

FAMILY RADIO SERVICE



A training course for REACT Teams and members

This is a new REACT course designed to provide REACT members basic information needed to operate a Family Radio Service radio for emergency communications. This knowledge will help you prepare to use the Family Radio Service to receive and answer calls for assistance and to coordinate communications operations with local FRS equipped groups in a major emergency or disaster.

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Course Number: 106B

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I. FAMILY RADIO SERVICE HISTORY

Following a 1994 proposal by Radio Shack, the Family Radio Service was first authorized in 1996 to provide communications for individual, family, group, recreational and business activities without requirement for individual licensing. The Family Radio Service is a licensed by rule service. Originally effective radiated power was restricted to 500 milliwatts. Seven channels in the range of frequencies used by the General Mobile Radio Service (8 to 14) were reserved for low power Family Radio Service use. Quickly combination radios that included both GMRS and FRS frequencies became popular. With this came the predictable outcome – numbers of unlicensed operators communicating on GMRS frequencies with GMRS transmission power.

In 2017 the Federal Communications Commission made significant changes to the Family Radio Service. FRS stations have been authorized to operate on all of the simplex GMRS frequencies, with changes in authorized power to 2 watts for channels 1 to 7 and 15 to 22. Effective in September 2019 combination radios can no longer be manufactured or sold, ensuring that FRS radios eventually will technically only be able to operate in compliance with FRS rules.

Canada has a 14 channel Family Radio Service, operating at a maximum of 500 milliwatts, that is compatible with the United States FRS. Mexico, Brazil, and some other Latin American countries have similar services.

II. INTRODUCTION TO BASIC RADIO THEORY

THE RADIO

In the early days of radio, there were two types of radios, transmitters which transmitted the signal and receivers which received the signal. With a single antenna, a physical transmit/receive switch switched the antenna from the transmitter to the receiver and vice versa during the communications process. A feedline ran from the transmit-receive switch to the antenna to carry signals from and to the antenna. Modern base station and mobile radios typically combine the transmitter, receiver, and the transmit-receive switch into a single unit termed a transceiver. Hand held radios mount the antenna directly to the transceiver.

Family Radio Service (FRS) radios are low powered handheld transceivers with an integral, non-removable antenna.

Although FRS radios are low cost and typically designed and marketed to appeal to people who are not experienced communicators, these radios are not toy walkie-talkies, useful only in childrens' play. FRS radios offer reasonable range for a low powered hand-held line-of-sight radio, use frequency modulation for reasonably clear signals, and have sufficient channels to allow a fairly complex communications system to meet its short range needs.

FREQUENCY AND CHANNEL DEFINED

Radio transmissions are electromagnetic waves that cycle at a given frequency. The most basic measurement of the cycle is expressed as one cycle per second, or 1 hertz. The hertz is named after Heinrich Hertz, the German physicist who first proved the existence of radio waves. Thus all frequencies are measured in the numbers of wave cycles generated in one second.

Frequencies in common communications use are expressed in hertz, kilohertz, megahertz, and gigahertz.

1 hertz (Hz)	=	1 cycle per second
1 kilohertz (kHz)	=	1,000 cycles per second
1 megahertz (MHz)	=	1,000,000 cycles per second or 1,000 kilohertz
1 gigahertz (GHz)	=	1,000,000,000 cycles per second or 1,000 megahertz

Channels are an assignment of a specific frequency to a number or letter or other designation, usually with a selector control that allows only access to the frequency by the channel designator. Thus Channel 1 is always frequency A, Channel 2 frequency B, etc. Current Family Radio Service radios have 22 channels.

The following table lists the channels assigned to the Family Radio Service. All of the channels authorized for use by the FRS are also shared with the General Mobile Radio Service. However, FRS users must abide by the maximum power output limitations below. This is a particular concern if you have an older combination FRS and GMRS radio. If you are operating with effective radiated power greater than the maximum power listed for a channel below, you must hold a valid GMRS license and operate under GMRS rules.

Channel Number	Maximum Power	Center Frequency (MHz)
1	2.0 Watts ERP	462.5625
2	2.0 Watts ERP	462.5875
3	2.0 Watts ERP	462.6125
4	2.0 Watts ERP	462.6375
5	2.0 Watts ERP	462.6625
6	2.0 Watts ERP	462.6875
7	2.0 Watts ERP	462.7125
8	0.5 Watts ERP	467.5625
9	0.5 Watts ERP	467.5875
10	0.5 Watts ERP	467.6125
11	0.5 Watts ERP	467.6375
12	0.5 Watts ERP	467.6625
13	0.5 Watts ERP	467.6875
14	0.5 Watts ERP	467.7125
15	2.0 Watts ERP	462.5500
16	2.0 Watts ERP	462.5750
17	2.0 Watts ERP	462.6000
18	2.0 Watts ERP	462.6250
19	2.0 Watts ERP	462.6500
20	2.0 Watts ERP	462.6750
21	2.0 Watts ERP	462.7000
22	2.0 Watts ERP	462.7250

The frequencies above are the center frequencies used to determine the channel. The actual bandwidth of the channel is up to 12.5 KHz, a maximum of 6.25 KHz in width on either side of the center frequency.

Channels in FRS are complicated by how the radios are advertised. For example, a radio may be advertised as having 50 channels. However, this does not mean that there are 50 channels, and that the maker has found a way to give you 28 channels that the Federal Communications Commission does not know about. There are 22 channels identified with the standard number and frequency; the remaining extra channels are specific combinations of a regular channel with a preprogrammed privacy code (but you don't necessarily know what those combinations are, making it almost impossible to use these "extra" channels with a radio that is not of the same make and model).

PRIVACY OR NOT

Manufacturers of FRS radios often provide privacy codes, sub codes, interference eliminator codes, private line or PL, quiet codes, or ... These codes work by deselecting any transmission received that does not have the privacy code attached. You simply do not hear the transmission. There are two basic forms of these codes, Continuous Tone-Coded Squelch System, commonly referred to as CTCSS, and Digital Coded Squelch, or DCS. CTCSS works by adding a low frequency tone to the transmission. DCS adds a sub-audible digital bitstream to the transmitted voice signal. Because they are marketed to people with no technical knowledge the makers simplify things by referring to both CTCSS and DCS generically as privacy codes.

There are long lists of available codes – numbers such as 121 or 142 or 210 to a possible total of 512 codes are mentioned in the advertising, along with the assertions that these, combined with the 22 channels give you literally thousands of privacy options. The first 38 codes in the list are normally CTCSS codes listed in the same order among most manufacturers. Above that are DCS codes. The problem is that DCS codes have been subject to error on decoding – as a result most manufacturers have used only the first 83 codes.

There are three problems with the use of privacy codes.

- First, the codes are not necessarily numbered the same between makers. To be sure you need to know the actual code designator that both you and the operator are using, or be sure that you are using the same make and model.
- Second, the privacy code does not give you privacy. True, you do not hear conversations coded differently than your own. But anyone who turns off their privacy code can hear all of the conversations within range on a channel.
- Third, as we will discuss further on in this text, if you have a privacy code on, and you call for help, a monitor operating without a code enabled may hear and respond to you. But you will not be hear their response.

RADIO SPECTRUM

Signals with a frequency of greater than 20 Kilohertz are called radio frequencies, and the range of these frequencies is termed the radio spectrum. The overall spectrum is divided into ranges as follows:

Very low frequency (VLF)	3 kHz to 30 kHz
Low frequency (LF)	30 kHz to 300 kHz
Medium Frequency (MF)	300 kHz to 3 MHz
High Frequency (HF)	3 MHz to 30 MHz
Very High Frequency (VHF)	30 MHz to 300 MHz
Ultra High Frequency (UHF)	300 MHz to 3 GHz (frequencies above 1 GHz are microwave frequencies)
Super High Frequency (SHF)	3 GHz to 30 GHz
Extremely High Frequency (EHF)	30 GHz to 300 GHz

The Family Radio Service operates in the range 462.5625 MHz to 467.7125 MHz, and is thus in the Ultra High Frequency (UHF) range.

BANDS

A band is a range of frequencies in which radio signals are used for a common function. Thus all of the radio services that REACT uses in the Personal Radio Service primarily operate in individual bands. The term Citizens Band comes from the idea of a band as a contiguous group of frequencies (note that the term Citizens Band is no longer in official use, having been replaced by CB Radio Service).

CB Radio Service	40 channels 26.965 MHz to 27.405 MHz (HF)
General Mobile Radio Service	22 channels 462.5625 MHz to 462.725 MHz (UHF)
Family Radio Service	22 channels 462.5625 MHz to 467.7125 MHz (UHF)
Multi-Use Radio Service	5 channels 151.820 MHz to 154.600 MHz (VHF)

METERS AND WAVELENGTH

As in metric measurements, not dials ... Traditionally Amateur Radio frequency bands are named by the wavelength of the signal, the distance the signal travels in one cycle, in meters. Citizens Band is commonly called 11 meters.

Why is this important to Family Radio Service operators? The wavelength is important to you because of its relationship to antenna length.

To find the wavelength of a specific frequency the formula is:

$$\text{Wavelength in meters} = 300 / \text{frequency in MHz}$$

To use FRS channel 1 as an example:

$$\text{Wavelength in meters} = 300 / 462.5625 = 0.6486 \text{ meters}$$

And to convert that to feet:

$$\text{Wavelength in feet} = \text{wavelength in meters} \times 3.28$$

Our channel 9 example's wavelength in feet is thus:

$$\text{Wavelength (feet)} = 0.6486 \times 3.28 = \text{approximately } 2.127 \text{ feet (about 2 feet } 1 \frac{1}{2} \text{ inches)}$$

This means that common antenna lengths for FRS channel 1 would be:

Full wave	2 feet 1 ½ inches
5/8 wavelength	1 foot 4 inches
½ wavelength	1 foot 1 inches
¼ wavelength	6.4 inches

FRS antennas are typically molded into the hand-held radio; Federal Communications Commission rules mandate that radio antennas not be removable from the radio. It is doubtful that you will have to ever measure and cut a full wave FRS base station antenna. But understanding the wavelength makes it obvious why FRS and GMRS can operate effectively with very short antennas and Amateur High Frequency and Citizens Band radios need much longer ones.

It also points out one of the strengths of the UHF radios used by FRS and GMRS operators. The relatively short wavelength of the signal provides good penetration of buildings, allowing indoor reception. And the short antenna makes the radio significantly less cumbersome in the field.

METHODS OF TRANSMISSION

Voice radios transmit information in two basic ways, amplitude modulation (AM) and frequency modulation (FM). All FRS radios are frequency modulated.

A radio signal on a frequency that never changes strength is a continuous wave (CW). A CW signal does not carry any information. The simplest way to add information is to turn the signal on and off in a pattern that has a predetermined meaning. This is what Morse Code transmissions do (and why they are commonly referred to as CW).

If speech is used to add information to a continuous wave, the process is called modulation. In amplitude modulation, information is added by varying the power to change the amplitude of the signal. An amplitude modulated (AM) transmitter adds your voice to the unmodulated signal by varying the amplitude in response to your voice.

In radios that use frequency modulation (FM), the frequency of the signal is modulated to add speech or data information. The signal amplitude is constant and the signal power does not change. The advantage of FM signals is that atmospheric and electric interference noise received by the radio is typically amplitude modulated and is removed by a limiter circuit in the radio. As a result the low noise of the FM signal is ideal for short range communications. However, the frequency variation, known as deviation, increases with loud speech, increasing the bandwidth with the possibility of interfering with signals on frequencies near the assigned frequency.

POLARIZATION

Polarization refers to the orientation of the radio wave as it travels through the atmosphere. In the Family Radio Service, we are concerned primarily with two types of polarization, vertical and horizontal. The simple way to understand this is that when your antenna is vertical (holding the handheld with the antenna pointed upward), the signal is vertically polarized. When your antenna is horizontal, parallel to the ground, the signal is horizontally polarized.

Polarization is important because conflicting polarization (for example, trying to talk from your handheld radio with the antenna vertical to someone who is holding their antenna horizontally) significantly reduces the range at which you can communicate. Best practice is to always hold the radio so that the antenna is vertical and you are

facing in the approximate direction of the station with which you wish to communicate.

PROPAGATION

Radio signals travel from your transmitter in two basic ways, by skywave and by ground wave. In the family Radio Service propagation will almost always be ground wave propagation. This occurs between the bottom of the ionosphere and the surface of the earth. The two types of ground wave signals that you may encounter are:

- (1) The Direct Wave – the most common form of propagation for FRS, this is essentially line of sight transmission. Think of this as drawing a straight line from the antenna of your radio to the antenna of the receiving station radio.
- (2) Reflected Signal – some signal is reflected by intervening buildings, the earth's surface, hills, etc. Given the low power of FRS radios, this is probably not a major factor in FRS communications.

This means that in most cases you will establish and maintain contact by Direct Wave. Operational planning for communications should thus be based on a good understanding of the radiation pattern of your station's direct wave, and of intervening terrain that might limit direct wave transmission.

RANGE

Determining the theoretical range of your radio depends on determining the distance to the radio horizon. This is a function of the height of your antenna. If for example you are holding your hand-held radio at about 6 feet above the ground, we can determine the radio horizon as follows:

Radio horizon = square root of the antenna height above ground X 1.4

Radio horizon = square root of 6 X 1.4

Radio horizon = 2.45 X 1.4

Radio horizon = 3.85 miles.

In this case 1.4 is a constant. However, the constant can vary up to as much as 2.0 in areas where there is good conductivity. But we are not finished, because if you are holding your hand held antenna at 6 feet you are probably trying to communicate with another station. For the scenario assume that the station is another handheld FRS radio station held at approximately 6 feet above the ground on top of a hill 30

feet higher than your position. That station's radio horizon is the square root of 36 feet (the terrain difference of 30 + the antenna height of 6 feet of antenna) X 1.4.

Radio horizon of your handheld = 3.85 miles
Radio horizon of the second handheld = 8.4 miles
Maximum possible contact range = 3.85 + 8.4
Maximum possible contact range = 12.25 miles

Notice that this says "maximum possible contact range." It is important to understand that this computation results in a theoretical range. There may be intervening terrain, heavy vegetation, buildings, or reduced surface conductivity that makes any contact difficult. Interference from other electrical sources, such as unfiltered ignition noise in a vehicle, will reduce the intelligibility of the signal, effectively reducing range. Transmission ranges advertised by manufacturers of FRS radios are commonly overstated, and you should determine actual typical ranges in your operating area by testing. Hand-held to hand-held radio range is probably no more than 1 to 2 miles under normal conditions.

III. CONTROLS

The displays and controls that manage how the radios perform vary from maker to maker. The addition of features such as Weather Radio further complicate the range of controls that impact how the radio operates. Basic controls that will be present in some form on most FRS radios include the following (note that these may be individual buttons or knobs or be controlled from the display with an up-down arrow):

Power On/Off and Volume control – typically a knob that rotates to turn the radio on or off and to adjust the volume the radio's speaker is producing.

Push to Talk button or pad – you depress the button to activate the transmit function of the radio. Release the button when you have finished transmitting.

Up and Down buttons – used to navigate menu items controlled on the radio's display.

Menu button – accesses the radio's menu on the display so that the Up and Down buttons can be used to select and control menu items.

Monitor button – depressing this button disables the internal squelch momentarily so that you can adjust volume or so that you can check activity on the channel prior to transmitting.

Scan button – pressing the scan button causes the radio to scan all installed channels, and halt for a set period of time on any active channel.

Channel selection – allows you to move through the list of channels and select the one on which you wish to communicate.

Privacy Code selection – allows you to enable or disable privacy codes on the radio. The number of the code may be displayed along with the channel on the radio's display. That number is the maker's designation for the code, not the actual CTCSS or DCS code (remembering that makers do not necessarily number codes the same way).

Transmit Power selection – found on GMRS/FRS combination radios to allow licensed GMRS users to select either a high or low power setting. The power setting may be higher than the setting allowed for unlicensed FRS users on that channel. Most model restrict power on Channels 8 through 14 to the FRS limit of 500 milliwatts.

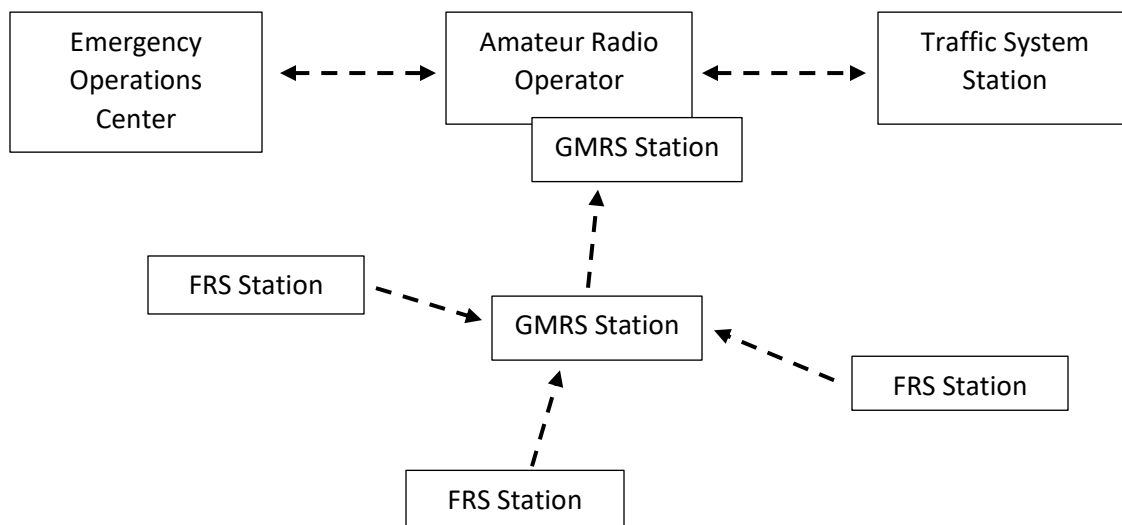
Voice Activated or Hands Free Transmission selection – this allows you to transmit without having to press the push to talk button. Although this sounds attractive, in practice voice activated radios transmit unintended background noise, including otherwise private conversations, and may cause interference or the compromise of personal or sensitive information. Best practice is not to use voice activation in emergency communications.

Consult your radio operating manual for specific directions on how to use these, and other controls, on your particular make and model of radio. A hint, if you do not use the radio regularly, it is a very good idea to make a copy of the instructions for the controls, laminate it, and keep it with the radio in your kit. Menu driven items may take several steps to activate, and must be done in the correct order if the control is to function.

IV. FRS SYSTEMS

Community Emergency Response Teams and other community groups have used Family Radio Service radios for their tactical communications. Having FRS radios in your Team's equipment cache gives you a ready resource for interface with these groups.

However, this is not the full extent of community use of FRS. The commonality of FRS frequencies with GMRS frequencies means that a neighborhood FRS group can provide an initial level of unlicensed radio communications. The next level is licensed GMRS radio stations with good antenna systems that can pick-up the local reports and pass them to a top level of licensed Amateur Radio operators, who also hold GMRS licenses, for relay to local emergency management or emergency services or through a traffic system to agencies a greater distance away. The following diagram shows this structure.



Such systems are now an established part of community readiness in several communities, operate their own nets, and appear to be working well.

V. EMERGENCY COMMUNICATIONS

STANDARD PROCEDURES

Standard communications procedures and terminology should be used on Family Radio Service channels. As is the case in all emergency communications, transmissions should be concise, to the point, and use standard procedural words.

Old style CB lingo, ten codes, rag-chewing or ratchet-jawing, and Q signals are not appropriate. Plain language should always be used to conform to established standards for incident command system communications. Think before you talk, say what needs to be said, listen, and, when you have completed your communications task, stop talking.

Radios used for emergency communications should be operated with privacy codes and voice activation turned off.

CALLS FOR HELP

The National SOS Network has established a protocol for use of FRS radios to call for help in emergencies and disasters. REACT International supports this protocol as a standard way for those in need of assistance to use. The station needing assistance should:

- Select Channel 1 on the FRS radio. Turn the privacy codes off.
- Every hour on the hour transmit the operator's name, detailed location, and nature of the emergency.
- Call for assistance for two minutes.
- Listen for three minutes for a reply.
- Turn off the FRS radio to conserve batteries and repeat the procedure every hour.

Their quick reminder phrase is:

Call for help on Channel 1 every hour. Talk for 2 minutes. Listen for 3 minutes.

MONITORING

Initiatives like those of the National SOS Network work if there are individuals monitoring FRS Channel 1 to receive calls for assistance. Because FRS radios have limited range, more than one station monitoring will be needed to provide coverage in even a small town.

Detailed instructions for monitoring for emergency calls can be found in REACT's Monitoring course. If you are going to use a FRS radio to monitor for calls for assistance, you should complete the Monitoring course, even if you have had previous experience as a monitor on Citizens Band.

When a call is received you can expect that it will not conform to any standard format. REACT used to emphasize an emergency report format based on CLIP:

CALL SIGN or name or handle
LOCATION
INJURED number and degree of injury if any
PROBLEM type

This serves as a useful way to remember what information is needed. Be certain that you recognize whether these elements are present, and work to get the details that are missing.

Remember that in an emergency or disaster you rely on the good will of the public for proper use of FRS radios to assist others. Be polite to other users, ask politely if you can have a clear channel to assist someone in distress, and remember that you have no authority to order anyone to do anything on the channel.

VI. FAMILY RADIO SERVICE IN CANADA

The Canadian Family Radio Service is a license-exempt service that operates on the following 14 simplex channels

Channel	Canadian GMRS	Frequency MHz	Channel	Frequency MHz
1	GMRS 2	462.5625	8	467.5625
2	GMRS 4	462.5875	9	467.5875
3	GMRS 6 MURS	462.6125	10	467.6125
4	GMRS 8 MURS	462.6375	11	467.6375
5	GMRS 10 MURS	462.6625	12	467.6625
6	GMRS 12 MURS	462.6875	13	467.6875
7	GMRS 14	462.7125	14	467.7125

Canadian channels 1 through 14 are the same as channels 1 through 14 allocated to the Family Radio Service in the United States. As noted above 7 of the FRS channels are shared with the Canadian General Mobile Radio Service (all in the 462 MHz portion of the FRS channel assignments). In addition, 4 channels are shared with the Canadian Multi-Use Radio Service. Canadian FRS radio devices are limited to 0.5 Watts effective radiated power or less.

VII. FEDERAL COMMUNICATIONS COMMISSION RULES

The following are the Federal Communications Commission rules that specifically govern the use of the Family Radio Service. In addition, Subpart A of Part 95 also has general rules that cover all of the Personal Radio Services (including Citizens Band, General Mobile, and Multi-Use Radio Services).

PART 95—PERSONAL RADIO SERVICES

Subpart B—Family Radio Service (FRS)

§95.501 Scope.

This subpart contains rules that apply only to the Family Radio Service (FRS).

§95.503 Definitions, FRS.

Family Radio Service (FRS). A short-distance two-way voice communication service, with limited data applications, between low power hand-held radios, for facilitating individual, family, group, recreational and business activities.

FRS unit. A transceiver for use in the FRS.

§95.519 FRS replacement parts.

The operator of a FRS unit may replace the batteries in the FRS unit with batteries of a type specified by the manufacturer. All other internal maintenance and repairs must be carried out in accordance with §95.319.

§95.531 Permissible FRS uses.

FRS units are primarily used for short-distance two-way voice communications between individuals.

(a) *Digital data.* In addition to voice conversations, FRS units may transmit digital data containing location information, or requesting location information from one or more other FRS or GMRS units, or containing a brief text message to another specific GMRS or FRS unit. Digital data transmissions must be initiated by a manual action of the operator, except that a FRS unit receiving an interrogation request may automatically respond with its location. *See also* §95.587(c).

(b) *One-way communications.* FRS units may be used for one-way communications that are emergency messages, traveler assistance communications, voice pages or brief equipment tests.

(c) *GMRS stations.* FRS units normally communicate with other FRS units, but may also be used to communicate with General Mobile Radio Service (GMRS) stations.

§95.533 Prohibited FRS uses.

FRS units must not be used for one-way communications other than those listed in §95.531(b). Initial transmissions to establish two-way communications and data transmissions listed in §95.531(a) are not considered to be one-way communications for the purposes of this section.

§95.561 FRS transmitter certification.

(a) Each FRS unit (a transmitter that operates or is intended to operate in the FRS) must be certificated for use in the FRS in accordance with this subpart and subpart J of part 2 of this chapter.

(b) A grant of equipment certification for the FRS will not be issued for any FRS transmitter type that fails to comply with all of the applicable rules in this subpart.

(c) A grant of equipment certification will not be issued for hand-held portable radio units capable of operating under both this subpart (FRS) and under any other subparts of this chapter (except part 15) if the application for such grant is filed on or after December 27, 2017.

§95.563 FRS channels.

The FRS is allotted 22 channels, each having a channel bandwidth of 12.5 kHz. All of the FRS channels are also allotted to the General Mobile Radio Service

(GMRS) on a shared basis. The FRS channel center frequencies are set forth in the following table:

Channel No.	Center frequency (MHz)
1	462.5625
2	462.5875
3	462.6125
4	462.6375
5	462.6625
6	462.6875
7	462.7125
8	467.5625
9	467.5875
10	467.6125
11	467.6375
12	467.6625
13	467.6875
14	467.7125
15	462.5500
16	462.5750
17	462.6000
18	462.6250
19	462.6500
20	462.6750
21	462.7000
22	462.7250

§95.565 FRS frequency accuracy.

Each FRS transmitter type must be designed such that the carrier frequencies remain within ± 2.5 parts-per-million of the channel center frequencies specified in §95.563 during normal operating conditions.

§95.567 FRS transmit power.

Each FRS transmitter type must be designed such that the effective radiated power (ERP) on channels 8 through 14 does not exceed 0.5 Watts and the ERP on channels 1 through 7 and 15 through 22 does not exceed 2.0 Watts.

§95.571 FRS emission types.

Each FRS transmitter type must be designed such that it can transmit only the following emission types: F3E, G3E, F2D, and G2D.

§95.573 FRS authorized bandwidth.

Each FRS transmitter type must be designed such that the occupied bandwidth does not exceed 12.5 kHz.

§95.575 FRS modulation limits.

Each FRS transmitter type must be designed such that the peak frequency deviation does not exceed 2.5 kHz, and the highest audio frequency contributing substantially to modulation must not exceed 3.125 kHz.

§95.577 FRS tone requirements.

In addition to the tones permitted under §95.377, FRS transmitter types may be designed to transmit brief tones to indicate the end of a transmission.

§95.579 FRS unwanted emissions limits.

Each FRS transmitter type must be designed to satisfy the applicable unwanted emissions limits in this paragraph.

(a) *Attenuation requirements.* The power of unwanted emissions must be attenuated below the carrier power output in Watts (P) by at least:

(1) 25 dB (decibels) in the frequency band 6.25 kHz to 12.5 kHz removed from the channel center frequency.

(2) 35 dB in the frequency band 12.5 kHz to 31.25 kHz removed from the channel center frequency.

(3) $43 + 10 \log (P)$ dB in any frequency band removed from the channel center frequency by more than 31.25 kHz.

(b) *Measurement bandwidths.* The power of unwanted emissions in the frequency bands specified in paragraphs (a)(1) and (2) of this section is measured with a reference bandwidth of 300 Hz. The power of unwanted emissions in the

frequency range specified in paragraph (a)(3) is measured with a reference bandwidth of at least 30 kHz.

(c) *Measurement conditions.* The requirements in this section apply to each FRS transmitter type both with and without the connection of permitted attachments, such as an external speaker, microphone and/or power cord.

§95.587 FRS additional requirements.

Each FRS transmitter type must be designed to meet the following additional requirements.

(a) *Transmit frequency capability.* FRS transmitter types must not be capable of transmitting on any frequency or channel other than those listed in §95.563.

(b) *Antenna.* The antenna of each FRS transmitter type must meet the following requirements.

(1) The antenna must be a non-removable integral part of the FRS transmitter type.

(2) The gain of the antenna must not exceed that of a half-wave dipole antenna.

(3) The antenna must be designed such that the electric field of the emitted waves is vertically polarized when the unit is operated in the normal orientation.

(c) *Digital data transmissions.* FRS transmitter types having the capability to transmit digital data must be designed to meet the following requirements.

(1) FRS units may transmit digital data containing location information, or requesting location information from one or more other FRS or GMRS units, or containing a brief text message to another specific FRS or GMRS unit or units.

(2) Digital data transmissions must be initiated by a manual action or command of the operator, except that FRS units may be designed to automatically respond with location data upon receiving an interrogation request from another FRS unit or a GMRS unit.

(3) Digital data transmissions must not exceed one second in duration.

(4) Digital data transmissions must not be sent more frequently than one digital data transmission within a thirty-second period, except that an FRS unit may automatically respond to more than one interrogation request received within a thirty-second period.

(d) *Packet mode.* FRS transmitter types must not be capable of transmitting data in the store-and-forward packet operation mode.

(e) Effective September 30, 2019, no person shall manufacture or import hand-held portable radio equipment capable of operating under this subpart (FRS) and other licensed or licensed-by-rule services in this chapter (part 15 unlicensed equipment authorizations are permitted if consistent with part 15 rules).

§95.591 Sales of FRS combination radios prohibited.

Effective September 30, 2019, no person shall sell or offer for sale hand-held portable radio equipment capable of operating under this subpart (FRS) and under any other licensed or licensed-by-rule radio services in this chapter (devices may be authorized under this subpart with part 15 unlicensed equipment authorizations).