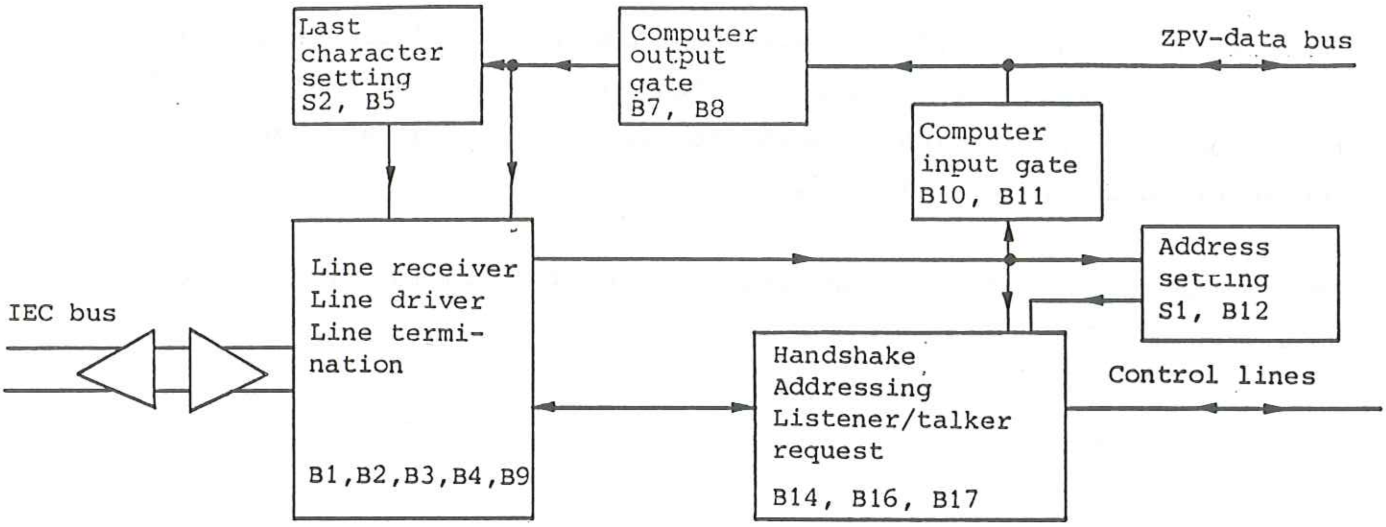


Fig. 4-14 Block diagram IEC-Interface

The lines of the IEC bus aue terminated by the resistor networks R1 to R4, R6, R9 and R10. Depending on the function, either input buffers (B9, B2, B13) or line drivers (B1, B3, B4) are connected to the lines used. A switching network with the field-programmable logic array (FPLA) B14, the memory module B17 and the inverter B16 provides for proper operational sequence of the listener and talker handshake (DAV, NRFD, NDAC, ATN, IFC as well as LADS, TADS, LOCAL and DAC), addressing, unaddressing and interrupt request of the microcomputer of the ZPV. The output 1Q of B17 stores the address status of the listener, whereas output 3Q stores the address status of the talker. The output 2Q of B17 stores the asynchronous IFC signal. This stored IFC signal is read in by the microcomputer (IEC-IN) prior to each data output and is erased again with the data output signal IEC-OUT. The output 4Q stores the active status of the talker, emits via the TACS signal an interupt request to the microcomputer and controls at the same time the bus drivers B3 and B4. Upon an interrupt request by TACS the microcomputer only applies the data byte just to be output to the output modules B7, B8. If the microcomputer is to accept data, addressed commands, universal commands or secondary talker addresses, it will receive an interrupt request via the LACS signal, whereupon it will in turn inhibit the handshake via the DAC signal until such information is accepted by the input modules B10 and B11.

Switch S1 and comparator B12 serve for setting and identifying the device address. The relation between the switch positions and the set device address is shown in Table 2-5.

The switches S2.1 to S2.4, the switching module B5 and the NAND gate B13 serve for setting, output and identification af the last character of a talk process. The relation between the switch positions and the set last character is shown in Table 2-6.

By closing the switch S2.6 the service request (SRQ) to the IEC bus can be disconnected.

5. Repair Instructions

5.1 Required Measuring Equipment and Accessories

Item	○ Designation, required specifications ● Recommended R&S instrument	Type	Order No.
1	○ Signal generator, 18 to 22 kHz, 1 to 2 MHz 1 V/50 Ω ● Signal generator, 10 Hz to 140 MHz	SMK	348.0010.03
2	○ Pulse generator, 20 to 200 Hz, 0 to +5 V		
3	○ Digital voltmeter, 1 mV to 1 V; 0 to >20 kHz, error <0.5% ● Digital multimeter	UDL4	346.7800.02
4	○ Attenuator set, 0 to 80 dB/50 Ω, error <0.02 dB ● Programmable Attenuator	DPVP	214.8017.52
5	○ Oscilloscope, 0 to 10 MHz, vert. 1 mV/cm, hor. 0.5 µs to 20 ms ● Oscilloscope, DC to 30 MHz	BOP	374.0020.02
6	○ 20-kHz generator with two output signals whose phase shift (-180° to +180°) is adjustable with an error of <±0.1°		
7	● Tuner plug-in, 0.1 to 1000 MHz	ZPV-E2	292.0010.02
8	○ Termination 50 Ω		
9	○ Selective millivoltmeter, 10 Hz to 40 kHz ● Test receiver, 9 kHz to 30 MHz	ESH2	303.2020.52
10	○ DC ammeter, 0 to 10 A, error ≤ 2%		
11	○ Load resistors, see section 5.2.1		

5.2 Adjustments

The location of the subassemblies and the adjusting elements is shown in Fig. 5-1.

5.2.1 Power Supply

See circuit diagram 291.6015 S

Set the voltage selector to the local AC supply (220 V). Connect the cables to the motherboard. Connect a load resistor of 270 Ω between ST14.3 (+15 V) and ST15.3 - 8 (ground) and one between ST14.5 (-15 V) and ST15.3 - 8. Load ST14.1 (+20 V) and ST14.8 (-20 V) with 43 Ω and ST14.9 (+120 V) with 8 kΩ referred to ground (ST15.3 - 8).

Adjust the voltage at ST14.1 with R14 in the power supply to +20 V ±0.01 V. Adjust the voltage at ST14.8 with R17 in the power supply to -20 V ±0.01 V. The hum voltage should not exceed 10 mV_{pp}. The voltage at ST14.3 should amount to +15 V ±0.3 V, at ST14.5 -15 V ±0.3 V and at ST14.9 +120 V ±0.5 V. In the case of deviations > ±0.5 V from 120 V, correct by means of R6 or R7. Load the +12-V power supply (ST14.15) with 24 Ω. The voltage should amount to +12 V ±0.6 V. The voltage at ST14.12, loaded with 16 Ω, should amount to +16 V ±2 V. When increasing the loads at the +12-V, +20-V and -20-V outputs, the maximum currents should not exceed 1 A.

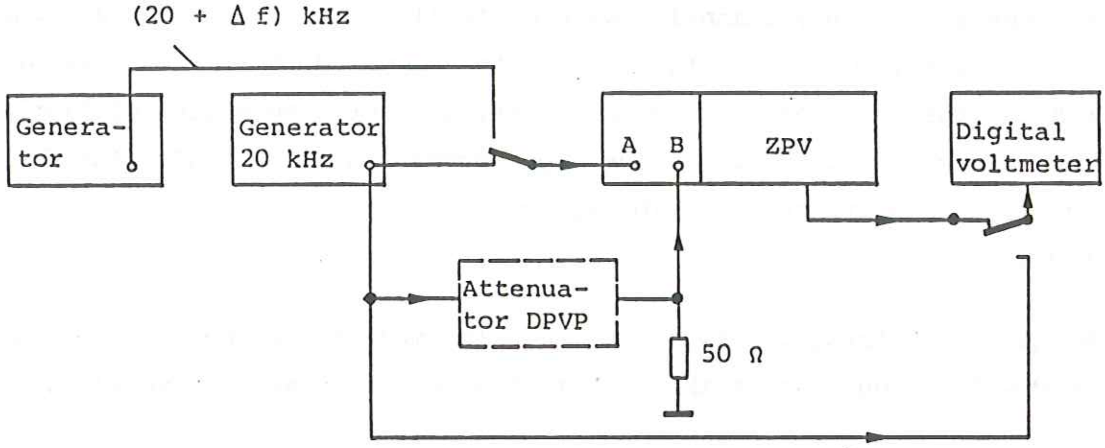
Load the -5-V supply unit (ST15.9) with 11 Ω and the +5-V supply unit (ST15.13 to 16) with 1.1 Ω. The voltage at ST15.9 should amount to -5 V ±0.25 V and at ST15.13 to +5 V ±0.3 V. Increase the load of the +5-V supply, measuring at the same time the maximum current, which should not exceed 7 A. The short-circuit current should not be smaller than 100 mA. Should the current exceed 7 A, check the input offset voltage of the amplifier B4 (for functioning of the current limiting circuit see section 4.1.3). Increase the load of the -5-V supply and measure the maximum current, which should not exceed ca. 0.8 A. Should the +5-V voltage be dependent on the load, check the +5-V sensor line (BU15.11). Should the other supply units be also dependent on the load of the +5-V voltage, check the 0-V sensor line (BU15.1).

Finally check the sense of rotation of the built-in blower M01. The air must be sucked in through the filter on the rear panel and blown into the basic unit ZPV. If necessary, two of the connections on the blower motor must be interchanged. Check the power supply also at the other AC supply voltages with the voltage selector set to the respective positions.

5.2.2 IF Section, Amplitude Measurement Branch

See circuit diagrams:	291.5319 S	- selectivity filter A	Y35
	291.5219 S	- preamplifier B	Y24
	291.5260 S	- digital filter	Y23
	291.5160 S	- amplitude indication	Y34

Test setup:



Apply the 20-kHz ±5 Hz signal from the signal generator with an amplitude of 100 mV to the IF inputs of the basic unit of the ZPV (BU42.A1/A4). For this adjustment of the basic unit without tuner connect the contacts 4 and 6 of socket BU42 (circuit diagram 291.4012 S) with a 560-Ω resistor to simulate the presence of the tuner for the calculator. Should the digital section of the ZPV be operative, select the operating mode A, LIN. Otherwise make sure that the operating mode A and the voltage measurement range 100 mV are switched on (see Table 4-4); bandwidth = 2 kHz (Table 4-5). Connect the oscilloscope to BU35.17a/b (Y35, selectivity filter A). Adjust with L1 for maximum voltage. Connect the DC voltmeter to BU34.3a (Y34, amplitude indication). Adjust the input signal to 0 V and adjust R32 (Y34) for 0 V at the output (BU34.3a). Set the input voltage to 100 mV and set with R33 (Y34) the output DC voltage to 7.9 V in the measurement range 100 mV. Connect the DC voltmeter to BU35.10a and check the two measured values (0 V and 7.9 V); repeat, if necessary, the adjustment of R33, R32 (7.9 V correspond to an indication of 100). Select mode B, measurement range 100 mV. Adjust with L1 (Y23, digital filter) for maximum voltage. Adjust with R40 (Y24, preamplifier B) for the same sensitivity at 100 mV as in channel A.

Disconnect the signal in channel A. Terminate channel A with 50 Ω. Connect channel B via a terminated attenuator set with the signal generator. Adjust the amplitude from the signal generator, reading from the digital voltmeter. Increase the attenuation of the attenuator set in 10-dB steps, switching over at the same time the amplitude measurement ranges of the ZPV and monitoring the DC voltage at the analog output BU35.10a. The deviations should not be greater than stated in the Specifications. Take into account the calibration curve of the attenuator set.

Adjust the input signal in channel B to 1 V (attenuator set 0 dB), measurement range 1 V. Supply channel A with a signal of ca. 0.5 mV and a frequency displaced by ca. 100 Hz (= Δf) referred to channel B. Select the measuring mode A and the measurement range A = 1 mV. Connect a selective millivoltmeter to the analog output BU35.10a. The superimposed AC voltage with the frequency Δf should not be greater than 16 mV, corresponding to a crosstalk attenuation of 120 dB min.

Exchange the IF inputs. Select the measuring mode B and the measurement range B = 1 mV and measure the crosstalk attenuation as in channel A.

Check finally whether the same signal is present at the IF outputs as at the IF inputs (Z_{out} = 1 kΩ).

5.2.3 Phase Measurement Branch

Test setup as in section 5.2.2

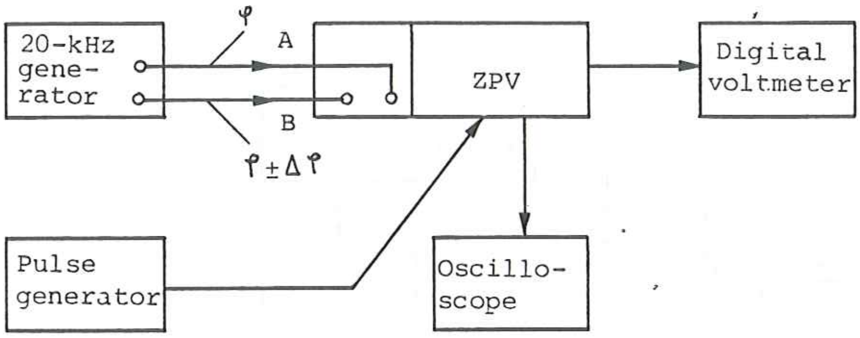
Adjust the level in both channels to approximately 100 mV, measurement range 1 V. Connect the DC voltmeter to BU36.17a/b. Adjust L1 in the amplifier A (Y36) such that the negative DC voltage at BU36.17a/b reaches its minimum. Connect a selective millivoltmeter to BU37.6a/b and adjust L1 in the limiter A (Y37) for optimum suppression of the 40-kHz signal. Adjust the amplifier B (Y25, BU25) and the limiter B (Y26, BU26) in the same way as the amplifier and limiter A. The signal amplitude at the output of the amplifier A (B) should be ca. 1000 mV_{pp} and hardly vary over a dynamic range of 1 V to < 100 µV.

Replace the 20-kHz signal generator by a 20-kHz generator with two output signals which can be shifted in phase. Connect a DC voltmeter to the analog output of the phase indication (BU27.4b). (For this purpose the D/A converter Y33 must be synchronized and the reference voltage of 6.3 V be available at BU27.4.) The DC voltage at BU27.7b should be +5 V ±20 mV for a phase difference of 0°. Minor deviations can be removed by fine adjustment of one of the filters in amplifier A (B).

5.2.3.1 Phase Indication

See circuit diagram 291.5060 S

Test setup:



Remove the computer board Y21. Connect BU27.32a with ground potential (logic level 0). The undelayed signal of channel B is thus disconnected (BU27.26a) and the signal delayed by 12.5 µs by B1 applied to B5.13. Check with the oscilloscope at B5.13 whether the switching circuit functions properly. A variation of the phase position of the input signals must not cause a change of the phase relationships at B4.8 and B4.11. Adjust the time delay in B4 to 12.5 ± 1 µs by suitable selection of the capacitance C4.

Connect the oscilloscope to BU27.21a. The pulse duty factor should be ca. 4:1. Apply logic 0 to BU27.31b. The pulse duty factor should be switched to ca. 4:3. The voltage at BU27.18b should in both cases amount to ca. +4 V. Connect the oscilloscope to BU27.11b and apply logic 0 to BU42.23. The pulse duty factor of the signal at BU27.11b should be similarly switchable as at BU27.31b. Connect the pulse generator to BU27.17a. Adjust the pulse amplitude to +5 V, the frequency to ca. 100 Hz and a pulse duty factor of 10:9. A squarewave signal with half the pulse frequency should be present at BU27.30a (180° bit).

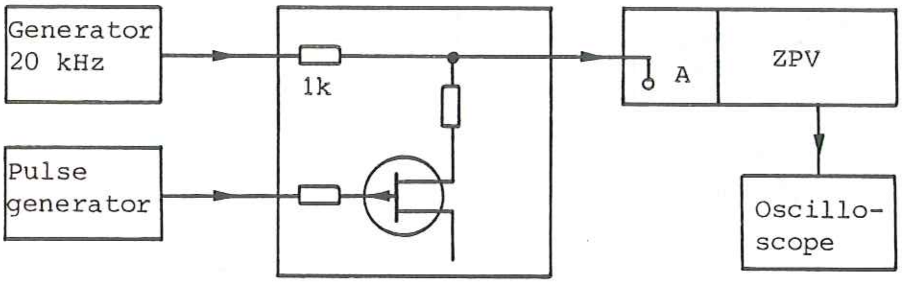
Disconnect BU27.23a from ground and apply logic 0 to BU27.17a. The 180° bit (BU27.30a) must now be periodically set and reset with a frequency of ca. 1 kHz.

Remove all additional connections. Vary the phase of the input signal in the range -180° to 0° to $+180^\circ$. The analog voltage at BU27.4b should accordingly reach, but not exceed, the following values: $V > 0$ and ≤ 10 V. The dependence of the analog output voltage V_φ and the 180° bit on the phase is shown in Fig. 4-8 (section 4.1.2).

5.2.4 Narrowband Sweeping

See circuit diagrams: 291.5319 S - selectivity filter A Y35
291.5060 S - phase indication Y27

Test setup:



Swept-frequency
attenuator

The swept-frequency attenuator is not required with signal generators which permit a periodic variation of the amplitude in a range of ca. 20 dB.

Select the operating mode SWEEP, B/A by applying logic 0 to BU35.2a and BU35.1b. Adjust the amplitude in channel A such that the DC voltage at BU35.14b reaches +4 V, corresponding to about 300 mV at the IF input A.

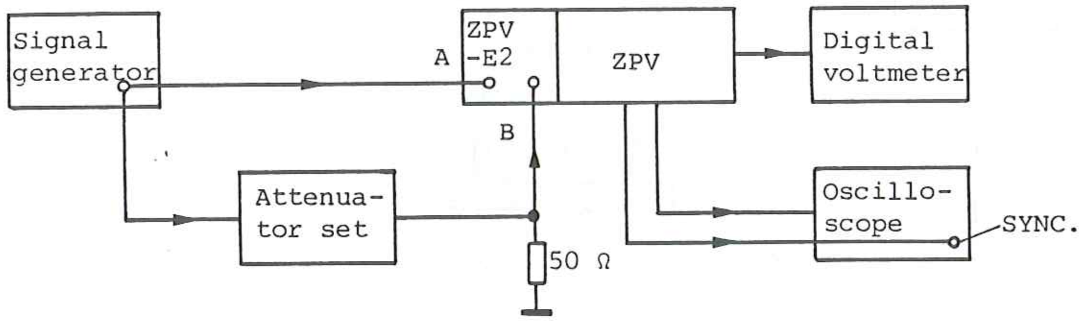
Select the operating mode B and the measurement range B = 1 V (see Table 4-4). Connect the oscilloscope to BU35.14a. Adjust the DC voltage with R41 (Y35) to 0 V. Vary the amplitude of the input signal in the range 0 to -20 dB, referred to the initial setting. Adjust the AC output voltage with R35 for minimum. Select the operating mode A and the measurement range A = 300 mV. The output voltage should be ca. 1 V. Vary the amplitude of channel A in the range 0 to -20 dB and adjust R44 for minimum variation of the output voltage. Repeat the adjustment (R44, R41, R35) if required. At the socket r on the rear panel of the ZPV ca. 20% of the voltage at BU35.14a should be present (Z_{out} = 1 kΩ). The suppression of the variations of the input reference level at socket r is typically -40 dB. Apply logic level 1 to BU35.1b. At BU35.14a and at socket r on the rear panel the swept-frequency representation of the input signal should now be present, without voltage ratio. The measured quantity is determined by the operating mode (A or B). With calculator-controlled ZPV, the B signal must be switched over accordingly for the adjustment.

Feed two 20-kHz signals shifted in phase into channel A and B. The voltage proportional to the phase must be present at T3 (Y27) and at socket on the rear panel with an amplitude of ±0.5 V/±180°.

5.2.5 Digital Filter

See circuit diagram 291.5260 S

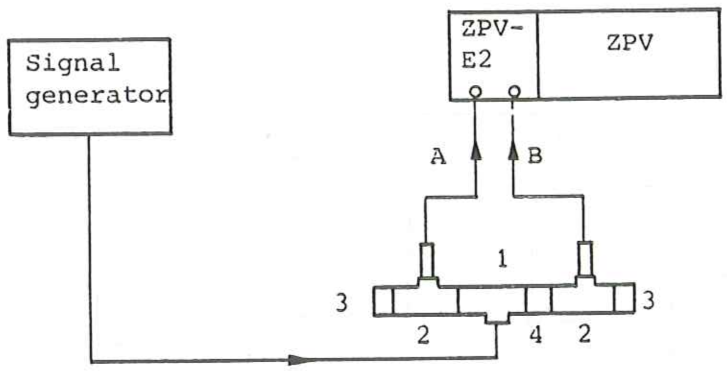
Test setup 1



Connect the oscilloscope to BU23.7b, the SYNC. input to BU23.1a. Select on the ZPV basic unit the local frequency control mode, operating mode B and measurement range B = 100 µV. Select on the ZPV-E2 plug-in the frequency range 600 to 100 MHz. The attenuation of the attenuator set is 60 dB. Adjust the output level of the signal generator to 200 mV and vary the frequency between ca. 19 and 21 kHz. The signal at BU23.7b must be synchronous with that at BU23.1a in a frequency range of at least 20 kHz ±500 Hz. If necessary, correct R2 (digital filter Y23). Set the signal generator frequency to ca. 1 MHz, with a level of 100 mV. Select the frequency range 1 - 2 MHz on the ZPV-E2 plug-in. Adjust with R24 on the digital voltmeter (BU35.10a) the same measured value for the measurement range B = 100 µV with an attenuation of 60 dB and for the measurement range B = 1 mV with an attenuation of 40 dB.

Separate the connection K59-BU24.1a (input of the preamplifier B) and connect the oscilloscope to BU23.31b. Adjust with R15 and R16 (Y23) for minimum crosstalk signal. The lamp UNSYNC. on the ZPV-E2 must not light. Re-establish the connection at BU24.1a and check the calibration of the measurement ranges 30 µV and 100 µV, taking into account the error of the attenuator set. The instrument must comply with the requirements in the Specifications.

Test setup 2



1 = feed unit ZPV-Z2

2 = insertion adapter ZPV-Z1

3 = 50-Ω termination

4 = attenuator 40 dB/50 Ω

Adjust the signal generator frequency in test setup 2 to 1 MHz and the level to ca. 200 mV. Select the frequency range 1 - 2 MHz on the ZPV-E2 plug-in and the measuring mode B/A on the ZPV basic unit. Store the indicated phase (button φ, τ REF. STORE). Adjust the output level from the signal generator according to the magnitude indication of the ZPV to ca. 70 to 80 µV. Adjust L1 in the amplifier B (Y25) such that the phase indication is smaller than $\pm 0.1^\circ$.

5.3 Trouble Shooting in the Digital Section

See circuit diagram 291.4812 S - computer board Y21

5.3.1 General

Since the microcomputer is involved in all digital operations of the instrument, trouble shooting appears almost impossible without knowing the complex program flow. The following hints can however be given:

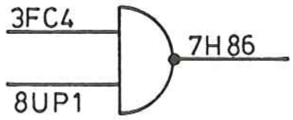
- The functioning of the 2-MHz clock pulse generator on the computer board is an essential condition for the functioning of the microcomputer (check ø1 and ø2 at B1).
- If the central processing unit B3 on the computer board is operative, the SYNC signal appears at B3.18, which consists of one pulse per 4 to 5 clock pulses (check SYNC signal).

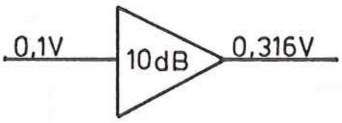
- All information from and to the central processing unit flows via the 8-bit data bus. Short circuits or interruptions of the data lines may lead to a behaviour of the microcomputer which appears completely senseless (check the data bus for short circuits and interruptions).
- From where and to where the information flows is also determined via the 16-bit address bus (not fully utilized). Short circuits and interruptions of the address lines may also lead to a meaningless behaviour of the microcomputer (check the address bus for short circuits and interruptions).
- The control lines of the bus controller B6 generate in conjunction with the address lines in the various selection decoders the write, read, input and output pulses for the individual memory and input/output modules. The absence of these selection pulses may also lead to a meaningless behaviour of the microcomputer (check selection pulses).

5.3.2 Signature Analysis

Signature analysis is a completely new method for trouble-shooting in digital systems.

Detection and analysis of digital signatures in digital systems is comparable to measurement and analysis of analog voltages in analog systems.





When the input signals of a component are correct but not the output signals, the component is either defective, it is too heavily loaded (e.g. shortcircuit) at its output, or the test point is not connected to the output of the component (e.g. interruption). If, for instance, a circuit diagram or corresponding tables with digital signatures are available, errors can be located even at component level.

The ZPV is designed to permit signature analysis. Using, for example, the attractively priced Signature Analyzer HP5004A the technique represents a new tool for rapid and accurate instrument servicing and trouble-shooting.

The tests made on the ZPV can be divided into two phases. In the first phase mainly the ROM content as well as the address and data busses are checked.

The second phase, which is based on the first, serves for checking the entire digital section with the aid of a test program included in the ROM.

5.3.2.1 Checking the ROM Content and the Address and Data Busses

5.3.2.1.1 Purpose

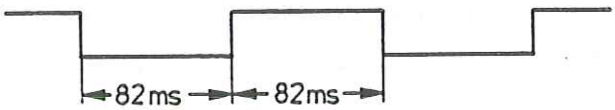
This test is carried out to ensure that
- the microprocessor (B1, B3, B6),
- the address bus drivers (B4, B5),
- the address bus,
- the ROM selection decoder (B10),
- the program memories (B11, B12, B13, B14) as well as
- the data bus

function properly.

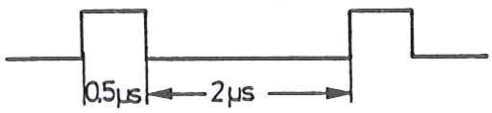
5.3.2.1.2 Preparation

a) Switch off ZPV; fix computer board to extension boards; insert sockets BU4 to BU11 such that contacts 2 and 3 of ST4 to ST11 are connected (links at the bottom); switch on ZPV.

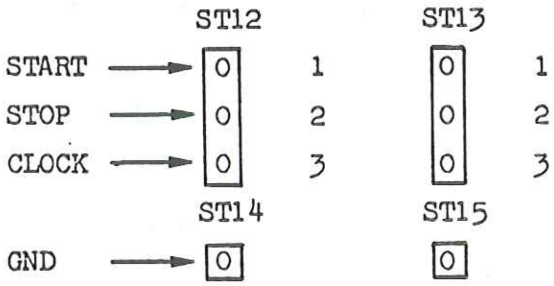
b) Check START/STOP signal 1 at ST12.1 and ST12.2 with an oscilloscope.



c) Check CLOCK signal 1 at ST12.3 with an oscilloscope.



d) Connect signature analyzer to ST12 and ST14



e) Setting of signature analyzer

START:  STOP:  CLOCK: 

5.3.2.1.3 Checking the Total ROM Content

The signatures given in table 5-1 can be measured at ST4.1 to ST11.1 on the computer board. If the measured signatures and those in the table are identical proceed to the second test phase. If this is not the case start error shooting as described under section 5.3.2.1.4.

5.3.2.1.4 Trouble-shooting in the ROM Range

If an error is found in the ROM section (section 5.3.2.1.3) the address lines A0 to A15 and some strobes must be checked according to table 5-2. The signatures of the address lines must first be verified at the CPU (B3 on computer board), then after the address bus drivers (B4 and B5 on the computer board), Any errors traced (shortcircuits, interruptions, defective components) must be eliminated before the strobes for the individual memory components can be checked. For this trouble-shooting use the remaining signatures of table 5-2.

Finally the content of each memory component can be checked. To this end remove all ROMs from the holders on the computer board except for the one to be measured. The signatures produced by each ROM at the data bus can be seen from table 5-3. Thus errors are easily localized (short-circuits, line interruptions or defective components).

Note: Insert each ROM in its proper socket.

5.3.2.2 Checking the Entire Digital Section

5.3.2.2.1 Purpose

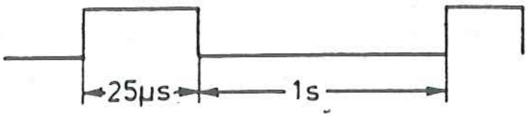
If the ROM content is in order, the digital sections of the total instrument and the RAM components can be checked in a second test phase by using a special test program (provided) in the ROMs.

During this test a certain test pattern is applied periodically to all output gates and RAM positions.

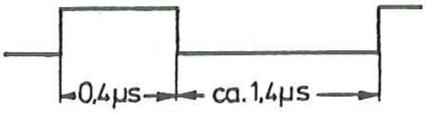
5.3.2.2.2 Preparation

a) Switch off ZPV.
   Connect BU4 to BU11 on the computer board such that contacts 1 and 2 of ST4 to ST11 are connected and connect BU17 on the computer board such that contacts 2 and 3 of ST17 are interconnected. Switch on ZPV.

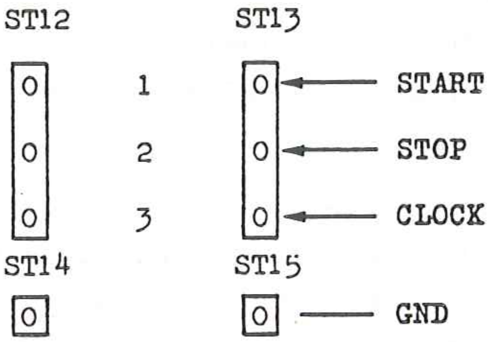
b) Check START/STOP signal 2 at ST13.1 and ST13.2 with an oscilloscope.



c) Check clock signal 2 at ST13.3 with an oscilloscope.



d) Connect signature analyzer to ST13 and ST15.



e) Set signature analyzer to

START:  STOP:  CLOCK: 

5.3.2.2.3 Trouble-shooting in the Digital Section

The running test program causes the indicator lamps to light so that each failure is clearly visible.

If an error occurs, trace back the signal path with the aid of the signatures listed in table 5-4 until the correct signature is measured. The error must then be near this point.