

## THE EXAM CORNER #8

By Steve Weeks, AA8SW

This is the last of three articles on the topic of emissions. This section deals with the rapidly-evolving subject of digital modes, and unfortunately that means that some of the questions (which were prepared in 2015) are a little outdated. In the 2019 revision, I'm sure that the examiners will update this material. In the meantime, we have to deal with the current question pool as we find it.

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 digital modes represent a merger of computer and radio functions. Accordingly, computer terms such as “bits” are involved. A bit is a single binary digit that can have the value of 0 or 1, and when transmitted by radio using Frequency Shift Keying, where one frequency represents a 0 and another frequency represents a 1, they are called “mark” and “space”.

G8C11 How are the two separate frequencies of a Frequency Shift Keyed (FSK) signal identified?

- A. Dot and Dash
- B. On and Off
- C. High and Low
- D. Mark and Space**

- Like in a computer, where a character is typically represented by a byte (8 bits), digital characters are sent by radio as a series of bits – which may be a specific number of bits for each character, or a varying number, depending on the protocol. Another name for one bit per second being transmitted is a “baud”.

At the time the questions were written, PSK31 was a very important protocol. The 31 stands for the transmitted symbol (baud) rate that it uses (about 31 bits per second). PSK 31 uses “Varicode” which represents different characters with varying numbers of bits, with more common characters using fewer bits, making it more efficient than having a fixed number of bits per character. Conversely, less common characters such as capital letters use more bits and slow down the transmission.

Radioteletype (RTTY) uses the Baudot code which has a fixed length of 7 bits – 5 for data, and the other two being start and stop bits.

G8C09 What does the number 31 represent in "PSK31"?

- A. The approximate transmitted symbol rate**
- B. The version of the PSK protocol
- C. The year in which PSK31 was invented
- D. The number of characters that can be represented by PSK31

G8C12 Which type of code is used for sending characters in a PSK31 signal?

- A. Varicode**
- B. Viterbi
- C. Volumetric
- D. Binary

G8C02 How many data bits are sent in a single PSK31 character?

- A. **The number varies**
- B. 5
- C. 7
- D. 8

*Hint: that's why they call it Varicode.*

G8C08 Which of the following statements is true about PSK31?

- A. Upper case letters make the signal stronger
- B. **Upper case letters use longer Varicode signals and thus slow down transmission**
- C. Varicode Error Correction is used to ensure accurate message reception
- D. Higher power is needed as compared to RTTY for similar error rates

● Some other protocols are based on those used to transmit data between computers (including over the Internet) which organize data into “packets”. The header of a data packet contains routing and handling information. Like in a computer network, a radio-based packet network evaluates each received packet and if an error is detected, it issues a NAK (negative acknowledgement) and requests retransmission.

G8C03 What part of a data packet contains the routing and handling information?

- A. Directory
- B. Preamble
- C. **Header**
- D. Footer

G8C07 How does the receiving station respond to an ARQ data mode packet containing errors?

- A. It terminates the contact
- B. **It requests the packet be retransmitted**
- C. It sends the packet back to the transmitting station
- D. It requests a change in transmitting protocol

*Hint: don't be distracted by the “ARQ” reference, just pick the obvious answer.*

G8C05 In the PACTOR protocol, what is meant by an NAK response to a transmitted packet?

- A. **The receiver is requesting the packet be retransmitted**
- B. The receiver is reporting the packet was received without error
- C. The receiver is busy decoding the packet
- D. The entire file has been received correctly

*Hint: don't be distracted by the “PACTOR” reference, just pick the obvious answer.*

● Like a timeout that occurs when computer communication fails, a radio-based packet network will drop the connection if excessive transmission attempts occur. Some more sophisticated protocols transmit redundant data which allow the receiver to correct an erroneous data packet without requesting retransmission; this is called “forward error correction” (FEC).

G8C06 What action results from a failure to exchange information due to excessive transmission attempts when using PACTOR or WINMOR?

- A. The checksum overflows
- B. **The connection is dropped**
- C. Packets will be routed incorrectly
- D. Encoding reverts to the default character set

G8C10 How does forward error correction (FEC) allow the receiver to correct errors in received data packets?

- A. By controlling transmitter output power for optimum signal strength
- B. By using the varicode character set
- C. **By transmitting redundant information with the data**
- D. By using a parity bit with each character

- When the questions were written, the weak-signal modes developed by Professor Joe Taylor at Princeton -- including JT9 and JT65 -- were just starting to be widely used (they now account for a large majority of all digital amateur radio communications).

G8C01 Which of the following digital modes is designed to operate at extremely low signal strength on the HF bands?

A. FSK441 and Hellschreiber

**B. JT9 and JT65**

C. Clover

D. RTTY

That's the end of installment #8, and the last 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](mailto:aa8sw@att.net), or Robert at [ak3q@ak3q.com](mailto:ak3q@ak3q.com).