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BAMA KOPIE

System Multimeter
PM2535

Operation Manual/Gebrachsanleitung/Notice d'emploi

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900810

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IMPORTANT

In correspondence concerning this instrument, please quote the type number and serial number as given on the type plate.

NOTE: *The design of this instrument is subject to continuous development and improvement. Consequently, this instrument may incorporate minor changes in detail from the information contained in this manual.*

WICHTIG

Bei Schriftwechsel über dieses Gerät wird gebeten, die genaue Typenbezeichnung und die Gerätenummer anzugeben. Diese befinden sich auf dem Leistungsschild.

BEMERKUNG: *Die Konstruktion und Schaltung dieses Geräts wird ständig weiterentwickelt und verbessert. Deswegen kannn dieses Gerät von den in dieser Anleitung stehenden Angaben abweichen.*

IMPORTANT

RECHANGE DES PIECES DETACHEES (Réparation)
Dans votre correspondance et dans vos réclamations se rapportant à cet appareil, veuillez TOUJOURS indiquer le numéro de type et le numéro de série qui sont marqués sur la plaquette de caractéristiques.

REMARQUE: *Cet appareil est l'objet de développements et améliorations continuels. En conséquence, certains détails mineurs peuvent différer des informations données dans la présente notice d'emploi et d'entretien.*

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1. OPERATOR SAFETY

Read this page carefully before installation and use of the instrument.

1.1 GENERAL INFORMATION

The instrument described in this manual is designed to be used by properly-trained personnel only. Adjustment, maintenance and repair of the exposed equipment shall be carried out only by qualified personnel, who are aware of the hazards involved.

1.2 SAFETY PRECAUTIONS

For the correct and safe use of this instrument it is essential that both operating and service personnel follow generally-accepted safety procedures in addition to the safety precautions specified in this manual. Specific warning and caution statements, where they apply, will be found throughout the manual. Where necessary, the warning and caution statements and/or symbols are marked on the apparatus.

1.3 CAUTION AND WARNING STATEMENTS

CAUTION: is used to indicate correct operating or maintenance procedures in order to prevent damage to or destruction of the equipment or other property.

WARNING: calls attention to a potential danger that requires correct procedures or practices in order to prevent personnel injury.

1.4 SYMBOLS

Read the operating instructions.

Explanation of symbol
To preserve the instrument from damage the operator must refer to an explanation in the instruction manual.

1.5 IMPAIRED SAFETY PROTECTION

Whenever it is likely that safe operation is impaired, the instrument **must** be made inoperative and secured against any unintended operation.
The appropriate servicing authority must then be informed.

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2. GENERAL INFORMATION

2.1 INTRODUCTION

The PM2535 is a digital, automatic multimeter controlled by a microcomputer.

The instrument has the following capabilities:
- Standard multimeter functions
- Help functions
- Input of figures
- Extended capabilities via the IEC-625/IEEE-488 interface

The standard multimeter functions (white text) are:
- Direct voltages (V⎓)
- Alternating voltages (V∼) true RMS, ac coupled.
- Direct currents (A⎓)
- Alternating currents (A∼) true RMS, ac coupled.
- Resistance, in two-wire (Ω-2 W) and four-wire (Ω-4 W) configuration
- Temperature °C

Ranges can be selected manually, automatically or remote.
Beside the standard functions the user can alter the speed to increase the number of measurements per second, or to obtain a higher resolution.
The filter function switches in a frequency filter in the function V∼ and A∼; in all other functions (except °C) it acts as a digital filter.
Offset in the lowest dc range can be compensated by using the NULL function.

Measurements can be started with an internal, manual or external facility. External starting is possible via the trigger input, or via the IEC/IEEE-bus interface.

The help functions (green text) are:
- Mathematical functions, processing the measuring data such as:
  AX + B
  Δ%
  dBm
  ZERO

- Aquisition/presentation of the measuring data such as:
  DELAY, LIMITS, BURST.
  RD.BUF, MIN/MAX, LIMITS, DIGITS

- Function programming such as:
  To store and call combinations of instrument settings. PROG, SEQU (SYSTEM 21)
- General
  Bleeper 🔈 on/off, CHECK, ENTER, CLR (CLEAR)

The input of figures (blue text)
0...9, polarity and decimal point

Extended capabilities via the IEC-625/IEEE-488 interface

All the manual controls are also possible via the interface.

The PM2535 is equipped with an internal guard, which is externally accessible. Therefore, very low levels with noise voltages can be measured with high accuracy.

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2.2 CHARACTERISTICS

2.2.1 Safety Characteristics

This apparatus has been designed and tested in accordance with Safety Class I requirements of IEC Publication 348, Safety Requirements for Electronic Measuring Apparatus and CSA 556B, and has been supplied in a safe condition.

This manual contains information and warnings which must be followed to ensure safe operation and to retain the instrument in a safe condition.
This instrument:
- satisfies the requirements of EEC Council Directive NO. 73/23 EEC in that it conforms with IEC Publication 348.
- is listed by the Canadian Standards Association as certified.
- is certified by the Independent German Testing and Approvals Institute VDE (and has been tested according to VDE 0411, Part 1).

2.2.2 Performance Characteristics

- Properties expressed in numerical values with stated tolerance are guaranteed by PHILIPS. Specified non-tolerance numerical values indicate those that could be **nominally** expected from the mean of a range of identical instruments.
- This specification is valid after the instrument has warmed up for 30 minutes (reference temperature 23 °C ± 2 °C) to reach the 90 days accuracy. The warm-up time to reach the 24 hours specification is 2 hours.

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2.2.3 Vdc

Ranges 300 mV, 3 V, 30 V, 300 V

Measuring modes:

Speed mode	Measuring speed (depending on measured value)	Nominal scale length	Resolution on 300 mV range
Speed 1	0.2 up to 0.3 meas/s	3 000 000	100 nV
Speed 2	2 up to 3 meas/s	300 000	1 μV
Speed 3	20 up to 30 meas/s	30 000	10 μV
Speed 4	>100 meas/s	3 000	100 μV

Notes: - Stated measuring speed is excluding IEC/IEEE controller.
- At speed 1 display value will be updated within 0.5 s after a step-change of input signal.

Accuracy is given in: ±(% of reading + % of range) relative to calibration values

Speed mode	Range	Accuracy 24 h, tcal ±1 °C	Accuracy 90 days, tcal ±5 °C	Accuracy 1 year, tcal ± 5°C
Speed 1 and 2	300 mV	0.0025 + 0.0013*	0.007 + 0.0017*	0.012 + 0.0017*
	3 V	0.0020 + 0.0010	0.005 + 0.0013	0.010 + 0.0013
	30 V	0.0025 + 0.0013	0.006 + 0.0017	0.015 + 0.0017
	300 V	0.0025 + 0.0010	0.006 + 0.0013	0.010 + 0.0013
Speed 3	300 mV - 300 V	0.0033 + 0.0033	0.008 + 0.005	0.010 + 0.005
Speed 4	300 mV - 300 V	0.033 + 0.033	0.04 + 0.05	0.05 + 0.05

* valid when using "NULL".

Temperature coefficient in range outside t_{cal} ± 5°C: ±(0.002 % of reading + 0.0005 % of range)/K

Input impedance: 10 MΩ // 30 pF
at overload on 300 mV and 3 V ranges:
100 kΩ // 30 pF

Offset current in input: <30 pA

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Series Mode Rejection:

	Mains frequency	
	50 or 60 Hz ±0.1 % *	50 or 60 Hz ±1 % *
Speed 1	>80 dB	>60 dB
Speed 2	>70 dB	>50 dB
Speed 3	>60 dB	>40 dB
Speed 4	0	0

* valid for 50 Hz or 60 Hz version respectively

Max. SM signal — Peak value 140 % of range

Common Mode Rejection
(measured with 1 kΩ unbalance, guard connected to CM voltage)

	DC signal	50 or 60 Hz ±0.1 % *	50 or 60 Hz ±1 % *
Speed 1	>140 dB	>160 dB	>140 dB
Speed 2	>140 dB	>150 dB	>130 dB
Speed 3	>140 dB	>140 dB	>120 dB
Speed 4	>140 dB	> 80 dB	> 80 dB

* valid for 50 Hz or 60 Hz version respectively

Max. CM voltage — 250 Vac or dc, 350 Vpeak between "0" and guard
250 Vac or dc, 350 Vpeak between guard and ground

Response time (Filter off): (at single trigger first reading is within specified distance from final value when step-input and trigger command are given simultaneously).

	excl. ranging		incl.ranging *		
	internal trigger	single trigger	internal trigger	single trigger	digits from final value
Speed 1	<5.0 s	<4.4 s	<5.1 s	<5.1 s	50
Speed 2	<950 ms	<540 ms	<750 ms	<800 ms	10
Speed 3	<100 ms	< 50 ms	<210 ms	<220 ms	10
Speed 4	< 30 ms	< 15 ms	< 80 ms	< 80 ms	5

* Ranging over max. number of ranges.

Maximum input voltage — Ranges 300 mV and 3 V: 400 V for <30 s
300 V continuously
600 Vpeak
Ranges 30 V and 300 V: 400 V continuously
600 Vpeak
Max. allowable V.Hz product 10^6

Zeroing — Offset voltage and thermal voltages on 300 mV range can be compensated via "NULL" pushbutton. Nulling range ±100 μV.

Filter — Digital filter can be switched on/off via "FILTER" pushbutton. Filter characteristic exponential with automatic reset after step change.

Clip indication — Signals clipping in input circuit during measuring cycle. Measuring cycle is normally finished and displayed including a warning symbol "↑".

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2.2.4 Vac

Converter type — AC-coupled RMS

Ranges — 300 mV, 3 V, 30 V, 300 V

Frequency range — Filter on 40 Hz - 100 kHz (default)
Filter off 400 Hz - 100 kHz

Measuring modes:

Speed mode	Measuring speed (int trig) (depending on measured value)	Nominal scale length	Resolution on 300 mV range
Speed 2 Speed 3	2.2 up to 3 meas/s 20 up to 30 meas/s	30 000 3 000	10 μV 100 μV

Note: Stated measuring is excluding IEC/IEEE controller.

Accuracy is: — Valid over 1-100 % of range;
±(% of reading + % of range) relative to calibrated values

Speed 2 and 3	Frequency range	Accuracy 24 h, tcal ± 1 °C	Accuracy 90 days, tcal ± 5 °C	Accuracy 1 year, tcal ± 5 °C
Filter on	40 Hz - 5 kHz	0.1 + 0.1	0.2 + 0.1	0.3 + 0.1
Filter off	400 Hz - 5 kHz	0.1 + 0.1	0.2 + 0.1	0.3 + 0.1
Filter on and off	5 kHz - 100 kHz	(0.02 + 0.02)/kHz	(0.04 + 0.02)/kHz	(0.06 + 0.02)/kHz

Temperature coefficient in range outside t_{cal} ±5 °C — ±0.03 % of reading/K

Input impedance — Ranges 300 mV and 3 V: 1.2 MΩ // 30 pF
Ranges 30 V and 300 V: 0.93 MΩ // 30 pF

Common Mode Rejection (guard connected to "0" 1 kΩ unbalance) — 120 dB for dc signals
80 dB for ac signals of 50 Hz, decreasing with 20 dB/dec

Maximum CM voltage — 250 Vac or dc, 350 Vpeak between "0" and guard
250 Vac or dc, 350 Vpeak between guard and ground

Response time: (at single trigger first reading is within specified distance from final value when step-input and trigger command are given simultaneously).

	Excl. ranging				Incl. ranging				Digits from final value
	Filter on		Filter off		Filter on		Filter off		
	Trigger		Trigger		Trigger		Trigger		
	internal	single	internal	single	internal	single	internal	single	
Speed 2	<1.8 s	<1.5 s	<1.1 s	<650 ms	<2.1 s	<3.1 s	<1.3 s	<1.5 s	10
Speed 3	<0.9 s	<1.0 s	<200 ms	<200 ms	<1.7 s	<2.7 s	<800 ms	<900 ms	10

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Crest factor	>3.3 at full scale, increasing down scale by $3.3 \times \frac{\text{full scale}}{\text{reading}}$ with a maximum of 33. Warning on display when clipping occurs, by symbol "↑".
Maximum input voltage	All ranges 400 Vac or dc, 600 Vpeak.
Maximum V.Hz product	10^7
Maximum dc voltage on input	400 V

2.2.5 **Resistance** (2-wire, 4-wire)

Input configuration	2-wire via "0" and "V-Ohm" 4-wire via PROBE
Ranges 2-wire	3 kΩ, 30 kΩ, 300 kΩ, 3 MΩ, 30 MΩ, 300 MΩ.
4-wire	3 kΩ, 30 kΩ, 300 kΩ, 3 MΩ.

Measuring modes:

Speed mode	Ranges	Measuring speed (depending on measured value)	Nominal scale length	Resolution
Speed 1	3 kΩ-3 MΩ	.2 up to .3 meas/s	3 000 000	1 mΩ - 1 Ω
	30 MΩ	.2 up to .3 meas/s	300 000	100 Ω
	300 MΩ	.2 up to .3 meas/s	30 000	10 kΩ
Speed 2	3 kΩ-3 MΩ	2 up to 3 meas/s	300 000	10 mΩ - 10 Ω
	30 MΩ	2 up to 3 meas/s	30 000	1 kΩ
	300 MΩ	2 up to 3 meas/s	3 000	100 kΩ
Speed 3	3 kΩ-3 MΩ	20 up to 30 meas/s	30 000	100 mΩ - 100 Ω
	30 MΩ	20 up to 30 meas/s	3 000	10 kΩ
	300 MΩ	20 up to 30 meas/s	300	1 MΩ
Speed 4	3 kΩ-300 kΩ	>65 meas/s	3 000	1 Ω - 100 Ω

Notes: - Stated measuring speed is excluding IEC/IEEE controller.
- At Speed 1 display value will be updated within 0.5 s after a step-change of input signal.

Accuracy is given in: ± (% of reading + % of range) relative to calibration values

Speed mode	Range	Accuracy 24 h, tcal ±1 °C	Accuracy 90 days, tcal ±5 °C	Accuracy 1 year, tcal ±5 °C
Speed 1, 2 and 3	3 kΩ - 300 kΩ	0.01 + 0.0033	0.02 + 0.0033	0.03 + 0.0033
	3 MΩ	0.02 + 0.0033	0.04 + 0.0033	0.05 + 0.0033
	30 MΩ	0.06 + 0.0033	0.10 + 0.0033	0.15 + 0.0033
	300 MΩ	0.8 + 0.033	1.6 + 0.033	2.0 + 0.033
Speed 4	3 kΩ-300 kΩ	0.033 + 0.033	0.05 + 0.033	0.06 + 0.033

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Temperature coefficient in range outside:
t_{cal} ±5 °C

Ranges 3 kΩ - 3 MΩ	±0.005 % of reading/K
30 MΩ	±0.02 % of reading/K
300 MΩ	±0.05 % of reading/K
Measuring current	1 mA at 3 kΩ down to 10 nA at 300 MΩ (non-linear)
Maximum lead resistance in 4-wire configuration	100 Ω
Maximum voltage at open input	<10 V
Polarity input sockets	"V-Ω" negative, "0" positive
Testing semiconductor junctions	Possible in forward (up to Vf = 3 V) and reverse direction
Protection	2-wire terminals: up to 250 Vac or dc, 350 Vpeak 4-wire terminals: up to 30 Vac or dc, 42 Vpeak

Common Mode voltage influence
(measured with "guard" and "0" connected to CM voltage)

Speed	DC signal	50 or 60 Hz ±0.1 %	50 or 60 Hz ±1 %
1, 2, 3	0.00002	0.00002	0.0002
4	0.002	0.01	0.01

Maximum CM voltage:	
- 2-wire configuration	250 Vac or dc, 350 Vpeak between "0" and guard 250 Vac or dc, 350 Vpeak between guard and ground
- 4-wire configuration	30 Vac or dc, 42 Vpeak between "0" and ground; guard must be connected to "0"

Response time: (filter off)
(at single trigger first reading is within specified distance from final value when step-input and trigger command are given simultaneously)

Speed Mode	Ranges	Excl. ranging		Incl. ranging		Digits from final value
		internal trigger	single trigger	internal trigger	single trigger	
Speed 1	3 kΩ - 3 MΩ	<5.0 s	<4.4 s	<5.2 s	<5.2 s	50
	30 MΩ	<5.2 s	<4.6 s	<5.6 s	<5.8 s	50
	300 MΩ	<5.5 s	<4.9 s	<5.8 s	<6.0 s	50
Speed 2	3 kΩ - 3 MΩ	<950 ms	<540 ms	<750 ms	<800 ms	10
	30 MΩ	<1.3 s	<700 ms	<1.1 s	<1.2 s	10
	300 MΩ	<2.0 s	<1.0 s	<1.3 s	<1.4 s	10
Speed 3	3 kΩ - 300 kΩ	<110 ms	< 60 ms	<220 ms	<230 ms	10
	3 MΩ	<140 ms	< 90 ms	<500 ms	<500 ms	10
	30 MΩ	<300 ms	<300 ms	<1.0 s	<1.0 s	10
	300 MΩ	<500 ms	<500 ms	<1.5 s	<1.5 s	10
Speed 4	3 kΩ - 300 kΩ	<40 ms	<25 ms	<90 ms	<90 ms	5

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Filter	Digital filter can be switched on/off via "FILTER" pushbutton. Filter characteristic: exponential with automatic reset after step change
Clip indication	Signals clipping in input circuit during measuring cycle. Measuring cycle is normally finished and displayed including a warning symbol "↑".

2.2.6 Idc

Ranges: 30 mA, 3 A

Measuring modes:

Speed mode	Measuring speed (depending on measured value)	Nominal scale length	Resolution on 30 mA range
Speed 2	2 up to 3 meas/s	300 000	100 nA
Speed 3	20 up to 30 meas/s	30 000	1 µA
Speed 4	>100 meas/s	3 000	10 µA

Note: - stated measuring speed is excluding IEC/IEEE controller.

Accuracy is given in: ± (% of reading + % of range) relative to calibration values

Speed mode	Range	Accuracy 24 h, tcal ±1 °C	Accuracy 90 days, tcal ±5 °C	Accuracy 1 year, tcal ±5 °C
Speed 2 and 3	30 mA and 3 A			
	<1 A	0.01 + 0.005	0.03 + 0.005	0.05 + 0.005
	>1 A	0.1 + 0.01	0.15 + 0.01	0.2 + 0.01
Speed 4	30 mA and 3 A			
	<1 A	0.01 + 0.03	0.03 + 0.03	0.05 + 0.03
	>1 A	0.1 + 0.05	0.15 + 0.05	0.2 + 0.05

Temperature coefficient outside range t_{cal} ±5 °C: ± (0.005 % of reading + 0.001 % of range)/K

Voltage drop: Range 30 mA <250 mV
Range 3 A <600 mV

Protection: By fuse 3.15 AF
Up to 250 Vac or dc, 350 Vpeak.

Series Mode Rejection

	Mains frequency	
	50 or 60 Hz ±0.1 % *	50 or 60 Hz ±1 % *
Speed 2	>70 dB	>50 dB
Speed 3	>60 dB	>40 dB
Speed 4	0	0

* valid for 50 Hz or 60 Hz version respectively

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Max. SM signal — Peak value 150 % of range

Common Mode voltage influence — ± (% of range/V)

	DC signals	50 or 60 Hz ±0.1 % *	50 or 60 Hz ±1 % *
Speed 2, 3	0.00002	0.00002	0.0002
Speed 4	0.002	0.01	0.01

* valid for 50 Hz or 60 Hz respectively

Max. CM voltage — 250 Vac or dc, 350 Vpeak between "0" and guard
250 Vac or dc, 350 Vpeak between guard and ground

Response time: (at single trigger first reading is within specified distance from final value when step-input and trigger command are given simultaneously)

	excl. ranging		incl.ranging		Digits
	internal trigger	single trigger	internal trigger	single trigger	from final value
Speed 2	<950 ms	<540 ms	<750 ms	<800 ms	10
Speed 3	<100 ms	<50 ms	<210 ms	<220 ms	10
Speed 4	<30 ms	<15 ms	<80 ms	<80 ms	5

Filter — Digital filter can be switched on/off via "FILTER" pushbutton.
Filter characteristic exponential with automatic reset at step change

Clip indication — Signals clipping in input circuit during measuring cycle.
Measuring cycle is normally finished and displayed including a warning symbol "↑".

2.2.7 Iac

Converter type — AC-coupled RMS, no DC component allowed.

Ranges — 30 mA, 3 A

Frequency range — Filter on: 40 Hz - 1 kHz (default)
Filter off: 400 Hz - 1 kHz

Measuring modes:

Speed mode	Measuring speed (int trig) (depending on measured value)	Nominal scale length	Resolution on 30 mA range
Speed 2	2.2 up to 3 meas/s	30 000	1 µA
Speed 3	20 up to 30 meas/s	3 000	10 µA

Note: Stated measuring speed is excluding IEC/IEEE controller.

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Accuracy is:

Valid over 1-100 % of range;
± (% of reading + % of range) relative to calibrated values

Speed 2 and 3	Frequency range	Accuracy 24 h, tcal ±1 °C	Accuracy 90 days, tcal ±5 °C	Accuracy 1 year, tcal ±5 °C
Filter on	40 Hz - 1 kHz	0.1 + 0.1	0.2 + 0.1	0.3 + 0.1
Filter off	400 Hz - 1 kHz	0.1 + 0.1	0.2 + 0.1	0.3 + 0.1

Temperature coefficient in range outside t_{cal} ±5 °C

±0.03 % of reading/K

Voltage drop

Range 30 mA <250 mV
Range 3 A <600 mV

Protection

By fuse 3.15 AF
Up to 250 Vac or dc, 350 Vpeak

Common Mode voltage influence

±0.0001 % of range/V for DC signals
±0.0001 % of range/V for AC signals up to 100 Hz

Maximum CM voltage

250 Vac or dc, 350 Vpeak between "0" and guard
250 Vac or dc, 350 Vpeak between guard and ground

Response time: (filter off)
(at single trigger first reading is within specified distance from final value when step-input and trigger command are given simultaneously)

	Excl. ranging				Incl. ranging				Digits from final value
	Filter on		Filter off		Filter on		Filter off		
	Trigger		Trigger		Trigger		Trigger		
	internal	single	internal	single	internal	single	internal	single	
Speed 2	<1.8 s	<1.5 s	<1.1 s	<650 ms	<2.1 s	<3.1 s	<1.3 s	<1.5 s	10
Speed 3	<0.9 s	<1.0 s	<200 ms	<200 ms	<1.7 s	<2.7 s	<800 ms	<900 ms	10

Crest-factor

>3.3 at full scale, increasing down scale by $3.3 \times \frac{\text{full scale}}{\text{reading}}$ with maximum of 33.

Warning on display when clipping occurs, by symbol "↑".

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2.2.8 Temperature (°C)

Measuring principle	Pt-100 probe, according to DIN 43760, in 4-wire configuration via PROBE input
Recommended probe	Philips PM 9249 (−60 °C up to +200 °C)
Range	−100 °C up to 850 °C
Resolution	Speed 2: 0.1 °C Speed 3: 1 °C
Measuring current	1 mA
Linearisation	Probe characteristics according to DIN 43760 is linearised within stated accuracy limits
Accuracy	Excl. probe ± (0.3 % of reading + 0.2 °C)
Temperature coefficient	± (0.01 % of reading + 0.003 % of range)/K

Response time (excl. probe)

	internal trig.	single trig.
Speed 2	<750 ms	<550 ms
Speed 3	<75 ms	<65 ms

Note: Stated measuring speed is excluding IEC/IEEE controller.

Max. voltage between "0" and guard	30 Vac or dc, 42 Vpeak
Max. voltage at probe tip	Depending on probe

2.2.9 Converter characteristics (of analog-to-digital converter)

Type of conversion	Linear
Operating principle	Integrating ADC
Commutation point	At the end of each representation unit
Basic mode of operation: - manually triggered - externally triggered	Via "SINGLE" pushbutton on front. In "SINGLE TRIGGER" mode via rear input "EXT TRIG" (BNC). Starting a measurement via the interface is possible in SINGLE TRIGGER mode.
- repetitive triggered	In "INT TRIGGER" mode a new measurement is started automatically after completing the previous one.
Range setting	Selectable between AUTO and MANUAL ranging - Manual with UP and DOWN switches - Automatic: • upranging at about 100 % of scale, 3 000/30 000/300 000/3 000 000 • downranging at about 9 % of scale, 270/2700/27 000/270 000
Polarity setting	Automatic setting on Vdc, Adc, °C, blanked in other functions

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Resolution

1 : 3 000
1 : 30 000
1 : 300 000
1 : 3 000 000
depending on selected function, range and speed mode

Initial settings after power on or reset

As stored in program 0. (PROG 0)

2.2.10 Time function

Input settling time

Automatically adapted to obtain a correct measuring result when input signal and trigger signal are given simultaneously in Single Trigger mode

Sampling time

Speed \ Version	50 Hz	60 Hz
1, 2, 3	20 ms	16⅔ ms
4	2 ms	2 ms

2.2.11 Input terminal arrangement

Number of sockets

- 5x safe 4 mm terminals on removable input unit mounted in front; can also be mounted on rear (guard, 0 $_{V\text{-}\Omega}$, 0$_A$, V-Ω, A).
- 2x 8 pin DIN connectors for PROBE, one on front and one on rear. Only one socket accessible at a time.

Input configuration

Asymmetrical, floating, guarded

Impedance between sockets

guard - ground	>10 GΩ // <1000 pF
guard - "0"	>10 GΩ // <1000 pF
"0" - ground	>20 GΩ // < 500 pF
"0" - V-Ω	depending on function and range, see relevant spec. points.
"0" - A	depending on function and range, see relevant spec. points.
"0$_{V\text{-}\Omega}$" - "0$_A$"	directly connected

Maximum voltage between input sockets

guard - ground	250 Vac or dc, 350 Vpeak
guard - "0"	250 Vac or dc, 350 Vpeak
"0" - ground	250 Vac or dc, 350 Vpeak
V-Ω - ground	450 Vac or dc, 600 Vpeak
A - "0"	250 Vac or dc, 350 Vpeak fuse protected (Imax. 3 A)
V-Ω - "0"	depending on function and range; see relevant specification

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2.3 OPERATIONAL DATA

Warm-up time	30 minutes to reach specified 90 days accuracy 2 hours before calibration and for 24 h specification
Safety	According to IEC-348/VDE 0411 Safety Class I CSA 556-B
Mechanical characteristics	Dimensions: 280 x 210 x 86 mm Mass: 2.85 kg. Cabinet material: Aluminium case plastic front
Recalibration interval	1 year
Back-up battery life-time	5 years

2.3.1 Display

Visual representation

Number of digits	6.5, 5.5, 4.5, 3.5, depending on function, range and speed mode
Number of representation units	3 000 30 000 300 000 3 000 000 depending on function, range and speed mode
Means of representation of output value	7-segment, reflective LCD display, 9 mm
Polarity representation	Automatic indication of + or −, or blanked according to measured quantity
Decimal point representation	Indicated in LCD display
Means of function representation	Selected function is indicated in LCD via units indication and annunciators
Means of units representation	Via 16-segment characters in LCD; mV, V, Ω, kΩ, MΩ, μA, mA, °C
Overload representation	Display indicates "OL"
Indication of exceeding crest-factor or clipping input circuit	"↑" in LCD, measured value remains on display
Data hold	Possible in SINGLE TRIGGER mode via "SINGLE" pushbutton or EXT TRIG input on rear, or by using Data Hold Probe PM9267
Range hold	Possible via RANGING "AUT/MAN" switch
Acoustic representation	Signal is given: - at Vdc and Vac when overload occurs on 300 V range (cannot be switched off) - at Adc and Aac when overload occurs on 3 A range (cannot be switched off) - in the help-funtions (selectable)

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2.3.2 IEC/IEEE interface

IEC/IEEE interface	According to IEC-625, IEEE-488
See section 5.2. for specification	

2.3.3 System 21 interface

Interface function	Master function System 21 bus
Connector type	9-pin female D-connector
Available supply	current 200 mA

2.3.4 External control

Remote programmable	Via IEC/IEEE-bus
External triggering	Via BNC on rear - Trigger pulse negative-going, width >15 µs H = +2.4 ... +20 V L = −20 ... +1 V - By short-circuiting EXT TRIG input one measurement is performed. Recovery time >10 ms - EXT TRIG input is protected up to 60 Vac or dc, 85 Vpeak

2.4 ENVIRONMENTAL CONDITIONS

General

The environmental data mentioned in this manual are based on the results of the manufacturer's checking procedures.
Details on these procedures and failure criteria are supplied on request by the PHILIPS organisation in your country, or by PHILIPS, INDUSTRIAL & ELECTRO-ACOUSTICAL EQUIPMENT DIVISION, EINDHOVEN, THE NETHERLANDS.

Operating conditions are specified according to IEC 359.

2.4.1 Climatic conditions

Group I with extension of the temperature limits

Temperature

Reference temperature	23 °C ±1 °C
Rated range of use	0 °C ... 50 °C
Limit range of operation	0 °C ... 55 °C
Limit range of storage and transport	−25 °C ... +70 °C

Humidity

Reference rel. hum.	45 - 75 % RH
Rated range of use	20 - 80 % RH (no condensation)
Limit range of operation	20 - 80 % RH
Limit range of storage and transport	5 - 95 % RH
Max. dew-point	25 °C

Barometric pressure

Rated range of use	70 kPa to 106 kPa (up to 2200 m)
Limit range for storage and transport	53.3 kPa to 106 kPa (up to 4300 m)

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2.4.2 Mechanical conditions

Group	2

2.4.3 Line supply conditions

Group	S2

Voltage

Reference value	230 V ±1 %
Rated range of use	230 V ±10 %

Note: Instrument can be altered internally for a nominal mains voltage of 115 V.

Frequency

Reference value	50 Hz ±1 %
Rated range of use	50 Hz ±1 %

Note: Instrument can be altered internally for a nominal mains frequency of 60 Hz

Interruptions

Interruption	<10 ms: no influence >10 <500 ms: instrument may either restart or continue >500 ms: instrument will restart, condition equals situation as stored in program 0 (PROG 0).

2.4.4 Power consumption

Power consumption	<20 VA

Electromagnetic compatibility

Conducted interference	CISPR publ 11 and 14 VDE 871-B and 875-K
Radiated interference	VFG 1046/84

2.4.5 Accessories

Supplied with instrument:

Measuring leads PM9266 (incl. probes)
Mains supply cable
Spare fuses
Operating manual
8-pin DIN connector

Optionally available

Specific accessories for PM2535	4-wire Ω cable	PM9264/01
	Shielded measuring cable	PM9265/01

Universal accessories

High frequency probe	PM9210
High frequency probe	PM9213
Current shunt	PM9244
Current transformer	PM9245
Current probe	PM9101
EHT probe	PM9246
Temp. probe (Pt-100)	PM9249
Data hold probe	PM9267
Rack mounting set	PM9280/02

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3. INSTALLATION INSTRUCTIONS

3.1 INITIAL INSPECTION

Check the contents of the shipment for completeness and note whether any damage has occurred during transport. If the contents are incomplete, or there is damage, a claim should be filed with the carrier immediately, and the Philips Sales or Service organisation should be notified in order to facilitate the repair or replacement of the instrument.

3.2 SAFETY INSTRUCTIONS

3.2.1 Earthing (Grounding)

Before any other connection is made, the instrument shall be connected to a protective earth conductor via the three-core mains cable.
The mains plug shall be inserted only into a socket outlet provided with a protective earth contact. The protective action shall not be negated by use of an extension cord without protective conductor.

WARNING: Any interruption of the protective conductor inside or outside the instrument, or disconnection of the protective earth terminal, is likely to make the instrument dangerous. Intentional interruption is prohibited.

3.2.2 Mains voltage setting and fuses

WARNING: The instrument shall be disconnected from all voltage sources when a fuse is to be renewed, or when the instrument is to be adapted to a different mains voltage.

- Before inserting the mains plug into the mains socket, make sure that the instrument is set to the local mains voltage.

Note: If the mains plug has to be adapted to the local situation it should only be done by a qualified person.

Figure 3.1 Mains fuse location

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- The instrument shall be set to the local mains voltage only by a qualified person who is aware of the hazards involved.

- Make sure that only fuses of the required current rating, and specified type are used for renewal. The use of repaired fuses, and/or the short-circuiting of fuse holders, is prohibited.

- Fuses shall only be renewed by a qualified person who is aware of the hazard involved.

Mains voltage

When despatched from the factory, the PM2535 is set to the local mains voltage of 230 V/50 Hz.
For modification to 115 V, or for modification to 60 Hz refer to the service manual of this instrument.

Mains fuse

The mains fuse is located in a holder on the rear panel, adjacent to the mains socket. To replace it, first remove the mains cable and prise out the lift-out lug with a screwdriver.

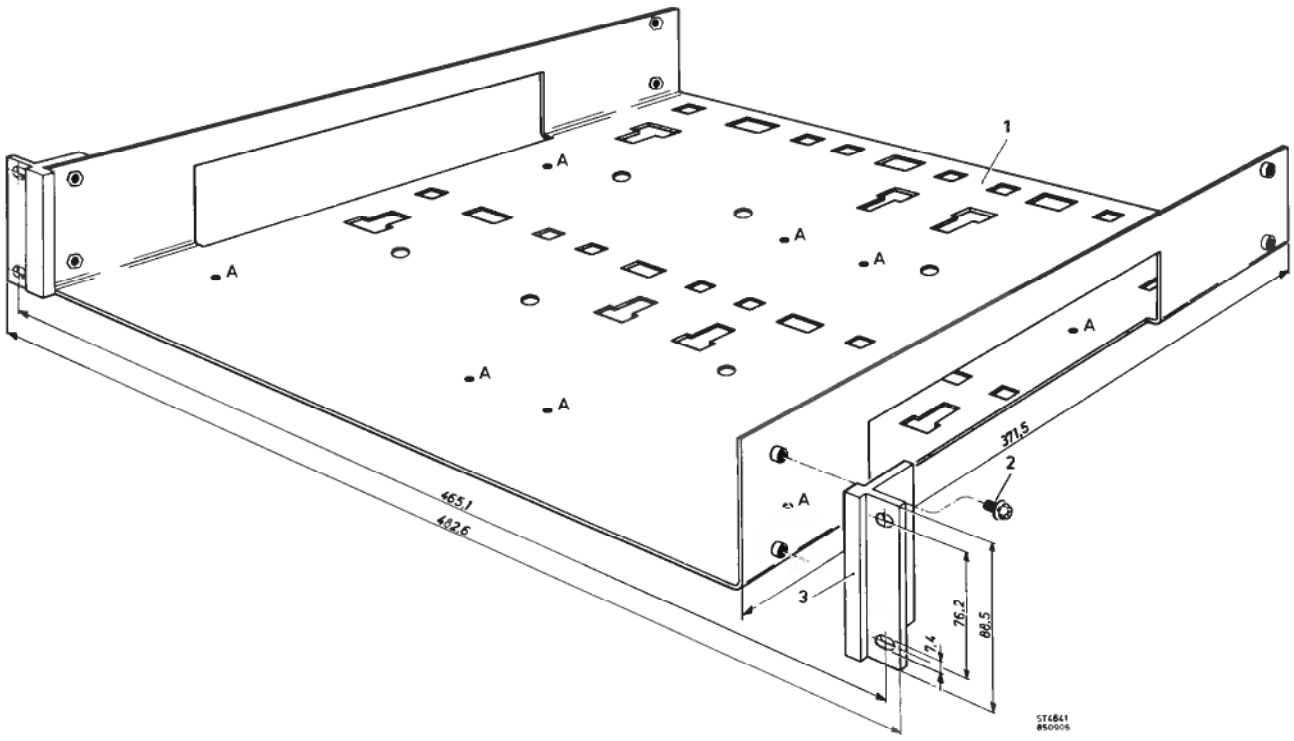
3.3 OPERATING POSITION OF THE INSTRUMENT

- The instrument may not only be used in horizontal position, but can also be used in a sloping position by folding down the handle. The characteristics mentioned in section 2.2 are guaranteed for the normal (horizontal) position as well as for the sloping position or when the handle is folded down.
- Do not position the instrument on any surface which produces or radiates heat, or in direct sunlight.

3.4 19-INCH RACK-MOUNTING

The PM9280/02 is a rack-mounting set for mounting two instruments (e.g. 2x PM2535) into a 19-inch rack. If a PM2535 has to be built-in, the feet of the PM2535 must be removed. The instrument can be mounted in the rack and fastened with the screws, delivered with the rack-mounting set. (The holes of the PM2535, without the feet correspond to the holes (A) in the rack).

Remark: Donot use longer screws (M3X5) than supplied with the PM9280/02 to avoid short circuit between mains earth (screening) and guard.



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4. OPERATING INSTRUCTIONS

4.1 GENERAL INFORMATION

This section outlines the procedures and precautions necessary for operation.

It is subdivided into three main parts viz:

- Manual operation (local) of the PM2535

This part identifies and briefly describes the functions of the front and rear panel controls and indicators. It also explains the practical aspects of operation to enable an operator to evaluate quickly the instrument's main functions.

- Operation via a IEEE controller (Remote)

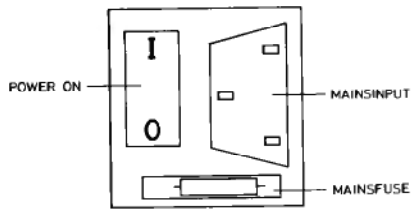
This section describes how to operate the instrument in a IEEE-488/IEC-625 configuration via a controller. It gives a detailed description of the functions, input and output data.

- Operation in combination with System 21

This section describes the practical use of the PM2535, in which the master function of System 21 is already included.

4.2 SWITCHING-ON

The instrument may be switched "ON" after making sure that the installation instructions, described in Section 3 have been followed.



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Having switched on, the PM2535 is immediately ready for use. After a warm-up time of 30 minutes the instrument meets the specifications listed in Section 2 (90 days specification).

Note: To meet the specifications use a shielded low thermal voltage cable. Recommended cable: PM9265/01

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The initial states after Power On are as stored in program 0 (PROG 0).
At delivery the following settings are stored:

Front		Via IEC-625/IEEE-488 interface
Function	: V⎓	FNC_VDC
Range	: AUTO	RNG_AUTO
Measuring speed	: 2	MSP_2
Resolution	: 6	RSL_6
Filter	: Off	FIL_OFF
Internal settling time	: On	IST_ON
Trigger	: Internal	TRG_I
Delay	: Off, 0	DLY_OFF,0
Display	: On	DSP_ON
		OUT_S
Null	: Off	NUL_OFF
Calibration	: Off	CAL_OFF
dBm	: Off, 600Ω	DBM_OFF, + 600
Δ%	: Off, + 1	PRC_OFF, 1
AX + B	: Off, + 1,0	SCL_OFF, + 1,0
Limits	: Off, 0,0	LIM_OFF, 0,0
Relative Reference	: Off, 0	ZER_OFF, 0
Burst	: Off, 999	BUR_OFF, 999
Digits	: 7	DIG_7
Bleeper	: On	BLP_ON
Sequence	: Off	SEQ_OFF
In the sequence program		
AID 20M0		-----
DSP 1.0S		----- Not possible
ST00 P.E		----- via the bus

Remark: It is possible to enter all delivery settings from the internal ROM into program 0 (PROG 0) by pressing the test-switch inside the instrument and meanwhile resetting the instrument. (Refer to the Service Manual)

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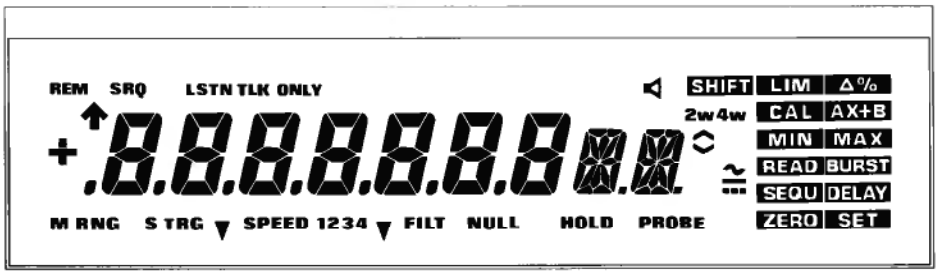
4.3 DISPLAY INDICATIONS



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IEC-625/IEEE-488 messages

REM	Remote	IEC-625/IEEE-488 interface messages
LSTN	Listener	
TLK	Talker	
TLK ONLY	Talk only	
SRQ	Service request, instrument asks service	

Bleeper function on on > limit, Buffer full in BURST mode

SHIFT Keyboard shift function indication. Functions indicated by the arrows (blue, green) are valid.

LIM Limits mode indication. The limit function is active.

Δ% Deviation in % indication. In this function the display indicates the Δ% from a preprogrammed value.

CAL Calibration mode on

AX + B Scaled measurements indication. In this function the measured value (X) is scaled via AX + B and displayed.

MIN / **MAX** Minimum/Maximum indication. This function displays the minimum and maximum value.

READ Read buffer indication
In this function a stored block of measuring data in the result buffer can be read out.

BURST Burst function indication.
A preprogrammed number of measurements is stored in the buffer.

SEQU Sequence function indication. In this function a preprogrammed sequence of measurements is carried out on a preprogrammed address and channel number. The sequence function can be used in combination with system 21.

DELAY Delay function indication. This function introduces a programmable delay between a trigger and the actual start of measurement.

ZERO Relative Reference mode.

SET Indication that figures must be entered.

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▼ (gn)	Helpfunction indication, green text is valid
▼ (bl)	Input of figures indication, blue text is valid
	Messages/Unit indication mV, V, Ω, A etc.
2W 4W	Configuration indication for OHM 2W = 2 wire via banana sockets 4W = 4 wire via probe input
^	High limit exceed
v	Lo limit exceed
~	ac/dc indication; ~ in functions V~, A~
⎓	⎓ in function V⎓, A⎓
PROBE	Message: This function needs a probe
HOLD	Data hold indication, in combination with a DATA HOLD probe.
NULL	Zero point correction indication (V⎓, 300 mV)
FILT	Filter on indication; 40 Hz in functions V~. A~. Digital filter in functions V⎓, A⎓, Ω-2W, Ω-4W.
SPEED 1234	Measuring speed indication
S TRG	Single trigger indication
M RNG	Manual ranging indication
÷	Polarity indication e.g. in functions: V⎓, A⎓, ZERO SET, °C
↑	Clip (V⎓, A⎓) or Crestfactor V~, A~) overflow

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- Result indication in the multimeter function
- Message indication in the help functions.

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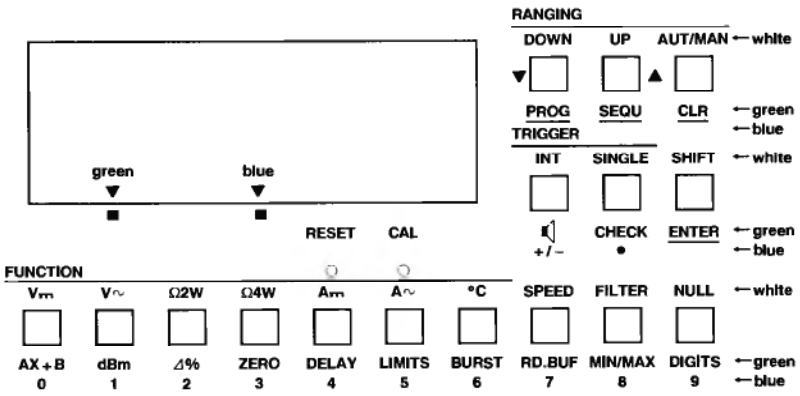
4.4 KEYBOARD



HOW TO OPERATE THE KEYBOARD

The functions can be subdivided into three catagories

1. Multimeter functions (white) - The indication is situated **above** the keys.
   - Direct operation, press once and the function is chosen.
2. Help functions (green) - The indication is situated in the first line **under** the keys.
   ▼ Arrow on display
   ■ points to green square. - Operation after pressing the SHIFT key.
3. Input of figures (blue) - The indication is situated **under** the key in the **second** line
   ▼ Arrow on display
   ■ points to blue square - The input of figures is automatically requested in the relevant help functions
   - The input of figures can be cleared (CLR key)
   - The input must be terminated with the ENTER key

The selected functions from catagories 1 and 2 are indicated in the display.

The arrows in the display point to the actual category (colour). Some key functions are active in categories 2 and 3. This is indicated with a blue line under the green text.

4.4.1 Multimeter functions, direct action (white).

FUNCTION	Selects the measurement functions ($V_{\overline{\cdots}}$, $V\sim$, etc)
RANGING	A selection can be made between manual (M RNG on display) or automatic ranging. The UP and DOWN buttons are used to range.
TRIGGER	A selection can be made between internal and single trigger (external trigger via BNC connector on the rear). The single trigger mode is indicated with S TRG on the display.
SPEED	Measuring speed 1,2,3, or 4 can be selected. (The default speed setting is always speed 2).
FILTER	On/off for ac filter in alternating current/voltage measuring functions or digital filter for all (except°C) other functions.
NULL	On/off for offset correction in $V_{\overline{\cdots}}$, 300 mV. (NULL on display)
SHIFT	SHIFT key to enable selection of the help functions (green)
CAL	The calibration mode (pencil-point operation) can be enabled. (Refer to the service manual of this instrument)
RESET	Pushbutton (pencil-point operation) to reset to initial state. The initial state is the state stored under program 0. (PROG 0)

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4.4.2 Help functions (green)

4.4.2.1 Function programming

PROG — In the PROG (program) function all relevant instrument settings can be stored under a certain number. At recall of that number the PM2535 will assume these settings.

SEQU — In the SEQU (sequence) function a number of sequential steps is carried out. Each step is a preprogrammed instrument setting with the possibility of outputting information for system 21 (scanning function).

4.4.2.2 General

CLR — CLEAR selectively switches - off a help function (green), or clears mistaken entry at input of figures (blue).

 — Switches on/off the bleeper.

CHECK — Selection of the IEEE 488/IEC-625 parameters, the selfdiagnostic mode or the calibration mode is possible.

ENTER — Enter function for all data and figures to be input

4.4.2.3 Mathematical functions (measuring data will be processed)

Remark: — A measuring function selection will switch-off the mathematical help function selected to avoid mistakes. The stored variables will be saved. The mathematical functions switch off each other except dBm and ZERO.

AX + B — Scaled measurement function. The instrument will ask the values A and B for calculating. The measured value is adapted according to the formula AX + B.

dBm — dBm (0dB 1mW) function. The instrument will ask the reference resistor value.
The dB value is calculated according $20 \log \frac{X}{Uref}$

Δ% — Deviation in % function. The instrument will ask the value from which Δ% has to be calculated.

displayed value $\frac{X - C}{C} \times 100\ \%$

ZERO — Relative reference

From the measured value (X) the contents of the Zero register is subtracted (X - D) and displayed. The instrument asks the value for the Zero register (D).

4.4.2.4 Aquisition/presentation of the measuring data

DELAY — Delay function. A delay can be programmed between a trigger command and the actual start of a measurement.
The instrument will request the delay time in milliseconds

LIMITS — In the limit function, a Lo and Hi limit can be programmed. If a limit is exceeded an indication will be given e.g. via the IEEE-448/IEC-625 interface, or display, and bleeper.

BURST — If the BURST function is selected, N measuring results (N can be selected) are stored in a buffer after a trigger command. A "full" indication is given in the display and a bleeper signal, after completing. If the BURST function is not selected, the last measuring results (max. 999) are stored in the buffer continuously.

RD.BUF — The buffer contents filled in the BURST on or off mode can be read on the display or via the IEC-625/IEEE-488 interface. Outputting of location numbers is also possible.

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MIN/MAX The instrument compares continuously the measured value with the contents of the minimum (MIN) and maximum (MAX) registers. The lowest and highest values are stored. Via MIN/MAX these values can be read out and also cleared if desired.

DIGITS In this function the display length can be programmed.

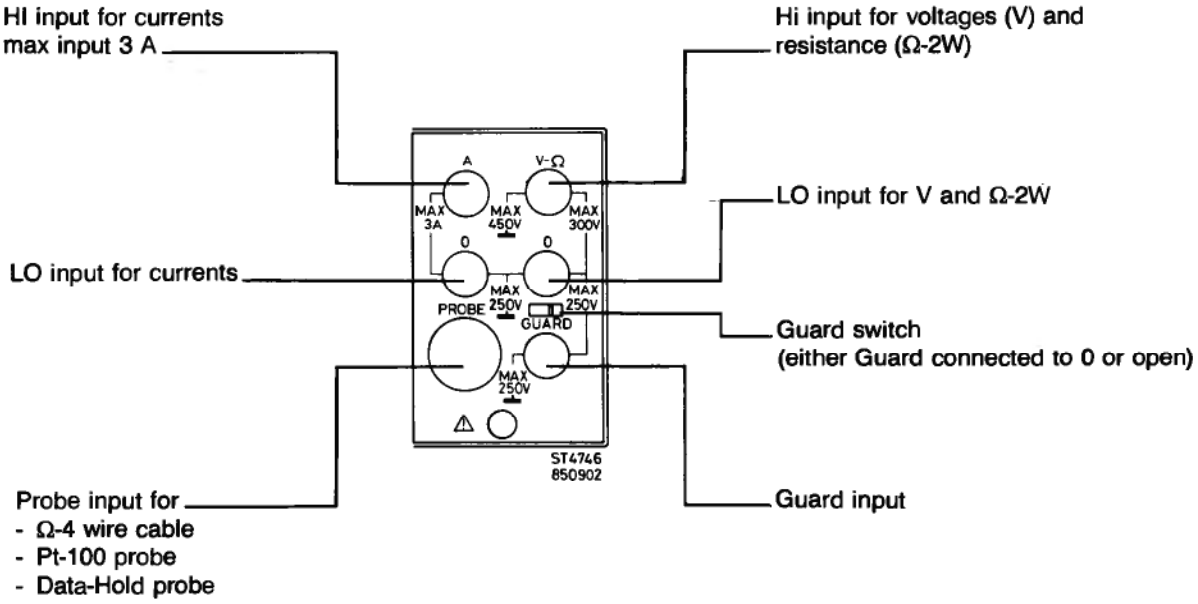
4.4.2.5 Input of figures (blue)

+ – 0/9 ● In the help functions figures have to be input for parameters. Filling the display goes from left to right.

At selection of a help function the old parameters are shown first. If no change is wanted ENTER can be pressed.

With the CLR key a mistaken entry of figures can be cleared

4.4.3 Inputs



When measuring voltages, resistance or currents the corresponding 0-socket function must be used. Although these 0-sockets have the same potential, incorrect use could result in measuring deviations.

4.4.4 Guard Usage

The PM2535 is equipped with a GUARD. This is an additional shield between the "0" input and earth. The GUARD increases the leakage impedance.
Increasing the leakage impedance improves the common mode rejection.
The GUARD may be connected to the circuit via a separate lead. Proper use of the GUARD provides a better common mode rejection and a higher accuracy, especially in the most sensitive ranges.
The guard can be connected via the switch to the 0-socket.

For an optimum GUARD connection, the following rules should be taken into account:

* Connect the signal to be measured to the PM2535 by means of a shielded measuring cable. This cable should not run in parallel to heavy current cables.

* Connect the GUARD to the same potential as the "0" input terminal.

* Connect the GUARD in such a way that no current due to common mode voltage flows through any source impedance.

Note: The guard must always be connected.

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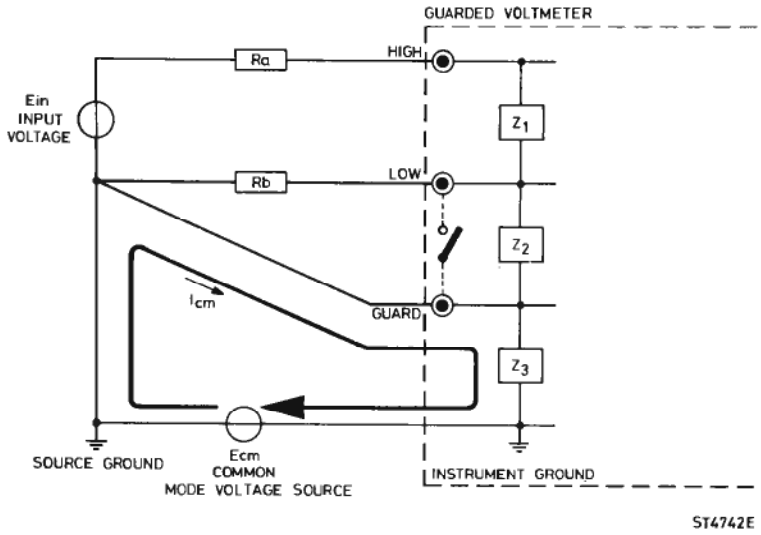
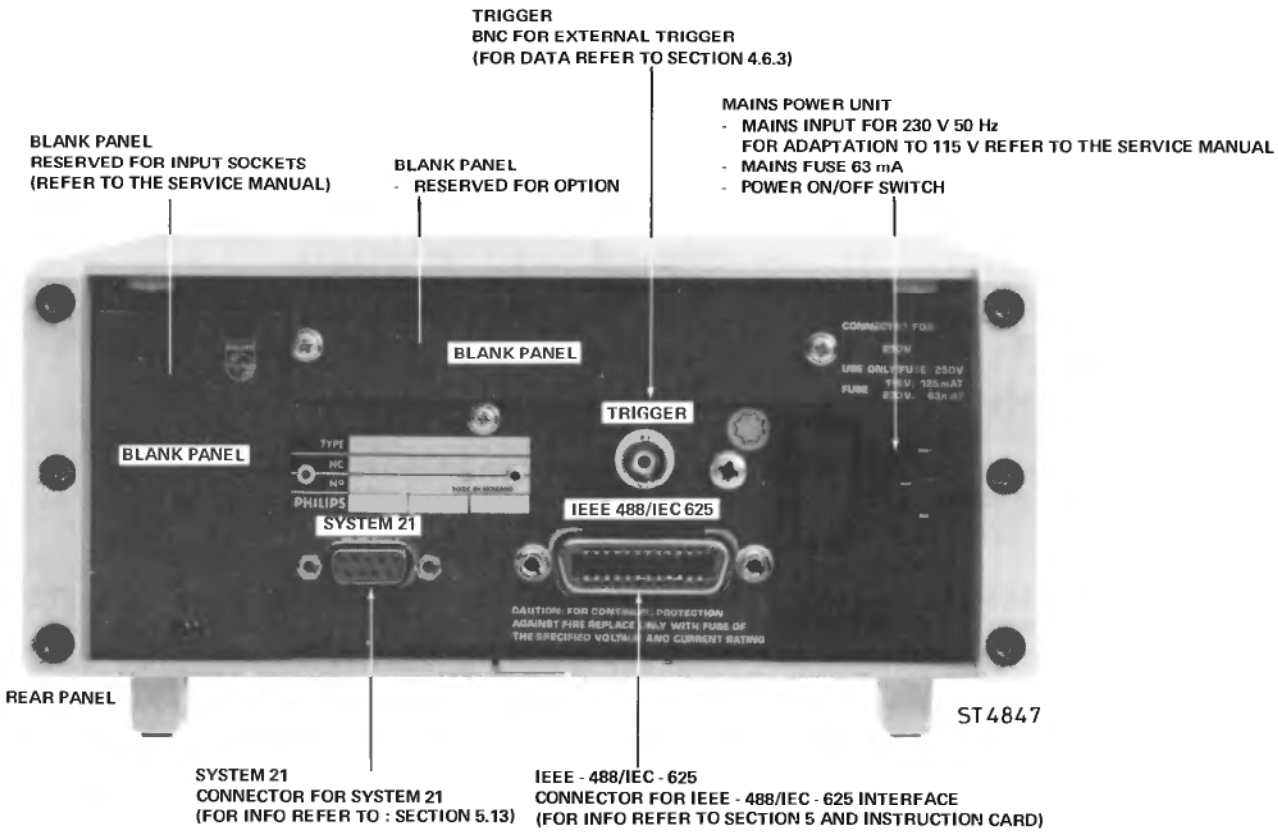


4.5 REAR PANEL CONTROLS



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4.6 DETAILED MULTIMETER FUNCTIONS EXPLANATION

4.6.1 Function selection

With the function keys the various functions can be selected.
The relevant measuring function is indicated on the display with unit indication and indices.

FUNCTION

V⎓	V∿	Ω2W	Ω4W	A⎓	A∿	°C
☐	☐	☐	☐	☐	☐	☐

4.6.2 Ranging

RANGING

DOWN	UP	AUT/MAN
☐	☐	☐

Manual or automatic ranging is available for all functions (except °C). Selection between the modes can be made by pressing the AUT/MAN pushbutton.
Manual ranging is indicated with M RNG on the display.

To range, proceed as follows:

EXAMPLE	OPERATION	DISPLAY
Select range 300V⎓	V⎓ AUT MAN	+ 000.000 mV⎓ MRNG SPEED 2
	UP UP UP	+ 000.000 V⎓ MRNG SPEED 2
Select range 3V⎓ (from range 300V⎓)	DOWN DOWN	+ 0.00000 V⎓ MRNG SPEED 2
Autoranging (from manual)	FUNCTION AUT MAN or X	+ 000.000 mV⎓ SPEED 2

Auto
- UP ranging at > 300000 dig.
- DOWN ranging at ⩽ 27000 dig.

To eliminate the hysteresis in the automatic range selection, a higher or lower range can be selected by means of the Up-Down key.

Remark: Selecting another measuring function will set the instrument to AUTO RANGING.

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4.6.3 Trigger

The trigger mode is divided into two trigger modes:

- Internal trigger mode

  A measurement is started automatically after completing a previous one.

- Single trigger mode

  A measurement can be started:

  - Manual:

    Pressing the SINGLE pushbutton performs one measurement. (In the automatic ranging mode first, if necessary, the correct range is selected and the new measurement is performed and displayed)

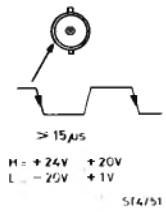
  - External:

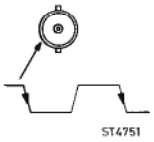
    - Via the the TRIGGER BNC connector at the rear of the PM2535
      A measurement is started by making this input low. (short-circuit or logic signal)

      Note: The EXT start input is galvanically separated from the measuring circuit.
    - Via the IEC-625/IEEE-488 bus interface (see section 5.5.7).
    - Via PM9267 Data Hold probe.

TRIGGER

INT **SINGLE**



EXAMPLE	OPERATION	DISPLAY
Single trigger	SINGLE	+ ———.——— mV⎓ STRG SPEED 2
		+ 000.000 mV⎓ STRG SPEED 2
	SINGLE —	+ ———.——— mV⎓ STRG SPEED 2
		+ 000.000 mV⎓ STRG SPEED 2
	EXTERNAL  	+ ———.——— mV⎓ STRG SPEED 2
		+ 000.000 mV⎓ STRG SPEED 2
Internal trigger (after single trigger)	INT	+ 000.000 mV⎓ SPEED 2

Remark: In Single Trigger mode the display shows ------- as long as no new result is available after a trigger command.

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4.6.4 Speed

The speed button selects the measuring speed and measuring resolution.
In the display, speeds 1, 2, 3 or 4 are indicated.

EXAMPLE	OPERATION	DISPLAY
Select range 300V⎓	V⎓	+ 000.000 mV⎓ SPEED 2
	SPEED SPEED	+ 0000.0 mV⎓ SPEED 4
Speed selection	2 SPEED → 3 SPEED; 1 SPEED ← 4 SPEED	

The possibilities are as follows.

Function	Speed	Ranges	Speed meas/s up to	Display length up to
V⎓	1 2 3 4	all all all all	0.3 3 30 100	3000000 300000 30000 3000
V~	2 3	all all	3 30	30000 3000
Ω 2-,4-wire (4-w max 3 MΩ)	1	3 kΩ-3 MΩ 30 MΩ 300 MΩ	0.3 0.3 0.3	3000000 300000 30000
	2	3 kΩ-3 MΩ 30 MΩ 300 MΩ	3 3 3	300000 30000 3000
	3	3 kΩ-3 MΩ 30 MΩ 300 MΩ	30 30 30	30000 3000 300
	4	3 kΩ-300 kΩ	65	3000
A⎓	2 3 4	all all all	3 30 100	300000 30000 3000
A~	2 3	all all	3 30	30000 3000
°C	2 3	all all		3000 300

Remarks: - Stated measuring speed excludes the time needed by the IEEE/IEC controller to perform the handshake. It is valid for a 50 Hz version.

- In speed 1, the display value will be updated within 0.5 s after a step change of the input signal.

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4.6.5 Filter

The front-panel FILTER pushbutton brings a filter into circuit, indicated in the display as FILT. There are two possibilities:

1. Digital filter in the functions V⎓, A⎓, Ω-2 wire and Ω-4 wire. If the filter is switched on in these functions, the display result is determined by the following formula:

   display result / 0.8 x previous result + 0.2 x actual measurement

   If the difference between the actual measurement and the previous result is too large, then the display result is equal to the actual result. When one of the above mentioned functions is selected the filter will always be in the off state.

2. In the function V~ and A~ a low pass frequency filter can be switched on. The bottom of the measurable frequency range is shifted from 40 Hz (filter on) to 400 Hz (filter off).
   If filter off is selected, the response time of the different ac measuring functions is decreased. When V~ or A~ is selected, the filter will always be in the on state. (40 Hz)

EXAMPLE	OPERATION	DISPLAY
Switch on digital filter in V⎓	V⎓ FILTER	+ 000.000 mV⎓ SPEED 2 FILT
Filter-off (after on)	FILTER	+ 000.000 mV⎓ SPEED 2

4.6.6 Null

The function can be switched on/off in speed 1, 2, 3 (speed 4 excluded) for zero-point correction to compensate offset and thermal voltages of max. 1000 digits in the 300 mV dc range. To compensate offset and thermal voltages short-circuit the input with the **measuring** leads. (recommended cable: shielded low thermal voltage cable PM9265/01).
Pushing Null will automatically select speed 1 to obtain the NULL value. The function active mode is indicated in the display as NULL and is only active for speeds 1, 2 and 3 in the 300 mV dc range.

EXAMPLE	OPERATION	DISPLAY
Switch on null mode in V⎓ (short cct input, autoranging)	V⎓ NULL	+ NULL mV⎓ SPEED 1
		+ 000.0000 mV⎓ SPEED 1 NULL
Null mode off (after on)	NULL	+ 000.0000 mV⎓ SPEED 1

Note: After Power On the function is not activated, unless stored in program 0 (PROG 0). However, once activated the state and value is kept in memory even if the V⎓, 300 mV range is left. Selecting V⎓, 300 mV range again will switch on the Null function. To enter a new NULL value, first the previous value has to be switched off.

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4.6.7 Selfdiagnostics (CHECK, ENTER keys)

EXAMPLE	OPERATION	DISPLAY
Switch on the Selfdiagnostic mode	SHIFT CHECK ENTER ENTER ENTER 1 ENTER	**test 0** **test 1** **SOFT 0X** **Display test** **test O.k.**

In case of an error refer to the service manual

Remark: - Via the CHECK button also the following IEC-625/IEEE-488 bus parameters can be set:
- REMOTE/LOCAL
- TALK ONLY
- IEC/IEEE ADDRESS

Refer to chapter 5 how to proceed.

- The Selfdiagnostics mode cannot be switched on in the Calibration, Burst and Sequence function. The entering of the test parameter will be skipped.

4.6.8 Reset

The RESET switch (pencil-point operation to avoid an unwanted reset) is used to give a reset. The instrument jumps to its initial state. All the functions are selected that are also valid after a power-on.

4.6.9 Calibration

Via the CAL switch (pencil-point operation) the electronic calibration mode is enabled. While pressing the CAL switch the RESET switch must be pressed. Release the RESET switch before releasing the CAL switch (cal on display).
The calibration mode is entered after pushing the SHIFT, CHECK button.

In the calibration mode the separate functions and ranges can be calibrated successively. The new calibration values are stored in a non-volatile RAM. The calibration mode is left with the SHIFT, CLR push button and disabled with the RESET switch.

For detailed calibration information refer to the service manual of the PM2535.

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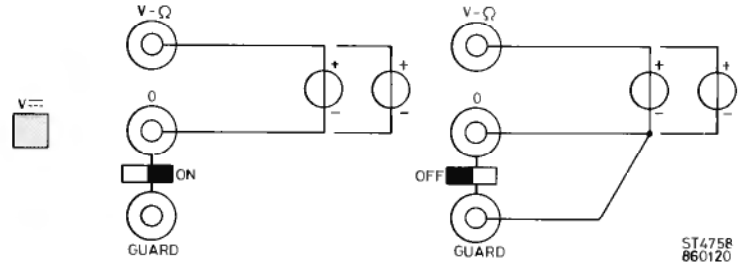
4.7 MEASURING FUNCTIONS EXPLANATION

The measuring functions, available on the PM2535 are selected by the appropriate function switch. Having selected the required function, further actions that are necessary are referred to in the following quick-check measuring procedure.

4.7.1 Direct voltage measurements



Valid modes

Ranging			Trigger		Speed				Filter		Null	Check/
Down	Up	Aut/Man	INT	Single	1	2	3	4	Freq	Dig		End
*	*	*	*	*	*	*	*	*		*	*)1	*

)1 300 mV only

Range \ Speed	1	2	3	4
300 mV	300.0000	300.000	300.00	300.0
3 V	3.000000	3.00000	3.0000	3.000
30 V	30.00000	30.0000	30.000	30.00
300 V	300.0000	300.000	300.00	300.0

Remarks: Maximum input voltage

Range: 300 mV/3 V — 400 V for <30 s
300 V continuously
600 V peak

30 V/300 V — 400 V continuously
600 V peak

Warning indications — Audible: ≈ max. input voltage exceeded
Visual: ↑ Clip indication
OL Overload

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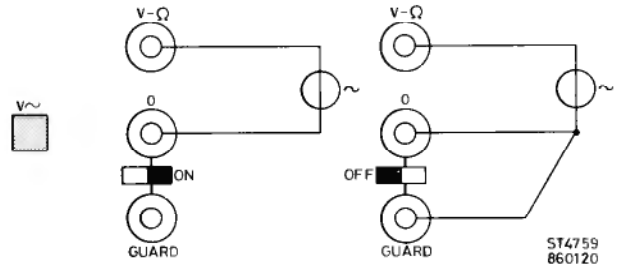
4.7.2 Alternating voltage measurements



Valid modes

Ranging			Trigger		Speed				Filter		Null	Check/
Down	Up	Aut/Man	INT	Single	1	2	3	4	Freq	Dig		End
*	*	*	*	*		*	*		*			*

└ 40 Hz or 400 Hz

Range \ Speed	2	3
300 mV	300.00	300.0
3 V	3.0000	3.000
30 V	30.000	30.00
300 V	300.00	300.0

Remarks:

Maximum input voltage

All ranges: 400 V ac or 400 Vdc continuously, 600 V peak

Warning indications

Audible: ≈ >300 V in 300 V range

Visual: ↑ Crest factor exceeded

OL Overload

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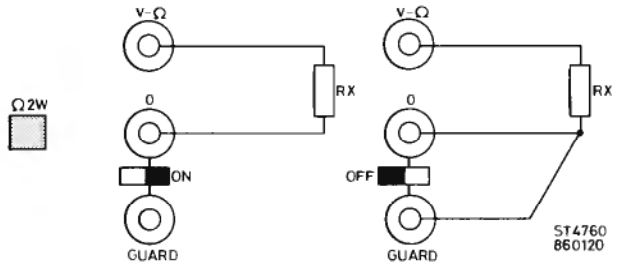
4.7.3 Resistance two-wire measurements



Valid modes

Ranging			Trigger		Speed				Filter		Null	Check/
Down	Up	Aut/Man	INT	Single	1	2	3	4	Freq	Dig		End
*	*	*	*	*	*	*	*	*		*		*

Speed / Range	1	2	3	4
3 kΩ	3.000000	3.00000	3.0000	3.000
30 kΩ	30.00000	30.0000	30.000	30.00
300 kΩ	300.0000	300.000	300.00	300.0
3 MΩ	3.000000	3.00000	3.0000	--
30 MΩ	30.0000	30.000	30.00	--
300 MΩ	300.00	300.0	300.0	--

Remarks:

Protection	2-wire terminals 250 V ac or dc 350 V peak
Warning indications	Visual: ↑ Clip indication OL Overload.

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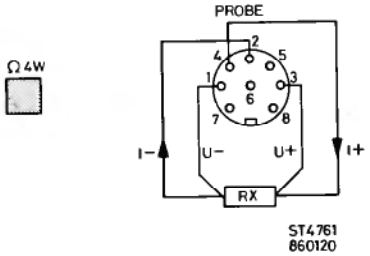
4.7.4 Resistance four-wire measurements



Valid modes

Ranging			Trigger		Speed				Filter		Null	Check/
Down	Up	Aut/Man	INT	Single	1	2	3	4	Freq	Dig		End
*	*	*	*	*	*	*	*	*		*		*

Range \ Speed	1	2	3	4
3 kΩ	3.000000	3.00000	3.0000	3.000
30 kΩ	30.00000	30.0000	30.000	30.00
300 kΩ	300.0000	300.000	300.00	300.0
3 MΩ	3.000000	3.00000	3.0000	--

Remarks:

Protection	4-wire terminals 30 V ac or dc continuously 42 V peak
Warning indications	Visual: ↑ Clip indication OL Overload.

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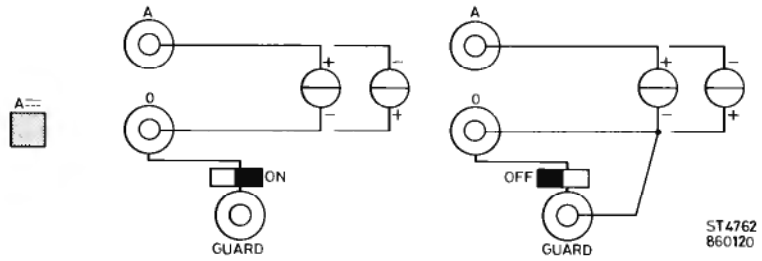
4.7.5 Direct current measurement

Remark:
Closing the guard switch with external guard connection introduces measuring errors.



Valid modes

Ranging			Trigger		Speed				Filter		Null	Check/
Down	Up	Aut/Man	INT	Single	1	2	3	4	Freq	Dig		End
*	*	*	*	*		*	*	*		*		*

Range \ Speed	2	3	4
30 mA	30.0000	30.000	30.00
3 A	3.00000	3.0000	3.000

Remarks:

Protection	With a fuse of 3.15 A (fast blow)
Warning indications	Visual: ↑ Clip indication OL Overload Audible: ≈ >3 A in 3 A range

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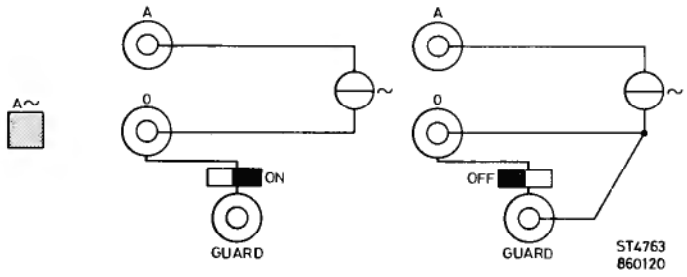
4.7.6 Alternating current measurements

Remark:
Closing the guard switch with external guard connection introduces measuring errors.



Valid modes

Ranging			Trigger		Speed				Filter		Null	Check/
Down	Up	Aut/Man	INT	Single	1	2	3	4	Freq	Dig		End
*	*	*	*	*		*	*		*			*

40 Hz or 400 Hz

Range \ Speed	2	3
30 mA	30.000	30.00
3 A	3.0000	3.000

Remarks:

Protection	With a fuse of 3.15 A (fast blow)	
Warning indications	Visual:	↑ Crest factor exceeded
		OL overload
	Audible:	≈ >3 A in 3 A range

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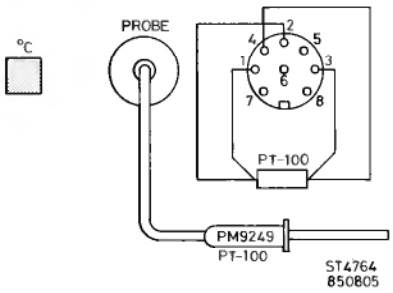
4.7.7 Temperature measurements



Valid modes

Ranging			Trigger		Speed				Filter		Null	Check/
Down	Up	Aut/Man	INT	Single	1	2	3	4	Freq	Dig		End
			*	*		*	*					*

Range \ Speed	2	3
– 100 °C up to 850 °C	3000.0	3000

Linearisation according to DIN 43760 is valid up to 850 °C.

Remark: Remove temperature probe when measuring in other function than °C.

4.7.8 Clipping- Crest- factor indication

Measuring dc voltages or currents with spikes can give an incorrect reading. The reading appears to be good but due to spikes the input circuit is overloaded and the reading is incorrect. The PM2535 indicates this with a ↑ on the display.
When the display shows ↑, a higher range must be selected untill the ↑ disappears.

Example:

If a spike exceeds a level of 1,5x full scale value the clip indication is displayed.

In V~ or A~ the ↑ symbol is used to indicate that the max. allowable crest-factor has been exceeded.

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4.8 HELP FUNCTIONS EXPLANATION

4.8.1 Mathematical functions explanations

4.8.1.1 AX + B scaled measurements

The measured value (x) is adapted according to the formula AX + B, A and B can be input via keyboard or interface

Valid in function	:	All multimeter functions (cannot be combined with other mathematic functions)
Selection	:	SHIFT, AX + B, ENTER, ENTER
Input parameters	:	A (no dimension)
	:	B (in units of measuring function)
Output	:	AX + B
Exit	:	SHIFT, CLR, AX + B, or function change
Exit saves	:	A, B
Function change saves	:	A, B
Power off/reset destroys	:	A, B, unless stored in program 0—9 (PROG).
Limits for A	:	$\pm (10^{13}....10^{-13})$ Input via keyboard ± (9999999....0000001)
Limits for B	:	$\pm (10^{13}....10^{-13})$ Input via keyboard Numerical value ± (9999999 .00000001)
Delivered from factory on	:	A = +1, B = 0

Brief application AX + B

Calculation from °C → °F

Formula $\frac{9}{5}$ °C + 32 = °F

Enter A = $\frac{9}{5}$ = 1.8

Enter B = 32

100 °C = A X + B = 1.8 x 100 + 32 = 212 °F
0 °C = A X + B = 1.8 x 0 + 32 = 32 °F

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EXAMPLE 1	OPERATION	DISPLAY	
ENTER	°C	+ 020.0 °C SPEED 2 PROBE	
	SHIFT AX+B	– 32.00000 A SHIFT SPEED 2 ▼ (bl) PROBE AX+B SET	①
A = +1.8	+ 1 . 8	+ 1.8 A SHIFT SPEED 2 ▼ (bl) PROBE AX+B SET	②
AND	ENTER	+ 22.23344 B SHIFT SPEED 2 ▼ (bl) AX+B SET	③
B = +32	+ 3 2	+32 B SHIFT SPEED 2 ▼ (bl) PROBE AX+B SET	④
	ENTER	+ 68.00000 ∗C SPEED 2 PROBE AX+B	⑤

① Previous value for A.
② Enter A. Remark. Press "CLR" key to clear mistaken entry.
③ Previous value for B.
④ Enter B. Remark: Press "CLR" key to clear mistaken entry.
⑤ After the next measurement AX + B is calculated and displayed.

EXAMPLE 2	OPERATION	DISPLAY	
CHECK A AND B	SHIFT AX+B	+ 1.800000 A SHIFT SPEED 2 ▼ (bl) PROBE AX+B SET	①
	ENTER	+ 32.00000 B... SHIFT SPEED 2 ▼ (bl) PROBE AX+B SET	②
	ENTER	+ 68.00000 ∗C... SPEED 2 PROBE AX+B	③

① A = +1.8.
② B = +32.
③ After the next measurement AX + B is calculated and displayed.

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4.8.1.2 dBm

The measured input voltage (∼ or ⎓) can be converted into a dB value (0 dBm ≙ 1 mW in a selectable reference resistor). The reference resistor value can be chosen and stored. It must lie between .0001 and 9999 Ω. At delivery the resistance value is 600 Ω.

At measuring overload, OL will appear on the display. At shortcircuited input "UL" which means "dB-underload" will appear on the display.

The calculated result is presented with two figures behind the decimal point. If the calculated result is small, only 1 or zero figures may be presented behind the decimal point.

Valid	:	V⎓, V∼ (can be combined with ZERO)
Selection	:	SHIFT, dBm, ENTER
Input parameter	:	reference resistance, initial 600Ω
Output	:	dBm
Exit	:	SHIFT, CLR, dBm or function change
Exit saves	:	Rref.
Function change saves	:	Rref.
Power off/reset destroys	:	Rref. unless stored in program 0—9 (PROG).
Limits for Rref	:	.0001 → 9999 Ω

EXAMPLE 1	OPERATION	DISPLAY	
ENTER 50Ω R REF IN FUNCTION V⎓	V⎓ SHIFT dBm	600.0Ω SPEED 2 ▼ (bl) SHIFT SET	①
	5 0	50Ω SPEED 2 ▼ (bl) SHIFT SET	②
	ENTER	+ 10.00 dB⎓ SPEED 2	③

① Previous value for Rref.
② Enter Rref. Remark: Press "CLR" key to clear a mistaken entry.
③ After the next measurement dBm with 50 Ω R ref in V⎓ is calculated and displayed.

EXAMPLE 2	OPERATION	DISPLAY	
CHECK R REF IN V⎓	SHIFT dBm	50.00Ω SPEED 2 ▼ (bl) SHIFT SET	①
	ENTER	+ 10.00 dB⎓ SPEED 2	②

① Previous value for Rref.
② After the next measurement dBm with 50Ω R ref in V⎓ is calculated and displayed.

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4.8.1.3 Δ %

The measured value (X) is adapted according to the formula $\frac{X - C}{C} \times 100\ \%$

Example: a. input = 10V (reference) Δ = 0V = 0%
b. input = 11V Δ = +1V = 10%

$$\Delta\% = \frac{X - C}{C} \times 100\% = \frac{X - 10}{10} \times 100\ \%$$

a. input 10V = $\frac{10 - 10}{10} \times 100\% = +0\%$

b. input 11V = $\frac{11 - 10}{10} \times 100\% = +10\%$

Valid in function	:	All multimeter functions (cannot be combined with other mathematical functions).
Selection	:	SHIFT, Δ %, ENTER
Input parameter	:	C
Output	:	$\frac{X - C}{C} \times 100\%$
Exit	:	SHIFT, CLR, Δ % or function change
Exit destroys	:	C
Function changes destroys	:	C
Power off/reset destroys	:	C, unless stored in program 0—9 (PROG).
Limits for C	:	± (10^{13}....10^{-13}) 0 excluded Numerical value ± (9999999 .0000001)
Delivered from factory on	:	C = +1

EXAMPLE 1	OPERATION	DISPLAY	
ENTER C = 10V⎓	V⎓	+000.0000 mV⎓ SPEED 2	
	SHIFT Δ%	+000.0000 mV⎓ SPEED 2 ▼ (bl)	①
	+ 1 0 0 0 0	10000 mV⎓ SPEED 2 ▼ (bl)	②
	ENTER	+ 10.00000% V⎓ SPEED 2 ▼ (bl)	③

① Last measured value on display. Press enter to use this value for parameter of C.

② Enter C. Remark: Press "CLR" key to clear mistaken entry.

③ After the next measurement $\frac{X - C}{C} \times 100\%$ is calculated and displayed. +11V will generate +10%.

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EXAMPLE 2	OPERATION	DISPLAY	
CHECK C WHEN IN FUNCTION Δ%	SHIFT Δ%	+ 10000.00 mV⎓ SHIFT Δ% SPEED 2 ▼ (bl) SET	①
	ENTER	+ 10.00000 %V⎓ Δ% SPEED 2	②

① Previous value for C.
② After the next measurement $\frac{X-C}{C}$ x 100% is calculated and displayed. +11V will generate +10%.

4.8.1.4 ZERO (Relative reference)

From the measured value (X) the contents of the ZERO register (D) is subtracted (X-D) and displayed.

Example: a. input = +10V ZERO = 0V
b. input = +11V ZERO = +1V

ZERO = X-D = X-10V

a. input = 10V = 10 – 10 = 0V
b. input = 11V = 11 – 10 = +1V

Valid	:	All multimeterfunctions, dBm (cannot be combined with other mathematical functions)
Selection	:	SHIFT, ZERO, ENTER
Input parameter	:	D
Output	:	X - D
Exit	:	SHIFT, CLR, ZERO or function change
Exit destroys	:	D
Function change destroys	:	D, ZERO function.
Power off/reset destroys	:	D unless stored in program 0—9 (PROG)
Limits for D	:	± (10^{13}...10^{-13}) Input via keyboard ±(9999999 .0000001)

EXAMPLE 1	OPERATION	DISPLAY	
ENTER D = 10V	V⎓	+000.000 mV⎓ SPEED 2	
	SHIFT ZERO	+000.000 mV⎓ SHIFT SPEED 2 ▼ (bl) ZERO SET	①
	+ 1 0 0 0 0	10000 mV⎓ SHIFT SPEED 2 ▼ (bl) ZERO SET	②
	ENTER	+ 01.0000 V⎓ ZERO SPEED 2	③

① Last measured value on display. Press ENTER to use this value for parameter of D.
② Enter D. Remark: Press "CLR" key to clear mistaken entry.
③ After the next measurement X – D is calculated and displayed. +11V will generate +1 V

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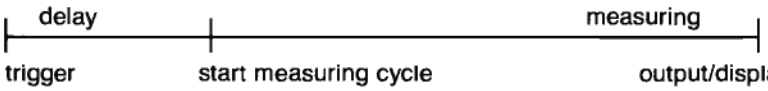
4.8.2 Aquisition/ Presentation of measuring data

4.8.2.1 DELAY

A delay can be programmed between a trigger and the actual start of a measurement.



Valid	:	All multimeter and mathematical functions
Selection	:	SHIFT, DELAY
Input parameter	:	X ms
Result	:	delay of x ms
Exit	:	SHIFT, CLR, DELAY
Exit saves	:	delay
Function changes saves	:	delay
Power off/reset destroys	:	delay unless stored in program 0—9 (PROG).
Limits for delay	:	8 000 000 ms
Delivered from factory on	:	Delay off, time 0 ms

EXAMPLE 1	OPERATION	DISPLAY	
PROGRAM 140ms DELAY	SHIFT DELAY	84320 ms SPEED 2 ▼ (bl)	①
	1 4 0	140 ms SPEED 2 ▼ (bl)	②
	ENTER	10.0000 XX SPEED 2	③

① Previous value for delay.
② Enter delay 140 ms Remark: Press CLR key to clear a mistaken entry.
③ After a trigger a delay of 140 ms will be executed before the measurement is started.

EXAMPLE 2	OPERATION	DISPLAY	
READ DELAY	SHIFT DELAY	140 ms SPEED 2 ▼ (bl)	①
	ENTER	10.0000 XX SPEED 2	②

① Pre-programmed delay.
② After a trigger a delay of 140 ms will be executed before the measurement is started.

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4.8.2.2 *LIMITS*

The measured or calculated results are compared with the contents of the LIM-LO and LIM-Hi registers. If the Limits values are exceeded an indication is given on the display by arrows (∧, ∨ or ◊) and by a bleeper signal if switched on, or via the IEC-625/IEEE-488 interface.

Valid in function	:	All
Selection	:	SHIFT, LIMITS
Input parameter	:	LIM-LO (indicated by ∨) LIM-HI (indicated by ∧)
Result	:	indication that Limits are exeeded. (∧, ∨, ◊, bleeper or interface)
Exit	:	SHIFT, CLR, LIMITS, or function change
Exit saves	:	LIM-LO, LIM-HI
Function change saves	:	LIM-LO, LIM-HI
Power off/reset destroys	:	LIM-LO, LIM-HI unless stored in program 0—9 (PROG).
Limit indication	:	LIM-LO < LIM-HI and input < LIM-LO ∧ LIM-LO < LIM-HI and input > LIM-HI ∨ LIM-LO ≥ LIM-HI and input < LIM-LO, > LIM-HI ◊

Limits for LIM-LO | LIM-LO and LIM-HI | ± (10^{13}...10^{-13})

Delivered from factory on LIM-LO = 0
LIM-HI = 0

EXAMPLE 1	OPERATION	DISPLAY	
ENTER LIM-LO = +126.5645	SHIFT LIMITS	+ 83.26241 mV⎓ ∨ SPEED 2 ▼ (bl) SHIFT LIM SET	①
	+ 1 2 6 . 5 6 4 5 ENTER	+ 126.5645 mV⎓ ∨ SPEED 2 ▼ (bl) SHIFT LIM SET	②
		+ 336.356 mV⎓ ∧ SPEED 2 ▼ (bl) SHIFT LIM SET	③
LIM-HI = +320.3651	+ 3 2 0 . 3 6 5 1 ENTER	+ 320.3651 mV⎓ ∧ SPEED 2 ▼ (bl) SHIFT LIM SET	④
		+ 100.000 mV⎓ SPEED 2 LIM	

① ∨ = LIM LO Previous value for LIM-LO
② Enter LIM LO Remark: Press CLR key to clear mistaken entry
③ ∧ = LIM-HI Previous value for LIM-HI
④ Enter LIM-HI Remark: Press CLR to clear mistaken entry

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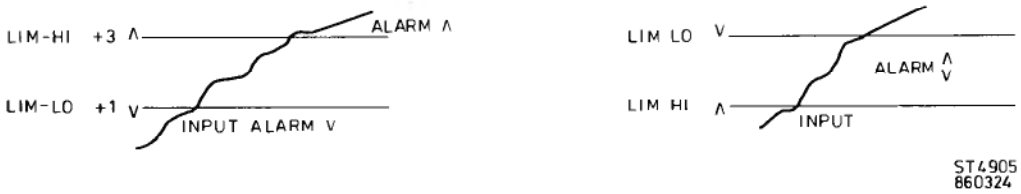

EXAMPLE 2	OPERATION	DISPLAY	
CHECK LIM-LO AND LIM-HI REGISTERS	SHIFT LIMITS	+ 126.5645 mV⎓ ∨ SPEED 2 ▼ (bl) SHIFT LIM SET	①
	ENTER	+ 320.3651 mV⎓ ∧ SPEED 2 ▼ (bl) SHIFT LIM SET	
	ENTER	+ 100.000 mV⎓ SPEED 2 LIM	②

① ∨ = LIM-LO
② ∧ = LIM-HI

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4.8.2.3 BURST

In the BURST function a preprogrammed number (N, max 999) of measurements are stored in a buffer after a trigger command. A buffer full indication is given on the display and via the IEC-625/IEEE-488 interface. The stored measuring results can be read on the display or via the interface in the Read Buffer fuction (RD.BUF).

BURST ON MODE

The burst on mode can be selected via the keyboard or interface. The PM2535 will ask for the number of measurement results (N) to be buffered.

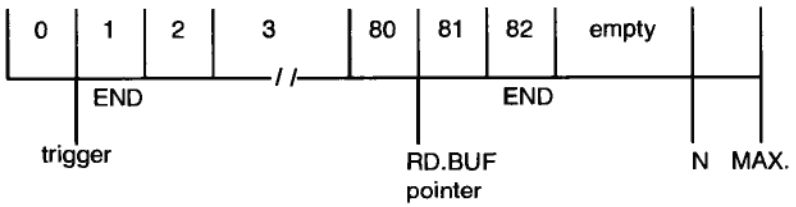
When (N) is entered the PM2535 will wait for a trigger command (single or internal).
- In single trigger mode the measuring process is stopped after (N) measurements. The PM2535 will wait for the next trigger.

After (N) measurements a full indication is given by means of:
Bleeper (if switched on)
Display (FULL)
Interface (DAV 1)

During the BURST process only the display will be refreshed about twice a second with the latest measurement result.
No interface output will be available during the BURST cycles.

The measuring results are buffered and can be read out in the RD.BUF function.

A function change will clear the buffer contents, but the BURST function stays on.



0	=	Empty
1	=	First result after trigger
82	=	Last result entered.
N	=	Number of results to be stored (BURST ON function)
Max.	=	Maximum locations number = 999
RD. BUF. pointer	=	Location to be read

Valid in function	:	All functions except SEQUENCE
Selection	:	SHIFT, BURST (PM2535 set to STRG)
Input parameter	:	N (number of measurements to be buffered).
Result	:	N measurements buffered.
Exit	:	SHIFT,CLR, BURST
Exit destroys	:	Contents of buffer
Exit saves	:	N, Single trigger
Function change destroys	:	Contents of buffer
saves	:	N, Single trigger
Power off/reset destroys	:	Contents of buffer, N
saves	:	N can be stored in program 0 (prog 0)

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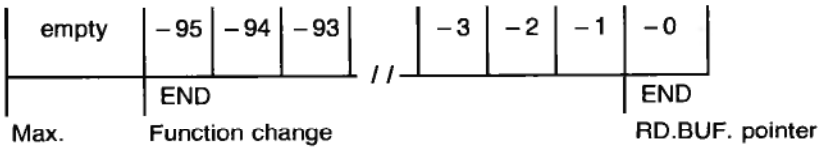
BURST-OFF MODE (normal measurement)

In the burst-off mode the last measured samples are present in the buffer, with a maximum of 999.

A function change (measuring or mathematical) will clear the buffer contents except in the sequence function (SEQU).

In the SEQU function the program number is also stored.

Reading the buffer can be done at any moment in the RD.BUF. function
The normal measuring process is stopped during reading. There is no buffer full-indication.



– 0	=	Actual measurement
– 1	=	Last measurement carried out
– 95	=	First measurement after function change
Max.	=	Maximum locations number = 999
Function change	=	Last function change
RD. BUF. pointer	=	Location to be read ate the moment of RD.BUF mode selection

Valid in function	:	ALL
Selection	:	Power on
Result	:	999 measuring results stored in 999 window out
Function change destroys	:	Contents of buffer
saves	:	N
Power of/reset destroys	:	Contents of buffer
saves	:	N can be stored in program 0—9 (PROG).

EXAMPLE 1	OPERATION	DISPLAY	
BUFFER 10 MEASURE-MENT RESULTS	SHIFT BURST	NO. 500 S TRG SPEED 2 ▼ (bl) SHIFT BURST SET	①
	1 0	NO. 10 S TRG SPEED 2 SHIFT BURST SET	②
	ENTER	+ ——.————— V⎓ S TRG SPEED 2 BURST	③
	SINGLE	FULL ⎓ S TRG Speed 2 BURST	④

EXAMPLE 2	OPERATION	DISPLAY	
CHECK NUMBER OF MEASURING RESULTS TO BE BUFFERED (N)	SHIFT BURST	NO. 10 S TRG SPEED 2 ▼ (bl) SHIFT BURST SET	⑤
	ENTER	+ ——.————— V⎓ S TRG SPEED 2 BURST	⑥

① Previous value for number of measurements (N) to be buffered. The single trigger mode is automatically selected.
② Enter 10 (N). Remark: Press CLR key to clear mistaken entry.
③ After a trigger (N) measuring results are buffered.
④ If (N) is reached a buffer full indication is given.
⑤ (N) = 10
⑥ After a trigger (N) measuring results are bufferd.

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4.8.2.4 RD. BUF (Read buffer)

In the RD. BUF function, the buffer contents stored in the BURST ON/OFF function can be read.

The measurement results are stored together with a buffer location number. When selecting RD.BUF first the PM2535 asks if the contents of the locations have to be sent to a listen-only IEC-625/IEEE-488 printer. If yes (1). The next step allows reading locations.

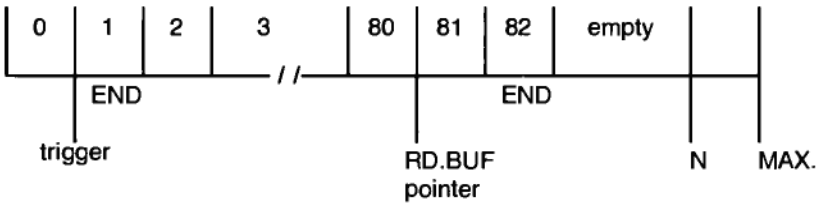
By entering a location number, on the display or interface another location can be read.
After the next ENTER, the print mode including the handshaking is set, and the contents of the selected location number is displayed and sent to the printer.

With the keys ▲ and ▼ the RD. BUF pointer can be moved to check the contents of the buffer.
The stepping is possible in the location number mode and the measuring result display mode.
If the keys are held for 1 second the checking is performed automatically.
Stop this by pushing the arrows once more. The reading speed is 1 result per second in print off mode. In print on mode the printer determines the speed.

Dependent on the BURST ON/OFF mode the location number are preceeded with "-" or blank.

BURST ON, RD.BUF.

- Location numbers are preceeded with a "blank".
- After activating SHIFT, RD. BUF. the last measuring result will be displayed.



0	=	Empty
1	=	First result after trigger
82	=	Last result entered.
N	=	Number of result to be stored (BURST ON function)
Max.	=	Maximum locations number = 999
RD. BUF. pointer	=	Location to be read

Valid in function	=	BURST
Selection	=	SHIFT, RD. BUF., if BURST is on
Input parameter	=	Location number 1 - 999 Print on/off ▲ (UP) ▼ (DOWN)
Output	=	Contents of buffer location number
Exit	=	CLR, RD.BUF CLR, BURST
Exit destroys	=	Contents of buffer
Power off/reset destroys	=	Contents of buffer, N N can be stored in program 0 (prog 0) N is related to the BURST ON function

The stepping is possible in the location number made and the measuring result display mode.

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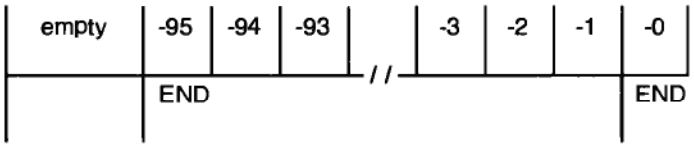
BURST OFF, RD.BUF.

- Location number is preceeded with a "-"
- Start of reading is the last measurement.



Max Function change RD.BUF. pointer

-0	=	Actual measurement
-1	=	Last measurement carried out
-95	=	First measurement after function change
max	=	maximum locations number = 999
Function change	=	Last function change
RD.BUF. pointer	=	Location to be read at the moment of RD.BUF mode selection

Valid in function	:	All multimeter function
Selection	:	SHIFT, RD. BUF
Input parameter	:	Location number 1 - 999 Print on/off ▲ (UP) ▼ (DOWN)
Output	:	Contents of buffer location number
Exit	:	CLR, RD. BUF
Exit destroys	:	Contents of buffer
saves	:	N
Power off/reset destroys	:	Contents of buffer
saves	:	N can be stored in program 0—9 (PROG)

EXAMPLE 1	OPERATION	DISPLAY	
FIRST CARRY OUT EXAMPLE 1 OF THE BURST MODE (CHAPTER 4.8.2.3) **READ BUFFER LOCATION 5 IN THE BURST ON MODE IN FUNCTION V⎓** **(NO PRINT OUT)**	SHIFT RD. BUF	**PRINT 0** S TRG SPEED 2 ▼ (bl)	①
	ENTER	**NO. 10** S TRG SPEED 2 ▼ (bl)	②
	5	**NO. 5** S TRG SPEED 2 ▼ (bl)	③
	ENTER	**+ 10.0000 V** S TRG SPEED 2 ▼ (bl)	④

① If contents of buffer location has to be print-out on a IEC 625/IEEEE 488 listen only printer enter "1".
② Most recent loaded buffer location (N = 10).
③ Enter buffer location 5. Remark: Press CLR key to clear mistaken entry.
④ Contents of buffer location no. 5.

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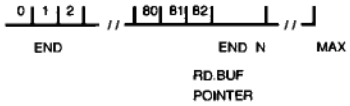
EXAMPLE 2	OPERATION	DISPLAY	
• FIRST CARRY OUT EXAMPLE 1 OF THE BURST MODE (CHAPTER 4.8.2.3) PRINT OUT ALL LOADED BUFFER LOCATIONS IN BURST ON MODE, FUNCTION V⎓ (IEC-625/IEEE-488) LISTEN ONLY PRINTER) • SET THE PM2535 TO TALK ONLY MODE VIA SHIFT, CHECK, ENTER 1, ENTER CHAPTER 5.4.3.	SHIFT RD. BUF	TLK ONLY PRINT 0 S TRG SPEED 2 ▼ (bl) SHIFT READ BURST SET	①
	1 ENTER	TLK ONLY PRINT 1 S TRG SPEED 2 ▼ (bl) SHIFT READ BURST SET	②
	ENTER	TLK ONLY NO. 10 S TRG SPEED 2 ▼ (bl) SHIFT READ BURST SET	③
	ENTER	TLK ONLY + 120.450 V⎓ S TRG SPEED 2 ▼ (bl) SHIFT READ BURST	④

① Print mode can be entered 0 = no printing (default) 1 = printing
② Print mode on. Remark: Press CLR key to clear mistaken entry.
③ Most recent loaded buffer location (N = 10).
④ Contents of buffer location no. 10 is displayed and sent to the printer
With ▼ or ▲ can be stepped through the buffer location contents (no location indication).
1 × press = 1 step (print-out) 1,5s press = auto step Stop = 1 × press ▲ of ▼
The printer will determine the stepping speed.
The end of the block of locations is indicated with "END" on the display.

Buffer contents



0 = empty
1 = first result after trigger
82 = last result entered
N = number of results to be stored (burst on function).
Max = maximum number of locations (999).
Rd. buf pointer = location to be read.

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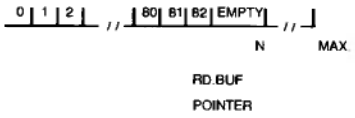
EXAMPLE 3	OPERATION	DISPLAY	
READ BUFFER LOCATIONS STEP BY STEP IN BURST ON MODE, FUNCTION $V_{\overline{\cdots}}$ (NO PRINT OUT) FIRST CARRY OUT EXAMPLE 1 OF THE BURST MODE (CHAPTER 4.8.2.3)	SHIFT RD. BUF	PRINT 0 S TRG SPEED 2 ▼ (bl) SHIFT READ BURST SET	①
	ENTER ENTER	+ 10.0000 $V_{\overline{\cdots}}$ S TRG SPEED 2 ▼ (bl) SHIFT READ BURST	②
	▼ ▲	+ 120.450 $V_{\overline{\cdots}}$ S TRG SPEED 2 ▼ (bl) SHIFT READ BURST	③

① Most recent loaded buffer location.
② Contents of buffer location no. 10
③ With ▼ or ▲ can be stepped. Through the buffer locations contents (no location indication).
1 × press = 1 step 1,5s press = auto step with 1s delay Stop = 1 × press ▲ of ▼
The end of the block of locations is indicated with "END" on the display.

Buffer contents



0 = empty
1 = first result after trigger
82 = last result entered
N = number of results to be stored (burst on function).
Max = maximum number of locations (999).
Rd. buf pointer = location to be read.

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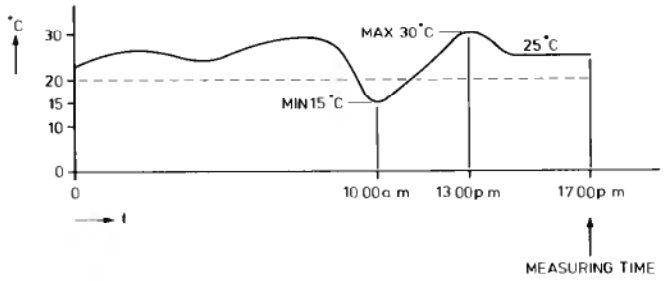
4.8.2.5 *MIN/MAX*

The function minimum/maximum is continuously updating the extreme values of the measuring results. The minimum and maximum measurement result including the proccessed data are stored in the minimum and maximum registers within one function. Via the MIN/MAX keys the stored values can be read.

During reading the measuring of the minimum and maximum values is continued. If a new extreme is measured it will be immediately displayed.

Valid in function	:	All
Selection	:	SHIFT, MIN/MAX
Result	:	Display minimum Display maximum
Exit	:	ENTER
Exit saves	:	Contents of MIN/MAX registers
Function change destroys	:	Contents of MIN/MAX registers (when MIN/MAX is not selected)
Power off/reset destroys	:	Contents of MIN/MAX registers
Clearing MIN/MAX registers	:	- Press CLR when MIN/MAX is switched on - First exit the MIN/MAX function and press SHIFT, CLR, MIN/MAX

Example: Measurement of minimum and maximum temperatures (MIN/MAX thermometer)



EXAMPLE 1	OPERATION	DISPLAY	
READ MINIMUM AND MAXIMUM TEMPERATURE. (FUNCTION°C WITH THE PT100 PROBE PM9249)		+ 025.0 °C SHIFT SPEED 2 PROBE	①
	SHIFT MIN MAX	+ 015.0 °C SHIFT MIN SPEED 2 ▼ (bl) PROBE	②
	MIN MAX	+ 030.0 °C MAX SPEED 2 ▼ (bl) PROBE	③
	ENTER	+ 025.0 °C SPEED 2 PROBE	④

① Present value
② Minimum value.
③ Maximum value.
④ New measuring value. While reading, the PM2535 keeps on measuring. The new results are compared with the "OLD" values and refreshed.

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4.8.2.6 *DIGITS (Display format function)*

Independent of other settings the maximum display length can be set.
The number of digits "d" can be programmed (o ⩽ d ⩽ 7). The displayed result is never longer than the measuring result of the function selected. If the number of figures in front of the decimal point is larger than "d", small zeros will be displayed up to the decimal point (significant blanks).

In exponent notation DIGITS are only related to the mantisse. The exponent will be displayed independent of the DIGITS function.

The DIGITS function is independent of the DISPLAY function, that can be used via the IEC-625/IEEE-488 interface.

e.g. Programmed 2 digits in V⎓
Display e.g. + 12._____ V⎓
Display + 20o._____ V⎓ in stead of + 20

Valid in function	:	All
Selection	:	SHIFT, DIGITS
Input parameter	:	Number of digits "d"
Result	:	Modified display length "d"
Exit	:	ENTER
Function change saves	:	"d"
Power off/reset destroys	:	"d", unless stored in program 0—9 (PROG).
Delivered from factory on	:	"d" = 7

EXAMPLE 1	OPERATION	DISPLAY	
PROGRAM MAX. DISPLAY LENGTH 3 DIGITS	SHIFT DIGITS	DIG 7 SPEED 2 ▼ (bl)	①
	3 ENTER	DIG 3 SPEED 2 ▼ (bl)	②
	ENTER	+ 12.3 V⎓ SPEED 2	③

① Previous programmed digits
② Enter 3 digits.
Remark: Press CLR key to clear mistaken entry.
③ All following measurements a display length of 3 is valid.

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4.8.3 FUNCTION PROGRAMMING

4.8.3.1 PROG function (PROGRAM)

Instrument settings including process functions and constants, can be stored under a program number (except rtl, tonly, address, test, MSR, SPR). The settings can be recalled (manual, via interface or in the sequence function) to set the instrument in predefined modes/functions.
The maximum number of programs is 10 (0-9)

The settings stored in P0 will be automatically taken over by the PM2535 at power on or reset

Valid in function	:	All
Selection	:	SHIFT, PROG
Input parameters	:	Program recall number PX (X = 0-9) Program store number PX
Result	:	Instrument settings stored in PX
Exit	:	ENTER
Exit saves	:	Settings PX
Function change saves	:	Settings PX
Power off/reset saves	:	Settings P0-P9

EXAMPLE 1	OPERATION	DISPLAY	
STORE ACTUAL INSTRUMENT SETTINGS IN P0		———.———* V⎓ STRG SPEED 2	①
	SHIFT PROG	PrcL – STRG SPEED 2 ▼ (bl)	②
	PROG	PSTo – *V⎓ STRG SPEED 2 ▼ (bl)	③ ④
	0 ENTER	PSTo 0 *V⎓ STRG SPEED 2 ▼ (bl) ACTUAL MEASUREMENT	⑤

① Actual settings to be stored.
② Program recall. No = prog. Yes = enter P number.
③ Programm store ? Enter P number.
④ Enter P number 0.
⑤ Instrument settings are stored in P1.

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EXAMPLE 2	OPERATION	DISPLAY	
CARRY OUT PROGRAM SETTINGS OF P0	SHIFT PROG	**PrcL –** SPEED 2 ▼ (bl) SHIFT SET	①
	0	**PrcL 0** SPEED 2 ▼ (bl) SHIFT SET	②
	ENTER	———.———*V⎓ STRG SPEED 2 AX + B BURST DELAY	③

① Programm to recall ?
② Enter P number 0.
③ Setting of P0 are carried out.

Remark: At power on or reset the settings programmed in P0 are automatically selected.

4.8.3.2 Sequence

The sequence function enables the PM2535 to carry out a number of sequential steps with different instrument settings as stored in the PROGRAM function.

At the same time control data can be output to System 21 modules in the System 21 scan function. In this case the PM2535 with system 21 modules can be used as stand-alone system (without controller).

The scan function (available only in some units) is used for the sequential select of inputs, switches, channels. A scan-cycle can be executed over channels of several units on the condition that:

- All units are of the same PM-number.
- All units are set for the same operating mode (see the System 21 manual and the operating cards of the slave units).
- No unit is in Execute Unconditional mode.
- The units have successive addresses with settings starting at 0.

The scan is initiated by the PM2535. The execution is automatically done with a number of execute commands or triggers in system 21 equal to the number of channels to be scanned. Under the above conditions a scan cycle will start with the lowest channel number of the unit with address-switch set to zero and continue along all channels and units.

Programming the Sequence function is only possible via the front keys.
(via IEC/IEEE interface is not implemented)
After pressing the SHIFT-SEQU keys the display asks "Run?".
With ENTER the sequence program will start.

The load-program mode is entered with SHIFT, SEQU, SEQU.
Sequentially a number of System 21 related questions have to be answered and entered.
After that, step numbers will be displayed, starting at step 0 (st 00).
The maximum number of steps is 99.
Every step has to be linked with the PROG number (instrument settings) wanted. The programming of the PROG numbers has to be made in the PROG function (refer to 4.8.3.1).

With "n" ("+/–" key) a PROG number can be skipped.
A number of steps can be terminated with "E" (“.” key), the sequence will start again on step 00.

It is not possible to carry out BURST measurements.
A stored BURST-ON in a PROG number will be ignored in the PROG function.

Different from the normal measuring modes the buffer is not cleared in the sequence function. In this way it is possible store measurement results with different settings. Checking afterwards is possible because the PROG number has also been stored.

During execution of the sequence program only the keys SHIFT,CLR, SEQU and SINGLE TRIGGER and function rtl (return to local) are active.

The execution can be stopped with SHIFT, CLR, SEQU

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4.8.3 FUNCTION PROGRAMMING

4.8.3.1 PROG function (PROGRAM)

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The maximum number of programs is 10 (0-9)

The settings stored in P0 will be automatically taken over by the PM2535 at power on or reset

Valid in function	:	All
Selection	:	SHIFT, PROG
Input parameters	:	Program recall number PX (X = 0-9) Program store number PX
Result	:	Instrument settings stored in PX
Exit	:	ENTER
Exit saves	:	Settings PX
Function change saves	:	Settings PX
Power off/reset saves	:	Settings P0-P9

EXAMPLE 1	OPERATION	DISPLAY	
STORE ACTUAL INSTRUMENT SETTINGS IN P0		———.———* V⎓ STRG SPEED 2	①
	SHIFT PROG	PrcL – STRG SPEED 2 ▼ (bl)	②
	PROG	PSTo – *V⎓ STRG SPEED 2 ▼ (bl)	③ ④
	0	PSTo 0 *V⎓ STRG SPEED 2 ▼ (bl)	⑤
	ENTER	ACTUAL MEASUREMENT	

① Actual settings to be stored.
② Program recall. No = prog. Yes = enter P number.
③ Programm store ? Enter P number.
④ Enter P number 0.
⑤ Instrument settings are stored in P1.

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EXAMPLE 2	OPERATION	DISPLAY	
CARRY OUT PROGRAM SETTINGS OF P0	SHIFT PROG	**PrcL –** SPEED 2 ▼ (bl) SHIFT SET	①
	0	**PrcL 0** SPEED 2 ▼ (bl) SHIFT SET	②
	ENTER	———.———*V… STRG SPEED 2 AX + B BURST DELAY	③

① Programm to recall ?
② Enter P number 0.
③ Setting of P0 are carried out.

Remark: At power on or reset the settings programmed in P0 are automatically selected.

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- All units are of the same PM-number.
- All units are set for the same operating mode (see the System 21 manual and the operating cards of the slave units).
- No unit is in Execute Unconditional mode.
- The units have successive addresses with settings starting at 0.

The scan is initiated by the PM2535. The execution is automatically done with a number of execute commands or triggers in system 21 equal to the number of channels to be scanned. Under the above conditions a scan cycle will start with the lowest channel number of the unit with address-switch set to zero and continue along all channels and units.

Programming the Sequence function is only possible via the front keys.
(via IEC/IEEE interface is not implemented)
After pressing the SHIFT-SEQU keys the display asks "Run?".
With ENTER the sequence program will start.

The load-program mode is entered with SHIFT, SEQU, SEQU.
Sequentially a number of System 21 related questions have to be answered and entered.
After that, step numbers will be displayed, starting at step 0 (st 00).
The maximum number of steps is 99.
Every step has to be linked with the PROG number (instrument settings) wanted. The programming of the PROG numbers has to be made in the PROG function (refer to 4.8.3.1).

With "n" ("+/–" key) a PROG number can be skipped.
A number of steps can be terminated with "E" ("." key), the sequence will start again on step 00.

It is not possible to carry out BURST measurements.
A stored BURST-ON in a PROG number will be ignored in the PROG function.

Different from the normal measuring modes the buffer is not cleared in the sequence function. In this way it is possible store measurement results with different settings. Checking afterwards is possible because the PROG number has also been stored.

During execution of the sequence program only the keys SHIFT,CLR, SEQU and SINGLE TRIGGER and function rtl (return to local) are active.

The execution can be stopped with SHIFT, CLR, SEQU

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Valid in function	:	All
Selection of execution	:	SHIFT, SEQU, ENTER
Selection of programming	:	SHIFT, SEQU, SEQU
Input parameters at programming	:	Srun Aid (system 21 module type) M (system 21 module mode) dsp (display time) ST00 P. (program number at step xx)
Result	:	- Sequential steps of program settings - scan function for System 21
Stop. Execution	:	SHIFT, CLR, SEQU
Exit	:	ENTER
Exit saves	:	P0-P9
Function change saves	:	P0-P9
Power off/reset saves	:	P0-P9

Enter the next in the prog. function: P0 = V⎓ Internal trigger. Speed 2. Auto ranging.
: P1 = Ω2W. Internal trigger. Speed 2. Auto ranging.
: P2 = V∿. Internal trigger. Speed 2. Auto ranging.

EXAMPLE 1	OPERATION	DISPLAY	
Enter the following sequence program STEP0 . Set PM2535 to setting of P2 . Display result for 5s. STEP1 . Skip settings of P1. STEP2 . Set PM2535 to setting of P0 . Display result for 5s. STEP3 . Terminate the program and return. This program can be used for a stand alone PM2535. A shorter program is: STEP0 P2.DSP 5s STEP1 P0.DSP 5s STEP2 TERMINATE To perform a step in the sequence-run mode the PM2535 needs to be internal of single triggered.	SHIFT SEQU	Srun SPEED 2 ▼ (bl)	①
	SEQU	AidxxMx SPEED 2 ▼ (bl)	②
	ENTER	dSP 1.5s SPEED 2 ▼ (bl)	③
	5 0	dSP 5.0s SPEED 2 ▼ (bl)	④
	ENTER	ST.00 P6 SPEED 2 ▼ (bl)	⑤
	2	ST.00 P2 SPEED 2 ▼ (bl)	⑥
	ENTER	ST.01 P6 SPEED 2 ▼ (bl)	⑦
	—	ST.01 Pn SPEED 2 ▼ (bl)	⑥

① PM2535 asks to run the sequence program. Enter = yes. SEQU = no = programming mode.
② PM2535 asks two parameters for system 21 use (Type.Mode). Press ENTER to continue.
③ PM2535 asks you for display time. (1.5s = previous display time).
④ Enter 5 seconds.
⑤ PM2535 asks P number (P6 = previous P number). PM2535 will start to ask with step 00. Maximum number of steps = 99
⑥ Enter 2 on step 3.
⑦ PM2535 asks P number (P6 = previous P number). Enter "–" on step 1. "–" = the PM2535 will not measure.
⑧ Enter "–" on step 01 to skip (n = displayed)

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EXAMPLE 1 (cont.)	OPERATION	DISPLAY	
	ENTER	ST.02 P6 SPEED 2 ▼ (bl)	⑨
	0	ST.02 P0 SPEED 2 ▼ (bl)	⑩
	ENTER	ST.03 P6 SPEED 2 ▼ (bl)	⑪
	.	ST.03 PE SPEED 2 ▼ (bl)	⑫
	ENTER	+ 12.34567 V⎓ SPEED 2	⑬

⑨ PM2535 asks P number (P6 = previous P number)
⑩ Enter 0 step 02
⑪ PM2535 asks P number (P6 = previous number)
⑫ Enter. on step 03 to terminate (E = displayed)
⑬ Actual-measurement

EXAMPLE 2	OPERATION	DISPLAY
Start (run) a Sequence program (refer to example program). To perform a step in the sequence-run mode, the PM2535 needs to be triggered internal or single	SHIFT SEQU ENTER	Srun ▼ (bl) + 000.0000 mV SPEED 2

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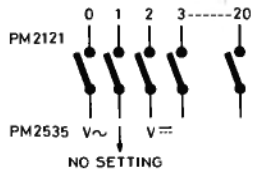
EXAMPLE 3	OPERATION	DISPLAY	
Make a program using the scan function of system 21. Suppose one PM2121 that has to be set to mode "M1" is used. Use the program of example 1 Total sequence program STEP 0. P2 settings. System 21 scan step (PM2121, M1 Display result for 5s STEP 1. PN System 21 scan step (PM2121.M1) STEP 2. P0 settings System 21 scan step (PM2121.M1) Display result for 5s STEP 3. PE (terminator)  Remarks- A system PM2121, M1 scan consists of 20 scan steps per slave connected. - With a programmed delay (chapter 4.8.2.1) a waiting loop between closing the PM2121 relay contact and the start measuring of the PM2535 can be inserted.	SHIFT SEQU SEQU	Aid 20 M0 (bl) ▼	①
	2 1	Aid 21 M—— ▼ (bl)	②
	1	Aid 21 M1 ▼ (bl)	③
	ENTER	dSP 5.0s ▼ (bl)	④
	continue with example 1		

① PM2535 asks slave type connected to perform the scan function
② Press: 21 (PM21 [21])
③ Enter: mode "M1"
④ PM2535 asks display time.

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4.9 GENERAL

4.9.1 Bleeper

The built in bleeper can be switched on or off for a number of functions.
For some alarm functions the bleeper cannot be switched off (not programmable).

The bleeper is programmable for the following alarm conditions.
- At exceed of the LIMIT values
- Buffer full in BURST mode

Not programmable:
- Overload in highest voltage and current ranges.

Valid in function = LIMIT, BURST
Bleeper on = SHIFT, 🔊, ENTER
Bleeper off = SHIFT, CLR, 🔊

Programmed at delivery: Bleeper on.

EXAMPLE 1	OPERATION	DISPLAY
SWITCH ON BLEEPER FUNCTION	SHIFT 🔊	+ 123.456 V⎓ SPEED 2
		🔊 + 123.456 V⎓ SPEED 2

EXAMPLE 2	OPERATION	DISPLAY
SWITCH OFF BLEEPER FUNCTION	SHIFT 🔊	+ 123.456 V⎓ SPEED 2

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4.9.2 CLR (clear)

With SHIFT, CLR selected help functions can be switched-off, by specifying the function to be switched-off.

At input of figure a mistaken entry can be cleared. The complete number of input figures will be cleared, after which a new input can be given. Escape from inputting is possible via **CLR**, ENTER.
No equivalent command is available for the interface (IEC/IEEE).

EXAMPLE 1	OPERATION	DISPLAY
SWITCH OFF A HELPFUNCTION E.G. AX+B		– 23.9876 * V⎓ SPEED 2 AX+B DELAY
	SHIFT CLR	CLEAR SPEED 2 ▼ (gn) SHIFT AX+B SET
	AX+B	+ 10.0000 V⎓ SPEED 2 DELAY

EXAMPLE 2	OPERATION	DISPLAY
CLEAR A MISTAKEN ENTRY OF FIGURES E.G. DURING INPUT OF "A" IN FUNCTION AX+B		+ 8.657 A SHIFT AX+B SET
	CLR	+ A RE-ENTER ALL FIGURES SHIFT AX+B SET

EXAMPLE 3	OPERATION	DISPLAY
ESCAPE OUT OF FUNCTION AX+B DURING INPUT OF FIGURES		+ 8.657 A SPEED 2 ▼ (bl) SHIFT AX+B SET
	CLR ENTER	+ 10.0000 V⎓ SPEED 2

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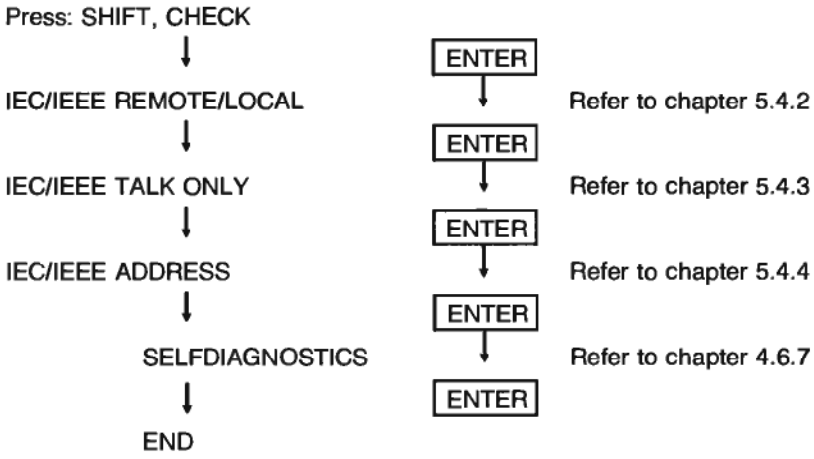
4.9.3 CHECK

In the check function a number of checks and tests are carried out sequentially. The checks and tests have been described in the relevant sections in this manual.

To enter the CHECK function press: SHIFT, CHECK. Sequentially a number of steps have to be carried out. Exit is possible with the CLR key.

The following checks and tests are implemented:



No equivalent command is available for the interface (IEC/IEEE)

4.9.4 SHIFT and ENTER

SHIFT allows to select the help functions.
If shift is activated an indication will appear on the display.

ENTER
With ENTER help functions selection or input of figures are terminated.

No equivalent commands are available for the interface (IEC/IEEE)

4.9.5 Input of figures (blue text)

Dependent on the help function selected, the PM2535 will ask for figures to be entered. Available are: 0....9 + − and . (decimal point).

+/− is an independent toggle function

Remark: Due to conversion from decimal to binary a rounding error of ± 1 digit may occur when recalling the entered 7 digit figures.

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5. OPERATING INSTRUCTIONS FOR REMOTE OPERATION VIA IEC-625/IEEE-488 INTERFACE

5.1 GENERAL

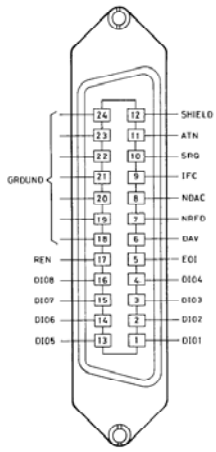
The PM2535 is an automatic ranging multimeter equipped as standard with an IEC/IEEE interface. It is designed to comply with the IEC-625/1 publication and has full remote control capabilities.

This section deals with hardware and software aspects of bus operation and describes programming functions in detail. Included are: general bus commands, device-dependent commands, status word and other operating commands. Via the interface, all functions are controllable that are normally selected by the front push-buttons. However, a number of special commands are implemented to meet the requirements of a system multimeter.

5.2 SPECIFICATIONS

5.2.1 Functional specification

Function	Identification	Description
Source-handshake	SH1	Complete capability
Acceptor	AH1	Complete capability
Talker	T5	Basic talker Serial poll possible Talk-only possible Unaddressed if "MY LISTEN ADDRESS"
Listener	L4	Basic listener Unaddressed if "MY TALK ADRESS
Service Request	SR1	Complete capability
Remote/Local	RL1	Complete local LOCK-OUT capability
Device Trigger	DT1	Complete capability
Device clear	DC1	Complete capability
Bus Drivers	E1	Open collector Isink 48 mA



IEEE-488/IEC-625
ST3891

5.2.2 Code specification

Code in use: ISO 7-bit (ISO-646).
Separator for input data : Fully programmable; initial separator after POWER-ON; LF or the END message (EOI).
Separator for output data : Same as the input separator; always with the END message.

5.2.3 Connector pinning

Type of connector : 24-pin female connector, contact assignment in accordance with IEEE-488.

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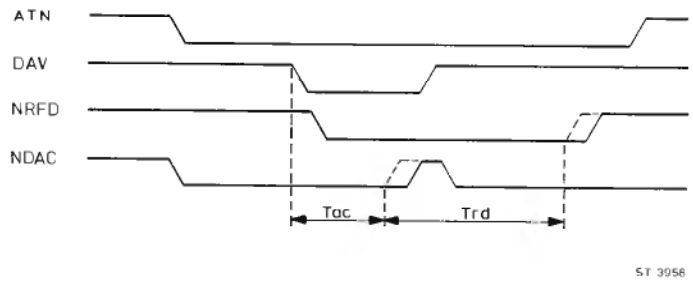
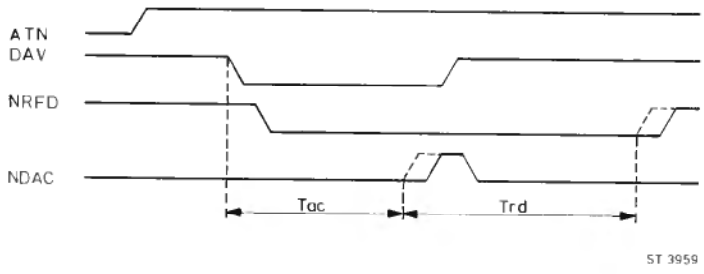
5.2.4 Timing specification

Interface messages (with ATN = 1) received e.g. MLA, MTA, UNL, GTL.



Tac = accept time; time needed to accept the interface message: 70 μs.
Trd = ready time; time needed until acceptor can receive new data: <220 μs.

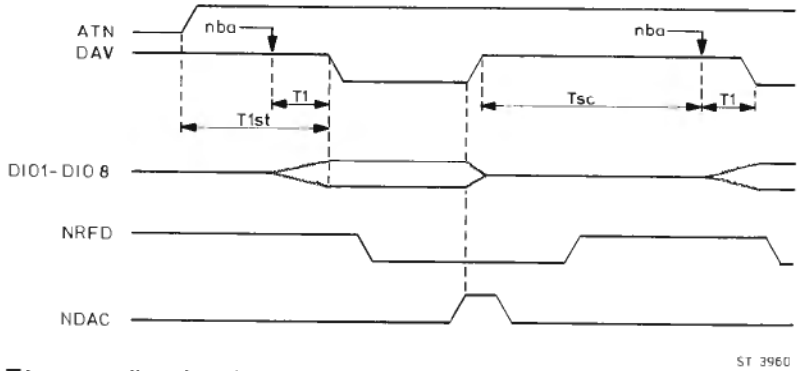
Data bytes (any input) received (with ATN = 0)



Tac = accept time; time needed to accept the data byte.
- for the first data byte (after addressing): 90 μs.
- for the second and following data bytes: 90 μs.

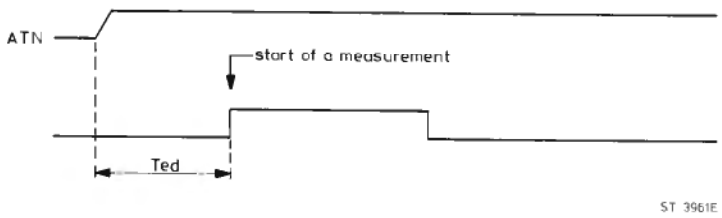
Trd = ready time; time needed until acceptor can receive new data: <350 μs.

Output data (measuring data and status data)



T1 = settling time (according to IEC625-1, section 3 cl 24): <150 μs.
T1st = time needed for the first data byte to become available on the bus: <400 μs (only if valid data is available).
Tsc = source time needed for next data byte to become available: <250 μs.

Execution time of the GET command (Group execute trigger).



Ted = execution delay time for the GET command: <500 μs.

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5.3 PROGRAMMING THE PM2535

5.3.1 General information

Programming the PM2535 is divided into three main parts: viz Interface Programming, Interface Program Data and Device programming.
The commands listed under interface programming do not influence the device functions. It is recommended to program first separators and service request masking.

5.4 iNTERFACE PROGRAMMING

5.4.1 Explanation

- Remote state

When the display indication "REM" is on, the PM2535 is in the remote state. In this state, the instrument can be controlled by device-dependent data via its interface. All control of the instrument via the front-panel is disabled, except for the SHIFT, CHECK keys and single trigger (when chosen). With the CHECK key, the return-to-local function can be chosen only if the remote state is not locked.

- Local state

When the front indication "REM" is off, the PM2535 is in the local state. In this state, the instrument can be controlled via its front keyboard. All control data received via the interface will be cancelled and not executed. In the remote state, the local state is chosen via the GTL (go to local) command.

- Device clear

By a device clear command the PM2535 is initialised. This command is comparable with POWER ON or RESET.
The device clear command can be given by:
- DCL Device clear
- SDC Selected device clear } see ASCII table

- Trigger command

To start a measurement in the PM2535 a trigger command can be given by:
- GET (group execute trigger).
- X1

- Serial Polling

The serial polling sequence is used to obtain the status byte of the PM2535. It is used to determine which of several devices has requested service over the SRQ line. However, the serial polling sequence may be used at any time to obtain the status byte, to give information of settings.

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5.4.2 REMOTE/LOCAL selection

EXAMPLE	OPERATION	DISPLAY
Return to local if PM2535 is remote	SHIFT CHECK	REM rtl 0 ▼ (bl) SHIFT SET
	1	REM rtl 1 ▼ (bl) SHIFT SET
	ENTER	NORMAL MEASUREMENT

Remark: rtl 1 sets the PM2535 to local and not the interface. LSTN or TLK will stay on the display until a UNL or UNT command.

5.4.3 TALK ONLY selection

EXAMPLE	OPERATION	DISPLAY
Switch-on Talk Only mode	SHIFT CHECK ENTER	t. only 0 SPEED 2 ▼ (bl) SHIFT SET
	1	t. only 1 SPEED 2 ▼ (bl) SHIFT SET
	ENTER	TLK only NORMAL MEASUREMENT
Switch-off Talk Only mode	SHIFT CHECK ENTER	TLK only t. only 1 SPEED 2 ▼ (bl) SHIFT SET
	0	TLK only t. only 0 SPEED 2 ▼ (bl) SHIFT SET
	ENTER	NORMAL MEASUREMENT

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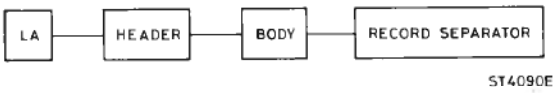
5.4.4 ADDRESS (At delivery 22) selection.

EXAMPLE	OPERATION	DISPLAY
Check Adress	SHIFT CHECK ENTER ENTER	Addr 22 SHIFT SET SPEED 2 ▼ (bl)
	CLR	NORMAL MEASUREMENT
Modify Address to e.g. 11	SHIFT CHECK ENTER ENTER	Addr 22 SHIFT SET SPEED 2 ▼ (bl)
	1 1	Addr 11 SHIFT SET SPEED 2 ▼ (bl)
	ENTER	NORMAL MEASUREMENT

5.4.5 Interface program data

Interface program data is used to specify the different interface settings or parameters. A message unit consists always of a header-body combination and **must always** preceeded by the listner address. The following structure of a program message must be used.



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Note: Before every header-body combination the listen address must be sent.

5.4.6 Sending program data

INTERFACE PROGRAMMING

The following program data can be given.

Function	Message	Description
Service request	MSR␣n [n] [n]	Setting of the service request mask. n [n] [n] is the decimal equivalent bit pattern
Separators	SPR␣nn [, nn]	Setting of the separators. nn is the decimal equivalent of a character of the ISO code table.
Identity	ID␣?	On receipt of this command the identity is returned.
Interface test	TSI␣U TSI␣<dec 170>	On receipt of these commands a self test is performed. (U = with service request) (<dec 170> means without service). 170 is the decimal value and can be programmed on most controllers with CHR$(170).

Notes: [ ] means optional
␣ = space

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Service request mask

The reasons to ask for service can be masked (see table). If a service request has to be enabled for a certain condition, its mask bit must be set to 1.

Bit	8	7	6	5	4	3	2	1	0
Decimal value	256	128	64	32	16	8	4	2	1

Bit	Reasons for service request	Description
8	Instrument no longer busy	The PM2535 has made a measurement and sent it via the interface. It can now be triggered.
7	System 21 event	A service request can be generated by the System 21 part.
6	Incorrect measurement	The PM2535 has made an incorrect measurement. (e.g. overload, crest-factor exceeded, failure in a calibration measurement or a faulty Null measurement).
5	Internal failure	The PM2535 has an internal failure (e.g. No CAL).
4	Program failure	An illegal body or header is received in a command.
3	Hi limit exceed ^	Exceed of programmed Hi limit
2	Lo limit exceedv	Exceed of programmed Lo limit
1	Hold mode	The hold mode is selected via the data hold probe. Also when the hold mode is released it can generate a service request.
0	Data available	Valid data is available in the output buffer.

A mask can be set by sending MSR n [n] [n] via the interface. n[n][n] represents the decimal equivalent of the bit pattern. The following sequence must be used.

Command: MSR_n [n] [n] = optional

If more than one reason for service request has to be enabled, the decimal value is the sum of the individual decimal values.

Example: MSR_97 specifies the bit pattern: 01100001

- Data available 1
- Internal failure 32
- Incorrect measurement 64

97

Note: At POWER ON all reasons for service request are masked. If a reason to ask for service occurs while its service request bit is masked, the reason is still specified in the status byte, but RQS = 0.

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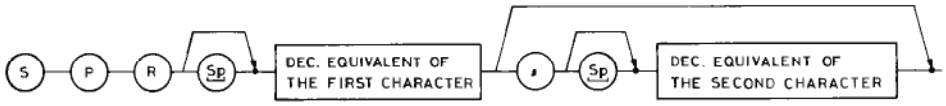
5.4.7 Separators

A record separator terminates the output or input sequence. It indicates that there is no additional information available. The PM2535 is capable of handling single and double input and output record separators. The record separator character(s) can be programmed to one or two characters of the ISO code table.
An ESC character is not acceptable as a record separator but no error message is given and the last programmed separator(s) will remain valid.
At POWER ON the separator is: NL (LF)

Note: For input data, the PM2535 allows but does not require the END message (EOI line). However, the PM2535 always sends out the END message concurrently with the last record separator character.

To program the separators the following sequence has to be used.



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5.4.8 Identity

If the interface programming code ID_? is decoded, and the PM2535 becomes talker, it responds with PM2535X SYY.

Command ID_? X = hardwareversion (e.g. 0)
YY = softwareversion (e.g.01)

Any additional data bytes sent in the program string are lost.

5.4.9 Interface test

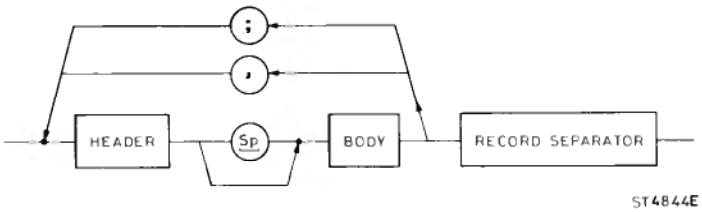
On receipt of TSI_U an interface self-test is performed. If correct, a response with a byte of decimal equivalent 170 is sent on the bus when the PM2535 becomes talker. A service request is generated.
If a byte of decimal equivalence 170 is received instead of the U, the same interface self-test is performed, but no service request is generated and the character U is sent out on the bus.

Commands: TSI_<dec. 170>
TSI_U

Additional data bytes are lost.

5.5 DEVICE PROGRAMMING

Device-dependent messages are used for device control purposes. The basic units consist of a header, a body and a separator. However, a complete program message may consist of one or more units. The following structure has to be used.



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The unit separator (comma) or semi colon must be used between the units. Upper and lower case characters are allowed. The execution of a message is according to the input sequence.

Example: "RNG_AUTO,X1"

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The device messages relating to the input data for the PM2535 deal with measurement start commands, speed and range selection, trigger modes function selection and display modes. These are listed on the next page.

5.5.1 Function selection

With this command, one of the seven measuring functions is selected.
The select function command sets the PM2535 to predetermined states as defined in the following table. All other program data not mentioned in the table will remain if another function has been chosen.

Commands: FNC␣xyz
xyz

Function	Program data x y z	Ranging	Speed	Filter	Internal settling time
V⎓	VDC	AUTO	2	OFF	ON
V∿	VAC	AUTO	2	ON	ON
Ω-2w	RTW	AUTO	2	OFF	ON
Ω-4w	RFW	AUTO	2	OFF	ON
A⎓	IDC	AUTO	2	OFF	ON
A∿	IAC	AUTO	2	ON	ON
°C	TDC	AUTO	2	OFF	ON

Ask function:

On receipt of the FNC␣? command the actual function is output.

Command: FNC␣?

Function	Output
V⎓	FNC␣VDC
V∿	FNC␣VAC
Ω-2w	FNC␣RTW
Ω-4w	FNC␣RFW
A⎓	FNC␣IDC
A∿	FNC␣IAC
°C	FNC␣TDC

5.5.2 Range selection

Range selection is achieved by sending the characters RNG as header. The body may consist of a decimal value with or without decimal point.
Also a technical or scientific notation is allowed.
A range is chosen by the instrument when the body is programmed as the expected measuring value. It is also possible to program the end of the range or a value within a range. The instrument will always choose the lowest possible range.

Commands: RNG␣A
RNG␣AUTO

RNG␣300

Ask range:
Sending the command RNG␣? will output the selected range

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Examples for output: RNG_300.E+6 (300 M Ω range MAN ranging)
RNG_30.E+00 (30 V range MAN ranging)

Note: Programming functions and ranges can be combined in one command. The headers FNC and RNG are in this case not necessary. The bodies described in Section 5.5.1 are used for this command as a header.

VDC_200	will select	V⎓ range 300 V
VDC_0.001	,,	V⎓ range 300 mV
VAC_2.0 E-3	,,	V∿ range 300 mV
RTW_1.5 E+3	,,	Ω-2W range 3 kΩ
IAC_AUTO	,,	In auto ranging

5.5.3 Measuring Speed/Resolution

The speed and the resolution are determined by the ADC and depend also on the selected function and range. These functions are displayed with SPEED 1 (2,3,4) as a relative number (1 = lowest speed and 4 = highest speed). The instrument selects the right combination of measuring speed and resolution. Default is speed 2 for all measuring functions. Changing the measuring function will select this speed.

- Measauring Speed

With the following commands the measuring speed is selected.

Commands: MSP_1
MSP_2
MSP_3
MSP_4

Ask measuring speed.

Command MSP_? will output the actual measuring speed.

Example: MSP_3

- Resolution

Commands: RSL_4
RSL_5
RSL_6
RSL_7

With this command a resolution of 4, 5, 6 or 7 digits is chosen.

Note: A non-valid resolution or measuring speed results in a program failure. After programming of resolution and speed the last command is always executed.

- Ask resolution

Command: RSL_?

The actual resolution is output.

Example: RSL_5

5.5.4 Filter

The filter function can be switched ON/OFF by means of:

Commands: FIL_OFF
FIL_ON

Note: Changing the function will select the default state.

Ask filter state.

Command: FIL_?

After sending this command, the PM2535 gives the state of the filter.

Example: FIL_OFF

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5.5.5 Trigger mode

The PM2535 has two trigger modes, namely Internal and Single. Selecting internal triggering will give a continuous measuring of the instrument. At single triggering the instrument must be started via a start command. This command can be given via the keyboard, via the IEC/IEEE bus or via the EXT TRIG input at the rear. Changing the function does not alter the selected trigger mode.

Commands: TRG␣I
TRG␣B
TRG␣E
TRG␣K

I: Internal triggering
B: Single triggering via IEC/IEEE bus
E: "EXT TRIG" input and via IEC/IEEE bus
K: Single triggering via IEC bus, EXT TRIG input or via the keyboard.

Ask trigger mode:
Command: TRG␣?

The trigger mode is output.
Example: TRG␣E

5.5.6 Internal settling time

The internal settling time is a waiting time after a start command.
Before the ADC starts converting, the signal conditioning circuit needs time to settle. The settling time depends on the function, range and speed and is determined by the instrument. This settling time can not be changed via the front panel but can be switched OFF via the IEC-625/IEEE-488 interface to obtain faster measurements. With the following command the settling time can be switched ON/OFF.

Commands: IST␣OFF
IST␣ON

Ask state internal settling time:
Command: IST␣?
This will give IST␣ON when the settling time is switched ON and IST␣OFF when it is switched OFF.

Note: Changing the function will switch the internal settling time ON.

5.5.7 Start command

X
X␣1
Start a measurement in the actual function.

5.5.8 Display mode (instrument display)

Commands: DSP␣OFF
DSP␣ON

Note: The display mode is not altered when changing the function.

Ask display mode:
Command: DSP␣?

Example: DSP␣OFF

The display can be filled with a value. This is done by sending the value as a character string to the instrument.

Command: TXT␣nnnn.nnn

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nnnn.nnn is the value that is written in the display.
The following characters can be sent to the PM2535:

Note: 0,1 or 2 decimal points can be sent.

5.5.9 Output mode

The string (measuring value) which is output to the controller can be made shorter.

Command: OUT_N,x
OUT_N
OUT_S

S = string is complete output
N = only numerical values are output (only body)
N,x = only numerical values are output with length specified in x.
Also dec. point and polarity are included in this number.

Example: OUT_N,6 will give +036.4

Note: The selected mode is not altered after changing the function.

Ask output mode:
Command: OUT_?

Example: OUT_N,5

5.5.10 Null

If a thermal e.m.f. occurs at the input sockets an offset voltage can arise. This offset voltage in the V⎓, 300 mV range can be compensated by pushing NULL if the input is short-circuited. This can also be done via the IEC-645/IEEE-488 interface. At POWER ON or RESET this function is not active. The state is kept in memory during function changing, and will be used again when V⎓, 300 mV is selected (Null function must be ON).

Commands: NUL_NEW
NUL_N
NUL_OFF
NUL_ON

NEW: The instrument is set in V⎓ 300 mV range.
Also TRG_K is selected.
To compensate the offset, short-circuit the V- and 0 socket and give one of the trigger commands (X1, GET). Also single trigger can be pushed or a single trigger via the BNC connector can be given.
The compensation value is stored in memory.

OFF: The Null function is switched off but the value is still kept in memory.

ON: The Null function is switched on with the stored value.

Ask Null state:
Command: NUL_?

Example: NUL_OFF

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5.6 HELP FUNCTIONS

5.6.1 Mathematic functions

5.6.1.1 AX + B

The measured value(X) is adapted according to the formula AX + B.
A and B can be input via keyboard or interface.

Valid in function	:	ALL
Selection command	:	SCL_ON
Input parameter	:	A
	:	B
Output	:	AX + B
Exit command	:	SCL_OFF
Exit saves	:	A, B
Function changes saves	:	A, B
Power off/reset destroys	:	A, B, unless stored in program 0—9 (PROG)
Limits for A	:	± (10^{13}....10^{-13}) Input via keyboard ± (9999999 to .0000001)
Limits for B	:	± (10^{13}....10^{-13}) Input via keyboard Numeric value ± (9999999 to .0000001) The multiplication factor as shown when entering B is included in the value of B.
Delivered from factory on	:	A = +1, B 0

Commands:

SCL_ON	:	Switches on function AX + B
SCL_OFF	:	Switches off function AX + B
SCL_ON, + 1234567, − 765.4321	:	Switches on function AX + B and fills A and B A = +1234567 B = −765.4321 (+ = optional)
SCL_?	:	Output the actual state of the AX + B function, technical notation Format: SCL_OFF, +123.4567E+00, −765.4321E-03 ↓ A ↓ B

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5.6.1.2 *dBm*

The measured input voltage (~ or ⎓) can be converted into a dB value (dBm = 1mW, with reference resistor). The reference resistor can be chosen and stored. It must lay between .0001 and 9999 Ω. At delivery the resistance value is 600 Ω.

Valid	:	V⎓, V~ (can be combined with ZERO)
Selection command	:	DBM␣ON
Input parameter	:	Reference resistance, at delivery 600 Ω
Output	:	dBm
Exit	:	DBM␣OFF
Exit saves	:	Rref
Function change saves	:	Rref
Power off/reset destroys	:	Rref, unless stored in program 0—9 (PROG)
Limits for Rref	:	.0001 → 9999 Ω
Delivered from factory on	:	Rref = 600 Ω

Commands:

DBM␣ON	:	Switches on the dBm function with the actual reference resistor.
DBM␣OFF	:	Switches off the dBm function
DBM␣ON, + 7,5 E + 01	:	Switches on the dBm function and sets Rref. to 75 Ω. + = optional
DBM␣OFF, 150	:	Switches off the dBm function and sets Rref. to 150 Ω.
DBM␣?	:	Outputs the actual state of the dBm function, technical notation Format: DBM␣OFF,␣␣␣␣+150.0000E+00

5.6.1.3 *△ %*

The measured value (X) is adapted according to the formula $\frac{X-C}{C} \times 100\%$

Valid in function	:	All (cannot be combined with other mathematical functions)
Selection command	:	PRC␣ON
Input parameter	:	C
Output	:	$\frac{X-C}{C} \times 100\%$
Exit	:	PRC␣OFF
Exit saves	:	C
Function change saves	:	C
Power off/reset destroys	:	C, unless stored in program 0—9 (PROG)
Limits for C	:	± (10^{13}...10^{-13}) 0 excluded. Numerical value ± (9999999 → .0000001) The multiplication factor as indicated when entering C is including the value of C.
Delivered from factory on	:	C = +1

Commands:

PRC␣ON	:	Switches on the △ % function with the actual reference constant C.
PRC␣OFF	:	Switches off the △ % function.
PRC␣M	:	Enter measured value as reference constant C.
PRC␣MEAS	:	and switches on function △ %
PRC␣ON,-168.4	:	Switches on function △ % and enters -168.4 as reference constant C.
PRC␣OFF, + 12345.67	:	Switches off function △ % and enters +12345.67 as reference constant C. + = optional
PRC␣?	:	Outputs the actual state of the △ % function, technical notation. Format: PRC␣OFF, +12.34567E+03

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5.6.1.4 ZERO (Relative reference)

From the measured value (X) the contents of the ZERO register (D) is subtracted (X-D) and displayed.

Valid in function	:	All multimeter functions, dBm (cannot be combined with other mathematic functions)
Selection	:	ZER_ON
Input parameter	:	D
Output	:	X-D
Exit	:	ZER_OFF
Exit saves	:	D
Function change saves	:	D, ZERO function?
Power off/reset destroys	:	D, unless stored in program 0—9 (PROG)
Limits for D	:	$\pm(10^{13}...10^{-13})$ Input via keyboard $\pm$ (9999999 → .0000001)

Commands:

ZER_ON	:	Switches on the ZERO function with the present value of the ZERO register.
ZER_OFF	:	Switches off the ZERO function
ZER_M	:	Enters the measured value as ZERO value and switches on the ZERO function
ZER_ON, + 1234,5E+00 + = optional	:	Switches on the ZERO function and enters + 1234.5 as ZERO value.
ZER_OFF, -34567.3	:	Switches off the ZERO function and enters -34567.3 as ZERO value.
ZER_?	:	Outputs the actual state of the ZERO function, technical notation. Format: ZER_OFF, -34.56730E+03

5.6.2 Aquisition/Presentation of measuring data

5.6.2.1 DELAY

A delay can be programmed between a trigger and the actual start of a measurement.

Valid in function	:	All
Selection command	:	DLY_ON
Input	:	x ms
Result	:	delay of x ms
Exit command	:	DLY_OFF
Exit saves	:	Delay
Function change saves	:	Delay
Power off/reset destroys	:	Delay, unless stored in program 0 (PROG)
Limits for delay	:	8 000 000 ms
Delivered from factory on	:	Delay off, time 0 ms.

Commands:

DLY_ON	:	Switches on the delay function with the actual delay time.
DLY_OFF	:	Switches off the delay function
DLY_1234	:	Delay time of 1234 ms is entered without modification of the delay on/off state.
DLY_ON,4321	:	Switches on the delay function with a delay time of 4321 ms
DLY_OFF,9878	:	Switches off the delay function and enters a delay time of 9878 ms.
DLY_?	:	Outputs the actual state and delay time. Format: DLY_ _ON, 0009878

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5.6.2.2 *LIMITS*

The measured or calculated results are compared with the contents of the LIM-LO and LIM-HI registers. If the limit values are exceeded an indication is given on the display by arrows (∨,∧or ◊) or by a bleeper signal, if switched on. Also a SRQ is given via the interface.

Valid in function	:	All
Selection command	:	LIM_ON
Input parameters	:	LIM-LO (indicated by ∨)
	:	LIM-HI (indicated by ∧)
Result	:	Indication at exceed of limits (∧, ∨, ◊ and/or bleeper and SRQ, status byte)
Exit command	:	LIM_OFF
Exit saves	:	LIM-LO, LIM-HI
Power off/reset destroys	:	LIM-LO, LIM-HI, unless stored in program 0—9 (PROG)
Limit indication	:	LIM-LO <LIM-HI and input <LIM-LO = ∨ LIM-LO <LIM-HI and input >LIM-HI = ∧ LIM-LO ≥LIM-HI and input <LIM-LO, >LIM LIM-HI = ◊
Limits for LIM-LO | LIM-LO and LIM-HI | and LIM-HI.		±(10^{-13}....10^{13})
Delivered from factory on		LIM-LO = 0 LIM-HI = 0

Commands:

LIM_ON	:	Switches on the LIMITS function with the actual LIM-LO and LIM-HI.
LIM_OFF	:	Switches off the LIMITS function: LIM-LO with LIM-HI are saved.
LIM_ON, + 123,-99.5 + = optional	:	Switches on the LIMITS function and enters LIM-LO with + 123 and LIM-HI with -99.5
LIM_OFF,-7880, + 16.189 + = optional	:	Switches off the LIMITS function and enters LIM-LO with -7880 and LIM-HI with + 16.189.
LIM_?	:	Outputs the actual condition and limit values. Format: LIM_OFF,-788.0000E + 03, + 16.18900E + 00

5.6.2.3 *BURST*

In the BURST function a preprogrammed number (N, max.999) of measurements are stored in a buffer after a trigger command. A buffer full indication is given on the display switch bleeper or via the IEC-625/IEEE-448 interface. The stored measurement results can be read on the display or via the interface in the Read Buffer (RD BUF) function.

Valid in function	:	All functions except SEQU
Selection command	:	BUR_ON (PM2535 set to STRG)
Input parameter	:	N (number of measurements to be buffered)
Result	:	N measurements buffered
Exit	:	BUR_OFF
Exit destroys	:	Contents of buffer
Exit saves	:	N, Single trigger
Function change destroys	:	Contents of buffer
Function change saves	:	N, Single trigger
Power off/reset destroys	:	Contents of buffer, N unless stored in program 0—9 (prog 0)

Commands:

BUR_ON	:	Switches on the BURST mode with the actual number of measurements to be buffered (N).
BUR_OFF	:	Stops the running BURST measurement and switches off the BURST mode. The buffer contents is cleared.
BUR_ON,320	:	Switches on the BURST mode with 320 (N) measuring results to be buffered.
BUR_OFF, 16	:	Stops the running BURST measurement. Switches off the BURST function. Enters 16 as number of measuring results (N) to be buffered.
BUR_?	:	Outputs the actual condition and (N). Format: BUR_OFF,_16.

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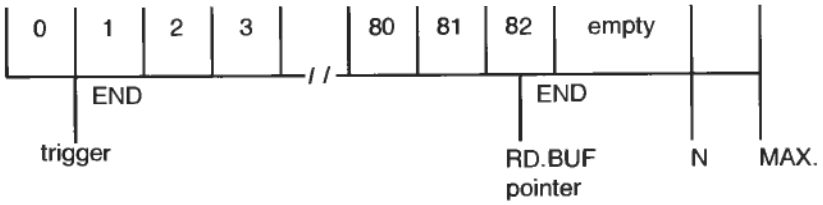
5.6.2.4 RD. BUF (Read Buffer)

In the RD. BUF function, the buffer contents stored in the BURST function can be read.

In BURST ON mode

- Location numbers are preceeded with "+" entered



0	=	Empty
1	=	First result after trigger
82	=	Last result entered
N	=	Number of result to be stored
Max	=	Maximum locations number
RD. BUF. pointer	=	Location to be read

Valid in function	:	BURST
Selection	:	BUR_ON
Input command	:	Location number 0 ...999 e.g. RBU_125
Output	:	Contents of buffer location number 125
Function selection destroys	:	Contents of buffer
Power off/reset destroys	:	Contents of buffer
BUR_OFF destroys	:	Contents of buffer
NEW BURST trigger destroys	:	Contents of buffer

Commands:

RBU_125 + = optional	:	Outputs buffer location and the measuring result stored on buffer location 125 If not measured a "?" is **emitted** in the output string Format: RBU_+125, MEASURING DATA
RBU_+20, +223	:	Outputs buffer location and the measuring results + = optional stored on buffer locations 20 to 223. (Order oldest ... youngest value). If not measured a "?" is emitted in the output string. Format: RBU_+125, MEASURING DATA
RBU_?	:	Outputs the buffer location number with the most recent measuring result. Format: RBU_+330 (max. 3 digits, fixed string length).

Remark: A requested location contents, outside the specified number (N) stored in the BURST function will generate a program failure and generate a SRQ (status byte). An incorrect input polarity will also give a program failure.

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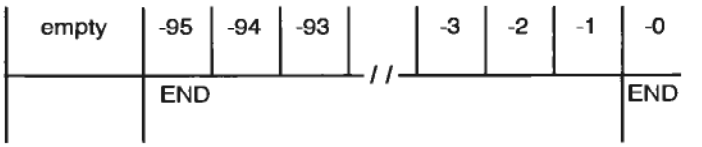
In BURST OFF mode
- Location numbers are preceeded with a "-".



Max Function change RD.BUF. pointer

-0	=	Actual measurement
-1	=	Last measurement carried out
-95	=	First measurement after function change
max	=	Maximum locations number 999
Function change	=	Last function change
RD. BUF. pointer	=	Location to be read at the moment of RD. BUF. mode selection.
Valid in function	:	All multimeter functions
Input command	:	e.g. RBU-125
Output	:	Contens of buffer
Function change destroys	:	Contents of buffer
Power off/ reset destroys	:	Contents of buffer

Commands:

RBU_-125	:	Outputs buffer location and the measurement result stored on buffer location-125. If not measured a "?" is emitted in the output string. Format: RBU_– 125, MEASURING DATA
RBU_-178,-37	:	Outputs buffer location and the measurement results stored on buffer locations-178 to -37. (Order oldest .... youngest value). If not measured a "?" is emitted in the output string. Format: RBU_– 125, MEASURING DATA
RBU_?	:	Outputs the buffer location number with the oldest value at this moment. Format: RBU_-128 (max 3 digits, fixed string length)

5.6.2.5 MIN/MAX

The function minimum/maximum is continuously present.
The minimum and maximum measurement result including the proccessed data are stored in the minimum and maximum registers within one function.

Valid in function	:	All
Selection Command	:	MIN or MAX
Result	:	Display minimum Display maximum
Function change destroys	:	Contents of MIN/MAX registers
Power off/reset destroys.	:	Contents of MIN/MAX registers
Clearing MIN/MAX register without entering the MIN/MAX function.	:	CLM

Commands

MIN	:	Outputs actual contents of MIN register. Format: MIN, measuring data
MAX	:	Outputs actual contents of MAX register. Format: MAX, measuring data
CLM	:	Clears MIN/MAX registers.

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5.6.2.6 DIGITS (Display format function)

Independent of other settings the maximum display length can be set.
The number of digits "d" can be programmed ($0 \leqslant d \leqslant 7$). Dependent on range and/or function the programmed number of digits is enabled.
If the number of figures in front of the decimal point is larger than "d", small zeros will be displayed up to the decimal point (significant zeros).
e.g. Programmed 2 digits in V⎓
Display e.g. + 12. V⎓
Display + 20o. V⎓, instead of +20.

If DIGITS is 0, only the polarity sign will be displayed.

Valid in function	:	All
Selection command	:	DIG_d
Input parameter	:	number of digits "d"
Result	:	modified display length "d"
Function change saves		: "d"
Power off/reset destroys	:	"d", unless stored in program 0—9 (PROG)
Delivered from factory on	:	"d" = 7

Commands:

DIG_d	:	Enters the number of digits to be displayed
($0 \geqslant d \geqslant 7$)	:	+1234567
DIG_?	:	Outputs number of digits selected "d" Format: DIG_6

5.6.3 Function programming

5.6.3.1 PROG function (PROGRAM)

Instrument settings including process functions and constants can be stored under a program number (except rtl, tonly, address, MSR, SPR). The settings can be recalled (manual, via interface) to set the instrument in predefined modes/functions.

The maximum number of programs is 10 (0-9).

The settings stored in P0 will be autmatically taken over by the PM2535 at power-on or reset.

Valid in function	:	All
Selection command	:	STO_X
Input parameter	:	(P)X X = 0-9
Result	:	Instrument settings stored in PX
Function change saves	:	Settings PX
Power off/reset saves	:	Settings P0

Commands:

STO_3	:	The actual settings of the PM2535 are stored in P3.
RCL_3	:	The settings stored in P3 will be taken over by the PM2535.

5.6.3.2 SEQUENCE

The sequence function enables the PM2535 to carry out a number of sequential steps, with different instrument settings as stored in the PROGRAM function.

At the same time control data can be output to System 21 modules in the System 21 scan function. In this case the PM2535 with System 21 modules can be used as stand-alone system (without controller).

The scan function (available only in some slave units) is used for the sequential select of inputs, switches, channels. A scan-cycle can be excecuted over channels of several units on the condition that:
- All units are of the same PM-number.
- All units are set for the same operating mode (see the System 21 manual and the operating cards of the slave units).
- No unit is in Execute Unconditional mode.
- The units have successive addresses with settings starting at 0.

The scan is initiated by the PM2535. The execution is done with a number of execute commands or triggers equal to the number of channels to be scanned. Under the above conditions a scan cycle will start with the lowest channel number of the unit with address-switch set to zero and continues along all channels and units.

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Programming the Sequence function is only possible via the front keys. (via IEC/IEEE interface is not implemented).

Valid in function	:	All
Selection	:	SEQ_ON
Result	:	Start of the SEQUENCE function
Exit	:	SEQ_OFF
Exit saves	:	P0-P9
Function change saves	:	P0-P9
Power off/reset saves	:	P0-P9

Remark: Programming of a sequence program is not possible via the interface. Start stop and trigger of the complete program is possible.
Commands that change instrument settings when the sequence program is in progress will be ignored and generate a program failure.

Commands:

SEQ_ON	Starts sequence program Trigger commands are allowed.
SEQ_OFF	Ends the sequence program and exits the sequence function.
SEQ_?	Outputs the actual SEQUENCE condition. Format: SEQ_OFF

5.6.3.3 BLEEPER

The built-in bleeper can be switched on or off for a number of functions.
For some alarm functions the bleeper cannot be switched off (not programmable).
The bleeper is programmable for the following alarm conditions:
- All exceeds of the LIMIT values.
- Buffer full in BURST mode.

Not programmable:
- Overload in highest voltage and current ranges.

Valid in function	:	LIMITS, BURST
Bleeper on command	:	BLP_ON
Bleeper off command	:	BLP_OFF
Programmed at delivery	:	Bleeper on

Commands:

BLP_ON	:	Switches on the bleeper function
BLP_OFF	:	Switches off the bleeper function (excluding overload alarms)
BLP_?	:	Outputs the actual bleeper condition. Format: BLP_OFF.

5.7 SYSTEM 21 MODE

To enable responses from System 21 part the command:
AID_E has to be sent.

To disable responses from the System 21 part the command:
AID_D has to be sent.

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5.8 SURVEY OF COMMANDS

The following table gives a survey of the commands that can be used to program the PM2535.

Commands	Description
Function	
FNC_xyz	xyz can be one of the following functions: VDC = Direct voltage IDC = Direct current VAC = Alternating voltage IAC = Alternating current RTW = Ohm 2-wire TDC = Temperature °C RFW = Ohm 4-wire
Ranging	
RNG_A[uto] RNG ±aaa.aE±aa	Auto-ranging The expected measuring value or the end-of-range can be programmed as range in scientific or technical notation. (e.g. RNG_3 or RNG_3.000E+03).
Measuring Speed/ Resolution	
MSP_x RSL_x	x = integer between 1 and 4 to program the measuring speed x = integer between 4 and 7 to program the resolution.
Filter	
FIL_ON FIL_OFF	Filter is switched ON/OFF.
Trigger mode	
TRG_I TRG_B TRG_E TRG_K	Internal triggering. Single triggering via IEEE/IEC bus. "EXT TRIGGER" input or via IEC/IEEE bus. Triggering via the keyboard (Single triggering), via the "EXT TRIGGER" input or via the IEC/IEEE bus.
Internal settling time	
IST_ON IST_OFF	Internal settling time switched ON/OFF.
Delay	
DLY_ON DLY_ON, X DLY_OFF DLY_OFF, X	Delay ON/OFF or x ms.
Start	
X_1	Starts a measurement.
Display	
DSP_ON DSP_OFF TXT_xxxxxxx	The display is switched ON/OFF. Text specified in xxxxxxx is displayed.
TST	Selfdiagnostic mode switched on (Refer to service manual)
Output mode	
OUT_S OUT_N OUT_N,x	The whole measuring data string is output. Only numerical results are output. A numerical result is output with a length specified in x.

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Commands	Description
Null mode	
NUL_ON NUL_OFF	The NULL function is switched ON/OFF.
NUL_[New]	A new NULL value is stored in memory.
Cal mode	
CAL_ON CAL_OFF	The cal mode is switched ON/OFF (Refer to service manual)
System 21	
AID_E AID_D	Output from System 21 part is enabled/disabled
AX + B	
SCL_ON SCL_OFF	Switches-on/off the AX + B function
SCL_ON,A,B	Switches on the AX + B function and fills A and B A = e.g. -765.4321 B = e.g. -.1234567
SCL_OFF,A,B	Switches-off the AX + B function and fills A and B A = e.g. + 1234567 B = e.g. -765.4321
dBm	
DBM_ON DBM_OFF	Switches-on/off the dBm function
DBM_ON,A	Switches-on the dBm function and sets Rref to the value of A. A = e.g. 150
DBM_OFF,A	Switches-off the dBm function and sets Rref to the value of A. A = e.g. 5E + 01 = 50Ω
△%	
PRC_ON PRC_OFF	Switches-on/off the △ % function with the actual reference constant.
PRC_M PRC_MEAS	Enters the measured value or reference constant and switches on the △ % function.
PRC_ON,A	Switches on the △ % function and enters A as reference constant. A = e.g. -168.4
PRC_OFF,A	Switches-off the △ % function and enters A as reference constant. A = e.g. + 12345.67
ZERO	
ZER_ON ZER_OFF	Switches-on/off the ZERO function with the present value of the ZERO register.
ZER_M ZER_MEAS	Enters the measured value as ZERO value and switched on the ZERO function.
ZER_ON,A	Switches-on the ZERO function and enters A as ZERO value. A = e.g. + 1234.5E + 00
ZER_OFF,A	Switches-off the ZERO function and enters A as ZERO value. A = e.g. + 1234.5

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Commands	Description
DELAY	
DLY_ON	Switches-on/off the delay function with the actual delay time
DLY_OFF	
DLY_ON,A	Switches-on the delay function with a delay time of a A ms. A = e.g. 1234
DLY_OFF,A	Switches-off the delay function and enters a delay time of A ms. A = e.g. 1000
LIMITS	
LIM_ON	Switches -on/off the LIMITS function with the actual LIM-LO and LIM-HI values
LIM_OFF	
LIM_ON,A,B	Switches-on the LIMITS functions and enters LIM-LO with A and LIM-HI with B. . A = e.g. 123 B = e.g. -99.5
LIM_OFF,A,B	Switches-off the LIMITS function and enters LIM-LO with A and LIM-HI with B. . A = e.g. -7880 B = e.g. +16.189
BURST	
BUR_ON	Switches-on the BURST mode with the actual number of measurements to be buffered (N).
BUR_OFF	Stops the running BURST measurement and switches-off the BURST mode. The BUFFER contents is cleared.
BUR_ON,N	Switches-on the BURST mode with N measuring results to be buffered.
BUR_OFF,N	Stops the running BURST measurement. Switches-off the BURST function. Enters N as number of measuring results to be buffered.
RD. BUF	
BURST ON	
RBU_A	Outputs buffer location and the measurement result stored-on buffer location A. If not measured a "?" is emitted in the output string.
RBU_A,B	Outputs buffer location and the measurement result stored on buffer location A to B.
BURST OFF	
RBU_−A	Outputs buffer location and the measurement result stored on buffer location −A. If not measured a "?" is emitted on the output string.
RBU_−A,−B	Outputs buffer location and the measurement results stored in buffer locations −A to −B.
MIN/MAX	
MIN	Outputs the actual contents of MIN register.
MAX	Outputs the actual contents of MAX register.
CLM	Clears MIN/MAX registers.
DIGITS	
DIG_A	Enters the number of digits to be displayed $0 \leqslant A \leqslant 7$
PROG	
STO_A	The actual settings of the PM2535 are stored in (P)A.
RCL_A	The settings stored in (P)A will be taken over by the PM2535.
SEQUENCE	
SEQ_ON	Starts sequence program.
SEQ_OFF	Ends the sequence program and exits the sequence function.

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Commands	Description

BLEEPER	
BLP_ON BLP_OFF	Switches-on the bleeper function. Switches-off the bleeper function (excluding overload alarms)
DUMP	Outputs all settings of the PM2535
DMP	

5.9 CALIBRATION VIA THE CONTROLLER

The calibration mode can be called via the IEEE-488/IEC-625 bus.
To enable the calibration mode push the CAL (pencil operation) and the RESET (Pencil operation) switch. Release the CAL switch after the RESET switch. The calibration mode is indicated on the display with the CAL symbol.

Via the command CAL_ON the calibration mode is started and the first range can be programmed. The normal commands to select a range or function can be used. On receipt of CAL_? the CAL state is output (Example: CAL_OFF).

For detailed calibration information, refer to the service manual of the PM2535.

5.10 SELFDIAGNOSTICS VIA THE CONTROLLER

It is possible to choose the selfdiagnostic mode via the interface.
This is done with the command TST. Refer to the service manual of the PM2535 for detailed information.

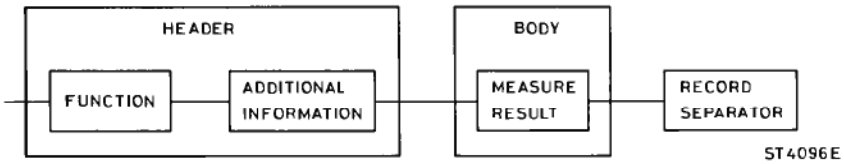
Remark: The testmode cannot be switched-on the Calibration, Burst and Sequence function. An illegal code will be generated.

5.11 OUTPUT DATA

5.11.1 Measuring data

Measurements is sent out as header body combinations

Format



FUNCTION/ADDITTIONAL INFORMATION

(1)	(2)	(3)	(4)	(5)	(6)
x	x	x	y	y	y

The first part of the header (xxx) is a three-character indication of the function separated by a space from the second part. The possibilities for xxx are given in the following table.

Function	Characters 1 2 3
V⎓	V D C
V∿	V A C
Ω-2w	R T W
Ω-4w	R F W
A⎓	I D C
A∿	I A C
°C	T D C

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The second part (YYY) of the header gives additional information.

4th character

_ no processing
S scaling (AX + B)
D decibel (dBm)
P △ %

5th character

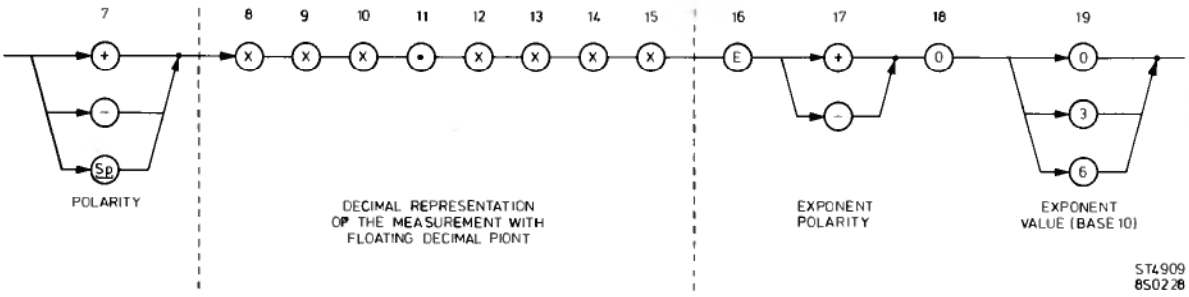
_ no processing
Z Zero set
C Calibration measurement

6th character

L Limits exceeded *
? dummy measurement output
_ normal measurement
O ADC overload
C Crestfactor, (V~A~), Clipping input circuit (other function)
U dBm underload
F Fail at calibration measurement
N Failure at NULL measurement
M Mathematical overflow
R Reduced accurate output

* Software version ≥ S04

MEASURING RESULT (body)



RECORD SEPARATOR

SR3 is the record separator with the END message. The record separator is programmable (see section 5.4.7). The initial state after POWER-ON is: NL
Data examples, and their representation in a header body are shown below.

Characters	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	V	D	C	Sp	Sp	C	+	1	2	3	.	4	5	6	7	E	-	0	3	SR3
	R	T	W	SP	Sp	Sp	+	1	2	.	3	4	5	6	7	E	+	0	3	SR3

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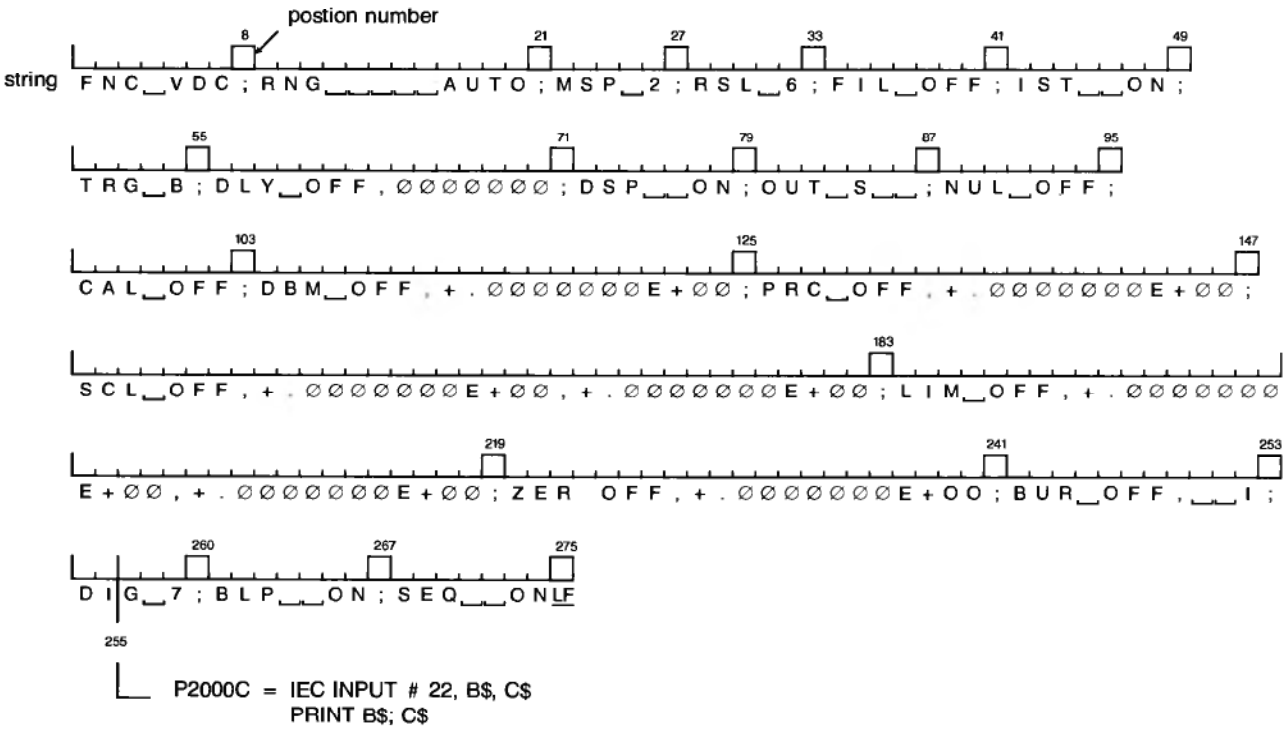
5.11.2 Dump

After the dump command, the PM2535 sends all the settings to the controller.

DMP

The output is always in a determined pattern as described in the section, Device Programming.

Remember: This outputted string can also be used to program the PM2535. The identical setting of the instrument is performed.



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5.11.3 Output of settings

The programmed PM2535 can give its setting by the DMP command (see section 5.11.2). However, the individual settings can also be obtained from the instrument. The instrument outputs a setting as it receives the header which is normally used to program the setting, and a question mark as body.

See the following table for outputs.

Command	Output	(Possibilities)
FNC_?	FUNCTION	FNC_VDC FNC_IDC FNC_VAC FNC_IAC FNC_RTW FNC_TDC FNC_RFW
RNG_?	RANGE	RNG_AUTO RNG_xxx.E±xx (x = integer between 0-9)
MSP_?	MEASURING SPEED	MSP_1 MSP_3 MSP_2 MSP_4
RSL_?	RESOLUTION	RSL_4 RSL_6 RSL_5 RSL_7
FIL_?	FILTER MODE	FIL_OFF FIL_ON
IST_?	INTERNAL SETTLING TIME	IST_OFF IST_ON
TRG_?	TRIGGER MODE	TRG_I TRG_B TRG_E TRG_K
DLY_?	DELAY	DLY_OFF,xxxxxxx (x = integer between 0 and 9) DLY_ON,xxxxxxx
DSP_?	DISPLAY STATE	DSP_OFF DSP_ON
OUT_?	OUTPUT MODE	OUT_S OUT_N OUT_N,x (x = integer between 1 and 9)
NUL_?	NULL MODE	NUL_OFF NUL_ON
CAL_?	CAL MODE	CAL_OFF CAL_ON
SCL_?	AX + B	SCL_OFF, +123.4567E+00, −765,4321E−03 SCL_ON, −123.4567E+00, −765,4321E−03
DBM_?	dBm	DBM_OFF, ____ +150.0000E+00 DBM_ON, +150.0000E+00
PRC_?	△%	PRC_OFF, +12.34567E+03 PRC_ON,
DLY_?	DELAY	DLY_ ON, 0009878 DLY_OFF,
LIM_?	LIMITS	LIM_OFF, −12345.67E+03, +12345.67E+03 LIM_ON, −12345.67E+03, + 12345.67E+03

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Command	Output	(Possibilities)
BUR␣?	BURST	BUR␣OFF,␣16 BUR␣␣ON,120
RBU␣?	RD. BUF.	RBU␣-128 (BURST OFF) RBU␣+128 (BURST ON)
DIG␣?	DIGITS	DIG␣6
BLP␣?	BLEEPER	BLP␣OFF BLP␣␣ON
SEQ␣?	SEQUENCE	SEQ␣OFF SEQ␣␣ON

Note: To avoid occasional incorrect read-out (measuring result) in the internal trigger mode, a delay of some machine cycles is advised.

Example P2000 C:
```
10 IEC INIT
20 IEC PRINT #22,"DMP?"
30 R=B
40 IEC INPUT #22,A$
50 PRINT A$
```
Delay ⟶

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5.11.4 Device status data

The device status data of the PM2535 is represented in one status byte (8 bits) and is built-up as follows:

bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
EX	RQS	AB	BSY	EF3	EF2	EF1	EF0

EX Extension (always 0)

RQS = 0 No request for service
RQS = 1 The PM2535 has requested for service

AB = 0 The PM2535 is not in an abnormal condition
AB = 1 The instrument is in an abnormal condition and is specified in the bits EF3 to EF0

BSY = 0 PM2535 is not measuring and the data of any previous measurement has been output.
BSY = 1 The PM2535 is measuring and/or data has not been output.

Description

If AB = 1 then the bits EF3-EF0 indicate the abnormal condition.

AB	BSY	EF3	EF2	EF1	EF0	Description
1	x	x	x	x	1	Program failure (e.g. an illegal body has been received).
1	x	x	x	1	x	Internal failure (e.g. No Cal condition).
1	x	x	1	x	x	Incorrect measurement (OL, CF, failure in a calibration measurement or a faulty NULL measurement).
1	x	1	x	x	x	System 21 event.

Note: One or more conditions can be specified, by the instrument, in the status byte.

After a serial poll, the bits AB and EF3 to EF0 are reset to zero.

If AB = 0 then the bits EF3 to EF0 indicate a normal condition.

AB	BSY	EF3	EF2	EF1	EF0	Description
0	0	x	x	x	0	No measurement is started and there is no data available.
0	1	x	x	x	0	A measurement is started but no data available.
0	1	x	x	x	1	Data is available, not yet sent via the interface.
0	0	x	x	x	1	Data is sent via the interface but remains available. Instrument can be triggered.
0	x	x	x	1	x	The HOLD mode is selected via the data hold probe.
0	x	1	x	x	x	HI Limit exceed
0	x	x	1	x	x	LO Limit exceed

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5.11.5 Identity

After the command ID_? the identity is output:

Characters	1	2	3	4	5	6	7	8	9	10	11	12
	P	M	2	5	3	5	0	SP	S	0	1	SR3

↑ depends on hardware version

↑ depends on software version

5.11.6 Interface test

On receipt of TSI_U or TSI + [CHR$(170)] a self-test is performed.

Programming	Output data (test o.k.)	Remark
TSI_U	dec. 170 [CHR$(170)]	with service request
TSI + [CHR$(170)]	U	without service request

5.12 REASONS FOR SERVICE REQUEST

Service is requested, if not masked, in the following way:

Program failure

If the PM2535 has received an illegal body or header the instrument responds with:

EX	RQS	AB	BSY	EF3	EF2	EF1	EF0
0	1	1	x	x	x	x	1

Internal failure

Service request will be given if an internal failure occurs. An internal failure is e.g. No Cal. The following will be given.

EX	RQS	AB	BSY	EF3	EF2	EF1	EF0
0	1	1	x	x	x	1	x

Incorrect measurement

Service will be requested when the PM2535 has made an incorrect measurement. This incorrect measurement can be Overload (OL), exceeding the Crest factor (CF), if a failure occurs at a calibration measurement or when the instrument has made a faulty NULL measurement. It responds with:

EX	RQS	AB	BSY	EF3	EF2	EF1	EF0
0	1	1	x	x	1	x	x

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System 21 event

In the PM2535 the master function of the System 21 is implemented. At a System 21 event (see also section 5.13) the master function draws the attention of the controller by asking service. The events are described in the System 21 manual which can be ordered with the reply card.

EX	RQS	AB	BSY	EF3	EF2	EF1	EF0
0	1	1	x	1	x	x	x

Data available

If the PM2535 has made a measurement and has valid data which has not been output, it responds with:

EX	RQS	AB	BSY	EF3	EF2	EF1	EF0
0	1	0	1	x	x	x	1

Waiting for a trigger command

If the instrument has sent the data to the interface and is waiting for a trigger command, the status byte will be the following: (BSY = 0)

EX	RQS	AB	BSY	EF3	EF2	EF1	EF0
0	1	0	0	x	x	x	1

The BSY (busy) bit will set after a trigger command has been received.

Hold mode

With the HOLD probe the HOLD mode can be entered. The reading is "frozen" on that moment. The instrument responds with:

EX	RQS	AB	BSY	EF3	EF2	EF1	EF0
0	1	0	x	x	x	1	x

If the HOLD mode is left by once more pushing the button on the HOLD probe, the instrument asks again for service and responds with the following byte:

EX	RQS	AB	BSY	EF3	EF2	EF1	EF0
0	1	0	x	x	x	0	x

Limit mode

Exceed of limits

	EX	RQS	AB	BSY	EF3	EF2	EF1	EF0
Lo	0	1	0	x	x	1	x	x
Hi	0	1	0	x	1	x	x	x

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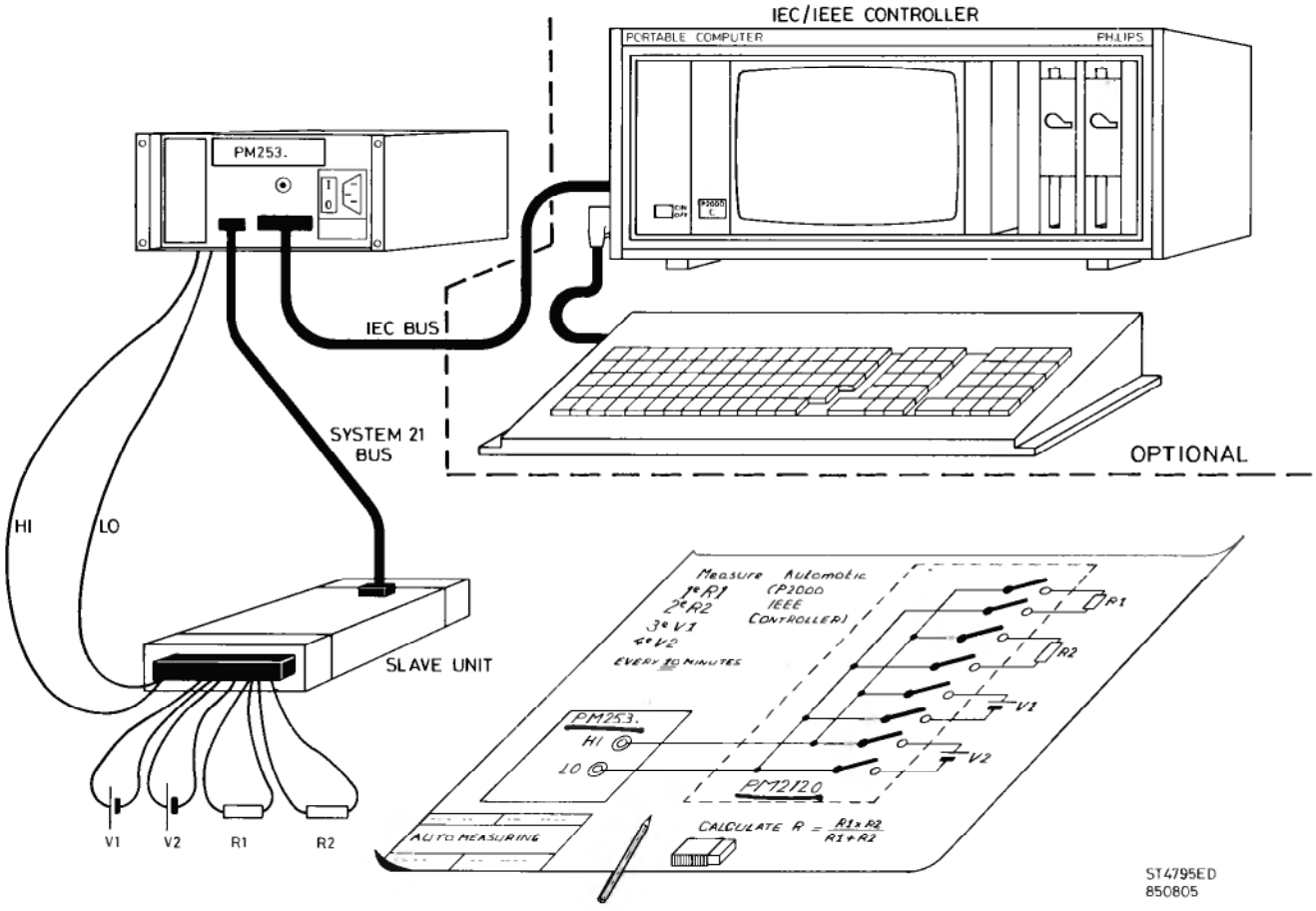
5.13 SYSTEM 21 MASTER FUNCTION

5.13.1 General

System 21 is a modular system consisting of a master and a number of independent functional units (slaves). It can be used in automatic test or measurement set-ups for auxiliary purposes, such as switch functions, I/O functions etc.

The main task of the master function is to pass data to the functional units. The communication between the external system and functional units is transparent. That means that the data is not affected during the transport from the external system to the functional unit and vice versa.

In the PM2535 a System 21 master function is implemented. This means that a number of slave units (depending on the supply current, fuse protected max. 200 mA) can be connected to the PM2535.
The System 21 with PM2535 set-up can be used in two ways via:
- as Stand-alone system without a controller
  The PM2535 can be programmed via the frontkeys in the SEQUENCE function to control the scan function of System 21.
- as Complete system with a controller



The System 21 commands are not handled here, but a full survey of the commands can be found in the Quick-operating guide delivered with the PM2535 and in the operating cards of the individual units (delivered with the units) for specific unit-dependent commands.
Remember that interface commands (such as service request masking, identity, etc) are only valid for the interface and will act as described in section 5.12.

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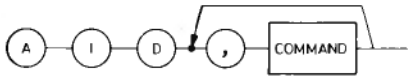
5.13.2 Contact assignment of System 21 connector

Pin number	Signal line
1	V+
2	data high
3	earth (shield)
4	ready
5	trigger
6	V–
7	data low
8	reset
9	V–

5.13.3 Addressing a message

Any message to the PM2535 preceded by the IEEE/IEC address is set by the CHECK/END button. The routing of a message to the master or to one of the slave units, is indicated by the first element of the message, the unit address.

The unit address for the master is recognized by the characters AID.
(Additional Instrumentation Devices). So a command for the master is as follows:



ST4796E

A command intended for a slave must be preceded by the characters AID and 3 digits.

ST4797E D

These 3 digits consist of the last two digits of the PM- number of the unit + 1 digit set on the unit address switch.

Separation between the unit address and the commands is achieved with ";" or ",". If more than one command is sent in one string, the individual commands need to be separated by commas.

5.13.4 Commands

Commands are given in ASCII-coded form. There are two types of commands:

1. Commands for the master function.
2. Commands for individual unit slaves.

A full summary is given overleaf of the System 21 master commands. Some of these commands request for return data.

Command	Description
Reset	
AID,RES	Reset the complete system to the power-on conditions.
enable/disable	
AID_E AID_D	Output from system 21 part is enabled/disabled

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Command	Description
Trigger mode and commands to trigger or to execute	
AID,TRG_R	Trigger in ready mode: enable the trigger-commands GET and "XCU_T" only when ready is true (ready line is high) or delay the received trigger command until ready becomes true.
AID,TRG_U	Trigger Unconditional mode: the trigger-commands GET and "XCU_T" will unconditionally generate an impulse on the trigger-line.
AID,XCU_T AID,XCU_nn	Execute the units by a pulse on the System 21 trigger-line if enabled. Execute all units with "PM21nn" numbers independent of the execution mode of the units. This command is useful when using I_S commands to perform a scan by more than one unit of the same type number.
Read trigger mode	
AID,TRG_?	Read current trigger mode Responses: AID;TRG_R Trigger in ready mode AID;TRG_U Trigger unconditional
sequential execution	
AID,SEQ_ON AID,SEQ_OFF	Sequential execution. (SEQ_ON) Parallel execution possible.
Read sequential mode	
AID,SEQ_?	Sequential execution ON or OFF ? Responses: AID;SEQ_ON Sequential execution on. AID;SEQ_OFF Sequential execution mode off.
System 21 event masking	
AID,MSK + <digits>	Mask System 21 events (maximum 9 digits). A zero digit disables the corresponding event to generate a Service Request. Digits 1 slave had a power fail or received a power-on reset. A unit received an illegal code or illegal sequence. 2 An addressed module is not present. 3 All units are ready performing the programmed actions. 4 All units are ready with the received data and may receive new data (input buffer is empty). 5 A unit has functional data available. 6 All units have completed the block or scan. 7 A unit has a warning. 8 The ready-line became high (ready true). 9 A trigger-pulse was captured on the trigger-line (not in PM2535).
Read event mask	
AID,MSK_?	Read current System 21 event mask. Response: AID;MSK + <9 digits> Indicates which events set the abnormal bit (AB) together with the EF3 bit in the Serial Poll byte.

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Command	Description

Request Configuration	
AID_?	Which unit addresses are present on System 21? Responses: AID + <address> List of addresses that are available

System 21 status	
AID,STA_?	Request System 21 Status.
	Response: AID;STA + <9 digits> Digits 1 Master received a power-on reset. 2 The addressed unit was not present. 3 A unit is busy. 4 A unit is not ready with the received data. 5 A unit has functional data available that should be read. 6 One or more units are busy with a block or scan. 7 A unit has a warning. 8 The master detected the ready-line high; ready is true. 9 The master captured a trigger pulse on the trigger-line (not available in PM2535). Digits 1, 2, 8 and 9 are cleared when read. A digit which is 0, indicates that the related message is not true.

Read ready-line	
AID,RDY_?	Logic state of the ready-line ? Responses: AID;RDY_0 If ready-line is low (ready false) AID;RDY_1 If ready-line is high (ready true)

Read trigger-mode	
AID,TRG_?	Read actual trigger mode Responses: AID;TRG_R Trigger if ready mode. AID;TRG_U Trigger unconditional mode.

Read programming of the master	
AID,DMP_?	Ask for the programming data of the master Response: AID; + <event mask> + <trigger mode> + <sequential mode>

End of block or scan	
AID,BBS_?	Which units are busy with a block or a scan? Response: AID;BBS + <addresses> List of addresses of units which are busy with a block or a scan.

Data available	
AID,DAV_?	Which unit addresses have Data available? Response: AID;DAV + <addresses> List of addresses of units which have data available. (Example: AID;DAV 310,311,312,).

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6. GLOSSARIES

6.1 GLOSSARY OF TERMS

A	Addr	Address (IEC-625/IEEE-488)
	AH1	Acceptor handshake (IEC-625,IEEE-488)
	AID	Auxillary instrumentation devices (system 21)
	ATN	Attention (IEC-625, IEEE-488)
	AUTO, AUT	Automatic (ranging)
	AX + B	Scaled measurements function
B	BLP	Bleeper
	BUR	Burst
C	CAL	Calibration
	CLR	Clear
	CM	Common mode
	CSA	Canadian Standard Assosiation
D	Δ%	Deviation in $\frac{X-C}{C} \times 100\%$
	DBM	Decibel measurements
	DAV	Data available
	DCL	Device clear
	DIG	Digit
	DIO-DIO8	Data input lines (IEC-625/IEEE-488)
	DLY	Delay
	DSP	Display
E	EOI	End or identify
F	FIL	Filter
	FNC	Function
G	GET	Group execute trigger
	GTL	Go to local
H	Hi	High-input
I	ID	Identity
	INT	Internal
	IST	Internal settling time
L	L4	Listener (basic)
	LF	Line feed
	LIM	Limit
	LO	Low-input
M	M	Mode
	MAX	Maximum
	MAN	Manual
	MIN	Minimum
	MLA	My listen address
	MRNG	Manual ranging
	MSR	Mask service request
	MTA	My talk address

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N	NDAC	Not data accepted
	NL	New line
	NRFD	Not ready for data
O	OL	Overload
P	P0	Program 0
	PROG	Program
	PRC	Percentage
	PX	Program X
R	REM	Remote
	RD BUF	Read buffer
	RH	Relative humidity
	RL1	Remote local 1
	RNG	Range
	R. REF	Reference resistor
	RSL	Resolution
S	SCL	Serial clock
	SDA	Serial data
	SDC	Selective device clear
	SEQ	Sequence
	SEQU	Sequence
	SH1	Source handshake 1
	SPR	Separator
	SR1	Service request 1
	SRQ	Service request
	STRG	Single trigger
	ST 00	Step 00
U	UL	Underload
	UNL	Unlisten
X	X1	Start command
Z	ZER	Zero (relative reference)

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6.2. SHORT SURVEY OF PROGRAM COMMANDS

BLP␣ON BLP␣OFF BLP␣? → BLP␣OFF BLP␣␣ON
BURST
BUR␣ON BUR␣OFF BUR␣ON, N BUR␣OFF, N BUR␣? → BUR␣OFF, N BUR␣␣ON, N
CAL
CAL␣ON CAL␣OFF CAL␣? → CAL␣OFF CAL␣␣ON
MIN/MAX
CLM
DBM
DBM␣ON DBM␣OFF DBM␣ON, A DBM␣OFF, A DBM␣? → DBM␣OFF, A DBM␣␣ON, A
DISPLAY
DSP␣ON DSP␣OFF DSP␣? → DSP␣OFF DSP␣␣ON
DIGITS
DIG␣A DIG␣? → DIG␣A
DELAY
DLY␣ON DLY␣OFF DLY␣ON, A DLY␣OFF, A DLY␣? → DLY␣OFF, A DLY␣␣ON A
FILTER
FIL␣ON FIL␣OFF FIL␣? → FIL␣␣ON FIL␣OFF

FUNCTION
FNC␣VDC VAC IDC RTW IAC RFW TDC FNC␣? → FNC␣VDC
Δ%
PRC␣ON PRC␣OFF PRC␣ON A PRC␣OFF, A PRC␣M [EAS] PRC␣? → PRC␣OFF, A PRC␣␣ON, A
RD. BUF
RBU␣A → RBU␣+A, DATA RBU␣A, B → RBU␣+A, DATA RBU␣–A → RBU␣–A, DATA RBU␣–A, –B → RBU␣–A, DATA RBU␣? → RBU␣–128, DATA RBU␣+128, DATA
RANGE
RNG␣A RNG␣3 RNG␣? → RNG␣␣␣␣␣AUTO RNG xxx. E + OX
RESOLUTION
RSL␣X RSL␣? → RSL␣X
AX+B
SCL␣ON SCL␣OFF SCL␣ON, A, B SCL␣OFF, A, B SCL␣? → SCL␣OFF, A, B SCL␣␣ON, A, B
SEQUENCE
SEQ␣ON SEQ␣OFF SEQ␣? SEQ␣OFF SEQ␣␣ON
TRIGGER
TRG␣I TRG␣B TRG␣E TRG␣K TRG␣? → TRG␣I TRG␣B TRG␣E TRG␣K

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TEST

TST

TEXT

TXT_xxxxxxx

SETTLING TIME

IST_ON
IST_OFF
IST_? → IST_ON
IST_OFF

LIMITS

LIM_ON
LIM_OFF
LIM_ON, A, B
LIM_OFF, A, B
LIM_? → LIM_OFF, A, B
LIM_ON A, B

MIN/MAX

MIN →MIN, A
MAX →MAX, A

SPEED

MSP_A
MSP_? → MSP_A

NULL

NUL_ON
NUL_OFF
NUL_N[EW]
NUL_? → NUL_OFF
NUL_ON

OUTPUT FORMAT

OUT_S
OUT_N
OUT_N, X
OUT_? → OUT_S
OUT_N
OUT_N, X

START

X [1]

ZERO

ZER_ON
ZER_OFF
ZER_M[EAS]
ZER_ON, A
ZER_OFF, A
ZER_? → ZER_OFF, A
ZER_ON, A

INTERFACE COMMANDS

SRQ MASK

MSR_n, [n] [n]

SEPARATOR

SPR_n n [, nn]

IDENTITY

ID_? → PM2535 X_SYY

INTERFACE TEST

TSI_<dec.170> → U
TSI_U →<dec. 170>

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