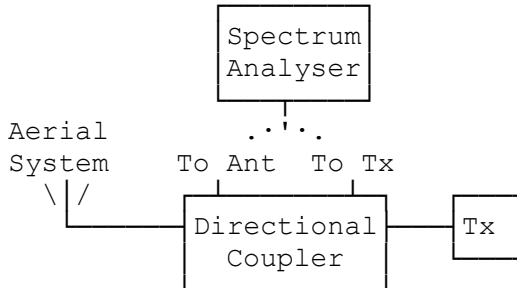RF Directional Coupler

By G8MNY   (Updated Nov 16)
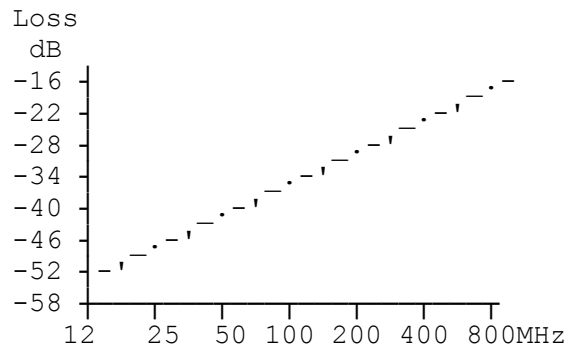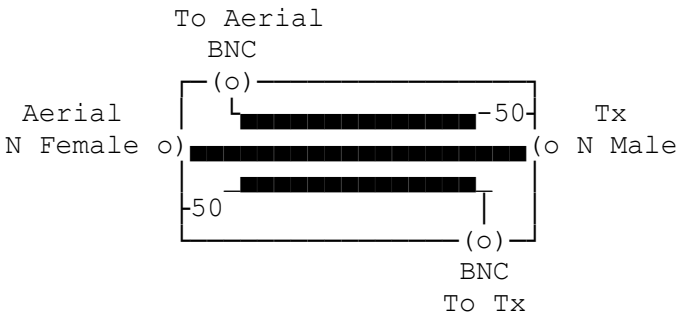(8 Bit ASCII graphics use code page 437 or 850, Terminal Font)
This is an item used for VHF broadcast transmitter monitoring. It provides a
low level calibrated RF sniff point in the aerial coax for Ofcom (UK regulator)
spectrum analyser etc. without turning the Tx off. It is not generally used by
other RF users!

```
                 ┌─────────────┐
                 │  Spectrum   │
                 │  Analyser   │
                 └─────────────┘
 Aerial              ..'..
 System        To Ant   To Tx
   \ | /       ┌─────────────┐      ┌────┐
    └──────────┤ Directional ├──────┤ Tx │
               │   Coupler   │      └────┘
               └─────────────┘
```
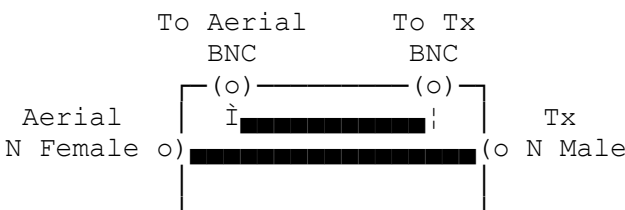
CIRCUIT
This is quite a straight forward 3 line directional coupler as used in some VHF
SWR bridges, but here all the lines are very accurate 50Û transmission lines.

```
      To Aerial                          Loss
        BNC                               dB
      ┌─(o)──────────┐                   -16 ┤                    _.-
Aerial│  └▄▄▄▄▄▄▄▄▄-50┤ Tx              -22 ┤                 _.-'
N Female o)▄▄▄▄▄▄▄▄▄▄▄▄(o N Male         -28 ┤             _.-'
      │ ▄▄▄▄▄▄▄▄▄▄▄▄ │                  -34 ┤          _.-'
      -50          │                    -40 ┤       _.-'
      └──────────(o)─┘                  -46 ┤    _.-'
                 BNC                     -52 ┤_.-'
                 To Tx                   -58 ┼──┬──┬──┬───┬───┬───┬───
                                             12 25 50 100 200 400 800MHz
```

Such couplers do not have a flat response, they typically have a 6dB per Octave
rise until they are near a resonance or some other losses affect them. Ofcom
said some spectrum analysers have calibration offset parameters that can allow
for this? (I have never seen one)

A HOMEMADE ONE
Simpler one I made up was from PCB..

```
         To Aerial      To Tx
           BNC           BNC
         ┌─(o)───────(o)─┐
 Aerial  │  Ì▄▄▄▄▄▄▄▄▄¦  │  Tx
N Female o)▄▄▄▄▄▄▄▄▄▄▄▄▄▄(o N Male
         │              │
         └──────────────┘
```

The 'N' connectors were bolted to 1" x1" PCB plates, the whole double sided
PCB box soldered up around them & the double sided PCB lines inside that. The
50ohm double sided PCB lines were salvaged from an old VHF SWR detector bridge.
But to make a really good accurate match, it needed solder added to them to get
a deep SWR null >30dB, on a good load. For this single pick up line design a
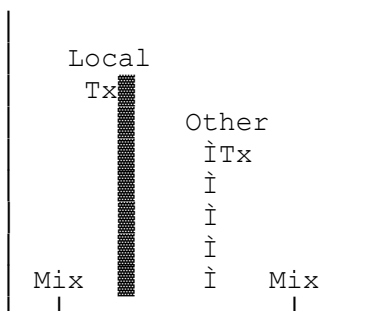50Û BNC terminator plug is used in the unused port.

IN USE
There are accuracy limits to all test gear, here if the transmission system is
not 50Û at the frequency of interest & the spectrum analyser results can be
meaningless! This is generally the case off frequency on a resonant aerial.

Actual power measurement is possible provided all the patch lead losses are
known & the match is good.

However the directional coupler does have the ability to show up which of any
RF mixing signals are internal & external to the Tx! So nearby corroded metal
joints, or other nearby transmitter PAs acting as a mixer etc, can easily be
identified as "QRM not in the local Tx". So it is very useful when tracking
down the real cause of QRM.

```
 | Local                  |      Local                |      Local
 |    Tx█                 |       Tx█                 |       Tx█
 |     █                  |        █  Other           |        █  Other
 |     █  Other           |        █   ÌTx            |        █   ÌTx
 |     █    Tx            |        █    Ì      Mix     |  Mix   █    Ì    Mix
 |     █     Ì            |        █    Ì             |   |    █    Ì     |
 | Mix █     Ì     Mix    |  Mix   █    Ì      Mix     |   |    █    Ì     |
 |  |  █     Ì      |     |   |    █    Ì       |      |   |    █    Ì     |
 |__|__█_____Ì_____|__   |___|____█____Ì_____|___  |___|____█____Ì____|__

   Tx Port Spectrum          Aerial Port Spectrum       Aerial Port Spectrum
                             Showing Local Tx Mixing    Showing External Mixing
                            (mix smaller than Tx Port)  (mix bigger than Tx Port)
```

Why Don't U send an interesting bul?

73 de John G8MNY @ GB7CIP