

Digital TV Reception

1. Introduction

A Digital TV transmission (broadcast) consists of a constant stream (millions per second) of very small 188 byte size digital data packets. Each data packet contains a defined portion of video, audio or service information data such as electronic program guides (EPG), clock, sub-titles, synchronisation timing data, etc.

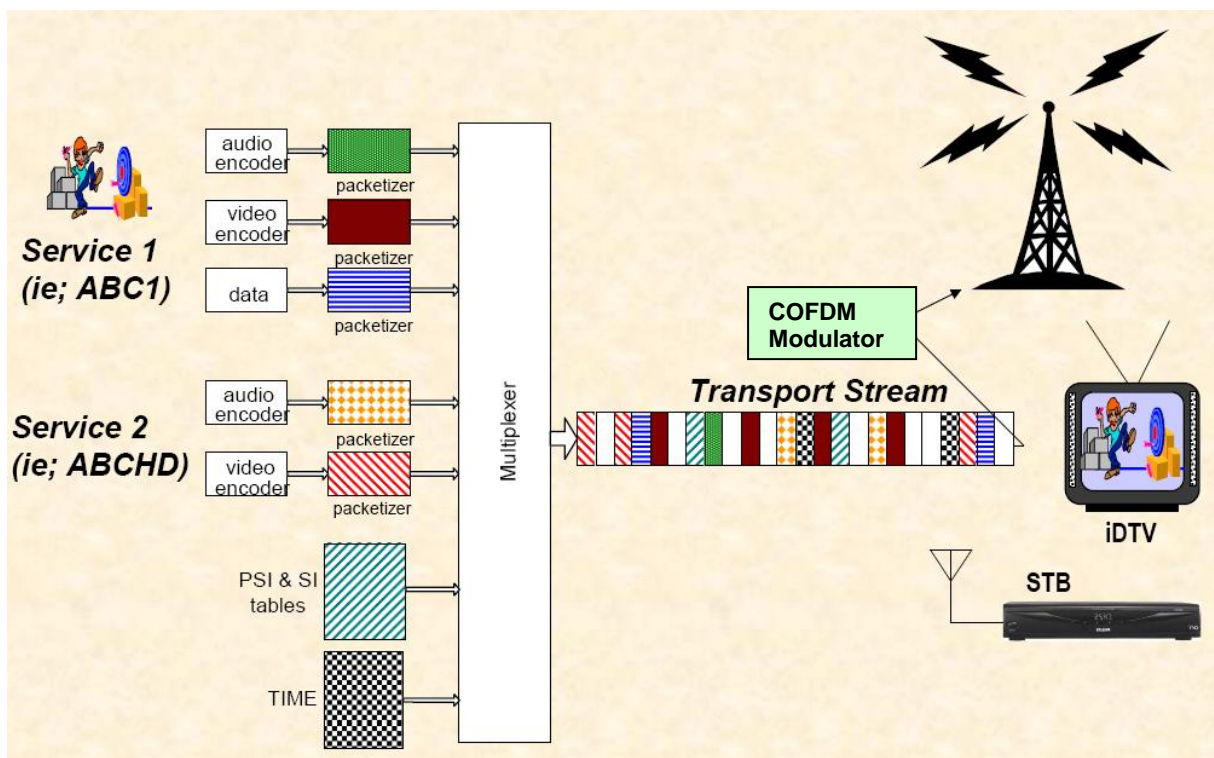


Fig. 1 Simplified overview of a DTV Transmission system

When these data packets reach the digital TV receiver via the customer's free to air TV antenna, they are reconstituted into pictures, sound and ancillary services such as EPG's, time etc.

2. The Digital Signal

DTV broadcasting uses a modulation system called COFDM (Coded Orthogonal Frequency Division Multiplex) as defined by DVB standards to deliver these digital data packets to the customers TV antenna. One of the major strengths of COFDM is its immunity to the effects of ghosts (ie reception of multiple images) that plagues the existing analogue (PAL) transmission system.

2. Electrical Interference and DTV signals

The DVB-T (Digital Video Broadcasting – Terrestrial) broadcasting system used in Australia transmits very robust DTV signals, but digital TV data packets carried by COFDM are still subject to corruption and degradation (like all communication signals!) as they travel between the broadcaster's transmission tower and the customer's digital TV receiver.

Electrical interference (commonly known as Impulse Noise) can corrupt many thousands of data packets. Depending on the nature of the corruption, some data packets are beyond the repair capabilities of the digital TV receiver. Corrupted data packets manifest themselves as picture break-up and or momentary audio dropouts.

It also stands to reason that the further you are from the transmission tower, the weaker DTV signals become. Weak signals are also more susceptible to corruption by electrical noise and atmospherics. At some point, the DTV signal becomes so degraded as to become un-useable. Digital TV receivers contain a signal quality checker where video & audio is muted when the packet error count exceeds a prescribed limit. At this point a 'No signal', 'Bad Signal', 'Check Antennal Connection' etc error message will appear on the screen.

3. Common Sources of Electrical Interference

- a) Generally speaking, older style thermostat based / brush type motor appliances such as stoves, ovens, air conditioners, swimming pool pumps and associated automatic chlorine / acid feeders, mixers, blenders, dishwashers, washing machines, hair dryers, electric drills, circular saws etc.
- b) Cordless telephones and other household RF transmission devices
- c) Household light switches / power point switches
- d) Ignition based systems (ie; spark plugs / ignition coils) such as motor cars, motor bikes, lawn mowers, edge trimmers etc
- e) Natural sources such as a local or distant lightning storm

4. How does this interference reach the DTV set?

Household interference is induced into the DTV normally via the customer's antenna cable system and or poor / corroded antenna connectors especially those using saddle clamp type connections as commonly used in TV outlet sockets, antenna splitters etc..

5. Typical DTV Reception Issues

Item	Reception Symptom	Possible Cause(s)	Diagnostic / Corrective Action(s)
1	Cannot receive or tune in a particular DTV channel	<ul style="list-style-type: none"> ▪ Inadequate or poor signal 	<ul style="list-style-type: none"> ▪ Using the TV's built-in 'DVB Signal Display' feature, check and note signal strength & quality reading of the wanted channel ▪ Check to ensure the wanted DTV channel is broadcast in your region ▪ If you live in a unit or apartment using a Master TV Antenna (MATV) system, check to ensure it can distribute analogue AND DTV signals ▪ If multiple RF input devices (VCR, DVD Recorder etc) are interconnected via RF loop-through, disconnect RF loop-through connection and re-try tuning with a direct connection to TV antenna wall socket ▪ The existing TV antenna installation / cabling is not designed or inadequate for reception of the wanted channel ▪ In all instances, consult your local TV antenna installer. Also note that DTV signal measurements must be made using a DTV signal meter for meaningful results
2	Loss of reception on one or more channels during certain periods of the day or night	<ul style="list-style-type: none"> ▪ Insufficient signal margin ▪ Inadequate or poor signal 	<ul style="list-style-type: none"> ▪ Using the TV's built-in 'DVB Signal Display' feature, check & note signal strength & quality readings of the wanted channel during good & bad reception periods ▪ Variances in and or constantly fluctuating signal levels between the good / bad reception readings indicate an inadequate TV signal to maintain good reception due to variances in the TV signal caused by atmospheric influences such as day/night, rain, wind, fog etc ▪ In all instances, consult your local TV antenna installer. Also note that DTV signal measurements must be made using a DTV signal meter for meaningful results

Item	Reception Symptom	Possible Cause(s)	Diagnostic / Corrective Action(s)
3	Intermittent and or regular picture break-up (pixilation) / loss of audio on some channels		<ul style="list-style-type: none"> ▪ Using the TV's built-in 'DVB Signal Display' feature, check & note signal strength & quality reading of the affected channel AND the other receivable channels ▪ Maximum (ie 100%) signal strength & quality levels may indicate <u>too</u> much signal usually caused by a TV antenna amplifier over-boosting and corrupting the incoming digital data packets. Try removing / by passing the aerial amplifier and or reducing the signal level with an attenuator.
4	Picture break-up & or audio dropouts when household electrical appliances are switched on/off or in operation	<ul style="list-style-type: none"> ▪ Too much signal! ▪ Weak signal ▪ Corrupted signal ▪ Signal corrupted by household electrical interference 	<ul style="list-style-type: none"> ▪ In the case of a weak signal, improve antenna / cabling as required ▪ Use a quality RG6 Quad shield antenna fly-lead between TV wall socket outlet and TV antenna input ▪ To minimise household electrical interference pickup, check / repair / replace ALL corroded / broken TV signal distribution connections including RF splitters and or improve antenna / cabling / connectors as required ▪ Saddle clamp connectors and 75ohm air-cored coaxial cabling (in common use since commencement of colour TV broadcasting) are susceptible to electrical noise pick up, that corrupt DTV data packets. Such cabling hardware should be replaced ▪ The use of purpose designed DTV antennas, RG6Quad Shield coax cable and 'F' connectors throughout the DTV signal distribution chain provide the best protection against household electrical interference pickup ▪ TOO much Signal will overload DTV tuner and cause picture pixilation! Simple rule of thumb: DTV signal quality (ie; reception of un-corrupted digital data packets) is <u>more</u> important than signal strength. A signal strength level of between 70% - 80% and 100% signal quality are ideal DTV signal levels ▪ In all instances, consult your local TV antenna installer. Also note that DTV signal measurements must be made using a DTV signal meter for meaningful results

6. Typical Sources of Impulse Noise pickup

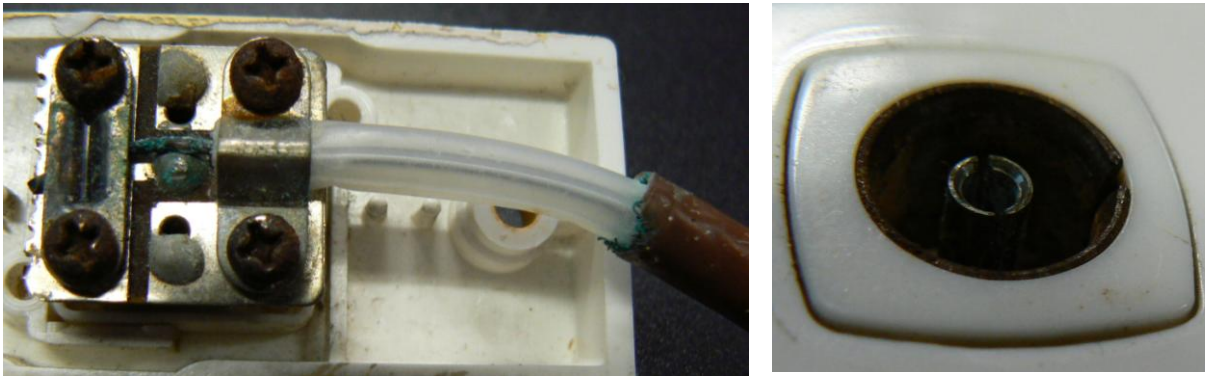


Fig. 2a & 2b This wall plate connection was causing intermittent pixilation on some channels only. Note: no earth braid connection & severely corroded connections & oxidation (green) of copper cable. When an installation is experiencing impulse noise interference, thoroughly inspect ALL RF connections including antenna, RF amplifier, splitters and wall sockets. Don't assume...



Fig. 3 75Ω 'air-cored' coaxial cable as used throughout Australia for TV antenna installations. The use of such cables must be avoided in DTV installations as they provide very poor immunity against impulse noise pickup.

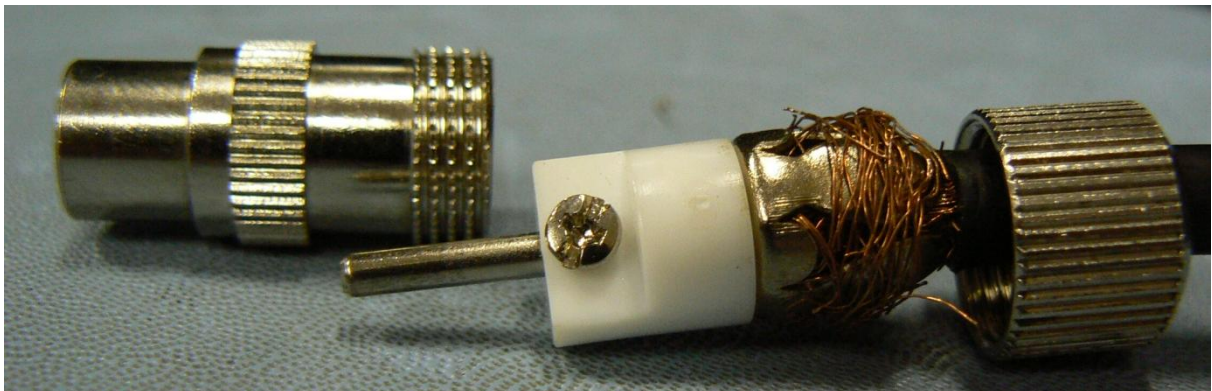
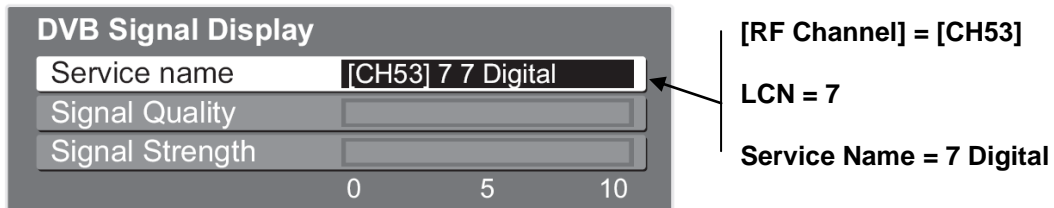


Fig. 4a & 4b 'Belling & Lee' type connectors should be avoided in DTV installations. Over time they lose their connectivity properties due to moisture ingress that tarnish the copper cable.

7. Customer DTV Signal Check List

- Setup a SD or HD FAV Channel list as described in the Operating Instructions
- Select the FAV channel list, then enter DVB Signal Display feature



Whilst in this menu, record (write down) DVB Signal Display details, indicating the status of the Signal Strength / Signal Quality bars; are they moving or stationary and their colour.



Use the remote control CH up/down key to move between the channels.

- Notes: 1) For meaningful results all 5 channels must be checked & recorder
 2) [RF Channel] number MUST be different in each table

	RF Channel	LCN	Service Name	
Service Name				
Signal Quality	/ 10	<input type="checkbox"/> Stationary Bar <input type="checkbox"/> Moving Bar		Bar Colour
Signal Strength	/ 10	<input type="checkbox"/> Stationary Bar <input type="checkbox"/> Moving Bar		Bar Colour

	RF Channel	LCN	Service Name	
Service Name				
Signal Quality	/ 10	<input type="checkbox"/> Stationary Bar <input type="checkbox"/> Moving Bar		Bar Colour
Signal Strength	/ 10	<input type="checkbox"/> Stationary Bar <input type="checkbox"/> Moving Bar		Bar Colour

	RF Channel	LCN	Service Name	
Service Name				
Signal Quality	/ 10	<input type="checkbox"/> Stationary Bar <input type="checkbox"/> Moving Bar		Bar Colour
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Signal Quality	/ 10	<input type="checkbox"/> Stationary Bar <input type="checkbox"/> Moving Bar		Bar Colour
Signal Strength	/ 10	<input type="checkbox"/> Stationary Bar <input type="checkbox"/> Moving Bar		Bar Colour

	RF Channel	LCN	Service Name	
Service Name				
Signal Quality	/ 10	<input type="checkbox"/> Stationary Bar <input type="checkbox"/> Moving Bar		Bar Colour
Signal Strength	/ 10	<input type="checkbox"/> Stationary Bar <input type="checkbox"/> Moving Bar		Bar Colour

Customer Name: _____ Suburb: _____ State: _____ P/Code: _____

Customer Contact details: _____ Date: _____

8. Australian DTV Channel Plan (Informative)

Digital channel	Nominal centre frequency (in MHz)
BAND III	
6	177.500
7	184.500
8	191.500
9	198.500
9A	205.500
10	212.500
11	219.500
12	226.500
BAND IV	
27	522.500
28	529.500
29	536.500
30	543.500
31	550.500
32	557.500
33	564.500
34	571.500
35	578.500
BAND V	
36	585.500
37	592.500
38	599.500
39	606.500
40	613.500
41	620.500
42	627.500

Digital channel	Nominal centre frequency (in MHz)
43	634.500
44	641.500
45	648.500
46	655.500
47	662.500
48	669.500
49	676.500
50	683.500
51	690.500
52	697.500
53	704.500
54	711.500
55	718.500
56	725.500
57	732.500
58	739.500
59	746.500
60	753.500
61	760.500
62	767.500
63	774.500
64	781.500
65	788.500
66	795.500
67	802.500
68	809.500
69	816.500

9. For the Technically Minded ...

DOMESTIC INSTALLATION CHECKLIST

Digital Television Antenna / Cabling Installation Best Practice

1. To ensure reliable digital television reception, always remember: Signal Quality is of greater importance than Signal Strength. Too much signal (strength) causes tuner overload and pixilation / audio breakup!
2. If only digital TV reception is needed, choose a digital optimised antenna for VHV Band III (Ch's 6-12) and/or Band IV or Band V (UHF) as required for the digital TV channels to be received. Do not use an antenna with Band I elements if low channel analog PAL reception is not required (eg. Channel 2 PAL). In the majority of cases, Band III (Ch's 6 – 12) digital only antennas will successfully receive the Ch 2 (64.250MHz) signal due to Ch 2's signal strength;
3. Always use good quality RG6 quad-shielded 75 ohm coaxial cable throughout the installation and 'F' type (crimp /compression) connectors. TV wall sockets should preferably be fitted with 'F' type screw-on connectors;
4. When the installation of a masthead amplifier is necessary, use a shielded amplifier (to minimise impulse noise pickup). Always start with the amplifier set to minimum gain and work up;
5. When using masthead amplifier, always use a DC power source to avoid DTV signal corruption;
6. Always use RG6Q/RG59Quad fly-leads with 'F' type connectors between the antenna wall socket & digital TV receiver – a PAL 'push-in' plug or 'F' type to PAL adapter may be required if the digital receiver is fitted with a PAL antenna socket;
7. After a working antenna configuration is achieved, temporally insert an attenuator (about 11dB), into the antenna installation chain and re-measure digital signal quality / strength levels *and* check receiver performance. This test will indicate if there is sufficient margin within the system to ensure signal levels remain adequate in the short & longer term.
8. When measuring DVB-T signals always use a signal meter designed for DVB-T signal measurements. Analogue TV signal meters are unsuitable that give erroneous results.

Recommended DVB-T (Digital) SIGNAL QUALITY Levels

Modulation Error Ratio (MER)	$\geq 25\text{dB}$ or higher
Bit Error Ratio (BER *) - pre-Viterbi	$< 8e10^{-3}$ (less than 8 errors per 1,000 data bits)
- post-Viterbi	$< 2e10^{-6}$ (less than 2 errors per 1,000,000 data bits)

*BER values are expressed in an exponential format: $e10^{-3} = 1,000$; $e10^{-4} = 10,000$; $e10^{-5} = 100,000$ and so on...

SIGNAL STRENGTH (Outlet)	DVB-T (Digital)	PAL-B (Analogue)
Acceptable Range	45 - 75 dB μ V	60 - 80 dB μ V (1mV ~ 20mV)