C O N T E N T S

1. IMPORTANT SAFETY REGULATIONS

A. Notes for Use

This measuring device is to be installed or used exclusively by specialists or trained persons acquainted with its techical data together with the following safety regulations and specifications.
In operation attention should be paid to the appropriate legal and safety requirements for the specific case of application. This also applies to accessories from other manufacturers.
If there is reason to believe that safe operation is no longer possible, the device should be taken out of service and secured against accidental use.

Impossibility of further safe operation must be assumed:
- if the instrument is visibly damaged,
- if the device no longer works,
- after a long storage period under adverse conditions (e.g. storage in extreme climates without appropriate air conditioning, etc.),
- after rough handling during transport (e.g. falling from a great height with no visible external damage, etc.).

WARNING !

Any external or internal break in the earth conductor or the earth conductor connection can render the device dangerous. Interruption of the earth conductor is forbidden.
Only the type of fuses stated and the nominal current should be used. The use of patched-up fuses or short-circuiting of the fuse switch is not permitted.

B. Maintenance

Service work is only to be carried out by trained specialists. Adjustment, maintenance and repair work should be avoided, as far as possible, while the device is open and connected to the power supply. If, however, such work is unavoidable, it should only be carried out by a trained technician who is familiar with the dangers involved.

Any repair or readjustment work must in no case impair safety by modifying any design parameters of the device; replacement parts must be the equivalent of the original parts replaced and reassembled in workmanlike manner to the original factory standard.

2. GENERAL

The MULTIMETER is a universal measuring instrument for research and development, for laboratories, testing rooms, education and servicing work. Its numerous measuring modes ensure this versatility of application. The integrating charge-balancing method for A/D conversion is supported by modern multiprocessor technology.
Full TALK-/LISTEN-PROTOCOL is available allowing all functions to be switched remotely via the IEC 625/IEEE 488 Interface, giving this meter full systems capability. The clearly arranged foil-type keyboard, together with the dedicated fluorescent alphanumeric display and software-supported prompting offer true simplicity of handling.

Maximum Safety

The high permissible input voltage (U_{rms} = 1000 V) and the floating inputs (1000 V with respect to earth/ground), together with high noise-voltage rejection and high-grade guard technology, permit use of the PRECISION MULTIMETER D4845 at high measuring accuracy in both power networks and sensitive measuring arrangements.
The double safety concept for current measurement offers optimum overload protection even under saturated short-circuit conditions and at high voltages. Separate input jacks for each measuring mode offer additional protection of both instrument and measuring arrangement against misoperation.

True RMS Measurement - Many Measuring Modes

True RMS measurements (RMS of the AC component) furnishes correct results even with distored curve forms and permits utilization of the high AC measuring accuracy. The facility for selecting two-pole or four-pole measurement in the resistance ranges affords a good compromise between simple connection and high accuracy at low resistance values. Another important measuring mode is measurement of temperature with standard Pt-100 sensors by means of a special resistance range with °C or °F selectable for display. A number of arithmetic functions (measurement offset/numeric offset) and different triggering modes (single trigger, external trigger, talk only) simplify measurements. The selectable measurement rate together with the variable display range permits optimum adaptation to the measuring task at hand.

Recalibration is effected digitally with prompting with no need to open the meter. Thus the high accuracy of the MULTIMETER may be fully utilized also under modified environmental conditions.
The built-in IEC 625/IEEE 488 Interface comes with every MULTIMETER supplied; it is an important component for every automatic testing system. All functions are programmable, and special trigger functions simplify operation. In combination with a fast Controller, the full measurement rate can be used by selecting the most favorable output format. In systems operation it is possible to direct prompting messages to the alphanumeric display via the bus.

3. CONSTRUCTION

The housing consists of two half-shells which are joined by two fins to form a single unit. The front face and the backplate with the mains transformer are fitted into slots in the fins. The printed-circuit boards for the analog processing and the RMS rectifier form one unit which is completely surrounded by a screen. The screen is switchable between LO socket and GUARD socket as required. The digital board is separated from the analog unit by an additional screen. The display unit which is on the front plate is connected to the digital unit by a lateral printed circuit board. Mains switch, mains current selector switch and mains plug are combined in one unit on the rear of the device.

4. TECHNICAL DATA

4.1 Direct Voltage Measurement

Range Nominal Value	Max.Display	Resolution at rate slow	medium	fast	Input-resistance
200 mV	.240000 V	1 µV	10 µV	100 µV	10 GOhm
2 V	2.40000 V	10 µV	100 µV	1 mV	10 GOhm
20 V	24.0000 V	100 µV	1 mV	10 mV	10 MOhm
200 V	240.000 V	1 mV	10 mV	100 mV	10 MOhm
1000 V	1000.00 V	10 mV	100 mV	1 V	10 MOhm

Error limits with measuring rate slow in ±(% of measured value + % of nominal value)

	1 year 23° ± 5° C		
200 mV	0.02	+	0.002
2 V to 200 V	0.01	+	0.002
1000 V	0.02	+	0.002

for medium measuring rate the error limit from the nominal value is increased to 0.01 %
for fast measuring rate the error limit from the nominal value is increased to 0.1 %

Temperature drift	: < 10 ppm/K (applies from 0...18° and 28...40° C)
Maximum input voltage	: 1000 V DC or 1000 V_{RMS} AC (sinusoidal) in all ranges
Maximum LO-earth	: 1000 V_{RMS}
Overload protection	: MOVs against short-term voltage peaks
Continous overload	: 1000 V
Autorange time	: max. 100 ms
Input current at 23°C	: < 40 pA (doubled at each 10 K)
Common mode rejection (CMR)	: > 150 dB at DC and 1 kOhm in High or Low > 140 dB at AC to 63 Hz and 1 kOhm in High > 100 dB at AC to 63 Hz and 1 kOhm in Low
Series mode rejection (SMR)	: without filter > 50 dB at 50 and 60 Hz (±0.1% frequency deviation) with 4 1/2 and 5 1/2 digits with filter additional > 55 dB at 50 Hz, approx. 60 dB per decade

4.2 AC Voltage measurement (RMS)

True Root Mean Square value of the AC component

Range Nominal Value	Max.Display	Resolution at rate slow	medium	fast
200 mV	.240000 V	1 µV	10 µV	100 µV
2 V	2.40000 V	10 µV	100 µV	1 mV
20 V	24.0000 V	100 µV	1 mV	10 mV
200 V	240.000 V	1 mV	10 mV	100 mV
1000 V	1000.00 V	10 mV	100 mV	1 V

Error limits at slow or medium measuring rate in ±(% of measured value + % of nominal value) and with sine-shaped input voltage 5 % of the nominal value.

	30Hz/45Hz	45Hz/100Hz	100Hz/20kHz	20kHz/100kHz	100kHz/160kHz
0.2V;2V;20V	1+0.1	0.15+0.1	0.1+0.1	1+0.1	2+0.1
200 V	1+0.1	0.15+0.1	0.1+0.1	1+0.1	--
1000 V	1+0.1	0.2+0.1	0.2+0.1	--	--

for fast measurement rate the error limit from the nominal value is increased to 0.2 %.

Input resistance in all ranges : 1 MOhm / 50 pF

Voltage-frequency product : 10^7 V Hz

Max. Crest factor : 3 at nominal input

Temperature drift : 200 ppm/K 30 Hz ... 50 kHz
700 ppm/K 50 kHz ... 100 kHz
(applies from 0...18° C and 28...40° C)

Maximum input voltage: 1000 V_{rms} (sinusoidal)

Maximal LO-earth : 1000 V_{rms}

Continous overload : 1000 V_{rms}

Common mode rejection : > 120 dB to 63 Hz and 1 kOhm in High
> 60 dB to 63 Hz and 1 kOhm in Low

4.3 DC Current measurement

Range Nominal Value	Max.Display	Resolution at rate slow	medium	fast	Shunt	Voltage drop
2 A	2.40000 A	10 µA	100 µA	1 mA	0.05 Ohm	100 mV

Error limits at slow measurement rate in

±(% of the measured value + % of the nominal value)

	1 year 23° ± 5° C
up to 1 A	0.05 + 0.01
up to 2 A	0.1 + 0.01

for medium measuring rate the error limit from the nominal value is increased to 0.02 %

for fast measuring rate the error limit from the nominal value is increased to 0.1 %

Voltage drop at input terminal at nominal current : approx. 0.5 V

Temperature drift : < 50 ppm/K (applies from 0...18° and 28...40° C)

Overload protection : Fuse 2 A/250 V fast-action (max. current 1500 A), on the front cover, internal 4 A/500 V (max. current 100 kA)

Continuous overload : 2.5 A

4.4 AC Current measurement (RMS)

True Root Mean Square value of the AC component

Range Nominal Value	Max.Display	Resolution at rate slow	medium	fast	Shunt	Voltage drop
2 A	2.40000 A	10 µA	100 µA	1 mA	0.05 Ohm	100 mV

Error limits at slow and medium measurement rates in ±(% of measured value + % of nominal value) and with sinusoidal input current 5 % of the nominal value.

	30Hz...45Hz	45Hz...100Hz	100Hz...5kHz
up to 1 A	1+0.1	0.2+0.1	0.25+0.1
up to 2 A	1+0.1	0.25+0.1	0.20+0.1

for fast measurement rate the error limit from the nominal value is increased to 0.2 %.

Voltage drop at input terminal with nominal current : approx. 0.5 V

Temperature drift : < 160 ppm/K (applies from 0...18° and 28...40° C)

Frequency range : 40 Hz ... 5 kHz

Max. Crest factor : 1.5 at nominal value

Overload protection : Fuse 2 A/250 V fast-action (max. current 1500 A), on the front cover, internal 4 A/500 V (max. current 100 kA)

Continuous overload : 2.5 A

4.5 Resistance measurement

Switchable for 2- or 4-wire measurement

Range Nominal Value	Max.Display	Resolution at rate slow	medium	fast	Measuring current	Measuring voltage at nom. value
200 Ohm	.240000 kOhm	1 mOhm	10 mOhm	100 mOhm	1 mA	200 mV
2 kOhm	2.40000 kOhm	10 mOhm	100 mOhm	1 Ohm	1 mA	2 V
20 kOhm	24.0000 kOhm	100 mOhm	1 Ohm	10 Ohm	10 µA	200 mV
200 kOhm	240.000 kOhm	1 Ohm	10 Ohm	100 Ohm	10 µA	2 V
2 MOhm	2400.00 kOhm	10 Ohm	100 Ohm	1 kOhm	500 nA	1 V
20 MOhm	21000.0 kOhm	100 Ohm	1 kOhm	10 kOhm	500 nA	10 V

Error limits at slow measurement rate in
$\pm$(% of measured value + % of nominal value)

	1 year 23° $\pm$ 5° C		
200 Ohm to 2 MOhm	0.02	+	0.005
20 MOhm	0.05	+	0.005

for medium measurement rate the error limit from the nominal value is increased to 0.02 %
for fast measurement rate the error limit from the nominal value is increased to 0.1 %

Temperature drift : < 30 ppm/K (applies from 0...18°C and 28...40°C)
Overload protection : up to max. 500 V_{rms}
No-load voltage : approx. 11 V

4.6 Temperature measurement

By means of external Pt100 sensor in 4-wire connection.

Linearisation by means of microprocessor according to DIN 43760.

Range Nominal Value	Max. Display	Resolution at rate slow	medium	fast	Measuring current	Measuring voltage at final value
-200...+600°C	600.00°C	0.01°C	0.1°C	1°C	0.71 mA	222 mA
-328...+999°F	999.99°F	0.01°F	0.1°F	1°F	0.71 mA	222 mA

Error limits for 1 year at 23 ± 5°C without sensor tolerance in ± °C or ± °F

-200...+100°C	0.1°C	0.2°C	1°C
+200...+600°C	0.2°C	0.3°C	1°C
-328...+220°F	0.2°F	0.3°F	1°F
+220...+999°F	0.4°F	0.5°F	1°F

Temperature drift : same like resistance measurement

Overload protection : up to max. 500 V_{rms}

No-load voltage : approx. 11 V

4.7 Runtime performance

Measurement rate without Auto Zero with internal triggering

Function, range	Rate (Measurements per second) slow	medium	fast
VDC, VAC	10	50	530
ADC, AAC	5	25	280
200 Ohm...200 kOhm	10	50	530
2 MOhm, 20 MOhm	5	25	280
°C, °F	10	50	400

With Auto Zero a zero point measurement takes place every 2 seconds, the duration can be read from the following table:

	slow	medium	fast
Filter OFF	340 ms	140 ms	26 ms
Filter ON	580 ms	260 ms	50 ms
for A, 2 MOhm and 20 MOhm additionally	+100 ms	+20 ms	+2 ms

Times of the trigger delay:

Rate	slow		Auto Zero off		Filter off	
Range:	0.2 ms	2 ms	20 ms	200 ms	2000 ms	20000 ms
VDC	40	40	40	40	40	-
VAC	300	300	300	300	300	-
ADC		40				
AAC		300				
kOhm	200	200	200	200	400*	400*
TEMP	200					

Deviations of vlaues from stable value: 10 counts (* 30 counts)
With medium measurement rates the times are reduced to half, with fast measurement to one tenth.
This is not valid for the AC-ranges (always 300 ms). The delay times are independent of "filter ON/OFF".
With "Auto Zero ON" the above delay times can be extended by the times of zero measurement (see table for Auto Zero Times), so a trigger will be additionally delayed, when it occurs within the Auto-Zero-measurement.

4.8 General

Digital display	: seven-figure alphanumerical vacuumflorescent display, 14-segment characters 10 x 6.5 mm automatic polarity display, dimension display, condition display
Range of display	: ± 240 000 (999999 with offset value)
Measurement process	: integrated charge compensation process controlled by microprocessor
Filter	: switchable by keyboard or bus command, effective in the functions DCV, Ohm/4w, °C, °F. Attenuation 55 dB at 50 Hz Frequency response approx. 60 dB/decade
Selection of measuring range	: manual at the front face by foil-type keyboard, remote controllable by interface or automatic Automatic range switching: 240.000 switching to the next higher range 200.000 switching to the next lower range
Selection of function	: manually at the front face by foil-type keyboard or remote control by interface
System interface	: IEEE Standard 488/1978/IEC 625 (24-pole plug)
Interface functions	: SH1, AH1, T5, L4, SR1, RL1, DT1, E2, TALK ONLY mode
Error limits	: are related to the nominal temperature range 23 ± 5°C and are guaranteed for 1 year
Calibration	: Digital with operator guidance through the display and by interface, with external reference voltage
Radio interference suppression	: Class B according to VDE 871 Part 1
Operating temp. range	: 0 ... 40°C
Nominal temp. range	: 18 ... 28°C
Storage temp. range	: -40 ... +70°C
Climatic class	: KYG according to DIN 400 40
Relative humidity	: 65 % average over the year, max. 85 %
Check	: according to DIN 43751, 5.87
Protection class	: 1 according to VDE 0411, Part 1/10.73 IEC 348, 2. Issue
Checking voltage	: Measurement inputs to housing and supply circuit 3 kV Supply circuit to housing 1.5 kV
Protection class	: IP 40 according to DIN 400 50 - 1920 (IEC 529)
Auxiliary power	: switchable 110/220 V ± 10 % 47 ... 63 Hz, approx. 10 VA
Dimensions	: Table housing 223 x 105 x 395 mm (W x H x D) For 19 inch installation: 23 x 89 x 395 mm (without feet) 1/2 19 inch 2 HE
Weight	: 4.1 kg

5. CONTROL ELEMENTS

5.1 Control Elements

1 Keyboard

2 14-element flourescent display

3 Safety socket 4 mm Ø

4 Fuse for current range (F 2 A / 250 V)

5 Mains switch

6 Mains plug

7 Mains selection switch, Mains fuse

8 BNC output end of conversion

9 BNC input ext. trigger

10 24-pole socket for BUS connection

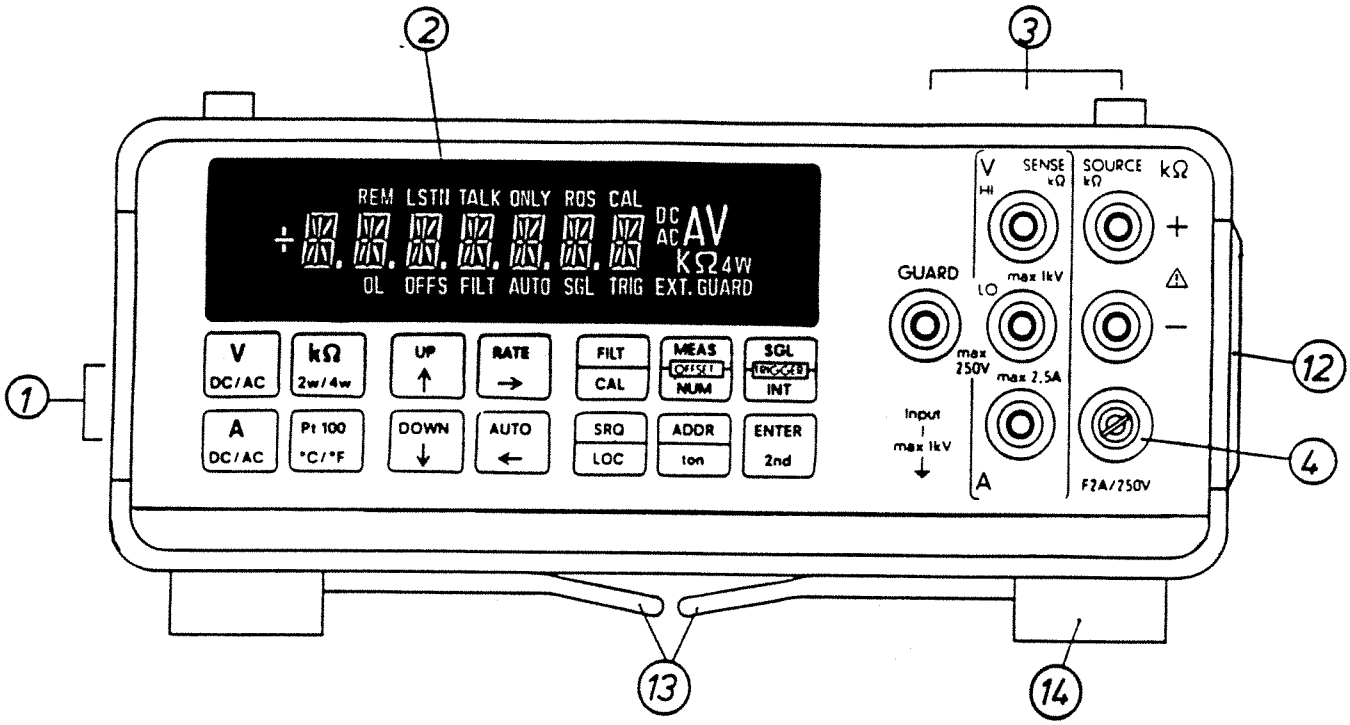
11 Terminal for Instrument ground/earth

12 Handles

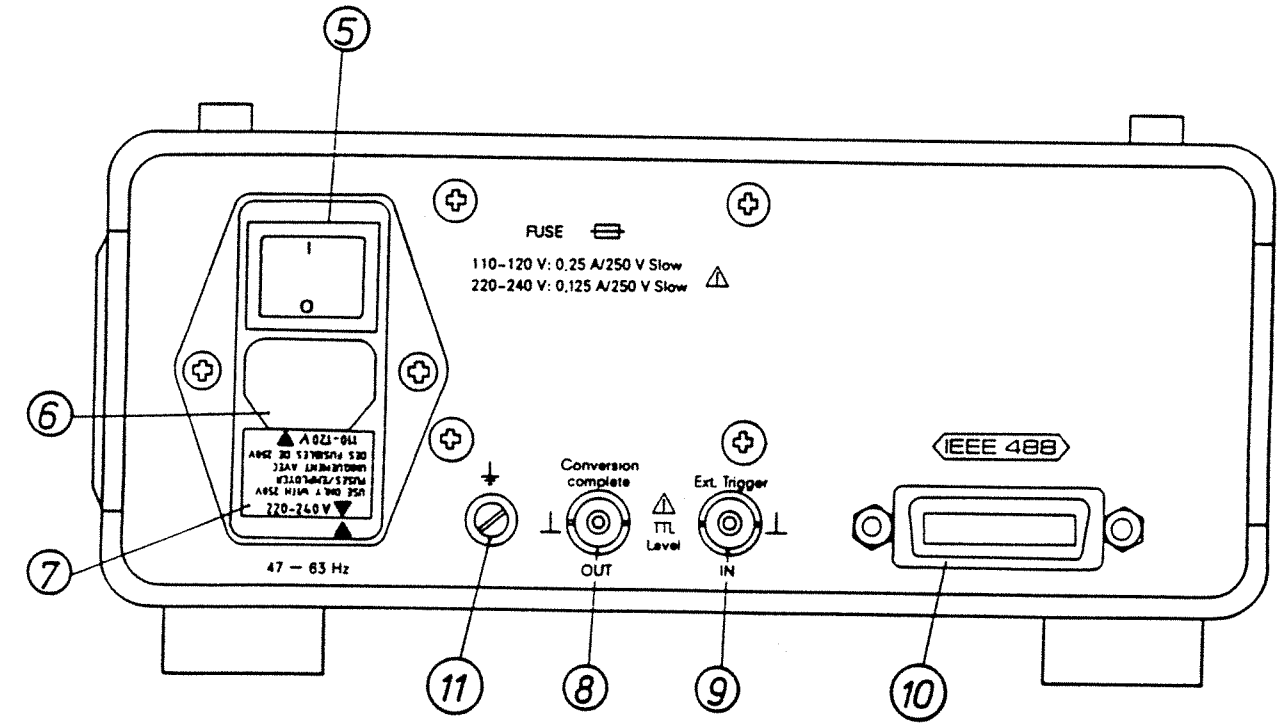
13 Support legs

14 Device feet

Front face



Rear face



5.2 Description of Control Elements

1 Keyboard:

V
DC/AC

On operation the voltage measurement will be selected. The last-chosen coupling (DC/AC) will be assumed and can be changed alternately by repeated pressing of the key.

A
DC/AC

On operation the current measurement will be selected. The last-chosen coupling (DC/AC) will be assumed and can be changed alternately by repeated pressing of the key.

kOhm
2w/4w

On operation the resistance measurement will be selected. The last-chosen type of connection (2w/4w) will be assumed and by repeated pressing of the key can be measured in 2-pole or 4-pole method.

Pt100
°C/°F

On operation the temperature measurement will be selected. The last-chosen type of display will be assumed. By repeated pressing of the key the temperature measured by the external Pt100 sensor can be displayed in either Degrees Centigrade or Degrees Fahrenheit.

Double functions:
The function of the cursor keys is dependent upon the operating condition.
In conjunction with a numerical input the cursor keys serve to move the numerical character by one step or to select the position to be altered.

UP ↑
DOWN ↓

With these keys the range selection is set on "manual" and the next higher or lower range will be selected.

RATE →

Each operation selects in cyclic order the three possible measurement speeds and thus the resolution (slow → medium → fast → slow → ...).

AUTO ←

Each operation of the key switches cyclically between automatic and manual selection of the measurement range.

ENTER
2ND

On pressing the key the numerical value input in the display will be stored and the instrument switched to the predetermined function.
If the instrument is not in the input mode, the second, lower function of the double function keys can be selected for approx. 3 secs after pressing the key.
After selection of this second function key or after 3 secs. this 2nd function will be reset on ENTER.

FILTER
CAL

By operating this key the filter will be alternately switched on or off (effective in DCV, Ohm/4w, °C, °F).
By pressing the key 2ND and CAL the calibration mode is selected.

SRQ
LOC

By pressing the key the BUS-line SERVICE REQUEST will be set (provided that the appropriate SRQ mask was activated by the controller in the device).
Following pressing of the keys 2ND and LOC the instrument switches from remote control to manual operation. The prerequisition is that no contradictory BUS command (LLO) has been sent.

MEAS
OFFS
NUM

On pressing the key the measured value shown in the display will be stored as Offset-value and taken into consideration during subsequent measurements. If the display does not show a measured value (SINGLE TRIGGER), the next measured value will be stored as offset value and simultaneously taken into consideration.
A further operation of the key switches off the consideration of the offset value again.
When the keys 2ND and OFFSET/NUM are pressed the stored offset value will be displayed and can be altered by input over the keyboard by means of the cursor keys and/or stored with ENTER.

ADDR
TON

On pressing the key the IEEE BUS address of the instrument will be displayed and can be altered with the cursor keys or stored with ENTER.
By pressing the keys 2ND and TON the TALK ONLY condition will be switched on. With the next operation the TALK ONLY mode is cancelled again. The TALK ONLY condition remains stored after the mains power supply has been switched off.

SGL
TRIG
INT

The first operation of the key sets the instrument in the condition for single measurement (HOLD-condition). Each further operation starts a measurement process.
Following pressing of the keys 2ND and TRIGGER/INT the measurement processes will be started continuously internally (continuous measurement).

2 Display Field:

7-figure green vacuum flourescent display alphanumerical 14-segment characters 10 x 6.5 mm
Display of measured value (max. 240 000) with units and indication of condition.

3 Connection field:

4 mm safety sockets

GUARD

With no plug in the internal GUARD (screen) is connected with LO.
The inseration of a plug will be recognised automatically and the internal connection with LO separated and the internal screen switched to the GUARD socket.

LO

Common socket LO for current and voltage measurement and simultaneous - SENSE socket for 4-pole resistance measurement.

V

HI socket voltage measurement up to 1000 V_{rms} and simultaneous + SENSE socket for 4-pole resistance measurement.

A

Socket for current measurement up to 2.4 A_{rms}.

kOhm+
kOhm-

Sockets for measurement of 2-pole resistance measurement.

4 Fuse for the current range F 2 A / 250 V. The heavy-duty fuse 4 A / 500 V is inside the instrument. This fuse should only be changed by trained persons.

5 Mains switch - separates two poles of the instrument from the mains.

6 Mains socket - for connection to the voltage supply.

7 Mains selection switch, mains fuse
To change the fuse or the supply voltage insert a pointed instrument (tweezers, screwdriver) in the opening on the inner side of the mains socket and with draw the fuse holder.
Fuses: 110 V ... 120 V 0.25 A / 250 V slow-blow
220 V ... 240 V 0.125 A / 250 V slow-blow

8 BNC output conversion complete
TTL signal is set if the conversion is ended and the measured value ready for output.

9 BNC Input of External trigger
By input of a TTL signal or short-circuiting of the socket a single measuring cycle will be started, provided that the instrument is in the HOLD condition. A new trigger pulse must be input for the next measurement.
In the RUN mode the current measurement will be interrupted by the trigger and a new measurement started. In this way several devices (with Auto Zero off) can be synchronised with one another.

10 BUS-connection
"D"-norm socket: IEEE Standard 488 - 24-pole

11 Protective conductor connecting terminal
For connection to the measuring earth.

12 Handle

6. SCOPE OF DELIVERIES, ACCESSORIES

6.1 Scope of Deliveries

MULTIMETER incl. Interface
(Mains voltage selection switch set at 220 V)

Supplied accessories:

1 off Mains connection cable 1.5 m long
4 off Reserve fuses
(1 pc 2 A/250 V, 1 pc 0.125 A/250 V, 1 pc 0.25 A/250 V)
1 pair Safety measurement cables 1 m long with test probes
1 off Instruction Manual

6.2 Optional Accessories

Precision current transformer 0.1 ... 150 A on clamps,
up to 4000 A as plug-on transformer
Temperature sensor Pt100
High voltage probe 3 kV
HF probe up to 800 MHz
Split-core type transformer

Measuring circuit for 4-pole resistance measurement with Kelvin-Varley clamps

19 inch rack mounting set

IEEE interface cable 0.5/1/2 m long

7. START UP OF THE EQUIPMENT

7.1 Preparations for the Start-up

After unpacking, the equipment should be visually checked for transit damage.

ATTENTION! Before connection the correct setting of the mains selection switch (7) and the attendant mains fuse should be checked and corrected if necessary.

For 220 V ... DIN 41662 T 0.125 A

For 110 V ... DIN 41662 T 0.25 A

Now the equipment can be connected to an earthed socket (6) with the supplied mains connection cable and switched on with the mains switch (5).

ATTENTION! The equipment is Protection Class I and must therefore always be operated with the housing earthed.

7.2 Switched-on Condition

After switch-on all elements of the display field light up for approx. 3 secs. A self-test will also be carried out. Following a satisfactory test the multimeter is ready to carry out measurements. The specified accuracy will be achieved after 30 minutes warm-up time.

After switch-on the Multimeter is in the following basic setting:

Measuring function V DC

Range	AUTO RANGE	Service Request	OFF
Rate	slow	Auto zero	ON
Filter	OFF	Ext.Trg., EOC slope	negative
Offset	OFF	Data output	18 bytes
Trigger	INTERNAL	Calibration	OFF

After connection of the equipment in accordance with the connection diagrams, measurements can begin.

7.3 Measuring with Special Functions

OFFSET

When the MEAS/OFFSET key is pressed the current measured value will be stored as a reference value. All following values will be displayed as deviations of this value. At the same time the symbol OFFS appears in the display as an indication that the Offset value has been stored.
This stored Offset value remains assigned on change of measuring function until a further Offset storage takes place, even if in the meantime another measurement function is measured without Offset.
The Offset function can thus only be applied to one measurement function.
A blinking OFFS display shows that during a measurement with switched-on Offset function there is a voltage which could be dangerous to the operator if touched. The blinking starts when there is a measured voltage of > 50 V at the sockets. The Offset value will be stored as absolute value. An overload message "OFFS.OL" can appear during the switching-down of the measurement range, as soon as the maximum display range 9999...999999 has been reached, according to measurement rate.

Numerical Input of an Offset Value:
The numerical input can be switched on by pressing the keys 2ND and OFFSET/NUM. In the display there will appear the last-stored value or 000000, if there is still no value stored.
The blinking figure can be altered by ↑ or ↓ . The input position will be altered by the ←→ keys. The input range is with ± 2400...±240000.

The altered figure will be stored with the ENTER key.
Exit from the OFFSET measurement is by a further operation of the OFFSET key. OFFS is erased from the display. However, the stored OFFSET value is retained and can be reactivated by means of the numerical OFFSET input.

TRIGGER

When the symbol TRIG lights in the display it means that the instrument is capable of being triggered.
Various sources can be used to send the trigger:
TRIGGER INT. / (within the instrument) - continuous release,
TRIGGER SGL. / a) (Trigger key) - single release
b) Socket EXT.TRG. (On back panel)
c) Triggering by BUS

Within the instrument:
After power-on the instrument will be switched automatically to the internal trigger mode (RUN condition). After expiry of the measuring time the next triggering takes place. TRIG appears in the display.

Triggering by Trigger key:
By pressing the SGL/TRG key the instrument is set in the single release mode (HOLD-condition). SLG TRIG lights in the display.
Each further pressing of the SGL/TRG key starts a measurement cycle.

Triggering over the socket EXT.TRG.:
A measurement process can be started by a triggering signal at the Ext. Trigger socket (TTL signal with minimum of 10 ps impulse duration).
In the RUN condition each trigger will be carried out, the current measurement interrupted and a new one started. If a triggering is too fast, then no measuring process will be ended, this also means that there will be no valid measurement values available for output.
In the HOLD condition (key or BUS command) a trigger which takes place during the measuring phase will be ignored and the bit "trigger error" set in the status byte (see remote control operation).
The active trigger slope is programmable by keyboard or through BUS commands.

Setting of the Trigger slope:
The input mode is selected by pressing the keys 2ND and ← .
The current stored slope appears in the display, e.g. "TRG _ ".
Key UP pos. slope, TRG _/ appears in the display.
Key DOWN neg. slope, TRG _ appears in the display.
Return to the measurement mode with ENTER.

Triggering with BUS:
See Point 10. (Control with BUS commands)

7.4 Calibration of the Instrument (manual)

During the calibration process a known reference source will be measured, a correction factor achieved and this factor stored in a non-volatile memory. The accuracy of the calibration source should be better than the device by a factor of 5 - 10.
Before the start of a calibration the instrument must be at operating temperature (warming-up time approx. 1 hour). The instrument may not be switched off during calibration. The calibrated values remain stored until the next calibration, independent of whether the machine is switched on or off.
Each calibration carried out will be numbered. This means that an issued calibration certificate is related to the internal calibration meter reading and is only valid if the same number is shown on the meter (if no further calibrations have been carried out).

ATTENTION! Calibration within the guarantee period invalidates the terms of the guarantee in relation to the calibrated accuracy!

Calibration code	see below right	(it is recommended that
Exit from cal.mode	key MEAS/OFFSET	this be cut off for
Skip from exist.functs.	key MEAS/OFFSET	purposes of secrecy)
Start of calibration	key FILT/CAL	
Check measurement before calibration	key SGL/TRIGGER	

The key ENTER/2ND is used in its ENTER function for the acknowledgement of the calibration setting.
For each calibration step the appropriate reference source must be connected to the sockets of the instrument. A stable, steady state must be achieved before the FILT/CAL key is pressed. Special attention should be paid to the thermal balance in the measurement area (thermal e.m.f.s at the connections).

CALIBRATION PROCESS DC

1 The calibration mode is prepared by pressing the keys 2ND and CAL (see Point 6.1).
COD = 000 lights up in the display.

2 Input of the correct code number.

CODE
986
Recommended this should be cut off

3 End with the ENTER key.
If the code is wrong, the indicator BADCODE will appear and it will switch back to the measuring operation.
With the correct code number the instrument will be switched into the calibration mode.

CAL lights up in the display and the following text runs through:

WARNING: THIS WILL CANCEL PRODUCER ACCURACY CERTIFICATE
KEY * OFFS * - EXIT (STOP)
KEY * CAL * - CALIBR. (CALIBRATION)
KEY * TRG * - MEASURE (MEASUREMENT)
CALIBRATION COUNTER = XXX (disappears after approx. 2 sec)

By pressing the OFFSET key the text will be skipped to the calibration counter.
The new consignment takes place with the counter reading 001. On carrying out the first calibration step the counter reading will be automatically raised by 1 !!
Switching over to the first range (200 mV DC).

4 Using the ENTER key the existing function in the display and the indicated range will be acknowledged and the display of the calibrated value will be switched on.
CAL VAL appears in the display. The displayed value can be altered by numerical input or accepted by means of ENTER.

5 Input of the calibration value

6 End with the ENTER key
CALIBRATION? appears in the display
If desired, before the calibration a check measurement can be started by pressing the TRIGGER key.

7 The calibration and storage of the correction factor is carried out by pressing the FILT/CAL key.
WAIT - CAL OK appears in the display.
A check measurement is then carried out using the new correction factor.
Then the instrument will be switched into the next higher range.

The following sequences and calibration values are shown in the display by the operator prompting during the calibration. The specified value of "CAL-VAL" corresponds to the nominal value for each measurement range and can be varied between 110 % and 45 % by input.

Function	V DC	and	V AC		
Range	200 mV	2 V	20 V	200 V	1000 V
CAL VAL	.200000	2.00000	20.0000	200.000	10000.00

The calibration can now be carried out with only one polarity (preferably positive).

Function	A DC	and	A AC
Range	2 A		
CAL VAL	2.00000		

In each of the AC ranges the calibration step will be carried out firstly in the lower frequency (approx. 130 Hz) and then in the higher frequency (A...5 kHz/1000V...30 kHz Resid. 100 kHz). The HI-FREQ calibration step lasts approx. 30 secs. These are the frequencies for optimal compliance with the frequency cycle. If the instrument is calibrated in other frequency ranges, partial frequencies can lie outside tolerance. Wide divergences can occur especially in the upper frequency ranges. Using the DOWN/UP key the instrument can be switched between LO-FREQ (DOWN) and HI-FREQ (UP).

Function	Ohm - 4 wire					
Range	200 Ohm	2 kOhm	20 kOhm	200 kOhm	2 MOhm	20 MOhm
CAL VAL	.200000	2.00000	20.0000	200.000	2000.00	20000.0

From time to time before a calibration in the ranges 200 Ohm and 2 kOhm a measurement must be carried out with externally short-circuit SENSE clips. The selection for the short-circuited measurement is carried out with "DOWN" and the measurement value with "UP".

	Display	R = SHORT
Function	Pt100	
CAL VAL	.100000 kOhm	

CALIBRATION PROCESS AC

1-5 As described previously

6 End with the ENTER key

LO FREQ appears in the display. The input of the previously-set calibration value with a low frequency (approx. 130 Hz) will be awaited.

7 Input of the LO FREQ calibration value

8 End with the ENTER key

CALIBR.? appears in the display

9 The calibration and storage of the correction factor is carried out by pressing the FILT/CAL key.

WAIT - CAL OK appears in the display

A check measurement is then carried out

HI FREQ appears in the display. The input of the above-set calibration value with approx. 100 kHz will be awaited.

10 Procedure as 7 - 9

Following the check measurement the machine will be switched to the next higher range.

CALIBRATION PROCEDURE 200 Ohm and 2 kOhm

Calibrations are carried out with 4-pole measurement in all ranges.

5 As described above

6 End with the ENTER key

R - SHORT appears in the display

Short-circuit the sensor cables at the resistance end of the cables.

7 End with the ENTER key

CALIBR.? appears in the display

3 The calibration and storage of the correction factor is carried out by pressing the FILT/CAL key.

WAIT - CAL OK appears in the display

A check measurement is then carried out using the new correction factor.

R-CALIBRATION also appears in the display.

Connect calibration resistance.

End with the ENTER key

CALIBR.? appears in the display.

10 The calibration and storage of the correction factor is carried out by pressing the FILT/CAL key.
WAIT - CAL OK appears in the display
A check measurement is then carried out using the new correction factor.
The instrument is then switched to the next higher measurement range.

CALIBRATION PROCEDURE over 2 kOhm
Calibration in all ranges is with 4-pole measurement, the calibration is carried out accordingly, but without R-Short calibration.

1-5 and 9-10 as in above procedure

CALIBRATION PROCEDURE Pt100
Standard calibration value 100 Ohm. For calibration see 200 Ohm range.

CHECK MEASUREMENT DURING CALIBRATION
Following the question CALIBR.? (Point 6), before calibration a check measurement of the calibration value can be carried out by pressing the SGL/TRIGGER key.
After this check the calibration can be carried out by pressing the FILT/CAL key and the procedure started as described above.

SKIPPING THE START TEXT DURING CALIBRATION PROCEDURE 3
During the text run the operator can skip immediately to the calibration counter by pressing the MEAS/OFFSET key.
A further pressing of this key causes the complete exit from the calibration cycle.

EXIT FROM THE CALIBRATION CYCLE
Exit can be achieved at any time by pressing the MEAS/OFFSET key.
This key also causes skipping of the next step within the range. According to condition the key might need pressing several times to cause exit. The exit has succeeded when the symbol CAL is erased from the display.
The instrument is then in the single-triggering mode.
Switching to the normal measuring mode is carried out by pressing the 2ND and TRIGGER/INT keys.

SELECTION OF SPECIFIC RANGES AND FUNCTIONS FOR THE CALIBRATION

Any arbitrary function and each measurement range can be specifically selected for a special calibration by pressing the required function key (A, V, Ohm, °C, AC/DC) and the range keys (UP, DOWN).

PRINT-OUT OF THE MEASURED VALUES

Following activation of the "TALK ONLY" function and connecting of a printer in the "LISTEN ONLY" mode via the IEEE interface the check values both before and after calibration can be printed-out and thus renders an easy documentation of the calibration.

CALIBRATION BY BUS (AUTOMATIC)

See Point 10 remote control commands

7.5 Overload

Analog overload:

If an overload occurs during the measuring cycle, then the symbol OL lights up in the display.

Digital overload:

If the measurement range (e.g. 240.000) is exceeded during a measurement cycle, "MEAS OL" appears in the display.

7.6 Setting of the Slope for End of Conversion at Socket B

The instrument is switched to the input mode by pressing the 2ND and → keys.
The currently stored slope appears in the display e.g. "EOC ⎺_ ".
Key UP pos. slope, EOC _/ appears in the display.
Key DOWN neg. slope, EOC _ appears in the display.
Return to the measuring mode with ENTER.
The output signal has TTL level.

7.7 Auto Zero

The AUTO ZERO is switched on with the 2ND and keys ↓ "A-Z ON"
The AUTO ZERO is switched off with the 2ND and keys ↑ "A-Z OFF"

7.8 Error Messages on the Display

See status byte (Point 10.6)

Table of error messages on the display and in BUS operation.

8. FUNCTIONAL DESCRIPTION

The processing of the measuring signal is carried out firstly in the floating analog part with additional analog/digital conversion.
The digital values are transmitted for further processing for display and interface by means of a pulse transformer, which represents the electrical isolation to the digital section.

8.1 Analog Section

VOLTAGE MEASUREMENT
The voltage applied to the input clamps V_{HI} and LO passes through input protection to the appropriate precision divider according to the measurement function.
The DC-voltage measurement is done via the DC divider, switchable low-pass filter, auto-zero switching and post-switched amplifier xl (xl0 with 200 mV) and overload detection to the buffer amplifier of the A/D converter.
With AC-voltage the measuring signal is capacively decoupled after the protective circuit and passed to the frequency-compensated AC divider.
After the overload detection the signal is reformed to an appropriate direct current for the effective value in the RMS convertor by means of an analog design process and passed to the buffer amplifier of the A/D converter.

CURRENT MEASUREMENT
The current passed to the input clamps A and LO produces a voltage drop at the precision shunt which, depending on the measurement value, is led to the DC or AC amplifier. In order to keep the temperatur error of the shunt to a minimum the voltage drop at 2 A with 50 mV is held as low as possible.
Further signal processing is carried out in a similar manner to that for voltage measurement. The shunt is protected against large overloads by two fuse cartridge switched in series, a further protection circuit protects the post switched amplifier against damage from too high voltages.

RESISTANCE MEASUREMENT

For the 2-wire measurement the resistance to be measured is connected to the +kOhm Source and -kOhm source via the switched constant current source according to the selected measurement range with overload protection against external interference voltage. The internally tapped voltage drop is passed through the auto-zero circuit to the xl/xl0 amplifier and finally to the buffer amplifier of the A/D converter.

With the 4-wire measurement the voltage drop is passed via the potential tap to the Sense input (+kOhm Sense and -kOhm Sense). The switchable low-pass filter reduces any interfering voltages which occur.

In order to avoid a limiting of the measuring range due to high circuit resistances, the -kOhm Source clamp is held at virtual earth (internal reference potential) via a compensation amplifier.

Further processing is carried out in a similar manner to that for the 2-wire measurement.

TEMPERATURE MEASUREMENT

The temperature is made by means of an external Pt100 measuring sensor. For reasons of accuracy the resistance measurement is carried out by a 4-wire connection.

In order to be able to use the whole measurement range without ranging, a specific Ohm range is selected. The linearization for the temperature display in °C or °F is carried out in the processor of the analog section.

GUARD CONNECTION

With standard measurements the internal guard screen is internally connected to the analog-low.

The insertion of a cable in the guard socket is detected automatically, so that a relay automatically separates the guard screen from the internal Low. Thus it is possible to avoid corruption under difficult voltage conditions due to leakage currents, parasitic capacitances, etc. and thus to use the high measuring accuracy of the instrument. This method is especially effective because of the realization of the guard screen into winding of the mains transformer. The correct connection of the guard socket is extremely important and can be found in the connection diagrams. A thorough check should be made that the guard is at the same potential as the Low connection, but is supplied from the signal source with a resistance as low as possible.

FILTER

This low-pass filter (attenuation > 55 dB at 50 Hz, approx. 60 dB per decade) can switched on for the measurement of DC voltages and the 4-wire resistance measurement for additional suppression of seriesmode interference voltages. This, however, increases the adjustment time of the measuring device.

AUTO ZERO, x1/x10 Amplifier

During measurements of DC voltage, DC current and resistances temperature drifts can be contained and stable zero points achieved by periodic run of auto-zero cycles. The input signals are disconnected at intervals of 2 secs. and the offset value is stored in the analog processor for the correction of the measured value. These auto-zero periods last approx. 340 ms. If the device is on Hold (single trigger), it waits in the auto-zero for the measuring command, thus the optimal accuracy and reliability is always achieved.

The amplifier (x1/x10) either switches the signal through directly or amplifies the small signals (200 mV) to the 2 V nominal value.

This process cannot be used for AC measurements because of the too-long response times, however the drifts are considerably smaller because of the AC connection, so that with careful selection of the circuit and components a sufficient stability for the accuracy can be achieved.

OVERLOAD DETECTION (DC OL / AC OL)

Analog overloads will be detected separately for DC voltage and AC voltage by appropriate comparators and indicated at the processor.

Digital overloads will be established directly in the processor. Even brief overloadings (voltage peaks) can lead to corruption of the measured value.

BUFFER AMPLIFIER, ANALOG/DIGITAL CONVERTER, ANALOG PROCESSOR

The buffer amplifier works as an impedance transformer and supplies the integrator of the A/D converter.

The analog/digital converter works according to the known principle of charge balancing and is thus considered as an integrated measuring process.

This principle is modified and tailored to the demands for accuracy and speed.

The measuring signal is applied continuously to the integrator and with its size thus alters its integration speed. Therefore this alters the pulse width ratio of the integrator which alternates between two threshold values.
The resulting gates will be counted out by the processer (80C31) of the analog section.
This processor calculates the exact calibrated measured value from these values, from the calibrated values stored in the EEPROM, the values from the auto-zero phase and the measuring range information. This has the advantage that the analog section can be calibrated as a completely separate entity.
The measured values are passed to the digital section via the impulse transmitter.

REFERENCE

The reference voltage is produced by a highly accurate, aged, temperature-compensated and heated reference diode.
The diode current is held constant by a control circuit. The reference voltage is required for the A/D conversion and for the current source for resistance measurement and along with the resistance-divider is responsible for the accuracy of the device.

8.2 Digital Section

IMPULSE TRANSMITTER

The internal transmission of data takes place serial via impulse steps so that a potential separation is achieved between the analog and the digital section. The transfer of control information and measured data takes place in each direction via separate transmitters according to a special code with error detection.

DIGITAL PROCESSER

The processer in the digital section controls the complete function sequence in the measuring device. The measured values supplied from the analog section will be processed as appropriate for the display and interface. Control signals such as ext. Trigger, Conversion. Complete etc. will be transmitted into or out of the analog section, just as input data will be processed via the keyboard or the IEEE 488 Interface.

KEYBOARD

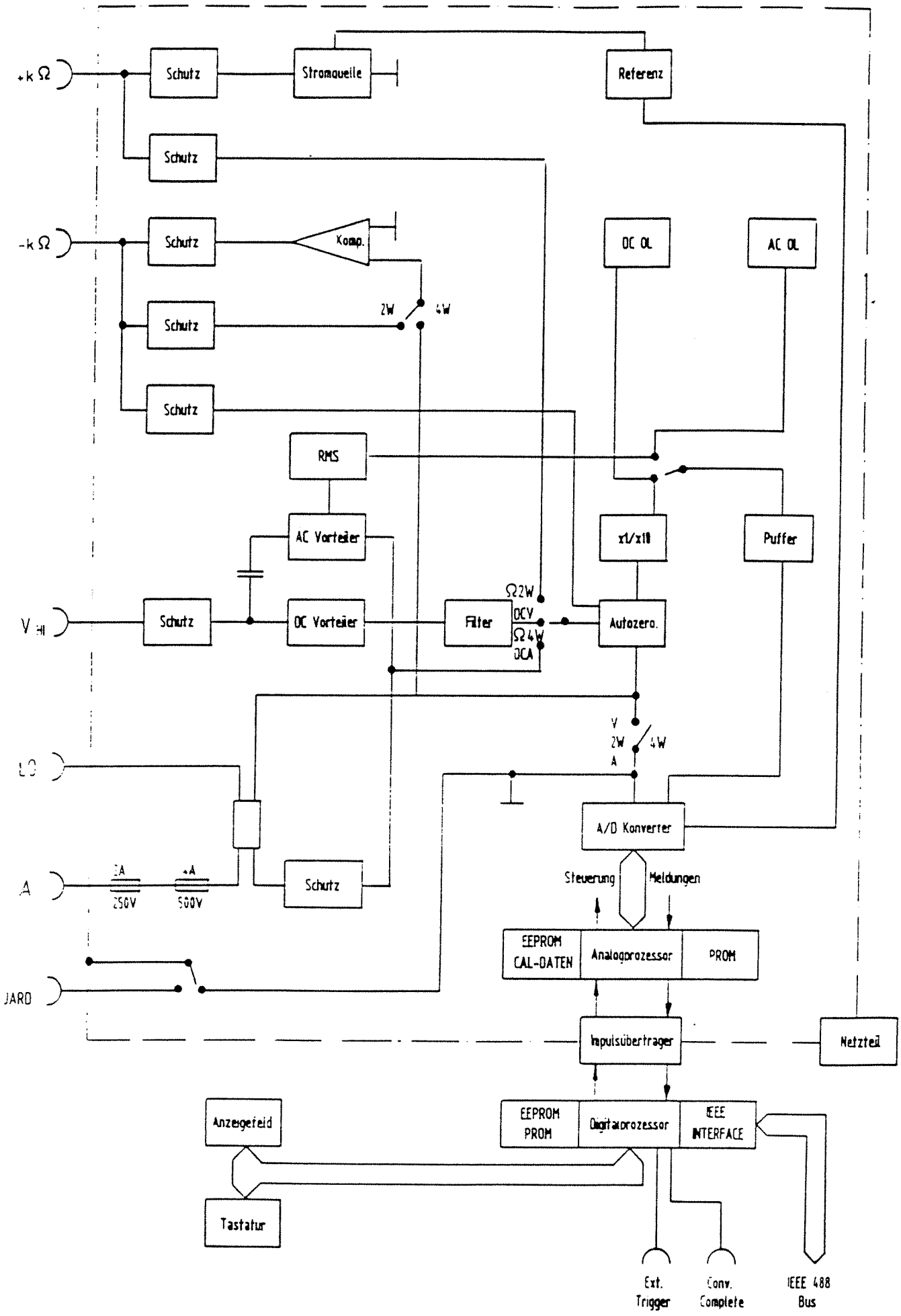
The keyboard is a foil-type keyboard of sandwich construction, offering a high degree of visibility and protection against contamination under adverse environmental conditions.

DISPLAY FIELD

The measured values will be shown in the display field, but besides the maximum seven digits all other details can also be displayed. Any pressing of a key on the keyboard will be acknowledged by an appropriate symbol as a feedback. During measurement and calibration brief guidance notes can be given to the operator by means of the alphanumerical layout of the main display. It is also possible to show messages via the IEEE Bus on the display.

POWER SUPPLY UNIT

The power supply provides the necessary voltages for analog and digital sections with the appropriate electrical isolation. The mains transformer is provided with all necessary coil screens.


+k Ω
Schutz
Stromquelle
Referenz
Schutz
-k Ω
Schutz
Komp.
OC OL
AC OL
2W
4W
Schutz
Schutz
RMS
AC Vorteiler
x1/x10
Puffer
V HI
Schutz
DC Vorteiler
Filter
Ω2W
DCV
Ω4W
DCA
Autozero.
V
2W
4W
A
LO
A/D Konverter
A
2A
250V
4A
500V
Schutz
Steuerung
Meldungen
EEPROM
CAL-DATEN
Analogprozessor
PROM
JARD
Impulsübertrager
Netzteil
Anzeigefeld
EEPROM
PROM
Digitalprozessor
IEEE
INTERFACE
Tastatur
Ext.
Trigger
Conv.
Complete
IEEE 488
Bus

9. CONNECTION DIAGRAMS

WARNING!
To avoid electrical shocks and/or damage voltages or currents higher than those stated in the tables below must not be applied to the measuring device.

Operational Condition:

Function	Connection Sockets	Maximum Value
V DC	V HI and LO	1000 V DC or RMS
A DC	A and LO	2.5 A DC or RMS
V AC	V HI and LO	1000 V AC RMS max. 1 x 10^7 V Hz
A AC	A and LO	2.5 A RMS
All Functions	Each connection socket to earth	1000 V DC or RMS
	LO-GUARD	250 V DC or RMS

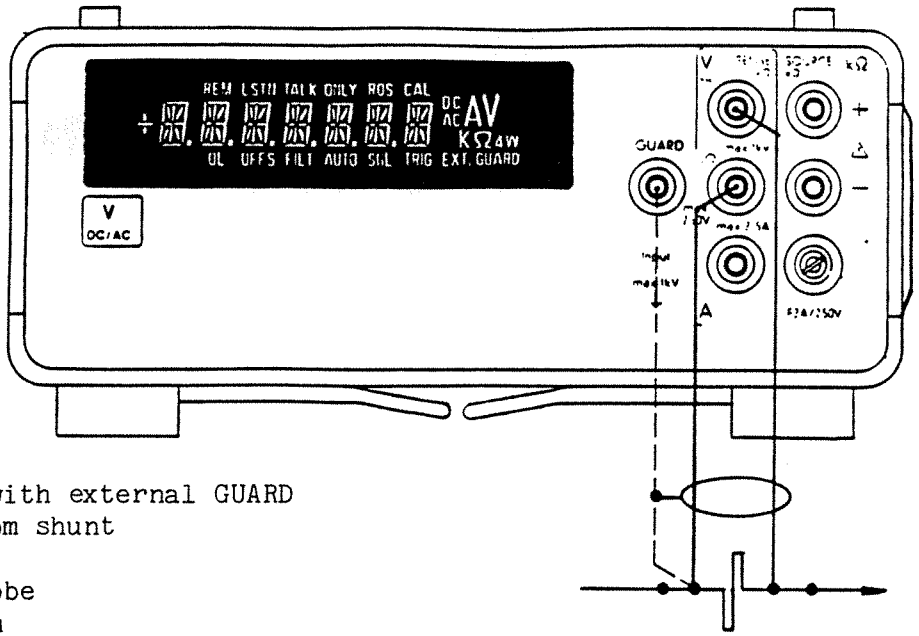
Overload Condition:

Function	Connection Sockets	Maximum Value
kOhm 2W	+kOhm (SOURCE) and -kOhm (SOURCE)	500 V RMS
kOhm 4W	HI against +kOhm (SOURCE) or -kOhm (SOURCE)	1000 V RMS
Pt100	kOhm (SENSE) and LO	1000 V RMS
	LO against +kOhm (SOURCE) or -kOhm (SOURCE)	500 V RMS
A DC or A AC	A and LO	max. 250 V DC or RMS

9.1 Voltage Measurement V DC, V AC

Voltage measurement with internal GUARD DC or AC

Measured quantity at LO and V

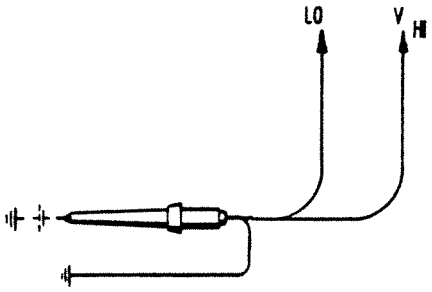


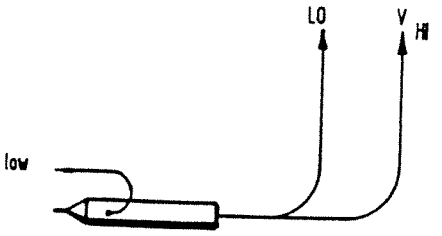
Voltage measurement with external GUARD
e.g. Voltage drop from shunt

With high voltage probe
3 kV 1:100 27 MOhm
In the range 20 V direct reading in kV

Error limits:
100 V ... 3 kV DC ± 1 % of measured value
100 V ... 3 kV AC ± 2.5 % of measured value
from 45 to 65 Hz

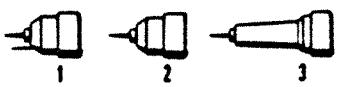
Do not measure in the 0.2 and 2 V ranges
(only for 10 MOhm input resistance)





With HF probe

Measurement range	: 0.1 ... 1-3-10-30 V
HF Voltage	: max. 25 V
DC Voltage	: max. 500 V
Output Voltage	: max. 1 V DC
Input impedance	: 100 kOhm//2 pF with 1 MHz and 1 V
Error limits	: in % of measurement range
Probe point 1	: ± 5 % (0.1 to 300 MHz)
	±15 % (300 to 800 MHz)
Probe point 2	: ± 5 % (0.1 to 100 MHz)
	±15 % (100 to 230 MHz)
Probe point 3	: ± 5 % (10 kHz to 30 MHz)
Battery (supplied)	: Button Cell 1.4 V, IEC MR 07

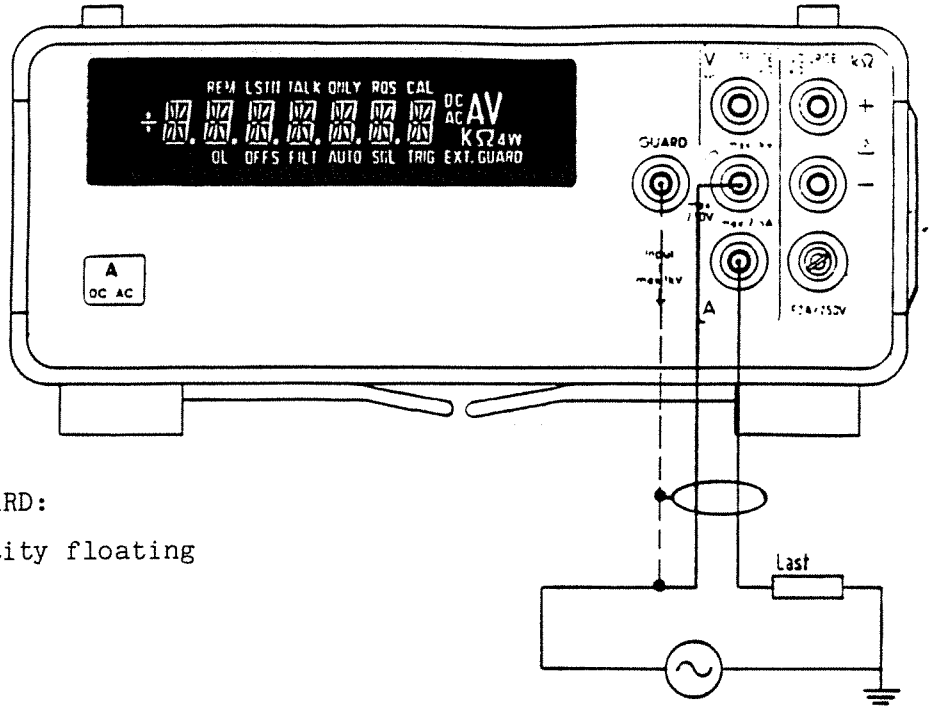


In the range 20 V DC reading x1, x3, x10, x30 according to switch setting of the probe head. Do not measure in the 0.2 and 2 V ranges (only for 10 MOhm input resistance).

9.2 Current Measurement A DC, A AC

Current measurement with internal GUARD DC or AC

Measurement quantity at LO and A

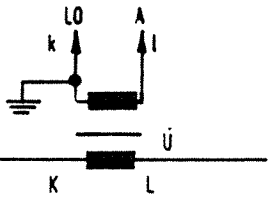


with external GUARD:

Measurement quantity floating

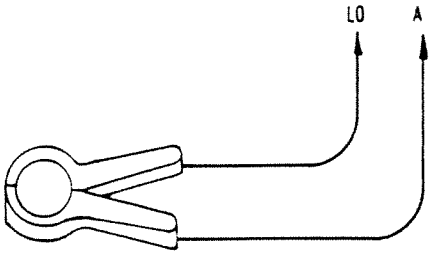
With current transformer AC

Iprim = Imeas. x ratio

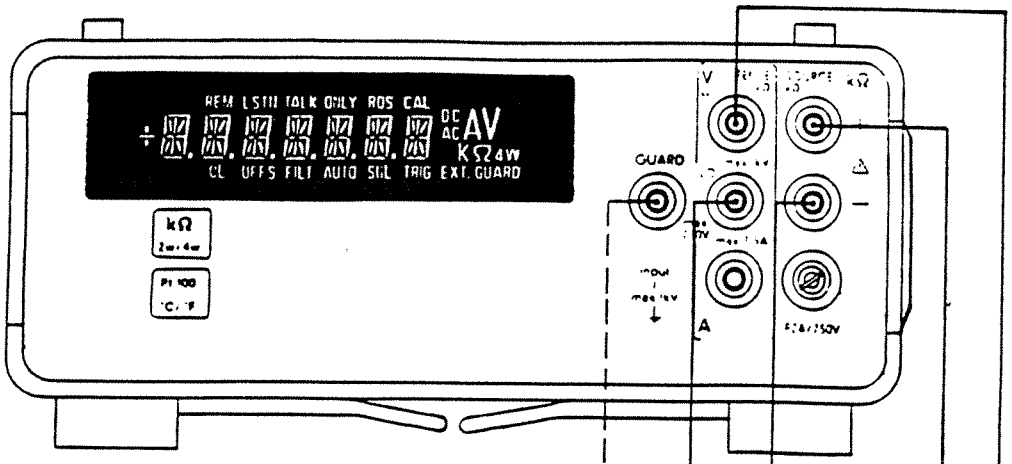


With clip-on current transformer AC

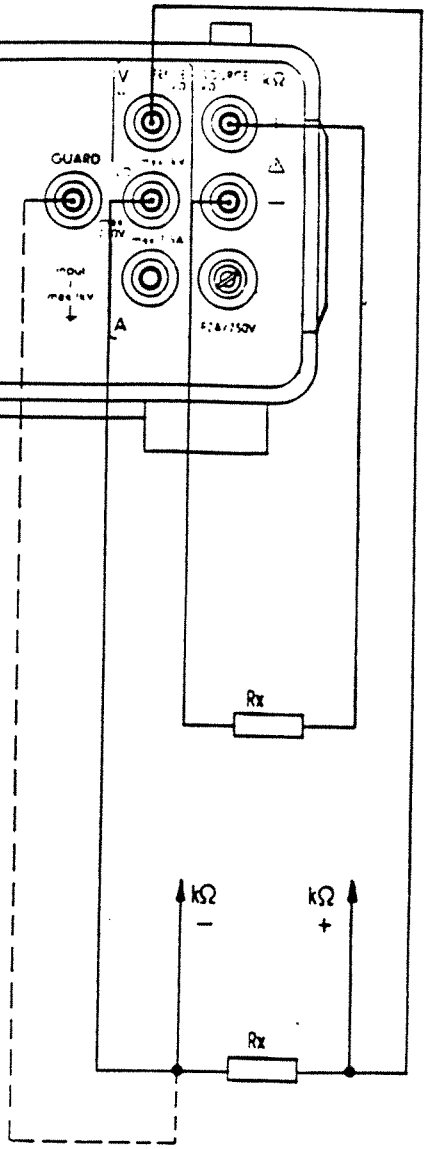
e.g.: 1000/1 A
0...1000 A = 0...1 A
max. 5 VA Cl. 0.5
50 Hz...5 kHz



9.3 Resistance Measurement and Temperature Measurement

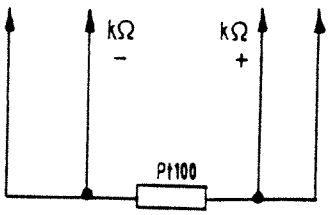


In two-pole connection



In four-pole connection

In four-pole connection with Pt100 Sensor



Reserved for personal remarks

10. REMOTE CONTROL OPERATION INTERFACE

10.1 Interface Functions

Designation	Abbreviation
Source Handshake	SH 0 ... SH 1
Acceptor Handshake	AH 0 ... AH 1
Talker	T 0 ... T 8
Talker extension	TE 0 ... TE 8
Listener	L 0 ... L 4
Listener extension	LE 0 ... LE 4
Service Request	SR 0 ... SR 1
Remote-Local	RL 0 ... RL 2
Parallel Poll	PP 0 ... PP 2
Device Clear	DC 0 ... DC 2
Device Trigger	DT 0 ... DT 1
Controller Function	C 0 ... C 28
Interface Type	E 1 ... E 2

For built-in functions see TECHNICAL DATA

Detailed description see NORM IEC 625/IEEE 488-1975.

10.2 Explanation for Abbreviations Used

Message	Mnemonic Abbreviation
Data-In-Out 1	DIO 1
Data-In-Out 8	DIO 8
Data valid	DAV
Not ready for Data	NRFD
Not Data accepted	NDAC
Attention	ATN
Interface Clear	IFC
Service request	SRQ
Remote enable	REN
Device clear	DLC
Selection device clear	SDC

Group execute Trigger	GET
Databyte	DAB
Databyte accepted	DAC
Go to local	GTC
My listen address	MLA
My talk address	MTA
Other talk address	OTA
Ready for data	RFD
Serial Poll enable	SPE
Unlisten	UNL
Untalk	UNT
Statusbyte	STB

The Bus structure is divided into three groups of signal lines:

Data bus : 8 Signal lines

Transfer control bus : 3 Signal lines

Interfaces control bus : 5 Signal lines

Level assignation:

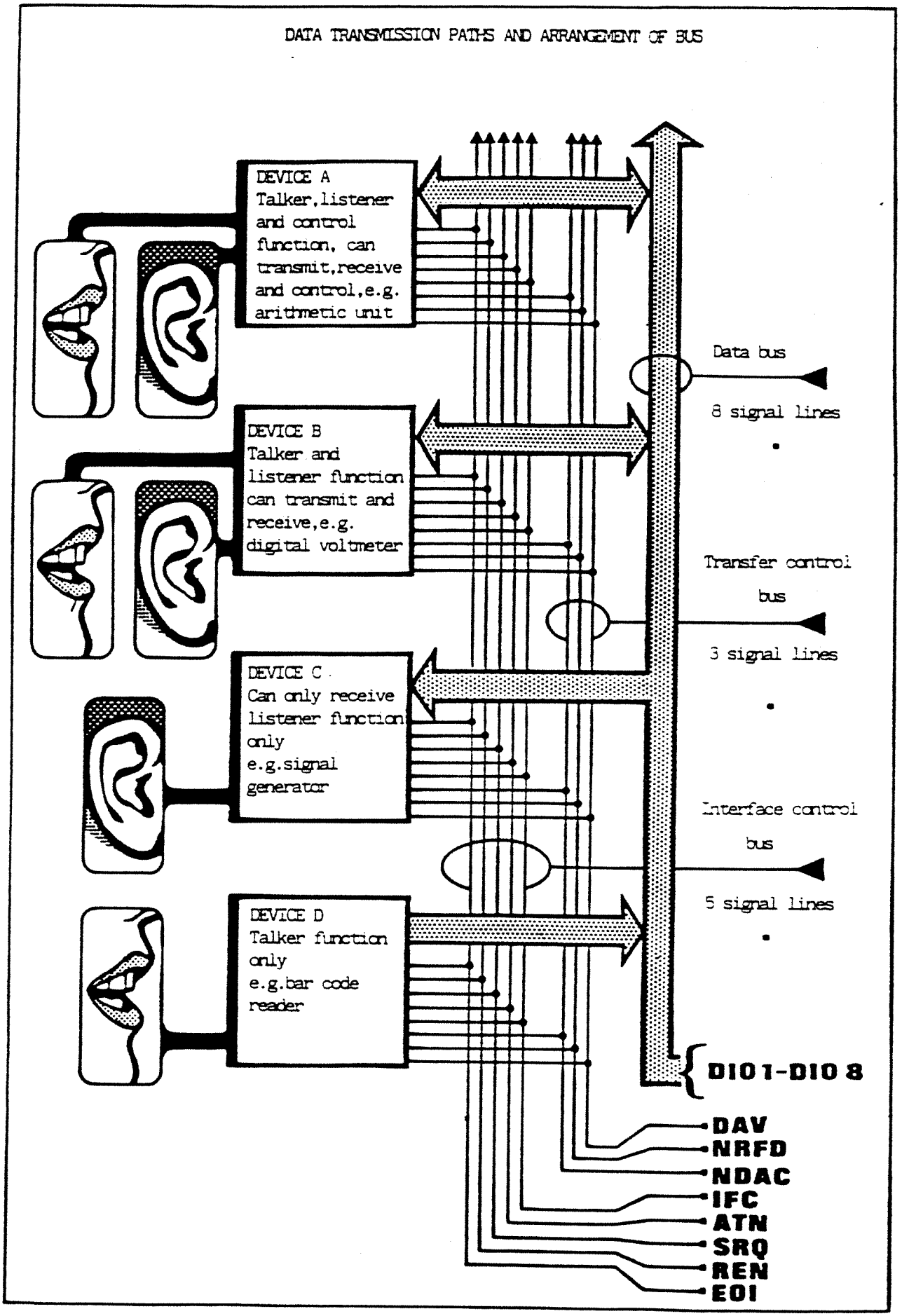
Log. 0 False High condition of signal level H (High)

Log. 1 True Low condition of signal level L (Low)

Type of Coding : E Uniline message M Multiline message

Class of message : AB Addressed Command
AD Address (to Talk and Listen)
GA Device dependent
HS Handshake
UB Universal command
SE Secondary message
ZS Status message

INTERFACE AND BUS STRUCTURE



Remote messages to which Interface responds

Message	Abbr.	Notes	Coding type	class	Bus signal line(s) and coding of true value of message DIO lines 87 654 321	DAV	NRFD	NDAC	ATN	EOI	SRQ	IFC	REN
ATTENTION	ATN		E	UB	XX XXX XXX	X	X	X	1	X	X	X	X
DATA BYTE	DAB	1,9	M	GA	DD DDD DDD 87 654 321	X	X	X	0	X	X	X	X
DATA ACCEPTED	DAC		E	HS	XX XXX XXX	X	X	ø	X	X	X	X	X
DATA VALID	DAV		E	HS	XX XXX XXX	1	X	X	X	X	X	X	X
GO TO LOCAL	GTL		M	AB	X ø øøø øø1	X	X	X	1	X	X	X	X
INTERFACE CLEAR	IFC		E	UB	XX XXX XXX	X	X	X	X	X	X	1	X
MY LISTEN ADDRESS	MLA[+]	3	M	AD	X ø 1 LL LLL 54 321	X	X	X	1	X	X	X	X
MY TALK ADDRESS	MTA[++]	4	M	AD	X 1 ø TT TTT	X	X	X	1	X	X	X	X
OTHER TALK ADDRESS	OTA		M	AD	(OTA = TAG $\overline{\text{MTA}}$)								
REMOTE ENABLE	REN		E	UB	XX XXX XXX	X	X	X	X	X	X	X	1
READY FOR DATA	RFD		E	HS	XX XXX XXX	X	ø	X	X	X	X	X	X
SERIAL POLL DISABLE	SPD		M	UB	X ø ø1 1 ø ø1	X	X	X	1	X	X	X	X
SERIAL POLL ENABLE	SPE		M	UB	X ø ø1 1 ø øø	X	X	X	1	X	X	X	X
UNTALK	UNT		M	AB	X 1 ø1 1 1 1 1	X	X	X	X	X	X	X	X
UNLISTEN	UNL		M	AB	X ø 1 1 1 1 1 1	X	X	X	1	X	X	X	X
LOCAL LOCK OUT	LLO x)		M	UB	X ø ø1 ø ø ø1	X	X	X	1	X	X	X	X
GROUP EXECUTE TRIGGER	GET x)		M	AB	X ø øø 1 ø øø	X	X	X	1	X	X	X	X

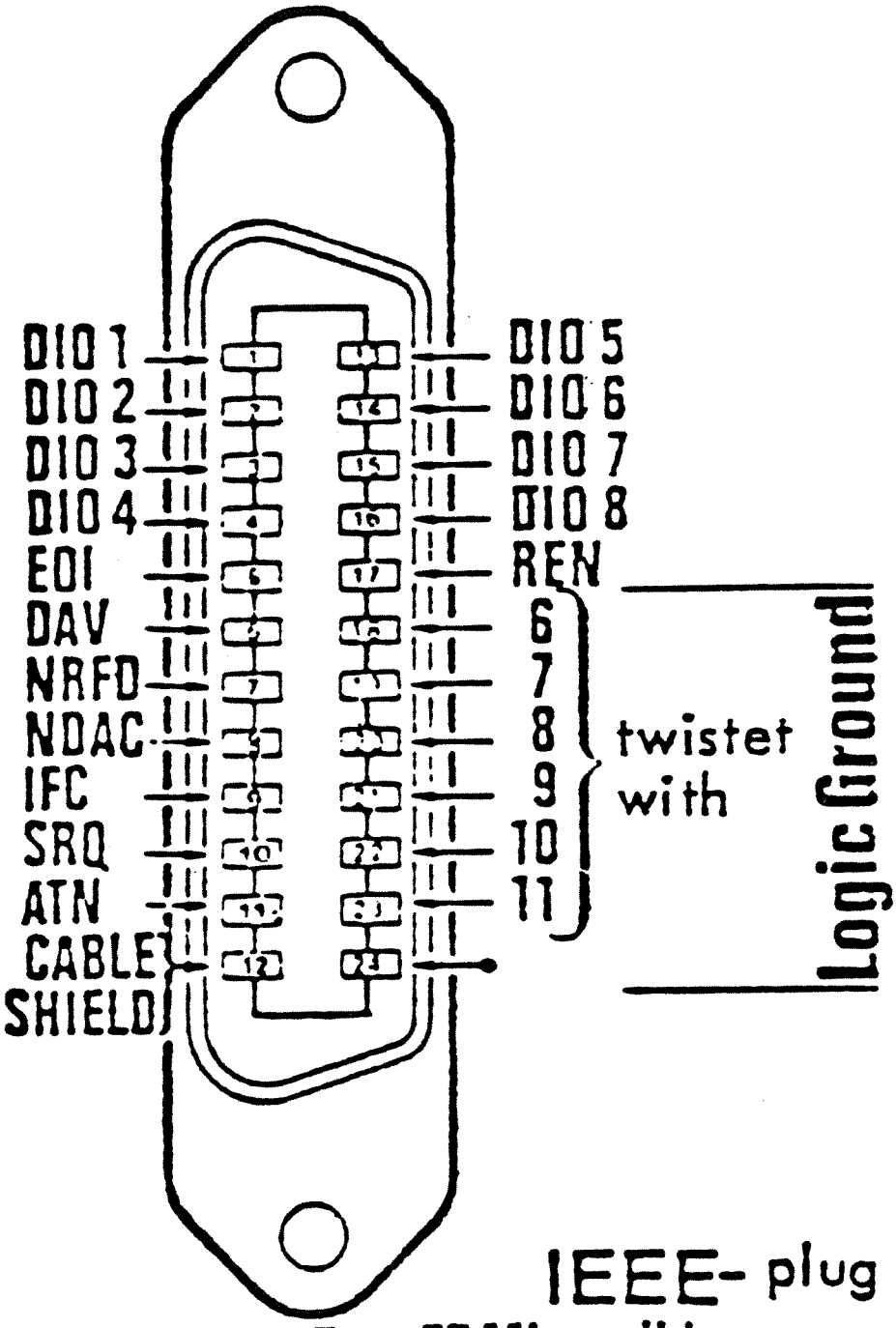
		T5	T4	T3	T2	T1
+	Bits L5 L4 L3 L2 L1 of Listener address correspond to bits as selected by slide switches					
++	Bits T5 T4 T3 T2 T1 of the Talker address can be selected by slide switches. Any combination is permitted except	1	1	1	1	1

Remote messages that can be transmitted by the Interface

Message	Abbr.	Notes	Coding type	class	Bus signal line(s) and coding of true value of message DIO lines 87 654 321	DAV	NRFD	NDAC	ATN	EOI	SRQ	IFC	REN
DATA ACCEPTED	DAC		E	HS	XX XXX XXX	X	X	ø	X	X	X	X	X
DATA VALID	DAV		E	HS	XX XXX XXX	1	X	X	X	X	X	X	X
DATA BYTE	DAB	1,9	M	GA	DD DDD DDD	X	X	X	ø	X	X	X	X
READY FOR DATA	RFD		E	HS	XX XXX XXX	X	ø	X	X	X	X	X	X
REQUEST SERVICE	RQS	9	E	ZS	X1 XXX XXX	X	X	X	ø	X	X	X	X
SERVICE REQUEST	SRQ		E	ZS	XX XXX XXX	X	X	X	X	X	1	X	X
STATUS BYTE	STB		M	ZS	SX SSS SSS	X	X	X	ø	X	X	X	X

Notes:
1 D1 ... D8 are the device-dependent data bits
3 L1 ... L5 are the device-dependent listener adress bits
4 T1 ... T5 are the device-dependent talker address bits
9 Messages on ATN lines emanate from Controller, while messages on the DIO lines are enabled by T function
X Disregard when decoding received messages
X Must not be set for decoding when transmitting a message

THE TWO BUS PLUGS



IEEE- plug
Type 57 Microribben connector

10.3 Setting the Address

The address will be shown in the display when the ADDR key is pressed. If another one is preferred, the address can be altered using the cursor keys. Storage is by means of the ENTER key (Input range 00 ... 30).

10.4 Remote Control Commands

* Marks switch-on condition or after DCL

		Measuring Function:
FUNCTION	: F0 * - VDC	DC voltage
	F1 - VAC	AC voltage
	F2 - ADC	DC current
	F3 - AAC	AC current
	F4 - KOHM 2W	Resistance two wire
	F5 - KOHM 4W	Resistance four wire
	F6 - Pt100, Centigrade	Temperature °C
	F7 - Pt100, Farenheit	Temperature °F

RANGE	: R0 * -	AUTO	---	AUTO
	R1 -	0.2 V	---	0.2 kOhm
	R2 -	2 V	---	2 kOhm
	R3 -	20 V	---	20 kOhm
	R4 -	200 V	---	200 kOhm
	R5 -	1000 V	2 A	2000 kOhm
	R6 -	---	---	20000 kOhm (only with 5 1/2 + 4 1/2 digit)

MEASUREMENT RATE
: S0 * - Measurement Rate Slow
S1 - Measurement Rate Medium
S2 - Measurement Rate Fast

FILTER
: L0 * - without filter
L1 - with filter (only for DCV, Ohm/4w, °C, °F)

OFFSET
: B0 * - without Offset
B1 - with Offset
00 - next measured value - Offset value
01<v>- numerical value - Offset value
maximum length according to the current display format

TRIGGER : T0 * - internal
T1 - BUS Trigger without delay
T2 - BUS Trigger + EXT TRG without delay
T3 - BUS Trigger with delay
T4 - BUS Trigger + EXT TRG with delay

SERVICE REQUEST : Q0 * - no service request
Q<m>- SRQ mask,<m>- number ≤ 63
m is the total of the valencies of the bits of the status byte to be activated for the SRQ (1...63 from ST1...ST6)
see 10.6 Statusbyte

AUTO ZERO : Z0 * - with Auto-Zero
Z1 - without Auto-Zero
Z2 - Zero measurement

DISPLAY : A0 * - normal display
A1<s>- controller message to the display field, max. 7 alphanumerical characters
A2 - Switched-off display except REM, TALK, LSTN

USER DEFINED MESSAGE : P0<s>- Controller message to - EEPROM, max. 16 alphanumerical characters
P1<s>- Controller message to - EEPROM, max. 16 alphanumerical characters

SLOPE OF THE TTL-SIGNAL : Y0 * - External Trigger _ End of Conversion _
Y1 - External Trigger _ End of Conversion _/
Y2 - External Trigger _/ End of Conversion _
Y3 - External Trigger _/ End of Conversion _/
The event occurs with the selected slope.

DATA OUTPUT (FORMAT) : G0 * - Alpha head, measured data, exponent (14...18 bytes)

G1 - Measured data, exponent (9...13 bytes)

G2 - Measured data (6...10 bytes)

G3 - Measured data binary coded (2 bytes)

G4 - Offset value (14...18 bytes)

G5 - User defined Message No. 1 (16 bytes)

G6 - User defined Message No. 2 (16 bytes)

G7 - Calibration counter (1... 5 bytes)

G8 - Extension of Status byte (1... 5 bytes)

The number of bytes depends on the measuring rate, output format and final character.

CALIBRATION : C0 * - Switch to the calibration mode

C1 - Calibration step 1

C2 - Calibration step 2

C3<v>- Calibration value

C4<c>- Calibration Code

ATTENTION! Transmission of C1 or C2 increases the calibration counter reading by 1 and nullifies the manufacturer's calibration guarantee!

The input of all values which are indicated by < > is to be terminated with ; (semicolon).

10.5 Data Output Format

MEASURED DATA IN TALK FUNCTION G0, G1, G2:

NR 2 - for temperature measurement

NR 3 - for V, A, Ohm

YYYOA	+-	X.XXXXX	E +- X	Final character
T	U	V	W	Y, Z

"T" field YYY : VDC, VAC, ADC, AAC, OHM, DGC (°C), (°F)

OA : 0 for Offset measurement otherwise empty field

A for analog overload otherwise empty field

"V" field : The length of the V field depends on the measurement rate, with specific measurement rate it always remains the same length.

"W" field : The exponent in steps from ± 3 (not for Temp)

The T and W field can be suppressed by means of the Bus command G1 (G2). In the field Y (Z) the last-received final characters in the Listener are used (power-on condition: CR, LF).
Measurement overload will be transmitted as 9.99999 E+9.
Offset overload will be transmitted as 9.99999 E+8.

Data output code		G0	G1	G2	G3
String length	fast rate	16	11	8	2
in	medium rate	17	12	9	
bytes with	slow rate	18	13	10	-

valid for end character CR + LF
Each measured value will be issued with the byte number stated above and ended with the final character which the controller used when setting instrument. All final characters which comply with DIN 66.22 will be accepted.

e.g.: ETB; ETX; CR, LF; CR/LF

All final characters can be combined with EOI or the data byte transmitted with EOI.

Power ON condition: CR/LF

MEASURED DATA IN TALK FUNCTION G3:

The measured data are represented as two-byte integer (two complement) (first LO byte then HI byte). No final characters will be used. Measurement overload will be issued in accordance with 7FFFH binary. Offset overload will be issued in accordance with 8000H binary.

e.g.:

Fast rate according to G2	Fast rate according to G3 Binary Representation HI - byte		LO - byte		Hexadecimal Representation
+ 2400	0000	1001	0110	0000	0960H
- 2400	1111	0110	1010	0000	F6A0H
+ 9999	0010	0111	0000	1111	270FH
- 9999	1101	1000	1111	0001	D8F1H
0000	0000	0000	0000	0000	0000H
+ 0001	0000	0000	0000	0001	0001H
- 0001	1111	1111	1111	1111	FFFFH
MEAS OL	0111	1111	1111	1111	7FFFH
OFFS OL	1000	0000	0000	0000	8000H

OFFSET VALUE IN TALKER FUNCTION G4:

The format is the same as that for the talker function G0.
Only the field "T" is different:

OFVDC, OFVAC, OFADC, OFAAC, OFOHM, OFDGC, OFDGF

USER MESSAGE IN THE TALKER FUNCTION G5 and G6:

The format is always 16 alphanumerical characters and final characters.

OUTPUT IN THE TALKER FUNCTION G7 and G8:

The format NR1 is used for the output of the calibration counter and the extended status byte.

10.6 Status byte - Error Messages in the Display and BUS-operation

To avoid false measurements and simplify the error detection the status byte can be interrogated and the error identified.
The status byte can be regarded as the decade sum of the values of the following 8 bits.

STATUS BYTE:

	DIO8	RQS						DIO1
Status byte	ST8	ST7	ST6	ST5	ST4	ST3	ST2	ST1
Value when bit is 1	128	64	32	16	8	4	2	1

ST1 ... 1 if a digital overload exists

ST2 ... 2 if an analog overload exists (also in Hold)

ST3 ... 4 if the SRQ key is pressed

ST4 ... 8 if a trigger command exists (trigger too fast)
e.g.: trigger had already been sent during the measuring phase

ST5 ... 16 if data are available
calibration step is finished (with calibration procedure)

ST6 ... 32 if totalling error exists due to status byte extension

ST7 ... 64 if there are RQS operation requirements

ST8 ...128 is not used (always zero)

STATUS BYTE EXTENSION:

After an error message under ST6 of the status byte the status byte extension can be read out with G8 and thus the totalling error can be further processed. These messages will also be represented in the display according to the following table.

Extended Status byte	EST8	EST7	EST6	EST5	EST4	EST3	EST2	EST1
Value if bis is 1	128	64	32	16	8	4	2	1

Message in Display		Meaning
SYNTAX/ERROR	EST1... 1	if input message is faulty
LENGTH/ERROR	EST1... 1	if program string longer than 25 characters
EXECUTE/ERROR	EST2... 2	if command can not be carried out (command not allowed in the present condition of device)
VALUE/ERROR	EST3... 4	if offset or calibrated value lies outside the permitted range
ERROR 8	EST4... 8	if faulty access to the EEPROM (the analog section) takes place
	EST5...16	if error exists in the digital section:
ERROR 1	EST5...16	RAM error
ERROR 2	EST5...16	EPROM error
ERROR 3	EST5...16	Convertor does not answer
ERROR 4	EST5...16	Fault in the internal serial transmission
	EST6...32	if error exists in the analog section
ERROR 5	EST6...32	RAM error
ERROR 6	EST6...32	EPROM error
ERROR 7	EST6...32	measuring process faulty
CAL/ERR	EST7...64	if content of the EEPROM (the analog section) is in error
	EST8...128	is not used

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10.7 Explanation of the Remote Control Commands

SEQUENCES:

The remote control commands for function, range and offset should be transmitted to the device in the same sequence as in the list at Point 10.4. Other sequences can lead to undesirable device settings. If only a part of a setting is to be altered, it is sufficient to transmit the necessary command and not repeat all the commands.

e.g.:

	Device condition	: V DC (FØ) 200 mV (R1) without Offset (BØ)
1	Setting String	: R3 B1 F4
	Setting	: V DC at 20 V V DC Offset active Switching to kOhm 2W in the F4 range assigned until now
2	Setting String	: FØ
	Setting	: V DC 20 V Offset active

COMMAND PROCESSING:

Command buffer is 25 bytes long. For effective command length in the buffer - see next Point.

The Bus commands will be first checked for SYNTAX (permitted characters) and then translated to the internal code and stored in the command buffer. The SYNTAX ERROR (character error) can activate the SRQ mechanism if the appropriate SRQ mask is set. After the receipt of the final character the command will be processed in the sequence in which it was received, if no SYNTAX ERROR should occur.

If an EXECUTE ERROR occurs, the process will be interrupted and the SRQ set, if this is allowed.

SYNTAX SYMBOLS:

Type	Structure	Effective Length in Command Buffer
Bus command	- 1 letter + ordinal no.	... 1 byte
String<s>	- n alpha characters + separation sign	... n + 1 bytes
Values<v>	- Format	... 4 bytes

Device accepts the following formats:
NR1 (F1) integer with and without sign (without comma)
NR2 (F2) with and without sign with comma
NR3 (F3) with and without sign with comma and exponent
NR .... numerical Representation set
(according IEEE 488/1975, IEC 625/1980)

1. With Bus commands blank spaces have no importance.
2. The leading blanks and zeros in < value > have no importance.
   The length may not exceed the current display format.
3. ";" is used as the string separating sign.
4. ";" is also useable as the separating sign between Bus commands, but it is not absolutely necessary.

OFFSET

The OFFSET value is programmed as measured value of the next measurement with 00 or as numerical value according to the measurement rate with the command 01. The input for OFFSET value over 2400 - 240000 (according to measuring rate) will be registered as "VALUE ERROR" in the display and as EST3 at the Bus. The OFFSET value will be assigned as absolute value of the specific active function. Thus it is clear that switching-down of the measuring range can result in an Offset Overload message, besides on change of function the old Offset value will be switched off.
Depending on the measurement rate the display range can go up to 9999-999999. If the difference between the measured value and the Offset value exceeds this display range, then "OFFS.OL" will be displayed and 9999-999999 E+8 transmitted to the BUS.
When 2400 - 240000 is exceeded without OFFSET then "MEAS OL" will be displayed, 9999-999999 E+9 will be transmitted to the BUS and ST1 set.

TRIGGER DELAY (T3/T4):

In this type of operation the trigger (externally or from the BUS) will be delayed internally long enough so that the device already measures the first measured value in a stable condition, if the measured value was inserted shortly before the trigger (e.g.: by means of a scanner). This internal delay time thus corresponds to the stabilization time for the specific function.

TRIGGER DELAY TIMES (ms)

Measuring rate	slow		Auto zero off			Filter off
Range:	0.2	2	20	200	2000	20000
VDC	40	40	40	40	40	-
VAC	300	300	300	300	300	-
VDC		40				
AAC		300				
KOHM	200	200	200	200	400*	400*
TEMP	200					

Deviations of values from stable value: 10 counts (* 30 counts)
With medium measurement rates the times are reduced to half, with fast measurement to one tenth.
This is not valid for the AC-ranges (always 300 ms). The delay times are independent of "filter ON/OFF".
With Auto Zero ON the above delay times can be extended by the times for zero measurement (see table for Auto Zero Times), so a trigger will be additionally delayed, when it occurs within the Auto-Zero-measurement.

SERVICE REQUEST MASK:
The mask is erased in the switch-on condition. If a Service Request is then sent on occurance of a specific event, then the total of the appropriate value of the status byte (ST1...St6, 1...63) must be transmitted with the "Q" command.

e.g.: SRQ should come after the end of the measurement phase
and with Overload Value ST1 + ST2 + ST5 = 19
Command Q19

SERVICE REQUEST INQUIRY:
For the automatic processing of the SRQ inquiries the Controller must be programmed to Interrupt through SRQ (e.g.: ON SRQ; SRQ # 200 etc.) or if required the SRQ should be interrogated. By means of the Serial Poll that device will be investigated, which has transmitted RQS and the Status byte read from that instrument.
By evaluation of the status byte the device condition can be investigated and processed in an appropriate manner.

e.g.: ST = 97 gives resolved 64 + 32 + 1 (if RQS is transmitted)
ST = 33 gives resolved 32 + 1 (no sent)
Therefore a "digital overload" exists as well as a message in the extended status byte. This will be read out with G8 and following evaluation gives the following result:
G8 = 4
Thus there also exists a false Offset value.

AUTO ZERO

The Auto-Zero will be carried out every two seconds. The duration depends on the filter and the measurement rate.

	Auto Zero Time in ms		
Rate	Filter ON	Filter OFF	for A, 2 MOhm and 2 MOhm Ranges
Slow	340	580	+ 100
Medium	140	260	+ 20
Fast	26	50	+ 2

With the "SINGLE TRIGGER" (Hold) type of operation the device stands in the Auto-Zero phase and waits for the trigger command in order to begin the measurement.

With the fast conversion rate the scanning rate can be briefly interrupted by an automatic Auto-Zero, thus creating undesirable scanning gaps. In order to avoid this, the Auto-Zero can be switched off with "Z1" and before the scanning procedure a single Auto-Zero with "Z2" will be released.

ATTENTION! If a trigger command is transmitted while the device is still in the measurement phase, then ST4 will be set in the status byte. The trigger will be stored and carried out at the earliest possible time, in order to prevent a Bus blockade because of the lack of a measurement value during the readout. Therefore an asynchronity can exist on triggering from several devices or to an external event. In order to establish this, the status byte should always be processed.

In order to gain time during the fast measuring series, the interlacing of trigger and readout is permitted, so that the readout can take place during the next measuring phase. To avoid trigger errors the status byte ST4 + ST5 must be noted without fail.

Command Sequence:

Trigger 1 - wait for SRQ if ST5 = 16
Trigger 2 - read out measurement value 1, wait for SRQ if ST5 = 16
Trigger 3 - read out measurement value 2, ...

A prerequisite is that the Controller can carry out the trigger processing and the preparation for the readout procedure. If the Controller needs longer than the measurement time for this, then the first measurement value will be lost.

If the device is in the internal condition, the BUS trigger (GET) will always be accepted, the current measurement interrupted and a new measurement cycle started. Thus several devices can be synchronised with one another (Auto-Zero OFF).

CALIBRATION

Access to the calibration routine is by means of C4 + calibration code (see Point 7.4). Please note warm-up time of 1 hour!

ATTENTION! With the first transmission of C1 or C2 the calibration counter will be raised by 1 and thus the guarantee for the maker's calibration will be rendered null and void!

A total calibration should take place in the same sequence as the manual calibration. It is generally possible to carry out the calibration of a specific range. The desired range will be selected by transmission of function and range. The calibration value must lie between 45 % and 110 % of the measurement range nominal value. With Pt100 this is 100 Ohm. The calibration value will be transmitted with C3.

Calibration Sequence:

DCV	0.2 V ... 1000 V		Calibration started with C1
ACV	0.2 V ... 1000 V	130 Hz	Calibration started with C1
	0.2 V ... 200 V	100 kHz	Calibration started with C2
	1000 V	30 kHz	Calibration started with C2
DCA	2 A		Calibration started with C1
ACA	2 A	130 Hz	Calibration started with C1
		5 kHz	Calibration started with C2
Ohm	200 Ohm, 2000 Ohm	Short Circuit	Calibration started with C1
	200 Ohm - 20 MOhm	Measured value	Calibration started with C2
Pt100	(100 Ohm)		Calibration started with C2

As the measuring device carries out a check measurement automatically after each calibration, the end of the calibration step can be determined by means of RQS or by readout of the measured value. The "TIME OUT" of the controller should be set at a minimum of 40 s, as the calibration of the AC range with C2 takes approx. 30 s.

Exit from the calibration mode is by means of "C0".

Reserved for personal remarks

11. GUIDE TO CORRECTION OF ERRORS

12. PROGRAMMING EXAMPLES

```
READY.

 10 REM ************************************************************************
 20 REM *              PROGRAMMINGEXAMPLE  OF   MULTIMETER                      *
 30 REM *                    BY NORMA CONTROLLER C9895                          *
 40 REM ************************************************************************
 50 REM :                                REM IEEE ADDRESS= 5
 60 CLI#:FORT=1TO2000:NEXTT:             REM INITIALIZE OF BUS
 70 REN#5:                               REM SET REMOTE ENABLE
 80 LLO#:                                REM SET LOCAL LOCK OUT
 90 DCL#:                                REM SET TO POWER-ON CONDITION
 100 FOR I=1 TO 400 : NEXT I :           REM WAIT UNTIL SETTIME IS FINISHED
 110 RED#5\A$ :                          REM READ OUT OF TESTRESULT
 120 PRINT A$ :                          REM PRINT TESTRESULT
 130 GOTO 110
READY.

READY.

 10 REM ************************************************************************
 20 REM *              PROGRAMMINGEXAMPLE  OF   MULTIMETER                      *
 30 REM *                    BY NORMA CONTROLLER C 9895                         *
 40 REM ************************************************************************
 50 REM :                                REM IEEE-ADDRESS= 5
 60 CLI#:FORT=1TO2000:NEXTT:             REM INITIALIZE OF BUS
 70 REN#5:                               REM SET REMOTE ENABLE
 80 LLO#:                                REM SET LOCAL LOCK
 90 DCL#:                                REM SET TO POWER-ON CONDITION
 100 WRT#5\"T1" :                        REM BUSTRIGGER WITHOUT DELAY
 110 WRT#5\"Z1" :                        REM WITHOUT AUTO-ZERO
 120 WRT#5\"Z2" :                        REM ZERO-MEASUREMENT
 130 FOR I=1 TO 400 : NEXT I :           REM WAIT UNTIL SETTIME IS FINISHED
 140 TRG#5 :                             REM START MEASUREMENT
 150 SPL#5:H = ST                        REM READ OUT OF STATUSBYTE
 160 IF H =  16 THEN 190 :               REM MEASUREMENT READY
 170 IF H <> 0 THEN 220 :                REM MULTIMETERMESSAGE OVERLOAD,SRQ ETC.
 180 GOTO 150
 190 RED#5\A$ :                          REM READ OUT OF TESTRESULT
 200 PRINT A$ :                          REM PRINT TESTRESULT
 210 GOTO 140
 220 :                                   REM ERROR-TEST
 230 END
READY.
```

```
READY.

 10 REM ************************************************************
 20 REM *              PROGRAMMINGEXAMPLE OF MULTIMETER             *
 30 REM *                   BY NORMA CONTROLLER C9895               *
 40 REM ************************************************************
 50 REM :                                REM IEEE-ADDRESS= 5
 60 CLI#:FORT=1TO2000:NEXTT:             REM INITIALIZE OF BUS
 70 SRQ#0 :                              REM DISABLE SRQ
 80 REN#5:                               REM SET REMOTE ENABLE
 90 LLO#:                                REM SET LOCAL LOCK OUT
 100 DCL#:                               REM SET TO POWER-ON CONDITION
 110 WRT#5\"T1" :                        REM BUSTRIGGER WITHOUT DELAY
 120 WRT#5\"G2" :                        REM WITHOUT ALPHA-HEAD
 130 WRT#5\"O1 10.0" :                   REM OFFSETVALUE = 10.0 VOLT
 140 WRT#5\"B1" :                        REM OFFSETMEASUREMENT ENABLE
 150 WRT#5\"Q16" :                       REM SRQ ON MEASUREMENT READY
 160 FOR I=1 TO 400 : NEXT I :           REM WAIT UNTIL SETTIME IS FINISHED
 170 TRG#5 :                             REM START MEASUREMENT
 180 SRQ#200 :                           REM SRQ-PRG ON LINE 200
 190 PRINTCHR$(145)+"WAIT FOR SRQ":GOTO 190
 200 REM ---------- SRQ PROGRAMM ----------------------------------------
 210 SPL#5 :H=ST                         REM TEST SRQ
 220 IF (H AND 64) <> 64 THEN 280 :      REM SRQ FROM OTHER DEVICE
 230 TRG#5 :                             REM TRIGGER FOR NEXT MEASUREMENT
 240 RED#5\A$ :                          REM READ OUT TESTRESULT
 250 PRINT A$ : PRINT :                  REM PRINT TESTRESULT
 260 RTS# :                              REM RETURN FROM SRQ
 270 REM ---------- SRQ PROGRAMM  END -----------------------------------
 280 :                                   REM TEST OF OTHER IEC-DEVICES
 290 PRINT"SRQ FROM OTHER DEVICE"
 300 RTS#
 310 END
READY.
```

```
READY.

 10 REM ************************************************************************
 20 REM *              PROGRAMMINGEXAMPLE OF MULTIMETER                        *
 30 REM *                    BY NORMA CONTROLLER C9895                         *
 40 REM ************************************************************************
 50 DIM A$(100)
 60 REM :                                  REM IEEE-ADDRESS= 5
 70 CLI#:FORT=1TO2000:NEXTT:               REM INITIALIZE OF BUS
 80 REN#5:                                 REM SET REMOTE ENABLE
 90 LLO#:                                  REM SET LOCAL LOCK OUT
 100 DCL# :                                REM SET TO POWER-ON CONDITION
 110 WRT#5\"G2" :                          REM WITHOUT ALPHA-HEAD
 120 WRT#5\"S1" :                          REM 4 1/2 DIGITS
 130 WRT#5\"Z1" :                          REM WITHOUT AUTO-ZERO
 140 WRT#5\"Z2" :                          REM ZERO-MEASUREMENT
 150 FOR I=1 TO 400 : NEXT I :             REM WAIT UNTIL SETTIME IS FINISHED
 160 T1=TI
 170 FOR I=1TO100 :                        REM READ OUT OF 100 TESTRESULTS
 180 RED#5\A$(I)
 190 NEXT
 200 T2=TI:T=(T2-T1)/60:                   REM TIME FOR 100 MEASUREMENTS
 210 PRINT "TIME FOR 100 MEASUREMENTS = ";T;" SECONDS"
 220 FOR I= 1 TO 100
 230 PRINT A$(I),
 240 NEXT I
READY.
```

PROGRAMMING EXAMPLES

```
10 REM ************************************************************************
20 REM *              PROGRAMMINGEXAMPLE  OF   MULTIMETER                      *
30 REM *                   BY SIEMENS CONTROLLER B 8012                        *
40 REM ************************************************************************
50 CLEAR # DIM A$(20)
60 A=5                                  #REM IEEE-ADDRESS= 5
70 ICL                                  #REM INITIALIZE OF BUS
80 REN1                                 #REM SET REMOTE ENABLE
90 LLO                                  #REM SET LOCAL LOCK OUT
100 DCL                                 #REM SET TO POWER-ON CONDITION
110 FOR I=1 TO 400 # NEXT I             #REM WAIT UNTIL SETTIME IS FINISHED
120 MES(V)A=A$                          #REM READ OUT OF TESTRESULT
130 PRA$                                #REM PRINT TESTRESULT
140 GOTO 120
```

```
10 REM ************************************************************************
20 REM *              PROGRAMMINGEXAMPLE  OF   MULTIMETER                      *
30 REM *                   BY SIEMENS CONTROLLER B 8012                        *
40 REM ************************************************************************
50 CLEAR # DIM A$(20)
60 A=5                                  #REM IEEE-ADDRESS= 5
70 ICL                                  #REM INITIALIZE OF BUS
80 REN1                                 #REM SET REMOTE ENABLE
90 LLO                                  #REM SET LOCAL LOCK OUT
100 DCL                                 #REM SET TO POWER-ON CONDITION
110 SET(V)A="T1"                        #REM BUSTRIGGER WITHOUT DELAY
120 SET(V)A="Z1"                        #REM WITHOUT AUTO-ZERO
130 SET(V)A="Z2"                        #REM ZERO-MEASUREMENT
140 FOR I=1 TO 400 # NEXT I             #REM WAIT UNTIL SETTIME IS FINISHED
150 TRG A                               #REM START MEASUREMENT
160 H = STA(A)                          #REM READ OUT OF STATUSBYTE
170 IF H =  16 THEN GOTO 200            #REM MEASUREMENT READY
180 IF H <> 0 THEN GOTO 230             #REM MULTIMETERMESSAGE OVERLOAD,SRQ ETC.
190 GOTO 160
200 MES(V)A=A$                          #REM READ OUT OF TESTRESULT
210 PR A$                               #REM PRINT TESTRESULT
220 GOTO 150
230 #                                    REM ERROR-TEST
240 END
```

```
10 REM ************************************************************************
20 REM *              PROGRAMMINGEXAMPLE  OF   MULTIMETER                     *
30 REM *                    BY SIEMENS CONTROLLER B 8012                      *
40 REM ************************************************************************
50 CLEAR # DIM A$(20)
60 A=5                                  #REM IEEE-ADDRESS= 5
70 ICL                                  #REM INITIALIZE OF BUS
80 OFF SRQ                              #REM SRQ DISABLE
90 REN1                                 #REM SET REMOTE ENABLE
100 LLO                                 #REM SET LOCAL LOCK OUT
110 DCL                                 #REM SET TO POWER-ON CONDITION
120 SET(V)A="T1"                        #REM BUSTRIGGER WITHOUT DELAY
130 SET(V)A="G2"                        #REM WITHOUT ALPHA-KOPF
140 SET(V)A="O1 10.0"                   #REM OFFSETVALUE = 10.0 VOLT
150 SET(V)A="B1"                        #REM OFFSETMEASUREMENT ENABLE
160 SET(V)A="Q16"                       #REM SRQ ON MEASUREMENT READY
170 FOR I=1 TO 400 # NEXT I             #REM WAIT UNTIL  SETTIME IS FINISHED
180 TRG A                               #REM START MEASUREMENT
190 ON SRQ GOSUB 220                    #REM SRQ-PRG ON LINE 220
200 PRINT\L"WAIT FOR SRQ"
210 GOTO 200
220 REM ---------- SRQ PROGRAMM ----------------------------------------
230 H = STA (A)                         #REM TEST SRQ
240 IF (H AND 64) <> 64 THEN GOTO 300 #REM SRQ FROM OTHER DEVICE
250 TRG A                               #REM TRIGGER FOR NEXT MEASUREMENT
260 MES(V)A=A$                          #REM READ OUT OF TESTRESULT
270 PR A$ # PR                          #REM PRINT TESTRESULT
280 RET                                 #REM RETURN FROM SRQ
290 REM ---------- SRQ PROGRAMM  END -----------------------------------
300 #                                    REM TEST OF OTHER IEC-DEVICES
310 PR "SRQ FROM OTHER DEVICE"
320 RET
330 END
```

```
10 REM ************************************************************************
20 REM *             PROGRAMMINGEXAMPLE  OF   MULTIMETER                      *
30 REM *                  BY SIEMENS CONTROLLER B 8012                        *
40 REM ************************************************************************
50 CLEAR # DIM A$(1000)
60 A=5                                  #REM IEEE-ADDRESS= 5
70 ICL                                  #REM INITIALIZE OF BUS
80 REN1                                 #REM SET REMOTE ENABLE
90 LLO                                  #REM SET LOCAL LOCK OUT
100 DCL                                 #REM SET TO POWER-ON CONDITION
110 SET(V)A="G2"                        #REM WITHOUT ALPHA-KOPF
120 SET(V)A="S1"                        #REM 4 1/2 DIGITS
130 SET(V)A="Z1"                        #REM WITHOUT AUTO-ZERO
140 SET(V)A="Z2"                        #REM ZERO-MEASUREMENT
150 FOR I=1 TO 400 # NEXT I             #REM WAIT UNTIL SETTIME IS FINISHED
160 T1=CLOCK
170 TRA(B1000)5=A$                      #REM READ OUT OF 100 TESTRESULTS
180 #                                    REM (1000 BYTES)
190 T2=CLOCK # T=T2-T1                  #REM TIME FOR 100 MEASUREMENTS
200 PR "TIME FOR 100 MEASUREMENTS= "T" SECONDS"
210 FOR I= 1 TO 100
220 PR MID$(A$,I*10-9,9)
230 NEXT I
```

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