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# Model LT-4200

# Trunked Repeater Manager

# USER'S INSTRUCTION MANUAL

Made in U.S.A.

**TABLE OF CONTENTS**

# NOTICES

## FEDERAL COMMUNICATIONS COMMISSION (FCC) REGULATIONS

Your LT-4200 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 interferance.

2. This device must accept any interferance received, including interferance 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.

## COPYRIGHT NOTICE



## TRADEMARKS

## LT-4200 DESCRIPTION

### OVERVIEW

The CSI LT-4200 is a sophisticated dispatch only Trunking Repeater Manager (Controller) for use on LTR trunked repeater systems. The LT-4200 may be used with any combination of other makes of dispatch or dispatch/interconnect controllers. The xx provides up to 250 USER ID's per repeater. There may be up to 20 repeaters per system.

The LT-4200 "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-4200 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.

**Airtime Accumulation**
The LT-4200 accumulates four accounting functions for each of 250 homed User ID's regardless on which repeater(s) were used:

1. Hits during regular time. Up to 65,536.
2. Hits during prime time. Up to 65,536
3. Time useage during regular time. Up to 4660 hours talk time.
4. Time useage during prime time time. Up to 4660 hours talk time.

The LT-4200 also keeps track of attempted useage by invalid User ID's.

Separate storage of regular time and prime time useage allows CSI BASE 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.

**Validator**
The built-in validator will only allow access to mobiles with enabled User ID's. The validator in your LT-4200 will also validate users on other makes of controllers that lack their own validator.

**Site Monitor**
The site monitor allows you to graphically view the activity of all channels on your system (even the channels with brand X panels) while running CSI BASE on your PC. The PC may be connected to to either RS-232 port of any LT-4200 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 busied up to send the station ID or because of a cross busy condition, a 253 will appear in the ID field.

**Modem**

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

NOTE: If you have even one LT-4900 on the system, you can use it's built-in modem 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.

**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 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 interrruption of service while you are programming or site monitoring.

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 generate customer invoices, or "export" billing files to your favorite accounting application. Call CSI for assistance if required.

**SPECIFICATIONS** (probably should have more specs)

**Mechanical**

| | | |
|---|---|---|
| Height | 1.75 | inch |
| Width | 19 | inch |
| Depth | 6.9 | inch |
| Weight | | lbs. |

**Power Requirements**

| | |
|---|---|
| DC Input Voltage | +10 to +16 Vdc |
| DC Input current | TBD, approx 200 Ma max |

**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

TX AUD 0 - 5 Vpp in two selectable ranges.
Output impedance = 1K ohm.

TX KEY Selectable sink to gnd, or pull to +12Vdc. 0.5 Amp maximum.

RX DET 15mV - 10V in two selectable ranges. Has de-emphasis built-in. Input impedance = 150K ohms.

TX SUB 0 - 5V pp in two selectable ranges. Output impedance = 5.1K ohms

RX COS 0 - 10 V. Adjustable threshold point. Selectable polarity. Input impedance = 100K ohms.

AUX RLY Selectable NO or NC contacts. 0.5 amp DC maximum.

SENSE 1 Used as cross busy input. A logic high instructs the LT-4200 to operate normally. A low instructs the LT-4200 to be busy. Low <= 1V. High >= 2V. Input impedance = 2.2k ohms pulled up to +5 Vdc.

SENSE 2 Low <= 1V. High >= 2V. 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 coax fitted with BNC connectors.

**CSI BUS** Uses proprietary Connect Systems, Inc. protocol. All CSI LT series controllers are interfaced with RG-58 coax fitted with BNC connectors.

## CONNECTING THE LT-4200 TO YOUR REPEATER

Interface the LT-4200 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:

**RX DET:** The RX DET input terminal must be connected directly (do not use a coupling capacitor) to the receiver discriminator (de-modulator) output.

**RX COS:** **NOTE:** You have a choice of either using the LT-4200 noise squelch or, if you prefer, to use the squelch built into the receiver. We recommend using the LT-4200 noise squelch and not bothering with the COS connection. The choice is yours. To use the noise squelch, simply remove JP13. If you wish to make a COS connection and use the Rx internal squelch, use the following directions:

Connect to a point that has good voltage swing when the squelch is opened/closed. The best point to connect is to 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 output of the noise rectifier.

If the point selected goes more positive (voltage increases) when a signal is received, strap JP-13center 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 zz), and JP-13 properly strapped (see page zz), the front panel LCD will indicate RX when a signal is received. This condition must be achieved for proper operation of the LT-4200.

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.

**TX AUD:** Connect to the transmitter voice audio input.

**TX KEY:** Connect to the transmitter PTT line.

**TX SUB:** The TX SUBTONE output is used to inject the digital subcarrier 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 modulation of the transmitter.

**+12 VDC:** Connect to a source of 12-16 Vdc. The LT-4200 is reverse polarity protected, so a polarity mistake will not damage your LT-4200. Connect the return lead (-) to GND.

**SENSE 1:** Is used as the Cross Busy input. The input is compatible with CMOS, TTL or open collector logic levels.

**SENSE 2:** Is a spare input, not yet defined. The input is compatible with CMOS, TTL or open collector logic levels.

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

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.

NOTE: The LT-4200 must be configigured for EFJ or Uniden bus compatibility. See page zz JP-??.

**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.

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

#################### **WARNING** ####################

The LT-4200 contains a power supply sensing circuit that continuously monitors the input supply voltage. An instantaneous drop below 10 VDC will 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 acceess 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-4200 JUMPERS

Prior to attempting adjustments or operation, all jumpers and dip switches must be properly selected.

**JP-1 Relay contact selector.** The auxilliary relay (RL1) can be set for NO or NC contacts available on the interface connector (labelled, AUX RLY). Simply install the strap center to NO for normally open or, center to NC for normally closed.

**JP-2 These four jumpers configure the LT-4200 for EFJ or Uniden**
**JP-3 bus compatibility.** Put all four jumpers in position E for
**JP-4** EFJ based systems or, put all four in position U for Uniden
**&** based systems.
**JP-5**

NOTE: 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!

**JP-6 Selects the termination resistor for the CSI BUS.** This bus must be terminated in only one of your LT series controllers 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** Is the termination resistor for the RPTR BUS. This bus must be terminated in only one controller on the 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 Rx Polarity.** A variety of factors can cause the digital subcarrier to be received "inverted". This causes the digital data to be undecodable. 'Strap in' is normal polarity, strap removed is inverted and corrects receiver inversion. If the mobile data can not be decoded after adjusting the PREAMP (see page zz) try the inverse polarity by removing JP-8.

**JP-9 Tx Polarity.** A variety of factors can cause the repeater digital subcarrier to be transmitted "inverted". This

causes the digital data to be undecodable in the mobiles. Strap in is normal polarity, strap removed is inverted and corrects transmitter inversion. If the repeater data can not be decoded try the inverse polarity by removing JP-8.

**JP-10** does not apply

**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** Is not used on the LT-4200 and should be left open.

**JP-13 COS Polarity Select.** This strap must be removed if using the LT-4200 noise squelch. To enable COS operation, simply install JP-13 connecting the center pin and the desired COS polarity. The polarity (+/-) is marked adjacent to JP13.

NOTE: See the COS adjustment P3 on page zz for more infromation on polarity selection.

**JP-14** does not apply

**JP-15 Coarse 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 TP3 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 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 installed in most installations.

**JP-18 DCS (Digital Coded Subcarrier) 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 in most installations.

**SETTING THE DIP SWITCHES**

Your LT-4200 has an eight position dip switch and a four position dip switch. Here are the four functions conrolled 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. | RS-232 Baud rate bit 1 | 1 - 0 |
| Pos 2. | RS-232 Baud rate bit 2 | 1 - 0 |
| Pos 3. | RNDL Master: | 1 - 0 |
| Pos 4. | CSI MASTER: | 1 - 0 |

**Dip switch setting procedure**

The LT-4200 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-4200 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 prodedure to restore these dip switches to the correct repeater number.

**8 Position Dip Switch**

**Repeater number**
Each repeater must be assigned a unique repeater number 1 - 20. Here are the binary codes:

| | **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 |

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.

**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-4200 should be used as a validator for other controllers not equipped with a validator. The LCD will show a capital "V" if enabled, a lower case "v" if disabled.

Pos 7. Validation 1 = Enabled 0 = Disable

**Test**
Test causes the LT-4200 to send a steady stream of Sub Code data so that you can easily set the TX SUB modulation, or for other test pusposes. The LCD will show a capital "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**

**RS-232 Baud rate**
The baud rate can be set to 300, 1200, 2400, 4800. The LCD will show e.g. B=2400 if the baud rate is currently set for 2400 bits/second.

| | **Baud Rate** |
|---|---|
| | 1 2 4 |
| | 3 2 4 8 |
| | 0 0 0 0 |
| | 0 0 0 0 |
| **Sw Pos** | --------- |
| Pos 1. \| | 0 1 0 1 |
| Pos 2. \| | 0 0 1 1 |

**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 a capital "R" if enabled or, a lower case "r" if disabled.

Pos 3. RNDL Master 1 = MASTER ON 0 = off

**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 a capital "C" if enabled or, a lower case "c" if disabled.

Pos 4. CSI MASTER 1 = MASTER 0 = off

**SETTING THE LEVELS**

**P1 PREAMP:** The **PREAMP** control is used to match the audio level from your receiver to the LT-4200. To adjust, a signal containing LTR subcode with about 1Khz deviation must be applied to the receiver. Adjust the PREAMP control until a level of 1V 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 subcode 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, disregard.

This completes the adjustment of the PREAMP control. Future adjustment should only be required if the LT-4200 is connected to a different receiver.

**P2 SQUELCH:** NOTE: If JP13 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 JP13 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 JP13 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 DCS:** The **DIGITAL CODED SUBCARRIER** control sets the modulation level of the subcarrier on the TX SUB output.

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

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

**P7 DTMF:** The **DTMF** control adjusts the deviation of the outgoing regenerated DTMF. Set for about 2.5 KHz. deviation.

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

**NOTE:** P5, P6, P9, P10, are not used in the LT-4200.

## DEFINITION OF TERMS

this is left over stuff

**Courtesy beep:** A brief tone at the end of a mobiles 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 merely stops transmitting until the input drops and is picked up anew.

**RX polarity:** Design characteristics of the repeater receiver design can invert the received digital subcarrier from the mobiles precluding decoding. The LT-4200 has the ability to invert the SubCode in software by removing JP-8 in essence correcting the unwanted inversion of the receiver. (see page zz).

**TX polarity:** Design characteristics of the repeater transmitter design can invert the digital subcarrier precluding decoding in the mobiles. The LT-4200 has the ability to invert the SubCode in

software by removing JP-9 in essence correcting the unwanted inversion of the transmitter. (see page zz).

**User Enable/Disable:** Ability to turn a subscriber off for non payment and back on in response to payment. Sometimes it may be desirable to put a subscriber into reserve tone status rather than use the deadbeat disable. That way he will realize that he is picking up the repeater but can't talk. This may give the user a clue that they need to write a check.

## 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 amps U35. 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 subcarrier for detection at the adaptive centering differential comparator. The comparator output (RX-SUBTONE) is fed to the subcarrier decoder CPU U8 for software detection and error correction. The six pole high pass filter U35/U36 removes the digital subcarrier data from the incoming audio to avoid the buzzing sound that would result if it were not

removed. The audio from the high pass filter continues through the squelch switch U46A, through the RPT level control and then on to the audio output amplifier U48A.

**COS and noise squelch**

The noise squelch is derived by passing the 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.

(((((((((((( Left off here ))))))))))))

**DTMF and MF decoding**

DTMF is decoded and regenerated by U49 with the assistance of CPU

MF is decoded by U34. When either occurs

The with some assistance from the microcomputer U12.

DCS is generated directly by the microcomputer U12. CTCSS is generated by waveform generator U16. The microcomputer U12 controls the U16 waveform generator via pins 34,35 and 36. DCS and CTCSS have separate level controls the output of each is fed to summation amplifier and four pole low pass filter U4. The output of U4 feeds the transmitter modulator with SUBTONE.

The PTT circuit consists of Q6, Q14 and Q20. This circuit is controlled by the microcomputer U12 via pin 7. A polarity select strap gives the choice of ground keying or plus keying.

A power on reset circuit consisting of Q21 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 the EE memory U13 on power down.

Counters U22 and U23 divide the 448 KHz clock from U11 and allow remote re-booting 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 Q9 which in turn enables the power on reset circuit.

The front panel digital display U6-U9 are controlled by the display driver U5. The microcomputer U12 talks to U5 via pins 37,38 and 39.

Incoming power is fed through reverse polarity protect diode D8 and then fuse F1. From there the +V voltage feeds a +5 volt regulator U20 used by the digital components. Another smaller +5 volt regulator U21 is used to supply bias and reference voltage to the analog op-amps etc.