

Model LT8R

8 Channel LTR Controller

Ver: 021508

**Installation &
Setup Manual**

by,

Idylltek, Inc.

PO Box 549
Idyllwild, CA 92549

Phone: 951.659.6125
Email: info@idylltek.com
Web: idylltek.com

Congratulations on the purchase of the LT8R

Thank you for your purchase of the LT8R.

The super low price and high performance of the LT8R allows aggressive LTR operators to profitably compete with cellular PTT operators. No other LTR panel gives you this cost edge. The majority of dispatch users are completely served by a reliable single site system. Make your service cheaper than PTT.. with less waiting and you're in business !

The LT8R is a new concept in small system LTR bringing many important features not previously seen in LTR. The multiple controllers in a single box concept saves space, eliminates network connections, reduces cost and enhances reliability. The 80 character LCD display shows all LTR activity on all 8 channels at once (including User ID's). Surface mount technology on the 2-Channel boards allows dense packaging and enhances reliability. Socketed IC's (microprocessors and memory) are installed in (expensive) machine collet sockets with gold flash for extreme reliability allowing field firmware upgrades.

No el cheapo leaf sockets will be found in an Idylltek product !!

Your product suggestions are encouraged and welcome. Thanks again for trusting Idylltek, Inc.

Malcolm Oakes
President, Chief Engineer

(FYI: Founder/owner/chief engineer of CSI 1882 – 2001)

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1 Connecting the Repeaters to the LT8R

1.0 Repeater Connections The repeater ports (up to 8) on the rear panel each come with a mating male plug which you use to connect the LT8R to each of the repeaters and to power. Each port has two connections to the Rx and three connections to the Tx plus signal ground. In addition there is a V+ and power ground connection. The repeater connector has 8 pins.

Important note: The connectors for repeaters 1-4 and repeaters 5-8 are reversed from one another because the boards are mounted 180 to each other. Please observe pin numbers silk screened onto the LT8R rear cover.

1.1 Connections Description The connections made from the LT8R to the power supply, receiver and transmitter are as follows..

Pin	Name	Description	Details
1	Power Ground	Coaxial power cable shield	(to - of power supply)
2	+11 to +15 VDC Power	Coaxial power cable center conductor	(to + of power supply)
3	Tx Audio	Transmitter rpt audio, inject before IDC.	(shielded)
4	Tx Data	Transmitter data inject at FM modulator	(shielded)
5	Tx Key	Transmitter Key (PTT)	(shielded)
6	Rx COS	COS from receiver squelch	(shielded)
7	Rx Disc	Receiver discriminator	(shielded)
8	Signal Ground	Connect all signal shields here.	(shield braid)

Power

We recommend providing a power supply for the LT8R which is separate from the repeater DC supplies. Could eliminate hum, ground loops, RF loops, RF feedback and/or misc noise hassles. A one ampere supply is plenty. Set for 12.5 VDC if adjustable. The LT8R draws about 500 mA if all four 2-Channel boards (8 repeaters) are installed.

Use a shielded cable from the power supply to each repeater port. At the power supply end connect - to the shields, + to the centers. At the repeater connector ends shield to pin 1, center to pin 2. The intent is that running separate power to all the repeater connectors will allow you to unplug any combination of repeaters without losing power. Alternately you can simply run power to any one of the repeater connectors but system power will be lost when that connector is unplugged.

Rx Signals

Two connections are made to the receiver. Use two separate shielded cables or a single shielded cable with two center conductors.

1. **The COS connection** (pin 6) is made to the receiver squelch circuit.
2. **The Discriminator** (pin 7) connection must be made directly to the FM detector output...
BEFORE DE-EMPHASIS !! DO NOT CAPACITOR COUPLE !!
3. **The Shield** (pin 8) goes to signal Ground.

The correct COS point will change in DC level at least 2 volts when the squelch is opened / closed. There may be more than one place to connect that will appear to do the job. However the correct connection will operate as well as the squelch in the receiver and not affect receive sensitivity. You might want to test the COS signal sensitivity using a service monitor RF generator. **The LT8R is designed to handle either COS polarity or any DC level. More about this under Adjustments.**

Note: Each 2-Channel board has jumpers (JP1-A and JP1-B) that provide a COS pullup if needed. One for each channel handled by the board. If the COS operates OK without them leave unstrapped. (If the jumper(s) is not used simply push onto one pin so the jumper strap will not be lost).

Tx Signals

Three connections are made to the transmitter. Use three separate shielded cables or a single shielded cable with three center conductors.

1. **Tx Audio** (pin 3) must inject to a suitable point before the IDC (instantaneous deviation control) clipper so that repeat audio cannot overmodulate the repeater causing splatter, adjacent channel interference and/or loss of LTR data causing mobile drop out.
2. **Tx Data** (pin 4) delivers the LTR data to the transmitter (**IMPORTANT: ALREADY CORRECTLY CAPACITOR COUPLED ON THE 2-CHANNEL BOARD DO NOT ADD CAPACITORS**) !! The connection must be made directly to the FM modulator or to a Tx data input.
3. **Tx Key** (pin 5) is simply connected to the transmitter PTT line. (The N Ch. MOSFET pull to ground can sink up to 1 amp).

NOTE: Accidentally connecting any of the Tx Key lines to a supply voltage **WILL DESTROY THE CORRESPONDING PTT MOSFET TRANSISTOR. Traces on the 2 Channel board may also be damaged.** This is not covered under warranty !! **PLEASE BE CAREFUL !!**

IMPORTANT: PM (Phase Modulated) transmitters cannot be used for LTR. PM transmitters have insufficient low frequency response for digital data use. **FM (Frequency Modulated)** transmitters are the only choice. Preferably with a data input port.

2 Programming the LT8R

Spend some time with this chapter, it will save you considerable time during initial and future setup. This product is a breeze to program once you get past the start up hump.

2.0 Getting Started

User programming of the LT8R may appear involved at first however once you get onto it you'll find that it is logically thought out, easy to use, easy to remember and very fast. Powerful LCD programming screens and the Quick Commands make navigation a snap. You can set programming mode to require a password (PW) or not for local programming however a password is always required for over the air remote programming. Remote programming must be done from a DTMF equipped service monitor or radio operating in conventional mode (not LTR) using Repeater 1 only.

Why DTMF Programming? The vast majority of good to excellent repeater sites have no phone lines available making over the air DTMF programming the only practical / economical choice.

Repeater No. vs Home No: Regardless of where your physical repeaters are located they become the repeater number of the LT8R port they are plugged into. The locations of the repeater ports, the electronics that process that port and the LTR data displays on the LCD are all pretty much physically oriented as below looking from the front of the unit..

R1	R5
R2	R6
R3	R7
R4	R8

FYI: Microprocessors U1- U8 belong to repeaters 1- 8. U0 is the Housekeeping processor.

It's easy to be confused (especially if you're new to LTR) between the concept of repeater no. and home no. Therefore this manual will attempt to use "repeater" when the context is about the repeater. "Home" will be used when the context is about the home. We think it improper to say that a user is trunked to another repeater. This manual will say a user is trunked to another home. The logic trunks to a home (whichever repeater happens to host that home). In this instance repeater no. is insignificant.

You must assign a home no 01- 20 to each repeater on setup line 002 in each repeaters setup area. Be sure to not duplicate home numbers. Unlike bus based LTR controllers there is no reason to use particular home numbers. If you wish, it's perfectly ok to assign Repeater 01 as Home 01, Repeater 02 as Home 02.... etc. In fact, you may find it less confusing to do so. How you allocate homes to repeaters is strictly up to you. Performance is not affected as with networked LTR panels.

Important Note: The LTR display on the LCD only shows data on repeaters that are installed and have their home numbers set to an active number (01 – 20). If a repeater's home no is set to 00 it is declared inactive and does not show on the LCD. Furthermore an inactive repeater must be set to home 00 so that it is declared not free. **THIS IS VERY IMPORTANT ELSE TRUNKING IS ADVERSELY AFFECTED.**

Setup line 002 in each repeaters setup area comes defaulted as follows: Repeater 01 set to home 01. Repeaters 02 – 08 are set as home 00. Repeater 01 is defaulted as active so that something will display when you take the LT8R out of the box. We were worried that some customers would assume it was defective. When you are setting home numbers to the repeaters, don't forget that you may not want repeater 01 set as home 01.

If a repeater is down for service, don't forget to temporarily set it as home 00 so that the system will not declare it free and trunk mobiles to a nonexistent repeater.

2.1 Programming Basics

The LT8R can be programmed remotely over the air from a conventional DTMF equipped radio or at the site by plugging almost any DTMF telephone into the front panel jack and using it as a keypad. A four digit password (PW) is required to access programming mode for over the air programming. A PW is optional for local programming. Remote programming is only available through Repeater 01. During programming mode (remote or local) repeater 01 transmits continuously and a status beep is heard every 12 seconds to remind you that you are in programming mode. When commands are sent to the LT8R, it responds with a single long feedback beep if a command was accepted. If the command was not received properly or sent with a syntax error five short feedback beeps are sent to indicate error (command rejected). Feedback beeps are delayed 3 seconds giving you time to return your programming radio to receive so the beeps are heard.

During programming mode the home no. you assign to repeater 01 is busied out causing users homed there (and wishing to make a call) to trunk away to a free home during programming operations. This prevents users on repeater 01 from inadvertently interfering with the programming process and is transparent to the users if there is a free home to trunk to. Naturally, repeater 01 continues to send LTR data to keep trunking operational while in programming mode.

Important LT8R channel considerations:

1. Remote programming can only be done through repeater 01.
2. A least one clear channel is required for the LT8R to operate.
3. Repeater 01 must be one of the clear channels.
4. All users must be homed on clear channel(s).
(Which implies that channels set for shared operation are trunk-to only)
5. You can assign any home number (01-20) in any order to any repeater 01-08.
(Do not duplicate home numbers)

Note: The LT8R is designed to not respond to over the air DTMF while a phone is plugged into the front panel jack. The intent is to eliminate unintentional (or intentional) DTMF interference during local programming.

You must remember to unplug the phone from the Front Panel when finished with local programming or you will have no remote programming access.

2.2 The Password

The LT8R has a user programmable four digit password (PW) which is stored in non volatile memory. There is also a board selectable fixed four digit password. The later is used to get you started when the LT8R is new or in case you forget the PW you have set. When JMP3 is installed the fixed PW is active, it is 2580 which must be prefaced with * and ended with #. So the complete syntax for the fixed password is *2580#. When you remove JMP3 the PW will be the user programmable code set in the Systems Programming area covered below. This will also begin with * and end with #.

The LT8R also lets you choose whether the PW will be required for local programming or not. If JMP5 is installed then a PW is not required for local programming. Simply hit any digit and you are in programming mode. If you remove JMP5 then the current PW will be required for local programming. Below is a summary of what JMP3 and JMP5 do..

	Jumper strapped	Jumper removed
JMP3	Fixed *2580# PW	User programmed PW
JMP5	No PW for local programming	PW required for local programming

To exit programming mode simply send *93#. The LCD will show.. "Exit Pgming Mode" then will return to the LTR activity screen. **(All repeaters with their home no set to 00 will be blank until you assign home no's to the repeaters).**

Note: JMP3 & JMP5 are on the mother board. Access is from the rear. Rear panel must be removed.

2.3 Programming Mode

Important: Below programming procedures are presented. It's important to know that when you enter new data it does not take effect until you exit programming mode either manually (by sending *93#) or by programming mode timeout. When programming mode is exit a routine transfers all programmed operating parameters to the 8 repeater processors, similar to boot up data transfer when you turn the power on.

Programming mode can be accessed over the air via Repeater 01 (only), or locally using a DTMF telephone as a keypad plugged into the front panel modular jack. While in programming mode the home no. assigned to Repeater 01 is busy'ed out so users homed on it are trunked to a free home to make a call. This prevents mobiles homed on repeater 01 from inadvertently causing interference during remote programming. In the meanwhile the home assigned to repeater 01 continues to send LTR data so that a called mobile is trunked to the home from where a member of his group originated the call. 29 separate programming areas are provided to organize setup data. At most you will use 17 of them depending upon how many repeaters are connected to the LT8R (8 maximum) and also how many homes have users homed to them. The programming areas are:

- System parameters:** 1 Setup area for system wide data.
- Homes:** 20 Home setup areas for UserID's. (Homes 01 - 20)
(Only homes with users homed to them get User ID's)
- Repeaters:** 8 Setup areas for repeater data. (Repeater's 01 – 08)
(One repeater setup area per installed repeater is setup)

Let's get started. Local Programming in Detail

Plug almost any DTMF telephone into the front panel modular jack and hit some digits other than * (star). You should see the digits you hit parading across line 3 of the LCD. In addition, **Enter Password** appears on line 1 of the LCD. Upon entering a valid password.

PROGRAMMING MODE will then replace **Enter Password** on line 1 and **System Setup** will appear on line 2 of the LCD. You can exit programming mode at any time by sending *93#. The LCD will then return to displaying active LTR data. Not to worry, if you forget to exit programming mode a software timer will automatically exit one minute after the last DTMF digit entered. When programming mode terminates, all repeaters reboot and acquire the new data you have setup. This will cause a momentary (about one second) system wide service disruption. Repeater 01 returns to LTR service. During local programming, status beeps are transmitted same as during remote programming. See **Over the Air Programming** below for details.

Important: The LT8R will **NOT respond** to over the air DTMF when a phone is plugged into the front panel. This was done to prevent on air DTMF interfering with local programming. **This also means that if you leave the phone plugged in when you leave the site, you will have no remote programming access.**

What the LCD displays in programming mode..

During programming mode, each of the four lines on the LCD are reserved as follows:

- a). The top line continuously displays "**PROGRAMMING MODE**" .
- b). Line 2 displays which of the three setup areas you are programming. e.g. **System SetUp**
- c). Line 3 displays your DTMF entry. All digits to the left of * are cleared for clarity.
- d). Line 4 displays verbose name of programming line and the result.

For Example: **CWID Char 1 00/13/46**

By way of this example, 00 and 46 indicate the allowable range limits for this parameter. The center digit is the currently set value. If you attempt to enter a value outside the allowable range then Line 4 will display **Syntax Error** for about two seconds and then go blank awaiting new input.

Here's a visual of what the LCD shows..

When a DTMF digit is received from a local DTMF pad or heard on repeater 01 (regardless of the Home no assigned to it) The LCD stops displaying active LTR data and temporarily displays the incoming DTMF. The display shows:

```
Enter Password
* <- DTMF
```

Lines 2 and 4 remain blank. If the correct password is not received within 5 seconds the display will revert back to LTR data display. If the correct password is received the display changes to:

```
PROGRAMMING MODE
System SetUp (always begins at System SetUp)
*2580# <- DTMF (or your personal password)
Line 4 is blank until a command is entered .
```

Now lets assume you want to change the CWID Interval (address 003) to 20 minutes in the System SetUp area. First enter *00# to get into the System SetUp area (assuming you are not already there). The display will look like this...

```
PROGRAMMING MODE
System SetUp
*00# <- DTMF
```

Before programming new data you might first want to verify what the current data value is. To check what the present setting of the CWID Interval is. Enter *003#

```
PROGRAMMING MODE
System SetUp
*003# <- DTMF
CWID intval 05/15/99 (currently set for 15 minutes)
```

Line 4 now shows the verbose name (**CWID intval**) of the parameter at address 003. To the right of that is the data field showing the current data value (15 minutes) and the allowable programming range for this parameter (In this case 05-99 minutes).

Next enter *20003# to make the desired change.

```
PROGRAMMING MODE
System SetUp
*20003# <- DTMF
CWID intval 05/20/99 (now set for 20 minutes)
```

Bingo! The center field now shows that the CWID Interval parameter is changed to 20 minutes as desired. Note that your entry was written to non volatile memory and the displayed data was actually read back from the memory giving total confidence in the result.

Had you entered data out of the allowed range (for example *04003#) the display would indicate "Syntax Error" for two seconds plus audible error beeps on repeater 01. Then Line 4 will revert to blank awaiting new input:

2.4 The Quick Commands

The two digit quick commands function only when in Programming Mode. To access PROGRAMMING MODE enter the PROGRAMMING MODE password. The System SetUp area is the default setup area upon entering PROGRAMMING MODE. Quick Commands that are specific to a particular programming area only function if your current programming area is correct for the command you are trying to use. You can navigate between System area, Any Home area or any Repeater area at any time. **For Example**, you are currently in Home 06 setup area and next want to get to Repeater 05 setup area.. simply enter *25# (remember to add 20 to repeater no. for repeater setup areas).

SYSTEM AREA Quick Commands

- *00# Use to make System SetUp the current programming area**
Example: Enter *00# if you want to alter parameters in the System SetUp area.
- *50# Resets all System SetUp parameters to factory defaults**
(Don't do it unless it's what you want. Will erase all currently set system setup parameters)

HOMES AREA Quick Commands

- *01# - *20# Use to make Home (01-20) the current programming area**
Example: Enter *07# to get to the home 07 setup area to enable/disable users homed on Home 07.
- *60# Resets (disables by setting to 00) all User ID's at the home currently pointed to**
(Don't do it unless it's what you want. Will erase all User ID's at current Home setup area)
- *65# Lists out all User ID's on the LCD that are enabled at the current Home setup area.**
(hit * to abort listing if desired)
- *69# MASTER Reset of all UserID's on all 20 homes at once.**
This command is dangerous if used unintentionally. The display will ask "Are You Sure" Enter 9 for Yes, 6 for No. (These are the "Y" and "N" buttons on the DTMF pad)
Note: This reset takes about 20 seconds dependent on the write speed of the EE Prom.

REPEATERS AREA Quick Commands

- *21# - *28# Use to make Repeater (01-08) the current setup area**
This is where you program parameters for the individual repeaters.

Since homes use the numbers 01-20, the repeater setup areas use 21-28.
To get to the repeater area you want to setup, add 20 to the repeater number. Examples.. to get to repeater 01 setup area enter *21#. to get to repeater 02 setup area enter *22#... To get to repeater 08 setup area enter *28#.
- *70# Resets current repeater to Factory Default Settings**
(Don't do it unless it's what you want)
- *79# Reset's ALL repeaters to Factory Default Settings**
This command is dangerous if used unintentionally. The display will ask "Are You Sure" Enter 9 for Yes, 6 for No. (These are the "Y" and "N" buttons on the DTMF pad)
Note: This reset takes up to 2 seconds.

Other Useful Commands..

- *93# PROGRAMMING MODE exit command.**
Note: This command also initiates a reboot of all the processors so that new setup data is read from memory and becomes immediately active at each repeater. Reboot takes a fraction of a second however current talker on each repeater will terminate requiring a new keyup (handshake) to continue. This is a minor disruption occurring only during setup when exiting programming mode.
- *99# CWID modulation level setting**
Simultaneously sends each repeaters programmed CW ID callsign from within Programming Mode. LCD responds with.. **"CWID level SetUp"**. Repeat as many times as you need to set CW ID transmit level on each repeater. Consult rules for required deviation in your service or country. (40% of maximum deviation is pretty standard. i.e. 2 kHz deviation on a 5 kHz system)
Note: Entering *99# causes each repeater to simultaneously ID. Since each repeater is busied out while IDing the entire system is temporarily out of service. So you might want consider doing level setup only at a time when the system is not in use. Once set you'll have no need to do this again.

2.5 System SetUp Parameters

To navigate to the System Settings area, enter *00#

Programming Syntax

***aaa#** Use to view the current setting of any programmed parameter in the System SetUp area without altering the current setting. Where aaa is the address of the parameter you are checking. (See table below)

***ddaaa#** Use to change the value of any dd (data) setting at any aaa address. Where dd is the parameter you want to change at address aaa (See table below)

For Example: You are currently in the System SetUp area and want to change the CWID Interval to 20 minutes. First, check the current setting, enter *003#. Then to change it enter *20003#.

Important: The dd field requires 2 digits. Add a leading zero if necessary. A value 3 must be entered as 03 into the dd field. The aaa field requires 3 digits. A value 6 must be entered as 006 into the aaa field. A value 15 must be entered as 015 .

System Operating Parameter	dd Min	Fcty RST	dd Max	aaa Adr	Comment
System Area Code	00	00	01	000	System wide setting. 00 or 01
PGM mode PW code H	00	25	99	001	First two digits of PW
PGM mode PW code L	00	80	99	002	Second two digits of PW
CWID interval	05	15	99	003	ID's every dd minutes
CWID speed	55	60	80	004	25 wpm / 20 wpm / 10 wpm
LTR Baud Rate	42	50	65	005	See text below
WatchDog E/D	00	01	01	006	Enable/Disable Watchdog Timer

System Area Code **dd: 00-01** **aaa: 000** **FctyRST: 00**

Sets the system area code to zero or one. All mobiles on the system must be set to agree.

Comment: The majority of LTR systems are set as Area Code = 0. (enter 00 for area code 0)

Programming mode PW code High **dd: 00-99** **aaa: 001** **FctyRST: 25**

Sets the first two (most significant or High digits) of the password.

Comment: If you want an access code say 7149. The two high digits (71) are set here.

Programming mode PW code Low **dd: 00-99** **aaa: 002** **FctyRST: 80**

Sets the second two (least significant or Low digits) of the password.

Comment: If you want an access code say 7149. The two low digits (49) are set here.

Note: The LT8R is shipped with JP-3 strapped, this makes the access code *2580#. If you change the password (previous two commands) simply remove JP-3 on the mother board and your new password takes effect next time you attempt to enter Programming Mode.

Should you forget your password (or set it incorrectly), restrap JP-3 on the mother board and your password returns to (*2580#). Now you can get back in and change the password to whatever you want. Don't forget to remove JP-3 afterward or your password will remain *2580# .

CWID interval **dd: 05-99** **aaa: 003** **FctyRST: 15**

Sets how frequently each repeater ID's in minutes.

Comment: The actual time is random within +/- one minute of what you set. The random idea is to keep as few repeaters from IDing at once as possible because each repeater is busy'ed out while IDing. (during a busyout mobiles homed on a repeater that is IDing will be trunked elsewhere until the CWID is completed. Thus users do not hear the ID). From a system standpoint it's clearly better to make the interval as long as rules allow. Check regulations for interval requirements.

CWID speed **dd: 55-80** **aaa: 004** **FctyRST: 60**

Sets the Morse code speed of the CWID on all repeaters the same.

Comment: The settable range is from approximately 10 - 25 wpm. The default setting (60) is approximately 20 wpm. When setting, a large number is slower a small number is faster. Check regulations for speed requirements.

LTR Baud Rate Control **dd: 42-65** **aaa: 005** **FctyRST: 50** (297.1 Hz)

Due to the evolution of LTR there appears to be no precise standard for LTR Data baud rate. Meaning different brands of radios and controllers may vary slightly. Clearly serial performance is optimum when serial transmitter and serial receiver baud rates are set the same.

2.7 Repeater SetUp Parameters

There are 8 repeater setup areas, one per repeater. You will need to setup all the repeater areas that you will be using on the system. To get to the repeater area you want to setup, add 20 to the repeater number. Examples.. to go to repeater 01 setup area enter *21#. To go to repeater 02 setup area enter *22#... To go to repeater 08 setup area enter *28#. Etc.

Programming Syntax

***21# - *28#** Use to get into the appropriate repeater 01 - 08 setup area.

***aaa#** Use to view the current setting of any programmed parameter in the current Repeater SetUp area without altering the current setting. Where aaa is the address of the parameter you are checking. (See table below)

For Example: To check 'This Rptr is Home No.' on Repeater 06, First get to the Repeater 06 SetUp area by entering *26#. Then enter *002# to view what home no repeater 06 is currently set to host.

***ddaaa#** Use to change the value of any dd (data) setting at any aaa address. Where dd is the parameter you want to change at address aaa (see table below)

For Example: You are currently in the Repeater 06 SetUp area and want to change the LTR Tx data polarity to 01 (one). First to check the present setting, enter *001#. Then to change it to a one enter *01001#.

Repeater Programmable Parameters

Repeaters 01-08 Parameter	dd Min	Fcty RST	dd Max	aaa Adr	Comment
LTR Rx data polarity	00	00	01	000	
LTR Tx data polarity	00	00	01	001	
This Rptr is Home No.	00	00	20	002	
COS Hangtime	03	20	99	003	1ms/step
Clear/Shared Channel	00	01	01	004	
Enable/Disable Idle Msg	00	01	01	005	
COS polarity	00	00	01	006	
Not used	00	00	00	007	
Not used	00	00	00	008	
Not used	00	00	00	009	
Not used	00	00	00	010	
CW ID Char 1	00	46	46	011	First CWID Char
CW ID Char 2	00	46	46	012	Second CWID Char
CW ID Char 3	00	46	46	013	3rd
CW ID Char 4	00	46	46	014	4th
CW ID Char 5	00	46	46	015	5th
CW ID Char 6	00	46	46	016	6th
CW ID Char 7	00	46	46	017	7th
CW ID Char 8	00	46	46	018	8th
CW ID Char 9	00	46	46	019	9th
CW ID Char 10	00	46	46	020	10th

LTR Rx data polarity dd: 00-01 aaa: 000 FctyRST: 00 (logic zero)

Use to reverse (correct) input LTR Data polarity if necessary.

Example: enter *01000# to invert from factory default polarity. Enter *00000# to return to default polarity.

Comment: Various system inversions create a 50/50 chance that a Rx data correction will be needed.

LTR Tx data polarity dd: 00-01 aaa: 001 FctyRST: 00 (logic zero)

Use to reverse (correct) output LTR Data polarity if necessary.

Example: enter *01001# to invert from factory default polarity. Enter *00001# to return to default.

Comment: Various system inversions create a 50/50 chance that a Tx data correction will be needed.

This Rptr is Home No. dd: 00-20 aaa: 002 FctyRST: 00

Use to define the Home No. for each repeater. Or, enter 00 to disable a repeater.

Comment: The LT8R comes with repeater 01 set as home 01. And repeaters 02 – 08 set as home 00 (disabled)

Therefore repeaters 02 – 08 do not show on the display until set with an active home no.

Examples:

You want Rptr 01 to be Home 11. Enter *21# to get to repeater 01 setup area. Then enter *11002#.

You want Rptr 02 to be Home 06. Enter *22# to get to repeater 02 setup area. Then enter *06002#.

Comment: Any Repeater can be set to any home no. 01-20. **Be sure to not duplicate home no's !**

COS Hangtime **dd: 03-99** **aaa: 003** **FctyRST: 20**

There likely will be no reason to change this. This was put in as a just in case it's ever needed. Time is in milliseconds.

Clear/Shared Channel **dd: 00-01** **aaa: 004** **FctyRST: 01 Clear**

LTR systems work best when all the repeaters are on clear channels. The LT8R can operate with as little as one clear channel (mobiles must be homed on a clear channel(s) and the rest may be Shared channels . A shared channel does not declare its self as free if there is COS activity on the channel. This parameter must be set as required for each repeater on the system. Set dd to 00 if shared channel. Set to 01 if clear channel.

Comment: Each active repeater shown on the LCD begins with a H (Home is clear channel) or h (meaning home is shared channel). if set to clear channel when the squelch is opened idle changes to IDLE on the LCD. If set to shared channel and the squelch is opened idle changes to BUSY and there is a 3 second hangtime before returning to idle. The hangtime protects users sharing the channel from trunk-to interference.

Enable/Disable Idle Msg **dd: 00-01** **aaa: 005** **FctyRST: 01 Enable**

Each repeater set as clear channel and having mobiles homed on them must send a idle message every 10 seconds when idle. Set dd = 01.

The idle message is optional on repeaters operating as clear channel but with no mobiles homed on them. Set dd = 00 or 01.

The idle message must be disabled on all repeaters set for shared channel. Set dd = 00

COS polarity **dd: 00-01** **aaa: 006** **FctyRST: 00** (logic zero)

The COS polarity for each repeater is correct when the LCD shows idle when squelch closed, and IDLE or BUSY with squelch open for each repeaters LCD sector. If all are set correct each will say idle when all squelches are closed. It may not be possible to complete this setting until the COS threshold settings are adjusted in next section, **LT8R SetUp and Adjustments**.

Note: This may be a bit awkward but you must be in programming mode to set the polarity and out of programming mode to view the **idle / IDLE** COS indication. Fortunately you only have to do it once. And if all repeater receivers are the same then all polarity settings will be the same.

The following programming lines are spares and not used or accessible.

Not Used	dd: 00-00	aaa: 007	FctyRST: 00	Spare
Not Used	dd: 00-00	aaa: 008	FctyRST: 00	Spare
Not Used	dd: 00-00	aaa: 009	FctyRST: 00	Spare
Not Used	dd: 00-00	aaa: 010	FctyRST: 00	Spare

These are the ten user programmable CW ID characters per repeater

CW ID Char 1	dd: 00-46	aaa: 011	FctyRST: 46	Leave set to 46 if not used
CW ID Char 2	dd: 00-46	aaa: 012	FctyRST: 46	Leave set to 46 if not used
CW ID Char 3	dd: 00-46	aaa: 013	FctyRST: 46	Leave set to 46 if not used
CW ID Char 4	dd: 00-46	aaa: 014	FctyRST: 46	Leave set to 46 if not used
CW ID Char 5	dd: 00-46	aaa: 015	FctyRST: 46	Leave set to 46 if not used
CW ID Char 6	dd: 00-46	aaa: 016	FctyRST: 46	Leave set to 46 if not used
CW ID Char 7	dd: 00-46	aaa: 017	FctyRST: 46	Leave set to 46 if not used
CW ID Char 8	dd: 00-46	aaa: 018	FctyRST: 46	Leave set to 46 if not used
CW ID Char 9	dd: 00-46	aaa: 019	FctyRST: 46	Leave set to 46 if not used
CW ID Char 10	dd: 00-46	aaa: 020	FctyRST: 46	Leave set to 46 if not used

Set the station callsign beginning at Char 1. Make sure that a 46 is in all the unused character positions after the callsign. 46 is used to indicate end of message and terminate the ID session.

CW ID CHARACTER TABLE

Char	dd	Char	dd	Char	dd
Zero	0	G	16	W	32
1	1	H	17	X	33
2	2	I	18	Y	34
3	3	J	19	Z	35
4	4	K	20	Char Space	36
5	5	L	21	Fwd Slash	37
6	6	M	22	Comma	38
7	7	N	23	Period	39
8	8	O	24	Question Mark	40
9	9	P	25	Hyphen	41
A	10	Q	26	KN	42
B	11	R	27	AR	43
C	12	S	28	SK	44
D	13	T	29	HI	45
E	14	U	30	End Of Msg	46
F	15	V	31		

2.8 Over the Air Programming

You will need a conventional radio (No LTR data and preferably no CTCSS or DCS) or a service monitor equipped with a DTMF pad. (Some LTR radios can be set for conventional operation as well as LTR which would be quite handy). Input/output frequencies must be set for repeater 01.

Although any of the commands described above for local programming could be used during remote programming we highly recommend not doing so. This is because you are not able to look at the LCD as in local programming. You could easily damage your setup and you won't have a clue what you did to cause it. This could easily force a trip to the site to fix.

Instead, we created a safe to use format just for remote enable/disable of User ID's. It is highly recommended that you do not venture past user ID setup while remote programming. Save it for when you are at site. Here is the command syntax:

***hdduuu#**

A complete UserID includes a users home **hh** and three digit user ID **uuu**. The **dd** field is 00 to disable or 15-40 to enable. The later selects a hangtime for this user (1.5 - 4.0 seconds), see details about hangtime below.

Example 1: Assume you would like to disable UserID 128 who is homed on home 12. Send the following sequence: *12 00 128 #. Spaces added for clarity only. (dd = 00 disable).

Example 2: To enable this same user, choose a valid hangtime between 15 and 40 (1.5 - 4.0 seconds). Let's assume you have chosen 2.0 seconds, enter *12 20 128#. Complete UserID 12-128 (home - ID) is now ready to use.

Important: Leading zero's may be required to complete field size. A field such as **hh** or **dd** requires two digits. So data value 3 must be entered as 03. Similarly **uuu** userID requires 3 digits. E.g. 11 must be entered as 011.

About hangtime: The hangtime setting dd is dual function. It both enables a user and lets you give separate hangtime's per user. It also disables a user if you enter a dd setting of 00. To enable a user enter a dd setting of 15 - 40, 1.5 - 4.0 seconds). The setting you choose sets how long this users LTR code can be absent without ending the call. This feature is useful for users that frequently operate in weak areas, e.g. drive thru tunnels frequently, parking garages etc. Since the set hangtime is terminated the moment the mobile sends its turn off code the length you set really does not change or affect any system operation. 2.0 seconds seems good for most users. We recommend setting most users to 20 (2.0 seconds) and exceptional users longer depending upon their circumstance up 40 (4.0 seconds). We'd appreciate feedback on the settings you use and your observations.

To exit programming mode simply send *93#. You will hear a long acknowledge beep. The programming mode status beeps will end. The transmitter will go off. If you are at the site, the LCD shows.. "Exit Pgming Mode" then returns to a LTR activity screen.

2.9 Over the air Remote Reset

We have provided a method of manually rebooting the LT8R remotely.. simply press and hold any DTMF digit transmitting on the input of Repeater 01 for 10-15 seconds (time is important) then release. If no luck try it a few more times. This feature could save you a trip to the site! Lightning or other events could occasionally necessitate a reboot.

Note: Neither remote programming mode nor remote reboot will function if you have left a phone plugged into the LT8R front panel phone jack.

3 LT8R SetUp and Adjustments

Adjustment locations: All 2-Channel board adjustments and LCD contrast control described below are hidden by the outer (cosmetic) front panel. Remove six flathead screws to reveal the adjustments and silk screened inner front panel with all adjustments clearly annotated. The Password jumpers on the mother board are accessed from the rear. To remove the rear panel unplug all the repeater connectors (be sure they are identified as to repeater for proper reinsertion) then unscrew.

LCD Contrast adjustment: While you have the front panel removed it might be a good idea to see if the LCD contrast is optimum. Adjust to suit. This may need to be adjusted from time to time to maintain optimum contrast.

3.0 Understanding the LTR Handshake

Before you begin, a basic understanding of the LTR handshake is essential to setting up and maintaining a LTR repeater!

Stated simply, LTR cannot work if handshake is not working !! LTR will not work well if handshake doesn't work well. It is critical to make all setup adjustments accurately and consistent from repeater to repeater within the system. This includes receive and transmit data levels and individual data polarity settings. Even the repeat level (RPT LVL) settings need to be consistent from repeater to repeater so that users do not sense an audio level change when trunking from one repeater to another.

Handshake Synopsis: When a mobile presses his PTT button he transmits on his home repeater if the channel is free. Otherwise he trunks to an available free channel, (if any are available). Even though the mobile continues to press his PTT button the first transmission only lasts as long as the 40 bit serial LTR data word (about .14 second). Not apparent to the mobile user, his radio returns to receive looking for a reply LTR data word from the repeater. If this data exchange handshake is successful the mobile radio resumes transmitting and the mobile radio provides a OK talk beep. This all occurs in less than .3 second. If handshake is not successful the mobile radio makes several more attempts to handshake. If handshake fails after several attempts an intercept (fail) tone is sounded by the mobile radio indicating he must try again later.

In order for the handshake to succeed the repeater logic checks several data words sent by the mobile:

1. The 9 bit sync word must correlate.
2. The 24 bits of data must mathematically correlate with the 7 bit error check code.
3. The area code must match the system area code setting.
4. The Goto word must match the home no. the user is transmitting to.
5. The User home and User ID pair must validate (meaning this mobile is an enabled user)
6. Data sent from the mobile is set to the correct deviation.
7. The repeater LTR Rx data polarity has been set to match data from the mobiles.
8. The LTR Rx data preamp is set for correct data level measured at a test point on the 2 Channel board.

If all of that is ok the repeater sends a LTR reply handshake word to the mobile. The following must all be ok:

9. 1-3 above must be Ok
10. The repeater LTR Tx data polarity has been set to match the mobiles.
11. LTR data from repeater to the mobile sent at correct deviation.

The reason for covering this is so that you'll understand how absolutely critical it is that all adjustments that affect LTR data are correct.

3.1 Step by step SetUp Procedure

Step 1. Match RF channels to repeaters. The first thing you must decide on is matching actual RF channels to repeater numbers in the LT8R. At this point you can simply plug any repeater connector into LT8R port 01 - 08 as desired.

Here are your considerations..

1. At least one clear channel is required for the LT8R to operate.
2. Repeater 01 must be one of the clear channels.
3. Remote programming can only be done through repeater 01.
4. All users must be homed on clear channel(s).
(Which implies that channels set for shared operation are trunk-to only)

Once you make the LT8R repeater no. to RF channel matchups you are pretty much locked into it. You'll be setting all of the mobiles to match etc. Please enter your choices into Table 1 which will be useful during the remainder of this setup and for future reference.

It is assumed that after this step all the repeaters in this system are all properly connected to the appropriate LT8R repeater port (01 - 08). Many steps that follow read as though all 8 repeaters are connected. Please read repeater 08 as meaning the actual quantity you are using. Please return and fill in the HOME's you select in step 2.

RPTR	HOME	Test UserID	RX freq	TX freq
01		101		
02		102		
03		103		
04		104		
05		105		
06		106		
07		107		
08		108		

TABLE 1 - LT8R Repeater, Home SetUp Information

Step 2. Assign Home no's to the repeaters You can assign any home number (01-20) in any order to any repeater 01 - 08. Unlike bus based LTR controllers there is no performance advantage in skipping home numbers. It's perfectly OK to make repeater 01 home 01, repeater 02 home 02 etc. In fact it may be less confusing to do so. (Do not duplicate active home numbers). **Installed LT8R repeater slots that are not in use must be declared inactive by setting them as home 00 . All repeaters that have an active home no. (01 - 20) appear on the LCD and are available to trunk-to. Repeaters set as home = 00 are declared inactive, do not appear on the LCD, and are not available to trunk-to. (Are never declared as free).**

Note: A repeater that is temporarily out of service must be set as Home = 00 so the system will not try to trunk-to a repeater that does not exist. When returning to service set the repeater back to its assigned home no.

Example of setting homes: First get into programming mode. To program repeater 01 as home 01 you'll need to navigate to the repeater 01 setup area.. enter *21#. Then make it home 01 by entering *01002#.

If your LT8R has more channels installed than you plan to use at this time you must set all the unused channels to home = 00. Example: to set repeater 08 to inactive, first navigate to the repeater 08 setup area.. enter *28# then enter *00002#. You can verify by entering *002#. Now go ahead and program the home no's you have selected into each active repeater, or 00 into inactive repeaters. When done exit programming mode by entering *93#.

Note: If the programming steps are not clear please return to section **2. Programming the LT8R** for review.

At this point each active repeater should be displaying its home no. adjacent to the repeater numbers annotated on the front panel. e.g. **R1 H:01- idle** is saying that repeater 01 is set to be Home 01. Ignore the idle or IDLE for now. Please be sure that the homes displayed match what you programmed. Please also be sure that repeater slots that are not in use at this time are not displaying.

PLEASE MAKE SURE THERE ARE NO DUPLICATED HOME NUMBERS

Before you begin the setup process, please take a moment to fill in the homes you have selected next to the repeater hosting same into **TABLE 1**. This will be a useful reference and an asset in setup steps that follow.

Step 3. Set Test Validation codes: Refer to **TABLE 1**. For reasons that will soon be clear, we need to program in Test UserID's (101 - 108). Since the homes you have selected for each repeater are not known (to us) it will be necessary to explain how to program by way of symbolic (hh) examples.

First get into programming mode..

(Below, at each repeater, hh refers to the home you have selected for that repeater. See **Table 1**)

- R01: Navigate to the Home setup area hh by entering *hh#. Then enable UserID 101 by entering *20101#
- R02: Navigate to the Home setup area hh by entering *hh#. Then enable UserID 102 by entering *20102#
- R03: Navigate to the Home setup area hh by entering *hh#. Then enable UserID 103 by entering *20103#
- R04: Navigate to the Home setup area hh by entering *hh#. Then enable UserID 104 by entering *20104#
- R05: Navigate to the Home setup area hh by entering *hh#. Then enable UserID 105 by entering *20105#
- R06: Navigate to the Home setup area hh by entering *hh#. Then enable UserID 106 by entering *20106#
- R07: Navigate to the Home setup area hh by entering *hh#. Then enable UserID 107 by entering *20107#
- R08: Navigate to the Home setup area hh by entering *hh#. Then enable UserID 108 by entering *20108#

Note: *20xxx# etc.. means that you have enabled ID xxx with a 2.0 second hangtime. 2.0 seconds is a good number for most (if not all) users. Please review **2.6 User Home / ID SetUp Parameters / About Hangtime:** for more about hangtime number.

Step 3. COS connections and settings: You should begin by checking with a DC scope or high Z voltmeter that all of the receiver COS connections work. The Voltage present at each COS connection should flip between voltage 1 and voltage 2 (varies receiver to receiver) when you open/close the respective repeater's squelch control (or apply/remove carrier). If one or more do not work you must pause here and get them working. You might also want to use a calibrated signal generator or service monitor to make sure that your selected COS takeoff point does not limit receive sensitivity by checking that the COS voltage flips between voltage 1 and voltage 2 at the same RF levels that the squelch you hear through the monitor speaker opens/closes.

Note that each 2-Channel board processes two separate repeaters. Each has clearly annotated adjustments for the two repeaters that are processed. The repeater pairs for each board are RPTR 1/RPTR 2, RPTR 3/RPTR 4, RPTR 5/RPTR 6, RPTR7/RPTR 8.

There are two COS THR (threshold) adjustments and also two pullup resistor straps (JP1A and JP1B) per board). The jumpers should be left disconnected unless adding a pullup resistor (100k) is needed to correct a problem such as COS speed or no pullup resistor (e.g. receiver open collector cos output). If not used leave the strap pushed on one pin so that it won't be lost.

The data display for each installed repeater should be showing on the LCD. Let's begin with COS settings for repeater 01 (upper left looking from the front)...

Setting COS Threshold and Polarity: Set the repeater 01 squelch control to just out of noise and into quiet. Rotate the RPTR 1 COS THR from end to end and verify that the display for R1 (repeater 01) flips between **idle** and **IDLE**.

Next, we need to set the RPTR 1 COS threshold so that it's in the center of the COS voltage swing range from the repeater 01 receiver.

1. Set repeater 01 squelch just into quiet zone. Then rotate the RPTR 01 COS THR adjustment until the point is found where the display for repeater 1 flips from **idle** to **IDLE** or **BUSY** . Note the physical setting of the COS THR adjustment where this occurs.
2. Set the repeater squelch to just out of quiet zone into noise zone. Then rotate the RPTR 01 COS THR adjustment until the point is found where the display for repeater 01 flips from **idle** to **IDLE** or **BUSY** Note the physical setting of the COS THR adjustment where this occurs.
3. Set the RPTR 01 COS THR adjustment to midway between the two physical settings noted in 1 and 2 above.

If the polarity setting happens to be correct the display for the repeater you are setting will show **idle** when the squelch is closed (quiet) and when you rotate the squelch to open (noise) **IDLE** or **BUSY** should appear.

If the display is indicating **idle** and **IDLE** or **BUSY** backward , the COS Polarity must be inverted. If it's set to 00 then set to 01. If it's set to 01 then set to 00. First enter programming mode. Then enter *21# to get into the repeater 01 setup area. Check the current polarity setting by entering *006#. Then enter the opposite setting by entering *xx006# (where xx is the opposite setting). Exit programming mode by entering *93# then recheck the COS polarity.

Final check: Set the repeater's squelch control into quiet zone the amount you normally would for this receiver. The display for repeater 01 should say **idle** when repeater 01 has no carrier, and **IDLE** or **BUSY** when a carrier is applied. It's very important that the COS threshold and polarity are set correct. Do it again a couple of times to be sure before moving onto repeaters 02 - 08. Repeat the steps above except to access repeater setup area's 02 - 08 you'll substitute quick commands *22# - *28# for repeater 02 - 08 SetUp areas.

Note: In the final setup phase you may set some channels as shared. if a channel is set as a shared channel the word **BUSY** replaces **IDLE**. Also, the **H** for home is replaced with **h** so that you can see at a glance which channels are set for clear channel or shared channel operation. (H = Set for clear channel, h = set for shared channel operation)

Step 4. Prepare a pair of radios for testing: The test method described will get you up and running faster than any other, Plus you'll be able to use the setups in the radios for fast future diagnostics because you'll be able to talk on any channel on the system more or less as a single channel trunking system operationally similar to a conventional repeater allowing you to test all repeaters individually with ease (even the trunk-to only channels)

You'll need to program a pair of LTR radios (preferably handhelds) with a repeater/ home channel. i.e. if this is to be a 5 channel LTR you'll need 5 systems programmed into each radio. This will let you test each channel separately with no trunking interaction. We advise leaving the setup in the handhelds (and the test user ID's in the LT8R) as in **TABLE 1** for future system testing / diagnostics.

Program the two portables with a system per repeater as follows:

- System 1:** Set the Rx/Tx freqs to talk to rptr 1. Set home same as TABLE 1. Set user ID to 101
- System 2:** Set the Rx/Tx freqs to talk to rptr 2. Set home same as TABLE 1. Set user ID to 102
- System 3:** Set the Rx/Tx freqs to talk to rptr 3. Set home same as TABLE 1. Set user ID to 103
- System 4:** Set the Rx/Tx freqs to talk to rptr 4. Set home same as TABLE 1. Set user ID to 104
- System 5:** Set the Rx/Tx freqs to talk to rptr 5. Set home same as TABLE 1. Set user ID to 105
- System 6:** Set the Rx/Tx freqs to talk to rptr 6. Set home same as TABLE 1. Set user ID to 106
- System 7:** Set the Rx/Tx freqs to talk to rptr 7. Set home same as TABLE 1. Set user ID to 107
- System 8:** Set the Rx/Tx freqs to talk to rptr 8. Set home same as TABLE 1. Set user ID to 108

On each system setting above be sure to only program the frequencies for the repeater shown thus preventing trunking away. Thus each system will behave as a single channel trunking system. This setup will allow you to talk test radio to test radio (when systems are set the same) through each repeater separately and achieve proper setup of each channel. This avoids having to work around trunking. The LCD will report the activity.

Note: You can also set a ninth system in the test radio's programmed as you would set any other radio on this system for ordinary use of the LTR repeater. It would be nice if the test radio also had a DTMF pad, then you could additionally set up a tenth system operating conventional on repeater 01 for remote programming. Set to no tone if possible. If you must set a tone choose 100.0 Hz CTCSS.

Step 5. Set the LTR Tx data deviation per channel: First you must determine the LTR data deviation you want to use in your system. 700 - 1000 Hz. is pretty standard. (Higher gives better data S/N performance). it's very important that all mobiles transmit exactly the same deviation. If all the mobiles have been accurately factory set to the same deviation, then there's no reason to not use that value system wide including repeater outputs which we'll do in next step.

The LT8R has been designed to send a sinusoidal (alternating 1010...) bit pattern at the proper LTR baud rate when not sending a LTR data word. This makes it very easy to set all 8 TX DATA deviations. Do repeater 01 - 08 in sequence..

Set the service monitor to receive the repeater 01 Tx freq. Key the repeater 01 transmitter (hopefully there is a test switch or PTT button for this purpose on the actual repeater). Otherwise, apply a ground to pin 5 of the repeater 01 connector.

Set the RPTR 01, TX DATA adjustment for the chosen deviation. Set it accurately. Then do the same for repeaters 02 - 08.

Note: You can also measure the baud rate of the LTR Tx data similarly.. except you must disable the **Enable/Disable Idle Msg** setting for repeater you are measuring. Connect a counter to the service monitor detector output. (Or measure directly with the service monitor if it has that capability).

For best accuracy set the counter for a 10 second count gate. Multiply the reading by 2 to get the actual LTR baud rate setting (this is crystal controlled and will be precisely same on all repeaters).

Step 6. Setting the LTR Rx data level per channel: These 8 settings are critical to handshake. Please set carefully.

Note: You will need to view the RX DATA test point for RPTR's 01 - 08 annotated on the inner front panel. There are two punched holes per 2-Channel board to access the RX DATA Test Points (one for each channel handled by this board). The TP pad is a large diameter pad off the end of IC U11 and U13 respectively. They are labeled TP1A and TP1B. Be sure to view and adjust only the repeater TP for the Rptr you are currently setting.

Set the service monitor to transmit on the repeater 01 input. Set to send any DCS (yes, DCS) code. Set the service monitor data deviation to the system wide level you are using. Monitor TP1 on the side of the 2-Channel board agreeing with the RPTR you are adjusting. Set for 2.0 Volts peak to peak. Repeat this procedure for repeaters 02 - 08. Be sure to not accidentally change these settings as you continue. **This setting is critical to handshake performance.**

Now Let's get the individual repeaters working !

Step 7. Setting the LTR Rx data polarity and Tx data polarity: Note that the home No. you set for each repeater is showing next to the H: in the appropriate R1- R8 sector of the LCD display. Recall that User ID 101- 108 was set for the homes you selected for repeaters 01 - 08. Also, the test radios were programmed to allow you to talk to each repeater separately. System 1 talks to repeater 1, System 2 talks to repeater 2 and so on. Each test radio system had a home no. and User ID set to agree with the corresponding repeater 01 - 08. Let's assume these settings are programmed OK and move on..

When a handshake works OK, the display for the repeater you are working on will change from **Rn Hhh- idle** to **Rn Hhh-hhnnn**. **Rn is the R1 - R8** repeater annotation on the front panel. hh is the home no. you selected for this repeater. nnn is the user ID being used to test repeater n. e.g. if we're testing repeater 01 with the test radio set for system 1, and the home you picked for repeater 01 is 12, the display would look like this.. **R1 H12-12101**.

Here is a detailed instruction to achieve handshake on repeater 01. For clarity let's assume you assigned Home no. 12 to repeater 01. You must keep in mind the actual home you choose for repeater 01 is likely different. Set one of the test radios for System 1. Key the radio. If you are very lucky meaning that (LTR Rx data polarity and LTR Tx data polarity settings are accidentally correct) then the R1 display will change from..

R1 H12- idle to: R1 H12-12101

If the display changes from **R1 H12- idle to: R1 H12- IDLE** then COS is working but the LTR data is not being recognized. You need to try the opposite setting of LTR Rx data polarity. Get into programming mode. Move to the repeater 01 setup area, enter *21#. Then find out the current LTR Rx data polarity setting by entering *000#. If it's 00 change it to 01. If it's 01 change it to 00. Enter *nn000# where nn is the new polarity setting. (If you want, you can confirm the entry by entering *000#). Exit programming mode by entering *93#.

Now Key the test radio again. If the display shows **R1 H12- idle to: R1 H12-12101** steady (without flashing on/off) handshake is working. Move onto next repeater. If the data (**12101**) is flashing on and off with each handshake attempt then the LTR Rx data polarity is OK., but the mobile is not understanding the handshake data from the repeater or the validator is not set for the test userID. . Likely the LTR Tx data polarity needs correcting.

Get into programming mode. Move to the repeater 01 setup area, enter *21#. Then find out the current LTR Tx data polarity setting by entering *001#. If it's 00 change it to 01. If it's 01 change it to 00. Enter *nn001# where nn is the new polarity setting. (If you want, you can confirm the entry by entering *001#). Exit programming mode by entering *93#.

Now Key the test radio again. If the display shows **R1 H12- idle to: R1 H12-12101** steady (without flashing on/off) handshake is working. If handshake is not working you need to review all of the setup steps above. If a repeater does not handshake after following the steps described, try another repeater. If it works might give you a lead or hint what to check on the ones that do not work.

At this point we'll assume that all repeaters are handshaking successfully and move on. Getting to this point is a milestone.

Step 8. Set the Repeat Audio levels: This can only be done accurately if you have a service monitor that can send LTR data letting you set desired LTR parameters. Set the area code to agree with the area code you set for this LTR system. Set the Goto same as the home no. assigned to the repeater you are testing. Set the ID to 101 for repeater 01, 102 for repeater 02 etc. Set the Free word to 31 (aka pass code). Set the Tx and Rx frequencies to talk to repeater 01. Setup to transmit a sinusoidal tone of 1 khz. Set the transmit deviation of the tone to 2 khz (don't include the LTR data in that measurement). Enable the service monitor. Hopefully it is handshaking with repeater 01 of the LT8R. Look at the repeater 01 output deviation. Adjust RPTR 1 **RPT LVL** to produce the same 1 kHz test tone deviation going out the transmitter as the service monitor is sending to the receiver.

Repeat this setup for repeaters 02 - 08.

If you don't have an LTR capable service monitor.. Sadly there is no way to set all the in/out deviations precisely the same unless you have an LTR service monitor because the LT8R will not respond to a signal that does not carry correct LTR data in proper LTR format. So here's the best we can do..

You'll need two service monitors. Monitor the transmit deviation of the test radio with one, monitor the output of repeater 01 with the other. Key the test radio and while talking, whistling etc adjust RPTR 1 **RPT LVL** to produce the same deviation on the service monitor viewing the output as the service monitor viewing the input.

The idea with repeat level is the repeater should not alter deviation. It should retransmit the same deviation that it receives on the input.

Step 7. Set the CW ID levels: If you do not plan to have CW ID on your system CW ID Char 1 - 10 must be set to 46 in each repeaters setup area. When that's done move to next step.

If you plan to have CW ID then you must enter the call signs as appropriate into CW ID Char 1 - 10 of each repeater. Leave 46 programmed into all the positions after the callsign if the callsign is fewer than 10 characters.

Assuming that all repeater call signs are entered then we can move on. Get into programming mode. Each time you enter *99# all of the repeaters will simultaneously ID. Set your service monitor to view the repeater 01 transmitter. Enter *99# and view the deviation. Adjust RPTR 1 **CW ID** to achieve the desired deviation. Reenter *99# as many times as necessary to get the deviation you want.

Repeat this procedure for repeaters 02 - 08. Exit programming mode when finished. Enter *93#.

Note: There may be legal requirements for ID deviation. It is your responsibility to set accordingly. 40% deviation (2 khz on a 5khz system is pretty common).

The system should now be capable of trunking. Below are the final SetUp choices..

Step 9. Setting Channels for Shared Operation: The default setting for Clear/Shared Channel is **Clear Channel** (setting 01) on line 004 of each repeaters setup area. It's important to review the following about channel allocation..

Important LT8R channel considerations:

1. Remote programming can only be done through repeater 1.
2. A least one clear channel is required for the LT8R to operate.
3. Repeater 1 must be one of the clear channels.
4. All users must be homed on clear channel(s).
(This implies that channels set for shared operation are trunk-to only)
5. You can assign any home number (01-20) in any order to any repeater 1-8.
Do not duplicate home numbers)

Channels that are intended to be shared with other services must be set as **Shared**. As such they may not have any users homed on them. These channels are trunk-to only. Channels set as shared have the H replaced with h on their LCD sector (for easy recognition as shared) and the idle/IDLE display (for squelch closed/open) changes to idle/BUSY. In addition, the BUSY display has a 3 second hangtime so it will quickly follow the COS into BUSY, but delays 3 seconds returning to idle when the COS is in inactive state. This hangtime protects a shared channel conversation that is in progress from being clobbered by a trunk to.

Note: A LTR system with three clear channels and two shared channels will have far less waiting than if it were operated as a three clear channel LTR system. In other words, better to have more channels even if some are not available all the time. You are statistically way ahead.

You set a channel into shared use by programming a 00 on line 004 of the repeater(s) in question.

Example: You'd like to set repeaters 03 and 07 into shared operation. First get into programming mode. Then make repeater 03 the current programming area, enter *23#. Then change line 004 to 00 (shared) enter *00004#. Then set repeater 07 for shared. Make repeater 07 the current programming area, enter *27# then set line 004 to 00, enter *00004#. Exit programming mode by entering *93#. The H on repeater 03 and 07 should now be replaced with an h indicating these repeaters are set for shared channel.

Finally, the idle message which is sent every ten seconds when a LTR channel is idle must be disabled on all channels set for shared channel in next step.

Step 10. Enabling or Disabling the idle message: Normally, an idle message is sent every ten seconds on all LTR channels that have users homed on them when the repeater is idle. The idle message lets mobiles just coming into service know that their home channel is free. It does so by sending a User ID of 255 (FF hex) and setting the Goto and FREE words same as the home no. of the repeater.

In summary, only repeaters that have Users homed to them need the idle message enabled. All other channels on the system, particularly those set for shared use must have the idle message turned off (disabled). You should check all eight repeaters for their Idle Msg status. Begin at repeater 01. First get into programming mode. To make repeater 01 the current setup area enter *21#. Then check the enabled (01) or disabled (00) status by entering *005#. If the current setting is what you want move onto repeater 02. If you need to change the setting of repeater 01 (it's still the current programming area) enter *nn005# where nn is the new idle setting you want for this repeater. 00 or 01.

More: Sometimes idle messages are used to make a 'keep off this clear channel' statement. So there may be non technical (political) reasons to enable or disable the idle message on various channels. Many radios are programmed smart enough that they do not need the idle message. There may also be legal reasons to enable or disable the idle message. The responsibility of how to set the idle messages rests with you, the system operator.

Step 11. Setting CWID Interval and CWID Speed: Hopefully you have already programmed the actual CWID message (generally the station call sign) on lines 011- 020 within each repeaters setup area. There may be legal requirements that control Interval, Speed and Deviation. Obtaining this information is the responsibility of the system operator. In general the less time the repeaters spend IDing (fast code speed and long interval) the better the system will perform on average due to reduced busyout time.

CWID interval sets how often the CW ID occurs. This can be set from 05 to 99 minutes. The actual interval is +/- one minute of what you set and occurs randomly within that two minute window. It is programmed to start randomly so that the CWID's of the individual repeaters tend to not synchronize. Idea is to try to keep IDing occurring one repeater at a time if possible because a repeater IDing is busy'ed out and made unavailable for the duration of the message. The display says 'IDing' whenever a repeater is busy'ed out with that activity.

CWID interval is programmed in the System Setup area. First get into programming mode. System SetUp will be the default setup area upon entering programming mode. If coming from another setup area enter *00#. CWID interval is set on line 003. To check the current setting enter *003#. If you want to change it enter *nn003# where nn is the new setting. This setting is common for all repeaters. Enter *93# to exit programming mode.

CWID speed has a setting range of 10 - 25 wpm. The setting is common for all repeaters. **Note:** The setting range is 55 - 80 which results in speeds of 25 - 10 wpm. A setting of 60 produces about 20 wpm which is generally the legal maximum.

CWID speed is programmed in the System Setup area. First get into programming mode. System Setup will be the current setup area. If coming from another setup area enter *00#. CWID interval is set on line 004. To check the current setting enter *004#. If you want to change it enter *nn004# where nn is the new setting. This setting is common for all repeaters. Enter *93# to exit programming mode.

Step 12. Setting LTR Baud Rate: LTR serial baud rate seems to have evolved and settled at about 297 Hz which is the default setting for the LT8R. Manufacturers in this industry typically do not share information. So it's likely that various brands of radios have slightly different baud rates. If you have a mix of makes / models of mobile and portables you should leave this setting at default setting of 50 (297 Hz.). However if all the radios are the same make and you have insider info about the baud rate then try the rate given you. Correctly aligned baud rates will always perform better than misaligned rates resulting in improved data s/n ratio and therefore higher percentage of successful handshakes.

LTR Baud Rate is programmed in the System Setup area. First get into programming mode. System Setup will be the current setup area. If coming from another setup area enter *00#. LTR Baud Rate is set on line 005. To check the current setting enter *005#. If you want to change it enter *nn004# where nn is the new setting. This setting is common for all repeaters. Enter *93# to exit programming mode.

Step 13. Setting WatchDog Enable/Disable: To augment reliability in some systems, we included a system wide watchdog timer in the LT8R that can be user enabled or disabled. The LT8R is shipped with the WDT enabled. When enabled the WDT in each processor is constantly checking for execution failure. If an execution failure is detected by any processor then it issues a reboot command that all 9 of the processors respond to. In about one second the system is fully up and running again. Like many things there are advantages and disadvantages to a watchdog timer. Most computer experts believe that a WDT is a good idea. Some do not like the concept. The main reason we included it is.. good repeaters sites can be quite hostile with lightening and high power transmitters. Particularly broadcast transmitters.

WatchDog Enable/Disable is programmed in the System Setup area. First get into programming mode. System Setup will be the current setup area. If coming from another setup area enter *00# to get to System Setup. WatchDog Enable/Disable is set on line 006. To check the current setting enter *006#. If you want to change it enter *nn006# where nn is the new setting. This setting is common for all repeaters. Enter *93# to exit programming mode.

Please let us know if you had reason to enable or disable the WD timer.

Your LT8R should now be fully setup and ready to play

4 Legal

The LT8R has been designed by professionals and is professionally manufactured using quality components. (Please keep in mind that none of these components are manufactured by Idylltek). Everyone knows that an electronic product can fail at any time. Possibly at an inopportune time. Idylltek, Inc. cannot and will not assume any responsibility or liability for damages (incidental or consequential) of any kind resulting from the use of this totally innocuous product. By choosing to use this product the customer therefore waives any and all damage claims arising out of its use. Please return unused for refund if this is not acceptable.

By placing the LT8R into service you tacitly agree to this provision.

5 Warranty and Service

What is Covered

Your LT8R is guaranteed against defects in material and workmanship for six months from date of purchase. Any failure occurring without outside help while the unit is properly installed **is covered** under warranty.

What is not covered

Failures resulting with help from the outside the unit are expressly not covered. These include but are not limited to the following:

- a) Damage occurring during shipping. Units are shipped insured.
- b) Overvoltage surge: e.g. applying incorrect voltage, power supply failure, lightening etc.
- c) Damage caused by the customer (e.g. rotating pots past their stops, attempted repairs, soldering or modifications, PC Board damage, etc).
- d) Transmitter keying (PTT) transistors (Q1 or Q2 on the 2-Channel boards). Or, resulting board damage.
- e) Damage resulting from any act of God, Nature or War.

Notes:

1. Failures resulting from external stimuli leave a forensic trail and are easy to identify. For example; an overvoltage failure generally results in multiple component failures. Lightening damage often causes multiple semiconductor failures and sometimes physical damage to the boards etc. Lightning damage shall be cause to terminate the product warranty because of overstress to all components that obviously cannot be the continuing responsibility of Idylltek, Inc. You should insure this product. Your customers should not have to suffer the reliability consequences of any equipment that has taken a hit. Sadly the best repeater sites are often the most risky considering lightening, theft and vandalism.

2. The Transmitter keying (PTT) mosfet transistors (Q1 or Q2 on the 2-Channel boards) are expressly not covered by the warranty. Only external electrical connections made to pin 5 (Tx Key) of the repeater connectors can be responsible for failure of these parts because the drains do not connect to anything internally. An accidental connection to supply voltage will most likely cause failure of the keying transistor and maybe the board. We made the pads and holes for the TO-251 mosfet's extra large to allow easier replacement, if necessary.

3. Damage resulting from any act of God or War is expressly not covered. This includes but is not limited to: lightening damage, overvoltage surge (for any reason), moisture/water damage, insect damage etc.

This warranty is a factory warranty which means that it is the responsibility of the customer to bring it in and pick it up, or cover round trip shipping costs if shipped.

Prior to shipping please call or email for a RMA number. The ship to: address for repairs is

Idylltek, Inc.
25491 Franklin Dr.
Idyllwild, CA 92549

Phone: 951.659.6125
Email: info@idylltek.com
Web: idylltek.com