CB SPECIFICATIONS MADE EASY

Become a more knowledgeable CB'er and get the most for your money by understanding and interpreting specifications.

IF YOU'RE a CB'er and don't have a degree in communications engineering, you might find the spec sheet of that transceiver you're thinking of buying to be so much alphabet soup. If you know how to read and interpret one, however, it can give you a capsule summary of performance expectations.

Let's look at the receiving section of the CB rig, which is really more important than the transmitter. (No matter how loud your signal is, you won't be able to establish contact with another station unless you can hear him.)

Receiver Specifications. The most important spec of a receiver is *Sensitivity*, which is composed of two parts. The first expresses the minimum signal strength that the receiver will respond to, and is measured in microvolts. (µV). The second part gives the ratio of the signal to the noise generated by the receiver circuits.

If this internal noise is great enough, it will mask the signal and make reception impossible. Therefore, while it is important to have a low sensitivity figure, it is just as important that the signal-to-noise, S/N, or signal-plus-noise-to-noise, (S+N)/N, ratio be as large as possible. Combined, the two tell you how much *usable* sensitivity can be exected from the receiver. The S/N ratio is expressed in decibels, and the most common reference is 10 dB (the signal is 3.2 times the value of the noise level).

The Electronic Industries Association (EIA) and the FCC set down minimum requirements for CB gear. Well-designed gear will meet or exceed these "worst-case" standards. In the case of receiver sensitivity, the EIA standard for an AM receiver is 1µV for a 10-dB (S+N)/N, using a 1000-Hz tone to modulate the carrier 30 percent. It is not uncommon to find transceivers with a sensitivity rating of 0.5 µV or less. Since this figure can vary due to component tolerances, many manufacturers use a worst-case value and specify it with the words "or less" or "at least."

SSB receiver sensitivity is measured by applying an unmodulated signal to the receiver input. The test-signal frequency is adjusted to produce a 1000-Hz tone at the receiver output. Its level is then adjusted to produce the desired ratio of receiver output to no-signal noise appearing at the output terminals. The EIA standard for SSB sensitivity is 0.5 µV for a 10-dB (S+N)/N ratio, in contrast to AM's 1 µV. You'll often find figures in the 0.1-to-0.25-µV range for the same (S+N)/N ratio. Occasionally, you may run across a receiver's "usable sensitivity" rating. This value is the minimum signal input required to produce half of the receiver's rated audio output for a given (S+N)/N ratio.

Selectivity, another important characteristic, is the receiver's ability to differentiate between an adjacent signal and the desired one. This is also referred to as the *Adjacent-Channel Rejection*, expressed as a ratio in decibels. This figure shows how much stronger an adjacent-channel signal (10 kHz away) must be to interfere with intelligible reception of the desired one. Sometimes selectivity is stated as the i-f bandpass, which is the width of

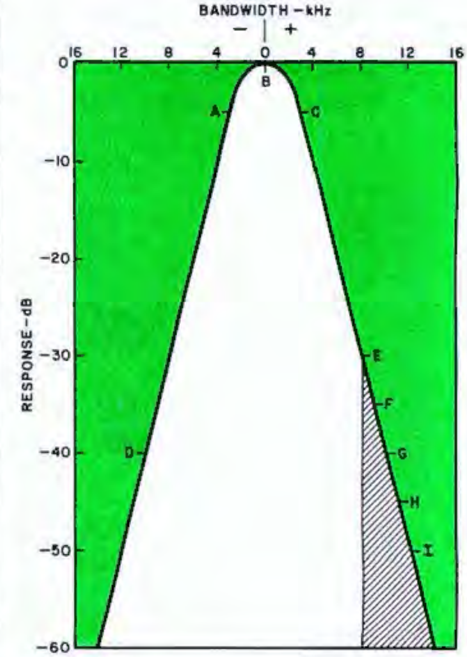

Fig. 1. The i-f selectivity curve of an AM receiver with 6-kHz bandwidth at 6 dB down and 2-kHz bandwidth at 40 dB down. Signal is tuned to center at (B). Shaded area may be occupied by 10-kHz adjacent channel with carrier at (G), modulated to 2 kHz. Lower sideband components will be down 35 and 30 dB (F and E). Upper sideband components are further attenuated (H and I).

the "window" the receiver can see through to detect signals of a specified strength.

Figure 1 shows a typical i-f response with a bandpass 6 kHz wide (± 3 kHz) for signals 6 dB below maximum response (points A and C), a 20-kHz width (± 10 kHz) at 40 dB down (D and G). The a-f response of a receiver can be approximated by halving the bandpass between the 6-dB points (2000 or 3000 Hz is considered optimum), while the ability to reject adjacent signals can be estimated by halving the bandpass between points of higher attenuation. For example, a 40-dB-down bandpass of 20 kHz (± 10 kHz) means that a signal 10 kHz away would have to be 40 dB higher (100 times stronger) than the desired signal if the two are to appear to have equal strength at the receiver output.

Selectivity depends not only on the i-f bandpass, but also on the receiver's *Desensitization* characteristic, which indicates to what extent a desired signal's strength will appear to be depressed by an adjacent signal. Such activity would further deteriorate the selectivity or adjacent-channel rejection rating. The EIA standard for adjacent-channel rejection is 30 dB. Typically, it will run from 30 to 50 dB.

SSB selectivity is commonly defined as the bandpass of the desired sideband response at the 6-dB points. Additionally, the bandpass at some point further down the selectivity curve (usually 60 dB) is specified. A complementary specification you should know is the unwanted side-band suppression at some specific audio frequency (1 kHz or so). This indicates the detected difference in signal strength between two equal-strength SSB signals operating on alternate sidebands of the same channel. The EIA standard for unwanted sideband suppression is 40 dB at 1 kHz (the tone used to modulate the sidebands). Many new SSB rigs are rated at 50 to 70 dB at 1 kHz.

Spurious Signal Rejection, expressed in decibels, tells how well the receiver is able to discriminate between a desired signal and another on some frequency other than the adjacent channel. No matter what generates the spurious signal—the receiver itself or some remote transmitter—the rejection ratio should be as high as possible. A receiver should respond only to the station to which it is tuned. The EIA standard for spurious-signal rejection (on AM) is 25 dB, except for image (internally generated) rejection, which is 10 dB. Image rejection is the ability of a receiver to ignore frequencies algebraically related to those of the desired signal and the receiver i-f. The image rejection of single-conversion receivers with 455-kHz i-f is rarely better than 10 dB (which is rather poor), but receivers with higher i-f do better—typically 40 to 80 dB.

Typical rejection performance for other spurious signals runs about 50 dB. The EIA SSB standard specifies a 35-dB spurious-response rejection ratio, an image response of 20 dB and an i-f rejection of 60 dB.

Squelch Threshold Sensitivity indicates the signal strength for which the squelch can be set to activate receiver audio, yet quiet the background noise in no-signal conditions. Maximum sensitivity allows the receiver to be squelched without missing weak signals. *Tight squelch* is the maximum signal-strength threshold to which the squelch can be adjusted. The EIA standard for squelch threshold sensitivity states that it shall be no greater than 1 µV on AM and 0.5 µV on SSB, and no greater than 1000 µV (AM), 500 µV (SSB), nor less than 30 µV. In practice, a tight squelch of 30 to 100 µV should be adequate.

Automatic Gain Control Figure of Merit indicates the change in audio output for a given change in r-f input, expressed in decibels. A good agc has a low figure of merit (ideally 0 dB). In operating practice it will minimize the need to readjust the volume control to reduce "blasting" by strong stations. The EIA minimum AM standard constrains the audio output to a 30-dB change in output for an r-f input change of 94 dB between 1 and 50,000 µV. For SSB, a 16-dB audio output change is allowed for an r-f input change of 100 dB between 0.5 and 50,000 µV. Generally, the greatest variation is experienced when input levels are below 5 to 10 µV, where minimum agc action is available. Above this point the output remains more constant.

A-F Output is the maximum a-f power output of the receiver at a specified distortion level (including public-address facilities). It is usually measured at 1000 Hz into a given load impedance (most often 8 ohms). The EIA standard is 2 watts at no more than 10-percent distortion. Typically, audio output will run from 1.5 to 4 watts at 10-percent (or less) distortion. In quiet locations, 1 watt will be adequate, while greater output will be needed for noisier locations.

A-F Response is indicative of the uniformity or flatness of the audio output over the modulating frequncy range. It is usually expressed as the audio passband over which the output is maintained within a specifed range (± X dB or from - X dB to +Y dB). The EIA standard for AM holds the audio response within a range from −14 to +2 dB of the 1000-Hz output level over a passband of 300 to 3000 Hz. Most manufacturers, however, specify the frequency range over a 3- or 6-dB level deviation. For SSB, the EIA standard a-f response is +3 dB to −6 dB over a passband of 2100 Hz.

Noise Limiter Figure of Merit described how well impulse noise can be suppressed while receiving a signal. It is expressed in decibels, relating the degree of suppression for a given signal-to-noise ratio. The EIA standard for noise limiter performance is 10 dB. However, this applies only to short-duration, "spike" noise like ignition interference. Generator hash, power-line and other noises will not necessarily be attenuated as effectively.

S-Meter Sensitivity tells what input-signal level is required to register an S-9 reading, which may vary anywhere from 10 to 1000 µV, depending on the individual receiver. However, the customary standard is 50 to 100 µV. A related standard defines an S unit as a 6-dB change in signal strength. Most S meters are not precisely calibrated, and many manufacturers do not provide calibration

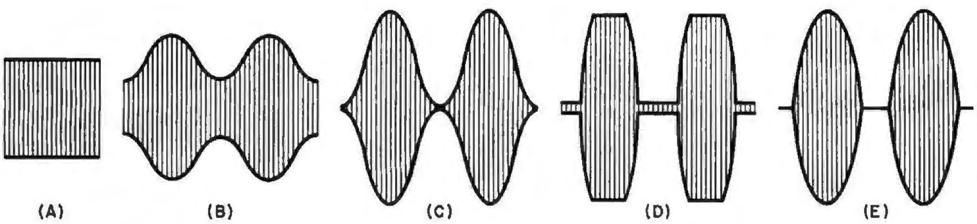

Fig. 2. R-f envelopes of an AM transmitter: (A) unmodulated; (B) 50% modulation; (C) 100%. Clipping (D) and overmodulation (E) cause station interference.

charts. These meters are intended to be relative, not absolute, signal-strength indicators.

Transmitter Specifications. The spec most CB'ers look for first is *r-f power output*. For an AM transmitter, this specification rates the amount of carrier appearing at its nominal load impedance. At full modulation, the peak power output is four-times that of the carrier. Only a small portion, however, is useful "talk" power. The EIA standard (also the legal limit) requires that the carrier output not exceed 4 watts with the equipment operated from a 117-volt ac or 13.8-volt dc source.

CB vacuum-tube transmitters usually have 3 to 3.5 watts of output, while solid-state units produce from 3.5 to 4 watts. It is worth noting that it is unlikely that anyone can hear the difference between a 3- and 4-watt signal.

On SSB, there is no carrier on which a power rating might be based. A quantity called the "peak envelope power" (PEP) is used as the yardstick. This is the output power at the crest of the modulated waveform. Under recently amended FCC regulations, the maximum PEP output is 12 watts. Late-model equipment produces this level in most cases. Older units generally run 8 to 10 watts PEP in output, which is not significantly lower. In contrast to AM emissions, *all* of the SSB output is useful "talk" power.

AM Modulation Percentage describes the amount of carrier modulation. The optimum value is 100 percent. Most CB rigs are capable of 90- to 100-percent modulation. The difference between the two values is not audibly perceptible, however. R-f envelopes with varying degrees of modulation are shown in Fig. 2. Some of the following comments are based on these sketches.

AM Harmonic Distortion denotes the quality of the modulated signal at a given modulation level. The EIA standard specifies a maximum of 10-percent distortion when the carrier is modulated 80 percent by a 1000-Hz tone. Typical performance is in the order of 7- to 10-percent distortion at 90- to 100-percent modulation. Considerably higher distortion levels and "splatter" can result from overmodulation.

AM-Transmitter Modulation Spectrum specifications illustrate the frequency spectrum occupied by the modulated signal. This is an important, though seldom-given, measurement. It shows the potential for "splatter" or interference to stations on other channels. Splatter is usually caused by overmodulation, which generates a wide band of spurious components. Excessive clipping may also be a cause. These are common operating conditions for many CB rigs, even those that employ some form of automatic modulation control (amc). The EIA standard (falling within FCC requirements) uses a 2500-Hz tone. Modulation products 4 to 8 kHz away from the carrier should be at least 25 dB below the unmodulated carrier level. At 8 to 10 kHz away they should be at least 35 dB down. Any products more than 20 kHz away should be 50 dB below the unmodulated carrier level. Typically, using the single-tone test, splatter at the adjacent channel will be at least 40 to 50 dB down.

SSB Intermodulation (IM) Distortion Products indicate if the modulated signal will extend beyond the normal passband. IM products, caused by transmitter nonlinearities or overmodulation, can produce splatter and deteriorate unwanted sideband suppression. The measurement uses two non-harmonically related tones of equal amplitude, such as 1000 and 1600 Hz to simultaneously modulate the transmitter. Odd-order distortion products are produced if the transmitter is not designed or driven correctly. They appear at odd multiples of the frequency difference between the test tones, as 3rd, 5th, 7th, etc., products away from the "carrier" frequency in ever-decreasing intensity.

The measurement is generally stated as follows: the X-order distortion products are at least Y dB below the peak level of the two equal-amplitude test tones. Other references include the mean power output (PEP/2), and the rated PEP output. Use of the latter references inflates the distortion measurement by 3 and 6 dB, respectively, but the performance only looks better. Therefore, the reference should always be specified. The EIA standard and the FCC requirement call for the SSB distortion products 2 to 6 kHz removed from the channel center to be at least 25 dB below the mean power output. Such products 6 to 10 kHz away must be 35 dB down. Equivalently, they must be 22 dB (2 to 6 kHz) and 32 dB (6 to 10 kHz) below the test tone's amplitude. We have typically found 3rd order products to run 19 to 22 dB down, with higher order products having greater attenuation.

Carrier Suppression tells how much the carrier is attenuated below a reference output level. The EIA standard states that the carrier must be at least 40 dB below the level of the two test tones, or 46 dB below rated PEP output. Typically, the carrier will run 40 to 50 dB below rated PEP.

Transmitter A-F Response. The definition of this spec is similar to that given for receiver a-f response. The EIA standard for AM transmitters is the same as that for receivers, except that a 6-dB/octave roll-off from 2500 to 3000 Hz is allowed. For SSB, the standard requires a minimum bandpass of 2000 Hz and a maximum of 3000 Hz over a range of −6 dB to +3 dB. See receiver specifications for the SSB low-frequency roll-off. Although the upper frequency limit for intelligibility in voice communications is generally recognized as 3000 Hz, the FCC-authorized bandwidth limit is 8000 Hz for AM and 4000 Hz for SSB, implying an upper a-f response limit of 4000 Hz.

Unwanted-Sideband Suppression ratings are the same as those for receivers.

Spurious Emissions indicate the strength of other transmitted signals outside the normal passband. This especially relates to r-f harmonics, a prime cause of interference (such as TVI) to other services. The EIA and FCC standards require that any spurious emissions of an AM transmitter removed 20 kHz or more from the center of the authorized bandwidth shall be at least [43 + 10 $\log_{10}$ (mean power in watts)] dB below the mean power output. For SSB emissions, the frequency limit is 10 kHz. At CB power levels, this comes out to about 50 dB down, or an attenuation of 100,000 times the fundamental output.

Frequency Stability limits the output frequency to within a certain range of the nominal value. The legal tolerance for frequency stability is 0.005 percent of the assigned channel frequency, or about 1350 Hz on the CB band. This must be maintained over a wide range of supply voltages and ambient temperatures (such as −30 to +50°C).

Where a transmitter "clarifier" control is included (as in many SSB rigs), its range should be somewhat less than the frequency tolerance to ensure legal operations. In most cases, its range is about ± 800 Hz, centered on the assigned frequency. ◈