9803 PROGRAMMABLE OSCILLOSCOPE CALIBRATOR

TECHNICAL MANUAL

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The 9803 is subject to continuous development and improvement and in consequence may incorporate minor detail changes from the information contained herein.

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PART No. 2770

ISSUE 2.4. – 7/05/96

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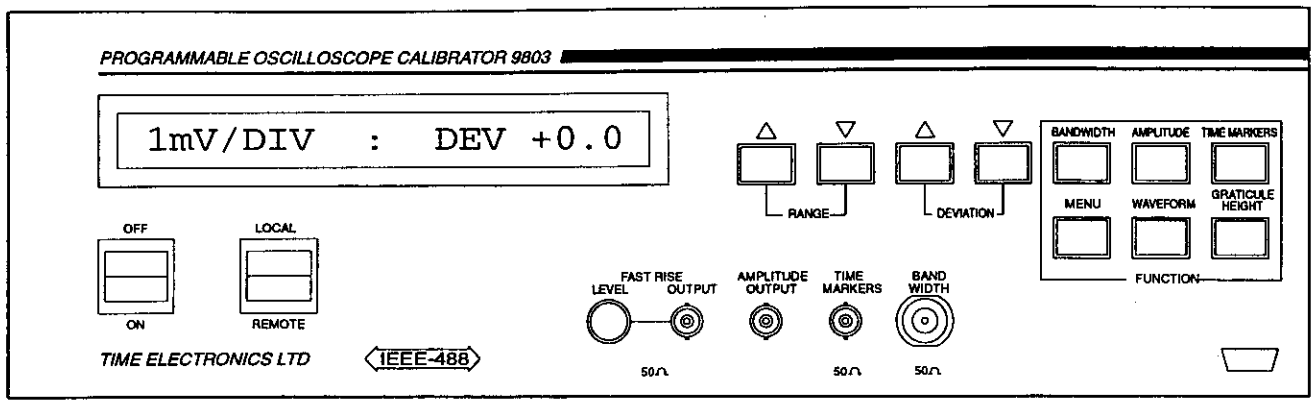


The 9803 high performance Oscilloscope Calibrator uses proven digital and analogue technology for assured accuracy, stability and ease of use while offering a cost effective solution to oscilloscope calibration.

Special consideration has been given to the operation of the 9803 to meet the requirements of oscilloscope calibration. An easily read display showing deviation directly, helps to ensure fast, error free calibration.

Features include the choice of calibrating at either 2, 4, 6 or 8 graticules high to suit the oscilloscope and with a selection of six waveforms including sine, square and trapezoidal. The oscilloscopes error can be read directly from the display of the 9803 to a resolution of 0.1%

Bandwidth tests can be performed with either the fast rise output or with an optional constant amplitude sweep frequency output enabling high performance testing of oscilloscopes up to 1GHz.

Software that allows semi-automated oscilloscope calibration and automatic certificate generation is also available for PC based machines. Fast and accurate calibration can then be performed, realising the full capability of the 9803 oscilloscope calibrator.

INSTALLING THE 9803

This section contains information about the power requirements, fuses and installation of the instrument.

GROUNDING REQUIREMENTS

This instrument is supplied with a three conductor A.C. power lead. This lead must be connected to a three conductor power supply that has its ground conductor connected to an electrical earth (safety ground). The power socket and cable both comply to IEC safety standards.

⚠ FOR CONTINUED PROTECTION AGAINST ELECTRICAL SHOCK, ALWAYS ENSURE THAT THE INSTRUMENT IS PROPERLY EARTHED.

POWER REQUIREMENTS

You can operate the multimeter from a single phase source rated at 110V A.C., 220V A.C., or 240V A.C. 50/60Hz.

Line voltage may vary by up to 10% but must not exceed 250V A.C.

The power lead must be wired in accordance with figure 1.1 shown below.

Be sure that the voltage setting on the instrument is correct before connecting to a power source and that the correct fuse has been installed.

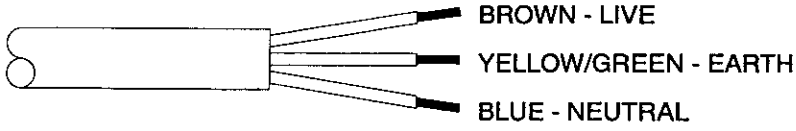


Figure 1.1

SETTING THE LINE VOLTAGE

To alter the line voltage setting, firstly remove the power lead from the instrument.

A small catch may be found at the top of the mains input connector. Unclipping this will reveal a mains voltage selector wheel and two fuse carriers as shown in figure 1.2.

Remove the wheel and rotate until the correct voltage setting is displayed in the window.

Install the correct fuses and replace the wheel. (800mA for 220/240V A.C. or 1.6A for 100V - 120V A.C.).

Snap the cover back in place.

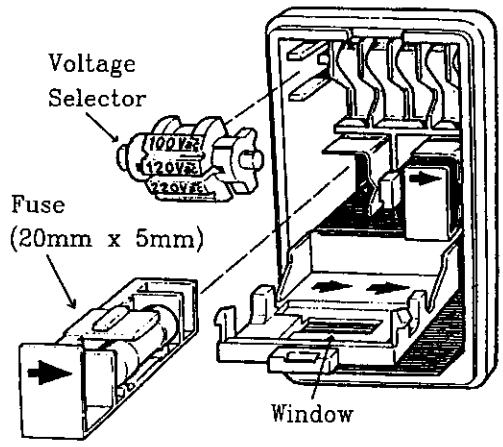


Figure 1.2

BENCH USE

The instrument may be used free standing by using the tilt feet on the base of its outer case.

19" RACK MOUNTING

Alternatively the 9803 may be removed from its outer case and fitted into a 19" rack.

IEEE-488 CONNECTION

The IEEE-488 bus is optional on the 9803.

This instrument implements the requirements of the IEEE - 488/1978 standard.

The connection is made by a standard 24 pin IEEE connector mounted on the rear panel. The IEEE address is selected by a DIP switch again on the rear of the instrument as shown in figure 1.3.

Refer to chapter 4 for IEEE operations.

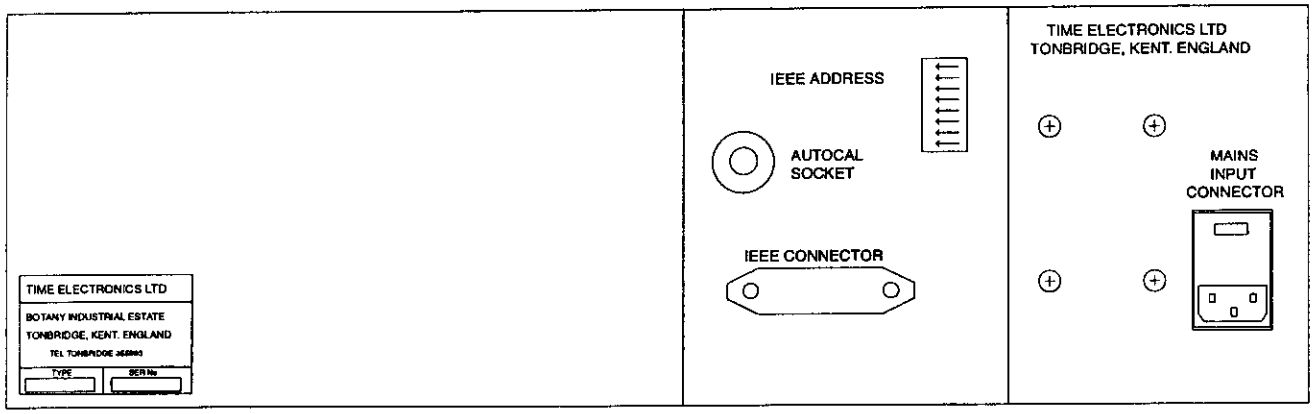


Figure 1.3

SECTION 2 - SPECIFICATIONS

GENERAL SPECIFICATIONS

MAINS SUPPLY

POWER : 110-120/220-240V A.C. ± 10%

FREQUENCY : 50-60 Hz.

FUSE RATINGS : 800mA @ 220-240V A.C. or 1.6A @ 110-120V A.C.

CONNECTOR : IEC Plug

CONSUMPTION : 30W Max

MECHANICAL

DIMENSIONS : 123 x 623 x 110 mm (19" Rack Mount)

WEIGHT : 5.5 kg.

ENVIRONMENTAL

TEMPERATURE : Operating : 0^{o} to $+40^{o}C$ Storage : $-20^{o}C$ to $+60^{o}C$

HUMIDITY : Operating ($0^{o}C$ to $30^{o}C$) <80% ($30^{o}C$ to $40^{o}C$) <60%

ALTITUDE : Operating 0 - 3km Non Operating 0 - 12km

WARM UP TIME : (To full specifications) 1hr

OPTIONS

INTERFACE : IEEE-488 (1978)

1GHz Constant Amplitude Frequency Sweep Board

OUTPUT CONNECTION

Amplitude, Time Marker and Fast Rise outputs are all via standard 50Ω BNC connectors. The Bandwidth output is connected by a 50Ω 'N' type connector.

AMPLITUDE

RANGE	WAVEFORMS	FREQUENCY	GRAT. HEIGHT	ACCURACY	T.C.	STABILITY
1mV/Div	Sine Ramp up Ramp down Sawtooth Trapezoidal D.C.	20Hz 100Hz 1kHz 10kHz	2,4,6,8	± 0.05%/± 10uV pk - pk	< 100ppm/°C	< 0.01%/Day
2mV/Div						
5mV/Div						
10mV/Div						
20mV/Div						
50mV/Div						
100mV/Div						
200mV/Div						
500mV/Div						
1V/Div						
2V/Div						
5V/Div						
10V/Div	Sine Trapezoidal	1kHz		± 0.1% pk - pk	<500ppm/°C	<0.05%/Day
20V/Div						
50V/Div						

All specifications into 1MΩ input impedance.

TIME MARKER OUTPUT

RANGE	ACCURACY	O/P LEVEL	STABILITY	T.C.	DEVIATION
1s/Div	<0.1%	Approx. 1V Amplitude into 1MΩ	< 0.005%/year	< 10ppm/°C	+/- 9.9% in 0.1% steps
500ms/Div					
200ms/Div					
100ms/Div					
50ms/Div					
20ms/Div					
10ms/Div					
5ms/Div					
2ms/Div					
1ms/Div					
500us/Div					
200us/Div					
100us/Div					
50us/Div					
20us/Div					
10us/Div					
5us/Div					
2us/Div					
1us/Div					
500ns/Div					
200ns/Div					
100ns/Div					-9.9% +2.2%

FASTRISE TIME

OUTPUT	AMPLITUDE	RISETIME	O/P IMPEDANCE	OVERSHOOT
Positive going pulse	Variable to 300mV pk - pk	< 1ns (10% - 90%)	50Ω	< 3%

Bandwidth Calculation : The oscilloscope bandwidth can be calculated by measuring the display risetime and using the equation - BW (MHz) = 350 / RISETIME (ns). This is reasonably accurate to about 100 MHz.

BANDWIDTH OSCILLATOR

FREQ. RANGE	OUTPUT LEVEL	AMPLITUDE FLATNESS	IMPEDANCE	ACCURACY	RESOLUTION
3MHz - 1GHz	Approx. 400mV pk	+/- 1dB	50Ω	± 1% of setting	1MHz

SECTION 3 - OPERATION PROCEDURE

INTRODUCTION

This section details the key functions and operation of the 9803 oscilloscope calibrator. This section also assumes familiarity with the oscilloscope under test which is an essential part of the calibration process.

Any test procedures mentioned are recommended practises and may not follow your laboratories guidelines.

SWITCHING ON

When powered up, the 9803 will run through a self test, display the internal software version number and its IEEE address.

```
9803  Ver X.X  IEEE XX
```

The display will then change to -

```
1mV/DIV : DEV +0.0%
```

This indicates that the 9803 is ready for use and is set to an amplitude output of 1mV per division with no deviation applied.

MANUAL OR IEEE BUS OPERATION

For manual operation, Local/Remote rocker switch should be in the Local position and in the Remote position for IEEE-488 bus operation.

PRELIMINARIES

Before calibrating an oscilloscope, ensure that both the 9803 and the unit under test have reached thermal equilibrium. This is typically about 1/2 hr from switch on.

Only use high quality screened 50Ω leads, preferably as short as possible, to reduce noise pickup.

GRATICULE HEIGHT

Before selecting an output, you must first set the correct graticule height. This must match the number of graticules (square divisions) on the oscilloscope screen.

To set the number of graticules, press the Graticule Height key repeatedly until the correct number is displayed.

DEVIATION CONTROLS

The deviation keys may be used to alter the Amplitude and Time Marker outputs by up to +/- 9.9%. Single key presses adjust the output by +/- 0.1%. By holding down the key, the deviation moves in +/- 0.3% steps.

The deviation keys have a secondary use when in the menu.

AMPLITUDE CALIBRATION

Connect to an oscilloscope using a high quality screened lead from the Amplitude BNC connector. Do **not** connect a 50Ω terminator to the cable.

Press the 'Amplitude' key. The display will show -

```
1mV/DIV : DEV +0.0%
```

Pressing the up or down 'Range' keys will alter the amplitude output. Select the range until the display shows that of the oscilloscope's range. The amplitude range is from 1mV to 50V per division. Ensure that the oscilloscope's Volts/Div Variable control is in the 'Cal' position.

By holding down the press switch, a repeat facility becomes available.

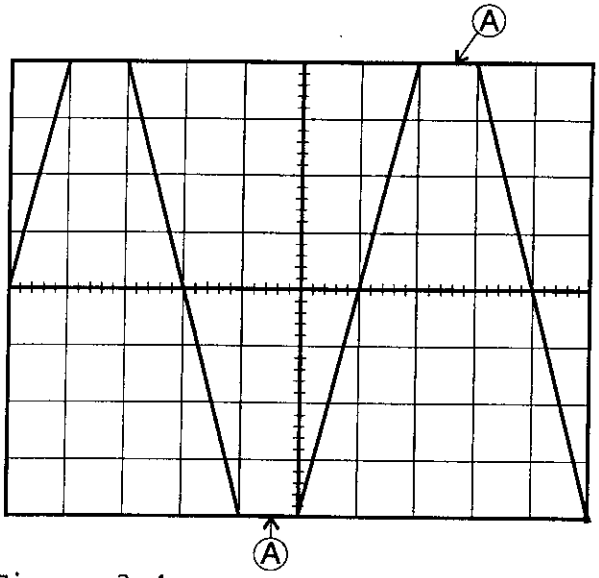


Figure 3.4

The default amplitude waveform is trapezoidal but may be changed for another waveform. See 'Waveforms'. On the 10V, 20V and 50V per division ranges, the waveform is limited to trapezoidal and sine only.

The output frequency of the amplitude waveform is set to 1kHz default. This is the standard frequency used for amplitude calibration. This may be changed however to 20Hz, 100Hz or 10kHz. See 'Menu'.

The waveform should now fit between the top and bottom (vertical or Y axis) graticule lines as shown in figure 3.4, points A. If the waveform does not fit the graticules, figure 3.5, points B, use the deviation keys to adjust the amplitude. When the waveform fits the graticules, the deviation from nominal, or the error may be read directly as a percentage from the 9803 display.

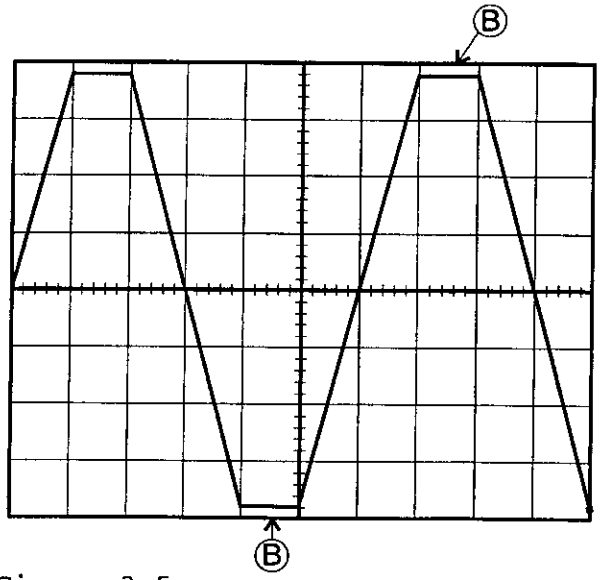


Figure 3.5

WAVEFORMS

A choice of waveforms is available for amplitude calibration. By pressing the 'Waveform' key, the choice of waveform may be altered.

Waveforms available are -

Sine Wave
Square Wave
Trapezoidal
Sawtooth
Ramp Up
Ramp Down
D.C.

TIMEBASE CALIBRATION

To calibrate an oscilloscope's timebase, connect a screened 50Ω cable to the Time Marker Output and for best results, terminate the oscilloscope with a 50Ω load, (see figure 3.6).

Figure 3.6

Press the Time Marker key. The display shows -

```
1s/Div : Dev +0.0%
```

Use the range keys to set to the corresponding range of the unit under test.

Ensure that the variable timebase potentiometer on the oscilloscope is in the 'Cal' position.

The output will be a 1V pulse (without the 50Ω terminator) which should correspond to the horizontal graticules (or X axis) of the oscilloscope. Point B, figure 3.7 shows the markers not lining up with the graticules.

Adjust the output using the deviation keys to line up the markers with the graticules as in figure 3.8, point A. The deviation applied is the error in the timebase.

The timebase may be altered by up to +/- 9.9% using the deviation keys to make the pulses correspond exactly with the graticules.

Range settings are from 100ns/Div to 1s/Div.

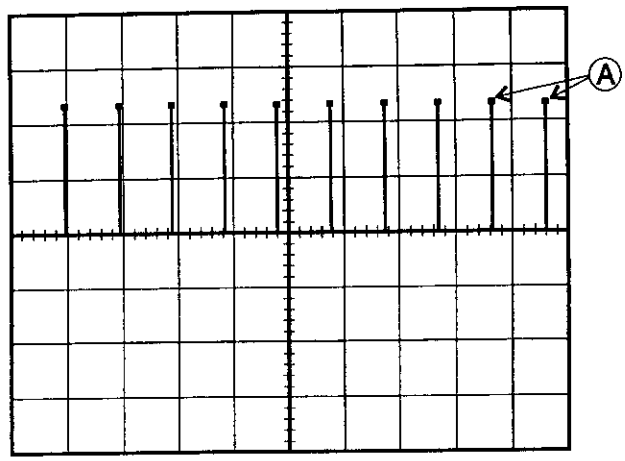


Figure 3.7

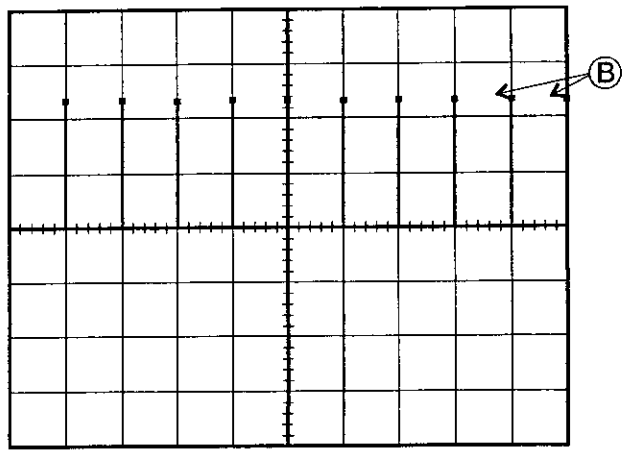


Figure 3.8

BANDWIDTH CALIBRATION

The oscilloscope's bandwidth may be calibrated using a number of methods.

Firstly the fast rise output may be used. This is a pulse with a very fast rise time of better than 1ns on its leading edge. This output is reasonably accurate for checking the bandwidth of oscilloscopes up to around 50MHz.

Secondly, the 1 GHz Constant Amplitude Frequency Sweep option may be used. This sources a sine wave of a variable frequency at a constant amplitude between 3MHz to 1GHz in 1MHz steps.

All these outputs require the use of a 50Ω terminator plugged into the oscilloscope for correct bandwidth calibration, (see figure 3.6).

FAST RISE

Connect the 9803 fast rise output to the oscilloscope via a 50Ω terminator and 50Ω screened cable.

Set the 9803 into Time Marker mode and 100ns/Div. Preset the oscilloscope controls. Ensure that the oscilloscope's Volts/Div Variable control is in the 'Cal' position.

Refering to figure 3.9, adjust the vertical positioning so that the zero reference of the waveform touches the 0% graticule line and the top of the waveform touches the 100% graticule line. The fast rise level potentiometer may be used to fit the waveform to the graticules.

Set the timebase to display of as much of the waveform as possible.

Horizontally position the display so the 10% point on the waveform intersects the second vertical graticule line. (Point A, figure 3.9).

Measure the horizontal distance between the 10% (point A) and 90% (point B) points and calculate the time duration using the following formula -

Rise time = Horizontal Distance (divisions) x Timebase

This will give you the rise time. By using the following formula, the rise time will give you the bandwidth -

$$Bandwidth(MHz) = \frac{350}{risetime}(ns)$$

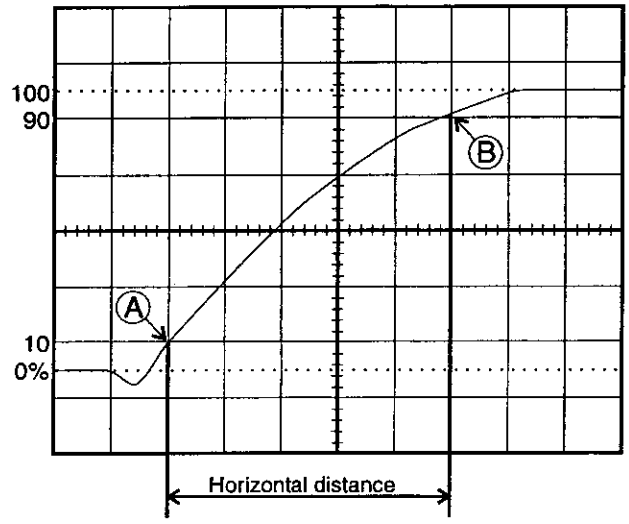


Figure 3.9

CONSTANT AMPLITUDE FREQUENCY SWEEP

The optional oscillator gives a constant amplitude across its entire frequency range. The frequency can be swept from 3MHz up to the 3dB down point which is the limit of the oscilloscopes bandwidth. The frequency may then be read directly from the 9803's display.

Connect the 9803 Bandwidth output to the oscilloscope via a 50Ω screened cable and a 50Ω terminator at the oscilloscope input.

Select the Bandwidth function and the display will show -

FREQUENCY 50MHz

Use the range keys to adjust the output frequency up or down. The 1GHz board will step up or down in 10MHz steps with the range keys, or in 1MHz steps if the deviation keys are used.

Preset the oscilloscopes controls and select the lowest frequency from the 9803. Set the oscilloscope up with this waveform to fill the vertical axis. For example, with an 8 graticule screen, align the input with the top and bottom graticule line, (see figure 3.10, points A).

Increase the frequency and when the waveform drops to 5.6 graticules (figure 3.11, points B), the 3dB down point, the frequency can be read from the 9803 display. This frequency is the resulting bandwidth of the unit under test.

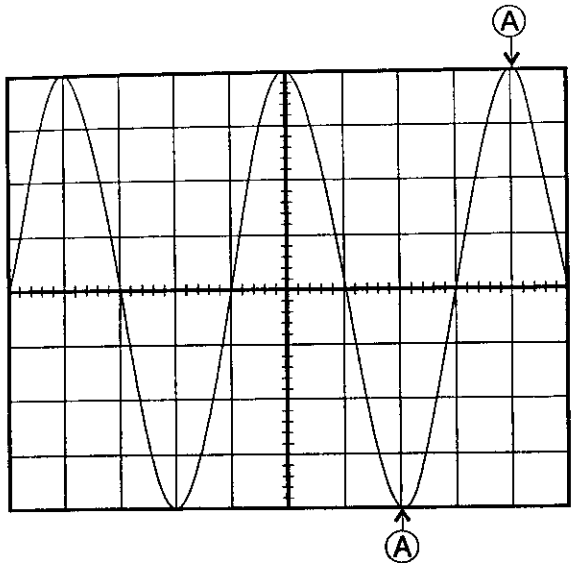


Figure 3.10

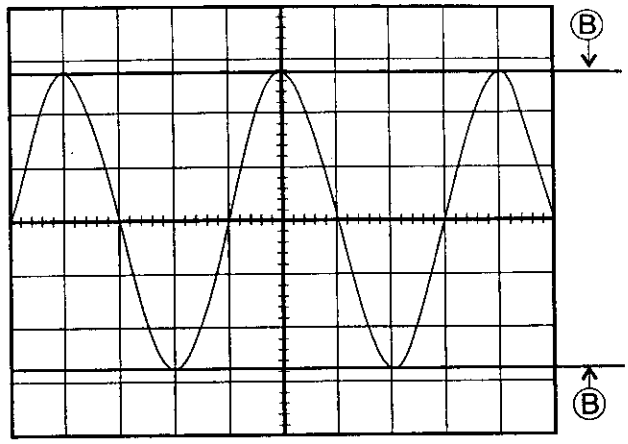


Figure 3.11

MENU

Entering the menu will allow you to alter or display the 9803 configuration. By pressing the up and down range keys, you may select the options. Pressing the deviation keys will alter them.

Amplitude Output Frequency may be altered from its default 1kHz to either 20Hz, 100Hz or 10kHz.

The IEEE address may be displayed and also the internal software version number.

SECTION 4 - IEEE OPERATION

This section only applies if the IEEE - 488 interface card (option 9880) has been installed into the 9803

INTRODUCTION

The IEEE-488 interface, sometimes called GPIB (General Purpose Interface Bus) or the HPIB (Hewlett Packard Interface Bus) allows remote control of the instrument by a suitable computer or controller.

Repetitive calibration work can be speedily and accurately carried out, giving printed results if required.

The 9803 is compatible with the IEEE-488 (1978) interface bus.

The IEEE-488 standard defines a complete interface system for the interconnection of instruments and computers using a bit parallel, byte serial bi-directional bus. Protocols, connections and cables are also defined, enabling computer controlled systems to be quickly realized.

The main limitations of the IEEE are :-

1) A maximum of 15 devices on the bus.

2) The maximum bus length should not be greater than 20m or number of devices x 2, which ever is the shorter.

DATA TRANSFER AND DEVICE ADDRESSING

Before a controller can send data it has to identify the recipient. Each device on the IEEE is given an address to which it will respond when called by the controller, in this way data can be transferred between selected devices in an orderly manner.

The rate at which data is transferred is controlled by hand shake signals, the speed being governed by the slowest device active on the bus.

Set baud rates are therefore unnecessary with this system.

IEEE CABLES

The IEEE-488 cable contains 24 wires terminated at both ends with identical plug/sockets which allow for daisy - chaining of additional cables to extend the bus.

Cables used on IEEE systems are available in various lengths to suit different layouts.

IEC BUS CONNECTIONS

Users requiring to connect the DMM to a European standard bus (IEC-625), must be aware of the differences in connector pin assignments from the IEEE bus and provide a suitable interface.

Table 4.1 compares the pin designations for each standard.

IEEE CONNECTOR

The pin connections and dimensions of the IEEE connector are illustrated in figure 4.1 and in table 4.1.

Figure 4.2 illustrates the connections.

PIN NUMBER	IEEE-488 STANDARD	IEC-625
	FUNCTION	FUNCTION
1	DIO 1	DIO 1
2	DIO 2	DIO 2
3	DIO 3	DIO 3
4	DIO 4	DIO 4
5	EOI	REN
6	DAV	EOI
7	NRFD	DAV
8	NDAC	NRFD
9	IFC	NDAC
10	SRQ	IFC
11	ATN	SRQ
12	SHIELD	ATN
13	DIO 5	SHIELD
14	DIO 6	DIO 5
15	DIO 7	DIO 6
16	DIO 8	DIO 7
17	REN	DIO 8
18	GND 6	GND 5
19	GND 7	GND 6
20	GND 8	GND 7
21	GND 9	GND 8
22	GND 10	GND 9
23	GND 11	GND 10
24	LOGIC GND	GND 11

Table 4.1

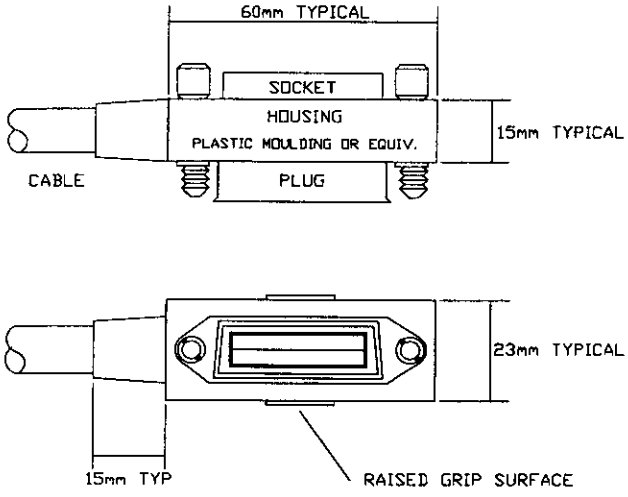


Figure 4.1

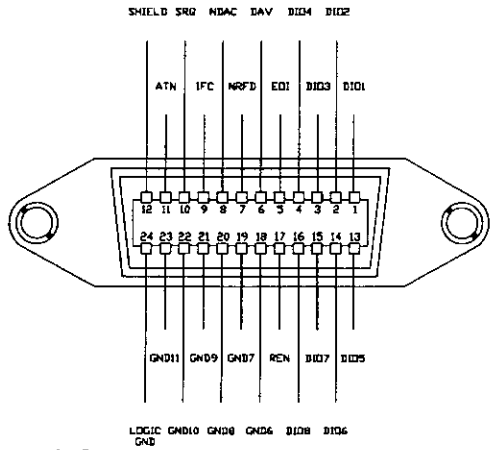


Figure 4.2

IEEE ADDRESS SELECTION

Before operating the 9803 over the IEEE bus, set the address on the rear of the unit to the required address and operating mode.

Addresses 0 and 16 are reserved for recalibration and should not be used unless recalibrating the instrument. Address 31 is used to select self test mode.

The first five switches set the IEEE address and the last three switches are used to select the instruments operation mode. The last three switches are normally set to off but may be used as follows :

Switch 6 - Disable IEEE talk (transmit) mode.

Switch 7 - Disable IEEE listen (receive) mode.

Switch 8 - Dual Primary Addressing mode. In this mode, the unit will respond to two primary addresses differing only in the least significant bit. For example, if the unit address selection switches are set for an address of 8, the unit will also respond to address 9.

NOTE : The instrument only reads the address switch upon power up. Therefore if the IEEE address is changed it will be necessary to switch the unit off and on again.

LOCAL/REMOTE OPERATION

The 9803 is may be used via the IEEE-488 bus when the Local/Remote switch is in the Remote position.

INTERFACE CLEAR COMMAND - IFC

This command initiates a complete reset of the unit, which is then unable to respond to any further IEEE commands for 1 second.

IEEE COMMAND FORMAT

IEEE commands are comprised of characters from the ASCII set. A series of commands can be used to simulate the manual operation of the unit.

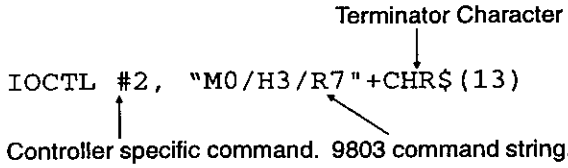
The commands must be in one of the following formats:

1.) A single upper case character (A to Z).

2.) An upper case character followed by a number.

Commands may be sent individually or built into a string separated with a slash character (/).

A command string may take the form of -



The controller specific command is an instruction to the IEEE controller to read or write the following string to the device on the bus. This command may vary considerably between controllers. The example shown is a typical QuickBasic language by Microsoft command. Refer to your IEEE controller for specific commands.

The 9803 command string consists of commands from the 9803 Instruction set. These commands will instruct the 9803 to output functions or perform other operations.

TERMINATING CHARACTER

All command strings must end with a terminator character for the string to execute.

This may be either a line feed or carriage return character as set by the T1 or T2 command.

IEEE COMMAND EXECUTION

Before an IEEE command can be executed the following conditions must be met.

1) The IEEE address and the talk/listen switches set correctly on the rear panel switch.

2) The command must be a valid command (invalid commands are ignored).

3) The command must be followed by a valid terminator character.

IEEE COMMAND LIST

RANGE		
COMMAND	AMPLITUDE	TIMEBASE
R1	1mV/Div	1s/Div
R2	2mV/Div	500ms/Div
R3	5mV/Div	200ms/Div
R4	10mV/Div	100ms/Div
R5	20mV/Div	50ms/Div
R6	50mV/Div	20ms/Div
R7	100mV/Div	10ms/Div
R8	200mV/Div	5ms/Div
R9	500mV/Div	2ms/Div
R10	1V/Div	1ms/Div
R11	2V/Div	500us/Div
R12	5V/Div	200us/Div
R13	10V/Div	100us/Div
R14	20V/Div	50us/Div
R15	50V/Div	20us/Div
R16	-	10us/Div
R17	-	5us/Div
R18	-	2us/Div
R19	-	1us/Div
R20	-	500ns/Div
R21	-	200ns/Div
R22	-	100ns/Div

MODE	
COMMAND	FUNCTION
M0	AMPLITUDE
M1	TIMEBASE
M2	BANDWIDTH

GRATICULE HEIGHT	
COMMAND	FUNCTION
H0	2 GRATICULES
H1	4 GRATICULES
H2	6 GRATICULES
H3	8 GRATICULES

WAVEFORM	
COMMAND	FUNCTION
W1	SINEWAVE
W2	SQUARE
W3	RAMP UP
W4	RAMP DOWN
W5	SAWTOOTH
W6	TRAPEZOIDAL
W7	D.C.

DEVIATION	
Positive Deviation	Px.x
Negative Deviation	P-x.x

FREQUENCY	
1GHz Board	FXXXX (F8000=8MHz)

PROGRAMMING EXAMPLE

The following simple demonstration program has been written in Microsoft™ QuickBasic®.

This program will allow the operator to send a valid IEEE command to the 9803 to set a range, function or deviation.

```
100 REM *** IEEE CONTROL DEMO PROGRAM
200 OPEN "IEEECTRL" FOR RANDOM AS #1          'Open Control File
210 OPEN "IEEEDATA" FOR RANDOM AS #2          'Open Data File
220 T$=CHR$(13) + CHR$(10)                    'Set the terminator character
230 CLS
240 INPUT "Enter IEEE Address of 9803 ";IE$ 'Select IEEE address
250 IOCTL #1,IE$                              'Send IEEE Address
300 INPUT "ENTER COMMAND (X TO EXIT) ";C$
310 IF C$ = "X" THEN END
320 IOCTL #2,C$ + T$                          'Send command to IEEE Bus
330 GOTO 300
```

Lines 200 and 210 open files for a specific IEEE interface card and may not be applicable to your controller.

SECTION 5 - FAULT DIAGNOSIS

FAULT DIAGNOSIS INTRODUCTION

This section gives details of some possible problems, and how to correct them, together with information about board replacement. Faulty items may be returned for repair or new spares obtained (see Section 8), quoting type and serial number, and giving details of the fault where possible.

FAULT CHECK LIST

1) If the 9803 is completely dead with no front panel lights, check the following -

a) Mains supply is on.
b) Mains fuse has not blown in plug.
c) Mains fuse has not blown in combination appliance inlet.
d) Internal fuses have not blown. (See fuse replacement).

2) If unit responds to manual control but not to IEEE control, check the following -

a) IEEE cable is not defective.
b) 9803 is correctly addressed.
c) Terminating characters are correct.
d) Processor and IEEE boards are correctly plugged in.

3) Unit displays ERROR 6.

a) Calibration RAM is corrupted.

4) Unit occasionally resets to power on (1mV range) condition.

a) Mains interference is causing the microprocessor to stop, tripping the watch - dog circuitry to give an automatic restart. Additional mains filtering is required.

FUSE REPLACEMENT

Three type of fuse are used in the 9803 -

1) 2 A 20mm quick blow - 5V supply.
2) 800mA 20mm anti-surge - Mains input.
3) 3.15A 20mm anti-surge - 18V supply.

See Section 8 (Spare Parts List) for fuse part numbers.

FUSE LOCATION AND REPLACEMENT PROCEDURE

1) Mains Fuse - These fuses are located in the mains inlet filter. To replace, disconnect equipment from mains and lever down hinged cover to reveal fuse holders. See figure 5.3.

2) 5V supply - The 5V supply fuse is mounted on the left-hand printed circuit board of the power unit. See figure 5.4.

3) +/- 18V fuses - These fuses are mounted on the right-hand printed circuit board of the power unit. See figure 5.5.

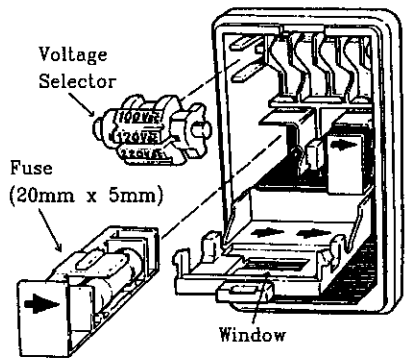


Figure 5.3

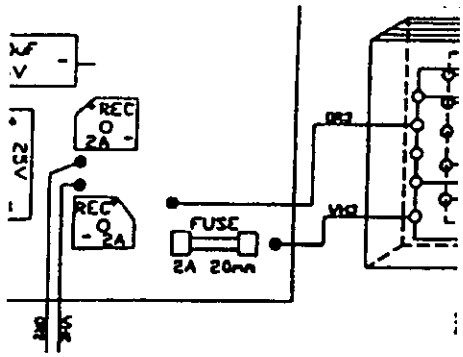


Figure 5.4

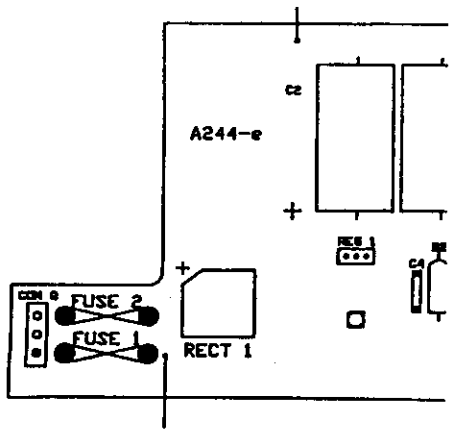


Figure 5.5

MAIN FRAME

The 9803 is constructed on a 19 inch Euro-card frame. Cards and modules plug into the frame from the rear of the unit.

All modules and printed circuit boards connect to the 64-way data bus via a DIN 41612 type connector.

The front panel is removed by unscrewing the four captive screws at each corner and then lifting away from the frame.

POWER MODULE REPLACEMENT

To remove the power unit module which is located on the right-hand side of the frame viewed from the rear, first REMOVE THE MAINS POWER.

Unscrew the four captive screws in the corners of the power unit rear panel. The power unit can then be pushed out of the rear of the frame. Reverse the order to replace the power module.

REPLACEMENT OF IEEE AND PROCESSOR BOARDS

The IEEE and processor boards are located behind the IEEE rear panel. To replace -

1) Remove the panel by unscrewing the four captive screws at each of its corners.
2) Disconnect the multi-pin plug that connects the rear panel to the IEEE panel.
3) Depress the black retaining clips located at the bottom of the frame to remove board.

NOTE: The IEEE multi-pin connector is not polarised and can be accidentally reversed during replacement. To avoid this, ensure the embossed arrow heads on the plug and socket are aligned. Care must also be taken to ensure the correct alignment of the IEEE address switch in the rear panel cut-out.

ANALOGUE AND TIME MARKER BOARDS REPLACEMENT.

The analogue and time marker boards are located behind the rear panel on the left of the frame when viewed from the rear. To replace a board -

1) Ensure the mains is switched off.
2) Remove rear panel.
3) Depress card retaining clip of board and pull board back.

When replacing both boards, additional connectors need to be disconnected as both boards are removed.

SECTION 6 - TECHNICAL DESCRIPTION

INTRODUCTION

This section contains a brief technical description of the 9803, starting with the mainframe and associated modules, followed by the plug-in boards. The technical description is divided into the following parts -

1) The Mainframe
2) The Front Panel Electronics Board
3) The Power Module
4) Microprocessor Board
5) The IEEE Interface Board
6) Analogue Board and Module
7) A.C. Board
8) Time Marker Board (including fast rise)
9) 1GHz C.A.F.S. Option

MAINFRAME

A 19" Eurocard frame houses all board and modules which plug into a 64 way bus via DIN 41612 type connectors.

THE FRONT PANEL ELECTRONICS BOARD

The front panel board consists of the necessary address decoding logic to read the press switches and drive the Vacuum-Flourescent display module. The VFD module contains all the necessary decode/driver logic for the display and also the H.V. converter to enable the display to run from a 5V supply.

THE POWER MODULE

The power module contains a 100VA rated mains transformer, DC regulated supplies and select circuitry for the LOCAL/REMOTE switch and indicators.

The mains transformer has two 120V RMS primary windings and 9V, 11V and two 22V RMS secondary windings.

The 9V winding connects, via a 2A fuse, to a full wave bridge rectifier and smoothing capacitor. It supplies a regulated 5V DC at 1A for the micro-processor board, the IEEE board and front panel display.

The 11V supply is full wave rectifier to supply an unregulated 14V DC at 1A. An unregulated 5V DC supply derived from this 14V DC drives the circuit relays and can be pulled up to 14V on command for latching the relays.

The 18V supply is rectified and regulated at +/-18V DC for the analogue circuitry.

THE MICROPROCESSOR BOARD

Mounted on the microprocessor board are the microprocessor, its clock, a PROM, the power-on-reset circuitry, address decoding and 32 lines of parallel input/output (I/O).

The microprocessor used in the 9803 is the Motorola MC6802. A 3.2768MHz crystal, divided down internally by the 6802, supplies the 8.192kHz clock.

Parallel I/O is provided by two MC6821 peripheral interface adaptors (PIA). Each of the 32 I/O lines is provided with a pull-up resistor.

An on-board link provides for the installation of either a 16K (2716), 32K (2732) or 64K (2764) PROM.

The power-on circuitry is a low frequency oscillator held off by the micro-processor stop, the oscillator does not receive a pulse and automatically resets.

A non-volatile RAM (type X2816), contains all the auto-cal information.

THE IEEE INTERFACE BOARD

The IEEE interface board is constructed around the Motorola MC68488 general purpose interface adaptor (GPIA). The I/O lines of the 68488 are driven through MC3448 drivers. The address select switche is mounted directly on the board and its condition is gated onto the 6802 uP bus via a 74LS244 tristate buffer.

THE ANALOGUE BOARD AND MODULE

The encapsulated reference circuitry consists of a precision, aged zener diode running at optimum current to supply the master reference voltage for the calibrator. An analogue switch enables selection of either '+' or '-' reference voltage. The reference voltage is fed via the A.C. board to a 14 bit D/A converter on the reference board which controls the level of the output. The reference module controls the range switching and final amplification is provided on the main board by a discrete component amplifier.

A.C. BOARD

The reference voltage from the reference board is fed into a digital to analogue convertor (D/A) mounted on this board. The control codes for the D/A are held in an EPROM, the sequence of which is controlled by an 8-digit binary counter, driven from a frequency synthesiser circuit. The D/A control codes determine the shape of the A.C. output.

TIME MARKER BOARD

A variable frequency up to 10MHz is output from the A.C. Board is taken to a pre-division circuit which allows fine deviation at low frequencies. Three dual decade counters 74LS390 are driven from the pre-divider I.C.'s. Each stage generates the decade ranges of time markers. The output from each counter is shaped by an R/C network. Any output can be selected by the 74HCT151 multiplexer which directly drives the output and the 'fast rise' buffer amp.

The fast rise circuit takes a time marker pulse and switches the leading edge very fast. The amplitude of this fast rise is control by a potentiometer on the front panel.

The time marker board also contains an isolated convertor which steps up the Amplitude output to give 10V, 20V and 50V per Division. The converter is switched in using a screened relay driven from a data line.

1 GHz CONSTANT AMPLITUDE FREQUENCY SWEEP OSCILLATOR OPTION

The 3MHz to 1GHz output is produced by mixing the output of two U.H.F. voltage controlled phase locked loop circuits.

One oscillator is fixed at a constant frequency, while the other is able to sweep from 1.8GHz to 2.8GHz using a microprocessor controlled synthesizer chip.

The two oscillators are then mixed and filtered to produced the resultant frequency.

A D.C. signal is taken from the reference board to give automatic gain control to the mixer output amplifier. This ensures constant amplitude across the entire output.

SECTION 7 - CALIBRATION

INTRODUCTION

The calibration of the 9803 can be split into two parts -

1) Calibration of Amplitude signals.

2) Calibration of the Time Marker signals.

EQUIPMENT REQUIRED FOR CALIBRATION

a) 6 1/2 digit multimeter for DC voltage.

b) Frequency counter with 1Hz to 10 MHz range for time markers or up to 1GHz for the oscillator output.

c) Calibration Key (supplied).

CALIBRATION OF AMPLITUDE SIGNALS

Calibration of the amplitude levels is performed using the 'Autocal' facility. To enable 'Autocal', select address 16 on the IEEE address switch and plug the Cal Key into the Autocal Key Socket on the rear of the instrument.

Note : In this address only amplitude signals are available, and the output is automatically set to DC.

When address 16 is used, 'Calibration Address' is displayed for a few seconds when the unit is first turned on. This display format in calibration mode is -

```
5mV/Div CAL  DEV 0.00%
```

Calibration is adjusted on the following ranges -

5mV/Div corresponding to 20mV D.C. O/P
50mV/Div corresponding to 200mV D.C. O/P
0.5V/Div corresponding to 2V D.C. O/P
5V/Div corresponding to 20V D.C. O/P
50V/Div corresponding to 200V Square Wave O/P

By inserting the 'CALKEY' into the rear panel, the D.C. outputs can then be adjusted using the deviation keys to alter to the correct level. This will automatically calibrate the remaining amplitude outputs.

Ensure that the waveshape of the 10V, 20V and 50V ranges are correct using VR1 on the time marker board before adjusting the 50V/Div range. When calibrating the 50V/Div range it is recommended that the output is rectified before measurement.

CALIBRATION OF TIME MARKER SIGNALS

The calibration of the time markers is not adjustable, any deviation from specifications indicates a fault in the instrument. Calibration is therefore limited to measurement of the period which can be performed by the use of a frequency counter.

It must be noted that because of the low level and fast pulse of this output, some frequency counters may not trigger properly and will give false readings.

CALIBRATION OF OSCILLATOR BOARDS

If it is found necessary for these boards to be calibrated in any respect, it is recommended that the unit is returned to the manufacturer.

SECTION 8 - SPARE PARTS

INTRODUCTION

We hold a comprehensive list of spare parts in stock. Please contact our sales office for prices or for parts not listed.

POWER SUPPLY

Fuse 20mm (2A)	6111	Mains Transformer	7529
Mains Fuse 20mm (800mA)	6128	+18V 1A Regulator LM7818CT	4318
Fuse A.S. (3.15A)	6129	-18V 1A Regulator LM7918CT	4319
2A Bridge Rectifier	4110	+5V 1A Regulator LM340AT-5.0	4310
3A Bridge Rectifier	4111	5V Regulator Heatsink	4623

PROCESSOR AND IEEE BOARD

8 Way D.I.L. Switch	6306	Crystal (3.2768MHz)	4559
IEEE Connector	6420	Microprocessor (6802)	4583
IEEE Driver (3448)	4555	PIA (6821)	4585
IEEE Interface (68488)	4556	12 Bit Timer (14040)	4590

FRONT PANEL

VF Display	7224	Fast Rise Level Potentiometer	1851
F/P Press Switch (without cover)	6341	Black Knob for fast rise adjustment	6057
Grey Button for 6341	6333	Red Top for above knob	6059
Red Button for 6341	6336	Keyboard Encoder I.C. 74C923N	4595
Blue Button for 6341	6335	50Ω BNC Cable Assembly	8613

A.C. BOARD

9.83040MHz Crystal	4510	Analogue Switch DG211CJ	4546
Opto Coupler 6N137	4425	Multiplexor I.C. 74LS153	4549
Dual Opto Coupler ILD74	4554	Dual Counter I.C. 74LS05A	4551
D to A I.C. MP7623AJN	4572	Negative 5V Regulator 79L05A	4314

ANALOGUE REFERENCE BOARD

Reference Module	9599	14 Bit Convertor AD7534JN	4571
Op-Amp OP-27GN	4407	250mA 5/8" Fuse	6102
Op-Amp OP-07CP	4415	S2-12V Relay	6314
Op-Amp RCA3140	4423	Thermal Cutout 70°C	6399
Opto Coupler ILD74	4554	Heatsink for Reference Board	8788

TIME MARKER BOARD

Screened Relay G5Y-5V	6324	Dual Counter IC 74LS390AN	4551
High Speed Diode 1N6263	4113	Multiplexor I.C. 74LS151E	4576
High Speed Transistor ZTX510	4225	High Voltage Transformer	7521
VMOS Transistor VN10-KM	4236	C30 Inductor 33uH	7537

3 - 1000MHz OSCILLATOR BOARD

Ceramic Trimmer 5p5 - 50pF	3020	Mixer Oscillator NE602N	4442
Schottky Diode 11DQ03	4117	Frequency Synthesizer SP5060	4443
Varicap diode BB119	4119	Microwave Amp I.C. MSA1104	4446
UHF Mixer UMX2020	4439	Crystal 8MHz (HC-49U)	4562
Oscillator VTO8150 (1.5-2.5GHz)	4440	Crystal 5.12MHz (HC-49U)	4563
Oscillator VTO8090 (0.9-1.6GHz)	4441	Filter Block 237LVS1070	7536

SECTION 9 - GUARANTEE AND SERVICING

GUARANTEE PERIOD

The 9803 is guaranteed against defects in materials and workmanship for a period of one year from its delivery to the customer.

We maintain comprehensive after sales Facilities and the unit can, if necessary be returned to us for servicing.

During this period, we will at our discretion repair or replace the defective item.

For servicing under guarantee, the instrument type and serial number must always be quoted, together with details of any fault and the service required. The purchaser of the instrument must pay all shipping charges to manufacturer. We will pay return shipping charges.

. This guarantee is void if servicing has been
. attempted by an unauthorised person or agent

. If, during the guarantee period, failure is due to misuse or abuse of the unit, the repair will be put in hand without delay and charged unless other instructions are received.

We guarantee that the software and firmware for this instrument will execute its programmed function. We do not guarantee that the operation will be uninterrupted or error free.

Please note that if you require a new NAMAS Certificate during the warranty period, this will be charged at the current rate on our price list.

SERVICE AFTER GUARANTEE PERIOD

Even after the guarantee period has expired, we can still recalibrate and service your instrument.

As the manufacturer, we have the specialised knowledge needed to keep your instrument in peak condition and we also maintain a comprehensive spare parts service.

Please enclose details of the service required and your full company details including a contact name.

RETURNING INSTRUMENTS

When returning instruments, please ensure that they have been adequately packed, preferably in the original packing supplied. **We will not accept responsibility for units returned damaged.**

Please ensure that all units have details of the service required and all relevant paperwork including contact name, address and telephone number.

SECTION 10 - DIAGRAMS AND LAYOUTS

Due to continuous improvement and development, the circuit diagrams and layouts printed in this manual may not correspond exactly with the unit that you may have.

Therefore if updated circuit diagrams are needed, please contact our sales office.

The circuit diagrams and layouts are listed below.

1) Microprocessor Board Circuit Diagram

2) Microprocessor Board Layout

3) IEEE Interface Board Circuit Diagram

4) IEEE Interface Board Layout

5) Power Supply Circuit Diagram 1 & Layout 1

6) Power Supply Circuit Diagram 2 & Layout 2

7) Front Panel Circuit Diagram

8) Front Panel Layout

9) Reference Board Circuit Diagram

10) Reference Board Layout

11) A.C. Synthesizer Board Circuit Diagram

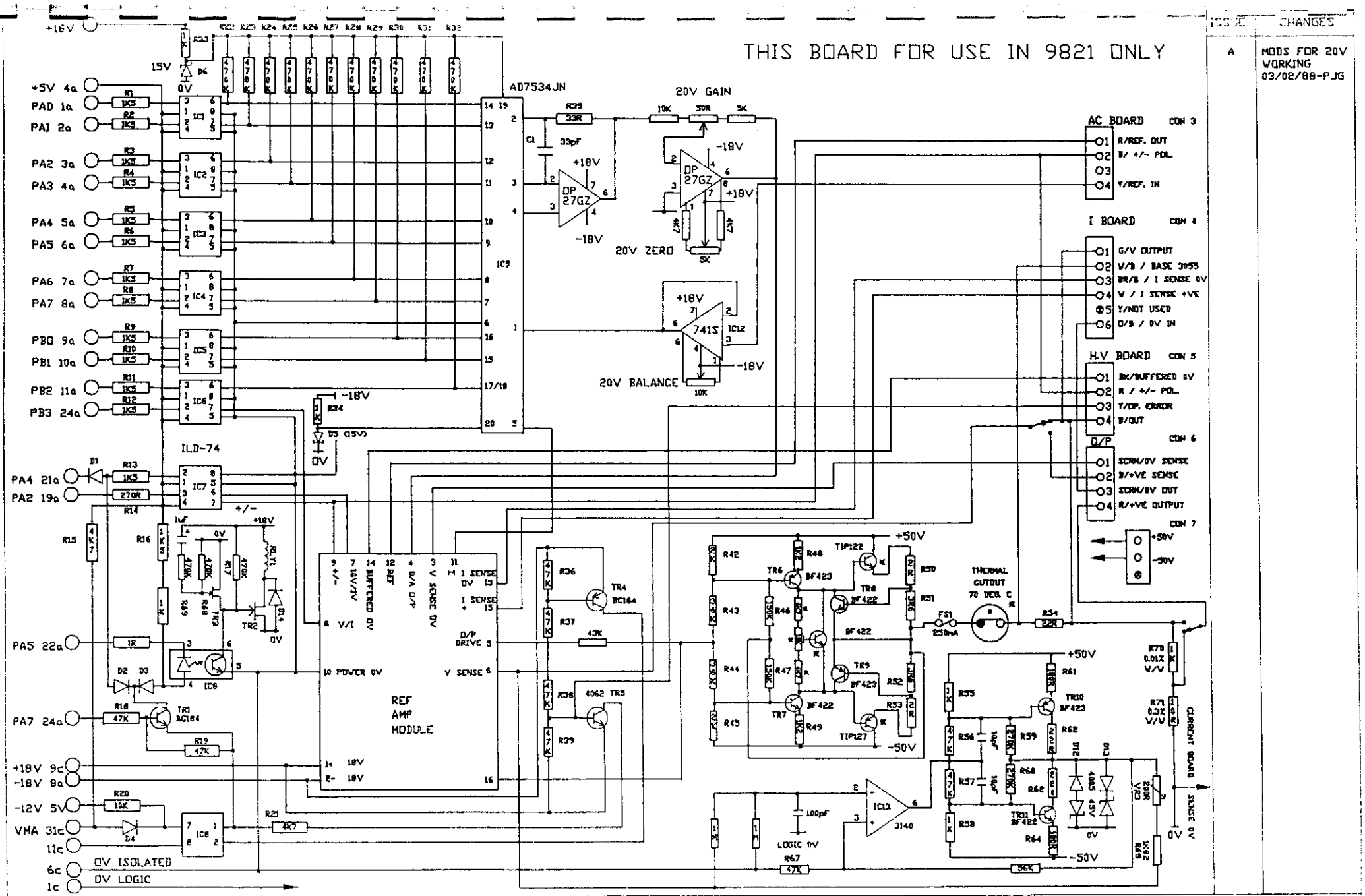
12) A.C. Synthesizer Board Layout

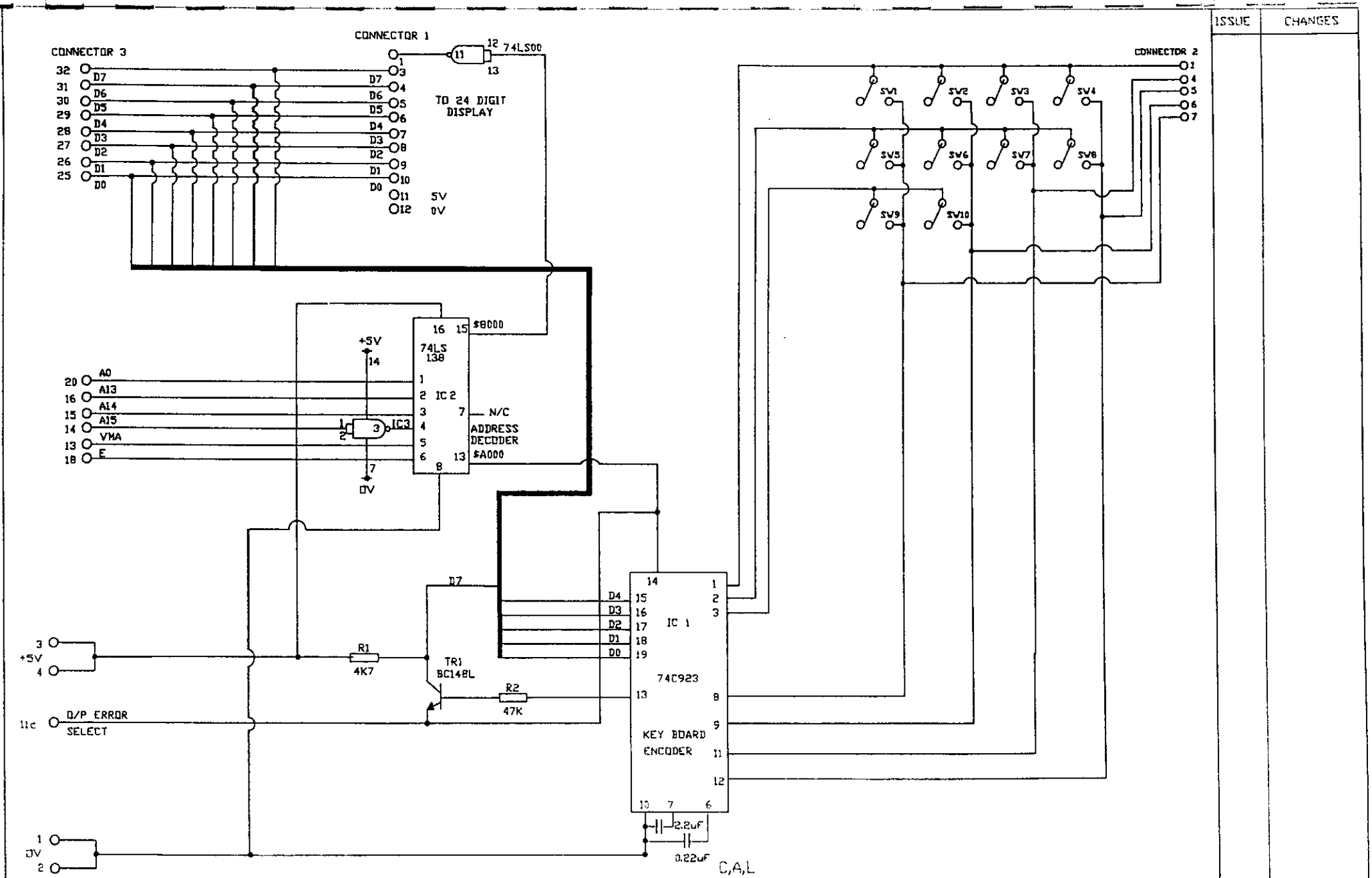
13) Time Markers and Fast Rise Circuit Diagram

14) Time Markers and Fast Rise Board Layout

15) Constant Amplitude 3MHz - 1GHz Oscillator Board Circuit Diagram

16) Constant Amplitude 3MHz - 1GHz Oscillator Board Layout

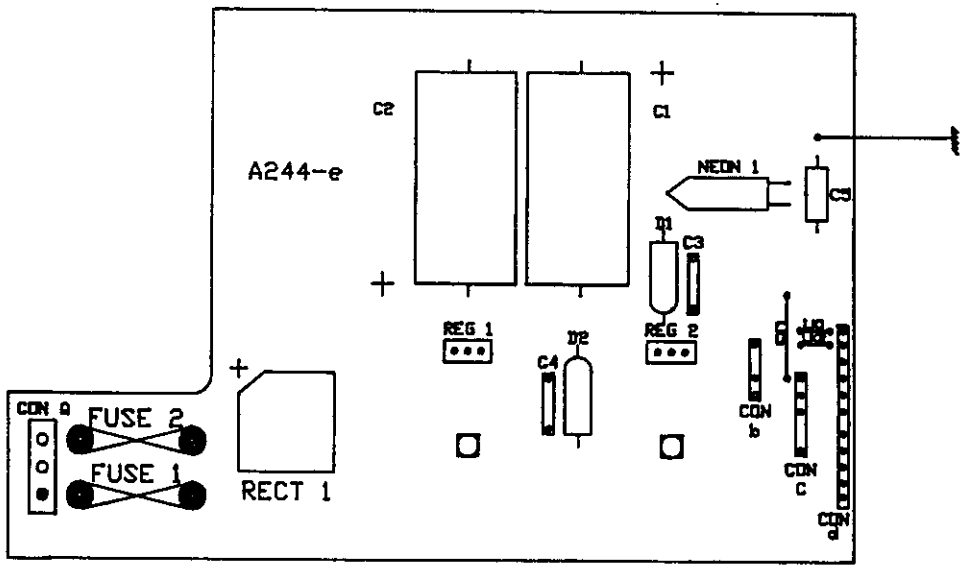

THIS BOARD FOR USE IN 9821 ONLY
ISSUE
CHANGES
A
MODS FOR 20V WORKING 03/02/88-PJG
AD7534JN
20V GAIN
20V ZERO
20V BALANCE
AC BOARD CON 3
I BOARD CON 4
H.V BOARD CON 5
O/P CON 6
CON 7
ILD-74
REF AMP MODULE
THERMAL CUTOUT 70 DEG C
CURRENT BOARD SENSE 0V
'A' REFERS TO COMPONENTS MOUNTED ON HEATSINK
DRAWN C.A.L.
APPRD
SCALE
DATE 24.2.87
TITLE
REFERENCE BOARD CIRCUIT DIAGRAM
THE CONTENTS OF THIS DRG MUST NOT BE COPIED OR USED WITHOUT PRIOR WRITTEN CONSENT OF TIME ELECTRONICS LIMITED
DRG No
9404C04



ISSUE	CHANGES

DRAWN	A.J.F	TITLE	9803 FRONT PANEL CIRCUIT DWG
APPRD	J.B.		
SCALE		THE CONTENTS OF THIS DRG MUST NOT BE COPIED OR USED WITHOUT PRIOR WRITTEN CONSENT OF TIME ELECTRONICS LIMITED	DRG No CIRCUIT/7415B05
DATE	10/10/89		

ISSUE	CHANGES



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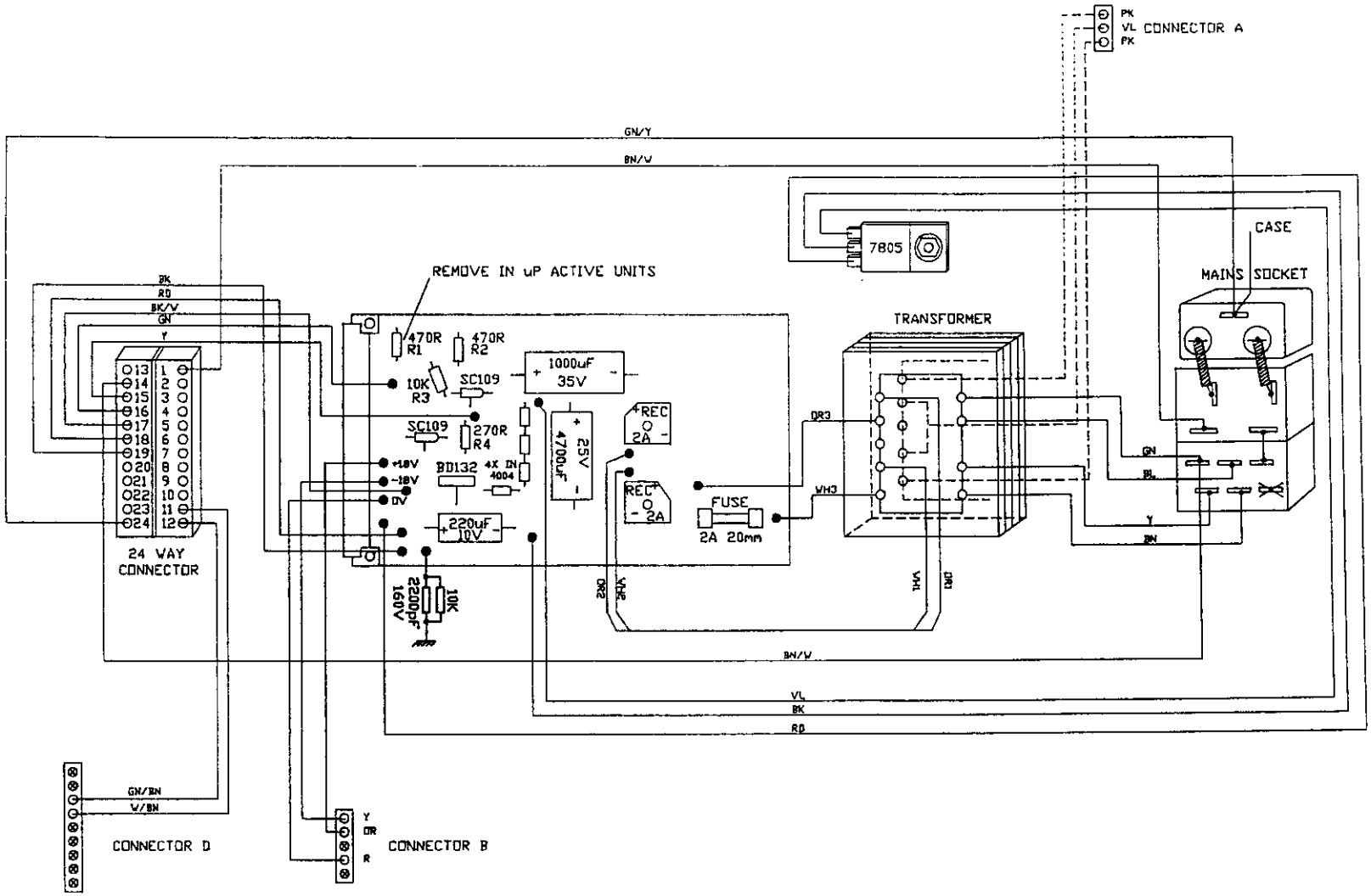
	APPRD		
	SCALE		
	DATE	25/8/87	DRG NO: 9572L03

ISSUE	CHANGES



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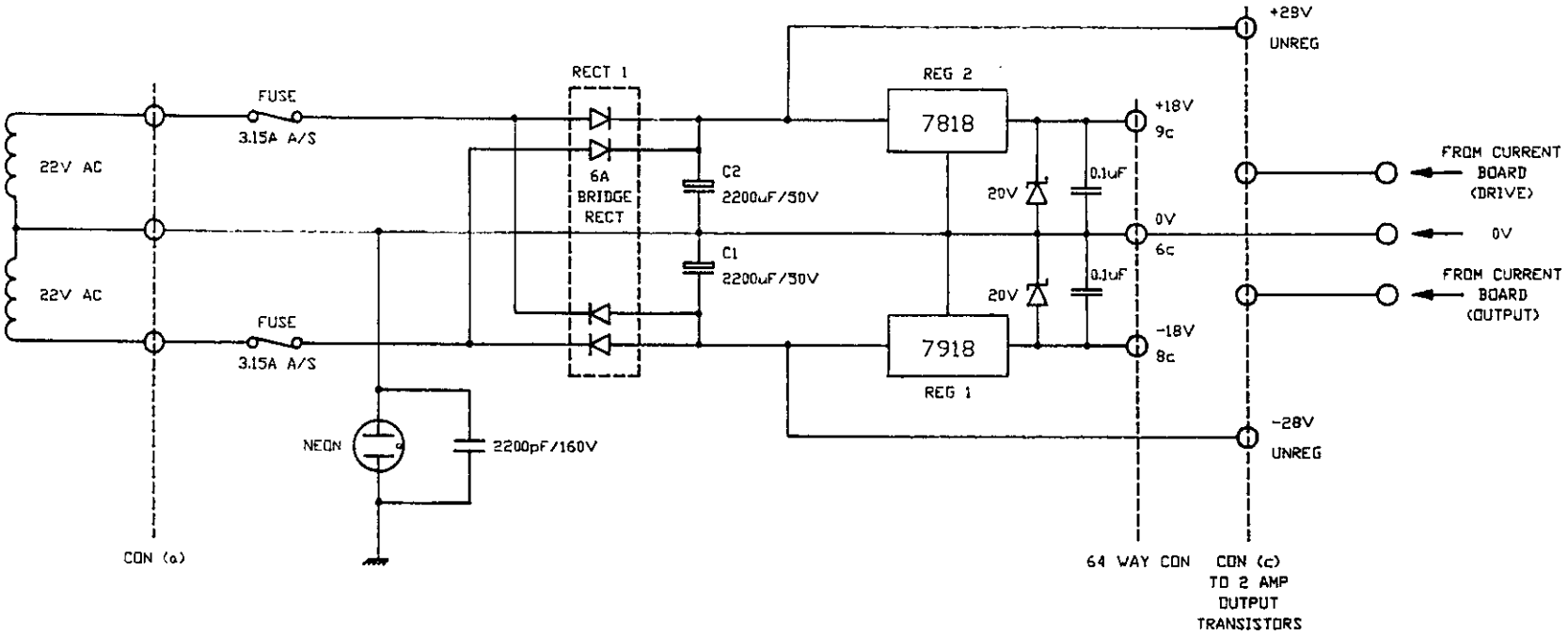
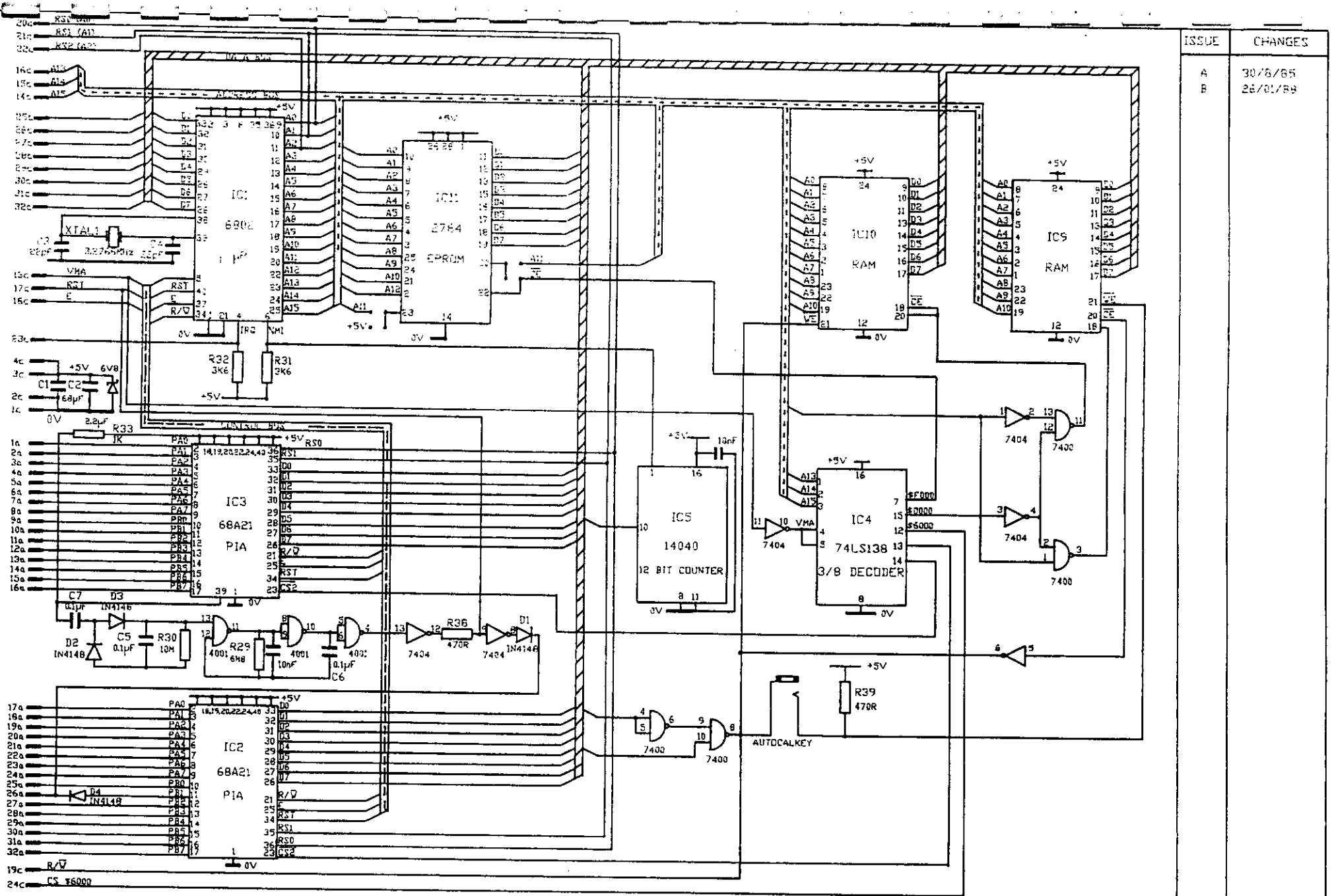
	APPRD		
	SCALE		
	DATE	31/3/87	DRG No: 9572L02

ISSUE	CHANGES
A	FUSES CHANGED TO 3.15A FROM 2.5A.
B	-18V PIN CORRECTION 09/09/88



DRAWN	P.J.G.	TITLE	9800 SERIES +18V POWER SUPPLY
APPRD			
SCALE			
DATE	28/1/88		DRG No 9572005



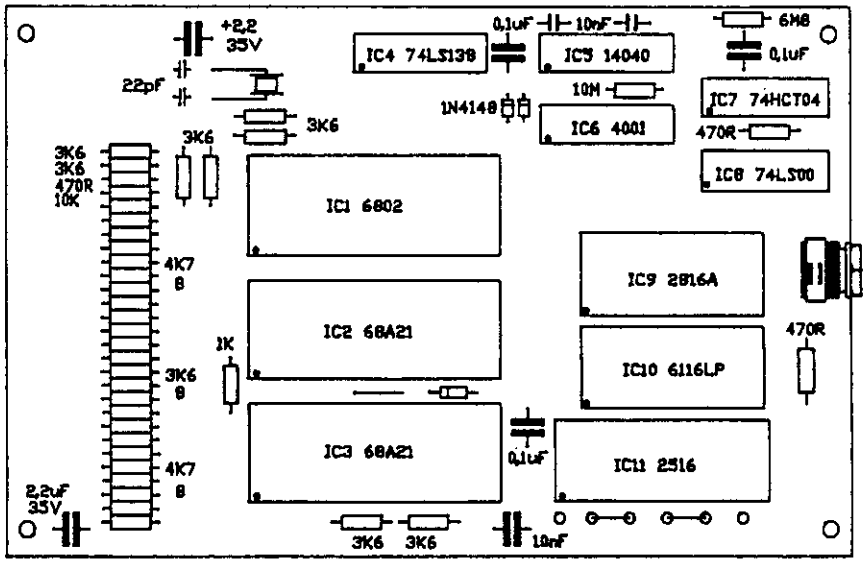
ISSUE	CHANGES
A	30/8/85
B	26/01/88

PULL UP RESISTORS

IC2			IC3		
A0..A7	R13..R5	4K7	A0..A7	R26..R21	4K7
A8	R4	10K	A8..A15	R20..R13	3K6
A9	R3	470R			
A10	R2	3K6			
A11	R1	1K			

DRAWN	B.D.	TITLE
APPRD		µP BOARD A270 V1.2 CIRCUIT BOARD
SCALE		
DATE	JANUARY 1985	DRG. NO. 9574C01

ISSUE	CHANGES



	DRAWN	C/A/L	TITLE
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	SCALE		
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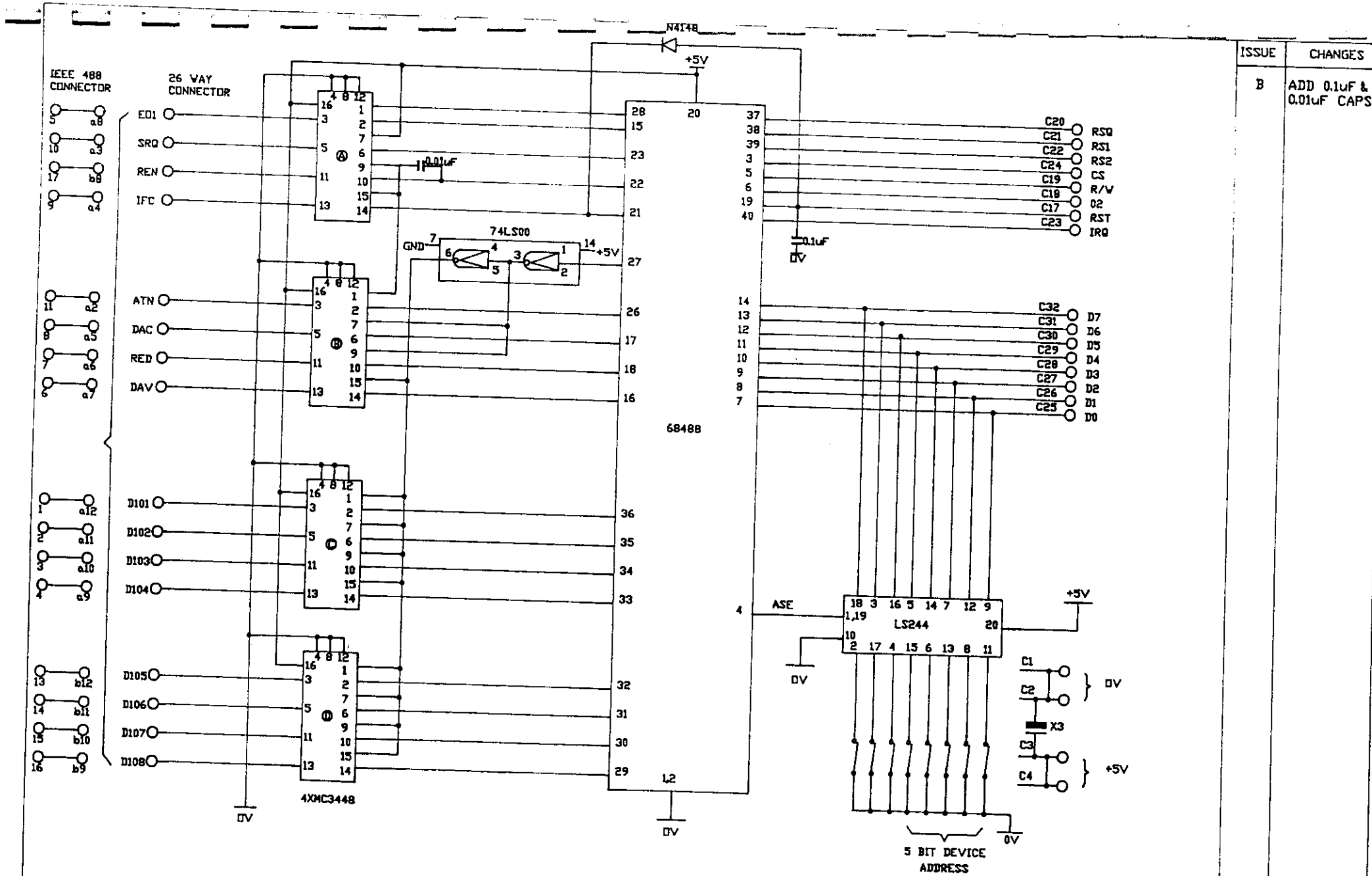


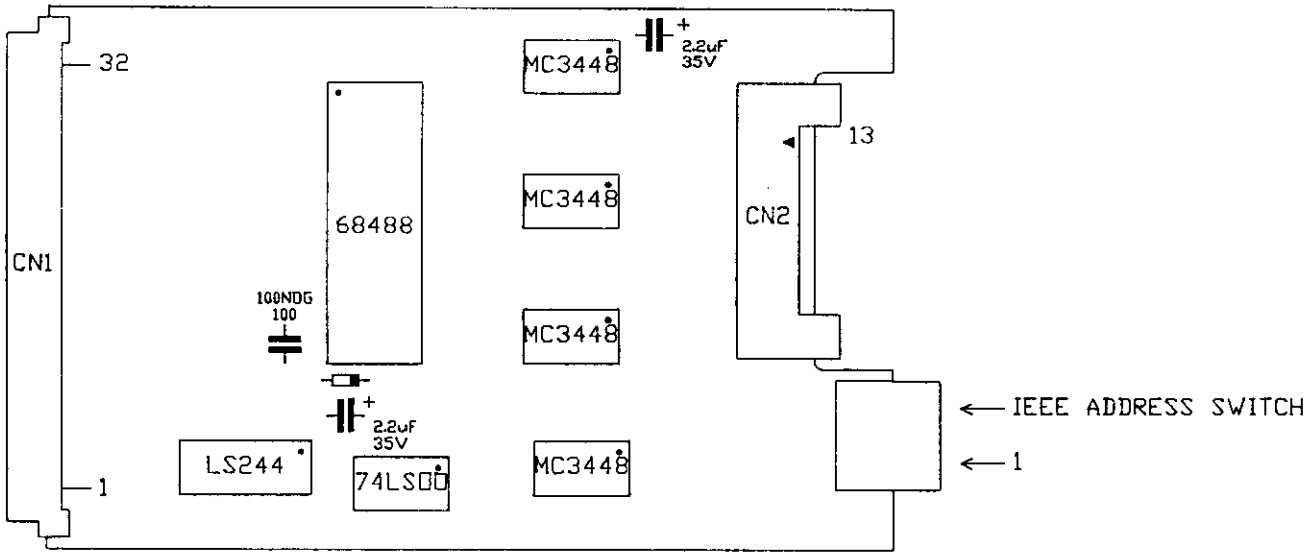
ISSUE	CHANGES
B	ADD 0.1uF & 0.01uF CAPS

DRAWN	P.J.G.	TITLE	IEEE INTERFACE BOARD
APPRD			
SCALE			
DATE	18/2/88	DRG No	CIRCUIT/9573C01

ISSUE	CHANGES

CN1 - BUS CONNECTOR

CN2 - IEEE BUS CONNECTOR



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SCALE			
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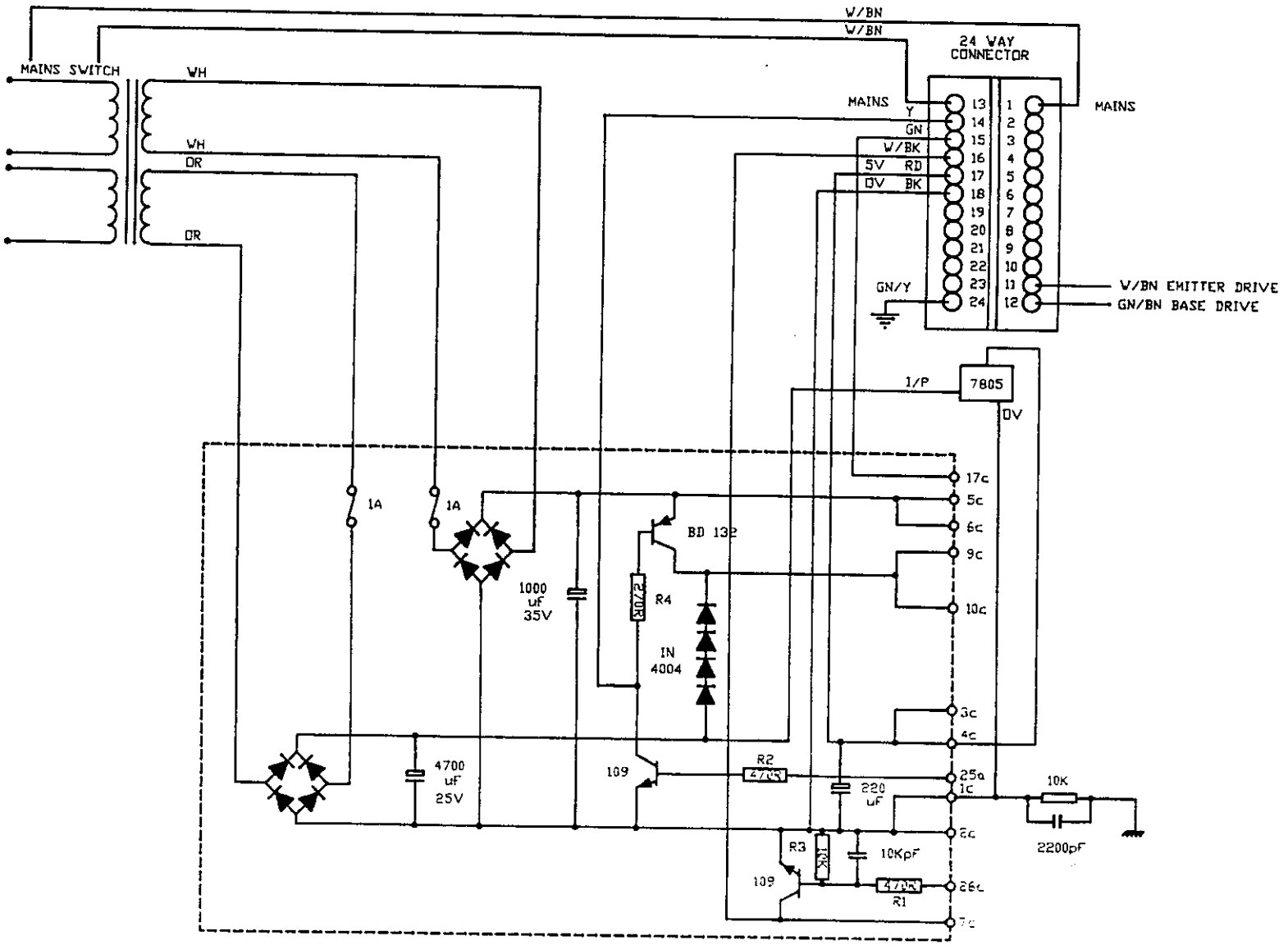

ISSUE	CHANGES

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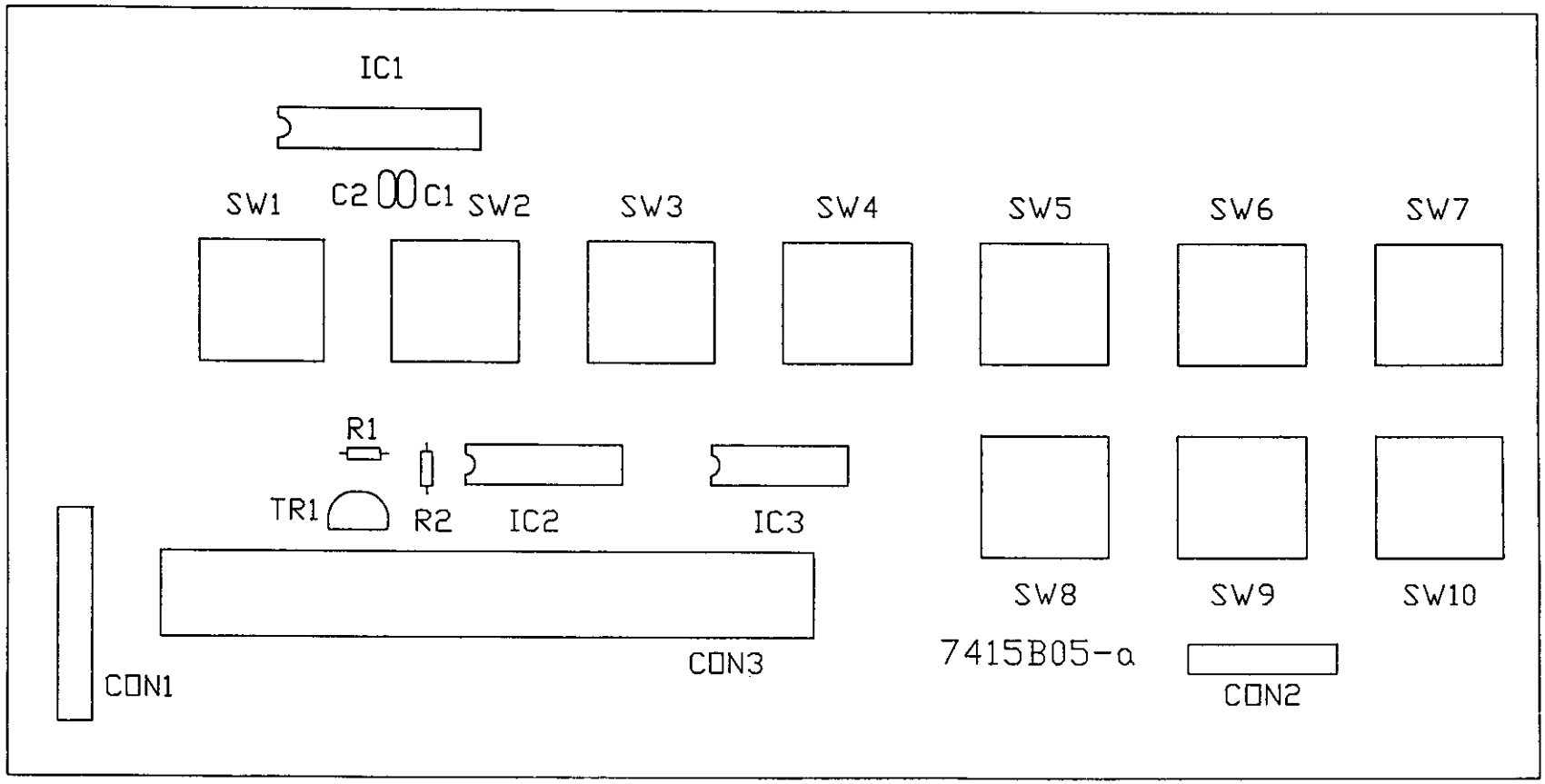
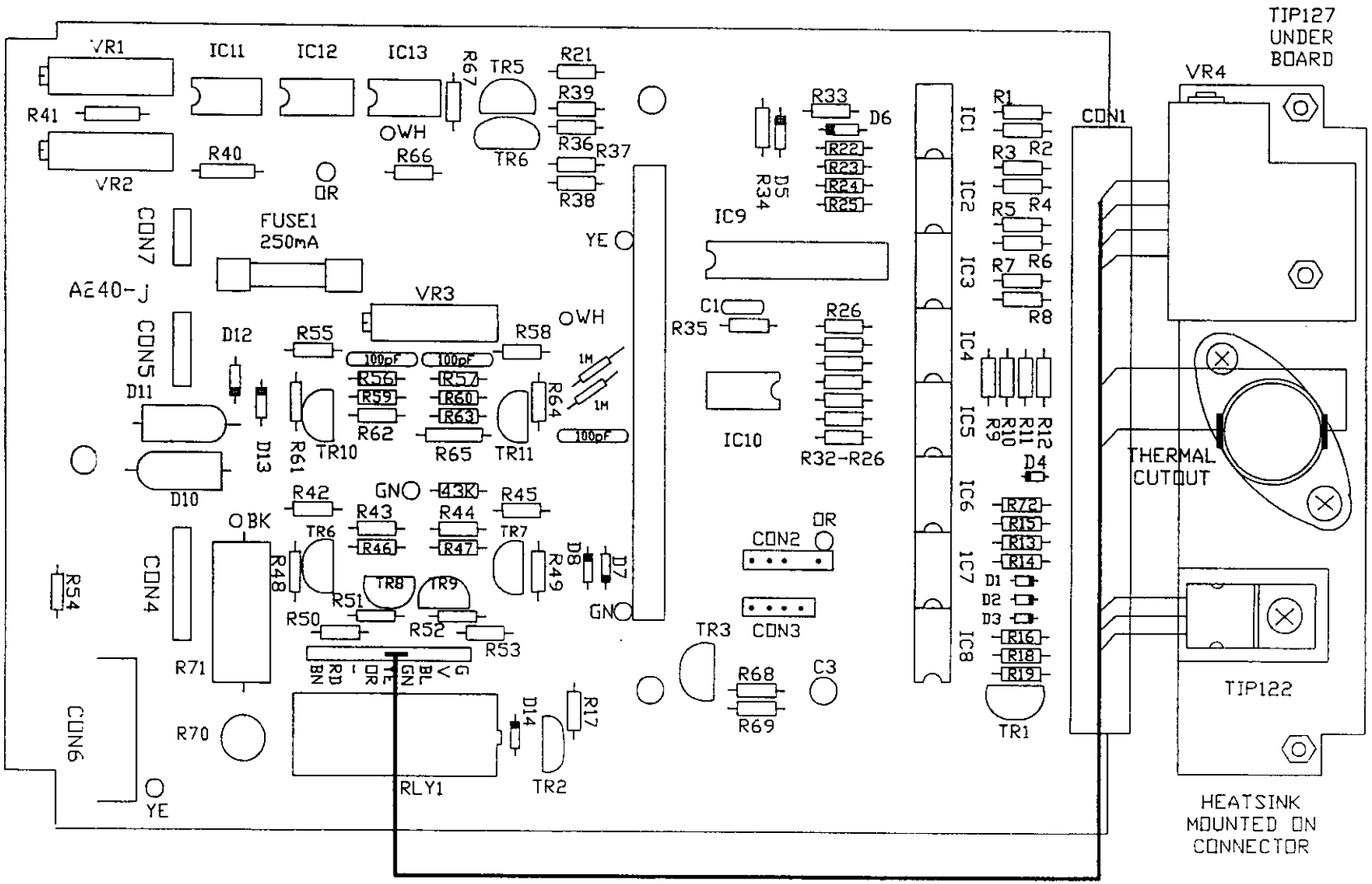
SCALE			
DATE	31/3/87	THE CONTENTS OF THIS DRG MUST NOT BE COPIED OR USED WITHOUT PRIOR WRITTEN CONSENT OF TIME ELECTRONICS LIMITED	DRG No 9572CC

ISSUE	CHANGES



DRAWN	A.J.F.	TITLE	9803 FRONT PANEL CIRCUIT COMPONENT LAYOUT
APPRD	J.B.		
SCALE		THE CONTENTS OF THIS DRG MUST NOT BE COPIED OR USED WITHOUT PRIOR WRITTEN	DRG No 7415L01
DATE	13/10/88		



ISSUE	CHANGES

DRAWN	P.J.G.	TITLE	REF. BOARD LAYOUT
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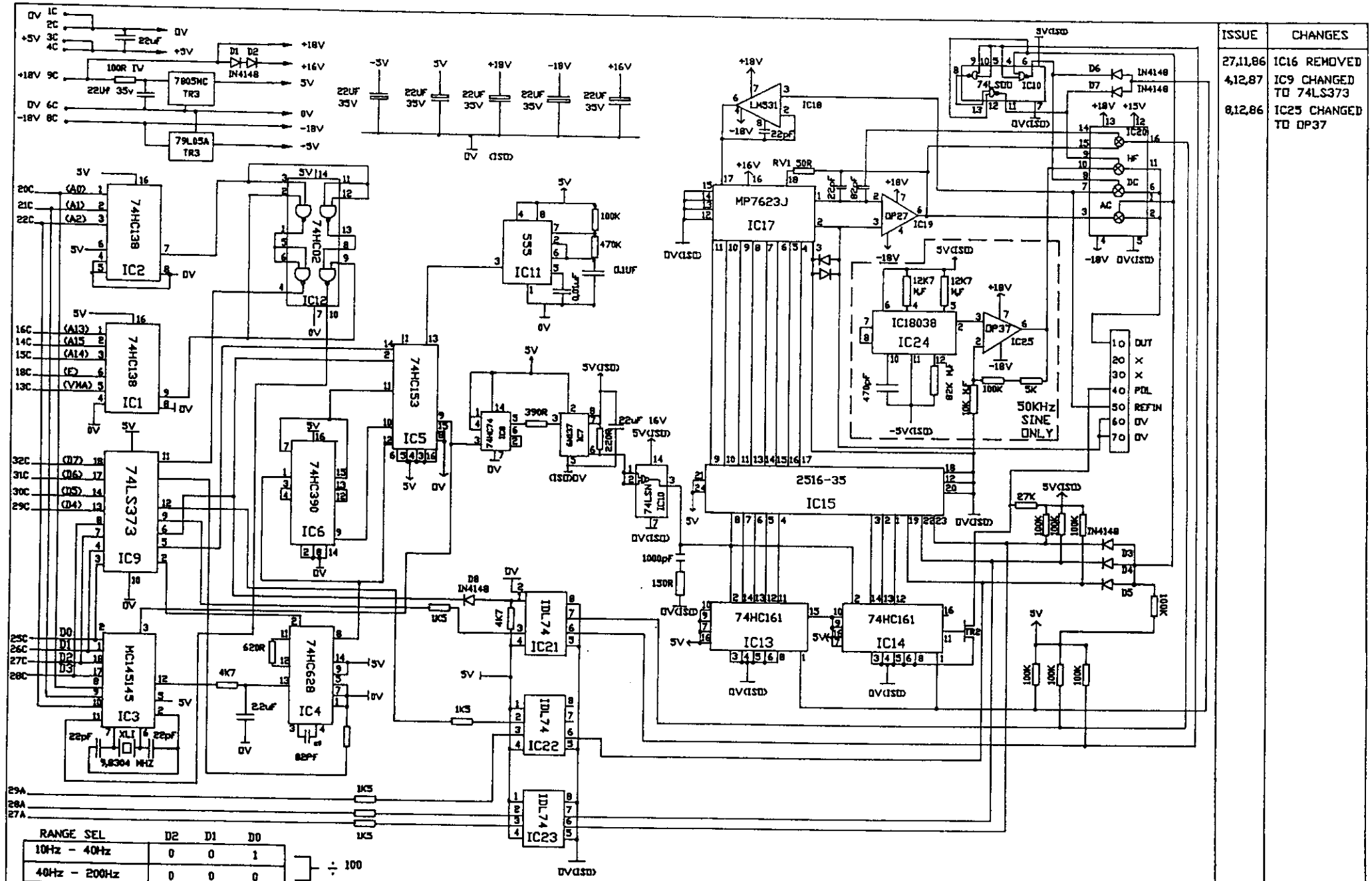
SCALE			
DATE	19/2/88	THE CONTENTS OF THIS DRG MUST NOT BE COPIED OR USED WITHOUT PRIOR WRITTEN CONSENT OF TIME ELECTRONICS LIMITED	DRG No 9404L01



ISSUE	CHANGES
27,11,86	IC16 REMOVED
4,12,87	IC9 CHANGED TO 74LS373
8,12,86	IC25 CHANGED TO OP37

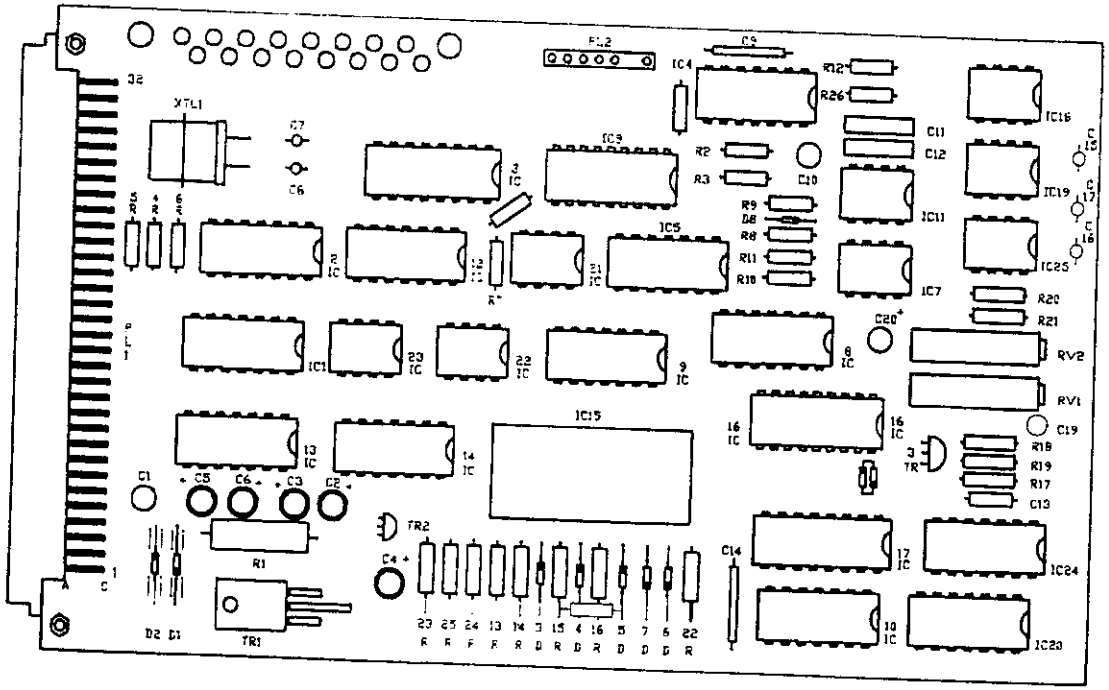
DRAWN	C.A.L
APPRD	
SCALE	(1.4=1)
DATE	10-3-86

TITLE

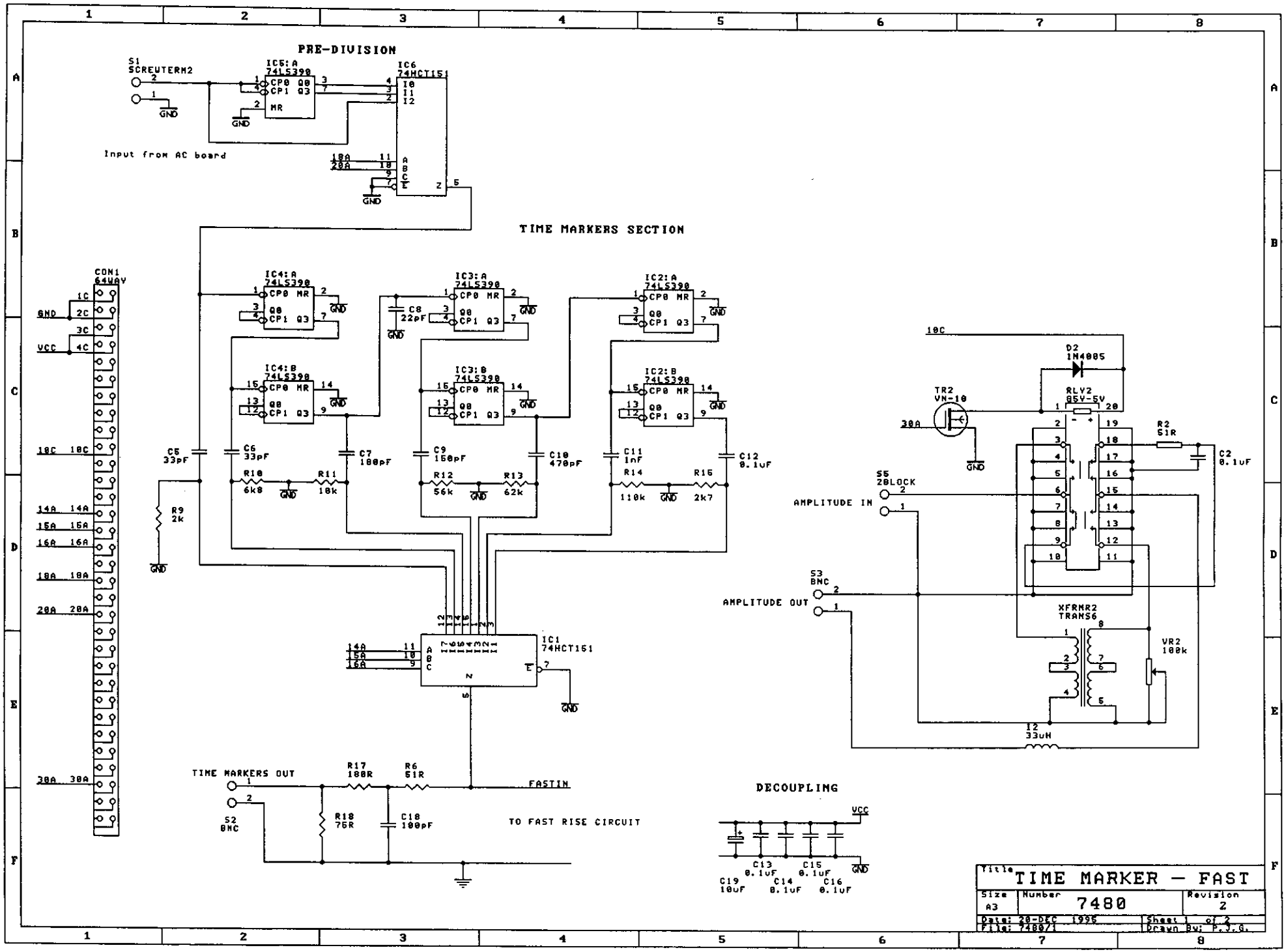
A.C. SYNTHESIZER BOARD

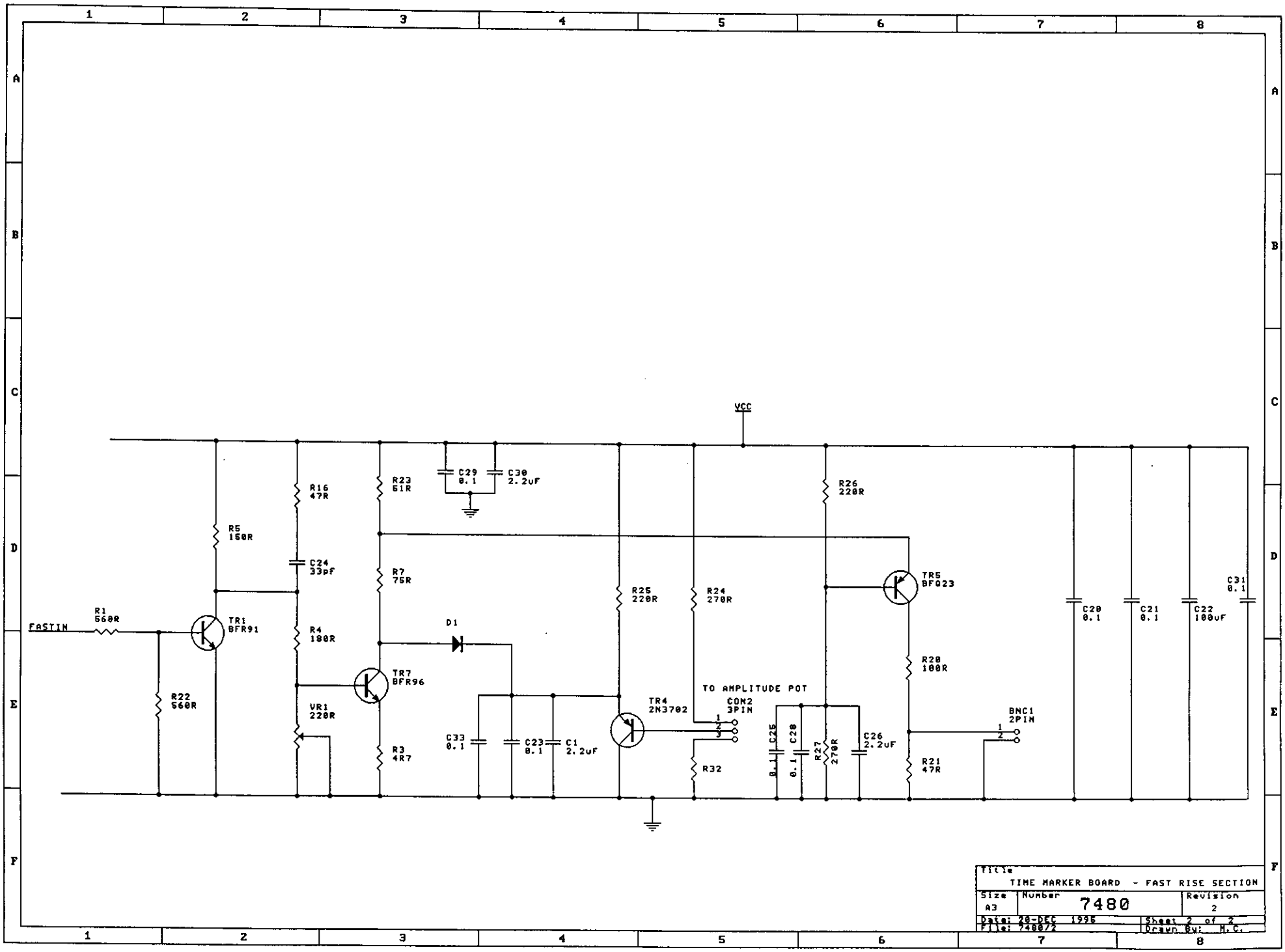
DRG No 9418C01

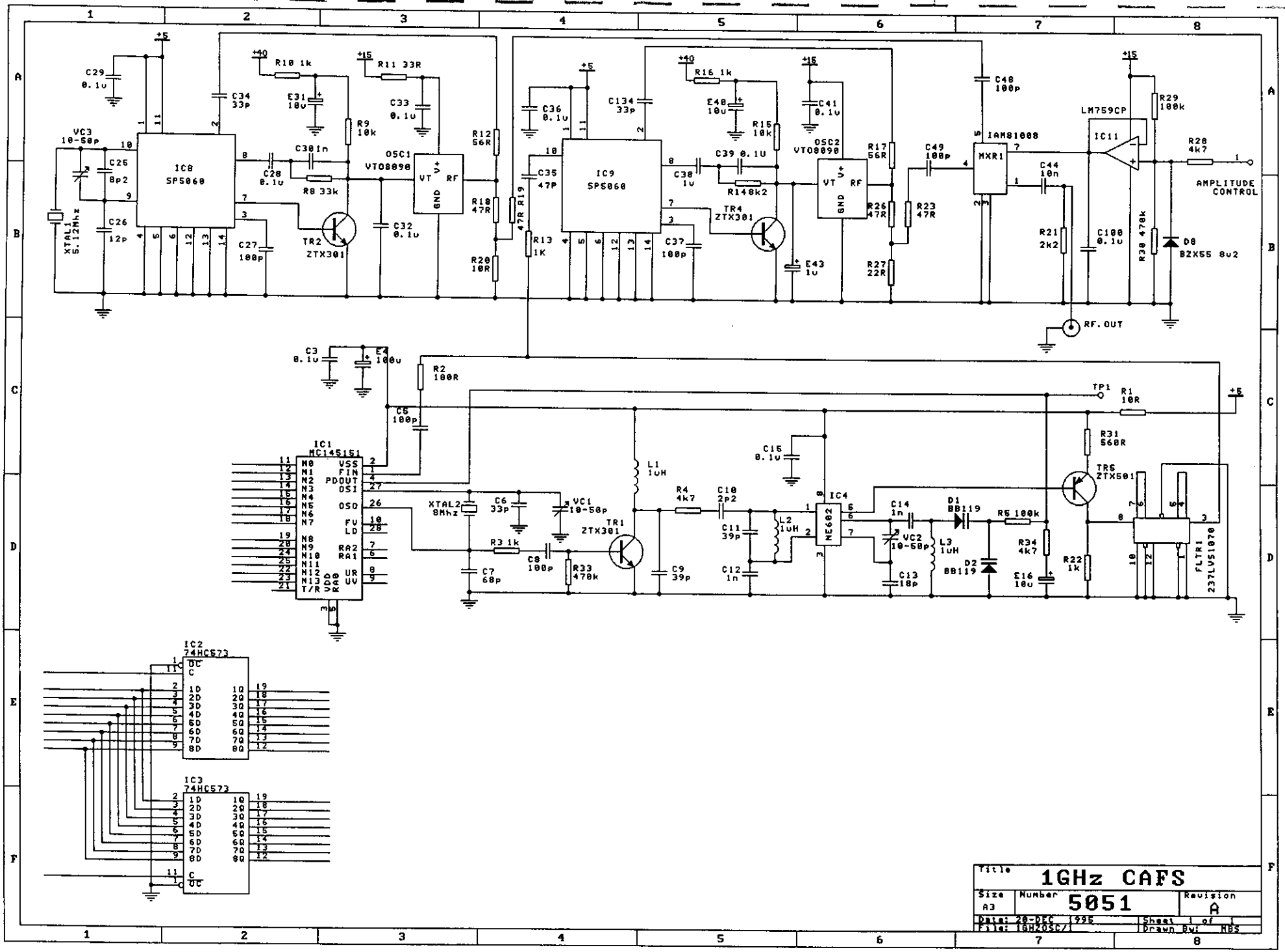
ISSUE	CHANGE'S



DRAWN	C,A,L	TITLE	A.C. SYNTHESIZER BOARD
APPRD			
SCALE			
DATE		THE CONTENTS OF THIS DRG MUST NOT BE COPIED OR USED WITHOUT WRITTEN PERMISSION OF THE ELECTRONICS LIMITED	DRG NO


PRE-DIVISION
S1
SCREWTERM2
IC5:A
74LS390
IC6
74HCT151
Input from AC board
TIME MARKERS SECTION
CON1
64WAY
IC4:A
74LS390
IC3:A
74LS390
IC2:A
74LS390
IC4:B
74LS390
IC3:B
74LS390
IC2:B
74LS390
C5
33pF
C6
33pF
C7
180pF
C8
22pF
C9
150pF
C10
470pF
C11
1nF
C12
0.1uF
R9
2k
R10
6k8
R11
10k
R12
56k
R13
62k
R14
110k
R15
2k7
IC1
74HCT151
TIME MARKERS OUT
S2
BNC
R17
180R
R6
51R
R18
75R
C18
100pF
FASTIN
TO FAST RISE CIRCUIT
D2
1N4005
TR2
VN-10
RLY2
85V-5V
R2
51R
C2
0.1uF
S5
2BLOCK
AMPLITUDE IN
S3
BNC
AMPLITUDE OUT
XFRMR2
TRANS6
VR2
100k
I2
33uH
DECOUPLING
VCC
C13
0.1uF
C15
0.1uF
C19
10uF
C14
0.1uF
C16
0.1uF
GND
Title
TIME MARKER — FAST
Size
A3
Number
7480
Revision
2
Date: 28-DEC 1995
Sheet 1 of 2
File: 7480/1
Drawn By: P.J.G.


VCC
FASTIN
R1 560R
TR1 BFR91
R22 560R
R5 150R
R16 47R
C24 33pF
R4 180R
VR1 220R
TR7 BFR96
R23 51R
C29 0.1
C30 2.2uF
R7 75R
R3 4R7
D1
C33 0.1
C23 0.1
C1 2.2uF
R25 220R
R24 270R
TR4 2N3702
TO AMPLITUDE POT
CON2 3PIN
R32
R26 220R
C25 0.1
C28 0.1
R27 270R
C26 2.2uF
TR5 BFQ23
R28 100R
R21 47R
BNC1 2PIN
C20 0.1
C21 0.1
C22 100uF
C31 0.1
Title
TIME MARKER BOARD - FAST RISE SECTION
Size A3
Number 7480
Revision 2
Date: 28-DEC 1995
File: 748072
Sheet 2 of 2
Drawn By: M.C.


IC8 SP5068
IC9 SP5068
OSC1 VT08090
OSC2 VT08090
IC1 MC145151
IC2 74HC573
IC3 74HC573
IC4 NE602
IC11 LM759CP
MXR1 IAM81008
TR1 ZTX301
TR2 ZTX301
TR4 ZTX301
TR5 ZTX501
D1 BB119
D2 BB119
D8 BZX55 8v2
FLTR1 237LVS1070
XTAL1 5.12Mhz
XTAL2 8Mhz
AMPLITUDE CONTROL
RF.OUT
Title 1GHz CAFS
Size A3
Number 5051
Revision A
Date: 20-DEC 1995
File: 1GH2OSC/
Sheet 1 of 1
Drawn By: NBS