MutAnt™

The must-have accessory for HF switching, testing and operating.

USER GUIDE revision 2.1

Product Version 2.0.0 Pre-launch information

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MutAnt™ is part of the ShortWaveModules™ range of accessories.

Designed and manufactured in the United Kingdom by QuietRadio®

About MutAnt

MutAnt is a multi-role switch unit for switching of Audio, Control and RF signals.

The name 'MutAnt' is a portmanteau of 'mute' and 'antenna'. The stepped line in the logo implies both an antenna and a control pulse. The MK1 unit was a four-port antenna transfer relay. The latest MK2 version retains the name but adds a further changeover relay, terminated in 3.5mm stereo sockets to greatly expand versatility. The two functions can be triggered together or separately via the tip and ring connections of the 3.5mm control jack.

MutAnt is designed and priced for the amateur radio and electronics hobbyist market and is not intended as laboratory-standard equipment.

Features

Audio and control signal switching: Two pole change-over relay using three 3.5mm stereo connectors – common, standby and active.

RF switching: SMA four-port multi-mode RF changeover relay for testing, isolation, source and side-chain selection (insert / bypass).

Control port: A 3.5mm stereo input initiates switching by grounding either the tip (RF switching) or ring (AF/Control switching) separately or in parallel.

Uses Include:

RF Switching

1) Source selection e.g., antenna selection.
2) Load selection e.g., switch between transceivers.
3) Receive antenna selection with PTT activated change-over.
4) Noise floor tests (terminate second port in 50Ω).
5) Isolator - break through path and terminate each end in 50Ω.
6) Insert side-chain kit into path, such as a filter or attenuator. *If a preamp is used you need to power it off when not selected as input/output would be connected together when offline – see diagram in examples below.*
7) Transfer relay. Swap two antennas between two transceivers.

AF / Control Switching

1) Select between two stereo audio inputs or outputs.
2) Dual channel control line switching.
3) Combo mono audio and single control line switching.
4) Isolate receive audio patch during transmit e.g., when using remote SDR for receive.

Control Panel

DC

2.1mm barrel connector for 12 V to 13.8 V DC. When unpowered, all connections are in the Standby state.

Stby – Com – Active (AF/Control line switching)

Three 3.5mm unterminated stereo jacks. When AF control line is inactive, or the unit is unpowered the Com (Common) port is connected to the Stby port. When the control line is active the Com port is connected to the Active port. Activate by grounding the ring connection of the control line.

AF Led

Lit when the AF/Control line is active (ring connection grounded).

RF Led

Lit when the RF control line is active (tip connection grounded).

The single colour leds remove any ambiguity often associated with multi-coloured indicators. Lit = active. Un-lit = Standby - whether powered or unpowered.

Control Port

3.5mm stereo socket. The tip connection when grounded operates the RF relay. The ring connection when grounded operated the AF / Control relay. When unpowered, the relays default to the standby state regardless of the control input as the relays are non-latching.

Control Port operation

When powered, there is a standing voltage of around 4 V on both the tip and ring connections of the control port. Ground either line to operate the relevant relay. Sink current is approx. 1.2 mA.

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RF Panel

When the RF control line is inactive, or the unit is unpowered, A1 is connected to A2, and separately, B1 is connected to B2.

When the RF control line is active, A1 is connected to B1, and separately, A2 is connected to B2.

Status is indicated by the RF Led on the Control panel at the other end of the case.

Do not overload the relay

The relay used for RF switching is not suitable for high power operation or operation at higher frequencies. Officially we state 30 MHz and 100 W as maximum frequency and power when cold switched. Hot switching should be avoided to preserve relay life. Switching time is < 2 ms which is much faster than the changeover time of typical software-controlled equipment even without the hold-off delay most transceivers have as a menu setting.

The relay currently used for RF and AF switching is the KEMET EC2-12NU. Please consult their data sheet for further information.

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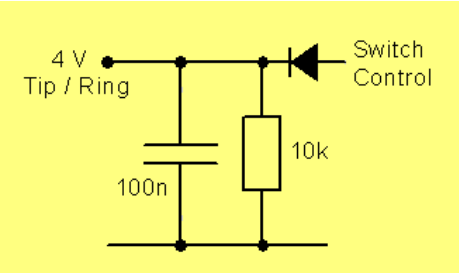
Interfacing the Control line to other equipment

There is no front panel switching control. In normal use Mutant would form part of a complete system and is more likely to be located 'under the bench'. For manual control attach a stereo cable to the control input and extend to one or two toggle switches in a convenient location.

Control Interfacing Examples



Internal circuit.

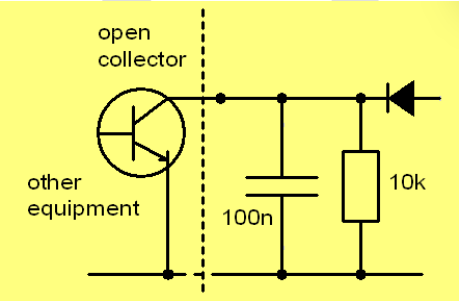
Ground the tip or ring connection on the 3.5 mm Control jack to operate.

The nominal 4 V standing voltage is derived from the 13.8 V DC input and will be correspondingly lower when 12 V is used. Short circuit current is approx. 1.2 mA.

An isolation diode prevents back-feeding of higher voltages when parallel connected with other equipment. The 100n capacitor shunts any RF present. The 10k resistor forms part of the potential divider circuitry, also providing a discharge path for the 100n.

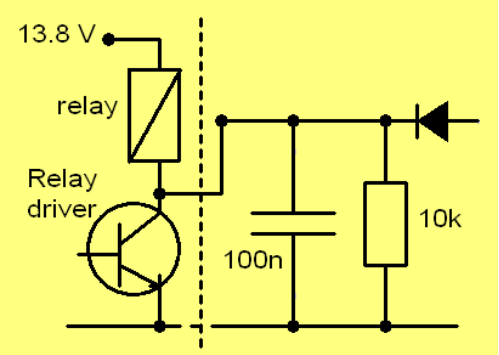
Be aware any other equipment connected in parallel will see 10 kΩ to ground.

Direct interfacing with open collector control lines



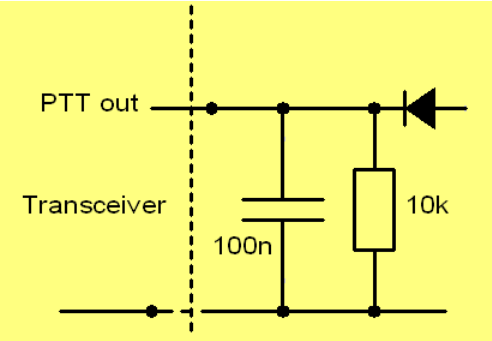
Many transceivers and some receivers have undedicated open collector outputs. Mutant could be used to swap antennas or insert an attenuator for instance.

Triggered from relay driver



Add Mutant to a relay driver to expand the switching capability. Check the relay is adequately suppressed.

Triggered by transceiver PTT out



PTT out lines vary. Some are open collector, and some use relay contacts.

The PTT signal should be clean and free from bounce. There is no debounce circuitry in MutAnt as this would lengthen the relay response times. There is negligible hysteresis on the control lines i.e., they are not Schmitt trigger inputs.

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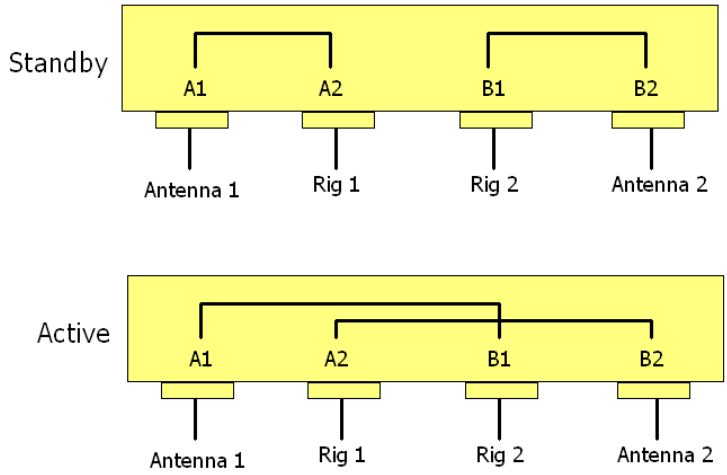
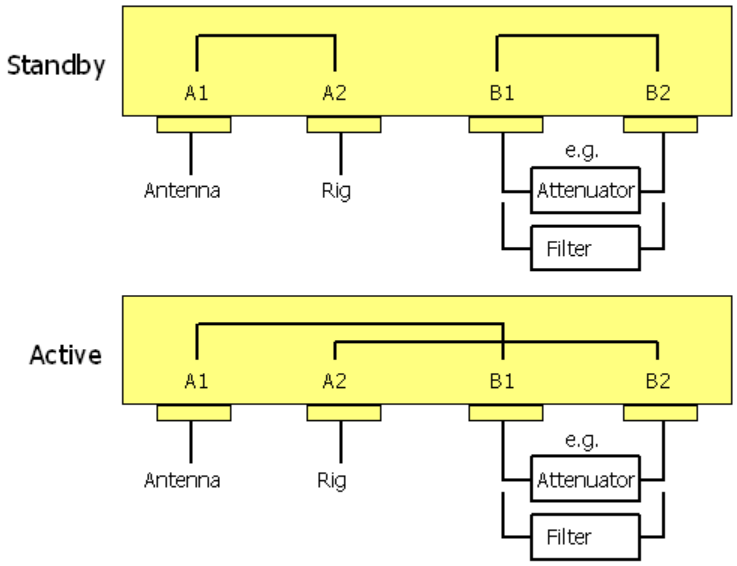
RF switch application examples

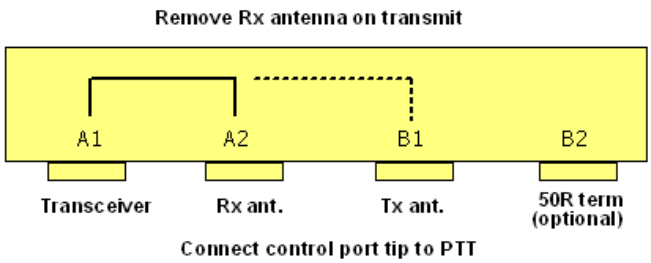
Dual channel changeover switch



Insert / Bypass Switch



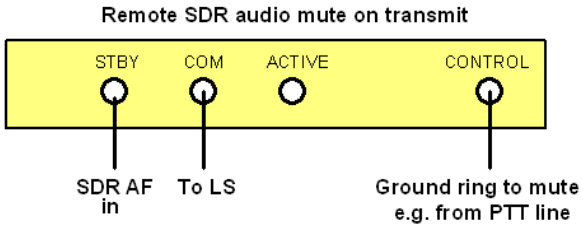
Receive antenna switching



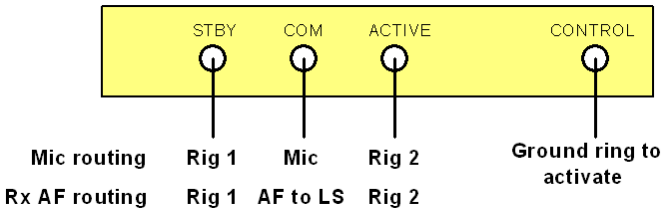
AF Switching application examples:

Remote SDR Rx Mute

Prevent echo or howl-round on transmit.

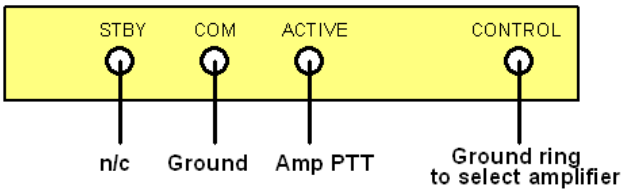


Destination control



Many other uses including control solutions:

Interlock Linear with Rx ant isolation when used with above RF example by grounding tip and ring together.



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Specifications

Supply voltage: 12 V min to 13.8 V max.

Standby current: < 5 mA

Operating current per channel: < 40 mA

Switching performance:

Test conditions: Supply voltage 13.8 V DC, triggered by dead short to ground.

Pull-in time: < 2 ms **Release time:** < 2 ms. Zero hysteresis – use clean keying.

Antenna Relay:

Recommended max frequency 30 MHz, max power 100 W cold-switched. Relay used is Kemet EC2-12NU signal relay. If in doubt consult manuf. datasheet. This is not an expensive RF relay hence the crosstalk figures shown in the test results limit use to HF and below if this aspect is important. Insertion loss <0.02 dB below 30 MHz**.**

AF/Control relay**:**

Stereo changeover relay (2 channels). Un-loaded, un-bypassed. Can be used for stereo audio switching or muting, or mono audio and single control channel, or two control channels.

Control Port:

Standing voltage on tip or ring of control port: 4 V nominal @ 13.8 V supply.

Short circuit current from tip or ring to ground: 1.2 mA nominal @ 13.8 V supply.

Internal resistance from control port to ground: 10 kΩ. i.e., connected equipment will see 10 kΩ to ground.

Tip/Ring resistance to ground to operate relay: Typically 1.2 kΩ.

Must operate below: 470 Ω. **Must release above:** 2.2 KΩ.

Note: Plugging in a 3.5 mm jack when MutAnt is powered may cause a momentary toggling of each relay.

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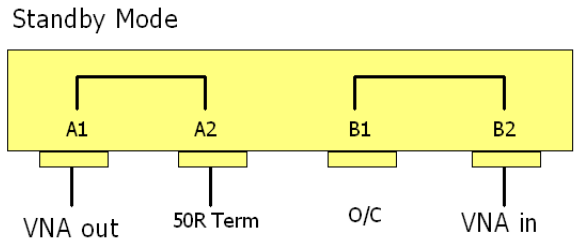
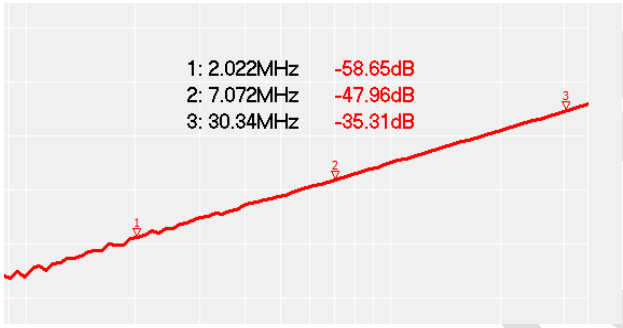
RF isolation measurements

Tests were carried out by feeding a VNA output into A1, with the output port A2 terminated. The VNA input was applied to B2. Test results are similar using B1.

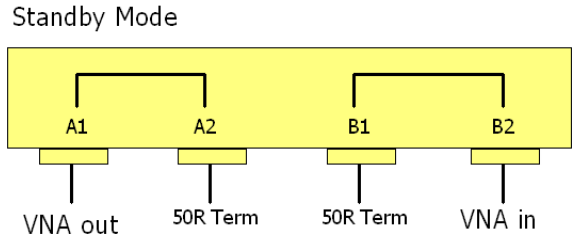
Test 1 with B1 O/C.

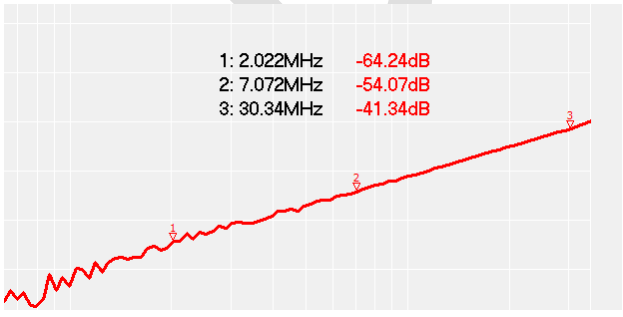




From actual VNA plot.

Test 2 with B1 terminated.





From actual VNA plot.

The figures of approx. -6 dB per octave degradation are as expected for relay crosstalk.

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