

**INTERIM MEETING OF THE IARU REGION 1 VHF/UHF/MICROWAVE COMMITTEE**  
**VIENNA 19.- 21. April 2013**

Document	VIE13_C5_33
Subject	Beacons – MGM Alignment
Society	RSGB
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Status	Proposal

### **Introduction**

The application of MGM (Machine Generated Modes) to VHF and Microwave beacons has been an area that has developed rapidly over the past few years. There are now a number of active beacons within IARU Region-1, which have evolved, with different placements of the MGM tones with respect to the beacon frequency.

The 2011 IARU Region-1 Conference in Sun City, agreed beacon timing sequences and also agreed that the first tone, or pilot tone of the MGM should be at the same frequency as the CW as per:-

"Should MGM also be used by a beacon, the nominal MGM tone (e.g. for sync, JT4 tone-0 etc.), should be exactly as per the nominal carrier frequency".

This results in a requirement for different receiver offsets from the CW frequency depending upon the characteristics of the MGM in use.

Since that meeting it has become apparent that this specification can lead to particular difficulties at VHF frequencies and to confusion amongst end users. As a result of a review we propose to replace the Sun City recommendation with a new standard offset of 1 kHz for the MGM tuning offset.

### **Background**

It has long been agreed that the operating frequency for CW transmissions is the frequency of the carrier wave that was keyed. Subsequent work established that the 'SSB reference frequency', was the frequency of the suppressed carrier of a standard SSB transmitter. These definitions are widely used and accepted by the amateur community.

Although MGM have been used for many years the development of the WSJT software suite by Joe Taylor K1JT has greatly increased its popularity for amateur communications. On many of the VHF bands WSJT supported MGMs have displaced CW as the preferred communications mode for Meteor Scatter (MS) and moon-bounce (EME). The advantages of demodulating weak MGM signals has been widely recognised and has resulted its deployment on beacons in the VHF and microwave bands.

The following table shows the lowest tone frequencies and total MGM signal width of a number of the amateur MGM modes most currently used on VHF and microwave frequencies including WSJT modes and two of the P14 modes developed by the Danish 'Next Generation Beacons' group.

MGM Mode	Lowest or Sync Tone, Hz	MGM Signal Width, Hz	Main Usage
FSK441	882.00	1323	VHF meteor scatter
JT6M	1076.66	926	50MHz EME + meteor scatter
JT65A	1270.48	175	50MHz EME + terrestrial
JT65B	1270.48	350	VHF EME + terrestrial
JT65C	1270.48	700	Microwave EME + terrestrial
JT4G	797.96	950	Microwave
ISCAT-A	1012.06	926	VHF-microwave
ISCAT-B	559.80	1852	Microwave
PI4	882.81	703	VHF Beacons
PI4-80	765.63	1406	Microwave beacons

The table shows that there is currently little standardisation concerning the frequency of the lowest tone, as it often varies with different MGM.

Reception and transmission of MGMs by amateurs is generally achieved by coupling a PC sound card to the audio output and input of a SSB transceiver. In normal QSO usage the frequency used is specified in the same way in which it is when using SSB. i.e. the frequency of the suppressed carrier. Therefore unsurprisingly the differences resulting from the way in which the CW and SSB frequencies are defined will become an issue when CW and MGMs are used on the same transmission from a beacon.

### Consideration of Users

Most users have a 'preferred' offset for the reception of CW; this varies typically between 500 and 800Hz. With modern transceivers this offset is often configurable with the frequency display showing the zero beat frequency when the beat note is at the 'preferred' offset. Those using SSB-only transceivers or receiving in the normal USB mode will have to offset their reception point by an appropriate offset on the low frequency side of the signal. As the majority of current users rely on CW reception, it is important that the impact on the CW user experience is minimised if features such as MGM are deployed.

The most common method for receiving the MGMs is to interface the audio output of a receiver into Personal Computer (PC) running WSJT software. For simplicity it is preferable to have the receiver tuning frequency for the nominal beacon frequency to be coincident with the displayed frequency of the SSB receiver. If coincidence between the displayed frequency and the nominal beacon frequency cannot be achieved and a frequency offset is required, this offset should be as simple as possible to avoid user confusion and mistakes.

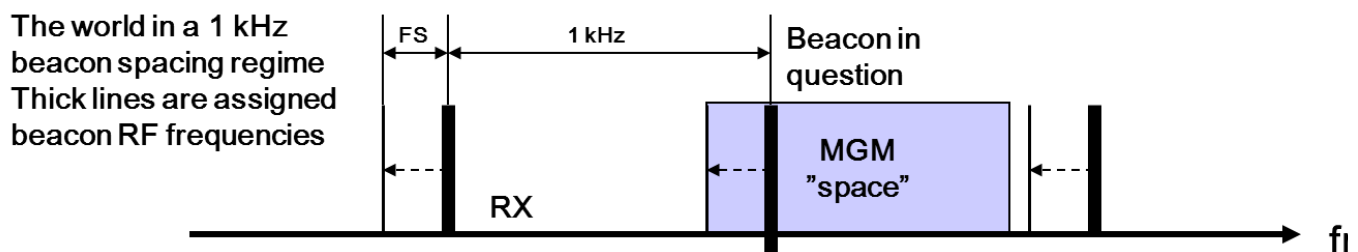
## Proposals

The experience of the ordinary user should be prioritised. This can be facilitated if the same offset can be used for all VHF and microwave bands. Otherwise changing offsets with changing bands or modes will lead to user confusion and mistakes.

Suggestions we have considered include 800Hz, 1270Hz and 1500Hz offset options, depending upon the particular MGM in use. However all these options have significant potential to confuse listeners and detract from the overall usability of MGMs deployed on amateur beacons. Therefore although it is a compromise we have concluded that a consistent, simple, single offset of 1kHz is best.

## Recommendations

- Should MGM be implemented on a beacon, a standard 1 kHz MGM tuning offset should be adopted (see diagram below)
- In any given frequency band, the specific MGM selection should have regard to the beacon frequency spacing and MGM bandwidth (see examples below)
- It is recognised that further experimentation and innovation may occur. Therefore the standards for the use of MGMs on beacons should be kept under review



### Examples

These are for MGM for the worst case 1kHz beacon spacing, 1kHz offset case. Note how some MGM would not be appropriate for such tightly spaced VHF allocations, but would be acceptable in wider spaced microwave beacon allocations.

