PREMA®

Scanner
Model 2024

Instruction Manual

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2024 - 9205
Subject to technical changes without notice

WARNING!

I/O terminals are sensitive to electrostatic voltage (especially the IEEE connector).
It can damage
your instrument!

OBSERVE PRECAUTIONS FOR HANDLING

Never touch input plugs or terminals without precautionary measures!

Damage caused by electrostatic voltage is not covered by warranty!

Nicht kopieren

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1. Introduction

1.1. General Description

The PREMA 2024 Scanner is a universal system-compatible measuring points selector switch for a wide range of applications with an excellent performance to price ratio. The bistable relays with low thermoelectric emfs used in this scanner permit high precision interrogation of measuring points with this instrument. The thermoelectric emfs at the contacts are smaller than 1 /uV.

It is also possible to route high currents (up to 2A) and high voltages (up to 250V) via the scanner. The floating potential relay contacts provide perfect isolation between the measured signals, the IEEE bus and the power mains circuit.

The scanner can be operated as 1 from 20 channel multiplexer in the operating mode "SINGLE SCAN" or as n from 20 channel coupling field in the operating mode "MULTI SCAN". Automatic channel switching "AUTO SINGLE SCAN" is possible in SINGLE SCAN mode. AUTOMATIC SINGLE SCAN provides the facilities for automatic switchover of previously defined channels according to a programmable time schedule.

A self-sufficient small data acquisition system for 20 channels can be set up by connecting a triggerable voltmeter (PREMA 5000 DMM) and a suitable printer.

When the scanner is connected to a computer, entries to the computer can be made on the keyboard of the scanner and the computer can output text to the display of the scanner.

The PREMA 2024 SCANNER is the ideal measuring points selector switch for frequently changing task requirements, in computer controlled as well as in manual operation. The 2024 Scanner is at present the most compact of all available 20 channel multiplexers which feature single or multichannel operation with full control via the keyboard and via the IEEE bus.

The attractive price and outstanding technology of this instrument are the result of dedicated utilization of microelectronic integration in the form of custom-specific integrated circuits, leading to a drastic reduction of the required number of components. This enhances dependability and simplifies service.

1.2. Functional Overview

Fig. 1.2 gives a short overview of the chief functions, displays and manual control elements.

(1) MAIN DISPLAY:
5 1/2 digit LED display for readout of channel numbers and switching states, IEEE setting and characters transmitted from the computer in display mode.

(2) AUXILIARY DISPLAY:
1 digit LED display for indicating the IEEE bus and remote control status as well as for showing program/error and test numbers.

(3) ENTRY AND FUNCTION DISPLAY:
All device setting entries are made with the 9 keys. LEDs in the keys indicate the current function of the instrument.

(4) FRONT PANEL SOCKETS:
Four independent signal paths A, B, C, D, can be connected or disconnected, with common shield. For connecting measuring and test instruments in the final set-up.

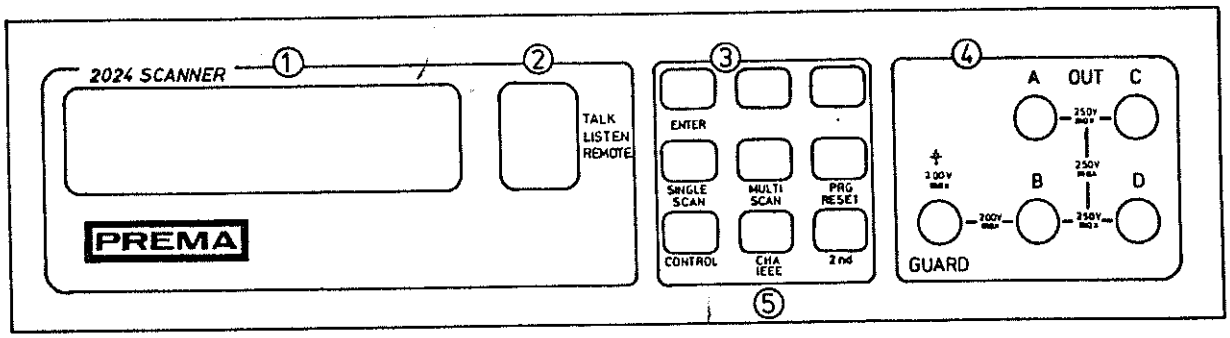


Fig. 1.2

(5) KEYBOARD

ENTER:	For terminating entries and for start and stop in AUTOMATIC SINGLE SCAN.
UP KEY:	To set data upwards in setting programs.
DOWN KEY:	To set data downwards in setting programs.
SINGLE SCAN:	Switch-on and indication of SINGLE SCAN operating mode.
MULTI SCAN:	Switch-on and indication of MULTI SCAN operating mode.
PRG:	Selection of five programs for automatic measuring points switching AUTO SINGLE SCAN in conjunction with the up and down keys.
P1 - P3:	Setting the timers for execution of the AUTOMATIC SINGLE SCAN.
P4:	Channel preselection of the switched channels in AUTOMATIC SINGLE SCAN.
P5:	Start and stop of the AUTOMATIC SINGLE SCAN
CHA:	Selection and deselection of channels in conjunction with the up and down keys, and indication of the channel selection.
2nd:	Switchover to the second function level (blue legend).
RESET:	Cancels all channel selections and sets the basic functions of the instrument.
IEEE:	Setting of the IEEE device address and terminating characters and trigger mode, in conjunction with the up and down keys.

2. Technical Data

2.1. SCANNER

Switching mode:	4 times, 1 from 20 or 4 times, n from 20, n $\leq$ 20
Number of channels:	20 channels
Contacts per channel:	4
Contact type:	bistable mechanical switch (relay)
Resting state:	contact closed or open, by chance
Thermoelectric emf:	smaller than 1 /uV after 1.5h run-in time
Protection shield:	common shield for all signal lines
Max. voltage between any two channels:	250 Vdc or 100 Vac up to 100 kHz limit
Max. measured voltage:	250 Vdc or 100 Vac up to 100 kHz limit
Max. slope of the input signal:	200 V/μs
Max. switched current:	2 A
Time between two switching actions:	20 msec
Max. continuous switching rate:	2 Hz (for the same channel)
Max. contact resistance values:	smaller than 20 mOhm (initial value)
Service life:	more than 200 million switching cycles (0.1 A, 10 Vdc)
Insulation resistance between any two contacts:	> 3 GOhm when relative humidity is under 60%
Insulation resistance to case:	> 3 GOhm when relative humidity is under 60%
Capacitance between the contacts:	less than 300 pF
Connector:	50-pole subminiature type D plug

2.2. Trigger Output

Pulse amplitude:	TTL level
Pulse width:	about 400 /us
Logic:	negative
Max. current:	40 mA
Plug connector:	3.5 mm jack plug
Max. voltage between socket and mains ground:	50 V

No external voltages may be injected into the trigger output. This socket is electrically isolated from the case. The ground connection of the socket (externally visible sleeve) is connected to IEEE ground.

2.3. IEEE Bus Interface

Decoupling from the measuring channels:	electrical isolation between the IEEE interface and the measuring channels
Output information:	channel numbers, operating status, program selection, timer, keyboard, input sockets status
Input information:	channel numbers, program selection, timer, display operating status, input sockets, START, STOP
Supported functions:	SH1, AH1, T6, L3, RC1, DC1, DT1, SR1
Keyboard:	can be switched off by REN can be switched on by GTL can be interrogated by computer (key codes)
Device address:	selectable from 00 to 30, can be set via the keyboard
Terminators:	9 different character combinations are selectable; CR, CR+LF, CR+LF+EOI, etc.
Compatibility:	IEEE Standard 488 (1978) and IEC 625 part 1 and 2
Bus plug connector:	24-pole, according to IEEE 488

2.4. General Data

Warm-up time:	1.5 h for thermoelectric emfs less than 1/uV		
Relative humidity:	up to 25°C up to 75% relative humidity above 25°C up to 65% relative humidity		
Power supply:	depending on version; 117,220,240 V; 50/60 Hz, 17 VA		
Weight:	about 3.4 kg		
Case:	flat aluminium case		
Dimensions:	height without feet	about 67.5 mm/2.7	in
	height with feet	about 84.0 mm/3.3	in
	width	about 255 mm/10.0	in
	depth	about 276 mm/10.9	in

3. Commencing Operation

Every P R E M A measuring instrument has been checked thoroughly for compliance with all technical specifications before leaving the factory. Therefore the instrument should be in perfect electrical condition on arrival. In order to verify this, please examine immediately for possible damage during shipping. In the case of any grounds for complaint, make a record of the detected damage in writing together with the person delivering the instrument.

Mains Connection

This P R E M A measuring istrument is available for delivery in the versions for 117, 220 or 240 Vac nominal mains input voltage. Before connecting the instrument to the mains voltage for the first time, check that the voltage stated on the type specification plate on the rear of the unit corresponds to the nominal value of the local mains voltage. Actual voltage differences and fluctuations of ±10% and frequency changes of ±4% are tolerated. The power consumption is about 17 VA. The cold equipment mains connector conforming to DIN with safety grounding contact, is located on the rear side of the instrument. The unit is protected by a 0.1A slow-blow miniature fuse. The double pole mains on/off switch is built into the cold equipment mains connector on the rear.

Grounding

For user protection, the case of the instrument is grounded by connecting the mains cable to a suitable power outlet socket which is fitted with a mains grounding contact. Do not use a mains connection without grounding contact. The case is electrically isolated from the signal shield and from the two inputs.

****
* WARNING *
****

This instrument contains bistable relays whose contact settings are arbitrary at switch-on or switch-off time. It is therefore very important to make sure that no measuring cables are connected when the instrument is switched on or off, if the signal sources could deliver voltages or currents which exceed the limiting values specfified in the technical data for this instrument. The arbitrary settings of the relay contacts at switch-off and switch-on time may short circuit some measuring signals, which could lead to damage in your measuring circuits or in the scanner.

We expressly point out that we accept no liability for any consequential damage.

Damage to the relay contacts is excluded from warranty too.

4. Description of the Instrument

The Scanner 2024 is a compact and versatile universal measuring points selector switch. The central processing unit (microprocessor) controls and interrogates the keyboard, display, IEEE interface and relay matrix.

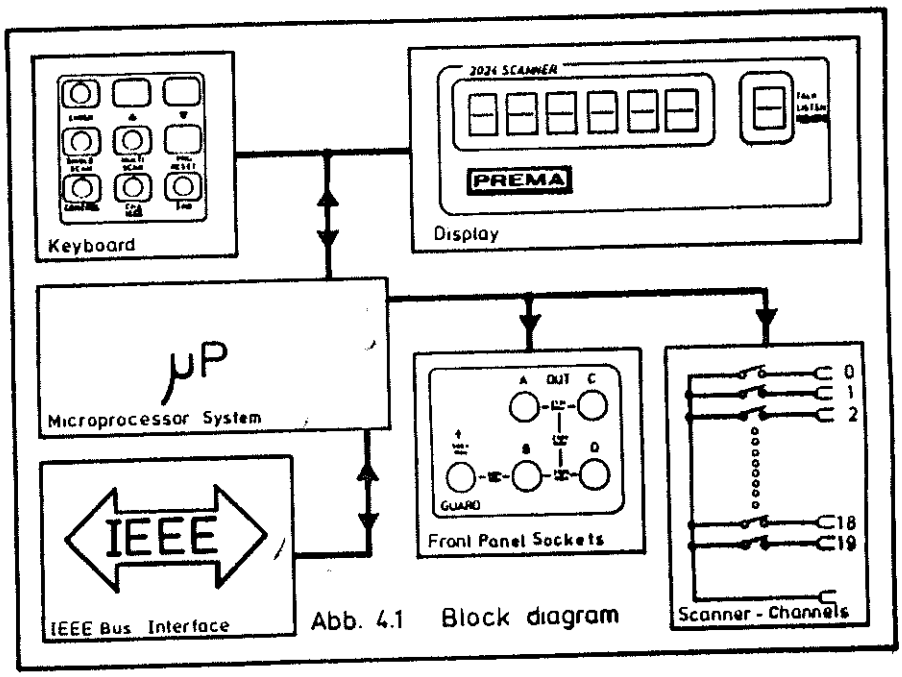


Fig.4.1 Block Diagram

The sturdy aluminium case is divided into two compartments. One compartment contains the microprocessor system, the power supply, the IEEE interface and the display. The other compartment contains the bistable relays which have 4-pole changeover contacts.

This strict separation of heat-dissipating components from the relays ensures that a stable and uniform temperature is established in the relay compartment, which is an important condition for very small thermoelectric emfs in the measuring channels. The second measure to suppress thermoelectric emfs is the use of bistable relays. These are energized with only a brief pulse to switch them over, so that they do not heat up progressively in an uncontrolled manner. The subdivision into two case compartments also efficiently shields the measuring circuits against radio frequency interference generated by the microprocessor system. As a further measure for interference suppression, the relays are not driven directly by the microprocessor system, but via a special relay driver chip which is loaded serially from a microprocessor port. Thus disturbing alternating voltages appear on the relay cards only during the actual relay switching phase.

4.1 Description of the Relay Matrix

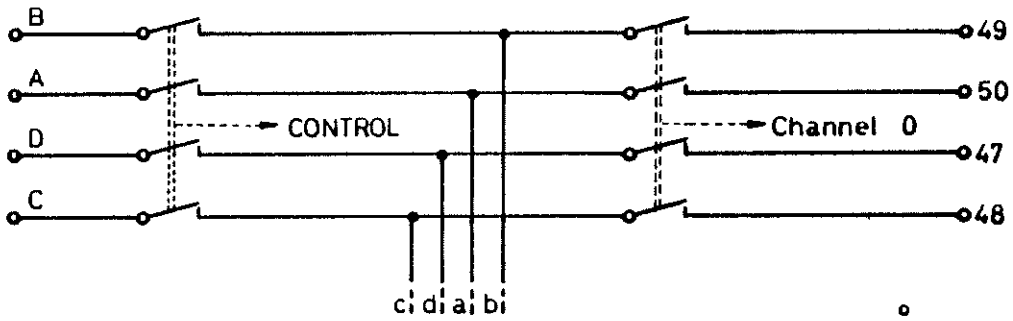
The inputs of the 20 four-pole scanner channels are connected to two 50-pole subminiature type D sockets on the rear side of the instrument. 10 channels are connected to each socket. The pinout of the two sockets is identical. Each channel can be connected onto a 4-pole bus system independently of the other channels, via its own relay with 4 make contacts. The four bus lines are connected to four pins of each subminiature type D socket, so that the scanner output can be taken optionally from both socket strip connectors. In addition thereto, the bus system can be connected via a further relay to the front panel sockets. The detailed pinout is shown in Fig.4.2.

4.2 Shielding

Each line of each channel is surrounded by a shield line. All shield lines are mutually connected. This shield system is connected to the blue front panel socket "Guard" and to one pin on each of the two 50-pole sockets on the rear of the instrument. These connections can be used to prevent leakage currents between the signal lines and the case of the scanner, which might otherwise appear when large potential differences are present between the signal source and ground and the relative humidity is very high. If the shield (guard) system is connected to a potential which corresponds to the potential difference between signal source and ground (thereby observe the limiting values specified in the technical data), then all leakage currents flow in the shield and not in the signal lines. Of course, these shielding measures must be continued in the same systematic manner outside the scanner too.

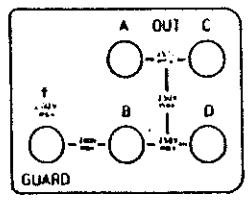
Front Input

Scanner Input



Contacts	B	A	D	C	SC
INPUT	Channel	0	-	9	
0	49	50	47	48	I
1	33	32	17	16	I
2	31	30	15	14	I
3	29	28	13	12	I
4	27	26	11	10	I
5	25	24	9	8	I
6	23	22	7	6	I
7	21	20	5	4	I
8	19	18	3	2	I
9	34	35	36	37	I
INPUT	Channel	10	-	19	
10	49	50	47	48	II
11	33	32	17	16	II
12	31	30	15	14	II
13	29	28	13	12	II
14	27	26	11	10	II
15	25	24	9	8	II
16	23	22	7	6	II
17	21	20	5	4	II
18	19	18	3	2	II
19	34	35	36	37	II
OUTPUT	Channel	0	-	19	
	41	40	39	38	I,II

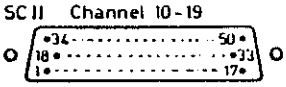
Front Panel



Rear Panel

SC I Channel 0 - 9

SC II Channel 10 - 19



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4.3. Operating Modes

4.3.1. Single Scan

Only one channel at a time is connected through in the "Single Scan" operating mode. The sequence of the selected channels can be arbitrary. The last selected channel is always disconnected again before the next channel is connected through. This is to prevent transient short circuits between two channels.

4.3.2. Multi Scan

In the "Multi Scan" operating mode, any number of channels can be switched onto the bus system and disconnected therefrom again, in any desired sequence and combination. All 20 channels can be mutually interconnected in this manner simultaneously.

4.3.3. Automatic Single Scan

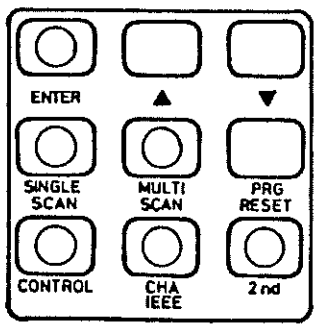
In this operating mode, up to 20 measuring points can be interrogated automatically in cyclic sequence. The time between two interrogation cycles, the time for switchover from one channel to the next and the time between completed switchover and output of a trigger pulse for a connected multimeter, can be chosen and set over a wide range.

4.4. Manual Control

All operating modes and all functions of the scanner can be set via the keyboard. A display field indicates the operating states, the currently switched-in channels and the set delay times. The IEEE interface permits remote control and interrogation of all settings and device data. Via the keyboard it is possible to switch-on the scanner operating modes SINGLE SCAN and MULTI SCAN, to open and close measuring channels, to connect and disconnect the front panel sockets, to enter and execute a program for automatic measuring points switching, to set timers and to enter the IEEE device address and terminator.

The keyboard can also be be interrogated by a computer via the IEEE bus and alphanumeric characters can be written from the computer directly to the display.

Description of the keyboard:



The keyboard consists of nine keys. Two functions are assigned to two of these keys, PRG/Reset and CHA/IEEE. The second functions (blue legend) are selected by sequentially pressing the "2nd" key followed by the key IEEE or RESET. Light emitting diodes in six of the keys indicate the status of the scanner.

5. SINGLE SCAN

In the SINGLE SCAN operating mode the scanner functions as 1 from 20 channels multiplexer. Only one of the 20 selectable channels (00-19) at a time is connected through and switched onto the bus lines a, b, c, d (see Fig.4.2). The measuring channels are connected via the 50-pole subminiature type D sockets on the rear panel of the instrument. The measuring unit can be connected to the scanner via the switched front panel sockets A, B, C, D, or directly to the bus lines via the 50-pole subminiature type D sockets. The scanner indicates the connected-through channel in the format "CH.xxc". "xx" is the number of the connected-through channel and the status indication "c" (closed) implies that the channel is connected. When none of the channels is connected-through, the display reads "CH.—".

5.1. Operating Instructions for SINGLE SCAN

The Single Scan operating mode of the scanner is selected by pressing the SINGLE SCAN key. On switching over from "Multi Scan" operating mode to "Single Scan", all channel settings are cancelled and all channels are opened. The active state of the "Single Scan" operating mode is indicated by the light emitting diode in the key.

5.2. Channel Selection in SINGLE SCAN Operating Mode

Scanner channels can be switched on or off with the CHA key. On pressing the key CHA, the digits and CH.— start to flash in the display and the light emitting diode in the key comes on. In Single Scan mode the status indication "o" or "c" after CH.xx disappears. The flashing digits indicate that a new channel number can be set. The channel setting is made with the UP, DOWN and ENTER keys. A single actuation of the UP key makes the channel number display count up cyclically from 00 to 19 starting at the last displayed number. A single actuation of the DOWN key makes the channel number display count down from 10 to 00. The cyclic counting of the channel numbers can be stopped and also started again by pressing one of the keys UP or DOWN. Pressing the ENTER key terminates the setting procedure in Single Scan mode, opens a previously closed channel and closes the newly selected channel. The number of the closed channel appears on the display with the format CH.xxc with status indication "c". The light emitting diode in the CHA key goes out.

5.3. Connecting and Disconnecting the Front Panel Sockets

The input sockets of the scanner can be connected or disconnected with the CONTROL key. The light emitting diode in the CONTROL key is lit when the input sockets are connected.

5.4. Cancelling the Channel Settings

All channel settings are cancelled by pressing the keys "2nd" and "Reset". CH.— appears in the display; all channels are switched off. The set operating mode Single Scan or Multi Scan is retained.
The display of the scanner shows the last switched on or changed channel in the format CH.XXc.
When all channels are switched off, the display reads CH.— .

6. MULTI SCAN

In the MULTI SCAN operating mode the scanner functions as n from 20 channels multiplexer, i.e. any desired number of the 20 channels (00–19) can be switched simultaneously onto the four pole bus a, b, c, d (see Fig.4.2). The channels are connected via the 50-pole subminiature type D sockets on the rear panel of the case. A further instrument can be connected directly to the bus lines at one of the 50-pole sockets, or via the switched front panel sockets A, B, C, D. The scanner always shows the last set channel in the format "CH.xxo" or "CH.xxc" .

"xx" is the number of this channel and "o" (open) or "c" (closed) is the status indication.

6.1. Operating Instructions for MULTI SCAN

The Multi Scan operating mode of the scanner is selected by pressing the MULTI SCAN key. On switching over from "Single Scan" operating mode to "Multi Scan", the channel setting is cancelled and all channels are opened. The active state of the "Multi Scan" operating mode is indicated by the light emitting diode in the key.

6.2. Channel Selection in MULTI SCAN Operating Mode

Scanner channels can be switched on or off with the CHA key. On pressing the CHA key, the digits after CH.— start to flash in the display and the light emitting diode in the key comes on. The flashing digits indicate that a new channel number can be set. The setting is made with the keys UP, DOWN and ENTER. On pressing the UP key once, the channel number display starts to count up cyclically from 00 to 19, starting at the last indicated number. A single press of the DOWN key starts cyclic count down of the channel number display from 19 to 00. The cyclic counting of the channel numbers can be stopped and also started again at any desired number by pressing one of the keys UP or DOWN. In Multi Scan operating mode, pressing the ENTER key changes the status of the last indicated channel. Closed channels (indicated by CH.xxc) are opened; opened channels (indicated by CH.xxo) are closed. To terminate the setting procedure, press the CHA key again. All channels now take over the new set states. The light emitting diode in the CHA key goes out and the last indicated channel remains in the display.

6.3. Connecting and Disconnecting the Front Panel Sockets

The input sockets of the scanner can be connected or disconnected by pressing the CONTROL key. The light emitting diode in the CONTROL key is lit when the input sockets are connected.

6.4. Cancelling the Channel Settings

All channel settings are cancelled by pressing the "2nd" key and then the "RESET" key. CH.— appears in the display and all channels are switched off. The set operating mode Single Scan or Multi Scan is retained.

The last set or changed channel always stands in the display in the format CH.xxo or CH.xxc .

7. AUTOMATIC SINGLE SCAN

7.1. Operating Instructions for Automatic Single Scan

In the SINGLE SCAN operating mode, the Scanner 2024 can automatically switch a preselected group of channels in a preselected time schedule for the sequence.
This operating mode with preselected channels and sequence times is called Automatic Single Scan.
In Automatic Single Scan, in each cycle switchover to each of the preselected channels takes place according to the timing parameters:

1. Scan cycle time
2. Channel switch-on duration
3. Trigger delay time
4. Switch-over duration

The switch-over duration is constant and has a value of 20 msec for each channel changeover.
The channels are switched over in ascending order from 00 - 19. Unselected channels are skipped in this sequence.
The timer for the scan cycle time is started on switch-on of the first preselected channel. The timers for channel switch-on duration and trigger delay time are started on switch-on of each channel.
After elapse of the trigger delay time, a trigger signal is output at the trigger socket on the rear panel or a SRQ is sent on the IEEE bus.
After elapse of the channel switch-on duration, the presently closed channel is opened, the next channel is closed (switch-over duration 20 msec.) and the timers for channel switch-on duration and trigger delay time are restarted.
After all channels have been switched-on once, expiry of the scan cycle time is awaited and then the next cycle is started.
The trigger delay time must be less than or equal to the channel switch-on duration for proper functioning, and the total of all channel switch-on durations must be smaller than the scan cycle time. If the scan cycle time is chosen too short, then the cycle restarts prematurely with the lowest number channel after expiry of the scan cycle time.
Setting of the timers for scan cycle time, channel switch-on duration and trigger delay time and activation of the Automatic Single Scan are made via the keyboard by using the programs P1 - P5.

PRG

Four setting programs P1 - P4 and the program for automatic measuring points switching P5 can be selected via the PRG key.
On pressing the PRG key, "P" appears in the display and a number from 1 to 5 in the right window. The display remains for about 1 sec; if no key is pressed during this time, then the last indicated program is executed. Another program number can be set by pressing the PRG key during the wait time. The program number counts cyclically 1 - 5 on repeatedly pressing the PRG key. When no further keypresses are made, the last indicated program is executed. The program number remains in the right window.
The timers are set with P1, P2 and P3. Channel preselection is made with P4 and the Automatic Single Scan is started and stopped with P5.

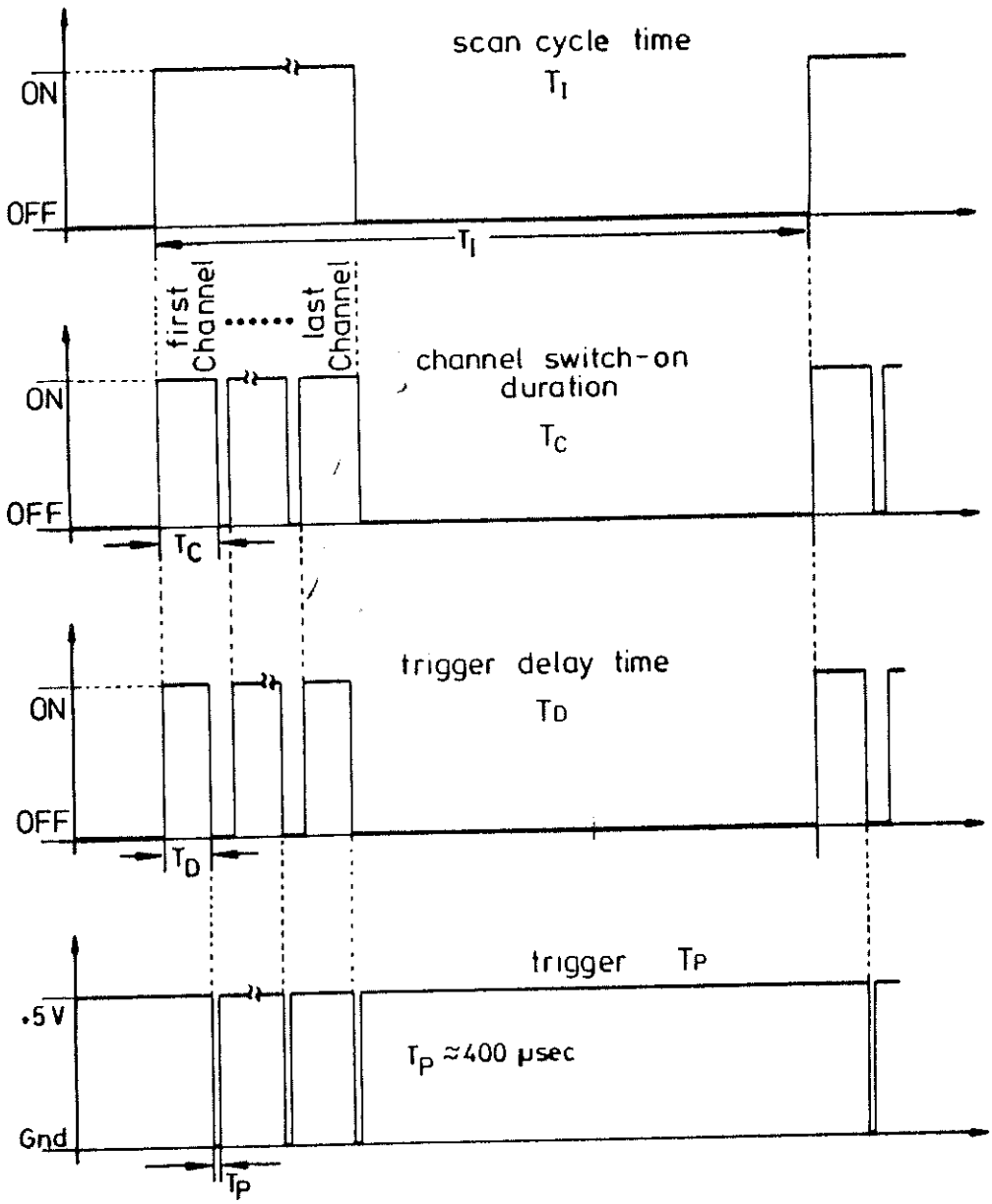


Abb. 7.1 Timing pulse waveforms for the adjustable timers

				Maßstab	
				SCANNER 2024	
		1984	Datum	Name	Timing pulse waveforms for the adjustable timers
		Bearb	06.12		
		Gepr			
		Norm			
Zust	Änderung	Datum	Name	84 49 152	Blatt Bl

7.2. Setting the Timers for AUTOMATIC SINGLE SCAN

P1 - P3

The operating procedure is the same for all three programs P1 - P3; they are used respectively to set the scan cycle time (P1), the channel switch-on duration (P2) and the trigger delay time (P3). The display shows for

P1: XXXX' 1 (min)
P2: XXX.X" 2 (sec)
P3: XXX.X" 3 (sec) .

The front digit flashes indicating that this digit can be changed. The keys UP, DOWN and ENTER are used to make changes. On pressing the UP key, the flashing digit counts cyclically starting at the initially indicated value, until it is stopped again by pressing either the UP or the DOWN key.
If the digit is stopped with the DOWN key, then the flashing digit jumps cyclically one position to the right. In response to each press of the DOWN key, the adjustable digit of the display moves one position to the right. When the value has been set correctly, it can be taken over by pressing the ENTER key. Pressing any other key terminates the program.
The numerical setting range is 0000 to 9999 for all three times. If a value of 0000 is entered for the channel switch-on duration (P2), then the scanner automatically replaces this entry with a minimum time of 100 ms. Entry 0000 for the trigger delay time (P3) means that the trigger signal will not be delayed. Entry 0000 for the scan cycle time (P1) means continuous operation.

7.3 Channel Preselection for AUTOMATIC SINGLE SCAN

The setting program P4 is used to preselect the channels for AUTOMATIC SINGLE SCAN.

P4

To select P4, press the PRG key. Each press of PRG increases the program number Px in the display by one. Press PRG as many times as necessary until P4 is standing in the display and then wait for about 1 second. Then CH.00o 4 or CH.00c 4 appears in the display; the program number 4 remains in the right window.
The digits "00" after "CH." flash and are ready for changing. Counting through the scanner channels 00-19 is started by pressing the UP or DOWN key. UP starts cyclic count up from 00-19 and DOWN starts cyclic count down from 19-00.
The cyclic counting is stopped by pressing UP or DOWN again. To select or deselect the currently displayed channel, press ENTER. A "c" after the channel number, e.g. "CH.03c", means that the currently displayed channel is selected ("c" = closed); an "o" means that the currently displayed channel is not selected ("o" = open).
Any desired number of channels can be preselected in any order.
Pressing any other key instead of UP, DOWN or ENTER terminates the channel preselection procedure and takes over the set data into the channel memory.
"CH.—" appears in the display.

7.4. Automatic Channel Switching
Starting and Stopping the AUTOMATIC SINGLE SCAN

P5

The Automatic Single Scan is set with P5.
In the display appears:

CH.00o 5 or CH.00c 5

The automatic mode is selected and ready for operation. The instrument goes into SINGLE SCAN operating mode and the SINGLE SCAN key lights. Press the ENTER key to start the program. Always the last switched channel appears in the display, and the letter "r" for "RUN" appears in the right display window. The program runs according to the times which have been set with P1-P3 and with the channels which have been preselected in P4. If no channel has been set in P4, then the display shows:

CH.00o r .

The program can be stopped at any time by pressing the ENTER key again. An "h" for "HALT" then appears instead of the "r" in the right display window. To continue the cycle, press the ENTER key. Pressing any other key instead of the UP, DOWN or ENTER key terminates the program. All channels are then switched off and the display shows:

CH.— .

If the input sockets of the scanner are to be connected-through during the automatic operation, then they must be switched on by pressing the CONTROL key already before calling P5.

7.5. Automatic Single Scan with Trigger Output

When the scanner is operated without computer connection in Automatic Single Scan, then a trigger pulse can be taken off at the trigger socket on the rear panel of the scanner for triggering peripheral units (e.g. a Multimeter 5000). For operation with trigger output, the IEEE status of the scanner must be set to "AUTO". Setting device addresses suppresses output of trigger pulses at the trigger output (SRQ is issued instead). A trigger pulse appears at the trigger output in Automatic Single Scan each time the trigger delay time has expired after switchover to the next channel.

The trigger output pulse is a TTL signal. The resting state is logic level HIGH (+5 V). For the trigger pulse, the logic state goes briefly to LOW (0.5 msec) and then back to HIGH.

When a triggerable Multimeter PREMA 5000 (in operating mode "TALK ONLY) is connected to the trigger output and a printer ("LISTEN ONLY") is connected to the multimeter, then a self-sufficient measurement acquisition system for up to 20 channels can be set up with the Scanner 2024.

8. IEEE Bus Interface

8.1. Operating the Scanner on the IEEE Bus

All functions of the scanner can be accessed via the keyboard as well as via the IEEE interface, with the exception of setting the device address and the terminator which are possible only via the keyboard.
As soon as the unit has received and executed the first command via the IEEE interface, the keyboard is disabled for manual control of the scanner. Manual control via the keyboard is possible again thereafter only when the computer enables it (command "GTL" = GO TO LOCAL) or when the "REN" line (REMOTE ENABLE) goes inactive and thus cancels the remote control status of the unit. The indicator "REMOTE" is lit in the right display window during remote control status.
The scanner accepts up to 30 characters in a command. All characters must be ASCII characters (ISO 7-bit code). Several commands can be concatenated as a string of characters, but some commands must be sent alone.
Output of the commands via the IEEE interface is according to the outputs from the particular computer which is being used. Please consult the manual provided by the computer manufacturer or the handbook for the IEEE bus interface (IEC bus) which you are using.
Any blank characters (SPACE, ASCII code 20H) containes in the string received by the scanner are ignored. If the received character string contains more than 30 characters, then the error message "ERROR 6" is issued. This is also the case when the terminator has been set incorrectly so that the end of the character string can not be recognized.
The scanner can receive commands (operation as listener) and it can transmit device status messages (operation as talker).
The time instant at which the scanner transmits device messages can be defined by the computer. One possibility is to let the computer address the scanner as talker and read the device message. The second possibility is to let the scanner operate in SRQ (SERVICE REQUEST) mode. The scanner then requests service by the computer when a status change has taken place. The scanner can be switched over to SRQ mode by command. The basic status after switch-on is operation without SRQ.
The Scanner 2024 understands the universal commands DCL (Device Clear), SPD (Serial Poll Disable) and SPE (Serial Poll Enable). The command DCL restores the scanner to its basic status (all channels switched off, operating mode Single Scan). Of the addressed commands, the scanner understands GTL (Go To Local) and SDC (Selected Device Clear).

8.1.1. Capabilities of the IEEE 488 Bus Interface

The IEEE computer interface of the scanner has the following capabilities as defined in the IEEE 488 Standard:

SH1	Handshake source function
AH1	Handshake sink function
T6	Talker function
L3	Listener function
RL1	Remote control
DC1	Reset function
DT1	Initiate function
SR1	Service request function

8.1.2. Setting the Scanner for Operation on the IEEE Bus

In order to operate the scanner on a computer with IEEE bus interface, some further conditions must be fulfilled in addition to connecting up the provided interface with the correct cable. The following settings must be made so that the computer and the scanner can communicate:
A device address must be assigned to the scanner under which it can be accessed by the computer. The address numbers 00-30 are allowed for this purpose in the IEEE 488 Standard. For proper functioning of data exchange between the two units, it must be agreed which character(s) will terminate a data transmission from both units. This terminator differs for different makes of computer, so that terminator agreements must be set on the scanner for compatibility. Please consult the manual for your computer or for the IEEE interface of your computer to determine the terminator which your computer uses.

The Scanner allows 9 terminator settings as tabulated below. Set the scanner to the terminator stated in the computer manual, by selecting the corresponding designation number.

Designation Number	Terminator	Typical Computer
0	CR + EOI line	Apple
1	CR	
2	LF + EOI line	
3	LF	
4	CR + LF + EOI line	
5	CR + LF	HP
6	LF + CR + EOI line	
7	LF + CR	
8	EOI line	Commodore

8.1.3. Setting the Device Address and the Terminator

The device address and the terminator of the scanner for operation on the IEEE bus must be set via the 9-key keyboard.
Suppose you wish to operate the unit on an Apple computer with CCS interface. Then the terminator CR + EOI line must be selected. The terminator CR + EOI line has the designation number 0 in the table. The device address is to be 17, for example.
Press the "2nd" key and then IEEE (blue legend). The display now shows, for example, "IEEE.07 8", which means that the unit is set to device address 7 and the terminator is at present No.8 (only EOI line). The "07" flashes in the display, showing that the device address can be changed. For the example taken above, the setting must be changed to "IEEE.17 0".
Now press the UP key. The device address starts to count cyclically from 00 to 30, starting at the last set number. Stop the counting as soon as "17" is reached, by pressing the UP or DOWN key. On stopping with DOWN, the display automatically moves to the state for changing the terminator and the last set terminator is now flashing. Here too, start the cyclic count up (0-8) by pressing the UP kay and stop when "0" is reached by pressing the UP or DOWN key. The display now shows "IEEE.17 0". Press the ENTER key to store this setting.
When counting up, the "Auto" function appears as further possible setting between the transition from 30 to 00. With the setting "Auto", in automatic mode a trigger pulse is output at the trigger socket on the rear of the scanner, for triggerable peripherals (see AUTOMATIC SINGLE SCAN).

8.2. Operating the Scanner as Listener

The scanner must be addressed as listener in order to prepare it for command reception. Please consult the manual provided by the computer manufacturer for instructions on how to do this. When the scanner has been addressed as listener, the right window of the display shows the message "LISTEN".

The scanner understands the following commands:

8.2.1. Description of the Commands Accepted by the Scanner

SS	Switch-on SINGLE SCAN operating mode
MS	Switch-on MULTI SCAN operating mode
RT	RESET, switch-off all channels

In the SINGLE SCAN operating mode:

CHxy	Switch-on channel xy (00-19)
CH—	Switch-off all channels

In the MULTI SCAN operating mode:

CHxx.....yy.....zz ON	Switch-on channels xx to zz (00-19)	1)
CHxx.....yy.....zz OF	Switch-off channels xx to zz (00-19)	1)

For AUTOMATIC SINGLE SCAN operating mode:

CAxx.....yy.....zz ON	Preselection for channels xx to zz (switch-on)	1)
CAxx.....yy.....zz OF	Preselection for channels xx to zz (switch-off)	1)

TDxxxx	Set trigger delay time (* 100 msec)	2)
TCxxxx	Set channel switch-on duration (* 100 msec)	2)
TIxxxx	Set scan cycle time (* 1 min)	2)

C0	Connect front panel sockets of the scanner	
C1	Disconnect front panel sockets of the scanner	
D0	Switch-off display mode	3)
D1	Switch-on display mode	3)
L0	Activate short string output	3)
L1	Activate long string output	3)
Q0	Switch-off SRQ mode	3)
Q1	Switch-on SRQ mode	3)

AU	Select automatic measuring points switching
ST	Start automatic measuring points switching
SP	Stop automatic measuring points switching

1) Only a switch-on or a switch-off command can be contained in one character string
2) These commands must be sent alone
3) See remarks on next page

When operating the scanner on the IEEE bus, three functions can be set only via the IEEE interface.
This is done using the commands Q0, Q1, D0, D1, L0 and L1.

Description of the functions:	Display mode	D0, D1
	String length selection	L0, L1
	SRQ mode (Service Request)	Q0, Q1

8.2.2. Display Mode

In display mode, the computer can output texts to the display of the scanner, irrespective of the other functions of the instrument. The display mode is switched on with the command "D1". The ASCII characters following this command appear as text in the display. All ASCII characters for which a segment code has been defined in the ASCII segment table (Fig.8.1.) can be displayed. All other characters blank the display. All surplus characters which may be present after "D1" and the output text are ignored. If "D1 text" is used together with other commands in the same string, then "D1 text" must be the last command in the string. The command "D0" switches the text display off again and the function display for the currently valid operating status reappears.

The characters and character combinations must be interpreted according to the following table:

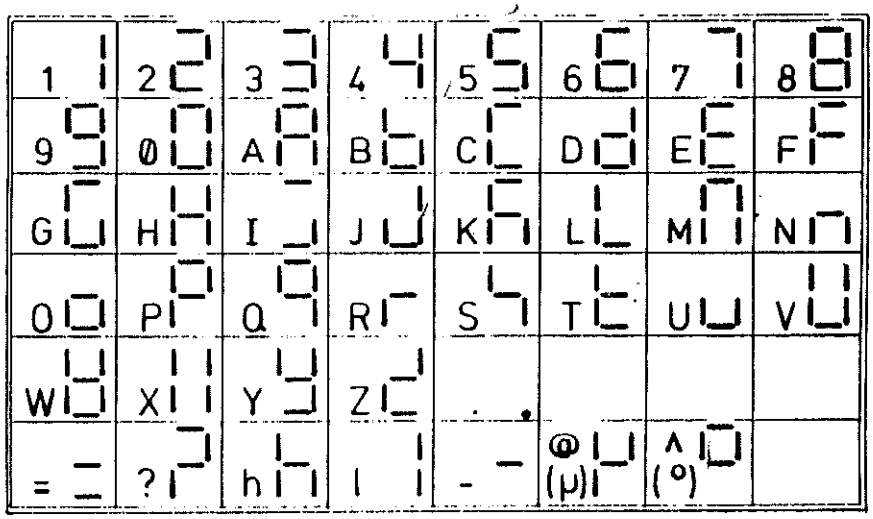


Fig.8.1.
Display code table ASCII SEGMENT CODE

8.2.3. String Length Selection

The scanner can send different length messages to the computer, whereby the computer selects the desired message length with the commands "L0" or "L1". When the computer issues the command "L0", then in Single Scan mode only the last switched channel and in Multi Scan mode a list of all last switched channels is output. The status information is not output in response to "L0". After "L1", the scanner outputs the data of the switched channels including the status information. In Multi Scan operation and with automatic channel preselection, the information output by the scanner consists of three individual strings. The first string contains the channels 0 to 9, the second string contains the channels 10 to 19 and the third string contains the status information. When short string output has been selected with "L0", two strings must be read successively (0-9, 10-19) (see TALKER).

8.2.4. SRQ (Service Request) Mode

If it is desired that the scanner shall not be interrogated (polled) continuously by the computer, but shall request service from the computer when a status change has taken place, then select SRQ (Service Request) mode with the command "Q1". A SRQ is sent out, for example, when a key has been pressed on the keyboard, when error messages appear, when the trigger delay time of a channel has expired or when a reset has been initiated. The use of SRQ mode requires that the connected computer can recognize a SRQ and can reply thereto with Serial Poll (see computer manual). SRQ mode is deselected again with "Q0". The basic status of the scanner is operation without SRQ.

8.3. Operating the Scanner as Talker

On request by the computer, the scanner sends a message stating its present status and the last switched or set channels. For this purpose, the computer must address the scanner as talker. For the instructions how to do this, please consult the manual provided by the computer manufacturer. When the scanner has been addressed as talker, the message "TALK" appears in the right window of the display.

The information sent by the scanner consists of a single string of characters (Single Scan) or several strings of characters (Multi Scan, Channel Preselection) and an agreed terminator at the end of each string of characters. The computer recognizes this terminator as the end of transmission. The message consists of two message units. The first unit contains information concerning the preselected and switched on or switched off channels. The second unit contains information on the programmed status of the scanner. Both messages are transmitted as complete message set. If transmission of the message set is discontinued before the terminator is sent (before status TIDS = Talker Idle State is reached), then the transmission is recommenced with the 1st character of the message set on the next call-up. The terminator is the one set with the IEEE setting program. ASCII code is used for the message transmission (ISO 7-bit code).

The length of the second message unit is fixed and always comprises 31 characters plus the terminator. The length of the first message unit varies according to the selected operating mode. It may have two different values.

The length of the first message unit is 4 characters in the SINGLE SCAN operating mode. The length of the first message unit is 2 x 31 characters in the operating modes MULTI SCAN and "Channel Preselection for Automatic Operating Mode". Each string of 31 characters is concluded with the terminator. Three readouts are necessary in this operating mode in order to read the complete message set. The first character string contains the data for the channels 0-9, the second character string contains the data for the channels 10-19 and the third character string contains the status infromation (2nd message unit).

When the output is requested as short string (command "L0"), then only the first message unit is transmitted. The status information (2nd message unit) is not transmitted in this case.

8.3.1. Description of the Transmitted Message Set

The following table gives an overview of the possible lengths of the message set depending on the chosen operating mode.
A character string consists of n characters (C) + Terminator (see Section 8.1.2.).

Operating Mode	1st Message Unit Part I Channels 0-9	1st Message Unit Part II Channels 10-19	2nd Message Unit	Number of required read operations
SINGLE SCAN				
a) Normal string	4 C	—	+31 C + Term.	1
b) Short string	4 C + Term.	—	—	1
MULTI SCAN				
c) Normal string	31 C + Term.	+31 C + Term.	+31 C + Term.	3
d) Short string	31 C + Term.	+31 C + Term.	—	2
Channel Preselection				
e) Normal string	31 C + Term.	+31 C + Term.	+31 C + Term.	3
f) Short string	31 C + Term.	+31 C + Term.	—	2
	/------ Short String "LO" -----/			
	/---------- Normal String "LI" ----------/			
g) Error messages and test messages in all operating modes	8 C + Term.	—	—	1

Examples for the above table:

a) CH01 SSTC000.0TD00.00TI0000Q0D0C0B0A + Terminator — 1 x read

b) CH00 + Terminator — 1 x read

c) CH ;01; ;03; ; ;06;07; ;09 + Terminator
CH ; ; ; ; ; ;16; ; ;19 + Terminator
MSTC000.1TD000.1TI0002Q0D0C0B0* + Terminator — 3 x read

d) CH ;01; ; ; ; ; ;07; ;09 + Terminator
CH ; ; ; ; ; ; ; ; ;19 + Terminator — 2 x read

e) CA ;01;02; ; ; ;06; ; ;09 + Terminator
CA ; ; ; ; ; ; ; ; ;19 + Terminator
SSTC000.3TD000.5TI0001Q0D0C0B0A + Terminator — 3 x read

f) CA ;01; ; ; ; ; ; ; ;09 + Terminator
CA ; ; ; ; ; ; ; ; ;19 + Terminator — 2 x read

g) ERROR 01 + Terminator — 1 x read

CONTR. 1 + Terminator

8.3.2. Description of the Characters Transmitted by the Scanner

The characters transmitted by the scanner have the following meanings, depending on the selected operating mode Single Scan or Multi Scan:

Operating Mode Single Scan:

The read-out string has the following form, for example:
CH01 SSTC 000.9TD000.4TI0002Q0D0C0B0* + Terminator

This string contains the number of the last switched-on channel ("CH01") and the status information. Possible values are "CH00" to "CH19". "CH--" means that all channels are switched off.

Operating Mode Multi Scan and Channel Preselection:

The read-out strings have the following form, for example:
CH00;01;02; ; ;05; ; ; ; + Terminator
CH10; ; ; ; ;15; ; ; ;19 + Terminator
MSTC000.9TD000.4TI0002Q0D0C0B0* + Terminator

These strings contain the numbers of all last switched or preselected channels, each separated by the delimiter ";". Each channel has a particular position in the string, which either contains the channel number (when the channel is switched on or preselected) or two space characters (ASCII 20H)(when the channel is switched off or not preselected).

In the above strings the channels 0,1,2,5,10,15 and 19 are switched on and all other channels are switched off.

Status Information:

The following characters are output as status information, to designate the device status or setting:

SSTC000.0TD000.0TI0000Q0D0C0B0* + Terminator
MS 000.1 000.1 0001 1 1 1 1A

9999 9999 9999 9

1st character 29th character
of the status information

8.3.3. Interrogation of the Keyboard via the IEEE Bus

When a key is pressed on the keyboard whilst the Scanner 2024 is in remote control status, the corresponding function is not executed but a code designating the last pressed key is output in the status information. This information can be used to make the scanner function as commanding unit in remotely controlled test systems. The keypresses can be interpreted in any desired manner by the operating program. For example, the keys can be programmed for yes/no replies in interrogation dialog procedures, for selecting menu numbers or to start test sequences.

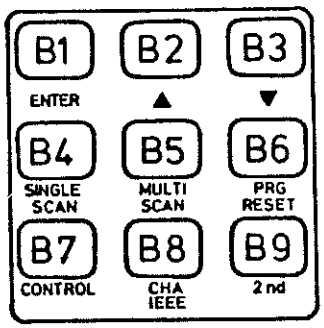


Fig.8.2.

The nine keys have the codes shown in Fig.8.2; each code starts with the letter "B". After each keypress, the IEEE output buffer is updated with the corresponding key code. The key code is set to B0 when this information has been read. This must be borne in mind for cyclic interrogation (polling). The scanner outputs B0 until a key is pressed. As soon as a key is pressed, the scanner outputs the corresponding code once. Once this code has been read, the scanner outputs B0 again until the next keypress. When the SRQ function is switched on, every keypress produces a SRQ (Service Request).

8.3.4. Table of Device Messages Transmitted by the Scanner (IEC 625 Part 2)

Character position (first, last character)					
(1,2)	SS	Operating mode SINGLE SCAN			
	MS	Operating mode MULTI SCAN			
(3,9)	TC xxxx	Channel switch-on duration TC000 corresponds to 100 msec			xxxx * 100 msec,
(10,16)	TD xxxx	Trigger delay time TD000 corresponds to undelayed			xxxx * 100 msec,
(17,22)	TI xxxx	Scan cycle time TI000 corresponds to continuous			xxxx * 1 min,
(23,24)	Q0	SRQ mode	0 (zero)	=	without SRQ
	Q1		1	=	with SRQ
(25,26)	D0	Display mode	0 (zero)	=	no display mode
	D1		1	=	display mode switched on
(27,28)	C0	Input sockets	0 (zero)	=	switched off
	C1		1	=	switched on
(29,30)	B0	Key code	0 (zero)	=	no key has been pressed
	Bx		1 - 9	=	key code 1-9 (nine keys)
(31)	A	Automatic mode selected (Auto Single Scan or Channel Preselect)			
	*	No automatic operation			
Character position (first, last character) within the channel information					
(1,2)	"CH"	designates switched channels			
	"CA"	designates preselected channels			
	"00"-"19"	specify the switched-on channels			
	" "	blank characters; the channel is switched off			
	";"	delimiter between channel numbers			

8.4. Service Request Interface Function (SRQ)

The IEEE interface of the Scanner 2024 is equipped to handle the service request function (SRQ). The following table specifies the meanings of the individual status bits which are thereby transmitted:

Bit 0	Trigger delay time has expired
Bit 1	A key has been pressed
Bit 2	not used
Bit 3	not used
Bit 4	Error message
Bit 5	Reset
Bit 6	SRQ
Bit 7	not used

Bit 6 is set after a reset, i.e. on power-up or in the case of a severe external disturbance. A reset takes the Scanner 2024 to its basic state, so that the scanner must thereafter be reprogrammed by the controlling computer.

8.5. Examples of Programs for the IEEE Bus Interface

Before the Scanner 2024 can be operated via the IEEE bus interface, the device address and the terminator must be set by the procedure described at the beginning of this chapter. In the following examples for Commodore and Tektronix computer, device address "7" has been chosen and number 8 (only EOI) is recommended as terminator.

COMMODORE CBM 3032

```
10    REM*****  DATA TRANSFER CBM 3032 -- PREMA S2024
20    REM       Set IEEE Data: 07.8
30    X=1:REM Flag for long string
40    PRINT "ENTER"
50    INPUT A$
60    IF A$="L1" THEN GOTO 100
70    IF A$<>"LO" THEN GOTO 110
80    X=0
90    GOTO 110
100   X=1
110   OPEN1,7:PRINT#1,A$:CLOSE1
120   FOR I= 1TO100
130   NEXTI
140   OPEN1,7:INPUT#1,Z$:CLOSE1
150   PRINTZ$
160   L=LEN(Z$)
170   IF L > 33 THEN GOTO 240
180   IF L < 10 THEN GOTO 240
190   OPEN1,7:INPUT#1,Z$:CLOSE1
200   PRINTZ$
210   IF X=0 THEN GOTO 240
220   OPEN1,7:INPUT#1,Z$:CLOSE 1
230   PRINT Z$
240   GOTO 40
250   END
```

TEKTRONIX 4051

```
1       REM **DATA TRANSFER TEKTRONIX 4051 -- PREMA S2024**
2       REM **SET DATA  IEEE.07.8**
3       GO TO 100
4       GOSUB 600
5       RETURN
99      REM.....................................................
100     INIT
110     SET KEY
120     ON SRQ GO TO 300
130     D=0
140     X=0
150     Y=1
155     A$="0"
160     REM **WAIT LOOP FOR SRQ**
170     IF X=0 THEN 170
180     PRINT S$
190     PRINT@7:S$
200     X=0
210     FOR I=1 TO 100
220     NEXT I
230     GOSUB 400
240     GO TO 160
250     REM.....................................................
300     REM **SERIAL POLL**
310     POLL M,P;7
320     GO TO M OF 350
330     RETURN
350     IF P<64 THEN 388
355     PRINT P
360     GOSUB 400
370     P=0
380     RETURN
390     REM.....................................................
400     REM **READ-OUT SCANNER**
410     INPUT@7:A$
420     PRINT A$
430     L=LEN(A$)
440     IF L>33 THEN 510
450     IF L<10 THEN 510
460     INPUT@7:A$
470     PRINT A$
480     IF Y=0 THEN 510
490     INPUT  a7:A$
500     PRINT A$
510     RETURN
520     REM.....................................................
600     REM ** INPUT VIA KEYBOARD **
610     REM ENTER "L0" OR "L1" AS SINGLE COMMAND
620     PRINT "PARAMETER ?"
630     INPUT S$
640     IF S$<>"L1" THEN 670
650     Y=1
660     GO TO 690
670     IF S$<>"L0" THEN 690
680     Y=0
690     X=1
700     RETURN
```

HEWLETT PACKARD 9816 (Series 200)

```
10    !***** DATA TRANSFER HP 9816  —  PREMA S2024
20    !
30    COM /S2024/ @Muxno,Setup$[30],Display$[40],P,X,Y
40    !
50    !Addresss assignment —>  7  =  @Muxno  IEEE.07.5 (CR LF)
60    !
70    ASSIGN @Muxno TO 707
80    ON INTR 7,1 CALL Serialpoll
90    ON KEY 5 LABEL "INPUT" CALL Input
95    Y=1                    !LONG STRING
100   !
110   !ENABLE INTERRUPT
120   !
130   ENABLE INTR 7;2        !INTERRUPT BY SRQ
140   Main:        !
150                IF X=0 THEN Main
160                PRINT Setup$
170                OUTPUT @Muxno;Setup$
180                X=0
190                WAIT .2   !WAIT UNTIL STRING UPDATED
200                Call Channels
210                GOTO Main
220                END
230   !.....!.....
240   !.....
250   SUB Serialpoll
260   !
270   !CHECKS DEVICE FOR SRQ, READS IF NECESSARY
280   !AND RETURNS TO WAIT LOOP OF MAIN PROGRAM
290   !
300   COM /S2024/ @Muxno,Setup$[30],Display$[40],P,X,Y
310   !
320   P=SPOLL(@Muxno)
330   !
340   IF P>63 THEN CALL Channels
350   ENABLE INTR 7
360   SUBEND
370   !.....
380   !.....
390   SUB Channels
400   !
410   !READS IN THE ACTUAL CHANNELS FROM MULTIPLEXER
420   !
430   COM /S2024/ @Muxno,Setup$[30],Display$[40],P,X,Y,L
440   ENTER @Muxno; Display$
450   PRINT Display$,P
460   P=0
470   L=LEN(Display$)
480   IF L>33 THEN Channelend
490   IF L<10 THEN Channelend
500   ENTER @uxno; Display$
510   PRINT Display$
520   IF Y=0 THEN Channelend
530   ENTER @Muxno; Display$
540   PRINT Display$
550   Channelend:   !
560   SUBEND
570   !.....
```

```
580   !.....................................................
590   SUB Input
600   !
610   !MAKES POSSIBLE KEYBOARD INPUT
620   !
630   COM /S2024/ @Muxno,Setup$[30],Display$[40],P,X,Y
640   PRINT "PARAMETER ?"       !ENTER "L1" OR "LO" AS SINGLE COMMAND
650   INPUT Setup$
660   IF Setup$ = "L1" THEN
670           Y=1
680   ELSE
690           IF Setup$ = "LO" THEN
                      Y=0
710           ENDIF
720   ENDIF
730   X=1
740   SUBEND
```

APPLE II with CCS Interface Module 7490

```
1000   PRINT
1010   PRINT "SET SCANNER 2024 TO ADDRESS"
1020   PRINT "          IEEE.09 0"
1030   PRINT
1040   PRINT " THEN PRESS THE RETURN KEY"
1060   INPUT C$
1070   SL% = 1 : REM FLAG FOR STRING LENGTH
1080   PRINT : PRINT
1090   PRINT "YOUR ENTRY PLEASE"
1110   INPUT B$
1112   PRINT : PRINT
1120   IF B$ = "L0" THEN SL% = 0
1130   IF B$ = "L1" THEN SL% = 1
1140   IA$ = B$
1150   AD% = 9 : REM ADRESS NO.9
1160   GOSUB 1410 : REM OUTPUT
1170   FOR I = 1 TO 750 : NEXT I
1180   AD% = 9 : GOSUB 1290 : REM READ-IN
1190   PRINT IE$
1200   IF LEN(IE$)<10 OR LEN(IE$)>33 THEN 1270
1220   GOSUB 1290 : REM   READ-IN SECOND PART
1230   PRINT IE$
1240   IF SL% = 0 THEN 1270
1250   GOSUB 1290 : REM   READ-IN THIRD PART
1260   PRINT IE$
1270   PRINT
1280   GOTO 1090
1290   REM ***READ-IN IEC ***
1292   REM SLOT ACCESS COMMANDS MUST BE ROUTED VIA DOS
1294   REM OTHERWISE DOS WILL BECOME DISCONNECTED
1300   PRINT : PRINT CHR$(4);"PR#3"
1310   REM
1320   REM  ADDRESS AS TALKER
1330   PRINT "@";CHR$(64+AD%);":"
1340   INPUT IE$
1350   REM  SWITCH TO UNTALK
1360   PRINT "@";CHR$(95);":"
1370   PRINT : PRINT CHR$(4);"PR#0"
1380   PRINT : PRINT CHR$(4);"IN#0"
1390   RETURN
1400   REM *** IEC READ-IN ***
1410   REM *** IEC OUTPUT  ***
1420   PRINT : PRINT CHR$(4);"PR#3"
1430   REM  ADDRESS AS LISTENER
1440   PRINT "@";CHR$(32+AD%);":"
1450   PRINT ",";IA$;",";
1460   REM  SWITCH TO UNLISTEN
1470   PRINT "@";CHR$(63);":"
1480   PRINT : PRINT CHR$(4);"PR#0"
1490   PRINT : PRINT CHR$(4);"IN#0"
1500   RETURN
1510   REM *** IEC OUTPUT ***
```

9. Error Messages and Self Tests

9.1. Error Messages

When the scanner detects an error, it issues an error message with the following format in the display and on the IEEE bus:

"Error" and a code number.

The error messages have the following meanings:

Error 1 : Too high channel number selected via IEEE bus

Error 6 : Error in IEEE data transmission; the device has received more than 30 characters (buffer overflow)

Error 8 : Error in RAM data (Checksum)

Error 9 : Error in program ROMs (Checksum)

9.2. Self Test

After switching-on the power supply, the scanner executes a self test (power-up test) and reports the progress of the self test routines in the display with the messages

Contr. 1, Contr. 2 and Contr. 3 .

Any errors detected during a self test are reported with the corresponding error messages.

Contr. 1 Switches all multiplexer relays on and off once in sequence, in order to establish a safe initial state (all channels open).

Contr. 2 The RAM checksum test is carried out. If a checksum error occurs, the message "Error 8" is shown.

Contr. 3 The program PROM checksum test is carried out. If a checksum error occurs, the message "Error 9" is shown.

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

11.1. 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 5000 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) (operating mode "LISTEN ONLY") can be connected to the multimeter (operating mode "TALK ONLY").

The Scanner 2024 and the Digital Multimeter 5000 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 channels to the Scanner 2024 via the subminiature type D sockets on the rear panel. Only one function, i.e. voltage, current or resistance, can be measured automatically. The chosen 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 to make a measurement. On completion of the measurement, the multimeter outputs the result to the connected printer.

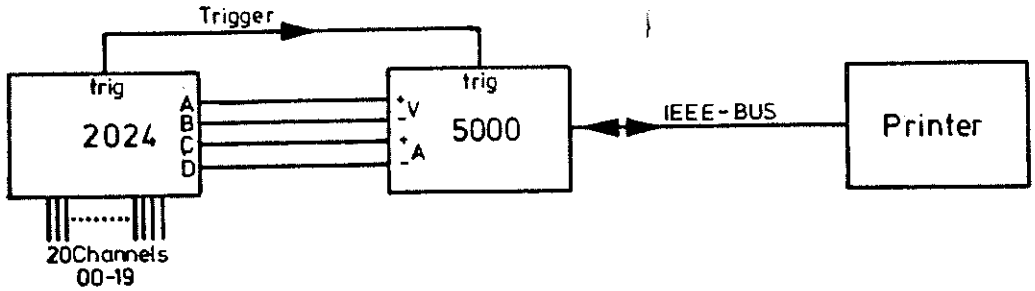


Fig. 11.1.

11.2. 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.

11.2.1. 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 5000, 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.

11.2.2. 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 through 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.

11.2.3. 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.

12. ACCESSORIES

12.1. Mating Plug for Sub-D (Option 6000/03)

For connecting the measuring lines to the scanner, a 50-pole subminiature type D plug can be used for each group of 10 channels. This plug connector has soldered connections and a cable outlet for round cables having up to 12 mm diameter. Two plugs are required for connecting all 20 channels.

12.2. Adapter Card (Option 6000/02)

One adapter card each can be plugged externally onto the two 50-pole subminiature type D sockets of the Scanner 2024, for connecting the measuring lines at screw terminals. The adapter card is also fitted with two antiparallel 3A clamp diodes for each current path, for using the scanner together with suitable multimeters (e.g. DMM 5000) to make current measurements (see circuit diagram of adapter card). These clamp diodes may be removed for other applications. Two adapter cards are required for connecting all 20 channels.

Maximum current	2.5 A
Maximum voltage	40 V

W A R N I N G

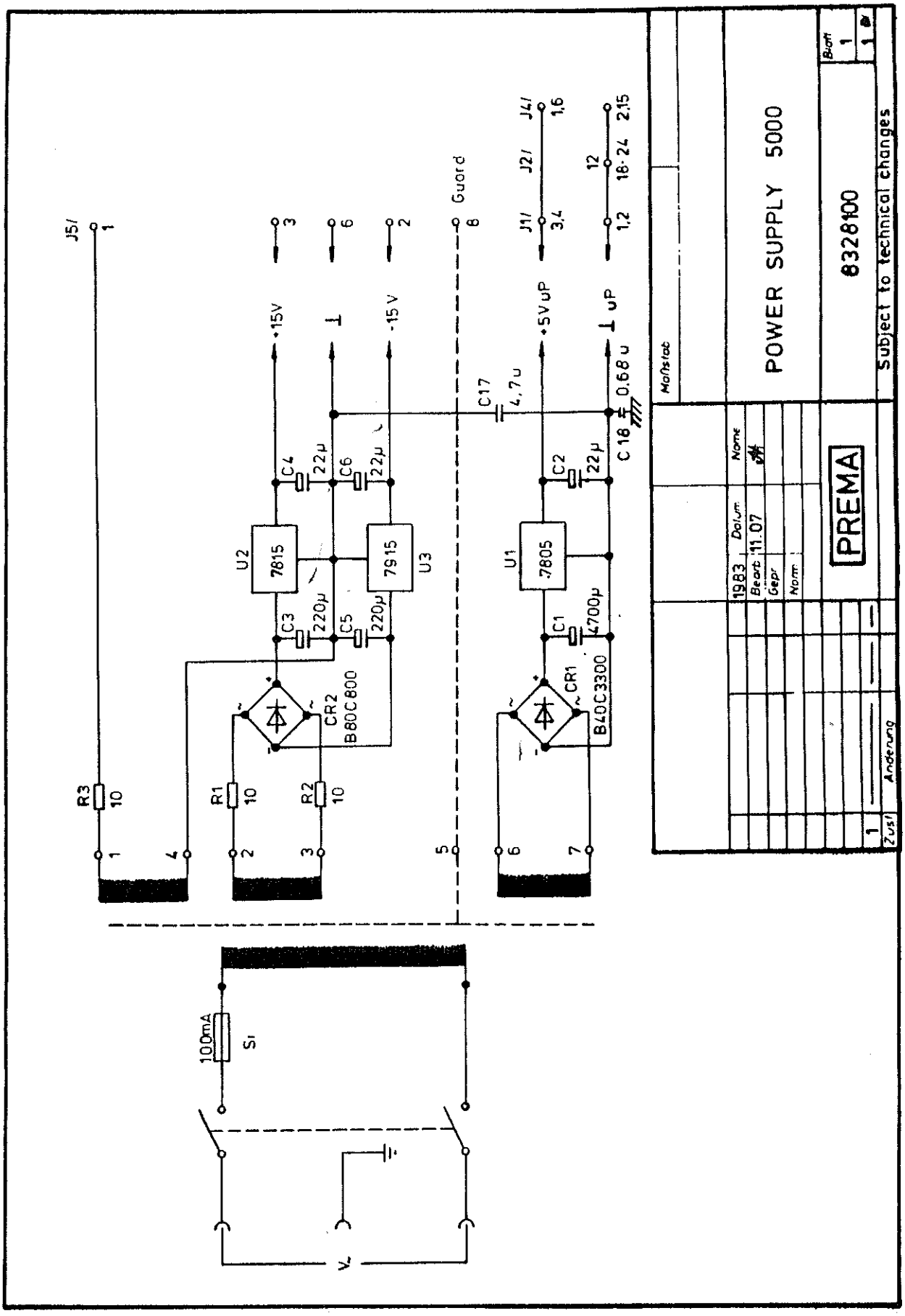
Safety considerations require that no voltages greater than 40 V with respect to ground may be connected, because the screw terminals are not protected against accidental human contact entailing danger of electric shock.

Dimensions	about 115 x 123 mm / 4.5 x 4.8 in

12.3 Rack Mounting Kit (Option 6000/04)

A complete kit is available for mounting a Scanner 2024 in a 19" equipment rack.

Height	2 HU


POWER SUPPLY 5000
8328100
PREMA
Subject to technical changes
Maßstab
Name
Datum
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1983
Bearb.
Gepr.
Norm
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J1/
J2/
J4/
Guard
+15V
-15V
+5V uP
⊥ uP
U1 7805
U2 7815
U3 7915
CR1 B40C3300
CR2 B80C800
C1 4700µ
C2 22µ
C3 220µ
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C5 220µ
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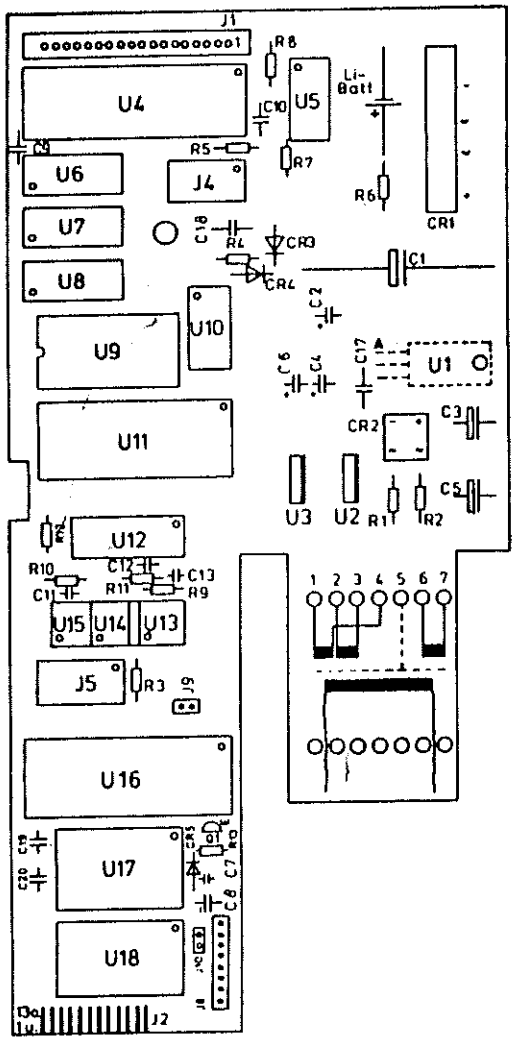
C17 4,7µ
R1 10
R2 10
R3 10
S1 100mA



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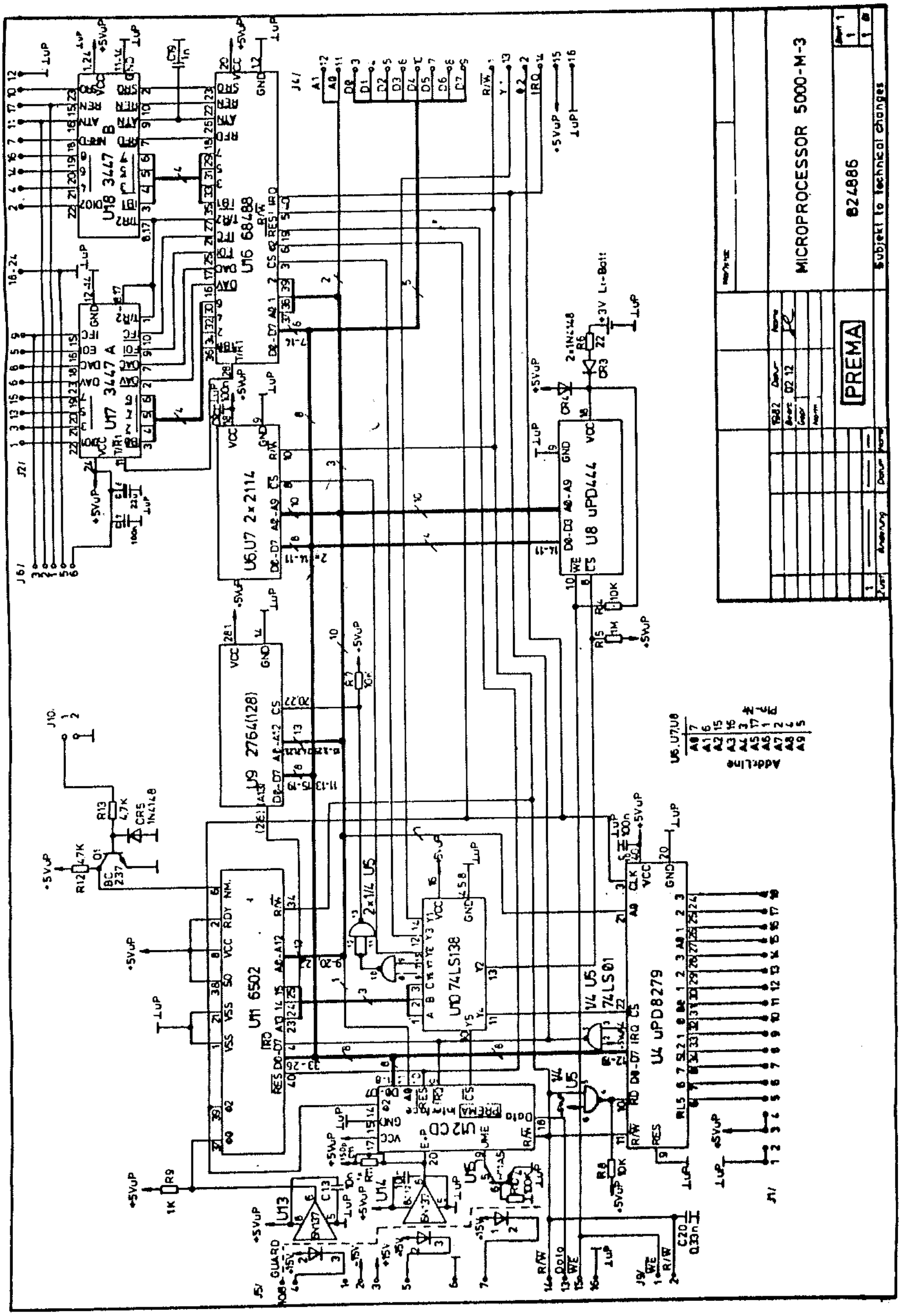
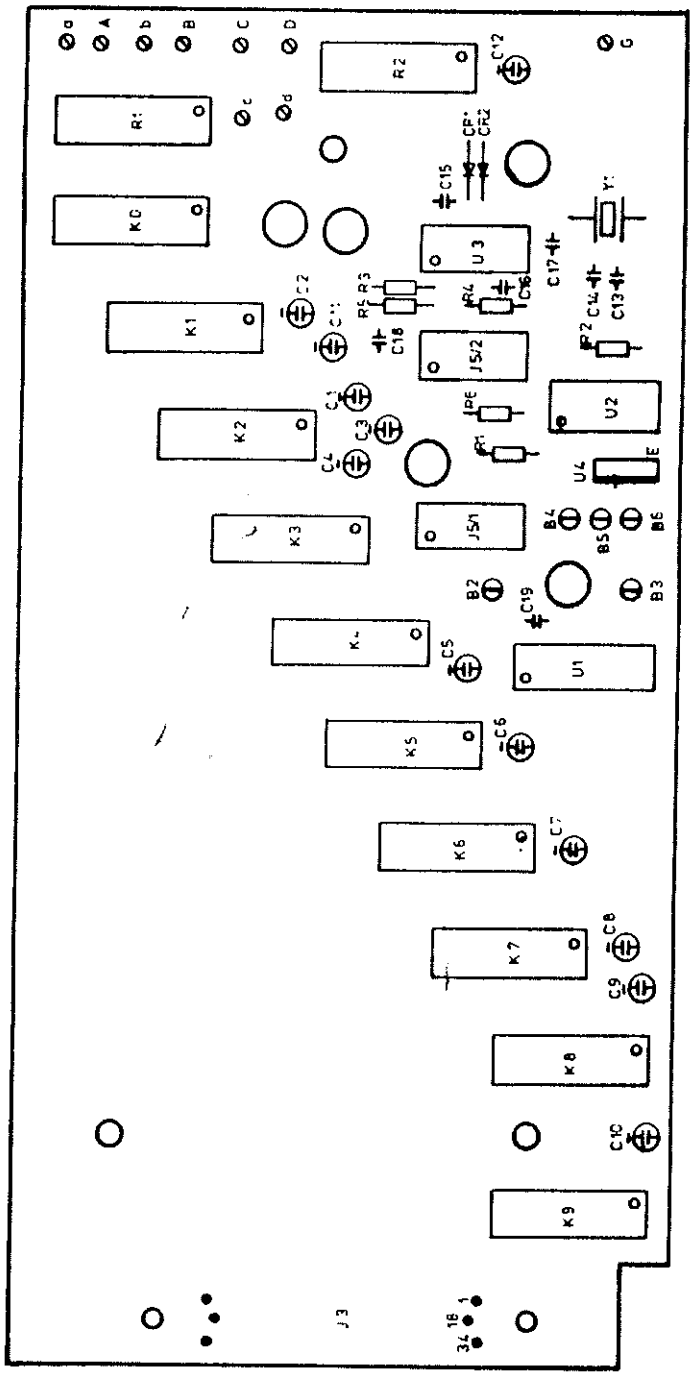

MICROPROCESSOR 5000-M-3
824886
PREMA
Subject to technical changes



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	Norm			
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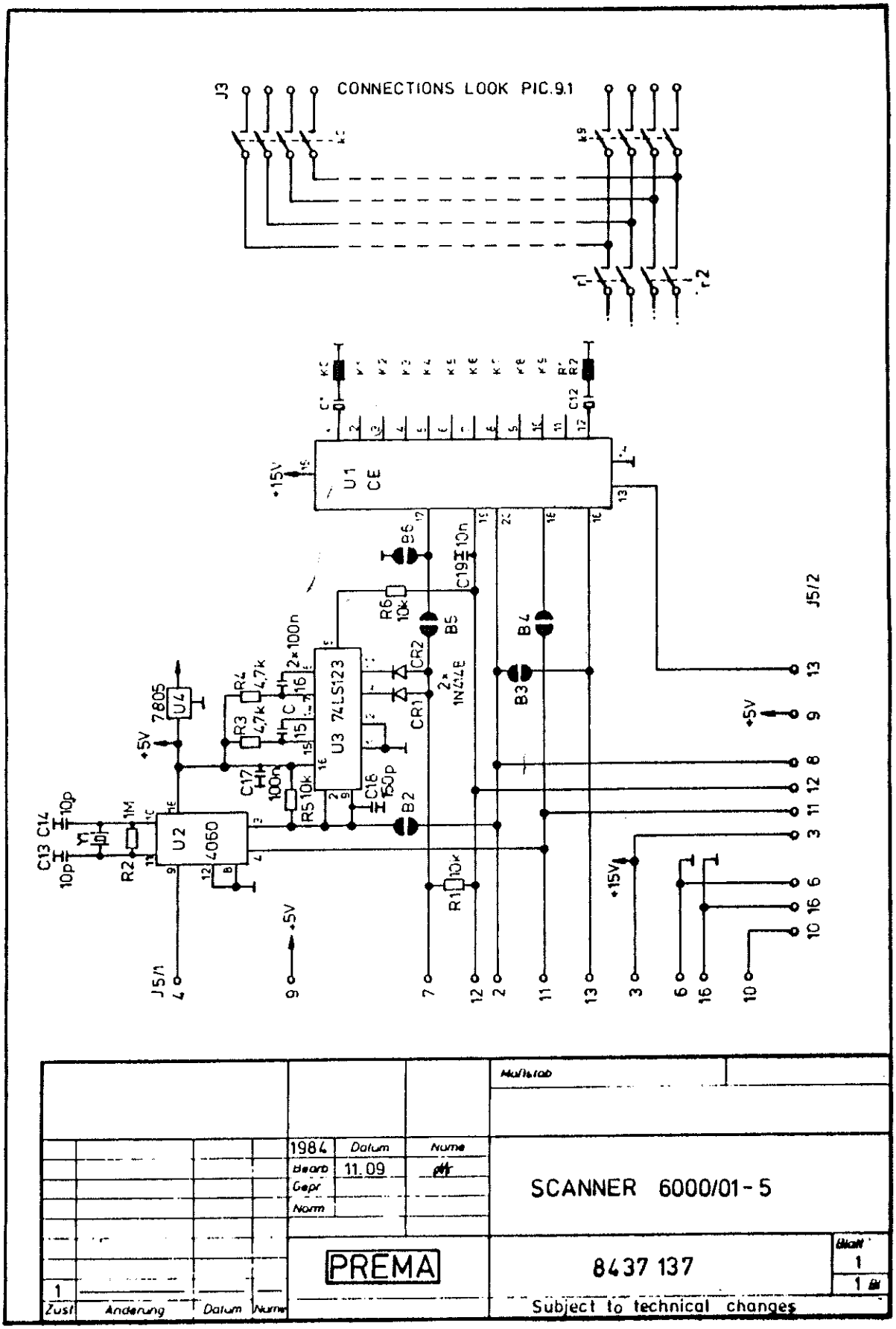
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CONNECTIONS LOOK PIC.9.1
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U2 4060
U3 74LS123
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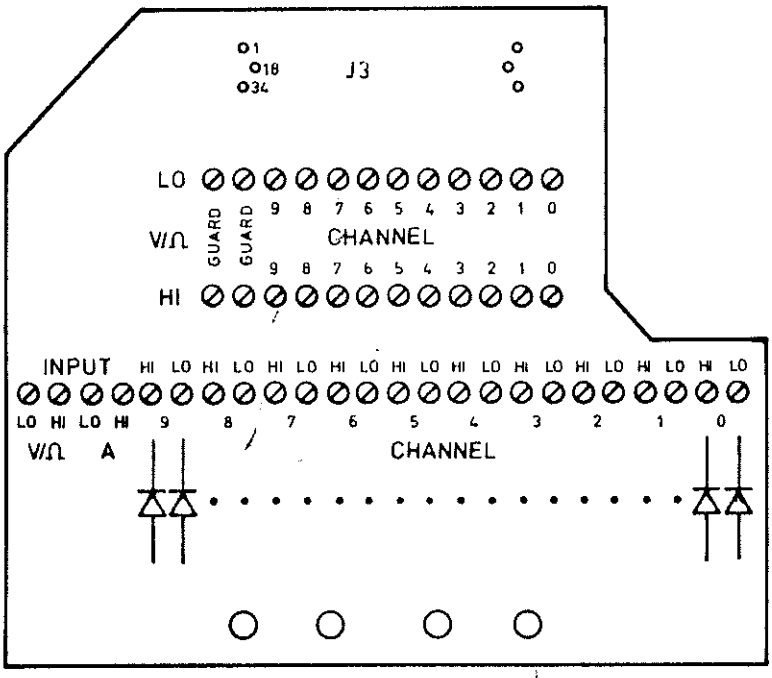
+15V
+5V
J5/1
J5/2
SCANNER 6000/01-5
8437 137
PREMA
Subject to technical changes



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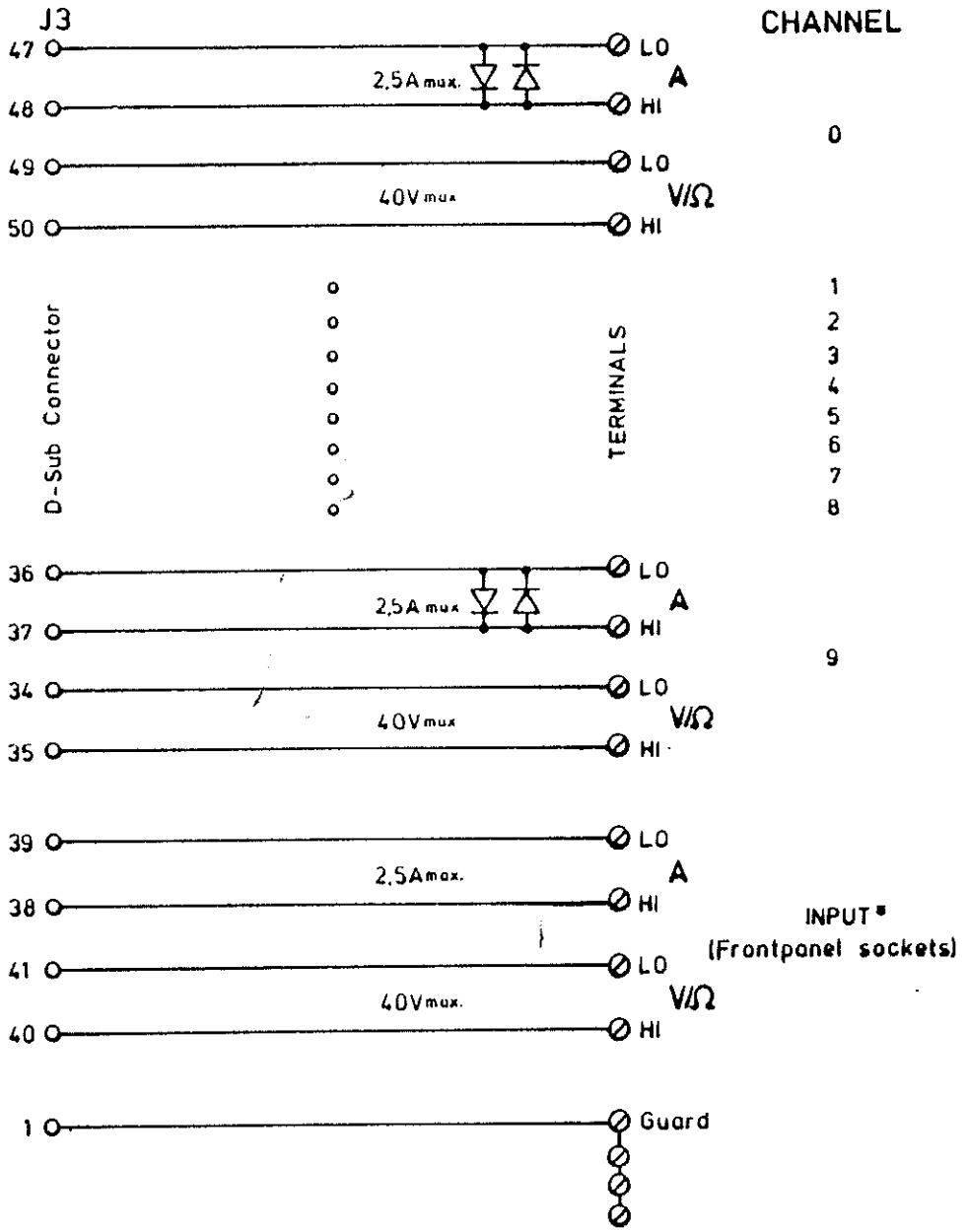

* Scanner 2024 only

					Maßstab	
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			Norm			
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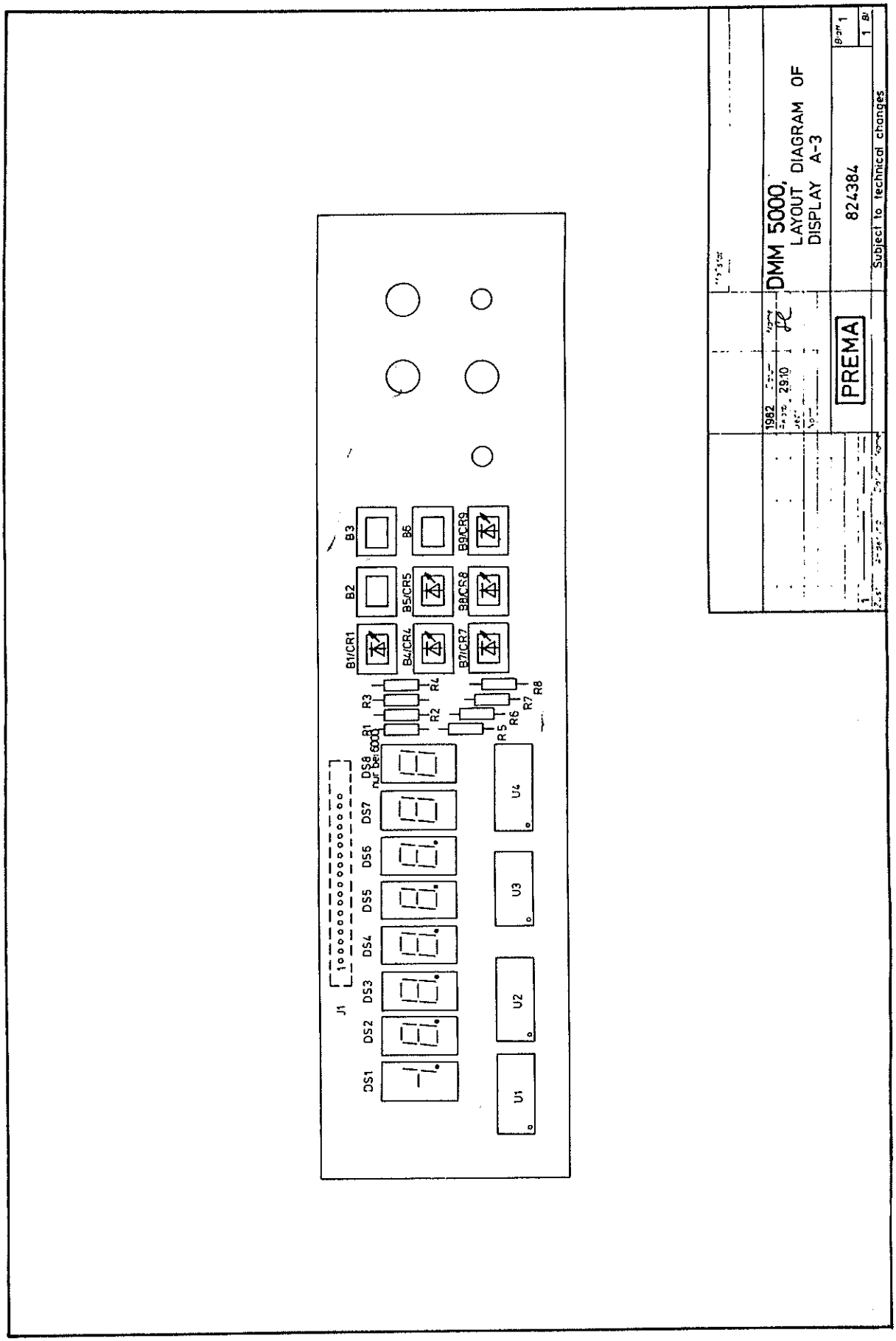
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PREMA
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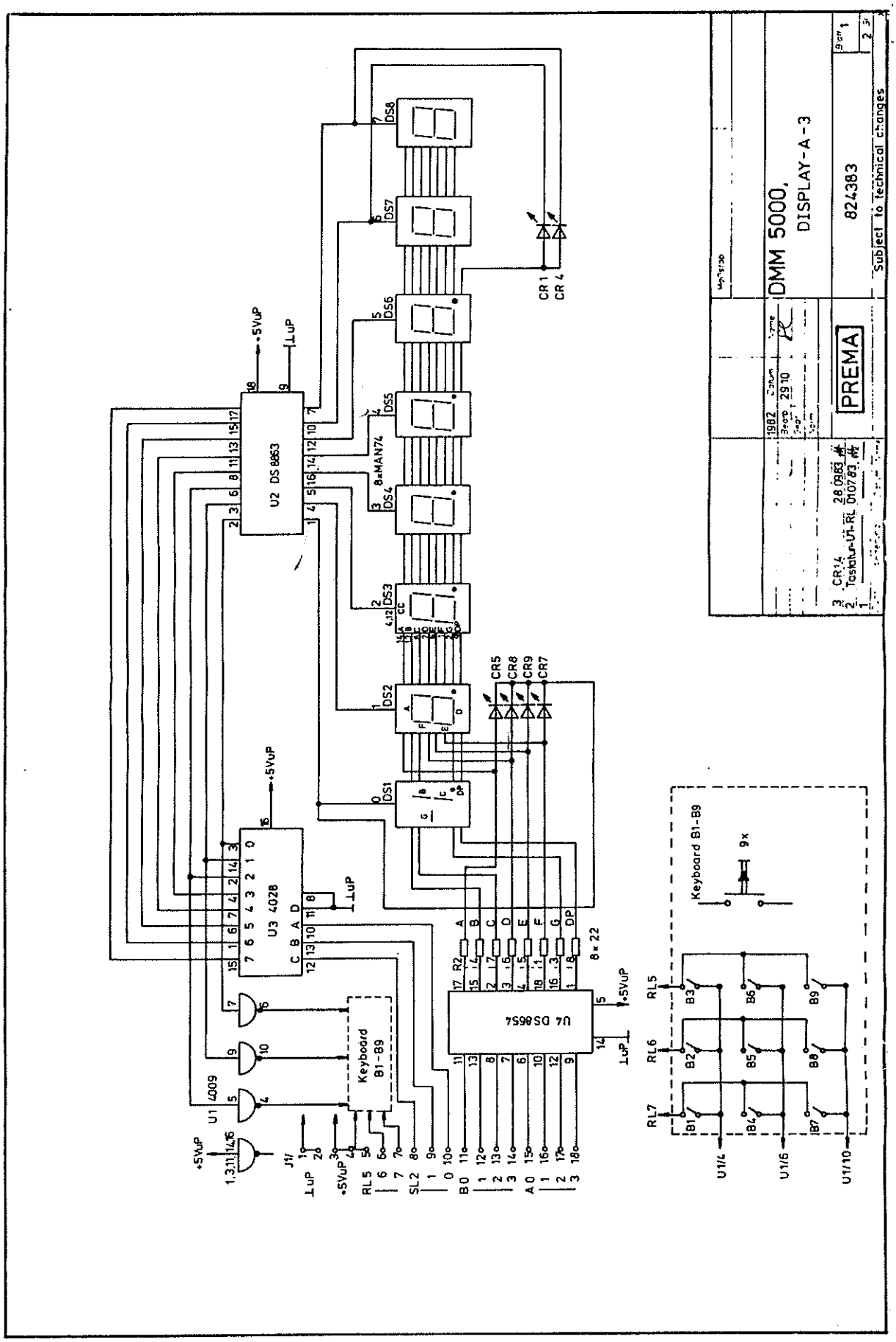
DS6
DS7
DS8
nur bei 6003
U1
U2
U3
U4
B1
B2
B3
B4/CR4
B5/CR5
B6
B7/CR7
B8/CR8
B9/CR9
B1/CR1
R1
R2
R3
R4
R5
R6
R7
R8


DMM 5000,
DISPLAY-A-3
824383
PREMA
Subject to technical changes
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U3 4028
U1 4009
U4 DS8654
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9x
8 x 22
+5VuP
⊥uP
CR1
CR4
CR5
CR8
CR9
CR7
RL5
RL6
RL7
U1/4
U1/6
U1/10