# Detection & Management of Digital Echo Propagation

**Author Ian Nagle Australia**

***Digital Echo Propagations*** **(transmissions) are causing significant frustrations for households in Australia, and European countries.** ***Radio Frequency Interference*** **(RFI) and** ***Impulsive Noise*** **are well-known causes of pixelation to a complete loss of signal, but digital echoes are rated as being the most undetected terrestrial TV interference.**

**Sadly very few antenna installers utilize professional field strength analyzers, whilst many more installers are unaware of the necessary (yet simple) skills for the detection and management of Terrestrial Digital Echoes.**

**The only proven technique to detect and manage terrestrial digital echoes is to utilize Roverinstrument's HD series Broadcast or Installation Analyzers that measure all Echoes in Real Time, and become skilled with my tutorial.**

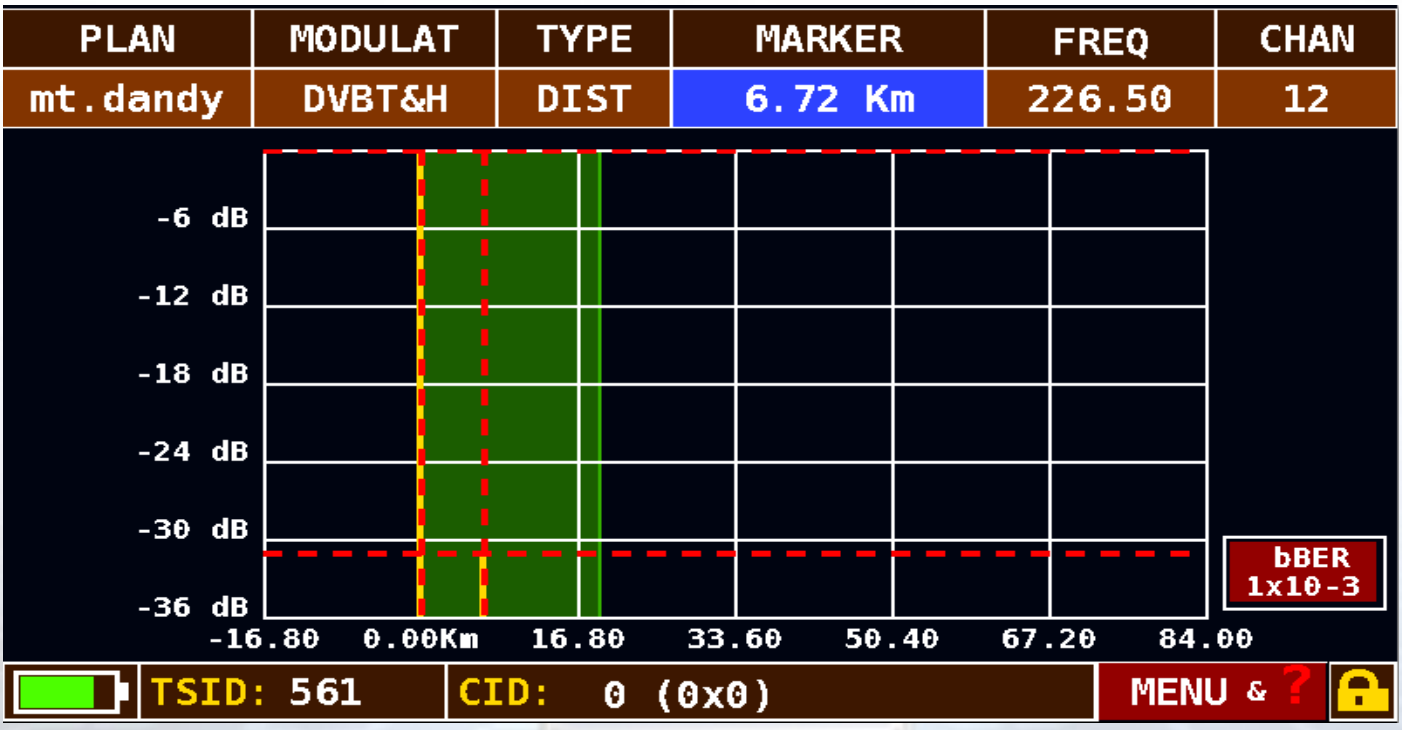
**Terrestrial Digital** ***Echoes*** **do not display visible ghosting (multiple images) on a digital receiver; however Echoes severely impact upon digital reception. Echoes can cause** ***pixelation*** **(fragmentation) of sound and picture, plus a permanent** ***loss of signal*** **- effecting one or more VHF or UHF channels.**

**My experience with detecting terrestrial echoes began in 2009, has involved two brands of professional analyzers, extensive self-learning experiences, supportive advice from senior R&D Engineers who manufacture analyzers in Europe, a senior Engineer - Broadcast Systems & Technical Services in Melbourne, plus extensive WEB research.**

## *The following Rover HD Analyzer screen capture displays the basics of Echo detection*

The **main signal** (yellow line) is always located above **0.00Km**

The **guard interval** (**G.I.**) is indicated by the ***green area***




**The** ***strength*** **of an echo is indicated by moving the marker to the post echo peak – in this case it is minus (-) 31dB.**

**At the same time the marker will automatically calculate the** ***distance*** **travelled by the post echo (reflection) to the receiving antenna location - in the above case 6.72 kilometres.**

✍ **My established procedure for the identification, detection and management of Digital Echoes may be downloaded in** ***pdf*** **format, saved, and utilized in any country that has terrestrial digital TV transmissions.**

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In September 2014 Roverinstruments presented a technical article on **Propagation Effects** upon DTT.

This month's technical article presents a proven technique for the **Detection and Management** of **Digital Echoes**. The author is an Australian antenna installer with 35 years experience who now specializes in digital TV interference.

Ian's tutorial is set in a sequential manner to update you with the latest facts, appraisal, and reduction of all **Echoes**. The tutorial is a result of Ian's echo detection field experiences in Victoria, Australia over the past 4 years.

Once you have mastered the technique of identifying the existence of digital echoes you will gain considerable skill confidence, increase your customer's satisfaction rating, and enhance your business reputation.

**Introduction:**

**Digital Echoes** are not evident on a client's television set, cannot be identified with a **Spectrum** or **MER-vs-Carrier scan,** but are simply detected with the aid of a professional analyzer equipped with the **Echo Detection** feature.

**Digital Echoes** cause significant frustrations for viewers, when the picture and sound begins to breakup **(pixelation)** frequently involving one or more channels. Echoes are renowned for causing a complete **loss of a signal or signals;** resulting in frantic, and at times irate complaints to antenna installers and television broadcast stations.

**Echo Types:**

There are chiefly two types of **Echoes** - **Pre and Post**. Depending upon geographical conditions **Pre and Post** echoes are able to cause varying degrees of **interference** that is linked to transmissions by Multi Frequency Networks (**MFN**) or Single Frequency Networks (**SFN**).

Weak Echoes (greater than **minus 24dB**) can exist **within** the **Guard Interval** (G.I.), tend to cause brief episodes of pixelation, and if greater than **minus 30dB** - are corrected by the **Forward Error Correction** (FEC) processes.

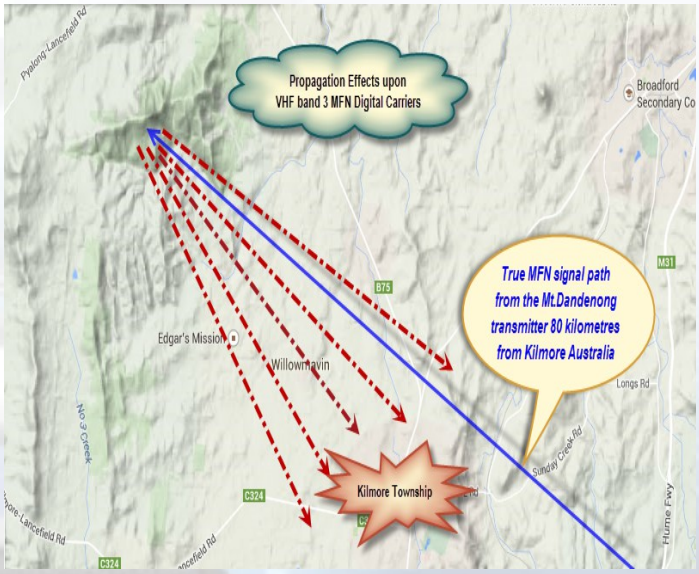
However dominant Echoes (less than **minus 18dB**) either **inside** or **outside** the G.I. will result in a loss of signal.

## Echo Development

*Echoes tend to exist in **moderate to poor** signal coverage areas, but can exist in locations where you would least expect them.*

*Echoes (**constant or of short duration** ) are in fact "**reflections**" of the true signal path bouncing off the sides of mountainous terrain, fixed structures, passing large aluminium transport structures like semi trailers, passenger trains, and in the most extraordinary circumstances e.g. reflecting off the large blades of wind-driven turbines for power generation.*

*The short duration echoes can be tricky to detect requiring constant monitoring of the Echo detection screen for several minutes. Strong winds moving tree-branches can cause fluctuation of echoes.*




**The adjacent image displays an example of multiple band 3 (VHF) MFN echoes reflecting from the slopes of a mountain range, travelling 23 kilometres, and causing constant pixelation or loss of signal for many households in Kilmore, Australia.**

Should you require additional specific information detailing recent types of RFI that exist (including screen captures of a range of MFN **Echo** displays) please feel free to visit Ian's web site www.kilmoredistricttvantennas.com.au then select page 3 (Technical Information).

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**Investigating the cause and type of Interference:**

As you arrive at your client's site be sure to observe the **height,** and the **type of terrain** that exists around the site. Also there may be other interference factors like arcing power lines, electric fences, and industrial premises nearby.

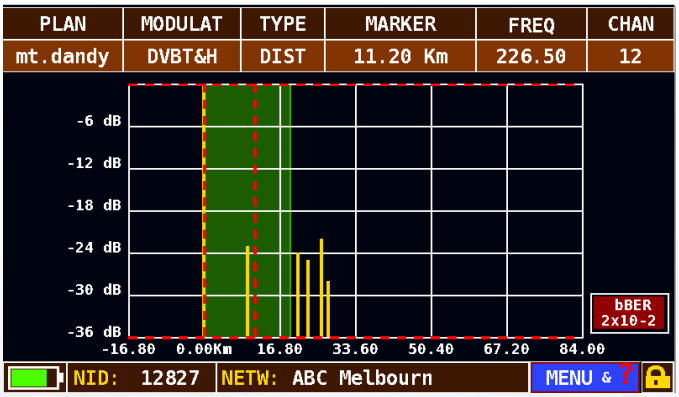
Depending upon the client's description of the interference including your previous knowledge of the area - you may have a pre-conceived idea of the ***type*** of interference to expect. Even so - always analyse your client's current issues at the most utilized TV outlet. Briefly observe all **Data Measurements, Spectrum display, Constellation diagram**, the **Echo Detection,** and **MER-vs-Carrier** screens. At this point you should have established the previous history, and the current reception issues; thus determining the course of corrective action to achieve digital viewing satisfaction.

**Given the interference is caused by echoes carefully re-examine and note the following data -:**

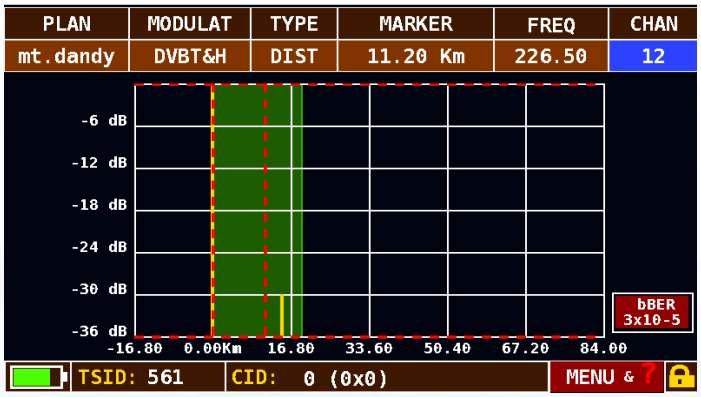
- **Modulation Error Ratio** (MER) is the most **critical measurement** for digital TV reception - **>26dB** or higher the better.
- **Noise Margin** (NMAR or Safety Margin) levels. The greater the safety margin **(>10dB)** – the better.
- **Carrier to Noise ratio**, (C/N or SNR). Again the higher C/N the better.
- **Constellation Display -** The locations of a **constellation** build up over a brief period of time to a near-perfect Red centre indicates a good signal. However the scattering of a **constellation** signifies a degrading state of the signal indicating the existence interference factors.
- **Echo Detection screen -** check for the display of **Pre or Post Echoes.** Be sure to observe the **Echo Detection** screen for several minutes as echoes can fluctuate very quickly.

**Below - Rover HD Analyzer Echo Detection screen captures were obtained at a Kilmore rural property displaying the *before and after* investigations to reduce Echoes.**

**Band 3 VHF, MFN, with the original antenna exposed to Multiple Post Echoes – inside & outside the G.I.**

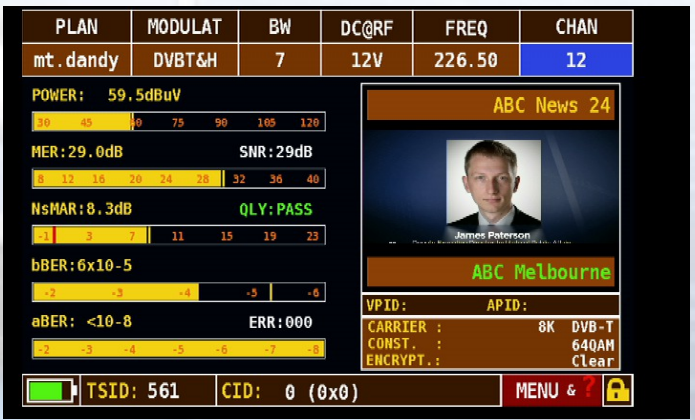



**Band 3 VHF, MFN, and the new antenna shielded by a metal roof, resulting in a reduced Post Echo – inside the G.I.**




***The presence of echoes has reduced MER, SNR, & NsMAR levels, but did not effect the digital power***


***Reducing Echoes has improved MER, SNR, & NsMAR levels, without seriously effecting the digital power.***



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**Reduction of Echoes:**

✍ Now that you have confirmed an **Echo or Echoes** are the problem - Echoes cannot be eliminated by installing a filter, a masthead amplifier or any other type of amplification. The reduction or elimination of Echoes can only be attained at the antenna so ensure that you have plenty of patience and time to investigate the source of echoes.

Echoes can exist in unusual locations, travel for either short or long distances, and fluctuate from being non-existent, weak to extremely strong. Also never consider utilizing a client's existing TV antenna for site testing purposes.
Before commencing a **site test** the most important consideration is to select a TV antenna that will provide -:

1. **Specifically** engineered for the frequencies or channels transmitted in the area to be site tested,
2. A good **MER** performance at the antenna (preferably without amplification),
3. A ***front to back ratio*** which is better than **22dB,**
4. The balun's internal housing is to be **spider-water proof** irrespective of the polarity (horizontal or vertical).

🗝 **Now a "solution" for the *Detection and Attenuation of Echoes*:**

**Using a portable mast 1.6m infinitely adjustable to 6m, a suitable antenna initially raised to 1.5m above the gutter-line, then walk slowly around and close to the building whilst observing the echo detection screen. As the echoes reduce, stop and slowly alter the height of the antenna, with a preference to lowering it first - until the echoes are reduced or eliminated. Next make careful notes of the exact location and height of the antenna. If need be consider lowering the antenna below the gutter-line or even lower. Sounds crazy but it gets results. The above process can be time-consuming and occasionally frustrating – but it works, and is well worth the effort!**

✍ When conducting a site test to reduce or eliminate echo/es initially **ignore** the **digital power** and concentrate upon the **Echo Detection** screen. When you have reduced or eliminated the echo/es go to the data measurement screen to confirm that the **MER, C/N, and NsMAR levels for all carriers** have significantly increased.

Given that you are happy with your site test efforts, then (without altering the height or position of the antenna) check the non-amplified digital power levels for all carriers are almost equal and not below 35dBuv. Most masthead amplifiers are capable of providing good results with a raw (passive) input power of approximately 35 dBuv.

✍ **Do not forget - Increasing the digital power level will never eliminate Echoes, but it will increase noise levels.**

**Finally:** **A**fter securing the antenna plus other necessary equipment verify that all data measurements at outlets meet the required standards. In particular if an amplifier (masthead or distribution) is utilized ensure you carefully adjust the gain controls to only maximize the **MER and Noise Margin** levels, and **NOT** the **DIGITAL POWER**.

**Photo: Location of the original and new antennas at a Kilmore property.**

## Original Antenna Site

***Exposed to multiple echoes.***

## New Antenna Site

***Shielded by Iron roof to reduce the existence of echoes, thus increasing MER & NsMar levels.***