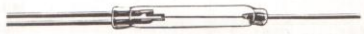
HAMLIN

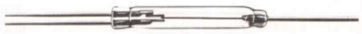
# Mini/Tiny/Compact- and Miniature, Mercury-wetted change over Contacts Form C

**MDRR-DT** M ≈ 1 : 1
Miniature changeover switch which, because of its small size, is ideal for DIL-Relays.



**DLC-DT** M ≈ 1 : 1,65
Lower priced, commercial grade, compact form C switch.

**MRG-DT** M ≈ 1 : 1
Miniature form C switch for use with medium loads. Can be supplied with formed and unformed leads.



**DRR-DTH** M ≈ 1 : 1
Compact size pressurized form C switch.

**MDC-DT** M ≈ 1 : 1
Hg wetted changeover switch for high speed switching with low C.R. and high loads. Also ideal for dry switching. Bounce free.

**DRT-DTH** M ≈ 1 : 1,65
Compact size pressurized form C switch. Tungsten contacts make this an ideal switch for inductive loads.

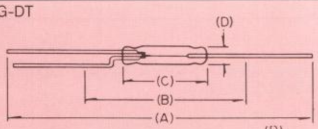
| **Specification** typical for | 30 AT | | 50 AT | 70 AT | | |
|---|---|---|---|---|---|---|
| Switch Type | MDRR-DT | MRG-DT | MDC-DT | DLC-DT | DRR-DTH | DRT-DTH |
| Switch Number | 1156 | 1151 | 1518 | 1410 | 1408 | 1407 |
| Contact Form<br>Contact Form Number | Form C<br>21 | Form C<br>21 | Form C<br>21 | Form C<br>21 | Form C<br>21 | Form C<br>21 |
| C = Center Contacts<br>0 = Off Center Contacts | 0 | 0 | 0 | 0 | 0 | 0 |
| Contact Rating (W) | 3 | 3 | 28 | 10 | 30 VA | 50 VA |
| Switching Voltage (V dc max.) | 200 | 200 | 200 | 200/220 AC | 250 | 500 |
| Switching Current (A dc max.) | 0,250 | 0,250 | 1,0 | 0,500 | 0,500 | 1,5 |
| Initial Contact Resistance (Ω) | 0,150 | 0,150 | 0,050 | 0,150 | 0,075 | 0,500 |
| Breakdown Voltage min. (VDC) | 200 | 200 | 1.000 | 350 | 1.000 | 1.000 |
| Capacitance typical (pF) | 1,0 | 1,0 | 1,0 | 3,0 | 3,0 | 3,0 |
| Insulation Resist. typical min. (Ω) | $10^9$ | $10^9$ | $10^9$ | $10^8$ | $10^8$ | $10^8$ |
| Shock (g) | 100 | 100 | on request | 100 | 100 | 100 |
| Resonance Freq. (Hz) | - | - | - | - | - | - |
| Operating Temp. (°C) | −40/+125 | −40/+125 | −35/+80 | −20/+125 | −20/+125 | −20/+125 |
| Storage Temp. (°C) | −65/+200 | −65/+200 | −65/+125 | −65/+200 | −65/+200 | −65/+200 |
| Stock Pull in Range AT | 20-50 | 20-60 | 55 | 50-100 | 50-115 | 55-110 |
| Normal Tolerance AT | ± 7,5 | ± 7,5 | ± 15 | ± 15 | ± 7,5 | ± 7,5 |
| Drop out Characteristics | Normal | Normal | Wide | Normal | Normal | Normal |
| Operate Time incl. Bounce ms. typical (Mercury Switches - No Bounce) | N.O. 1,0<br>N.C. 1,5 | N.O. 1,0<br>N.C. 1,5 | N.O. 2,0<br>N.C. 1,5 | N.O. 2,0<br>N.C. 5,0 | N.O. 2,0<br>N.C. 5,0 | N.O. 2,0<br>N.C. 4,0 |
| Test Coil | L-4989 | L-4989 | L-4989 | L-4988 | L-4988 | L-4988 |

**Dimensions** (in mm, ( ) — in inches)

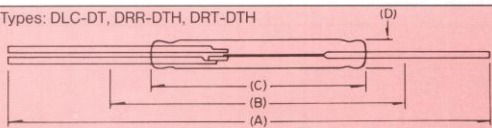
| | MDRR-DT | MRG-DT | MDC-DT | DLC-DT | DRR-DTH | DRT-DTH |
|---|---|---|---|---|---|---|
| A=Overall Length - nom. | 52,7 (2.08) | 54,0 (2.12) | 40,7 (1.6) | 85,7 (3.37) | 85,7 (3.37) | 85,7 (3.37) |
| B=Trim Length - min. | 17,5 ( .68) | 18,7 ( .73) | 18,9 ( .75) | 42,9 (1.68) | 42,9 (1.68) | 42,9 (1.68) |
| C=Glass Length - max. | 14,3 ( .56) | 15,5 ( .61) | 15,8 ( .61) | 39,7 (1.56) | 39,7 (1.56) | 39,7 (1.56) |
| D=Glass Diameter max. | 2,7 ( .10) | 3,3 ( .12) | 3,3 ( .13) | 5,6 ( .22) | 5,6 ( .22) | 5,6 ( .22) |

## Single Pole Double-Throw – Form C

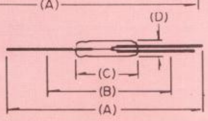
Types: MRG-DT



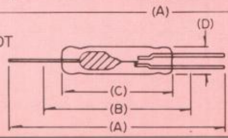

Types: DLC-DT, DRR-DTH, DRT-DTH




Types: MDRR-DT



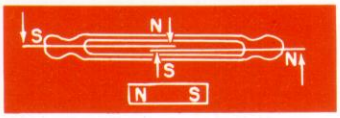

Types: MDC-DT



# What are magnetic Reed Switches?

A basic magnetic reed switch consists of a pair of low reluctance, ferromagnetic, slender flattened reeds, hermetically sealed into a glass tube with a controlled atmosphere in cantilever fashion so that the ends align and overlap – but with a small air gap.

Since the reeds are ferromagnetic, the extreme ends will assume opposite magnetic polarity when brought into the influence of a magnetic field. When the magnetic flux density is sufficient, the attraction forces of the opposing magnetic poles overcome the reed stiffness causing them to flex toward each other and make contact. This operation can be repeated millions of times at extremely high speeds.




# Reed Switches offer the following advantages

**Reliability**
Hermetically sealed contacts in a clean atmosphere are unaffected by dust, corrosion, or oxidation, and design allows no opportunity for sticking, binding, or wearing of hinged joints.

**Long Life**
With proper circuitry, magnetic reed switches can offer a life span in excess of 100 million operations.

**Speed of Operation**
Although slower than transistorized logic, it is sufficiently faster than conventional relays to allow use in high speed switching applications.

**Packaging**
Provides package density which approaches that of its solid state counter-part, but is far greater than is available with conventional relays.

**Price Advantage**
When compared to transistorized logic, the necessary coupling circuitry between the logic and input and output devices is less complicated and less expensive.



# Operating Magnetic Reed Switches

Magnetic reed switches are actuated by the presence of a magnetic field with sufficient flux. This can be accomplished by either bringing a permanent magnet close to the switch, or by energizing an electromagnetic coil which is mounted around or near the switch.

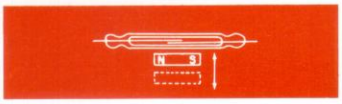
# Permanent Magnet Actuation

A permanent magnet is the most common source for operating the magnetic reed switch. The method used to position the magnet depends upon the switching requirement, but it is usually accomplished in one (or a combination) of four basic techniques: proximity motion, rotation, shielding, and biasing.

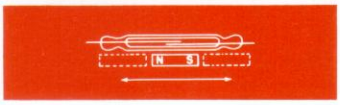
# Proximity Motion

In all systems, magnet and switch must be brought to within a specific proximity of each other. This distance will vary in accordance with the sensitivity of the switch and the strength of the magnet. When the magnet is close enough, the normally open contacts will close or pull-in. When the magnet is taken away, the contacts will open or drop-out. The relative distance for pull-in is always less than that for drop-out.

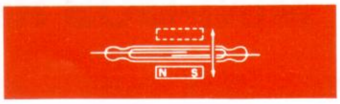
**Examples of proximity motion switching are shown below:**




**Perpendicular Motion**
Provides only one switch closure with maximum magnet movement.




**Parallel Motion**
Provides as many as three closures with maximum magnet travel. Allows one closure with minimum magnet travel.

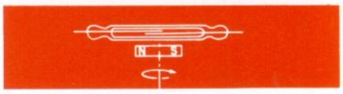



**Front to Back Motion**
Somewhat similar to parallel motion, except magnet motion is at right angles to switch and provides only one switch closure with maximum magnet travel.


**Pivoted Motion**
Large angular magnet travel necessary to achieve one switch closure.

# Rotation

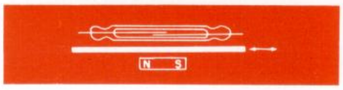
Revolving the magnet or switch normal to their axes will result in two switch closures per revolution. When these axes are parallel, the switch closes. When the axes are perpendicular, the switch opens. Although the poles reverse, they still induce the opposite poles that close the switch.




**Rotary Motion**
Magnetic polarity is reversed – two switch closures for each complete revolution.

# Shielding

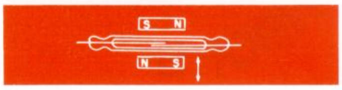
In this type of actuation, magnet and switch are permanently fixed in such a position that the switch contacts are closed. A piece of ferromagnetic material is passed between the magnet and switch to cause drop-out. The magnetic field is shunted, eliminating the attraction between the reeds. When the shield is removed, the switch closes.




**Shielding**
Switching by removal of shield. The shield short circuits the magnetic flux, preventing formation of a field at the switch.

# Biasing

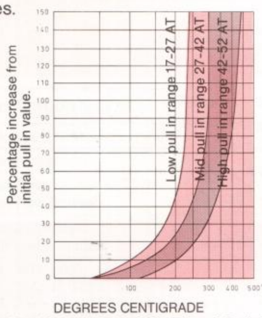
A biasing effect is produced by placing a stationary magnet near the switch to keep it normally closed. The approach of another magnet with reversed polarity cancels the magnetic lines of force, and the switch opens.



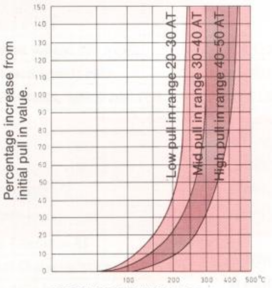

**Biasing**
Bias magnet holds switch closed until actuating magnet cancels magnetic flux and opens switch.

## Temperature — effect on pull-in

Increased temperature causes a change in the atomic structure of the alloy used for magnetic reed switch leads reducing their magnetic properties until the switch fails to close. The switch may open if closed prior to temperature elevation. The accompanying graphs show typical sensitivity changes for MSR-MR and MR-DT type switches. Intermittent and erratic switch operation may be expected at temperatures where the data line approaches a vertical direction.
It should be noted that in every case more sensitive switches are stable to higher temperatures and should be recommended over higher pull-in switches. Write for Hamlin Bulletin D-00600 for further data on other switch types.




**Typical "miniature" Form A SPST Reed Switch**

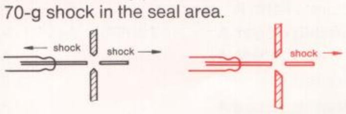



**Typical "miniature" Form C SPDT Reed Switch**

## Physical Modifications

### Cutting

Cutting the leads of a reed switch removes low reluctance iron and introduces high reluctance air into the magnetic circuit, much the same as adding resistance to an electrical circuit. The result is that a greater number of equivalent ampere turns is required to close a switch of a given sensitivity after cutting.
Physical problems involved in cutting a reed switch include proper support between the cutting point and the glass-to-metal seal to prevent seal breakage. It is recommended that end nippers, rather than conventional wire cutters be used. Wire cutters may produce as much as 70-g shock in the seal area.

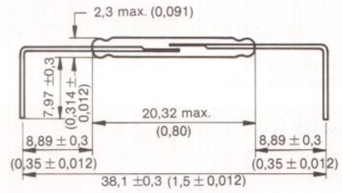



**Wire Cutters** **End Nippers**

### Dimensioning

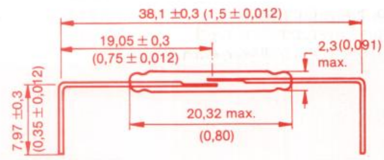
Illustrated are two methods for dimensioning the same modification. The top illustration presents an unlivable situation to the set-up man because the glass length and its position relative to the gap vary greatly between switches. Compared to the precise dimensions of the reeds, it is unadvisable to use the envelope as a reference point. A common error is stacking three dimensions to come up with a toleranced overall length. This is quite an accomplishment especially when one dimension is specified as "maximum".

**Incorrect**




Dimensions in mm, () = inches

**Correct**



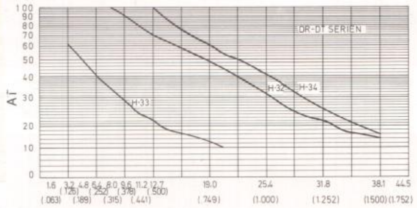

The lower figure has all the necessary dimensions referenced either from the air gap or the reed, both of which can be held with close tolerances. The bends are set up equally from the magnetic center of the switch which is located at the air gap. If a magnet is used for actuation the operating point for switches with the same pull-in value will be uniform. A switch dimensioned in this manner can have leads cut and formed in one operation. The number of measurements required to inspect the modified switch is minimized.

### Magnetic Actuation:

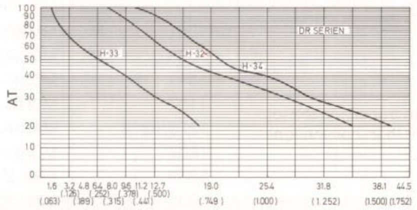
The following data was compiled to assist in determining the correct sensitivity of a magnetic reed switch when used with a given magnet and required to operate at specific distances.

### Example:

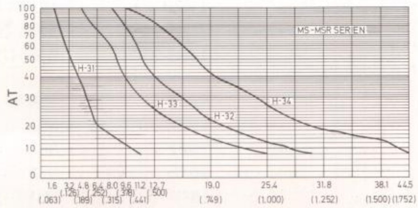
Using an H-31 magnet, an MSR type switch is required to pull-in before the magnet gets to within 1/8" of the switch and drop-out before the magnet switch distance is 3/8". At 1/8" the equivalent field is equal to approximately 53 AT and at 3/8" it is 11 AT. Therefore a switch specification of 53 AT maximum pull-in and 11 AT minimum drop-out could be used. The pull-in drop-out charts for the various switches should then be consulted to select the best switch.
All measurements were taken with the magnet parallel to the switch and centered on the contacts. Graph applies only to a full length switch. All data is approximate. For additional data refer to Hamlin Bulletins E-00300A and F-00300.




Distance in mm, ( ) = in inches



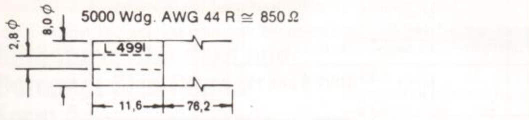

Distance in mm, ( ) = in inches



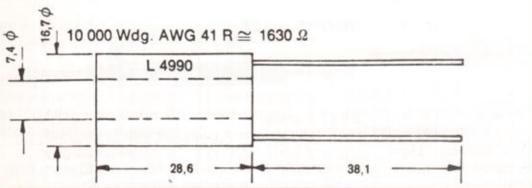

Distances in mm, ( ) = in inches

# Test coils

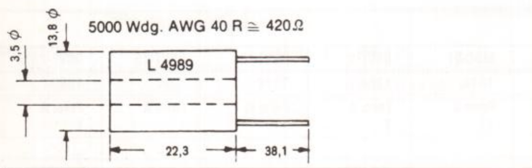
L 4991



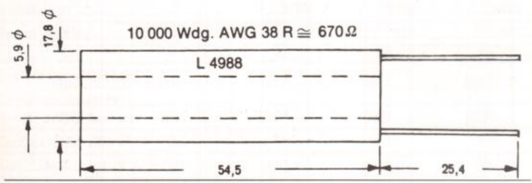

L 4990




L 4989




L 4988

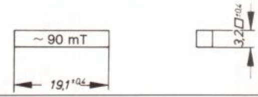



# Permanent magnets (Alnico or Ticonal 600)

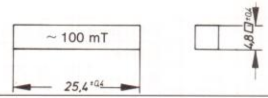
**Rectangular magnets**

**H 31**

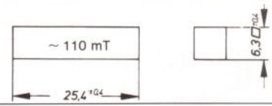

**H 33**




**H 32**

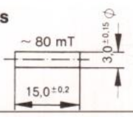



**H 34**

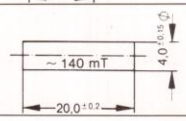



**Round magnets**

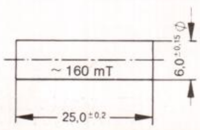
**315**




**420**




**625**




# Consider these points before specifying a particular reed switch

A) Glass Size (length and diameter)
B) Overall Switch Size (including leads)
C) Resistive, Inductive or Capacitive Load
D) Voltage and Current to be Switched
E) Method of Actuation
   1. Permanent Magnet 2. Coil
F) Life Expectancy
G) Physical Modifications (cutting or forming the leads)
H) Electrical Modifications (special operate and release characteristics)
I) Contact Protection (capacitive, inductive loads) – capacitor discharge, lamp-loads.

**For switches not listed in this catalgue please contact HAMLIN.**

# HAMLIN OFFERS

### Factory Modifications

Physically modifying a reed switch can be very costly if not done properly. Switch breakage, seal degradation and bent leads are just a few of the many problems encountered when modifying a reed switch. Hamlin has standard forming and cutting operations already set-up. Tooling is complete so lead times are shorter if the form or cut is a standard, and generally no tooling charge is involved. Check with our Application Engineering Department before you finalize that drawing. We may be able to save you time and money.

### Special Packaging

Units are available from Hamlin that are already potted. (See illustration) This packaging permits bending or cutting the leads without the support or care used with conventional reed switches because the glass capsule is completely protected.

For more information consult our Application Engineering Department or your local Hamlin representative.

### Application engineering assistance

Hamlin offers engineering assistance to help you in selecting the proper reed switch for your application. Our Application Engineers will work with you to insure your circuit, size, cost, etc., requirements are taken into consideration before recommending a reed switch for your application. Consult our Application Engineering Department before a switch is "designed in."

Hamlin offers the industry's finest selection of reed switches and very capable engineering assistance to help with your application.

### Welding and Soldering

In some instances, neither cutting nor forming can provide the required lead configuration, and welding or soldering additional material to the leads is the only answer. The leads of a standard reed switch are composed of approximately 50 % nickel and 50 % iron. These leads are plated after assembly with either gold or tin to improve weldability and solderability. Welding is preferred to soldering because less heat travels to the seal area.

The coefficients of thermal expansion of the leads and glass are closely matched, but welding and soldering heat the wire more quickly than the glass. The result is that metal expansion can loosen or crack the glass-to-metal seal. Properly heat-sinked welding fixture and optimized welding cycles can produce strong bonds without seal degradation.

### Forming

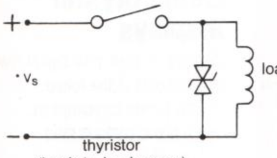
Many of the same rules that pertain to cutting also apply to forming. Stops or guides that use the end of the seal as a reference point for forming can lead to damaged seals.
Also, using the seal as a dimensional reference point, invariably results in variation of the lead dimensions. The recommended practice is to use the end of a lead as a reference.

Support must be provided between the end of the seal and the form. A clamping device is usually recommended because as the lead is bent stress must not be transferred to the seal area.
This approach also allows for normal variations in glass envelope length and the distance between seal and lead ends.

## ARC Suppression

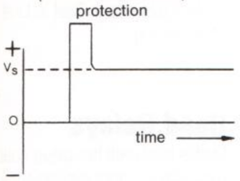
In order to keep the contacts within the voltage or current ratings stated, it is often necessary when switching lamp, capacitive or inductive circuits to use some form of transient suppression:

### D. C. Inductive

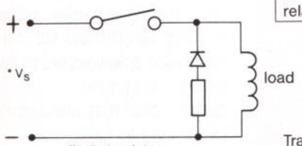



thyristor
(back-to-back zener)
protection

Transient voltage is equal to thyristor voltage. Transient time is shortest for a given maximum voltage transient.

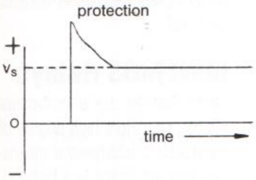


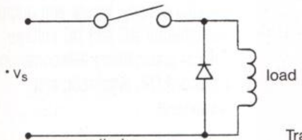

Notes:
*$V_s$ is DC source. Voltage wave forms are observed across relay contacts.




diode/resistor
protection

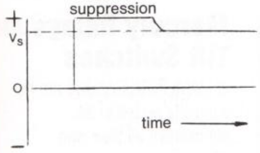
Transient voltage is equal to current at opening x resistance. Transient time is short. Best trade-off of price/$V_s$ performance.



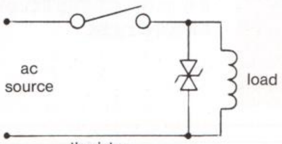




diode
suppression

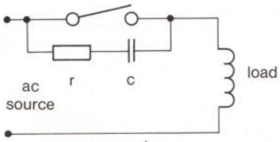
Transient voltage is equal to forward drop of diode. Transient time is long.




### A. C. Inductive

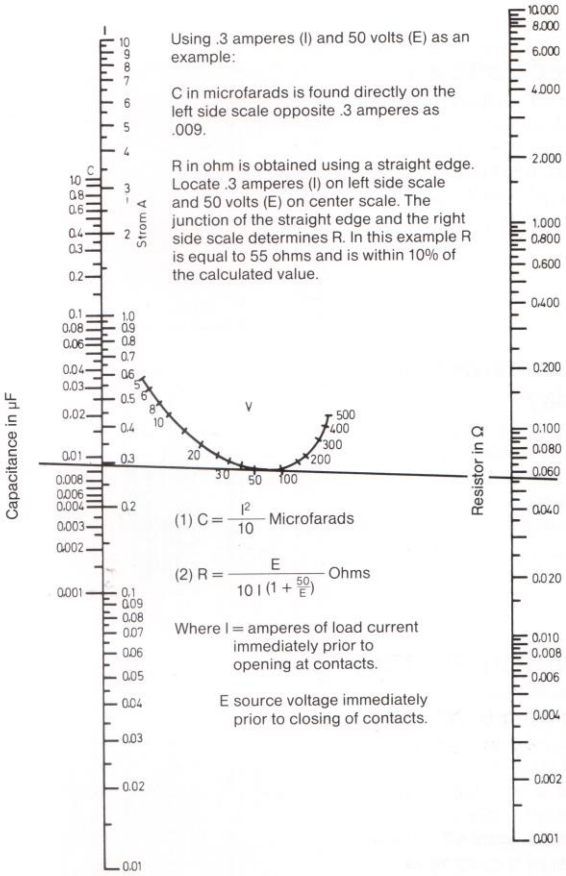



thyristor
(back-to-back zener)
protection




rc suppression

## Nomograph for Contact Protection




Using .3 amperes (I) and 50 volts (E) as an example:

C in microfarads is found directly on the left side scale opposite .3 amperes as .009.

R in ohm is obtained using a straight edge. Locate .3 amperes (I) on left side scale and 50 volts (E) on center scale. The junction of the straight edge and the right side scale determines R. In this example R is equal to 55 ohms and is within 10% of the calculated value.

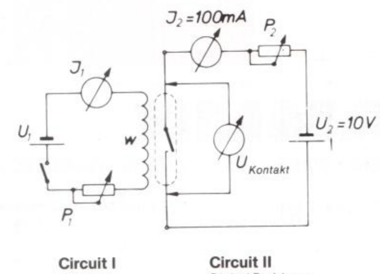
(1) $C = \frac{I^2}{10}$ Microfarads

(2) $R = \frac{E}{10\,I\,(1 + \frac{50}{E})}$ Ohms

Where I = amperes of load current immediately prior to opening at contacts.

E source voltage immediately prior to closing of contacts.

## Test circuit for PI/DO/CR




**Circuit I**
AT Range

**Circuit II**
Contact Resistance