

GTech Surveys Limited

Post-Construction Television Signal Survey and Reception Impact Assessment

Paterson

Planning Condition 21

CHANGE HISTORY

Issue	Date	Details of Changes
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Author: G Phillips		Reviewer: O Lloyd

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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 final impact and effects on local television reception arising from the completed Paterson development. The work has been conducted with the following associated planning condition (number 21) in mind;

21) During the construction of the development and within one month following the substantial completion of the development hereby approved, the City Council may request in writing a TV, Radio Impact and WIFI Assessment study of the existing television signal within the potential impact area (as previously identified in the GTech Surveys Limited - Baseline Television Signal Survey & Television Reception Impact Assessment stamped as received on 28th May 2019) to be undertaken and compared with the Assessment study undertaken in 2019. The study shall identify such measures necessary to maintain at least the pre-existing level and quality of signal reception (as identified in the submitted Baseline Television Signal Survey & Television Reception Impact Assessment) and a timetable for the implementation, if required, of any remediation measures. The study shall be submitted to the City Council as local planning authority for approval and any remediation measures shall be implemented in accordance with the approved study.

Reason - To ensure that the development at least maintains the existing level and quality of television signal reception, as advised in Planning Policy Guidance Note 8: Telecommunications.

Initially during December 2018, a pre-construction reception study was undertaken. The findings are presented in the report; “GTech Surveys Limited - Baseline Television Signal Survey & Television Reception Impact Assessment”. The report concluded that interference to the reception of digital terrestrial television (DTT – Freeview) services may occur in areas to the immediate southeast of the Site (Rathen Road and Wilmslow Road) and mitigation (antenna betterment, repositioning etc.) may be required to restore good reception.

During October 2021, the survey area was visited again to assess the existing reception conditions and to determine if the development in its current form had caused any signal or reception degradation. Whilst it was not possible to compare the pre-construction reception data to the mid-phase construction reception data (because all Winter Hill television transmitter parameters had changed since December 2018), it was concluded that the development, (through the assessment of available signal levels and qualities), had caused degradation to reception conditions in an area to the immediate southeast of the Site (Rathen Road and Wilmslow Road).

Suggested mitigation involved the betterment of antenna systems and included any of the following;

- Replacement of components not fit for purpose (damaged, water ingress in cables / antennas, electrically faulty, old brown type coax etc.)
- Replacement or installation of a mast head amplifier and new antenna
- Replacement of old coax cable to better signal throughput and to reduce unwanted electrical pickup
- Installation of a higher gain antenna
- Good earthing on antenna systems and associated components to help reduce unwanted electrical system noise
- Installation of a higher antenna (above ground level) in a location as far away from the Site as possible i.e. on another chimney stack etc. in a more southeasterly location

It was also considered that coverage was likely to improve once tower cranes have been removed and the construction compound dismantled.

During January 2023, the study area was revisited again to undertake a final signal survey. When the reception data from the October 2021 survey was compared with the updated survey data, no further signal degradation was noted. This was an expected finding since the majority of the signal disruption would have occurred once the building's structure had been completed. As no additional signal interference has occurred and the reception environment remains stable, no further mitigation work to restore reception conditions are required. This report can be used to discharge the associated planning condition.

1 - Introduction

This report details the findings of a final study to determine the overall effects the Paterson development (in its completed form) has had on local television reception to satisfy the requirements of an associated planning condition as a result of reported television interference;

21) During the construction of the development and within one month following the substantial completion of the development hereby approved, the City Council may request in writing a TV, Radio Impact and WIFI Assessment study of the existing television signal within the potential impact area (as previously identified in the GTech Surveys Limited - Baseline Television Signal Survey & Television Reception Impact Assessment stamped as received on 28th May 2019) to be undertaken and compared with the Assessment study undertaken in 2019. The study shall identify such measures necessary to maintain at least the pre-existing level and quality of signal reception (as identified in the submitted Baseline Television Signal Survey & Television Reception Impact Assessment) and a timetable for the implementation, if required, of any remediation measures. The study shall be submitted to the City Council as local planning authority for approval and any remediation measures shall be implemented in accordance with the approved study.

Reason - To ensure that the development at least maintains the existing level and quality of television signal reception, as advised in Planning Policy Guidance Note 8: Telecommunications.

During December 2018, a pre-construction television reception impact assessment was undertaken to assess the possible reception impacts within the study area. The assessment concluded that there was the possibility of digital terrestrial television (DTT, commercially known as Freeview) interference in areas to the immediate southeast of the Site.

During October 2021, the study area was revisited again to assess the then existing reception conditions and to determine if the part-completed development had caused any signal or reception degradation. During the survey, signal measurements were undertaken to record the current reception conditions and signal levels. Analysis was undertaken to assess the differences between the pre-construction and mid-phase construction survey data and to determine the impacts of the development upon local television reception conditions. Overall, it was concluded that some interference has occurred and satiable mitigation was suggested and implemented in any affected properties.

During January 2023, the study area was revisited again to undertake a final signal survey. The effects on digital terrestrial television and digital satellite television reception have been assessed. This report concludes summing the overall effects the development has had on television reception for local residents. The report also details the existing reception conditions for future reference.

This report follows the following structure:

Chapter 1 introduces the work and the associated planning requirement

Chapter 2 describes the post-construction and mid phase-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 post-construction and mid phase-construction television reception conditions around the development and within the survey area from the results of the January 2023 post-construction survey and October 2021 mid phase-construction assessment

Chapter 4 identifies any differences between the mid phase-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

2 - Post-Construction and Mid Phase-Construction Television Services

Mid Phase-Construction Television Broadcast Services

Analogue Terrestrial Television

The area around the Site is no longer served by analogue television transmissions due to the completed Digital Television Switchover. All analogue services were switched off in 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 310° (with respect to true north) and 25km away. The transmitter is shown with respect to the proposed development 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*.

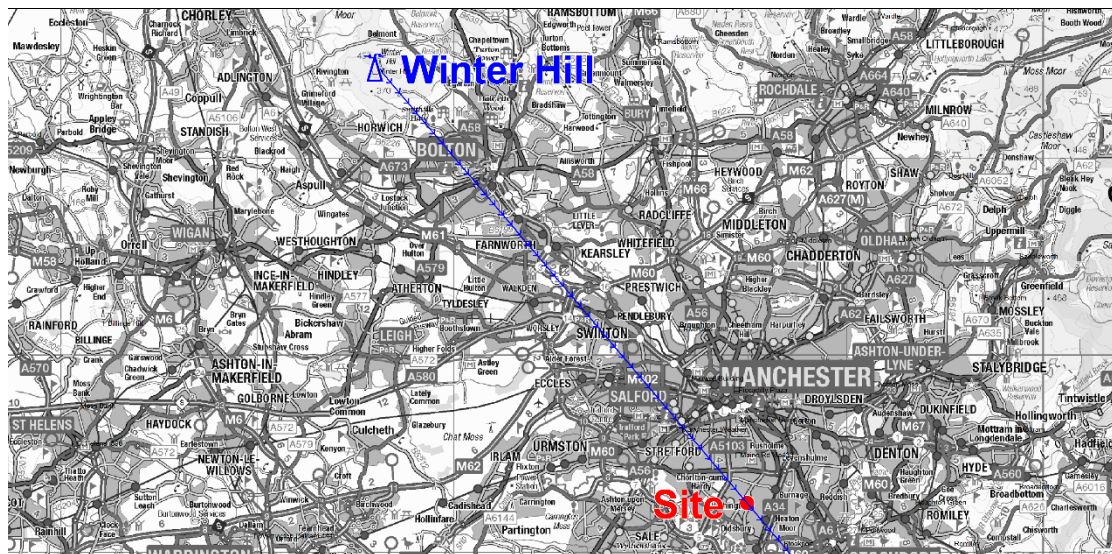


Figure 1 - The Location of the Winter Hill Transmitter, the Site and the direction of the incoming DTT signals at the Site

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 Broadcast Services

Analogue Terrestrial Television

The area around the development is 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 mid-phase construction study, only one significant change has occurred to terrestrial television transmissions from the Winter Hill transmitter due to the introduction of new 4G mobile phone networks in the region. These are summated;

The removal of the COM7 high definition multiplex (collection of television channels and services), decreasing the number of main multiplexes transmitted from Winter Hill from seven to six

Technical transmission information for each service at the transmitter site is detailed in Table B, found in the Appendix - *Television Transmission Frequencies*. Up to date technical information regarding the Granada TV region and Winter Hill transmitter group can be found on the Digital UK website - <http://www.digitaluk.co.uk>

Non-Terrestrial Television Services - Freesat & Sky

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 Mid-Phase Construction Signal Surveys and Findings

Mid-Phase Construction Survey Overview

During October 2021, the study area was visited, and signal measurements were undertaken in areas around the Site and up to two kilometres away from the Site. Additionally, investigations were carried out in all areas where predicted interference could occur (areas to the immediate southeast of the Site). The general survey locations are identified in Figure 2, and the signal measurements are detailed in Table C, found in the Appendix.

During the survey, 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

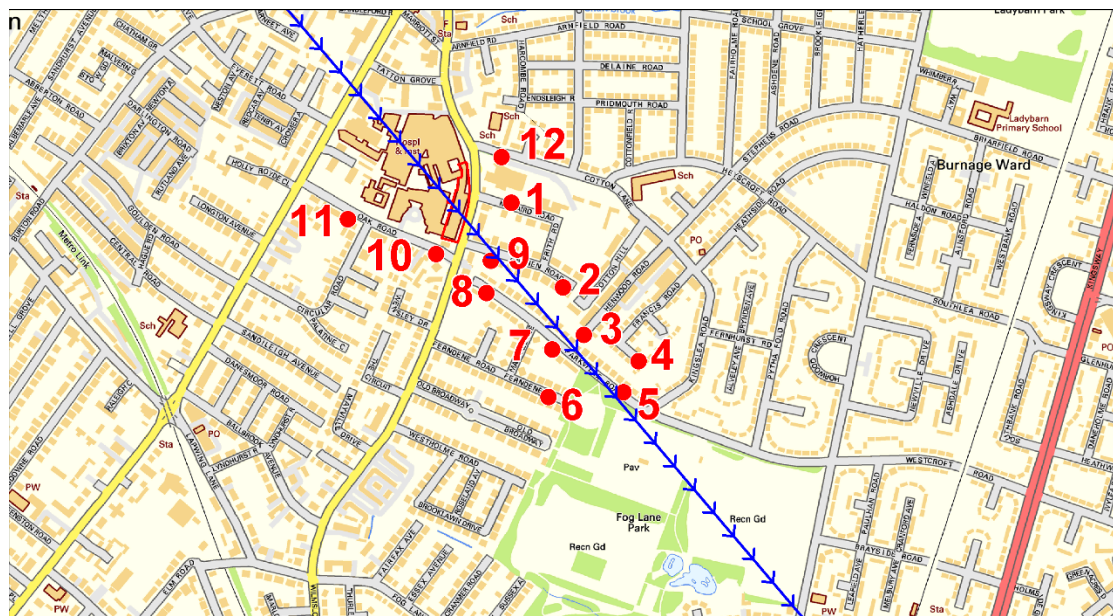


Figure 3 - Surveyed Locations. The blue arrow indicates the direction of the incoming DTT signals from the Winter Hill transmitter

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 Results and Observations

Three tower cranes were in use at the Site and a significant construction compound had been built to facilitate the building work. All signal receive antenna systems were still mounted on building sides or rooftops. All terrestrial television antennas are still directed towards the Winter Hill transmitter.

Analogue Terrestrial Television

Due to the completed Digital Television Switchover, analogue television signals are still not available in the study area.

Digital Terrestrial Television - Freeview

DTT services were available at all surveyed locations from the Winter Hill transmitter. Away from the Site, received signal levels were in excess of recommended minimum amounts and the technical quality of received signals was found to be good. Nearer the Site, the effects of signal attenuation on received signals was evident and received levels were lower compared to locations not located in the signal shadow created by the tower cranes, construction compound buildings or new development.

Digital Satellite Television - Freesat & Sky

A number of properties were noted to have satellite dishes installed, particularly along Rathen, Kinnaird and Oak Road. Satellite dishes may also be mounted on rooftops which would not be visible from street level. No existing interference has been identified for any satellite television platform.

Mid-Phase Construction Survey Overview

During January 2023, the study area was visited again, and signal measurements were undertaken in areas around the Site and up to two kilometres away from the Site. Additionally, investigations were carried out in all areas where interference had previously been reported (areas to the immediate southeast of the Site). The general survey locations are identified in Figure 2, and the signal measurements are detailed in Table D, found in the Appendix.

During the survey, 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

Survey Results and Observations

The development appeared complete. All signal receive antenna systems were still mounted on building sides or rooftops. All terrestrial television antennas are still directed towards the Winter Hill transmitter. A number of new antenna installations were noted on properties around the Site.

Analogue Terrestrial Television

Due to the completed Digital Television Switchover, analogue television signals are still not available in the study area.

Digital Terrestrial Television - Freeview

DTT services were available at all surveyed locations from the Winter Hill transmitter. Away from the Site, received signal levels were in excess of recommended minimum amounts and the technical quality of received signals was found to be good. Nearer the Site, signal levels were found to be at acceptable levels¹.

¹ - Signal levels as specified by the CAI - Association for Audio Visual Professionals

Code of Practice (COP) For the Installation of Aerials/Antennas & Receiving Equipment in the Single Dwelling Unit
CAI COP 2: September 2022

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

Digital Satellite Television - Freesat & Sky

A number of properties were still noted to have satellite dishes installed, particularly along Rathen, Kinnaird and Oak Road. Satellite dishes may also be mounted on rooftops which would not be visible from street level. No existing interference has been identified for any satellite television platform.

4 - Analysis between Post-Construction and Mid Phase-Construction Survey Reception Data

Analogue Television Services

A comparison between mid-phase construction and post-construction analogue reception conditions was not possible because no analogue services were present during the 2021 mid-phase construction reception work.

Digital Terrestrial Television Services

Based on signal measurements, received signal levels in the signal shadow area of the development were noted to be reduced (in line with expectations). Elsewhere, reception conditions were still good. Based on existing signal and technical measurements, all signal levels are above recommended minimum amounts (as specified in Code of Practice (COP) For the Installation of Aerials / Antennas & Receiving Equipment in the Single Dwelling Unit CAI COP 2: September 2022). Consequently, it can be demonstrated that whilst the development has had a minor adverse effect on reception conditions in some areas, overall, the development has not caused widespread interference on received television signals within the survey area.

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 Survey Findings after Data Analysis

Broadcast platform	Has interference occurred?	Mitigation required?
Analogue TV	Not possible	N/A
DTT - Freeview	Some minor signal strength reductions nearer the Site	No because all required mitigation has been implemented
Digital Satellite TV - Freesat & Sky	No	No

Table 1 - Summary of Television Interference

5 - Mitigation Measures

With respect to the requirement of mitigation, planning condition 21 states;

During the construction of the development and within one month following the substantial completion of the development hereby approved, the City Council may request in writing a TV, Radio Impact and WIFI Assessment study of the existing television signal within the potential impact area (as previously identified in the GTech Surveys Limited - Baseline Television Signal Survey & Television Reception Impact Assessment stamped as received on 28th May 2019) to be undertaken and compared with the Assessment study undertaken in 2019. The study shall identify such measures necessary to maintain at least the pre-existing level and quality of signal reception (as identified in the submitted Baseline Television Signal Survey & Television Reception Impact Assessment) and a timetable for the implementation, if required, of any remediation measures. The study shall be submitted to the City Council as local planning authority for approval and any remediation measures shall be implemented in accordance with the approved study.

Whilst it is now considered that all interference issues have been dealt with and no new reports of interference have been received for some time, should any resident with an antenna which requires upgrading, the following mitigation measures are appropriate.

Mitigation Measures

Due to the different performance characteristics of each antenna system in use (some will include mast head amplifiers and better individual components and others will be more prone to the impacts and effects of externally generated interference), mitigation will have to be identified and supplied on a case-by-case basis.

For any affected Freeview viewers to the immediate southeast of the Site where signal reception has been degraded, the betterment of antennas is likely to restore services. Betterment of antenna systems could include any of the following;

- Replacement of components not fit for purpose (damaged, water ingress in cables / antennas, electrically faulty, old brown type coax etc.)
- Replacement or installation of a mast head amplifier and new antenna
- Replacement of old coax cable to better signal throughput and to reduce unwanted pickup
- Installation of a higher gain antenna

- Good earthing on antenna systems and associated components to help reduce unwanted electrical system noise and unwanted electrical pickup
- Installation of a higher antenna (above ground level) in a location as far away from the Site as possible i.e. on another chimney stack etc.

These are common and simple mitigation solutions for similar situations where local television reception conditions have been affected by adjacent construction work. A registered installer should be able to advise on the most effective mitigation measures once the existing installed antenna system has been inspected and construction-generated interference has been identified.

It is recommended that all antenna work (relocating, betterment etc.) is undertaken by a registered installer (Confederation of Aerial Industries (CAI) Accredited) and that all system components used must be CAI Certified. More information regarding the CAI & Registered Installers can be found on the CAI's website - <http://www.cai.org.uk/index.php>

The CAI's Certification scheme ensures that the cables and antennas have passed minimum requirements for the use of DTT and digital satellite television reception. The use of non-certified products in an antenna system would degrade overall performance and effectiveness of the system, increasing the risk from interference. More information on CAI Certified Products can be found on the CAI's website -

<https://www.cai.org.uk/index.php/services/product-certification-scheme>

6 - Conclusions

A final signal survey (post-construction) has been performed to assess the possible effects and impacts on the reception of television broadcast services from the Paterson development, as required in planning condition 21.

21) During the construction of the development and within one month following the substantial completion of the development hereby approved, the City Council may request in writing a TV, Radio Impact and WIFI Assessment study of the existing television signal within the potential impact area (as previously identified in the GTech Surveys Limited - Baseline Television Signal Survey & Television Reception Impact Assessment stamped as received on 28th May 2019) to be undertaken and compared with the Assessment study undertaken in 2019. The study shall identify such measures necessary to maintain at least the pre-existing level and quality of signal reception (as identified in the submitted Baseline Television Signal Survey & Television Reception Impact Assessment) and a timetable for the implementation, if required, of any remediation measures. The study shall be submitted to the City Council as local planning authority for approval and any remediation measures shall be implemented in accordance with the approved study.

Reason - To ensure that the development at least maintains the existing level and quality of television signal reception, as advised in Planning Policy Guidance Note 8: Telecommunications.

The 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, locations were visited which were located in and near to the theoretical signal shadow zone.

Digital Terrestrial Television (DTT) - Freeview

As predicted during the pre-construction reception impact assessment, reception conditions were degraded in some areas to the immediate southeast of the Site, however, the survey has indicated that signal levels are still above minimum recommended thresholds.

Reports of interference were dealt with during the construction phase and a number of antenna systems were upgraded / updated. Since that mitigation work, no additional interference complaints have been received.

Digital Satellite Television

The development is unlikely to have had any adverse effect upon the reception of digital satellite television services such as Freesat and Sky. No interference has been identified.

From the findings of the post-construction signal survey and this comparative assessment, it has been concluded that the development has had a minor adverse effect upon the reception of television broadcast services for local residents with poorer quality antenna installations. However, suitable mitigation has been supplied and no further interference is expected. Since the mid-phase construction report, no additional reports of interference have been received. This report can be used to discharge the associated planning condition.

APPENDIX

Television Transmitter Frequency Tables

Signal Survey Measurements

An Overview of Signal Measurements

Calculation of Received Field Strength

Survey Equipment

Mapping Data

Television Transmitter Frequency Tables

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
COM7 - HD	Arqiva	55	746.000	22.9

Table A - 2021 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 - 2023 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 Survey Measurements

Measurement Point Number	Channel Frequency Service	32	34	35	29	31	37	55
		562.00	578.00	586.00	538.00	554.00	602.00	746.00
		BBC A	D3&4	BBC B	SDN	Arqiva A	Arqiva B	COM7
1	FS	90.4	83.0	86.1	92.4	87.9	88.5	80.7
	CSI	23.0	21.0	-	19.9	21.7	20.7	-
	MER	29.4	30.1	-	30.2	30.1	31.9	-
2	FS	69.9	66.8	74.9	67.8	73.4	67.4	62.0
	CSI	21.3	22.8	-	26.3	27.8	24.1	-
	MER	28.3	26.3	-	27.0	27.5	29.4	-
3	FS	87.8	84.2	88.2	87.5	86.7	90.6	82.1
	CSI	27.0	25.4	-	19.4	21.0	24.3	-
	MER	29.4	31.4	-	30.3	31.0	29.9	-
4	FS	87.3	84.7	89.4	89.9	95.5	88.9	86.8
	CSI	20.3	24.1	-	22.1	19.4	19.9	-
	MER	31.7	29.4	-	30.8	29.0	30.8	-
5	FS	89.7	86.2	93.2	87.7	92.3	84.4	78.5
	CSI	19.6	19.3	-	20.1	20.7	26.0	-
	MER	32.4	31.5	-	30.5	30.3	30.9	-
6	FS	85.8	90.0	89.7	87.9	84.9	90.0	82.6
	CSI	22.2	18.3	-	21.5	17.0	19.1	-
	MER	31.2	29.5	-	29.9	30.5	30.7	-
7	FS	67.8	74.9	68.2	71.9	69.6	70.5	61.0
	CSI	24.2	23.6	-	19.0	21.2	22.1	-
	MER	27.6	26.1	-	28.2	26.0	29.0	-
8	FS	71.4	71.0	71.6	72.2	73.5	69.9	65.0
	CSI	22.8	18.2	-	25.7	27.6	19.6	-
	MER	28.7	27.5	-	28.0	26.4	27.4	-
9	FS	70.4	72.5	72.3	74.7	70.5	73.7	65.9
	CSI	22.7	28.1	-	22.9	22.0	25.0	-
	MER	28.8	28.1	-	27.0	29.6	28.9	-
10	FS	84.9	83.7	87.7	89.2	92.9	81.9	88.4
	CSI	26.0	25.3	-	19.5	20.8	27.8	-
	MER	31.6	31.5	-	29.4	30.6	28.2	-
11	FS	89.0	84.8	90.8	85.4	88.4	93.6	84.0
	CSI	20.1	27.3	-	22.2	19.2	29.2	-
	MER	31.0	29.9	-	28.5	31.4	27.6	-
12	FS	89.0	86.1	87.5	91.6	86.0	90.1	80.1
	CSI	18.7	19.5	-	20.5	24.5	23.1	-
	MER	32.4	31.0	-	30.5	31.5	30.9	-

Table C - 2021 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	87.1 23.7 29.6	79.4 21.9 30.9	83.4 - -	88.8 20.0 30.4	84.8 22.5 30.9	84.9 20.9 32.2
2	FS CSI MER	70.7 22.2 29.2	68.1 23.1 26.5	76.2 - -	67.8 27.2 27.1	73.5 27.8 27.6	67.6 24.7 29.6
3	FS CSI MER	87.1 27.6 29.7	82.6 26.0 32.0	87.7 - -	86.4 20.3 30.6	85.3 21.1 31.7	89.7 24.6 30.5
4	FS CSI MER	88.4 20.3 32.3	86.5 24.8 29.7	89.5 - -	90.3 22.7 31.2	89.0 19.9 30.0	89.0 20.6 31.7
5	FS CSI MER	87.6 19.8 31.0	78.0 19.4 31.9	93.2 - -	86.6 20.2 31.5	91.5 20.8 31.2	84.3 26.4 31.8
6	FS CSI MER	86.2 22.4 32.0	81.0 19.2 30.1	91.7 - -	88.9 21.6 30.1	82.0 17.2 30.8	91.9 19.3 31.5
7	FS CSI MER	64.8 24.8 27.9	74.7 23.9 26.7	67.7 - -	70.0 19.0 29.2	69.5 21.3 26.3	69.8 22.4 29.2
8	FS CSI MER	73.0 23.7 29.4	71.5 18.6 28.3	72.9 - -	73.4 26.5 29.0	75.3 28.2 27.2	70.2 19.9 27.4
9	FS CSI MER	68.8 23.3 29.2	71.9 28.9 28.8	71.3 - -	74.1 23.1 27.6	70.3 22.3 30.4	72.9 25.8 29.2
10	FS CSI MER	85.9 27.0 32.1	84.2 25.5 31.9	79.0 - -	86.0 19.8 29.8	83.0 21.2 31.0	82.0 28.1 29.1
11	FS CSI MER	87.0 20.3 31.9	84.1 27.3 30.0	78.9 - -	84.1 23.2 29.1	86.6 20.1 32.2	93.0 29.3 27.8
12	FS CSI MER	89.9 19.2 31.0	87.7 20.2 31.3	89.4 - -	92.6 21.4 31.2	86.1 24.6 32.2	76.0 23.8 31.7

Table D - 2023 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

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.

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



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

References

The building information found in Chapter 2 was sourced from the following Ofcom document –

http://licensing.ofcom.org.uk/binaries/spectrum/fixed-terrestrial-links/wind-farms/tall_structures.pdf

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.

Digital terrestrial television (Freeview) coverage may vary as a result of engineering works or any frequency changes authorised by Ofcom. We advise that consumers always check future reception predictions (<http://www.digitaluk.co.uk/coveragechecker/>) before buying TV equipment. GTech Surveys Limited, Ofcom and Digital UK are not responsible for household TV reception arrangements.

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