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Model LT-4900

Trunked Repeater / Interconnect Manager

PRELIMINARY
USER'S INSTRUCTION MANUAL

Made in U.S.A.
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NOTICES

FEDERAL COMMUNICATIONS COMMISSION (FCC) REGULATIONS

Your LT-4900 complies with Part 15 of the FCC rules for a Class A digital computing device. Operation is subject to the following regulations:

1. This device may not cause harmful interference.
2. This device must accept any interference received, including interference that may cause undesired operation.

In order to assure that operation remains in compliance with FCC Part 15, all repairs must be performed by CSI, or an authorized CSI repair station.

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LT-4900 DESCRIPTION

OVERVIEW

The CSI LT-4900 is a sophisticated dispatch and interconnected Trunking Repeater Manager (Controller) for use on LTR trunked repeater systems. The LT-4900 may be used with any combination of other makes of dispatch or dispatch/interconnect controllers. The LT-4900 provides up to 250 USER ID's per repeater. There may be up to 20 repeaters per system.

The LT-4900 "talks" to the other controllers on the system using an LTR REPEATER BUS which the user must set for either EFJ or Uniden protocol. In addition, CSI LT series controllers "talk" amongst themselves using a second bus we call the "CSI BUS". The CSI BUS allows the CSI controllers to perform advanced trunking features unavailable in competing controllers and the ability to program or download any CSI controller on the system through any individual CSI controller. Thus a modem connected to any CSI panel gives programming and downloading control of all other CSI controllers on the same system.

The CSI LT-4200 and LT-4900 are the only panels available with a front panel LCD display that keeps you totally informed about repeater and system status while you are at the repeater site. User ID and other useful data are constantly displayed.

Another unique feature is a removable front panel that gives access to all internal adjustments without removing the controller from service or removing the controller from the rack.

Although the CSI LT-4200 and LT-4900 operate flawlessly with other makes of controllers, the advanced features made possible with the CSI BUS are good reasons to use CSI controllers exclusively on each system you operate.

A CLOSER LOOK

Dispatch Logic Unit

The LT-4900 decodes and encodes digital trunking data to and from the mobile units, routes conversations to other repeaters, controls audio paths, maintains operator programmed talk limit timers, and more.

The REPEATER BUS can be user set for EFJ or Uniden bus compatibility.

Interconnect Logic Unit

The LT-4900 uses the same logic board as the LT-4200 but adds an interconnect board (model 4000) to provide the interface to multiple phone lines. This board has two independent phone ports. Line 1 is a standard FCC part 68 End-to-End phone connection. Line 2 may be configured as either an End-to-End, DID (Direct Inward Dialing), or E&M (Ear and Mouth) four wire interface. A unique feature of the LT-4900 is that line 1 and line 2 may be both enabled. Naturally, only one can be used at a given moment, but, for example, line 2 may be configured as DID, to accept incoming calls, and line 1 can be used for out going calls. Thus full flexibility of your system is maintained.

Air Time Accumulation

The LT-4900 accumulates four accounting functions for each of 250 homed User ID's regardless of which repeater(s) were used:

1. Hits during non-prime time. Up to 65,536.
2. Hits during prime time. Up to 65,536
3. Non-prime time airtime. Up to 4660 hours talk time.
4. Prime time airtime. Up to 4660 hours talk time.

The LT-4900 also keeps track of attempted usage by invalid User ID's.

Separate storage of regular time and prime time airtime accumulators allows CSIBASE to give you the option of prime time billing which also helps control loading during peak use hours. Time accumulation is maintained to the nearest second.

In addition, all necessary data is stored allowing you to view repeater loading statistics in both data and graphical form on your computer for:

1. The past 24 hours. or,
2. Midnight to present time.

Call Detail Records

When the SMDR call record option is included, the LT-4900 will also record up to 6000 calls made on your LT-4900. The call detail records include the date, time, user ID of caller, phone number dialed, and call length. All records are readily downloaded to your office PC for billing purposes.

Validator

The built-in validator will only allow system access to mobiles with enabled User ID's. The validator in your LT-4900 will also validate users on other makes of controllers that lack their own validator.

IMPORTANT: The built in validator is always enabled. The validator switch on SW-2 is used if and only if you are using the LT-4900 on the same repeater bus with other controllers requiring an external validator. If you enable the validator, only do so on one LT-4900, LT-4200 or other brand controller on the same repeater bus.

Site Monitor

The CSIBASE site monitor feature allows you to graphically view the activity of all channels on your system (even the channels with brand X panels.) The PC may be connected to the front panel or rear panel RS-232 port of any LT-4900 or LT-4900 on the system (or use a MODEM as explained below for remote viewing).

You will see the repeater number, the mobile (home ID) using that channel, the type of call (dispatch or interconnect), and how long that dispatch has been in progress. **If the mobile has been invalidated in the data base, a home=21 will appear on the screen.** If the repeater is busy for station ID or because of a Cross Busy condition, a Busy will appear in the ID field for that repeater.

Modem

An external 1200/2400 Baud modem may be connected to the front or rear RS-232 port on any LT-4900 on your system. All other LT-4200's or LT-4900's on the system can be accessed via this single modem using a standard end to end phone line.

If you have even one LT-4900 on the system, you can use it's optional built-in modem (P/N LT-MOD) to access all of your LT series panels.

IMPORTANT: Having RS-232 ports on both the front and rear panel is a convenience only. YOU MAY ONLY CONNECT AND USE ONE AT A TIME. The connection of a modem or a computer to either RS-232 port does not disable the internal modem; however, communication will not be possible on both the internal modem and an external port at the same time.

Alarms

The LT-4900 can generate alarms for various fault conditions. The conditions which can generate the alarm and the effect of each condition is programmable with CSIBASE. The alarm conditions are as follows:

A Repeater or CSI Bus fault including multiple masters or missing master.

The SMDR record buffer is 85% full (LT-4900 only).

A sense 1 ground condition is detected.

A sense 2 ground condition is detected.

For each of these conditions, the LT-4200/LT-4900 may be programmed to respond in either or both of the following ways:

1. Transmit alert tones at programmable intervals for a programmable number of times (per alarm condition) and with a programmable LTR group ID. This notifies the system operator of the fault condition.
2. Activate the AUX Relay. This allows any additional action which the operator desires to be triggered.

MANAGING THE SYSTEM WITH YOUR PC

Your system is totally managed using CSIBASE, a software application for your PC. CSIBASE runs either under DOS or using a DOS window from WINDOWS. CSIBASE will manage all of the individual repeaters (with LT series panels) in a system and also manage all of your systems running with LT series controllers.

You have total control of all LT series panels on each system from any RS-232 port or remotely using an external modem connected to any LT-4200, LT-4900, or the built in modem in any LT-4900.

CSIBASE stores the set up parameters of all repeaters on each system. You may review the set up, edit to any extent you wish off line, then quickly transfer new programming data and/or download billing data with a quick call. Your LT-4200 can service mobile users and on line programming simultaneously, therefore there is no interruption of service while you are programming or site monitoring.

IMPORTANT: You must remember to upload programming data to the repeater site when you change the programming in CSIBASE. Without updating the system, the programming on the PC will be ineffective.

CSIBASE also incorporates a site monitoring capability which allows you to view the entire operation of a system from your office, or use the convenient histograms to analyze loading etc. It may be very convenient to have a laptop connected to an RS-232 port when you are at the site so you are totally aware of what the system is doing at all times. (The front panel LCD displays also keep you informed).

CSIBASE can "export" billing files to your favorite accounting application. Call CSI for assistance if required.

Another program, CALLPRT, supplied with CSIBASE, prints summary data suitable for generating billings from the raw data downloaded by CSIBASE.

MANAGING USERS WITH DTMF REMOTE PROGRAMMING

Starting with version 1.17 of the LT-4200 firmware, you may enable and disable users using a DTMF pad on an LTR radio. The procedure is simple, but you must follow all steps to be sure of success.

- 1) Using CSIBASE, you must change the password of your system to an all numeric password with exactly six digits, e.g. "123456."
- 2) Using CSIBASE set the test ID for all repeaters to the same value. The factory default is 001. Select a home repeater for programming and be sure the test ID for that user is enabled for dispatch use (Status = V). It will work if the user is enabled either by default (unassigned users = 'V') or if the Status is 'V' or 'D'. It will not work if status = 'I' and it will not work if the test ID is an interconnect user of any kind.
- 3) Using CSIBASE, upload this to the system.

To do remote programming: Access the system using a mobile or portable radio programmed for the test ID. Press the following DTMF sequence without releasing PTT. There is a 3 second interdigit timeout.

##PPPPPP##HH##III##S# : PPPPPP = 6 digit password, HH-III is the user ID to change, S is the new status.

Example: ##123456#02#112#2# changes user 02-112 to Status Deferred.

For S use 0 to change user to "Undefined", 1 for "Valid", 2 for "Deferred", and 3 for "Invalid".

All other user parameters will remain as programmed and can only be changed with CSIBASE.

If the LT-4200 accepts programming, the LT-4200 will respond with the DTMF sequence: HH*SIII*. (On a CD-2 or LT-2, this will display as HH-S followed by III-).

WARNING: Do not turn off the test ID or you will disable remote programming!

IMPORTANT: Remember to keep CSIBASE up to date with parameters you have DTMF programmed. Otherwise you may inadvertently undo your DTMF programmed changes when you update the next time from CSIBASE.

LT-4900 SPECIFICATIONS

Mechanical

Height	3.5 inch
Width	19 inch
Depth	6.9 inch
Weight	7.5 lb.

Power Requirements

DC Input Voltage +12 to +14 VDC (13.8 VDC typical)
DC Input current 270 mA typ. (750 mA max with talk battery enabled)

Interface to the Rx and Tx

Connector	Phoenix 12 Pin P/N MSTB2.5/12ST-5.08
Mating Plug	Phoenix 12 Pin P/N MSTBA2.5/12G-5.08
Connections	DC Power, GND, TX AUD, TX KEY, RX DET, TX SUB, RX COS, AUX RLY, AUX RLY, SENSE 1, SENSE 2
GND (1,3)	POWER and SIGNAL Grounds
+12V (2)	+12-14VDC
TX AUD (4)	0 - 5 Vpp in two selectable ranges. Output impedance = 1K ohm.
TX KEY (5)	Selectable sink to gnd, or pull to +12Vdc. 0.5 Amp maximum.
RX DET (6)	15mV - 10V in two selectable ranges. Has de-emphasis built-in. Input impedance = 150K ohms.
TX SUB (7)	0 - 5V pp in two selectable ranges. Output impedance = 5.1K ohms AC coupled.
RX COS (8)	0 - 10 V. Adjustable threshold point. Selectable polarity. Input impedance = 100K ohms.
AUX RLY (9-10)	Selectable NO or NC contacts. 0.5 amp DC maximum.
SENSE 1 (11)	Used as cross busy input. A logic high instructs the LT-4900 to operate normally. A low instructs the LT-4900 to be busy. Low <= 1V. High 2-14V. Input impedance = 2.2k ohms pulled up to +5 VDC
SENSE 2 (12)	Low <= 1V. High 2-14V. Input impedance = 2.2k ohms pulled up to +5 VDC

Interface to the other Repeater Controllers

- RPTR BUS** Uses EFJ or Uniden protocol. (User selectable). All system controllers are interfaced with RG-58, or other 50 ohm coax, fitted with BNC connectors.
- CSI BUS** Uses proprietary Connect Systems, Inc. protocol. All CSI LT series controllers are interfaced with RG-58, or other 50 ohm coax, fitted with BNC connectors.

Interface to the Phone Lines

- Line 1** Standard End-to-End telco phone interface using an RJ-11 phone jack. Two connectors are provided for convenience of daisy-chaining phone lines.
- Line 2-EE** Line 2 may be configured as an End-to-End line. As such it is identical to line 1.
- Line 2-DID** Line 2 may be configured as a Direct Inward Dialing port. This simulates a PBX port to the central office and allows customer direct phone number access without over-dial to individual users.
- Line 2-E&M** Line 2 may also be configured as a four wire/six wire Ear and Mouth full duplex interface. This interface may operate as a microwave interface or it may operate as a full capability DID/DOD port.

All line ports are fully compliant with FCC part 68 and DOC requirements. In addition, they are fully lightning protected using Varistors and fast blow fuses to protect your investment.

CONNECTING THE LT-4900 TO YOUR REPEATER

Interface the LT-4900 to the Rx and Tx via the 12 pin connector. Use shielded wiring for all connections (be sure to connect all shields to GND). For your convenience, the plug is removable:

+12 VDC: Connect to a source of 12-14 VDC. The LT-4900 is reverse polarity protected, so a polarity mistake will not damage your LT-4900. Connect the return lead (-) to GND.

TX AUD: Connect to the transmitter voice audio input. The controller audio is flat, so the repeater must pre-emphasize the audio prior to transmission. Connection to line or microphone input should accomplish this.

TX KEY: Connect to the transmitter PTT line. PTT may be negative sense (most common) or positive sense. See JP-11 to select proper polarity.

RX DET: The RX DET input terminal must be DC coupled to the receiver discriminator (de-modulator) output. The bandwidth at this point must be from 8KHz minimum.

TX SUB: The TX SUBTONE output is used to inject the digital sub carrier directly into the transmitter modulator. This injection point must be past IDC and must not interfere with the voice modulation.

NOTE: Only true FM (frequency modulation) can be used for the digital SUBTONE modulation of the transmitter.

RX COS: **NOTE:** You have a choice of either using the LT-4900 noise squelch or, if you prefer, to use the squelch built into the receiver. We recommend using the LT-4900 noise squelch because its noise squelch has a faster reaction time. The choice is yours, however. To use the noise squelch simply remove JP-13. If you wish to make a COS connection and use the receiver squelch, follow these directions:

Connect to a point that has good voltage swing when the receiver squelch is opened/closed. The best point for connection is the collector of the transistor that controls the busy light (if the receiver has one). Otherwise, you may connect to the squelch gate control voltage. Your last choice would be to connect to the output of the noise rectifier.

If the point selected goes more positive (voltage increases) when a signal is received, strap center to the + side. If the point goes to a lower voltage, strap JP-13 from center to the - side.

When the COS threshold control P3 has been properly adjusted (see page 24), and JP-13 properly strapped (see page 11), the front panel LCD will indicate Rx when a signal is received. This condition must be achieved for proper operation of the LT-4900.

NOTE: The squelch control in the receiver must be set for quiet (squelched) receive. Set the squelch as you would any squelch, but remember if you set it too tight receive sensitivity may suffer.

AUX RLY: Used only for special applications. JP-1 allows selection of NO or NC operation. Do not exceed .5 amp contact current.

SENSE 1: Is used as the Cross Busy input or as Sense 1 alarm input. The input is compatible with CMOS, TTL or open collector logic levels. A voltage less than 0.5 volts is active. An open or a voltage above 3 volts is inactive.

SENSE 2: Is used as the Sense 2 alarm input. The input is compatible with CMOS, TTL or open collector logic levels. A voltage less than 0.5 volts is active. An open or a voltage above 3 volts is inactive.

The following connections are required to the other repeater controllers on the system:

RPTR BUS BNC female. All controllers on a system must be connected in a daisy chain with RG-58 fitted with BNC's. Use BNC "T" adapters as necessary to complete the daisy chain.

CAUTION: All LT-4900s must be configured for EFJ or all for Uniden bus compatibility. See page 11 JP-2 .. JP-5, and page 16 for SW1.

CSI BUS BNC female. All LT-4200's and LT-4900's on a system must be connected in a daisy chain with RG-58 fitted with BNC's. Use BNC "T" adapters as necessary to complete the daisy chain.

CAUTION: All LT-4900s must be configured for EFJ or all for Uniden bus compatibility. See page 11 JP-2 .. JP-5, and page 16 for SW1.

NOTE: Do not attempt to connect the CSI BUS to the SUBSCRIBER BUS on Zetron panels or to any other product.

WARNING

The LT-4900 contains a power supply sensing circuit that continuously monitors the input supply voltage. An instantaneous drop below 12 VDC may cause a microcomputer reset. If the power supply has poor regulation, erratic operation may result.

The purpose of the input voltage sensor is to protect the random access memory (RAM) during power up and power down.

If erratic operation is observed, be suspicious of poor regulation from the power supply.

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SET UP AND ADJUSTMENTS

SETTING THE LT-4900 MAIN BOARD JUMPERS

Prior to attempting adjustments or operation, all jumpers and dip switches must be properly selected. Figure 1 shows the locations of all main board jumpers.

JP-1 Relay contact selector. The auxiliary relay (RL1) can be set for NO or NC. Contacts are available on the interface connector (labeled, AUX RLY). Simply install the strap center to NO for normally open or, center to NC for normally closed. If the AUX RLY is not used, the jumper does not matter.

JP-2..5 These four jumpers configure the LT-4900 for EFJ or Uniden bus compatibility. Put all four jumpers in position E for EFJ based systems or, put all four in position U for Uniden based systems. (See also SW1, page 16)

IMPORTANT: It is very important that all four of these jumpers are in the same position. All in E or, all in U! DO NOT MIX! In addition, all controllers connected to the CSI controllers must also be set consistently with the CSI settings (all EFJ or all Uniden).

JP-6 Selects the termination resistor for the CSI BUS. This bus must be terminated in only one controller per system.

For LT series units which are not to be terminations for the CSI BUS, put the jumper in position O (open).

The one LT unit selected as the system CSI BUS termination must have the jumper in position E if used on an EFJ based system or, put in position U if used on a Uniden based system.

JP-7 Selects the termination resistor for the RPTR BUS. This bus must be terminated in only one controller per system.

For units which are not to be terminations for the RPTR BUS, put the jumper in position O (open).

The one unit selected as the RPTR BUS termination must have the jumper in position E if used on an EFJ based system or, put in position U if used on a Uniden based system.

JP-8 Tx Polarity. A variety of factors can cause the repeater digital sub carrier to be transmitted "inverted". The mobiles cannot decode the digital data if it is inverted. Strap **in** is normal polarity, strap **out** is inverted and corrects transmitter inversion. If the repeater data cannot be decoded, try the inverse polarity by removing JP-8.

JP-9 Rx Polarity. A variety of factors can cause the digital sub carrier to be received "inverted". The digital data cannot be decoded if it is inverted. 'Strap in' is normal polarity, strap removed is inverted and corrects receiver inversion. If the mobile data cannot be decoded after adjusting the PREAMP (see page 20), try the inverse polarity by removing JP-9.

JP-10 On Rev A boards only. Installed gives DC coupling to the LTR output.

JP-11 TX KEY Polarity. This strap gives you a choice of pull to GND, or pull to POS (+12 VDC) for transmitter keying.

JP-12 **MUST be removed in the LT-4900.**

JP-13 COS Polarity Select. This strap must be removed if using the LT-4900 noise squelch. To enable COS operation, simply install JP-13 connecting the center pin to the appropriate end pin for the desired COS polarity. The polarity (+/-) is marked adjacent to JP-13.

NOTE: See the COS adjustment P3 on page 24 for more information on polarity selection.

- JP-14** Not used.
- JP-15** PRE-AMP gain select strap: When strapped the PRE-AMP is operating at lowest gain. Try to complete the PRE-AMP adjustment with the strap installed. Only remove JP-15 if the desired level measured at TP-3 can not be achieved.
- JP-16** LED Power: Removal eliminates power to LED's (e.g. Power LED on the front panel). Used to conserve a small amount of power in solar powered installations.
- JP-17** TX AUDIO Output level strap. The audio output is selectable in two ranges. With the strap installed, the audio out is 0-1 volt. With the strap removed, the output range is 0-5 volts. The strap should be left installed if possible.
- JP-18** LTR level strap. The TX SUB output level is selectable in two ranges. With the strap installed, the level is 0-1 volt. With the strap removed, the output range is 0-5 volts. The strap should be installed if possible.
- JP-19** Not used, leave out.
- JP-20** Selects external EPROM. Leave as delivered or as instructed in CSI upgrade.
- JP-21** Sets EPROM size. Do not change.

This page reserved for main board jumper picture

SETTING THE LT-4900 TELCO BOARD JUMPERS

Prior to attempting adjustments or operation, all jumpers and dip switches must be properly selected. Figure 2 shows the locations of all telco jumpers.

Line 1 jumpers:

JP-3 Line in use detect. Reserved for future use. Must be left in open position.

Line 2 jumpers:

JP-1 E lead and M lead reversal. JP-1 uses two jumpers in conjunction which must both be in position A, or both in position B. Position A makes J1 / J2 pin 1 Ear and pin 6 Mouth. Position B makes J1 / J2 pin 1 Mouth and pin 6 Ear. JP-1 has no effect if not using E&M.

JP-2 Line in use detect. Reserved for future use. Must be left in open position.

JP-4,5 DID, End to End or E&M Mode select. The JP-4 and JP-5 jumpers must be used in conjunction to select the desired mode for Line 2. For DID operation, put both in "DID" (connecting pins 3 and 4). For End to End operation, put both in position "EE" positions 2 and 3). For E&M operation, put both in position "EM" (positions 1 and 2).

JP-6 Install only if using Line 2 as an End to End line with ground start supervision.

JP-7 Selects whether the M lead will provide ground (GND) or -48V to signal an off-hook condition.

JP-8 Selects whether the E lead will respond to a ground (GND) or -48V request.

JP-9 Talk battery enable. Install only if E&M or DID is to be used. (The talk battery power supply draws quite a bit of current from your 12 VDC supply so do not strap unless needed).

JP-10 This is a three position strap. Select the "EM" side for E&M operation. Select the D/EE side for DID or End to End operation.

JP-11 Install strap for E&M operation only. Leave open for DID or End to End.

JP-12 Install for DID or End to End operation. Leave open for E&M operation

This page reserved for telco jumper picture

SETTING THE DIP SWITCHES

Your LT-4900 has an eight position dip switch (SW2) and a four position dip switch (SW1) on the main board. Here are the four functions controlled by the eight position switch:

Sw Pos	Function	Physical Position
Pos 1.	Repeater number bit 1	1 - 0
Pos 2.	Repeater number bit 2	1 - 0
Pos 3.	Repeater number bit 4	1 - 0
Pos 4.	Repeater number bit 8	1 - 0
Pos 5.	Repeater number bit 16	1 - 0
Pos 6.	Area bit	1 - 0
Pos 7.	Validation	1 - 0
Pos 8.	Test	1 - 0

The four position switch controls three functions:

Sw Pos	Function	Physical Position
Pos 1.	EFJ or Uniden Timing	1 - 0
Pos 2.	RS-232 Baud rate	1 - 0
Pos 3.	RNDL Master:	1 - 0
Pos 4.	CSI MASTER:	1 - 0

Dip switch setting procedure

The LT-4900 has been programmed to allow the front panel LCD display to assist you in setting the dip switches. Watch the display and you simply can't go wrong!

Begin by turning on the LT-4900 by applying 12 VDC power. To get into the dip switch setting mode, put all five switches that control the **Repeater number** into logic 0 (to the right) and tap the CPU reset button SW3. The LCD will now display "INVALID REPEATER". As soon as you begin to set the repeater number, the LCD will change screens and show all seven of the current dip switch settings. You can now change switch settings in any order you like.

Resetting all Parameters to Factory default settings

The factory default settings for all programmable parameters can be restored by placing all five of the **repeater number** dip switches into the 1 position (to the left) and tapping the CPU reset button (SW3). Afterward, you will have to follow the dip switch setting procedure to restore these dip switches to the correct repeater number. This destroys all programming data and will require the use of CSIBASE to restore any programming including your site password. (**Exception:** If you are connected via CSI BUS to another properly programmed LT-4900. In that case, the other LT-4900s will clone their data to the erased unit.)

You can use the front panel display to assist in setting the switches by switching all of the 8 position dip switches to the right. The display states "ILLEGAL REPEATER". Changing any switch will show the current switch positions which allow setting all 12 dip switch positions as desired. When all switches are set in accordance with your preferences, tap RESET, SW3 to restore normal operation.

8 Position Dip Switch (SW2)

Repeater number

Each repeater must be assigned a unique repeater number 1 - 20. Here are the binary codes (**1 is to the left, "OFF", and 0 is to the right, "ON"**):

	Repeater Number																			
	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	2
	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0
Sw Pos																				
Pos 1	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0
Pos 2	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1	0
Pos 3.	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1	0	0	0	0	1
Pos 4.	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0
Pos 5.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1

By beginning on an illegal repeater number, such as 0, you can almost "feel" the five binary switches into the position you desire because the computer is constantly converting the binary dip switch setting and displaying the repeater number as a two digit decimal number on the LCD.

NOTE: Five dip switches can set the decimal equivalent to numbers 0 - 31. However only 1 - 20 are valid repeater numbers. Do not set to a number outside of this range. The only exception is the setup mode described in the paragraph above.

Area Bit

The area bit is set to 1 or 0 as desired to match the area bit settings of the mobiles. The LCD will show: "A# 1" or, "A# 0".

Pos 6. Area bit 1 0

Validation

Set whether this LT-4900 should be used as a validator for other controllers not equipped with a validator. The LCD will show an upper case "V" if enabled, a lower case "v" if disabled. Do not enable validation on more than one controller per system. Do not enable validation unless required by non-CSI controllers.

Pos 7. Validation 1 = Enabled 0 = Disable

Test

Test causes the LT-4900 to send a steady stream of sub code data so that you can easily set the TX SUB modulation, or for other test purposes. The LCD will show an upper case "T" if in test mode, a lower case "t" if not in test mode.

Pos 8. Test 1 = on 0 = off

4 Position Dip Switch (SW1)

Uniden/Johnson Rptr Bus Timing

If you are using the EFJ repeater bus, you should place this switch to the left. For Uniden timing, set to the right. The LCD display will show an 'E' for EFJ timing and a 'U' for Uniden timing. (See also JP-2..5 on page 11)

Pos 1, Johnson/Uniden timing: 1 = EFJ 0 = Uniden

RS-232 Baud rate

The baud rate can be set to 1200, or 2400. The LCD will show the baud rate, e.g. B=2400 if the baud rate is currently set for 2400 bits/second.

Pos 2, Baud Rate 1 = 2400 0 = 1200

Repeater Bus (RNDL) Master

Any controller (regardless of make) on the system can be the Repeater Bus MASTER. (BE SURE ONLY ONE CONTROLLER IS SET TO BE THE REPEATER BUS MASTER). The LCD will show an upper case "R" if enabled or, a lower case "r" if disabled.

Pos 3. RNDL Master 1 = enabled 0 = disabled

CSI BUS Master

Any LT series repeater on the system can be the CSI BUS MASTER. (BE SURE ONLY ONE CSI LT SERIES CONTROLLER IS SET TO BE THE CSI BUS MASTER). The LCD will show an upper case "C" if enabled or, a lower case "c" if disabled.

Pos 4. CSI MASTER 1 = enabled 0 = disabled

INSTALLATION PROCEDURE

Install the bus jumpers, on the main board, as follows:

- JP-2-JP-5** As required for the Rptr Bus and CSI Bus. (See page 11). If the bus is E.F. Johnson compatible, place all jumpers on 'E'. If the bus is Uniden compatible, place all jumpers on 'U'. Do not mix settings on the same bus or possible damage to unit may occur. (see SW1, page 16)
- JP-6** Rptr Bus termination. Install exactly one jumper on the bus on 'E' or 'U' as appropriate. Place all other repeaters on 'O', which disconnects the termination.
- JP-7** CSI Bus termination. Install exactly one jumper on the bus on 'E' or 'U' as appropriate. Place all other repeaters on 'O', which disconnects the termination.

Connect the 12 pin radio interface connector to the repeater in accordance with the description of the connections in the section "CONNECTING THE LT-4900 TO YOUR REPEATER."

Connect all repeaters (CSI and other brands) on the same system together via the RPTR bus using RG-58 cables with BNC connectors. If the LT-4900 is not at the end of the "daisy chain," then a BNC 'T' connector is required at the back of the LT-4900. Make sure the jumpers are set in accordance with the above table prior to making the connections to the other repeaters or possible damage either to the LT-4900 or to the other repeaters may occur. The system cannot trunk without this connection.

Connect all LT-4200s and LT-4900s on the same system together via the CSI bus using RG-58 cables. **Do not connect any other brand of controller on the CSI bus.** The CSI bus allows programming and data downloading to occur using only one LT-4200 or LT-4900 for the entire system.

Set the DIP switches in accordance with your needs and the DIP switch setting procedure above. Be sure that all repeaters on the system are set to the same AREA bit setting and that each repeater number is unique, whether it is an LT-4200, LT-4900, or other brand of controller.

You only need to set the Validator switch if you have older LTR controllers on your system which require an external validator. The LT-4200 and LT-4900 are self validating and unlike the competition, will not allow a mobile to transmit if it is not valid.

Be sure that only one controller is a RPTR bus master and only one controller is a CSI bus master. If multiple masters are enabled on SW1, then the display will show a "MUL RBUS" or "MUL CBUS" fault. If no controller is designated master, then a "NO RBUS" or "NO CBUS" error will be displayed. These conditions must be corrected before the system will operate.

The rest of this procedure is for any DCS compatible repeater. If you have the installation notes for your repeater, then you do not need these installation instructions except for reference.

Install main board Jumpers as follows:

JP-1	Aux Relay - as desired
JP-8	TX Polarity - see alignment below.
JP-9	RX Polarity - see alignment below.
JP-10	Out
JP-11	GND if normal PTT, POS if positive keying, such as RCA.
JP-12	Voice Programming - Installed, not used on LT-4900
JP-13	COS polarity - Not installed. See page 11 note.
JP-15	Audio Gain - Installed unless removal required below.
JP-16	LED Power - Installed. Enables power LED.
JP-17	TX Gain - Installed unless removal required below.
JP-18	Sub tone Gain - Installed unless removal required below.

ALIGNMENT PROCEDURE

This procedure assumes that the LT-4900 is connected to the repeater system, connections have been completed in accordance with the installation procedure, and jumpers are installed per recommendations.

We suggest you do not program the LT-4900 until after the alignment procedure is complete. If you have programmed the panel, we suggest you return the programming to factory defaults using the factory procedure on page 16.

Program an LTR radio for the test ID, 001, and make the ID an interconnect ID. This allows the radio to transmit even when receiving its ID from the repeater.

Do the following with the telco board removed for convenience and access to jumpers. Remove the board by removing power, removing the four screws and gently pulling straight up.

Transmitter alignment, first pass

Place the LT-4900 into test mode by moving position 8 (TEST) of SW2 to the left (off) position and the position 7 (Validate) to the right (on) position and tap RESET (SW3). The display will show TEST MODE, TX HH-001. The transmitter should now be on. Adjust JP-18 and the LTR pot, P4, for 1KHz deviation. The radio you programmed should unquench. If it does not, try changing TX POL (JP-8). Check the waveforms to see that the waveform at the output of the LT-4900 TX-SUB matches the demodulated waveform in your service monitor. In most synthesized transmitters, there is a feed forward balance potentiometer which allows you to compensate for these effects by applying sub-audible tones to both the VCO and XTAL reference with a variable ratio between the two. Adjust the pot for best match to the signal you see on the output of the LT-4900. See figures 3, 4, 5, and 6 below.

Figure 3: Normal LTR Waveform,
1 Hz cutoff. Correctly coupled

Figure 4: LTR Waveform,
16 Hz cutoff. This will be unreliable at best.

Figure 5: LTR Waveform,
32 Hz cutoff. This will almost certainly fail.

Figure 6: LTR Waveform,
PLL distortion

Receiver alignment

If the installation notes specify a position for JP-15, leave it in that position; otherwise start with JP-15 in the -20DB position.

Apply power to both the LT-4900 and the repeater.

With no signal received, and receiver connected to a dummy load, adjust P1, PREAMP, to make the LEVEL LED, D15, just flicker. If maximum gain of P1 does not achieve this, then remove JP-15 and readjust P1.

Set service monitor to send LTR (or DCS if LTR not available) encoding on the receive frequency with a 1KHz deviation. Re-adjust P1 to just slightly clockwise of the position where D15 just begins to flicker. Remember, leave JP-15 on the -20DB position if at all possible.

Turn off the service monitor output. Using the LTR radio you programmed for ID 001, key the LTR radio. (You are still in test mode with the LTR radio unquelled.) The LTR radio should transmit continuously while keyed. Make a fine adjustment of the PREAMP with this actual LTR signal. Review the signal appearing at the RX DET input to the LT-4900 with an oscilloscope. (Oscilloscope should be either DC coupled or have a frequency response to below 1Hz.) It should look like figure 3 above. If it does not, you may need to find a better DC coupled connection to the receiver detector. Unkey the LTR radio.

Take the LT-4900 out of test mode. Remove the signal from the receiver and adjust P2, SQUELCH, fully counter clockwise (CCW). The letters Rx will be displayed on the front panel LCD display. Adjust P2, SQUELCH, clockwise (CW) until the Rx just disappears. (If using COS, see pages 9, 11, and 24 for COS connection and adjustments.)

Transmitter alignment, pass 2

Place the LT-4900 back into test mode by moving position 8 (TEST) of SW2 to the left (off) position and the position 7 (Validate) to the right (on) position and tap RESET (SW3). The display will show TEST MODE.

Using the service monitor, generate a 1KHz tone modulated at 3KHz deviation.

Turn P4 (LTR) fully CCW to turn off the outgoing LTR code word. Install JP-17 and adjust P6 (RPT) for 3KHz deviation of the tone modulation at the transmitter. If this level cannot be achieved, remove JP-17 and readjust P6 (RPT).

Change position 7, Validate, to the left (off) position and tap the RESET switch (SW3). This enables the CWID generator. Adjust P8 (SIGNAL 1) for CWID level and Alarm level as required. This is also used for one of the two tones which constitute ringout sound. Adjust P9 to the same position as P8 to allow the ringout sound to be correct.

Change position 7, Validate, back to the right (on) position and tap the RESET switch (SW3). Disconnect the service monitor or change the frequency so that the Rx indicator is off on the front panel display. Adjust P4 (LTR) to achieve 1KHz deviation on the transmitted signal.

Return the test switch, position 8, to the right and the validate as desired then tap RESET (SW3).

Adjust P7 fully CCW. This is not used in the LT-4900 or LT-4200 configuration.

Balancing the hybrids

Re-install the telco board, if it was removed for the alignment above.

If any of the mobiles on the system will be using full duplex on End to end and/or DID lines, the hybrids of the line ports being used must be balanced out for minimum sidetone (least mobile return trip audio). If using E&M on line 2 the line 2 hybrid is not used and will not require alignment.

To align the hybrid(s), you will need a duplex Mobile or preferably portable radio that has been set for full duplex operation on the system. (A half duplex radio can be used to align the hybrid, but the system MUST be set for full duplex for the user ID of performing the test).

To perform the alignment, you will need an oscilloscope monitoring the TX Audio output of the LT-4900. Alternatively, watch the transmitter output on a service monitor.

The quickest and easiest method we've devised to null the hybrids is to simply gently blow (with lips together) across the mobile mic while a land call is in process. This creates audio noise across the 300 - 3000 Hz. spectrum. The hybrids must be adjusted at the site while connected to the actual lines to be used. You cannot adjust on your shop lines and then take the unit to the site and expect the balance to be correct. The complex impedance of a phone line varies site to site, and line to line, and it is the complex impedance that is being balanced out.

To align the hybrids you will need to have a phone call connected on line 1 to balance the Line 1 hybrid. Similarly, another call must be made to balance Line 2.

To balance Line 1, make an outgoing call. This will route through Line 1 if not using E&M. While blowing into the mobile mic and watching the audio as described above, interactively adjust both L1 hybrid adjustments (P3 and P4) until the deepest null (minimum blowing audio) is observed on the A-scope or dev-scope.

The Line 2 hybrid should be adjusted using it in the desired operating mode (End to end or DID). If using line 2 as an incoming End to end line, call it from any phone and answer with the mobile/portable radio. If using Line 2 in DID mode, call in using the appropriate mobile DID phone number. After the call is established, repeat the above alignment procedure using the L2 hybrid adjustments (P1 and P2).

The procedure described works better than using an audio generator because you will be achieving a balance over the entire audio spectrum rather than optimizing the null on a single audio frequency which may result in a poor overall null.

Testing Direct Inward Dialing

In order for DID to operate, user programming (both CSIBASE and jumper straps) and physical connections (ring-tip polarity) to the DID trunk line must all be correct. Unlike an end to end line, a DID line is polarity sensitive so it may be necessary to reverse the ring/tip wires. Using CSIBASE, the supervision of the line (wink or immediate start), number of DID feed digits and DTMF or pulse inward dialing must all be specified in CSIBASE "Repeater Config" for the trunk line in use. Also the actual feed digits (access code) must be entered for each user ID. (The feed digits are the last two digits of the phone number if using a 100 number selector level, last three digits if using a 1000 number selector level, etc).

You will more than likely have to work with the boys in the Central Office when connecting your DID trunk lines. They will inform you if the polarity is ok, and if the supervision (immediate or wink) is working. Before you get them involved, perform the test below to get some confidence that your LT-4900 is really ready to setup with the CO.

A quick way to establish if DID is close to working, is to connect an ordinary DTMF or pulse dial telephone to the DID port on the rear of the LT-4900. (Use a DTMF phone if your DID feed will be DTMF. Use a pulse dial phone if your DID feed will be pulse). The port is annotated "Line 2 DID IN". Take the phone off-hook, wait a moment and dial the feed digits from the phone number of the user ID you wish to call. A ringout should occur to the intended user ID. If the mobile answers, a two-way voice communication should be possible between the test phone and the mobile. All described thus far must work before you call the CO for hook-up. If there is a problem, you must locate the programming error and/or jumper select error before you proceed.

Once you can dial a mobile and talk both ways full duplex using a test phone, you are ready for CO hook-up. The Central office may tell you your ring-tip is backward (not correctable in the LT-4900, must be corrected in external phone wiring), or they may tell you that the supervision is wrong, (change from wink to immediate, or vice versa using CSIBASE)

Upon completion, you should be able to call any interconnect enabled mobile using the DID trunk.

Summary of Telco Jumpers

Below is a summary of the LT-4900 telco board jumpers for your convenience. We recommend leaving JP2 and JP3 out. Line in use detection is intended for a future product. All jumpers below, except JP3, apply only to line 2. If you are not using line 2, then make sure JP3 and JP9 are removed, then all other jumpers are irrelevant.

Jumper	E-E (line2)	DID	E&M
JP1	OUT	OUT	A OR B
JP2	OUT	OUT	OUT
JP3	OUT	OUT	OUT
JP4	EE	DD	EM
JP5	EE	DD	EM
JP6	L2-GND ST	OUT	OUT
JP7	OUT	OUT	GND/ -48
JP8	OUT	OUT	GND/ -48
JP9	OUT	IN	IN
JP10	DD/EE	DD/EE	EM
JP11	OUT	OUT	IN
JP12	IN	IN	OUT

LEVEL ADJUSTMENTS SUMMARY FOR THE MAIN BOARD

P1 PREAMP:

The PREAMP control is used to match the audio level from your receiver to the LT-4900. To adjust, a signal containing LTR sub code with about 1Khz deviation must be applied to the receiver. Adjust the PREAMP control until a level of 1.2V P-P is observed at TP-3 using an oscilloscope.

An alternate (but less accurate) method of PREAMP adjustment is to apply a signal containing LTR sub code and advance the PREAMP adjustment CW from its fully CCW position until the LVL LED (adjacent to the PREAMP control) just begins to flash. Stop at the point where regular flashing occurs. The LVL LED will also flash on noise when there is no signal. That may be disregarded.

This completes the adjustment of the PREAMP control. Future adjustment should only be required if the LT-4900 is connected to a different receiver.

P2 SQUELCH:

NOTE: If JP-13 has been strapped for COS operation, then P2 is not used and has no effect.

P2 is set like a conventional squelch control. The RX icon on the LCD will come on when the squelch setting is below threshold or, when a signal is received.

P3 COS: **NOTE:** If JP-13 has been strapped for noise squelch operation, then P3 is not used and has no effect.

The COS control sets the COS input threshold level. Measure the voltage at TP-2 with no signal, then measure the voltage again with a signal applied. Adjust the COS control until the voltage reading at TP-3 is approximately midway between the two readings previously obtained at TP-2.

For example: If TP-2 read 2 volts with no signal, and 4 volts with a signal applied to the receiver, TP-3 would be set to read 3 volts.

IMPORTANT: If the COS polarity select strap JP-13 is set correctly and the COS control is properly adjusted the Rx icon in the LCD will illuminate when there is a signal, and will go out when the signal is removed.

P4 LTR: The LTR control sets the modulation level of the sub carrier on the TX SUB output.

P5 VOICE: The VOICE control sets the level of the voice prompts transmitted to the mobile if the voice prompt option (LT-VOI) is installed.

P6 RPT AUDIO: The REPEAT AUDIO control sets the level of the voice audio. Set so that 3KHz. input deviation causes 3KHz. output deviation. This will cause a 1:1 input/output relationship.

NOTE: The RPT AUDIO control should only be adjusted after the PREAMP control has been properly adjusted.

P8 SIGNAL 1: Adjust for the desired CW ID modulation level.

P9 SIGNAL 2: Adjust to approximately the same position as P8. This sets the proper sound for ringout.

P10 CONTRAST: Adjusts the contrast on the front panel display.

NOTE: P7 is not used in the LT-4900 and should be set fully CCW.

ADJUSTMENTS SUMMARY FOR THE TELCO BOARD

P1,P2 G/R-BAL: Adjust P1 and P2 interactively until optimum line hybrid balance (maximum rejection of mobile return trip audio) is achieved.

P3,4 G/R-BAL: Adjust P1 and P2 interactively until optimum line hybrid balance (maximum rejection of mobile return trip audio) is achieved.

P5 LINE SENSE: Adjust fully clockwise for most applications. Adjust for optimum decode of dial pulses when programmed to detect pulse dialing on an End-to-End line.

P6 M->L: Mobile to Land level. Adjust for optimum phone line level with the mobile talking.

P7 L->M: Land to Mobile level. Adjust the modulation level for a person talking on the phone. This level is independent of repeat audio.

DEFINITION OF TERMS

Alarm: An alert condition requiring attention of the system operator. The LT-4200/LT-4900 generate alarms for the following conditions: Loss of Repeater Bus Sync, Loss of CSI Bus Sync, Multiple masters on either bus, a sense 1 condition, or a sense 2 condition. Alarms may generate a contact closure, an alarm tone over the air, or both.

Courtesy beep: A brief tone at the end of a mobile's transmission that lets the other mobile know that it is their turn to reply.

CW ID: Automatic identification of call sign in Morse code.

Stuck Mic. activity timer: Sets the maximum continuous (uninterrupted) talk time. If a user talks past the activity timer time, the repeater stops transmitting until the input drops and is picked up anew.

RX polarity: Design characteristics of the repeater receiver can invert the received digital sub carrier from the mobiles precluding decoding. The LT-4900 has the ability to invert the sub code in software by removing JP-9 in essence correcting the unwanted inversion of the receiver. (see page 11).

TX polarity: Design characteristics of the repeater transmitter can invert the digital sub carrier precluding decoding in the mobiles. The LT-4900 has the ability to invert the sub code in software by removing JP-8 in essence correcting the unwanted inversion of the transmitter. (see page 11).

User Enable/Disable: Ability to turn a subscriber off for non payment and back on in response to payment.

CIRCUIT DESCRIPTION

ANALOG CIRCUITS

The audio path

The incoming audio is buffered, de-emphasized and amplified to the amount set by the PREAMP control by input op amp U35A/B. De-emphasis is provided by U35B. The audio then proceeds to a five pole low pass filter and a six pole high pass filter. The low pass filter U36 removes voice audio and extracts the mobile digital sub carrier for detection at the adaptive centering differential comparator. The comparator output (RX-SUBTONE) is fed to the sub carrier decoder CPU U8 for software detection and error correction. The six pole high pass filter U35/U36 removes the digital sub carrier data from the incoming audio to avoid the buzzing sound that would result if it were not removed. The high pass filtered audio continues through the squelch switch U46A, through the RPT level control, P6, and then on to the audio output amplifier U48A. Filtered audio is also fed to the telco circuits and DTMF decoder.

COS and noise squelch

The noise squelch is derived by passing the non de-emphasized PREAMP output through a five pole high pass filter U37A/U37B which eliminates all voice band power. The filtered noise is then amplified by U37C whose gain is adjusted by the squelch control P2. The filtered noise is then full wave rectified by D13/D14 and detected by U40B then sent through R87 to inverter U26B.

The COS input is buffered by U40C and compared using U40D to a reference voltage with which is set by the COS threshold pot P3. The output then proceeds to the polarity select strap JP-13.

If JP-13 is not strapped, the noise squelch is active. If JP-13 is installed in either polarity, the COS overwhelms the noise squelch due to the presence of R87. The resultant carrier detection (REC) is sent to the main CPU U15.

DTMF is decoded and regenerated by U49 with the assistance of CPU. Audio for DTMF decoding is switched between telco and mobile audio with the U39A switch.

MF is decoded by U34. MF decoding is only done from telco audio.

LTR codes are generated and decoded directly by the microcomputer U8. The output of U8 consists of two digital signals which are amplified and summed by U38. The LTR level is controlled by P4 and by JP-18. The LTR code is output at the SUB CODE connection on the rear of the LT-4200/LT-4900.

The **PTT** circuit consists of Q4, Q5 and Q6. This circuit is controlled by the microcomputer U15 via pin 6, and U26 pin 12. A polarity select strap gives the choice of ground (GND) keying or positive (POS) keying. The circuit is designed to leave the transmitter unkeyed during a main processor reset.

A power on **reset** circuit consisting of Q3 and associated components monitors the input voltage and quickly halts the microcomputer if the applied input voltage is too low. The power on reset circuit provides proper computer start up after power is applied and protects repeater on power down.

Counters U16 and U23 divide the 448KHz clock from U11 and allow remote rebooting of the microprocessor when any incoming DTMF digit exceeds 9 seconds in duration. At the end of nine seconds U22 pin 15 turns on transistor Q2 which in turn enables the power on reset circuit. This circuit also acts as a watchdog timer in case the microprocessor gets into an incorrect state.

The front panel digital display LCD2 is controlled by the U15 microprocessor with access control provided by U19A, U19B, U7A, and U7B along with the address decoder U25.

Incoming power is fed through reverse polarity protect diode D1 and then fuse F1. From there, the +V voltage feeds a +5 volt regulator U1 used by the digital components. Another smaller +5 volt regulator U2 is used to supply bias and reference voltage to the analog circuits.

Alarms and **CWID** tones are generated by a sine wave generator U42. The output level is controlled by P8.

Alarm Sense and **Cross Busy** sense are provided with a simple diode protection circuit which feeds the LTR processor, U8. U8 informs the main processor when a sense1 or sense2 event occurs.

DIGITAL CIRCUITS

The heart of the LT-4200/LT-4900 is the main processor, U15. All functions are controlled by U15. An auxiliary processor, U8, is used for LTR encoding and decoding and communication with the main processor is with a parallel bus.

In addition, most peripherals are controlled on the main data bus. Program memory is internal to the main processor. RAM is contained both within the processor and externally in U14. U14 is a 32Kx8 battery backup CMOS RAM and clock. U14 may also be a 128Kx8 CMOS RAM when detail call accounting is installed. All repeater memory is mapped to the lower 32K. The next 16K is used exclusively to map the call detail memory. The top 16K is used to control the peripherals with memory mapping. Memory mapping is provided by U10, U13, U22, and U28.

The repeater and CSI buses are serial busses controlled by a dual UART (Universal Asynchronous Receiver Transmitter), U30. Analog interface to the bus is provided with U4, U5, and U6.

Voice processor, U24, installed only as an option on the LT-4900, is controlled directly by U15.

Programming is via RS-232 with a RS-232 interface device U3. U3 directly connects to the main processor, U15, which uses its self contained UART to provide the programming interface.

INTERCONNECT (TELCO) BOARD

The interconnect board contains the following circuits which are described below:

1. Power Supply
2. Control
3. Modem
4. Line 1 Telco Interface
5. Line 2 Telco Interface
6. Input/Output Amplifiers and Compandor
7. Talk Battery

Power Supply

Incoming power (+VS) arrives on pins 18/19 of Interconnect board connector J7. The +VS is cleaned up by pi filter C9/C10, L1, C48/C42 etc and regulated/filtered as necessary to provide all interconnect board operating voltages (+V, +5, A, and B). A and B are very clean 5 volt pseudo ground references.

Control

The main board CPU controls the states of the relays and digital listeners by shifting appropriate control words into shift registers U6/U7. The CPU reads the states of talkers (such as loop current detectors) by placing their data on the data bus (D0 - D7) via U5 when RD/ and TELEN are both low.

Modem

The optional modem (U3) transmits and receives modem audio signals on the phone line via TELAUDIO and PTXAUDIO. The modem communicates with the main board CPU using the D0 - D7 data bus and controlled by: ALE, WR/, RD/, MOCE, MINT/ and RESET from the CPU.

Line 1 Telco Interface

Line 1 is an End to End only line. Line 1 can be used for ringout or over dialed incoming calls and outgoing calls.

Line 1 has two parallel RJ-11 jacks J5/J6 which may be used as input and daisy chain output if needed. The ring/tip pass through protective fuses F3/F4 and are shunted by MOV's V5/V6. Ringing is detected by Q3 and "line in use" is detected by Q4. The line pair then proceed to ground start relay RL4 and thence to loop start relay RL5, thence to the hybrid transformer T4. Direction and presence of loop current are detected by Q7/Q13. The active hybrid (used to eliminate/minimize mobile return trip audio) consists of hybrid transformer T4, feedback amplifier U10A and the associated feedback components including the balance adjustments P3/P4.

Line 2 Telco Interface

Line 2 can be user setup to receive an End to End, DID or E&M line. RJ-11 jacks J3/J4 are used for E/E or DID. E&M is handled on RJ-11 jacks J1/J2. If using J3/J4 for E/E or DID, nothing can be plugged into the E&M jacks J1/J2 and vice versa.

The programming flexibility designed into line 2 makes it a bit difficult to functionally describe. The E/E and DID jacks J3/J4 flow into protective fuses F1/F2 and are shunted by MOV's V3/V4. E/E ringing is detected by Q1 and "line in use" is detected by Q2. The line pair then proceed to ground start relay RL3 and thence to loop start relay RL2, thence to the hybrid transformer T3. Direction and presence of loop current are detected by Q10/Q11. The active hybrid (used to eliminate/minimize mobile return trip audio in E/E and DID operation) consists of hybrid transformer T3, feedback amplifier U10B and the associated feedback components including the balance adjustments P1/P2.

When using Line 2 for E&M applications, RJ-11 jacks J1/J2 are the correct inputs. MOV's V1/V2 protect the LT-4900 from line surges on the E&M inputs. The four wire signals are fed to the transmitter and receiver using separate transformers T2/T3. Jumpers disable the hybrid in E&M operation for maximum duplex performance. E&M signalling (control) leads may be reversed using JP-1. JP-7 allows the M lead to transmit a ground or -48V off-hook signal. JP-8 allows the E lead to respond to either a ground or -48V incoming signal.

Jumpers JP-4, JP-5, JP-10, JP-11 and JP-12 are used to configure the hybrid for the desired operating mode (E/E, DID or E&M). Please see Figure 2, Telco Board Jumpers page 14 for settings and additional descriptions.

In DID operation, -48V talk battery is fed to the hybrid via ring/tip short circuit protect lamps LP2/LP4-6 and polarity reverse relay RL6.

Input/Output Amplifiers and Compandor

Mobile audio (MOBAUD) arrives from the main board and goes to the compandor U12. Switch U4A allows the selection of linear or compandored audio to be sent to the M -> L level control P6. Mobile audio is then sent to line driver U13A or U13D depending on whether line 1 or line 2 is being in used.

Audio originating from the phone line is received by amplifier U11B and passed through a four pole high pass filter U13A/U11C and then through reference setting amplifier U11D thence to compandor U12. Switch U4B allows transmitting phone audio linear or compandored. The audio then proceeds through the L -> M level control P7 and on to the main board (LMAUDIO), eventually sent to the transmitter.

An audio line sensor circuit consisting of U11A/Q19 allow detection of all call progress tones and dial click detection in software by the main CPU. P5 allows setting the detection levels.

Talk Battery

A DC/DC converter consisting of transformer T1 driven by Q5/Q6 oscillates between 20-25 kHz depending upon input voltage. The -55 to -65 Volt rectified output is regulated by Q14 to -48VDC +/- 4V and is used in either DID or E&M operation.

Making Connection to the RS-232 ports

There are two RS-232 ports on the LT-4900. The two ports are connected in parallel and may not be used simultaneously. You may connect to only one port at a time.

Direct Connection to your computer

Both ports are designed to be connected with a straight through cable from an IBM compatible computer serial port (COM1 or COM2). These cables are available at most electronics and computer stores.

Figure 7, RS-232 Connections for Computer

Connection to an external modem

IMPORTANT: If the rear connector of the LT-4200 is a female connector, you have a Rev - board (The revision is just behind the RESET switch). If you have a male rear DB-9, then you have a Rev A board. The connections for a Rev - board are below. To connect a Rev A board to a modem, a simple, straight through, connector may be used, the same cable you would use on your computer to connect to a modem.

To connect the RS-232 port to a modem, a Null Modem cable is required. A cable with a male connector at both ends is required or a gender changer at one end will be required. The complete wiring diagram for these cables is in figure 8.

If at all possible, when connecting a modem, make a complete login by way of modem to the LT-4900 before leaving the site.

Figure 8, RS-232 Connections for Modem
Notes for making a connection to an external modem

First, get out your modem manual. You should make note of all of the commands necessary to do the following:

Echo off (normally E0)
Result codes (normally Q1) This is not usually a problem, in fact we use Q0 in our default string.
Verbal result codes (normally V1)
Simple result codes (normally X0)
Set auto answer to ring 1 (normally S0=1)

Our default string is "AT E0 Q0 V1 X1 S0=1"

In addition, you will probably have to disable all handshaking and disable response to all control lines, and fix the baud rate at either 1200 or 2400 baud. THE BAUD RATE MUST MATCH THE DIP SWITCH SETTINGS FOR BAUD RATE IN THE LT-4200.

For example, for the Sportster Vi, we recommend the following:

Command	Means
&B1	Fixed baud rate
&C0	CD Override
&D0	DTR Override
&H0	Flow Control disabled
&I0	SW flow control disabled
&K0	disable compression
&N3	set 2400 baud

The full string would be:

ATE0Q0V1X1S0=1&B1&C0&D0&H0&I0&K0&N3

YOU WILL HAVE TO READ YOUR OWN MODEM MANUAL TO OBTAIN THE PROPER STRING!

In order to set this string, you must be able to access your LT-4200. If your modem is not working, you must connect directly to the front or rear panel RS-232 jack. You must disconnect the modem in this case.

When connected directly with your computer, make sure the Site Access in the Site Global Data menu is for local (L) connection and the baud rate is set to match the LT-4200, probably 2400 baud.

Then go to the Site Menu and choose Connect. After connecting, choose Site Control. In the Site Control menu, you select Modem String. At this point you can enter the modem string.

Then make the RS-232 connections in accordance with the previous page between the modem and the LT-4200. While you have access to two phone lines try to make the connection while you are with the LT-4200. Do not leave the site until you are sure it is working. You will need to set the Site Access in CSIBASE to 'X' and the baud rate to 2400 before trying with the modem.

THE VOICE PROMPTS OPTION

Description:

The voice prompt option has eight messages as follows:

- 1) Message one is the Welcome message. This message comes on after the phone line is answered.
- 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 within the mobile answer time limit you have programmed.
- 3) Message three is the "Thank-you" message. This message comes on after a valid mobile overdial has been entered by the calling party.
- 4) Message four is the "Please wait, your call is being processed" message. This message comes on if the LT-4900 is busy redialing for PTC users or Autodial phone numbers.
- 5) Message five is the "The number you have dialed is invalid" message. This message comes on if the number overdialed is not a valid user id or access code.
- 6) Message six is the "Number is not valid, please retry" message. This message comes on when the number dialed has an error but he is allowed to try one more time.
- 7) Message seven is the "Please proceed" message. This message comes on when an inbound call is connected to an Autonet user.
- 8) Message eight is the "Alarm on repeater message. This message is played on the repeater when a valid alarm condition is detected.

Operation and programming of Voice Prompts

If you have the LT-VOI option installed, then you have the voice processor option. To use the voice processor option, you must first enable the voice processor by entering 'Y' in the Repeater Config menu under "Voice Prompts". Second, you must program the actual voice prompts.

Programming of voice prompts is accomplished over the telephone. First dial the phone number of the LT-4900. After the normal auto answer prompt, dial 00 followed by the three digit test id.

The following are the command codes:

0	Erase
2	Play
9	Record
*	Stop recording message
##	Hang up phone.

To program, press the command code followed by the message number. For example, to erase message 2 press 02. To record message 6, press 96. To listen to message 3, press 23.

Voice prompt audio level is preset and should be acceptable in most installations. If the level is unacceptable, it can be changed by changing R42 on the Telco board. The nominal value of R42 is 22K. To increase voice prompt level, reduce R42. To decrease voice prompt level, increase R42.

Audible prompts are given during programming as follows:

ACCOUNTING FILE FORMATS
Detail Call Records

FILE NAME: MMDDSITE.DRR

MM = MONTH, DD = DAY, SITE = SITE NUMBER, D = 'D', RR = RPTR NR

HEADER:

M49 SITEDMM/DD/YYHH:NN:SSMM/DD/YYHH:NN:SS #####

COL	DESCR
1	M49 = model designator
6	SITE = 4 digit SITE number
10	'D' for detail record
11	MM/DD/YYHH:NN:SS Date stamp of last download or start time
27	MM/DD/YYHH:NN:SS Date stamp of this download
43	##### record count, right justified in 5 digit field
48	processed flag, normally blank
49	10 spaces to fill 58 columns

Example:

M49 0001D08/31/9410:40:3709/02/9416:48:27 167

Each Detail record

COL	DESCR
1	Home Repeater (2 digits)
3	USER (3 digits)
6	'C' call qualifier, see below
7	'M' or 'L', call type
8	time HH:MM, 5 columns
13	5 digit of call duration, seconds
18	16 columns for phone number
34	2 digit repeater number of call (redundant with file name)
36	Date of call (8 columns MM/DD/YY)
44	(4 digits) condition code 1-13; it seems to have no effect

Example:

01065CM10:46 655953872 108/31/94 10
condition codes:

call type='L'

Code	Description	Qualifier
1	Normal call	C
2	Normal call timed out	C
3	Not enough rings	E
4	Dialing not done in time	E
5	Invalid User	I
6	Mobile did not answer	N
7	Turn around timer	C
8	Too many calls, busy or no outgoing	B
9	2nd Dialtone	E
10	# from Mobile	C
11	# from Landline	C
12	Incorrect linetype	E
13	Battery removal, reversal	E

call type='M'

Code	Description	Qualifier
1	Normal call	C
2	Normal call timed out	C
3	Dial Tone not detected	D
4	Dialing not done in time	E
5	Restricted Access Dialed	R
6	Not Used	E
7	Turn around timer	C
8	Too many calls	B
9	2nd Dialtone	E
10	# from Mobile	C
11	# from Landline	C
12	Incorrect linetype	E
13	Battery removal, reversal	E

User file

FILE NAME: MMDDSITE.U00

MM = MONTH, DD = DAY, SITE = SITE NUMBER, U = 'U'

HEADER:

M49 SITEU#####

COL	DESCR
1	M49 = model designator
6	SITE = 4 digit SITE number
10	'U' for user records
11	##### record count, right justified in 5 digit field
16	processed flag, normally blank
17	10 spare characters, spaces
27	crlf

Example:

M49 0001U 5

Each User record

1	Home Repeater (2 digits)
3	USER (3 digits)
6	User type (D, I, A)
7	User Status (V, I, U, D)
8	Account name, 10 characters
18	Rate Code, 5 characters
23	Comments (from line 2 comments, 19 characters)
42	Create Date (MM/DD/YY)
50	Altered Date (MM/DD/YY)
58	Bill as duplicate (Y or N)
59	Number of mobiles with this ID (normally blank, 3 characters)
62	crlf

Example:

02008IVCHARLES 3003 TOP CUSTOMER 05/01/9307/01/95N

Accumulated Call Data File

FILE NAME: MMDDSITE.ARR

MM = MONTH, DD = DAY, SITE = SITE NUMBER, A = 'A', RR = Repeater Nr

HEADER:

M49 SITEAMM/DD/YYHH:MM:SSMM/DD/YYHH:MM:SS#####

COL	DESCR
1	M49 = model designator
6	SITE = 4 digit SITE number
10	'A' accumulator record
11	MM/DD/YYHH:NN:SS Date stamp of last time cleared
27	MM/DD/YYHH:NN:SS Date stamp of this download
43	##### record count, right justified in 5 digit field
48	processed flag, normally blank
49	10 spaces to fill 58 columns

Example:

M49 0001A08/31/9410:40:3709/02/9416:48:27 167

Each Accumulator record

1	Home Repeater (2 digits)
3	USER (3 digits)
6	Total Prime time seconds, 8 characters
14	Total Prime time accesses, 5 characters
19	Total off-Prime time seconds, 8 characters
27	Total off-Prime time accesses, 5 characters
32	crlf

Example:

02008 567 45 345 22

LIMITED WARRANTY

Connect Systems Inc. (CSI) hereby warrants our products to be free from defective workmanship for a period of one year and defective parts for a period of five years from date of sale to the initial end user. This warranty applies only to the original consumer / end user purchaser of each CSI product. During the first year of warranty, CSI will repair any of its products at no charge providing the defective unit is returned prepaid to Connect Systems Inc. During years 2-5, there shall be no charge for replacement parts providing that the defective unit is shipped prepaid and service is performed by CSI. Conventional prevailing labor and shipping charges will apply following the end of the first year. CSI, at its sole discretion, will replace defective parts on an exchange basis for the first five years of ownership by the original purchaser. All shipping costs are the responsibility of the customer.

This warranty is in lieu of all other warranties, statements or representations, and unless stated herein, all such warranties, statements or representations made by any other person or firm are void. All implied warranties in connection with the sale of this equipment, including the warranty of merchantability, shall be of the same duration as the warranty period stated above. Some states do not allow limitations of how long an implied warranty lasts, so the above limitation may not apply to you. In the event of product failure which proves to be caused by a defect in workmanship or materials, your sole remedy shall be the repair of the defect by CSI or its appointed repair station as stated in this warranty, and under no circumstances shall CSI be liable for any loss or damage, direct, incidental, or consequential, arising out of the use, or inability to use, this CSI product. Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

What is not covered by this limited warranty

This warranty shall not apply if, in our judgment the defects are caused by misuse, lightning strikes, customer modification, water damage, negligent use, improper installation, overloads caused by external voltage fluctuations, use of unregulated power supply, damage caused in transit or handling or any abusive treatment not in accordance with ordinary product use or the product serial number has been removed, altered or defaced. **Specific Exclusions:** This warranty specifically excludes lightning protection devices (MOVs and phone line fuses) and transistors in the PTT (Push to Talk) circuitry. These components can only fail from external abuse.

If your new CSI product should ever fail, contact Connect Systems Inc. Customer Service Dept. for repair and warranty information at (805) 642-7184 or send, freight prepaid, to...

**Connect Systems Inc.
1802 Eastman Ave. Suite 116
Ventura, CA 93003**

Note: Connect Systems Inc. reserves the right to render a modest service charge when returned units are found to be free of parts or workmanship defect(s) (i.e. operating to factory specifications) within the first year of the warranty. Such units will be returned freight collect to the sender, including the appropriate service charge.