# MODEL AERONAUTICAL ASSOCIATION OF AUSTRALIA

# FREQUENCY DIRECTIVE ISSUE 6 - 2007

MOP013

APPROVED M.A.A.A. PRESIDENT Date: 08/07/2007

## Table of Contents

# M.A.A.A. R/C FREQUENCY DIRECTIVE ISSUE 6 - 2007

## 1 INTRODUCTION

1.1 This Frequency Directive MOP 013 only applies to the 29, 36 and 40 MHz bands. 27 MHz and 2.4 GHz are now also approved by the M.A.A.A. and reference should be made to MOP 048 and 058 for the relevant procedures for these bands.

1.2 Radio Controlled Model Aircraft can only operate legally in Australia on frequencies approved by the Australian Communications Authority. The frequency bands approved by the M.A.A.A. are 29.720 - 30.000MHz, 36.000 - 36.600MHz and 40.660 - 40.700MHz. It should be noted that the assigned centre frequencies for operation are 5kHz removed from the band edges. Frequencies other than those identified above are not recommended to be used at any field operated by the M.A.A.A., any State Association, Club, or any M.A.A.A. affiliated member. To do so may invalidate any insurance cover provided by the M.A.A.A..

1.3 Each of the frequency bands is divided into individual assignments of 10kHz, however, due to the limitations of some radio control equipment a frequency spacing of greater than 10kHz may be required in practice. This document contains operating procedures and testing requirements to allow operation of equipment at specified frequency spacings. It should be stated that to operate at 10kHz spacing, more stringent requirements are placed on the users.

1.4 If those controlling a particular flying area cannot or do not wish to comply with the 10kHz operating requirements, they shall use a minimum of 20kHz frequency separation between operating transmitters. In addition, at a flying area where 10kHz operation is permitted, an individual may choose to operate with a 20kHz or greater separation between transmitter frequencies.

1.5 The following rules apply to radio control equipment used for the control of model aircraft and operated by affiliated members of the M.A.A.A.

## 2 GENERAL

2.1 Any model flier may use equipment with any type of modulation (within Australian Communications Authority Specifications) on any channel.

2.2 The M.A.A.A. recommends that model control equipment, both transmitters and receivers, be tested in accordance with this directive at time of purchase, in the event of a change to an untested frequency, after repair, following a crash or when the modeller has any doubt as to the performance of the equipment.

Evidence of testing is identified by a self-adhesive label being affixed to the equipment and signed by an approved testing station.

2.3 All R/C equipment used at events sanctioned by the M.A.A.A. or State/Territory Associations shall have been functionally tested in accordance with this directive except when a 40kHz key is used.

2.4 The use of the "Silvertone" type Keyboard system at individual club flying fields is strongly recommended for frequency control. The "Silvertone" type Keyboard shall be used to control frequency allocation and separation at National and State Championships and at any other M.A.A.A. sanctioned events (as distinct from State Association sanctioned events). The key is to carry the name of the owner and the number of the channel used.

2.5 One inch wide keys, or their metric equivalent, shall not be used in keyboards where two inch keys are used for 20kHz operation. It is recommended that a notice is placed on these keyboards banning the use of one inch keys, since they would imply 10kHz operation which, in accordance with a decision of the M.A.A.A. Council, is not allowed with this model of keyboard.

# 3 FREQUENCY CONTROL and MANAGEMENT

## 3.1 For 40kHz operation.

Some equipment still exists that will only meet the 40kHz bandwidth testing requirements. This equipment shall be used with a "Silvertone" type key of the appropriate width that blanks a 40kHz window on the keyboard.

## 3.2 For 20kHz operation.

Where equipment meets the 20kHz bandwidth testing requirements, this equipment shall be used with a "Silvertone" type key of the appropriate width that blanks a 20kHz window on the keyboard.

## 3.3 For 10kHz operation.

To operate at 10kHz, more stringent requirements are placed on the users, covering both equipment and field practice.

### Flight Equipment

3.1.1 It is mandatory that both transmitters and receivers are tested and certified for 10kHz operation in accordance with test procedures at Annex B. In the event that more than one receiver is used with one transmitter then each receiver shall be individually tested in order to comply.

3.3.2 The 10kHz certification is valid for one year and upon expiry must be renewed for continuing operation at 10kHz. In addition users should pay particular attention to the recommendations for re-testing referred to in the general section of this directive.

### Field Practice

3.3.3 The use of a metric "Silvertone" type keyboard is mandated at all venues where those controlling the flying area permit 10kHz operations. For clarification the metric keyboard uses 12.5mm wide keys for 10kHz certified equipment, 25mm wide keys for 20kHz equipment and 50mm wide keys for 40kHz equipment.

3.3.4 10 kHz operation shall only be permitted when a controlled flight line is operating. This means that pilots shall conduct themselves in accordance with the field layout specified in Annex D.

3.3.5 Radio Control Pilots who operate aircraft that would be susceptible to a higher probability of flight control problems caused by glitches, such as large or fast models, should be aware of the reduced safety margin of operating at 10 kHz channel spacing. Models that fall into this

category include ducted fans, turbines, pylon racers, large-scale models and larger aerobatic models. It should again be noted that 10kHz operation is not mandatory under current M.A.A.A. policy, and so equipment that is certified for 10kHz operation may be used at 20kHz spacing if the user so desires.

3.3.6 Good field management practices must be emphasised and are even more important for 10 kHz operation than previously identified for 20kHz operations. Education and publicity of good field practice must be continued.

3.3.7 Modellers who regularly fly together on frequencies that are 10kHz separated are advised to periodically perform the 10 to 1 range ratio tests referred at Annex E. This test should also be performed when there is suspicion of mutual interference.

# 4 M.A.A.A. APPROVED TESTING STATIONS

4.1 Testing of R/C equipment is to be carried out by testing stations approved by the M.A.A.A. A State/Territory Association may consider recommending a testing station situated in another State and should recognise the validity of tests conducted in other States.

4.2 Two categories of testing station are recognised by the M.A.A.A. General testing stations that have equipment and skills to test in accordance with Annex A may be approved to certify equipment for operation at 20kHz and wider bandwidth. Testing stations having the equipment and skills enabling then to meet the requirements of Annex B may be approved to certify equipment for operation under the more stringent requirements for 10kHz operation.

4.3 Before recommending a testing station for approval, a State Association shall be satisfied that the testing station has the equipment, and skills necessary to perform the stipulated tests at the time of application and into the future. This should include state of repair and calibration of the equipment. A suitably qualified person, such as the State Representative on the M.A.A.A. Frequency Sub-Committee shall do the verification. This can be achieved by an inspection of the facilities and the testing process or by a written statement detailing the facilities and tester's capabilities provided this adequately demonstrates the tester competency. If necessary both processes may be used. It is not necessary for the station to own the test equipment, but loss of access to test equipment shall the invalidate approval.

4.4 The State Association shall recommend to the M.A.A.A. Secretary when a station is considered suitable for approval or when an approval is invalidated. After approval by the M.A.A.A. Executive the M.A.A.A. Secretary shall be responsible for placing the station on an approved list and the distribution of the certification labels and copies of the ‘Remote Control Equipment - Information For Modellers’ (see Annex C).

4.5 On completion of a test, a copy of the ‘Remote Control Equipment - Information For Modellers’ is to be issued with the equipment by the testing station.

# 5 FREQUENCY BANDS and CHANNELS

## 5.1 27 MHz

26.957 - 27.282. This band is allocated for general use. It is principally available for the control of toys, where toys are using transmitters with a power output lower than that required to be used on 29 and 36 MHz. The M.A.A.A. does not recommend the use of equipment in this band because of the possibility of interference.

## 5.2 29 MHz

**TABLE 1**

| Channel No | Tx Frequency | Channel No | Tx Frequency |
|---|---|---|---|
| 10 (FM only) | 29.725 MHz | 24 | 29.865 |
| 11 | 29.735 | 25 | 29.875 |
| 12 | 29.745 | 26 | 29.885 |
| 13 | 29.755 | 27 | 29.895 |
| 14 | 29.765 | 28 | 29.905 |
| 15 | 29.775 | 29 | 29.915 |
| 16 | 29.785 | 30 | 29.925 |
| 17 | 29.795 | 31 | 29.935 |
| 18 | 29.805 | 32 | 29.945 |
| 19 | 29.815 | 33 | 29.955 |
| 20 | 29.825 | 34 | 29.965 |
| 21 | 29.835 | 35 | 29.975 |
| 22 | 29.845 | 36 | 29.985 |
| 23 | 29.855 | 37 - 49 | Reserved |

## 5.3 40 MHz

**TABLE 2**

| Channel No | Tx Frequency |
|---|---|
| 50 | 40.665 MHz |
| 51 ** | 40.675 |
| 52 ** | 40.685 |
| 53 | 40.695 |

Users of this band should be aware it is not a band specifically for model use and amongst others is known to be used by mine safety equipment.

** It is also known that Channels 51 and 52 are subject to interference from paging systems.

## 5.4 **36 MHz**

### TABLE 3

| Channel No | Tx Frequency | Channel No | Tx Frequency |
|---|---|---|---|
| | | 630 | 36.300 |
| 601 | 36.010 | 631 | 36.310 |
| 602 | 36.020 | 632 | 36.320 |
| 603 | 36.030 | 633 | 36.330 |
| 604 | 36.040 | 634 | 36.340 |
| 605 | 36.050 | 635 | 36.350 |
| 606 | 36.060 | 636 | 36.360 |
| 607 | 36.070 | 637 | 36.370 |
| 608 | 36.080 | 638 | 36.380 |
| 609 | 36.090 | 639 | 36.390 |
| 610 | 36.100 | 640 | 36.400 |
| 611 | 36.110 | 641 | 36.410 |
| 612 | 36.120 | 642 | 36.420 |
| 613 | 36.130 | 643 | 36.430 |
| 614 | 36.140 | 644 | 36.440 |
| 615 | 36.150 | 645 | 36.450 |
| 616 | 36.160 | 646 | 36.460 |
| 617 | 36.170 | 647 | 36.470 |
| 618 | 36.180 | 648 | 36.480 |
| 619 | 36.190 | 649 | 36.490 |
| 620 | 36.200 | 650 | 36.500 |
| 621 | 36.210 | 651 | 36.510 |
| 622 | 36.220 | 652 | 36.520 |
| 623 | 36.230 | 653 | 36.530 |
| 624 | 36.240 | 654 | 36.540 |
| 625 | 36.250 | 655 | 36.550 |
| 626 | 36.260 | 656 | 36.560 |
| 627 | 36.270 | 657 | 36.570 |
| 628 | 36.280 | 658 | 36.580 |
| 629 | 36.290 | 659 | 36.590 |

**NOTE**

Only 10kHz approved equipment shall be used on Channel 10, 601 and 659 due to an Australian Communications Authority requirement.

# 6 LABELS

6.1 To enable effective monitoring of the uses of the keyboard transmitters should be clearly marked with the owner's name.

6.2 The issue of a separation label is conditional on the results of functional testing detailed in Annex A or B. For Annex A tests, if both a transmitter and receiver are tested they are done so as a pair. For Annex B if the Rx passes the test then it can have a 10kHz sticker applied. If the Tx passes the test in Annex B then it can have a 10kHz sticker applied.

6.3 If a transmitter is used with a receiver with a different bandwidth, then THE PILOT MUST USE A KEY THAT CORRESPONDS TO THE TRANSMITTER OR RECEIVER WITH THE GREATER BANDWIDTH.

6.4 Labels are to be issued as follows:

6.4.1 40 kHz separation

A 40kHz label will be issued if testing in accordance with Annex A or B indicates that such frequency separation is required for safe operation. The label will be affixed to the transmitter even if the receiver is the limiting equipment.

6.4.2 20kHz separation.

A 20 kHz label will be issued when testing in accordance with Annex A or B indicates that such frequency separation is necessary for safe operation. The label will be affixed to the transmitter.

6.4.3 10 kHz separation

A 10 kHz label will be affixed to the transmitter once the transmitter has passed the test for 10kHz operation in accordance with Annex B.

A 10 kHz label will be affixed to the receiver once the receiver has passed the test for 10kHz operation in accordance with Annex B. In the event that an owner does not wish to have the receiver removed from the model it is acceptable for the label to be fixed inside the model adjacent to the receiver location, but see note below.

For transmitters and receivers, a 10kHz sticker that is dated more than one year prior to the current date, or with an illegible date, is equivalent to a certification for 20kHz operation.

**NOTE**

For M.A.A.A. sanctioned events, National and State Championship events, the user of R/C equipment is to have a frequency key of the appropriate width for each transmitter/receiver combination. In the event that the organisers require proof of the currency of the

equipment certification this shall be by reading the label in the case of the transmitter. In most cases it will not be possible to see the label on the receiver, if 10kHz spacing is to be used, without removing it from the model. In these cases it is recommended that the entry form, or equivalent, should contain a section for the owner to sign stating that the receiver has a current certification for 10kHz. Modellers who use some receivers that are certified for 10kHz and others that are certified for 20kHz operation, are strongly advised to keep careful track of which receiver in each model either by a label inside the model or otherwise.

6.5 The labels will conform to the following

- A yellow square label carrying, in black the channel on which the equipment operates.
- A coloured square label carrying the following
  a) the M.A.A.A. logo
  b) The approved frequency separation for the equipment and the testing station or club authentication and date. The identity of the testing station shall be printed to enable tracability.
- The colour of this label will indicate the approved frequency separation: -

  green - 10kHz,
  orange - 20kHz, and
  yellow - 40 kHz.

## 7. **Annexes**

A Testing of R/C equipment for 20kHz or greater separation
B Testing of R/C equipment for 10kHz separation
C Remote Control Equipment – Information for Modellers
D Field Layout for 10kHz
E Field Range Ratio Test
F Testing Jig.

# ANNEX A

# TESTING OF R/C EQUIPMENT

## For 20kHz or greater separation

## TRANSMITTER

Equipment Required Spectrum Analyser capable of Resolution Bandwidths of 1kHz
Frequency Counter capable of resolving 100Hz.
RF Signal Generator

Test Set Up Set the Spectrum Analyser resolution bandwidth to a maximum of 1kHz
Set the centre frequency to within 1kHz of the nominal channel frequency.

Attach a short antenna to the Spectrum Analyser input

Test Method Turn the transmitter on and ensure that the attenuator on the spectrum analyser is set to force the peak signal to be at least 10dB below the top of the screen or move the transmitter away from the spectrum analyser antenna to affect the same result.

Determine the frequency bandwidth at the -40dB point on the curve relative to the peak of the fundamental modulated carrier.

Measurement of the centre frequency of PCM transmitters may be executed using an antenna connected to the input of the frequency counter.

For PPM and PCM transmissions the centre frequency may be measured by setting a marker on the spectrum analyser using the RF Signal Generator and frequency counter. The signal generator shall be unmodulated. The measurement of centre frequency using this method is subjective, but is best estimated at the centre of the modulated envelope at approximately 20dB below the peak of the signal. If the centre frequency is more than approximately 1 kHz offset, then the -40dB points may fall outside the limits allowed for 20kHz operation. If this occurs the tester should confirm that the correct crystals are fitted or that the transmitter oscillator is working correctly.

Specification

a) The -40dB points on the curve shall be less than +/- 40kHz for 40kHz operation.
b) The -40dB points on the curve shall be less than +/- 20kHz for 20kHz operation.

The larger difference from the nominal channel frequency is used to determine the channel spacing.

c) Frequency accuracy to be within +/- 1kHz

Examples
1. If the -40 dB points are +15kHz and -18kHz, then a 20kHz separation is required for the transmitter.
2. If the -40 dB points are +15kHz and -22kHz, then a 40kHz separation is required for the transmitter

Stickers After the test the appropriate sticker should be affixed in accordance with Section 6 of the Directive.

## RECEIVER - Non PCM

Equipment Required Spectrum Analyser capable of Resolution Bandwidths of 1kHz
Frequency Counter capable of resolving 100Hz
RF Signal Generator

Test Set Up Connect the output of the Signal Generator to the input of the Spectrum Analyser and loosely couple the signal generator output to the receiver antenna. Annex F describes one way of achieving this.

This procedure provides the 40dB points on the receiver selectivity curve.

The Spectrum Analyser is used to measure the signal levels when using a signal generator that is not fitted with a calibrated attenuator.

Test Method Turn on both the transmitter and the receiver with at least one servo connected and move the transmitter away (or collapse its antenna if this is not damaging to the transmitter) until the servos just operate without noise or jitter.

Turn on the signal generator set to carrier only (no modulation). Set the generator to the transmitter nominal channel frequency and increase the output level until some interference is caused to the receiver, (e.g. the servos just jitter).

Set the signal generator frequency to a value at least 100kHz above the nominal transmitter channel frequency.

Increase the signal generator level by 40 dB and move the signal generator frequency slowly towards the channel frequency until there is the same level of interference caused to the receiver as before (e.g. the servos just jitter). Note the frequency.

Repeat the test setting the signal generator to the lower side of the transmitter channel frequency. Note the frequency.

Specification

a) The 40dB points on the curve shall not exceed +/- 40kHz for 40kHz operation.
b) The 40dB points on the curve shall not exceed +/- 20kHz for 20kHz operation.

The larger difference from the nominal channel frequency is used to determine the channel spacing.

Examples
1 If the 40dB points are +15kHz and -18kHz, a 20kHz separation is required for the receiver.
2. If the 40dB points are +15kHz and -22kHz, a 40kHz separation is required for the receiver.

Stickers After the test the appropriate sticker should be affixed in accordance with Section 6 of the Directive.

**NOTE** If the receiver test result is 20 kHz then the pilot is instructed to use the appropriate key for 20kHz operation even if the transmitter has a narrower bandwidth certification.

Similarly, if the receiver test result is 40 kHz then the pilot is instructed to use the appropriate key for 40kHz operation since in this case the transmitter will also have a 40 kHz sticker attached.

## RECEIVER - PCM (or equivalent)- WITH FAIL SAFE ENABLED

Equipment Required Spectrum Analyser capable of Resolution Bandwidths of 1kHz
Frequency Counter capable of resolving 100Hz
RF Signal Generator

Test Set Up Connect the output of the Signal Generator to the input of the Spectrum Analyser and loosely couple the signal generator output to the receiver antenna. Annex F describes one way of achieving this.

This procedure provides the 40dB points on the receiver selectivity curve. The Spectrum Analyser is used to measure the signal levels when using a signal generator that is not fitted with a calibrated attenuator.

Test Method Turn on both the transmitter and the receiver and move both control sticks off centre by at least 25% of the travel. While holding the sticks in this position, set the fail-safe.

Having released the sticks, move the transmitter away (or collapse its antenna if this is not damaging to the transmitter) until the servos move to the fail-safe position. Bring the transmitter back towards the receiver until the servos just return to normal.

Turn on the signal generator, set to carrier only (no modulation). Set the generator to the transmitter nominal channel frequency and increase the output level until the servos move to the fail-safe position.

Set the signal generator frequency to a value at least 100kHz above the nominal transmitter channel frequency.

Increase the signal generator level by 40 dB and move the signal generator frequency slowly towards the channel frequency until the failsafe operates.
Note the frequency.

Repeat the test setting the signal generator to the lower side of the transmitter channel frequency. Note the frequency

**NOTE** The signal generator must be moved towards the centre frequency more slowly than with FM PPM receivers to allow for the delayed response of the fail-safe system.

Specification

a) The 40dB points on the curve shall not exceed +/- 40kHz for 40kHz operation.
b) The 40dB points on the curve shall not exceed +/- 20kHz for 20kHz operation.

The larger difference from the nominal channel frequency is used to determine the channel spacing.

Examples
1. If the 40dB points are +15kHz and -18kHz, a 20kHz separation is required for the receiver.
2. If the 40dB points are +15kHz and -22kHz, a 40kHz separation is required for the receiver

Stickers After the test the appropriate sticker should be affixed in accordance with Section 6 of the Directive.

**NOTE** If the receiver test result is 20 kHz, then the pilot is instructed to use the appropriate key for 20kHz operation even if the transmitter has a narrower bandwidth certification.

Similarly, if the receiver test result is 40 kHz then the pilot is instructed to use the appropriate key for 40kHz since in this case the transmitter will also have a 40 kHz sticker attached

## RECEIVER - PCM (or equivalent)- WITHOUT FAIL SAFE

Equipment Required Spectrum Analyser capable of Resolution Bandwidths of 1kHz
Frequency Counter capable of resolving 100Hz
RF Signal Generator

Test Set Up Connect the output of the Signal Generator to the input of the Spectrum Analyser and loosely couple the signal generator output to the receiver antenna. Annex F describes one way of achieving this.

This procedure provides the 40dB points on the receiver selectivity curve. The Spectrum Analyser is used to measure the signal levels when using a signal generator that is not fitted with a calibrated attenuator.

Test Method Turn on both the transmitter and the receiver and move the transmitter away (or collapse its antenna if this is not damaging to the transmitter) operating at least one servo from the transmitter controls until the servo stops moving.

Bring the transmitter back towards the receiver until the servos moves again.

The following test may require a second operator to enable the transmitter to be operated.

Turn on the signal generator, set to carrier only (no modulation). Set the generator to the transmitter nominal channel frequency and increase the output level until the servo stops moving

Set the signal generator frequency to a value at least 100kHz above the nominal transmitter channel frequency.

Increase the signal generator level by 40 dB and with the transmitter controls moving; reduce the signal generator frequency slowly towards the channel frequency until the servo stops moving. Note the frequency.

Repeat the test setting the signal generator to the lower side of the transmitter channel frequency. Note the frequency

Specification

a) The 40dB points on the curve shall not exceed +/- 40kHz for 40kHz operation.
b) The 40dB points on the curve shall not exceed +/- 20kHz for 20kHz operation.

The larger difference from the nominal channel frequency is used to determine the channel spacing.

Examples

1 If the 40dB points are +15kHz and -18kHz, a 20kHz separation is required for the receiver.
2 If the 40dB points are +15kHz and -22kHz, a 40kHz separation is required for the receiver

**NOTE** If the receiver test result is 20 kHz then the pilot is instructed to use the appropriate key for 20kHz operation even if the transmitter has a narrower bandwidth certification.

Similarly, if the receiver test result is 40 kHz then the pilot is instructed to use the appropriate key for 40kHz operation since in this case the transmitter will also have a 40 kHz sticker attached.

# ANNEX B

## TESTING OF R/C EQUIPMENT

### For 10kHz Separation

### TRANSMITTER

Equipment Required Spectrum Analyser capable of Resolution Bandwidths of 100Hz
Frequency Counter capable of resolving 10Hz.
RF Signal Generator

Test Set Up Set the Spectrum Analyser resolution bandwidth to a maximum of 100Hz
Set the centre frequency to within 100Hz of the nominal channel frequency.

Attach a short antenna to the Spectrum Analyser input

Test Method Turn the transmitter on and ensure that the attenuator on the spectrum analyser is set to force the peak signal to be at least 10dB below the top of the screen or move the transmitter away from the spectrum analyser antenna to affect the same result.

Determine the frequency bandwidth at the -50dB point on the curve relative to the peak of the fundamental modulated carrier.

Measurement of the centre frequency of PCM transmitters may be executed using an antenna connected to the input of the frequency counter.

For PPM and PCM transmissions the centre frequency may be measured by setting a marker on the spectrum analyser using the RF Signal Generator and frequency counter. The signal generator shall be unmodulated. The measurement of centre frequency using this method is subjective, but is best estimated at the centre of the modulated envelope at approximately 20dB below the peak of the signal. If the centre frequency is more than approximately 1 kHz offset, then the -50dB points will fall outside the limits allowed for 10kHz operation. If this occurs the tester should confirm that the correct crystals are fitted or that the transmitter oscillator is working correctly.

Specification

a) The -50dB points on the curve shall be less than +/- 10kHz for 10kHz operation.
b) Frequency accuracy to be within +/- 600Hz

Examples 1 If the -50 dB points are +5kHz and -8kHz, then a 10kHz separation is required for the transmitter.

2 If the -50dB points are +5kHz and -11kHz, a 20kHz separation is required for the transmitter.

3. Centre frequency is more than 600Hz from nominal then a minimum 20kHz separation is required irrespective of the bandwidth.

Stickers After passing the test a 10kHz transmitter sticker should be affixed in accordance with the Section 6 of the Directive.

## RECEIVER - Non PCM

Equipment Required Spectrum Analyser capable of Resolution Bandwidths of 100Hz -- Frequency Counter capable of resolving 100Hz
RF Signal Generator

Test Set Up Connect the output of the Signal Generator to the input of the Spectrum Analyser and loosely couple the signal generator output to the receiver antenna. Annex F describes one way of achieving this.

This procedure provides the 50dB points on the receiver selectivity curve.

The Spectrum Analyser is used to measure the signal levels when using a signal generator that is not fitted with a calibrated attenuator.

Test Method Turn on both the transmitter and the receiver with at least one servo connected and move the transmitter away (or collapse its antenna if this is not damaging to the transmitter) until the servos just operate without noise or jitter.

Turn on the signal generator, set to carrier only (no modulation). Set the generator to the transmitter nominal channel frequency and increase the output level until some interference is caused to the receiver, (e.g. the servos just jitter).

Set the signal generator frequency to a value at least 100kHz above the nominal transmitter channel frequency.

Increase the signal generator level by 50 dB and move the signal generator frequency slowly towards the channel frequency until there is the same level of interference caused to the receiver as before (e.g. the servos just jitter).
Note the frequency.

Repeat the test setting the signal generator to the lower side of the transmitter channel frequency. Note the frequency.

Specification

The 50dB points on the curve shall not exceed +/- 8kHz for 10kHz operation.

The larger difference from the nominal channel frequency is used to determine the channel spacing.

Examples
1 If the 50dB points are +5kHz and -7kHz, a 10kHz separation is required for the receiver.
2 If the 50dB points are +5kHz and -11kHz, a 20kHz separation is required for the receiver.

Stickers After passing the test a 10kHz receiver sticker should be affixed in accordance with the Section 6 of the Directive.

## RECEIVER - PCM (or equivalent) - WITH FAIL SAFE ENABLED

Equipment Required Spectrum Analyser capable of Resolution Bandwidths of 100Hz
Frequency Counter capable of resolving 100Hz
RF Signal Generator

Test Set Up Connect the output of the Signal Generator to the input of the Spectrum Analyser and loosely couple the signal generator output to the receiver antenna. Annex F describes one way of achieving this.

This procedure provides the 50dB points on the receiver selectivity curve. The Spectrum Analyser is used to measure the signal levels when using a signal generator that is not fitted with a calibrated attenuator.

Test Method Turn on both the transmitter and the receiver and move both control sticks off centre by at least 25% of the travel. While holding the sticks in this position, set the fail-safe.

Having released the sticks, move the transmitter away (or collapse its antenna if this is not damaging to the transmitter) until the servos move to the fail-safe position. Bring the transmitter back towards the receiver until the servos just return to normal.

Turn on the signal generator, set to carrier only (no modulation). Set the generator to the transmitter nominal channel frequency and increase the output level until the servos move to the fail-safe position.

Set the signal generator frequency to a value at least 100kHz above the nominal transmitter channel frequency.

Increase the signal generator level by 50 dB and move the signal generator frequency slowly towards the channel frequency until the failsafe operates.
Note the frequency.

Repeat the test setting the signal generator to the lower side of the transmitter channel frequency. Note the frequency.

**NOTE** The signal generator must be moved towards the centre frequency more slowly than with FM PPM receivers to allow for the delayed response of the fail-safe system.

Specification

The 50dB points on the curve shall not exceed +/- 8kHz for 10kHz operation.

The larger difference from the nominal channel frequency is used to determine the channel spacing.

Examples
1. If the 50dB points are +5kHz and -7kHz, then a 10kHz separation is required for the receiver.
2. If the 50dB points are +5kHz and -11kHz, a 20kHz separation is required for the receiver

Stickers After passing the test a 10kHz receiver sticker should be affixed in accordance with the Section 6 of the Directive.

## RECEIVER - PCM (or equivalent)- WITHOUT FAIL SAFE

Equipment Required Spectrum Analyser capable of Resolution Bandwidths of 100Hz
Frequency Counter capable of resolving 100Hz
RF Signal Generator

Test Set Up Connect the signal generator to the Spectrum Analyser input using the test jig shown in the Annex to this document.
Place the receiver antenna into the test jig shown at Annex F.
**Or**
Loosely couple the signal generator output to the receiver antenna.

This procedure provides the 50dB points on the receiver selectivity curve. The Spectrum Analyser is used to measure the signal levels when using a signal generator that is not fitted with a calibrated attenuator.

Test Method Turn on both the transmitter and the receiver and move the transmitter away (or collapse its antenna if this is not damaging to the transmitter) operating at least one servo from the transmitter controls until the servo stops moving.

Bring the transmitter back towards the receiver until the servos moves again.

The following test may require a second operator to enable the transmitter to be operated.

Turn on the signal generator, set to carrier only (no modulation). Set the generator to the transmitter nominal channel frequency and increase the output level until the servo stops moving

Set the signal generator frequency to a value at least 100kHz above the nominal transmitter channel frequency.

Increase the signal generator level by 50 dB and with the transmitter controls moving; reduce the signal generator frequency slowly towards the channel frequency until the servo stops moving. Note the frequency.

Repeat the test setting the signal generator to the lower side of the transmitter channel frequency. Note the frequency.

Specification

a) The -50dB points on the curve shall be less than +/- 8kHz for 10kHz operation.
b) Frequency accuracy to be within +/- 600Hz

Examples

1 If the -50 dB points are +5kHz and -7kHz, then a 10kHz separation is required for the transmitter.
2 If the -50dB points are +5kHz and -11kHz, a 20kHz separation is required for the receiver.
3. Centre frequency is more than 600Hz from nominal then a minimum 20kHz separation is required irrespective of the bandwidth.

Stickers After passing the test a 10kHz receiver sticker should be affixed in accordance with the Section 6 of the Directive.

# ANNEX C

## REMOTE CONTROL EQUIPMENT INFORMATION FOR MODELLERS

Your equipment has been tested by an M.A.A.A. Approved Testing Station in accordance the M.A.A.A. Frequency Directive. Unless otherwise stated, the Testing Station does not accept any further responsibility or liability for the mechanical or electronic condition or operation of the equipment tested.

Evidence of testing is identified by self-adhesive labels being affixed some or all of to the equipment. These have the following meaning;

- A yellow square label carrying, in black, the channel on which the equipment operates.

- A coloured square label carrying the following;
  a) the M.A.A.A. logo
  b) The approved frequency separation for the equipment and the testing station or club authentication and date.

- The colour of this label will indicate the approved frequency separation: -

  green – 10kHz,
  orange – 20kHz, and
  yellow - 40kHz.

If the receiver does not have a sticker applied, the minimum frequency spacing it shall be used on is 20kHz even if 10kHz is identified on the transmitter. Receivers that are capable of operating at 10kHz spacing also have a sticker affixed to them. In the event that the receiver was not removed from the model for the purpose of the test, the label will be fixed inside the model adjacent to the receiver location.

In order to be permitted to operate at 10kHz spacing, both the Transmitter and the Receiver must have a 10kHz sticker that has been signed within the last 12 months. A transmitter that is certified for 10kHz operation must NOT be used at 10kHz separation if the receiver in the model is not certified. Even both items are certified for 10kHz operation, it is not mandatory to use them on that spacing. Operation of the identical equipment at 10kHz channel spacing reduces the margin of safely from adjacent transmitters compared to operating it at 20kHz spacing. Radio Control Pilots who operate aircraft that would be susceptible to a higher probability of flight control problems caused by glitches, such as large or fast models, should be aware this reduced margin of safety. Models that could fall into this category include ducted fans, turbines, pylon racers, large-scale models and larger aerobatic models. In addition the site operation has to conform to the field layout and operating conditions specified in the M.A.A.A. Frequency Directive.

The M.A.A.A. recommends that model control transmitters and receivers be tested in accordance with the Frequency Directive at time of purchase, in the event of a change to an untested frequency, after repair, following a crash or when the modeller has any doubt as to the performance of the equipment.

For M.A.A.A. sanctioned events, National and State Championship events, the user of R/C equipment is to have a frequency key of the appropriate width for each transmitter/receiver combination. In the event that the organisers require proof of the currency of the equipment

certification this shall be by reading the label in the case of the transmitter. In most cases it will not be possible to see the label on the receiver, if 10kHz spacing is to be used, without removing it from the model. In these cases it is recommended that the entry form, or equivalent, should contain a section for the owner to sign stating that the receiver has a current certification for 10kHz. Modellers who use some receivers that are certified for 10kHz and others that are certified for 20kHz operation, are strongly advised to keep careful track of which receiver in each model either by a label inside the model or otherwise.

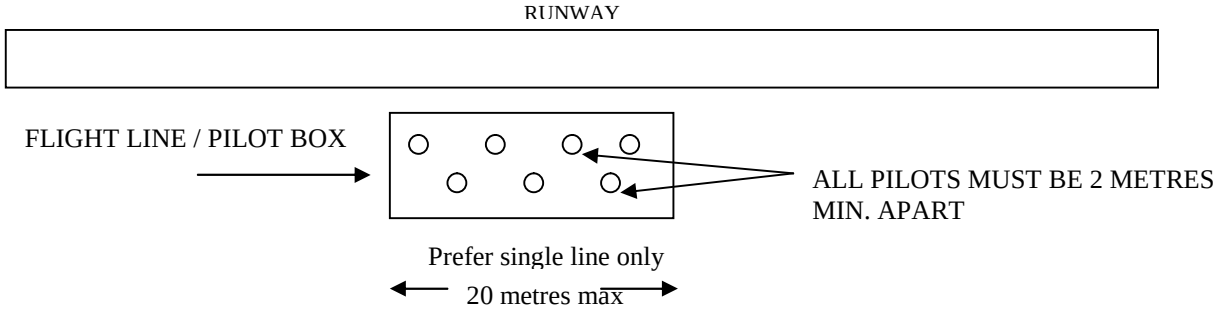
# ANNEX D

## FIELD LAYOUT FOR 10kHz.

When operating at 10kHz, pilots on the flight line shall be spaced a minimum of 2 metres apart. The flight line shall not exceed 20 metres in length.

If any pilot needs to move out onto the runway with his transmitter, for example to stand behind his model for a difficult takeoff, then only one pilot is allowed to do this at any one time. In order to maintain an acceptable range ratio the pilot shall not move down the runway beyond the outer limits of the group of other pilots on the flight line.

It is desirable that all pilots shall stand in a single line. However if due the numbers this cannot be done within the 2 metre minimum separation then a staggered line is required. The two metre minimum separation still has to be maintained, although a pilot can of course move forward to improve visibility for landing and takeoff.



# ANNEX E

## ADJACENT CHANNEL FIELD TESTING OF R/C EQUIPMENT

The following test should be conducted to confirm the performance of the control equipment by modellers who regularly fly together on frequencies that are 10kHz separated. This test should also be performed when there is suspicion of mutual interference. See Figure 1 at end of this Annex.

Set the model on the ground with the Rx antenna raised above the model or tethered to a point on the model above the ground. The Rx antenna should not be touching the ground. If the antenna is low on the model and attached to the tail, then if possible raise the tail of the model to a position as high as possible.

Fully extend the antennas of both the control transmitter and the adjacent channel transmitter. Take the control transmitter for the model under test to a point approximately 30 metres from the model at an angle approximately 45 degrees from the heading of the model fuselage. Switch on the transmitter and the receiver. Hold the Tx antenna vertically.

Check the operation of the controls in the model to ascertain that all are working correctly.
Take the interfering transmitter out to approximately 10 metres but on a line approximately 45 degrees to the opposite side of the model heading to the control transmitter. With the interfering Tx antenna fully extended switch on the Tx and hold the antenna vertical. This ensures that the receiver antenna is evenly polarised with signals from both transmitters.
At this distance there should not be any noticeable interference to the model controls.

Walk toward the model with the interfering transmitter along the 45 degree line. Keep moving closer until the controls begin to exhibit some sign of interference. Note the distance from the model at which this occurs. The ratio of the two distances of the transmitters from the model should be greater than 10:1. The interfering Tx should be closer to the model than three metres before interference occurs.

Confirm that the performance of the radio being used for the model belonging to the interfering Tx is also satisfactory by reversing the roles.

If both models operate with a Tx distance ratio of greater than 10:1 then this confirms both models can be operated together with a 10kHz frequency separation, provided of course that they have a current certification.

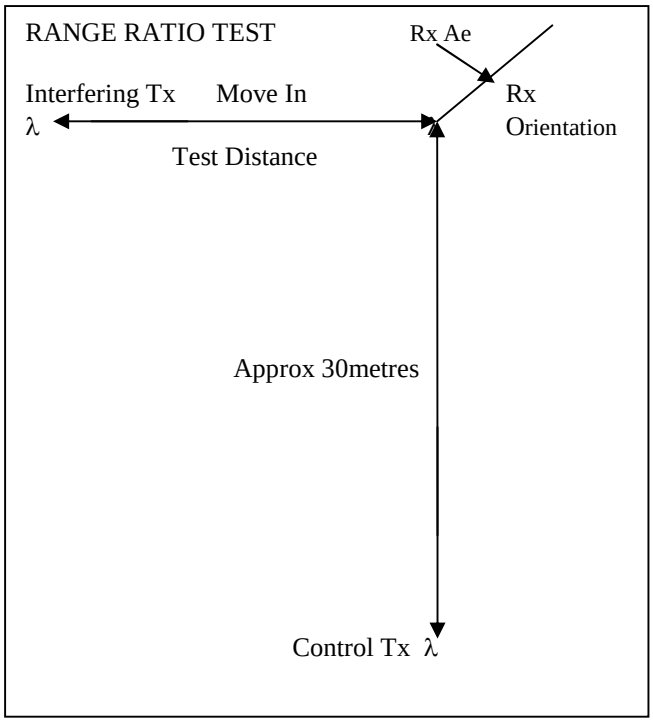

RANGE RATIO TEST
Rx Ae
Interfering Tx
λ
Move In
Rx
Orientation
Test Distance
Approx 30metres
Control Tx λ

Figure 1.

# ANNEX F

## TESTING JIG.

There are many ways of achieving a satisfactory test set up and most testing stations would already have something suitable.

If something is not available, one way to loosely couple the receiver antenna is to build a simple test jig. It would be inserted between the output of the Signal Generator and the input of the Spectrum Analyser. It would have an appropriate coaxial connector on each end and obviously maintain earth continuity. The signal would be connected between the two connectors with a short open wire. The receiver antenna could be pushed into a 'spaghetti' tube a suitable distance from the wire to give adequate pickup for the test to carried out.