MODERN RELAY TECHNOLOGY

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Second edition

410 Illustrations
50 Tables
240 Relay types with approx.
6000 Characteristics

Dr. Alfred Huethig Verlag, Heidelberg

Mercury Wetted Relays: are relays having a protective envelope for the contacts (→ Reed relays), with mercury wetted contacts (utilizing capillary action). They display virtually no contact bounce, low constant contact resistances, and therefore have long life with high reliability. There is a possibility of problems arising, due to their being position dependent when there is plenty of mercury, or due to a break in the mercury film or the forming of an amalgam in the case of insufficient mercury and arcing. The max. permissible temperature range is −37 °C to +107 °C.

Reed Relays: were developed in the 'thirties' by the Bell Telephone Laboratories. Reeds literally mean, "thin, flat leaves or tongues". Distinction is made as follows:

- dry reeds: dry switching, ferromagnetic reed contacts, which have to date proved successful only as make contacts. With change-over or break contacts, the contact force is very low, the contact resistance is too high and manufacture not particularly economical.
- ferreeds: also have dry switching reed contacts, but these consist either of iron with a high remanence, or a permanent magnet flux is superimposed on them. If over-energized, the contact reed usually returns to its original position, severely limiting their range of application.
- reed change-over relays: in their polarized version, these have found a broad field of application. A relay of this type, the R-relay, which received an award from an international jury at the "Electronica 68" Exhibition in Munich, for its high technology, is illustrated in figs. 121 and 279.

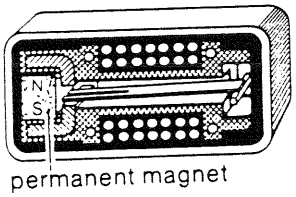


Fig. 121: Polarized reed changeover relay

In the intervening period extensive improvements have been carried out on the R-relay [20, 77, 78], such that contact reliability has been increased enormously. The R-relay has a permanent magnetic field which amplifies the energizing flux, generated by the coil, in the air gap, (contact gap), and thus gives rise to high contact force — without saturation effect. The power consumption is low. The *efficiency* of this polarized relay is approximately 50 times higher than that of non-polarized relays. That is why monostable R-relays are also polarized. In the bistable (latching) version, the influence of the ambient temperature on the pull-in voltage is largely compensated, and in all hermetically sealed versions the permanent magnet is now activated as a *getter*.

Because of their low inductance and capacitance, reed contacts are very suitable for switching HF circuits, provided the contact reed has a surface coating which

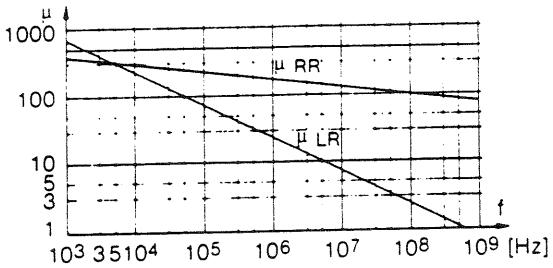


Fig. 122: Frequency dependance of real component μ_{LR} and imaginary component μ_{RR} of the complex permeability of NiFe wire (50/50)
l = 45 mm; d = 0.5 mm

takes the *skin effect* into account. Ulbricht [79] reported fully on this, and established frequency dependencies, as illustrated in figs. 122 and 123.

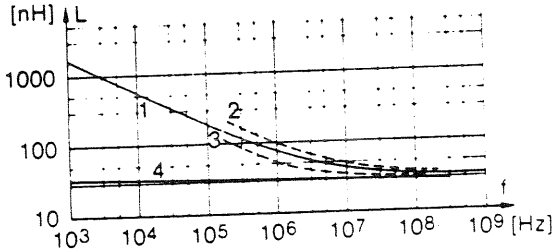
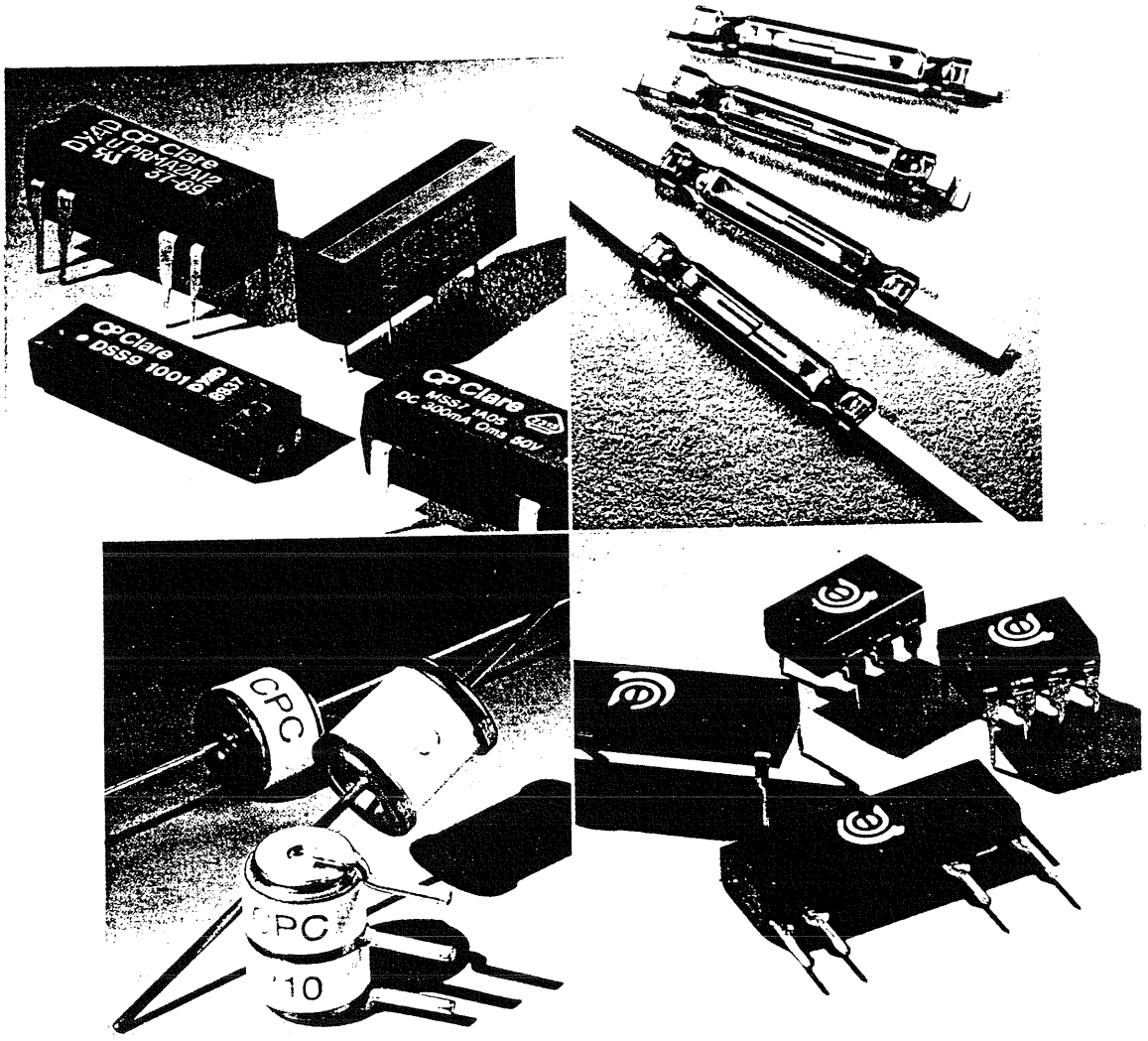


Fig. 123: Frequency dependance of inductance for miniature reed contact
1)* Calculated curve for a single strand NiFe (50/50) wire
l = 45 mm; d = 0.5 mm
2)* Measured curve — low frequency contact
l = 45 mm
3)* Measured curve — high frequency contact
l = 45 mm
4)* Calculated curve for a single strand copper wire
l = 45 mm; d = 0.5 mm
* Please check diagram carefully

Lars Hellberg.

CP Clare CORPORATION

Catalog 220



Electromagnetic Relays
Solid State Switches
Reed Switches
Surge Arresters
Display Components

Clare
Reed Switches

What is a Reed Switch?

The basic reed switch consists of a pair of low reluctance ferro-magnetic reeds, which overlap at their free ends—the contact area. The reeds are hermetically sealed in a narrow glass tube to protect the contact area from contamination by external effects of dust, moisture, oils, etc. When a magnetic field is brought in proximity to the reeds, the extreme ends assume opposite magnetic polarity. When the magnetic field is strong enough (typically 300-3000 guass), the overlapping ends attract and are brought together, completing an electrical circuit. When the field is removed, the reeds separate by their own spring tension back to their original, normally open position.

The principal advantages of a reed switch include:

- Hermetically sealed contacts
- Low resistance when contacts are closed
- High resistance when contacts are open
- Complete isolation between input and output
- Long life where needed; predictability when only occasional actuation is required

Enhancements to Reed Technology

Since the invention of glass enclosed contacts in the late 1950's, the technique for producing them has remained the same. So much the same that there are commonly identified issues with using reeds.

CP Clare Corporation has addressed each of these issues. The FR2 series is not just another reed switch. Immediate improvements in end product reliability, production yields, and switching characteristics at low level loads (12V, 10-30mA) can be experienced with this switch.

Advantages specific to the Clare FR2 series reed switch include:

- Flexible leads can be bent or formed without special fixturing, and without breaking or stressing the switch.
- Flat reed design provides a larger surface area for weld, solder or crimp joints, resulting in stronger, more reliable connections.
- Flat glass/flat blade allows the designer to define the orientation of the reeds, increasing the switch ability to absorb shocks or vibrations.
- Flat leads provide the capability for surface mounting; it is compatible with vapor phase and reflow soldering processes.
- A Ruthenium contact exhibits less wear, provides stable contact resistance throughout life and exhibits virtually no tendency to cold weld or stick.

Application for Reed Switches

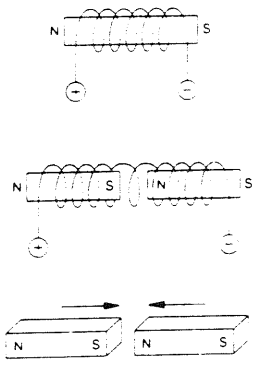
Over the past three decades, billions of reeds have been used in thousands of applications. The current trend in the design of automobiles, security systems, consumer goods and business machines is for more sophisticated electronic controls. The large degree of electronic design effort has also brought with it a need for higher levels of reliability. This increases the need for a reliable, low cost sensor to measure various parameters such as speed, position, direction and current or temperature changes. The reed switch is an economical non-contact switching alternative to the push switch, microswitch and solid state switch And where load switching requirements are microamps or milliamps, the reed switch is an ideal solution.

Clare
Reed Switches

Operation of a Reed Switch Permanent Magnet and Electromagnetic Coil Actuation

The reed switch depends upon an induced magnetic field for its operation. Reed switches are activated by the presence of a magnetic field with sufficient flux to pull the reed blades together.

This can be accomplished by either using a permanent magnet—bringing the magnet close to the switch to turn it on—or by energizing an electromagnetic coil that is mounted around or near the switch. The balance of this page will review the actuating characteristics of a reed switch via these two methods.



Coil Actuation

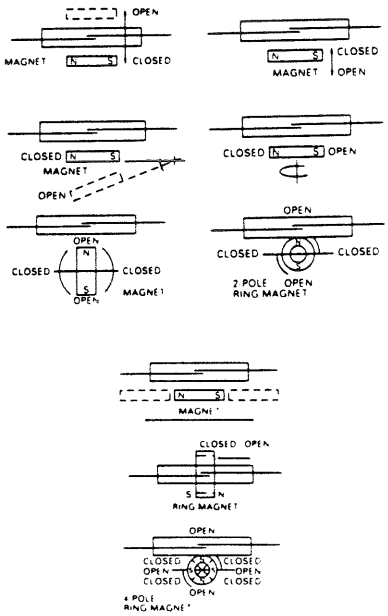
The operation of a reed switch via an electromagnetic coil provides the designer with a method of actuation from a remote source. This is a very simple method of actuation.

When the reed switch is placed inside or close to a coil of wire and a current is passed through the coil, each lead of the reed switch becomes strongly magnetized. One end of the reed switch will become a north pole and the other a south pole. Because the reed blades overlap in the center of the glass housing, with a few thousandths of an inch separating the overlapping ends, each lead will have a north and south pole. The overlapping reed blades come together (close) when the electrical current generates sufficient magnetic flux in the coil. When the current to the coil is turned off, the reed blades return to their open condition.

The efficiency of the reed switch actuation is largely dependent upon the coil. The size, shape, wire type, and the number of turns of wire on the coil determines its efficiency. In addition, the proximity of the switch to the coil determines the efficiency of the coil (ie, if the switch is placed inside or very close to the coil, the coil requires little current to actuate the switch. The farther the switch is from the coil, the more magnetic flux the coil must generate to cause switch closure). Two or more switches can be actuated by a single coil.

Permanent Magnet Actuation

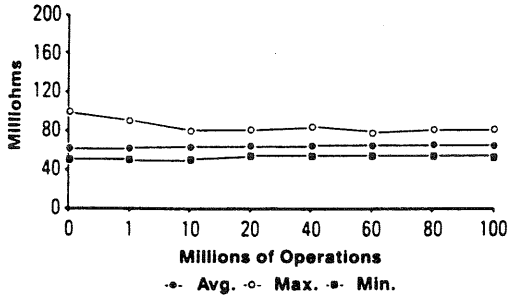
A permanent magnet is the most common means of operating the reed switch. As with a coil, to actuate the reed switch, a magnet and switch must be positioned within a specific proximity of each other. This distance is related to the sensitivity of the switch and the strength of the magnet. For the normally open reed switch, when the magnetic field is close enough the contacts will close and when the magnetic field is taken away, the contacts will open. There are many ways to use a permanent magnet to actuate the reed switch. Below we have addressed the most popular techniques.



Reed Switch
Operating Specifications

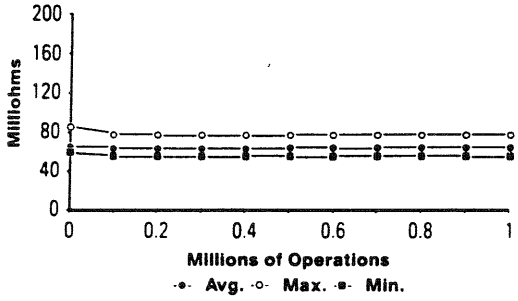
Contact Resistance vs. No. of Operations

Quantity 56
Load 10V 12mA, 350Hz



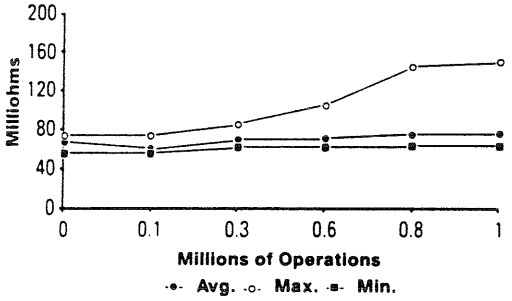
Contact Resistance vs. No. of Operations

Quantity 56
Load 15V 300mA, 12Hz



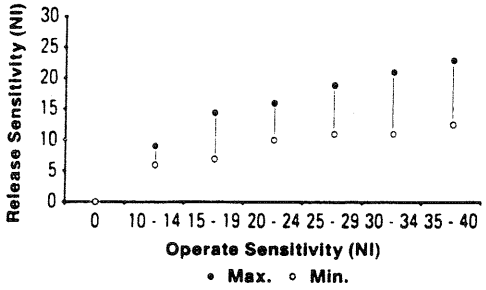
Contact Resistance vs. No. of Operations

Quantity 56
Load 48V 100mA, 5Hz



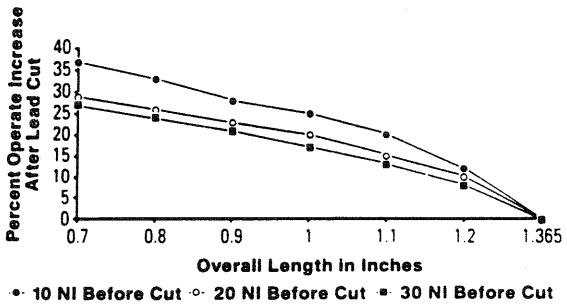
Operate NI vs. Release NI

Quantity 150,000
Test Coil: NARM I



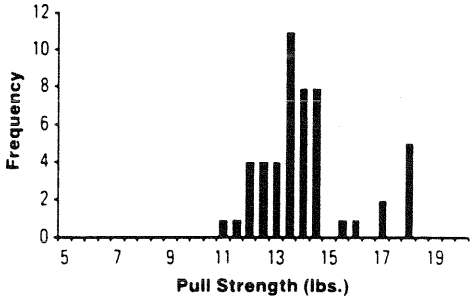
Operate Shift After Lead Trimming

Quantity 100 ea.



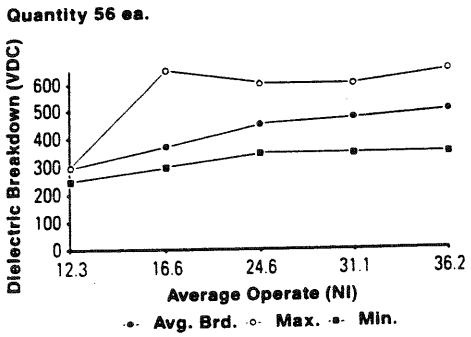
Pull To Fracture Test Distribution

Quantity 50
15-25 NI Operate

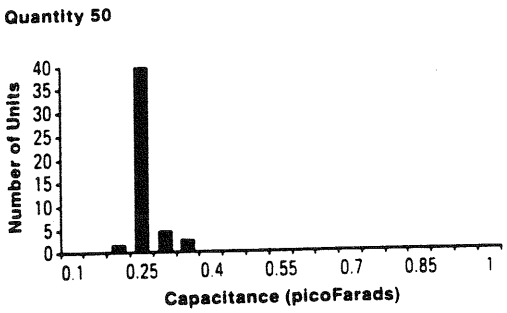


Reed Switch
Operating Specifications

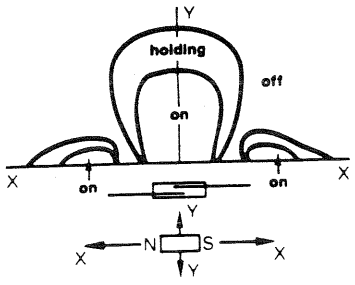
Dielectric Breakdown vs. Operate Sensitivity

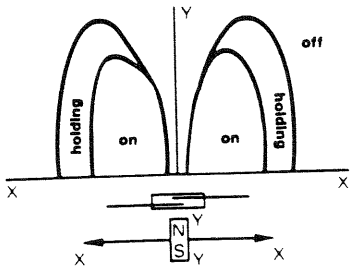


Capacitance Across Open Contacts



Permanent Magnet Actuation





Permanent Magnet Activation Distance (N.O. Contacts)