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The IOSDL Waterfall Box

D White

1992

Natural Environment Research Council

INSTITUTE OF OCEANOGRAPHIC SCIENCES
DEACON LABORATORY

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Wormley
Godalming
Surrey GU8 5UB UK
Tel +44-(0)428 684141
Telex 858833 OCEANS G
Telefax +44-(0)428 683066

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AUTHOR

WHITE, D

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ABSTRACT

A handbook for the IOSDL Waterfall Box, giving details for its operation. Includes details of use with a MORS TT301 Deck Unit and a Waterfall Display.

KEYWORDS

ACOUSTIC RELEASE
BEACON
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ISSUING ORGANISATION

Institute of Oceanographic Sciences
Deacon Laboratory
Wormley, Godalming
Surrey GU8 5UB. UK.

Director: Colin Summerhayes DSc

Telephone Wormley (0428) 684141
Telex 858833 OCEANS G.
Facsimile (0428) 683066

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1 Introduction

The IOSDL Waterfall Box is a front-end interface for a waterfall display. It takes a transducer input and gives filtered, a DC-coupled 0-12V output. It also provides a synchronising pulse for tracking beacons with various repetition rates, and can be adapted for use with other systems such as the MORS TT300 series deck units.

2 Connections and Switches

A brief description of the connectors and switches on the front and back panels of the box.

2.1 "POWER" : External Power Supply

BNC socket. Centre pin requires +13V to +30V and draws about 120mW. Outer is the ground, or 0V, and is common to all the BNCs. It is connected to P1 pin 27 (positive) & pin 31 & 32 (10V). There is an on-board regulator and invertor. Some units have an encapsulated PSU fitted, in which case this BNC may not be connected.

WARNING: connecting DC power to one of the other signal sockets may damage the unit.

2.2 "INPUT" : Signal Input

BNC socket. Centre pin is the signal, outer is the ground. In normal use as a stand-alone receiver, a transducer is connected directly to "INPUT". The signal is connected to a transformer (IOS drawing 5230 detail 184 or 47) whose receiver winding is connected to inputs 'A' and 'B', pins 18 and 20 on P1. When used with the TT301, the signal goes to SW2 pin 2.

2.3 "OUTPUT" : DC Signal Output

BNC socket. Centre pin is the signal, outer is ground. Taken from "OUT" on the board, it is a DC-coupled signal. It can be attenuated by turning the 10 kohm potentiometer directly beneath it.

2.4 "TRIG" : Display Synch Pulse Output and Sweep Rate Switch

BNC socket. Centre pin is the signal, outer is ground. Taken from the "TRIG" output on the board. It is a 12V low-going-high pulse, diode protected and tied low. It can drive several TTL loads. Adjustment of

the sweep rate between 0.5, 1.0 and 2.0 seconds is by the rotary switch directly beneath it, which goes to the 4-pin plug marked "FREQ/2.5kHz" etc. See also 2.7.

2.5 "Q" : Band-pass Filter Control

Locking DPDT switch. Up is 'hi-Q', down is 'lo-Q'. 'Lo-Q' switches out one of the two stages in the band-pass filter. Normally used in the "hi-Q" position.

2.6 "ATTN" : Pre-amplifier gain

Decade rotary switch. Connected to P2, not functional when used with the TT301. It adjusts the gain of the differential pre-amp signal, the lowest gain is '9'. (It is this way round for consistency with other IOSDL units, which use an attenuator to adjust the output.)

2.7 "REP RATE" : Fine control for TRIG Sweep Rate

Three decade rotary switches, units, tens and hundreds. Units go to 11-pin plug (3+8) marked "UNITS/9/8..."; tens go to 4-pin plug marked "TENS/00/01/09"; hundreds go to the 3-pin plug marked "HUNDREDS/100/000". It switches the "TRIG" multiplier from 0.90 to 1.19.

3 Theory of operation

3.1 Pre-amplifier

This is a differential amplifier (original design by A J Harris, IOSDL) which uses a super-matched pair, IC1, for the first stage to drive a three op-amp instrumentation amplifier configuration. Gain is adjusted using a resistor ladder switched by the decade rotary switch "ATTN". The connector marked "JUMPER" is for permanent setting of the gain with no trailing leads, or in case pick-up in the ribbon cable becomes a problem. Common mode noise can be reduced by adjusting POT1 and C9.

Normally the transformer and matching circuitry are separate, but an on-board matching pi-network is available for the IOS mushroom transducer's transformer. IC2 is sometimes replaced by a 5532, and/or IC3 by a 5534. This has no effect on performance.

3.2 Bandpass filter and detector

The band-pass filter consists of two dual-amplifier band-pass (DABP) stages using IC4, a quad op-amp IC, followed by a unity gain buffer, IC5. SW2 can switch out the first stage to give a lower Q filter. R27 and R33 have been reduced from 16 kohm to 13 kohm to prevent oscillation in very high signal (i.e. transmitting) situations. The filtered output is available at the test-point "BPASS".

The detector has a diode feed-back stage and a gain stage using half of IC6. The gain is adjusted by POT3 and the threshold by POT2.

The final stage is a low-pass filter, using the other half of IC6, to give a smoothed envelope. The unfiltered detector output is available at "DET", the final filtered envelope is at "OUT".

3.3 Pulse generation

A crystal oscillator produces a precise pulse repetition rate. The repetition rate is controlled by the three decade rotary switches marked "REP RATE",and can be set between 0.90 and 1.19 to give all the values used by IOS CR200 releases. The sweep rate can be set at 0.5, 1 or 2 seconds depending on the sweep rate in use on the waterfall display. The pulse is only a few microseconds long, and it drives a BC441 emitter-follower. It goes through D10 for extra protection, and is tied low.

3.4 Power supplies

The supplied DC voltage is regulated at +12V by a 7812, VREG, which can cope with up to 1 amp. The negative rail, -12V, is derived from this by VCONV, a 7661 micropower invertor. This can provide up to 40 mA for the op-amps. There are two 470 uF electrolytic capacitors each with a 1 kohm resistor in parallel across the power rails.

4 Modifications for use with a MORS TT301

To track a MORS 661-series release in pinger mode using a MORS deck unit such as the TT301, a third receiver channel and a waterfall display is required. For IOSDL (and most of NERC) the specification is a 10kHz pinger with a repetition rate of 1.00 seconds.

Several modifications to the LF Receiver-Power board in the TT301 are necessary as follows:

The pre-amp is tapped at Z8 pin 6 by soldering a small co-axial cable to the back of the LF Receiver-Power board. This is held securely in place by the pressure of the shield behind the board.

When using an IOS PES transducer in air, it was found that a 4.7 kohm resistor in series with L4 gave reasonable matching when transmitting through the MORS transformer. There is an SPDT switch to switch the resistor in or out.

The transducer leads are extended to one pole of a DPDT switch; the matching transformer, from the small screw-connector block, is taken to the centre of the switch with the BNC for the PES transducer on the other pole. Thus the transducers can be switched over independently. The power is taken from either end of C5, the big electrolytic capacitor on the same board.

In the Waterfall box the differential pre-amp is not used, so the signal line between the "PREAMP" pin and SW2 pin 2 is cut by drilling out a plated-through hole which is near the "PREAMP" pin. The "INPUT" signal is taken from a patch-panel inside the TT301 directly to SW2 pin 2. Normally, the detector gain is set using POT3 and rarely adjusted, but a pot is put on the front panel with which "OUTPUT" can be attenuated if required. "Q" is always used on "HI".

4.1 Fitting a Waterfall card inside the TT301 case

This was done to the IOS unit TT301/001. The card is mounted on an aluminium plate, which is bolted to the case in the space behind the main circuit boards (see appendix C). It is very tight, and the power connector to the Ni-Cad battery pack should not normally be left plugged in with the back of the case closed. The switches and BNC connectors for the Waterfall card are on the top and side of the case, labelled as on the Waterfall box. The connections between the Waterfall card and the TT301 are hard-wired in.

4.2 Connecting a box to a TT301

A better solution is to leave the TT301 case intact and to connect a receiver box to the TT301 via an internal patch panel as was done with unit TT301/002 (see appendix C). This has the advantage that both units can be separated and used independently. The modifications are made to the LF Receiver-Power board as above, but the connections and the two switches are brought to a small patch-panel which is mounted on the back of the card. The two switches for the transducer and matching resistor ("T/D" and "CHOKE") are as before; the PES transducer plugs into "XDUCER" and "PRE-AMP" goes to "INPUT" on the receiver box. The "POWER" BNC provides 24V to power the Waterfall box.

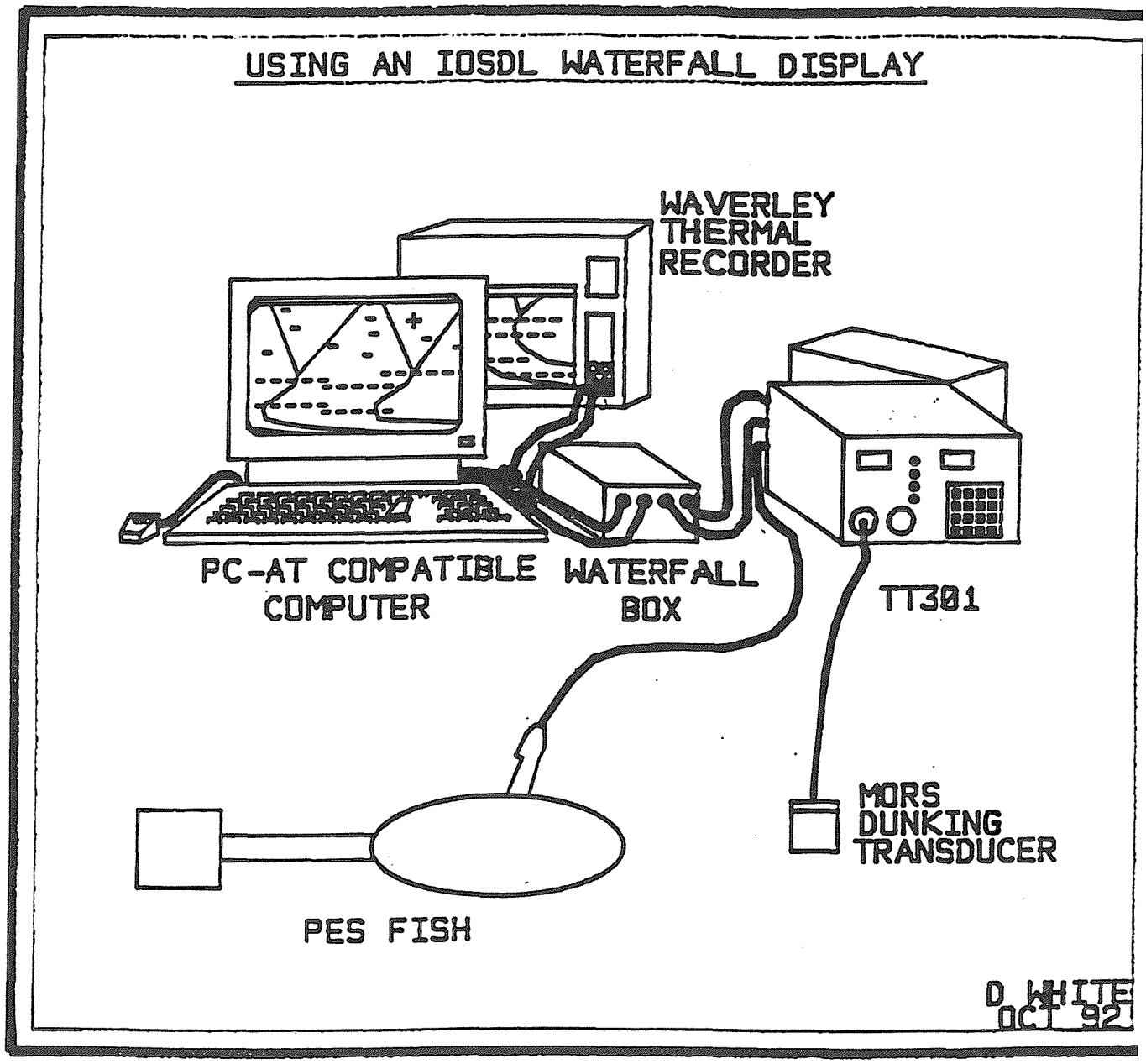
4.3 Reverting from TT301 to stand-alone use

To change a Waterfall box that has been converted for use with a TT301 back to a stand-alone receiver box for a waterfall display requires a few internal modifications.

The drilled-out plated-through hole must be re-connected with a pcb through-pin.

The line to SW2 is removed, and "INPUT" is connected to an IOS transformer, which can be bolted to the inside the box. The input side of the transformer is connected to pins 18 and 20 on P1. If the transformer is connected through the "INPUT" socket from outside the box, the BNC must be isolated from the panel or one side of the differential amplifier will be grounded.

Any DC power supply of 13-30 volts and 120mW can be used, alternatively an encapsulated PSU can be fitted to allow mains operation. (e.g. RS component 592-767 & 592-947). Care should be taken not to simply connect a mains plug to the "POWER" BNC connector!


USING AN IOSDL WATERFALL DISPLAY
WAVERLEY
THERMAL
RECORDER
PC-AT COMPATIBLE
COMPUTER
WATERFALL
BOX
TT301
MORS
DUNKING
TRANSDUCER
PES FISH
D WHITE
OCT 92

APPENDIX A

Connections

A summary of the interconnections between the Waterfall box and a TT301.

TT301	POWER	Waterfall box	POWER
TT301	PRE-AMP	Waterfall box	INPUT
TT301	XDUCER	IOS PES Transducer	
TT301	XDC	MORS ceramic ring transducer	
Waterfall box	TRIG	Waterfall Display trigger	
Waterfall box	OUTPUT	Waterfall Display signal	
Waterfall box:	ATTN	P2	(10-pin)
internal	REP RATE	UNITS	(3-pin + 8-pin)
connections		TENS	(4-pin)
		HUNDREDS	(3-pin)
	TRIG	FREQ	(4-pin)
	INPUT	SW2	(pin 2)
	OUTPUT	OUT	
	POWER	P1	(V+ = pin 27
			0V = pin 32)

APPENDIX B

B Component List For Waterfall Card Mk2a July 1992 Rev (1)

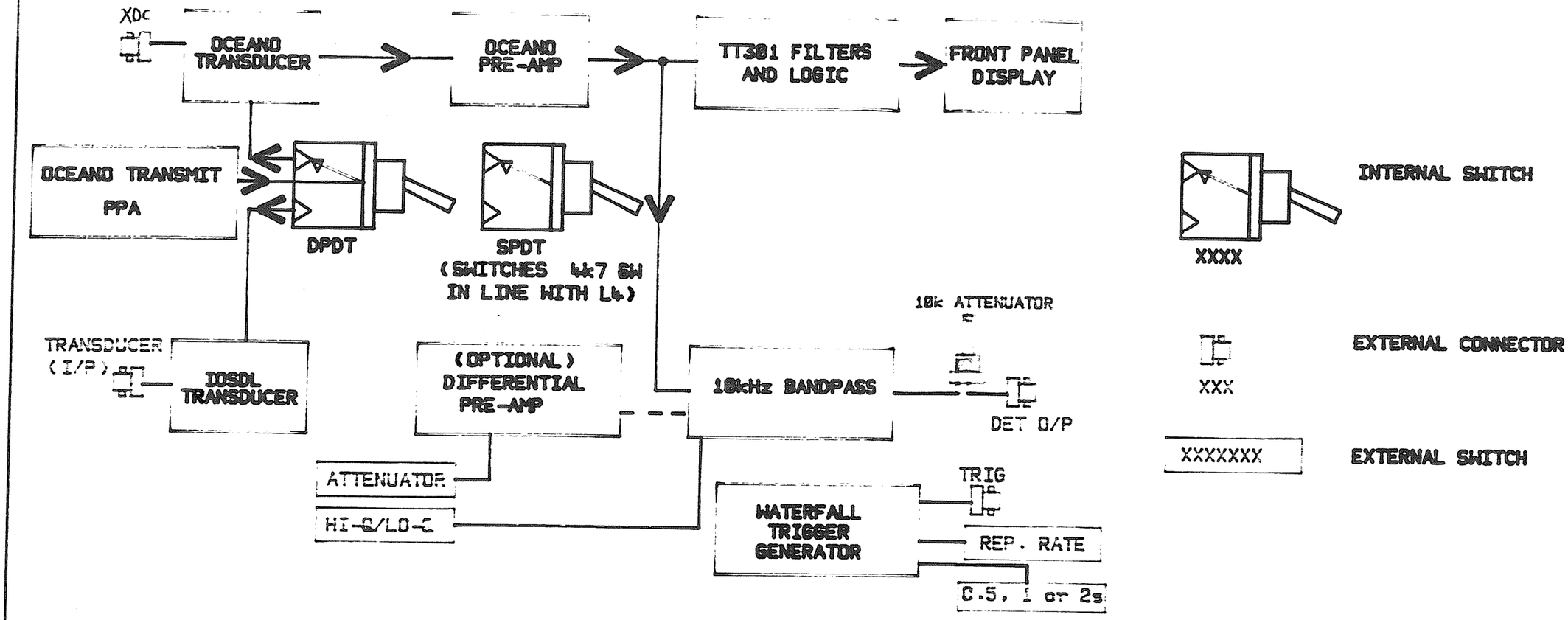
9	1N4148	D1-D10
1	7661	VCONV
2	100u 16V elect axial	C31, C32
2	100u 16V radial	C29, C30
1	4011	U1
5	4017	U3-U7
1	4023	U6 (14-pin)
1	4040	U2
1	LM394	IC1
2	LT1012	IC3, IC5
1	LT1013	IC2
2	LT1014	IC4, IC6
1	NPN BC441	TR1
1	X33U 320kHz XTAL	320KHZ
1	8p2 ceramic	C26
2	10p ceramic	C4, C5
3	22p ceramic	C6-C8
1	33p ceramic	C11
1	47p ceramic	C39
1	100p ceramic	C28
1	150p ceramic	C38
1	470p ceramic	C23
1	820p ceramic	C27
1	1u0 tantalum	C41
2	22u tantalum	C2, C3
2	100u tantalum	C1, C37
4	1nO polyester	C12-C15
1	2n2 polyester	C16, C20, C21
1	4n7 polyester	C35
1	6n8 polyester	C34
2	22n polyester	C19, C33
2	47n polyester	C17, C36
1	68n polyester	C22

1	5-30p cermet	C9
1	22R	R5
1	43R	R6
1	91R	R7
1	180R	R8
1	360R	R9
1	750R	R10
3	1K0	R54-R56
1	1K2	R1
3	1K5	R11, R26, R32
1	3K0	R50
2	3K3	R20, R21
2	5K6	R18, R19
1	6K2	R51
2	6K8	R12, R13
1	7K5	R39
11	10K	R14-R17, R28, R29, R34, R35, R57
2	13K	R27, R33
6	15K	R23, R25, R31, R36-R38
1	16K	R22
8	27K	R2, R3, R41, R43-R46, R52
2	100K	R4, R40
2	330K	R24, R30
1	10M	R53
1	500R	POT2
1	2K0	POT1
1	50K	POT3
1	10-PIN MOLEX	
1	8-PIN MOLEX	
2	4-PIN MOLEX	
2	3-PIN MOLEX	
5	8-PIN IC SOCKETS	
4	14-PIN IC SOCKETS	
5	16-PIN IC SOCKETS	
4	DECADE ROTARY SWITCHES	
1	DPDT LOCKING SWITCH	

APPENDIX C

Diagrams

TT301FLO	Modifications block diagram.
DCWWATER	Circuit diagrams:
	1 Pre-amp, band-pass and detector
	2 Display synch pulse
	3 Board lay-out
TT3PNLS	Receiver box end-panels
TT3PLUG	Patch panel inside TT301
TT301	Arrangement of first prototype inside TT301



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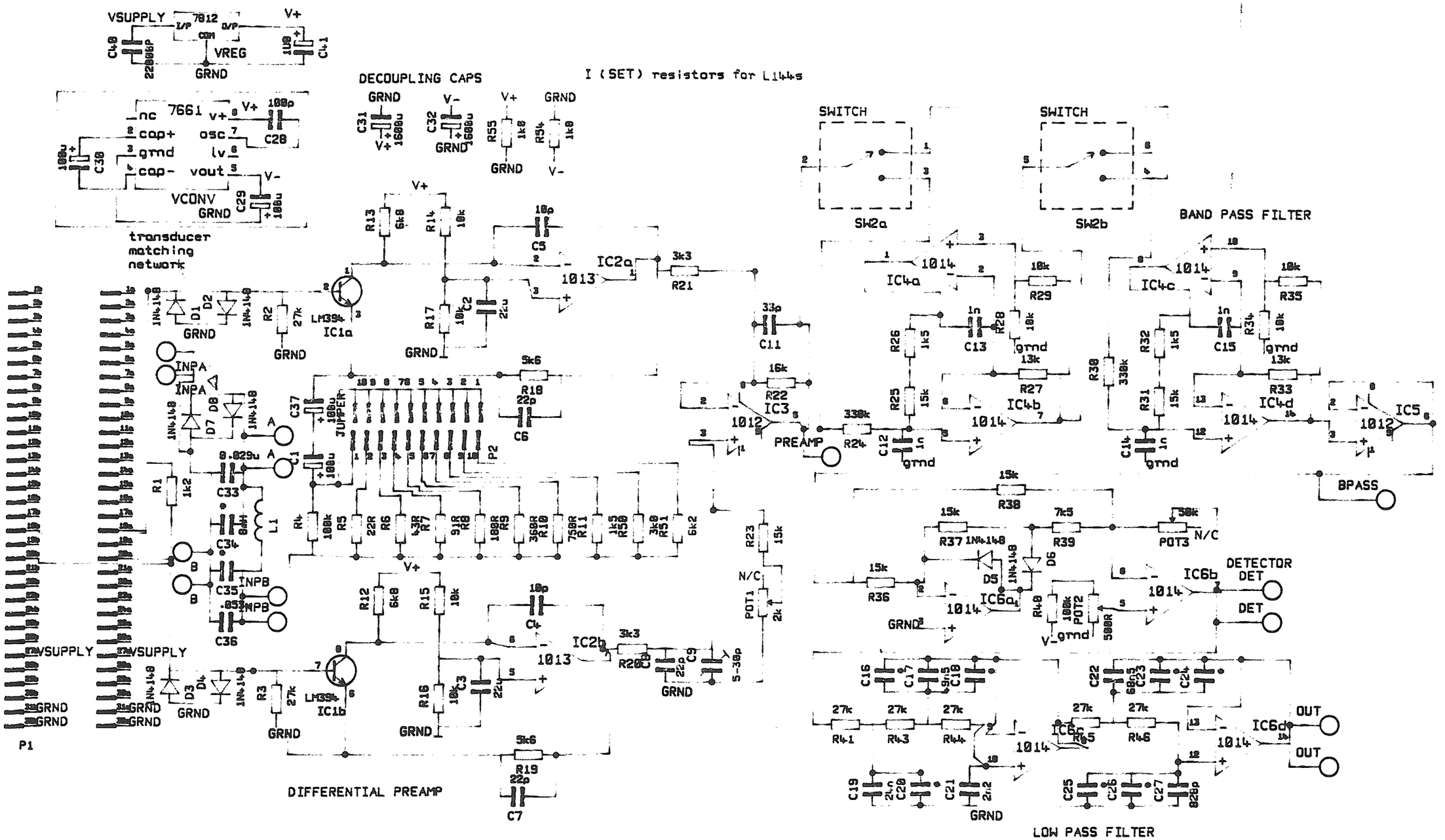
			ISSUE
			DATE



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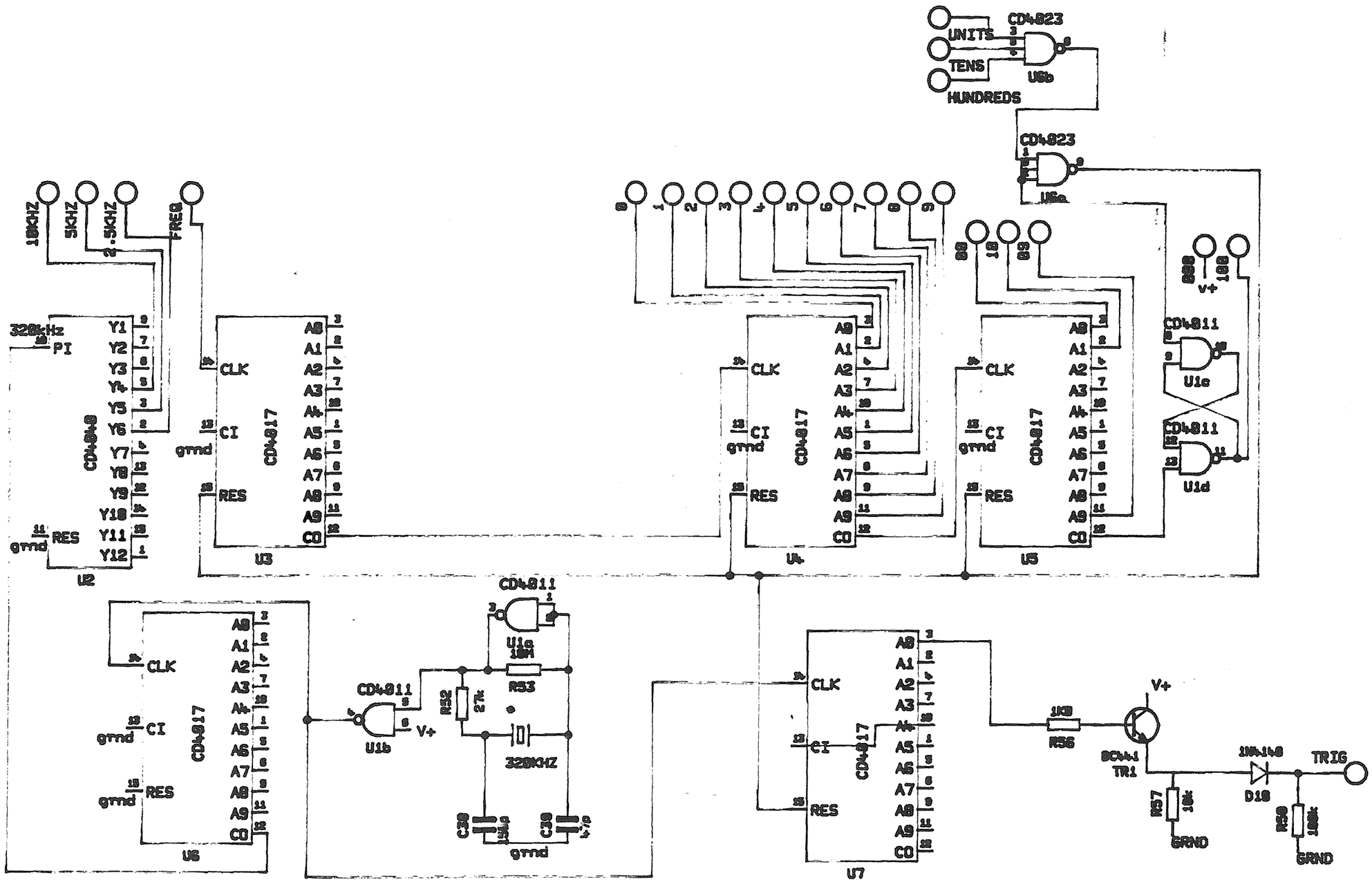
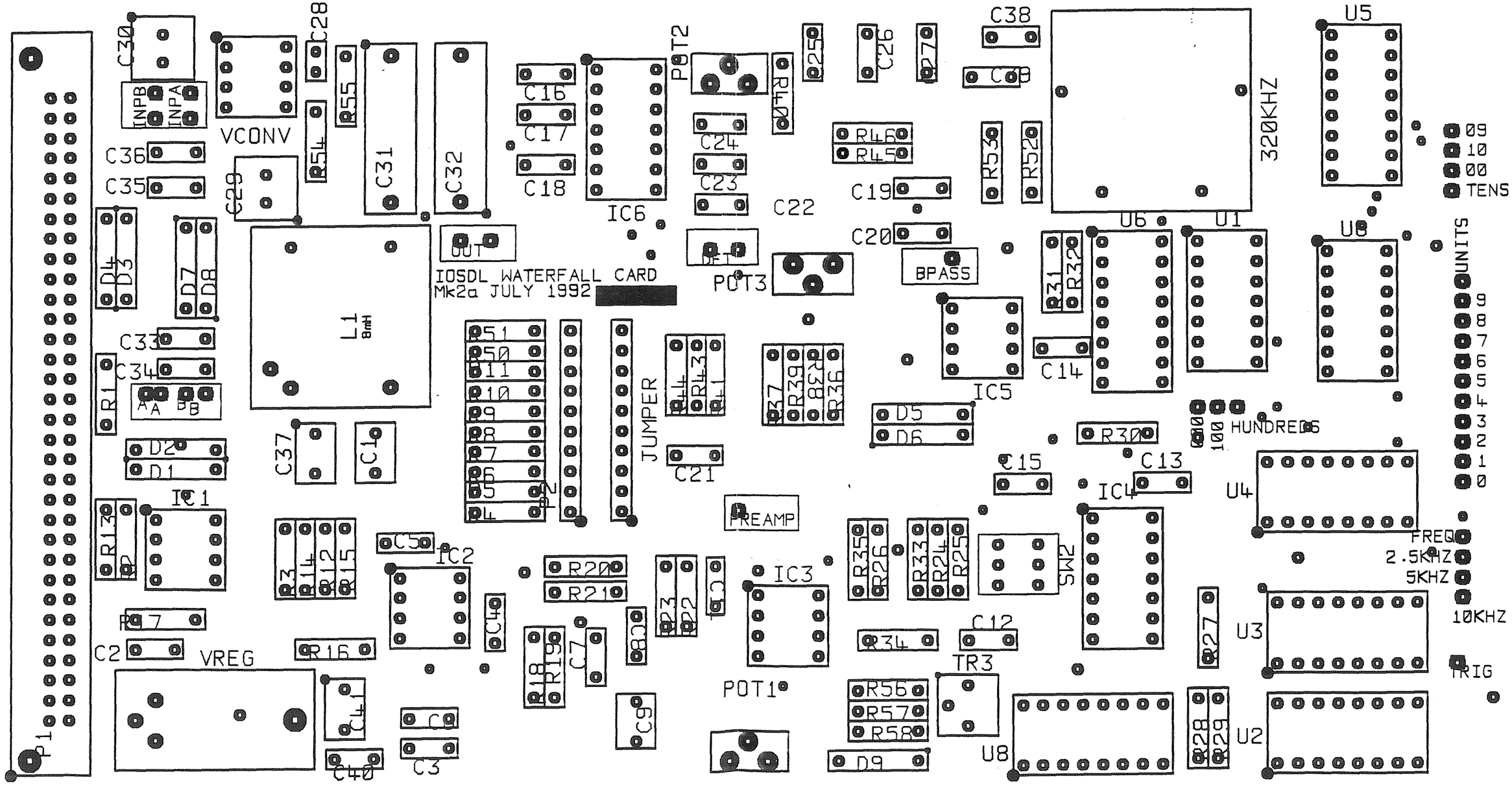
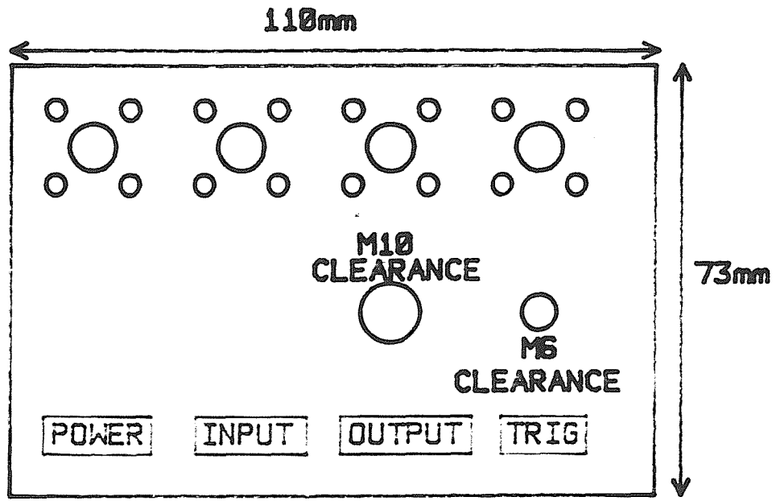
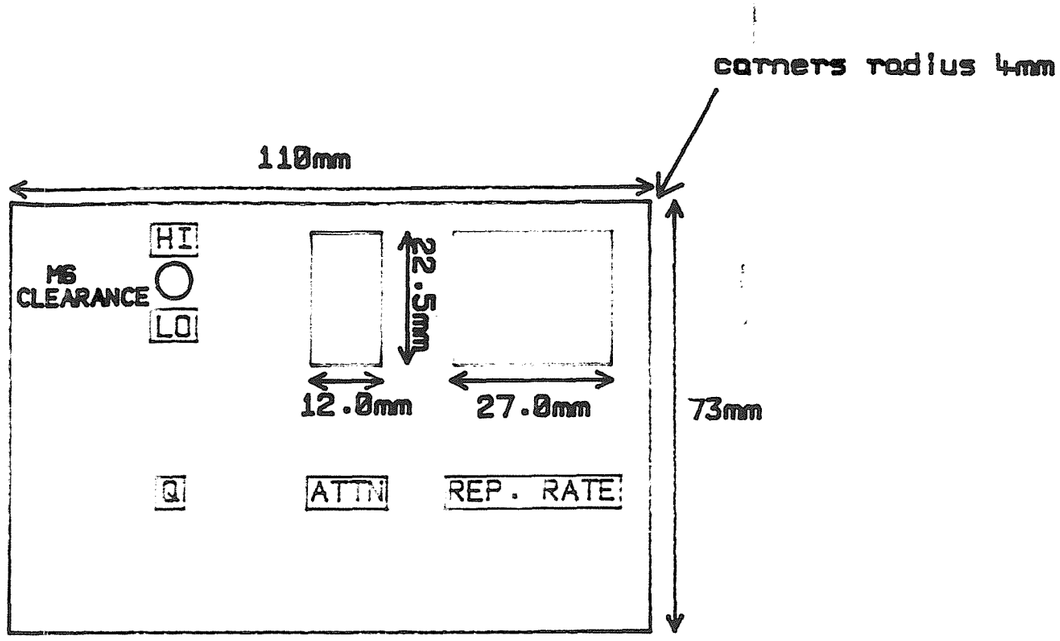


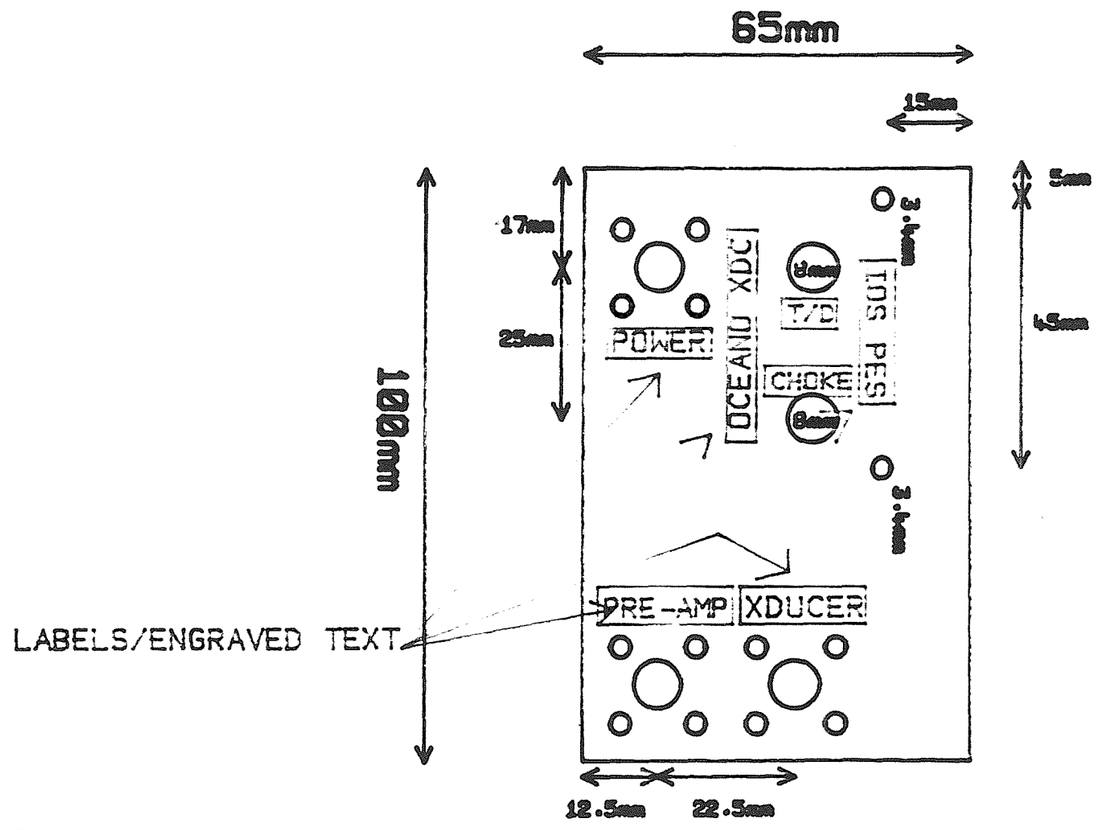
INSTITUTE OF OCEANOGRAPHIC SCIENCES. DEACON LABORATORY.BROOK ROAD.WORMLEY. GODALMING.SURREY.GU8 5UB.ENGLAND.	FILENAME	WATERFALL DISPLAY AND DCU SYNCHRONISING PULSE GENERATOR	SHEET
	DCWWATER		ISSUE D WHITE
			DATE AUG 1992


IOSDL WATERFALL CARD
Mk2a JULY 1992
320KHZ
VCONV
VREG
IC1
IC2
IC3
IC4
IC5
IC6
U1
U2
U3
U4
U5
U6
U8
POT1
POT2
POT3
JUMPER
PREAMP
BPASS
TR3
SW2
L1
8mH
INPB
INPA
OUT
IN
TENS
UNITS
HUNDREDS
FREQ
2.5KHZ
5KHZ
10KHZ
TRIG
P1
P2



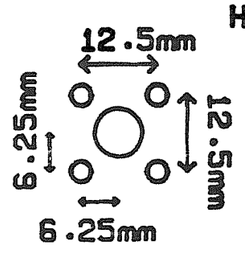


INSTITUTE OF OCEANOGRAPHIC SCIENCES. DEACON LABORATORY.BROOK ROAD.WORMLEY. GODALMING.SURREY.GU8 5UB.ENGLAND.	FILENAME	END-PANELS OF RECEIVER BOX	SHEET	
	TT3PNLS		ISSUE	D WHITE
			DATE	OCT 1992



HOLE DIAMETERS
3.4mm
8mm

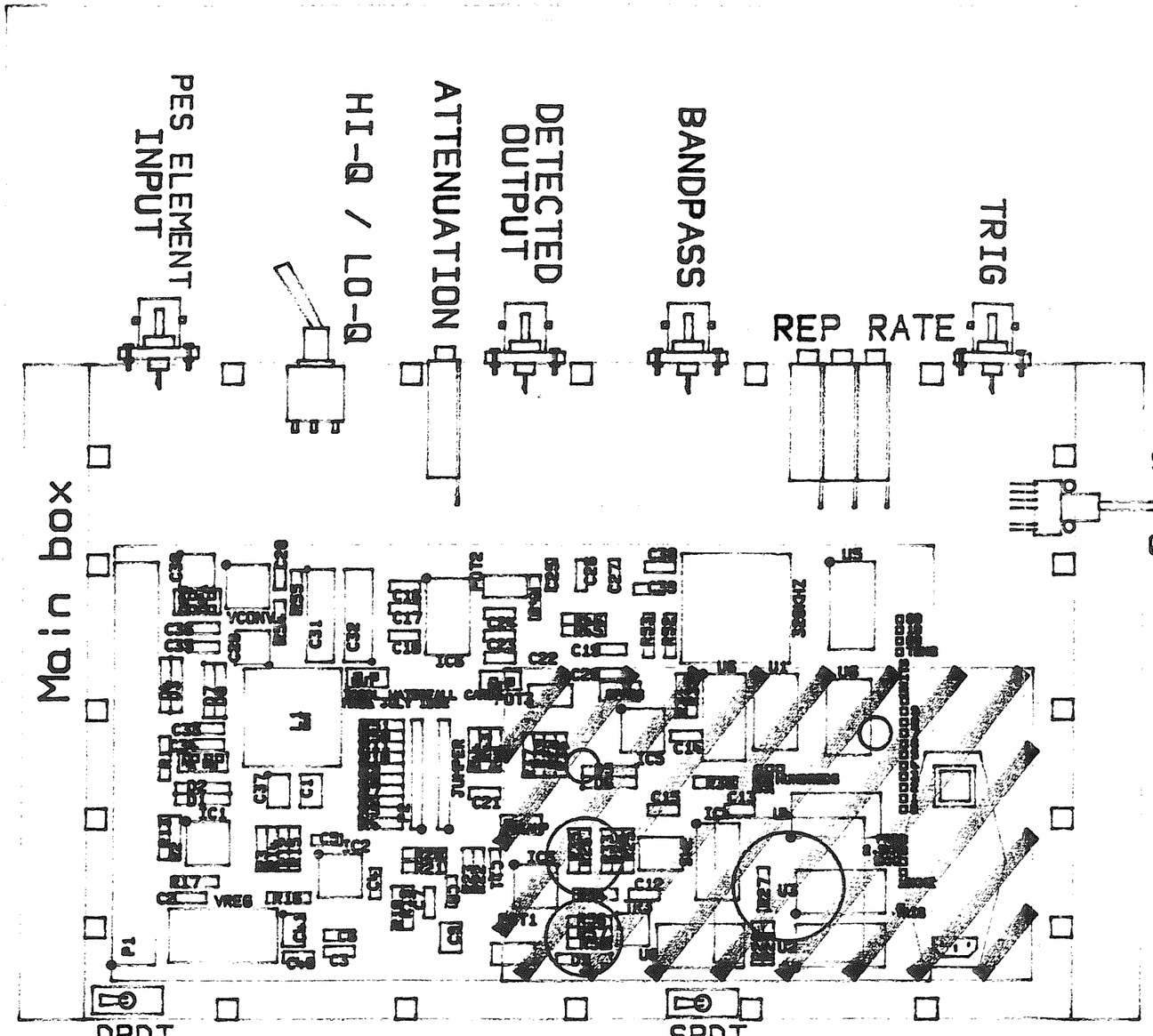
BNC TEMPLATE:



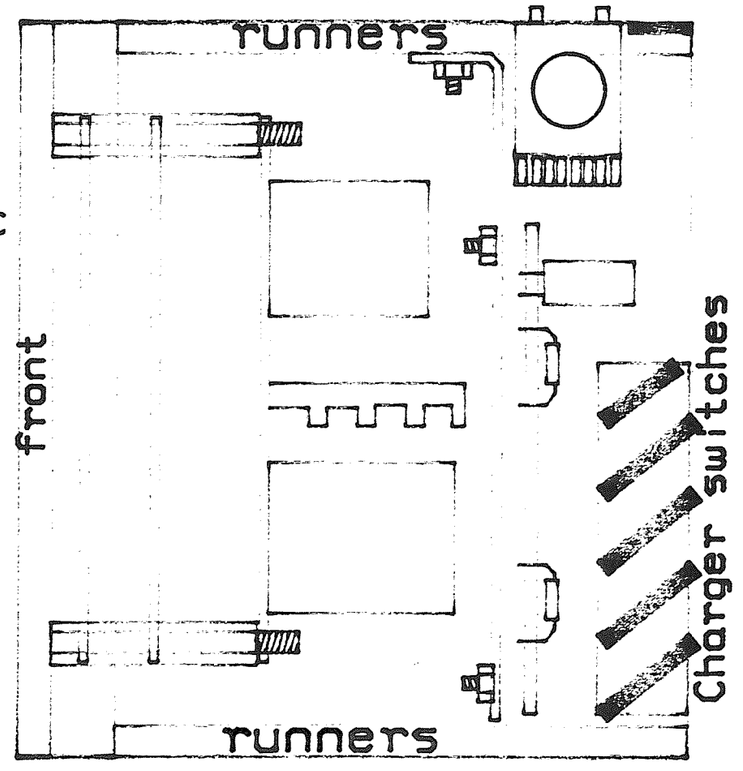
MATERIAL:

TOLERANCES: 1mm EXCEPT: 3.4mm = M3 CLEARANCE
BNC TEMPLATE = 0.5mm
TEXT POSITION AND TYPE

INSTITUTE OF OCEANOGRAPHIC SCIENCES. DEACON LABORATORY.BROOK ROAD.WORMLEY. GODALMING.SURREY.GU8 5UB.ENGLAND.	FILENAME	PATCH PANEL FOR TT301 UP-GRADE	SHEET	
	TT3PLUG		ISSUE	D WHITE
			DATE	OCT 1992



REAR VIEW



SIDE VIEW

INSTITUTE OF OCEANOGRAPHIC SCIENCES, DEACON LABORATORY, BROOK ROAD, WORMLEY, GODALMING, SURREY, GU8 5UB, ENGLAND.	FILENAME	G.A. TT301 DECK UNIT WITH IOSDL WATERFALL CARD FITTED INTERNALLY	SHEET	
	TT301.DGM	D WHITE	ISSUE	
			DATE	7 OCT 1992

Brook Road, Wormley, Godalming
Surrey, GU8 5UB,
United Kingdom
Telephone +44 (0) 428-684141
Facsimile +44 (0) 428-683066
Telex 858833 OCEANS G

Natural
Environment
Research
Council