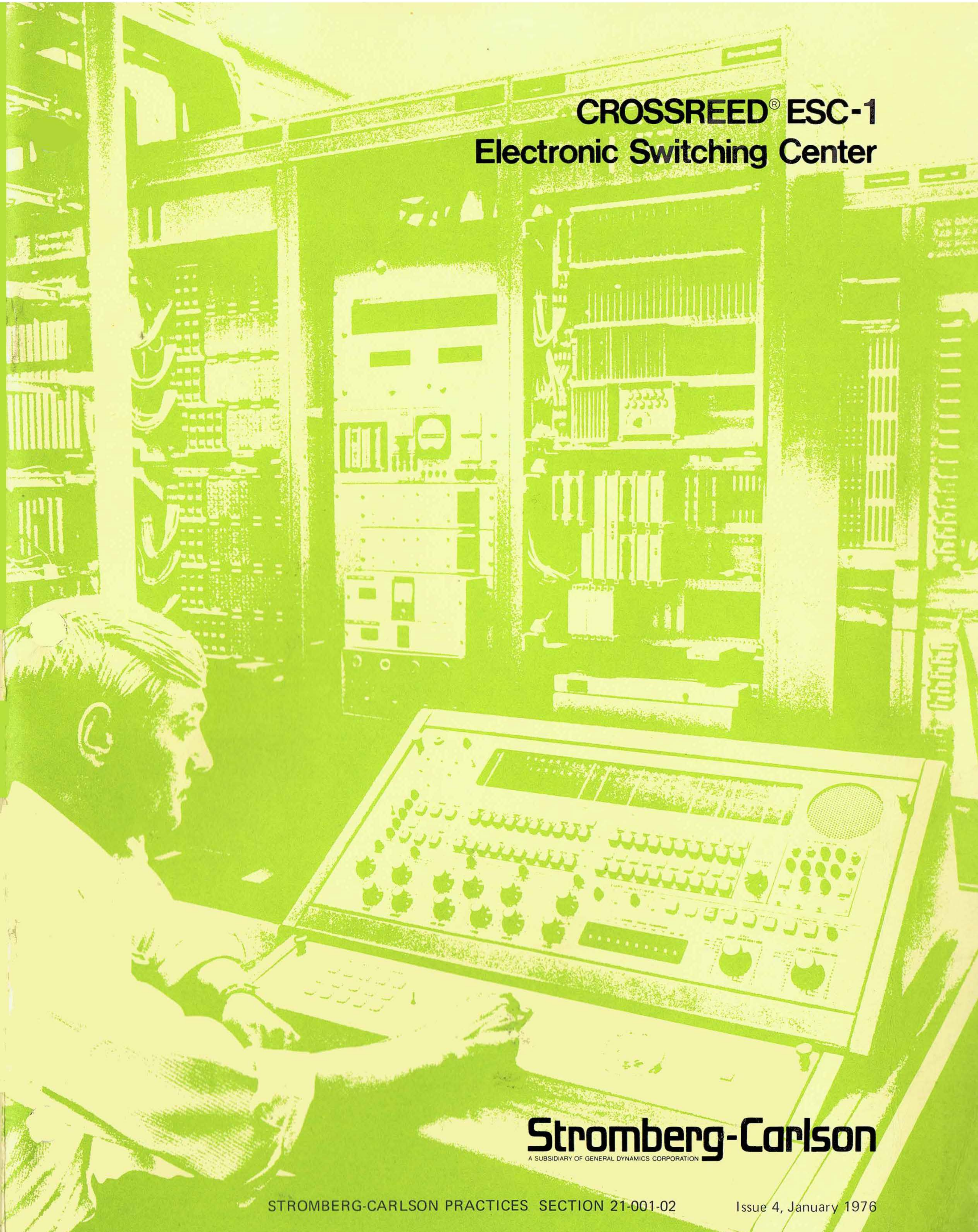
CROSSREED® ESC-1
Electronic Switching Center



Stromberg-Carlson
A SUBSIDIARY OF GENERAL DYNAMICS CORPORATION

STROMBERG-CARLSON PRACTICES SECTION 21-001-02 Issue 4, January 1976

CROSSREED® ESC-1
ELECTRONIC SWITCHING CENTER

GENERAL DESCRIPTION

CONTENTS

ILLUSTRATIONS

ILLUSTRATIONS (Cont)

1. INTRODUCTION

1.01 This section provides a general description of the STROMBERG-CARLSON® CROSSREED ESC-1. It also describes the equipment and the technical characteristics and includes operational descriptions of certain basic types of calls.

1.02 This section is reissued to incorporate changes to the trunk link network and the trunk cabinet, and to update information on operating limits of subscriber lines. Other information is revised and updated. Significant changes and additions are indicated by bars in the margins. There are 14 new illustrations and others are revised.

2. RELATED INFORMATION

2.01 Section 21-001-00 provides a complete listing of the publications applicable to the CROSS-REED ESC-1.

2.02 A Sales and Instructional Literature Index, which lists the latest publications available from Stromberg-Carlson Corporation, can be obtained from your Stromberg-Carlson sales representative or from Publications Services, Stromberg-Carlson Corporation, 100 Carlson Road, Rochester, New York 14603.

3. PURPOSE AND USE

3.01 The S-C electronic switching center (ESC) is a common-control type switching system which can be used as a dial telephone office for an MDO, CDO, or PABX with or without CU CENTREX features.

3.02 The ESC provides all of the basic functions and facilities provided in existing switching systems of this type and has the capacity to accommodate additional features which may be required in the near future. The modular design of the equipment provides for the maximum use of automatic equipment during manufacturing and permits flexibility in packaging to economically customize systems to special arrangements.

3.03 The ESC is designed to economically serve central offices ranging in size from about 1000 lines to a maximum of 10,000 lines and a maximum of 15,000 directory numbers. The trunk capacity is not rigidly fixed, but depends upon a compromise between a maximum of 240 registers (lines and incoming trunks), 3000 TLN input ports, and 3000 TLN output ports. In a standard system configuration serving a 10,000-line central office, the ESC will accommodate trunks in the following manner:

a. Up to 1800 outgoing trunks, arranged in up to 100 groups.

b. Up to 1800 incoming trunks in any quantity of groups when the average calling rate of lines is 2.7 hundred call-seconds (CCS) per line.

c. Up to 1500 incoming trunks in any quantity of groups when the average calling rate of lines is 3.6 CCS per line.

d. Up to 600 incoming trunks in any quantity of groups when the average calling rate of lines is 5.4 CCS per line.

See paragraph 4.05 for relationship between CCS per line and line unit size.

4. TRAFFIC CAPACITY

4.01 The call processing capacity of the system is determined primarily by the capacity of the common control to establish call paths through the trunk link network (TLN). The common control is designed to process 23,940 busy-hour calls through the TLN. The capacity is conservatively based on a common control occupancy of approximately 65 percent. In other words, the common control is called upon to operate only 65 percent of the total available time when handling a full-rated load. The remainder of the processing capacity allows a generous margin for false traffic and traffic peaking effects in excess of the busy-hour rated load level.

4.02 The traffic carrying capacity of the trunk link network is 58,320 CCS with an internal matching loss (IML) of 1 percent or less.

4.03 The ESC can be used to switch a considerable amount of tandem traffic in addition to the traffic generated by its full complement of 10,000 subscriber lines. Both the TLN and the common control are designed to accommodate additional tandem trunk traffic, up to the call processing and network traffic capacities just stated.

4.04 The objectives used in the design of the switching networks allow the following IMLs:

CONNECTION	*IML*
Line-to-trunk	1% or less
Line-to-line	2% or less
Trunk-to-line	2% or less

4.05 The lines are arranged in line units (LUs). The capacity of 1 LU is 2700 CCS for originating and terminating traffic. One LU, when fully equipped, can serve 1000, 750, or 500 lines depending upon the average calling rate of the lines as follows:

1000 lines at 2.7 CCS per line,
750 lines at 3.6 CCS per line, and
500 lines at 5.4 CCS per line.

Higher calling rates can be obtained by reducing the number of lines.

4.06 One ESC unit can be equipped with a maximum of 20 LUs serving up to a maximum total of 10,000 lines.

PART I. EQUIPMENT DESCRIPTION

5. GENERAL

5.01 The assembly of the equipment is modular and so arranged that additional features and capacity can be obtained by the addition of plug-in modules and/or printed wiring board assemblies (PWBAs). Basically, all equipment, except for the maintenance test console and the fault recorder teletype (TTY) machine, is mounted in equipment cabinets.

5.02 The cabinets (fig. 1) are provided with swing-out type gates on which the modules and PWBAs are mounted. This provides a compact design and yet makes everything easily accessible for testing and maintenance. Integrated circuits and other semiconductor devices together with S-C CROSSREED switches are used throughout the system for increased system reliability.

6. EQUIPMENT CABINETS

6.01 The equipment cabinets form a double-sided housing 95 inches (241.3 cm) high, 30-1/2 inches (77.4 cm) wide, and 22 inches (55.9 cm) deep, which is open on both sides. Removable double doors can be added for security.

6.02 Each side of a cabinet is normally equipped with supervisory and fuse panels and can be arranged for mounting other panel assemblies, up to six swing-out type gates, or combinations of panels and gates. Fuse alarm indicator lamps are mounted at the top of each cabinet, front and rear, so that an alarm indication for the cabinet is visible from the aisle.

6.03 Gates, with hinge pins on the left-hand side, swing out to provide access to connector wiring for PWBAs and modules. Either one full-length standard control gate or two full-length low-profile gates (one inner and one outer) can be mounted on each side of a cabinet. Alternately, three shorter control gates or six shorter low-profile gates (three inner and three outer) can be mounted on each side of a cabinet. The shorter gates may be either bolted together vertically or allowed to swing separately.

6.04 Several of the basic cabinets available for use in the ESC are listed below. Information pertaining to the equipment furnished in these cabinets is provided in paragraph 14, Equipment Capacity.

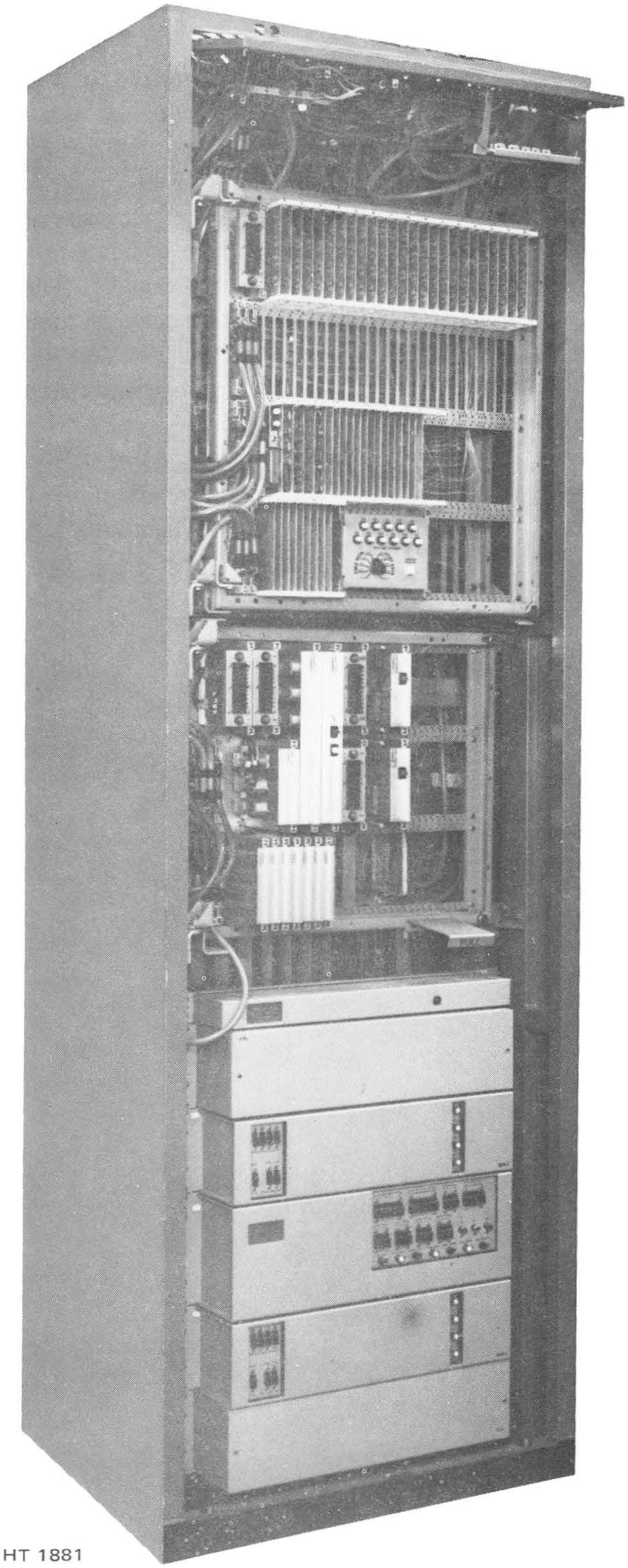


Figure 1. Typical ESC-1 Cabinet Assembly

a. Line link network (LLN) cabinets:
LLA (type AA)
LLB (type BB)
LLC (type CC)
LLD (type DD).

b. Trunk link network (TLN) cabinets:
TLC (1 DE and 1 GH grid and TLN control)
TLD (2 DE and 2 GH grids)
TFA (FA stage)
TFB (FB stage).

c. Trunk cabinets (TRK and MIS).

d. Trunk service link network cabinet (TSN).

e. Translator cabinets:
TRA (types A1 and A2)
TRB (types B1 and B2)
TRC (types C1 and C2)
TRD (types C1 and C3)
TRE (types C1 and C2).

f. Common control (CC) cabinets:
CCL (type CC1- local)
CCT (type CC2- trunk).

g. Register-sender cabinet (RS).

h. Auxiliary register-sender cabinet (RSA).

i. Junctor and ringing control cabinet (JRC).

j. Supervisory cabinet (CSR).

k. Power cabinets (PE and PD).

l. Main fuse cabinet (MFB).

6.05 Some of the cabinets available in the ESC which contain equipment for optional system features as follows:

a. Fire alarm and generator cabinet (FAL).

b. Traffic metering cabinet (MTR).

c. Test cabinet (TST).

d. Repeat coil cabinet (RPC).

e. Jackfield cabinet (JFL).

f. Special line circuit cabinet (LLS).

g. Register-sender cabinet (RS).

h. Auxiliary register-sender cabinet (RSA).

i. Trunk recorder cabinet (TR).

j. LAMA-ONI cabinet (CAM).

k. Identity sender and trunk cabinet (SST).

l. Magnetic tape control unit cabinet (MAG).

7. GATE ASSEMBLIES

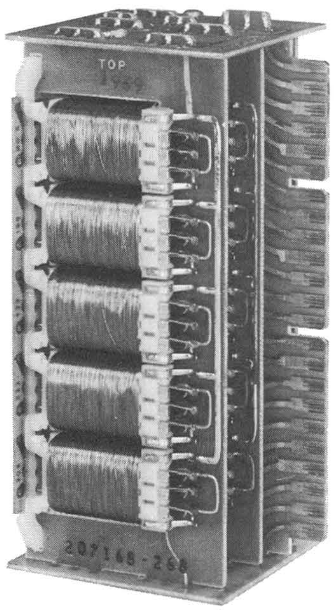
7.01 Two types of gate assemblies are used: low-profile gates and standard or high-profile gates. For both types, the short gates are 27 inches (68.6 cm) high and the full-length gates and combinations of three short gates bolted together vertically are 82 inches (208.3 cm) high. Both types are approximately 24 inches (61 cm) wide but vary in depth, depending on the equipment mounted on them; standard gates are approximately 8-1/2 inches (21.6 cm) deep, and low-profile gates are approximately 4-1/2 inches (11.4 cm) deep with equipment mounted.

7.02 Standard gates are used for mounting regular single-level and two-level high-profile PWBAs; low-profile gates are used for mounting low-profile matrix modules and low-profile PWBAs. Two low-profile gates can occupy the same space as that required for a single standard gate.

8. MATRIX MODULES

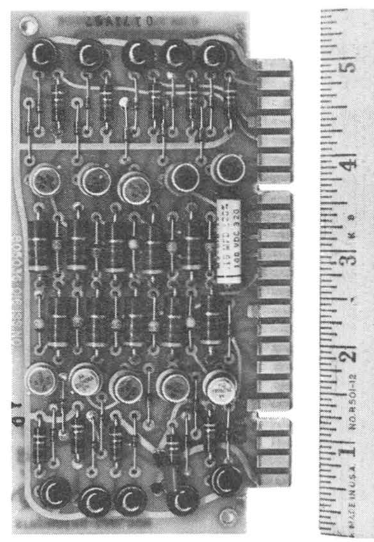
8.01 Matrix modules are used in the ESC to provide crosspoint connections in the various matrices within the system. Each module consists of a number (15, 20, or 25) of CROSSREED relays mounted on small printed wiring boards, one of which can be plugged into a 46-contact connector. Each relay consists of three, four, or six hermetically sealed reed switches mounted in a single bobbin which has two windings (one for operating and one for holding).

8.02 CROSSREED relays used in the ESC-1 are assembled in different basic matrix arrays: 5 x 5, 5 x 4, and 5 x 3. Low-profile (cordwood) modules



HT 3333

Figure 2. Low-Profile Matrix Module



HT 3426

Figure 3. Typical Low-Profile Circuit Card

(fig. 2) are 5-1/2 inches (14 cm) high, 3 inches (7.6 cm) deep, and 3-3/4 inches (9.5 cm) wide. Highly standardized matrix modules provide the flexibility that enables the ESC-1 to be easily adapted to the needs of traffic requirements of any office.

9. PRINTED WIRING BOARD ASSEMBLIES

9.01 Two types of PWBAs are used in the ESC-1: the low-profile PWBA and the regular or standard PWBA. These assemblies are used primarily for mounting of circuit components, such as integrated circuits (ICs), transistors, resistors, and capacitors.

9.02 Low-profile PWBAs (fig. 3) are approximately 5-1/2 inches (14 cm) high and 3 inches (7.6 cm) deep; single-level, high-profile PWBAs (fig. 4) are approximately 5-1/2 inches (14 cm) high and 7-1/4 inches (18.4 cm) deep; and two-level, high-profile PWBAs (fig. 5) are approximately 11-3/4 inches (29.8 cm) high and 7-1/4 inches (18.4 cm) deep. All high-profile PWBAs have extruded aluminum or plastic stiffeners and use guide studs at top and bottom. The low-profile PWBAs use plastic card guides.

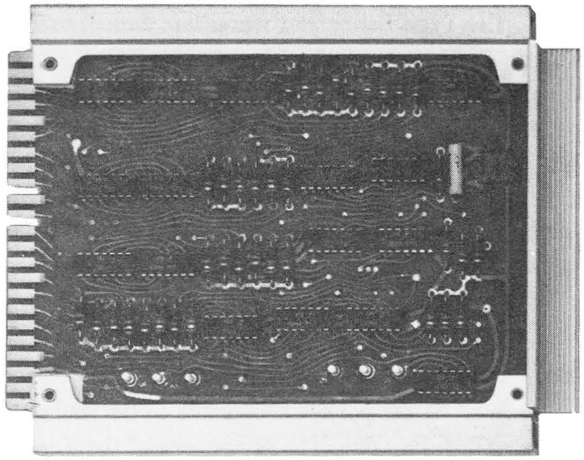
9.03 Functional circuits, such as trunks, line circuits, and junctors, are completely incorporated on standard size PWBAs, either single-level or two-level, as needed. Functional circuits that cannot be incorporated on one assembly, or those that can more economically be designed using subcircuits, use low-profile cards.

10. POWER EQUIPMENT

10.01 All power supply equipment is mounted separately from the switching equipment. The power equipment includes a negative 48-volt main battery source, a positive 8-volt main battery source, –48- and +8-volt standard commercial full-float type battery chargers, and ringing supply equipment.

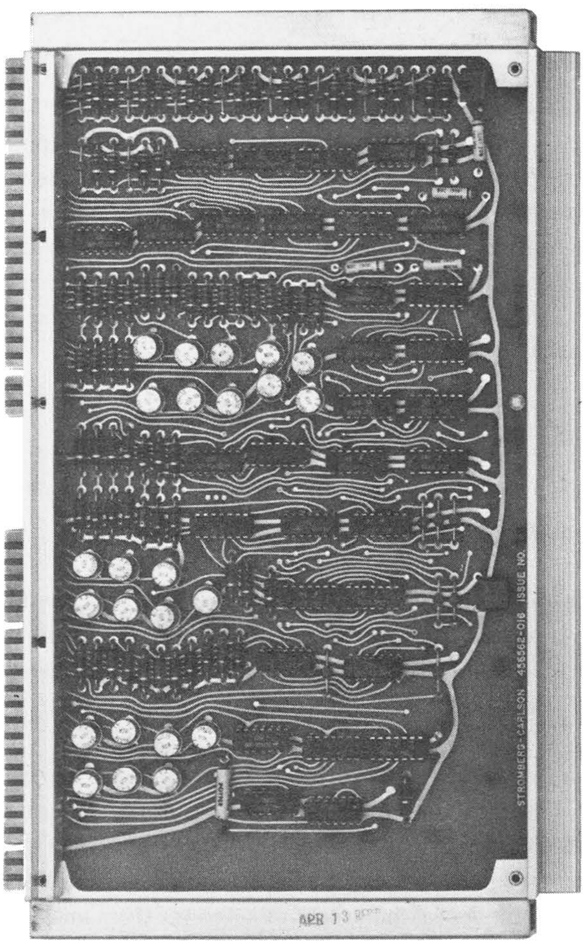
10.02 The negative 48-volt battery supply has 24 cells; the positive 8-volt supply has 4 cells. Busy-hour reserve for the batteries is normally specified by the customer for the particular office.

10.03 Battery chargers are standard commercial units of the full-float type using solid-state rectifiers. Depending on the size of the unit required, it will operate from commercial 115-volt, single-phase, 60-Hz power or from commercial 208/240-volt, 3-phase, 60-Hz power. The output of the charger is sufficient to carry the average busy-hour load requirements of the sytem.



HT 3332

Figure 4. Typical Single-Level High-Profile Circuit Card



HT 3332

Figure 5. Typical Two-Level High-Profile Circuit Card

10.04 Duplicate ringing supplies are provided, with automatic switchover in the event of failure of one unit. Ringing supplies are operated from the battery supply.

11. SUPERVISORY EQUIPMENT

11.01 Supervisory equipment is distributed throughout the various equipment cabinets; each cabinet has its own supervisory panel at the top of the cabinet, but most of the equipment is located in the supervisory cabinet. Interrupter equipment, tone generators, and alarm-sending equipment are mounted in the supervisory cabinet. The supervisory equipment is duplicated, where necessary, to provide uninterrupted service if trouble should occur.

12. TEST FACILITIES

12.01 Test Panel for Line Testing.

a. The test panel provides the facilities for line testing in an ESC office. The panel consists of illuminated pushbuttons, rotary dial, meter, test telephone jack, and selector switch.

b. The test panel provides access to the ESC equipment by way of test selector trunks, test shoes, special test trunks, line circuits, or main distributing frame (MDF) test trunk.

c. The test panel is used to test:

1. Tip, ring, and loop capacitances.
2. Tip, ring, and loop ground.
3. Tip and ring battery.
4. Loop resistance.
5. Ringing and howler.
6. Heat coil.

12.02 Maintenance Test Console (MTC).

a. The MTC provides access to the ESC equipment by way of test lines or incoming test trunks.

b. The MTC has an equipment routiner, equipment selector, register storage display, remote control transfer, alarm monitor, and line load control. It is used for manually selecting any register, junctor (JCTR), ringing control, or outgoing trunk, and any common piece of equipment and placing calls through the equipment under actual call conditions. It has the capability to allow selection of any individual register, junctor, ringing control, or outgoing trunk which has been manually made busy.

c. The MTC provides indications of the progress of a test call, the status of all common equipment, all office alarms, and all information stored in a register during a test call; the register display also displays the terminating equipment number and the ringing code (party number) on locally terminated calls. Transfer keys are available for switchover of common equipment, and a line load control panel is provided for taking desired line groups out of service.

12.03 The JCTR/TLN control test panel is used to test junctor controls, TLN controls, and all available paths through the TLN matrix. It can be mounted either with its associated circuitry in the CCT cabinet or in a test console adjacent to the MTC.

12.04 Fault Recorder.

The fault recorder consists of a fault recording control (FRC) circuit and a TTY for printout. When a call is not properly originated or terminated within the preallotted time required for the common equipment to set up a call, a fault printout is initiated. This printout records the date, time, and status (at time of failure) of circuits involved in the unsuccessful call attempt. The FRC and date-time calendar circuits are located in the supervisory cabinet.

12.05 Automatic Call Generator.

The automatic call generator, which normally operates continuously, can be programed to generate and check up to 20 line-to-trunk and 20 trunk-to-line test calls. All common control elements, junctors, and ringing controls can be automatically tested by programing test calls through one test line in each line unit and one test trunk in each trunk common control group. The generator can be strapped, in 12-second steps, to originate test calls every 24 to 120 seconds.

12.06 Line and Trunk Test Desk.

The Type G line and trunk test desk is used to check the condition and electrical characteristics of lines and trunks in the ESC. It is designed to check resistance, capacitance, and voltage on both inside and outside plant facilities. The test desk also provides a howler circuit, sounder circuit, and connections for a portable or built-in Wheatstone bridge to aid in clearing line faults.

13. DISTRIBUTING FRAMES

13.01 Intermediate Distributing Frame (IDF).

Most of the connections made at the IDF use a direct plug-in type cable. The assignment of these cables is according to an office interconnection plan.

13.02 Combined Distributing Frame (CDF).

The CDFs are used to provide terminals for connections between the outside subscriber loop and trunk plant and the ESC switching equipment.

14. EQUIPMENT CAPACITY

14.01 General.

A typical floor plan of an ESC office, equipped for 1500 lines, is shown in figure 6; provision is made for expansion to 4500 lines. More detailed information on the functional arrangement of the equipment is provided in Part III of this section. The following paragraphs describe the various types of cabinets and the capacity of each type.

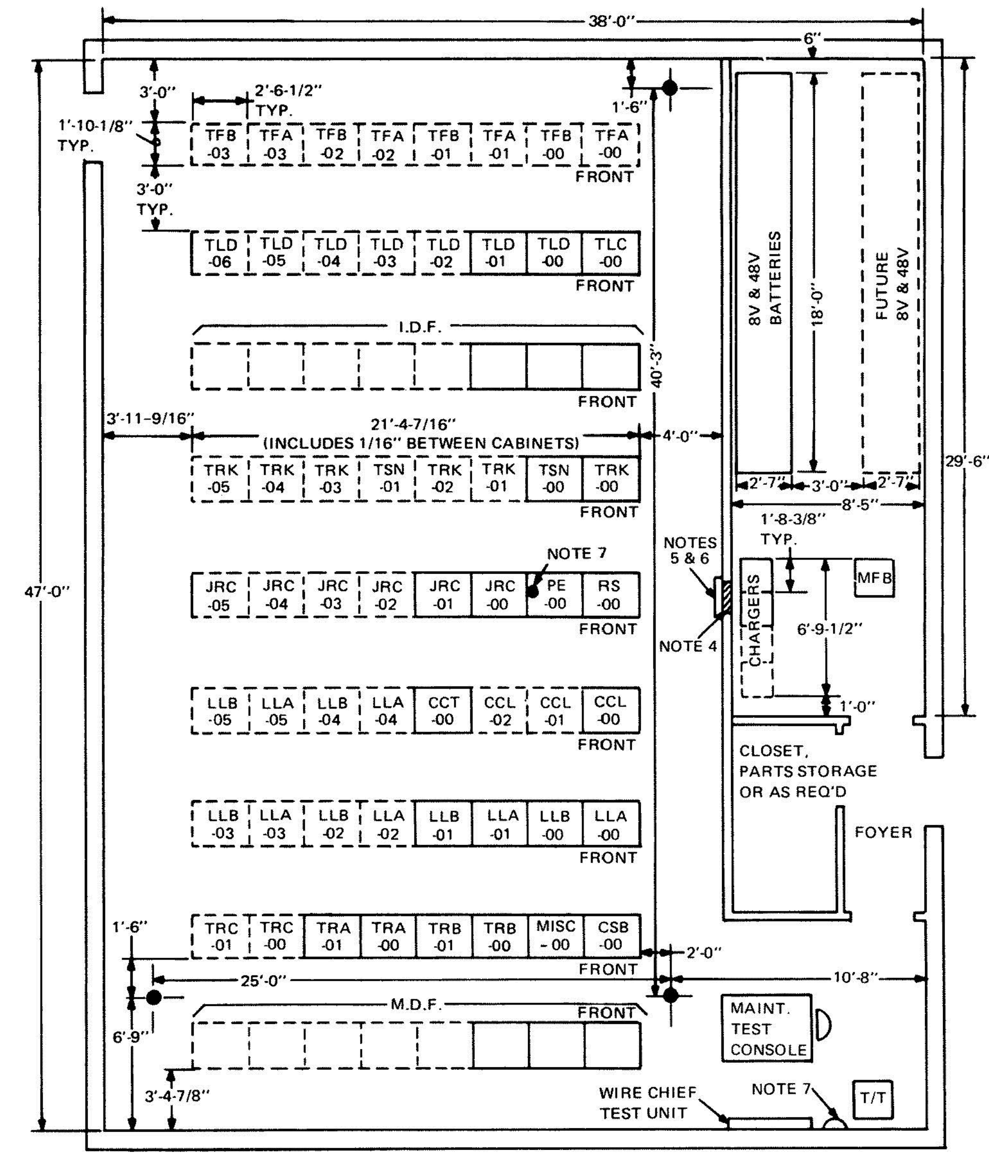
14.02 Line Link Network (LLN) Cabinets.

Four types of LLN cabinets are used in an ESC office. Office requirements will determine the number and types of LLN cabinets to be used.

a. LLA (type AA) – This cabinet contains the line circuits for 300 regular lines and the A and B switching stages required for these lines. The C stage for the entire LU is also contained in this cabinet.

b. LLB (type BB) – This cabinet contains the line circuits for 200 regular lines and the A and B switching stages required for these lines. It also contains the line circuits for 250 auxiliary lines along with the A switching stage required for these lines.

c. LLC (type CC) – This cabinet contains 2 groups of 200 regular line circuits each and the A and B switching stages required for these lines.



METRIC EQUIVALENTS

150 lbs/sq ft	735 kg/lm²
1/4"	0.64 cm
2"	5.08 cm
6"	15.24 cm
1'-0"	30.48 cm
1'-6"	45.6 cm
1'-7"	48.1 cm
1'-8-3/8	51.7 cm
1'-10-4/8"	56.2 cm
2'-0"	61 cm
2'-6-1/2"	77.5 cm
2'-7"	78.7 cm
3'-0"	91.4 cm
3'-4-7/8"	103.9 cm
3'-11-9/16"	120.7 cm
4'-0"	121.9 cm
6'-0"	182.9 cm
6'-9-1/2"	206.8 cm
7'-1"	215.9 cm
7'-10"	238.7 cm
8'-1"	246.4 cm
8'-5"	256.6 cm
10'0"	305.0 cm
10'-8"	325.1 cm
21'-4-7/16"	651.5 cm
25'-0"	762 cm
29'-6"	899 cm
38'-0"	1158 cm
47'-0"	1432 cm

* 1500 lines, 5000 directory numbers with growth to 4500 lines, 10,000 directory numbers

NOTES:

1. Height of ceiling - 10'-0" (MIN)
2. Height of equipment (less cabinet trough) - 7'-10"
3. Weight of equipment - 150 lbs. P.S.F.
4. 1'-7" x 1'-0" Cable hole in wall 8'-1" from floor to bottom edge
5. Ground bar 18" x 2" x 1/4" (S-C Furnished). 7'-1" from floor to bottom edge.
6. Customer to furnish a No. 1/0 AWG stranded cold water pipe ground with a minimum 25' tail coiled in equipment room.
7. Essential A.C. outlet required, 1 on ceiling for PE cabinet and one in wall for teletypewriter.

CP 2758A

CABINET DESIGNATIONS:

SB	–	Supervisory Cabinet
MISC	–	Miscellaneous Cabinet
TRB TRA TRC	}	Translator Cabinets
LLA	–	Line & Line Link Network Cabinet (Type 'AA')
LLB	–	Line & Line Link Network Cabinet (Type 'BB')
CCL	–	Common Control (Local) Cabinet
CCT	–	Common Control (Trunk) Cabinet
RS	–	Register Sender Cabinet
PE	–	Power Cabinet
JRC	–	Junctor & Ringing Control Cabinet
TRK	–	Trunk Cabinet
TLC	–	Trunk Link Network Cabinet (Control)
TLD	–	Trunk Link Network Cabinet ('D', 'E', 'G' & 'H' stages)
TFA	–	Trunk Link Network Cabinet ('FA' stage)
TFB	–	Trunk Link Network Cabinet ('FB' stage)
T/T	–	Teletypewriter
TSN	–	TSLN Cabinet

Figure 6. Sample Floor Plan

d. LLD (type DD) – This cabinet contains the line circuits and the A switching stage required for 1 group of 250 auxiliary lines.

14.03 Trunk Link Network (TLN) Cabinets.

Four types of TLN cabinets are used in an ESC office:

a. TLC – This cabinet contains 1 DE and 1 GH grid (50 inlets and 50 outlets) and the TLN and junctor controls.

b. TLD – This cabinet contains 2 DE and 2 GH grids (100 inlets and 100 outlets).

c. TFA – This cabinet contains the FA stage (seventy-five 5 x 5 modules) for 1 originating supergrid.

d. TFB – This cabinet contains the FB stage (seventy-five 5 x 5 modules) for 1 terminating supergrid.

14.04 Trunk Cabinets (TRK and MIS).

a. The trunk cabinet (TRK) can mount any combination of six of the following gates:

1. Two-way trunk gate; circuit capacity is variable, depending on trunk type.

2. Incoming trunk gate; capacity 20 circuits.

3. Outgoing trunk gate; standard capacity 40 circuits, although with certain circuits (such as CLR) only 20 can be equipped.

4. Inband coin trunk gates; typical capacity is 4 two-way circuits, 6 incoming circuits, or 7 outgoing circuits.

5. Repeat coil gate (for association with loop-type trunks); capacity 80 circuits.

b. The miscellaneous trunk cabinet (MIS) contains all the service trunks required in the system as well as prepay paystation adapters.

14.05 Trunk Service Link Network (TSN) Cabinet.

This cabinet mounts up to four TSLN grids and trunk grouping circuitry associated with incoming trunks.

14.06 Translator Cabinets.

Seven types of translator cabinets are used in an ESC office. Office requirements will determine the number and types of translator cabinets to be used. Cabinet types A1 and B1 also contain the code translators used to translate central-office prefixes, area codes, and special service codes into routing information required in the processing of calls. Optional six-digit translation code expansion is available with cabinet type A2. The following combinations are available:

a. TRA (types A1 and A2) and TRB (types B1 and B2) – These 4 cabinets are required for the identification of 5000 lines and the translation of 5000 directory numbers.

b. TRA (types A1 and A2), TRB (types B1 and B2), and TRC (types C1 and C2) – These 6 cabinets are required for the identification of 5000 lines and the translation of 10,000 directory numbers.

c. TRA (types A1 and A2), TRB (types B1 and B2), TRC (types C1 and C2), and TRD (types C1 and C3) – These 8 cabinets are required for the identification of 10,000 lines and the translation of 10,000 directory numbers.

d. TRA (types A1 and A2), TRB (types B1 and B2), TRC (types C1 and C2), TRD (types C1 and C3), and TRE (types C1 and C2) – These 10 cabinets are required for the identification of 10,000 lines and the translation of 15,000 directory numbers.

14.07 Common Control Cabinets.

a. Common control cabinet CCL (CC1, local) contains the line marker, line scanner, register dial-pulse acceptors (DPA), tone detectors, and service link network control circuits used in processing local traffic. One CCL common control cabinet is provided for every two LUs.

b. Common control cabinet CCT (CC2, trunk) contains the trunk markers (incoming and outgoing), incoming trunk scanner, trunk register

DPAs, toll multifrequency (MF) detectors, MF current supply, and TSLN control circuits used in processing trunk traffic. This cabinet is provided according to trunk traffic requirements of the ESC office and serves up to 300 incoming trunks and 100 outgoing trunk groups of various sizes.

14.08 Local-Junctor and Ringing Control Cabinet (JRC).

The local-junctor and ringing control cabinet is normally wired for 120 junctors and ringing controls (60 junctors/60 ringing controls). An additional 10 junctors (for a total of 70) can be accommodated when traffic warrants. The SLN associated with these junctors is also contained in this cabinet. One JRC is provided for each LU.

14.09 Register-Sender Cabinet (RS).

The register-sender cabinet contains 2 register commons, 4 register buffers, 80 registers, and 20 senders. One register-sender cabinet is provided when an office is equipped with up to four common control cabinets.

14.10 Auxiliary Register-Sender Cabinet (RSA).

The auxiliary register-sender cabinet contains 40 registers, 40 senders, and 2 register buffers. One auxiliary register-sender cabinet is provided when an office is equipped with up to six common control cabinets, or if more than five senders per group are required.

14.11 Supervisory Cabinet (CSR).

The supervisory cabinet contains the tone generators and the supervisory and alarm equipment. One cabinet is provided per office.

14.12 Power Cabinets (PE and PD).

The PE cabinet contains the ringing generator, ringing generator monitor, and various power supplies used throughout the system. One PE cabinet is provided per office. The PD cabinet contains the power distribution circuitry for the office. One or more PD cabinets are provided for the office, depending upon the floor plan.

14.13 Main Fuse Cabinet (MFB).

This cabinet contains the main discharge fuses for the system.

15. TRUNK CIRCUITS AVAILABLE

15.01 The major types of trunk circuits available are:

a. Incoming loop trunks.

b. Outgoing loop trunks.

c. Incoming E&M trunks.

d. Outgoing E&M trunks.

e. Two-way loop trunks.

f. Two-way E&M trunks.

g. CLR toll trunks.

h. Special service trunks.

1. Operator service.
2. Operator out-dial.
3. Revertive call.
4. Recording.
5. Tape announcer.
6. Test desk.
7. Intercept.
8. Information and repair.
9. Inspectors.
10. MDF test.
11. Permanent signal holding.
12. Busy verification.
13. Dial-back.
14. Test selector.

16. SYSTEM FEATURES

16.01 Standard System Features.

a. Lockout-type subscriber lines.

b. Rotary-dial calling.

c. High-level ringing.

d. Immediate ringing.

e. Single-, two-, four-, and eight-party lines.

f. Supervisory tones using precise tone plan.

g. Flat-rate service.

h. Revertive call by directory number.

i. PBX hunting (consecutive and nonconsecutive).

j. DP outpulsing.

k. Permanent signal trunks.

l. CLR holding.

m. 225 classes of service.

n. Intercept number assignment.

o. PBX night service.

p. Direct inward dialing to PBX.

q. Line load control.

r. Full availability to trunks.

s. No-charge paystation emergency calls.

t. Test and maintenance facilities.

u. Fault recording (teletype printer).

v. Automatic number identification (ANI).

w. Malicious call printout.

x. Semipostpay paystations.

16.02 Optional System Features.

a. Nonlockout-type subscriber lines.

b. TONE-DIAL® telephone calling.

c. Message rate charge service for single-party lines on local calls.

d. Prepay paystations.

e. Wide-area telephone service (WATS) (one originating area).

f. Off-hook service.

g. Automatic electronic traffic measuring facilities.

h. Manual service for the handicapped.

i. Centralized automatic message accounting (CAMA).

j. Local automatic message accounting (LAMA).

k. MF signaling.

l. Abbreviated dialing (speed-calling).

m. Call forwarding.

n. Third-party conference (three-way calling).

o. Call waiting.

p. Operator busy verification.

q. Pad control.

r. Centralized telephone answering.

s. Message recordings.

t. Volunteer fire alarm.

u. Alarm sending and receiving.

v. Malicious call alarm.

17. TRAFFIC MEASURING FACILITIES

17.01 Traffic measuring leads for measuring traffic usage, timed all-trunks-busy (ATB), internal blocking, and peg counts are brought out to a central point. These measurements are made on circuits connected to inlets and outlets of the TLN, such as local junctors, registers, senders, and trunks. The optional measuring equipment, consisting of electronic scanners and electronic registers arranged for local or remote teletype, punch-tape or magnetic-type printout, can be connected to those leads as required. The measuring equipment has optional automatic local or remote start-stop capability.

PART II. TECHNICAL CHARACTERISTICS

18. TRANSMISSION CHARACTERISTICS

18.01 Insertion Loss.

The insertion loss will not exceed the following values for either line-to-line or line-to-trunk connections:

FREQUENCY (Hz)	*INSERTION LOSS (dB)*
300	1.5
500	1.0
1000	0.7
3400	0.7

The transmitter current for the subscriber loop will vary over the range of 20 to 100 milliamperes.

18.02 Echo Return Loss (ERL).

The measurement of ERL is made at the MDF side of the trunk equipment with a connection established through the switching equipment and terminated in 900 (±1%) ohms in series with a 2.14-2.18 microfarad capacitor at the subscriber-line connection point. The ERL will be greater than 26 dB for all trunks with a transmitter current range of 20 to 100 milliamperes for the subscriber loop.

18.03 Singing Margin.

The singing point measured under the same test conditions as used for ERL will not be less than 16 dB.

18.04 Longitudinal Balance.

The longitudinal balance from MDF to MDF of any connection through the switch will be greater than 60 dB over the frequency range of 180 to 3400 Hz.

18.05 Low Frequency Induction.

All signaling and transmission functions are done properly by the switch in the presence of a signal of up to 6 volts, 60 Hz, applied longitudinally between both tip and ring conductors and ground during the talking condition. The maximum steady noise for this condition will not exceed 22 dBrnC for 6 volts, 60 Hz; or 16 dBrnC for 3 volts, 60 Hz.

18.06 Idle Channel Noise.

The background noise for any idle, terminated connection through the switch will not exceed 16 dBrnC with an average traffic load on the system.

18.07 Crosstalk.

Crosstalk coupling loss between coexisting transmission channels through the switch will be in excess of 90 dB at 1000 Hz.

18.08 Impulse Noise.

The impulse noise measured on any idle, terminated connection will be less than 5 counts in 5 minutes at a counting threshold of 54 dBrnC for 50 percent of the measurements made during the busy hour.

19. OPERATING VOLTAGES

19.01 Main battery supply: −44 to −54 volts; +7.5 to +9 volts for common control.

19.02 Booster battery for message-rate metering: +48 volts.

19.03 Coin-control battery: ±125 to ±135 volts.

19.04 Commercial power: 110-volt, 60-Hz, single-phase; or 208/240-volt 60-Hz, 3-phase.

19.05 Frequency ringing: harmonic, synchromonic, decimonic.

Harmonic:

FREQUENCY (Hz)	*NOMINAL RMS VOLTAGE*	*VOLTAGE LIMITS*
16-2/3	90	72-108
25	100	80-120
33-1/3	110	88-126
50	125	100-150
66-2/3	140	112-168

Decimonic:

FREQUENCY (Hz)	*NOMINAL RMS VOLTAGE*	*VOLTAGE LIMITS*
20	95	76-114
30	105	84-126
40	115	92-138
50	125	100-150
60	135	108-162

Synchromonic:

FREQUENCY (Hz)	*NOMINAL RMS VOLTAGE*	*VOLTAGE LIMITS*
16	90	72-108
30	105	84-126
42	115	92-138
54	125	100-150
66	140	112-168

19.06 Single-frequency ringing, coded: 90 volts rms ±20 volts at 20 Hz.

20. OPERATING LIMITS

20.01 Subscriber Lines.

a. Battery Voltage Range.

1. Central-Office (CO) Battery.
   –44- to –54-volt (standard regulation)
   –51.6- to –54-volt (special regulation).

2. Boost Battery (elevated voltage).
   This battery (24 ±3 V) can be added to the CO battery to guarantee a minimum loop current for extended ranges. When used, the boosted battery must feed the junctors, register DPAs, outgoing trunks, and the line circuit (if S-807500 line circuit is used).

3. Thirty-Volt Reduction Circuit.
   This circuit is associated with the ring-control circuit and must be used when the loop resistance is less than 1900 ohms. Its primary function is to avoid premature tripping and is active during ring periods only. This circuit permits increased line loading with ringers.

b. Insulation Resistance and Available Line Terminations for Various Loops.

Minimum line leakage resistance is determined, among other factors, by the type of line termination used. Available line terminations within various line leakage limits are listed for the S-807500 and S-807625 line circuits in tables 1 and 2, respectively. Available ringer loads are listed in table 3.

c. Line Treatment.

Individual line treatment is done by the use of loop extenders and voice frequency (VF) repeaters. The loop extender, specifically the Lorain SRM-169, is used to increase the supervisory and transmission current capabilities of a line. VF repeaters, S-C E6 or equivalent, make up for VF transmission losses in long loops.

d. Dial Speed and Pulse Ratio.

From 8 to 12 pulses per second with closed interval pulsing ratios of 34 to 42-1/2 percent make (57-1/2 to 66 percent break).

e. Pushbutton Dialing.

1. Duration of valid tone pulses: greater than 40 milliseconds.

2. Cycle time of valid tone pulses: not less than 80 milliseconds.

3. Interdigital interval of valid tone pulses: not less than 0 milliseconds.

20.02 Interoffice Trunks.

a. Loop-Type Trunks.

1. Trunk-line loop resistance: 3000 ohms.

2. Trunk-line insulation resistance: minimum of 30,000 ohms dc insulation resistance between conductors or between either conductor and ground.

b. Trunk release time: 600 to 800 milliseconds to guard against reseizure prior to release.

20.03 Off-Hook, On-Hook Recognition Limits.

a. Interdigit, closed-circuit (off-hook) recognition time: 180 milliseconds.

b. Disconnect, open-circuit (on-hook) recognition time: 180 milliseconds (not required where hookswitch flash is not detected).

Table 1. Operating Limits for Line Circuit S-807500

	LINE LEAKAGE (OHMS)	AVAILABLE LINE TERMINATIONS					BATTERY				INDIVIDUAL LINE TREATMENT		
							CO		BOOST				
		PBXs	SUBSCRIBER CARRIERS	NEON LAMPS	NEON LAMPS AND AUDIO UNITS (S-C 96A)	RINGERS	44 to 54 VOLTS	51.6 TO 54 VOLTS	JCTR & DPA OUTGOING TRUNKS	LINE CIRCUIT	LOOP EXTENDER (LORAIN SRM-169)	REPEATERS** (S-C E6)	NONE
Regular Lines (0-1500 Ω)†	15K					X	X						X
	100K	X	X	X	X	X	X						X
Regular Lines (0-1900 Ω)†	15K					X		X					X
	100K	X		X	X	X		X					X
Long Lines (1900-3000 Ω)	100K	*				X		X	X	X		X	
	100K	*				X	X				X	X	
Extra Long Lines (3000-4500 Ω)	100K	*				X		X			X	X	

*Availability depends on PBX trunk circuit limitations.

**Repeaters are normally used with loops of greater than 2200-ohm resistance only.

†Refer to table 3.

Table 2. Operating Limits for Line Circuit S-807625

	AVAILABLE LINE TERMINATIONS						BATTERY			INDIVIDUAL LINE TREATMENT		
							CO		BOOST			
	LINE LINKAGE (OHMS)	PBXs	SUBSCRIBER CARRIERS	NEON LAMPS	NEON LAMPS AND AUDIO UNITS (S-C 96A)	RINGERS	44 to 54 VOLTS	51.6 to 54 VOLTS	JCTR & DPA OUTGOING TRUNKS	LOOP EXTENDERS (LORAIN SRM-169)	REPEATERS** (S-C E6)	NONE
Regular Lines (0-1500Ω)†	15K					X	X					X
	25K	X				X	X					X
	100K	X	X	X	X	X	X					X
Regular Lines (0-1900Ω)†	15K					X		X				X
	25K	X				X		X				X
	100K	X		X	X	X		X				X
Long Lines (1900-3000Ω)	100K	*				X		X	X		X	
	100K	*				X	X			X	X	
Extra Long Lines (3000-4500Ω)	100K	*				X		X		X	X	

*Availability depends on PBX trunk circuit limitations.

**Repeaters are normally used with loops of greater than 2200-ohm resistance only

†Refer to table 3.

Table 3. Ringer Capacities for Regular Lines

			FREQUENCY SELECTIVE (Hz)					
		STRAIGHT LINE RINGERS	*20*	*30*	*40*	*50*	*60*	*COMBINED NO. OF EACH*
Line Leakage Resistance (Ohms)	15K	3	4	6	8	8	10	2
	25K	5	5	10	10	10	10	3
	50K	7	7	10	10	10	10	4
	100K	7	7	10	10	10	10	4

20.04 Party Identification.

The party test required for two-party ANI can be successfully made through a total path resistance of up to 4100 ohms in the presence of a 5-volt rms ac ground potential.

20.05 Office Impedance.

The working impedance of the internal switching paths of the ESC-1 is 900 ohms at 1000 Hz. The registers, senders, test circuits, and trunk circuits are designed to a 900-ohm impedance. Use of the 900-ohm impedance reconciles subscriber-loop plant cable impedance with that of physical trunk loaded plant cable, as well as 900-ohm carrier terminal equipment. If 600-ohm physical trunks or carrier terminal equipment are to be switched through the ESC-1, appropriate nonunity ratio repeat coils should be specified on the trunk equipment.

21. ENVIRONMENTAL REQUIREMENTS

21.01 Temperature.

Limits: 32° to 120°F
(0° to 49°C)

21.02 Humidity.

Limit: 90%.

PART III. SYSTEM DESCRIPTION

22 FUNCTIONAL DIVISION OF SYSTEM EQUIPMENT

22.01 A block diagram of the electronic switching center is shown in figure 7. The functional elements of the ESC can be broadly divided into four basic areas: (1) switching network which includes line circuits, LLN, TLN, junctors, and trunks; (2) common control equipment which includes controls, scanners, markers, registers, and translators; (3) test and supervisory equipment; and (4) power equipment and distributing frames.

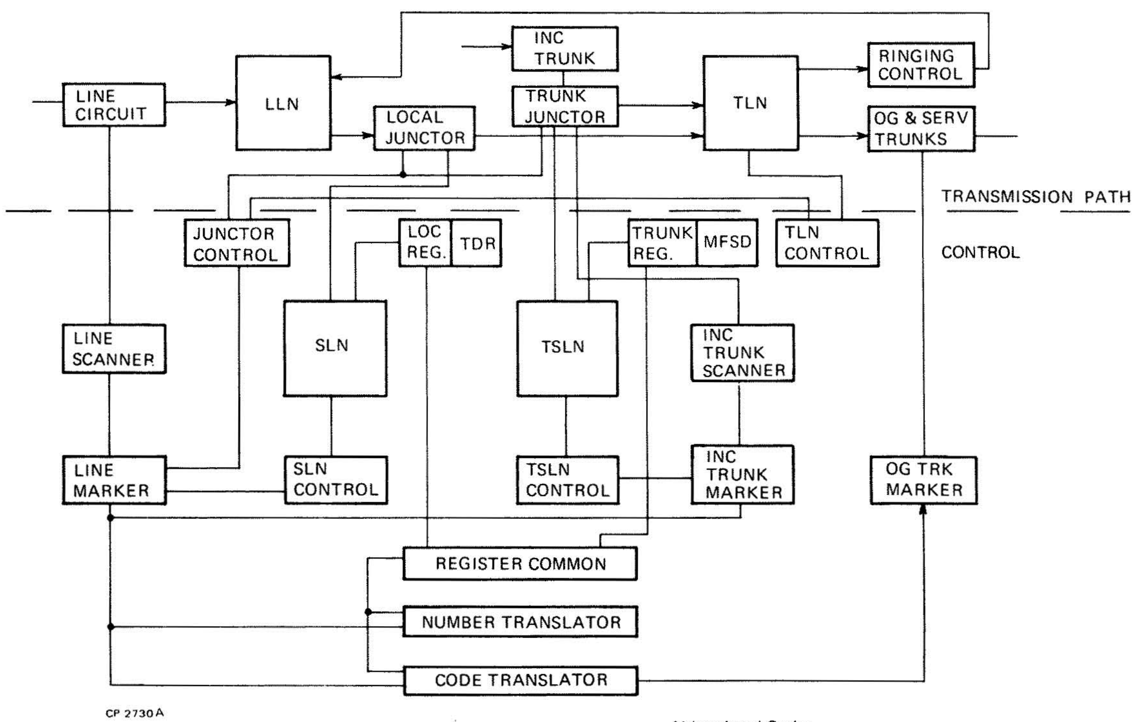
23. SWITCHING NETWORK

23.01 General.

a. The switching network establishes a two-wire metallic path for analog (voice) transmission and signaling. In addition to interconnecting lines and trunks, this network interconnects various types of service circuits.

b. Each crosspoint in the switching network consists of four reed relays, two of which are used for switching the tip and ring leads, one for the sleeve and hold, and the fourth for marking purposes. The mark lead is used as the idle/busy network memory and for path finding purposes. The sleeve lead is used for holding the crosspoint.

c. A block diagram of the equipment contained in the switching network is shown in figure 8. It consists of two main link networks, the line link network (LLN) and the trunk link network (TLN), which are interconnected by junctors and ringing



Abbreviated Codes

LLN	–	LINE LINK NETWORK
TLN	–	TRUNK LINK NETWORK
SLN	–	SERVICE LINK NETWORK
TSLN	–	TRUNK SERVICE LINK NETWORK
DPA	–	DIAL PULSE ACCEPTOR
TDR	–	TONE DIAL RECEIVER
MFSD	–	MULTIFREQUENCY SIGNAL DETECTOR

Figure 7. Electronic Switching Center, Block Diagram

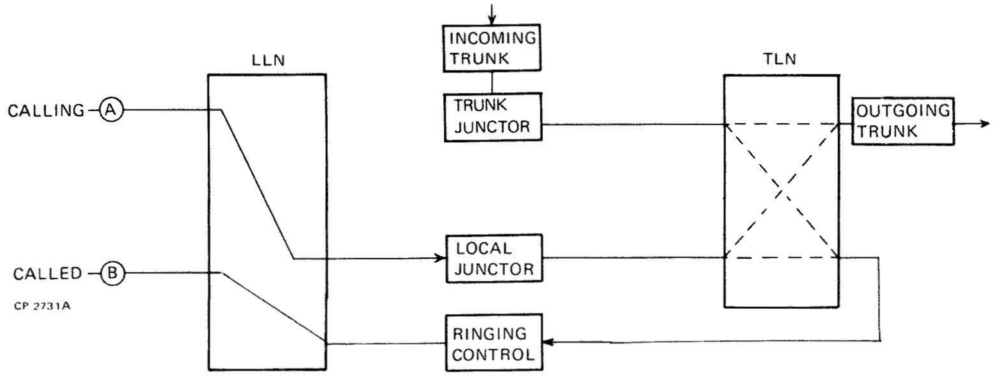


Figure 8. Transmission Switching Network

controls. A brief description of each block is provided in the following paragraphs.

23.02 Line Link Network.

a. The configuration of the line link network (LLN) is shown in figure 9. It is a 3-stage concentration network that concentrates 1000, 750, or 500 subscriber lines, depending on traffic, to a maximum of 120 outlets. An optional matrix configuration will increase the maximum to 130 outlets. (Refer to Note on figure 9.).

b. The LLN consists of five subnetworks, called AB networks. An AB network is a 2-stage concentration network that concentrates 200, 150, or 100 subscriber lines to 30 outlets for both originating and terminating traffic. The AB subnetwork consists of two separate networks – one regular and one transposed. The subscriber line circuits are connected to each of the networks but, whereas the regular network is arranged in groups of 10 based on the same tens digit, the transposed network is based on groups of 10 based on the same units digit. This means that a line is associated with a different group on each of the networks and results in better traffic balancing. Each subnetwork consists of 10 A switches with 3 outlets linked to 3 B switches with 5 outlets. The 30 outlets from 5 (AB) subnetworks are connected to thirty 5 x 4 C switches, 1 link to each switch.

c. The outlets from the C stage are connected to local junctors for originating traffic and to ringing controls for terminating traffic. Normally, 2 local junctors and 2 ringing controls are connected to each C switch, providing a total of 60 local junctors and 60 ringing controls for 1 line unit.

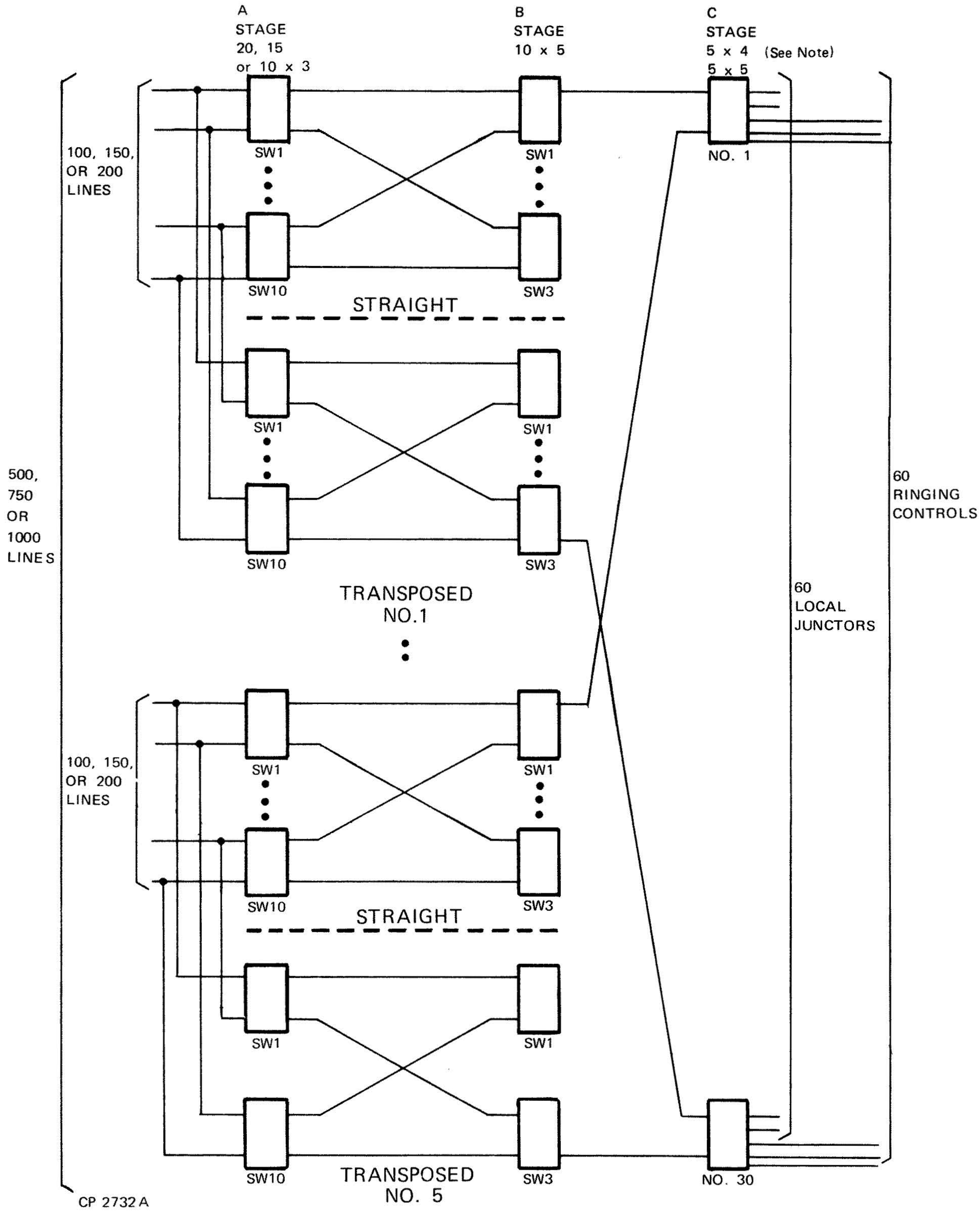
23.03 Trunk Link Network.

There are 2 versions of the trunk link network (TLN): (1) the 4-stage TLN (no longer available) providing a maximum of 250 inlets and 250 outlets; and (2) the 6-stage TLN used for large offices providing a maximum of 3000 inlets and 3000 outlets. The local junctors and incoming trunk junctors are connected to the inlets of the TLN, and the ringing controls and outgoing trunks are connected to the outlets of the TLN. Each outgoing trunk or ringing control circuit occupies one outlet.

a. Four-Stage TLN.

1. The configuration of the 4-stage TLN is shown in figure 10. It consists of a maximum of five DE grids and five GH grids. The GH grid is the mirror image of the DE grid. The DE grids form the originating side of the TLN; the GH grids form the terminating side.

2. A DE grid consists of five 10 x 15 D switches and fifteen 5 x 5 E switches interconnected by single linkage. Thus a DE grid is an expansion 2-stage link network providing 50 inlets and 75 outlets. Similarly, the GH grid is a contraction network providing 75 inlets and 50 outlets. The local junctors and the incoming trunk junctors are connected to the inlets of the DE grids, and the ringing controls and the outgoing trunks are connected to the outlets of the GH grids.



Note. Seventy local junctors and seventy ringing controls can be furnished when traffic warrents. The LLN C-stage switch would then be 5x5.

Figure 9. Line Link Network

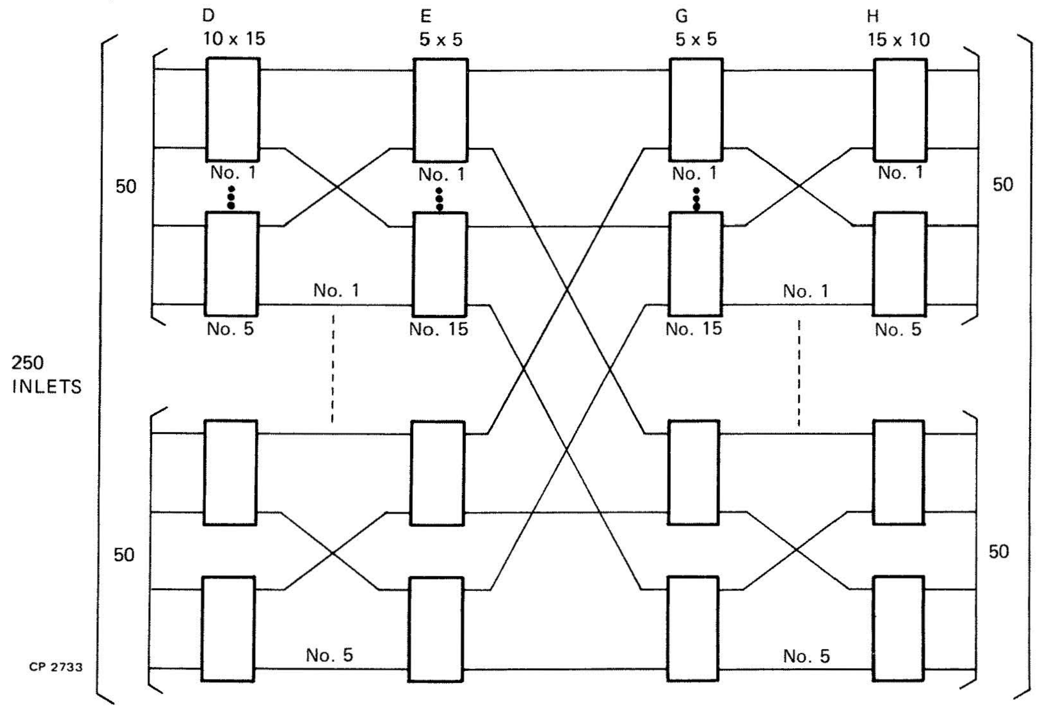


Figure 10. Four-Stage Trunk Link Network

3. The capacity of the 4-stage TLN varies from 100 inlets and 100 outlets to 250 inlets and 250 outlets with increments of 50 inlets and 50 outlets. The expansion is made by means of plug-in cables.

b. Six-Stage TLN.

1. The configuration of the 6-stage TLN is shown in figure 11. It consists of a maximum of 12 originating supergrids and 12 terminating supergrids which are interconnected. A terminating supergrid is the mirror image of an originating supergrid. An originating supergrid is a 3-stage expansion network of 250 x 375, the configuration of which is shown in figure 12. It consists of three switching stages: D, E, and F. Each supergrid consists of 5 DE grids (50 x 75) which are connected to a common F stage consisting of seventy-five 5 x 5 switches. Each DE grid is connected to the F switch by one link. The F stage of an originating supergrid is designated by the letter F with the subscript A (FA), and that of the terminating supergrid by the letter F with the subscript B (FB). The 6-stage TLN can consist of a minimum of 1 originating and 1 terminating supergrid providing 250 inlets and 250 outlets to a maximum of 12 originating and 12 terminating supergrids providing 3000 inlets and 3000 outlets.

2. The interconnections between the FA and FB switches are made by plug-in cables to facilitate growth of the TLN. The 375 outlets from a supergrid are connected to 25 plug-ended cables, each consisting of 15 links.

23.04 Junctors (Local and Trunk).

a. A junctor is a circuit which extends a transmission path from one switching network to another. The junctor also provides transmission battery to both the calling and called parties on intraoffice calls. On calls encountering station- or trunk-busy conditions, busy tone is returned to the calling party from the junctor.

b. The local junctor connects the LLN to the TLN on local or outgoing trunk calls. From 32 to 70 regular junctors plus 2 dedicated-access junctors can be equipped per LU.

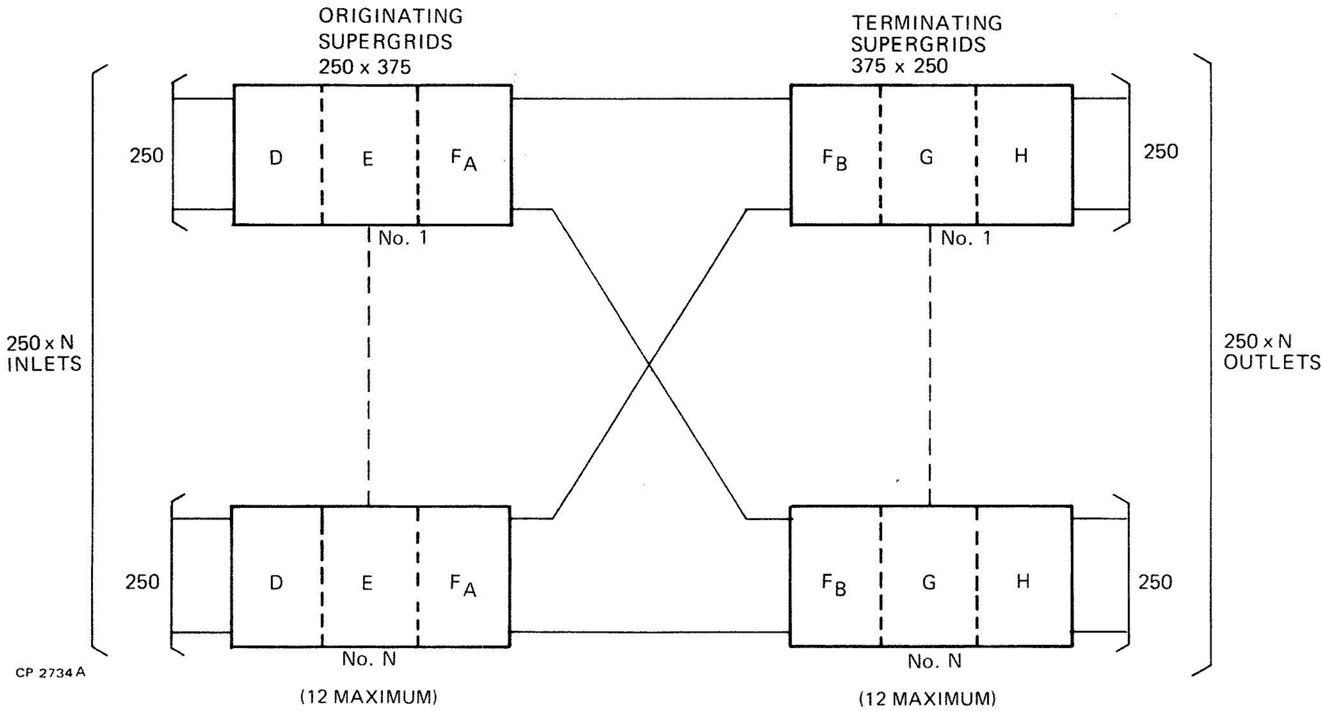


Figure 11. Six-Stage Trunk Link Network

c. The trunk junctor connects the associated incoming trunk circuit to the TLN.

23.05 Ringing Control.

The ringing control circuit (RC) provides ringing to the called station, detects the ring-trip condition of the called station, and provides ringback tone to the calling station. On busy verification tests, it receives the premature ring-trip signal. A maximum of 60 ringing controls can be equipped per LU.

23.06 Line Circuits.

a. The primary function of the line circuit is to provide signals to the line scanner when a subscriber originates a request for service. On a terminating call, the line circuit provides the line scanner with an indication of the idle/busy condition of the called station. The line circuit removes its own bridge and switches the line through when the line is to be connected by way of the LLN to a junctor or ringing control.

b. Two types of line circuits are available: the nonlockout and the lockout types. The lockout type is a standard feature of ESC-1.

23.07 Trunk Circuits.

a. Four general classifications of trunk circuits are used: incoming trunks, outgoing trunks, two-way trunks, and service trunks. All but the service trunks can be of either the loop or E&M type.

b. Service trunks are used for services, such as tape announcer, intercept, information and repair, inspectors, and revertive call.

24. COMMON CONTROL

24.01 General.

The main common control circuits (fig. 13) used in the ESC-1 system are divided into three groups. The first group includes the common circuits in an LU, comprising the line scanner, line marker, SLN, SLN control, local DPA, TONE-DIAL receiver, and sender.

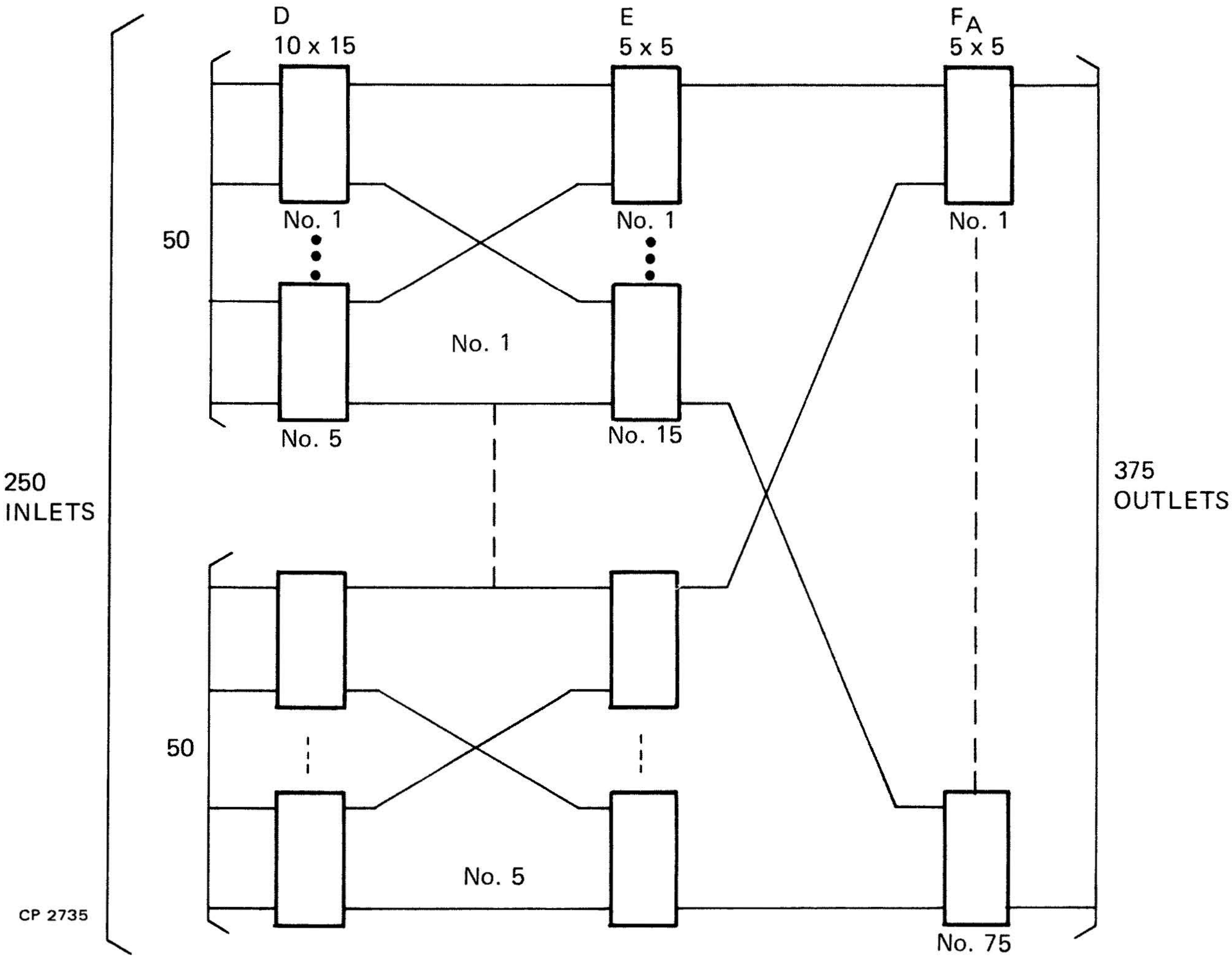


Figure 12. One Originating Supergrid (250 x 375)

The second group includes the common circuits associated with trunks, comprising the incoming trunk scanner, incoming trunk marker, outgoing trunk marker, TSLN, and TSLN control. The third group includes the system's common control units, junctor control, register common, TLN control, number translator, and code translator. Two identical circuits are provided for every type of common control circuitry (except register common), one regular and one standby; a minimum of two register commons are furnished to share the load. Most functions of the active common control are monitored, and, if a fault is detected, fault recording is initiated. If several minor faults occur within a specified period of time, or if a major fault occurs, transfer to the standby common control circuit is initiated. A brief description of the equipment in each block follows.

24.02 Line Scanner.

a. The line scanner is continuously scanning the line circuits for an originating request for service. The scanner operates in both the originating and terminating modes.

b. In the originating mode, the line scanner is continuously scanning, sequentially, for an off-hook condition on a line associated with the line scanner marker. When this condition is found, the scanner stops. The positions of the counters in the scanner (hundreds, tens, and units) represent the equipment number of the originating line. This information is sent to the line marker which, in turn, forwards it to the local register which is connected to the line. After a register is connected to the calling line, the line scanner restarts and scans for other lines

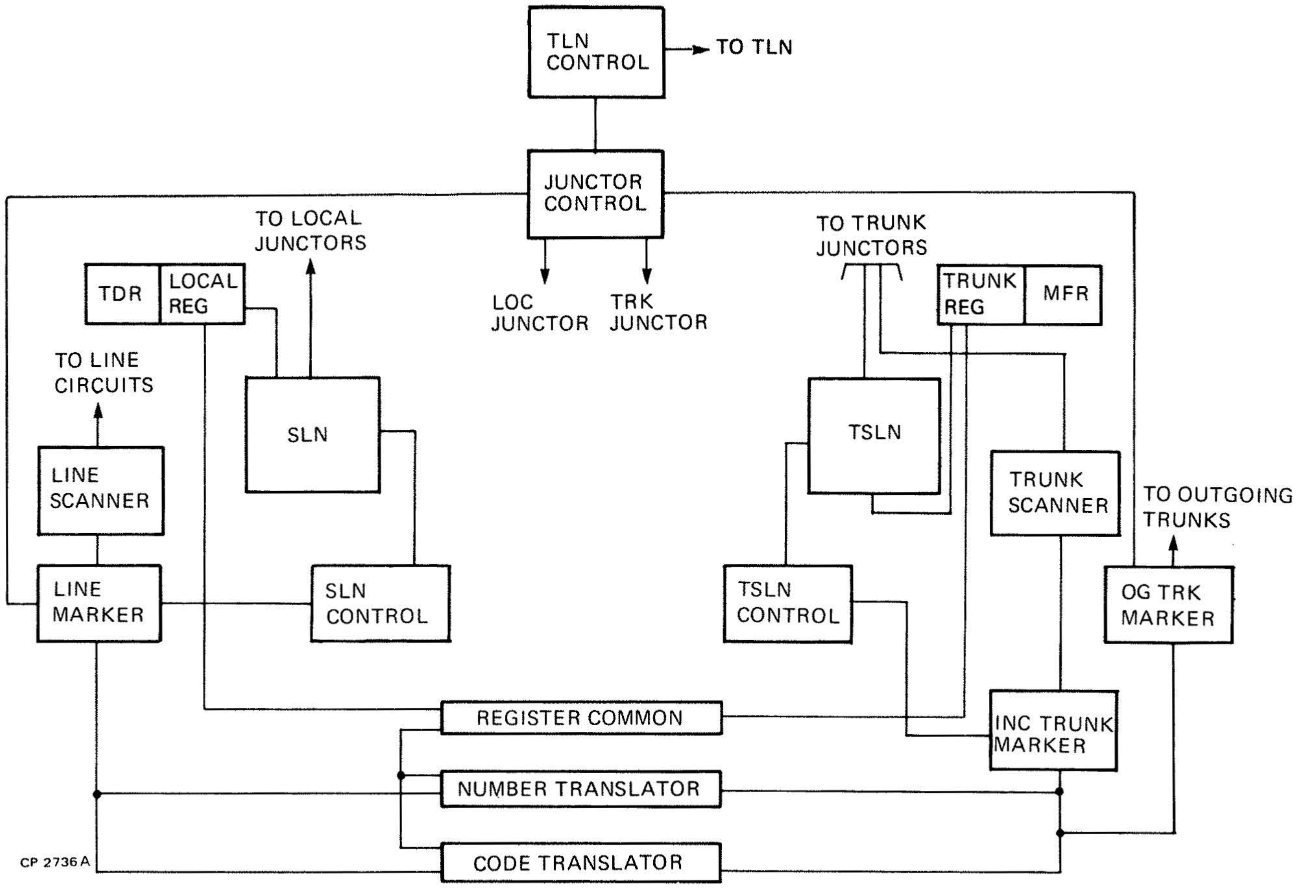


Figure 13. Common Control, Block Diagram

requesting service. When the scanner is in the process of completing an origination (connecting a line to a DPA), any termination request is held until the scanner has completed the originating scan routine.

c. In the terminating mode, the line scanner is seized by the number translator, causing the scanner to stop. The line scanner receives the called line equipment number, ringing code, and class of service (COS) from the number translator and forwards this information to the line marker. After the line is marked and a continuity test is done in the junctor control, the scanner is released to continue its scanning functions.

24.03 Line Marker.

a. The line marker operates in both the originating and terminating modes in conjunction with the line scanner. On originating and terminating local calls, the line marker supplies negative 48-volt marking potential to the mark lead of the appropriate line circuit.

b. The line marker continuously receives equipment number signals during the time that the line scanner is scanning for an originating service request. If an all-register-busy detector circuit determines that all registers are busy, the line marker instructs the line scanner to ignore service requests. If there is an available register, the line marker sends the equipment number to this register when it is connected, applies marking battery to the appropriate line circuit, and sends seizure and line group selection signals to the SLN control circuit. When the register is connected to the calling line, the line marker is released by the SLN control.

c. On terminating service requests, the line marker receives the equipment number, COS, and ringing code from the number translator by way of the line scanner. The line marker sends a seizure signal, the COS, and a ringing code to the junctor control circuit; a group selection signal to the terminating group relays; and marking battery to the appropriate line circuit. If either a busy or premature ring-trip signal is received, it is forwarded to the junctor control circuit. When a path is established and a continuity test done in the junctor control, the line marker releases.

24.04 Incoming Trunk Scanner.

a. The incoming trunk scanner (capacity 300 trunks) is continuously scanning for trunks requesting service. A complete scan of 300 incoming trunks occurs once every 1.28 milliseconds.

b. When an incoming trunk service request is found, the scanner stops. The positions of the scanning counters represent the equipment number of the seized trunk. This information is forwarded to the incoming trunk marker which initiates a search for an idle trunk register. When a trunk register is found, the equipment number is stored and the scanner restarts and scans for other incoming trunks requesting service.

24.05 Incoming Trunk Marker.

a. The incoming trunk marker operates in conjunction with the incoming trunk scanner. One marker serves up to 300 incoming trunks.

b. When an incoming trunk service request is found, the incoming trunk scanner forwards the trunk equipment number to the incoming trunk marker. If all trunk registers are busy, the scanner does not accept service requests. When a register is connected, the marker sends the trunk equipment number to the register, a mark battery to the trunk group marking circuit, a trunk selection signal to the TSLN grid selector circuit, and a seizure signal to the TSLN control. When a path is established to the register and a continuity test has been satisfactorily done, the incoming trunk marker releases.

24.06 Outgoing Trunk Marker.

a. One outgoing trunk marker is required per office.

The marker receives binary coded information from either the code or number translator for terminating outgoing calls. This information is decoded into trunk group numbers and equipment busy or paystation indications. The ringing codes for revertive calls are received from the number translator.

b. The marker uses the trunk group number signal to mark the group of outgoing trunk circuits to be supplied with marking battery. The ringing codes are transmitted to the revertive call trunks; the paystation indication is sent to the group of CLR toll trunks; and, when no trunks are available within a trunk group, as determined by the translators, an equipment-busy code is sent to the marker. The marker then sends an equipment-busy indication to the junctor control. When a trunk is seized, the outgoing trunk marker releases upon signal from the junctor control.

24.07 Service Link Network.

The configuration of the SLN is shown in figure 14. It consists of a 2-stage network which provides access from 60 junctors serving 1 LU to a maximum of 20 local registers. Two SLN networks serving 2 LUs share a common group of 20 registers (fig. 15). An SLN network consists of twelve 5 x 4 SB switches and four 15 x 5 SA switches interconnected by a single linkage.

24.08 Trunk Service Link Network.

The TSLN provides access from 300 trunk junctors to 20 trunk registers. Figure 16 shows the configuration of the TSLN. It consists of a maximum of 6 grids, each providing access for 50 trunks. Each grid is a 3-stage network consisting of ten 5 x 5 TSC switches, five 10 x 5 TSB switches, and five 5 x 4 TSA switches interconnected by a single linkage.

24.09 Service Link Network Control.

a. The SLN control serves to establish a path from a line circuit to a local register. It controls the operation of the crosspoints in the A, B, and C stages of the LLN and the crosspoints of the SA and SB stages of the SLN. The SLN control is released when dial tone is returned to the calling party.

b. Upon seizure, the SLN control determines if a path is available from the line circuit to an idle

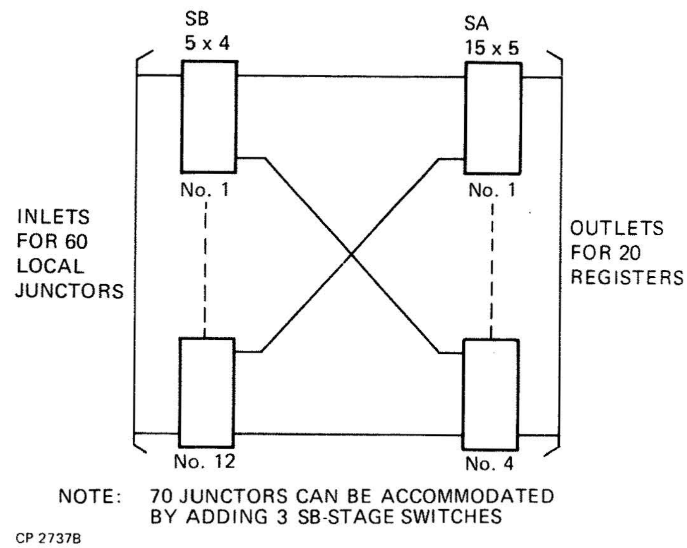


Figure 14. Service Link Network

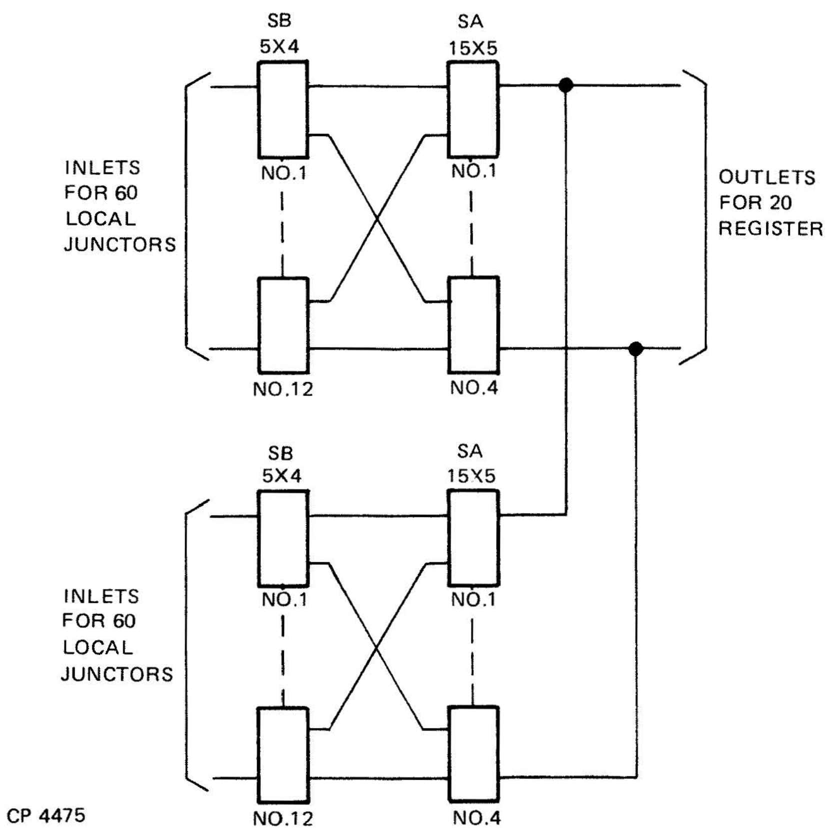


Figure 15. Typical SLN Showing 60 Inputs and 20 Outputs

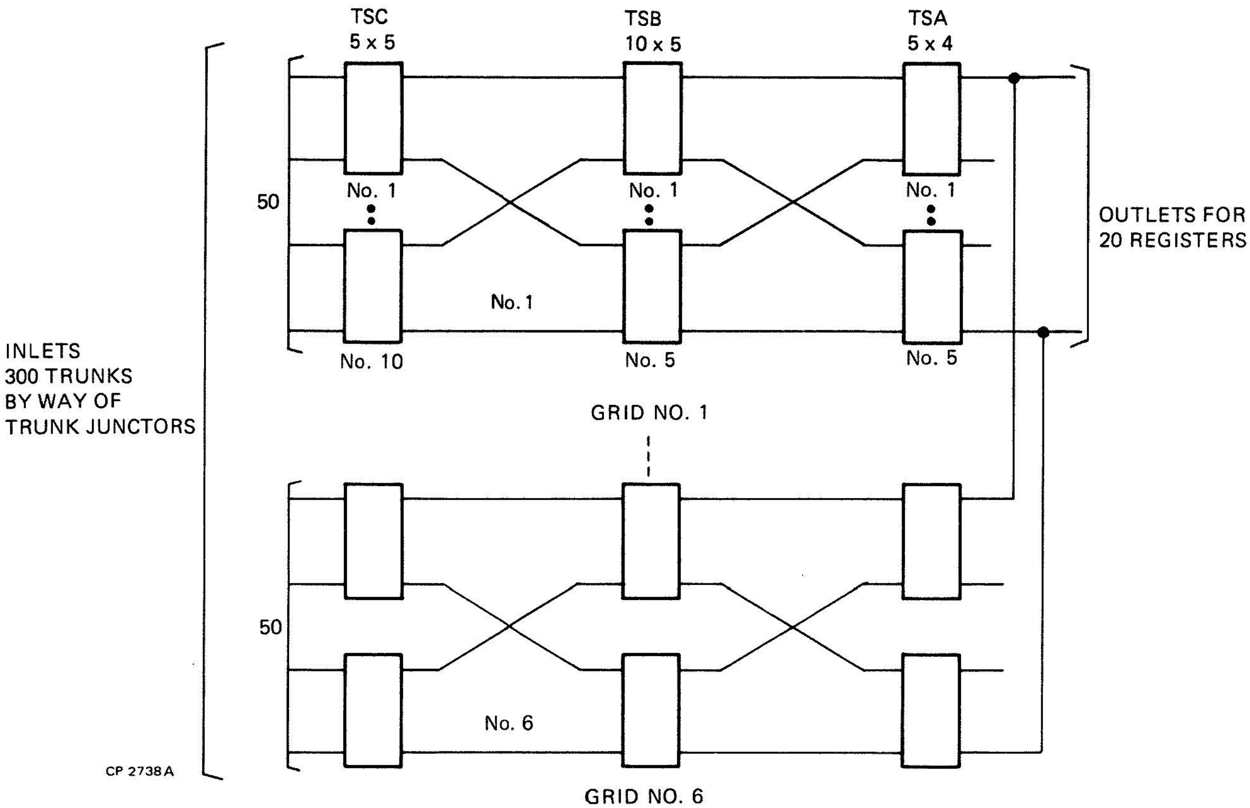


Figure 16. Trunk Service Link Network

register. This is done by using end-to-end marking. The line marker marks the line requesting service with resistance battery. At the other end, the matrix scanner scans all links for a path to an idle register. This path is detected by a current detector in the matrix scanner common circuit.

c. The pathfinding action is done by the matrix scanner circuit in three scans. The first scan selects an idle register and its associated SA stage of the SLN; the second selects the SB stage of the SLN; and the third selects one of five junctors connected to the SB stage. At the end of the third scan, a unique path from the local register to the line circuit is established. The SLN control operates the crosspoints of this path, checks for continuity, and, if successful, applies ground to the sleeve of the line circuit. This ground operates a cutoff relay in the line circuit and also provides holding ground for all crosspoints in the path. When the path is completed, dial tone is returned to the calling party and the SLN control then releases. The time required to connect a calling party to an idle register and to apply dial tone is approximately 65 milliseconds.

24.10 Trunk Service Link Network Control.

a. The TSLN control assists in establishing a connection from an incoming trunk to a trunk register.

b. The incoming trunk marker marks the trunk and seizes the TSLN control. A path is established to an idle trunk register by end-to-end marking similar to SLN control application. The TSLN application differs in the fact that each incoming trunk has its own junctor, allowing a path to be established in only two scans.

c. The first trunk scan selects an idle trunk register and the associated TSA stage of the TSLN. When the incoming trunk marker seizes the TSLN control, it also identifies the grid containing the calling trunk by operating the TSLN grid selector. The grid selector, being a switchthrough circuit, enables the matrix connector circuit in the proper grid of the TSA stage of the TSLN. At the end of the first scan, the TSLN control operates the matrix connector circuit to establish a path from the idle trunk register to the TSA stage of the TSLN.

d. The second scan establishes which output from the TSA stage has a path to the incoming trunk. When this path is detected, marking, tip-ring continuity check, and release functions similar to those described for the SLN spplication occur. The time required to connect an idle trunk register to an incoming trunk is approximately 50 milliseconds.

24.11 Trunk Link Network Control.

a. The TLN control does the control functions necessary to establish a transmission path through the TLN. It works on the principle of end-to-end marking with one call at a time.

b. When junctor switchthrough occurs, a request is forwarded to the TLN control to begin scanning for a free path through the matrix. The first TLN control scanner scans the 25 groups of 15 lines between the H, G, and FB stages and a ground through the FA and FB stages to detect marking current from the marker through the H, G, and FB stages and a ground through the FA, E, and D stages. When a path in one of the groups is detected, that scanner stops and the second scanner starts scanning to find a free link within the group which corresponds to a particular FB-stage module. The second scanner stops when a module is selected, and scanner No. 3 starts to scan the output links of this module, to select one of five G-H grids. When the grid is selected, scanner No. 3 stops and scanner No. 4 starts to scan the outputs of the H-stage grid, to select 1 link out of 50. When this link is determined, scanner No. 4 stops and this unique path through the TLN is marked, to operate the crosspoints.

c. At this time, call processing is completed by the junctor control, which checks continuity and ensures a sleeve-holding ground. When continuity of the path is confirmed, the TLN control and junctor control release.

24.12 Junctor Control.

a. The junctor control does the functions to complete a terminating call. Two junctor controls, regular and standby, are provided for each ESC-1 system.

b. When a register receives sufficient digits for terminating a call, it seizes either the number or code translator to start the terminating process. The number or code translator, depending on the type of call (local or trunk), does the necessary translation and seizes the line marker (local call) or outgoing trunk marker (trunk call). The marker, in turn, seizes the junctor control associated with the junctor which received a switchthrough signal from the register. The junctor control seizes the TLN control which, in turn, does the pathfinding through the TLN. After a path is found, the TLN control causes the junctor control to close the crosspoints in the established path and to do a continuity test. When continuity is confirmed, the junctor control signals the junctor to switch through the calling party. On local calls, the junctor control informs the ringing control as to what ringing instructions are to be followed. When the path is established, the junctor control releases.

24.13 Registers.

a. Two types of registers are used: local registers and trunk registers. The local register contains a register DPA equipped with optional TONE-DIAL receiver (TDR) and, when required, ANI and/or coin detector. The trunk register contains a similar DPA but without a TONE-DIAL receiver, ANI, or coin detectors; it, however, can be equipped with an MF detector. Up to 20 local registers can serve 2 LUs, and 20 trunk registers can serve up to 300 incoming or 2-way trunks.

b. The register DPA serves as an interface between either the SLN or TSLN and the associated local or trunk register circuit. The register DPA indicates to the SLN or TSLN the busy/idle state of the register. When a register DPA is used in conjunction with the SLN, it returns dial tone to the calling party.

c. The register storage contains a semipermanent memory that stores the digits received.

d. The register output circuit acts as a buffer between the register common and the register storage. It generates COS requests and processes party-line-identification and coin-detect signals.

e. Local and/or trunk register features:

1. Provide dial tone (local).
2. Send wink start, when required (delay-dial trunk).
3. Store up to 12 dialed-in digits.
4. Store up to three routing digits.
5. Store equipment number of calling line.
6. Store calling COS.
7. Store type-of-call code.
8. Store calling directory number (local).
9. Receive either DP or DTMF information (local).
10. Receive DP or 2-out-of-6 (2/6) MF information (trunk).
11. Have access to a maximum of 10 senders per 20 registers. (Arrangements available are 20 registers to 5 senders or, in high traffic situations, 10 registers to 5 senders.) The senders can outpulse in either DP or MF mode.
12. Detect tip or ring party (local).
13. Provide paystation coin detection, when required.
14. Provide critical or noncritical timeout.

24.14 Senders.

a. The sender works in conjunction with a register to provide DP pulses or optional MF signals to a distant office. It consists of two portions: the sender output and the sender common and its control circuit. (A maximum of 5 senders can be provided for every 10 registers.)

b. The sender common circuit operates in conjunction with the sender output and sender control circuits. When seized by a register, it receives and stores outpulsing information from the code translator. It counts and memorizes the number of outpulsed digits and instructs the register common circuit which digit to enable next. The sender common circuit detects end-of-routing digits (if routing digits have been outpulsed) and also controls the steering-out of the calling party's identified directory number.

c. The sender control circuit receives DP or MF outpulsing instructions from the sender common and forwards this information to the sender output circuit.

d. The sender output circuit repeats dial pulses or converts binary information to MF signals for transmission to a distant office.

e. Sender features:

1. Provides DP pulses at the rate of 10 pulses per second (pps).
2. Provides toll MF signals at the rate of 7 pps (optional).
3. Provides skipping of up to 12 digits.
4. Provides sending of up to three routing digits in DP or MF.
5. Provides stop-go or wink-start detection.
6. Sends ANI on DDD calls.

24.15 Register Common.

a. The register common circuit serves as the common control for the 60 registers and 30 senders of the register group. A maximum of four register commons can be provided in an office. For service protection, a maximum of 20 registers serving 2 LUs is served by 2 register commons.

b. The register common provides interface and common control functions between three register-sender groups and the number and code translators. All information sent and received by the translator from the register is timeslot controlled. A register timeslot of 508 microseconds duration is assigned to each register. There are 64 register timeslots of which 60 are used to provide a maximum of 60 registers per register common.

c. Each register timeslot is subdivided into 64 "information" timslots which are common to all registers. Each information timeslot is of 4 microseconds duration and is separated from the next one by 4 microseconds.

d. A register timeslot is used to enable a register; information timeslots are used to gate information in or out of the register that was enabled.

e. The register common does the following additional functions:

1. Examines access and office-code digits to establish the type of call.

2. Controls the steering-in of digits dialed into the register storage.

3. Controls the steering-out of digits when outpulsing or MF sending is required.

4. Decodes the single-digit, office-code prefix into three-digit office codes applicable to the exchange.

5. Provides access to the translator, fault recorder, and maintenance console.

6. Receives all-sender-busy conditions.

24.16 Number Translator.

a. The number translator does the dual function of converting the dialed directory number into the equipment location as well as converting the equipment location into the directory number.

b. On originating calls, the number translator receives the equipment number of the calling line from the register and translates this number into the directory number of the line. The translator also provides the register with the COS and miscellaneous information assigned to the calling line.

c. On terminating calls, the number translator receives the directory number of the called line and translates this number into the line equipment location and ringing code. The translator also provides the line marker with the COS and miscellaneous information assigned to the called line. The translator can provide information for consecutive as well as nonconsecutive PBX hunting and other miscellaneous information.

d. All information required for number translation is stored in a read-only memory which can be easily altered and updated as required. The memory devices employed are ferrite U cores which are operated as pulse transformers. For translation of directory numbers, cores are provided to obtain the equipment numbers, miscellaneous information, and COS. The miscellaneous information indicates such things as the ringing codes, PBX lines, intercept, jump instructions, last line of PBX hunting group, and DID PBX lines.

e. Cores are provided for translation of equipment numbers into directory numbers. These cores also provide miscellaneous and COS information. The miscellaneous information indicates the calling office-code prefix, centrex lines, lines requiring digit prefixing, and lines requiring operator number identification (ONI). These cores are driven by pulses from drivers in the number translator. The interrogate winding consists of a single wire threaded through the proper cores to produce the desired output data. Each core has a sense winding wired to a logic register in the translator output register circuit. See figure 17.

f. The translator circuit is accessed by the registers on a time-division-multiplex basis. This allows each register a time frame of 508 microseconds to gate information in and out.

g. Number translator features provide:

1. Translation of a maximum of 15,000 directory numbers into 10,000 equipment numbers.

2. 225 COS combinations for lines and trunks.

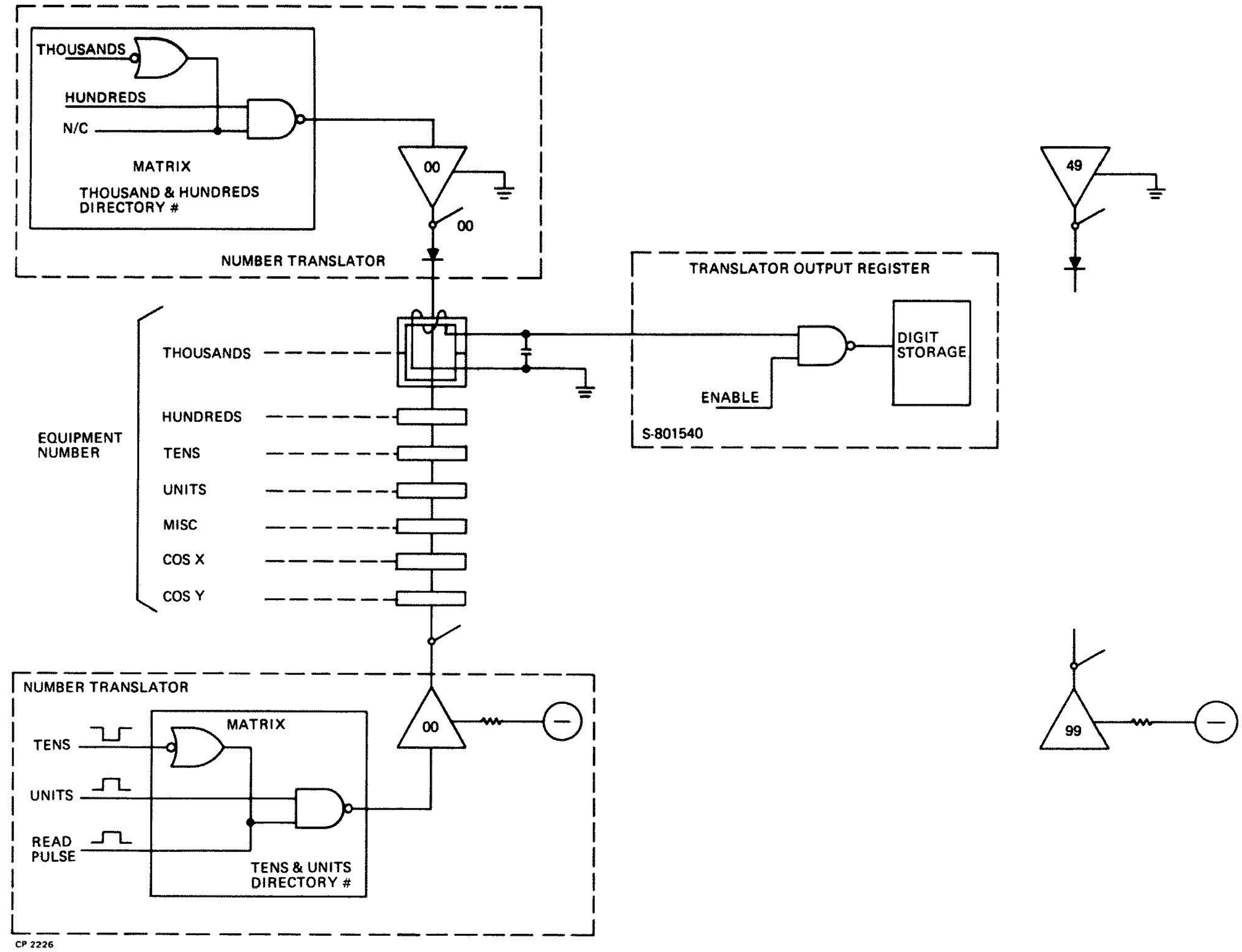


Figure 17. Example of a Directory Number to Equipment Number Translator

3. Identification of five central-office prefixes (two for accounting purposes only).

4. Ringing codes for four and eight parties.

5. ONI for more than two party lines.

6. Reverting calls by directory number.

7. Use of a maximum of three central-office prefixes with the same directory numbers.

8. Printout of calling equipment numbers and called directory numbers for malicious calls.

9. Printout of calling equipment numbers and called directory numbers in case of timeout or fault detection.

10. Blocking of two local central-office prefixes.

11. Consecutive and nonconsecutive PBX hunting with a given marker group.

12. PBX night service.

13. Various intercept codes.

14. DID to PBXs requiring two-, three-, or four-digit outpulsing.

15. Operator-busy verification by COS and prefix, or by COS only.

24.17 Code Translator.

a. The code translator translates central-office prefixes, area codes, and special service codes into routing information.

b. Code translator features provide:

1. One- through 6-digit translation, with initial capability of 48 codes.
2. Six hundred forty 6-digit translation codes per code expander (up to 3 code expanders can be equipped).
3. Alternate routing; primary route and up to three alternate routes.
4. Routing by COS.
5. Routing by critical timeout.
6. Critical timing start.
7. Call restriction by COS.
8. Conflicting code detection and intercept.
9. No return of equipment-busy until last digit is dialed.
10. Emergency and operator calls from paystations without depositing coin.
11. Early or delayed outpulsing, as required.
12. Maximum of 100 trunk group numbers.
13. Prefix a maximum of three routing digits.
14. Skip from 1 to 12 digits.
15. Optional extended area service (OEAS).
16. Wink start.
17. WATS service for one originating area.

25. TEST AND SUPERVISORY CIRCUITS

25.01 Test Panel.

a. The test panel (fig. 18) provides maintenance personnel with the facilities necessary for line testing in an ESC office. The test panel consists of pushbuttons, rotary dial, meter, test telephone jack, and a selector switch.

b. Access to the ESC for testing is done through test trunks, line circuits, or MDF test trunks. Tip and ring binding posts are provided to connect test equipment through the test panel circuit to a line.

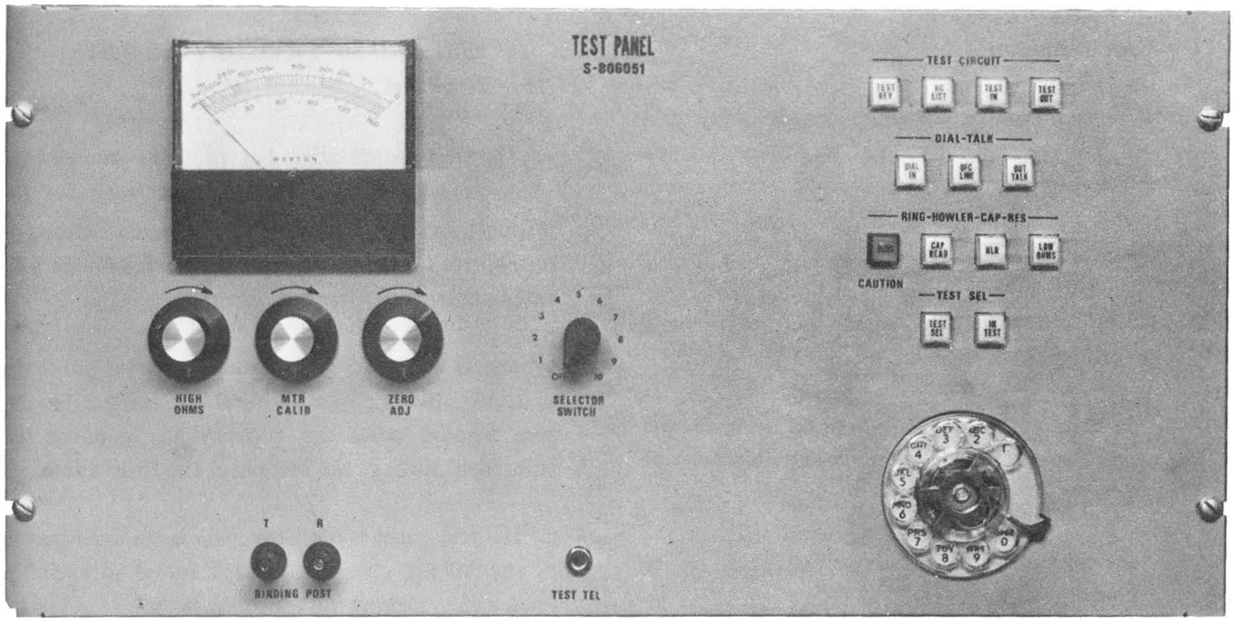
c. The test panel is used for making on-line listening and talking checks, to check access to exchange lines, and in making the following tests:

1. Ringing.
2. Howler.
3. Tip, ring, and loop capacitance.
4. Tip and ring voltage.
5. Tip, ring, and loop resistance.
6. Tip-to-ring leakage resistance.
7. Generator ground cutoff.
8. Heat coil.
9. Reverse polarity.

25.02 Maintenance Test Console.

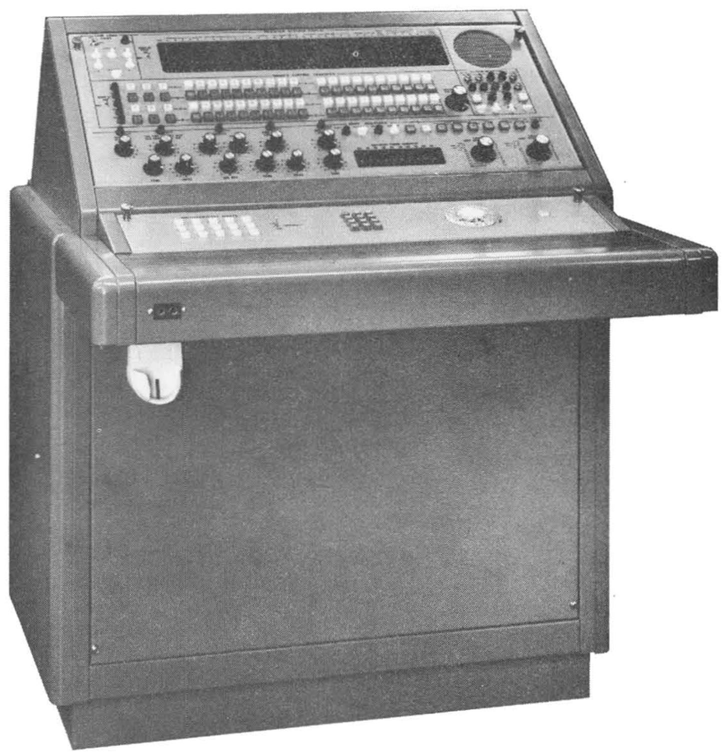
The MTC (fig. 19) is used to monitor and to routine specific portions of the system. The console houses the following circuits:

a. Equipment routiner (fig. 20) is used to aid maintenance personnel in locating or simulating troubles. When test calls are placed through the system, specific parts of the common equipment can be selected at the test console for routining. In addition, with the use of cabinet frame jacks and the operation of proper controls, any line circuit, incoming trunk, register, junctor, outgoing trunk, or



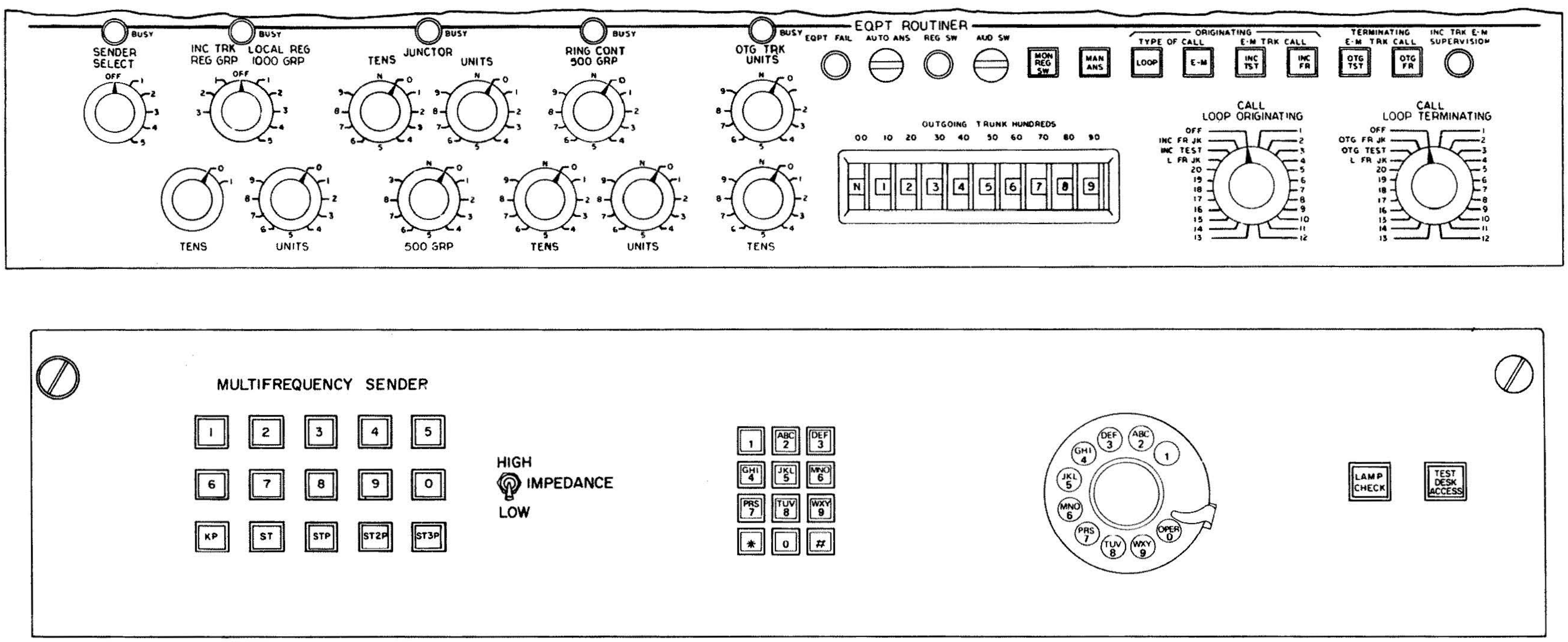
HT 1949

Figure 18. ESC-1 Test Panel



HT 3417

Figure 19. Maintenance Test Console



CP-2597A

Figure 20. Equipment Routiner

ringing control can be selected for routine testing. All routine tests are made under actual call conditions. The progress of the test call is displayed by lamps on the display panel of the test console.

b. Register storage display is used to visually display all information stored in a particular register during a test call.

c. Alarm monitor provides a visual display of all office alarms. Alarm disabling and monitor controls are also part of this circuit.

d. Remote control transfer displays status of all common equipment and whether the regular or the standby unit is in service. Transfer of common equipment from regular to standby can be made by means of appropriate pushbuttons.

e. Line load control common allows desired line groups to be taken out of service in a predetermined priority sequence. This provides a means of selectively restricting calls during emergencies and allowing the handling of essential traffic only.

25.03 JCTR/TLN Control Test Panel.

The JCTR/TLN control test panel (fig. 21) is provided to test the junctor controls, TLN controls, and all available paths through the TLN matrix. The unit can be used to test either on-line or off-line circuits. When used for testing on-line circuits, it operates in conjunction with the MTC and the fault recorder.

25.04 Fault Recorder.

a. This equipment consists of an FRC circuit and a TTY (fig. 22). The main function of the fault recording equipment is to assist in locating troubles within the system. Maintenance instructions to interpret fault printouts are provided as an aid in troubleshooting.

b. Any time a call is not properly originated or terminated within a preallotted time period, a fault printout is initiated. This feature is provided in all major common circuits.

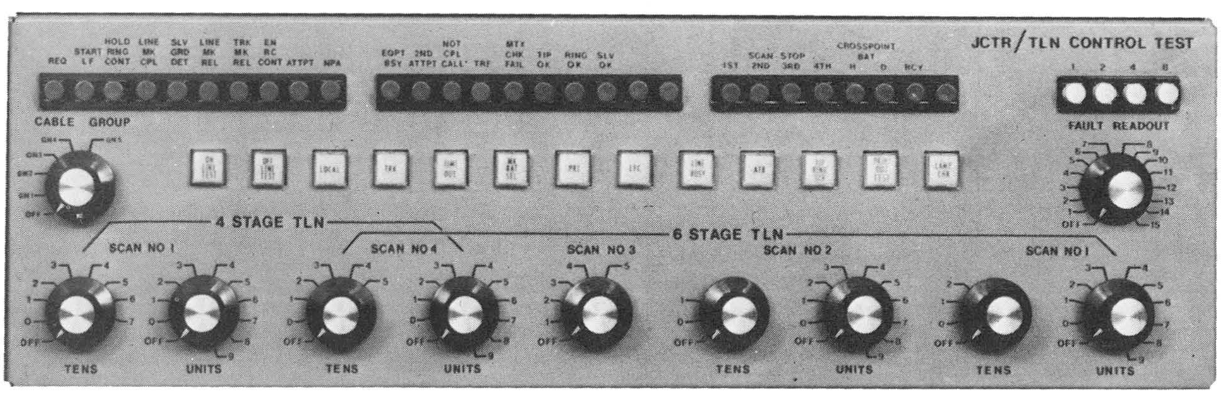
25.05 Date-Time Calendar.

a. The date-time calendar (fig. 23) is a self-contained, integrated logic circuit. It provides minute, hour, day, and month signals to the fault recorder at the time of printout.

b. One date-time calendar panel is provided per office. It is located in the supervisory cabinet. This panel also contains a selector switch and lamp display to monitor date and time signals. Failure of the clock pulse or self-contained positive 5-volt power supply produces an alarm.

25.06 Automatic Call Generator.

a. An automatic test routiner (fig. 24) is provided to generate and check test calls through the system. A ring-core programer is provided for setting into the



HT 2405

Figure 21. JCTR/TLN Control Test Panel

HT 3382

Figure 22. Teletype Machine

generator up to 20 line-to-trunk and 20 trunk-to-line test calls. The generator can be strapped to originate test calls between the limits of once every 24 seconds and once every 2 minutes.

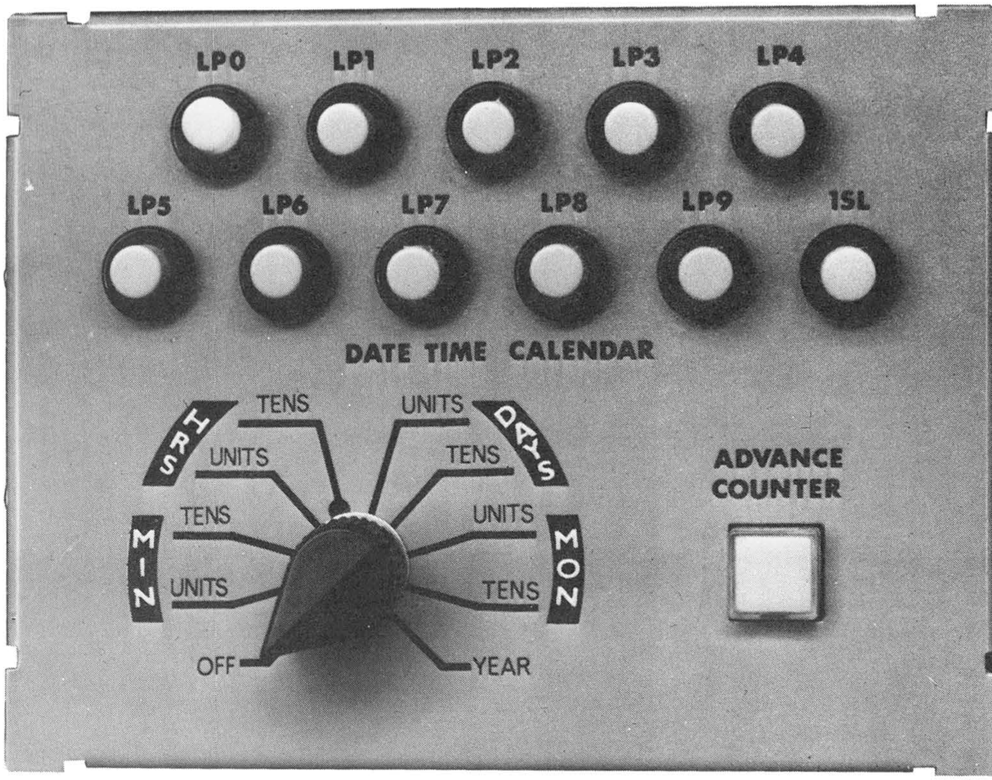
b. Programing a test line in each LU and a test trunk in each trunk common control group for test calls ensures automatic testing of all common control elements, junctors, and ringing controls.

c. The generator usually remains in continuous operation. It generates an alarm if an excessive number of test calls fail.

25.07 Common Supervisory.

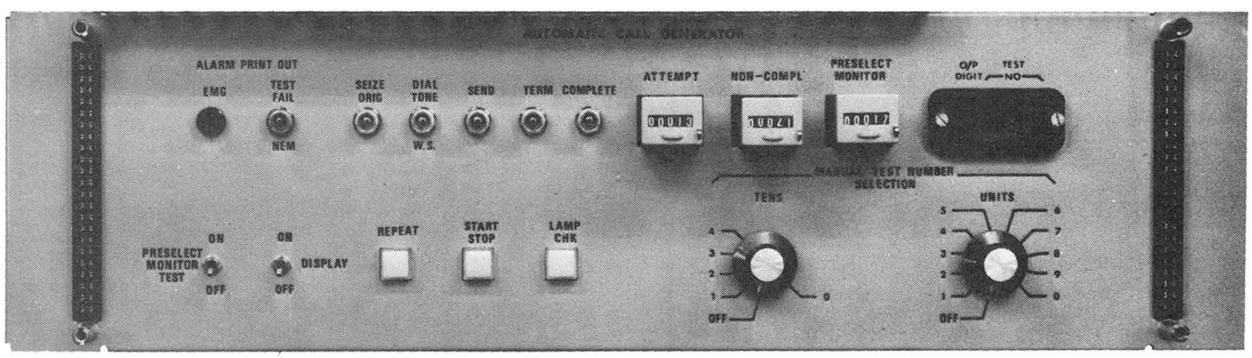
a. Any alarm condition in the system is detected in the common supervisory circuit. One common supervisory circuit is provided per office. It is located in the supervisory cabinet.

b. There are two classes of alarms: major and minor. Blown fuse, power failure, or failure of both tone supplies causes a major alarm. Carrier failure, heat-coil activation, supervisory cabinet minor alarm, delay alarms, or failure of one of the two common control circuits causes a minor alarm. All minor



HT 1947

Figure 23. Date-Time Display Panel



HT 1948

Figure 24. Automatic Call Generator, Control Panel

alarms are sent immediately to the alarm and monitoring circuit; delayed alarms are normally sent after a 2-4 minute delay; and permanent signal alarms are sent after an 18-24 minute delay.

c. Alarms, visual and audible, can be terminated internally or sent over a trunk circuit to a remote office. An assigned directory number is reserved for alarm checking from remote locations. When the alarm-checking number is dialed, the appropriate audible code representing the alarm status of the office is returned to the caller. A major alarm results in no tone or signal being returned to the caller; some minor alarms cause a 120-ipm tone to be returned, others cause a 60-ipm tone to be returned; a no-alarm condition causes a 2-ring code to be returned; and a permanent-signal alarm causes a 1-ring code to be returned.

25.08 Precise Tone Plant.

a. The precise tone plant is a dc-operated unit consisting of a primary and a secondary tone generator. One precise tone plant is provided per office.

b. All tones used in the system are of the precise-tone type, consisting of four basic tones: high tone, low tone, dial tone, and ringback tone. Failure of a single-tone output causes all four tones to be transferred to the standby unit. This type of failure produces a minor alarm.

25.09 Electronic Interrupter.

The electronic interrupter is an integrated-logic circuit with mercury-wetted relay contact outputs. Regular and standby electronic interrupters are provided.

26. POWER

26.01 Charger and Battery.

a. The system operates from negative 48-volt and positive 8-volt power supplies provided by chargers operating on commercial ac power. The batteries act as standby and are used when the commercial ac power fails.

b. The battery chargers are of the full-float type, using solid-state rectifiers and operating from either 115-volt, single-phase, 60-Hz or 208/240-volt, 3-phase, 60-Hz, depending on office size.

c. The negative 48-volt battery has 24 cells and the positive 8-volt battery has 4 cells. The busy-hour reserve for the battery is specified according to office requirements.

26.02 Power Distribution.

a. The negative 48 volts and positive 8 volts are routed from the chargers and standby battery through appropriate fuses to the power distribution circuit.

b. The negative 48-volt supply is connected through a shunt and ammeter to the negative 48-volt battery bus. A series of circuit breakers, part of the power distribution circuit, is connected to the output of this bus. These breakers provide the system with transmission battery, switching battery, and common equipment battery.

c. Transmission battery can be increased to 76 volts when loop resistance exceeds 1900 ohms. This is done by strapping in the battery distribution circuit and by adding a special, dc-operated, transmission battery supply.

d. The positive 8-volt supply is connected to battery buses in the same manner as the negative 48-volt supply. Instead of circuit breakers in series, as in the negative 48-volt supply, individual circuit breakers are provided. The 8-volt supply is used in the common equipment only.

e. The recommended voltage of all integrated circuits in the common equipment is positive 5 volts. This voltage is obtained by converting the positive 8-volt supply into a closely regulated, positive 5-volt supply.

PART IV. OPERATION, TYPICAL CALLS

27. LOCAL-TO-LOCAL CALL

27.01 Dial-Tone Connection (Fig. 25).

a. When a local subscriber goes off-hook, the loop across the line is detected by the associated line circuit, operating the associated line relay (LR). A path is now established through the contacts of relay LR, signaling the scanner that a line is off-hook.

b. In the idle condition, the hundreds and tens counters of the line scanner are continuously scanning groups of 10 line circuits, searching for an off-hook signal. When an off-hook signal is detected, the hundreds and tens counter in the scanner is stopped. With the hundreds and tens counter stopped, the units counter is started. When the count in the units counter matches the units digit of the off-hook line circuit, the units counter is stopped. This causes relay HT in the line circuit to operate, establishing a mark path to the LLN. The position of the counters (hundreds, tens, and units) represents the line equipment number. At this time, the line marker is seized and receives, from the scanner, BCD signals representing the equipment number of the calling line. One scanner is associated with each two line units, so the appropriate thousands digit is determined by the marker used.

c. The line marker now signals the SLN control to connect the calling line to an idle register DPA. The line marker also indicates to the SLN control which of the two LUs controlled by this SLN is requesting service. The line marker, by using the units digit of the equipment number, connects mark battery to the units mark lead. After a register is connected to the calling line, the complete equipment number is forwarded through the equipment number distribution circuit to the register storage where it is stored until the register is released.

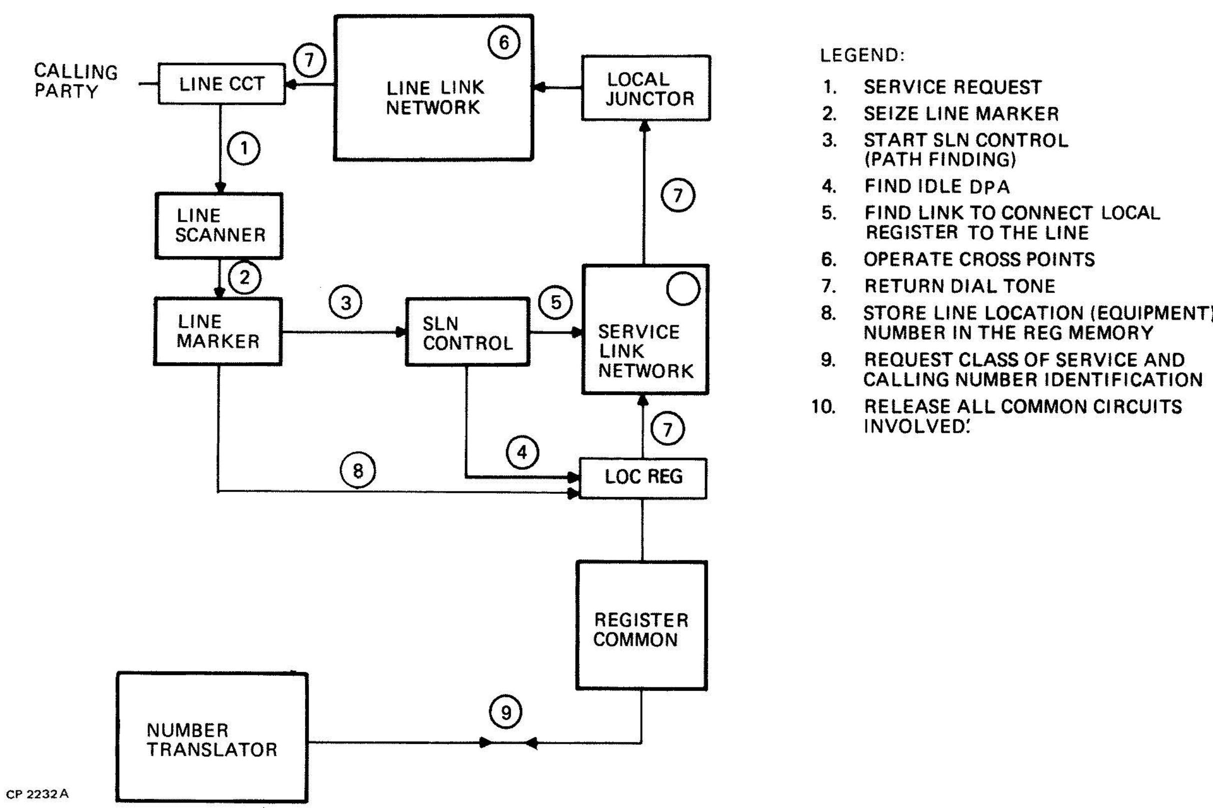


Figure 25. Dial-Tone Connection, Functional Diagram

d. The SLN control now starts the pathfinding process to connect the calling line to an idle register. This is done by end-to-end marking through the LLN, an idle junctor, and the two stages of the SLN (SA and SB). Three scans by the matrix scanner are required to establish this connection. The first scan selects an idle register and its associated SA stage of the SLN. The second scan selects the SB stage of the SLN matrix which has an idle path to the previously selected register. The third scan selects one of five junctors that have access to the selected SB stage of the SLN matrix. The selected junctor has its own unique path through LLN stages A,B, and C to the calling line.

e. At the end of the third scan, the SLN control applies ground to the mark lead of the selected path. This ground closes all crosspoints in the path by energizing the windings of all relays in the mark lead path. A tip-and-ring continuity test is then done by the SLN control to ensure that the crosspoints in the chosen path have operated properly. When continuity is confirmed, ground is applied to the sleeve lead in the register DPA. This ground operates the cutoff relay (CO) in the line circuit and all the guard relays associated with the links of the selected path. The register returns dial tone to the calling party. The equipment number of the calling party is stored in the register storage at this time.

f. When the path to the register is completed, the register accesses the number translator during the timeslot interval assigned to that register. The equipment number and COS check request are sent to the number translator. The number translator uses the equipment number to identify the directory number, COS, and miscellaneous information of the calling party.

27.02 Dialing.

a. The calling party can be equipped with a rotary-dial or TONE-DIAL telephone. All register DPAs can be equipped with tone detection as an option.

b. When the calling party receives dial tone and dials the number of the called party, the pulses of the dialed digits are detected in the register DPA by a magnetic core sensor which is a current detector. The unsaturated or saturated state of the core represents an open or closed loop, thus enabling the detection of off-hook conditions and dial pulses. When the core is saturated, a transistor in the register DPA is turned off, indicating an off-hook condition. As a digit is dialed, contacts of the dial open and close the loop, turning a transistor on and off, respectively.

c. The digits received by the register DPA are stored in the register storage circuit under control of the register common circuit. The first three digits dialed are decoded by BCD-to-decimal converters in the register common and are used as inputs to the register common strapping field. This strapping field is strapped, according to office requirements, to produce the proper type-of-call (TOC) signals. The following types of calls can be strapped in the register common equipment:

1. Local calls (maximum of three central-office prefixes).
2. Busy verification.
3. DDD trunk call.
4. Emergency call 911.
5. PPCS (0–, 0+).
6. EAS.
7. DID.

d. If, after three digits have been dialed, the register common recognizes that the call is to be intraoffice, a signal is sent to the register storage circuit to erase the three digits stored there. After four more digits are received and stored in the register, the number translator is seized for final translation.

27.03 Final Translation.

A TOC signal, indicating that the call is an intraoffice call, is forwarded from the register common to the translator together with the equipment number of the calling party, the directory number dialed, and the calling COS. The directory number dialed is translated into a called equipment number. The calling-party and called-party equipment numbers are now compared in the translator to see if any special routing is required. A COS check is also done to identify any special features and to determine whether special routing will be required to terminate the call.

27.04 Termination of an Intraoffice Call (Fig. 26).

a. The translator selects the proper line scanner by means of the thousands digit of the called-party equipment number. After the scanner is selected, the translator forwards the remaining hundreds, tens, and units digits, plus a ring code, to the line scanner. If the call requires special routing, a COS indication is also sent to the line scanner.

b. The line scanner does an idle/busy check and if the line is idle, the line marker is seized, marking the mark lead of the called line with resistance battery. A request signal is sent by the number translator to the register DPA which, in turn, sends it through the junctor which is connected to the calling party, to seize the junctor control. A start terminating local (STL) signal is also sent from the line marker to the junctor control, causing the junctor control to seize the TLN control. The junctor now connects to the TLN D stage and identifies the TLN grid and the D-stage switch within this grid that will be used for terminating the call. This is used to operate the TLN grid selector and TLN matrix selector associated with the selected D stage of the TLN.

c. The end-to-end marking principle is used to determine if a path is available to the called line circuit. This is done by applying sequential scan pulses from the TLN control, through the TLN and LLN, to the line circuit marked with resistance battery. When the path is established, the crosspoints of the TLN and of the LLN are operated, resulting in a path from the called line, through the junctor, to the junctor control.

d. A continuity test is now done to check whether a metallic path has been established from the local junctor. If the transmission loop is closed, a relay in

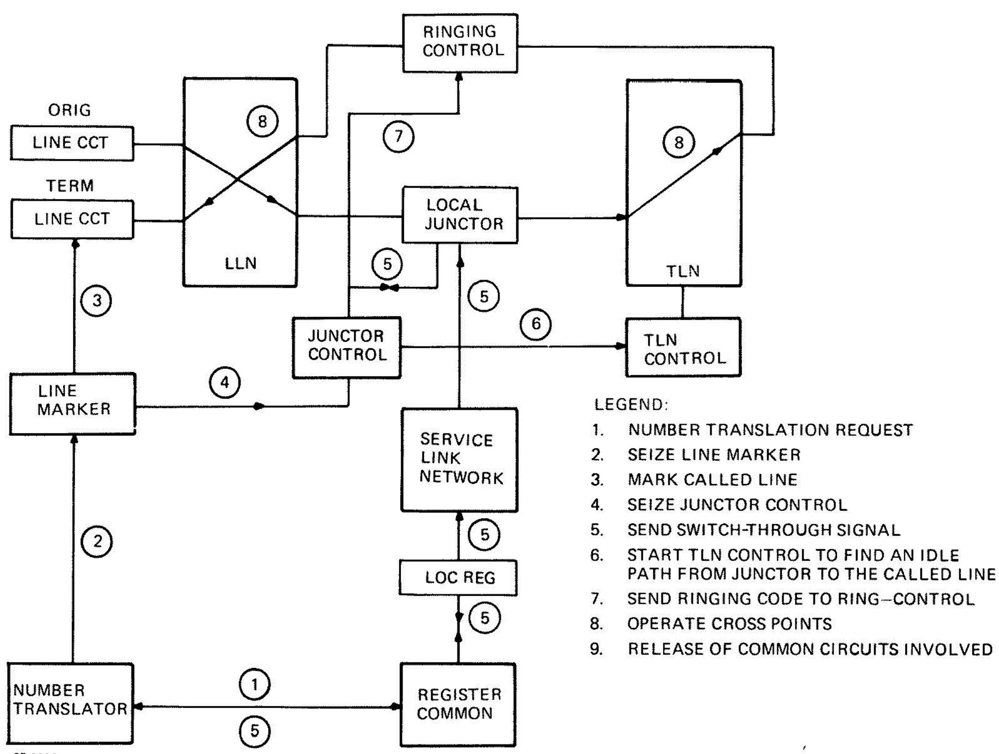


Figure 26. Termination of a Local Call, Functional Diagram

the junctor control operates, confirming continuity. When continuity is confirmed, the junctor control applies ground to the sleeve of the called line circuit (operating the cutoff relay) and requests the junctor to cut through the calling party. The junctor control then sends a release signal to the line marker which, in turn, releases the line scanner and number translator. The junctor control now releases, the sleeve ground being supplied by the junctor.

e. During this time, the ringing control provides splash ringing followed by successive ringing to the called party and ringback tone to the calling party. When the call is answered, ringing is tripped, and a metallic cutthrough path and battery feed are provided from the local junctor to both parties.

f. The call is under control of the calling party at all times except when the called party goes on-hook and the calling party fails to restore the on-hook condition within 20 seconds. In this case, the junctor releases forward removing ground from the sleeve lead, and 120-ipm busy tone is returned to the calling party.

28. LOCAL-TO-TRUNK CALL

28.01 General.

The following paragraphs describe a direct distance dialing (DDD) call with access digit 1 and ANI. The termination of other types of outgoing trunk calls is similar.

28.02 Seizure and Dialing.

The equipment seizure and dialing functions for this type of call are the same as those described in paragraphs 27.01 and 27.02.

28.03 Translation.

a. When access digit 1 is dialed, it is recognized by the TOC detector in the register common. The register common generates a signal for DDD which is written into the register memory. The presence of the TOC signal inhibits the TOC detector from all further action for this particular call. The same TOC signal directs the code translator to examine the called directory number as it is dialed and stored in the register.

b. When the code translator receives the second digit of the area code, it determines the number of digits required to complete the call. If the second digit stored is a 0 or a 1, a 10-digit expected signal is generated after the third digit, if not wired as a conflicting code. A 7-digit-expected signal is generated if the second digit of the first 3 digits is any number from 2 to 9. This digit-expected information is forwarded, in BCD form, to the register storage during a preallotted timeslot. This information is required later to control the outpulsing of the called number by the sender. When there is conflict between an area and office code, strapping in the code translator starts critical timing after the seventh digit has been dialed. If the register critically times out, the call is treated as a 7-digit call and an end-of-dial signal is generated. If the eighth digit is received, critical timing is cancelled and the call is treated as a 10-digit call.

c. As each digit is received by the code translator, the number of digits dialed is compared with the number of digits expected. When the two numbers match (digits dialed equal digits expected), the outgoing trunk marker is seized. This will occur only if the following conditions are met:

1. There is a sender available.

2. There is an appropriate DDD trunk available.

3. The number translator is not terminating an intraoffice call.

4. The calling COS indicates no restriction.

28.04 Termination of Outgoing Trunk Call (Fig. 27).

a. When the outgoing trunk marker receives the trunk group number from the code translator, the trunk marker acknowledges the seizure of the code translator and causes the translator to reject information from other registers until the call is terminated.

b. The outgoing trunk marker uses the trunk group number to operate a matrix for connecting resistance battery to the mark leads of all idle trunks in that group. In addition, the outgoing trunk marker

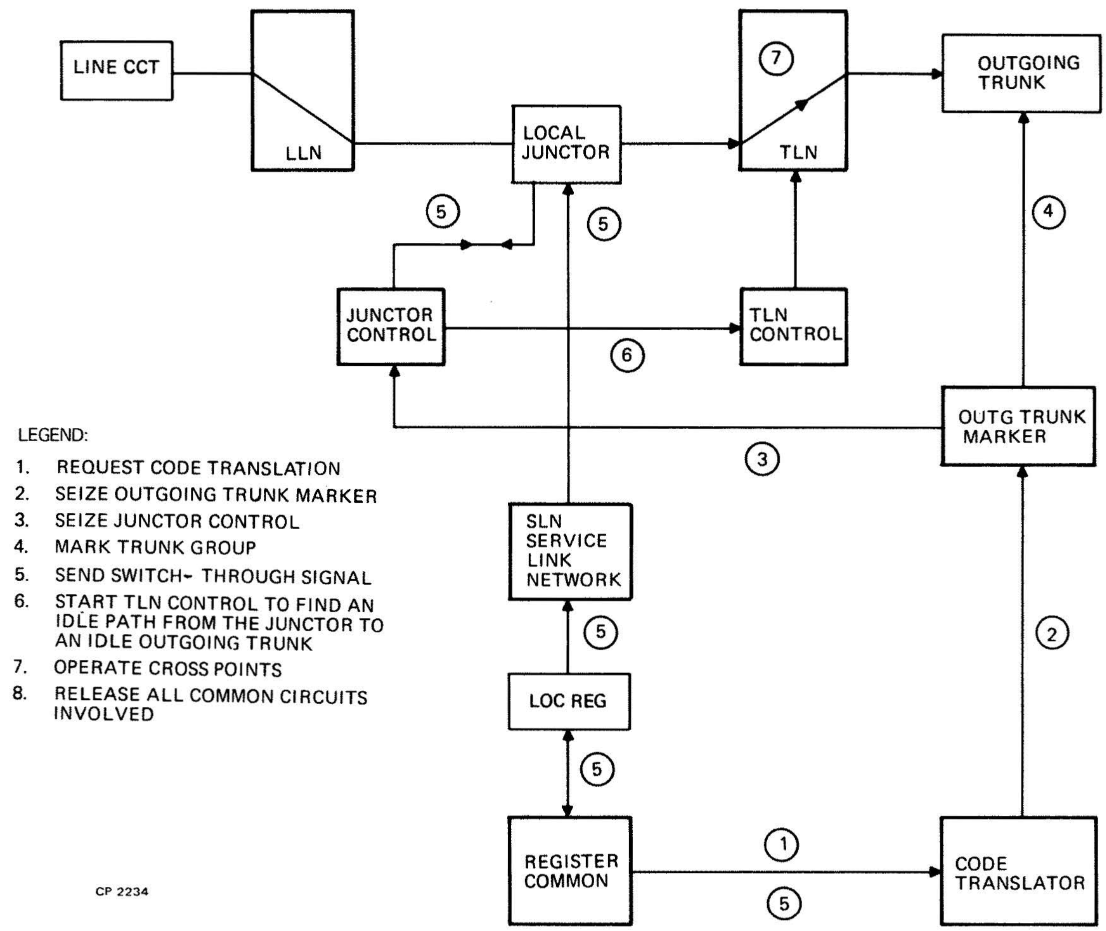


Figure 27. Termination of a Trunk Call, Functional Diagram

signals the junctor control to start termination of the call. At the same time, the code translator sends a switchthrough signal to the register which, in turn, grounds the switchthrough lead in the register DPA. Simultaneous signals from the outgoing trunk marker and from the register DPA complete the seizure of the junctor control. The junctor control now signals the TLN control to find a path from the junctor to an idle trunk. Additional information received by the register from the code translator at this time includes:

1. Mode of outpulsing.

2. Digits to be skipped.

3. Send calling directory number signal.

4. Send routing digit signal.

5. Delay sending (wink start).

c. When a trunk is seized, the junctor control initiates the release sequence for the outgoing trunk marker and the code translator. During this time, the register attaches itself to a sender that is connected through the DPA and local junctor to the outgoing trunk. According to instructions received earlier from the code translator, the called number followed by the calling directory number is now outpulsed to the DDD office. The calling number is not outpulsed until requested by an off-hook signal from the ticketing office. When the outpulsing is complete, the register releases, and a metallic path from the local junctor is cut through to the outgoing trunk.

d. If any of the previously stated requirements for seizing the outgoing trunk marker were not met, the following conditions would have arisen:

1. No sender is available. The calling party holds the register until a sender becomes available or the register times out.

2. No trunk is available. The outgoing trunk marker gains access to the junctor control which switches the local junctor into a busy state and returns 120-ipm busy tone to the calling subscriber.

3. A local call is in progress. The call is delayed in the register until the local call is established.

4. COS indicates a restriction. The outgoing trunk marker is seized and the call is routed to intercept.

29. TRUNK-TO-LOCAL CALL (FIG. 28)

29.01 Incoming Trunk to Register Seizure.

a. The incoming trunk scanner is continuously scanning all incoming trunks. When a calling trunk is detected, the scanner stops and the position of the scanning counter represents the equipment number of the seized trunk. If the all-register-busy detector determines that all registers are busy, the incoming trunk marker instructs the trunk scanner to ignore the service request. When all registers of a group (20) are busy, accelerated timeout occurs until an idle register is available. If, however, a register is available and connected, the incoming trunk marker sends the trunk equipment number to the register, a trunk selection signal to the TSLN grid selector, and a seizure signal to the TSLN control. The incoming trunk marker also supplies negative 48-volt mark battery, which is sent through the trunk group marking circuit, marking the trunk junctor associated with the incoming trunk.

b. The TSLN control, being seized, starts the pathfinding process using the end-to-end marking procedure. This pathfinding action is done by the matrix scanner common circuit in two scans. Since each incoming trunk is hard-wired to its trunk junctor, a third scan to select a junctor is not required.

c. The first scan identifies an available register and the associated TSLN matrix TSA stage. When the incoming trunk marker seizes the TSLN control, it also operates a relay in the TSLN grid selector, seizing the grid containing the calling trunk. The grid selector is a switchthrough circuit which enables the matrix connector circuit in the proper grid. At the end of the first scan, the TSLN control operates the matrix connector circuit associated with the identified TSA stage.

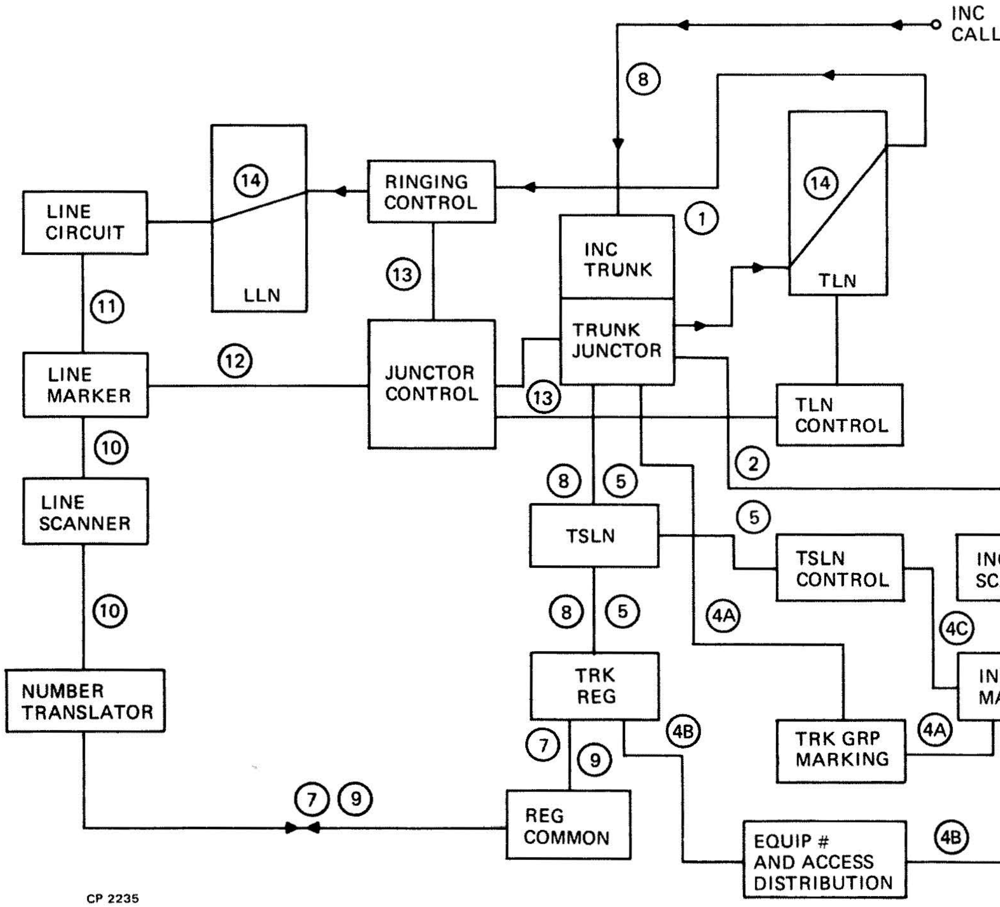
d. The second scan establishes which output of the TSA stage has an idle path to the incoming trunk. At the end of the second scan, the TSLN control applies ground to the mark lead. This ground closes all crosspoints in this path by energizing the operate winding of the relays associated with the mark lead path.

e. When this path is established, a tip and ring continuity test is done by the TSLN control circuit to ensure that all crosspoints have operated properly. If continuity is not confirmed, the selected path is dropped and a scan for a new path is initiated. When continuity is confirmed, ground is applied to the sleeve lead in the register DPA. The TSLN control now releases which, in turn, causes the release of the incoming trunk scanner and incoming trunk marker. A path is now established from the incoming trunk circuit to a register to receive signals from the distant office.

f. After seizure has been completed, the register accesses the number translator during the timeslot frame allotted to this register. The trunk equipment number, a request for a COS check, and an identification request are sent to the number translator by means of register timeslots. The number translator uses the equipment number as the address to reach a location in its own memory cores where the COS for the trunk can be found.

29.02 Dialing.

a. Certain incoming trunks may be associated with equipment that absorbs one or all of the central-office (CO) prefix digits in the calling office. These lost digits can be prefixed in the number translator. This is done by strapping in the translator memory core field. For those trunks that require a prefix strap, cores for a hundred, ten, and/or units digit are wired to represent the CO prefix digits which have been lost in the calling office.



LEGEND:

1. TRUNK SEIZURE
2. SEIZURE STOPS INCOMING TRUNK SCANNER
3. EQUIPMENT # OF TRUNK SENT TO INC TRK MARKER

4A. MARK INC TRK

4B. SEND EQUIPMENT # TO REGISTER

4C. MARKER SEIZES TSLN CONTROL

5. START PATHFINDING TO ESTABLISH PATH FROM JUNCTOR TO REGISTER
6. OPERATE CROSSPOINTS
7. REQUEST COS AND TRUNK EQUIPMENT #
8. RECEIVE DIGITS DIALED
9. NUMBER TRANSLATION REQUEST
10. SEIZE LINE MARKER
11. MARKED CALLED LINE
12. START TLN CONTROL TO FIND PATH FROM JUNCTOR TO CALLED LINE
13. SEND RINGING CODE
14. OPERATE CROSSPOINTS

Figure 28. Trunk-to-Local Call, Functional Diagram

b. Digits received from the calling office are stored in the register storage circuit. This circuit is under control of the register common. After the CO digits have been dialed, the register common recognizes that the call will be terminated within the local office. The register common instructs the register to erase the CO digits in storage at this time. After four more digits have been received, the number translator is seized by way of the register common for final translation.

29.03 Final Translation.

Information that the call is of a local type is forwarded to the translator, together with the equipment number of the calling line, directory number dialed, and the calling COS. Using the directory number as an address, the equipment number, ringing information, and COS of the called line are read from the number translator memory. The COS is checked by the translator to determine if any special functions are required to terminate the call.

29.04 Termination of Call.

The termination of an incoming trunk to local call is done in the same manner as that described in paragraph 27.04.

30. TRUNK-TO-TRUNK CALL (TANDEM)

30.01 The incoming trunk to register seizure for this type of call is the same as that described in paragraph 29.01. The dialing, translation, and termination are the same as those functions described in paragraphs 27.02, 28.03, and 28.04, respectively.

READERS COMMENT FORM

SCP No. ______________________ **Issue No.** ______________

Title ____

How did you use this publication?

_____ Product familiarization _____ Training

_____ Installation _____ Maintenance

Other ______________________________

Did you find this publication suitable for your needs?

_____ Yes _____ No

Please check specific criticism(s), give page number(s), and explain below:

_____ Clarification on page(s) _____ Deletion on page(s)

_____ Addition on page(s) _____ Error on page(s)

Explanation:

Cut along Line

Name ______________________________ Date ______________

Company ____

Address ____

Your Function ____

FOLD

FIRST CLASS
Permit No. 462
(Sec. 510 P.L.&R.)
Rochester, N. Y. 14603

BUSINESS REPLY CARD
NO POSTAGE NECESSARY IF MAILED IN UNITED STATES

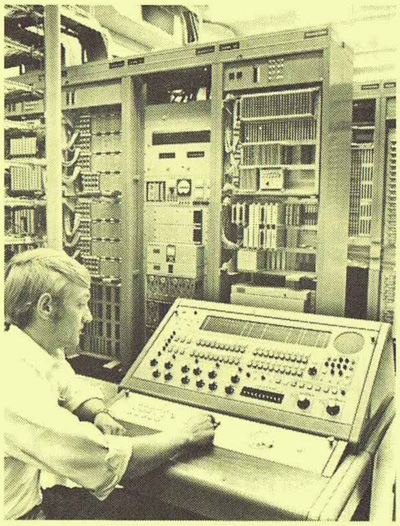
POSTAGE WILL BE PAID BY

STROMBERG-CARLSON CORP.
100 CARLSON ROAD
ROCHESTER, N. Y. 14603

Attention: Publications Department

FOLD

STAPLE STAPLE



CROSSREED® electronic switching center serving Hinckley, Ohio.

Stromberg-Carlson
A SUBSIDIARY OF GENERAL DYNAMICS CORPORATION

100 Carlson Road, Rochester, New York 14603

SCP 21-001-02/Issue 4/Jan. 76