

### **Frequency Control of Non-2.4 GHz Spread Spectrum R/C Radio Systems:**

2.4 GHz Spread Spectrum R/C Systems do not require frequency management to prevent interference between users.

For RC model operation on 27 MHz, 50 MHz, 53 MHz, 72 MHz and 75 MHz, it is necessary to maintain strict control of these transmitters at a flying site. Only one transmitter can be operated on any given frequency at any time. Operation of more than one transmitter on the same frequency will cause loss of model control. Safe management of operating transmitters can be aided by:

1. Use of frequency pins to identify the frequency in use. Pins, often clothespins, are marked with the color or channel number of the frequencies they represent. Only one pin is available at the flying site for each frequency. Transmitters shall not be operated without possession of a pin that identifies the frequency in use.
2. Clubs providing a flight-line control system for the use of spread spectrum radios. This system should be similar to the frequency control plan currently in use at the site. For spread spectrum, multiple pins or identification spaces should be provided.
3. Keeping transmitter antennas collapsed when models are not being flown.

Active frequency monitoring at flying sites is encouraged. Scanning receivers or a spectrum analyzer are excellent monitors of unwanted signals.

It is recommended that CDs or club officers require tests, or implement special frequency-control arrangements, as may be necessary, to reduce the chance of interference among RC systems.

### **Transmitter Requirements**

Narrowband transmitters are required for use with all channel number frequencies (CH 00-09 and 11-90).

Identification of narrowband transmitters is normally accomplished by a sophisticated laboratory test. Narrowband transmitters can also be identified as follows.

1. All PPM/FM and PCM/FM transmitters are narrowband. Only AM transmitters sold as new, prior to March 1993, are suspect.
2. The manufacturer of a suspect AM transmitter can verify if it is narrowband. If it is not, the manufacturer may offer to modify it to narrowband specifications.

Any user modification of a transmitter that might affect the transmitted signal is prohibited by law and safety concerns. This includes user replacement of frequency determining plug-in crystals and use of plug-in frequency modules from another manufacturer. Transmitter crystal replacement, with or without a change in frequency, requires transmitter emission realignment by the manufacturer. Use of a frequency determining module manufactured for use in another brand of transmitter can result in off frequency and spurious emissions that cause interference to other fliers.

## **Frequencies for Radio Control:**

1.0. The Federal Communications Commission (FCC) allocates and manages radio signals and emissions in the United States, including those used for radio control (RC) of models. The transmitters and receivers used for RC must be manufactured to FCC-specified technical requirements and operated on specific radio frequencies and bands. More complete information is available in the Code of Federal Regulations (CFR), reference 1. This document lists the current radio bands designated for remote control of models.

1.1. RC is permitted in three Personal Radio Service bands

1.1.1. The 27 MHz band uses six frequencies listed in paragraph 2.1.1. RC of model aircraft and surface craft is permitted. Model aircraft RC users should be aware of possible interference from nearby RC surface craft users. In addition, 27.255 MHz is shared with non-RC services and is not recommended for RC of model aircraft.

1.1.2. The 72 MHz band uses 50 frequencies listed in paragraph 2.1.2. Only RC of model aircraft is permitted. Model aircraft include model rockets, Control Line model aircraft, and lighter-than-air balloon models.

1.1.3. The 75 MHz band uses 30 frequencies listed in paragraph 2.1.3. Only radio control of model surface craft is permitted. Model surface craft include cars, boats, robots, and hovercraft.

1.2. RC is permitted in the Amateur Radio Service bands in accordance with FCC regulations, CFR Part 97, ref 1.

1.2.1. Nineteen Amateur Radio Frequencies listed in paragraphs 2.1.4., 2.1.5., and 2.1.7 are traditionally used by licensed amateurs for RC of all types of models. RC operation in the amateur bands is shared with other Amateur Radio services, so RC is subject to interference from non-RC users. Station identification of RC transmissions is not required. Narrowband transmitters are required on CH 00 to CH 09 when operating at AMA sanctioned events. Narrowband transmitter technical requirements are defined in reference 2.

1.3. RC is permitted using the Low Power band:

1.3.1. Five frequencies, 49.83 MHz to 49.89 MHz on 0.015 MHz spacing, are used for RC of all types of devices as well as short-range communication services.

1.4. RC is permitted in the 2.4 GHz industrial, scientific, and medical (ISM) band using spread spectrum technology from 2.4 GHz to 2.485 GHz.

## **Frequency Identification and Display:**

2.0. Frequency control at an RC operating site is necessary to prevent simultaneous operation of transmitters on the same frequency. Simultaneous operation on the same frequency causes loss of control even if the transmitters use different forms of modulation or coding, such as AM, FM, or PCM.

2.1. Frequency Identification: The radio frequencies are listed in Megahertz (MHz) units. For convenience, SINGLE-COLOR, TWO-COLOR, CHANNEL number, and 27 MHz CHANNEL number designate the frequencies.

2.1.1. 27 MHz Band - Identified as SINGLE COLOR or 27 MHz CHANNEL number frequencies:

26.995 -	BROWN	or	27 MHz CHANNEL 1
27.045 -	RED	or	27 MHz CHANNEL 2
27.095 -	ORANGE	or	27 MHz CHANNEL 3
27.145 -	YELLOW	or	27 MHz CHANNEL 4
27.195 -	GREEN	or	27 MHz CHANNEL 5
27.255 -	BLUE	or	27 MHz CHANNEL 6

2.1.2. 72 MHz Band - Identified as CHANNEL number frequencies:

72.01	CHANNEL 11	72.51	CHANNEL 36
72.03	CHANNEL 12	72.53	CHANNEL 37
72.05	CHANNEL 13	72.55	CHANNEL 38
72.07	CHANNEL 14	72.57	CHANNEL 39
72.09	CHANNEL 15	72.59	CHANNEL 40
72.11	CHANNEL 16	72.61	CHANNEL 41
72.13	CHANNEL 17	72.63	CHANNEL 42
72.15	CHANNEL 18	72.65	CHANNEL 43
72.17	CHANNEL 19	72.67	CHANNEL 44
72.19	CHANNEL 20	72.69	CHANNEL 45
72.21	CHANNEL 21	72.71	CHANNEL 46
72.23	CHANNEL 22	72.73	CHANNEL 47
72.25	CHANNEL 23	72.75	CHANNEL 48
72.27	CHANNEL 24	72.77	CHANNEL 49
72.29	CHANNEL 25	72.79	CHANNEL 50

72.31	CHANNEL 26	72.81	CHANNEL 51
72.33	CHANNEL 27	72.83	CHANNEL 52
72.35	CHANNEL 28	72.85	CHANNEL 53
72.37	CHANNEL 29	72.87	CHANNEL 54
72.39	CHANNEL 30	72.89	CHANNEL 55
72.41	CHANNEL 31	72.91	CHANNEL 56
72.43	CHANNEL 32	72.93	CHANNEL 57
72.45	CHANNEL 33	72.95	CHANNEL 58
72.47	CHANNEL 34	72.97	CHANNEL 59
72.49	CHANNEL 35	72.99	CHANNEL 60

2.1.3. 75 MHz Band - Identified as CHANNEL number frequencies:

75.41	CHANNEL 61	75.71	CHANNEL 76
75.43	CHANNEL 62	75.73	CHANNEL 77
75.45	CHANNEL 63	75.75	CHANNEL 78
75.47	CHANNEL 64	75.77	CHANNEL 79
75.49	CHANNEL 65	75.79	CHANNEL 80
75.51	CHANNEL 66	75.81	CHANNEL 81
75.53	CHANNEL 67	75.83	CHANNEL 82
75.55	CHANNEL 68	75.85	CHANNEL 83
75.57	CHANNEL 69	75.87	CHANNEL 84
75.59	CHANNEL 70	75.89	CHANNEL 85
75.61	CHANNEL 71	75.91	CHANNEL 86
75.63	CHANNEL 72	75.93	CHANNEL 87
75.65	CHANNEL 73	75.95	CHANNEL 88
75.67	CHANNEL 74	75.97	CHANNEL 89
75.69	CHANNEL 75	75.99	CHANNEL 90

2.1.4. 50 MHz Band - Identified as CHANNEL number frequencies:

50.80	CHANNEL 00	50.90	CHANNEL 05
50.82	CHANNEL 01	50.92	CHANNEL 06
50.84	CHANNEL 02	50.94	CHANNEL 07
50.86	CHANNEL 03	50.96	CHANNEL 08
50.88	CHANNEL 04	50.98	CHANNEL 09

2.1.5. 53 MHz Band - Identified as TWO-COLOR frequencies:

53.10	BROWN/BLACK	53.50	GREEN/BLACK
53.20	RED/BLACK	53.60	BLUE/BLACK
53.30	ORANGE/BLACK	53.70	PURPLE/BLACK
53.40	YELLOW/BLACK	53.80	GREY/BLACK

Other Amateur Radio Service frequencies:      WHITE/BLACK

2.1.6. 2.4 GHz band using spread spectrum technology: 2.4 GHz-2.485 GHz.

2.1.7 433 MHz band using spread spectrum technology: 430 MHz – 440 MHz (70cm) Amateur Radio Service requires proper FCC licensing

### **FCC Legal Requirements and Safety Recommendations**

3.0. RC users shall comply with FCC regulations. Some of the more pertinent regulations have been presented in this document. Complete RC regulations are contained in the CFR, reference 1. RC users of the 27 MHz, 72 MHz, and 75 MHz bands are required to comply with the CFR Part 95. RC users of the Amateur Radio Service are required to comply with the CFR Part 97. RC users of the Low Power 2.4 GHz band are required to comply with CFR Part 15. The AMA will not assume responsibility for enforcement of the CFR. However, if the violation impacts safety, corrective action may be taken.

3.1. AMA RC event officials shall enforce FCC Amateur Radio Operator licensing requirements. Use of legal Amateur Radio Service frequencies other than those listed in paragraph 2.1.4. And 2.1.5. is permitted at sanctioned events at the discretion of the event officials. For these frequencies, black and white ribbons, with the frequency inscribed on the white ribbon, is an acceptable frequency display.

3.2. The FCC prohibits radio transmissions on any 72 MHz or 75 MHz channel frequency for the purpose of telemetering data. Event signaling by radio telemeter is permitted on the 27 MHz RC frequencies.

3.3. Control interference between adjacent flying sites separated by less than 3 miles may occur if the same frequencies are used at both sites. The AMA Safety Code regulates AMA club flying sites to avoid such interference. However, small RC models, often flown in back yards and parks, are unregulated and can be a source of interference between sites. Back yard/park flying site adherence to the AMA Safety Code, Radio Control, Item 5, is encouraged to eliminate adjacent site interference.

#### **References:**

1. Code of Federal Regulations: (CFR) Title 47, Telecommunications: Part 0 to 19 and Part 80 to End.

Special reference is made to the following:

- Part 2 - Certification Procedure, Subpart: Equipment Authorization Procedure; starting with paragraph 2.901

- Part 15 - Radio Frequency Devices: Subpart C - Low Power Communication Devices; General Requirements and paragraphs 15.235 (49.82 to 49.90 MHz) apply.

- Part 95 - Personal Radio Service (PRS): Subpart C - Radio Control (R/C) Radio Service: Paragraphs 95.201 to 95.225 apply. Subpart E - Technical Standards for PRS Devices: Paragraphs 95.601 to 95.673 apply.

- Part 97 - Amateur Radio Service: all paragraphs apply.