User's Manual
2214

Frequency Relay Test Set
(Frequency Relay Tester)
Model : RY-2005

Inserted drawing : General View   # 02920

: Circuit Diagram   # 0269.121L

Appended : Instruction manual   # 7433

for mounted

MCS-5000 Millisecond counter / Frequency meter

First published: July 22, 2005

TABLE of CONTENTS

SAFETY INSTRUCTIONS

Attention: The RY-2005 frequency relay test set hereafter described is manufactured and tested according to its specifications, and when used for normal applications and within the normal electrical limits it will not cause hazard to health and safety, provided that it must be operated by trained personnel only.
Would the test set be used beyond its specified limits, the safety of the test set could be impaired.
Before starting the test set up, carefully read the following safety instructions. The test set must not be put into operation without full knowledge of this information.

For your safety

‣ Mains supply (power supply) characteristics are :
  ・ Voltage: 240VAC ± 10%,   50-60Hz.
  ・ Power consumption: 100VA maximum.

‣ **Do not operate the test set if not connected to ground: because of filter capacitors, the case would grow to a voltage equal to the half of the supply, i.e. 120 V.   Besides, in this situation there is no filtering against common-mode noise coming from the mains: this can cause sudden faults.   This type of faults is not covered by the warranty.**

‣ The connection to ground is provided through the mains supply cable; however, for added safety, the test set should be connected to ground using the dedicated guard post.

‣ **If the ground is not available at the mains supply, connect the test set to ground using the dedicated guard post.**

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‣ The generator outputs supply voltages up to 300Vac that may be lethal to the operator.
  Besides, in order to avoid any danger in case of fault inside the test set, the test object
  should have the following characteristics:
 ・ Input circuits must have an isolation degree at least equal to the one of the test set.

‣ Do not leave the generator cables open.
‣ When connecting and disconnecting the test object make sure that generator output have
  been turned off.   Never disconnect the test object when output switch is "ON".
‣ Never insert conductive parts (screwdriver, etc.) into the binding posts or sockets.
‣ Do not operate in a wet or humid environment.
‣ Do not operate where an explosion hazard exists.
‣ Do not operate if you suspect that a fault exists.   In this case of doubt, please contact
  your Seller; however, the Seller and Manufacturer, declines any and all responsibility
  due to improper usage, or any usage outside the specified limits.

If the mains fuse must be replaced

‣ **Mains fuse of RY-2005 test set:**
 ・ **In the "FUSE" holder on the front panel: a fuse rated 1A / 250V.**
 ・ **In the fuse housing of the mains supply cable plug: a fuse rated 13A / 250V.**

‣ Turn the POWER switch "OFF".
‣ Turn the OUTPUT switch "OFF", and return the "COARSE" and "FINE" knobs of OUTPUT
  ADJ completely counter-clockwise.
‣ Disconnect the mains supply cable plug from the power source plug outlet.
‣ Remove the top of "FUSE" holder and replace the fuse.
‣ Re-connect the mains cable plug to the plug outlet and turn the POWER switch "ON".
‣ If the mains POWER lamp does not turn on, return the POWER switch "OFF" and
  disconnect the mains supply cable plug once more again.
‣ Remove the fuse housing cover of the mains supply cable plug and replace the fuse.

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1. INTRODUCTION

The RY-2005 frequency relay test set is suited for the testing and adjustments of the frequency relays.   The test set can measure easily the threshold values (the pickup and the drop-out frequencies) and the delay times (at the pickup and the drop-out) of the frequency relays.

And besides, the test set can also be used to test some frequency meters and some voltage relays.

Switching the frequency is performed with the aid of the digital setting switch and the setting push-button.   When pressing the SETTING push-button the output frequency is switched from one to the other that set on the digital switch, at the zero-crossing of the waveforms.   Output voltage can be adjusted by the doubled knob of coarse and fine.

FEATURES

- ・ Power supply **:** 240Vac, 1-phase, 50 / 60Hz
- ・ Low distortion output waveform **:** 2% and less
- ・ High stability **:** output voltage and frequency for supply fluctuation.
- ・ Pressing frequency setting button, in an instant output frequency switches from the pre-fault one to the fault one that set on the digital switch.
- ・ When frequency is switched, millisecond counter starts counting the delay time of relay and stops that by getting the pickup signal of relay.
- ・ Easy and simple output voltage adjustment **:** reading value on the DVM display, acting on the doubled adjuster-knob of coarse and fine.
- ・ Available on the test of over and under voltage relays, and some frequency meters.
- ・ Protection to avoid damage **:** for over-load, short-circuit output or miss-operation.

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2. THE FRONT PANEL EXPLANATION
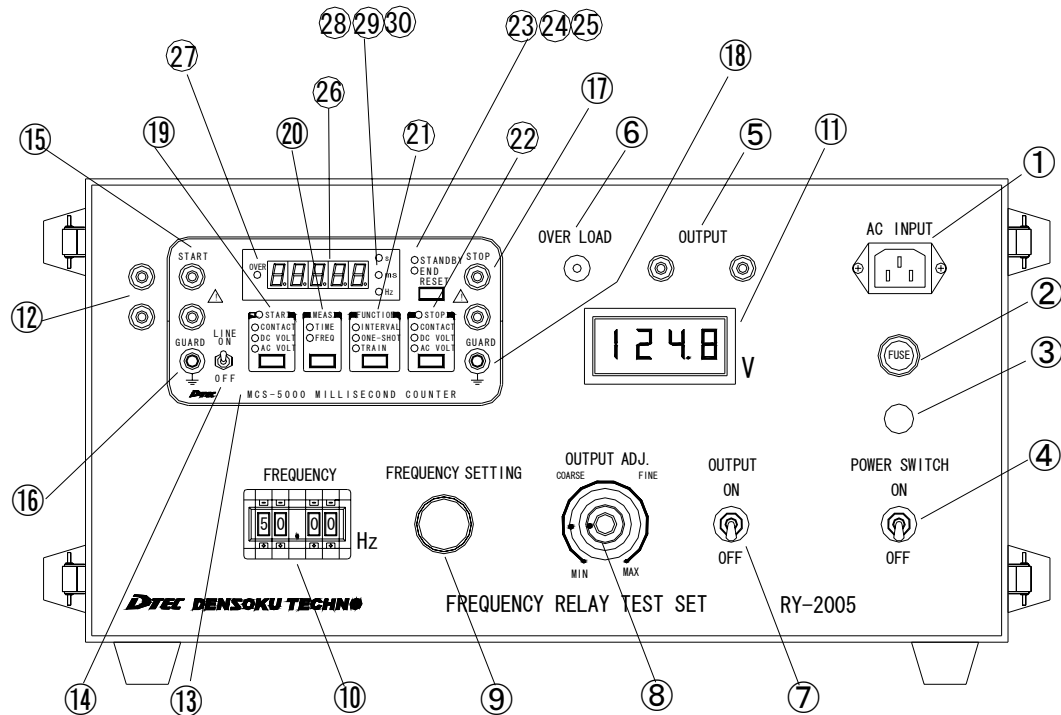
#	Description	#	Description
1	AC INPUT: Mains supply inlet; 240VAC	16	GUARD: Stop side post of MCS-5000
2	Mains fuse holder: fuse; 5A / 250V	17	STOP: Stop input binding post of MCS-
3	Mains light	18	GUARD: Start side post of MCS-5000
4	POWER SWITCH: Mains supply switch	19	START: Contact / AC / DC selector
5	OUTPUT: Voltage output binding posts	20	MEAS: Time / Frequency selector
6	OVER LOAD: Voltage output over-load light	21	FUNCTION: Interval / one-shot / Train sel.
7	OUTPUT ON / OFF: Output switch	22	STOP: Contact / AC / DC selector
8	OUTPUT ADJ: Output voltage adjuster	23	STANDBY: Counting-start standby light
9	FREQUENCY SETTING: Push-button	24	END: Counting-end light
10	FREQUENCY ,Hz: Setting digital switch	25	RESET: Millisecond counter reset switch
11	DVM: for Generation voltage measurement	26	Numeral LED: Millisecond or Frequency
12	No-named: Frequency switching signal out	27	OVER: Over-counting light
13	MCS-5000: Millisecond / Frequency meter	28	s : Unit ; second light
14	LINE ON / OFF: Line switch of MCS-5000	29	ms : Unit ; millisecond light
15	START: Start input binding post of MCS-	30	Hz : Unit ; Frequency light

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3. OVER / UNDER FREQUENCY RELAY TESTING

3.1 Introduction

Frequency relay monitor the frequency of generator voltage outputs; if the upper or lower frequency threshold is reached, the relay picks up and issues a trip command for the circuit breaker, in order to preserve the generator safety.

The test is performed by switching the frequency using both the digital switch and the push-button that allow setting the output frequency.   We will take advantage of modifying frequency bit by bit, and also of pre-fault and fault setting so that:
- ・ Pre-fault output is set at standard or nominal voltage and nominal frequency;
- ・ Fault output voltage has the same amplitude, but frequency is only modified according to our test.

During the test the relay is powered with standard or nominal voltage amplitude; as the frequency changes, amplitude and phase are not affected .

3.2 Preliminaries

Refer to the front panel explanation on the last page and the connection schematic on the next page.
- ・ Confirm that both the POWER switch (4) and the OUTPUT switch (7) are "OFF".
- ・ Set the doubled knob OUTPUT ADJ COARSE and FINE (8) completely counter-clockwise.
- ・ Confirm that the LINE switch (14) on MCS-5000 (13) is "ON".
- ・ Confirm that the binding posts (12) are connected to the START binding posts (15) on MCS-5000 (13).
- ・ Connect the mains supply cable to the AC INPUT inlet socket (1) and the other terminal plug to power supply source outlet 240Vac.
- ・ Connect the relay to the OUTPUT binding posts (5).
- ・ Connect the STOP binding posts (17) on MCS-5000 (13) to the pickup of the relay.
- ・ Power-on RY-2005, acting on switch (4): the power light (3) turns on, and also the DVM (11) and millisecond counter MCS-5000 (13) turn on.

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- Select the START mode (19) of MCS-5000 on "CONTACT" as the internal start signal of RY-2005 is "a" contact.
- Select the STOP mode (22) of MCS-5000 according to the object relay.
- Select the MEAS mode (20) of MCS-5000 on "TIME".
- Select the FUNCTION mode (21) of MCS-5000 on "INTERVAL".

3.3 Connection schematic

The following is the connection schematic.
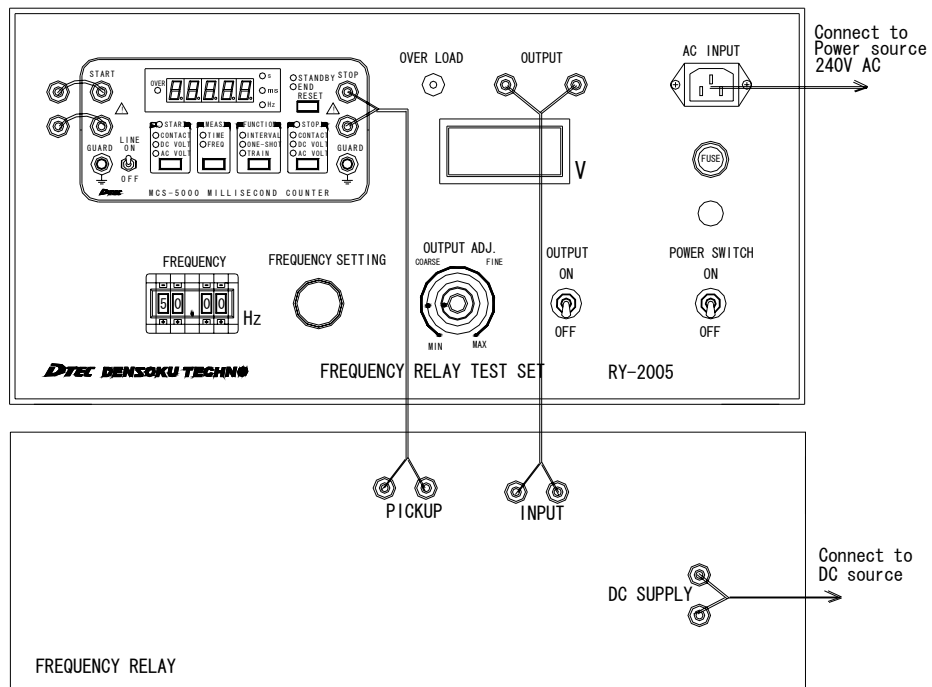
3.4   Threshold frequencies : pickup and drop-out

Voltage output frequency must be set by using the FREQUENCY digital switch (10) and
FREQUENCY SETTING push-button (9).
  ・ Put a frequency value on the FREQUENCY digital switch (10).
  ・ Pressing the FREQUENCY SETTING push-button (9), the new frequency data is
   stored on the memory and the output frequency is switched to new one.
The amplitude of test voltage is adjusted by the doubled adjuster-knob of COARSE and
FINE (8) and the voltage value is displayed on the DVM window (11).
The standard value is computed from the nominal relay (phase to phase) voltage Vn:
$V_{pre-fault} = V_{fault} = V_s = V_N / 1.73$
The standard values Vs are: 57.8 V for $V_N = 100$ V; 63.5 V for $V_N = 110$ V.
After this adjustment the standard (or nominal) voltage is generated through all tests.
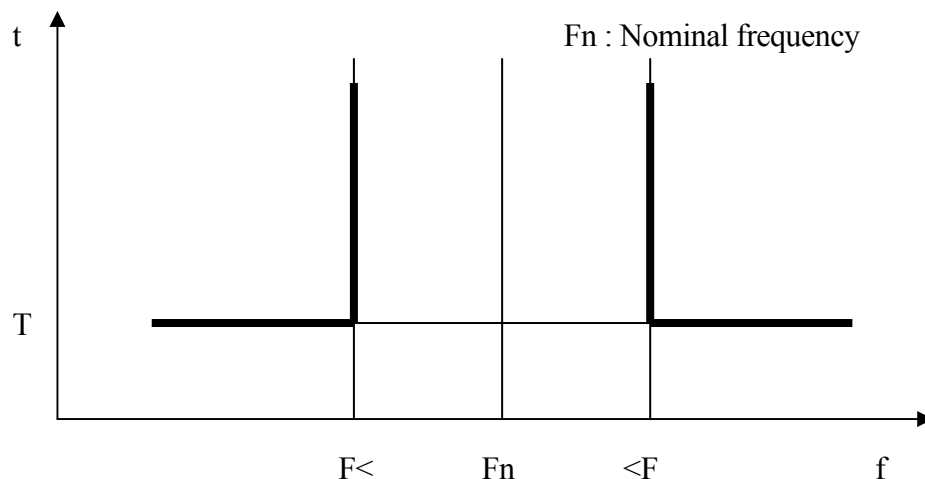
The first session is finding "pickup" threshold <F.
Increase the frequency step by step or bit by bit, but it is to be desirable that in the last
resort we have to change the setting 1-digit by 1-digit to gain the reliable test results.

**NOTE: Before pressing the FREQUENCY SETTING push-button (9), we have to be
sure to press the RESET button (23) of MCS-5000 (13).**

As the relay picks up, the millisecond counter stops and the END light (24) turns on, we
will find "pickup" threshold <F, but we don't have to read the time on the millisecond
counter.

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Next, we find "drop-off" threshold for <F.

From the last frequency above decrease it by means of 1-digit by 1-digit.

NOTE: Before pressing the FREQUENCY SETTING push-button (9), we have to be sure to press the RESET button (23) of MCS-5000 (13).

As the relay resets, the millisecond counter stops and the END light (24) turns on, we will find "drop-out" threshold for <F, but we don't have to read the time on the millisecond counter.

The second session is finding "pickup" threshold F<.

From the last frequency above decrease it close by <F but higher, by jumping the frequency setting, and after continuous to test by means of step by step or bit by bit, or digit by 1-digit.

NOTE: Before pressing the FREQUENCY SETTING push-button (9), we have to be sure to press the RESET button (23) of MCS-5000 (13).

As the relay picks up, the millisecond counter stops and the END light (24) turns on, we will find "pickup" threshold F<, but we don't have to read the time on the millisecond counter.

Next, we find "drop-off" threshold for F<.

From the last frequency above increase it by means of 1-digit by 1-digit.

NOTE: Before pressing the FREQUENCY SETTING push-button (9), we have to be sure to press the RESET button (23) of MCS-5000 (13).

As the relay resets, the millisecond counter stops and the END light (24) turns on, we will find "drop-out" threshold for F<, but we don't have to read the time on the millisecond counter.

3.5   Delay times : for pickup and drop-out

Set the output frequency the nominal value by using the FREQUENCY digital switch (10) and FREQUENCY SETTING push-button (9).

After this the nominal frequency have to be generated as the pre-fault one prior to pickup tests.

The first session is measuring "pickup timing" for threshold <F.

Put a fault frequency value on the FREQUENCY digital switch (10).

Reset the millisecond counter (13) by pressing the RESET button (25).

Pressing the FREQUENCY SETTING push-button (9), the fault frequency data is stored on the memory and the output frequency is switched to the fault one, and at the same time the millisecond counter (13) starts.

NOTE: Before pressing the FREQUENCY SETTING push-button (9), we have to be sure to press the RESET button (23) of MCS-5000 (13).

As the relay picks up, the millisecond counter stops and the END light (24) turns on, we will find "pickup timing" for threshold <F on the millisecond counter.

Next, we find "drop-off timing" for threshold <F.

From the last frequency above, switch it to the nominal frequency as follows.

Put the nominal frequency value on the FREQUENCY digital switch (10).

Reset the millisecond counter (13) by pressing the RESET button (25).

Pressing the FREQUENCY SETTING push-button (9), the nominal frequency data is stored on the memory and the output frequency is switched to the nominal one.

NOTE: Before pressing the FREQUENCY SETTING push-button (9), we have to be sure to press the RESET button (23) of MCS-5000 (13).

As the relay resets, the millisecond counter stops and the END light (24) turns on, we will find "drop-out timing" for threshold <F on the millisecond counter.

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The second session is measuring "pickup timing" for threshold F<.

From the last frequency that is nominal above, switch it to the fault frequency as follows.

Put a fault frequency value on the FREQUENCY digital switch (10).

Reset the millisecond counter (13), by pressing the RESET button (25).

Pressing the FREQUENCY SETTING push-button (9), the fault frequency data is stored on the memory and the output frequency is switched to the fault one.

NOTE: Before pressing the FREQUENCY SETTING push-button (9), we have to be sure to press the RESET button (23) of MCS-5000 (13).

As the relay picks up, the millisecond counter stops and the END light (24) turns on, we will find "pickup timing" for threshold F< on the millisecond counter.

Next, we find "drop-off" threshold for F<.

From the last frequency above, switch it to the nominal frequency as follows.

Put the nominal frequency value on the FREQUENCY digital switch (10).

Reset the millisecond counter (13), by pressing the RESET button (25).

Pressing the FREQUENCY SETTING push-button (9), the nominal frequency data is stored on the memory and the output frequency is switched to the nominal one.

NOTE: Before pressing the FREQUENCY SETTING push-button (9), we have to be sure to press the RESET button (23) of MCS-5000 (13).

As the relay resets, the millisecond counter stops and the END light (24) turns on, we will find "drop-out timing" for threshold F< on the millisecond counter.

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4.   OTHERS TESTING

4.1   Over and under voltage relay

4.1.1   Introduction

There are three types of voltage relay that are an over voltage, an under voltage and an over/under voltage.   The range of voltage relay testing that we can do using this test set are restricted.   Threshold voltage tests so called pickup test and drop-out test can be done easily, and also delay time tests so called pickup timing test or drop-out timing test are possible too.

4.1.2   Preliminaries

Refer to the front panel explanation on page 6 and the connection schematic on the next page.

・ Confirm that both the POWER switch (4) and the OUTPUT switch (7) are "OFF".
・ Set the doubled knob OUTPUT ADJ COARSE and FINE (8) completely counter-clockwise.
・ Confirm that the LINE switch (14) on MCS-5000 (13) is "ON".
・ Select the START mode (19) of MCS-5000 on "AC VOLT" as the output voltage of RY-2005 will be used for the start signal of millisecond counter.
・ Separate the START binding posts (15) on MCS-5000 (13) from the binding posts (11) and connect to the voltage OUTPUT binding posts (5) .
・ Connect the mains supply cable to the AC INPUT inlet socket (1) and the other terminal plug to a power supply source outlet 240Vac.
・ Connect the relay to the OUTPUT binding posts (5).
・ Connect the STOP binding posts (17) on MCS-5000 (13) to the pickup of the relay.
・ Power-on RY-2005, acting on switch (4): the power light (3) turns on, and also the DVM (11) and millisecond counter MCS-5000 (13) turn on.
・ Select the STOP mode (22) of MCS-5000 according to the object relay.

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・ Select the MEAS mode (20) of MCS-5000 on "TIME".
・ Select the FUNCTION mode (21) of MCS-5000 on "INTERVAL".

4.1.3   Connection schematic

The following is the connection schematic.
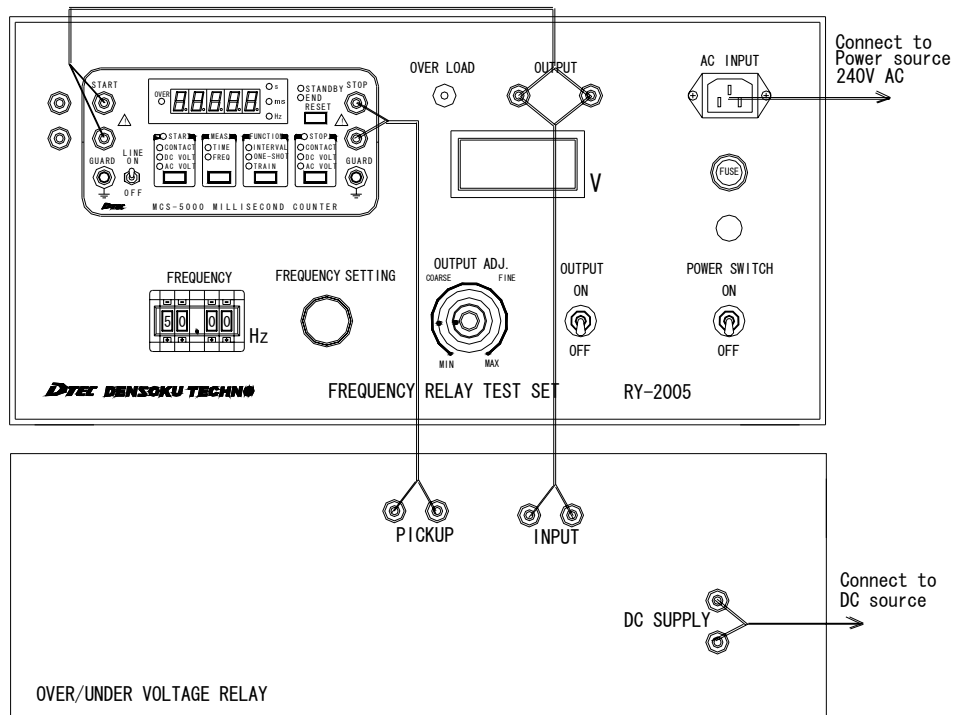
4.1.4   Threshold voltages : pickup and drop-out

Voltage output frequency must be set by using the FREQUENCY digital switch (10) and
FREQUENCY SETTING push-button (9).
- Put a frequency value on the FREQUENCY digital switch (10).
- Pressing the FREQUENCY SETTING push-button (9), the new frequency data is
  stored on the memory and the output frequency is switched to new one.

Set the output frequency the nominal value.
After this the nominal frequency have to be generated through all tests.

The amplitude of test voltage have to be adjusted by the doubled adjuster-knob of
COARSE and FINE (8) and the voltage value is displayed on the DVM window (11).
The standard value is computed from the nominal relay (phase to phase) voltage Vn:
Vs = Vn / 1.73
The standard values Vs are: 57.8 V for Vn = 100 V; 63.5 V for Vn = 110 V.
Set the output voltage the standard (or nominal) value according to the object relay.

Vn : Nominal Voltage
Vs : Standard Voltage
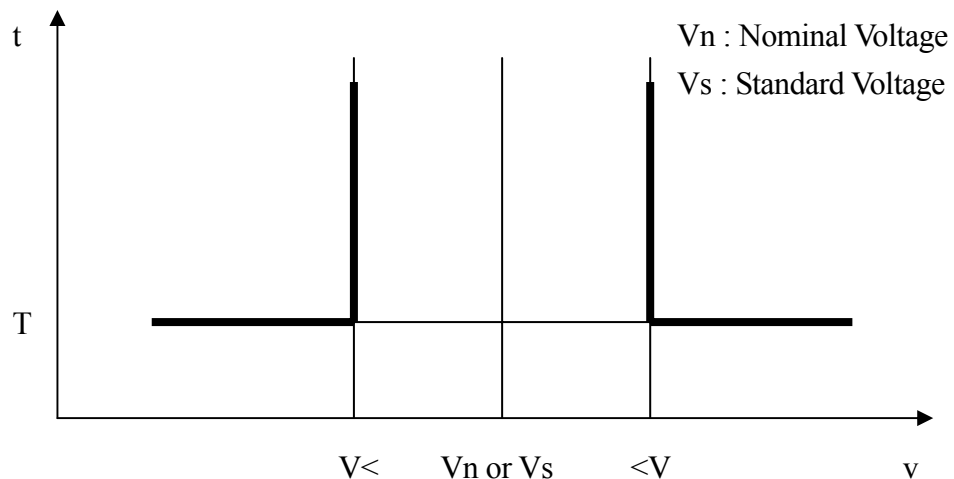
The first session is finding "pickup" threshold <V.
Using the OUTPUT knobs slowly increase the Output voltage.
As the relay trips, immediately stop to increase the voltage.
We will find "pickup" threshold <V on the DVM display.

NOTE: read value is the voltage as relay trips.   This corresponds to the relay threshold only if the voltage did not change very much while the relay timing elapsed; however, trip timing is usually short, so voltage does not change very much at release, and the measurement is accurate.

If threshold measurement was not good because you were moving too fast, do repeat the test.

Next, we find "drop-off" threshold for <V.
From the last voltage above very slowly decrease the voltage.
As the relay resets, immediately stop to decrease the voltage.
We will find "drop-out" threshold for <V on the DVM display.

NOTE: read value is the voltage as relay resets.   This corresponds to the relay threshold only if the voltage did not change very much while the relay timing elapsed; however, reset timing is usually short, so voltage does not change very much at release, and the measurement is accurate.

If threshold measurement was not good because you were moving too fast, do repeat the test.

The second session is finding "pickup" threshold V<.
From the last voltage above decrease the voltage close by the nominal (or standard) voltage.   After this slowly decrease the voltage.
As the relay picks up, immediately stop to decrease the voltage.
We will find "pickup" threshold V< on the DVM display.

NOTE: read value is the voltage as relay trips.   This corresponds to the relay threshold only if the voltage did not change very much while the relay timing elapsed; however, trip timing is usually short, so voltage does not change very much at release, and the measurement is accurate.

If threshold measurement was not good because you were moving too fast, do repeat the test.

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Next, we find "drop-off" threshold for V<.

From the last voltage above very slowly increase the voltage.

As the relay resets, immediately stop to increase the voltage.

We will find "drop-out" threshold for V< on the DVM display.

NOTE: read value is the voltage as relay resets.   This corresponds to the relay threshold only if the voltage did not change very much while the relay timing elapsed; however, reset timing is usually short, so voltage does not change very much at release, and the measurement is accurate.

If threshold measurement was not good because you were moving too fast, do repeat the test.

4.1.5   Delay times : for pickup and drop-out

Voltage output frequency must be set by using the FREQUENCY digital switch (10) and FREQUENCY SETTING push-button (9).

・ Put a frequency value on the FREQUENCY digital switch (10).

・ Pressing the FREQUENCY SETTING push-button (9), the new frequency data is stored on the memory and the output frequency is switched to new one.

Set the output frequency the nominal value.

After this the nominal frequency have to be generated through all tests.

NOTE: In the case of this test set, either pre-fault voltage or fault voltage must be zero.   If a pre-fault has some voltage a fault is zero, or in contrast with this.

The amplitude of test voltage have to be adjusted by the doubled adjuster-knob of COARSE and FINE (8) and the voltage value is displayed on the DVM window (11).

The standard value is computed from the nominal relay (phase to phase) voltage Vn:

$Vs = Vn / 1.73$

The standard values Vs are: 57.8 V for Vn = 100 V; 63.5 V for Vn = 110 V.

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The first session is measuring "pickup timing" for threshold <V.

Under the OUTPUT switch is "OFF", adjust the amplitude of output voltage to a fault test value by using the doubled adjuster-knob (8).

Reset the millisecond counter (13) by pressing the RESET button (25), the STANDBY light (23) turns on.

Turn the OUTPUT switch "ON", the fault voltage is supplied the relay under test and the START (15) of millisecond counter (13), and on the instant the counter starts.

NOTE: Before turning the OUTPUT switch "ON", we have to be sure to press the RESET button of MCS-5000.

As the relay picks up, the millisecond counter stops and the END light (24) turns on, we will find "pickup timing" for threshold <V on the millisecond counter.

Next, we find "drop-off timing" for threshold <V.

In keeping the fault voltage above, reset the millisecond counter (13) by pressing the RESET button (25) the STANDBY light (23) turns on.

And then turn the OUTPUT switch (7) "OFF", the fault voltage that was supplied to the relay under test and the START (15) of millisecond counter (13) is cut off and on the instant the counter starts..

NOTE: Before turning the OUTPUT switch "OFF", we have to be sure to press the RESET button of MCS-5000.

As the relay resets, the millisecond counter stops and the END light (24) turns on, we will find "reset timing" for threshold <V on the millisecond counter.

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The second session is measuring "pickup timing" for threshold V<.

From the last voltage that is the upper fault value above, adjust the amplitude of output voltage to the nominal value by using the doubled adjuster-knob (8) under the OUTPUT switch is "OFF".

Turn the OUTPUT switch "ON", the nominal voltage is supplied to the relay under test and the START (15) of millisecond counter (13).

Reset the millisecond counter (13), by pressing the RESET button (25) the STANDBY light (23) turns on.

Turn the OUTPUT switch (7) "OFF", the nominal voltage that was supplied to the relay under test and the START (15) of millisecond counter (13) is cut off and on the instant the counter starts.

NOTE: Before turning the OUTPUT switch "OFF", we have to be sure to press the RESET button of MCS-5000.

As the relay picks up, the millisecond counter stops and the END light (24) turns on, we will find "pickup timing" for threshold V< on the millisecond counter.

Next, we find "drop-off" threshold for V<.

In keeping the fault state that is zero voltage output above, reset the millisecond counter (13) by pressing the RESET button (25) the STANDBY light (23) turns on.

And then turn the OUTPUT switch (7) "ON", the nominal voltage is supplied to the relay under test and the START (15) of millisecond counter (13), and on the instant the counter starts..

NOTE: Before turning the OUTPUT switch "ON", we have to be sure to press the RESET button of MCS-5000.

As the relay resets, the millisecond counter stops and the END light (24) turns on, we will find "drop-out timing" for threshold V< on the millisecond counter.

4.2   Frequency meter for external use

MCS-5000 that is mounted on RY-2005 can be used as the Frequency meter for external use.   Please refer the appended manual **:** MCS-5000 Instruction manual #7433.

4.3   Millisecond counter for external use

MCS-5000 that is mounted on RY-2005 can be used as the Millisecond counter for external use.   Please refer the appended manual **:** MCS-5000 Instruction manual #7433.

5.   SPESIFICATIONS

- ・ Power supply   **:** 240Vac,   ±10%,   50 / 60Hz,   1-phase
- ・ Power consumption **:** 100VA
- ・ Output voltage   **:** 0 - 300V
- ・ Output power   **:** 30VA (continuous)
- ・ Waveform distortion **:** 2% and less (at rated voltage with resistance load)
- ・ Digital voltmeter   **:** LED display,   0 - 600.0V,   ±(0.1% of rdg) ± 20digt
  (mean-detection and rms-expression)
- ・ Digital time-counter **:** LED display, 0.0ms - 999.99s, ±(0.01% of rdg) ± 1digt + Δt
  (Δt : on AC voltage, +0.1 to 2.5ms)
  Start / stop contacts ; make / break with auto-selection
  Operating voltage ; AC / DC,   5 - 250V
  Frequency range ; 44.00 - 66.00Hz, ±(0.1% of rdg) ± 1digt
- ・ Output frequency   **:** 44.00 - 66.00Hz,   Accuracy ; 0.02Hz
- ・ Insulation resistance **:** More than 100MΩ at 500VDC
  at 23 °C room temperature,   60% relative humidity
- ・ Dielectric strength   **:** 1.5kVAC   1 minute
- ・ Dimension and mass **:** 480(W) × 240(H) × 550(D) mm,   23kg

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6. ACCESSORIES

・ Mains supply cable   **:** 250Vac / 13A, terminated with 3-Pins plug / socket   1 cable
・ Mains spare fuse   **:** 5A / 250V, glass-tube type   5 pcs
・ Short jumper cable   **:** terminated with banana plugs, 100mm long

                                                                  1 red and 1 black   2 cables

・ Shielded cables   **:** terminated with banana plugs and clip plugs, 5m long   2 cables
                                    for START and STOP signal cables
・ External reset cord   **:** terminated with a pin-plug and a push-button 2 m long 1 cable