ENGLISH

HAMEG®
Instruments

Power Supply HM8142

MANUAL•HANDBUCH•MANUEL

KONFORMITÄTSERKLÄRUNG
DECLARATION OF CONFORMITY
DECLARATION DE CONFORMITE

CE

HAMEG® Instruments

Name und Adresse des Herstellers **Manufacturer´s name and address** **Nom et adresse du fabricant**	**HAMEG GmbH** **Kelsterbacherstraße 15-19** **D - 60528 Frankfurt**

Die HAMEG GmbH / bescheinigt die Konformität für das Produkt
The HAMEG GmbH / herewith declares conformity of the product
HAMEG GmbH / déclare la conformite du produit

Bezeichnung / Product name / Designation:	**Labornetzgerät/Power Supply/Alimentation de Laboratoire**
Typ / Type / Type:	**HM8142**
mit / with / avec:	**-**
Optionen / Options / Options:	**HO88/HO8**

mit den folgenden Bestimmungen / with applicable regulations / avec les directives suivantes

EMV Richtlinie 89/336/EWG ergänzt durch 91/263/EWG, 92/31/EWG
EMC Directive 89/336/EEC amended by 91/263/EWG, 92/31/EEC
Directive EMC 89/336/CEE amendée par 91/263/EWG, 92/31/CEE

Niederspannungsrichtlinie 73/23/EWG ergänzt durch 93/68/EWG
Low-Voltage Equipment Directive 73/23/EEC amended by 93/68/EEC
Directive des equipements basse tension 73/23/CEE amendée par 93/68/CEE

Angewendete harmonisierte Normen / Harmonized standards applied / Normes harmonisées utilisées

Sicherheit / Safety / Sécurité

EN 61010-1: 1993 / IEC (CEI) 1010-1: 1990 A 1: 1992 / VDE 0411: 1994
Überspannungskategorie / Overvoltage category / Catégorie de surtension: II
Verschmutzungsgrad / Degree of pollution / Degré de pollution: 2

Elektromagnetische Verträglichkeit / Electromagnetic compatibility / Compatibilité électromagnétique

EN 61326-1/A1
Störaussendung / Radiation / Emission: Tabelle / table / tableau 4, Klasse / Class / Classe B.
Störfestigkeit / Immunity / Imunitee: Tabelle / table / tableau A1.

EN 61000-3-2/A14
Oberschwingungsströme / Harmonic current emissions / Émissions de courant harmonique:
Klasse / Class / Classe D.

EN 61000-3-3
Spannungsschwankungen u. Flicker / Voltage fluctuations and flicker / Fluctuations de tension et du flicker.

Datum /Date /Date
15.01.2001

Unterschrift / Signature /Signatur

E. Baumgartner
Technical Manager
Directeur Technique

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
HAMEG GmbH

General information regarding the CE marking
HAMEG instruments fulfill the regulations of the EMC directive. The conformity test made by HAMEG is based on the actual generic- and product standards. In cases where different limit values are applicable, HAMEG applies the severer standard. For emission the limits for residential, commercial and light industry are applied. Regarding the immunity (susceptibility) the limits for industrial environment have been used.
The measuring- and data lines of the instrument have much influence on emmission and immunity and therefore on meeting the acceptance limits. For different applications the lines and/or cables used may be different. For measurement operation the following hints and conditions regarding emission and immunity should be observed:

1. Data cables
For the connection between instruments resp. their interfaces and external devices, (computer, printer etc.) sufficiently screened cables must be used. Without a special instruction in the manual for a reduced cable length, the maximum cable length of a dataline must be less than 3 meters long. If an interface has several connectors only one connector must have a connection to a cable.
Basically interconnections must have a double screening. For IEEE-bus purposes the double screened cables HZ72S and HZ72L from HAMEG are suitable.

2. Signal cables
Basically test leads for signal interconnection between test point and instrument should be as short as possible. Without instruction in the manual for a shorter length, signal lines must be less than 3 meters long.
Signal lines must screened (coaxial cable - RG58/U). A proper ground connection is required. In combination with signal generators double screened cables (RG223/U, RG214/U) must be used.

3. Influence on measuring instruments.
Under the presence of strong high frequency electric or magnetic fields, even with careful setup of the measuring equipment an influence of such signals is unavoidable.
This will not cause damage or put the instrument out of operation. Small deviations of the measuring value (reading) exceeding the instruments specifications may result from such conditions in individual cases.

December 1995
HAMEG GmbH

Avis sur le marquage CE
Les appareils de mesure HAMEG sont conformes à la réglementation européenne sur la compatibilité électromagnétique. Lors des contrôles de conformité, il est pris pour base de contrôle, les normes produits ou les normes spécialisées concernées. Si diverses valeurs limites sont possibles, HAMEG choisit toujours les conditions de contrôle les plus dures. Pour les émissions parasites, les valeurs limites concernant l'environnement "résidentiel commercial et industrie légère" ont été utilisées. En ce qui concerne l'immunité aux perturbations, les valeurs limites concernant l'environnement "industriel" ont été prises en compte.
Les câbles de transmission de données ou de signaux influencent de façon importante le respect des valeurs prescrites. Ces câbles sont cependant très différents selon les applications. Dans la pratique, il convient de respecter les instructions suivantes pour ce qui concerne les émissions parasites et l'immunité aux perturbations.

1. Câbles de transmission de données
La liaison entre les appareils ou leurs interfaces à des appareils externes (imprimantes, ordinateurs, etc...) doit être réalisée par des câbles suffisamment blindés. Si la notice d'emploi ne prescrit pas de longueur maximale plus courte, les câbles de transmission de données ne doivent pas dépasser une longueur de 3 mètres. S'il est possible de brancher plusieurs câbles sur une interface, un seul doit être branché.
Il faut veiller à utiliser en général des câbles de transmission de données à double blindage. Le câble HAMEG HZ72 à double blindage est approprié pour le transfert du Bus IEEE.

2. Câbles de transmission de signaux
Les câbles de transmission de signaux entre points de test et appareils doivent être aussi courts que possible. Dans le cas où aucune longueur plus courte n'est prescrite, il ne doivent pas dépasser 3 mètres.
Tous les transferts de signaux doivent être réalisés par des câbles coaxiaux blindés (par exemple RG58/U). On doit veiller au bon contact des masses. Lorsqu'on utilise des générateurs de signaux, on doit utiliser des câbles coaxiaux à double blindage (ex. : RG223/U, RG214/U).

3. Influence sur les appareils de mesure
Lorsqu'on se trouve en présence de champs électriques ou magnétiques haute fréquence très forts, il se peut qu'une partie du champ indésiré s'introduise dans l'appareil à travers le câble qui lui est connecté. Ceci n'entraîne pas, sur les appareils HAMEG, d'arrêt de l'appareil ou de panne. De petits écarts passagers par rapport aux spécifications peuvent cependant se produire dans certains cas très particuliers.

HAMEG
Décembre 1995

Power Supply HM8142

The programmable Power Supply **HM8142** offers a number of features not normally found in comparable instruments of its kind. In addition to its function as regulated triple-output supply, it can be utilized as an **electronic sink/load**, a power amplifier and an arbitrary waveform generator.

The **HM8142** is a linear power supply which offers lower noise and other advantages compared to switching power supplies commonly available. Two of the electrically isolated outputs are adjustable from **0-30V** and can source up to **1A**. Parallel or series connection of these outputs is possible to obtain higher current or voltage operation. The third output provides **5V** at a maximum current of **2A**..

Tracking operation is available with either identical values of the two variables or by retaining a selectable offset for current limit and voltage. The **sense** operation allows for compensation of voltage drop on the leads between supply and connected load.

A unique feature of the **HM8142** is its **arbitrary waveform** function, which allows generation of a freely programmable sequence of output voltages and step widths. For this purpose a table with **512 voltage and time parameters** can be stored in the non-volatile memory of the instrument via optional keypad or remote control interfaces. The output of these waveforms may be single, repetitive, or continuous. In addition, the programmable output voltages can be **modulated** via the external control inputs, whereby the linear regulation assures a noise-free output and a wide frequency range up to 8kHz.

The front panel of the instrument has been designed for fast and easy operation, providing **four displays** for independent voltage and current readings with a maximum resolution of **10mV** or **1mA**, respectively. All parameters are programmable or retrievable via the optional keyboard or the field-installable **IEEE-488** or **RS232** interface. The interface can also be used to access the separate built-in measuring circuits for the read-back of voltage and current actually present at the output terminals with an accuracy of 12 bits.

All these features considered, the **HM8142** is ideally suited for innumerable applications in laboratory use and automated test systems, making it a true "power manager".

Specifications HM 8142

(Ref. temp.: 23°C ± 2°C)

Output voltages:	2 x 0 - 30V; 1 x 5V
Output currents:	2 x 0 - 1A; 1 x 2A
Resolution:	10mV, 1mA resp.
Operating modes:	Constant Voltage (CV) Constant Current (CC)
Output impedance:	<5mΩ||0.1µF + 1.5mH (V-source)
Ripple and noise: (V):	<2mV$_{RMS}$ (at max. load; 10Hz - 100kHz) <3mV$_{RMS}$ (at max. load; 10Hz - 1MHz)
(A):	<60µA$_{RMS}$ (at max. load)
Bandwidth (-3dB):	>8kHz
Slew rate (dV/dt):	typ. >0.7V/µs
Rise time:	typ. 50µs
Recovery time:	typ. 40µs
Attack time of current limiter:	200µs (2µs at I_{OUT} >3A)
Recovery time:	typ. 40µs
Stability: (dU/dϑ):	<300ppm/°C+250µV/°C
(dI/dϑ):	<300ppm/°C+25µA/°C
Modulation inputs:	0 - (3V±1V); Ri = 10kΩ
Accuracy: (setting):	0.2% of value ± 3 digit
(measurement):	0.2% of value ± 1 digit
Load regulation:	0.03% (at V_{OUT} = 15V; ΔI = 1A)
Line regulation:	<1mV / V
Settling time:	<5ms (manually); <10ms (IEEE)

Arbitrary Function: (only for 1 output voltage)

Points:	512 (voltage and time)
Min. time interval:	100µs
Max. time interval:	50s
Step width:	100µs - 50s (16 values)
Repetition of ARB. function:	1 - 255 times or continuous
Vertical resolution:	10mV

Sink-mode

Operating mode:	constant current
Max. power:	30VA (max. 1A)
Output impedance:	>100kΩ + 1µF (I-source)
Programming accuracy:	0.2% of value ± 3 digit
Resolution:	1mA
Meas. accuracy:	0.2% of value ± 1 digit
IEEE bus equipment:	Talker (T5) and Listener (T3) SH1, AH1, RL1, DC1, DT1 and SR1

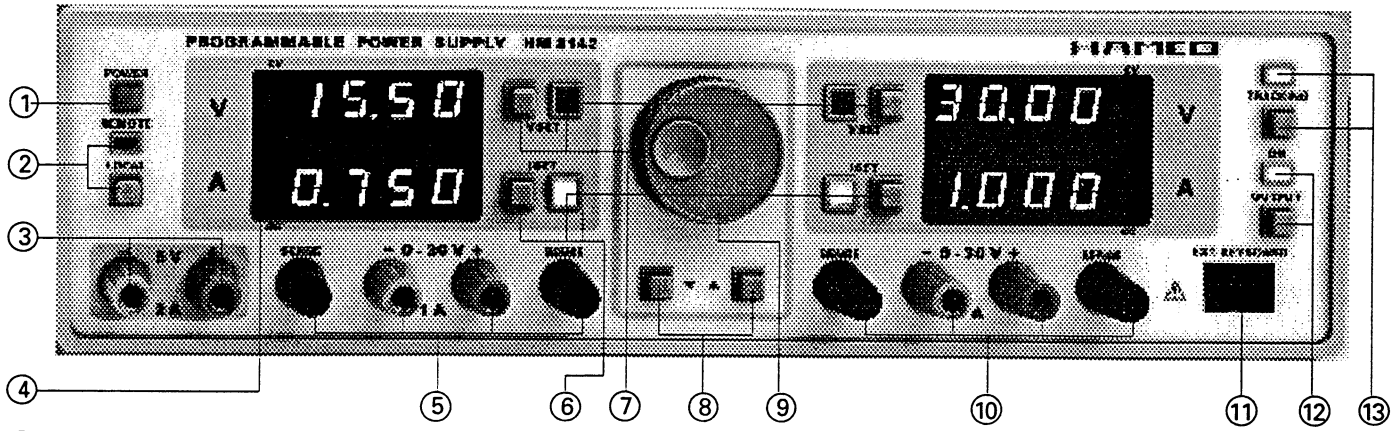
General

Dimensions:	285x85x365mm (WxHxD)
Weight:	approx. 10kg
Power consumption:	approx. 160W
Temperature:	–10°C to +40°C (operation)
Humidity:	10%-90% no condensation 5%-95% RH
Supply voltage:	115/230V ± 15%; 50/60Hz
Safety:	Class I, according to IEC 348

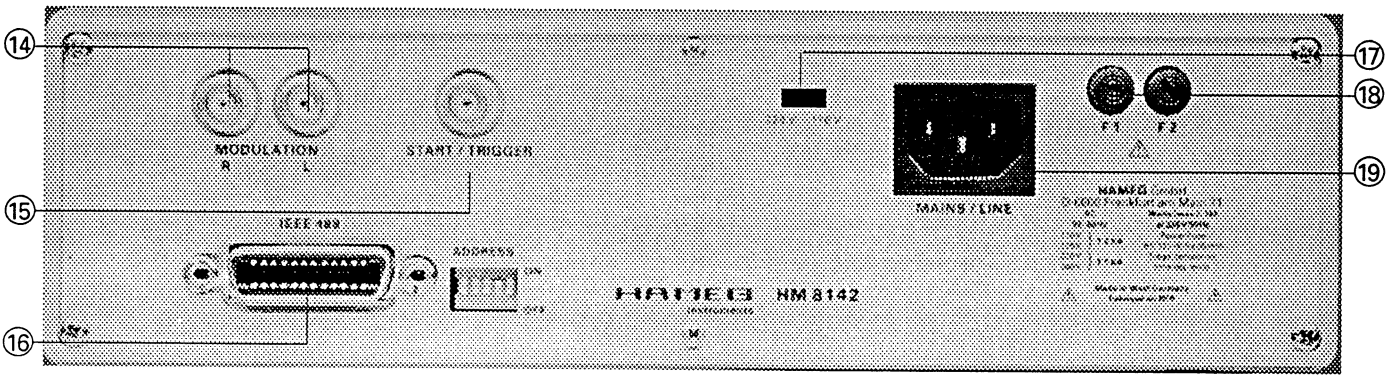
Accessories:

HZ42: 19" rack-mount-kit; **HZ72-S/L:** Double shielded IEEE-bus cable, 1m/1.5m;
HZ842: External keypad; **HO88:** IEEE-488 Interface; **HO89:** RS 232-Interface.

LabWindows and PowerLab instrument drivers on request.



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 the local-switch is possible, provided the instrument is not in local lockout state.
③ **5V** Fixed 5V-output; max. 2 Amps.
④ **Digital Display** (2x4 digit)
Simultaneous display of settings and measurement values for output voltage and output current.
⑤ **30V** (adjustable, 0-30V)
4mm banana-type output sockets for "force" and "sense".
⑥ **I-Set** (pushbutton and LED)
Setting of current limit via frontpanel. When depressing the button the setting function is active and the appertaining LED is lit for approx. 4 sec.
⑦ **V-Set** (pushbutton and LED)
Setting of output voltage via frontpanel. When depressing the button the setting function is active and the appertaining LED is lit for approx. 4 sec.
⑧ **UP / DOWN** (pushbuttons)
Decreases or increases the current and voltage settings by 1mA and 10mV steps respectively.
⑨ Parameter setting for voltage and current values.
⑩ **30V** (adjustable, 0-30V)
4mm banana-type output sockets for "force" and "sense".
⑪ **EXT. KEYBOARD**
Input socket for optional ext. keypad.
⑫ **OUTPUT** (pushbutton and LED)
On/off key for all output voltages.
⑬ **TRACKING** (Taste und LED)
Aktivation of the tracking function for the 30V-outputs.

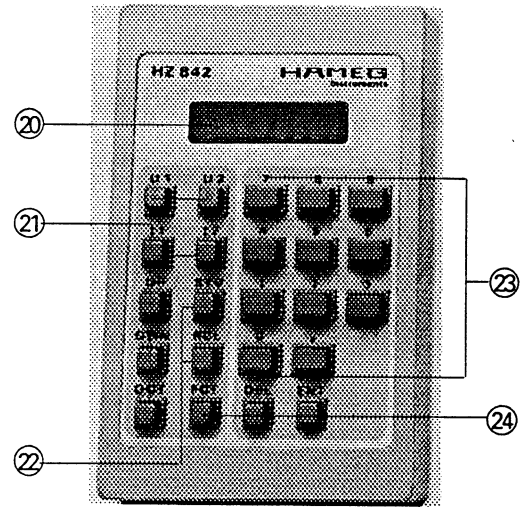


⑭ **MODULATION R / L** (BNC-sockets)
Analog modulation inputs for the 30V-outputs.

Attention!
The BNC-sockets are connected to ground.

⑮ **START / TRIGGER** (BNC-socket)
Bidirectional "tri-stae" input/output for start and trigger signals to/from the HM8142.
⑯ **IEEE-488** Standard IEEE-488 connector (option HO88).
⑰- ⑲ Mains connector, fuses, and voltage selector.

External Keyboard HZ842



⑳ **Display**
8-digit alphanumeric display for HM8142 settings and "help"-informations.

㉑ Keypad for function activation.

㉒ Keypad for memory control.

㉓ Numeric keypad.

㉔ Keys for special functions.

Introduction to using the HM 8142

When the HM 8142 is powered 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, all of the front-panel LEDs light up together and the version number of the EPROM appears in the top right-hand display (for the 2nd output voltage). Once testing has been completed, the HM8142 is restored to the same operational state that it had been in before last being switched off. All that is left to do before actually using it is to press the OUTPUT button to enable the outputs. This approach was selected in order to prevent damage being inadvertently caused to connected loads because the stored voltage or current setting might be too high for the application at hand.

Setting output voltages and the current limiter

The user-changeable parameters (output voltages and current limit) are set using 3 controls situated in the middle of the instrument's front panel (a large dial and **UP** and **DOWN** buttons). To change set values, first select the appropriate parameter with the VSET and ISET buttons. Then use the dial to quickly set the desired value.

If the **UP** or **DOWN** button is held depressed, after a short time an autorepeat feature is activated, incrementing or decrementing the value in 10-mV or 1-mA steps. When both buttons are pressed at once the value is decremented.

The HM 8142 is normally in "actual value" display mode; in other words, the output voltage and current values measured by the instrument are displayed. The controls (the dial and the **UP** and **DOWN** buttons) are disabled in this mode. The programming mode is activated by briefly pressing one of the **VSET** or **ISET** buttons. The LED next to the button lights up to indicate that this mode is active, and the corresponding target value appears in the display. The controls are now enabled for programming. The desired output voltage or a value for current limitation can be input. If more than about 10 seconds elapse without any of the controls being pressed or manipulated, than an automatic time-out function switches the HM 8142 back to its normal operating mode. The "**time-out**" function can be overridden from the optional external keyboard.

Resolution

The attainable resolution with the dial is 100 mV for voltage and 10 mA for current. If greater resolution is necessary, it can be achieved by using the **UP** and **DOWN** buttons. 10 mV steps and 1 mA current increments are programmable in this way.

Operating modes

Constant voltage operation (CV)

The HM 8142 programmable power supply features various different operating modes. Of these, it is probably used most often as a voltage source. This is the normal mode and is indicated by the **CV** (const. volt.) LEDs in the displays (in this mode $V_{actual} = V_{set}$ and $I_{actual} < I_{limit}$). Here, the displayed values represent the measured output voltages and the measured output current.

Constant current operation (CC)

As soon as the output current reaches the programmed current limit value, the power supply automatically switches into its **current source** mode. This mode is indicated by the **CC** (constant current) LEDs (now $I_{actual} = I_{limit}$ and $V_{actual} - V_{set}$); the **CV** LEDs extinguish. The measured output voltage generally drops below the programmed voltage. The actual **measured** value can be read off the display.

Serial or parallel operation

To increase the output voltages and currents, the two "power supply halves" can be connected either in series or in parallel.

It is important to keep in mind that when the two output circuits are connected in series a greater voltage than that ordinarily permitted for safety reasons can develop. The HM 8142 may therefore be used only by personnel who are familiar with the associated risks.

Electronic load

The HM 8142 also offers a mode in which it functions as an **electronic load** (current sink). The instrument goes into this mode automatically, and it can be recognized by a negative sign in front of a displayed current value. The same limit values apply to voltage and current as in normal operating mode.

Arbitrary-waveform mode

By way of the IEEE-488 (GPIB) bus or from the optional external keyboard, the HM 8142 can also be made to generate freely programmable waveforms within the set limit values (arbitrary mode). For more information on this feature, see the sections on the external keyboard and the IEEE-488 bus.

Trigger-Input / Trigger-Output (Start/Stop)

In order to permit easy triggering of a connected oscilloscope with the output signals of the HM8142, especially in arbitrary mode, the instrument is equipped with a trigger jack (start/stop) on its rear panel. This is configured as a tri-state output and permits a trigger signal to be taken off after each signal period in arbitrary mode, or the arbitrary function to be activated by an external trigger signal.

Modulation inputs

By virtue of the modulation inputs on its rear panel, the HM 8142 can also be used as a modulated power amplifier. These inputs have a gain by a factor of 10. The frequency range (-3 dB) extends from DC to 8 kHz.

Caution! These terminals are not electrically isolated from the instrument ground!

Tracking

With the aid of the tracking function, it is possible to simultaneously vary 2 setting parameters. In other words, either both output voltage settings or both current limits can be varied at the same time by using the tracking function. This function is activated by pressing the **TRACKING** button.

This has the effect of clearing all previously activated functions, and from then on whenever a value is called and changed both halves of the instrument are identically affected (the 5-volt output remains unchanged). It doesn't matter which values had been set prior to changing one of the parameters; in tracking mode, the HM 8142 always retains the respective differences between the voltages values and the current limits of the power supply's two halves. When the maximum permissible level is reached by the larger value, its lower counterpart cannot be increased further either.

For instance, if one half of the power supply is set to 22 V and the other to 10 V, the greatest possible output voltages that can be programmed in tracking mode are 30 V and 18 V, respectively. The same applies analogously to the programmed current limit values. To exit tracking mode, press the **TRACKING** button again.

Safety features

The HM 8142 is equipped with a variety of safety features to prevent damage being caused to the instrument by short-circuits or overheating. If one of the output voltages is short-circuited, the current limiter automatically keeps the current from rising beyond the programmed maximum output current. The response time is approx. 200 µsec. If the output current should exceed the programmed limit during the response time, then a second current limitation feature takes effect after a delay time of 2 µsec, preventing the current from exceeding a level of 3 A.

Cooling

The heat generated in the HM 8142 is removed by a temperature-controlled fan. This is located together with the heat sink for the power transistors in a "cooling channel" that runs straight through the instrument. Air is drawn in on the right-hand side of the unit and blown out again on the left-hand side. This also prevents excessive dust accumulation, which can interfere with efficient heat removal from the ICs.

Always make sure that there is sufficient open space for cooling on both sides of the HM 8142. In no case may the cooling holes on the sides of the unit be covered.

If the temperature on the inside of the HM 8142 should nevertheless rise to above 80°C, an automatic temperature-controlled safety circuit is activated. The outputs are put into the state "Output-off" and the **REMOTE** LED on the front panel flashes. The message "U-1" appears in the display and "Temp-lim" is displayed on the ext. keyboard, if connected. After the unit has cooled down sufficiently, operation can be resumed by pressing the **LOCAL** button and activating the outputs by pressing the **OUTPUT** button.

Error messages

When problem states occur during operation of the HM 8142 in its normal modes, error messages are displayed on the instrument or external keyboard. The possible error states are as follows:

HM 8142	Keyboard display	
U1	Temp-lim	Overheated
U2	RAM-ERR	Zero-power RAM is defective
U3	Bad IEC!!	Illegal IEC address
U4	Checksum	EPROM defective
U5	Over-V!	Measured voltage ≥ 31 V*
U6	Over-I!	Measured current ≥ 1.1 A

* Also displayed if an input voltage greater than 3 V is applied to one of the modulation inputs.

When any of these error conditions occur, the outputs are disabled and a sweeping light appears in the displays in addition to the error message. Errors 2 and 4 are hardware defects and require servicing by an experienced technician. The other error messages can be reset by pressing the **LOCAL** button. Once the error condition has been remedied, normal operation can be resumed by activating the outputs (press the **OUTPUT** button).

The external keyboard (Option HZ 842)

The HM 8142 power supply is equipped with an 8-pin front-panel jack for connection of an external keyboard. The functions of this optional external accessory can be divided into four categories:

A Selection of functions	(21)	see front panel elements
B Numeric keypad	(23)	-"-
C Memory control	(22)	-"-
D Delete, entry, special functions	(24)	-"-

All information appears in the 8-digit alphanumeric display of the keyboard. The following can be performed:

1. Direct numerical entry of voltage and current values.
2. Storage of setting complete setups for the HM 8142.
3. Calling of various additional functions.
4. Programming and control of the arbitrary function.

1. Numerical entry of voltage and current values

Example: The left-hand side of the power supply to output 12.34 V at a maximum current of 0.5A.

Voltage:

1. Select function U1	Display: U1:_._
2. Enter the voltage value:	
'1'	Display: U1: 1.00
'2'	Display: U1:12.00
'.'(Decimal point not obligatory)	Display: U1:12.00
'3'	Display: U1:12.30
'4'	Display: U1:12.34
3. 'ENT' to enter the value.	

Current:

1. Select function I1	Display: I1:_._
2. Enter the current value:	
'0' ('0' not obligatory here)	Display: I1:0.___
'.' (Decimal point not obligatory)	Display: I1:0.___
'5'	Display: I1:0.5__
3. 'ENT' to enter the value.	Display: I1:0.500

It is only necessary to insert a decimal point when entering a voltage <=9.99 V and current values < 0.1 A. Voltage values > 30 V are rejected, and an error message appears in the display.

Using the DEL key:

If a function has been called, pressing the **DEL** key cancels the selected function. The message **CANCELED** then appears in the display. If a value has already been typed in or entered, then pressing the **DEL** key once causes the entered value to be deleted. If the **DEL** key is then pressed a second time, the called function is cancelled.

Incrementing and decrementing

The **UP** and **DOWN** keys can be used to increment or decrement the currently active parameter. The steps by which the value is changed can be set to either 100 mV/10 mA or 10 mV/1 mA (see explanation of **FCT+'1'** below). This function is activated by pressing the U1, U2, I1, or I2 key.

2. Storing and recalling settings

a) Storing
10 memory locations are available for storage of 4 parameter settings each (U1, U2, I1 and I2). ('**STO**' key + **'0' - '9'**).

1. Press the **STO**rage key — Display: STORE =_
2. Choose a memory location, e.g.: 3 — Display: STORE=3
3. Store with '**ENT**' — Display: STORE : 3
   or cancel with '**DEL**' — Display: CANCELED

b) Recalling
1. Press the **RCL** (recall) key
2. Select a memory location, e.g.: 3 Display: RCL =3
(The parameters stored in this register appear in the corresponding displays of the power supply with a flashing decimal point. At this point, however, they have not yet been accepted by the power supply.
3. Acknowledge with '**ENT**' Display: RCL :3
(the values are accepted) or cancel by pressing '**DEL**' Display: CANCELED (the old settings are restored)

3. Special functions

The FCT (function) key is used to access a number of instrument functions that are either not available at all without the external keyboard or can otherwise only be executed via the IEEE-488 bus. To activate them, press first the FCT key and then another key as follows:

FCT	+ [additional key]
+ 0	Tracking on/off
1	Min/max stepwidth for the UP and DOWN keys
2	Beeper in the HM 8142 on/off
3	Outputs on/off
4	10-second time-out of setting dial active/inactive
5	Display IEEE-488 bus address
6	Arbitrary waveform
7	Changing IEEE-488 bus modes
9	Key lock
Ux/Ix	Display measured values on the external keyboard
FCT	Brief operating instructions (help text)

FCT "FCT": brief operating instructions

The text moves across the display at a speed that permits it to be easily read. If the output speed is nevertheless too fast for you, the text can be halted by pressing the ENT key. The **DEL** key exits the help mode. To speed up the rate of text output, strike the **FCT** key.

FCT "5": Display IEEE-488 bus address

If an IEEE-488 bus interface HO 88 is installed in the HM 8142 and the external keyboard is connected, then at power-up the instruments IEEE-488 bus address is briefly shown on the external keyboard's display (e.g.: IEEE #07). At any time after this, the address can also be displayed by pressing '**FCT**' followed by '5'.

FCT "6": Programming and controlling the arbitrary fct.

FCT "7": Changing IEEE-488 bus modes

Special function 7 of the external keyboard can be used to switch the HM 8142 from "normal" IEEE-488 operation to "**mixed**" mode and vice versa (see IEEE-488 bus H088).

FCT "9": Disabling the keyboard (key lock)

Striking "FCT" followed by "9" activates the 'key lock' fct.. In this mode all the front-panel controls on the HM 8142 and parts of the external keyboard are disabled. To cancel this mode, press "FCT" + "9" again. If the ext. keyboard is disconnected while the key lock mode is active, then the values set in the power supply can no longer be changed. This mode also remains active if the power supply is switched off. When this mode is active the **LOCAL** Led is illuminated on the front panel of the HM 8142, and "**KEY-LOCK**" appears in the ext. keyboard's display.

Programming and control of the arbitrary function

The arbitrary waveform mode is used for generation of virtually any desired waveforms (respecting the specification-limits of the HM 8142). For this purpose, a table comprising up to 512 voltage and time values can be defined in the power supply. This table is stored in nonvolatile RAM with back-up battery; the values are not lost when the instrument is powered down. A function menu is provided for operation and programming of this mode:

1 Input **2** Input n **3** Edit **4** Run

These menu items can be selected using 2 methods:

1. Direct input of the corresponding number.
2. Using the **UP** and **DOWN** keys on the keyboard to move to the desired menu item, and then pressing the **ENT**er key to activate it. The **DEL** key exits the arbitrary menu and returns the power supply to its normal operating mode.

The arbitrary waveform mode only affects the "left-hand" half of the power supply; rapid waveform generation is possible with this voltage source only.

When the arbitrary mode is activated, the outputs of the HM8142 are also automatically enabled. Arbitrary mode can be terminated by three different means:

1. By pressing the **LOCAL** key
2. By pressing the **OUTPUT** key
3. By function **"STP"**

When the arbitrary function is terminated by pressing the LOCAL key, the last voltage value of the arbitrary function is retained, and the outputs are switched on.

While a waveform is being generated, the front-panel controls are disabled, with the exception of the **OUTPUT** and **LOCAL** keys. The arbitrary mode can be terminated by pressing the **OUTPUT** key. This also has the effect of switching off the outputs. Pressing this key again causes the outputs of the power supply to be switched back on, and those levels reappear at the outputs that had been active prior to calling the arbitrary function.

During operation, the right-hand display shows the SET value of the "right-hand" voltage source; due to time and accuracy limitations while the arbitrary mode is active, the HM 8142 is unable to measure the actual states of the parameters of this source. If the arbitrary mode is restarted, it always begins again with value #1.

While the arbitrary function is running, the set current limit cannot be changed. However, current flow through the output (in either direction) cannot exceed the set value. The following information is displayed while the arbitrary mode is active:

Display L	Display R	Keyboard	Device state
A--	e.g. 18.00	Main menu	Normal mode
A- II	e.g. 18.00	TRG-wait	Waiting for trigger
A---	e.g. 18.00	Running	Arbitrary function runs

Programming of the arbitrary function

1. Input
You are asked whether or not you really want to make an entry. If you answer this question with '1' = yes, then you define a new table, overwriting the old one, if it exists. Strike '0' = no (or the **DEL** key) to return to the arbitrary mode menu.

Display: "STEP #1"

Press the **ENT** key or one of the numeric keys; the display then changes to:

"U1=__+__"

A voltage value between 0.00 V and 30.00 V can now be entered. Use the **DEL** key to clear wrong entries; to confirm an entered value, press **ENT**.

The following is now displayed: "time=__"
Here you can stipulate the amount of time the entered voltage level is to appear at the instrument's outputs. To do so, enter a number between 0 and 15 as defined in the following table:

0 = 100 µs
1 = 1 ms
2 = 2 ms
3 = 5 ms
4 = 10 ms
5 = 20 ms
6 = 50 ms
7 = 100 ms
8 = 200 ms
9 = 500 ms
10 = 1 s
11 = 2 s
12 = 5 s
13 = 10 s
14 = 20 s
15 = 50 s

The **DEL** key can be used to clear wrong entries. Strike the **ENT** key to confirm entry (ENT without having entered a number results in entry of the value 0=100 !s). The following appears in the display: **"Step #2"**. The rest of the values in the table are entered using the same procedure.

Once you have entered all of the values for the voltage waveform to be generated, you can interrupt entry whenever "Step #n" appears in the display by pressing the **DEL** key; this takes you back to the arbitrary function menu.

2. Number of repetitions/input n
n = 0 : Continuous repetition
n = 1-255 : Repeats 1-255 times

3. Edit
This feature can be used to change individual values in the table without having to reenter the entire table. When this function is called, the number of entered steps is displayed.

e.g.: "step# 10"

Press DEL to obtain this display: "step#___"
The number of the line which it is wished to change can now be entered. After confirming by pressing ENTer, the voltage entered in this line is displayed. The time value corresponding to this voltage is then displayed. When the "step" display reappears, the editing mode can be exited by pressing the **DEL** key, or else an additional data record can be changed by entering another step number.

4. Start/Run
When this function is invoked, the available possibilities for starting output are displayed. These are:

1. By pressing the '1' key on the keyboard
2. By the bus command "RUN"
3. By a LOW level applied to the start-trigger input

This function can be terminated by :

1. Pressing the **DEL** key
2. The bus command **"ABX"**.

If one of the start conditions is met, then waveform generation is started. Generation can be halted by:

1. Pressing the **OUTPUT** key on the front panel (Caution: the outputs remain switched on!)
2. By the bus command **"STP"**
3. Automatically when the programmed number of repetitions has been run through.

Afterwards the power supply is put back into the same operating mode that it was in before calling fct. 4 **(Run)**.

IEEE-488-Bus-Interface (HO 88)

The HM 8142 understands the following commands:

RM1/RM0 : REMOTE ON/OFF
LK1/LK0 : LOCAL ON/OFF
SU1 : SET VOLTAGE 1
SU2 : SET VOLTAGE 2
SI1 : SET CURRENT 1
SI2 : SET CURRENT 2
RU1 : RECALL VOLTAGE 1 *
RU2 : RECALL VOLTAGE 2 *
RI1 : RECALL CURRENT 1 *
RI2 : RECALL CURRENT 2 *
MU1 : MEASURE VOLTAGE 1 *
MU2 : MEASURE VOLTAGE 2 *
MI1 : MEASURE CURRENT 1 *
MI2 : MEASURE CURRENT 2 *
MXI/MX0 : MIXED MODE ON/OFF
OP1/OP0 : OUTPUT ON/OFF
TRU : TRACK VOLTAGE
TRI : TRACK CURRENT
SR1/SR0 : SERVICE REQUEST ON/OFF
ABT : ARBITRARY WAVEFORM MODE
RUN : START ARBITRARY
STP : STOP ARBITRARY
ABX : EXIT ARBITRARY
VER : GET VERSION *
STA : GET STATUS *
ID? : GET IDENTIFIER*

All of the commands marked with an asterisk ("*") cause the HM 8142 to output a response over the bus. The HM 8142 should be subsequently switched to **TALK** mode by being addressed as a talker.
If it is not switched to **TALK** mode, the reply to one command, which has been output to the interface buffer - can be overwritten by another command of this type.

Example:
Sending the command sequence "**RU1 RI1**" only results in the output of the current limit value after the HM 8142 has been addressed as a TALKER, since the second command "RI1" causes the voltage value that has already been output to the buffer of the IEEE-488 bus interface to be overwritten before it can be transferred over the bus.

Solution:	(LISTEN)	RU1	Send 1st command
	(TALK)	U1=12.34V	Get 1st reply
	(LISTEN)	RI1	Send 2nd command
	(TALK)	I1=0.123A	Get 2nd reply

When being controlled by the IEEE-488 bus, the HM 8142 immediately goes into Remote mode as soon as a command arrives at the interface. Mixed operation, in which the instrument can also be manually operated using the front-panel controls although it is connected to the IEEE-488 bus, is possible by using the command MX1. The same effect is achieved from the external keyboard by means of the sequence FCT+7. This disables the bus until the keyboard entry has been completed.
If the wait times set in the controller are too short, this can lead to "time-out" errors.

IEEE-488 bus commands for the HM 8142

RM1/RM0

Format : **RM1**
Function : Places the power supply in ReMote mode. The front-panel controls are disabled. In this mode, the power supply can only be operated over the IEEE-488 bus. This mode can be terminated by sending a RM0 command or pressing the LOCAL button on the HM 8142.
Format : **RM0**
Function : Disables ReMote mode, returning the power supply to local mode (permitting operation using the front-panel controls). Note: The RM0 command also has the effect of counteracting the LK1 command.

MX1/MX0

Format : **MX1**
Function : Switches the power supply from REMOTE mode into mixed mode. In mixed mode, the instrument can be operated either over the IEEE-488 bus or using the front-panel controls.
Format : **MX0**
Function : Terminates mixed mode and returns the instrument to "normal" IEEE-488 bus mode.

LK1/LK0

Format : **LK1**
Function : Switches the HM 8142 to local-inhibit mode. The LOCAL button is disabled. The power supply can now only be operated over the IEEE-488 bus. It is not possible to use the LOCAL button to switch it back to local mode.
Format : **LK0**
Function : Takes the HM 8142 out of local-inhibit mode. The instrument can now be returned to local mode by pressing the **LOCAL** button. The front-panel controls are re-enabled.Note:The local-inhibit mode is also terminated by the **RM0** command.

SU1 and SU2

Format : SU1 VV.mVmV or SU2 01.34
Function : Sets voltage 1 or voltage 2 to the indicated value (SET value; BCD format)
Example : SU1 1.23 => U1 = 1.23 V
SU2 12.34 => U2 = 12.34 V
SU2 .1234 => U2 = 0.12 V

SI1 & SI2

Format : SI1 A.mAmAmA or SI1 0.123
Function : Sets current 1 or current 2, as the case may be, to the indicated value (LIMIT value)
Examples: SI1 1.000 => I1 = 1.000 A
SI2 0.123 => I2 = 0.123 A
SI1 .1234 => I1 = 0.123 A
The values must be in BCD format.

RU1 & RU2

Format : **RU1** or **RU2**
Reply : U1:12.34V or U2:12.34V
Function: The voltage values sent back by the HM 8142 are the programmed SET voltage values. **Note:** Use the **MUx** commands to query the **ACTUAL** values.

RI1 & RI2

Format : **RI1** or **RI2**
Reply : I1:_1.000A or I2:_0.012A
Function: The current values sent back by the HM 8142 represent the programmed LIMIT values for the current. **Note:** Use the **MIx** commands to query the **ACTUAL** current values.

MU1 & MU2

Format : **MU1** or **MU2**
Reply : U1:12.34V or U2:12.24V
Function: The voltage values sent back by the HM 8142 represent the **ACTUAL** voltage values last measured at the outputs. **Note:** Use the **RUx** commands to query the **SET** voltage values.

MI1 & MI2

Format : **MI1** or **MI2**
Reply : I1=+1.000A or I2=-0.123A
Function : The current values sent back by the HM 8142 represent the **ACTUAL** current values last measured. **Note:** Use the **RIx** commands to query the programmed current LIMIT value. If the outputs are switched off, then the reply will be I1:_1.000A.

TRU

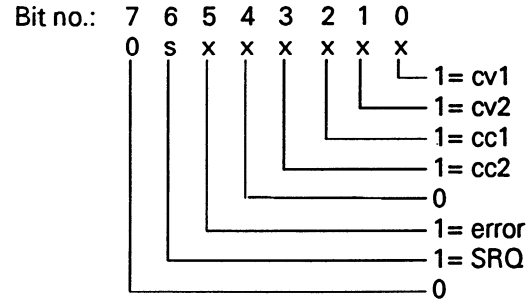
Format : **TRU** VV.mVmV
Function : Sets voltage 1 AND voltage 2 to the indicated value (SET voltage values in TRACKING mode).
Examples: TRU 1.23 => U1 = U2 = 1.23 V
TRU 01.23 => U1 = U2 = 1.23 V
TRU 12.34 => U1 = U2 = 12.34 V
TRU .1234 => U1 = U2 = 0.12 V
(The values must follow the BCD format.)

TRI

Format : **TRI** A.mAmAmA
Function : Sets current 1 AND current 2 to the indicated value (LIMIT values in TRACKING mode).
Examples: SI1 1.000 => I1 = 1.000 A
SI2 0.123 => I2 = 0.123 A
SI1 .1234 => I1 = 0.123 A
(The values must be in BCD format.)

SR1 & SR0

Format : **SR1**
Function : This command enables service request mode. Any change in the device status triggers an **SRQ**.
Format : **SR0**
Function : This command disables SRQ mode. The possible reasons for a service request are: Overheating; change in the operating mode of one or both voltage sources from CC to CV or vice versa; when the outputs are switched on or off.
Note: These commands only have an effect when the power supply is equipped with an IEEE-488 bus interface (option H088); they have no effect in conjunction with the RS-232C interface (Option HO 89). The SRQ status byte contains the new device status. Changes in status can be detected by comparing the new status byte with the old one. The status byte has the following format:



STA

Format : **STA**
Reply : OP1/0 SQ1/0 ER0/1 CV1/CC1 CV2/CC2 RMO/1
Function : This command causes the HM 8142 to send a text string containing inform. on the current device status.
OP0 The outputs are switched off.
OP1 The outputs are switched on.
SQ1 This 3-character string indicates that the device status has changed (cv to cc, op1 to op0, etc.) (only active when the service request function has been enabled; see **SR1** command above).
SQ0 When the service request mode is enabled, this indicates no changes in the device status.
ER0 No error conditions
ER1 Overheated
CV1 Source 1: constant voltage operation
CC1 Source 1: constant current operation
CV2 Source 2: constant voltage operation
CC2 Source 2: constant current operation
RM1 Device in remote-control mode
RM0 Device not in remote-control mode

OP1 & OP0

Format : **OP1**
Function : The outputs are switched on.
Format : **OP0**
Function : The outputs are switched off.
Note: If the outputs are switched off, then "—_—" is sent instead of CV1/CC1 or CV2/CC2.
Example: OPO0 SQ0 ER0 — — RMO

Clear

Format : **Clr**
Function : This command interrupts **all** functions of the HM 8142, initializing it to "zero status" in remote-control mode. The keyboard is not enabled, the outputs are switched off, and the voltages and currents are set to 0.

VER

Format :**VER**
Reply : swVx.xhwVx.xxxxxxx HAMEG/Paris KRP&VM
Function : Displays the software (s) and hardware (h) vers. of HM 8142;
the date of the last change is displayed.

ID?

Format : **ID?**
Reply : HM8142-1
Function : HAMEG device identification

ARBITRARY WAVEFORM MODE

The arbitrary waveform mode can be used for generation of virtually any desired waveforms. For this purpose, a table comprising up to 512 voltage and time values can be defined. This table is stored in nonvolatile memory with a back-up battery, and is not lost when the instrument is powered down. The following commands are available for operating and programming this function over an IEEE-488 or RS-232C bus system:

ABT Transfer of arbitrary values
RUN Start waveform generation
STP Stop waveform generation
ABX Exit arbitrary mode

Attention: The arbitrary waveform mode only affects the "left-hand" half of the power supply; rapid waveform generation is possible with this voltage source only.

When the arbitrary mode is activated, the outputs of the HM 8142 are automatically activated. The arbitrary mode can be terminated by 2 different means:

1. By pressing the **LOCAL** button
2. By pressing the **OUTPUT** key
3. By means of the command "**STP**"

When the arbitrary function is terminated by pressing the LOCAL key, the last voltage value of the arbitrary function remains active, and the outputs are switched on. While a waveform is being generated, the front-panel controls are disabled, with the exception of the **OUTPUT** (and **LOCAL**) key. The arbitrary mode can be terminated by pressing the **OUTPUT** key. This also has the effect of switching off the outputs. Pressing this key again switches the outputs of the power supply back on, and that voltage value reappears at the outputs that had been present prior to invoking the arbitrary function.

During operation, the right-hand display shows the SET value of the "right-hand" voltage source; due to time and accuracy limitations while the arbitrary mode is active, the HM 8142 is unable to measure the actual voltage and current values of this source. If the arbitrary mode is restarted, it always begins again with value #1.

While the arbitrary function is running, the set current limit cannot be changed. The current flow in either direction cannot exceed the programmed value. In order to prevent jitter of the waveform, no data should be transferred over the bus while the function is running. Exception: the terminating command '**STP**'.

f incorrectly formatted data is received while the instrument is loading the values of a function table, an audible alarm sounds. "**A-oo** " appears in the display of the HM 8142, and "**Data-ERR**" in the display of the external keyboard. The **LOCAL** key also begins flashing. This situation can be remedied in two ways: by pressing the LOCAL button or sending a "clear" command over the IEEE-488 bus.

ABT

Format: **ABT** <list of values> N <number of repetitions>
ABT tvv.vv tvv.vv .... N n
t = time code 0-9, A,B,C,D,E,F; vv.vv = 0-30V
There **may** be a "**space**" between "t" and "vv.vv";
there **must** be a "**space**" between "vv.vv" and "t".
N = end-of-table character; n = number of repetitions.
There **must** be a "**space**" between vv.vv and N;
there **may** be a "**space**" between "N" and "n".

Function: Programming of the arbitrary waveform functionThe power supply permits creation of a data list containing up to 512 voltage values along with the corresponding time duration values. This list is transferred in the form of a series of alternating values for voltages in the range between 0.00 and 30.0 V and hexadecimal codes representing the time duration of each voltage; at the end of the list, the number of repetitions is indicated. The end of the list is marked by the letter 'n'.

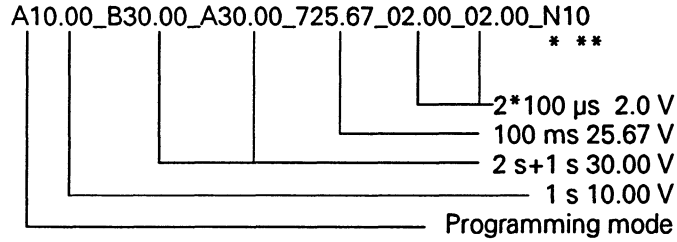
How long each voltage appears at the outputs of the HM 8142 is derived from the following table:

0_h	=	**100 µs**	8_h	=	**200 ms**
1_h	=	**1 ms**	9_h	=	**500 ms**
2_h	=	**2 ms**	A_h	=	**1 s**
3_h	=	**5 ms**	B_h	=	**2 s**
4_h	=	**10 ms**	C_h	=	**5 s**
5_h	=	**20 ms**	D_h	=	**10 s**
6_h	=	**50 ms**	E_h	=	**20 s**
7_h	=	**100 ms**	F_h	=	**50 s**

Example: It is wished to program the following waveform:

1 s	10.00 V
3 s	30.00 V
100 ms	25.67 V
200 µs	2.00 V

It is also wished to repeat this sequence 10 times. The required data table is as follows:



* End-of-list
** N = 0 : Continuous repetition
N = 1-255 : Waveform is repeated 1-255 times

During data transfer, the left-hand display of the power supply shows A- 1 (for arbitrary programming), and the right-hand display shows the SET voltage value for the "right-hand" voltage source; due to time limitations, the power supply is unable to measure the actual current and voltage values of this source when in arbitrary mode.

After the table of values has been transferred, the power supply indicates that it is ready for the start signal by outputting 'A II'in its left-hand display. This start signal can be:
- The bus command 'RUN';
- A low level applied to the start input of the instrument'
- Pressing the '1' key on the external keyboard.

This wait state can be interrupted by sending the command 'ABX'; the table of values remains stored in memory, and can be started by the 'RUN' command.

RUN

Format : **RUN**
Function : Starts waveform generation in arb. mode

STP

Format : **STP**
Function : Interrupts the arbitrary function while running. The power supply is put into its waiting mode (see **ABX** command above); it can now be restarted by '**RUN**', or arbitrary mode can be exited by the command '**ABX**'.

ABX

Format : **ABX**

Function : Exits the arbitrary waveform mode. The power supply is returned to its normal mode, in other words the same state as after power-up. **Note:** This command does not interrupt waveform generation while it is running; it only terminates the waiting mode. To interrupt **and** exit this mode, the sequence **STP ABX** is required.

Error message: If the HM 8142 is addressed as a "talker" **without** it having previously received a command that prompts it to send a reply (one of the commands marked with an asterisk in the list), then the HM 8142 sends the message "ERROR: No leading command" over the interface. This prevents the bus system from getting "hung up.

RS-232C interface (Option HO 89)

The RS-232C interface HO 89 is available as an optional accessory for the HM 8142. The power supply can be easily retrofitted with this interface at any time: the installation procedure is described in the manual for the HO 89. For information, see the section on the IEEE-488 interface.

A number of bus commands are available for controlling the power supply. The HM 8142 understands the following commands:

RM1/RM0	:	**REMOTE ON/OFF**
LK1/LK0	:	**LOCAL ON/OFF**
SU1	:	**SET VOLTAGE 1**
SU2	:	**SET VOLTAGE 2**
SI1	:	**SET CURRENT 1**
SI2	:	**SET CURRENT 2**
RU	:	**RECALL VOLTAGE 1 ***
RU2	:	**RECALL VOLTAGE 2 ***
RI1	:	**RECALL CURRENT 1 ***
RI2	:	**RECALL CURRENT 2 ***
MU1	:	**MEASURE VOLTAGE 1 ***
MU2	:	**MEASURE VOLTAGE 2 ***
MI1	:	**MEASURE CURRENT 1 ***
MI2	:	**MEASURE CURRENT 2 ***
OP1/OP0	:	**OUTPUT ON/OFF**
TRU	:	**TRACK VOLTAGE**
TRI	:	**TRACK CURRENT**
ABT	:	**ARBITRARY WAVEFORM MODE**
RUN	:	**START ARBITRARY**
STP	:	**STOP ARBITRARY**
ABX	:	**EXIT ARBITRARY**
ID?	:	**GET IDENTIFIER***
CLR	:	**RESET INSTRUMENT**

The HO 89 interface is a serial, full-duplex interface that complies with the European V.24 standard (equivalent to the American RS-232C 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 message**
*	**#CR**	**Send copyright message**
	#X1	**Enable XON/XOFF protocol**
	#XO	**Disable XON/XOFF protocol**
	#BC	**Clear all I/O buffers**
+	**#BD**	**Enable newly programmed baud rate**
+	**#W7**	**Select 7-bit word length**
+	**#W8**	**Select 8-bit 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 commands marked with an asterisk (*) in the list cause the HM 8142 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 - SoftwareB
c)	#ST	HM232 W(7/8) S(1/2) P(N/EO) X(1/0) e.g. HM232W7S2PNX0

Setting the transfer parameters

The commands marked with a "+" 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 it is switched on (or after the #BD command) is a space (20h). The interface uses it to calculate the baud rate used for transmission, and automatically adapts to it. If any other character or an incomplete character is received, the system is prevented from working.

DIP switch settings

Number	ON	OFF	Function
1	7	8	Word length
2	1	2	Stop bit(s)
3	ON	OFF	Parity
4	even	odd	Parity
5	CR	CR+LF	End-of-transmission

XON/XOFF protocol

The command #X1 is used to activate so-called software handshaking (it is counteracted by the command X0). In software handshaking mode, data transfer between the computer and the interface is no longer synchronized by the hardware handshake lines; instead, this function is performed by 2 commands:

XON = 11h = Continue transmission
XOFF = 13h = Halt transmission

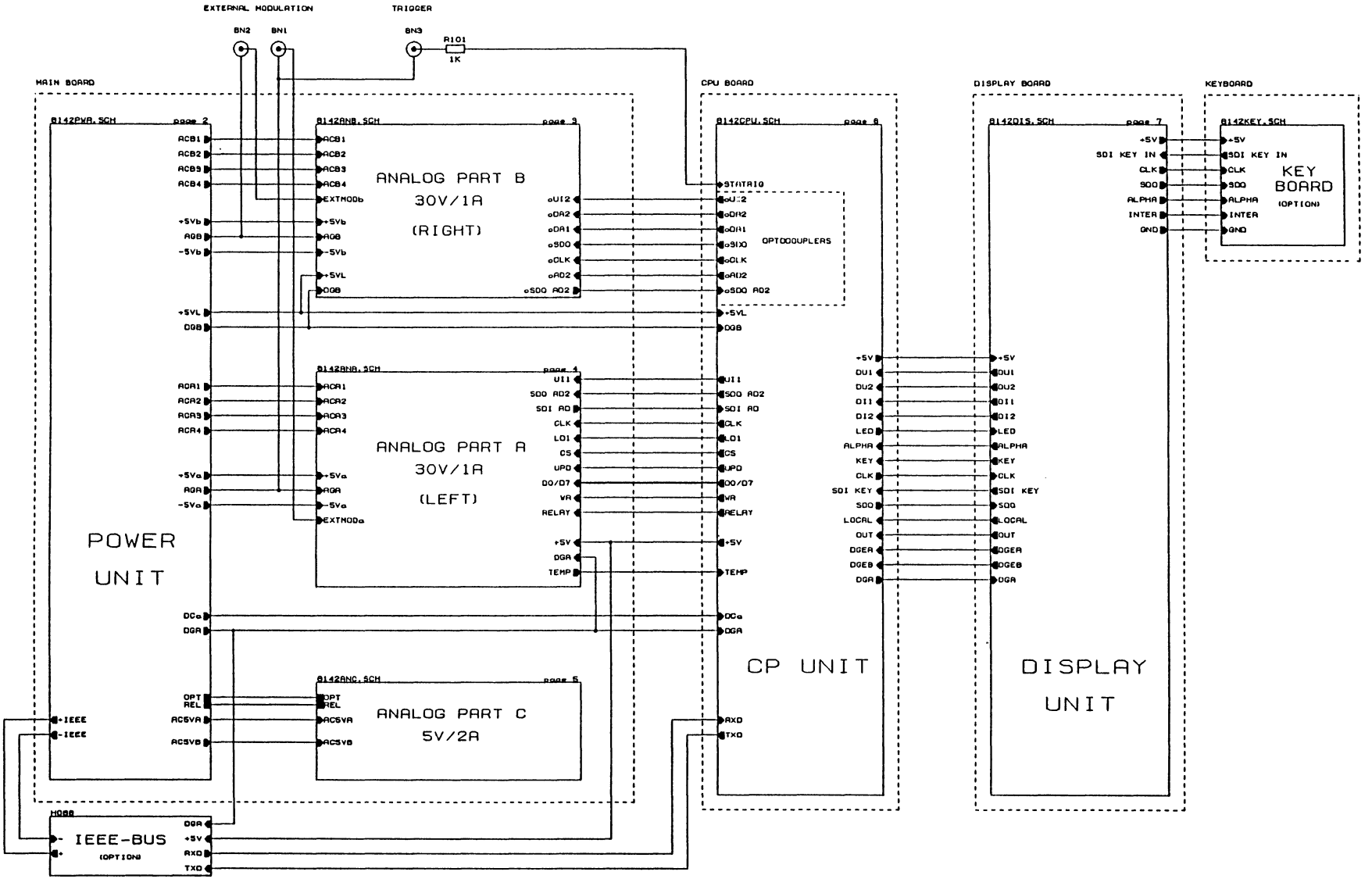
Alignment procedure HM8142

Measurement equipment required
Digital Multimeter (DMM) HM8011, 4½ digit or HM8112 6½ digit.
Power supply 17V, min. 1,2A.
Load 15Ω, 15W.

Pre settings:
Switch on the HM8142 while depressing "LOCAL ON" - key. Service mode is now indicated by the blinking decimal points in the display. Switch the output "ON" and tracking mode "OFF" and start the adjustment procedure described below. The index is subdivided into the left side of the power supply (index **a**) and the right side of the power supply (index **b**). (Adjustment points and figures see section "circuit diagrams").

Adjustment	HM8142 Settings	Connection of measuring instruments	Adjustm. point	Adjustm. value
Output 5V/2A		DMM to 5V output	VR206 (1)	5 V ± 5 mV
Initial current I_0a	15.00 V 0.002 A	DMM 0.2V,DC to CN107 checkpoint TP1-TP2	VR153 (2)	6 mV ± 0,5 mV
Initial current I_0b	"	DMM 0.2V,DC to CN107 checkpoint TP7-TP8	VR253 (3)	6 mV ± 0,5 mV
Offset +Ia	"	DMM 20mA,DC to output 30V/1A left side	VR156 (4)	2,25 mA ± 0,03 mA
Offset +Ib	"	as above, but right side	VR256 (5)	2,25 mA ± 0,03 mA
Offset -Ia	"	Connection as fig.1, DMM 20mA,DC to 30V/1A left side	VR157 (6)	2,25 mA ± 0,03 mA
Offset -Ib	"	as above, but right side	VR257 (7)	2,25 mA ± 0,03 mA
Maximum value -Ib	15.00 V 1.000 A	Connection as fig.1, DMM 2A,DC 30V/1A right side	VR259 (8)	-1 A ± 0 A
Maximum value -Ia	"	as above, but left side	VR159 (9)	-1 A ± 0 A
Maximum value +Ia	"	DMM 2A,DC to output 30V/1A left side	VR158 (10)	1 A ± 0 A
Maximum value +Ib	"	as above, but right side	VR258 (11)	1 A ± 0 A
Current display right side	"	DMM 2A,DC to output 30V/1A right side	VR255 (12)	1 A ± 0 A Display
Current display left side	"	as above, but left side	VR155 (13)	1 A ± 0 A Display
Offset Ua	0.00 V 0.010 A	DMM 0,2V,DC to output 30V/1A left side	VR151 (14)	0 mV + 2 mV
Offset Ub	"	as above, but right side	VR251 (15)	0 mV + 2 mV
Maximum value *1 Ub	19.00 V 0.010 A	DMM 20V,DC to output 30V/1A right side	VR252 (16)	19 V ± 3 mV
Maximum value *1 Ua	"	as above, but left side	VR152 (17)	19 V ± 3 mV
Voltage display *1 left side	"	-	VR154 (18)	19 V ± 0 V Display
Voltage display *1 right side	"	-	VR254 (19)	19 V ± 0 V Display
Statistical internal resistance right side	14.00 V 1.000 A	Connection as fig.2, DMM 20V,DC to output 30V/1A right side	VR260 (20)	du <= 1 mV
Statistical internal resistance left side	"	as above but left side	VR160 (21)	du <= 1 mV

Notice:
***1:**
If a multimeter with min. 30 000 digit resolution is available, set output voltage to 30.00V and adjust to 30V±3mV.



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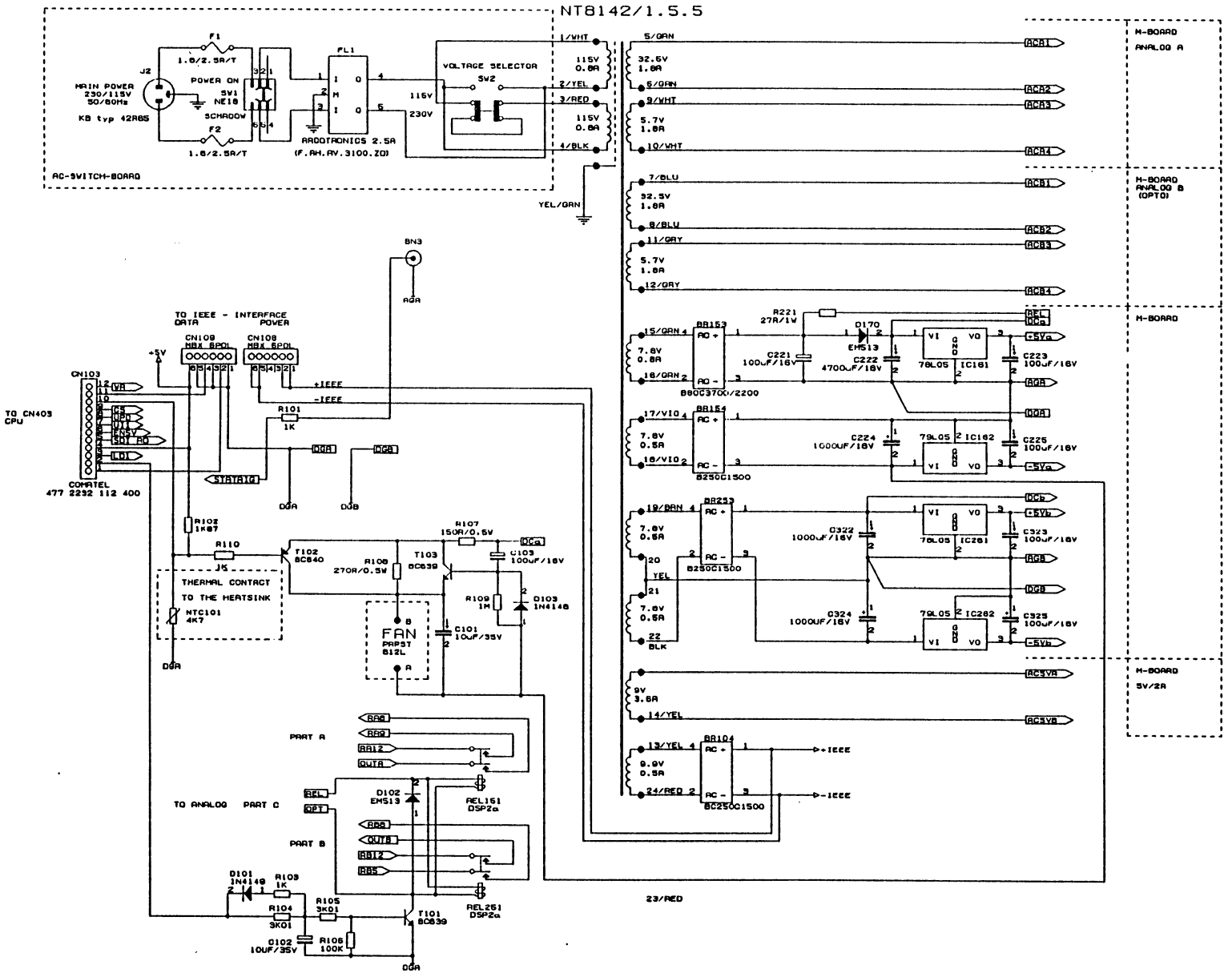
WIRING DIAGRAM		
Size	Document Number	REV
C	HAMEG Instruments HM8142 BLK	1.2
Date: January 8, 1991	Sheet	7



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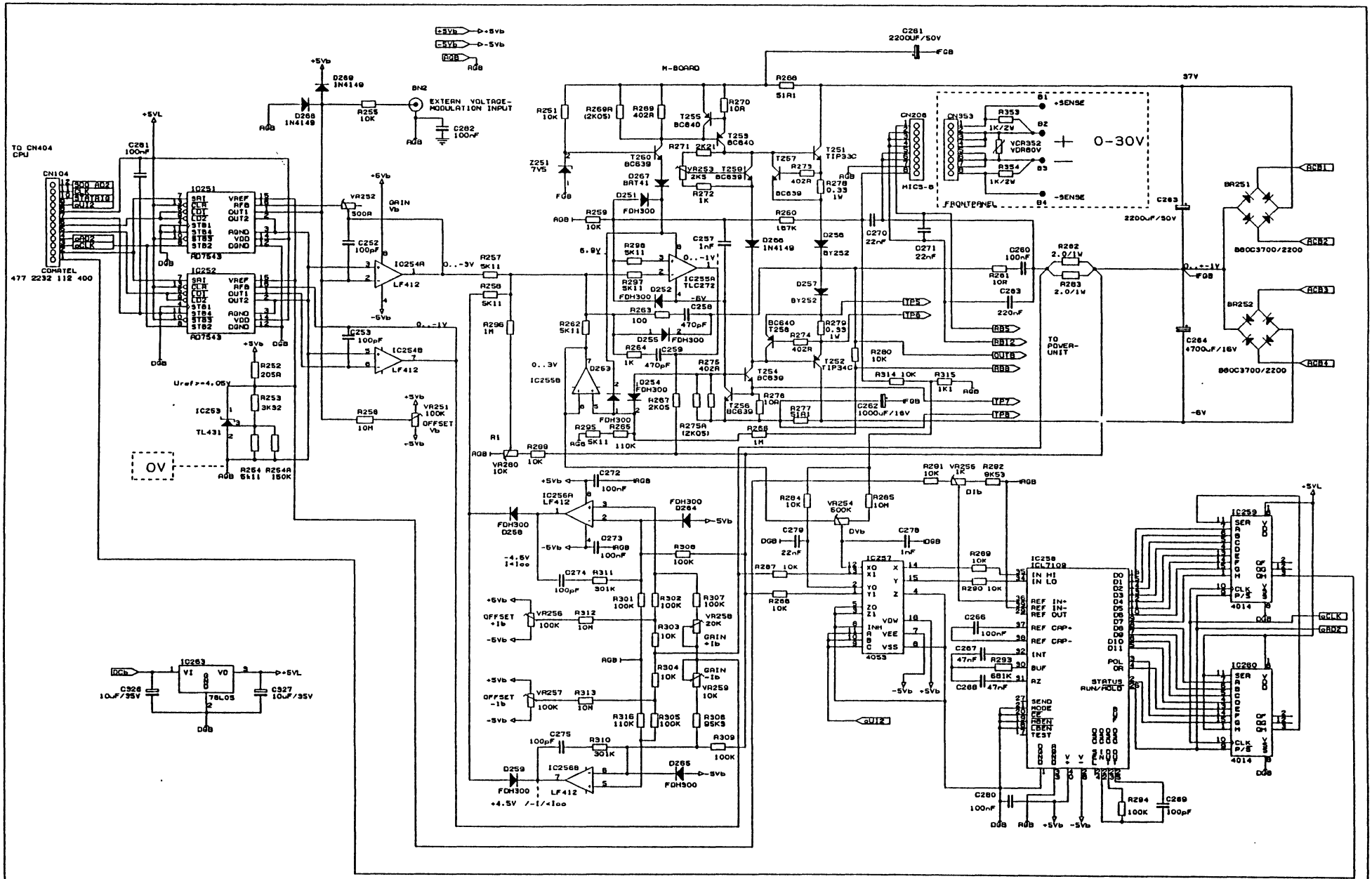
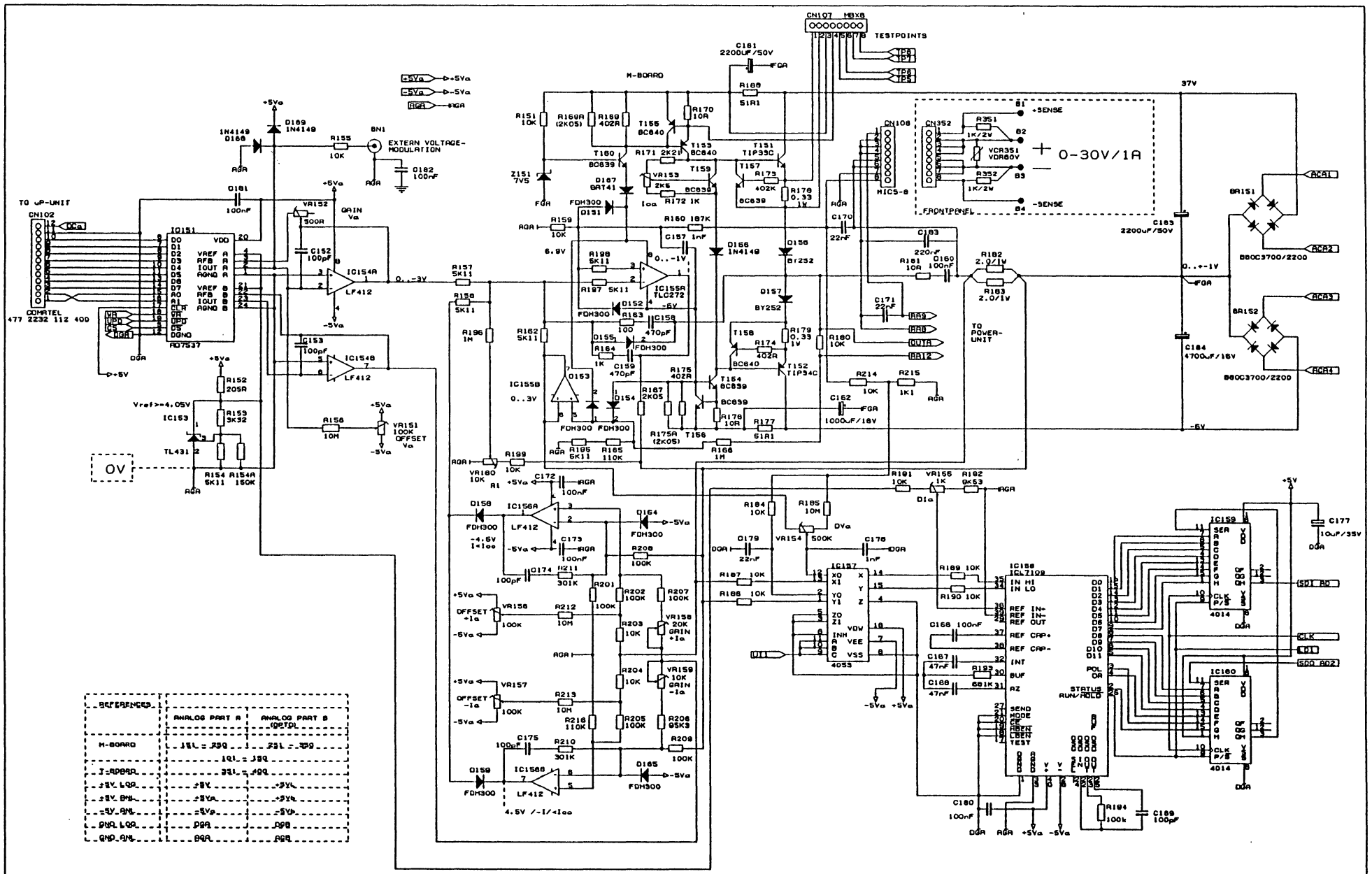
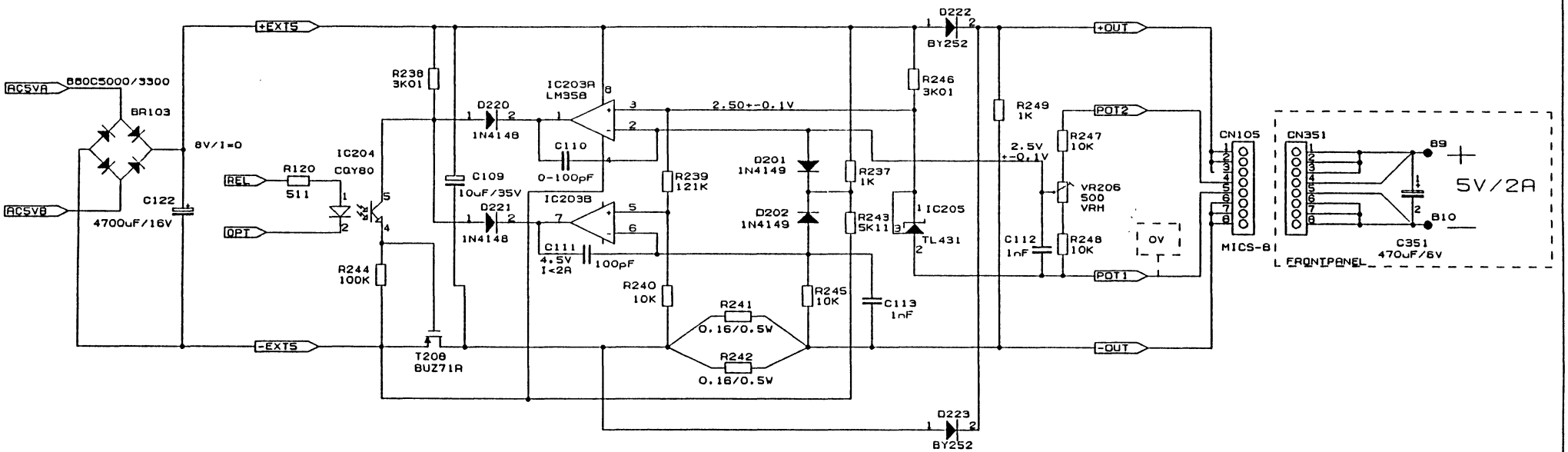
POWER UNIT		
Size C	Document Number HAMEG Instruments 8142PWR P80-52	REV 1.2
Date: January 9, 1991	Sheet 2 of 7	



ANALOG PART B		
Size C	Document Number HAMEG Instruments 8142ANB	REV 1.2
Date: January 8, 1991	Sheet	7


TO µP-UNIT
CN102
COMATEL
477 2232 112 400
IC151
AD7537
VREF A
RFB A
IOUT A
AGND A
VREF B
RFB B
IOUT B
AGND B
VDD
DGND
VR152
300R
GAIN
Va
C152
100pF
IC154A
LF412
IC154B
C153
100pF
R156
10M
VR151
100K
OFFSET
Va
R157
5K11
R158
5K11
R196
1M
R162
5K11
R155
10K
EXTERN VOLTAGE-
MODULATION
BN1
D182
100nF
C181
100nF
D169
1N4149
D168
1N4149
R152
205R
R153
3K32
IC153
TL431
Vref>=4.05V
OV
R154
5K11
R154A
150K
M-BOARD
C181
2200uF/50V
R188
51R1
CN107 M8X8
TESTPOINTS
TP6
TP7
TP8
TP9
R151
10K
R169A
(2K05)
R189
402R
T155
BC640
R170
10R
T180
BC639
R171 2K21
T153
BC640
T151
TIP33C
T159
VR153
2K5
BC639
R172 1K
T157
R175
402K
BC639
R179
0.33
1W
Z151
7V5
D167
BAT41
FDH300
D131
R159
10K
R160 187K
C157 1nF
6.9V
D166
1N4148
D156
BY252
D157
BY252
R198
5K11
IC155A
TLC272
R197 5K11
D152
FDH300
R183
100
C158
470pF
D155
FDH300
R164
1K
C159
470pF
IC155B
0..3V
D153
D154
FDH300
FDH300
R195
5K11
R165
110K
R187
2K05
R175A
(2K05)
T156
T158
R174
402R
BC640
R176
10R
T154
BC639
T152
TIP34C
R177
51R1
R166
1M
R180
10K
R214
10K
R215
1K1
C162
1000uF/16V
CN108
MICS-8
CN352
FRONTPANEL
R351
1K/2W
VCR35I
VDR60V
R352
1K/2W
+SENSE
-SENSE
+ 0-30V/1A
37V
C183
2200uF/50V
C184
4700uF/16V
-6V
C170
22nF
C183
220nF
R161
10R
D160
100nF
R182
2.0/1W
R183
2.0/1W
TO
POWER-
UNIT
C171
22nF
RA9
RA8
OUTA
RA12
BR151
B80C3700/2200
BR152
B80C3700/2200
ACA1
ACA2
ACA3
ACA4
0..+-1V
+FGA
-FGA
R199
10K
VR160
10K
A1
C172
100nF
IC156A
LF412
D158
FDH300
-4.6V
I=Ioa
C173
100nF
C174
100pF
R211
301K
D164
FDH300
R208
100K
R201
100K
R202
100K
R207
100K
VR156
OFFSET
+Ia
100K
R212
10M
R203
10K
VR158
20K
GAIN
+Ia
R204
10K
VR159
10K
GAIN
-Ia
VR157
OFFSET
-Ia
100K
R213
10M
R218
110K
R205
100K
R206
95K3
R209
100K
C175
100pF
R210
301K
IC156B
LF412
D159
FDH300
D165
FDH300
4.5V /-I/<Ioa
R191
10K
VR155
1K
R192
9K53
Dia
R184
10K
R185
10M
DVa
C179
22nF
VR154
500K
C176
1nF
R187 10K
R186 10K
IC157
4053
VH
R189 10K
R190 10K
IC158
ICL7109
IN HI
IN LO
REF IN+
REF IN-
REF OUT
REF CAP+
REF CAP-
INT
BUF
AZ
SEND
MODE
CE
CBEN
CBEN
TEST
POL
OR
STATUS
RUN/HOLD
C166 100nF
C167
47nF
C168
47nF
R193
681K
C180
100nF
R194
100k
C189
100pF
IC159
4014
IC160
4014
C177
10uF/35V
SDI AD
CLK
LDI
SDO AD2
REFERENCES
ANALOG PART A
ANALOG PART B
DIGITAL
M-BOARD
I-BOARD
+5V LOG
+5V ANL
-5V ANL
GND LOG
GND ANL
+5V
-5V
DGA
AGA
Subject to change without notice
ANALOG PART A
Size
Document Number
REV
HAMEG Instruments 8142ANA P90-52
1.2
Date: January 9, 1991 Sheet 4 of 7



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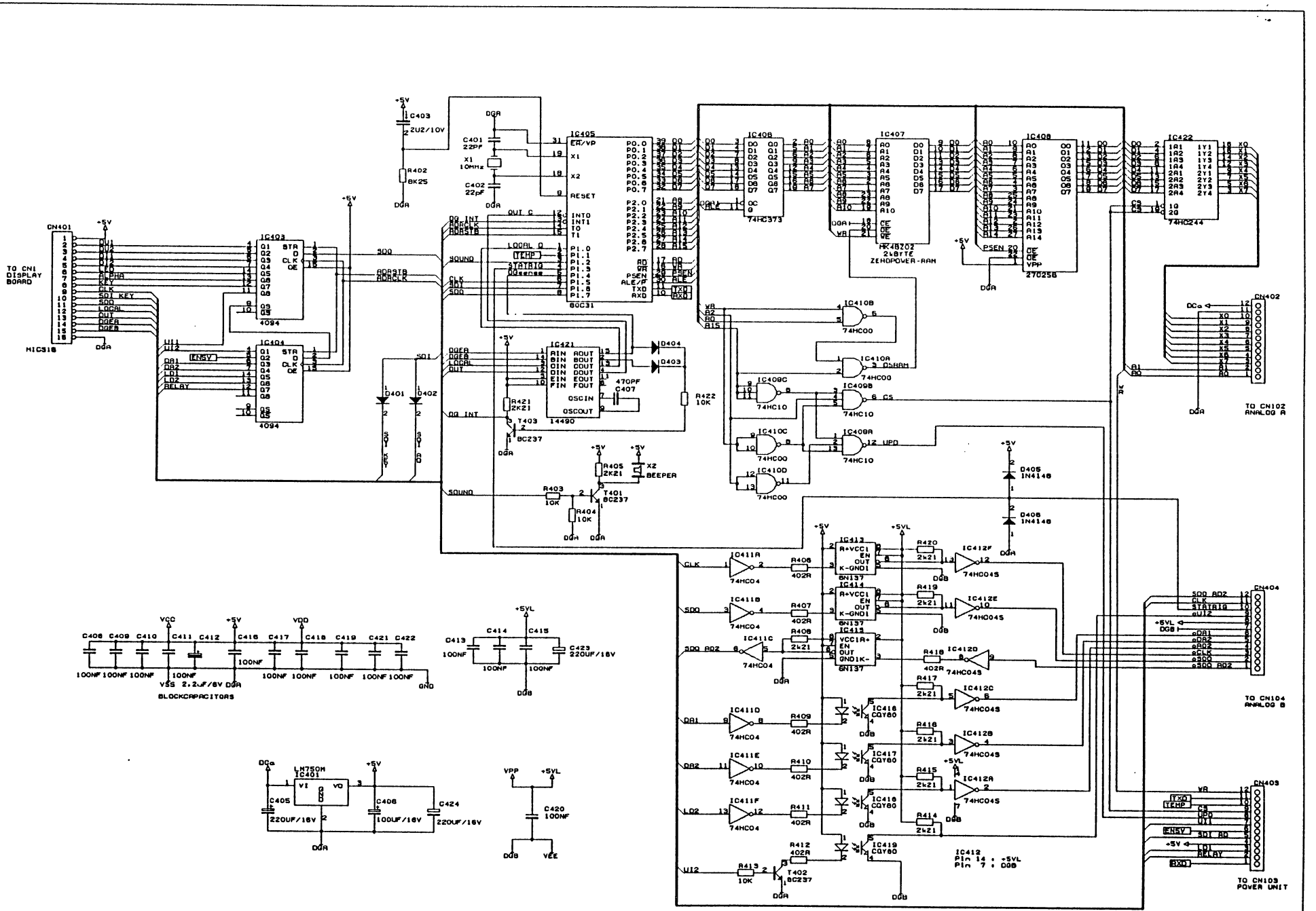
ANALOG PART C		
Size: B	Document Number: HAMEG Instruments 8142ANC P90-??	REV: 1.2
Date: January 9, 1991	Sheet	7


CPU
Size C
Document Number
HAMEG Instruments 8142CPU P81-14
REV 1.2
Date: June 25, 1991 Sheet 8 of 7
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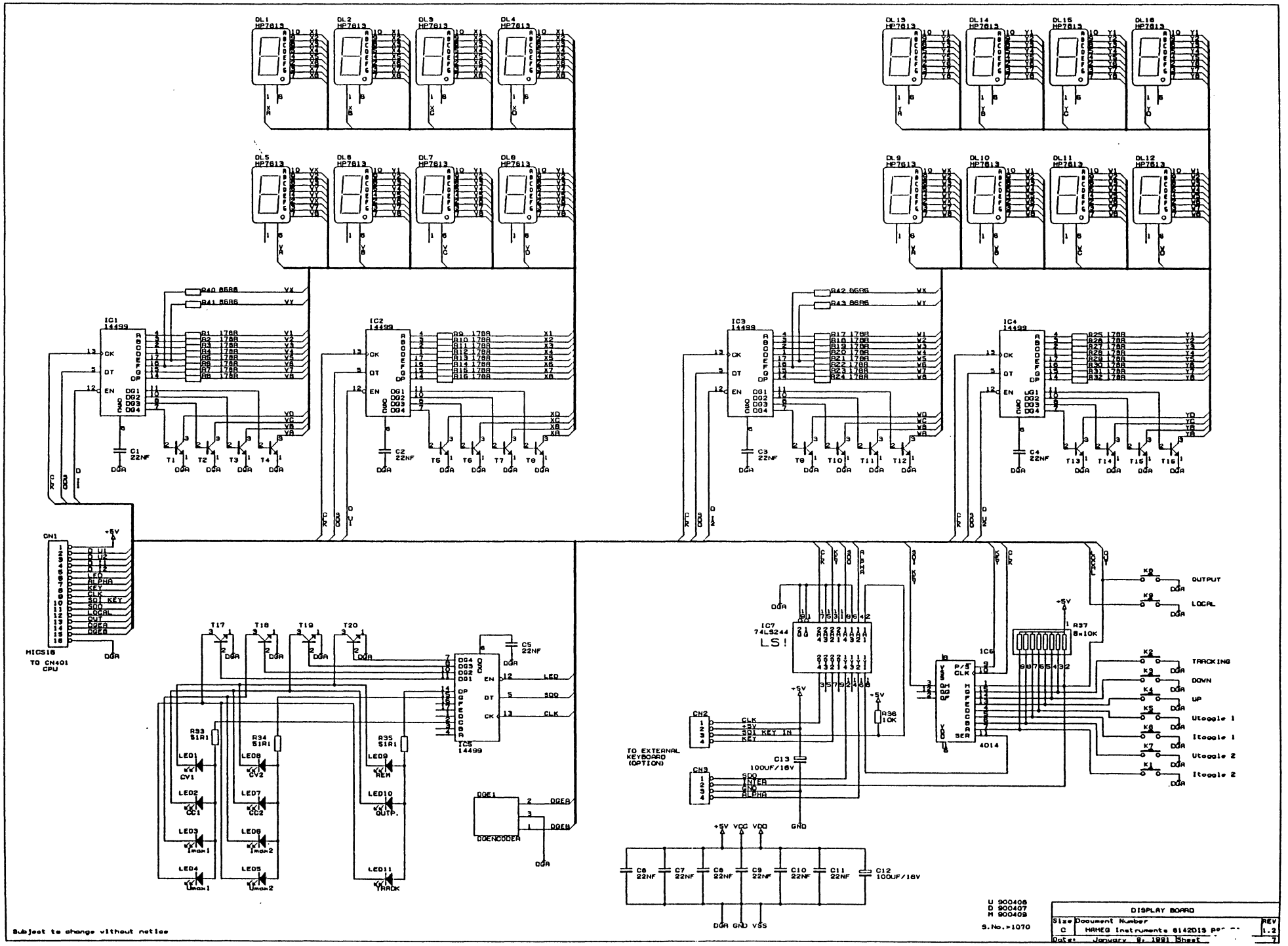
TO CN1 DISPLAY BOARD
TO CN102 ANALOG A
TO CN104 ANALOG B
TO CN103 POWER UNIT
ZEHDPOWER-RAM
BLOCKCAPACITORS
IC412 Pin 14 : +5VL Pin 7 : DGB


DL1 HP7813
DL2 HP7813
DL3 HP7813
DL4 HP7813
DL5 HP7813
DL6 HP7813
DL7 HP7813
DL8 HP7813
DL9 HP7813
DL10 HP7813
DL11 HP7813
DL12 HP7813
DL13 HP7813
DL14 HP7813
DL15 HP7813
DL16 HP7813
IC1 14499
IC2 14499
IC3 14499
IC4 14499
IC5 14499
IC6 4014
IC7 74LS244 LS!
CN1
MICS16
TO CN401 CPU
CN2
CN3
TO EXTERNAL KEYBOARD (OPTION)
DOENCODER
OUTPUT
LOCAL
TRACKING
DOWN
UP
Utoggle 1
Itoggle 1
Utoggle 2
Itoggle 2
LED1 CV1
LED2 CC1
LED3 Imax1
LED4 Umax1
LED8 CV2
LED7 CC2
LED6 Imax2
LED5 Umax2
LED9 REM
LED10 OUTP.
LED11 TRACK
U 900408
D 900407
M 900409
S.No.>1070
DISPLAY BOARD
Size C
Document Number HAMEG Instruments 8142D13
REV 1.2
Date: January 8, 1991 Sheet 7
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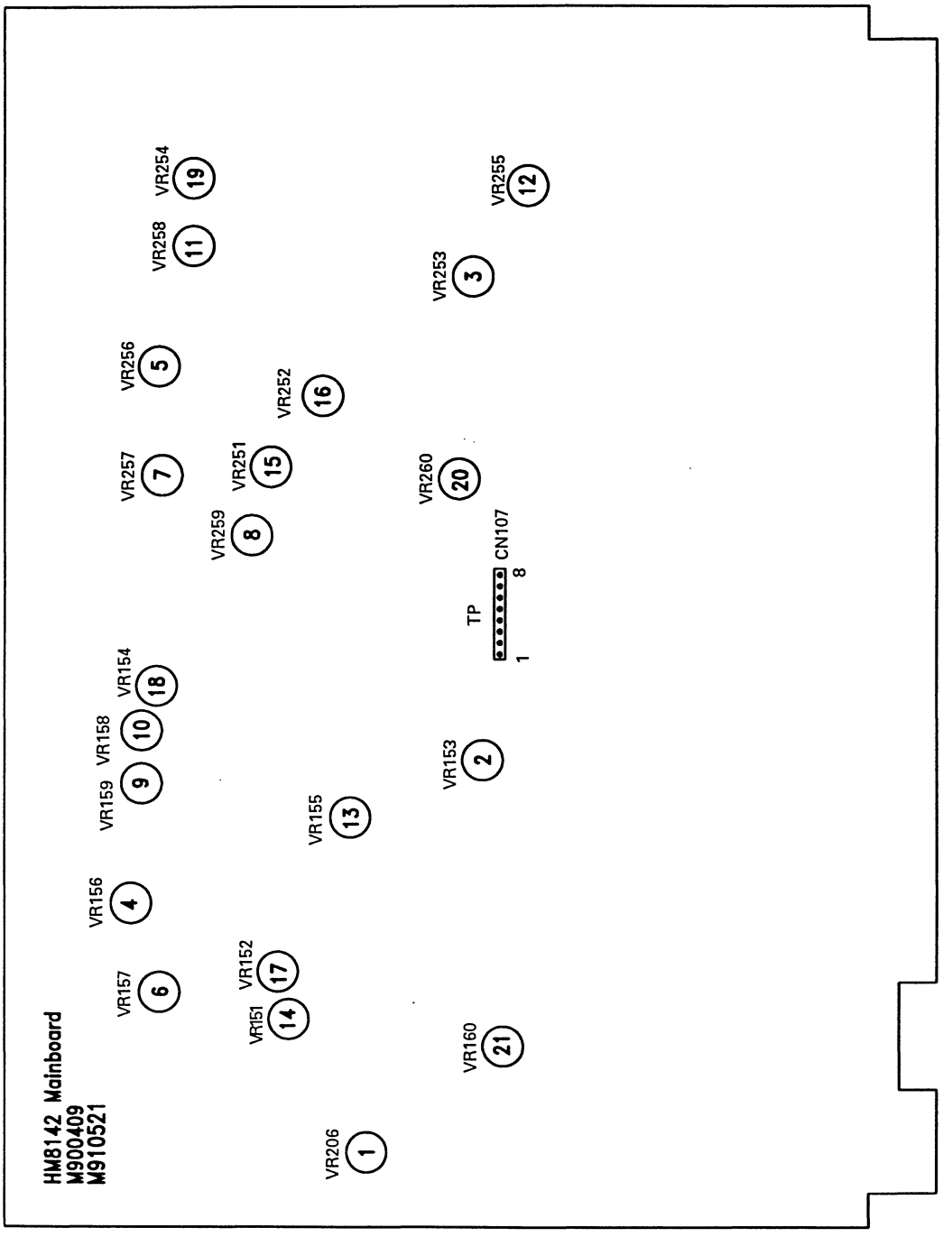


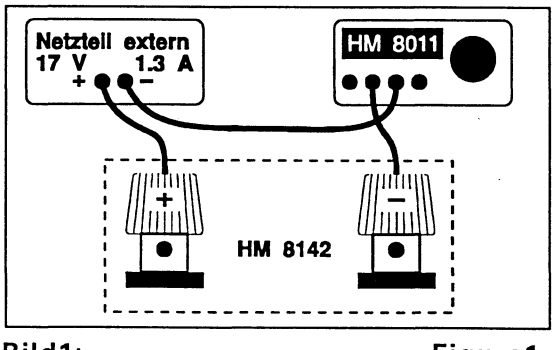


Bild1: **Figure1:**
Anschluß von separatem Netzteil und Multimeter
Connection of separate power supply and DMM
Branchement de l'alimentation extérieure et du multimètre

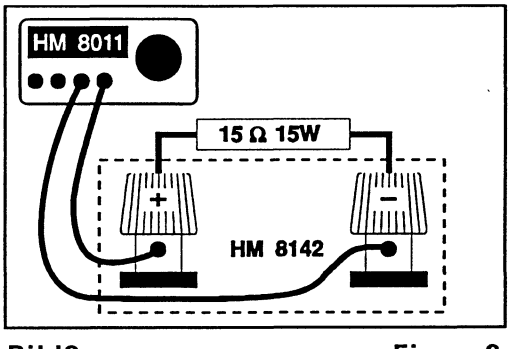
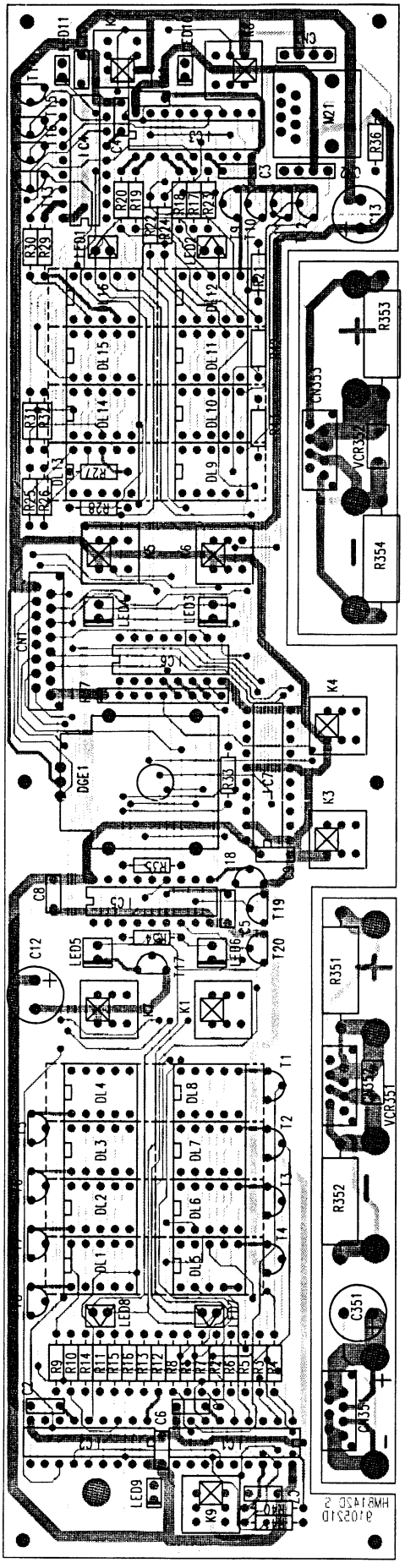
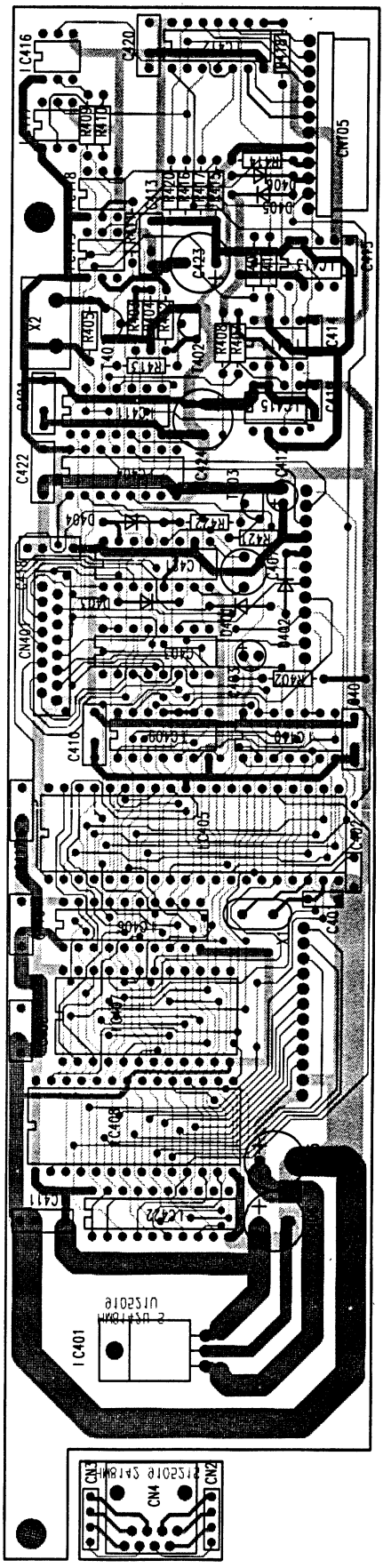
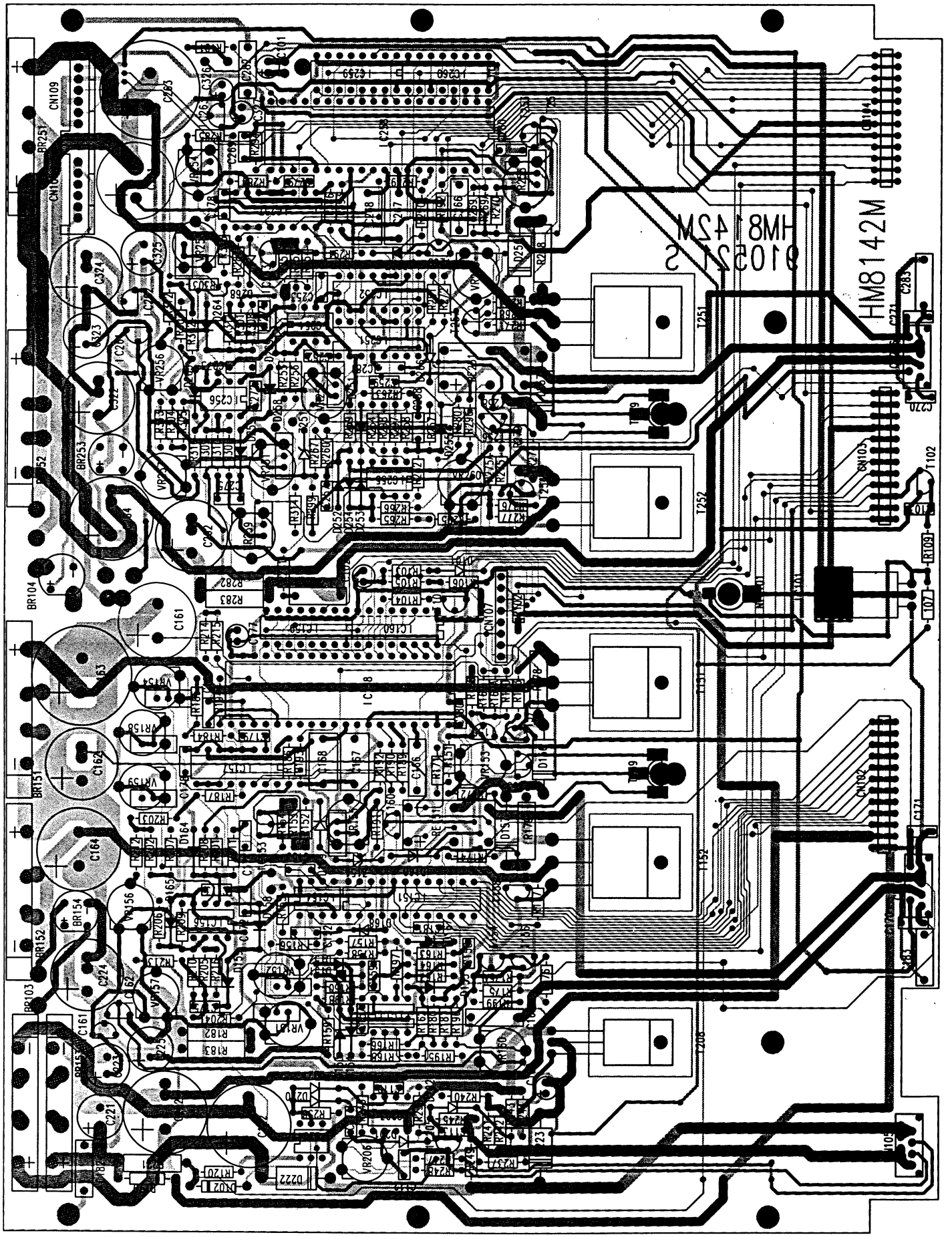


Bild2: **Figure2:**
Anschluß des Lastwiderstandes
Connection of load resistance
Branchement de la charge



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