Mors Smitt
A Wabtec Company

# Portable relay tester PRT-MS1

## User manual


www.morssmitt.com

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Note:
The performance of an electromechanical relay depends on several external factors. The testresults achieved with Portable Relay Tester PRT-MS1 are valid for the particular relay under test at that particular moment. There is no guarantee that the tested relay will have the same performance in an electrical installation, or at another moment.

## Content

# 1 Preface

Congratulations on your purchase of the Portable Relay Tester PRT-MS1.

Portable relay test system designed to facilitate rapid verification of relay condition. The system is battery powered (lasts 8 hours standard use), and allows the operator to perform tests on both instantaneous and timer relays. Efficiently determine correct relay functionality including minimum operating voltage, contact quality and delay times. Defects such as jammed contacts are identified. Including contact wetting possibility to electrically clean relay contacts.

The PRT-MS1 is the ideal choice to offer a low-cost relay testing capability to service engineers for onboard train applications.

- Fast & easy field testing
- Fault finding
- Calibration of timer relays
- Incoming goods inspection

# 2 Safety and operational considerations

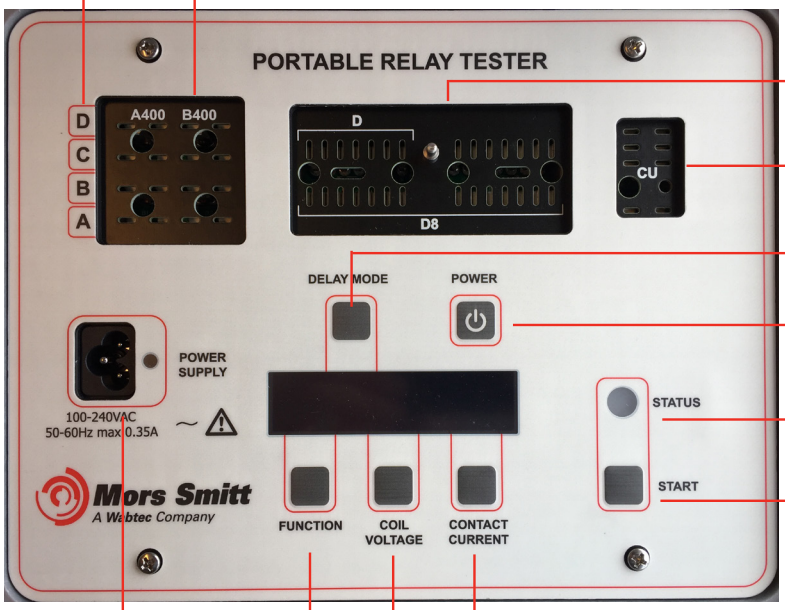
## Warnings and notes

In order to maintain the highest level of operator safety while operating the equipment, Mors Smitt recommends keeping your Portable Relay Tester in good condition and undamaged. When using the instrument, consider the following general warnings:

General warnings related to safety:

- If the test equipment is used in a manner not specified in this user manual, the protection provided by the equipment could be impaired
- Read this user manual carefully, otherwise the use of the instrument may be dangerous for the operator, the instrument or for the equipment under test
- Do not use the instrument or any of the accessories if any damage is noticed
- Consider all generally known precautions in order to avoid risk of electric shock while dealing with hazardous voltages
- Do not use the instrument in other power supply systems than 100-240 VAC 50-60 Hz
- The instrument is suitable to be used only in a dry environment
- Service, repairs or adjustment of the test equipment instruments and accessories is only allowed to be carried out by Mors Smitt
- All normal safety precautions must be taken in order to avoid risk of electric shock while working with the test equipment
- Only use suitable relays (see page 6), other types may cause damage to the instrument or relay
- Only use relays with undamaged cover and warranty sticker
- Before inserting/extracting relay from installation: disconnect power supply first (no hot swapping)!
- Relays should never be swapped to other circuit positions when taken out of its socket for inspection or fault finding, always place it back into the original position to prevent contact resistance problems
  (Contact resistance problems can be created when swapping relays between different circuit loads due the contact wear/ condition having changed during its operational life)
- Relay tester results do not imply or conclude warranty defects, quality issues, or manufacturing flaws. If required to know the root cause of the failure, Mors Smitt relays which do not pass this test should be investigated further. Mors Smitt can assist with a detailed evaluation.

## 3 Instrument description




Alignment indication: Must correspond to letters on bottom side relay

Socket for A/B platform relay:
A 400, B 400, TBAA 400, TBAU 400, TEAU 400

Socket for D platform relay:
D-U, D8-U, TDB4-U, TDE4-U, TDE4N-U

Socket for CU platform relay:
CU-U

Delay mode button

Power button

Status LED

Start button

Power inlet

Function button

Coil voltage button

Contact current button

### Standard set is including:

- Portable Relay Tester PRT-MS1 including battery
- Power cable
- Manual (hard copy)

## 4 Suitable relays

| Relay | Nominal voltage | Options | Remarks |
|---|---|---|---|
| CU-U | 24 VDC (type U201)<br>36 VDC (type U207)<br>48 VDC (type U202)<br>72 VDC (type U203)<br>96 VDC (type U205)<br>110 VDC (type U204) | B, E, G, Lg, Lr, keying | |
| D-U | 24 VDC (type U201)<br>36 VDC (type U207)<br>48 VDC (type U202)<br>72 VDC (type U203)<br>96 VDC (type U205)<br>110 VDC (type U204) | C, E, K, L, M, N, P, Q, T, X, X2, Z, 11, keying | |
| D8-U | 24 VDC (type U201)<br>36 VDC (type U207)<br>48 VDC (type U202)<br>72 VDC (type U203)<br>96 VDC (type U205)<br>110 VDC (type U204) | C, E, K, L, M, N, P, Q, X2, Z, keying | |
| TDB4-U | 24 VDC (type U201)<br>36 VDC (type U207)<br>48 VDC (type U202)<br>72 VDC (type U203)<br>96 VDC (type U205)<br>110 VDC (type U204) | C, E, K, M, N, Q, keying | Maximum time delay: 10 minutes |
| TDE4-U | 24 VDC (type U201)<br>36 VDC (type U207)<br>48 VDC (type U202)<br>72 VDC (type U203)<br>96 VDC (type U205)<br>110 VDC (type U204) | C, E, K, N, keying | |
| TDE4N-U | 24-60 VAC/DC<br>72-230 VAC/DC | C, E, K, M, N, keying | |
| A 400 | 24 VDC (keying code AG)<br>36 VDC (keying code FL)<br>48 VDC (keying code DG)<br>72 VDC (keying code BG)<br>96 VDC (keying code US)<br>110 VDC (keying code SV) | C, F, P, S, V | |
| B 400 | 24 VDC (keying code AG)<br>36 VDC (keying code FL)<br>48 VDC (keying code DG)<br>72 VDC (keying code BG)<br>96 VDC (keying code US)<br>115 VDC (keying code EG) | F, P, S, V | Tested as relay with 110 VDC nominal voltage |
| TBAA 400 | 24 VDC (keying code GT)<br>36 VDC (keying code HT)<br>48 VDC (keying code JT)<br>72 VDC (keying code KT)<br>96 VDC (keying code MT)<br>110 VDC (keying code LT) | F, 1-10 | |
| TBAU 400 | 24 VDC (keying code GP)<br>36 VDC (keying code HP)<br>48 VDC (keying code JP)<br>72 VDC (keying code KP)<br>96 VDC (keying code MP)<br>110 VDC (keying code LP) | C, F | Maximum time delay: 10 minutes<br>Only with delay-on setting<br>(Dip switch 10 set to ON, see datasheet TBAU 400 on www.morssmitt.com for details) |
| TEAU 400 | 24 VDC (keying code GP)<br>36 VDC (keying code HP)<br>48 VDC (keying code JP)<br>72 VDC (keying code KP)<br>96 VDC (keying code MP)<br>110 VDC (keying code LP) | C, F, 1, 2 | Maximum time delay: 10 minutes<br>Only with delay-on setting<br>(Dip switch 10 set to ON, see datasheet TEAU 400 on www.morssmitt.com for details) |

# 5 Instrument operation

The correct test parameters must be selected for each relay type. The relay tester starts with the last used settings.

## 5.1 Test Relay

Switch on tester:

press


Screen is on?

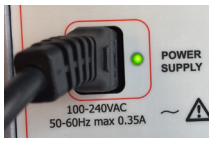
No

Battery is empty

Charge battery: connect power cord to relay tester, LED is red/orange


Remark: during charging the tester is disabled!

Battery fully charged: LED is green




Remove power cord


Yes

Insert relay in correct socket.
Important: Only 1 relay per test.

Press 

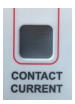
until TEST is shown

Press 

to select delay mode: NO DELAY for instantaneous relays
DELAY-ON for timer relays with delay on pull-in
DELAY-OFF for timer relays with delay on drop-out

Press 

to select coil voltage: 24, 36, 48, 72, 96 or 110 VDC

Press 

to select the test current which comes closest to the current used in the application:
LOW for testing with 10 mA
MED for testing with 100 mA
HIGH for testing with 1 A
⚠ Warning: do not use HIGH for relays with gold contacts!
If the application current is unknown, select MED.

Press 

to start testing

## 5.2 Testing – Test result

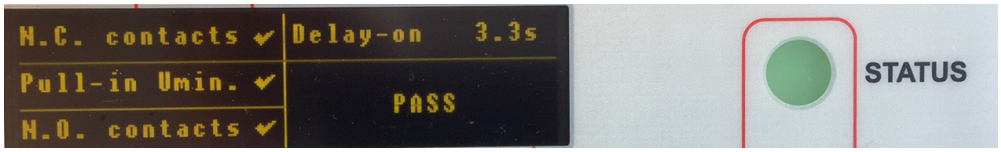
During testing the status LED is blinking orange and the screen shows BUSY


During testing the test can be aborted by pressing 

or 


After testing the status LED shows the test result:

Green LED: test PASSED
The screen shows PASS




When DELAY ON or DELAY OFF is selected, the measured time delay is shown.
Remark: the measured time delay is no pass/fail criterion.

Red LED: test FAILED
The screen shows FAIL


In the screen is shown with X at which test step the test failed.
Follow the procedure as mentioned in chapter '8.1 What to do when relay fails the test'.

To repeat the test press 


To test another relay or change test parameters:

Follow the procedure as mentioned in chapter ´5.1 Test relay´

## 5.3 Contact cleaning (not for timer relays, not for gold contacts)

Switch on tester:

press 


Insert relay in correct socket.
Only 1 relay per test.
Remark: only instantaneous relays are suitable for contact cleaning as the delay time with timer relays will prevent 10 times switching.

Press 

until 

is shown

⚠ Warning: do not use cleaning mode for relays with gold contacts, this will damage the contacts!

Press 

to select coil voltage: 24, 36, 48, 72, 96 or 110 VDC

Press 

to start cleaning the contacts

During cleaning the status LED is blinking orange and the screen shows CLEANING


Cleaning can be aborted by pressing 

or 


After 10 switching cycles the contact cleaning is finished, the screen shows:


To repeat the cleaning process: press 


To test the relay: press 

until 

is shown

Further follow the procedure as mentioned in chapter ´5.1 Test relay´.

## 5.4 Language selection

Press both buttons 

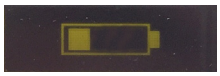
and 

for 5-10 seconds to switch language between English and Chinese.

## 6 Battery indication

 Battery full

 Battery medium

 Battery low

The tester will automatically switch off when not in use for approximately 1 minute. Battery lasts 8 hours (standard use).
Battery charging time approximately 2 hours. During charging the tester is disabled.

## 7 Test specifications

The Portable Relay Tester PRT-MS1 performs a functional test and a contact quality test. For timer relays the time delay will be measured. Separate from testing, the relay contacts can be cleaned.

## 7.1 Functional test

| | |
|---|---|
| Coil voltage | 70% of nominal value |
| If relay does not pull-in | FAIL |

Coil power limit
The coil power is measured, the test is PASSED when the power is not higher than the following value:

| | | |
|---|---|---|
| - | CU socket | 1.0 W |
| - | D socket | 2.7 W |
| - | A/B socket | 3.0 W |
| - | D8 socket | 4.0 W |

## 7.2 Contact quality test

Voltage drop per relay contact > 2.4 V FAIL

Background information:
Often contact resistance will be used as a value for relay contact quality. However contact resistance will vary depending on contact current: a reduction in current will increase the contact resistance. For increased contact resistance it must be known what level of resistance will result in an application problem. This level depends on several parameters like type of circuit (for example relay panel with several relay contact switching in series), the total circuit resistance and minimum voltage level the relay needs to operate.

The portable relay tester is designed to have an indication about contact quality in a fast and easy way without having to adjust many parameters per test. Therefore the contact quality is investigated by measuring the level of voltage drop between contacts, according IEC 60947-5-4.

In this way the most reliable test result will be achieved suitable for the actual application without the need of adjusting test parameters. Only the contact test current must be set to the value most reflecting the actual contact current in the application. Three levels can be selected:

- Low 10 mA
- Med 100 mA
- High 1 A

According IEC 60947-5-4 the threshold value is 10% voltage drop of the circuit voltage. To be on the safe side, the PASS/FAIL voltage is maximum 10% voltage drop of 24V, which is the lowest voltage in common contact circuit voltages.

This means:

- Voltage drop per relay contact ≤ 2.4V → PASS
- Voltage drop per relay contact > 2.4V → FAIL

Examples related to contact resistance

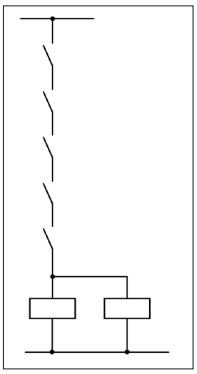
1. A relay contact switches a load which consumes a current of 2.4 A

   This will result in the following contact failure thresholds:
   - Maximum allowable voltage drop over the contact is 2.4 V as mentioned above
   - Maximum allowable contact resistance is 1 Ω (=2.4 V / 2.4 A)

2. Relay logic panel 110 V (theoretical application)

   Five contacts in series are switching two D-U204 relays as part of a bigger relay logic panel. The power supply is 89 V (on the low side). The two D-U204 relays need a voltage of 77 V to operate. The relays have a coil resistance of 5330 Ω so they consume 14.5 mA at 77 V each. This results in the following contact failure thresholds:

   - Maximum allowable voltage drop over a contact: (89 V–77 V) / 5 contacts = 2.4 V
   - Maximum allowable contact resistance: 2.4 V / (2*14.5 mA) = 83 Ω



## 7.3 Timing test

- Coil voltage 100% of nominal value
- Contact test current 10 mA
- Maximum delay-on 10 minutes
- Maximum delay-off 10 minutes

Only measuring, no PASS/FAIL criterion.

## 7.4 Contact cleaning

- Coil voltage 70% of nominal value
- Contact current 1 A
- Contact voltage 24 V

With each cleaning cycle all contacts will be switched 10 times.

## 7.5 Accuracy

| | |
|---|---|
| Voltage drop measurement | ± 2.5 % |
| Coil supply voltage | ± 5 % |
| Coil supply power limit | ± 10 % |
| Contact current | ± 5 % ± 2 mA |
| Timing measurement | ± 5 % ± 1 digit |

# 8 Relay test failures

## 8.1 What to do when the relay fails the test

When the relay fails the test, follow the following steps:

- Check if the delay mode, coil voltage and test current is set correct
- Check if the relay is suitable for the tester (see page 6)
- For A/B platform relays: check if the relay is inserted correct (see possible failures below)
- For TDE4 and TDE4N relays when failure occurs at initial test: as there is a latching relay inside, check if the contacts are in the correct position. If not, put nominal voltage on the relay to set contacts back in correct position and test again
- Test the same relay again; If the relay fails the test again, check at which step the relay failed the test
- If the relay failed at the N/O contacts or N/C contacts and the relay is an instantaneous relay with no gold contacts, clean the contacts (see page 9) and test again
- See the possible failures below to check if one of the described failures is applicable
- If possible test a similar new relay: result must be PASS, otherwise this is a strong indication the relay is not suitable for the tester

It is possible the relay fails the test while the relay is working correct in the application. In this case the reason for the negative test result can be the stringent PASS/FAIL criteria, for example the maximum allowable level of voltage drop of 2.4 V which is selected to be on the safe side as explained in 7.2.

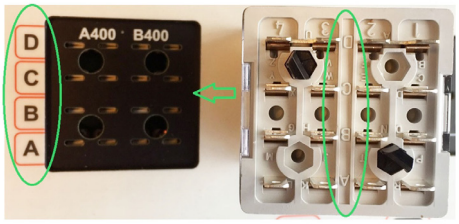
When the relay keeps failing and the cause is not clear, and the relay has not reached its end-of-life, it can be useful to find the root cause of the failure. Mors Smitt can assist with a detailed evaluation, please contact your local Mors Smitt Sales representative.

## 8.2 Possible failures (examples)

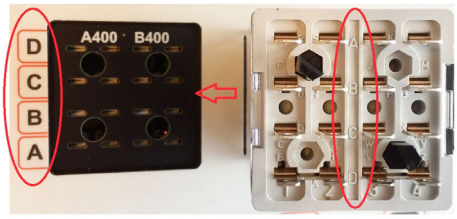
**Failure at initial or N/C contacts test step**

- Broken coil
- No relay placed
- More than one relay placed
- Relay not suitable for tester
- Normally closed contacts failure
- Reversed mounting of relay (A/B socket only)






OK




Not OK

**Failure at pull-in test step**

- Relay not functional
- Relay uses too much power
  - Incorrect voltage selected
  - Shorted relay coil
  - Shorted relay diode
- Delay mode selected incorrectly
- Delay-on out of range
- Relay not suitable for tester


**Failure at N/O contact step**

- Normally open contacts failure
- Delay mode selected incorrectly
- Delay-off out of range

# 9 Maintenance

Unauthorized persons are not allowed to open the Portable Relay Tester. There are no user replaceable components inside the instrument.

## 9.1 Cleaning

No special maintenance is required for the housing. To clean the surface of the instrument use a soft cloth slightly moistened with soapy water. Then leave the instrument to dry totally before use.

Warnings:
- Do not use liquids based on petrol or hydrocarbons
- Do not spill cleaning liquid over the instrument
- Do not use 'sprayer' on the instrument

## 9.2 Periodic calibration

We recommend a periodic calibration for correct test results. Especially when the tester is used intensively, we recommend an annual calibration. Please contact your Mors Smitt Sales representative for more information.

## 9.3 Service

For repairs under warranty or technical support:

- helpdesk.msa@wabtec.com For regions Asia and Oceania
- helpdesk.msbv@wabtec.com For all other regions

Or contact your local Mors Smitt representative.

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