

Ham Radio Troubleshooting

FRRL Program

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AH6EZ

Troubleshooting is a HUGE Topic

- Focus here is on RF and Audio issues
 - Computer issues are a whole separate issue
- Calm and well reasoned thought process
- Steps to divide and conquer
- Basic test equipment and metering

Keeping Things Straight

- How can you tell if something is wrong?
 - “Smoke and fire” or reception report?
- What are you trying to solve?
 - Signal path or signal quality?
- How will you know when you have fixed it?
- Is a temporary fix ok?
 - Middle of a contest, signal still legal and proper?
- Get all of the manuals and schematics ready
 - Understand how your station normally works
 - Gathering information so others can help you
- Label your cables

Knowing Something is Wrong

- Know what normal operation looks like
- Pay attention to your meters
- Listen to and accept signal reports
- Investigate quickly
 - Don't cause QRM or transmit spurious signals
- Do what it takes to keep your signals legal and proper

Divide and Conquer

- Transmit or receive only?
- Equipment or antenna?
- Connection or failure?
- Equipment misadjustment?

RF Issues

- Weak signal reports
 - Low power output
 - Transmitter path failure
- Weak reception
 - Bad antenna connections
 - Receiver misadjusted
- High SWR
 - Loose RF cable connections
 - Antenna failures
- RF getting into your transmit audio
 - Sounds like raspy distortion on voice peaks with SSB
 - Can be howling sounds with FM

Audio Issues

- Audio level (usually a tx problem)
 - Bad audio connection?
 - Misadjustment?
- Audio distortion
 - Level or compression misadjusted?
 - RF getting into your transmit audio?
- Hum
 - Bad ground?
 - Broken shield in cable?
- RF in audio
 - Bad grounding?
 - Shield broken?

Safety

- If you can troubleshoot as follows, do so
 - AC and/or DC power turned off
 - All equipment enclosures closed
 - Do not touch antennas when transmitting
- If power on and enclosures closed
 - Use a dummy load
 - Use internal and/or external metering
 - Do not transmit without an antenna
- If power on and enclosures open
 - Special caution for tube equipment, high voltage
 - Watch out for large capacitors
 - Use insulated probes to avoid shorts
 - Insulated probes do not necessarily protect you
 - One hand in your pocket

Basic Troubleshooting Process

- Check connections
- Check adjustments
- Check power supply voltages
- Using schematic and board layouts
 - Generate or monitor levels and signal quality
 - Try to isolate the faulty function or circuit
 - Transmit path from Mic to antenna output
 - Receiver path from antenna input to speaker output
 - Finally identify faulty device or component

Basic RF troubleshooting steps

- Before you transmit
 - Loosen, clean, retighten all RF & audio connectors
 - Clean, tighten power supply connections
 - Check all radio control settings
 - Inspect antenna for physical integrity
- Listen to your transmitted signal if possible
 - Separate receiver or built-in transmit monitor
- Use a dummy load in case of spurious emissions
- Use antenna analyzer if possible on antenna
- If troubleshooting a circuit move from input to output

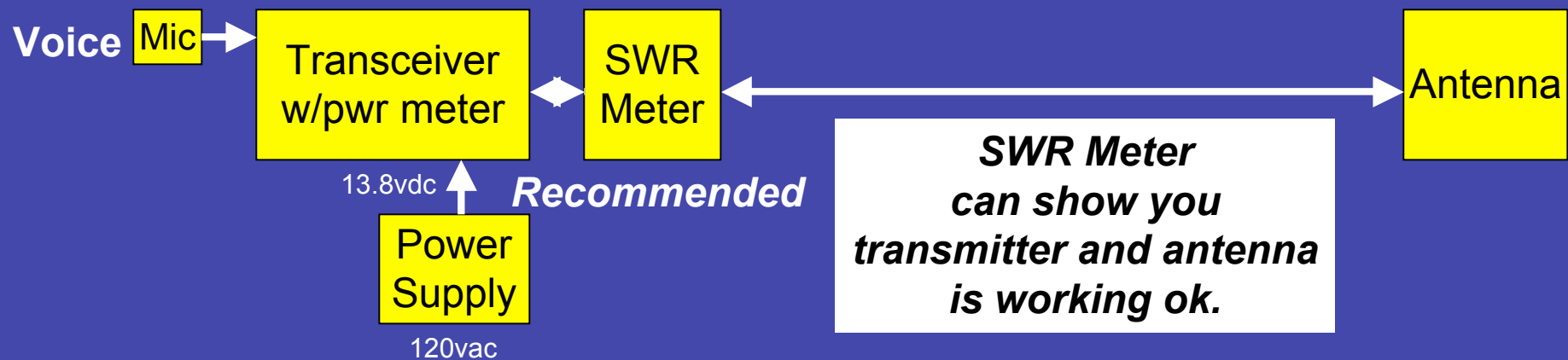
Basic Test Equipment

- SWR meter
 - Hopefully calibrated forward/reflective power
- Dummy load
- Separate receiver (or built-in monitor)
- Backup transceiver for substitution testing
- Backup antenna for substitution testing
- Digital meter
 - AC and DC volts
 - AC and DC current
 - Resistance
- Antenna analyzer such as MFJ-259
 - Low power SWR meter
 - Signal generator
 - Frequency counter

Troubleshooting Examples

Basic VHF/UHF station components

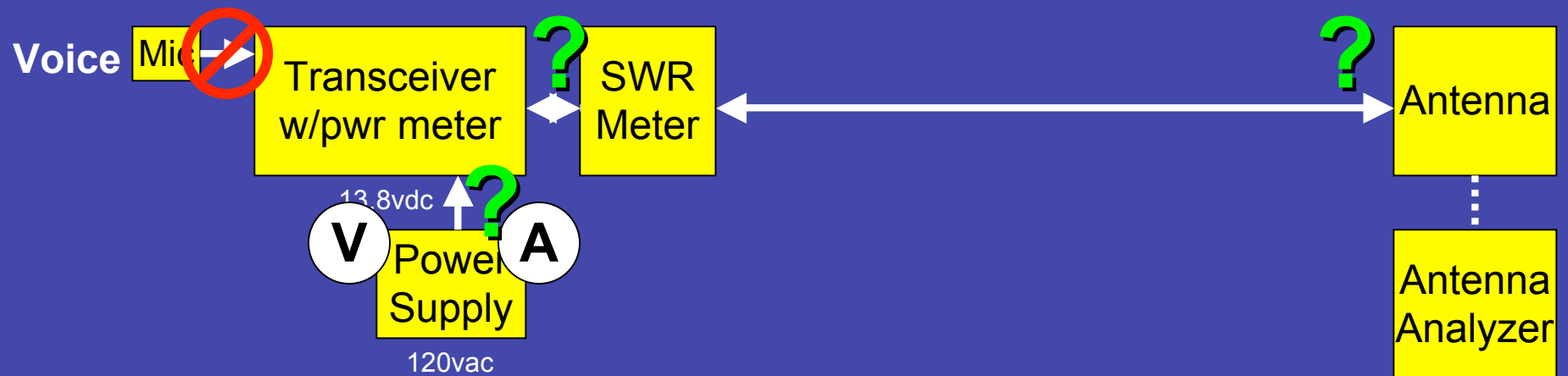
Remember some power meters do not indicate actual transmit power. Few simple rigs have any SWR metering.



Do you have an analog or digital volt meter?

Basic VHF/UHF station components

Symptom = Scratchy audio on transmit and receive



**Sudden or gradual problem?
One band or both bands?
Loose, dirty, or intermittent connections?**

Basic HF station components

Most transceivers will fold back their transmit power to protect themselves. Most HF rigs have SWR metering.

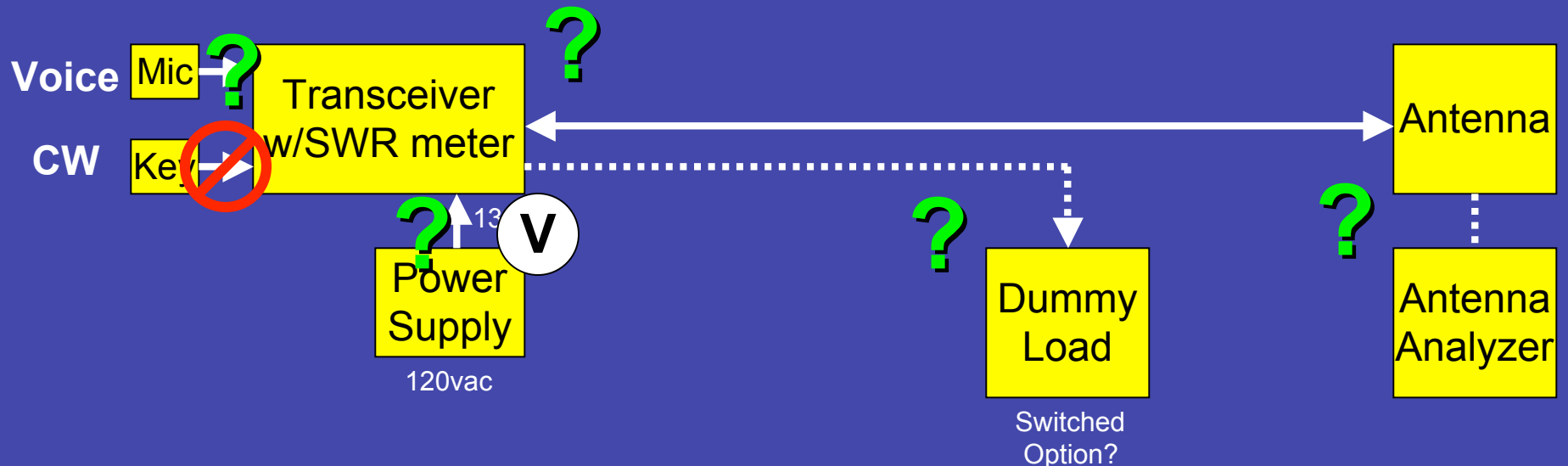
Multiple antennas useful for indoor troubleshooting



Highly recommended to be able to transmit without causing QRM

Basic HF station components

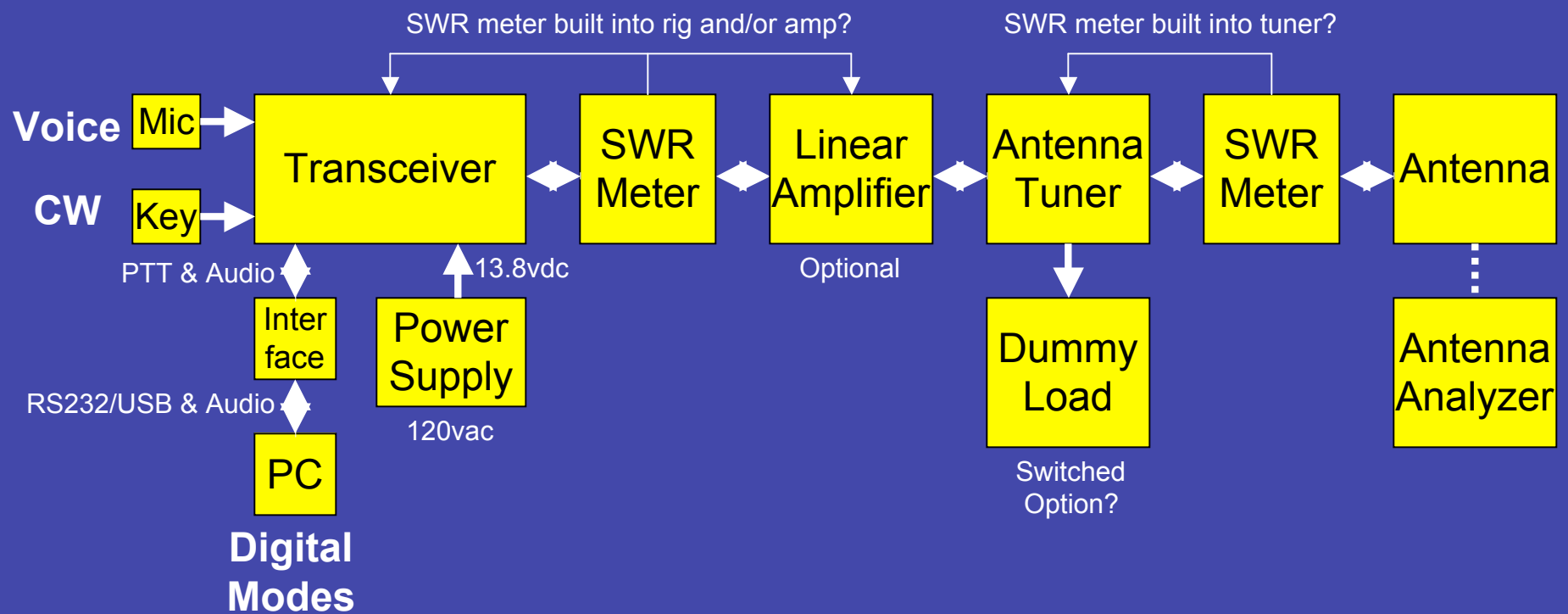
Symptom = Poor transmitted signal strengths (poor RST reports)



***Sudden or gradual problem?
Just band conditions?
Problems with other guy's receiver/antenna?
Bad RF cable connections?
Bad antenna?***

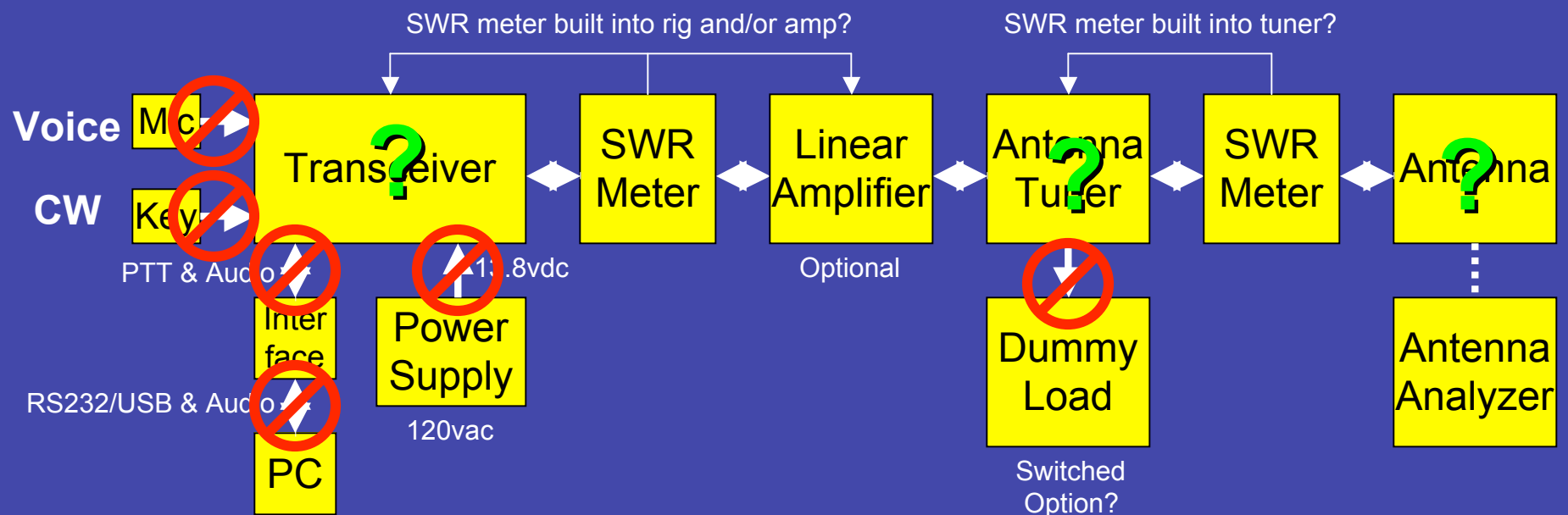
More advanced HF station components

Lots of modes, RF and audio connections, adjustments and metering



More advanced HF station components

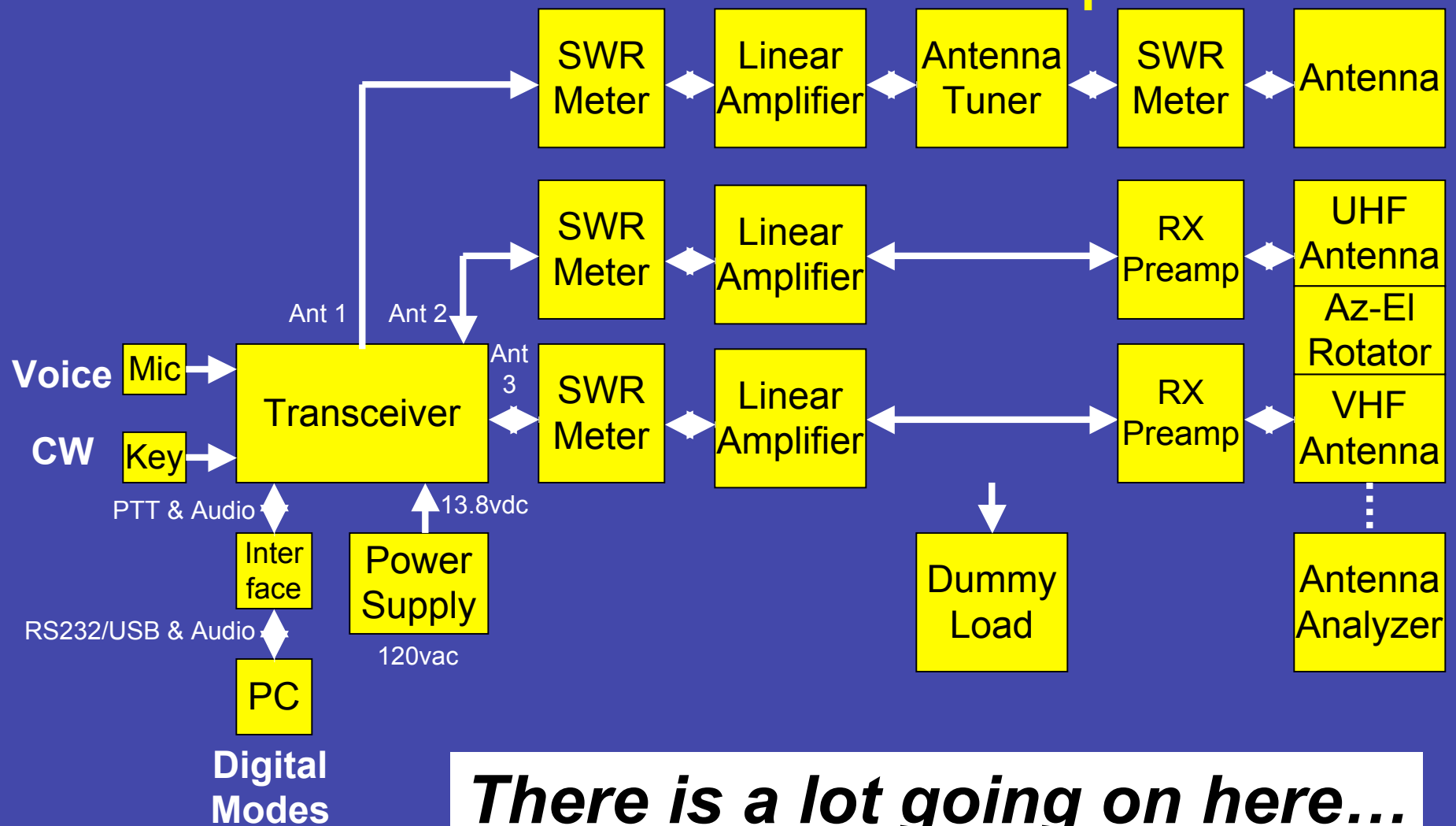
Symptom = Low received signal strengths



Digital Modes

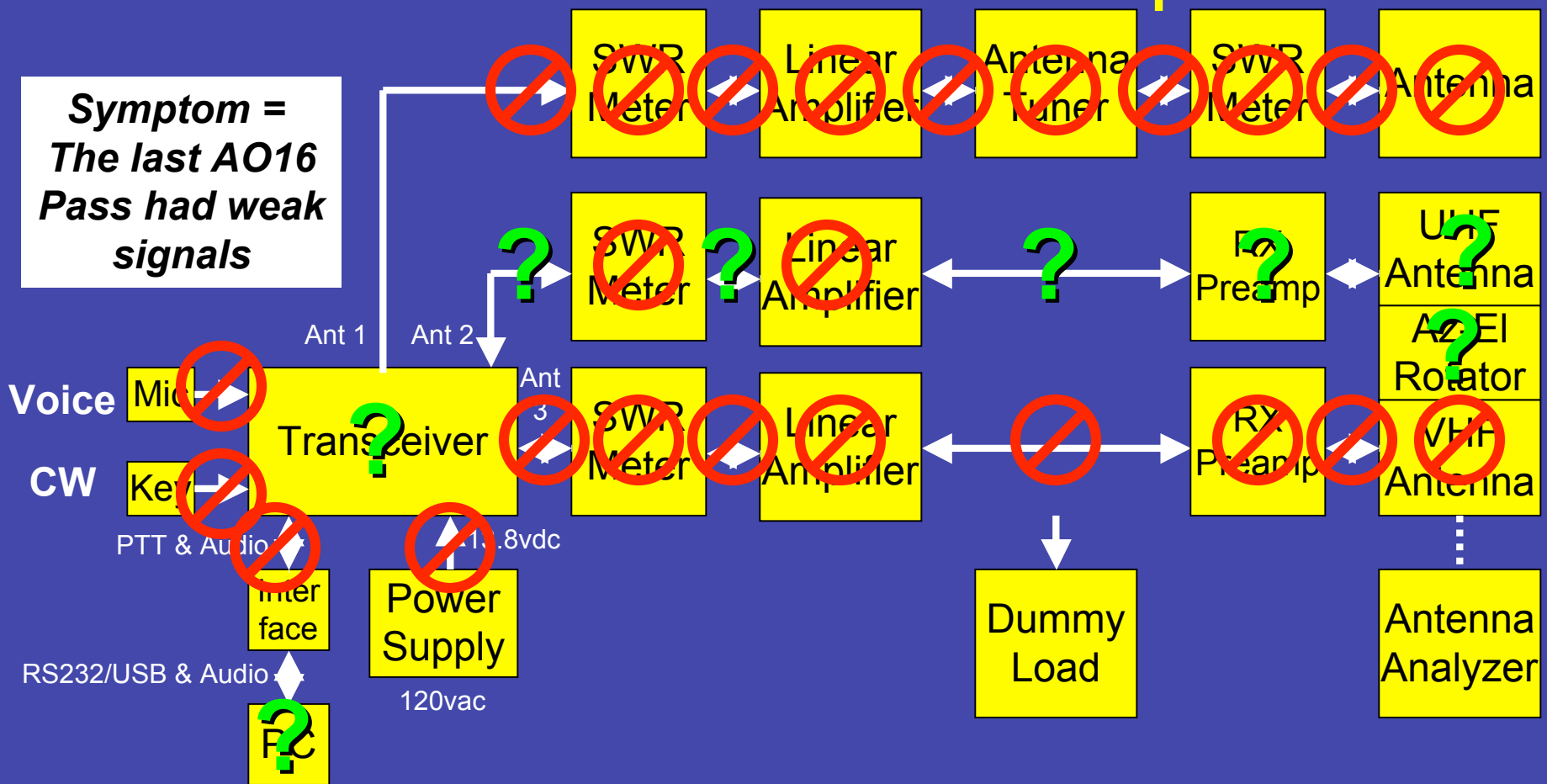
**Sudden, gradual, intermittent?
Antenna tuner in-line, but on wrong band?
Is transmit power and SWR ok?
Receiver misadjusted? Attenuator? RF gain?
Switched to wrong antenna?
Antenna damaged?**

More advanced HF/VHF/UHF station components



There is a lot going on here...

More advanced HF/VHF/UHF station components



**Symptom =
The last AO16
Pass had weak
signals**

**Are your Keplarian Elements updated?
DC power to receiver preamplifier?
Is the Az-El Rotator moving properly?
Satellite malfunctioning?**

**Digital
Modes**

Things to remember when troubleshooting

- Do not cause QRM
- Do not make things worse
- Consult your manuals
- Ask your fellow club members for advice/help
- Be logical and think before acting
- Be patient
- You will feel real good when you fix it...

May all your problems
be little inexpensive ones