

TECHNICAL CODE

DIGITAL TERRESTRIAL TELEVISION (DTT) - ACTIVE INDOOR ANTENNA (FIRST REVISION)

Developed by



Registered by



Registered date: 5 July 2022

© Copyright 2022

MCMC MTSFB TC T014:2022

Development of technical codes

The Communications and Multimedia Act 1998 ('the Act') provides for Technical Standards Forum designated under section 184 of the Act or the Malaysian Communications and Multimedia Commission ('the Commission') to prepare a technical code. The technical code prepared pursuant to section 185 of the Act shall consist of at least, the requirement for network interoperability and the promotion of safety of network facilities.

Section 96 of the Act also provides for the Commission to determine a technical code in accordance with section 55 of the Act if the technical code is not developed under an applicable provision of the Act and it is unlikely to be developed by the Technical Standards Forum within a reasonable time.

In exercise of the power conferred by section 184 of the Act, the Commission has designated the Malaysian Technical Standards Forum Bhd (MTSFB) as a Technical Standards Forum which is obligated, among others, to prepare the technical code under section 185 of the Act.

A technical code prepared in accordance with section 185 shall not be effective until it is registered by the Commission pursuant to section 95 of the Act.

For further information on the technical code, please contact:

Malaysian Communications and Multimedia Commission (MCMC)

MCMC Tower 1
Jalan Impact
Cyber 6
63000 Cyberjaya
Selangor Darul Ehsan
MALAYSIA

Tel: +60 3 8688 8000
Fax: +60 3 8688 1000
<http://www.mcmc.gov.my>

OR

Malaysian Technical Standards Forum Bhd (MTSFB)

MCMC Centre of Excellence (CoE)
Off Persiaran Multimedia
Jalan Impact
63000 Cyberjaya
Selangor Darul Ehsan
MALAYSIA

Tel: +60 3 8320 0300
Fax: +60 3 8322 0115
<http://www.mtsfb.org.my>

Contents

	Page
Committee representation.....	ii
Foreword	iii
1. Scope	1
2. Normative references	1
3. Abbreviations.....	1
4. Terms and definitions	2
4.1 Active indoor antenna	2
5. Requirements	2
5.1 General requirements.....	2
5.2 Technical requirements	3
Annex A Normative references	8
Annex B Testing procedures	9

MCMC MTSFB TC T014:2022

Committee representation

This technical code was developed by the Multimedia Broadcast Receiver Sub Working Group under the Broadcast Technology Working Group of the Malaysian Technical Standards Forum Bhd (MTSFB) which consists of representatives from the following organisations:

Fraunhofer IIS

LG Electronics (M) Sdn Bhd

Maxis Broadband Sdn Bhd

Measat Broadcast Network System Sdn Bhd

Media Prima Berhad

Multimedia University (MMU)

MYTV Broadcasting Sdn Bhd

Samsung Malaysia Electronics (SME) Sdn Bhd

Sharp Electronics (M) Sdn Bhd

SIRIM Berhad

SmarDTV Global S.A.S

Sony EMCS Malaysia Sdn Bhd

Telekom Malaysia Berhad

Wideminds Pte Ltd

Foreword

This technical code for Digital Terrestrial Television (DTT) - Active Indoor Antenna ('this Technical Code') was developed pursuant to Section 95 and Section 185 of the Act 588 by the Malaysian Technical Standards Forum Bhd ('MTSFB') via its Broadcast Technology Working Group.

This Technical Code was developed for the purpose of certifying communications equipment under the Communications and Multimedia (Technical Standards) Regulations 2000.

Major modifications in this revision are as follows:

- a) Removal of technical requirements which are passive antenna gain, suppression of unwanted signals and power consumption.
- b) Update of the frequency range for DTT active indoor antenna between 470 MHz to 694 MHz (Clause 5.2.1).
- c) Update of the antenna gain parameter between 6dBi to 20dBi (Clause 5.2.2).
- d) Update of clause title from directivity parameter to antenna pattern directivity and categorised it as an optional technical requirement (clause 5.2.6).
- e) Update of temperature range between 15°C to 35°C (Clause 5.2.7).
- f) Inclusion of normative references of ETSI EN 303 354 and IEC 61000-4-2 in Annex A.
- g) Removal of testing procedures for passive antenna gain and directivity in Annex B.

This Technical Code replaces the MCMC MTSFB TC T014:2017, Digital Terrestrial Television (DTT) - Active Indoor Antenna.

This Technical Code shall continue to be valid and effective from the date of its registration until it is replaced or revoked.

(THIS PAGE IS INTENTIONALLY LEFT BLANK)

**DIGITAL TERRESTRIAL TELEVISION (DTT) -
ACTIVE INDOOR ANTENNA**

1. Scope

This Technical Code specifies the minimum requirements for Digital Terrestrial Television (DTT) active indoor antennas for the reception of DTT broadcast services in the Ultra High Frequency (UHF) range of 470 MHz - 694 MHz.

2. Normative references

The following normative references are indispensable for the application of this Technical Code. For dated references, only the edition cited applies. For undated references, the latest edition of the normative references (including any amendments) applies.

See Annex A.

3. Abbreviations

For the purposes of this Technical Code, the following abbreviations apply.

AC	Alternating Current
DC	Direct Current
DTT	Digital Terrestrial Television
ESD	Electrostatic Discharge
EUT	Equipment Under Test
IDTV	Integrated Digital Television
IM	Intermodulation
LOS	Line of Sight
NF	Noise Figure
OIP ₃	Output 3rd Order Intercept Point
PVC	Polyvinyl Chloride
RF	Radio Frequency
S/N	Signal-To-Noise
STB	Set Top Box
UHF	Ultra High Frequency
USB	Universal Serial Bus
VSWR	Vertical Standing Wave Ratio

MCMC MTSFB TC T014:2022

4. Terms and definitions

For the purposes of this Technical Code, the following terms and definitions are applied.

4.1 Active indoor antenna

An antenna that contains active electronic components such as transistors, as opposed to most antennas which only consist of passive components such as metal rods, capacitors and inductors. Active antenna designs allow antenna of limited size to have a wider frequency range (bandwidth) than passive antenna, and are primarily used in situations where a larger passive antenna is either impractical (inside a portable radio) or impossible (suburban residential area that disallows use of large outdoor low frequency antenna).

5. Requirements

5.1 General requirements

DTT active indoor antenna shall be designed not to cause interference with other authorised radiocommunication services, and be able to tolerate any interference caused by other radiocommunication services, electrical or electronic equipment.

5.1.1 Power supply

The equipment may be Alternating Current (AC) or Direct Current (DC) powered. For AC powered equipment, the operating voltage shall be 240 V +5 %, -10 % and frequency 50 Hz ± 1 % as according to MS 406 or 230 V ± 10 % and frequency 50 Hz ± 1 % as according to MS IEC 60038 whichever is current.

Where external power supply is used, e.g. AC adaptor, it shall not affect the capability of the equipment to meet this specification. Adaptor must be pre-approved by the relevant regulatory body before it can be used with the equipment. Adapter shall be subjected to test under tropical condition as specified in the related standard.

Typically, an active indoor antenna requires voltage and current of 5 V/50 mA (maximum). Alternatively, the power supply may be integrated in the Set Top Box (STB) or Integrated Digital Television (IDTV) with Universal Serial Bus (USB) power.

5.1.2 Power supply cord and mains plug

If the equipment is fitted with power supply cord and mains plug, the power supply cord and mains plug shall be pre-approved by the relevant regulatory body with the following requirements before being used with the equipment:

- a) The power supply cord shall be certified according to:
 - i) MS 2112-5 or BS EN 50525-2-11 or IEC 60227-5 (for Polyvinyl Chloride (PVC) insulated – flexible cables or cords); or
 - ii) MS 2127-4 or IEC 60245-1 (for rubber insulated - flexible cables or cords).
- b) The mains plug shall be certified according to:
 - i) MS 589-1 or BS 1363 (for 13 A, fused plug); or

- ii) MS 1577 (for 15 A, fused plugs); or
- iii) MS 1578 or BS EN 50075 (for 2.5 A, 250 V, flat non-rewireable two-pole plugs with cord for the connection of class II equipment).

5.1.3 Radio Frequency (RF) input connector

The Radio Frequency (RF) input connector shall be complied to IEC 61169-2.

5.1.4 Marking

The antenna shall be marked with the following information:

- a) supplier or manufacturer’s name or identification mark;
- b) supplier or manufacturer’s model or type reference; and
- c) other markings as required by the relevant standards.

The markings shall be legible, indelible and readily visible. All information on the marking shall be either in Bahasa Melayu or English Language.

5.2 Technical requirements

The antenna shall comply with the technical requirements as summarised in Table 1.

Table 1. Summary of technical requirements for indoor DTT antenna

No.	Parameter	Limit
1.	Operating frequency range	470 MHz – 694 MHz (UHF)
2.	Antenna gain	6 dBi – 20 dBi
3.	Noise Figure (NF)	≤ 1.5 dB
4.	Output 3 rd order intercept point (OIP ₃)	≥ 30 dBm
5.	Return loss	≤ - 10 dB
6.	Antenna pattern directivity	The indoor antenna should have a near to omni-directivity pattern as shown in Figure 4.
7.	Temperature range	15 °C to 35 °C
8.	Electrostatic Discharge (ESD)	The ESD of indoor antenna shall withstand contact discharges of 2 kV and 4 kV and air discharges of 2 kV, 4 kV and 8 kV with both polarities plus (+) and minus (-).

The antenna shall be tested according to the test methods specified in Annex B.

5.2.1 Operating frequency range

MCMC MTSFB TC T014:2022

The active indoor antenna for DTT broadcast service receivers shall operate in the frequency range of 470 MHz - 694 MHz (UHF).

5.2.2 Antenna gain

The active antenna gain is defined as the sum of the passive antenna gain and the amplifier gain. The amplifier in an active antenna is primarily designed to overcome the coaxial loss by cable and should provide a sufficient gain margin of the total system gain. Deploying an active antenna allows placing an antenna remotely (with relatively long cable) as the antenna is powered conveniently over the same cable.

The total antenna gain shall be 6 dBi to 20 dBi antenna gain over the complete frequency band (470 MHz – 694 MHz) as stipulated in ETSI EN 303 354.

5.2.3 Noise Figure (NF)

The low NF is an important performance characteristic of the antenna amplifier which in general, it is better than the front end of the STB to ensure the ability to receive weak stations is greatly improved.

NF is a measure of degradation of the Signal-To-Noise (S/N) caused by noise contributed by components in the RF signal chain. Less noise contribution will produce a better S/N ratio at the output of RF signal chain.

The total noise figure (F) in a system is defined as:

$$F = F_1 + \frac{F_2 - 1}{G_1} + \frac{F_3 - 1}{G_1 G_2} + \frac{F_4 - 1}{G_1 G_2 G_3} + \dots + \frac{F_n - 1}{G_1 G_2 G_3 \dots G_{n-1}}$$

where,

F_n is the noise figure of the n-th device.

This is the case when several devices are cascaded.

The illustration of an antenna with integrated amplifier connected to a STB is shown in Figure 1.

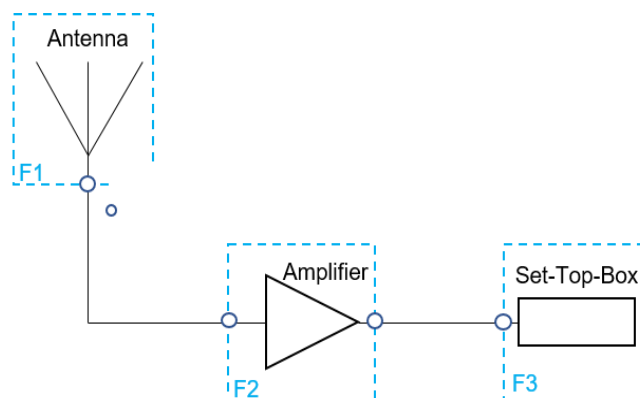


Figure 1. System setup of the installation diagram

The indoor antenna shall have a typical noise figure of ≤ 1.5 dB.

5.2.4 Output 3rd order Intercept Point (OIP3)

OIP₃ specifications provide a useful figure for determining the degree of linearity exhibited by RF electronic devices or systems. The linearity of the system will be getting better when the OIP₃ produce higher value, thus the RF domain will have better performance in regarding of spectral purity.

The OIP_3 is the theoretical output level at which the third-order two-tone distortion products are equal in power to the desired (wanted) signals. The calculation is based on the following equation.

$$IM_3 = 3P_{out} - 2OIP_3$$

where,

IM_3 is third order intermodulation level (dBm);

P_{out} is single tone power at output (dBm); and

OIP_3 is output third-order intercept point (dBm).

The Intermodulation (IM) products created in active components like amplifiers shall be kept as low as possible.

In order to achieve low IM products (- 60 dBc), amplifiers with high OIP_3 are needed. Figures 2 and 3 show the result of two carriers when it applied to the amplifier. In Figure 2, each 1 dB increment at the input will increase the output carrier by 1 dB as well but the IM product will be increased by 3 dB. Figure 3 shows its measurement on a spectrum analyser. The distance between the wanted carriers and the IM products is called IMA should be as high as possible.

The UHF spectrum is more occupied by high RF level mobile telecom signals, thus more demands on linearity (OIP_3) of the antenna amplifier.

The amplifier shall be capable of handling signals with 0 dBm output level, and assuming that IM products are at - 60 dBc.

$$OIP_3 = (3P_{out} - IM_3)/2$$

$$OIP_3 = (3 \times 0 - (- 60))/2$$

$$OIP_3 = 30 \text{ dBm}$$

The indoor antenna shall have a OIP_3 level of ≥ 30 dBm.

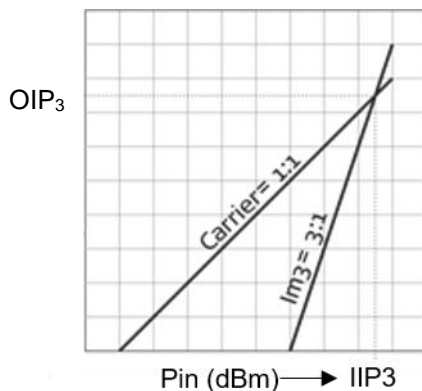


Figure 2. OIP_3 table

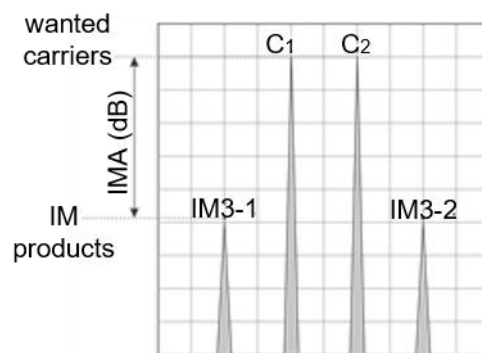


Figure 3. OIP_3 analysing

MCMC MTSFB TC T014:2022

5.2.5 Return loss

Antenna impedance and the quality of the impedance match are most commonly characterised as return loss. These impedance parameters are to measure value of the RF power supplied to the STB receiver reflects back to the antenna terminals.

For efficient transfer of DTT RF signals between an antenna and STB receiver the return loss should be ≤ -10 dB for 75Ω system impedance.

The indoor antenna shall have a return loss of ≤ -10 dB.

5.2.6 Antenna pattern directivity

An antenna is a physical device that radiates or receives energy, almost always with some directional dependence. Theoretically, for efficient transfer of energy between 2 antennas, their respective radiation patterns shall be optimised in the correct direction and the antenna shall be polarised with the same orientation. However, where Line of Sight (LOS) between 2 antennas rarely exist, and at frequencies above about 500 MHz, objects in the path between the antennas (walls, structures, people, terrain, etc.) may substantially alter both the effective radiation patterns and the polarisation.

Even if a device is located in a fixed position, polarisation will typically change with time due to movement of nearby objects. As a result, while some general attention shall be paid to radiation pattern shape and antenna polarisation, these parameters can be optimised for a particular situation in only a general way. Since indoor reception is commonly multipath reception (Rayleigh), an omni-directional or slight directivity is recommended. As for information, the DTT transmitter antenna in Malaysia is using horizontal mode.

The antenna directivity shall be measured as a minimum at the lowest, middle and highest frequency of the declared frequency band(s).

The indoor antenna should have a near to omni-directionality pattern as shown in Figure 4.

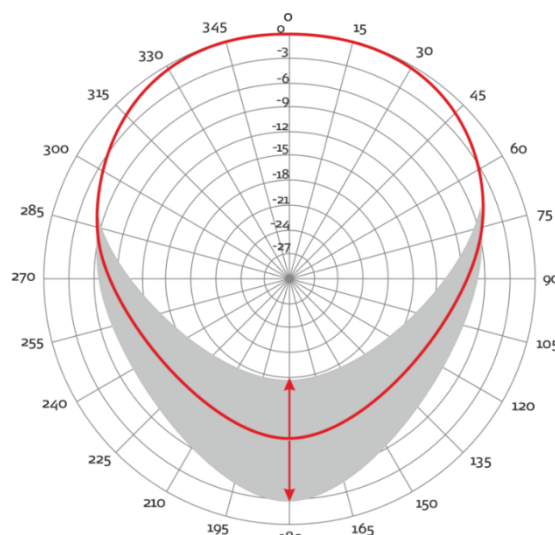


Figure 4. Directivity antenna pattern

5.2.7 Temperature range

Operating temperature range for the antenna shall be within 15 °C to 35 °C as stipulated ETSI EN 303 354.

An operating temperature is the temperature at which an electrical or mechanical device operates. The device will operate effectively within a specified temperature range which varies based on the device function and application context, and ranges from the minimum to the maximum operating temperature.

5.2.8 Electrostatic Discharge (ESD)

The discharge of ESD can affect the correct functioning of equipment. The charge is created by the friction of two materials, one of which is non-conductive. ESD interference derives its strength from the very short rise time (up to less than 1 ns), and the short duration (typically less than 100 ns) of a pulse in combination with a large current or voltage.

The device shall be protected with special components which leads the charge to ground to avoid component damaged by ESD. Mostly the components are assembled to the input and output of the device.

The device shall withstand contact discharges of 2 kV and 4 kV and air discharges of 2 kV, 4 kV and 8 kV with both polarities plus (+) and minus (-).

The ESD of the antenna shall withstand contact discharges of 2 kV and 4 kV and air discharges of 2 kV, 4 kV and 8 kV with both polarities plus (+) and minus (-) as stipulated in IEC 61000-4-2.

Annex A
(normative)

Normative references

MS 589-1, *13 A plugs, socket-outlets, adaptors and connection units - Part 1: Specification for rewirable and non-rewirable 13A fused plugs*

MS 1577, *Specification for 15 A plugs and socket-outlets for domestic and similar purpose*

MS 1578, *Specification for flat non-rewirable two-pole plugs, 2.5 A, 250 V, with cord, for the connection of class II-Equipment for household and similar purposes*

MS 2112-5, *Electric cable and wire - Polyvinyl Chloride (PVC) insulated cables of rated voltages up to and including 450/750 V - Part 5: Flexible cables*

MS 2127-4, *Rubber insulated cables of rated voltages up to and including 450/750 V - Part 4: Cords and flexible cables*

MS IEC 60038, *IEC standard voltages*

IEC 60227-5, *Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V - Part 5: Flexible cables (cords)*

IEC 60245-1, *Rubber insulated cables - Rated voltages up to and including 450/750 V - Part 1: General requirements*

IEC 61000-4-2, *Electromagnetic compatibility (EMC) Part 4.2: Testing and measurement techniques- Electrostatic discharge immunity test*

IEC 61169-2, *Radio-frequency connectors - Part 2: Sectional specification - Radio frequency coaxial connectors of type 9,52*

ETSI EN 303 354, *Amplifiers and active antennas for TV broadcast reception in domestic premises; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU*

BS 1363: Part 1, *13 A plugs, socket-outlets, adaptors and connection units - Part 1: Specification for rewirable and non-rewirable 13 A fused plugs*

BS EN 50075, *Specification for flat non-wirable two-pole plugs 2.5 A 250 V, with cord, for the connection of Class II-equipment for household and similar purposes*

BS EN 50525-2-11, *Electric cables. Low voltage energy cables of rated voltages up to and including 450/750V (U0/U) Cables for general applications. Flexible cables with thermoplastic PVC insulation*

Annex B (normative)

Testing procedures

B1. Antenna gain

To determine the total antenna gain, the EUT is connected to the input of the network analyser through impedance matching (see Figure B1). The gain flatness can be determined after gain measurement is completed.

In order to measure the field strength of the calibrated reference antenna, the following steps shall be followed:

- a) Arranged all devices as illustrated in Figure B1.
- b) Both antenna shall be connected to the network analyser which generates a sweep in the frequency range the EUT is specified.
- c) The transmit antenna will transmit the signal to the reference antenna with a fixed distance e.g 3 meters
- d) Values of the received signal which measured by the reference antenna shall be recorded.
- e) Replace the reference antenna with the EUT and connect to network analyser through impedance matching
- f) Repeat steps specified in (b) until (d)

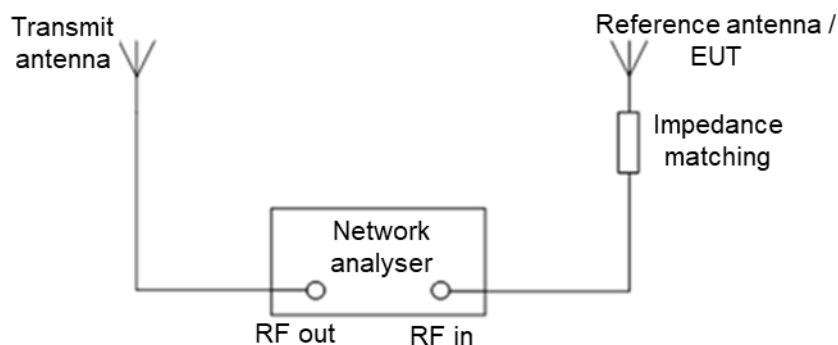


Figure B.1. Antenna gain measurement

MCMC MTSFB TC T014:2022

B.2. Noise figure (amplifier)

To determine the noise figure of the amplifier a measurement setup which consist of spectrum analyser and noise source as illustrated in Figure B.3 shall be arranged.

In order to measure the noise figure, the following steps shall be followed:

- a) Calibrate the measurement setup.
- b) Connect a noise source with a calibrated noise figure to the spectrum analyser.
- c) The frequency shall be set in the operating frequency range of the antenna.
- d) Measure the noise level.
- e) The noise source shall be connected to the input of the amplifier.
- f) A sweep shall be made in the same frequency range as in step (c).

Note: The added noise in the circuit is the noise level of the amplifier EUT.

- g) All measurements shall be recorded.

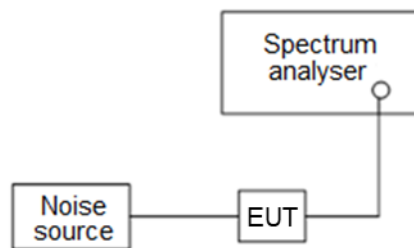


Figure B.2. Noise measurement

B.3. Output 3rd Order Intercept Point (OIP3)

To determine the OIP₃ of the amplifier, a measurement setup which consist of 2 units of signal generator, 2 units of 10 dB attenuator, a 20 dB attenuator, combiner and spectrum analyser as illustrated in Figure B.4 shall be arranged.

In order to measure the noise figure, the following steps shall be followed:

- a) Connect the outputs of two RF signal generators with a combiner after passing through a 10 dB attenuator. The attenuator is necessary to avoid coupling between the RF signal generators.
- b) The combiner's output shall be connected to the amplifier's EUT input.
- c) The EUT shall be connected to the spectrum analyser through a 20 dB attenuator to protect the spectrum analyser against overloading.
- d) Set the RF signal generators to 1 MHz spacing (i.e. if signal generator 1 is at 500 MHz, then signal generator 2 shall be set at 501 MHz).
- e) The amplified carriers with the IM products will be displayed on the analyser's screen.
- f) The software in the equipment will provide the value of OIP₃ on the screen.

To get an overview of the OIP₃ for the whole frequency band, it shall be measured in steps of 50 MHz.

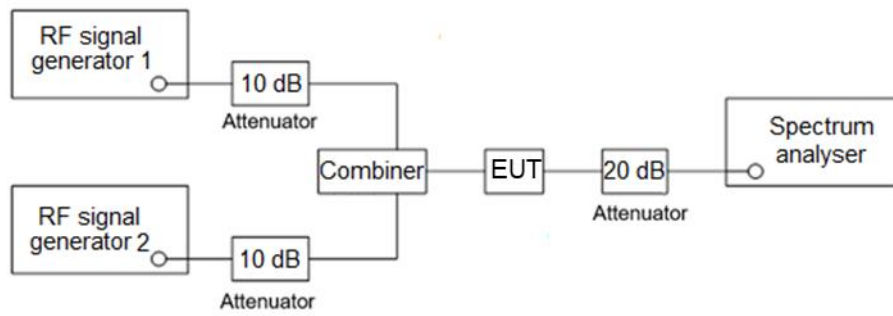


Figure B.3. OIP₃ measurement

B.4. Return loss

In order to measure the return loss, the following steps shall be followed:

- a) Connect the antenna to a network analyser with built-in voltage or Vertical Standing Wave Ratio (VSWR) bridge.
- b) The measuring port shall be first calibrated.
- c) It shall be set to "Open", "Short" and a "Load".
- d) The impedance of the load shall be matched with the impedance of the antenna.
- e) Measure the return loss of the antenna after calibrating the setup.

Acknowledgements

Members of the Multimedia Broadcast Receiver Sub Working Group

Ts Mazlan Mahdi (Chairman)	MYTV Broadcasting Sdn Bhd
Ms Syaida Syarafina Sohaimi (Vice Chairman)	SIRIM Berhad
Ms Hafizah Zainal Abiddin (Draft lead)	SIRIM Berhad
Ts Mohammad Hafiz Halal /	Malaysian Technical Standards Forum Bhd
Mr Muhaimin Mat Salleh (Secretariat)	
Mr Sharad Sadhu	Fraunhofer IIS
Mr Mohd Suhairi Mohd Noor	LG Electronics (M) Sdn Bhd
Dr Mun Wai Yuen	Maxis Broadband Sdn Bhd
Mr Adrian Van Win Sen /	Measat Broadcast Network System Sdn Bhd
Mr Mohamad Isa Mohd Razhali /	
Mr Sheikh Azhar Sheikh Razak	
Dr Ahmad Zaki Mohd Salleh /	Media Prima Berhad
Mr Asri Abd Rahman /	
Ms Imaliana Muzni /	
Mr Mohd Sharil Duki	
Ir Dr Lim Heng Siong	Multimedia University (MMU)
Mr Mohd Khairul Abdul Kadir /	MYTV Broadcasting Sdn Bhd
Mr Shamsul Najib Mohtar	
Mr Navin Kumar /	Samsung Malaysia Electronics (SME) Sdn Bhd
Mr Zainuddin Mohd Zainon	
Mr Chin Ket Ming	Sharp Electronics (M) Sdn Bhd
Mr Al Hafiz Abu Bakar /	SIRIM Berhad
Ms Norhanisah Mohd Basri /	
Ms Nurhafenah Abdul Jalil /	
Mr Zul Jaafar	
Mr Bertrand Pennachio /	SmarDTV Global S.A.S
Mr Erik Gazzoni	
Mr Muhd Kamarul Hafiz Mohd Tang /	Sony EMCS Malaysia Sdn Bhd
Mr Stephen Anthony Cleary	
Mr Najib Fadil Mohd Bisri @ Bisri	Telekom Malaysia Berhad
Mr Low Wei Yap	Wideminds Pte Ltd

By invitation:

Ts Amirah Jaafar Mad Ariff /

Jabatan Penyiaran Malaysia

Mr Karim Sadiran /

Ts Khairuddin Hj Osman /

Ms Norhanim Yahya /

Mr Wan Ariffin Wan Hussin

Mr Mohd Fakhruzzaman Mohd Noor /

Smart Digital International Sdn Bhd

Mr Sallehuddin Wagimen

Mr Mohamad Hafizal Mohamed Ariffin

Al Hijrah Media Corporation