



# 39 MHz Mobile Meteor Burst Communications / TV (IF) Compatibility

Project 576

Version 1.2

**An RTCG Project Report**

**26<sup>th</sup> June 2000**



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## **Radio Technology & Compatibility Group**

Project No. 576

### **39 MHz Mobile Meteor Burst Communications / TV (IF) Compatibility**

Version 1.2

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## 1. ABSTRACT.

Meteor Burst Communications Systems operating between 39.0 and 39.2 MHz may cause interference to UK television reception, due to IF breakthrough, when operating in residential areas. The transmission time is very low however (30→100 ms) and a transmission is only expected on average once per hour.

Theoretical studies, measurements and field trials conducted by other administrations indicate that the introduction of these systems will not result in unacceptable interference. The work detailed in this report was conducted to determine if this applied to the UK as expected, and identify any potential problems that may demand further investigation.

The greatest variables affecting the magnitude of the interference were considered to be the rate at which the transmissions occur in a particular area (the local density), and the layout of the domestic television installation. Typical interference distances were estimated to be 102 metres for Grade 4, 50 metres for Grade 3 and 36 metres for Grade 2 impairments. Furthermore, a subjective assessment of 30→100ms bursts suggested that a single burst of Grade 2 impairment would be acceptable approximately once per hour. This report concludes that:

- The magnitude of the interference is likely to be negligible in general, but some higher levels of localised interference may need to be resolved. This should only require the insertion of a simple filter. Digital television reception is not expected to suffer interference as the intermediate frequencies employed by these receivers do not encompass 39.0→39.2 MHz.
- It would be prudent to check that the number (spatial density) and transmission rate (temporal density) of the Mobile Meteor Burst Station's (MMBS) does not, statistically, exceed that likely to result in an MMBS transmitting within the interference distances detailed in this report more frequently than that deemed acceptable in this report. This would however, appear to demand completely unrealistic MMBS densities.
- Trials involving a real MMBS sited at various distances from a number of domestic premises, but modified so that a transmission could be triggered on any channel desired by an engineer visiting these homes, and asking the home owner for their opinion regarding the interference, would provide valuable information and confirm the validity of the interference distances and subjective assessments detailed in this report.

## **2. INTRODUCTION.**

Meteor Burst Communications Systems operating between 39.0 and 39.2 MHz may cause interference to UK television reception, due to IF breakthrough, when operating in residential areas. The transmission time is very low however (30→100 ms) and a transmission is only expected on average once per hour.

Theoretical studies, measurements and field trials conducted by other administrations indicate that the introduction of these systems will not result in unacceptable interference. The work detailed in this report was conducted to determine if this applied to the UK as expected and identify any potential problems that may demand further investigation.

### 3. TEST METHODS.

#### 3.1 EN55020.

The immunity test methods detailed in 'Electromagnetic Immunity of Broadcast Receivers and Associated Equipment (EN 55020:1995)' provide a definitive means of quantifying the unwanted signal rejection performance of television receivers for compliance purposes. These methods are not however, the most appropriate means of evaluating the magnitude of interference that a domestic television installation would suffer when subjected to a specific interference threat. This is because the methods detailed in EN 55020 were designed to provide a repeatable means of determining the relative performance of receivers, and to achieve this a number of variables present in a domestic television installation have been eliminated e.g. the effects of feeder length, location and orientation, and the proximity of the actual receiver to other objects including the ground. As the magnitude of the interference is likely to be significantly affected by these variables, a more pragmatic approach was adopted.

**Note:** Although the effect of these variables could be considered theoretically, considerable uncertainties are introduced e.g. EN 55020 tests a receivers ability to reject voltages induced on the screen of its antenna feeder by applying an e.m.f. to a coupling unit, with the receiver 100 cm above a large ground plane. Any relationship linking this e.m.f. to a field strength, when the E field and feeder are cross-polarised and the ground plane is absent, must be considered highly questionable.

#### 3.2 Practical Tests.

**3.2.1** A typical television installation was subjected to a continuous 10 kbit/s GMSK horizontally polarised field, radiated from a dipole (3 metres a.g.l.) at distance of 30 metres to simulate a Mobile Meteor Burst Station (MMBS). The median field strength produced at the base of the domestic television feeder, by a 50 W e.r.p. transmission from this location (location A), was 119 dB $\mu$ V/m. The e.r.p. was adjusted and that resulting in CCIR Grade 2, 3 and 4 impairment was recorded. The assessments were made after the frequency of the wanted television signal had been adjusted (upto  $\pm 8$  kHz) to obtain the worse-case frequency relationship. The test configuration is shown in figures 1 and 2.

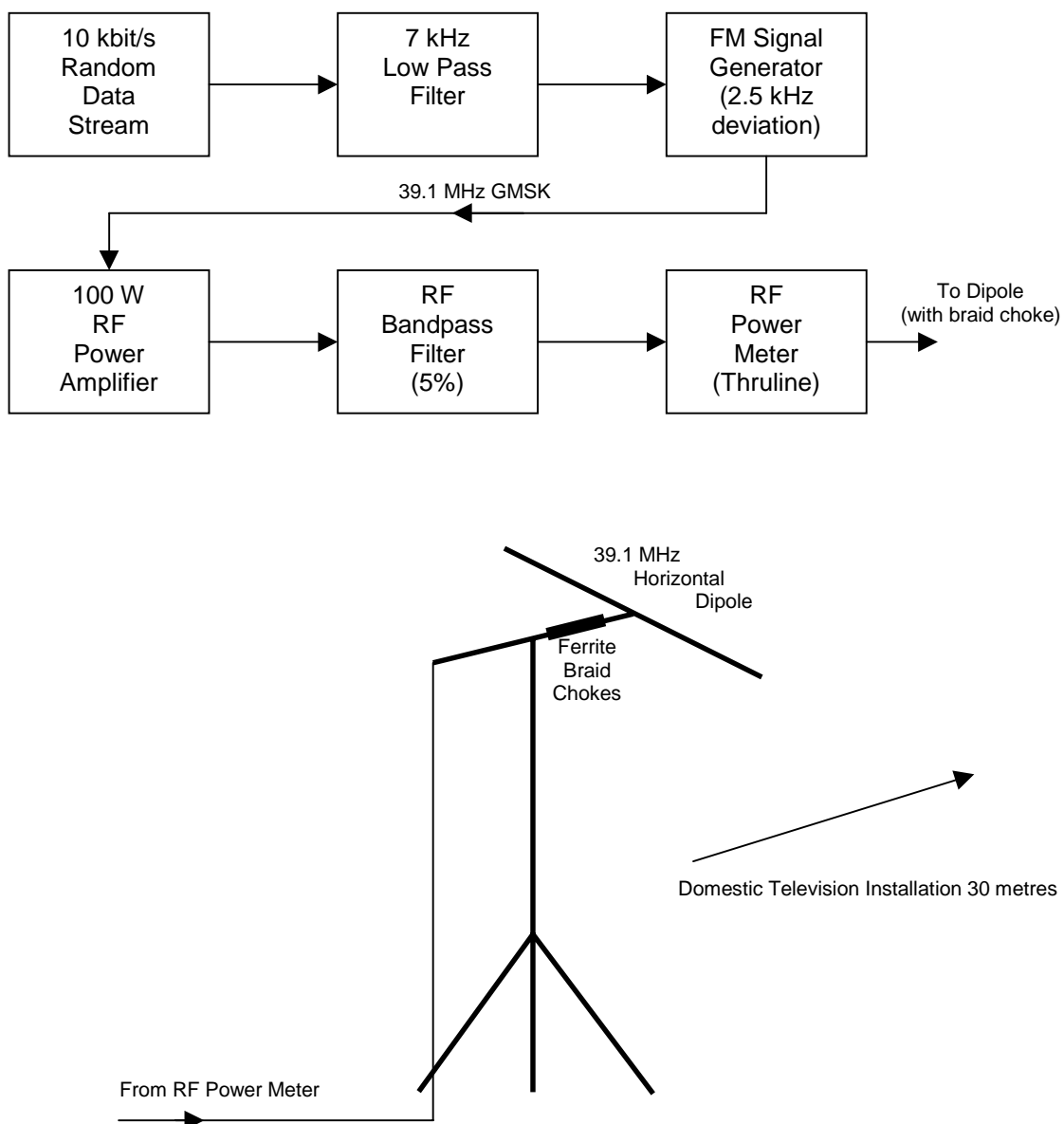
**3.2.2** Tests were conducted with a number of television receivers and three different wanted signal levels. The tests were repeated with the MMBS at a second location, 45-degrees to the first, but still at a distance of 30 metres. The median field strength produced at the base of the domestic television feeder, by a 50 W e.r.p. transmission from this location (location B), was 121 dB $\mu$ V/m.

**3.2.3** Limited tests were also conducted with a Digital Set-top box and Video Cassette Recorder. Finally a single test was conducted with a television receiver connected to the cabled distribution system at the RTCG.

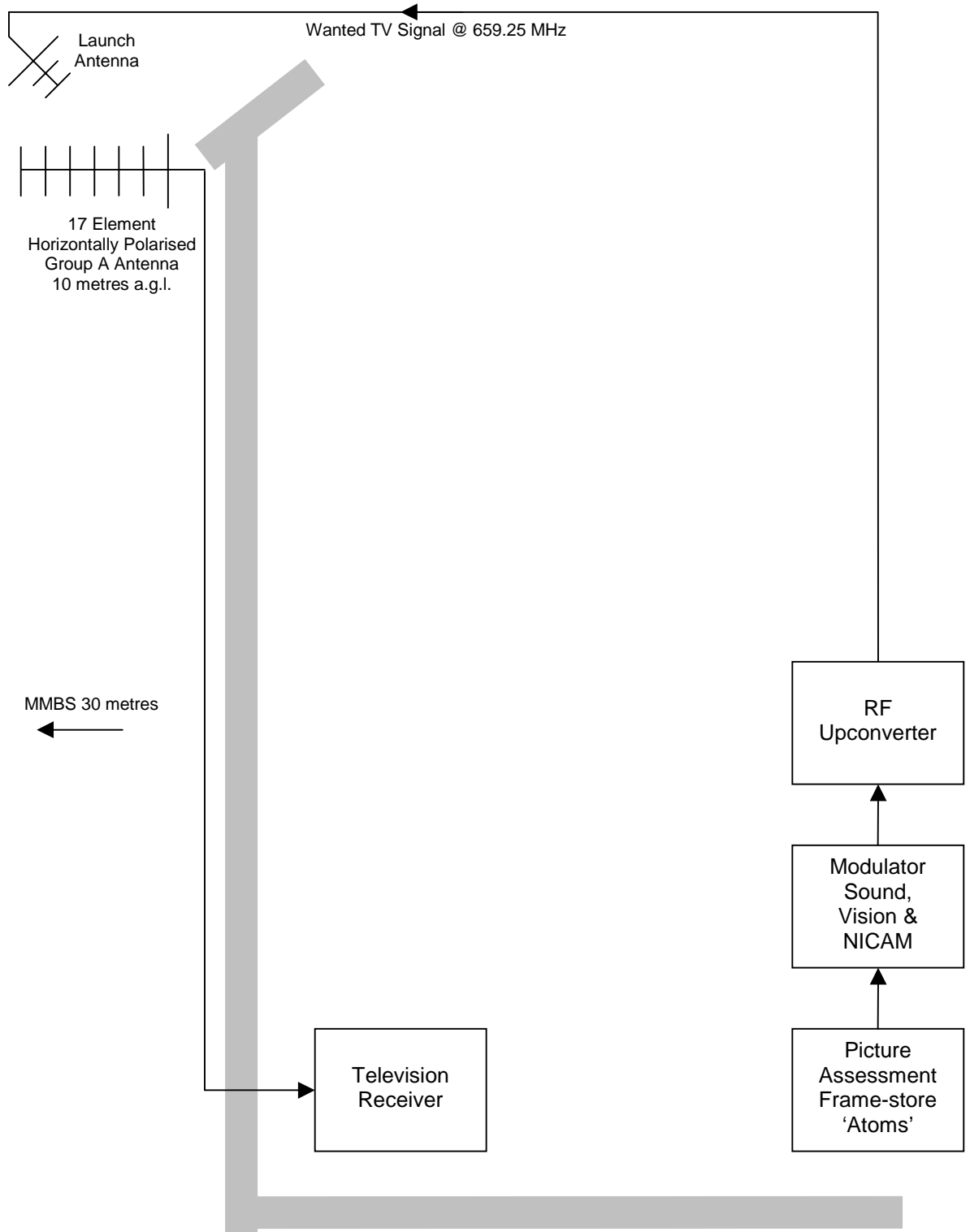
**3.2.4** The dominant interference mechanism was determined using filters, and the affect of any changes in the layout of the domestic installation noted.

**3.2.5** The simulated MMBS's antenna (horizontal dipole) was rotated (main lobe directed away from the domestic television installation) to check the magnitude of any non-intentional vertically polarised E field component that was being radiated from the vertical feeder. The magnitude of the interference fell by 5→10 dB, confirming that radiation from the feeder was below that required to significantly affect the results.

**Figure 1 – Simulated MMBS.**



**Figure 2 – Domestic Television Installation.**



## 4. RESULTS

### 4.1 Television Receiver (#1770)

#### 4.1.1

<b>ERP (dBW) Resulting in Grade 2, 3 and 4 Impairment at 30 Metres</b> Transmitter Location A, Subjective Viewer A, Static Picture 'Atoms'			
Television Receiver (#1770)	Wanted TV Signal Level		
	50 dB $\mu$ V p.d.	60 dB $\mu$ V p.d.	70 dB $\mu$ V p.d.
Grade 4	+12.3	>+18.9	>+18.9
Grade 3	+13.4	>+18.9	>+18.9
Grade 2	+18.4	>+18.9	>+18.9

#### 4.1.2

<b>ERP (dBW) Resulting in Grade 2, 3 and 4 Impairment at 30 Metres</b> Transmitter Location A, Subjective Viewer B, Static Picture 'Atoms'			
Television Receiver (#1770)	Wanted TV Signal Level		
	50 dB $\mu$ V p.d.	60 dB $\mu$ V p.d.	70 dB $\mu$ V p.d.
Grade 4	+11.5	>+18.9	>+18.9
Grade 3	+16.0	>+18.9	>+18.9
Grade 2	+18.2	>+18.9	>+18.9

#### 4.1.3

<b>ERP (dBW) Resulting in Grade 2, 3 and 4 Impairment at 30 Metres</b> Transmitter Location B, Subjective Viewer B, Static Picture 'Atoms'			
Television Receiver (#1770)	Wanted TV Signal Level		
	50 dB $\mu$ V p.d.	60 dB $\mu$ V p.d.	70 dB $\mu$ V p.d.
Grade 4	+0.0	+3.4	+10.9
Grade 3	+6.0	+10.9	+15.1
Grade 2	+11.5	+14.0	+17.6

#### 4.1.4

<b>ERP (dBW) Resulting in Grade 2, 3 and 4 Impairment at 30 Metres</b> Median of Above			
Television Receiver (#1770)	Wanted TV Signal Level		
	50 dB $\mu$ V p.d.	60 dB $\mu$ V p.d.	70 dB $\mu$ V p.d.
Grade 4	+11.5	>+18.9	>+18.9
Grade 3	+13.4	>+18.9	>+18.9
Grade 2	+18.2	>+18.9	>+18.9

## 4.2 Television Receiver (#2711)

### 4.2.1

<b>ERP (dBW) Resulting in Grade 2, 3 and 4 Impairment at 30 Metres</b> Transmitter Location A, Subjective Viewer A, Static Picture 'Atoms'			
Television Receiver (#2711)	Wanted TV Signal Level		
	50 dB $\mu$ V p.d.	60 dB $\mu$ V p.d.	70 dB $\mu$ V p.d.
Grade 4	>+18.3	>+18.3	>+18.3
Grade 3	>+18.3	>+18.3	>+18.3
Grade 2	>+18.3	>+18.3	>+18.3

### 4.2.2

<b>ERP (dBW) Resulting in Grade 2, 3 and 4 Impairment at 30 Metres</b> Transmitter Location A, Subjective Viewer B, Static Picture 'Atoms'			
Television Receiver (#2711)	Wanted TV Signal Level		
	50 dB $\mu$ V p.d.	60 dB $\mu$ V p.d.	70 dB $\mu$ V p.d.
Grade 4	+9.0	+16.8	+17.9
Grade 3	+13.0	+17.6	>+18.9
Grade 2	+17.2	>+18.9	>+18.9

### 4.2.3

<b>ERP (dBW) Resulting in Grade 2, 3 and 4 Impairment at 30 Metres</b> Transmitter Location B, Subjective Viewer B, Static Picture 'Atoms'			
Television Receiver (#2711)	Wanted TV Signal Level		
	50 dB $\mu$ V p.d.	60 dB $\mu$ V p.d.	70 dB $\mu$ V p.d.
Grade 4	+5.2	+7.8	+12.6
Grade 3	+6.5	+9.3	+14.5
Grade 2	+12.3	+12.6	+15.8

### 4.2.4

<b>ERP (dBW) Resulting in Grade 2, 3 and 4 Impairment at 30 Metres</b> Median of Above			
Television Receiver (#2711)	Wanted TV Signal Level		
	50 dB $\mu$ V p.d.	60 dB $\mu$ V p.d.	70 dB $\mu$ V p.d.
Grade 4	+9.0	+16.8	+17.9
Grade 3	+13.0	+17.6	>+18.3
Grade 2	+17.2	>+18.3	>+18.3

### 4.3 Television Receiver (#2684)

#### 4.3.1

<b>ERP (dBW) Resulting in Grade 2, 3 and 4 Impairment at 30 Metres</b> Transmitter Location A, Subjective Viewer A, Static Picture 'Atoms'			
Television Receiver (#2684)	Wanted TV Signal Level		
	50 dB $\mu$ V p.d.	60 dB $\mu$ V p.d.	70 dB $\mu$ V p.d.
Grade 4	>+17.6	>+17.6	>+17.6
Grade 3	>+17.6	>+17.6	>+17.6
Grade 2	>+17.6	>+17.6	>+17.6

#### 4.3.2

<b>ERP (dBW) Resulting in Grade 2, 3 and 4 Impairment at 30 Metres</b> Transmitter Location A, Subjective Viewer B, Static Picture 'Atoms'			
Television Receiver (#2684)	Wanted TV Signal Level		
	50 dB $\mu$ V p.d.	60 dB $\mu$ V p.d.	70 dB $\mu$ V p.d.
Grade 4	+6.0	+15.1	+17.6
Grade 3	+12.3	+18.3	>+18.9
Grade 2	+15.9	>+18.9	>+18.9

#### 4.3.3

<b>ERP (dBW) Resulting in Grade 2, 3 and 4 Impairment at 30 Metres</b> Transmitter Location B, Subjective Viewer B, Static Picture 'Atoms'			
Television Receiver (#2684)	Wanted TV Signal Level		
	50 dB $\mu$ V p.d.	60 dB $\mu$ V p.d.	70 dB $\mu$ V p.d.
Grade 4	+2.0	+7.4	+9.5
Grade 3	+6.5	+12.2	+13.3
Grade 2	+10.6	+15.4	+15.4

#### 4.3.4

<b>ERP (dBW) Resulting in Grade 2, 3 and 4 Impairment at 30 Metres</b> Median of Above			
Television Receiver (#2684)	Wanted TV Signal Level		
	50 dB $\mu$ V p.d.	60 dB $\mu$ V p.d.	70 dB $\mu$ V p.d.
Grade 4	+6.0	+15.1	>+17.6
Grade 3	+12.3	>+17.6	>+17.6
Grade 2	+15.9	>+17.6	>+17.6

**4.4 Television Receiver (#2838)****4.4.1**

<b>ERP (dBW) Resulting in Grade 2, 3 and 4 Impairment at 30 Metres</b> Transmitter Location A, Subjective Viewer A, Static Picture 'Atoms'			
Television Receiver (#2838)	Wanted TV Signal Level		
	50 dB $\mu$ V p.d.	60 dB $\mu$ V p.d.	70 dB $\mu$ V p.d.
Grade 4	+14.6	>+18.3	>+18.3
Grade 3	>+18.3	>+18.3	>+18.3
Grade 2	>+18.3	>+18.3	>+18.3

**4.4.2**

<b>ERP (dBW) Resulting in Grade 2, 3 and 4 Impairment at 30 Metres</b> Transmitter Location A, Subjective Viewer B, Static Picture 'Atoms'			
Television Receiver (#2838)	Wanted TV Signal Level		
	50 dB $\mu$ V p.d.	60 dB $\mu$ V p.d.	70 dB $\mu$ V p.d.
Grade 4	>+18.9	>+18.9	>+18.9
Grade 3	>+18.9	>+18.9	>+18.9
Grade 2	>+18.9	>+18.9	>+18.9

**4.4.3**

<b>ERP (dBW) Resulting in Grade 2, 3 and 4 Impairment at 30 Metres</b> Transmitter Location B, Subjective Viewer B, Static Picture 'Atoms'			
Television Receiver (#2838)	Wanted TV Signal Level		
	50 dB $\mu$ V p.d.	60 dB $\mu$ V p.d.	70 dB $\mu$ V p.d.
Grade 4	>+18.9	>+18.9	>+18.9
Grade 3	>+18.9	>+18.9	>+18.9
Grade 2	>+18.9	>+18.9	>+18.9

**4.4.4**

<b>ERP (dBW) Resulting in Grade 2, 3 and 4 Impairment at 30 Metres</b> Median of Above			
Television Receiver (#2838)	Wanted TV Signal Level		
	50 dB $\mu$ V p.d.	60 dB $\mu$ V p.d.	70 dB $\mu$ V p.d.
Grade 4	>+18.9	>+18.9	>+18.9
Grade 3	>+18.9	>+18.9	>+18.9
Grade 2	>+18.9	>+18.9	>+18.9

**4.5 Television Receiver (#2781)****4.5.1**

<b>ERP (dBW) Resulting in Grade 2, 3 and 4 Impairment at 30 Metres</b> Transmitter Location A, Subjective Viewer A, Static Picture 'Atoms'			
Television Receiver (#2781)	Wanted TV Signal Level		
	50 dB $\mu$ V p.d.	60 dB $\mu$ V p.d.	70 dB $\mu$ V p.d.
Grade 4	+15.1	>+18.3	>+18.3
Grade 3	>+18.3	>+18.3	>+18.3
Grade 2	>+18.3	>+18.3	>+18.3

**4.5.2**

<b>ERP (dBW) Resulting in Grade 2, 3 and 4 Impairment at 30 Metres</b> Transmitter Location A, Subjective Viewer B, Static Picture 'Atoms'			
Television Receiver (#2781)	Wanted TV Signal Level		
	50 dB $\mu$ V p.d.	60 dB $\mu$ V p.d.	70 dB $\mu$ V p.d.
Grade 4	>+18.9	>+18.9	>+18.9
Grade 3	>+18.9	>+18.9	>+18.9
Grade 2	>+18.9	>+18.9	>+18.9

**4.5.3**

<b>ERP (dBW) Resulting in Grade 2, 3 and 4 Impairment at 30 Metres</b> Transmitter Location B, Subjective Viewer B, Static Picture 'Atoms'			
Television Receiver (#2781)	Wanted TV Signal Level		
	50 dB $\mu$ V p.d.	60 dB $\mu$ V p.d.	70 dB $\mu$ V p.d.
Grade 4	>+18.9	>+18.9	>+18.9
Grade 3	>+18.9	>+18.9	>+18.9
Grade 2	>+18.9	>+18.9	>+18.9

**4.5.4**

<b>ERP (dBW) Resulting in Grade 2, 3 and 4 Impairment at 30 Metres</b> Median of Above			
Television Receiver (#2781)	Wanted TV Signal Level		
	50 dB $\mu$ V p.d.	60 dB $\mu$ V p.d.	70 dB $\mu$ V p.d.
Grade 4	>+18.9	>+18.9	>+18.9
Grade 3	>+18.9	>+18.9	>+18.9
Grade 2	>+18.9	>+18.9	>+18.9

## 4.6 Television Receiver (#1806)

### 4.6.1

<b>ERP (dBW) Resulting in Grade 2, 3 and 4 Impairment at 30 Metres</b> Transmitter Location A, Subjective Viewer A, Static Picture 'Atoms'			
Television Receiver (#1806)	Wanted TV Signal Level		
	50 dB $\mu$ V p.d.	60 dB $\mu$ V p.d.	70 dB $\mu$ V p.d.
Grade 4	+1.0 (-1.5)	+1.0 (-1.0)	+0.0 (-1.0)
Grade 3	+9.0 (+4.8)	+7.5 (+4.8)	+6.0 (+4.8)
Grade 2	+10.0 (+6.5)	+9.5 (+6.4)	+9.0 (+6.3)

Measurements were repeated to confirm poor immunity. 2<sup>nd</sup> measurement results brackets.

### 4.6.2

<b>ERP (dBW) Resulting in Grade 2, 3 and 4 Impairment at 30 Metres</b> Transmitter Location A, Subjective Viewer B, Static Picture 'Atoms'			
Television Receiver (#1806)	Wanted TV Signal Level		
	50 dB $\mu$ V p.d.	60 dB $\mu$ V p.d.	70 dB $\mu$ V p.d.
Grade 4	+9.0	+11.5	+13.0
Grade 3	+13.0	+14.1	+15.6
Grade 2	+15.9	+16.8	+17.6

### 4.6.3

<b>ERP (dBW) Resulting in Grade 2, 3 and 4 Impairment at 30 Metres</b> Transmitter Location B, Subjective Viewer B, Static Picture 'Atoms'			
Television Receiver (#1806)	Wanted TV Signal Level		
	50 dB $\mu$ V p.d.	60 dB $\mu$ V p.d.	70 dB $\mu$ V p.d.
Grade 4	+0.0	+0.0	-3.0
Grade 3	+6.0	+7.8	+5.4
Grade 2	+9.3	+10.8	+9.2

### 4.6.4

<b>ERP (dBW) Resulting in Grade 2, 3 and 4 Impairment at 30 Metres</b> Median of Above			
Television Receiver (#1806)	Wanted TV Signal Level		
	50 dB $\mu$ V p.d.	60 dB $\mu$ V p.d.	70 dB $\mu$ V p.d.
Grade 4	+0.5	+0.5	-0.5
Grade 3	+7.5	+7.6	+5.7
Grade 2	+9.6	+9.8	+9.1

#### 4.7 Television Receiver (#1715)

##### 4.7.1

<b>ERP (dBW) Resulting in Grade 2, 3 and 4 Impairment at 30 Metres</b> Transmitter Location A, Subjective Viewer A, Static Picture 'Atoms'			
Television Receiver (#1715)	Wanted TV Signal Level		
	50 dB $\mu$ V p.d.	60 dB $\mu$ V p.d.	70 dB $\mu$ V p.d.
Grade 4	-16.2	-14.4	-14.4
Grade 3	-5.2	-3.0	-3.0
Grade 2	+0.0	-2.2	-1.5

##### 4.7.2

<b>ERP (dBW) Resulting in Grade 2, 3 and 4 Impairment at 30 Metres</b> Transmitter Location A, Subjective Viewer B, Static Picture 'Atoms'			
Television Receiver (#1715)	Wanted TV Signal Level		
	50 dB $\mu$ V p.d.	60 dB $\mu$ V p.d.	70 dB $\mu$ V p.d.
Grade 4	-10.0 (-3.0)	-1.0 (-1.0)	-5.2 (+8.5)
Grade 3	-4.0 (+0.4)	+1.8 (+6.0)	+4.0 (+11.8)
Grade 2	+0.0 (+7.0)	+4.8 (+13.2)	+7.0 (+15.8)

Measurements were repeated to confirm poor immunity. 2<sup>nd</sup> measurement results in brackets.

##### 4.7.3

<b>ERP (dBW) Resulting in Grade 2, 3 and 4 Impairment at 30 Metres</b> Transmitter Location B, Subjective Viewer B, Static Picture 'Atoms'			
Television Receiver (#1715)	Wanted TV Signal Level		
	50 dB $\mu$ V p.d.	60 dB $\mu$ V p.d.	70 dB $\mu$ V p.d.
Grade 4	-28.0 (-42.5)	-7.0 (-16.0)	-5.2 (-13.7)
Grade 3	-15.0 (-13.0)	-1.5 (-10.0)	-3.0 (-8.2)
Grade 2	-7.0 (-6.0)	+1.5 (-3.5)	+1.5 (-3.2)

Measurements were repeated to confirm poor immunity. 2<sup>nd</sup> measurement results brackets.

##### 4.7.4

<b>ERP (dBW) Resulting in Grade 2, 3 and 4 Impairment at 30 Metres</b> Median of Above			
Television Receiver (#1715)	Wanted TV Signal Level		
	50 dB $\mu$ V p.d.	60 dB $\mu$ V p.d.	70 dB $\mu$ V p.d.
Grade 4	-16.2	-7.0	-5.2
Grade 3	-5.2	-1.5	-3.0
Grade 2	+0.0	+1.5	+1.5

#### 4.8 Video Cassette Recorder (#1724), and its Effect on the Immunity of TV (#1715)

##### 4.8.1

<b>ERP (dBW) Resulting in Grade 2, 3 and 4 Impairment at 30 Metres</b> Previous Results for Transmitter Location B, Subjective Viewer B			
Television Receiver (#1715)	Wanted TV Signal Level		
	50 dB $\mu$ V p.d.	60 dB $\mu$ V p.d.	70 dB $\mu$ V p.d.
Grade 4	-28.0 (-42.5)	-7.0 (-16.0)	-5.2 (-13.7)
Grade 3	-15.0 (-13.0)	-1.5 (-10.0)	-3.0 (-8.2)
Grade 2	-7.0 (-6.0)	+1.5 (-3.5)	+1.5 (-3.2)

Measurements were repeated to confirm poor immunity. 2<sup>nd</sup> measurement results brackets.

##### 4.8.2

<b>ERP (dBW) Resulting in Grade 2, 3 and 4 Impairment at 30 Metres</b> Repeat (3 <sup>rd</sup> ) Measurements for Transmitter Location B, Subjective Viewer B			
Television Receiver (#1715)	Wanted TV Signal Level		
	50 dB $\mu$ V p.d.	60 dB $\mu$ V p.d.	70 dB $\mu$ V p.d.
Grade 4	-18.0	-15.2	-11.0
Grade 3	-14.0	-10.0	-5.2
Grade 2	-7.0	-3.7	-1.2

##### 4.8.3

<b>ERP (dBW) Resulting in Grade 2, 3 and 4 Impairment at 30 Metres</b> Transmitter Location B, Subjective Viewer B, Static Picture 'Atoms'			
TV (#1715) via VCR (#1724)	Wanted TV Signal Level		
	50 dB $\mu$ V p.d.	60 dB $\mu$ V p.d.	70 dB $\mu$ V p.d.
Grade 4	-3.6	-7.7	-7.0
Grade 3	-0.7	-1.5	-2.0
Grade 2	+2.00	+2.5	+1.5

##### 4.8.4

<b>ERP (dBW) Resulting in Grade 2, 3 and 4 Impairment at 30 Metres</b> Transmitter Location B, Subjective Viewer B, Static Picture 'Atoms'			
VCR (#1724) with TV (#2684)	Wanted TV Signal Level		
	50 dB $\mu$ V p.d.	60 dB $\mu$ V p.d.	70 dB $\mu$ V p.d.
Grade 4	+8.5	+16.8	>+20.0
Grade 3	+15.8	+19.3	>+20.0
Grade 2	+20.0	>+20.0	>+20.0

## 4.9 Summary of Results for Television Receivers

### 4.9.1

<b>ERP (dBW) Resulting in Grade 2, 3 and 4 Impairment to 10% of the Television Receivers at a Distance of 30 Metres</b>			
10 Percentile	Wanted TV Signal Level		
	50 dB $\mu$ V p.d.	60 dB $\mu$ V p.d.	70 dB $\mu$ V p.d.
Grade 4	-14.3	-5.2	-5.2
Grade 3	-4.8	-0.5	-0.9
Grade 2	+0.0	+2.5	+3.0

### 4.9.2

<b>ERP (dBW) Resulting in Grade 2, 3 and 4 Impairment to 50% of the Television Receivers at a Distance of 30 Metres</b>			
50 Percentile (Median)	Wanted TV Signal Level		
	50 dB $\mu$ V p.d.	60 dB $\mu$ V p.d.	70 dB $\mu$ V p.d.
Grade 4	+7.5	+13.3	+15.3
Grade 3	+12.6	+15.8	+16.6
Grade 2	+15.9	+12.2	+17.6

### 4.9.3

<b>ERP (dBW) Resulting in Grade 2, 3 and 4 Impairment to 90% of the Television Receivers at a Distance of 30 Metres</b>			
90 Percentile	Wanted TV Signal Level		
	50 dB $\mu$ V p.d.	60 dB $\mu$ V p.d.	70 dB $\mu$ V p.d.
Grade 4	>+18.9	>+18.9	>+18.9
Grade 3	>+18.9	>+18.9	>+18.9
Grade 2	>+18.9	>+18.9	>+18.9

### 4.9.4

<b>Median Distance (Metres) from a (+17dBW ERP) MBCS Transmitter for Grade 2, 3 and 4 Impairment to a Domestic Television Installation</b>			
Distances extrapolated assuming far-field freespace	Wanted TV Signal Level		
	50 dB $\mu$ V p.d.	60 dB $\mu$ V p.d.	70 dB $\mu$ V p.d.
Grade 4	90	46	36
Grade 3	50	34	31
Grade 2	34	52	28

**4.10 On-Digital Set-top Box (#2835)****4.10.1**

<b>ERP (dBW) Resulting in Grade 2, 3 and 4 Impairment at 30 Metres</b> Transmitter Location B, Subjective Viewer B, Moving Picture 'Off-Air'	
On-Digital Set-top Box (#2835)	Wanted TV Signal Level 46 dB $\mu$ V p.d. (with considerable multipath present)
Grade 4	>+20.0
Grade 3	>+20.0
Grade 2	>+20.0

I.F. centred on 36.0 MHz. Receivers using the latest chip-set may be centred on 4.57 MHz.

**4.11 Television Receiver (#1771) Connected to Cable System at the RTCG****4.11.1**

<b>ERP (dBW) Resulting in Grade 2, 3 and 4 Impairment at 30 Metres</b> Transmitter Location B, Subjective Viewer B, Moving Picture 'Off-Air'	
RTCG Cable System with TV (#1771)	Wanted TV Signal Level 67 dB $\mu$ V p.d. (cable system launch level not known)
Grade 4	-1.0
Grade 3	+8.1
Grade 2	+16.5

**4.11.2**

<b>Median Distance (Metres) from a (+17dBW ERP) MBCS Transmitter for Grade 2, 3 and 4 Impairment to a Cabled Distribution System</b>	
Distances extrapolated assuming far-field freespace	Wanted TV Signal Level 67 dB $\mu$ V p.d. (cable system launch level not known)
Grade 4	238
Grade 3	84
Grade 2	32

## 4.12 Subjective Assessment of 30→100ms Bursts of Interference

### 4.12.1

<b>Average Time Between 30ms Bursts Considered to Result in Annoyance</b> When Viewing 'Off-Air' Moving Picture			
Television Receiver (#1806)	Magnitude of Interference when Continuous		
	Grade 2	Grade 3	Grade 4
Viewer 1	3 sec	not noticed	not noticed
Viewer 2	10 sec	not noticed	not noticed
Viewer 3	15 min	not noticed	not noticed
Viewer 4	1 min	not noticed	not noticed

### 4.12.2

<b>Average Time Between 65ms Bursts Considered to Result in Annoyance</b> When Viewing 'Off-Air' Moving Picture			
Television Receiver (#1806)	Magnitude of Interference when Continuous		
	Grade 2	Grade 3	Grade 4
Viewer 1	3 sec	not noticed	not noticed
Viewer 2	1 min	not noticed	not noticed
Viewer 3	1 hour	15 min	not noticed
Viewer 4	1 min	1 min	not noticed

### 4.12.3

<b>Average Time Between 100ms Bursts Considered to Result in Annoyance</b> When Viewing 'Off-Air' Moving Picture			
Television Receiver (#1806)	Magnitude of Interference when Continuous		
	Grade 2	Grade 3	Grade 4
Viewer 1	1 min	1 min	not noticed
Viewer 2	1 min	not noticed	not noticed
Viewer 3	1 hour	1 hour	not noticed
Viewer 4	3 min	3 min	not noticed

**4.12.4**

<b>Average Time Between 30ms Bursts Considered to Result in Annoyance</b> When Viewing 'Off-Air' Moving Picture			
Television Receiver (#2711)	Magnitude of Interference when Continuous		
	Grade 2	Grade 3	Grade 4
Viewer 1	not noticed	not noticed	not noticed
Viewer 2	not noticed	not noticed	not noticed
Viewer 3	not noticed	not noticed	not noticed
Viewer 4	not noticed	not noticed	not noticed

**4.12.5**

<b>Average Time Between 65ms Bursts Considered to Result in Annoyance</b> When Viewing 'Off-Air' Moving Picture			
Television Receiver (#2711)	Magnitude of Interference when Continuous		
	Grade 2	Grade 3	Grade 4
Viewer 1	3 sec	not noticed	not noticed
Viewer 2	1 min	not noticed	not noticed
Viewer 3	15 min	not noticed	not noticed
Viewer 4	1 min	1 sec	not noticed

**4.12.6**

<b>Average Time Between 100ms Bursts Considered to Result in Annoyance</b> When Viewing 'Off-Air' Moving Picture			
Television Receiver (#2711)	Magnitude of Interference when Continuous		
	Grade 2	Grade 3	Grade 4
Viewer 1	1 min	1 min	not noticed
Viewer 2	1 min	1 min	not noticed
Viewer 3	15 min	15 min	not noticed
Viewer 4	3 min	3 min	not noticed

## **5. OBSERVATIONS.**

### **5.1 Mobile Meteor Burst Station.**

**5.1.1** In general the channel used by the Mobile Meteor Burst Station (MMBS) did not affect the magnitude of the interference (some channels cause less interference than others to a particular receiver, but these channels depend not only on the receiver, but how the receiver is tuned to the wanted television signal).

**5.1.2** The magnitude of the interference peaked every 15.625 kHz when the frequency of the wanted television signal, the unwanted MMBS, or the television receiver tuning was adjusted. The difference between the unwanted MMBS signal levels, for the same subjective impairment at the worse and best-case frequencies was of the order of 10→15 dB. The MMBS channels can not be matched to the best-case frequencies however, as these will vary from receiver to receiver.

**5.1.3** The MMBS modulation had negligible effect on the magnitude of the interference.

**5.1.4** The magnitude of the interference is expected to increase if any significant vertical E field component is radiated by the MMBS.

**5.1.5** The maximum MMBS transmission duration is 100 ms, but the rate at which these 100 ms transmissions occur can be dramatically increased for short periods to transfer long messages. Consideration should be given to limiting the maximum length of message that can be transferred and the minimum interval between transmissions, in order to limit the annoying interference that a very long message transfer might cause.

**5.1.6** One of the greatest variables affecting the magnitude of the interference is the rate at which the MMBS transmissions will occur. Although this can be estimated statistically from the number, distribution and activity of the MMBS transmissions, considerable uncertainty can be introduced when assumptions or simplifications have to be made e.g. if uniform distributions (in time and space) are assumed, any high level localised interference will not be identified. Because little firm information regarding the number, distribution or activity of the MMBS transmissions is available, no estimate has been attempted.

### **5.2 Domestic Television Installation.**

**5.2.1** A simple ferrite filter inserted at the receivers antenna terminals reduced the magnitude of the interference by 15→20 dB in all cases. This indicates that the dominant interference mechanism was RF voltage induced on the screen of the antenna feeder.

**5.2.2** The magnitude of the interference is likely to be significantly greater for domestic television installations incorporating horizontal feeder runs e.g. those with a distribution amplifier feeding a number of television receivers.

**5.2.3** The layout of the receiving installation was found to affect the magnitude of the interference as expected, but what proved best for one receiver did not necessarily prove best for another. Repeatability was also poor however, demonstrating why it was necessary for EN 55020 to adopt test methods that have little in common with practical installations.

**5.2.4** The immunity of the poorer television receivers was improved when they were connected to the antenna via a video cassette recorder with relatively good immunity. NB this improvement was not due to the effective change in the length of the antenna feeder.

**5.2.5** Digital television reception is not expected to suffer interference providing SCART rather than RF interconnection is used, as the intermediate frequencies employed by these receivers do not encompass 39.0→39.2 MHz.

**5.2.6** The limits detailed in EN55020 do not apply to frequencies at the receivers intermediate frequency (there are no limits for these frequencies). Furthermore, as the interference mechanism is likely to be different for frequencies within the receiver's intermediate frequency, the limits applicable to other nearby frequencies can not be expected to provide an accurate indication of the receivers immunity to unwanted signals within its intermediate frequency.

### **5.3 Re-Broadcast Link's.**

**5.3.1** Although the loan of several RBL's was sought, none were available at the time of testing. These would however, be expected to have significantly better unwanted signal rejection performance to that of a domestic television receiver. Although no major problems are therefore expected, the relatively long horizontal feeders that some will employ may result in induced voltages greater than those that can be rejected. Fortunately a simple filter can be installed to eliminate this problem where necessary.

### **5.4 Interference.**

**5.4.1** All measurements were intended to relate to the worse-case frequency offset condition. The short term stability of some television receiver local oscillators rendered this relationship difficult to maintain however, and others appeared to change frequency when the unwanted signal level was adjusted (but not always). This accounts for the occasional anomalous result for a particular receiver at a particular location, but does not account for the poor overall repeatability.

**5.4.2** The interference produced vertical wavy lines at the worse-case frequency relationship which rotated and tended to merge with the line structure as the best-case frequency relationship was approached. At the best-case relationship, fainter patterning appeared at approximately 45-degree angles in both directions. The precise effect depended on the television receiver and, with some receivers, changed quite dramatically over a short period of time.

**5.4.3** The median distance at which interference would occur (from a 50 W e.r.p. MMBS) is estimated to be 102 metres for Grade 4 impairment, 50 metres for Grade 3 impairment and 36 metres for Grade 2 impairment.

**5.4.4** A subjective assessment of 30→100ms bursts of interference by a small number of viewers suggests that a single burst of Grade 4 impairment would not be noticed, a single burst Grade 3 impairment would be acceptable quite frequently (every few minutes), and a single burst of Grade 2 impairment would be acceptable approximately once per hour. This assessment assumed single bursts occurring at random times and did not consider the multiple bursts that would be necessary to transfer a long message.

## **5.5 CEPT SE Final Report, SE(99)T19 rev 2.**

**5.5.1** Although the methodology used to determine the interference distances presented in doc. SE(99)T19 is considered questionable, it does result in similar distances to those extrapolated from the practical measurements detailed in this report.

**5.5.2** The conclusion given in doc. SE(99)T19 that the risk of interference is negligible assumes infrequent transmissions (estimated to be 1 per hour) from MMBS stations, the majority of which will not be in a residential area. This does not appear unreasonable, but it can not be checked without knowing the likely MMBCS station densities, and the densities assumed in doc. SE(99)T19.

**5.5.3** Doc. SE(99)T19 appears to only consider the overall magnitude of the interference as it fails to mention the localised interference that should be expected when significant numbers of MMBS stations congregate in or near residential areas e.g. residential areas close to ports, motorway service areas or over-night parking areas. Fortunately it appears that a simple filter can solve this type of problem.

## **5.6 Further Work.**

**5.6.1** Because the magnitude of the interference depends on the layout of the television installation as much as the unwanted signal rejection performance of the receiver, and because it is expected to increase if any significant vertical E field component is radiated by the MMBS, trials using a real MMBS mobile and actual domestic installations may be desirable. CEPT SE(99)T19 notes that trials were carried out in Germany, the Netherlands, Belgium and Denmark with no interference being reported to the respective administrations. This only means that the interference was not sufficiently annoying to be reported, or was perhaps not present for a sufficient period (many weeks) to be identified as interference. Trials involving a real MMBS sited at various distances from a number of domestic premises, but modified so that a transmission could be triggered on any channel desired by an engineer visiting these homes, and asking the home owner for their opinion regarding the interference, would provide valuable information and confirm the validity of the interference distances and subjective assessments detailed in this report.

## **6. CONCLUSIONS.**

**6.1** The magnitude of the interference is likely to be negligible in general, but some higher levels of localised interference may need to be resolved. This should only require the insertion of a simple filter. Digital television reception is not expected to suffer interference as the intermediate frequencies employed by these receivers do not encompass 39.0→39.2 MHz.

**6.2** It would be prudent to check that the number (spatial density) and transmission rate (temporal density) of the MMBS's does not, statistically, exceed that likely to result in an MMBS transmitting within the interference distances detailed in this report more frequently than that deemed acceptable in this report. This would however, appear to demand completely unrealistic MMBS densities.

**6.3** Trials involving a real MMBS sited at various distances from a number of domestic premises, but modified so that a transmission could be triggered on any channel desired by an engineer visiting these homes, and asking the home owner for their opinion regarding the interference, would provide valuable information and confirm the validity of the interference distances and subjective assessments detailed in this report.

**7. KEY EQUIPMENT USED.**

<b>Key Test Equipment Used</b>				
<b>Plant No.</b>	<b>Equipment Manufacturer</b>	<b>Model No.</b>	<b>Equipment Type</b>	<b>Cal. Class</b>
0171	RF Power Labs	-	100W RF Power Amplifier	2
0358	Hewlett Packard	436A	RF Power Meter	1
1220	Hewlett Packard	8566B	Spectrum Analyser	1
1243	Bird	43	RF Power Meter	3 <small>[see 1]</small>
1254	Bird	8308-200	100W RF Attenuator	2 <small>[see 2]</small>
1626	Hewlett Packard	8481A	RF Power Sensor	1
1698	Rohde & Schwarz	ESVP	Measuring Receiver	1
1715	Restricted – Commercial		Television / VCR combo	3
1724	Restricted – Commercial		Video Cassette Recorder	3
1770	Restricted – Commercial		Nicam Television Receiver	3
1771	Restricted – Commercial		Nicam Television Receiver	3
1794	Hewlett Packard	8006A	PRBS Generator	3
1806	Restricted – Commercial		Nicam Television Receiver	3
2064	Fern Development	EF5-05	HP/LP Filter	2 <small>[see 3]</small>
2115	Rohde & Schwarz	HFH2-Z2	HF Measuring Antenna	1
2132	CEL	P167-10	Frame Store	3
2133	CEL	P167-18	Frame Store Controller	3
2574	K&L	5BT-24/48-5	Tuneable Bandpass Filter	1
2684	Restricted – Commercial		Television Receiver	3
2711	Restricted – Commercial		Nicam Television Receiver	3
2751	Hewlett Packard	E4433A	RF Signal Generator	1
2781	Restricted – Commercial		Television Receiver	3
2835	Restricted – Commercial		On-Digital Set-top Box	3
2838	Restricted – Commercial		Nicam Television Receiver	3

[1] Correction factors were derived for each of the plug-in sensors used with this power meter by comparing the indicated power, with the power measured using calibration class 1 equipment (Hewlett Packard 436A Power Meter and Sensor). These correction factors were applied to improve the accuracy of the measurements derived from this power meter.

[2] The insertion loss off this attenuator was checked at 39.1 MHz using calibration class 1 equipment (Hewlett Packard 436A Power Meter and Sensor) and found to be as specified.

[3] The frequency response of this filter was checked using calibration class 1 equipment (Hewlett Packard 8566B Spectrum Analyser).