

REPEATERS!!
WHAT ARE THEY?
WHAT DO THEY DO?
HOW DO THEY WORK?

What is a Repeater?

A duplex repeater, in concept, is not really a complicated device.

It's a 'duplexed' two-way radio set that listens on one frequency, then re-transmits what it hears on another; and does it simultaneously.

These systems are usually located in places of high elevation (on mountains and tall buildings) and are equipped with

large - efficient antennas,

extremely low loss feed lines, and a transmitter and receiver that is very durable

and

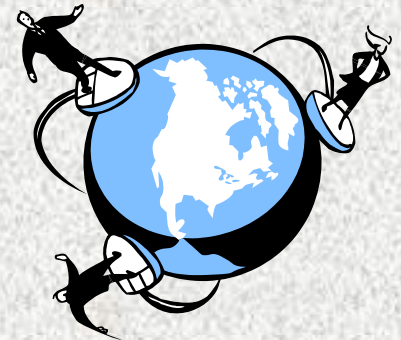
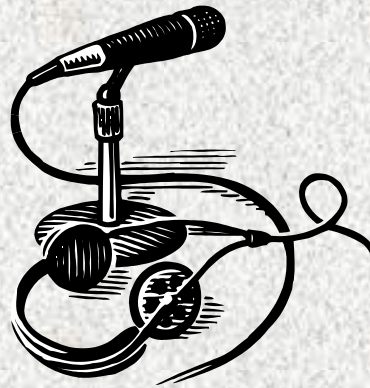
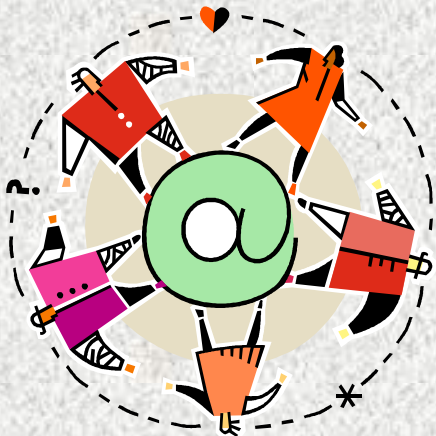
rated for continuous duty.

By the way there are many SIMPLEX REPEATERS..

WHAT A REPATER PROVIDES

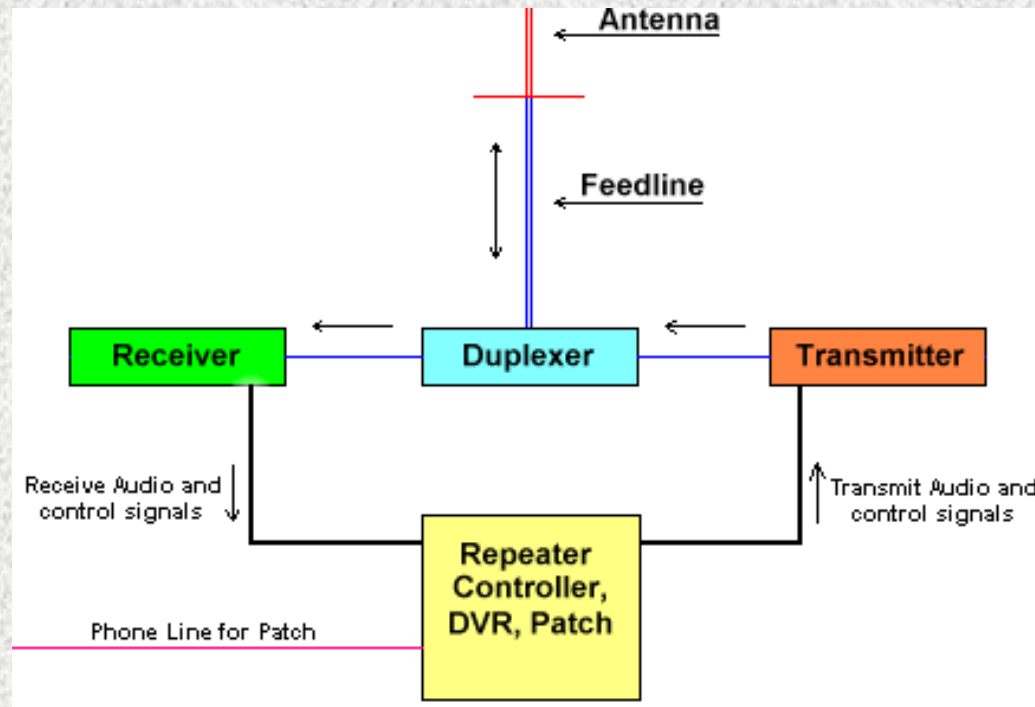
People using a repeater get much greater range from their radio equipment than would be possible talking simplex (from radio to radio).

This is how an individual with a portable walkie-talkie (handheld) transceiver can communicate with people many miles away with good clarity. Repeaters are used in Commercial (Business) Communications, Emergency Communications (either by 'hams' or by Federal or Local Government agencies).



How does a Repeater work?

At first glance, a repeater might appear complicated, but if we take it apart, piece by piece, it's really not really so difficult to understand. A basic repeater consists of several individual pieces that, when connected, form a functional system. Here's a simple block diagram of a repeater:



Duplexer

This device serves a critical role in a repeater. To make a long story short, the duplexer separates and isolates the incoming signal from the outgoing and vice versa. Even though the repeaters input and output frequencies are different, the duplexer is still needed. Why? Have you ever been in a place where there's lots of RF activity, and noticed the receive performance of your radio degrades to some degree? This is called desensitization, or desense, and it's a bad thing on a repeater. The receiver goes deaf or gets desensitized from the strong RF signals being radiated in its vicinity and confused about which signal it should receive. The result is poor receive quality, or in extreme cases, complete lack of receive capability.

Keep in mind that in this example, the radios are picking up radiated power from one another and that's enough to cause trouble. Now imagine how much trouble there will be if you not only have the transmitter and receiver close together, but connect them to the same antenna!

Transmitting only a few hundred kHz away in frequency would blow away the input to the receiver if the equipment was simply connected together with a Tee. That's where the duplexer comes in; it prevents the receiver and transmitter from 'hearing' one another by the isolation it provides.

And the more isolation the better.

A duplexer is a device that is referred to by several different names like cavities or cans. A duplexer has the shape of tall canisters and is designed to pass a very narrow range of frequencies and to reject others. There is some loss to the system because of the duplexer, however, the advantage of being able to use a single antenna usually outweighs the drawbacks.

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Controller -

This is the brain of the repeater. It handles station identification (through either CW or voice or both), activates the transmitter at the appropriate times,

controls the auto patch, and sometimes does many other things.

Some machines also have a DVR (Digital Voice Recorder) for announcements and messages.

The controller is a little computer that's Programmed and optimized to control a repeater.

The various models of controllers have different useful features like speed-dial for phone patches, a voice clock, facilities to control a remote base or linking, etc.

The controller gives the repeater its 'personality'.

Whenever you're using a repeater, you're interacting with its controller.

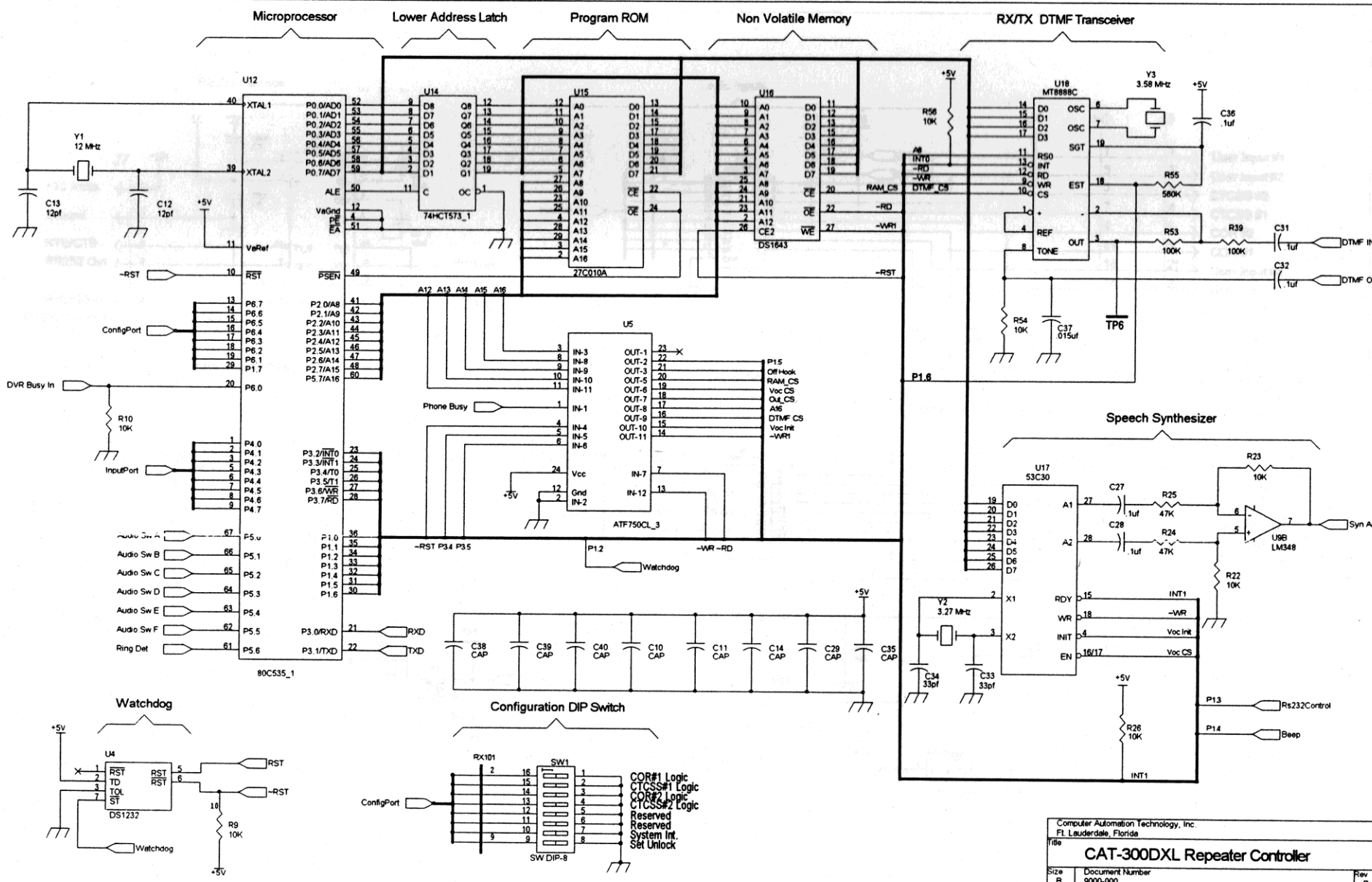
WAIT FOR THE TONE!!!

Most machines have what is called a courtesy tone..

This tone is thee to indicate the station has stopped transmitting

And is ready for the next transmission.

There is a delay between the carrier drop and the tone to allow for a different Station to jump in and ID. Thus the term "COURTESY TONE"



| | | |
|---|--------------------------|-------|
| Computer Automation Technology, Inc. Fl. Lauderdale, Florida | | |
| File CAT-300DXL Repeater Controller | | |
| Size B | Document Number 9000-000 | Rev B |

What is The Offset?

144 to 148 MHz BAND PLAN

| | | | | |
|---|--|--|----------------------|--|
| 144.000 - 144.100 | CW | | 145.500 - 145.800 | Simplex and Experimental |
| 144.100 - 144.275 | Weak Signal SSB (144.200 Calling Freq.) | | 145.800 - 146.000 | Satellite Sub-Band |
| 144.275 - 144.300 | Propagation Beacons | | 146.020 - 146.400 | Repeater Inputs - paired with 146.62-147.00 Outputs |
| 144.300 - 144.500 | Satellite Sub-Band | | 146.400 - 146.600 | Simplex (146.520 Natl. Calling Freq.) |
| 144.390 | Automatic Position Reporting System | | 146.620 - 147.000 | Repeater Outputs - 20 KHz spacing even 10 KHz (-) |
| 144.500 - 144.900 | Repeater Inputs - paired with 145.10-145.50 Outputs | | 147.000 - 147.380 | Repeater Outputs - 20 KHz spacing even 10 KHz (+) |
| 144.900 - 145.100 | Packet | | 147.400 - 147.600 | Simplex |
| 145.100 - 145.500 | Repeater Outputs - 20 KHz spacing odd 10 KHz (-) | | 147.600 - 147.980 | Repeater Inputs - paired with 147.00-147.38 Outputs |
| Note 1. All Repeater input to output spacing is 600 KHz. | | | | |
| Note 2. The 145.25 Tx, 144.65 Rx repeater pair is a limited range, shared, non-protected channel and requires CTCSS or equivalent on the input and output | | | | |

REPEATERS ON OTHER BANDS!!

What is The Offset?

10 Meters (28-29.7 MHz):

| | |
|---------------|---------------------|
| 28.000-28.070 | CW |
| 28.070-28.150 | RTTY |
| 28.150-28.190 | CW |
| 28.200-28.300 | Beacons |
| 28.300-29.300 | Phone |
| 28.680 | SSTV |
| 29.000-29.200 | AM |
| 29.300-29.510 | Satellite Downlinks |
| 29.520-29.590 | Repeater Inputs |
| 29.600 | FM Simplex |
| 29.610-29.700 | Repeater Outputs |

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|------------------------|---|
| 51.12-51.48 | Repeater inputs (19 channels) |
| 51.12-51.18 | Digital repeater inputs |
| 51.62-51.98 | Repeater outputs (19 channels) |
| 51.62-51.68 | Digital repeater outputs |
| 52.0-52.48 | Repeater inputs (except as noted; 23 channels) |
| 52.02, 52.04 | FM simplex |
| 52.2 | TEST PAIR (input) |
| 52.5-52.98 | Repeater output (except as noted; 23 channels) |
| 52.525 | Primary FM simplex |
| 52.54 | Secondary FM simplex |
| 52.7 | TEST PAIR (output) |
| 53.0-53.48 | Repeater inputs (except as noted; 19 channels) |
| 53.0 | Remote base FM simplex |
| 53.02 | Simplex |
| 53.1, 53.2, 53.3, 53.4 | Radio remote control |
| 53.5-53.98 | Repeater outputs (except as noted; 19 channels) |
| 53.5, 53.6, 53.7, 53.8 | Radio remote control |
| 53.52, 53.9 | Simplex |

What
is The
Offset
?

1.25 Meters (222-225 MHz):

What is The Offset?

| | |
|---------------|---|
| 222.0-222.150 | Weak-signal modes |
| 222.0-222.025 | EME |
| 222.05-222.06 | Propagation beacons |
| 222.1 | SSB & CW calling frequency |
| 222.10-222.15 | Weak-signal CW & SSB |
| 222.15-222.25 | Local coordinator's option; weak signal, ACSB, repeater inputs, control |
| 222.25-223.38 | FM repeater inputs only |
| 223.40-223.52 | FM simplex |
| 223.52-223.64 | Digital, packet |
| 223.64-223.70 | Links, control |
| 223.71-223.85 | Local coordinator's option; FM simplex, packet, repeater outputs |
| 223.85-224.98 | Repeater outputs only |

70 Centimeters (420-450 MHz):

What
is The
Offset
?

| | |
|---------------|--|
| 420.00-426.00 | ATV repeater or simplex with 421.25 MHz video carrier control links and experimental |
| 426.00-432.00 | ATV simplex with 427.250-MHz video carrier frequency |
| 432.00-432.07 | EME (Earth-Moon-Earth) |
| 432.07-432.10 | Weak-signal CW |
| 432.10 | 70-cm calling frequency |
| 432.10-432.30 | Mixed-mode and weak-signal work |
| 432.30-432.40 | Propagation beacons |
| 432.40-433.00 | Mixed-mode and weak-signal work |
| 433.00-435.00 | Auxiliary/repeater links |

70 Centimeters (420-450 MHz): CONTINUED

What is The Offset?

| | |
|-------------------|---|
| 435.00- 438.00 | Satellite only (internationally) |
| 438.00- 444.00 | ATV repeater input with 439.250-MHz video carrier frequency and repeater links |
| 442.00- 445.00 | Repeater inputs and outputs (local option) |
| 445.00- 447.00 | Shared by auxiliary and control links, repeaters and simplex (local option) |
| 446.00 | National simplex frequency |
| 447.00- 450.00 | Repeater inputs and outputs (local option) |

33 Centimeters (902-928 MHz):

What is The Offset?

| | |
|-------------|--|
| 902.0-903.0 | Narrow-bandwidth, weak-signal communications |
| 902.0-902.8 | SSTV, FAX, ACSSB, experimental |
| 902.1 | Weak-signal calling frequency |
| 902.8-903.0 | Reserved for EME, CW expansion |
| 903.1 | Alternate calling frequency |
| 903.0-906.0 | Digital communications |
| 906-909 | FM repeater inputs |
| 909-915 | ATV |
| 915-918 | Digital communications |
| 918-921 | FM repeater outputs |
| 921-927 | ATV |
| 927-928 | FM simplex and links |

Many more Visit ARRL.ORG



What is CTCSS or a PL Tone?

PL, an acronym for Private Line, is Motorola's proprietary name for a radio communications industry standard signaling scheme called the Continuous Tone Coded Squelch System, or CTCSS.

General Electric uses the name "Channel Guard" or CG for the same system. Other names, such as Call Guard or Quiet Channel are used by other manufacturers. No matter what the name, the system is used to prevent a repeater from responding to unwanted signals or interference. Tone Squelch is an electronic means of allowing a repeater to respond only to stations that encode or send the proper tone.

Any station may be set up to transmit this unique low frequency tone that allows the repeater to operate. If a repeater is "in PL mode" that means it requires a CTCSS tone to activate the repeater. In days of old, repeaters that used PL were considered to be closed or private. This is no longer the case as tone operation has become more the rule instead of the exception.

CTCSS is often referred to as PL, Channel Guard, and others.



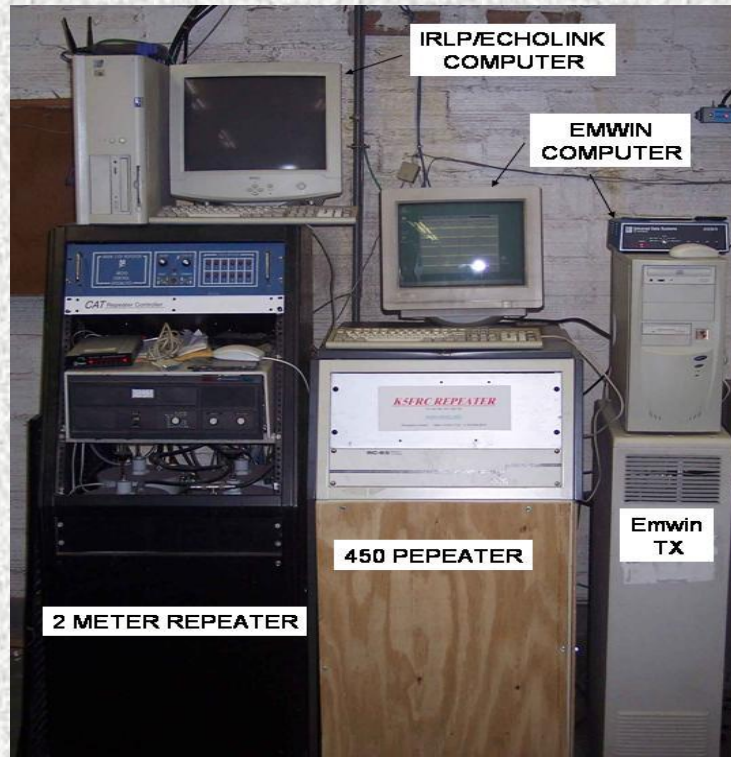
This chart shows each PL tone's two-character alphanumeric designator and corresponding tone frequency in Hertz.

| | | | | | |
|-----------------|-----------------|-----------------|------------------|-----------------|-----------------|
| XZ 67.0 | B 107.2 | 6A 173.8 | WZ 69.3 | 2Z 110.9 | 6B 179.9 |
| XA 71.9 | 2A 114.8 | 7Z 186.2 | WA 74.4 | 2B 118.8 | 7A 192.8 |
| XB 77.0 | 3Z 123.0 | M1 203.5 | WB 79.7 | 3A 127.3 | 8Z 206.5 |
| YZ 82.5 | 3B 131.8 | M2 210.7 | YA 85.4 | 4Z 136.5 | M3 218.1 |
| YB 88.5 | 4A 141.3 | M4 225.7 | ZZ 91.5 | 4B 146.2 | 9Z 229.1 |
| ZA 94.8 | 5Z 151.4 | M5 233.6 | ZB 97.4 5 | A 156.7 | M6 241.8 |
| 1Z 100.0 | 5B 162.2 | M7 250.3 | 1A 103.5 | 6Z 167.9 | 0Z 254.1 |



FCRC REPEATERS

K5FRC/R



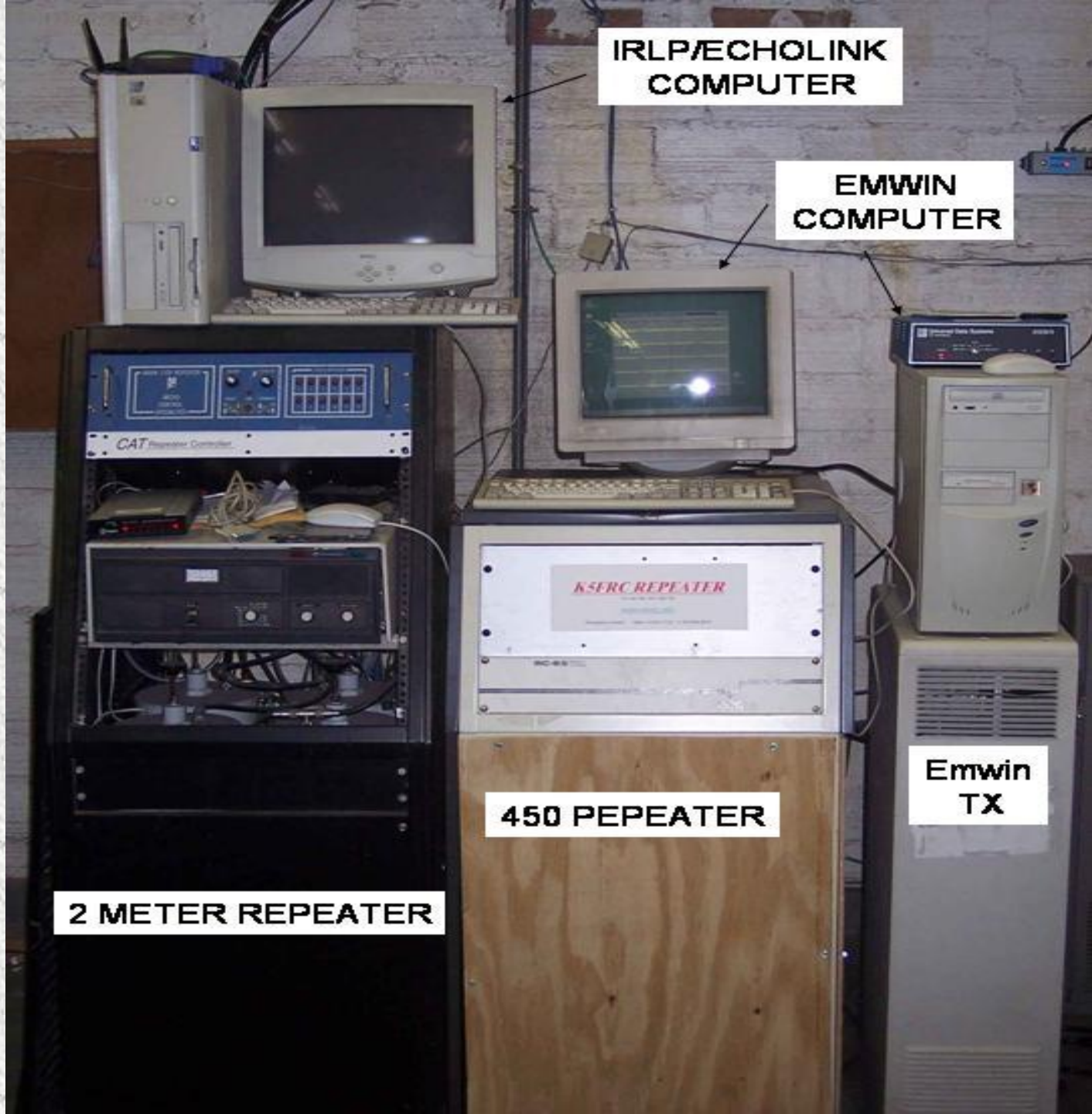
**IRLP/ECHOLINK
COMPUTER**

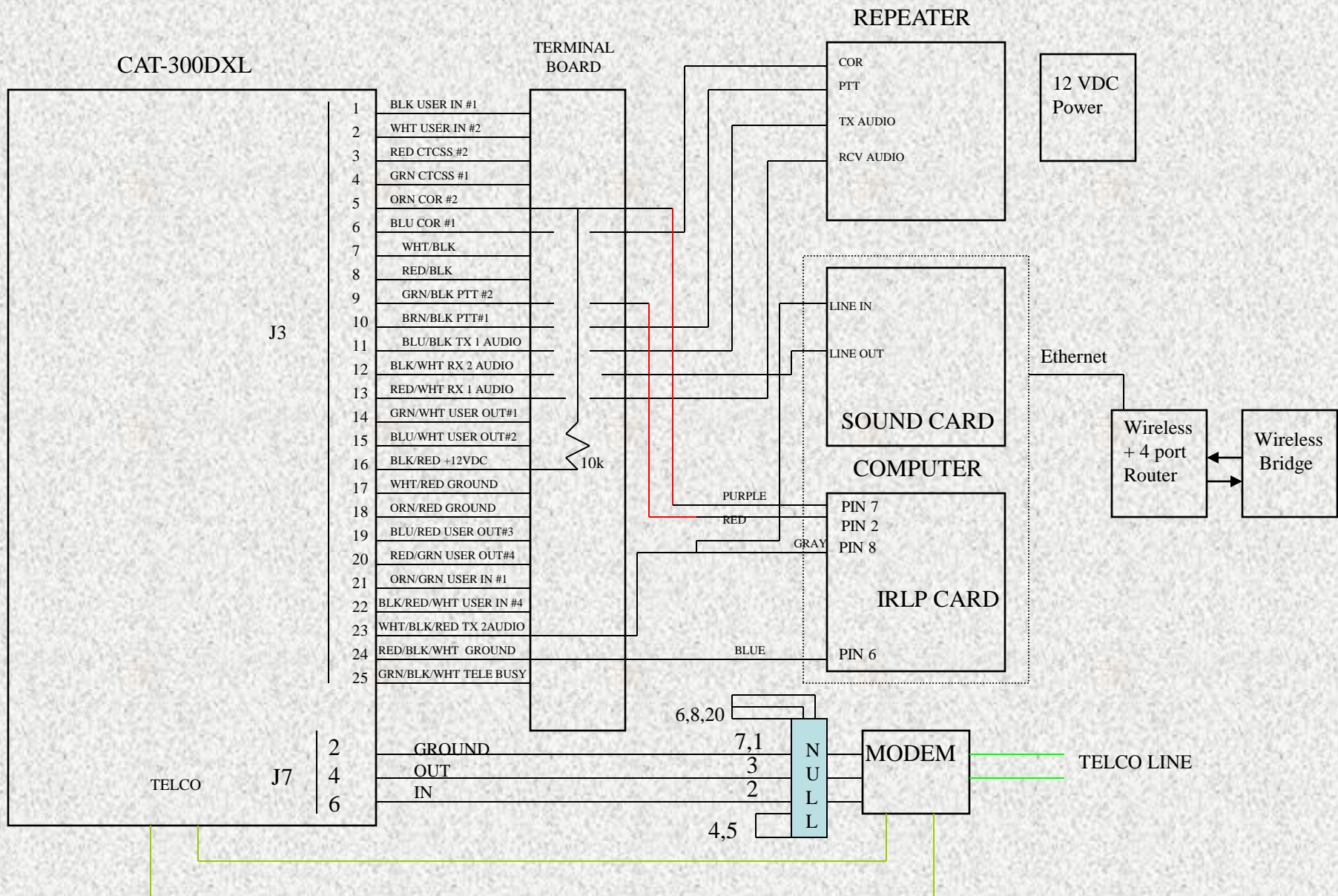
**EMWIN
COMPUTER**

2 METER REPEATER

450 PEPEATER

**Emwin
TX**





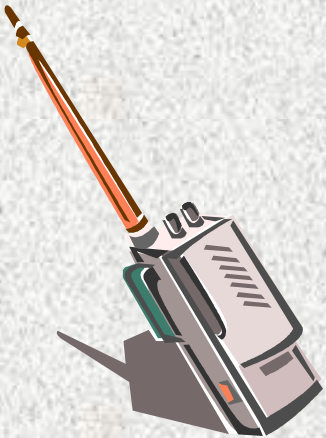
K5FRC TWO METER SYSTEM

USING A REPEATER

There are two types of repeater operators:
Control Operators and Users:

The Control Operator has control over the functions, configuration,
And all operational features of the systems.
THE CONTROL OPERATOR IS THE REPEATER GOD!!

Users are the normal operators using the repeater functions.
Control functions in some cases are available to the users.
i.e. IRLP, ECHOLINK, Touch Tone Testing,
Phone Patches, etc.



FCARC Repeaters

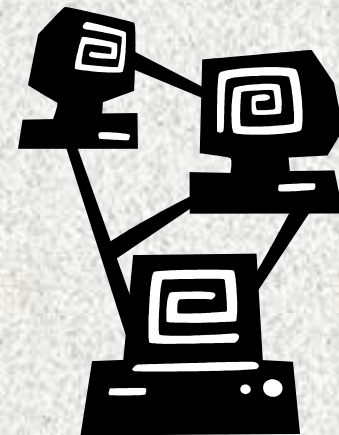
IRLP NODE 3602 ECHOLINK 143902 on 145.47
IRLP NODE 7901 ECHOLINK 554534 ON 443.750

The FCARC sponsors 3 FM repeaters:

2-meter FM repeater is located at 145.470 MHz, with a negative offset.
Also located on a northern tower 145.130 MHz. with negative offset.

The K5FRC 70cm repeater is located at 443.750 MHz (+ 5MHz offset),
with an input frequency of 448.750 MHz.

There is an available auto patch on the 145.47 all the repeaters are open,
and all are welcome to use them.



Portable system



REPEATER OPERATION

To access phone auto patch

1. Identify
2. PTT then enter * plus 10 digit phone number.
3. Release and wait for call to complete.
4. PTT to talk with phone in simplex.
5. PTT and enter # to drop phone line.
6. Identify

To check your audio on K5FRC 2 meter repeater. 145.47 only

1. Identify.
2. PTT and enter A7.
3. Release PTT and wait for voice prompt.
4. PTT and do your audio test.
5. Release and listen to the recording playback.
6. Test ends automatically.
7. Repeat (PTT and A7) as needed.
8. Identify.

If you dial 911 BE SURE TO GIVE YOUR LOCATION AND IDENTIFY YOURSELF AS A RADIO OPERATOR!!!

THE 911 OPERATOR WILL SEE YOU AS LOCATED IN THE VA HOSPITAL..

REPEATER OPERATION

Key Pad Test

1. Identify.
2. Key up and send digit A5 followed by any other keys you want to test.
3. Release PTT and listen to results.
The repeater will respond WITH THE DIGITS SENT if it decodes you properly.
By the way # reply is Pound * reply is sierra.
4. Note - a good signal is required to decode the touch tones.
The D does not respond on 2 meters!!
5. Identify.
6. To test your audio with out IRLP just the repeater Hit A7 145.47 only
You will hear "START TEST NOW" Key up and talk.
Your voice will be recorded and played back to you.

Various voice programs (time, model number, etc.)

1. Identify

For the 2 145.47 meter repeater the sequence is A3XX where XX is 01 - 20

What good are these functions?

The keypad test is a good way to tell if that "5" on your keypad really is flaky or is it your antenna/location that is giving you a poor signal.

It takes a good signal (near full quieting) for the controller to decode the keypad signals. How do you "REALLY" sound on the repeater.

Do you have a broken mic cord like the last QSO told you?

Do you hold the mic too close? too far? Speak too loud? Too soft? Background noise?

Most FM rigs do not have a mic gain control so you have to learn where to hold the mic for your voice on your rig.

EchoLink

**K5FRC HAS TWO EchoLink node numberS
143902 ON 145.47 AND 554534 ON 443.750**

From the echolink.org web site:

"EchoLink software allows licensed Amateur Radio stations to communicate with one another over the Internet, using voice-over-IP (VoIP) technology.

The program allows worldwide connections to be made between stations, or from computer to station, greatly enhancing Amateur Radio's communications capabilities. There are more than 150,000 registered users in 152 nations worldwide!"

For more information on echolink, and to download the software, see the echolink.org web site.

To access Echolink

1. Identify.
2. PTT then enter # + the remote node number.
3. Release and wait for voice message.
4. PTT to talk with remote node (pause before speaking after each PTT).
5. PTT and enter #73 to drop link.
6. Identify.

The courtesy tone for the IRLP and ECHOLINK stations is different Than the normal tone so it is easy to tell when the station as unkeyed.

IRLP

K5FRC is IRLP node number 3602 on 145.47

And 7901 on 443.750

From the IRLP.net web site:

"The aim of this project is to reliably and inexpensively link amateur radio systems without the use of RF links, leased lines, or satellites.

The IRLP uses Voice-Over-IP (VoIP) custom software and hardware.

Coupled with the power of the Internet, IRLP will link your repeater site or simplex station to the world in a simple and cost effective way.

IRLP operates a worldwide network of dedicated servers and nodes offering very stable worldwide voice communications between hundreds of towns and cities. All this with unsurpassed

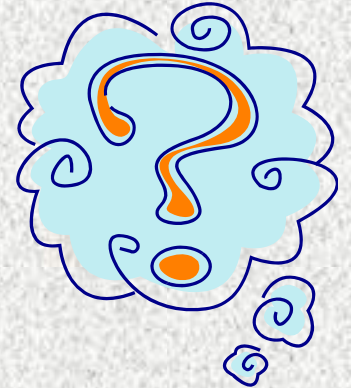
uptimes and the full dynamic range of telephone quality audio" IRLP.net web site.

To access IRLP

1. Identify
2. PTT then enter the node number.
3. Release and wait for voice message.
4. PTT to talk with remote node (pause before speaking after each PTT).
5. PTT and enter 73 to drop link.
6. Identify.

**FCRC
REPEATER SYSTEM**

VIDEO TOUR!!



QUESTIONS?

