2

General Class Unit 6
Question Pool §8

Signals and Emissions

3 Questions

3

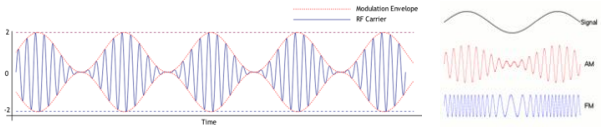
Modulation… A Review

G8A05 G8A11

Amplitude Modulation (AM)

Varies the instantaneous power level of the RF signal.

The modulation envelope is *the waveform created by connecting the peak values of the modulated signal*.



4

Modulation… A Review

G8A07 G8A10

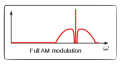
Single Sideband (SSB) is a variant of AM.

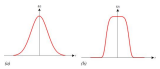
Lower sideband (LSB) and upper sideband (USB)

Carrier suppression in sideband transmissions allows for the available transmitter power to be used more effectively.

Single Sideband is the phone emission with the narrowest bandwidth.

"Flat-topping" in a single-sideband phone transmission refers to *signal distortion caused by excessive drive*.





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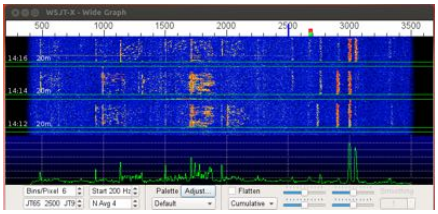
Modulation… A Review

G8A08

If a transmitter is over modulating it can cause your signal to use *excessive bandwidth*.



Modulation… A Review

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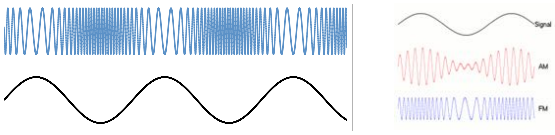
G8A03

Frequency Modulation (FM)

Changes the instantaneous frequency of an RF wave to convey information.



Modulation… A Review

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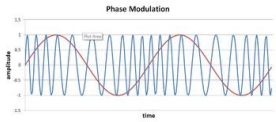
G8A02 G8A04

Phase Modulation (PM)

Very similar to FM, however the signal is modulated by changing the phase angle of the RF signal.

Phase modulation is produced by a reactance modulator connected to a transmitter RF power amplifier stage.



Digital Modulation

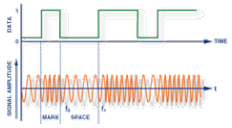
8

G8A01

Frequency Shift Keying (FSK)

A frequency modulation scheme in which digital information is transmitted through discrete frequency changes of a carrier signal.

A frequency shift keyed (FSK) signal is generated *by changing an oscillator's frequency directly with a digital control signal*.



Digital Modulation

9

G8A12 G8A09 G8A06

FT8 is a narrow-band digital mode that can receive signals with very low signal-to-noise ratios.

The FT8 digital mode uses *8-tone frequency shift keying* modulation.

A characteristic of QPSK31 is:

it is sideband sensitive.

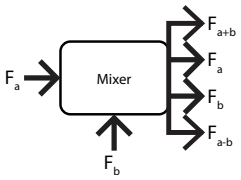
its encoding provides error correction.

its bandwidth is approximately the same as BPSK31.

Mixer

24 G8B11

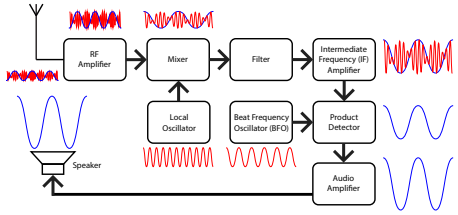
The output of a mixer's Local Oscillator (LO) and RF input frequencies is the combination of *the sum and difference*.



AM Frequency Mixing

25 G8B03

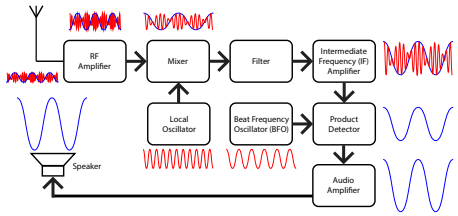
Heterodyning is another term for the mixing of two RF signals.



AM Frequency Mixing

26 G8B01

The *local oscillator* mixer input is varied or tuned to convert signals of different frequencies to an intermediate frequency (IF).



AM Frequency Mixing

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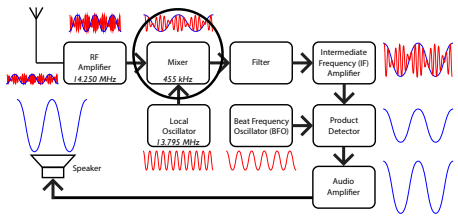
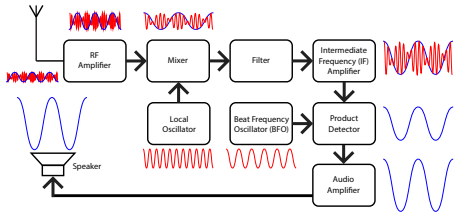
For example: A 14.250 MHz input signal and a 13.795 MHz oscillator signal will produce an intermediate frequency of 455 kHz, because 14.250 MHz – 13.795 MHz = 455 kHz.



AM Frequency Mixing

28 G8B02

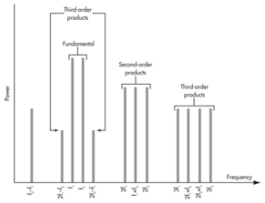
If a 13.800 MHz oscillator is mixed with a 14.255 MHz signal, to produce a 455 kHz IF, a 13.345 MHz signal will produce *image response* interference. 13.345 MHz – 14.255 MHz = -455 kHz



Intermodulation

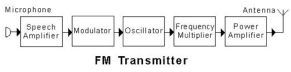
29 G8B12

Two signals that are combined in a non-linear circuit or connection to produce unwanted spurious outputs is *intermodulation*.



FM Frequency Multiplier

30 G8B04



FM Transmitter

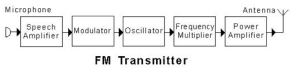
A frequency *multiplier* stage uses a local oscillator (LO) to generate harmonics of a lower frequency signal to reach the desired operating frequency.

For example, a 146.52 MHz signal is generated from the 12th harmonic of a local oscillator at 12.21 MHz.

12.21 MHz x 12 = 146.52 MHz.

FM Deviation

31 G8B07



FM Transmitter

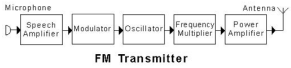
As the frequency of the local oscillator is multiplied, so too is the deviation of the FM signal.

To keep the peak deviation of the final frequency limited, the deviation of the LO must be very small.

For example: for a 146.52 MHz frequency with a deviation of 5 kHz, the LO must have a deviation of no more than 416.7 Hz. 5,000 Hz divided by 12 harmonics = *416.7 Hz*

FM Bandwidth

32 G8B06



FM Transmitter

An unmodulated FM phone signal's peak deviation should be limited to 5 kHz maximum.

The total bandwidth of an FM transmitter is twice the sum of the peak deviation and the highest audio frequency.
BW = 2 x (peak dev. + modulating freq.)

For example: a 5 kHz deviation with a 3 kHz audio frequency has a bandwidth of:
2 × (5 kHz + 3 kHz) = *16 kHz*.

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Bandwidth

33 G8B09 G8B10 G8B05

Matching your receiver's bandwidth to the signal's bandwidth *results in the best signal-to-noise ratio*.

When transmitting data, *higher symbol rates require higher bandwidth*.

The approximate bandwidth of a PACTOR-III signal at maximum data rate is *2300 Hz*.

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Duty Cycle

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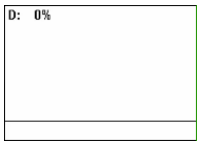

The duty cycle of the mode you are using is important as *some modes have high duty cycles that could exceed the transmitter's average power rating.*

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Digital Modes

51 G8C03 G8C10

The *header* of a packet radio frame contains the routing and handling information.

Forward error correction (FEC) allows the receiver to correct errors in received data packets *by transmitting redundant information with the data*.

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Digital Modes

52 G8C04

Baudot code is *a 5-bit code with additional start and stop bits*.

Émile Baudot (French: [emil bodo]; 1845 – 1903), French telegraph engineer and inventor of the first means of digital communication Baudot code, was one of the pioneers of telecommunications. The baud unit was named after him.

TABLE OF ALPHABETS

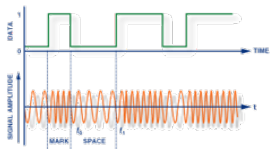
LET-TERS	FRE-QUENCY	"MURRAY" SIGNALS	"MURRAY" TAPE	BAUDOT ALPHABET	"INTERNATIONAL" MORSE	"AMERICAN" MORSE
1	e	14.000	·-	·-·-·	·-	·-
2	t	10.000	-	·-·--	-	-
3	a	9.000	·--	--·-·	·-	·-
4	i	9.000	··	--·--	··	··
5	n	8.000	-·	-·-··	-·	-·
6	o	8.000	---	-·--·	---	---
7	s	8.000	···	-·---	···	···
8	r	7.000	·-·	---··	·-·	·-·
9	h	6.000	····	---·-	····	····
10	d	5.000	·-·	---··	·-·	·-·
11	l	5.000	·-··	---·-	·-··	·-··
12	u	4.500	··-	----·	··-	··-
13	c	4.000	-·-·	-----	-·-·	-·-·
14	m	3.000	--	·-···	--	--
15	f	3.000	··-·	·-··-	··-·	··-·
16	w	2.500	·--	·-·-·	·--	·--
17	y	2.500	-·--	·-·--	-·--	-·--
18	p	2.400	·--·	·--··	·--·	·--·
19	b	2.000	-···	·--·-	-···	-···
20	g	2.000	--·	·--··	--·	--·
21	v	1.500	···-	·--·-	···-	···-
22	k	800	-·-	·---·	-·-	-·-
23	q	600	--·-	·----	--·-	--·-
24	j	500	·---	·----	·---	·---
25	x	500	-··-	·----	-··-	-··-
26	z	300	--··	·----	--··	--··
27	.	4.500	·-·-	·----	·-·-	·-·-
28	,	3.000	--·--	·----	--·--	--·--
29	Space Key			·----		
30	Cushi Key			·----		
31	Figure Key			·----		
32	Release Key			·----		

BAUDOT
1=ℓ
2= "ERROR"
3 = NOT USED

Digital Modes

53 G8C11

The two separate frequencies of an FSK signal are identified as *mark and space*.



PSK31

54 G8C09 G8C12 G8C08

In "PSK31" the number 31 is *the approximate transmitted symbol rate*.

Varicode is used for sending characters in a PSK31 signal.

The number of bits varies per character based on how often the letter occurs in English.

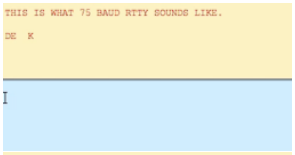
Upper case letters use longer Varicode bit sequences and thus slow down transmission.

For example: e = "11" and Q = "111011101"

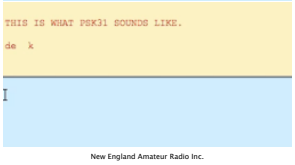
The Sounds of Digital

56

75 baud RTTY



PSK 31



PACTOR

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G8C07 G8C05 G8C06

PACTOR utilizes a combination of simple FSK modulation, and the ARQ protocol for robust error detection and data throughput.

A receiving station responds to an ARQ data mode packet containing errors by *requesting the packet be retransmitted*.

The NAK (Not AcKnowledged) response to a transmitted packet means *the receiver is requesting the packet be retransmitted*.

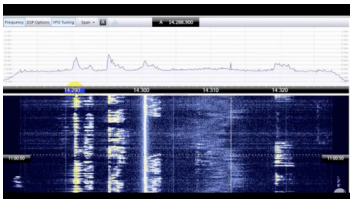
When a failure to exchange information due to excessive transmission attempts happens, *the connection is dropped*.

Waterfall

58

G8C14 G8C13

A waterfall display is a graph where *frequency is horizontal, signal strength is intensity, and time is vertical*.



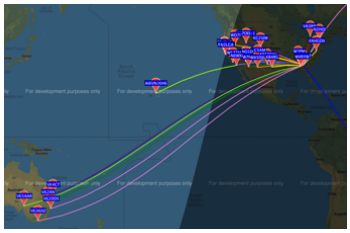
On a waterfall display one or more vertical lines on either side of a digital signal indicate *overmodulation*.

WSPR

59

G8C02

WSPR (Weak Signal Propagation Reporter) is a digital mode that is used as a low-power beacon for assessing HF propagation.



WiFi

61

G8C01

Amateurs share channels with the unlicensed Wi-Fi service in the *2.4 GHz* band.