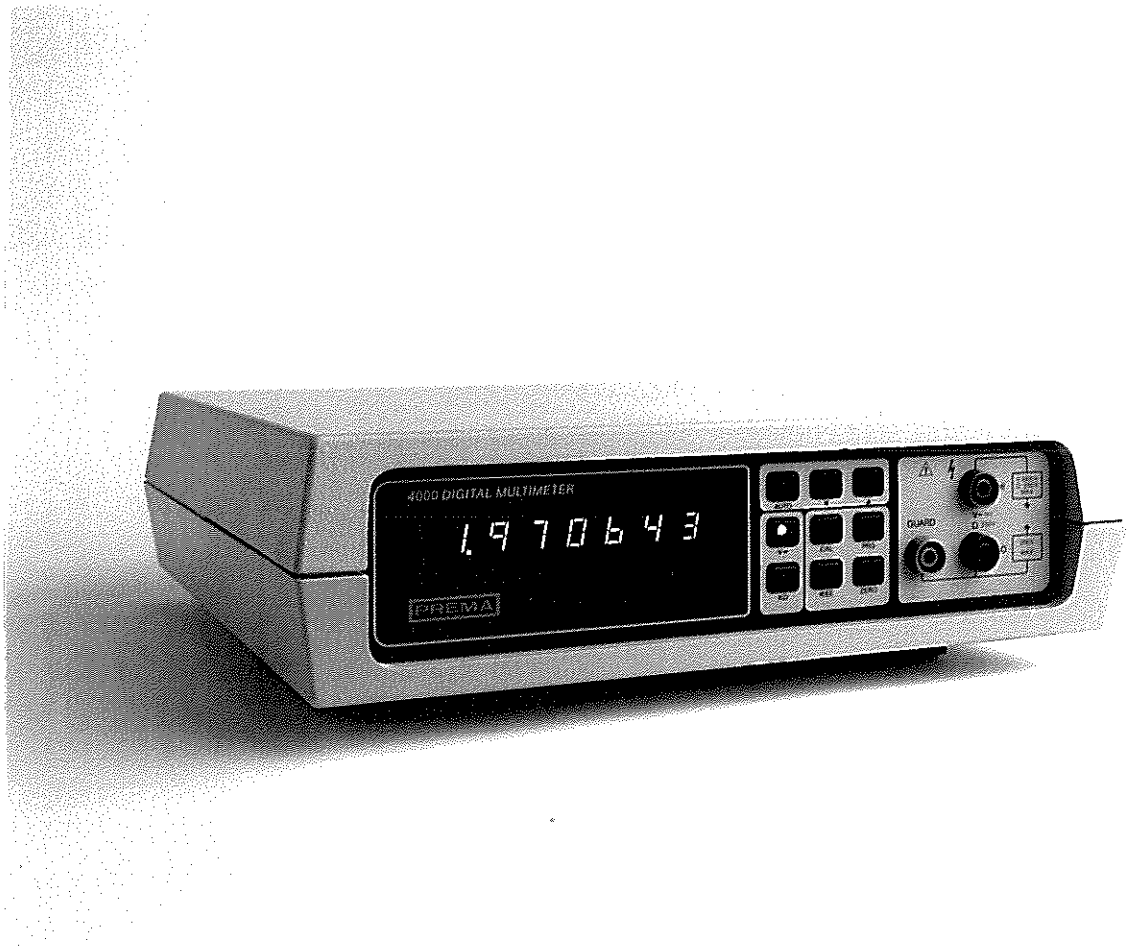
INSTRUMENTS

PREMA



DIGITAL MULTIMETER

4000

Instruction Manual

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1.1. General Description

The P R E M A 4000 DMM/Scanner is a fully equipped 6 1/2 digit digital multimeter with an outstanding price to performance ratio.It features all characteristics of a high class device normally available only for a higher price, such as 1 GOhm input resistance up to +/- 2V and 100 nV resolution for direct voltage measurements and resistance measurements with 1mOhm resolution. An additional offset correction facility permits compensation of thermoelectric EMFs for direct voltage measurements, with the measuring leads shorted, and correction for the line resistance when making resistance measurements. The PREMA multiple ramp method for analog to digital conversion ensures excellent linearity and long-term accuracy, with continuous integration of the signal beeing measured, for averaging out any interference, without falsifying breaks.
The digital multimeter is equipped with programs which include start (triggered) operating mode and signal integration over fixed selected times.

An IEEE 488 bus interface is a standard feature which permits remote control and remote monitoring of all functions of the multimeter including the digital calibration. Excellent electrical isolation between the measured signal input sockets and the interface plug connector permits clean 100 nV resolution for direct voltage measurement even in system operation.

A simple digital calibration procedure simplifies the alignment procedure for the multimeter. A single nominal value, which may lie anywhere within a wide range and can be entered via the keyboard or via the IEEE 488 bus, suffices to calibrate a measuring range. Each measuring range of each function can be recalibrated independently. A covered mechanical switch on the rear of the multimeter gives protection against unintentional destruction of the correction factors.

The uncompromising utilization of micro-electronic integration has drastically reduced the number of discrete electronic components in this device. This has facilitated servicing and has considerably enhanced reliability.

1.2. Measuring Principle

The P R E M A multiple ramp method for analog to digital conversion (German patent No. 2114 141, US.-Pat.No. 3765012) is used in the Model 4000. It is the basis for a reliable digital multimeter featuring excellent linearity and longterm accuracy, with continuous integration of the measured signal to average out any interference, without falsifying breaks.

An amplifier which operates as integrator with the capacitor C (fig.1) continuously integrates a current Ie which is proportional to the voltage to be measured. This procedure has a very good linearity, because the input voltage does not need to be switched away, which would otherwise cause an error which changes with the magnitude of the input voltage, due to the varying switching surges caused by the capacitance of the transistors used as signal switches in presentday circuit practice. The capacitor is periodically discharged (fig.2) by a current Iref from a reference voltage source which has opposite polarity with respect to the signal voltage being measured, Uref (discharge times t1 to tn). Before the start of a down integration, the comparator determines the sign of the input voltage and thus defines the polarity of the reference voltage. The same reference voltage is used for both polarities and thus the same down integration resistor, so that the numerical readout value is closely the same when polarity of the input voltage is reversed. The end of a down integration is defined by coincidence of comparator response and a pulse flank of the clock oscillator. Since the total change of charge on the capacitor during one measuring cycle is zero, it follows that

$$\frac{1}{T}\int_0^T U_e\,dt = -\frac{R_e}{R_o\,T}\,U_{ref}\sum t_i$$

In other words, the sum of the discharge times ti is proportional to the average value of the input voltage, and is displayed as result of the measurement.

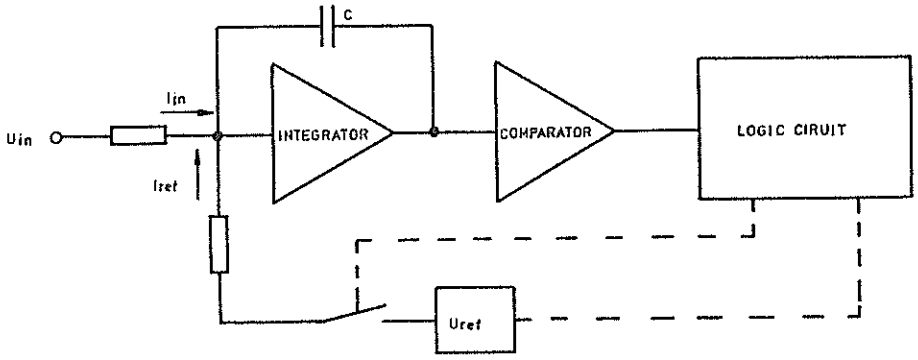


fig.1 Simplified block diagramm

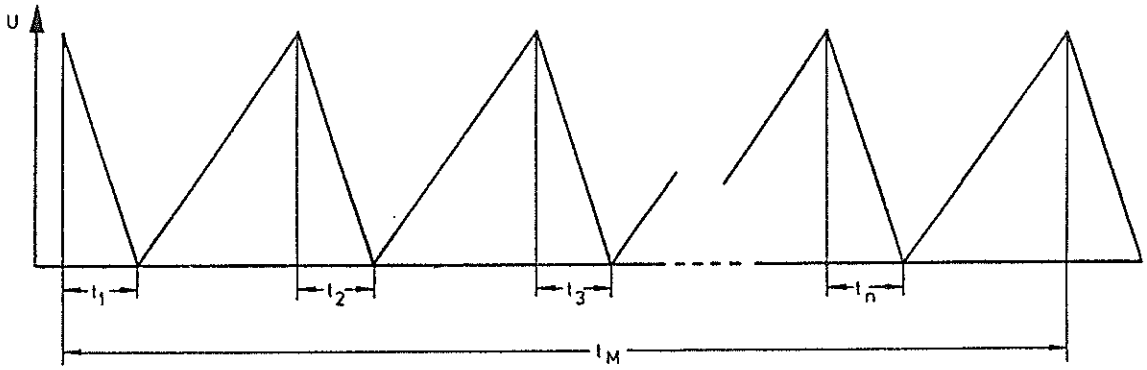


fig.2 Integrator output voltage

In this method of voltage to time conversion, the result is not falsified by the loss factor of the capacitor or by any drift of the capacitance value C. The measurement result is also independent of the frequency of the clock oscillator used for making the time measurement, because T and all ti are determined with the same frequency. Only modest requirements with regard to drift and speed are imposed on the comparator in the PREMA multiple ramp method, so that a low cost circuit design is possible in spite of the excellent performance as digital voltmeter.

4000 SPECIFICATIONS

Anbient temperature at calibration 23°C

VOLTAGE VDC

RANGES ..... +/-0.2V; +/-2V; +/-20V; +/-200V; +/-1000V

INTEGRATION TIMES (sec).....	0.1	1+10
FULL SCALE (except 1000V)....	199999	1999999
1000 V Range	100000	1000000
RESOLUTION	1 V	100nV

RANG SELECTION..... manual, automatic or by remote-control

ACCURACY +/-(% of reading (%rdg.) + % of full scale (%f.s.))*)

	24h, 23°C+/-1°C	
RANGE	%rdg.	%f.s.
0.2V	0.005	0.0007
2V	0.003	0.0005
20V	0.005	0.0016
200V	0.005	0.0016
1000V	0.005	0.0015

	1 year, 23°C+/-5°C	
RANGE	%rdg.	%f.s.
0.2V	0.012	0.0007
2V	0.010	0.0005
20V	0.012	0.0015
200V	0.013	0.0015
1000V	0.013	0.0015

*) Add +/-1 Digit. "Guard" connected to "V/Ohm-LO". After zeroing

TEMPERATURE COEFFICIENTS (10°C to 18°C and 28°C to 40°C)

RANGE	+/- (%rdg.+	%f.s.)/ C
0.2V	0.001	0.00015
2V	0.0003	0.0001
20V	0.001	0.0001
200V	0.001	0.0001
1000V	0.001	0.0001

TEMPERATURE COEFFICIENTS (0°C to 50°C) Double the values at 10°C to 40°C

ZERO STABILITY
Offsetvoltage (after 1 hour warm-up time)

Temperatur drift ..... less then 0.3 V/°C
Long term stability ..... better than 5 V in 90 days

INPUT RESISTANCE
RANGE
+/- 0.2V, +/-2V .... 1 GOhm

+/- 20V, +/-200V, +/- 1000V .. 10 MOhm

INTERFERENCE REJECTION (Ratio of peak to peak interference to 1 digit reading error with an integration time of 1s)

SERIES MODE REJECTION
50/60 Hz power line frequency. better than 60 dB

COMMON MODE REJECTION (Up to 1 kOhm in the "Lo"-lead; guard connected to the "V-LO"- input socket)
DC Voltage ..... 140 dB
50/60Hz power line frequency.. 140 dB

MEASURING PAUSES ..... 125 ms after range or function change

MEASURING METHOD..... Fully integrating PREMA multiple ramp procedure (German Pat. No. 2114141, 2820601C2; US-Pat. No. 3765012, 4361831)

POLARITY CHANGE..... automatic

OVERLOAD PROTECTION

Between "V/Ohm-HI" and case ..... +/- 1000 V peak
with the restriction 10 000 000 V x Hz
Between "V/Ohm-HI" and "V/Ohm-LO" input +/-0.2V, +/-2V -range for
60 sec. ..... +/- 1000V
continous ..... +/- 700V
+/-20V, +/-200V, +/-1000V-range, continous ..... +/- 1000V

Between "V/Ohm/LO" input and guard ..... 50V DC or peak

Between guard and case ..... 200V DC or peak

OVERLOAD INDICATION ..... ERROR 1 in the display

RESISTANCE Ohm/kOhm

MEASURING METHOD ..... 2 wire circuit

RANGES ..... 200 Ohm, 2 kOhm, 20 kOhm, 200 kOhm, 2 MOhm, 10 MOhm

INTEGRATION TIMES (sec.)	0.1	1+10
FULL SCALE	199999	1999999, in the 10 MOhm-range 1200000
RESOLUTION	1 mOhm	1 mOhm

RANGE SELECTION ..... manual, automatic or by remote control

ACCURACY +/- (% of reading (%rdg.) + % of full scale (% f.s.))*)

	24h, 23°C+/-1°C	
RANGE	% rdg.	% f.s.
200 Ohm	0.01	0.002
2 kOhm	0.005	0.001
20 kOhm	0.005	0.001
200 kOhm	0.005	0.001
2 MOhm	0.005	0.001
10 MOhm	0.05	0.003

	1 year, 23°C+/-5°C	
RANGE	% rdg.	% f.s.
200 Ohm	0.015	0.003
2 kOhm	0.015	0.002
20 kOhm	0.015	0.002
200 kOhm	0.015	0.002
2 MOhm	0.015	0.002
10 MOhm	0.1	0.006

*) Add +/- 1 Digit. "Guard" connected to "V/Ohm-LO". After autozero.

TEMPERATURE COEFFICIENTS
(10°C to 18°C and 28°C to 40°C)

RANGE	+/-(%rdg.	+ %f.s.)/°C
200 Ohm	0.002	0.0005
2 kOhm, 20 kOhm, 200 kOhm	0.0015	0.0005
2 MOhm	0.002	0.0005
10 MOhm	0.01	0.0005

TEMPERATURE COEFFICIENTS
(0°C to 50°C) Double the values for 10°C to 40°C

CURRENT THROUGH UNKNOWN RESISTOR

RANGE		
200 Ohm, 2 kOhm	0.7	mA
20 kOhm	70	A
200 kOhm	7	A
2 MOhm, 10 MOhm	0.7	A

OPEN CIRCUIT TERMINAL VOLTAGE .. about -14 V max.

MEASURING PAUSES ..... 125 ms after range or function change

OVERLOAD LIMIT ..... +/- 300 V peak

OVERLOAD INDICATION ..... ERROR 1 in the display

TRIGGER INPUT

TRIGGERING	positive flank
min. pulse amplitude	+ 2 V
max. pulse amplitude	+ 15 V
overload limit	+/- 25 V
plug connector	3.5 mm post office type jackplug
max. voltage between socket and mains ground	50 V

The socket is electrically isolated from the case. The ground connection of the socket (external visible sleeve) is connected to IEEE 488 ground.

IEEE 488 BUS INTERFACE

OPERATING MODES ..... Talker/Listener or Talk Only

DECOUPLING ..... Galvanically insulated from the input stage

OUTPUT INFORMATION ..... Numerical read out of measurement result, function, range, integration time

INPUT INFORMATION ..... Function, range, integration time, start command, nominal value for calibration

ADDRESS ..... From 0 to 30, TALK ONLY, selectable via keyboard

FUNCTIONS SH1, AH1, T5, L3, RL1, DC1, DT1, SR1

KEYBOARD ..... Can be switched off via REN, can be switched on via GTL.

END-CHARACTER ..... 9 different terminating character combinations, selectable via keyboard

COMPATIBILITY ..... IEEE-Standard-488 (1978) and IEC 625 part 1 and 2

BUS CONNECTOR ..... 24 pin compatible to IEEE 488

GENERAL

WARM-UP TIME ..... 20 min. 1 year accuracy
1.5h for full rated accuracy

RELATIVE HUMIDITY
up to 25 C ..... max. 75%
above 25 C ..... max. 65%

POWER SUPPLY
Voltage ..... 220 V (110 V, 120 or 240 V selectable)
Power consumption ..... about 17 VA
Frequency ..... 50/60 Hz

WEIGHT ..... about 3.4 kg

ENCLOSURE ..... Slim line aluminium case

DIMENSIONS
Height without feet ..... about 67.5 mm (2.66 ins)
Height with feet ..... " 84 mm (3.31 ins)
Width ..... " 255 mm (10.04 ins)
Depth ..... " 276 mm (10.87 ins)

3. Commencing Operation

Every P R E M A measuring unit has been carefully tested in detail before leaving the factory, to make sure that its function conforms to all technical specifications. The unit should be in perfect electrical condition on arrival at the customer. To verify this, the unit should be examined for transportation damage immediately on arrival. In the case of grounds for complaint, a protocol of damage found should be drawn up together with the deliverer.

Mains Connection

This P R E M A measuring unit is intended for connection to one of the voltages 110V, 120V, 220V,or 240V, 50/60 Hz AC mains input voltage as power supply. Make sure you have an instrument that corresponds to your power line voltage!

Voltage fluctuations of +/- 10% and frequency fluctuations of +/- 4% are tolerated. The power consumption is about 17 VA. A cold equipment mains connector with grounding contact, conforming to DIN, is located on the rear of the unit. The unit is protected by a slow blow 0.1 A(220V, 240V line voltage) or 0.2 A(110V or 120V line voltage) miniature fuse. The rocker switch, which is an integral part of the cold equipment mains connector on the rear of the unit, disconnects the unit from the AC mains voltage.

Grounding

To protect the user against possible electric shock, the case of the unit must be grounded by connecting the mains cable to a suitable power outlet with grounding contact. The case is electrically isolated from the shield and from the two input sockets.

4. Keyboard and Auto ranging

The functions direct voltage "V=" and resistance "Ohm" are selected by pressing the respective key. The LEDs are lit respective to the selected function.

Range selection is automatic when the "Auto" key has been pressed, or manual with the range keys (up and down keys). When one of these keys is pressed, the autoranging function is switched off and the active range is switched one step up or down for each keypress.

The fast autoranging function makes a preliminary decision within the first third of the set measuring time, wether the active range is the correct one. If the set range is retained after the preliminary decision (fast autoranging), then two further checks are made after elapse of the complete measuring time:

1. The next higher range is selected if the span limit is reached or exceeded.
2. If less than 8% of the set span is reached, then the next lower range is selected. The next measurement then commences in the new range 100 msec after switchover.

When range selection is made via the rear input (see section headed IEEE 488 bus interface, then the range keys on the front panel are disabled. The control unit is electrically isolated from the input.

A brief measurement with reduced accuarcy is inititated in response to each keypress and each range change, when autoranging is switched on. The brief measurement takes 200 ms and produces no service request when SRQ is selected in IEC bus operation.

The functions of the keys "Cal", "Zero", "IEEE" and "MUX" are described in the corresponding subsections.

5. Numerical Display

The measurement results with decimal point, the negati sign and error messages are shown on the numerical display of the digital multimeter. Certain operating modes of the multimeter are indicated here too.

The active function and the operating mode are indicated by LEDs in the respective keys.

Display variants are:

"+ 19.3457"	measurement result 5 1/2 digit
"+ 112.3572"	measurement result 6 1/2 digit
"null "	offset correction is executed
"CAL "	calibration switch on the rear is in "CAL"-position or cilbration is executed
"IEEE.07.8"	IEEE-adress and termination character code for IEEE-bus operation
"P 2"	Selecting an operation programm
"trig on"	Selecting trigger on or off ("on", "oF")
"1-5 SEC"	Selecting integration times and 5 1/2 or 6 1/2 digit display
"ERR 1"	Overload indication

6. Offset Correction

Zero point displacement (drift) is one possible source of error. Normally this type of error is immediately evident by a display reading differing from Zero when the input is shorted. A zero point correction can be made with the "Zero" key. For this purpose place a short circuit at the "VOhm" input and then press the "Zero" key. The instrument makes a zero point measurement whose duration is determined by the set integration time. With 6 1/2 digit display, the zero point measurement takes 20 seconds in the function "Vdc", during which time the display shows "null" and the remaining time in seconds until the end of the measurement. With 5 1/2 digit display, the zero point measurement takes 2 seconds and only the text message "null" appears in the display. The keyboard is disabled during the correction measurement. The sequence of the correction measurement differs slightly from the description given above, for the functions "Ohm". For this function the zero point is corrected immediately by continual observation of the measured value. If autoranging was switched on before calling the zero point measurement, then all ranges of one function are corrected in succession for zero point. Now the zero point measurement takes 10 seconds for each 6 1/2 digit display span, and 1 second for each 5 1/2 digit display span. When the measurement duration is 10 seconds, the display shows "null" and the remaining time. When the measuring time is 1 s, only the text message "null" appears in the display.

No short circuit is placed internally in the multimeter for the offset correction, so that the user can place the short circuit at any desired location in the external circuit, to include external error sources in the compensation. This is particulary important for the 2-wire resistance measuring function. The error due to the finite resistance of the measuring leads can be eliminated by the offset correction.

Deviations up to 1% of the measuring range span can be corrected. If the deviation exceeds this limit, then the message " Error 4 " appears in the display and on the IEEE 488 bus, and the old correction value is preserved.

7. Error Messages and Self-Test

7.1. Error Messages

The digital multimeter recognizes the following error situations caused by incorrect operation or manual control. They are reported in the main display and via the IEEE 488 bus with the designation "Error" and a code number. The code numbers have the following meanings:

1 - Overflow for measurement: The reading exceeds the allowed numerical range

4 - Error during offset measurement: The offset present at the input sockets is too large for compensation.

5 - Error during calibration:
1. Nominal value smaller than 5% or greater than 100% of the display span.
2. Calibration switch on the rear of the unit is set to "MEAS".

6- Error in the IEEE 488 bus interface: The multimeter has received a message string containing more than 30 characters.

8- Error during self-test 2: The redetermined and the old check sum do not agree (Lost data in battery backed RAM).

9 - Error during self-test 3 (Error in the program ROMs.)

7.2. Self-Test

The digital multimeter executes an automatic self-test routine on mains power-up. Progress of the individual test routines is indicated in the main display by the message "Contr.". If an error occurs during the self-test, this error is reported by a corresponding error message and the multimeter aborts further execution of the self-test routines. To resume execution of the self-test routines press any key. No voltage greater than 300 V may be present at the input sockets of the multimeter during self-test.

Contr. 1 initializes the multimeter and checks for correct functioning of the analog section.

Contr. 2 forms a checksum of the calibration factors stored in the battery backed up RAM and compares this recalculated checksum with the old stored value.

Contr. 3 forms a checksum for the program ROMs and compares this recalculated checksum with a stored control checksum.

8.1. Operating Instructions for DC Voltage Measurements Vdc

Connecting the voltage to be measured

Connect the voltage to be measured to the two input sockets marked "V/Ohm" on the front panel. A voltage which is positive at the red socket relative to the black socket gives a positive readout in the display. Make sure that the maximum permitted values of the "LO" input and guard (see section "shielding"), and 500 V direct voltage or peak-peak alternating voltage between guard and case, are not exceeded. This condition must be taken into consideration when selecting polarity for high voltage circuits which are not isolated from the power mains.

Input resistance Vdc

In order to make full use of the excellent linearity of the measuring method, the input resistance for voltage measurement is extremely high in some ranges. For example, this still permits relatively accurate measurements up to +/- 2 V when the internal resistance of the measured voltage source is 100 kOhm. In the 20 V, 200 V and 1000 V direct voltage measuring ranges, 100 Ohms internal resistance of the measured voltage source already give an error of 1 digit when using 100 thousand digits resolution. The input resistance, display span and resolution are summarized in the following table for the respective measuring ranges:

Range	Maximum Display span	Input Resistance	Maximum Resolution
0,2 V	.1999999 V	1 GOhm	100 nV
2 V	1.999999 V	1 GOhm	1 V
20 V	19.99999 V	10 MOhm	10 V
200 V	199.9999 V	10 MOhm	100 V
1 000 V	1000.000 V	10 MOhm	1 mV

Overload Protection

All ranges are very effectively protected against destruction by voltages much greater than the range end value. The maximum tolerated overloads in this sense are:

+/-0.2V,+/-2V ranges: +/- 1000V for 60 sec or
+/- 700V continuous

+/-20V, +/-200V, +/-1000V ranges: +/- 1000V continuous

However, bear in mind that heavy overloads in the lower ranges will inevitably cause heat-up of the safety resistors and diodes, so that subsequently thermoelectric EMFs may cause a zero displacement until internal temperature equilibrium has been reestablished.

Common mode supression

The common mode rejection of a measuring unit is the capability of indicating only the wanted difference signal between the "HI" and "LO" input, with ideally complete supression of any response to a common voltage which both input terminals may have with respect to ground.Where as an ideal system would give no response to a common mode signal, so that it would show no error due to this cause, in a practical system stray capacitances, finite insulation resistance and resistive circuit assymmetry will convert a portion of the common mode voltage to a series voltage. The common mode rejection factor of this multimeter is better than 140 dB when the resistive asymmetry of the measuring leads has any value up to 1 kOhm.

Shielding

If no problems due to common mode voltage are expected in a given measuring task, then the guard input (blue socket) should be strapped to the "LO" input (black socket) .

A high rejection factor for direct voltage and common mode voltage can be obtained in critical cases by appropriate connection of the guard input. Common mode voltages are voltages which lie between the low point of the voltage to be measured and mains (power) ground, or between power ground of the voltage source and ground potential of the measuring unit. Common mode voltages attempt to send currents in the same direction via both input sockets. For optimum shielding effect, connect the guard input to a direct voltage potential equal to that of the "LO" input such that currents flowing in the shield do not flow through resistances in the voltage source circuit and voltage measuring leads, which could disturb the voltage being measured.

8.2. Operating Instructions for Resistance Measurements Ohm/kOhm

Resistance measurements with this multimeter are made according to the following principle: A load-independent current (I) is passed through the resistance (Rx) which is to be measured. This current also flows via a known internal range resistor. The voltage drop across Rx is measured via the input sockets "V=" and the ratio of this voltage drop to the voltage drop across the internal range resistor is determined. Thus any drift or ageing of the reference voltage source has no effect on the accuracy of the resistance measurements.

The digital multimeter makes resistance measurements in 2-wire circuit. For measuring small resistances too with high accuracy, careful compensation of the measuring lead resistances and of thermoelectric EMFs is required, with the aid of the offset correction facility. For this purpose connect the two measuring leads with their test clips to one side of the resistor to be measured, as shown in fig. 8.1, and then make offset correction by pressing the "Zero" key. This correction compensates for all possible sources of error, such as measuring lead resistance, contact resistance and thermoelectric EMFs at the transitions between different metals. Shielded measuring should be used when measuring large resistances (100 kOhm or greater). Connect the shield to ground potential, to prevent errors due to foreign voltages (mains ripple).

General Comments:
The currents trough the resistance to bemeasured have the following values in the respective ranges:

200 Ohm-, 2 kOhm-ranges	700 ^{2}A
20 kOhm-range	70 ^{2}A
200 kOhm-range	7 ^{2}A
2 MOhm-, 10 MOhm-ranges	0,7 ^{2}A

The polarity of the current flowing trough Rx is defined such that the end of Rx which is connected to the upper "HI" socket of the "V/Ohm" input has a negative potential with respect to the other end of Rx.

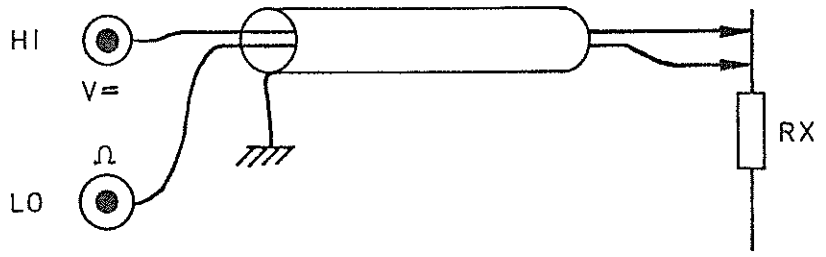


Figure 8.1

9. Integration Time and Trigger Setting

After pressing the "Prg" key, "P1" appears in the display for about 1s. If the "Prg" key is pressed again within the 1s delay time, then "P2" appears, again for 1s. "P1" and "P2" stand for "Program 1" and "Program 2".

If no key is pressed during the 1 second delay time, then the programs are executed.

Program 1: Setting the integration time

Program 2: Switch-on, switch-off of the external trigger facility

The up and down keys are used to set the integration time. The following measuring times are available:

0.1 sec.	100 ms	integration time,	display 5 1/2 digit
1 - 5 sec.	1 s	integration time,	display 5 1/2 digit
1 - 6 sec.	1 s	integration time,	display 6 1/2 digit
10 sec.	10 s	integration time,	display 6 1/2 digit

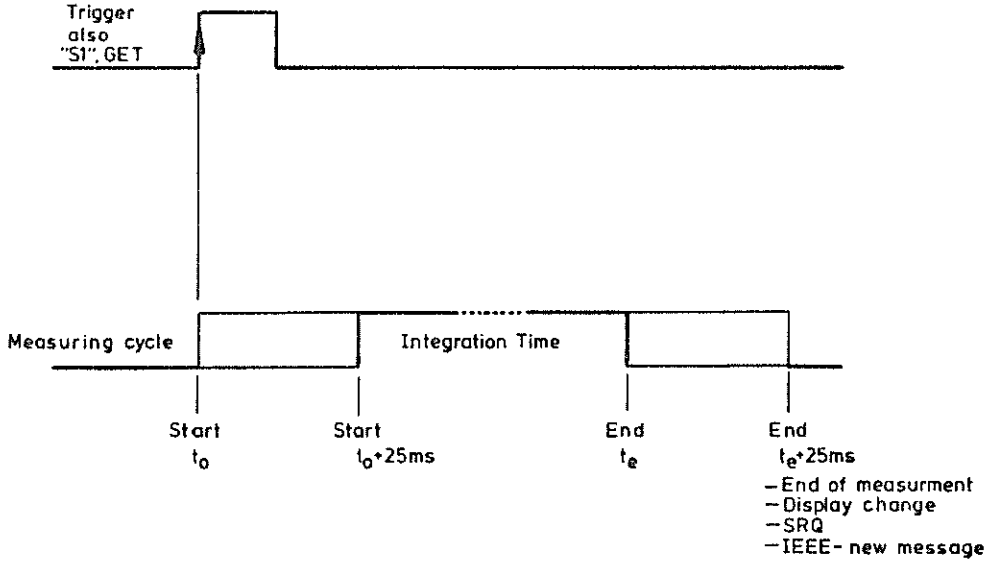
Pressing any other key exits this program and the integration time standing in the display at this instant is taken over for determining the measured values.

Switch-on and switch-off of the external trigger facility is made with the "up" key. The display shows "trig on" or "trig off", after alternate presses of the "up" key. Pressing any other key exits the program and the last displayed status is taken over. If start mode has been chosen, then the actual measured value appears in the display.

10.1 EXTERNAL TRIGGERING

The digital multimeter can be triggered for a single measurement via a 3.5 mm post office type jackplug mounted on the rear panel. A second start mode under software control is posible too, via the IEEE 488 bus. Both start modes have the same time sequence.

If program 2 (see the section describing the keyboard) has placed the digital multimeter in "trig on" status, single measurements can be started via the trigger socket. The start time is the rising flank of a trigger pulse with a time jitter not exceeding 25 ms (see Fig. 10.1). Via the IEEE bus, the digital multimeter is placed in start mode by the command "S1". Each further transmission of "S1" then corresponds to a trigger as described above. The digital multimeter can also be started by the addressed command GET (Goup Execute Trigger). The display and the IEEE message are refreshed at the end of the measuring time. If service request is switched on, then the SRQ line is activated. In "TALK ONLY" mode, the digital multimeter sends a message to a connected device in "LISTEN ONLY" mode.



Range and function switching operations carried out shortly before triggering may lead to delay times of up to 225 ms.

11. IEEE 488 - Bus - Interface

Capabilities of the IEEE 488 bus interface

SH1	Handshake source function
AH1	Handshake sink function
T5	Talker function
L3	Listener function
RL1	Remote control
DC1	Reset function
DT1	Trigger function
SR1	Service request function

11.1. Programming the Digital Multimeter via the IEEE 488 bus Interface

Set the device address using the numerical keyset of the digital multimeter. For this purpose, first press the "IEEE"-key . The digital multimeter is then in status "set device address". The display shows the present device address setting, e.g. "IEEE.07.8" which means that the unit is set at present to device address 7 and end character type 8. The digital multimeter is set to this device address and end character as delivered from the factory. The "07" in the display is flashing, to indicate that the device address can now be changed.

Use the "up" key to change the device address. The first actuation of this key starts a cyclic run-through of device addresses from 01 to 30. After address 30 the characters "--" appear in the display for operating status "TALK ONLY". When the desired address or "TALK ONLY" is reached, the process is stopped by pressing the "up" key again. To select the end character by its designation number, press the "down" key. The digit after the decimal point now flashes, indicating that the end character can now be changed. Selection of one of nine possible end characters is made with the "up" key in the same manner as for selecting the device address.

The following terminating characters and terminating character combinations are available :

Designation Number	Terminating Character (Combination)
0	CR + EOI
1	CR
2	LF + EOI
3	LF
4	CR + LF + EOI
5	CR + LF
6	LF + CR + EOI
7	LF + CR
8	EOI

The desired device address including the designation number of the terminating character combination is now present in the display. Press any key except a range key to transfer this address information into working memory and exit the status "set device address". If it is desired to take over these new settings into protected memory, set the calibration switch on the rear of the unit to position "Cal" before takeover of the address data.

```
**********************************************************
* DO NOT FORGET TO RETURN THE CALIBRATION SWITCH TO THE *
*                                                        *
*                   POSITION " M E A S "                 *
**********************************************************
```

The new device address will now not be lost when the digital multimeter is switched off. The keyboard of the digital multimeter is disabled after the digital multimeter has been accessed once via the IEEE 488 bus interface. The keyboard is enabled again when the "REN" becomes inactive or when the controller transmits the addressed command GTL (go to local).

The "TALK ONLY" capability in conjunction with a printer with "Listen Only" attribute, permits set-up of a self-complete measuring station. After each end of measurement (e.g. after atrigger), the multimeter outputs a measured value with the selected terminating characters to the IEEE bus.

The digital multimeter does not interrupt its continuous measuring sequence within the talker function. The digital multimeter understands the universal commands DCL(Device Clear), SPD(Serial Poll Disable), and SPE(Serial Poll Enable). The command DCL sets the digital multimeter into status "Direct voltage measurement with 1000 V range".

To program the digital multimeter, proceed as follows: Data input is possible as a character string of length 2 to 30 characters, e.g. "VDR3A0Q1L1" or "VDR3" or "R3". Every digital multimeter command consists of two characters. The sequence of several commands within one string is arbitrary, with the exeption of the command "NV" (see description of this

command). The ISO-7-bit code is used for command transfer. Any spaces in the transferred string are ignored. If the digital multimeter receives more than 30 characters (excluding any spaces), then it evaluates the first 30 characters and also reports a transmission error (see section headed "error messages").

Device Messages understood by the digital multimeter

VD	Direct Voltage			
O2	Resistance measurement, 2-wire circuit			
R1	Range	0,2	Vdc,	kOhm
R2	Range	2	Vdc,	kOhm
R3	Range	20	Vdc,	kOhm
R4	Range	200	Vdc,	kOhm
R5	Range	1000	Vdc,	2000kOhm
R6	Range	10000	...	12000kOhm
A0	(A/Zero) Autoranging off			
A1	Autoranging on			
T1	Integration time 100ms; display 5 1/2 digits			
T2	Integration time 1 s; display 5 1/2 digits			
T3	Integration time 1 s; display 6 1/2 digits			
T4	Integration time 10 s; display 6 1/2 digits			
Z0	Zero			
S1	Start mode, Start			
S0	(S/Zero) continuous measuring			
L0	(L/Zero) Digital multimeter transmits only measurement result			
L1	Digital multimeter transmits measurement and programmed status data			
Q0	(Q/Zero) without Service Request SRQ			
Q1	with Service Request SRQ			

NVXXXXXX Nominal value (for calibration)

Description of the device messages

"VD" Selects the measuring function "direct voltage" in the digital multimeter.

"O2" Selects the "resistance" measuring function. Measurements are made in 2-wire circuit.

"RX" The measuring range within each function is selected with "RX". "X" stands for the designation number of the desired measuring range. Note that some measuring ranges can be selected only in conjunction with a corresponding measuring function, e.g. R6 only for function "kOhm".

"A0" (A/Zero) switches off autoranging.

"A1" switches on autoranging.

"TX" Sets the integration time and the number of digits shown in the display for the measurement result. 6 1/2 digits are always transmitted via the IEEE 488 bus.

"Z0" Starts an offset correction. The instructions in the section headed "offset correction" are valid.

"S0" (S/Zero) Starts the continuous measuring sequence.

"S1" Stops the continuous measuring sequence. The delay until execution of the commands "S0" and "S1" may amount up to 25 msec.

"L0" (L/Zero) Short format: The multimeter transmits only the first data block (measurement data and text messages).

"L1" Long format: The multimeter transmits both data blocks (measurement data and text messages in first block and programming data in second block).

"Q0" (Q/Zero): The multimeter transmits no Service Request SRQ.

"Q1" The multimeter transmits a Service Request SRQ with:
- each new measurement result
- each error message
- reset

"NVXXXXXX" After NV the multimeter expects a 6-digit unsigned decimal integer number as nominal value for calibration via the IEEE 488 bus. A nominal value for calibration must be transmitted alone, i.e. no further command from the table above may be contained in the same string. The digital multimeter commences the calibration measurement after receiving the nominal value

11.2. Device Messages Transmitted from the Multimeter

The device messages transmitted from the multimeter consist of a data set which is generated and transmitted as a block, with end specification. The data set consists of two data blocks. The first data block contains programming status data. Each data block consists of a character string with a fixed number of characters, so that no end character is required or sent between the two data blocks. The first character string contains 12 characters and the second character string contains 12 characters + terminating character(s).
If character transmission from the multimeter is discontinued before the multimeter has gone to TIDS status, transmission commences with the first character of the data set after a new call.

The terminating character(s) of the data set are as chosen according to the section headed "Programming the digital multimeter via the IEEE 488 bus interface".

The ISO-7-bit code is used for transmitting the device messages.

Description of the transmitted data set

The contents of the display are transmitted in the 12 characters of the first data block. These are measurement results and text messages. The measurement results are always transmitted right justified, i.e. termination with the 12th character.

The first character is always the sign, "+" or "-", for DC voltage measurements. All not required leading digits before the measurement result are filled with zero.
No sign is output for resistance measurements and all not required leading digits in front of the measurement result are filled with zero.
Measurement results are output in exponential form without spaces,

e.g. +01.9876E+2

The text messages have the format:

"ERR. X", "NULL", "CAL."

These messages are always left justified, i.e. they commence with the first character of the data block. All not required characters are filled with spaces (blanks).

The second data block always commences with the 13th character. This data block outputs the programmed status of the multimeter. Output of the second data block can be enabled or disabled with the digital multimeter command "L1" or "LO" (L/Zero) respectively (see section headed "Programming the digital multimeter via the IEEE bus interface").

Device messages transmitted by the multimeter

(IEC 625 Part 2)

```
 1st. character          24.th character
 !                       !
 +X.XXXXXXE+XVDRXAOTXSOQO
             O2  A1  S1Q1
                         .
                         .
                         END
 (----------)(----------)
 1st. data    2nd. data
 block        block
```

+	Sign of mantissa for VD Zero for O2
X.XXXXXX	7 digit mantissa
E+X	1-digit exponent with sign
VD,O2	Measuring function: VD - Direct voltage O2 - Resistance, 2-wire-circuit
R1-R6	Measuring range: R1 = 0.2 Vdc, kOhm R2 = 2 Vdc, kOhm R3 = 20 Vdc, kOhm R4 = 200 Vdc, kOhm R5 = 1000 Vdc, 2000 kOhm R6 = 10000 ..., 12000 kOhm
AO, A1	Autoranging (O(Zero) = off, 1 = on)
T1-4	Integration time, number of display digits
T1	100ms , 5 1/2
T2	1s , 5 1/2
T3	1s , 6 1/2
T4	10s , 6 1/2
SO, S1	Start, Stop
QO, Q1	SRQ-status (O(Zero)=without, 1=with SRQ)
END	Terminating character(s) as selected when setting the device address. For terminating character No.8, EOI is transmitted together with the final (26th.) string character.

Service request function (SR interface function)

The IEEE 488 bus interface of the digital multimeter is equipped with a service request function (SR function, SRQ). The individual status bits transmitted with a service request have the following meanings:

Bit 1: End of measurement
Bit 3: Overflow during measurement
Bit 4: Error messages
Bit 6: Reset
Bit 7: SRQ

Bit 1, end of measurement, can appear together with the other status bits, in order not to falsify the SRQ in the case of fast measurement sequences.

Bit 6 appears with a reset, i.e after power-up or in the case of a strong external source interference event. A reset always takes the multimeter to basic status (DC, 1000V, etc.), so that the control computer must reprogram the multimeter according to section 11.1 after detecting a reset.

Programming examples for the IEEE 488 bus interface

Before the digital multimeter can be operated via the IEEE 488 bus interface, the device address and the end character(s) must be set as described at the beginning of this section. Address 7 and the end character number 8 (only EOI) are recommended in the following examples for Commodore and Tektronix computers.

COMMODORE CBM 3032

Control of the digital multimeter by the CBM 3032. The CBM 3032 is the controller and the digital multimeter is the listener.

```
CBM 3032: 100 print " your entry please "
          110 input a$
          120 open 1,7
                                "7" is the device address of
                                the digital multimeter
          130 print#1,a$
          140 close 1
```

Reading the character string from the digital multimeter with the CBM 3032. The CBM 3032 is the controller, the digital multimeter is the talker.

```
CBM 3032: 200 open 2,7
                                "7" is the device address of
                                the digital multimeter
          210 input#2,b$
          220 close 2
          230 print b$
          240 goto 100
```

TEKTRONIX 4051:

Control of the digital multimeter with the Tektronix 4051: The Tektronix 4051 is the controller, the digital multimeter is the listener

```
4051: 100 PRI " YOUR ENTRY PLEASE "
      110 INP A$
      120 PRI @ 7:A$
                              "7" is the device address of
                              the digital multimeter
      130 GO TO 100
```

Reading the character string from the digital multimeter by the Tektronix 4051. The Tektronix 4051 is the controller, the digital multimeter is the talker.

```
4051: 140 INP @ 7:B$
                              "7" is the device address of
                              the digital multimeter
      150 PRI B$
      160 GO TO 100
```

HEWLETT PACKARD HP 85

The device address of the multimeter is 7, the end character is No.5 (CR+LF without EOI).

Control of the digital multimeter by the HP 85. The HP 85 is the controller and the digital multimeter is the listener.

```
HP 85 : 130 PRINT " YOUR ENTRY PLEASE "
        140 INPUT B$
        160 OUTPUT 707;B$
        190 END
```

Reading the character string from the digital multimeter with the HP 85. The HP 85 is the controller, the digital multimeter is the talker.

```
HP 85 : 530 DIM A$ [50]
                          string size agreement ;choose
                          large enough, at least 29 charac-
                          ters
        550 ENTER 707;A$
        580 DISP A$
        590 END
```

HEWLETT PACKARD HP 87

The device address of the multimeter is 7, the end character is No.5 (CR+LF without EOI).

```
HP 87 : 10 DIM A$ [40] , B$ [30]
```

string size agreement, chose large enough, at least 29 characters

Control of the digital multimeter by the HP 87. The HP 87 is the controller and the digital multimeter is the listener.

```
20 INPUT B$
```

entry via HP 87 keyboard (voltmeter code), up to 30 characters

```
30 OUTPUT 707;B$
```

string transfer from the HP 87to the digital multimeter

Reading the character string from the digital multimeter with the HP 87. The HP 87 is the controller, the digital multimeter is the talker.

```
40 ENTER 707;A$
```

string transfer from digital multimeter to the HP 87 (26-28 characters)

```
50 PRINT A$

60 GOTO 20
```

HEWLETT PACKARD HP 87

Operation of the digital multimeter as before, but now with SRQ.

The device address of the multimeter is 7, the end character is No.5 (CR+LF without EOI).

```
HP 87 :  10 ON INTR 7 GOSUB 500
                        checks IRQ from IEEE 488 bus
         20 DIM A$ [30] , B$ [40]
                        string size agreement, choose
                        large enough, at least29 charac-
                        ters
         30 INPUT B$
                        entry via HP 87 keyboard , e.g.:
                        "Q1" for SRQ enabled
         40 OUTPUT 707;B$
                        string transfer from the HP 87 to
                        the digital multimeter
         50 ENABLE INTR 7;8
                        enable IRQ initiated by SRQ
         60 GOTO .....
                        line number of user program


        500 STATUS 7,1; W

        510 P=SPOLL (707)
                        transfer of the SRQ status regis-
                        ter
        520 IF P>63 THEN GOSUB 1000
                        evaluation of the register con-
                        tents
        530 ENABLE INTR 7,8
                        enable IRQ initiated by SRQ
        540 RETURN



       1000 ENTER 707;A$
                        read in the message from the
                        digital multimeter
       1010 PRINT A$, P, "DEVICE NO.7"
                        and print it on the screen to-
                        gether with status information
       1020 RETURN
```

HP 9816 (200 Series)

```
1000    !******** Data transmission HP 9816 *****
1010    !
1020    !Declaration of variables
1030    !
1040    COM / DMM      / @ Dmmnr, Setup$  [30] , DISPLAY$  [30]
1050    !
1060    ! Adress assignment -- 7 = @Dmmnr
1070    !
1080    ASSIGN  @ Dmmnr TO 707
1085    ON INTR 7,1 CALL Serialpoll
1090    !
1100    READING THE DESIRED SETUP VIA THE KEYBOARD
1110    !
1120    INPUT Setup$
1130    OUTPUT  @ Dmmnr ; Setup$
1140    !
1150    ! ENABLE INTERRUPT
1160    !
1170     ENABLE INTR 7;2        !IRQ by appearence of an SRQ
signal
1180 Haupt:    !
1190           GOTO Haupt
1200           END
1210
!.....................................................
1220
!.....................................................
1230    SUB Serialpoll
1240    ! CHECKS DEVICE FOR SERVICE REQUEST, READS IF REQUIRED
AND
1250    ! RETURNS TO THE WAITING LOOP OF THE MAIN PROGRAM
1260    !
1270    !
1280    COM /Dmm     / @ Dmmnr, Setup$  30 , DISPLAY$  30 ,
1290    !
1300    P=SPOLL (@ Dmmnr)
1310    !
1320    IF P>63 THEN CALL Measval
1330    ENABLE INTR 7
1340    SUBEND
1350     !.....................................................
1360     !.....................................................
1370    SUB Measval
1380       !.....................................................
1390    !READS IN THE PRESENT MEASURED VALUE FROM THE VOLTMETER
1400       !.....................................................
1410    COM/Dmm     / @ Dmmnr, Setup$ [30], DISPLAY$ [30],P
1420    ENTER @  Dmmnr; DISPLAY$
1430    PRINT DISPLAY$,P
1440    SUBEND
```

APPLE II with CCS Interface Module 7490

```
 2 PRINT
 3 PRINT "SET DMM      TO ADDRESS.07.0  "
 5 PRINT
 6 PRINT "WHEN YOU HAVE DONE SO,"
 7 PRINT "PRESS THE RETURN KEY."
 8 INPUT C$
10 DIM A$(30), B$(30)
                    dimension the string arrays sufficiently
                    large
12 PRINT:PRINT
15 PRINT "YOUR ENTRY PLEASE:"
20 INPUT B$
30 PR #3
                    initialize slot 3 for output
40 PRINT "@':"
                    @  switches to address mode;
                       REN and ATN active;
                    '  transmits listener address 7;
                    :  switches back to Command mode;
50 PRINT "'";B$;"'"
                    the message is transmitted;

                    '  switches text mode on and off;
60 PRINT "@G:"
                    @  switches to address mode;
                    G  transmits talker address 7;
                    :  switches back to Command mode;
70 PR #0
                    data from IEEE bus are printed directly
                    on the screen
80 INPUT "";A$
                    read-in the message from the IEEE bus
90 IN #0
100 GOTO 20
```

Lines 20 to 100 are essential.

Lines 2 to 15 are optional for user guidance.

12. CALIBRATION

12.1.0 Calibration

Allow a period of 2-3 hours to elapse after switching on, before commencing calibration, so that the digital multimeter has reached thermal equilibrium.
The digital multimeter has a digital calibration facility which permits individual range or complete recalibration. It is not necessary to open the unit for recalibration. Recalibration is possible under front panel keyboard control or via the IEEE 488 bus. The correction values from the first calibration carried out in the PREMA factory are stored in the programm EPROM and in a CMOS RAM with a lithium battery as backup power supply. The multimeter normally uses the correction values which are stored in the CMOS RAM. The service life of the battery is about 10 years. To prevent unintentional destruction of the correction values, they are protected in memory by setting a recessed sliding switch S2 which is located in the middle on the rear of the unit. The settings of this switch are marked "MEAS" and "CAL". To recalibrate the digital multimeter, move the witch S2 with the aid of a small screwdriver or similar tool from "MEAS" to "CAL".
The "CAL" operating mode is indicated by periodic appearance of the legend "CAL" in the main display. In this status the correction values stored in the CMOS RAM are unprotected and can be overwritten. If correction values have been lost accidently by improper calibration attempts and recalibration is not possible because no calibration standards are available, then the correction values which have been stored by PREMA in the program EPROM at the time of initial calibration of the instrument, can be copied into the CMOS RAM. For this purpose, set the mains switch of the multimeter once to "OFF" and then to "ON" again, whereby the calibration switch on the rear side of the instrument must be left in setting "CAL". Hereby the calibration correction factors are automatically copied from the EPROM to the battery backed-up CMOS RAM and all correction values for the input offset are cleared. Thus it is necessary thereafter to make new compensation of the input offset for all functions and ranges.
For this purpose, place a short circuit at the input sockets V/Ohm" of the digital multimeter, select measuring function "Vdc" and "Auto" for autoranging and then press the "Zero" key. The multimeter now corrects all Vdc measuring ranges in automatic succession and places the found correction values in the RAM which can subsequently be protected. To correct a single measuring range, select just this range, leaving autoranging ("Auto")switched off.
Proceed in the same manner for the other functions too (observe the instructions given in section 12-1-4).

12.1.1. Calibrating the Direct Voltage Measuring ranges

First select the measuring range which is to be calibrated and then connect an exactly known positive or negative reference voltage to the input sockets. This reference voltage should not be less than 5% or more than 100% (preferably 50% to 100%) of the range span. The multimeter now displays a measurement result whichhas been calculated using the old calibration factor. If this actual value differs unacceptably from the nominal value (known value of the reference voltage), then call the calibration program by pressing the "Cal" key. The nominal value can now be set using the "up" and "down" keys. The "down" advances the digit opened for correction. When the digit to be corrected in the display has been reached, it starts counting cyclically 0-9 after a short delay. This counting can be stopped and started again with the "up" key. When all digits have been corrected to the nominal value, start the actual calibration measurement by pressing the "Cal" key (without first pressing the "2nd" function key). "CAL." thereupon appears in the display and the remaining time of the calibration measurement is counted down to Zero in the display, similar to the sequence of events for a Zero point measurement.

There after the unit exits the calibration program and new functions and ranges can be selected. The calibration program is also aborted when any other key except "up", "down" or "Cal" is pressed, in which case the old calibration factor is retained and no change has been made. To recalibrate several measuring ranges individually, start the entire procedure as described above for each range. After completing all intendend recalibrations, make quite sure that the recessed switch S2 on the rear panel of the unit is returned from "Cal" to "Meas", so that the calibration data are protected again.

Calibration procedure via the IEEE 488 bus is basically analogous to the described procedure via the front panel keyboard. The nominal value is set as integer number with the command "NVXXXXXX" (see calibration program in the section headed "IEEE 488 bus interface"). The calibration program and the calibration measurement are started automatically on transmission of the nominal value. When no further ranges and functions are to be calibrated, terminate the calibration procedure by returning the switch S2 on the rear panel of the unit from setting "Cal" to setting "Meas".

12.1.2. Calibrating the Resistance Measuring Ranges

The resistance measuring ranges are calibrated in 2-pole circuit. First connect the zero point by the procedure described in section 12.1. Also observe the instructions given in the section headed "operating instructions for resistance measurements Ohm/kOhm", in particular regarding compensation of the measuring leads resistance. Calibration procedure for the resistance measuring ranges is otherwise analogous to calibration of the direct voltage measuring ranges.

```
**********************************************************
* DO NOT FORGET TO RETURN THE CALIBRATION SWITCH TO THE *
*                                                        *
*              POSITION      " M E A S "                 *
**********************************************************
```

13. Setting-Up a Self-Sufficient System for Automatic Acquisition of Measurement Data

13.1. Description of the Measuring Set-Up

A small data acquisition system for 20 channels (4-pole) which operates on its own without computer control, can be set up with the PREMA Digital Multimeter 4000 as triggerable multimeter and the PREMA Scanner 2024 as 20 channel scanner. For documentation of the measurements data, a printer with IEEE bus interface (e.g. Epson RX 80 with Interface 8165) (operation mode "LISTEN ONLY") can be connected to the multimeter (operating mode "TALK ONLY").

The Scanner 2024 and the Digital Multimeter 4000 are connected with the trigger cable via the rear panel trigger sockets, and the front panel sockets of the instruments are connected up with the appropriate measuring cables (V/Ohm, A and A, B, C, D).

Connect the 20 channel to the Scnner 2024 via the subminiature type D sockets on the rear panel. Only one function, i.e. voltage or resistance, can be measured automatically. The selected function must be set on the multimeter before starting the measuring run. Fixed ranges can be preset, or the autoranging function of the multimeter may be used.

The measuring channels, measuring times and switching intervals are determined by the scanner. The scanner outputs a trigger signal during the switch-on time of each channel, to cause the multimeter outputs the result to the connected printer.

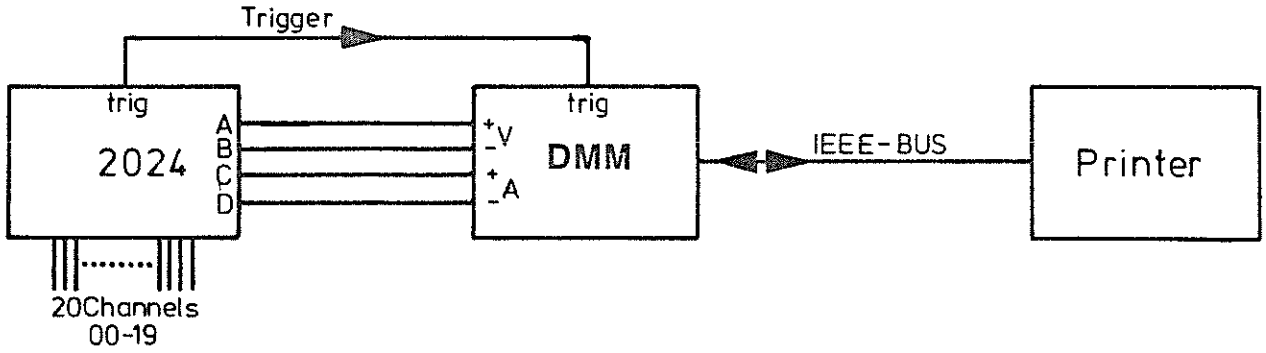


Fig. 13.1.

13.2. Example of a Measuring Sequence

For example, the channels CH 10 - CH 19 are to me measured automatically every 10 minutes with a channel switch-on duration of 15 seconds for each channel. The results of the measurements are to be output to a printer.

13.2.1. Settings of the Scanner 2024 and the Multimeter 5000

Preselect the channels CH 10 - CH 19 on the Scanner 2024. Set the scan cycle time to 10 minutes, the channel switch-on duration to 154 seconds and the trigger delay time to 2 seconds. The IEEE setting must be "AUTO" (between 00 and 30) (this activates the trigger output). The front panel sockets A, B, C, D of the scanner must be connected (CONTROL).

On the Multimeter 4000, set the integration time to 10 seconds, for example. The IEEE setting must be "TALK ONLY" and choose CR+LF (5) as terminator. Switch to triggered mode. The autoranging function may be switched on to obtain maximum resolution for all values.

Connect the printer ("LISTEN ONLY") to the IEEE bus connector of the multimeter.

13.2.2. Starting the Measuring System

Start and stop the measuring system via the scanner in Automatic Single Scan mode.
After start, channel CH 10 is connected througt and after a delay time of 2 seconds the Scanner 2024 outputs a trigger pulse which starts the measurement by the multimeter. After elapse of the 10 second integration time, the multimeter outputs the measurement result data to the printer, together with the status information for function, range, etc. After expiry of the channel switch-on duration of 15 seconds, channel CH 10 is disconnected and channel CH 11 is now connected. After the last channel (CH 19) has been disconnected again after measurement, the end of the 10 minute scan cycle time is awaited and then a new measuring cycle is started. The measuring sequence can be stopped or aborted at any time.

13.2.3. Output to a Computer

When the multimeter is set to a device address instead of "TALK ONLY" and the proper terminator for the computer is selected and SRQ mode is chosen, then a SRQ (Service Request)

is issued at the end of each measurement. The computer is connected in place of the printer and reads the measurement result on receiving the SRQ. The computer need not perform any control functions; it can be used purely for data collection.

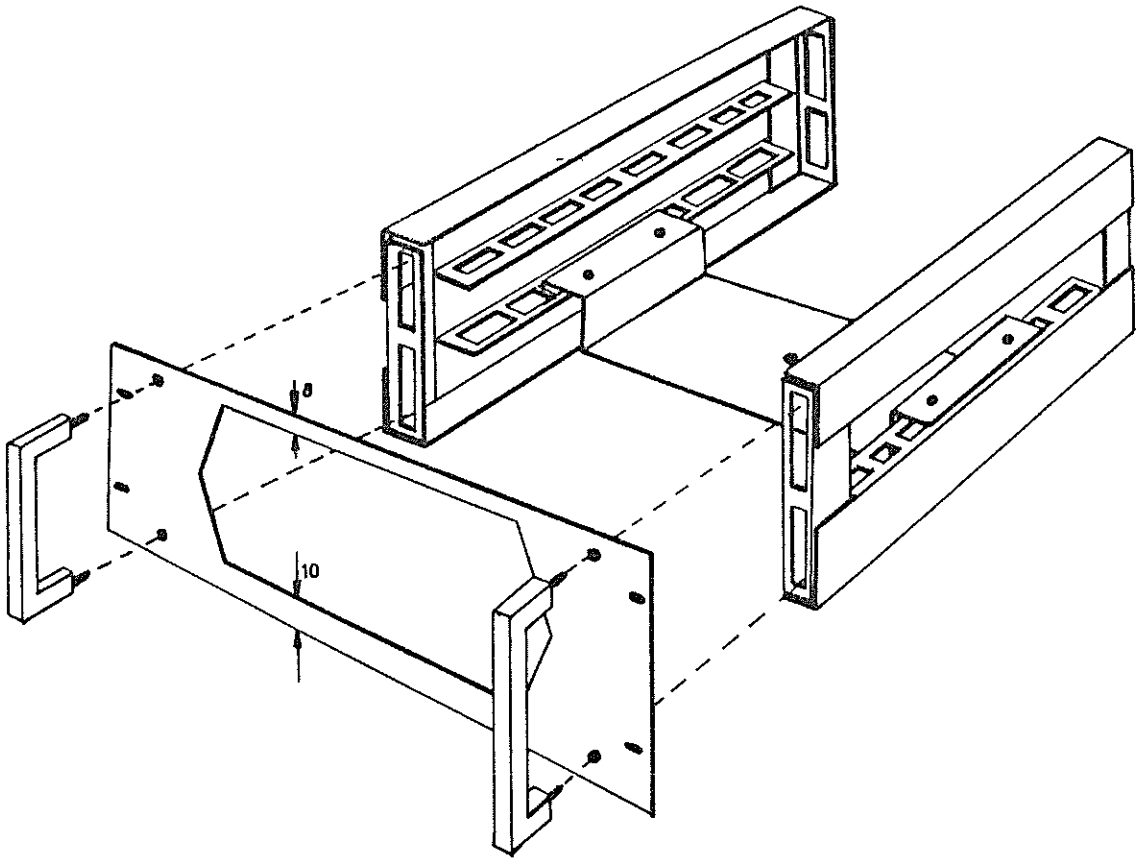
The settings of the other device parameters for the scanner and for the multimeter can be retained.

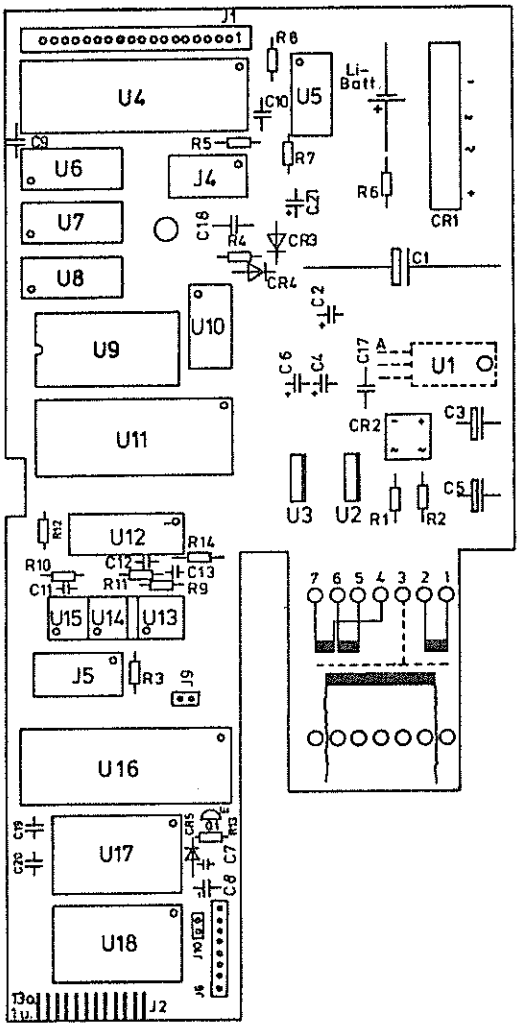
14. ACCESSORIES

14.1. Rack Mounting Kit (Option 6000/04)

A complete kit is available for mounting a DMM 4000 in a 19" equipment rack.

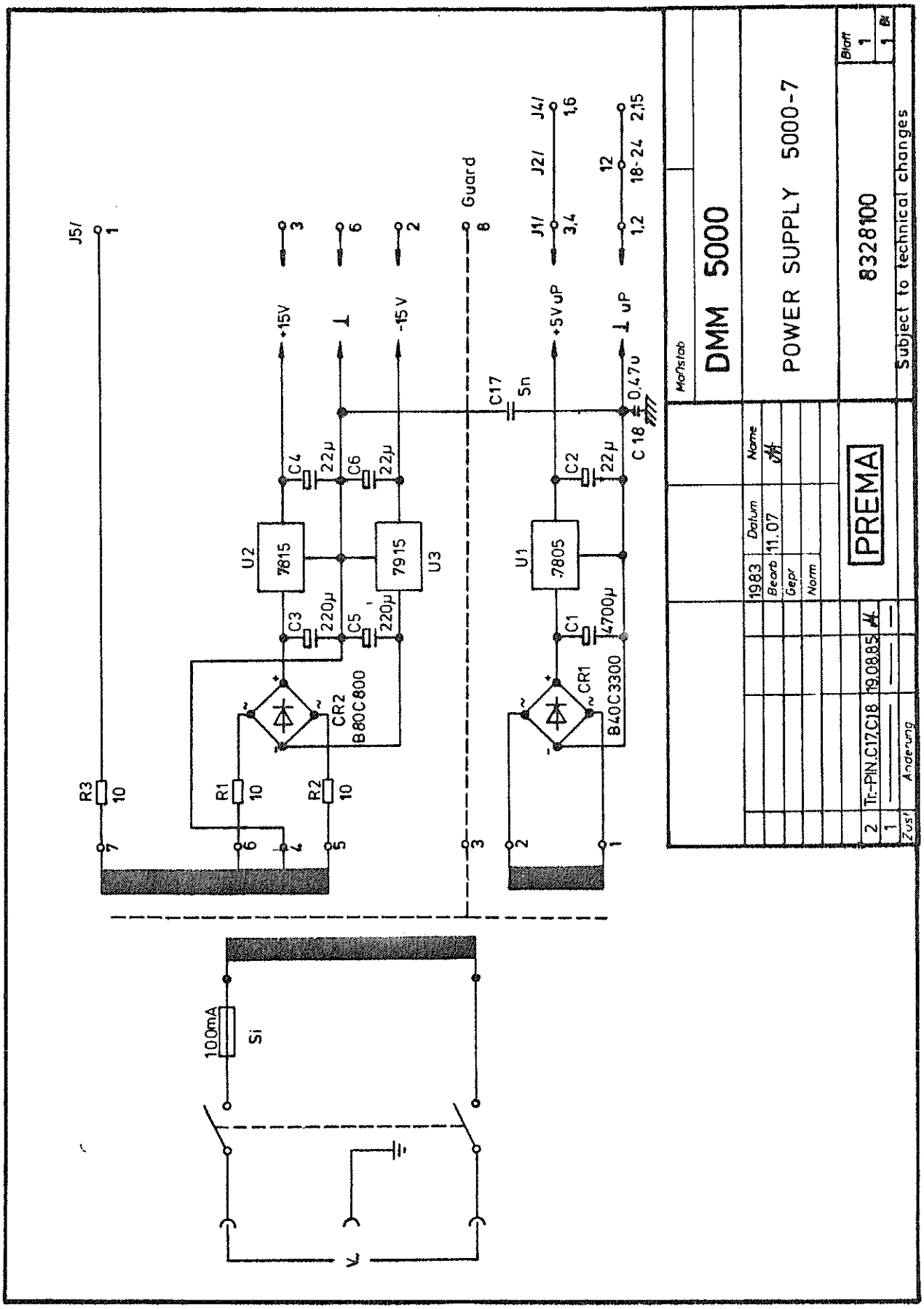
Height 2 HU

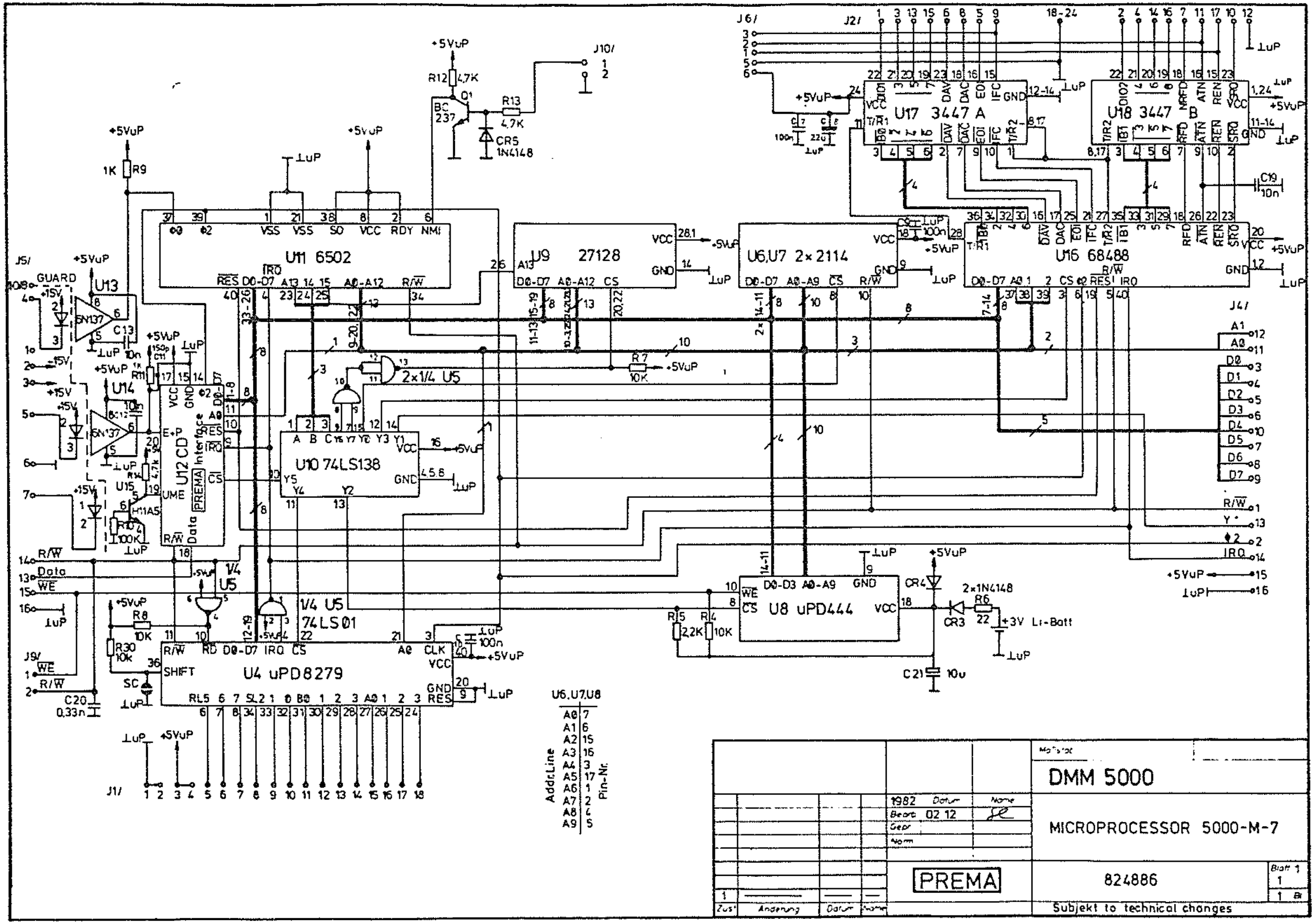


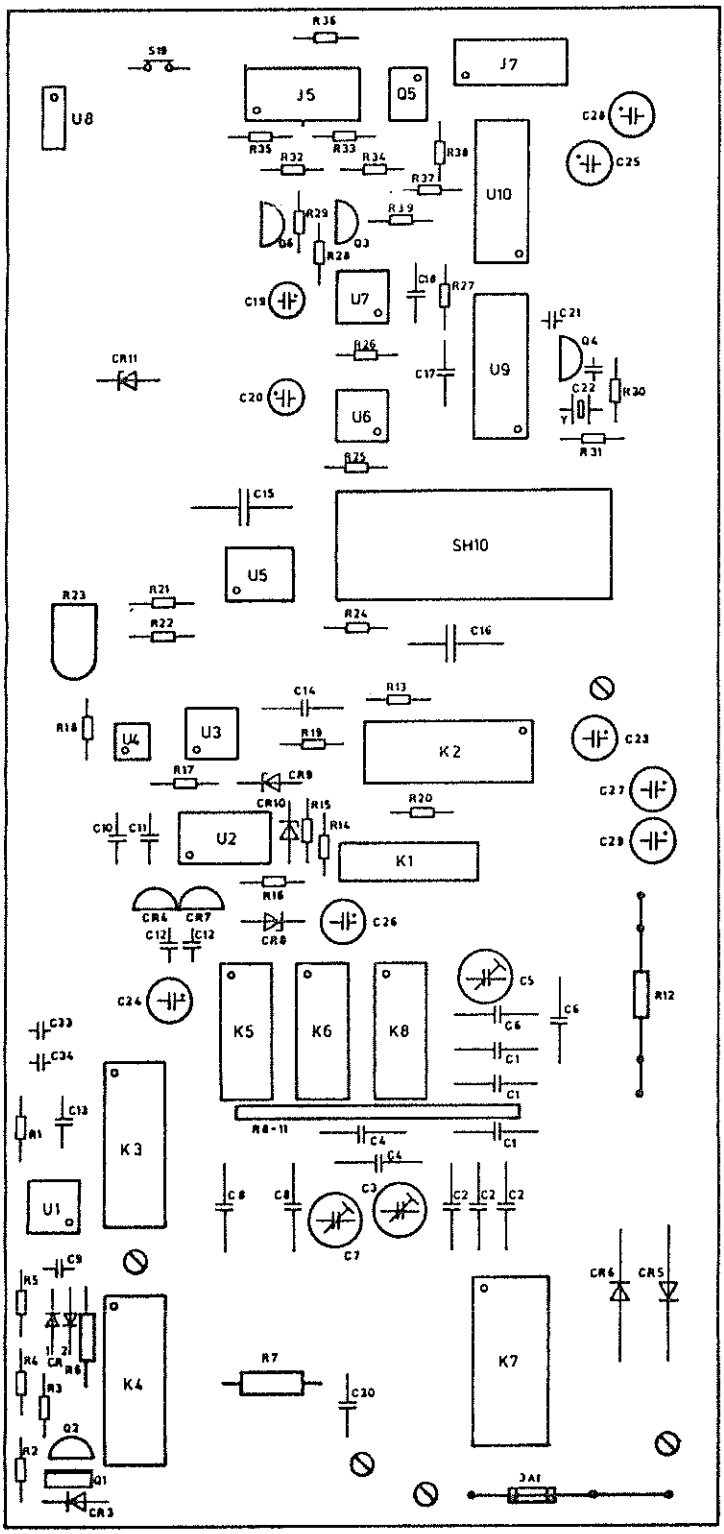


				Maßstab	DMM 5000
			1983 Datum Name		
			Bearb 12.07		LAYOUT DIAGRAM OF
			Gepr		MICROPROCESSOR 5000-M-7
			Norm		
				PREMA	8328101
1 Zust	Änderung	Datum	Name		Subject to technical changes

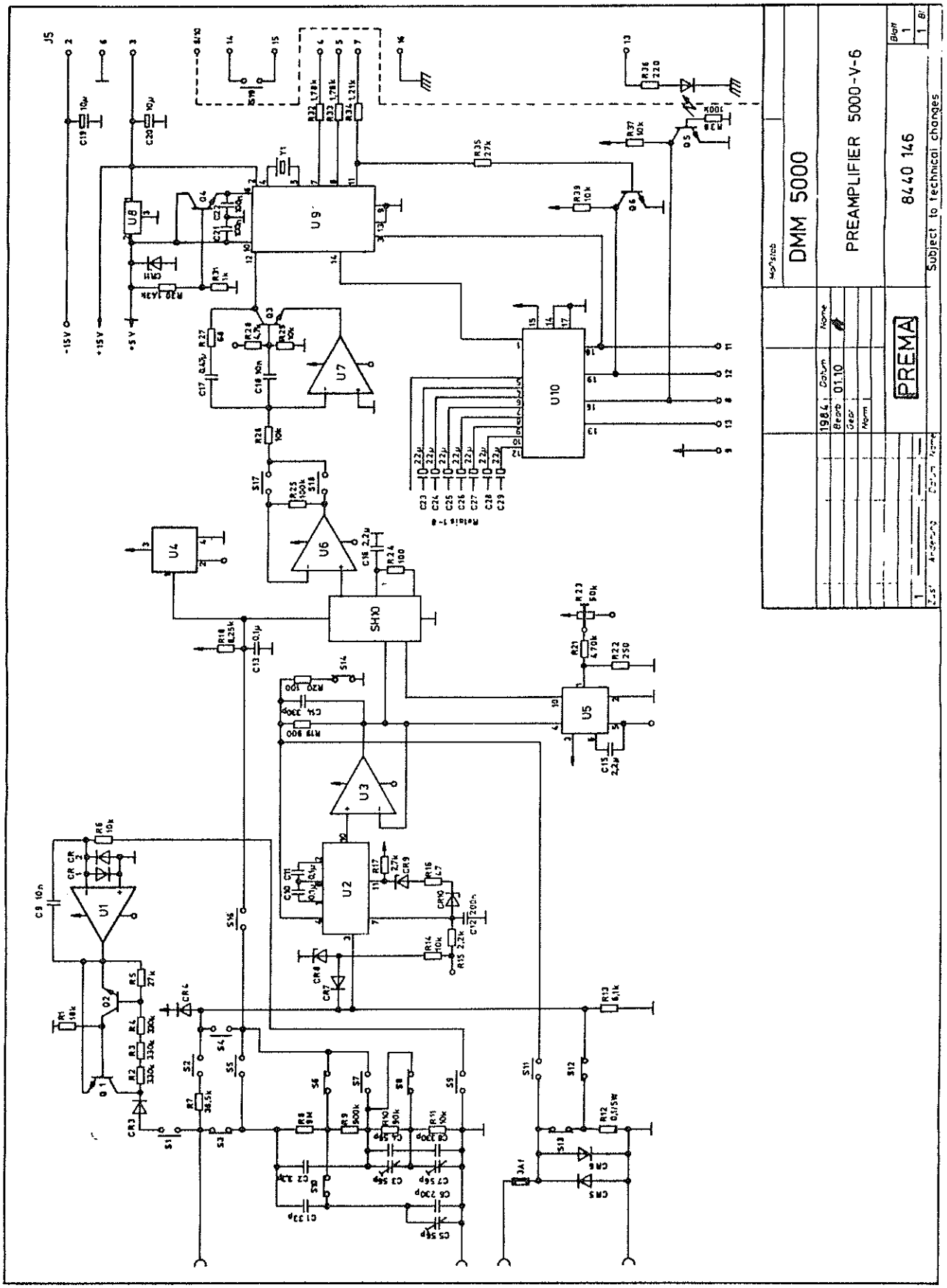
Blatt 1
1 Bl

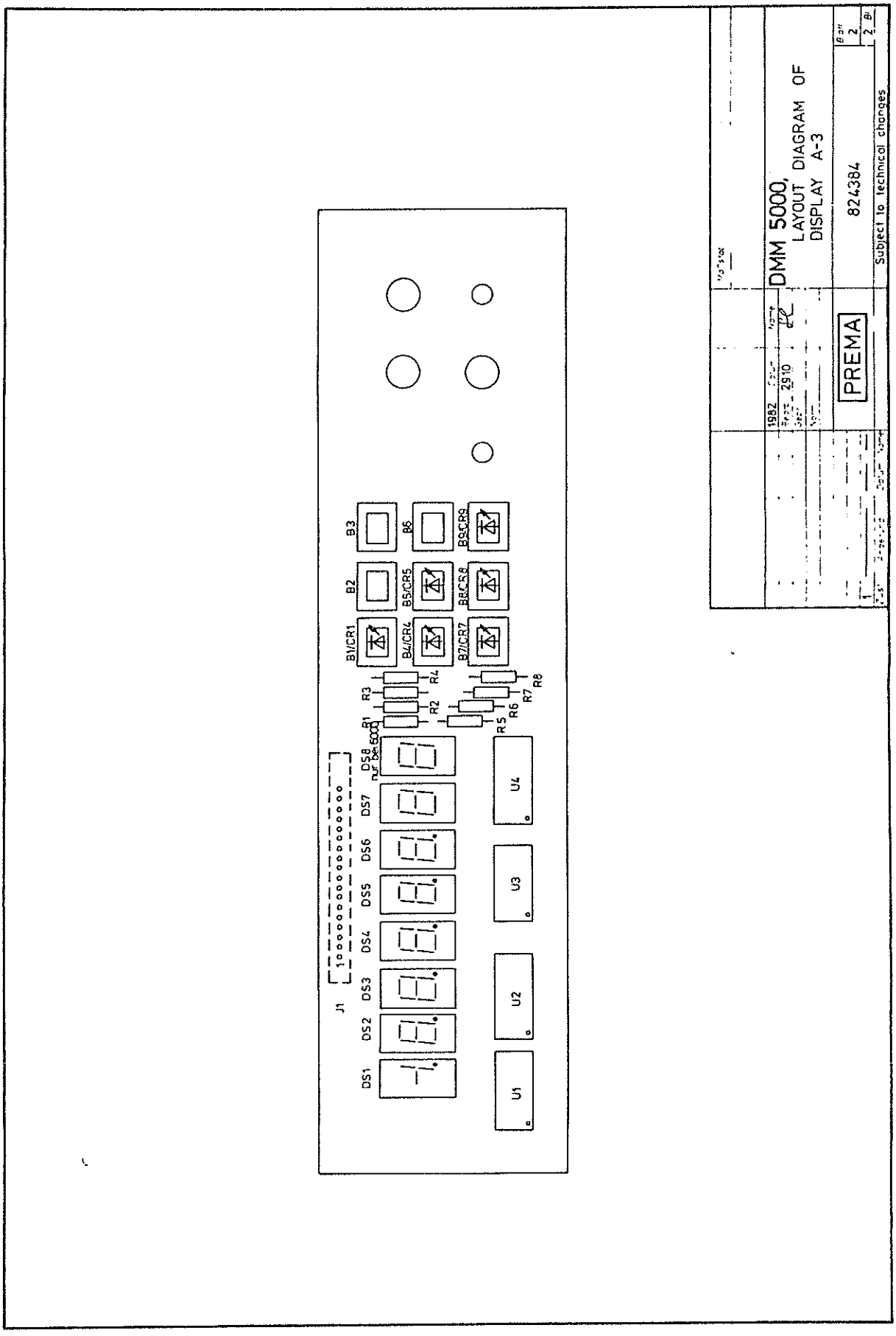

J5/
1
3
6
2
Guard
8
J1/
3,4
J2/
1,6
12
1,2
18-24
2,15
+15V
⊥
-15V
+5V uP
⊥ uP
C17
5n
C18
0.47u
C4
22µ
C6
22µ
C2
22µ
U2
7815
7915
U3
U1
7805
C3
220µ
C5
220µ
C1
4700µ
CR2
B80C800
CR1
B40C3300
R3
10
R1
10
R2
10
7
6
4
5
3
2
1
100mA
Si
V
Maßstab
DMM 5000
POWER SUPPLY 5000-7
8328100
Blatt
1
1
Bl
1983
Datum
Name
Bearb
11.07
Gepr
Norm
PREMA
2
Tr-PIN.C17.C18
19.08.85
1
—
—
Zust
Änderung
Subject to technical changes

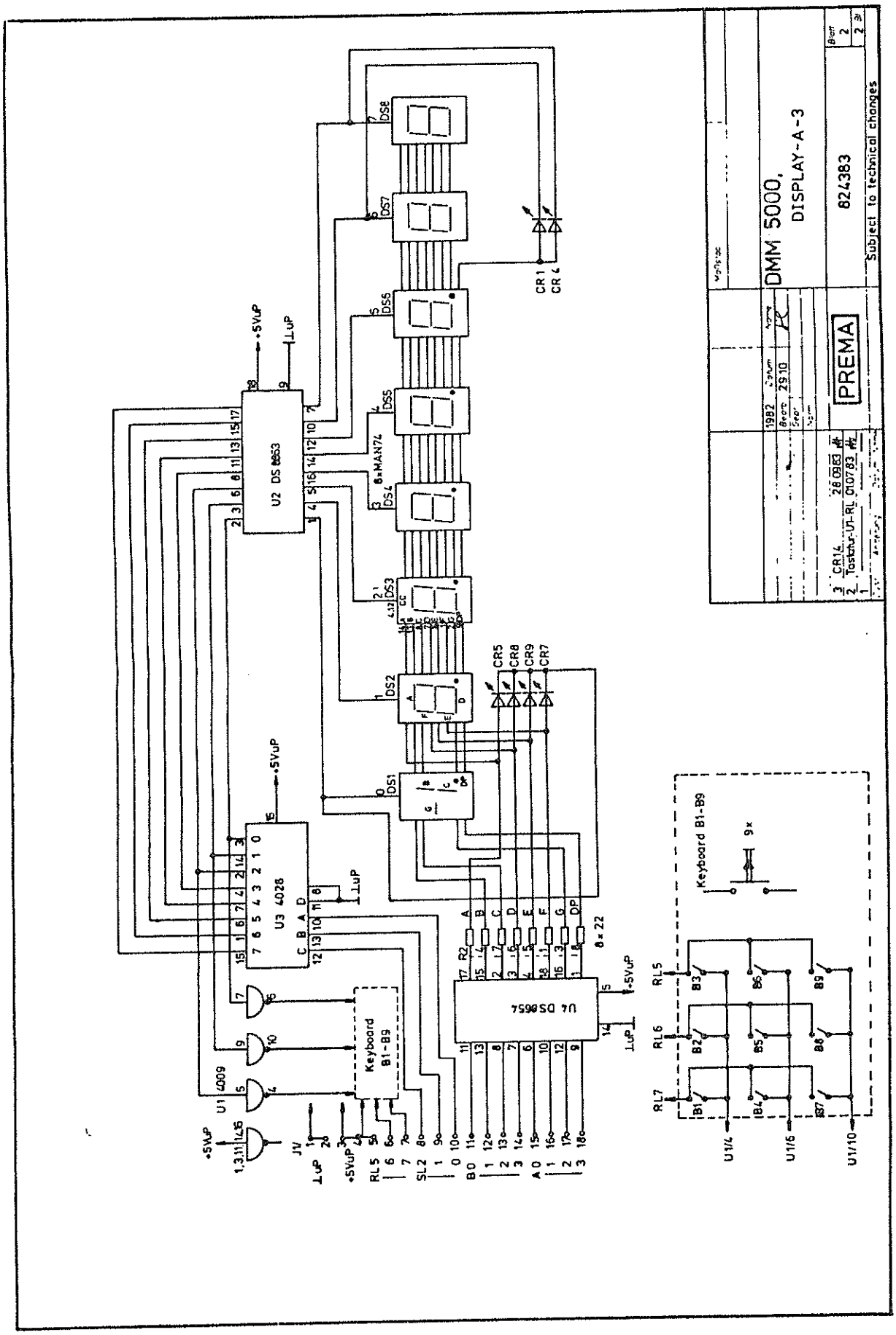

DMM 5000
MICROPROCESSOR 5000-M-7
824886
PREMA
Subjekt to technical changes



		Material: DMM 5000	LAYOUT DIAGRAM OF PREAMPLIFIER 5000-V-6	Blatt 1 1 Bl.	Subject to technical changes
		1981 Datum 0310 Name	PREMA	8440 147	
		Bearb. Gepr. Norm			


DMM 5000
PREAMPLIFIER 5000-V-6
8440 146
PREMA
Subject to technical changes


DMM 5000,
LAYOUT DIAGRAM OF
DISPLAY A-3
PREMA
824384
Subject to technical changes
1982
Sept 2910
J1
DS1
DS2
DS3
DS4
DS5
DS6
DS7
DS8
U1
U2
U3
U4
B1/CR1
B2
B3
B4/CR4
B5/CR5
B6
B7/CR7
B8/CR8
B9/CR9
R1
R2
R3
R4
R5
R6
R7
R8


DMM 5000,
DISPLAY-A-3
824383
PREMA
Subject to technical changes
U2 DS 8863
U3 4028
U4 DS8654
U1 4009
8xMAN74
8 x 22
Keyboard B1-B9
9x
CR1
CR4
CR5
CR8
CR9
CR7
+5VuP
⊥uP