

THE EXAM CORNER #6

By Steve Weeks, AA8SW

So far, we have covered electrical and RF safety, and propagation. The third major topic in this series is emissions. General Class amateurs may transmit many different kinds of signals – the FCC refers to these as “emissions”. It sounds complicated but at the General Class exam level, it isn’t.

Again, I will briefly discuss what you need to know about an aspect of that subject, then show you the only exam questions that could appear on that aspect, and follow with hints as to how you can remember the right answer. The correct answer is in bold.

- The process of encoding a “plain” RF signal (known as a carrier) with audio or other information is called “modulation”. The basic types of modulation are:

- Amplitude modulation, which varies the amplitude (instantaneous power level) of the signal. This is the oldest type of audio modulation and is widely used in broadcasting (such as the 540 to 1600 kHz band, known as the AM Broadcast Band). It is a double-sideband format since both sidebands are modulated equally. The “modulation envelope” of an AM signal is the waveform created by connecting consecutive peak values of the modulated signal.

- Frequency modulation, which varies the instantaneous frequency of an RF wave. An example of this is the FM Broadcast Band from 88 to 108 MHz. FM is also used for typical 2-meter repeater operations. Frequency Shift Keying (FSK) is a form of FM for digital communications where the binary bits (each a zero or a one) are represented by two different frequencies and the oscillator is directly controlled by a computer or other digital source to generate the varying frequencies.

- Single sideband (SSB), which is the most common voice transmission mode used by radio amateurs on HF bands. In this mode, the carrier and one of the sidebands are suppressed, and all of the transmission power is concentrated into the remaining single sideband so it uses the transmitter power most effectively of the voice modes. It also produces the narrowest bandwidth of the voice modes, since the carrier and one sideband are suppressed.

- Phase modulation, which varies the phase angle of an RF wave. It is produced by a “reactance modulator”.

So let’s review – amplitude modulation varies the amplitude (power level); frequency modulation varies the frequency; phase modulation varies the phase; and single sideband uses one sideband. Don’t make it difficult, just go with the obvious answers. Remember a “modulation envelope” is a “waveform”, “reactance modulator” goes with “phase modulation”, and FSK uses digital control over the oscillator.

G8A05 What type of modulation varies the instantaneous power level of the RF signal?

- A. Frequency shift keying
- B. Phase modulation
- C. Frequency modulation
- D. Amplitude modulation**

Hint: amplitude = power.

G8A11 What is the modulation envelope of an AM signal?

- A. The waveform created by connecting the peak values of the modulated signal**
- B. The carrier frequency that contains the signal
- C. Spurious signals that envelop nearby frequencies
- D. The bandwidth of the modulated signal

Hint: "envelope" is a waveform.

G8A03 What is the name of the process that changes the instantaneous frequency of an RF wave to convey information?

- A. Frequency convolution
- B. Frequency transformation
- C. Frequency conversion
- D. Frequency modulation**

Hint: modulation is the process of encoding information on a radio signal.

G8A01 How is an FSK signal generated?

- A. By keying an FM transmitter with a sub-audible tone
- B. By changing an oscillator's frequency directly with a digital control signal**
- C. By using a transceiver's computer data interface protocol to change frequencies
- D. By reconfiguring the CW keying input to act as a tone generator

G8A02 What is the name of the process that changes the phase angle of an RF wave to convey information?

- A. Phase convolution
- B. Phase modulation**
- C. Angle convolution
- D. Radian inversion

G8A04 What emission is produced by a reactance modulator connected to a transmitter RF amplifier stage?

- A. Multiplex modulation
- B. Phase modulation**
- C. Amplitude modulation
- D. Pulse modulation

Hint: this is one that you just have to remember – there is no logical connection between the terms reactance and phase.

G8A07 Which of the following phone emissions uses the narrowest bandwidth?

- A. Single sideband**
- B. Double sideband
- C. Phase modulation
- D. Frequency modulation

Hint: because the carrier and the other sideband are suppressed.

G8A06 What is one advantage of carrier suppression in a single sideband phone transmission versus full carrier amplitude modulation?

- A. Audio fidelity is improved
- B. Greater modulation percentage is obtainable with lower distortion
- C. Available transmitter power can be used more effectively**
- D. Simpler receiving equipment can be used

Hint: this is why SSB is by far more prevalent on amateur bands than AM – it generates a much stronger signal for each available watt of power..

- Overmodulation is a big problem in amateur radio. If you send too much audio power to the modulator, the resulting signal will be distorted and will “splatter”, covering excessive bandwidth; if you look an overdriven SSB signal on an oscilloscope, it will show “flat topping”. ALC is the amateur transceiver function that is activated by excessive audio drive and too much ALC action means that the microphone gain or other audio drive control needs to be reduced.

G8A08 Which of the following is an effect of overmodulation?

- A. Insufficient audio
- B. Insufficient bandwidth
- C. Frequency drift
- D. Excessive bandwidth**

Hint: also known as “splatter”.

G8A10 What is meant by the term flat-topping when referring to a single sideband phone transmission?

- A. Signal distortion caused by insufficient collector current
- B. The transmitter's automatic level control (ALC) is properly adjusted
- C. Signal distortion caused by excessive drive**
- D. The transmitter's carrier is properly suppressed

Hint: this term relates to what the overdriven output looks like on an oscilloscope, “bumping up” against the top and flattening out.

G8A09 What control is typically adjusted for proper ALC setting on an amateur single sideband transceiver?

- A. The RF clipping level
- B. Transmit audio or microphone gain**
- C. Antenna inductance or capacitance
- D. Attenuator level

Hint: ALC is the transceiver function that helps to limit audio overdrive. Too much ALC action means there is too much audio drive.

That’s the end of installment #6, and the first of the three exam sections on emissions. One question on the exam is guaranteed to come from the list above (so there will be a total of three exam questions on emissions).

Comments are welcome -- contact me at aa8sw@att.net, or Robert at ak3q@ak3q.com.