' & 'R'
(1) 2-W from GS is tip gnd and ring -48v (see note below)

BUSY
(3) No SF transmitting
(2) No SF receiving
(1) 2-W from loop is closed between 'T' & 'R' (Note 1, page 3.79)
(1) 2-W from GS is tip gnd and ring -48v

RINGING
(2) 2 Second Spurts of SF tone receiving
(1) 2-W side of GS puts out 20 HZ 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' loop closure makes and breaks with dialing pulses and information is sent out with spurts of SF for each digit dialed.

GS- GROUND START OPTION

IDLE
SF transmitting (3) and receiving (2)
(1) 2-W side from FS tip open and ring batt
(1) 2-W from loop tip -48v and ring open
(See Note below)

BUSY
No SF transmitting (3) and receiving (2)
(1) 2W side tip ground and -48v on ring

NOTE:
In the idle condition it will not be possible to see the -48v on the tip of the loop using the testboard voltmeter. A ground present in the voltmeter will cause a relay to operate at the station removing the -48v.

DIALING — Customer seizes circuit with ring ground from loop, SF is cut trans and in turn it also becomes cut receiving. Dialing operation is now same as for Loop Start option.

RINGING — SF tone transmitting. Receiving SF tone is modulated at 20 HZ for 2 sec., no tone for 4 sec. When modulated tone is received the GS passes 20 HZ ring to loop.

GS- UNITS

OPTIONS (On Printed Board)

Loop Start - LP SW operated*
Ground Start - LP SW Released*
Alarm Make Busy - ALB Operated*
Alarm Override - ALO Operated*

GSB UNITS only (GSB units are equipped with variable gain circuits to allow Gain Transfer similar to the FUD unit).

Loaded Cable - Switch S2 to "LC"
Non-Loaded Cable - Switch S2 to "NLC"
Comp Net - Switch S4 to "COMP"
Bal. NET - Switch S4 to "BN"
Test Position - Switch S1 to "T"

LEVEL ADJUSTMENTS

GSA - Adjust Transmit and Receive pads on Face of unit.

GSB - Adjust Transmit and Receive amplifier on Face of unit and attenuators on printed board. Slope adjustment is also available on the printed board. BSP 179-407-502 contains graphs that aid in setting the slope control

BALANCE

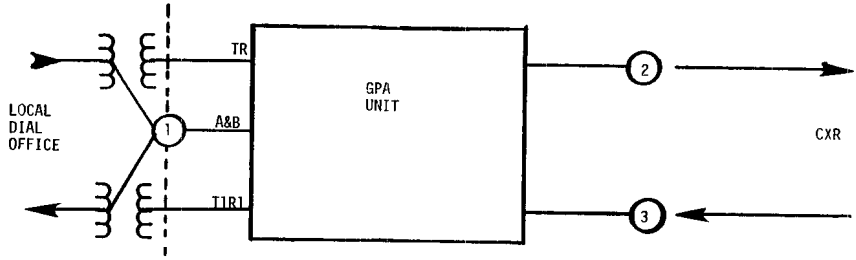
GSA - Adjust NBOC on printed board.

GSB - Adj. BOC on printed board in "COMP" position; Adj. Balance network in "BN" position. When Switch S2 is in the "LC" (Loaded Cable) position the BOC in across the line side of the hybrid and is used to build out the cable length.

*When Red number is exposed switch is operated. White indicates switch is open.

Note 1: - The term closed used instead of Short. Actually a low resistance short.

GPA SFXTA40D



GPA — LOOP START OPTION

IDLE CONDITION
(3) SF tone receiving from carrier
(2) No SF tone leaving from GPA
(1) 'A' & 'B' leads high resistance from GPA
(1) "A" Gnd and "B" Batt (-48v) from dial office*

BUSY CONDITION
(3) No SF tone receiving from carrier
(2) No SF tone Trans from GPA
(1) 'A' & 'B' leads low resistance short from GPA

RINGING
(1) 20 HZ from local dial office over "A" & "B"
(2) SF tone transmitted from GPA as 20 HZ is applied (1)
(1) Ring cycle (2 sec. on & 4 sec. off) stops when no SF received (3) and 'A' & 'B' lead is shorted from GPA

INCOMING CALLS
SF incoming is cut (3) and 'A' & 'B' short is applied from GPA (1) thus drawing dial tone from local dial office. SF pulse received (3) makes and breaks short from GPA (1) thus passing information to dial office.

GPA — GROUND START OPTION

IDLE
SF tone transmitting (2) and receiving (3). From GPA (1) "A" -48V & B". From local dial office (1) "A" open & "B" -48V.

BUSY
No SF transmitting (2) or receiving (3). From GPA (1) "A" -48V and "B" GND.
From local office (1) "A" GND & "B" -48V.

INCOMING CALL
(3) No SF receiving
(1) From GPA "A" -48V & "B" GND.
(1) From local dial office "A" GND & "B" -48V
(2) SF tone is cut transmitting
Dialing information is same as for loop start.

*When a GPA is used to feed certain equipment, such as a 800A PBX, consisting of Solid State interfaces, the tip will be +10V and the ring -20V.

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

GPA OPTIONS (on printed Board)

Loop Start - operate Switch to LS
Ground Start - operate Switch to GS
Alarm Make Busy - ALB on
Alarm - ALM on
Alarm Override - ALO on
Alarm Ring Ground - ARG on
Alarm Ring Ground off - ARO on
Make Busy Ground - MBG on
Make Busy Ground off - MBO on
NonLoaded Cable - SL Switch to "N"
Loaded Cable - SL Switch to "L"
Reverse "A" & "B" Leads - Operate "REV" Switch
Internal Simplex - "SX" operated
External "A" & "B" leads - "AB" operated (2 switches)
Make Busy Relay - "MB" operated

LEVEL ADJUSTMENTS - Adjust transmit and receive pads on face of unit.

EQUALIZING THE GPA

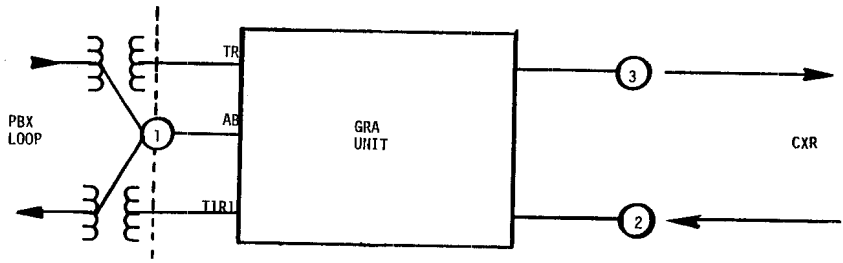
Switches BW*, HT*, SL* and HLMO operated in accordance with procedures in BSP 179-407-502 (cable makeup known) or 179-407-501 (cable makeup not known).

*Switches closed when white numerals are exposed and open when numbers are covered.

NOTE It may be necessary to use an external voltmeter to check for grounds on some equipment. If the ground is isolated through a diode the polarity of the testboard voltmeter may be wrong.

*Component is in the circuit when the white numbers are exposed and shorted out when they are covered.

GRA SFXSA40D



GRA — LOOP START OPTION

IDLE
(2) No SF receiving
(3) SF tone transmitting
(1) Open "A" & "B" from PBX
(1) "A" ground "B" Battery (-48V) from GRA

BUSY
(3) No SF transmitting
(2) No SF receiving
(1) Shorted "A" & "B" from PBX
(1) "A" gnd and "B" -48V from GRA

RINGING
(2) Spurts of SF tone receiving
(1) GRA puts out 20 HZ 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)
"A" & "B" 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).

GRA — GROUND START OPTION

IDLE
SF transmitting (3) receiving (2)
(1) "A" -48V & "B" open from Loop (see note on opposite page)
(1) "A" open & "B" -48V from GRA

BUSY
No SF transmitting (3) or receiving (2)
(1) "A" -48V "B" GND from loop
(1) "A" GND & "B" -48V from GRA

DIALING
(1) Customer seizes circuit with GND from loop on B.
(3) SF is cut transmitting and in turn is also cut receiving (2) when dial receiving equip is connected at Far End.
Dialing operations is now same as for loop start.

RINGING
(3) SF tone transmitting
(2) Receiving SF tone is modulated by 20 HZ for 2 seconds, followed by no tone for 4 seconds.
(1) When modulated tone is received the GRA passes 20 HZ ring to the loop.

GRA OPTIONS (On Printed Board)

Loop Start - LP SW operated**
Ground Start - LP SW released**
Alarm Make Busy - ALB SW operated**
Alarm Override - ALO Sw operated**
Non-Loaded Cable - SL Switch to "N"
Loaded Cable - SL Switch to "L"
Reverse "A" & "B" leads - Operate "REV" Switch
Internal Simplex - Operate "SX" Switch
External "A" & "B" leads - Operate "AB" Switch

LEVEL ADJUSTMENTS - Adjust transmit and receive pads on face of unit.

EQUALIZING THE GRA

Switches BW*, HT* SL* and HLMO operated in accordance with procedures in BSP 179-407-502 (cable makeup known) or 179-407-501 (cable makeup not known)

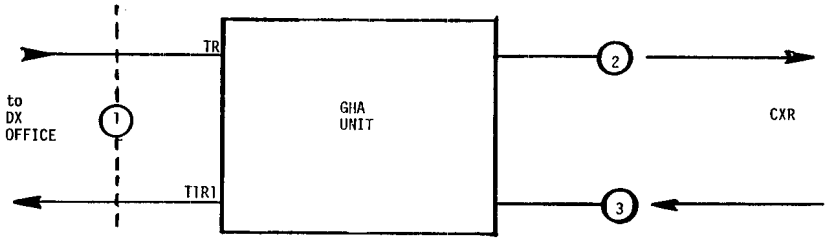
*Component is in the circuit when the white numbers are exposed and shorted out when they are covered.

**When Red number is exposed switch is operated white indicates switch is open.

NOTES In the idle condition (ground start) it will not be possible to see the -48v on the tip of the loop using the testboard voltmeter. A ground present in the voltmeter will cause a relay to operate at the station removing the -48v.

It may be necessary to use an external voltmeter to check for grounds on some equipment. If the ground is isolated through a diode the polarity of the testboard voltmeter may be wrong.

GHA



GHA

IDLE CONDITION (3) SF Tone Receiving
(2) SF Tone Transmitting
(1) "T1R1" Ground from GHA (A lead)
(1) "T1R1" Ground from Station DX ("A" lead)

BUSY CONDITION (3) No SF Tone Receiving
(2) No SF Tone Transmitting
(1) "T1R1" Battery (-48V) from GHA ("A" lead)
(1) "T1R1" Battery (-48V) from Station DX ("A" lead)

NOTE: "TR" ("B") lead is always app. -20V from both the GHA and the Station DX. It is used for balance only.

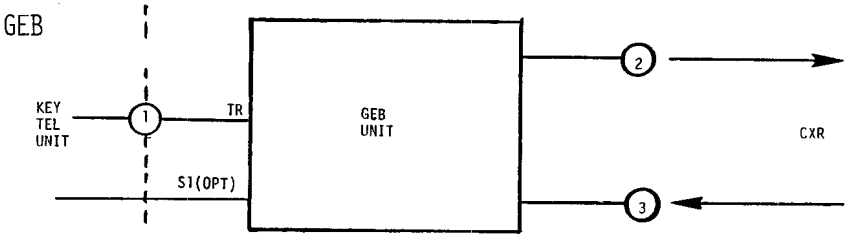
OUTGOING CALLS -48V battery on "T1R1" ("A" lead) (1) from Station DX. SF tone removed transmitting (2) Dial pulses alternate batt & ground from Station DX causing alternate SF tone off and on. When distant end answers, SF tone removed from receiving line (3) and battery on "T1R1" from GHA (1).

INCOMING CALL Far end removes SF Tone receiving (3) causing -48V battery on "T1R1" ("A" lead) from GHA (1). Far end dials causing alternate off and on SF tone receiving (3) and alternate grd and battery on "T1R1" from GHA (1). When station answers station DX converts ground to battery on the "T1R1" toward the GHA (1).

This is a 4-wire SF-DX combination that effectively replaces the FHA unit previously used.

This unit will not be available until the first quarter of 1981. Option information is not yet available at this writing, but probably be similar to those listed on page 3.81.

NOTE: It may be necessary to use an external voltmeter to check for grounds on some equipment. If the ground is isolated through a diode the polarity of the testboard voltmeter may be wrong.

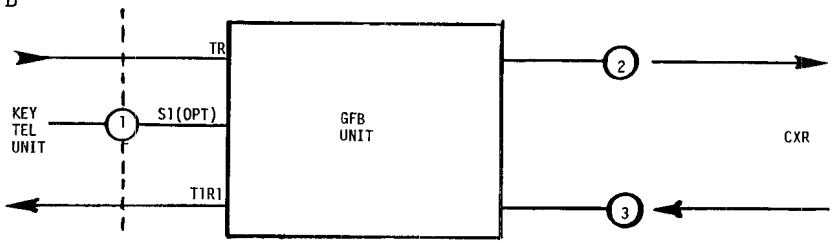


GEB

IDLE	(2) SF Tone off Transmitting (3) SF Tone off Receiving (1) No ring from customer or GEB (1) Grd on S1 lead from GEB; (This condition on DC Ringing option only)
BUSY	Same as Idle
OUTGOING CALL	20 HZ ringing burst from Station (1) causes corresponding SF Tone burst Transmitting (2); (in the case of the DC ringing option a -48V battery followed by an open from the station on the "S1" lead accomplishes the same thing).
INCOMING CALL	SF Tone burst receiving (3) causes corresponding 20 HZ ring to be sent to Station over loop (AC ringing option) or -48V from the GEB on the S1 lead (1) (DC ringing option). A "Code" Mode is available, also. This requires a specific number of SF bursts to be received before the AC or DC signal is sent to the station.

This unit will not be available until the first quarter of 1981. Option information is not yet available at this writing, but probably will be similar to those listed on page 3.77.

GFB



GFB

IDLE

(2) SF Tone off Transmitting
(3) SF Tone off Receiving
(1) No ring from customer or GFB on simplex of loop pairs
(1) Grd on S1 from GFB; (This condition on DC Ringing option only)

BUSY

Same as idle

OUTGOING CALL

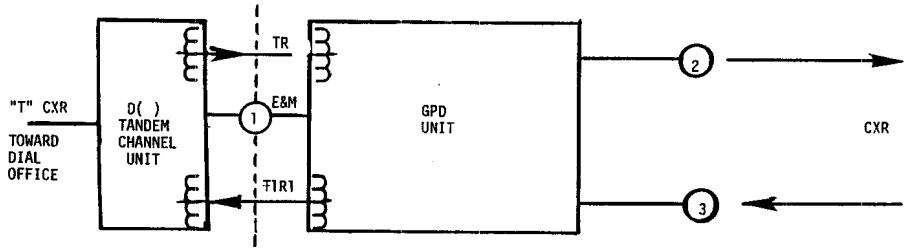
20 HZ ringing burst from Station on simplex (1) causes corresponding SF Tone burst Transmitting (2); in the case of the DC ringing option a -48V battery followed by an open from the station on the "S1" lead accomplishes the same thing.

INCOMING CALL

SF Tone burst receiving (3) causes corresponding 20 HZ ring on simplex to be sent to Station over loop (AC ringing option) or -48V from the GFB on the S1 lead (1) (DC ringing option). A "Code" Mode is available, also. This requires a specific number of SF bursts to be received before the AC or DC signal is sent to the station.

This unit will not be available until the first quarter of 1981. Option information is not yet available at this writing, but probably will be similar to those listed on page 3.81.

GPD- OFFICE FUNCTION *



GPD — LOOP START OPTION

IDLE

(3) SF Tone Receiving from carrier
(2) No SF Tone leaving the GPD
(1) BATT & GRD on Loop Simplex from "D" unit open or high resistance short on simplex from GPD, "M" lead Battery, "E" lead open

BUSY

(3) No SF Tone Receiving from carrier
(2) No SF Tone Leaving the GPD
(1) BATT & GRD on Simplex for "D" unit closure on simplex from GPD, "M" lead Battery, "E" lead ground.

RINGING FROM DIAL OFFICE

(1) Alternate open (no ring) and ground (ring) on simplex on T1R1 from "D" unit. "M" lead grounded.
(2) Alternate no SF Tone and SF Tone leaving the GPD.
(3) SF Tone Receiving from carrier. When Station answers SF Tone is removed, the "E" lead is grounded toward the "D" unit, the "M" lead changes to Battery and the ringing stops.

CALLS FROM PBX

SF Tone incoming (3) is cut, Loop closure, is sent from GPD unit to the "D" unit via the simplex (1) across TR & T1R1, which causes "D" unit to draw dial tone from the CO. SF pulses from the PBX transmits dialing information to the C.O. "E" lead alternate between the GRD and open with pulses. Simplex loop opens and closes with pulses.

* For this function, the "OFF-STA" switch on the GPD must be in the "OFF" position.

GPD — GROUND START OPTION

(E&M Leads not used with Ground Start)

IDLE — SF Tone transmitted from (2) and received to (3) the GPD unit.
(1) BATT and GRD from the D unit, open from the GPD unit on the TR - TIRI simplex.

BUSY — No SF Tone either way (2 & 3) TR - TIRI simplex loop.

RINGING FROM DIAL OFFICE — Alternate open (no ring) and Ground (ring) from "D" unit on simplex (1) of TIRI, causing alternate SF Tone OFF and ON leaving GPD unit (2). SF Tone receiving from carrier (3) is cut when Station answers. Removal of SF (3) causes a ground to be transmitted on the simplex of the TR from the GPD to the "D" unit, causing the ringing to stop.

CALLS FROM PBX

SF tone incoming (3) is cut, causing a ground to be transmitted from the GPD to the "D" unit over the simplex (1) on TR causing "D" unit to draw dial tone from the central office. This causes the "D" unit to ground the simplex on TIRI to the GPD, and removes the SF tone transmitting (2). Dial pulses from the PBX are transmitted as SF pulses, which alternately opens and ground the simplex on TR toward the D unit (1).

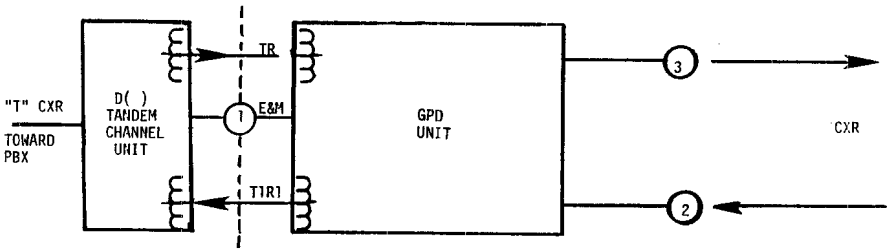
OPTIONS - This unit will not be available until the first quarter of 1981. Option information is not available at this writing, but probably will be similar to those listed on page 3.81.

NOTES:

The GPD unit is used on special services at an intermediate office when an Analog facility such as a "L" carrier channel works in tandem with a "T1" carrier channel. While this equipment is used in this configuration, it is included in this job aid since the private line group may have to test the unit. Reference point (1) on the sketch may not be readily available for testing in some offices. The "D" unit must be equipped with a 4 wire tandem plug-in unit optioned as per Table D or Table E or BSP 179-365-101.

When the GPD is used with an D3 or D4 tandem unit a SG lead is also required between the units.

GPD - STATION FUNCTION *



GPD — LOOP START OPTION

IDLE

(2) No SF Tone Receiving from CXR
(3) SF Tone Transmitting to CXR
(1) Open or high resistance short on Loop simplex from "D" unit. Batt & Grd on simplex from GPD "E" lead Grd, "M" lead Grd.

BUSY

(2) No SF Tone Receiving
(3) No SF Tone Transmitting
(1) Closure on Simplex loop from "D" unit Batt & Grd a simplex from GPD "E" lead Grd, "M" lead Batt.

RINGING FROM DIAL OFFICE

CO seizes circuit causing SF tone to be received by the GPD from the CXR (2) during Ringing.
This opens the "E" lead to the "D" unit.

Alternate No SF Tone - Tone signals (Ring from CO) is received from the CXR (2) causing the GPD to send ringing signal over on TR (1) to the "D" unit. When PBX answers the "D" unit the Loop simplex provides a closure to the GPD unit and Batt is placed on the "M" lead (1). The SF Tone Transmitting to the Cxr is removed (3) and ringing stops.

CALLS FROM PBX

Seizure by PBX causes closure to the GPD unit over the loop simplex and Batt on the "M" lead (1). This removes the SF Tone transmitting to the CXR. When the CO answers, dial tone is returned to the PBX. Dialing then proceeds by alternate open-closures on the Loop Simplex to the GPD unit and alternate Grd-Battery on the M Lead.

* For this function, the "OFF-STA" switch on the GPD must be in the "STA" position.

GPD — GROUND START OPTION

(E&M leads not used with Ground Start)

IDLE — SF Tone on Transmitting (3) and Receiving (2) Simplex loop open or high resistance short from "D" unit, Batt and Grd from GPD (1).

BUSY — No SF Tone transmitting (3) or Receiving (2) simplex loop closed from "D" unit.

RINGING FROM DIAL OFFICE — CO seizes circuits causing SF tone to be removed Receiving to SF (2). Loss of SF causes GPD to ground the TR simplex to the "D" unit (1). When the PBX answers, the "D" unit grounds the TlRl simplex to the GPD (1) removing the SF Tone Transmitting (3) and ringing stops.

CALLS FROM PBX

When the PBX seizes the circuit the "D" unit grounds the TlRl simplex (1) removing the SF Tone Transmitting (3). When the CO answers, SF Tone is removed receiving from the carrier (2) grounding the TR simplex to the "D" unit. Dial tone is provided to the PBX. Dialing consists of alternate simplex loop opens and closures (1) and SF Tone on and offs transmitting (3).

OPTIONS - This unit will not be available until the first quarter of 1981. Option information is not available at this writing, but probably will be similar to those listed on page 3.81.

NOTES:

The GPD unit is used on special services at an intermediate office when an Analog facility such as an "L" carrier channel work in tandem with a "Tl" carrier channel. While this equipment is used in this configuration, it is included in this job aid since the private line group may have to test the unit. Reference point (1) on the sketch may not be readily available for testing in some offices. The "D" unit must be equipped with a 4 wire tandem plug-in unit optioned as per Table D or Table E of BSP 179-365-101.

When the GPD is used with a D3 or D4 tandem unit a SG lead is also required between the units.

"G" TYPE UNIT LIST

CODE OF SF UNIT	DRAWING SD-7C----01	SWITCHING					SIGNALING									NEAREST TYPE F SIGNALING UNIT	NEAREST TYPE E SIGNALING UNIT	NOTES
							ADDRESS											
							TRANSMIT TO FAR END		RECEIVE FROM FAR END									
		PRINCIPAL TYPE OF SERVICE	CIRCUIT END	CONDUCTORS IN SPEECH PATH	IMPEDANCE OHMS	SUPERVISORY	TYPE OF PULSING	PULSE CORRECTION	TYPE OF PULSING	PULSE CORRECTION	PULSING TOWARD OFF-HOOK	CGA TRUNK CONDITIONING	LINE BUILDOUT RESISTANCE	LIGHTNING PROTECTION				
GAA	061	MSG	O,T	2	900	E,M	DP,MF	PS	DP,MF	PS	Yes	Yes	—	No	FAA, FAF, FAC		E1A	3
GAB	062	MSG	O,T	2	600	E,M	DP,MF	PS	DP,MF	PS	Yes	Yes	—	No	FAB, FAD, FAF		E1A	3
GBA	063	MSG	O,T	4	600	E,M	DP,MF	PS	DP,MF	PS	Yes	Yes	—	No	FBA, FBB, FBC, FWA, FWC		E4B	5
GBM	071	MSG	O,T	4	600	E,M	DP,MF	PS	DP,MF	PS	Yes	Yes	—	No	FBM, FBN, FBO		E4B	
GCA	064	MSG	O	2	900	LPR	DP,MF	PS	—	—	Yes	Yes	No	Yes	FCA		E4C	2
GDA	065	MSG	T	2	900	LPR	—	—	DP,MF	CPB	Yes	Yes	Yes	Yes	FDA, FDB		E4D	2
GEA	075	PVT	O,T	2	900		—	—							None		None	
GEB	066	PVT	O,T	2	900	LP	RD	—	RD	—	—	—	—	Yes	FGM, FGN		None	
GFA	074	PVT	O,T	4	LM		—	—		—					None		None	4
GFB	067	PVT	O,T	4	LM	LP	RD	—	RD	—	—	—	—	Yes	FHM, FHN		None	4
GHA	070	SA	INT	4	LM	DX	DP	PS	DP	PS	Yes	Yes	—	Yes	FHA		None	1,4
GLA	058	SA	CO	2	900	LS/GS	—	—		CPB	No	Yes	Yes	Yes	FLA, FLC		E2L/LA	
GLB	060	SA	CO	2	900	LS/GS	—	—		CPB	No	Yes	Yes	Yes	FUD + FLA, FUD + FLC			
GMA	076	TO	INT	4	600										FMA, FMF, FMG, FMJ			
GMB	079	TO	INT	4	600										FMB			
GMC	077	TO	INT	4	LM										FMC			4
GNA	078	TO	INT	2	LM										FMD, FME			6
GPA	059	SA	CO	4	LM	LS/GS	—	—	DP	CPB	No	Yes	Yes	Yes	FPA		E1P	4
GPD	072	SA	INT	4	600		— DP	PS	DP —	CPB	No	Yes	—	Yes	FPD, FRD			8,9
GRA	055	SA	STA	4	LM	LS/GS	DP	PS	—	—	No	Yes	No	Yes	FRA		E1R	4,7
GSA	054	SA	STA	2	900	LS/GS	DP	PS	—	—	No	Yes	No	Yes	FSA, FSC		E25/SA	
GSB	056	SA	STA	2	900	LS/GS	DP	PS	—	—	No	Yes	Yes	Yes	FUD + FSA, FUD + FSC		None	

Legend:

CO	Central Office
CPB	Constant Percent Break
DP	Dial Pulse
DX	As in DX Signal Transmission System
EM	E- and M-Lead Signaling
GS	Ground-Start
INT	Located at Intermediate Central Office
LM	Line Matching
LP	Loop
LPR	Loop Reverse Battery
LS	Loop-Start
MF	Multifrequency Pulse
MSG	Intertoll, Toll Connecting, and Other Trunks
O	Originating
PS	Pulse Shaper
PVT	Private
RD	Ringdown
SA	Special Access Lines and Trunks
STA	Station
T	Terminating

Notes:

1. Used to extend signaling on metallic facilities, by means of DX signal transmission, from a carrier terminal situated at an intermediate location on a circuit.
2. Suitable loop signaling trunk circuits may not be available for intertoll applications.
3. Has slide switch for connecting or disconnecting the 1 μF capacitor across the A and B leads.
4. Line matching capabilities with basic settings of 1200/600/150Ω.
5. Must be used with noncompandored facility in same building only.
6. Has line matching capabilities of 600Ω and 900Ω for FMD and FME units.
7. Automatic buildout resistance.
8. For use in tandem analog carrier—T1 carrier.
9. 2-state to 3-state conversion.

SPECIAL ACCESS SF UNIT COMPATIBILITY

AT OR TOWARD CENTRAL OFFICE END	MODE OF OPERATION	AT OR TOWARD CUSTOMER END											
		GRA	GSA GSB	GA__ GBA	FRA	FRD	FSA FSB	FSC FSD	FA__ FB__ FWA	E2BK E2BKA E3BK E3BKA OR E4B	E2S	E2SA	E1R
GLA & GLB	LS	√	√	1, 3	√	√	√	√	1, 3	1	√	No	√
	GS	√	√	No	√	√	√	No	No	No	√	√	√
GPA	LS	√	√	1, 3	√	√	√	√	1, 3	1	√	No	√
	GS	√	√	No	√	√	√	No	No	No	√	√	√
GA__ & GBA	LS	No	No		2, 3	No	2, 3						
	GS	No	No		No	No	No						
FLA & FLB	LS	√	√	1, 3	√	√	√	√	1, 3	1	√	No	√
	GS	√	√	No	√	√	√	No	No	No	√	√	√
FPA	LS	√	√	1, 3	√	√	√	√	1, 3	1	√	No	√
	GS	√	√	No	√	√	√	No	No	No	√	√	√
FPD	LS	√	√	No	√	√	√	√	No	No	√	No	√
	GS	√	√	No	√	√	√	√	No	No	√	√	√
FLC & FLD	LS	√	√		√	√	√	√			√	No	√
FA__ FB__ FWA	LS	No	No		2, 3	No	2, 3						
	GS	No	No		No	No	No						
E2L	LS	√	√		√	√	√	√			√	No	√
	GS	√	√		√	√	√	No			√	√	√
E2LA	LS	No	No		No	No	No	No					
	GS	√	√		√	√	√	No					
E1P	LS	√	√		√	√	√	√			√	No	
	GS	√	√		√	√	√	No			√	√	

Note 1: When used with SD-96252-01 DLL circuit.

Note 2: When used with SD-96251-01 DLL circuit.

Note 3: Not a desirable arrangement.

"F" TYPE SF UNIT LIST

CODE OF AUX MODULE	DRAWING SD 82- - 01	SWITCHING					SIGNALING									NOTES
							ADDRESS									
							TRANSMIT TO FAR END		RECEIVE FROM FAR END							
		PRINCIPAL TYPE OF SERVICE	CIRCUIT END	CONDUCTORS IN SPEECH PATH	IMPEDANCE OHMS	SUPERVISORY	TYPE OF PULSING	PULSE CORRECTION	TYPE OF PULSING	PULSE CORRECTION	PULSING TOWARD OFF-HOOK	CGA TRUNK CONDITIONING	LINE BUILDOUT RESISTANCE	LIGHTNING PROTECTION	NEAREST TYPE E SIGNALING UNIT	
FAA	227	MSG	O, T	2	900	EM	DP, MF	PS	DP, MF	Timer	Yes	Yes	—	No	E1A	1
FAB	227	MSG	O, T	2	600	EM	DP, MF	PS	DP, MF	Timer	Yes	Yes	—	No	E1A	1
FAC	227	MSG	O, T	2	900	EM	DP, MF	PS	DP, MF	Timer	Yes	Yes	—	No	E1A	1,6,7
FAD	227	MSG	O, T	2	600	EM	DP, MF	PS	DP, MF	Timer	Yes	Yes	—	No	E1A	1,6
FBA	227	MSG	O, T	4	600	EM	DP, MF	PS	DP, MF	Timer	Yes	No	—	No	E4B	1
FBB	227	MSG	O, T	4	600	EM	DP, MF	PS	DP, MF	Timer	Yes	Yes	—	No	E4B	1
FBM	227	MSG	O, T	4	600	EM	DP, MF	PS	DP, MF	Timer	Yes	Yes	—	No	E4B	1
FBN	227	MSG	O, T	4	600	EM	DP, MF	PS	DP, MF	Timer	Yes	Yes	—	No	E4B	1
FCA	228	MSG*	O	2	900	LP	DP, MF	PS	—	Timer	Yes	Yes	No	Yes	E4C	2
FDA	229	MSG*	T	2	900	LP	—	—	DP, MF	Timer	Yes	Yes	Yes	Yes	E4D	2
FDB	229	MSG*	T	2	900	LP	—	—	DP, MF	CPB	Yes	Yes	Yes	Yes	E4D	2
FGA	373	PVT	INT	2	900	DX	DX	Timer	DX	Timer	Yes	Yes	—	Yes	None	2,3
FGM	153	PVT	O, T	2	900	LP	RD	—	RD	—	—	—	—	Yes	None	2
FGN	153	PVT	O, T	2	900	LP	RD	—	RD	—	—	—	—	Yes	None	2
FHA	373	PVT	INT	4	600	DX	DX	Timer	DX	Timer	Yes	Yes	—	Yes	None	2
FHM	153	PVT	O, T	4	600	LP	RD	—	RD	—	—	—	—	Yes	None	1,3
FHN	153	PVT	O, T	4	600	LP	RD	—	RD	—	—	—	—	Yes	None	1
FLA	231	SA	CO	2	900	LP	—	—	DP	CPB	No	Yes	Yes	Yes	E2L/LA	2
FLB	231	SA	CO	2	600	LP	—	—	DP	CPB	No	Yes	Yes	Yes	E2L/LA	2
FLC	231	SA	CO	2	900	LP	—	—	DP	CPB	No	Yes	Yes	Yes	E2L/LA	2
FLD	231	SA	CO	2	600	LP	—	—	DP	CPB	No	Yes	Yes	Yes	E2L/LA	2
FMA	296	Replaces FU where only adjustable transmission loss and echo suppressor access are required.														4
FMB	296	Replaces FUA or AUX when fixed 4-wire zero trans loss and no echo supp. access are required.														4
FMC	296	Replaces AUX module when a 4-wire extension network with adjustable equalization is required.														5
FMD	296	Replaces AUX module when a 900-ohm 4-wire circuit is required.														5
FME	296	Replaces AUX module when a 600-ohm 4-wire circuit is required.														5
FPA	231	SA	CO	4	600	EM, LP	—	—	DP	CPB	No	Yes	Yes	Yes	E1P	1,8
FPD	039*	SA	Note 10	4	600	Note 11	—	—	DP	CPB	No	Yes	—	Yes	—	10,11
FRA	230	SA	CUS	4	600	EM, LP	DP	PS	—	—	No	Yes	No	Yes	E1R	1,8
FRD	040*	SA	Note 10	4	600	Note 11	DP	PS	—	—	No	Yes	—	Yes	—	10,11
FSA	230	SA	CUS	2	900	LP	DP	PS	—	—	No	Yes	No	Yes	E2S/SA	2
FSB	230	SA	CUS	2	600	LP	DP	PS	—	—	No	Yes	No	Yes	E2S/SA	2
FSC	230	SA	CUS	2	900	LP	DP	PS	—	—	No	Yes	No	Yes	E2S/SA	2
FSD	230	SA	CUS	2	600	LP	DP	PS	—	—	No	Yes	No	Yes	E2S/SA	2
FWA	225	MSG	O, T	4	600	EM	DP, MF	PS	DP, MF	Timer	Yes	No	—	No	E4B	
FWB	225	AVN	O, T	4	600	EM	DP, MF	PS	MF	Timer	Yes	No	—	No	E1J	
FWC	583	MSG	O, T	4	600	EM	MF	PS	MF	Timer	Yes	No	—	No	E4B	9

Legend:

AVN Autovon Network
CO Central Office
CPB Constant Percent Break
CUS Customer
DP Dial Pulse
DX As in DX Signal Transmission System
EM E- and M-Lead Signaling
LP Loop
INT Located at Intermediate Central Office
MF Multifrequency Pulse
MSG Intertoll, Toll Connecting and Other Trunks
O Originating
PS Pulse Shaper
SA Special Access Lines and Trunks
T Terminating
* Suitable Loop Signaling Trunk Circuits may not be Available for Intertoll Applications
RD Ringdown
PVT Private

Notes:

1. Must be associated with FUA signaling converter.
2. Must be associated with FUA or FUD signaling converter.
3. Used to extend signaling on metallic facilities, by means of DX signal transmission, from a carrier terminal situated at an intermediate location on a circuit.
4. Must be associated with FMB, FMC, FMD, or FME to maintain continuity in absence of signaling functions.
5. Used with FMA or FMB to maintain circuit continuity when signaling function is not desired.
6. Has screw switch for connecting or disconnecting the 1 μF capacitor across the A and B leads.
7. Has 3 μF capacitor which may be connected, by means of a screw switch, in parallel with the fixed 1 μF capacitor which is in series with the balancing windings of the hybrid.
8. E and M lead supervisory only available for loop-start applications.
9. Must be used with noncompandored facility in same building only.
10. For use in tandem analog carrier (T1 carrier).
11. 2-state to 3-state conversion.

COMMON LANGUAGE CODES USED ON NEW WORD DOCUMENTS

See Section 1 for a discussion of Common Language and WORD Documents.

The Common Language codes for all equipments discussed in JA9 are shown on the page that cover the equipment. For Example:

LOOP SIGNALING CONVERTER (SD 95060) SCLE**** (Note)

Some other SF Common Language equipment codes that may be of use to you are listed below:

E1A - SFEE*00L
E1B - SF60**0L
E1D (MF) - SFYT*00L
E1D (DT) - SFDT*00L
E1E - SFR0*00*
E1F - SFRT*00L
E1H - SF6P200M
E1J - SF6P*0*L
E2B - SF60***M
E2C - SFD0*00M
E2D - SFDT*00M
E2F - SFRT*00M
E3D - SFTY*00M
E4B - SF60****
E4C - SFD0*00S
E4D - SF0T100L
E5C - SFD0400S
E5D - SF0T200L
FAA - SFEEF**A
FAB - SFEEF**A
FAC - SFEEF**A
FAD - SFEEF**A
FAE - SFEEF**A
FAF - SFEEF**A
FBA - SF60F1HA
FBB - SF60F*HA
FBC - SF60F*HA
FBM - SFAXE1HB
FBN - SFAXE*HB
FBO - SFAXE*HB
FCA - SFD0F*HA
FDA - SFDTF0HA
FDB - SFDTF0HA
FMA - SFCTF1HC
FMB - SFCTF0HC
FMC - XN4WWFHD
FMD - 4T6F000A
FME - 4T9F000A
FMF - SFCTF2HC
FMG - SFCTF1HC
FMJ - SFCTF3HC
FMK - SFCTF4HC
FWA - SF60F*HE
FWB - SF6PF*HN
FWC - SF60F4HF
GAA - SFEE900B
GAB - SFEE600C
GBA - SF60B00B
GCA - SFD0G00B
GDA - SFDTG00B
GMB - SFCTG00D

Mountings: "E" Type - SFM*****
"F" Type - SFMM**** or SFMSF00A
"G" Type - SFMMG0*F

Note - * indicates a variable. See the BSP for the base code for details (795-201-XXX).

CENTRAL OFFICE EQUIPMENT

INDEX - SECTION 4

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 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 news 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 impedance (balanced bridge). This requires unused legs to be terminated by means of a resistor in the impedance of the legs used. (This is normally 600 OHMS.)

BRIDGE COMMON LANGUAGE CODING

1st and 2nd digit - BR . . . . . To indicate "bridge"
3rd digit 2 or 4 . . . . . 2-wire or 4-wire
4th digit 3-9, M or T . . . . . Number of sides to the bridge, 3-9. More than 9. - "M"

BRIDGE CODING	OUTPUTS
BR2M100*	10
BR2M190*	19
BR24**0*	5
BR25**0*	5
BR28*00*	8
BR44****	4
BR46****	6

Loss varies with type of Bridge (Shown as variable in code).

APPLICATIONS OF ECHO SUPPRESSORS

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 or 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 eliminates a feedback to the speaker which would be of a delay or time lag represented as an echo or echoes to the speaker.

Tests and Adjustments for the Echo Suppressors can be found in BSP 332-4XX-XXX. The units are adjustable for sensitivity to voice and noise and have an adjustment to control release time. 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.

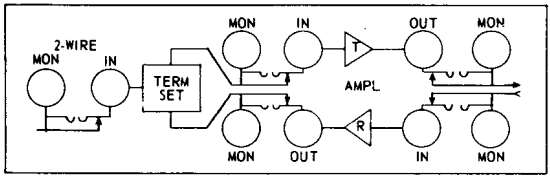
No circuit which has been designed to operate with an echo suppressor should ever be operated without one.

V4 TELEPHONE REPEATER

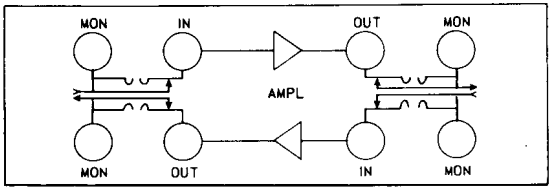
The subdivisions of sections describing V4 repeater equipment are-

24V4 repeater mounting shelves 332-105-XXX
44V4 repeater mounting shelves 332-106-XXX
227 - type amplifiers 024-140-XXX
849 - type networks 332-115-XXX
359 - type equalizers 332-116-XXX
648 - type filter 332-117-XXX
1 type terminating sets 332-800-XXX
4066 type networks 332-852-XXX

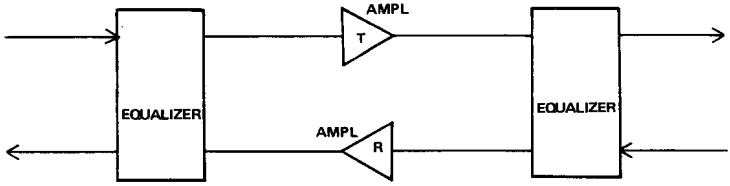
The 24V4 repeater is designed for use between 2-wire (900 or 600 OHM Central Office or PBX installations), and 4-wire loaded and non-loaded cable or the 4-wire terminals of inter-toll facilities.



The 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 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.



227 - TYPE AMPLIFIER VRA0***A

The 227 - type amplifier is a transistorized, plug-in type amplifier which may be arranged for either 600- or 1200- ohm input and output impedance in accordance with the following strapping of the connector block.

INPUT IMPEDANCE	600 OHMS	1200 OHMS
Strap Terminals	11-13	9-13
Connect to Terminals	1-5	1-5

OUTPUT IMPEDANCE	600 OHMS	1200 OHMS
Connect to Terminals	4-8	2-10

For measuring gain and output level, a 600-ohm transmission measuring set is used and corrections to the readings applied as shown below:

AMPLIFIER IMPEDANCE		CORRECTION TO BE ADDED TO TRANSMISSION MEASURING SET READING	
INPUT	OUTPUT	GAIN (dB)	OUTPUT POWER (dB)
600	600	0	0
1200	600	+0.5	0
600	1200	+0.5	+0.5
1200	1200	+1.0	+0.5

227-TYPE AMPLIFIERS

AMPLIFIER (NOTES 1, AND 2)	USE	IMPEDANCE (OHMS) (NOTE 3)		SIMPLEX PATH RESISTANCE (OHMS) (NOTE 4)			PROTECTION PROVIDED FOR LIGHTING OR INDUCED POWER VOLTAGES	SUITABLE FOR SPECIAL DATA CIRCUITS	REVERSES POLARITY AT INPUT AND OUTPUT (NOTE 5)
		INPUT	OUTPUT	INPUT	OUTPUT WINDING				
					600 OHM	1200 OHM			
227A	ALL BURIED CABLE	600 OR 1200	600 OR 1200	8.5	17.5	23.75	NO	NO	YES
227B	AERIAL OR BURIED CABLE	600 OR 1200	600 OR 1200	8.5	17.5	23.75	YES	NO	YES
227C	AERIAL OR BURIED CABLE	600 OR 1200	600 OR 1200	8.5	17.5	23.75	YES	YES	YES
227D	AERIAL OR BURIED CABLE	600 OR 1200	600 OR 1200	8.5	17.5	23.75	YES	YES	NO
227E	ALL BURIED CABLE	600 OR 1200	600 OR 1200	8.5	17.5	23.75	NO	NO	NO
227F	AERIAL OR BURIED CABLE	600 OR 1200	600 OR 1200	8.5	17.5	23.75	YES	NO	NO
F58122	(NOTE 6)	600 OR 1200	600 OR 1200	8.5	17.5	23.75	YES	YES	YES

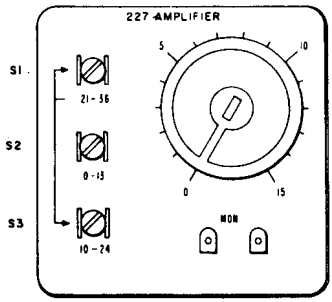
REFERENCE INFORMATION	
SECTION	TITLE
024-140-101	227A,B,E, AND F AMPLIFIERS – DESCRIPTION
024-140-103	227C AND 227D AMPLIFIERS – DESCRIPTION
332-104-501	227-TYPE AMPLIFIERS – TEST AND ADJUSTMENTS
332-104-103	F58122 AMPLIFIER
332-104-503	F58122 AMPLIFIER – TESTS AND ADJUSTMENTS

NOTES:

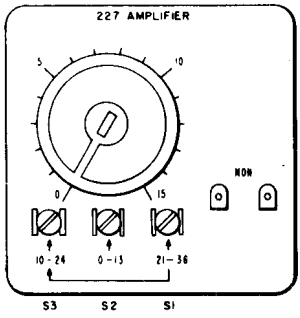
1. THE 227A,B, AND C AMPLIFIERS ARE RATED MFR. DISC. AND REPLACED BY THE 227E,F, AND D RESPECTIVELY.
2. ALL AMPLIFIERS HAVE A GAIN OF 0 TO 36 dB AND MAY BE ADJUSTED AS FOLLOWS:
   0-13 dB – S2 SCREWDOWN
   10-24 dB – S3 SCREWDOWN
   21-36 dB – S1 AND S3 SCREWDOWN
3. THE INPUT AND OUTPUT TRANSFORMER OF THE AMPLIFIERS ARE DESIGNED PRIMARITY TO PROVIDE EITHER 600- OR 1200-OHM LINE IMPEDANCES WITH A BALANCED CENTER-TAP CONNECTION FOR SIMPLEX SIGNALING. ADDITIONAL INPUT AND OUTPUT IMPEDANCES OF 150 AND 300 OHMS CAN BE OBTAINED FOR SPECIAL APPLICATIONS THROUGH USE OF THE CENTER TAP AS ONE SIDE OF THE TRANSMISSION CIRCUIT. HOWEVER, THIS PRECLUDES USE OF THE CENTER TAP FOR SIMPLEX SIGNALING.
4. FOR CALCULATIONS OF SIGNALING RANGES, ADD 15% TO THE TABULATED AVERAGE VALUES. THIS COMPENSATES FOR MANUFACTURING VARIATIONS AND TEMPERATURE.
5. THE 227A,B, AND C AMPLIFIERS HAVE A BUILT IN PHASE SHIFT OF APPROXIMATELY 180° (POLARITY REVERSAL) BETWEEN THE INPUT AND OUTPUT. IN CERTAIN APPLICATIONS, SUCH REVERSALS ARE NOT ACCEPTABLE. THE 227D,E, AND F AMPLIFIERS HAVE BEEN DESIGNED TO ELIMINATE THIS REVERSAL.
6. THE F58122 AMPLIFIER, WHICH HAS AUTOMATIC GAIN CONTROL (AGC), IS FOR USE IN THE TRANSMITTING LEG BETWEEN CUSTOMER-PROVIDED FACILITIES AND BELL SYSTEM FACILITIES. IT PROVIDES LIMITING CAPABILITY TO ENSURE COMPLIANCE WITH STANDARDS FOR INBAND SIGNALS.

The gain of the 227 - type amplifiers is adjusted by means of fixed steps and a potentiometer. The gain and switch settings are as follows:

GAIN RANGE IN DB	SCREW-TYPE SWITCH POSITIONS		
	S1	S2	S3
21-36	Closed	Open	Closed
10-24	Open	Open	Closed
0-13	Open	Closed	Open



FACEPLATE OF EARLY PRODUCTION AMPLIFIER



FACEPLATE OF PRESENT PRODUCTION AMPLIFIER

849 - TYPE NETWORKS VRNZ*00M

The 849-type network can be used in place of 227-type amplifiers where gain is not required. They are described in BSP 332-115-XXX.

849-TYPE NETWORKS

NETWORK NOTE 4 AND 5	4-WIRE FACILITY	ASSOCIATED WITH FACILITY DESIGNATED		1 KHz POWER LOSS BETWEEN NORMAL IMPEDANCES NOTE 6)	TRANSFORMER IMPEDANCE RATIO—OHMS		SIMPLEX PATH RESISTANCE (OHMS) (NOTE 3)
		24V4	44V4		EQUIP	LINE	
849A	LOADED CABLE H88 OR D88	T	1 OR 2	0.4 + PAD	600	1200	15.7
849B (NOTE 2)	LOADED CABLE H88 OR D88	R	1 OR 2	0.4 + PAD	600	1200	15.7
849C	600-OHM EQUIP. OR NON-LOADED CABLE	T OR R	1 OR 2	PAD	–	–	–
849D (NOTE 1)	LONG LENGTHS OF NON-LOADED CABLE	–	–	0.5 + PAD	600	150	1.3
849E (NOTE 1)	SHORT LENGTHS OF NON-LOADED CABLE	–	–	0.5 + PAD	600	600	6.25
849F	LOADED CABLE H44	T	1 OR 2	0.3 + PAD	600	600	1.5
849G	LOADED CABLE H44	R	1 OR 2	0.3 + PAD	600	600	1.5
849H	LOADED OR NONLOADED	USED IN 424V4 REPEATER		–	–	–	22.0

REFERENCE INFORMATION	
SECTION	TITLE
332-115-101	849A NETWORK – DESCRIPTION
332-115-102	849B NETWORK – DESCRIPTION
332-115-103	849C NETWORK – DESCRIPTION
332-115-104	849D NETWORK – DESCRIPTION
332-115-105	849E NETWORK – DESCRIPTION
332-115-106	849F NETWORK – DESCRIPTION
332-115-106	849G NETWORK – DESCRIPTION

NOTES:

1. THE 849D AND E NETWORKS WERE DESIGNED FOR USE IN BASIC V4 REPEATERS AND THEREFORE, MAY NOT BE USED IN 24V4 OR 44V4 APPLICATIONS.
2. THE 849B NETWORK WAS DESIGNED FOR USE IN 24V4 AND 44V4 APPLICATIONS AND SHOULD NOT BE USED IN BASIC V4 APPLICATIONS.
3. FOR CALCULATION OF SIGNALING RANGES ADD 15% TO THE TABULATED AVERAGES VALUES. THIS COMPENSATES FOR MANUFACTURING VARIATIONS AND TEMPERATURE.
4. THE 849-TYPE NETWORKS ARE USED INSTEAD OF 227-TYPE AMPLIFIERS WHEN AMPLIFICATION IS NOT REQUIRED
5. THE 849-TYPE NETWORK RECEIVES AN 89-TYPE RESISTOR ON A PLUG-IN BASIS. LOSS IS ADJUSTABLE IN 0.25 dB STEPS BY SELECTION OF THE PROPER 89-TYPE RESISTOR. SEE SECTION 852-307-102.
6. THIS IS THE LOSS USED IN COMPUTATIONS OF LEVELS.

359 - TYPE EQUALIZERS VREL*00M

The 359-type equalizers are used on the line side of the terminal repeater when gain or equalization is required. Screw settings for the various networks are found in BSP 332-116-1XX.

359 - TYPE EQUALIZERS

EQUALIZER	4-WIRE FACILITY	EQUALIZATION		1 Kz LOSS BETWEEN NORMAL IMPEDANCES (NOTE 3)	TRANSFORMER IMPEDANCE RATIO		IMPEDANCE FACING FACILITIES (OHMS)	ADJUSTABLE
		TRANS	REC		EQUIP	LINE		
359A	LOADED CABLE – H88 WITH GAIN (AMPLIFIER) REQUIRED	NO	YES	6.2 TO 9.2	–	–	1200	YES
359B	LONG LENGTHS NON-LEADED CABLE	YES	YES	0.5	600	150	150	NO
359C DUMMY	600-OHM EQUIP. (NO EQUALIZER)	NO	NO	0	–	–	600	NO
359D	LOADED CABLE – H88 WITH 849B NETWORK REQUIRED	NO	YES	0 TO 15.0	–	–	1200	YES
359E	SHORT LENGTHS LOADED CABLE – H88 WITH AMPLIFIER (NO EQUALIZATION)	NO	NO	0	–	–	1200	NO
359F	SHORT LENGTHS NON–LOADED CABLE	YES	YES	0.5	600	600	600	NO
359G	LOADED CABLE OR CARRIER CHANNELS DATA	NO	YES	8.5 TO 20.0	–	–	600	YES
359H	LOADED CABLE OR CARRIER CHANNELS DATA	NO	YES	0.9 TO 1.2	–	–	600	YES
359J DUMMY	SHORT LENGTHS LOADED CABLE – H88 WITH 849B NETWORK REQUIRED (NO GAIN OR EQUALIZATION)	NO	NO	0	–	–	600	NO
359K (NOTE 2)	LOADED CABLE – H44 WITH GAIN (AMPLIFIER REQUIRED)	NO	YES	6.2 TO 7.8	–	–	600	YES
359L	LOADED CABLE – H44 WITH 849G NETWORK	NO	YES	0 TO 1.6	–	–	600	YES
359M	LONG LENGTHS NON–LOADED CABLE CRITICAL VOICE BAND DATA SYSTEMS	YES	YES	0.3	600	150	150	NO
359N	SHORT LENGTHS NON–LOADED CABLE CRITICAL VOICE BAND DATA SYSTEMS	YES	YES	0.3	600	600	600	NO
359P	UNIGAUGE	NO	YES	6.2 TO 24.5	–	–	1200	YES
359R	Q44 LOADED	NO	YES	6.2 TO 21.0	–	–	1200	YES

359-TYPE EQUALIZER

REFERENCE INFORMATION	
SECTION	TITLE
332-116-101	359A EQUALIZER – DESCRIPTION
332-116-102	359B EQUALIZER – DESCRIPTION
332-116-103	359C EQUALIZER – DESCRIPTION
332-116-104	359D EQUALIZER – DESCRIPTION
332-116-105	359E EQUALIZER – DESCRIPTION
332-116-106	359F EQUALIZER – DESCRIPTION
332-116-107	359G EQUALIZER – DESCRIPTION
332-116-108	359H EQUALIZER – DESCRIPTION
332-116-109	359J EQUALIZER – DESCRIPTION
332-116-110	359K EQUALIZER – DESCRIPTION
332-116-111	359L EQUALIZER – DESCRIPTION
332-116-112	359M EQUALIZER – DESCRIPTION
332-116-113	359N EQUALIZER – DESCRIPTION
332-116-114	359P EQUALIZER – DESCRIPTION
332-116-115	359R EQUALIZER – DESCRIPTION

NOTES:

1. FOR CALCULATIONS OF SIGNALING RANGES, ADD 15% TO THE TABULATED AVERAGE VALUES. THIS COMPENSATES FOR MANUFACTURING VARIATIONS AND TEMPERATURE.
2. INCLUDES A 6.2 dB PAD.
3. THIS IS THE LOSS USED IN COMPUTATION OF LEVELS. SEE SECTION 852-307-101 FOR 359-TYPE EQUALIZER SCREW SETTINGS.

648A FILTER VRF0000M

The 648A filter is a balanced low pass filter with a high frequency cut-off at 3150 Hz. The filter compensates for poor balance and helps prevent singing. The screw down switch should be operated when the filter is connected to a 600-ohm resistive termination.

1 - TYPE TERMINATING SETS VRT6*00M (600 OHMS)
VRT9*00M (900 OHMS)

Most 1-type terminating sets consists of a 2 - transformer hybrid, compromise network, adjustable building - out capacitor, pads and simplex leads.

The different types of terminating sets are described in BSP 332-800-101.

4066 - TYPE NETWORKS VRNBJ00M (PRECISION)
VRNC00M (COMP)

The 4066-type networks are a series of plug-in precision balancing networks designed primarily to work with V4 repeaters.

Screw settings for the various networks can be found in the respective 332-852-XXX BSP section for the network.

4182-TYPE NETWORKS AND 437A PLUG
(4-WIRE EXTENSION NETWORKS)
(NOTES 1 AND 4)

NETWORK (NOTE 2)	APPLICATION	TRANSFORMER IMPEDANCE RATIO		SIMPLEX PATH RESISTANCE PER TRANSFORMER (OHMS) (NOTE 3)
		LINE	EQUIP	
4182A NOTE 5	LEVEL ADJUSTING	–	–	–
4182B	LEVEL ADJUSTING AND IMPEDANCE MATCHING	150 600 1200 (NOTE 6)	600 600 600 (NOTE 6)	18 3.5 55
4182C	LEVEL ADJUSTING AND LOSS EQUALIZATION	1200	600	55
437A PLUG (DUMMY)	4-WIRE TO 4-WIRE CIRCUIT CONTINUITY (NOTE 8)	–	–	–

REFERENCE INFORMATION	
SECTION	TITLE
332-700-101	4182A NETWORK – DESCRIPTION
332-700-102	4182B NETWORK – DESCRIPTION
332-700-103	4182C NETWORK – DESCRIPTION

NOTES:

1. 4182-TYPE NETWORKS MAY BE USED INTERCHANGEABLY WITH 1-TYPE TERM. SETS. SUBSTITUTION OF A 4182 NETWORK FOR THE TERM. SET EFFECTIVELY CONVERTS THE 24V4 TO A 44V4 REPEATER. THIS SHOULD BE CONSIDERED ONLY WHERE 2-WIRE AND 4-WIRE FLEXIBILITY ADVANTAGES OUTWEIGH SPACE LOSSES.
2. ON 4182-TYPE NETWORKS TERMINAL 10 AND 11 (NORMALLY SERVES AS LEADS NT AND NR FOR PRECISION BALANCING) MUST BE EXTENDED TO PERMIT EXTERNAL CONNECTION TO THE 4-WIRE CIRCUIT.
3. FOR CALCULATIONS OF SIGNALING RANGES, ADD 15% TO THE TABULATED AVERAGE VALUES. THIS COMPENSATES FOR MANUFACTURING VARIATIONS AND TEMPERATURE.
4. SEE SD-97138-01 FOR 4182-TYPE CIRCUITS.
5. THE 4182A SHOULD NOT BE USED FOR DIRECT CONNECTION TO CABLE FACILITIES EXCEPT WHEN USED AS A CONTINUITY PLUG (EQUIPPED WITH 89A RESISTOR-0dB).
6. THE 4182B NETWORK PROVIDES IMPEDANCE RATIOS AS FOLLOWS:

TRANSFORMER RATIO	FACILITY
150:600	LONG LENGTHS OF NONLOADED CABLE
600:600	PARTIAL EQUALIZATION FOR SHORT LENGTHS OF NON-LOADED CABLE
1200:600	LOADED CABLE - H88

7. INTENDED FOR LONG LENGTHS OF H88 LOADED CABLE.
8. WHEN THE 437A PLUG IS USED T1 AND R1 WILL APPEAR ON PINS 9 AND 8 OF P1 RESPECTIVELY. WHEN THE 4182-TYPE NETWORK IS USED, T1 AND R1 WILL APPEAR ON PINS 11 (NT) AND 10 (NR) OF P1 RESPECTIVELY.

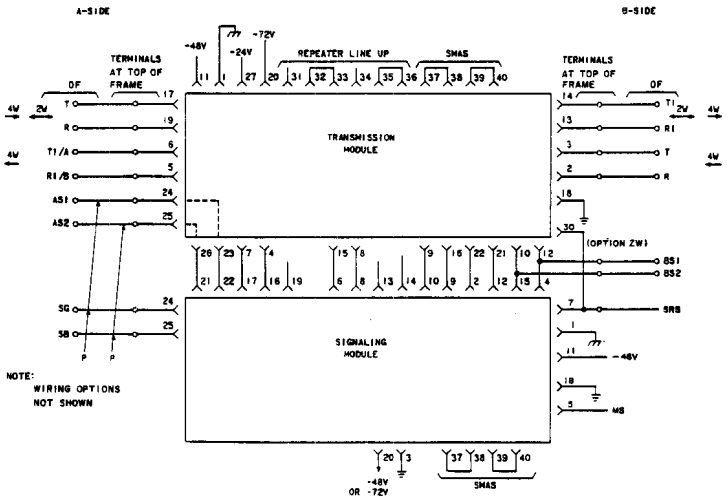
METALLIC FACILITY TERMINAL (MFT)

The Metallic Facility Terminal is a standard arrangement for providing transmission and/or signaling functions that are required in association with metallic (cable) facilities. In most cases these are loop facilities on private line. Metallic facilities are by definition cable facilities that are not used for Digital or Analog carrier systems.

The primary use of the MFT is to allow flexibility in providing the necessary transmission and signaling equipment with a minimum of cross connections. This is accomplished by providing a family of plug-in units that fit into equipment frames with standard wiring.

Two basic mounting arrangements are available. The first consists of a single slot for each circuit. This is used primarily for the message network since only a transmission plug-in is needed. (Signaling is either CCIS or MF from the switching equipment.)

The second consists of a double slot mounting that is arranged for a transmission unit and a signaling unit to be placed side by side. Since most private line services use this type of mounting, it will be covered in this J.A.



J99343A-2 Shelf Wiring

A late version two-unit mounting is shown above. The SMAS and Repeater line up options are shown bypassed. Option 'ZW' is required if the new combined function plug-ins are to be used. Other type mountings are covered in BSP 332-910-101

Some of the MFT bays are equipped for SMAS.

Plug in units for the MFT come in two families.

The first is the Transmission unit, which will plug into the left hand slot of the double mounting. All necessary configuration, 2 wire or 4 wire and all level adjustments are provided in this unit. It is necessary to plug in the correct unit for the service involved (Page 4.15).

The second is the Signaling unit, which plugs into the right hand slot. All necessary signaling functions are provided in this unit. It is necessary to plug in the correct unit for the service involved (Page 4.16).

The Double Mounting has hardwiring between the two slots. By selecting the proper transmission unit and Signaling unit, almost any circuit configuration can be established.

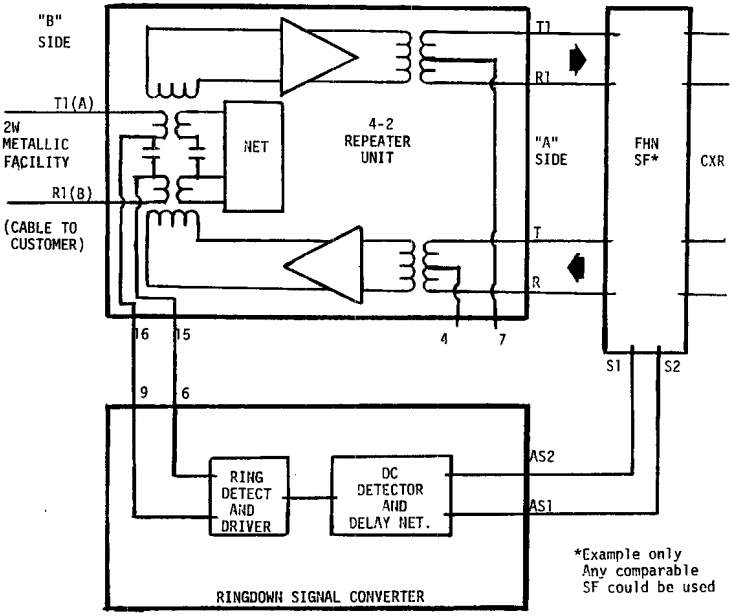
Some new plug in units have been developed combining the Signaling and Transmission units. They are called "Combined Function" units and were primarily designed for single-slot mounting bays. However, they can also be used in the double-slot mountings.

Because of the large number of plug-in units available, and the even larger number of combinations of Transmission and Signaling units, it is impossible to show all configurations of MFT. The simplified sketch on page 4.9 shows a typical combination of a 4-2 Repeater Unit (MT42100A) and a Ringdown Signaling Converter Unit (MTSC100A).

The repeater units provides level adjustment and gain plus a 2-wire to 4-wire conversion, while the converter provides the basic function of a DIB.

A Flip Chart simulator called "SPEEDI" is available from BSCTE at Lisle, Illinois in quantities of 10 or more. These charts are helpful in showing the various combination of Transmission and Signaling units available, and option information for the units.

A Facility matching Test set is available to make return loss tests and aid in balancing whenever 2 wire metallic facilities are used. This set and its usage is covered in BSP 332-910-103.



INCOMING CALL FROM DISTANT CITY - SF Tone burst from cxr causes SF to place ground on S2 and battery on S1 to Signal Converter. This is converted to 20 Hz ring on the cable facility by the converter.

CALL FROM LOCAL CUSTOMER TOWARD DISTANT CITY - 20 Hz ring from cable facility operates Ringing Detector and places ground on S2 and battery on S1 toward the SF, which transmits burst of SF toward the cxr.

Conversion from 2-wire operation to 4-wire and level adjustments are made in the 4-2 Repeater unit. The simplex coils on the 4-wire side are not used in this application.

The MFT combination used as an example here takes the place of a Terminating Set, amplifiers, and DIB (except "S " leads used instead of "E&M").

LIST OF TRANSMISSION UNITS FOR THE MFT

UNIT NAME	"J" IDENTIFICATION	COMMON LANGUAGE CODE
2-Wire Transmission Unit	J99343BA	MTT210*A
Bypass Transmission Unit	J99343BB	MTT2200A
2-Wire Transmission Unit	J99343BC	MTT2300A
4-Wire Transmission Unit	J99343BD	MTT4100A
2-4 Wire Transmission Unit	J99343BE	MTTH100A
2-4 Wire Transmission Unit	J99343BF	MTTH200A
2-2 Terminal Repeater (L)	J99343PA	MT22100A
2-2 Terminal Repeater (NL)	J99343PB	MT22200A
2-2 Intermediate Repeater (L-L)	J99343PC	MT22300A
2-2 Intermediate Repeater (NL-NL)	J99343PD	MT22400A
2-2 Intermediate Repeater (L-NL)	J99343PE	MT22500A
2-2 Intermediate Repeater (NL-L)	JJ9343PF	MT22600A
2-2 Terminal Repeater (L)	J99343PG	MT22A**A
2-2 Intermediate Repeater (L-L)	J99343PH	MT22B20A
2-2 Intermediate Repeater (L-NL)	J99343PJ	MT22C20A
2-2 Intermediate Repeater (NL-L)	J99343PK	MT22D20A
2-2 Dual Terminal Repeater	J99343PL	MT22A*** (1)
2-4 Terminal Repeater	J99343RA	MT24100A
4-2 Intermediate/Terminal Repeater (L)	J99343RB	MT42100A
4-2 Intermediate/Terminal Repeater (NL)	J99343RC	MT42200A
2-4 Intermediate Repeater (L)	J99343RD	MT24200A
2-4 Intermediate Repeater (NL)	J99343RE	MT24300A
2-4 Terminal Repeater (Pre-Eql)	J99343RF	MT24110A
4-2 Terminal Repeater	J99343RG	MT42310A
2-4 Terminal Repeater (L)	J99343RH	MT245*0A
4-4 Terminal Repeater	J99343SA	MT44100A
4-4 Intermediate Repeater	J99343SB	MT44200A
Amplitude and Delay Equalizer	J99343SN	MTEZ100A (2)

(1) not used on PL services.
(2) For two directions of transmission, mount one in transmission unit position, the other in the Signal unit position.

LIST OF SIGNALING UNITS FOR THE MFT

UNIT NAME	"J" IDENTIFICATION	COMMON LANGUAGE CODE
Loop Signaling Repeater (LS-GS)	J99343AA	MTSRG*0A
Loop Signaling Repeater (LSO)	J99343AB	MTSRL*0A
Loop Signaling Repeater (LS-GS)	J99343AC	MTSRG10A
Loop Signaling Repeater (LSO)	J99343AD	MTSRL10A
Loop Start/Ground Start Converter	J99343AE	MSTRC00A
Loop Signaling Repeater (LS-GS)	J99343AF	MTSRT1*B
Loop Signaling Repeater (LS-GS)	J99343AH	MTSRG**A
*Loop Signaling Extender	J99343CA	MTSX100A
*Loop Signaling Extender	J99343CB	MTSX200A
*Loop Signaling Extender	J99343CC	MTSX110A
*Loop Signaling Extender	J99343CD	MTSX31*A
DX1	J99343DA	MTDX100A
DX1/DX2	J99343DB	MTDX200A
Code Select Ringdown	J99343EA	MTSC200A
Ringdown Converter	J99343EB	MTSC100A
Private Line Automatic Ringdown	J99343EC	MTSC300A
Loop Start/Ground Start to DX or E&M	J99343FA	MTSC4**A
Loop Start/Ground Start to DX or E&M	J99343FB	MTSC600A
Loop Start/Ground Start to DX or E&M	J99343FC	MTSC500A
Loop Start/Ground Start to DX or E&M	J99343FD	MTSC700A

*These Signaling Units can also function in the transmission unit position of a double module frame, or in a single module frame, when level correction is not required.

COMBINED UNITS

The following units combine both transmission and signaling functions in one circuit pack. They are used in Single unit frame or in the transmission position of a double unit frame.

Loop Start Signaling/2W Transmission	J99343GA	MTC21**A
2-2 Wire Term Repeater/Loop Sig. Ext.	J99343GB	MTC22**A
2-2 Wire Term Repeater/Loop Sig. Ext.	J99343GE	MTC2240A
SF Sig/4-4 Wire Repeater	J99343SF	MTC45**A

MFT REFERENCES

GENERAL

Description	332-910-100
Application	332-910-180
Frame Arrangements	332-910-101
Use of Test Extender	332-910-102
Facility Matching Test Set	332-910-103
Compatibility Charts	332-910-180

DESCRIPTION BSP's

Loop Signal Repeaters (AB, AC, AD, AE)	332-911-101
Loop Signal Extenders (CA, CB, CC)	332-911-102
DX Signaling Units (DA, DB)	332-911-103
Ringdown Signaling Units (EA, EB, EC)	332-911-104
Signaling Converters (FA, FB, FC, FD)	332-911-105
Signaling Lead Access Unit	332-911-106
2W Transmission Units (BA, BB, BC)	332-912-101
2-4W Transmission Units (BE, BF)	332-912-102
4-4W Transmission Units (BD)	332-912-104
2W Terminal Repeaters (PA, PB, PC, PD, PE, PF)	332-912-111
2-2W Terminal Repeaters (PB)	332-912-114
2-2W Intermediate Repeaters (PD)	332-912-115
2-2W Intermediate Repeaters (PC, PH)	332-912-116
2-2W Intermediate Repeaters (PE, PJ, PK)	332-912-117
2-4 and 4-2W Terminal Repeaters (RC, RD, RE)	332-912-121
2-4 and 4-2W Terminal Repeaters (RA, RF, SA, SB)	332-912-131
4-4W Terminal Repeaters (SA, SB)	332-912-134
2-4W Terminal Repeaters (RA, RF)	332-912-135
2W Dual Repeater (PL)	332-912-141
SF Sig/4-4 wire Repeater (SF)	332-912-151
Loop Start Sig/2W Transmission unit (GA)	332-912-152
2-2 Wire Terminal Repeater/Loop Sig. Extender (GB)	332-912-153
2-2 Wire Terminal Repeater/Loop Sig. Extender (GE)	332-912-156
Amplitude and Delay Equalizer (SN)	332-912-250

INSTALLATION AND TESTING BSP's

Loop Signal Repeaters (AB, AC, AD, AE)	332-911-201
Loop Signal Extenders (CA, CB, CC, CD)	332-911-202
DX Signaling units (DA, DB)	332-911-203
Ringdown Signaling Units (EA, EB, EC)	332-911-204
Signal Converters (FA, FB, FC, FD)	332-911-205
2 Wire Transmission Units (BA, BB, BC)	332-912-201
2-2 Wire Terminal Repeaters (PA, PB, PC, PD, PE, PF)	332-912-211
2-2 Wire Terminal Repeaters (PA, PB)	332-912-214
2-2 Wire Intermediate Repeaters (PH, PD, PE, PF, PJ, PK)	332-912-215
2-4 Wire and 4-2 Wire Terminal Repeaters (RC, RG, RE, RH)	332-912-221
4W Transmission Units (RA, SA, SB)	332-912-231
4-4 Wire Repeaters (SA, SB)	332-912-234
2-4 Wire Terminal Repeaters (RA, RF)	332-912-235
2 Wire Dual Repeater (PL)	332-912-241
Amplifier and Delay Equalizer (SN)	332-912-250
SF Sig/4-4W Repeater (SF)	332-912-251
Loop Start Sig/2W Transmission unit (GA)	332-912-252
2-2 Wire Terminal Repeater/Loop Sig. Extender (GB)	332-912-253
2-2 Wire Terminal Repeater/Loop Sig. Extender (GE)	332-912-256

PRESCRIPTION SETTINGS

2-2 Wire Terminal Repeaters (PA, PB, PC, PD, PE, PF)	332-912-212
2-4 & 4-2 Wire Terminal Repeaters (RB, RD, RE)	332-912-222
4 Wire Transmission Units (RA, SA, SB)	332-912-232
4-4 and 2-4 Wire Terminal Repeaters (RA, RF, SA, SB)	332-912-233

PBX INFORMATION

STATION JACK

Positive Battery on Ring
Ground on Tip
20 HZ Generator Ring

STN JACK OUTPUTS

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

TRUNK JACK

Accepts incoming 20 HZ ring

Battery on ring, comp 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 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 0 (cal).
5. Set FUNCTION to CAL SEND.
6. Set the SEND IMP to 600 ohms.
7. Adjust CAL SEND for 0dBm on meter.
8. Set FUNCTION to CAL REC.
9. Adjust CAL REC for 0dBm 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 to 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.

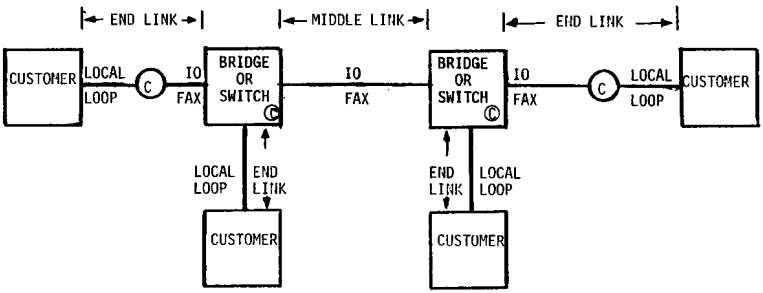
5. Turn REC LEVEL switch to obtain a convenient reading on the meter (between the -3 and 3 dBm marks, if possible).

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.

VOICEBAND DATA SERVICES



(C) = Serving Central Office

IO FAX = INTEROFFICE FACILITY

Terminology

The sketch above illustrates a typical multipoint private line data service and the terminology used on these services.

An End Link is the facility between a switching or bridging central office and the customer interface. It may or may not include an interoffice facility.

A Middle Link is the facility between central office bridging or switching locations. The equipment between two bridges in the same office is not a middle link.

End and middle link terminology is not used on two point services.

Benchmark measurements are made immediately following installation and circuit order tests and used as a reference for future test purposes.

Holding tone is a single frequency (usually 1004 Hz) applied at the transmitting end of a circuit to simulate a data signal. It is always applied at the data level (-13 below test level). It is then filtered out at the receiving end of the service with a notched filter to allow noise tests to be made.

Parameters refer to definable characteristics of a facility or system. They are used in establishing test requirements.

CONDITIONING

Different data services require different transmission objectives. The specific requirements for these voice band channels are specified by a conditioning designation as shown below:

Basic - standard 2000 series or 3002 Voiceband channel.

C1 - Lowest grade conditioning for data transmission.

C2 - An intermediate grade. Requirements more severe than C1.

C4 - A high intermediate grade.

C5 - High grade conditioning. Only on 2 point circuits.

C7, C8 - Used with switched services, Switch to Switch, with Switch at customer location.

The C- Conditioning refers to parameters on attenuation distortion and Delay distortion. The requirements for the various C conditioning can be found in Tables K (page 5.16) and Q (page 5.23).

Note: C3 conditioning is used only with Switched Service networks such as CCSA. C6 is used only for protective relay channels. Since these are not primarily considered Voice Band data services they are not covered in this handbook. Switched Service Networks are covered in BSP 309-200-300 and protective relays circuits are covered in BSP 310-540-XXX.

HIGH PERFORMANCE DATA CONDITIONING

"High Performance Data Conditioning" deals with parameters of intermodulation distortion, and "C" notched noise expressed as "Signal to Noise Ratio". The intermodulation distortion is shown in Table L (page 5.17) and the "C" notched noise requirement states that the signal to noise must be greater than or equal to 28dB.

High Performance Data Conditioning may be required in addition to "C"-conditioning or on a stand alone basis. It is preceded with a "D" and when required, shown on the WORD document.

D1 - For 2 point service only with no switching and no more than one station per service point.

D2 - For a 2 point or 3 point service where there is no more than 3 stations per channel.

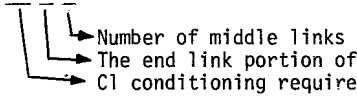
WORD documents may refer to the parameters for the various conditioning by stating the makeup of the service as follows:

VB - Basic Voiceband
C1 - C1 conditioning; C2 - C2 conditioning; etc.
D1 - D1 conditioning; D2 - D2 conditioning

The services are also broken down into end and middle links as follows:

E1 - one end link; E2 - two end links; etc.
M1 - one middle link; M2 - two middle links; etc.

For example - a designation of C1E1 would indicate a C1 conditioned end link with 1 middle line. This is somewhat confusing so let's break it down.



This heading would indicate the limit for that portion of the overall service only.

A designation of C1M2 would indicate the requirements for a C1 conditioned middle link when two middle links are used on the service.

DATA SERVICE TESTING

Different types of tests may be made depending on the circumstances.

End to End measurements - measurements made from the customer interface at one end to the customer interface at the other. These tests require personnel at both customer locations. (See page 5.29)

Straightaway tests - measurements made in one direction, or in both directions simultaneously, between two offices or between an office and the customer station location. (See page 5.30)

Loopback tests - measurements made from an office to a loopback device and back to the office.

The table on page 5.5 shows the tests made on Data services and their recommended order.

During the investigation of a trouble report, the highest ranked parameter should be measured first. The exception to this rule is the P/AR measurement. If P/AR is found out-of-limits, the following tests should be performed:

(a) A complete attenuation distortion measurement

(b) Return loss

(c) Envelope delay distortion

(d) Intermodualtion distortion.

By installation, it is meant those tests should be performed on a data channel as a result of a service order for new or additional service. Some companies have categorized these as pre-installation tests.

All switched private line data services shall be maintained in accordance with Table E.

Routine measurement of private line channels shall be made in accordance with Table E under Routine (Switched). An agreement should be made with the customer before the circuit may be taken out-of-service. Measurements of channel parameters on working circuits are currently under investigation.

TABLE E BSP 314-010-101

RECOMMENDED ORDER OF TESTS TO BE PERFORMED DURING INSTALLATION, ROUTINE AND TROUBLE REPORTS

NOTE: A total power requirement (page 5.6) is also required.

RECOMMENDED ORDER OF TESTS	INSTALLATION	ROUTINE(SWITCHED)	TROUBLE REPORT
1. Continuity (include DC Loop Tests - page 5.6)	X	X	X
2. Loss	X	X	X
3. "C" Notched Noise	X	X	X
4. Impulse Noise			X
5. Phase Jitter	(5)		X
6. Gain Slope (3 tone)	(6)	X	X
7. P/AR	(1,7)		(1)
8. Attenuation Distortion (Comp)	(3)		X
9. Intermodulation Distortion	(2)		X
10. Hits, Dropouts			X
11. Return Loss	(4)	X	X
12. Single Freq. Interf.			X
13. Frequency Offset			X
14. Envelope Delay Dist	(3)		X

Notes:

1. If P/AR fails, skip immediately to measuring attenuation distortion return loss and envelope delay distortion.
2. Required on all "D" conditioned circuits.
3. Required on all Basic and "C" conditioned circuits.
4. Required on all data channels with 2 wire sections or 2-wire data terminals.
5. Two of three phase jitter measurements required (4-20, 20-300, or 4-300 Hz).
6. Required on all circuits which have access to the Public Switched Network if a P/AR test is not made.
7. For a basic channel (voiceband), P/AR may be used in place of attenuation distortion and EDD if done on an overall basis for 2 point, or on End-Link and Mid-Link basis for Multipoint. P/AR should be made on a loop-back (Bench Mark) basis for "C" conditioned channels after attenuation distortion and EDD.

INITIAL CIRCUIT TESTS

When initial circuit tests are made, the circuit control office should record the results on Form E-5596.

All Transmission and line-up testing must be done at data levels, rather than voice levels, in order to lessen the possibility of intelligible crosstalk or increasing intermodulation products and to avoid compandor tracking problems.

DIRECT CURRENT MEASUREMENTS

The dc loop resistance of cable pairs or pairs between STC and the customer station should be measured and recorded on Form E-5596 for use as a benchmark figure in the event of a later trouble condition. The overall requirements are as follows:

MAXIMUM PERCENT CHANGE IN LOOP RESISTANCE

STC-STA	Predominantly Aerial Cable	20%
	Predominantly Underground Cable	5%

DATA LEVEL MEASUREMENTS (BSP 314-010-101, 3.04 and 314-310-300, 3.11)

Measure the total output power of the data signal generated by the transmitting equipment, either CPE or Bell System provided, which is directly associated with the data channel.

Check WORD documents for proper data levels. The latest circuit design for data services requires a data level of -13 dBm0. This test must be made initially and every 6 months thereafter.

The measurement limits for the total power are as follows:

Maximum Signal Power from Customer Station	-13 dBm0

Other measurements are to be performed according to the chart on page 5.5.

While the above tests are required on Initial Testing, they may also be performed on routines and Trouble investigation.

CONTINUITY

The most convenient way of testing for continuity is with the office milliwatt supply and monitor (ear phone, head set, speaker, etc.). A tone generator, oscillator or transmit portion of a transmission measuring set (TMS) may be substituted for the milliwatt supply. For switched services, dial-up milliwatt numbers are used.

The continuity test checks for an uninterrupted electrical connection between two points. It does not indicate that proper equipment has been installed or properly adjusted. Because of this, no requirements are given for this test.

1004-Hz LOSS TEST

The 1004-Hz loss measurement is typically made with a TMS. The test set must be accurate to ±.1dB and capable of receiving an input signal in the level range of +10 dBm to -40 dBm. Straight-a-way measurements require two test sets. Measurements on access-type lines on switched services use a dial-up tone generator and the receive portion of a TMS.

The 1004-Hz loss measurements are used to determine the loss of a circuit or overall connection on switched services. In addition, loss measurements are used in conjunction with noise measurements to determine the signal-to-noise ratio.

REQUIREMENTS

TABLE A BSP 314-410-500

1004-HZ LOSS DEVIATION (NOTE)

CONNECTION	CIRCUIT ORDER	ROUTINE OR TROUBLE ISOLATION
End Link	±0.5 dB	±2.0 dB
Middle Link	±0.5 dB	±1.0 dB
End-to-End	±1.0 dB	±4.0 dB
Loop-Back	±0.8 dB	±2.0 dB

Note: Maximum deviation from EML stated in the WORD document.

C-NOTCHED NOISE

A noise measuring test set equipped with a C-notched filter measures the noise in the presence of a signal. This signal, known as a holding tone, is 1004-Hz and is placed on the circuit at data level (-13 dBm0). The measurement can be looped, straight-a-way or, as for switched services, the holding tone is dial accessed.

In addition to measuring noise in the presence of a signal, the C-notched noise measurement can also be used to calculate a signal-to-noise ratio (required for high performance conditioning). This can be accomplished by subtracting the measurement of noise with tone from a measurement of the same tone made with the C-notched filter reversed in the noise measuring test set. (Reversing the filter disables it, allowing the 1004-Hz tone to be measured.) A listening (monitor) test for impulse noise or single tone interference should be made whenever practicable. If tone interference is detected every effort should be made to detect the frequency of the tone. Detection of the interfering tone frequency may assist field forces to determine its source, e.g., power line hum.

REQUIREMENT "C" NOTCHED NOISE BSP 314-410-500

TABLE B

COMPANDORED FACILITIES OR COMBINATION FACILITIES

OVERALL CIRCUIT LENGTH (MILES)	dBrnC0	
	N1,ON D1A,D1B CARRIER	N2,N3,N4 D2,D3,D4 CARRIER
0-100	48	41
101-200	48	42
201-400	48	42
401-1000	48	43
1001-1500	48	43
1501-2500	48	45
2501-4000	49	45
4001-8000	50	48
8001-16000	52	50

TABLE C

NONCOMPANDORED FACILITIES ONLY

OVERALL CIRCUIT LENGTH (MILES)	dBrnC0
0-100	32
101-200	34
201-400	35
401-1000	38
1001-1500	39
1501-2500	41
2501-4000	43
4001-8000	46
8001-16000	49
SAT. CHAN.	44*

*Add Satellite link to land channel as per table on 5.26

TABLE "B" is to be used whenever any part of the circuit uses compandored facilities. If two different type of compandored facilities are used, the worst case reading rules. Individual Facility noise requirements will be found in the BSP for the Facility.

NOTE: STANDARD CHANNEL should have at least a 24dB Signal to "C" notched noise Ratio. "D" conditioned channels should have at least a 28dB signal to "C" notched noise Ratio.

IMPULSE NOISE

An impulse noise counter equipped with a C-notched filter counts the number of impulse hits occurring above a set threshold in the presence of a 1004-Hz holding tone. As in the case of C-notched noise the impulse measurement can be looped, straight-a-way or, as for switched services, the holding tone is dial accessed. A 15 minute test period is normally used for these tests.

The impulse noise measurement is a record of impulse noise peaks that exceed a given threshold in the voice frequency band of interest. The threshold level is adjustable by an attenuator on the test set. Some impulse noise test sets have multiple attenuators providing multiple thresholds.

REQUIREMENTS

TABLE D BSP 314-410-500

MAXIMUM ALLOWABLE IMPULSE COUNTS (15-MINUTE PERIOD)

COUNTER CIRCUIT	MAXIMUM COUNTS
1 Threshold *	15
2 Threshold + 4 dB	9
3 Threshold + 8 dB	5

* 71 dBrnCo at the customer interface or as specified in Table "E" for facilities.

TABLE E BSP 314-410-500

IMPULSE NOISE THRESHOLD SETTINGS IN dBrncO

LENGTH (MILES)	TYPE FACILITY (1)	(2)	(3)	(4)	(5)
0-59	54	73	67	70	58
60-124	54	73	67	70	58
125-249	54	73	67	70	59
250-499	54	73	67	70	59
500-999	-	-	-	-	59
1000-1999	-	-	-	-	61
over 2000	-	-	-	-	64

(1) Voice frequency cable facilities only
(2) N3 carrier with VF amplifiers
(3) N, O, ON, N3L junction facilities or T carrier facilities
(4) N2, N3, N4 carrier facilities
(5) LMX carrier facilities

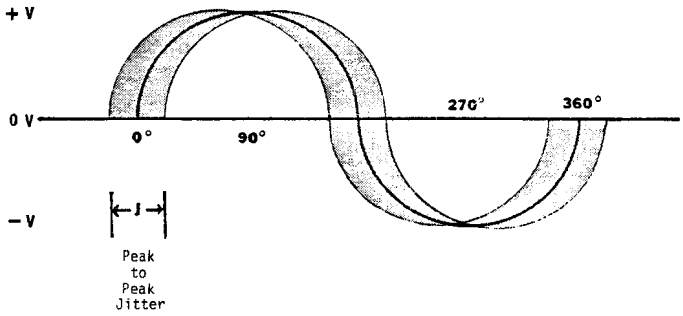
Note 1: These thresholds assume the use of a -13 dBmO holding tone. Do not use other holding tone levels as the above thresholds for type 2 (compandored) facilities would be incorrect.

Note 2: On PBX tie trunks, a minimum threshold of 59 dBrncO should be used.

PHASE JITTER

Phase jitter is measured with a phase jitter test set using a 1004-Hz holding tone. C-notched noise measurements should always be made in conjunction with phase jitter measurements to assure that noise is not the chief contributor to the phase jitter readings.

A phase jitter measurement indicates the cumulative effect of incidental phase modulation and additive tones or noise on the zero crossing of the holding tone. To reduce the effect of additive noise, the peak-to-peak deviations in zero crossing are detected after being band limited. The standard limiting band is 20 to 300 Hz and referred to as "Bell".



Phase jitter is also known to occur below 20 Hz. A second limiting band is used to detect phase jitter in the frequency range of 4 to 20 Hz. This is known as "low frequency" (LF). Phase jitter measurements can be made in three ranges:

Bell

LF

Bell plus LF

Bell plus LF has a frequency range of 4 to 300 Hz. Any two of the three measurements may be specified and are considered a valid measurement. The "Bell plus LF" measurement is not provided in SARTS.

See page 5.11 for Requirements.

PHASE JITTER REQUIREMENTS

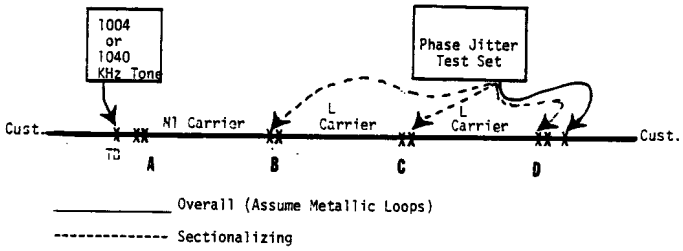
TABLE F BSP 310-410-500

MAXIMUM PEAK-TO-PEAK PHASE JITTER REQUIREMENTS*

FACILITY LENGTH (MILES)	MAXIMUM LIMITS (DEGREES P-P)		
	BELL (20-300 Hz)	LF (4-20 Hz)	BELL PLUS LF 4-300 Hz
0-250	2	5	7
251-500	4	5	9
501-1000	6	5	11
1001-2000	8	5	13
2001-4000	10	5	15
Overall	10	5	15

The overall limits are used whenever End to End Tests are made on a private line, regardless of mileage.

Loopback Phase jitter measurements are not valid.



Sketch above shows the method for making Phase jitter tests. Since jitter cannot occur on metallic loops, it is not necessary to make these tests from the customer to achieve end to end results. However if carrier is used between the TB and the customer it may be necessary to make the test from the customer location.

*Phase Jitter limits in this table are given in mileage bands for use at test positions. Phase Jitter limits for carrier facilities are given in BSP 356-022-504 determined by the number of modulation steps in the facility. The 356 BSP takes precedence when a conflict exists.

GAIN SLOPE

Gain slope measurements are typically made with a TMS. Straight-a-way measurements on a PL circuit or switched connection require two TMSs. On switched access circuits, a step generator is dial-accessed in place of the far end TMS.

Gain slope is the differential loss between 404 and 1004 Hz, and 1004 and 2804 Hz. The gain slope measurement may be required for access lines and/or end-to-end connections on the PSN. The gain slope measurement is a recommended benchmark measurement used in conjunction with the peak-to-average ratio (P/AR) measurement on PL and SSN circuits.

REQUIREMENTS

The requirements for this test depend on the conditioning of the service. If any of the "C" conditionings are provided, an Attenuation Distortion Test must be made and this test is not necessary. If Basic Conditioning is specified this test may be made and the requirements must conform to the limits given for the frequencies under the tables for Attenuation Distortion on page 5.16 relative to the type of facilities used.

PEAK-TO-AVERAGE RATIO (P/AR)

For P/AR measurements, a P/AR transmitter and a P/AR receiver are connected to opposite ends of a voiceband transmission channel. The transmitter sends a precisely controlled complex pulse train of known peak-to-full-wave average ratio (10 dB) through the channel, where each pulse is altered by the distortions it encounters. The P/AR receiver measures the absolute peak and full-wave rectified average values of the pulse train and displays their ratio on a zero-suppressed scale.

Acceptable P/AR together with acceptable gain slope measurements provide a better than 99 percent assurance factor of acceptable attenuation distortion, return loss, and EDD measurements. P/AR alone can provide a 97 percent assurance factor.

REQUIREMENTS

P/AR limits are strongly tied to the types of facilities used in trunk makeup. This is primarily because the filters in channel banks of different facilities are not all alike and hence have different amounts of EDD. Trunk maintenance limits of P/AR for channels using many different kinds of facilities are given in Table H, page 5.14.

As of now no fixed P/AR limits are available for C conditioned private lines. This is mostly due to a lack of measurements on such lines and the difficulties involved in trying to turn such services down for a sample measurement. At present, the best procedure for conditioned lines is after acceptance by an EDD and loss run, a benchmark P/AR reading should be taken and recorded on the history record. Future readings ±4 P/AR points from the initial reading will indicate trouble in one of the three parameters that P/AR evaluates.

When the Western Electric 27 series P/AR equipment is considered, the 27F or later models must be used. Previous versions of the 27 series of P/AR equipment should never be used because of built-in distortions.

TABLE G BSP 314-410-500

MINIMUM P/AR OBJECTIVES

CONNECTION	MINIMUM VALUE
Mid Link	80
End Link	80
End-to-End	50

TABLE I BSP 314-410-500 TABLE J

P/AR VALUES FOR NONREPEATERED CABLE

TYPE	LENGTH	MAINTENANCE LIMIT
Nonloaded	0-18 kft	97
H88	0-18 kft	94

P/AR VALUES FOR REPEATERED CABLE

TYPE	LENGTH	MAINTENANCE LIMIT
Nonloaded	0-18 kft	90
H88	0-36 kft	90
H88	36 kft	80

TABLE H BSP 314-410-500

P/AR VALUES FOR SINGLE AND MULTIFACILITY CHANNELS

TYPE	MAXIMUM (NOTE 1)	MAINTENANCE LIMIT (NOTE 2)	TYPICAL VALUE (NOTE 3)
O, ON, N3	94	86	90
N1	98	86	92
A (L or R)	99	87	93
N2	101	93	97
T1	102	93	97
2T1	97	88	92
2N3	93	83	88
2N2	96	88	92
2N1	93	85	89
T1 + N3	95	87	91
T1 + N2	96	88	92
N1 + N3	97	87	92
ON + T1	96	87	91
ON + A	93	83	88
ON + N3	93	83	88
ON + N2	96	88	92
ON + N1	96	88	92
2 ON	91	83	87
T1 + N1	96	87	91
N2 + N3	97	87	92
N1 + N2	95	87	91
2 "A" Type	92	82	87
A + T1	95	86	90
A + N3	91	83	87
A + N2	96	86	91
A + N1	96	86	91
3A	83	74	78

Note 1 Highest allowable value

Note 2 Minimum allowable value

Note 3 Expected value

ATTENUATION DISTORTION

Attenuation distortion measurements are typically made with a TMS. Straight-a-way measurements require two TMSs.

The attenuation distortion measurement is the differential loss between 1004 Hz and all other required frequencies with the band of interest. The required frequencies and the band of interest can be found in the table below. The measurement is not a required measurement on access lines and end-to-end connections on the PSN. Attenuation distortion is not the same as the gain slope measurement discussed on page 5.12

HERTZ	CONDITIONING											
	BASIC		C1		C2 & C5		C4		C7		C8	
	ATT DIST	ENV DEL	ATT DIST	ENV DEL	ATT DIST	ENV DEL	ATT DIST	ENV DEL	ATT DIST	ENV DEL	ATT DIST	ENV DEL
304	X		X		X		X					
404									X		X	
504	X		X		X	X	X	X	X		X	
604	X		X		X	X	X	X	X		X	
804	X	X	X	X	X	X	X	X	X		X	
1004	X	X	X	X	X	X	X	X	X	X	X	X
1204	X	X	X	X	X	X	X	X	X	X	X	X
1404	X	X	X	X	X	X	X	X	X	X	X	X
1604	X	X	X	X	X	X	X	X	X	X	X	X
1804	X	X	X	X	X	X	X	X	X	X	X	X
2004	X	X	X	X	X	X	X	X	X	X	X	X
2204	X	X	X	X	X	X	X	X	X	X	X	X
2404	X	X	X	X	X	X	X	X	X	X	X	X
2504	X	X	X	X	X	X	X	X	X	X	X	X
2604 *	X	X	X	X	X	X	X	X	X	X	X	X
2704 †	X		X		X	X	X	X	X		X	
2804	X		X		X	X	X	X	X		X	
3004	X		X		X		X	X				
3204							X					

Make frequency response and/or envelope delay distortion runs at the frequencies indicated for each type of data channel. The limits are found under each configuration.

* Do not measure at this frequency if 2600-Hz signaling units are used in the layout. Instead interpolate from the values measured at 2504 and 2704 Hz.

† Tone-operated loop-back devices (such as the 44A1 data unit) must be disabled.

TABLE K

PRIVATE LINE VOICE BANDWIDTH CIRCUIT ATTENUATION DISTORTION REQUIREMENTS (dB) (NOTE)

FREQUENCY RANGE IN HZ *	2-POINT	0	1		2		3		4	
		MID LINK	MID LINK		MID LINK		MID LINK		MID LINK	
		END LINK	END LINK	MID LINK	END LINK	MID LINK	END LINK	MID LINK	END LINK	MID LINK
3002 (ALSO 2001)										
BASIC	(VB)	(VBE0)	(VBE1)	(VBM1)	(VBE2)	(VBM2)	(VBE3)	(VBM3)	(VBE4)	(VBM4)
500 – 2500	–2 to +8	–1.5 to +4	–1 to +4	–1 to +3.5	–1 to +4	–1 to +3.5	–1 to +3.5	–0.8 to +3.5	–0.8 to +3.5	–0.8 to +3
300 – 3000	–3 to +12	–1.5 to +6	–1.5 to +6	–1.5 to +6	–1.5 to +6	–1.5 to +5	–1.5 to +5	–1 to +4.5	–1.5 to +4.5	–1 to +4.5
C1	(C1)	(C1E0)	(C1E1)	(C1M1)	(C1E2)	(C1M2)	(C1E3)	(C1M3)	(C1E4)	(C1M4)
1000 – 2400	–1 to +3	–0.7 to +1.5	–0.6 to +1.5	–0.5 to +1.5	–0.5 to +1.5	–0.5 to +1.5	–0.5 to +1.5	–0.5 to +1	–0.5 to +1.5	–0.5 to +1
300 – 2700	–2 to +6	–1.5 to +3	–1 to +3	–1 to +3	–1 to +3	–1 to +2.5	–1 to +3	–0.8 to +2	–0.8 to +3	–0.8 to +2
2700 – 3000	–3 to +12	–1.5 to +6	–1.5 to +6	–1.5 to +6	–1.5 to +6	–1.5 to +5	–1.5 to +5	–1.5 to +4.5	–1.5 to +4.5	–1 to +4.5
C2	(C2)	(C2E0)	(C2E1)	(C2M1)	(C2E2)	(C2M2)	(C2E3)	(C2M3)	(C2E4)	(C2M4)
500 – 2800	–1 to +3	–0.7 to +1.5	–0.6 to +1.5	–0.5 to +1.5	–0.5 to +1.5	–0.5 to +1.5	–0.5 to +1.5	–0.5 to +1	–0.5 to +1.5	–0.5 to +1
300 – 3000	–2 to +6	–1.5 to +3	–1 to +3	–1 to +3	–1 to +3	–1 to +2.5	–1 to +3	–0.8 to +2	–0.8 to +3	–0.8 to +2
C4	(C4)									
500 – 3000	–2 to +3									
300 – 3200	–2 to +6									
C5	(C5)									
500 – 2800	–0.5 to +1.5									
300 – 3000	–1 to +3									
C7	(C7)									
400 – 2800	–1 to +4.5									
C8	(C8)									
400 – 2800	–1 to +3									

Classification Codes – Examples

* The upper limit Frequency is actually the Frequency shown plus 4 Hz.

( ) Figures in parentheses are classification codes which may be found on some **WORD Documents** to indicate the conditioning requirement for each link of the circuit.

\+ means loss with respect to 1004 Hz.

– means gain with respect to 1004 Hz.

Note: Requirements using the Collins CI.A-101A system are given in Section 314-410-104 (or on Page 5.39)

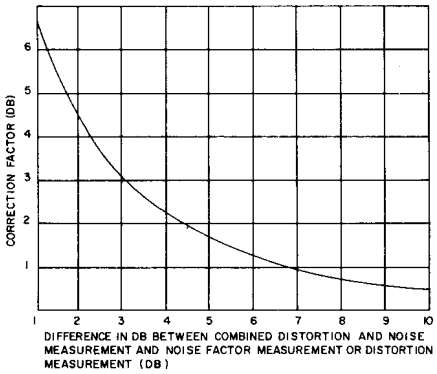
INTERMODULATION DISTORTION

The term "intermodulation distortion" is preferred to the term "nonlinear distortion". In addition, the intermodulation distortion measurements replaces the harmonic distortion measurement.

This test is accomplished by transmitting four equal level tones arranged in two "pairs". One pair called A is located at about 860 Hz, and the other pair called B is located at 1380 Hz. The receiver takes the power average of A+B and B-A products to determine second order distortion and displays the ratio , R2, of the fundamental power to second order power. It also measures the ratio of fundamental to some third order products, R3, located at 2B-A.

If the C-notched noise on the circuit being measured is high, or the nonlinear distortion on the facility is low, the distortion measurement may be influenced by the channel noise. Therefore, the distortion measurement reading obtained from the nonlinear distortion test set is actually the uncorrected distortion. The nonlinear distortion test set is equipped with a signal-to-noise mode which removes the tone pair at "B" and increases the power of the tone pair at "A" by 3 dB to transmit the same total power over the channel as is transmitted during the nonlinear distortion test mode. A correction is then applied as shown below (If the original distortion meets the requirement this correction is not required).

Determine difference between distortion mode reading and signal to noise mode reading. Using chart below determine corrections factor. Add correction factor to distortion reading to determine corrected Distortion.



REQUIREMENT
TABLE L BSP 314-410-500

OVERALL INTERMODULATION DISTORTION LIMITS

WITHOUT D-TYPE CONDITIONING	
PRODUCT	LIMIT
Second Order Third Order	27 dB 32 dB
WITH D-TYPE CONDITIONING	
PRODUCT	LIMIT
Second Order Third Order	35 dB 40 dB

This measurement technique has been recommended because the amplitude distribution of the test signal closely approximates a typical high speed data signal. In addition, the multitone technique provides a more stable measurement of the channel nonlinearities which are frequency dependent and time variable.

HITS AND DROPOUTS

Gain and phase hits are moderate changes (less than 12 dB) in the amplitude or phase of a signal lasting for at least 4 ms and returning to the original value within 200 ms. A change lasting *less than* 4 ms is classified as impulse noise. A change in amplitude and phase lasting longer than 200 ms is considered a gain or phase change.

A major cause of gain and phase hits is the switching to backup facilities in long-haul carrier. Likewise, a gain change could occur should the backup facility be lined up at a different transmission level. As a result, gain hits are more common than phase hits.

Dropouts are short duration impairments in which the transmitted signal experienced a sudden drop in power, to the extent that the signal is undetectable. They have been defined as any sudden decrease in level equal to or greater than 12 dB which lasts longer than 4 ms. Dropouts are a serious form of performance degradation with over 40 percent lasting longer than 200 ms. They usually occur rather infrequently but have been observed to occur at a rate greater than once per hour.

Dropouts are caused by the same forms of incidental modulation that cause phase jitter, gain hits, and phase hits, In addition, dropouts are caused by maintenance activities such as facility patching.

There are several test sets available which accurately measure these parameters. Some are phase jitter test sets, pen recorders, the combination of phase jitter test sets and hit monitors, and vector scope techniques. Hit and dropout measurements are not provided in SARTS.

Hit and dropout measurements are a means of recording the number of hits or dropouts that exceed a predetermined threshold. The threshold for gain hits and dropouts is measured in dB while the threshold for phase hits is measured in degrees.

REQUIREMENTS

TABLE M BSP 314-410-500

PHASE HIT, GAIN HITS, AND DROPOUT LIMITS

TRANSIENT	MID LINK	END LINK	END-TO-END
Phase Hits	$\leq$2 in 15 min $\geq$20°	$\leq$2 in 15 min $\geq$20°	$\leq$8 in 15 min $\geq$20°
Gain Hits	$\leq$2 in 15 min $\geq$3 dB	$\leq$2 in 15 min $\geq$3 dB	$\leq$8 in 15 min $\geq$3 dB
Dropouts	$\leq$2 in 15 min $\geq$12 dB	$\leq$2 in 15 min $\geq$12 dB	$\leq$2 in 15 min $\geq$12 dB

Note: $\geq$ Equal to or greater than.
$\leq$ Equal to or less than.

RETURN LOSS

The return loss measurement indicates the presence or absence of an echo caused by an impedance mismatch or discontinuity in the channel. This mismatch, and resulting echo, can be controlled by proper balancing. Echo occurs when a signal passes from 4-wire to 2-wire portions of the circuit or connection. If impedances are not matched or balanced, part of the signal energy travels back toward the source in the form of talker echo. If the echo is reflected by a similar imbalance at the transmit end, the effect is listener echo. Both talker and listener echo are detected by the return loss measuring set or singing point test set. Only talker echo can be measured by SARTS.

Return loss measurements are required whenever 4-wire to 2-wire conversions are in the transmission path. These tests insure that a given data set receiver will not receive any transmitted signal above an interfering level more than once (listener echo). To operate satisfactorily, the level of echo must be 12 dB or more below the level of the original received signal. The return loss measurement is especially important when data service is provided over tandem networks, PBX-CO trunks and the PSN.

The KS20501 Return Loss Test Set (page 2.5) should be used for these measurements.

REQUIREMENT

TABLE N BSP 314-410-500

RETURN LOSS REQUIREMENTS

NUMBER OF 2-WIRE STATIONS	MINIMUM RETURN LOSS (EACH STATION)
1-2	10 dB
3-4	16 dB
5-8	22 dB
Over 8	28 dB

SINGLE FREQUENCY INTERFERENCE

Single-frequency interference, also known as single-tone interference, is the presence of one or more unwanted steady tones on a channel. This form of noise is commonly detected by the use of audio monitoring arrangement on the output of a C-message noise test set. Other methods of detection are by the use of the frequency selective voltmeter and spectrum analyzer test sets.

Common causes of single-frequency interference are singing repeaters, crosstalk, and cross-modulation of single-frequency signaling tones. Occasional bursts of low-amplitude signals that occur from crosstalk of multifrequency signaling are not considered single-frequency interference.

A listening test or the use of the monitor during the C-notched noise test is normally sufficient for the detection of single frequency interference. However, to identify the frequency of a specific interfering tone, a spectrum analyzer or frequency selective voltmeter is required.

REQUIREMENT

TABLE 0 BSP 314-410-500

SINGLE FREQUENCY INTERFERENCE
REQUIREMENTS

CIRCUIT LENGTH MILES	LEVEL OF MEASURED TONE dBrnc0
0-50	28
51-100	31
101-400	34
401-1000	38
1001-1500	40
1501-2500	42
2501-4000	44
4001-8000	47
8001-16,000	50
Satellite Channel	41

FREQUENCY OFFSET

Frequency offset, also called frequency shift, may exist on single sideband suppressed carrier systems. This offset is the result of the difference in frequency between the modulating and demodulating carriers. The resulting frequency offset contributes a constant change at all frequencies in the frequency spectrum.

The frequency offset measurement is generally made with two frequency counters. A looped test is not valid as the offsets can cancel. These measurements are only required on the carrier channel portions of the circuit and should not normally include metallic facilities.

To measure frequency offset, a frequency counter is used at both ends of the carrier portion of a channel to compare the frequency of tone which is transmitted from one end to the other.

Frequency offsets that return to zero by as much as 100 Hz have been observed. These offsets can last from a few milliseconds to 5 seconds. A frequency meter and phase jitter test set may be helpful in detecting this problem. An electronic frequency counter cannot detect this type of problem.

REQUIREMENT

TABLE P BSP 314-410-500

FREQUENCY OFFSET REQUIREMENTS

CONNECTION	MAXIMUM ALLOWABLE SHIFT
Mid Link	$\leq$ 1 Hz
End Link	$\leq$ 1 Hz
End-to-End	$\leq$ 5 Hz Max

Note: $\leq$ Equal to or less than.

ENVELOPE DELAY DISTORTION (EDD)

This parameter is sometimes referred to as delay, delay distortion or envelope delay. EDD is the difference between the time delay at any frequency and that of a relative frequency, generally around 1800 Hz. The reference frequency should be the fastest frequency (the frequency of least delay). The frequencies used are listed in Table C (page 5.15).

Envelope delay distortion measurements are typically made with voiceband gain and delay sets. The SARTS system does not measure EDD. The EDD measurement must be made with two test sets as the looped measurements is not a valid test. The EDD measurement must be made only after the channel has been brought into attenuation distortion specifications.

Once delay equalization is correctly applied to a data circuit, EDD has proven to be the least critical parameter when a trouble arises. Some data sets provide adaptive equalizers. Acceptable P/AR measurements are accurate indicators of acceptable EDD.

REQUIREMENT

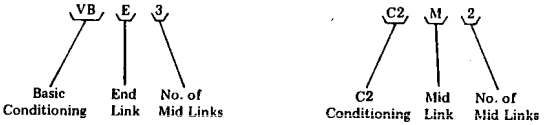
The table on page 5.23 reflects the requirements for EED for various conditioned Data services.

PRIVATE LINE VOICE BANDWIDTH CIRCUIT ENVELOPE DELAY REQUIREMENTS (MICROSECONDS) (NOTE)

FREQUENCY RANGE IN HZ *	2-POINT	0	1		2		3		4	
		MID LINK	MID LINK		MID LINK		MID LINK		MID LINK	
		END LINK	END LINK	MID LINK	END LINK	MID LINK	END LINK	MID LINK	END LINK	MID LINK
3002 (ALSO 2001)										
BASIC	(VB)	(VBE0)	(VBE1)	(VBM1)	(VBE2)	(VBM2)	(VBE3)	(VBM3)	(VBE4)	(VBM4)
800 – 2600	1750	960	685	550	550	400	400	375	375	275
C1	(C1)	(C1E0)	(C1E1)	(C1M1)	(C1E2)	(C1M2)	(C1E3)	(C1M3)	(C1E4)	(C1M4)
1000 – 2400	1000	550	400	300	300	250	250	200	200	175
800 – 2600	1750	960	685	550	550	400	400	375	375	275
C2	(C2)	(C2E0)	(C2E1)	(C2M1)	(C2E2)	(C2M2)	(C2E3)	(C2M3)	(C2E4)	(C2M4)
1000 – 2600	500	275	200	150	150	125	125	100	100	80
600 – 2600	1500	825	600	450	450	375	375	300	300	260
500 – 2800	3000	1650	1200	900	900	750	750	600	650	500
C4	(C4)									
1000 – 2600	300									
800 – 2800	500									
600 – 3000	1500									
500 – 3000	3000									
C5	(C5)									
1000 – 2600	100									
600 – 2600	300									
500 – 2800	600									
C7	(C7)									
1000 – 2600	550									
C8	(C8)									
1000 – 2600	125									

( ) Figures in parentheses are classification codes which may be found on some WORD Documents to indicate the conditioning requirement for each link of the circuit.

Classification Codes – Examples



* The upper limit Frequency shown is actually the Frequency shown plus 4Hz.

Note: Requirements using the Collins CLA-101A system are given in Section 314-410-104 (or on Page 5.40)

ESTIMATION OF TRANSMISSION PERFORMANCE

"End to End" Transmission Performance Tests are sometimes difficult to make for various reasons. It is permissable to estimate End to End performance by making sectional measurements and combining the results. These sectional measurements can be parts of 2-point PL, end links and middle links of multipoint PL, or access lines and trunks of end-to-end connections on the Public Switched Network (PSN) or the Special Service Networks (SSN).

All the methods of combining discussed here apply to one direction of transmission. LOOP-BACK tests are not valid for Estimation. In general, the results of these methods are approximations. Therefore, if the results are out of limits, an actual end-to-end measurement must be made.

ATTENUATION DISTORTION (Page 5.15)

Measurements should be made on the various sections of the circuit and the results added algebrically for each frequency.

Example:

LOSS WITH RESPECT TO 1004 HZ (dB)

FREQUENCY* (HZ)	LINK A	LINK B	OVERALL
304	1.0	-0.3	0.7
504	0.8	-0.2	0.6
604	0.4	-0.2	0.2
804	0.2	-0.1	0.1
1004	0	0	0
1204	-0.1	-0.1	-0.2
etc.			

*Frequency measured depends on the conditioning of the circuit as shown in Table C (Page 5.15).

The overall results are then compared to the requirements as shown in Table K (Page 5.16).

ENVELOPE DELAY DISTORTION (Page 5.22)

The sectional EDD measurements should be added algebraically for each frequency.

Example:

ENVELOPE DELAY (MICROSECONDS)

FREQUENCY* (HZ)	LINK A	LINK B	OVERALL
504	410	380	790
604	320	270	590
804	180	170	350
1004	130	100	230
1204	80	50	130
1404	40	20	60
1604	20	0	20
1804	0	-30	-30
2004	15	-10	+5
2204	30	5	35
2404	70	30	100
2504	110	70	180
2604	160	120	280
2704	220	180	400
2804	290	260	550

*Frequencies measured depend on the conditioning of the circuit as shown in Table C (page 5.15).

By observing the results in the "overall" column, calculate the Delay as follows:

The minimum envelope delay between 1004 and 2604 Hz = -30 usec
The maximum envelop delay between 1004 and 2604 Hz = 280 usec
The minimum envelope delay between 604 and 2604 Hz = -30 usec
The maximum envelope delay between 604 and 2604 Hz = 590 usec
The minimum envelope delay between 504 and 2804 Hz = -30 usec
The maximum envelope delay between 504 and 2804 Hz = 790 usec

The overall envelope delay distortion between 1004 and 2604 Hz = 280-(-30) = 310 usec
The overall envelope delay distortion between 604 and 2604 Hz = 590-(-30) = 620 usec
The overall envelope delay distortion between 504 and 2804 Hz = 790-(-30) = 820 usec

These results are then compared with the requirements as shown in Table Q (page 5.23).

C-NOTCHED NOISE (Page 5.8)

SINGLE FREQUENCY INTERFERENCE (Page 5.20)

Combine the sectional measurements on a power basis using Table B

TABLE B

COMBINING POWERS

DIFFERENCE IN dB BETWEEN TWO QUANTITIES	COMBINING TERM IN dB	DIFFERENCE IN dB BETWEEN TWO QUANTITIES	COMBINING TERM IN dB	DIFFERENCE IN dB BETWEEN TWO QUANTITIES	COMBINING TERM IN dB
0–0.1	3.0	2.2–2.4	2.0	5.7–6.1	1.0
0.2–0.3	2.9	2.5–2.7	1.9	6.2–6.6	0.9
0.4–0.5	2.8	2.8–3.0	1.8	6.7–7.2	0.8
0.6–0.7	2.7	3.1–3.3	1.7	7.3–7.9	0.7
0.8–0.9	2.6	3.4–3.6	1.6	8.0–8.6	0.6
1.0–1.2	2.5	3.7–4.0	1.5	8.7–9.6	0.5
1.3–1.4	2.4	4.1–4.3	1.4	9.7–10.7	0.4
1.5–1.6	2.3	4.4–4.7	1.3	10.8–12.2	0.3
1.7–1.9	2.2	4.8–5.1	1.2	12.3–14.5	0.2
2.0–2.1	2.1	5.2–5.6	1.1	14.6–19.3	0.1
				19.4–Up	0

Example: C-NOTCHED NOISE

Link A 31 dBrncO
Link B 36 dBrncO

Difference between quantities = 36 - 31 = 5 dB
From Table B combining term = 1.2 dB
Add combining term to the higher number: 36 + 1.2 = 37.2

The overall noise should be 37 dBrncO (rounded off). Requirements are on page 5.8.

It may sometimes be necessary to combine voltages as part of the private line job. The table below may be used for this purpose.

COMBINING VOLTAGES

DIFFERENCE IN dB BETWEEN TWO QUANTITIES	COMBINING TERM IN dB	DIFFERENCE IN dB BETWEEN TWO QUANTITIES	COMBINING TERM IN dB	DIFFERENCE IN dB BETWEEN TWO QUANTITIES	COMBINING TERM IN dB
0–0.1	6.0	4.6–4.7	4.0	11.5–11.9	2.0
0.2–0.3	5.9	4.8–5.0	3.9	12.0–12.5	1.9
0.4–0.5	5.8	5.1–5.3	3.8	12.6–13.0	1.8
0.6–0.7	5.7	5.4–5.6	3.7	13.1–13.5	1.7
0.8–0.9	5.6	5.7–5.9	3.6	13.6–14.1	1.6
1.0–1.1	5.5	6.0–6.2	3.5	14.2–14.8	1.5
1.2–1.3	5.4	6.3–6.5	3.4	14.9–15.4	1.4
1.4–1.6	5.3	6.6–6.8	3.3	15.5–16.1	1.3
1.7–1.8	5.2	6.9–7.1	3.2	16.2–16.9	1.2
1.9–2.0	5.1	7.2–7.4	3.1	17.0–17.8	1.1
2.1–2.2	5.0	7.5–7.7	3.0	17.9–18.7	1.0
2.3–2.5	4.9	7.8–8.1	2.9	18.8–19.7	0.9
2.6–2.7	4.8	8.2–8.5	2.8	19.8–20.9	0.8
2.8–2.9	4.7	8.6–8.9	2.7	21.0–22.2	0.7
3.0–3.2	4.6	9.0–9.3	2.6	22.3–23.6	0.6
3.3–3.4	4.5	9.4–9.7	2.5	23.7–25.4	0.5
3.5–3.7	4.4	9.8–10.1	2.4	25.5–27.6	0.4
3.8–3.9	4.3	10.2–10.5	2.3	27.7–30.7	0.3
4.0–4.2	4.2	10.6–11.0	2.2	30.8–35.1	0.2
4.3–4.5	4.1	11.1–11.4	2.1	35.2–44.9	0.1

IMPULSE NOISE (Page 5.9)

Use an impulse noise threshold as shown in Table E (page 5.9) for each facility. Algebraically add the number of impulses recorded in 15 minutes on each section to obtain the overall counts.

Example: Link A = 5 counts
Link B = 2 counts
Overall = 7 counts

INTERMODULATION DISTORTION (Page 5.17)

Combining intermodulation distortion measurements is not recommended.

PHASE JITTER (Page 5.11)

Combine phase jitter measurements expressed in degrees using Table D.

TABLE D*

COMBINING TWO PHASE JITTER MEASUREMENTS
EXPRESSED IN DEGREES PEAK-TO-PEAK

LINK B \ LINK A	1	2	3	4	5	6	7	8	9	10
1	2	3	4	4	5	6	7	8	9	10
2	3	3	4	5	6	7	8	9	10	11
3	4	4	5	6	7	8	9	10	11	12
4	4	5	6	7	8	8	9	10	11	12
5	5	6	7	8	8	9	10	11	12	13
6	6	7	8	8	9	10	11	12	13	14
7	7	8	9	9	10	11	12	13	13	14
8	8	9	10	10	11	12	13	13	14	15
9	9	10	11	11	12	13	13	14	15	16
10	10	11	12	12	13	14	14	15	16	17

* This combining table applies only to Bell weighting. LF Jitter is added algebraically to the Bell reading.

Example: Link A = 3°
Link B = 5°

From Table D the overall phase jitter would be expected to approximate 7°.

FREQUENCY OFFSET (Page 5.21)

Add the frequency shift for each section algebraically. Note whether the shift for each link is + or - with respect to the source.

Example: Link A = +1 Hz
Link B = -2 Hz
Overall = -1 Hz

END TO END TROUBLE TESTS

The end-to-end trouble tests are required if the customer is not satisfied with the service and the following steps have been taken:

(1) Loop-back tests have been made at each end of the circuit and all limits met.

(2) Interexchange or midlink tests have been made and all limits met.

(3) The customer has been requested to verify the proper operation of his equipment and has reported back that no trouble has been found but problems are still being encounterd overall.

To make the tests, repair personnel should be dispatched to the appropriate customer locations for purposes of end-to-end trouble tests. In the case of certain multipoint circuits, where the trouble is limited to transmission to a single remote station it may only be necessary to make tests of the end link from the bridge to the customer location, and coverage may not be required at any other stations.

It is not always necessary to make all End to End tests if the customer's problem may be satisfactorily resolved.

When the customer has CPE modem equipment the initial trouble reports tests specified in Table E (page 5.5) should be made and any troubles cleared. Tests through the CPE equipment should not be made except under conditions specified in BSP's 471-000-005 and 314-010-103.

Telephone company personnel should <u>not</u> attempt to provide better than Bell System specification.

LOOPBACK TESTS

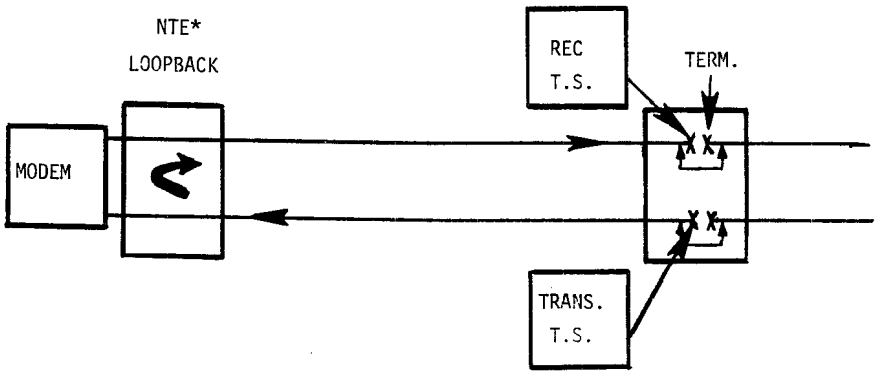
The following loop-back tests should be performed for purposes of trouble sectionalization on 4-wire facilities from the SSC or STC.

Net Loss

C-Notched Noise

Impulse Noise

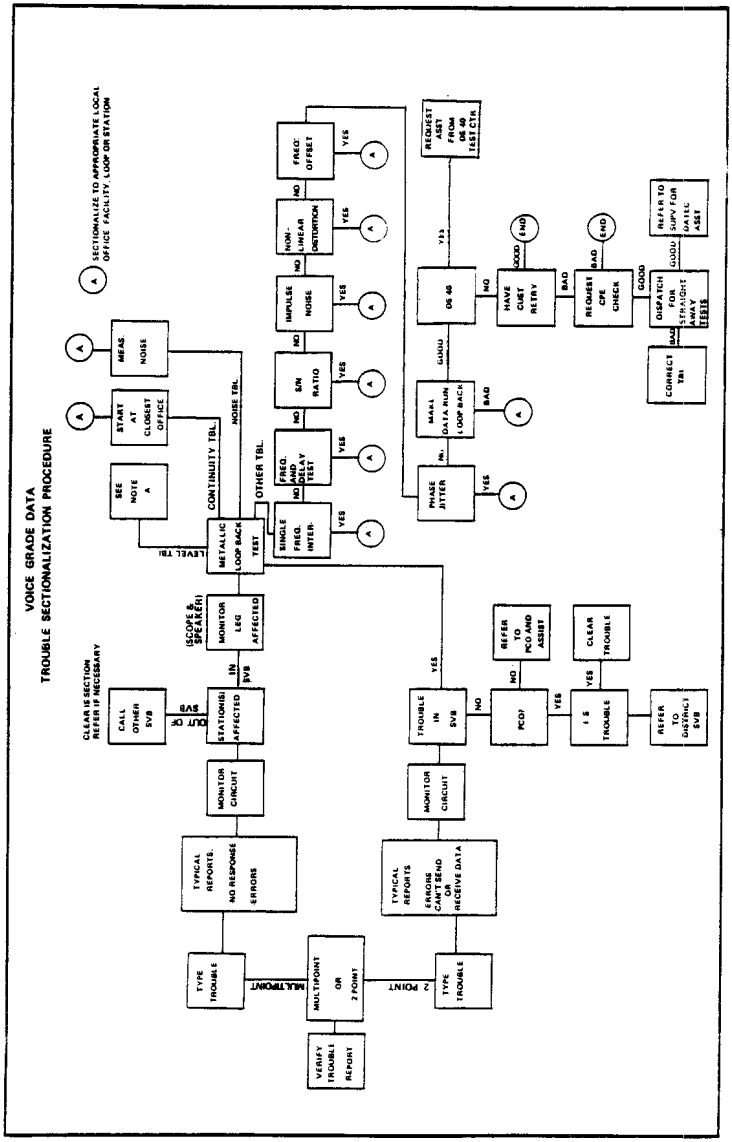
The actual loop is made **at the customer station**. Before operating the loop-back arrangement at the customer station, the transmit leg from the customer station should be terminated at a point looking toward the other customer station to prevent the operation of loopbacks at the other end. This termination should be at some point that does not interfere with the actual loopback test.



If the loopback tests indicate trouble, the isolation should be made with straight away tests. Loopback tests are not always accurate since a trouble in one direction may be matched by an opposite trouble in the other. Because of this Loopback test requirements are not specified in the BSP.

*NTE = Network Channel Terminating Equipment

VB DATA TROUBLE CHART



The chart above is a guide only, and will not necessarily cover all trouble conditions.

PROBABLE SOURCES OF IDENTIFIED TRANSMISSION IMPAIRMENTS

Table "F" on page 5.34 is meant to aid the technician in locating the source of trouble whenever the impairment causing the trouble is known. A probability is listed for each facility/equipment for each parameter where information is available. The probabilities assume that the circuit loss is correct, and they are abbreviated as h (high), m (medium), l (low) and a dash (-) to indicate no probability. A blank entry indicates insufficient data at this time to estimate a probability. In some instances, numbered notes indicate a known trouble condition, which if present, would cause the probability to be medium or high. To a large extent, the probability associated with the note indicates the probability that the condition of the note will occur.

Properly selected and installed facilities, which are appropriate for a given type of data modem will not cause problems. This table is to be used when something has gone wrong. The table can be used to minimize trouble location time for a given impairment by selecting the facility with the highest probability to be tested first, or conversely by not testing facilities which could not cause the impairment (T-Carrier cannot produce phase modulation, for example).

Several abbreviations defining impairments are used in Table F. They are as follows:

ABBREVIATION	DESCRIPTION
LEVEL* vs. T	Level variation with time. Obvious level fluctuations observable on a standard level measuring set within 15 seconds observation.
LEVEL vs. L	Variations in circuit loss with the level of the input signal, level tracking, compandor tracking.
LEVEL vs. f	Level variations versus test tone frequency variation, attenuation distortion.
G-S	Level measurements made at 404 Hz, 1004 Hz and 2804 Hz. A special case of LEVEL vs. f.
EDD	Envelope delay distortion.
RL	Return loss as measured with three standard bands of random noise.
P/AR	A complex pulse train is measured to produce a single number weighting (P/AR) of a facility for intersymbol interference, which is caused by the simultaneous effects of envelope delay distortion, attenuation distortion and poor return loss.

*the symbol "$\mathcal{L}$" is used to indicate level.

ABBREVIATION	DESCRIPTION
CN (C-NOTCH)	C-Notch noise measured with a holding tone on the circuit.
NOISE SFI	Single frequency interference is present if a single tone, other than a harmonic of a holding tone (if present), is the primary contributor to the measured noise.
INTERMODULATION 2nd, 3rd	Second and third order intermodulation distortion as measured with a multi-tone test signal.
Ø JITTER	Phase jitter on a facility as measured with a 20 to 300 Hz bandwidth around a holding tone of 1 kHz.
1f Ø JITTER	Phase jitter in the band below 20 Hz2 around a 1004 Hz holding tone.
Amp JITTER	Amplitude jitter measured in the same frequency band as phase jitter.
Ø MODULATION	Classic mathematically described phase modulation resulting from one or more tones producing pairs of sidebands on the holding tone. Additive random noise can produce phase jitter, but no phase modulation.
AMP	Classic mathematically described amplitude modulation. Additive random noise can produce amplitude jitter, but no amplitude modulation.
fSh	Frequency shift.
TRANSIENTS Imp	Impulse noise is large excursions on the received signal which are higher than the normal peaks of message circuit noise.
ØH	Phase hits are changes in the nominal phase of the circuit which exceed a preselected threshold for at least 4 milliseconds.
GH	Gain hits are changes in the nominal loss at the circuit which exceed a preselected threshold for a least 4 milliseconds.
Do	A dropout is a negative gain hit of at least 12 dB.

TABLE F

PROBABLE SOURCES OF IDENTIFIED TRANSMISSION IMPAIRMENTS

FACILITY/EQUIPMENT	IMPAIRMENTS																			
	Level							Noise		Intermodulation		Jitter			Modulation		Transients			
	γ₂T	γ₂L	γ₂F	G-S	EDD	RL	PAR	CN	SF1	2nd	3rd	Φ	fFΦ	Amp	Φ	fSh	Imp	ΦH	GH	De
LOOP PLANT																				
Cable with sealing current	—	—	m	m	m	m	l	l	l	—	—	—	—	—	—	—	m	—	—	—
Cable without sealing current	l	—	m	m	m	m	l	m[1]	l	—	—	—	—	—	—	—	m[1]	—	m[1]	h[1]
Data Aux. Sets 828.829	—	—	l[2]	l	l	l	l	l	l	l	l	—	—	—	—	—	l	—	—	—
Subscriber Loop Carrier																				
SLC™ 8	—	h[3]	m[4]	l	m[4]	l	l	l	l	m	l	—	—	—	—	—	l	—	l	l
SLC™ 40	l	m	l	l	l	l	l	h[12]	m	m	m	l	l	m	—	—	m	l	l	l[5]
SLC™ 96	m[6]	l	l	l	l	l	l	m	l	l	l	l	l	l	—	—	m	l	l	l[5]
TERMINATING EQUIPMENT																				
Repeaters																				
E6, E7	—	—	l[7]	l[7]	l	l[7]	l	l	l	l	l	—	—	—	—	—	l	—	—	—
44 V4	—	—	l	l	l	—	l	l	—	l	l	—	—	—	—	—	l	—	—	—
44 MFT	—	—	l	l	l	—	m	l	—	l	m	—	—	—	—	—	l	—	—	—
22, 24 V4*	—	—	l	l	l	l	l	l	—	l	—	—	—	—	—	—	l	—	—	—
22, 24 MFT*	—	—	l	l	l	l	l	l	—	l	m	—	—	—	—	—	l	—	—	—
Hybrid	—	—	m[8]	l[8]	m[8]	l[8]	m[8]	—	—	—	—	—	—	—	—	—	—	—	—	—
SF (260 Hz) SIGNALING*																				
E	—	l	l[9]	l[9]	l[9]	m[11]	l[9]	l	l	m[10]	m[10]	—	—	—	—	—	l	—	—	l
F	—	—	m[9]	l[9]	l[9]	—	l[9]	l	l	l	l	—	—	—	—	—	l	—	—	l
G	—	—	l[9]	l[9]	l[9]	—	l[9]	l	l	l	l	—	—	—	—	—	l	—	—	l
ANALOG CARRIER*																				
1ON	m	h[3]	h[19]	h[14]	m	—	m	h[14]	l	m	m	l	l	l	l	l	m	l	l	l
N1	m	h[3]	h[14]	h[14]	m	—	m	h[14]	m	h[15]	l	m	l	m	—	h[13]	l	l	l	
N2	m	h[3]	m	m	l	—	l	m	l	m	l	l	l	l	l	—	m	l	l	l
N3	m	h[3]	l	l	m	—	m	l[16]	m[17]	m	m	m[18]	m[18]	l	m[18]	m	m	m[18]	l	l
N4	l	h[3]	l	l	l	—	l	m	m[17]	m	l	l	l	l	l	m	l	l	l	l
Channel Banks																				
A4	l	l	m	l	l	l	l	l	l	l	l	m	m	l	l	l	l[19]	h[19]	l	l
A5	l	l	m[20]	l	l	l	l[20]	l	l	l[20]	l	l	m	l	l	l	l[19]	h[19]	l	l
A6/DFSG	l	l	m	l	l	l	l	l	l	l	l	l	l	l	l	l	m[19]	h[19]	l	l
LMX-MMX	l	l	m[4]	l	m[4]	—	l[4]	l[21]	m[22]	m[22]	m[22]	m[24]	m[24]	l	m[24]	m[20]	m[19]	m[24]	m[25]	m[25]
Microwave Radio	m[27]	m[27]	—	—	—	—	—	m[27]	m[27]	m[27]	m[27]	m[27]	—	—	—	—	h[25]	h[25]	h[25]	h[25]
LT-1	m[6]	l	l	l	l	—	l	m	m	l	l	l	l	l	m	l	m[29]	l	l	l[30]

FACILITY/EQUIPMENT	IMPAIRMENTS																		
	Level				EDD	RL	PAR	Noise		Intermodulation		Jitter			Modulation		Transients			
	γ₂T	γ₂L	γ₂F	G-S				CN	SFI	2nd	3rd	Φ	ΔΦ	Amp	Φ	fSh	Imp	ΦH	GH	De
DIGITAL CARRIER*																				
D1A, D1B, D1C	m[6]	m	l	l	l	—	l	h[22]	m	h[31]	m	l	l	l	—	—	m[29]	l	l	l[5]
D1D, hardened	m[6]	l	l	l	l	—	l	m	l	l	l	l	l	l	—	—	m[29]	l	l	l[5]
D2	h[6]	m	l	l	l	—	l	m	l	l	l	l	l	l	—	—	m[29]	l	l	l[5]
D3, D4	m[6]	l	l	l	l	—	l	m	l	l	l	l	l	l	—	—	m[29]	l	l	l[5]
PBX																				
SXS 701								h[24]									h[24]			
DIMENSION* 100or 400	—		m	l	l	l	l	l[26]	l	l	l	l	—	l	l	—	l	—	—	l
" 2000 or Custom	m[25]		m	l	l	l	l	l[26]	l	l	l	l	m[25]	l	l	—	l	—	—	l
HORIZON*	—	l	m	l	l	l	l	l	—	l	l	l				l	l			
ECHO SUPPRESSORS																				
Analog 3A, 4A	—	—	—	—	—	—	—	l	—	l	l	—	—	—	—	—	—	—	—	l[27]
Digital	—	—	—	—	—	—	—	l	—	l	l	—	—	—	—	—	—	—	—	l[27]
TASI*																				
A	m[6]	m[28]	l[28]	l[28]	m[28]	—	m	m[28]	m	m	m					—	h[22]	l	m	m
B	l[28]	l[28]	l[28]	l[28]	l[28]	—	l	h[28]	m	m	m					—	m	l	l	l
E	m[6]	l[28]	l[28]	l[28]	l[28]	—	l	m[41]		m	m	l	l	l	—	—	m[28]	l	l	l[5]
SATELLITE																				
COMSTAR	l	l	l	l	m[40]	m[40]	m	l	l	l	l	l[24]	l[24]	l	l[24]	m	l	m	m	m
HYBRID	—	—	m	l	m	l	m	—	—	—	—	—	—	—	—	—	—	—	—	—
SWITCHING EQUIPMENT																				
SXS	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	h[42]	—	l[43]	l[42]
Crossbar	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	m	—	—	—
1ESS, 2-Wire	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	l	—	—	—
1ESS, 4W HiLo	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	m[44]	—	—	—
2ESS, 3ESS, 4ESS	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	l	—	—	—
4ESS with VIU's	m[6]	l	l	l	l	l	l	m		l	l	l	l	l	—	—	l	l[45]	l	l[5]

TABLE F

NOTES

* See also the Hybrid row for 2-4 wire conversion.

1. Oxidized cable splices, half of which can be fixed with the application of sealing current. See EL 4504, 3-17-76.
2. Misadjusted equalizers on installation.
3. Syllabic compandors.
4. Edge channels only.
5. 25 to 50 msec dropout of reframing; lightning, for example.
6. Will exhibit level fluctuations at test frequencies which are integral submultiplex of the 8000 Hz sampling rate.
7. Equalizers not properly adjusted at installation.
8. Precision balance networks improperly set on installation.
9. 2600 Hz band rejection notch improperly impressed on channel after cut-thorugh.
10. E-type SF signaling units typically do no meet D-1 intermodulation distortion requirements.
11. If the condition of Note 9 occurs for E-type SF units, the return loss i poor even in the 4-wire case.
12. Adaptive delta modulation gives poor (25 dB) S/N ratio for data signals with high frequency components.
13. If engineered for the earlier longer span between repeaters.
14. Aging of vacuum tubes. Tubes should be replaced with hybrid integrated networks (HINs).
15. Facility immediate action limits are only R2 = 26 dB, R3 = 30 dB.
16. If the N3 Compandor Applique for operator service trunks is applied to long haul facilties.
17. 4000 Hz carrier.
18. Faulty Frequency Corrector Unit as described in EL 2497, 8-9-73.
19. Switching transient effects in adjacent channels of LMX-2.
20. Ferrte slug in the 561K filter comes unglued, causing loss bumps, or channel banks in the A5 Channel Bank Reuse Program.
21. When LMX channels 6 and 7 are used for program, the Program Blocking Filter roll-off is not sufficient to stop interference in channels 5 and 8.
22. Intermodulation products from hot tones in other channels.
23. On some LMX-2 channels.
24. LMX-1 Primary Frequency Converter with 4 kHz and 128 kHz feeds from different Primary Frequency Supplies for low frequency variations in power feeds to LMX or MMX bays.
25. 30 msec dropout due to protection switch on microwave facility caused by instantaneous loss of signal rather than fading.
26. 228D, 231D or 231E amplifiers sensitive to battery voltage transients.
27. During periods of fading on the microwave links.
28. Protection switching on microwave channels, particular hose without differential absolute delay equalization (DADE).
29. Strikes on a T-Carrier link.
30. Loss of synchronization by the PFS2-Type Primary Frequency Supply.
31. High intermodulation distortion caused by high level signals in adjacent channels.
32. Immediate action limit for S/N is only 24 dB.
33. Needs routing for adjacent channel crosstalk.

TABLE F

NOTES (CONT'D)

34. The 701 PBX requires special grounding, quiet battery and shielded wire to control noise and impulse noise.
35. Clock differences between modules willcause beating (3 Hz maximum rate) when single tones are used for testing, rising from 0.1 dB at kHz to 1 dB at 3.2 kHz.
36. Two or more trunks terminated with the LC11 and LC11B vintage 1 circuit packs can have high crosstalk.
37. Occasionally, high impulse noise or high longitudinal noise causes false suppressor operation.
38. TASI is energy-actuated, so test tones must be continuous.
39. Will exhibit level fluctuations at test tones which are integral submultiples of the 10 kHz sampling frequency.
40. Long 300 msec echo delays aggravate hybrid unbalance problems.
41. Noise matching circuits may put on noise when disconnected which matches noise level of power line hum when connected.
42. Mechanical shaking of SXS switch due to release of adjacent SXS switches. See EL 4205, 1-16-76.
43. Phase hits occurring at periodic intervals as a result of clock slippage between 4ESS and downstream T-Carriers.
44. 3-wire equivalent of 4-wire circuit: crosstalk spikes caused by False Cross and Ground Checks.

COLLINS CLA TYPE SYSTEM

The CLA-type system uses test frequencies spaced at 250-Hz intervals ranging from 250 Hz to 3500 Hz. The conditioning test requirements for voice bandwidth data channels are stated differently when using the CLA-type system test equipment. This difference is due to the different test frequencies that are used. Limits have been developed for attenuation and envelope delay distortion at the CLA-type frequencies that will give reasonable assurance that the channel conditioning requirements are met within the specified frequency bands.

The limits for attenuation and envelope delay distortion are given in Tables A & B (pages 5.39/40). These tables should be substituted for the attenuation and envelope delay distortion requirements given in Section 314-410-500 up through C4 when the Collins CLA-type system is used to perform these tests. Manual measurements must be performed for C5, C7 and C8 tests. Use the requirements as given in Section 314-410-500 (page 5.16 and 5.23). However, it is recommended to make CLA-type measurements for benchmark readings.

The Collins CLA-type system uses a complex signal and performs a dynamic frequency response measurement. By comparison, the Bell System measurement technique used at this time is a static frequency response measurement. As a result a compandored channel will appear to have a wider bandwidth when using the Collins CLA System. In some cases the customer, when using a single frequency transmission measuring set, may report that the frequency response is out of limits. However, subsequent testing using the Collins CLA-type system may indicate the frequency response is within specified limits. In these cases, the circuit must be adjusted to meet requirements using the static frequency response technique (measuring one frequency at a time).

TABLE A

PRIVATE LINE VOICE BANDWIDTH CIRCUIT ATTENUATION DISTORTION REQUIREMENTS (dB) USING COLLINS CLA-TYPE SYSTEM

FREQUENCY RANGE IN HZ	0		1		2		3		4	
	2-POINT	MID LINK END LINK	MID LINK		MID LINKS		MID LINKS		MID LINKS	
			END LINK	MID LINK	END LINK	MID LINK	END LINK	MID LINK	END LINK	MID LINK
3002 (ALSO 2000)										
BASIC	(VB)	(VBE0)	(VBE1)	(VBM1)	(VBE2)	(VBM2)	(VBE3)	(VBM3)	(VBE4)	(VBM4)
500-2500	-2 to +8	-1.5 to +4	-1 to +4	-1 to +3.5	-1 to +4	- to +3.5	-1 to +3.5	-0.8 to +3.5	-0.8 to +3.5	-0.8 to +3
250-3000	-3 to +12	-1.5 to +6	-1.5 to +6	-1.5 to +6	-1.5 to +6	-1.5 to +5	-1 to +5	-1 to +4.5	-1.5 to +4.5	-1 to +4.5
C1	(C1)	(C1E0)	(C1E1)	(C1M1)	(C1E2)	(C1M2)	(C1E3)	(C1M3)	(C1E4)	(C1M4)
1000-2500	-1 to +3	-0.7 to +1.5	-0.6 to +1.5	-0.5 to +1.5	-0.5 to +1.5	-0.5 to +1.5	-0.5 to +1.5	-0.5 to +1	-0.5 to +1.5	-0.5 to +1
250-2750	-2 to +6	-1.5 to +3	-1 to +3	-1 to +3	-1 to +3	-1 to +2.5	-1 to +3	-0.8 to +2	-0.8 to +3	-0.8 to +2
250-3000	-3 to +12	-1.5 to +6	-1.5 to +6	-1.5 to +6	-1.5 to +6	-1.5 to +5	-1.5 to +5	-1.5 to +4.5	-1.5 to +4.5	-1 to +4.5
C2	(C2)	(C2E0)	(C2E1)	(C2M1)	(C2E2)	C2M2)	(C2E3)	(C2M3)	(C2E4)	(C2M4)
500-2750	-1 to +2.7	-0.6 to +1.4	-0.5 to +1.4	-0.5 to +1.4	-0.5 to +1.4	-0.5 to +1.4	-0.5 to +1.4	-0.5 to +1	-0.5 to +1.4	-0.5 to +1
250-3000	-2 to +6	-1.5 to +3	-1 to +3	-1 to +3	-1 to +3	-1 to +2.5	-1 to +3	-0.8 to +2	-0.8 to +3	-0.8 to +2
C3 ACCESS LINE*†	(C3A)(C3AC)									
500-2750	-0.5 to +1.3									
250-3000	-0.8 to +3									
C3 TRUNK*	(C3T)									
500-2750	-0.5 to +1									
250-3000	-0.8 to +2									
C4	(C4)									
500-3000	-2 to +3									
250-3250	-2 to +7									
C5 C7 C8 ‡										

( ) Figures in parentheses are classification codes which may be found on some CLRs to indicate the conditioning requirement for each link of the circuit.

* C3 conditioning requirements apply to AUTOVON and CCSA circuits only. Refer to Sections 309-200-300 and 309-200-301 for more information.

† Classification code C3AC assumes measurement taken with compromise equalizer temporarily out of service.

‡ Manual measurements are required and the CLA-type system is recommended for benchmark measurement only.

TABLE B

PRIVATE LINE VOICE BANDWIDTH CIRCUIT ENVELOPE DELAY REQUIREMENTS (MICROSECONDS) USING COLLINS CLA-TYPE SYSTEM

FREQUENCY RANGE IN HZ		0	1		2		3		4	
	2-POINT	MID LINK END LINK	MID LINK		MID LINKS		MID LINKS		MID LINKS	
			END LINK	MID LINK	END LINK	MID LINK	END LINK	MID LINK	END LINK	MID LINK
3002 (ALSO 2000)										
BASIC	(VB)	(VBE0)	(VBE1)	(VBM1)	(VBE2)	(VBM2)	(VBE3)	(VBM3)	(VBE4)	(VBM4)
750-2750	1900	1050	750	630	630	450	450	420	420	300
C1	(C1)	(C1E0)	(C1E1)	(C1M1)	(C1E2)	(C1M2)	(C1E3)	(C1M3)	(C1E4)	(C1M4)
1000-2500	1000	550	400	300	300	250	250	200	200	175
750-2750	1900	1050	750	630	630	450	450	420	420	300
C2	(C2)	(C2E0)	(C2E1)	(C2M1)	(C2E2)	(C2M2)	(C2E3)	(C2M3)	(C2E4)	(C2M4)
1000-2500	400	240	200	150	150	125	125	100	100	80
750-2750	1100	700	520	380	380	330	330	250	250	220
500-2750	2500	1500	1100	800	800	690	690	600	600	450
C3 ACCESS LINE*†	(C3A)(C3AC)									
1000-2500	100									
750-2750	240									
500-2750	600									
C3 TRUNK*	(C3T)									
1000-2500	80									
750-2750	200									
500-2750	450									
C4	(C4)									
1000-2500	260									
750-2750	450									
750-3000	1500									
500-3000	3000									
C5 C7 C8 ‡										

( ) Figures in parentheses are classification codes which may be found on some CLRs to indicate the conditioning requirement for each link of the circuit.

* C3 conditioning requirements apply to AUTOVON and CCSA circuits only. Refer to Sections 309-200-300 and 309-200-301 for more information.

† Classification code C3AC assumes measurement taken with compromise equalizer temporarily out of service.

‡ Manual measurements are required and the CLA-type system is recommended for benchmark measurement only.

NETWORK CHANNEL TERMINAL EQUIPMENT (NTE)

The DAS (Data Aux. Set) 829 is the Bell System standard NTE for terminating 4-wire PL voiceband data channels. Other types of equipment may be specified and are generally similar in function, such as the older DAS 828. The work order record detail (WORD) document should indicate the type of equipment to be used to provide channel termination, equalization and maintenance features.

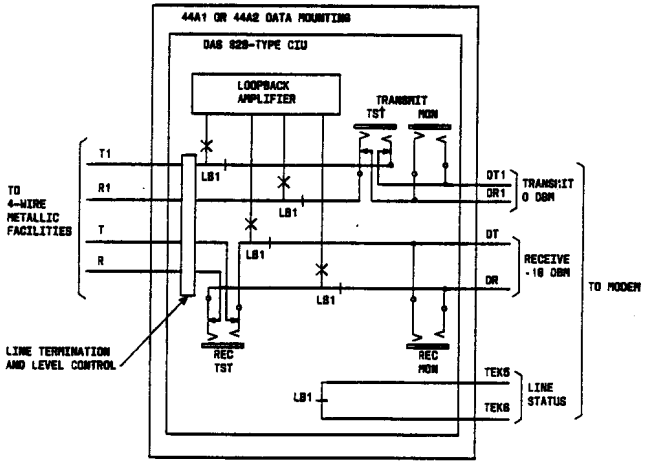
Three basic station codes of the DAS 829 are available:

DAS 829A - is used for short loops when no gain is required in the transmit or receive paths. Slope equalization is accomplished with 600- or 1200-ohm line terminations. Attenuation is accomplished in the transmit or receive paths.

DAS 829B - is used for longer nonloaded loops and provides 150-, 600-, or 1200-ohm line termination for slope equalization. Gain or attenuation can be provided in the receive path. Attenuation is provided in the transmit path.

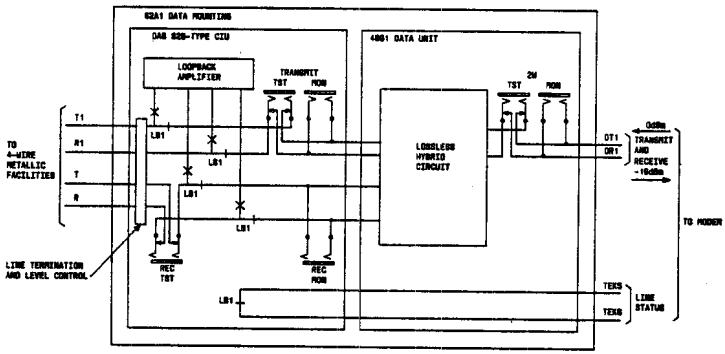
DAS 829C - is used for longer loaded loops and provides extensive equalization capability. This unit provides the same equalization capabilities as the 359A or the 359K equalizer. Gain or attenuation can be provided in the transmit path.

The configuration used for a 4-wire Data Set without voice is shown below.



Levels are shown for the side facing the customer. Overall tests are made from these jacks at a 600 ohm impedance.

The sketch below shows the configuration for a 2 wire Data Set without voice. Overall tests are made from the 2-wire jack at 600 ohm impedance.



When voice sharing is used with either a 4-wire or a 2-wire Data Set, a 48A1 unit is added to allow conversion by the customer. In both cases the data service is lined up from the same jacks as without voice sharing. Because the 4-wire metallic facilities vary in impedance, the lineup of the DAS should be done between the central office and the jacks on the customer side (the 4-wire metallic facilities should have been measured before this measurement is made).

LOOP-BACK ARRANGEMENTS

A remotely controlled equal-level loop-back arrangement is required at the customer locations on 4-wire circuits. The DAS 829-type has a tone-activated loopback.

To activate the loop-back a 2713 ± 2 Hz tone is applied toward the station at data level for not less than 5 seconds. Upon removal of the tone, the loop-back path will be established. To deactivate the loop-back, the 2713-Hz tone is again applied for a minimum of 5 seconds. The 406A tone generator is available for use at the testboard to supply the 2713-Hz signal for activation and release of the tone activated loop-back.

Note: See procedure for making loopback tests on page 5.30 to prevent false operation of Loopback at other end of the service.

INTERCONNECTION

Interconnection is the connection of CPE to Bell System facilities or terminal equipment. The connection could be independent facilities if in independent company (ICO) territory. The Federal Communication Commission (FCC) requires all station terminal equipment that may be connected to the PSN (Public Switched Network) to be either grandfathered or registered, or if not, the equipment must be connected via a grandfathered or registered protective circuitry (eg, a protective connecting arrangement [PCA]).

Registered Equipment: Registered equipment complies with Part 68 of the FCC rules and regulations and has been granted a registration number.

Grandfathered Equipment: Grandfathered equipment is nonregistered equipment that was either directly connected to telecommunications facilities without a telephone company (TELCO)-provided PCA or data access arrangement (DAA) as of October 17, 1977.

INTERPOSITIONING

Interpositioning is where telephone company terminal equipment accesses telephone company through CPE (Customer Provided Equipment). Typical applications involve customer-provided data sets interpositioned between Bell-provided DATASPEED® terminals and Bell facilities and customer-provided patch panels or diagnostic units interpositioned between Bell-provided data sets and Bell facilities.

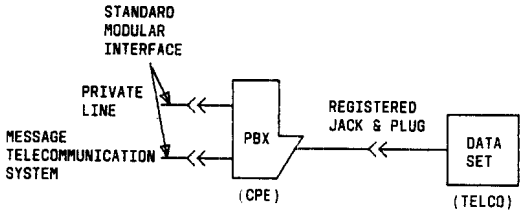
It is the Bell System policy to satisfy service needs involving interpositioning of terminal equipment when all of the following conditions are met:

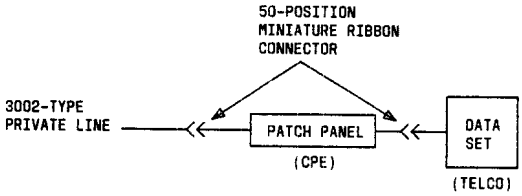
The interconnection of Bell-provided facilities and terminal equipment and customer-provided terminal equipment conforms to the FCC registration program rules, or to applicable tariffs.

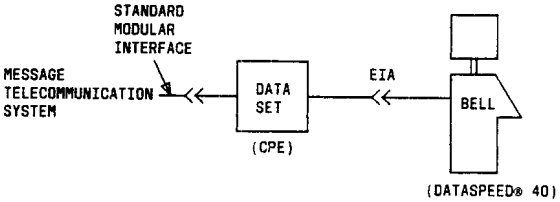
Standard interfaces exist for the Bell facilities and Bell and customer-provided terminal equipment to be interconnected.

Additional costs, if any, incurred by the Bell System in providing such arrangements will be recovered in appropriate rates.

Some examples of interpositioning are shown on page 5.44.







TELCO and Customer Responsibilities

Interpositioning involves the interconnection of CPE and therefore interpositioning arrangements are classified as either transmission systems or assemblies. It is the responsibility of the customer to ascertain the proper operation of the CPE *before* reporting a trouble to TELCO.

Testing through CPE can be helpful in isolating trouble conditions. Testing through customer-provided patch panels is an obvious case. Obviously, for various technical reasons, personnel will not always be able to test through an interpositioned CPE modem to assure proper Bell terminal operation. If, however, such a through test is possible, and it is done *with the permission of the customer*, the results may determine that the Bell terminal equipment is functioning properly. If dispatch of a craft is necessary, the customer should be given a maintenance of service charge warning. If the craftsperson on site determines that the Bell terminal is in fact functioning properly but there is a customer system trouble, eg, protocol or language incompatibility, a maintenance of service charge would be applicable.

Complete information on Interconnection and Interpositioning may be found in BSP 314-010-103.

DATA SERVICES SUPPORT

All services offered by the Bell System are supported for a minimum quality level, recognizing that some services are supported to a higher degree than others. For instance, a 2-point PL 3002 channel (data communication system), as described in this section, is supported for data in terms of transmission parameters and error performances. Whereas an arrangement such as a foreign exchange (FX) circuit when used for data transmission to locations beyond the radius of 200 airline miles from the dial tone office, is supported for voice only. The Bell System has an obligation to insure that all services meet their *design* specification, even though the circuits are not being used for their designed purpose.

Private Line data services are available as 2-point or multipoint arrangements. The customer must specify the desired conditioning at the time of ordering the service, usually as recommended by the manufacturer of the terminal equipment (data set). The service and support definitions for private line data services are characterized as either *Systems or Assemblies*.

Systems are PL channels that are designed for data transmission and are used within their designed capabilities. The telephone company (TELCO) has no control over the customer's choice of data set [TELCO or customer-provided equipment (CPE)]. Systems are broken down further as:

Data Transmission System: The TELCO provides a channel only. The service, in terms of transmission parameters only, is provided between the Network Channel Terminating Equipment (NTE). Typically, the NTE is a data auxiliary set (DAS) 829.

Data Communications Systems: The TELCO provides the channel and data sets. The channel must be ordered with the recommended channel conditioning (C- and/or D-type). In addition to the transmission parameters, as specified for data transmission systems, an error performance is also specified as covered in the various data set documentations.

Assemblies are PL channels or arrangements of channels that were not normally intended or designed for data transmission. (Assemblies could be a channel designed and intended for data transmission but not designed to the specifications recommended by the modem supplier.) However, these arrangements will not be improved beyond their designed specifications. Channels are supported as ordered, and it is understood data services *may* perform satisfactorily. The TELCO has not specified and does not support assemblies for error performance.

It is the responsibility of the company to maintain the systems or assemblies only for the parameters specified.

The various types of services available to the customer and the support specified for each is detailed in BSP 314-010-102.

DATA TECHNICAL SUPPORT (DATEC)

There will be some circustances under which special technical support will be needed in order to solve a service problem. Technical support should be sought under the following conditions:

(a) The service meets all Bell System specifications but does not meet the customer's performance expectations. Telephone Company personnel should not attempt to provide better Bell System specifications without higher management approval.

(b) The service does not meet Bell System specifications and the problem source cannot be identified.

(c) Excessive trouble reports have been received and have been closed out at "Test OK," "Came Clear,", "Found OK," or "No Trouble Found". This type of condition should be referred immediately upon receipt of the third trouble report within a two month period.

(d) The customer reports a transmission parameter as being out of limits but no mention is made in the section of that parameter. As an example, a report of "percent phase distortion" should be referred for technical support.

Additional information on the DATEC team can be found in BSP 010-521-100 and 010-521-101.

The Long Lines DATEC team is covered in BSP 002-502-920LL.

DATAPHONE® II

DATAPHONE® II service combines data transmission and multiplexing with advanced diagnostics to allow the customer to quickly determine the status of the service and isolate troubles. Faults can be displayed by location and type. Dataphone® II provides four-wire, full duplex service.

The service is available in three levels of diagnostic managements.

DATAPHONE® II service Level I System Management offers all these significant advantages-

- Central site control.
- Continuous monitoring of system.
- System faults automatically located and diagnosed.
- Test Menu-signal level, signal quality, modem test, end-to-end test and more.
- Command Menu-disable remote, display and change local options, and more.
- New EIA RS 449/423 interface with RS 232 compatibility.
- Automatic or remote data set/terminal isolation.
- Human engineered data set control panel.
    - Four character alphanumeric display for ease of communication to user.
    - Fault location identification.
    - System element identification (i.e. transmission channel, port, terminal, etc.)

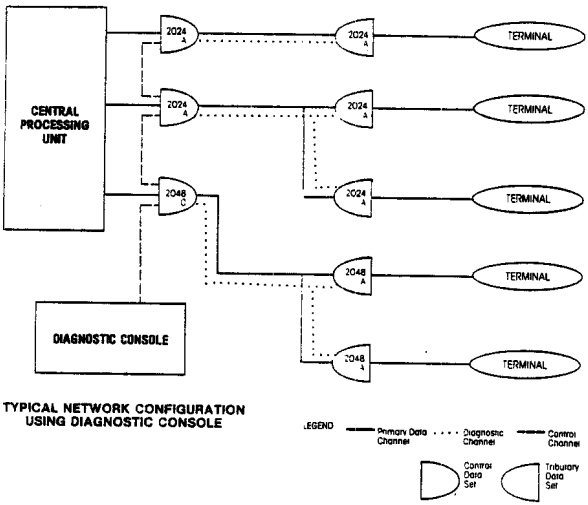
Level II Systems Management provides a single management console for multiple "basic systems" and provides all the significant advantanges of Level I Systems Management. In addition it provides these new capabilities:

- Expanded test and command capabilities.
- Abilities to extend the duration of certain tests.
- Ability to monitor every data set in the network.
- Ability to transmit tests and commands and receive results from any data set in the network.
- Ability to gather, display and maintain a real time record of network faults and their locations.
- Quick access to five test or command selections via pushbuttons.
- Ability to display and change the options of any data set in the network.
- Capability to permit secure network access from a remote DATAPHONE® II service Network Controllers.
- Ability to obtain a "snapshot" of the EIA interface and any data set in the network.

Level III Systems Management provides all the significant advantages of Level I Systems Management and all the new capabilities of Level II Systems Management.

In addition it provides:

- Communications Management Console - Keyboard display (e.g., DATASPEED® 40/2).
- Automatic queuing of multiple tests and commands.
- Delayed execution of tests and commands.
- Ability to create and store routines, consisting of sequences of test and commands.
- Storage and retrieval of network information from tape.
- Support for remote operation.
- Interface with an optional printer.
- Optional automatic trouble reporting to the Telephone Company.
- Ability to permit secure network access from a remote terminal or another Network Controller.
- Communicates to the user in common English language terms.
- Extensive user prompting.



TYPICAL NETWORK CONFIGURATION USING DIAGNOSTIC CONSOLE

DATAPHONE® II REAL-TIME DIAGNOSTIC SYSTEM FAULT MESSAGES

FAULT MESSAGE	FAULT TYPE	DESCRIPTION
MD	Modem	Failure in data set.
FA	Facility	Signal quality or level degraded.
SR	Streaming	Streaming terminal detected.
NR	No Response	No response on diagnostic channel.
PRT	Port X	Failure in extended network off the identified port.

SUPPORTING DOCUMENTATION FOR DATAPHONE® II

System Overview

592-840-150 Description

Data Mountings

590-102-160 63-Type
590-102-161 64-Type
590-102-162 65-Type

Private Line Data Sets

592-040-120 Description
592-040-220 Installation
592-040-520 Test

2100A Data Control Unit

592-101-100 Description
592-101-200 Installation
592-101-500 Test

Testing and Administration

666-513-100 DATAPHONE® II Remote Access Description
668-301-500 Test Procedures - DTC
666-617-104 Administrative Procedures

2200A Data Control Unit

592-102-100 Description
592-102-200 Installation
592-102-500 Test

User Manuals

999-100-200 2100A Data Control Unit
999-100-201 2200A Data Control Unit
999-100-210 PL 2400 & 4800 bps
999-100-211 PL 9600A bps

Miscellaneous

590-000-103 Data USOC Codes and Implementation Guide
590-106-050 425A - Adapter
590-010-201 Multiple Installation Information

Technical References

41901 System Description
41910 PL Data Sets

41920 2100A Diagnostic Console
41930 2200A Network Controller
41940 Diagnostic And Control Channel Protocols

DATASPEED® 40

A Dataspeed® 40 station is a combination of modular components interconnected to provide data communications. Various types are offered to the customer.

40/1 Switched network and 2-point private line (asynchronous)

40/2 Time-sharing and 2-point private line (asynchronous)

40/3 Multi-point private line, polling-type with 9140 controller (asynchronous)

40/4 Multi-point private line, using polling procedures

High Speed - Synchronous

Clustering capability using station cluster controllers

Up to 36 terminal devices per station

Up to 32 stations per circuit

4540 multipoint private line service with cluster controllers built into terminal (new version of 40/4) with a maximum of 32 terminal devices

The Terminal Devices of a Dataspeed® 40 or 4540 may consist of any combination of the following:

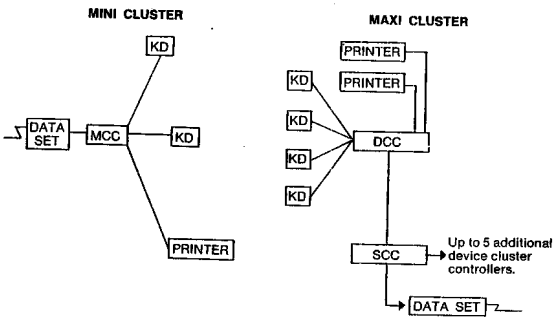
K - Keyboard Unit

D - Display Unit (CRT)

P - Printer

A controller is used in all configurations.

The Dataspeed® 40/4 may use a mini-cluster or a maxi cluster arrangement as shown below:



The Mini Cluster arrangement uses an MCC (Mini-Cluster Controller) which is limited to 3 terminal devices.

The Maxi Cluster arrangement:

Uses Station Cluster Controller (SCC) to connect up to 6 Device Cluster Controllers (DCC)

Each DCC controls up to 6 terminal devices

This allows up to 36 devices per station.

The Dataspeed® 4540 is similar to DS 40/4 except that no SCC or DCC's are used. A built-in controller has the capability of serving 32 terminal devices.

TROUBLE REPORTS

Trouble reports require up to 3 stages of action.

In stage 1, the customer is asked certain questions to insure that certain basic tests on the terminal equipment have been performed before the trouble was reported. These questions are covered in BSP 579-505-353 and in most cases will locate troubles in the station devices.

If stage 1 does not solve the problem, then:

the STC technician should obtain a release (if necessary) and perform stage 2 tests

further testing is necessary to verify trouble location.

WARNING: When testing Dataspeed services REMEMBER several pieces of equipment are common to the entire station and any testing without a circuit release from the customer may result in up to 36 out-of-service devices.

1. Check loop's DC and AC conditions against benchmarks of the installation record.
2. Verify continuity to the line facility.
3. Verify incoming poll (call distant end).
4. If on poll (CPU is asking station for response), is poll leaving Central Office toward station?
5. Operate 829A, B or C (loop back) by applying 2713 hertz at Odb toward the station, hold tone for 5 seconds. Then take a loop back measurement. (This loop back is before the data set and doesn't check the data set).

If the trouble appears to be a station trouble, or if operational testing is required, the Data Test Center (DTC) should be asked for assistance. The DTC should be advised of the trouble report, what tests were performed and the test results. The DTC will then perform Stage 3 tests. When the assistance of the DTC is obtained, the responsibility for trouble clearing still remains with the Serving Test Center (STC). Trouble disposition should be properly classified (ie. data terminal, data set, etc.).

The DTC personnel are equipped with the latest test equipment and information regarding Dataspeed®40 services. They are also in close contact with the DATEC team, and are able to maintain and install Dataspeed® 40 services in a professional manner. They can be utilized to solve more complex MODEL 40 troubles by sending and receiving test messages, and verifying the operation of the various station arrangements.

The Circuit must be patched to DTC using:

Remote Test Access Unit (RTAU)

Transparent Line

BSP's for Dataspeed® 40 station are in the 582-2 and 582-3 layers.

Other BSP's relative to Dataspeed® 40 operation are listed below:

668-125-500	DATASPEED 40 Switched Network Service - Test Procedures Using DATASPEED Test Position
668-125-501	DATASPEED 40 Private Line BIS - Test Procedures Using DATASPEED Test Position
668-125-502	DATASPEED 40 With 9140 Station Controller for Private Line - Test Procedures Using DATASPEED 40 Test Position
668-125-503	Synchronous DATASPEED 40 Station Using Binry Synchronous Line Control Protocol - Test Procedures Using a DATASPEED Test Position
668-125-504	DATASPEED 40/4 4540 Test Procedures Using a 18388 Test Signal Generator (TSG 40/4)
668-125-507	Synchronous DATASPEED 40/4 Direct Distance Dialed Display Station (ANSI X3.28 -- 1971 Sub 2.2/B2) TEsting Using Pacer M-103, LB1/2 Data Line Monitor/Simulator
668-125-508	DATASPEED 40/4 Test Procedures Using Pacer - 103 LB1 Data Line Monitor/Simulator
668-125-509	Integrated Synchronous DATASPEED 40 Receive-Only Printer Station - Using Pacer M103-LB2 Test Set
668-125-510	DATASPEED 4540 Private Line Display Station for ADCCP System Applications Testing - Using Pacer M-103-LB1/2 Data Line Monitor/Simulator
668-125-511	Synchronous DATASPEED 40/4 - 4540 Bi-Synchronous Test Procedures (/4ATC-3 and /4ETC-3) Testing - Using Commercial Test Set Pacer M-103

The ® symbol has been left off the word "Dataspeed" in the list above for purposes of clarity only.

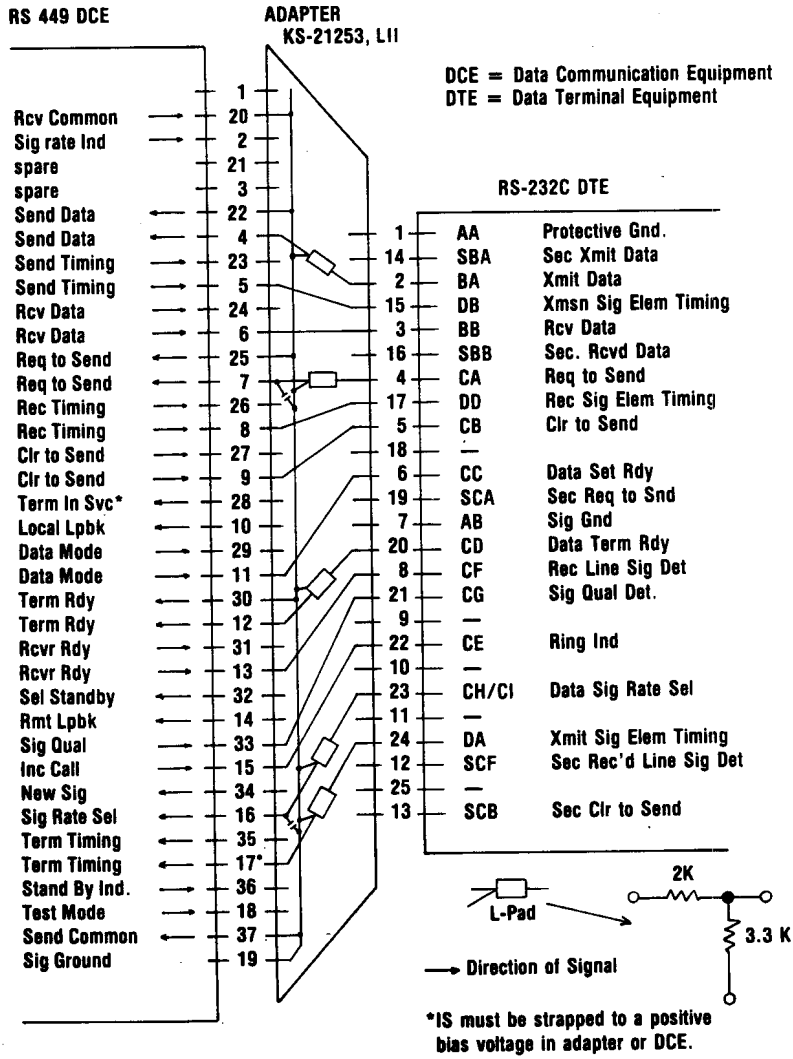
EIA INTERFACE LEAD DESIGNATIONS

PIN NO.	EIA RS-232C NOMENCLATURE		LEAD DESIGNATION	
1	Protective Ground	(AA)	Frame Ground	(FG)
2	Transmitted Data	(BA)	Send Data	(SD)
3	Received Data	(BB)	Receive Data	(RD)
4	Request-to-Send	(CA)	Request-to-Send	(RS)
5	Clear-to-Send	(CB)	Clear-to-Send	(CS)
6	Data Set Ready	(CC)	Data Set Ready	(DSR)
7	Signal Ground	(AB)	Signal Ground	(SG)
8	Rec. Ln. Signal Detector	(CF)	Data Carrier Detector	(CO)
9	Reserved for Data Set Testing		+V dc for testing	
10	Reserved for Data Set Testing		-V dc for testing	
11	Unassigned			
12	Secondary Rec. Ln. Signal Detector	(SCF)	Secondary Carrier On	(SCO)
13	Secondary Clear-to-Send	(SCB)	Secondary Clear-to-Send	(SCS)
14	Secondary Trans. Data	(SBA)	Secondary Send Data	(SSD)
15	Transmitter Signal Element Timing	(DB)	Serial Clock Transmitter (Internal)	(SCT)
16	Secondary Rec. Data	(SBB)	Secondary Received Data	(SRD)
17	Receiver Signal Element Timing	(DD)	Serial Clock Rec.	(SCR)
18	Unassigned			
19	Secondary Request-to-Send	(SCA)	Secondary Request-to-Send	(SRS)
20	Data Terminal Ready	(CD)	Data Terminal Ready	(DTR)
21	Signal Quality Detector	(CG)	Received Signal Quality	(SQ)
22	Ring Indicator	(CE)	Ring Indicator	(RI)
23	Data Signal Rate Selector	(CH)	Speed Select	(SS)
24	Transmitter Signal Element Timing	(DA)	Serial Clock Transmitter (External)	(SCTE)
25	Unassigned			

Use the BSP for the particular type of data set being considered, as not all leads are used by all data sets.

PIN NO.	EIA RS449 NOMENCLATURE	
1	Shield	
2	Sig. Rate Ind.	(SI)
3	Spare	
4	Send Data	(SD)
5	Send Timing	(ST)
6	Rec Data	(RD)
7	Req to Send	(RS)
8	Rec Timing	(RT)
9	Clr to Send	(CS)
10	Local Lpbk	(LL)
11	Data Mode	(DM)
12	Term Ready	(TM)
13	Recr Ready	(RR)
14	Rmt Lpbk	(RL)
15	Inc Call	(IC)
16	Sig Rate Sel	(SR)
17	Term Timing	(TT)
18	Test Mode	(TM)
19	Sig Ground	(SG)
20	Receive Common	(RC)
21	Spare	
22	Send Data	(SD)
23	Send Timing	(ST)
24	Rec Data	(RD)
25	Req to Send	(RS)
26	Rec Timing	(RT)
27	Clr to Send	(CS)
28	Term in Serv.	(IS)
29	Data Mode	(DM)
30	Term Ready	(TR)
31	Rec Ready	(RR)
32	Sel Standby	(SS)
33	Sig Qual	(SQ)
34	New Sig	(NS)
35	Term Timing	(TT)
36	Stand By Ind	(SB)
37	Send Common	(SC)

RS449—RS232C Adapter & Lead Identification



25 TYPE GAIN AND DELAY MEASURING SETS

CALIBRATION - 25A, 25B AND 25BR

1. Connect power to set.

2. Set the front panel as follows:

CONTROL	SETTING
FREQUENCY	To red mark on meter (approx. 1800 Hz)
RCVR INPUT-ADD DB	0
TRMTR OUTPUT-DBM	0
(25A) RECEIVER MODE	NORMAL
(25B,BR) OFF-NORMAL-REP	NORMAL
TRANSMIT	LINE A or LINE B (Not on 25BR)
(25B,BR) DIAL- MEAS	MEAS 600 or 900
(25A) IMPEDANCE	600 or 900

3. Connect the set back-to-back by patching the LINE A and LINE B jacks together.

4. Allow a warm-up period of at least 20 minutes.

5. Adjust the LEVEL ADJ control to produce an exact 0 indication on the RCVD LEVEL meter.

   Note: If an external oscillator is used, it should be set to deliver a 2-kHz signal and its output level (approximately +3.0 dBm) should be adjusted for exactly 0 on the RCVD LEVEL meter.

6. Set the RCVR INPUT-ADD DB control to +5 and verify that the RCVD LEVEL meter reading is within +0.05 dB of the -5 marker. If it is not, follow the internal calibration procedure for the Rec meter in the BSP.

7. Return the RCVR INPUT-ADD DB control to 0 and switch the ADD MICROSECONDS control to the position that produces an on-scale DELAY meter indication on the 25 B or BR, or the MICROSECONDS meter on the 25A.

8. Use the DELAY ZERO control to adjust the DELAY (or MICROSECONDS) meter indication to 0 (black scale).

   Note: It may be necessary to change the ADD MICROSECONDS switch on position clockwise or one position counterclockwise to make this adjustment.

9. Pull out the ADD MICROSECONDS knob and reengage it with its pointer set to 0.

10. Set the ADD MICROSECONDS knob to the 3500 position and adjust the SENSITIVITY control to produce an indication of 500 on the DELAY (or MICROSECONDS) meter.

11. Reset the ADD MICROSECONDS knob to the 0 position and readjust the DELAY ZERO control to obtain a meter indication of 0.

12. Repeat Steps 10 and 11 until both conditions are met. The set is now calibrated.

    Note: If any of the above conditions cannot be met, it may be necessary to adjust one or more of the internal controls. Since this procedure is somewhat lengthy refer to the BSP when required.

    25A - 103-115-100
    25B, 25BR - 103-115-101

OTHER COMMON CARRIER (OCC) RELATED BSPs

010-520-124	Intercompany Services Coordination Plan (ISC) Responsibilities for Other Common Carrier (OCC) Circuits
471-000-001	Administrative Overview
471-000-005	Plant Administration of Facilities Furnished to Other Common Carriers
471-000-011	Pre-Service Acceptance and Trouble Test Requirements for Facilities Furnished to Other Common Carriers
471-010-005	Completion Activities
471-010-006	Order Status, Control, and Tracking Procedures
471-010-007	Coordinated Conversion
471-010-008	Additional Billing Activities
471-020-001	Post-Installation Activities
471-050-001	OCC - Request Form
471-050-002	Compatibility Checklists
471-100-030	Cable Termination at OCC Terminals
471-210-010	Pre-Service Acceptance and Trouble Test Requirements
471-210-020	Impedance Balance Methodology
471-210-030	Signaling Tests - Methodology and Limits
660-100-011	CTRAP - Categories of Trouble Reports and Classes of Service Measured
660-100-013	CTRAP - Trouble Reports - Type, Disposition, and Cause
660-207-010	Restoration Sequence - Message and Special Service Circuits
660-225-100	Special Service System - General

SWITCHED SERVICE NETWORKS

INDEX - SECTION 6

SWITCHED SERVICES

Switched Services circuits are connected in a common control switching arrangement (CCSA) to provide maximum efficiency for customers requiring nationwide communications for business purposes. The switched service network incorporates the following types of service:

1. Tandem Tie Line Networks
2. Foreign Exchange
3. Long Distance

The switched services network combines and interconnects all of the above services with the result of increased effiency and decreased operational costs for both the customer and the Bell System.

ACCESS LINES - LLP

The line link pulsing equipment (LLP) is used as a switched service access line with multiple extension dialing capabilities. The associated crossbar equipment allows the assignment of a three-digit location code with the remaining four digits used as extension designations. An alternate arrangement consisting of a four-digit location code and three-digit extension numbers is often used. LLP's may be pulsed with either touchtone or dial pulses depending on crossbar wiring. When test dialing from the circuit patch bay or the 17E testboard toward the customer, only the extension digits are dialed. When going through the entire switching procedure from another circuit or from a spare drop, all seven digits must be dialed.

Figure No. 1a shows the equipment needed when a local cable pair is used and Figure No. 1b shows carrier associated arrangements. All LLP's terminate in PBX's at the customer locations. All extensions are then linked to the PBX.

SUBSCRIBER LINE

This type of arrangement is normally used on circuits terminating in a key set or manual switchboard at the customer location. If the circuit utilizes a local cable pair, the equipment in Figure No. 2a will be used. This allows for simplex signalling in conjunction with the amplifiers and terminating set. If the circuit uses a carrier facility, the arrangement in Figure 2b will be used. This, of course, requires the SF signal unit to maintain compatibility with the carrier. Both of these circuit types are used in conjunction with a standard private line type testboard. No. 5 crossbar equipment allows for a circuit of this type to be assigned a single seven-digit number and does not have the capability of direct extension dialing.

Dialing may be done with either touchtone or dial pulses, according to crossbar requirements.

NETWORK TRUNKS

The network trunk is used only between switching offices. Both ends terminate directly in a switching machine. Figure No. 3 indicates the typical central office arrangement. Only multi-frequency (MF) pulses may be used on network trunks. MF and touchtone are not the same type of signalling. Although both pulsing systems utilize multiple frequency tones, they do not use the same type of crossbar equipment and are, therefore, not compatible.

OFF-NETWORK ACCESS LINES

An off-network access line (Figure No. 4) is essentially the same as an LLP, but terminates in a local exchange in the distant city. This type of circuit is used by switched service customers to reach regular DDD numbers. Signalling may be done with dial pulses or touchtone according to specification. LONAL's (local off-net access lines) and ONAL's operate one-way out from the switching machine office.

FIGURE 1A LOCAL ACCESS LINE - LLP - 17E

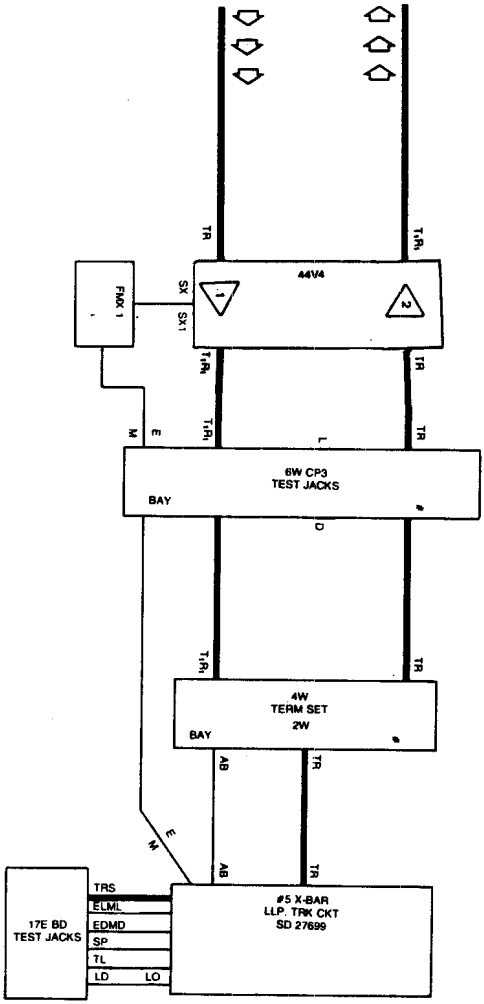


FIGURE 1B LLP - LINE LINK PULSING ACCESS LINE - 17E

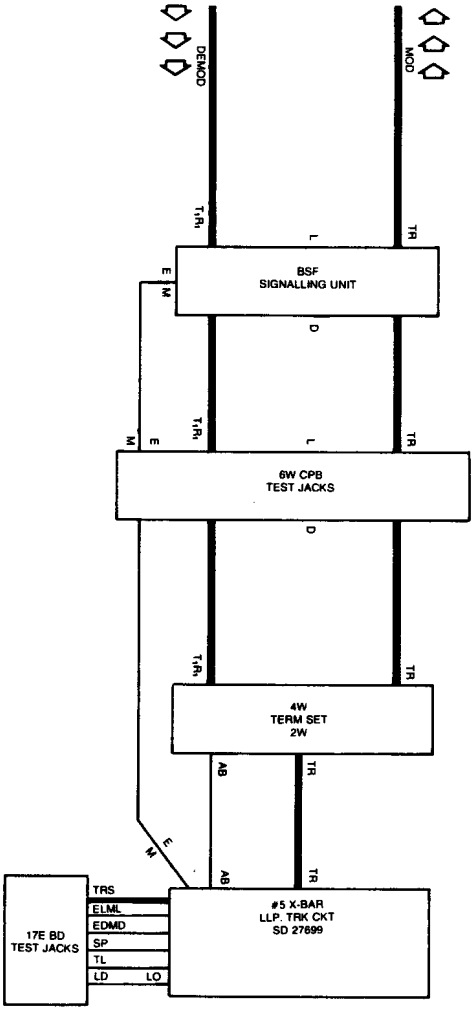


FIGURE 2A LOCAL ACCESS LINE - MANUAL - PLB

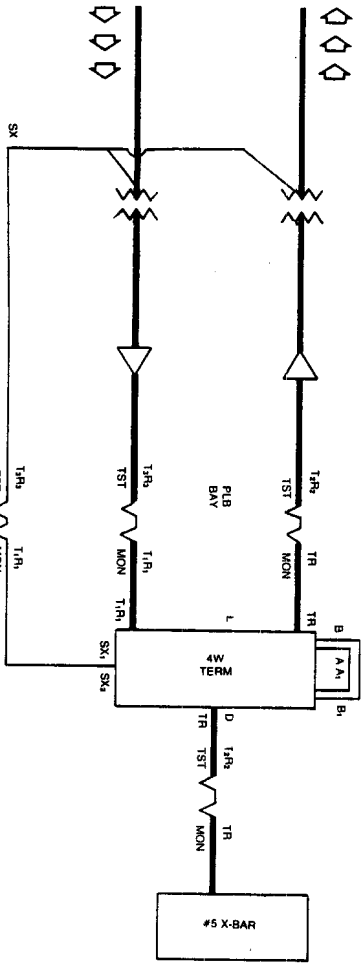


FIGURE 2B MANUAL ACCESS LINE - PLB

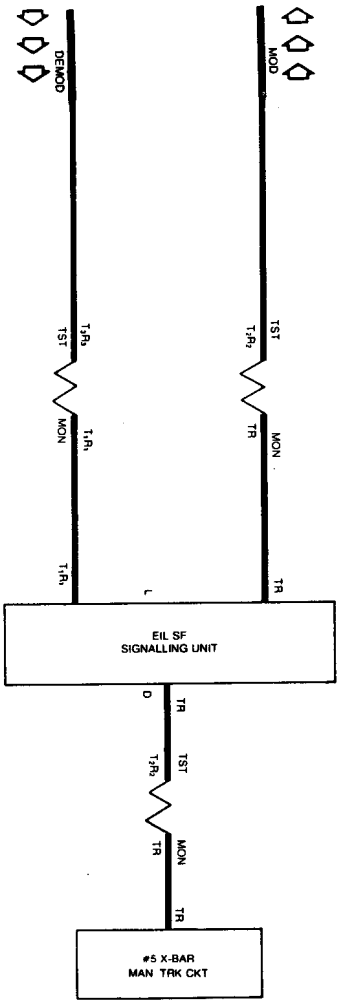


FIGURE 3 NETWORK TRUNK - 17E

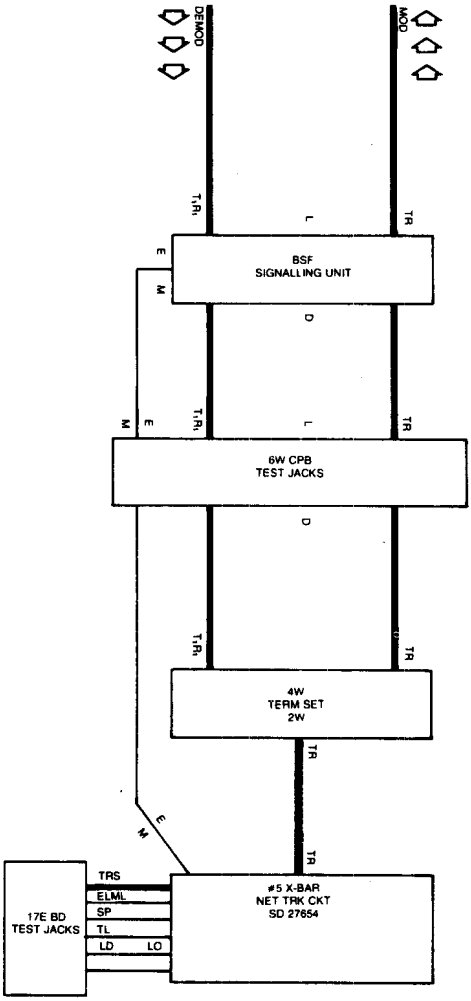
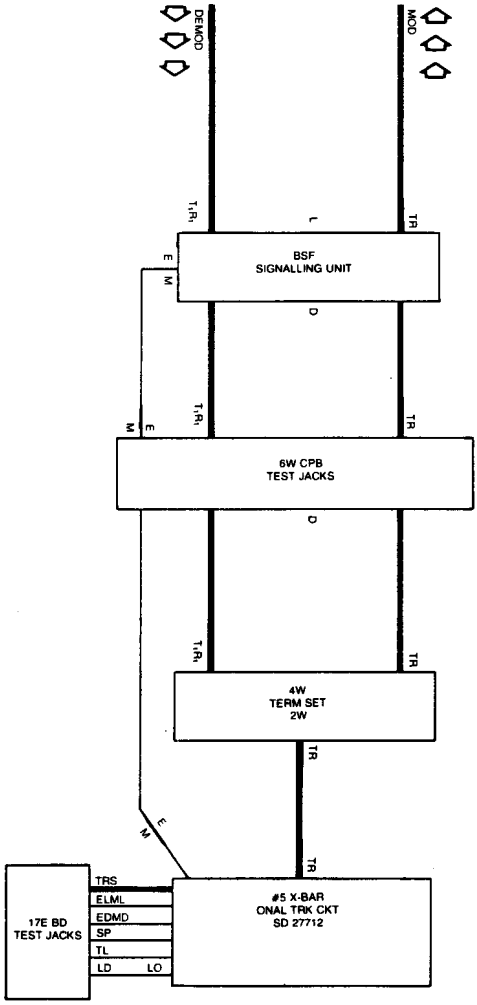


FIGURE 4 ONAL - OFF NETWORK ACCESS LINE - 17E



CIRCUIT NOTES

1. A split echo suppressor is required on:

   a. All network trunks between Class SS-1 offices, between Class SS-2 offices, and between Class SS-1 and SS-2 offices.

   b. All other network trunks whose computed VNL exceeds 2.5dB.

   c. All network trunks over 2500 miles in length.

   d. All network trunks which can be connected in tandem with other echo suppressor-equipped circuits.

2. A fixed echo suprressor is required on network trunks between Class SS-3 offices whose computed VNL does not exceed 2.5dB, or whose overall mileage is less then 2500 miles.

3. Use SD27654-01 in a Phase I or Phase II centrex office. SD27655 is used in a Phase III centrex office where dial transfer is required.

4. Use built-in signalling or SF signalling if carrier is used.

5. The 600-ohm PBX impedance concept should be used on all new PBX's (except No. 101 ESS and Centrex CO) per E.L. 246. Also, conversion of existing PBX's from 900-ohm to 600-ohm is recommended.

6. SX resistance is the simplex-looped resistance which is equal to one-half the loop resistance. Loop resistance is the resistance of a pair of wires from tip to ring with one end shorted.

7. LONAL's and ONAL's operate one-way out from the switching machine office.

8. The Auxiliary Line Circuit, SD27516-01, is modified for tone-off (toward station) operation per WA-21271 drawing.

ENGINEERING ABBREVIATIONS

AIOD	- Automatic Identification of Outward Dialing
CCSA	- Common Control Switching Arrangement
CPB	- Circuit Patch Bay
CPE	- Customer-Provided Equipment
CO	- Central Office
CXR	- Carrier Facility
DAS	- Data Auxiliary Set
ES	- Echo Suppressor
ESC	- Echo Suppressor Control Lead
FVNL	- Facility Via Net Loss
VNL	- Via Net Loss
CX	- Loop Resistance (See Note 6)
ONAL	- Off-Net Access Line. This circuit allows calls to be completed from the CCSA Network to the DDD Network. (FX)
SF	- Single Frequency Signal Unit
SS-1, SS-2, SS-3	- Classes of Switched Services Network Offices
SX	- Simplex Resistance (See Note 6)
TP2	- 2dB Test Pad which is inserted into a circuit when it is connected to the Testboard
WATS	- Wide-Area Telephone Service
2LC/4LC	- Two-Wire or Four-Wire Local Channel
25X/45X	- Two-Wire or Four-Wire No. 5 Crossbar Switching Machine

BELL SYSTEM PRACTICES

EQUIPMENT TESTS

069-020-801	Apparatus - Method of Blocking and Insulating Contacts.
024-170-105	Telephone Repeater Terminal Unit 7300A, 7303A (ALTEC).
024-170-505	Telephone Repeater Terminal Unit 7300A, 7303A (ALTEC).
179-316-501	E1B, E2B, E3B S.F. Signalling Circuits - Out-of-Service Tests using Portable Test Stand SD96533.01.
330-300-503	Exchange Area Cables - Completion Tests.
332-015-100	Simplified Theory of Sing Point Tests.
332-015-300	Singing Point Tests.
332-104-100	V4 Telephone Repeaters.
332-104-101	V4 Telephone Repeater with 227-Type Amplifier.
332-104-102	24 V4 B Telephone Repeater.
332-104-500	V4 Telephone Repeaters - Initial Lineup.
332-104-501	V4 Telephone Repeaters with 227 Amplifier - Initial Lineup.
332-410-100	1A Echo Suppressor.
332-410-301	1A Echo Suppressor Operational Test from Circuit Terminals.
332-410-500	1A Echo Suppressor and Disabler Adjustments.
332-412-101	3A Echo Suppressor - General.
332-412-300	3A Echo Suppressor - Circuit Order and Maintenance Tests.
332-412-500	3A Echo Suppressor - Maintenance
332-412-501	3A Echo Suppressor - Line-up Detail.
332-810-100	Type 1C, 1D, 1F - Four-Wire Term Set.
540-105-301	Equipment and Circuits - Method of taking Out-of-Service 700 Series PBX's.
540-120-503	Selectors - Pulsing Tests - Using Test Set SD31481-01 700 Series PBX.
540-120-505	Selectors - B Relay Timing Tests - 700 Series PBX.

540-120-507	Selectors - Rotary and C Relay Timing Tests using Test Set SD09418-01 - 700 Series PBX.
540-134-701	Selectors, Connectors, and Selector Connectors - Correction of Pulsing Failures using Test Set SD31481-01 700 Series PBX.
540-143-504	Connectors and Selector - Connectors Pulsing Tests using Test Set SD31481-01 - 700 Series PBX.
540-143-507	Connectors and Selector - Connectors B, C, and E Relay Timing Tests using Test Set SD90418-01.
540-301-501	Tie Trunk Circuit SD65718-01 and SD66799-01 using Test Set SD31667-01 Pulse Repeating or Test Set SD31481-01, Step-by-Step and Crossbar-Type PBX.
634-020-500	Insulation Resistance Tests - Paper Insulated Cables.

17E OR 19A TESTBOARDS

666-200-100	17E Testboard General Description.
666-200-300	17E Testboard Measurement and Adjustment of Pads for the Transmission Measuring Circuit.
666-200-500	17E Testboard Measurement and Adjustment of Office Losses.
666-200-501	17E Testboard Operations Tests.
666-201-100	19A Testboard General Description.
666-201-300	19A Testboard Measurement and Adjustment of Pads for the Transmission Measuring Circuit.
666-201-500	19A Testboard Operational Tests.

TRANSMISSION TESTS

309-200-502	Transmission Testing Methods at PBX's.
309-200-503	Transmission Testing Methods at Subscriber Locations.
309-200-550	Balance Testing Methods in Two-Wire No. 5 Crossbar Offices.
310-315-100	Foreign Exchange Circuits (ONAL's).
331-850-505	Transmission Testing - Noise Measurements on Two-Wire Subscriber Loops.
331-855-500	Circuit Order and Trunk Order Transmission Tests - PBX Central Office Trunks, Off-Premise Station Lines and Tie Trunks having Access to the DDD Network.
331-855-501	Transmission Testing - 1000 Cycle and Noise Measurements PBX Central Office Trunks, Off-Premise Station Lines and Tie Trunks.

SWITCHED SERVICES - GENERAL

309-200-000	Switched Service Networks using Central Office Switching Machines - General.
309-200-001	General Procedures and Responsibilities - Trouble Reporting Procedures.
309-200-002	Trouble Ticket Form E6944.
309-200-003	Trouble Reports - Classification and Codes.
309-200-004	Preparation and use of Switched Services History Cards Forms E5122 and E5123.
309-200-005	Trouble Analysis Procedures.
309-200-007	Network Numbers and Office Numbers.
309-200-100	Description - General.
309-204-100	Description of General Electric Network.
309-204-300	General Electric Service Maintenance.
309-285-501	Office Wiring and Equipment - Two Wire Switching Offices Measuring and Adjustment of 1 KHz.
309-200-300	Service Maintenance.
309-200-500	Transmission Testing Methods Four-Wire No. 5 Crossbar.
309-200-501	Transmission Testing Methods Two-Wire No. 5 Crossbar.
309-300-XXX	Enhanced Private Switched Communications Service (EPSCS).
309-400-XXX	Electronic Tandem Network (ETN).
309-500-XXX	Tandem Tie Trunk Network (TTTN).

TEST EQUIPMENT

100-232-101	Pulsing Test Set (J34717-A) Description and Use.
100-263-501	2B Signalling Test Set (J64730-B) Procedures.
103-106-105	2D, 2E, Singing Point Test Set (94002) Description.
103-202-100	2AB Auxiliary Transmission Measuring Set (94002-AB).
103-204-100	Northeast Electronics TTS4 Series Transmission Measuring Set.
103-221-100	21A Transmission Measuring Set (J94021-A) Description.
103-221-101	21A Transmission Measuring Set - Calibration and Checking Procedures.
103-345-100	201B Noise Generator - Description, Operation and Maintenance.
103-611-100	3A Noise Measuring Set (J94003-A).
103-620-100	6A Impulse Counter (J94006-A).

PULSING TESTS

333-121-500	Overall Dial Pulsing Test - General
333-122-501	Application of the 2B or 2B-1 Test Sets and Pulse-Repeating Adaptor.
333-122-605	Overall-Dialing Trunk-Pulsing Test for Two-Way Trunk Test Jack.
333-123-500	Dial-Pulsing Tests on Intertoll and Toll-Connecting Trunks.
333-125-500	Dialing Pulsing Test on FX and WATS Circuits.
333-126-500	Pulsing Tests on Dial Tie Trunks.
333-127-500	Pulsing Tests on Switched Services Networks Access Lines.

GLOSSARY

ACCESS LINES

a. A circuit, or circuits, which connects a customer location directly to a switching center.

b. These circuits which connect main PBX's to Class SS-1, SS-2, or SS-3 offices in a hierarchy plan to to inner to middle ring offices in a hub plan. These lines are normally four-wire facilities and terminate on a two-wire PBX or No. 5 CENTREX office. They are designed to operate on a VNL basis.

ALTERNATE ROUTING (ROUTE ADVANCE)

An arrangement that permits routing from one trunk group to subsequent trunk groups when all trunks of the preceding group are busy. Automatic assignment of alternate communication path when direct or primary path is busy.

AMA (AUTOMATIC MESSAGE ACCOUNTING)

AMA, as used on switched networks is a sample of messages taken at the switching center. This mechanized record usually samples every fifth call (20 percent sample) that is completed and provides the following information: The originating station or access line group (calling number) terminating (called) number, connect time, disconnect time, and date.

ANI (AUTOMATIC NUMBER IDENTIFICATION)

Equipment permitting fully automatic recording of calling number.

ASSISTANCE CALL

A call that the user would normally dial directly but he dials an operator for assistance.

ATB (ALL TRUNKS BUSY)

a. All possible routes a call could travel are in use.

b. Register used on non-graded tie trunk groups at PBX locations to register the number of times all trunks in the group are busy.

ATTENDANT TRUNK

A trunk provided between the PBX switching equipment and the operator used to connect incoming switched service calls to the operator, for assistance or relay to the public network.

AVERAGE HOLDING TIME

The average length of time a service is used to handle a single call. This includes both conversation time and operating time.

BUSY HOUR LOAD

The traffic load carried on a communication facility during the busiest hour of the day. Usually expressed in 100-second units of time; i.e., 456 busy hour CCS, which is interpreted to be 45600 seconds of usage.

BY (BUSY)

Circuits or other telephone equipment that is in use for voice or other message. Used primarily in Traffic Department as abbreviation for busy.

CAMA (CENTRALIZED AUTOMATIC MESSAGE ACCOUNTING)

Same as AMA except that an operator in a central location requests and records the number of the calling subscriber.

CAMP-ON

A form of priority in which the waiting call is connected to the first idle trunk in a busy trunk group. Used in military networks only.

CCS

One CCS is the equivalent of one call of 100 seconds duration, or three calls for 33.3 seconds each, etc. Hundred call seconds or CCS is the unit of time used with Telephone Traffic engineering schedules to determine the requirements on our telephone dialing system. It can be easily used in decimal form for study and billing computations. It is the unit of measure that is used to liquidate switched service expense to the user.

CCSA (COMMON CONTROL SWITCHING ARRANGEMENT)

The type of service provided by a switched service network. Defined in tariff Federal Communications Commission No. 135.

CENTREX

A type of private branch exchange in which incoming calls can be dialed direct to any station without an operator's assistance. Outgoing and intercom calls are dialed direct by the extension user.

There are two common types of Centrex arrangements.

a. Centrex CO - Switching equipment on Telephone Company premises.

b. Centrex CU - Switching equipment on customer's premises.

CLASS OF SERVICE

A designation for the privileges that a users telephone line may be assigned. Also provides for segregation of customers served by common switching equipment.

CLASS OF SERVICE PEG COUNT

Registers the number of completed marker seizures by a specific network originating calls.

COMPLETING MARKER PEG COUNT

Register which indicates the number of times any attempt is handled by the machine, in, out, tandem, or interoffice.

CONCENTRATOR

A unit in a switching center which provides for concentration of access and subscriber lines. It requires a remote concentrator for oepration. See REMOTE CONCENTRATOR.

CONCENTRATOR TRUNK

The portion of an access line or subscriber line between a concentrator and a remote concentrator.

CONCENTRATOR TRUNK EXTENSION

The portion of an access line or subscriber line between the remote concentrator and the PBX or station.

CONNECT TIME

The time at which a call is actually established and conversation may begin.

CONTROLLED ECHO SUPPRESSOR (CES)

Refers to the operation of the suprressor on a network trunk. Split echo suppressors are always provided on trunks between four-wire machines. They are equipped for both tone disabling and mark enabling. During the idle condition, the suppressors are not in the circuit. When the trunk is seized and the suppression is required, a signal from the four-wire machines activates the suppressor. See also FIXED ECHO SUPPRESSOR (FES).

CROSSBAR SYSTEM

Dial-switching system using mechanisms called crossbar switches. These consist of contact spring units operated in coordination by horizontal and vertical section.

DATA-PHONE SERVICE

A service which provides for the interchange of data signals between business machines over the same circuits used for voice communications.

DATA SETS

Signal converters and interfaces between a business (data) machine and communication facilities. Usually a modulator-demodulator (MODEM).

DIAL TONE MARKER PEG COUNT

Register which indicates the number of times a dial tone marker is seized.

DIRECT DISTANCE DIALING (DDD)

A service whereby a telephone user can dial subscribers outside his local area without the assistance of an operator.

DIRECT DISTANCE LEASED LINES (DDLL)

Same as DDD except service is over-leased lines rather than public toll service.

DIRECT IN-DIALING (DID)

Direct dialing by the calling PBX station over the message network. This permits extensions to dial outside calls without going through the switchboard.

DIAL USE FOUR-WIRE SUBSCRIBER LINES

Lines designed for use either as subscriber lines or access lines. The circuits generally terminate in a two-wire PBX for connection to two-wire stations. The PBX and terminating set are bypassed when the circuit is used for four-wire voice or data. A fixed nonsplit echo suppressor will always be required when the PBX uses the line.

EXCHANGE

A unit of a telephone company for the administration of communication service in a specified area. It consists of one or more central offices together with the associated plant used in furnishing communication service in that area.

FACSIMILE TRANSMISSION (FAX)

Provides transmission of handwritten messages or sketches by means of a private line or when associated with a DATA-Phone data set (or an acoustic coupler), over the regular telephone networks or the CCSA-SSN.

FIXED ECHO SUPPRESSOR (FES)

One that is enabled permanently. It may be either a split or a non-split suppressor.

FOREIGN EXCHANGE (FX)

A local telephone service in a commonly originating at a telephone exchange in another community, e.g., a line from a telephone station or switchboard in city "A" used for calls to or from any telephone station in a local telephone company service area in distant city "B".

HIERARCHY SWITCHING NETWORK

An arrangement similar to the DDD network. It is arranged with classes of offices and has subscriber lines, access lines, and network trunks.

HUB SWITCHING NETWORK

An arrangement whereby four-wire switching offices "home" on each other for survivability reasons. There are no classes of offices similar to those on the DDD network, and multiple trunk routes are provided from each four-wire office.

INCOMING MATCHING LOSS

Failure to complete a terminating incoming call.

INCOMING REGISTER GROUP BUSY TIME

Scores once per second while all incoming registers are busy.

INTERCEPT

Routing of a call to an operator or answering machine, when placed to a disconnected or non-existent telephone number.

INTERSTATE

Between states.

KEY SET

A station served by a station line directly off of an SS-2 or SS-3 office. Usually a push-button telephone wherein the buttons are used for intercom, holding, signalling and/or pick-up of additional telephone lines.

LAMA (LOCAL AUTOMATIC MESSAGE ACCOUNTING)

Same as AMA except that all pertinent data is recorded fully automatically in the local central office.

LINE

An electrical conductor extending between user stations and central offices, or between a user station and a manual or dial PBX, whether they be in the same or different communities.

LLP (LINE LINK PULSING EQUIPMENT)

Two-way trunk relay equipment used to terminate an access line at the two-wire switching center and arranged to out pulse digits on completing calls over access lines to dial PBX's. Appears on line link frame only.

LINE LOAD CONTROL

A feature provided to permit control of access to a switching machine during heavy traffic periods.

LOCAL ATTENDANT TRUNK

A trunk between the PBX switching equipment and the telephone switchboard used for operator assistance.

LOMAR (LOCAL MANUAL ATTEMPT RECORDING)

A system to be used in small and medium size PBX's to record the calling party extension number for a call dialed on a CCSA*SSN.

LONAL

A local off-network access line.

LTB (LAST TRUNK BUSY)

Register used on graded tie trunk groups at PBX locations to score the number of times the last trunk in the selection sequence was seized for use.

LUNK

A combined line and trunk circuit which may be used on a four-wire access line at a four-wire No. 5XB office so that dialing toward a SXS main PBX may be accomplished. Performs same functions as LLP but has appearances on line link and trunk link frames of switching system.

MACHINE PERFORMANCE

Index of a switching machine used in conjunction with customer service and routine testing in determining the switched service network monthly results.

MANUAL TELEPHONE SYSTEM

A telephone system in which telephone connections between users are established by telephone operators. See MANUAL PBX.

MAIN PBX

Any PBX which has direct circuits to an SS-3 or higher class office.

METERING

Meters or registers used to measure usage for purposes of billing or volume studies.

NIGHT LINES

Permits incoming calls on central office trunks to ring at specific stations after the switchboard is closed.

NETWORK IN-DIALING (NID)

Direct dialing to a PBX station over the SSN.

NSE AND NAS

Network Service Engineer and Network Accounting Supervisor.

NETWORK TRUNK

A circuit between Class SS-3 or higher switching offices in the hierarchy plan or between any two offices in the hub plan.

NNX CODE

The first three (3) digits of a seven (7) digit telephone number.

n = any number 2 through 9
x = any number 0 through 9

NPA (NUMBERING PLAN AREA*AREA CODE)

First three (3) digits of a ten (10) digit telephone number.

NUMBERING PLAN

The unique scheme of uniform seven-digit numbers assigned to customer's location on a switched service network. For all on-network calls this will consits of any access digit where required, an NNX location code and a four-digit station number.

OFF-NET TO ON-NET CALLS

Terms used to reference switched service calls from a public telephone company service area that are relayed by a customer operator to the SSN.

ON-NET TO OFF-NET CALLS

Terms used to reference calls from the SSN that are relayed by a customer operator to a public telephone service area.

ONAL (OFF-NETWORK ACCESS LINE)

A circuit which enables the customer to complete calls to and from points on the DDD network.

OPX (OFF-PREMISE EXTENSION)

A customer extension that is connected through a main switchboard to a location at a different address.

ORIGINATING MATCHING LOSS

Scored when marker fails to obtain channel on second attempt between line equipment and trunks.

PAX (PRIVATE AUTOMATIC EXCHANGE)

An automatic telephone switching system that interconnects telephone stations but cannot connect to the public network or to a SSN.

PBX (PRIVATE BRANCH EXCHANGE)
PABX (PRIVATE AUTOMATIC BRANCH EXCHANGE)

A switching system, located on customer premises, which connects telephone station over a common group of trunks to the public network, with each other, and/or a SSN switching center. A PBX can switch incoming calls, outgoing calls, and interconnect office extensions.

PBX COMPLEX

An arrangement of PBX's in an area consisting of a main PBX, and satellite PBX's. The main PBX will normally be the switching point for access lines connecting the complex to a Class SS-3 or higher office in a hierarchy plan or to a four-wire office in a hub plan.

PBX TIE TRUNK

A direct circuit between two PBX's.

PEG COUNT (PC)

Term used in recording the number of times a circuit or piece of apparatus is used in a given period.

PCO (PEG COUNT OVERFLOW)

Scoring a register whenever an attempt was made for a circuit group or certain equipment units and such attempt was not completed initially.

PERCENT DIAL TONE SPEED OVER THREE SECONDS

The total number of test attempts divided into number of test attempts where dial tone was delayed more than three seconds in the busy hour.

PNM

Plant network manager responsible for network performance.

PSC

Plant service center. The local plant which usually receives DDD trouble reports from customers.

REMOTE CONCENTRATOR

A unit located at the customer premises or in an intermediate location for concentration of access and subscriber lines.

ROUTE ADVANCE

See ALTERNATE ROUTING

ROTARY HUNT GROUP

Term used to indicate the wiring of groups of telephone lines so that when a call is placed to the listed number of the group, the call will consecutively "hunt" through the group to find an idle line. In "step-by-step" equipment, groups may consist of two to ten lines.

SATELLITE DIAL PBX (PABX)

A dial PBX which home a main PBX and has the listed number of the PBX on which it homes. Operator services are provided from the main PBX.

SERVICE ORDER

A sales issued order to provide service for a customer under the tariff of that company.

SPECIAL GRADE NETWORK TRUNK

A trunk specially treated to give it transmission characteristics different than those found in the DDD network for the purpose of handling special services usually conditioned to give it transmission characteristics suitable for handling data grade services.

STATION

An installed telephone or other communications device that has been given a telephone number and is the instrument through which service is furnished. The first station is called the main or primary station. Additional stations sharing the same service (line) are called bridged or extension stations.

STC (SERVING TEST CENTER)

The plant office responsible for service to the local customer location on a private line service.

STEP-BY-STEP

Automatic dial system in which calls go through the automatic equipment by a succession of switches which move a step at a time, each step being made in response to the dialing of a number or letter.

SUBSET

See DATA SETS.

SWITCHED NETWORK (PUBLIC MESSAGE NETWORK)

An intricate nationwide of diversified channels and switching equipment that automatically routes communications between the calling and the called person on data equipment.

SWITCH ROOM (TELEPHONE EQUIPMENT ROOM)

That part of the building which houses the telephone switching equipment.

SWITCHED SERVICES NETWORK

A large user service employing Central Office switching machines to switch private lines. Circuits are provided for the exclusive use of a customer whereas the switching machines are shared with other services and other Switched Service customers. The typical network will be switched from one or more swtiching offices, each serving a group of a customer locations. Private line circuits interconnecting the switching offices of a typical network are called trunks.

SWITCHED SERVICES NETWORK - OFFICES

(Classes SS-1, SS-2, SS-3)
Switching offices used in the hierarchy plan and normally located on telephone company premises. The central office equipment used for the services will sometimes be an adjunct to existing equipment. Class SS-1 and SS-2 offices should always be four-wire switching machines. Class SS-3 offices may be either two-wire or four-wire machines but should be four-wire, whenever possible, for transmission reasons.

SWITCHED SERVICES NETWORK OFFICES

(Inner Ring, Middle Ring)
Switching offices used in the hub plan and normally located on telephone company premises. They are always four-wire switching.

TERMINATING PRIORITY

A feature which advances a call to an assistance operator if it encounters an all trunk busy or called line busy conditions.

TIE LINE OR TIE TRUNK

Tie lines providing two-way communications between two PBX's; may appear on a jack on a switchboard or key on a console as well as in any associated dial equipment; or may be only in one or the other. They are used when there is a large volume of traffic between certain specified locations.

a. STATION TO TRUNK TIE LINE
A line that connects a station from one PBX system to terminate as a trunk in another PBX system.

b. DIAL REPEATING TIE LINE
A tie line that connects two dial systems together, and is arranged to repeat dial pulses.

TIME SHARING COMPUTER

A problem solving type of computer system which is usually accessed through remote consoles (teletypewriters), and can simultaneously service several users.

TOLL CALL

Any call to a destination outside the local service area of the calling party. (Not over SSN).

TOLL DIVERSION

An arrangement made to the local telephone switching equipment so that all attempts by the user to place toll calls will be deiverted to the PBX operator.

TONE DIALING

An equipment arrangement used to disable split echo suppressors for the transmission of data. The suppressor is removed from the circuit "electrically" by means of tone transmitted from the called data set.

TNSS

Traffic Network Service Supervisor.

TRIBUTARY DIAL PBX (PABX)

A dial PBX which homes on a main PBX for SSN service but has its own listed number, and provides its own operator services.

TRIBUTARY MANUAL PBX

A manual PBX which homes on a main PBX for SSN service but has its own listed number, and provides its own operator services.

TRUNK

A channel or a line between telephone company central offices (switching centers) or from the central office to a user's private branch exchange. (Channel between SSN switching centers.)

TUR (TRAFFIC USAGE RECORDER)

A register which indicates in CCS (hundred call seconds) the amount of time a circuit, group of circuits, or piece of equipment is in use.

UNIVERSAL SERVICE

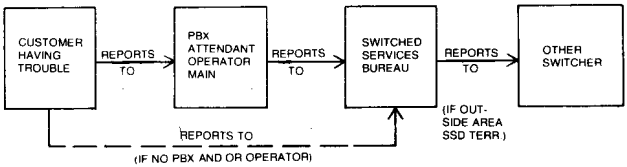
Refers to the interconnection of a switched services netowkr with the DDD networks.

VOICE GRADE NETWORK TRUNK

A trunk designed to the DDD network standards.

TROUBLE REPORTS

Although a switched services network provides a customer with a form of private line services, its requirements for receiving and handling trouble reports are different. A user gains access to the network and completes his calls by dialing, and the switching machines can automatically alternate route the call. As a result, there is no rapid way to determine the exact circuits that were used on a given call. For this type of service, it is imperative that the trouble reports be directed to the location that is best equipped to handle and analyze them. Procedure is as follows:



The form providing the basic information needed to properly analyze trouble reports and measure service is the Trouble Ticket Form E-6944. A ticket prepared in a particular situation will include only those entries which are applicable. Additional information in connection with details of trouble found and the chronological record of the investigation of trouble found or other action taken must be entered on the back of the ticket. It is essential to have sufficient detail for future analysis or investigations if required. Detailed instructions may be found in BSP 660-225-104 (also see page 1.26).

SWITCHED SERVICE NETWORK

PLANT RESULTS MEASUREMENT PLAN

Analysis of switched services is achieved through the results as indicated monthly in the Plant Results Measurement Plan. Three areas are covered in the plan: (1) customer service as indicated by the information on Trouble Ticket Form E-6944, (2) switching machine performance based on the switcher's index each month, and (3) transmission performance based on routine testing. Each of these areas is weighted in order to arrive at a composite numerical index for each Switched Service Bureau.

17E TESTBOARD AND CIRCUIT PATCH BAY WIRING AND POTENTIALS

SIG LINE	TIP	EL	OPEN
	RING	ML	GRND
SIG DROP	TIP	ED	-48VDC
	RING	MD	GRND (IDLE) -48VDC (BUSY)

CIRCUIT PATCH BAY

TEST	2 TIP	X	OPEN
	RING	X	GRND
	SLEEVE	LO	-48VDC
	1 TIP	T	GRND
	RING	R	-48VDC
	SLEEVE	S	2000 OHMS TO GRND
SIGNAL	L TIP	EL	-48VDC
	RING	ML	GRND
	SLEEVE	SP	-48VDC
	D TIP	ED	-48VDC
	RING	MD	GRND
	SLEEVE	X	OPEN

17E TESTBOARD (IDLE CONDITION)