200kHz Pulse Generator

Introduction

This apparatus is designed to show how electrical pulses are propagated along a transmission line, including demonstration of the way that signals are reflected at cable ends. The apparatus can also be used to experimentally calculate the speed at which electrical signals travel.

Operation

The unit requires a power supply of +5V to 12V d.c. smoothed and regulated (e.g. Regulated Power Supply IPC-0201-P). The power supply should be connected to the pair of sockets on the front panel marked '+5 – 12V d.c.' (red) and '0V' (black).

When connecting the power supply, care should be taken to ensure correct polarity of the connections.

With the power supply connected and switched on, the unit will generate a train of positive going pulses at approximately 200kHz. Connection is made via the pair of sockets marked 'OUTPUT' (white) and '0V' (black). NB: The two black sockets are internally connected together.

<u>Experiment 1 – Determination of the speed of propagation of electrical pulses</u>

1. Connect the 200kHz Pulse Generator to a power supply, a length of coaxial cable and an oscilloscope as shown in Fig 1. (NB: Good results can be gained with a cable length between 50m and 200m).
2. With the end of the coaxial cable open circuit, the pulse sent down the cable will be reflected with the same polarity as the original pulse, the reflected pulse will then be similarly reflected at the other end. The pulse will travel up and down the cable several times before being attenuated.
3. With the oscilloscope timebase set to 0.5µs per division, it should be possible to see two or three reflections of the original pulse on the oscilloscope as shown in Fig 2.
4. The speed of propagation of the pulse can then be calculated:

Velocity = distance ÷ time

For 2 reflected pulses the total distance travelled is four times the length of the cable = 4 x 200m = <u>800m</u>

By measurement on the oscilloscope:

Time taken for the pulse to be reflected twice back to the oscilloscope = 2 x 2.05µs = <u>4.10µs</u>

So velocity = 800 ÷ 4.1×10^{-6} = <u>1.95×10^{8} metres per second</u>

Fig 1.

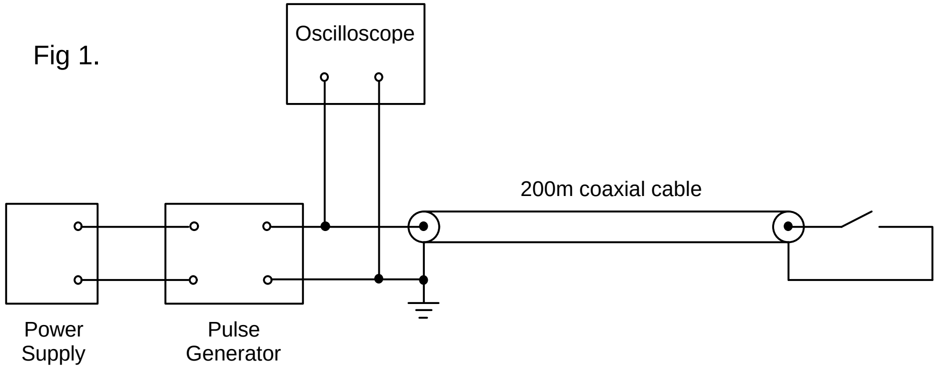
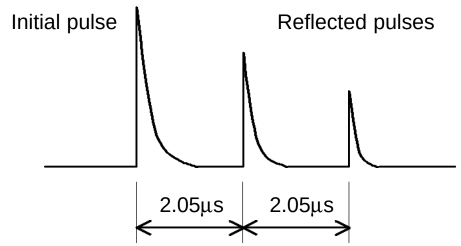


Fig 2.



<u>Experiment 2 – Pulse reflection modes at cable end</u>

1. With the apparatus connected as for experiment 1, observe the reflected pulse displayed on the oscilloscope. It can be seen that the pulse has been reflected back from the open circuit end of the cable with the same polarity as the incident pulse each time.

2. Short-circuit the free end of the cable by connecting the core of the cable to the outer screen.

3. It can now be seen on the oscilloscope that the pulse is inverted when it is reflected at the short circuited end of the cable as shown in Fig 3.

Fig 3.