

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

1. GENERAL

1.01 This section provides schematic information for the 400-series key telephone units (KTUs) which provide services auxiliary to Central Office (CO), Private Branch Exchange (PBX), or private line services.

1.02 This section is reissued to:

- Expand information on 428A KTU
- Incorporate information from addendum of April 1980
- MD the 471B and 479B KTUs.

1.03 The auxiliary service KTUs covered in this section provide operating features in addition to those provided by the line service units. These features include:

- Conference arrangements—417A KTU
- Multiline exclusion—405A manufacture discontinued (MD) or 428A KTU
- Supplemental hold arrangements—406A (MD), 429A (MD), 429B (MD), and 429C KTUs
- Music-on-hold—451B and 498A KTU
- Toll restriction—471A (MD), 471B (MD), 471C, 479A, 479B (MD), or 479C KTUs

Information on line services is covered in 518-215-400; intercom services and associated features, 518-215-402; control circuits including audible signals, 518-215-403.

A. Mechanical

1.04 All circuit components on these KTUs are mounted on 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. Typical 4- and 8-inch KTUs are shown in Fig. 1 and 2.

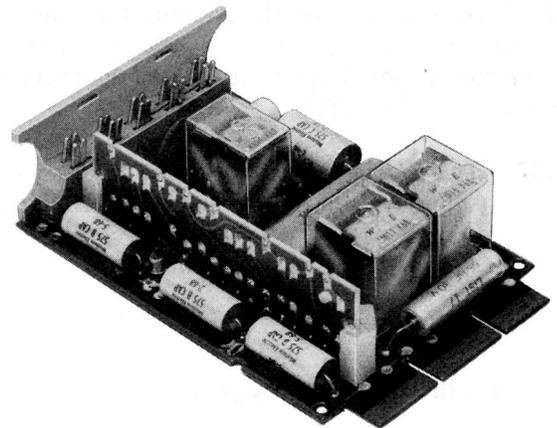


Fig. 1—Typical 4-Inch Key Telephone Unit

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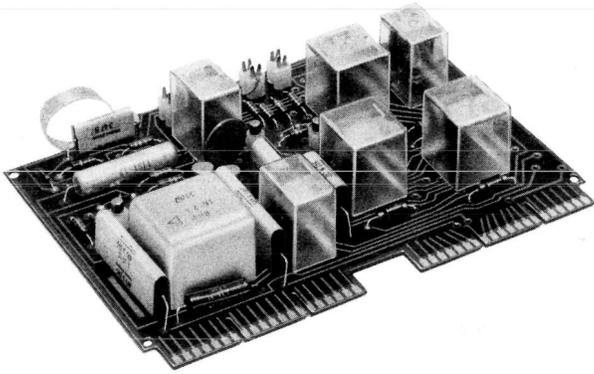


Fig. 2—Typical 8-Inch Key Telephone Unit

B. Electrical

1.05 Functional schematics (Fig. 3 through 14) 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 paragraph 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, depending on the mounting arrangement, but not on the KTU.

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

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

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

SD-69489-01, Issue 5—405A and 428A KTUs

SD-69530-01, Issue 8B—406A, 408A, 429-type, and 430A KTUs

SD-69561-01, Issue 2—417A KTU

SD-69590-01, Issue 2—421A KTU

SD-69922-01, Issue 2—451B, 498A KTUs, and 116A1 CM

SD-69921-01, Issue 4—471- and 479-type 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.

1.09 After January 1, 1980, connection of customer-provided equipment (CPE) or telephone company-provided equipment to the 1A2 Key Telephone System (KTS) requires the use of a 33B voice coupler when providing music-on-hold. Also after January 1, 1980, the 471C and 479C KTUs must be used when providing their related services. Previously connected or Class C voice couplers and KTUs may be used for additions and maintenance at grandfathered installations for the life of the equipment, provided they are not modified. Class C stock may also be used in new installations after January 1, 1980.

1.10 Incoming CO lines to be installed in compliance with the Federal Communications Commission (FCC) Registration Program must be routed through a standard network interface. Information on approved interfaces is contained in Sections 463-400-100 through 463-400-150.

2. IDENTIFICATION

A. 405A KTU (MD) (Multiline Exclusion Circuit)

2.01 The 405A KTU (MD) (Fig. 3) is a 4-inch, 20-contact unit which must be used with a 259B or 272A KTU. The 405A KTU has been replaced by the 428A KTU (see paragraph 2.06 for features) which conforms to standard contact lead configuration.

Note: A 405A KTU (MD) cannot be used in the 513-, 514-, or 515-type KSU, 597- or 598-type panel, or 69-type apparatus mountings.

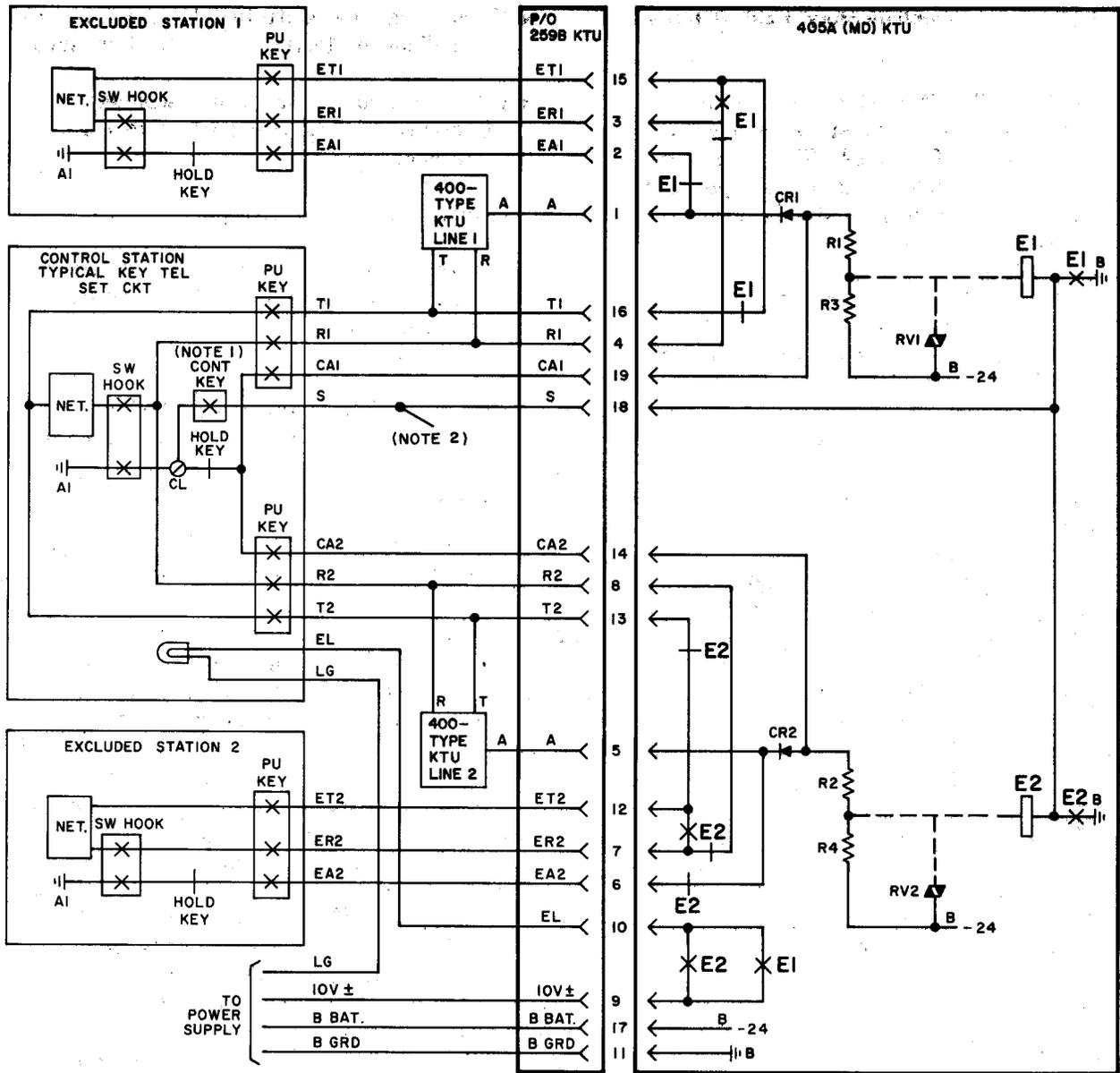


Fig. 3—Condensed Functional Schematic of 405A KTU (MD) (Multiline Exclusion Circuit)

B. 406A KTU (MD) (Supplementary Hold Detector Circuit)

2.02 The 406A KTU (MD) (Fig. 4) is a 4-inch, 18-contact unit which must be used with a 259B or 272A KTU. The 406A KTU has been replaced by the 429A KTU (see paragraph 2.09 for features) which conforms to standard contact lead configuration.

Note: A 406A KTU (MD) cannot be used in the 513-, 514-, or 515-type KSU, 597- or 598-type panel, or 69-type apparatus mountings.

C. 408A KTU (MD) (Flutter Generator Circuit)

2.03 The 408A KTU (MD) (Fig. 5) is a 4-inch, 18-contact unit which must be used with a 259B or 272A KTU. The 408A KTU has been replaced by the 430A KTU (see paragraph 2.09 for features) which conforms to standard contact lead configuration.

Note: A 408A KTU (MD) cannot be used in the 513-, 514-, or 515-type KSU, 597- or 598-type panel, or 69-type apparatus mountings.

D. 417A KTU (Add-on Conference Circuit)

2.04 The 417A KTU (Fig. 6) is a 4-inch, 40-contact unit that provides for bridging of two lines for a 3-way conference in the following arrangements:

- (a) A CO line and a PBX line
- (b) Two PBX lines or two CO lines
- (c) A CO or PBX line and an intercom line.

The 417A KTU has the following features:

- Circuit can be operated by exclusion switch, external nonlocking key, or converted line pickup key.
- Circuit busy lamp when line pickup key is used.
- Control station can leave conference by placing line on hold and remaining off-hook, allowing other parties to continue conversation without transmission loss.

- Circuit may be controlled by two stations when diode protection is locally furnished.

- Either control station can disconnect from conference leaving two parties to continue conference.

- Compatible with speakerphone.

- Circuit is arranged to cancel conference when handset is placed on-hook or speakerphone is returned to OFF.

- One of the conferenced lines may be disconnected by returning exclusion key to normal or by operating the nonlocking key.

E. 428A KTU (Multiline Exclusion Circuit)

2.05 The 428A KTU (Fig. 7) is a 4-inch, 40-contact unit which replaces the 405A KTU (MD).

2.06 The 428A KTU permits a key telephone set to exclude any number of stations from either of two CO, PBX, intercom, or private lines using a common control key. The two exclusion circuits on the KTU must be associated with the same control station. One key can provide control for as many exclusion circuits as are required at a control station. An exclusion key, cutoff or turnbutton key, convertible pickup key, or an external locking or nonlocking key, may be used as the control key. The exclusion may be released by placing the line on hold or by hanging up the control stations. Of the various locking keys which may be used, only the switchhook plunger (manual exclusion key) is self-restoring. With any other type of locking key, the operation of the exclusion circuit depends on the state of the control key when the control station goes off-hook. A visual signal can be provided at the control station, indicating exclusion is in use.

F. 429-Type, 429B (MD), and 429C KTUs (Supplementary Hold Detector Circuit) and 430A KTU (Flutter Generator Circuit)

2.07 The 429-type and 430A KTUs (Fig. 8 and 9) are 4-inch, 40- and 20-contact units which replace the 406A and 408A KTUs, respectively.

2.08 These KTUs together provide an adjustable lamp flutter of approximately 12 interruptions per second to indicate a supplementary hold condition

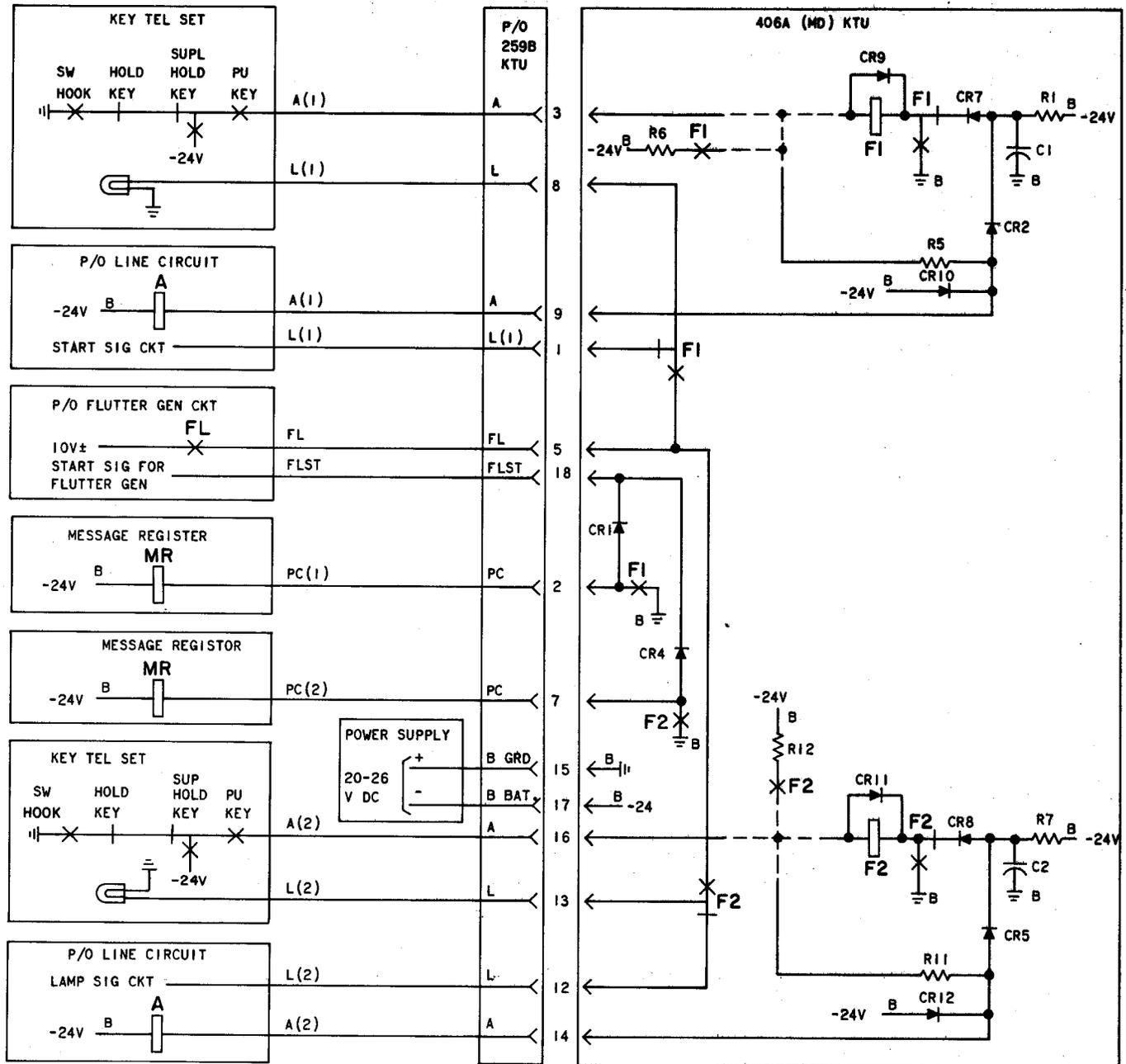


Fig. 4—Condensed Functional Schematic of 406A KTU (MD) (Supplementary Hold Detector Circuit)

as distinguished from lamp wink or steady signal associated with a normal hold condition. ♦The 429C KTU is the same as the 429B KTU which it replaces, except for the addition of components to assure release from *I Hold* by a noninitiating station.♦

2.09 Supplementary hold provides two features:

- (a) **Priority Hold** where the flutter indication is desired at all stations having access to lines so equipped. It serves to alert personnel

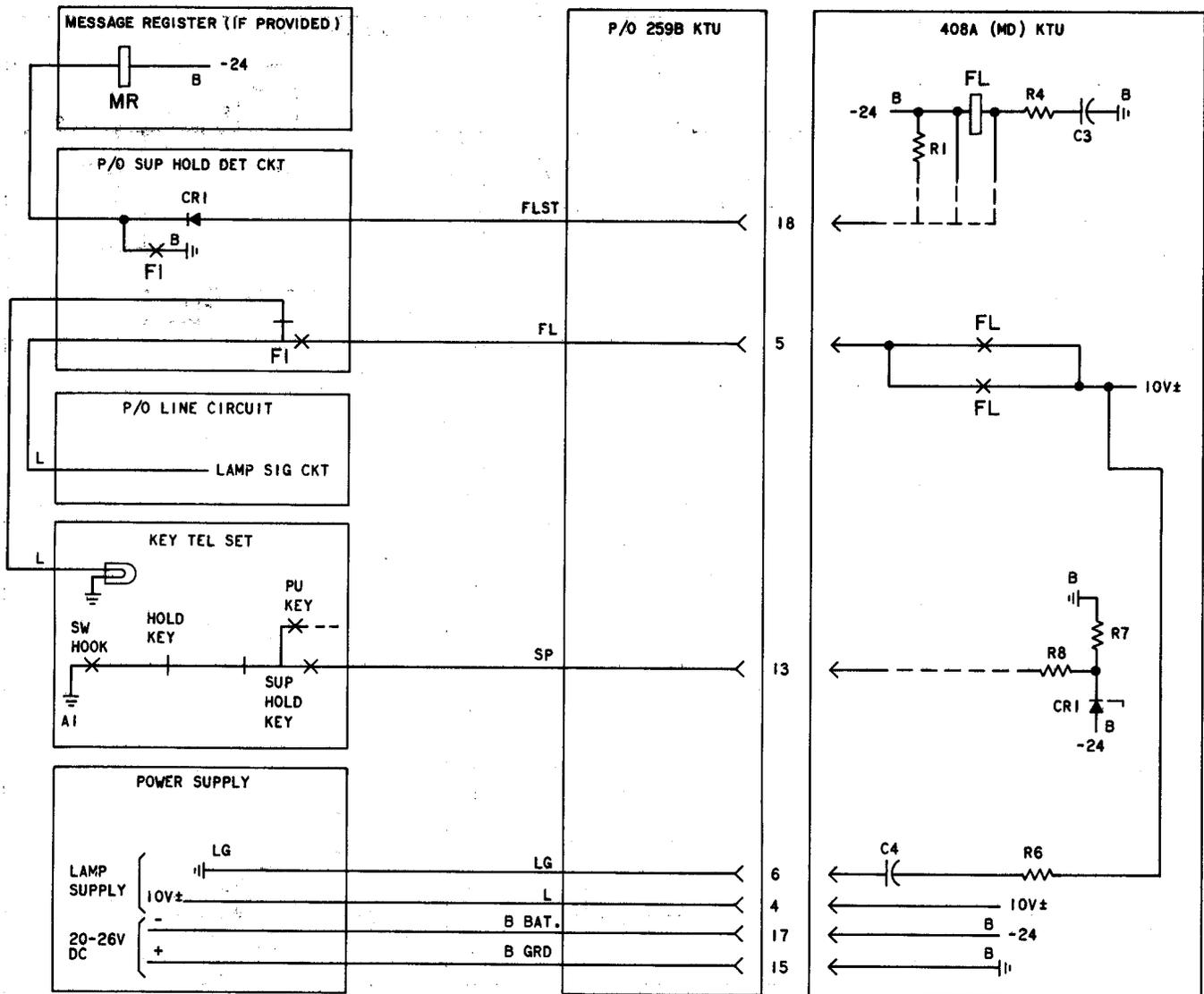


Fig. 5—Condensed Functional Schematic of 408A KTU (MD) (Flutter Generator Circuit)

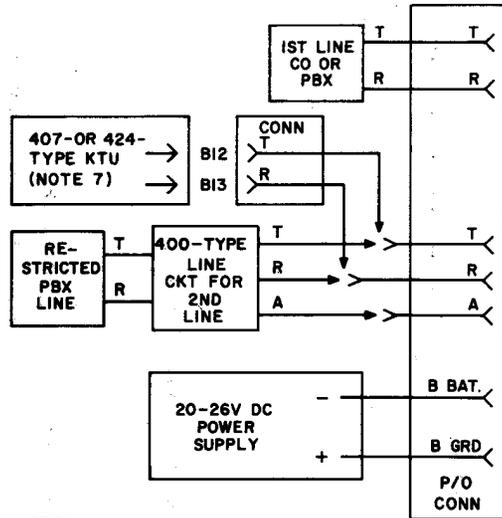
that an incoming call has been answered (acknowledged only), placed on hold, and should be completed as soon as the first available attendant is able to do so. **Priority Hold** requires a key which contains the supplementary hold button as well as the regular hold button.

(b) **I Hold** where the flutter indication is desired **only** on the line appearance at the station initiating the hold. All other stations receive the normal hold signal. This enables an attendant, having access to a number of lines, to recognize calls he has placed on hold and calls being held by associate attendants. **I Hold**

does not require the use of a supplementary hold button; however, the regular hold button must be equipped with a transfer contact arrangement, as in the 565HK-type telephone set.

2.10 A hold detector circuit is required on a **per line** basis with **priority hold** and on a **per station per line** basis with **I hold**. The 429-type KTU provides two detector circuits.

2.11 The 430A (flutter generator) can connect to a maximum of 100 lamps and 20 supplementary and/or regular hold buttons.



NOTES:

1. REQUIRES A MOUNTING FACILITY EQUIPPED WITH A 40-PIN CONNECTOR.
2. DIODES SHOWN FOR "W" OPTION ARE KS-15724,L1 AND MUST BE ORDERED AND INSTALLED LOCALLY.
3. "Z" OPTION MUST BE PROVIDED WHEN THE CONTROL STATION IS EQUIPPED WITH THE SPEAKERPHONE FEATURE.
4. REMOVE AND INSULATE EXCLUSION KEY LEADS FROM TERMINALS 1T AND 1R IN THE TELEPHONE SET, IF SO CONNECTED.
5. KS-15724,L1 DIODE MUST BE INSTALLED IN "A" LEAD OF TEL SET WHEN CONFERENCE CIRCUIT IS CONTROLLED BY A NONLOCKING KEY. FOR METHOD OF CONNECTION, USE STATION BUSY OPTION AS SHOWN IN CONNECTION SECTION OF TYPE SET USED.
6. ASSOCIATED LAMP LEADS FROM 400-TYPE LINE CIRCUITS ARE CONNECTED DIRECTLY TO TEL SETS.
7. THE 417A KTU MAY BE USED TO PROVIDE THE ADD-ON FEATURE WITH DIAL INTERCOM.

OPTIONS:

Z		CONTROLLED BY NONLOCKING KEY
X	ONE STATION	
W	TWO STATIONS	
Y	CONTROLLED BY EXCLUSION KEY	

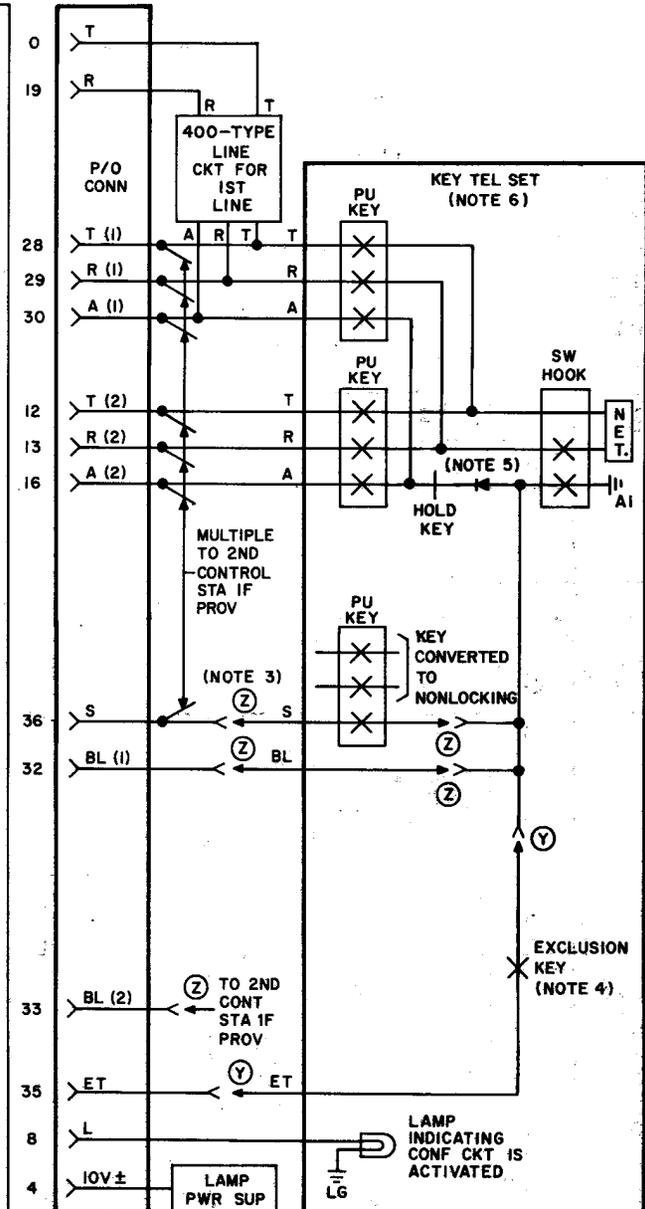
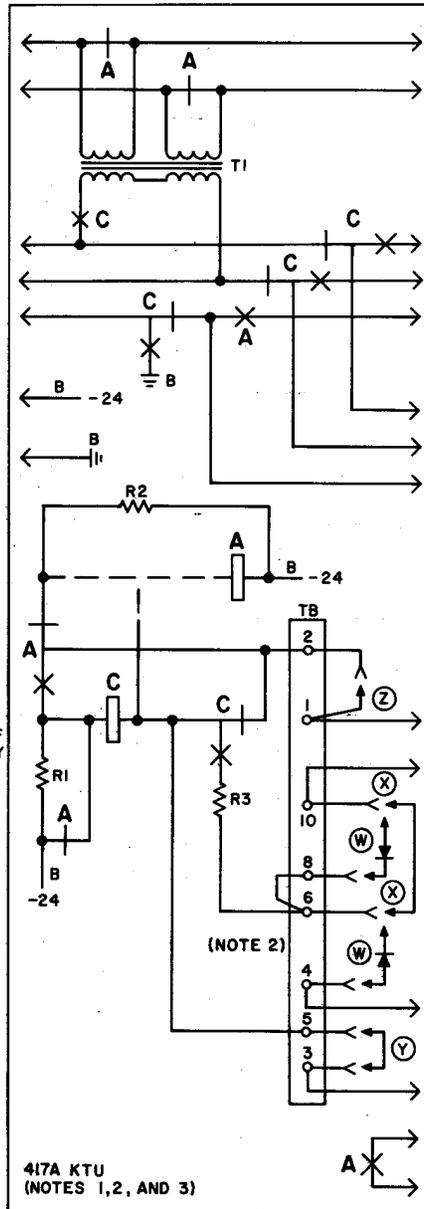
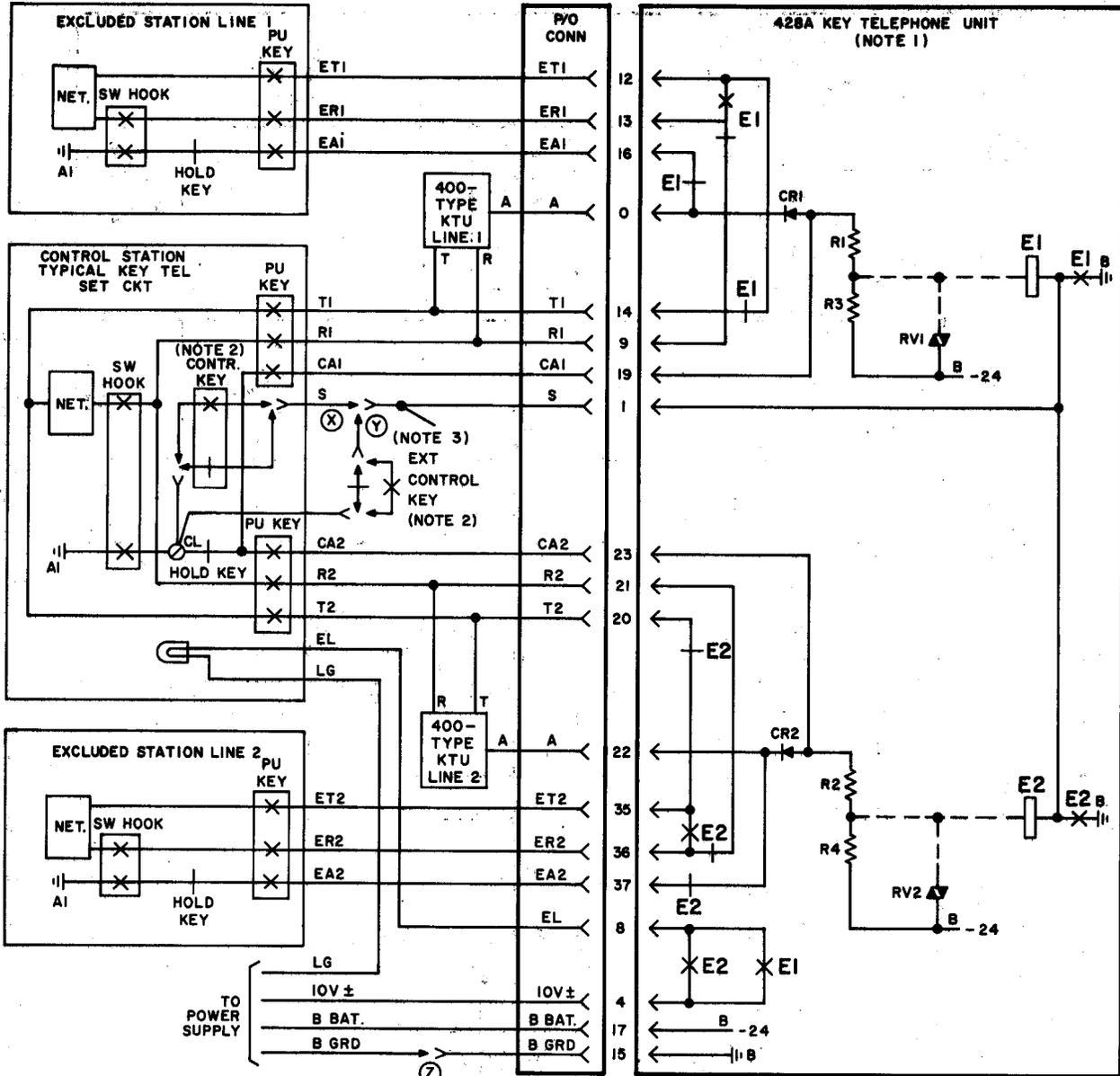


Fig. 6—Condensed Functional Schematic of 417A KTU (Add-On Conference Circuit)



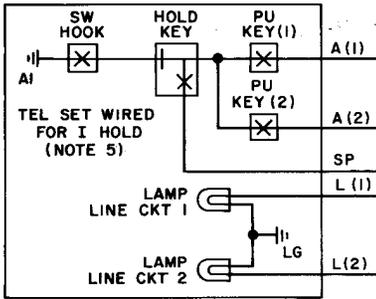
- NOTES:
1. REQUIRES A MOUNTING FACILITY EQUIPPED WITH A 40-PIN CONNECTOR.
 2. CONTROL KEY MAY BE A LOCKING OR NONLOCKING. LOCKING KEY MAY BE NORMAL MADE OR NORMAL OPEN. NONLOCKING KEYS CANNOT BE USED FOR AUTOMATIC OPERATION.
 3. "S" LEAD CAN ONLY MULTIPLE TO OTHER 428A KTUS CONTROLLED BY THE SAME STATION.

Fig. 7—Condensed Functional Schematic of 428A KTU (Multiline Exclusion Circuit)

G. 451B KTU (Music-On-Hold)

2.12 The 451B KTU (Fig. 10) is a 4-inch, 40-contact unit that provides music-on-hold to CO/PBX line circuits.

2.13 The 451B KTU transmits music to distant stations that are placed on hold by users of this system. The KTU contains seven identical circuits, each of which may provide music-on-hold to one CO/PBX line circuit. The music source



NOTES:

1. THE 429A KTU WILL PROVIDE SUPPLEMENTARY HOLD FOR TWO CO OR PBX-LINE CIRCUITS. EACH HOLD CIRCUIT MAY BE ASSIGNED AS PRIORITY OR I HOLD.
2. REQUIRES A MOUNTING FACILITY EQUIPPED WITH A 20- OR 40-PIN CONNECTOR.
3. LIMITATIONS OF THE 430A KTU ARE AS FOLLOWS:
 - A. FL1 OR FL2 LEAD CAN SERVE A MAXIMUM OF 50 LAMPS.
 - B. SP LEAD CAN CONNECT TO A MAXIMUM OF 20 STATIONS.
4. TO PROVIDE PRIORITY HOLD, A 599H KEY UNIT CONTAINING A SUPPLEMENTAL HOLD KEY AS WELL AS A REGULAR HOLD KEY, MUST BE SUBSTITUTED FOR THE EXISTING KEY UNIT IN THE 1ST MODULE OF THE "CALL DIRECTOR" TELEPHONE.
5. ANY TELEPHONE SET EQUIPPED WITH A HOLD KEY HAVING A SET OF TRANSFER CONTACTS AND SUFFICIENT CORD LEADS CAN INITIATE I HOLD. REWIRE HOLD KEY ACCORDING TO CONNECTION SECTION OF TYPE SET USED.
6. TELEPHONE SETS EQUIPPED WITH 635-TYPE KEYS REQUIRE A KIT OF PARTS. REFER TO APPROPRIATE TELEPHONE SET SECTION FOR INFORMATION.

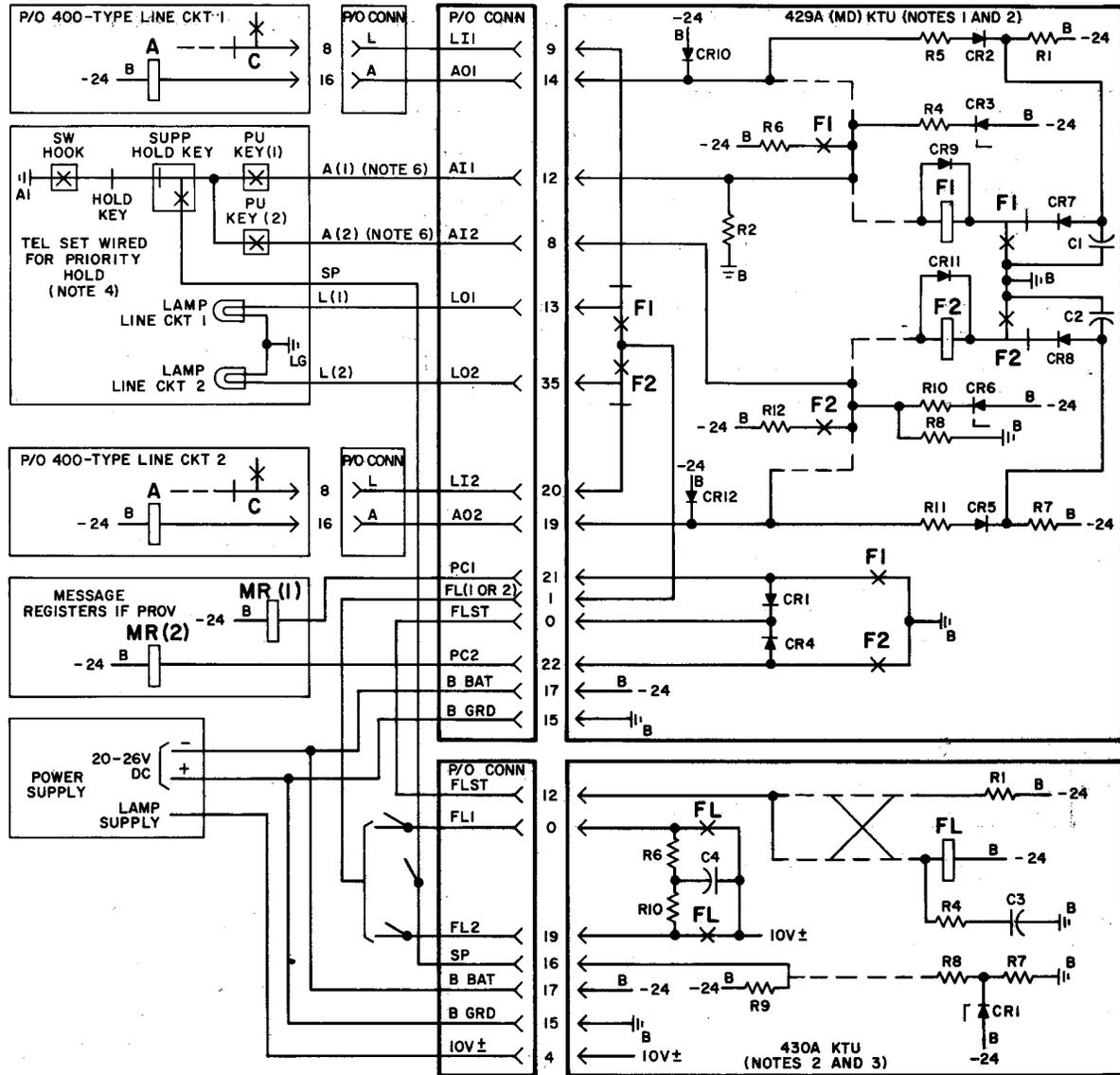
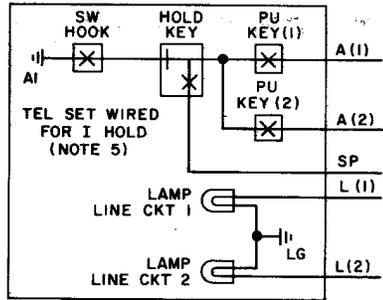


Fig. 8—Condensed Functional Schematic of 429A KTU (MD) (Supplementary Hold Detector Circuit) and 430A KTU (Flutter Generator Circuit)



NOTES:

1. THE 429B KTU WILL PROVIDE SUPPLEMENTARY HOLD FOR TWO CO OR PBX LINE CIRCUITS. EACH HOLD CIRCUIT MAY BE ASSIGNED AS PRIORITY OR I HOLD.
2. REQUIRES A MOUNTING FACILITY EQUIPPED WITH A 20- OR 40-PIN CONNECTOR.
3. LIMITATIONS OF THE 430A KTU ARE AS FOLLOWS:
 - A. FL1 OR FL2 LEAD CAN SERVE A MAXIMUM OF 50 LAMPS.
 - B. SP LEAD CAN CONNECT TO A MAXIMUM OF 20 STATIONS.
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5. ANY TELEPHONE SET EQUIPPED WITH A HOLD KEY HAVING A SET OF TRANSFER CONTACTS AND SUFFICIENT CORD LEADS CAN INITIATE I HOLD. REWIRE HOLD KEY ACCORDING TO CONNECTION SECTION OF TYPE SET USED.
6. TELEPHONE SETS EQUIPPED WITH 635-TYPE KEYS REQUIRE A KIT OF PARTS. REFER TO APPROPRIATE TELEPHONE SET SECTION FOR INFORMATION.

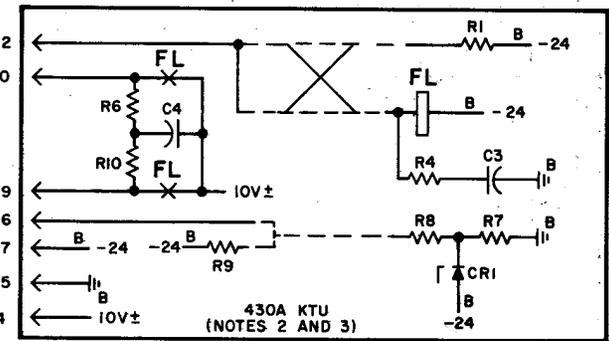
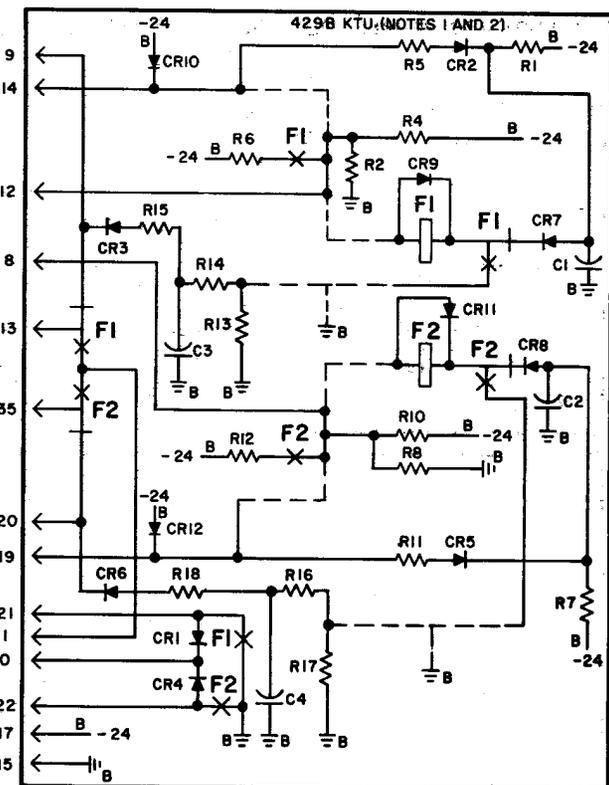
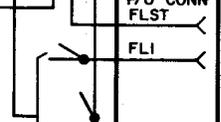
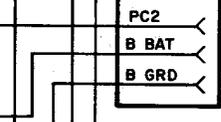
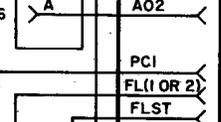
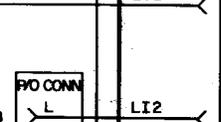
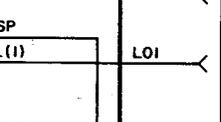
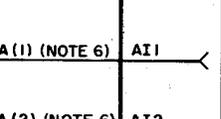
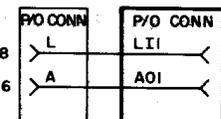
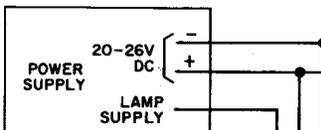
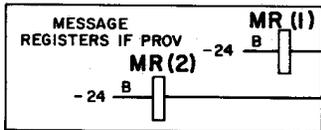
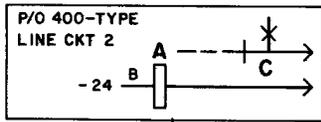
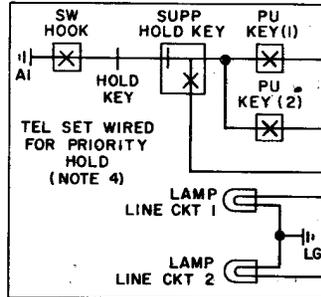
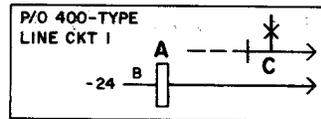
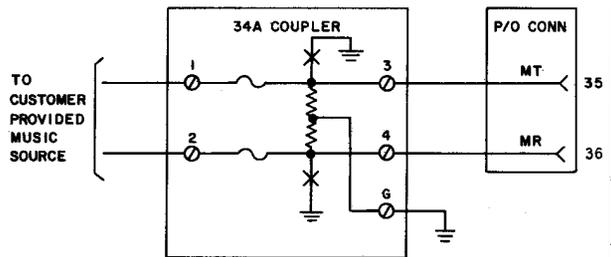


Fig. 9—Condensed Functional Schematic of 429B (MD) or 429C KTU (Supplementary Hold Detector Circuit) and 430A KTU (Flutter Generator Circuit)



NOTES:

1. REQUIRES A MOUNTING FACILITY WITH A 40-PIN CONNECTOR
2. EACH 451B KTU PROVIDES MUSIC ON HOLD FOR SEVEN CO OR PBX LINES
3. CONNECT THESE LEADS TOGETHER AS CLOSE TO 451B KTU AS POSSIBLE.

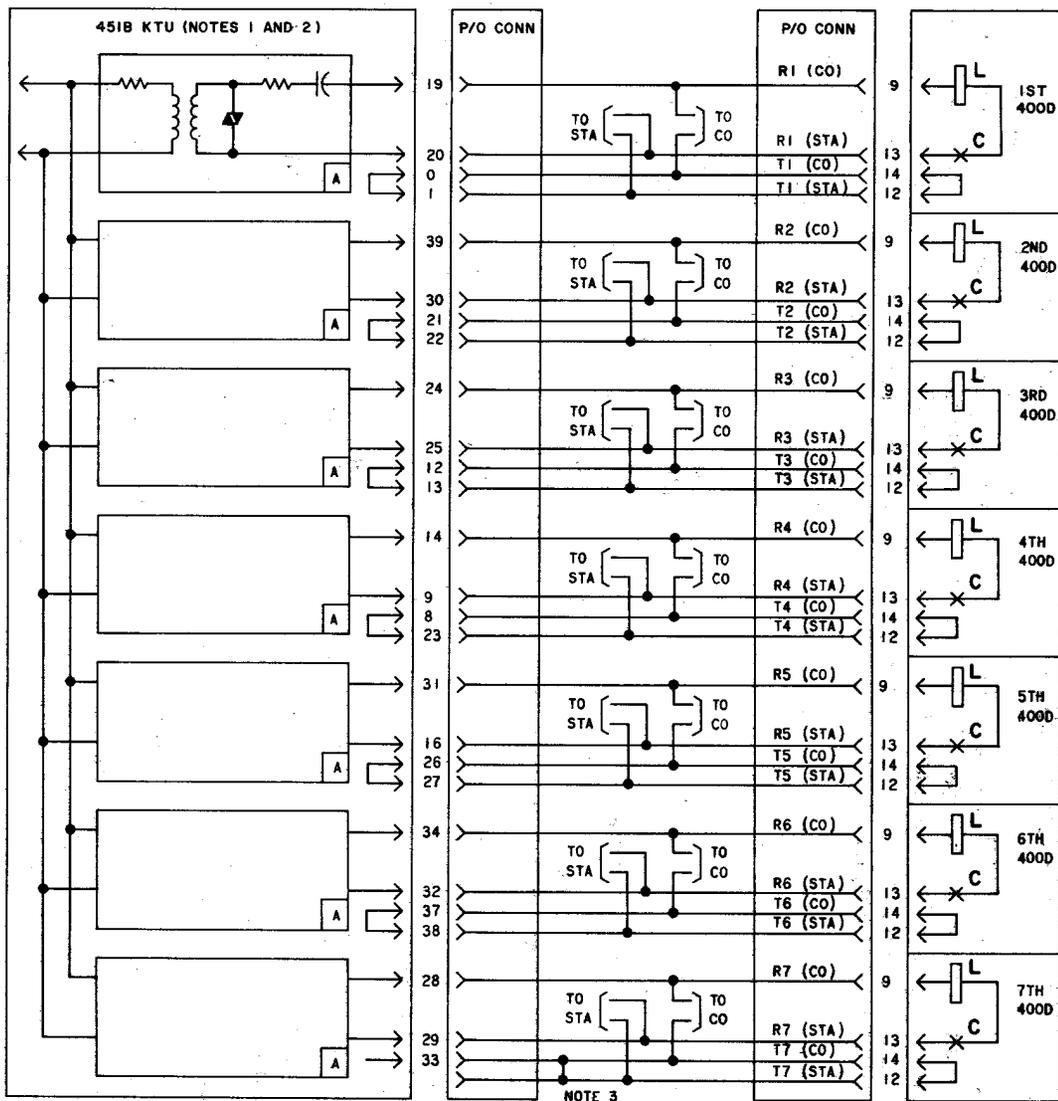


Fig. 10—Condensed Functional Schematic of 451B KTU (Music-On-Hold)

should have an adjustable volume control so the listening level of the music may be adjusted.

Note: The 451B KTU is not electrically interchangeable with the 498A KTU, and it cannot be used with the 400H KTU. The 451B KTU cannot be used in the apparatus mounting listed in Table A.

TABLE A

EQUIPMENT USED WITH 498A KTU AND 116A1 CM

498A KTU (4 LINES)		
KSU	PANEL	APP MTG
570B 580B 513A1, A2, A3 515A1, A2, A3	597B 598B 642A	69D
498A KTU PLUS 116A1 CM (7 LINES)		
570B 580B	702B 703B 642A	69D*

* A 69D equipped with 7-line music-on-hold (116A1 CM) cannot be used with a second 498A equipped with a 116A1 CM or another KTU which requires the use of the RN lead.

H. 471A (MD), 471B (MD), and 471C KTUs (Battery Reversal Toll Restriction)

2.14 The 471-type KTU (Fig. 11) is a 4-inch, 18-contact unit which provides for restricting toll calls on a per-line basis to key telephone stations. This circuit can only be used with CO circuits that provide a polarity reversal on the tip and ring of the line on toll calls.

2.15 The toll restriction circuit is provided to:

- Determine that a toll call has been dialed
- Drop toll calls from restricted stations by opening the tip and ring
- Allow toll calls from unrestricted stations.

2.16 The status of each station during toll calls is determined by the manner in which the station A lead is wired. Restricted stations are wired to the A lead from the associated CO/PBX line circuit; unrestricted stations are wired to the A(U) lead from the 471-type KTU (standard wiring arrangement, Fig. 11). This is the preferred method of wiring. The 471-type KTU can also be used in installations where grouping of restricted or unrestricted A leads is not desired or where A lead control is not used. In these cases, the 471-type KTU is installed in the tip and ring between the line circuit, if used, and the restricted telephone sets (alternate wiring arrangement, Fig. 11). With this wiring, restricted stations on the line may be cut off for approximately 2 seconds during polarity reversal. No A lead connections are made to the 471-type KTU.

2.17 The 471-type KTU can be installed in any slot of a mounting arrangement that will accept a 400-type KTU line circuit.

2.18 The 471B KTU is identical to the 471A (MD) KTU except that it has been updated for use with the privacy and supplementary hold feature. In addition, the 471B (MD) has been improved to reduce the minimum duration of polarity reversal that is detected.

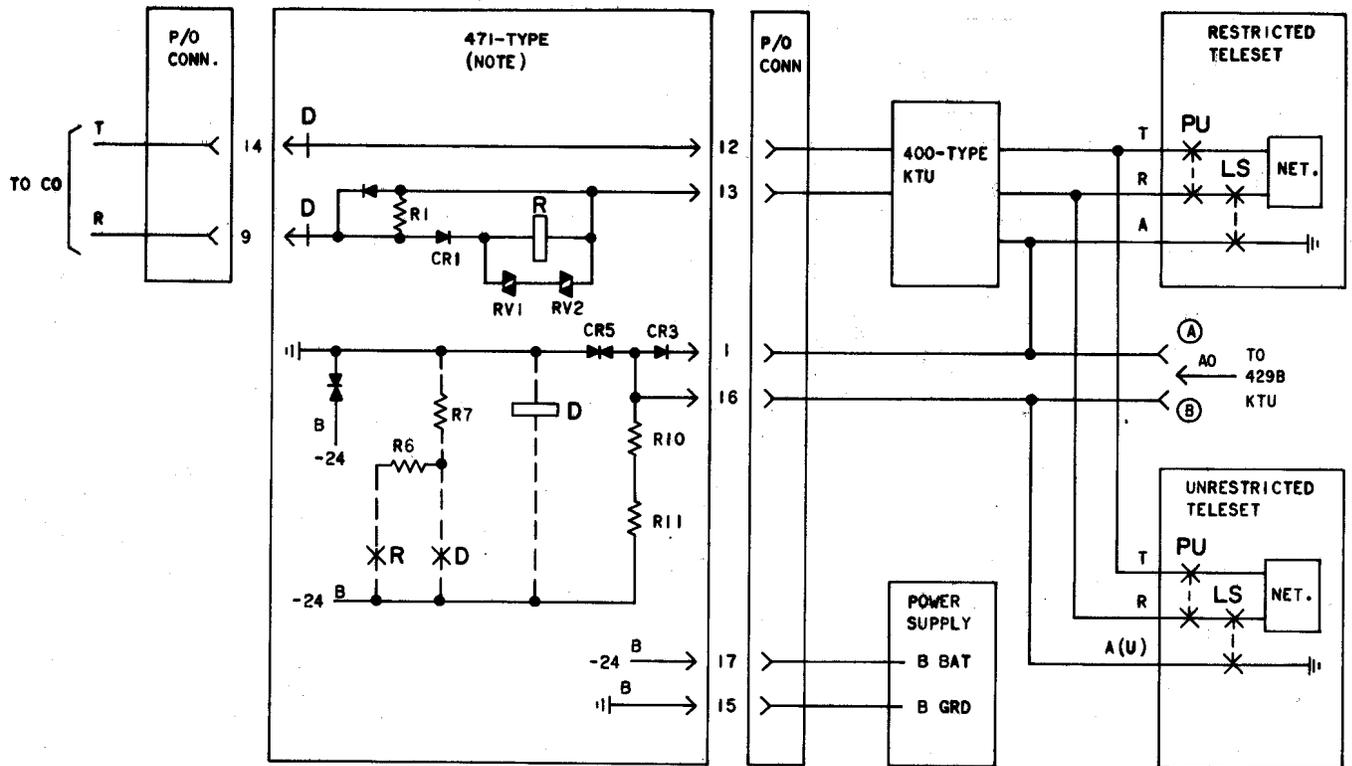
2.19 The 471C KTU is the same as the 471B KTU (MD) except that it has been modified to meet FCC balance requirements.

I. 479A (MD), 479B (MD), and 479C KTUs (Rotary Dial Toll Restriction)

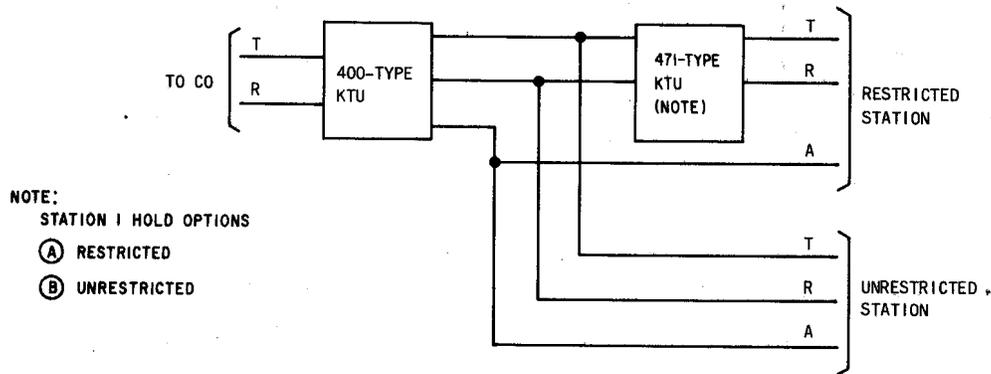
2.20 The 479-type KTU (Fig. 12) is an 8-inch, 20-contact unit which provides toll restriction on rotary lines where central office toll diversion is not available. Optional circuit modules can be mounted on the 479-type KTU to provide digit absorption (107A) or to allow restricted stations to call foreign number plan areas (107B).

2.21 The 479-type KTU:

- Monitors rotary dialing to detect restricted digit combinations
- Restricts calls to operator and foreign Numbering Plan Areas (NPA)
- Allows service calls or 800 area code numbers



A. STANDARD WIRING ARRANGEMENT



B. ALTERNATE WIRING ARRANGEMENT

NOTE:
REQUIRES A MOUNTING FACILITY EQUIPPED
WITH AN 18-, 20-, OR 40-PIN CONNECTOR

Fig. 11—Condensed Functional Schematic of 471-Type KTU (Battery Reversal Toll Restriction Circuit)

- Optionally restricts or passes toll calls in home NPAs where the prefix 1 is used
- Can be arranged for loop-start or ground-start operation. Ground-start operation provides

more security against “nonallowed” calls being placed.

2.22 The 479B (MD) is the same as the 479A KTU (MD) except it can be used with the

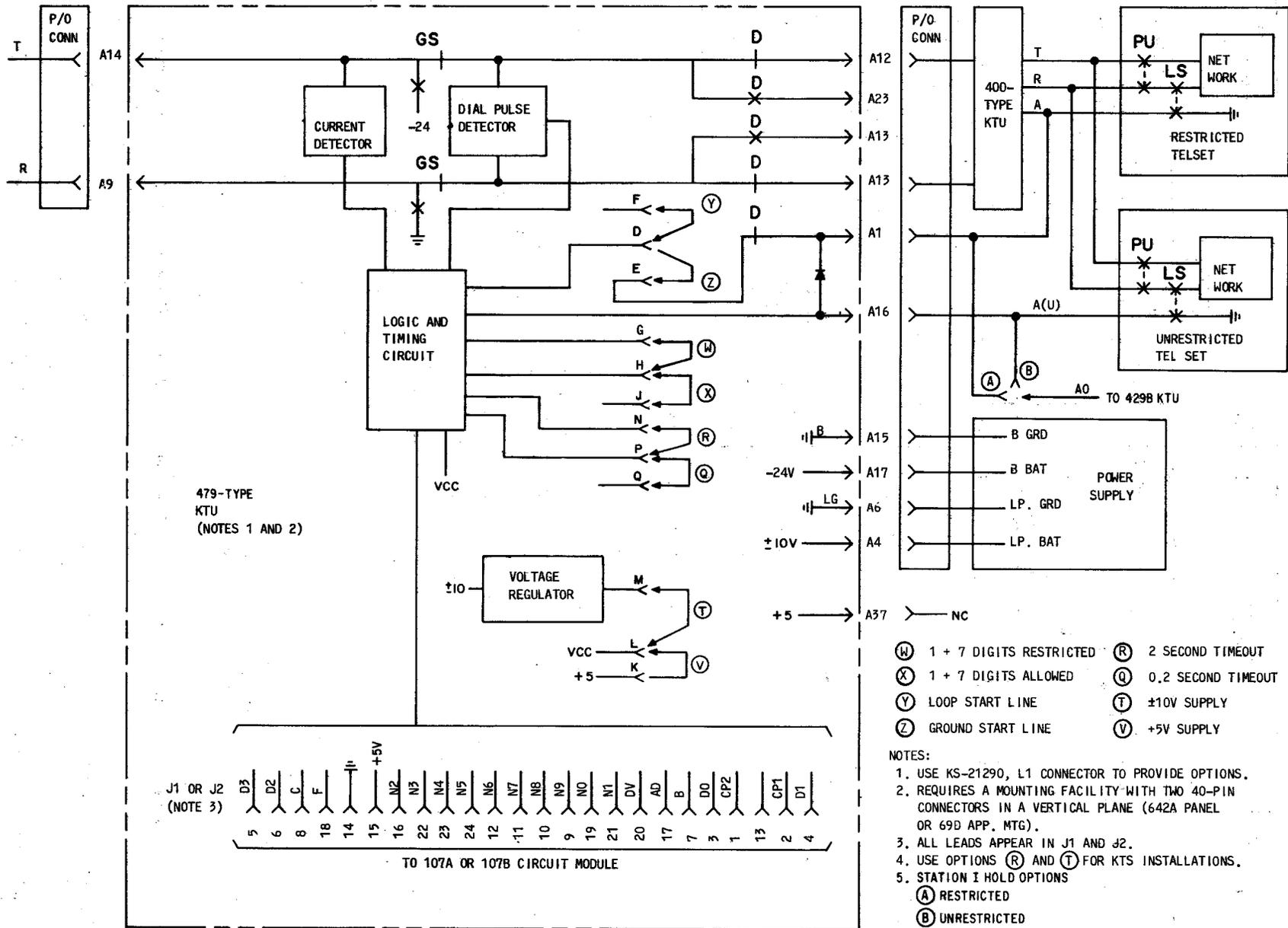
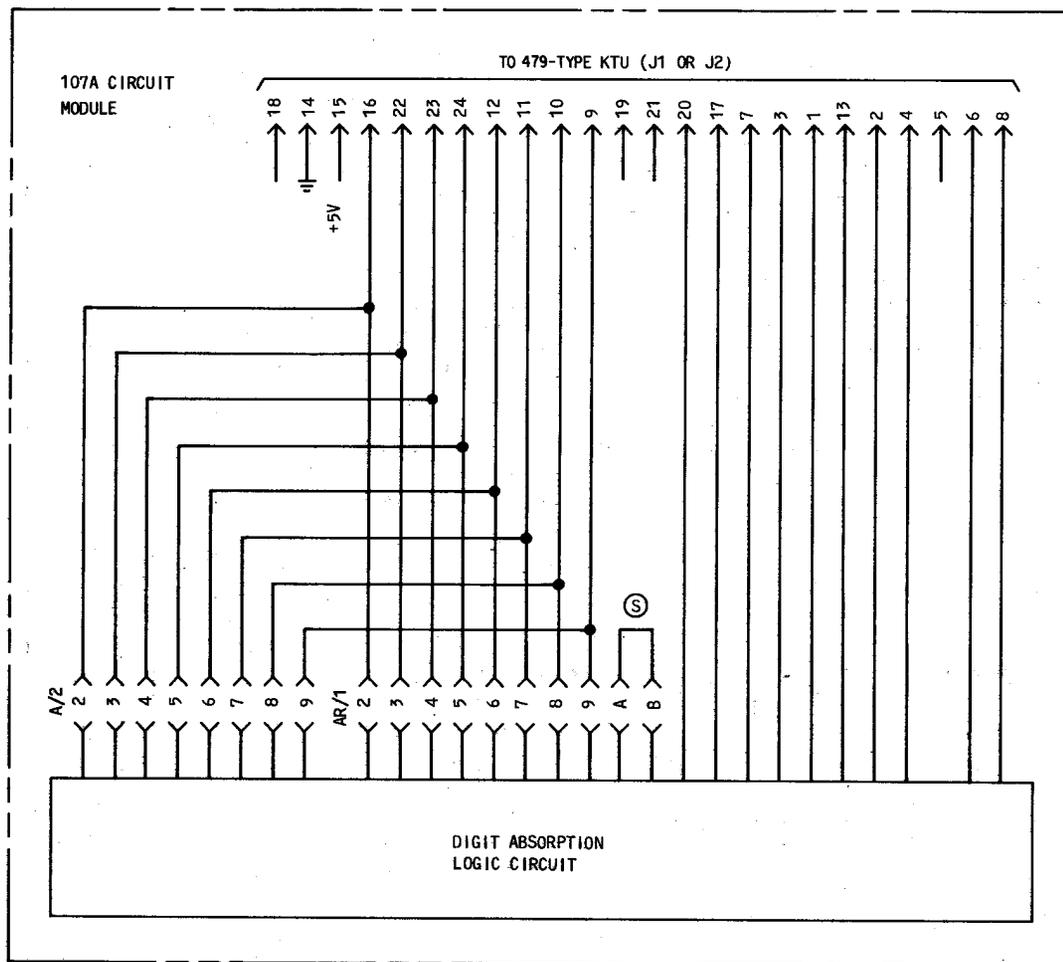


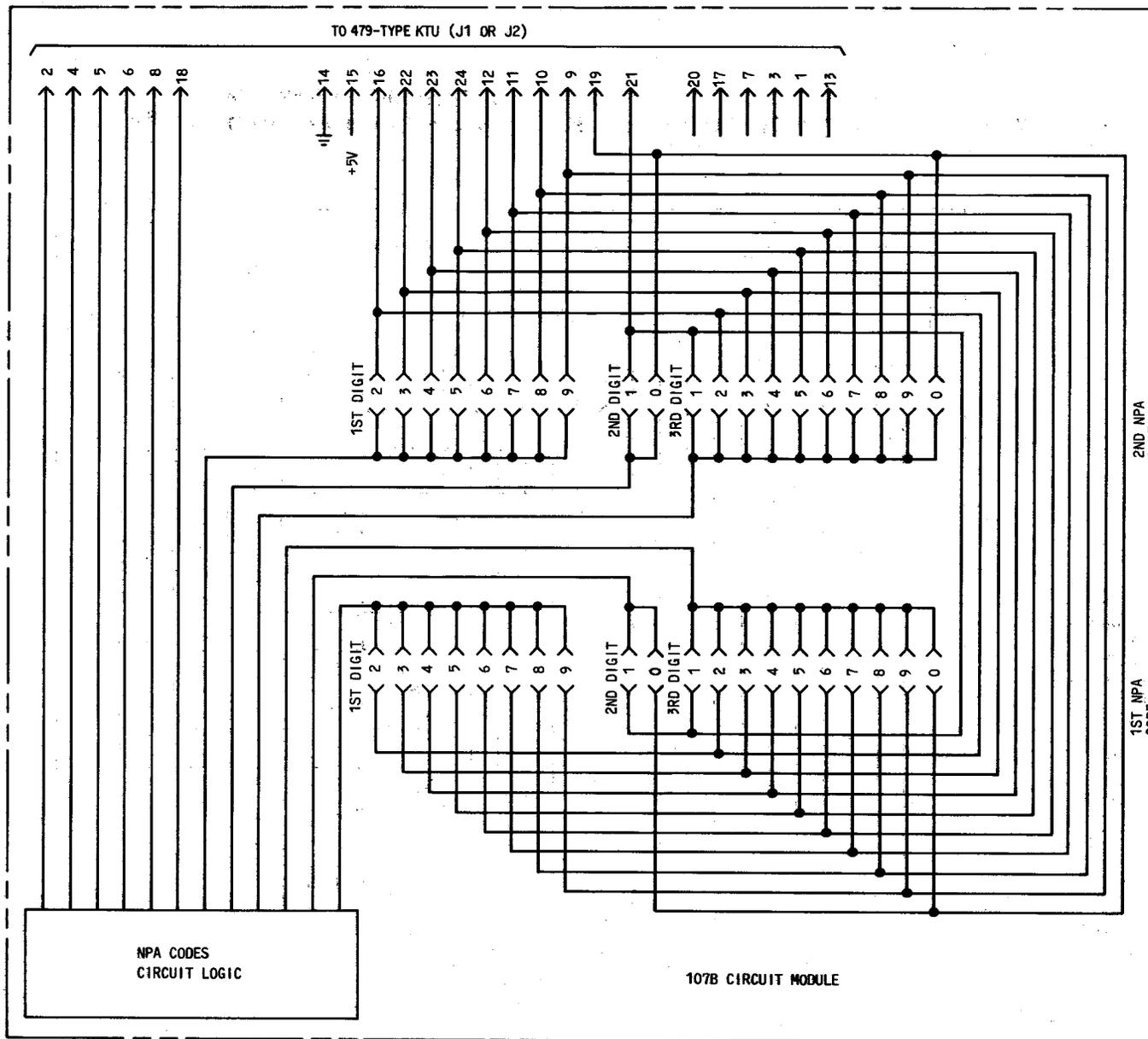
Fig. 12—Condensed Functional Schematic of 479-Type KTU, 107A and 107B Circuit Module (Rotary Dial Toll Restriction Circuit) (Sheet 1 of 3)



NOTES:

1. TO PROVIDE TWO-DIGIT ADSORPTION:
 - A. ADD (S) OPTION, USING KS-21290, L1 CONNECTOR IN TERMINALS A AND B.
 - B. ADD CONNECTOR IN OPTION FIELD AR/1 FOR EACH NUMBER TO BE ABSORBED AS 1ST DIGIT.
 - C. ADD CONNECTOR IN OPTION FIELD A/2 FOR EACH NUMBER TO BE ABSORBED AS 2ND DIGIT
2. TO ABSORB REPEATEDLY AND/OR ABSORB ONLY ONCE:
 - A. REMOVE CONNECTOR, IF PROVIDED FROM TERMINALS A AND B.
 - B. ADD CONNECTOR IN OPTION FIELD AR/1 FOR EACH NUMBER TO BE ABSORBED REPEATEDLY
 - C. ADD CONNECTOR IN OPTION FIELD A/2 FOR EACH NUMBER TO BE ABSORBED ONLY ONCE
3. PROGRAM CIRCUIT MODULE BEFORE MOUNTING ON EITHER J1 OR J2 OF THE 479A KTU.

Fig. 12—Condensed Functional Schematic of 479-Type KTU, 107A and 107B Circuit Module (Rotary Dial Toll Restriction Circuit) (Sheet 2 of 3)



NOTES:

1. PROGRAM CIRCUIT MODULE BY PROVIDING KS-21290L1 CONNECTOR IN EACH NUMBER OF NPA CODE NOT TO BE RESTRICTED. EACH 107B CIRCUIT MODULE WILL HANDLE TWO NPA CODES.
2. IF 107A IS NOT REQUIRED, TWO 107B MODULES CAN BE MOUNTED ON THE 479A KTU FOR A TOTAL OF FOUR NPA CODES.

Fig. 12—Condensed Functional Schematic of 479-Type KTU, 107A and 107B Circuit Module (Rotary Dial Toll Restriction Circuit) (Sheet 3 of 3)

privacy feature and/or supplementary hold. The 479B (MD) also offers better protection against registration of false digits in step-by-step (SXS) central offices.

2.23 ♦The 479C KTU is the same as the 479B KTU (MD) except it has been modified to meet FCC balance requirements.♦

2.24 All programming and options (Fig. 12) are applied to the 479-type KTU and the 107A or 107B CM using KS-21290, L1 connectors as follows:

- Ground start or loop start—479-type KTU
- Prefix 1 calls, restricted or permitted—479-type KTU
- Digit absorption—107A CM
- Unrestricted dialing of one or two foreign NPAs—107B CM.

Note: If 107A CM is not required, two 107B CMs can be mounted on the 479-type KTU for a maximum of four allowed NPA codes.

2.25 Because the 479-type KTU is an 8-inch board, it requires a mounting arrangement having two vertical connectors such as a 69D apparatus mounting, 642A panel, or 513-, 514-, or 515-type KSU. The status of the stations during toll calls is determined by how the station A lead is wired. Restricted stations are wired to the A lead of the associated line circuit; unrestricted

stations are wired to the A(U) lead from the 479-type KTU. Ground start lines require the A lead be wired as shown in Fig. 12 for start-up control. During power failure, the 479-type KTU will be inoperative and a momentary close contact key must be provided to furnish the ground-start function.

J. 498A (Music-On-Hold)

2.26 The 498A KTU (Fig. 13) is a 4-inch, 40-contact unit which provides music-on-hold for four CO/PBX line circuits. An optional circuit module, 116A1 (Fig. 14), can be mounted on the 498A KTU to provide music-on-hold for an additional three lines.

2.27 The 498A and 116A1 CM provide a balanced connection of music-on-hold to the tip and ring. The music source should have an adjustable volume control so the music level may be adjusted.

2.28 Table A lists the key service units, panels, and apparatus mounting compatible with the 498A KTU and the 116A1 CM.

2.29 The 498A KTU is not compatible with the 570A and 580A KSUs, 702A and 703A panels. New COM KEY* system installations, with the 570B and 580B KSUs or the 702B and 703B panels with the music-on-hold feature, must include the 498A KTU plus the 116A1 CM for each group of seven lines.

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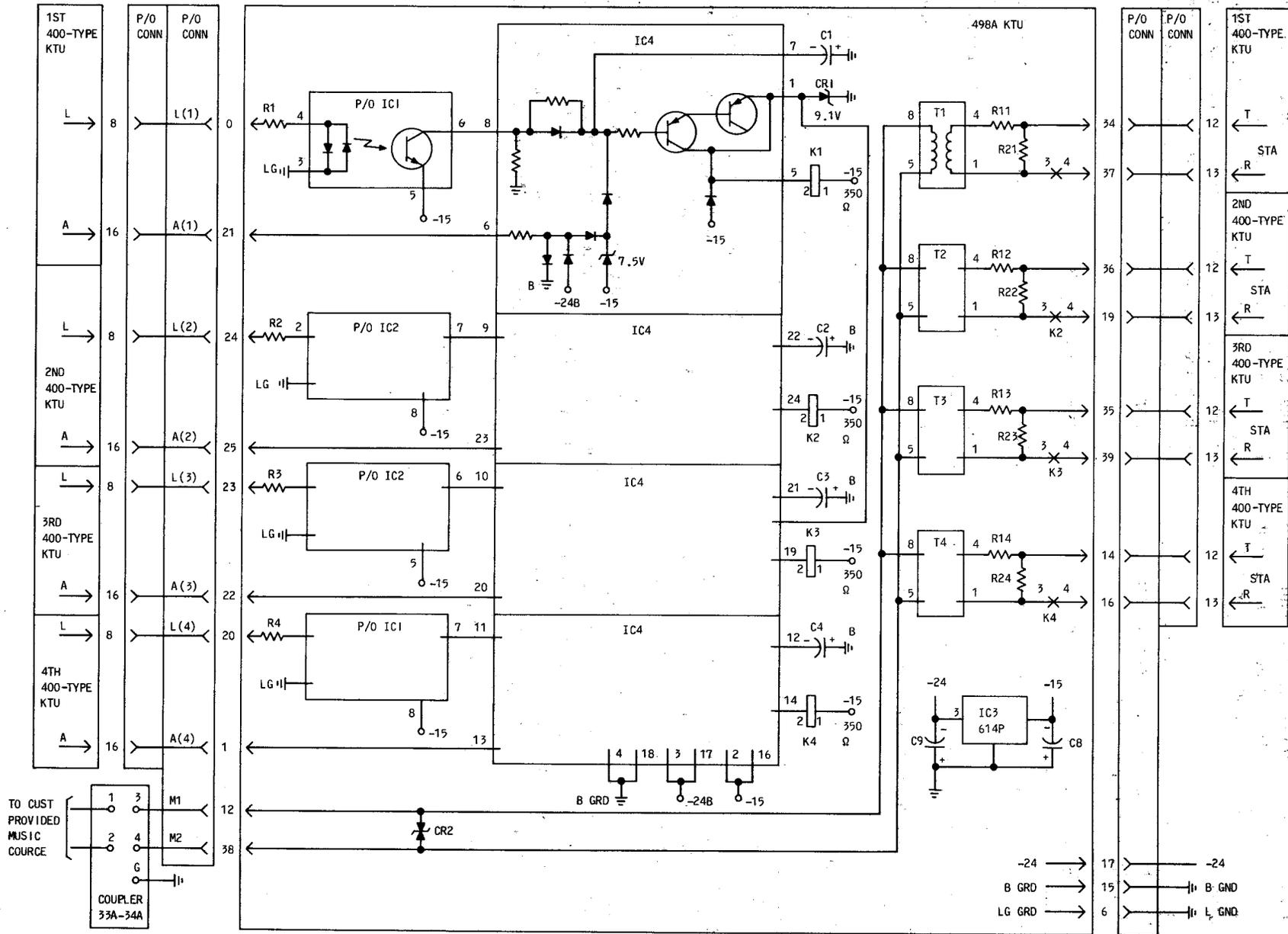


Fig. 13—Condensed Functional Schematic of 498A KTU (Music-On-Hold Circuit)

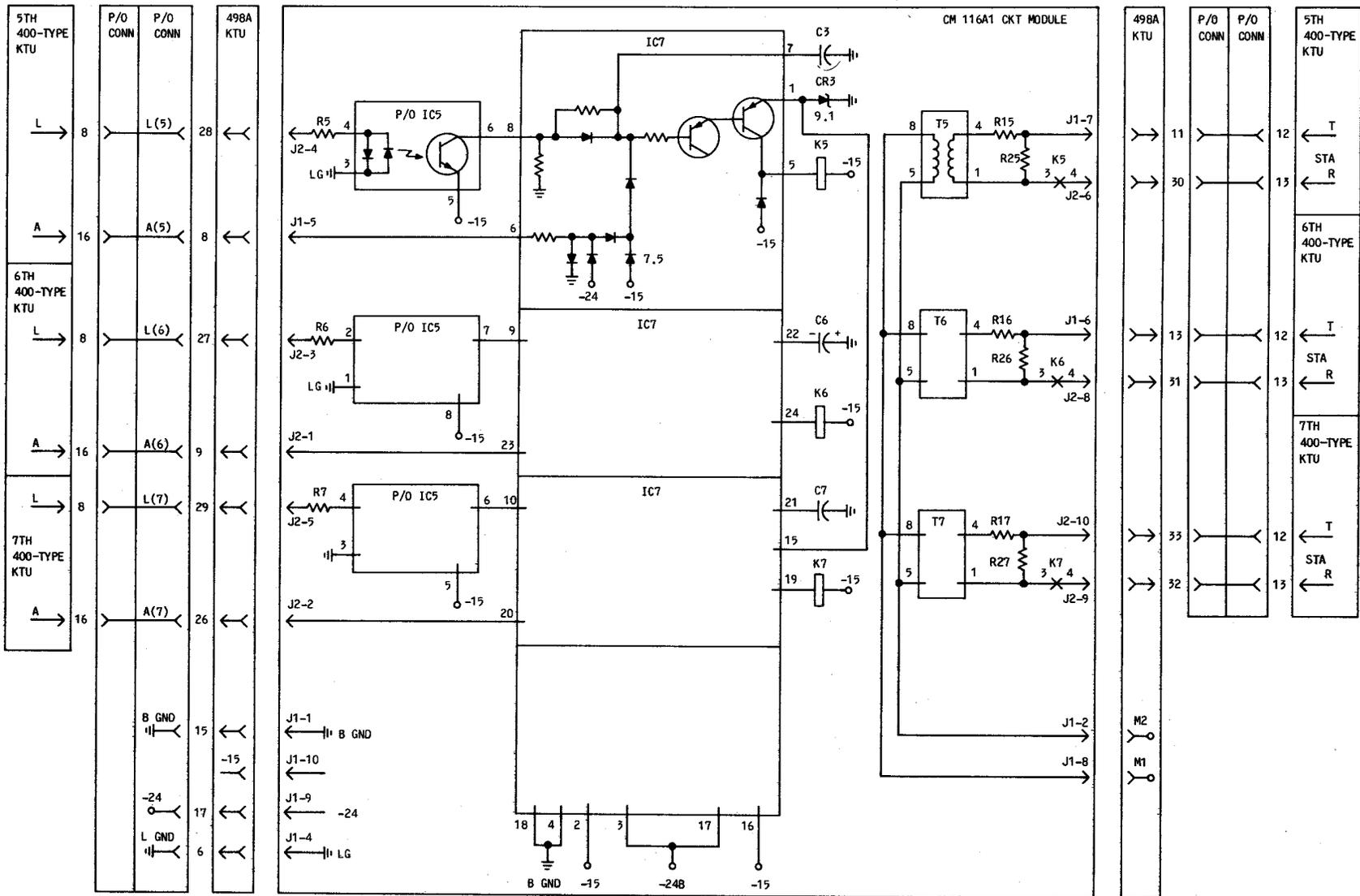


Fig. 14—Condensed Functional Schematic of 116A1 CM (Music-On-Hold Circuit)