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Application Note AN261197
Testing two single contacts on each RT90/RT290 changeover contact

1. Contents.

2. Introduction.

This note discusses how to connect two single contacts to each RT90 or RT290 changeover contact wiring to enable a relay constructed as (say) 2 Form-A and 2 Form-B contacts to be tested. Diagrams show how to connect the Kelvin wiring together with a small amount of additional circuitry and how to control it from the test program.

3. General outline of the problem.

Each relay 'pole' wiring of our RT90 and RT290 parametric test system is a changeover contact with force and sense Kelvin wire pairs for each pole as follows:
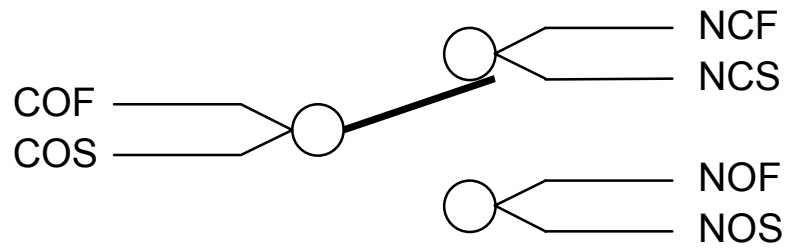
CO = Common
NO = Normally Open
NC = Normally Closed
F = Force
S = Sense
(eg NOS is Normally Open Sense)

Fig 1. Changeover contact wiring RT90/RT290

This contact wiring can be used to test a Form-A, B or C contact with the maximum number of contact sets that can be tested equal to the changeover (c/o) contact capability installed in the system. For example a 4C/O RT290 can test 4 changeover contacts, 4 Form-A contacts, or 2 Form-A and 2 Form-B.

Sometimes it can be useful to map two Form-A or B contacts on to a single changeover connection, for example where the additional system contact cost is not justified by an occasional test requirement or where the total relay poles to be tested exceed the 8 contact maximum capability of the system. For example, it may be required to test a device with 4 NO contacts and 4 NC contacts on a 4C/O RT290.

At first sight it may seem possible to share the wiring by paralleling the Kelvin connections, possibly as follows:
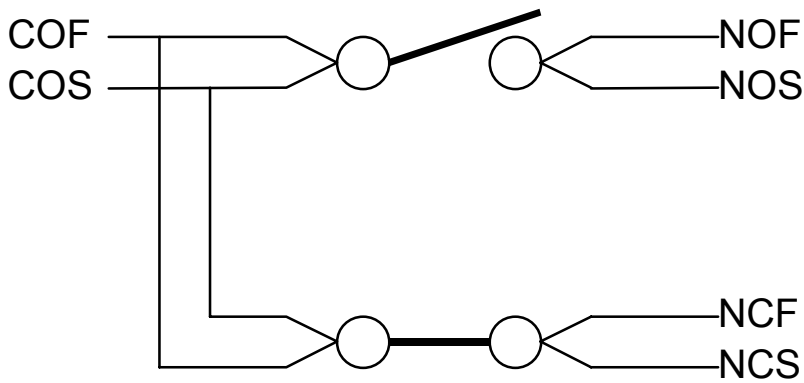
Fig 2. This does not work

Unfortunately this does not work since only the force-sense join of COF and COS nearest to the test system will produce valid results and the other contact will have additional wiring resistance in series with it causing contact resistance errors.

A solution which produces correct CR results and allows individual testing of NO and NC contacts is to dynamically switch the common sense wire to the required contact before testing it as follows:
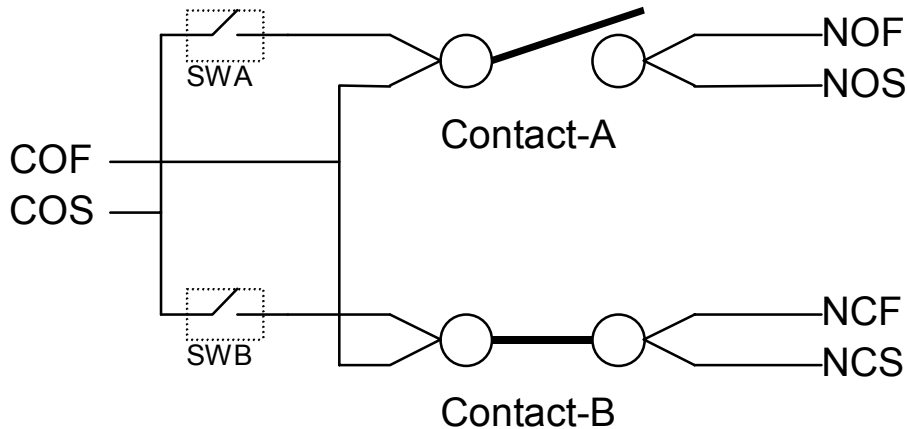

Fig 3. Solution for connecting two single contacts

Here, the common sense wire has been routed to one or other contact by means of two NO switches SWA and SWB. The relevant switch must be closed before testing either Contact-A or Contact-B. This ensures that a valid Kelvin connection is made to one or other contact prior to its testing. As more contacts are mapped on to additional poles, SWA and SWB must be repeated for each pole and controlled in parallel.

4.   Implementing the solution.

A practical solution based on Fig 3 requires the following items.

- Choice of appropriate switch.
- Control wiring must be brought from the adaptor back to the RT90/290 for operating the switches.
- An addition must be made to the test program to control the switches.

4.1   Choice of switch for SWA and SWB.

For a very simple solution, SWA and SWB can be implemented using another small changeover relay – this could even be driven in parallel with the device coil (if the resulting coil resistance errors and other test program implications such as operate / release voltage can be tolerated).

An independently driven solution is preferred where the RT90/290 I/O output control is used to drive either a relay or a solid-state switch. Normally-open Photo-MOS devices are a low-cost and excellent choice, and the subsequent description will be based on these.

4.2   Control wiring.

For ease of wiring, and since this circuitry is usually device-specific, the switches should be located within the adaptor, bringing back only simple control lines to the RT90/290 37-way handler port connector as follows:
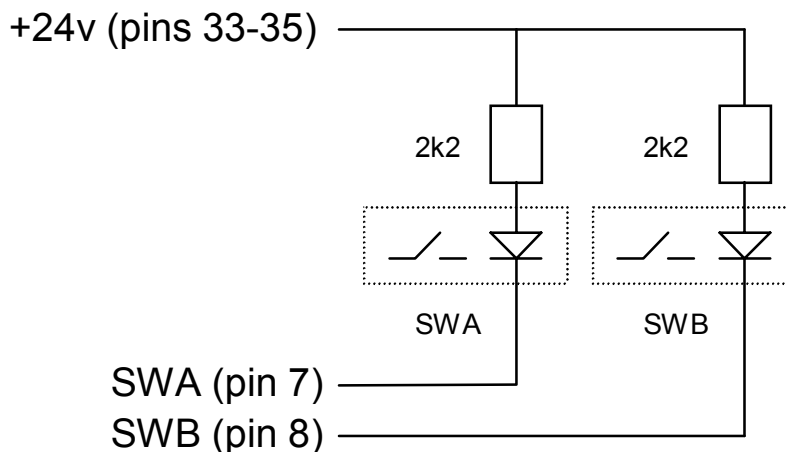

Fig 4. Typical Photo-MOS drive circuit

Here, the active-low RT90/290 control lines are used to enable the appropriate switch by sinking approx. 10mA through its LED. These two switches would be repeated for each changeover pole to be modified, but the three control lines (+24V, SWA and SWB) can be parallel across all poles and connected back to the handler interface port of the RT90/290 using the pins shown.

Note also that due to the availability of 24v, multiple Photo-MOS LED's could be connected in series instead of parallel, but this does make finding a faulty device more difficult.

If a relay is used instead of a photo-MOS device, simply use a 24V relay coil and connect a suppression diode across the coil in the appropriate polarity.

Although there are some small differences between the pull-up resistors, the RT90 and RT290 outputs appear typically as shown in Fig 5. Every output defaults to an 'off' state, inactive high with an N-channel power-MOS device switching an internal pull-up resistor to +24v. When an output becomes active, it goes low, sinking current from the pull-up resistor and any external circuit. Up to 250mA of external current can be sinked in this way. Unloaded, the output voltage excursion is from around 0.5V (active, low) to +24 (inactive, high). Clamping to around +26V and -0.7V is also provided for low energy inductive discharges.

+24v

Pullup <10k

I/O Connector pin

VOut

33v

Inactive, Vout unloaded is 22-25V
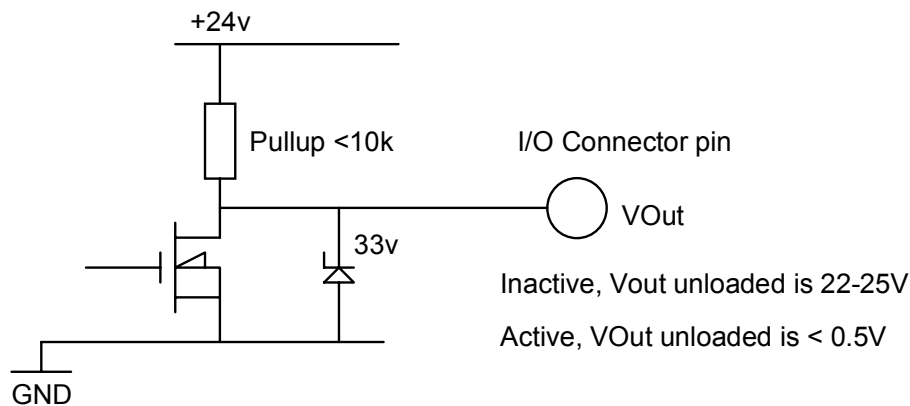
Active, VOut unloaded is < 0.5V

GND

Fig 6. RT90/290 Typical hardware output.

Two of these outputs can be used to drive SWA and SWB respectively. (Spare outputs OP6 and OP7 are suggested). The outputs and their pins numbers and bit weights are shown in the following table.

'37W pin' describes the pin number of the handler port 37-way 'D'-type connector. On the RT90 this is immediately adjacent to the heatsink, and facing the rear of the system. On the RT290 this is the 37-way 'D' socket located in the PC area.

'Reg ID' is a special value relevant for the 'Port I/O test step', which can access these outputs.

'Bit weight' is the decimal representation of each bit for use in constructing bit patterns and masks.

Ground is available on pins 17-19 inc. and 36,37.

+24v is available on pins 33-35 inc.

Ref	Description	Reg ID	Bit weight	37W pin.
OP0	Handler bin 0. Lowest weight of 5 binary-coded handler bin outputs.	0	1	1
OP1	Handler bin 1	0	2	2
OP2	Handler bin 2	0	4	3
OP3	Handler bin 3	0	8	4
OP4	Handler bin 4. Highest weight of handler bin outputs.	0	16	5
OP5	Busy in test.	0	32	6
OP6	SPARE	0	64	7
OP7	SPARE	0	128	8

4.3   Controlling SWA and SWB from a test program.

With the wiring complete, an existing test program can be modified to control the switches. This is done by inserting an 'I/O control test step' to activate either SWA's or SWB's where required. For the example 4NO+4NC device, the device could be tested in two 'halves' with all NO contacts tested in one first group followed by a second half testing the NC contacts. In this case, only two I/O control test steps are required – one before each group to put the switches into the required state.

To insert an I/O control test step select the type 'I/O port control utility' from the device tests menu on the RT90 or RT290. Give it a suitable name like 'Activate all SWA switches'. This test step can output a pulse or fixed patterns – you will use it in simple fixed output mode only. Move to this test step and set:

- OutputPortID = 0 (the default) – this identifies OP0..OP7 as your working output bits.
- OutputFixedMask = 192 – this is the sum of the decimal bit weights 128 and 64, corresponding to your OP6 and OP7 outputs bits in use.
- OutputFixedPattern = 64 – this sets OP6 high, and OP7 low, activating SWA switches (128 would activate OP7 and the SWB switches)

Run the test. SWA switches should activate.

To work with the required test program, place a copy of this test step before each group of device tests that relate the 'A' or 'B' contacts, so that the relevant contacts are connected to the test system before the device tests start. (Note that this means that device tests can only be made on the contact groups separately and not on the device as a single operation).

More information on the I/O port utility is given in the RT90 and RT290 manual with additional worked examples.