Video Fundamentals 13

Using & interpreting test signals

Brian Summers G8GQS

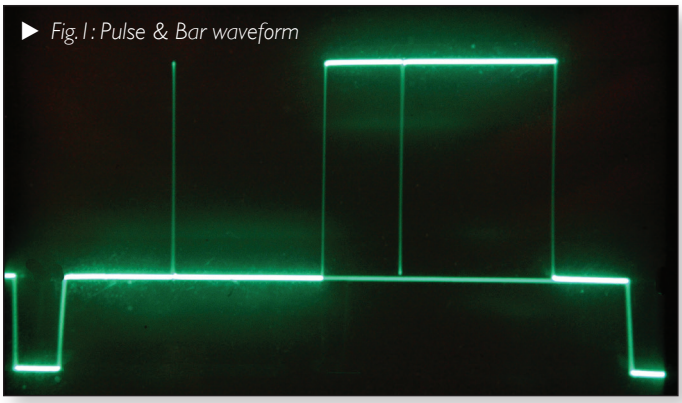


What they are for

There are a very large number of different test signals of all sorts of measurements to reveal different aspects of performance. We are going to look at the pulse and bar test signal. It is one of the oldest dating back to the earliest days of television. It has stood the test of time and with the addition of the 5,10 & 20T pulses, much can be learned about the colour performance of cables and equipment.

Testing Cables

Following on from number 12 last time I would like to explore the use of the sine squared pulse & bar signal to test cables and networks. This test signal comes in many different permutations from the simple monochrome one shown in fig. 1 to its inclusion in the ITS[1] and even incorporated into test cards.



▶ *Fig. 1: Pulse & Bar waveform*

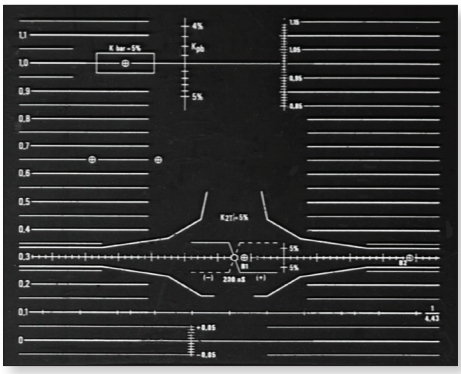
The sin² pulse is for the higher frequencies and the bar tests the low frequencies. The output of the cable or network to be measured is observed on an oscilloscope with a special graticule, called a "K" rating graticule see fig. 2. If the oscilloscope was adjusted to display the P&B in the graticule boxes the K factor could be read off in percentage terms according to the "fit" within the graticule.

The sin² pulse had 5 different "T" ratings used according to what parameter you wish to measure.

1T pulse with significant frequency components to 10 MHz.

2T pulse with significant frequency components to 5 MHz.

5, 10 or 20T pulse with subcarrier for chrominance gain & delay measurements.

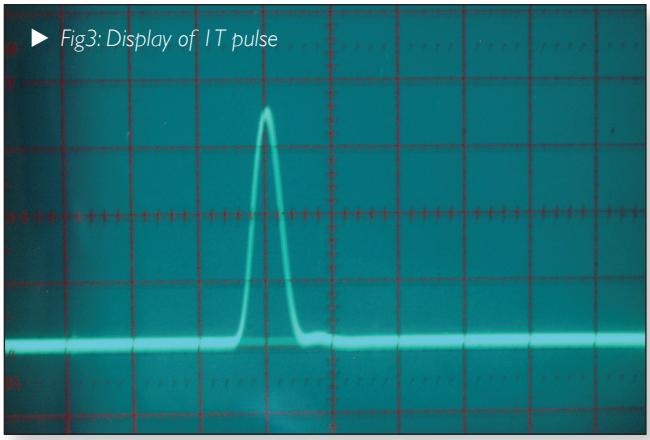


▶ *Fig. 2: K measurement Graticule*

The BBC monograph number 58 has much information as to using P&B signal for testing and is available free from the BBC[2] .

Use as a Time Domain Reflectometer, TDR

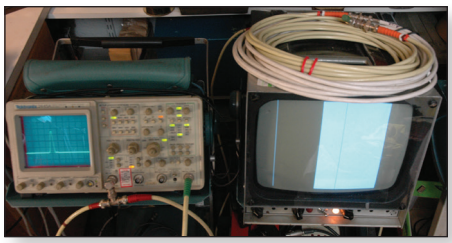
One of the interesting and useful things you can do is to put a "pulse" down a cable and observe the result. I set up the equipment, using equipment that was to hand, to display the 1T sin² pulse on the oscilloscope as in fig 3. I used a BNC "tee" connector and a further length of cable with a 75Ω termination was connected[3].



▶ *Fig3: Display of 1T pulse*

In fig. 3 the term is connected and there is no reflection, and from the 'scopes point of view the cable is infinitely long.

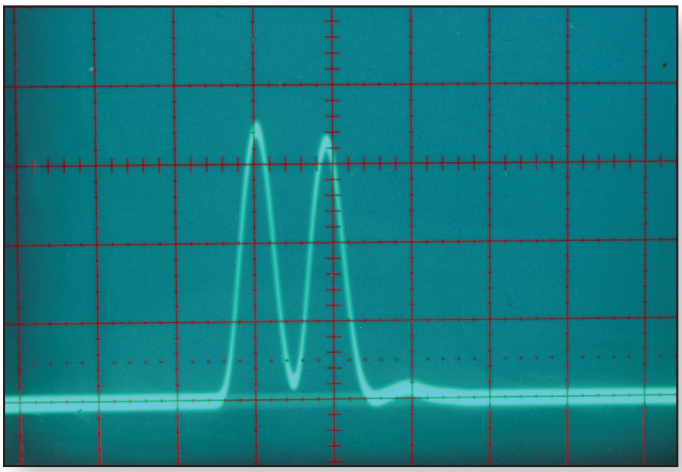
This is the set-up in Fig.4, the scope with the tee piece, the cable, the line drive as external trigger to the scope



▶ *Fig. 4: 'Scope, cable and monitor*

input and a monitor to show what P&B looks like. In this picture the termination, with a green cap, can just be seen on the end of the cable coil.

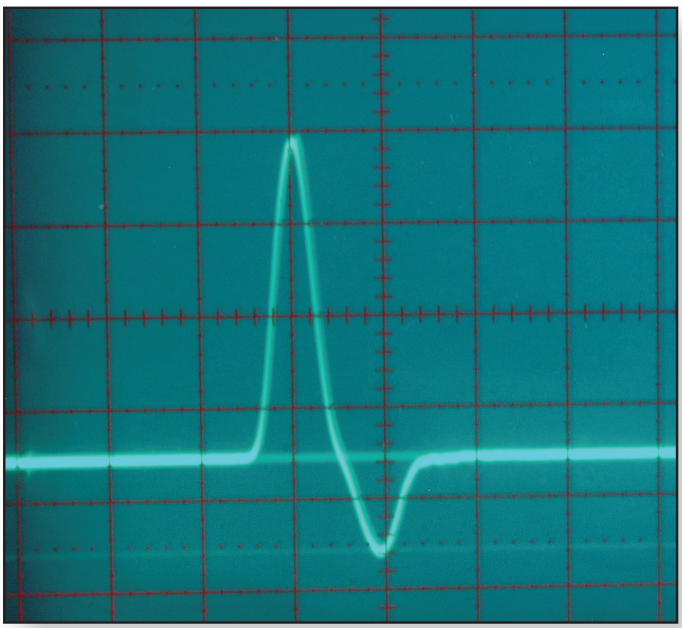
In Fig. 5 the termination has been removed from the end of the long cable, open circuit, and the pulse has been reflected back up the cable (think poor SWR). From this the length of the cable can be calculated



▶ *Fig. 5: Cable unterminated with reflection*

by measuring the delay. About 200nS. in this case, so a bit of maths gives:- C x velocity factor x delay & divide 2 (there and back!).

300x.65x200nS/2 = 19.5m which is about the length I had.



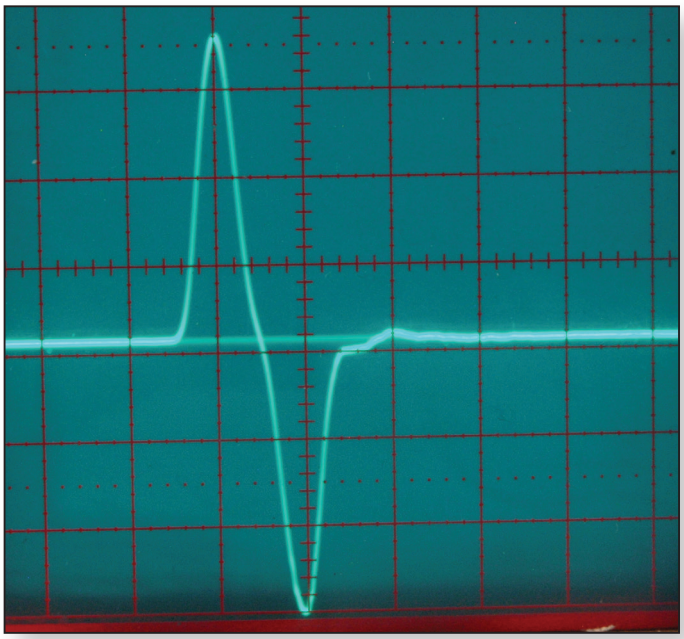
▶ *Fig. 6: Double termination (2 x 75Ω)*

In Fig 6, I have double terminated the end of the cable, effectively 37.5Ω. You can see that the reflection is now inverted because the termination is less than the characteristic impedance of the cable.

Fig. 7 shows the extreme case of a short circuit on the cable end. If the X deflection speed was reduced to show the more of the P&B signal you would not be surprised to see that the signal is really wrecked!

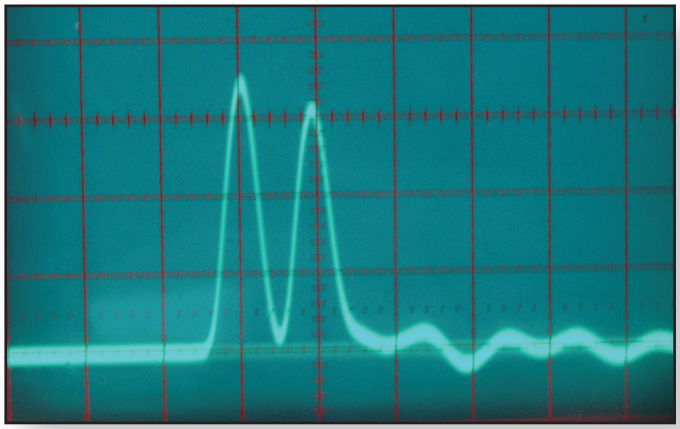
This technique is really useful for determining, for instance which end of a cable might be faulty or were it is severed.

When I was at work for BBC outside broadcasts we had a really useful unit, made by the boffins in base. It made a suitable pulse and had a readout so you could identify



▶ *Fig. 7: Short circuit at cable end*

the distance to a fault. When setting up there was lots of occasions for using it, my very favourite phrase was "it's open circuit at your end!"



▶ *Fig. 8: With length of 50 cable added.*

In Fig. 8, I have added a length of 50Ω cable to the end of the 75Ω length to show the effect of the impedance discontinuity.

Although I have used analogue test signals here to examine cables, the cables don't care whether the signals are analog or digital, as far as the cable goes a digital signal is just a collection of waves of different frequencies.

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1. ITS = Inserted Test Signal in the field blanking of TV signals
2. ***http://www.bbc.co.uk/rd/publications/bbc_monograph_58***
3. To clarify, the output of the P&B generator was connected to the tee piece, on the scope input and further length of 75Ω cable. For convenience the scope was triggered from Line Drive to give a nice stable trace.