

APPLICATION NOTE

AQ 2xx Relay Output Guideline

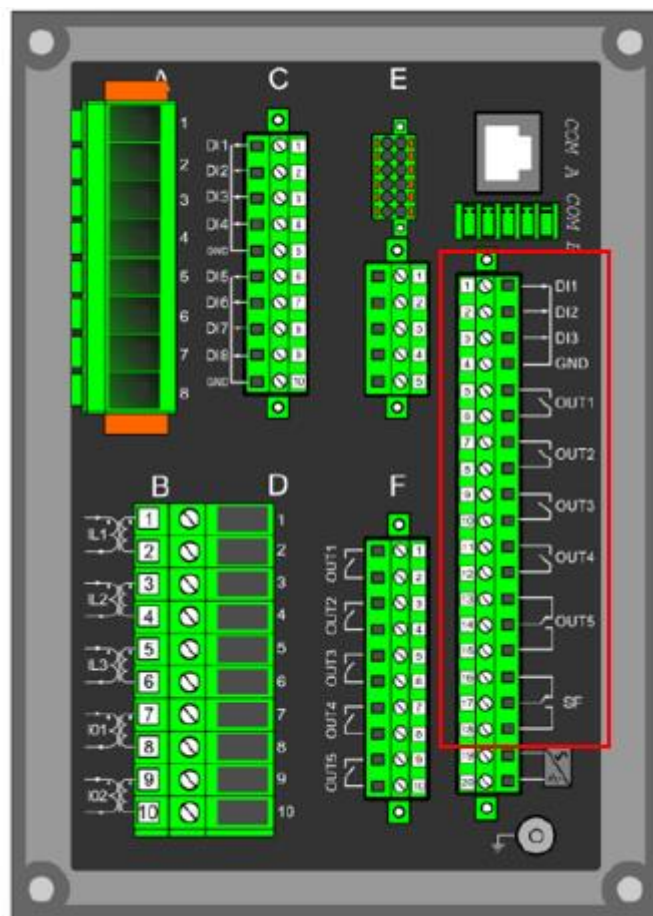
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1 RELAY OUTPUTS IN GENERAL

Generally, protection relay outputs can be used for many different things. Most important usage for outputs in protection relay is clearly controlling the circuit breaker opening and closing coils. This can be done either directly or via auxiliary relay, especially auxiliary relay is used when multiple circuit breakers are controlled simultaneously. Other uses for relay outputs are for example interlocking of control signals, interlocking signalling between relays, protection signalling between relays and alarm signalling to RTU. This guideline concentrates to circuit breaker control with relay outputs.



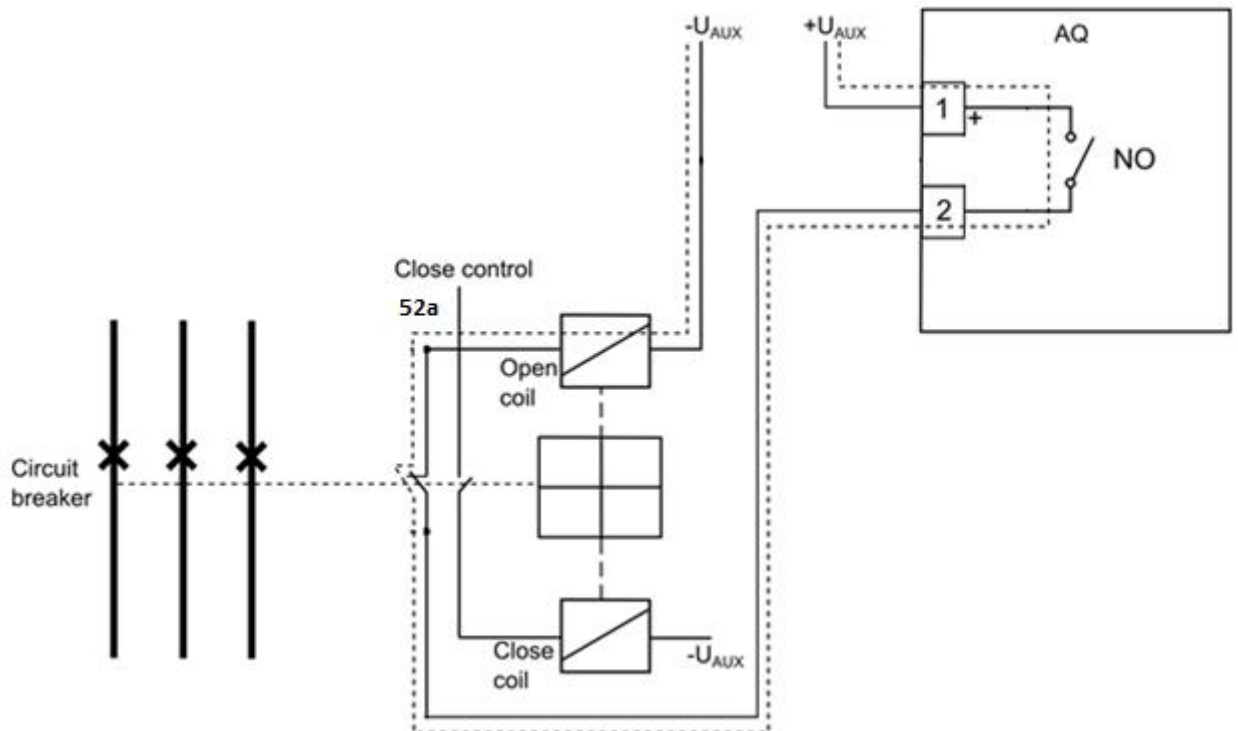
Picture 1: AQ21x has as a standard 6 relay outputs which are presented in this picture. Outputs 1 to 4 are normally open type, output 5 and output SF are change-over type of output contacts.

2 CONTROLLING CIRCUIT BREAKER COILS WITH RELAY OUTPUTS

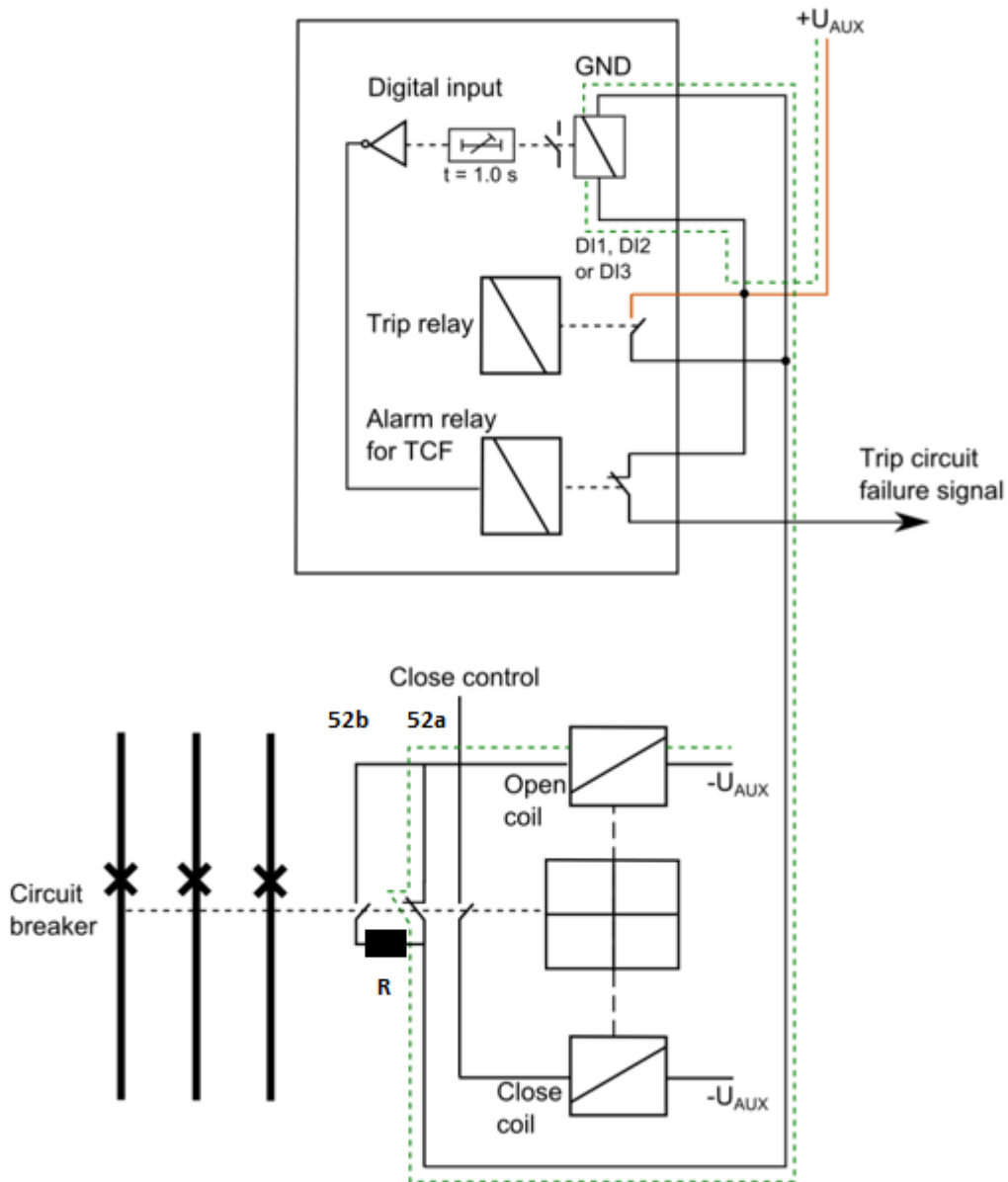
OUTPUTS

2.1 CIRCUIT BREAKER CONTROLLED DIRECTLY WITH RELAY OUTPUTS

Direct way to control circuit breaker opening or closing coil is wiring auxiliary voltage to protection relays relay output pins other side and then the other side to closing or opening coil of the circuit breaker via circuit breakers auxiliary contacts. The key word here is circuit breaker auxiliary contacts because they are used to prevent disturbance coming from opening or closing coil when relay output controls the coil. Using the circuit breaker auxiliary contacts also saves the lifetime of relay outputs by taking care of the inductive breaking.



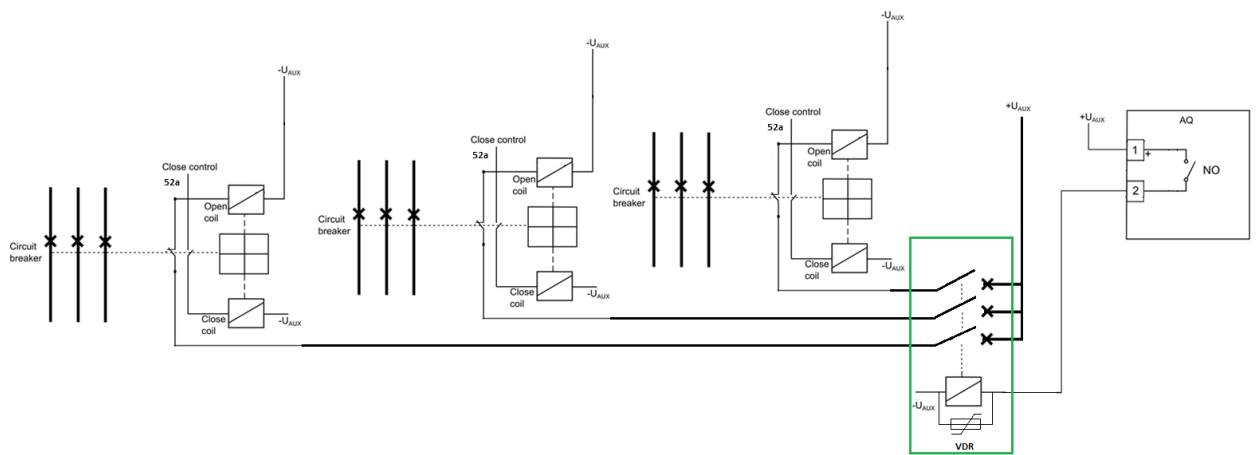
Picture 2: Basic idea of circuit breaker opening coil control. When circuit breaker opens the auxiliary contact of circuit breaker cuts the inductive current to the coil and after that the protection relay output is released.



Picture 3: Connection example when trip circuit supervision is used. With this connection, the current keeps flowing to circuit breaker opening coil via the closing auxiliary contacts (52b) of the circuit breaker even after the circuit breaker is opened. This leads to a need for resistor R which will reduce the current so that the coil is not energized and the relay output does not need to cut off the coils inductive current.

2.2 CIRCUIT BREAKER CONTROLLED VIA AUXILIARY RELAY

When multiple circuit breakers are controlled with one relay output there is a common practise to use auxiliary relay for circuit breaker coil control and the relay output only controls the auxiliary relay coil. In this case the auxiliary relay coil inductive current comes to relay outputs and current breaking capacity and EMC capability must be ensured. For this reason, auxiliary relays must be usually equipped with surge suppressor components that will prevent the voltage rise in coil poles when relay output contact is opened.



Picture 4: Three circuit breaker opening coils controlled via auxiliary relay contacts. Auxiliary relay is controlled via relay outputs and voltage limiting resistor (varistor) is connected to auxiliary relay coil to prevent voltage peaks from coil de-energization.

3 USING SURGE SUPPRESSORS

3.1 WHAT IS SURGE SUPPRESSOR

Surge suppressor is a protective device that is used to prevent high voltage peaks to build-up when coil is de-energized and the magnetic field collapses causing the amount of energy stored in the coil to be released.

3.2 AQ2XX PROTECTION RELAY IMMUNITY TO ELECTROMAGNETIC DISTURBANCE

All AQ2xx protection relays are tested according to following related standards IEC 60255-26, EN 61000-4-2 class III, EN 61000-4-3 class III, EN 61000-4-4 level IV, EN 61000-4-5 level IV, EN 61000-4-6 class III. In certain cases, the disturbances are higher than in these standards and therefore using surge suppressors with AQ2xx protection relays is recommended.

3.3 APPLICATIONS WHEN SURGE SUPPRESSORS ARE RECOMMENDED

Surge suppressors are recommended when circuit breaker coil is controlled directly via relay output contact without having circuit breaker auxiliary contact series in the control circuit because in this case the energy from the coil is released to the relay output contact. Surge suppressors are also always recommended when relay outputs are used to control contactors.

3.4 DIFFERENT TYPES OF SURGE SUPPRESSORS

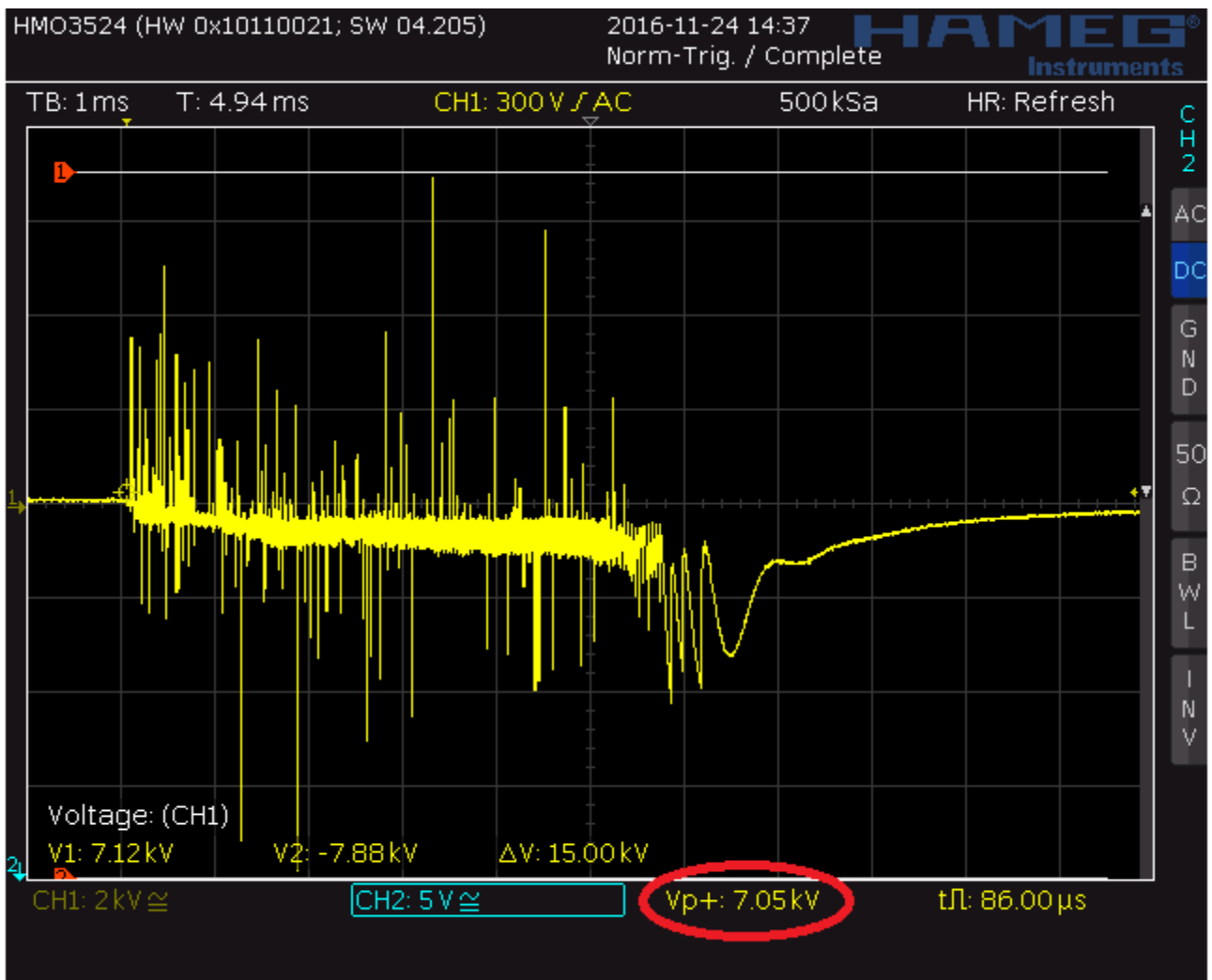
- Diode suppressor (Only for DC)
 - Suppresses the DC voltage by recirculating the current released from the coil back through the coil. The coil will consume the energy itself.
- Resistor Capacitor suppressor (Only for AC)
 - The resistor connected in series with capacitor limits the rate of rise of voltage (dV/dt) over the coil.
 - The voltage across a capacitor cannot change instantaneously, so a decreasing transient current will flow through it for a small fraction of a second, allowing the voltage across the coil to increase more slowly.
 - Resistor limits the charging current of the capacitor.
- Varistor suppressor (For AC and DC)
 - A varistor remains non-conductive as a shunt-mode device during normal operation when the voltage across it remains well below its "clamping voltage", but when voltage rises it comes conductive and this way prevents high voltage peaks building up.

- Bidirectional peak limiting diodes (For AC and DC)
 - Basically, operates same way as varistor but has faster reaction time.
 - Maximum reduction of transient voltage peaks.
 - Arcteq recommendation

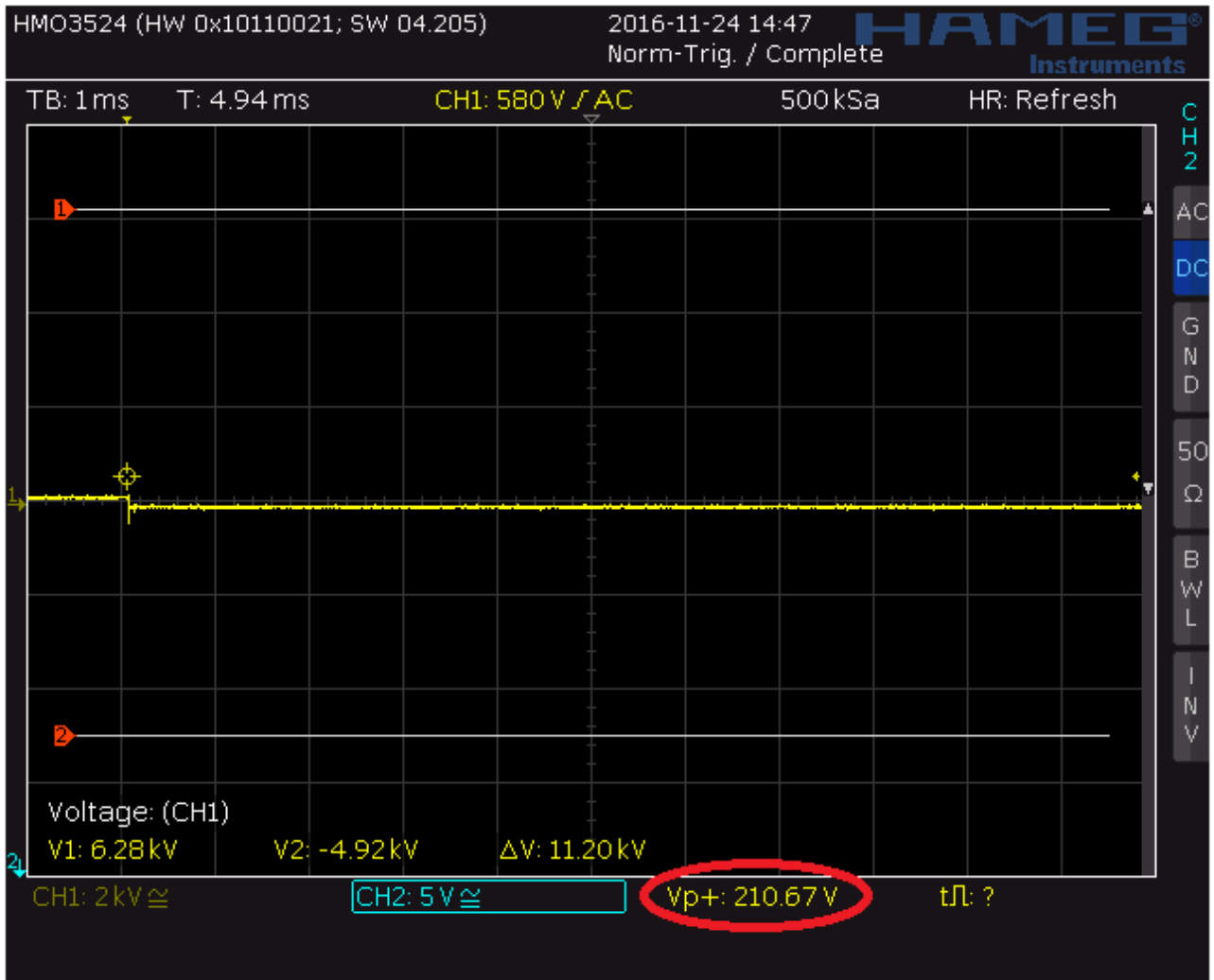
4 EXAMPLE OF CONTACTOR CONTROL WITH AND WITHOUT SURGE SUPPRESSION

Tested object was small magnetic contactor with following specifications:

- IEC AC-3 nominal power at 400VAC 4kW
- IEC AC-3 nominal current at 400VAC 9A
- Nominal coil voltage 220VDC



Picture 5: Voltage measured over contactor coil without surge suppression V_{peak} 7.05kV



Picture 6: Voltage measured over contactor coil with surge suppression Vpeak 210V

5 REFERENCE INFORMATION

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