

GTech Surveys Limited

Post-Construction Television Signal Survey

MMU SODA

CHANGE HISTORY

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Contents	Page
GTech Surveys Limited	
Executive Summary	
1 - Introduction	4
2 - Pre-Construction and Post-Construction Television Services	6
3 - Pre-Construction and Post-Construction Signal Surveys and Findings	8
4 - Analysis between Pre-Construction and Post-Construction Survey Reception Data	12
5 - Mitigation Measures	13
6 - Conclusions	14
Appendix	16
Television Transmitter Frequencies	
Signal Measurements	
An Overview of Signal Measurements	
Survey Equipment	
Calculation of Received Field Strength	
Mapping Data	

GTech Surveys Limited

GTech Surveys Limited is a Midlands based broadcast and telecommunications consultancy conducting projects throughout the entire UK. We undertake mobile phone network, television and radio reception surveys (pre- and post-construction signal surveys), conduct broadcast interference and reception investigations, and support telecommunications planning work for wind energy developers, construction companies, architects, broadcasters and Local Planning Authorities.

In addition to radio interference modelling services and television reception surveys, we produce EIA and ES Telecommunications Chapters (also known as an 'Electronic Interference Chapter'); satisfying the requirements of Part 5, Regulation 18 (Parts 5a and 5b) of The Town and Country Planning EIA Regulations 2017. We peer review ES and EIA work, liaising with telecommunications providers (Arqiva, BT etc.) and advise developers with respect to associated Section 106 (Town and Country Planning Act 1990) and Section 75 (Town and Country Planning (Scotland) Act 1997) agreements.

GTech Surveys Limited is a consultant member of the Trade Association for Content Delivery - (Confederation of Aerial Industries Ltd - CAI) and the RDI - the digital sector's professional body and trade organisation. We are listed on Constructionline and verified as a Safety Schemes in Procurement (SSIP) member by Safety Management Advisory Services (SMAS), making us compliant with the industry standard PAS 91:2013 + A1:2017.

Professional broadcast trained project engineers deliver, and supply QBE insured technical products to support planning applications, discharge planning conditions (including S106 Agreements) and for due diligence. For more information about GTech Surveys Limited please visit our website - www.gtechsurveys.com



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Executive Summary

A post-construction signal survey and reception impact assessment has been undertaken to determine the effects on local television reception arising from the completed MMU SODA development. The work has been conducted to discharge the associated planning condition;

Within one month of the practical completion of the development or before the development is first occupied, whichever is the sooner, and at any other time during the construction of the development if requested in writing by the City Council as local planning authority in response to identified television signal reception problems within the potential impact area, a new television signal survey shall be submitted to the City Council as Local Planning Authority that shall identify any measures necessary to maintain at least the pre-existing level and quality of signal reception identified in the Baseline Television Signal Survey & Television Reception Impact Assessment report by GTech Surveys Ltd, dated 3 September 2018. The measures identified must be carried out either before the building is first occupied or within one month of the study being submitted to the City Council as local planning authority, whichever is the earlier.

During August 2018, a pre-construction television reception impact assessment was undertaken to assess the possible reception impacts within the study area. The full reception impact assessment is detailed in the, “Baseline Television Signal Survey & Television Reception Impact Assessment, MMU SODA Development” report, by GTech Surveys Ltd, dated 3 September 2018.

During August 2022, the survey area was visited again to assess the post-construction reception conditions and to determine if the development had caused any signal interference or television reception degradation. Whilst it has not been possible to compare all the pre-construction reception data to the post-construction reception data (because most Winter Hill television transmitter parameters have changed since August 2018), it has been concluded that in its current form, through the assessment of available signal levels and signal qualities, the development has had a neutral effect upon the reception of television services for local residents. No interference has been identified and consequently no mitigation measures for the restoration of television reception are required.

The post-construction survey and television reception assessment was undertaken to discharge the associated planning condition.

1 - Introduction

This report details the findings of a desk-based study and post-construction signal survey to determine the effects the MMU SODA development has had on local television reception to satisfy the requirements of an associated planning condition. The planning condition states;

Within one month of the practical completion of the development or before the development is first occupied, whichever is the sooner, and at any other time during the construction of the development if requested in writing by the City Council as local planning authority in response to identified television signal reception problems within the potential impact area, a new television signal survey shall be submitted to the City Council as Local Planning Authority that shall identify any measures necessary to maintain at least the pre-existing level and quality of signal reception identified in the Baseline Television Signal Survey & Television Reception Impact Assessment report by GTech Surveys Ltd, dated 3 September 2018. The measures identified must be carried out either before the building is first occupied or within one month of the study being submitted to the City Council as local planning authority, whichever is the earlier.

A signal reception survey has been conducted to assess the post-construction reception conditions around the Site.

During August 2018, a pre-construction television reception impact assessment was undertaken to assess the possible reception impacts within the study area. The full reception impact assessment is detailed in the, “Baseline Television Signal Survey & Television Reception Impact Assessment, MMU SODA Development” report, by GTech Surveys Ltd, dated 3 September 2018.

During August 2022, the study area was visited again to assess the post-construction reception conditions and to determine if the development had caused any signal interference or reception degradation. During the survey, signal measurements were undertaken to record the existing reception conditions and signal levels. Analysis has been undertaken to assess the differences between the pre-construction and post-construction survey data to determine what impacts the development has had on local television reception conditions. The effects on digital terrestrial television and digital satellite television reception have been assessed. This report concludes by summing the what overall effects the development has had on television reception for local residents.

This report follows the following structure:

Chapter 1 introduces the work and the associated planning requirement

Chapter 2 describes the pre-construction and post-construction television services in the survey area; the locations of local transmitters, the situation regarding the ongoing digital television upgrade project, the orientation of incoming signals etc.

Chapter 3 describes the pre-construction and post-construction television reception conditions around the development and within the survey area from the results of the August 2018 pre-construction survey and August 2022 post-construction survey and assessment

Chapter 4 identifies any differences between the pre-construction and post-construction survey data

Chapter 5 identifies any suitable mitigation circumstances and measures for any potentially affected television user

Chapter 6 presents the conclusion

This study was undertaken in August 2022. The report details the existing reception conditions for future reference and can be used to discharge the associated planning condition.

2 - Pre-Construction and Post-Construction Television Services

Pre-Construction Television Services

Analogue Terrestrial Television Services

The area around the Site was no longer served by analogue television transmissions due to the completed Digital Television Switchover. All analogue services were switched off in Manchester and the Granada television region during 2009.

Digital Terrestrial Television (DTT) - Freeview

The survey area was served by DTT services (Granada TV region) from the Winter Hill transmitter (grid reference SD 66053 14463), on a bearing of 313° (with respect to true north) and 25km away from the Site. The transmitter is shown with respect to the Site in Figure 1.

Technical transmission information for each service at the aforementioned transmitter site is detailed in Table A, found in the Appendix - *Television Transmission Frequencies*.

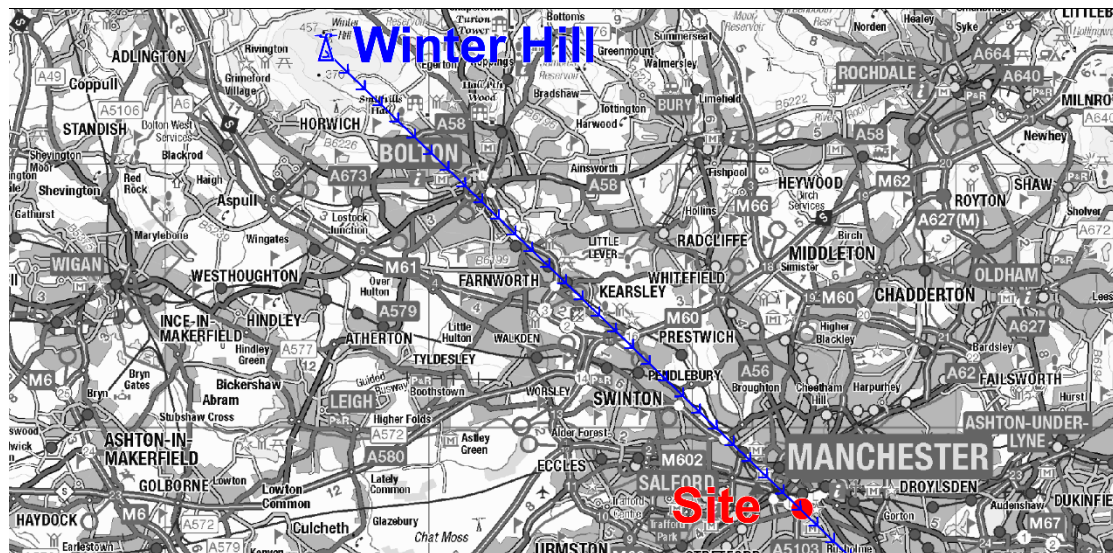


Figure 1 - The Location of the Winter Hill Transmitter, the Site and the direction of the incoming DTT signals at the Site (shown by the blue arrow)

Non-Terrestrial Television Services (Digital Satellite Television)

For the reception of the 28.2 degrees east ASTRA satellite cluster (Freesat and Sky services), dish elevations of 22.9 degrees are required at this latitude. Optimal receive dish azimuths are 143.8 degrees with respect to true north.

Post-Construction Television Services

Analogue Terrestrial Television Services

The areas around the Site are still not served by analogue television transmissions.

Digital Terrestrial Television (DTT) - Freeview

The area is still served by DTT services from the Winter Hill transmitter. Since the pre-construction study, significant changes occurred to all terrestrial television transmissions from the Winter Hill transmitter due to the introduction of new local 4G mobile phone networks. These changes include;

The BBC A multiplex, now transmitted on UHF channel number 32 with respect to the pre-construction UHF channel number 50;

The D 3 & 4 multiplex, now transmitted on UHF channel number 34 with respect to the pre-construction UHF channel number 59;

The BBC B multiplex, now transmitted on UHF channel number 35 with respect to the pre-construction UHF channel number 54-;

The SDN multiplex, now transmitted on UHF channel number 29 with respect to the pre-construction UHF channel number 58;

The Arqiva A multiplex, now transmitted on UHF channel number 31 with respect to the pre-construction UHF channel number 49;

The COM 7 multiplex has been shut down (during 2021); and

The COM 8 multiplex has been shut down (late June 2022).

Technical transmission information for each service at the Winter Hill transmitter site is detailed in Table B, found in the Appendix - *Television Transmission Frequencies*.

Non-Terrestrial Television Services (Digital Satellite Television)

For the reception of the 28.2 degrees east ASTRA satellite cluster, dish elevations of 22.9 degrees are still required at this latitude. Optimal receive dish azimuths are still 143.8 degrees with respect to true north.

3 - Pre-Construction and Post-Construction Signal Surveys and Findings

Pre-Construction Survey Overview

The pre-construction survey was undertaken during August 2018. Twelve survey locations were visited within the possible signal shadow areas. These are identified in Figure 2, and the measurements are detailed in Table C, found in the Appendix - *Signal Measurements*.

In particular, the following data was recorded:

- Field strength and technical signal measurements of DTT transmissions from the Winter Hill transmitter
- Viewing preference (choice of television transmitter) of residents in all areas visited

All television measurements were carried out using a log-periodic receive antenna, mounted on GTech Surveys's broadcast survey vehicle, at a receive height of 10m AGL (industry standard height for such work - used to mimic standard aerial installation height on domestic properties). During the survey, no assessment was made of reception conditions within viewers' homes.

Survey procedures, signal measurements and the survey equipment used are detailed in the Appendix - *Survey Equipment*.

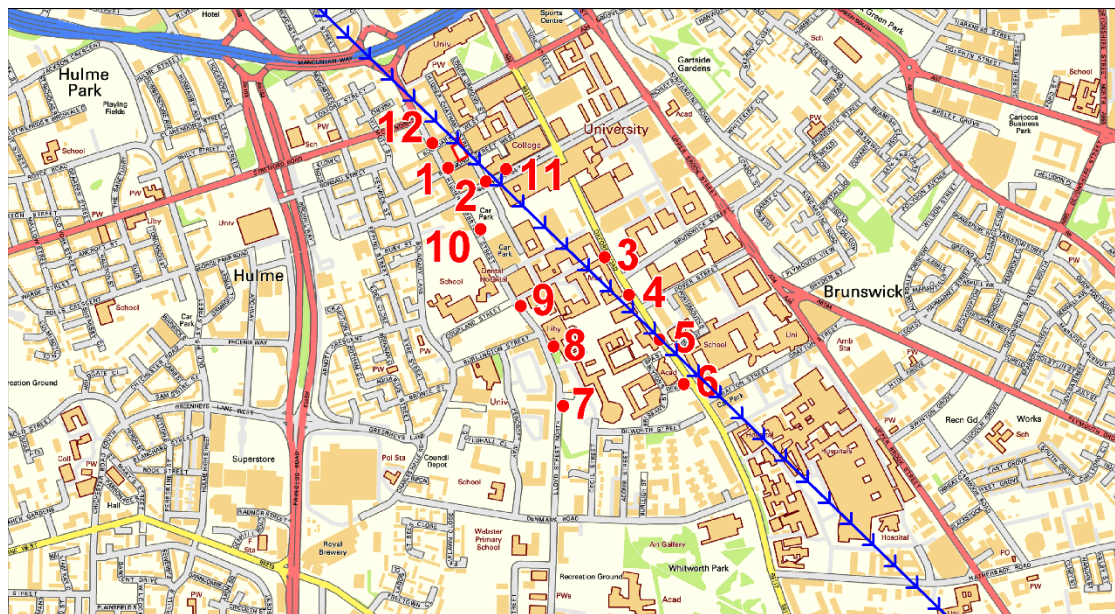


Figure 2 - Surveyed Locations. The blue arrow indicates the direction of the incoming DTT signals from Winter Hill

Survey Results and Observations

In general, building use around the Site was mainly for apartment type residential (student in particular) and commercial use. There are a number of existing tall and wide MMU use buildings around the Site. All signal receive antenna systems are mounted on building sides or rooftops, ensuring optimal reception conditions. All terrestrial television antennas are directed towards the Winter Hill transmitter, however, due to the heights of existing buildings, few antennas could be seen during the survey work.

Analogue Terrestrial Television Services

Due to the completed Digital Television Switchover, analogue television services were no longer available in the study area.

Digital Terrestrial Television - Freeview

DTT services were available at all surveyed locations from the Winter Hill transmitter. At all locations, received signal levels were well in excess of recommended minimum amounts and the technical quality of received signals was found to be good. DTT services provided good coverage and service throughout the study area.

Digital Satellite Television - Freesat & Sky

Few dishes were noted during the survey. Dishes may also be mounted on rooftops which would not be visible from street level. No existing interference was identified for any satellite television platform.

Post-Construction Survey Overview

The survey was undertaken during August 2022. 12 locations were visited in areas identified in Figure 2 and signal measurements were undertaken to assess the quality and availability of terrestrial television services. the measurements are detailed in Appendix - *Signal Measurements*. The following data was recorded:

Field strength and technical signal measurements of DTT transmissions from the Winter Hill transmitter

Viewing preference (choice of television transmitter) of residents in all areas visited

All television measurements were carried out using a log-periodic receive antenna, mounted on GTech Surveys's broadcast survey vehicle, at a receive height of 10m AGL (industry standard height for such work - used to mimic standard aerial installation height on domestic properties).

During the survey, no assessment was made of reception conditions within viewers' homes. Survey procedures, signal measurements and the survey equipment used are detailed in the Appendix - *Survey Equipment*.

Survey Results and Observations

Building use around the Site is still mainly for apartment type residential (student in particular), educational and commercial use. There are a number of existing tall and wide MMU use buildings around the Site. All antenna systems are mounted on building sides or rooftops, ensuring optimal reception conditions. All digital terrestrial television antennas are directed towards the Winter Hill transmitter, however, due to the heights of existing buildings, few antennas could be seen during the survey work.

Analogue Terrestrial Television Services

Analogue television services are still unavailable in the study area.

Digital Terrestrial Television - Freeview

DTT services were available at all surveyed locations from the Winter Hill transmitter. At all locations, received signal levels were well in excess of recommended minimum amounts and the technical quality of received signals was found to be good¹. DTT services provide good coverage and service throughout the study area.

Digital Satellite Television - Freesat & Sky

As with the pre-construction work, few dishes were noted during the survey. Dishes may also be mounted on rooftops which would not be visible from street level. No existing interference was identified for any satellite television platform.

¹ - Signal levels as specified by the *Code of Practice Confederation of Aerial Industries (CAI) COP 01 - Installation of Terrestrial and Satellite TV Reception Systems (MDU & Commercial)*, CAI, January 2021

Additional technical information regarding the Freeview signal can be found in the Appendix - *An Overview of Signal Measurements*

4 - Analysis between Pre-Construction and Post-Construction Survey Reception Data

Digital Terrestrial Television - Freeview

Due to the complex and fundamental changes that have been made at the Winter Hill transmitter as a result of radio spectrum clearance for regional 4G mobile phone networks, no precise assessments can be made with respect to how the reception environment has changed since the pre-construction and post-construction time period. However, based on existing signal and technical measurements, all signal levels are above recommended minimum amounts. Consequently, it can be demonstrated that the development has had a neutral effect upon the quality of received television signals within the survey area.

Overall, the survey work has indicated that digital terrestrial television services have not been disrupted by signal interference generated by the development.

Digital Satellite Television - Freesat & Sky

Unless interference has been reported, it is unlikely that the development has adversely impacted the reception of digital satellite television services such as Sky and Freesat.

Overall, the survey work has indicated that digital satellite television services have not been disrupted by signal interference generated by the development.

Summary of Post-Construction Survey Findings after Data Analysis

Broadcast platform	Has interference occurred?	Mitigation required?
DTT - Freeview	No	No
Digital Satellite TV - Freesat & Sky	Not possible to verify, but unlikely	No

Table 1 - Summary of Television Interference

Effects on Television Reception - Conclusions

Interference to DTT service reception has not occurred

Interference to digital satellite television reception is unlikely to have occurred

5 - Mitigation Measures

With respect to the requirement of mitigation, the associated planning condition states;

Within one month of the practical completion of the development or before the development is first occupied, whichever is the sooner, and at any other time during the construction of the development if requested in writing by the City Council as local planning authority in response to identified television signal reception problems within the potential impact area, a new television signal survey shall be submitted to the City Council as Local Planning Authority that shall identify any measures necessary to maintain at least the pre-existing level and quality of signal reception identified in the Baseline Television Signal Survey & Television Reception Impact Assessment report by GTech Surveys Ltd, dated 3 September 2018. The measures identified must be carried out either before the building is first occupied or within one month of the study being submitted to the City Council as local planning authority, whichever is the earlier.

However, as no television interference has been identified, no mitigation measures are required to restore the reception of television services.

6 - Conclusions

A post-construction signal survey has been performed to assess the possible effects and impacts on the reception of television broadcast services from the MMU SODA development, as required in an associated planning condition. The planning condition states;

Within one month of the practical completion of the development or before the development is first occupied, whichever is the sooner, and at any other time during the construction of the development if requested in writing by the City Council as local planning authority in response to identified television signal reception problems within the potential impact area, a new television signal survey shall be submitted to the City Council as Local Planning Authority that shall identify any measures necessary to maintain at least the pre-existing level and quality of signal reception identified in the Baseline Television Signal Survey & Television Reception Impact Assessment report by GTech Surveys Ltd, dated 3 September 2018. The measures identified must be carried out either before the building is first occupied or within one month of the study being submitted to the City Council as local planning authority, whichever is the earlier.

During August 2018, a pre-construction television reception impact assessment was undertaken to assess the possible reception impacts within the study area. The full reception impact assessment is detailed in the “Baseline Television Signal Survey & Television Reception Impact Assessment, MMU SODA Development”, report by GTech Surveys Ltd, dated 3 September 2018.

This study has focused on the television broadcast platforms that could possibly be affected by the development; digital terrestrial television and digital satellite television services. During the survey work, to assess the possible impacts to local television reception, 12 locations were visited which were located in and near to the theoretical signal shadow zone. The pre-construction and post-construction survey data has been compared and the impacts and effects on local television reception have been assessed.

Digital Terrestrial Television (DTT) - Freeview

DTT reception is robust and coverage is good in the survey area. All services received were above minimum required levels for coverage. The survey work has indicated that the reception of Freeview services has not been disrupted by signal interference generated by the development.

Digital Satellite Television - Freesat & Sky

The development is unlikely to have had any adverse effect upon the reception of digital satellite television services such as Freesat and Sky.

From the findings of the post-construction signal survey and this assessment, it has been concluded that the development has had a neutral effect upon the reception of television broadcast services for local residents. No mitigation measures are required, and no interference has been created for any television broadcast platform. This report can be used to discharge the associated planning condition.

APPENDIX

Television Transmitter Frequencies

Signal Measurements

An Overview of Signal Measurements

Survey Equipment

Calculation of Received Field Strength

Mapping Data

Television Transmitter Frequencies

Digital TV Multiplex	Multiplex Operator	UHF Channel Number *	Channel Frequency Fc (MHz) **	Transmitter Power (kW)
BBC A	BBC	50	706.000	100.0
D3&4	Digital 3 & 4	59	778.000	100.0
BBC B - HD	BBC	54-	737.866	100.0
SDN	SDN	58	770.000	100.0
Arqiva A	Arqiva	49	698.000	100.0
Arqiva B	Arqiva	37	602.000	100.0
COM7 - HD	Arqiva	55	746.000	22.9
COM8 - HD	Arqiva	31	554.000	22.6

Table A - 2018 Winter Hill Digital Terrestrial Television Services

Digital TV Multiplex	Multiplex Operator	UHF Channel Number *	Channel Frequency Fc (MHz) **	Transmitter Power (kW)
BBC A	BBC	32	562.000	100.0
D3&4	Digital 3 & 4	34	578.000	100.0
BBC B - HD	BBC	35	586.000	100.0
SDN	SDN	29	538.000	100.0
Arqiva A	Arqiva	31	554.000	100.0
Arqiva B	Arqiva	37	602.000	100.0

Table B - 2022 Winter Hill Digital Terrestrial Television Services

Public Service Broadcaster (PSB) Digital Multiplexes
Commercial (COM) Digital Multiplexes

* - Digital multiplexes with a "+" or "-" sign operate with a frequency offset making the channel frequency + or - 167 kHz.

** - The nominal channel frequency, Fc (in Megahertz) of the multiplex can be calculated using $F_c = 8n + 306$, where 'n' is the UHF channel number.

Signal Measurements

Measurement Point Number	Channel Frequency Service	50 706.00 BBC A	59 778.00 D3&4	54 738.00 BBC B -	58 770.00 SDN	49 698.00 Arqiva A	37 602.00 Arqiva B -	55 746.00 COM7	31 554.00 COM8
1	FS CSI MER	83.1 23.8 29.0	92.9 32.2 31.0	82.8 - -	74.8 22.0 31.3	92.8 24.0 30.3	82.2 20.8 32.9	70.5 - -	68.4 - -
2	FS CSI MER	82.7 20.8 31.4	85.8 24.8 30.9	87.1 - -	75.3 21.2 30.2	86.9 17.5 32.1	83.3 26.7 31.0	70.8 - -	70.9 - -
3	FS CSI MER	83.4 16.7 33.2	84.1 24.2 30.4	91.6 - -	74.3 32.4 28.4	86.0 28.1 29.4	88.0 28.2 31.6	72.2 - -	73.6 - -
4	FS CSI MER	80.0 28.8 30.7	86.0 27.1 30.0	88.3 - -	90.1 19.8 31.1	85.2 20.8 32.9	89.7 29.6 31.3	78.2 - -	71.2 - -
5	FS CSI MER	82.9 26.3 30.2	93.0 26.7 33.1	78.9 - -	85.1 20.9 31.0	78.8 30.8 28.9	87.2 23.1 34.5	74.6 - -	75.2 - -
6	FS CSI MER	81.6 27.0 30.2	84.0 21.4 29.1	85.6 - -	84.3 22.8 30.4	82.0 27.4 29.9	79.6 25.2 31.1	72.5 - -	67.3 - -
7	FS CSI MER	91.6 24.2 31.3	88.9 25.4 29.9	71.5 - -	85.4 22.8 29.4	84.3 18.9 31.5	90.2 29.5 32.0	70.8 - -	73.5 - -
8	FS CSI MER	86.6 25.6 31.9	91.6 28.0 32.2	98.8 - -	90.1 27.0 30.2	88.3 28.7 32.4	72.3 33.0 31.2	74.2 - -	71.6 - -
9	FS CSI MER	78.8 20.9 32.2	78.6 22.6 31.8	79.9 - -	80.4 19.3 30.4	88.3 18.2 31.2	82.2 19.1 27.8	71.1 - -	69.1 - -
10	FS CSI MER	73.3 29.3 28.4	84.5 23.3 30.9	84.7 - -	82.6 29.5 28.5	85.5 25.8 31.9	85.1 20.4 30.4	75.7 - -	73.8 - -
11	FS CSI MER	87.2 18.3 29.9	89.9 20.4 29.0	89.9 - -	90.7 28.5 28.4	84.2 27.9 28.8	69.7 20.1 30.1	69.8 - -	69.1 - -
12	FS CSI MER	92.8 19.2 29.2	74.8 24.5 31.0	77.8 - -	89.3 30.0 31.5	89.8 23.1 31.3	83.3 18.4 31.1	73.2 - -	73.1 - -

Table C - 2018 Measurements of Winter Hill Digital Television Services

Key -

Frequencies listed in MHz

Field strength (FS) values indicated in dB μ V/m

Channel Status Information (CSI) %

Modulation Error Ratio (MER) dB

Measurement Point Number	Channel Frequency Service	32 562.00 BBC A	34 578.00 D3&4	35 586.00 BBC B	29 538.00 SDN	31 554.00 Arqiva A	37 602.00 Arqiva B
1	FS CSI MER	89.9 22.5 31.7	92.1 22.2 30.5	90.4 - -	91.5 21.1 30.6	97.8 22.9 31.5	85.9 24.9 30.7
2	FS CSI MER	87.3 20.9 28.9	86.0 19.3 30.1	86.7 - -	88.0 26.1 31.0	92.0 26.7 29.5	93.6 19.7 32.9
3	FS CSI MER	92.8 24.3 31.8	92.9 29.8 29.4	87.9 - -	87.0 25.6 30.9	84.3 23.4 32.1	89.9 22.1 31.8
4	FS CSI MER	92.1 27.8 31.7	89.8 26.0 29.6	93.8 - -	91.9 21.7 32.3	92.2 20.9 30.8	87.9 28.9 31.8
5	FS CSI MER	92.0 23.7 31.9	93.9 28.2 30.0	89.7 - -	90.7 24.2 31.0	92.6 21.0 29.3	86.7 30.9 31.7
6	FS CSI MER	93.7 20.7 32.5	90.3 20.3 30.4	85.6 - -	94.5 23.9 30.8	93.2 25.6 30.6	89.7 24.3 31.0
7	FS CSI MER	91.7 21.7 32.2	84.5 21.7 31.8	93.7 - -	83.0 17.1 30.4	91.8 21.7 30.1	86.0 24.2 29.9
8	FS CSI MER	85.4 21.7 28.4	82.3 19.7 31.2	95.3 - -	92.3 24.3 32.2	82.3 24.9 30.7	91.3 18.8 31.1
9	FS CSI MER	93.5 25.4 31.3	81.5 29.9 31.8	98.8 - -	84.5 23.6 31.2	93.2 21.5 30.7	86.5 20.9 31.5
10	FS CSI MER	90.1 27.2 32.6	89.9 24.3 32.7	91.6 - -	86.2 21.1 29.5	84.0 19.9 29.8	88.4 28.6 30.7
11	FS CSI MER	84.0 22.5 31.7	89.8 29.0 31.2	95.9 - -	89.5 23.6 30.3	85.6 20.5 30.8	83.0 31.1 31.2
12	FS CSI MER	88.0 21.2 30.7	90.7 19.5 30.8	94.5 - -	90.3 21.6 30.9	90.3 24.9 31.4	91.4 24.8 30.0

Table D - 2022 Measurements of Winter Hill Digital Television Services

Frequencies listed are in MHz

Field strength (FS) values are indicated in dB μ V/m

CSI Channel Status Information (%)

MER Modulation Error Ratio (dB)

An Overview of Signal Measurements

The first and easiest parameter to check is signal level (also referred to as amplitude or terminated signal strength). In many cases this gives a good indication of the available decoding margin, or the extent of any shortfall.

At the receiver input, the terminated level of a DTT signal is measured in the usual units of dB μ V (a maximum signal level of 70 dB μ V and a minimum signal level of 50 dB μ V). It is helpful to understand that the level of a DTT signal represents the total power of all the carriers in the Coded Orthogonal Frequency Division Multiplexing (COFDM) signal and not the level of each individual COFDM carrier. For satisfactory reception of digital signals, it is important the signals applied to the receiver are within these ranges. These maximum and minimum levels define a so-called window of operation for the receiver.

Common practice dictates that in order to measure the quality of a received DTT signal we have to look at one or more of the following parameters: Bit-Error Rate (BER), Channel BER (CBER), Carrier-to-Noise Ratio (CNR) and Modulation Error Ratio (MER). The Channel State Information (CSI) feature available in DTT measurement equipment is a very valuable tool providing additional insight into the quality of reception in a typical domestic or professional DTT installation.

Using the BER alone is an ill-advised “hit-or-miss” strategy because of the 'cliff-edge effect' characteristic of any digital TV system. A BER reading below the reference quasi error free (QEF) value of 2×10^{-4} might wrongly lead us to conclude that the receiving conditions are satisfactory.

However, the BER provides a very narrow signal measurement range. Even for vanishingly small BER readings, a small drop in the level of received DTT signal can push the DTT receiver over the digital cliff edge beyond the point of system failure. The CBER is closely related to the BER providing a wider signal measurement range. Depending on the type(s) of unknown disturbance(s) affecting our DTT installation (noise, co-channel or adjacent PAL, co-channel DTT, etc.), the CBER corresponding to the reference QEF BER of 2×10^{-4} varies between 4 and 7 in 100 [1]. Unfortunately, the CBER is not a reliable indicator of how far the digital cliff edge is.

DTT engineers need a tool with a wide measurement range that solves the shortcomings of the BER and CBER. This measurement tool should provide some estimate of the noise margin of the DTT installation. A first candidate comes to mind: CNR or, alternatively, its sibling the MER.

The CNR is defined as the ratio of the average RF power of the DTT signal to the power of the noise present in the UHF channel. Similarly, the MER is defined as the ratio of the average power of the DTT signal to the average power of the constellation errors. It can therefore be used to give a more direct indication of decoding margin when, as is often the case, there is co-channel

interference as well as noise in the channel. The higher the MER value, the **better** the reception conditions. Our measurement equipment provides a maximum MER measurement value of up to 35 dB.

In situations where there is no multipath propagation so that the channel frequency response remains reasonably flat, CNR and MER are in principle the same thing. In practice, the accuracy of the measured CNR is limited by the noise floor of the measurement equipment and by the presence of other disturbances on adjacent UHF channels. Likewise, both the receiver's noise floor and other issues resulting from its practical implementation degrade the MER estimate.

Channel State Information (CSI)

Some flavour of CSI is used internally by all commercial DTT receivers to achieve the recommended target system performance². The CSI counts the effect of both the noise present in the channel and the shape of the transmission channel itself. In other words, the CSI gives a measure of the reliability of the received DTT signal. We measure the average of the CSI across the UHF channel occupied by the DTT signal. The higher the percentage value of CSI, the **less** reliable DTT reception is.

As explained, the CSI can be used as a means to measure the noise margin in a DTT installation. Let us call CSI_{QEF} the percentage CSI measured at the point where the measurement equipment displays the reference QEF BER. The noise margin in dB is then approximately given by –

$$NM \text{ (dB)} = \frac{CSI_{QEF} - CSI}{2.6}$$

This empirical approximation represents a good estimate for NM below 8dB. The CSI alone, on the other hand, has a wider measurement range, providing meaningful results for NM of up to 15dB.

² - J. Lago-Fernández, "Using Channel State Information (CSI) to Characterize DVB-T Reception", IBC, Amsterdam, 12-17 September 2002

Survey Equipment

1 x Promax Prolink 4C Premium – Serial Number PK4COPAB11B /
060419030005 Running firmware version 2.47

1 x Sony Wide screen CRT Reference Receiver KV-16TIU – Serial Number
4014480

1 x Professional Broadcast Wideband Log Periodic 8 element antenna –
Amphenol Jaybeam (details below)

**Amphenol JAYBEAM**

468-860 MHz

A Log Periodic antenna designed for UHF Broadcast, TETRA and Cellular communications applications. This antenna is often used in a stacked array to form a rugged, high power, extended range antenna. Produced to the highest quality standards, these robust antenna designs will insure reliable operation in harsh environmental conditions.

Replace "x" with desired model number option.

LPU/Rx
V-Pol or H-Pol | Log Periodic | 70° | 7.9 dBd

Electrical Characteristics		
Frequency band	468-860 MHz	
Model number options (x)	Model Number LPU/R-N LPU/R-7/16	Connector type N-Female 7/16-DIN Female
Polarization	Vertical or Horizontal	
Horizontal beamwidth	70°	
Gain	7.9 dBd	
Impedance	50Ω	
VSWR	<1.3:1	
Maximum power	250 W	
Connector type	see model number options above	
Lightning protection	DC grounded	
Mechanical Characteristics		
Materials	Aluminium Alloy	
Dimensions (Length x Width)	1210 x 320 mm	47.6 x 12.6 in
Weight without bracket	3.5 kg	7.7 lbs
Mounting Options		
Mounting	Mounting bracket included to fit 38-50 mm dia. pipe.	



Technical Specification for an Amphenol Jaybeam Professional Broadcast Wideband Log Periodic 8-Element Antenna

All RF cables, interconnects and systems of professional quality and calibrated to determine feeder losses and antenna gains. These are factored into the results, providing accurate descriptions of actual field strength values at 10m AGL for each surveyed location – see *Calculation of Received Field Strength*

Calculation of Received Field Strength

The Field Strength (dBμV/m) is derived from the Terminated Level (dBμV) as measured at the input of the Promax measurement receiver in the survey vehicle.

Field Strength (dBμV/m) = Terminated Level (dBμV) – Aerial Gain (a) + Dipole Factor (b) + Feeder Loss (c)

where -

Dipole Factor (to matched load)	(b)	$20\text{Log}\left(\frac{2\pi}{\lambda}\right)$ <i>Where λ = Transmission Wavelength (m)</i>
Feeder Loss	(c)	3 dB
Aerial Gain (dB _{dipole})	(a)	10 dB

Mapping Data

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The UK's terrestrial television networks are highly complex engineering systems and are constantly being modified, re-designed, upgraded and maintained. The reception conditions detailed in this report were those prevailing at the time of the survey in the survey area. Engineering work at transmitter sites, weather conditions and the time of the year will influence the quality and coverage of terrestrial services and their susceptibility to interference. Whilst every effort was made to accurately measure and assess the available television transmissions and services at the time of the survey, GTech Surveys Limited cannot assume that any part of the television broadcast network or transmission from any transmitter was operating in required specification or correctly to any design criteria. The signal measurements undertaken during the survey work were used to define the possible impacts to television reception for this project. Although best practice has been applied in understanding the potential impacts, due to the complex nature of the subject, GTech Surveys Limited is not accountable in anyway whatsoever if unpredicted impacts occur at any location anywhere in the survey area.

Modelling parameters assume that all installed UHF antenna systems are mounted at least 10m AGL and installed to a modern standard, with all components meeting CAI quality standards. Antennas mounted at lower heights and poor-quality installations will be more prone to the effects of interference from external sources and as such, reception conditions to installations with the aforementioned characteristics have not been accounted for in any impact modelling. Consequently, properties with such installations may be prone to interference effects that have not been identified. Such installations are commonly found in camping and caravan parks, on bungalows and properties where it is not possible to attach an antenna to the exterior roof. Antennas mounted in lofts are also more prone to interference effects arising from the signal attenuation caused by roofing materials. Again, reception conditions to properties with the aforementioned antenna installation characteristics have not been accounted for in any impact modelling and as such, properties with these installations may be prone to interference effects that have not been identified.

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