554A-TYPE CHANNEL SERVICE UNIT

DESCRIPTION

CIRCUIT SWITCHED DIGITAL CAPABILITY

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1. GENERAL

1.01 This section contains physical and functional descriptions of the 554A-type channel service unit (CSU) used on the circuit switched digital capability (CSDC). Information pertaining to the associated customer provided equipment (CPE) is not given. However, descriptions of interface signals and customer options are provided.

1.02 Whenever this section is reissued, the reason(s) for reissue will be given in this paragraph.

1.03 The CSDC is an alternate voice/data capability in which the choice of transmitting analog voice or 56-kb/s full duplex data is the customer's option. The 554A CSU operates in the voice mode or data mode. When operating in the voice mode, the customer utilizes a 2-wire portion of the network interface to initiate a call and for subsequent voice communications with the distant station. In the data mode, the customer utilizes a 4-wire portion of the network interface to transmit and receive 56-kb/s data. The 554A CSU connects to central office facili-

ties via a 2-wire circuit. In the voice mode, loop transmission takes place in a normal analog fashion. In the data mode, loop transmission takes place at 144 kb/s using time compression multiplexing (TCM). The TCM is a means for providing full duplex transmission over a single nonloaded pair of wires. The TCM does this by partitioning the bit stream in each direction of transmission into segments. Each segment is transmitted on the loop at approximately 2.25 times the incoming data rate. Segments from each direction of transmission are bursted in alternating disjointed time intervals. The TCM is often referred to as burst-mode transmission. The TCM circuitry, upon receiving a burst from the far-end, expands the bit stream by reading the data at the network interface at the original rate of 56 kb/s, thus restoring the continuous signal transmitted by the customer. The 554A CSU supports the full duplex transmission of 56 kb/s at the network interface. There are no subrate applications.

1.04 The CSU provides a customer interface consisting of the following eight leads:

- Two leads, status indicator (SI) and ground (G), conform electrically to Electronic Industries Association (EIA) Standard RS-410N. The SI lead is a control lead and the G lead provides ground return for the SI lead.
- Four data leads, DT, DR, DT1, and DR1, provide a balanced, 135-ohm interface but do not conform to EIA standards.
- Two voice leads, T and R, support analog signal transmission and other Public Switched Network functions such as call setup, disconnect, and ringing.

1.05 The 554A CSU is apparatus-coded 554A-L1/2.

2. PHYSICAL DESCRIPTION

2.01 The 554A-type CSU (Fig. 1) consists of a housing and one circuit pack (CP). The CP is mounted in an extruded aluminum housing with black plastic, injection molded snap-on covers.

2.02 The CSU is approximately 5-3/4 inches wide, 2-1/4 inches high, and 10-3/4 inches deep; it weighs approximately 3 pounds 10 ounces.

2.03 The CSU will operate in an environment of +40 to +120°F with a relative humidity of less than 95 percent.

2.04 Power requirements for the self-contained unit are 105 to 129 volts ac at 57 to 63 Hz. The CSU consumes approximately 5 watts of power. It is equipped with a 7-foot, 3-conductor Switchcraft P2720 power cord for connection to a customer provided ac outlet which should not be under control of

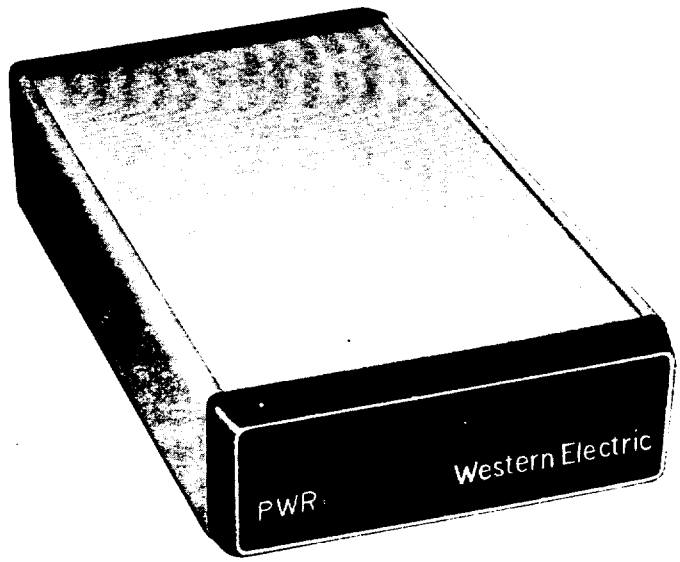

Fig. 1—554A-Type Channel Service Unit

a switch. The power cord is connected to the CSU via a 3-prong International Electrotechnical Commission (IEC) jack.

2.05 One light-emitting diode (LED) indicator is visible through the CSU cover and is designated PWR.

2.06 The CSU is intended for desk-top stand-alone mounting. There are no multiple mounting arrangements. No more than two CSUs may be stacked.

2.07 All customer interface leads of the CSU are terminated in an 8-pin female, nonkeyed modular connector.

2.08 The signal ground option (Fig. 2) is located on the receiver circuit card.

2.09 The CSU is provided with a fuse holder assembly which is equipped with a 1/4-ampere, 3AG fuse.

2.10 The connection to the central office loop is terminated in a 4-pin female, nonkeyed modular connector.

3. FUNCTIONAL DESCRIPTION

3.01 Refer to Fig. 3 for a functional block diagram of the 554A-type CSU. The 554A-type CSU has three operational states which are customer controlled: IDLE, TIP, and DATA. These states are defined as follows:

(a) The IDLE state provides an extension of the loop metallic pair to the network interface (NI) for 2-wire voice transmission, call setup, and disconnect.

(b) In the TIP state, or transition-in-progress state, the CSU loop conditioning circuits are adjusting, but there is not yet virtual continuity from the 4-wire data portion of the NI to the 2-wire office loop.

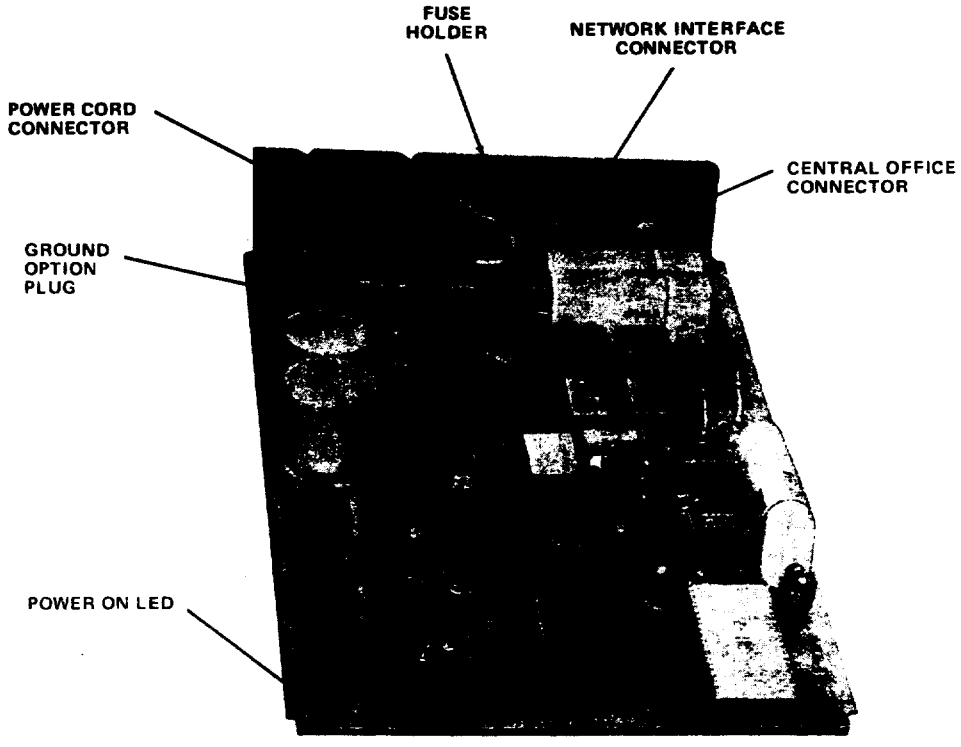

Fig. 2—554A-Type Channel Service Unit—Cover Removed

(c) In the DATA state, the CSU is transparent to data from the 4-wire data portion of the NI to and from the 2-wire office loop.

3.02 The 554A-type CSU has three maintenance states that are initiated for maintenance of the network by the Serving Test Center (STC). These states are defined as follows:

(a) ***MVOICE:*** In the MVOICE state, a termination is switched across the 2-wire portion of the 8-wire NI in response to a tone from the STC. This creates an off-hook, or loop current, condition as viewed from the STC.

(b) ***MTIP:*** The MTIP state is the same as the TIP state except it is initiated in response to a second test tone from the STC.

(c) ***MDATA:*** The MDATA state is similar to the DATA state except the data circuits and loopback relay are energized, allowing the STC to loop test the data portion of the CSU.

A. Loop Overvoltage Protection Network

3.03 The loop overvoltage protection network (Fig. 3) is placed in the 2-wire office loop portion of the data/voice network associated with the TCM. The circuitry has high impulse current capability which protects analog and digital circuits connected to the TCM input/output transformer from high-voltage transients or commercial power crosses on the 2-wire loop.

B. Data Pair Line Sink

3.04 When the CSU is in the data mode, only loop current from the central office poled opposite from that supplied in the voice mode (data battery, ie, tip negative and ring positive) will flow in the 2-wire loop. The line sink is a series resistance inductor and diode combination. The diode is part of an opto-isolator. The inductor helps maintain a high (bridging) impedance at the line rate frequency, and the resistor limits the maximum loop current. The discrete diode blocks high-voltage transients and protects the opto-isolator diode. The capacitor blocks direct current flow in the primary of the TCM input/output transformer, preventing saturation. The output of the opto-isolator is passed as one input to the microcomputer. Presence of this input (+5 volts) denotes presence of data poled battery. Data-battery poled-current flow indicates to the CSU microcomputer that central office equipment has connected data conditioning circuitry to the 2-wire loop.

C. Tone Receiver, Phase Locked Loops

3.05 There are two tone receivers bridged across the 2-wire voice portion of the 8-wire NI. These receivers recognize the maintenance test tones (2713 and 2025 Hz) which originate at the STC. Two high-value resistors provide bridging points for the input coupling network. Direct current is blocked by two series capacitors. The reactance of these capacitors at STC voice frequencies adds to the bridging impedance. The signals are coupled through an input transformer, which has a high front-to-back sustaining voltage capability. The signals are then applied to an operational amplifier. The output of the operational amplifier drives two resistance-capacitance phase-locked loop tone detectors. The output of the detectors provide two inputs to the microcomputer.

D. Maintenance Line Sink

3.06 The maintenance line sink is a shunt resistance and is normally an open, nonlatching relay contact arrangement. The relay is activated via the microcomputer, upon receipt, by one tone receiver, of the 2713-Hz maintenance test tone.

E. Time Compression Multiplex

3.07 In the transmit direction, the TCM function converts a dual-rail, unipolar, return-to-zero (RTZ), 56-kb/s signal to a 2-wire, 144-kb/s burst modulated, bipolar [alternate-mark-invert (AMI)] format. It performs the reverse function in the received direction. A standard 40-pin NMOS silicon integrated circuit performs functions related to digital needs, and a 40-pin hybrid integrated circuit (HIC) performs the analog functions.

3.08 There are three primary inputs to the TCM:

(a) Dual-rail, transistor-transistor logic (TTL), compatible, 56-kb/s, unipolar, RTZ, 50 percent duty cycle data signal from the line receivers at the NI.

(b) Single-rail, unipolar, TTL signal from the microcomputer to the TCM as a command to begin conditioning.

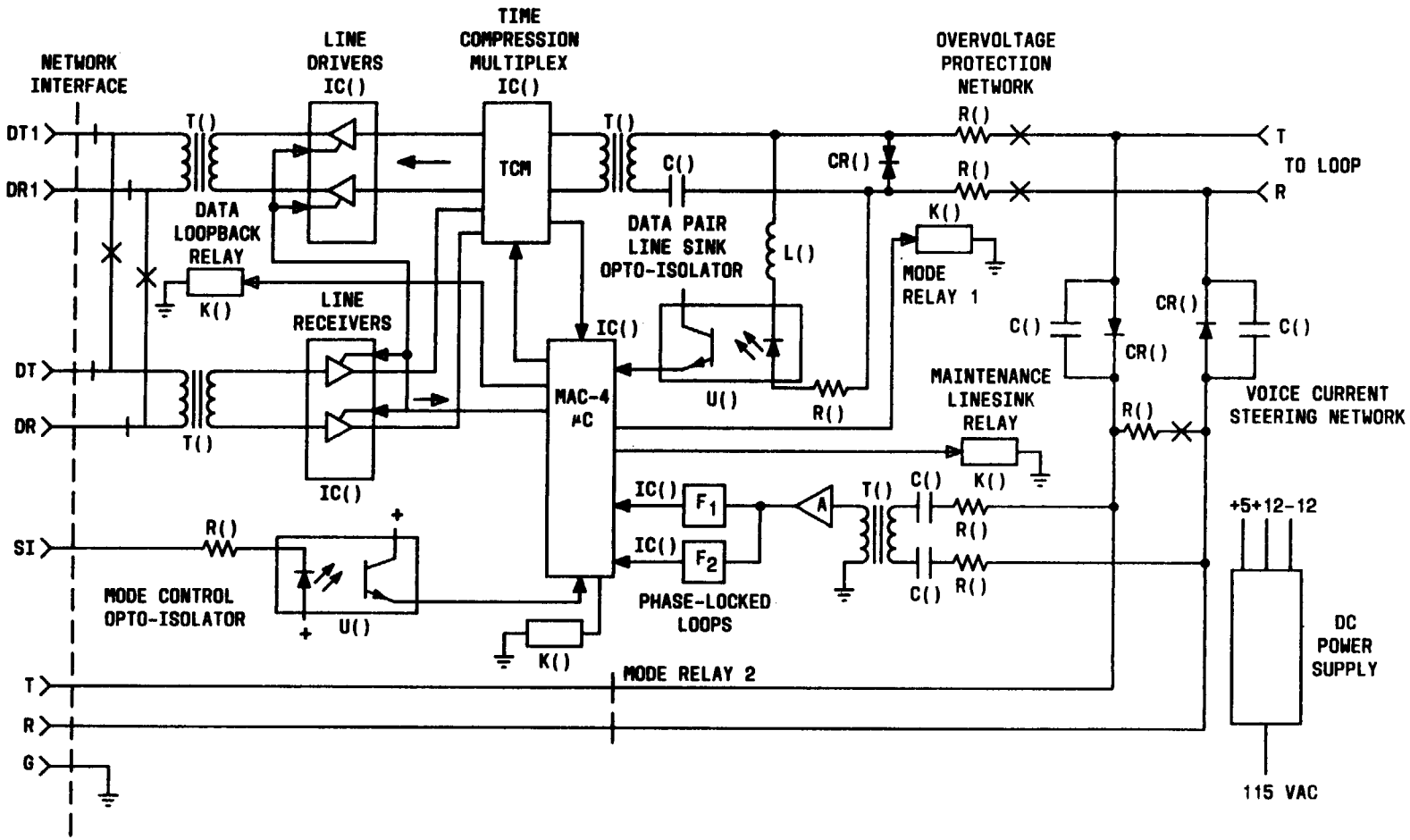

Fig. 3—554A-Type CSU Functional Block Diagram

(c) Single-rail, bipolar, 144-kb/s burst mode signal from the office loop via a transformer connected to the 2-wire loop. This signal contains the TCM formatted data from the CSU to the central office equipment.

3.09 There are three outputs from the TCM:

(a) Dual-rail, TTL, compatible, 56-kb/s, unipolar, RTZ, negative logic, 50 percent portion of the NI duty-cycle data signal to the line drivers at the NI.

(b) Single-rail, unipolar, TTL signal to the microcomputer. This is the signal indicating that the handshaking between the CSU TCM and central office TCM has occurred.

(c) Single-rail, bipolar, 144-kb/s burst mode signal from the TCM via a transformer to the 2-wire loop. This signal contains both the TCM formatted data from the CSU to the central office equipment.

F. Microcomputer

3.10 The microcomputer is a BELLMAC 4* microcomputer operating asynchronously. The BELLMAC 4 operates in conjunction with several auxiliary inputs. A self-contained clock oscillator provides a source of clock for the microcomputer. A reset function is initiated upon initial application of power.

G. Line Drivers

3.11 The line drivers are high output current devices connected to a transformer. These drivers convert the dual-rail, unipolar, RTZ signal to an AMI signal at the 2-wire receive data portion of the NI. Inverters convert the negative logic dual-rail signal. The line receiver is enabled from an output of the microcomputer. This enabling occurs if the TCM has signaled the microcomputer that the handshaking is complete. A transformer couples the dual-rail, unipolar signal to the NI and converts dual-rail unipolar to single-rail bipolar (AMI). This transformer has a high front-to-back sustaining voltage capability. It also serves to isolate internal biases from dc voltages that might be applied to the NI by the customer.

* Trademark of Western Electric.

H. Line Receivers

3.12 The line receivers are coupled to the 2-wire transmit portion of the NI by a transformer. The transformer and the receivers convert an AMI signal to a dual-rail, RTZ signal. This transformer has a high front-to-back sustaining voltage capability. It also serves to isolate internal biases from dc voltages that might be applied to the NI by the customer. The line receiver is enabled from an output of the TCM. This enabling occurs if the TCM has signaled the microcomputer that the handshaking is complete. Because the receivers operate from a single supply voltage, two receiver sections are required to convert signals from AMI to unipolar. The dual-rail, unipolar, RTZ, TTL, compatible data is then passed on to the TCM.

I. Data Loopback Relay

3.13 The data loopback relay is a 4-pole, single-throw, nonlatching configuration which when energized from the microcomputer connects the receive out (AMI) signal port at the NI to the transmit-in signal port at the NI. During the loopback the customer is open circuited at the data ports of the NI.

J. Mode Control Relay 1 and Relay 2

3.14 The mode control relays are 2-pole, single-throw, nonlatching configurations which connect the 2-wire office loop to either the tip and ring portion of the NI for voice mode operation or to the overvoltage protection network and TCM for data mode operation. Two relays are provided so that mode switching can take place in a sequence controlled by the microcomputer.

K. DC Power Supply

3.15 The power supply generates the required dc voltage of +5, +12, and −12 volts for use by the CSU. The unit consists of a line cord connector, fuse holder and fuse, and line transformer. The line transformer and rectifiers are followed by filter networks and three 3-terminal series regulators for the +5, +12, and −12 volts, respectively. An option plug is provided on the CP to allow connection of circuit and building ground if required.

L. Mode Control Circuit

3.16 The mode control lead (SI) terminates on a resistor and opto-isolator. Current in the resistor light emitting diode circuit will cause the transistor portion of the opto-isolator to conduct signaling a switch command to the microcomputer.

M. Interface Leads

3.17 The 554A-type CSU is provided with eight interface leads for connection to the CPE. These leads and corresponding pin numbers are given in Table A.

3.18 ***Transmitted Data (DT and DR):*** The direction of signal flow on these leads is from the CPE to the CSU. The balanced, bipolar data signals on these leads are generated by the CPE for transmission to the distant CPE.

3.19 ***Received Data (DT1 and DR1):*** The direction of signal flow on these leads is from the CSU to the CPE. Balanced, bipolar data signals are presented to the CPE. The customer is responsible for extracting timing, detecting network control codes, and processing the data.

3.20 ***Status Indicator (SI):*** The direction of signal flow on this lead is from the CPE to the CSU. The SI lead conforms to the electrical characteristics of EIA Standard RS-410N. The CPE uses the SI lead and the associated ground return to effect mode changer in the CSU (data/voice).

3.21 ***Signal Ground (G):*** This lead provides a ground return for the SI interface lead.

N. LED Indicator

3.22 The PWR LED is located on the circuit board and is illuminated when ac power is supplied to the CSU.

O. Signal Ground Option

3.23 The signal ground option internally connects signal ground to frame ground. This option plug may be provided on customer request or stowed in an unused position. The use of this option is subject to local noise conditions, ground potentials, and local safety regulations.

TABLE A

554-A TYPE CSU INTERFACE

INTERFACE PIN NO.	554A TYPE CSU LEAD	DESTINATION	SIGNAL DIRECTION
1	Transmitted Data	DR	From CPE to Network Interface
2	Transmitted Data	DT	From CPE to Network Interface
3	Mode Control	SI	From CPE to Network Interface
4	Voice Ring	R	To and From the Network Interface
5	Voice TIP	T	To and From the Network Interface
6	Mode Control	G	From Network Interface to CPE
7	Received Data	DT1	From Network Interface to CPE
8	Received Data	DR1	From Network Interface to CPE