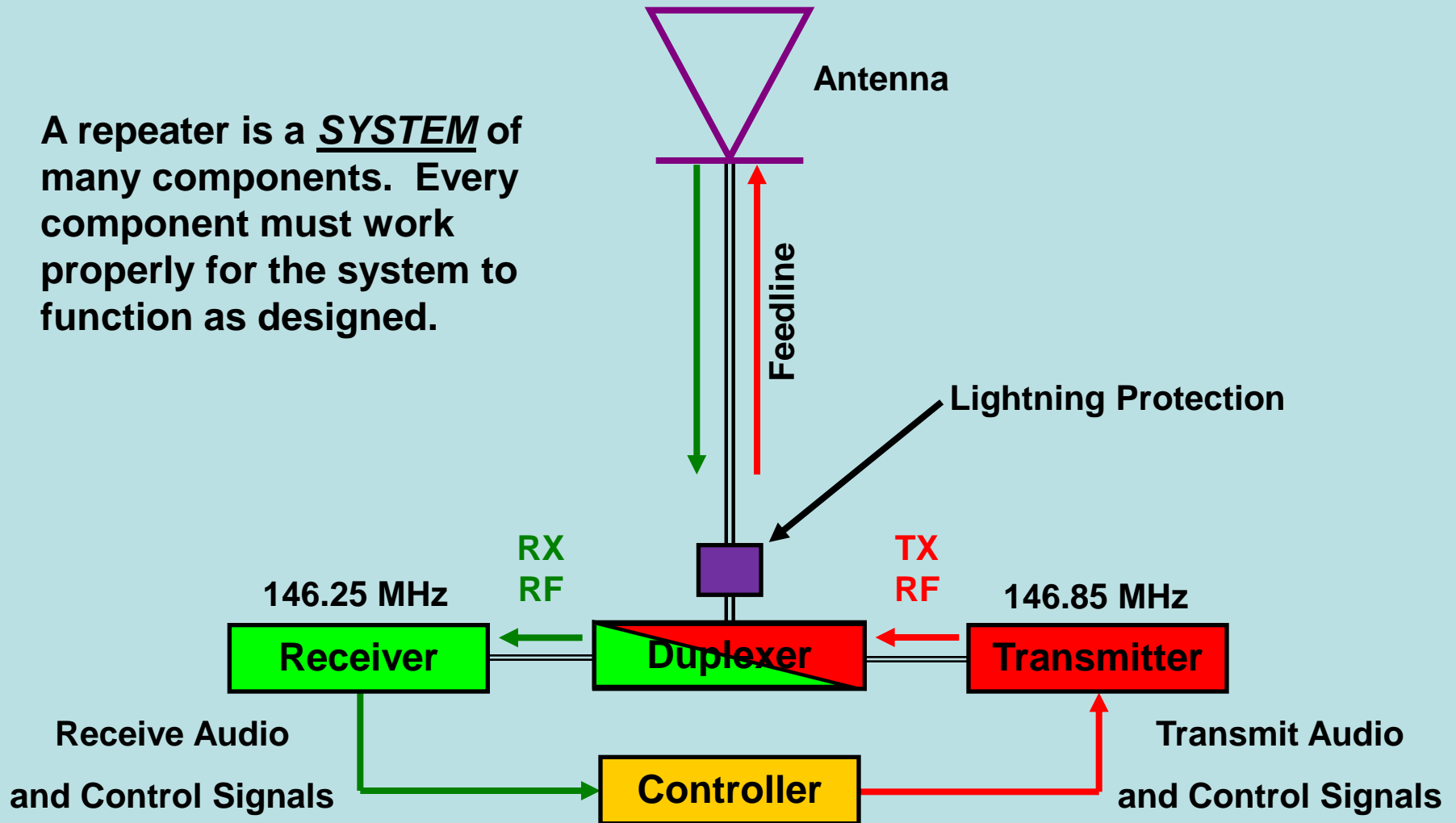


Repeater 101



Repeater Block Diagram

A repeater is a SYSTEM of many components. Every component must work properly for the system to function as designed.



Repeater Components



Cochran Site – 145.110



Repeater Components



Receiver



CAT-1000 Controller, Digital Voice Recorder, and Audio Delay Board



Warner Robins Equipment – 146.850

Antenna

- Specially designed for duplex operation
- Extremely rugged design
- Omnidirectional
- Handles 500 watts
- 6 dB gain
- 21 feet long
- 32 lbs
- Survivable in 80 MPH winds
- Approximately \$700



Feedline



- **7/8" Heliax**
- **Helical outer shield with 100% coverage**
- **Helical, hollow center conductor**
- **Foam Dielectric**
- **Good for 315 watts @ 2.5 GHz**
- **Loss = 0.254 dB per 100 feet @ 150 MHz**
- **Minimum bend radius = 20"**
- **Weight = 0.82 pounds per foot**
- **Special connectors required – about \$50 each**

What is a Duplexer?



- A cavity-type filter consisting of 4 or 6 separate cavities or 'cans'; a Band-Pass/Band Reject filter
- 2 cavities are connected in series with the transmitter and the other two cavities are connected in series with the receiver
- The other end of the cavities connect to the antenna system with a Tee-Connector
- The cavities tied to the transmitter pass the transmit frequency and attenuate the receive frequency
- The cavities tied to the receiver pass the receive frequency and attenuate the transmit frequency

What Does a Duplexer Do?

**RX Cavity: Passes the Receiver Frequency
and Blocks the Transmitter Frequency**

Receiver Frequency: 146.25
~ 1.5 dB loss @ 146.25
~ 85 dB attenuation @ 146.85

$$\begin{array}{r} 0.16 \text{ uV} = -123 \text{ dBm} \\ \text{minus} \quad -1.5 \text{ dB} \\ \hline -121.5 \text{ dBm} = 0.19 \text{ uV} \end{array}$$

(Actual Receiver Sensitivity)
(Loss at RX Frequency)
(Apparent Receiver Sensitivity)

$$\begin{array}{r} 30 \text{ W} = 45 \text{ dBm} \\ \text{minus} \quad 85 \text{ dB} \\ \hline -40 \text{ dBm} = 0.000003 \text{ W} \end{array}$$

(Transmitter Power Output)
(Attenuation at TX Frequency)
(Apparent TX power at RX Input)

3dB loss = 1/2 power

What Does a Duplexer Do?

**TX Cavity: Passes the Transmitter Frequency
and Blocks the Receiver Frequency**

Transmitter Frequency: 146.85

~ 1.5 dB loss @ 146.85

~ 85 dB attenuation @ 146.25

30 W = 45 dBm

minus 1.5 dB

43.5 dBm = 21.5 W

(Transmitter Power)

(Loss at TX Frequency)

(Apparent Transmitter Power)

0.16 uV = -123 dBm

minus 85 dB

-208 dBm = 8.9 pV

or 0.0000000000089 V

or 8.9 Trillionths of a Volt

(RX Signal Level)

(Attenuation at RX Frequency)

(Apparent RX Signal at TX Input)

3dB loss = 1/2 power

What Does a Duplexer Do?

Receiver Frequency: 146.25

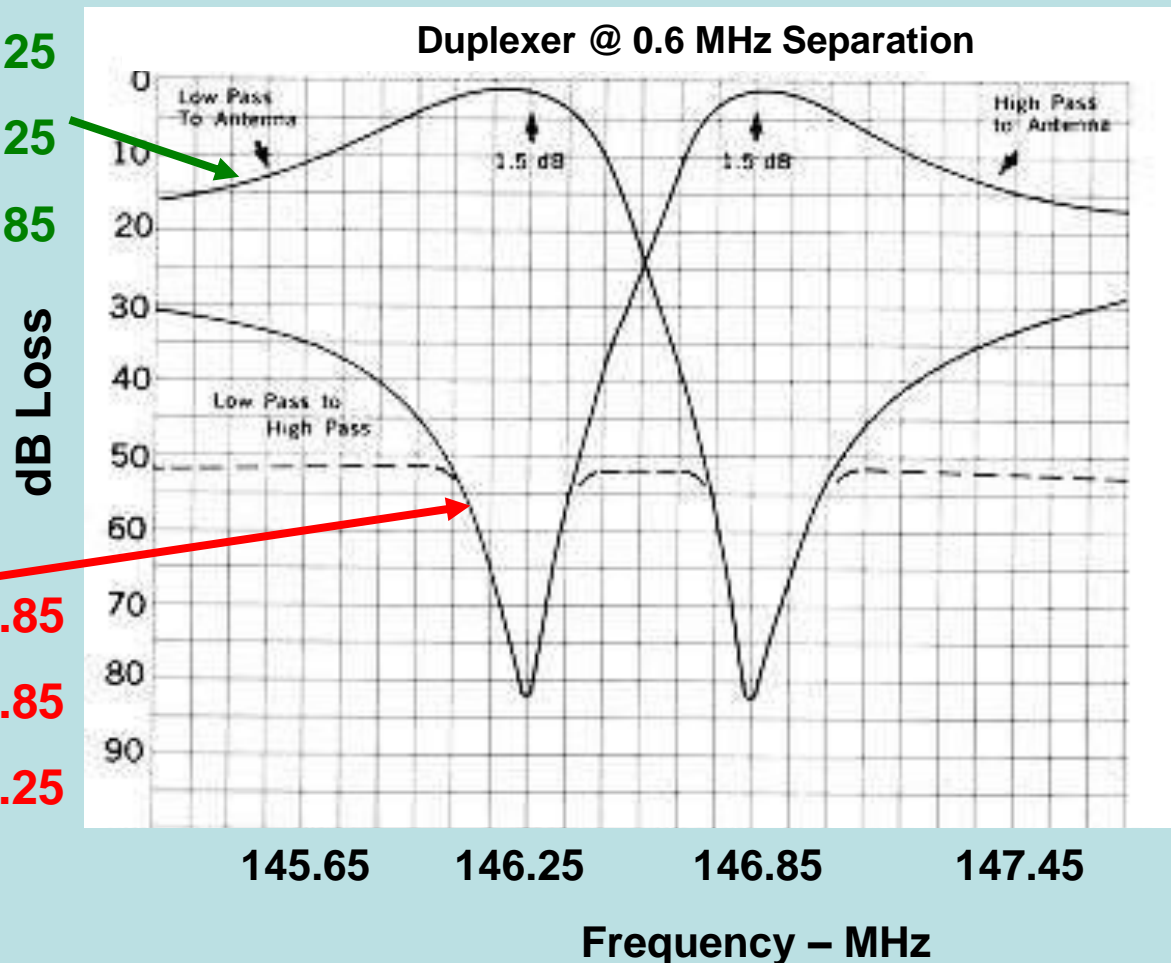
~ 1.5 dB loss @ 146.25

~ 85 dB attenuation @ 146.85

Transmitter Frequency: 146.85

~ 1.5 dB loss @ 146.85

~ 85 dB attenuation @ 146.25

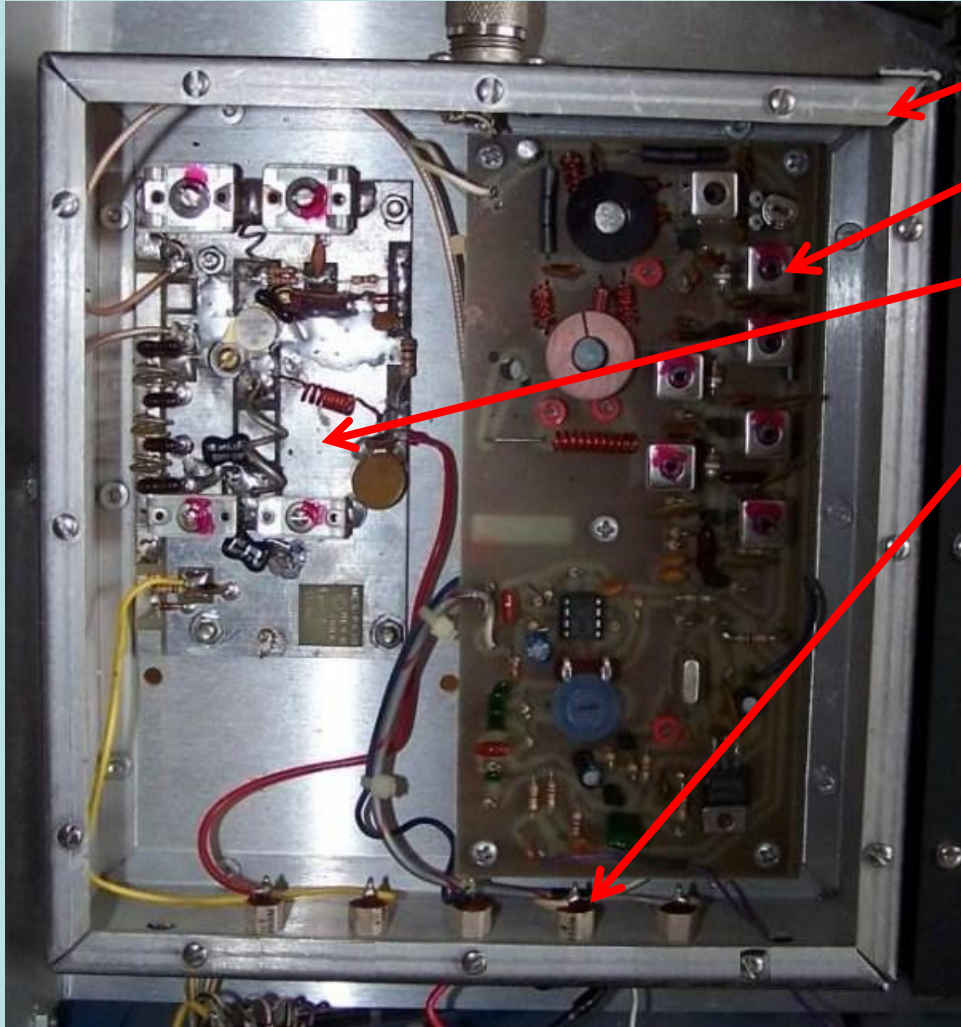


The Receiver



- Heavy Duty Case
- Helical Resonators in RF/IF Section to Increase Selectivity
- Entire Board Heavily Shielded
- Inputs Filtered/Bypassed to Prevent RF Leakage
- Provides Fixed-Level Audio Output and Carrier Operated Squelch Signal for Controller

The Transmitter

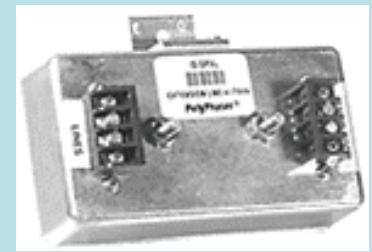


- Heavy Duty Case
- Multiplier Section Heavily Filtered
- PA Section Heavily Shielded
- Inputs Filtered/Bypassed to Prevent RF Leakage
- Designed for 100% Duty Cycle

What is a Controller?



- Links receiver audio to transmitter
- Controls transmitter Push-to-Talk
- Contains and manages all timers
 - e.g. Time-out-Timer, Squelch Tail Timer, ID Timer
- Manages repeater IDs
- Interface to APRS Weather Station, WX-200 WX receiver, autopatch, link radio
- Accepts inputs from the outside world to trigger events (e.g. an input from the battery-backup circuit changes the voice message if power fails)
- Provides outputs to outside world based on user requests or scheduled events (e.g. turn WX-200 WX receiver on & off)
- **MANY** more functions



What Else?

- All the cables inside the shack must be double shielded silver braid MIL-SPEC RG-214

- Anything less than 100% shield coverage WILL cause problems

- Type 'N' connectors are preferred

- Must be MIL-SPEC

- Any adapters must be MIL-SPEC and should be avoided if at all possible

- Lightning Protection

- Polyphaser installed on feedline

- Polyphaser installed on phone line

- Ground System

- At least four 8-foot ground rods (installed at each corner of the building)

- #4 or larger wire used to encircle shack, attached at each rod

- Single #4 or larger conductor leading into shack grounding block



Questions?

