

**RTCG REPORT No. 397**

Low Power Device / Television Receiver  
(*I.F. Breakthrough*)  
Compatibility

9 April 1997

for

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Date *6<sup>th</sup> May 1997*

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## **1.0 Abstract**

A low power hand held transmitter proposed for sale within the UK, poses a potential compatibility (interference) problem to UK television receivers, as the operating frequency coincides with the intermediate frequency of these receivers.

This report details the magnitude of the interference observed when a 'typical' television receiving installation was subjected to low power transmissions at this frequency.

## 2.0 Introduction

**2.1** It has been proposed that a low power hand held transmitter, for the control of toys, be sold within the UK. As the operating frequency of these units coincides with that used as an intermediate frequency by UK television receivers, these units pose a potential compatibility (interference) problem.

**2.2** The technical characteristics of the hand held unit are;

Radiated Power	-	1 $\mu$ W e.r.p.
Emission:	-	6K00F3E
Frequencies	-	From within the band 36.61 - 36.79 and 37.01 - 37.19

MHz,

Note: there are no channel plans for these bands.

**2.3** To obtain an initial measure of the magnitude of the potential problem quickly, a 'typical' television receiving installation was subjected to a low power transmission at frequencies from within the proposed bands, as well as the theoretical worse case I.F. frequency of ~38.4 MHz (0.5 MHz above the vision carrier).

### 3.0 Compatibility Tests.

#### 3.1 Victim TV Installation Assessed.

##### 3.1.1 Television Receivers.

The following receivers were placed on a wooden support 0.8 metres high and connected to the TV antenna system described in 3.1.2.

Television Receivers Assessed					
_	Make	Model	Type	Approx. Age	Plant Number
1	Philips	28PW632A/05	28" 16:9 TV	2 Years Old	2413
2	Hitachi	C2119T	21" TV	3 Years Old	2185
3	JVC	C-21ET1EK	21" TV	3 Years Old	2505
4	Philips	21GR2550/05B	25" TV	6 Years Old	1769
5	Toshiba	217D9B	21" TV	7 Years Old	1805
6	Ferguson	59H3	23" TV	7 Years Old	1807
7	Panasonic	TC-1485	14" Portable	5 Years Old	1817
8	JVC	HR-D540EK	VHS VCR	6 Years Old	1724

##### 3.1.2 TV Antenna System.

The antenna system used was professionally installed approximately seven years ago. It consists of an 18 element 'Group A' yagi mounted approximately 10 metres a.g.l. and directed toward Crystal Palace. The feeder employed was standard TV antenna downlead (URM 202).

##### 3.1.3 TV Channels.

Potential interference to BBC1, BBC2, ITV, Channel 4 and Channel 5 was assessed. The signal level of each channel was ~90 dB $\mu$ V p.d. (before being attenuated), except for Channel 5 which was 54 dB $\mu$ V p.d. Channel 5 exhibited serious ghosting (grade 3), believed to be due to reflections from the main Crystal Palace mast.

### 3.2 Interferer (Low Power Device) Simulation.

#### 3.2.1 Radiating Device.

At a frequency of 37 MHz, the reactive field of even a relatively small radiating antenna will extend several metres. The magnitude of the interference within this area will therefore depend on the type of radiating antenna employed (E or H), and the route into the victim equipment. Considering the application, an E field radiating antenna seems the most likely, and a standard 'Biconical' measurement antenna was therefore used as the radiating device. The Biconical antenna was placed in very close proximity to the television receiver and oriented for maximum interference (vertical).

### 3.2.2 Effective Radiated Power.

The antenna factor of the biconical antenna used was -15.5 dB at 37 MHz, and the antenna factor of a dipole is +0.5 dB at the same frequency. The biconical antenna was therefore, 16 dB less efficient than a dipole, and required an input power of +16 dB $\mu$ W (-14 dBm) to radiate 1  $\mu$ W e.r.p.

### 3.2.3 Modulation.

The maximum impairment to a TV picture is known to result from a CW signal when the frequency is adjusted to produce vertical bars that drift slowly across the TV screen. This worse case impairment was used in the simulation. The presence of modulation on the unwanted signal would tend to reduce the magnitude of the interference, but only slightly for the narrow band modulation proposed.

### 3.2.4 Frequency of Operation.

Frequencies within the operational bands proposed (36.61 - 36.79 MHz and 37.01 - 37.19 MHz) were assessed, as well as the theoretical worse case I.F. frequency of ~38.4 MHz (0.5 MHz above the vision carrier).

## 3.3 Interference Assessment.

### 3.3.1 Wanted Signal Levels.

The level of the four main channels was reduced to a realistic level (~66 dB $\mu$ V p.d.) by inserting a 24 dB fixed attenuator in the TV antenna downlead, approximately 3 metres, before it entered the receiver. This attenuator was removed for the assessment of interference to Channel 5 which was already at a low level 54 dB $\mu$ V p.d.

### 3.3.2 Method.

The TV antenna downlead was initially dropped through the Biconical antenna to aid the positive identification of the interferer, and the adjustment of its frequency for the worse case interference.

Moving the TV antenna downlead also assisted in identifying the interference mechanism i.e. via the downlead or directly into the TV, which was then confirmed by fitting a filter immediately before the TV. The TV antenna downlead was then moved to a 'typical' position and any interference noted.

### 3.4 Results.

#### 3.4.1 Interference Directly into the TV.

<b>Interferer ~250 mm from the Television Receiver</b> (and well clear of the TV antenna download).		
TV	1 $\mu$ W e.r.p. Interferer at ~37.19 MHz (i.e. at the worse case frequency from within the proposed bands)	500 $\mu$ W e.r.p. Interferer at ~38.4 MHz (i.e. at the worse case IF frequency, for information only)
1	Grade 5 (None)	Grade 5 (None)
2	Grade 5 (None)	Grade 5 (None)
3	Grade 5 (None)	Grade 5 (None)
4	Grade 5 (None)	Grade 5 (None)
5	Grade 5 (None)	Grade 5 (None)
6	Grade 5 (None)	Grade 4 (Perceptible, but not Annoying)
7	Grade 5 (None)	Grade 4 (Perceptible, but not Annoying)
8	Grade 5 (None)	Grade 5 (None)

#### 3.4.2 Interference Via the TV Antenna Download.

##### 3.4.2.1 Worst Case (for information only).

<b>Interferer Touching the TV Antenna Download</b> (and 250 mm from the Television Receiver)		
TV	1 $\mu$ W e.r.p. Interferer at ~37.19 MHz (i.e. at the worse case frequency from within the proposed bands)	500 $\mu$ W e.r.p. Interferer at ~38.4 MHz (i.e. at the worse case IF frequency, for information only)
1	Grade 5 (None)	Grade 2 (Annoying)
2	Grade 5 (None)	Grade 2 (Annoying)
3	Grade 5 (None)	Grade 2 (Annoying)
4	Grade 5 (None)	Grade 5 (None)
5	Grade 5 (None)	Grade 2 (Annoying)
6	Grade 3 (Slightly Annoying)	Grade 1 (Very Annoying)
7	Grade 3 (Slightly Annoying)	Grade 1 (Very Annoying)

8	Grade 5 (None)	Grade 4 (Perceptible, but not Annoying)
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### 3.4.2.2 Typical Case.

<b>Interferer ~1000 mm from the TV Antenna Downlead (and ~250 mm from the Television Receiver)</b>		
TV	1 $\mu$ W e.r.p. Interferer at ~37.19 MHz (i.e. at the worse case frequency from within the proposed bands)	500 $\mu$ W e.r.p. Interferer at ~38.4 MHz (i.e. at the worse case IF frequency, for information only)
1	Grade 5 (None)	Grade 5 (None)
2	Grade 5 (None)	Grade 5 (None)
3	Grade 5 (None)	Grade 5 (None)
4	Grade 5 (None)	Grade 5 (None)
5	Grade 5 (None)	Grade 5 (None)
6	Grade 5 (None)	Grade 3 (Slightly Annoying)
7	Grade 5 (None)	Grade 3 (Slightly Annoying)
8	Grade 5 (None)	Grade 5 (None)

#### 4.0 Conclusions

**4.1** The dominant interference mechanism proved to be coupling into the television receiver via the screen of the TV antenna downlead (coaxial cable) as would be expected.

**4.2** The wanted signal level did not affect the magnitude of the interference although it was less visible when the wanted picture quality was already poor e.g. Channel 5.

**4.3** Providing the e.r.p. is limited to  $1 \mu\text{W}$ , no television interference problems are envisaged, even although the proposed band of operating frequencies (36.61 - 36.79 MHz and 37.01 - 37.19 MHz) coincide with that used as an intermediate frequency by UK television receivers.

**5.0 Test Equipment Used**

<b>Test Equipment Used</b>				
<b>Instrument</b>	<b>Purpose</b>	<b>Make</b>	<b>Model</b>	<b>Plant Number</b>
Spectrum Analyzer	Measure TV Signal Level	Hewlett Packard	HP8591A	1826
Signal Generator	Generate Interference	Marconi	2032	2130
Biconical Antenna	Radiate Interference	Chase	VBA 6106	1965