

**SERVICE**  
**1A2 KEY TELEPHONE SYSTEM**  
**KEY TELEPHONE UNITS**  
**LINE SERVICES**

**1. GENERAL**

**1.01** This issue provides schematic information for the 400-series KTUs which provide line services. Line service KTUs provide switching, control, and signaling functions which permit key telephones in a 1A2 KTS to be connected to CO or PBX lines, key telephone sets of other systems, or private lines. These units include circuits for audible or visual signals and a time-out feature for incoming calls which are not answered.

**1.02** This section is reissued to:

- Add information on the 419B KTU
- Add two additional restrictions on the use of the 400H KTU and revise two existing restrictions.

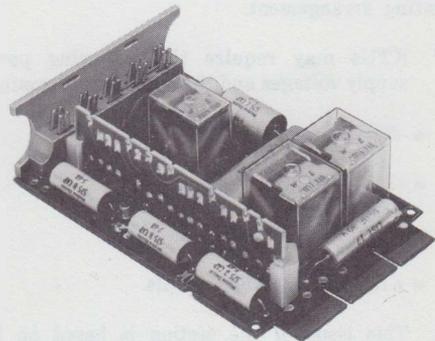
**1.03** The following KTUs and their functions are covered in this section:

- 400B, C and D (all MD) and 400G and H—CO or PBX Line Circuit
- 414A—Manual Signaling, Ringdown, Private Line Circuit
- 415A—Automatic, DC Signaling, Private Line Circuit
- 416A—Station Line Circuit
- 418A—Short Range, DC Signaling, Private Line Circuit
- 419A—Automatic Signaling, Ringdown, Private Line Circuit

- 461A—Manual Signaling, Ringdown, Private Line Circuit.

**Mechanical**

**1.04** All circuit components on these KTUs are mounted in a plug-in printed wiring board, one end of which is equipped with contacts. A 4-inch board may have 18, 20, or 40 contacts; an 8-inch board will have 80 contacts (requiring two vertical 40-pin connectors). The circuit boards plug into mating connectors in key service units, panels, or apparatus mountings. Wiring from the connectors will be dedicated or nondedicated leads. Dedicated leads are those that normally appear on the same contacts of all KTUs, such as supply voltages and grounds, and are normally factory-wired. Nondedicated leads are those whose designation and function vary and are made available for installer connections. Fig. 1 and 2 show typical 4- and 8-inch KTUs.



**Fig. 1—Typical 4-Inch KTU**

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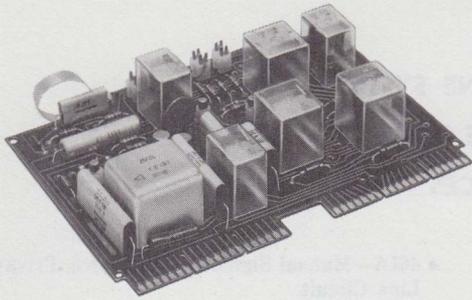


Fig. 2—Typical 8-Inch KTU

### Electrical

1.05 Functional schematics cover the basic circuitry of each KTU, contacts used, and its relationship to telephone sets, other KTUs, power supplies, and apparatus. Dashed lines are used to simplify the schematics and to indicate intermediate circuitry. If full schematics are required, refer to the SDs listed in 1.08.

1.06 Voltages required for operation of the KTU, or provided to associated apparatus by the KTU, are shown with their connector pins. Other voltages may appear on the contacts of the mating connector, but not on the KTU, depending on the mounting arrangement.

1.07 KTUs may require the following power supply voltages and their associated grounds:

- -24V (B battery) for control
- -24V (A battery) for talk
- ±10V for visual signals
- ±105V for audible signals.

1.08 This issue of the section is based on the following drawings:

SD-69513-01, Issue 15—400D KTU

SD-69651-01, Issue 3 —400G KTU

SD-69942-01, Issue 1—400H KTU

- SD-69559-01, Issue 9 —414A, 415A, 416A, 418A, 419-type, 461A KTUs.

If this section is to be used with equipment or apparatus reflecting later issues of the drawings, reference should be made to the CDs and SDs to determine the extent of the changes and the manner in which the section may be affected.

## 2. IDENTIFICATION

### 400B, C, D, G and H KTUs (CO or PBX Line Circuit)

2.01 The latest version of the line circuit KTU is the 400H. The 400B, C, and D KTUs are rated MD, and the 400G is still AT&TCo Standard. The earlier KTUs may be used for replacements or new installations when the features provided by later models are not required. There are a large number of earlier KTUs in service in the field (particularly 400Ds), and they should not be replaced if they are operating satisfactorily.

2.02 The 400-type KTUs (Fig. 3 through 9) are 4-inch 18-contact units used to provide a key telephone set with CO or PBX line services. In conjunction with the set, it provides the following features:

- Pickup and hold of a CO or PBX line
- Flashing line lamp on incoming call
- Audible line signal and/or common audible signal on incoming call
- Steady lamp indicating busy condition
- Steady or winking lamp indicating hold condition
- Talking circuit connection to CO or PBX line maintained during periods of power failure
- Individual line time-out on unanswered incoming calls with different timing interval options
- Delayed hold release
- Maximum loop resistance of 50 ohms or approximately 1000 feet of 24-gauge IW cable between KTU and telephone set.

**2.03** If false release of the hold circuit is encountered, verify type of serving facility (CO, Centrex, or PBX) and apply appropriate option. Variables may be encountered in any given application which will result in unexpected false releases. In these cases the option applied must be determined locally. See Tables A, B, and C.



***In the 400D (MD) KTU, option ZD is replaced by option ZJ. However, it is not necessary to update circuits previously modified with option ZD.***

**Note:** Options ZC, ZD and ZJ are installer provided options that delay the release of the local hold circuit when the telephone line is opened for short intervals. These line opens usually occur when the switching machine reswitches the line after the transmission path has been established. The delay interval prevents false release of hold during this action. It is not recommended that these options be applied on a widespread basis, but

only if false release from hold is actually encountered.

**2.04** The number of bridged ringers that may be used with each 400B, C, D, G or H KTU is listed in Table D.

**2.05** The 400B KTUs can be utilized in conjunction with 701 PBXs and the central offices listed in Table E, provided the operating characteristics in 2.06 are acceptable.

**2.06** The 400B KTU has some restrictions which result from the unit's sensitivity to certain line conditions which are common to all types of telephone lines. The 400B KTU is susceptible to the following characteristics:

(a) **Longitudinal Voltages:** KTU may ring up falsely in response to longitudinally induced 60-Hz voltage greater than 12 volts RMS. KTU may also fail to hold when induced voltages exceed 65 volts RMS in the answer state.

TABLE A

APPLICATION OF OPTIONS ZC AND ZJ - 400D KTU

PBX	TYPE OF CENTRAL OFFICE							
	STEP-BY-STEP		PANEL	NO. 1 X-BAR	NO. 5 X-BAR		ESS	
	WITHOUT PERM. SIGNAL TRUNKS	WITH PERM. SIGNAL TRUNKS			UNMOD PERM. SIGNAL TRUNKS	MODIFIED PERM. SIGNAL TRUNKS		
None	*	*	*	*	ZJ	ZJ	ZC	
701	Outgoing	*	*	*	*	ZJ	ZJ	ZC
	Incoming	*	*	*	*	ZJ	ZJ	ZC
756/757/758	*	*	*	*	ZJ	ZJ	ZC	
770	ZC	ZC	ZC	ZC	ZC	ZC	ZC	
800/801	ZJ	ZJ	ZJ	ZJ	ZJ	ZJ	ZC	
805	ZJ	ZJ	ZJ	ZJ	ZJ	ZJ	ZC	
812	ZC	ZC	ZC	ZC	ZC	ZC	ZC	
CSS 201	*	*	*	*	*	*	*	

\* None required.

TABLE B

## HOLD RELEASE OPTIONS – 400G KTU

PBX	TYPE OF CENTRAL OFFICE						
	STEP-BY-STEP		PANEL	NO. 1 X-BAR	NO. 5 X-BAR		ESS
	WITHOUT PERM. SIGNAL TRUNKS	WITH PERM. SIGNAL TRUNKS			UNMOD PERM. SIGNAL TRUNKS	MODIFIED PERM. SIGNAL TRUNKS	
None	R	R	R	R	R	R	*
701	R	R	R	R	R	R	*
756/757/758	R	R	R	R	R	R	*
770	*	*	*	*	*	*	*
800/801	R	R	R	R	R	R	*
805	R	R	R	R	R	R	*
812	*	*	*	*	*	*	*
CSS 201	*	*	*	*	*	*	*

\* Factory-provided option, 600 ms (minimum) time-out.

Note: R option is short time-out, 25 ms minimum.

(b) **Polarity of Central Office Battery:**

Hold circuit will not respond when the line is associated with negative grounded battery plants such as No. 101 Electronic Switching System.

(c) **Hold Circuit:** Hold circuit cannot be released from central offices during permanent signal release routine. Release time of the hold circuit exceeds the release signal interval.

(d) **Flash and Recall:** Circuit connects a shunt across the line for 100 to 250 milliseconds when the switchhook is depressed during the station flash operation. This abbreviates or completely suppresses the flash indication.

(e) **Time-out:** Short time-out interval cannot be altered by installer.

(f) **Transmission:** A 15 dB transmission loss can be expected in arrangements that require

line transmissions while the holding bridge is connected to the line.

**2.07** The 400C KTU has the same characteristics as the 400B except those covered in 2.06(a).

**Note:** 400-type KTUs may serve a maximum of 20 multiplied lamps.

**2.08** The 400D KTUs stenciled SD-69513-01, Issue 10, have been modified by removal of the C4 capacitor. With this change, the circuit will not release a held line on battery reversal.

**2.09** Improvements to overcome silicone contamination of the relay contacts have been included on Issue 12 and subsequent issues of the 400D KTU. Repaired units containing these changes can be identified by a star or C stamped on the label after the issue number or by the new label.

TABLE C

## HOLD RELEASE OPTIONS – 400H KTU

PBX	TYPE OF CENTRAL OFFICE						
	STEP-BY-STEP		PANEL	NO. 1 X-BAR	NO. 5 X-BAR		ESS
	WITHOUT PERM. SIGNAL TRUNKS	WITH PERM. SIGNAL TRUNKS			UNMOD PERM. SIGNAL TRUNKS	MODIFIED PERM. SIGNAL TRUNKS	
None	R	R	R	R	R	R	S
701	R	R	R	R	R	R	S
756/757/758	R	R	R	R	R	R	S
770	S	S	S	S	S	S	S
800/801	R	R	R	R	R	R	S
805	R	R	R	R	R	R	S
812	S	S	S	S	S	S	S
CSS 201	S	S	S	S	S	S	S

Note: S option is factory-provided for long time-out. R option is short time-out.

**2.10** The 400D KTUs stenciled SD-69513-01, Issue 13, and KTUs repaired after July 1, 1971, will have a new label which will include space for the line number and the words "Outward" and "Trouble". If the KTU is removed from service because of trouble, it shall be marked "Trouble" in the space provided before being turned in for repair. If the KTU is removed from service for reasons other than trouble, it shall be marked "Outward". The new KTUs will have a separate label with the date of manufacture placed on the back of the handle (ie, 3-71 will identify a KTU manufactured in March 1971). The repaired KTUs will have the date of repair stamped on the printed wiring board. An orange repair date stamp indicates those units tested defective when returned from the field, and a white stamp indicates those tested O.K.

**2.11** Wiring changes were made to the 400D KTU manufactured after November 1974 to cover specific trouble indications. The modified

KTUs are marked Issue 15 and are recommended where the following conditions are encountered:

- Power supply voltage variations
- Non A-lead stations behind KTU
- High resistance ground.

**2.12** In some instances, noise or crosstalk may be encountered due to an unbalanced condition of the transmission circuit of 400D and G KTUs while on hold. The condition can be corrected by placing a KS-19524, List 9 capacitor (60  $\mu$ F), or equivalent, across leads R (CO) and R (Sta). The capacitor should be connected to the leads where they appear on the connecting blocks associated with the mounting arrangement involved. A multiple point may be required using either 183A2 adapters on the terminals or using spare terminals or another 66-type connecting block. It is not recommended that the capacitor be added to the pins of the connector where the KTU is plugged in. (The use

TABLE D

## RINGING BRIDGE LIMITATIONS – 400-TYPE KTU

KTU	MINIMUM RMS RINGING VOLTAGE (20 Hz)	MINIMUM LEAKAGE RESISTANCE (OHMS)	MAXIMUM NUMBER OF BRIDGED RINGERS			
			0	1	2	3
			MAXIMUM RINGING RANGE (OHMS)			
400B	72V	15K	4446	1788	1119	814
	80V		6062	2438	1526	1110
	84V		6871	2763	1729	1258
400C	72V	15K	5140	2434	1594	1185
			10K	4060	1722	1093
	80V	5537	2349	1490	1091	
	84V	6225	2662	1689	1237	
400D	72V	15K	4799	2354	1560	1166
			10K	2408	1334	922
	80V	3284	1819	1258	961	
	84V	3722	2062	1426	1090	
400G 400H	72V	10K	3148	1873	1333	1034
			10K	3100	2000	1475
	80V	4000	2550	1900	1500	
	84V	4500	3000	2125	1625	
	84V	20K	5850	3500	2500	1800

of a capacitor is never required in a 400H KTU because its transmission circuit is perfectly balanced.)

**2.13** Either the 400H KTU or the 400G can be used for any 1A2 KTS CO or PBX line circuit application. In addition to circuit improvements, the 400H and G KTUs differ from earlier 400-type KTUs in that they have a line status indicator and option plugs for connecting the various options.

**2.14** Line status is indicated by a light emitting diode (LED) located in the option block-handle assembly of the 400G (Fig. 4) or 400H (Fig. 7). The LED will light in all active states of the line circuit as shown in Table F. ♦Those 400G KTUs

labeled Issue 2 are equipped with a 556A LED which replaces the original 538A LED.♦

**2.15** Features or service options are connected in the 400G (Fig. 5, 6, and Table B) and in the 400H (Fig. 8, 9, and Table C) by means of option plugs in the option block-handle assembly. Spare option plugs are available for the 400G by ordering a D-180768 kit of parts; each kit contains five option plugs. For the 400H KTU, the D-180826 kit of parts contains six option plugs and three J3 jumper connectors.

**2.16** The 400G can be arranged for short interval ringup time-out (approximately 5 seconds)

**TABLE E**  
**KTU COMPATIBILITY WITH CENTRAL OFFICES**

TYPE KEY TEL. SYS.	TYPE KTU	ESS			NO. 5 X - BAR CENTREX			NO. 1 X - BAR	NO. 5 X-BAR	PANEL	S X S WITH PS TRUNKS
		BRIDGE RESW. OPEN*	CKT. MOD.	RLS. ON PS OPEN*	BRIDGE RESW. OPEN*	CKT. MOD.	RLS. ON PS OPEN*	RELEASE ON PS OPEN*			
		462 ms		1000 ms	20 ms		144 ms	400 ms	144 ms	530 ms	1000 ms
1A2	400A, B and C	Yes	—	No	Yes	—	No	No	No	No	No
	400D	No	OPT ZC	Yes	No	OPT ZJ	Yes	Yes	Yes	Yes	Yes

\* Reswitch (Resw.) opens specified are maximums and permanent signal (PS) release opens are specified at minimums.

**TABLE F**  
**INDICATIONS OF LINE STATUS LED**

LINE STATUS	LED CONDITION	
	400G KTU	400H KTU
Idle	Off	Off
Ringing	Steady	Flashing
Off-Hook	Steady	Steady
Hold	Steady	Winking

by providing option Z or, for long interval time-out (approximately 20 seconds), by removing option Z. With the 400H, a short interval time-out is factory-provided and cannot be altered.

2.17 The 400H KTU has a pair of test pins, accessible through a window in the front of the option block-handle (Fig. 7), which allow an installer or repairperson to determine whether the KTU is on an active CO/PBX line even when no telephone set is connected. When the two pins are shorted together with a screwdriver blade, the line status LED will light and the associated interrupter motor will start if the KTU is connected to an active line. If it is not, the LED will remain dark, but the interrupter motor will still start. In COM KEY\* 2152, the interrupter runs continuously as long as power is connected.

\* Trademark



*Observe the following restrictions on the use of the 400G and 400H KTUs:*

- *The 400H must be in the off-hook state, with dial tone on the line for at least 2 seconds before it can be put into the hold state. When testing a 400H:*
  - (1) *Go off-hook.*
  - (2) *Listen for dial tone.*
  - (3) *Wait at least 2 seconds after dial tone is received.*
  - (4) *Depress hold button.*
- *The 400H will not go into the hold state if the peak metallic noise voltage on the tip and ring leads at the time the HOLD button on the telephone set is depressed is greater than 2.5 volts.*
- *The 400H is compatible only with Issue 5 and later issues of the 412A KTU (auxiliary relay circuit). Issues 1 through 4 of the 412A may be used if the 186-type protection networks are clipped out of the circuit.*
- *When music-on-hold is required in conjunction with 400G or H line circuits,*

*the music-on-hold KTU installed must be compatible with the mounting facilities available. A 451-type KTU cannot be plugged into a connector intended for a 498A, and vice versa (see Section 518-215-401).*

- **◆** *The 400H KTU contains a relay having mercury-wetted contacts and must be mounted in the proper position. Current production of the 400H has an arrow printed on the front label which indicates the proper installation position.*
- *For proper lamp operation, when the line circuit is a 400H, the lamp power must be an ac voltage—a dc voltage cannot be used.*◆

#### 414A KTU (Manual Signaling, Ringdown, Private Line Circuit)

2.18 The 414A KTU (Fig. 10) is a 4-inch, 20-contact unit for connecting a telephone set to a private line terminated at a distant location. Another tie line circuit KTU is required at the distant location. A nonlocking key on the telephone set, or an externally mounted key in addition to the line pickup key, is required for signaling. The 414A KTU provides a talking and manual signaling circuit with the following operating features:

- Flashing line lamp on an incoming call.
- Steady lamp indicating line busy.
- Time-out on unanswered incoming calls; optional time intervals.
- Choice of audible signals, common audible, steady, or interrupted.
- Audible ringback signal option so calling party can hear a tone from the distant telephone.
- Idle line termination when KTU is connected to lines having repeaters.
- A spare relay contact is available for control functions.
- Line hold feature is **NOT** available.

- Ringing ranges are shown in Table G.

TABLE G

RINGING RANGES — 414A KTU

MINIMUM RMS RINGING VOLTAGE	STANDARD LOOPS 15K-OHM LEAKAGE	UNIGAUGE LOOPS 20K-OHM LEAKAGE*
		OHMS
75 } volts (20 Hz)	2600 ohms	4000
84 }		4600
92 }		5000
110 } volts (30 Hz)		5000
120 }		5400

\*These ringing ranges are also valid with unigauged plant which may use an E6 repeater in each subscriber loop.

#### 415A KTU (Automatic, DC Signaling, Private Line Circuit)

2.19 The 415A KTU (Fig. 11) is a 4-inch, 18-contact unit for connecting a telephone set to a private line terminated at a distant location. Another 415A KTU, or other tie line KTU which will respond to a dc signal, is required at the distant location. The distant telephone set is automatically signaled when the line key on the local telephone set is operated and the handset is lifted. The 415A KTU provides a talking and signaling circuit with the **same** operating features as the 414A KTU and, in addition, provides:

- Optional lamp wink as an indication of hold
- Ringing ranges with -20 volt battery supply are shown in Table H.

#### 416A KTU (Station Line Circuit)

2.20 The 416A KTU (Fig. 12) is a 4-inch, 20-contact unit for connecting a private line between a local telephone set and a telephone set at a distant location. A nonlocking key, in addition to the line pickup key at the local telephone set, is required to operate the audible signal at the distant station. The local station is signaled by lifting the handset

TABLE H

## RINGING RANGES - 415A KTU

MINIMUM BATTERY VOLTAGE	STANDARD LOOPS 15K-OHM LEAKAGE	UNIGAUGE LOOPS 20K-OHM LEAKAGE*
-20 volts	2300 ohms	2200 ohms

\*These ringing ranges are also valid with unigauge plant which may use an E6 repeater in each subscriber loop.

and operating the line key associated with the set at the distant location. The 416A KTU provides a talking and signaling circuit with the following operating features:

- Visual lamp signal to indicate incoming call, or line busy.
- Choice of audible signals, common audible, steady, or interrupted.
- Audible ringback signal option.
- A spare relay contact is available for control.
- Line hold feature is **NOT** available.
- Ringing ranges with -20 volt battery supply on standard loops is 750 ohms.

#### 418A KTU (Short Range, DC Signaling, Private Line Circuit)

2.21 The 418A KTU (Fig. 13) is a 4-inch, 20-contact unit for connecting a private line between two telephone sets, usually on the same premises. A single KTU will serve two stations. The unit may be connected for one of three methods of signaling: two-way automatic, two-way manual, or automatic one-way and manual one-way. The 418A KTU provides a talking and signaling circuit and the following operating features:

- Flashing line lamp on an incoming call.
- Steady lamp indicating line busy.
- Choice of audible signals, common audible, steady or interrupted.
- Audible ringback signal option at both stations.

- Line hold feature is **NOT** available.
- Ringing range is 100 ohms with -20 volt battery supply.

#### 419-Type KTU (Automatic Signaling, Ringdown, Private Line Circuit)

2.22 The 419-type KTU (Fig. 14) is an 8-inch, 80-contact unit for connecting a telephone set over a private line to a distant location. Another 419-type KTU, or tie line KTU which will respond to and transmit ringing voltage, is required at the distant location. The distant telephone set is automatically signaled when the line key on the local telephone set is operated and the handset is lifted. The 419-type KTU provides a talking and signaling circuit with the following operating features:

- Pickup of a private line.
- Flashing line lamp on an incoming call.
- Steady lamp indicating line busy.
- Winking hold lamp.
- Choice of audible signals: common audible, steady, or interrupted.
- Audible ringback signal optional.
- Idle line termination when KTU is connected to lines using repeaters.
- Time-out on unanswered incoming calls; optional time-intervals.
- Hold-interrupt control to change status of 419-type KTU at a distant location from HOLD to Incoming Call (by switchhook flash).
- Ringing ranges are shown in Table I.

2.23 ♦The 419B KTU is directly interchangeable with the 419A (MD). The 419B should be used in those installations where problems are encountered with false ringups due to line capacitance on long loops.♦

TABLE I

## RINGING RANGES—419-TYPE KTU

MINIMUM RMS RINGING VOLTAGE	STANDARD LOOPS 15K-OHM LEAKAGE	UNIGAUGE LOOPS 20K-OHM LEAKAGE*
		OHMS
75 } volts (20 Hz) 84 } 92 }	2600 ohms	4000
		4600
		5000
110 } volts (30 Hz) 120 }		5000
		5400

\*These ringing ranges are also valid with unigauged plant which may use an E6 repeater in each subscriber loop.

## 461A KTU (Manual Signaling, Ringdown Private Line Circuit)

2.24 The 461A KTU (Fig. 15) is an 18-contact version of the 414A KTU. The spare contact available on the 414A has been eliminated and B ground used for RG. Another tie line circuit KTU is required at the distant location. A nonlocking key on the telephone set, or an externally mounted key in addition to the line pickup key, is required for signaling. The 461A KTU provides a talking and manual signaling circuit with the following operating features:

- Flashing line lamp on an incoming call.
- Steady lamp indicating line busy.

- Time-out on unanswered incoming calls; optional time intervals.
- Choice of audible signals: common audible, steady, or interrupted.
- Audible ringback signal option so calling party can hear a tone from the distant telephone.
- Idle line termination when KTU is connected to lines having repeaters.
- Line hold feature is **NOT** available.
- Ringing ranges are shown in Table J.

TABLE J

## RINGING RANGES — 461A KTU

MINIMUM RMS RINGING VOLTAGE	STANDARD LOOPS 15K-OHM LEAKAGE	UNIGAUGE LOOPS 20K-OHM LEAKAGE*
		OHMS
75 } volts (20 Hz) 84 } 92 }	2600 ohms	4000
		4600
		5000
110 } volts (30 Hz) 120 }		5000
		5400

\*These ringing ranges are also valid with unigauged plant which may use an E6 repeater in each subscriber loop.

**SECTION 518-215-400**

**NOTES:**

1. REQUIRES A MOUNTING FACILITY EQUIPPED WITH AN 18-, 20-, OR 40-PIN CONNECTOR.
2. THE STATUS OF THE RELAYS FOR ALL FUNCTIONS OF THE KTU ARE AS FOLLOWS:

RELAY	FUNCTION		
	INCOMING RING CYCLE	ANSWERING OR INITIATING CALL	HOLD
A	R	O	R
B	O	R	O
C	R	O	O
L	O *	R	O

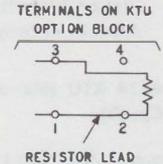
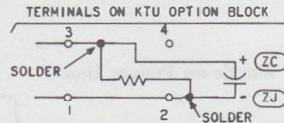
R= RELEASED O= OPERATE \*= FOLLOWS RINGING

3. FOR 30 SECOND TIME-OUT CYCLE, REMOVE Z OPTION STRAP BETWEEN TERMINALS 1 AND 2.
4. TO PROVIDE TIME-OUT CYCLES OF RING-UP CIRCUITS FROM 3.4 TO 7.5 SECONDS, REPLACE Z OPTION STRAP WITH A KS-13490, L1 OR EQUIVALENT (1/2 WATT) RESISTOR. USE ONE RESISTOR LEAD AS A STRAP BETWEEN TERMINALS 1 AND 2 AND CONNECT THE OTHER LEAD TO TERMINAL 3. USE TABLE BELOW FOR RESISTOR VALUE REQUIRED FOR DESIRED TIME-OUT INTERVAL.

TIME IN SEC FROM 10 SEC TO:	RESISTOR MEGOHM	EFFECT ON DELAYED HOLD RELEASE OPTIONS	
		ZC	ZJ
7.5	1.2	NONE	NONE
6.7	.75	NOT RECOMMENDED (NOTE 5)	
5.0	.39		
3.4	.20		

IF THE TIME-OUT CYCLE IS REDUCED IN CONJUNCTION WITH ZC OR ZJ OPTION, CONNECT THE RESISTOR AND CAPACITOR AS SHOWN BELOW:

IF TIME-OUT CYCLE IS REDUCED, CONNECT RESISTOR AS SHOWN BELOW:



5. NO. 1 ESS SPECIAL LINE APPLIQUE CIRCUIT (5D-1A297) SHOULD BE USED IN APPLICATIONS WHERE ZC OPTION CANNOT BE APPLIED.
6. WHEN Z OPTION IS PROVIDED WITH ZC OR ZJ OPTIONS, REMOVE THE Z STRAP AND USE THE CAPACITOR LEAD AS A STRAP BETWEEN TERMINALS 1 AND 2.

**OPTIONS**

OPTION	FEATURES	OPTION BLOCK STRAPPING	
		400A,B,C	400D
	LONG TIME DELAY (APPROXIMATELY 30 SECONDS)		
Z	SHORT TIME DELAY (APPROXIMATELY 10 SECONDS)	1 TO 2	1 TO 2
Y	LAMP WINK	8 TO 9	10 TO 7
X	LAMP STEADY	7 TO 9	9 TO 7
W	INTERRUPTED RING	5 TO 6	5 TO 8
T	STEADY RING	4 TO 6	6 TO 8
S	COMMON WITH DIODE MATRIX CONTROL	5 TO 6	5 TO 8
V	COMMON WITH RELAY CONTROL	3 TO 6	4 TO 8
ZC (NOTE 7)	RELEASE OF HOLDING BRIDGE FROM CO OR PBX BY LINE CURRENT OPENS GREATER THAN 500 MILLISECONDS WHEN ASSOCIATED WITH ESS HAVING RESWITCH CAPABILITY * (USE 5 UF CAPACITOR, 601A OR EQUIVALENT) † (USE 1.62 UF CAPACITOR, 701G OR EQUIVALENT)	NOT USED	SEE 2.03
ZJ	50 MILLISECONDS WHEN ASSOCIATED WITH NO. 5 X-BAR CENTREX HAVING AUTOMATIC PERMANENT SIGNAL RELEASE * (USE 0.5 UF CAPACITOR, 575B OR EQUIVALENT) † (USE 0.162 UF CAPACITOR OR EQUIVALENT)		

\* WHEN USED WITH Z OPTION

† WHEN USED WITH LONG TIME DELAY

‡ ONLY BARE WIRE STRAPS SHOULD BE

USED ON KTUS MANUFACTURED PRIOR TO 1966

7. WHEN THE ZC OPTION IS USED DUE TO THE DELAYED RELEASE OF THE HOLDING BRIDGE, SOME TRANSMISSION LOSS IS ENCOUNTERED FOR APPROXIMATELY 1 SECOND WHEN A STATION REENTERS A HELD CALL.
8. V OPTION MAY BE USED IN LOCALLY ENGINEERED ARRANGEMENTS OR RELAY COMMON AUDIBLE ARRANGEMENTS.
9. ZD OPTION IS REPLACED BY ZJ OPTION, HOWEVER IT IS NOT NECESSARY TO UPDATE CIRCUITS PREVIOUSLY MODIFIED WITH OPTION ZD.

**Fig. 3—Condensed Functional Schematic of 400-Type (Except 400G and H) KTU (CO or PBX Line Circuit) (Sheet 1 of 2)**

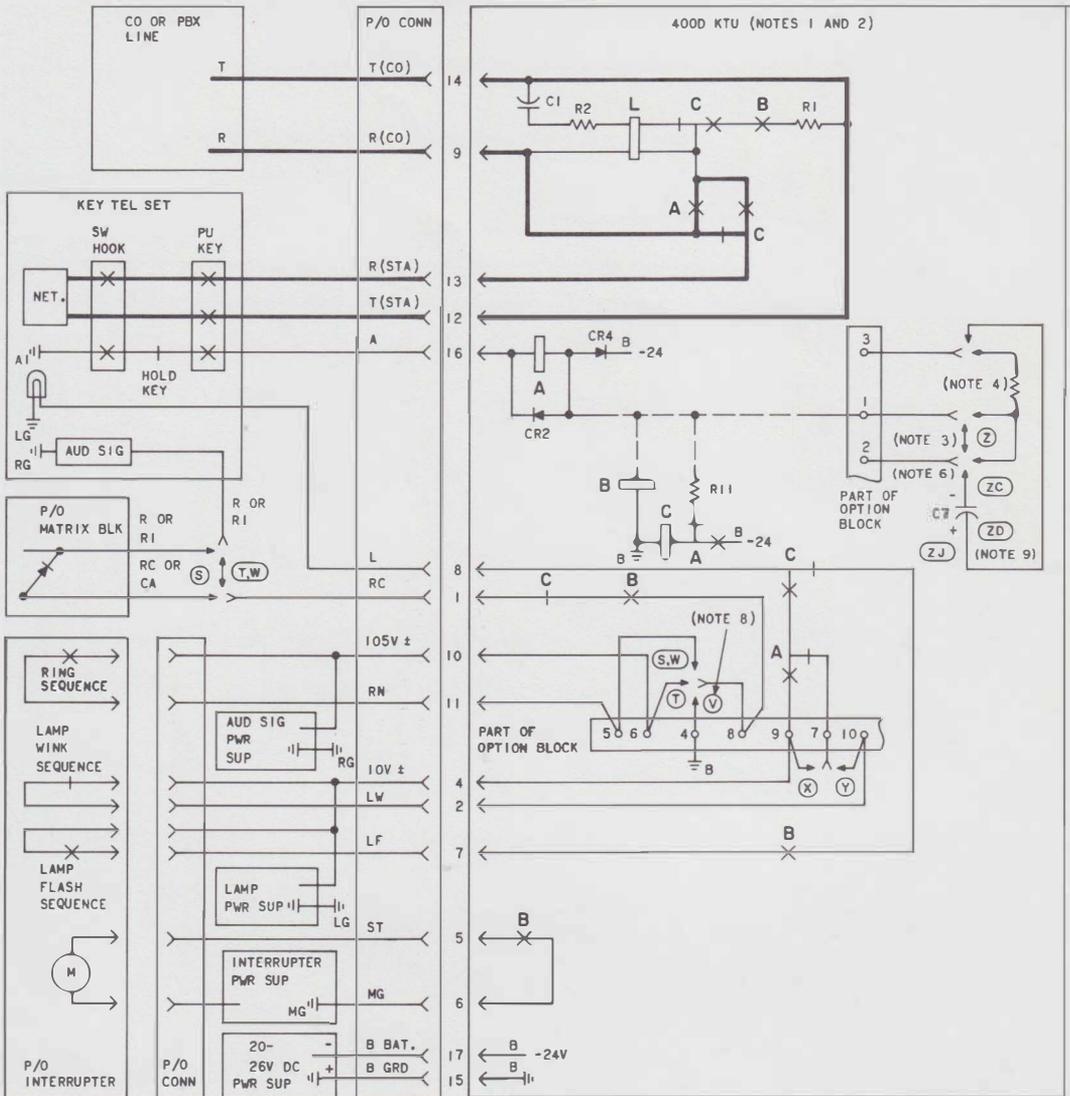


Fig. 3—Condensed Functional Schematic of 400-Type (Except 400G and H) KTU (CO or PBX Line Circuit) Sheet 2 of 2)



Fig. 4—Line Status Indicator in 400G KTU

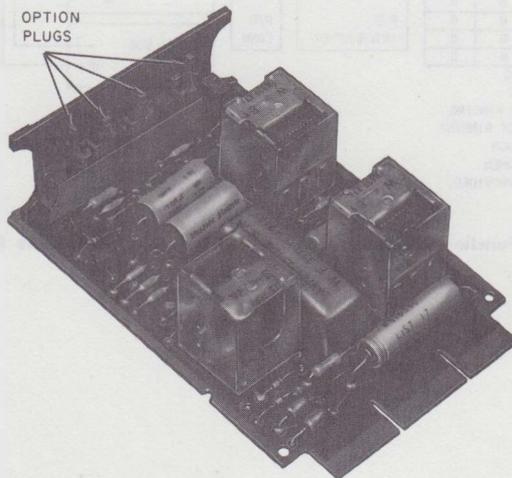


Fig. 5—400G KTU

OPTIONS		FEATURES	
M	TIMEOUT	LONG TIME DELAY (APPROXIMATELY 20 SECONDS)	
Z		SHORT TIME DELAY (APPROXIMATELY 5 SECONDS)	
Y	VISUAL	LAMP WINK	
X	HOLD CKT	LAMP STEADY	
W		INTERRUPTED RING	
T		STEADY RING	
S	AUDIBLE SIGNAL	COMMON WITH DIODE MATRIX CONTROL	
V		COMMON WITH RELAY CONTROL	
R	DELAYED HOLD RELEASE	RELEASE OF HOLDING BRIDGE FROM CO OR PBX BY LINE CURRENT OPENS	MINIMUM OF 25 MS
			600 MS
N	CONNECTS TO 50A CUSTOMER PREMISES SYSTEM		

NOTES:

- REQUIRES A MOUNTING FACILITY REQUIPPED WITH AN 18-, 20-, OR 40-PIN CONNECTOR.
- THE STATUS OF THE RELAYS FOR ALL FUNCTIONS OF THE KTU ARE AS FOLLOWS:

RELAY	FUNCTION			
	INC RING CYCLE	ANS OR INIT CALL	HOLD	
A	R	O	R	
B	O	R	O	
C	R	O	O	
L	D*	R	O	

- R = RELEASED  
 O = OPERATE  
 \* = FOLLOWS RINGING
- DO NOT CONNECT RINGING VOLTAGE THROUGH TERMINAL TO WHEN N OPTION IS PROVIDED.

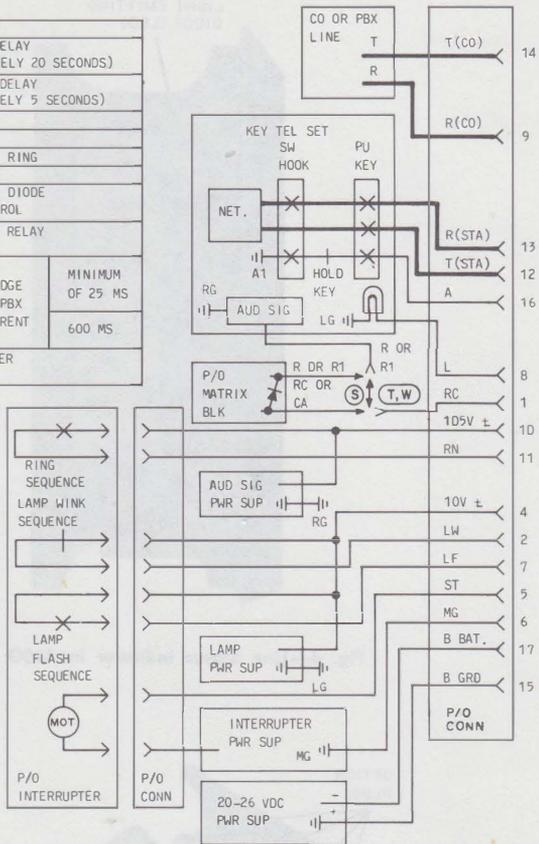


Fig. 6—Condensed Functional Schematic of 400G KTU (CO or PBX Line Circuit) (Sheet 1 of 2)

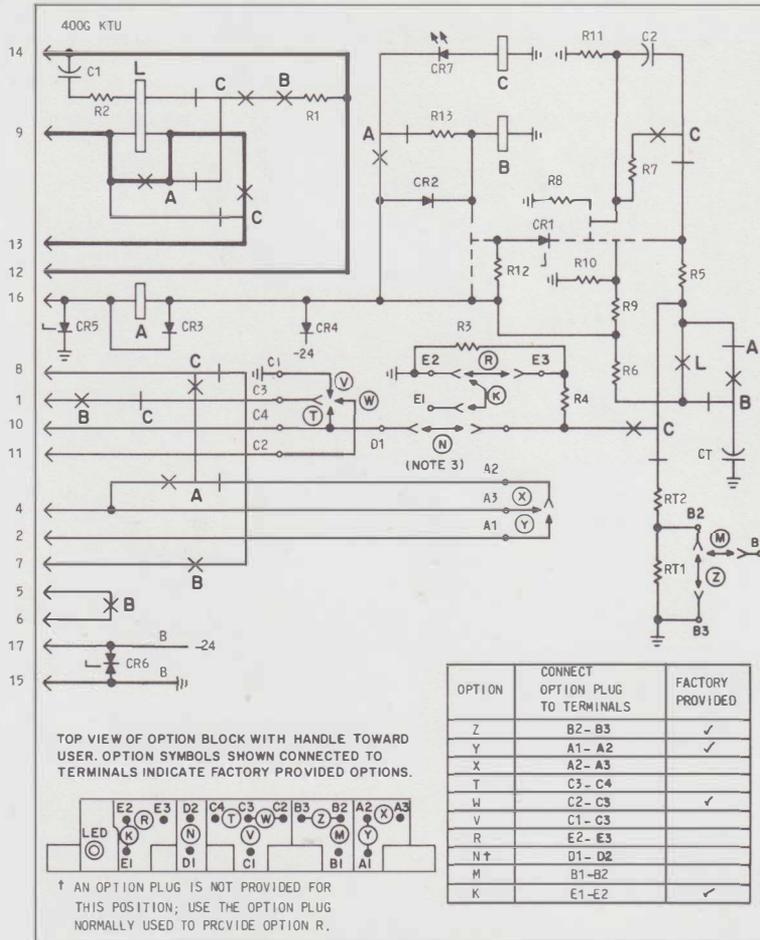


Fig. 6—Condensed Functional Schematic of 400G KTU (CO or PBX Line Circuit) (Sheet 2 of 2)

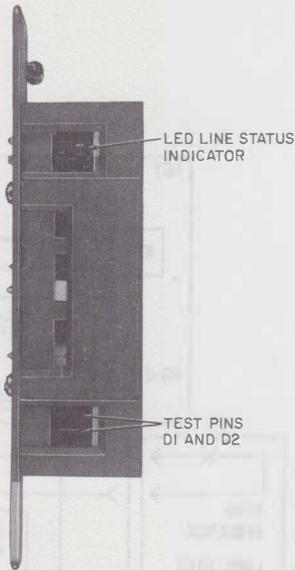


Fig. 7—Line Status Indicator and Test Pins in 400H KTU

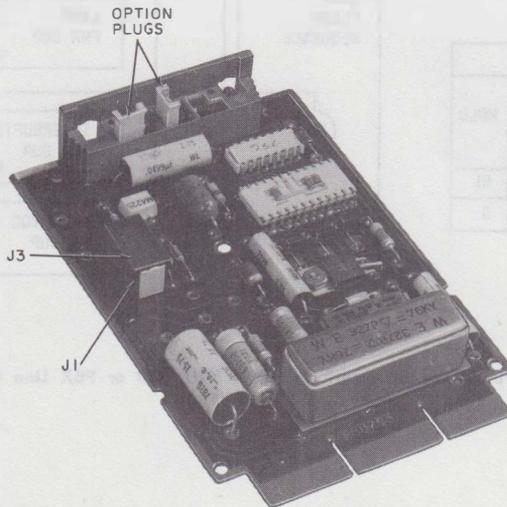


Fig. 8—400H KTU

OPTIONS

OPT	FEATURES	
T*	CO OR PBX LINE CIRCUIT	
W*	INTERRUPTED RING	
V	AUDIBLE SIGNAL	COMMON AUDIBLE WITH GROUND FOR RELAY CONTROL
S*	HOLD CIRCUIT RELEASE	LONG HOLD ABANDON TIMEOUT (FOR ESS #1, ESS #2, B12 PBX, 770 PBX, DIMENSION PBX)
R		SHORT HOLD ABANDON (FOR ALL OTHERS)

\*FACTORY INSTALLED

NOTES:

1. REQUIRES A MOUNTING FACILITY EQUIPPED WITH AN 18-, 20-, OR 40-PIN CONNECTOR.
2. THE STATUS OF THE RELAYS FOR ALL FUNCTIONS OF THE KTU ARE AS FOLLOWS:

RELAY	FUNCTION		
	INCOMING RING-CYCLE	ANSWERING OR INITIATING CALL	HOLD
R	O	RL	RL
H	RL	RL	O

RL - RELEASED  
O - OPERATED

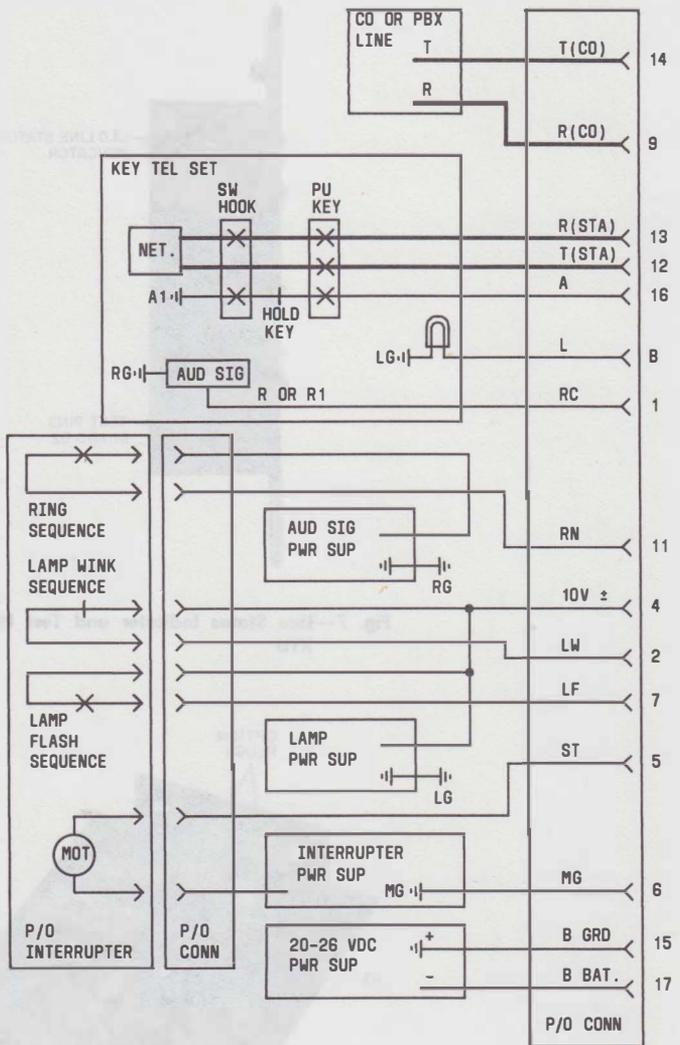


Fig. 9—Condensed Functional Schematic of 400H KTU (CO or PBX Line Circuit) (Sheet 1 of 2)

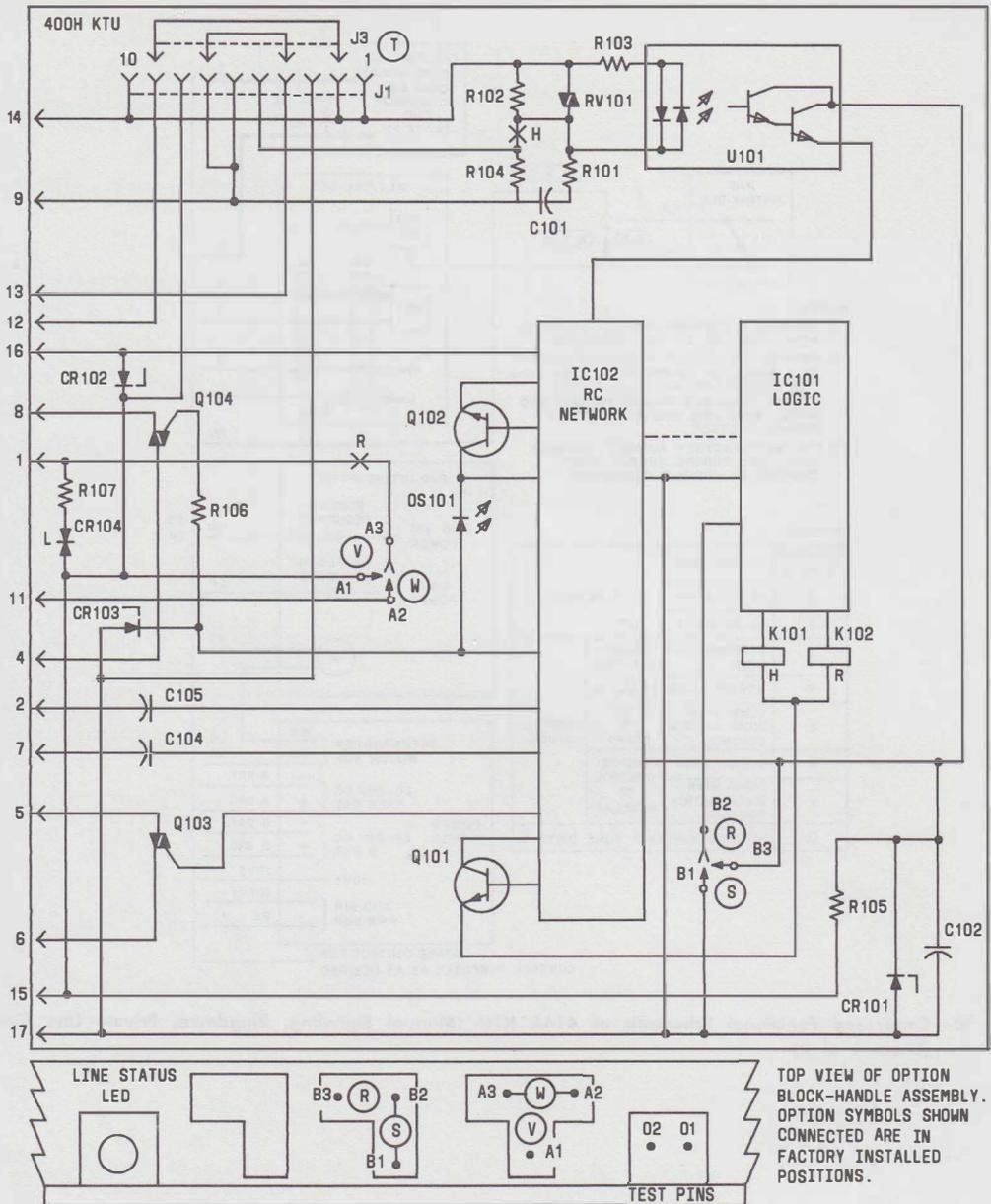


Fig. 9—Condensed Functional Schematic of 400H KTU (CO or PBX Line Circuit) (Sheet 2 of 2)

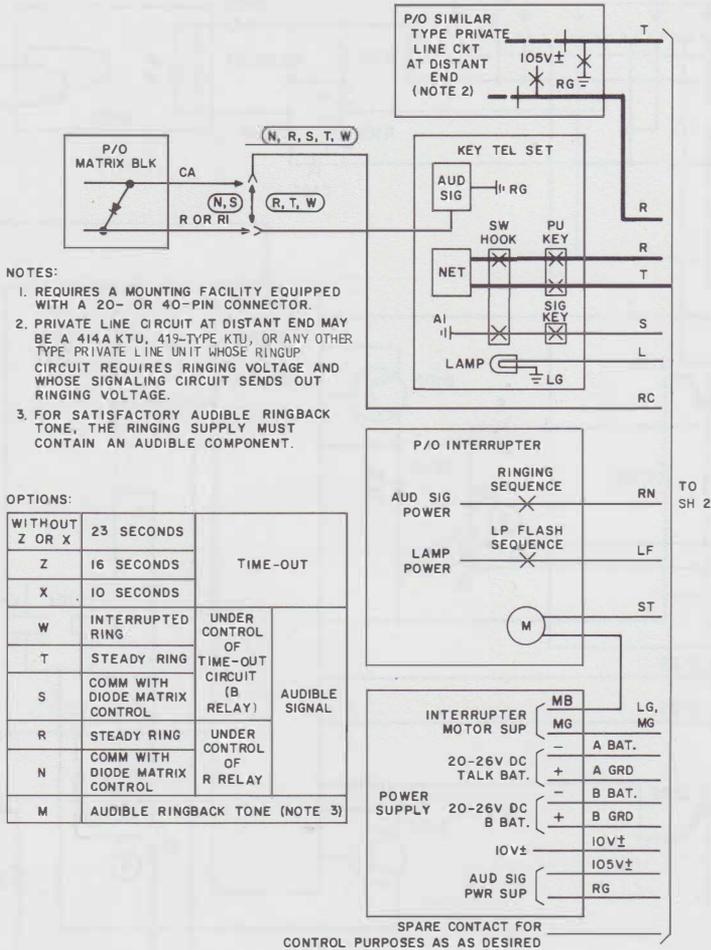


Fig. 10—Condensed Functional Schematic of 414A KTU (Manual Signaling, Ringdown, Private Line Circuit) (Sheet 1 of 2)



NOTES:

1. REQUIRES A MOUNTING FACILITY EQUIPPED WITH AN 18-, 20-, OR 40-PIN CONNECTOR.
2. NOMINAL DC SIGNALING RANGE AT MINIMUM BATTERY VOLTAGE (-20V) IS 2200 OHMS.
3. PRIVATE LINE CIRCUIT AT DISTANT END MAY BE A 415A KTU OR ANY OTHER TYPE PRIVATE LINE RINGUP CIRCUIT REQUIRES A DC VOLTAGE AND WHOSE SIGNALING CIRCUIT SENDS OUT A DC VOLTAGE.
4. FOR SATISFACTORY AUDIBLE RINGBACK TONE THE RINGING SUPPLY MUST CONTAIN AN AUDIBLE COMPONENT.
5. FOR IDLE LINE TERMINATION CONNECT A KS-13490, L1, 910 OHM RESISTOR IN SERIES WITH A 542F, 2 μF CAPACITOR ACROSS TERMINALS 9 AND 10. ORDER AND PLACE COMPONENTS LOCALLY.

OPTIONS:

W	INTERRUPTED RING	AUD SIG
T	STEADY RING	
S	COM WITH DIODE MATRIX CONTROL	
M	AUDIBLE RINGBACK TONE (NOTE 4)	
Y	VISUAL HOLD SIG	

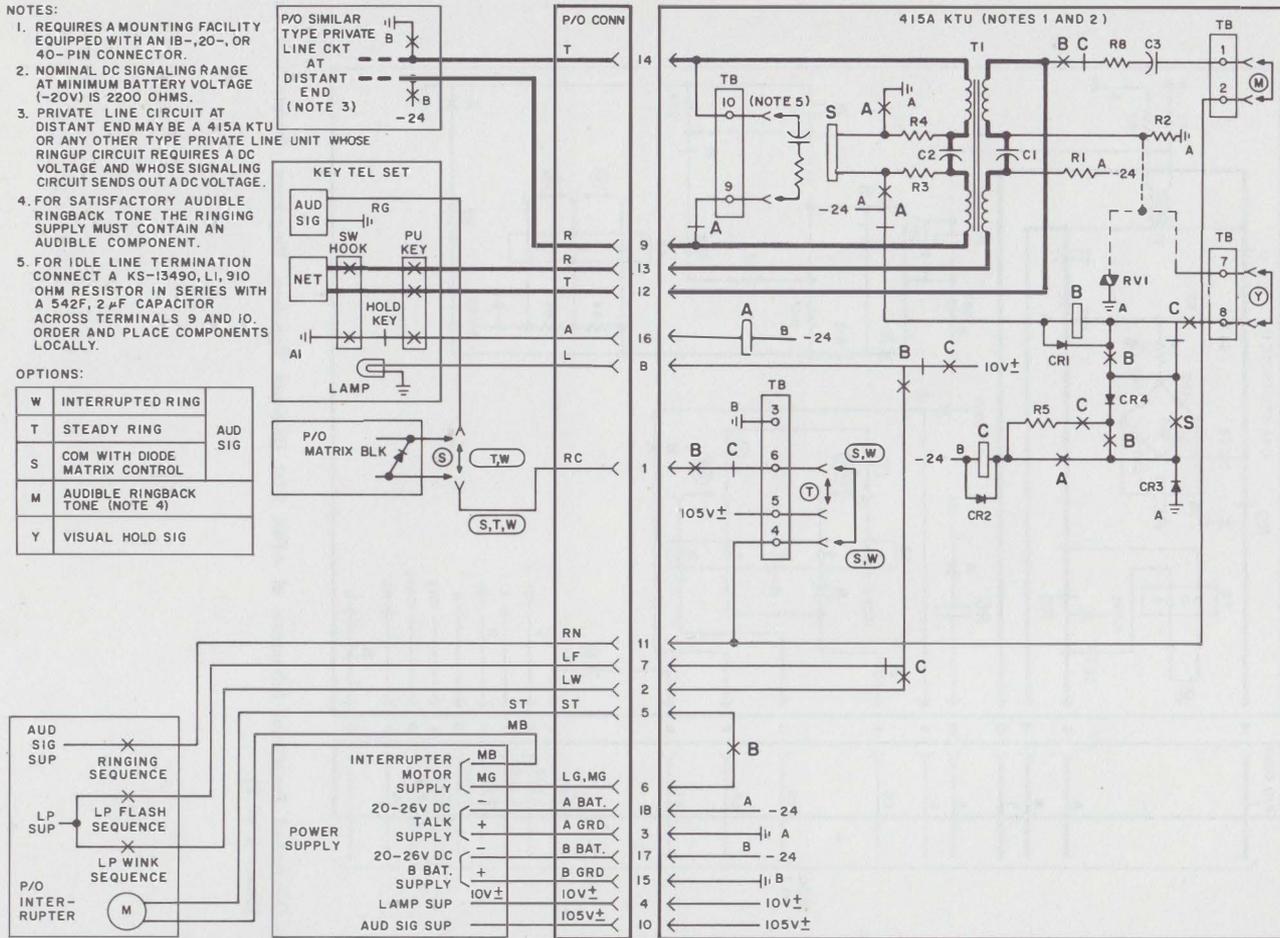


Fig. 11—Condensed Functional Schematic of 415A KTU (Automatic, DC Signaling, Private Line Circuit)

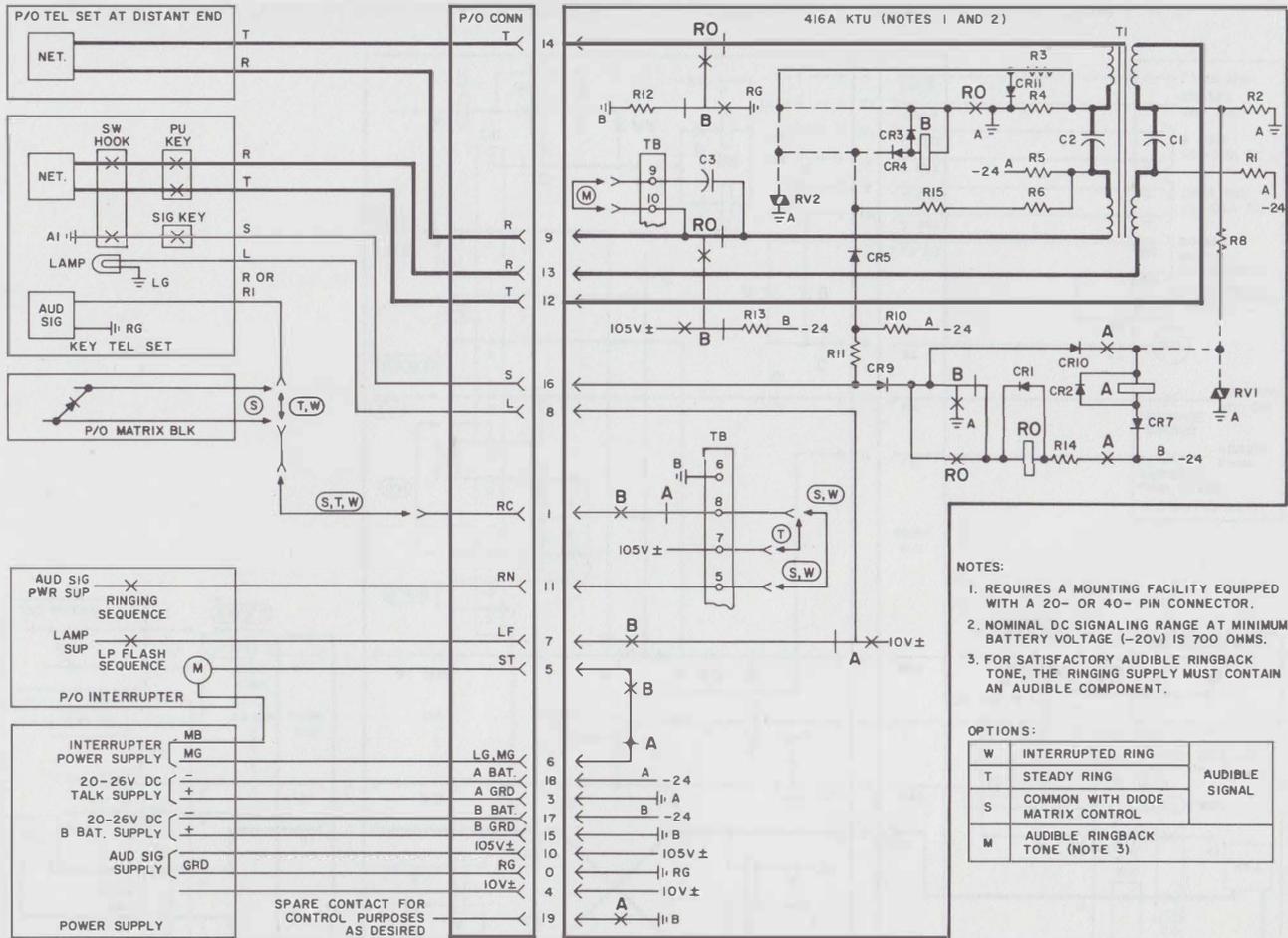


Fig. 12—Condensed Functional Schematic of 416A KTU (Station Line Circuit)

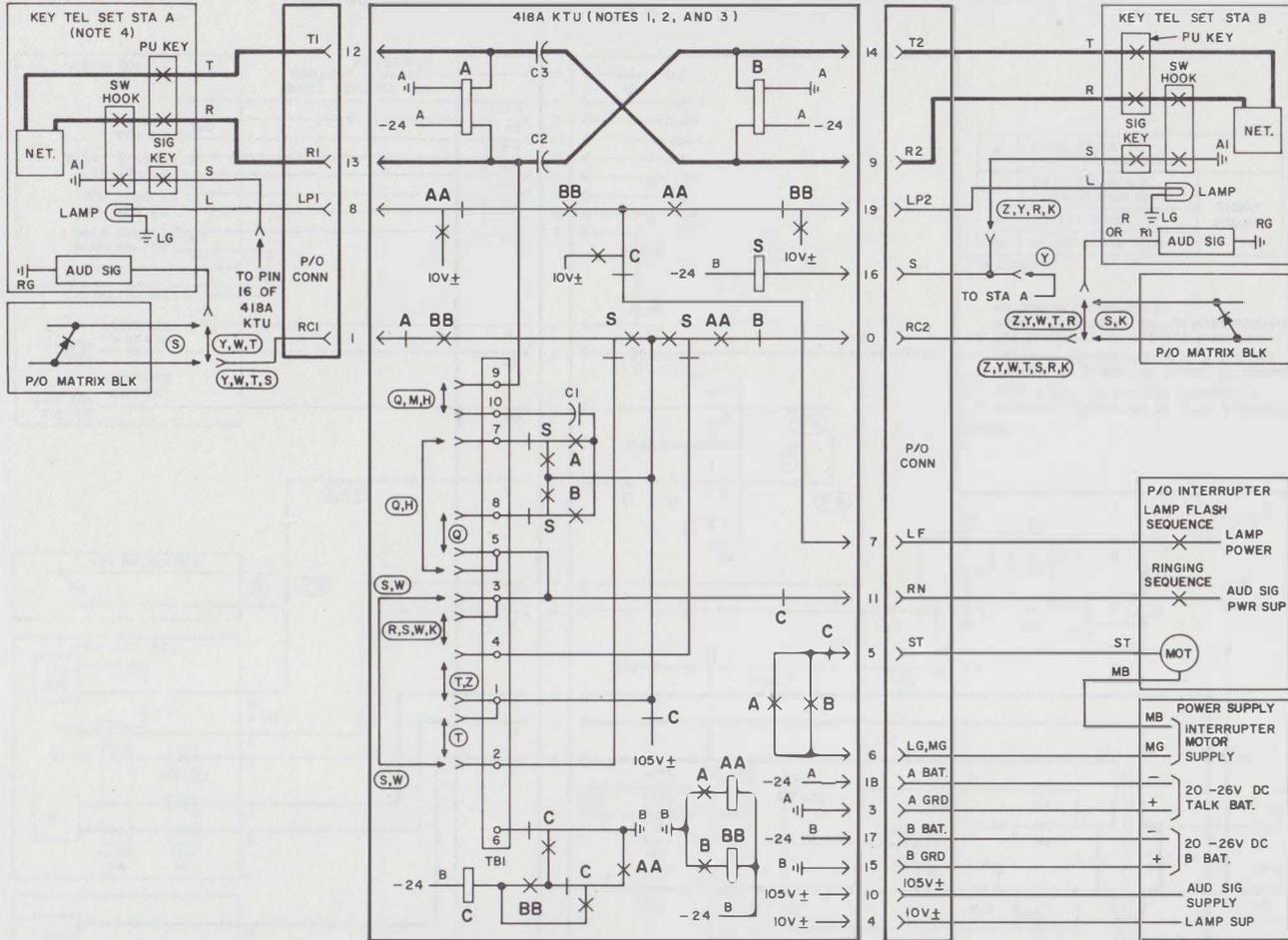


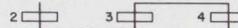
Fig. 13—Condensed Functional Schematic of 418A KTU (Short Range, DC Signaling, Private Line Circuit) (Sheet 1 of 2)

OPTIONS:

W	INTERRUPTED RING	TWO-WAY AUTOMATIC	SIGNALING	
T	STEADY RING			
S	COM AUD WITH DIODE MATRIX CONTROL			
R	INTERRUPTED RING	ONE-WAY AUTOMATIC ONE-WAY MANUAL (NOTE 5)		
Z	STEADY RING			
K	COM AUD WITH DIODE MATRIX CONTROL			
Y	TWO-WAY MANUAL (NOTE 6)			
Q	TWO-WAY AUTOMATIC			AUDIBLE RINGBACK TONE (NOTE 7)
H	ONE-WAY AUTOMATIC, ONE-WAY MANUAL			
M	TWO-WAY MANUAL			

NOTES:

1. REQUIRES A MOUNTING FACILITY EQUIPPED WITH A 20- OR 40-PIN CONNECTOR.
2. FOR SATISFACTORY OPERATION OF RELAYS A AND B THE MAXIMUM DC RANGE IS 100 OHMS WITH A MINIMUM BATTERY VOLTAGE OF -20V. WHERE LAMPS ARE OPERATED FROM THE KTU WITHOUT AUXILIARY APPARATUS, THE NORMAL 50-OHM LOOP RANGE APPLIES.
3. THE CONTINUOUS METHOD OF STRAPPING MUST BE USED ON TBI FOR OPTIONS REQUIRING STRAPS BETWEEN 3 TERMINALS. FOR EXAMPLE S,W OPTION WOULD BE WIRED FROM 2, THRU 3, TO 4 AS FOLLOWS:



4. STATION "A" IS ALWAYS ASSIGNED AS THE AUTOMATIC SIGNALING STATION WHENEVER THE ONE-WAY AUTOMATIC, ONE-WAY MANUAL SIGNALING OPTION IS USED.
5. THESE OPTIONS APPLY TO THE SIGNAL KEY AND AUDIBLE SIGNAL AT STA "B" ONLY. THE AUDIBLE SIGNAL AT STA "A" IS UNDER CONTROL OF RELAY "S". THE AUDIBLE SIGNAL AT STA "A" MAY BE PART OF A COMMON AUDIBLE ARRANGEMENT PROVIDED THE DIODE MATRIX IS USED FOR CONTROL.
6. THE AUDIBLE SIGNALS AT STA "A" AND "B" MAY BE PART OF A COMM AUDIBLE ARRANGEMENT PROVIDED THE DIODE MATRIX IS USED FOR CONTROL.
7. FOR SATISFACTORY AUDIBLE RINGBACK TONE THE RINGING SUPPLY MUST CONTAIN AN AUDIBLE COMPONENT.

Fig. 13—Condensed Functional Schematic of 418A KTU (Short Range, DC Signaling, Private Line Circuit) (Sheet 2 of 2)

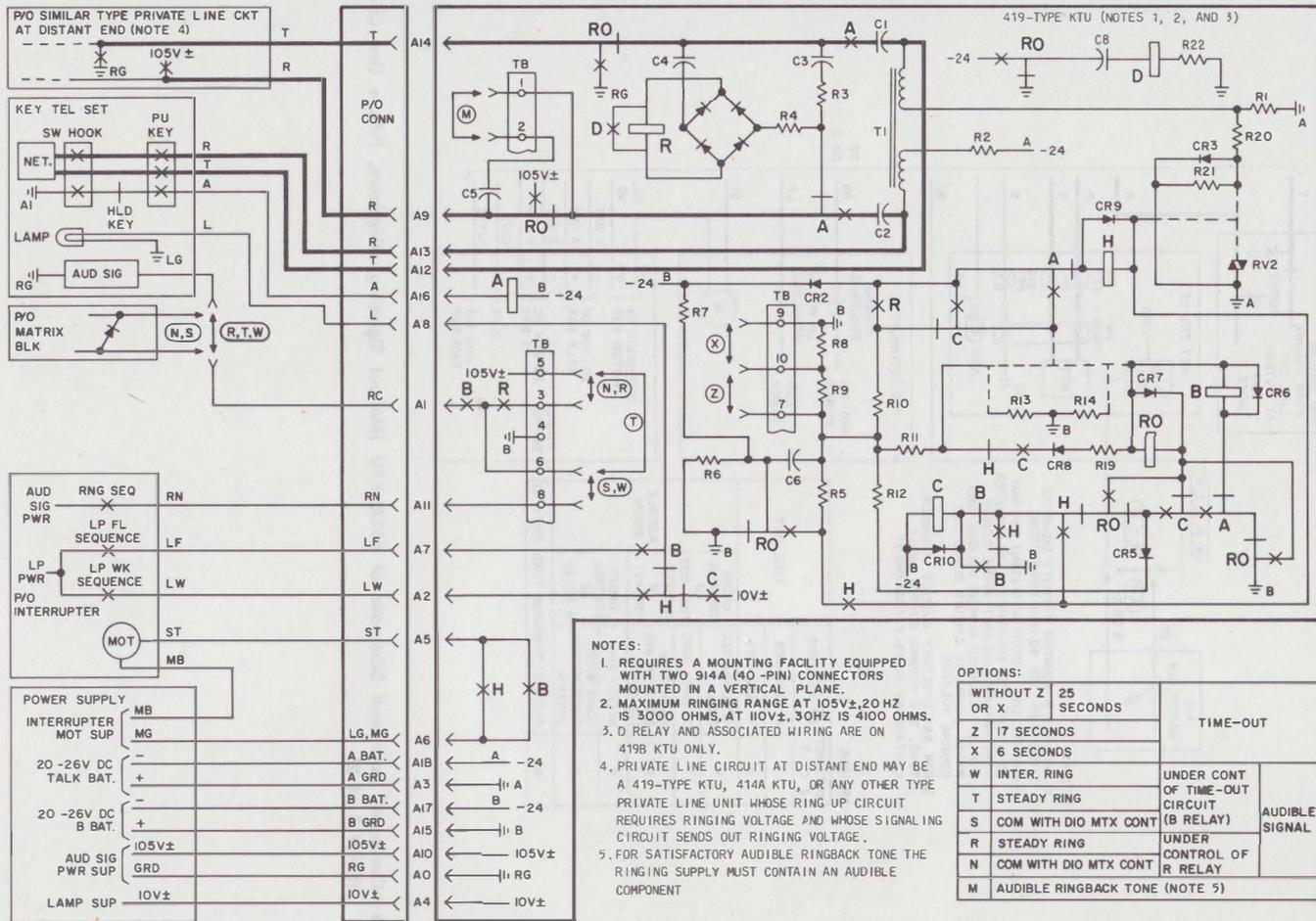


Fig. 14—Condensed Functional Schematic of 419-Type KTU (Automatic Signaling, Ringdown, Private Line Circuit)

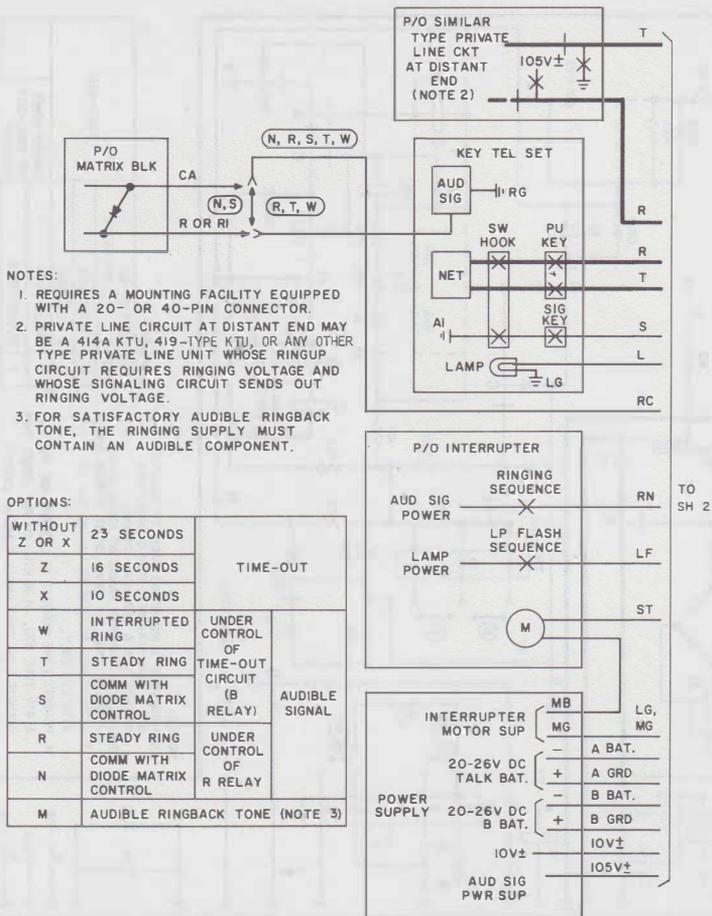


Fig. 15—Condensed Functional Schematic of 461A KTU (Manual Signaling, Ringdown, Private Line Circuit) (Sheet 1 of 2)

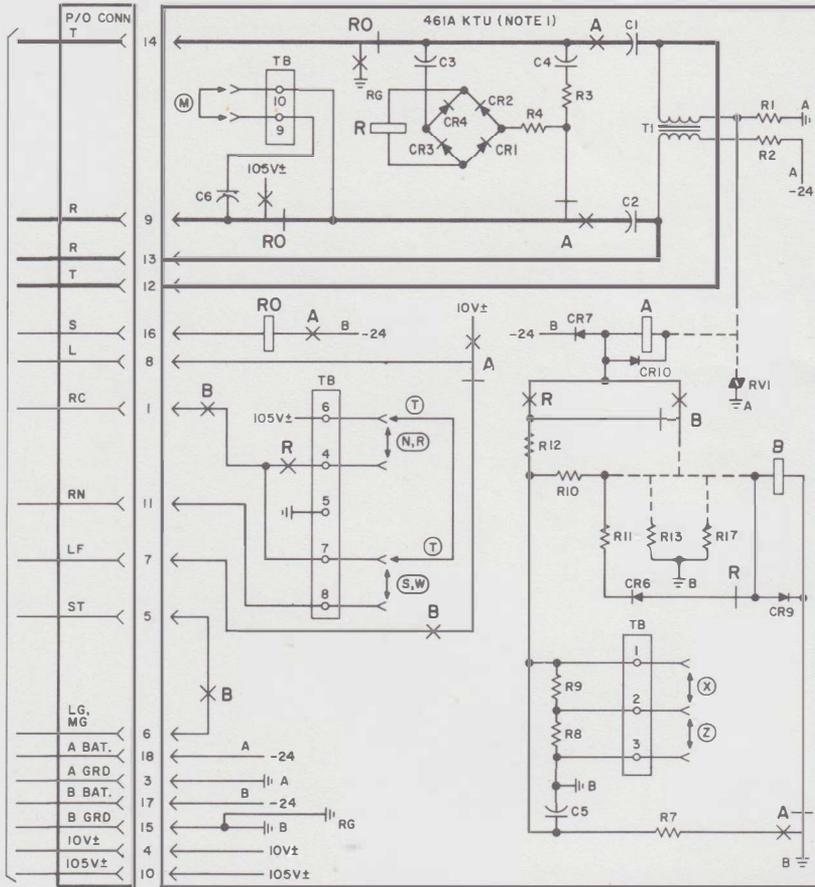


Fig. 15—Condensed Functional Schematic of 461A KTU (Manual Signaling, Ringdown, Private Line Circuit)  
(Sheet 2 of 2)