TEST EQUIPMENT
DESCRIPTION
NO. 3 ELECTRONIC SWITCHING SYSTEM

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Table

1. GENERAL

1.01 This section describes the test equipment necessary to maintain a No. 3 Electronic Switching System (ESS) office. It is intended to familiarize the reader with the test equipment available to a No. 3 ESS office. Also, it is to be used as a reference source to more detailed information.

1.02 When this section is reissued, this paragraph will contain the reason for reissue.

1.03 In the No. 3 ESS, test equipment can be placed into one of two categories:

- Test equipment that is internal to the system
- Test equipment that is external to the system.

1.04 Test equipment that is internal to the system:

- Trunk and line test panel (TLTP)
- System status panel (SSP)
- Teletypewriter (TTY)
- 3A central control (3A CC) control panel
- Office alarm structure
- 71F milliwatt reference generator and distributing network
- 60A control unit (loop-around)
- TOUCH-TONE station test receiver
- False cross and ground and power cross detector test circuit
- Peripheral test unit which contains the following test circuits:
  - (a) Milliwatt and transmission environment test
  - (b) Station ringer test line
  - (c) Transmission test termination
  - (d) Dial pulse receiver test
  - (e) Incoming local test desk (LTD) trunk
  - (f) Continuity and polarity test
  - (g) Loop environment test
  - (h) TOUCH-TONE receiver (detector)
  - (i) Line insulation test
  - (j) Tone presence detector
- Protector test set
- Test talk facility.

1.05 Test equipment external to the system (may be in the office or shared among several No. 3 ESS offices):

- Pulse checking test set (J94723A)
- Contact closure test set (J94724A)

- Mercury contact relay test set (J94725)
- Clip-on milliammeter (Hewlett Packard Model 428B or equivalent)
- ODA dial-up data set (201A3)
- Oscilloscope
- 23A transmission measuring set (J94023A)
- 3A noise measuring set (J94003A)
- 6A impulse counter (J94006A)
- Voice frequency oscillator (KS-19353)
- PAR meter (J94027)
- Return loss test set (KS-20501)
- Attenuator (5A)
- Electronic counter.

1.06 The No. 3 ESS is compatible with a switching control center (SCC). The SCC provides the capability for remote control and monitoring of the No. 3 ESS office. The information it receives indicates office alarms, generalized trouble locating information, and system and building status. All TTY maintenance messages are received from the No. 3 ESS office by the SCC and stored.

2. PHYSICAL DESCRIPTION

2.01 Table A is a list of the test equipment pertinent to the No. 3 ESS office. This list provides the equipment location and operation.

3. FUNCTIONAL DESCRIPTION

INTRODUCTION

3.01 Testing consists of diagnostics which may be done routinely by the system or manually by the maintenance personnel. Testing, therefore, results in replacement of pluggable equipment diagnosed as faulty by the system; it also results in recognition of failures beyond system ability to diagnose. This section describes the functions of test equipment needed when programmed diagnostics and replacements do not solve the problem.

TEST EQUIPMENT INTERNAL TO THE SYSTEM

A. Trunk and Line Test Panel (TLTP)

3.02 The TLTP (Fig. 1) is a manual test facility for performing various transmission and operational tests on trunks, service circuits, lines, and junctors.

3.03 The following test capabilities are provided by the TLTP:

- Operational and transmission tests of trunks, junctors, lines, and service circuits
- Leakage and continuity checks on lines and trunks
- Complete functional testing of subscribers lines
- Transmission checks on subscribers lines, PBX-type trunks, and interoffice trunks
- Removal of trunk circuits, junctors, lines, and service circuits from service and restoring to service under key control
- Voice communication via private lines and regular telephone channels to other points within the No. 3 ESS office and to distant offices
- Removal of peripheral decoder (PD) boards from service under key control.

3.04 The TLTP is equipped with a voltmeter (KS-19395) and may have an optional 23A transmission measuring meter (KS-20355). These meters are used to indicate testing results.

B. System Status Panel (SSP)

3.05 The SSP (Fig. 2) provides indications of normal as well as emergency and alarm conditions. The SSP provides designated keys to implement system emergency manual control as well as keys for test control, alarm control, and panel power. Visual indications are provided also, to relate instantaneous system status. The types of indications include system control status, other equipment status, equipment troubles, and power failures.

TABLE A

TEST EQUIPMENT FOR NO. 3 ESS

TEST EQUIPMENT	LOCATION	OPERATION	FIGURE
A. PART OF NO. 3 ESS SYSTEM			
Trunk and Line Test Panel	Test Frame	Manual	1
System Status Panel	Maintenance Frame	Software Manual	2
Teletypewriter	Maintenance Frame	Software Manual	3
3A CC Control Panel	Processor Frame	Software Manual	4
Office Alarm Structure	Through-out No. 3 ESS	Software	—
71F Milliwatt Reference Generator and Distributing Network	Test Frame	Software	5
60A Control Unit	Test Frame	Software	5
False Cross and Ground and Power Cross Detector Test Circuit	Control Frame	Software	—
Peripheral Test Unit	Test Frame (behind TLTP)	Software	5
B. EXTERNAL TO NO. 3 ESS			
Pulse Checking Test Set (J94723A)	Portable	Manual	—
Contact Closure Test Set (J94724A)	Portable	Manual	—
Mercury Contact Relay Test Set (J94725)	Portable	Manual	—
Clip-on Milliammeter	Portable	Manual	—
Oscilloscope	Portable	Manual	—
23A Transmission Measuring Set (J94023A)	Portable	Manual	—
3A Noise Measuring Set (J94003A)	Portable	Manual	—
6A Impulse Counter (J94006A)	Portable	Manual	—
Voice Frequency Oscillator (KS-19353)	Portable	Manual	—

TABLE A (Cont)

TEST EQUIPMENT FOR NO. 3 ESS

TEST EQUIPMENT	LOCATION	OPERATION	FIGURE
B. EXTERNAL TO NO. 3 ESS (Cont)			
PAR Meter (J94027)	Portable	Manual	—
Return Loss Test Set (KS-20501)	Portable	Manual	—
Attenuator (5A)	Portable	Manual	—
Electronic Counter	Portable	Manual	—

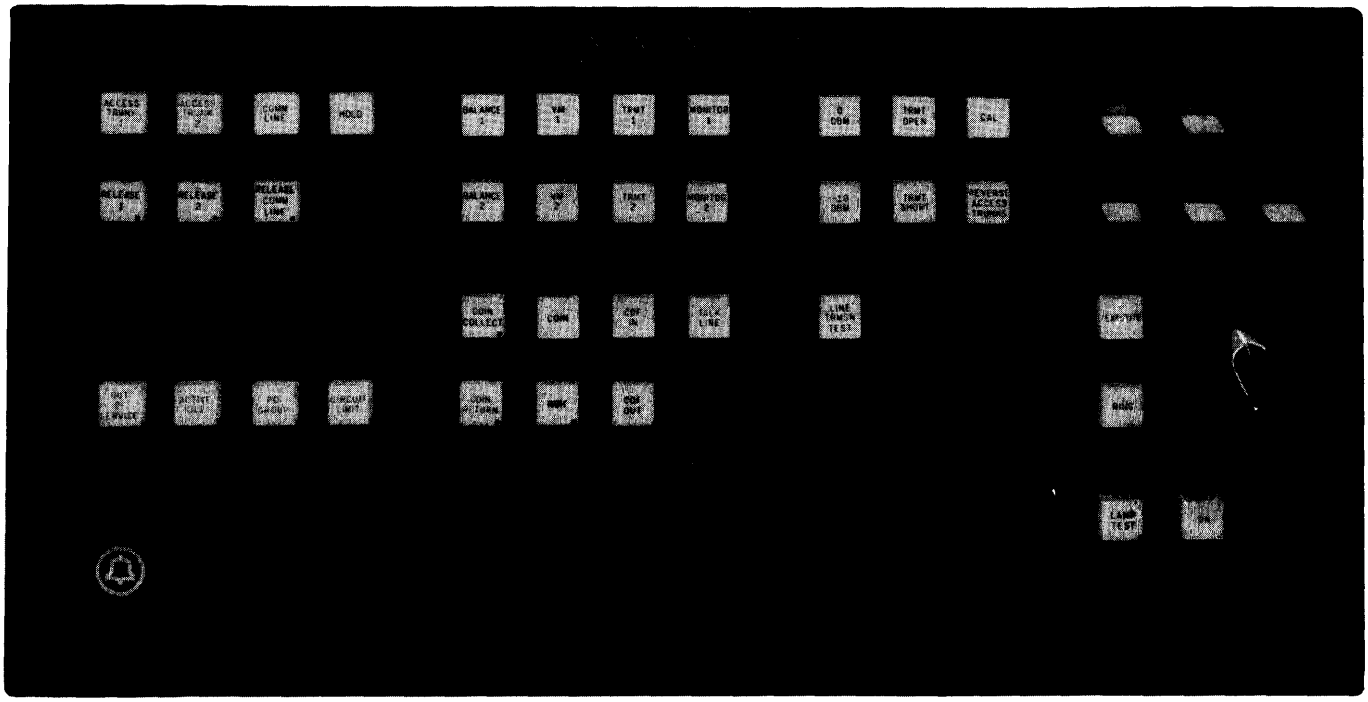

Fig. 1—Trunk and Line Test Panel

C. Teletypewriter (TTY)

3.06 The TTY (Fig. 3) is the primary means of man-machine communication with the system. The TTY prints test results, trouble records, and diagnostic results. The TTY is also used for manually requesting tests, diagnostics, removal of equipment from service, and restoring equipment to service.

D. 3A Central Control (3A CC) Control Panel

3.07 The 3A CC control panel (Fig. 4) provides a means of communication between the user and the 3A CC for maintenance purposes. The

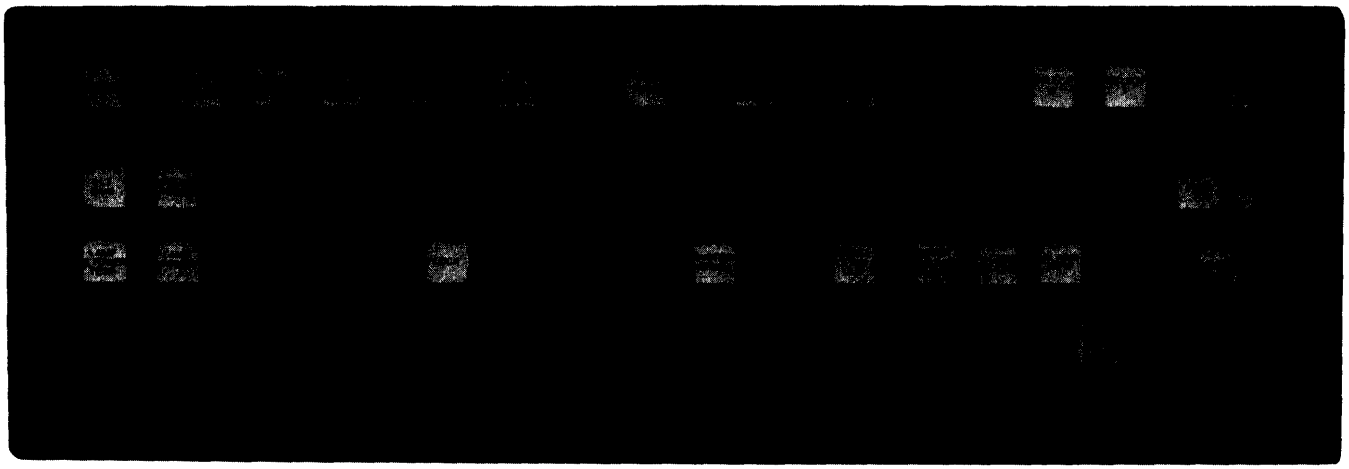

Fig. 2—System Status Panel

control panel may be used to direct the operation of the standby 3A CC for clearing a trouble condition. The control panel includes the following:

- Lamps to indicate status of 3A CC, 3A CC power and register selected for manual functions
- Lamps to display data in or address of memory or registers
- Keys for selecting registers to be loaded or displayed
- Keys to load data or compare data in registers
- Keys to select desired manual control mode
- Keys to control status of 3A CC and 3A CC power.

E. Office Alarm Structure

3.08 System maintenance is supported by an office alarm structure which serves as the stimulus for software-controlled diagnostics. Both visual and audible alarm indications are provided. When a particular alarm is sounded, a corresponding message printed on the TTY indicates the category and source of the alarm. The alarm classifications are:

(1) ***Critical***—Indicates that the system, or a major portion or capability of the system, is inoperable.

(2) ***Major***—Indicates a partial loss of the system capability or a failure such that another similar failure could result in a critical condition.

(3) ***Minor***—Indicates a minor loss of the system capability or some other condition requiring the attention of the maintenance personnel.

(4) ***Major power***—Indicates a major failure in the power equipment.

(5) ***Minor power***—Indicates a minor failure in the power equipment.

(6) ***Alarm circuit***—Indicates a trouble in the alarm detection circuits associated with the miscellaneous power circuit.

(7) ***Fuse***—Indicates a blown fuse.

(8) ***Service loss***—Indicates that recovery has taken command.

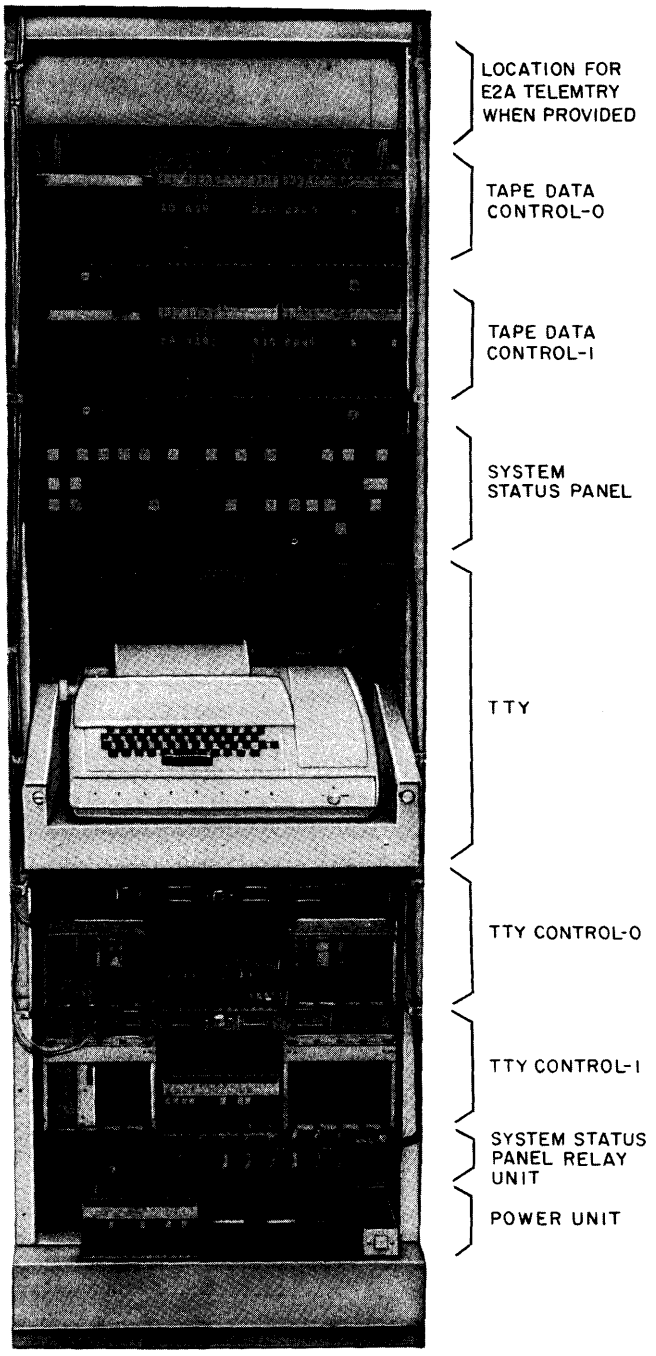

Fig. 3—Teletypewriter (Shown on Maintenance Frame)

F. 71F Milliwatt Reference Generator and Distribution Network

3.09 The milliwatt generator is used to generate a 1000 Hz tone at 1 milliwatt (0 dB) into the reference load (600 ohms). This tone is used for testing voice channels, trunks, lines, circuits, and networks. It is also used to provide a reference source for calibrating test equipment. In addition, milliwatt test lines deliver 1000 Hz test power to trunks through the automatic switching equipment in dial offices or through a cord connection.

3.10 The distributing networks are connected between the milliwatt generator and the test power outlet. The distributing network is designed to compensate for office wiring and equipment loss between the generator and the outlet. The network is used to match an impedance of 600 or 900 ohms and is arranged on the network panel in one or two groups of five.

G. 60A Control Unit

3.11 In conjunction with loop-around test facilities that are provided in the milliwatt and transmission environment test circuit, the 60A control unit provides a means for detecting a 1000 Hz test tone and closing the loop-around path when the test tone on either line exceeds -15 dBm. In addition, it opens the loop-around path and terminates both lines upon detection of speech at a level greater than -45 volume units (VU). See Section 103-240-500 for tests and adjustments.

H. TOUCH-TONE Receiver (Detector)

3.12 This circuit is used in conjunction with the station ringer test circuit to check voice frequency TOUCH-TONE signals from a customer telephone set for correct frequency and amplitude. Its function is to receive these frequencies, detect what frequencies are present, and saturate the correct ferrod sensors. This circuit will detect oscillator drift (frequency or amplitude) before it drifts outside the permissible operating range of the TOUCH-TONE calling detector circuit.

I. False Cross and Ground and Power Cross Detector Test Circuit

3.13 The false cross and ground and power cross detector test circuit is used to perform tip-to-ring leakage tests, tip-to-ground leakage tests, ring-to-ground leakage tests, and positive/negative dc voltage tests, and ac voltage tests.

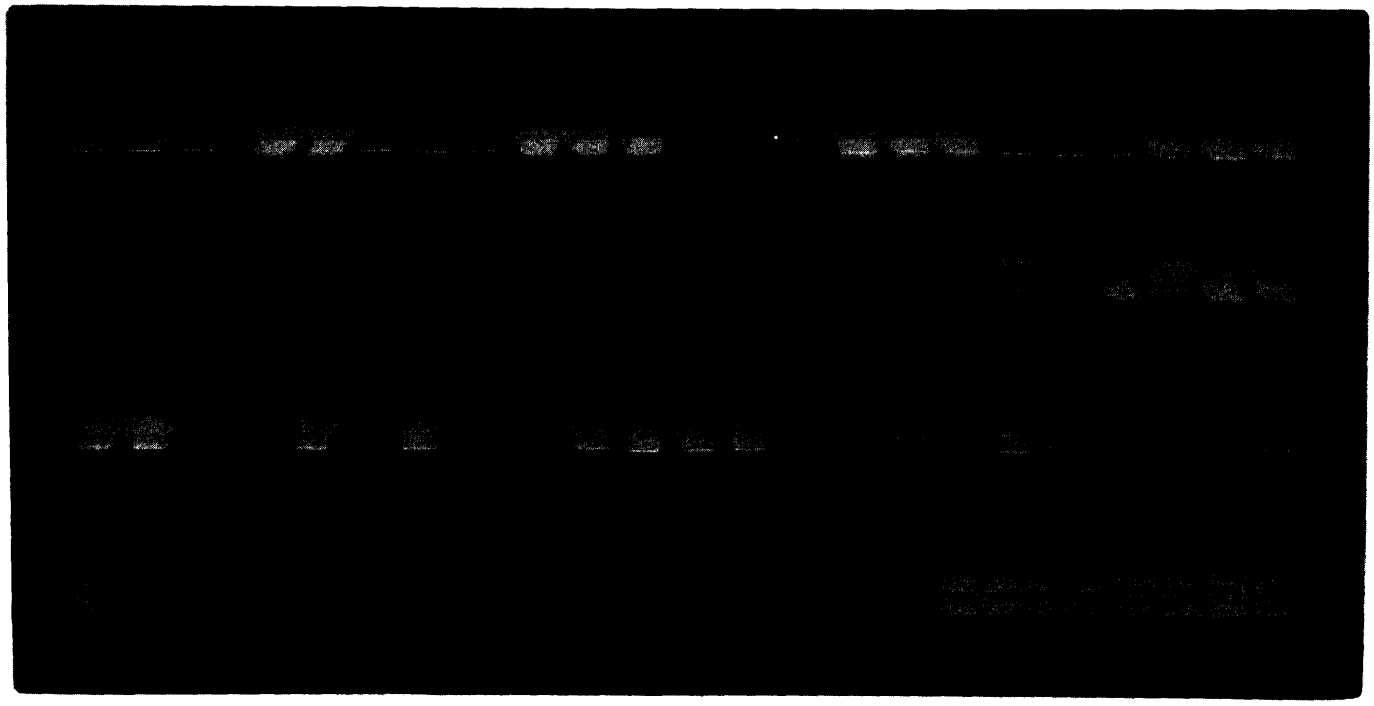

Fig. 4—3A CC Control Panel

J. Peripheral Test Unit

3.14 The peripheral test unit contains the following test circuits. These circuits and their function are also listed. This unit is located behind the TLTP on the test frame (Fig. 5).

MW and Transmission Environment Test Circuit

3.15 The MW and transmission environment test circuit is a two-port test circuit which provides the capabilities for:

- Providing a flat loss load required for performing threshold power measurements on an MF transmitter
- Providing the attenuation required for performing flat loss and twist tests on an MF receiver
- Generating a third frequency required for performing double keying and modulation products test on an MF receiver
- Providing the flat loss required to perform measurements for excessive loss on junctor circuits
- Providing MW for testing trunk loss to other offices
- Providing loop-around for testing trunk loss from other offices.

Station Ringer Test Line Circuit (Two-Port Circuit)

3.16 The station ringer test line circuit provides the capabilities for:

- Requesting software to conduct equipment number/directory number translation checks on a line requesting access to the circuit. The results are shown to be successful if ringing is received when going on-hook
- Performing ringer ground test on a two-party line with the station subset off-hook
- Providing access to TOUCH-TONE station test receiver circuit

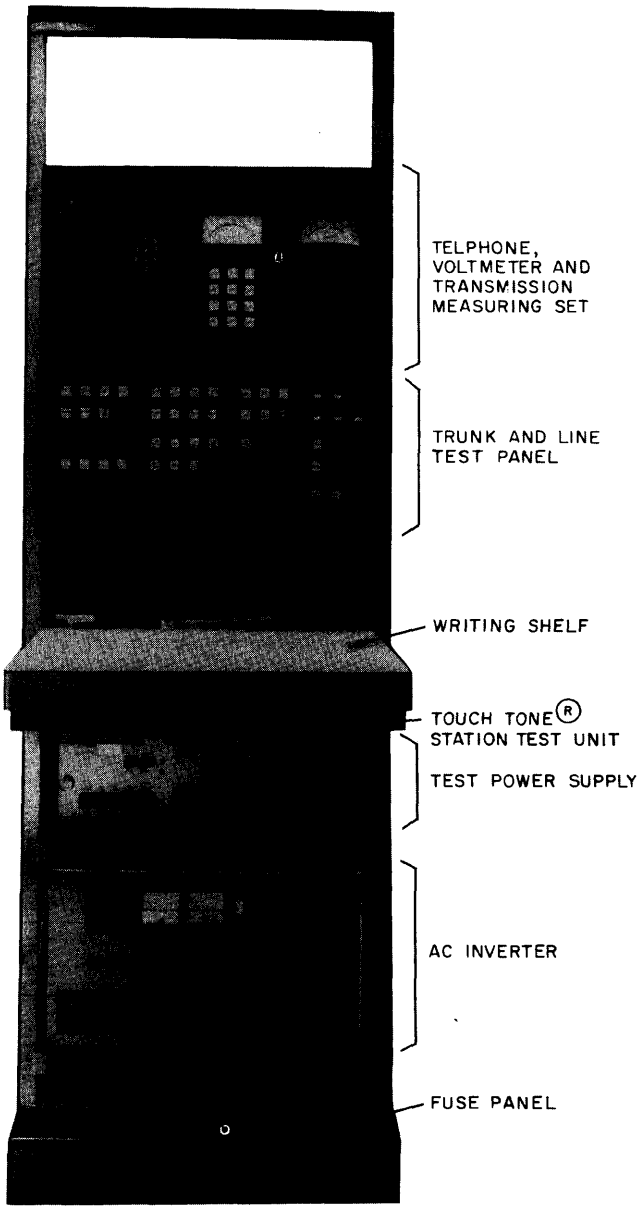

Fig. 5—Test Frame

- Returning suitable pass/fail indications to station
- Providing second port access to local test desk (LTD) for testing by customer under LTD direction and monitoring.

Transmission Test Termination Circuit

3.17 The transmission test termination circuit provides the capabilities for providing two independent terminations: ac short - by capacitor; ac open - by bridging inductor, which presents an open circuit (very high) impedance to a 1000 Hz signal. This circuit is used for testing trunks primarily; it may also be used to test lines.

Dial Pulse Receiver Test Circuit

3.18 The dial pulse receiver test circuit provides the capabilities for:

- Performing specific supervision tests
- Testing the customer dial pulse receiver (CDPR)
- Testing incoming trunks.

Incoming Local Test Desk (LTD) Trunk

3.19 This circuit provides a means for establishing a test path from a local test desk (No. 14 or No. 16) to a customer line via a No. 3 ESS central office. This trunk circuit is capable of receiving additional testing signals over sleeve and ground leads from the local test desk.

3.20 The state of the trunk circuit is switched to connect the suitable MF digit receiver directly to the incoming trunk circuit. Supervision of the trunk is maintained at the receiver during pulsing. Following pulsing, the trunk circuit state is again switched, supervision is maintained at the trunk circuit, and the receiver is released.

3.21 The 3A CC establishes connection to the called line and switches the trunk circuit to a state to provide for testing capabilities. Upon disconnect, the trunk circuit is idled.

Continuity and Polarity Test Circuit

3.22 This circuit provides the capabilities for performing tests on the following:

(a) ***Dial Pulse Transmitter:*** Continuity, wink (reverse battery detect), bridge removal

(b) ***MF Transmitter:*** Continuity, wink (reverse battery detect)

(c) ***Supervision Test:*** Polarity check of supervisory elements, capability of supervisory element to detect on-hook and off-hook (particularly

for junctors) and distant office loop incoming trunks.

Loop Environment Test Circuit

3.23 This test circuit provides the terminations required for making the following tests:

(a) ***Regular Ringing Circuit:*** Low leakage resistance test, ringing continuity, capability to apply ringing on tip/ring tests, ringing trip/nontrip tests

(b) ***Special Ringing Circuit:*** Superimposed trip/nontrip tests in addition to regular ringing circuit tests

(c) ***Coin Control Circuit:*** Coin collect test, coin presence detect/do not detect tests.

TOUCH-TONE Receiver (Detector) Test Circuit

3.24 This test circuit generates the tones required for making the functional tests of the TOUCH-TONE detector. This is accomplished by the circuit generating signals which are on the high-band edge or low-band edge of each detector in the receiver. Also, it generates tones which are out-of-band to verify that the bandwidth of the detector is not too wide. It can generate these tones mixed together (normal operation) or generate single tones in the high group only or low group only to verify that the receivers will require both tones before passing a satisfactory check to the processor. The circuit also generates a third tone frequency signal to verify that the receiver will reject even valid TOUCH-TONE signals if these are in the presence of other signals such as voice.

Line Insulation Test Circuit

3.25 The line insulation test circuit provides the capabilities for automatic testing of customers' lines. This test is used to detect troubles in cables or drop wires before they result in customer trouble reports. This is accomplished by measuring the leakage resistance between tip and ring and between tip or ring to ground. The circuit also detects for presence of an FEMF (foreign electromotive force, unexpected potential on the conductor).

Tone Presence Detector

3.26 The tone presence detector is used to perform the following tests:

(a) ***Tone Circuit Check:*** Check capability to return tone and the timing on interrupted tones

(b) ***Recorded Announcement:*** Check circuit capability to provide recorded announcement

(c) ***CDPR:*** Test the capability to return dial tone

(d) ***Junctor Circuit:*** Test the capability to return audible and overflow tone

(e) ***Loss Measurement:*** With a 1000 Hz tone from the MW and transmission environment circuit make loss measurements on all junctor circuits to detect faults which are otherwise undetectable.

K. Protector Test Set

3.27 This unit is mounted at the end guard of the low-profile combined distributing frame (LPCDF) to provide ready access for protector unit testing. The protector test set checks the protector for opens, grounds, and continuity.

L. Test Talk Facility

3.28 Test talk facilities are provided on each side of the low profile combined distributing frame. Test jacks are provided for -48 volts (fused at 1.33 ampere), ground (GRD), telephone (TEL), spare (SP), high resistance ground (HRG), in (IN), and out (OUT). This facility provides an input to the trunk and line test panel, also communication to other frames.

TEST EQUIPMENT EXTERNAL TO THE NO. 3 ESS SYSTEM

A. Pulse Checking Test Set

3.29 The pulse checking test set (J94723A) is used to measure pulsing speed and percent break of interrupter circuits by direct reading of the meter. An external power source of 48 volts is required for the operation of the test set (supplied by 151A power plant in the No. 3 ESS office).

B. Contact Closure Test Set

3.30 The contact closure test set (J94724A) makes use of lamp signals as a positive means of indicating contact closures. Two lamps mounted in the contact closure indicator are used to indicate when the left or right contacts are closed. The test set requires 115 volts ac 60 Hz power for its operation.

C. Mercury Contact Relay Test Set

3.31 The mercury contact relay test set (J94725) is used in conjunction with a 35-type test set to test mercury contact relays. Five sockets are provided for connecting the winding of the various relays to the test circuit. Power is supplied to the test set from the office battery supply (48 volts).

D. Clip-On Milliammeter

3.32 A clip-on milliammeter (Hewlett Packard Model 428B or equivalent) is used to measure direct current from 1 milliampere to 10 amperes without interrupting or loading down the test circuit. Current is measured by using a clip-on transducer that converts the magnetic field about the conductor to an ac voltage proportional to the dc current. This instrument has an accuracy of 3 percent and requires a power source of 115 volts ac 60 Hz for operation. The instrument comes equipped with a current probe.

E. Oscilloscope

3.33 The oscilloscope used to test the No. 3 ESS system should have the following capabilities:

- A dual trace capability
- Vertical Deflection—DC to 50 MHz bandwidth
- Vertical Deflection—Rise time 7 nanoseconds
- Vertical Deflection—Volts/div range from 5 mV/div to 5V/div
- Vertical Deflection—Accuracy 3 percent
- Horizontal Deflection—Time base 0.05 usec/div to 0.5 sec/div
- Horizontal Deflection—X10 MAG to extend sweep rate to 5 nanosec/div
- Horizontal Deflection—Delay sweep
- Horizontal Deflection—Trigger modes
- Horizontal Deflection—Accuracy 3 percent
- Calibrated output to check scope
- Accessories—Probes (X1 and X10).

This instrument requires a power source of 115 volts ac 60 Hz for operation.

F. 23A Transmission Measuring Set

3.34 A 23A transmission measuring set (J94023A) is a portable unit for measuring net loss of 600- and 900-ohm trunks. No battery or power supply is required. The 23A is accurate to 0.1 dB from +10 to -15 dBm at 1000 Hz. It has a level range of +10 to -25 dBm and a frequency range of 400 to 5000 Hz. The meter scale is divided into 0.1 dB intervals. Jacks are provided to access the 23A circuitry. This instrument does not require a power source for operation.

G. 3A Noise Measuring Set

3.35 The 3A noise measuring set (J94003A) is used to measure noise on message and program circuits. It has both dynamic and frequency characteristics which make its reading comparable to the response of the human ear. Internal calibration is provided on the set. Also, power is provided from a self-contained source.

H. 6A Impulse Counter

3.36 The 6A impulse counter (J94006A) provides a rapid, simple method for determining impulse noise characteristics of data transmission circuits. The 6A has the following characteristics:

- Indicator—Electromechanical capacity of 9999 counts resettable to zero
- Range—30 dBrn to 90 dBrn
- Accuracy of dBrn threshold—±0.5 dB

- Input Impedance—600 ohm nominal (negligible error on 900 ohm circuit)
- Built-in self timer
- Adjustable threshold attenuator (3 dB steps)
- Resettable counter
- Battery operated
- Internal weighing network.

I. Voice Frequency Oscillator

3.37 The voice frequency oscillator (KS-19353) is a portable oscillator. It has a continuous variable output frequency range of 50 to 20,000 Hz with output impedance of 600 to 900 ohms balanced. The output level is adjustable from -30 dBm to +10 dBm in calibrated 0.1 dB steps. It may be either battery operated or operated from a 115 volt ac 60 Hz power source.

J. PAR Meter

3.38 The PAR (peak to average ratio) meter (J94027) is a portable unit for measuring the capability of a voice channel to transmit data signals. The unit is composed of a generator and a receiver. The generator produces a test pulse which is transmitted over the circuit under test. The receiver compares the peak pulse power with its average value and displays it on the meter. Power is supplied by self-contained batteries.

K. Return Loss Measuring Set

3.39 The return loss measuring set (KS-20501) generates a wide band of random noise which is passed through one of three filters to provide frequency weighing for testing the low, center, and high frequencies of the voiceband. It may be used with an external oscillator to measure return loss versus frequency over a range of 200 to 5000 Hz. Power from a 115 volt 60 Hz source is necessary to operate the set.

L. 5A Attenuator

3.40 The 5A attenuator is a balanced attenuator consisting of keys, resistances, jacks, and binding post. It is adjustable in 1 dB steps over a range of 0 to 81 dB. The 5A is used for general testing purposes in the No. 3 ESS office. This instrument does not require a power source for operation.

M. Electronic Counter

3.41 The electronic counter used in the maintenance of the No. 3 ESS system should have the following minimum capabilities:

- Six digit display
- Frequency range 10 Hz to 1 MHz
- Accuracy ±1 count ±time base accuracy
- Input impedance 1M ohm
- Sensitivity (minimum) 250mV RMS
- Adjustable trigger level (negative, positive)
- Period measuring capability
- Time interval measuring capability (0.1 usec to 100 K sec)

This instrument requires a power source of 115 volts ac 60 Hz for operation.

4. POWER

A. Test Equipment Internal to the System

4.01 The test equipment normally is supplied with its required voltages from the frame on which it is mounted (ie, the SSP gets power from the maintenance frame).

4.02 The frame that provides the power also supplies the filtering and fusing as required for proper operation. Power control may be supplied by the frame supplying the power or the 151A power plant, as the case may be.

4.03 Alarms are provided by the frame supplying the power to the test equipment.

B. Test Equipment External to the System

4.04 The external test equipment is provided operating power (if needed) from one of the following three sources:

- Test equipment that has self-contained power—battery
- Test equipment that receives necessary operating power from the circuit under test
- Test equipment that operates from 115 volts ac 60 Hz supplied by local power company or from battery voltage (-48 volts) supplied by the 151A power plant.

4.05 Power control and power indicators are provided on the test equipment where necessary.

5. MAINTENANCE

INTRODUCTION

5.01 The test equipment that is part of the system is checked on a periodic basis as prescribed by the maintenance procedures or when a malfunction is suspected.

5.02 The external test equipment is checked as prescribed by the maintenance procedures (or by recommendation of the manufacturers) or when a malfunction is suspected.

TEST EQUIPMENT INTERNAL TO SYSTEM

5.03 The majority of the test equipment in the No. 3 ESS is checked by software routines. The TLTP, TTY, and office alarm structure have manual tests to verify proper operation.

TEST EQUIPMENT EXTERNAL TO SYSTEM

5.04 Maintenance checks on external test equipment will be mainly performed by measuring standard criteria (voltage, current, frequency, resistance, etc). Some of the equipment comes equipped with internal calibration features.

6. GLOSSARY

6.01 A glossary of terms is provided to aid in the understanding of definitive words in this section.

Diagnostics Specially coded programs which direct the hardware within a circuit to perform specific actions.

Fault A condition which causes a device, a component, or an element to fail to perform in a required manner.

Line Any connection to a network terminal which is not classified as a trunk or service circuit.

Loop A closed path in which a signal may circulate. This path may be within a piece of equipment.

Service Circuit An auxiliary circuit connected through the switching network to lines or trunks as required. It performs a specialized function such as dial-pulse detection.

Terminal A point at which information can enter or exit a communication network.

Trunk A channel connecting switching centers or exchanges. An interface circuit for transmission and supervisory purposes.

7. REFERENCES

7.01 The following list of documents contain pertinent information which is relevant to this section:

Section 966-210-100—General Description No. 3 ESS

Section 233-001-011—Equipment Test List No. 3 ESS

Section 233-001-030—Portable Maintenance Equipment, Cords, Tools, and Material for No. 3 ESS

Section 233-110-100—3A CC Description No. 3 ESS

Section 233-110-115—TTY and TTY Controller Description and Theory of Operation No. 3 ESS

Section 233-110-120—SSP Description and Theory of Operation No. 3 ESS

Section 233-130-100—Power Equipment Description No. 3 ESS

Section 233-135-105—TLTP Description and Theory of Operation No. 3 ESS

Section 233-140-100—Office Maintenance Description No. 3 ESS

SD-3H520-01—Peripheral Test Unit

KS-19395 Voltmeter

KS-20355 23A Transmission Measuring Meter

Section 233-142-100—Task Oriented Practices

Section 100-234-101—Pulse Checking Test Set

Section 100-138-101—Contact Closure Test Set

Section 100-139-101—Mercury Contact Relay Test Set

Section 100-655-100—Oscilloscope Tektronix 453

Section 103-223-100—23A Transmission Measuring Set

Section 103-611-100—3A Noise Measuring Set

Section 103-620-101—6A Impulse Counter

Section 103-302-106—Voice Frequency Oscillator

Section 103-110-110—PAR Meter

Section 103-106-115—Return Loss Test Set

Section 103-100-100—5A Attenuator

Section 103-335-500—71F Milliwatt Reference Generator

Section 103-240-500—60A Control Unit