Z E T R O N

Model 49 Trunking Repeater Manager
Operation and Installation Manual

#025-9108R

Technician's Note:

Zetron makes improvements to its products on a regular basis. Each circuit card in the product is marked with a hardware revision letter and if it has software, a version number. When you call Zetron engineers for installation or service assistance, they may ask you for the revision and version of your equipment.

The main circuit card is marked 702-9202x (x is the hardware revision letter, such as F). Earlier version boards are labeled in the front, right-hand corner. Later version boards are labeled in the front, between the DIP switches and POLL LED, behind the standoffs. The main operating software is stored in chip U31, marked with a version number v.v, such as 3.2. The tone generator software is stored in chip U7 with a version number such as 1.2.

The protocol card is 702-9218x with a hardware revision such as B, and its LTR encode/decode software is in ASIC chip U2 with a version number such as 3.0. Other option cards such as telephone interfaces, audio compandor, etc. are similarly marked.

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WARRANTY STATEMENT

Zetron's warranty is published in the current Zetron Price List for Land Mobile Products.

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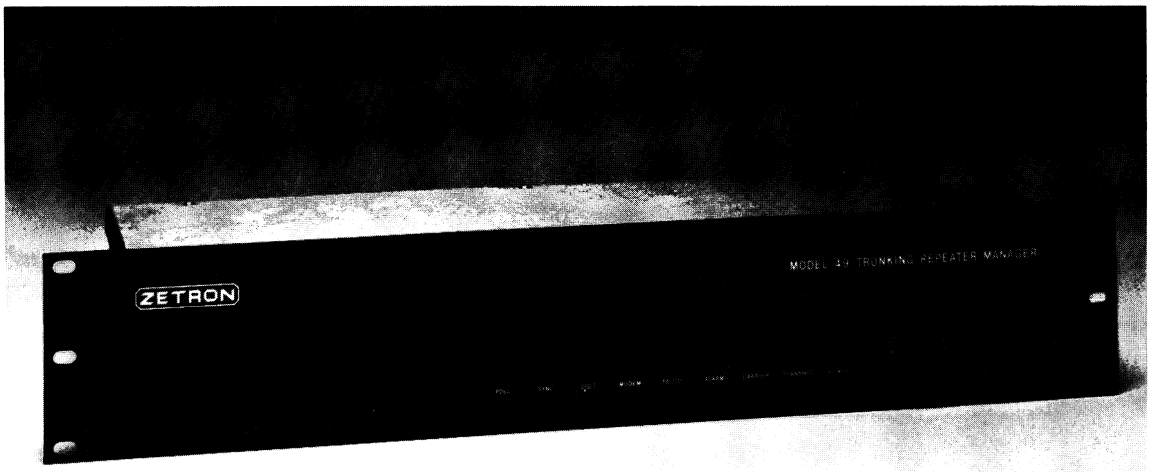
TRADEMARKS

INSTALLATION WARNING

This equipment generates, uses, and can radiate radio frequency energy; and if not installed and used in accordance with the instruction manual, may cause interference to radio communications.

Installation of this equipment should be accomplished by personnel with experience in radio trunking systems. Specialized knowledge in telephone systems is also important to ensure a smooth interface when connecting with the Telco network.

1. SYSTEM OVERVIEW



NEW GENERATION

The Zetron Model 49 Trunking Repeater Manager is an LTR radio channel controller. The design of this unit advances the state of LTR equipment and eliminates many of the quirks of traditional control.

Interconnect capabilities were designed in from the start, not added on. Great importance was placed upon compatibility with every brand of mobile and portable radio, and with the existing trunking system infrastructure pioneered by E.F. Johnson and Uniden. You do not have to replace all of your fixed equipment to use Zetron; simply add on as your system expands and as your interconnect requirements grow.

Here are a few of the major benefits of Zetron control:

* Simple programming and billing access of multiple sites from a central computer
* Easier to get an interconnect when one is free
* High priority users get preferential interconnect access
* Reduced system congestion with load sensitive call limiting
* Better audio quality of telephone calls
* Individual mobile calling privileges
* DID option is built-in, fast, and low cost
* Air time billing is cost effective even on 3-channel systems
* No extra phone lines are needed for billing access

* Expandability into networking

* Programming access to the system, even while trunking

* Improved reliability with modularity and fewer parts

* E&M 4-wire Type I capability

* Encode and decode capability

* Networking capability

CAPACITIES

Zetron complies with the standard E.F. Johnson LTR trunking protocol that supports:
- 1 to 20 RF channels per system
- 250 user ID's per channel (5000 per system)

Air time accumulation for Model 49 home-channel users:
- 500 accumulators (prime and non-prime time per User ID)
  - to count 0 to 16,777,216 (194 days)
- 500 hit counters (prime and non-prime time per User ID)
  - to count 0 to 65,536

Hourly repeater loading statistical data:
- Previous 24-hour period
- Today's data from midnight to current time

Call detail (SMDR) buffer:
- 6000 call records in <u>each</u> Model 49 (Revision H and above)
  - more 49s means more storage
- Short calls occupy no space (if minimum call time to store is set > 0)

MULTIPLE CAPABILITIES

The Model 49 installs in a radio repeater rack and fully manages the operation of one channel of a trunked radio system. A Zetron can turn any DPL capable repeater into a fully functional LTR channel. One Model 49 controls one repeater channel.

A Zetron Model 49 controller performs the functions of many equipment units: Logic Unit, Validator, Interconnect, Air time Accumulator, Call Detail Buffer, Access Modem, and Site Monitor.

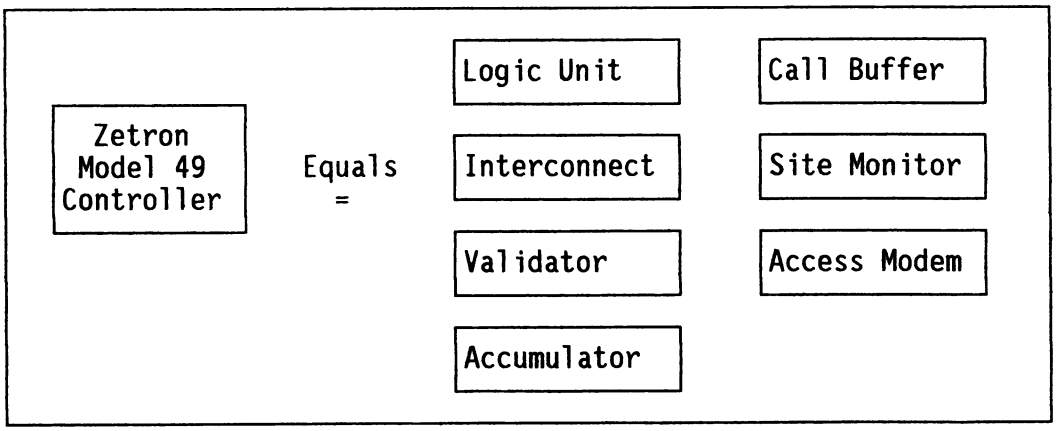


Figure 1.1 - Model 49 Capabilities

Logic Unit
As a logic unit, the Model 49 decodes and encodes the trunking data from and to mobiles or portables, routes RX to TX repeat audio, limits mobile conversation lengths, and allocates radio channel access on a multi-channel trunking system.

In a multi-channel LTR trunked radio system, Model 49's can be mixed with traditional E.F. Johnson Logic units. The Model 49 is compatible with the trunking repeater buses from E.F. Johnson and Uniden.

Validator
The built-in validator permits or prevents access from mobile users with designated dispatch and interconnect ID's. User ID's can be validated or invalidated without site visits, using a PC compatible office computer. The Model 49 can even serve as an EFJ or Uniden compatible validator for Johnson Logic or Uniden Logic on the same repeater bus.

A Zetron proprietary feature provides automatic validation based upon the time of the day. Two time-of-day periods can be specified as prime time. Individual user ID's can be marked as Deferred and have access to the system only during non-prime time. This allows you to provide after hours service which increases system loading without sacrificing system availability during peak periods. Note: The Model 49 considers Saturday and Sunday as non-prime time.

Interconnect
An interconnect option, built into the Model 49, provides telephone line or microwave radio connection to the radio channel for conversations between land line parties and mobile subscribers. A choice of telephone interface (end-to-end, DID, or E&M) adapts the Model 49 to your preferred interconnect arrangement.

Zetron's special interconnect features give you a high capability mobile telephone system at an economical price. If a land side caller, through a Model 49, tries to reach a mobile that is already making an interconnect call on any channel, the Model 49 gives the land side caller a busy signal.

With DID access, your mobile clients can have private direct dial 7-digit telephone numbers. Mobile users can be reached by callers from any location, from any telephone (rotary or tone). Telephone numbers are easy to assign to any mobile user ID, in any order you choose. When you retrofit one of your dispatch channels with a DID equipped Model 49, you don't even have to reprogram your mobiles!

High quality telephone hybrid circuitry allows your full duplex mobiles to operate effectively. When E&M microwave circuits are available, you can eliminate hybrids at the site and further improve audio fidelity.

Dynamic interconnect call limits control the length of each telephone call based upon actual measured system load. Dispatch throughput no longer has to suffer at the expense of interconnect calls. You select call length and number of active interconnect calls for five loading levels for two classes of customers: high and low priority. For software versions 6.1 and above, there are four classes of customers available: low, medium, high, and very high.

Intelligent free channel allocation improves system access at sites with a mixture of dispatch-only and interconnect channels. When a dispatch Model 49 becomes busy, it designates another dispatch channel as the next free one, not just any adjacent channel. This keeps interconnect channels free until all of your dispatch channels are full. Mobiles have a better chance of making a call on the first attempt, saving them frustration, and saving you air time.

Two mobile answer time limits also save air time. You can program long horn honk times, and short times for normal mobile customers.

An interconnect Compandor audio processing board is available which improves the audio quality of interconnect calls. Noise introduced by the mobile to land line RF path is reduced to the point that mobile radio calls sound as good as regular land-to-land telephone calls. If your full duplex mobile is equipped with an audio compandor, you will be able to improve the quality of the land-to-mobile audio as well.

Air Time Accumulator

Totals of air time used on a per user ID basis are accumulated within each Model 49 for its home channel users. This standard feature tracks usage in seconds per ID for two time-of-day periods; prime time and non-prime time. It even keeps track of all attempts at system access by invalid user IDs for that home channel.

With a prime time premium billing rate in your invoicing system, you can encourage off hours business and smooth out peak usage. The air time accumulator is equipped with a huge memory that keeps track of 194 days of air time used per ID.

Regardless of which channel is used by a particular mobile user ID, its home channel Model 49 accumulates its air time usage total. You retrieve the air time totals from the site with your PC office computer via telephone modem.

The air time for dispatch ID's is kept accurate to the nearest second since LTR dispatches are short fragments of conversations. Interconnect calls, however are message trunked, using the channel for the duration of the conversation. If desired, the air time of each interconnect call will be rounded up to the next minute whenever a mobile uses .1 (6 seconds) of the next minute (same method used by telephone companies).

Call Detail Buffer
The SMDR (station message detail record) buffer is used in conjunction with the interconnect option to record each telephone call placed through the Model 49. The buffer can hold 6000 call records. Each record contains the mobile ID, date and time of call, number dialed, and call length.

You retrieve the call detail records from the site with your PC office computer via telephone modem. The records are transmitted in a compact binary format to save telephone transmission time, and converted to universal ASCII codes within the PC computer. Since the Model 49 keeps accurate call length totals, you can bill to the nearest second of actual usage. If you allow "free calls under so many minutes", you can tell the Model 49 not to store these calls and save SMDR buffer space.

Access Modem
A built-in 1200 bps modem is part of the interconnect option. With interconnect, you do not need a separate telephone line for modem access; any Zetron channel doubles as modem and interconnect.

If you want to keep all of your telephone lines available for interconnect, or if you are operating only dispatch (no interconnect), or if 1200 bps is not fast enough, you can attach an external modem with its own end-to-end telephone line to the Model 49 front panel RS-232 port. Configuration switches on the Model 49 select the preferred modem data rate of 300, 1200, or 2400 bps.

SYSTEM MANAGEMENT BY COMPUTER

Programming of the Model 49's mobile user database is performed with a PC compatible office computer running Zetron's Multibase software system. This software keeps track of Model 49's on multiple channels at multiple sites. The settings are programmed "off-line" on computer disk and loaded into the Model 49's with a telephone call via the computer's modem.

In like manner, billing data and repeater loading information are retrieved from the channel controllers for processing in the office computer. Since the modem links are used only during actual data transfers, not during clerical "thinking" time, telephone charges are kept to a minimum.

Repeater loading histograms and a real-time site monitor display are also standard features of the Model 49. You can even use Zetron's ZEBRA billing software to process the usage data from your Model 49s to print customer invoices. ZEBRA is a full accounts receivable program and integrates with ACCPAC Plus accounting modules from Computer Associates.

Special Note: Only one telephone call to the site is required to retrieve data from all of your Zetron Model 49s. Zetron's proprietary subscriber bus allows one Model 49 to access all the others at the radio site.

MODEL 49 SPECIFICATIONS

Physical

Height	3.5 in.
Width	19 in.
Depth	6.95 in.
Weight	4.5 lb (US)
Mounts	Two styles of mounting are pre-stamped into the front panel: 1. The front panel is configured for standard 19-inch rack mounting, with holes vertically separated by 3 inches (two "rack spaces"). 2. The front panel has two holes for the locking screws and side-mounting captive nuts to fit slide mounts of E.F. Johnson Repeater cabinets.

Power Supply

DC Input	+10 to +16 Vdc
DC Power	10.7 Wdc @ 16 Vdc input if all options installed

Environmental

Temperature Range	+32 to +140 degrees Fahrenheit (0 to +70 degrees Celsius)
Humidity	5% to 90% relative humidity, non-condensing

Telephone Interface

Line Type	Three options available: 1. End-To-End: Loop Start or Ground Start 2. Type I E&M 4-Wire: Two-way DID/DOD interface Wink Start or Immediate Start 2 to 4 feed digits DTMF, MF, or Dial Pulse Feed Digit Decoding 3. DID: Direct Inward (ONLY) Dial Wink Start or Immediate Start 2 to 4 feed digits DTMF, MF, or Dial Pulse Feed Digit Decoding
Connector	RJ11

Radio Interface

Connector	15-pin Weidmueller card-edge connector
Connections	AC/DC Power Input, PTT Output (Relay NO/COM/NC or Transistor open collector), Control Line Output, Sense Input, COR (Carrier Operated Relay) Output, Tx Audio, SubOut (Tx Data), Disc In (Rx Audio).
Rx Audio Input	100 mVpp - 10 Vpp in two selectable ranges
Rx Audio Impedance	Zin = 50 kΩ minimum
Tx Audio Output	0 to 8 Vpp in two selectable ranges
Tx Audio Impedance	Zout = 1.2 kΩ maximum
SubOut Level	0 to 1.2 Vpp, continuously variable
SubOut Impedance	Zout = 1 kΩ AC or DC coupled, jumper selectable
PTT Outputs	Selectable outputs: Relay Type: Normally Open (NO) Closes for PTT Common (COM) Strapped in Cable Normally Closed (NC) Opens for PTT Transistor Type : Open Collector Output

Control-Sense Interface

Connector	12-pin Weidmueller card-edge connector
Connections	Control Lines 2, 3, and 4. Sense Lines 2, 3, and 4. GND
Control Lines	Software-controlled selectable relay outputs: Normally Open (NO) Closes for output Common (COM) Strapped in cable Normally Closed (NC) Opens for output
Sense Lines	Software controlled (A to D) inputs, 0 to 6 Vdc. Used by alarm software; detection windows selectable.
GND	Reference ground connections for each sense line.

2. SYSTEM OPERATION

DISPATCH OPERATION (Mobile to Mobile Calling)

The basic dispatch version of the Model 49 is more than just a traditional trunking logic unit. It performs the following major functions:

a. Controls 2 to 20 channel repeater trunking, or 1 channel stand-alone sites
b. Accumulates air time for two time-of-day periods (prime and non-prime time) for its home users
c. Validates mobile access to prohibit invalid mobile users
d. Monitors mobile activity in real time on each repeater
e. Stores repeater loading data for current and previous day's system usage and stores All Repeaters Busy data

When a mobile user wants to call a group of users, he/she presses the microphone push-to-talk button on his/her mobile radio. The radio tunes to a free channel and transponds data packets with the repeater logic unit that then becomes busy with the calling mobile.

Using the repeater data bus, the repeater tells all other repeaters which user group (home channel + ID) is being called. If the calling mobile is not on its home channel, then the members of the called group are still tuned to their home channel repeater. To get the group together on the calling repeater, the home repeater sends "Go To" data packets to cause the called radios to tune to the calling repeater frequency.

As long as the calling mobile remains keyed, the logic unit sends data packets to keep the group together, and the calling mobile can talk to the group. As soon as the calling mobile releases his/her microphone button, the logic unit sends the group "home" with a "turn-off" code and releases the repeater for another one-way "conversation".

This so-called "transmission trunking" is very efficient in the use of air time. Less than 300 milliseconds is required to get a dispatch message going, and less than 200 milliseconds to release the channel each time.

DISPATCH AIR TIME

Each Model 49 is equipped to total the air time used and number of accesses for two time-of-day periods by each of the 250 ID's on that repeater home channel. By monitoring the repeater bus, the Model 49 records usage by its home channel users, even when the users are trunked to other channels.

This capability makes it easy for you to add air time billing to your system by replacing one of your existing logic units with a Zetron one, and keeping your users "homed" to the Model 49. You can then move your old logic to new channels that have no home users, but can be used for trunking.

Air time accumulation is kept to the nearest second, so customers are accurately billed for their short dispatch conversations. When you import the air time values into your billing system, you can convert these totals into minutes if necessary. Multibase retrieves the air time totals into your office computer for import into your billing system.

LAND LINE TO MOBILE CALLING

A land line party calls an LTR mobile party by dialing the telephone number of an interconnected LTR channel. With end-to-end telco interface equipped Model 49's, this 7-digit number accesses the Zetron controller by "ringing the line." The Model 49 "answers" and mimics the beep tones of an EFJ or Uniden system or plays voice prompts to the phone caller. The caller then uses his/her Touch-Tone telephone to key in the mobile User ID as a five-digit number (HHIII, where HH is the mobile's two-digit home channel and III is the mobile's three-digit ID). Instead of the five-digit ID code, a Model 49 site can be programmed to accept a four-digit access code.

With a DID telco interface, each interconnected mobile user can have their own 7-digit telephone number. This eliminates the need for phone callers to "over dial" the 5-digit number, and callers can use old-style rotary telephones to reach mobile users.

When a Model 49 is equipped with an E&M interface, access to the site is direct via RF or microwave links. The 4-wire audio system into the Model 49 eliminates any hybrid circuitry at the site. The E&M signals supervise interconnect calls and can carry "DID or overdial" type calls. Interface equipment at the base end of the system (such as a PBX or Tellabs/Wescom module) determine whether the E&M link will act like a DID or overdial type of circuit. Programming settings in the Model 49 tailor its software to handle the circuit.

If the LTR channel is busy with a dispatch call when the phone "rings", the Model 49 waits for the mobile user to release PTT and end their short transmission. At that time, the mobile user will trunk to a free channel so the telephone party's call can be processed.

The Model 49 checks the database to make sure that the User ID is an interconnect ID and has been validated for service. If so, subaudible LTR data packets are generated to the designated mobile along with audible ringing tones. The mobile has one of two "Answer Times" as programmed in the Site Config Interconnect database to press PTT and answer the call. Some users can be programmed for long times so they can answer their "horn honk".

If the ID is not interconnect or is not valid, and the incoming call is not a DID call, the caller will hear a "retry" tone. At this time the caller will be given another opportunity to enter a valid ID. After the second try, if the ID entered is still invalid, the phone party will hear "error" tones and the call will be disconnected. If the incoming call is DID no retries are allowed.

Once the call is answered by the mobile party, telephone audio is opened to the mobile and the call timer and billing timer begin. The mobile and phone parties can then converse (see subsections on Conversing below).

MOBILE TO LAND LINE CALLING

The mobile party selects an interconnect ID on the mobile radio system & group switches. Then the user presses the PTT or SEND key to access an interconnected LTR channel. If there is no free channel at all, the radio will not transmit and will immediately return a busy indication to the mobile user. If there is no free interconnected channel, the mobile may end up on a dispatch channel and will get "turn off" packets from the controller. If a mobile ends up on an interconnected channel that does not allow outgoing calls the Model 49 will play busy before sending "turn-off" packets.

If the mobile accesses a channel equipped with an interconnected Model 49, the mobile's ID is validated for outgoing interconnect service from the User ID database settings. The Model 49 waits for the mobile to un-key, then accesses the telco line, waits for dial tone from the telephone system, and cuts the audio through to the mobile.

The mobile then has to enter the phone number to dial, using the DTMF keypad on the mobile radio. As programmed in the Site Config Interconnect database, the mobile user has specific time limits within which he/she must enter the first and subsequent digits of the telephone number into the Model 49. Phone number dialing is regenerated by the Model 49's built-in DTMF generator, providing accurate dialing in the presence of weak radio reception. A minimum and maximum number of dialed digits (programmed in the Site Config Interconnect database) speeds phone call placement. If the mobile user unkeys after entering the minimum regenerated digits, the Model 49 will assume dialing is completed, and any subsequent digits will not be regenerated; they will pass through directly. These digits will however be stored in the Call Detail Record, up to the maximum regenerated digits, or until the interdigit timeout occurs.

Note: The Model 49 is compatible with the special automatic dialing sequences of E.F. Johnson's 8865 and Uniden's SMS-300 full duplex mobile radios.

INTERCONNECT AIR TIME

Each Model 49 is equipped to total the air time used and number of accesses for two time-of-day periods by each interconnect ID on that repeater home channel. By monitoring the repeater bus, the Model 49 records usage by its home channel users, even when the users are trunked to other channels.

This capability makes it easy for you to add air time billing to your system by replacing one of your existing interconnect and logic units with a Zetron one, and keeping your users "homed" to the Model 49. You can then move your old equipment to new channels that have no home users, but can be used for trunking.

Air time is accumulated for each interconnect call to the nearest second. You can specify that the Model 49 round calls up to the next minute before adding them into the air time totals (see Site Config Interconnect database). In addition, you can ignore short calls and not add them into the air time totals, such as for giving people "free" 3-minute calls (see Site Config Interconnect database).

Multibase retrieves the air time totals from your Model 49's and puts the data onto your office computer hard disk in ASCII file format. You can use these files with Zetron's billing system or your own.

CALL DETAIL (SMDR)

For each telephone call (land line to mobile and mobile to land line) that is processed by the Model 49, a call detail record is generated and stored in its internal SMDR memory. These records keep track of length of call, number dialed (mobile to land line), time of day, date, user ID, and status of call. The memory is automatically protected from power failures for more than 5 years of continuous power-off.

Calls that are determined to be "incomplete" can be omitted from the call detail memory to save space and retrieval time. In the Site Config Interconnect database, you specify that local calls shorter than a specific time be discarded. With this feature, you can 1) sell "free" 3-minute local calls, 2) eliminate calls that are not answered by the mobile, or 3) not charge for calls that don't go through in so many rings. Toll calls shorter than the minimum of the programmable "minimum call time to store" and 30-seconds are not stored. This gives you more room in your call detail buffer and reduces the telephone time to retrieve billing records from the site.

The time accumulation for land line to mobile calls begins when the mobile radio users keys up to answer the ringing tones from the Model 49. On mobile to land line calls, there is not so positive an indication of "called party answer". The Model 49 begins the call timer on these calls when dialing is complete.

Your office staff uses the Multibase system to retrieve call detail records from the Model 49's by telephone modem. Individual named and dated computer files are generated in ASCII data format each time you perform a retrieval. At the end of a billing period, these files are collated and sorted by your billing system to produce invoices for each customer account. If you use Zetron's ZEBRA Billing Software, this operation becomes quite straightforward.

SMDR call records are stored in compact binary images inside the Model 49 to save space and reduce transmission time. Each record requires only 16 bytes of storage in the Model 49. Transfer of this data to the office computer by 1200 bps modem occurs at approximately 400 records per minute. On large systems, you can further reduce communications time by using a high speed modem connected to the front panel RS-232 port on the Model 49.

HALF-DUPLEX CONVERSING

The mobile party presses the PTT microphone button whenever he/she wishes to speak to the land line party, and releases the button to listen. If the "Turn-Around" beep is programmed "Y" in the User ID database, then the phone party will hear a "go-ahead" beep each time the mobile releases the PTT button.

There is a "Turn-Around" time programmed in the Site Config Interconnect database. This timer (typically 30 seconds by F.C.C. rules) requires that the mobile periodically presses PTT to keep the interconnect conversation active, otherwise a short warning beep is issued to the mobile. If the mobile presses PTT within 5 seconds of the warning, the conversation stays alive, otherwise the Model 49 terminates the call.

An interconnect call can be terminated by either the land line or mobile party by pressing the "#" key on their DTMF keypad. The person on the phone side must hold the # key for a long 1/2 second before the Model 49 will terminate the call. A short 80 millisecond # key from the mobile radio party will terminate the call almost instantly. (In software version 6.1 and above, calls from the mobile radio terminate on a # key press of programmable length [60 to 500 milliseconds].)

If the land line party just hangs up the telephone, the Model 49 can detect this and terminate the call automatically if the telco circuit is equipped for:

1) a "ground start" end-end line or
2) a loop start end-end line with reverse battery supervision or
3) DID or E&M trunk idle supervision or
4) dial tone detection (only detected when mobile carrier and/or packets are not present)

Note: for further details on telco services, call Zetron Applications Engineering

If the call is ended without a "#" key or telco disconnect detection, the Model 49 will terminate the call when the mobile turn-around timer expires (set in Site Config Interconnect database). Billing timing stops when the call is actually terminated. Obviously, to avoid being billed for wasted air time, your clients are encouraged to use their "#" key to end calls. Some microphones can automatically generate "#" when placed back in their hanger to make call termination quick and easy.

The Model 49 runs a timer during the conversation and checks its value against the Call Limit as determined by the Dynamic Call Limit Table (see subsection below). For 30 seconds prior to call limit termination, the Model 49 plays a "tick" once per second to the mobile party as a countdown warning. Obviously, if the mobile party is transmitting during this warning period, he/she will not hear the ticks.

In addition, a warning tone time can be set in the Site Config Interconnect database. When the programmed time has elapsed a "warning" tone will be played every 10 seconds. This tone can be used to let callers know that they have exceeded some billing threshold, and are now being billed at a premium.

FULL-DUPLEX CONVERSING

The audio path is open continuously between the phone and mobile parties for the entire conversation. Either party can speak to the other whenever they wish, interrupting freely. There are no turn-around beeps or turn-around time requirements to concern the mobile party. In most ways, LTR full-duplex interconnect rivals mobile telephone systems with simplicity of use.

In full-duplex mode the call can be terminated by the mobile party at any time by pressing the # key on the DTMF keypad. The landline party can only disconnect with a # if the mobile carrier and/or data packets are not present. The person on the phone side must hold the # key for a long 1/2 second before the Model 49 will terminate the call. A short 80 millisecond # key from the mobile radio party will terminate the call almost instantly. (In software version 6.1 and above, calls from the mobile radio terminate on a # key press of programmable length [60 to 500 milliseconds].)

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Most full-duplex LTR mobile units automatically send a "#" key when the handset is returned to its hanger, thereby terminating the call. If the handset is misplaced and the mobile radio continues transmission, the call can still be terminated by telco circuit conditions (see above). However, the "stuck transmit" condition of the mobile will cause a succession of interconnect attempts and prevent other mobiles from accessing the system. In this case, you must rely on the mobile's built-in transmit time-out timer (TOT) to shut it off. If the mobile signal fades completely, the call is terminated when the turn-around timer expires (programmed in Multibase Site Config Interconnect database).

The Model 49 runs a timer during the conversation and checks its value against the Call Limit as determined by the Dynamic Call Limit Table (see section below). For 30 seconds prior to call limit termination, the Model 49 plays a "tick" once per second to the mobile party as a countdown warning.

Note: You can use Multibase's Traffic Monitor feature to call your Model 49 at the site and determine exactly which mobile User ID is holding any channel busy. The Model 49 monitors traffic from <u>all</u> channels at the site, whether they have Johnson, Uniden, or Zetron logic controllers.

DIALED NUMBER RESTRICTION

As the phone number to be dialed is being regenerated by the Model 49, the number is checked for authorization in the User ID database. Specific User ID's can be given privileges for no outgoing, autodial numbers only, local, credit card, operator, long distance or international dialing. Specific 4-digit calling prefixes can be designated as allowed or restricted in the Site Config Interconnect Prefixes database screen. A '?' can be used to designate a digit as a wild card.

Restricted prefixes are useful for screening out telephone numbers that you wish to prohibit, since they might cost money or are sources of phone abuse. If the prefix is restricted from use by the User ID, the call is terminated before the phone number is completely regenerated, thereby preventing any billing.

Allowed prefixes are useful if you want to limit certain users to dialing a few selected prefixes.

To further prevent "smart" users from cheating the system, the Model 49 can be programmed (Site Config Interconnect 2nd Dialtone/DTMF Thru database setting) to prevent dialing extra DTMF digits after a specific time period once the call is placed. The 2nd Dialtone/DTMF Thru and Overdialing Time Limit values in the Site Config Interconnect database screen let you set appropriate call screening conditions.

SECOND OVERDIAL

If a caller from the landside overdials an invalid ID, the Model 49 will give the caller a second chance to overdial the correct ID without disconnecting the call.

AUTODIALING

Up to 100 numbers can be programmed into a Model 49 system as Autodial numbers. The mobile party can use these preprogrammed numbers by entering *nn, instead of a phone number after accessing the system and hearing dial tone. The "*" tells the Model 49 that the digits to follow are for an autodial number and the "nn" is the two-digit number that indicates which entry in the autodial table to use. After *nn is received the Model 49 out-dials the phone number and the call continues as a normal mobile to landline call.

Note: Depending on how an autodial number is programmed, a call can have toll restriction (toll restriction includes prefix restrict and toll privileges) applied to the autodial phone number.

AUTO OVERDIAL USERS

Any user programmed as Interconnect can also be programmed as Auto Overdial. These users are treated in a special way when they access an autodial table entry, or are homed on a channel with a direct link to another LTR site.

When an Auto Overdial User enters *nn to select an autodial table entry, the number selected will be dialed by the Model 49. If the number being called is marked in the autodial table to be another LTR site the Model 49 will automatically overdial the ID or access code associated with the user initiating the call.

If an Auto Overdial User is homed on a channel with a direct link to another LTR site, when the mobile keys up the Model 49 will take the phone offhook and overdial the ID or access code of the initiating mobile.

If a user who is programmed as Auto Overdial receives an incoming call and the Model 49 has been programmed for Answer Mode: "A" (Autonet DTMF), a prompt tone will be sent to the caller once the ID code has been sent out and the caller can begin talking. No ringing tones are sent.

PUSH TO CONNECT (PTC) USERS

Interconnect users may be designated as Push to Connect users. Each PTC user has an autodial table entry associated with it, plus if another LTR site is being called, an ID code to overdial on the answering system. When a PTC user keys up, the Model 49 automatically out-dials the autodial number designated for that user, and automatically overdials the programmed ID code if necessary. To make a PTC call, all the user needs to do is key up, no DTMF is required.

A time delay can be programmed as part of the PTC configuration before the Model 49 does the autodialing. This allows a user programmed as PTC to use the same ID code to make regular phone calls.

VOICE MESSAGING ACCESS USING THE # KEY

A user can turn off the pound (#) disconnect feature during a call. This is sometimes necessary for customers that use voice messaging systems. To disable the DTMF #:

1. Press the DTMF '*' key twice, "* *". The Model 49 prompts you with four low tones to indicate that the '#' hangup has been disabled.

2. Press the DTMF '*' key twice again and the Model 49 prompts you with four high tones to indicate that the '#' hangup has been re-enabled again.

Since some voice messaging services also respond to the DTMF '*' key, it is recommended that you dial the voice messaging number and disable the DTMF '#' during the ringing to keep the voice messaging system from being confused.

DYNAMIC CALL LIMITING

The time limit of each interconnect call and number of active calls can be regulated automatically by the Model 49, based upon measured system activity. During busy system periods, you can 1) maintain a specific grade of service for your interconnect users by cutting back on call lengths and 2) give preferred system availability to dispatch users by cutting back on the number of allowed interconnect calls. In this way, you can maintain loading requirements and still provide excellent interconnect availability during non-peak periods.

The system loading (0 to 100%) is determined based upon the number of channels and total air time used during a 5-minute period. Every 30 seconds a new loading value is calculated and the 'maximum call length' and 'simultaneous calls allowed' values are updated. Active interconnect users are continuously being checked to make sure the maximum call length has not been exceeded. If an interconnect user has been on too long, then that user is given a warning and 30 seconds to complete his/her phone call. The maximum simultaneous calls are checked only when a call is initiated.

Multibase gives you the facility to program interconnect call limits and number of concurrent calls for each loading point in 20% steps, for two classes of users: high and low priority. For software versions 6.1 and above, there are four classes of customers available: low, medium, high, and very high.

You can also give individual User ID's premium service. Those high priority ID's can obtain more interconnect channels during peak periods when you program the maximum simultaneous calls in the Dynamic Call Limit Table. During the busiest time periods, you can even deny interconnect access to low priority users by setting their number of calls to 0.

Note: If you prefer fixed (non-dynamic) time limits, put the same value in each entry of the Dynamic Call tables.

INTELLIGENT FREE REPEATER ALLOCATION

Most LTR systems have rigid repeater system setups in which you must install interconnects in consecutively numbered repeaters for best results. You usually assign interconnects to the lowest numbered repeaters, but other configurations work well as long as all RICs are installed consecutively.

On systems with two or three interconnected channels, all interconnect users are usually "home channeled" on the lowest numbered repeater. This lets users be trunked up to the other interconnected repeaters if their home channel is busy. The problem with most LTR systems is that interconnect users homed on upper channels have difficulty obtaining a free repeater for mobile to land line calls.

Zetron's Intelligent Repeater Channel allocation designates the next free repeater based on trunking information programmed for each repeater. Channels can be set up so that the next free repeater is based upon whether the home channel is dispatch-only or interconnect capable. Mobiles homed on interconnect channels will be trunked to interconnected channels first, before ending up on a dispatch channel. Similarly, mobiles homed on dispatch channels will be trunked to other dispatch channels first, keeping the interconnected ones free as long as possible. Your mobile users will be able to make interconnect calls more easily, improving your system's grade of service.

To activate this feature, put all of your trunking channels into Multibase and fill in the "Trunking: From___ To___" fields in the Repeater Config screen.

DID OPTION

The Model 49 can be equipped with a DID (direct inward dial/selector-level) interface card (in place of an end-end station card) so that phone callers can access mobile users without overdialing the user ID. Any mobile user can be given his/her own personal telephone number, just as in cellular radio service.

Due to the way DID trunks work, they cannot be used to place outgoing calls from mobiles. Fortunately, since you have a trunking system, you can equip some repeater channels with DID for fast incoming calls and other channels with end-end interfaces for outgoing calls. If you make at least 20% of your revenue from dispatch users, then you can effectively place a DID Model 49 in place of any dispatch-only channel. If you have to provide out-calling service on all of your channels, then a separate DID converter unit will be the most beneficial to you.

You order DID service from your local telephone company in blocks of 100 telephone numbers. For example 555-34xx covers the 100 numbers from 555-3400 through 555-3499. When you order more than 100 numbers, the phone company may provide you with disjoint blocks of numbers, such as 555-34xx and 555-36xx for 200 numbers.

When you setup the Model 49, you program the DID Access # in the USER ID database for each mobile getting DID service.The DID access number is the last 2, 3, or 4 digits of the phone number, depending upon whether the phone company is gives you "2, 3, or 4-digit feed".

When a phone caller dials one of the phone numbers in the bank, the phone equipment 'feeds' the last digits of the phone number down the wire pair as either pulses or DTMF, drawing current from the -48V power supply built into the Model 49. These feed digits are then used to look up the particular mobile ID from the DID access table database.

No beep tones are issued to the caller on DID since the digits are automatically sent by the phone company. The Model 49 supplies the necessary ringing and busy tones so that phone callers know what's happening. If a caller accesses a number that you have not programmed into the database, or if a user ID is invalid, then the Model 49 plays "reorder tones" to the caller for a few seconds and hangs up.

Note: You can give any mobile User ID any DID access number you choose. No matter which channel the user is homed on, a call through a DID trunk will generate a message on the repeater bus to move the mobile over and receive the call.

AUDIO COMPANDOR OPTION

This optional plug-in circuit card improves telephone interconnect audio fidelity by reducing the noise introduced by radio signal propagation. The 2:1 compandor circuitry is similar to that used in cellular mobile telephone systems. The Zetron Model 49 Compandor is the ideal companion to full-duplex mobiles that are equipped with compandors.

For those mobiles without built-in compandors, the Model 49's card can be operated just in mobile to phone Expansion mode (without phone to mobile Compression). This reduces "data rumble" and reduces the hisses and pops, so common to line of sight radio reception. By improving the received signal to noise ratio, even telephone hybrid adjustment becomes less critical. (This mode should not be used with Zetron Model 810.)

Individual User ID's are programmed using Multibase to utilize or bypass the compandor audio processor. In this way, you have full flexibility and control over audio processing. As you add new compandored mobiles to the system, you can obtain the full benefit of your Compandor card.

VOICE PROMPT OPTION

This optional plug-in circuit card provides recordable voice prompts for each Model 49 in which it has been installed.

If a voice prompt has not been recorded the progress tones will be played. As the voice prompts are recorded they will be played instead of the progress tones. The following are some of the voice prompts available:

1. Welcome
2. Call cannot be completed
3. Thank you
4. Please wait, connecting
5. The number you dialed is invalid
6. The number is not valid, please retry
7. Please proceed
8. Alarm on repeater

For more information on voice prompts for software version 6.1 or above, please refer to the Model 49 Multibase Version 6.1 or Above Operation Manual (Part No. 025-9297).

ALARM MONITORING

The alarm feature provides the capability in each Model 49 to monitor up to 3 analog sense inputs for out-of-range conditions, as well as loss of Sync and SMDR storage nearly full. Each of the five possible alarms can be individually enabled by repeater.

Once one of the alarm conditions has been met a tone or voice prompt will be transmitted to the ID code entered in Multibase as the alarm ID. The alarm can be programmed to be retransmitted up to 999 times with a selectable time interval between each transmission.

Three control outputs are also available to correspond to each sense input. If desired, the Model 49 will automatically set the appropriate control when an alarm occurs on the sense input. The control outputs are form-relay closures that are jumper selectable for N.O. or N.C.

STATION ID OPERATION

The built-in tone generator plus software on the main board provides station identification using International Morse Code CW ID. When enabled through Multibase programming in the Repeater Configuration database, transmissions occur automatically at programmable intervals. If you already have a channel transmitting station IDs, you simply disable the Model 49 through programming.

During station identification, the Model 49 sends sub-audible LTR data packets with an ID=253, thereby marking the channel busy so that mobiles will trunk off to a free channel (unlike some systems where mobiles end up camping on until identification finishes). Also, if the ID timer comes due while the channel is busy, the Model 49 waits for the channel to go idle before commencing station identification.

TRAFFIC MONITOR

The traffic monitor feature of the Model 49 displays, on your computer screen, the activity for each repeater channel at the selected site. Activity is shown for <u>all</u> repeater logic units connected to the repeater bus (Johnson, Uniden, and Zetron). You use Multibase to connect to your Model 49 to the remote site through the interconnect line. (For further explanation, see the Multibase Manual.)

EQUIPMENT CONNECTIONS

The block diagram in Figure 2.1 shows the architecture of a typical trunked radio system. Note that the radio controllers (Zetron Model 49) communicate with each other via a repeater bus (which can be shared with E.F. Johnson or Uniden logic units) to allocate repeater channel use.

A second bus, the subscriber bus, is used by Zetron Model 49's for database and billing information transmission. With this bus, one phone call to any Model 49 can update the database and retrieve billing data for all Zetron channels.

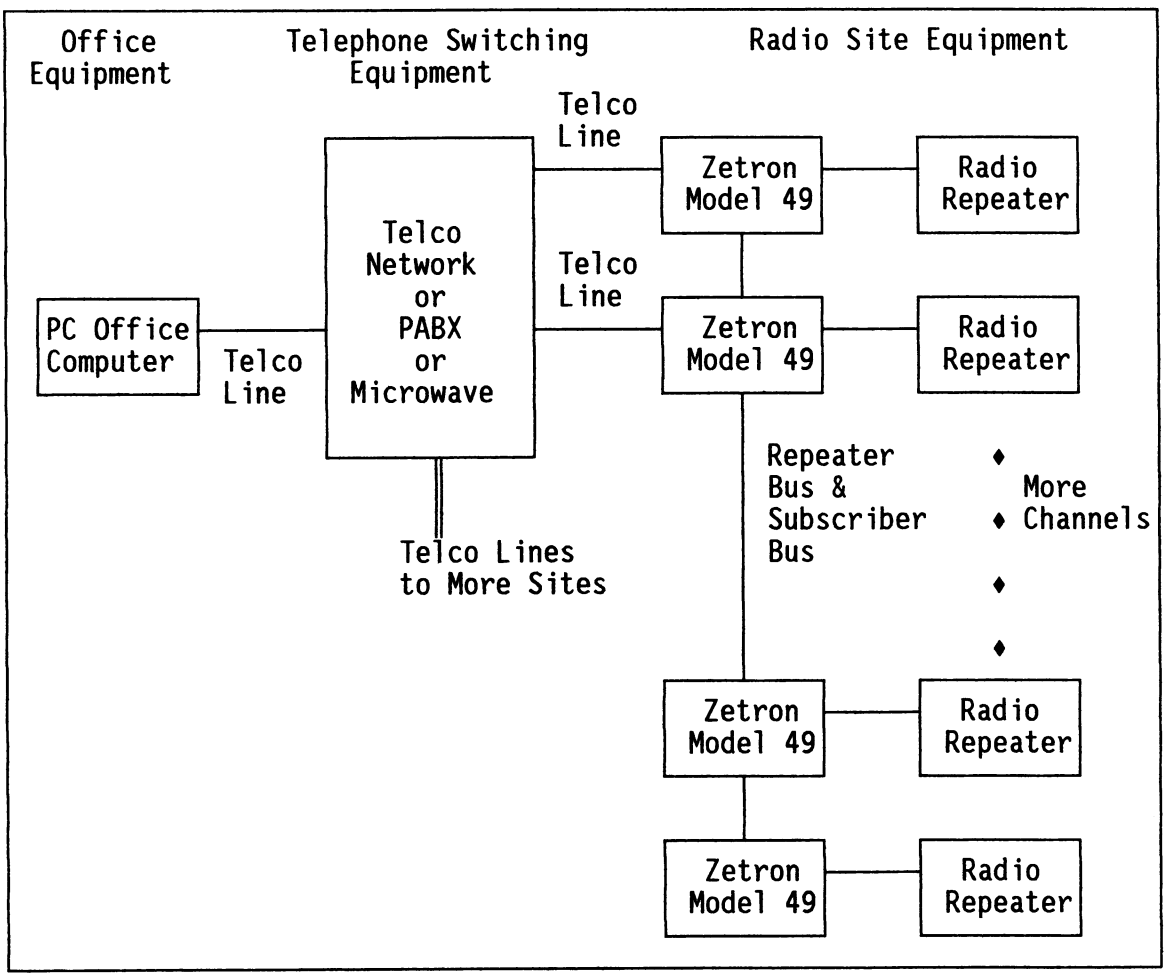


Figure 2.1 - System Block Diagram

REPEATER CONNECTIONS

Each radio channel consists of a channel controller and a radio repeater. Typical connections between the controller and the repeater consist of discriminator audio, transmit audio/data, P.T.T., and power/ground:

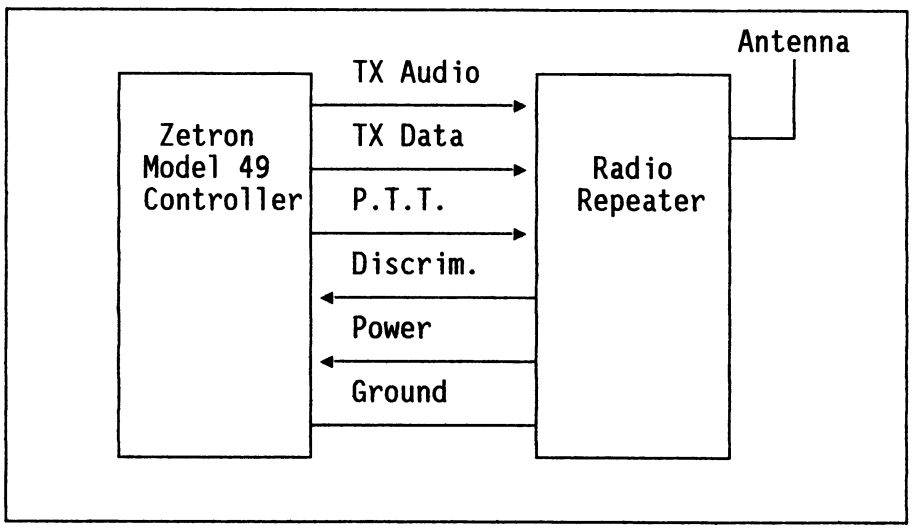


Figure 2.2 - Model 49/Repeater Connections

REMOTE PROGRAMMING

Many operational settings for the mobile users are programmable on a per user basis. These settings are stored in non-volatile memory in the Model 49 which is kept intact even during power failures. Programming of these settings is performed with Zetron's Multibase software on an IBM compatible personal computer and loaded into the Model 49 either to the site by telephone modem or locally in the shop via an RS-232 port.

You can handle multiple Model 49's at multiple sites with one Multibase software system. Programming settings and retrieving billing data is performed right from your office. With Zetron's automatic cloning, one telephone call to any Model 49 at the site automatically loads all of the Zetron units without extra telephone calls.

Multibase is easy for clerical personnel to learn and use. Arrow keys permit navigation on the screen to select menu items and to fill in forms. Help screens give specific instructions, examples, and hints for each operation. (Refer to the Multibase Manual for more information.)

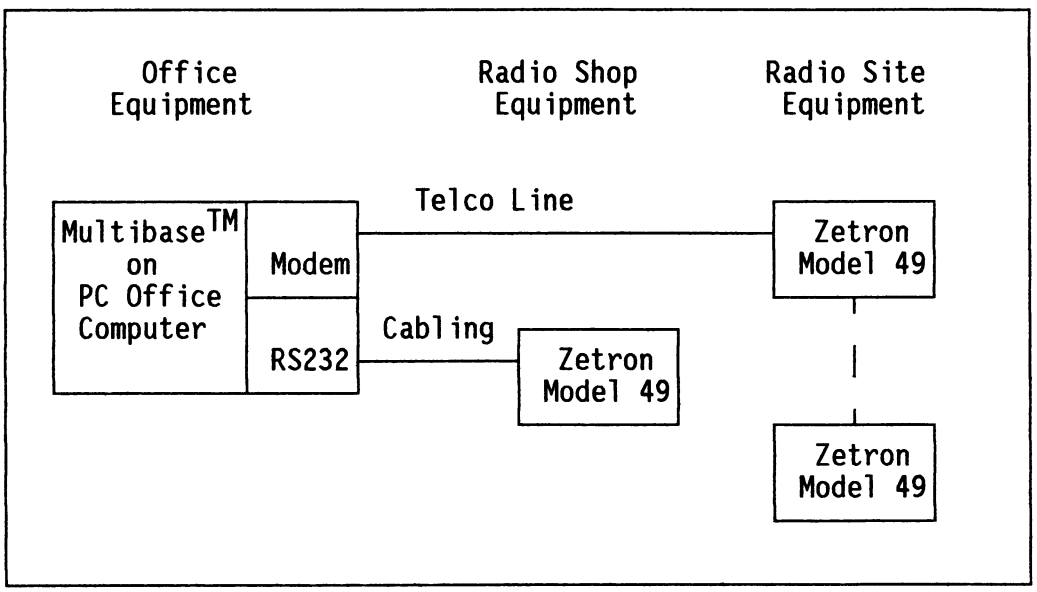


Figure 2.3 - Model 49 Local/Remote Programming

3. LTR TRUNKING

LTR PROTOCOL CARD

A plug-in circuit card, the LTR protocol card, gives the Model 49 its LTR personality. This card decodes and encodes the LTR subaudible data streams through the radio repeater from the mobile radios. This smart card has analog filtering and data processing to extract data packets from noisy radio channels.

Simple TX and RX data level adjustments on the protocol card set the RF channel deviation levels (950 Hz for 800 MHz, 800 Hz for 900 MHz) recommended for the subaudible data. Indicator lamps show transmitted and received data packets as well as receive signal quality. Quick communication between the protocol card and the main Model 49 processor keeps LTR data packets flowing smoothly from/to the mobile radios to maintain channel efficiency.

TRUNKING BUSES

Multi-channel repeater channel allocation is performed using the high-speed repeater bus. The Model 49 configured with jumpers for compatibility with the E.F. Johnson HDB, or Uniden RNDL bus. Each repeater controller (numbered 1 through 20) has a designated time slot on the bus, during which it indicates the currently active user on its repeater. The other control units use this information to determine available free channels and to send "go to" commands to gather groups of mobiles. Since Zetron is compatible with standard buses, you can add Zetron Model 49's to your existing LTR trunking systems.

The subscriber bus is used for communicating database and billing information from one Model 49 to another. When the office computer connects into one Model 49 by modem, it can obtain data from any Model 49 via the subscriber bus.

There is a pair of BNC connectors for each bus on the rear panel of the Model 49, making it easy to daisy-chain the cables. These party-line buses connect logic units together with 50-ohm coaxial shielded cable. On EFJ systems, termination resistors at the ends pull the open-emitter drivers to ground through 100-ohm. On Uniden systems, a 100 ohm resistor (installed inside one of the logic units) on each bus pulls the open-collector drivers to +5 volts.

Note: For proper operation, <u>each</u> bus must have <u>one</u> terminating resistor.

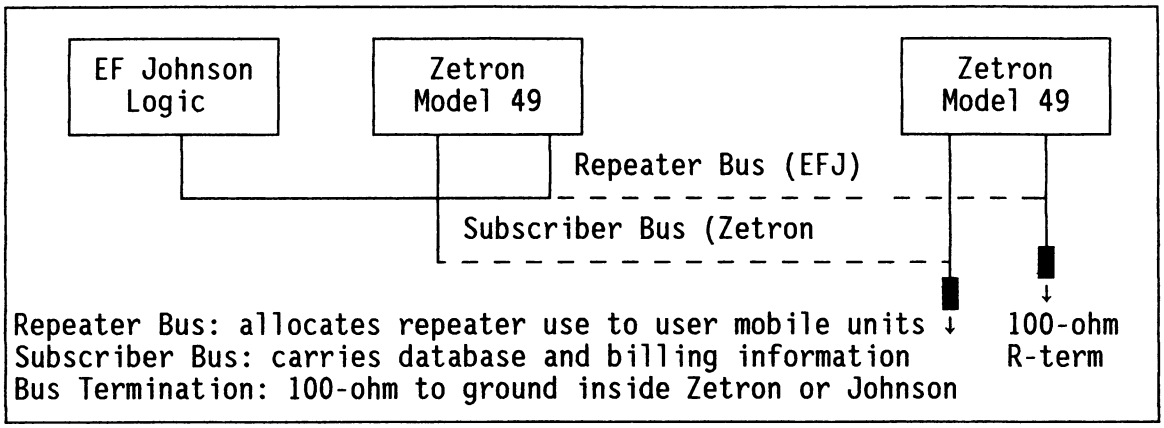


Figure 3.1 - Model 49 Trunking Buses (Johnson Compatible)

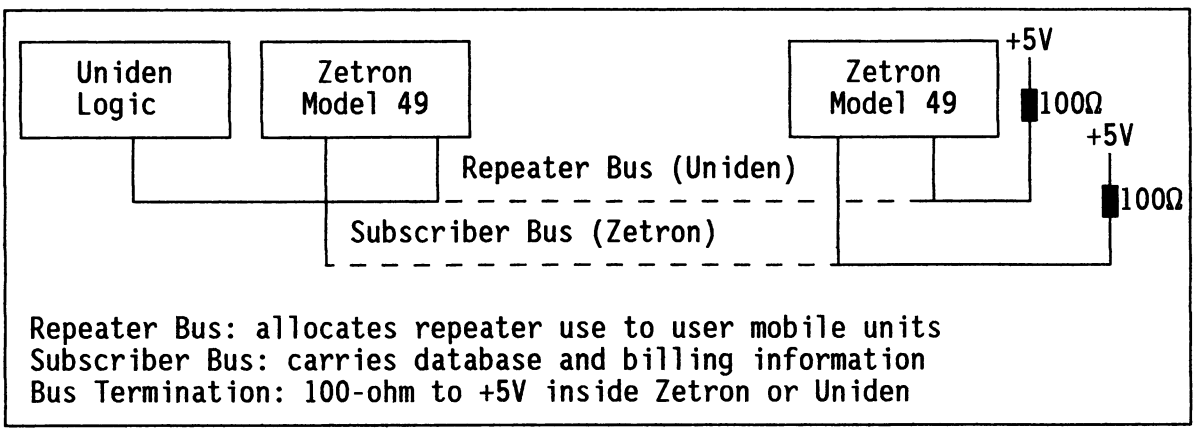


Figure 3.2 - Model 49 Trunking Buses (Uniden Compatible)

REPEATER BUS OPERATION

This bus is called the high-speed data bus (HDB) on E.F. Johnson systems and the repeater network data link (RNDL) on Uniden systems. The bus is a coaxial cable system and has a time slot for each active repeater on the system to identify which user (home channel + ID) is using that repeater.

If the repeater is available (free) then a home channel of 255 and ID of 255 appears on the bus. One logic unit is designated the bus master and provides the sync pulse necessary for bus operation. Either a Zetron Model 49 or other brand of logic unit can operate as the sync master. If the sync master fails to generate sync pulses at the appropriate time (at least every 35 milliseconds), then the repeater controllers do not trunk, but revert to single channel LTR radio repeaters. As soon as sync reappears, trunking resumes automatically.

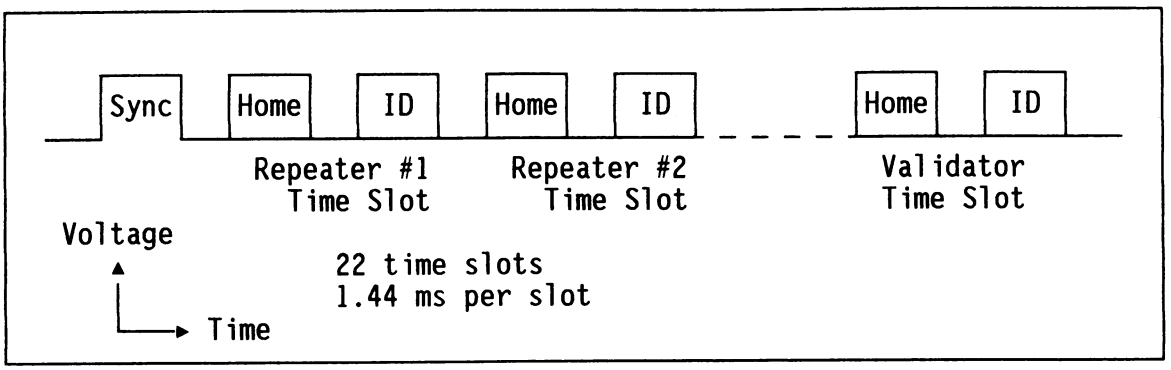


Figure 3.3 - Repeater Bus Timing

The sync pulse on the repeater bus notifies all of the logic units when time slot #1 begins. Only one logic unit, designated the "sync master" generates the sync pulse for each bus cycle. A switch setting in each Johnson/Uniden Logic Unit and in each Zetron Model 49 designates whether it generates or looks for sync pulses. Only one unit on each repeater bus should be configured as the sync master to generate sync.

Slot #21 is used to convey user ID validation information on systems with a separate validator box. Slot #22 is not used. If a user ID has been set as invalid, then the active repeater sets a home channel of 21 along with the ID being invalidated in its repeater bus time slot.

The SYNC light on the front of the Model 49 indicates when it is generating/receiving sync depending upon whether it is set as a repeater bus master/slave. Similar SYNC light on Johnson and RCD light on Uniden logic confirm proper repeater bus operation.

SUBSCRIBER BUS OPERATION

This bus carries messages among Zetron Model 49's at the site. The bus provides access to database and billing data of all Model 49's from any one Model 49. The messages carry database information for automatic cloning, air time and detail records for billing data retrieval, and repeater loading data for system use analysis.

The bus is a coaxial cable party-line system where one Model 49 is a "subscriber master" and the others slaves. When the master talks to the slaves, its front panel POLL light is lit steadily and the slave POLL lights flicker quickly. During database cloning, the POLL light flashes every second or so until cloning is complete.

Note: As jumpered in the Model 49, this bus is electrically identical to the repeater bus so that cross connecting the buses will cause no damage. However, just like the repeater bus, the subscriber bus requires its own termination resistor.

USER ID VALIDATION

Many LTR systems operate with no validation system, i.e. any LTR radio that is programmed to the correct frequencies can access the system. With validation, a standard feature of the Zetron Model 49, only those designated user ID's are permitted system access. If an invalidated user ID attempts access, the logic unit for that channel sends a "turn-off" message to the mobile, causing the mobile radio to squelch. If the mobile is half-duplex, it won't hear the "turnoff" packet until it stops transmitting.

The validation system in the Model 49 is very flexible. Depending upon the settings of the Validate and Sync switches, the Model 49 can validate its own users (internal validation), look for validation information from a system validator on the repeater bus (external validation), or generate validation information for other logic units (validator function). Refer to Section 4 for setting up the validation system.

When the Model 49 is performing validation on other logic units, it will only tell the other logic units whether or not an ID is valid. Therefore, the ID's capability is determined by the channel that the call is being made on. This is true for a trunked or homed call. When using Uniden or EFJ logic the IDs are programmed on a block approach. The preceding facts make it necessary that all channels must be programmed in identical increments. This is true even in the Zetron channel.

Example:

Model 49
Chan.
1

IDs 1 - 100 Dispatch capable
IDs 101 - 150 Interconnect with only local capability
IDs 151 - 250 Interconnect with long distance capability

EFJ
Chan.
2

IDs 1 - 100 Dispatch capable
IDs 101-150 Interconnect with only local capability
IDs 151-250 Interconnect with long distance capability

TRUNKING DATA PACKETS

A mobile radio is normally tuned to its "home" channel, listening for data packets from its home repeater. These data packets tell the radios which repeater is available for use and whether any mobile or telephone party is calling them.

If all channels are busy, then a "Free" repeater number of 0 is sent by the logic unit. If the home repeater is free, the logic unit sets "Go To=Home" and sends idle packets at regular intervals to keep mobiles updated, typically every 10 seconds.

The "Check" field guarantees accurate communication of data between the logic units and the mobiles. Packets in error are discarded.

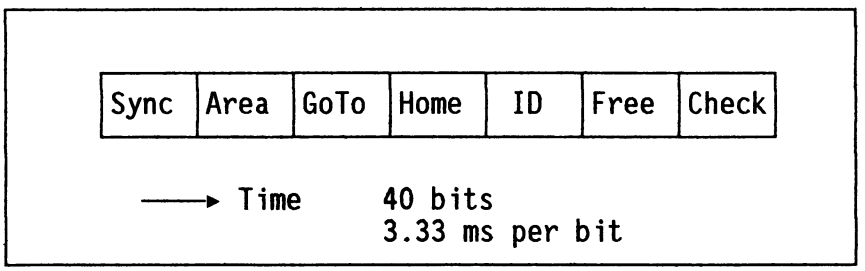


Figure 3.4 - LTR Data Packet Format

4. MODEL 49 SETUP

OVERVIEW

The Model 49 is designed with a heavy-duty face plate that has holes to accommodate standard 19" rack mounting. Additional holes in the front and side panels provide compatibility with E.F. Johnson racking systems. The #8-32 side holes attach directly to the slide rails from an EFJ modular mounting frame.

Power consumption of the Model 49 is approximately 400 mA on a Dispatch Unit, 500 mA on an End-End Interconnect Unit, and 600 mA on a DID Interconnect Unit. Generally, sufficient spare +12V DC power is available from the radio repeater to power the Model 49. Note: DC input power must be at least +10.5V DC for proper Model 49 operation.

The following equipment is recommended to make installation and programming easy:

Equipment	Purpose
Tool kit with screwdrivers	Mechanical assembly
Comm. monitor with deviation meter	Adjusting RX and TX levels
Voltmeter	Adjusting RX and TX audio levels
1000-Hz audio oscillator	Adjusting modulation limiter
Trunking radio, with DTMF keypad*	Adjusting RX and TX data levels
LTR encoder, decoder	Adjusting RX and TX data levels
Model 49 Trunking Repeater Manager	System component
Radio repeater	System component
Cable from repeater to Model 49	System component
BNC cables between all logic units	System component
IBM compatible PC (w/ Hayes modem)	Program site, repeater, user IDs
RS-232 cable from computer to Model 49	Programming connection
Telephone line or telco simulator*	Adj. telco levels and balance
Modular telephone cord*	Telephone connection

*Note: This item required only for telephone interconnect installations

We recommend that you allot sufficient time in your radio shop to become familiar with the Model 49 and to set up and operate your first Zetron controlled repeater there, before traveling to the repeater site. Although the Model 49 is a small unit, its comprehensive capabilities will require time to adjust it, to program its database, and to become familiar with its operation. Applications engineers at Zetron are available by telephone to assist you in your installation.

NOTICE

This equipment generates, uses, and can radiate radio frequency energy; and if not installed and used in accordance with the instruction manual, may cause interference to radio communications. Installation should be accomplished by personnel with experience in radio trunking systems. Specialized knowledge in telephone systems is also important when interconnecting with telco or microwave networks.

INSTALLATION CHECKLIST

Note that some jumpers on the Model 49 are underneath the LTR Protocol Card, inside the unit. (There are no jumpers under the telephone interface card). All adjustment pots and DIP switches are behind a removable front panel cover and are accessible without removing the top cover from the unit.

Start with the unit in your shop and:

Step 1: Set jumpers.

Step 2: Clear memory.

Step 3: Set dip switches.

Step 4: Modify and install repeater.

Step 5: Set repeater levels

Step 5A: Set repeater levels for V6.10 firmware

Step 6: Make trunking connections.

Step 7: Test dispatch calls.

Step 8: Test trunking.

Step 9: Test interconnect.

Step 10: Make telco adjustments.

Step 11: Program users and time.

Once your system is operating well in your shop, record the equipment settings and any pertinent notes on the worksheet provided in the Appendix. Keep this record for future reference; it will make installing more Zetron units a lot easier.

WARNING

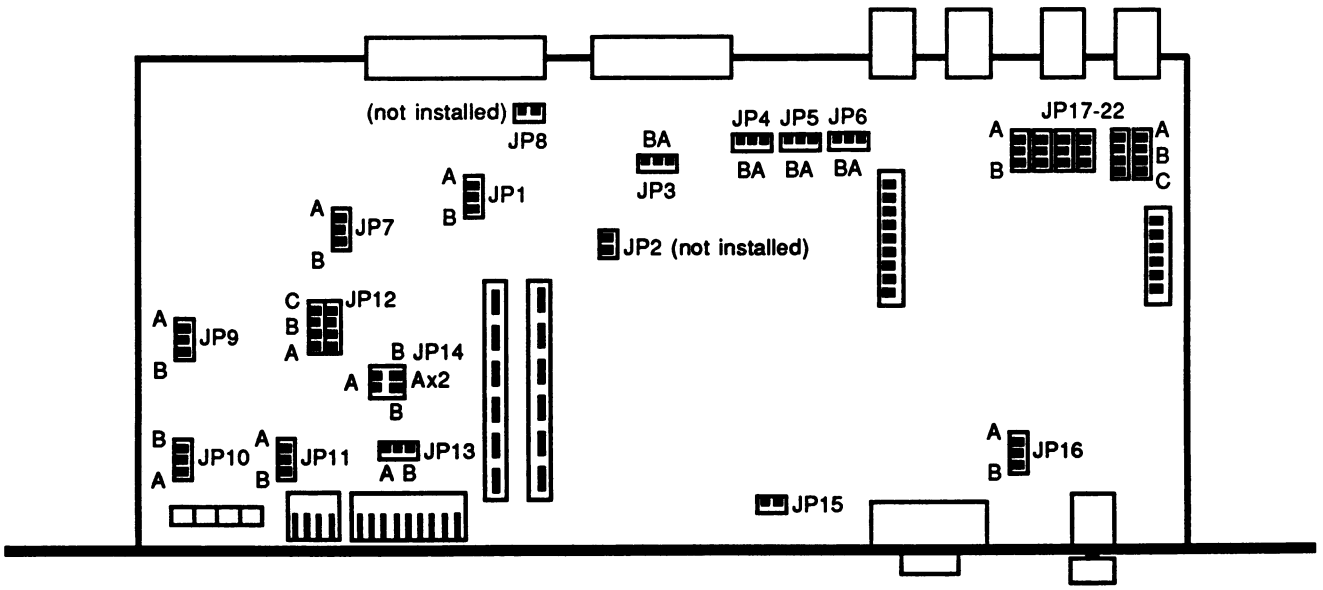
To protect this equipment against high voltage surges induced by lightning, care must be taken to observe proper grounding practices for both the radio and telephone transmission systems. Installation should be accomplished by personnel with experience in radio-telephone equipment. Consequent damage due to failure to provide adequate protection is not covered under Zetron's warranty.

Step 1: Setting the Jumpers

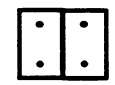
[]1. Remove the Model 49 top cover.

[]2. Remove the Protocol Card.

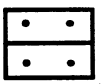
See Figure 4-1 for the location of the main board jumpers.



Note:
(As viewed from front)



JP14 = AA



JP14 = BB

Figure 4-1. Model 49 Main Board Jumpers

[]3. Match Model 49 Jumpers to Repeater type (See A-G below).

A. Daniels Electronics Repeater*

Set Main Board Jumpers as follow:

JP1	B=TX discriminator audio
JP7	B=TX De-emphasized audio
JP9	B=RX amp 0 dB gain
JP10	A=TX amp high range
JP12	A=COR from internal noise squelch
JP13	B=300 Hz High pass filtering on repeat audio
JP14	BB=Negative COR Polarity
JP16	B=Front Panel button enabled

Set Protocol Card Jumpers as follows:

JP1	B=Invert RX data polarity
JP2	A=True TX data polarity

B. EF Johnson Repeater Repeater*

Set Main Board Jumpers as follow:

JP1	B=TX discriminator audio
JP7	B=TX de-emphasized audio
JP9	A=RX amp 20 dB gain
JP10	A=TX amp high range
JP12	A=COR from internal noise squelch
JP13	B=300 Hz High pass filtering on repeat audio
JP14	BB=Negative COR polarity
JP16	B=Front panel button enabled
JP17 to JP22	pertains to trunking buses

Set Protocol Card Jumpers as follow:

JP1	A=True RX data polarity
JP2	A=True TX data polarity

Cut out R57 on the Main Board using a pair of diagonal cutters.

C. Motorola Micor Repeater*

Set Main Board Jumpers as follow:

JP1	B=TX discriminator audio
JP3 to JP6	pertains to alarm option
JP7	B=TX de-emphasized audio
JP9	A=RX amp 20 dB gain
JP10	A=TX amp high range
JP12	A=COR from internal noise squelch
JP13	B=300Hz high pass filtering on repeat audio
JP14	BB=Negative COR polarity
JP16	B=Front panel button enabled

Set Protocol Card Jumpers as follow:

JP1	A=True RX Data
JP2	B=Invert TX Data

D1. New Relm Repeater*

Set Main Board Jumpers as follow:

JP1	B=RX discriminator audio
JP7	B=Tx Tone De-Emphasis
JP9	A=RX amp 20 dB gain
JP10	A=TX amp high range
JP12	A=COR input (INT)
CUT R57	AC coupled SUBOUT data

Protocol Card Jumpers:

JP1	B=Invert RX data polarity
JP2	A=True TX data polarity

D2. Old Relm Repeater*

Set Main Board Jumpers as follow:

JP1	B=TX discriminator audio
JP7	B=TX de-emphasized audio
JP9	A=RX amp 20 dB gain
JP10	A=TX amp high range
JP12	A=COR from internal noise squelch
JP13	B=High pass filtering on repeat audio
JP14	BB=Negative COR polarity
JP16	B=Front panel button enabled
JP17 to JP22	pertains to trunking buses

Set Protocol Card Jumpers as follow:

JP1	B=Invert RX Data
JP2	A=True TX Data

E1. Standard RP70K Repeater*

Set Main Board Jumpers as follow:

JP1	B=TX discriminator audio
JP7	B=TX de-emphasized audio
JP9	A=RX amp 20 dB gain
JP10	B=TX amp low range
JP12	A=COR from internal noise squelch
JP13	B=300 Hz High pass filtering on repeat audio
JP14	BB=Negative COR polarity
JP16	B=Front panel button enabled
JP17 to JP22	pertains to trunking buses

Set Protocol Card Jumpers as follow:

JP1	B=Invert RX data
JP2	B=Invert TX data

E2. Standard RPT-38 Repeater*

Set Main Board Jumpers as follow:

JP1	B=TX discriminator audio
JP7	B=TX De-emphasized audio
JP9	B=RX amp 0 dB gain
JP10	A=TX amp high range
JP12	A=COR from internal noise squelch
JP13	B=300 Hz High pass filtering on repeat audio
JP14	BB=Negative COR Polarity
JP16	B=Front Panel button enabled

Set Protocol Card Jumpers as follows:

JP1	B=Invert RX data polarity
JP2	A=True TX data polarity

F1. Tait Rackframe Repeater*

Set Main Board Jumpers as follow:

JP1	B=TX discriminator audio
JP7	B=TX De-emphasized audio
JP9	B=RX amp 0 dB gain
JP10	A=TX amp high range
JP12	A=COR from internal noise squelch
JP13	B=300 Hz High pass filtering on repeat audio
JP14	BB=Negative COR Polarity
JP16	B=Front Panel button enabled

Set Protocol Card Jumpers as follows:

JP1	B=Invert RX data polarity
JP2	A=True TX data polarity

F2. Tait Slimline Repeater*

Set Main Board Jumpers as follow:

JP1	B=TX discriminator audio
JP7	B=TX De-emphasized audio
JP9	B=RX amp 0 dB gain
JP10	A=TX amp high range
JP12	A=COR from internal noise squelch
JP13	B=300 Hz High pass filtering on repeat audio
JP14	BB=Negative COR Polarity
JP16	B=Front Panel button enabled

Set Protocol Card Jumpers as follows:

JP1	B=Invert RX data polarity
JP2	A=True TX data polarity

G1. Uniden MRS804 Repeater*

Set Main Board Jumpers as follow:

JP1	B=TX discriminator audio
JP7	B=TX de-emphasized audio
JP9	A=RX amp 20 dB gain
JP10	A=TX amp high range
JP12	A=COR from internal noise squelch
JP13	B=300 Hz High pass filtering on repeat audio
JP14	BB=Negative COR polarity
JP16	B=Front panel button enabled
JP17 to JP22	pertains to trunking buses

Set Protocol Card Jumpers as follow:

JP1	A=True RX Data
JP2	B=Invert TX Data

G2. Uniden MRS802 Repeater*

Set Main Board Jumpers as follow:

JP1	B=TX discriminator audio
JP7	B=TX de-emphasized audio
JP9	A=RX amp "20" dB gain
JP10	A=TX amp high range
JP12	A=COR from internal noise squelch
JP13	B=High pass filtering on repeat audio
JP14	BB=Negative COR polarity
JP16	B=Front panel button enabled
JP17 to JP22	pertains to trunking buses

Set Protocol Card Jumpers as follow:

JP1	A=True RX Data
JP2	B=Invert TX Data

* These jumper positions have been found to operate properly with the factory default settings of the repeater. However, the settings of these repeaters may have been changed in the field or elsewhere. Therefore, some of these jumper positions may need to be changed to obtain proper operating levels.

[]4. Repeater Bus Compatibility Jumpers
The Subscriber bus is used for the programming, SMDR, and call accumulation of Zetron units. The Repeater bus is used for trunking and loading information that all logic units need. These buses must be connected and terminated properly for correct operation. While the Model 49 can work properly with any equipment, Uniden and EFJ logic units cannot coexist. If the Model 49 is in a system with Uniden logic, pick Uniden logic from below. If the Model 49 is in a system with EFJ logic, pick EFJ logic from below. If the Model 49s are the only logic in the system, either Uniden or EFJ logic will work properly.

Uniden logic:

JP11	A=Uniden RNDL Repeater Bus Timing
JP17,19	B=Uniden Subscriber Bus hardware
JP18,20	B=Uniden Repeater Bus hardware
*JP21	A=Uniden 100 ohm pull-up Subscriber bus termination
*JP22	A=Uniden 100 ohm pull-up Repeater Bus termination

EFJ logic:

JP11	B=EFJ HDB Repeater Bus timing
JP17,19	A=EFJ Subscriber Bus hardware
JP18,20	A=EFJ Repeater Bus hardware
*JP21	B=EFJ 100 ohm pull-down Subscriber Bus termination
*JP22	B=EFJ 100 ohm pull-down Repeater Bus termination

For any type of logic there should only be 1 pull up or down resistor on the Subscriber or Repeater bus. Because of this it is necessary on all other logic units to remove any termination. This is done on the Model 49 by placing JP21 and JP22 in the C position.

See the Trunking Connections in Detail subsection later in this section for a detailed explanation of trunking operations and connections.

[]5. Site Alarm and Cross-busy Jumpers.
The site alarm interface and cross-busy features have relay outputs that can be normally open (N.O.) or normally closed (N.C.). The corresponding jumpers are as follows:

Cross-busy (CTL-1)

JP3	A = N.O.
	B = N.C.

Alarm (CTL2-4)

JP4-6	A = N.O.
	B = N.C.

[]6. Reinstall the Protocol Card.

[]7. The following tables summarize the previous jumper settings. A blank Model 49 Jumper Table (Literature No. 005-0560) for recording the jumper settings for your specific installation site and repeaters is included in your order. Displaying the filled-in jumper table at your site is useful for service personnel.

Jumper Name	Label	A Setting	B Setting	C Setting
Radio TX Audio	JP1	__ Flat	__ Discriminator	
Reset	JP2	__ Out=Run	__ In=Reset	
Alarm 1	JP3	__ N.O.	__ N.C.	
Alarm 2	JP4	__ N.O.	__ N.C.	
Alarm 3	JP5	__ N.O.	__ N.C.	
Alarm 4	JP6	__ N.O.	__ N.C.	
TX Tone	JP7	__ Flat	__ Deemphasis	
PTT (Rev E,F)	JP8	__ Out=Relay	__ In=Transistor	
Telco to TX (Rev B-D)		__ Thru	__ 300Hz Hi-Pass	
Radio RX amp	JP9	__ x20	__ x40	
Radio TX amp	JP10	__ High	__ Low	
EFJ/Uniden bus	JP11	__ Uniden	__ Johnson	
COR select	JP12	__ Internal	__ External	__ VOX
Radio RX filter	JP13	__ Direct	__ High pass	
COR polarity	JP14	__ Positive	__ Negative	
+12V to J9	JP15	__ Out=Off	__ In=On	
Connect button	JP16	__ Off	__ On	
EFJ/Uniden bus	JP17-20	__ Johnson	__ Uniden	
Subs bus Resistor	JP21	__ Uniden 100Ω (Rev E)	__ EFJ 100Ω	__ No resistor
Rptr bus Resistor	JP22	__ Uniden 100Ω (Rev E)	__ EFJ 100Ω	__ No resistor

Jumper Settings on LTR Protocol Card

Jumper Name	Label	A Setting	B Setting
RX Data Polarity	JP1	__ Normal	__ Invert
TX Data Polarity	JP2	__ Normal	__ Invert

Jumper Settings on End-End Telephone Interface Card (702-9227)

Jumper Name	Label	A Setting	B Setting
Supervision	JP1	__ Loop Start	__ Gnd Start

Jumper Settings on End-End Telephone Interface Card (702-9283)

Jumper Name	Label	A Setting	B Setting
Balance	JP1	__ Bal Cap In	__ Bal Cap Out

Jumper Settings on E&M Interface Card (702-9228)

Jumper Name	Label	A Setting	B Setting
Supervision	JP1	__ M control	__ E control
Control Relay	JP2	__ Norm Open	__ Norm Closed
Off-Hook Sense	JP3	__ -Volts	__ Ground
Off-Hook Control	JP4	__ Ground	__ -Volts

M49 Jumper Table

Repeater Model	Main Board Jumper Number																						Protocol		Comp	Voice Prompt				E-E Telco			E&M 4W Telco			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	1	2	1	1	2	3	4	Main 1	Bal. Bd. 1	Bal. Bd. 2	1	2	3	4
Daniels Electronics	B	--					B	--	B	A	*	A	B	BB	--	B	*	*	*	*	* C	* C	B	A			B	B	AB	--	A	A				
E.F. Johnson 8600	B	--					B	--	A	A	*	A	B	BB	--	B	*	*	*	*	* C	* C	A	A			B	B	AB	--	A	A				
Motorola Micor	B	--					B	--	B	A	*	A	B	BB	--	B	*	*	*	*	* C	* C	B	A			B	B	AB	--	A	A				
NewRelm 800 MHz	A	--					A	--	B	A	*	A	A	BB	--	B	*	*	*	*	* C	* C	A	A			B	B	AB	--	A	A				
Old Relm 800 MHz	B	--					B	--	A	A	*	A	B	BB	--	B	*	*	*	*	* C	* C	B	A			B	B	AB	--	A	A				
Standard RP70K	B	--					B	--	B	B	*	A	B	BB	--	B	*	*	*	*	* C	* C	B	B			B	B	AB	--	A	A				
Standard RPT-38	B						B	--	B	A	*	A	B	BB	--	B	*	*	*	*	* C	* C	B	A			B	B	AB	--	A	A				
Tait RackFrame / Slimline	B	--					B	--	B	A	*	A	B	BB	--	B	*	*	*	*	* C	* C	B	A			B	B	AB	--	A	A				
Uniden MRS 804	B	--					B	--	A	A	*	A	B	BB	--	B	*	*	*	*	* C	* C	A	B			B	B	AB	--	A	A				
Uniden MRS 802	B	--					B	--	B	A	*	A	B	BB	--	B	*	*	*	*	* C	* C	A	B			B	B	AB	--	A	A				
E&M Config. for M810																																	A	A	B	B
*Uniden Logic (100Ω +5v)											A						B	B	B	B	A C	A C														
*EFJ Logic (100Ω -Gnd)											B						A	A	A	A	B C	B C														
Functional Descriptions	Tx Audio to Radio: A=Flat, B = Disc	Reset (Active = IN) Normally Out	Alarm 1 (X-BSY) : A = N.O.; B = N.C.	Alarm 2 : A = N.O.; B = N.C.	Alarm 3 : A = N.O.; B = N.C.	Alarm 4 : A = N.O.; B = N.C.	Tx Tone : A = Flat; B = De-emph.	PTT Drive : OUT = Relay; IN = Trans.	Radio Rx Amp: A = High ; B = Low	Radio Tx Amp : A = High; B = Low	EFJ /Uniden Bus : A = Uni.; B = EFJ	COR Drive: A=ISQ; B=EXT; C=VOX	Radio Rx Filter: A = Thru; B = HPF	COR Polarity : A = Pos; B = NEG	+12 Vdc to J9 : OUT = OFF; IN = ON	Connect Button : A = OFF; B = ON	EFJ/Uniden : A = EFJ; B = Uniden	EFJ/Uniden : A = EFJ; B = Uniden	EFJ/Uniden : A = EFJ; B = Uniden	EFJ/Uniden : A = EFJ; B = Uniden	Subsc. Bus Termnation : Master / Slaves (Poll Lamp)	Rptr. Bus Termination : Master / Slaves (Sync. Lamp)	Rx Data Polarity : A = Normal B = Invert	Tx Data Polarity : A = Normal B = Invert	Rx Disc Audio Filter : A = Flat B = HPF	RAM Voltage	Read Control	Audio Input	Write Control	Not Installed	Z-Match Telco to Hybrid A = Normal Line; B = Long Line	Z-Match Telco to Hybrid A = Short Line; B = Normal Line	Supervision: A=M control; B=E control	Output Control Relay Contacts A = N.O. ; B = N.C.	Sense Detection Off-Hook Voltage A = -48V ; B = Ground	Control Lead Output Off-Hook Voltage A = Ground ; B = -48V

Notes:
N.O. = Normally Open
N.C. = Normally Closed
H.P.F. = High Pass Filter

Step 2: Clearing Memory

HARD RESET
When you install the Model 49 for the first time, move the unit from one channel to another, or put a spare unit into service, it is important to guarantee that all database and billing information is cleared. To do this, perform the following steps:

> CAUTION
> A hard reset will result in the loss of both the Air Time Accumulator and the Call Detail Record data from the Model 49 memory. Retrieve this data before doing a hard reset.

[]1. Make sure that JP16 is in position B.

[]2. Power on the Model 49 and wait about 5 seconds for the front panel lights to stabilize.

[]3. Set all the front panel DIP switches to the DOWN position.

[]4. Press and release the front panel the Connect/Disconnect button four times. The rate at which you press the button is important. To get an idea as to how quickly, read the following out loud:

Press...Release...Press...Release...Press...Release...Press ...Release.

After you release the button for the second time, the five LED's: POLL, SYNC, DIGIT, MODEM, and ALARM lights flash briefly. On the third press and release, these LED's will stay on. On the fourth press and release, the LED's will go out. This is your indication that the Model 49 has successfully cleared all of its memory to factory settings.

[]5. Set all the front panel DIP switches back to their operating positions.

[]6. Press the Connect/Disconnect button twice. You will see the POLL, SYNC, DIGIT, MODEM, and ALARM lights come on and then go off. Press the Connect/Disconnect button twice again. The five lights will flash briefly. The Model 49 has read the front panel switches.

Note: You can disable the front panel button by setting jumper JP16 to position A.

SOFT RESET
Unlike the full database hard reset, the reset will not alter the Air Time Accumulators or the Call Detail Buffer. The main purpose of the soft reset is to "read" the front panel DIP switches. We also recommend that you do a soft reset after removing or installing either the repeater or subscriber bus cables.

Every time you change a switch setting you must make the Model 49 read the new settings. You can cycle the power off then on, or you can do the following:

[]1. Make sure that jumper JP16 is in position B.

[]2. Press and release the Connect/Disconnect button twice.

The five LED's: POLL, SYNC, DIGIT, MODEM, and ALARM lights flash briefly. If you don't see the lights flash or if a call is in progress, wait for it to complete and try pressing the button again.

Note: You can disable the front panel button by setting jumper JP16 to position A.

Step 3: Setting DIP Switches

The DIP switches (behind the front panel cover) make it easy for you to set the Model 49 for multi-channel trunking without programming PROMS! There are two switches; the 4-position one on the left is called A, and the 8-position one is called B. Refer to "Hardware Layout" later in this section for a diagram of these switches.

Switch A:1 should be in the Down position for normal operation. The Up position is used for activating test modes for alignment (requires software version 3.5 or later).

Switch A:2 selects repeater data bus validation. This switch setting is not important until you begin connecting the Model 49 to other logic units on the repeater bus.

Switches A:3 and A:4 set the communications speed between the Model 49 front panel RS-232 connector and a computer. When the Model 49 uses its internal modem (through the interconnect port), the data rate is 1200 bits/per second and these switches are ignored.

Switch B:1 sets up the Model 49 for communication on the Subscriber Bus used for database cloning and billing data retrieval. The subscriber bus is only used between Zetron units, and only one Zetron unit should be set with this switch Up (bus master unit). Other units (slaves) should have this switch set Down. This switch setting is not important until you begin connecting the Model 49 to other Model 49's.

Switch B:2 sets up the Model 49 for communication on the Repeater Bus used for trunking with other channels. The repeater bus is used by all the logic units. Only one logic unit should be set as Bus Master (this switch Up on the Model 49). Other units have to be set as slaves (this switch Down on the Model 49). This switch setting is not important until you begin connecting the Model 49 to other logic units.

Switch B:3 selects the LTR Area being controlled by your trunking system. The setting of this switch must agree with your other logic units and with the programming of all of your mobiles. Set this switch Up for Area 1, and Down for Area 0.

Five switches, B:4 through B:8, select the Repeater channel number being controlled by your Model 49. Your mobiles are programmed with F.C.C. RF channels that correspond to certain repeater numbers. So, the frequency of the repeater connected to the Model 49 determines these switch settings. Most repeater numbering systems evenly space the repeaters numbers. A 5-channel system usually has repeaters 1, 5, 9, 13, 17; a 10-channel system has repeaters 1, 3, 5, 7, 9, 11, 13, 15, 17, 19. These switches are coded in binary with the least significant bit on the right (B:8). Refer to the foldout pages at the end of this section for coding of these switches.

Note: Changing the switch settings requires a soft reset before the switches are read.

Step 4: Repeater Modification and Installation

Select the appropriate repeater from the list below and follow the corresponding modification and installation procedure.

A. Daniels Electronics

B. EF Johnson

C. Motorola Micor

D1. New Relm

D2. Old Relm

E1. Standard RP70K

E2. Standard RPT-38

F1. Tait Rackframe

F2. Tait Slimline

G1. Uniden MRS804

G2. Uniden MRS802

If you are using a repeater not listed, contact a Zetron Mobile Systems Division Applications Engineer at (206) 820-6363.

A. DANIELS ELECTRONICS REPEATER

Be sure that the Model 49 jumpers are set per 3A in "Step 1: Setting the Jumpers". Then perform the following steps:

[]1. Connect the Model 49 to the Daniels MT-3 Repeater using the Daniels Auxiliary Control interface cable. See Figure 4-2. Be careful to reference the correct rackframe slots (A or B) for the transmitter module and receiver module applicable for your installation.

Repeater Backplane Interface		Zetron LTR Repeater Managers		Function
Solder Terminals Located on Repeater Backplane PCB	Auxiliary Control P2	M42 / M49 "A"	M42 / M49 "B"	
	B - 2	1	1	+13.8 Vdc
	Z - 2			
	D - 32	3	3	GND
	B - 32			
	Z - 32			
		4	4	PTT COM
		6	6	
	B - 6	7		PTT NO "A"
	B - 8	10		COR "A"
	D - 18	11		Tx AUDIO "A"
Tx A Sub Input 2 (J17,right)		13		Tx Data "A"
	B - 10	15		Disc In "A"
	Z - 6		7	PTT NO "B"
	Z - 8		10	COR "B"
	D - 16		11	Tx AUDIO "B"
Tx B Sub Input 2 (J15,right)			13	Tx Data "B"
	D - 28		15	Disc In "B"

Figure 4-2. M42/M49 Interface Cabling to Daniels MT-3 Repeater

[]2. Perform the following modifications to the repeater.

Note that these modifications will be performed by Daniels Electronics if requested at time of purchase.

Receiver

Replace C48 (1 μF Nonpolar) with 10 μF Tantalum Electrolytic capacitor (16V), oriented with negative (-) lead toward TP9. Nonpolar would be best.

JU5 Installed (solder bridged)

Transmitter

Replace the following transmitter module components:

MT-3 Audio Processing Board:

C40 (330 nF) changed to 10 μF, (-) toward R44. (J16 out)

MT-3 800 MHz Synthesizer:

Install Solder bead for JU2.
R11 (2.80 KΩ) changed to 10 KΩ
R12 (2.37 KΩ) changed to 33.2 KΩ
C10 (470 nF) changed to 33 nF
C11 (2.2 μF) changed to 220 nF
C14 (33 nF) changed to 2.2 nF

MT-3 800 MHz Tx Module Main Board:

Connect JA4-2 (Subtone #2 Output) to JS1-18 (Spare Synth I/O), using shielded coaxial cable
J6 Installed (solder bridged)

Set the TX and RX audio and data levels by following the procedure described in "Step 5: Setting Repeater Levels" or "Step 5A: Setting Repeater Levels for V6.10 Firmware".

Note: You can record your settings on the worksheet in the Appendix.

B. E.F. JOHNSON REPEATER

Be sure that the Model 49 jumpers are set per 3B in "Step 1: Setting the Jumpers". Then perform the following modifications to your EFJ repeater:

[]1. Remove the E.F. Johnson Logic Unit, RIC, and cabling harness from the repeater cabinet.

[]2. Remove the slide brackets from the EFJ Logic Unit and attach them to the Model 49.

[]3. Mount the Model 49 into the EFJ repeater cabinet.

[]4. Attach the Zetron cable harness to the Model 49, EFJ Exciter, EFJ Receiver, and EFJ power supply (P/N 709-7117). Note that each connector is marked. Connect the Model 49 to the E.F. Johnson repeater with the repeater cable. See Figure 4-3.

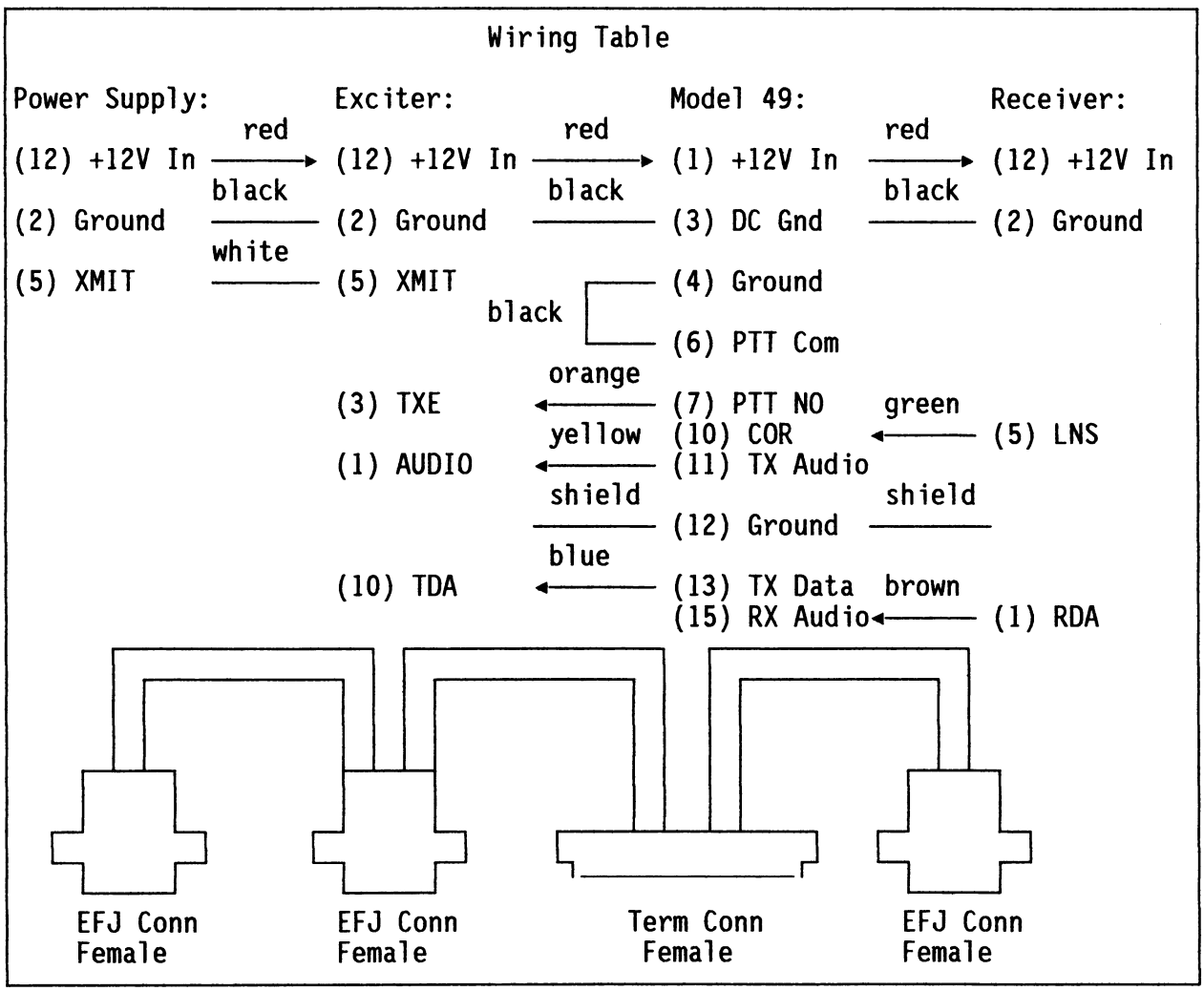


Figure 4-3. Model 49 to E.F. Johnson 800 MHz Repeater Cable (P/N 709-7117)

[]5. Remove R57 in the Model 49. This will install DC decoupling capacitors in the subout path.

Set the TX and RX audio and data levels by following the procedure described in "Step 5: Setting Repeater Levels" or "Step 5A: Setting Repeater Levels for V6.10 Firmware".

Note: You can record your settings on the worksheet in the Appendix.

C. MOTOROLA MICOR REPEATER

Be sure that the Model 49 jumpers are set per 3C in "Step 1: Setting the Jumpers". Then perform the following modifications to provide interface signals to the Motorola Repeater:

[]1. Remove all modules except the Station Control and Squelch Gate modules.

[]2. Connect the Model 49 to the Motorola Repeater using the repeater interface cable (part #709-7116). See Figure 4-4.

[]3. Remove CR12 in the Station Control module.

[]4. Remove J12 in the Squelch Gate module.

[]5. Connect a jumper wire at the Model 49 end of the cable between pins four and six.

[]6. Set up the squelch gate module jumpers for a base station.

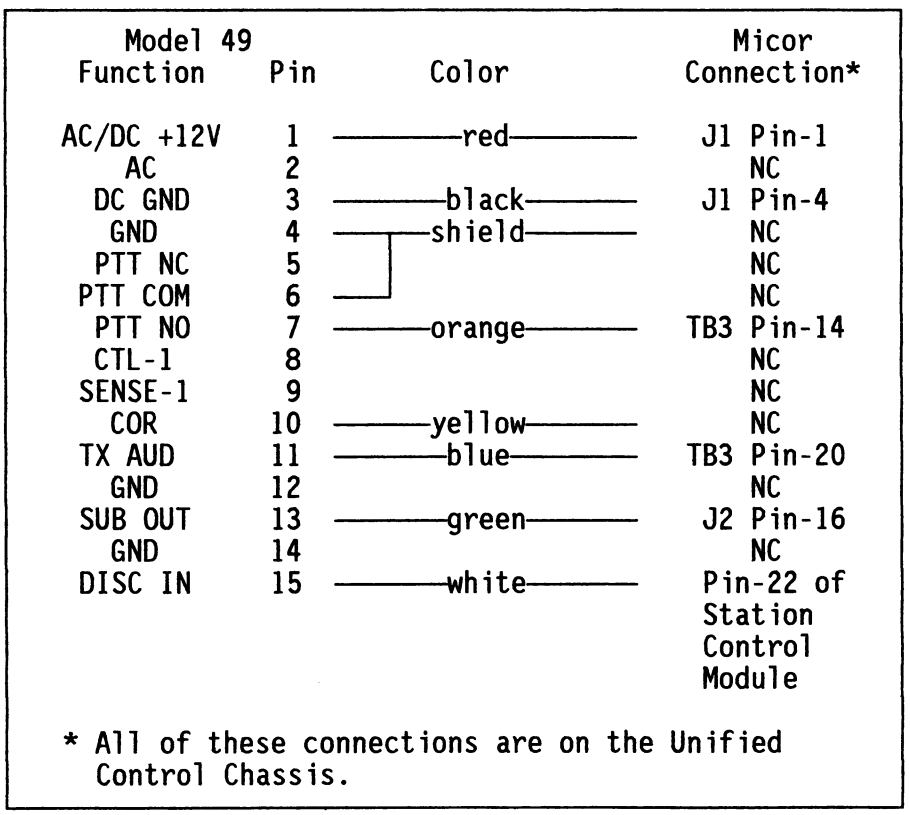


Figure 4-4. Model 49 to Motorola Micor Repeater Cable (P/N 709-7116)

Perform the following modifications to the Model 49:

[]1. Remove the Model 49 top cover.

[]2. Remove the Protocol Card.

[]3. Cut the trace that goes from U10 pin-2 to R28 on the Protocol Card. Install a 47K ohm resistor from U10 pin-2 to R28. See Figure 4-5.

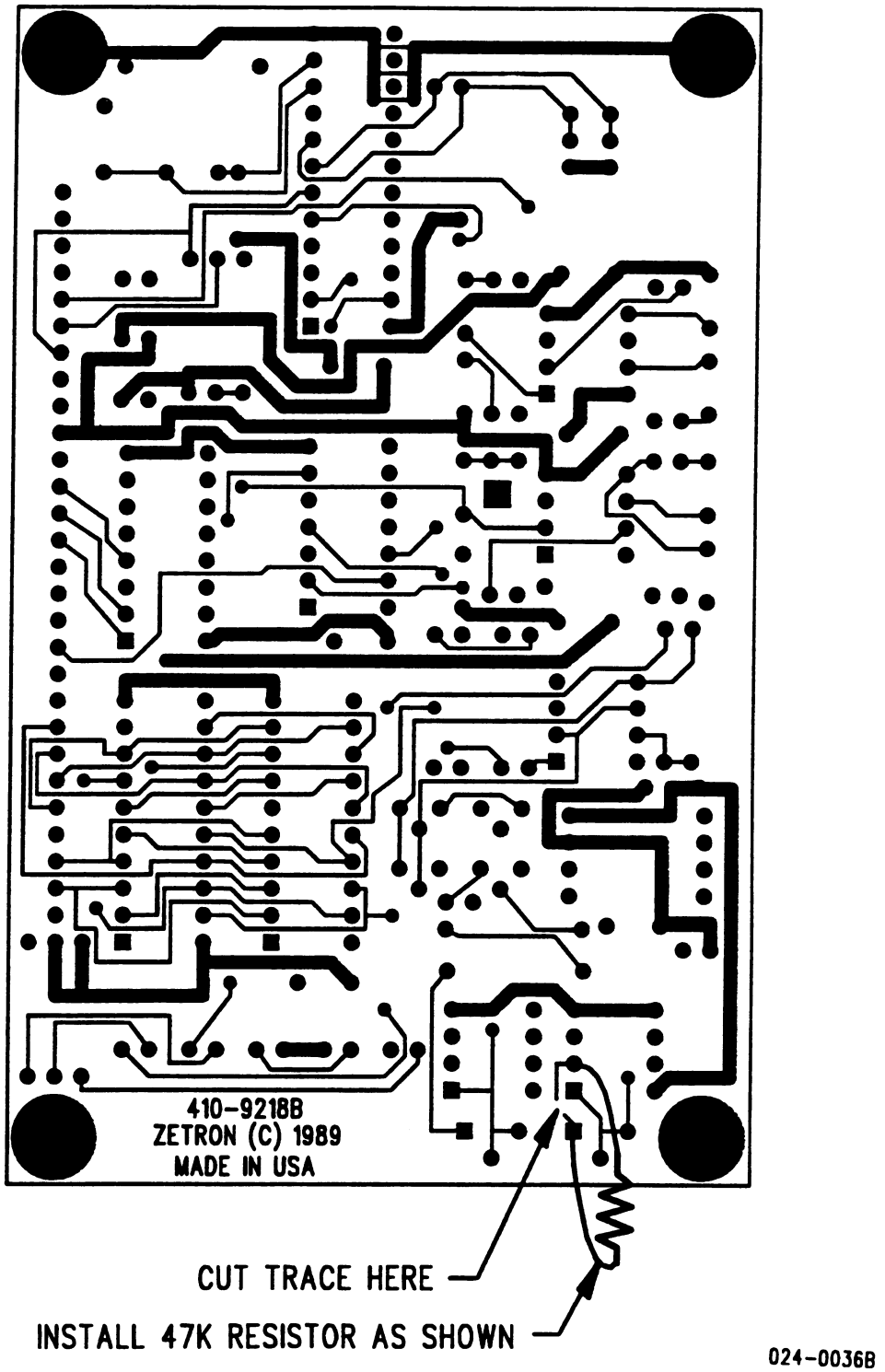


Figure 4-5. Protocol Board Modification for Motorola Micor Repeaters

D1. NEW RELM 800MHZ REPEATER

Be sure that the Model 49 jumpers are set per 3D1 in "Step 1: Setting the Jumpers". Then perform the following steps:

[]1. Set the repeater front panel controls as follow:

VOLUME: Any position (receiver level to Zetron Model 49 is independent)
SQUELCH: Any position (Model 49 squelching is independent)

[]2. Connect the Model 49 to the Relm bulkhead connector with the new Relm repeater cable (709-7279) as shown in Figures 4-6 and 4-7.

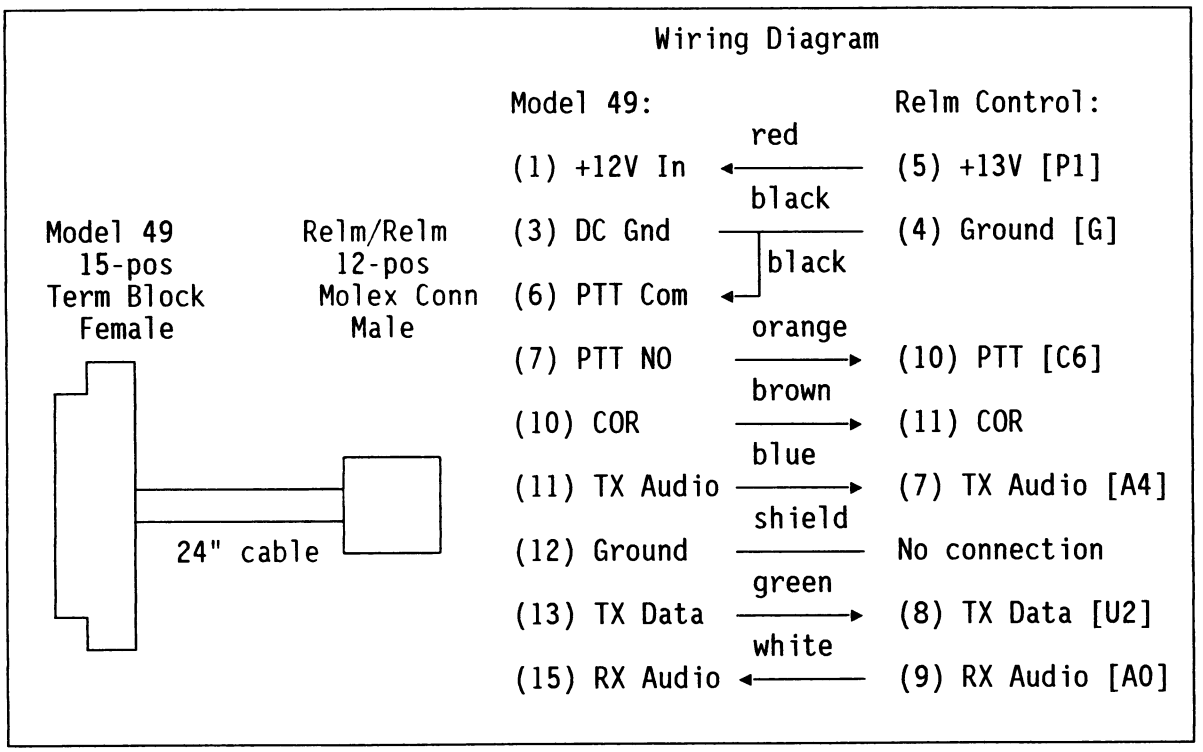


Figure 4-6. Model 49 to New Relm Repeater Cable (P/N 709-7279)

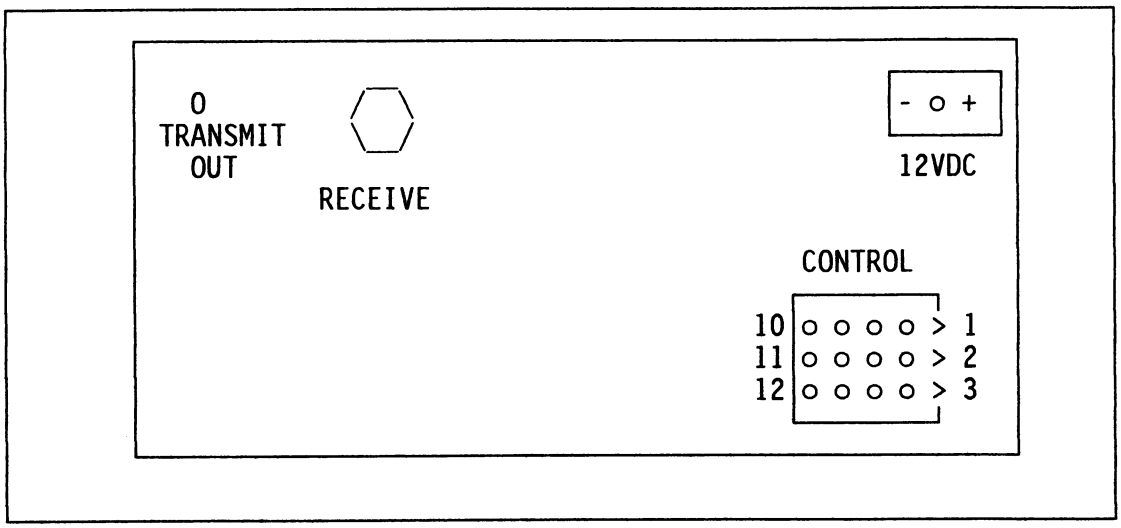


Figure 4-7. Relm/Regency Rear Panel

[]3. Repeater Adjustments:

Transmit Level Adjustments

[]a. Put Model 49 into Test mode: put SW1-1 up, press and hold the connect/disconnect button about 2 seconds, or until the front panel lights flash and go off. Then release the button. The Model 49 should boot up transmitting data and ring bursts.

During the following steps, verify that the Model 49 "Compat. Mode" is set to "J" (use the following screens: Multibase / Edit / Site Config / Compat. Mode [located near the middle of the screen]). If you need to change the setting, make note of the original setting.

[]b. Disconnect the blue and green wires (pins 11 & 13) from the radio connector on the Model 49.

[]c. Connect a 1000-Hz audio oscillator between the green wire (disconnected above) and the base station ground lead (pin 3 - radio connector on Model 49).

[]d. While monitoring transmitter deviation with a service monitor, adjust the audio oscillator until the modulation level doesn't increase with any further increase in the output of the audio oscillator.

[]e. Double the output level of the audio oscillator (to insure that you are well into the transmitters limiter).

[]f. Adjust the transmitter modulation pot (R337D) for 4.0 kHz (assuming 5.0 kHz total channel deviation). Disconnect the audio oscillator after this adjustment is complete.

[]g. Reconnect the green lead to pin 13 of the Model 49 radio connector.

[]h. Adjust the Model 49 TX DATA for 0.95-kHz deviation.

[]i. Reconnect the blue lead to pin 11 of the Model 49 radio connector.

[]j. Adjust the Model 49 TX AUD for 4.5-kHz deviation during ring bursts.

[]k. Turn off Test mode: set SW1-1 down and reset. To reset, press and hold the connect/disconnect button about 2 seconds, or until the front panel lights flash and go off. Then release the button.

Squelch Adjustments

[]l. With NO Receive carrier applied to the repeater, adjust the Model 49 SQUELCH fully CW. The "CARRIER" LED should light. Adjust slowly CCW until the LED goes off steady.

Receive Level Adjustments

[]m. Inject 1 mV Receive carrier directly into the Repeater RX Antenna port.

[]n. With 1-kHz tone modulating at 4-kHz deviation, adjust the Model 49 RX AUD potentiometer until 1 V p-p (354 mVrms) is measured at Model 49 TP5.

[]o. With 100 Hz sinewave tone modulating at 0.8 KHz deviation (with or without the 1 KHz tone), adjust the Rx Data CW from fully CCW until the Peak Data LEDs (second and third from left on the protocol card) both light equally.

[]p. Remove the service monitor, and reconnect the antenna. Test the repeater using radios having VALID ID numbers.

D2. OLD RELM 800MHZ REPEATER

Be sure that the Model 49 jumpers are set per 3D2 in "Step 1: Setting the Jumpers". Then perform the following modifications to provide interface signals on the Relm rear panel connector:

[]1. Remove the top cover of the Relm.

* * * * * * * * * * * * * * * NOTE * * * * * * * * * * * * * * *

If a second feed-thru exists between the Relm Rx and Tx cavities *and* is wired, contact RELM personnel about upgrading the repeater before using.

* *

[]2. Locate the Zetron jumper cable (Part No. 709-7152) in the cable kit (Part No. 709-7148). See Figure 4-8.

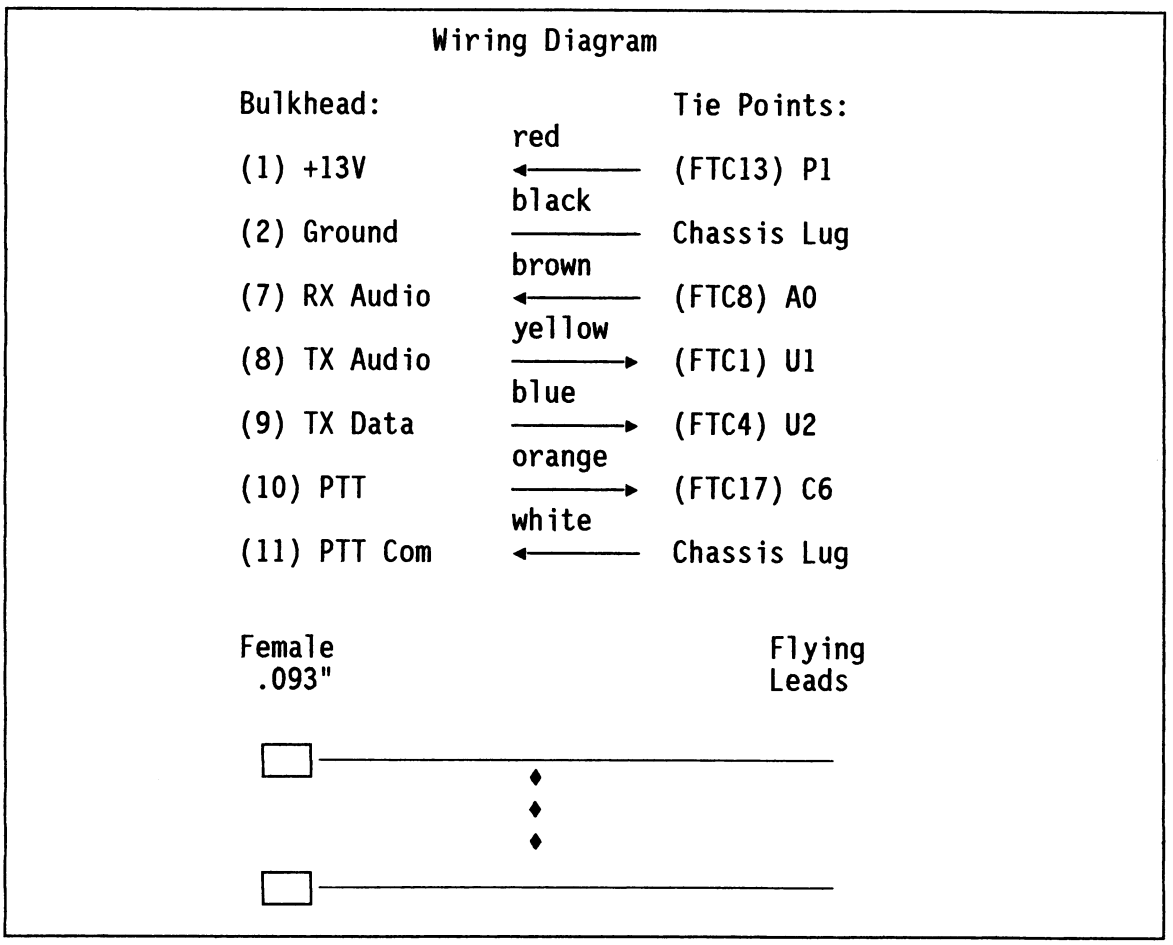


Figure 4-8. Relm Repeater Jumper Cable (P/N 709-7152)

[]3. Solder the bare wire ends to the feed-thru capacitors in the walls of the RF cabinet as shown in Figure 4-9. Note that the blue wire has a resistor lead exposed.

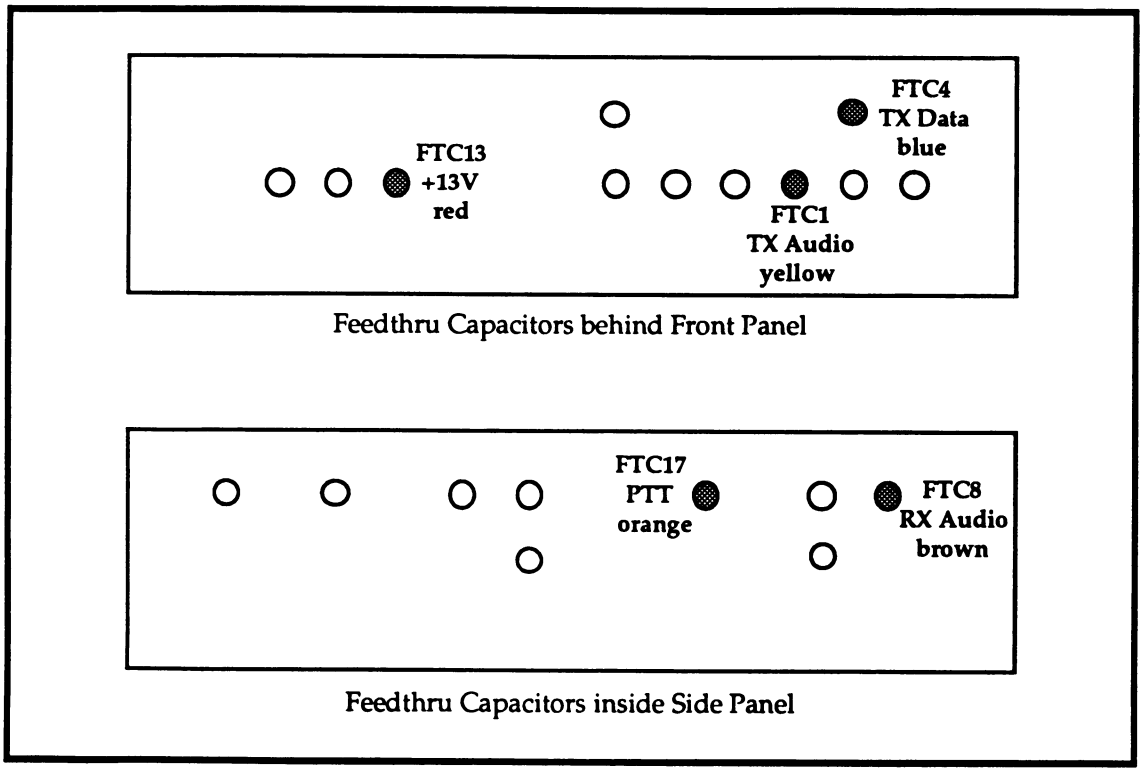
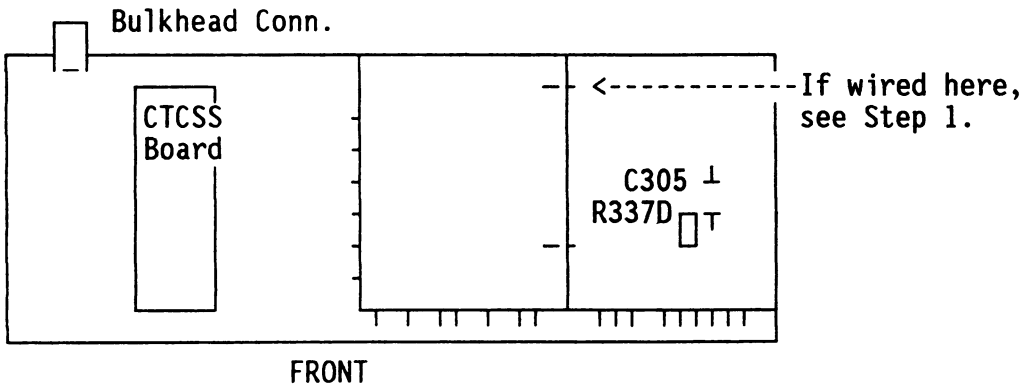


Figure 4-9. Relm Repeater Tie Points

[]4. Solder the 100-ohm, ¼-watt resistor from the cable kit (Part No. 709-7148) across C305 of the repeater. C305 is located behind and to the right of R337D, the Transmit Limit Adjust potentiometer in the repeater transmit cavity. Refer to illustration below:



[]5. Solder the black, white, and bare shield wires to a convenient chassis lug.

[]6. Insert the female 0.093-inch sockets from the jumper cable into the 12-position plastic bulkhead connector per the pin numbers shown in Figure 4-10.

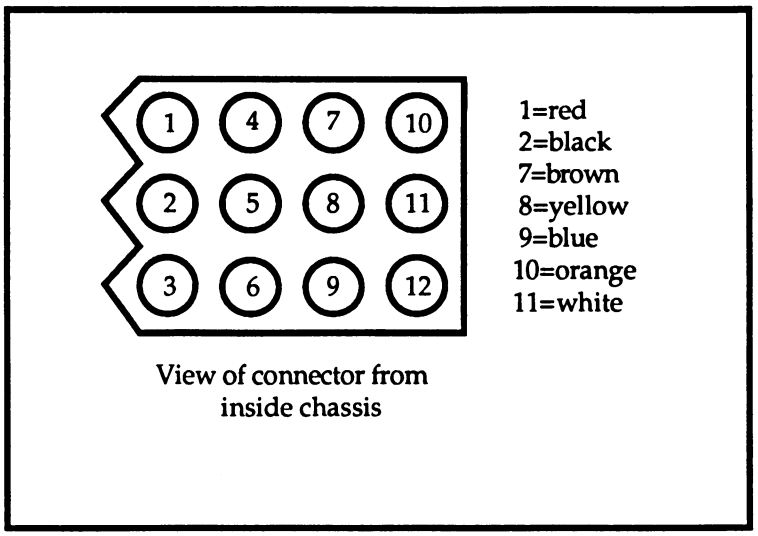


Figure 4-10. Relm Bulkhead Connector Pinout

[]7. Route the cable along the Relm rear panel (along the bottom chassis) and secure with tie-wraps.

[]8. Set the front panel controls as follow:

VOLUME: any position (receiver level to Zetron Model 49 is independent)
SQUELCH: any position (Model 49 squelching is independent)
REPEAT/LOCAL: put switch into IN (repeat) position

[]9. Connect the Model 49 to the Relm bulkhead connector with the repeater cable as shown in Figures 4-11 and 4-12.

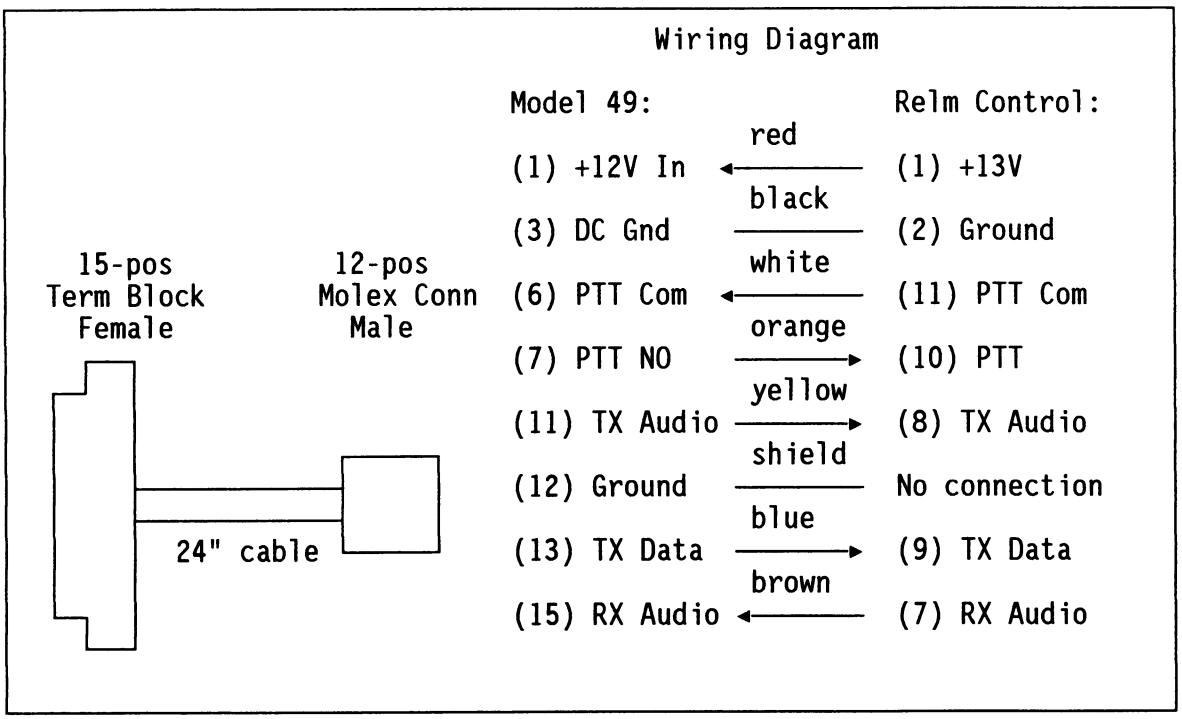


Figure 4-11. Model 49 to Relm Repeater Cable (P/N 709-7148)

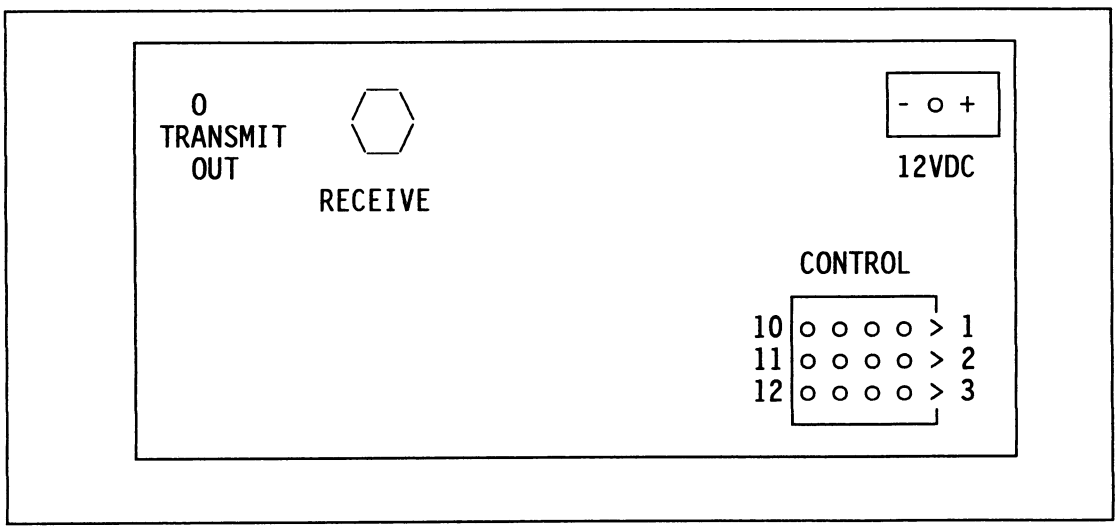


Figure 4-12. Relm Rear Panel

[]10. Transmit Level Adjustments:

a. Put Model 49 into Test mode: put SW1-1 up, press and hold the connect/disconnect button about 2 seconds, or until the front panel lights flash and go off. Then release the button. The Model 49 should boot up transmitting data and ring bursts.

During the following steps, verify that the Model 49 "Compat. Mode" is set to "J" (use the following screens: Multibase/Edit/Site Config/Compat. Mode [located near the middle of the screen]). If you need to change the setting, make note of the original setting.

b. Disconnect the blue and yellow wires (pins 11 & 13) from the radio connector on the Model 49.

c. Connect a 1000-Hz audio oscillator between the yellow wire (disconnected above) and the base station ground lead (pin 3 - radio connector on Model 49).

d. While monitoring transmitter deviation with a service monitor, adjust the audio oscillator until the modulation level doesn't increase with any further increase in the output of the audio oscillator.

e. Double the output level of the audio oscillator (to insure that you are well into the transmitters limiter).

f. Adjust the transmitter modulation pot (R337D) for 4.0 kHz (assuming 5.0 kHz total channel deviation). Disconnect the audio oscillator after this adjustment is complete.

g. Reconnect the blue lead to pin 13 of the Model 49 radio connector.

h. Adjust the Model 49 TX DATA for 0.95-kHz deviation.

i. Reconnect the yellow lead to pin 11 of the Model 49 radio connector.

j. Adjust the Model 49 TX AUD for 4.5-kHz deviation during ring bursts.

k. Turn off Test mode: set SW1-1 down and reset. To reset, press and hold the connect/disconnect button about 2 seconds, or until the front panel lights flash and go off. Then release the button.

[]11.Receive Level Adjustments:

a. With NO Receive carrier applied to the repeater, adjust the Model 49 SQUELCH fully CW. The "CARRIER" LED should light. Adjust slowly CCW until the LED goes off steady.

b. Inject 1 mV Receive carrier directly into the Repeater RX Antenna port.

c. With 1-kHz tone modulating at 4-kHz deviation, adjust the Model 49 RX AUD potentiometer until 1 V p-p (354 mVrms) is measured at Model 49 TP5.

d. With 100-Hz tone modulating at 0.8-kHz deviation (with or without the 1-kHz tone), adjust the RX DATA CW from fully CCW until the Peak Data LEDs (second and third from the left on the Protocol Card) both light equally.

e. Remove the service monitor, and reconnect the antenna. Test the repeater using radios having VALID ID numbers.

[]12.Verify connections of the BNC-cabled (daisy chain) "Subscriber" and "Repeater" buses and associated line terminations. Refer to Section 3 for detailed explanations of these buses. To prevent data loading problems, we recommend only ONE termination resistor per bus.

[]13.Replace the repeater top cover and the Model 49 top cover.

[]14.Set the Model 49 "Compat. Mode" to its original (prior to Step 10a) setting (see Step 10a above).

[]15.Your system is ready for use.

E1. STANDARD RP70K REPEATER

Be sure that the Model 49 jumpers are set per 3E1 in "Step 1: Setting the Jumpers". Then perform the following modifications to make the RP70K capable of handling the subaudible data requirements of LTR:

[]1. Remove the bottom cover.

[]2. Remove the shields from the TX and RX assemblies.

[]3. Unplug W201 from J201 on the Control Card. Slide the Yellow wire out of W201 pin 2. See Figure 4-13.

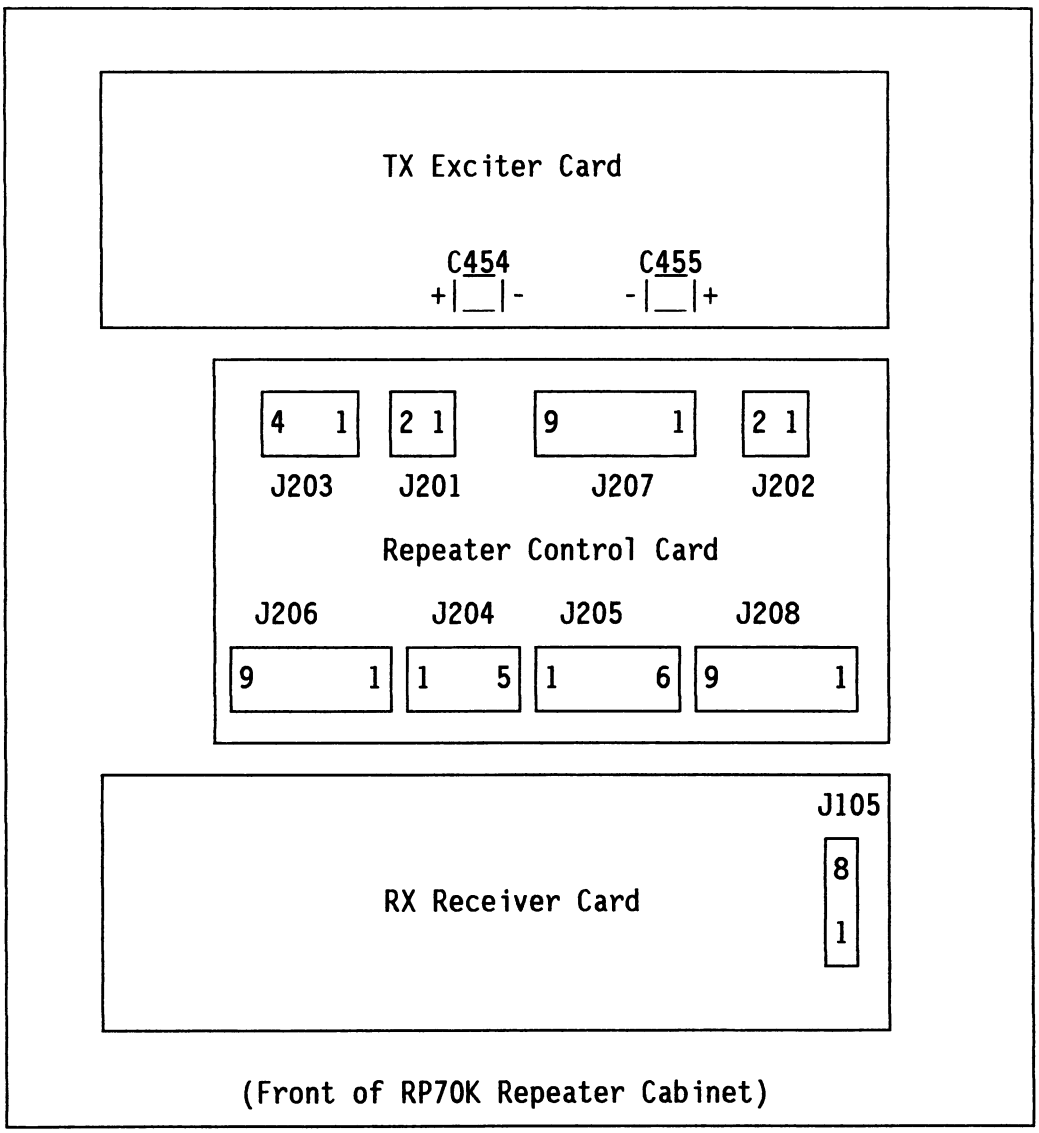


Figure 4-13. Layout of RP70K Cards and Connectors

[]4. Unplug W207 from J207 on the Control Card. Slide the White wire out of W207 pin 6.

[]5. Connect the Yellow wire to the White wire. [Data Input Signal]

[]6. Plug connectors W201 and W207 back into place.

[]7. Unplug W205 from J205 on the Control Card. Slide the shielded cable from out of connector W205 pins 5&6. Cut the ends, strip back 1/16", and tin the leads.

[]8. Unplug W105 from J105 on the Receiver Card. Slide Black and Yellow wires out of pins 1 and 2.

[]9. Solder the shielded cable from W205 to the wires from W105:

White to Yellow, Black to Black. [RX Discriminator Audio]

[]10. Insert the White/Yellow wire into W105 pin 2, the Black/Black wire into W105 pin 1.

[]11. Plug connectors W105 and W205 back into place.

[]12. Unscrew the 4 mounting screws from the TX Exciter Card and flip it

[]13. Replace C454 and C455 capacitors with 100 μF 25 V each. Observe correct polarity!

[]14. Reinstall the TX Exciter Card.

[]15. Reinstall the shields and bottom cover.

[]16. Set the repeater front panel controls as follow.

TONE1 and TONEB switches in OUT positions
MONITOR switch in OUT position
BASE/REPEATER switch in IN (base) position
SQL control in IN (preset) position
VOLUME control IN to turn off the speaker or OUT to listen

[]17. Connect the Model 49 to the RP70K with the repeater cable. See Figure 4-14.

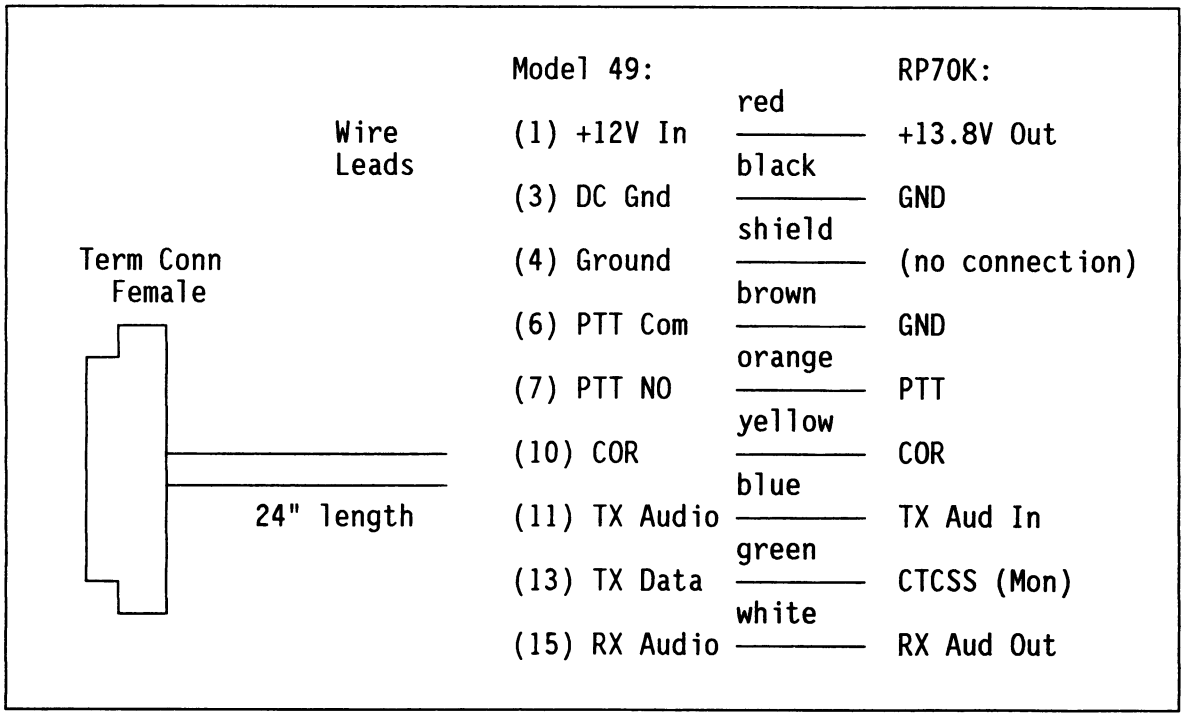


Figure 4-14. Model 49 to Generic Repeater Cable (P/N 709-7116)

Set the TX and RX audio and data levels by following the procedure described in "Step 5: Setting Repeater Levels" or "Step 5A: Setting Repeater Levels for V6.10 Firmware".

Note: You can record your settings on the worksheet in the Appendix.

E2. STANDARD RPT-38 REPEATER

Be sure that the Model 49 jumpers are set per 3E2 in "Step 1: Setting the Jumpers". Then perform the following modifications to make the RP70K capable of handling the subaudible data requirements of LTR:

[]1. Connect the Model 49 to the Repeater using the generic repeater interface cable (part #709-7116). See Figure 4-15.

[]2. Connect a jumper wire at the Model 49 end of the cable between pins four and six.

Model 49		709-7116	**Standard RPT-38 Repeater Connections**			
Function	J1	Wire Color	TB1	Color	RX DB-15	TX DB-15
AC/DC +12V	1	RED	TB-11	RED	9,10	9,10
AC	2					
DC GND	3	BLACK	TB-12	BLA	14,15	14,15
GND	4	SHIELD	NC			
PTT NC	5		TB-3	ORG	NC	4
PTT COM	6	←Add jumper				
PTT NO	7	ORANGE	TB-9	WHI	NC	13
CTL-1	8					
SENSE-1	9					
COR	10	YELLOW	TB-8	GRA	11	NC
TX AUD	11	BLUE	TB-4	YEL	NC	1
GND	12					
SUB OUT	13	GREEN	TB-6	BLU	NC	8
GND	14					
DISC IN	15	WHITE	TB-5	GRN	6	NC

NOTES:

1. The Standard RPT-38 Repeater is configured to facilitate one transmitter T881 module and one receiver T885 module, mounted onto a single 19" rack faceplate.
2. ONLY ONE M42 or M49 should be connected to each transmit / receive pair of modules via the "TB" connector. (All Tx/Rx terminations are shown for technical convenience.)
3. Remove any TB1 jumpers NOT shown in the above wiring list.

Figure 4-15. Model 49 to Repeater Cable (P/N 709-7116)

[]3. Verify the RPT-38 T881 Transmitter jumpers, and T885 Receiver jumpers as follows:

T881 Tx Jumpers	T885 Rx Jumpers
PL100 = 3-4	PL100 = 2-3
PL101 = 1-2	PL101 = 1-2
PL102 = 9-10	PL102 = 1-2
PL103 = 3-4	PL104 = 1-2
	PL105 = 2-3
Remove R257 (0Ω) to disable Tx TOT (near IC202 on bottom of board).	PL103 = Place jumper onto pin 3 only (not installed).
	PL106 = Place jumper onto pin 3 only (not installed).
	Add: Jumper wire soldered from PAD111 [DEMOD O/P] to PAD122 [AUDIO 2] (or PL106-1).

Set the TX and RX audio and data levels by following the procedure described in "Step 5: Setting Repeater Levels" or "Step 5A: Setting Repeater Levels for V6.10 Firmware".

Note: You can record your settings on the worksheet in the Appendix.

F1. TAIT RACKFRAME REPEATER

Be sure that the Model 49 jumpers are set per 3F1 in "Step 1: Setting the Jumpers". Then perform the following steps.

[]1. Connect the Model 49 to the Tait Repeater using the generic repeater interface cable (Part No. 709-7116). See Figure 4-16. Be careful to reference the correct rackframe slots for the transmitter module and receiver module applicable for your installation.

[]2. Connect a jumper wire at the Model 49 end of the cable between pins 4 and 6.

Model 49		709-7116	Tait Transmitter Rackframe Connections					Tait Receiver Rackframe Connections				
Function	J1	Wire Color	CH 1	CH 2	CH 3	CH 4	CH 5	CH 1	CH 2	CH 3	CH 4	CH 5
AC/DC +12V	1	RED	TB1-1	TB1-6	TB1-11	TB2-1	TB2-6					
AC	2											
DC GND	3	BLACK	TB1-2	TB1-7	TB1-12	TB2-2	TB2-7					
GND	4	SHIELD	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
PTT NC	5											
PTT COM	6	←Add jumper										
PTT NO	7	ORANGE	TB1-5	TB1-10	TB1-15	TB2-5	TB2-10					
CTL-1	8											
SENSE-1	9											
COR	10	YELLOW						TB1-2	TB1-4	TB1-6	TB1-8	TB1-10
TX AUD	11	BLUE	TB1-3	TB1-8	TB1-13	TB2-3	TB2-8					
GND	12											
SUB OUT	13	GREEN	TB1-4	TB1-9	TB1-14	TB2-4	TB2-9					
GND	14											
DISC IN	15	WHITE						TB1-1	TB1-3	TB1-5	TB1-7	TB1-9

NOTES:

1. The Tait Rackframe configuration is configured to facilitate 5 transmitter T881 modules in one rack, and five receiver T885 modules in a second rack.
2. ONLY ONE M49 should be connected to each transmit / receive pair of modules (i.e. Five (5) M49 units are required for five repeaters). All Tx/Rx terminations are shown for convenience.
3. The receiver connections will need to be extended with wires to the receiver rackframe. Shielded wires are preferred, having the shield connected at one end only.

Figure 4-16. Model 49 to Tait Repeater Cable (P/N 709-7116)

[]3. Verify the Tait T881 Transmitter jumpers, and T885 Receiver jumpers as follows:

T881 Tx Jumpers	T885 Rx Jumpers
PL100 = 3-4	PL100 = 2-3
PL101 = 1-2	PL101 = 1-2
PL102 = 9-10	PL102 = 1-2
PL103 = 3-4	PL104 = 1-2
	PL105 = 2-3
Remove R257 (0Ω) to disable Tx TOT (near IC202 on bottom of board).	PL103 = Place jumper onto pin 3 only (not installed).
	PL106 = Place jumper onto pin 3 only (not installed).
	Add: Jumper wire soldered from PAD111 [DEMOD O/P] to PAD122 [AUDIO 2] (or PL106-1).

Set the TX and RX audio and data levels by following the procedure described in "Step 5: Setting Repeater Levels" or "Step 5A: Setting Repeater Levels for V6.10 Firmware".

Note: You can record your settings on the worksheet in the Appendix.

F2. TAIT SLIMLINE REPEATER

Be sure that the Model 49 jumpers are set per 3F2 in "Step 1: Setting the Jumpers". Then perform the following steps.

[]1. Connect the Model 49 to the Tait Repeater using the generic repeater interface cable (part #709-7116). See Figure 4-17.

[]2. Connect a jumper wire at the Model 49 end of the cable between pins 4 and 6.

Model 49		709-7116	**Tait Slimline Repeater Connections**			
Function	J1	Wire Color	TB1	Color	RX DB-15	TX DB-15
AC/DC +12V	1	RED	TB-11	RED	9,10	9,10
AC	2					
DC GND	3	BLACK	TB-12	BLA	14,15	14,15
GND	4	SHIELD	NC			
PTT NC	5		TB-3	ORG	NC	4
PTT COM	6	←Add jumper				
PTT NO	7	ORANGE	TB-9	WHI	NC	13
CTL-1	8					
SENSE-1	9					
COR	10	YELLOW	TB-8	GRA	11	NC
TX AUD	11	BLUE	TB-4	YEL	NC	1
GND	12					
SUB OUT	13	GREEN	TB-6	BLU	NC	8
GND	14					
DISC IN	15	WHITE	TB-5	GRN	6	NC

NOTES:

1. The Tait Slimline Repeater is configured to facilitate one transmitter T881 module and one receiver T885 module, mounted onto a single 19" rack faceplate.
2. ONLY ONE M42 or M49 should be connected to each transmit / receive pair of modules (i.e. each Slimline), via the "TB" connector.
   (All Tx/Rx terminations are shown for technical convenience.)
3. Remove any TB1 jumpers NOT shown in the above wiring list.

Figure 4-17. Model 49 to Tait Repeater Cable (P/N 709-7116)

[]3. Verify the Tait T881 Transmitter jumpers, and T885 Receiver jumpers as follows:

T881 Tx Jumpers	T885 Rx Jumpers
PL100 = 3-4	PL100 = 2-3
PL101 = 1-2	PL101 = 1-2
PL102 = 9-10	PL102 = 1-2
PL103 = 3-4	PL104 = 1-2
	PL105 = 2-3
Remove R257 (0Ω) to disable Tx TOT (near IC202 on bottom of board).	PL103 = Place jumper onto pin 3 only (not installed).
	PL106 = Place jumper onto pin 3 only (not installed).
	Add: Jumper wire soldered from PAD111 [DEMOD O/P] to PAD122 [AUDIO 2] (or PL106-1).

Set the TX and RX audio and data levels by following the procedure described in "Step 5: Setting Repeater Levels" or "Step 5A: Setting Repeater Levels for V6.10 Firmware".

Note: You can record your settings on the worksheet in the Appendix.

G1. UNIDEN MRS804 REPEATER

Be sure that the Model 49 jumpers are set per 3G1 in "Step 1: Setting the Jumpers". Then perform the following modifications to provide interface signals on the Uniden MRS804 rear panel Accessory connector:

[] 1. Remove the top cover of the MRS804 or slide it forward in its rack-mounting frame.

[] 2. Tilt up the transceiver sub-chassis.

[]3a. For MRS804S (conventional): disconnect the 13-pin CN1 connector from J601 on the repeater control board. The 14-pin CN2 connector should be loose already.

[]3b. For MRS804T (trunking): disconnect the 13-pin CN1 and 14-pin CN2 connectors from the logic board.

[] 4. Connect the Zetron jumper board (Part No. 702-9404) between CN1 and CN2. Note that the Uniden connectors have plastic keys in the pin 2 position. See Figure 4-18.

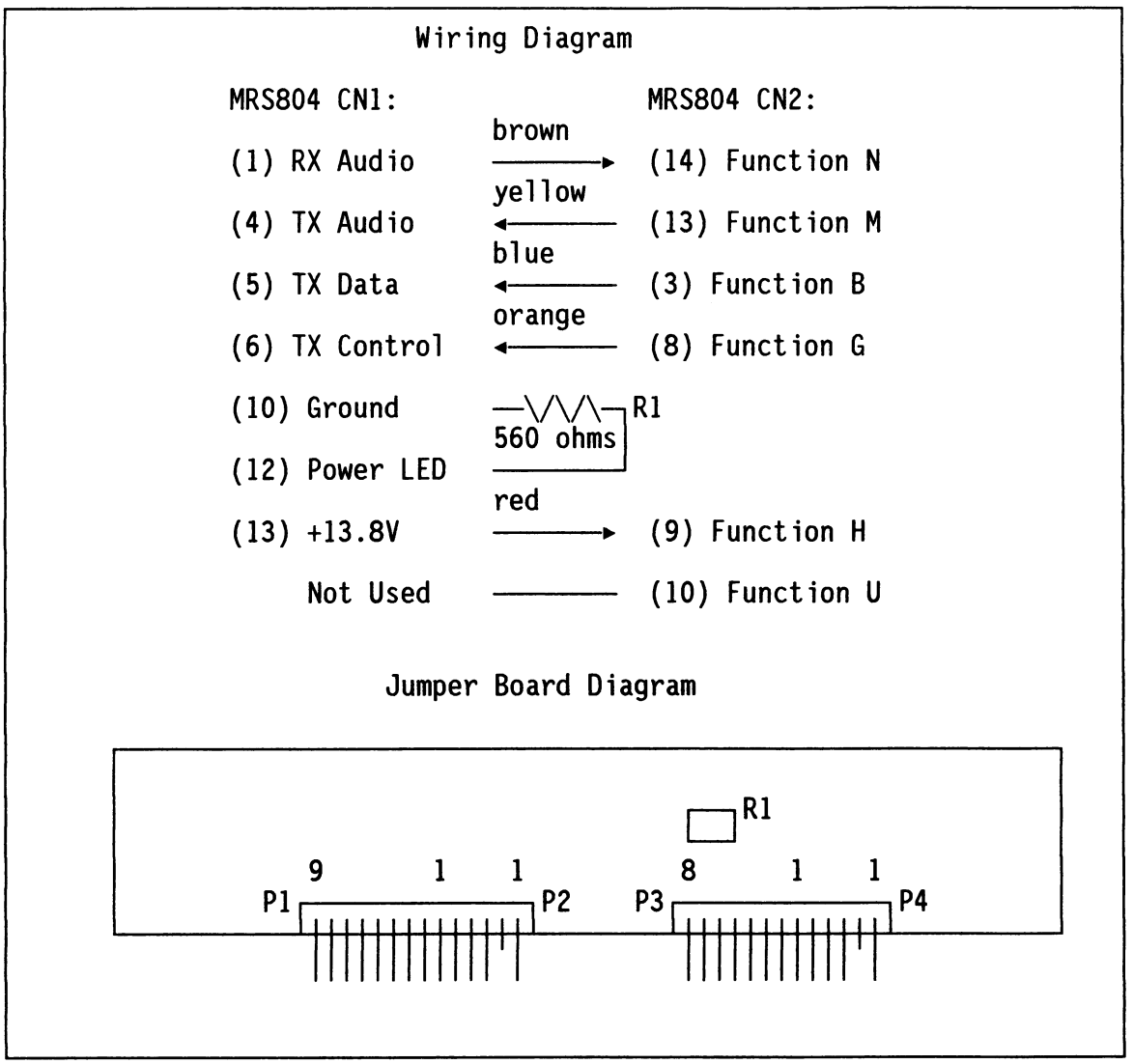


Figure 4-18. Zetron/Uniden MRS804 Jumper Board (P/N 702-9404)

Note: If you have an early cable instead of a board, the green wire on the jumper cable will not be used.

[] 5. Carefully close and lock the sub-chassis, being careful not to pinch the exciter coax nor the power wires.

[] 6. Secure the sub-chassis with the locking screws.

[] 7. Turn VR103 on the MRS804 exciter about 1/4 turn clockwise to get more adjustment range on the Zetron transmit data deviation. See Figure 4-19.

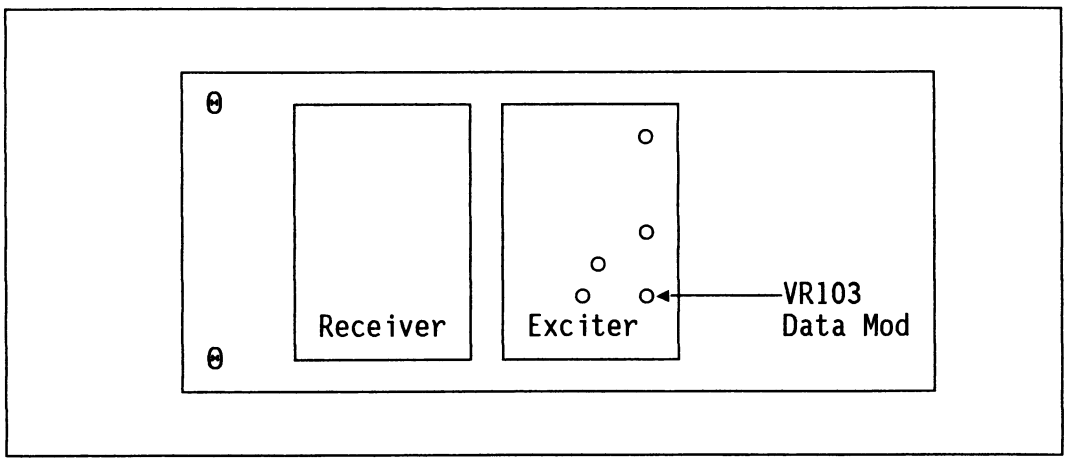


Figure 4-19. Uniden MRS804 Internal Sub-Chassis

[] 8. Replace the top cover on the MRS804 or slide it back into its rack-mounting frame.

[] 9. Set the front panel controls as follow:

VOLUME any position (receiver level to Zetron Model 49 is independent)
SQUELCH any position (squelch level is set in the Model 49)
REPEAT/LOCAL switch in IN (repeat) position
OPT switch either position

Connect the Model 49 to the MRS804 Accessory connector with the repeater cable. See Figure 4-20.

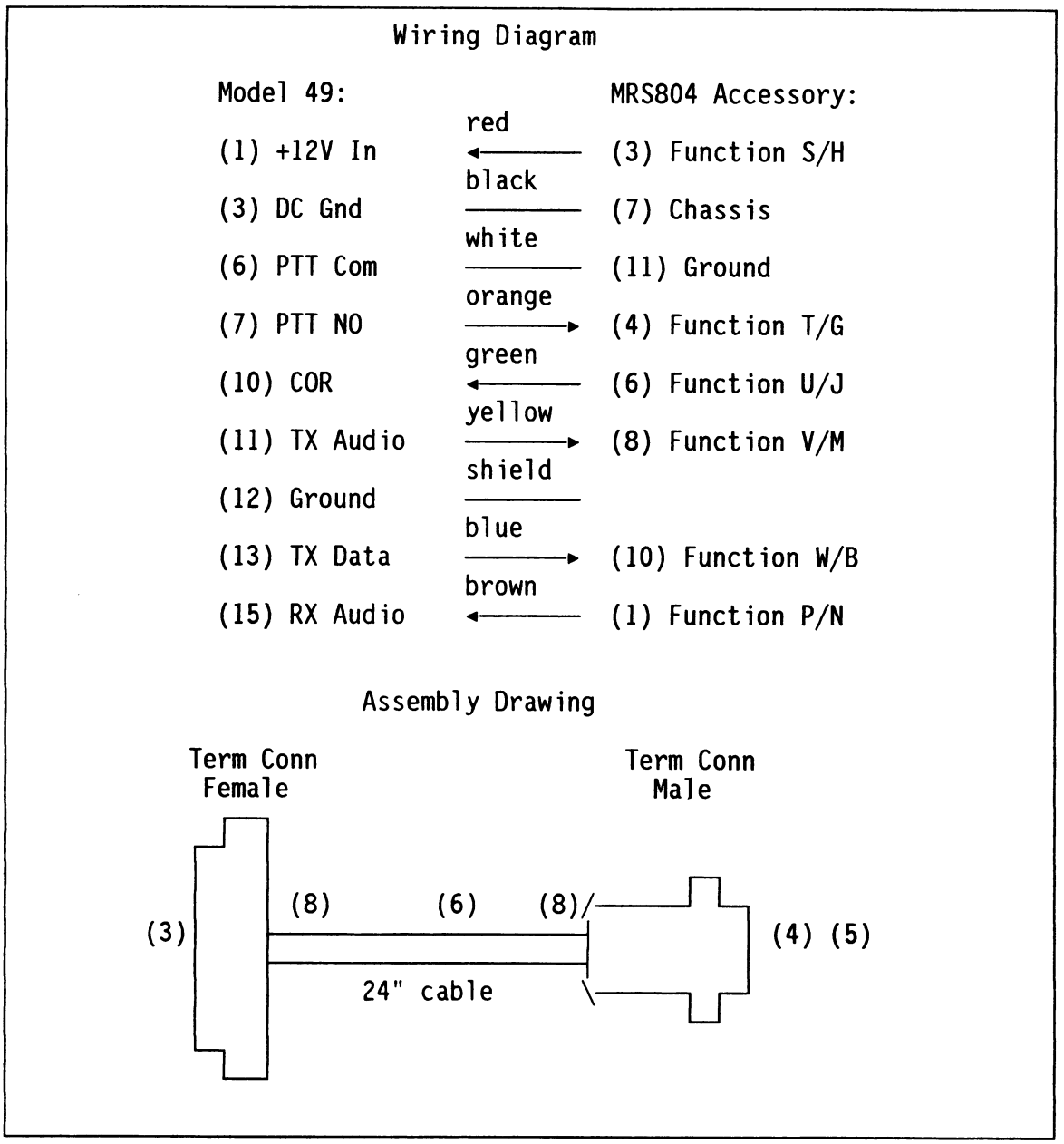


Figure 4-20. Model 49 to Uniden MRS804 Repeater Cable (P/N 709-7132)

Set the TX and RX audio and data levels by following the steps listed below. See Figure 4-21.

Note: This procedure requires two service monitors and an LTR encoder. If not all the equipment is available, follow the procedure described in "Step 5: Setting Repeater Levels" or "Step 5A: Setting Repeater Levels for V6.10 Firmware".

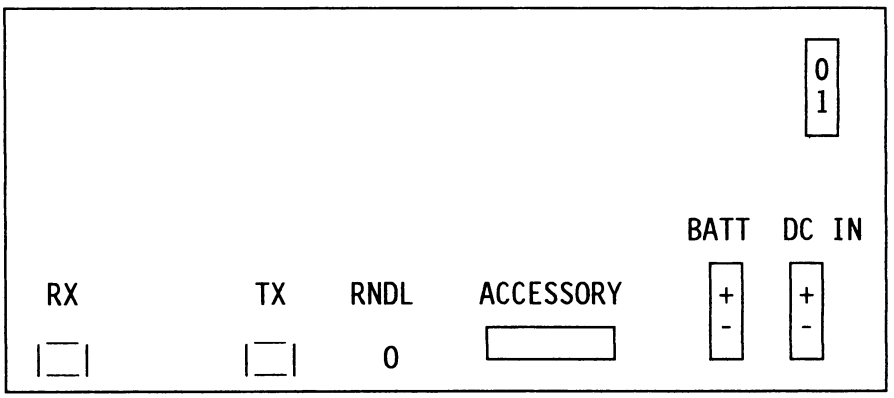


Figure 4-21. Uniden MRS804 Rear Panel

NOISE SQUELCH LEVEL

[] 1. Set the first communications monitor to generate an RF signal of 0.25 μV on the repeater receive frequency.

[] 2. On the Model 49, set the front panel COR pot to midway.

[] 3. On the Model 49, turn the front panel SQ pot counterclockwise until the COR light goes out. Turn the SQ pot clockwise until the COR light just comes on solid.

RECEIVE LEVELS

[] 1. Increase the RF signal level to 1 mV, modulated with a 1kHz sine wave at ±4 kHz modulation. Attach an AC voltmeter to TP5, behind the front panel RX pot (Model 49). Adjust the RX AUD pot on the Model 49 for a 0.35 VAC RMS reading on the meter (1 V p-p on an oscilloscope).

[] 2. Apply an RF signal at 1 mV output, modulated with the proper LTR data at 1 kHz modulation. Turn the RX DATA pot on the Model 49 Protocol card fully counterclockwise so that only one RX CENTER light is flickering. Now turn the pot clockwise until both RX CENTER lights flicker rapidly (this should produce a 1.3 V p-p (0.46 VAC rms) waveform at U11-1 on the Protocol card.

[] 3. The Model 49 CARRIER, TRANSMIT, RX PACKET, TX PACKET and RX DATA CENTERING lights should all be lit at this time. If not, double check the Protocol card jumpers, the Repeater and Area switches on the Model 49 front panel, and ensure the proper LTR data is being generated at the communications monitor.

TRANSMIT LEVELS

[] 4. Set the second communications monitor to receive on the Repeater transmit frequency.

[] 5. Set the TX AUDIO pot fully counterclockwise.

[] 6. Adjust the TX DATA pot on the Model 49 Protocol card fully clockwise or to 11 o'clock. Adjust VR103 on the Repeater Transmitter Module for ±1 kHz deviation as measured on the second monitor.

[] 7. Modulate the first communications monitor with a 1kHz tone, set the total modulation for 4 kHz (1.6 kHz for 900 MHz), or 5 kHz with subaudible (2.5 kHz for 900 MHz).

[] 8. Set the TX AUD pot on the Model 49 front panel halfway or to 6 o'clock.

[] 9. Set VR105 on the Repeater Transmitter Module so that the transmitted 1kHz tone (as seen on the second monitor) is just starting to clip at the peaks.

[]10. Set VR104 on the Repeater Transmitter Module so that the total transmitted deviation is 5 kHz (2.5 kHz for 900 MHz).

G2. UNIDEN MRS802 REPEATER

Be sure that the Model 49 jumpers are set per 3G2 in "Step 1: Setting the Jumpers". Then perform the following modifications to provide interface signals on the Uniden MRS802 rear panel ACC (ARX780) connector:

[] 1. Remove the top and bottom covers of the MRS802.

[]2a. For MRS800 (conventional): disconnect the 13-pin CN1 connector from the repeater control board. The 13-pin CN2 connector should be loose already.

[]2b. For MRS802 (trunking): disconnect the 13-pin CN1 and CN2 connectors from the logic board underneath the repeater frame.

[] 3. Connect the Zetron jumper cable (in the 709-7147 cable kit) between CN1 and CN2. The 7-position Zetron jumper connects its orange wire to CN2's orange wire. The 13-position end connects its red wire to CN1's red wire. See Figure 4-22.

Note: Connectors CN1 and CN2 each have 13 positions. CN2 is the one with a short pink wire loop from pins 1 & 4. On CN1, pin 13 has a red wire, CN2-13 has an orange wire.

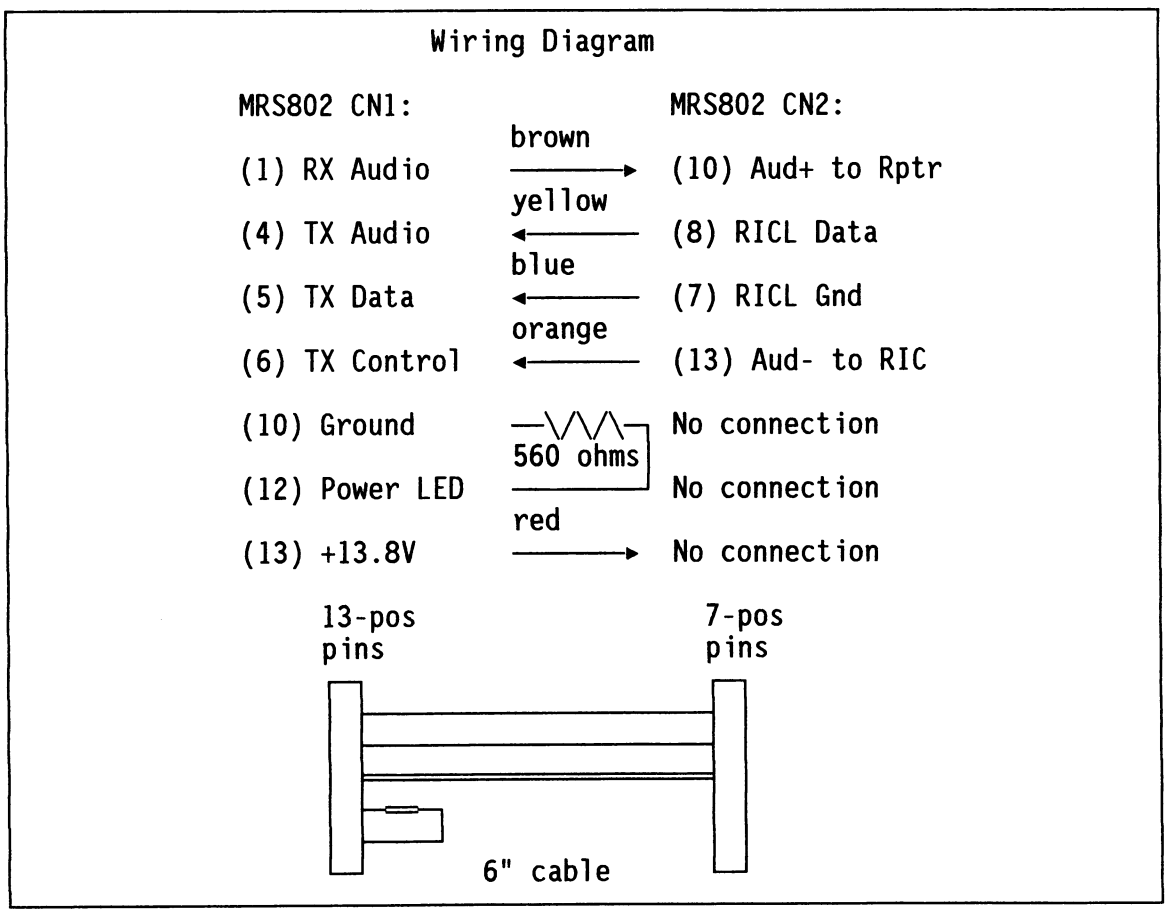


Figure 4-22. Zetron/Uniden MRS802 Jumper Cable (P/N 709-7147)

[] 4. Tuck the Zetron jumper cable under the main chassis plate, making sure that it does not short to the chassis.

[] 5. Turn the DATA pot R32 on the Local Oscillator about 1/4 turn clockwise to get more adjustment range on the LTR transmit data deviation. See Figure 4-23.

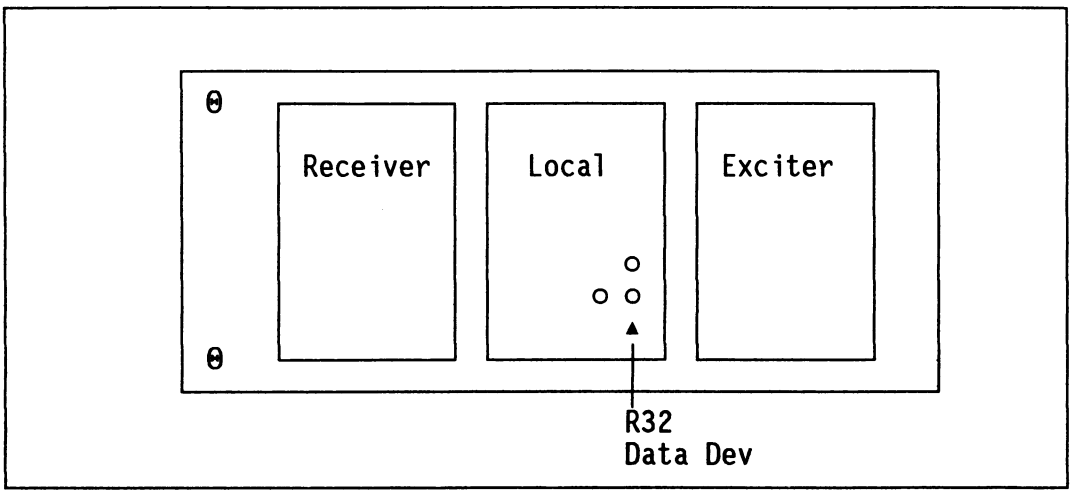


Figure 4-23. Uniden MRS802 Internal Sub-Chassis

[] 6. Replace the covers on the MRS802.

[] 7. Set the MRS802 front panel controls as follow:

VOLUME any position (receiver level to Zetron Model 49 is independent)
SQUELCH any position (squelch level is set in the Model 49)
REPEAT/LOCAL switch in IN (repeat) position
OPT switch either position

[] 8. Connect the Model 49 to the MRS802 ACC (ARX780) connector with repeater cable. See Figure 4-24.

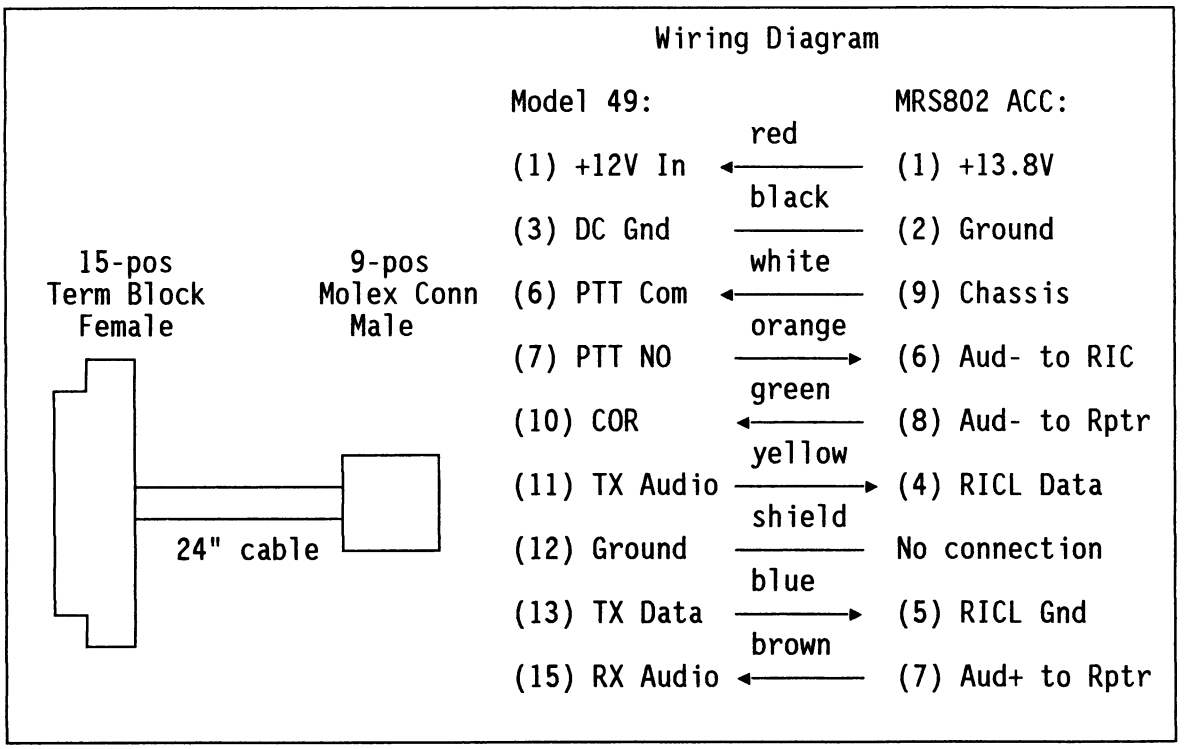


Figure 4-24. Model 49 to Uniden MRS802 Repeater Cable (P/N 709-7147)

Set the TX and RX audio and data levels by following the procedure described in "Step 5: Setting Repeater Levels" or "Step 5A: Setting Repeater Levels for V6.10 Firmware".

Note: You can record your settings on the worksheet in the Appendix.

Step 5: Setting Repeater Levels

The following procedures are for the E.F. Johnson, Standard RP70K, Uniden MRS802, Tait, and Motorola Micor repeaters. Uniden MRS804 and Relm repeater level setting procedures are part of their modification instructions described earlier in this section.

Also, for Model 49 units equipped with Version 6.10 (or higher) firmware, an alternate procedure is provided under Step 5A.

The following procedures are used to set the audio and data levels. You will need a communications monitor and a test mobile or portable programmed for your repeater number and frequency. If you are also setting up interconnect, you will need a radio with a DTMF keypad.

These procedures will set transmit and receive audio levels and transmit data level.

If your repeater has internal Rx and Tx level adjustments that affect the Rx or Tx levels to or from the Model 49, set these levels according to the manufacturer's service manual. It will be helpful to mark these settings or note their positions for your future reference.

Included below is a step that sets the transmitter modulation limiter. If there is another recommended procedure, it may be substituted. **IT IS CRITICAL THAT THE MAXIMUM AUDIO DEVIATION DOES NOT EXCEED ±4 kHz** (assuming maximum 5 kHz channel deviation). If the maximum allowed channel deviation is other than 5 kHz, set the base station modulation limiter to a value that is equal to the maximum channel deviation minus the data deviation.

If not already off, remove the Model 49's front window cover.

TRANSMIT LEVELS

*1. Set your communications monitor to receive on the repeater's transmit frequency.

*2. Disconnect the blue and yellow wires (pins 11 & 13) from the radio connector on the Model 49.

*3. Connect a 1000-Hz audio oscillator between the yellow wire (disconnected above) and the base station ground lead (pin 3 - radio connector on Model 49).

*4. Set the Model 49 front panel DIP switch A:1 up and A:2 down, press the front panel CONNECT/DISCONNECT switch twice to force the Model 49 to reset and read the front panel switches. The Model 49 will enter the test mode and continuously transmit. (It would send the Test ID if the blue and yellow wires were connected.)

During the following steps, verify that the Model 49 "Compat. Mode" is set to "J" (use the following screens: Multibase/Edit/Site Config/Compat. Mode [located near the middle of the screen]). If you need to change the setting, make note of the original setting.

*5. While monitoring transmitter deviation with a service monitor, adjust the audio oscillator until the modulation level doesn't increase with any further increase in the output of the audio oscillator.

*6. Double the output level of the audio oscillator (to insure that you are well into the transmitters limiter).

*7. Adjust the transmitter modulation pot for 4.0 kHz (assuming 5.0 kHz total channel deviation). Disconnect the audio oscillator after adjustment is complete.

*8. Reconnect the blue lead to pin 13 of the Model 49 radio connector.

*9. Adjust the Model 49 TX DATA for 0.95 kHz deviation.

*10. Reconnect the yellow lead to pin 11 of the Model 49 radio connector.

*11. Adjust the Model 49 TX AUD for 4.5 kHz deviation during ring bursts.

*12. Set the front panel DIP switch A:1 down. Press and hold the disconnect switch until the Model 49 resets and reads the switches, thus exiting the test mode.

*13. Set the Model 49 "Compat. Mode" to its original (prior to Step 4) setting (see Step 4 above).

RECEIVE LEVELS

*1. Turn OFF all mobiles and handhelds in the area.

*2. Adjust the COR adjustment on the main board to 6 o'clock, (screwdriver slot straight up and down).

*3. Turn the SQ adjustment fully clockwise and observe that the CARRIER LED is on solid.

*4. Slowly turn the SQ adjustment counter-clockwise until the CARRIER LED goes out.

*5. Place an oscilloscope probe on test point 5 (TP5 is located behind the front panel RX pot).

*6. Set up your communications monitor to generate a signal on the repeater input frequency. Use the service monitor to generate a 1-kHz tone at a modulation level of 4 kHz. Adjust RX AUDIO level on the main board so that you measure 1 V p-p on the oscilloscope.

*7. Key up with your mobile radio. If the radio will not get in, you will need to adjust the RX DATA potentiometer until you do. With the radio still keyed up (no audio necessary), turn the RX DATA adjustment fully counter-clockwise. Now turn the RX DATA clockwise until both RX CENTER LEDs start to flicker consistently. The RX CENTER LEDs are the second and third LEDs from the left on the LTR Protocol card.

Step 5A: Setting Repeater Levels for V6.10 firmware

The Test Mode operation and Test Tone levels have been changed in this firmware upgrade to facilitate proper FCC adjustments of LTR repeater operations. This set of instructions relates correct procedures and level settings only for those Model 49 units equipped with version 6.10 or higher firmware (U29, U31), and the required associated Tone Generator ASIC (U7) version 1.4. Option Bytes of these IC chips are "matched" so that upgrade sets must therefore be carefully installed without intermixing. Improper test tone operation may indicate mismatched IC sets.

The new Model 49 Test Mode utilizes four operational states as listed below:

Test Mode 1: Transmit Zetron Ringing with Data
Test Mode 2: Transmit Data Only
Test Mode 3: Transmit 1 KHz Test Tone with Data
Test Mode 4: Transmit 1 KHz Test Tone Only

RECEIVE LEVELS

*1. Turn off all mobiles and handhelds in the area. Disconnect the receive port antenna temporarily.

*2. Adjust the COR adjustment on the main board to six o'clock (screwdriver slot straight up and down).

*3. Turn the SQUELCH adjustment of the main board fully clockwise and observe that the CARRIER LED is on steady.

*4. Turn the SQUELCH adjustment *slowly* counter-clockwise until the CARRIER LED goes off steady. Do not set beyond this point.

*5. Connect an oscilloscope probe to test point 5 (TP5 is located behind the RX AUD pot on the main board) with the ground referenced at TP8 (TP8 is located at the right side of the COR pot).

*6. Connect a Communications Service Monitor Tx Output directly to the repeater Rx antenna port. Inject the appropriate RF carrier frequency at a level of 1 mVrms, modulated by a 1 KHz sine wave at 3.5 KHz deviation. Adjust the RX AUD pot on the main board until 1.0 Vpp (354 mVrms) is measured at TP5 on the oscilloscope. This should be an undistorted sine wave. Signal distortion indicates probable repeater Rx tuning required.

*7. Change the modulation signal to a 100 Hz sine wave at 1.0 KHz deviation. Observe DS2 and DS3, the Rx Data peak indicators on the Protocol Board (2nd and 3rd from left), while adjustng the RX (R29) data pot on the Protocol Card. First turn the pot fully counter-clockwise. One of the LEDs should be on, the other off. Slowly turn the pot clockwise until both LEDs are illuminated approximately the same, but no further.

*8. Alternately switching the 1 KHz test tone (from step 6) on/off should not affect the Rx Data peak indicator operation. Also, 200-300 mVpp (71-110 mVrms) of "data" test tone (100 Hz) should be present at TP5.

*9. Disconnect the Service Monitor and reconnect the Rx Antenna coaxial cable.

TRANSMIT LEVELS

*1. Verify the repeater modulation limiter setting:
   a. Set the Communications Service Monitor to receive the repeaters transmitted signal and attach a receive antenna to the Service Monitor input port.
   b. Connect a 1 KHz Sinewave Generator to the Tx Audio input of the repeater. Typically a generator capable of 10 Vpp output (max) is adequate for this task.
   c. Key the repeater.
   d. Verify undistorted modulation when at 3KHz deviation (well below normal limiting), and that deviation limiting occurs at 4 KHz when generator output is increased.
   e. If 4 KHz limiting does not occur, adjust the generator until hard limiting occurs (sinewave peaks are flattened), and re-adjust the repeater deviation limiter for 4 KHz maximum deviation.
   f. Unkey and disconnect the tone generator. Leave the Service Monitor setup for step 2.

*2. Set Transmit Data Level:
   a. Place the Model 49 into Test Mode by pushing dipswitch SW1-1 up and resetting the Model 49 (press and hold the connect/disconnect switch for about 2 seconds or until the POLL, SYNC, DIGIT, MODEM, and ALARM LEDs flash).
   b. Test Mode 1 should initialize, wherein ringing and data are transmitted from the repeater/M49.
      Note: SW1-2 UP: Generates Test ID = 253 (Channel Busy)
      SW1-2 DOWN: Generates Test ID from Multibase Rptr Config
   c. Select Test Mode 2 (Tx Data Only) by pressing the Connect / Disconnect switch twice (not too fast, lest ye reset the unit).
   d. Adjust the "Tx" (R28) Data pot on the Protocol Card to attain 1.0 KHz deviation of data modulation as indicated by the Service Monitor.

*3. Set Transmit Audio Level from the Model 49:
   a. Select Test Mode 4 (1 KHz Tone without Data) by repeatedly pressing the Connect / Disconnect switch twice slowly (wait briefly between pairs of pushes).
   b. Adjust the TX AUD pot on the main board until the 1 KHz tone modulation reaches 2 KHz carrier deviation as indicated on the Service Monitor.

Step 6: Trunking Connections

* 1. Connect the Repeater Bus by daisy chaining (Repeater Bus channel 1 to Repeater Bus channel 2) shielded BNC cables among all logic units.

* 2. Connect the Subscriber Bus by daisy chaining (Subscriber Bus channel 1 to Subscriber Bus channel 2) shield BNC cables among all Zetron logic units.

Step 7: Testing Dispatch Calls

When the memory is cleared, the M49's default program will make all ID's valid for dispatch calls. This fact allows us to test dispatch calls.

* 1. Program two mobiles with the same ID for dispatch.

* 2. Key up the first mobile. The carrier and transmit LED on the front of the M49 should come on.

* 3. While the mobile is keyed up the second mobile should hear what the person on the first mobile is saying.

Step 8: Testing Trunking

To test trunking it is necessary that two mobiles are programmed with two different dispatch ID's. These ID's should be homed on the same channel.

* 1. Use the Multibase Manual to program site configuration and repeater configuration.

* 2. Check the ID's programmed into the mobiles by testing each mobile one at a time for dispatch. Verify that they home on the same channel.

* 3. Key up the first mobile. The home channel's transmit and carrier LED's should come on. With the first mobile still keyed up, key up the second mobile with the second ID. At this time one of the other M49's on the system should have its transmit and carrier LED's on.

Step 9: Testing Interconnect

To test interconnect it will be necessary to have one ID in a mobile programmed for interconnect.

* 1. Use the Multibase Manual to program the M49's site configuration and repeater configuration for interconnect.

* 2. Use the Multibase Manual to program the proper ID for interconnect. Be sure to program the ID to match the capabilities of the mobile.

* 3. Key up the mobile. The Model 49 should open the correct audio paths and return a dial tone to the mobile, and the transmit, carrier, and telco LED's on the front of the Model 49 should go on.

Note: On a full-duplex mobile it is not necessary to unkey before dial tone will be heard. On a half duplex mobile it is necessary to key up then unkey before dial tone will be heard.

Step 10: Telco Adjustments

A. HYBRID ADJUSTMENTS
As discussed earlier, audio levels to and from the Model 49 as well as hybrid adjustments are performed on the telco card.

In the following procedure, you will first set the hybrid using the internal tone generator, then set the TO and FROM levels for proper modem operation, following up with a final hybrid adjustment.

DID (702-9229) PROCEDURE

* 1. Set both the TO and FROM levels fully clockwise. This is referred to as the 11 o'clock position.

* 2. Connect a telephone line to the Model 49.

* 3. Connect an AC voltmeter to either test point 12 on the main board (Rev. E and above) or pin 11 on the telco card. TP12 is located on the main board slightly in front of the telco card, and is accessible through the front panel cutoff.

* 4. Place DIP switch A:1 to the UP position. Press the front panel CONNECT/DISCONNECT switch twice to force the Model 49 to reset and read the front panel switches.

* 5. Now place a telephone call to the Model 49. The model 49 will play one of three tones out the phone line, each time you press the front panel CONNECT/DISCONNECT button the tone being played will change. Adjust BAL-R and BAL-C for the minimum voltage reading on the meter.

* 6. Once achieved, set DIP switch A:1 down, and press and hold the CONNECT/DISCONNECT button until the Model 49 performs a soft reset.

DUAL TRANSFORMER E-E (950-9241) PROCEDURE

* 1. Set both the TO and FROM levels fully clockwise. This is referred to as the 11 o'clock position.

* 2. Connect a telephone line to the Model 49.

* 3. Connect an AC voltmeter to either test point 12 on the main board (Rev. E and above) or pin 11 of the telco card. TP12 is located on the main board slightly in front of the telco card, and is accessible through the front panel cut-out.

* 4. Verify JP1 is in the A position and JP2 is in the A position on the balance board.

* 5. Adjust all three pots on the balance board (R9, R10, R11) fully counter-clockwise if this is the first time adjusting this board.

* 6. Place DIP switch A:1 to the UP position. Press the front panel Connect/Disconnect button twice to force the Model 49 to reset and read the front panel switches.

* 7. Using another telephone, dial the number of the phone line connected to the Model 49.

* 8. When the Model 49 answers the call, a 400Hz tone should be heard in the telephone receiver.

* 9. While monitoring the FROM TELCO (pin 11) on JB3 (also U5 pin 7 or TP12 on rev E+ Mother Boards), adjust R11 (far left pot) on the balance board for a null.

* 10. Press the Connect/Disconnect button on the front panel 2 times. The tone should change to 1000Hz.

* 11. Adjust R10 (center pot) for a null while monitoring the FROM TELCO.

* 12. Press the Connect/Disconnect button 2 times again. The tone should now be 2500Hz.

* 13. Adjust R9 (far right pot) for a null. If your phone line is very short, this adjustment may be all the way one direction. This is not a problem.

* 14. Now press the Connect/Disconnect button 2 more times. The tone should go away.

* 15. Wait 5 seconds and press the Connect/Disconnect button 2 more times. The Model 49 should now be sending the 400Hz tone again. If you do not wait 5 seconds, the Model 49 will reset and you will need to start over again.

* 16. Go through steps 9 to 15 approximately 3 more times to get the appropriate nulls.

* 17. Your hybrid should be balanced at this point.

B. TO AND FROM LEVEL ADJUSTMENTS

The FROM TELCO pot will adjust the audio gain from the phone line into the Model 49. Just beyond the telco card, the audio from the phone will go through an AGC circuit on the main board.

The TO TELCO adjustment is designed to set the audio gain from the Model 49 to your local C.O.

There are two methods provided for adjustment of the TO and FROM TELCO pots. One method uses dial tone and the second method uses DTMF. Each method has unique benefits. When adjusting using dial tone, the dial tone signal is at a known level but the C.O. loss is unknown. When adjusting using DTMF, the C.O. loss is known but the DTMF level is unknown.

Both methods are used for E-E, DID, or E&M telco cards.

DIAL TONE

FROM TELCO

* 1. Complete the hybrid balance procedure.
* 2. Complete the TX and RX AUDIO adjustment procedures.
* 3. Using a valid Interconnect ID, key up the Mobile radio and obtain dial tone.
* 4. a- While dial tone is present adjust the FROM TELCO pot to obtain a 75 mV p-p signal at test point 12 on the main board or pin-11 on JB3 of the telco card.
   or
   b- While dial tone is present adjust the FROM TELCO pot to obtain 2.2 kHz of deviation on the transmit frequency of the repeater.

It is extremely important that the FROM TELCO pot not be turned up too high as background noise and feedback may become a problem.

Most Microwaves have a maximum transmitted level of +7dBm, if this is the case with your equipment and an E&M card is being used, replace R13 with a 100k ohm resistor.

TO TELCO

* 1. Put the Model 49 into the test mode by placing dip switch A1 up and depressing the connect/disconnect button twice.
* 2. Call into the Model 49 from the landside. When the Model 49 answers, a 400 Hz tone should be heard by the landside user.
* 3. Depress the connect/disconnect button twice. A 1000 Hz tone should be heard.
* 4. Adjust the TO TELCO pot for a 750 mV p-p or 270 mV rms signal measuring at the following points, on the appropriate telco card:
   E-E card- Across pin-3 and pin-4 of J2.
   DID card- Across pin-3 and pin-4 of J2.
   E&M card- Across pin-5 and pin-2 of J2.
* 5. Take the Model 49 out of the test mode by placing dip-switch A1 down and depressing the connect/disconnect button twice rapidly.

The TO and FROM TELCO levels should be close but may need to be fine tuned for personal taste.

If there is an E&M card that is connected to a microwave, adjust the TO TELCO pot to match the desired input level of the microwave.

When using the Model 49 in a direct AUTONET configuration, it is suggested to first adjust the TO TELCO pots on both Model 49's, and secondly use the DTMF procedure for adjusting the FROM TELCO pots.

DTMF

FROM TELCO

* 1. Complete the hybrid balance procedure.
* 2. Complete the TX and RX AUDIO adjustment procedures.
* 3. Establish an Interconnect call.
* 4. From the phone side continuously depress the 5 button.
* 5. a- While the digit 5 is being depressed, adjust the FROM TELCO pot for a 150 mV p-p (53 mV rms) signal at test point 12 on the main board or pin-11 on JB3 of the telco card.

or

b- While the digit 5 is being depressed use a service monitor to look at the amount of deviation. As the FROM TELCO pot is turned clockwise it is seen that the amount of deviation will increase. The amount of deviation should be increased until the increasing deviation slows down (the AGC's limiter, in the Model 49, is taking effect). This should be around 4.5k Hz.

It is extremely important not to turn the FROM TELCO pot up too high as background noise and feedback may become a problem.

Most Microwaves have a maximum transmitted level of +7dBm, if this is the case with your equipment and an E&M card is being used, replace R13 with a 100k ohm resistor.

TO TELCO

* 1. Put the Model 49 into the test mode by placing dip switch A1 up and depressing the connect/disconnect button twice.
* 2. Call into the Model 49 from the landside. When the Model 49 answers, a 400 Hz tone should be heard by the landside user.
* 3. Depress the connect/disconnect button twice. A 1000 Hz tone should be heard.
* 4. Adjust the TO TELCO pot for a 750 mV p-p or 270 mV rms signal measuring at the following points, on the appropriate telco card:
  E-E card- Across pin-3 and pin-4 of J2.
  DID card- Across pin-3 and pin-4 of J2.
  E&M card- Across pin-5 and pin-2 of J2.
* 5. Take the Model 49 out of the test mode by placing dip-switch A1 down and depressing the connect/disconnect button twice rapidly.

The TO and FROM TELCO levels should be close but may need to be fine tuned for personal taste.

If there is an E&M card that is connected to a microwave, adjust the TO TELCO pot to match the desired input level of the microwave.

When using the Model 49 in a direct AUTONET configuration, it is suggested to first adjust the TO TELCO pots on both Model 49s, and secondly use the DTMF procedure for adjusting the FROM TELCO pots.

Step 11: Programming Users and Time
To finish installing the system all of the user information needs to be programmed in for individual customers. Use the Multibase Manual to assist with this.

Some of the advanced operating features of the Model 49 utilize its built-in clock chip that keeps track of the time of day and day of week. These features include deferred access during non-prime time, air time accumulation during prime and non-prime time, repeater loading statistics by the hour, and telephone call detail date and time-of-day marking.

The clock chip is built into the socket underneath memory chip U27 and keeps time even during power failures. You set the clock by selecting "Other" in the Multibase Comm Menu. When the detailed Other Menu comes up, select "Set Date & Time."

Multibase will connect to the site selected and allow you to set the time and date while you are connected (on-line) to the Model 49. You can set the clock for the site's local time. This may be different from your office clock.

Note: The time and date are automatically cloned to all Zetron units at the site which are connected to the Zetron Subscriber bus.

HINT

Before you leave the repeater site, turn around and take one last look at the Model 49 front panel LED's.

On the Subscriber Master unit (switch B:1=ON - left-hand switch on group of 8), the POLL LED should be almost steady. Some flashing may be detectable.

On the Subscriber Slave units (switch B:1=OFF), the POLL LED should flash briefly in response to the master.

Note: For specific information about your repeater, see individual subsections in this section. If your repeater is not listed, contact Zetron for assistance.

TRUNKING CONNECTIONS IN DETAIL

After you have tested each Model 49 connected to its designated repeater operating in "single channel trunking", connect it to other logic units and make sure that they "trunk" and work properly with all of your channels. See Figures 4-25 and 4-26.

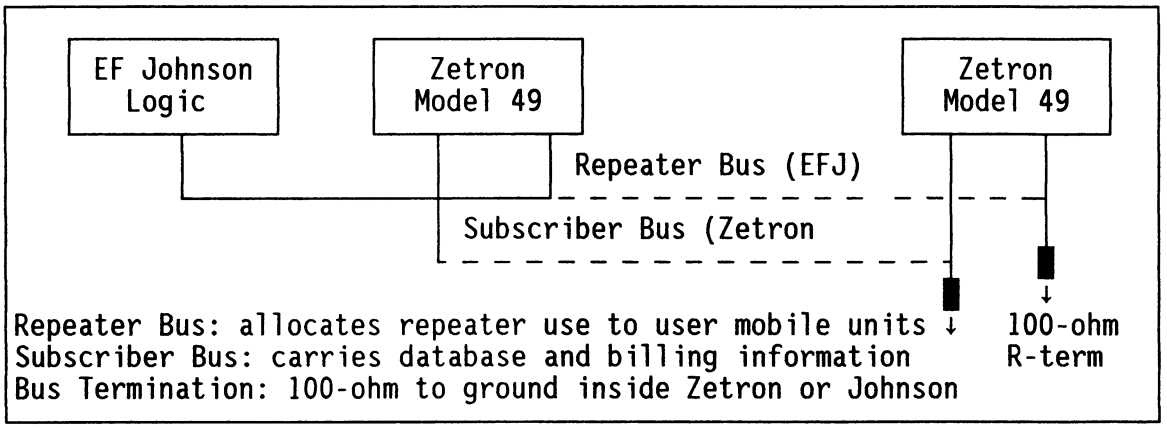


Figure 4-25. Model 49 Trunking Buses (Johnson Compatible)

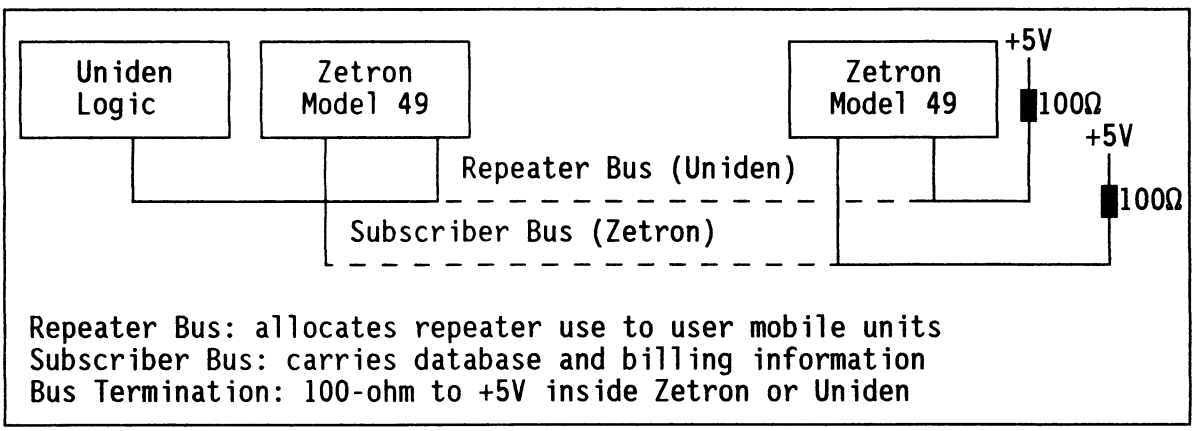


Figure 4-26. Model 49 Trunking Buses (Uniden Compatible)

Here is a simple checklist to make sure you have set up your system:

* 1. Set the Bus Jumpers in all Zetron Model 49's for electrical and timing compatibility with E.F. Johnson HDB or Uniden RNDL buses as follows:

JP11 Repeater Bus Timing
A=Uniden RNDL B=EFJ HDB
JP17,19 Subscriber Bus Electrical
A=EFJ hardware B=Uniden hardware
JP18,20 Repeater Bus Electrical
A=EFJ hardware B=Uniden hardware
JP21 Subscriber Bus Termination
A=Uniden 100 ohm pull-up B=EFJ 100 ohm pull-down C=jumper storage
JP22 Repeater Bus Termination
A=Uniden 100 ohm pull-up B=EFJ 100 ohm pull-down C=jumper storage

Note: The Zetron Subscriber Bus will operate with EFJ or Uniden Hardware compatibility. For safeguards in case the repeater and subscriber buses get cross-connected by accident, set jumpers JP17-JP20 all to A or B. Then both buses will have same electrical characteristics. You only need one resistor on each bus.

* 2. Connect the daisy-chain Repeater Bus shielded BNC cables among all logic units.

* 3. Connect the daisy-chain Subscriber Bus shielded BNC cables among all logic units.

* 4. Terminate one end of each bus with a 100 ohm resistor. For EF Johnson, the termination is a resistor to ground. Like the terminators shipped with EFJ LTR systems, you can use a BNC connector with a resistor soldered inside of it. On Model 49's with main circuit board Rev. E or later, you can set JP21 and JP22 in one of the units for termination.

For Uniden, the termination is a resistor connected to +5 volts. On Uniden MRS804 and MRS802 repeaters, you connect the resistor by leaving the pink wire loop intact on connector CN2 one of the logic units (on other units, cut the wire loop). On Model 49's, with main circuit board Rev E or later, you can set JP21 and JP22 in one of the units for termination.

* 5. Set the DIP switch on one logic unit on the Repeater Bus Sync to be Master and all other units to be Sync Slaves. On the Zetron Model 49, this is switch B:2 Master=Up, Slave=Down (8-position switch, 2nd position from the left - see fold-outs at the end of this section). Refer to your EFJ or Uniden manuals for information on their switches.

* 6. Set the DIP switch on one Zetron unit to be the Subscriber Bus Poll Master and all other units to Poll Slaves. This is switch B:1 Master=Up, Slave=Down (8-position switch, 1st position on the left - see fold-outs at the end of this section).

* 7. Set the Area DIP switch to be the same on every unit (area 0 or 1). On the Model 49 this is switch B:3 Area 1=Up, Area 0=Down (8-position switch, 3rd position from the left). Refer to your EFJ or Uniden manuals for information on their switches.

* 8. Set the DIP switches on each unit to its assigned repeater number. On the Model 49 this is switches B:4 through B:8 coded in binary (right-most 5 positions of 8-position switch - see table at the end of this section). Refer to your EFJ or Uniden manuals for information on their switches.

Note: Only repeater numbers 1 through 20 are valid; other settings will stop a logic unit from working.

* 9. Program the Repeater Config information in Multibase for all repeater channels, including non-Zetron ones. Update all of your Zetron Model 49's so that they know about all of the channels.

* 10. Set the Validate DIP switch A:2 (4-position switch, 2nd position from the left on Zetron Model 49's as follows:

If all of your Zetron logic units are performing their own validation from Multibase settings, set the Validate DIP switch A:2=Down on all Zetron units. The units will also check for validation information from a "validator box" should it place information in slot 21 of the Repeater Bus.

If you want a Zetron Model 49 to act as a "validator box" for non-Zetron units, then you must make a Zetron unit the Repeater Bus Sync Master (step 5 above). On the Zetron Sync Master unit B:2=Up, set its Validate DIP switch A:2=Up. On all other Zetron units, set the Validate DIP switch A:2=Down.

If you have a "validator box" and want to use it exclusively for validation for your Zetron units (Zetron units will ignore Multibase validation bits), then set the Validate DIP switch A:2=Up on all of the Zetron units. In addition, the Repeater Bus Sync Master cannot be a Zetron unit, so all of the Zetrons should have switch B:2=Down.

* 11. If you are using the Model 49 to validate users on non-Zetron channels, you must program the IDs with Multibase into the User ID database. This can be a time-consuming task when you only want to invalidate a few users.

To make your job easier, the Model 49 can treat all unprogrammed user IDs as automatically Valid or Invalid. Program the "Unassigned Users" in the Site Config database as you wish. Then, you only have to program the particular users in the User ID database that are opposite to your unassigned default choice.

VOICE PROMPTS

Field installation of the voice prompts card (702-9391)

* 1. Remove power from the Model 49, remove the top cover, plug in the voice prompt card into J3, and secure the card with the screw provided.

* 2. Using Multibase, enable operation of the voice prompts.

* 3. Call into the Model 49 from a landside line and record the voice prompts. (See below)

* 4. Call into the Model 49 from a landside line and listen to the recorded message. Adjust R5 on the voice prompt card to match the audio level of the voice prompts to interconnect audio.

* 5. Reinstall the top cover.

Voice Prompt List

The following is a list of the available voice prompts. Message numbers one and two have a maximum length of 7.5 seconds. All other messages have a maximum length of 3.7 seconds.

For Model 49 units equipped with version 6.10 firmware, the prompt set has been completely reconfigured and is detailed in the version 6.1 and up Multibase Manual p/n 025-9297.

1. Message One is the "Welcome" message. This message comes on after the phone line is answered and before the beep or dial tone prompt is sent. DTMF can be entered during the voice message. This is for experienced users who don't want to listen to the whole message. When the first DTMF digit is received, the voice message will stop. Dial click detection is not enabled until after the voice message so anyone using a rotary phone will need to wait until after the voice message to begin dialing. If the message is not recorded the beep or dial tone prompt will be sent immediately.

2. Message Two is the "Your call cannot be completed at this time" message. This message comes on if the mobile does not answer the call after the mobile ringing timeout period, or the mobile ID called is busy. The line is disconnected after this message is sent out to the calling party. If this message is not recorded, a reorder tone (fast busy) will be sent to the calling party.

3. Message Three is the "Thank You" Message. This message comes on after a valid mobile ID has been entered by the calling party. If this message is not recorded the M49 will go directly to ringing.

4. Message Four is the "Please wait, your call is being processed" message. This message comes on if the Model 49 is busy redialing for PTC Autonet or Autodial applications. If this prompt is not recorded, the M49 will issue two short beeps.

5. Message Five is the "The number you dialed is invalid" message. This message comes on if the number dialed is not a valid user ID (one that is not programmed in the unit). If this message is not recorded the M49 will issue a reorder tone and disconnect the call.

6. Message Six is the "Number is not valid, please retry" message. If the number dialed had an error, the caller may try one more time before getting the invalid message above.

7. Message Seven is the "Please Proceed" message. This is issued to inbound dialers after their call has been connected to an Autonet user. Since no ringing is audible to an Autonet dialing party from another LTR site, this prompt notifies them to begin conversation.

8. Message Eight is the "Alarm on Repeater" message. This message comes on if "alarms" has been set up in Multibase and an alarm condition has occurred. This message is played out to the mobile ID that has been designated to receive alarm messages.

Programming Voice Prompts

GAINING ACCESS
To gain access to programming voice prompts on the Model 49 with an End-to-End card installed or an E&M card with End-to-End emulation, wait for the prompt then dial 00 followed by the test ID. The Model 49 will respond with two ding-dongs indicating that the Model 49 is now ready to receive voice prompt commands.

To gain access to programming voice prompts on the Model 49 with a DID card installed, an E&M card with DID emulation, or overdial access number set to "yes" in site configuration, dial an invalid phone number, wait for the reorder tones, then dial 00 followed by the test ID twice.

VOICE PROMPT COMMANDS
The following commands are used to program the voice prompts:

0	for	Erase
2	for	Play
9	for	Record
*	for	Stop Recording Message
##	for	Hang up phone line

The following prompts are heard to guide you:

Two Ding-Dongs:	This prompt is sent when you first enter the programming mode.
Fast Busy Tone:	This prompt is sent if you wait too long between recording. The Model 49 hangs up the line after this prompt.
Three Ding-Dongs:	This prompt is sent after an invalid command or message number.

Six Beeps:	This prompt is sent at the beginning of recording a message.
Eight Beeps:	This prompt is sent to indicate a message is being erased.
One Ding-Dong:	This prompt is sent after a message has been erased or the maximum length of the message has been recorded.

Commands are given by keying in a series of numbers. The first number is the command code, the next is the message number.

For example, if you enter 02, you are telling the Model 49 you wish to erase message number 2. You will hear eight beeps verifying that the message is being erased.

If you enter 22, you wish to play message number 2. The message will play immediately after receiving the command.

If you enter 92, you wish to record message number 2. You will hear six beeps indicating start recording. Record your message and then enter * to indicate stop recording.

DIAL CLICK DECODER

Field installation of the dial click decoder card (702-9242):

* 1. Remove power from the Model 49, remove the top cover, plug in the dial click card into J8, and secure the card with the screw provided.

* 2. Using Multibase enable operation of the dial click card.

* 3. Call into the Model 49 using a rotary phone.

* 4. Once it has answered the call, use the rotary phone to dial a zero. Adjust R6 to where the light pulses on the LED have a 50% duty cycle.

* 5. Reinstall the top cover.

HARDWARE LAYOUT

Figure 4-27 shows the locations of the Model 49 daughter boards.

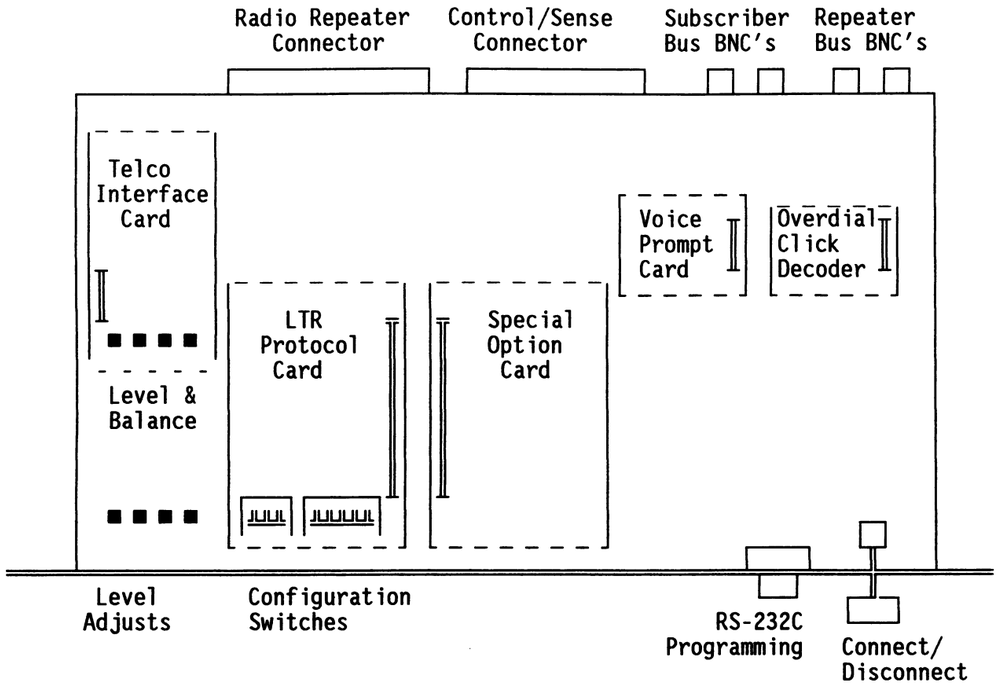


Figure 4-27. Daughter Card Locations

Note: The telephone interface card fits snugly into the rear panel. It's easiest to remove and install it by removing the screws retaining the rear panel as shown in Figure 4-28.

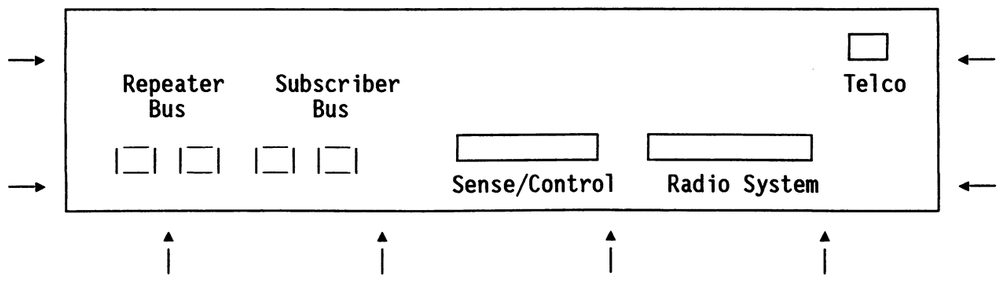


Figure 4-28. Locations of Rear Panel Screws

Figure 4-29 shows the configuration of the DIP switches.

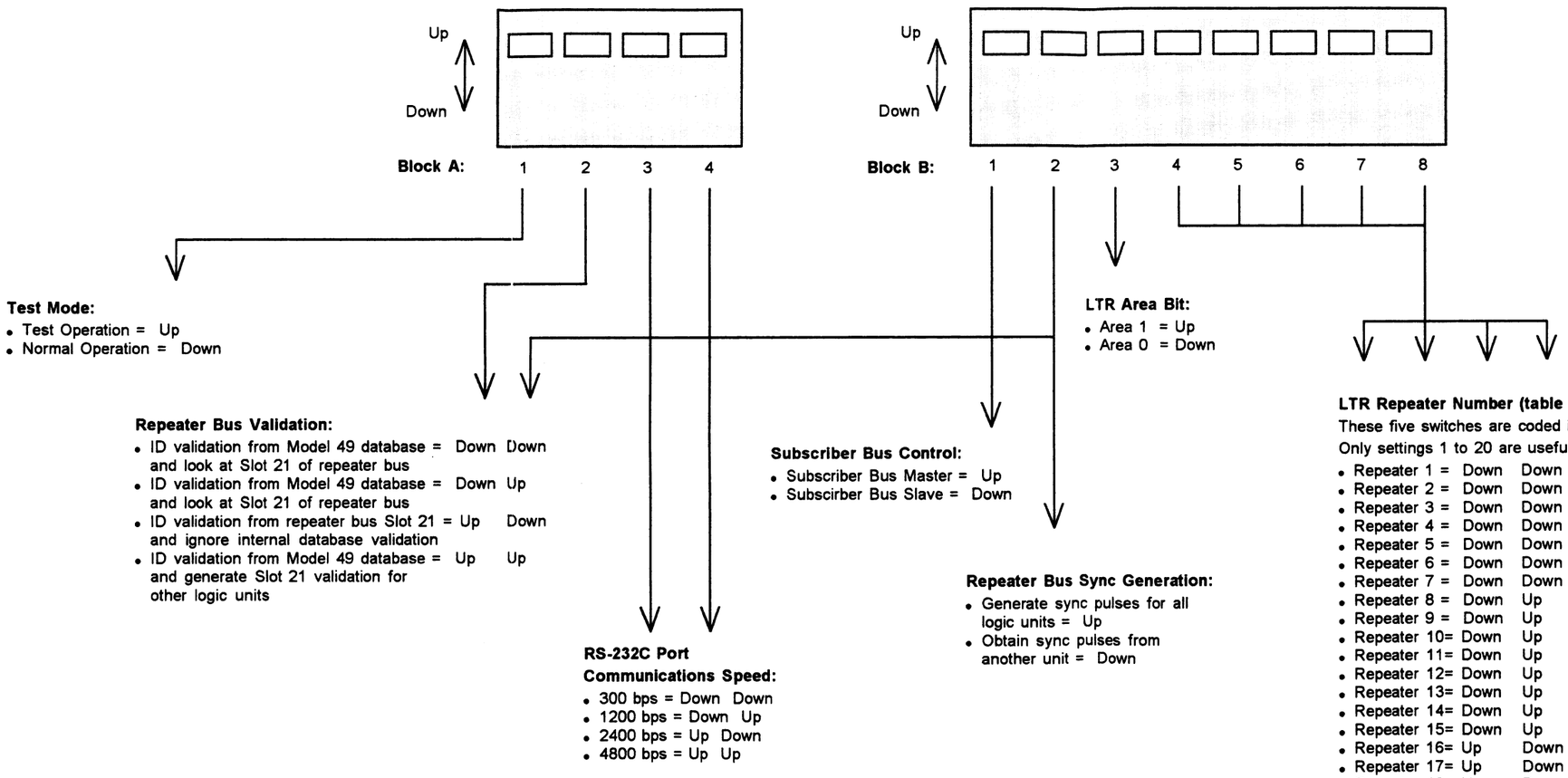


Figure 4-29. DIP Switch Configuration

Figure 4-30 shows the location of the pots, lights, and DIP switches (after removing the front cover).

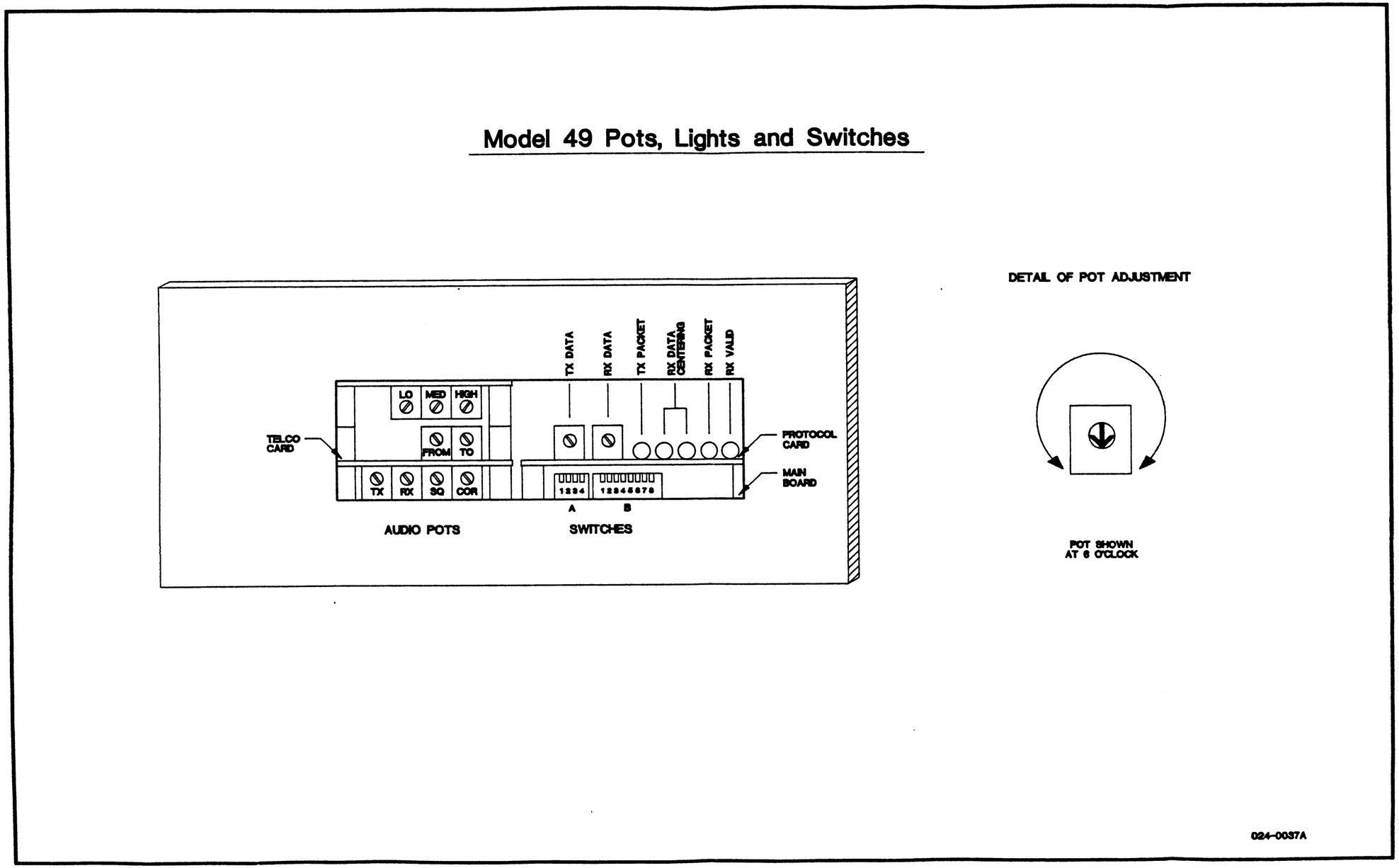


Figure 4-30. Model 49 Pots, Lights, and DIP Switches

MODEL 49 INSTALLATION WORKSHEET

Use this page to record details about your Model 49 installation.

Site Location: _____

Repeater Number: _____

Install Date: _____

Main Board, Part No. 702-9202, Revision _____

Protocol Board, Part No. 702-9218, Revision _____

Compandor, Part No. 702-9276, Revision _____

Telco Interface:

DID, Part No. 950-9252, Revision _____

End-to-End Duplex, Part No. 950-9241, Revision _____

E&M, Part No. 950-9253, Revision _____

Other Options:

Dial Click, Part No. 702-9010, Revision _____

Voice Prompts, Part No. 702-9391, Revision _____

Pot Settings on Main Board:

Pot Name	Label	Setting
TX Audio Level	R90	____ o'clock
RX Audio Level	R100	____ o'clock
COR Threshold	R103	____ o'clock
Internal Squelch	R101	____ o'clock

Pot Settings on LTR Protocol Card:

Pot Name	Label	Setting
TX Data Level	R28	____ o'clock
RX Data Level	R29	____ o'clock

Pot Settings on Interconnect Card:

Pot Name	Label	Setting
Balance R	R___	____ o'clock
Balance L	R___	____ o'clock
Balance C	R___	____ o'clock

Pot Name	Label	Setting
To Tel Level	R___	____ o'clock
From Tel Level	R___	____ o'clock

LTR SITE CONFIGURATION WORKSHEET

Use this page to record details about your LTR site configuration.

Repeater Bus

___ EFJ Bus ___ Uniden Bus

Sync master is channel ____ Termination resistor is on channel ____

Validation is Zetron channel ____ or Other unit brand/model _____

Repeater numbers are set on dip switches in each logic unit ___

System is set for area: ___ 0 ___ 1

Subscriber Bus

Poll master is channel ____ Termination resistor is on channel ____

Air Time Billing

___ ZEBRA ___ Uniden ARX-850 ___ Radio-Pac _____ Other

Other Options

Morse ID is generated by channel _____
Other equipment installed _____

Repeater Channels

Repeater Number	Repeater RF Brand/Model	Logic Unit Brand/Model	Interconnect Brand/Model	Air time Accumulation
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

5. GENERAL HARDWARE INFORMATION

SOFTWARE UPDATE

> CAUTION
> If you have more than one Model 49, you must update all of your units to the same revision of main software (U29, U31 chips) so that the units are compatible with one another.

When a factory update is shipped for installation into the Model 49, new software chips that contain the operating software may have to be changed. The software is generally contained in one chip with 28 pins to be plugged into socket U31 for dispatch only units, and in two chips with 28 pins to be plugged into sockets U29 and U31 for interconnected units.

If you are not installing any new options, but just updating the software PROM, follow the simple procedure. You may also have to change your Multibase programming - see following sections on Simple and Full Update Installation.

The label on your software PROMs contain important information and looks like this:

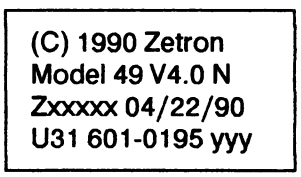
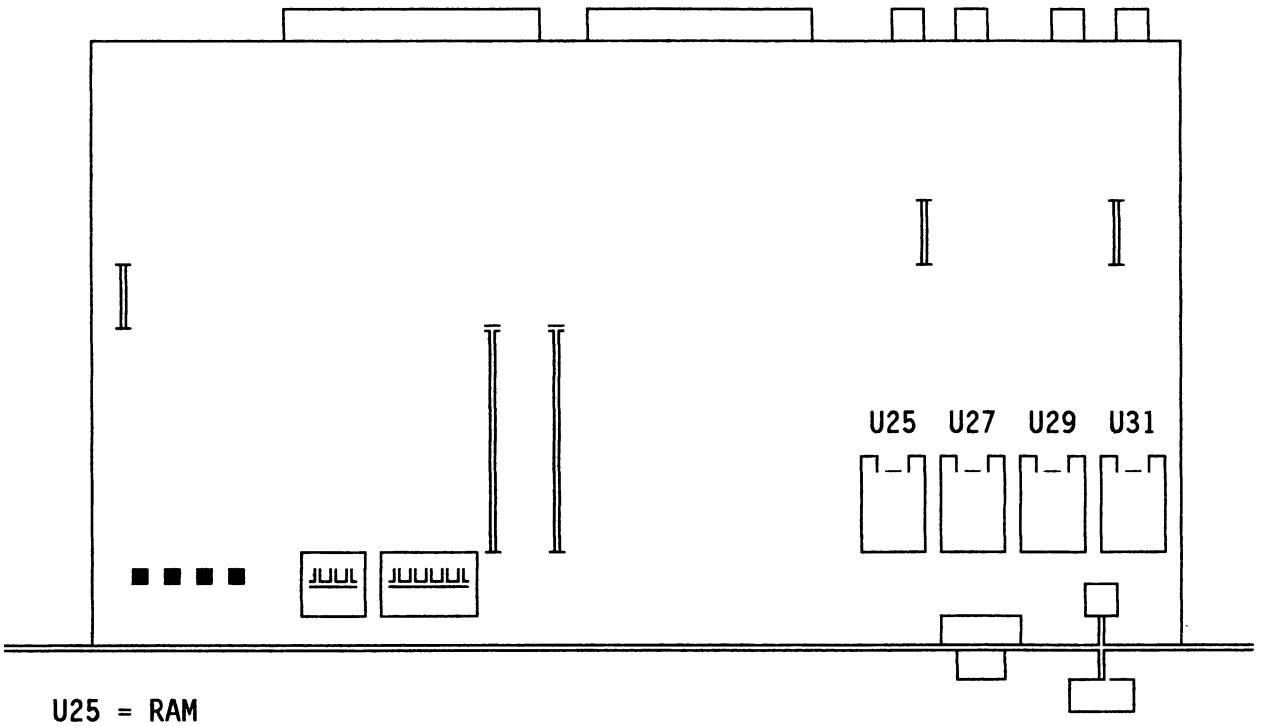


Figure 5.1 - Sample Software PROM Label

The software version number is the "4.0" following the letter "V". The last character on the line determines compatibility with the revision of main board hardware (702-9202). "H" PROMs are for Rev H and later. "N" PROMs are for Revs E, F, and G, and "O" for Rev D and earlier.

The "xxxxx" is your sales order number and should match the PROM that you are removing from the unit. The last line reminds you that the chip goes into socket location U31 or U29 and contains options "yyy". These options are DIS=dispatch with CW ID, ITC=interconnect which includes CW ID, and SDR=interconnect with SMDR call detail buffer and CW ID.

Some field installed options, such as the interconnect and SMDR options, require a larger RAM chip as well as a PROM chip. The RAM chip that requires replacement may contain information that you want to save, such as air time totals or repeater loading. Before replacing a RAM chip, be sure you have used Multibase to retrieve all of the data you want to save. Then you can proceed with the update.



U25 = RAM
U27 = RAM + Clock
U29 = PROM
U31 = PROM

Figure 5.2 - Physical Location of RAM and PROM Chips

HINT
Read all of the following instructions and call Zetron for clarification before starting your update.

SIMPLE UPDATE INSTALLATION

> CAUTION
> If 1) you are installing new option cards, or 2) your update requires a new Multibase, or 3) you are upgrading main software from version 3.x to version 4.x refer to the instructions on the next page. Your Air Time Accumulation and Call Detail Buffer will be erased inside the Model 49's.

* 1. Disconnect the Repeater Bus and Subscriber Bus cables from the back of the Model 49 you are to update.

* 2. Power off the unit and remove it from its installed location so you can work on it. Remove the top cover to expose the main circuit board.

* 3. Remove the old PROM U31 and replace it with the new one.
Remove the old PROM U29 and replace it with the new one.

Note: Be sure that the orientation notch on the new PROM matches the white ink outline on the circuit board.

* 4. Take some time to look carefully at all of the pins of the chip that you have installed. Be sure that all the pins are in their proper places, fully inserted, and not bent underneath.

* 5. Turn on the power and make sure that the front panel lights do their normal thing.

* 6. Reconnect the Repeater Bus and Subscriber Bus cables in the back.

* 7. Perform a Memory Soft Reset.

* 8. In about 30 seconds, the POLL light on the Subscriber Master may pulse about once per second as it clones its new data into the Model 49. The full data cloning takes about 2 minutes -- be patient. Cloning may not be necessary.

* 9. Using your mobile or portable radio, make sure that the unit performs its trunking radio function.

* 10. Replace the top cover of the unit.

* 11. Return the old part to Zetron in protective packaging.

FULL UPDATE INSTALLATION

> CAUTION
> Use this procedure to retrieve the Model 49 RAM contents before doing your update. This will put your Air Time Accumulators, Call Detail Buffer, and Repeater Loading data into your office computer.

* 1. Retrieve current air time totals and repeater loading data (if the information is important to you) using "Comm Retrieve" from Multibase on your office computer. Backup your data to floppy diskettes with the Backup menu item.

* 2. Install your new Multibase by running the INSTALL program on the floppy diskette from Zetron. It will ask you questions and guide you through the installation process. The installation will create backups of your old database data files in case you need them.

* 3. Run Multibase and fill in any fields that apply to your new option.

* 4. If you are going out to the site to install the chips and option cards into your units, have an assistant available at your office computer to load the new database settings into the site.

* 5. Install your new hardware as follows:

> CAUTION
> Be sure that the orientation notch on each integrated circuit matches the white ink outline on the circuit board.

a. Remove the old PROM U31 and replace it with the new one. Remove the old PROM U29 (if it exists) and replace it with the new one.

b. If you received a card and a set of chips for the Interconnect option, install them as follows:

Chip Type	Location	Function
27C256	U29	Software PROM
27C256	U31	Software PROM
73K222L	U37	Modem
75T204	U21	DTMF Decoder
ASIC	U7	Tone Generator

c. If you received a set of chips for the call detail (SMDR) option, install them as follows:

Chip Type	Location	Function
27C256	U29	Software PROM
27C256	U31	Software PROM
82257	U25	SMDR RAM

d. Take some time now to look carefully at all of the pins of the parts you have installed. Be sure that all the pins are in their proper places, fully inserted, and not bent underneath.

* 6. Disconnect the Repeater Bus and Subscriber Bus cables from all of the Model 49's.

* 7. Perform a Memory Hard Reset to <u>each</u> Model 49.

* 8. Reconnect the Repeater Bus and Subscriber Bus cables to all Model 49's and non-Zetron logic units.

* 9. Leave all of the Zetrons powered off, except channel that is set as the Subscriber Master Unit (the one with switch B:1 ON). Observe the front panel lights. The POLL light should come on steadily, indicating that this unit is the Subscriber Master.

* 10. Power up each Model 49 and do a Memory Soft Reset.

* 11. Have your assistant use Multibase to perform a Comm Update Entire Datagase to load the database settings into the master unit. Messages in the Status window on the office computer should show a successful update of that one channel.

* 12. During the update, the POLL light on the Subscriber Master should pulse about once per second as it clones its new data into all of the Model 49's. The full data cloning takes about 2 minutes -- be patient.

If cloning does not work, double check the connections on all of your BNC cables running among the Repeater Buses and the Subscriber Buses. Also try cycling power off then on to the Subscriber Master Unit to make it locate all of the slave units and perform the cloning operation.

* 13. Using your mobile or portable radio, make sure that the system performs its trunking radio function.

* 14. Return the old parts to Zetron in protective packaging.

INTERCONNECT OPTION

This option package provides interconnect service in the Model 49 between the radio repeater system and a telephone, RF, or microwave system. You can place calls from land line to mobile and/or mobile to land line. With Multibase, you designate which repeaters are capable of interconnect, whether incoming/outgoing/both calling is permitted, and which user IDs are allowed interconnect service.

Note: You should enter all of your interconnected repeater channels into Multibase, whether they are Zetron, Johnson, or Uniden. Information about the repeaters is used by the Model 49 Intelligent Free Repeater Allocation software to provide the best chance of mobile users to get an interconnected channel when they want one.

Adding Interconnect to a Dispatch Unit

If you are adding the Interconnect Option to a Dispatch Model 49, you will be plugging an interface card into the Model 49, installing a kit of integrated circuits with a new operating software PROM chip, connecting your telco/microwave line, adjusting the telephone levels and hybrid balance, and setting up Multibase.

Install the kit of parts, following the instructions described earlier in this section entitled "New Option Installation Checklist". Then follow the steps "Setting Levels" in Section 4.

Note: Don't forget to set up Multibase for interconnect before you attempt to make a test call.

Interconnect Setup

If your Model 49 came equipped from the Zetron factory with the Interconnect Option already installed, you will be connecting your telco/RF/microwave line, performing a full repeater setup including adjusting the telephone levels and hybrid balance, and setting up Multibase. There are detailed instructions in section 4 to help you install your interconnected Model 49 onto your repeater. Zetron applications engineers are also available.

Note: Don't forget to set up Multibase for interconnect before you attempt to make a test call.

End-End Telco Interface Card
A 702-9227 or 702-9283 End-End Telco Interface connects your Model 49 to a regular subscriber telco line. Each card has two audio level adjustments (to and from telco). The 702-9227 card has two hybrid balance adjustments, and the 702-9283 card has three adjustments.

To the rear of the telco interface card is a modular RJ-11C style telephone jack that carries all necessary signals for interfacing to a telephone or microwave system. See the diagram below for connector pin out assignments.

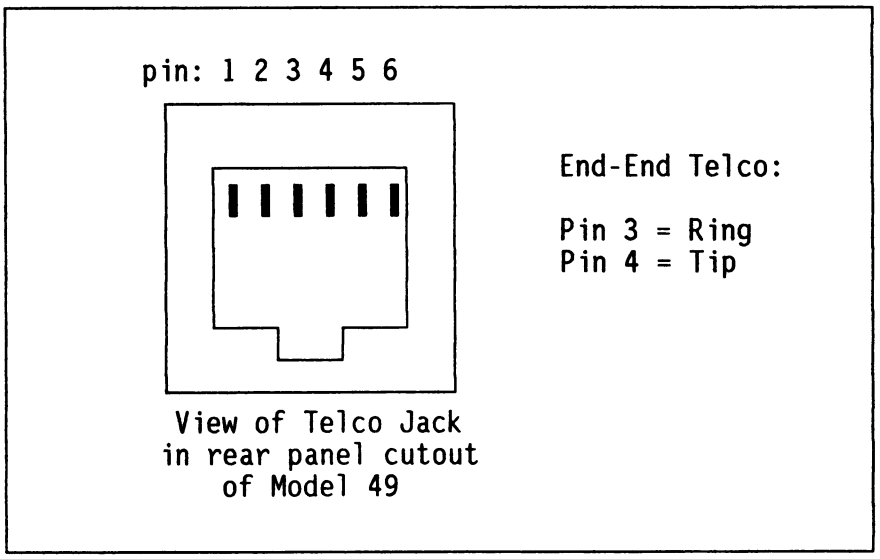


Figure 5.3 - Pin out for End-End RJ11-C Telco Jack

Ask your telephone company whether your phone line uses "loop start" or "ground start" line supervision. Ground start supervision informs the Model 49 when the phone party disconnects, thereby speeding up call processing.

The 702-9283 card has a dual-transformer hybrid balance circuit with three adjustment pots and a coarse capacitor selection jumper. The best balance can be obtained by sending high, low, and mid-band test tones through the interconnect while adjusting the three balance pots. In most circumstances, JP1 on the 702-9283 card will have little effect upon the balance.

For ground start lines, it is necessary to cut the trace going from pin-4 of K2 to ground and install a 470-ohm resistor there.

DID Telco Interface Card

A 702-9229 Selector Level/DID Telco Interface card connects your Model 49 to a central or tandem office selector level telco line. The card has two adjustments for hybrid balance and two audio level pots (to and from telco).

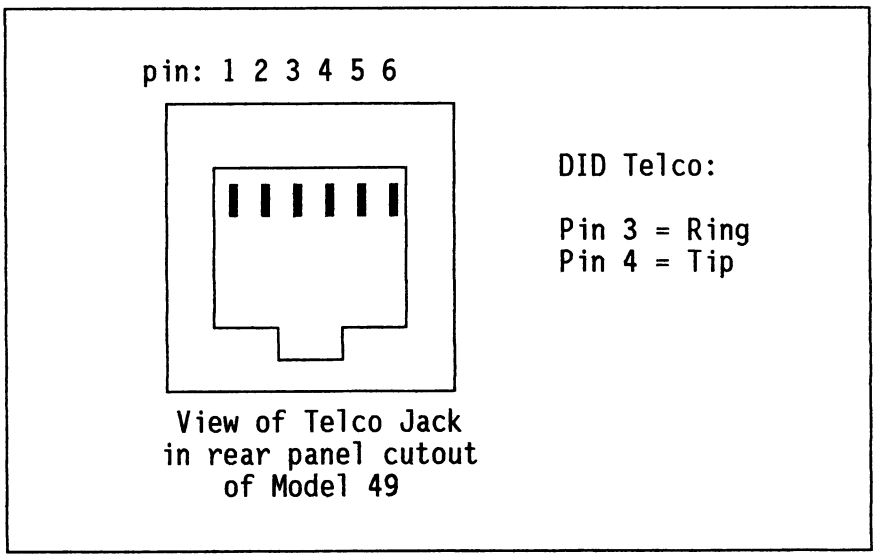


Figure 5.4 - Pin out for DID RJ11-C Telco Jack

Connection to the telephone system follows standardized practices. The Model 49 provides a chassis ground referenced -48 volt power supply across the tip/ring telephone wire pair. When the Model 49 is idle, -48 appears on the Ring lead with ground on Tip. When the Model 49 answers a call, -48 appears on the Tip lead with ground on Ring. You can adjust the Model 49's -48V supply with the pot on the motherboard underneath the telephone interface card. There are no jumpers to set on the DID card.

Ask your telephone company for the following information and make sure to program the Rptr Config Interconnect settings in Multibase with this information:

1. Line Supervision: __Immediate Dial (Pulse) __ Wink Start (DTMF)
2. Feed Digits: __Two __Three __Four

An easy way to test your DID equipped Model 49 is to plug an ordinary telephone right into the modular connector on the back. You can pick up the receiver, dial in the feed digits, and speak to a mobile radio.

Note: If DID works with a phone set but does not seem to work correctly when connected to the telco line, 1) make sure you have a DID trunk from the phone company and 2) try reversing the Tip and Ring wires.

E&M 4-Wire Telco Interface Card
A 702-9228 E&M Telco Interface card connects your Model 49 to an RF, microwave or leased telephone line that carries two wire pairs (4 wires) for audio and one pair for call supervision (E-lead and M-lead). The card has two adjustments for audio level (to and from telco).

The audio on each tip-ring wire pair is balanced using transformer isolation to and from the interface connector:

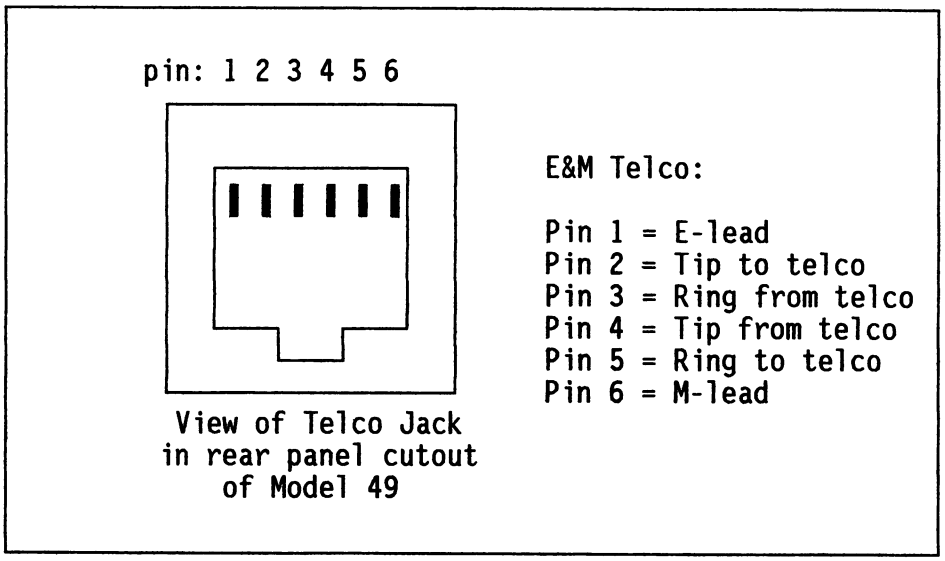


Figure 5.5 - Pin out for E&M RJ11-C Telco Jack

The jumper settings on the card give you flexibility in connecting the card to Bell Standard Type I or Type V E&M trunks:

JP1 selects the supervision leads (E or M) for sense and control
A = E is sense, M is control
B = M is sense, E is control

JP2 selects the control relay contacts for normally open or normally closed
A = control relay is normally open (N.O.)
B = control relay is normally closed (N.C.)

JP3 sets the sense lead to see ground or minus voltage as "off-hook" incoming
A = minus voltage from telco means "off-hook"
B = ground from telco means "off-hook"

JP4 sets the control lead to assert ground or -48V as "off-hook" for outgoing
A = ground to telco means "off-hook"
B = -48V to telco means "off-hook"

Note: You can adjust the Model 49's -48V supply with the pot on the motherboard underneath the telephone interface card.

TEST MODE

Various test modes can be enabled in the Model 49 using the front panel dip switches A:1 and A:2. The different test modes are as follows:

Switch A:1 up, A:2 down. The Model 49 will continuously transmit the test ID code that has been programmed in the Multibase Repeater Configuration screen and send "ringing tones" out the transmitter.

Switch A:1 up, A:2 up. The Model 49 will continuously transmit ID code 253 (Repeater Busy).

If an interconnect call is made into the Model 49, the Model 49 will answer and continuously send one of three tones to the phone. To change the tone being sent, press the front panel CONNECT/DISCONNECT button; each time the button is pressed a new tone is selected. If the button is pressed 4 or more times in a 2-second period the Model 49 will reset. The available tones are at a frequency of 400, 1000 and 2500 Hz.

FRONT PANEL LIGHTS

Main Board Lights (labeled on front panel):

POLL Indicates polling activity on the Zetron Subscriber Bus between Model 49's. If the Model 49 has been designated as the Master (switch B:1 Up), then the POLL light will be ON steady. The poll light on the slave units (switch B:1 Down) will flash when polled by the master unit.

During database cloning, the POLL light will flash briefly about once per second. Cloning of the full database takes approximately 2 minutes. If a POLL light is not lit, check cabling on both buses for continuity and terminating resistors.

SYNC This LED responds to the high-speed Repeater Bus and indicates sync activity. If the Model 49 has been designated as the Sync Master (switch B:2 Up), then the SYNC light indicates that sync is being generated. The SYNC lights on all of the slave units (switch B:2 Down) show that they are receiving sync from the master.

If a sync light is not lit, check the Repeater Bus cabling for a break in continuity or a missing bus terminating resistor. On E.F. Johnson logic, the sync light is labeled SYNC; on Uniden it's labeled RCD.

DIGIT When a DTMF digit is received from the mobile or telephone party, then this LED blinks. This LED is used only on Model 49's equipped with the interconnect option package.

MODEM When the Model 49's internal modem is in use this LED lights. This LED is used only on Model 49's equipped with the interconnect option.

TELCO When the telephone interconnect card is active this LED lights. This LED is used only on Model 49's equipped with the interconnect option.

ALARM This LED lights when an Alarm condition has been sensed.

CARRIER This LED lights when the Model 49 has detected RF carrier from the repeater. Also refer to jumper settings on JP12 and JP14.

TRANSMIT This LED lights when the Model 49 has activated PTT (push-to-talk) to put the repeater into transmit.

POWER This green LED lights when 12V power is present to the Model 49.

Protocol Card Lights (5 LEDs in front panel window, from left to right):

TX PACKET This LED lights when the Model 49 is transmitting LTR subaudible data packets to the LTR mobile through the repeater.

RX CENTER These <u>two</u> LEDs light when sub-audible data packets received from the LTR mobile through the repeater are properly triggering the high and low peak detectors on the Protocol Card.

RX PACKET This LED lights when a sync code pattern is recognized in the received sub-audible data packet from the LTR mobile through the repeater. The light turns off at the end of a packet.

RX VALID This LED lights when an accurate sub-audible data packet is received from the LTR mobile through the repeater. This light turns off when a packet error is received or when the RF carrier drops.

Compandor Card Lights (2 LEDs visible when Model 49 top cover is removed):

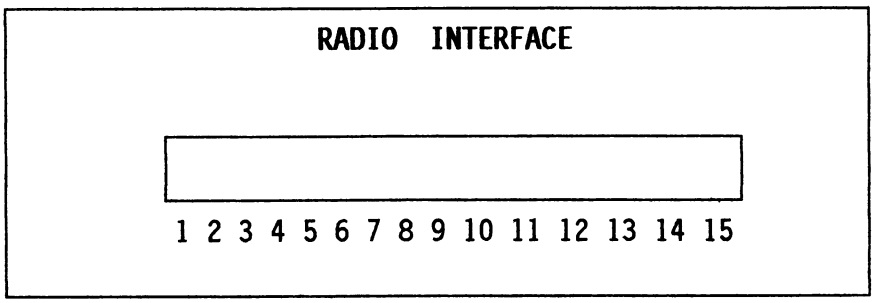
EXPAND This LED lights when the Model 49 is expanding the dynamic range of audio from the mobile radio to the telephone line. (receive expandor)

COMPRESS This LED lights when the Model 49 is compressing the dynamic range of audio from the telephone line to the mobile radio. (transmit compressor)

REPEATER CONNECTIONS

Use a shielded cable between the Model 49 rear panel terminal block labeled RADIO INTERFACE and your radio repeater equipment. This terminal block is detachable, so you or Zetron can pre-wire cables for fast installation and service.

The following diagram shows the signals available at the Model 49's radio connector:



1 = AC/+12V	9 = SENSE 1
2 = AC	10= COR
3 = DC GND	11= TX OUT
4 = GND	12= GND
5 = PTT NC	13= SUB OUT
6 = PTT COM	14= GND
7 = PTT NO	15= DISC IN
8 = CTL 1	

Figure 5.6 - Model 49 Rear Panel Radio Connector

AC/DC Power Apply 10.5 to 14 VAC between pins 1 and 2 or
Apply 12 to 15 VDC between pins 1 and 3

PTT Relay Obtain contact closure on pin 6 to key the transmitter. Connect return lead to pin 5 or 7. The relay life is about 7 years when the idle packet timer is set for every 10 seconds in Multibase. If you wish to use open collector transistor PTT drive in parallel with the relay contacts, solder a wire jumper in position JP8 (near relay K1) on the Model 49 main card.

CTL 1 Used when the Model 49 is sharing the repeater with another controller.

SENSE 1 Used when the Model 49 is sharing the repeater with another controller.

COR Apply carrier indication from the receiver, if available, to pin 10. Jumper JP12 in position B selects receiver COR, jumper JP14 selects polarity, and front panel COR control sets voltage threshold. (We recommend that you use the Model 49 noise squelch circuit: set JP12 = A, JP14 = BB, pin 10 is ignored, adjust the front panel squelch level, and set the COR pot to 12 o'clock).

TX OUT Pin 11 is transmit audio from the Model 49 to the repeater exciter. Set jumper JP10 for coarse level (A=high, B=low), and adjust front panel pot for fine level. Set jumper JP7 for transmit audio flatness (A=flat, B=deemphasis for microphone inputs). Set jumper JP13 for repeat audio filtering (A=direct, B=300 Hz hi-pass filtering)

SUB OUT Pin 13 is sub-audible transmit data from the Model 49 to the repeater exciter. Inject this 10 Hz to 150 Hz signal into the DPL/DCG input on your transmitter. Adjust TX Data level on the Protocol Card as described in the preceding section, "Model 49 Setup" - "Step 5: Setting Levels".

Note: Make sure your transmitter can handle low frequency DPL data!

DISC IN Apply audio from the repeater receiver to pin 15. The signal's bandwidth should be 10 Hz to 10 kHz, containing high frequency noise, voice audio, and sub-audible data. Set jumper JP9 for coarse level (A=20, B=0), and adjust front panel pot for fine level. Set jumper JP1 for receive audio flatness (A=flat, B=deemphasis for discriminator). Adjust RX Audio level on Main Card and RX Data level on the Protocol Card as described in the preceding section, "Model 49 Setup" - "Step 5: Setting Levels".

Note: Use discriminator audio from the receiver's 2nd IF, ahead of any squelch circuitry.

Shield Ground your cable shield at only one end, preferably the Model 49 end.

Ground Do not rely on the cable shield to carry ground. Use pin 3 for power ground, pin 4 for PTT return, and pins 12 and 14 for any twisted ground signals. Do not combine high PTT keying current inputs onto the same ground wire as your low level audio or data signals.

Note: Repeater cables are available from Zetron for popular repeaters (contact a sales engineer).

REPEATER TIMING

There are two important settings in the Site Config and Repeater Config databases that relate to operational timing settings for your repeaters. You need to make sure that these settings are correct for your system, otherwise you will experience problems such as mobiles failing to access the system, audio squelch tail, dropped calls, etc.

Zetron engineers could probably have made these values fixed, but that might not have worked with every repeater. The settings of concern are shown below along with the Zetron recommended values:

Keyup Delay	0.02 sec (Repeater Config)
COR Hold Time	0.30 sec (Site Config)

Keyup Delay
The Keyup Delay is the time from the Model 49 closing the PTT relay to transmit, until it begins sending LTR data packets to the mobile. Any repeater suitable for trunking must be able to come to full power in less than .1 sec (100 milliseconds). This is necessary for the fast LTR handshaking that occurs each time a mobile user presses PTT. Due to software processing delays, the Model 49 adds about .01 to .02 sec (10 to 20 milliseconds) to the value programmed in Multibase. The recommended total delay becomes about 35 milliseconds. Lengthen this time if you are sure that your repeater is slow. If you make it too long or too short, however, mobiles will not "get in" on the first try.

COR Hold Time
The COR (carrier squelch) Hold Time is the time from the Model 49 losing mobile carrier, until the Model 49 considers that the mobile is done transmitting. This time is used by the Model 49 whenever the mobile RF signal fades without a normal "turn off" packet. If the RF carrier fades and then returns in less than the COR Hold Time, then the mobile call continues normally.

If you make this time too long, then you will hear a squelch tail from the mobile when the signal is weak and the Model 49 misses the "turn off" packet. If you think the Model 49 is missing too many turn-off packets, check the adjustment of the SQUELCH and COR pots and settings of jumpers JP12 and JP14.

COR Mute Time
This carrier squelch Mute Time is the time from the Model 49 losing mobile carrier, until the Model 49 mutes audio. This applies to dispatch operation only.

This time is fixed at .1 sec (100 milliseconds). If mobile carrier fades and comes back within this time period (for example due to RF multi-path) the Model 49 keeps the audio path active continuously, without introducing picket-fencing.

Packet Loss Time
This is the time from the Model 49 losing valid data packets from the mobile it was receiving, until the Model 49 drops the mobile call. RF fade, skip, or interference from other trunking system mobiles can cause loss of receive packets. (For example, other mobiles capture the LTR receiver) The packet loss time is set to a fixed 2 second value.

Repeater Hold Time
The Repeater Hold Time that appears in the Site Config database is useful, but not critical to system operation. The Repeater Hold Time keeps the repeater transmitter keyed after a dispatch mobile releases PTT. A value of 1 to 3 seconds can reduce thermal stresses on the RF power amp from keying up and down.

Repeater Timeout Timer
The Repeater Timeout that appears in the Site Config database is useful, but not critical to system operation. The Repeater Timeout causes a mobile to become invalid and mutes the audio if a dispatch mobile has stayed keyed continuously for too long.

ASSIGNING INTERCONNECT CHANNELS

Smart Free Channel Allocation

The Zetron Model 49, with compatible repeater bus circuitry, built-in interconnect, and smart database gives you flexibility in adding interconnect to your existing E.F. Johnson or Uniden LTR trunking system. You can place the Model 49's in any channel in your system; adding new ones or replacing existing ones. Where you place the Zetrons can improve the trunking efficiency of your system, as we explain.

EFJ systems operate best when you place all of your interconnected channels together, consecutively numbered. This is because EFJ systems "trunk up", that is, they send mobiles to the next "higher numbered" repeater when they are busy. Uniden systems give you a little more flexibility by allowing each interconnect to "point" to the next preferred channel for trunking, so you can trunk up, down, or spread out your interconnected channels.

Zetron's Intelligent Repeater Channel Allocation designates the next free repeater based upon whether the home channel is capable of handling outgoing interconnect (mobile to land line) calls. Since each Model 49 knows these channels from the information you have programmed into Multibase, it can point to another channel of like capability when it is busy.

Mobiles homed on outgoing interconnect channels will trunk to an interconnected channel as long as one is available. Similarly, mobiles homed to dispatch channels will not trunk to an interconnect channels until all of the dispatch-only channels are full. With mobiles homed on a Zetron Model 49, your users will make interconnect calls more easily, improving your system's grade of service.

To activate this feature, you simply fill in the capabilities of all of your trunking channels into the Multibase programming system in the Repeater Config database. The Model 49's then know where to trunk dispatch and interconnect home channel users.

All Zetron Channels

With Intelligent Repeater Channel Allocation, your Zetron units are smart and trunk efficiently, regardless of how you number them and regardless of which channels are dispatch-only or interconnected.

Johnson and Zetron Interconnect

Suppose you already have some interconnected channels from EFJ and are going to add in some new Zetron ones. You want to let your EFJ channels continue to "trunk up", so put your Zetrons just above your Johnsons. Mobiles homed on the Johnson interconnect channels will find more interconnects available and find it easier to get an interconnect. Mobile homed on the new Zetron channels, won't trunk up; they will go directly to a free interconnect (Johnson or Zetron) as available.

Make sure that you program the Repeater Config information in Multibase with all of your Johnson channels so that the Zetrons know which channels are capable of outgoing interconnect.

Uniden and Zetron Interconnect
Suppose you already have some interconnected channels from Uniden and are going to add in some new Zetron ones. You want to let your Uniden channels continue to "trunk up or down", so put your Zetrons just above (if trunking up) or below (if trunking down) your Unidens. Mobiles homed on the Uniden interconnect channels will find more interconnects available and find it easier to get an interconnect. Mobile homed on the new Zetron channels, won't trunk up or down; they will go directly to a free interconnect (Uniden or Zetron) as available.

Make sure that you program the Repeater Config information in Multibase with all of your Johnson channels so that the Zetrons know which channels are capable of outgoing interconnect.

Busy Mobile Handling
The Zetron Model 49 is smarter than the average interconnect. If a phone caller tries to reach a mobile who is already on another interconnect call, the Model 49 plays "busy tones" to the phone party. This saves air time and notifies the phone caller to try again later. Other interconnects are not as smart and waste billable air time by just "ringing" the mobile, who cannot receive the call anyway.

Zetron DID Interconnect
If you are going to put a Zetron DID-equipped Model 49 into your existing Johnson or Uniden system, you can do this without having to reprogram your mobiles, as long as the mobiles are equipped with System Scan. Since DID equipped Model 49's cannot not make outgoing calls, the mobiles should not be programmed to recognize a DID Model 49 channel as interconnected. However, if you have different home channel assignments in the mobile for dispatch IDs and interconnect IDs, the mobile user should use system scan to receive both types of calls.

A DID channel can handle land line to mobile interconnect calls as well as mobile to mobile dispatch calls. When a dispatch call is in progress and a land line caller comes in on the DID, the Model 49 gives ringing tones to the phone caller until the talking dispatch mobile releases PTT. Then, the Model 49 gives the channel to the DID caller, and the dispatch traffic gets trunked to another channel.

Phone callers will get through faster on the DID trunk if you do not home a lot of dispatch users on the DID Model 49. Dispatch traffic will start up on their own home channels first and tend to keep the DID channels more open. Regardless of the mobile's home channel, it can get sent to the DID Model 49 to receive a call, by the home/ID information put onto the repeater bus. You assign any DID number to any mobile ID in the Multibase User ID screen.

REPEATER SHARING

The Model 49 (with main software version 3.5 and later) can share the repeater with a Zetron conventional control terminal (Model 45B Z-Patch Interconnect or Model 48B Repeater Manager). You can thereby provide LTR and conventional operation, with some limitations, on the same repeater frequency at the same site.

First of all, your conventional mobiles must be equipped with "busy channel lockout". This provides the necessary privacy to which trunking customers are accustomed.

Second, separate telephone lines must be provided to the terminals (sharing of a common phone line between the terminals is not done; after all, when it rings, which one should answer?).

Third, conventional sub-audible digital channel guard (DCG/DPL) has not been tested for compatibility and may false the Model 49, making it think an LTR mobile is attempting access. Also, some CTCSS tones may also false some LTR data codes.

For mobile to mobile and mobile to land line calling, each terminal listens to the RX discriminator audio from the repeater's receiver. If an LTR mobile accesses the channel, the Model 49 decodes the LTR data packet and takes control of the channel by activating its CTL1 relay (closure to ground) and PTT relay (closure to ground). Conversely, if a conventional mobile accesses the channel with its CTCSS tone, the Model 45/48 decodes the tone and takes control of the channel by activating its PTT relay. When the channel is in use by one of the terminals, the other one ignores the RX discriminator input.

For land line to mobile calling, each control terminal watches its incoming telephone line. When a call arrives, and the radio channel is available, the respective terminal takes the radio channel by activating its relay outputs. If a phone call comes into either control terminal and the radio channel is already in use, the phone line will be answered (to check for access by a computer for database update, billing retrieval, or system monitoring). If the calling party is not a computer modem, then the caller is given "reorder" tones for a few seconds and the call is disconnected.

The following connection diagram shows you how to wire a Zetron Model 49 to a Zetron Model 45 or 48. The RX discriminator audio, TX audio output, TX sub-audible output, and PTT transmitter keying are connected in pairs to the repeater. The adjustments of the TX output levels on the two control units is interdependent since each output places an electrical load on the other.

It will be necessary to apply the PTTs of the Model 49 and Models 45 and 48 into an 'OR' gate. The output of the 'OR' gate should go to the PTT of the repeater.

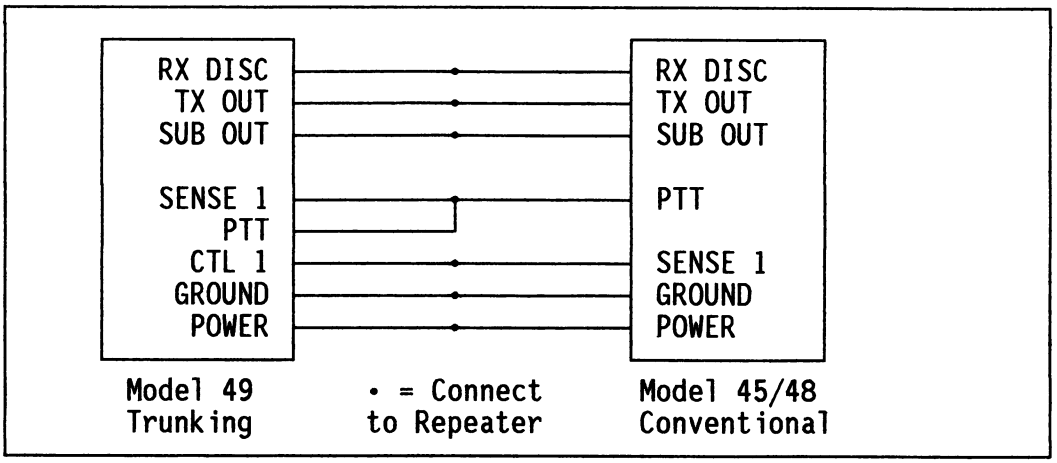


Figure 5.7 - Model 49 to Model 45/48 Connection Diagram

To keep calls flowing smoothly, make sure to set the Repeater Hold Time on each control terminal to 2 to 5 seconds. Make this value long enough so that a pair of mobiles can have the channel for the duration of a "back and forth" dispatch call. You don't want the channel to drop and the other terminal to grab it between the PTT's of two mobile parties who are conversing.

If you have more than one repeater that you wish to share between Model 49's and conventional controllers, trunking becomes tricky. LTR mobiles that are homed on the Model 49's return there for trunking instructions. If the conventional controller has the channel tied up, the LTR mobiles are stuck and do not trunk. Therefore, to make trunking work, you need to home your LTR mobiles onto Model 49's that have free access to their repeaters (not shared). Other Model 49's can share repeaters and be used as "trunk to" channels; just don't home any mobiles there.

ALARM MONITORING

The Model 49 has 3 external alarm inputs (Sense 1, 2, & 3). These inputs are analog (or 5 volts). The inputs are protected by 6.2-volt Zener diodes.

If the alarm feature is enabled, the voltage reading that is obtained is compared against the ranges programmed in the repeater configuration. If the reading is outside the valid range, that alarm is set. The Model 49 also has relay outputs that can be used in conjunction with the alarms to turn on a fan, etc. If programmed correctly, when an alarm is set, an output relay will be set. These relays are identified as control 2, 3, & 4. These relays can be made either normally open (N.O.) or normally closed (N.C.)

The following jumper selections determine whether the control relay output is N.O. or N.C.:

	Position A	Position B
CTL2 JP4	N.O.	N.C.
CTL3 JP5	N.O.	N.C.
CTL4 JP6	N.O.	N.C.

6. TELEPHONY SIGNALING

E-E LOOP START

Idle Condition
Looking toward the CO (central office) switch, the Ring lead is attached to the battery (-48 VDC) and the Tip to ground. Both Tip and Ring are open, looking toward the Model 49.

Outgoing Call
An outgoing call is originated when the Model 49 seizes the trunk by applying a loop closure across the tip-ring (T-R) leads, causing current to flow in the loop between the Model 49 and the CO. The CO senses the current flow and attaches a digit receiver to the circuit in preparation for receiving address information. Once the equipment is attached, the CO provides dial tone to the Model 49. The Model 49 then passes dial tone through to the mobile caller. The caller's dialed information gets regenerated after dial tone is detected or after the "Start Supervision Seek Time" has elapsed if no dial tone is detected.

Incoming Call
An incoming call from the CO is originated when the CO applies ringing voltage on the facility toward the Model 49, superimposed on the -48 VDC battery voltage. The ringing signal is 105V, 20 Hz, 2 sec on, 4 sec off.

The Model 49 detects the ringing voltage and answers the call by closing the loop. Upon sensing loop current, the CO disconnects the ringing generator and completes the call by establishing an audio path to the Model 49. At this time the Model 49 plays the go ahead prompt to the CO or landside user and waits for the over dial digits.

Call Disconnect
Either the calling or called party may disconnect the call by going on hook. However, a landside disconnect signal is not required to be relayed to the Model 49 by the CO under the loop signaling format. There is no change of state; Ring remains connected to battery, and Tip to ground. Special equipment must be available at the CO to send a disconnect signal. The COs that have this capability will give a battery reversal (i.e., place the battery on the Tip and ground on the Ring), which the Model 49 can detect and disconnect on.

The Model 49 will disconnect by going on hook or opening the loop toward the CO.

DIRECT INWARD DIALING

DID trunks allow a landside caller to directly dial a mobile served by a Model 49 without the necessity of the caller over dialing an ID. All calls over DID trunks originate from the switched public network and terminate at a Model 49; therefore, DID trunks are called "1-way incoming trunks".

Idle Condition
This is when both the Model 49 and the CO are on hook. In a DID configuration, the Model 49 looks like the CO and the CO looks like the phone; therefore, the Model 49 will place ground on the Tip and -48 VDC on the Ring and the CO will not allow loop current to flow.

The Call
A DID call is initiated when the landside calling party goes off hook and sends address digits to the originating CO. The call is routed through the public network to the terminating CO. Up to this point, the call is handled in the same manner as other calls placed over the public switched network.

The CO switch determines the trunk group (in this case, a DID trunk group) over which the call is to be completed to the customer's Model 49. In addition, the CO switch determines the number of extension digits that are to be transmitted to the Model 49. In general, the extension digits will consist of from two to four of the station digits. The station digits are the last four digits dialed by the calling party.

The CO seizes an idle circuit in the DID trunk group by going off hook or closing the loop.

For an Immediate Start Line: The CO will then send the feed digits some time later (a minimum of 150ms); therefore, the Model 49 must be ready to receive the digits very quickly. The Model 49 will translate those feed digits and start ringing the appropriate ID. When the call is answered, the Model 49 gives an answer supervision or reverse battery back to the CO. This reverse battery means that the Model 49 places -48 VDC on the Tip and ground on the Ring. The CO sees this and connects the audio through to both sides. Figure 6.1 illustrates the entire process.

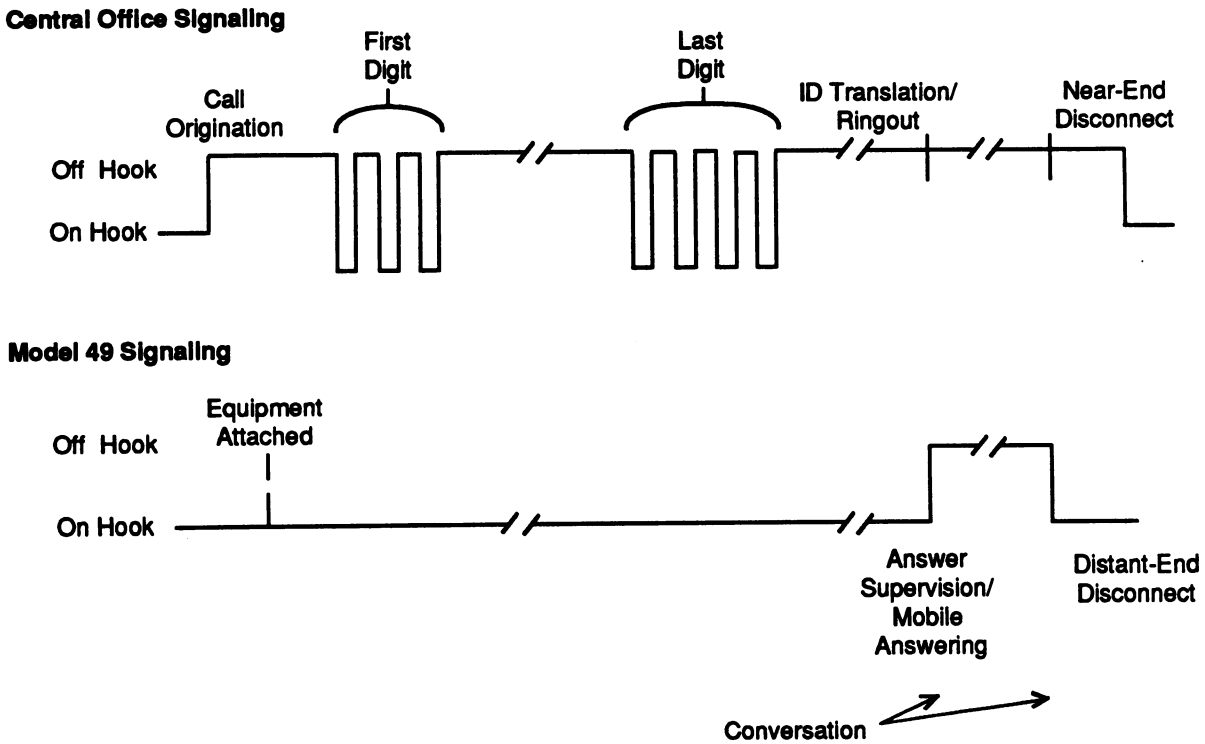


Figure 6.1 - Immediate Start, Entire Call

For a Wink Start Line: When the Model 49 is ready to receive the extension digits, it sends out a "wink" in the form of a temporary battery reversal. This reverse battery means that the Model 49, momentarily, places -48 VDC on the Tip and ground on the Ring. This is the start dialing signal to the CO, which then sends the feed digits to the Model 49. The Model 49 will translate those feed digits and start ringing the appropriate ID. When the call is answered the Model 49 gives an answer supervision or reverse battery back to the CO. The CO sees this and connects the audio through to both sides. Figure 6.2 illustrates the entire process.

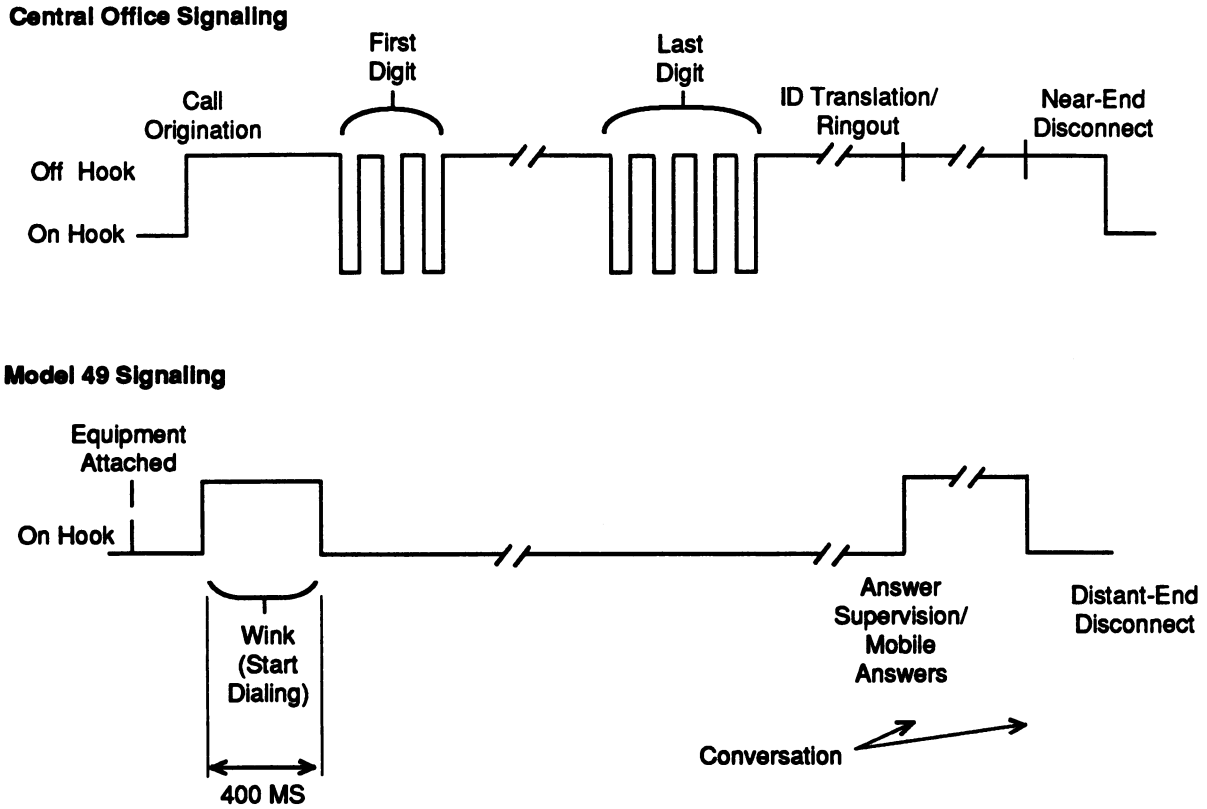


Figure 6.2 - Wink Start, Entire Call

Call Disconnect
Either party may disconnect the call by going on hook.
The CO does this by opening the loop causing current to quit flowing, which the Model 49 will see. The Model 49 will disconnect by going back on hook which the CO sees and opens the loop.

TYPE I FOUR-WIRE WITH E&M SIGNALING

Type I service is unique in that these trunks can be used to do DID calls and outbound calls. It also has improved audio for several reasons. Two hybrids are eliminated, signal levels are more tightly specified, and acceptable line losses are smaller.

Only two conditions are represented by E&M signaling, on hook and off hook. By convention, switching equipment, such as a PBX and the Model 49, transmits on its M lead (mouth) and receives on its E lead (ear).

The conventions used to represent on hook and off hook states for E&M Type I are summarized below.

State	From M49 to CO (M lead)	From CO to M49 (E lead)
on hook	Ground	Open
off hook	-48 VDC	Ground

For the proper signaling to take place an Inverted M Lead Protocol is used so that the M (mouth) lead signals the E (ear) lead, as shown in Figure 6.3.

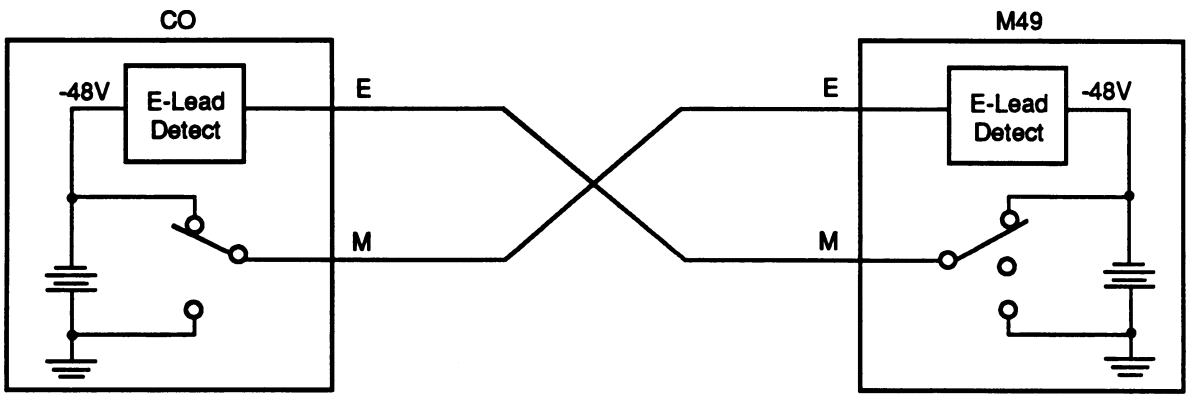


Figure 6.3 - Inverted M Lead Protocol

Figure 6.4 shows the entire picture. The Tip1 and Ring1 leads are for audio from the CO to the Model 49, while the Tip2 and Ring2 leads are for audio from the Model 49 to the CO.

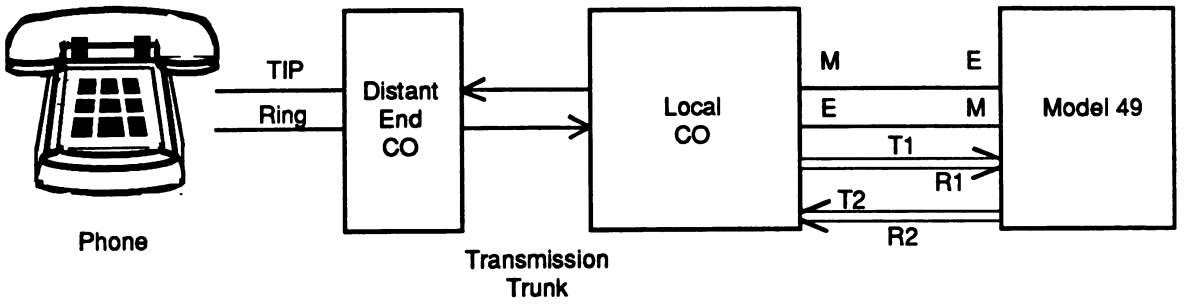


Figure 6.4 - Type I Four-Wire with E&M Signaling

Idle Condition
Figure 6.5 illustrates the idle condition (on hook) for Type I E&M signaling between a Model 49 and telco interface equipment. To signal off hook to the telco equipment, the Model 49 switches its M lead from ground to -48 VDC. To signal to the Model 49 that the distant end has gone off hook, the telco equipment grounds the E lead.

Incoming DID Call
Either Immediate or Wink Start signaling can be used. With E&M four-wire, everything is identical to two-wire except the E and M leads do the signaling of the off hook and on hook conditions. This is illustrated in Figures 6.5 and 6.6.

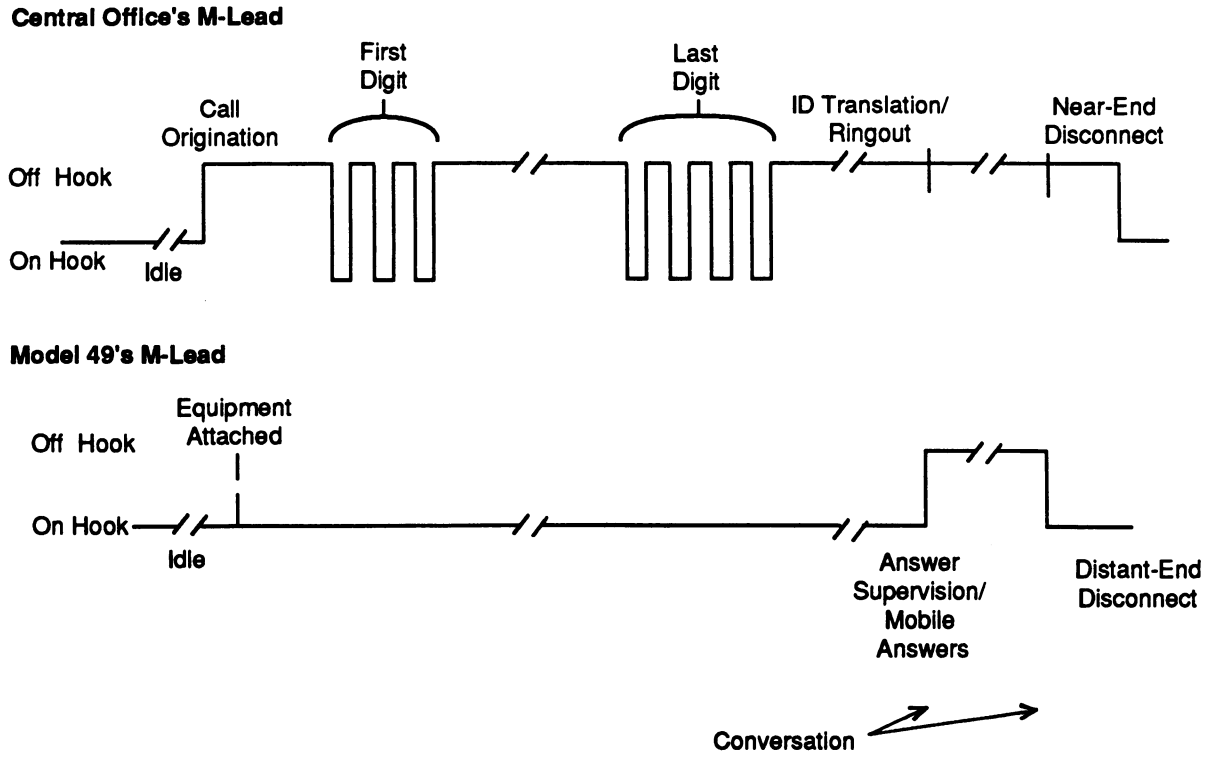


Figure 6.5 - Immediate Start, Entire Call

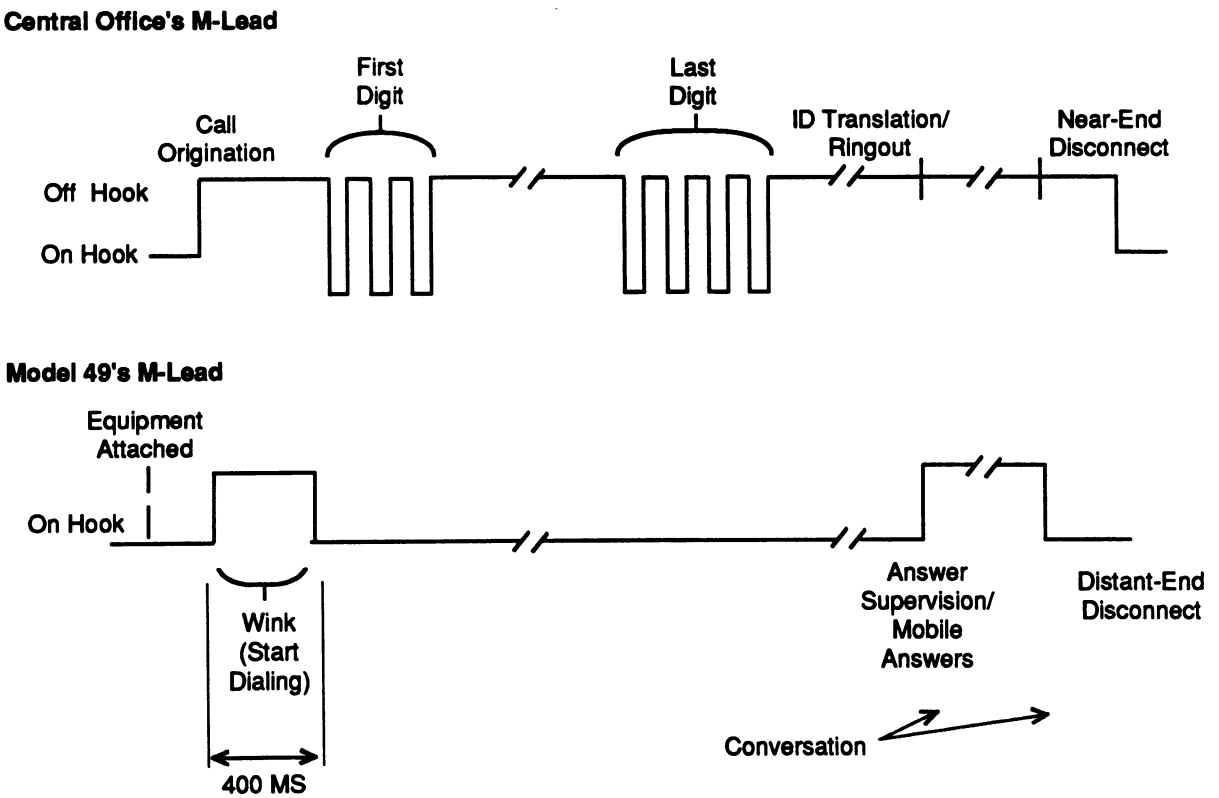


Figure 6.6 - Wink Start, Entire Call

Outgoing Calls

An outgoing call is originated when the Model 49 seizes the trunk by going off hook with its M-lead. The CO sees this and attaches a digit receiver to the circuit in preparation for receiving address information. Once the equipment is attached, the CO provides dial tone to the Model 49. The Model 49 then passes dial tone through to the mobile caller. The callers dialed information gets regenerated after dial tone is detected or after the "Start Supervision Seek Time" has elapsed if no dial tone is detected.

Once the CO is done routing the call it will send ringback to the Model 49. And when the landside phone is answered and goes off hook an off hook condition is sent back to the Model 49. At this point the CO will connect the audio through in both directions and the call has been established. Either the Model 49 or the caller can disconnect the call by going on hook. When the caller goes on hook, the CO signals the Model 49 on the Model 49's E-lead by going on hook as well. Figure 6.7 illustrates this entire process.

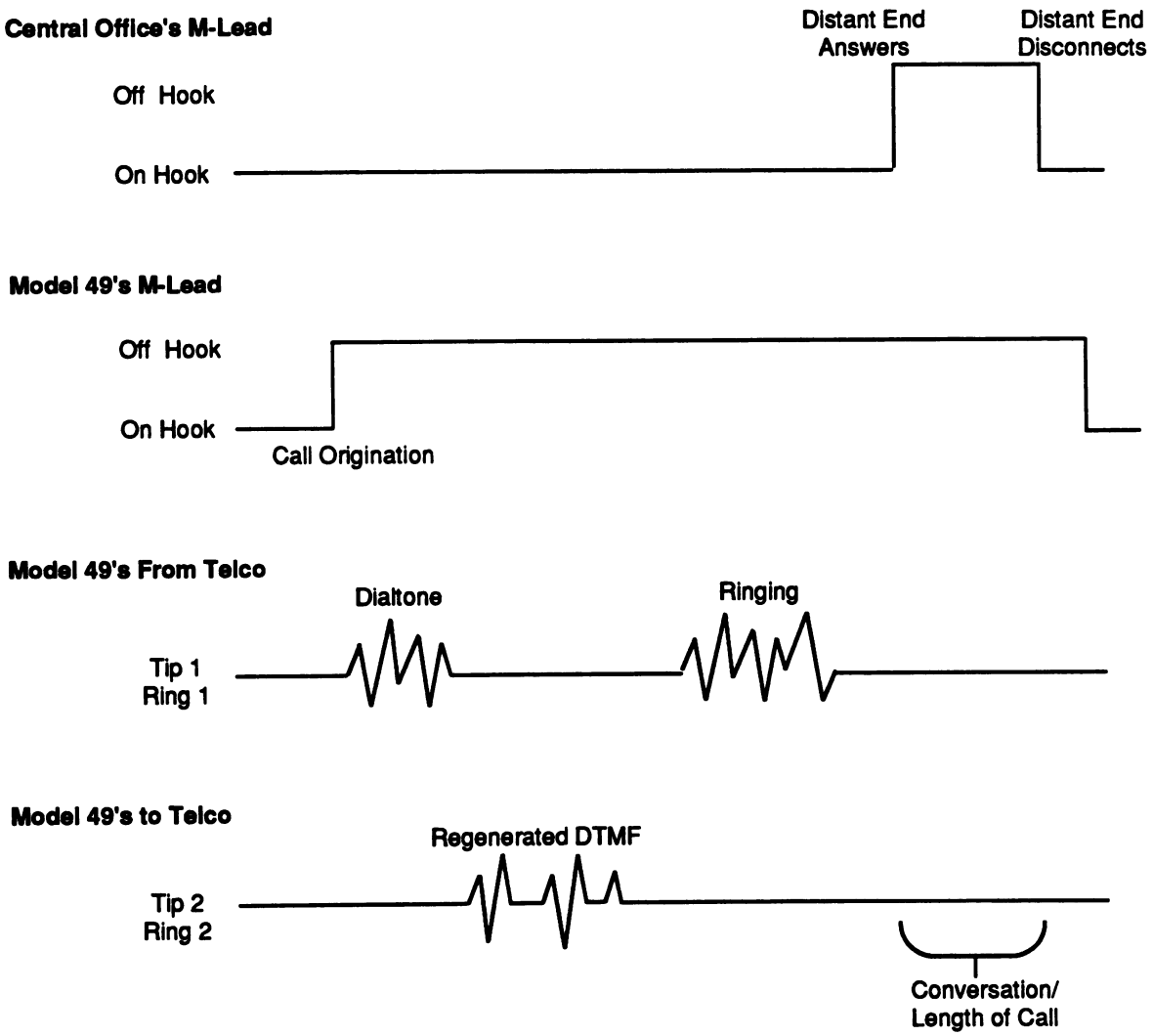


Figure 6.7 - Outgoing Calls

DIRECT AUTONET

A direct autonet setup has two Model 49s directly connected via RF link, microwave link, or leased line. These two Model 49s are located at different sites and can only do dispatch or direct autonet calls. Figure 6.8 shows the suggested wiring for a direct autonet call.

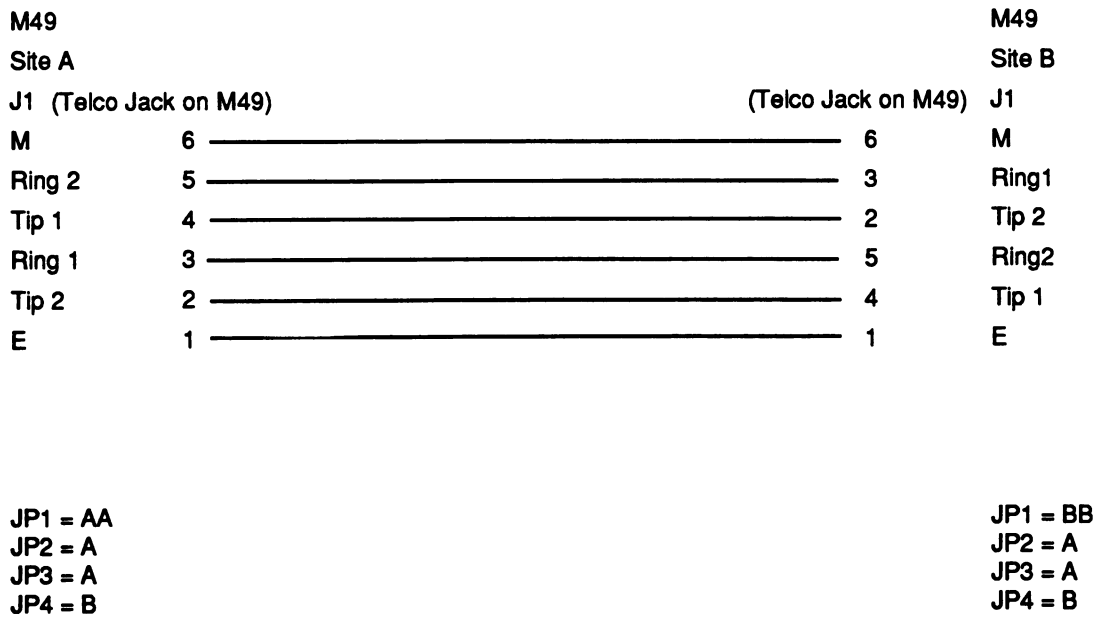


Figure 6.8 - Direct Autonet

The following table shows the off hook and on hook conditions of the two Model 49s.

State	Site A Model 49	Site B Model 49
on hook	Open	Open
off hook	-48 VDC	-48 VDC

A call is initiated when the user keys up with a push to connect interconnect ID that is programmed for direct link. The calling Model 49 will go off hook. A short time later, the called Model 49 will send back DTMF '*5' to tell it that it has received the off hook condition and is free to do the call. When the calling Model 49 receives the '*5', it will send the DTMF overdial. After the called Model 49 receives the DTMF overdial, it will start ringing the mobile and send ring back to the calling Model 49. Once the mobile answers, the called Model 49s M-lead is taken off hook and audio is passed through in both directions. Either the calling or called Model 49 may terminate the call with a '#'.

Figure 6.9 shows direct autonet calls.

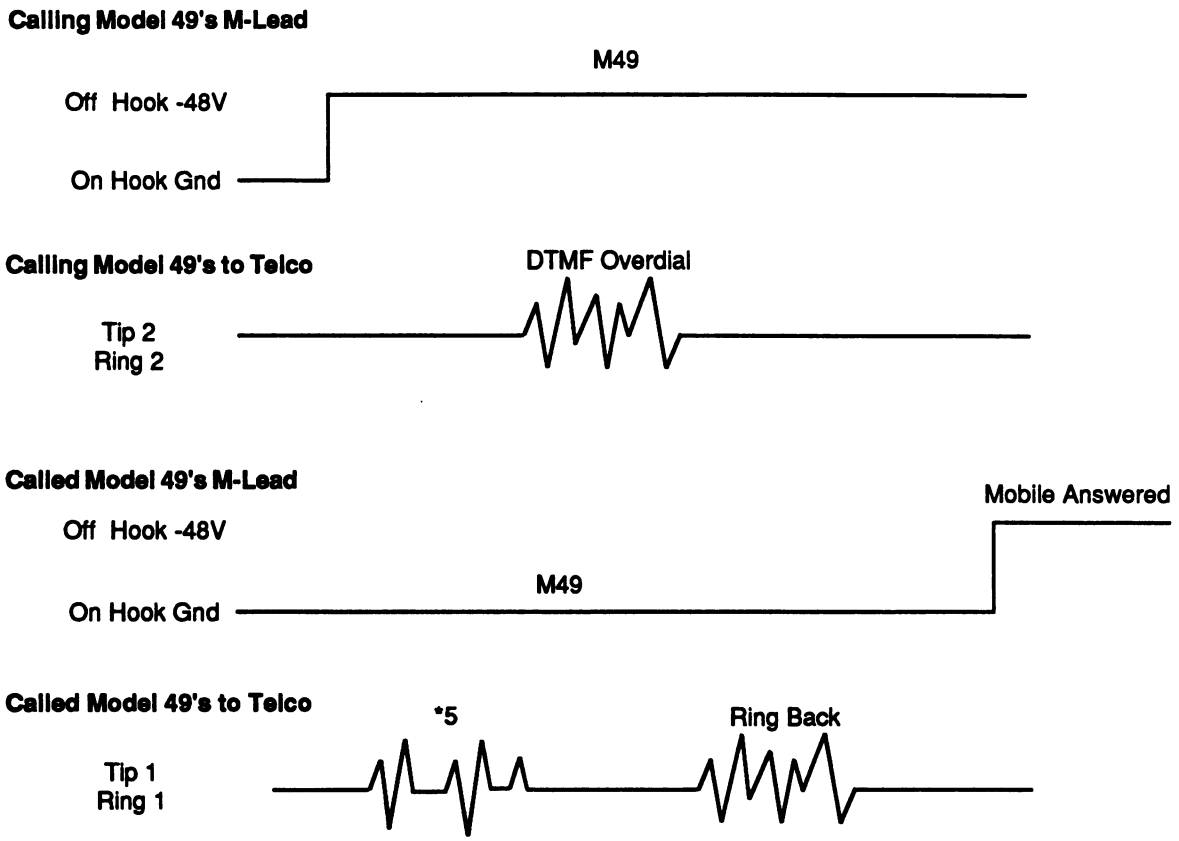


Figure 6.9 - Direct Autonet Call

7. TROUBLESHOOTING AND REPAIR

The following sections are included to assist you in troubleshooting common problems that many technicians encounter during installation of the Model 49 into an LTR system. Each paragraph deals with an observed fault symptom, possible causes for the symptom, and some recommended remedies.

Determine if your problem is related to dispatch, interconnect, or computer access. If possible, disconnect the Model 49 from other logic units to see if you have a system-related or single repeater problem. The troubleshooting sections below deal with these separate problem cases.

DISPATCH PROBLEMS

Fault Symptom	Possible Cause(s)	Remedy
No mobile can access system	COR signal polarity	Jumper JP14
	RX or TX data level	LTR card adjustments
	RX or TX data polarity	LTR card jumpers
	Key up delay timing in Multibase	Set .02 sec in Rptr Config
	User ID not valid in Multibase	Set user valid in User IDs
	User ID set deferred in Multibase	Set user valid in User IDs
	Repeater number set wrong	Model 49 panel switches
	Multiple sync masters on bus	Model 49 panel switches
	Repeater off frequency	Set repeater frequency
	Wrong area set	Model 49 panel switches
Some mobiles can't access system	User ID not valid in Multibase	Set user valid in User IDs
	User ID set deferred in Multibase	Set user valid in User IDs
	RX or TX data level	LTR card adjustments
	Multiple sync masters on bus	Model 49 panel switches
	Mobile programming	Check mobile program.
	Slow COR detector	See rework #065-0076
	Uniden SPS320TS portable	Co-channel interference
	Wrong area set	Model 49 panel switches
Occasional difficulty accessing system	RX or TX data level	LTR card adjustments
	Transmitter over modulation	TX audio level
	Repeater hold time in Multibase	Set .3 sec in Site Config
	Key up delay timing in Multibase	Set .02 sec in Rptr Config
	Weak RF signal	Check antenna cabling
	Low DC input power:<10.5V	Boost input voltage
	Squelch adjustment	See Section 4

Fault Symptom	Possible Cause(s)	Remedy
System not trunking	No repeater bus sync master	Bus cables or Sync switches
	Multiple sync masters on bus	Model 49 panel switches
	Duplicate repeater number	Model 49 panel switches
	Repeater bus terminator missing	Put terminator on one repeater
	Wrong mobile programming	Put repeaters into mobile
Audio picket fencing	COR hold time too short	Set >.3 sec in Site Config
Frequent audio squelch tail	COR hold time too long	Set <.5 sec in Site Config

INTERCONNECT PROBLEMS

The following information pertains to Model 49 units equipped with the Interconnect Option. First, make sure your system works with dispatch mobiles using the troubleshooting chart above, then use the chart below to get your interconnect working.

Fault Symptom	Possible Cause	Remedy
Land line to mobile calls don't work	Repeater not set in Multibase	Set up Repeater Config
	Telco card not set in Multibase	Set up Repeater Config
	No Incoming Calls in Multibase	Set up Repeater Config
	User ID not Type=I in Multibase	Set up user in User IDs
	User ID not valid in Multibase	Set user valid in User IDs
	User ID set deferred in Multibase	Set user valid in User IDs
	Call limits =0 in Multibase	Set Load Table in Site Config
	System heavily loaded	Set Load Table in Site Config
	Answer time too short	Set Answer in Site Config
	Dial Click Decode set with no dial click board installed	Set Dial Click Decode Mode to "N" in Repeater Config

Fault Symptom	Possible Cause	Remedy
Interconnect mobiles can't draw dial tone	Repeater disabled in Multibase	Set up Repeater Config
	Telco card disabled in Multibase	Set Telco in Rptr Config
	Outgoing Calls =N in Multibase	Set up Repeater Config
	User ID not Type=I in Multibase	Set up user in User IDs
	User ID not valid in Multibase	Set user valid in User IDs
	User ID set deferred in Multibase	Set user valid in User IDs
	Call limits =0 in Multibase	Set Load Table in Site Config
	System heavily loaded	Set Load Table in Site Config
	Model 49 cannot hear dial tone	Adjust FROM TEL pot
	Start Supervision Seek Time set too short	Set up Repeater Config
Interconnect mobiles draw dial tone, but calls don't go	Audio level from telco	Adjust FROM TEL pot
	Audio level to telco	Adjust TO TEL pot
	Number of DTMF digits	Set Min/Max in Site Config
	Timing of DTMF digits	Set Time outs in Site Config
	Toll restricted number	Set Privileges in User IDs
	Toll restricted prefix	Set Prefixes in Site Config
	Telephone hybrid unbalanced	Adjust BAL R and C pots
System not trunking all interconnects	Some repeaters not in Multibase	Set up Repeater Config
	Mobile programming	Check mobile program.
Mobiles calls sometimes dropped	COR hold time in Multibase	Set .3 sec in Site Config
	Repeater hold time in Multibase	Set .3 sec in Site Config
	Turn around time too short	Set 30 sec in Site Config
	Squelch adjustment	See section 4
	Call limits too short in Multibase	Set Load Table in Site Config
	System heavily loaded	Set Load Table in Site Config
	False "#" tones detected	Decrease FROM TEL pot
	False "#" tones detected	Adjust Hybrid balance
	No exciter headroom for TX data	Set Rptr TX limiter to 4 kHz

Fault Symptom	Possible Cause	Remedy
Audio muting phone to mobile	Squelch adjustment	See Section 4
	COR hold time in Multibase	Set .3 sec in Site Config
	RX data level	LTR card adjustments
	Weak RF signal	Check antenna cabling
mobile to phone	TX data level	LTR card adjustments
	Weak RF signal	Check antenna cabling
	RF fade to Uniden SMS300	Tell user to press PTT again

Note: With some particular RF signal conditions and antenna systems, mobiles may have difficulty "getting in" to the system. You may find it desirable to increase or decrease the TX or RX audio levels in the Model 49 from the nominal settings described above.

Note: In software versions 3.3 and earlier, there are no "end-of-call" termination beeps given to the mobile. This saved air time on each telephone call. With later software versions, you choose sets of beep tones to mimic EF Johnson, Uniden, or Zetron. With Zetron tones, you save on telephone and radio time.

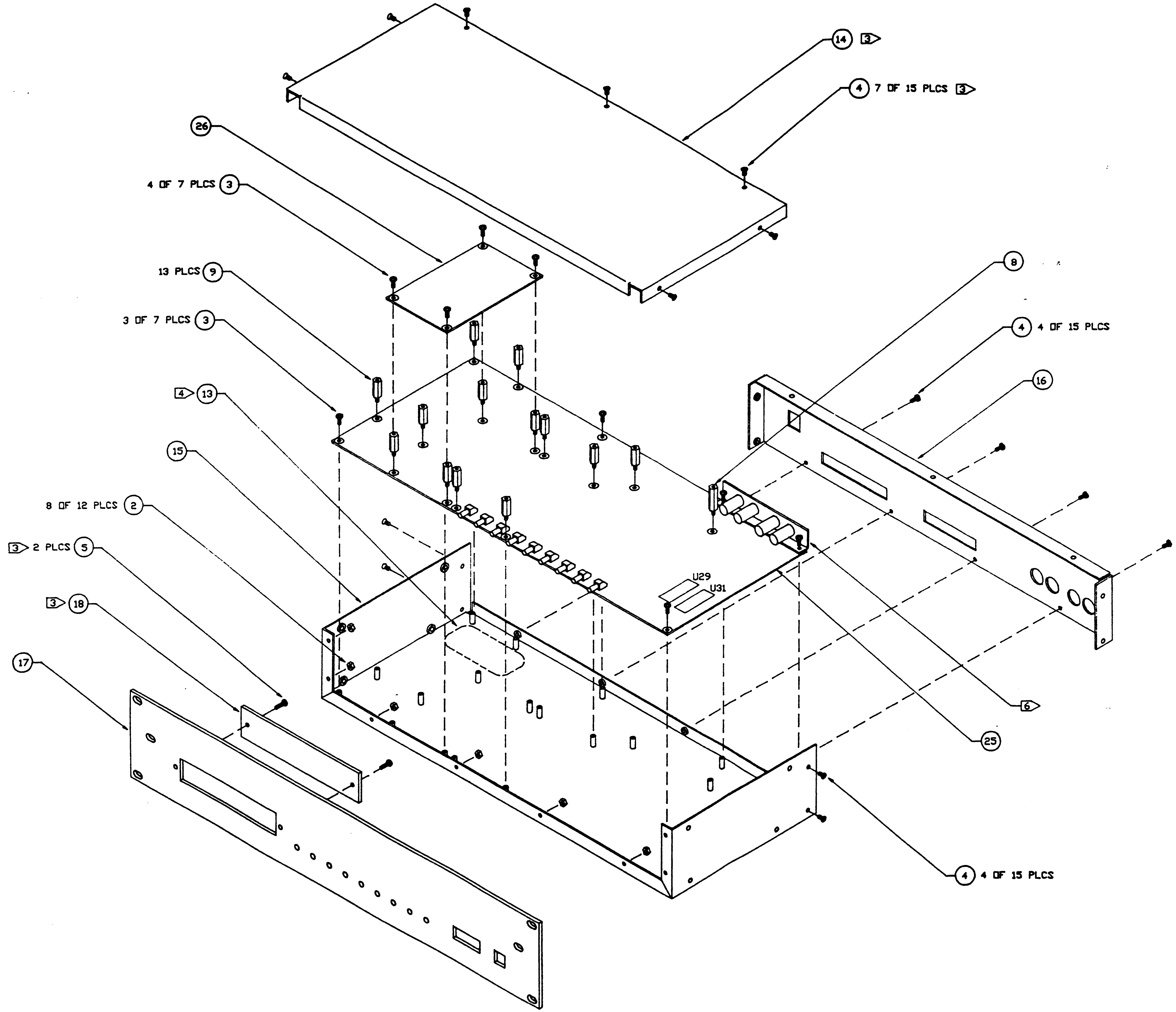
COMPUTER ACCESS PROBLEMS

Fault Symptom	Possible Cause	Remedy
Computer cannot program Model 49 w/ local comm cable	Computer comm port #	Set port # in Site Config
	Computer IRQ line	Jumpers on computer card
	Computer baud rate	Set baud rate in Site Config
	Model 49 baud rate	Model 49 panel switches
	Programming cable	Check cable wiring
	Password corrupted	Clear memory U25 & U27
	Low DC input power:<10.5V	Boost input voltage
	Sync masters on repeater bus	Model 49 panel switches
	Access modem	Check modem setup
	Repeater number 1 to 20 not set	Model 49 panel switches
	Incompatible Multibase	Install Multibase update
Computer cannot program w/ external Model 49 modem	Modem settings	Check modem setup
	Model 49 baud rate	Model 49 panel switches
	Computer baud rate	Set baud rate in Site Config
	Cloning active (POLL LED off)	Wait for cloning (2 min.)
Computer cannot program w/ internal Model 49 modem	Computer comm port #	Set port # in Site Config
	Computer IRQ line	Jumpers on computer card
	Computer baud rate	Set baud rate in Site Config
	Wrong access in Multibase	Access = "I" in Site Config
	Modem not 100% Hayes	Modem string in Other
	Password corrupted	Clear memory U25 & U27
	Telephone hybrid unbalanced	Adjust BAL R and C pots
	Cloning active (POLL LED off)	Wait for cloning (2 min.)
	2400 modem slow going to 1200	1st digit=9.9, Incoming Site
	Modem not doing Hayes "AT"	Set modem for Smart mode
Multibase cannot clone all installed Model 49s	No poll master on Zetron bus	Cabling or poll switches
	Repeater number duplicates	Model 49 panel switches
	Zetron bus resistor missing	Put resistor on <u>one</u> repeater
	Incompatible software in Zetrons	Same version in all 49's

GENERAL PROBLEMS

Fault Symptom	Possible Cause	Remedy
Data noise from half-duplex mobile	RX audio hi-pass filter disabled	Set JP13 to position B
	RX audio clipping	Adjust RX audio level
	Mobile data deviation wrong	See mobile radio manual
Data noise from full-duplex mobile	RX audio hi-pass filter disabled	Set JP13 to position B
	RX audio clipping	Adjust RX audio level
	Telephone hybrid unbalanced	Adjust BAL on telco card
	Uniden SMS300	Get Uniden AMX670 kit
Frequent audio squelch tail	COR hold time too long	Set <.5 sec in Site Config
	User set full duplex in Multibase	Set half-duplex in User IDs

REV	DESCRIPTION	DRAWN	APPRVD	DATE
H.5	REDLINE	AH	[illegible]	6-93



NOTES:

1. PLACE ITEMS IN 3X5 PLASTIC BAG.
2. TO BE PROGRAMED AND INSTALLED BY PRODUCTION TECHNICIAN.
3. TO BE ASSEMBLED BY PRODUCTION TECHNICIAN.
4. INSTALL DECAL IN THIS AREA ON OPPOSITE SIDE.
5. USE (4) 440 NUTS TO SECURE STANDOFFS WHEN 415-9414D IS USED WITH 410-9202F PCB.
6. DISCARD 440 NUTS FROM BNC BRACKET, USE SCREWS TO SECURE BRACKET AND PCB TO CHASSIS.
7. SEE 029-9147 FOR PACKAGING INSTRUCTIONS.

	ITEM	QTY.	PART #	DESCRIPTION
	26	1	702-9218	LTR PROTOCOL CARD
	25	1	702-9202	M49 CONTROL CARD
2 U29,U31	24	1	601-0195	M49 FIRMWARE
	23	1	449-9018	BAG, PLASTIC, 3X5
7	22	1	449-0092	M49 FOAM END CAPS
7	21	1	449-0091	M49 ACCESSORY BOX
7	20	1	449-0090	M49 BOX
UNIT	19	1	449-0009	BAG, PLASTIC, 15X24
3	18	1	415-9419	M49 LENS
	17	1	415-9416-1	FRONT PANEL
	16	1	415-9415-1	REAR PANEL
	15	1	415-9414	BOTTOM CHASSIS
3	14	1	415-9413	TOP COVER
4	13	1	415-9003	DECAL,TI5100 PN/SN/OPT
1	12	1	401-0058	15 POS. BLOCK FEMALE
1	11	1	401-0016	12 POS. BLOCK FEMALE
2 U29,U31	10	2	322-7256	32KX8 CMOS EPROM
	9	13	250-0105	440X5/8 STANDOFF W/STL
	8	1	250-0104	440X1/2 STANDOFF W/ST
1	7	4	236-0004	WASHER NYLON #10 BLK
1	6	4	220-0250	1032X3/4 FH PHILLIPS
3	5	2	220-0213	440X3/8 SCREW BLACK
	4	15	220-0212	440X3/8 FH PHILLIPS
	3	7	220-0108	440X1/4 PAN PHILLIPS
5	2	12	210-0001	440 KEPT NUT PLATED
2	1	1	005-0332	PRODUCT REG. CARD

DRN AH 6-22-93
CHK [illegible] 6-93
APV

ZETRON

ZETRON, INC. [illegible]

TITLE: MODEL 49 TRUNKING REPEATER MANAGER ASSEMBLY

TOLERANCES EXCEPT AS NOTED — DECIMAL, ANGULAR

SCALE —

SHEET 1 OF 1

DRAWING NUMBER: 901-9147

REV: H.5

DO NOT SCALE DRAWING

Model 49 Interconnect Option 950-9167 Rev. D

ITEM	QTY	ZETRON P/N	DESCRIPTION	REFERENCE
1.	1	011-0086	INSTALLATION INSTRUCTIONS	
2.	1	316-7840	REGULATOR, SWITCHING	U1
3.	1	321-0204	DTMF RECEIVER	U21
4.	1	321-0222	5V 1200 BAUD SINGLE CHIP MODEM	U37
5.	1	322-7256	32Kx8 CMOS EPROM	NOTE 1
6.	1	709-7000	6 COND MODULAR CABLE 10'	

NOTES:

1. SEE MODEL 49 PROM PROGRAMMING INSTRUCTIONS 022-0010.

Model 49 SMDR Option 950-9168 Rev. B

ITEM	QTY	ZETRON P/N	DESCRIPTION	REFERENCE
1.	1	011-0086	INSTALLATION INSTRUCTIONS	

Model 49 Main Board 702-9202 Rev. Q

LEGEND: + = OPTION, # = NOT INSTALLED, ^ = INSTALLED ON HIGHER ASSY

Item	Quantity	Reference	Part	Description	Mfg.Part No.
1	3	R1,R2,R57	101-0010	1 OHM 1/4W 5% CARBON FILM	1/4-5%
2	1	R10	101-0013	2.2 OHM 1/4W 5% CARBON FILM	
3	5	R4,R23,R26,R27,R89	101-0047	47 OHM 1/4W 5% CARBON FILM	
4	6	R12,R46,R139,R140,R141, R142	101-0049	100 OHM 1/4W 5% CARBON FILM	
5	4	R22,R66,R110,R126	101-0057	220 OHM 1/4W 5% CARBON FILM	
6	6	R7,R28,R40,R88,R108, R115	101-0066	510 OHM 1/4W 5% CARBON FILM	
7	19	R21,R41,R52,R70,R74,R82, R109,R116,R117,R118,R119, R120,R125,R127,R128,R132, R133,R134,R135	101-0073	1K 1/4W 5% CARBON FILM	
8	1	R107	101-0075	1.5K 1/4W 5% CARBON FILM	
9	4	R13,R29,R84,R87	101-0081	2.2K 1/4W 5% CARBON FILM	
10	1	R62	101-0083	2.7K 1/4W 5% CARBON FILM	
11	3	R11,R60,R105	101-0085	3.3K 1/4W 5% CARBON FILM	
12	1	R53	101-0087	3.9K 1/4W 5% CARBON FILM	
13	6	R42,R67,R93,R95,R130, R137	101-0089	4.7K 1/4W 5% CARBON FILM	
14	1	R50	101-0093	6.8K 1/4W 5%	
15	17	R36,R37,R38,R65,R71,R77, R94,R111,R122,R123,R124, R136,R145,R146,R147,R148, R149	101-0097	10K 1/4W 5% CARBON FILM	
16	2	R15,R112	101-0099	12K 1/4W 5% CARBON FILM	
17	4	R6,R8,R44,R49	101-0101	15K 1/4W 5% CARBON FILM	
18	1	R68	101-0104	20K 1/4W 5% CARBON FILM	
19	2	R16,R102	101-0105	22K 1/4W 5% CARBON FILM	
20	1	R61	101-0106	24K 1/4W 5% CARBON FILM	
21	6	R43,R45,R58,R64,R73,R76	101-0109	33K 1/4W 5% CARBON FILM	
22	1	R63	101-0111	39K 1/4W 5% CARBON FILM	
23	26	R14,R24,R25,R30,R31,R32, R33,R34,R35,R54,R55,R56, R69,R78,R79,R86,R91,R96, R97,R104,R113,R114,R131, R138,R143,R150	101-0113	47K 1/4W 5% CARBON FILM	
24	3	R18,R59,R99	101-0115	56K 1/4W 5% CARBON FILM	
25	7	R9,R19,R20,R51,R72,R75, R98	101-0121	100K 1/4W 5% CARBON FILM	
26	1	R39	101-0131	270K 1/4W 5% CARBON FILM	
27	1	R17	101-0138	510K 1/4W 5% CARBON FILM	
28	4	R48,R83,R106,R121	101-0145	1M 1/4W 5% CARBON FILM	
29	2	R80,R81	101-0148	2M 1/4W 5% CARBON FILM	
30	1	R129	101-0160	10M 1/4W 5% CARBON FILM	
30.5	1	R3	103-2015	150 OHM 2W 5% CARBON FILM	

Model 49 Main Board 702-9202 Rev. Q (cont'd)

Item	Quantity	Reference	Part	Description	Mfg.Part No.
31	1	R47	104-0118	75K 1/4W 1%	
32	2	R90,R101	107-0010	10K POT 1 TURN R/A	3386X-1-103
33	2	R100,R103	107-0015	50K POT 1 TURN R/A	3386X-1-503
34	1	R5	115-0196	1.96K 1/4W 1%	RN50EBF1.96K
35	3	RP3,RP4,RP5	119-0006	10K x 9 R-SIP	4610X-101-103
36	2	RP1,RP2 *NOTE 5	119-0021	R/2R 100K/200K 10 PIN	RSC10L104G
37	4	C63,C64,C65,C66	150-0010	10 PF 1KV +-10% CERAMIC DISC	
38	2	C92,C93	150-0024	24 PF 1KV +-10% CERAMIC DISC	GG-240K
39	2	C84,C85	150-0033	33 PF 1KV +-10% CERAMIC DISC	GH-330K
40	4	C55,C57,C111,C112	151-0010	100 PF 50V +-10% CERAMIC, TEMPERATURE STABLE	CW15C101K
41	3	C18,C47,C69	151-0047	470 PF 50V +-10% CERAMIC, TEMPERATURE STABLE	CW15C471K
42	1	C105	151-0199	.47 UF 50V +-5% POLYESTER	ECQVIH474JZ
43	44	C3,C11,C25,C26,C27,C28, C29,C30,C31,C32,C33,C39, C43,C44,C46,C49,C50,C51, C56,C60,C62,C67,C68,C70, C74,C76,C80,C81,C82,C83, C86,C87,C88,C90,C91,C94, C99,C100,C104,C106,C107, C108,C109,C110	152-0012	.1 UF 50V +-5% POLYESTER	ECQ-V1H104JZ
44	1	C75	152-0040	4.7 UF 50V NON-POLAR ELECTROLYTIC	EHN-4.7M50BA
45	2	C48,C77	152-0080	.22 UF 50V +-5%	ECQ-V1H224JZ
46	12	C15,C17,C19,C20,C45,C53, C58,C78,C79,C101,C115, C116	152-0085	.01 UF 50V +- 5% POLYESTER	ECQ-V1H103JZ
47	5	C37,C38,C41,C54,C59	152-0088	.0047UF 50V +-5% POLYESTER	ECQ-B1H472JZ
48	11	C2,C6,C7,C9,C10,C16,C21, C22,C36,C72,C73	152-0089	.001 UF 50V +-5% POLYESTER	ECQB1H102JZ
49	2	C34,C52	152-0250	.047 UF 50V POLYESTER	ECQ-V1H473JZ
50	4	C14,C40,C61,C71	154-0025	1 UF 35V TANTALUM	ECS-F-35E1
51	11	C13,C24,C35,C42,C89,C95, C96,C97,C98,C113,C114	155-0052	10 UF 35V +-20% RADIAL ALUMINUM ELECTROLYTIC	ECEA1VU100
52	3	C4,C102,C103	155-0077	100UF 25V +-20% RADIAL ALUMINUM ELECTROLYTIC	ECEA1EU101
53	1	C1	155-0081	220 UF 100V +50%-10% AXIAL ALUMINUM ELECTROLYTIC	ECEB2AV221S
54	2	C8,C12	155-0083	470 UF 10 VOLT RADIAL ALUMINUM ELECTROLYTIC	ECEA-1AU471
55	1	C23	155-0140	3300 UF 25V +50%-10% AXIAL ALUMINUM ELECTROLYTIC	ECEB1EU332
56	19	E1,E2,E3,E4,E5,E6,E7,E8, E9,E10,E11,E12,E13,E14, E15,E16,E17,E18,E19 *NOTE 1	305-0007	BEAD FERRITE PLZ	56-590-65-3
57	1	L1	305-0023	500uH INDUCTOR 1A	IHA-104
58	8	DS1,DS2,DS3,DS4,DS5,DS6, DS7,DS8	311-0011	LED RED FLUSH	LT741R-81
59	1	DS9	311-0012	LED GREEN FLUSH	TLSG-5201
60	1	U40	316-0232	RS232 DRIVER	AD232JN
61	1	U32	316-0272	DUAL OP-AMP	TLC272CP
62	8	U2,U5,U13,U14,U16,U17, U33,U36	316-0358	OP-AMP, DUAL	LM358N

Model 49 Main Board 702-9202 Rev. Q (cont'd)

Item	Quantity	Reference	Part	Description	Mfg.Part No.
63	1	VR1	316-7805	REGULATOR, +5V 1.5A	LM340T-5
64	0	U1+	316-7840	REGULATOR, SWITCHING	78S40
65	1	U11	317-5121	DUAL LINE RECEIVER	SN75121
66	1	U12	317-5122	TRIPLE LINE RECEIVER	SN75122
67	1	U41	317-5138	QUAD BUS XCOR	SN75138
68	0	U21+	321-0204	DTMF RECEIVER	75T204
69	0	U37+	321-0222	5V 1200 BAUD SINGLE CHIP MODEM	SSI73K212LIP
70	1	U7 *NOTE 6	321-0751	ASIC-001	ASIC-001
71	2	U25,U27	321-1001	1MEG STATIC 128K X 8 RAM	HM628128
72	1	U23	321-2181	DUAL UART	2681
73	1	U39	321-6811	UP-HC MOS	MOT68HC11A0FN
74	0	U29^,U31^	322-7256	32Kx8 CMOS EPROM	AM27C256-200DC
75	1	U3	323-4053	3PDT SWITCH	MC144053
76	1	U15	323-4066	QUAD ANALOG SWITCH	MC14066B
77	0	U18+	323-8207	MF DECODER	78A207
78	4	U26,U30,U42,U46	324-4138	DECODER 1 OF 8	MCH74HC138
79	1	U45	324-4153	DUAL 4 IN MULTIPLEX	74HC153
80	2	U34,U35	324-4165	8 BIT SR	74HC165N
81	2	U19,U20	324-4259	LATCH, 8 BIT ADDRESSABLE	74HC259
82	1	U24	324-4373	OCTAL LATCH	MC74HC373
83	1	U28	324-7400	QUAD NAND	MC74HC00
84	1	U44	324-7408	QUAD 2 IN AND	74HC08
85	2	U10,U22	324-7414	HEX SCHMIDT	74HC14
86	4	U6,U8,U9,U43	325-4374	OCTAL DFF REG TS	74HCT374
87	1	Q1	340-0172	PNP 3A 80V	MJE172
88	2	U4,U38	340-2003	RELAY DRIVER 50V/.5A	ULN2003
89	1	Q2	340-3821	JFET N-CHAN Vp=-2.5V	MPF3821
90	3	Q5,Q6,Q7	340-3904	NPN 40V/200MA	2N3904
91	1	Q3	340-3906	PNP 40V/200MA	2N3906
92	1	Q4	340-5460	JFETP-CHAN	2N5460
93	11	CR2,CR11,CR12,CR14,CR15, CR16,CR17#,CR18,CR19, CR20,CR21,CR22	342-3009	SILICON .50 SP	1N4148
94	4	CR4,CR5,CR6,CR7	342-3011	SILICON 1A 1000V .50 SP	1N4007
95	1	CR1	342-4935	SIL FAST 200V .50 SP	1N4935
96	5	CR3,CR8,CR9,CR10,CR13	343-3030	1W 6.2V +-5% .50 SP	1N4735A
97	1	SW3	371-0005	SINGLE KEY RA PWB MOUNT	L21217-2-MV-02-G
98	1	SW1	371-0007	SW QUAD DIP	CTS-194-4S
99	1	SW2	371-0008	SW OCTAL DIP	CTS-194-8ST
100	1	Y2 *NOTE 1	376-0358	3.58 MHz HC 18 CASE	SKO-DS357
101	1	Y4 *NOTE 1	376-0737	7.3728MHz XTAL HC-18	MP49-7.3728 18pf
102	1	Y3 *NOTE 1	376-1106	11.06 MHz HC-18 CASE	MP49 11.0592 18PF
103	1	Y1 *NOTE 1	376-1600	16 MHz HC-18 CASE	160
104	4	K2,K3,K4,K5	380-0001	SPDT 12V	M2-12HG-C
105	1	K1	380-0030	DPDT 12V COIL MINI RELAY	FBR244ND012/02CP
106	1	J9	401-0021	DB9 S	DEP-9S-CA
107	1	J1	401-0059	15 POS R/A HEADER	6923.6
108	1	J2	401-0086	12-POS R/A HEADER	1116.6

Model 49 Main Board 702-9202 Rev. Q (cont'd)

Item	Quantity	Reference	Part	Description	Mfg.Part No.
109	4	J4,J5,J6,J7 *NOTE 3	401-0221	BNC BULKHEAD RECEPTACLE	31-221
110	1	J3	401-6001	10-POS FEMALE	09-52-3103
111	1	J8	401-6005	6-POS FEMALE	09-52-3063
112	0	JP2#,JP8#,JP15#	403-0002	2 OF 401-0052	
113	15	JP1,JP3,JP4,JP5,JP6,JP7, JP9,JP10,JP11,JP13,JP16, JP17,JP18,JP19,JP20	403-0003	3 OF 401-0052	
114	2	JP21,JP22	403-0004	4 OF 401-0052	
115	1	JP14	403-0202	4 OF 401-0052 [2X2]	
116	1	JP12	403-0203	6 OF 401-0052 [2x3]	
117	1	P1	404-2016	16 OF 401-0180	
118	2	PA2,PB2	406-0012	12 OF 401-0108	
119	2	PA3,PB3	406-0016	16 OF 401-0108	
120	12	TP1,TP2,TP3,TP4,TP5,TP6, TP7,TP8,TP9,TP10,TP11, TP12	406-1001	1 OF 401-1364	
121	1	F1	416-1576	FUSE AGC 1 A	AGC 1
122	5	XVR1,XJ9,BNC BRACKET	210-0001	#4 NUT	
123	2	XJ9	220-0102	440X3/8 PAN PHILLIPS	
124	3	XVR1,BNC BRACKET	220-0108	440 X 1/4" PAN PHILLIPS	
125	1	XVR1 *NOTE 2	381-0004	HEATSINK TO-220, 10W	
126	2	XJ9	401-0042	DB LOCK SCREWS	
127	20	XJP1,XJP3,XJP4,XJP5,XJP6, XJP7,XJP9,XJP10,XJP11 XJP12,XJP13,XJP14 (2), XJP16,XJP17,XJP18,XJP19, XJP20,XJP21,XJP22	402-3040	MINI JUMPER	
128	9	XU2,XU5,XU13,XU14,XU16, XU17,XU32,XU33,XU36	407-0008	SKT, 08 PIN DIP	
129	6	XU10,XU15,XU21,XU22,XU28, XU44	407-0014	SKT, 14 PIN DIP	
130	17	XU1,XU3,XU4,XU11,XU12, XU19,XU20,XU26,XU30,XU34, XU35,XU38,XU40,XU41,XU42, XU45,XU46	407-0016	SKT, 16 PIN DIP	
131	6	XU6,XU8,XU9,XU18,XU24, XU43	407-0020	SKT, 20 PIN DIP	
132	1	XU7	407-0023	SKT, 24 PIN DIP SKINNY	
133	3	XU29,XU31,XU37	407-0028	SKT, 28 PIN DIP	
134	2	XU25,XU27 *NOTE 4	407-0032	SKT, 32 PIN DIP	
135	1	XU23	407-0040	SKT, 40 PIN DIP	
136	1	XU39	407-0052	SKT, 52 PIN QUAD	
137	4"	XJ4,5,6,7 *NOTE 3	408-0012	22 GA BARE WIRE	
138	1	PCB	410-9202F	MODEL 49 PCB	
139	1	XJ4,5,6,7 *NOTE 3	415-9712	M49 BNC BRACKET	

Model 49 Main Board 702-9202 Rev. Q (cont'd)

Item	Quantity	Reference	Part	Description	Mfg.Part No.
140	1	XU25 *NOTE 4	416-1215	32 PIN SKT, BATTERY	
141	1	XU27 *NOTE 4	416-1218	32 PIN BATT/WATCH 8K/32K	
142	2	XF1	416-3040	FUSE CLIP	
143	9	XDS1,XDS2,XDS3,XDS4,XDS5, XDS6,XDS7,XDS8,XDS9	417-0010	LED MOUNT	
144	A/R	XVR1 *NOTE 2	561-0001	THERMAL COMPOUND	
145	1	U7 *NOTE 6	601-0224	M49 TONE GENERATOR SOFTWARE	

REFERENCE DESIGNATORS NOT USED: R85,R92

NOTES:

1. SECURE COMPONENTS TO BOARD USING 22GA WIRE OR EQUIVALENT.
2. USE THERMAL COMPOUND (561-0001) OR EQUIVALENT BETWEEN HEATSINK AND VR1.
3. ON COMPONENT SIDE SOLDER A 1" PIECE OF 22 GA WIRE TO SOLDER CUP OF EACH BNC CONNECTOR AND THE OTHER END TO THE PAD ON PCB DIRECTLY BEHIND THE CONNECTORS. ASSEMBLE AS SHOWN:
4. PLACE 32-PIN SOCKETS IN PCB. THEN PLACE 32-PIN BATTERY SOCKETS IN THE 32-PIN SOCKETS.
5. THIS PART MUST BE INSTALLED REVERSED END-TO-END FROM THE WAY THE PCB SILKSCREEN INDICATES. (DOT ON PART OUTLINE CANNOT BE INSTALLED INTO SQUARE PAD.)
6. TO BE INSTALLED AND PROGRAMMED BY PRODUCTION TECHNICIAN.

Model 49 LTR Protocol Card 702-9218 Rev. G

LEGEND:
= NOT INSTALLED
^ = INSTALLED ON HIGHER ASSY
+ = OPTION (INSTALLED PER CUSTOMER ORDER)

ITEM	QTY	COMPONENT REFERENCE	PART NO.	DESCRIPTION	MANUFACTURE P/N
1	1	RX1 (NOTE 3)	101-0057	220 OHM 1/4W 5% CARBON FILM	
2	5	R17,R21,R30,R31,R32	101-0061	330 OHM 1/4W 5% CARBON FILM	
3	2	R9,R10	101-0073	1K 1/4W 5% CARBON FILM	
3.5	1	RX3 (NOTE 8)	101-0075	1.5K 1/4W 5% CARBON FILM	
4	2	R19,R23	101-0081	2.2K 1/4W 5% CARBON FILM	
5	1	R22	101-0085	3.3K 1/4W 5% CARBON FILM	
6	2	R7,R12	101-0091	5.6K 1/4W 5% CARBON FILM	
7	6	RX2,R3,R4,R5,R11,R15 (NOTE 5)	101-0097	10K 1/4W 5% CARBON FILM	
8	2	R8,R13	101-0109	33K 1/4W 5% CARBON FILM	
9	1	R18	101-0113	47K 1/4W 5% CARBON FILM	
10	2	R6,R14	101-0115	56K 1/4W 5% CARBON FILM	
11	3	R16,R26,R27	101-0121	100K 1/4W 5% CARBON FILM	
12	1	R24	101-0131	270K 1/4W 5% CARBON FILM	
13	1	R25	101-0145	1M 1/4W 5% CARBON FILM	
14	1	R28	107-0015	50K POT 1 TURN R/A	3386X-1-503
15	1	R29	107-0020	1M POT 1 TURN R/A	3386X-1-105
16	2	C5,C6	150-0010	10 PF 1KV +-10% CERAMIC DISC	
17	12	C11,C12,C13,C15,C16,C18, C19,C20,C22,C23,C25,C27	152-0012	.1 UF 50V +-5% POLYESTER	ECQ-V1H104JZ
18	2	C10,C21	152-0085	.01 UF 50V +- 5% POLYESTER	ECQ-V1H103JZ
19	2	C14,C17	152-0250	.047 UF 50V POLYESTER	ECQ-VIH473JZ
20	2	C24,C26 (NOTE 2)	154-0100	10 UF 16V TANTALUM	ECS-FICE106K
21	3	C7,C8,C9	155-0052	10 UF 35V +-20% RADIAL ALUMINUM ELECTROLYTIC	ECEA1VU100
22	5	DS1,DS2,DS3,DS4,DS5	311-0011	LED RED FLUSH	TLSR-5201
23	5	U3,U4,U7,U10,U11 (NOTE 4)	316-0358	OP-AMP, DUAL	LM358N
24	1	U2 *NOTE 7	321-0751	ASIC 001	ASIC 001
25	1	U6	324-4138	DECODER 1 OF 8	MCH74HC138
26	1	U5	324-7414	HEX SCHMIDT	74HC14
27	2	U8,U9	325-4374	OCTAL DFF REG TS	74HCT374
28	2	Q1,Q2	340-3904	NPN 40V/200MA	2N3904
29	2	Q3,Q4	340-3906	PNP 40V/200MA	2N3906
30	1	CRX1 (NOTE 6)	342-3009	SILICON .50 SP	1N4148
31	0	CR1#	343-3029	1W 5.1V +-5% .50 SP	1N4733A
32	1	Y1 (NOTE 1)	376-1600	16 MHZ HC-18 CASE	160
33	1	TP1	403-0001	1 OF 401-0052	

Model 49 LTR Protocol Card 702-9218 Rev. G (cont'd)

ITEM	QTY	COMPONENT REFERENCE	PART NO.	DESCRIPTION	MANUFACTURE P/N
34	2	JP1,JP2	403-0003	3 OF 401-0052	
35	1	JA1	407-0108	SKT, 8 PIN SIP	65780-044
36	2	JB1,JC1	407-0110	SKT, 10 PIN SIP	65780-046
37	2	XJP1,XJP2	402-3040	MINI JUMPER	
38	5	XU3,XU4,XU7,XU10,XU11	407-0008	SKT, 8 PIN DIP	
39	1	XU5	407-0014	SKT, 14 PIN DIP	
40	1	XU6	407-0016	SKT, 16 PIN DIP	
41	2	XU8,XU9	407-0020	SKT, 20 PIN DIP	
42	1	XU2	407-0023	SKT, 24 PIN DIP SKINNY	
43	1	PCB	410-9218B	M49 LTR PROTOCOL CARD	
44	5	XDS1,XDS2,XDS3,XDS4, XDS5	417-0010	LED MOUNT	
45	1	(U2)	601-0199	LTR PROTOCOL SOFTWARE	

REFERENCE DESIGNATORS NOT USED: C1,C2,C3,C4,P1,R1,R2,R20,U1

E&M Interface 702-9228 Rev. C

LEGEND:
^ = INSTALLED ON HIGHER ASSEMBLY
# = NOT INSTALLED
+ = OPTION, INSTALL PER CUSTOMER ORDER

ITEM	QTY	COMPONENT REFERENCE	PART NO.	DESCRIPTION	MANUFACTURE P/N
1	1	R13	101-0010	1 OHM 1/4W 5% CARBON FILM	
2	1	R14	101-0057	220 OHM 1/4W 5% CARBON FILM	
3	4	R2,R9,R11,R12	101-0067	560 OHM 1/4W 5% CARBON FILM	
4	1	R10	101-0073	1K 1/4W 5% CARBON FILM	
5	0	R15#	101-0075	1.5K 1/4W 5% CARBON FILM	
6	1	R7,R16#	101-0085	3.3K 1/4W 5% CARBON FILM	
7	2	R5,R6	101-0097	10K 1/4W 5% CARBON FILM	
8	1	R8,R17#	101-0101	15K 1/4W 5% CARBON FILM	
9	1	R3,R18#	101-0109	33K 1/4W 5% CARBON FILM	
10	1	R4	103-2015	150 OHM 2W 5% CARBON FILM	BWH-150-5%
11	1	R1	103-3300	3.3K 1W 5% CARBON FILM	
12	2	RV1,RV2	105-0001	VARISTOR 250V AC	V250LA20
13	0	R19#	107-0501	5K POT 1 TURN	3386P-1-502
14	0	R20#	107-0502	50K POT 1 TURN	3386P-1-503
15	3	C8,C9,C10	152-0012	.1 UF 50V +-5% POLYESTER	ECQ-V1H104JZ
16	2	C3,C4	152-0085	.01 UF 50V +- 5% POLYESTER	ECQ-V1H103JZ
17	1	C6	155-0013	4.7 UF 100 VOLT RADIAL ALUMINUM ELECTROLYTIC	ECE-A2AU4R7
18	3	C1,C2,C5	155-0052	10 UF 35V +-20% RADIAL ALUMINUM ELECTROLYTIC	ECEA1VU100
19	1	C7	155-0083	470 UF 10 VOLT RADIAL ALUMINUM ELECTROLYTIC	ECEA-1AU471
20	2	T1,T2	305-0600	600:600 OHM AUDIO	MR671-0064
21	1	U1	311-1001	OPTO ISOLATOR, BI-POLAR	H11AA1
22	1	U2	316-0358	OP-AMP, DUAL	LM358N
23	1	Q1	340-0014	NPN DARLINGTON	MPSA14/MPSA13
24	2	CR1,CR2	342-3009	SILICON .50 SP	1N4148
25	1	K1	380-0001	SPDT 12V	MZ-12HG
26	1	J1	401-0080	6-PIN LO PRO R/A TELCO	520250-3
27	3	JP2,JP3,JP4	403-0003	3 OF 401-0052	
28	1	JP1	403-0202	4 OF 401-0052 [2X2]	
29	1	J2	401-0150	6-POS THRU PCB CONNECTOR	22-14-2064
30	2	JA3,JB3	401-0151	8-POS THRU PCB CONNECTOR	22-14-2084
31	1	R19	107-0005	5K POT IT R/A	
32	1	R20	107-0015	50K POT IT R/A	
33	5	XJP1,XJP2,XJP3, XJP4 (POS A)	402-3040	MINI JUMPER	
34	1	XU1	407-0006	SKT, 06 PIN DIP	
35	1	XU2	407-0008	SKT, 08 PIN DIP	
36	1		410-9228B	PCB	

DID Interface 702-9229 Rev. C.1

LEGEND:
^ = INSTALLED ON
HIGHER ASSEMBLY
/ = NOT INSTALLED
+ = OPTION, INSTALL PER
CUSTOMER ORDER

ITEM	QTY	COMPONENT REFERENCE	PART NO.	DESCRIPTION	MANUFACTURE P/N
1	3	R1,R16,R25	101-0049	100 OHM 1/4W 5% CARBON FILM	
2	5	R9,R15,R19,R22,R26	101-0065	470 OHM 1/4W 5% CARBON FILM	
3	1	R21,R27/	101-0073	1K 1/4W 5% CARBON FILM	
4	2	R14,R18,R28/,R29/,R32/	101-0075	1.5K 1/4W 5% CARBON FILM	
5	0	R30/,R31/	101-0085	3.3K 1/4W 5% CARBON FILM	
6	4	R2,R5,R17,R24	101-0097	10K 1/4W 5% CARBON FILM	
7	1	R3	101-0105	22K 1/4W 5% CARBON FILM	
8	1	R23	101-0113	47K 1/4W 5% CARBON FILM	
9	1	R20	101-0119	82K 1/4W 5% CARBON FILM	
10	1	R4	101-0129	220K 1/4W 5% CARBON FILM	
11	1	R6	101-0145	1M 1/4W 5% CARBON FILM	
12	2	R7,R8	104-0048	75 OHM 1/2W .1%	CMF-6075R0BT-2
13	4	R10,R11,R12,R13	104-0114	49.9K 1/8W .1%	RNC-55J4992BS
14	2	RV1,RV2 *NOTE 1*	105-0001	VARISTOR 250V AC	V250LA20
15	0	R33,R35,R36 *NOTE 2	107-0501	5K POT 1 TURN	3386P-1-502
16	0	R34 *NOTE 2	107-0502	50K POT 1 TURN	3386P-1-503
17	3	C2,C5,C9	152-0012	.1 UF 50V +-5% POLYESTER	ECQ-V1H104JZ
18	1	C11	152-0080	.22 UF 50V +-5%	ECQ-V1H224JZ
19	1	C8	152-0088	.0047UF 50V +-5% POLYESTER	ECQ-B1H472JZ
20	2	C7,C10	152-0089	.001 UF 50V +-5% POLYESTER	ECQB1H102JZ
21	2	C1,C6	155-0013	4.7 UF 100 VOLT RADIAL ALUMINUM ELECTROLYTIC	ECE-A2AU4R7
22	1	C3	155-0052	10 UF 35V +-20% RADIAL ALUMINUM ELECTROLYTIC	ECEA1VU100
23	1	C4	155-0079	100 UF 100V +50%-10% RADIAL ALUMINUM ELECTROLYTIC	ECEA2AV101S
24	1	C12	155-0083	470 UF 10 VOLT RADIAL ALUMINUM ELECTROLYTIC	ECEA-1AU471
25	2	E1,E2	305-0007	BEAD FERRITE PLZ	56-590-65-3
26	1	T1	305-1540	LO SIZE/COST PHONE HYBRID XFMR	671-1540
27	1	U3	311-0008	OPTO ISOLATOR	4N26
28	2	DS1,DS2	311-0028	28V LAMP	2187D
29	1	U4	316-0358	OP-AMP, DUAL	LM358N
30	1	U1	324-7414	HEX SCHMIDT	74HC14
31	1	U2	340-2003	RELAY DRIVER 50V/.5A	ULN2003
32	3	Q1,Q2,Q4	340-3904	NPN 40V/200MA	2N3904
33	1	Q3	340-4250	PNP 60V BETA >250	MPS4250A
34	2	CR1,CR2	343-3035	1W 12V +-5% .50 SP	1N4742A
35	2	K1,K2	380-0030	DPDT 12V COIL MINI	DS2E-M-DC12V
36	1	J1 *NOTE 1*	401-0080	6-PIN LO PRO R/A TELCO	520250-3
37	1	J2	401-0150	6-POS THRU PCB CONNECTOR	22-14-2064
38	2	JA3,JB3	401-0151	8-POS THRU PCB CONNECTOR	22-14-2084
39	3	R33,R35,R36 *NOTE 2	107-0005	5K POT IT R/A	
40	1	R34 *NOTE 2	107-0015	50K POT IT R/A	

DID Interface 702-9229 Rev. C.1 (cont'd)

ITEM	QTY	COMPONENT REFERENCE	PART NO.	DESCRIPTION	MANUFACTURE P/N
41	1	XU3	407-0006	SKT, 06 PIN DIP	
42	1	XU4	407-0008	SKT, 08 PIN DIP	
43	1	XU1	407-0014	SKT, 14 PIN DIP	
44	1	XU2	407-0016	SKT, 16 PIN DIP	
45	1		410-9229B	PCB	

NOTES:
1. INSTALL J1 BEFORE RV1,RV2 TO ASSURE CLEARANCE.
2. INSTALL RIGHT ANGLE POTS IN THESE LOCATIONS.

Compandor Card 702-9276 Rev. C

/ = NOT INSTALLED
^ = INSTALLED ON HIGHER ASSY
+ = OPTION (INSTALLED PER CUSTOMER ORDER)

ITEM	QTY	COMPONENT REFERENCE	PART NO.	DESCRIPTION	MANUFACTURE P/N
1	1	R20	101-0047	47 OHM 1/4W 5% CARBON FILM	
2	1	R17	101-0057	220 OHM 1/4W 5% CARBON FILM	
3	2	R25,R26	101-0061	330 OHM 1/4W 5% CARBON FILM	
4	2	R4,R19	101-0066	510 OHM 1/4W 5% CARBON FILM	
5	1	R18	101-0073	1K 1/4W 5% CARBON FILM	
6	2	R10,R11/,R16/,R23	101-0089	4.7K 1/4W 5% CARBON FILM	
7	1	R2	101-0092	6.2K 1/4W 5% CARBON FILM	
8	5	R1,R13,R14,R22,R24	101-0097	10K 1/4W 5% CARBON FILM	
9	1	R5	101-0099	12K 1/4W 5% CARBON FILM	
10	2	R15,R21	101-0101	15K 1/4W 5% CARBON FILM	
11	2	R9,R12	101-0105	22K 1/4W 5% CARBON FILM	
12	2	R7,R8	101-0109	33K 1/4W 5% CARBON FILM	
13	2	R3,R6	101-0113	47K 1/4W 5% CARBON FILM	
14	9	C1,C2,C6,C9,C10,C11,C18, C19,C20,C22/,C23/	152-0012	.1 UF 50V +-5% POLYESTER	ECQ-V1H104JZ
15	2	C7,C8	152-0085	.01 UF 50V +- 5% POLYESTER	ECQ-V1H103JZ
16	3	C4,C16,C21	154-0025	1 UF 35V TANTALUM	ECS-F-35E1
17	2	C5,C15	155-0012	2.2 UF 100V +50-10% RADIAL ALUMINUM ELECTROLYTIC	ECEA2AV2R2S
18	1	C12	155-0013	4.7 UF 100 VOLT RADIAL ALUMINUM ELECTROLYTIC	ECE-A2AU4R7
19	1	C14	155-0052	10 UF 35V +-20% RADIAL ALUMINUM ELECTROLYTIC	ECEA1VU100
20	2	C13,C17	155-0077	100UF 25V +-20% RADIAL ALUMINUM ELECTROLYTIC	ECEA1EU101
21	2	DS1,DS2	311-0011	LED RED FLUSH	TLSR-5201
22	2	U2,U4	316-0358	OP-AMP, DUAL	LM358N
23	1	U3	316-0575	COMPANDOR	NE575N
24	1	U1	323-4053	3PDT SWITCH	MC144053
25	1	U5	324-4259	LATCH, 8 BIT ADDRESSABLE	74HC259
26	1	JP1	403-0003	3 OF 401-0052	
27	1	JA1 *NOTE 1	407-0108	SKT, 8 PIN SIP	65780-044
28	2	JB1,JC1 *NOTE 1	407-0110	SKT, 10 PIN SIP	65780-046
29	1	XJP1 (POS. A)	402-3040	MINI JUMPER	
30	2	XU2,XU4	407-0008	SKT, 8 PIN DIP	
31	2	XU1,XU5	407-0016	SKT, 16 PIN DIP	
32	1	XU3	407-0020	SKT, 20 PIN DIP	
33	1		410-9276B	PCB	

NOTES:
1. INSTALL JA1,JB1, & JC1 ON SOLDER SIDE.

End-End Duplex Interface 702-9283 Rev. E

= NOT INSTALLED
^ = INSTALLED ON HIGHER ASSY
+ = OPTION (INSTALLED PER CUSTOMER ORDER)

Item	Quantity	Reference	Part	Description	Mfg.Part No.
1	0	R18#	101-0049	100 OHM 1/4W 5% CARBON FILM	
2	2	R5,R17#,R19#,R22	101-0065	470 OHM 1/4W 5% CARBON FILM	
3	2	R21,R12	101-0068	620 OHM 1/4W 5% CARBON FILM	
4	1	R3	101-0081	2.2K 1/4W 5% CARBON FILM	
5	3	R9,R10,R23	101-0090	5.1K 1/4W 5% CARBON FILM	
6	5	R11,R15,R16,R20,R25	101-0097	10K 1/4W 5% CARBON FILM	
7	1	R4	101-0105	22K 1/4W 5% CARBON FILM	
8	1	R24	101-0113	47K 1/4W 5% CARBON FILM	
9	3	R7,R8,R13	101-0129	220K 1/4W 5% CARBON FILM	
10	1	R14	101-0133	330K 1/4W 5% CARBON FILM	
11	1	R6	103-3300	3.3K 1W 5% CARBON FILM	
12	2	RV2,RV1	105-0001	VARISTOR 250V AC	V250LA20
13	2	R2,R1	106-0047	4.7 OHM 1/2W 5% FUSIBLE	BW1/2F-4.7OHM5%B
14	0	R27#,R26# (NOTE 2)	107-0003	2K POT 1 TURN R/A	3386X-1-202
15	2	R29,R30	107-0005	5K POT 1 TURN R/A	3386X-1-502
16	0	R28#	107-0015	50K POT 1 TURN R/A	3386X-1-503
17	1	C6	151-0010	100PF 50V/100V +-10%/5% CERAMIC, TEMPERATURE STABLE	CW15C101K
18	2	C13,C5	151-0020	.001UF 50V +-10% CERAMIC, TEMPERATURE STABLE	CW15C102K
19	4	C4,C7,C9,C10	151-0180	.1UF 50V +-10% CERAMIC, UNSTABLE	AVXSR205E104MAA
20	1	C1	152-0021	.47 UF 250V +-10% POLYESTER	713A1KK474PK251SM
21	2	C3,C14	152-0080	.22 UF 50V +-5%	ECQ-V1H224JZ
22	1	C8	152-0088	.0047UF 50V +-5% POLYESTER	ECQ-B1H472JZ
23	0	C12# (NOTE 4)	152-0089	.001 UF 50V +-5% POLYESTER	ECQB1H102JZ
24	0	C2#	152-0251	.047 UF 250V POLYESTER	712A1BB273P*251SK
25	0	C11#	154-0035	2.2UF (16V-25V)	TAP225K025SCS
26	2	T2,T1 (NOTE 1)	305-1540	LO SIZE/COST PHONE HYBRID XFMR	671-1540
27	2	U2,U3	311-0008	OPTO ISOLATOR	4N26
28	1	U1	311-1001	OPTO ISOLATOR, BI-POLAR	H11AA1
29	1	U6 (NOTE 10)	316-0662	OP-AMP, CMOS, DUAL	LMC662CN
30	1	U5 (NOTE 10)	316-3072	DUAL HF OP-AMP	MC33072P
31	1	U4	324-7414	HEX SCHMIDT	74HC14
32	2	Q1,Q2	340-3904	NPN 40V/200MA	2N3904
33	3	CR1,CR2,CR3	342-3009	SILICON .50 SP	1N4148
34	2	CR4,CR5#,CR6	343-3035	1W 12V +-5% .50 SP	1N4742A
35	2	K2,K1	380-0030	DPDT 12V COIL MINI RELAY	G5V-2
36	1	J1	401-0080	6-PIN LO PRO R/A TELCO	520250-3
37	1	J2	401-0150	6-POS THRU PCB CONNECTOR	22-14-2064
38	2	JB3,JA3	401-0151	8-POS THRU PCB CONNECTOR	22-14-2084
39	0	JP1#	403-0003	3 OF 401-0052	

End-End Duplex Interface 702-9283 Rev. E (Continued)

Item	Quantity	Reference	Part	Description	Mfg.Part No.
40	2	PCB (702-9283)	210-0001	440 KEPT NUT PLATED	
41	4	2EA PCB 702-9312),(BAG 2)	220-0108	440 X 1/4 PAN PHILLIPS	
42	2	PCB (702-9283) NOTE 9	250-0102	440 X 1 W/STUD	
43	3	XU1,XU2,XU3	407-0006	SKT, 6 PIN DIP	
44	2	XU5,XU6	407-0008	SKT, 8 PIN DIP	
45	1	XU4	407-0014	SKT, 14 PIN DIP	
46	3"	(NOTE 5)	408-2401	24GA, WIRE STRANDED, BLACK	
47	3"	(NOTE 6)	408-2402	24GA, WIRE STRANDED, RED	
48	5"	(NOTE 7)	408-2405	24GA, WIRE STRANDED, GREEN	
49	6"	(NOTE 8)	408-2409	24GA, WIRE STRANDED, WHITE	
50	1		410-9283A	PCB	
51	1	(2 OF 220-0108)	449-9042	BAG 2 X 3	
52	1		702-9312	BALANCE BOARD	

NOTES:

Notes are for production use only.

Balance Board Parts List 702-9312 Rev. C.1

LEGEND:
= NOT INSTALLED
^ = INSTALLED ON HIGHER ASSY
+ = OPTION (INSTALLED PER CUSTOMER ORDER)

Item	Quantity	Reference	Part	Description	Mfg.Part No.
1	0	R6#	101-0045	82 OHM 1/4W 5% CARBON FILM	
2	1	R5	101-0049	100 OHM 1/4W 5% CARBON FILM	
3	2	R4,R7	101-0065	470 OHM 1/4W 5% CARBON FILM	
4	1	R3	101-0097	10K 1/4W 5% CARBON FILM	
5	1	R8	101-0099	12K 1/4W 5% CARBON FILM	
6	1	R2	101-0100	13K 1/4W 5% CARBON FILM	
7	1	R11,R12# (NOTE 3)	107-0003	2K POT 1 TURN R/A	3386X-1-202
8	1	R10	107-0015	50K POT 1 TURN R/A	3386X-1-503
9	1	R9	107-0203	200K 1 TURN R/A	3386X-1-204
10	2	C1,CX2 (NOTE 1)	151-0020	.001 UF 50V +-10% CERAMIC, TEMPERATURE STABLE	CW15C102K
11	1	C9	151-0095	.0047 UF 50V +-10% CERAMIC, TEMPERATURE STABLE	CW15C472K
12	1	C11	151-0120	.01 UF 50V +-10% CERAMIC, TEMPERATURE STABLE	CW15C103K
13	3	CX1,C5,C12 (NOTE 2)	151-0180	.1 UF 50V +-10% CERAMIC, UNSTABLE	AVXSR205E104MAA
14	1	C7,C8#,C10#	154-0035	2.2UF 16V TANT	ECSFICE225
15	2	C3,C4	155-0077	100UF 25V +-20% RADIAL ALUMINUM ELECTROLYTIC	ECEA1EU101
16	0	C6#	155-0078	100 UF 6.3V +50%-10% AXIAL ALUMINUM ELECTROLYTIC	ECEB0JV101S
17	1	C2	155-0083	470 UF 10 VOLT RADIAL ALUMINUM ELECTROLYTIC	ECEA-1AU471
18	1	T1	305-0600	600:600 OHM AUDIO	MR671-8205
19	1	U1	316-3172	LOW POWER DUAL OP-AMP	MC33172P
20	1	U2	324-7414	HEX SCHMIDT	74HC14
21	2	CR1,CR2	342-0103	SCHOTTKEY .37V @ 20MA	SD103A
22	1	CR3	343-3035	1W 12V +-5% .50 SP	1N4742A
23	0	P1#,P2#,P3#,P4# (NOTE 4)	403-0001	1 OF 401-0052	
24	1	JP2	403-0003	3 OF 401-0052	
25	1	JP1	403-0004	4 OF 401-0052	
26	2	XJP1 (POS A) XJP2 (POS B)	402-3040	MINI JUMPER	
27	1	XU1	407-0008	SKT, 08 PIN DIP	
28	1	XU2	407-0014	SKT, 14 PIN DIP	
29	1		410-9312A.1	PCB	

NOT USED: R1

NOTES:
1. ON SOLDER SIDE SOLDER ONE END OF CX2 TO U1.4 OTHER END TO R4 (CLOSEST TO BOARD EDGE).
2. ON SOLDER SIDE SOLDER ONE END OF CX1 TO (-) SIDE OF C2 AND OTHER END TO (+) SIDE OF C2.
3. ON COMPONENT SIDE WIRE JUMPER FROM THE JUNCTION OF R12 AND R11 TO THE JUNCTION OF R12 AND CR3. ON SOLDER SIDE SOLDER WIRE LEADS.
4. MASK HOLES WHEN SOLDERED.

Model 49 Voice Card Parts List 702-9391 Rev. C

LEGEND:
= NOT INSTALLED
^ = INSTALLED ON HIGHER ASSEMBLY
+ = OPTION, INSTALL PER CUSTOMER ORDER

ITEM	QTY	COMPONENT REFERENCE	PART NO.	DESCRIPTION	MANUFACTURE P/N
1	1	R6	101-0073	1K 1/4W 5% CARBON FILM	
2	1	R3	101-0090	5.1K 1/4W 5% CARBON FILM	
3	1	R2 *NOTE 2	101-0105	22K 1/4W 5% CARBON FILM	
4	1	R4	101-0121	100K 1/4W 5% CARBON FILM	
5	1	R1 *NOTE 2	101-0129	220K 1/4W 5% CARBON FILM	
6	1	R5	107-0501	5K POT 1 TURN	3386P-1-502
7	2	C3,C5	151-0010	100 PF 50V +-10% CERAMIC, TEMPERATURE STABLE	CW15C101K
8	1	C12	151-0199	.47 UF 50V +-5% POLYESTER	ECQVIH474JZ
9	2	C7,C11	152-0085	.01 UF 50V +- 5% POLYESTER	ECQ-V1H103JZ
10	3	C1 *NOTE 2, C4,C10	152-0089	.001 UF 50V +-5% POLYESTER	ECQBIH102JZ
11	4	C2,C6,C8,C9	154-0025	1 UF 35V TANTALUM	ECS-F-35E1
12	4	U5,U6,U7,U8	321-8256	32K X 8 RAM LP	HPD43256-15L
13	1	U4	323-8830	STATIC VOICE REC/PLAY LSI	T8830
14	1	U2	324-4132	QUAD NAND SCHMIDT	MCH74HC132
15	1	U3	324-7414	HEX SCHMIDT	74HC14
16	1	U1	324-7427	TRIPLE 3 INPUT NOR	74HC27
17	2	Q1,Q2	340-3904	NPN 40V/200MA	2N3904
18	1	CR1	342-3008	DO NOT USE - GERMANIUM .50 SP	1N100
19	1	CR2	342-3009	SILICON .50 SP	1N4148
20	1	Y1	376-0500	500 KHz CER RESONATOR	CSB500E
21	2	P1,P2 *NOTE 1	401-6008	5-POS MALE ROUND	26-51-0051
22	1	TP1	403-0001	1 OF 401-0052	
23	0	JP1#	403-0002	2 OF 401-0052	
24	1	BT1	416-0002	LITH CELL BATT	BR2325
25	1	*NOTE 3	251-1240	440X.062 FIBER	
26	3	XU1,XU2,XU3	407-0014	SKT, 14 PIN DIP	
27	4	XU5,XU6,XU7,XU8	407-0028	SKT, 28 PIN DIP	
28	6	XJP2,XJP3 (POS B) XJP4 (POS A & B) XJP5 (POS A & D)	408-0001	WIRE JUMPER	
29	1	PCB	410-9193C	M4X\64 VOICE CARD	
30	1	XBT1 *NOTE 4	415-9432	BATTERY INSULATOR	
31	1	XBT1	416-0001	LITH COIN BATT HOLDER	BH906
32	A/R	*NOTE 3	561-0010	TAK PAK	

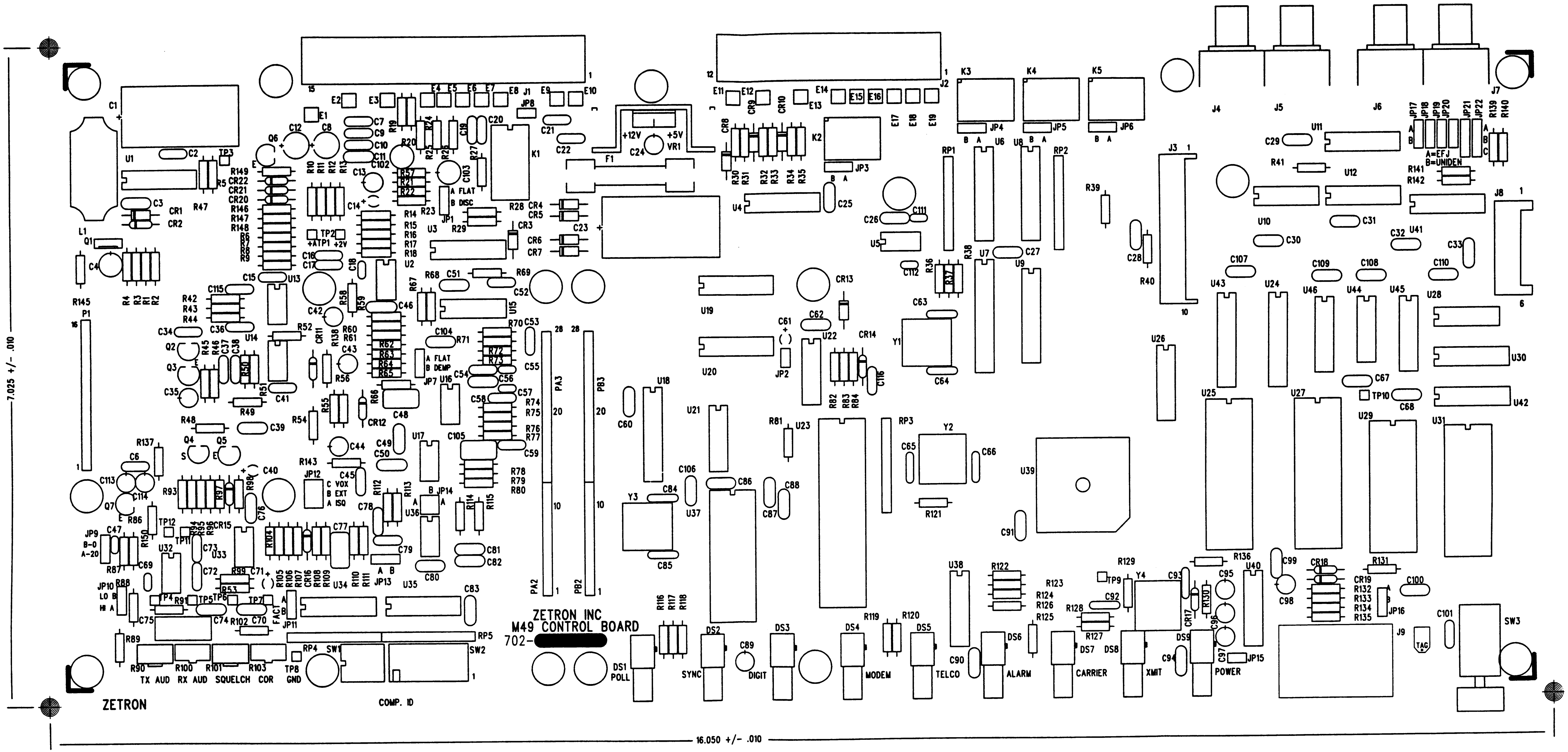
NOTES:
1. INSERT P1, P2 FROM COMPONENT SIDE, SOLDER OTHER SIDE, CUT LEADS CLOSE TO PLASTIC BASE.
2. CUT LEADS FROM R1, R2 AND C1 AS CLOSE AS POSSIBLE WITH FLUSH CUTTERS.
3. ON SOLDER SIDE, GLUE FIBER SPACER, CENTERING OVER MOUNTING HOLE USING TAK PAK.
4. INSERT INSULATOR BETWEEN BATTERY AND HOLDER CONTACT.

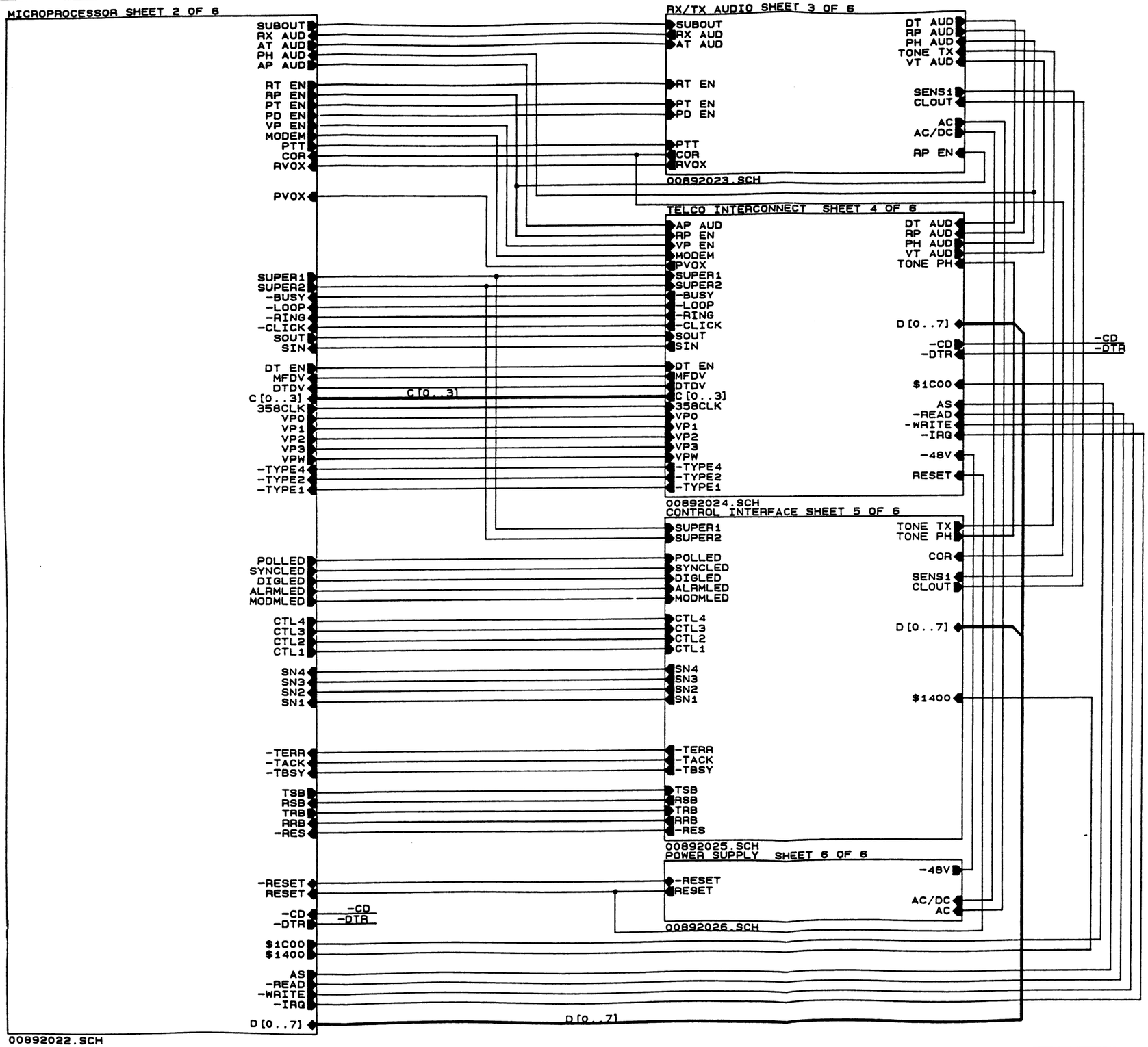
Model 4XB Dial Click Parts List 702-9242 Rev. E

= NOT INSTALLED
^ = INSTALLED ON HIGHER ASSY
+ = OPTION (INSTALLED PER CUSTOMER ORDER)

ITEM	QTY	COMPONENT REFERENCE	PART NO.	DESCRIPTION	MANUFACTURE P/N
1	1	R22	101-0065	470 OHM 1/4W 5% CARBON FILM	
2	1	R12,R25#	101-0071	820 OHM 1/4W 5% CARBON FILM	
3	2	R1,R13,R19#,R26#	101-0081	2.2K 1/4W 5% CARBON FILM	
4	6	R4,R5,R8,R9,R11,R15#, R16#,R20#,R21#,R24#,R28#, R29	101-0097	10K 1/4W 5% CARBON FILM	
5	2	R7,R14,R27#,R31#	101-0101	15K 1/4W 5% CARBON FILM	
6	2	R2,R3,R17#,R18#	101-0123	120K 1/4W 5% CARBON FILM	
7	1	R6,R30#	107-0504	200K POT 1 TURN	3386P-1-204
8	1	C4,C9#	151-0020	.001 UF 50V +-10% CERAMIC, TEMPERATURE STABLE	CW15C102K
9	1	C1,C10#	151-0120	.01 UF 50V +-10% CERAMIC, TEMPERATURE STABLE	CW15C103K
10	3	C2,C3,C6#,C7#,C11	151-0180	.1 UF 50V +-10% CERAMIC, UNSTABLE	AVXSR205E104MAA
11	2	C5,C8,C12#	154-0025	1 UF 35V TANTALUM	ECS-F-35E1
12	2	C13,C14,C15#,C16#	155-0055	22 UF 25V +50%-10% AXIAL ALUMINUM ELECTROLYTIC	TLBIE220M
13	1	DS1,DS2#	311-0010	LED RED LAMP	HLMP3300
14	1	VR1	316-0005	REGULATOR 5V LOW POWER	LM78L05
15	2	U1,U2,U3#,U4#	316-0358	OP-AMP, DUAL	LM358N
16	1	Q1,Q2#	340-3904	NPN 40V/200MA	2N3904
17	1	CR5,CR7#	342-0103	SCHOTTKEY .37V @ 20MA	SD103A
18	3	CR1,CR2,CR3#,CR4#,CR6, CR8#	342-3009	SILICON .50 SP	1N4148
19	2	JA1,JB1 *NOTE 1	401-6008	5-POS MALE	09-64-1051
20	2	TP1,TP2,TP3#	403-0001	1 OF 401-0052	
21	2	XU1,XU2	407-0008	SKT, 8 PIN DIP	
22	1		410-9119B	PCB	

NOTES:
1. INSTALL JA1 AND JB1 FROM COMPONENT SIDE - LONG PINS THROUGH PCB (PLASTIC BASE ON COMPONENT SIDE) - CUT PINS FLUSH WITH BASE.


ZETRON INC
M49 CONTROL BOARD
702-[redacted]
ZETRON
COMP. ID
7.025 +/- .010
16.050 +/- .010
TX AUD
RX AUD
SQUELCH
COR
GND
POLL
SYNC
DIGIT
MODEM
TELCO
ALARM
CARRIER
XMIT
POWER
A=EFJ
B=UNIDEN
A FLAT
B DISC
A FLAT
B DEMP
C VOX
B EXT
A ISQ
+12V
+5V

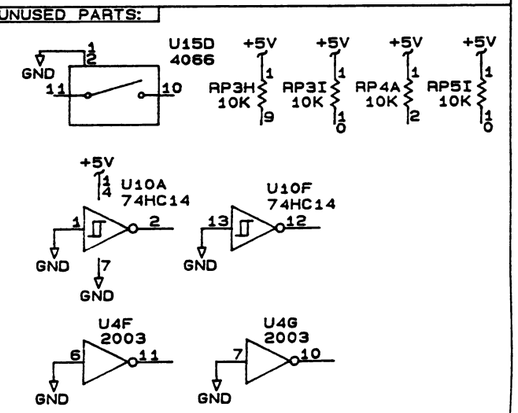


REV	DESCRIPTION	DRN	APV	DATE
B	RELEASE	DGW		
B	ECN 806	KJN		
C	ECN 841	KJN		
D	ECN 859/860	KJN		
E	ECN 809/882	KJN		
E	ECN 883	KJN		
E	ECN 915	DGW		
F	ECN 884	DGW		
G	ECN 1050	KM		
H	ECN 1059/1118/1133	DGW		
J	ECN 1220	GH		
K	ECN 1325	KN		
L	HCN 1435A	DGW		
M	HCN 1797	GH		
N	HCN 1798	GH	TJB	7-29-92
P	HCN 1927A	GH	TJB	8-15-92
Q	HCN 2063	GH	TJB	1-23-93

NOTES: UNLESS OTHERWISE SPECIFIED.

1. ALL CAPACITORS ARE IN MICROFARADS.
2. ALL RESISTORS ARE IN OHMS, 1/4W, 5%.
3. ALL POTENTIOMETERS ARE 1 TURN.

UNUSED PARTS:



LEGEND:

+	OPTION, INSTALL PER CUSTOMER ORDER.
-	INSTALLED ON HIGHER ASSEMBLY.
*	NOT INSTALLED.
——X——	CUT TRACE.
- - - - - - - - - -	JUMPER WIRE.

ZETRON, INC.
12335 134TH COURT N.E.
REDMOND, WASHINGTON, 9805

Title: MODEL 49 CONTROL BOARD

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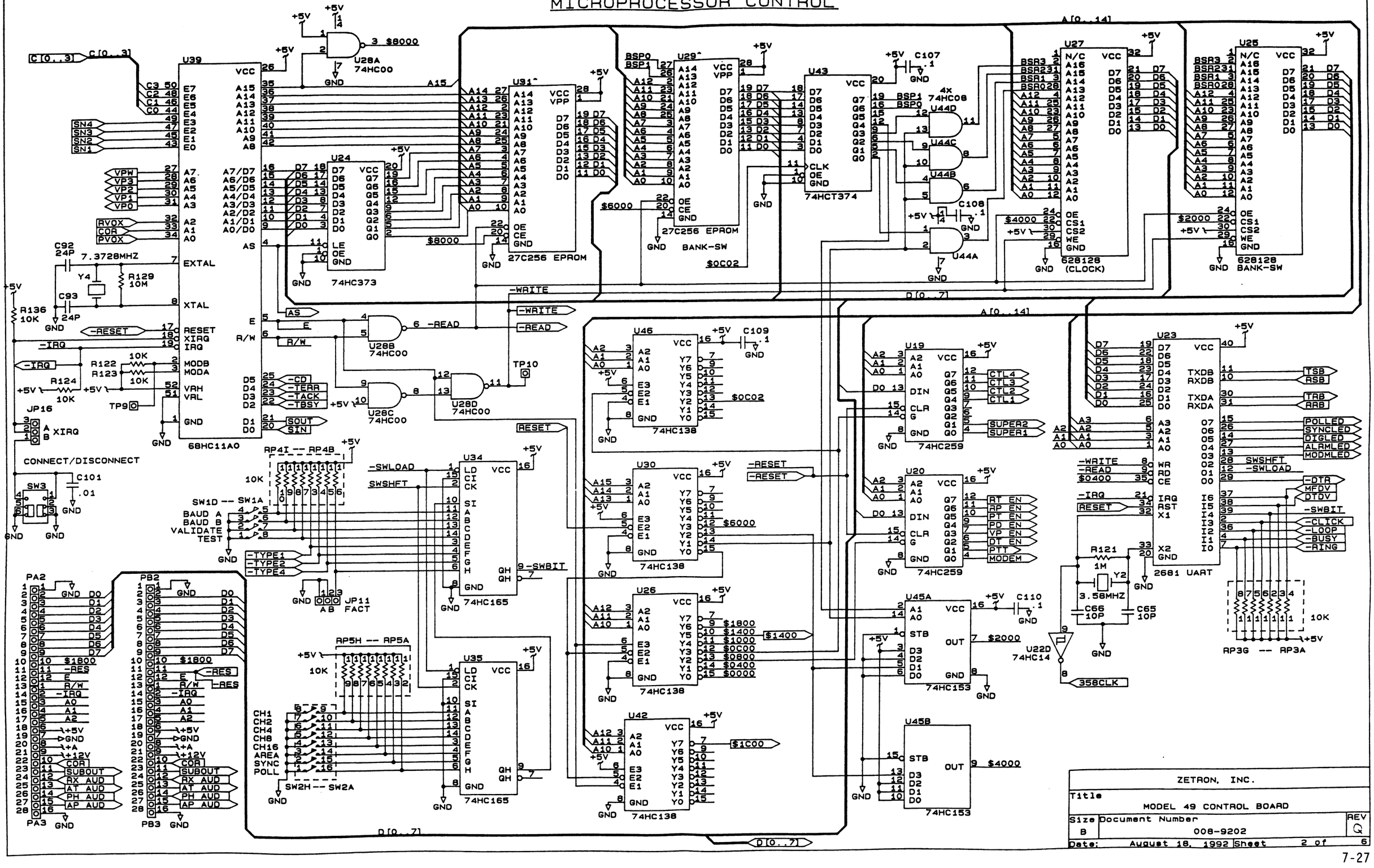
MICROPROCESSOR CONTROL



ZETRON, INC.

Title: MODEL 49 CONTROL BOARD

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Date: August 18, 1992 Sheet 2 of 6

RECEIVER - TRANSMITTER AUDIO

DUAL-TIME SQUELCH

DISCRIMINATOR BUFFER

RECEIVER VOX

COR SELECT

AUDIO HIPASS 300 HZ

TRANSMIT COMBINING AMP

DTMF DE-EMP FILTER

ZETRON INC.	
Title: MODEL 49 CONTROL BOARD	
Size: B	Document Number: 008-9202 REV: Q
Date: April 28, 1992	Sheet 3 of 6

TELCO INTERCONNECT

PHONE AUDIO COMBINING AMP

"TO TEL" TP11
6000HZ C18 470P
R16 22K AP AUD
R17 510K TONE PH
R18 56K
R15 12K VP AUD
VT AUD
U3B 4053 VP EN
J3 VOICE PROMPTS VP0 VP1 VP2 VPW VP3
+12V +5V GND
R39 270K
RP EN
RP AUD
MODEM
R7 510
U2A 358
R14 47K
R58 33K
U3C 4053
R69 47K
C52 .047
U15C 4066
+12V +2V GND

MODEM

C106 .1
U37+
C86 .1
C89 10
D[0..7]
SOUT
RXA TXD EXCLK AD7 AD6 AD5 AD4 AD3 AD2 AD1 AD0 CS ALE RD WR INT RESET GND
V+ TXA TXCLK RXD RXCLK CLK X2 X1 ISET VREF
11.06MHZ Y3 C85 33P C84 33P
$1C00 AS -READ -WRITE -IRQ RESET
C86 .1 R81 2M
C87 .1
OPTION

P1
+5V +12V GND -48V SUPER1 SUPER2 -BUSY -RING -LOOP -TYPE4 -TYPE2 -TYPE1
"FROM TEL" TP12

RS232 BUFFER

PROGRAM J9 DTR CD TX RX
JP15#
U40 MAX232
C1+ C1- C2+ C2- VCC +10 -10 T1O T2O R1I R2I T1I T2I R1O R2O GND
C95 10 C96 10 C98 10 C97 10
R133 1K R134 1K R132 1K R135 1K
R131 47K
CR17# 1N4148 CR18 1N4148 CR19 1N4148
-DTR -CD MODEM SOUT SIN
R130 4.7K

MF/DTMF DECODERS

U18+ 78A207 MF DECODER OPTION
VIN EN CSTR HEX QUAL LKP AGND DGND VCC D5 D4 D3 D2 D1 D0 DV DE XOUT X1 X2
C[0..3] C3 C2 C1 C0 MFDV
U21+ 75T204 DTMF DECODER
XEN ATB EN AIN GND VCC D8 D4 D2 D1 DV XO X1
DTDV 358CLK
DT EN DT AUD

PHONE AGC AMP

DIAL-CLICK J8 -CLICK +12V +5V GND
-16dBm AGC
C34 .047 R43 33K 225HZ
Q2 MPF3821
R44 15K C36 .001 C42 10
R52 1K U13A 358
C115 .01 R42 4.7K
R46 100 Q3 2N3906
C35 10 R45 33K
1.2VPP PH AUD
R29 2.2K R40 510

PHONE VOX

1400HZ
U14A 358
C37 .0047 C38 .0047 R51 100K R50 6.8K
U14B 358 CR11 1N4148
C41 .0047 R49 15K
+VX +2V
R138 47K PVOX
C43 .1 R143 47K

LEVEL TO PHONE

ANY,	1VPP	= -2dBm
TONE,	1VPP	= -5dBm
VPROMPTS,	0.3VPP	= -3dBm
VOICE,	0.3VPP	= -7dBm
MODEM,	2.2VPP	= -9dBm

ZETRON INC.		
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LIGHTS

+12V
U38A 2003
DS1
POLLED → POLL R116 1K +12V
GND
U38B 2003
DS2
SYNCLED → SYNC R117 1K +12V
U22F 74HC14
DS7
COR → CARRIER R126 220 +5V
U38C 2003
DS3
DIGLED → DIGIT R118 1K +12V
U38D 2003
DS6
ALARMLED → ALARM R125 1K +12V
U38E 2003
DS4
MODMLED → MODEM R119 1K +12V
U38F 2003
DS5
SUPER1 → TELCO R120 1K +12V
U38G 2003
SUPER2

CONTROL/SENSE

+12V +12V +12V +12V
R30 47K, R32 47K, R34 47K, R24 47K
J2
SENSE 4 — R31 47K — SN4
GND
SENSE 3 — R33 47K — SN3
GND
SENSE 2 — R35 47K — SN2
GND
CONTROL 4 — R25 47K — SN1
CONTROL 4
CONTROL 3
CONTROL 3
CONTROL 2
CONTROL 2
SENS1
GND
CR8 6.2V, CR9 6.2V, CR10 6.2V, CR3 6.2V
GND GND GND GND

K5 +12V — JP6 — U4B 2003 — CTL4
K4 +12V — JP5 — U4C 2003 — CTL3
K3 +12V — JP4 — U4D 2003 — CTL2
K2 +12V — JP3 — U4E 2003 — CTL1
CLOUT
GND

TONE GENERATORS

U7 ASIC 001
+5V
C63 10P, C64 10P, 16MHZ, Y1
GND
R38 10K, R37 10K, R36 10K
P0.2 P0.1 P0.0 RST GND
P3.7 P3.6 P3.5 P3.4 P3.3 P3.2 P3.1 P3.0
P1.7 P1.6 P1.5 P1.4 P1.3 P1.2 P1.1 P1.0
PD7 PD6 PD5 PD4 PD3 PD2 PD1 PD0
-TERR, -TACK, -TBSY
DB4 DB3 DB2 DB1 DB0 DB6
D[0..7]
DB[0..7]

U6 74HCT374
U8 74HCT374
D7 D6 D5 D4 D3 D2 D1 D0
Q7 Q6 Q5 Q4 Q3 Q2 Q1 Q0
CLK OE GND VCC
RP1 128 OUT 64 32 16 8 4 2 1 GND 100K/200K
RP2 128 OUT 64 32 16 8 4 2 1 GND 100K/200K

U9 74HCT374
D7 D6 D5 D4 D3 D2 D1 D0
Q7 Q6 Q5 Q4 Q3 Q2 Q1 Q0
DB7 DB6 DB5 DB4 DB3 DB2 DB1 DB0
$1400 → LE, OE, GND
-RES

6000HZ
R72 100K, R73 33K, C53 .01, C54 .0047, C55 100P
U16A 358 — C104 .1 — TONE PH
R70 1K
C111 100PF

6000HZ
R75 100K, R76 33K, C58 .01, C59 .0047, C57 100P
U16B 358 — C105 .47 — TONE TX
R74 1K
C112 100PF

U5B 358 — R71 10K
U5A 358 — R77 10K

100HZ
150HZ

BUS INTERFACES

U11 SN75121
TSB → U10D 74HC14
TRB → U10E 74HC14
1A 1B 1C 1D 1E 1F 2A 2B 2C 2D 2E 2F
1Y 2Y
GND

J4 BNC, J5 BNC — SUBSCRIBER BUS
J6 BNC, J7 BNC — REPEATER BUS
JP17 JP18
R139 100, R140 100, R141 100, R142 100
JP21 JP22

U12 SN75122
1R 1S 1A 1B 2R 2S 2A 2B 3R 3S 3A 3B
1Y 2Y 3Y
+5P
R41 1K
JP19 JP20
U10B 74HC14 — RSB
U10C 74HC14 — RRB

U41 SN75138
1D 1R 2D 2R 3D 3R 4D 4R S GND1 GND2
1B 2B 3B 4B

ZETRON INC.		
Title: MODEL 49 CONTROL BOARD		
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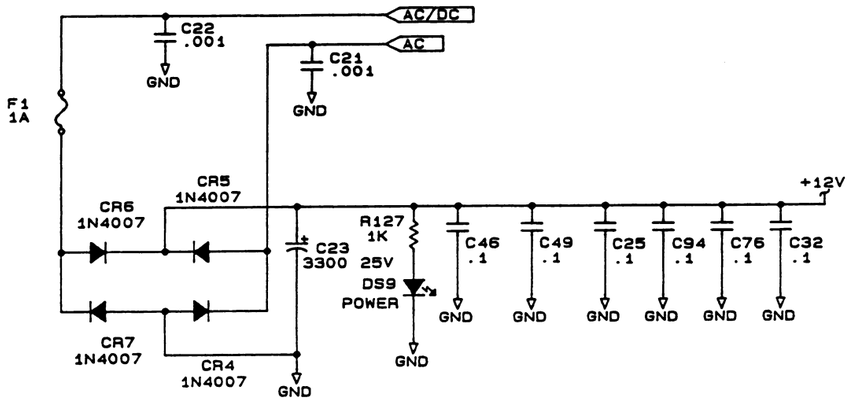
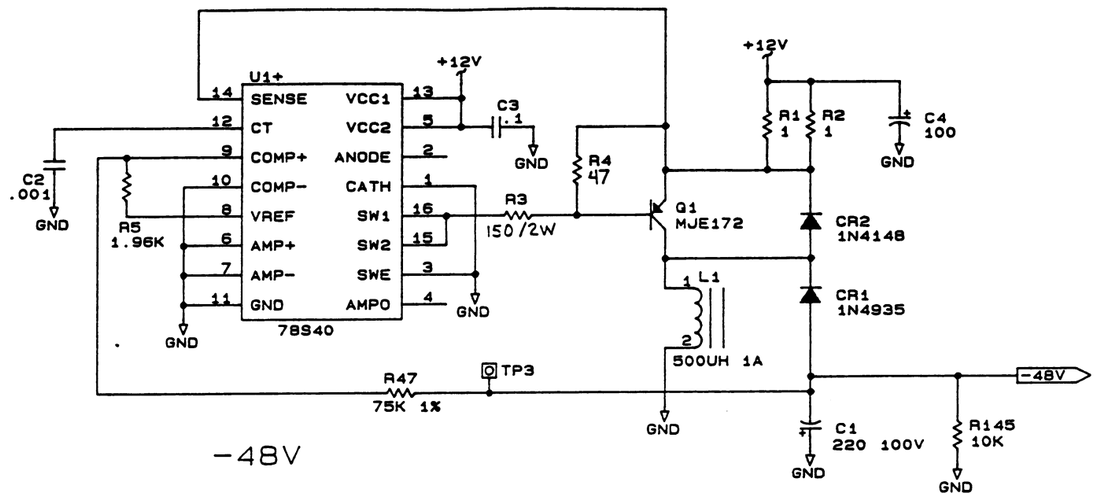
POWER SUPPLY

AC/DC INPUT

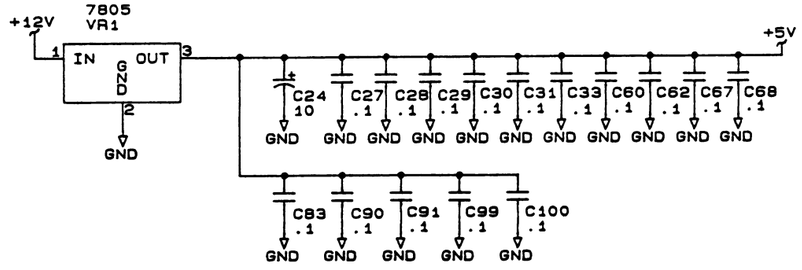


+12V TO -48V INVERTER

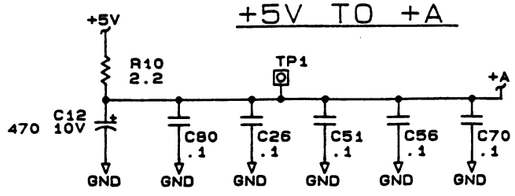


-48V

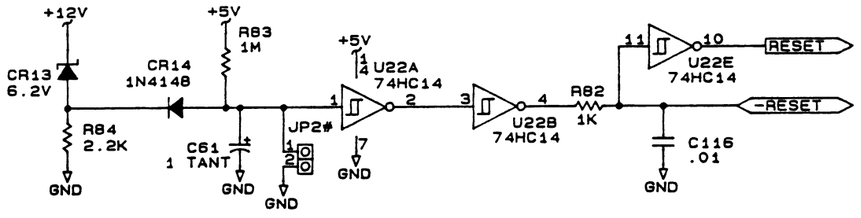
+12V TO +5V



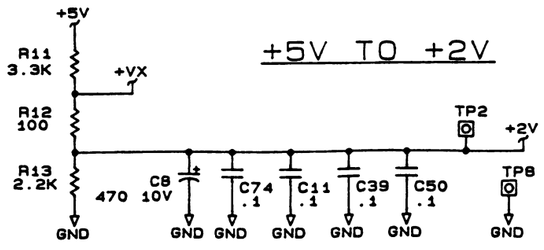
+5V TO +A



POWER-UP RESET



+5V TO +2V



ZETRON INC.		
Title: MODEL 49 CONTROL BOARD		
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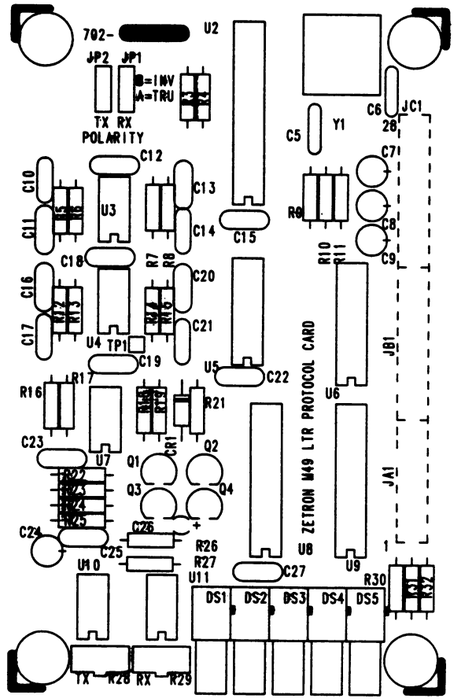
Model 49 LTR Protocol Card Silkscreen 702-9218 Rev. G



REV	DESCRIPTION	DRN	APD	DATE
AX	PROTO	GWH		
B	RELEASE	DGW		
C	ECN 1022	GWH		
D	ECN 1111	GWH		
E	ECN 1189	KM		
F	ECN 1281 (REV CHG ONLY)	KN		
G	ECN 2069	GH	KW	1-4-93

U5D 74HC14 — DS5 "QUAL" — R31 330
U5E 74HC14 — DS1 "TX" — R30 330
U5C 74HC14 — DS4 "RX" — R32 330
+5V

U2 ASIC 001
Y1 16MHZ, C6 10P, C5 10P
VCC, X2, X1, RST, GND, +5V
P3.7 P3.6 P3.5 P3.4 P3.3 P3.2 P3.1 P3.0
-HOFROM -HOTO PRECHG TXDATA RXDATA
P0.2 P0.1 P0.0
P1.7 P1.6 P1.5 P1.4 P1.3 P1.2 P1.1 P1.0
E7 E6 E5 E4 E3 E2 E1 E0

JP2 TX POL AB, JP1 RX POL AB
R3 10K, R4 10K, R11 10K
U5F 74HC14

U5A 74HC14 — R25 1M
U5B 74HC14 — R24 270K

R28 50K "TX"
U10A 358 — R12 5.6K, R13 33K, C16 .1, C17 .047
U4B 358 — R15 10K, R14 56K, C20 .1, C21 .01
U4A 358 — TP1, R10 1K SUBOUT 0.8V P-P, R9 1K

TX FILTER

RXAUD — R7 5.6K, R8 33K, C13 .1, C14 .047
U3A 358 — R5 10K, R6 56K, C11 .1, C10 .01
U3B 358
CRX1 1N4148, RX2 10K +12V

RX FILTER

E[0..7] → U8 74HCT374 (-HOTO, -REN, CLK, OE, GND)
D[0..7] → U9 74HCT374 (-WLAT, -HOFROM, CLK, OE, GND)

JA1 GND D0 D1 D2 D3 D4 D5 D6 D7
JB1 D7 -SEL -RES E R/W -IRQ A0 A1 A2 +5V
JC1 GND +A +12V COR SUBOUT RXAUD ATAUD PHAUD APAUD GND

U6 74HC138 — A2 A1 A0, E3 E2 E1, Y7 Y6 Y5 Y4 Y3 Y2 Y1 Y0 → -REN, -WLAT

SUB-AUDIBLE CENTERING CIRCUIT

R27 100K, R29 1M, "RX"
U11A 358 — +0.6V.P. — R21 330
R18 47K, R19 2.2K → RXDATA
U7A 358 +12V
R26 100K
Q3 2N3906, Q4 2N3906, Q1 2N3904, Q2 2N3904
U11B 358
U7B 358 — R17 330, R16 100K
RX1 220, C26 10 TANT
RX3 1.5K, CR1* 5.1V
DS2 "A", DS3 "B"

C7 10, C19 .1, C25 .1
C9 10, C15 .1, C22 .1, C27 .1
C23 .1, C8 10, C12 .1, C18 .1, R22 3.3K, R23 2.2K, C24 10 TANT, +2V

UNUSED PARTS
U10B 358

LEGEND
- INSTALLED ON HIGHER ASSEMBLY
- NOT INSTALLED
- CUT TRACE
- JUMPER WIRE

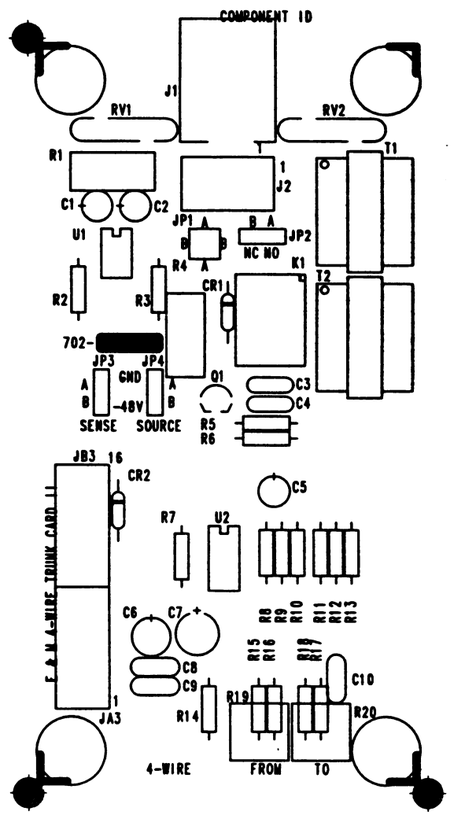
ZETRON INC.

Title: MODEL 49 LTR PROTOCOL CARD

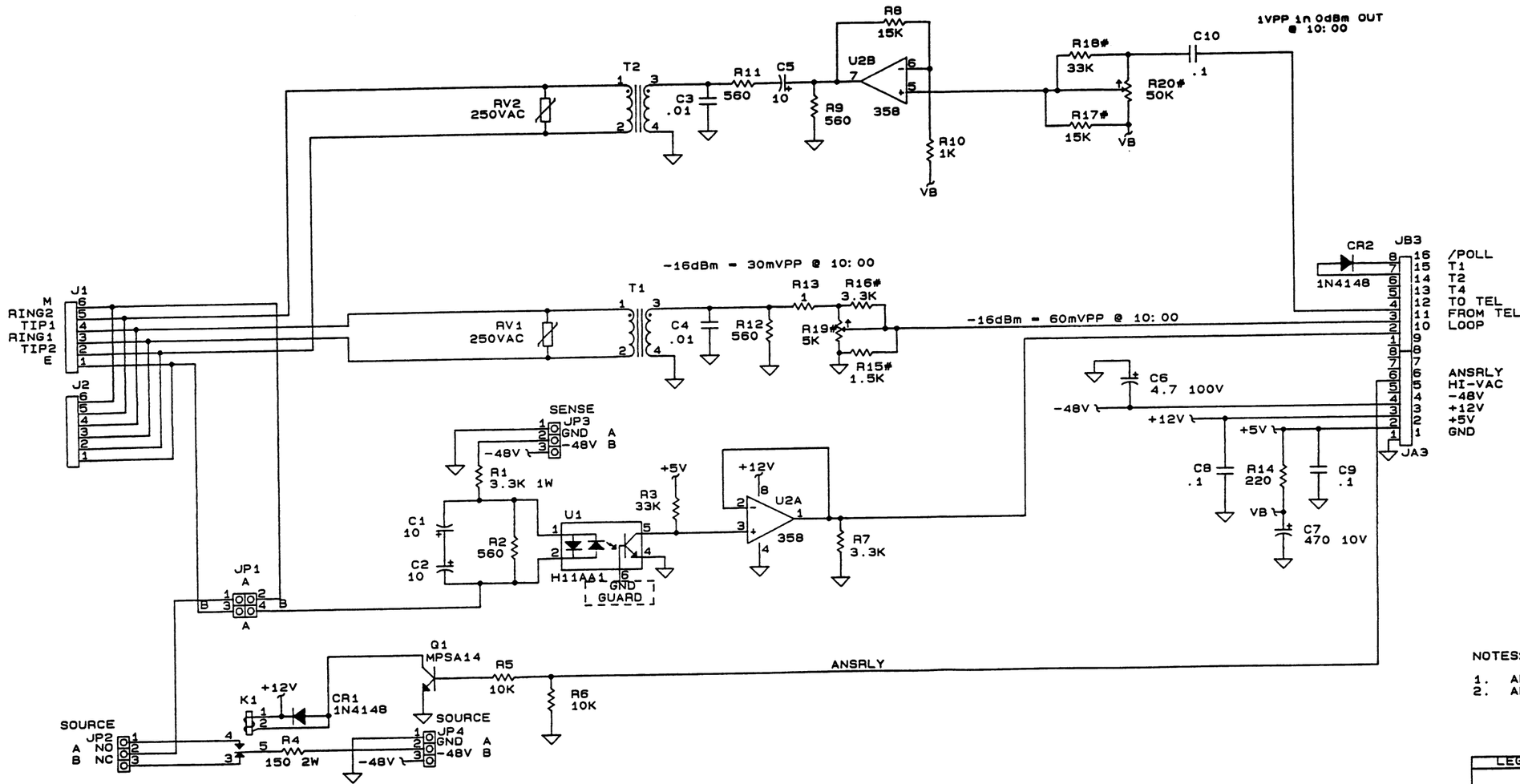
Size	Document Number	REV
B	008-9218	G

Date: December 29, 1992 Sheet 1 of 1

E&M 4-Wire Trunk Card II Silkscreen 702-9228 Rev. C



REV	DESCRIPTION	DRN	APD	DATE
A	RELEASE	GWH		
B	ECN 717	GWH		
C	ECN 1014	GWH	KW	6-14-90



FOR MICROWAVE SYSTEMS:

R10 from 1K to 1.5K for 1VPP in = -16dBm out @ 10: 00
R13 from 1 to 75K for +7dBm in = 60mVPP out @ 10: 00

NOTES:

1. ALL RESISTOR VALUES ARE IN OHMS 1/4W, 5%.
2. ALL CAPACITOR VALUES ARE IN MICROFARADS.

LEGEND

-	INSTALLED ON HIGHER ASSEMBLY
#	NOT INSTALLED
——X——	CUT TRACE
- - - - - - - -	JUMPER WIRE

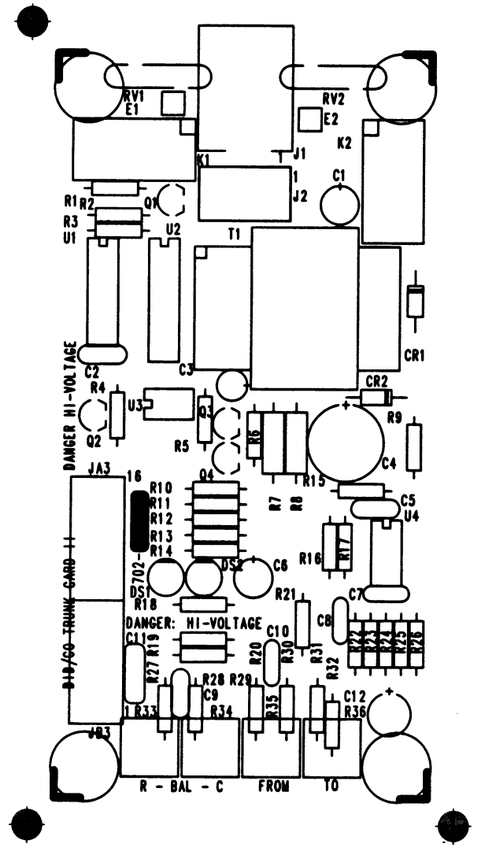
ZETRON, INC.
12335 134th COURT N.E.
REDMOND, WA 98052-2433

Title: E&M 4-WIRE TRUNK CARD II

Size	Document Number	REV
B	008-9228	C

Date: June 13, 1990 Sheet 1 of 1

DID/CO Trunk Card II Silkscreen 702-9229 Rev. C.1



REV	DESCRIPTION	DN	APD	DATE
A	RELEASE	GR		
B	ECN 1144	KN		
C	ECN 1399	KN		
C.1	ECN 1584	KM		10-18-91

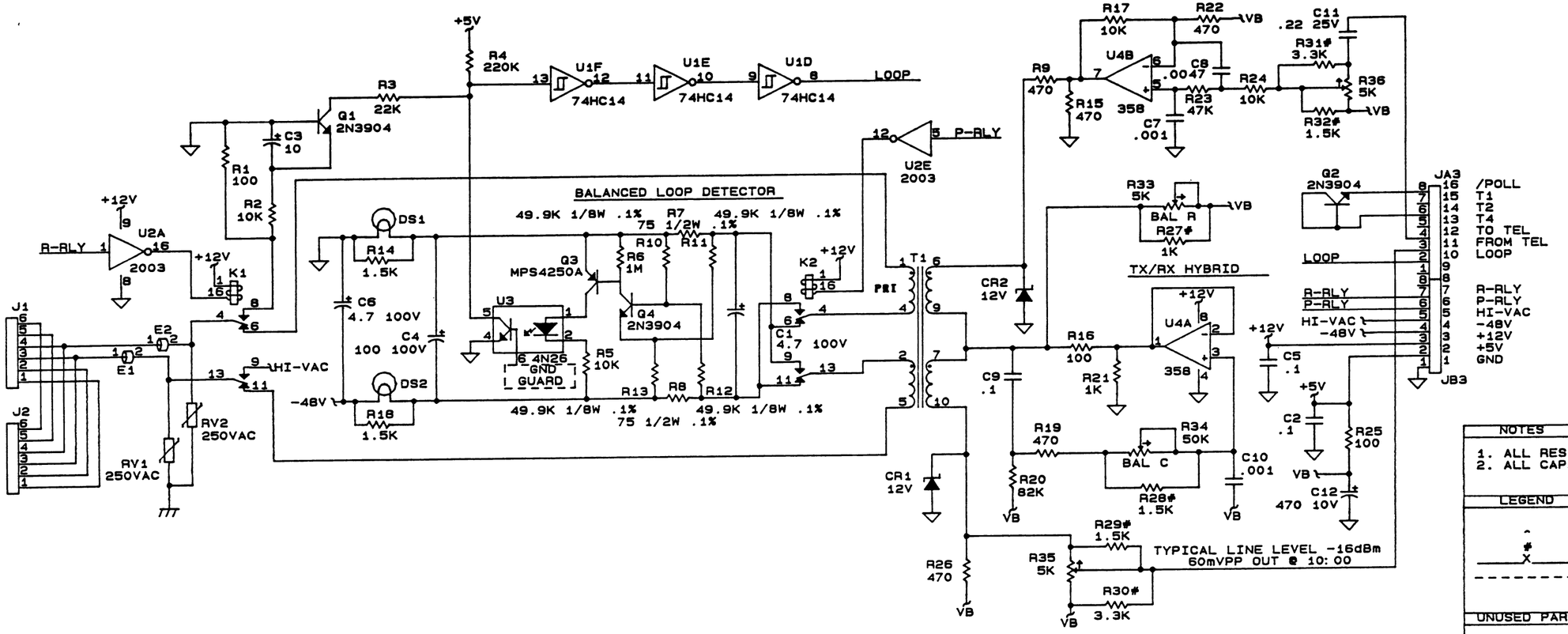
BANDPASS AMP 150-3.5kHz

DTMF 1VPP = 0dBm OUT
VOICE 0.5VPP = -6dBm OUT
GAIN @ 10:00

BALANCED LOOP DETECTOR

TX/RX HYBRID

TYPICAL LINE LEVEL -16dBm
60mVPP OUT @ 10:00



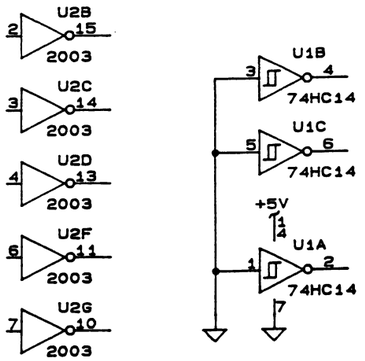
NOTES

1. ALL RESISTOR VALUES ARE IN OHMS 1/4W, 5%.
2. ALL CAPACITOR VALUES ARE IN MICROFARADS

LEGEND

^	INSTALLED ON HIGHER ASSY.
#	NOT INSTALLED
X	CUT TRACE
- - - - - - -	JUMPER WIRE

UNUSED PARTS



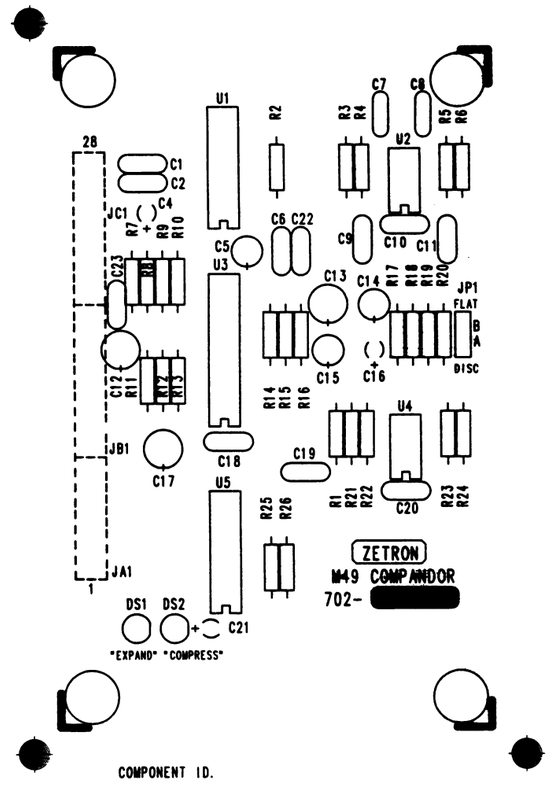
ZETRON, INC.
12335 134th COURT N.E.
REDMOND, WA 98052-2433

Title: DID/CO TRUNK CARD II

Size	Document Number	REV
B	008-9229	C.1

Date: October 17, 1991 Sheet 1 of 1

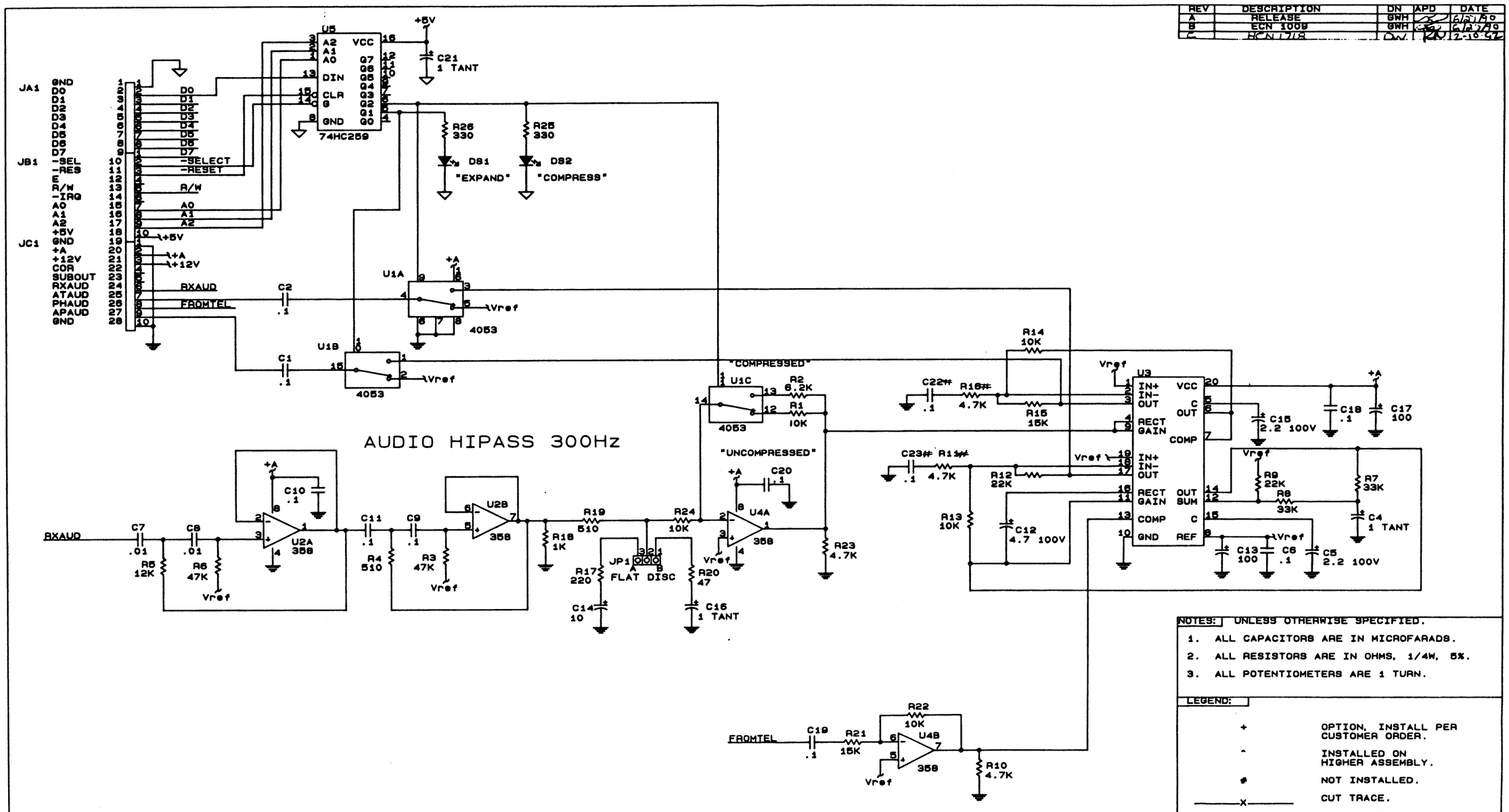
Model 49 Compandor Card Silkscreen 702-9276 Rev. C



COMPONENT ID.

Model 49 Compandor Card Schematic 008-9276 Rev. C

REV	DESCRIPTION	DN	APD	DATE
A	RELEASE	GWH		6/21/90
B	ECN 1009	GWH		6/27/90
C	ECN 1718	DW		12-10-92



NOTES: UNLESS OTHERWISE SPECIFIED.

1. ALL CAPACITORS ARE IN MICROFARADS.
2. ALL RESISTORS ARE IN OHMS, 1/4W, 5%.
3. ALL POTENTIOMETERS ARE 1 TURN.

LEGEND:

+	OPTION, INSTALL PER CUSTOMER ORDER.
^	INSTALLED ON HIGHER ASSEMBLY.
#	NOT INSTALLED.
——x——	CUT TRACE.
- - - - - - - - - -	JUMPER WIRE.

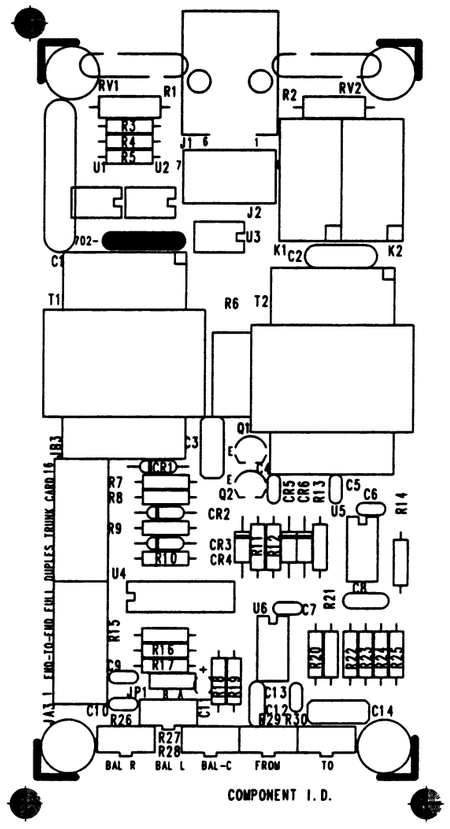
ZETRON, INC.
12335 134th COURT N.E.
REDMOND, WA 98052-2433

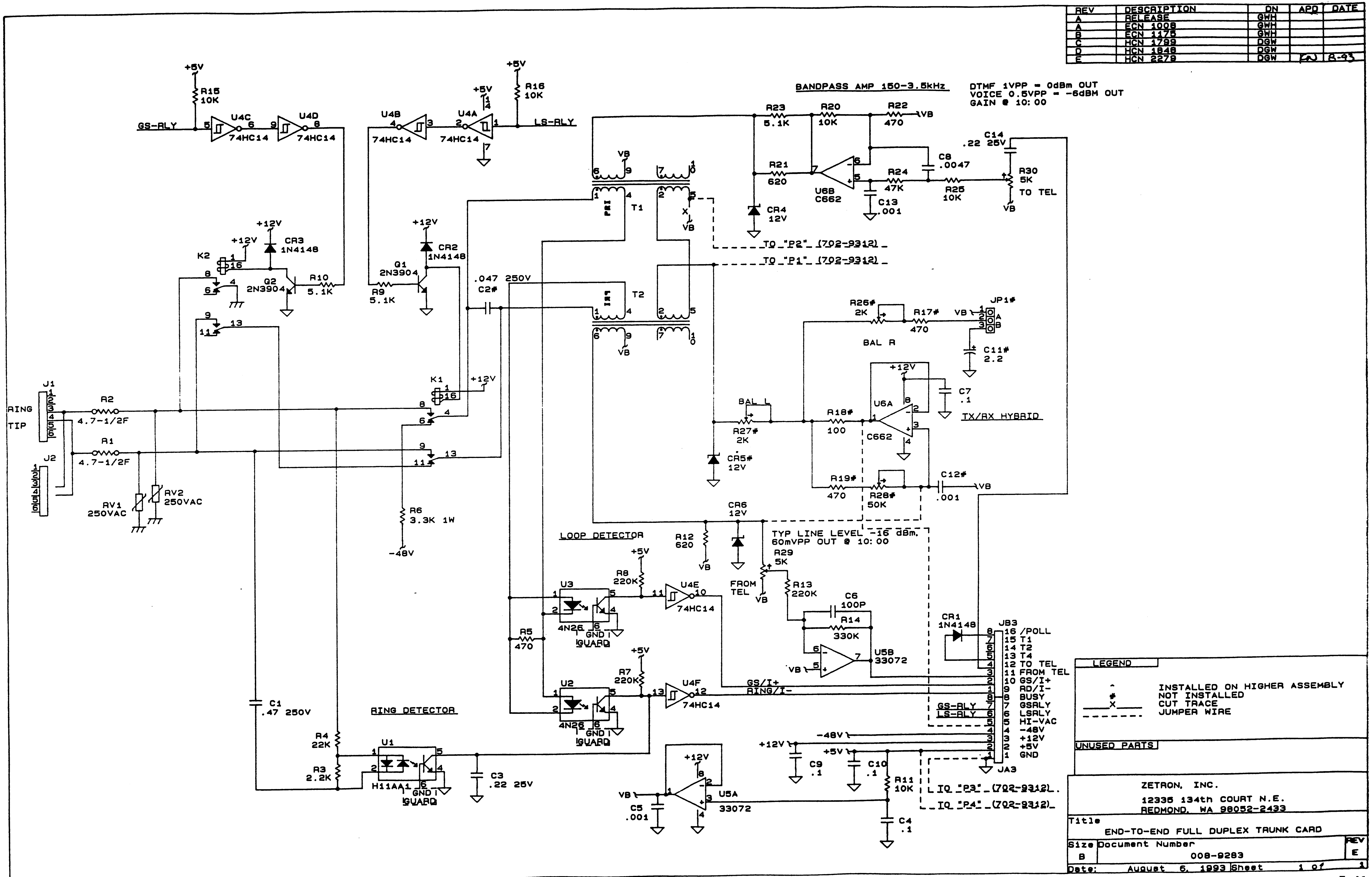
Title: M49 COMPANDOR

Size	Document Number	REV
B	008-9276	C

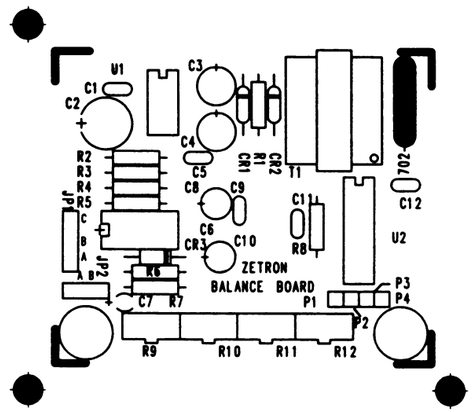
Date: June 27, 1990 Sheet 1 of 1

End-End Full Duplex Trunk Card Silkscreen 702-9283 Rev. E

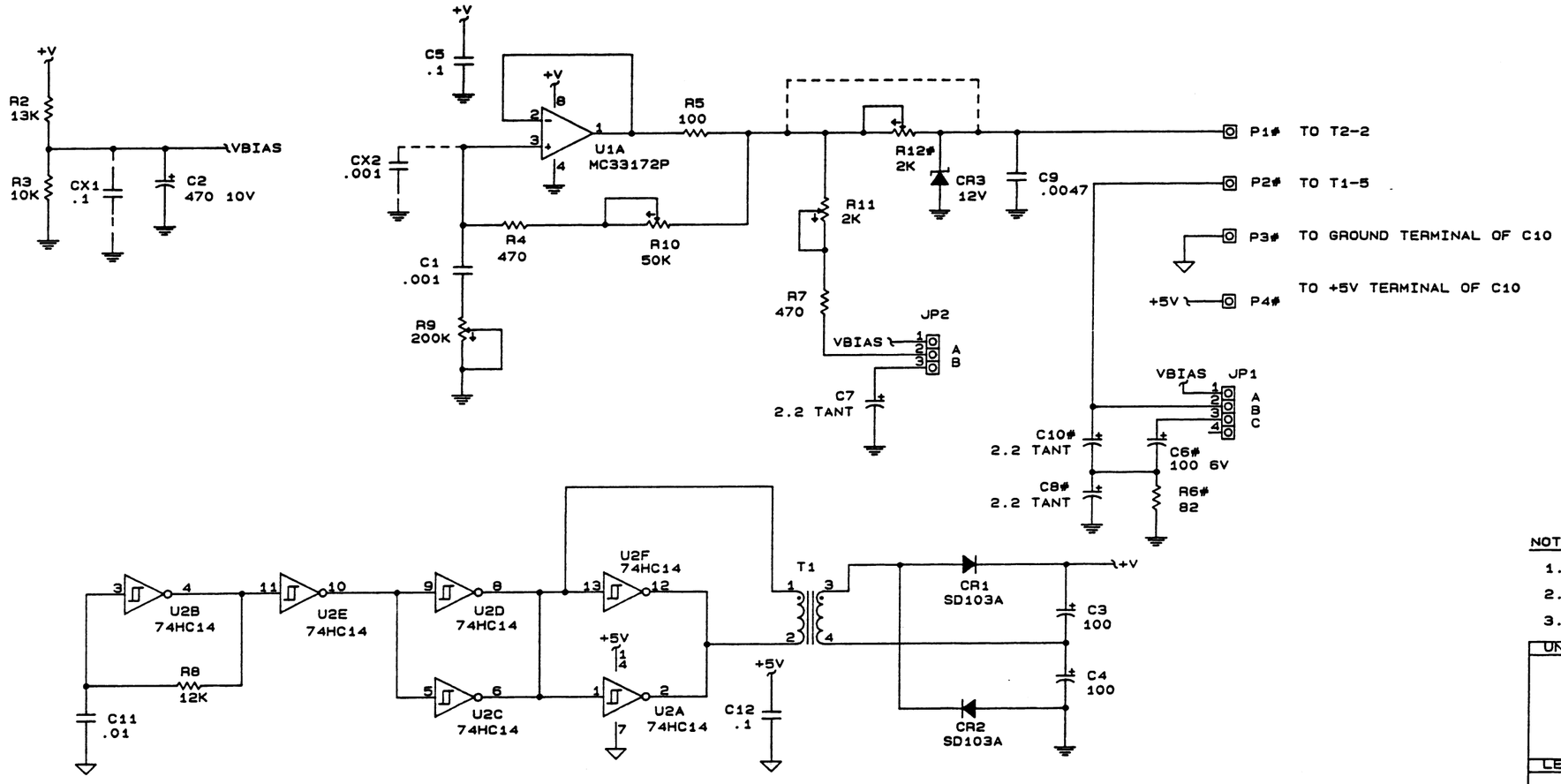



REV | DESCRIPTION | DN | APD | DATE
- RELEASE GWH
A ECN 1008 GWH
B ECN 1175 GWH
C HCN 1799 DGW
D HCN 1848 DGW
E HCN 2279 DGW 8-93
BANDPASS AMP 150-3.5kHz
DTMF 1VPP = 0dBm OUT
VOICE 0.5VPP = -6dBM OUT
GAIN @ 10:00
GS-RLY
LS-RLY
R15 10K
R16 10K
U4A U4B U4C U4D U4E U4F 74HC14
R23 5.1K
R20 10K
R22 470
R21 620
U6B C662
R24 47K
R25 10K
C8 .0047
C13 .001
C14 .22 25V
R30 5K
TO TEL
CR4 12V
T1
T2
TO "P2" (702-9312)
TO "P1" (702-9312)
K1
K2
CR3 1N4148
CR2 1N4148
Q1 2N3904
Q2 2N3904
R9 5.1K
R10 5.1K
.047 250V C2#
R26# 2K
R17# 470
JP1#
C11# 2.2
BAL R
BAL L
R27# 2K
R18# 100
U6A C662
C7 .1
TX/RX HYBRID
CR5# 12V
R19# 470
R28# 50K
C12# .001
J1
RING
TIP
J2
R2 4.7-1/2F
R1 4.7-1/2F
RV1 250VAC
RV2 250VAC
R6 3.3K 1W
-48V
LOOP DETECTOR
CR6 12V
R12 620
TYP LINE LEVEL -16 dBm
60mVPP OUT @ 10:00
R29 5K
FROM TEL
R13 220K
C6 100P
R14 330K
U5B 33072
U3 4N26
U2 4N26
R8 220K
R7 220K
R5 470
GND I GUARD
CR1 1N4148
JB3
16 /POLL
15 T1
14 T2
13 T4
12 TO TEL
11 FROM TEL
10 GS/I+
9 RD/I-
8 BUSY
7 GSRLY
6 LSRLY
5 HI-VAC
4 -48V
3 +12V
2 +5V
1 GND
JA3
GS/I+
RING/I-
C1 .47 250V
RING DETECTOR
R4 22K
R3 2.2K
U1 H11AA1
C3 .22 25V
C9 .1
C10 .1
R11 10K
U5A 33072
C5 .001
C4 .1
TO "P3" (702-9312)
TO "P4" (702-9312)
LEGEND
INSTALLED ON HIGHER ASSEMBLY
NOT INSTALLED
CUT TRACE
JUMPER WIRE
UNUSED PARTS
ZETRON, INC.
12335 134th COURT N.E.
REDMOND, WA 98052-2433
Title
END-TO-END FULL DUPLEX TRUNK CARD
Size B
Document Number 008-9283
REV E
Date: August 6, 1993 Sheet 1 of 1

Balance Board Silkscreen 702-9312 Rev. C



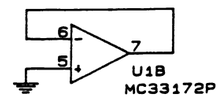
REV	DESCRIPTION	DR	APRD	DATE
A	RELEASE	GH		
B	ECN 1159	DW		
C	ECN 1272	KM	JL	1/11/91



NOTES: UNLESS OTHERWISE SPECIFIED.

1. ALL CAPACITORS ARE IN MICROFARADS.
2. ALL RESISTORS ARE IN OHMS, 1/4W, 5%.
3. ALL POTENTIOMETERS ARE 1 TURN.

UNUSED PARTS:



LEGEND:

+	OPTION, INSTALL PER CUSTOMER ORDER.
-	INSTALLED ON HIGHER ASSEMBLY.
#	NOT INSTALLED.
———X———	CUT TRACE.
- - - - - - - - - -	JUMPER WIRE.

ZETRON, INC.

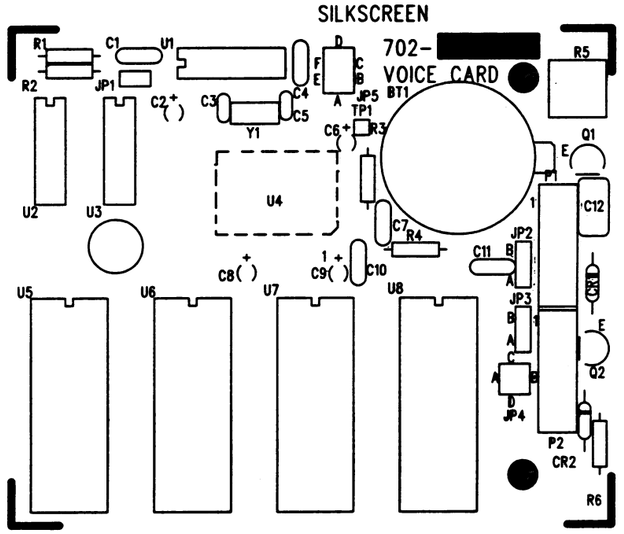
12335 134TH COURT N.E.
REDMOND, WASHINGTON, 98052-2433

Title: BALANCE BOARD

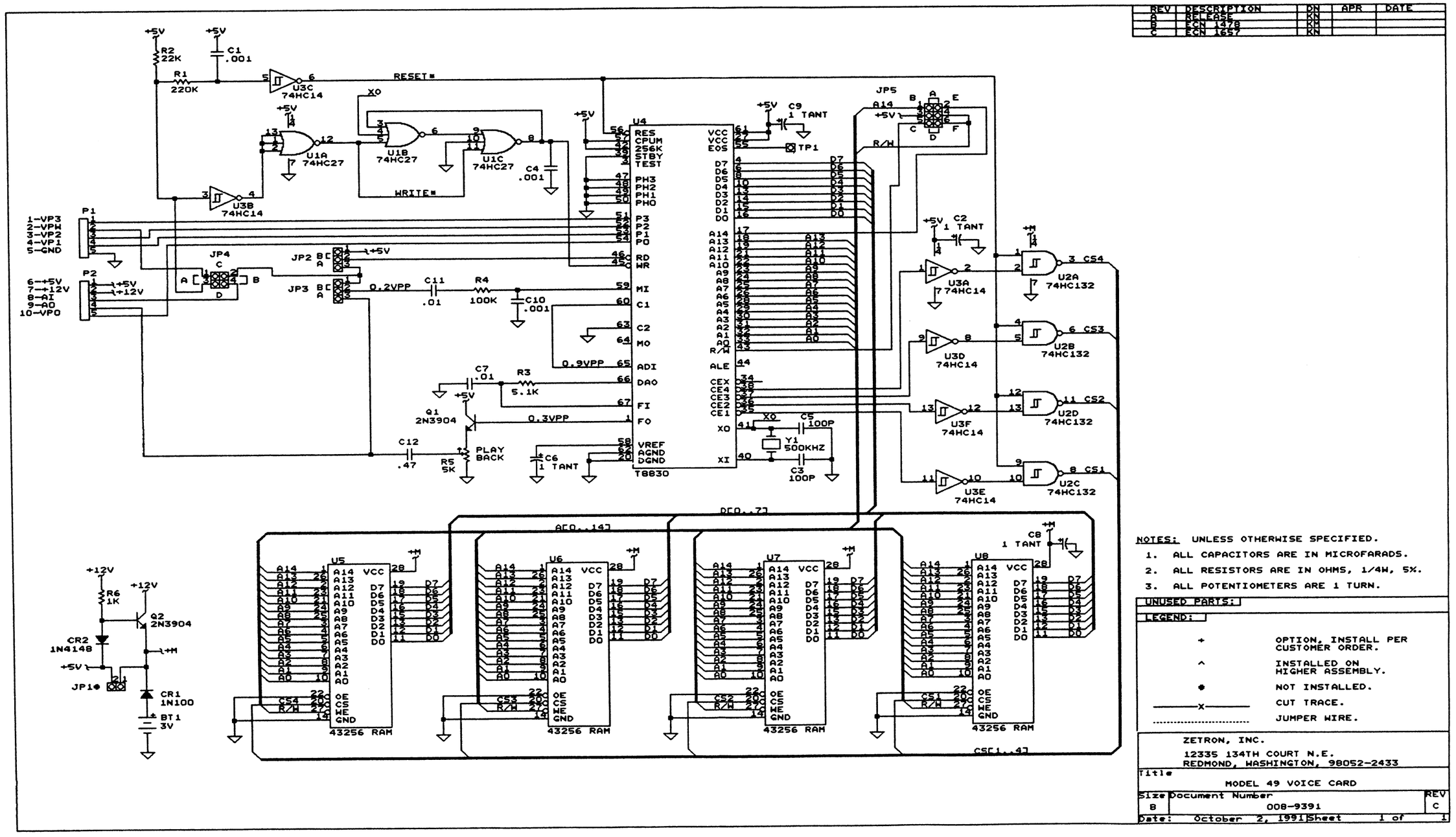
Size	Document Number	REV
B	008-9312	C

Date: January 11, 1991 Sheet 1 of 1

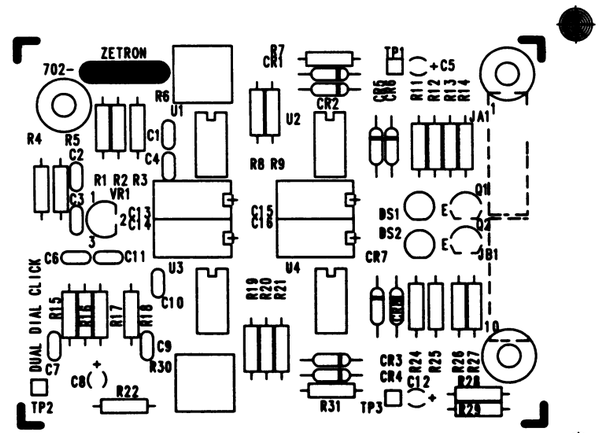
Model 49 Voice Card Silkscreen 702-9391 Rev. C



Model 49 Voice Card Schematic 008-9391 Rev. C

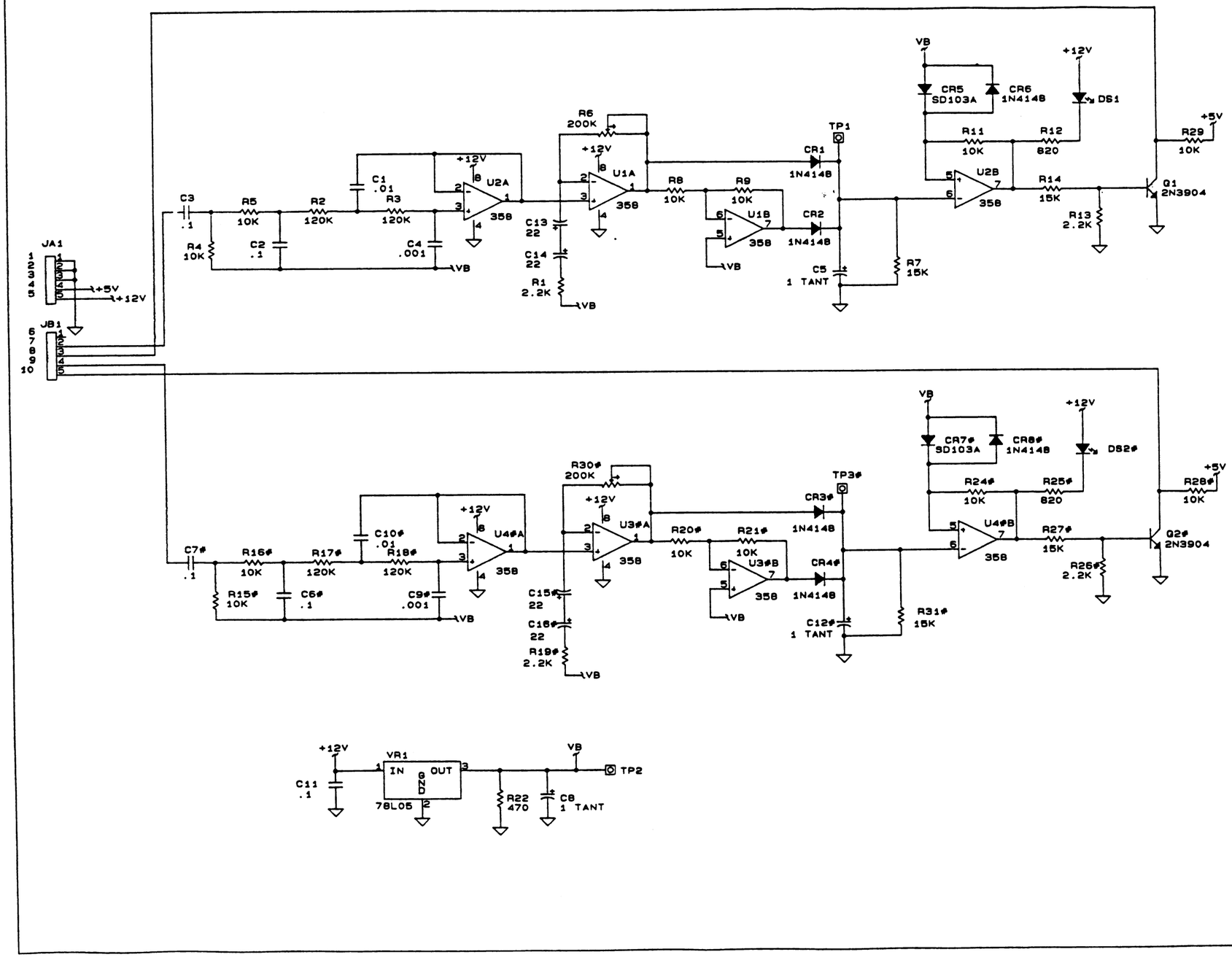


Model 4XB Dial Click Card Silkscreen 702-9242 Rev. E



Model 4XB Dial Click Card Schematic 008-9242 Rev. E

REV	DESCRIPTION	DN	APD	DATE
D	ECN 817	GH		
E	ECN 964	GH	DCV	4-30-90



NOTES: UNLESS OTHERWISE SPECIFIED.

1. ALL CAPACITORS ARE IN MICROFARADS.
2. ALL RESISTORS ARE IN OHMS, 1/4W, 5%.
3. ALL POTENTIOMETERS ARE 1 TURN.

LEGEND:

+	OPTION, INSTALL PER CUSTOMER ORDER.
-	INSTALLED ON HIGHER ASSEMBLY.
#	NOT INSTALLED.
——X——	CUT TRACE.
- - - - - - - - - -	JUMPER WIRE.

ZETRON, INC.
12335 134th COURT N.E.
REDMOND, WA 98052-2433

Title: M4XB DIAL CLICK

Size: B | Document Number: 008-9242 | REV: E

Date: April 30, 1990 | Sheet 1 of 1

8. GLOSSARY

ACCPAC- Accounting software.

ASCII- American Standard Code for Information Interchange.

Call Detail- A detailed listing of interconnect calls that were made. This would include the ID, phone number called, time of day call was made, and length of call.

Carrier- Unmodulated RF energy that carries desired information.

CAS- Carrier Activated Squelch. See COR.

Channel- A specific transmitter frequency and receiver frequency for electromagnetic signals.

CO- Central Office. A switching system serving a group of customer lines within a particular area.

COG- Centralized Operations Group. A group within the phone company that takes interface orders.

Comm Port- Communications port. Device used in a computer to talk with the outside world.

Companding- Process that improves the telephone interconnect audio fidelity. This is done by reducing the noise introduced by radio signal propagation.

Conventional- Community style repeater with no trunking.

COR- Carrier Operated Relay. Circuit used to detect that the carrier signal is present.

COS- Carrier Operated Squelch. See COR.

CTCSS- Continuous Tone Carrier Squelch System. Subaudible tone signaling used to mute a receiver.

CTL- Control. An output on the M49 that is used for cross-busying and alarms.

dB- Decibel. A method of comparing two signals on a logarithmic scale.

dBm- Decibel Measurement Relative To One Milliwatt. A method of comparing a signal's power against 1 milliwatt. This ratio is based on the logarithmic scale.

DID- Direct Inward Dialing. Type of telephone line that represents a bank of sequential numbers. When a caller dials one of the numbers, the phone equipment signals the last 2 to 7 digits of the phone number across the phone wire pair.

Dispatch- A mobile to mobile call.

DPL- Digital Private Line. Digitally coded system for two-way radio.

DSC- Digital Squelch Control. See DPL.

E&M 4 Wire- Earphone and Mouthpiece. Type of line that carries two wire pairs (4 wire) for audio and one pair for call supervision (E-lead and M-lead.)

E-E- End to End. Transmits and receives telephone signals over two wires.

Full Duplex- A call in which audio can be transmitted and received at the same time.

Group- Term used in LTR mobile programming to designate an ID in a System.

Half Duplex- A call in which audio may be sent in only one direction at a time.

HDB- High-speed Data Bus.

Home- A channel in an LTR system that mobiles listen to for trunking information.

icom- A plug-in circuit containing both a crystal and temperature compensator.

ID- Identification. A three-digit number used in LTR to designate a user on a particular home repeater.

Interconnect- A landside-to-mobile or mobile-to-landside call.

ISQ- Internal Squelch. Circuit that is used to detect audio signal and mute the signal if only noise is found.

LTR- Logic Trunked Radio. EF Johnson signaling format used for trunked radio systems.

MMDD- Month digits (MM) and day digits (DD)

Packet- Data transmitted by a mobile or repeater that is used to control the trunking and security features of LTR.

Poll Master- Channel in Zetron LTR system that controls the Subscriber Bus.

PSTN- Public Switch Telephone Network.

PTC- Push To Connect. A method of initiating a call. A person only needs to key up and the call is started.

PTT- Push To Talk. A switch closure that activates the transmitter.

RAM- Random Access Memory. Electronic device used to store information.

RCC- Radio Common Carrier.

Repeater Bus- Communications line used on LTR equipment to share channel activity between channels. The Sync LED indicates this activity.

RIC- Repeater Interconnect Controller. EF Johnson's interconnect logic.

RNDL- Repeater Network Data Link. Uniden's version of the Repeater Bus.

RUS- Receiver Unoperated Squelch. See COR.

Sense- An input on the M49 that is used for cross-busying and alarms.

Simplex- A call in which audio may be sent in only one direction.

SMDR- Site Management Detail Records. See Call Detail.

SMR- Specialized Mobile Radio.

Subaudible Data- Signaling format used in LTR for data exchange between mobiles and the repeater managers. This data is transmitted below the audible region at approximately 300 Hz.

Sub Out- An output signal on the M49 that goes to the repeater. This signal is then transmitted by the repeater. This signal is the subaudible data.

Subscriber Bus- Communications line that carries database and billing data between Zetron's M49. The Poll LED indicates this activity.

Sync- A signal the Sync Master applies to the Repeater Bus. This signal is used for timing by the channels to properly control data on the Repeater Bus.

Sync Master- Channel in LTR system that generates sync on the Repeater Bus.

System- Term used in LTR mobile programming to define a group of channels making up a "trunk group", and a home channel within that group.

TLA- Trunk Line Accounting. EF Johnson's accounting bus for their LTR equipment.

TOT- Time Out Timer. Term used in programming LTR mobiles that sets the maximum time the mobile can remain keyed-up.

Trunked- A mobile that has gone to a non-home channel as the home channel is busy.

Trunking- The pooling of a group of radio channels in which all users have automatic access to all channels.

VOX- Voice Operated Relay. A circuit that detects if there is voice present.

ZEBRA- Zetron's billing software.