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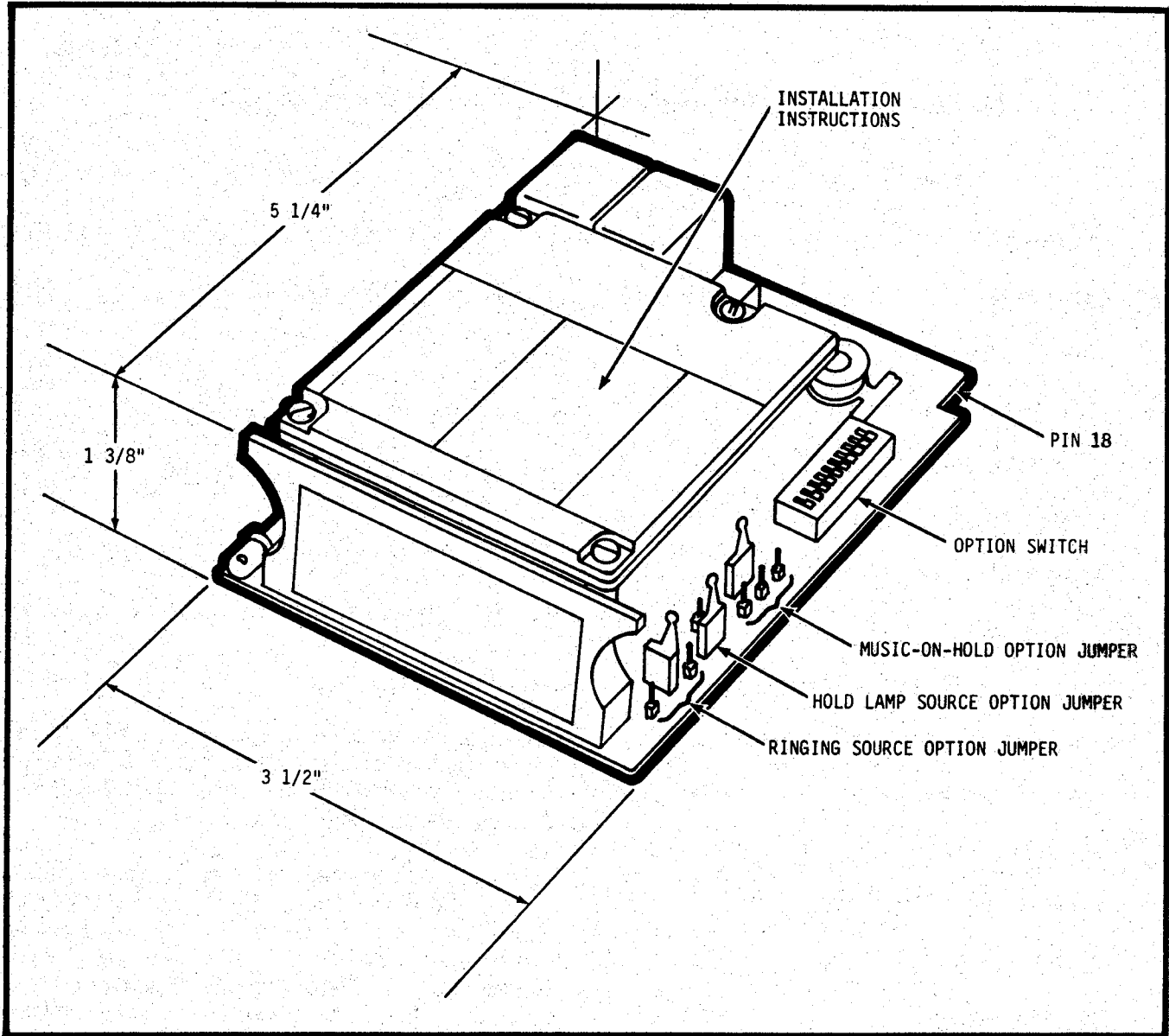
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## M-487 Off-Premises Supervision Control and Line Card

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| 4. INSTALLATION . . . . .  | 6    | <b>1. GENERAL</b>   |      |
| FCC RULES COMPLIANCE . . . . .                                   | 6    | <b>1.01</b> This section describes applications, operation, installation, and maintenance of the TELONE® M-487 Off-Premises Supervision Control and Line Card.  |      |
| INSTALLATION PROCEDURE . . . . .                                 | 6    | <b>1.02</b> This practice is reissued to add warnings about the use of long-line adapters or repeaters and grounding the M-487, to change the ring detect specification and to incorporate the FCC Part 68 approval of this product. The previous reissue supplied information about the option settings and added specifications for the M-487-02.       |      |
| INSTALLATION TEST . . . . .                                      | 9    | <b>2. CONCEPT</b>   |      |
| 5. MAINTENANCE . . . . .   | 9    | <b>2.01</b> The M-487, shown in Figure 1, performs both normal line card functions for a Key Telephone System (KTS) and supervision of an off-premises extension (OPX) or off-premises KTS line. Two models are available, the M-487-01 and -02. They are identical except that on- and off-hook recognition timing has been lengthened for the M-487-02. |      |
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**Figure 1 M-487 Off-Premises Supervision Control and Line Card**

**2.02** The OPX phone (or KTS line) is able to break hold and cause the KTS phone lamp to light. The KTS phone is able to put the OPX phone (or KTS line) on hold. Only Tip and Ring connections are necessary at a non key OPX phone. The M-487 may be used in any 1A or 10A type Key Service Unit. One M-487 is required per line in each key unit.

**2.03** The M-487 includes the following standard line card features:

- Pickup and hold of a CO or PBX line
- Audible line signal or common audible signal control on incoming call
- Flashing lamp indicating incoming call on line
- Steady lamp indicating busy condition
- Winking or steady lamp indicating hold condition

- Selectable ring state time-out on incoming calls (to accommodate interrupted ringing)
- Maximum loop resistance of 1400 ohms
- Delayed hold release during dry circuits
- Trunk bypass (talking circuit to CO or PBX line maintained during power failure).

**2.04** The M-487 provides the following additional standard features:

- Music-on-hold inputs (single and balanced) (also compatible with WECO 498A)
- Off-premises phone supervision

Off-premises on hold—all loop length conditions up to 1400 ohms

- FCC Registration.

**2.05** Optional feature settings are available through an Option Selection Switch and option strapping. These settings include the following:

Strapping options (using easily inserted plugs):

- Steady or winking hold lamp
- Interrupted, steady, or common (ground) control to ringer
- Balanced or single ended music-on-hold input, 10 ohm or 66 ohm DC impedance

Switch selectable options (using an easily accessed ten-position switch):

- Dry circuit time-out (three settings)
- Ring time-out (seven settings)
- Direct ring

- High or low hold release detector sensitivity for varying loop lengths.

**2.06** The M-487 Control and Line Card has been approved by the Federal Communications Commission for direct connection to telephone company lines. As required by Part 68 of the FCC Rules and Regulations, the following information appears on the M-487 registration label:

- Registration Number: AHH9WA-69272-KX-N
- Ringer Equivalence Number: 1.0B

**2.07** Part 68 of the FCC Rules and Regulations defines the responsibilities of both the customer and the telephone company concerning the installation and repair of Part 68 registered equipment. Refer to the installation and maintenance parts of this technical practice for important Part 68 compliance procedures.

### 3. APPLICATIONS

**3.01** The M-487 can be used in place of standard four-inch, 18-contact line cards in 1A or 10A type Key Telephone Systems. No additional cables are required. Typical applications are shown in Figure 2.

#### KTS COMPATIBILITY

**3.02** The M-487 OPX/KTU provides standard Western Electric 400 series or Automatic Electric 1400 series line card functions. Music-on-hold and off-premises supervision are also provided as standard features. The M-487 occupies any standard line card position in the host KTU. Pin descriptions are provided under Functional Description in this technical practice. Maximum ringer load of five and lamp load of 20 is permissible. A partial list of compatible KTU's is provided in Table 1.

#### CENTRAL OFFICE COMPATIBILITY

**3.03** The M-487 provides considerable flexibility in adapting to Central

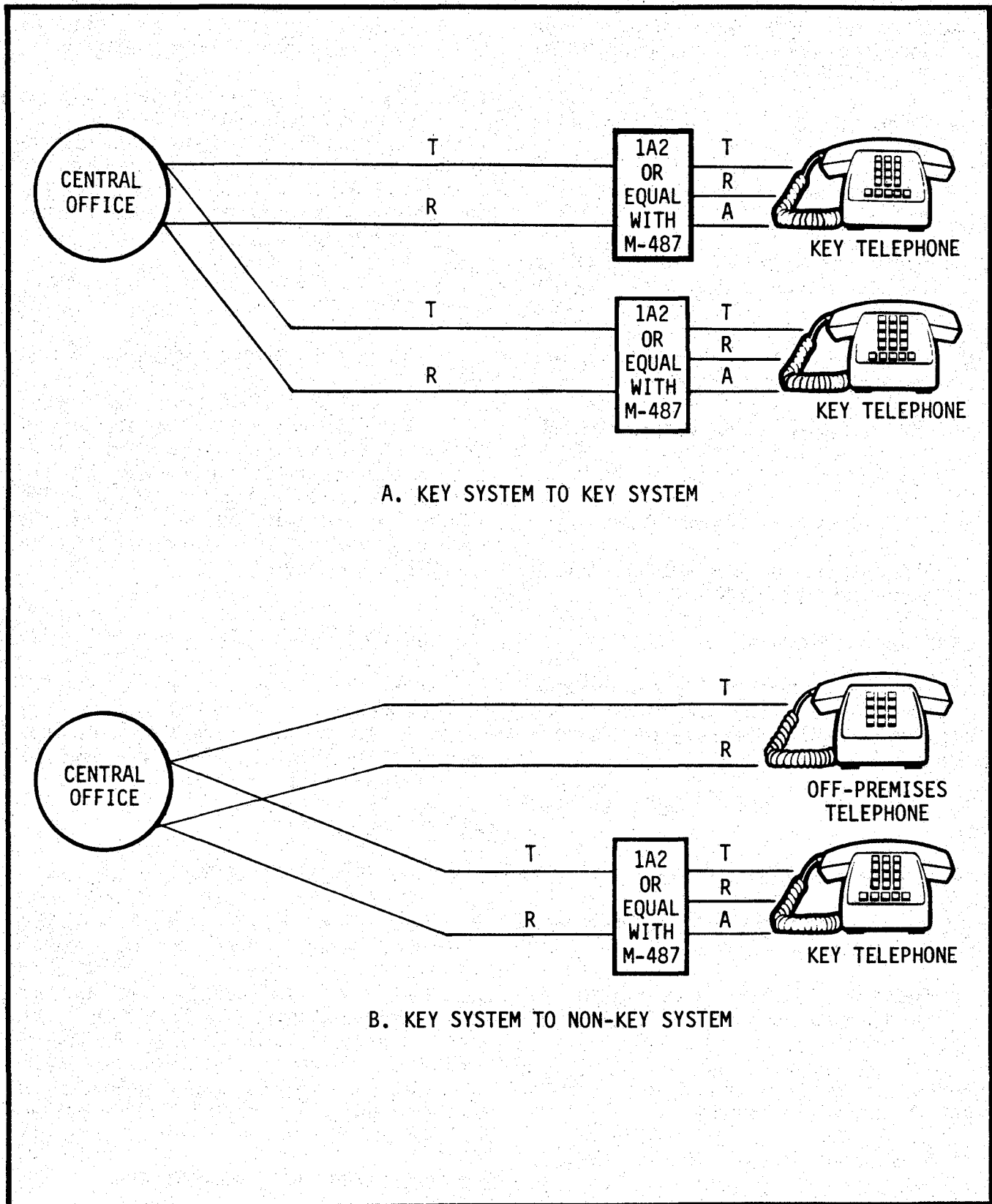
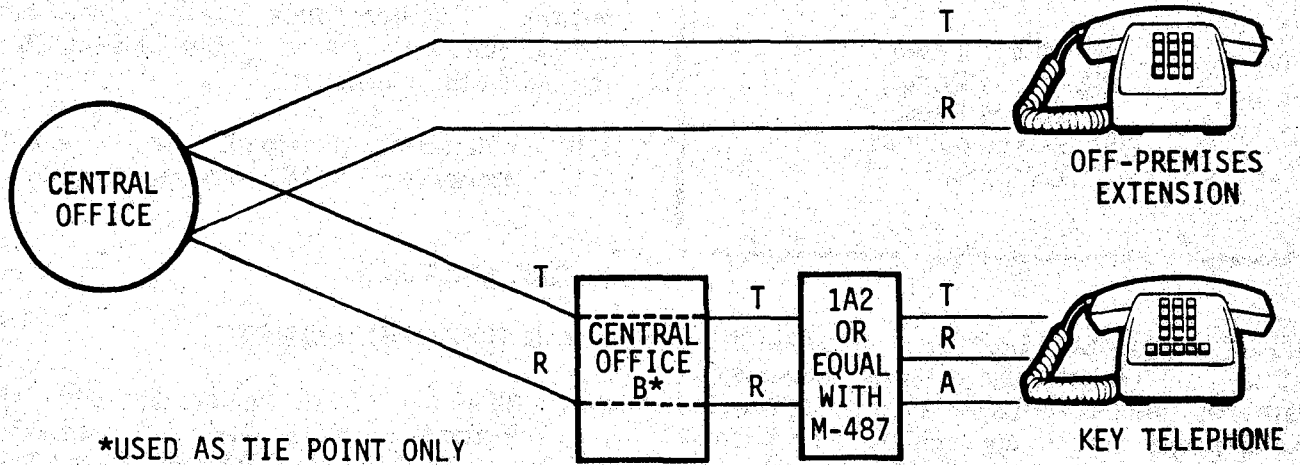
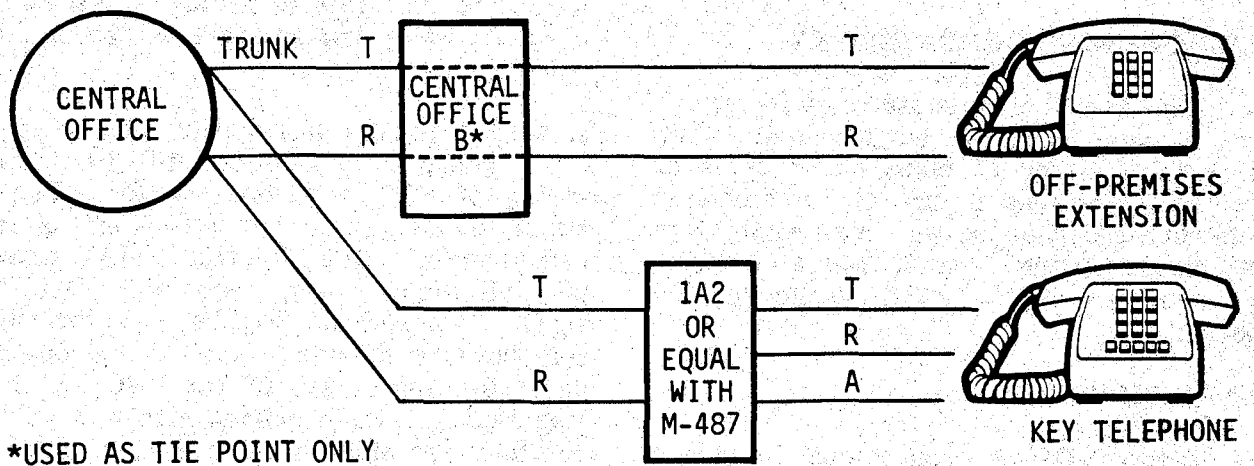


Figure 2 Typical Applications (Sheet 1 of 2)



C. KEY SYSTEM WITH OFF-PREMISES EXTENSION IN THE CENTRAL OFFICE



D. KEY SYSTEM IN THE CENTRAL OFFICE WITH OFF-PREMISES REMOTE EXCHANGE

Figure 2 Typical Applications (Sheet 2 of 2)

**Table 1 Partial List of Compatible KTU's**

|  |
|--|
| <p>WEC0 551 Panel<br/> WEC0 584 Panel<br/> WEC0 620 Panel<br/> WEC0 Comkey 2152<br/> GTE 17A</p> |
|--|

Office conditions. Loss of a hold condition during line reswitching after a transmission path has been established can be prevented through use of the appropriate Dry Circuit Time-out setting. Loop limits of 1400 ohms (or 1300 ohms with mini bridge lifters) are permissible. Proper operation with a noise level up to 56 V p-p (longitudinally induced, 60 Hz voltage) is possible. High or low hold release detection sensitivity can be selected to accommodate local noise and/or loop length requirements.

#### MUSIC-ON-HOLD COMPATIBILITY

**3.04** The M-487 can be strapped for either a balanced or a single-ended music source with either 10 ohms or 66 ohms of D.C. resistance (see Figure 4). A balanced music source cannot be used in an application using direct ringing. The M-487 is compatible with the WEC0 498A music-on-hold function.

#### RESTRICTIONS

**3.05** Central Office ground must be within  $\pm 1/2$  VDC of M-487 ground for proper operation under longest loop conditions. The M-487 must have a metallic path between the OPX phone and the key phone so that at least 22 mA is drawn from the key phone battery feed by the off-premises phone going off-hook. In the applications shown in Figures 2B, 2C, and 2D, the off-premises phone can be on carrier if this off-hook current requirement is met.

**3.06** Certain restrictions must be observed when entering the hold state. A

momentary pause (the off hook recognition time) is necessary between going off-hook (receiving steady lamp) and pressing the hold button. Further, once pressed, the hold button must be released within 1.6 seconds or the hold will be dropped.

**3.07** When not grounded, the A lead is pulled to -15 VDC through a resistor.

#### 4. INSTALLATION

##### FCC RULES COMPLIANCE

**4.01** The M-487 is registered with the Federal Communications Commission (FCC) as a KX device. Part 68 of the FCC Rules and Regulations stipulates that a customer must notify the telephone company of the customer's intent to install an M-487 OPX/KTU Line Card. The customer must provide the telephone company with the information provided in Table 2 and the identity of the key telephone system into which the unit will be installed. The M-487 does not alter the system's Ringer Equivalence Number.

**4.02** Where the installation of the M-487 requires connections to the internal wiring of FCC registered devices, Part 68 stipulates that such connections and changes can be made only by the registration grantee, his authorized agents, equipment manufacturers, registered telephone refurbishers, telephone companies, and those qualified under Section 68.215 of the FCC Rules and Regulations. Such connections and changes can be made only with the permission of the host equipment owner.

##### INSTALLATION PROCEDURE

###### Warning:

- (1) Be sure there are no long-line adapters or repeaters that split or isolate the battery and ground between the key system and the Central Office. Any such adapters or repeaters will interfere with M-487 operation. (Adapters on the CO-to-off-premises phones are acceptable provided

**Table 2 Information Required by the Telephone Company**

**Name of Device: Teltone M-487 Off-Premises Supervision Control and Line Card**

**FCC Registration Number: AHH9WA-69272-KX-N**

**Ringer Equivalence Number: 1.0B**

an off-hook metallic path of less than 1400 ohms is maintained.)

(2) Ensure that the key system into which the M-487 will be installed has a good connection to earth ground. This is particularly important in areas having a high probability of lightning and power line surges.

**4.03** Refer to Figure 3 when locating components called for in the following installation steps. Perform these steps in sequence:

(1) Remove the M-487 from its shipping container and look for evidence of damage. Do not install a unit that appears to be damaged.

(2) If the factory option switch and strapping settings are not the desired ones, select the desired options. Refer to Table 3 for switch settings and Figure 4 for strapping. Factory settings are:

- **HOLD SURVIVE ON CO OR PBX DRY CIRCUITS SHORTER THAN 470 ms.** WeCo ESS #1, ESS #2, 812 PBX, 770 PBX, Dimension PBX and CCS 201 use this setting normally. Other WeCo circuits use 20 ms. GTE circuits normally use 140 ms.
- **5.1 second RING STATE TIME-OUT AFTER FINAL RING BURST (OR GROUND REMOVAL FROM PIN 18 IF DIRECT RINGING SELECTED).** Special applications may require selection of longer time-out periods. Manually

initiated ringing (as by a PBX operator) may require selection of 19.5 or 30 second time-out.

- **DIRECT RINGING DISABLED** (ringing is not initiated by a ground on pin 18). Special applications may require **DIRECT RINGING**. (**DIRECT RINGING** is not compatible with **BALANCED MUSIC ON HOLD**).
- **DETECTOR SENSITIVITY HIGH** (loops 700 to 1400 ohms). Short loop applications (under 700 ohms) may require the low setting.

**INTERRUPTED RINGING SOURCE.**

**WINKING LAMP ON HOLD.**

**NO MUSIC ON HOLD** (Required WeCo setting).

(3) The M-487 may be used in a 1A or 10A type Key Service Unit (KSU). When a C.O. line is to appear at off-premises locations, one M-487 is required for each appearance of that C.O. line in a Key Service Unit (see Figure 2).

(4) Remove the KTU retaining bar (if used) and position the M-487 with the component side of the main card facing right (LED Line Indicator at the top).

(5) Align the M-487 in the desired set of card guides.

(6) Push the unit in and verify a firm mating with the KSU connector.

(7) Reinstall the retaining bar (if used).

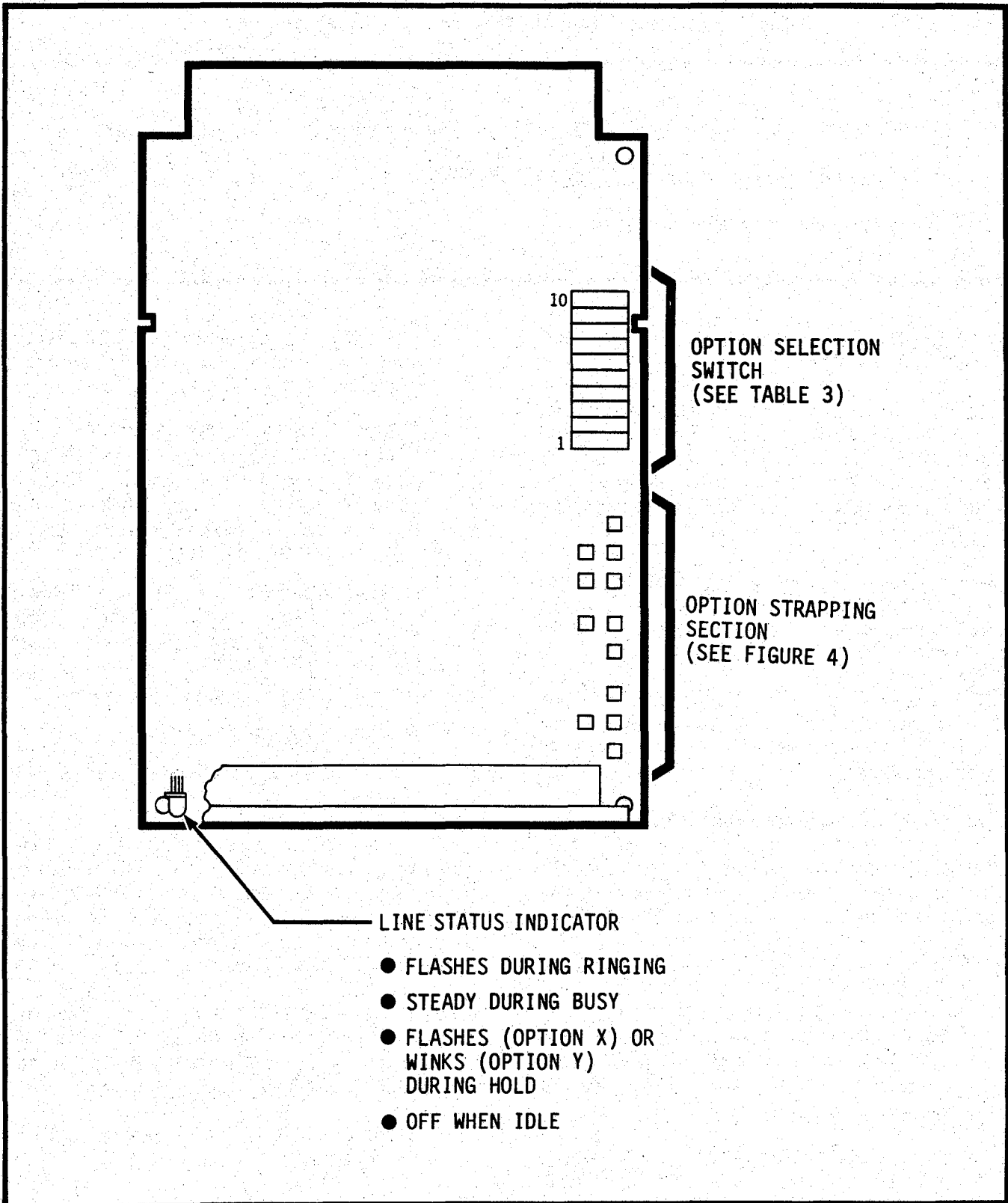


Figure 3 Component Locations

**Table 3 Option Selection Switch Settings**

|  |              | SWITCH SEGMENT |     |     |     |     |     |     |     |   |    |     |     |
|--|--------------|----------------|-----|-----|-----|-----|-----|-----|-----|---|----|-----|-----|
|  |              | 1              | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9 | 10 |     |     |
| Hold Survive on Dry Circuit Shorter Than                                       | 470 ms*      | OFF            | OFF |     |     |     |     |     |     |   |    |     |     |
|  | 140 ms       | ON             | OFF |     |     |     |     |     |     |   |    |     |     |
|  | 20 ms        | OFF            | ON  |     |     |     |     |     |     |   |    |     |     |
| Ring State Time-Out After Final Ring Burst                                     | 30 seconds   |                |     | OFF | OFF | OFF | OFF | OFF | OFF |   |    |     |     |
|  | 19.5 seconds |                |     | ON  | OFF | OFF | OFF | OFF | OFF |   |    |     |     |
|  | 12 seconds   |                |     | OFF | ON  | OFF | OFF | OFF | OFF |   |    |     |     |
|  | 9 seconds    |                |     | OFF | OFF | ON  | OFF | OFF | OFF |   |    |     |     |
|  | 6 seconds    |                |     | OFF | OFF | OFF | ON  | OFF | OFF |   |    |     |     |
|  | 5.1 seconds* |                |     | OFF | OFF | OFF | OFF | ON  | OFF |   |    |     |     |
|  | 3.4 seconds  |                |     | OFF | OFF | OFF | OFF | OFF | ON  |   |    |     |     |
| Direct Ringing   | ENABLE       |                |     |     |     |     |     |     |     |   |    | ON  |     |
|  | DISABLE*     |                |     |     |     |     |     |     |     |   |    | OFF |     |
| Detector Sensitivity Select  | HIGH*        |                |     |     |     |     |     |     |     |   |    |     | OFF |
|  | LOW**        |                |     |     |     |     |     |     |     |   |    |     | ON  |
| This information is also provided in the instructions on the top of the M-487. |              |                |     |     |     |     |     |     |     |   |    |     |     |
| *Factory set option.<br>**Loops less than 700 ohms.                            |              |                |     |     |     |     |     |     |     |   |    |     |     |

**INSTALLATION TEST**

**4.04** Insure that the local key system phone and the off-premises phone are in proper operating condition. Then, for each M-487 installed, perform the installation test procedure presented in Table 4.

**5. MAINTENANCE**

**5.01** Part 68 of the FCC Rules and Regulations stipulates that no customer may attempt to operate or repair malfunctioning Part 68 registered equipment. The latter stipulation applies equally to equipment in

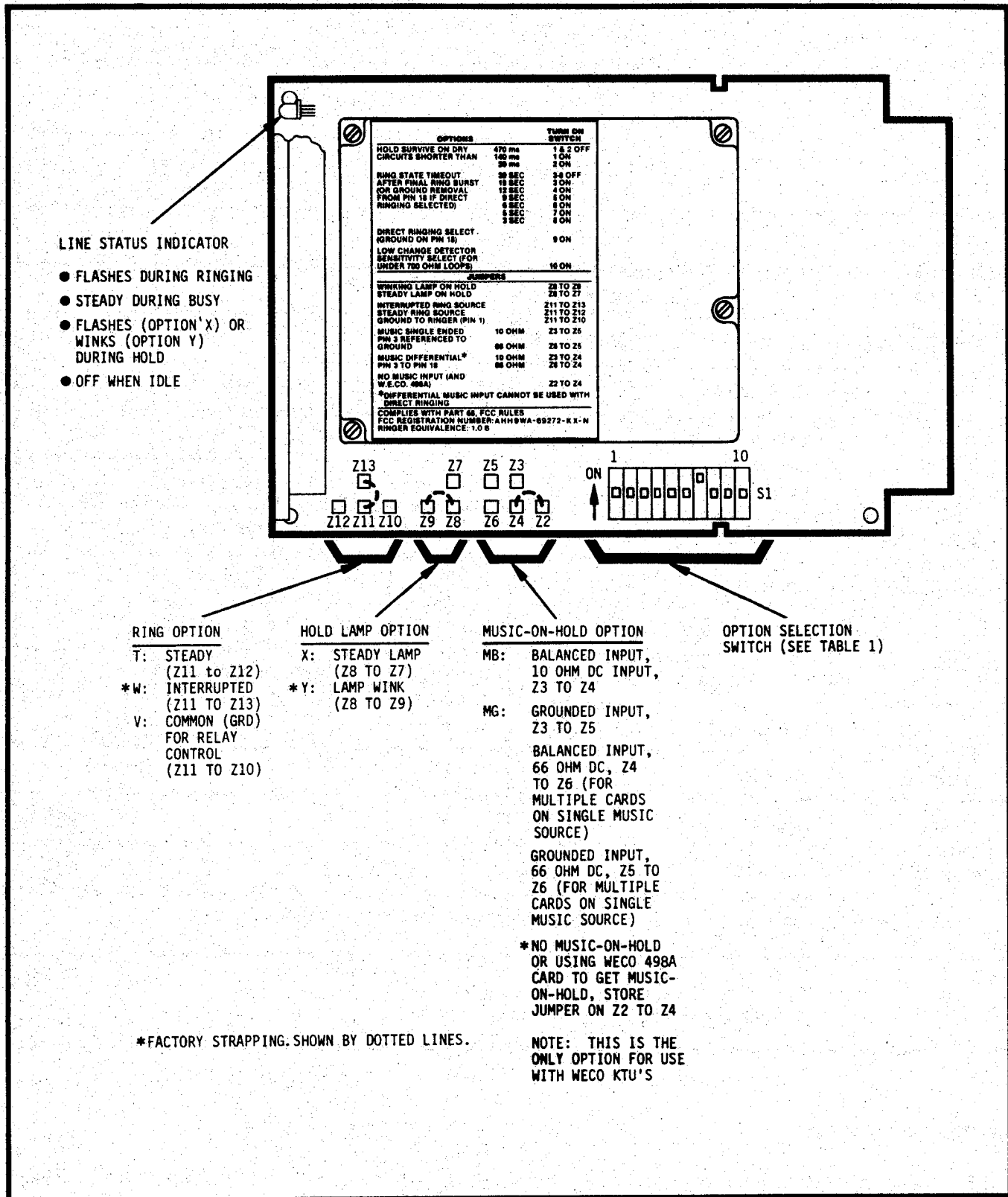


Figure 4 Option Strapping

Table 4 Installation Test

| STEP | ACTION   | ON-PREMISES<br>PHONE<br>(M-487 indicator<br>matches line<br>lamp)           | OFF-PREMISES<br>KEY PHONE<br>(KEY SYSTEM TO<br>KEY SYSTEM<br>ONLY)* |
|------|--|---|---|
| 1    | Go off-hook at the off-premises phone  | Line lamp lights  | Line lamp lights and dial tone is present                           |
| 2    | Go off-hook at the on-premises phone   | Line lamp remains steadily lighted  | Line lamp remains steadily lighted                                  |
| 3    | At the on-premises key phone put the connection on hold                                | Line lamp remains steadily lighted or begins winking (depends on strapping) | Line lamp remains steadily lighted                                  |
| 4    | At the off-premises phone, (after at least 2 seconds) go on-hook to cause hold release | Line lamp becomes steady and then goes dark                                 | Line lamp goes dark   |
| 5    | Have the line called from another line   | Line lamp flashes and phone rings   | Line lamp flashes and phone rings                                   |
| 6    | Have the calling party hang up and allow ringing to continue until time-out            | After the time-out interval, line lamp goes dark and ringing stops          | After the time-out interval, line lamp goes dark and ringing stops  |
| 7    | Have the line called from another line   | Line lamp flashes and phone rings   | Line lamp flashes phone rings                                       |
| 8    | At the on-premises key phone, go off-hook  | Line lamp lights steadily and ringing stops                                 | Line lamp lights steadily and ringing stops                         |
| 9    | At the on-premises key phone, put the connection on hold and go on-hook                | Line lamp remains steadily lighted or begins winking (depends on strapping) | Line lamp remains steadily lighted                                  |
| 10   | At the off-premises phone (after at least 2 seconds) go off-hook to cause hold release | Line lamp lights steadily   | Line lamp remains steadily lighted                                  |
| 11   | At the off-premises phone, go on-hook  | Line indicator goes dark  | Line indicator goes dark  |

\* With key system to key system installations, this test must be run for both M-487's. Consider the phone at the location of the M-487 being tested as the on-premises phone.

and out of warranty. Should such unauthorized repair be performed, both the registration of the equipment and the warranty are null and void.

**5.02** If malfunctioning is suspected, the M-487 must be disconnected. It should then be determined whether the cause of malfunction is attributable to the M-487.

**5.03** If the M-487 is faulty, it must not be reconnected to the telephone line until repairs are made. The failure must be reported directly to Teltone Corporation or an authorized agent of Teltone Corporation.

**5.04** If equipment failure occurs after the warranty period has lapsed, Teltone Corporation offers a flat rate repair service.

## 6. FUNCTIONAL DESCRIPTION

**6.01** The M-487 provides full line card functions and off-premises telephone supervision while maintaining uninterrupted Tip and Ring connections to the KTU. Power is fed from the KTU -24 V (A) supply. Local power failure does not interrupt outgoing calls. Refer to Figure 5 during the following description of M-487 operation.

### A. Ring State

**6.02** The ring state is entered when ringing voltage is detected for longer than 350 ms. The R relay closes to start the KTS interrupter (pin 6 to 5), turn on lamp flash to the M-487 Line Indicator and the KTS phone lamp (pin 7 to 8), and apply ringing voltage to the KTS phone (pin 10, 11, or 15 to pin 1).

**6.03** Ring state time-out is selectable; time-outs of 30, 19.5, 12, 9, 6, 5.1, or 3.4 seconds are available through settings on the Option Selection Switch. If ring voltage ceases before the call is answered, the timer is started. If ringing voltage has not returned when the time-out has elapsed, the M-487 returns to the idle state. The selectable time-out is to accommodate interrupted ringing. If the direct ring option is employed, the ring state can be enabled for as long as a

ground is applied to pin 18 (time-out selectable as usual).

**Note:** Since pin 18 is used for direct ringing input, balanced (pin 18 to pin 3) music input can not be used at the same time as direct ringing.

### B. Busy State

**6.04** The M-487 enters the busy state when either the OPX or KTS phone goes off-hook. An OPX off-hook condition is detected as a voltage level on Tip and Ring (both leads more negative than -3 V). The M-487 then pulls the A lead to ground through two diode drops. A KTS off-hook condition is detected when the A lead is grounded. Busy state entry causes release of the R relay and closure of the B relay. Steady lamp is applied to the KTS phone (pin 4 to 8) and the M-487 Line Indicator.

**6.05** If only the OPX phone is off-hook and then goes on-hook, the Tip and Ring voltage level detector discharges and the M-487 returns to the idle state. If both phones are off-hook and the KTS phone goes on-hook, both an A lead removal and a loop voltage change are detected. The M-487 now remains in the busy state until Tip or Ring voltage becomes more positive than -3 V (signifying both phones are on-hook). The idle state is then entered.

**Note:** Once steady lamp is received at the KTS phone, a slight pause is necessary before the hold button should be pressed (the off-hook recognition time). The A lead ground forces the busy state, **but both A lead and off-hook voltage detection are necessary to go to the hold state.**

### C. Hold State

**6.06** The hold state is entered when the A lead is removed while Tip and Ring are still more negative than -3 V and no loop voltage change is detected. Three actions now take place: the B relay is released, the H relay is closed, and a 1.6 second timer is started. The H relay switches a hold shunt

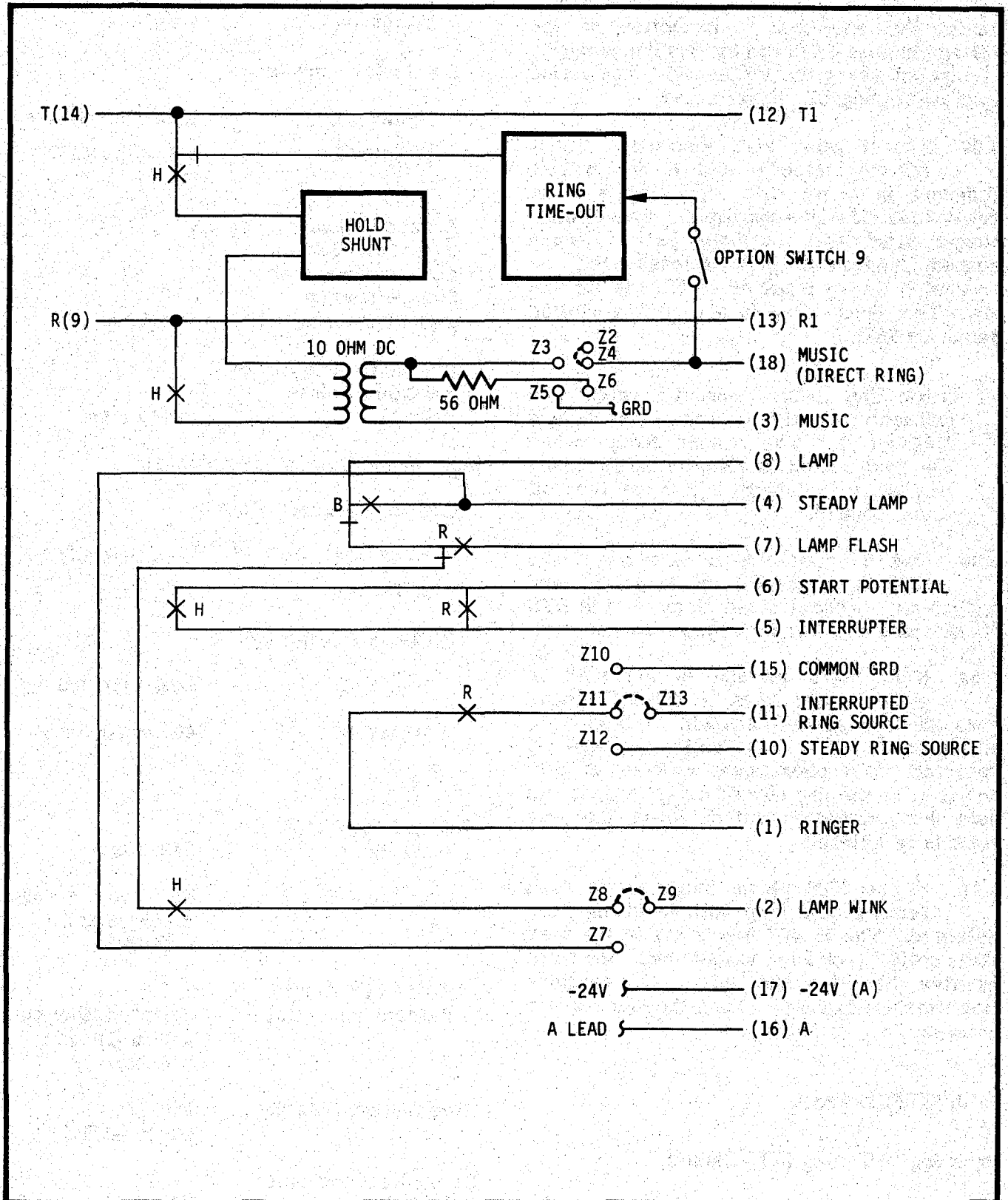


Figure 5 Simplified Block Diagram

## SECTION 487-100

across Tip and Ring. Detection of the voltage change produced by this line shunting is negated during the 1.6 second timer period to prevent undesired hold release.

**6.07** The H relay also connects a shunt current detector and a dry circuit time-out in series with Tip, Ring and the active load. If a line re-switching (dry circuit) occurs after the telephone path is established, undesired hold release can be prevented during a period of 20, 140, or 470 ms. This delay time is set on the Option Selection Switch.

**Note:** The total time to press and release the hold button must not exceed 1.6 seconds. The voltage change when the hold button is released after being held down that long will cause the call to be dropped.

**6.08** The H relay closure also starts the KTS interrupter (pin 6 to 5) and applies lamp wink or steady lamp to the KTS phone and the M-487 Line Indicator.

**6.09** Hold state release is achieved in either of two ways. If the KTS phone goes off-hook (grounds A lead), the busy state is regained. If a loop voltage change is detected (OPX phone goes on-hook or off-hook), or if the dry circuit delay expires and hold shunt current is not detected, the busy state is re-entered.

**6.10** If the KTS phone hangs up, A lead removal and loop voltage change are detected. The M-487 now stays in the busy state until Tip or Ring voltage becomes more positive than -3 V and the on-hook recognition time has expired. Then the idle state is entered.

## 7. SPECIFICATIONS

### Input Signal Timing (KTS Phone)

#### Off-Hook Recognition

M-486-01                      Less than 500 ms

M-486-02                      1 to 2 sec

#### On-Hook Recognition

M-487-01                      Less than 500 ms

M-487-02                      400 ms to 1500 ms

A Lead Ground  
(less than 500 ohms  
and one diode drop  
from A lead to  
ground) Recognition      50±10 ms

A Lead Ground Removal  
Recognition (see  
Note 1)                      50±10 ms

### Input Signal Timing (OPX Phone)

#### Off-Hook Recognition

M-487-01                      Less than 500 ms

M-487-02                      1 to 2 sec

#### On-Hook Recognition

M-487-01                      Less than 500 ms

M-487-02                      400 to 1500 ms

### Timing

Ring Detect (120 Vrms  
at 20 Hz)                      350±150 ms

Ring Time-Out                      Selected time-out  
± 16% (3 to 30  
seconds)

Hold Dry Circuit  
Release Time-Out                      Selected time-out  
± 11% (20 ms to  
470 ms)

Ring Voltage Blocking                      150 Vrms  
(15 to 70 Hz)

### Power Requirements

Central Office  
Voltage                      -44 to -56 VDC

|  |  |
|--|--|
| Key System Supply<br>(A Battery)                                   | -18 to -28 VDC   |
| Supply Current   |  |
| Idle   | 30 mA maximum,<br>22 nominal                                 |
| Busy   | 80 mA maximum,<br>63 nominal                                 |
| Hold or Ring   | 80 mA maximum,<br>62 nominal                                 |
| Ground Potential<br>Variation                                      | (see Note 2)   |
| Allowable Noise Level<br>(longitudinally induced<br>60 Hz voltage) | 56 V p-p common<br>mode Tip and Ring<br>unterminated to grd. |
| Forward Loop Current<br>Recognition                                | 22 mA minimum  |
| Reverse Loop Current<br>Recognition                                | 22 mA minimum  |
| DC Input Impedance   | 60 M ohm Tip or<br>Ring to grd.,<br>minimum                  |
| Allowable Loop<br>Resistance                                       | 1400 ohms maximum<br>(1300 ohms with<br>mini bridge lifters) |
| Lamp Load  | 20 lamps   |
| Ringer Load  | 5 ringers  |
| Environmental  |  |
| Temperature  | 0° to 55° C  |
| Relative Humidity  | 0 to 85%<br>noncondensing                                    |
| Dimensional  | See Figure 1   |

**Notes**

- 1 When the A lead is not grounded by either the M-487 or the external equipment, it is pulled to -15 VDC by the M-487.
- 2 Central Office ground must be within -2/+1 volt of M-487 ground for correct operation under longest loop conditions.