MAGNETIC PRODUCTS

# DATA HANDBOOK

## Dry-reed Switches

BOOK MA04 1993

Philips Components


PHILIPS

## QUALITY ASSURED

Our quality system focuses on the continuing high quality of our components and the best possible service for our customers. We have a three-sided quality strategy: we apply a system of total quality control and assurance; we operate customer-oriented dynamic improvement programmes; and we promote a partnering relationship with our customers and suppliers.

## PRODUCT SAFETY

In striving for state-of-the-art perfection, we continuously improve components and processes with respect to environmental demands. Our components offer no hazard to the environment in normal use when operated or stored within the limits specified in the data sheet.

Some components unavoidably contain substances that, if exposed by accident or misuse, are potentially hazardous to health. Users of these components are informed of the danger by warning notices in the data sheets supporting the components. Where necessary the warning notices also indicate safety precautions to be taken and disposal instructions to be followed. Obviously users of these components, in general the set-making industry, assume responsibility towards the consumer with respect to safety matters and environmental demands.

All used or obsolete components should be disposed of according to the regulations applying at the disposal location. Depending on the location, electronic components are considered to be 'chemical', 'special' or sometimes 'industrial' waste. Disposal as domestic waste is usually not permitted.

# Dry-reed Switches

## DEFINITIONS

| **Data sheet status** | |
|---|---|
| Objective specification | This data sheet contains target or goal specifications for product development. |
| Preliminary specification | This data sheet contains preliminary data; supplementary data may be published later. |
| Product specification | This data sheet contains final product specifications. |
| **Limiting values** | |
| Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of this specification is not implied. Exposure to limiting values for extended periods may affect device reliability. | |
| **Application information** | |
| Where application information is given, it is advisory and does not form part of the specification. | |

## LIFE SUPPORT APPLICATIONS

These products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. Philips customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Philips for any damages resulting from such improper use or sale.

# SELECTION GUIDE

**Table 1** Type selection on electrical and magnetic characteristics.

| OPERATE RANGE (note 1) (At) | RELEASE RANGE (note 1) (At) | MAXIMUM SWITCHED POWER (W) | MAXIMUM SWITCHED CURRENT (mA) | MAXIMUM SWITCHED VOLTAGE | | TYPE NUMBER | PAGE |
|---|---|---|---|---|---|---|---|
| | | | | DC (V) | AC (V) | | |
| **General purpose micro-reed** | | | | | | | |
| 8 to 70 | 4 to 32 | 10 | 500 | 200 | 140 | RI-23 series | 25 |
| **High power micro-reed** | | | | | | | |
| 8 to 16 | 4 to 14 | 10 | 750 | 200 | 140 | RI-25AAA | 35 |
| 14 to 32 | 7.5 to 22 | 15 | 1 000 | 200 | 140 | RI-25 series | 35 |
| 28 to 70 | 12 to 32 | 25 | 1 000 | 200 | 140 | RI-25 series | 35 |
| **Close differential micro-reed** | | | | | | | |
| 14 to 23 | typ. 80% of the operate value | 15 | 1 000 | 200 | 140 | RI-26AA | 47 |
| 18 to 32 | typ. 75% of the operate value | 15 | 1 000 | 200 | 140 | RI-26A | 47 |
| 28 to 52 | typ. 70% of the operate value | 20 | 1 000 | 200 | 140 | RI-26B | 47 |
| **General purpose pico-reed** | | | | | | | |
| 10 to 19 | 4 to 16 | 10 | 500 | 180 | 130 | RI-27AAA | 57 |
| 16 to 34 | 5 to 19.5 | 10 | 500 | 200 | 140 | RI-27 series | 57 |
| **High power pico-reed** | | | | | | | |
| 16 to 25 | 5 to 18 | 15 | 1 000 | 200 | 140 | RI-29AA | 67 |
| 20 to 34 | 7 to 19.5 | 20 | 1 000 | 200 | 140 | RI-29A | 67 |
| **Main voltage micro-reed** | | | | | | | |
| 27 to 59 | 8 to 21 | 40 | 1 000 | – | 250 | RI-45 | 77 |
| **High power micro-reed** | | | | | | | |
| 10.5 to 28 | 4 to 16 | 30 | 1 000 | 200 | 250 | RI-46 series | 85 |
| 24 to 70 | 8 to 22.5 | 40 | 1 000 | 200 | 250 | RI-46 series | 85 |

**Note**

1. Basic magnetic characteristics measured with the Philips standard coil.

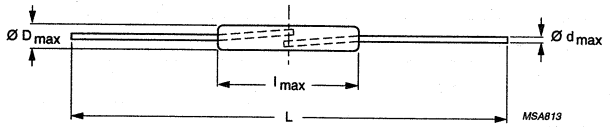



Fig.1 Outline dry-reed switch, for dimensions see Table 2.

**Table 2** Type selection on dry-reed switch dimensions (see Fig.1).

| $\phi$ $d_{max}$ (mm) | $\phi$ $D_{max}$ (mm) | $l_{max}$ (mm) | L ± 0.5 (mm) | TYPE NUMBER | PAGE |
|---|---|---|---|---|---|
| 0.60 | 2.54 | 15 | 46 | RI-23 series | 25 |
| 0.60 | 2.54 | 15 | 46 | RI-25 series | 35 |
| 0.60 | 2.54 | 15 | 46 | RI-26 series | 47 |
| 0.50 | 1.8 | 13.5 | 46 | RI-27 series | 57 |
| 0.50 | 1.8 | 13.5 | 46 | RI-29 series | 67 |
| 0.65 | 2.7 | 21.5 | 54.8 | RI-45 | 77 |
| 0.65 | 2.7 | 21.5 | 54.8 | RI-46 series | 85 |

# GENERAL

## DESCRIPTION

A dry-reed switch assembly contains ferromagnetic contact blades, hermetically sealed in a glass envelope which is filled with an inert gas. The switch is operated by an externally generated magnetic field, either from a coil or permanent magnet.

## FEATURES

- Long life
- Contacts isolated from the environment
- Excellent glass-to-metal seal
- Ambient operating temperature −55 to +150 °C
- Low operating power
- Plated or sputtered ruthenium on diffused gold for very low and stable contact resistance
- Better than $10^{12}$ Ω open resistance
- Low cost compared with other magnetic devices
- UL recognition for the following types: RI-23; RI-25; RI-27; RI-29 and RI-46.

## APPLICATIONS

Dry-reed switches may be used in a wide range of applications, including:

- Reed relays, for use in
  - Audio and video equipment
  - Automatic test equipment (ATE)
  - Broadcast equipment
  - Copy machines
  - Motor transport
  - Data processing equipment
  - Domestic appliances
  - Facsimile equipment
  - Measuring and test equipment
  - Military applications
  - Modems
  - Aircraft
  - Security systems
  - Smoke detectors
  - Telephony.
- Keyboards, for use in
  - Computers
  - Military equipment
  - Terminals
  - Telephones
  - Vending machines.
- Key switches, for use in
  - Audio and video equipment
  - Domestic appliances
  - Pocket torches.
- Automotive applications, for use with
  - Cruise control
  - Level detectors
  - Light control
  - Safety belt sensors
  - Tacho-meters and speedo-meters.
- Proximity switches, for use in
  - Conveyors
  - Elevators
  - Escalators
  - Pneumatic cylinders
  - Robots.
- Security system applications, used in
  - Door sensors
  - Window sensors
  - Position sensors.
- Human implantation, for use in
  - Pace-makers.
- Games and toys, for use in
  - Chess boards
  - Dolls
  - Trains.
- Miscellaneous applications, including
  - Automatic change machines
  - Flow sensors
  - Float sensors
  - Power meters
  - Thermostats
  - Domestic machines.

## CUSTOMIZED DRY-REED SWITCHES

In addition to the standard products described in this publication, the following features can be supplied:

- Operate ranges to customer specification
- Preformed leads
- Leads tinned to the glass envelope (with exception of the RI-45 and RI-46 series)

**DEFINITIONS** (based on IEC 255-9)

**Dry-reed switch**

A dry-reed switch is an assembly containing ferromagnetic contact blades, hermetically sealed in a glass envelope and operated by an externally-generated magnetic field, e.g. that from an actuating coil.

**Must-not-operate value**

The must-not-operate value is the stated limit of the applied magnetic field at which the dry-reed switch shall not operate (see Fig.1).

**Must-operate value**

The must-operate value is the stated limit of the applied magnetic field at which the dry-reed switch shall operate (see Fig.1).

**Operate time**

The operate time is the time between the instant of application of a magnetic field to a dry-reed switch and the instant of the first physical closing of this switch. The operate time does not include bounce time.

**Must-not-release value**

The must-not-release value is the stated limit of the applied magnetic field at which the operated dry-reed switch shall remain physically closed (see Fig.1).

**Must-release value**

The must-release value is the stated limit of the applied magnetic field at which the closed dry-reed switch shall physically release (see Fig.1).

**Release time**

The release time is the time between the instant of removal of an applied magnetic field to a dry-reed switch and the instant of the first physical opening of this switch. The release time does not include bounce time.

**Bounce**

Bounce is a momentary opening of a switch after initial closing, or a momentary closing after initial opening.

**Bounce time**

The bounce time is the interval of time between the instant of initial closing (or opening) and the instant of final closing (or opening) of the dry-reed switch.

**Dry-reed switch contact resistance**

The dry-reed switch contact resistance is the resistance of the dry-reed switch under specified conditions of measurement.

**Saturate value**

The saturate value is the arbitrary defined value of the applied magnetic field at which the dry-reed switch is unaffected by further increase of the applied magnetic field (see Fig.1).

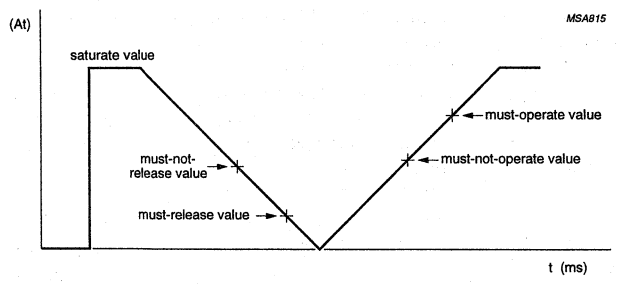



Fig.1 Graphical representation of parameters.

## CHARACTERISTICS

### Operate and release values

Operate and release values are dependent on the measuring coil, the rate of energization (0.1 At/ms), the detection of the operate (closing) and the release (opening) moment, the position of the measuring coil relative to the earth's magnetic field and on the environmental conditions.

### Operate and release times

The operate and release times are dependent mostly on the energization and de-energization rate.
They are proportional to the R/L time of the coil. Operate time is inversely proportional to the ratio of energization to operate value. Release time is proportional to the ratio of energization to release value.

### Bounce time

The bounce time is almost independent of the energization, however, a high energization gives a somewhat shorter bounce time. The bounce time is dependent on the current to be switched; above approximately 100 mA the bounce time is almost zero.

### Contact resistance

The contact resistance is dependent on the wire diameter, energization and contact layer. The published contact resistance is measured with an open contact voltage of 20 mV and a current through the closed contacts of 10 mA, using the 4-point method (Kelvin method).

### Breakdown voltage

The breakdown voltage depends on the gap between the contact blades, gas pressure, material of the contact layer and the availability of free electrons in the gas. The first three items are set by the design of a particular reed switch. The last item is very dependent on ambient conditions. Therefore minimum values are given in the published data.

### Insulation resistance

The insulation resistance is dependent on the condition of the inside of the glass envelope and on the environment, e.g. relative humidity, conducting layers on the outside of the glass envelope.

### Life expectancy

The life of a dry-reed switch is influenced by the contact layer, the wire diameter, the load, the load circuit parameters and the applied magnetic field. The contact layer and the wire diameter are determined by the manufacturer. Load, load circuit parameters and magnetic field are determined by the user. The load should be within the maximum published values. The load circuit parameters, e.g. wiring capacitance and inductance, should be kept as low as possible and the applied magnetic field must be stronger than necessary for obtaining the maximum must-operate value.

### Note:

Owing to the influence of the load circuit upon contact resistance and sticking, and also the influence of the applied magnetic field and used coil or magnet, life-test information can only be compared when they are the result of testing under exactly the same conditions (test equipment).

## APPLICATION NOTES

### Cutting and bending

Ensure that the glass-to-metal seals are not stressed while cutting and bending the leads. Shocks should be avoided. Cutting and bending the leads increases the must-operate value and the must-release value.

### Coils

Most of the electrical characteristics are measured using the Philips standard coil. The operate and release ranges are also measured using the standard MIL coil A. Using another coil may change these characteristics. The measuring method e.g. speed, detection, and the position of the coil with respect to the earth's magnetic field may also affect the characteristics. Definitions of both coils:

PHILIPS STANDARD COIL

5 000 turns of 42 SWG single enamelled copper wire on a coil former of 25.4 mm winding length and a core diameter of 8.75 mm.

STANDARD MIL COIL A ACCORDING TO MIL-S-55433B (3/4 INCH COIL)

10 000 turns of 48 SWG single enamelled copper wire on a coil former of 19.05 mm winding length and a core diameter of 4.32 mm.

The relationship between both coils is given with each dry-reed switch type.

**Calculating the magnetic field strength for a dry-reed switch in a coil**

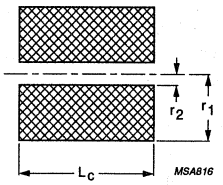



Fig.2 Calculation of the magnetic field for a dry-reed switch in a coil.

The magnetic field strength at any point x on the central axis of a coil (see Fig.2) can be calculated using the formula:

$$H_x = \frac{NI_c}{2L_c(r_1 - r_2)}\left[(x + L_c)\ln\frac{\sqrt{r_1^2 + (x + L_c)^2} + r_1}{\sqrt{r_2^2 + (x + L_c)^2} + r_2} - x\ln\frac{\sqrt{r_1^2 + x^2} + r_1}{\sqrt{r_2^2 + x^2} + r_2}\right]$$

The number of windings in the coil is calculated using the formula:

$$N = \frac{4f_{sp}L_c(r_1 - r_2)}{\pi d^2_{Cu}}$$

Coil resistance is calculated using the formula:

$$R_c = \frac{16f_{sp}\rho L_c(r_1^2 - r_2^2)}{\pi d^4_{Cu}}$$

Where:

$r_1$ outer radius of a coil (mm)
$r_2$ inner radius of a coil (mm)
$L_c$ length of a coil (mm)
$d_{Cu}$ diameter of the copper wire used in a coil (μm)
$f_{sp}$ space factor of a coil
N number of turns in a coil
$R_c$ coil resistance (Ω)
Ic coil current (mA)
ρ specific resistivity of copper (Ωcm)
$H_x$ magnetic field strength at point x ($Atm^{-1}$)

## OPERATION

A dry-reed switch is operated by an externally generated magnetic field, either using a coil or a permanent magnet.

**The operate and release actions of a dry-reed switch are dependent upon:**

- Type of dry-reed switch
- Dimensions of the dry-reed switch
- Sensitivity (operate and release values) of the dry-reed switch
- Position of the dry-reed switch with reference to the coil and/or permanent magnet
- Dimensions of the coil
- Current through the coil
- Strength of the permanent magnet
- Influence of other magnetic materials and/or fields nearby.

**Operation using a coil**

Figures 3 to 5 illustrate the various methods of operating the switch using a coil.

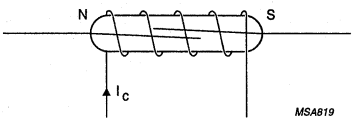



Fig.3 A dry-reed switch mounted within a coil.

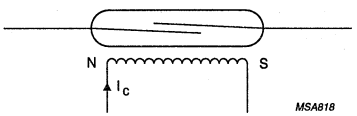



Fig.4 A dry-reed switch mounted outside a coil.

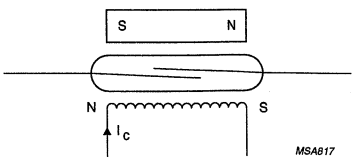



Fig.5 A dry-reed switch biased by a permanent magnet and operated by a coil.

With the method given in Fig.5, the dry-reed switch and/or permanent magnet can be placed either within or outside the coil.

**Operation using a permanent magnet**

Permanent magnets are also often used to operate dry-reed switches. Figures 6 to 9 illustrate the various methods available.

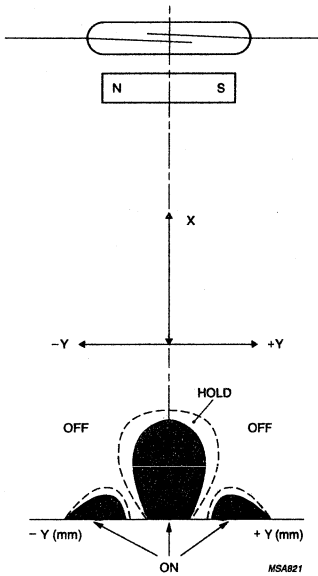



Fig.6 Movement, with the magnetic field parallel to the dry-reed switch.

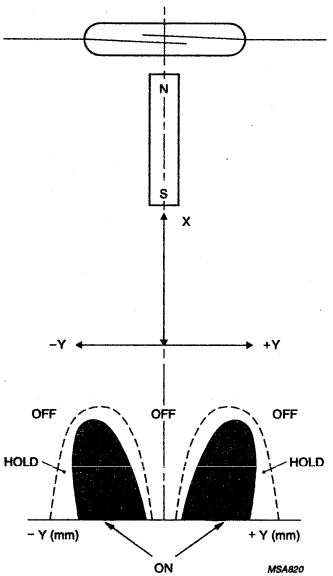



Fig.7 Movement, with the magnetic field perpendicular to the dry-reed switch.

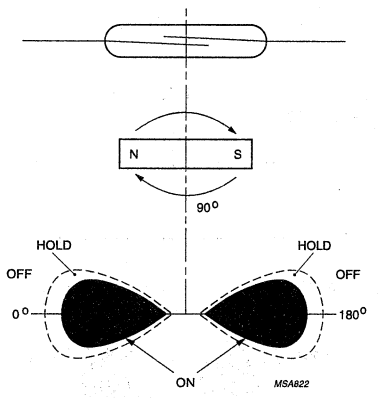



Fig.8 Rotational movement with a bar shaped permanent magnet.

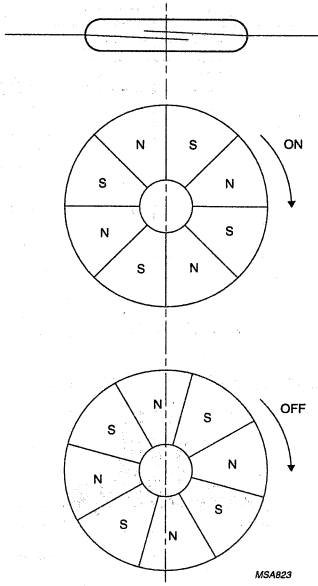



Fig.9 Rotational movement with two or more pole ring magnets.

### Shielding

Ferromagnetic materials which shunt the magnetic fields may be used to shield a dry-reed switch (see Fig.10).

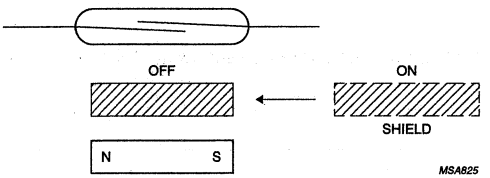



Fig.10 Shielding a magnetically operated switch.

### General

Should your application require further information, please consult your nearest Philips Components national organization.

### Contact protection

The published life-expectancy data are based on resistive loads unless stated otherwise. For inductive, capacitive or lamp loads, inrush current or reverse voltage can affect the life of a reed switch. For a maximum life-time, contact protection is advised.

### Inductive loads

To reduce the high reverse voltage produced when a reed switch opens, the following contact protection can be applied.
a) DC voltage: a diode parallel to the load or the reed switch (see Fig.11).

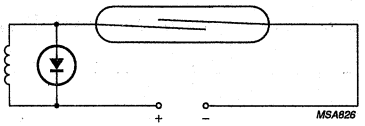



Fig.11 DC voltage contact protection.

b) AC voltage: an RC-network parallel to the load or the reed switch (see Fig.12).

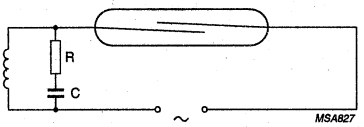



Fig.12 AC voltage contact protection.

$$C = \frac{i^2}{10} \qquad R = \frac{u}{10(1 + 50/u)}$$

C in μF and i in A
R in Ω and u in V

### Capacitive loads

To reduce the high inrush current when a cold incandescent lamp has to be switched by a reed switch (closing only), a resistor must be connected in series with the lamp or parallel to the reed switch.

**MAGNET APPLICATION**

There are many applications for dry-reed switches in combination with a permanent magnet. Figure 13 shows the relation between the Gauss values of a permanent magnet and the At values of the Philips dry-reed switches in the Philips standard coil. This allows the quick calculation of which reed switch At range can be used in combination with a permanent magnet.

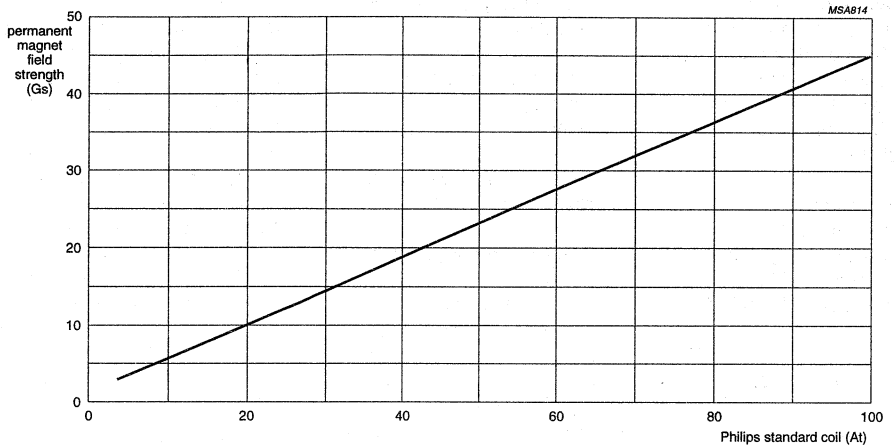



Fig.13 Relation of the field strength of a permanent magnet and the ampere-turns values of Philips dry-reed switches in the Philips standard coil.

## QUALITY

Dry-reed switches are designed for, and used in, the most demanding applications; these include computer keyboards, telephone equipment, automatic test equipment and automobiles. Thus, their quality must be exceptionally high regarding conformity and reliability aspects. This quality is built into our dry-reed switches during every stage of their design and manufacture.

Quality methods are generally in accordance with IEC Publication 68, with procedures corresponding to CECC 19 000 (although CECC release is not available).

### Organized for Quality

The exceptional quality of our dry-reed switches is founded at every stage of their design, development, manufacture and application. Responsibilities and communication paths are well defined. Quality control is independent, but integrated with production and development. The importance of continual education and training is fully recognized and implemented. The quality achieved is evident from:

- Uniform product characteristics from batch to batch
- Rugged construction
- Long life
- Low early-failure rate
- Low AQLs (from 0.065%) ensuring that only reliable products are supplied
- Process-average reject level better than AQLs.

The high quality of our dry-reed switches is constantly being improved. Our comprehensive quality improvement programme features:

- Close collaboration with customers to satisfy specific application requirements
- Production-processing spread reduction
- Stabilization of process conditions with rigorous significant change procedures
- Involvement of everyone in improvement activities
- Statistical process control
- Well understood quality indicators.

Our working environment is designed to encourage quality awareness with:

- Close collaboration between individuals and departments
- Close co-operation between Marketing, Quality, Development and Production departments
- Clearly defined responsibilities
- ISO 9000 procedures guiding all activities
- In-depth training
- High-grade support from service departments
- Effective dissemination of information at all levels.

## QUALITY PROCEDURES

Properly documented procedures are essential to the achievement, maintenance and improvement of high product quality. They help to ensure that all aspects of our dry-reed switch activity, from development to customer service, are carried out thoroughly, and that maximum information is available to refine designs and processes, and also to generate new designs.

### Release procedure

Before new dry-reed switches can be delivered, even as samples, to customers, they must be granted an approval for delivery (AFD), in accordance with our release procedure. This is obtained at a meeting including representatives from the Development, Marketing, Production and especially, Quality departments, at which data obtained from samples is reviewed.

Once AFD is granted, small scale production is sanctioned. Quality evaluation during this stage provides data for a release report. This report is examined at a release meeting, before release for (full scale) production (RFP) is granted. Release for production is also required for new cropped and/or pre-formed lead versions of existing dry-reed switches.

### Manufacturing instructions

The routing of dry-reed switches through the production process is fully documented in the manufacturing instructions for each type. These instructions also describe incoming and on-line inspection, and quality control methods and requirements.

### Calibration procedures

Accurate test and measuring equipment is an essential pre-requisite for the maintenance and improvement of product quality. Calibration procedures are laid down in the quality manual. Basic requirements include regular calibration of all

equipment, with clear reporting of accuracy.

Deviations from the required accuracy of any equipment must be clearly reported and acknowledged.
Nature of the deviation must be specified and responsibility for the equipment defined, so that its rectification can be verified.

## QUALITY REPORTING

**Quality reporting requirements are laid down for:**

- Incoming material and component inspection
- Production yield
- Sampling inspection (quality control) results
- Customer returns
- Quality improvement planning
- Process and performance changes

## QUALITY IN DRY-REED SWITCH PRODUCTION

Inspection and quality control are integrated in our dry-reed switch production. Quality control inspections are carried out both by the operators and line inspectors. The quality department monitors quality control, inspection, and process conditions, and carries out final acceptance and qualification testing. Test equipment is checked by line inspectors and calibrated by the Technical Service and Support department (see Fig.14).

**Incoming inspection**

Wire used in the manufacture of dry-reed switches is checked for:

- Appearance
- Diameter
- Circularity
- Chemical composition
- Magnetic characteristics
- Scoring and cracking.

After the annealing process is complete, the expansion coefficient of the wire is checked, and the magnetic characteristics are measured again.

Glass tubing used in the manufacture of dry-reed switches is checked for:

- Appearance
- Dimensions.

before being ultrasonically cleaned and dried.

**Quality control inspection**

As shown in Fig.14, inspection or quality control is performed after each mechanical or chemical process stage. In addition, to ensure product uniformity, the following critical process conditions are monitored constantly:

- Gold plating
- Gold diffusion
- Ruthenium plating or sputtering
- Sealing
- Appearance
- Dust levels in the dust free room.

**Acceptance testing**

Samples of dry-reed switches are taken from each batch in accordance with the requirements of MIL-STD 105D (ISO 2859). These samples are subjected to in-depth evaluation to ensure that all requirements are fully met before despatch.

**Acceptance tests**

Using the Philips standard coil, samples of dry-reed switches from each batch are tested for:

- Dynamic contact resistance
- 'Must-not-release' ampere-turns value
- 'Must-release' ampere-turns value
- 'Must-not-operate' ampere-turns value
- 'Must-operate' ampere-turns value
- Static contact resistance
- Visual inspection
- Solderability
- Gauge check (dimensions)
- Hermeticity.

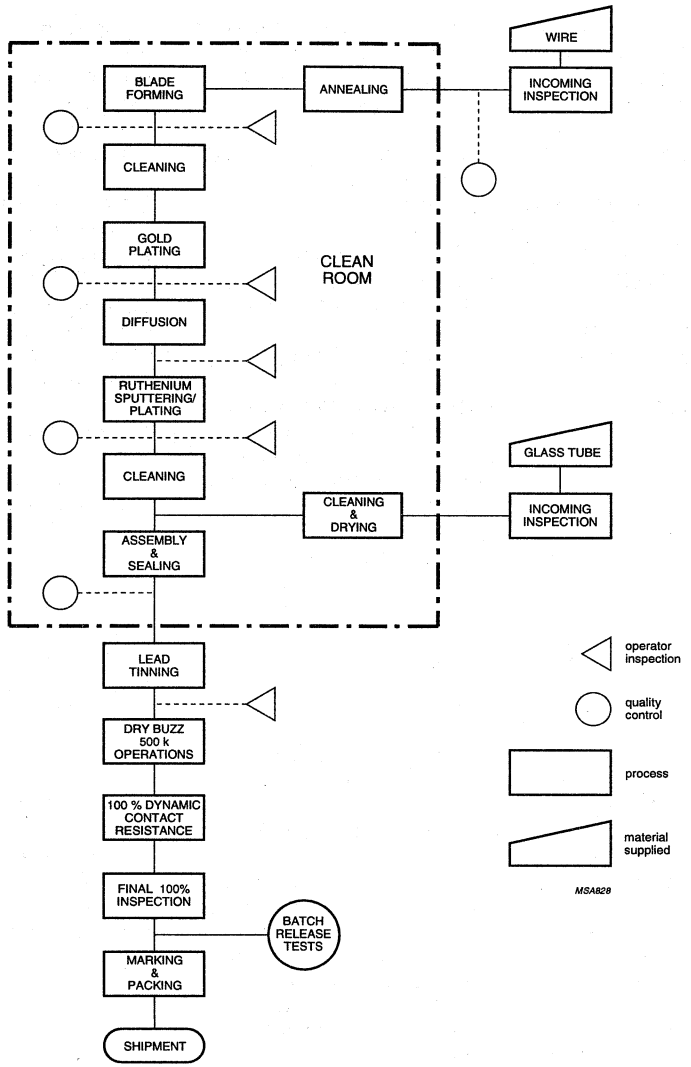



Fig.14 Quality control and inspection flow chart for the production cycle.

Text to Fig.14

By integrating Quality Control fully with inspection and production, we are able to maintain and progressively improve the quality of our dry-reed switches.

**Life tests**

Samples of dry-reed switches are subjected to the life tests and all failures are analyzed to provide additional corrective action data.

Note: Due to wiring inductance and capacitance, switching waveforms in the loaded life tests include an initial, very short, high current pulse component. It is necessary to specify and control the amplitude of this pulse, since it can have a marked effect on the results of the life tests.

**Laboratory tests**

Samples are tested for conformance to the published data at four monthly intervals, and the results recorded.

The samples are tested for:

- Operate and release ampere-turns
- Operate/release ampere-turns ratio
- Dynamic and static contact resistance
- Static contact resistance change
- Insulation resistance
- Capacitance
- Operate, bounce and release times
- Breakdown voltage with and without pre-ionization
- Remanence
- Bend, tensile and torsional strain
- Dimensions.

**Packing and labelling**

After a batch is accepted according to the specification, the dry-reed switches are packed and labelled with the production week number for traceability.

**CUSTOMER RETURNS**

The efficient processing of returned dry-reed switches is regarded as vitally important, both to our customers and to ourselves. Our in-depth examination of rejected switches provides valuable additional data for our own quality improvement activities, helps to guide the development of new or improved switches, and extends our knowledge of their behaviour in real applications.

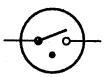
# DEVICE DATA

## DESCRIPTION

Micro dry-reed switch hermetically sealed in a gas-filled glass envelope. Single-pole, single-throw (SPST) type, having normally open contacts, and containing two magnetically actuated reeds. The switch is of the double-ended type and may be actuated by an electromagnet, a permanent magnet or a combination of both. The device is intended for use in push buttons, relays or in similar devices, in conjunction with semiconductor devices.

## QUICK REFERENCE DATA

| PARAMETER | LEVEL | VALUE | UNIT |
|---|---|---|---|
| Contact type | | SPST | |
| Contact arrangement | | normally open | |
| Switched power | max. | 10 | W |
| Switched voltage (DC) | max. | 200 | V |
| Switched voltage (AC; RMS value) | max. | 140 | V |
| Switched current (DC) | max. | 500 | mA |
| Switched current (AC; RMS value) | max. | 500 | mA |
| Contact resistance (initial) | max. | 100 | mΩ |



MSA182

Fig.1 Symbol.

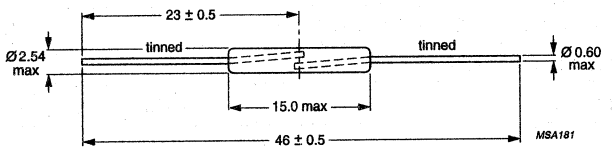
## BASIC MAGNETIC CHARACTERISTICS

Measured with the Philips standard coil.

| PARAMETER | VALUE | | | | | UNIT |
|---|---|---|---|---|---|---|
| | RI-23AAA | RI-23AA | RI-23A | RI-23B | RI-23C | |
| Operate range | 8 to 16 | 14 to 23 | 18 to 32 | 28 to 52 | 46 to 70 | At |
| Release range | 4 to 14 | 7.5 to 17.5 | 8 to 22 | 12 to 29 | 16 to 32 | At |

## MECHANICAL DATA

| PARAMETER | VALUE | UNIT |
|---|---|---|
| Contact arrangement | normally open | |
| Lead finish | tinned | |
| Resonant frequency of single reed | ≈ 5 500 | Hz |
| Net mass | ≈ 0.19 | g |
| Mounting position | any | |




Dimensions in mm.

Fig.2 Outline.

**Mechanical strength**

The robustness of the terminations is tested in accordance with IEC Publication 68-2-21, test $Ua_1$ (load 40 N).

**Mounting**

The leads should not be bent closer than 1 mm to the glass-to-metal seals. Stress on the seals should be avoided. Care must be taken to prevent stray magnetic fields from influencing the operating and measuring conditions. The switches can also be supplied with cropped and pre-formed leads, to customer specification.

**Resistance to soldering heat**

The switch can withstand soldering heat in accordance with IEC Publication 68-2-20 test Tb, method 1B: solder bath at 350 ±10 °C for 3.5 ±0.5 s.

**Solderability**

Solderability is tested in accordance with IEC Publication 68-2-20, test Ta, method 3: solder globule temperature 235 °C; ageing 1b: 4 h steam.

**Weldability**

The leads are weldable.

## LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

| PARAMETER | MIN. | MAX. | UNIT |
|---|---|---|---|
| Switched power | – | 10 | W |
| Switched voltage (DC) | – | 200 | V |
| Switched voltage (AC; RMS value) | – | 140 | V |
| Switched current (DC) | – | 500 | mA |
| Switched current (AC; RMS value) | – | 500 | mA |
| Current through closed contacts (DC) | – | 2 | A |
| Current through closed contacts (AC; RMS value) | – | 2 | A |
| Operating ambient temperature; note 1 | –55 | +125 | °C |
| Storage temperature; note 1 | –55 | +125 | °C |

**Note**

1. Temperature excursions up to 150 °C may be permissible. For more information consult your nearest Philips Components national organization.

## CHARACTERISTICS

| PARAMETER | CONDITIONS | PHILIPS STANDARD COIL | | | STANDARD MIL COIL | | | UNIT |
|---|---|---|---|---|---|---|---|---|
| | | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. | |
| **RI-23AAA** | | | | | | | | |
| NOT-OPERATE | | | | | | | | |
| Insulation resistance (initial) | RH ≤ 45% | $10^6$ | – | – | $10^6$ | – | – | MΩ |
| Contact capacitance | without test coil | – | – | 0.3 | – | – | 0.3 | pF |
| Must-not-operate value | | – | – | 8 | – | – | 9 | At |
| OPERATE | | | | | | | | |
| Must-operate value | | – | – | 16 | – | – | 15 | At |
| Operate time (including bounce time) | operate value = 100 At | – | 0.1 | 0.25 | – | – | – | ms |
| Bounce time | operate value = 100 At | – | 0.05 | 0.15 | – | – | – | ms |
| Contact resistance (initial) | operate value = 20 At; ρ = 1.6 mΩ/mm typical; note 1 | – | 70 | 100 | – | – | – | mΩ |
| NOT-RELEASE | | | | | | | | |
| Must-not-release value | | 14 | – | – | 12 | – | – | At |
| RELEASE | | | | | | | | |
| Must-release value | | – | – | 4 | – | – | 4 | At |
| Release time | operate value = 100 At | – | – | 70 | – | – | – | µs |
| **RI-23AA** | | | | | | | | |
| NOT-OPERATE | | | | | | | | |
| Insulation resistance (initial) | RH ≤ 45% | $10^6$ | – | – | $10^6$ | – | – | MΩ |
| Contact capacitance | without test coil | – | – | 0.3 | – | – | 0.3 | pF |
| Must-not-operate value | | – | – | 14 | – | – | 13 | At |
| OPERATE | | | | | | | | |
| Must-operate value | | – | – | 23 | – | – | 20 | At |
| Operate time (including bounce time) | operate value = 100 At | – | 0.25 | 0.5 | – | – | – | ms |
| Bounce time | operate value = 100 At | – | 0.15 | 0.3 | – | – | – | ms |
| Contact resistance (initial) | operate value = 25 At; ρ = 1.6 mΩ/mm typical; note 1 | – | 70 | 100 | – | – | – | mΩ |

| PARAMETER | CONDITIONS | PHILIPS STANDARD COIL | | | STANDARD MIL COIL | | | UNIT |
|---|---|---|---|---|---|---|---|---|
| | | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. | |
| NOT-RELEASE | | | | | | | | |
| Must-not-release value | | 17.5 | – | – | 15 | – | – | At |
| RELEASE | | | | | | | | |
| Must-release value | | – | – | 7.5 | – | – | 7 | At |
| Release time | operate value = 100 At | – | – | 30 | – | – | – | μs |
| **RI-23A** | | | | | | | | |
| NOT-OPERATE | | | | | | | | |
| Insulation resistance (initial) | RH ≤ 45% | $10^6$ | – | – | $10^6$ | – | – | MΩ |
| Contact capacitance | without test coil | – | – | 0.25 | – | – | 0.25 | pF |
| Must-not-operate value | | – | – | 18 | – | – | 16 | At |
| OPERATE | | | | | | | | |
| Must-operate value | | – | – | 32 | – | – | 27 | At |
| Operate time (including bounce time) | operate value = 100 At | – | 0.25 | 0.5 | – | – | – | ms |
| Bounce time | operate value = 100 At | – | 0.15 | 0.3 | – | – | – | ms |
| Contact resistance (initial) | operate value = 30 At; ρ = 1.6 mΩ/mm typical; note 1 | – | 70 | 100 | – | – | – | mΩ |
| NOT-RELEASE | | | | | | | | |
| Must-not-release value | | 22 | – | – | 19 | – | – | At |
| RELEASE | | | | | | | | |
| Must-release value | | – | – | 8 | – | – | 7 | At |
| Release time | operate value = 100 At | – | – | 30 | – | – | – | μs |
| **RI-23B** | | | | | | | | |
| NOT-OPERATE | | | | | | | | |
| Insulation resistance (initial) | RH ≤ 45% | $10^6$ | – | – | $10^6$ | – | – | MΩ |
| Contact capacitance | without test coil | – | – | 0.25 | – | – | 0.25 | pF |
| Must-not-operate value | | – | – | 28 | – | – | 23 | At |
| Operate | | | | | | | | |
| Must-operate value | | – | – | 52 | – | – | 42 | At |
| Operate time (including bounce time) | operate value = 100 At | – | 0.25 | 0.5 | – | – | – | ms |

| PARAMETER | CONDITIONS | PHILIPS STANDARD COIL | | | STANDARD MIL COIL | | | UNIT |
|---|---|---|---|---|---|---|---|---|
| | | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. | |
| Bounce time | operate value = 100 At | – | 0.15 | 0.3 | – | – | – | ms |
| Contact resistance (initial) | operate value = 40 At; ρ = 1.6 mΩ/mm typical; note 1 | – | 70 | 100 | – | – | – | mΩ |
| NOT-RELEASE | | | | | | | | |
| Must-not-release value | | 29 | – | – | 24 | – | – | At |
| RELEASE | | | | | | | | |
| Must-release value | | – | – | 12 | – | – | 10 | At |
| Release time | operate value = 100 At | – | – | 30 | – | – | – | μs |
| **RI-23C** | | | | | | | | |
| NOT-OPERATE | | | | | | | | |
| Insulation resistance (initial) | RH ≤ 45% | $10^6$ | – | – | $10^6$ | – | – | MΩ |
| Contact capacitance | without test coil | – | – | 0.25 | – | – | 0.25 | pF |
| Must-not-operate value | | – | – | 46 | – | – | 37 | At |
| OPERATE | | | | | | | | |
| Must-operate value | | – | – | 70 | – | – | 55 | At |
| Operate time (including bounce time) | operate value = 100 At | – | 0.25 | 0.5 | – | – | – | ms |
| Bounce time | operate value = 100 At | – | 0.15 | 0.3 | – | – | – | ms |
| Contact resistance (initial) | operate value = 40 At; ρ = 1.6 mΩ/mm typical; note 1 | – | 70 | 100 | – | – | – | mΩ |
| NOT-RELEASE | | | | | | | | |
| Must-not-release value | | 32 | – | – | 27 | – | – | At |
| RELEASE | | | | | | | | |
| Must-release value | | – | – | 16 | – | – | 13 | At |
| Release time | operate value = 100 At | – | – | 30 | – | – | – | μs |
| **All types** | | | | | | | | |
| Breakdown voltage | | see Fig.7 | | | – | | | |

**Note**

1. Distance between measuring points: 41 mm.

## LIFE EXPECTANCY AND RELIABILITY

The life expectancy data given below are valid for a coil energized at 1.25 times the published must-operate value for each type in the RI-23 series.

**No-load conditions (operating frequency: 100 Hz)**

Life expectancy: min. $10^8$ operations with a failure rate of less than $10^{-9}$ with a confidence level of 90%.

End of life criteria:
contact resistance >1 Ω after 2 ms;
release time >2 ms (latching or contact sticking).

**Loaded conditions (resistive load: 12 V; 4 mA; (15 mA peak); operating frequency: 170 Hz)**

Life expectancy: min. $10^7$ operations with a failure rate of less than $10^{-8}$ with a confidence level of 90%.

End of life criteria:
contact resistance >2 Ω after 4 ms;
release time >0.7 ms (latching or contact sticking).

**Note:**

Switching different loads involves different life expectancy and reliability data. Further information is available on request.

## SHOCK AND VIBRATION

### Shock

The switches are tested in accordance with IEC Publication 68-2-27, test Ea (peak acceleration 150 g, half sinewave). Such a shock will not cause an open switch (no magnetic field present) to close, nor a switch kept closed by an 80 At coil to open.

### Vibration

The switches are tested in accordance with IEC Publication 68-2-6, test Fc (acceleration 10 g; below cross-over frequency 57 to 62 Hz; amplitude 0.75 mm; frequency range 10 to 2 000 Hz, duration 90 minutes). Such a vibration will not cause an open switch (no magnetic field present) to close, nor a switch kept closed by an 80 At coil to open.

## COILS

For definitions of the Philips standard coil and the standard MIL coil see chapter Application notes of the General Section.

### Relationship between Philips standard coil and standard MIL coil

Operate value of standard MIL coil = 0.74 x operate value of Philips standard coil + 2.78 At.
Release value of standard MIL coil = 0.80 x release value of Philips standard coil + 0.66 At.

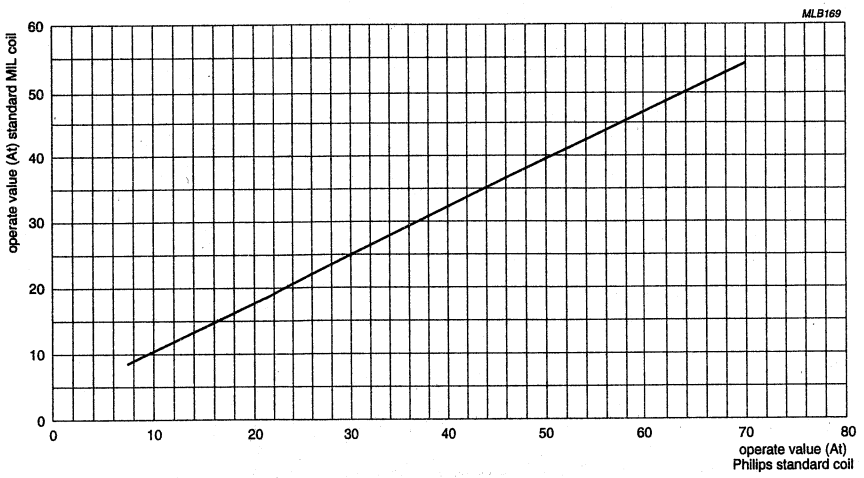



Fig.3 Correlation of operate value in standard MIL coil and Philips standard coil.

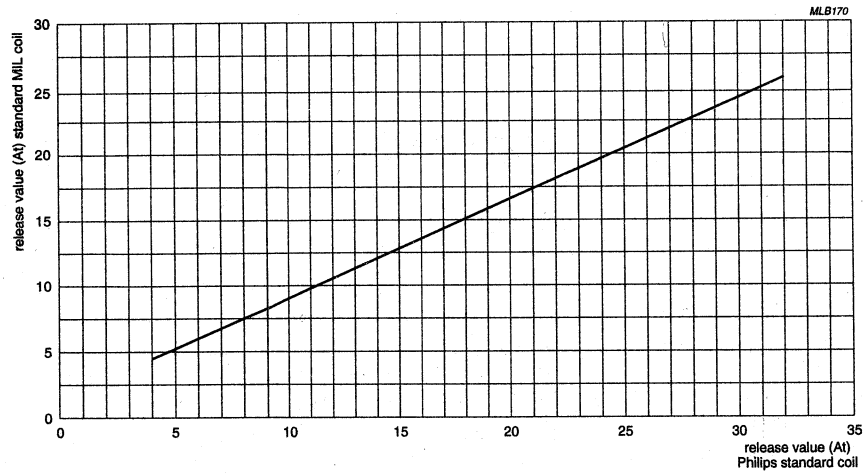



Fig.4 Correlation of release value in standard MIL coil and Philips standard coil.

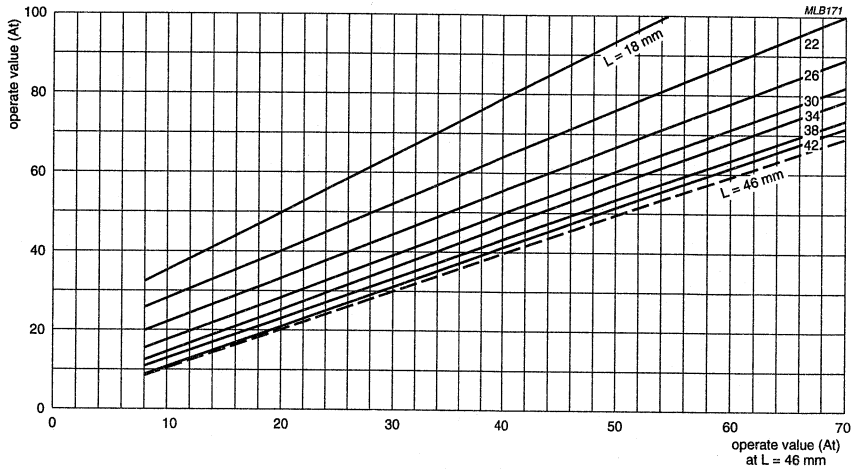



Fig.5 Operate value at various overall lengths (L) compared with standard length of 46 mm (Philips standard coil).

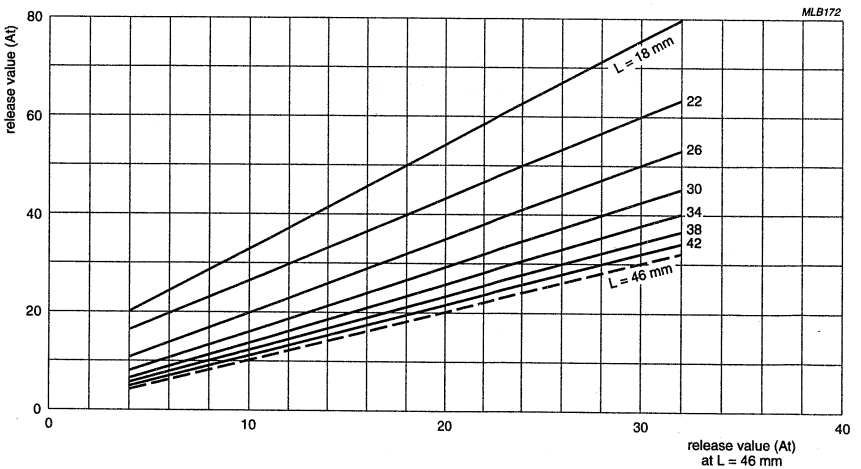



Fig.6 Release value at various overall lengths (L) compared with standard length of 46 mm (Philips standard coil).

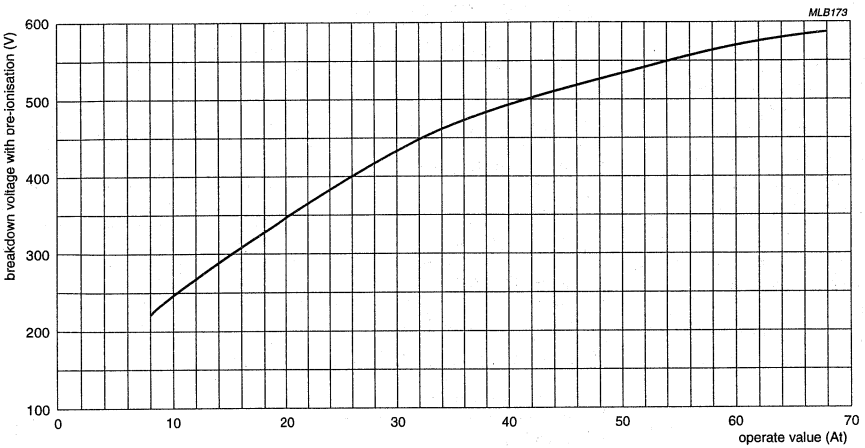



Fig.7 Minimum breakdown voltage with pre-ionisation as a function of operate value (Philips standard coil).

## DESCRIPTION

Micro dry-reed switch hermetically sealed in a gas-filled glass envelope. Single-pole, single-throw (SPST) type, having normally open contacts, and containing two magnetically actuated reeds. The switch is of the double-ended type and may be actuated by an electromagnet, a permanent magnet or a combination of both. The device is intended for use in high load applications in relays or switching devices.

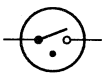



Fig.1 Symbol.

## QUICK REFERENCE DATA

| PARAMETER | LEVEL | VALUE | UNIT |
|---|---|---|---|
| Contact type | | SPST | |
| Contact arrangement | | normally open | |
| Switched power | | | |
| RI-25AAA | max. | 10 | W |
| RI-25AA; RI-25A | max. | 15 | W |
| RI-25B; RI-25C | max. | 25 | W |
| Switched voltage (DC) | max. | 200 | V |
| Switched voltage (AC; RMS value) | max. | 140 | V |
| Switched current (DC) | | | |
| RI-25AAA | max. | 750 | mA |
| RI-25AA; RI-25A; RI-25B; RI-25C | max. | 1 000 | mA |
| Switched current (AC; RMS value) | | | |
| RI-25AAA | max. | 750 | mA |
| RI-25AA; RI-25A; RI-25B; RI-25C | max. | 1 000 | mA |
| Contact resistance (initial) | max. | 100 | mΩ |

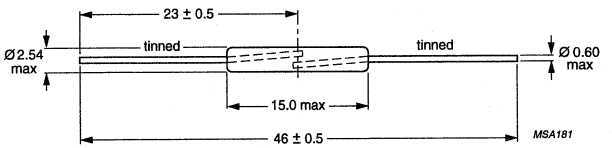
## BASIC MAGNETIC CHARACTERISTICS

Measured with the Philips standard coil.

| PARAMETER | VALUE | | | | | UNIT |
|---|---|---|---|---|---|---|
| | RI-25AAA | RI-25AA | RI-25A | RI-25B | RI-25C | |
| Operate range | 8 to 16 | 14 to 23 | 18 to 32 | 28 to 52 | 46 to 70 | At |
| Release range | 4 to 14 | 7.5 to 17.5 | 8 to 22 | 12 to 29 | 16 to 32 | At |

## MECHANICAL DATA

| PARAMETER | VALUE | UNIT |
|---|---|---|
| Contact arrangement | normally open | |
| Lead finish | tinned | |
| Resonant frequency of single reed | ≈ 5 100 | Hz |
| Net mass | ≈ 0.19 | g |
| Mounting position | any | |




Dimensions in mm.

Fig.2 Outline.

**Mechanical strength**

The robustness of the terminations is tested in accordance with IEC Publication 68-2-21, test $Ua_1$(load 40 N).

**Mounting**

The leads should not be bent closer than 1 mm to the glass-to-metal seals. Stress on the seals should be avoided. Care must be taken to prevent stray magnetic fields from influencing the operating and measuring conditions. The switches can also be supplied with cropped and pre-formed leads, to customer specification.

**Resistance to soldering heat**

The switch can withstand soldering heat in accordance with IEC Publication 68-2-20 test Tb, method 1B: solder bath at 350 ±10 °C for 3.5 ±0.5 s.

**Solderability**

Solderability is tested in accordance with IEC Publication 68-2-20, test Ta, method 3: solder globule temperature 235 °C; ageing 1b: 4 h steam.

**Weldability**

The leads are weldable.

## LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

| PARAMETER | MIN. | MAX. | UNIT |
|---|---|---|---|
| Switched power | | | |
| RI-25AAA | – | 10 | W |
| RI-25AA; RI-25A | – | 15 | W |
| RI-25B; RI-25C | – | 25 | W |
| Switched voltage (DC) | – | 200 | V |
| Switched voltage (AC; RMS value) | – | 140 | V |
| Switched current (DC) | | | |
| RI-25AAA | – | 750 | mA |
| RI-25AA; RI-25A; RI-25B; RI-25C | – | 1 000 | mA |
| Switched current (AC; RMS value) | | | |
| RI-25AAA | – | 750 | mA |
| RI-25AA; RI-25A; RI-25B; RI-25C | – | 1 000 | mA |
| Current through closed contacts (DC) | | | |
| RI-25AAA | – | 1.5 | A |
| RI-25AA; RI-25A | – | 2 | A |
| RI-25B; RI-25C | – | 2.5 | A |
| Current through closed contacts (AC; RMS value) | | | |
| RI-25AAA | – | 1.5 | A |
| RI-25AA; RI-25A | – | 2 | A |
| RI-25B; RI-25C | – | 2.5 | A |
| Operating ambient temperature; note 1 | –55 | +125 | °C |
| Storage temperature; note 1 | –55 | +125 | °C |

**Note**

1. Temperature excursions up to 150 °C may be permissible. For more information consult your nearest Philips Components national organization.

## CHARACTERISTICS

| PARAMETER | CONDITIONS | PHILIPS STANDARD COIL | | | STANDARD MIL COIL | | | UNIT |
|---|---|---|---|---|---|---|---|---|
| | | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. | |
| **RI-25AAA** | | | | | | | | |
| NOT-OPERATE | | | | | | | | |
| Insulation resistance (initial) | RH ≤ 45% | $10^6$ | – | – | $10^6$ | – | – | MΩ |
| Contact capacitance | without test coil | – | – | 0.3 | – | – | 0.3 | pF |
| Must-not-operate value | | – | – | 8 | – | – | 9 | At |
| OPERATE | | | | | | | | |
| Must-operate value | | – | – | 16 | – | – | 15 | At |
| Operate time (including bounce time) | operate value = 20 At | – | 0.25 | 0.5 | – | – | – | ms |
| Bounce time | operate value = 20 At | – | 0.05 | 0.15 | – | – | – | ms |
| Contact resistance (initial) | operate value = 20 At; ρ = 1.6 mΩ/mm typical; note 1 | – | 70 | 100 | – | – | – | mΩ |
| NOT-RELEASE | | | | | | | | |
| Must-not-release value | | 14 | – | – | 12 | – | – | At |
| RELEASE | | | | | | | | |
| Must-release value | | – | – | 4 | – | – | 4 | At |
| Release time | operate value = 20 At | – | – | 70 | – | – | – | µs |
| **RI-25AA** | | | | | | | | |
| NOT-OPERATE | | | | | | | | |
| Insulation resistance (initial) | RH ≤ 45% | $10^6$ | – | – | $10^6$ | – | – | MΩ |
| Contact capacitance | without test coil | – | – | 0.3 | – | – | 0.3 | pF |
| Must-not-operate value | | – | – | 14 | – | – | 13 | At |
| OPERATE | | | | | | | | |
| Must-operate value | | – | – | 23 | – | – | 20 | At |
| Operate time (including bounce time) | operate value = 29 At | – | 0.25 | 0.5 | – | – | – | ms |
| Bounce time | operate value = 29 At | – | 0.15 | 0.3 | – | – | – | ms |
| Contact resistance (initial) | operate value = 25 At; ρ = 1.6 mΩ/mm typical; note 1 | – | 70 | 100 | – | – | – | mΩ |

| PARAMETER | CONDITIONS | PHILIPS STANDARD COIL | | | STANDARD MIL COIL | | | UNIT |
|---|---|---|---|---|---|---|---|---|
| | | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. | |
| NOT-RELEASE | | | | | | | | |
| Must-not-release value | | 17.5 | – | – | 15 | – | – | At |
| RELEASE | | | | | | | | |
| Must-release value | | – | – | 7.5 | – | – | 7 | At |
| Release time | operate value = 29 At | – | – | 30 | – | – | – | µs |
| **RI-25A** | | | | | | | | |
| NOT-OPERATE | | | | | | | | |
| Insulation resistance (initial) | RH ≤ 45% | $10^6$ | – | – | $10^6$ | – | – | MΩ |
| Contact capacitance | without test coil | – | – | 0.25 | – | – | 0.25 | pF |
| Must-not-operate value | | – | – | 18 | – | – | 16 | At |
| OPERATE | | | | | | | | |
| Must-operate value | | – | – | 32 | – | – | 27 | At |
| Operate time (including bounce time) | operate value = 40 At | – | 0.25 | 0.5 | – | – | – | ms |
| Bounce time | operate value = 40 At | – | 0.15 | 0.3 | – | – | – | ms |
| Contact resistance (initial) | operate value = 30 At; ρ = 1.6 mΩ/mm typical; note 1 | – | 70 | 100 | – | – | – | mΩ |
| NOT-RELEASE | | | | | | | | |
| Must-not-release value | | 22 | – | – | 19 | – | – | At |
| RELEASE | | | | | | | | |
| Must-release value | | – | – | 8 | – | – | 7 | At |
| Release time | operate value = 40 At | – | – | 30 | – | – | – | µs |
| **RI-25B** | | | | | | | | |
| NOT-OPERATE | | | | | | | | |
| Insulation resistance (initial) | RH ≤ 45% | $10^6$ | – | – | $10^6$ | – | – | MΩ |
| Contact capacitance | without test coil | – | – | 0.25 | – | – | 0.25 | pF |
| Must-not-operate value | | – | – | 28 | – | – | 23 | At |
| OPERATE | | | | | | | | |
| Must-operate value | | – | – | 52 | – | – | 42 | At |
| Operate time (including bounce time) | operate value = 65 At | – | 0.25 | 0.5 | – | – | – | ms |

| PARAMETER | CONDITIONS | PHILIPS STANDARD COIL | | | STANDARD MIL COIL | | | UNIT |
|---|---|---|---|---|---|---|---|---|
| | | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. | |
| Bounce time | operate value = 65 At | – | 0.15 | 0.3 | – | – | – | ms |
| Contact resistance (initial) | operate value = 40 At; $\rho$ = 1.6 mΩ/mm typical; note 1 | – | 70 | 100 | – | – | – | mΩ |
| NOT-RELEASE | | | | | | | | |
| Must-not-release value | | 29 | – | – | 24 | – | – | At |
| RELEASE | | | | | | | | |
| Must-release value | | – | – | 12 | – | – | 10 | At |
| Release time | operate value = 65 At | – | – | 30 | – | – | – | µs |
| **RI-25C** | | | | | | | | |
| NOT-OPERATE | | | | | | | | |
| Insulation resistance (initial) | RH ≤ 45% | $10^6$ | – | – | $10^6$ | – | – | MΩ |
| Contact capacitance | without test coil | – | – | 0.25 | – | – | 0.25 | pF |
| Must-not-operate value | | – | – | 46 | – | – | 37 | At |
| OPERATE | | | | | | | | |
| Must-operate value | | – | – | 70 | – | – | 55 | At |
| Operate time (including bounce time) | operate value = 88 At | – | 0.25 | 0.5 | – | – | – | ms |
| Bounce time | operate value = 88 At | – | 0.15 | 0.3 | – | – | – | ms |
| Contact resistance (initial) | operate value = 40 At; $\rho$ = 1.6 mΩ/mm typical; note 1 | – | 70 | 100 | – | – | – | mΩ |
| NOT-RELEASE | | | | | | | | |
| Must-not-release value | | 32 | – | – | 27 | – | – | At |
| RELEASE | | | | | | | | |
| Must-release value | | – | – | 16 | – | – | 13 | At |
| Release time | operate value = 88 At | – | – | 30 | – | – | – | µs |
| **All types** | | | | | | | | |
| Breakdown voltage | | see Figs 7 and 8 | | | – | | | |

**Note**

1. Distance between measuring points: 41 mm.

## LIFE EXPECTANCY AND RELIABILITY

The life expectancy data given below are valid for a coil energized at 1.25 times the published must-operate value for each type in the RI-25 series.

**No-load conditions (operating frequency: 100 Hz)**

Life expectancy: min. $3 \times 10^8$ operations with a failure rate of less than $0.9 \times 10^{-9}$ with a confidence level of 90%.

End of life criteria:
contact resistance >1 Ω after 2 ms;
release time >2 ms (latching or contact sticking).

**Loaded conditions (resistive load: 20 V; 500 mA; operating frequency: 125 Hz)**

RI-25AAA

Life expectancy: min. $10^6$ operations with a failure rate of less than $2.5 \times 10^{-7}$ with a confidence level of 90%.

End of life criteria:
contact resistance >2 Ω after 2.5 ms;
release time >2.5 ms (latching or contact sticking).

RI-25AA; RI-25A; RI-25B; RI-25C

Life expectancy: min. $5 \times 10^7$ operations with a failure rate of less than $5 \times 10^{-9}$ with a confidence level of 90%.

End of life criteria:
contact resistance >2 Ω after 2.5 ms;
release time >2.5 ms (latching or contact sticking).

**Loaded conditions (resistive load: 50 V; 100 mA; operating frequency: 50 Hz)**

Life expectancy: min. $10^6$ operations with a failure rate of less than $2 \times 10^{-7}$ with a confidence level of 90%.

End of life criteria:
contact resistance >1 Ω after 5 ms;
release time >2 ms (latching or contact sticking).

**Note:**

Switching different loads involves different life expectancy and reliability data. Further information is available on request.

## SHOCK AND VIBRATION

### Shock

The switches are tested in accordance with IEC Publication 68-2-27, test Ea (peak acceleration 150 g, half sinewave). Such a shock will not cause an open switch (no magnetic field present) to close, nor a switch kept closed by an 80 At coil to open.

**Vibration**

The switches are tested in accordance with IEC Publication 68-2-6, test Fc (acceleration 10 g; below cross-over frequency 57 to 62 Hz; amplitude 0.75 mm; frequency range 10 to 2 000 Hz, duration 90 minutes). Such a vibration will not cause an open switch (no magnetic field present) to close, nor a switch kept closed by an 80 At coil to open.

**COILS**

For definitions of the Philips standard coil and the standard MIL coil see chapter Application notes of the General Section.

**Relationship between Philips standard coil and standard MIL coil**

Operate value of standard MIL coil = 0.74 x operate value of Philips standard coil + 2.78 At.
Release value of standard MIL coil = 0.80 x release value of Philips standard coil + 0.66 At.

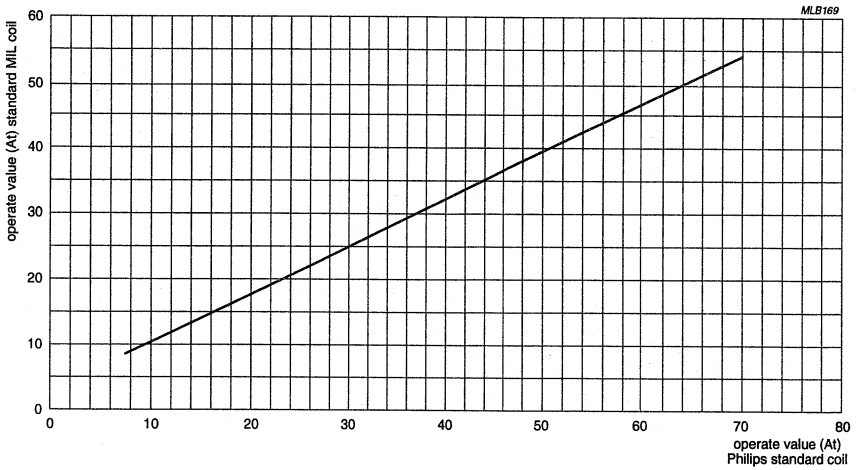



Fig.3 Correlation of operate value in standard MIL coil and Philips standard coil.

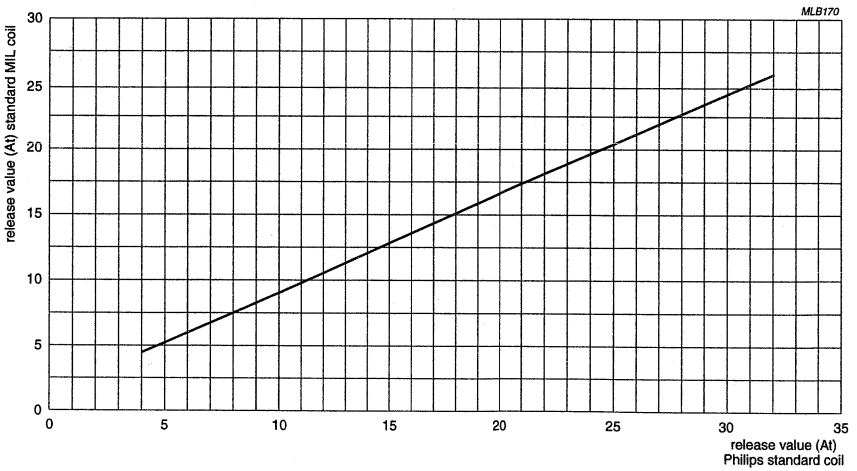



Fig.4 Correlation of release value in standard MIL coil and Philips standard coil.

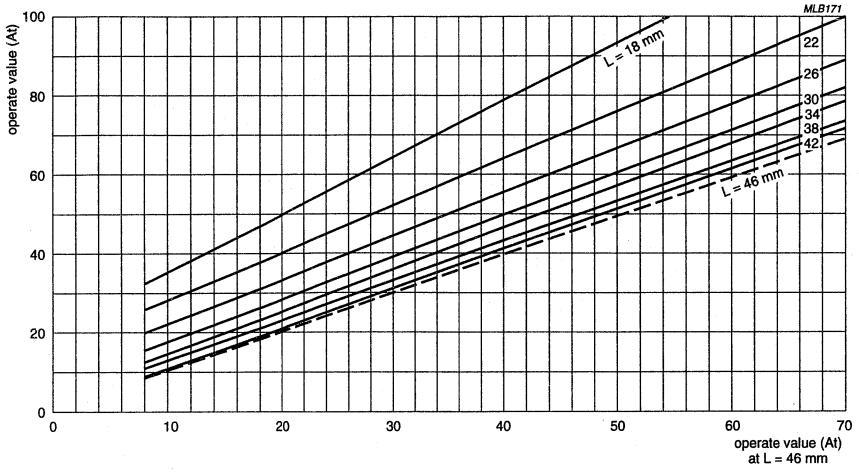



Fig.5 Operate value at various overall lengths (L) compared with standard length of 46 mm (Philips standard coil).

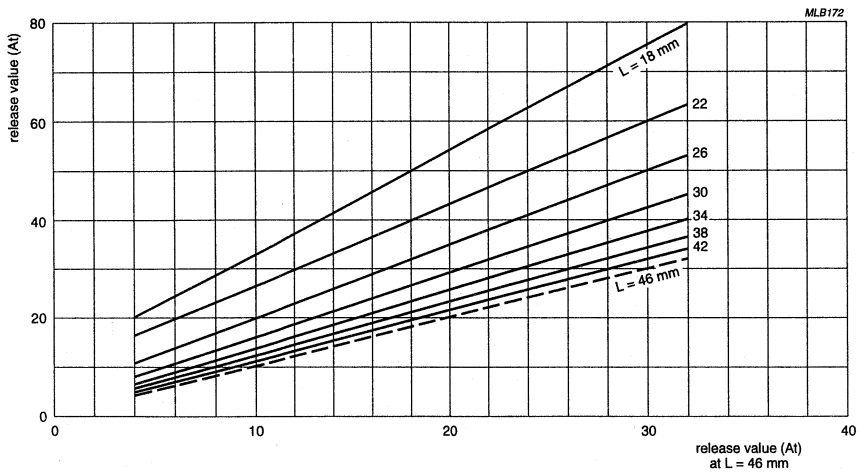



Fig.6 Release value at various overall lengths (L) compared with standard length of 46 mm (Philips standard coil).

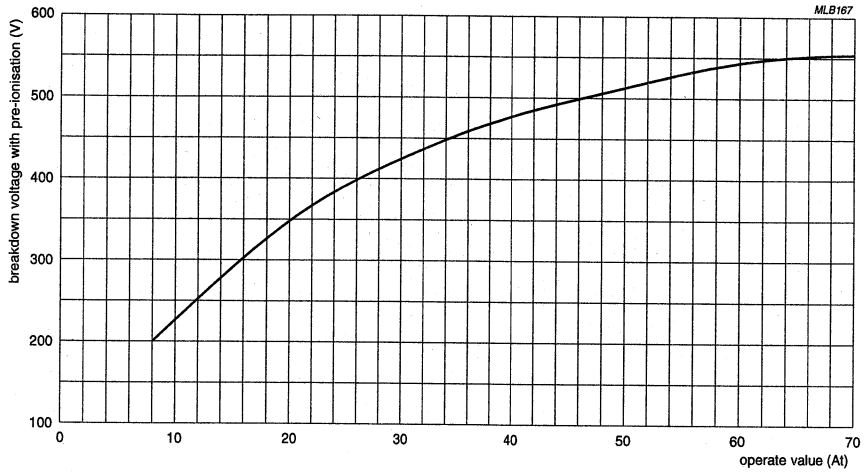



Fig.7 Minimum breakdown voltage with pre-ionisation as a function of operate value (Philips standard coil).

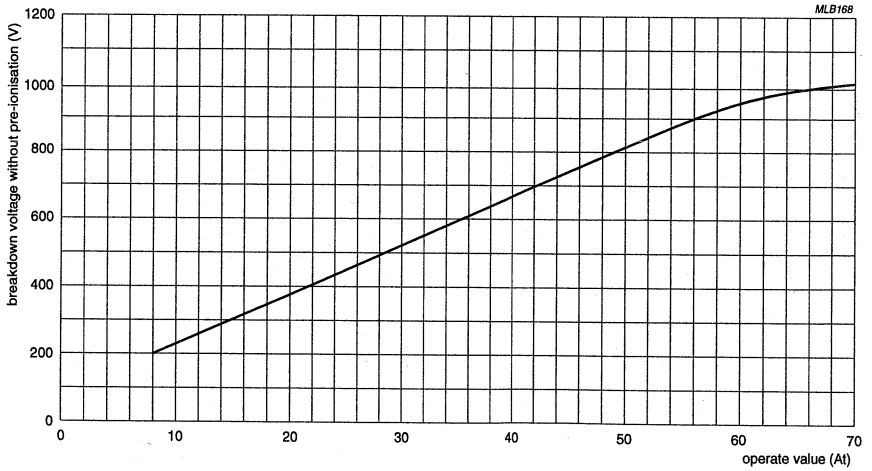



Fig.8 Minimum breakdown voltage without pre-ionisation as a function of operate value (Philips standard coil).

## DESCRIPTION

Close differential micro dry-reed switch hermetically sealed in a gas-filled glass envelope. Single-pole, single-throw (SPST) type, having normally open contacts, and containing two magnetically actuated reeds. The switch is of the double-ended type and may be actuated by an electromagnet, a permanent magnet or a combination of both. The device is intended for use in applications with small hysteresis in switching behaviour.

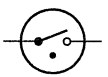



Fig.1 Symbol.

## QUICK REFERENCE DATA

| PARAMETER | LEVEL | VALUE | UNIT |
|---|---|---|---|
| Contact type | | SPST | |
| Contact arrangement | | normally open | |
| Switched power | | | |
| RI-26AA; RI-26A | max. | 15 | W |
| RI-26B | max. | 20 | W |
| Switched voltage (DC) | max. | 200 | V |
| Switched voltage (AC; RMS value) | max. | 140 | V |
| Switched current (DC) | max. | 1 000 | mA |
| Switched current (AC; RMS value) | max. | 1 000 | mA |
| Contact resistance (initial) | max. | 105 | mΩ |

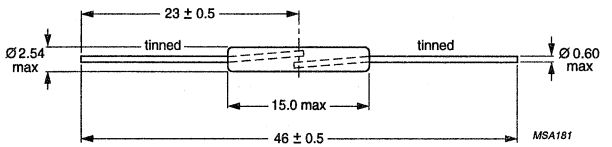
## BASIC MAGNETIC CHARACTERISTICS

Measured with the Philips standard coil.

| PARAMETER | LEVEL | VALUE | | | UNIT |
|---|---|---|---|---|---|
| | | RI-26AA | RI-26A | RI-26B | |
| Operate range | | 14 to 23 | 18 to 32 | 28 to 52 | At |
| Release range (in % of operate values) | typ. | 80 | 75 | 70 | % |

## MECHANICAL DATA

| PARAMETER | VALUE | UNIT |
|---|---|---|
| Contact arrangement | normally open | |
| Lead finish | tinned | |
| Resonant frequency of single reed | ≈ 5 500 | Hz |
| Net mass | ≈ 0.19 | g |
| Mounting position | any | |




Dimensions in mm.

Fig.2 Outline.

**Mechanical strength**

The robustness of the terminations is tested in accordance with IEC Publication 68-2-21, test $Ua_1$ (load 40 N).

**Mounting**

The leads should not be bent closer than 1 mm to the glass-to-metal seals. Stress on the seals should be avoided. Care must be taken to prevent stray magnetic fields from influencing the operating and measuring conditions. The switches can also be supplied with cropped and pre-formed leads, to customer specification.

**Resistance to soldering heat**

The switch can withstand soldering heat in accordance with IEC Publication 68-2-20 test Tb, method 1B: solder bath at 350 ±10 °C for 3.5 ±0.5 s.

**Solderability**

Solderability is tested in accordance with IEC Publication 68-2-20, test Ta, method 3: solder globule temperature 235 °C; ageing 1b: 4 h steam.

**Weldability**

The leads are weldable.

## LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

| PARAMETER | MIN. | MAX. | UNIT |
|---|---|---|---|
| Switched power | | | |
| RI-26AA; RI26A | – | 15 | W |
| RI-26B | – | 20 | W |
| Switched voltage (DC) | – | 200 | V |
| Switched voltage (AC; RMS value) | – | 140 | V |
| Switched current (DC) | – | 1 000 | mA |
| Switched current (AC; RMS value) | – | 1 000 | mA |
| Current through closed contacts (DC) | | | |
| RI-26AA | – | 1.25 | A |
| RI-26A | – | 1.50 | A |
| RI-26B | – | 1.75 | A |
| Current through closed contacts (AC; RMS value) | | | |
| RI-26AA | – | 1.25 | A |
| RI-26A | – | 1.50 | A |
| RI-26B | – | 1.75 | A |
| Operating ambient temperature; note 1 | –55 | +125 | °C |
| Storage temperature; note 1 | –55 | +125 | °C |

**Note**

1. Temperature excursions up to 150 °C may be permissible. For more information consult your nearest Philips Components national organization.

## CHARACTERISTICS

| PARAMETER | CONDITIONS | PHILIPS STANDARD COIL | | | STANDARD MIL COIL | | | UNIT |
|---|---|---|---|---|---|---|---|---|
| | | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. | |
| **RI-26AA** | | | | | | | | |
| NOT-OPERATE | | | | | | | | |
| Insulation resistance (initial) | RH ≤ 45% | $10^6$ | – | – | $10^6$ | – | – | MΩ |
| Contact capacitance | without test coil | – | – | 0.3 | – | – | 0.3 | pF |
| Must-not-operate value | | – | – | 14 | – | – | 13 | At |
| OPERATE | | | | | | | | |
| Must-operate value | | – | – | 23 | – | – | 20 | At |
| Operate time (including bounce time) | operate value = 29 At | – | 0.3 | 0.5 | – | – | – | ms |
| Bounce time | operate value = 29 At | – | 0.15 | 0.3 | – | – | – | ms |
| Contact resistance (initial) | operate value = 33 At; ρ = 1.6 mΩ/mm typical; note 1 | – | 75 | 105 | – | – | – | mΩ |
| RELEASE | | | | | | | | |
| Release value (in % of operate value) | | 70 | 80 | – | 70 | 80 | – | % |
| Release time | operate value = 29 At | – | – | 30 | – | – | – | μs |
| **RI-26A** | | | | | | | | |
| NOT-OPERATE | | | | | | | | |
| Insulation resistance (initial) | RH ≤ 45% | $10^6$ | – | – | $10^6$ | – | – | MΩ |
| Contact capacitance | without test coil | – | – | 0.25 | – | – | 0.25 | pF |
| Must-not-operate value | | – | – | 18 | – | – | 16 | At |
| OPERATE | | | | | | | | |
| Must-operate value | | – | – | 32 | – | – | 27 | At |
| Operate time (including bounce time) | operate value = 40 At | – | 0.3 | 0.5 | – | – | – | ms |
| Bounce time | operate value = 40 At | – | 0.15 | 0.3 | – | – | – | ms |
| Contact resistance (initial) | operate value = 46 At; ρ = 1.6 mΩ/mm typical; note 1 | – | 75 | 105 | – | – | – | mΩ |

| PARAMETER | CONDITIONS | PHILIPS STANDARD COIL | | | STANDARD MIL COIL | | | UNIT |
|---|---|---|---|---|---|---|---|---|
| | | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. | |
| RELEASE | | | | | | | | |
| Release value (in % of operate value) | | 60 | 75 | – | 60 | 75 | – | % |
| Release time | operate value = 40 At | – | – | 30 | – | – | – | µs |
| **RI-26B** | | | | | | | | |
| NOT-OPERATE | | | | | | | | |
| Insulation resistance (initial) | RH ≤ 45% | $10^6$ | – | – | $10^6$ | – | – | MΩ |
| Contact capacitance | without test coil | – | – | 0.25 | – | – | 0.25 | pF |
| Must-not-operate value | | – | – | 28 | – | – | 23 | At |
| OPERATE | | | | | | | | |
| Must-operate value | | – | – | 52 | – | – | 42 | At |
| Operate time (including bounce time) | operate value = 65 At | – | 0.3 | 0.5 | – | – | – | ms |
| Bounce time | operate value = 65 At | – | 0.15 | 0.3 | – | – | – | ms |
| Contact resistance (initial) | operate value = 53 At; ρ = 1.6 mΩ/mm typical; note 1 | – | 75 | 105 | – | – | – | mΩ |
| RELEASE | | | | | | | | |
| Release value (in % of operate value) | | 55 | 70 | – | 55 | 70 | – | % |
| Release time | operate value = 65 At | – | – | 30 | – | – | – | µs |
| **All types** | | | | | | | | |
| Breakdown voltage | | see Figs 7 and 8 | | | – | | | |

**Note**

1. Distance between measuring points: 41 mm.

## LIFE EXPECTANCY AND RELIABILITY

The life expectancy data given below are valid for a coil energized at 1.5 times the published must-operate value for each type in the RI-26 series.

### No-load conditions (operating frequency: 100 Hz)

Life expectancy: min. $3 \times 10^8$ operations with a failure rate of less than $0.9 \times 10^{-9}$ with a confidence level of 90%.

End of life criteria:
contact resistance >1 Ω after 2 ms;
release time >2 ms (latching or contact sticking).

### Loaded conditions (resistive load: 20 V; 500 mA; operating frequency: 125 Hz)

Life expectancy: min. $2 \times 10^7$ operations with a failure rate of less than $10^{-8}$ with a confidence level of 90%.

End of life criteria:
contact resistance >2 Ω after 2.5 ms;
release time >2.5 ms (latching or contact sticking).

### Note:

Switching different loads involves different life expectancy and reliability data. Further information is available on request.

## SHOCK AND VIBRATION

### Shock

The switches are tested in accordance with IEC Publication 68-2-27, test Ea (peak acceleration 50 g; half sinewave). Such a shock will not cause an open switch (no magnetic field present) to close, nor a switch kept closed by a coil energized at 1.5 times the published must-operate value to open.

### Vibration

The switches are tested in accordance with IEC Publication 68-2-6, test Fc (acceleration 10 g; below cross-over frequency 58 Hz; amplitude 0.75 mm; frequency range 10 to 2 000 Hz; duration 75 minutes in each direction). Such a vibration will not cause an open switch (no magnetic field present) to close, nor a switch kept closed by a coil energized at 1.5 times the published must-operate value to open.

## COILS

For definitions of the Philips standard coil and the standard MIL coil see chapter Application notes of the General Section.

### Relationship between Philips standard coil and standard MIL coil

Operate value of standard MIL coil = 0.74 x operate value of Philips standard coil + 2.78 At.
Release value of standard MIL coil = 0.80 x release value of Philips standard coil + 0.66 At.

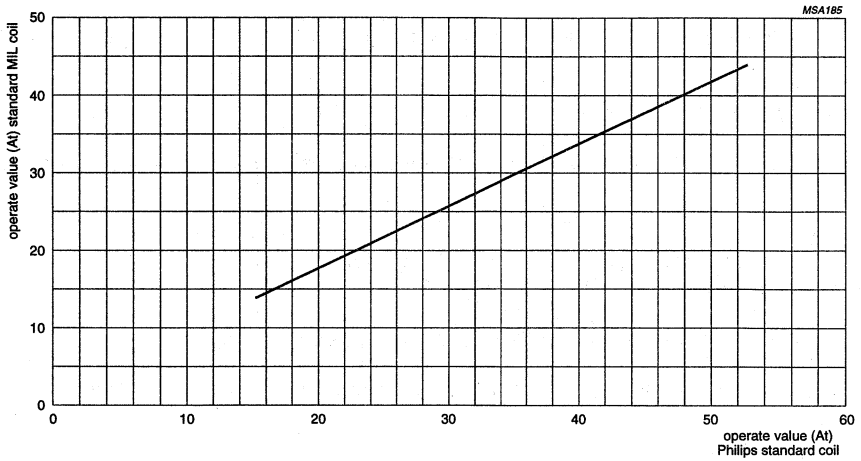



Fig.3 Correlation of operate value in standard MIL coil and Philips standard coil.

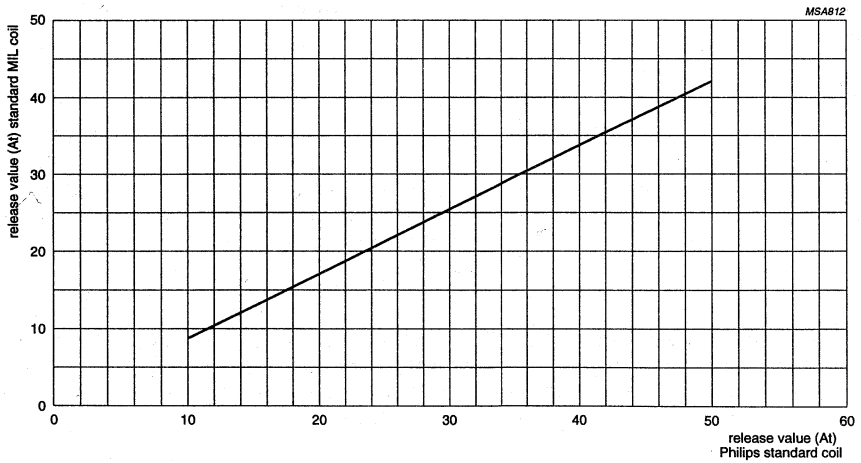



Fig.4 Correlation of release value in standard MIL coil and Philips standard coil.

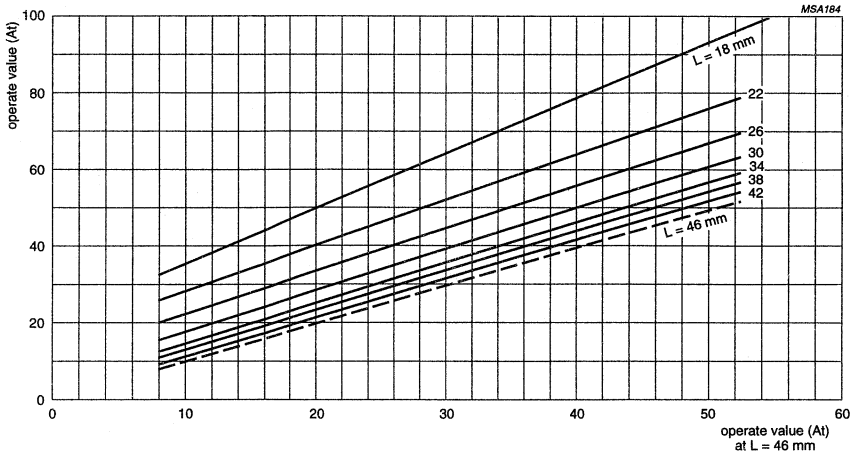



Fig.5 Operate value at various overall lengths (L) compared with standard length of 46 mm (Philips standard coil).

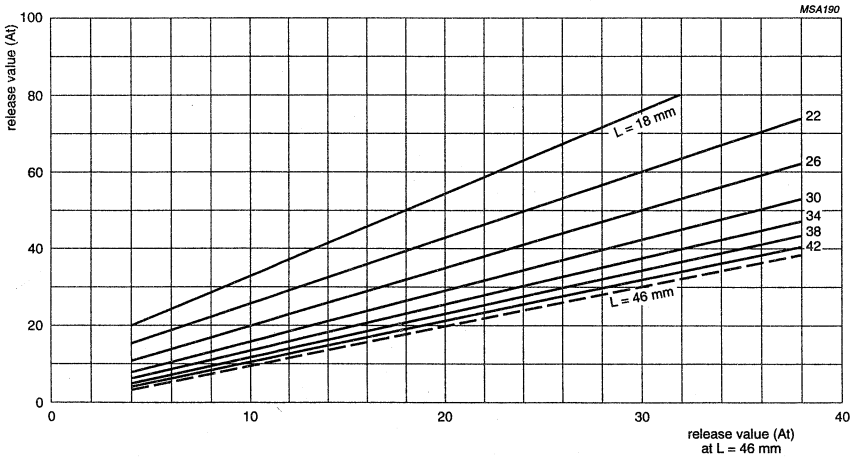



Fig.6 Release value at various overall lenghts (L) compared with standard length of 46 mm (Philips standard coil).

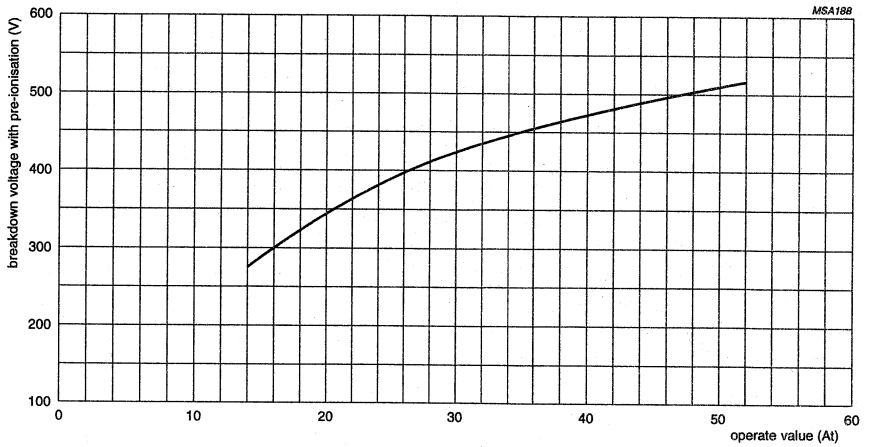



Fig.7 Minimum breakdown voltage with pre-ionisation as a function of operate value (Philips standard coil).

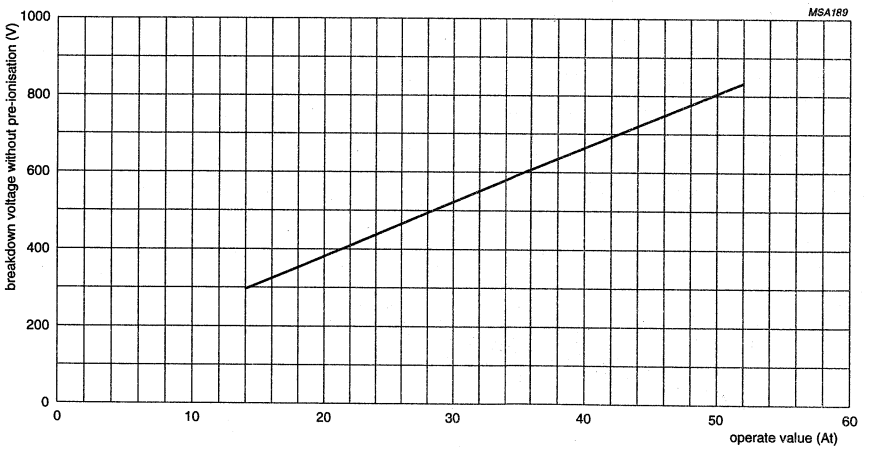



Fig.8 Minimum breakdown voltage without pre-ionisation as a function of operate value (Philips standard coil).

## DESCRIPTION

Pico dry-reed switch hermetically sealed in a gas-filled glass envelope. Single-pole, single-throw (SPST) type, having normally open contacts, and containing two magnetically actuated reeds. The switch is of the double-ended type and may be actuated by an electromagnet, a permanent magnet or a combination of both. The device is intended for use in relays or in similar devices.

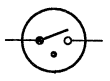



Fig.1 Symbol.

## QUICK REFERENCE DATA

| PARAMETER | LEVEL | VALUE | UNIT |
|---|---|---|---|
| Contact type | | SPST | |
| Contact arrangement | | normally open | |
| Switched power | max. | 10 | W |
| Switched voltage (DC) | | | |
| RI-27AAA | max. | 180 | V |
| RI-27AA; RI-27A | max. | 200 | V |
| Switched voltage (AC; RMS value) | | | |
| RI-27AAA | max. | 130 | V |
| RI-27AA; RI-27A | max. | 140 | V |
| Switched current (DC) | max. | 500 | mA |
| Switched current (AC; RMS value) | max. | 500 | mA |
| Contact resistance (initial) | max. | 115 | mΩ |

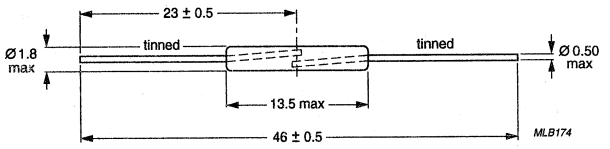
## BASIC MAGNETIC CHARACTERISTICS

Measured with the Philips standard coil.

| PARAMETER | VALUE | | | UNIT |
|---|---|---|---|---|
| | RI-27AAA | RI-27AA | RI-27A | |
| Operate range | 10 to 19 | 16 to 25 | 20 to 34 | At |
| Release range | 4 to 16 | 5 to 18 | 7 to 19.5 | At |

## MECHANICAL DATA

| PARAMETER | VALUE | UNIT |
|---|---|---|
| Contact arrangement | normally open | |
| Lead finish | tinned | |
| Resonant frequency of single reed | ≈ 6 700 | Hz |
| Net mass | ≈ 0.1 | g |
| Mounting position | any | |




Dimensions in mm.

Fig.2 Outline.

**Mechanical strength**

The robustness of the terminations is tested in accordance with IEC Publication 68-2-21, test $Ua_1$ (load 10 N).

**Mounting**

The leads should not be bent closer than 1 mm to the glass-to-metal seals. Stress on the seals should be avoided. Care must be taken to prevent stray magnetic fields from influencing the operating and measuring conditions. The switches can also be supplied with cropped and pre-formed leads, to customer specification.

**Resistance to soldering heat**

The switch can withstand soldering heat in accordance with IEC Publication 68-2-20 test Tb, method 1B: solder bath at 350 ±10 °C for 3.5 ±0.5 s.

**Solderability**

Solderability is tested in accordance with IEC Publication 68-2-20, test Ta, method 3: solder globule temperature 235 °C; ageing 1b: 4 h steam.

**Weldability**

The leads are weldable.

## LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

| PARAMETER | MIN. | MAX. | UNIT |
|---|---|---|---|
| Switched power | – | 10 | W |
| Switched voltage (DC) | | | |
| RI-27AAA | – | 180 | V |
| RI-27AA; RI-27A | – | 200 | V |
| Switched voltage (AC; RMS value) | | | |
| RI-27AAA | – | 130 | V |
| RI-27AA; RI-27A | – | 140 | V |
| Switched current (DC) | – | 500 | mA |
| Switched current (AC; RMS value) | – | 500 | mA |
| Current through closed contacts (DC) | | | |
| RI-27AAA | – | 1.5 | A |
| RI-27AA; RI-27A | – | 1.75 | A |
| Current through closed contacts (AC; RMS value) | | | |
| RI-27AAA | – | 1.5 | A |
| RI-27AA; RI-27A | – | 1.75 | A |
| Operating ambient temperature; note 1 | –55 | +125 | °C |
| Storage temperature; note 1 | –55 | +125 | °C |

**Note**

1. Temperature excursions up to 150 °C may be permissible. For more information consult your nearest Philips Components national organization.

## CHARACTERISTICS

| PARAMETER | CONDITIONS | PHILIPS STANDARD COIL | | | STANDARD MIL COIL | | | UNIT |
|---|---|---|---|---|---|---|---|---|
| | | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. | |
| **RI-27AAA** | | | | | | | | |
| NOT-OPERATE | | | | | | | | |
| Insulation resistance (initial) | RH ≤ 45% | $10^6$ | – | – | $10^6$ | – | – | MΩ |
| Contact capacitance | without test coil | – | – | 0.3 | – | – | 0.3 | pF |
| Must-not-operate value | | – | – | 10 | – | – | 8.5 | At |
| OPERATE | | | | | | | | |
| Must-operate value | | – | – | 19 | – | – | 16 | At |
| Operate time (including bounce time) | operate value = 24 At | – | 0.25 | 0.5 | – | – | – | ms |
| Bounce time | operate value = 24 At | – | 0.05 | 0.15 | – | – | – | ms |
| Contact resistance (initial) | operate value = 20 At ρ = 1.8 mΩ/mm typical; note 1 | – | 90 | 115 | – | – | – | mΩ |
| NOT-RELEASE | | | | | | | | |
| Must-not-release value | | 16 | – | – | 13.5 | – | – | At |
| RELEASE | | | | | | | | |
| Must-release value | | – | – | 4 | – | – | 3 | At |
| Release time | operate value = 24 At | – | – | 30 | – | – | – | µs |
| **RI-27AA** | | | | | | | | |
| NOT-OPERATE | | | | | | | | |
| Insulation resistance (initial) | RH ≤ 45% | $10^6$ | – | – | $10^6$ | – | – | MΩ |
| Contact capacitance | without test coil | – | – | 0.3 | – | – | 0.3 | pF |
| Must-not-operate value | | – | – | 16 | – | – | 13.5 | At |
| OPERATE | | | | | | | | |
| Must-operate value | | – | – | 25 | – | – | 21 | At |
| Operate time (including bounce time) | operate value = 31 At | – | 0.25 | 0.5 | – | – | – | ms |
| Bounce time | operate value = 31At | – | 0.05 | 0.15 | – | – | – | ms |
| Contact resistance (initial) | operate value = 25 At; ρ = 1.8 mΩ/mm typical; note 1 | – | 90 | 115 | – | – | – | mΩ |

| PARAMETER | CONDITIONS | PHILIPS STANDARD COIL | | | STANDARD MIL COIL | | | UNIT |
|---|---|---|---|---|---|---|---|---|
| | | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. | |
| NOT-RELEASE | | | | | | | | |
| Must-not-release value | | 18 | – | – | 15 | – | – | At |
| RELEASE | | | | | | | | |
| Must-release value | | – | – | 5 | – | – | 4 | At |
| Release time | operate value = 31At | – | – | 30 | – | – | – | µs |
| **RI-27A** | | | | | | | | |
| NOT-OPERATE | | | | | | | | |
| Insulation resistance (initial) | RH ≤ 45% | $10^6$ | – | – | $10^6$ | – | – | MΩ |
| Contact capacitance | without test coil | – | – | 0.25 | – | – | 0.25 | pF |
| Must-not-operate value | | – | – | 20 | – | – | 16 | At |
| OPERATE | | | | | | | | |
| Must-operate value | | – | – | 34 | – | – | 27 | At |
| Operate time (including bounce time) | operate value = 42.5 At | – | 0.25 | 0.5 | – | – | – | ms |
| Bounce time | operate value = 42.5 At | – | 0.05 | 0.15 | – | – | – | ms |
| Contact resistance (initial) | operate value = 25 At; ρ = 1.8 mΩ/mm typical; note 1 | – | 90 | 115 | – | – | – | mΩ |
| NOT-RELEASE | | | | | | | | |
| Must-not-release value | | 19.5 | – | – | 16 | – | – | At |
| RELEASE | | | | | | | | |
| Must-release value | | – | – | 7 | – | – | 6 | At |
| Release time | operate value = 42.5 At | – | – | 30 | – | – | – | µs |
| **All types** | | | | | | | | |
| Breakdown voltage | | see Fig.7 | | | – | | | |

**Note**

1. Distance between measuring points: 41 mm.

## LIFE EXPECTANCY AND RELIABILITY

The life expectancy data given below are valid for a coil energized at 1.25 times the published must-operate value for each type in the RI-27 series.

**No-load conditions (operating frequency: 100 Hz)**

Life expectancy: min. $2 \times 10^8$ operations with a failure rate of less than $10^{-9}$ with a confidence level of 90%.

End of life criteria:
contact resistance >1 Ω after 2 ms;
release time >2 ms (latching or contact sticking).

**Loaded conditions (resistive load: 5 V, 100 mA; operating frequency: 125 Hz)**

RI-27AAA

Life expectancy: min. $2 \times 10^7$ operations with a failure rate of less than $10^{-8}$ with a confidence level of 90%.

End of life criteria:
contact resistance >1 Ω after 2.5 ms;
release time >1 ms (latching or contact sticking).

RI-27AA; RI-27A

Life expectancy: min. $5 \times 10^7$ operations with a failure rate of less than $0.5 \times 10^{-8}$ with a confidence level of 90%.

End of life criteria:
contact resistance >1 Ω after 2.5 ms;
release time >1 ms (latching or contact sticking).

**Loaded conditions (resistive load: 12 V; 4 mA; (15 mA peak); operating frequency: 170 Hz)**

RI-27AAA

Not applicable.

RI-27AA; RI-27A

Life expectancy average $45 \times 10^6$ operations (tested up to $50 \times 10^6$ operations).

End of life criteria:
contact resistance >2 Ω after 4 ms;
release time >0.7 ms (latching or contact sticking).

**Note:**

Switching different loads involves different life expectancy and reliability data. Further information is available on request.

## SHOCK AND VIBRATION

### Shock

RI-27AA; RI-27A

The switches are tested in accordance with IEC Publication 68-2-27, test Ea (peak acceleration 150 g; half sinewave). Such a shock will not cause an open switch (no magnetic field present) to close, nor a switch kept closed by an 80 At coil to open.

### Vibration

The switches are tested in accordance with IEC Publication 68-2-6, test Fc (acceleration 10 g; below cross-over frequency 57 to 62 Hz; amplitude 0.75 mm; frequency range 10 to 2 000 Hz; duration 90 minutes). Such a vibration will not cause an open switch (no magnetic field present) to close, nor a switch kept closed by an 80 At coil to open.

## COILS

For definitions of the Philips standard coil and the standard MIL coil see chapter Application notes of the General Section.

### Relationship between Philips standard coil and standard MIL coil

Operate value of standard MIL coil = 0.78 x operate value of Philips standard coil + 1.02 At.
Release value of standard MIL coil = 0.83 x release value of Philips standard coil + 0.01 At.

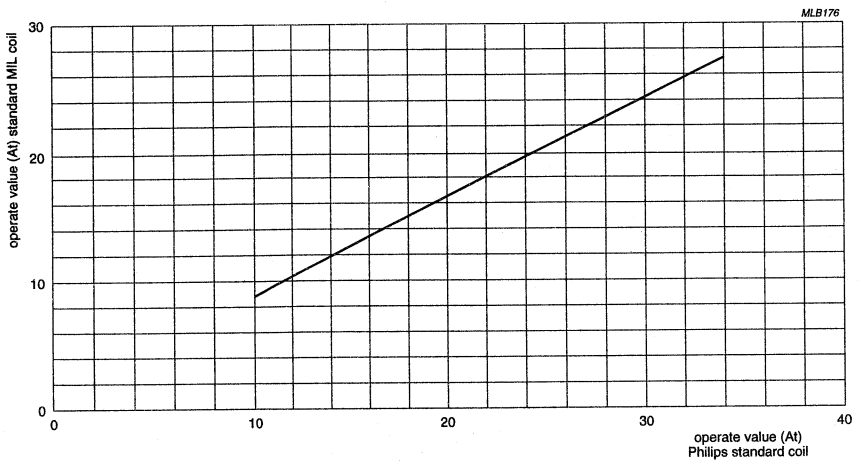



Fig.3 Correlation of operate value in standard MIL coil and Philips standard coil.

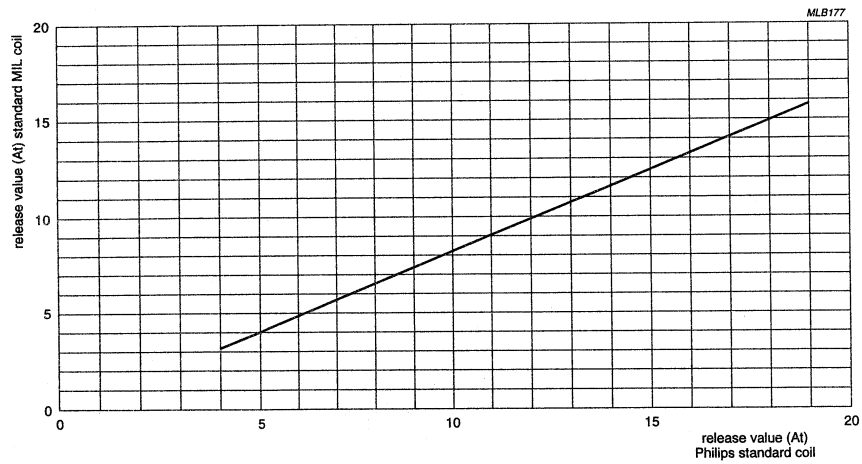



Fig.4 Correlation of release value in standard MIL coil and Philips standard coil.

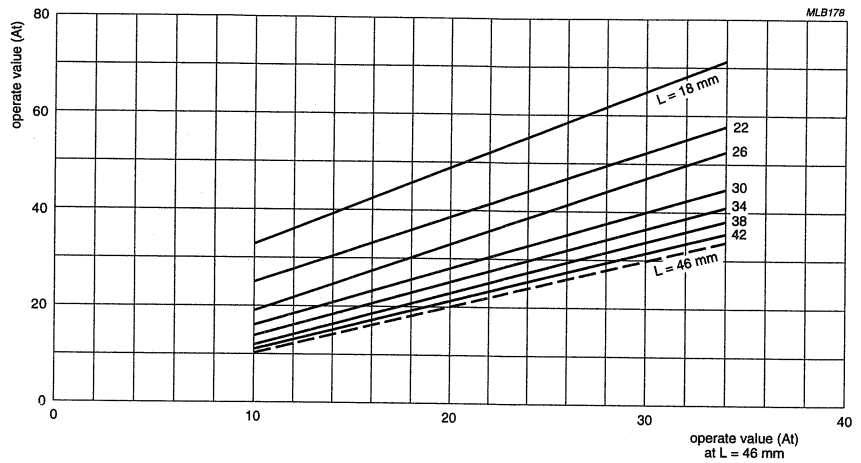



Fig.5 Operate value at various overall lengths (L) compared with standard length of 46 mm (Philips standard coil).

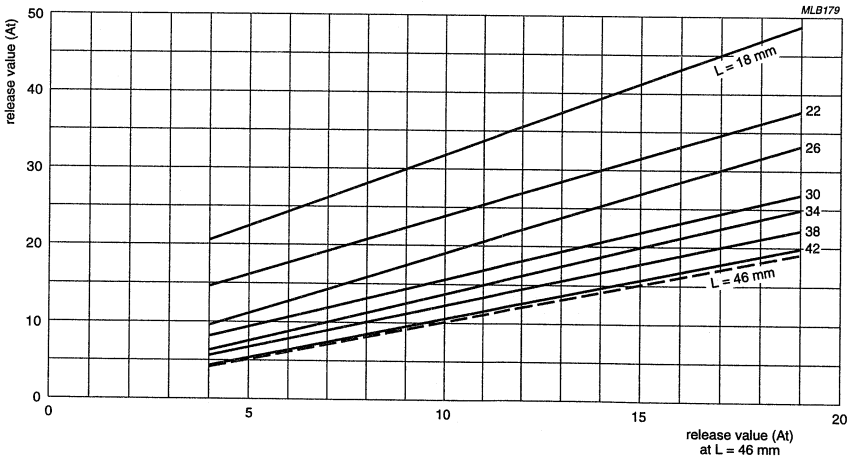



Fig.6 Release value at various overall lengths (L) compared with standard length of 46 mm (Philips standard coil).

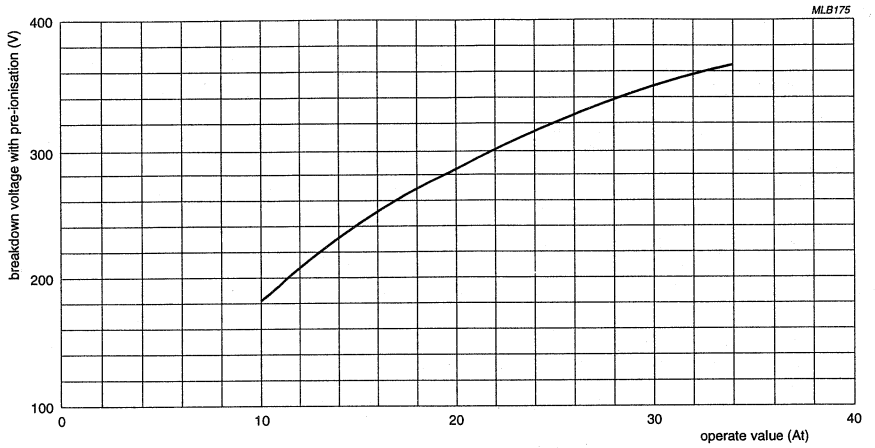



Fig.7 Minimum breakdown voltage with pre-ionisation as a function of operate value (Philips standard coil).

## DESCRIPTION

Pico dry-reed switch hermetically sealed in a gas-filled glass envelope. Single-pole, single-throw (SPST) type, having normally open contacts, and containing two magnetically actuated reeds. The switch is of the double-ended type and may be actuated by an electromagnet, a permanent magnet or a combination of both. The device is intended for use in high inrush current applications in relays or switching devices.


Fig.1 Symbol.

## QUICK REFERENCE DATA

| PARAMETER | LEVEL | VALUE | UNIT |
|---|---|---|---|
| Contact type | | SPST | |
| Contact arrangement | | normally open | |
| Switched power | | | |
| RI-29AA | max. | 15 | W |
| RI-29A | max. | 20 | W |
| Switched voltage (DC) | max. | 200 | V |
| Switched voltage (AC; RMS value) | max. | 140 | V |
| Switched current (DC) | max. | 1 000 | mA |
| Switched current (AC; RMS value) | max. | 1 000 | mA |
| Contact resistance (initial) | max. | 115 | mΩ |

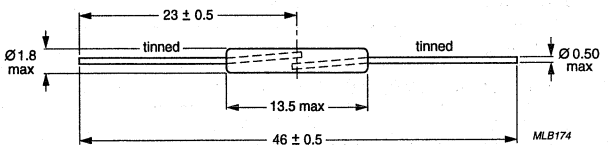
## BASIC MAGNETIC CHARACTERISTICS

Measured with the Philips standard coil.

| PARAMETER | VALUE | | UNIT |
|---|---|---|---|
| | RI-29AA | RI-29A | |
| Operate range | 16 to 25 | 20 to 34 | At |
| Release range | 5 to 18 | 7 to 19.5 | At |

## MECHANICAL DATA

| PARAMETER | VALUE | UNIT |
|---|---|---|
| Contact arrangement | normally open | |
| Lead finish | tinned | |
| Resonant frequency of single reed | ≈ 6 500 | Hz |
| Net mass | ≈ 0.1 | g |
| Mounting position | any | |




Dimensions in mm.

Fig.2 Outline.

### Mechanical strength

The robustness of the terminations is tested in accordance with IEC Publication 68-2-21, test $Ua_1$ (load 10 N).

### Mounting

The leads should not be bent closer than 1 mm to the glass-to-metal seals. Stress on the seals should be avoided. Care must be taken to prevent stray magnetic fields from influencing the operating and measuring conditions. The switches can also be supplied with cropped and pre-formed leads, to customer specification.

### Resistance to soldering heat

The switch can withstand soldering heat in accordance with IEC Publication 68-2-20 test Tb, method 1B: solder bath at 350 ±10 °C for 3.5 ±0.5 s.

### Solderability

Solderability is tested in accordance with IEC Publication 68-2-20, test Ta, method 3: solder globule temperature 235 °C; ageing 1b: 4 h steam.

### Weldability

The leads are weldable.

## LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

| PARAMETER | MIN. | MAX. | UNIT |
|---|---|---|---|
| Switched power | | | |
| RI-29AA | – | 15 | W |
| RI-29A | – | 20 | W |
| Switched voltage (DC) | – | 200 | V |
| Switched voltage (AC; RMS value) | – | 140 | V |
| Switched current (DC) | – | 1 000 | mA |
| Switched current (AC; RMS value) | – | 1 000 | mA |
| Current through closed contacts (DC) | – | 1.25 | A |
| Current through closed contacts (AC; RMS value) | – | 1.25 | A |
| Operating ambient temperature | –55 | +75 | °C |
| Storage temperature; note 1 | –55 | +125 | °C |

**Note**

1. Temperature excursions up to 150 °C may be permissible. For more information consult your nearest Philips Components national organization.

## CHARACTERISTICS

| PARAMETER | CONDITIONS | PHILIPS STANDARD COIL | | | STANDARD MIL COIL | | | UNIT |
|---|---|---|---|---|---|---|---|---|
| | | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. | |
| **RI-29AA** | | | | | | | | |
| NOT-OPERATE | | | | | | | | |
| Insulation resistance (initial) | RH ≤ 45% | $10^6$ | – | – | $10^6$ | – | – | MΩ |
| Contact capacitance | without test coil | – | – | 0.3 | – | – | 0.3 | pF |
| Must-not-operate value | | – | – | 16 | – | – | 13.5 | At |
| OPERATE | | | | | | | | |
| Must-operate value | | – | – | 25 | – | – | 21 | At |
| Operate time (including bounce time) | operate value = 31 At | – | 0.25 | 0.5 | – | – | – | ms |
| Bounce time | operate value = 31 At | – | 0.05 | 0.15 | – | – | – | ms |
| Contact resistance (initial) | operate value = 25 At ρ = 1.8 mΩ/mm typical; note 1 | – | 90 | 115 | – | – | – | mΩ |
| NOT-RELEASE | | | | | | | | |
| Must-not-release value | | 18 | – | – | 15 | – | – | At |
| RELEASE | | | | | | | | |
| Must-release value | | – | – | 5 | – | – | 4 | At |
| Release time | operate value = 31 At | – | – | 30 | – | – | – | μs |
| **RI-29A** | | | | | | | | |
| NOT-OPERATE | | | | | | | | |
| Insulation resistance (initial) | RH ≤ 45% | $10^6$ | – | – | $10^6$ | – | – | MΩ |
| Contact capacitance | without test coil | – | – | 0.25 | – | – | 0.25 | pF |
| Must-not-operate value | | – | – | 20 | – | – | 16 | At |
| OPERATE | | | | | | | | |
| Must-operate value | | – | – | 34 | – | – | 27 | At |
| Operate time (including bounce time) | operate value = 42.5 At | – | 0.25 | 0.5 | – | – | – | ms |
| Bounce time | operate value = 42.5 At | – | 0.05 | 0.15 | – | – | – | ms |
| Contact resistance (initial) | operate value = 25 At; ρ = 1.8 mΩ/mm typical; note 1 | – | 90 | 115 | – | – | – | mΩ |

| PARAMETER | CONDITIONS | PHILIPS STANDARD COIL | | | STANDARD MIL COIL | | | UNIT |
|---|---|---|---|---|---|---|---|---|
| | | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. | |
| NOT-RELEASE | | | | | | | | |
| Must-not-release value | | 19.5 | – | – | 16 | – | – | At |
| RELEASE | | | | | | | | |
| Must-release value | | – | – | 7 | – | – | 6 | At |
| Release time | operate value = 42.5 At | – | – | 30 | – | – | – | µs |
| **All types** | | | | | | | | |
| Breakdown voltage | | see Fig.7 | | | – | | | |

**Note**

1. Distance between measuring points: 41 mm.

## LIFE EXPECTANCY AND RELIABILITY

The life expectancy data given below are valid for a coil energized at 1.25 times the published must-operate value for each type in the RI-29 series.

**No-load conditions (operating frequency: 100 Hz)**

Life expectancy: min. $2 \times 10^8$ operations with a failure rate of less than $10^{-9}$ with a confidence level of 90%.

End of life criteria:
contact resistance >1 Ω after 2 ms;
release time >2 ms (latching or contact sticking).

**Loaded conditions (capacitive load: 80 V; 0.1 mA; (700 mA peak); operating frequency: 100 Hz)**

RI-29AA

Life expectancy: min. $10^7$ operations with a failure rate of less than $2 \times 10^{-8}$ with a confidence level of 90%.

End of life criterion:
release time >2 ms (latching or contact sticking).

RI-29A

Life expectancy: min. $2 \times 10^7$ operations with a failure rate of less than $10^{-8}$ with a confidence level of 90%.

End of life criterion:
release time >2 ms (latching or contact sticking).

**Note:**

Switching different loads involves different life expectancy and reliability data. Further information is available on request.

## SHOCK AND VIBRATION

### Shock

The switches are tested in accordance with IEC Publication 68-2-27, test Ea (peak acceleration 150 g; half sinewave). Such a shock will not cause an open switch (no magnetic field present) to close, nor a switch kept closed by an 80 At coil to open.

### Vibration

The switches are tested in accordance with IEC Publication 68-2-6, test Fc (acceleration 10 g; below cross-over frequency 57 to 62 Hz; amplitude 0.75 mm; frequency range 10 to 2 000 Hz; duration 90 minutes). Such a vibration will not cause an open switch (no magnetic field present) to close, nor a switch kept closed by an 80 At coil to open.

## COILS

For definitions of the Philips standard coil and the standard MIL coil see chapter Application notes of the General Section.

### Relationship between Philips standard coil and standard MIL coil

Operate value of standard MIL coil = 0.78 x operate value of Philips standard coil + 1.02 At.
Release value of standard MIL coil = 0.83 x release value of Philips standard coil + 0.01 At.

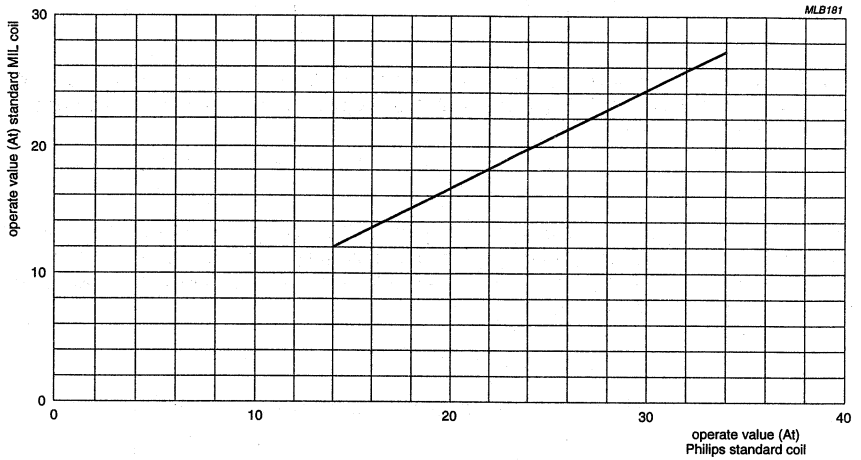



Fig.3 Correlation of operate value in standard MIL coil and Philips standard coil.

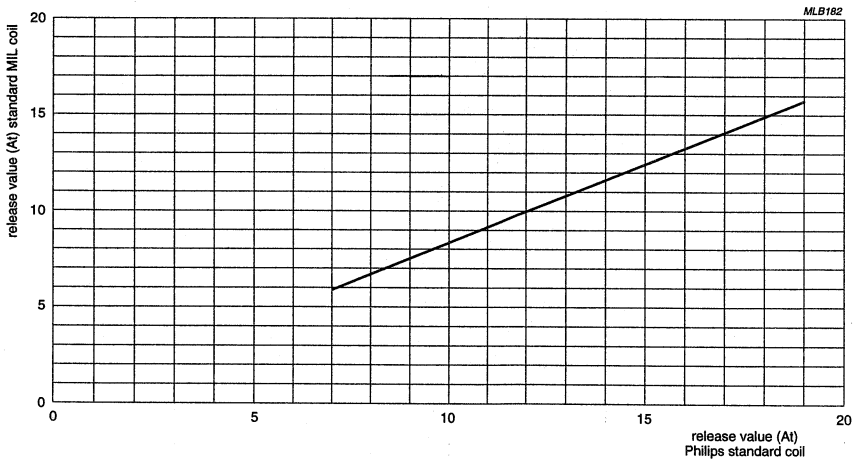



Fig.4 Correlation of release value in standard MIL coil and Philips standard coil.

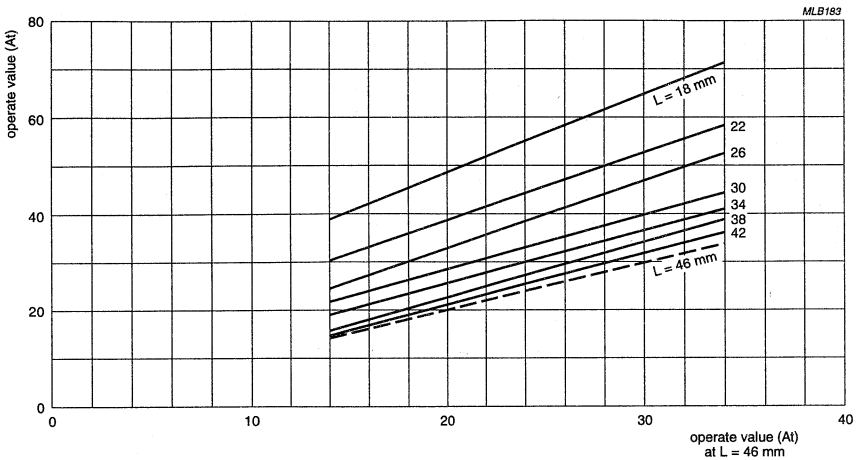



Fig.5 Operate value at various overall lengths (L) compared with standard length of 46 mm (Philips standard coil).

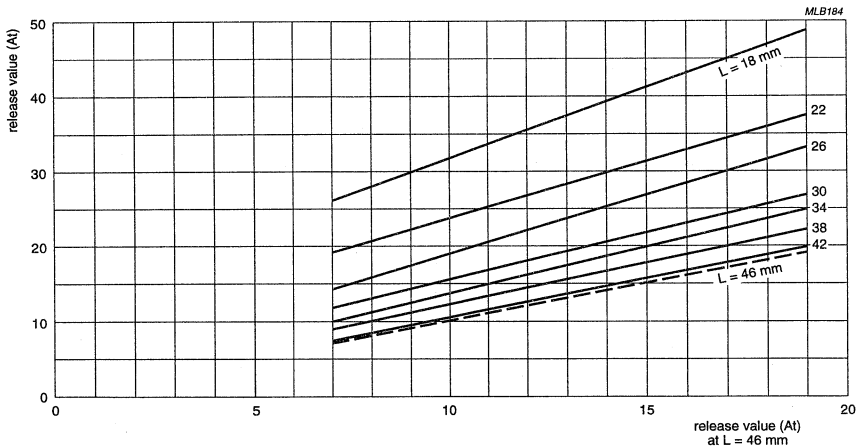



Fig.6 Release value at various overall lengths (L) compared with standard length of 46 mm (Philips standard coil).

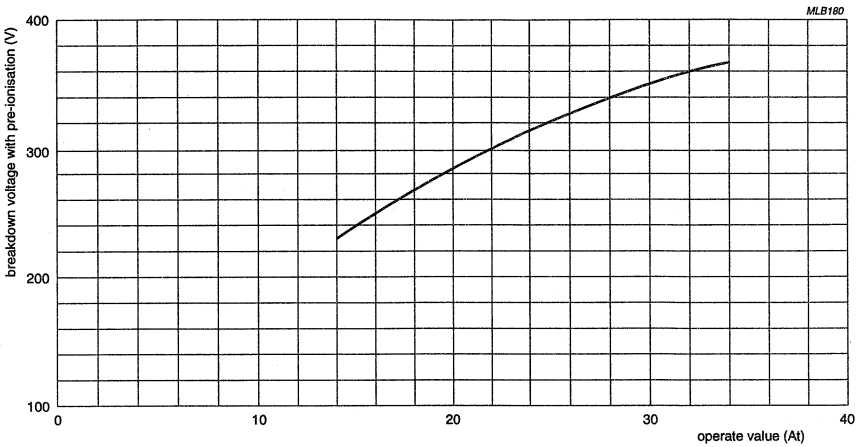



Fig.7 Minimum breakdown voltage with pre-ionisation as a function of operate value (Philips standard coil).

# Dry-reed Switch | RI-45

## DESCRIPTION

Micro dry-reed switch hermetically sealed in a gas-filled glass envelope. Single-pole, single-throw (SPST) type, having normally open contacts, and containing two magnetically actuated reeds. The switch is of the double-ended type and may be actuated by an electromagnet, a permanent magnet or a combination of both. The device is intended for use in relays for switching main loads.

## QUICK REFERENCE DATA

| PARAMETER | LEVEL | VALUE | UNIT |
|---|---|---|---|
| Contact type | | SPST | |
| Contact arrangement | | normally open | |
| Switched power | max. | 40 | W |
| Switched voltage (AC; RMS value) | max. | 250 | V |
| Switched current (resistive; AC; RMS value) | max. | 1 000 | mA |
| Contact resistance (initial) | max. | 90 | mΩ |

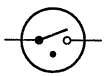



Fig.1 Symbol.

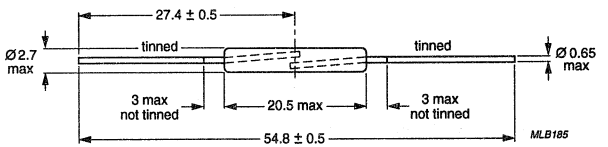
## BASIC MAGNETIC CHARACTERISTICS

Measured with the Philips standard coil.

| PARAMETER | VALUE | UNIT |
|---|---|---|
| Operate range | 27 to 59 | At |
| Release range | 8 to 21 | At |

## MECHANICAL DATA

| PARAMETER | VALUE | UNIT |
|---|---|---|
| Contact arrangement | normally open | |
| Lead finish | tinned | |
| Resonant frequency of single reed | ≈ 3 200 | Hz |
| Net mass | ≈ 0.28 | g |
| Mounting position | any | |




Dimensions in mm.

Fig.2 Outline.

**Mechanical strength**

The robustness of the terminals is tested in accordance with IEC Publication 68-2-21, test $Ua_1$ (load 40 N).

**Mounting**

The leads should not be bent closer than 1 mm to the glass-to-metal seals. Stress on the seals should be avoided. Care must be taken to prevent stray magnetic fields from influencing the operating and measuring conditions. The switches can also be supplied with cropped and pre-formed leads, to customer specification.

**Resistance to soldering heat**

The switch can withstand soldering heat in accordance with IEC Publication 68-2-20 test Tb, method 1B: solder bath at 350 ±10 °C for 3.5 ±0.5 s.

**Solderability**

Solderability is tested in accordance with IEC Publication 68-2-20, test Ta, method 3: solder globule temperature 235 °C; ageing 1b: 4 h steam.

**Weldability**

The leads are weldable.

## LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

| PARAMETER | MIN. | MAX. | UNIT |
|---|---|---|---|
| Switched power | – | 40 | W |
| Switched voltage (AC; RMS value) | – | 250 | V |
| Switched current (resistive; AC; RMS value); note 1 | – | 1 000 | mA |
| Current through closed contacts (AC; RMS value) | – | 3 | A |
| Operating ambient temperature; note 2 | –55 | +125 | °C |
| Storage temperature; note 2 | –55 | +125 | °C |

**Notes**

1. Switching higher currents is possible depending on the signature of the load.

2. Temperature excurcions up to 150 °C may be permissible. For more information consult your nearest Philips Components national organization.

## CHARACTERISTICS

| PARAMETER | CONDITIONS | PHILIPS STANDARD COIL | | | STANDARD MIL COIL | | | UNIT |
|---|---|---|---|---|---|---|---|---|
| | | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. | |
| NOT-OPERATE | | | | | | | | |
| Breakdown voltage | | 750 | – | – | 750 | – | – | V |
| Insulation resistance (initial) | RH ≤ 45% | $10^6$ | – | – | $10^6$ | – | – | MΩ |
| Contact capacitance | without test coil | – | – | 0.2 | – | – | 0.2 | pF |
| Must-not-operate value | | – | – | 27 | – | – | 23.5 | At |
| OPERATE | | | | | | | | |
| Must-operate value | | – | – | 59 | – | – | 49 | At |
| Operate time (including bounce time) | operate value = 75 At | – | 0.35 | 0.5 | – | – | – | ms |
| Bounce time | operate value = 75 At | – | 0.15 | 0.3 | – | – | – | ms |
| Contact resistance (initial) | operate value = 35 At ρ = 1.2 mΩ/mm typical; note 1 | – | 60 | 90 | – | – | – | mΩ |
| NOT-RELEASE | | | | | | | | |
| Must-not-release value | | 21 | – | – | 18.5 | – | – | At |
| RELEASE | | | | | | | | |
| Must-release value | | – | – | 8 | – | – | 8 | At |
| Release time | operate value = 75 At | – | – | 30 | – | – | – | µs |

**Note**

1. Distance between measuring points: 41 mm.

## LIFE EXPECTANCY AND RELIABILITY

The life expectancy data given below are valid for a coil energized at 1.5 times the published must-operate value.

**Loaded conditions (inductive load: 220 V (AC; RMS); L = 3.95 H; R = 662 Ω; operating frequency: 2 Hz)**

Life expectancy: min. $10^4$ operations with a failure rate of less than $2 \times 10^{-5}$ with a confidence level of 90%.

End of life criterion:
release time >2.5 ms (latching or contact sticking).

**Loaded conditions (inductive load: 220 V (AC; RMS); L = 5.5 H; R = 2230 Ω; operating frequency: 2 Hz)**

Life expectancy: min. $10^5$ operations with a failure rate of less than $2 \times 10^{-6}$ with a confidence level of 90%.

End of life criterion:
release time >2.5 ms (latching or contact sticking).

**Loaded conditions (inductive load: 220 V (AC; RMS); L = 0.28 H; R = 106 Ω; switching on only; operating frequency: 0.6 Hz)**

Life expectancy: min. $2 \times 10^4$ operations with a failure rate of less than $2 \times 10^{-5}$ with a confidence level of 90%.

End of life criterion:
release time >2.5 ms (latching or contact sticking).

**Loaded conditions (resistive load: 250 V (AC; RMS); R = 1 MΩ; operating frequency: 20 Hz)**

Life expectancy: min. $2 \times 10^6$ operations with a failure rate of less than $10^{-7}$ with a confidence level of 90%.

End of life criteria:
contact resistance >100 Ω after 2 ms;
release time >2.5 ms (latching or contact sticking).

**Note:**

Switching different loads involves different life expectancy and reliability data. Further information is available on request.

## SHOCK AND VIBRATION

### Shock

The switches are tested in accordance with IEC Publication 68-2-27, test Ea (peak acceleration 500 g; half sinewave). Such a shock will not cause an open switch (no magnetic field present) to close, nor a switch kept closed by an 75 At coil to open.

**Vibration**

The switches are tested in accordance with IEC Publication 68-2-6, test Fc (acceleration 10 g; below cross-over frequency 57 to 62 Hz; amplitude 0.75 mm; frequency range 10 to 2 000 Hz; duration 90 minutes). Such a vibration will not cause an open switch (no magnetic field present) to close, nor a switch kept closed by an 75 At coil to open.

**COILS**

For definitions of the Philips standard coil and the standard MIL coil see chapter Application notes of the General Section.

**Relationship between Philips standard coil and standard MIL coil**

Operate value of standard MIL coil = 0.79 x operate value of Philips standard coil + 2.26 At.
Release value of standard MIL coil = 0.83 x release value of Philips standard coil + 1.31 At.

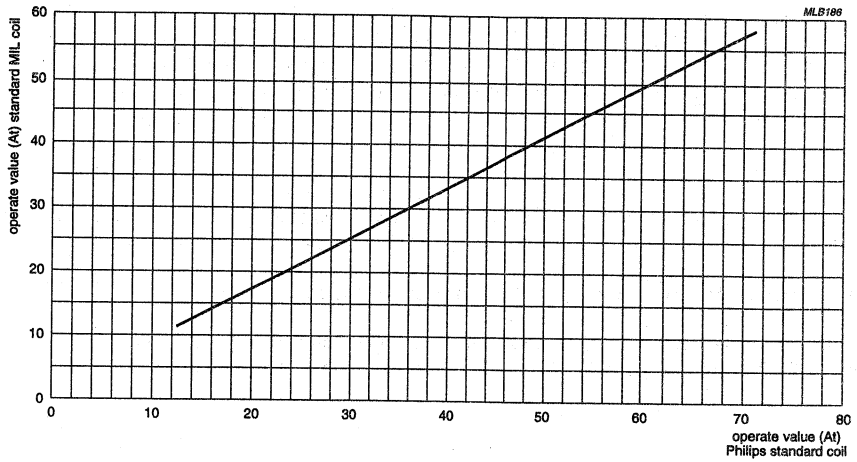



Fig.3 Correlation of operate value in standard MIL coil and Philips standard coil.

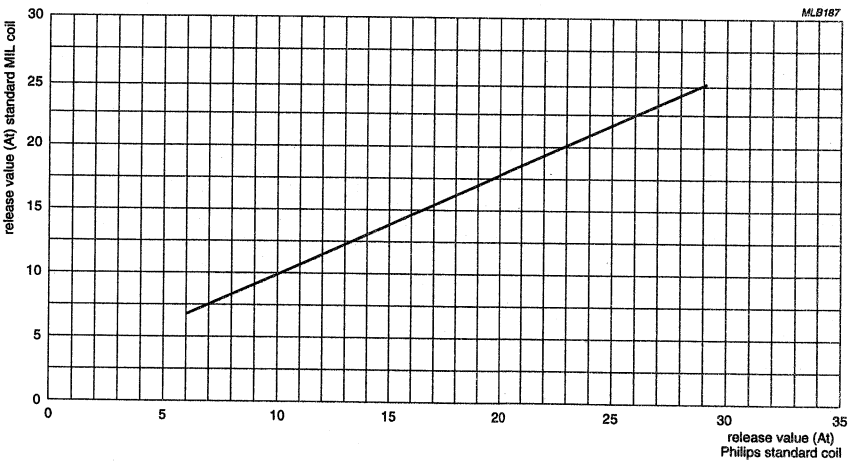



Fig.4 Correlation of release value in standard MIL coil and Philips standard coil.

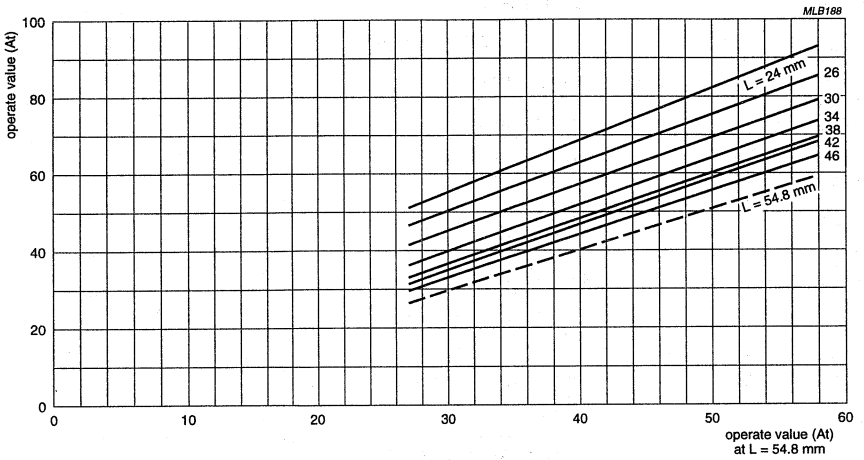



Fig.5 Operate value at various overall lengths (L) compared with standard length of 54.8 mm (Philips standard coil).

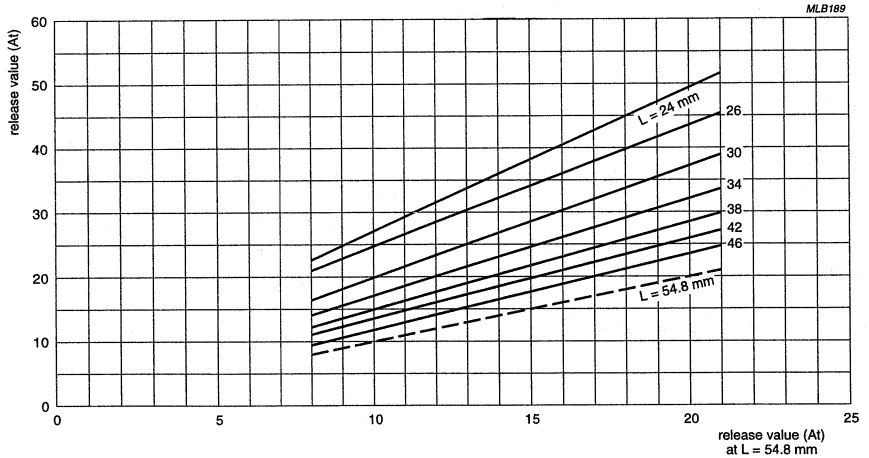



Fig.6 Release value at various overall lenghts (L) compared with standard length of 54.8 mm (Philips standard coil).

## DESCRIPTION

Micro dry-reed switch hermetically sealed in a gas-filled glass envelope. Single-pole, single-throw (SPST) type, having normally open contacts, and containing two magnetically actuated reeds. The switch is of the double-ended type and may be actuated by an electromagnet, a permanent magnet or a combination of both. The device is intended for use in relays for switching power loads and high stand-off voltage applications.

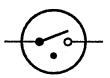



Fig.1 Symbol.

## QUICK REFERENCE DATA

| PARAMETER | LEVEL | VALUE | UNIT |
|---|---|---|---|
| Contact type | | SPST | |
| Contact arrangement | | normally open | |
| Switched power | | | |
| RI-46AA; RI-46A | max. | 30 | W |
| RI-46B; RI-46C | max. | 40 | W |
| Switched voltage (DC) | max. | 200 | V |
| Switched voltage (AC; RMS value) | max. | 250 | V |
| Switched current (resistive DC) | | | |
| RI-46AA | max. | 750 | mA |
| RI-46A; RI-46B; RI-46C | max. | 1 000 | mA |
| Switched current (AC; RMS value) | | | |
| RI-46AA | max. | 750 | mA |
| RI-46A; RI-46B; RI-46C | max. | 1 000 | mA |
| Contact resistance (initial) | max. | 90 | mΩ |

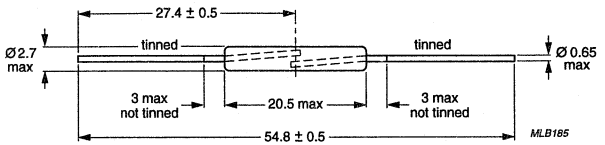
## BASIC MAGNETIC CHARACTERISTICS

Measured with the Philips standard coil.

| PARAMETER | VALUE | | | | UNIT |
|---|---|---|---|---|---|
| | RI-46AA | RI-46A | RI-46B | RI-46C | |
| Operate range | 10.5 to 19 | 15 to 28 | 24 to 51 | 46 to 70 | At |
| Release range | 4 to 12 | 5 to 16 | 8 to 20.5 | 12 to 22.5 | At |

## MECHANICAL DATA

| PARAMETER | VALUE | UNIT |
|---|---|---|
| Contact arrangement | normally open | |
| Lead finish | tinned | |
| Resonant frequency of single reed | ≈ 3 200 | Hz |
| Net mass | ≈ 0.28 | g |
| Mounting position | any | |




Dimensions in mm.

Fig.2 Outline.

**Mechanical strength**

The robustness of the terminations is tested in accordance with IEC Publication 68-2-21, test $Ua_1$ (load 40 N).

**Mounting**

The leads should not be bent closer than 1 mm to the glass-to-metal seals. Stress on the seals should be avoided. Care must be taken to prevent stray magnetic fields from influencing the operating and measuring conditions. The switches can also be supplied with cropped and pre-formed leads, to customer specification.

**Resistance to soldering heat**

The switch can withstand soldering heat in accordance with IEC Publication 68-2-20 test Tb, method 1B: solder bath at 350 ±10 °C for 3.5 ±0.5 s.

**Solderability**

Solderability is tested in accordance with IEC Publication 68-2-20, test Ta, method 3: solder globule temperature 235 °C; ageing 1b: 4 h steam.

**Weldability**

The leads are weldable.

## LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

| PARAMETER | MIN. | MAX. | UNIT |
|---|---|---|---|
| Switched power | | | |
| RI-46AA; RI-46A | – | 30 | W |
| RI-46B; RI-46C | – | 40 | W |
| Switched voltage (DC) | – | 200 | V |
| Switched voltage (AC; RMS value) | – | 250 | V |
| Switched current (resistive DC); note 1 | | | |
| RI-46AA | – | 750 | mA |
| RI-46A; RI-46B; RI-46C | – | 1 000 | mA |
| Switched current (AC; RMS value); note 1 | | | |
| RI-46AA | – | 750 | mA |
| RI-46A; RI-46B; RI-46C | – | 1 000 | mA |
| Current through closed contacts (DC) | | | |
| RI-46AA | – | 2 | A |
| RI-46A | – | 2.5 | A |
| RI-46B; RI-46C | – | 3 | A |
| Current through closed contacts (AC; RMS value) | | | |
| RI-46AA | – | 2 | A |
| RI-46A | – | 2.5 | A |
| RI-46B; RI-46C | – | 3 | A |
| Operating ambient temperature; note 2 | –55 | +125 | °C |
| Storage temperature; note 2 | –55 | +125 | °C |

**Notes**

1. Switching higher currents is possible depending on the signature of the load.
2. Temperature excurcions up to 150 °C may be permissible. For more information consult your nearest Philips Components national organization.

## CHARACTERISTICS

| PARAMETER | CONDITIONS | PHILIPS STANDARD COIL | | | STANDARD MIL COIL | | | UNIT |
|---|---|---|---|---|---|---|---|---|
| | | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. | |
| **RI-46AA** | | | | | | | | |
| NOT-OPERATE | | | | | | | | |
| Insulation resistance (initial) | RH ≤ 45% | $10^6$ | – | – | $10^6$ | – | – | MΩ |
| Contact capacitance | without test coil | – | – | 0.2 | – | – | 0.2 | pF |
| Must-not-operate value | | – | – | 10.5 | – | – | 10.5 | At |
| OPERATE | | | | | | | | |
| Must-operate value | | – | – | 19 | – | – | 17.5 | At |
| Operate time (including bounce time) | operate value = 24 At | – | 0.35 | 0.5 | – | – | – | ms |
| Bounce time | operate value = 24 At | – | 0.15 | 0.3 | – | – | – | ms |
| Contact resistance (initial) | operate value = 27 At; ρ = 1.2 mΩ/mm typical; note 1 | – | 60 | 90 | – | – | – | mΩ |
| NOT-RELEASE | | | | | | | | |
| Must-not-release value | | 12 | – | – | 11.5 | – | – | At |
| RELEASE | | | | | | | | |
| Must-release value | | – | – | 4 | – | – | 5 | At |
| Release time | operate value = 24 At | – | – | 30 | – | – | – | µs |
| **RI-46A** | | | | | | | | |
| NOT-OPERATE | | | | | | | | |
| Insulation resistance (initial) | RH ≤ 45% | $10^6$ | – | – | $10^6$ | – | – | MΩ |
| Contact capacitance | without test coil | – | – | 0.2 | – | – | 0.2 | pF |
| Must-not-operate value | | – | – | 15 | – | – | 14 | At |
| OPERATE | | | | | | | | |
| Must-operate value | | – | – | 28 | – | – | 24.5 | At |
| Operate time (including bounce time) | operate value = 35 At | – | 0.35 | 0.5 | – | – | – | ms |
| Bounce time | operate value = 35 At | – | 0.15 | 0.3 | – | – | – | ms |
| Contact resistance (initial) | operate value = 27 At; ρ = 1.2 mΩ/mm typical; note 1 | – | 60 | 90 | – | – | – | mΩ |

| PARAMETER | CONDITIONS | PHILIPS STANDARD COIL | | | STANDARD MIL COIL | | | UNIT |
|---|---|---|---|---|---|---|---|---|
| | | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. | |
| NOT-RELEASE | | | | | | | | |
| Must-not-release value | | 16 | – | – | 14.5 | – | – | At |
| RELEASE | | | | | | | | |
| Must-release value | | – | – | 5 | – | – | 5.5 | At |
| Release time | operate value = 35 At | – | – | 30 | – | – | – | µs |
| **RI-46B** | | | | | | | | |
| NOT-OPERATE | | | | | | | | |
| Insulation resistance (initial) | RH ≤ 45% | $10^6$ | – | – | $10^6$ | – | – | MΩ |
| Contact capacitance | without test coil | – | – | 0.2 | – | – | 0.2 | pF |
| Must-not-operate value | | – | – | 24 | – | – | 21 | At |
| OPERATE | | | | | | | | |
| Must-operate value | | – | – | 51 | – | – | 42.5 | At |
| Operate time (including bounce time) | operate value = 64 At | – | 0.35 | 0.5 | – | – | – | ms |
| Bounce time | operate value = 64 At | – | 0.15 | 0.3 | – | – | – | ms |
| Contact resistance (initial) | operate value = 36 At; ρ = 1.2 mΩ/mm typical; note 1 | – | 60 | 90 | – | – | – | mΩ |
| NOT-RELEASE | | | | | | | | |
| Must-not-release value | | 20.5 | – | – | 18.5 | – | – | At |
| RELEASE | | | | | | | | |
| Must-release value | | – | – | 8 | – | – | 8 | At |
| Release time | operate value = 64 At | – | – | 30 | – | – | – | µs |
| **RI-46C** | | | | | | | | |
| NOT-OPERATE | | | | | | | | |
| Insulation resistance (initial) | RH ≤ 45% | $10^6$ | – | – | $10^6$ | – | – | MΩ |
| Contact capacitance | without test coil | – | – | 0.2 | – | – | 0.2 | pF |
| Must-not-operate value | | – | – | 46 | – | – | 38.5 | At |
| OPERATE | | | | | | | | |
| Must-operate value | | – | – | 70 | – | – | 57.5 | At |
| Operate time (including bounce time) | operate value = 87.5 At | – | 0.35 | 0.5 | – | – | – | ms |

| PARAMETER | CONDITIONS | PHILIPS STANDARD COIL | | | STANDARD MIL COIL | | | UNIT |
|---|---|---|---|---|---|---|---|---|
| | | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. | |
| Bounce time | operate value = 87.5 At | – | 0.15 | 0.3 | – | – | – | ms |
| Contact resistance (initial) | operate value = 36 At; ρ = 1.2 mΩ/mm typical; note 1 | – | 60 | 90 | – | – | - | mΩ |
| NOT-RELEASE | | | | | | | | |
| Must-not-release value | | 22.5 | – | – | 20 | – | – | At |
| RELEASE | | | | | | | | |
| Must-release value | | – | – | 12 | – | – | 11.3 | At |
| Release time | operate value = 87.5 At | – | – | 30 | – | – | – | μs |
| **All types** | | | | | | | | |
| Breakdown voltage | | see Figs 7 and 8 | | | – | | | |

**Note**

1. Distance between measuring points: 41 mm.

## LIFE EXPECTANCY AND RELIABILITY

The life expectancy data given below are valid for a coil energized at 1.5 times the published must-operate value for each type in the RI-46 series.

**No-load conditions (operating frequency: 100 Hz)**

Life expectancy: min. $10^8$ operations with a failure rate of less than $10^{-9}$ with a confidence level of 90%.

End of life criteria:
contact resistance >1 Ω after 2 ms;
release time >2 ms (latching or contact sticking).

**Loaded conditions (resistive load: 20 V; 500 mA; operating frequency: 125 Hz)**

RI-46AA

Life expectancy: min. $10^7$ operations with a failure rate of less than $10^{-8}$ with a confidence level of 90%.

End of life criteria:
contact resistance >2 Ω after 2.5 ms;
release time >2.5 ms (latching or contact sticking).

RI-46A; RI-46B; RI-46C

Life expectancy: min. 2.5 x $10^7$ operations with a failure rate of less than $10^{-8}$ with a confidence level of 90%.

End of life criteria:
contact resistance >2 Ω after 2.5 ms;
release time >2.5 ms (latching or contact sticking).

**Note:**

Switching different loads involves different life expectancy and reliability data. Further information is available on request.
Currents between 50 and 200 mA may result in a reduced life expectancy.

## SHOCK AND VIBRATION

### Shock

The switches are tested in accordance with IEC Publication 68-2-27, test Ea (peak acceleration 500 g, half sinewave). Such a shock will not cause an open switch (no magnetic field present) to close, nor a switch kept closed by an 80 At coil to open.

### Vibration

The switches are tested in accordance with IEC Publication 68-2-6, test Fc (acceleration 10 g; below cross-over frequency 57 to 62 Hz; amplitude 0.75 mm; frequency range 10 to 2 000 Hz, duration 90 minutes). Such a vibration will not cause an open switch (no magnetic field present) to close, nor a switch kept closed by an 80 At coil to open.

## COILS

For definitions of the Philips standard coil and the standard MIL coil see chapter Application notes of the General Section.

### Relationship between Philips standard coil and standard MIL coil

Operate value of standard MIL coil = 0.79 x operate value of Philips standard coil + 2.26 At.
Release value of standard MIL coil = 0.83 x release value of Philips standard coil + 1.31 At.

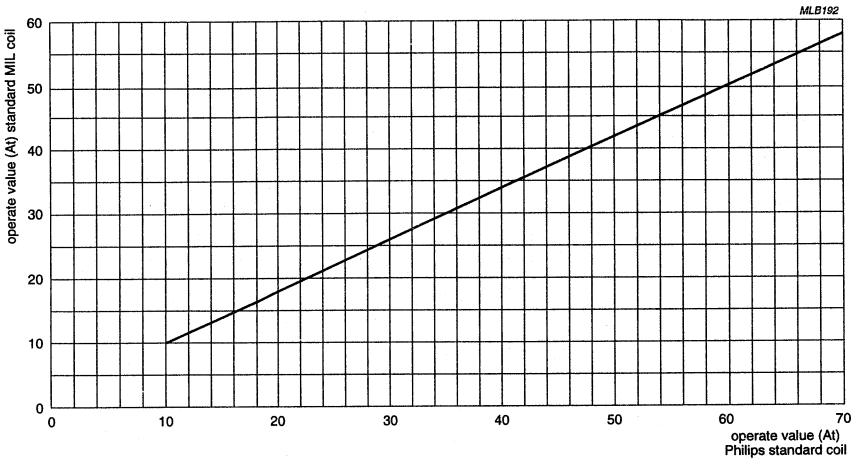



Fig.3 Correlation of operate value in standard MIL coil and Philips standard coil.

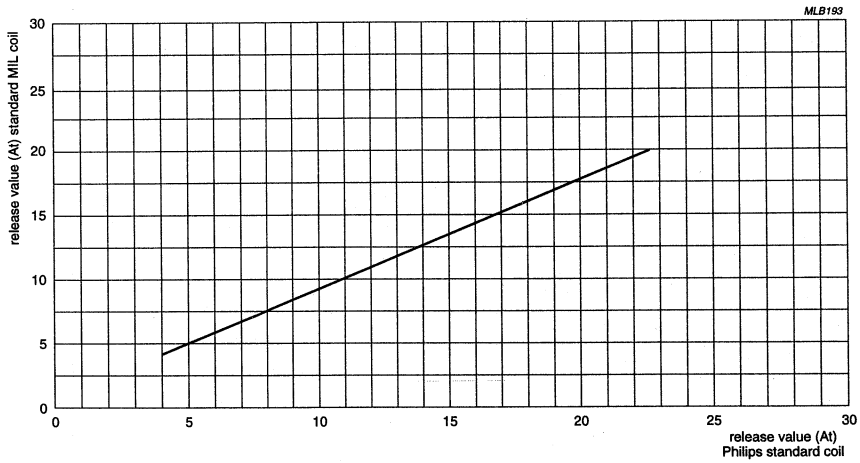



Fig.4 Correlation of release value in standard MIL coil and Philips standard coil.

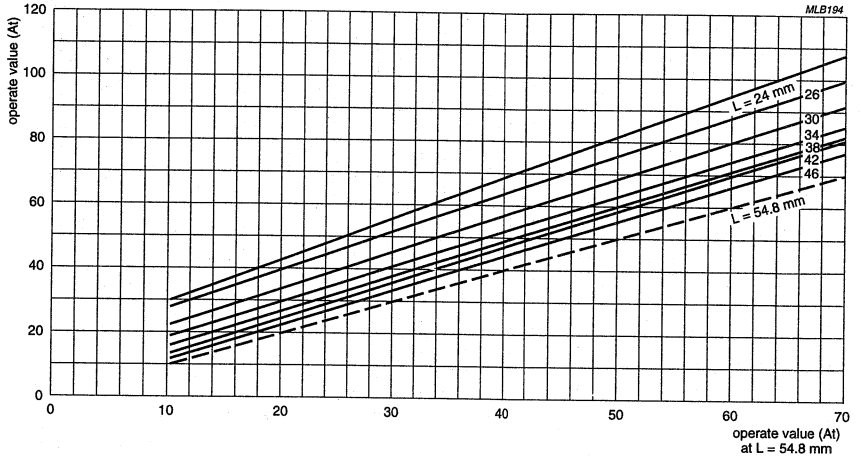



Fig.5 Operate value at various overall lengths (L) compared with standard length of 54.8 mm (Philips standard coil).

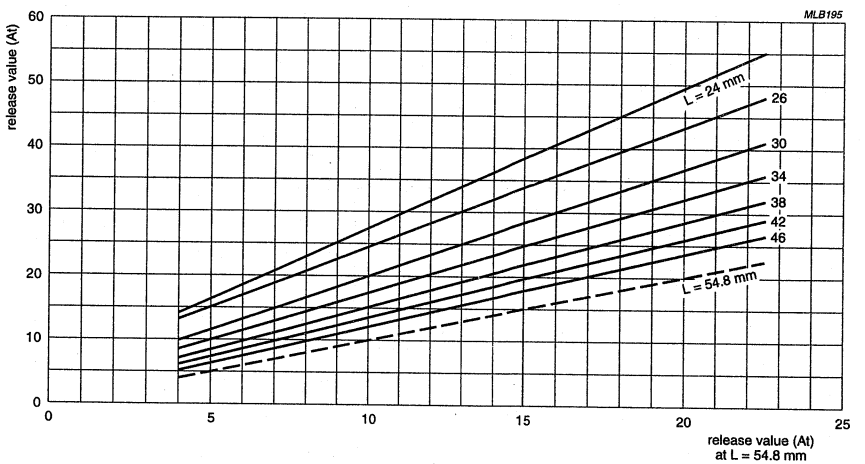



Fig.6 Release value at various overall lengths (L) compared with standard length of 54.8 mm (Philips standard coil).

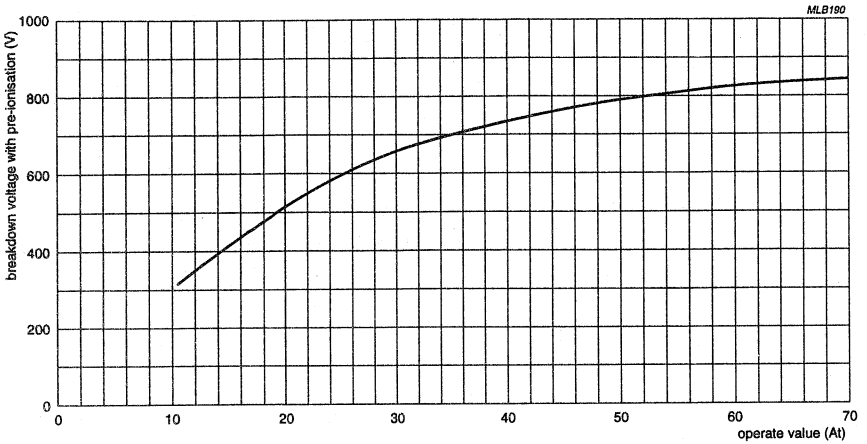



Fig.7 Minimum breakdown voltage with pre-ionisation as a function of operate value (Philips standard coil).

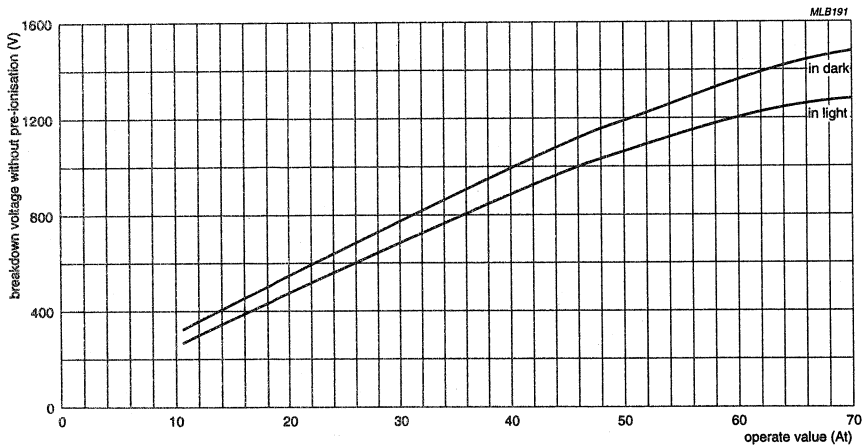



Fig.8 Minimum breakdown voltage without pre-ionisation as a function of operate value (Philips standard coil).

# Data handbook system

## DATA HANDBOOK SYSTEM

Philips Components data handbooks are available for selected product ranges and contain all relevant data available at the time of publication and each is revised and updated regularly.

Loose data sheets are sent to subscribers to keep them up-to-date on additions or alterations made during the lifetime of each edition.

Our data handbook titles are listed here.

**Display components**

| *Book* | *Title* |
|---|---|
| DC01 | Colour Display Components<br>Colour TV Picture Tubes and Assemblies<br>Colour Monitor Tube Assemblies |
| DC02 | Monochrome Monitor Tubes and Deflection Units |
| DC03 | Television Tuners, Coaxial Aerial Input Assemblies |
| DC05 | Flyback Transformers, Mains Transformers and General-purpose FXC Assemblies |

**Magnetic products**

| | |
|---|---|
| MA01 | Soft Ferrites |
| MA03 | Piezoelectric Ceramics and Specialty Ferrites |
| MA04 | Dry-reed Switches |

**Passive components**

| | |
|---|---|
| PA01 | Electrolytic Capacitors |
| PA02 | Varistors, Thermistors and Sensors |
| PA03 | Potentiometers and Switches |
| PA04 | Variable Capacitors |
| PA05 | Film Capacitors |
| PA06 | Ceramic Capacitors |
| PA07 | Quartz Crystals for Special and Industrial Applications |
| PA08 | Fixed Resistors |
| PA10 | Quartz Crystals for Automotive and Standard Applications |
| PA11 | Quartz Oscillators |

**Professional components**

| | |
|---|---|
| PC04 | Photo Multipliers |
| PC05 | Plumbicon Camera Tubes and Accessories |
| PC07 | Vidicon and Newvicon Camera Tubes and Deflection Units |
| PC08 | Image Intensifiers |
| PC12 | Electron Multipliers |

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Our sister product division, Philips Semiconductors, also has a comprehensive data handbook system to support their products. Their data handbook titles are listed here.

**Integrated circuits**

| *Book* | *Title* |
|---|---|
| IC01 | Semiconductors for Radio and Audio Systems |
| IC02 | Semiconductors for Television and Video Systems |
| IC03 | Semiconductors for Telecom Systems |
| IC04 | CMOS HE4000B Logic Family |
| IC05 | Advanced Low-power Schottky (ALS) Logic Series |
| IC06 | High-speed CMOS Logic Family |
| IC08 | 100K ECL Logic Family |
| IC10 | Memories |
| IC11 | General-purpose/Linear ICs |
| IC12 | Display Drivers and Microcontroller Peripherals (planned) |
| IC13 | Programmable Logic Devices (PLD) |
| IC14 | 8048-based 8-bit Microcontrollers |
| IC15 | FAST TTL Logic Series |
| IC16 | ICs for Clocks and Watches |
| IC18 | Semiconductors for In-car Electronics and General Industrial Applications (planned) |
| IC19 | Semiconductors for Datacom: LANs, UARTs, Multi-protocol Controllers and Fibre Optics |
| IC20 | 8051-based 8-bit Microcontrollers |
| IC21 | 68000-based 16-bit Microcontrollers (planned) |
| IC22 | ICs for Multi-Media Systems (planned) |
| IC23 | QUBIC Advanced BiCMOS Interface Logic ABT, MULTIBYTE™ |
| IC24 | Low Voltage CMOS & BiCMOS Logic |

**Discrete semiconductors**

| | |
|---|---|
| SC01 | Diodes |
| SC02 | Power Diodes |
| SC03 | Thyristors and Triacs |
| SC04 | Small-signal Transistors |
| SC05 | Low-frequency Power Transistors and Hybrid IC Power Modules |
| SC06 | High-voltage and Switching NPN Power Transistors |
| SC07 | Small-signal Field-effect Transistors |
| SC08a | RF Power Bipolar Transistors |
| SC08b | RF Power MOS Transistors |
| SC09 | RF Power Modules |
| SC10 | Surface Mounted Semiconductors |

**Discrete semiconductors** (continued)

| | |
|---|---|
| SC13 | PowerMOS Transistors including TOPFETs and IGBTs |
| SC14 | RF Wideband Transistors, Video Transistors and Modules |
| SC15 | Microwave Transistors |
| SC16 | Wideband Hybrid IC Modules |
| SC17 | Semiconductor Sensors |

**Professional components**

| | |
|---|---|
| PC01 | High-power Klystrons and Accessories |
| PC06 | Circulators and Isolators |

## MORE INFORMATION FROM PHILIPS SEMICONDUCTORS?

For more information contact your nearest Philips Semiconductors national organization shown in the following list.

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**Australia:** NORTH RYDE, Tel. (02)805 4455, Fax. (02)805 4466
**Austria:** WIEN, Tel. (01)601011236, Fax. (01)60101 1211
**Belgium:** EINDHOVEN (Netherlands), Tel. (31)40 783 749, Fax. (31)40 788 399
**Brazil:** SÃO PAULO, Tel. (011)829 1166, Fax. (011)829 1849
**Canada:** Integrated Circuits – Tel. (800)234 7381, Fax. (708)296 8556;
Discrete Semiconductors – SCARBORBOUGH, Tel. (0416)292-5161 ext. 2336, Fax. (0416)292-4477
**Chile:** SANTIAGO, Tel. (02)773 816, Fax. (02)777 6730
**Colombia:** BOGOTA, Tel. (571) 217 4609, Fax. (01)217 4549
**Denmark:** COPENHAGEN, Tel. (032)88 2636, Fax. (031)57 1949
**Finland:** ESPOO, Tel. (9)0-50261, Fax. (9)0-520971
**France:** SURESNES, Tel. (01)4099 6161, Fax. (01)4099 6431
**Germany:** HAMBURG, Tel. (040)3296-0, Fax. (040)3296 213
**Greece:** TAVROS, Tel. (01)4894 339/4894 911, Fax. (01)4814 240
**Hong Kong:** KWAI CHUNG, Tel. (0)4245 121, Fax. (0)4806 960
**India:** BOMBAY, Tel. (022)4938 541, Fax. (022)4938 722
**Indonesia:** JAKARTA, Tel. (021)5201122, Fax. (21)5205189
**Ireland:** DUBLIN, Tel. (01)640 000, Fax. (01)640 200
**Italy:** MILANO, Tel. (02)6752.1, Fax. (02)6752 3350
**Japan:** TOKIO, Tel. (03)3740 5101, Fax. (03)37400 570
**Korea** (Republic of): SEOUL, Tel. (02)709 1412, Fax. (02)709 1415
**Malaysia:** SELANGOR, Tel. (03)757 5511, Fax. (03)757 4880
**Mexico:** EL PASO, TEXAS, Tel. 9-5(800)234 7831, Fax. (708)296 8556
**Netherlands:** EINDHOVEN, Tel. (040)783 749, Fax. (040)788 399
**New Zealand:** AUCKLAND, Tel. (09)849 4160, Fax. (09)849 7811
**Norway:** OSLO, Tel. (22)74 8000, Fax. (22)74 8341
**Pakistan:** KARACHI, Tel. (021)577 039, Fax. (021)569 1832
**Philippines:** MANILA, Tel. (02)810 0161, Fax. (02)817 3474
**Portugal:** LISBOA, Tel. (01)683 121, Fax. (01)658 013
**Singapore:** SINGAPORE, Tel. (65)350 2000, Fax. (65)251 6500
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