MT-1/NT9
User's Guide

Version 3.0 – January 2019

IT IS ESSENTIAL THAT THIS INSTRUCTION BOOK BE READ
THOROUGHLY BEFORE PUTTING THIS PRODUCT INTO SERVICE.

© Copyright 2019 by Probewell Lab Inc. Printed in Canada.

All rights reserved, including those to reproduce this manual or parts thereof, in any form without the express written permission of Probewell Lab Inc.

Limited Warranty[1]

Your MT-1/NT9 comes with a two-year hardware warranty. Probewell Lab Inc. (Probewell) warrants this MT-1/NT9 against defects in material and workmanship for a period of two (2) years from the date of purchase from Probewell. This warranty applies only to the original purchaser of the MT-1/NT9 and is not transferable.

All accessories come with a two-year hardware warranty. Probewell warrants all accessories against defects in material and workmanship for a period of two (2) years from the date of purchase from Probewell. This warranty applies only to the original purchaser and is not transferable.

This warranty does not cover any damage caused neither by negligence, non-authorized modifications, or parts installed without prior written permission from Probewell.

This warranty does not apply if the product has been damaged by accident, abuse, misuse, or misapplication, nor as a result of service to the product by anyone other than Probewell.

Probewell is not responsible for any lost profits, lost savings or other incidental or consequential damages arising out of the use, or inability to use, of this product. This includes damage to property and damages for personal injury. This warranty is in lieu of all other warranties including implied warranties of merchantability and fitness for a particular purpose.

Disclaimer

Probewell Lab Inc., (Probewell) reserves the right to make changes to this document and the products which it describes without notice. Probewell shall not be liable for technical or editorial errors or omissions made herein; nor for incidental or consequential damages resulting from the furnishing, performance, or use of this material.

Features and specifications are subject to change without notice.

[1] 2-years limited warranty is applicable to units shipped to USA and Canada. For other countries, a 1-year warranty is applicable.

Table of Contents

List of Abbreviations

Abbreviation	Complete Term
A	Ampere
Amp	Ampere
AC	Alternating Current
ATK	Accuracy Testing Kit
CFM	Cubic feet per minute
CL	Class
CSV	Comma Separated Value
CT	Current Transformer
DSP	Digital Signal Processor
HL	High Load (Full Load)
Kh	Watthour constant. The number of watthours represented by one revolution of the disk. Also, called disk constant.
Kt	Test constant. For electronic (no disk) meter, the amount of energy represented by each calibrated pulse of the LED.
kW	Kilowatt
Lb	Pound
LL	Light Load
NIST	National Institute of Standard and Technology
PF	Power Factor
PPI	Pores per inch
Rev	Revolution, number of revolutions
RMS	Root mean square
TA	Test Ampere
THD	Total Harmonic Distortion
V	Volt
VA	Volt-Ampere
VAC	Volt Alternating Current
VARh	VARhour (Volt Ampere Reactive Hour)
Vdc	Voltage direct current
VT	Voltage Transformer
W	Watt(s)

Wh	Watthour
µWh	Micro-Watthour
µVARh	Micro-VARhour

Chapter 1

Introduction

The Probewell Lab MT-1/NT9 is a portable three-phase meter tester that tests self-contained and CT rated meters, forms 1S, 2S, 3S, 4S, 6S, 8S, 9S, 12S, 14S, 15S and 16S.

MT-1/NT9 Overview

The MT-1/NT9 test socket adapter weighs only 6.4 lb, an ideal tool for testing in the field and in the meter shop. Within a few minutes, a residential, commercial or industrial electricity meter can be accurately tested on site by meter shop technicians. The MT-1/NT9 can be set to test all 3 phases simultaneously in one step (Mode Preset-quick) or set to do a full test consisting of the 3 phases simultaneously followed by each element separately (Mode Preset-full). The MT-1/NT9 provides measurements for active and reactive energy with forward and reverse flow testing capability.

The MT-1/NT9 has a built-in 3-phase phantom load made of synthesized 50A current sources and a 3-phase electronic standard with an accuracy of ±0.02% typical, ±0.05% guaranteed. The MT-1/NT9 comes with a complete calibration report certifying measurement accuracy across its entire operating range.

The handheld remote that comes with the MT-1/NT9 has a keypad and LCD display and weighs only 0.6 lb. With the help of the simple and intuitive operation menus, the operator selects test parameters and initiates the test.

The MT-1/NT9 comes with a shock resistant carrying bag. The bag has individual compartments for the test socket adapter, the handheld remote control, the cable, the pickups and the user's guide. There is also enough space for small accessories such as the magnetic adapter for the optical pickup, seals, pliers, etc.

Chapter 2

Description

The first part of this chapter shows a detailed description of the MT-1/NT9 socket and the handheld remote control. The second part explains the functioning theory of the MT-1/NT9 tester.

MT-1/NT9 Socket

The MT-1/NT9 socket is cylinder-shaped, designed to be easily inserted in both ringless and ring-type meter bases. It weighs only 6.4 lb. A latch, with quick release mechanism, is available as an option for ring-type meter bases.

The socket contains three 50A synthesized AC current sources to simulate resistive and reactive loads, a high accuracy 3-phase electronic standard and a full-duplex communication controller.

The rear of the socket has 6 standard fixed tabs with bypasses and 2 removable twist tabs, with hand-twist & lock mechanism. The socket obtains its power directly from these back tabs and accepts an input voltage from 100 to 600VAC.

The twist tabs can be located at 3, 5, 6 and 9 o'clock positions as required by the meter base where the test is conducted. The twist tab at 3 o'clock can be inserted at 2 different positions to hold either forms 6S/8S/9S or form 4S. The twist tab at 9 o'clock can be inserted at 2 different positions to hold either forms 6S/8S/9S or forms 3S/4S/12S. One of the twist tabs can be positioned at 5 o'clock for some 12S meter bases or positioned at 6 o'clock for 14S/15S/16S meter bases. See Appendix C for all back-twist tab configurations.

The front of the socket has 7 jaws and 5 spring loaded contact pistons. The pistons are actuated by the middle lugs of the meter. A spring contact at 6 o'clock is also provided for 12S meters. The meter under test is entirely controlled by the socket. No setup wiring is needed.

The socket has a deadfront design for safer operation. The front jaws of the socket become live only when a meter is inserted. See Appendix A for all technical specifications.

Front/Rear View of the Socket

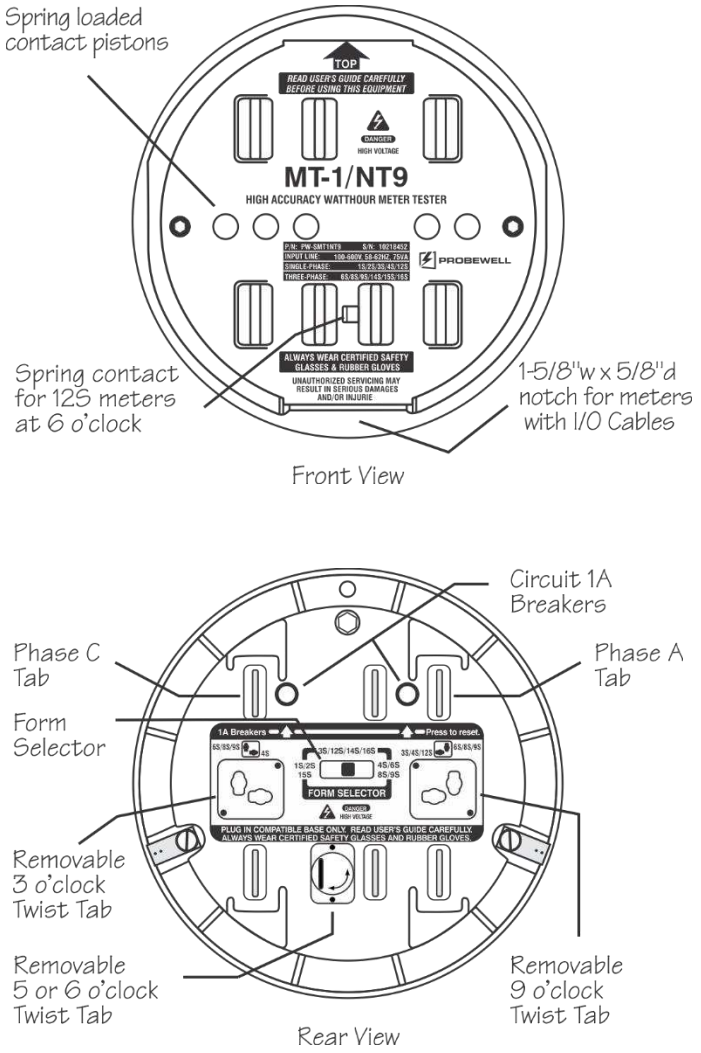


Fig. 2.1 – Front and Rear View of the Socket

Fig. 2.1 shows the removable twist tabs which do not require any tools to be moved from a position to another. The above illustration shows only the twist tab positioned at 5 o'clock.

Side View of the Socket

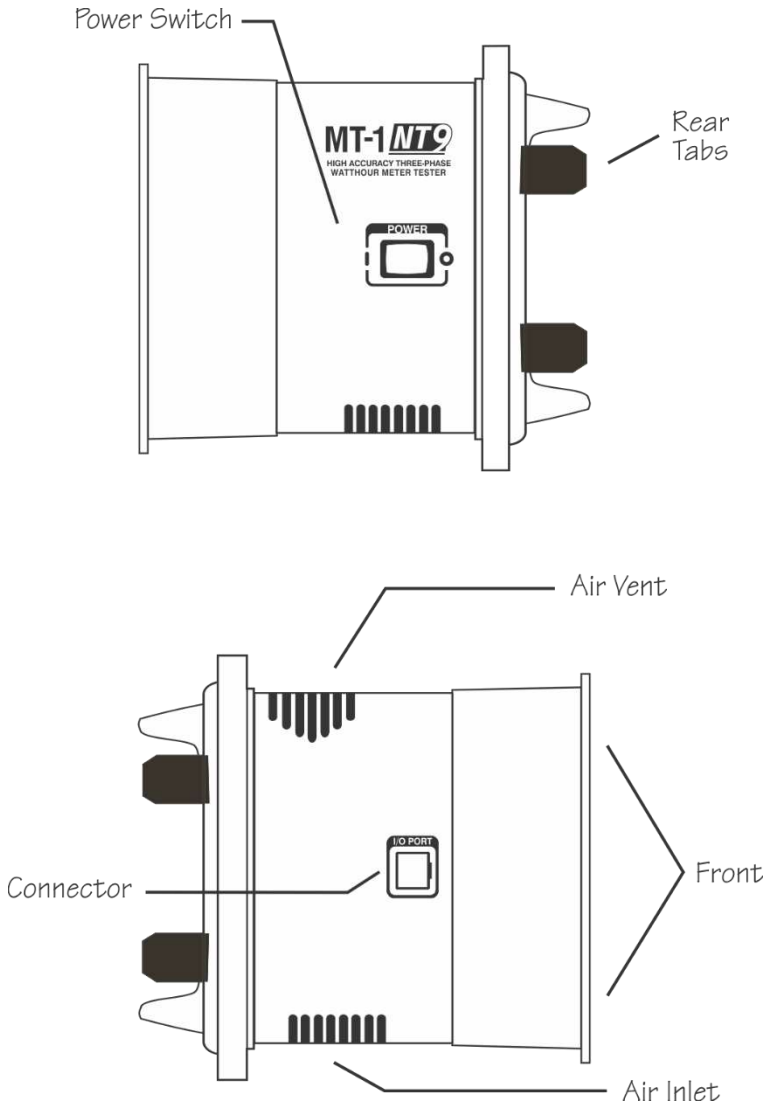


Fig. 2.2 – Side View of the Socket

Identification	Brief Description
Rear Tabs	They connect the socket to the front jaws of the meter base. The socket gets its power directly from the meter base (100-600VAC) circuit. The service current shorting bars (bypasses) are rated for high capacity amperage.
Removable Tabs	These tabs can be easily positioned at 3, 5, 6, or 9 o'clock positions as required by the meter base where the test is conducted. See Appendix C.
Form Selector	In position 1S/2S/15S, the unit is powered from the two upper tabs. In position 3S/12S/14S/16S, the unit is powered from the Phase C and the neutral tab. In position 4S/6S/8S/9S, the unit is powered from the 3 & 9 o'clock tabs
Circuit Breakers	Protection for the MT-1/NT9 and the meter. Two circuit 1A breakers which can easily be reset by pressing a spring-loaded button.
Power Switch	Socket's main power on/off switch.
Front Jaws	The front jaws are controlled by internal relays allowing to test meters. The front jaws become live only when a meter is inserted. The voltage on the front jaws is current limited for additional protection.
Pistons	These are actuated by the small lugs on the back of the meter when inserted for testing.
Connector	Isolated full-duplex communication port. It also provides an isolated and current limited low voltage supply for the handheld remote control and accessories.
Air Vent [1]	Warm air exit. A 5 CFM miniature fan forces air circulation inside the socket.
Air Inlet [1]	Cool air input. Filtered through polyurethane foam filter.

[1] Do not block air circulation. Keep away from direct heat or flame.

Handheld Remote Control

The handheld remote control is made of resistant ABS, weighing only 0.6 lb and holds easily in one hand. The remote control is a small device that send commands and receive all measurements data from the socket. The remote control is connected to the socket using the extensible cable with RJ12-type quick connect plugs. There is no test voltage or current inside the remote control.

The remote control features a 4-line, 16-character LCD display and a 24-key keypad with direct access to all the test parameters and operating modes to choose from. The keys are grouped under **Control**, **Setup**, **Load** and **Data Logging menus**. Menus are described on the next pages.

While in test, the remote control retrieves from the socket all important measurements such as cumulative watthour energy, test voltage, test current and other test status, all of which are shown on the LCD display. After a test, the remote control displays an accuracy report in either percentage error (Ex. -0.02%) or percentage registration (Ex. 99.98%).

Data Logging operations take place once a successful test has been completed. The remote control can store up to 100 test results. The stored test results can then be viewed directly from the remote control using the built-in record viewer or uploaded to a PC using the USB device included with the optional Probewell's NTDataOne Remote Manager software.

The stored test results are CSV (comma separated value) format and can be viewed through a simple text editor file such as Microsoft® WordPad. CSV files can be easily imported to different data management software such as Microsoft® Excel, Microsoft® Access or others. See Appendix E for a description of all the fields contained in the .CSV file.

Detailed instructions are provided when this option is purchased.

View of the Handheld Remote Control

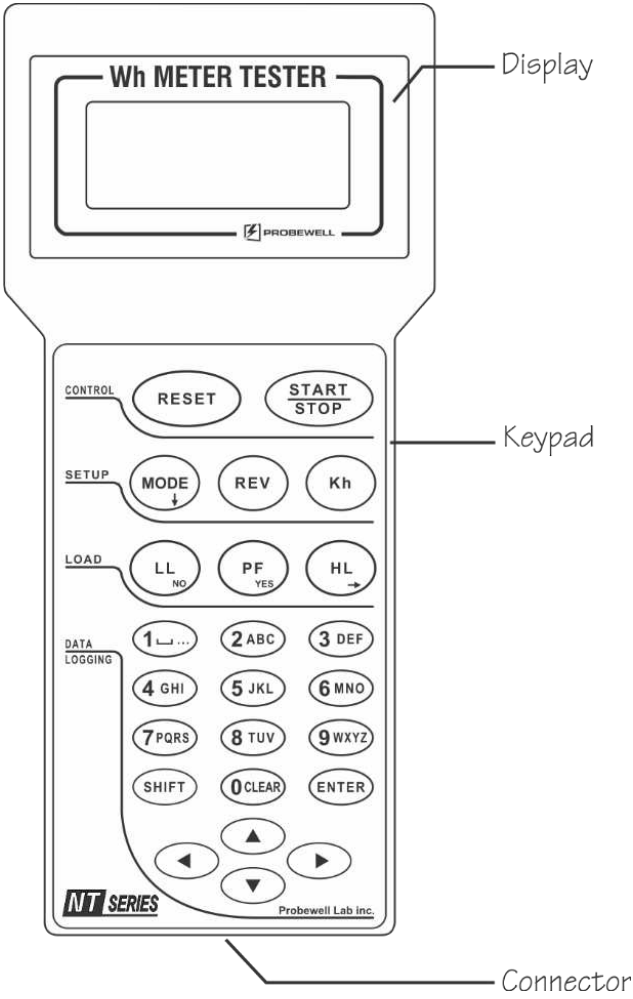


Fig. 2.3 – Handheld Remote Control

Identification	Brief Description
DISPLAY	4-line, 16-character LCD display.
CONNECTOR	Full-duplex communication port linking the remote control to the socket with an extensible cable (cross-wiring) with RJ12-type quick connect plugs. Note: Do not use other types of cable as they may damage the remote control and the test socket.
KEYPAD	Control, Setup, Load and Data Logging sections.
CONTROL	
Reset	Halts immediately the test in progress, if any.
Start/Stop	Ends the test in progress (if used without a pickup), if any, and starts a new test.
SETUP	
Mode	Chooses operation modes to check the meter.
Rev	Chooses the number of revolutions to be done by the meter disk under test.
Kh	Chooses the Kh corresponding to the meter under test.
LOAD	
HL	High Load current test point.
PF	0.5 Lagging Power Factor current test point.
LL	Low Load current test point.

Identification	Brief Description
DATA LOGGING	12 alphanumeric keys and 4 arrows for easy positioning and text edition.

Data Logging takes place once a test has been completed.

0 – 9:	Default key settings
A – Z:	Enabled with "SHIFT" key. Special characters also available.
SHIFT:	Press and hold to enable the yellow printed function key.
ENTER:	Confirms data entry.
ARROWS:	Cursor movement:
	Left/Right or Page Up/Down

SPECIAL FUNCTIONS

Backspace:	Shift + Left Arrow
Insert:	Shift + Right Arrow
Clear Line:	Shift + 0
Edit Stack:	Shift + Enter

Cursor Movement for Text Edition

When you need 2 or more consecutive letters on the same key (e.g.: C+A+B as in CABLE), press and hold the SHIFT key and press the "2" key 3 times for C. Release the SHIFT key to move over cursor and restart process for the A and B.

When you need 2 letters found on different keys (e.g.: M+E as in METER), press and hold the SHIFT key and press the "6" key once for the M then, while keeping the SHIFT key held, press the "3" twice for E. When letters are on different keys, the cursor automatically moves over when a different key is pressed.

Description of the Menus

The keys on the keypad of the remote control are grouped under four menus: **Control**, **Setup**, **Load** and **Data Logging**. All of these are described below and in the next pages. Please note, all default parameters in the menus can be modified according to your needs using the Configuration Menu.

Control Menu

Reset

This key halt immediately any test in progress and reinitializes both the remote and the socket to accept a new operator command.

Start/Stop

When a pickup is used, this key starts a test. The test in progress will end automatically when the predetermined number of disk revolutions is reached or the minimum time per test point is reached in the case of a solid-state meter.

Without a pickup, this key ends a test in progress if any, or starts a new test. The operator counts the disk revolutions manually. The starting point is critical as well the ending point for a test to be valid and accurate.

Setup Menu

Mode

This key determines the test mode. The test mode is selected by pressing the Mode key and the up/down keys. When a pickup is used, there are 3 test modes available: **User-defined**, **Preset-quick** and **Preset-full**. Without a pickup, only two modes are available: **Manual** and **Tracking**. Modes are described hereafter:

With a pickup

User-defined mode consists in choosing one of the 3 loads to apply to the meter, HL, PF or LL. The disk revolutions or pulses are counted automatically by the pickup. No critical timing is required to start a test. The test ends automatically.

When testing a 3-phase meter, you can also choose to apply the load on all phases (ABC) at the same time or on each phase individually (A, B or C). The phase selection is done by pressing one of the load keys one or more times. Example, by pressing two times the **HL** key, phase B will be selected and shown on the remote display.

Preset-quick or **Preset-full** modes are made up of a predetermined sequence of consecutive steps and tests, all of which are done in one operation. The sequence is programmable and can be modified through the Configuration Menu. By default, the sequence includes one test point with each of the loads HL, PF and LL. In mode **Preset-quick** the MT-1/NT9 tests the 3 phases simultaneously (ABC) in one step.

In mode **Preset-full** it does a full test consisting of the 3 phases simultaneously (ABC) followed by each phase separately (A, B, and C).

Please note that with single-phase meters, the mode **Preset-quick** is renamed Preset. Obviously, there is no mode **Preset-full** for single-phase meters.

Without a pickup

Manual mode is the mode where the operator counts the disk revolutions manually. The **Start/Stop** key is used to start and end the test manually. The operator can set his own parameters for conducting a test, such as the number of revolutions and the load to be applied. The load can be switched dynamically during the test.

Please note that without the help of a pickup, if you signal the start or the end of a test too soon or too late using the **Start/Stop** key, the number of disk revolutions (a whole number without fraction) might not be accurate and will affect the precision of the test.

Tracking mode is like manual mode except the remote counts and displays the number of revolutions. The count is based on the selected Kh of the meter and the cumulative watthours recorded by the MT-1/NT9 and not the physical count of the disk revolutions. The **Start/Stop** key is used to start and end the test.

Rev

This key allows to choose a predetermined number of disk revolutions per test point. By default, 7 sets of Revs are already stored in the remote: 1, 2, 5, 10, 20, 30 and 50. Up to ten sets can be stored in the remote.

When testing a solid-state meter with a pickup, the Rev key becomes inactive (N/A). The concept of disk revolution is replaced by a minimum time allowed per test point. By default, the minimum time per test point is at least 20 seconds.

Kh

This key allows to choose the Kh corresponding to the one indicated on the meter nameplate. By default, eleven Kh are already stored in the remote: 0.3, 0.6, 1.0, 1.8, 3.6, 6, 7.2, 12 and 14.4, 21.6 and 36. Up to eighteen Kh can be stored in the remote.

When a pickup is used, a quick test is done by the socket prior to the main test to estimate the Kh of the meter. If the estimated Kh found is already stored in the remote, it is chosen to do the test. If the estimated Kh is not already stored, the user can either accept or change the estimated Kh and store it in the remote. If for some reason the Kh does not match the Kh indicated on the meter, the operator can always change it manually.

Load Menu

This menu has three load keys: **HL**, **PF** and **LL**. Each sets the current load (test point) applied to the meter. By default, **HL** is set at 100% of the TA, **PF** is set at 100% of the TA with 0.5 lagging power factor (60o lag) and **LL** is set at 10% of the TA.

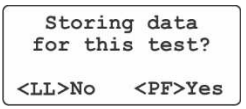
Example: If the TA of the meter under test is 30A, then **HL** is set to 30A, **PF** is set to 30A (current is 60o behind applied voltage) and **LL** is set to 3A.

Note: In VARh mode, the **LL** and **HL** loads are 90o lag and the **PF** load is 30o lag (current lagging on voltage). More details about VARh mode are provided in chapter 3.

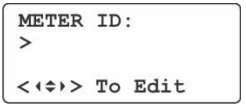
Data Logging Menu [2]

Data Logging operations take place once a successful test has been completed with the MT-1/NT9 using a pickup. Once the test results appear on screen, the operator must press the **Reset** key to begin the Data Logging process.

The following screen will then appear:

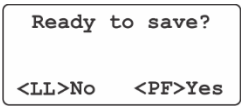


Afterwards the following message appears, and the operator must enter the meter ID using the keypad:



Other questions can be programmed using the NTDataOne Remote Manager offered as an option.

Once completed, it is time to save the data that will be stored in the remote's memory, up to 100 test results:



To let the operator, see the test results in the field, a built-in record viewer has been incorporated in the remote control. See the chapter Advanced Functions for a description and the navigation functions.

[2] Data Logging is enabled by default. To disable see the Configuration Menu.

Description of Pickups

Metercam

When the Metercam pickup is used with an electromechanical meter (rotating disk), the test becomes fully automatic by pressing only one key.

The Metercam is a digital disk sensor without the many drawbacks found on usual photoelectric sensors, such as difficulty to align properly and sensitivity to light. With the Metercam, no alignment is necessary since it detects and picks up the disk by itself. Another feature is its electronic shutter which makes it insensitive to light variations including bright sunlight.

The Metercam is built around a miniature digital camera with a 1/2" field view combined with a RISC processor that detects the position of the meter disk and locks automatically on the reference point (black flag).

The Metercam is mounted on four suction cups installed directly on its backside. These sticks quite well on most meter covers. Thus, the Metercam can be installed within a few seconds.

For a good and lengthy hold, lightly wet the inside of the suction cups, especially when field testing in colder weather. Also, keep the inside of the suction cups clean.

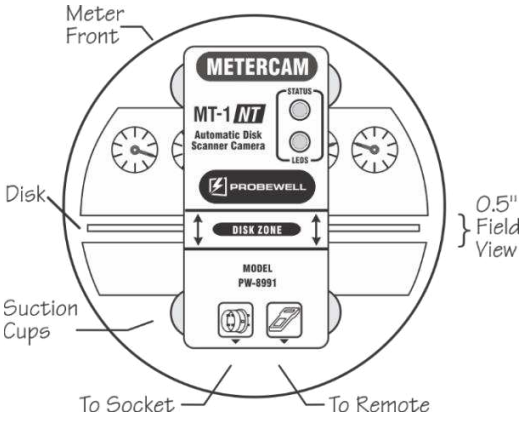


Fig. 2.4 - Metercam

Note: For electromechanical meters with a hidden disk, a side-mount Metercam is available.

Optical Pickup

The Optical Pickup is used with solid-state meters. It is mounted with a suction cup or integrated in a magnetic head that detects infrared light pulses from solid-state meters. The Optical Pickup uses edge triggering for less sensitivity to changes. On the top of the head of the pickup, there is a pulse indicator in the form of a visible red led that flashes when pulses are being received.

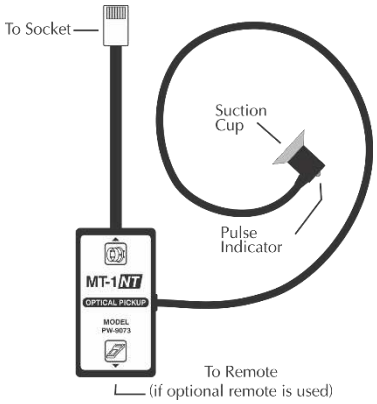


Fig. 2.5a – Optical Pickup

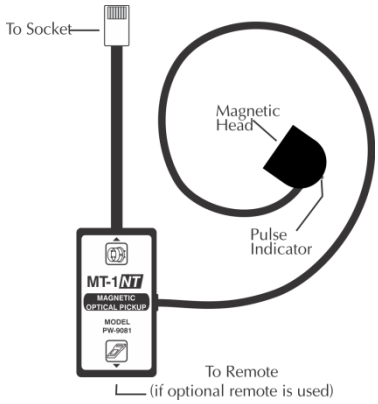


Fig. 2.5b – Magnetic Optical Pickup

Adapters

The **Focus Adapter** is used with the Optical Pickup for meters with a protuberant shape over the test pulse.

The **Magnetic Adapter** is used to install the suction cup of the Optical Pickup on meters with a metallic port.

Functioning Theory

MT-1/NT9 applies a load to the meter under test then measures exactly the quantity of energy that passes through the meter. After a predetermined number of disk revolutions, or pulses in the case of a solid-state meter, the test ends and the remote control displays the difference in percentage obtained by the meter and the MT-1/NT9's internal electronic standard. This difference can be read as a **percentage error** or as a **percentage registration**. The Configuration Menu allows the choice of one or the other.

Percentage error is the difference between the recording in percentage and 100%. Example: a meter having a percentage error of -5% is considered slow by 5%; it measures less energy. The result should be nearest 0% for an accurate meter.

Percentage registration is the relation between the recording obtained by the meter and the true value measured during a specific period, expressed in percentage. Example: a meter having a percentage registration of 105% is considered fast by 5%. It should be nearest 100% for an accurate meter.

Current Applied to the Meter

The current applied to the meter under test is achieved by three independents built-in 50A synthesized AC current sources. The current level is adjustable and regulated. The current sources allow to simulate loads at unity and 0.5 lagging power factor. They are isolated and form three independent current loads in closed-link arrangement. This configuration allows to check a meter without the need to open the potential link of the meter and no wiring setup is necessary.

Voltage Applied to the Meter

The voltage applied to the front jaws is derived from the meter base circuit. For safety reasons, the voltage is applied to the front jaws only when a meter is inserted. The voltage is also current limited.

The front jaws of the MT-1/NT9 are controlled by internal relays allowing to test self-contained 3-phase and single-phase watthour meter Form configurations without wiring setup.

Accuracy Test

The MT-1/NT9's electronic standard is calibrated using a primary standard traceable to NIST and comes with a complete calibration report certifying measurement accuracy on both Wh and VARh scales over its entire operating range. Socket accuracy test can be done in your own lab using:

- An electronic reference standard traceable to NIST. The electronic standard must have at least 1 isolated current input port of a minimum capacity of 50A with autoranging capability and a typical precision of 0.01% or better;
- A laboratory stabilized and isolated AC power source with fundamental waveform selectable 120V or 240V, 60Hz, rated at least 150VA;
- The Accuracy Testing Kit (ATK-3) for three-phase testers.

For more information on socket accuracy test please refer to the ATK-3 documentation.

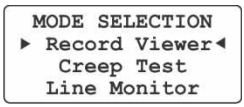
Chapter 3

Advanced Functions

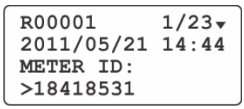
In addition to the test modes available to check Wh meters, the MT-1/NT9 offers advanced functions: **Record Viewer**, **Line Monitor**, **Creep Test**, **KW Demand Test**, **Wh/VARh** and **Reverse Flow Test**.

Record Viewer

To view a saved result, use the Record Viewer in the remote control. In the Mode Menu, press the **up/down** arrow keys to select the Record Viewer. The following display appears:



Press **Enter** to access. A description and the navigation keys of the Record Viewer are described below.



R00001: This is a permanent record number (with the prefix R) and cannot be modified nor deleted. This number is incremented after saving a test. It starts at 00001 up to 99999, then restarts at 00001.

1/23: This number shows the number of test results currently stored in the non-volatile memory.

Navigation Functions:

UP/DOWN arrows:	Line up/down through the results of a test.
SHIFT + UP/DOWN:	Page up/down through the results of a test.
LEFT/RIGHT arrows:	Moves to another test.
SHIFT + Left arrow:	Backs to the first test in memory.
SHIFT + Right arrow:	Goes to the last test in memory.
Clear key:	Deletes record appearing on the display.
SHIFT + Clear key:	Deletes all records.

Line Monitor Test

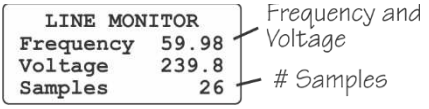
Analyzes the input voltage to determine statistically the line voltage, frequency fluctuations and its harmonic content (THD) up to the 32nd order.

In the Mode Menu, press the **up/down** arrows to select Line Monitor then press **Enter** to access. The following display should appear:

```
  LINE MONITOR
Frequency  59.99
Voltage    239.9
Samples        0
```

You can read on the display the line frequency and voltage. The THD is also displayed on the fourth line.

Press **Start/Stop** to start sampling.



On the display on line 4 the number of samples increases with time. A beep is heard each time a new minimum or maximum is detected. During sampling, the THD is not displayed.

To end the test, press **Start/Stop**. On the display, you can see the Minimum, Maximum and Average values of the line frequency and voltage during the sampling period.

```
      Freq.  Volt
Min: 59.98 239.2
Max: 60.02 240.6
Avg: 60.00 239.9
```

Creep Test

A meter is considered to creep if, with the load wires removed (no current) and nominal voltage applied to the meter, the disk makes one complete revolution in 10 minutes or less. With solid-state meters, no more than 1 pulse must be measured per quantity at 0.00A (no current).

Note: The MT-1/NT9 uses a closed-link arrangement on the meter's load terminals and cannot be opened. However, in creep test mode, the internal current synthesizers are set to 0.00A (no current), thus simulating an open circuit.

In the Mode Menu, press **up/down** arrows to select Creep Test then press **Enter** to access. The following display should appear:

```
   CREEP TEST
Timer:     05:00

<START>    <↕>
```

The **up/down** arrow keys allow to set the time period for the Creep Test. There are three-time intervals available: 5, 10 and 15 minutes.

When ready, press the **Start/Stop** key to begin the test.

Warning: The deadfront safety is disabled when this test is initiated. Do not remove the meter during this test, line voltage is applied on the upper front jaws! A flashing warning message is displayed during this test.

```
   CREEP TEST
Timer:     04:27
 WARNING: Dead-
 front Disabled
```

When the creep test ends, the following message appears and deadfront safety is re-enabled. If the disk has not completed a full revolution or received more than one pulse during a test, that means the meter does not creep.

```
   CREEP TEST
Timer:     00:00

Creep Test Ended
```

kW Demand Test

This function allows the operator to do a kW demand test. The kW demand test is calculated using the following formula:

kW = kWh x 60/T

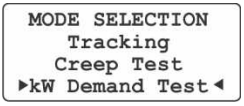
Where T = Demand interval length in minutes

Note: With solid-state metering, conducting energy and demand tests may be considered redundant since they are both results of the same measurement.

Set up the meter for a kW demand test following the manufacturer's instructions. Please note that the kW demand test method varies according to the brand of meter being tested. Consult the meter manufacturer's Reference Technical Guide for instructions.

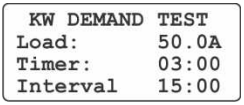
Initialization

In the Mode Menu, press the **up/down** arrows to select kW Demand Test then press **Enter** to access. The following display will appear:



Enter the load you wish to use for the demand test. The load can be set up to 50A. By default, the maximum load will be applied to the meter.

Then set the timer for the duration of the test. The timer must be less or equal the demand interval of the meter under test. By default, the timer is set to 3 minutes.



Finally, make sure the interval matches the demand interval length of the meter under test. The test interval can be set between 1 and 99 minutes. By default, the test interval is set at 15 minutes.

Loading and Testing

At the same time, you reset the demand register on the meter under test press the **Start/Stop** key on the MT-1/NT9's remote control.

On the display, the timer for the duration of the test will be counting down while the kW Max will accumulate.

When the timer for the duration of the test reaches zero, the load is removed, and the demand test has ended. The following display appears:

```
Enter the demand
 meter register.
    00.000kW
<ENTER>    <↑↕↓>
```

Type in the value of the demand meter register using the keypad on the remote control. A typical display is shown here.

```
Enter the demand
 meter register.
    22.939kW
<ENTER>    <↑↕↓>
```

Afterwards press **Enter** and the MT-1/NT9 will calculate and display the results.

```
 KW DEMAND TEST
Mt-1     22.898kW
Meter    22.939kW
Regis.    100.18%
```

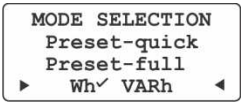
A result higher than 100% means the meter records a higher kW demand compared to the reference. Conversely a result lower than 100% means the meter records less kW demand compared to the reference.

Please note, the response time to signal the beginning of the test and reset the demand register may affect the precision of the test.

See the "KW Demand Test" example on page 51.

Wh/VARh

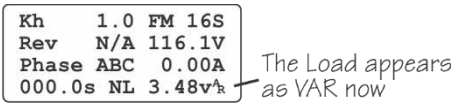
When enabled in the configuration menu, the VARh test option appears in the Mode Menu as displayed here:



To select VARh, press **Enter** then press the **left/right** arrows to select it as indicated by a small checkmark. Press **Enter** twice to confirm the VARh test mode.

Note: After a power off, the remote reverts to Wh test mode.

When VARh mode is selected, the load now appears as VAR as shown here in the test menu:



In VARh mode, the **LL** and **HL** loads are 90o lag and the **PF** load is 30o lag (current lagging on voltage).

Before conducting a test with a solid-state meter, make sure the meter's output pulses are set to VARh. The instructions to set a meter in VARh are different from a meter to another. Check the meter manufacturer's Reference Technical Guide for instructions.

Please note that with solid-state meters there are several recognized methods to calculate VARs. With harmonic content, solid-state meters show variation in VAR results according to the method used. It gets worse as the harmonic content increases. Explanations about these variations fall beyond the scope of this guide. The MT-1/NT9 borrows the vector method using VA RMS for VAR calculations.

Reverse Flow Testing

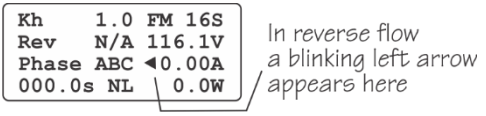
Normally a meter measures the energy **delivered** to the customer by the grid. If the current flow is reversed the energy is **received** by the grid from the customer. Some solid-state meters have the capability to measure the energy in both directions.

It is important to mention that the **Wh** reverse flow testing is available with or without the optical pickup, and the **VARh** reverse flow testing is only available with the optical pickup. However, this feature is not available when a Metercam is connected.

The MT-1/NT9 has also the capability to reverse the current flow and thus test the accuracy of a solid-state meter in received flow.

Before accessing the reverse flow test, press **Reset** to make sure there is no load applied to the meter. Then you select the reverse current flow by pressing and holding the **Shift** key while pressing the **Mode** key.

Please note that to show the difference between a normal and a reverse flow test, a small blinking left arrow is shown on the left side of the load displayed on the remote.



Chapter 4

Operations

CAUTION!

The use of MT-1/NT9 is strictly reserved to personnel authorized to manipulate electric installation meters. For safety reasons, **certified safety glasses and rubber gloves** are strongly recommended but are not provided with the MT-1/NT9.

The operation of removing and inserting a meter from its meter base under power exposes live electric terminals. **Be careful. Do no stick your hands or any metal objects into the open meter base. You could suffer bodily burns, electric shocks and even electrocution.**

It is imperative you **follow the safety procedures** of your company.

Operations Summary

The MT-1/NT9 is compatible with meter Forms 1S, 2S, 3S, 4S, 6S, 8S, 9S, 12S, 14S, 15S and 16S. **Before testing a meter in the field, always make sure the electrical wiring of the meter base is fully compatible with those shown in Appendix B.**

The MT-1/NT9 socket must first be inserted between the meter base and the meter. The installation procedure for a ringless meter base is described hereafter in Fig. 4.1.

After powering on, the MT-1/NT9 recognizes the type of meter installed and asks you to validate the Form and the TA. With some meters, it is sometimes necessary to select the Form manually.

If a pickup is used, the socket does a quick test to estimate the Kh of the meter. If the estimated Kh found is already stored in the remote, it is chosen to do the test. If the estimated Kh is not already stored, the user can accept or change the estimated Kh and store it in the remote. Without a pickup, the Kh is chosen according to the meter Form as defined by default in the remote. If for some reason the Kh does not match the Kh indicated on the meter, the operator can change it manually.

Then a test mode is chosen to do the test. If a pickup is used, the test becomes fully automatic and the modes available are User-defined, Preset-quick and Preset-full. Without a pickup, the modes Manual and Tracking are available. The test is done manually and the meter disk (or the simulated disk in case of a solid-state meter) must do a precise whole number of revolutions. It is up to the operator to start and stop the test precisely using the key Start/Stop.

Once the load is applied and the test has started, the MT-1/NT9 measures with its internal electronic standard the energy that passes through the meter. Important measurements are shown on the remote's display while testing.

When the test ends, the remote control displays the test result in percentage error (Ex. -0.02%) or in percentage registration (Ex. 99.98%).

Installation of the Socket

1. Meter Removal

WARNING:

Do not remove the meter when it is under a heavy load to avoid sparks. The front jaws of the meter base are live; do not stick your hands or any metal objects into the meter base! Certified safety glasses and rubber gloves are strongly recommended.

Carefully remove the meter from its meter base **according to your company safety procedure**s. Avoid removing the meter under heavy load due to sparks. Before removing the meter from a CT rated meter base, **make sure to short the secondary CT's** to prevent equipment damages and personal injuries.

Make sure that the wiring connecting the meter to the line is compatible with one of the configurations shown in Appendix B. If not compatible, stop here and put the meter back into place. Field-testing with the MT-1/NT9 is not possible for that meter installation.

2. Installation of the MT-1/NT9 Socket[3]

Make sure the power switch of the MT-1/NT9 socket is OFF. Check Appendix C to setup the twist tabs and the Form Selector before inserting into the meter base. With ringless meter base, remove the latch if necessary using the quick release mechanism.

Firmly take the MT-1/NT9 socket with the arrow pointing upward and align the rear tabs of the socket with the front jaws of the meter base. Then firmly insert the MT-1/NT9 socket into the meter base. Secure the installation. For ring-type meter bases, a latch can be purchased as an option.

[3] When the MT-1/NT9 is used in the meter shop, do not plug it in a testboard. It will not run properly. You may use a single-phase 4-jaw meter base of at least 150VA capacity and keep the Form Selector in the 1S/2S/15S position for all types of meters. The nominal voltage must be respected according to the meter being tested.

3. Installation of the Meter

Plug in the meter into the front of the MT-1/NT9 socket. If I/O cables are present push them into the notch before inserting the meter. Make sure everything is well secured. The socket installation is complete.

Operation examples are provided further on.

Installation Procedure (ringless meter base)

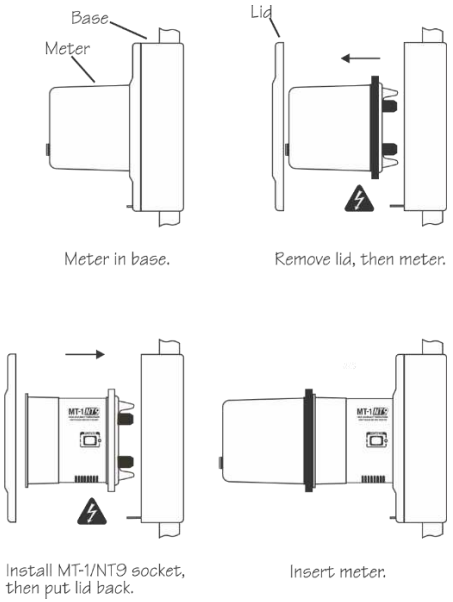


Fig. 4.1 – Installation Ringless Meter Base

THIS SYMBOL INDICATES THAT VOLTAGE IS PRESENT AND EXTREME CARE SHOULD BE USED.

INSTALL THE MT-1/NT9 SOCKET ONLY IN A COMPATIBLE METER BASE. SEE APPENDIX B FOR COMPATIBILITY.

Operation Examples

In the following examples, we assume the MT-1/NT9 socket is already installed into the meter base and the meter under test is also plugged into the MT-1/NT9 socket and the installation is well secured.

Example 1: Solid-state 9S meter tested in Preset-quick Mode

Meter used:	Solid-State, Form 9S
Voltage:	120-480V
Kh:	1.8
TA:	2.5
CL:	20

Preset-quick mode is chosen which consists to apply loads of at least 20 seconds for each of the loads HL, PF and LL. Please note that the 3 potential coils of the meter are automatically switched in parallel by the socket.

Here are the steps to be followed:

1. Connecting the cables
2. Switching ON the tester
3. Pulse detection and Kh estimation
4. Initialization
5. Loading and Testing
6. Checking Results while testing
7. Obtaining the test results

1. Connect the cables

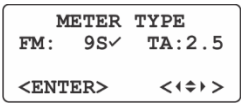
To connect the cables:

1. Plug the RJ12 connector of the straight cable of the optical pickup into the test socket telephone connector.
2. Connect the handheld remote to the optical pickup using the coiled cable. Be careful not the reverse the cables otherwise it will not work
3. Look for the LED output pulse of the meter and put the suction cup of the optical pickup directly over it.

Note: An optional adapter may be required on some meters and can be purchased as an option.

2. Switch on tester

Switch on the MT-1/NT9. The remote self-tests and a display appears which indicates the Form and the TA of the meter, 2.5A being the TA by default.

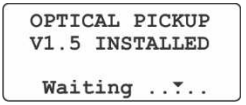


The suggested form is 9S as indicated by a small checkmark. If the Form and the TA displayed are correct as shown above press **Enter**; otherwise use the arrow keys to change them.

If the message "Check Insertion!" appears on the display of the remote, this means that the meter is not inserted all the way into the front of the MT-1/NT9.

3. Pulse detection & Kh estimation

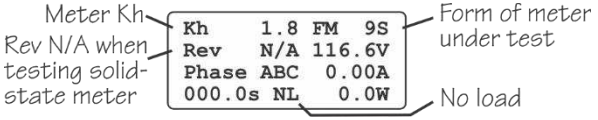
Once the remote has detected the presence of the optical pickup the following display appears.



Then a quick test is done automatically to estimate the Kh of the meter. If the estimated Kh found is already stored in the remote, it is chosen to do the test. Otherwise, you can accept or change the estimated Kh and store it in the remote. If for some reason the Kh does not match the meter, you can always change the Kh manually. The following display appears for a few seconds:

4. Initialization

Once the pulses have been found, the following display appears:



To make sure that the mode is **Preset-quick**, press the **Mode** key and the following display will appear:

```
  MODE SELECTION
    User-defined
▶   Preset-quick ◀
    Preset-full
```

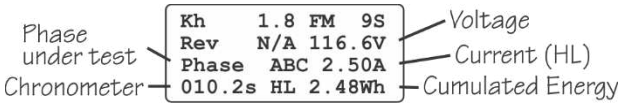
Press **Mode** again to come back to the test menu as shown below.

```
Kh     1.8 FM  9S
Rev    N/A 116.6V
Phase ABC  0.00A
000.0s NL   0.0W
```

5. Loading and Testing

Press **Start/Stop** to initiate the sequence; the load current will increase to HL and the meter will start to send pulses and the internal electronic standard begins to register the energy that passes through the meter. At the same time, you will hear a double beep indicating that the test has begun.

In addition to the test parameters appearing on the display, the operator can see the voltage and current applied to the meter, the chronometer and the cumulated energy registered by the electronic standard. A typical running test display is shown below.



6. Checking the results while testing

While testing, you can check the partial results of the test by pressing the **Mode** key.

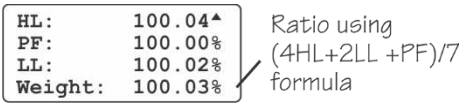
```
  PHASE   ABC ▾
HL:      100.03%
PF:      Testing
LL:        -
```

Press **Mode** again to come back to the test menu.

7. Test Results

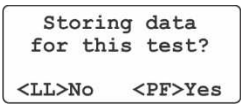
After the 3 test points, the watthour measurement period ends automatically. Then the load is removed and three test results are displayed, one for HL, one for PF and one for LL. A typical test result is shown below with the 3 test points:

A fourth test results is available, showing the average according to the formula (4HL+2LL+PF)/7. You can see the weighted result by scrolling down one line with the help of the arrow/down on the keypad. Here is a typical display showing the 4 test results together:

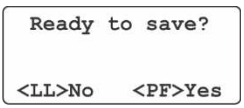


Note that when you see the cursor symbols on the upper right end of the display, this mean that you can scroll down line by line. You can also press the left/right arrows to view page by page.

You can save your test results by pressing the **Reset** key as shown below:



Press **PF** to start the saving procedure. If you do not want to save these results, then press **LL**.



Please note that if you had chosen the **Preset-full** Mode in this example, the test would have continued, checking each of the phases A, B, C, one after the other under the HL, PF and LL loads. Remark: To speed up the test in Preset-full Mode, the LL load can be disabled using the configuration menu.

In the **Preset-full** Mode, once the test of all phases ABC together is completed and the test of each phase has begun, you can conclude the test at any time by pressing **Reset**. The results obtained beforehand can then be saved.

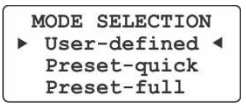
Example 2: Solid-state 9S meter tested in User-defined Mode

Meter used:	Solid-State, Form 9S
Voltage:	120-480V
Kh:	1.8
TA:	2.5
CL:	20

User-defined Mode is chosen which consists in applying a HL load during at least 20 seconds. Once the installation completed and steps 1 to 3 described in example 1, we proceed with the initialization.

1. Initialization

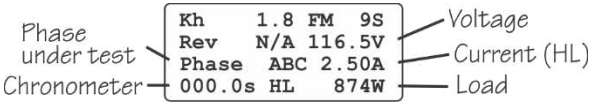
Press the **Mode** key and choose **User-defined**.



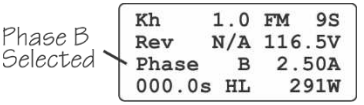
Press **Mode** again to come back to the test menu.

2. Loading and Testing

Press **HL**, the load current will increase to 2.5A and the meter will start to send pulses. In the following display, the meter sees a load of 874W (voltage x current x 3):



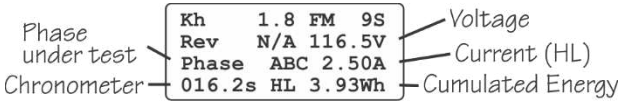
Note: If you wish to test only Phase A, press **HL** a second time. If you wish to test only phase B, press **HL** another time and so on. Here is a display where only phase B is selected. The selection is shown on the third line in the middle of the screen.



By pressing 2 times on **HL**, phases ABC are again chosen, as per this example.

Press **Start/Stop** to start the test. The meter sends pulses and the internal electronic standard of the MT-1/NT9 starts measuring the energy sent to the meter. At the same time, you will hear a double beep indicating that the test has begun.

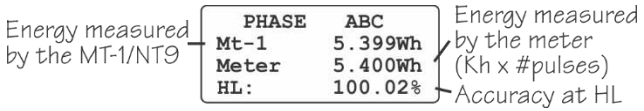
In addition to the test parameters appearing on the display, the operator can see the voltage and current applied to the meter, the chronometer and the cumulated energy registered by the electronic standard. A typical running test display is shown below:



On this display, the internal electronic standard of the MT-1/NT9 shows that it has registered up to now 3.93Wh (voltage x load x 3 x time/3600). When calculating Wh, time is expressed in hours.

3. Test Results

The watthour measurement period ends automatically after the minimum time of test by default, here >20 seconds. Then the load is removed automatically and test results are displayed. A typical test result is shown below.



The test result shows this meter has a percentage registration of 100.02% under a 2.5A load. By default, the test result is displayed in percentage registration. Then, by pressing the **Reset** key, you can store the results of your test or not.

Please note that you can abort a test at any time by pressing the **Reset** key.

Example 3: 12S(N) meter tested in Tracking Mode

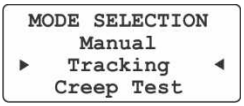
Meter used:	Solid-State, Form 12S
Voltage:	120V, 3-wire network
Kh:	14.4
TA:	30
CL:	200

Tracking Mode is chosen which consists in applying a 30A (HL) load over 10 revolutions. No pickup is used for this test. The **Start/Stop** key is used to start and end the test.

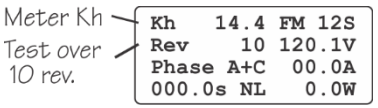
We assume that the installation procedures have been completed. Connect the coiled cable from the remote control to the test socket. Turn on the MT-1/NT9. After a few seconds, the remote control displays the form and the TA of 30A. Here the form detected by the MT-1/NT9 is 12S because the meter has a 9 o'clock contact terminal that presses down on the proper piston on the front of the test socket. However, if a meter has a 6 o'clock terminal, the form detected would be 2S. In that case, use the **up/down** arrows on the keypad to select form 12S instead of 2S. Once the proper form appears, press **Enter**.

1. Initialization

Press the **Mode** key and choose **Tracking**.



Press **Mode** again to come back to the test menu.

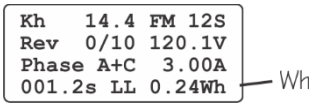


By default, the selected Kh for a 12S meter is 14.4. It can be changed by using the **Kh** key. The test is done over 10 revolutions by default. It can be changed by using the **Rev** key.

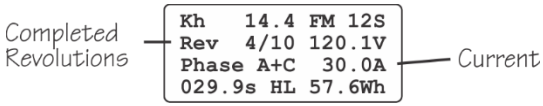
2. Loading and Testing

Press **LL**, the load current will increase to 3A and the disk will start to rotate. When the black flag of the disk lines up with the black line (on the meter nameplate), press **Start/Stop** to initiate the test. At this precise moment, the internal electronic standard of the MT-1/NT9 begins to register the energy that goes through the meter. Note: it is easier to start and end a test when the disk rotates slowly.

On this display, the internal electronic standard measures the energy that passes though the meter:



Press on **HL**. The current will increase to 30A and the disk will rotate rapidly. See display below:

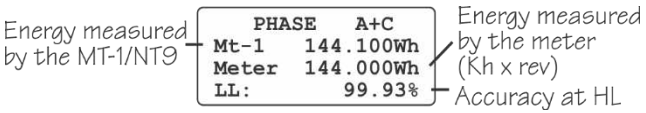


The remote control emits a beep each time the disk has completed one revolution. The number of completed revolutions also appears on the display. The count of the revolutions is based on the meter Kh and the Wh recorded by the MT-1/NT9.

At the 9th revolution, the sound of the beep is different to warn that the end of the test is near. Press **LL** to slow down the disk then, when the black flag of the disk lines up with the black line, press **Start/Stop** to end the test.

3. Test Results

Typical test results are shown below:



The result indicates that the meter is accurate at 99.93% under a load of 30A, therefore slightly slow by -0.07%. Remark: On the fourth line of the display, it is normal to see LL instead of HL because the last revolution was ended in LL. However most of the test was conducted at HL, even if LL is displayed in the result.

Note: The results of a test in **Manual** or **Tracking** modes cannot be saved.

Example 4: 2S meter tested in User-defined Mode with Metercam

Meter used:	Electromechanical, Form 2S
Voltage:	240V
Kh:	7.2
TA:	30
CL:	200

User-defined Mode is chosen which consists in applying a 30A load during 10 revolutions. The Metercam is used for this test. We assume that the installation procedures for the socket have been completed.

Here are the steps to be followed:

1. Installing the Metercam and the cables
2. Switching ON the MT-1/NT9
3. Disk detection
4. Initialization
5. Loading and Testing
6. Obtaining results

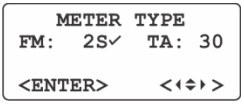
1. Install the Metercam and the cables

Install the Metercam and the cables:

1. Roughly align the 0.5" field view disk zone of the Metercam with the meter disk.
2. Press the four corners of the Metercam onto the meter cover hard enough to allow the suction cups to take hold.
3. Notes: Make sure that the 4 suction cups stick perfectly on the meter cover during the entire test. If necessary lightly wet the inside of the suction cups.
4. Connect the coiled cable from the socket to the bottom left connector of the Metercam.
5. Connect the other coiled cable from the remote to the bottom right connector of the Metercam. See Fig. 2.4.

2. Switch on the tester

Switch on the MT-1/NT9. The remote self-tests and a display appears which indicates the Form and the TA of the meter, 30A being the TA by default.



If the Form and the TA displayed are correct as shown above, press **Enter**, otherwise use arrow keys to change them.

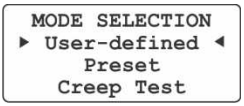
3. Disk Detection

Once the remote has detected the presence of the Metercam a load is applied automatically to the meter to spin the disk. The Metercam starts the scanning process to detect the position of the meter disk. The red LED turns on when the scanning starts. The green LED turns on when the Metercam has found the position of the disk. Finally, the red LED turns off when the black flag is found on the disk and turns on only when the black flag passes in front of the Metercam.

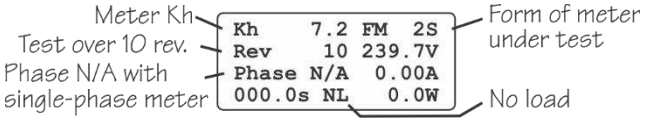
Once the Metercam has found the black flag, a quick test is done automatically to estimate the Kh of the meter. If the estimated Kh found is already stored in the remote, it is chosen to do the test. Otherwise, you can accept or change the estimated Kh and store it in the remote. If for some reason the Kh does not match the meter's, you can always change the Kh manually.

4. Initialization

Press the **Mode** key and choose **User-defined**.



Press **Mode** again to come back to the test menu.

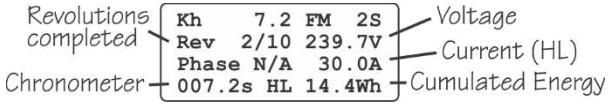


In the test menu, check that the Kh is 7.2 and the number of revolutions for the test is 10. With a single-phase meter, the phase is not displayed.

5. Loading and Testing

Press **HL**, the load current will increase to 30A and the disk will start to rotate. Press **Start/Stop** to initiate the test. The measurements will begin only when the Metercam has picked up the black flag and starts to count the disk revolutions. At this precise time, the MT-1/NT9 starts to measure the energy that passes through the meter. You will hear a double beep indicating that the test has begun.

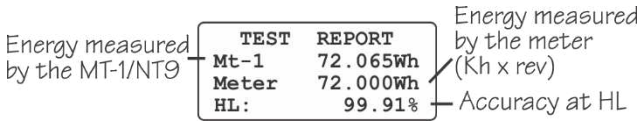
In addition to the test parameters appearing on the display, the operator can see the voltage and current applied to the meter, the chronometer and the cumulated energy registered by the electronic standard. A typical running test display is shown on the next page.



On this display, the internal electronic standard of the MT-1/NT9 shows that it has registered up to now 14.4Wh (voltage x load x time/3600). When calculating Wh, time is expressed in hours.

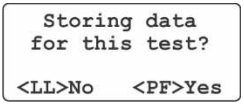
6. Test Results

The watthour measurement period ends automatically after the 10th disk revolution is completed i.e. when the Metercam has registered its 10th revolution. Then the load is removed automatically to stop the disk and test results are displayed. A typical test result is shown below:



The test result shows this meter has a percentage registration of 99.91% under a 30A load, therefore slightly slow by -0.09%.

Now, you can save your test results by pressing the **Reset** key as shown below:



Press **PF** to start the saving procedure. Once this is done, the remote goes back to the test menu. You can then repeat the test at PF or LL.

If you do not want to save these results, then press **LL**. The remote control goes right back to the test menu and you can repeat the test at PF or LL if desired.

Example 5: KW Demand Test

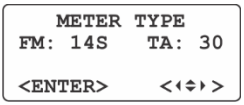
Meter used:	Electromechanical, Form 14S
Voltage:	120V, 3-wire network,
Kh:	21.6
TA:	30
CL:	200

The meter is equipped with an electronic kW demand register (Type M-90). The kW demand test will be done at 50A on 15 minutes' time interval. You must first set the meter in kW demand test by removing the meter's cover and flip over the small tab located on the M-90's face plate. This enables kW demand test by pressing a small push-button switch.

We assume the MT-1/NT9 socket is already installed into the meter base and the meter is also plugged into the MT-1/NT9 socket and the installation is well secured.

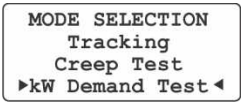
1. Connect the cable and switching on

Connect the coiled cable from the remote control to the test socket. Switch on the MT-1/NT9. After a few seconds, the remote control displays the form and the TA. The suggested form is 16S as indicated by a small checkmark. Use the **up/down** arrows on the keypad and choose 14S. By changing the form manually, the checkmark disappears. Once the form 14S selected, press **Enter**.

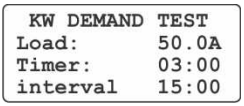


2. Initialization

Press the **Mode** key and choose **kW Demand Test**.



Press **Enter** to access the kW Demand Test menu as shown below.



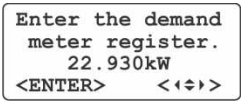
By default, the maximum load applied to the meter is 50A, the timer or test duration is 3 minutes and the meter's demand interval is 15 minutes. We will set the test duration (timer) from 3 to 15 minutes using the arrow keys.

3. Loading and Testing

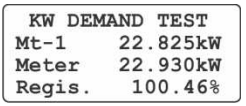
Press the RESET button on the front of the M-90's meter demand register. Then release it while pressing the **Start/Sto**p key on the MT-1/NT9's remote control **at the same time**.

You will see the meter's display showing the time interval counting down, the same as you can see on the remote's display. By pressing the DISPLAY button on M-90's demand register, display no. 2 will appear showing the kW Max accumulating, the same as seen on the display of the remote.

At the end of the test, press the DISPLAY button again to see display no. 3 showing the result of the test, being the kW Max value recorded by the demand register. Enter this value on the remote control using the keypad.



Press **Enter**, the MT-1/NT9 will calculate and display the results.



Example 6: Meter tested in the meter shop

The MT-1/NT9 can be used as a testboard in the meter shop in order to check both single-phase and 3-phase meters using a single-phase 4-jaw meter base mounted on the wall. The meter base must provide a voltage of 120V or 240V on the 2 upper jaws with a capacity of at least 150VA. The meter base's voltage must respect the nominal voltage value of the meter under test.

Before inserting the MT-1/NT9 in the meter base the form selector switch in the back of the tester must be set in the 1S/2S/15S position so that the MT-1/NT9 is powered from the 2 upper tabs. See figure 6.1 on page 72. The use of a holding ring to keep the MT-1/NT9 in place is recommended.

Once installed, the test procedure is the same as testing in the field.

Temporary Configuration Menu

During a test, you might wish to bring a temporary change to the **Setup** or **Load** Menus. For example, you are facing a meter with a Kh that does not appear in the Kh Table. Another example, you want to set a load of 25A instead of 30A with the HL key.

By following the procedures described below, it is possible to bring one or many changes. Please note that the temporary configuration is lost when the remote control is powered off.

If you wish to bring a permanent change, you must access the **Configuration Menu**, described in the chapter 5. This menu is more complete and versatile.

Adding a new Kh

From the main menu, press and hold **Kh** at least 2 seconds; a small menu appears. Write in the new Kh with the help of the keypad and the arrows. The maximum value for Kh is 50.00000.

In the case of a Kh with a fraction, write in the fraction in decimal form. For example, a Kh of 6-2/3 is written as 6.66666; a Kh of 10-3/4 is written as 10.75000, etc.

Adding a new Rev

From the main menu, press and hold **Rev** at least 2 seconds; a small menu appears. Write in the new Rev with the help of the keypad and arrows. Acceptable whole values for Rev range from 1 to 99 inclusively.

Changing the Load

From the main menu, press and hold **HL**, **PF** or **LL** at least 2 seconds; a small menu appears. Write in the new current load with the help of the keypad and arrows. The key takes in temporarily the new load value.

Note: A meter must be inserted in MT-1/NT9 socket to change the load.

Chapter 5

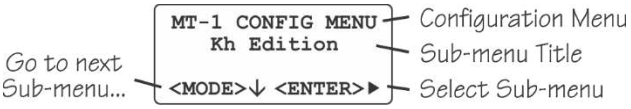
Configuration

The MT-1/NT9 comes with manufacturer default operation parameters that can be easily changed according to your needs using the Configuration Menu. Parameters are stored in the non-volatile memory of the remote control. The available sub-menus are described below.

Sub-Menu	Description
Kh Edition	Adds, changes or deletes a Kh value
Kh Default	Assigns the Kh by default to each of the forms
Rev Edition	Adds, changes or deletes a Rev
Load Edition	Defines a new TA Load percentage
Preset Edition	Defines a new sequence of consecutive tests
General Edition	lizes parameters such as: Rev by default Mode by default Preset by default LL/Phase for individual Phase Test (Preset-Full) Report Format (Error/Registration) Time/Test (Min. duration time per test point) Language selection Warning when results are over a predetermined percentage AutoKh Sensus Warning Enable Fitzall™ Enable VARh test mode Enable Data Log Enable Auto Save mode Time and Date
Factory Default	Manufacturer's default Configuration
Accuracy Test	Tests the MT-1/NT9's internal watthour standard against a NIST traceable standard
User Calibration	Calibration by the user (±0.05% maximum shift allowed from factory calibration, step ±0.001%).

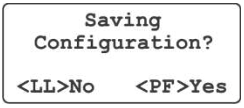
How to Access the Configuration Menu

Press and hold **Reset** on the remote while turning on the MT-1/NT9. After a few seconds, the configuration menu will appear. Release **Reset**. The configuration menu lets you access one of the nine sub-menus.



The title of the sub-menu is displayed on the second line. To move from one sub-menu to the next, press **Mode**. To access a sub-menu, press **Enter** then follow the new indications appearing on line 4 of the sub-menu. To return to the configuration menu, press **Reset** only once.

To exit the configuration menu, press **Reset** twice. If there has been a change in a sub-menu, a saving menu appears.



Press **PF** to save the changes or **LL** to discard any changes. A Beep is heard when data is saved in the non-volatile memory. Afterwards, the remote comes back to the Main Menu.

Description of the Sub-Menus

This section describes and shows how to use each of the sub-menus. Examples are provided at the end of this chapter.

Kh Edition Sub-Menu

With this sub-menu, you can modify the content of the Kh Table. The Table already contains eleven Kh values: 0.3, 0.6, 1.0, 1.8, 3.6, 6, 7.2, 12, 14.4, 21.6 and 36. You can add, change or delete one or many Kh in the table which can contain a maximum of eighteen Kh. The maximum value that can be given a Kh is 50.00000.

In the case of a Kh with a fraction, use decimals. For example, a Kh of 6-2/3 is written in as 6.66666.

Procedure

In the configuration menu, press **Mode** to reach the 'Kh Edition' sub-menu appearing on the second line of the display. Press **Enter** to access. The following sub-menu should appear:

The numeric keypad or the **up/down** arrow keys allow to change the value under the cursor. The **left/right** arrow keys allow to move the cursor. To go to the next Kh press **Mode**.

Adding, Changing, Deleting a Kh

To add a new Kh, press **Mode** to scroll down in the table until the Kh value is 00.00000. Write in the new Kh using arrows keys.

To change an existing Kh, press **Mode** to scroll down in the table until you reach the Kh. Write in the new Kh using arrows keys.

To delete a Kh, press **Mode** to scroll down in the table until you reach the Kh and write in the value 00.00000.

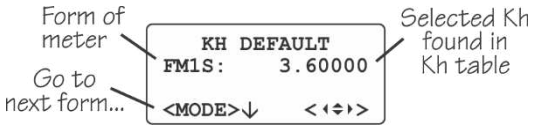
Note: the 7.2 Kh value cannot be deleted.

Kh Default Sub-Menu

With this sub-menu, you can assign a default Kh according to the Form of the meter. The Kh default is assigned only when the pickup is not used. With a pickup, there is no Kh by default, the Kh is estimated regardless of the Form of the meter.

Procedure

In the configuration menu, press **Mode** to reach the 'Kh Default' sub-menu appearing on the second line of the display. Press **Enter** to access. The following sub-menu should appear:



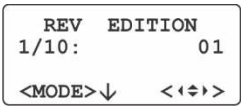
The **up/down** arrow keys allow you to go up and down the Kh table and choose a different Kh by default to be assigned to the form currently displayed. To go on the next Form, press **Mode**.

Rev Edition Sub-Menu

With this sub-menu, you can modify the content of the Rev table. The table already contains seven Rev values: 1, 2, 5, 10, 20, 30 and 50. You can add, change or delete one or many Rev in the table which can contain a maximum of ten Rev. The Rev value must be between 1 and 99.

Procedure

In the configuration menu, press **Mode** to reach the 'Rev Edition' sub-menu appearing on the second line of the display. Press **Enter** to access. The following sub-menu should appear:



The numeric keypad or the **up/down** arrow keys allow to change the value under the cursor. The **left/right** arrow keys allow to move the cursor. To go to the next rev press **Mode**.

Adding, Changing, Deleting a Rev

To add a new Rev, press **Mode** to scroll down in the table until the Rev value is 00. Write in the new Rev using arrows keys.

To change an existing Rev, press **Mode** to scroll down in the table until you reach the Rev. Write in the new Rev using arrows keys.

To delete a Rev, press **Mode** to scroll down in the table until you reach the Rev and write in the value 00.

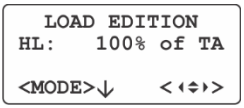
Note: the 10 Rev value cannot be deleted.

Load Edition Sub-Menu

With this sub-menu, you can assign for each of the 3 load keys (LL, PF and HL) a percentage from 10 to 100% of the TA (Test Ampere). By default, **HL** and **PF** are set at 100% of the TA and **LL** is set at 10% of the TA. Example: If the TA of the meter is 30A, then **HL** is set to 30A, **PF** is set to 30A (current 60o behind voltage) and **LL** is set to 3A.

Procedure

In the configuration menu, press **Mode** to reach the 'Load Edition' sub-menu appearing on the second line of the display. Press **Enter** to access. The following sub-menu should appear:



The numeric keypad or the **up/down** arrow keys allow to change the value under the cursor. The **left/right** arrow keys allow to move the cursor. To go to the next Load press, **Mode**.

Changing a Load

Choose the load key you want to change with the **Mode** key then change the percentage of the TA you want. Repeat this operation if necessary for each one of the three loads, **HL**, **PF** and **LL**.

Preset Edition Sub-Menu

This sub-menu has four parameters. The first three parameters define the sequence of the test. The sequence for electromechanical meters is the number of revolutions to be done by the disk at HL, PF and LL respectively. By default, the sequence is 10 revs at HL, 5 revs at PF and 1 rev at LL. The number of Rev at HL and at LL cannot be less than 3 and 1 respectively. If the number of Rev at PF is set at 0, the test at PF is skipped.

Note that for solid-state meters the number of revolutions is replaced by a minimum time per test point. By default, the minimum time is 20 sec. This can be changed using the configuration menu. Again, if PF is set at 0, the test is skipped.

The last parameter applies only for single-phase meters including 12S. It defines the ratio used in calculating the weight of a test report (4 by default). For 3-phase meters the weight is computed using a set formula of (4HL+2LL+PF)/7 or (4HL+PF)/5 if LL is disabled in Preset-full.

Procedure

In the configuration menu, press **Mode** to reach the 'Preset Edition' sub-menu appearing on the second line of the display. Press **Enter** to access. The following sub-menu should appear:

The numeric keypad or the **up/down** arrow keys allow to change the value under the cursor. The **left/right** arrow keys allow you to move the cursor. To go to the next parameter, press **Mode**.

By pressing the **Mode** key, you reach the second parameter that determines the number of revolutions to be done at PF and so on.

By pressing the **Mode** key again, you reach the third parameter that determines the number of revolutions to be done at LL.

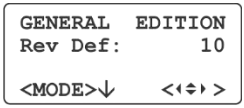
Finally, by pressing the **Mode** key again, you reach the fourth parameter that determines the ratio used in calculating the weight of a test for single-phase meters only. With a ratio of 4:1, the formula is (4HL+ 1LL)/5. With a ratio of 2:1, the formula is (2HL+1LL)/3 and so on.

General Edition Sub-Menu

This sub-menu includes several factory default settings. You can change these default settings according to your needs and specifications.

Procedure

In the configuration menu, press **Mode** to reach the 'General Edition' sub-menu appearing on the second line of the display. Press **Enter**. The following sub-menu should appear:



The first setting shown is 'Rev Def:'. To go to the next setting press **Mode**. These settings are described below.

Settings	Description
Rev Def:	Rev selected at power on. Press the **up/down** arrow keys to select another one contained in the Rev table. Default is 10.
Mode Def:	Mode selected at power on. Press the **up/down** arrow keys to toggle between MAN/USR and TRK/PRE Modes. Default is TRK/PRE.
Preset Def:	Preset Mode selected at power on. Press the **up/down** arrow keys to toggle between Preset-quick and Preset-full. Default is Preset-quick.
LL/Phase:	Enable LL load during individual phase test in Preset-full mode only. Default is disable.
Report:	Percentage format report. Press the **up/down** arrow keys to toggle between % error or % registration. Default is % registration.
Time/Test:	Minimum duration time by test point for solid-state meter. Press the **up/down** arrow keys to set the duration time. Minimum time is 10 sec and maximum time is 120 sec. Default is 20 sec.
Language:	Selection of language. Use the **up/down** arrow keys to toggle between English, Spanish and French. Default is English.

Warning: A warning message is displayed when the test result is over a predetermined percentage. Use the **up/down** arrow keys to set the percentage. Available percentages are 1%, 1.5%, 2%, 3%, 5% and 10%. By default, any Warning is disabled.

AutoKh: Automatic detection of the Kh value. Use the **up/down** arrow keys to enable or disable this option. By default, it is enabled.

Sensus Warning: Displays a warning after detection of a 3S meter. At first, a question is asked if this is a Sensus meter. By answering NO to the previous question, the test continues. If YES, another question is asked if you have an adaptor. If YES, the test continues. If NO, the test stops to prevent damage to the Sensus meter. This function can be enabled or disabled by using the **up/down** arrow keys. By default, it is enabled.

Fitzall[tm] Enable Enable/Disable support of the GE Fitzall[tm] meters. The form will have an F to indicate it's a Fitzall[tm] meter (i.e. 6F for a 6S Fitzall[tm] meter). By default, this function is disabled.

VARh: VARh test mode appears in the Mode test menu. The user can select Wh or VARh test mode to conduct a test. By default, VARh is disabled.

Datalog: Data Logging operations take place after a successful test. Use the **up/down** arrow keys to enable or disable. Default is Datalog enable.

Auto Save: It is to save the results automatically to the handheld. It can be disabled or saves after 1, 2, 5 or 10 seconds after the completion of the test. It will not auto save if the data logging function is disabled. By default, this function is disabled.

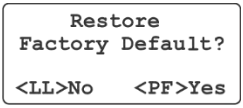
Time and Date: Set the Time and the Date in the Remote. Use the **up/down** and **left/right** arrow keys to change time or date.

Factory Default Sub-Menu

With this sub-menu, you can revert to factory configuration when you first purchased the MT-1/NT9 except for the language of the display and the user calibration factor. User calibration is stored in the non-volatile memory of the socket and not in the remote.

Procedure

In the configuration menu, press **Mode** to reach the 'Factory Default' sub-menu appearing on the second line of the display. Press **Enter** to access. The following sub-menu should appear:



Press **PF** to restore to the factory default. Press **LL** to keep the actual configuration.

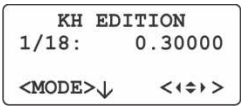
Configuration Examples

The following examples will give you a good idea of how the Configuration Menu works.

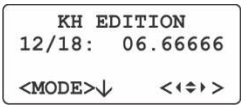
Addition of a New Kh

Kh: 6-2/3 (6.66666 decimal form)

1. Access the configuration menu.
2. Press Enter to access to the 'Kh Edition' sub-menu:



3. Press **Mode** eleven times to go to Kh no. 12 (12/18).
4. Press **right** arrow to move the cursor to the right.
5. Press **6** on the keypad six times to write 06.66666.



6. Once the right Kh is written in, press Reset twice. The Saving Menu appears. Press PF to save the new Kh in non-volatile memory. The new Kh is now recorded in the table.

Changing Preset Default Sequence

Change the default Preset Mode sequence to 12 revs at HL, 4 rev at PF and 2 rev at LL and a 1:1 weighted ratio, (1HL+ 1LL)/2.

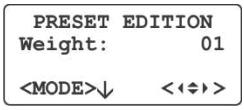
1. Access the configuration menu.
2. Press **Mode** four times to reach the 'Preset Edition' sub-menu appearing on the second line of the display. Press **Enter**, to access HL preset. The following display should appear:

3. Press **left** arrow key to move cursor and write the number 12 using the keypad instead of 10 revolutions at HL.

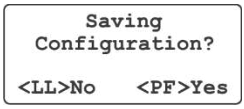
4. Press **Mode** to access **PF** preset. Press left arrow key to move cursor and write the number 4 using the keypad instead of 5 revolutions at PF.

5. Press **Mode** to access LL preset. Press **left** arrow key to move cursor and write the number 2 using the keypad instead of 1 revolution at LL.

6. Press **Mode** key again to reach the 'Weight' sub-menu. Write the number 1 using the keypad instead of 04. The ratio is now 1:1.



7. Once the change done, press **Reset** twice. The Saving Menu appears:



Press **PF** to save the change in non-volatile memory or **LL** to discard changes.

Appendix A

Specifications

General

Physical Dimensions (HxLxD)

Test Socket (Diam. x D)	6.9" x 7.7" (175 x 195 mm)
Remote Control	8.3" x 3.9" x 1" (210 x 100 x 26 mm)
Carrying Bag	11" x 11" x 8" (280 x 280 x 203 mm)

Weight

Test Socket	6.4 lb (2.91 kg)
Remote Control	0.6 lb (0.28 kg)
Overall with Carrying Bag	9.1 lb (4.14 kg)

Temperature

Operation	-4 to 140ºF (-20 to 60ºC)
Storage	-4 to 140ºF (-20 to 60ºC)
Humidity	0% to 95% (non-condensing)

Optional Test Accessories

Metercam	Metercam (digital camera disk sensor)
Pulse pickup	Optical pickup for electronic meters
Magnetic optical pickup	Magnetic Optical Pickup for electronic meters with metallic output pulse
MT-1/ATK-3	Accuracy Testing Kit
Remote Control	An optional handheld controller
Latch	To secure socket to the ring typed meter bases
Quick Release	A quick release to remove the latch from the socket
Focus Adapter	Used with the MT-1/PUL-3 optical pickup for L&G Focus with a triangle output pulse
Magnetic Adapter	Used with optical pickup MT-1/PUL-3 for meters with metallic output pulse
KYZ device	To monitor the KYZ output for meter equipped with the KYZ feature.

Test Socket Adapter

Input

Voltage	100-600VAC
Line Frequency	58-62Hz
Power Consumption	75VA (maximum)
Bypass Circuit	200A (standard)
Circuit Breakers	2 x 1A (press to reset mechanism)

Output

Voltage	No voltage source is included in the MT-1/NT9. The Line Voltage is used for the energy measurement. Therefore, the accuracy is less than 200ppm.
Current	The current sources are designed with a very tight feedback loop to get the most accurate current, therefore the current accuracy is less than 200ppm.

Serial communication port Full-duplex (isolated)

Forms of Meter

Single-phase	1S, 2S, 3S, 4S, 12S(N), 25S
Three-phase	6S, 8S, 9S, 12S, 14S, 15S, 16S
Fitzall[tm]	CT-rated and Self-Contained
Class	CL10, CL20, CL100, CL200, CL320

Current Synthesizers

Adjustable Current	0.25 to 50A
Phase Angle (Wh)	Unity and 60° Lag
Phase Angle (VARh)	90° Lag and 30° Lag

Voltage Applied to Meter Line-voltage protected by two 1A circuit breakers and activated only when meter is inserted. Voltage is also current limited.

Electronic standard accuracy[†]

Typical	±0.02%
Maximum guaranteed	±0.05%
Influence affecting accuracy	None

Multifunction measurements accuracy

RMS Voltage	±0.05%, maximum
RMS Current	±0.05%, maximum
Frequency	±0.01%, maximum

† The MT-1/NT9's internal electronic standard is calibrated using a reference standard traceable to NIST and comes with a complete calibration report certifying measurement accuracy for both Wh and VARh scales over its entire operating range. Test accuracy can be done using a reference standard and the three-phase Accuracy Testing Kit (ATK-3). The calibration of the MT-1/NT9's standard can be slightly changed using the User calibration menu. However, User calibration offset is limited to ±0.05% (with steps of ±0.001%) from the factory calibration. User Calibration is stored in the non-volatile memory of the socket. The socket contains a unique internal number that identifies its internal electronic standard.

Handheld Remote Control

Input

Voltage	12VDC ± 10%
Consumption	2.5W (maximum)

Display	LCD, 4-line x 16-character
Keypad	24-key, tactile
Serial communication port	Full-duplex RS-232

Data Storage

Flash	Provision for firmware upgrades
EEPROM	User setup and data logging storage

Time

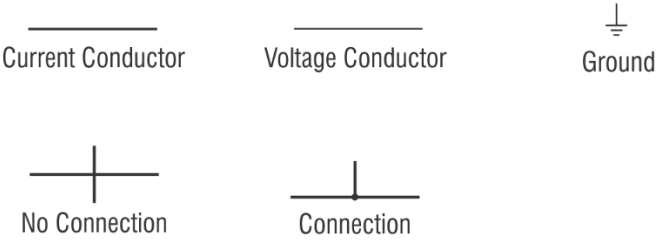
Real-time clock	Time and date stamp

Appendix B

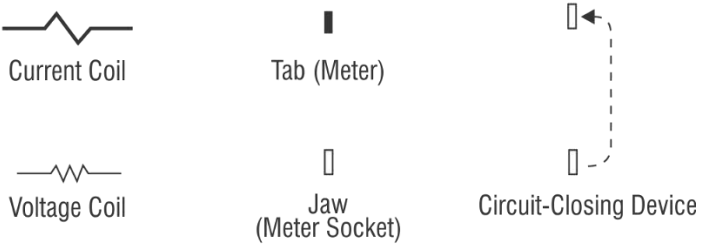
Compatible Meter Forms

This Appendix refers to all meter Forms compatible with the MT-1/NT9. For each meter Form, the electrical service is shown at the top left and an internal schematic of the meter installed at the top right. Wiring that connects the meter to the line and load is also shown. Before proceeding to a field test, make sure that the connections to the socket for a given Form are like those shown hereafter. The symbols used are described here:

Circuit



Meter & Meter Socket

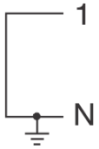


Instrument Transformer

Current Transformer (CT)
With Polarity Marks

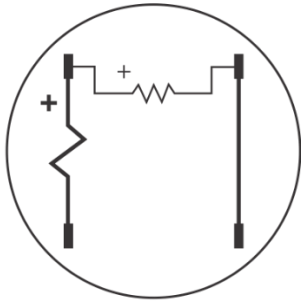
Form 1S

Single-Phase Two-Wire

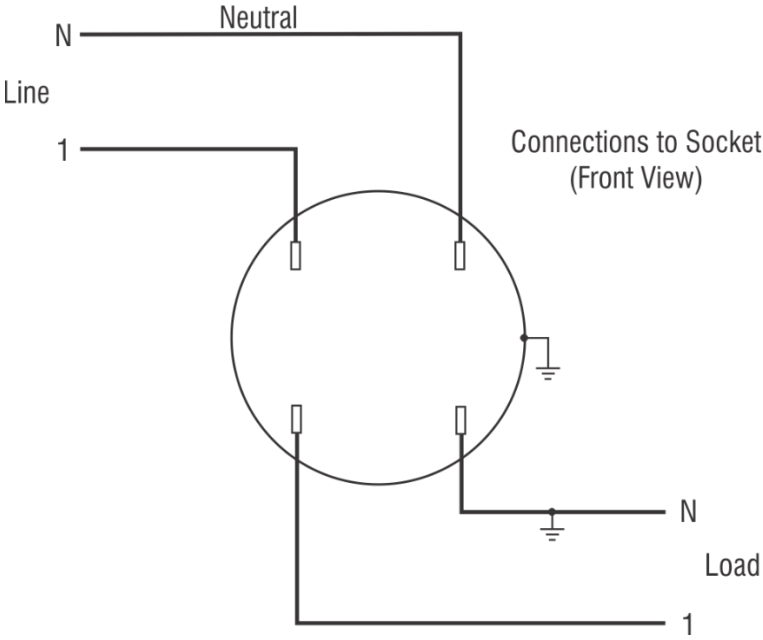


120 or 240 volts

Form 1S

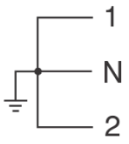


Meter Internal Wiring
(Front View)



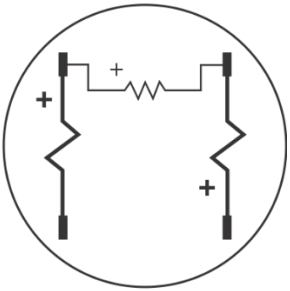
Form 2S

Single-Phase Three-Wire

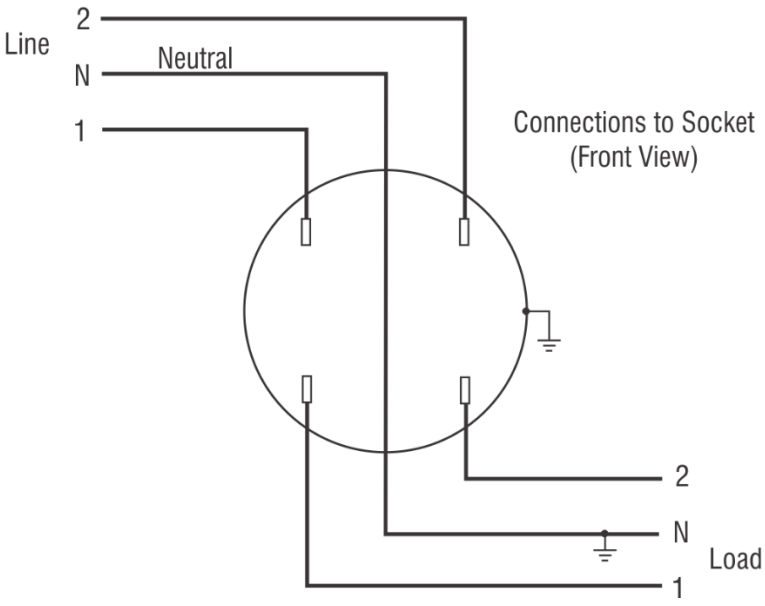


120 volts line-to-neutral
240 volts line-to-line

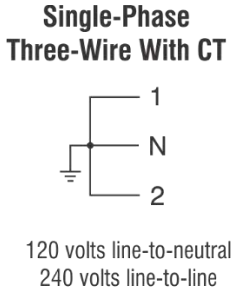
Form 2S

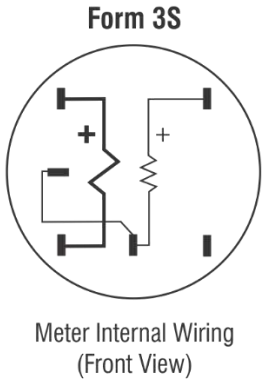


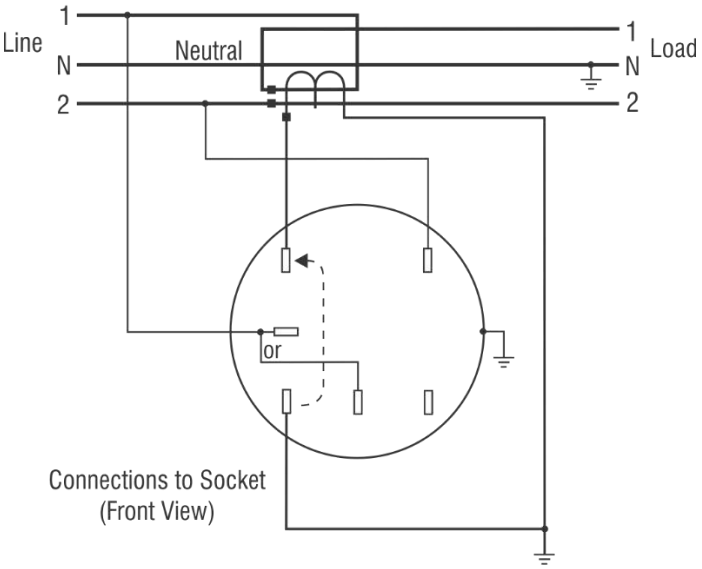
Meter Internal Wiring
(Front View)



Form 3S







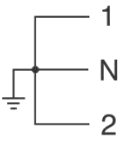
Form 3S single-phase, 120 volts two-wire with CT is also compatible.

Caution: Never open a circuit-closing device if current is flowing in the CT primary. Serious personal injury may result.

Note: Some 3S, 240V of older design have higher impedance and will not reach full HL when tested with MT-1/NT9. However, it will test as high as it can.

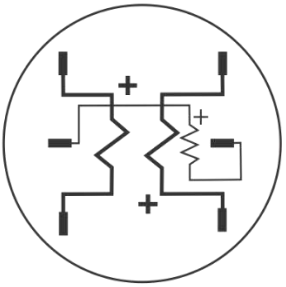
Form 4S

Single-Phase
Three-Wire Two CTs

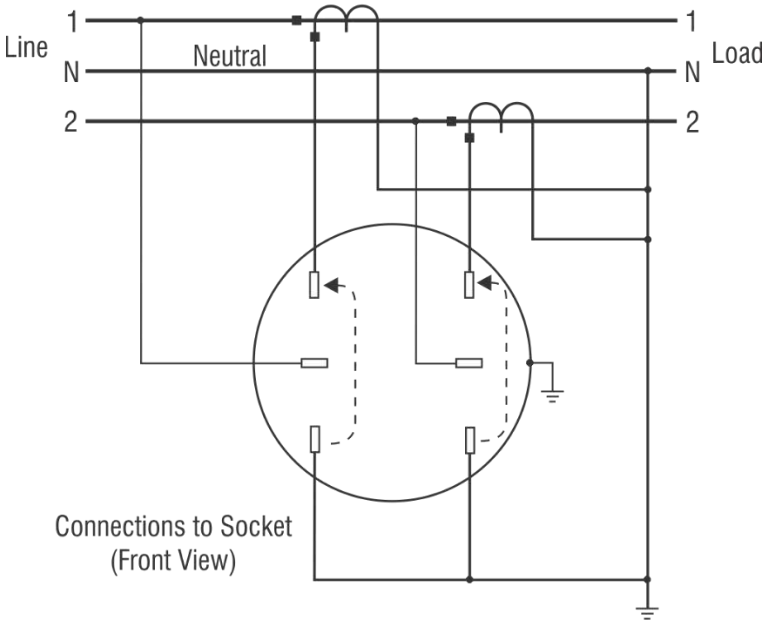


120 volts line-to-neutral
240 volts line-to-line

Form 4S



Meter Internal Wiring
(Front View)

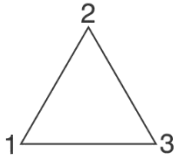


Connections to Socket
(Front View)

Caution: Never open a circuit-closing device if current is flowing in either CT primaries. Serious personal injury may result.

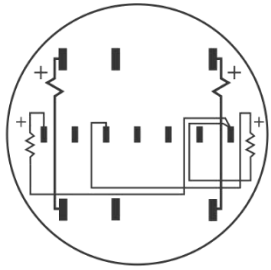
Form 5S, 35S & 45S Fitzall^{tm} (3Δ 2CT)

Three-Phase
Three-Wire Delta
With Two CTs

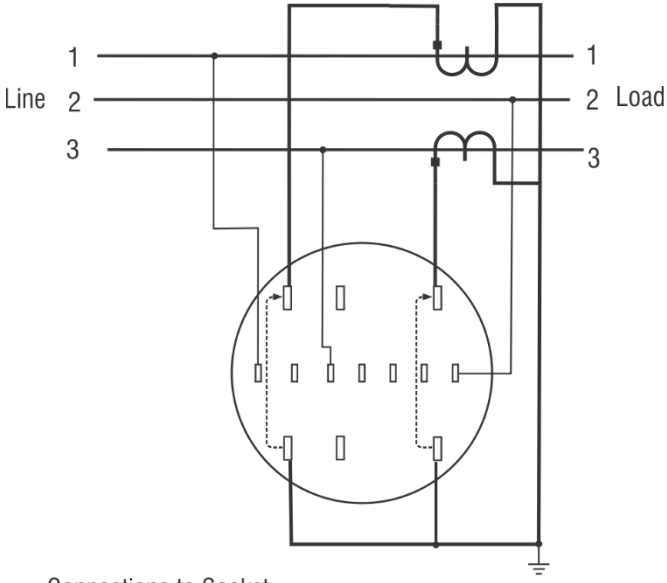


240 volts line-to-line
or 480 volts line-to-line
or 120 volts line-to-line

FITZALL Form 5S, 35S, 45S



Meter Internal Wiring
(Front View)

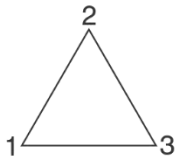


Connections to Socket
(Front View)

Caution: Never open a circuit-closing device if current is flowing in either CT primaries. Serious personal injury may result.

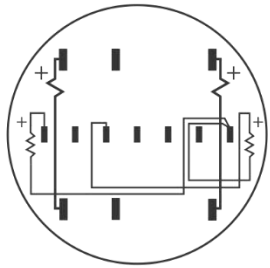
Form 5S, 35S & 45S Fitzall^{tm} (3Δ 2CT 2PT)

Three-Phase
Three-Wire Delta
With Two CTs and Two VTs

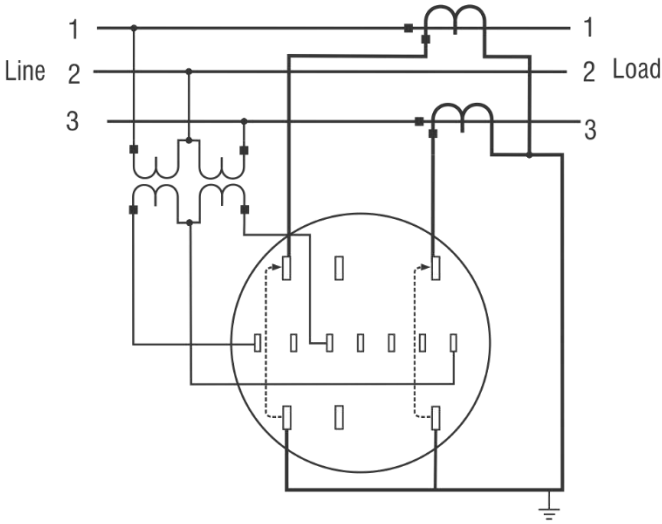


240 volts line-to-line
or 480 volts line-to-line
or 120 volts line-to-line

FITZALL Form 5S, 35S, 45S



Meter Internal Wiring
(Front View)

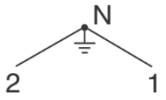


Connections to Socket
(Front View)

Caution: Never open a circuit-closing device if current is flowing in either CT primaries. Serious personal injury may result.

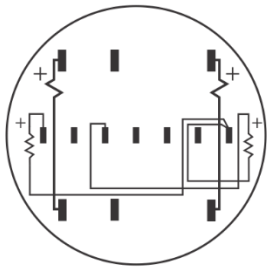
Form 5S, 35S & 45S Fitzall^{tm} (N 2CT)

Three-Wire Network With Two CTs

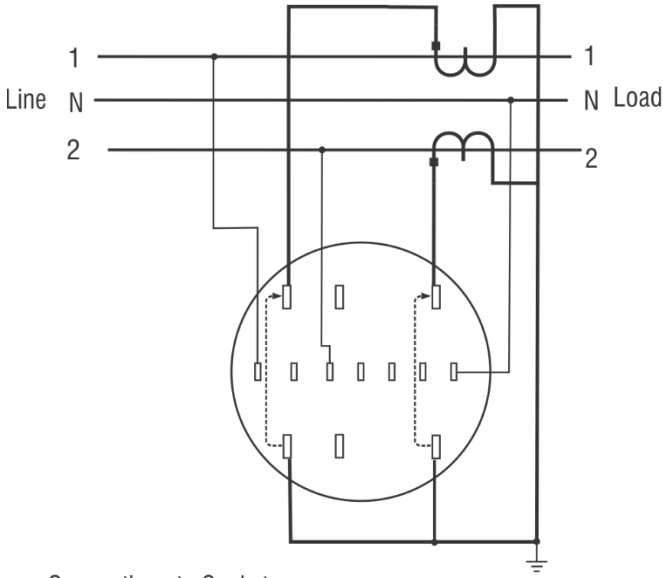


120 volts line-to-neutral
208 volts line-to-line

FITZALL Form 5S, 35S, 45S



Meter Internal Wiring
(Front View)

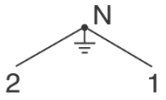


Connections to Socket
(Front View)

Caution: Never open a circuit-closing device if current is flowing in either CT primaries. Serious personal injury may result.

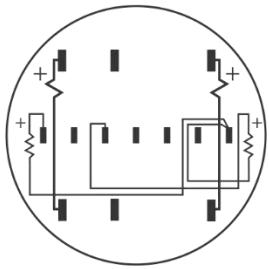
Form 5S, 35S & 45S Fitzall^{tm} (N 2CT 2PT)

Three-Wire Network
With Two CTS and Two VTS

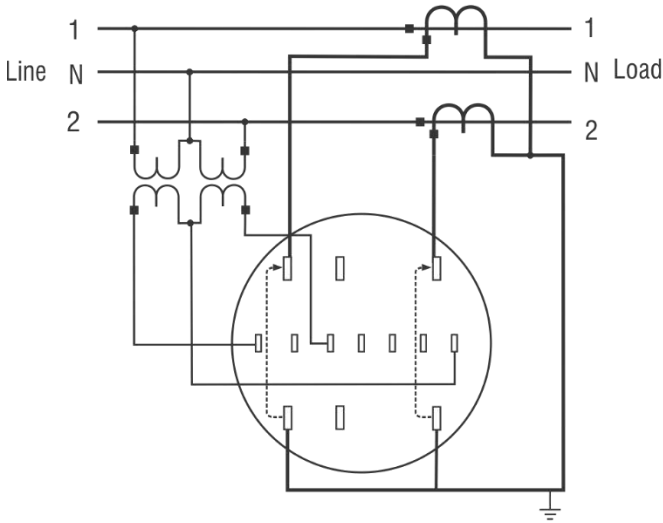


120 volts line-to-neutral
208 volts line-to-line

FITZALL Form 5S, 35S, 45S



Meter Internal Wiring
(Front View)

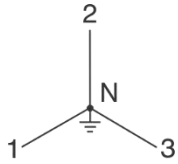


Connections to Socket
(Front View)

Caution: Never open a circuit-closing device if current is flowing in either CT primaries. Serious personal injury may result.

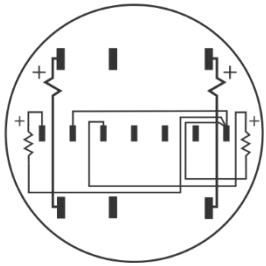
Form 5S, 35S & 45S Fitzall^{tm} (Y 3CT)

Three-Phase Four-Wire Wye With Three CTs

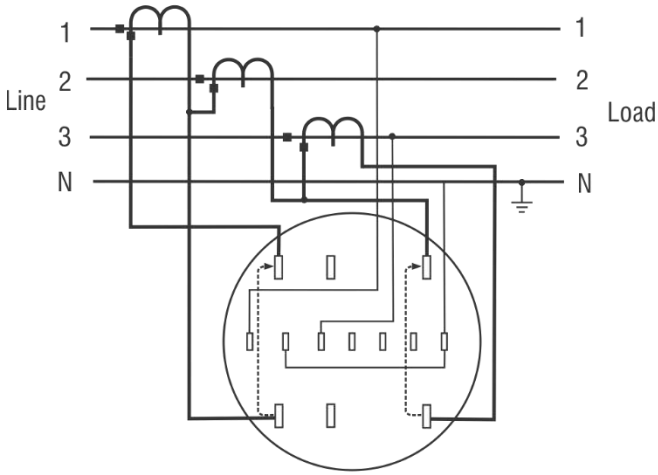


208 volts line-to-line
120 volts line-to-neutral
or
480 volts line-to-line
277 volts line-to-neutral

FITZALL Form 5S, 35S, 45S



Meter Internal Wiring
(Front View)

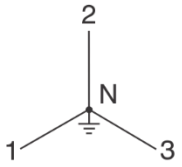


Connections to Socket
(Front View)

Caution: Never open a circuit-closing device if current is flowing in either CT primaries. Serious personal injury may result.

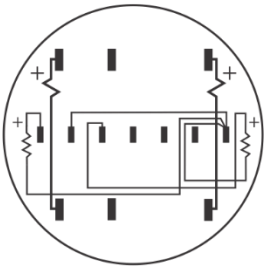
Form 5S, 35S & 45S Fitzall^{tm} (Y 3CT 2PT)

Three-Phase
Four-Wire Wye
With Three CTs and Two VTs

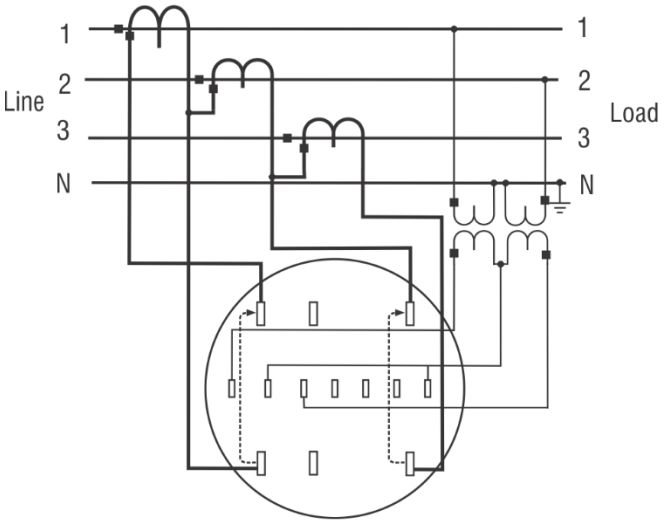


208 volts line-to-line
120 volts line-to-neutral
or
480 volts line-to-line
277 volts line-to-neutral

FITZALL Form 5S, 35S, 45S



Meter Internal Wiring
(Front View)

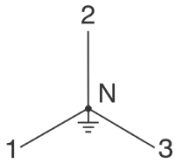


Connections to Socket
(Front View)

Caution: Never open a circuit-closing device if current is flowing in either CT primaries. Serious personal injury may result.

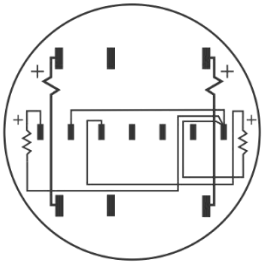
Form 5S, 35S & 45S Fitzall^{tm} (Y 2CT)

Three-Phase
Four-Wire Wye
With Two Equal-Ratio CTs

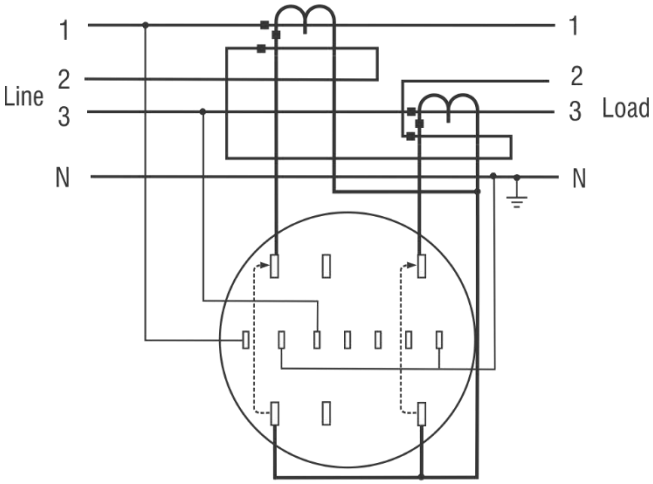


208 volts line-to-line
120 volts line-to-neutral
or
480 volts line-to-line
277 volts line-to-neutral

FITZALL Form 5S, 35S, 45S



Meter Internal Wiring
(Front View)

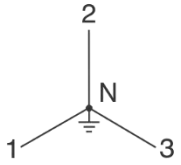


Connections to Socket
(Front View)

Caution: Never open a circuit-closing device if current is flowing in either CT primaries. Serious personal injury may result.

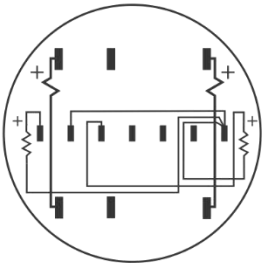
Form 5S, 35S & 45S Fitzall^{tm} (Y 3CT 2PT)

Three-Phase
Four-Wire Wye
With Three CTs and Two VTs

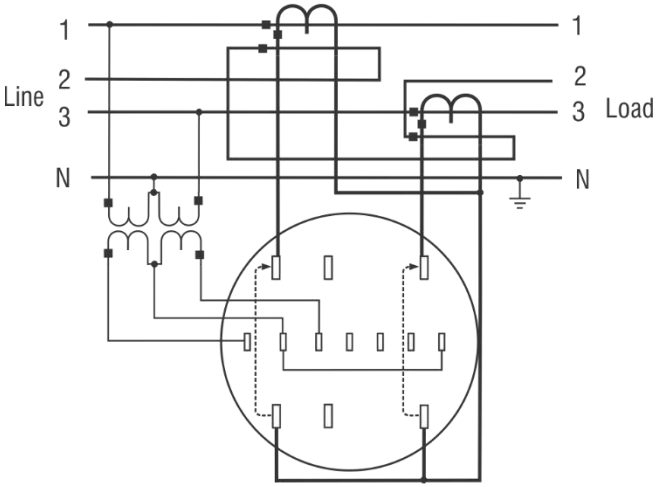


208 volts line-to-line
120 volts line-to-neutral
or
480 volts line-to-line
277 volts line-to-neutral

FITZALL Form 5S, 35S, 45S



Meter Internal Wiring
(Front View)

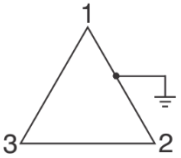


Connections to Socket
(Front View)

Caution: Never open a circuit-closing device if current is flowing in either CT primaries. Serious personal injury may result.

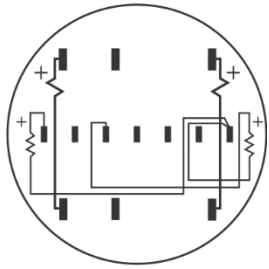
Form 5S, 35S & 45S Fitzall^{tm} (4Δ 3CT 2PT)

Three-Phase Four-Wire Delta With Three CTs

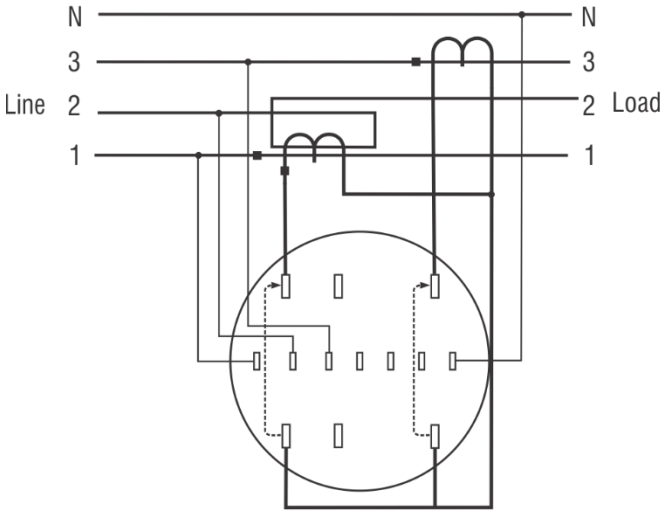


240 volts line-to-line
or 480 volts line-to-line
or 120 volts line-to-line

FITZALL Form 5S, 45S



Meter Internal Wiring
(Front View)

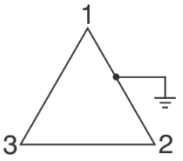


Connections to Socket
(Front View)

Caution: Never open a circuit-closing device if current is flowing in either CT primaries. Serious personal injury may result.

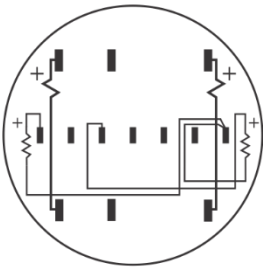
Form 5S, 35S & 45S Fitzall^{tm} (4Δ 3CT)

Three-Phase Four-Wire Delta With Three CTs

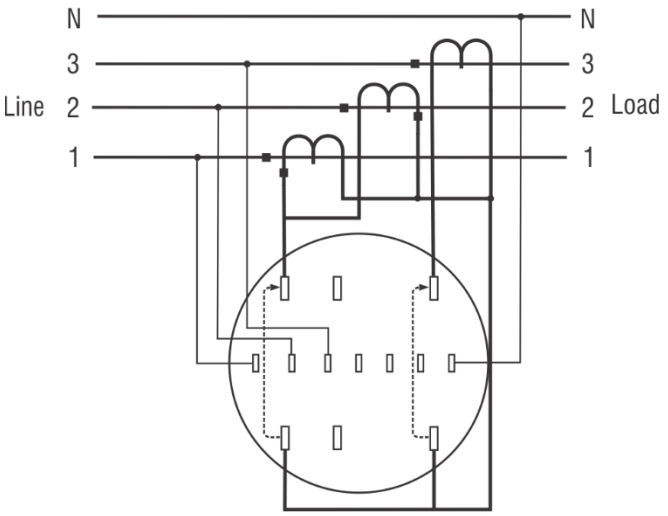


240 volts line-to-line
or 480 volts line-to-line
or 120 volts line-to-line

FITZALL Form 5S, 45S



Meter Internal Wiring
(Front View)



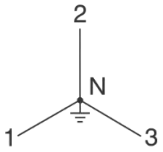
Connections to Socket
(Front View)

Caution: Never open a circuit-closing device if current is flowing in either CT primaries. Serious personal injury may result.

Form 6S (36S, 46S) (Y 3CT)

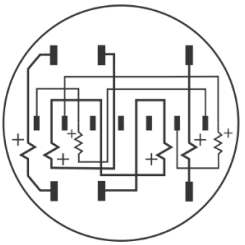
Wye with three CTs

Three-Phase
Four-Wire Wye
With Three CTs

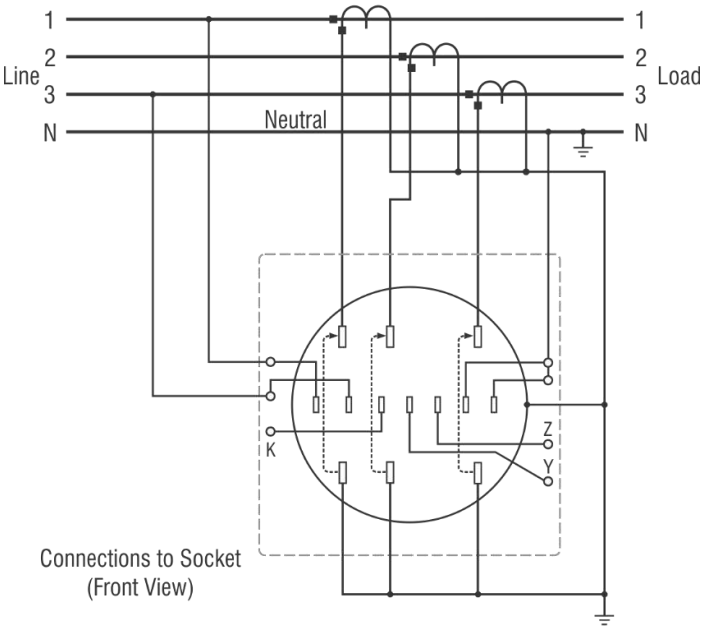


208 volts line-to-line
120 volts line-to-neutral
or
480 volts line-to-line
277 volts line-to-neutral

Form 6S



Meter Internal Wiring
(Front View)

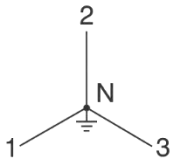


Connections to Socket
(Front View)

Caution: Never open a circuit-closing device if current is flowing in the CT primary. Serious personal injury may result.

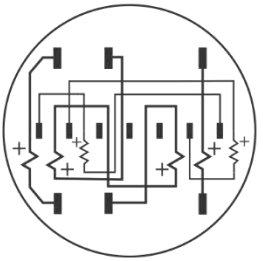
Form 6S (36S, 46S) (Y 3CT 2PT)

Three-Phase
Four-Wire Wye
With Two VTs and Three CTs

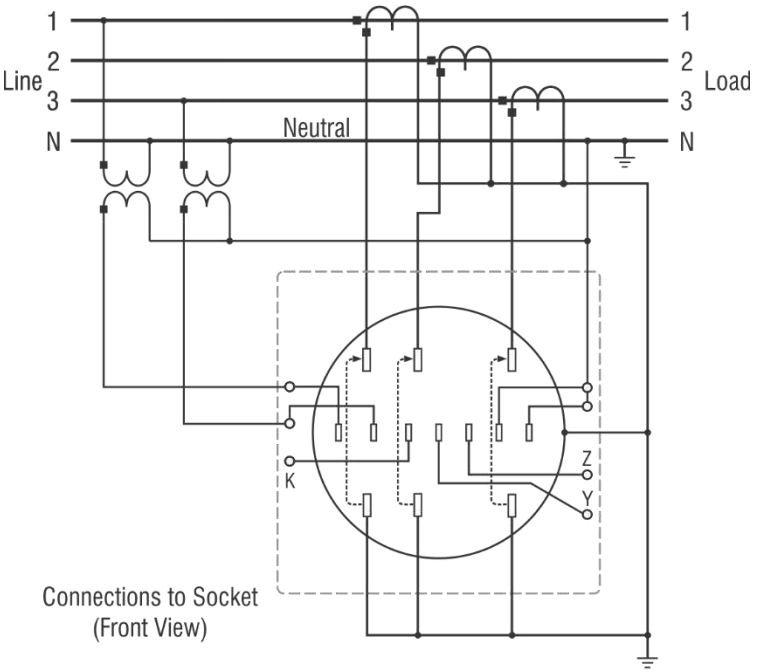


For high voltages.
The VTs apply reduced
voltages to the meter.

Form 6S



Meter Internal Wiring
(Front View)

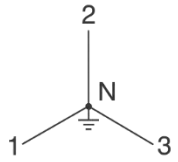


Connections to Socket
(Front View)

Caution: Never open a circuit-closing device if current is flowing in the CT primary. Serious personal injury may result.

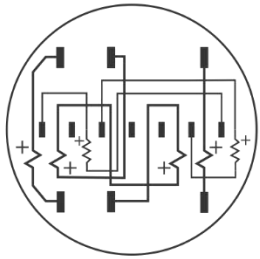
Form 6S (36S, 46S) Fitzall^{tm} (Y 3CT)

Three-Phase
Four-Wire Wye
With Three CTs

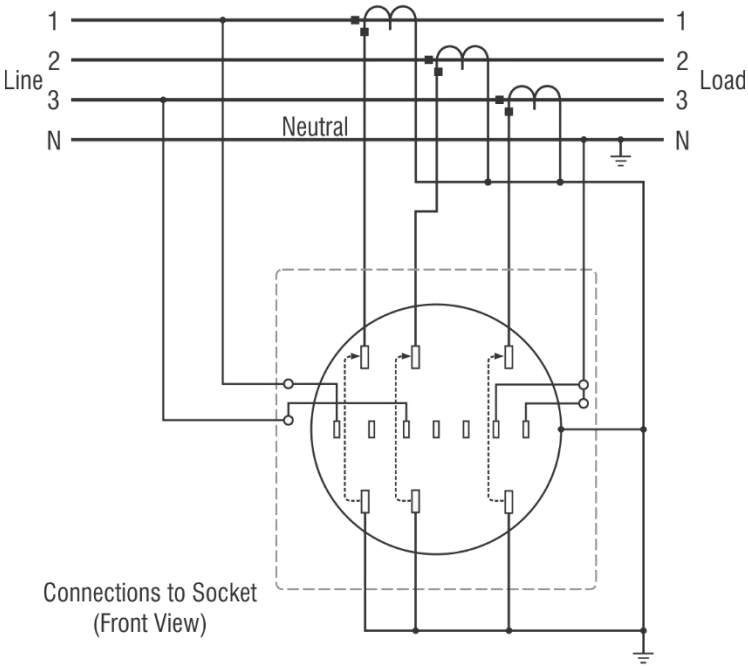


208 volts line-to-line
120 volts line-to-neutral
or
480 volts line-to-line
277 volts line-to-neutral

Form 6S FITZALL



Meter Internal Wiring
(Front View)

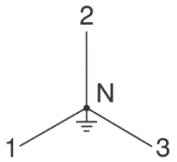


Connections to Socket
(Front View)

Caution: Never open a circuit-closing device if current is flowing in the CT primary. Serious personal injury may result.

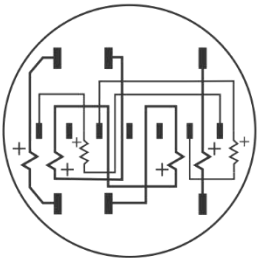
Form 6S (36S, 46S) Fitzall^{tm} (Y 3CT 2PT)

Three-Phase
Four-Wire Wye
With Two VTs and Three CTs

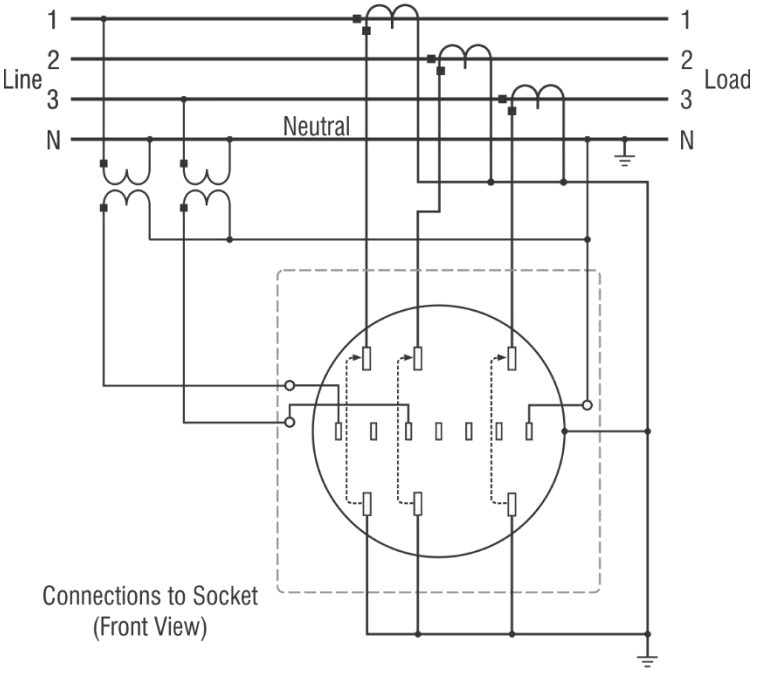


For high voltages.
The VTs apply reduced
voltages to the meter.

Form 6S FITZALL



Meter Internal Wiring
(Front View)

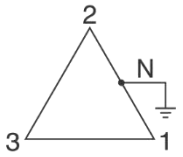


Connections to Socket
(Front View)

Caution: Never open a circuit-closing device if current is flowing in the CT primary. Serious personal injury may result.

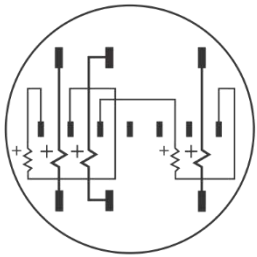
Form 8S (4Δ 3CT)

Three-Phase
Four-Wire Delta
With Three CTs

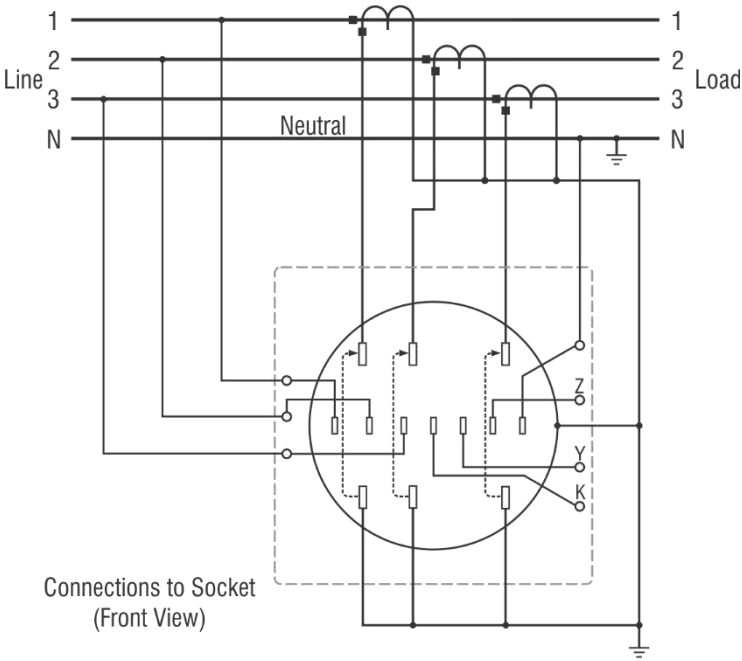


240 volts: 1 to 2, 2 to 3, 3 to 1
120 volts: 1 to neutral, 2 to neutral
208 volts: 3 to neutral

Form 8S



Meter Internal Wiring
(Front View)

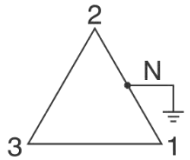


Connections to Socket
(Front View)

Caution: Never open a circuit-closing device if current is flowing in the CT primary. Serious personal injury may result.

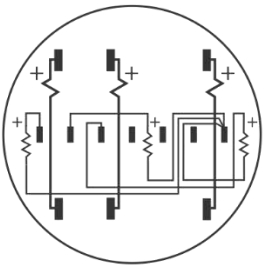
Form 9S (4Δ 3CT)

Three-Phase
Four-Wire Delta
With Three CTs

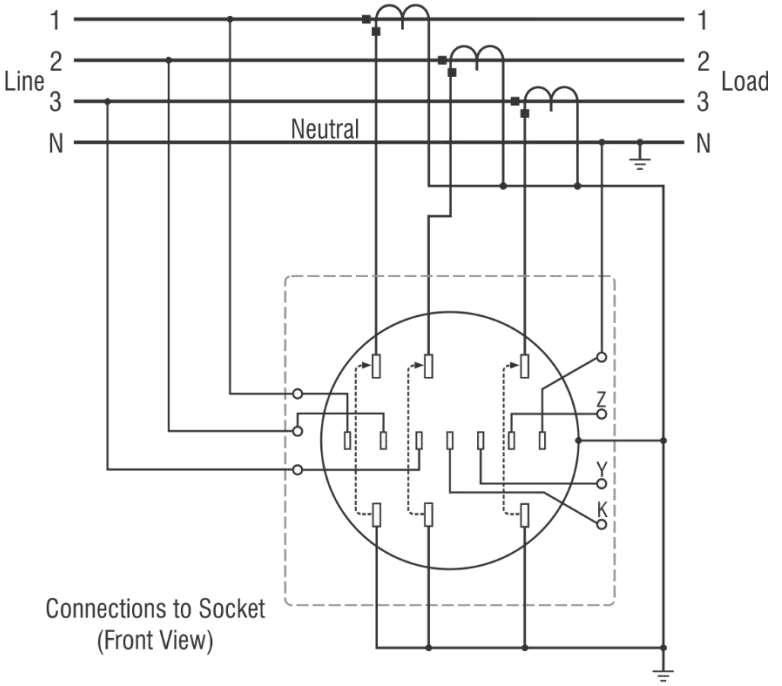


240 volts: 1 to 2, 2 to 3, 3 to 1
120 volts: 1 to neutral, 2 to neutral
208 volts: 3 to neutral

Form 9S



Meter Internal Wiring
(Front View)

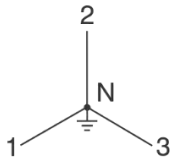


Connections to Socket
(Front View)

Caution: Never open a circuit-closing device if current is flowing in the CT primary. Serious personal injury may result.

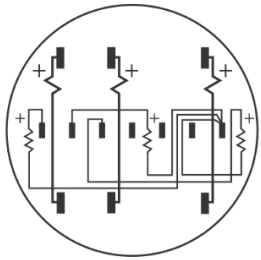
Form 9S (Y 3CT)

Three-Phase
Four-Wire Wye
With Three CTs

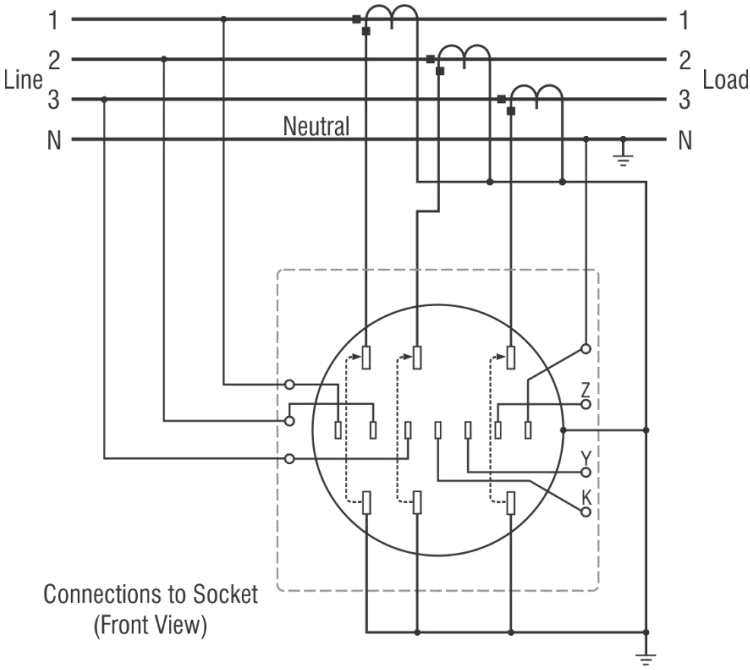


208 volts line-to-line
120 volts line-to-neutral
or
480 volts line-to-line
277 volts line-to-neutral

Form 9S



Meter Internal Wiring
(Front View)

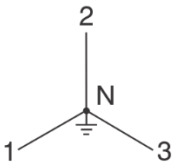


Connections to Socket
(Front View)

Caution: Never open a circuit-closing device if current is flowing in the CT primary. Serious personal injury may result.

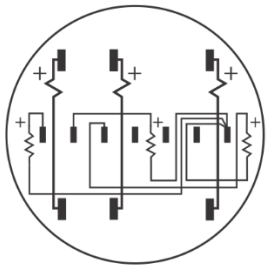
Form 9S (Y 3CT 3PT)

Three-Phase
Four-Wire Wye
With Three VTs and Three CTs

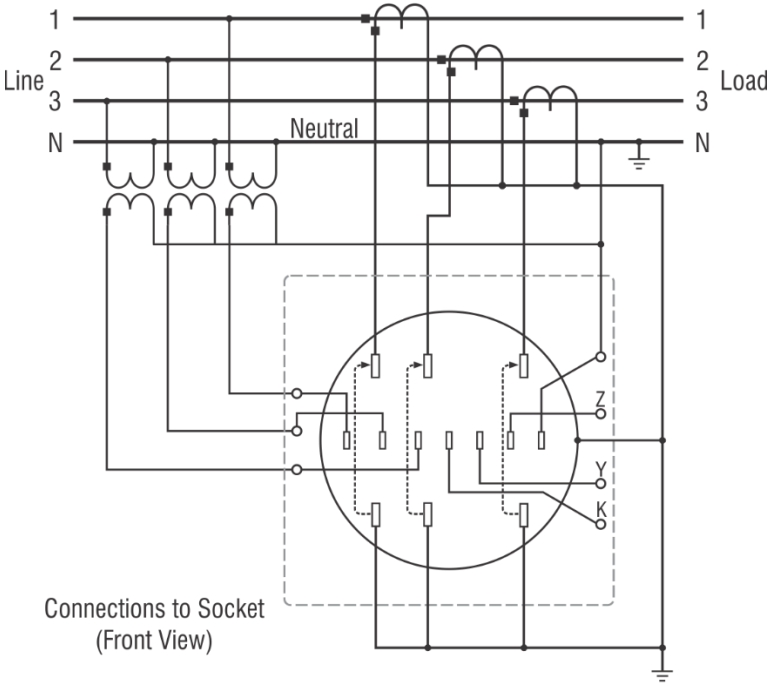


For high voltages.
The VTs apply reduced voltages to the meter.

Form 9S



Meter Internal Wiring
(Front View)



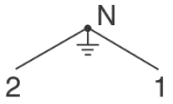
Connections to Socket
(Front View)

Caution: Never open a circuit-closing device if current is flowing in the CT primary. Serious personal injury may result.

Form 12S (25S) (3N)

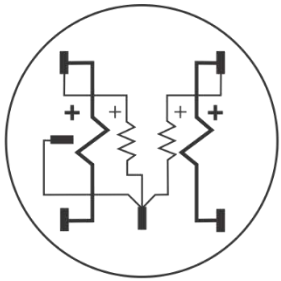
(N) Network

Three-Wire Network

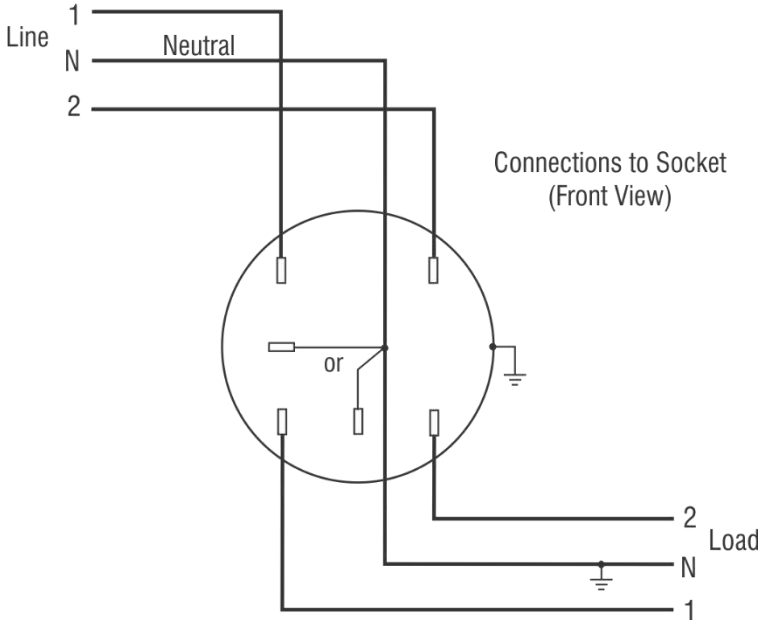


120 volts line-to-neutral
208 volts line-to-line

Form 12S



Meter Internal Wiring
(Front View)

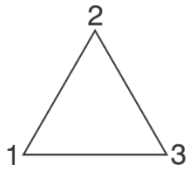


Connections to Socket
(Front View)

Form 12S (25S) (3Δ)

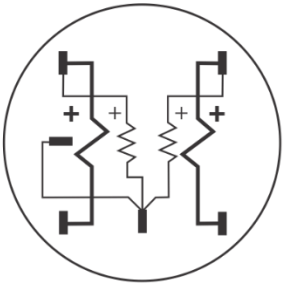
(25S) Delta

Three-Phase
Three-Wire Delta

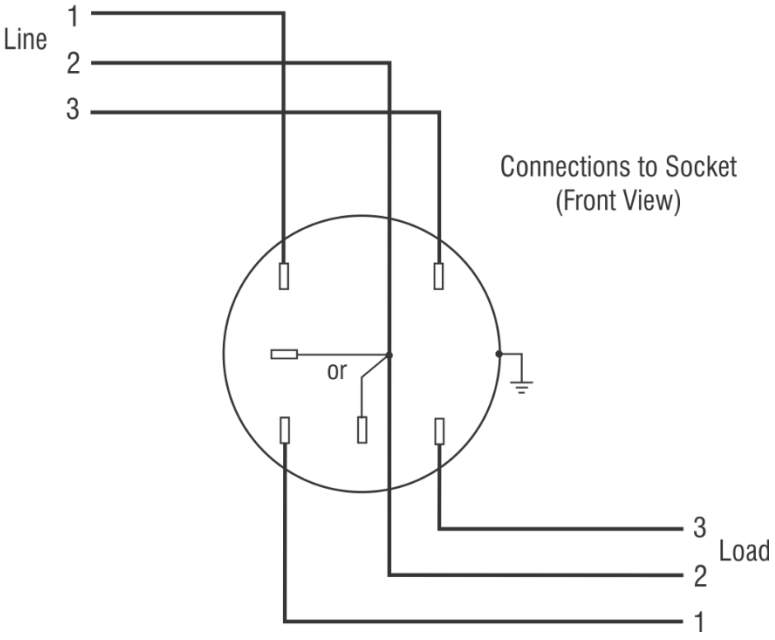


240 volts line-to-line
or 480 volts line-to-line
or 120 volts line-to-line

Form 12S

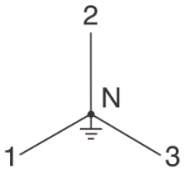


Meter Internal Wiring
(Front View)



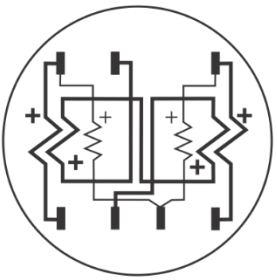
Form 14S (4Y)

Three-Phase Four-Wire Wye

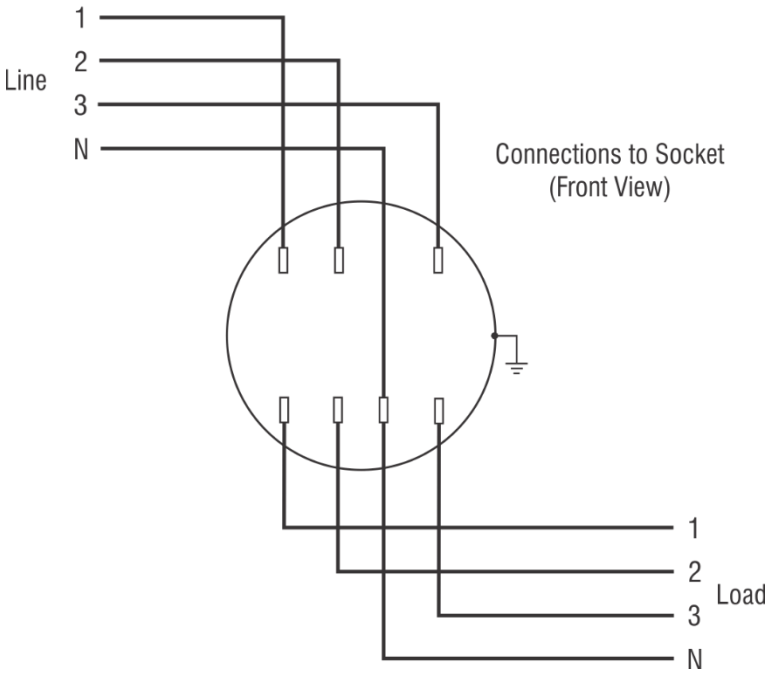


208 volts line-to-line
120 volts line-to-neutral
or
480 volts line-to-line
277 volts line-to-neutral

Form 14S

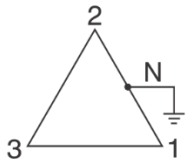


Meter Internal Wiring
(Front View)



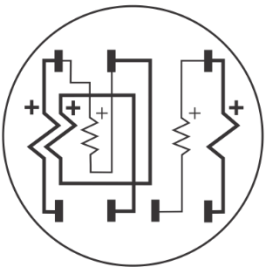
Form 15S (4Δ)

Three-Phase Four-Wire Delta

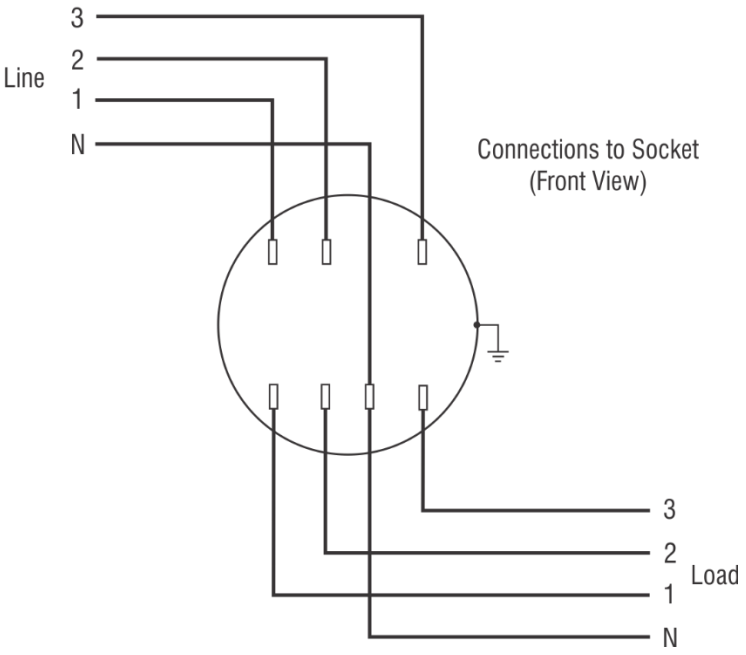


240 volts: 1 to 2, 2 to 3, 3 to 1
120 volts: 1 to neutral, 2 to neutral
208 volts: 3 to neutral

Form 15S

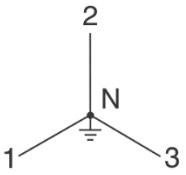


Meter Internal Wiring
(Front View)



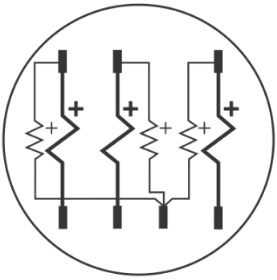
Form 16S (4Y)

Three-Phase Four-Wire Wye

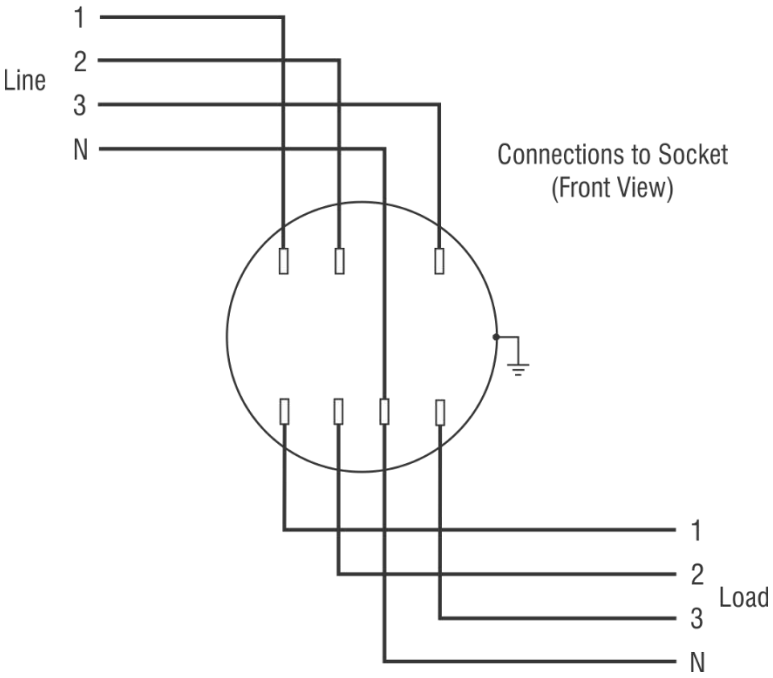


208 volts line-to-line
120 volts line-to-neutral
or
480 volts line-to-line
277 volts line-to-neutral

Form 16S



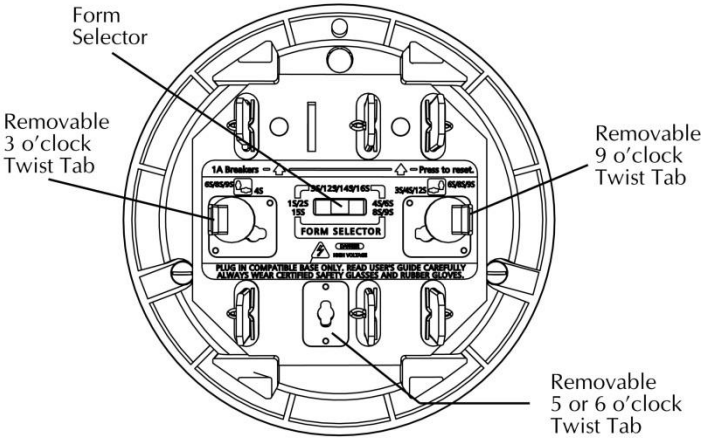
Meter Internal Wiring
(Front View)



Appendix C

Form Configurations

Below are shown various back tabs configurations for the test socket that you could configure according to the meter base being used.



Forms	3 o'clock	6 o'clock	9 o'clock	Form Selector
1S, 2S				
3S, 12S		or		
4S				
6S, 8S, 9S, 36S, 46S, (Fitzall 5S, 6S, 36S, 45S)				
15S				
14S, 16S				

Appendix D

Troubleshooting

If the MT-1/NT9 seems to have operation problems, consult the following list to help determine the source of the problem. If any problem persists, please contact Probewell Lab Inc. Technical Services.

FAULT	DESCRIPTION	FIX
AT POWER ON THE SOCKET DOES NOT START	The socket is not powering up and no display on the handheld controller	• Check if the fan inside the socket is running. • Make sure the form selector is set according to the meter base being used. • Verify the voltage of the meter base between 100 and 480VAC. • The meter base must be able to provide at least 150VA • Do not install tester in a test board.
AT POWER ON THE REMOTE CONTROL DOES NOT WORK	If the fan inside the socket is running but the remote control's display is blank	• Check the coiled cables for damaged connector • Check the contacts of the coiled cable at both ends • Check the RJ12 connector on the handheld and the socket. • Try another coiled cable
METER UNDER TEST DOES NOT WORK	If the meter is not powering up after selection of the form	• Make sure the selected **Form** matches with the one indicated on the meter nameplate. • Turn the MT-1/NT9 off and on and try again. • Check meter insertion. • The meter could be defective. Try another meter.

FAULT	DESCRIPTION	FIX
NO PULSE FOUND (SOLID-STATE METERS)	If the remote control displays "Waiting....." and nothing happen.	• Make sure the sensor is positioned over the IR pulse emitter of the meter. • Some meters need to be set in Test Mode to emit a proper pulse for testing. See the meter user manual
METER NOT INSTALLED	The socket is not detecting the meter current elements and a message meter not installed is displayed on the handheld controller.	• Make sure the meter tabs are fully plugged in MT-1/NT9 front jaws. • Check if the front jaws of the MT-1/NT9 socket are clean and in good condition. • Check the meter's contacts for good condition and cleanliness. • Try another meter. • Turn off and on the MT-1/NT9 and start again.
METERCAM IS NOT SYNCHRONIZED WITH THE DISK	The Metercam is not detecting correctly the black flag on the disk	• Make sure the Kh of the remote control does correspond to the one indicated on the nameplate of the meter. • Reposition Metercam and start test over again.
METERCAM KEEPS ON SCANNING WITHOUT FINDING THE DISK	The Metercam is not detecting the black flag on the disk of the meter being tested.	• Check if the disk is turning. • Check the dick of the meter is in the Metercam disk zone. • Check that the suction cups are adhering properly on the meter face. If needed, lightly wet the suction cups.

FAULT	DESCRIPTION	FIX
HIGH ERROR OR OVER% RESULT	After completion of test you have results with high value or OVER%.	• Make sure the Kh of the remote control does correspond to the one indicated on the nameplate of the meter. • Without pickup, this indicates a bad synchronization at the beginning and the end of a test. Start the test again with a higher number of revolutions. The meter might be defective. • If the Metercam is used, make sure that the 4 suction cups stick perfectly on the meter cover ***during the entire test.*** • Some meter requires to be put in TEST MODE to stop the pulses from the communication module. Check meter user manual for details. • With a communication module, restart the test but remove the head of the Optical Pickup from the meter and select your meter form on the remote, then wait about 15 to 20 seconds before putting the head back on meter. This will let the test pulse from the AMI module pass, and you will get a proper Kh evaluation.

Error Messages

When an error message is displayed on the remote control, it means that the MT-1/NT9 has detected something wrong in the system. If any of the messages still appear after a second powering on, please contact Probewell Lab Inc. Technical Service.

ERROR MESSAGE	DESCRIPTION	FIX
COM ERROR: 91!	A communication error between the socket and the remote control has been detected. When this message is displayed, the meter does not power up.	• Check cable connection • Check if your cable(s) are connected in the right order with the unit and the pickup you are using, check description of pickups in the user guide for proper connections. • If this message still appears, please contact Probewell Lab Inc. Technical Service.
CONFIG ERROR!	An error in the EEPROM memory of the handheld remote control has been detected. The configuration of the user is stored in this memory.	• It is possible at this time to come back to the manufacturer's configuration by pressing **PF**. • If the message still appears after a second powering on, please contact Probewell Lab Inc. Technical Service.
CAL.DATA ERROR!	An error in the EEPROM memory of the socket has been detected. The calibration values are stored in this memory.	• If the message continues to appear, please contact Probewell Lab Inc. Technical Service.

ERROR MESSAGE	DESCRIPTION	FIX
CHECKSUM ERROR!	An error in the EEPROM memory of the socket has been detected.	• If the message continues to appear, please contact Probewell Lab Inc. Technical Service.
DATALOG MEMORY ACCESS ERROR!	An error in the EEPROM memory of the socket has been detected. The Datalog results are stored in this memory.	• If the message continues to appear, please contact Probewell Lab Inc. Technical Service.
MT-1 BIOS ERROR!	An error in the EEPROM memory of the socket has been detected.	• If the message continues to appear, please contact Probewell Lab Inc. Technical Service.
LINE VOLTAGE OUT OF RANGE!	This message appears when the voltage is outside the voltage parameters of the test unit (100-480 VAC).	• Check input voltage. • If the message continues to appear, please contact Probewell Lab Inc. Technical Service.
VOLTAGE ON FRONTSHELL!	This message appears while doing a calibration and voltage is detected on the front jaws of the Probewell tester.	• Check connection from the accuracy test jack. • Check that there is no connection between the auxiliary power and potential input of your standard. • If the message continues to appear, please contact Probewell Lab Inc. Technical Service.

ERROR MESSAGE	DESCRIPTION	FIX
ERROR CAN'T TEST SENSUS METER!	This message appears after you answered "YES" at testing SENSUS meters and "NO" at using a 3S ADAPTER.	• Use an adapter to test the 3S SENSUS meters. • The 4S SENSUS meter cannot be tested with the **MT-1/NT4**. • If the message continues to appear, please contact Probewell Lab Inc. Technical Service.
WRONG FIRMWARE!	The handheld is not detecting the right socket to work with.	• You are using a handheld controller that is not matched to your socket. • If the message continues to appear, please contact Probewell Lab Inc. Technical Service.
SOCKET ERROR!	An error in the EEPROM memory of the socket has been detected. The calibration values are stored in this memory.	• If the message continues to appear, please contact Probewell Lab Inc. Technical Service.
CHECK INSERTION!	This message appears when the meter is not making proper contact with the pistons of the meter (only with MT-1/NT5 and MT-1/NT9)	• Remove and reinstall meter making sure that it's fully inserted. • With meters without KYZ tab this message will appear just continue the test this will not affect your test. (MT-1/NT9 only)

Appendix E

Parameters for Data Logging Option

The following describes the different data fields contained in the .CSV (Comma Separated Value) file generated by Probewell's NTDataOne.

1- TEST#	This test # is given to each subsequent test conducted in the field. The unit can store up to 100 tests. Once the tests have been uploaded into your PC and deleted from the remote, the test # restarts at 1.
2- REC#	This is a permanent record number, with the prefix R, and cannot be modified or deleted (already stored in remote). This number is incremented at each new logged test. It starts at R00001 and increment by 1 up to R99999 then restarts at R00001.
3- DATE/TIME	Stamp date and time of the test.
4- REMOTE#	Remote Serial Number (already stored in remote).
5- SOCKET#	Socket Serial Number (already stored in socket).
6- FORM	Meter form
7- PHASE	Phase tested
8- TA	Testing Amperage of meter tested.
9- Kh	Kh of the meter tested.
10- MODE	Mode in which test was conducted. Result can be: PRESET or USER.
11- SENSOR	Indicates what type of sensor was used during test. Result can be PULSE or CAM.
12- METER ID:	Tested meter's serial number as entered by the technician in the field.
13- %HL	Result of HL test in registration percentage.
14- %LL	Result of LL test in registration percentage.
15- %WT	Weighted average in registration percentage as calculated with the configured ratio.
16- %PF	Result of PF test in registration percentage.
17- CREEP	Status and result of creep test. There are 4 possible answers:

a) N/A	This will be returned when the %HL and %LL error difference falls within the acceptable error margin and no creep test needs to be run.
b) SKIP	This will be returned when the %HL and %LL error difference is outside the acceptable error margin, but the technician decided not to run a creep test.
c) YES	This will be returned when the %HL and %LL error difference is outside the acceptable error margin; a creep test has been run and the technician answers YES to the question: Does the meter creep?
d) NO	This will be returned when the %HL and %LL error difference is outside the acceptable error margin; a creep test has been run and the technician answers NO to the question: Does the meter creep?
18- 25 []	8 programmable questions. Each programmable question will be transferred between brackets []. Answers will be transferred without brackets.
26- RevHL	Revolutions run during HL test.
27- RevLL	Revolutions run during LL test.
28- RevPF	Revolutions run during PF test.
29- RatioWT	Weighted error ratio as defined in configuration.
30- AmpHL	Load in amps applied during HL test.
31- AmpLL	Load in amps applied during LL test.
32- AmpPF	Load in amps applied during PF test.
33- WhHL	Watthours recorded during HL test.
34- WhLL	Watthours recorded during LL test.
35- WhPF	Watthours recorded during PF test.
36- VOLT	Line voltage recorded at end of all tests.
37- FREQ	Line Frequency recorded at end of all tests.

Appendix F

Customer Service

If your MT-1/NT9 becomes defective while under warranty (two years after original date of purchase) Probewell Lab Inc. will repair or replace it. If the unit becomes defective after the warranty has expired, Probewell Lab. Inc. will repair it charging the cost of labor and spare parts.

Please do not return your MT-1/NT9 without contacting customer service at 1-866-626-1126 or send an email at info@probewell.com. Detailed delivery procedure will be provided to you.

If you have a technical question regarding the MT-1/NT9 operation, contact the technical support at 1-866-626-1126 or send an email at support@probewell.com.

Appendix G

Recommendations

Probewell Lab Inc. suggests that you respect the following recommendations to gain maximum use of the MT-1/NT9 and its accessories for many years. **Any unauthorized modifications or broken seals will immediately void the warranty and any further services.**

MT-1/NT9

- Do not try to open the MT-1/NT9 socket; there are no serviceable parts inside.
- Never block the air vents on the MT-1/NT9 socket.
- Never expose equipment to bad weather or direct rain.
- Keep front jaws and rear tabs clean. Use lubricant for electric contacts. **Do not** use abrasive materials.
- Never use **solvent** to clean the MT-1/NT9. Use a soft moist cloth with non-abrasive soap to clean surface.
- Handle the MT-1/NT9 with care.

Metercam & Optical Pickup

- Do not try to open; there are no serviceable parts inside.
- Never expose equipment to bad weather or direct rain. Do not expose to direct sunlight for long periods at a time.
- Keep the back window of the Metercam and the suction cups clean. **Do not** use abrasive materials. Use a soft moist cloth with non-abrasive soap to clean surface. Use mineral oil to soften hardened suction cups.
- Handle both pickups with care. Use one of the side pouches located inside the carrying bag to store the Metercam and the optical pickup.