

## MULTICHANNEL TONE TEST UNIT—SD-7C004-01

### DESCRIPTION

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#### 1. GENERAL

**1.01** This section describes the multichannel tone test unit (MTTU). The MTTU is intended to be used in conjunction with automatic message accounting (AMA) equipment.

**1.02** The MTTU has the capability of monitoring a maximum of 100 trunks for the presence

of unauthorized 2600-Hz tone signals. Bridging loss is limited to .05 dB maximum.

**1.03** The MTTU interfaces with the office AMA equipment to permit calling station identification. The MTTU must be equipped with the trunk identification option for this feature.

#### 2. EQUIPMENT ELEMENTS

##### A. General

**2.01** There are two equipment versions of the MTTU: (1) relay rack mounted, and (2) cabinet mounted. The cabinet-mounted version, which is equipped with caster wheels, offers added protection and portability. Both versions occupy approximately 4 vertical feet in a standard 23-inch relay rack mounting. Fig. 1 is a photograph of the portable version of the MTTU equipped with the trunk identification feature.

**2.02** The various equipment configurations for the MTTU are as follows:

| WIRING LIST | EQUIPMENT CONFIGURATION              |
|-------------|--------------------------------------|
| L1          | Basic MTTU Unit (standard)           |
| L2          | Trunk Identification Unit (optional) |
| L3          | Portable Cabinet (optional)          |

A layout of an MTTU equipped with all of the wiring lists is shown in Fig. 2.

##### B. Plug-In Units

**2.03** The plug-in units consist of printed wiring boards mounted to a die cast aluminum frame. These units are approximately 8 inches high, 10 1/2 inches deep and 1 1/2 inches wide. The LS1 CHANNEL DETECTOR has two printed wiring boards mounted parallel to each other on

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one frame while the LS2 FUSE AND ALARM, LS3 REGISTER DRIVER, LT1 TEST SIGNAL GENERATOR, LU1 MATRIX DECODE, and LW1 5 VOLT POWER SUPPLY have only one printed wiring board. All interconnections between the bay and each plug-in unit are via 40 gold finger contacts which are part of the printed wiring board. The gold finger contact portion of the boards are code slotted and the connectors, which are mounted on the shelves, are keyed to prevent insertion of the wrong unit.

**2.04** The face plates (Fig. 3) of the plug-in units are finished in Bell System grey with silk screen lettering (or equivalent).

**2.05** Most of the plug-in units can be placed into their in-service position by inserting them into the guides of the appropriate shelf position and sliding them toward the rear of the shelf. A locking device on the face plate of the units locks the units in place when sufficient contact with the rear of the shelf is made. To remove the units, release the locking device and withdraw the units from the shelf.

### 3. APPLICATION

**3.01** The MTTU may be used in a local office equipped with local AMA (LAMA), or in a toll office providing centralized AMA (CAMA) service. In a local office the MTTU inputs are bridged across the T and R conductors of outgoing DDD access trunks at the main distributing frame (0dB TLP), Fig. 4. In a 2-wire toll office, such as crossbar tandem, the MTTU inputs are bridged across the T and R conductors of incoming CAMA trunks at the main distributing frame (-2dB TLP), Fig. 4. In the case of a 4-wire toll office (No. 4A crossbar), the MTTU is bridged across the T1 and R1 conductors of the incoming CAMA trunks (-2dB TLP), ie, across the voice path carrying speech *from* the originating station. See Fig. 4.

**3.02** When connected as described in 3.01, the MTTU will detect the presence of unauthorized 2600-Hz tones, and, if equipped with List 2, will identify to the AMA equipment the trunk which has the tone.

**3.03** If the AMA interface is not provided, the MTTU will only count and record on the message register panel the number of times that an SF signal appears on the trunks.

**3.04** The MTTU provides two jack fields which are located on the power control and access panel (Fig. 1); one to monitor trunks, and the other to allow the operator to inject test signals into the MTTU to check the electrical parameters of the 100 CHANNEL DETECTORS. The test signals are obtained from the LT1 TEST SIGNAL GENERATOR (Fig. 3) which is one of the plug-in units of the MTTU.

### 4. OPERATION

**4.01** When bridged across a trunk (Fig. 5) in a 2-wire central office, the MTTU will detect a single frequency signal tone generated by a customer. The MTTU may be connected with up to five call identity indexers (CII) through spare CII trunk access ports. When a long distance call is made by the customer, the CII identifies the trunk and passes this information on to the AMA recorder. After AMA receives trunk identification, the customers telephone number, the time the call was made, date, and trunk number are recorded for accounting center processing. During the call, speech energy on the bridged trunk is connected to the MTTU POWER CONTROL AND ACCESS panel (ED7C031) through one of 10 input cables. If an unauthorized SF tone with a duration greater than 210 ms  $\pm 10\%$  is generated during that call, the signal tone is detected by the channel detector connected to the trunk.

#### A. Power Control and Access Panel

**4.02** The POWER CONTROL AND ACCESS panel has ten connector inputs which divide the 100 trunks into 10 groups of 10 trunks. The panel also has 200 test jacks which are divided into two groups. In the first group of 100 there is a test jack assigned to each trunk. This allows the operator to monitor a trunk for excessive noise or for the presence or absence of 2600-Hz SF tone. The other group of 100 test jacks allows the operator to inject into each channel a 2600-Hz SF tone to check the channel detector electrical parameters. The POWER CONTROL AND ACCESS panel is connected to the central office alarm system so that the +130 volts, -48 volts and the presence of 2600-Hz signal with duration greater than 10 seconds can be monitored. If the source voltage is disrupted or a 2600-Hz signal tone with duration greater than 10 seconds appears on a trunk, a visual and audio alarm will be given. The outputs of the POWER CONTROL AND ACCESS panel are

assigned to specific channels of the CHANNEL DETECTOR circuit packs (LS-1).

## B. Channel Detector

**4.03** The CHANNEL DETECTOR (LS1 circuit pack) has five individual channels associated with each circuit pack. Each of these channels will be assigned to a specific trunk to monitor. For instance, channel 76 must be assigned to trunk 76. Assigning MTTU channel to trunks which do not have matching identity numbers is not recommended. The channel detector shelf positions are assigned positions 1 through 24. The top shelf of the CHANNEL DETECTORS contains positions 13 through 24 and the bottom shelf contains positions 1 through 12. Channels 00 through 49 are assigned positions 13 through 24 and channels 50 through 99 are assigned positions 1 through 12. If any of the CHANNEL DETECTORS are not used, the unused channels should be terminated with a 600-ohm termination [part No. PJ-741(ADC)]. This termination is used to minimize a possible crosstalk condition. This termination may be left in while making tests.

**4.04** Each channel has three electrical sections. These three sections are: (1) analog section, (2) digital section, and (3) timing section. The timing section is shared by all five channels within a given circuit pack. Any 2600-Hz tone appearing on a trunk will be detected, provided the duration is greater than 210 ms  $\pm 10\%$ . The dynamic range of the analog section is from +15 dbm to -35 dbm across 600-ohms, and +15 dbm to -37 across 900-ohms. The bandwidth for signal detection is 100 Hz, and the signal/guard ratio is approximately 7 dB. Trunk bridging loss is limited to .05 dB maximum.

**4.05** The analog section consists of amplifiers, rectifiers, and a tuned network. Any 2600-Hz tone with a duration greater than 210 ms  $\pm 10\%$  applied to the input will be detected and passed on to the digital section. The analog section has two inputs. One input is connected to the trunk, and the other is connected to the TEST SIGNAL GENERATOR (LT1 circuit pack).

**4.06** The digital section receives a voltage shift from the analog section. The presence of a voltage shift causes the FD indicator and the storage indicator to illuminate. The FD indicator will illuminate only if a tone is detected with a

duration of 210 ms  $\pm 10\%$ , while the storage indicator will remain illuminated until the AMA equipment records the identity information, or until the timing circuit automatically times out after 11 to 12 seconds.

**4.07** The digital section has four output signals: (1) trunk identity, (2) FD signal, (3) register, and (4) 2600-Hz alarm.

### Trunk Identity Signal

**4.08** The trunk identity signal is routed to the MATRIX DECODE circuit (LU1 circuit pack) causing a 2 out of 5 code to be generated. The 2 out of 5 code is illustrated in Table A. This code is used to identify the activated channel (1 of a possible 100) of the MTTU. These channels are designated 00 through 99; therefore, each channel identity code has a tens digit and a units digit. Each digit, whether it is a tens digit or a units digit, has an integer value of 0 through 9. Any units digit or tens digit may be represented by a proper combination of two numbers from a five-element additive code (see Table A). The addition of any pair (except 7 and 4) of the 7-4-2-1-0 code will equal a number from 1 through 9. The number 0 is assigned a code of 7 and 4. A proper channel identity would comprise two elements for the tens digit and two elements for the units digit, such as Ta, Tb; Ua, Ub. An example of a complete code for channels 70 and 96 is 7, 0; 7, 4 and 7, 2; 4, 2, respectively. When tone is detected, the voltage output of that channel is connected through a 4-diode gate (which represents Ta, Tb; Ua, Ub), to the tens matrix and units matrix. The Ta, Tb outputs are connected to a 7-4-2-1-0 tens matrix, and the Ua, Ub outputs are connected to a 7-4-2-1-0 units matrix.

### FD Signal

**4.09** The FD signal is presented to the switching and relay circuit to operate the CII relays.

### Register Signal

**4.10** The register signal is presented to the REGISTER DRIVER circuit (LS3 circuit pack) to operate a MESSAGE REGISTER (ED-7C033).

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### 2600-Hz Alarm

**4.11** The 2600-Hz alarm signal is presented to the FUSE AND ALARM circuit (LS2 circuit pack) to initiate office alarms.

**4.12** Since there are five digital sections in one CHANNEL DETECTOR, four of these sections must be turned off while the one section is providing trunk identity information to the switching and relay circuits. These four channels are blocked by the inhibit signal from the time-shared counter circuit. The one channel needs only to receive the tone a few nanoseconds ahead of the other channels in order to block the four channels from receiving and storing the tone detection. This inhibiting of the tone storage does not block the register signal since the register signal is developed in the time-shared circuit. The digital section has two time delays which are developed in the time-shared circuit. One of the delays is a nominal ten-second delay (actually 11 to 12 seconds), and the other is a 128 seconds delay. The ten-second delay resets the storage circuit if a momentary tone is detected and the MTTU fails to send a clearing pulse. The 128-second delay unlocks the time-shared circuit in the event a continuous tone is detected for the 128-second time interval or longer and is not corrected manually. The time-shared counter is controlled by the 1 PPS signal which is generated by the TEST SIGNAL GENERATOR (LT-1 circuit pack). The time-shared circuit is also controlled by the five digital sections outputs, F0 through F4 and CLR0 through CLR4.

### C. Fuse and Alarm

**4.13** The FUSE AND ALARM unit (LS2 circuit pack) is the central power distribution point for the regulated power supplies. The LS2 unit also has amplifiers, binary counters, and relays which are used to turn on the central office alarm system. The -24 volts from the J-87304 power supply is connected to two fused busses, -24V1 and -24V2, within the LS2 unit. Each of these busses are fused at 3.0 amperes. The voltage from the +5 VOLTS POWER SUPPLY (LW1 circuit pack) is also connected to two busses within the LS2 unit. These busses are designated +5V1 and +5V2 and are fused at 5 amperes. The LS2 unit is capable of initiating two alarms in the central office (CO): (1) minor alarm and, (2) major alarm. The minor alarm will be initiated if the -24 volt or +5 volt fuses are blown, or if 2600-Hz tone is

continuously present on any of the 100 channels for 11 to 12 seconds. The major alarm will be initiated if any one of the following conditions exist:

- -48 volt fuse blown
- +130 volt fuse blown
- main power switch turned off
- AMA lockup, which occurs if the AMA doesn't provide the recording complete (RC) function to the SWITCH AND RELAY panel within 11 to 12 seconds after a 2600-Hz tone detection.

**4.14** The MTTU can be operated without the use of the SWITCH AND RELAY panel. When the SWITCH AND RELAY panel is not used, provisions have been made to remove the +130 volt and AMA lockup alarms. Switches S-1 and S-2 in the LS-2 FUSE AND ALARM circuit must be closed to remove these two alarm functions.

### D. Register Driver

**4.15** The REGISTER DRIVER (LS3 circuit pack) is used to pulse the registers in the register panel. It consists of eleven multivibrators (MV) circuits. Ten of the MV circuits drive resettable registers, while the eleventh MV circuit drives two summing registers, one of which is resettable. The eleventh MV circuit receives its input signal from any of the other ten MV circuits.

**4.16** The MTTU design is such that the 100 channels are divided into ten groups of ten, with one register counting tone detection for ten channels; each register is driven by two CHANNEL DETECTORS, LS-1 circuit packs. The pulse duration of these input pulses to the MV circuit is 75 milliseconds. Therefore, if two pulses are received by the MV circuit, there must be a separation between the two pulses of more than 75 ms.

### E. Test Signal Generator

**4.17** The TEST SIGNAL GENERATOR (LT1 circuit pack) contains: (1) the MTTU system clock, (2) the clear signal generator, and (3) binary gates to establish test tone duration. There is also an analog amplifier to control the level of the 2600-Hz test tone. The 2600-Hz signal is generated by the

FYA unit and is supplied to the TEST SIGNAL GENERATOR when the signal mode switch on the TEST SIGNAL GENERATOR is switched to test mode.

**4.18** The clear signal pulse generated by the TEST SIGNAL GENERATOR occurs when the call identity indexer in the AMA grounds the RC lead in the switch and relay panel. The ground on the RC lead causes the MA relay on the SWITCH AND RELAY panel to release. The release of the MA relay causes the contacts to close, which provides an AMA clear pulse to the TEST SIGNAL GENERATOR. This AMA clear pulse triggers a 150 ms delay after which a 15 ms clear pulse is generated by the TEST SIGNAL GENERATOR. If the clear pulse is not initiated by the AMA, then the MANUAL CLEAR pushbutton on the TEST GENERATOR faceplate can be depressed to generate the clear pulse.

**4.19** The timing and basic counting for the MTTU is provided by a 1 PPS free running flip-flop (FRFF). A panel mounted potentiometer, designated PULSE FREQ. ADJ., enables manual frequency adjustment to the 1 PPS FRFF.

**4.20** Two control gate pulses in the TEST SIGNAL GENERATOR are used to test the CHANNEL DETECTORS. These gating pulses are 180 ms and 240 ms in duration. The width of these gating pulses are controlled by the 2600-Hz tone which is received from the FYA unit. Either one of these gating pulses can be selected by the rotary switch mounted on the TEST SIGNAL GENERATOR faceplate. There is also a pushbutton on the faceplate which allows for a manual pulse of the CHANNEL DETECTOR gates. Five test tone signals can be selected to test the CHANNEL DETECTORS for the ability to detect the 2600-Hz at different signal duration and level. The conditions are:

- (1) continuous tone at 0.245 Vrms, 17.34 mVrms and 6 mVrms
- (2) 180 ms tone duration at 0.245 Vrms
- (3) 240 ms tone duration at 0.245 Vrms
- (4) 240 ms tone duration at 17.34 mVrms
- (5) 240 ms tone duration at 6 mVrms.

The tone duration and levels listed can be selected at a 1 PPS rate, or manual single pulse.

**4.21** A test jack on the faceplate of the TEST SIGNAL GENERATOR allows for an external test cable to be connected for channel testing. There is also internal cabling through a ten-position switch which allows the test tone signals to be routed to each of the five channels of each odd numbered LS-1 CHANNEL DETECTOR circuit pack and each of the five channels of the even numbered LS-1 CHANNEL DETECTOR circuit pack. With these testing capabilities, all 100 channel detectors can be quickly tested for detection time (210 ms nominal), high level pulsing, and sensitivity threshold.

**4.22** The TEST SIGNAL GENERATOR has four indicators located on the faceplate. One of the indicators illuminates to show that the 1 PPS FRFF is operating. The second indicator shows that the TEST SIGNAL GENERATOR is in the test mode. The third indicator illuminates only when the 2600-Hz tone is being received from the FYA unit. The fourth indicator illuminates only when the 150 ms clear pulse is generated. Only the 1 PPS indicator will be flashing when the MTTU is in normal operation. The other three will remain off unless a clear pulse is generated. The 2600 Hz tone is furnished to the CO through the power input (TB1) of the POWER CONTROL AND ACCESS panel ED-7C031 to test the MTTU. This tone is then switched in the CO to the MDF to energize each of the 100 channels sequentially, thereby checking the CO cables and AMA/CII interface.

#### F. Matrix Decode

**4.23** The MATRIX DECODE (LU-1 circuit pack) is optional. The MATRIX DECODE is used in conjunction with the switch and relay panel when trunk identity is desired. The MATRIX DECODE interfaces with the channel detectors. The MATRIX DECODE unit provides three primary functions:

- (1) Drive voltage for the identity disconnect (ID) relay and ten trunk identity (TI) relays.
- (2) Logic and drive signal for the FD relay.
- (3) Test circuitry for verifying the MTTU interface to the AMA.

**4.24** The trunk identity drive circuitry and disconnect circuitry consist of ten identical silicon controlled rectifier (SCR) stages. Each stage is coupled through a normally closed identity disconnect relay (ID) contact. The ID relay is common to all ten circuits, plus one circuit for the ID indicator. When a 2600-Hz signal is detected by any one of the 100 channel detectors, the output from the CHANNEL DETECTOR is routed into the trunk identity drive circuitry in the form of "2 out of 5" code. The output of the trunk identity drive circuitry is connected to ten trunk identity relays in the switch and relay panel. The input signal to the trunk identity drive circuitry, in addition to providing trunk identity, is split off and gated to the logic and drive circuitry which operates the FD relay. Upon tone detection, the TI and FD relays simultaneously operate along with the respective CII relay. When the CII relay operates, it causes the ID relay to operate which disconnects the output of the CHANNEL DETECTOR from the MATRIX DECODE. This action is necessary to prevent interference from a detected tone that may occur before the first detection is processed.

**4.25** The FD relay logic and drive circuit consists of an "and" gate and flip-flop circuit. It is reset when the MA relay on the SWITCH AND RELAY panel is operated.

**4.26** The MATRIX DECODE has a test circuit for verifying the MTTU interface to the AMA. There are two rotary switches (CII and TI) and three push-button switches on the faceplate which allow for simulated detected tone and activation of all the control relays (FD, RR, ID, and MA). The four relays control the open and closed status of the four control leads (CH, DJ, OT, and RC) and ten trunk identity leads. Indicators located on the faceplate show the status of the control leads and control relays when the rotary switches are placed in a test mode of operation. The control relay indicators are also activated during normal operation which indicates the progression of control events when tone detection occurs. The CII rotary switch allows for a test to be made of the CII relays in the SWITCH AND RELAY panel. The trunk identity circuit is checked by operating the TI rotary switch. When the TI rotary switch is operated through its five positions, a combination of two of the matrix circuits and two TI relays are activated and tested. This combination will be one matrix circuit representing one of the "2 out of 5" code (0, 1, 2, 4, 7) for the tens digit

and one circuit for the "2 out of 5" code (0, 1, 2, 4, 7) for the units digit. There are ten indicators on the faceplate that represent these tens and units matrix circuits, and when this switch is operated through its five positions, these indicators will illuminate if the circuit is functional. There is also an indicator that represents the "Test Mode" that illuminates when the CII and TI switches are in any position other than OPERATE. Tests are routed through a test connector on the front of the SWITCH AND RELAY panel. When tests are performed, the cables connected to the CII-0 through CII-4 connectors on the front of the SWITCH AND RELAY panel must be disconnected. There is a test cable which is connected between any one of the five CII connectors and the test connector.

#### **G. Switch and Relay Panel**

**4.27** The SWITCH AND RELAY panel is optional equipment and used only when trunk identity is desired. The SWITCH AND RELAY panel provides direct interface with the CII and AMA recorder. Its primary functions are commanding and responding to AMA when 2600-Hz tone detection occurs. This unit is used to assign the CII's to specific detector channels. There are 100 six-position switches (0 through 5) mounted to the faceplate of the SWITCH AND RELAY panel. These switches are connected to the FD output of the CHANNEL DETECTORS and to the CII relays. Any detector can be assigned to any of one of five CII's, or any one of the CII's can be connected to all 100 detectors through these switches. The detector number must agree with the trunk number, and the CII assigned to the detector must be the same one which serves the trunk for billing purposes. When 2600-Hz tone is detected by any one of the 100 channel detectors, an FD signal is generated and routed to the preselected CII relay through the switch which is assigned to that particular channel. The CII relay coil circuitry is designed so that when any one of the five CII relays operate, the other four relays are inhibited for the duration of the FD signal period. This prevents multiple FD information from being transmitted to the AMA call identity indexer.

**4.28** When the CII relay operates, the trunk identity relay coils are grounded, which allows the TI relays to operate when signal voltage is received from the SCR circuits in the MATRIX DECODE unit. When the signal is received from the MATRIX DECODE, four of the ten TI relays

(two tens and two units relays) representing the appropriate 2 out of 5 code will operate. The TI relays will remain operated as long as the CII relay is closed. Operation of the CII relays also completes the circuit for the ID relay in the MATRIX DECODE unit. Operation of the ID relay opens the input circuits of the ten SCR circuits of the MATRIX DECODE.

**4.29** The FD, RR, and MA relays provide the appropriate process and hold sequence necessary to transmit and receive information to and from the CII and AMA. When the FD relay operates, it connects the winding of the RR relay to the CH lead which initiates a bid for the recorder in the AMA (see Fig. 6). If a recorder is not available, the channel detector will be cleared within 11 to 12 seconds and the trunk identification will not be made. The availability of a recorder is determined by the CH interface lead from the AMA being grounded. Ground on the CH lead activates the RR relay. Contact closure of the RR relay provides an operating path for the MA relay. Operation of the MA relay produces the following circuit functions:

- (1) Applies a ground to the FD disable circuit causing the FD relay to release, which in turn causes the RR relay to release.
- (2) Closes the CH and DJ interface control lead loop between the MTTU and AMA call identity indexer (CII), Fig. 6.
- (3) Closes the RC and OT interface control leads between the MTTU and AMA CII (see Fig. 6).
- (4) Provides self-latching of the MA relay.
- (5) Provides an operate path for the CII relay in the MTTU after the FD and RR relays released.
- (6) Provides an AMA lock-up alarm signal to the fuse and alarm unit.

**4.30** Closure of the MA relay applies +130 Vdc to the OT lead, which causes the OT and FD relay in the AMA CII to operate (see Fig. 6). When the OT relay operates, a numeral "3" is generated in digit position "A" of the AMA entry. A numeral "8" will be generated in digit positions "B, C and D" when the FD relay in the CII/AMA

recorder is operated. Also, when the FD relay in the CII/AMA recorder operates, it transfers control of trunk identification leads to the MTTU detection equipment. The trunk identity relays have been previously operated to identify the MTTU channel (channels 00 through 99) which detected the SF tone.

**4.31** The digits "3" and "8" are special code numbers for MTTU identification. As stated previously, they are perforated on the tape in digit positions "A, B, C, D". The MTTU channel identity number is perforated in digit positions "E and F". A single frequency (SF) tone detected on MTTU channel 79 would be perforated as 388879.

**4.32** The CII relay coil paths are connected through three parallel sets of contacts from the FD, RR, and MA relays. This circuit configuration is necessary in order to keep the CII relay operated during complete tone detection and recording period. When the recording on the AMA recorder is complete, the RC interface lead is grounded (see Fig. 6). The ground on the RC lead causes the MA relay to release, which in turn releases the CII relay and the ID relay. When the ID relay releases, it restores the drive paths to the ten SCR circuits in the MATRIX DECODE unit. The MTTU has now completed its detection and recording cycle and is ready for its next tone detection.

#### H. Register Panel

**4.33** The register panel contains twelve registers of which eleven are resettable and one non-resettable. Two of the twelve registers are electrically connected in parallel and respond any time one of the remaining ten registers is pulsed. These two registers are summing registers. One of these summing registers is resettable.

**4.34** The 100 channels are grouped in 10 groups of 10 channels. Each register will be assigned to monitor 10 channels. The input pulse to the REGISTER panel is generated in the REGISTER DRIVER (LS3 circuit pack) as the result of tone detection.

#### I. Power Supply

**4.35** The POWER SUPPLY (LW1 circuit pack) is mounted to a printed circuit board that is modified to fit a standard type F SF signaling frame.

4.36 The POWER SUPPLY converts a -48 Vdc to a regulated +5 Vdc, at 5 amps maximum dual output. The electrical characteristics of the POWER SUPPLY unit are listed in Table B.

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5.01 There are no field adjustments provided for the plug-in units. Units not meeting circuit requirements should be sent to Western Electric Company for repair. When a unit becomes defective, it should be replaced by a spare unit.

5.02 When panel mounted equipment becomes defective, the repairs will be made at the field location.

TABLE A

| DIGIT | TWO OUT OF FIVE CODE |   |   |   |   |
|-------|----------------------|---|---|---|---|
|       | 7                    | 4 | 2 | 1 | 0 |
| 0     | X                    | X |   |   |   |
| 1     |                      |   |   | X | X |
| 2     |                      |   | X |   | X |
| 3     |                      |   | X | X |   |
| 4     |                      | X |   |   | X |
| 5     |                      | X |   | X |   |
| 6     |                      | X | X |   |   |
| 7     | X                    |   |   |   | X |
| 8     | X                    |   |   | X |   |
| 9     | X                    | X |   |   |   |

TABLE B

| POWER SUPPLY CHARACTERISTICS              |   |
|---|---|
| Supply Voltage                            | -44 to -55 Vdc continuous to -60 Vdc for 2 minutes max., 10% duty cycle |
| Load                                      | Internally limited  |
| Operating Temperature                     | 0°C to 50°C at full load to 70°C with reduced load                      |
| Overload Protection                       | Power shutdown with automatic cycling and restart when fault is removed |
| Voltage at Rated Current                  | +5.1  |
| Current                                   | 5 Amperes, each output  |
| Voltage Setting Tolerance                 | ±.05V   |
| Regulation (Combined Line and Load)       | ±.1V  |
| Voltage Regulation with Temp. 0°C to 70°C | 1%  |
| Output Noise and Ripple                   | 100 mV  |
| Max. Output Voltage Under Fault           | 7 Vdc   |
| Max. Load Capacitance                     | 4000 μf   |

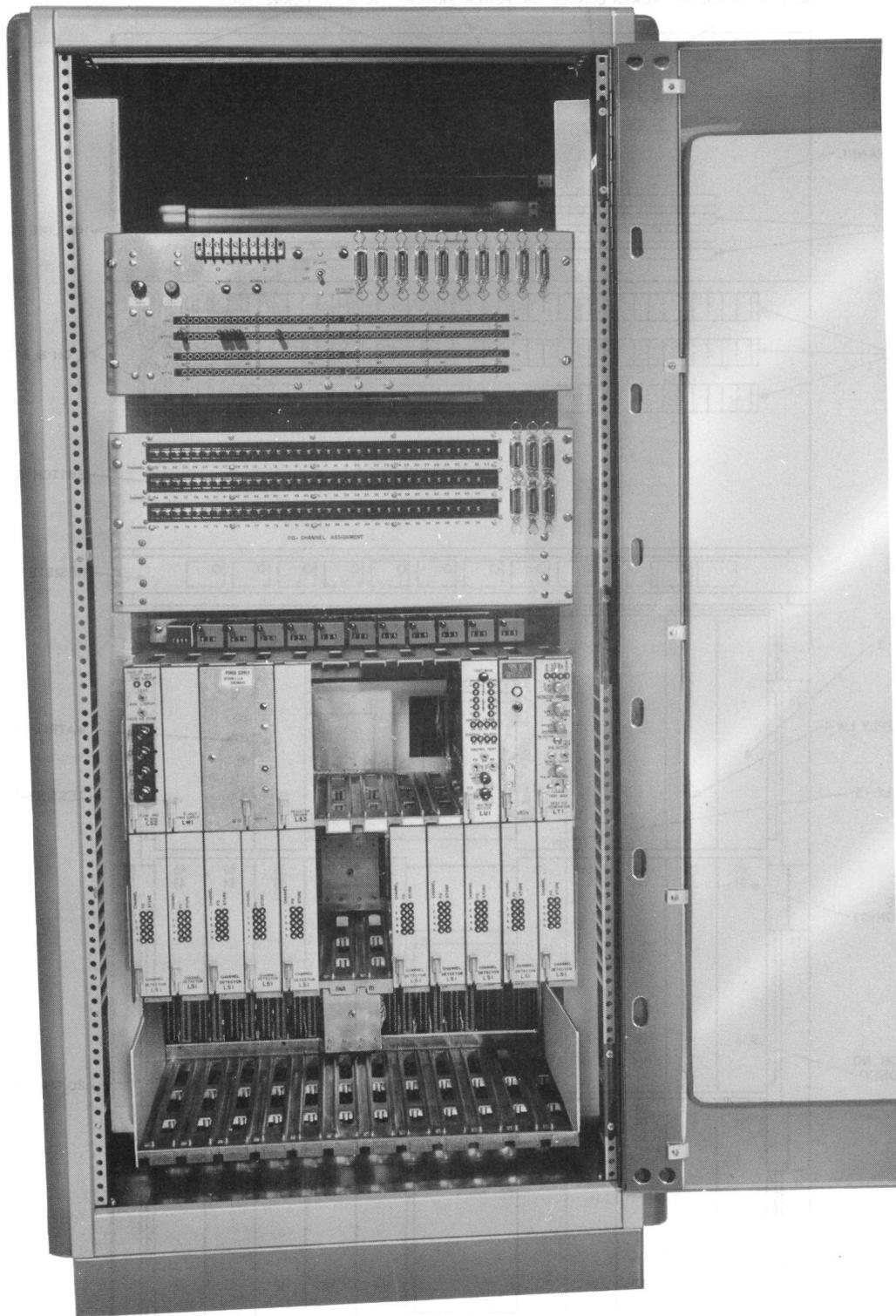


Fig. 1—Portable Version of MTTU

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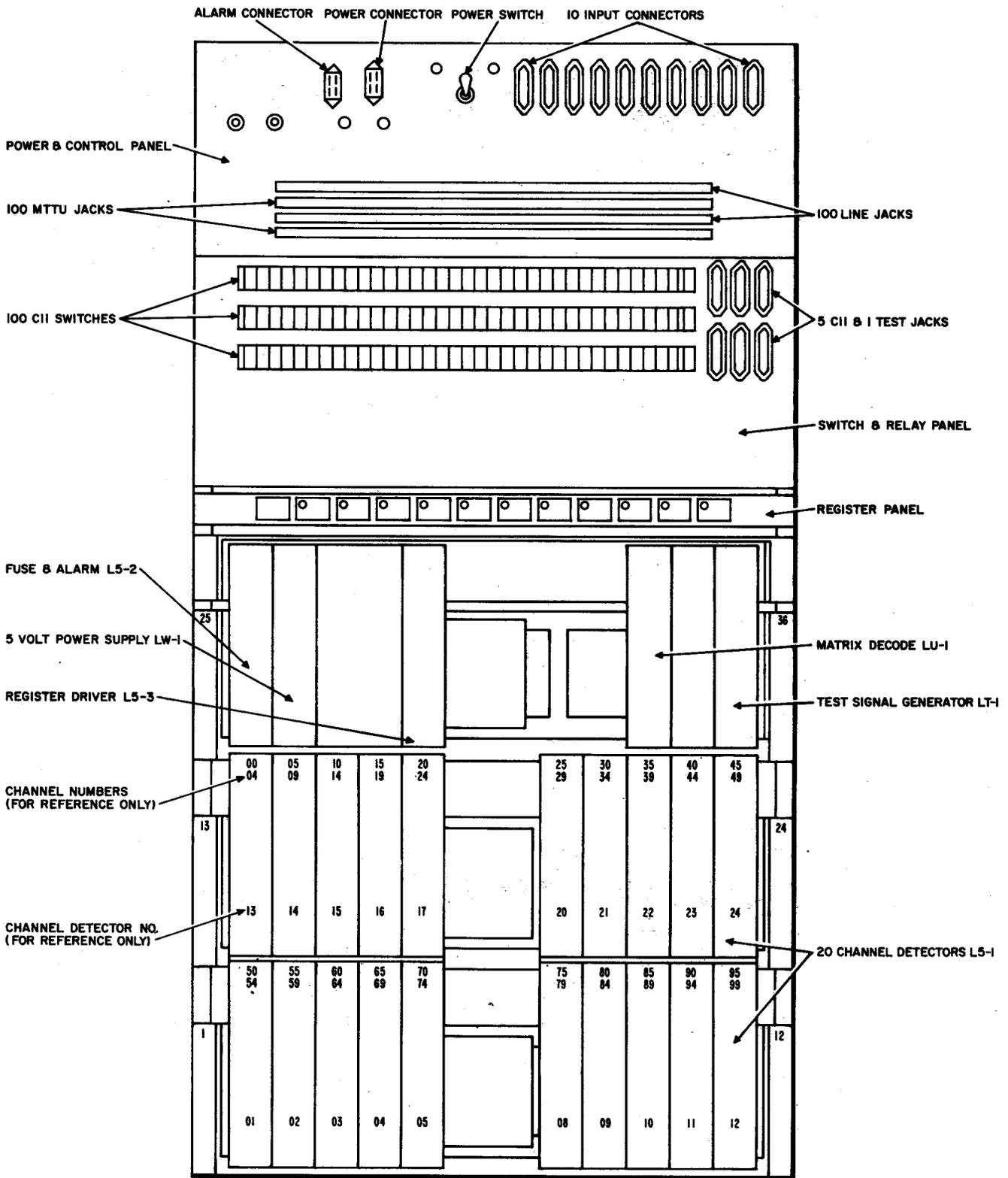


Fig. 2—MTU Equipment Layout

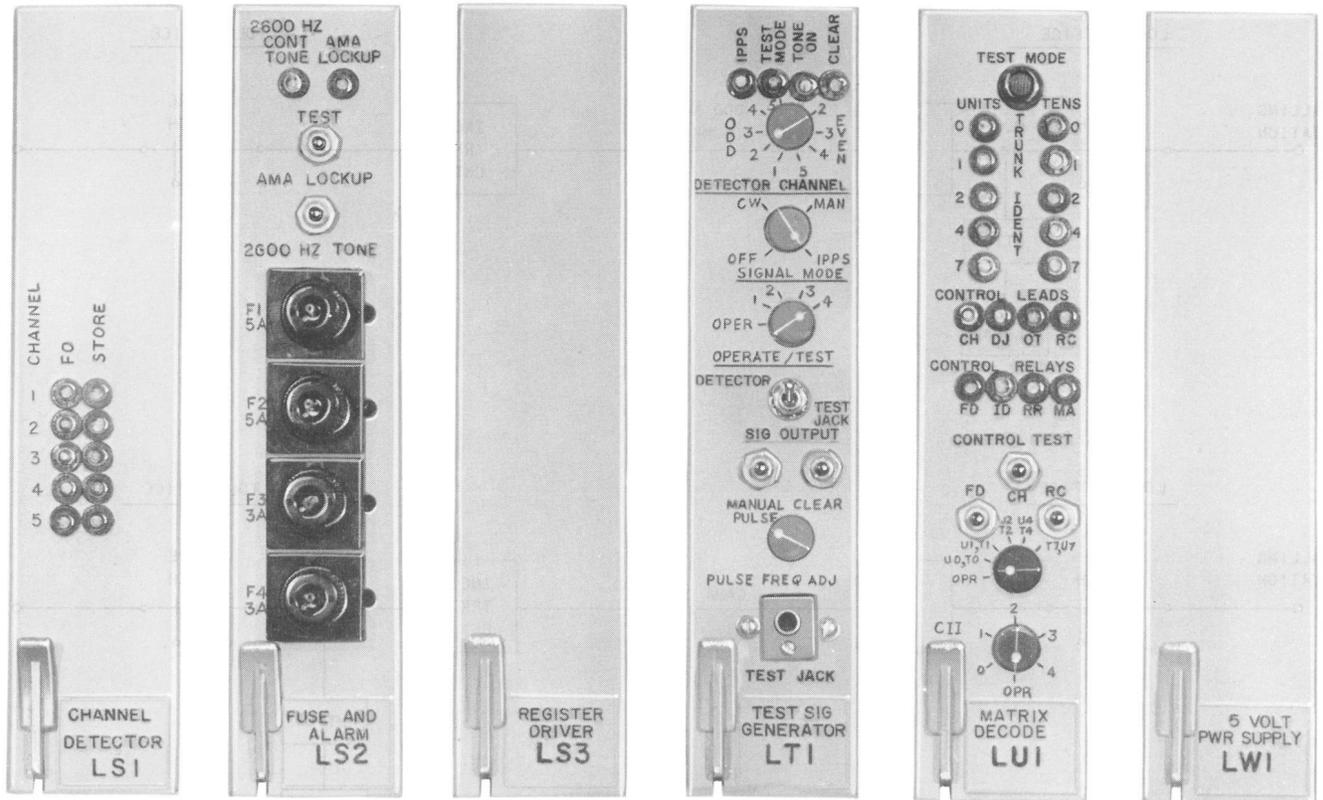


Fig. 3—MTTU Circuit Pack Faceplates

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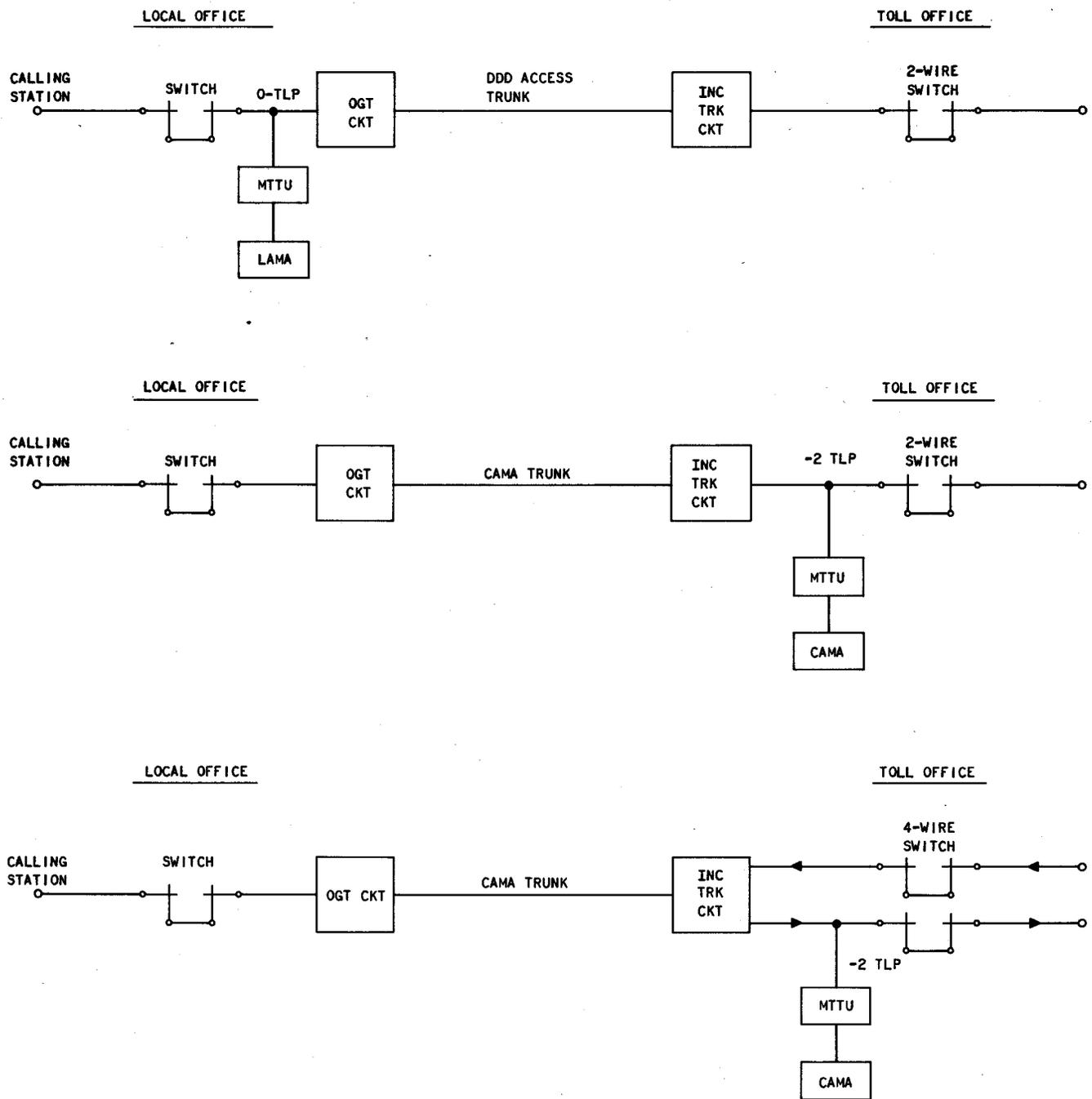


Fig. 4—Typical MTU Applications

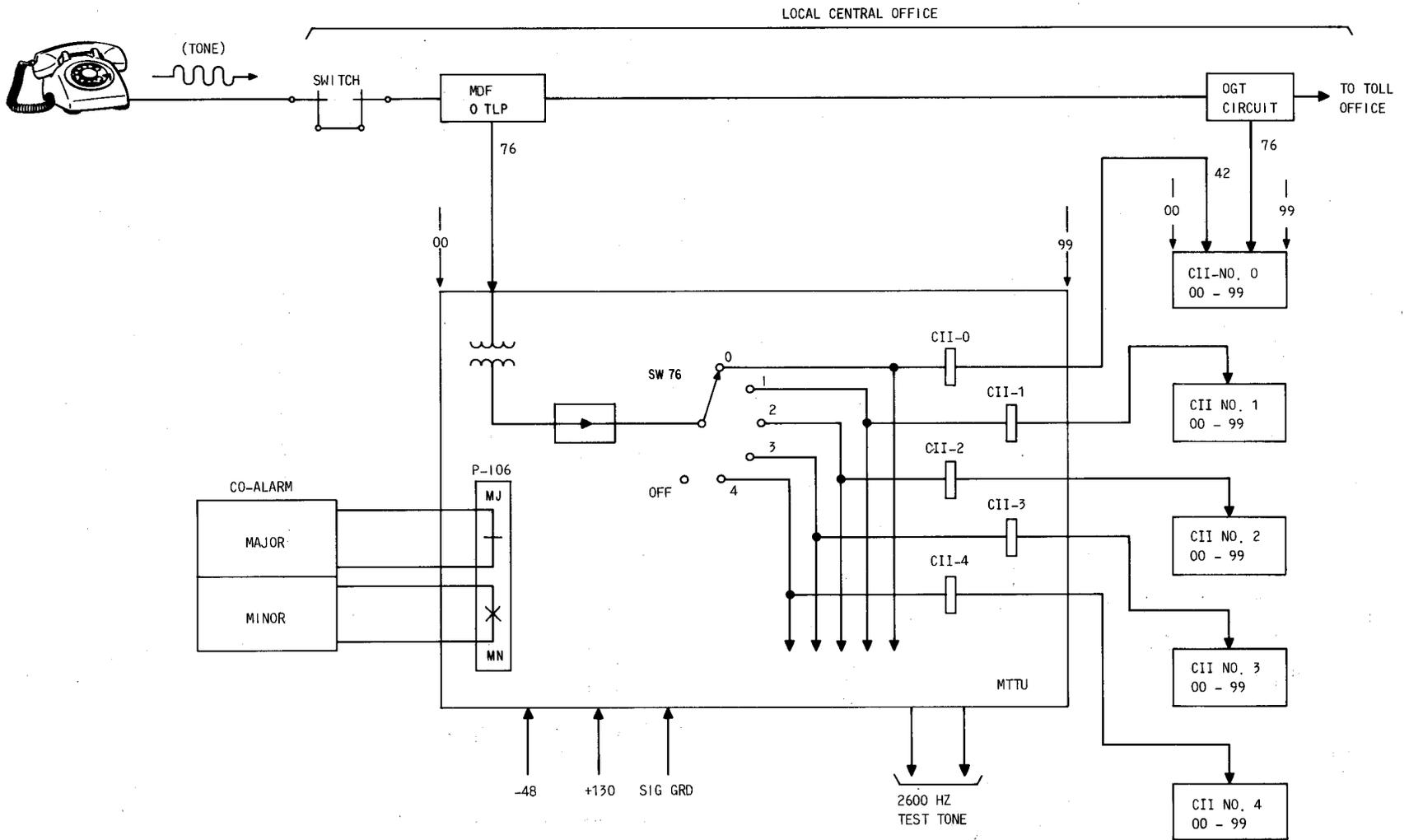


Fig. 5—MTU Interface with Central Office

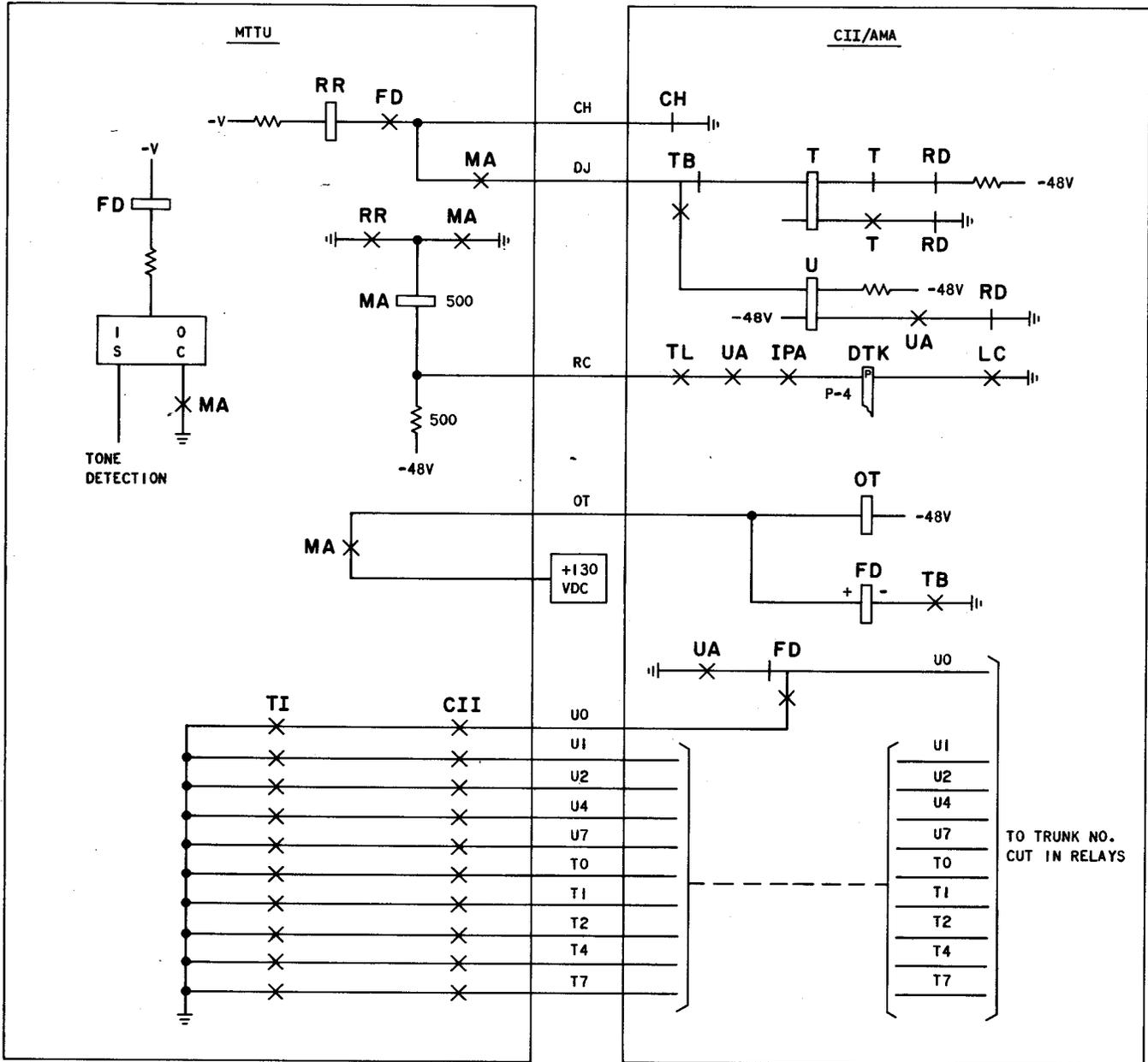


Fig. 6—MTTU to CII/AMA Interface