# Subelement G8 - Signals And Emissions

**Group G8A - - Carriers and modulation: AM, FM, and single sideband; modulation envelope; digital modulation; overmodulation; link budgets and link margins**

### G8A01 (B)

**How is direct binary FSK modulation 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 (B)

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

- A. Phase convolution
- B. Phase modulation
- C. Phase transformation
- D. Phase inversion

### G8A03 (D)

**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

### G8A04 (B)

**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

### G8A05 (D)

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

- A. Power modulation
- B. Phase modulation
- C. Frequency modulation
- D. Amplitude modulation

### G8A06 (D)

**Which of the following is characteristic of QPSK31?**

- A. It is sideband sensitive
- B. Its encoding provides error correction
- C. Its bandwidth is approximately the same as BPSK31
- D. All these choices are correct

### G8A07 (A)

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

- A. Single sideband
- B. Vestigial sideband
- C. Phase modulation
- D. Frequency modulation

### G8A08 (D)

**Which of the following is an effect of overmodulation?**

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

### G8A09 (A)

**What type of modulation is used by FT8?**

- A. 8-tone frequency shift keying
- B. Vestigial sideband
- C. Amplitude compressed AM
- D. 8-bit direct sequence spread spectrum

### G8A10 (C)

**What is meant by the term "flat-topping," when referring to an amplitude-modulated phone signal?**

- 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 or speech levels
- D. The transmitter's carrier is properly suppressed

### G8A11 (A)

**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

### G8A12 (D)

**What is QPSK modulation?**

- A. Modulation using quasi-parallel to serial conversion to reduce bandwidth
- B. Modulation using quadra-pole sideband keying to generate spread spectrum signals
- C. Modulation using Fast Fourier Transforms to generate frequencies at the first, second, third, and fourth harmonics of the carrier frequency to improve noise immunity
- D. Modulation in which digital data is transmitted using 0-, 90-, 180- and 270-degrees phase shift to represent pairs of bits

### G8A13 (C)

**What is a link budget?**

- A. The financial costs associated with operating a radio link
- B. The sum of antenna gains minus system losses
- C. The sum of transmit power and antenna gains minus system losses as seen at the receiver
- D. The difference between transmit power and receiver sensitivity

### G8A14 (B)

**What is link margin?**

- A. The opposite of fade margin
- B. The difference between received power level and minimum required signal level at the input to the receiver
- C. Transmit power minus receiver sensitivity
- D. Receiver sensitivity plus 3 dB

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## Group G8B - - Frequency changing; bandwidths of various modes; deviation; intermodulation

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### G8B01 (B)

**Which mixer input is varied or tuned to convert signals of different frequencies to an intermediate frequency (IF)?**

- A. Image frequency
- B. Local oscillator
- C. RF input
- D. Beat frequency oscillator

### G8B02 (B)

**What is the term for interference from a signal at twice the IF frequency from the desired signal?**

- A. Quadrature response
- B. Image response
- C. Mixer interference
- D. Intermediate interference

### G8B03 (A)

**What is another term for the mixing of two RF signals?**

- A. Heterodyning
- B. Synthesizing
- C. Frequency inversion
- D. Phase inversion

### G8B04 (D)

**What is the stage in a VHF FM transmitter that generates a harmonic of a lower frequency signal to reach the desired operating frequency?**

- A. Mixer
- B. Reactance modulator
- C. Balanced converter
- D. Multiplier

### G8B05 (C)

**Which intermodulation products are closest to the original signal frequencies?**

- A. Second harmonics
- B. Even-order
- C. Odd-order
- D. Intercept point

### G8B06 (D)

**What is the total bandwidth of an FM phone transmission having 5 kHz deviation and 3 kHz modulating frequency?**

- A. 3 kHz
- B. 5 kHz
- C. 8 kHz
- D. 16 kHz

### G8B07 (B)

**What is the frequency deviation for a 12.21 MHz reactance modulated oscillator in a 5 kHz deviation, 146.52 MHz FM phone transmitter?**

- A. 101.75 Hz
- B. 416.7 Hz
- C. 5 kHz
- D. 60 kHz

### G8B08 (B)

**Why is it important to know the duty cycle of the mode you are using when transmitting?**

- A. To aid in tuning your transmitter
- B. Some modes have high duty cycles that could exceed the transmitter's average power rating
- C. To allow time for the other station to break in during a transmission
- D. To prevent overmodulation

### G8B09 (D)

**Why is it good to match receiver bandwidth to the bandwidth of the operating mode?**

- A. It is required by FCC rules
- B. It minimizes power consumption in the receiver
- C. It improves impedance matching of the antenna
- D. It results in the best signal-to-noise ratio

### G8B10 (B)

**What is the relationship between transmitted symbol rate and bandwidth?**

- A. Symbol rate and bandwidth are not related
- B. Higher symbol rates require wider bandwidth
- C. Lower symbol rates require wider bandwidth
- D. Bandwidth is half the symbol rate

### G8B11 (C)

**What combination of a mixer's Local Oscillator (LO) and RF input frequencies is found in the output?**

- A. The ratio
- B. The average
- C. The sum and difference
- D. The arithmetic product

### G8B12 (A)

**What process combines two signals in a non-linear circuit to produce unwanted spurious outputs?**

- A. Intermodulation
- B. Heterodyning
- C. Detection
- D. Rolloff

### G8B13 (C)

**Which of the following is an odd-order intermodulation product of frequencies F1 and F2?**

- A. 5F1-3F2
- B. 3F1-F2
- C. 2F1-F2
- D. All these choices are correct

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## Group G8C - - Digital emission modes

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### G8C02 (A)

**Which digital mode is used as a low-power beacon for assessing HF propagation?**

- A. WSPR
- B. MFSK16
- C. PSK31
- D. SSB-SC

### G8C03 (C)

**What part of a packet radio frame contains the routing and handling information?**

- A. Directory
- B. Preamble
- C. Header
- D. Trailer

### G8C04 (C)

**Which of the following describes Baudot code?**

- A. A 7-bit code with start, stop, and parity bits
- B. A code using error detection and correction
- C. A 5-bit code with additional start and stop bits
- D. A code using SELCAL and LISTEN

### G8C05 (A)

**In an ARQ mode, what is meant by a NAK response to a transmitted packet?**

- A. Request retransmission of the packet
- B. Packet was received without error
- C. Receiving station connected and ready for transmissions
- D. Entire file received correctly

### G8C06 (B)

**What action results from a failure to exchange information due to excessive transmission attempts when using an ARQ mode?**

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

### G8C07 (B)

**Which of the following narrow-band digital modes can receive signals with very low signal-to-noise ratios?**

- A. MSK144
- B. FT8
- C. AMTOR
- D. MFSK32

### G8C08 (B)

**Which of the following statements is true about PSK31?**

- A. Upper case letters are sent with more power
- B. Upper case letters use longer Varicode bit sequences and thus slow down transmission
- C. Error correction is used to ensure accurate message reception
- D. Higher power is needed as compared to RTTY for similar error rates

### G8C09 (B)

**Which is true of mesh network microwave nodes?**

- A. Having more nodes increases signal strengths
- B. If one node fails, a packet may still reach its target station via an alternate node
- C. Links between two nodes in a network may have different frequencies and bandwidths
- D. More nodes reduce overall microwave out of band interference

### G8C10 (C)

**How does forward error correction (FEC) allow the receiver to correct data errors?**

- 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

### G8C11 (D)

**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

### G8C12 (A)

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

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

### G8C13 (D)

**What is indicated on a waterfall display by one or more vertical lines on either side of a data mode or RTTY signal?**

- A. Long path propagation
- B. Backscatter propagation
- C. Insufficient modulation
- D. Overmodulation

### G8C14 (C)

**Which of the following describes a waterfall display?**

- A. Frequency is horizontal, signal strength is vertical, time is intensity
- B. Frequency is vertical, signal strength is intensity, time is horizontal
- C. Frequency is horizontal, signal strength is intensity, time is vertical
- D. Frequency is vertical, signal strength is horizontal, time is intensity

### G8C15 (C)

**What does an FT8 signal report of +3 mean?**

- A. The signal is 3 times the noise level of an equivalent SSB signal
- B. The signal is S3 (weak signals)
- C. The signal-to-noise ratio is equivalent to +3dB in a 2.5 kHz bandwidth
- D. The signal is 3 dB over S9

### G8C16 (D)

**Which of the following provide digital voice modes?**

- A. WSPR, MFSK16, and EasyPAL
- B. FT8, FT4, and FST4
- C. Winlink, PACTOR II, and PACTOR III
- D. DMR, D-STAR, and SystemFusion

## Subelement G9 - Antennas And Feed Lines

**Group G9A - - Feed lines: characteristic impedance and attenuation; standing wave ratio (SWR) calculation, measurement, and effects; antenna feed point matching**

### G9A01 (A)

**Which of the following factors determine the characteristic impedance of a parallel conductor feed line?**

- A. The distance between the centers of the conductors and the radius of the conductors
- B. The distance between the centers of the conductors and the length of the line
- C. The radius of the conductors and the frequency of the signal
- D. The frequency of the signal and the length of the line

### G9A02 (B)

**What is the relationship between high standing wave ratio (SWR) and transmission line loss?**

- A. There is no relationship between transmission line loss and SWR
- B. High SWR increases loss in a lossy transmission line
- C. High SWR makes it difficult to measure transmission line loss
- D. High SWR reduces the relative effect of transmission line loss

### G9A03 (D)

**What is the nominal characteristic impedance of "window line" transmission line?**

- A. 50 ohms
- B. 75 ohms
- C. 100 ohms
- D. 450 ohms

### G9A04 (C)

**What causes reflected power at an antenna's feed point?**

- A. Operating an antenna at its resonant frequency
- B. Using more transmitter power than the antenna can handle
- C. A difference between feed line impedance and antenna feed point impedance
- D. Feeding the antenna with unbalanced feed line

### G9A05 (B)

**How does the attenuation of coaxial cable change with increasing frequency?**

- A. Attenuation is independent of frequency
- B. Attenuation increases
- C. Attenuation decreases
- D. Attenuation follows Marconi's Law of Attenuation

### G9A06 (D)

**In what units is RF feed line loss usually expressed?**

- A. Ohms per 1,000 feet
- B. Decibels per 1,000 feet
- C. Ohms per 100 feet
- D. Decibels per 100 feet

### G9A07 (D)

**What must be done to prevent standing waves on a feed line connected to an antenna?**

- A. The antenna feed point must be at DC ground potential
- B. The feed line must be an odd number of electrical quarter wavelengths long
- C. The feed line must be an even number of physical half wavelengths long
- D. The antenna feed point impedance must be matched to the characteristic impedance of the feed line

### G9A08 (B)

**If the SWR on an antenna feed line is 5:1, and a matching network at the transmitter end of the feed line is adjusted to present a 1:1 SWR to the transmitter, what is the resulting SWR on the feed line?**

- A. 1:1
- B. 5:1
- C. Between 1:1 and 5:1 depending on the characteristic impedance of the line
- D. Between 1:1 and 5:1 depending on the reflected power at the transmitter

### G9A09 (A)

**What standing wave ratio results from connecting a 50-ohm feed line to a 200-ohm resistive load?**

- A. 4:1
- B. 1:4
- C. 2:1
- D. 1:2

### G9A10 (D)

**What standing wave ratio results from connecting a 50-ohm feed line to a 10-ohm resistive load?**

- A. 2:1
- B. 1:2
- C. 1:5
- D. 5:1

### G9A11 (A)

**What is the effect of transmission line loss on SWR measured at the input to the line?**

- A. Higher loss reduces SWR measured at the input to the line
- B. Higher loss increases SWR measured at the input to the line
- C. Higher loss increases the accuracy of SWR measured at the input to the line
- D. Transmission line loss does not affect the SWR measurement

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## Group G9B - - Basic dipole and monopole antennas

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### G9B01 (B)

**What is a characteristic of a random-wire HF antenna connected directly to the transmitter?**

- A. It must be longer than 1 wavelength
- B. Station equipment may carry significant RF current
- C. It produces only vertically polarized radiation
- D. It is more effective on the lower HF bands than on the higher bands

### G9B02 (B)

**Which of the following is a common way to adjust the feed point impedance of an elevated quarter-wave ground-plane vertical antenna to be approximately 50 ohms?**

- A. Slope the radials upward
- B. Slope the radials downward
- C. Lengthen the radials beyond one wavelength
- D. Coil the radials

### G9B03 (D)

**Which of the following best describes the radiation pattern of a quarter-wave ground-plane vertical antenna?**

- A. Bi-directional in azimuth
- B. Isotropic
- C. Hemispherical
- D. Omnidirectional in azimuth

### G9B04 (A)

**What is the radiation pattern of a dipole antenna in free space in a plane containing the conductor?**

- A. It is a figure-eight at right angles to the antenna
- B. It is a figure-eight off both ends of the antenna
- C. It is a circle (equal radiation in all directions)
- D. It has a pair of lobes on one side of the antenna and a single lobe on the other side

### G9B05 (C)

**How does antenna height affect the azimuthal radiation pattern of a horizontal dipole HF antenna at elevation angles higher than about 45 degrees?**

- A. If the antenna is too high, the pattern becomes unpredictable
- B. Antenna height has no effect on the pattern
- C. If the antenna is less than 1/2 wavelength high, the azimuthal pattern is almost omnidirectional
- D. If the antenna is less than 1/2 wavelength high, radiation off the ends of the wire is eliminated

### G9B06 (C)

**Where should the radial wires of a ground-mounted vertical antenna system be placed?**

- A. As high as possible above the ground
- B. Parallel to the antenna element
- C. On the surface or buried a few inches below the ground
- D. At the center of the antenna

### G9B07 (B)

**How does the feed point impedance of a horizontal 1/2 wave dipole antenna change as the antenna height is reduced to 1/10 wavelength above ground?**

- A. It steadily increases
- B. It steadily decreases
- C. It peaks at about 1/8 wavelength above ground
- D. It is unaffected by the height above ground

### G9B08 (A)

**How does the feed point impedance of a 1/2 wave dipole change as the feed point is moved from the center toward the ends?**

- A. It steadily increases
- B. It steadily decreases
- C. It peaks at about 1/8 wavelength from the end
- D. It is unaffected by the location of the feed point

### G9B09 (A)

**Which of the following is an advantage of using a horizontally polarized as compared to a vertically polarized HF antenna?**

- A. Lower ground losses
- B. Lower feed point impedance
- C. Shorter radials
- D. Lower radiation resistance

### G9B10 (D)

**What is the approximate length for a 1/2 wave dipole antenna cut for 14.250 MHz?**

- A. 8 feet
- B. 16 feet
- C. 24 feet
- D. 33 feet

### G9B11 (C)

**What is the approximate length for a 1/2 wave dipole antenna cut for 3.550 MHz?**

- A. 42 feet
- B. 84 feet
- C. 132 feet
- D. 263 feet

### G9B12 (A)

**What is the approximate length for a 1/4 wave monopole antenna cut for 28.5 MHz?**

- A. 8 feet
- B. 11 feet
- C. 16 feet
- D. 21 feet

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**Group G9C - - Directional antennas**

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### G9C01 (A)

**Which of the following would increase the bandwidth of a Yagi antenna?**

- A. Larger-diameter elements
- B. Closer element spacing
- C. Loading coils in series with the element
- D. Tapered-diameter elements

### G9C02 (B)

**What is the approximate length of the driven element of a Yagi antenna?**

- A. 1/4 wavelength
- B. 1/2 wavelength
- C. 3/4 wavelength
- D. 1 wavelength

### G9C03 (A)

**How do the lengths of a three-element Yagi reflector and director compare to that of the driven element?**

- A. The reflector is longer, and the director is shorter
- B. The reflector is shorter, and the director is longer
- C. They are all the same length
- D. Relative length depends on the frequency of operation

### G9C04 (B)

**How does antenna gain in dBi compare to gain stated in dBd for the same antenna?**

- A. Gain in dBi is 2.15 dB lower
- B. Gain in dBi is 2.15 dB higher
- C. Gain in dBd is 1.25 dBd lower
- D. Gain in dBd is 1.25 dBd higher

### G9C05 (A)

**What is the primary effect of increasing boom length and adding directors to a Yagi antenna?**

- A. Gain increases
- B. Beamwidth increases
- C. Front-to-back ratio decreases
- D. Resonant frequency is lower

### G9C07 (C)

**What does "front-to-back ratio" mean in reference to a Yagi antenna?**

- A. The number of directors versus the number of reflectors
- B. The relative position of the driven element with respect to the reflectors and directors
- C. The power radiated in the major lobe compared to that in the opposite direction
- D. The ratio of forward gain to dipole gain

### G9C08 (D)

**What is meant by the "main lobe" of a directive antenna?**

- A. The magnitude of the maximum vertical angle of radiation
- B. The point of maximum current in a radiating antenna element
- C. The maximum voltage standing wave point on a radiating element
- D. The direction of maximum radiated field strength from the antenna

### G9C09 (B)

**In free space, how does the gain of two three-element, horizontally polarized Yagi antennas spaced vertically 1/2 wavelength apart typically compare to the gain of a single three-element Yagi?**

- A. Approximately 1.5 dB higher
- B. Approximately 3 dB higher
- C. Approximately 6 dB higher
- D. Approximately 9 dB higher

### G9C10 (D)

**Which of the following can be adjusted to optimize forward gain, front-to-back ratio, or SWR bandwidth of a Yagi antenna?**

- A. The physical length of the boom
- B. The number of elements on the boom
- C. The spacing of each element along the boom
- D. All these choices are correct

### G9C11 (A)

**What is a beta or hairpin match?**

- A. A shorted transmission line stub placed at the feed point of a Yagi antenna to provide impedance matching
- B. A 1/4 wavelength section of 75-ohm coax in series with the feed point of a Yagi to provide impedance matching
- C. A series capacitor selected to cancel the inductive reactance of a folded dipole antenna
- D. A section of 300-ohm twin-lead transmission line used to match a folded dipole antenna

### G9C12 (A)

**Which of the following is a characteristic of using a gamma match with a Yagi antenna?**

- A. It does not require the driven element to be insulated from the boom
- B. It does not require any inductors or capacitors
- C. It is useful for matching multiband antennas
- D. All these choices are correct

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## Group G9D - - Specialized antenna types and applications

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### G9D01 (A)

**Which of the following antenna types will be most effective as a near vertical incidence skywave (NVIS) antenna for short-skip communications on 40 meters during the day?**

- A. A horizontal dipole placed between 1/10 and 1/4 wavelength above the ground
- B. A vertical antenna placed between 1/4 and 1/2 wavelength above the ground
- C. A horizontal dipole placed at approximately 1/2 wavelength above the ground
- D. A vertical dipole placed at approximately 1/2 wavelength above the ground

### G9D02 (D)

**What is the feed point impedance of an end-fed half-wave antenna?**

- A. Very low
- B. Approximately 50 ohms
- C. Approximately 300 ohms
- D. Very high

### G9D03 (C)

**In which direction is the maximum radiation from a VHF/UHF "halo" antenna?**

- A. Broadside to the plane of the halo
- B. Opposite the feed point
- C. Omnidirectional in the plane of the halo
- D. On the same side as the feed point

### G9D04 (A)

**What is the primary function of antenna traps?**

- A. To enable multiband operation
- B. To notch spurious frequencies
- C. To provide balanced feed point impedance
- D. To prevent out-of-band operation

### G9D05 (D)

**What is an advantage of vertically stacking horizontally polarized Yagi antennas?**

- A. It allows quick selection of vertical or horizontal polarization
- B. It allows simultaneous vertical and horizontal polarization
- C. It narrows the main lobe in azimuth
- D. It narrows the main lobe in elevation

### G9D06 (A)

**Which of the following is an advantage of a log-periodic antenna?**

- A. Wide bandwidth
- B. Higher gain per element than a Yagi antenna
- C. Harmonic suppression
- D. Polarization diversity

### G9D07 (A)

**Which of the following describes a log-periodic antenna?**

- A. Element length and spacing vary logarithmically along the boom
- B. Impedance varies periodically as a function of frequency
- C. Gain varies logarithmically as a function of frequency
- D. SWR varies periodically as a function of boom length

### G9D08 (B)

**How does a "screwdriver" mobile antenna adjust its feed point impedance?**

- A. By varying its body capacitance
- B. By varying the base loading inductance
- C. By extending and retracting the whip
- D. By deploying a capacitance hat

### G9D09 (A)

**What is the primary use of a Beverage antenna?**

- A. Directional receiving for MF and low HF bands
- B. Directional transmitting for low HF bands
- C. Portable direction finding at higher HF frequencies
- D. Portable direction finding at lower HF frequencies

### G9D10 (B)

**In which direction or directions does an electrically small loop (less than 1/10 wavelength in circumference) have nulls in its radiation pattern?**

- A. In the plane of the loop
- B. Broadside to the loop
- C. Broadside and in the plane of the loop
- D. Electrically small loops are omnidirectional

### G9D11 (D)

**Which of the following is a disadvantage of multiband antennas?**

- A. They present low impedance on all design frequencies
- B. They must be used with an antenna tuner
- C. They must be fed with open wire line
- D. They have poor harmonic rejection

### G9D12 (A)

**What is the common name of a dipole with a single central support?**

- A. Inverted V
- B. Inverted L
- C. Sloper
- D. Lazy H