

K400E KEY TELEPHONE UNIT

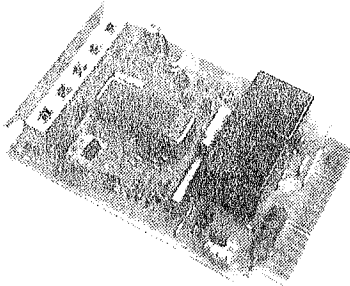


Figure 1—K400E Key Telephone Unit

1.00 GENERAL

1.01 The K400E Key Telephone Unit (KTU) is a plug-in CO/PBX line circuit for use in K-1A2 Key Telephone Systems.

1.02 The unit is interchangeable and compatible with K400B and K400D KTU's and is compatible with all types of COs and PBXs.

1.03 A light emitting diode (LED) is provided in the circuit to indicate to a repairman if the KTU is idle or in ringing, busy, or hold condition.

1.04 Ringing bridge impedance is approximately equal to one high impedance ringer. A maximum of three ringers may be connected across the line ahead of or behind the K400E.

1.05 The K400E KTU is normally unaffected by induced foreign potentials on the CO line up to approximately 24 volts RMS transversely or 90 volts RMS longitudinally.

2.00 INSTALLATION

Plugging In

2.01 K400E KTU's are installed one KTU per line required. The units plug into the connectors provided in the Key Service Unit with the printed circuit side to the installer's left, (K501 and K512 KSU), or on the bottom (K36A KSU). Be sure the KTU is plugged in

firmly. Some KSU's include a Retaining Bar to insure that the KTU's are held in position. Loosen or remove the Retaining Bar before installing the KTUs, then install the Retaining Bar and tighten the two attaching screws securely.

Circuit Options

2.02 The K400E KTU provides the options listed below. It is factory wired for options Z, W, Y, and BR. If other options are required, the installer must rewire or change the jumper options (See Table A).

Z — Short Time-out. (Used with automatic ringing CO or PBX.)

W — Interrupted Ringing.

T — Steady Ringing.

V — Auxiliary Common Audible Signal Circuit.

Y — Winking lamp on "hold".

BR — Bridged Ringing.

RG — Ringing from ring side of line to ground.

RU — Ringing from a separate lead to ring side of line.

DR — Direct Ringing. (From -24 VDC source.)

M — Music on "hold". (Requires additional equipment.)

TU — Ringing from a separate lead to tip side of line.

Special Instructions for Installation of (DR), (M), or (RU) Option

CAUTION

In some Key service units, Pins 3 and 18 of the K400E card connectors provide Talk Battery, (filtered -24 V dc), and ground. These connections must be cut or removed if any deviation from instructions given in Table "A" is used. This precaution is necessary to avoid possible damage to the K400 E card.

2.03 Either of two methods can be used for (RU) or (DR) options: The DR or RU lead can be brought to pin 3 of the K400E KTU via system wiring or the lead can be plugged directly into option block No. 2 of the K400E KTU. Both methods are covered in Table A.

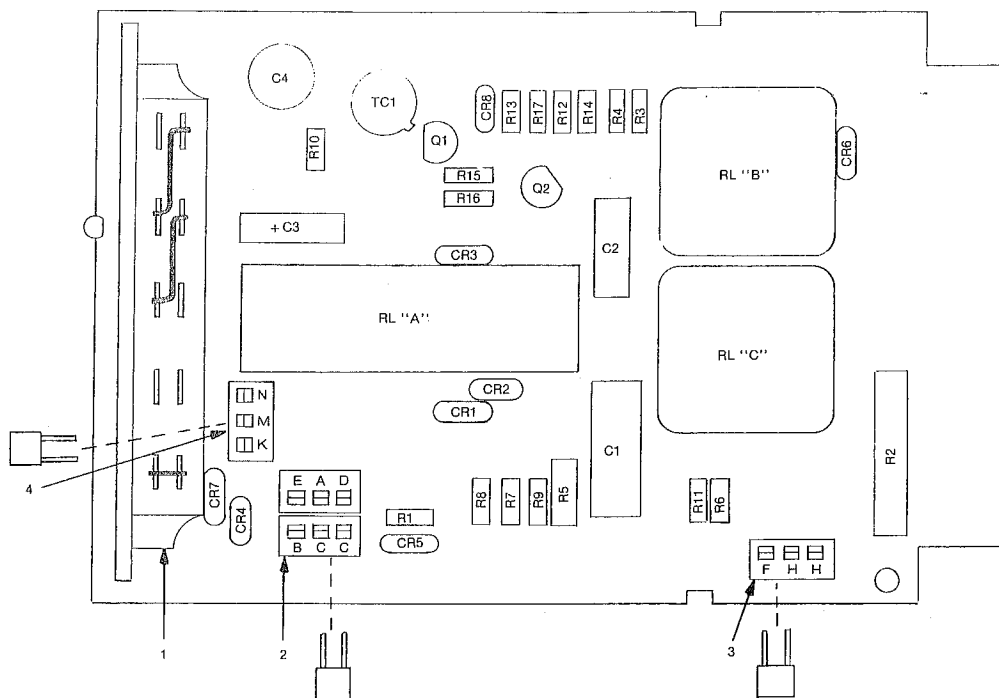


Figure 2—Location of Option Blocks, K400E KTU

Table A. Wiring Options, K400E KTU

CODE	OPTION	OPTION BLOCK No.	STRAPPING OR JUMPER	
			(Note 1)	(Note 2)
Z	Short time-out (Factory Strapping)	(1)	1 - 2	1 - 2
W	Interrupted ringing (Factory Strapping)	(1)	5 - 8	5 - 8
T	Steady ringing	(1)	6 - 8	6 - 8
V	Auxiliary Common Audible signal control	(1)	4 - 8	4 - 8
Y	Winking lamp on "hold" (Factory Strapping)	(1)	10 - 7	10 - 7
X	Steady lamp on "hold"	(1)	9 - 7	9 - 7
BR	Bridged ringing	(2), (4)	C-D, M-N	C-D, M-N
R G	Ringing from Ring side of line to Ground	(2), (4)	C-B, M-N	C-B, M-N
TU	Ringing from a separate lead to Tip side of line	(2), (4)	K-M, C-C	K-M, C-A
RU	Ringing from a separate lead to Ring side of line	(2), (4)	C-C, M-N	C-A, M-N
DR	Direct ringing (-24 V dc applied thru relay contact)	(2)	C-C	A-E
M	Music on hold (Requires additional equipment)	(3)	H-H	F-H

NOTE 1: Use this strapping when (DR) or (RU) leads or (M) leads are plugged into the K400E KTU. Insert (RU) lead into terminal "C". Insert (DR) lead into "E". Insert (M) leads, (from K403A KTU), into "D" and "F".

NOTE 2: Use this strapping when (DR) or (RU) lead is connected to pin 3 via the card connector. (M) leads from K403A KTU must be permanently wired to pins 12 and 18 of K400E card connector. (Standard on K76A Key Systems.)

3.00 OPERATION

IDLE CONDITION

3.01 In the idle condition all relays are in the unoperated state, and transistors Q1 and Q2 are off. The operational amplifier is held off by the bias applied to pin 2 from the voltage divider network of R12 and R13. The operation amplifier responds to the difference in voltage between pins 2 and 3. The voltage at pin 3 of the operational amplifier is determined by the charge on capacitor C3.

Ringing Current Applied

NOTE: Ringing voltage can be applied in a number of ways: from ring to ground, bridged, or on a separate lead. (See Table A for details of connections and options required.) Two options are available for ringing on a separate lead: 1) Ringing voltage, (105 volt 20/30 Hz), applied to the ring side of the line via the RU options and, 2) "B" battery, (-24 volt DC), through a relay contact closure via the DR option on the K400E card.

Operation of the K400E KTU is the same in every case except for the DR option. The DR option bypasses "L" relay contacts 2 and 5. (Ringing options must be properly strapped on the board terminals.) The ringing voltage causes a current to flow through the 710 ohm winding of the L relay energizing it on the negative and positive half cycles.

3.02 When the L relay energizes, contacts 2 and 5 close. Capacitor C3 can now charge toward a -24 volts through R9, CR5, and R5. When the L relay de-energizes due to the polarity changes of the ringing voltage, C3 discharges slightly through R9, R7, and R8. After a sufficient number of cycles of ringing, the charge on C3 overcomes the bias on the operational amplifier. The operational ampli-

fier turns on Q1 which turns on Q2. Q2 energizes the B relay. The B relay, operated, connects the LG lead to the ST lead, the L lead to the LF lead, and interrupted (option W) or steady (option T) ringing current or ground (option V) to the RC lead for audible signal control. The operational amplifier, Q1, and Q2 are held on until the call is answered or timed out.

Answering an Incoming Call

3.03 An incoming call is answered by operating the pickup key associated with the line being run and going off-hook. The station is then connected across the line through the hookswitch and key contacts, and ringing is tripped at the Central Office or PBX. Ground is also connected through the hookswitch and key contact to the A lead, operating the C relay which removes the short between terminals 2 and 3 of relay L. Relay L operates with line current. C3 is given a quick path for discharge through the contacts of relay C and R6, R9, CR5, CR4, and a parallel path of R11. The operational amplifier cuts off causing Q1 and Q2 to cut off and relay B to de-energize. Contacts of relay C disconnect the secondary of relay L and eliminate the shunting effect on the line of the secondary winding in series with R1 and C1. The R lead from the CO or PBX is connected to the R lead of the key set by the parallel combination of CR1 and CR2. Relays C and B connect the L lead to the LB lead and open the RC lead to discontinue local audible signaling.

Outgoing Call

3.04 Operating the pickup button and going off-hook causes a ground to be placed on the coil of the C relay of the K400E. The R lead from the CO or PBX is connected to the R lead of the key set by the parallel connection CR1 and CR2. The C relay contacts also open the secondary of the L relay, removing any shunting effect on the line, and connect the L lead of the LB lead, causing the lamp associated with that line on the key set to light steadily. The call can now be placed.

Holding

3.05 A busy line can be placed on hold by operating the hold button on the telephone. When the hold button is depressed, ground is disconnected on the A lead on the K400E. Relay L remains energized by the line current. C3 can now charge through the contacts of relay C, R6, R5, and the contacts of relay L to a negative potential. The operational amplifier conducts when the potential of C3 rises above its cutoff value and relay B is energized by the conduction of Q2. Relay B places a resistor to ground on the coil of relay C which is sufficient to allow holding current to flow through relay C. When the ground was previously removed from relay C through CR3 and the A lead, the charge on C2 was sufficient to hold relay C energized until relay B could be energized. Energizing both relay C and relay B causes line current to flow through the primary of relay L and R2 when the handset is placed on hook. The line will remain on hold until released or the held party "abandons" the call.

Release of the Holding Bridge by a Station

3.06 Any station of the key telephone system that seizes the line by operating the associated pickup key and going "off-hook" will cause the B relay to de-energize which will remove R2 from across the line. This is accomplished by grounding the A lead and giving C3 a discharge path through R6, R9, CR5, and CR4. The operational amplifier cuts off, causing Q1 and Q2 to cut off and relay B to de-energize. Relay C is held operated by the ground on the A lead and relay L is held operated by the line current to the key set. The circuit is thus restored to the busy state.

Operation with Local Power Failure

3.07 During periods when the local DC supply is inoperative, it is possible to originate outgoing calls. When a station goes off-hook, connections to the line are metallic. The primary of the L relay is short circuited by the C relay contacts and the secondary is connected in series with resistor R1 and capacitor C, but this has negligible effect on the talking circuit used, then incoming calls are signaled in the usual way although visual and common audible signals are inoperative.

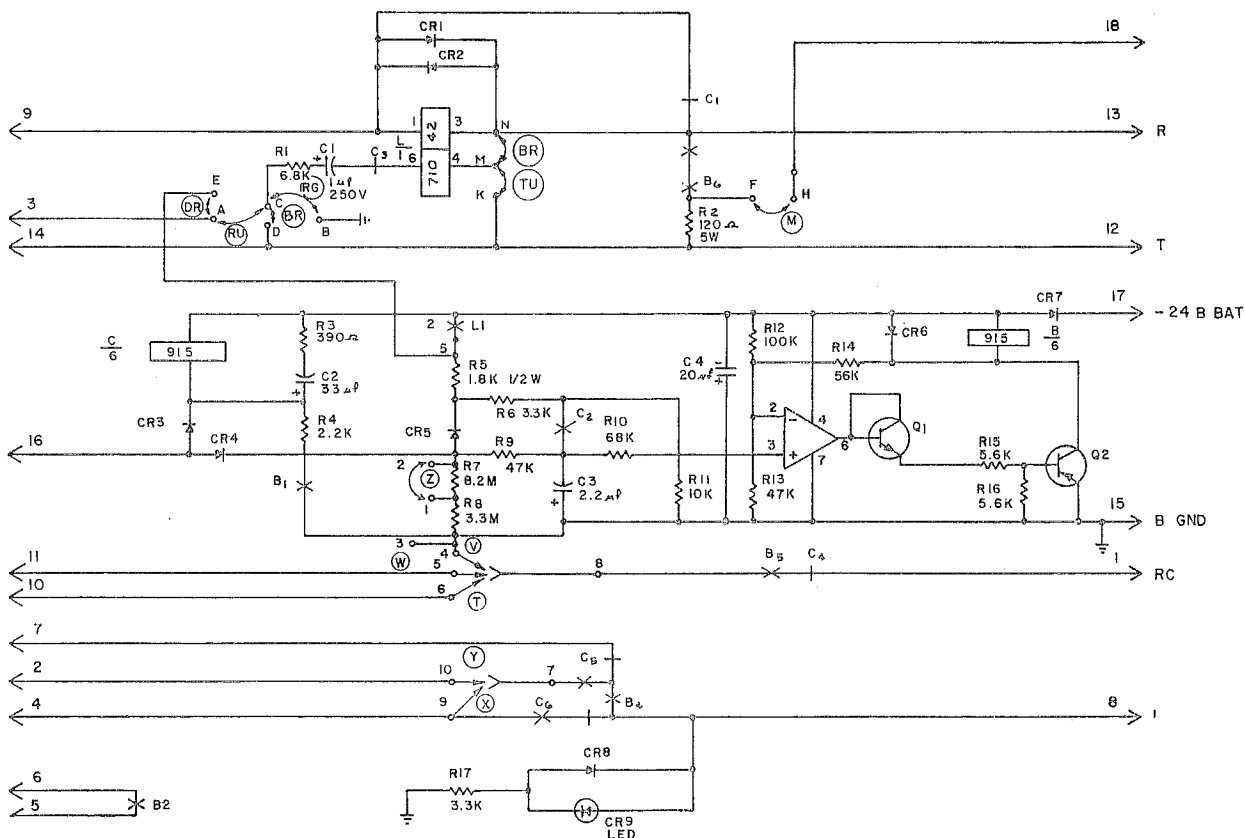


Figure 3—Circuit Schematic, K400E. (Options RU, DR and M not shown. See Table A.)