Stationary Meter Test Systems
MTE offers a broad range of customized high precision test systems for customers such as utilities, meter manufacturers and meter test laboratories.

The individual system components of a MTE meter test system are modularly developed and can be combined in any order for testing of single- and three-phase meters with or without closed I-P links. This modular design gives flexibility and enables MTE to provide the optimal customer orientated solution for each single- or three-phase meter test system the customer requires to meet the changing needs in the metering world.

MTE offers and respects the importance to upgrade existing test systems and provides solutions to gradually replace existing systems with modern components.

Whatever the needs, wherever the customers, MTE has the innovative solutions and the focus to contribute to the efficiency, profitability and quality of our customers.

Configuration of a meter test system

[Diagram showing the configuration of a meter test system]
MTE’s modular system components

For the detailed explanation of different components, we refer to page 4 ff. or the specific MTE leaflets.
Electronic power sources

SPE system, three-phase power source

The SPE system is an electronic voltage- and current power source and a meter supply unit (phantom load) for testing electricity meters or for testing other devices which use current or voltage. The network as generated by the SPE system is completely distinct / independent from that of the mains power supply.

The cabinet is equipped with the following components:

- Control unit STE 10
- Power source SPE 120.3 with digital voltage and current amplifiers
- Digital electronic reference meter SRS 121.3 or other types (options)
- Voltage and current ranges:
  - 30 V up to 300 V
  - 1 mA up to 120 A or 1 mA up to 200 A
- Output power per phase:
  - 300 VA or 600 VA (Voltage and current)
- Power efficiency: > 85 %

SQE system, three-phase power source

The SQE 120.3 is a further development of the SPE 120.3 with increased short term stability and integrated power quality test functions.

The SQE System is especially appropriate for test laboratories to perform compliance, acceptance or type test of electricity meters and different types of power, energy and power quality measurement devices, following the existing (IEC 61000-4-30, EN 50160) and the new (IEC 62586-1,2) power quality standards.

The cabinet is equipped with the following components:

- Control unit STE 10
- Power source SQE 120.3 with digital voltage and current amplifiers
- Digital electronic reference meter SRS 121.3 or other types (options)
- Voltage and current ranges:
  - 0 V up to 480 V
  - 1 mA up to 120 A
- Output power per phase:
  - 600 VA (Voltage and current)
- Power efficiency: > 85 %
ZVE system, single- up to three-phase power sources

The ZVE system is an electronic voltage- and current power source and a meter supply unit (phantom load) for testing electricity meters or for testing other devices which use current or voltage. The network as generated by the ZVE system is completely distinct / independent from that of the mains power supply.

The ZVE system is composed, in general terms, of the following principal units:

- One up to three voltage sources PSU 10
- One up to three current sources PSI 10
- Control unit STE 10
- Digital electronic reference meter SRS 121.3 or other types (options)
- Voltage and current ranges:
  - 30 V up to 300 V
  - 1 mA up to 120 A or 1 mA up to 200 A
- Output power per phase:
  - 1000 VA / 2000 VA / 4000 VA (Voltage and current)
- Power efficiency: > 85 %

PSP system, single- up to three-phase power sources

The PSP system is an electronic voltage- and current power source and a meter supply unit (phantom load) for testing electricity meters or for testing other devices which use current or voltage. The network as generated by the PSP system is completely distinct / independent from that of the mains power supply.

The cabinet is equipped with the following components:

- Control unit STE 10
- One up to three power sources PSP 10 with digital voltage and current amplifier
- Digital electronic reference meter SRS 121.3 or other types (options)
- Voltage and current ranges:
  - 30 V up to 300 V
  - 1 mA up to 120 A
- Output power per phase:
  - 800 VA (Voltage)
  - 1200 VA (Current)
- Power efficiency: > 85 %
Reference standards / comparator

**Stationary reference standards**
The electronic system reference standards in accuracy class 0.05 or 0.02 are precision measurement units for all AC values, which are used in the measurement of energy. The wide measurement range and the high precision are the main characteristics of the reference standards.

- **SRS 121.3, accuracy 0.05 %**
  Current range: 1 mA ... 120 A or 1 mA ... 200 A

- **SRS 400.3, accuracy 0.02 %**
  Current range: 1 mA ... 120 A or 1 mA ... 200 A

**PRS 600.3 Portable reference standard**
The PRS 600.3 is a combination of a three-phase portable reference standard of class 0.02 and an IEC 61000-4-30 Class A compatible power quality analyzer with 3 voltage and 3 current channels. The device is equipped with two 8.4” colours TFT VGA displays with touch screen operation. The reference standard is used to test single- and three-phase meters, instrument transformers and installations on site.

The power quality analyzer is used to resolve disputes at contractual applications, for statistical surveys, including EN 50160 reporting, and for online troubleshooting of different kind of power quality problems.

**K2006 Comparator**
The K2006 is a high accuracy comparator of accuracy class 0.01, especially suitable for use in metrological institutes and high precision measuring laboratories.

Its ability to compare directly to an external DC reference allows easy traceability to national standards.

Comparators are regularly used for checking of reference standard meters, for the calibration of precision current and voltage sources and for the verification of electrical standard measurements and electricity test systems.
The modular evaluation system **SMM 400 performs error calculation**, testing of emitting contacts and communication to tariff device units to the meter under test.

Four different versions covering customer’s requirements are available:

- **Meter error calculator** with SMM 400 bus-master without error display
- **Basic meter error calculator** with SMM 400 bus-master and SMM 400 error calculator module
- **Standard evaluation system** with SMM 400 bus-master and SMM 400+ system evaluation module
- **Extended evaluation system** with SMM 400 bus-master, SMM 400+ system evaluation module and addition IN/OUT module for 8 in-and 8 outputs and / or COMM communication module

### Functions
- Meter error measurement with scanning head
- Meter error measurement of emitting contacts
- Impulse generator
- Graphic meter error display
- Reset button
- Communication interfaces RS 232, RS 485, CL, M-Bus and ETHERNET

### Options
- **IN/OUT** module for 8 in- and 8 pulse outputs and 10-30 VDC supply for S0 inputs
- **COMM** module with ETHERNET, M-Bus and RS 485 interfaces
Error evaluation systems

SMM 400 Bus-Master provides the interface between personal computer (via ETHERNET) and the system modules over RS 485-Ringbus. The SMM 400 Bus-Master is equipped with an error calculator for 10 meter positions and 10 direct inputs for scanning head pulses.

SMM 400 is a one channel error calculator with one input on the rear side for scanning head pulses from SH 2003 or SH 11. A reset-button allows a restart of the measurement. The meter error is shown on a full graphic OLED display.

SMM 400+ Meter evaluation module with a full graphic OLED display, reset-button and 2 scanning head pulse inputs is the perfect solution for testing modern (smart) meters. The sockets are used for:
- **Socket IN/OUT**: IN and OUT of fast and slow pulses
- **Socket D**: Serial interface RS 232 and 20mA - current loop interface (CS)
- **Socket IR**: Serial infrared interface, e.g. for readout of tariff devices with optical communication head OKK

The module IN/OUT is equipped with the following in-/ outputs:
- 8 Pulse inputs (IN) for testing of meter emitting contacts
- 8 Plus outputs (OUT) send pre-defined pulse to the meter under test

The module COMM is equipped with the following interfaces:
- ETHERNET
- M-Bus interface
- RS 485 interface
CALegration® is an all-in-one software package designed to control the latest MTE test equipment product line, including the recording and evaluation of meter and measurement data.

CALegration® bundles the functionalities and advantages in one brand new and comprehensive software package.

Covering all requirements of the modern meter testing environment CALegration® also provides the flexibility to easily incorporate future meter testing requirements.

Tests can be carried out for simple or highly complex meters (smart meters) in accordance with the customers requirements and national / international test and calibration regulations (e.g. PTB, IEC, BS, ANSI).

Advantages of CALegration®

- **Reduced complexity** due to an all-in-one software for the entire MTE product portfolio
- **User-friendly operations** and clearly arranged user interface making the system easy understandable, also to operators with limited computer knowledge
- **SQL based database** with stable access, organized backups, extended database size and server installation support
- **Full database interchange** between portable devices and CALegration® with control of portable functions by external PC
- **Flexible access** to database and **fast storage and interchange** of new testing data packages
- **Fully-automatic test sequences** for meter testing with clearly laid out database structure
- **Manual control module** for testing various individual functions such as meter test, recording of load values, detection of installation errors and many more
- Prepared for **power quality testing** and analysis functions according to IEC 62586 and IEC 61000-4-30 for specific MTE devices
- Transparent evaluation and presentation of results, **statistics and schematic diagrams** of all relevant values in an individual created protocol
- **Modular system** allows the integration of customer specified applications
- Suitable for use with **various hardware combinations**
- **Data export** in standard format (e.g. MS Excel)
- **Operator interface available in several languages** and in different color profiles

CALegration® combines the various functional modules required in modern stationary and portable test devices, with a common and consistent user interface.

The modular system allows control of various hardware units with a common software platform.

**Automatic meter testing**

Automatic meter tests are executed in three steps:

1. The user defines the meter and meter type, the test point elements and the test procedures
2. The test is executed and the results are stored in the database
3. The results can be presented in a simple test results form, or be post-processed for the presentation in form of a report
Meter and meter type definition

The meter and meter type definition function is used to define and administrate any kind of meters. The meter type definition contains the electrical and functional definitions of meters under test (connection values, meter constants, registers etc.). The type definitions can further be called up and allocated to the meter stock / inventory of the customer (meter name, manufacturer number etc.).

For the tariff device communication, a communication module is assigned to the meter types. This defines the data to be selected or programmed plus the dispatching commands, adaptable by the customer, makes the fully automatic examination of high-functional meters and tariff devices possible.

The basic version supports the communication protocol in accordance with IEC 62056-21 Mode C standard. As an additional option the communication protocol is prepared according to dlims / COSEM.

Test procedure

A test procedure or test sequence describes the order and content of different test point elements in a whole procedure. For each test step the desired source settings (current, voltage, phase angle, frequency etc.), test settings (e.g. error measurement) and control functions (e.g. automatic meter readout) can be specified.

In addition to the respective test method (e.g. error measurement, register tests etc.) each checkpoint can be linked with control commands. Control commands display for instance instructions to the operator, switching of tariff relays or dispatching of commands.

Meter testing

By undertaking an automatic test the user allocates to each active measurement position a meter type and selects a test procedure. Subsequently the user will comfortably be guided through the test.

The actual status of the test and active test point is clearly indicated at all times.
Results
After executing an automatic test sequence all saved results are available for further data processing, such as creating an individual test report or the export to Excel tables. The results can also be viewed and evaluated directly using several sort criterias in a separate result tab in the database.

The CAlegation Report Designer, enables the user to create and define their own protocol masks (calibration certificates, pass / fail reports, statistical reports, customer reports etc). Furthermore the CAlegation Report Designer has the flexibility to add to reports logos, diagrams and fields (e.g. for signatures) etc.

Optional software modules
- Tariff device communication / dlms
- Reference meter testing
- Tariff device testing with pulse transmitter
- Error compensation
- Sample test modules
- Database storing
- Generation of ripple control signals
- Generation of special test signals and wave shapes according to IEC 62052-11 and IEC 62053-11/-21/-22
- Generation of harmonics

Customer specified adaptations
MTE provides customer specified modules which can be integrated into the standard software for fully automatic calibration of modern meters. MTE also supports the integration of alternative communication protocols for tariff devices.

Manual control
The manual control module allows a simple quick check of a meter's accuracy and other functions. This module has an interface that directly controls various parts of the test system such as power source, reference standard and error evaluation system.

All the manual measured and gathered results can be saved and printed out as well.
Scanning head SH 2003
The SH 2003 photoelectric scanning head is suitable for use with both LED impulses from static / electronic meters and also for detecting the marks on Ferraris / mechanical rotating disc meters, selectable via a switch. Due to its high performance and robust construction it is suitable for both stationary and portable test systems.

Scanning head SH 11 with integrated teach function
The SH 11 scanning head was especially designed for scanning of the marks on the rotating discs of Ferraris / mechanical meters or simulated disc marks on LCD displays plus the detection of light emitting diodes (LED's) of static / electronic meters. The choice of operation with mechanical or electronic meters is made by simple rotation of a selection switch. The manually sensibility set-up for the disc or LCD marks is not necessary.

The optimal set-up is automatically learned by the integrated teach function, which can be activated by the rotary switch or an external control signal.

Scanning head carriages
SHC 1.2 and SHC 2.2
The SHC range of scanning head carriages has been designed for use with the SH 2003 and SH 11 model scanning heads. The range is user friendly and offers a high degree of flexibility.

- Horizontal adjustment and scanning head fixing are built into each individual support position
- Depth adjustment has also been provided in order to adapt the scanning head to meters of diverse constructional depths
- Fast height adjustment by using the direct 'press-button' control
- There is a fine setting control, both in depth and height, for each version of the scanning head. Meters may be scanned from the side by simple rotation of the fine setting
Quick connection devices IEC-, BS-, ANSI-standards

Quick connection device QCD
This QCD quick connector may be used with current levels up to 80 A for long period testing, and with up to 100 A for short periods of time. The connector is available in three different versions, which may be used together with single- and three-phase meters.

The QCD 3 I/U is constructed identically to the QCD 3 I, with the difference that the voltage connection is assured over a jumping finger contact system.

Quick connection device EMP 1.3
The EMP 1.3 quick connection device is especially recommended for situations where the time factor is of importance.

Thanks to the universal construction of the EMP 1.3 quick connection device, it may be used for the support and connection of practically all types of electricity meters.

This EMP 1.3 quick connection device can be used with current levels up to 100 A testing, and even with the additional high current adapters up to 120 A.

Quick connection device QCD Form S
Due to its universal construction the QCD Form S quick connection device may be used for the support and connection of practically all types of self contained (direct connected) or transformer operated ANSI socket meters, including the most used forms 1S, 2S, 3S, 4S, 5S, 6S, 8S, 9S, 12S, 13S, 14S, 15S, 16S and 17S.

This QCD Form S quick connection device can be used with current levels up to 200 A.
**Accessories**

**Isolation current transformer ICT 2.3**
The ICT 2.3 three-phase Isolation Current Transformer is used on multi position test benches for testing three-phase meters with closed links between the current and voltage measuring circuits (C-P-links).

Meters of this type are produced and used with increasing frequency.

**Hand held terminals**
The HT 2010 cordless hand held terminal with an integrated bar code reader is designed for recording meter specific data at meter test systems.

**Impulse interface adapter**
The IMP-IF1 impulse interface adapter is suitable to interface MTE reference standards with meters having retransmitting contacts, open-collector transistor outputs or true S0-outputs to allow full testing of meters with these types of outputs interfaces.

**OKK optical communication head**
The communication to sophisticated electronic tariff devices / meters is performed according to IEC 62056-21 (IEC 61107) mode C, using an OKK optical communication head.

The OKK is directly connected to the corresponding interface of the standard evaluation system SMM 400+.

**Accessories for quick connection devices**
- Adapters to electronic meters for fast connection of the measuring voltage
- Voltage contacts for transformer connected meters
- Customized meter templates for fast assembly of the quick connection device
- High current screw adapters for currents up to 120 A
Testing single-phase meters with closed IP-links using MSVT

Overview

If the meters under test do not allow opening the I-P links, then there is an unwanted connection between voltage and current path at every meter position.

Because of these connections, the line (input) and load (output) of each current measurement element are forced to be at the same potential, an effective short-circuit path exists across the current measuring circuit of every meter under test, causing a large measurement error. It is therefore not possible to test multiple meters with closed I-P connections on a conventional meter test installation without additional facilities. To be able to test these types of meters, galvanic isolation must be provided between the current and voltage circuits of each meter under test. This isolation must ensure that the closed I-P links in the meters do not cause these unwanted short-circuits and the resultant measurement errors. With single-phase meters, galvanic isolation can theoretically be carried out using either voltage or current isolation transformers.

In this case, a connected I-P link does not cause a short-circuit, as this connection is now made on the secondary side of the transformer, thus avoiding any direct connection with the other meters in the circuit.

For the testing of multiple single-phase meters with fixed / closed links between the voltage and current path (I-P links), galvanic isolation must be provided at each test position. In practice this is normally done by connecting the voltage circuit of every meter under test, through a high accuracy voltage transformer (MSVT). For cost reasons a voltage transformer with several galvanically isolated secondary windings is used.
Overview
While testing meters with fix closed IP-links, unwanted connections between voltage and current path at each test position will cause significant accuracy reduction.

In this case transformers in the current circuit are required to decouple the voltage from the current path.

The ICT 2.3 three-phase Isolation Current Transformer is used on multi position meter test systems for testing three-phase meters with closed links between the current and voltage measuring circuits (IP-links). Electronic meters with closed links are becoming increasingly common.

To achieve complete decoupling the test installation needs to be fitted with one current transformer per phase for each test position.
Testing meters with closed IP-links using MSVT or ICT

Key Advantages
- Customized test system for testing single-or three-phase meters without or with closed I-P links using a high accuracy voltage transformer (MSVT) or Isolation Current Transformer (ICT 2.3)
- Covering all legal test requirements for simple meters, high precision multifunction meters, smart meters and reference standards
- Multiple individual measurement positions
- Several quick connection devices according to IEC-, BS- or ANSI-standards allowing fast suspension and connection of meters

Example of a MSVT meter test system with 10 positions

Example of an ICT meter test system with 20 positions
In meter testing stations, dangerous voltages above 50V AC might be available. The user must be protected from them. Following measures secure and enable a voltage separation:

- Stationary separating safety equipment
- Movable separating safety equipment
- Non-separating safety equipment

In many meter test stations, separation between energized parts and the users of test stations cannot be realized by means of stationary separating safety equipment only. For this reason, movable or non-separating safety equipment is used. To allow the use of safety switches or light curtains in meter testing stations, a safety related signal evaluation is required. Here a safety relay analyzes the starting conditions and in case of needed interrupts the dangerous voltage. This functionality is realized by a safety shutdown device (VSB10.3) connected between power source and meter test rack. The connected safety equipment (safety switch/ light curtain) acknowledges the safety.

The measurement wires are separated and lead back to the power source in order to avoid over modulation in the power source.

In addition, the power source receives over a safe contact information about safety shutdown. After that the modulation switches off. As soon as the meter test equipment returns to safe state the process can be started again automatically or manually (this can be freely adjusted).
Our meter test racks are made of robust aluminum profiles. The standard rack consists of a working table, equipped with fixations for single- or three-phase meters. The quick connections for the meters under test can be arranged horizontal or in the vertical way. Each meter position is equipped with an error evaluation system, safety sockets for the connection of the measuring voltage and movable scanning head carriages.

Thanks to the modular design structure of the meter test racks, special versions can be adapted easily with regard to the number of measurement positions, mechanical arrangements and technical specifications according to customer needs:

- Several quick connection devices according to IEC-, BS- or ANSI-standards are available, which allow fast suspension and connection of meters
- Relay outputs for tariff control
- Hand held terminal with or without barcode reader
- Tariff readout system etc.

This picture shows a meter test rack with total 10 measurement positions for 10 bottom connected DIN meters or 10 chassis meters.

This example shows a meter test rack with total 20 horizontal measurement positions in one row of ten on the front and one row of ten on the rear side.
System layouts

For the substantial throughput of single- and three-phase meters (volume production) MTE recommends the horizontal alignment of the meters under test in an automatic test system. Whilst the test of the meters of the first load is running, a second load of meters can already be assembled on another sledge. In addition, due to the more stabilized horizontal positioning and arrangement of the scanning heads, readjustment is seldom and the efficiency of the whole testing process can be increased significantly. This setting ensures a high degree of efficiency.

Gantry systems on trolleys are used, if many special or different single- and three-phase meter types require a quick and flexible adaptation in the test procedures. Whilst the test is running other trolleys can be used in parallel to perform the assembly, preheating and if required meter isolation test. That guarantees the user an ongoing throughput.
Overview
For increasing the output volume and succeeding in major "Smart Meter Rollout Projects", global meter manufacturers are asking for solutions to modernize their production processes and enhancing their productivity.

As an experienced and innovative engineering company, MTE provides customized automatic and fully automatic test systems (Smart Test Systems) and supports their clients in achieving substantial throughput of single- or three-phase meters.

Key Advantages

- **efficiency**
  - reduced cycle time
  - reduced manpower
  - increased throughput

- **reliability**
  - long time accuracy in test equipment
  - accurate testing results
  - verification for tested meters

- **functionality**
  - easy handling
  - fast loading / unloading of meters
  - no readjustment of scanning heads

- **quality**
  - long-lasting investment
  - successful installation and satisfied customers
  - proven MTE standards

- **repeatability**
  - process standardization
  - high degree of automation
  - operational excellence

In this highly customized approach MTE combines and merges the key advantages and success factors that will enable the global meter manufacturers smoothening their production processes and enhancing their productivity.
Automatic test systems for the volume production of meters

Example of an automatic three-phase test system for 40 positions

The photos show an automatic test system for e-distribuzione, Italy. This system can be divided basically into three sections. In the left or right section the meters are assembled, in the middle section the meters are tested. Once calibrated, configurated and examinated, they are removed from the test system in the right or left section. While the test of the meters of the first load is running, a second load of meters can already be assembled on the other sledge, providing a continuous flow of tested meters and substantial throughput.

Having more than 10 years of experience with such sophisticated systems, MTE continuously improved its approach with innovative developments to meet highest customer requirements.
This highly customized project example shows a fully automatic test system for single-phase meters on 5 trays with 10 measuring positions each. The system is divided into 6 different sections and test modules. Its throughput is up to one million tested meters per year.

Following steps and individual test modules are integrated in the system:

- Function and high voltage test
- Voltage and current connection / meter calibration
- Meter configuration and examination of displays
- Automatic laser printing of name plates

Furthermore, this Smart Test System got the approval for the security of their system according to the ISO / IEC 27001 standards that are describing best practice for an Information Security Management System (ISMS).
The following MTE leaflets are available:

Overviews:
Portable Test Equipment / Stationary Meter Test Systems
Automatic Test Systems / Transformer Monitoring / Company Portrait
K2006 Comparator / PRS 600.3 / CALPORT 300
PWS 3.3 / PWS 2.3 genX
CheckMeter 2.3.genX / CheckMeter 2.1
PTS 400.3 PLUS / PTS 3.3 C / PTS 2.3 C / PTS 2.3 genX
CheckSystem 2.3 / CheckSystem 2.1 / CheckSystem 2.1 S
PPS 400.3 / CheckSource 2.3
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