TRACE ELLIOT

SERVICE MANUAL NO. SM00052

ISSUE 1

Date: April 9th 1998
Product Code : T3485 / T3475
Model No : SPEED TWIN H100 / C100
Technical File No : TE000052

Issued by:

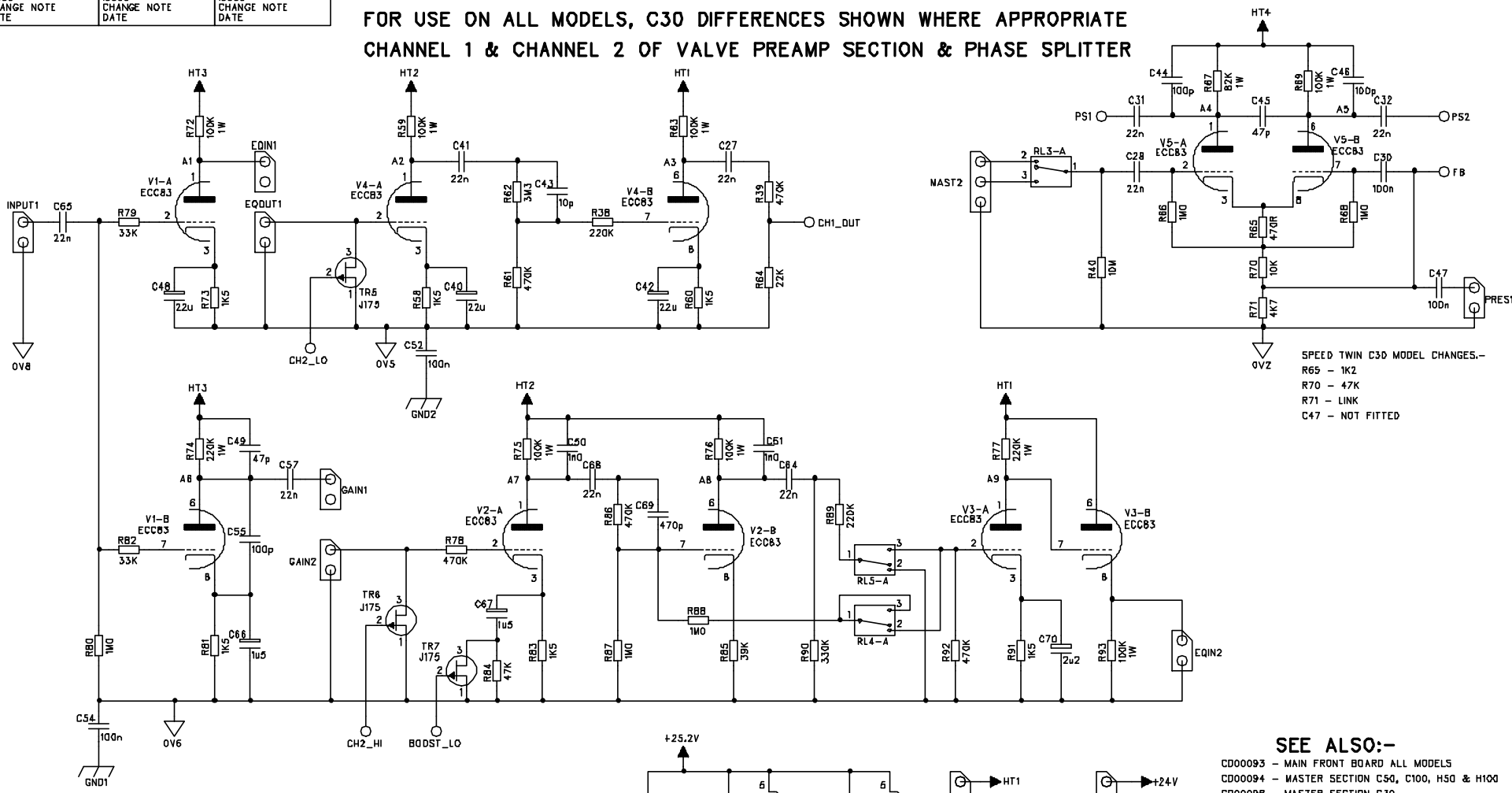
Trace Elliot Limited.
Blackwater Trading Estate
The Causeway, Maldon
Essex CM9 4GG.

ISSUE CHANGE NOTE DATE	ISSUE CHANGE NOTE DATE	ISSUE CHANGE NOTE DATE
ISSUE CHANGE NOTE DATE	ISSUE CHANGE NOTE DATE	ISSUE CHANGE NOTE DATE

SPEED TWIN '98 GUITAR AMPLIFIERS – MAIN PREAMP PCB

FOR USE ON ALL MODELS, C30 DIFFERENCES SHOWN WHERE APPROPRIATE

CHANNEL 1 & CHANNEL 2 OF VALVE PREAMP SECTION & PHASE SPLITTER



SPEED TWIN C30 MODEL CHANGES.–
R65 – 1K2
R70 – 47K
R71 – LINK
C47 – NOT FITTED

TEST VOLTAGES

	HT1	HT2	HT3	HT4	V1p1	V1p6	V2p1	V2p6	V3p1	V3p6	V4p1	V4p6	V5p1	V5p6
C30	315	325	330	333	224	151	210	305	135	138	210	200	255	250
C50/H50	335	345	350	315	225	170	225	330	150	152	215	215	206	204
C100/H100	340	350	360	320	235	170	230	330	150	152	230	225	200	190

TOLERANCE +/– 5%

SEE ALSO:–

CD00093 – MAIN FRONT BOARD ALL MODELS
CD00094 – MASTER SECTION C50, C100, H50 & H100
CD00098 – MASTER SECTION C30
CD00091 – 100 WATT VALVE OUTPUT STAGE & DC SUPPLY
CD00085 – 50 WATT VALVE OUTPUT STAGE & DC SUPPLY
CD00096 – 30 WATT VALVE OUTPUT STAGE & DC SUPPLY
CD00097 – 5 FUNCTION FOOTSWITCH

COMPONENTS USED ARE OF AN APPROVED TYPE AND MUST BE REPLACED ACCORDINGLY

SHEET 1/3

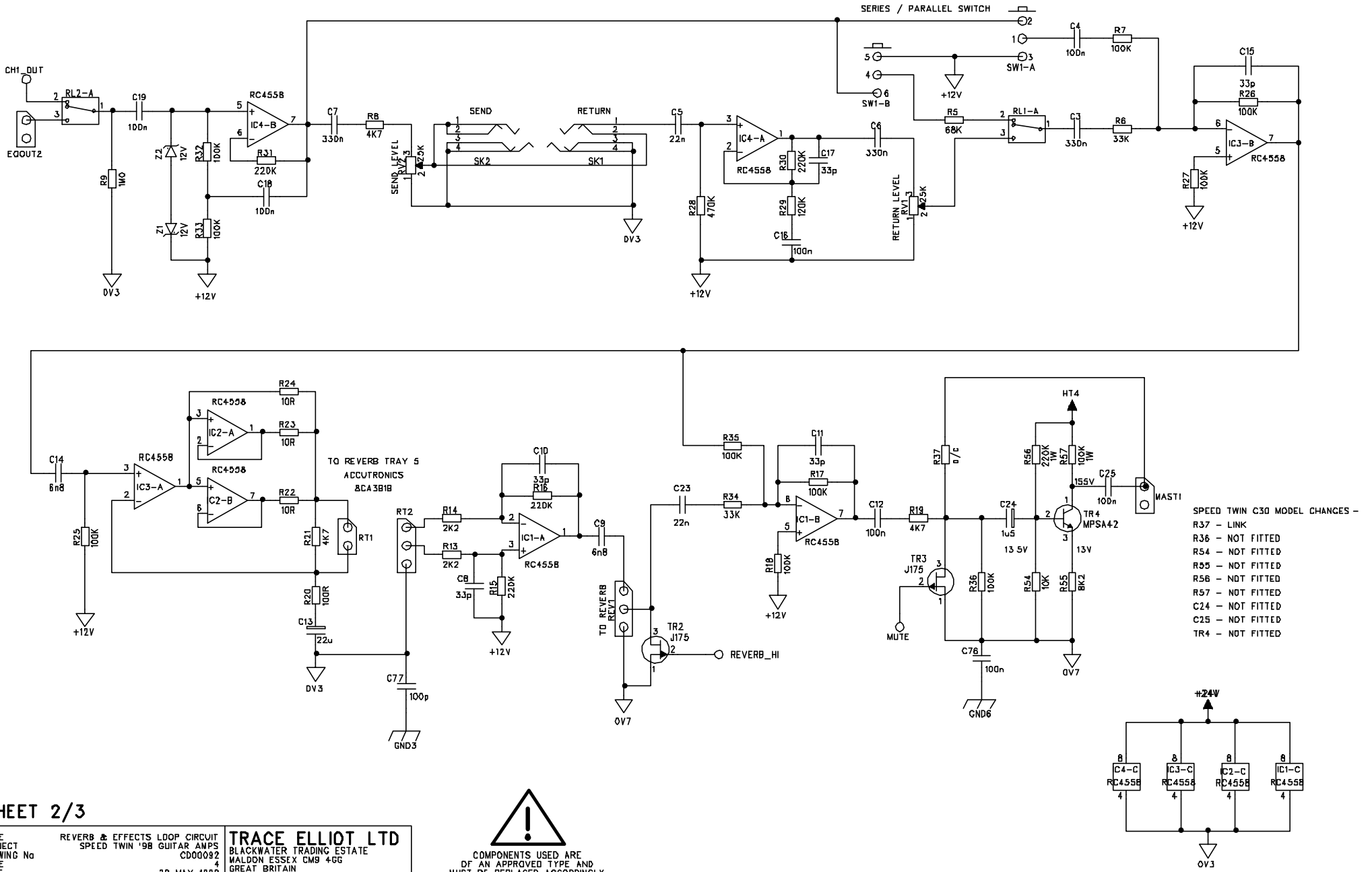
TITLE	CH1 & CH2 VALVE PREAMP SECTION
PROJECT	SPEED TWIN '98 GUITAR AMPS
DRAWING No	CD00092
ISSUE	4
DATE	28 MAY 1998
DRAWN BY	PAUL STEVENS

TRACE ELLIOT LTD
BLACKWATER TRADING ESTATE
MALDON ESSEX CM9 4GG
GREAT BRITAIN
TEL (01621) 851851
FAX (01621) 851875

FOR USE WITH PCD0088

ISSUE CHANGE NOTE DATE	ISSUE CHANGE NOTE DATE	ISSUE CHANGE NOTE DATE
ISSUE CHANGE NOTE DATE	ISSUE CHANGE NOTE DATE	ISSUE CHANGE NOTE DATE

EFFECTS LOOP AND REVERB CIRCUITRY



SHEET 2/3

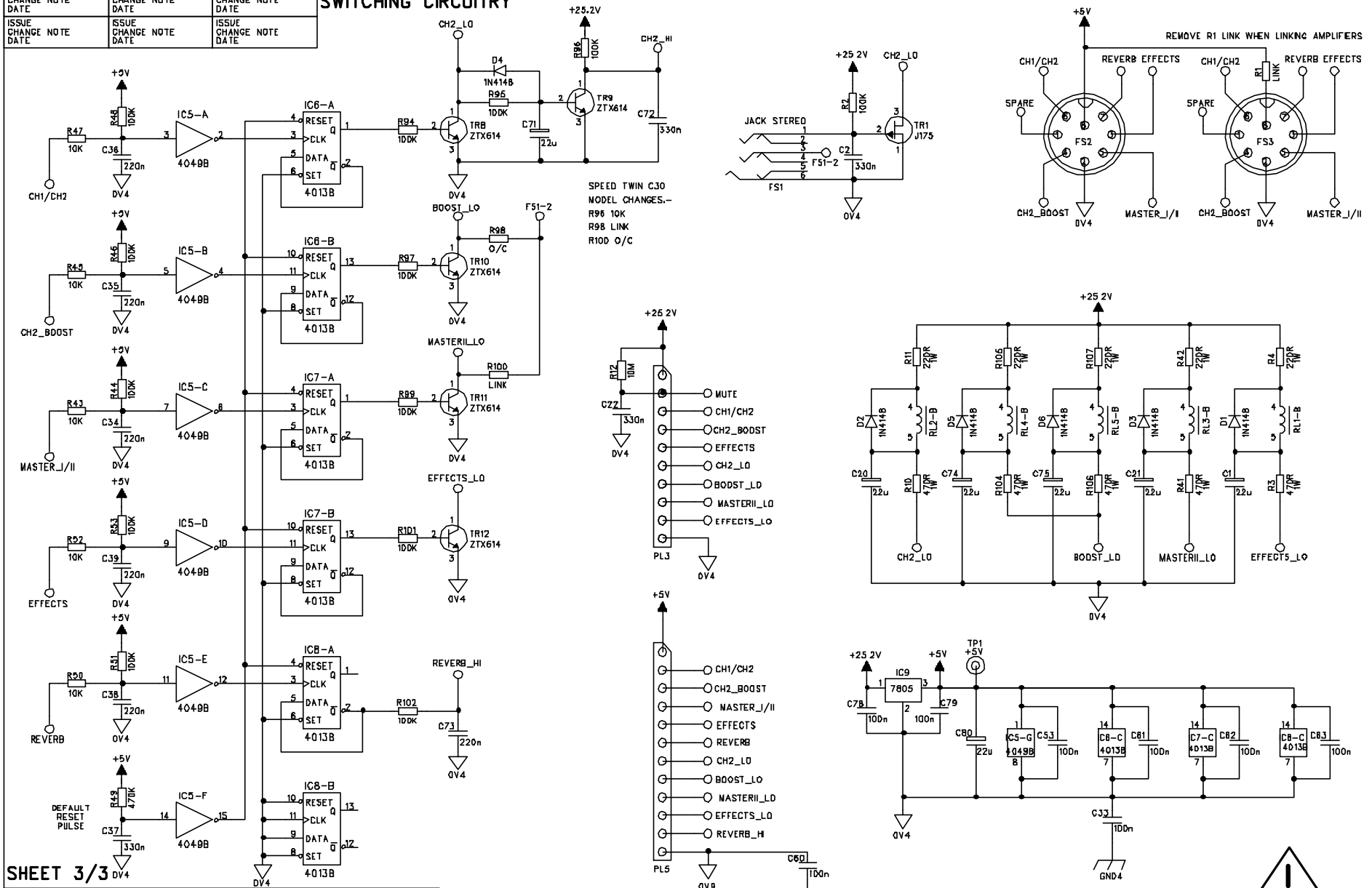
TITLE	REVERB & EFFECTS LOOP CIRCUIT
PROJECT	SPEED TWIN '98 GUITAR AMPS
DRAWING No	CD00092
ISSUE	4
DATE	28 MAY 1998
DRAWN BY	PAUL STEVENS

TRACE ELLIOT LTD
BLACKWATER TRADING ESTATE
MALDON ESSEX CM9 4GG
GREAT BRITAIN
TEL (01621) 851851
FAX (01621) 851975

COMPONENTS USED ARE
OF AN APPROVED TYPE AND
MUST BE REPLACED ACCORDINGLY

ISSUE CHANGE NOTE DATE	ISSUE CHANGE NOTE DATE	ISSUE CHANGE NOTE DATE
ISSUE CHANGE NOTE DATE	ISSUE CHANGE NOTE DATE	ISSUE CHANGE NOTE DATE

SWITCHING CIRCUITRY



SHEET 3/3

TITLE	SWITCHING AND LOGIC CIRCUITRY
PROJECT	SPEED TWIN '98 GUITAR AMPS
DRAWING No	CDQQ082
ISSUE	4
DATE	28 MAY 1998
DRAWN BY	PAUL STEVENS

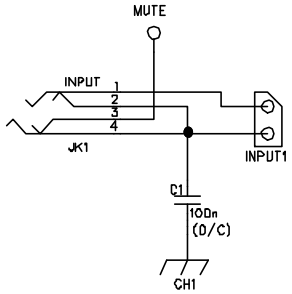
TRACE ELLIOT LTD
BLACKWATER TRADING ESTATE
MALDON ESSEX CM9 4GG
GREAT BRITAIN
TEL (01621) 851851
FAX (01621) 851975

ISSUE CHANGE NOTE DATE	ISSUE CHANGE NOTE DATE	ISSUE CHANGE NOTE DATE
ISSUE CHANGE NOTE DATE	ISSUE CHANGE NOTE DATE	ISSUE CHANGE NOTE DATE

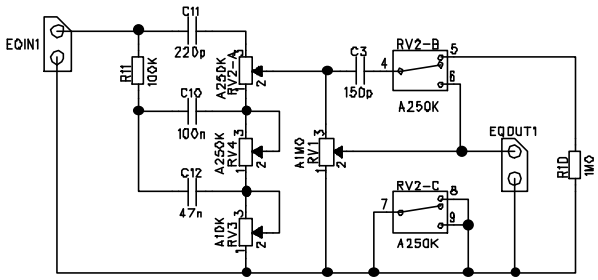
SPEED TWIN MAIN FRONT PANEL

FOR USE ON ALL MODELS

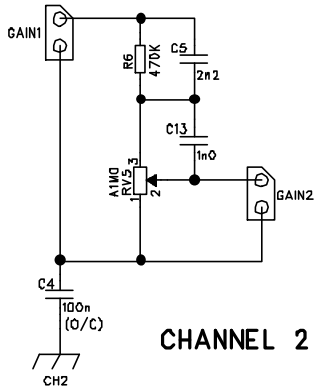
(FIGURES IN BRACKETS VALUES FOR COMBO VERSIONS)

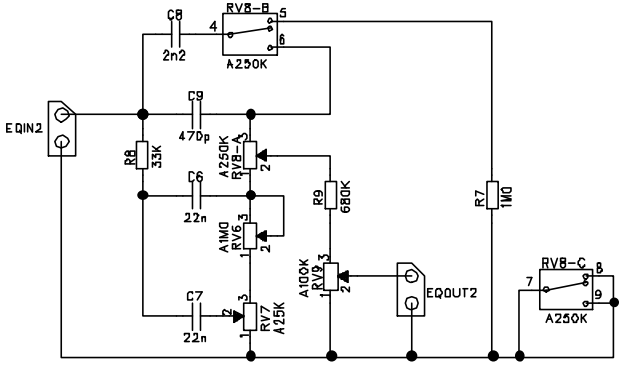


INPUT

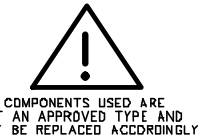


CHANNEL 1 – EQ & VOLUME CONTROLS

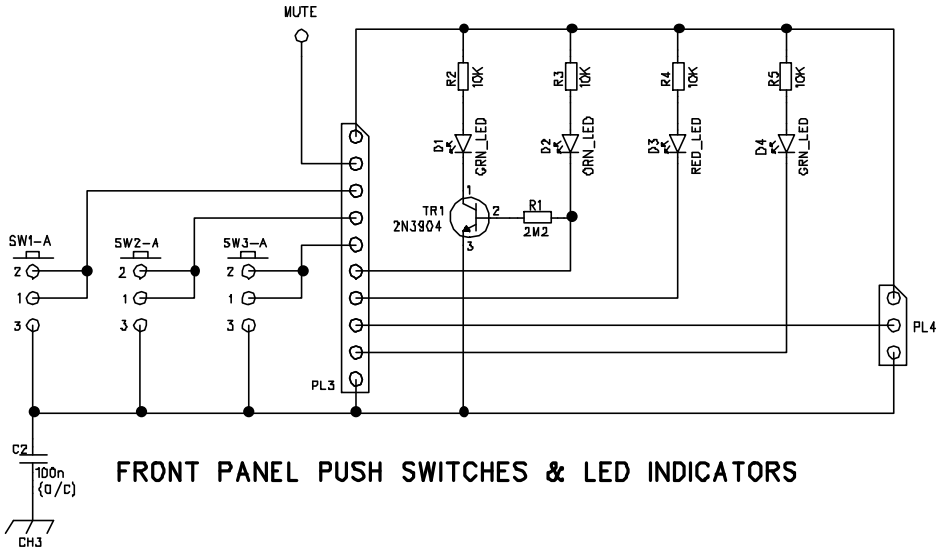




CHANNEL 2 – GAIN, EQ & LEVEL CONTROLS



FOR USE WITH PC00089 & PC00090
CONNECTS TO:–
PC00088 CD00092 MAIN PREAMP ON ALL MODELS
PC00093 CD00094 MASTER SECTION ON H50 & H100
PC00094 CD00094 MASTER SECTION ON C50 & C100
PC00091 CD00098 MASTER SECTION ON C30



FRONT PANEL PUSH SWITCHES & LED INDICATORS

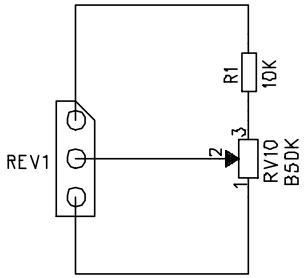
TITLE	MAIN FRONT PANEL PCB
PROJECT	SPEED TWIN '98 GUITAR AMPS
DRAWING No	CD00093
ISSUE	2
DATE	21 APRIL 1998
DRAWN BY	PAUL STEVENS

TRACE ELLIOT LTD
BLACKWATER TRADING ESTATE
MALDON ESSEX CM9 4GG
GREAT BRITAIN
TEL (01621) 851851
FAX (01621) 851975

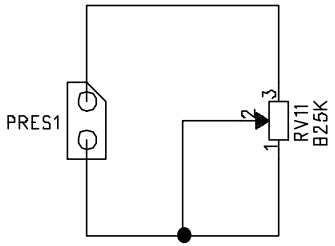
ISSUE CHANGE NOTE DATE	ISSUE CHANGE NOTE DATE	ISSUE CHANGE NOTE DATE
ISSUE CHANGE NOTE DATE	ISSUE CHANGE NOTE DATE	ISSUE CHANGE NOTE DATE

SPEED TWIN FRONT PANEL MASTER SECTION

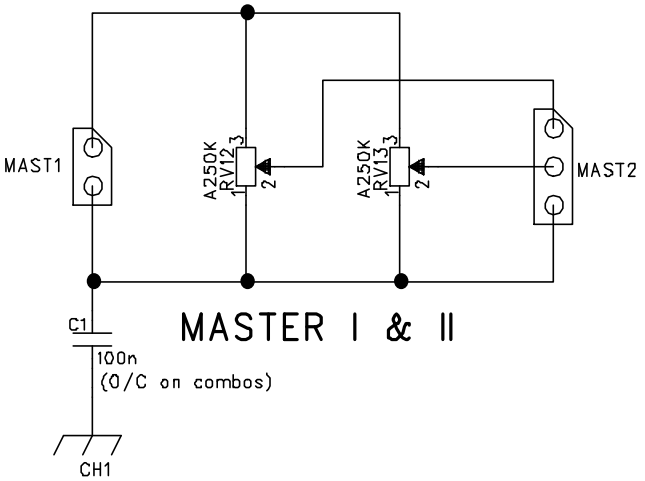
FOR USE ON H100, H50, C100 & C50



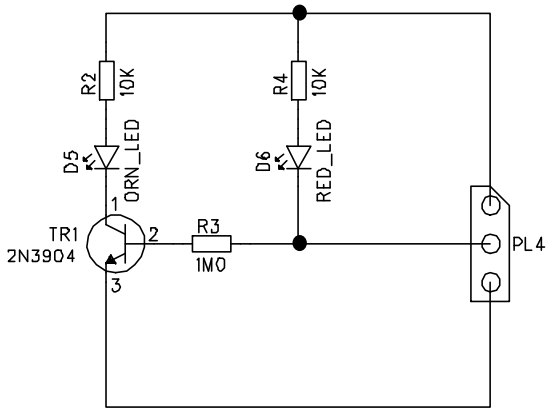
REVERB



PRESENCE



MASTER I & II



LED INDICATORS

COMPONENTS USED ARE
OF AN APPROVED TYPE AND
MUST BE REPLACED ACCORDINGLY

FOR USE WITH PC00093 & PC00094

CONNECTS TO:-

PC00089 CD00093 MAIN FRONT PANEL ON H50 & H100

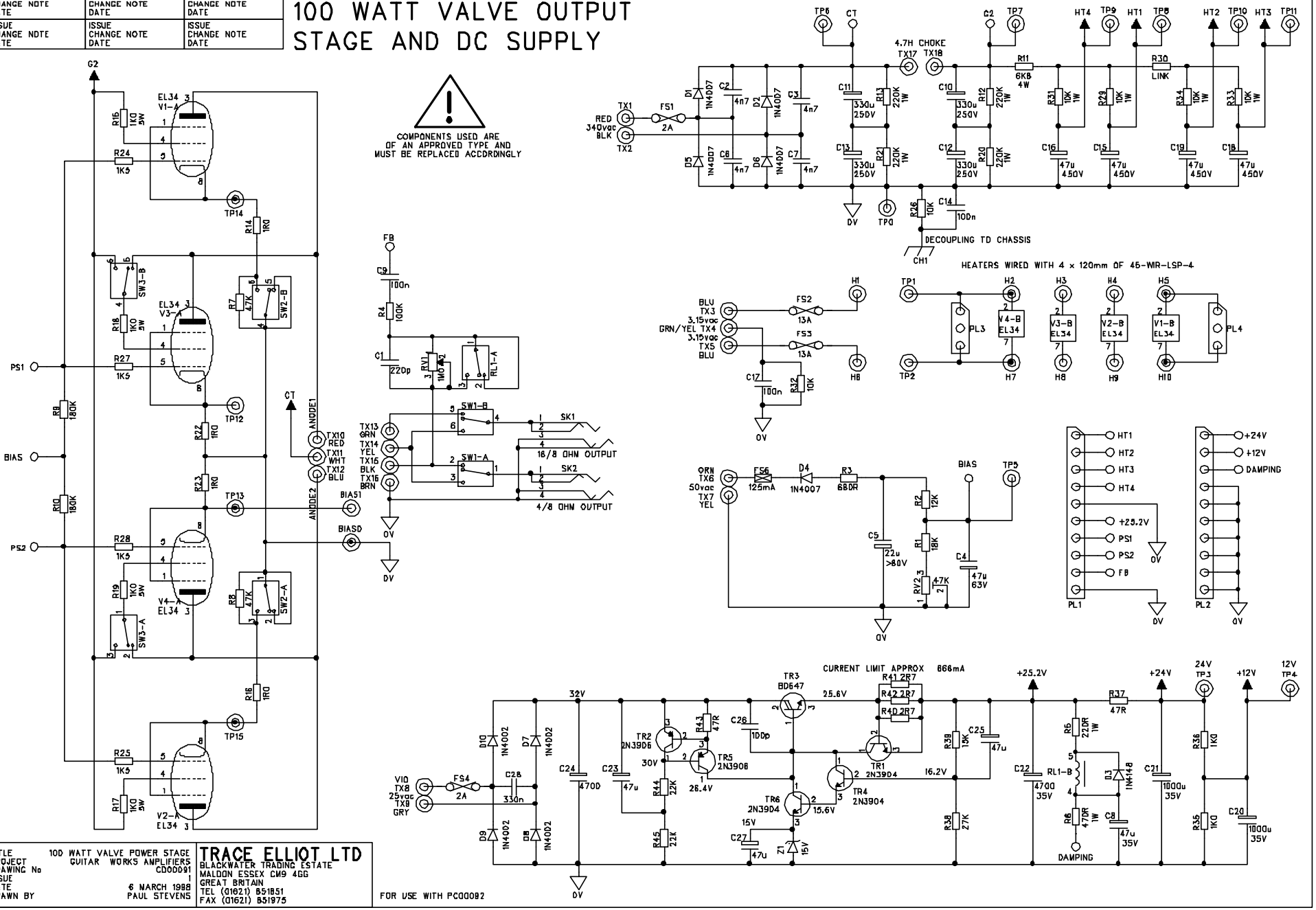
PC00090 CD00093 MAIN FRONT PANEL ON C50 & C100

TITLE	50/100W FRONT PANEL MASTER SECTION
PROJECT	SPEED TWIN '98 GUITAR AMPS
DRAWING No	CD00094
ISSUE	1
DATE	6 MARCH 1998
DRAWN BY	PAUL STEVENS

TRACE ELLIOT LTD
BLACKWATER TRADING ESTATE
MALDON ESSEX CM9 4GG
GREAT BRITAIN
TEL (01621) 851851
FAX (01621) 851975

ISSUE CHANGE NOTE DATE	ISSUE CHANGE NOTE DATE	ISSUE CHANGE NOTE DATE
ISSUE CHANGE NOTE DATE	ISSUE CHANGE NOTE DATE	ISSUE CHANGE NOTE DATE

100 WATT VALVE OUTPUT STAGE AND DC SUPPLY



TITLE	100 WATT VALVE POWER STAGE
PROJECT	GUITAR WORKS AMPLIFIERS
DRAWING No	CD00091
ISSUE	1
DATE	6 MARCH 1988
DRAWN BY	PAUL STEVENS

TRACE ELLIOT LTD
BLACKWATER TRADING ESTATE
MALDON ESSEX CM9 4GG
GREAT BRITAIN
TEL (01621) 851851
FAX (01621) 851975

PARTS LIST FOR SPEED TWIN '98
MAIN PRE AMP PCB FOR 50W & 100W MODELS

C32-PCB-SP2-M **ISSUE 2 9/4/98 PS**

Description	Part Code	Qty	Where Used
PCB	PC00088 issue 2	1	
RESISTORS			
0 ohm link	72-RCZERO	2	R1 R100
10R 1/4W	72-RM10R	3	R22 R23 R24
100R 1/4W	72-RM100R	1	R20
220R 1W	72-RM220R-1WATT	5	R4 R11 R42 R105 R107
470R 1/4W	72-RM470R	1	R65
470R 1W	72-RM470R-1WATT	5	R3 R10 R41 R104 R106
1K5 1/4W	72-RM1K5	6	R58 R60 R73 R81 R83 R91
2K2 1/4W	72-RM2K2	2	R13 R14
4K7 1/4W	72-RM4K7	4	R8 R19 R21 R71
8K2 1/4W	72-RM8K2	1	R55
10K 1/4W	72-RM10K	7	R43 R45 R47 R50 R52 R54 R70
22K 1/4W	72-RM22K	1	R64
33K 1/4W	72-RM33K	4	R6 R34 R79 R82
39K 1/4W	72-RM39K	1	R85
47K 1/4W	72-RM47K	1	R84
68K 1/4W	72-RM68K	1	R5
82K 1W	72-RM82K-1WATT	1	R67
100K 1/4W	72-RM100K	23	R2 R7 R17 R18 R25 R26 R27 R32 R33 R35 R36 R44 R46 R48 R51 R53 R94 R95 R96 R97 R99 R101 R102
100K 1W	72-RM100K-1WATT	8	R57 R59 R63 R69 R72 R75 R76 R93
120K 1/4W	72-RM120K	1	R29
220K 1/4W	72-RM220K	7	R15 R16 R30 R31 R38 R56 R89
220K 1W	72-RM220K-1WATT	2	R74 R77
330K 1/4W	72-RM330K	1	R90
470K 1/4W	72-RM470K	7	R28 R39 R49 R61 R78 R86 R92
1M0 1/4W	72-RM1M	6	R9 R66 R68 R80 R87 R88
3M3 1/4W	72-RM3M3	1	R62
10M 1/4W	72-RM10M	2	R12 R40
82R 4W	72-RWW82R-4W	1	R103
NOT FITTED			R37 R98
CAPACITORS			
33p 100V axial	72-C33P-100VCA	5	C8 C10 C11 C15 C17
100p 100V axial	72-C100P-100VCA	1	C77
6n8 100V axial	72-C6N8-100VCA	2	C9 C14
22n 100V axial	72-C22N-100VCA	4	C5 C23 C28 C65
100n 100V axial	72-C100N-100VCA	16	C4 C12 C16 C18 C19 C30 C33 C47 C52 C53 C54 C60 C61 C62 C63 C76
220n 100V axial	72-C220N-50VCA	6	C34 C35 C36 C38 C39 C73

330n 50V axial	72-C330N-50VCA	7	C2 C3 C6 C7 C22 C37 C72
10p 500V ceramic	72-C10P-500VCD	1	C43
47p 500V ceramic	72-C47P-500VCD	2	C45 C49
100p 1KV ceramic	72-C100P-1KVCD	3	C44 C46 C55
470p 1KV ceramic	72-C470P-1KVCD	1	C69
1n0 1KV ceramic	72-C1000P-1KVCD	2	C50 C51
22n 400V poly box	72-C22N-400VP	7	C27 C31 C32 C41 C57 C64 C68
100n 250V poly box	72-C100N-250VP	1	C25
1u5 35V tant	72-C1.5-35VT	3	C24 C66 C67
2u2 35V tant	72-C2.2-35VT	1	C70
22u 63V elect rad	72-C22-63VER	15	C1 C13 C20 C21 C26 C29 C40 C42 C48 C56 C58 C59 C71 C74 C75
SEMICONDUCTORS			
1N4148	72-D-IN4148	6	D1 D2 D3 D4 D5 D6
12V ZENER	72-D-BZX55C12V	2	Z1 Z2
ZTX614 Darlington	72-TZTX614	5	TR8 TR9 TR10 TR11 TR12
J175	72-FET-J-175	6	TR1 TR2 TR3 TR5 TR6 TR7
MPSA42	72-TMPSA42	1	TR4
RC4558	72-IC-RC4558P	4	IC1 IC2 IC3 IC4
4049B -Hex Inverter	72-IC-4049B	1	IC5
4013B -Dual D Type	72-IC-4013B	3	IC6 IC7 IC8
CONNECTORS			
10 way 0.1"	72-HEAD-10W	3	PL1 PL2 PL3
12 way 0.1"	72-HEAD-12W	0	PL5 NOT FITTED YET
SOCKETS			
¼" Mono Jack SKT	72-SKT-JCKBNBG	2	SK1 SK2
¼" Stereo Jack SKT	72-SKT-JCKBBBG	1	FS1
8 pin DIN SKT PCB	73-SKT-DIN-8PIN	2	FS2 FS3
SWITCH	73-SWT-F2UEE	1	SW1
POTENTIOMETERS	73-POT-A25K	2	RV1 RV2
RELAY Omron G5V-1	73-RELAY-5V-SPCO	5	RL1 RL2 RL3 RL4 RL5
B9A PCB valve base	73-VAL-SOCKET	5	V1 - V5 (on underside of PCB)
MODIFICATION			
22u 63V elect rad	72-C22-63VER	1	ACROSS C63
7805 voltage regulator	72-IC-7805-REG	1	AS SHOWN ON SAMPLE

PARTS LIST FOR SPEED TWIN '98 MAIN FRONT PCB

C32-PCB-SP2-FC & C32-PCB-SP2-FH **ISSUE 2 27/4/98 PS**

Description	Part Code	Qty	Where Used
PCB	PC00089x2 or...	1	For H100 and H50
	PC00090x2	1	For C100, C50 and C30
RESISTORS			
10K 1/4W	72-RM10K	4	R2 R3 R4 R5
33K 1/4W	72-RM33K	1	R8
100K 1/4W	72-RM100K	1	R11
470K 1/4W	72-RM470K	1	R6
680K 1/4W	72-RM680K	1	R9
1M0 1/4W	72-RM1M	2	R7 R10
2M2 1/4W	72-RM2M2	1	R1
CAPACITORS			
100n 100V axial	72-C100N-100VCA	3	C1 C2 C4
150p 100V ceramic	72-C150P-100VCD	1	C3
220p 1KV ceramic	72-C220P-1KVCD	1	C11
470p 1KV ceramic	72-C470P-1KVCD	1	C9
1n0 1KV ceramic	72-C1000P-1KVCD	1	C13
2n2 1KV ceramic	72-C2200P-1KVCD	2	C5 C8
22n 400V poly box	72-C22N-400VP	2	C6 C7
47n 400V poly box	72-C47N-400VP	1	C12
100n 250V poly box	72-C100N-250VP	1	C10
SEMICONDUCTORS			
2N3904	72-T2N3904	1	TR1
3mm GRN LED	72-LED-GRN-3mm	2	D1 D4
3mm YEL LED	72-LED-YEL-3mm	1	D2
3mm RED LED	72-LED-RED-3mm	1	D3
CONNECTORS			
3 way 0.1"	72-HEAD-3W-2	1	PL4
10 way 0.1"	72-HEAD-10W	1	PL3
1/4" MONO JACK SKT	72-SKT-JCKBNBG	1	JK1
PUSH SWITCH	73-SWT-F2UEE-MOM	3	SW1 SW2 SW3
POTENTIOMETERS			
10K	73-POT-A10K	1	RV3
25K	73-POT-A25K	1	RV7
100K	73-POT-A100K	1	RV9
250K	73-POT-A250K	1	RV4
250K with Pull Switch	73-POT-A250K-PS	2	RV2 RV8
1M0	73-POT-A1M	3	RV1 RV5 RV6

PARTS LIST FOR SPEED TWIN '98
MASTER SECTION PCB FOR 50W & 100W MODELS

C32-PCB-SP2-FMC & C32-PCB-SP2-FMH **ISSUE 2 27/4/98 PS**

Description	Part Code	Qty	Where Used
PCB	PC00093x2 or...	1	For H100 and H50
	PC00094x2	1	For C100 and C50
RESISTORS			
0 ohm link	72-RCZERO	3	PC00093 where shown
0 ohm link	72-RCZERO	4	PC00094 where shown
10K 1/4W	72-RM10K	3	R1 R2 R4
1M0 1/4W	72-RM1M	1	R3
CAPACITOR			
100n 100V axial	72-C100N-100VCA	1	C1
SEMICONDUCTORS			
2N3904	72-T2N3904	1	TR1
3mm YEL LED	72-LED-YEL-3mm	1	D5
3mm RED LED	72-LED-RED-3mm	1	D6
POTENTIOMETERS			
50KB	73-POT-B50K	1	RV10
25KB	73-POT-B25K	1	RV11
250K	73-POT-A250K	2	RV12 RV13
CONNECTOR			
3 way 0.1"	72-HEAD-3W-2	1	PL4

PARTS LIST FOR SPEED TWIN '98
MASTER SECTION PCB FOR C30 MODEL

C32-PCB-SP2-FM30 **ISSUE 1 6/3/98 PS**

Description	Part Code	Qty	Where Used
PCB	PC00091x1	1	C30
RESISTOR			
10K 1/4W	72-RM10K	1	R1
CAPACITOR			
100n 100V axial	72-C100N-100VCA	1	C1
POTENTIOMETERS			
50KB	73-POT-B50K	1	RV10
250K	73-POT-A250K	1	RV11

C32-PCB-100W-VPx2.

PARTS LIST FOR PC00092 - 100W VALVE POWER BOARD

ISSUE 2 20/7/98 PS

Description	Part Code	Qty	Where Used
PCB	PC00092 issue 1	1	
RESISTORS			
0 Ohm Link	72-RCZERO	1	R30
2R7 1/4W	72-RM2R7	3	R40 R41 R42
47R 1/4W	72-RM47R	2	R37 R43
220R 1W	72-RM220R-1WATT	1	R5
470R 1W	72-RM470R-1WATT	1	R6
680R 1/4W	72-RM680R	1	R3
1K0 1/4W	72-RM1K	2	R35 R36
1K5 1/4W	72-RM1K5	4	R24 R25 R27 R28
10K 1/4W	72-RM10K	2	R26 R32
10K 1W	72-RM10K-1WATT	4	R29 R31 R33 R34
12K 1/4W	72-RM12K	1	R2
15K 1/4W	72-RM15K	1	R39
18K 1/4W	72-RM18K	1	R1
22K 1/4W	72-RM22K	2	R44 R45
27K 1/4W	72-RM27K	1	R38
47K 1W	72-RM47K-1WATT	2	R7 R8
100K 1/4W	72-RM100K	1	R4
180K 1/4W	72-RM180K	2	R9 R10
220K 1W	72-RM220K-1WATT	4	R12 R13 R20 R21
1R0 4W	72-RWW1R-4W	4	R14 R16 R22 R23
1K0 4W	72-RWW1K-6W	4	R15 R17 R18 R19
6K8 4W	72-RWW6K8-4W	1	R11
PCB MOUNT FUSE	72-FUS-125MA-F	1	FS6
DIODES			
1N4002	72-D-IN4002	4	D7 D8 D9 D10
1N4007	72-D-IN4007	5	D1 D2 D4 D5 D6
1N4148	72-D-IN4148	1	D3
15V ZENER	72-D-BZX55C15V	1	Z1
CAPACITORS			
220p 100V axial	72-C220P-100VCA	1	C1
100n 100V axial	72-C100N-100VCA	3	C9 C14 C17
330n 50V axial	72-C330N-50VCA	1	C28

100p 1KV ceramic	72-C100P-1KVCD	1	C26
4n7 1KV ceramic	72-C4700P-1KVCD	4	C2 C3 C6 C7
22u 160V elect radial	72-C22-160VER	1	C5
47u 63V elect radial	72-C47-63VER	5	C4 C8 C23 C25 C27
1000u 35V elect radial	72-C1000-35VER	2	C20 C21
4700u 35V elect radial	72-CAP-470035V	2	C22 C24
47u 450V elect radial	72-CAP-47450V	4	C15 C16 C18 C19
330u 250V elect radial	72-CAP-330250V	4	C10 C11 C12 C13
SEMICONDUCTORS			
2N3904	72-T2N3904	3	TR1 TR4 TR6
2N3906	72-T2N3906	2	TR2 TR5
BD647	72-TBD647	1	TR3 see below for heat sink
RELAY Omron G5V-1	73-RELAY-5V-SPCO	1	RL1
CONNECTORS			
3 way 0.1”	72-HEAD-3W-2	2	PL3 PL4
10 way 0.1”	72-HEAD-10W	2	PL1 PL2
JACK SOCKETS	73-SKT-JCKBNBG	2	SK1 SK2
SWITCHES	73-SWT-SLIDER-DP	3	SW1 SW2 SW3
POTENTIOMETERS			
47K vertical trimmer	72-PRESET-47K-V	1	RV2
1M0	73-POT-A1M	1	RV1
FUSE HOLDERS	72-FUS-HLD-PCB-4	8	FS1-FS4 (check insertion)
CRIMP CONNECTORS	72-CRIMP-PCB-TAB	18	TX1-TX18
BIAS TEST POINTS	73-TERM-SCREW-M3	2	BIAS0 BIAS1
0V TEST POINT PIN	73-TERM-PIN	1	TP0
HEATER WIRING	C00-LEAD-100-HTR	1	H1-H10
OCTAL VALVE BASES	73-VAL-SOCKET-2	4	V1 V2 V3 V4
TO220 HEATSINK	G13-HS-ST	1	TR3
M3 SCREW	71-SCR-M3X12PPB	1	Part of heat sink assembly
M3 WASHER	71-WAS-M3INTSP	1	See drawing
M3 WASHER	71-WAS-M3ABLK	1	“
M3 NUT	71-NUT-M3ZINC	1	“
INSULATING KIT	72-MOS-PAD-TO220	1	“
Heat sink compound			Between TR3, heat sink & chassis

SPEED TWIN ’98 CIRCUIT DESCRIPTION

Please refer to the following circuit diagrams:-

CD00092	**MAIN PREAMP PCB**
CD00093	**MAIN FRONT PANEL PCB**
CD00094	**50W/100W FRONT PANEL MASTER SECTION**
CD00098	**C30 FRONT PANEL MASTER SECTION**
CD00096	**30 WATT VALVE POWER STAGE & DC SUPPLY**
CD00085	**50 WATT VALVE POWER STAGE & DC SUPPLY**
CD00091	**100 WATT VALVE POWER STAGE & DC SUPPLY**

*Where necessary, where particular components are referred to, to avoid confusion due to component numbers being repeated on other PCBs, the **CD000??** number will be shortened to the last two figures and shown in brackets following the component number, with, where necessary the sheet number; i.e.* TR4 (92/2) *is referring to Transistor 4 on Sheet 2 of CD00092 (Main Preamp PCB).*

For more information it may be useful to refer to the Test Procedure and Operating Instructions.

1) SIGNAL FLOW

VALVE PREAMP

INPUT

The instrument is connected to the INPUT JK1 (93) which is connected to INPUT 1 on the main preamp board.

The MUTE control line will be at either 0V or 25.2V depending on whether a jack is inserted, this controls the MUTE function described later.

C65 (92/1) blocks any DC from the input that may unintentionally be present, this would otherwise change the bias point of the first valve stage and affect the sound.

The signal is now split for the input sections of each channel with R79 and R82 (both 92/1) feeding Channels 1 and 2 respectively, R80 (92/1) sets the input impedance.

CHANNEL 1

V1A is the input stage of this channel and is configured as a cathode bias, common cathode, voltage amplifier with a high value capacitor bypassing the cathode resistor for increased gain and extended lower frequency response.

The anode is connected to the tone controls on the front board which all work in the traditional passive manner.

The frequency of the BRIGHT effect is set by C3 (93), which, when switched in, is connected across pins 2 and 3 of RV1 (93) VOLUME. Obviously connected like this the amount of brightness added will decrease as RV1 is turned up.

The signal then returns to the main board where it is either muted or un-muted by TR5 (92/1) depending on the state of the CH2_LO control line.

V4A is the next gain stage configured the same as before. R62, C43, and R61 (all 92/1) form a high pass filter which gives a considerable presence lift at around 4.8KHz.

V4B is the final gain stage in Channel 1 again configured and biased as before.

R39 and R64 (both 92/1) form a potential divider which reduces the signal level before the solid state section.

CHANNEL 2

V1B is the input stage of this channel and again is configured as a cathode bias, common cathode, voltage amplifier. However due to the values chosen it has increased gain at a selective frequency range. C55 (92/1) helps to keep the circuit stable.

The signal is then sent to the front board. R6 and C5 give a slight upper frequency boost, RV5 sets the GAIN and C13 increases the brightness depending on the setting of RV5.

The signal then returns to the main board where it is either muted or un-muted by TR6 depending on the state of the CH2_HI control line.

V2A is the next gain stage, the amount of gain depends on the state of the BOOST_LO control line and consequently the condition of TR7. Without the boost selected BOOST_LO will be high and the source and drain pins of TR7 will be open circuit resulting in normal gain. Pulling BOOST_LO down will bring the resistance between the source and drain down to around 50 ohms effectively shorting out R84 and letting C67 almost completely bypass R83. This will result in increased gain.

R86, C69 and R87 (all 92/1) give a slight presence lift before the third gain stage.

V2B is configured to give more gain with an extended lower frequency response, this is effectively switched in or out of the circuit by RL4A and RL5A which are both controlled by the BOOST_LO control line.

V3A is the final gain stage, configured for high gain, the signal is then fed into V3B configured as a cathode follower. This reduces the impedance to drive the tone network.

The tone network on the front board is passive and works in the manner traditional to guitar amplifiers. The PULL SHIFT function, controlled by RV8B, lowers the operating frequency of the TREBLE control by switching in C8 in parallel with C9 (both 93).

RV9 sets the signal level of Channel 2 sent into the solid state section and is restricted by R9 to prevent unwanted distortion.

EFFECTS LOOP AND REVERB SECTIONS

RL2 (92) selects which of the two channels is fed into the solid state section which is buffered by IC4B, configured as a boot strapped voltage follower. Z1 and Z2 have been added to prevent spikes from damaging the opamp, this should in practise never happen.

The signal from the output of IC4B is split two ways for the effects loop. One goes to the series/parallel switch, SW1, the other goes to the SEND socket SK2 via R8 and RV2 (both 92/2). These reduce the nominal send level to between -20 and 0dBu.

SK1 is the RETURN socket which feeds the effect loop signal into IC4A which is configured as a non-inverting voltage amplifier. RV1 sets the level of the effects loop signal sent to RL1. This relay basically turns the effects loop on or off depending on the state of the EFFECTS_LO control line.

Depending on the setting of the series/parallel switch , the dry and effects loop signals are mixed together by IC3B configured as a standard virtual earth mixer, then the signal is split again to drive the reverb section.

C14 and R25 roll off a lot of the lower frequencies before the signal gets sent to IC3A, IC2A and IC2B. These opamps are configured for current gain, the actual gain being dependant on the impedance/frequency curve of the reverb tray. Because of this it is crucial to the correct operation of the reverb that the right reverb tray is used. This should be an Accutronics 8CA3B1B.

The output of the reverb tray goes into IC1A. This is configured as a differential amplifier as a way of reducing any hum that may be picked up by the sensitive reverb return leads.

RV10 (94 or 98 depending on model) controls the level of the reverb. Across pins 1 and 2 is TR2 (92/2), a J175 FET which mutes or un-mutes the reverb signal depending on the state of the REVERB_HI control line.

IC1B is configured as a standard virtual earth mixer section which mixes in the reverb with, the already mixed, dry and effects loop signals.

TR3 (92/2) mutes or un-mutes the overall signal depending on the state of the MUTE control line. Without a jack plugged into the INPUT socket the MUTE control line will be at
0V which will virtually short out pins 1 and 3 of TR3 and mute the signal. Inserting a jack plug will allow the MUTE control line to rise up to +25.2V, changing the state of the FET and consequently un-mute the signal.

TR4 (92/2) is an MPSA42, a high voltage transistor. This, along with its associated components, is used to amplify the signal up to levels required to drive the valve output stage. Due to its very high head room and the way in which it is being used in the circuit, this stage will be totally transparent and have no effect on the audio signal apart from increasing the amplitude.
This section is not fitted to the SPEED TWIN C30 model due to the difference in sensitivity between the EL34 and EL84 power stages.

The signal is now sent to the Front Panel Master Section board (see either CD00094 or CD00098 depending on model) where the Master Volume is set by either RV11 (98) or RV12/RV13 (94).

PHASE SPLITTER

The signal is returned to the main preamp board where RL3 (92/1) selects whether MASTER I or MASTER II is used. On the C30 model the relay switches between the MASTER setting and MUTE. The relay is set by the MASTERII_LO control line.

The phase splitter (V5) is a standard differential input splitter which produces the anti-phase signals necessary to drive the push pull output stages.

The 50 and 100 watt models have a connection to the Front Master Board for the PRESENCE control, this is basically an overall tone control working in the negative feedback loop of the power stage. The C30 model does not have a PRESENCE control due to its traditional open loop design not having a negative feedback loop.

POWER STAGES

Within the SPEED TWIN range three different power amplifier sections are used.

The C30 is powered by four EL84's configured in CATHODE BIASED CLASS A, WITHOUT any NEGATIVE FEEDBACK. This is the traditional arrangement for a guitar amplifier of this type and will produce at least 30 watts RMS with the valves supplied.

The C50/H50 and C100/H100 are each powered by two or four EL34's respectively. These are configured for GRID BIASED CLASS A/B. This is the traditional arrangement for a guitar amplifier of this type and will produce at least 50 or 100 watts RMS respectively with the valves supplied.

Other differences are explained below.

OUTPUT BIASING (C50, C100, H50 & H100)

The holes in the chassis marked BIAS MEASUREMENT and BIAS ADJUST allow the biasing of the output valves to be checked or reset easily and safely if necessary. It also allows the use of several different types of output valve including EL34, 6L6, 6550 and 5881.

On a new unit the biasing will be factory set for the particular set of EL34's supplied with the amplifier. Although this should not need to be adjusted unless a new set of output valves is fitted, on all amplifiers as valves age their bias requirements may change.

There are several methods that are used to bias valve amplifiers, the following is one of the easiest, safest and ensures that the output valves do not draw too much current which can result in thermal run away and damaged valves.

To check or reset bias on currently installed valves:-

1) Ensure unit is correctly loaded. Connect to mains, switch to STANDBY and allow to warm up for at least one minute.

2) Ensure that MASTER controls are turned to zero and switch from STANDBY to ON.

3) Set volt meter to 200mV range and insert probes into BIAS MEASUREMENT holes.

4) There should now be a reading of 33mV (+/-3mV) on the volt meter. If yes amplifier is correctly biased, if not follow point 5.

5) Using a trimmer tool or small flat bladed screwdriver carefully rotate the BIAS ADJUST control to give the correct reading in the volt meter. Turning clockwise will increase the value and vice versa.

To install new valves and bias amplifier:-

1) Ensure unit is disconnected from mains supply and that valves have had time to cool down.

2) Remove rear grille and carefully remove old valves.

3) Install new valves making sure that they are inserted correctly.
N.B. Only use matched sets of output valves.

4) Using trimmer tool turn BIAS ADJUST control fully anti-clockwise.

5) Ensure unit is correctly loaded. Connect to mains, switch to STANDBY and allow to warm up for at least one minute.

6) Ensure that any MASTER controls are turned to zero and switch from STANDBY to ON.

7) Set volt meter to 200mV range and insert probes into BIAS MEASUREMENT holes.

8) Using trimmer tool carefully rotate the BIAS ADJUST control to give the correct reading on the volt meter as shown below:-

EL34	33mV (+/-3mV)	
6L6	27mV (+/-3mV)	
6550	37mV (+/-3mV)	
5881	27mV (+/-3mV)	
KT88	37mV (+/-3mV)	50 watt models only - due to wider glass envelope

The above values are a guide line but should be OK for most brands of valves, although the bias point for any amplifier is somewhat subjective. Increasing the values shown may improve the tone but will make the valves run hotter reducing their life, whereas lower values will run valves cooler, increasing life and reliability at the sacrifice of increasing cross over distortion.
The individual quiescent current for each valve can be measured if desired, to make sure the set is matched, at TP12, 13, 14 and 15 (inside the unit on the power board).

The output valves on the C30 do not require biasing to be manually set due to the CATHODE SELF BIAS design of the output stage which is set by R9 and R19 (96).
Therefore to change valves simply follow points 1, 2 and 3 immediately above.

OUTPUT POWER SWITCH - FULL/HALF (100 watt models only)

The power stage on the 100 watt board can be set to either FULL or HALF power.

With the switch in the FULL power setting all four power output valves are in operation.
When switched to the HALF power setting two of the output valves (V1 & V2) are turned off obviously leaving just two in operation (V3 & V4) resulting in a reduction in output power.
The actual available output power will depend on the setting of the OUTPUT STYLE switch explained below.

OUTPUT STYLE SWITCH - PENTODE/TRIODE (50 and 100 watt models only)

This switch works slightly differently depending in the model.

On the 50 watt board both the valves in the output stage can be set to either PENTODE or TRIODE operation. PENTODE operation produces full power from the valves, whereas in TRIODE operation the output is reduced to about half. This enables the user to switch from 50 watts down to about 25 watts.

On the 100 watt board, which has four output valves, the switch controls the PENTODE or TRIODE operation of just two of the four valves (V3 & V4) leaving the other two (V1 & V2) permanently configured for PENTODE operation when used.
By combining the functions of both the OUTPUT POWER and OUTPUT STYLE switches four different output powers are then possible:-

OUTPUT POWER	**OUTPUT STYLE**		
FULL	PENTODE	(all four valves in pentode mode)	~100 W RMS
FULL	TRIODE	(V1 & V2 pentode mode, V3 & V4 triode)	~75 W RMS
HALF	PENTODE	(V1 & V2 off, V3 & V4 pentode mode)	~50 W RMS
HALF	TRIODE	(V1 & V2 off, V3 & V4 triode mode)	~25 W RMS

OUTPUT TRANSFORMERS

The output transformers convert the high voltage low current output from the power valves into low voltage, high current for driving the speaker load.

OUTPUT DAMPING (50 and 100 watt models only)

The OUTPUT DAMPING control sets the amount of negative feedback sent back to the phase splitter when on CHANNEL 2.
When CHANNEL 1 is selected the OUTPUT DAMPING control is automatically bypassed by RL1 which is set by the DAMPING and CH2_HI control lines.

SPEAKER OUTPUTS AND IMPEDANCE SELECTOR SWITCH

The 30 watt power board has three ¼" jack sockets for connection to 8Ω or 16Ω loads.
The two 8Ω sockets are in parallel.

The 50 and 100 watt power boards have connections for driving loads of 4Ω, 8Ω or 16Ω, depending upon which socket is used and how the impedance selector switch is set.

One position sets the sockets for either 4Ω or 16Ω, as indicated on the unit, only one socket should be used at a time in this mode.

The other position sets both sockets to 8Ω. In this mode either socket can be used to drive an 8Ω cabinet or both sockets can be used to drive two 16Ω cabs (in parallel), also indicated on the unit.

2) SWITCHING CIRCUITRY

The basic switching circuit architecture is based around momentary switching of CMOS electronic latches which then control relays or FET's within the audio circuitry to switch functions. This provides very low noise, discrete switching and enables the user to control the functions from different places.

Momentary shorting to 0V of any of the control lines; CH1/CH2, CH2_BOOST, MASTER_I/II, EFFECTS or REVERB; anywhere in the circuit (including externally via FS2 and FS3) will send a negative pulse to the associated 4049 gate which will then be inverted into a positive pulse. This is then sent to the clock input of a 4013 configured as a 'divide by two' electronic latch. One of the outputs of these then sets the states of the control lines; CH2_LO, CH1_HI, BOOST_LO, MASTERII_LO, EFFECTS_LO and REVERB_HI; sometimes via ZTX614 Darlington transistors (where necessary for higher current requirements) and consequently the settings of the primary functions of the amplifier via relays or FET's.

Using a footswitch in FS1 (92/3) merely shorts the CH2_LO and MASTERII_LO or BOOST_LO control lines (depending on model) to 0V to control the associated functions.

Throughout the switching circuitry additional resistors, capacitors, diodes and FET's have been used to slow down switching transients and reduce switching noise further.

Descriptive terms were used for the control lines to make fault finding easier; i.e. CH2_LO means that Channel 2 is selected when this control line is at a low state, and so on.

The 12 way IDC connector PL5 will be used in the future to connect to a MIDI interface daughter board.

3) POWER SUPPLIES

All supplies; HT, ac filament heater, low voltage DC and grid bias, have secondary fusing on the PCB. This is for approvals reasons and to protect the mains transformer.

The HT supply uses a simple bridge rectifier diode network, with a 4n7 1KV capacitor across each diode for EMC reasons. This is smoothed by a large capacitance to supply the centre tap of the output transformer. This main supply is then further smoothed to supply the screen grids, phase splitter and preamp.

On each board resistors have been added to discharge the high voltage capacitors when the unit is turned off.

The ac heater supply is simply connected directly to the necessary pins on the power valves via the secondary fuses. This supply is also used to light the green lamp on the front panel.

The DC supply is a highly regulated supply using a BD647 as the main regulating device.
An isolated heat sink should be fitted with heat sink compound to disperse the heat from this on to the chassis. Tests have shown that this *considerably* reduces the running temperature of the device.

Two of the 2N3906 transistors provide a constant current source for the 15 volt zener.
The DC voltage is then set by the ratio of the 27K and 15K resistors which provide the feedback to stabilise the whole circuit.
The three 2R7 resistors across one of the 2N3906 transistors form a current limiter. This provides protection for the circuit and also forces the whole DC circuit voltage to gradually ramp up at switch on. This is due to the fact that when cold the heater filaments of the preamp valves have resistance of about a third of what it is when fully warmed up.

The +25.2V supply is used for the heater filaments and the relay switching circuits. It is routed through the filaments of pairs of the valves in series resulting in each filament having the nominal 6.3 volts across them, the supply voltage to V1 is dropped through R103 (92/1) to ~12V.
To prevent switching noise getting into the audio path via opamp circuitry, the supply is then dropped to +24V and filtered further. The opamp bias voltage is then derived by halving this to +12V and adding more filtering.
On the main preamp board one other (+5V) supply is generated from the +25.2V supply by a 7805 regulator. This powers all the CMOS circuitry and any 5 way foot controllers used via FS2 and FS3. It will also be used in the future to power a MIDI switching PCB.

The grid bias supply (50 and 100 watt power boards only) is ~50vac half wave rectified and smoothed to provide approximately between -35V and -57VDC to bias the output valves. This should be a large enough range to bias most valve types and small enough so that the setting of RV2 on the power boards is not too sensitive.

Paul Stevens - Design Engineer
2 April 1998