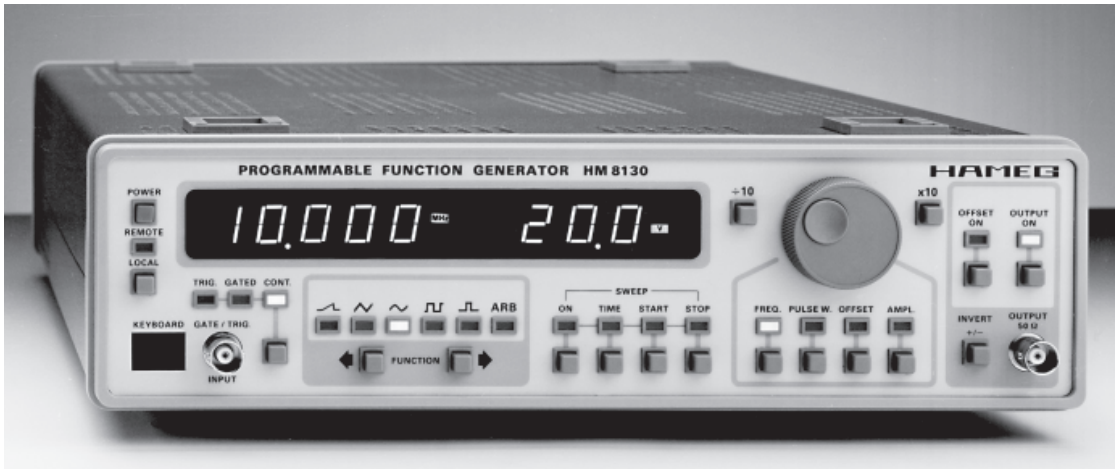
ENGLISH

HAMEG®
Instruments

Function Generator HM8130



MANUAL•HANDBUCH•MANUEL

Important

As the instrument is an electrical apparatus, it may be operated only by trained personnel. Maintenance and repairs may also be carried out only by qualified personnel.

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

HM 8130

HAMEG GmbH Kelsterbacher Str. 15-19 60528 Frankfurt am Main Germany

General Information

The operator should not neglect to carefully read the following instructions, to avoid any operating errors and to be fully acquainted with the instrument when later in use. After unpacking the instrument, check for any mechanical damage or loose parts inside. Should there be any transportation damage, inform the supplier immediately and do not put the instrument into operation.

Safety

This instrument has been designed and tested in accordance with ***IEC Publication 1010-1, Safety requirements for electrical equipment for measurement, control, and laboratory use***. The CENELEC regulations EN 61010-1 correspond to this standard. All case and chassis parts are connected to the safety earth conductor. Corresponding to Safety Class 1 regulations (three conductor AC power cable). Without an isolating transformer the instrument must be plugged into an approved three contact electrical outlet, which meets International Electrotechnical Commission (IEC) safety standards.

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

The instrument must be disconnected and secured against unintentional operation if there is any suggestion that safe operation is not possible. This may occur:

- if the instrument has visible damage,
- if the instrument has loose parts,
- if the instrument does not function,
- after long storage under unfavourable circumstances (e.g. outdoors or in moist environments),
- after excessive transportation stress (e.g. in poor packaging)

When removing or replacing the metal case, the instrument must be completely disconnected from the mains supply. If any measurement or calibration procedures are unavoidable on the opened-up instrument, these must be carried out only by qualified personnel acquainted with the danger involved.

Symbols As Marked on Equipment

⚠ **ATTENTION - refer to manual**

⚠ **Danger - High voltage**

⏚ **Protective ground (earth) terminal**

The max. permissible external voltage applied between inputs and outputs against ground is 42V.

Warranty

Before being shipped, each instrument must pass a 24 hour quality control test. Provided the instrument has not undergone any modifications HAMEG warrants that all products of its own manufacture conform to HAMEG specifications and are free from defects in material and workmanship when used under normal operating conditions and with the service conditions for which they were furnished.

The obligation for HAMEG shall expire two (2) years after delivery and is limited to repairing, or at its option, replacing without charge, any such product which in HAMEGs sole opinion proves to be defective with the scope of this warranty.

This is HAMEGs sole warranty with respect to the products delivery hereunder. No statement, representation, agreement or understanding, oral or written, made by an agent, distributor, representative or employee of, which is not contained in this warranty will be binding upon HAMEG, unless made in writing and executed by an authorized HAMEG employee. HAMEG makes no other warranty of any kind whatsoever, expressed or implied, and all implied warranties of merchantibility and fitness for a particular use which exceed the aforestated obligation are hereby disclaimed by HAMEG be liable to buyer, in contract or in tort, for any special, indirect, incidental or consequential damages, espresses, losses or delays however caused.

In case of any complained, attach a tag to the instrument with a description of the fault observed. Please supply name and department, address and telephone number to ensure rapid service.

The instrument should be returned in its original packaging for maximum protection. We regret that transportation damage due to poor packaging is not covered by this warranty.

Installation

This instrument is intended for connection to 220V or 110V, 50/60Hz mains input voltage. Before installing the instrument, ensure that it is set to the local line voltage. On delivery the unit is set to either 110V or 220V, as indicated on the line voltage selector on the rear panel. If the line voltage setting is incorrect, set the line voltage selector in accordance with the local line voltage before connecting the instrument to the line.

The instrument is protected by two primary fuses. These have to be changed when the line voltage changes.

For 220V / 110V use delayed action fuses. Remove the line plug before fitting the fuses. Ensure that only fuses of the specified type are used.

FUNCTION GENERATOR HM 8130

The Function Generator **HM8130** is a highly versatile, **all-purpose signal source** which is equally at home on the bench or in automated test systems. It combines synthesizer, sweep generator, and **arbitrary waveform** function in one compact unit. In addition to the 5 standard waveforms, "self-constructed" signals can be generated using the arbitrary function with storage capacity of **1024** points in both vertical and horizontal direction. Data entry, readout, and editing is possible via the optional external keyboard or **IEEE-488** interface, which also allows the transfer of waveform data stored in **HAMEG** digital scopes. All arbitrary waveform data are stored in a non-volatile memory for quick recall until re-programmed.
Another feature of the **HM8130** is the integrated sweep generator with two frequency ranges. Sweep rate and start and stop frequencies are exceptionally quick and easy to set. Separate inputs are provided for external amplitude modulation, trigger/burst, and gate.
The frequency range of sinewave and squarewave is **10mHz** to **10MHz**. The range of the other waveforms is limited due to their digital generation. Low harmonic distortion, low aberration, and fast rise and fall times (<10ns) underscore the excellent overall performance of the **HM8130**. Frequencies are indicated on a bright, **5-digit LED-display** with a resolution of up to **10mHz**. DC-offset is adjustable up to **±7.5V** independent of waveform. The highest available output voltage for all waveforms is **20V$_{pp}$** O.C. or **10V$_{pp}$** into **50Ω**. This is indicated on a separate **2 ½** digit display. Signal output is short circuit proof and protected against a maximum of ±15V of external voltage.

In spite of its versatility, the **HM8130** offers remarkable comfort and simplicity of operation. All variable parameters are quickly and precisely adjustable by means of the center dial. The bright display and the clearly arranged front panel design allow the user to be informed about the instrument status and all important parameters at a glance. Full programmability for use in automated measurement systems is provided with the optional **IEEE-488** or **RS-232** interface. Device drivers for various measurement control programs are available as options.

Specifications HM 8130

(Ref. temp.: : 23°C ± 2°C)

Frequency

Range: 10mHz to 10MHz
Resolution: 5 digit, max. 10mHz
Display: 5 digit; LED
Accuracy: ±(1 digit + 5mHz)
Setting: remote controlled via interface or manual via front panel or ext. keyboard
Temperature coeff.: 0.5ppm/°C
Aging: 2ppm/year

Waveforms

Sine

Frequency range: 10mHz to 10MHz
Amplitude: 0 - 20V$_{pp}$ (OC)
Harmonic Distortion: <0.5% (to 500kHz)
<1% (500kHz - 3MHz)
<3% (3MHz - 10MHz)

Square

Frequency range: 10mHz to 10MHz
Amplitude: 0 - 20V$_{pp}$ (OC)
Rise-/Falltime: <10ns
Aberration: <5% (U_{out} ≥ 200mV)
Symmetry: 50% ±(5% + 10ns)

Pulse:

Frequency range: 10mHz to 5MHz
Amplitude: 0 ... +10V or 0 ... -10V
Rise-/Falltime: <10ns
Pulse width: 100ns to 80s
Duty cycle: max. 80%

Ramp

Frequency range: 10mHz to 10kHz
Amplitude: 0 - 20V$_{pp}$ (OC)
Linearity: better than 1%

Triangle

Frequency range: 10mHz to 100kHz
Amplitude: 0 - 20V$_{pp}$ (OC)
Linearity: better than 1%

Arbitrary

Frequency range: 10mHz to 100kHz
Amplitude: 0 - 20V$_{pp}$ (OC)
Sampling rate: 10MHz
Resolution: X: 1024; Y: 1024 (10 bit)

Inputs

GATE/ TRIGGER: (BNC jack)
Impedance: 5kΩ II 100pF; protected up to ±30V
LEVEL CONTROL: (AM; BNC jack)
Impedance: 10kΩ; protected up to ±30V

Outputs

Signal output: (BNC jack)
short circuit proof; ext. voltage up to max. ±15V
Impedance: 50Ω
Output voltage: 2.1 - 20V$_{pp}$ (OC)
0.21 - 2.0V$_{pp}$ (OC)
20 - 200mV$_{pp}$ (OC)
Resolution: 100mV
10mV
1mV
Accuracy: (1kHz) ±2% (2.1 - 20V)
±3% (0.21 - 2V)
±4% (20 - 200mV)
for pulse and square additional 3%
Flatness: ±0.2dB <100kHz
±0.5dB 100kHz - 2MHz
+0.5dB/-3dB 2MHz - 10MHz
Offset: ±50mV (Range 3)
Display: 2 ½ digit (LED)
Setting: remote controlled via interface or manual via front panel or ext. keyboard

DC Offset

Output voltage: -7.5V...+7.5V (OC)
-0.75V...+0.75V (OC)
-75mV...+75mV (OC)

Trigger Output

Ramp: 0 to 5V (sweep out)
Level: 5V / TTL
Output impedance: 1kΩ

Sweep (internal)

Internal sweep: all waveforms
2 ranges: 10mHz to 550kHz / 450kHz to 10MHz
free setting of start and stop frequency
Sweep time: linear from 20ms to 100s
continuous or triggered via ext. signal, ext. keyboard, interface

Amplitude Modulation

Modulation via external signal
Modulation depth: 0 to 100%
Bandwidth: DC - 20kHz (-3dB)

Gate (asynchronous)

Modulation on/off via external TTL signal
Delay time: <150ns
Input signal: TTL

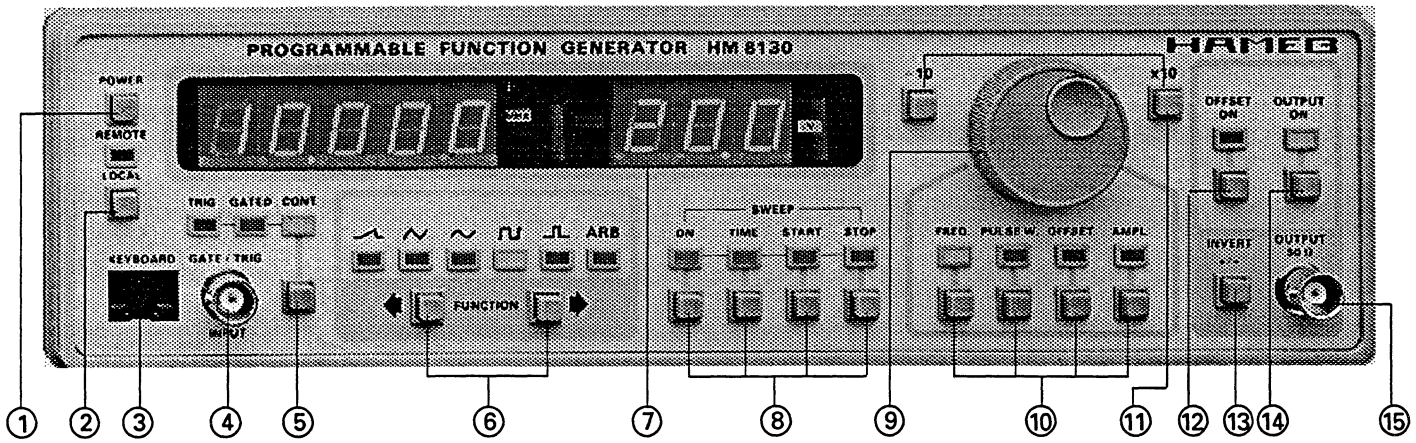
Triggerfunction (synchronous)

Frequency range: <500kHz
Single burst via ext. trigger input or interface

General

1 Last set-up memory (+9 via ext.keyboard)
1 memory array 1024x1024 for Arb. signal
External keyboard (Option HZ830 for setting of parameters and programming of Arb. signal
RS232 Interface (Option HO89)
IEEE-488 Interface (Option HO88)
Power requ.: 110/220V ±15%; 45-60 Hz, 40 VA
Ambient temperature: -10°C to +40°C
Humidity: 10%-90%, no condensation,
Dimensions: 285x85x365mm (WxHxD),
Weight: approx. 5 kg
Safety: Class I, According to IEC 348

Accessories:
HZ33, HZ34: 50Ω Coaxial cable BNC-BNC; **HZ24:** Set of BNC attenuators 3/6/10 and 20dB; **HZ42:** 19" rack-mount-kit; **HZ72:** Double shielded IEEE-bus cable; **HO88:** IEEE-488 Interface; **HO89:** RS 232-Interface; **HZ830:** External keypad.



① **POWER** Power switch.

② **REMOTE / LOCAL** (pushbutton and LED)
The REMOTE LED is lit when the instrument is operated via the IEEE-488 bus. Return to local by depressing the local-switch is possible, provided the instrument is not in the local lockout state.

③ **EXT. KEYBOARD**
Input socket for optional ext. keypad (HZ830).

④ **GATE / TRIG.** (BNC socket)
Input for trigger and gate signals.

⑤ **TRIG./GATED/CONT.** (pushbuttons and LED's))
Selection of operating mode: gated, triggered, and continuous.

⑥ **FUNCTION** (pushbuttons and LED's)
selection of function: ramp, triangle, sinewave, squareqave, pulse, arbitrary.

⑦ **Display** (digital display)
Display for frequency and output voltage. Frequency resolution is 5 digit. Output voltage is indicated as V_{pp} with open circuit on a 3 digit display.
When sweep-mode is active display indicates sweep-time, start frequency, or stop-frequency resp.
If pulse is selected, the frequency display is replaced by the display for pulsewidth. Similar holds for the output voltage display. When "Offset" is selected, the display indicates the DC-offset value (open circuit).

⑧ **SWEEP** (pushbuttons and LED's)
Selection of parameter for sweep mode. Sweep-time, start-frequency, and stop-frequencycan be set indepently from each other. Setting can also be accomplished during sweep. The modification is carried out immediately.

⑨ **Dial** (synchro generator)
Dial for setting of all values (frequency, voltage, time) in the different operating modes.

⑩ Pushbuttons and LED's for setting of parameters
Selection of frequency of output signal, pulsewidth, offset, and output voltage. The active parameter is indicated by a lit LED, and can than be modified by the center dial. Step width of the dial is dependent on the acceleration when tuning. When turning slowly 1 digit resolution is achieved. When turning fast the step width is bigger, thus enabling to cover the entire frequency range with only a few turns of the dial.

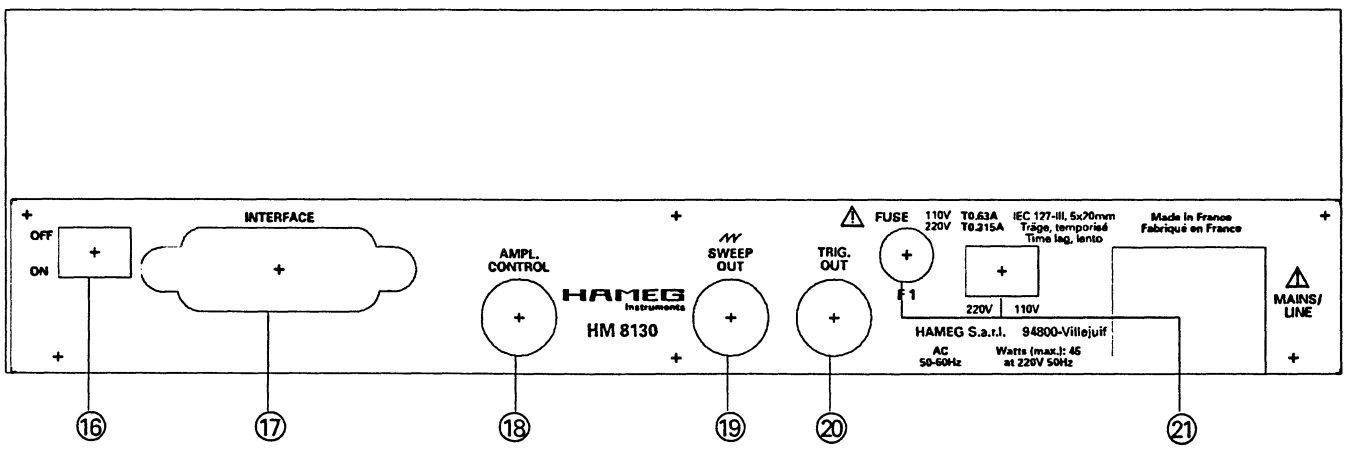
⑪ **÷10 / x10** (pushbuttons)
Decadic range setting for all parameters.

⑫ **OFFSET** (pushbutton and LED)
Pushbutton for activating the offset function. A DC voltage is superimposed for the output. Offset can be selected indepently from output voltage.

⑬ **INVERT** (pushbutton)
Pushbutton for the inversion of offset and pulses.

⑭ **OUTPUT ON** (pushbutton)
Output on/off.

⑮ **OUTPUT** (BNC socket)
Signal output, impedance 50Ω.



⑯ **OFF/ON** Address selector for interface
⑰ **INTERFACE** Connector for either IEEE-488 or RS232 interface
⑱ **AMPL. CONTROL** Analog modulation input for AM
⑲ **SWEEP OUT** Saw-tooth output (sweep mode)
⑳ **TRIG. OUT** Trigger output
㉑ Mains connector, voltage selector, and fuse

Operating principle of the HM 8130

Signal generation in the HM 8130 is based on direct digital synthesis prinziples. Signal information is stored in the memory of the HM 8130 and is read out or newly calculated when the corresponding function is selected. Due to the limited speed of the uprocessor and access time to memory, this basic principle is limited when the upper frequency range is concerned. Therefor the frequency range of the HM 8130 has been subdivided into 2 ranges. Up to 500 KHz the HM 8130 works with the precision of a digital synthesizer. Above 500 KHz a PLL system determines the specifications of the instrument.

Introduction to using the HM 8130

Selftest

When the HM 8130 is power up, it automatically performs a self-test routine, which checks all of the unit's important functions and the contents of the internal memories and registers. While self testing is going on, the type and version number of the EPROM appears in the display. If fitted, also the type of the interface installed is indicated together with the set IEEE-488-address. If the ***LOCAL***-pushbutton is depressed during power-up, the internal program halts until the pushbutton is released. Depressing it again the serial number of the instrument is shown on the display. Thereafter the HM 8130 returns to its standard self-test routine. Failures detected during self-test are indicated on the display.

General

The HM 8130 can be operated via the front panel, an external keypad, or IEEE-488, and RS 232 interfaces. The external keypad (HZ 830) and the interfaces (HO88, HO89) are available as options. All parameters of the instrument can be set easily by means of a digital rotary dial. The selection of the parameter to set is made via the function selection push buttons (10). After power-up the instrument is restored to the same operational state that it had been in before last being switched off. All settings are saved in a nonvolatile memory, and become valid again when using the instrument again.

Display

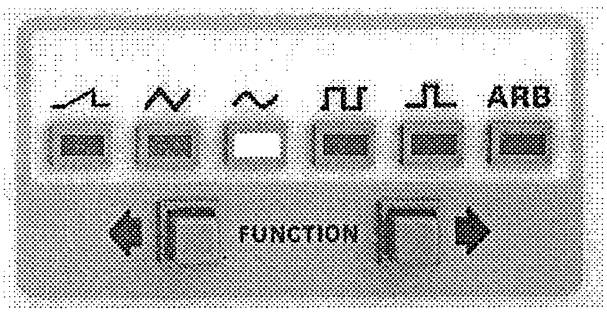
In normal operating mode, the display provides information about the frequency and amplitude settings, with indication of the units in each case. The frequency display shows 5 digits, and has a maximum resolution of 10 mHz. Amplitude values are displayed with 3 digits, and can be set to a maximum resolution of 1 mV. The displayed amplitude values presuppose that the output is unloaded, and must be divided by 2 to yield the correct value when using a terminating resistance of 50 Ohms. In addition, in normal mode the displayed values are peak-to-peak values. When the offset function is activated, the offset voltage is shown on this display. Here too, the displayed values refer to an unloaded output.

In pulse mode, when setting the pulse width the frequency display is switched to show the pulse duration. The duration of the positive pulse or - if a negative sign is stipulated by pressing the corresponding button - the negative pulse is displayed. In sweep mode, like in all other cases, the frequency display switches automatically among the sweep time, the start frequency, and the stop frequency, depending on the selected function.

Operation using the front panel

After selecting the desired waveform by pressing one of the pushbuttons (6), the two parameters frequency and voltage can be set with the rotary dial and the decade range switches. To do so, press either the ***Frequency*** button or the ***Amplitude*** button and then turn the rotary dial to obtain the desired value. When turning the rotary dial slowly, each step increments or decrements the smallest digit; turning the dial faster considerably speeds up the rate of change, thus permitting changes to be made rapidly over the entire frequency range of the HM 8130. The range can be changed by a power of ten in either direction using the two range switches /10 and x10.

When selecting the pulse waveform, the rotary dial can be used in the way just described to set the pulse width. If it is additionally desired to superimpose an offset value onto the output signal, then the size of this value can also be varied by selecting the offset function, and using the rotary dial.



Waveforms

The HM 8130 offers a choice among 6 different waveforms, of which 4 have fixed shapes that cannot be changed. With the sawtooth (ramp), triangle, sine and square-wave signals, only the frequency and amplitude can be varied. The pulse function permits the pulse width to be modified. The arbitrary function can be freely defined by the user (within the limits imposed by the HM 8130).

Sawtooth Because digital signal generation is used, the frequency range only extends from 10 mHz to 10 kHz. Linearity is better than 1%. The max. no-load output voltage is 20 Vpp. A positive-going or negative-going ramp can be selected by pressing (or not pressing) the ***Invert*** button (3).

Triangle The max. frequency is 100 kHz. Linearity is better than 1%. The maximum no-load voltage is 20 Vpp.

Sine Maximum frequency: 10 MHz.

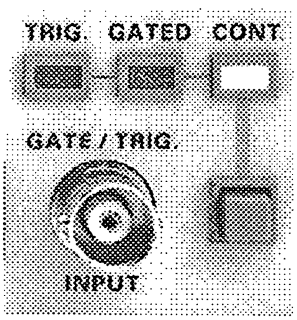
Square Maximum frequency: 10 MHz.
Rise time < 10 ns.

Pulse Positive and negative pulses can be generated at a maximum frequency of 5 MHz. The pulse width can be set to between 100 ns and 80 s. The largest settable duty cycle is 80%. The rise and fall times are as given for the square-wave signal. The output amplitude can be set to between -10 V and +10 V.

Arbitrary The maximum signal frequency is 100 kHz at a sampling rate of 10 MHz. The resolution of the definable signal is 1024 points in both axes (x and y); this corresponds to 10 bits. For more detailed information on this function, please refer to the section "Arbitrary waveform".

Operating modes

The HM 8130 permits different operating modes to be used. Besides the standard operating mode ("continuous"), it offers the possibility of generating signals either in response to a trigger event or gating signal. The operating mode is selected with pushbutton (5). The factory setting is continuous mode. To activate the sweep feature, press the "***Sweep On***" button.



The following combinations of operating modes are possible: With the sweep feature disabled, in continuous mode the generator operates at the frequency shown in the display. The resulting signal is then continually available at the output jack (15). In gated mode, the output signal is controlled (modulated) by a signal applied to the gate/trigger input (4) on the front panel. This operating mode is asynchronous, i.e. the output signal can be tapped or interrupted at any point in its phase, or in other words, signal generation begins immediately regardless of the momentary phase condition. An output signal is always generated when an applied TTL-compatible gating signal is "high". When a "low" signal is applied to the gate input, no signal is output.

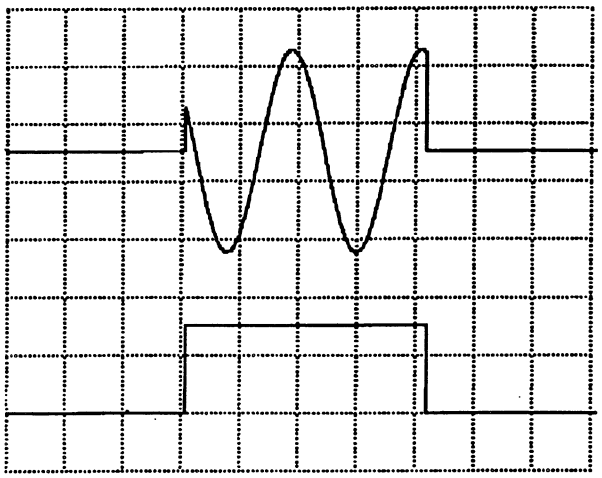


Figure 3: Output signal controlled by Gate-signal

In triggered mode, the trigger signal is also applied to input (4). This operating mode is synchronous, i.e. an output signal generated in response to a trigger signal starts at the zero crossing. One or more signal periods are generated, depending on the length of the trigger signal. This permits generation of bursts, although the number of oscillations per burst is not programmable.

The trigger mode works with all signal functions within the indicated frequency ranges, with an upper frequency limit of 500 kHz for sine, square and pulse signals. If the duration of the trigger pulse is shorter than the signal period, only one signal period is generated. A burst signal ends upon completion of the signal period during which the negative slope of the trigger signal is received.

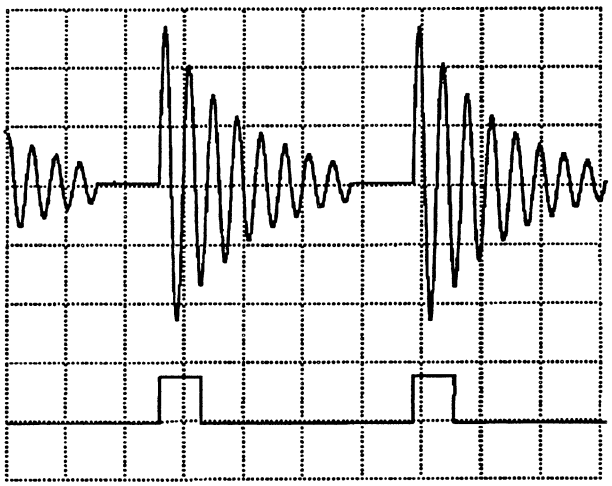
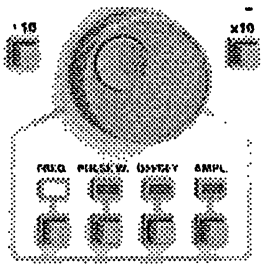


Figure 4: Output signal controled by trigger-signal

With the HM 8130, bursts can only be generated with the aid of an external trigger signal. This can come from an interface, from the external keypad, or from an external generator.

If the sweep feature is enabled, sweeps are continuously performed in continuous mode. The gate function cannot be used in sweep mode.

Setting the parameters



All of the parameters of each function can be set simply and precisely using a (digital) rotary dial and two decade range switches. The first step is to select the parameter to be changed by pressing the corresponding button (frequency, pulse width, offset, amplitude) below the rotary dial. When one of these parameters has been selected, this is indicated by a lit LED. The operating parameters of the sweep function can be set in the same way, except that they must be selected using the buttons situated next to the sweep function.

Frequency

The frequency of the output signal is set using the digital rotary dial and the two buttons for changing the frequency range by powers of ten. The rotary dial has an acceleration-dependent resolution; in other words, turning it slowly will increment or decrement the value of the smallest digit, but turning it faster advances through the frequency range in larger steps. Before the frequency can be set, the "Freq." button must be pressed to activate this parameter.

Pulse width

The pulse width for the pulse function is changed using the same rotary dial as for frequency. To do so, first press the "***Pulse W.***" button to enable this parameter. When the pulse function has been selected, the currently set pulse duration appears in the display. The displayed value refers to the positive pulse duration. Only pulse durations within the permissible range for the selected frequency are displayed. Attempts to set a time value outside of this range causes an audible beep, and the entry is not accepted. The maximum pulse width is defined by the following formula: pulse width = 0.8 / frequency. If the ***Invert +/-*** button (13) is pressed, negative pulses are generated. In this case, the time for the negative pulse width is shown in the display. If the sweep function is enabled, the pulse width is determined by the highest stipulated start or stop frequency.

Amplitude

The output amplitude is basically changed in the same way as the two parameters just described. The value shown in the display is the peak-to-peak voltage for the output in an **unloaded** state. Pulses start at the zero crossing, and are either positive or negative, depending on whether or not the ***Invert +/-*** button (13) is pressed. The positive or negative signal amplitude - in reference to the baseline - is then shown in the display.

The ranges for setting the output amplitude are as follows:

	Unloaded	Into 50 Ohms
Range 1	2.1 V to 20 V	±1.05 V to ±10 V
Range 2	0.21 V to 2.0 V	±0.105 V to ±1 V
Range 3	20 mV to 200 mV	±10 mV to ±100 mV

The "decade" buttons can be used to manually switch among these ranges. The rotary dial (9) is used to vary the amplitude within each range, with the next-highest or next-lowest range being automatically switched to when the limits of the current range are exceeded. When the output is loaded with 50 Ohms the values shown in the display must be divided by 2 to obtain the correct result. If an offset voltage is added, then it may not be in a higher range than the amplitude setting (see section on offset below).

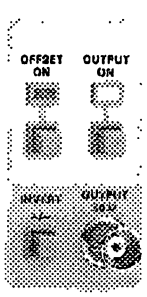
Offset

A negative or positive DC offset voltage can be superimposed to the output signal. This function is enabled by pressing a button, and an LED lights up to indicate that it is active. The rotary dial (9) is used in conjunction with the **Invert** button and the decade range buttons in the same way as already explained to set the value for the offset voltage. The maximum possible offset voltages are as follows:

Range 1 ±7.5 V
Range 2 ±0.75 V
Range 3 ± 75 mV

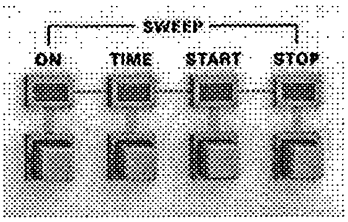
The offset voltage cannot be within a smaller range than the value selected for the amplitude. For example, an offset of 5 V cannot be used for a signal voltage of 20 mV. Within a given range, the offset voltage can be varied continuously from negative to positive values. For setting resolution in these cases please refer to specs. **Attention:** If, while the offset function is disabled, an offset value is selected that exceeds the maximum value of the range within which the signal amplitude has been set, then upon activation of the offset function the set offset value will be automatically deleted and not superimposed to the output signal. The same conditions apply to use of the offset with the sweep function.

Signal output



The signal output of the HM 8130 has an impedance of 50 Ohms and can be switched on and off using the ***Output On*** button (14). If an offset voltage is being used, it is also switched on and off by this button. An LED lights up to indicate that the output is active. The ***Invert +/-*** button is used to reverse the polarity of the output signal.

Sweep mode
Sweep mode can be additionally enabled to supplement the operating modes continuous, gated and triggered. Sweep mode is activated by pressing the "***Sweep On***" button, and the fact of its being enabled is indicated by the LED above this button.



The parameters of sweep time, start frequency and stop frequency can be set independently of each other. This is done in the same way as when setting the normal frequency. The parameters can also be set or changed while sweep mode is active (on-line), and the changes immediately become visible. In such cases the sweep currently in progress is interrupted, regardless of where it is at that point in time, and a new sweep is started. At the same time, the activated parameter is shown in the display. However, such on-line changes are subject to the condition that the start and stop frequency must be within the same frequency range (range 1: 10 mHz - 550 kHz; range 2: 450 kHz - 10 MHz). As soon as sweep mode is enabled, the start frequency is shown in the display, unless the stop frequency is currently being selected. The sweep proceeds linearly from the start frequency to the stop frequency, and can go either from low to high frequencies or vice versa. It is not possible to program a sweep to cross from one range to another; although the start and stop frequencies can be set in different ranges while the sweep mode is disabled, such settings will be ignored upon activation of sweep mode. A sawtooth signal corresponding to the sweep pattern is then available at the BNC jack ***Sweep Out*** (19) on the rear panel. The output voltage range is 0 V (start frequency) to +5 V (stop frequency).

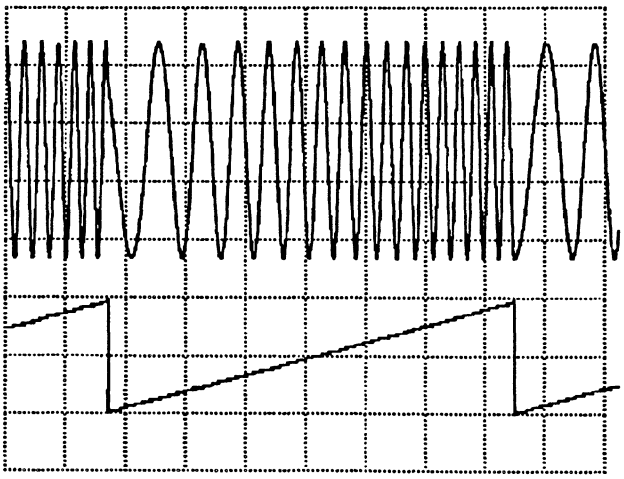


Figure 8: Sweep mode; sawtooth output

Controlling the output voltage
The HM 8130 lets you vary the output signal by means of an applied external DC voltage. The ***Ampl. Control*** jack (18) on the rear panel is used to input the control voltage. A signal between 0 V and +5 V applied to this jack diminishes the output voltage of the HM 8130, and changes the **set** output voltage to zero volt. **Attention: The displayed output voltage remains unchanged.** If the output is not terminated (no-load), then the output voltage can be calculated using the following equation: Vout(pp) = Vdisplay x K, where K = (5 V - external DC voltage) / 5. The output voltage of the HM 8130 is varied within the previously set voltage range. By applying an external voltage of 5 V, it is also possible to achieve an output voltage of approx. 0 volt at the output of the HM 8130.

Amplitude modulation
The HM 8130 is not equipped with any internal means of generating an amplitude-modulated signal. However, the **Ampl. control** jack (18) on the rear panel described in the previous section can be used for this purpose. An external signal for amplitude modulation can be input there. Modulation factors up to 100% can be achieved. Since a bipolar signal is needed for modulation, it is necessary to superimpose a DC offset voltage of 2.5 V to this input in addition to the modulation signal. Ideally, this should be obtained from a function generator with an offset function (e.g. the HM 8030). In such cases, however, the amplitude appearing in the HM 8130's display is greater than the actual output voltage.

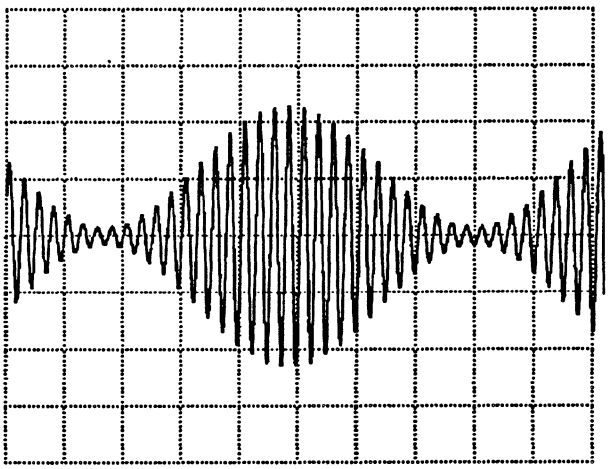


Figure 9: Sinewave with AM

To set the external DC voltage for optimum amplitude modulation symmetry, proceed as follows:
1. Do not apply any signals to the external input.
2. Set the HM 8130 to the desired output voltage (Vout(pp)).
3. Measure the amplitude of this signal.
4. Apply a DC signal to the external input. Keep increasing this voltage until the output voltage of the HM 8130 falls to 50% of its previous amplitude.
5. Apply the AC voltage for setting the desired modulation factor.

The modulation factor will now remain constant, regardless of the set amplitude for the generator output voltage. The generator output signal is modulated invers to the ext. modulation signal.

Arbitrary function

In addition to the fixed signal shapes, the HM 8130 also allows generation of a user-definable waveform. When defining this signal, however, certain rules and limiting specifications must be observed. These are described in the following.

Arbitrary signals are digitally generated, and can therefore be defined with fairly good resolution. The frequency and amplitude of a waveform defined in this way can be varied like with the "hard-wired" signals. Besides the constraints imposed by the equipment specifications (due to the integrated D/A converter), it must always be taken into account that freely defined and digitally generated curve shapes are accompanied by harmonics situated far above the actual signal frequency. When using such signals, Therefore, it is important to keep in mind the effects that they can have on circuits under test.

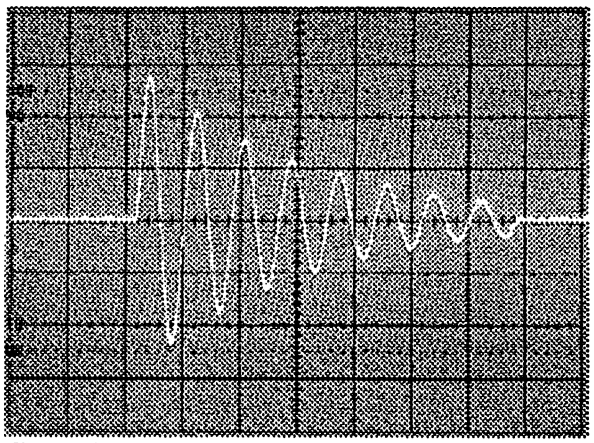


Figure 10: Arbitrary signal (default shape)

With the HM 8130, arbitrary signals can be defined in any of three different ways - either using an attached HZ 830 (optional accessory), by way of an interface (also available as an optional accessory), or by downloading a signal from an HAMEG HM 408 oscilloscope. Once such a signal has been defined, it is stored in the HM 8130's memory and can be dealt with just like one of the "hard-wired" signals.

For this purpose, the HM 8130 is equipped with memory space in the form of a 1024x1024-point matrix. This is equivalent to a resolution of 10 bits each in the horizontal and vertical directions. The contents of this matrix correspond to one signal period. The y-axis is for the amplitude values, and the x-axis represents the phase values. The possible amplitude values extend from -511 to +512, and the phase values from 0 to 1023. A signal between -511 and +512 generates an amplitude of ±10 V at the HM 8130's output (under no-load conditions) when the amplitude is set to 20 Vpp.

Although it is theoretically possible to use the external keypad to enter all of the required phase and amplitude values, it is thus time-consuming that preference is generally given to letting the HM 8130 perform linear interpolation on the basis of a few reference points. In this case, the firmware installed in the HM 8130 uses interpolation to draw a linear connection between two entered reference points. The keyboard can then be used to enter additional reference points or vary the original ones, thus modifying the curve.

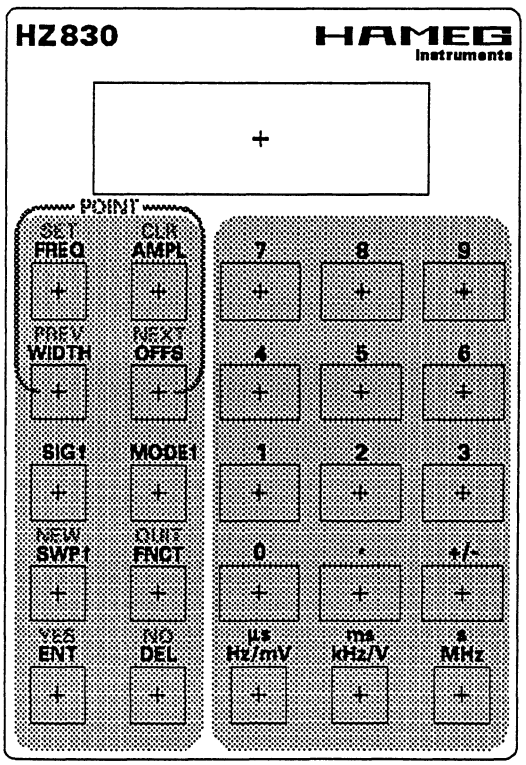
More detailed instructions on entering values are contained in the following section on the external keyboard.

The external keyboard HZ 830

The HZ 830 keyboard was developed to permit quick and convenient changing of the HM 8130's operating parameters. It can also be used to program the arbitrary function without having to resort to an additional interface and a computer. All setting functions available on the front panel can also be accessed from the keypad. In addition, more features can be accessed:

- Storage and recall of 9 complete sets of equipment settings.
- Resetting to the default (factory) settings.
- Manual trigger functions.

There are 25 keys for performing entries. As entries are made, they are echoed to an 8-character alphanumeric display. The set parameters can also be read off there.



Caution! Always turn the HM 8130 off before plugging in or unplugging the keyboard!

The display shows the value as it is entered.

3. Select a unit, e.g. **kHz**.
   The value is shown in the display as **123.45+3**.
4. Press "**ENT**" (enter) to acknowledge.
   The entered value now appears on the display of the HM 8130.

Attempts to enter illegal values, i.e. outside of the specified ranges, are responded to by an error message "ERROR" in the display, and an audible alarm beep. If a value is accepted, then "ok" appears in the display. As long as a value has not yet been acknowledged by pressing "**ENT**" (enter), it can be cleared by pressing "**DEL**" (delete).

A special feature must be observed when entering amplitude values. If a value is entered **unsigned**, then the equipment assumes that it represents the peak-to-peak voltage (with pulses the peak voltage is half as large). For symmetrical signals (sine, square, etc.), the actual value is then twice as high and the sign is meaningless. With pulses, the peak value is equal to the signal amplitude. The polarity, in reference to 0 V, is then given by the sign.

The waveshape is selected using the **SIG** key. The first time this key is pressed, sine-wave is selected; pressing it again selects square-wave, etc. When the desired function is reached, it must be confirmed by pressing "**ENT**". This setting is then immediately accepted by the HM 8130. If a selection has not yet been acknowledged, the function can be exited with no effect by pressing "**DEL**". Then the waveshape setting in the HM 8130 is not changed.

Selecting the operating mode
Selection of operation mode via keyboard is similar to frontpanel operation.

Sweep mode
The HM 8130 is equipped with an internal sweep function. This permits linear sweeps to be performed in two frequency ranges, with the sweep time, start frequency and stop frequency being freely definable. The frequency ranges are: 10 mHz to 550 kHz, and 450 kHz to 10 MHz. It is not possible to perform sweeps across both ranges. However, the fact that the two ranges overlap lets sweeps be performed in the important AM-IF range.

The first time the "**SWP**" (sweep) key is pressed, the message "***swp on?***" appears in the display. If "**ENT**" is now pressed, the sweep mode is enabled. If the HM 8130 is already in sweep mode, then the suggestion "***swp off?***" is displayed. Pressing "**ENT**" here disables the sweep mode. Pressing the "**SWP**" key again without acknowledging changes the display to a request to change the start frequency: "***START?***". If desired, at this point the start frequency can be entered (see the section on data entry) and acknowledged. Pressing the "**SWP**" button once again advances to the stop frequency: "***STOP?***". The last parameter reached in this way is the sweep time: "***TIME?***". The setting mode can be exited at any time by pressing "**DEL**".

The function key "FNCT"
The function key is always pressed in conjunction with one of the numeric keys. In this way, additional functions can be accessed from the keyboard.

FNCT 0: Switches the output off/on*.
FNCT 1: Enables/disables the offset function*.
FNCT 2: When this function is selected, "TRIG?" is displayed, and a trigger signal is emitted as soon as the "**ENT**" key is struck. If the HM 8130 is in triggered mode, a signal period is thus started. If sweep mode is enabled, a complete sweep is started*.
FNCT 3: Switches the signal generator on/off*.
FNCT 4: Stores equipment settings.
FNCT 5: Recalls equipment settings.
FNCT 9: Activates the arbitrary editor.
* Confirm with "**ENT**"; exit with "**DEL**".

Functions 4 and 5 permit access to the HM 8130's feature for storing parameter settings. Each set of values comprises frequency (including start and stop frequencies), amplitude, offset values, operating mode, waveshape, sweep time, and pulse width. These values can be stored in any of the 9 selectable registers, and can be recalled at any time. Register 9 is read-only, and contains the factory (default) settings. The HM 8130 only permits storage of one arbitary function, which remains as it is until overwritten by a new "curve".

Attention! When invoking the contents of register 9, the stored arbitrary function (if any) will also be overwritten by the curve stored in the factory.

Arbitrary editor (function 9)
The arbitrary editor mode can be called by entering the key combination **FNCT 9**. In this mode, combinations of amplitude and phase values defining the arbitrary curve can be successively entered. The phase values (0-1023) are designated as x-values, and the amplitude coordinates (-511 to +512) as y-values (corresponding to the max. positive and negative amplitudes). The duration of the pulses defined by the entered values is fixed at 100 ns, and cannot be changed. This yields a upper frequency limit of 10 kHz in arbitrary mode for a signal with 1024 values defined in the x-axis. If fewer than this number of values are entered for such a signal, which is the normal state of affairs, the microprocessor of the HM 8130 automatically calculates the values lying between the **reference points**. At a signal base frequency of 100 kHz, correspondingly fewer (approx. 100) points per period are used. At low signal frequencies, this also results in signals consisting largely of calculated values. A relatively small number of reference points is generally sufficient when "constructing" an

arbitrary function with the HM 8130. The intermediate points are calculated, and hereinafter are referred to as **"calculated values"**. Reference points and calculated values are both automatically stored when exiting the arbitrary editor. **The point with the phase value of zero is always a reference point**, and its default amplitude setting is 0, although this can be changed using the editor.

The front panel in editor mode
In editor mode, the front panel of the HM 8130 is disabled for normal operation. The display shows the following information: amplitude values (y) in the right-hand section with 3 digits, and the corresponding amplitude phase values in the left-hand section with 4 digits. Reference points are indicated by a leading "A" in the left-hand display section. By contrast, calculated values are preceded by a blank. The phase data can be "scanned" using the rotary dial. This can be utilized to easily gain an overview of the stored amplitude values. The "***NEW***" key deletes all stored arbitrary values, i.e. all reference values are deleted and the amplitude values are reset to zero. The "zero-phase point" (y = 0) is then the only value remaining in memory. The "New" key should be pressed if it is wished to define a new signal. However, this key **should not be pressed** under any circumstances if it is only wished to modify the already stored signal.

Entering reference points
To enter a new reference point, proceed as follows:

Key	Display	Remarks
SET	SET pnt?	Must be acknowledged
YES	x=____	Acknowledgment
100	x=_100	Data entry
ENT	Y=____	Acknowledgment
-200	Y=-200	Data entry
ENT	X=____	Acknowledgment and
or		entry of a new value
DEL	ok	Exits function

Deleting a single reference point
The "***CLR***" key is used to delete reference points from the arbitrary memory. The first point (x = 0) is always a reference point and cannot be deleted. In this case, pressing the "***CLR***" key only resets the amplitude value to zero. Otherwise, proceed as follows:

Key	Display	Remarks
CLR	CLR pnt?	Must be acknowledged
YES	x=____	Acknowledgment
100	x=_100	Data entry
ENT	ok	Point has been deleted

Displaying reference points (next, previous)
The **NEXT** and **PREV** keys are used to "scan" the reference point list, starting at the current position in memory. The coordinates of each successive point as displayed. If no further reference points are found, then a beep sounds and it can be concluded that the display is showing the first or last stored reference point. The last value has no y-coordinate. The first point always has a y-value stored for it.

The rotary dial can be used to scan the data ***between*** the defined reference points. When doing so, it should be kept in mind that the calculated values are not recalculated until the edit mode is exited. Then, if reference points have been added or deleted, the intermediate values are calculated anew. To exit this mode, press **Quit** followed by **ENT**.

Interfaces
The HM 8130 can be equipped with an IEEE-488 bus (optional accessory HO 80) or a serial interface (HO 89). These are either installed in the factory (if specified in your order), or can be field installed added at any time if required. With an interface installed, the HM 8130 understands the following commands:

Commands without data

SIN	Sinewave signal function
TR	Triangle signal function
SQR	Squarewave signal function
PLS	Pulse signal function
RMP	Sawtooth, positive-going
RMN	Sawtooth, negative-going
ARB	Arbitrary function

SW1/0	Sweep mode on/off
CTM	Continuous mode
GTM	Gated mode
TRM	Triggered mode
OT1/O	Output signal on/off
OF1/O	Offset on/off

DFR	Display signal frequency
DST	Display start frequency
DSP	Display stop frequency
DWT	Display pulse width
DSW	Display sweep time
DAM	Display output amplitude
DOF	Display offset voltage

RMO Disable REMOTE status. The front-panel controls can again be used for operation. This condition can also be brought about by pressing the ***Local*** key. **Note:** ***RMO*** also terminates a sent **LK1** command.

LK1 Enables local-inhibit status. The **LOCal** key is disabled. The HM 8130 can now only be controlled via the interface. It is not possible to switch back to local status by pressing the **LOCal** key.
LK0 Disables local-inhibit status. It is now possible to return the unit to local status by pressing the **LOCal** key. The front-panel controls can be used again. **Note:** the **RM0** command also has the effect of terminating **LK1** status.

TRG Triggers a signal period (sweep off) or a complete sweep (sweep on).

CLR Resets the HM 8130 and returns all settings to their default states*. **CLR** has the same effect as the IEEE-488 command ***SDC***.

ARC Deletes all arbitrary data and resets the internal arbitrary counter to zero.

ARE Terminates the arbitrary editor.

***Default settings:** Frequency: 1 kHz; start frequency: 2 kHz; stop frequency: 10 kHz; amplitude: 10 V; offset voltage: 1 V; sweep time: 100 ms; pulse width: 50 µs; signal shape: sinewave; sweep off; offset disabled; positive pulses; positive-going sawtooth. Stored values and the arbitrary data remain in memory.

Commands with floating-point data

Format: all commands with floating-point data consist of 3 letters followed by a colon. The maximum data length is 5 digits plus a decimal point. The format is unrestricted in the sense that data with or without an exponent, with or without a decimal point, or in the form of a floating-point number will all be accepted. With fixed-format data the units V, Hz and sec are not explicitly transmitted. If necessary, the data can be preceded by a sign. Positive signs can be left off. No blanks are allowed between sign and value.

Examples:	FRQ:1000	FRQ:1000.0
	FRQ:1E3	FRQ:1E+3
	FRQ:1.0000E+3	FRQ:10E+2
	FRQ:0.0001E7	FRQ:10000E-1

Available commands:

FRQ: <Data>	Set frequency to	<.....>Hz*
STT: <Data>	Set start frequency to	<.....>Hz*
STP: <Data>	Set stop frequency to	<.....>Hz*
SWT: <Data>	Set sweep time to	<.....>s*
WDT: <Data>	Set pulse width to	<.....>s*
AMP: <Data>	Set amplitude to	<.....>V**
OFS: <Data>	Set offset to	<.....>V**

*max. of 5 digits **max. of 3 digits

The amplitude can be set in either of 2 different ways. If an unsigned value is entered, it is assumed that a peak-to-peak voltage is desired (in the case of pulsed signals, the peak voltage is equivalent to half of this value). Signed values are assumed to be peak voltages. With symmetrical signals, the peak-to-peak voltage is then twice as large and the sign is irrelevant. With pulses, the output voltage is as entered and the polarity is indicated by the sign.

Commands with whole-number values

These commands are used with an equals sign. No exponents or decimal points are allowed. Each data string can contain up to 4 digits. If necessary, a sign can be added. Positive signs are not necessary. No blanks are permitted.

STO=<Data>	Store values	<0...8>
RCL=<Data>	Read values	<0...9>

ARB=<Data> Read in arbitrary data and increment the internal counter. Data range: -511 to +512. Up to 1023 data values can be input.

ARP=<Data1>:<Data2> Input of a reference point with the values Data1 (x) and Data2 (y).
Data1 (x): -511 to +512
Data2 (y): 0 to 1023

Request commands

These command cause a string to be generated that can then be read out as soon as the HM 8130 is addressed as a Talker. The following commands fetch data on:

FRQ?	Frequency
STT?	Start frequency
STP?	Stop frequency
SWT?	Sweep time
WDT?	Pulse width
AMP?	Output voltage
OFS?	Offset
ARD?	Arbitrary data
ID?	Device ID
VER?	Equipment version
STA?	Device status

The output values are in floating-point format with exponents. Each string begins with the respective command itself:

"FRQ:1.2345E+3"
"OFS:-3.0E+0"
"WDT:45.6E-6"

The CLR command

The resulting string is 21 characters long and indicates the status of the front panel. The following sequence is used (blanks are not normally contained in the string, and have only been added here to improve readability):
Status after **CLR** command:

OT0	**OF0**	**SW0**	**SIN**	**CTM**	**DFR**	**DAM**
1	2	3	4	5	6	7

1 Output on/off
2 Offset on/off
3 Sweep on/off
4 Signal type (here: sinewave)
5 Operating mode (here: continuous)
6 Display contents (right), here: frequency
7 Display contents (left), here: amplitude

Output of arbitrary data

The **ARD?** command resets the internal arbitrary counter to 0 and permits output of the data stored in memory. Each time the HM 8130 is addressed as a Talker, a new value is output and the arbitrary counter is incremented by one. For complete output of the data stored in memory, it is necessary to send the **ARD?** command once and then address the HM 8130 1024 times. The counter then counts from 0 to 1023. The **ARD?** command can be terminated by any other request command containing a "?". Each string output in response to **ARD?** is 6 characters long. Reference points are marked by "R" and calculated values by "C".

Example:
ARD? is sent
Talk string: "R=+100" Reference point x=0, y=100
Talk string: "R=+100"Calculated value x=1, y=100
Talk string: "R=+102"Calculated value x=2, y=102
...
Talk string: "R=-511" Ref. point x=1023, y=-511
Talk string: "no leading command" - no data

The following examples illustrate several data strings and what they accomplish.

"FRQ:12.3E+3 TRI OT1 AMP:10"
Frequency 12.3 kHz; triangle; output on; output voltage amplitude 10 V.
"ARC ARD=500"
Delete all arbitrary data and send the first data string.
"ARD=501"....."ARD=455"
Send the next data string ... Send the 1024th data string.
"ARB TRM FRQ:1"
Enable the arbitrary function in triggered mode.
"ARC" Delete arbitrary data.
"ARP=100:500"
Set a reference point at x=100 y=500.

RS-232 interface (Option HO89)
The RS 232 interface HO89 is available as an optional accessory for the HM 8130. The instrument can be easily retrofitted with this interface at any time. The installation procedure is described in the manual for the HO89. The commands for controlling the HM 8130 by the RS 232 interface are basically the same as for the IEEE-488 interface. Please refer to this section.
The HO89 interface is a serial, full duplex interface that complies with the European V.24 standard. The baud rate is automatically detected by means of a start character (space). The operating system of the card is equipped with the following built-in commands:

***#VR**	send Version
***#CR**	send Copyright
#X1/0	XON-XOFF-Protocol on/off
#BC	clear all I/O buffers
+#BD	Enable newly programmed baud rate
+#W7	Select 7bit word length
+#W8	Select 8bit word length
+#S1	Select 1 stop bit
+#S2	Select 2 stop bits
+#PN	no parity
+#PE	"Even" parity
+#PO	"odd" parity
***#ST**	send status

The listed commands marked with an asterisk* cause the HM 8130 to output a reply. The formats of these replies are:
a) #VR Hameg HO89 Version 1.OD 210290
b) #CR (c) 88/89 By MTE - SoftwareX
c) #ST HM232 W(7/8) S(1/2) P(N/EO) X(1/0)

Setting the transfer parameters

The commands marked with an "+" in the table are used for this purpose. a command string is passed to the interface; the last command in the string is #BD. This has the effect of simultaneously activating all of the commands that have been passed to the interface in the string. Afterwards the baud rate is also redetermined.

Automatic baud rate detection
The first character that must be sent to the interface when power on or after the #BD command is a space (20h). The interface needs it to calculate the baud rate used for transmission, and automatically adapts it to it. If any other character or an incomplete character is received, the system is prevented from working.

DIP switch settings

Nr	On	Off	Function
1	7	8	Wordlength
2	1	2	Stop bit(s)
3	on	off	Parity
4	even	odd	Parity
5	CR	CR+LF	End of transmiss.

Xon/Xoff protocoll
The command #x1 is used to activate so-called software handshaking (it is encountered by the command Xo). In software handshaking mode, data transfer between the computer and the interface is no longer synchronized by the hardware lines; instead, this function is performed by 2 commands: Xon = 11h = continue transm.
Xoff = 13h = halt transmission

Equipment
60 MHz Oscilloscope (HM604)
Digital Multimeter (HM8011)
Spectrum Analyzer (HM8028 + HM203)
Frequency Counter (HM8021-3)
Distortion Meter (HM8027)

A power divider is necessary to monitor the output signal on the oscilloscope and the spectrum analyzer simultaneously. It can be easily built according to the following drawing.

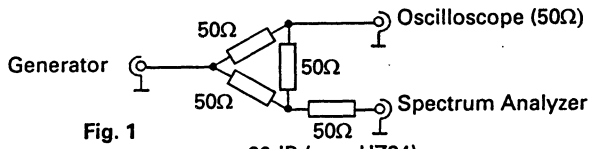


Fig. 1

Preparation
For a first time calibration, set all potentiometers to center position.
For a partial calibration please refer to the respective settings.

Calibration procedure:

1) Output Amplifier DC Gain
Signal: Square Wave, Frequency = 50Hz, Amplitude = 2.0V
Output connected to the oscilloscope (50Ω input impedance).
Adjust VR18 to obtain a square wave on the oscilloscope screen.

2) Offset Null
Mode: Gated, Amplitude = 20V, Offset: OFF
Output connected to the multimeter (0.2V) without load.
Adjust VR11 for 0 ± 10mV reading.

3) Max. Offset
Mode: Gated, Amplitude =20V, Offset:ON; Offset = 7,5V.
Output connected to the multimeter (20V DC) without load.
Adjust VR17 to obtain 7.5V ± 50mV einstellen.

4) LF Signal Offset
Offset: OFF, Signal: Sine Wave, Mode: TRIG,
Amplitude = 20V, Frequency = 1kHz
Output connected to the multimeter (0,2V DC) without load.
Adjust VR10 for 20mV ± 10mV reading.

5) LF Signal Amplitude
Offset: OFF, Signal Sine Wave, Mode: CONT,
Amplitude = 20V, Frequency = 1kHz
Connect the DMM (2V AC) between TP1 (output of U45) and ground.
Adjust VR9 for 0.707V ± 10mV reading.

6) Max. Output Voltage
Same conditions as above.
Connect the DMM to the output of the HM8130 (no load)
Adjust VR14 for 7.07V ± 10mV reading.

7) Min. Output Voltage
Change the Output Voltage to 2.1V.
Adjust VR15 for 0.742V ± 1mV reading.
Repaet steps 6) (20V) and 7) (2.1V) until both settings are correct.

8) Positive Pulse Amplitude
Signal: Positive Pulse, Frequency = 1kHz, Amplitude = +10V, Pulse Width = 100µs, Mode: CONT
Oscillocope connected to the output without 50Ω load.
Adjust VR13 to obtain a +10V pulse on the oscilloscope screen.

9) Negative Pulse Amplitude
Change the signal to negative Pulse. Frequency = 1kHz, Amplitude = –10V
Adjust VR12 to obtain a –10V pulse on the oscilloscope screen.

10) Pulse Width
Signal = Positive Pulse, Pulse Width = 100µs, Frequency = 1kHz
Connect the frequency counter (function = positive pulse width measurement) to the output of the HM8130.
Adjust VR8 to obtain 100µs ±1µs.

11) Distortion
Signal = Sine Wave, Frequency = 1kHz, Amplitude = 2.1V.
Connect the Distortion Meter to the output of the HM8130.
Adjust VR3 for the lowest possible distortion.

12) Output Amplifier Response
Signal = Square Wave, Frequency = 1MHz, Amplitude = 20V.
Connect the oscilloscope to the output through a 50Ω load.
Adjust VC3 for lowest aberation and fastest rise time.

13) PLL Settings
Signal = Sine Wave, Amplitude = 2V.
Connect the power divider to the output of the HM8130. One output feeds the oscilloscope through a 50Ω load, the other output is connected to the Spectrum Analyzer (see fig. 1).
Connect a probe (1:1) to TP4.
Set the frequency of the HM8130 to 50kHz and adjust the oscilloscope for a 6 div. vertical deflection. take care that the signal is exactly centered on the oscilloscope screen (DC coupling). The sensitivity and vertical setting of the oscilloscope should not be modified during this test.

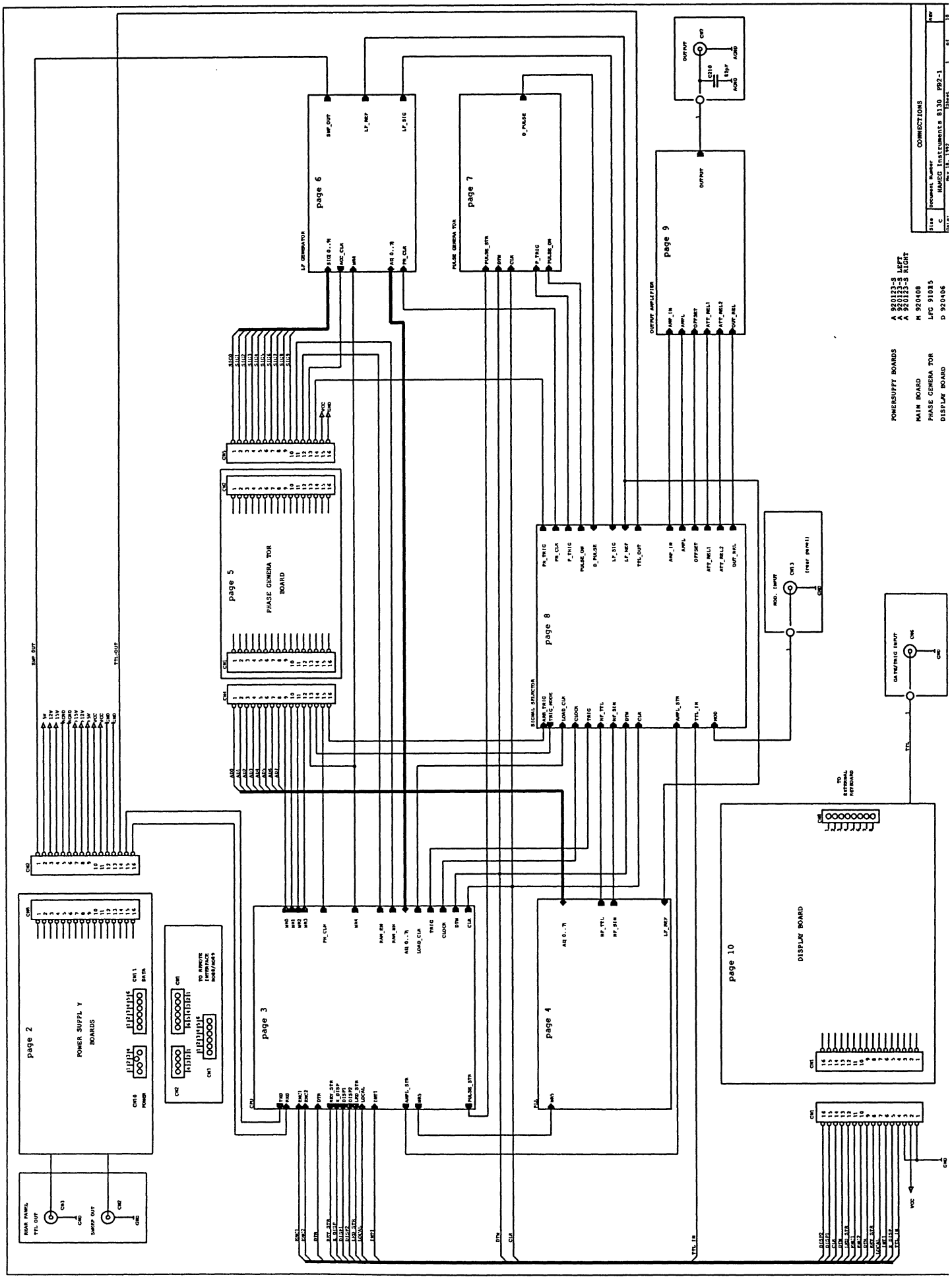
The following setting is only necessary for the first time calibration of the HM8130:
Adjust VR4 to center position. Adjust for a sine wave signal with 6 div. vertical deflection on the screen by means of VR5 and VR6. Center the signal on the oscilloscope screen by means of VR19. Change the function to square wave and adjust for a 50% duty cycle by means of VR2. Change function to sine wave again.

a) Frequency = 3MHz
Adjust for lowest harmonic distortion by means of VR2.
Check with spectrum analyzer.

b) Frequency = 501kHz
The following settings should be adjusted for the best possible results:
VC2 for 0V ± 0,5V at TP2.
VR1 for the lowest possible 2nd harmonic.
VR5 and VR6 for lowest overall harmonics.
VR19 to center the signal on the screen.
When all settings are done and the level on the oscilloscope is lower than 6 divisions, increase up to 6 div. again by means of VR4 and adjust all settings again.

c) Repeat steps a) and b) untill all settings are correct.
Change the frequency to 10MHz and adjust VC1 for a 5V ± 0,5V reading at TP4.

14) Frequency Accuracy
Frequency = 1MHz, Signal = Square Wave..
Adjust VC4 for 1MHz ± 5Hz.


page 2
POWER SUPPLY BOARDS
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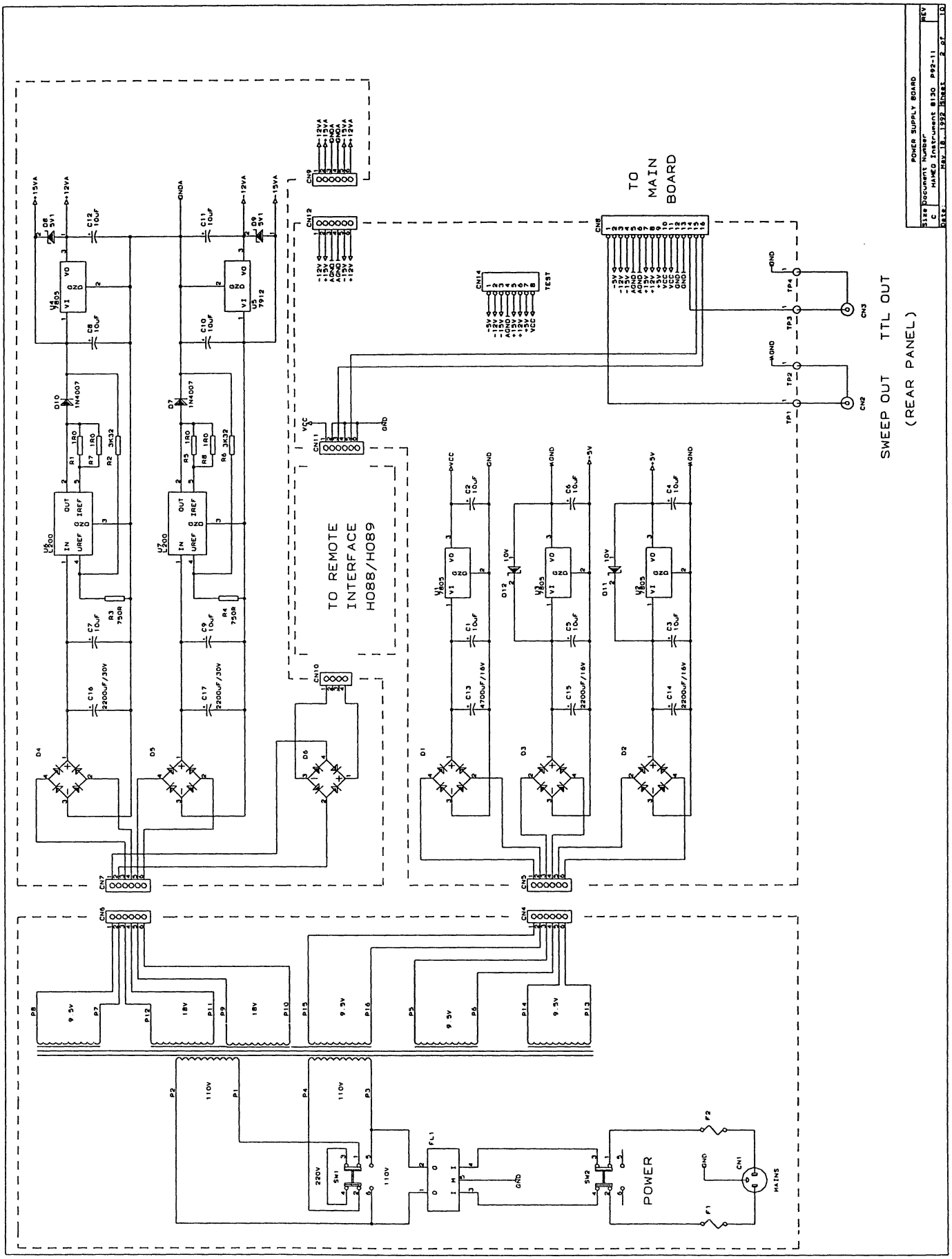
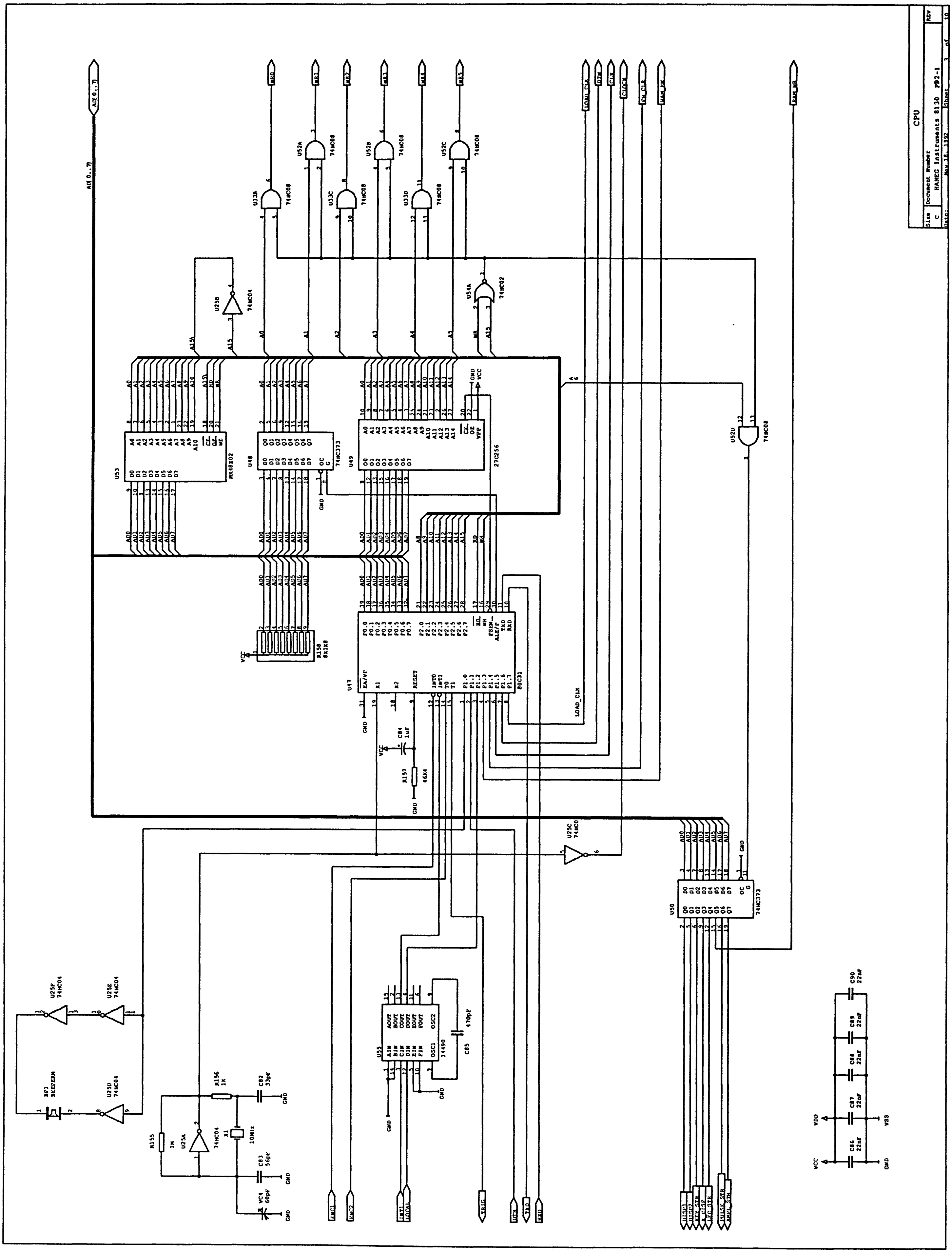
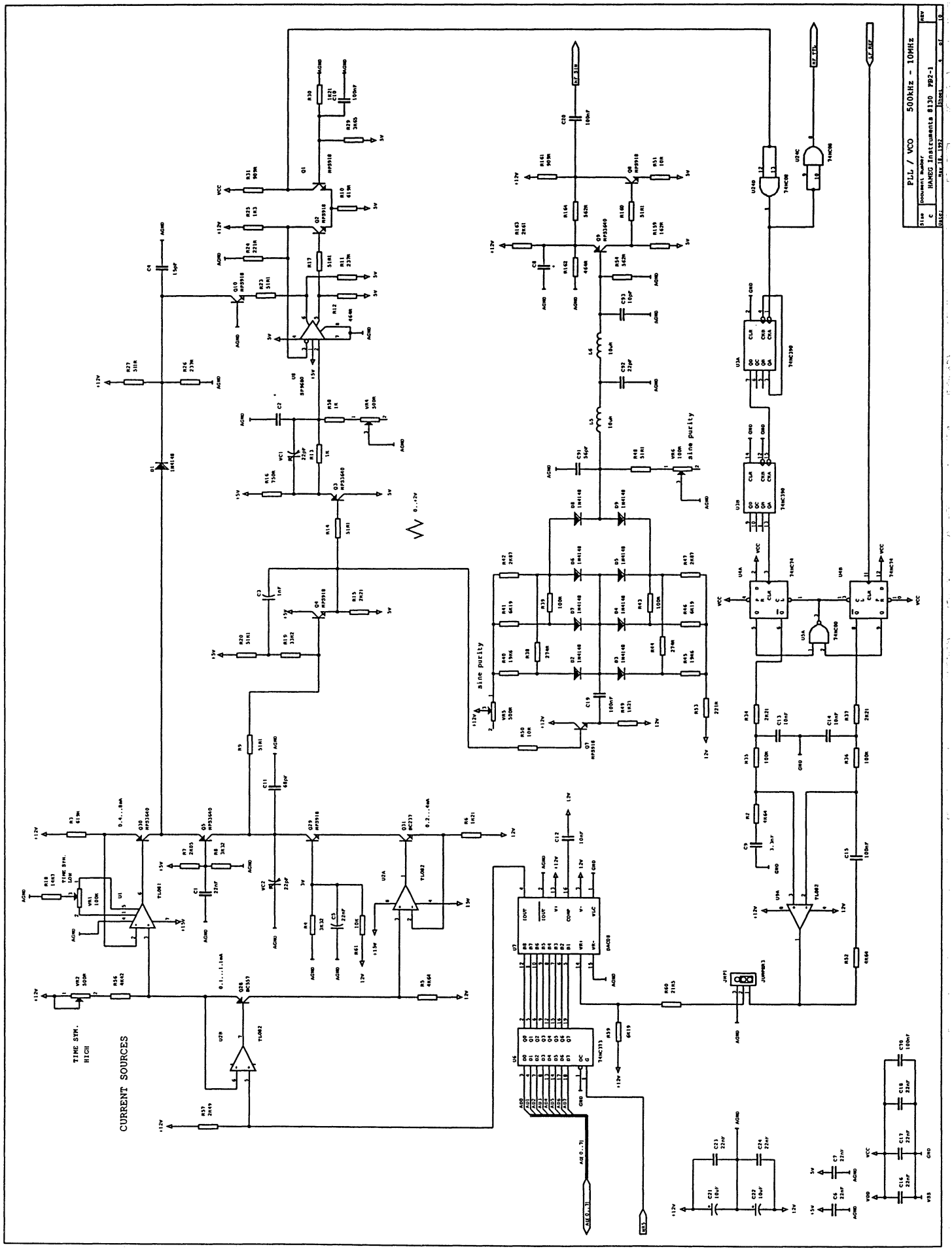
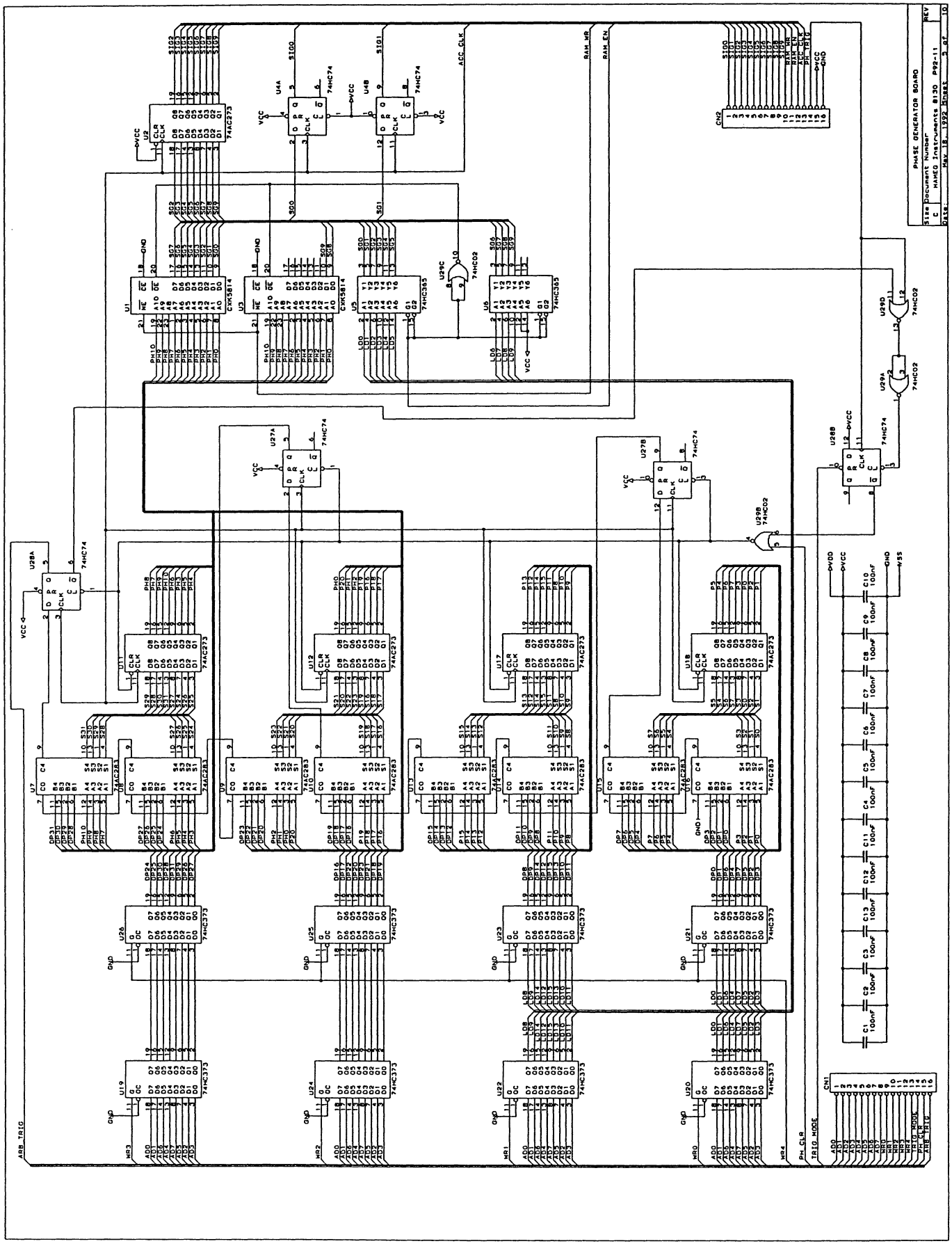
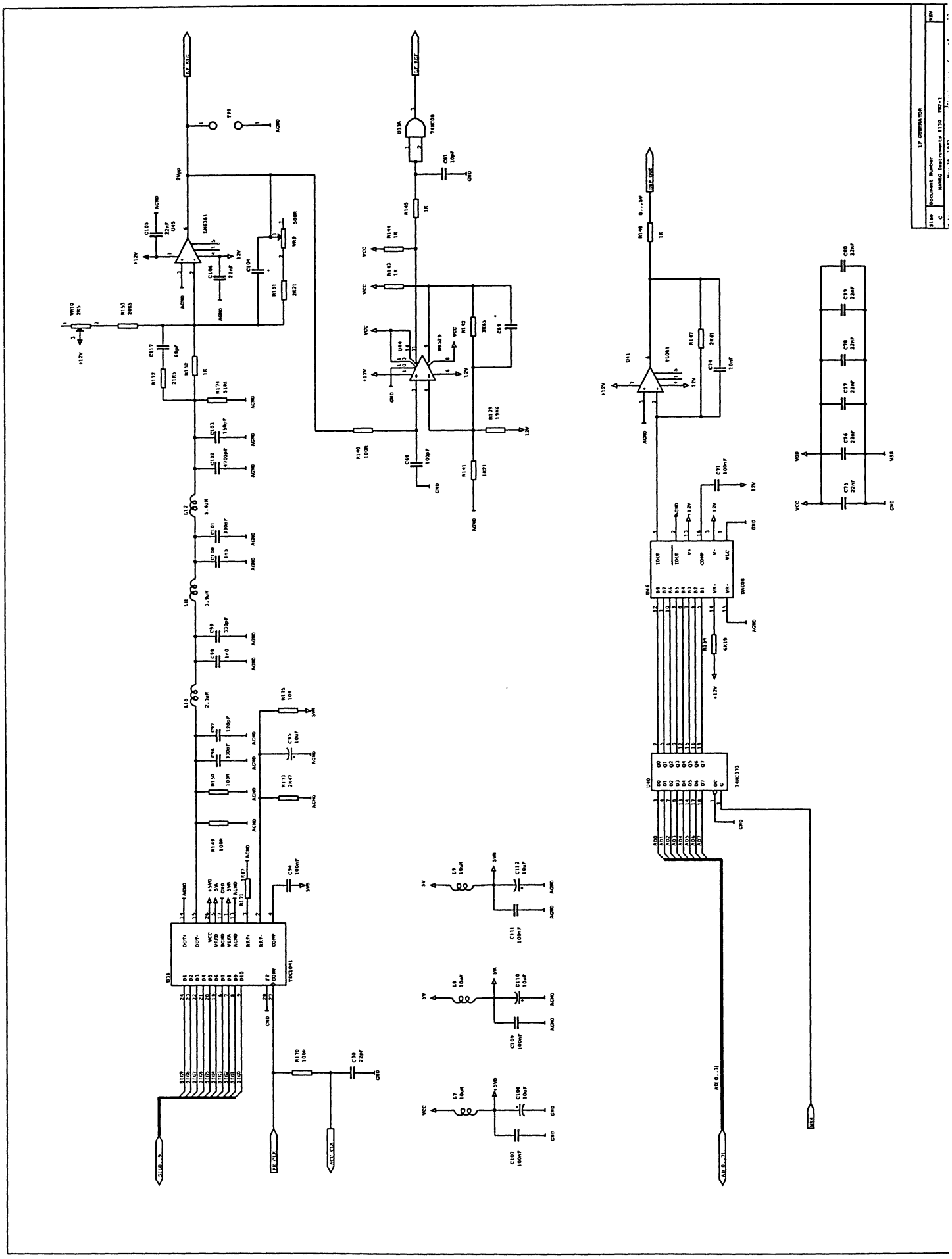
PHASE GENERATOR BOARD
page 6
page 7
page 8
page 9
OUTPUT AMPLIFIER
page 10
DISPLAY BOARD
CONNECTIONS
POWERSUPPY BOARDS A 920123-S LEFT
A 920123-S RIGHT
MAIN BOARD M 920408
PHASE GENERATOR LFG 91085
DISPLAY BOARD D 920406

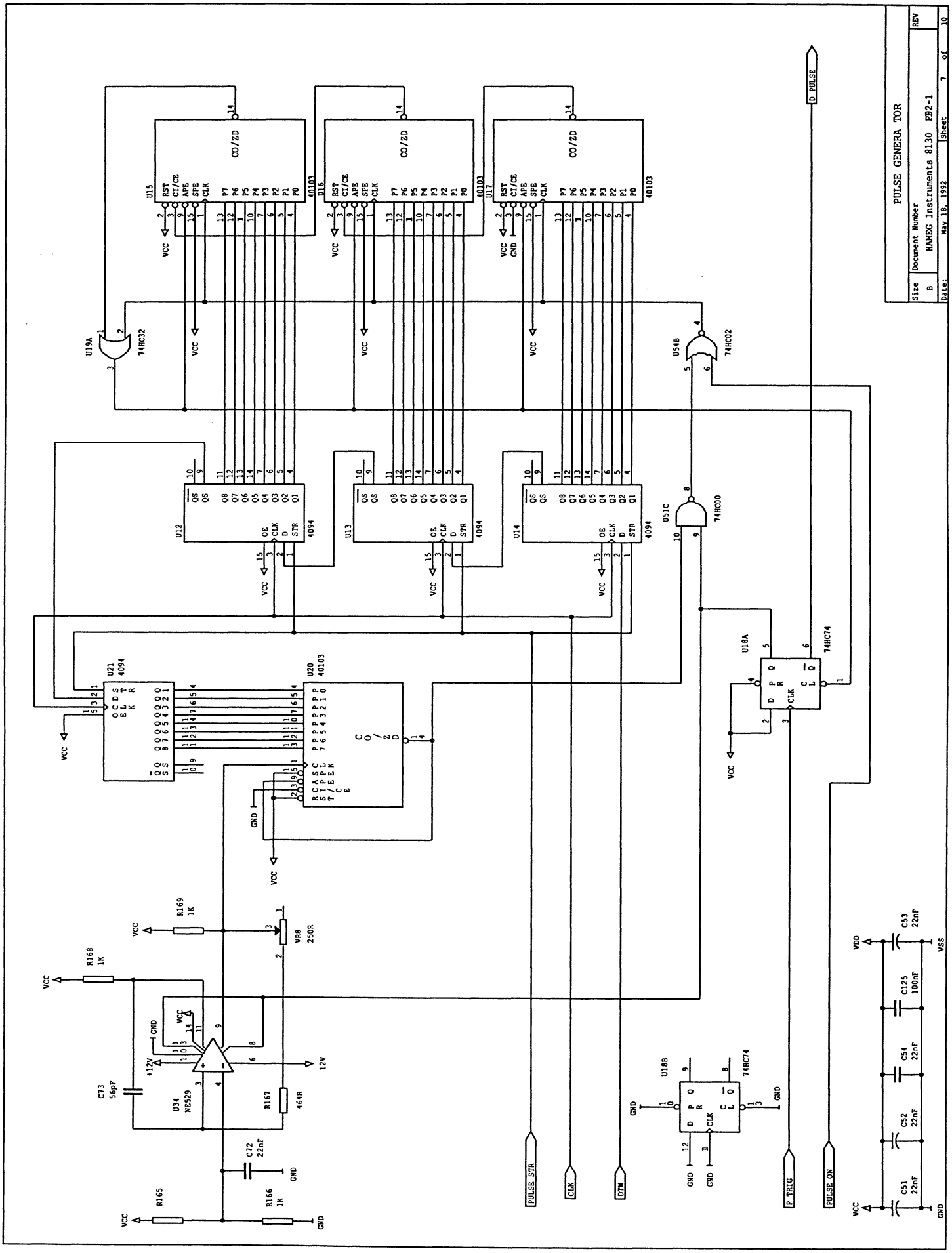


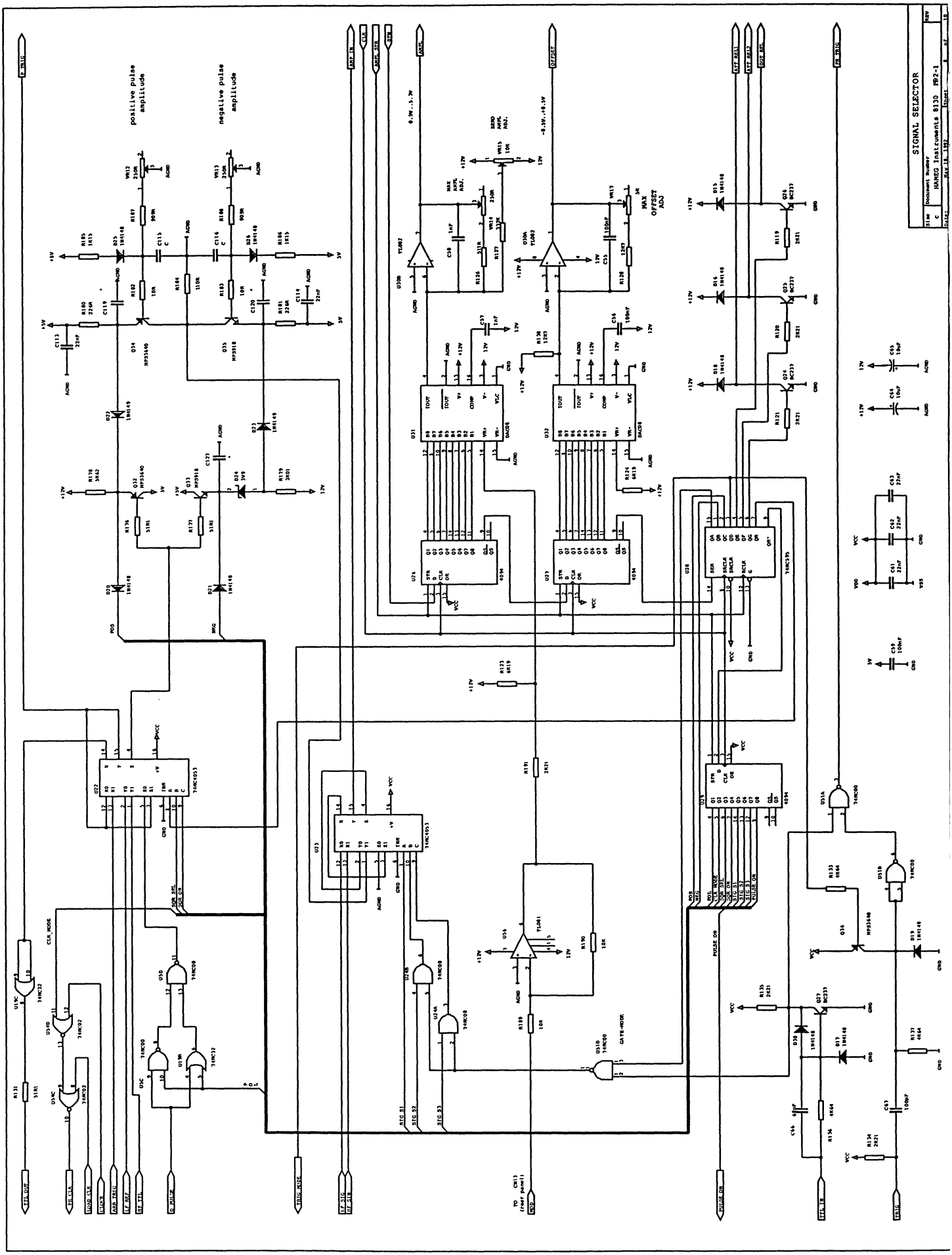

CPU
HAMEG Instruments 8130 PP2-1

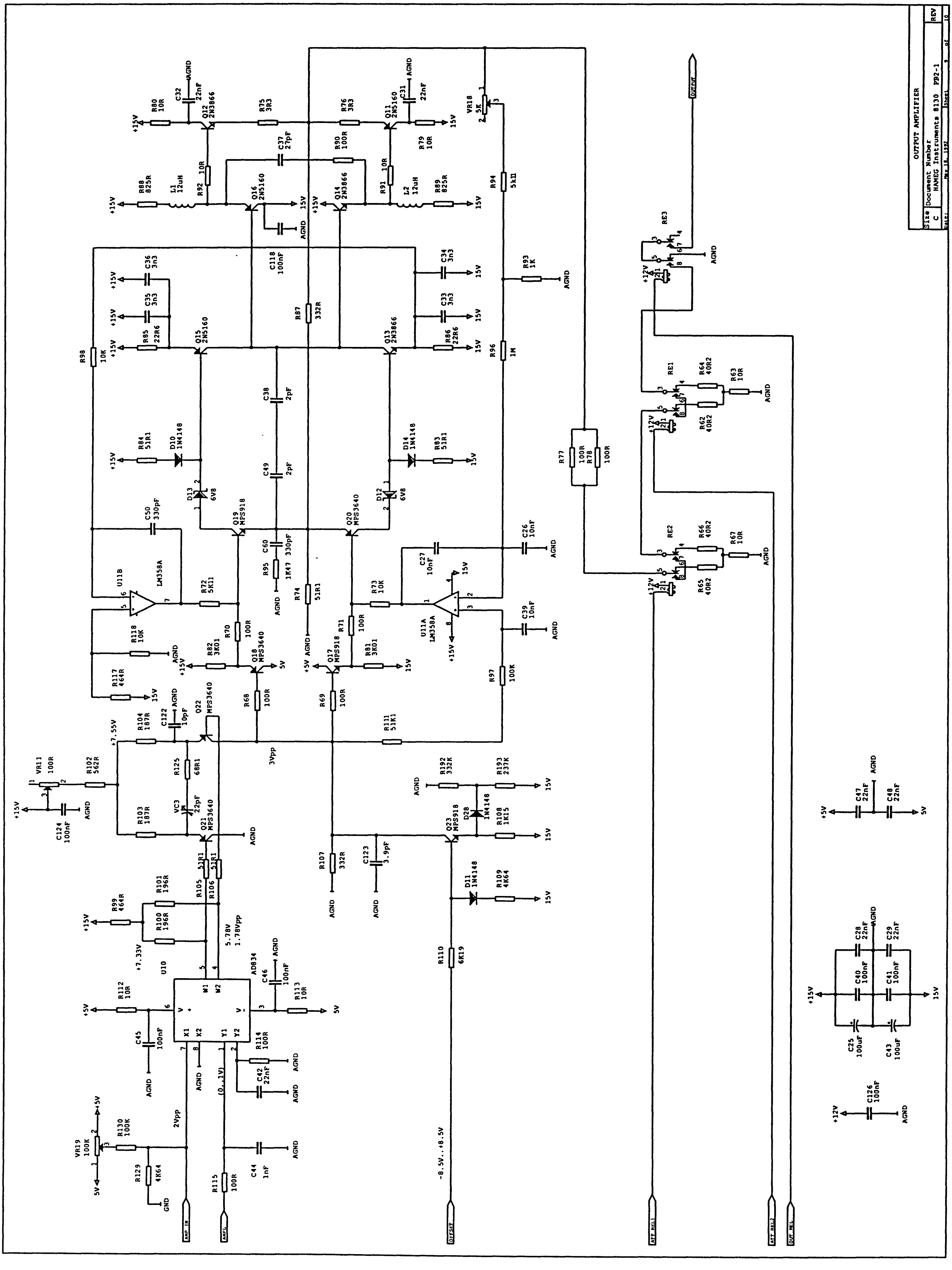



PHASE GENERATOR BOARD
Size Document Number REV
C HAMEG Instruments 8130 P92-11
Date: May 18, 1992 Sheet 2 of 10
ACC_CLK
RAM_WR
RAM_EN
TRIG_MODE
ARB_TRIG
PH_CLR
DVCC
DVDD
GND
VSS




PULSE GENERATOR
Size B
Document Number
HAMEG Instruments 8130 PB2-1
Date: May 18, 1992
Sheet 7 of 10
REV
D_PULSE
PULSE_STR
CLK
DTM
P_TRIG
PULSE_ON
VCC
GND
VDD
VSS
+12V
12V
U15
U16
U17
U12
U13
U14
U19A
74HC32
U54B
74HC02
U51C
74HC00
U18A
U18B
74HC74
U21
4094
U20
40103
U34
NE529
VR8
250R
R167
464R
R168
1K
R169
1K
R165
R166
C72
22nF
C73
56pF
C51
22nF
C52
22nF
C54
22nF
C125
100nF
C53
22nF

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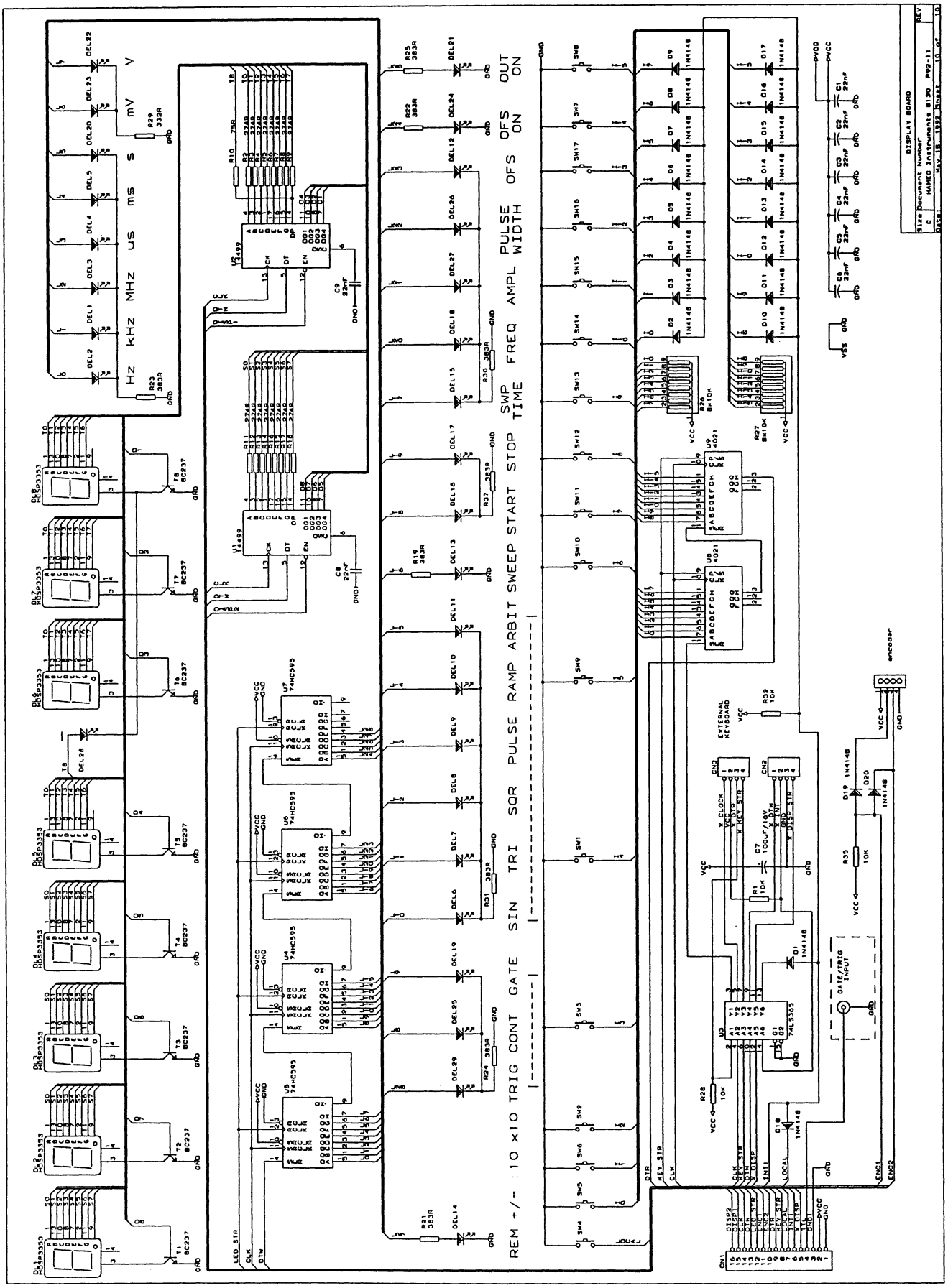
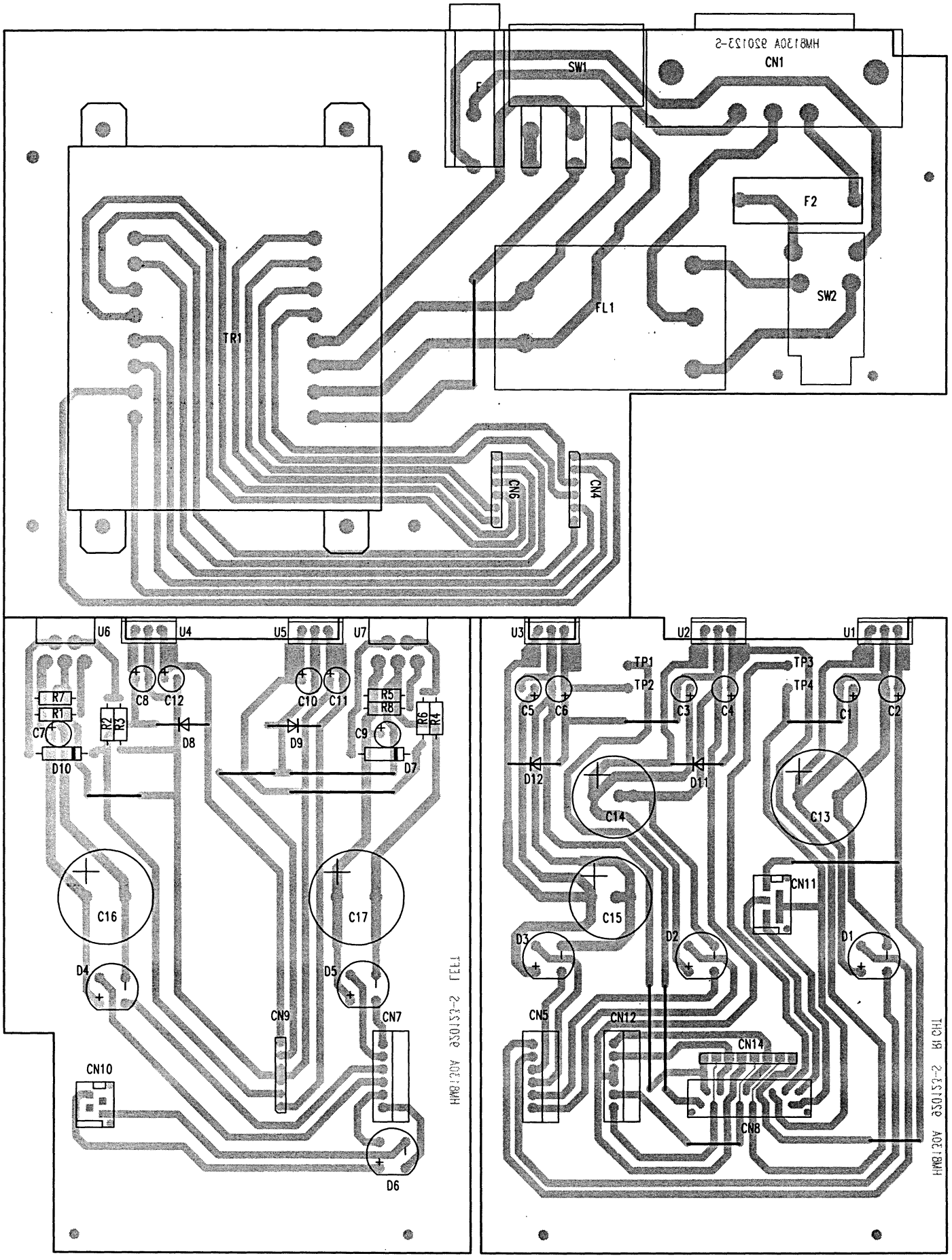
Document Number
HAMEG Instruments 8130 PB2-1




SW1
CN1
F2
SW2
FL1
TR1
CN6
CN4
U6
U4
U5
U7
U3
U2
U1
TP1
TP2
TP3
TP4
C5
C6
C3
C4
C1
C2
C8
C12
C10
C11
C7
R7
R1
R2
R3
R5
R8
R6
R4
C9
D8
D9
D7
D10
D12
D11
C14
C13
C16
C17
C15
CN11
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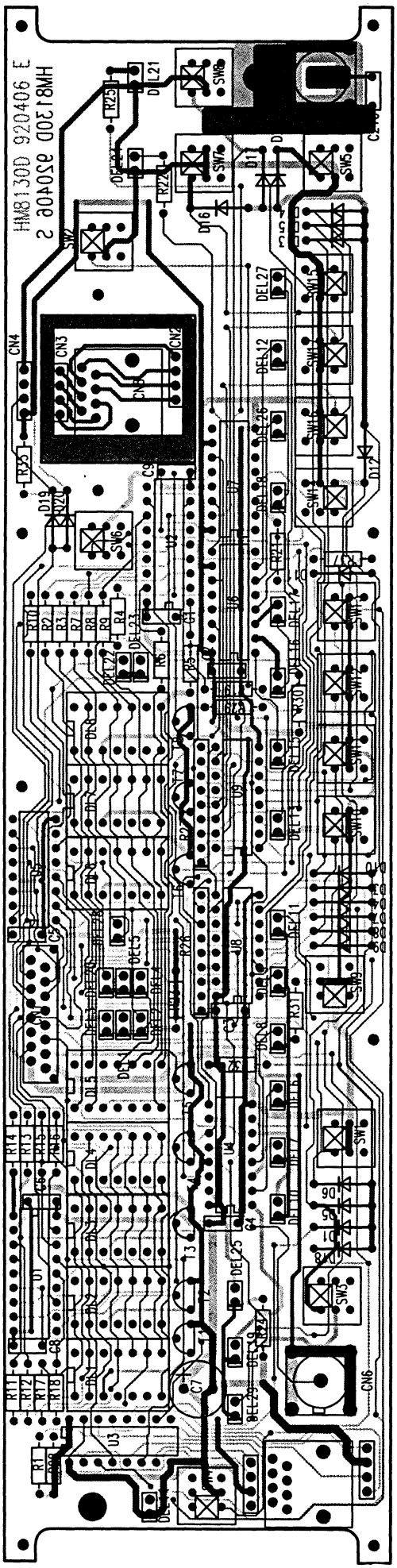
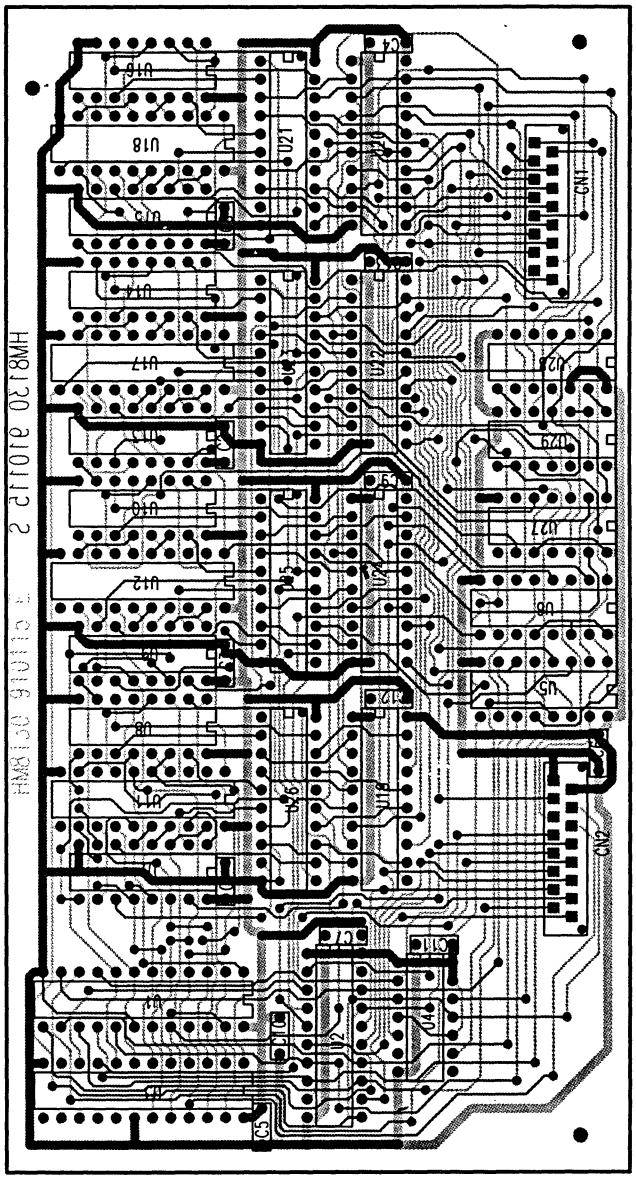
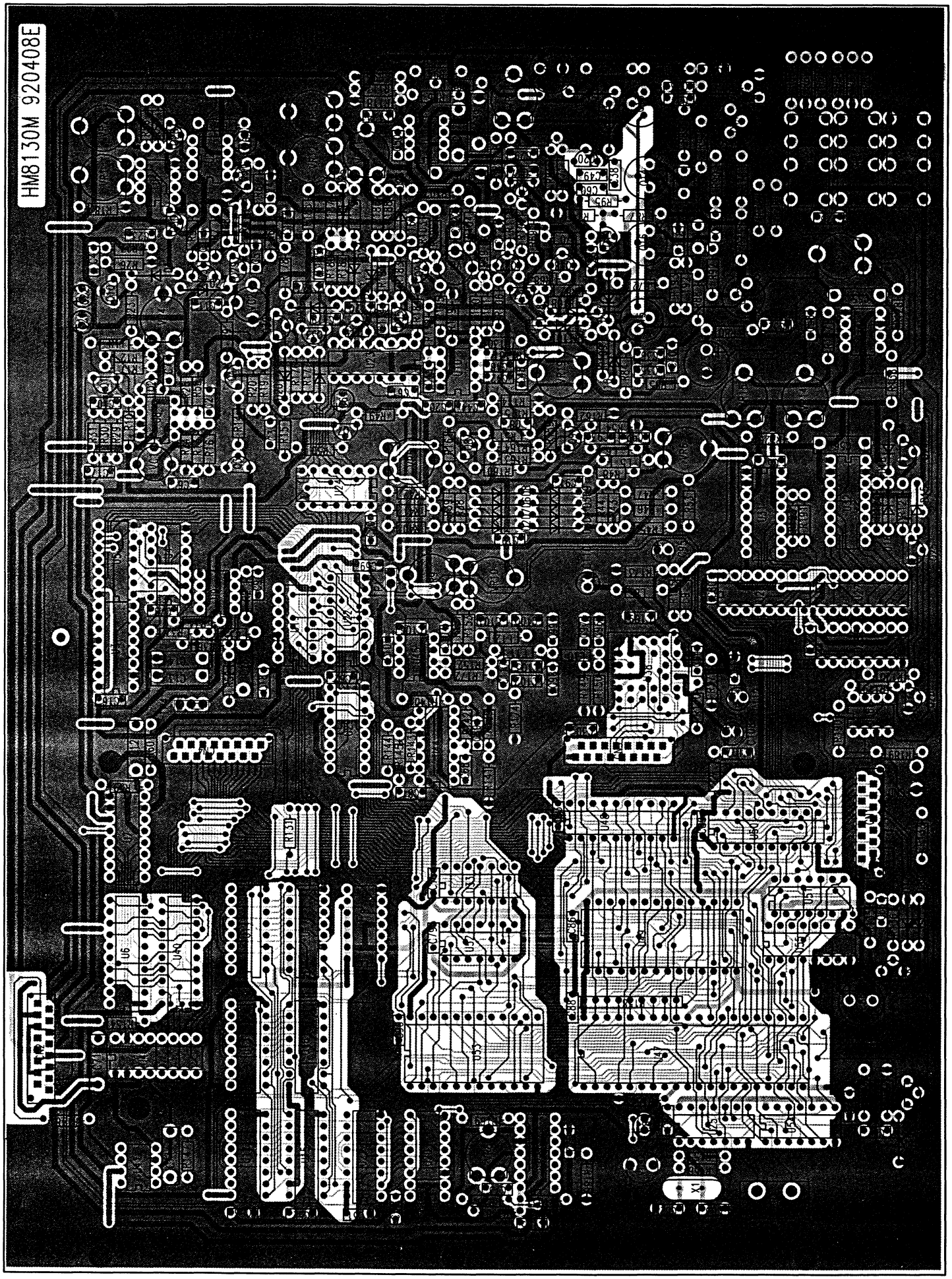
CN7
CN5
CN12
CN14
CN10
CN8
D6






HM8130M 920408E

Allgemeine Hinweise zur CE-Kennzeichnung

HAMEG Meßgeräte erfüllen die Bestimmungen der EMV Richtlinie. Bei der Konformitätsprüfung werden von HAMEG die gültigen Fachgrund- bzw. Produktnormen zu Grunde gelegt. In Fällen wo unterschiedliche Grenzwerte möglich sind, werden von HAMEG die härteren Prüfbedingungen angewendet. Für die Störaussendung werden die Grenzwerte für den Geschäfts- und Gewerbebereich sowie für Kleinbetriebe angewandt (Klasse 1B). Bezüglich der Störfestigkeit finden die für den Industriebereich geltenden Grenzwerte Anwendung.

Die am Meßgerät notwendigerweise angeschlossenen Meß- und Datenleitungen beeinflußen die Einhaltung der vorgegebenen Grenzwerte in erheblicher Weise. Die verwendeten Leitungen sind jedoch je nach Anwendungsbereich unterschiedlich. Im praktischen Meßbetrieb sind daher in Bezug auf Störaussendung bzw. Störfestigkeit folgende Hinweise und Randbedingungen unbedingt zu beachten:

1. Datenleitungen

Die Verbindung von Meßgeräten bzw. ihren Schnittstellen mit externen Geräten (Druckern, Rechnern, etc.) darf nur mit ausreichend abgeschirmten Leitungen erfolgen. Sofern die Bedienungsanleitung nicht eine geringere maximale Leitungs- länge vorschreibt, dürfen Datenleitungen zwischen Meßgerät und Computer eine Länge von 3 Metern aufweisen. Ist an einem Geräteinterface der Anschluß mehrerer Schnittstellenkabel möglich, so darf jeweils nur eines angeschlossen sein.

Bei Datenleitungen ist generell auf doppelt abgeschirmtes Verbindungskabel zu achten. Als IEEE-Bus Kabel sind die von HAMEG beziehbaren doppelt geschirmten Kabel HZ72S bzw. HZ72L geeignet.

2. Signalleitungen

Meßleitungen zur Signalübertragung zwischen Meßstelle und Meßgerät sollten generell so kurz wie möglich gehalten werden. Falls keine geringere Länge vorgeschrieben ist, dürfen Signalleitungen eine Länge von 3 Metern nicht erreichen.
Alle Signalleitungen sind grundsätzlich als abgeschirmte Leitungen (Koaxialkabel -RG58/U) zu verwenden. Für eine korrekte Masseverbindung muß Sorge getragen werden. Bei Signalgeneratoren müssen doppelt abgeschirmte Koaxialkabel (RG223/U, RG214/U) verwendet werden.

3. Auswirkungen auf die Meßgeräte

Beim Vorliegen starker hochfrequenter elektrischer oder magnetischer Felder kann es trotz sorgfältigen Meßaufbaues über die angeschlossenen Meßkabel zu Einspeisung unerwünschter Signalteile in das Meßgerät kommen. Dies führt bei HAMEG Meßgeräten nicht zu einer Zerstörung oder Außerbetriebsetzung des Meßgerätes.

Geringfügige Abweichungen des Meßwertes über die vorgegebenen Spezifikationen hinaus können durch die äußeren Umstände in Einzelfällen jedoch auftreten.

Dezember 1995

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