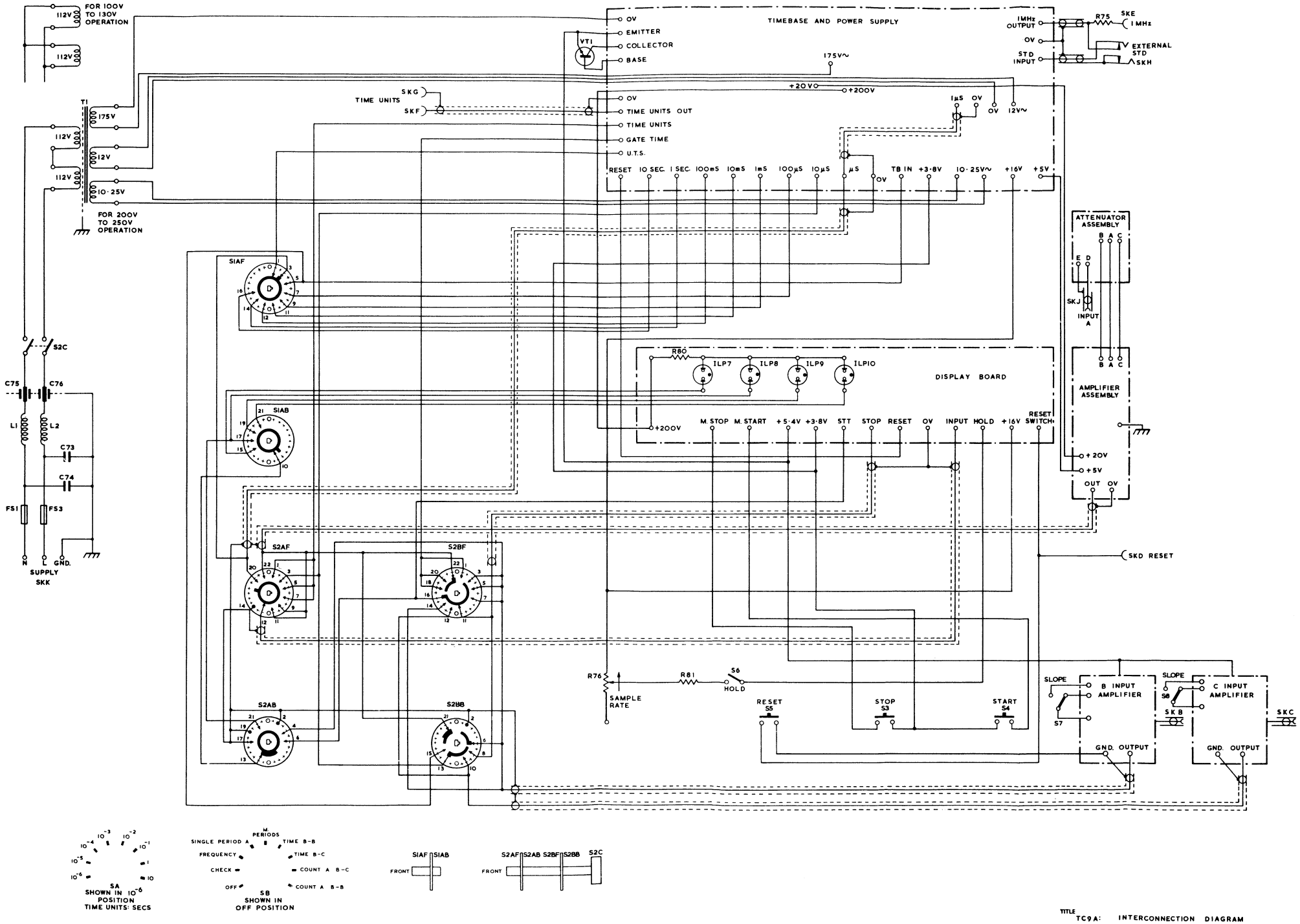
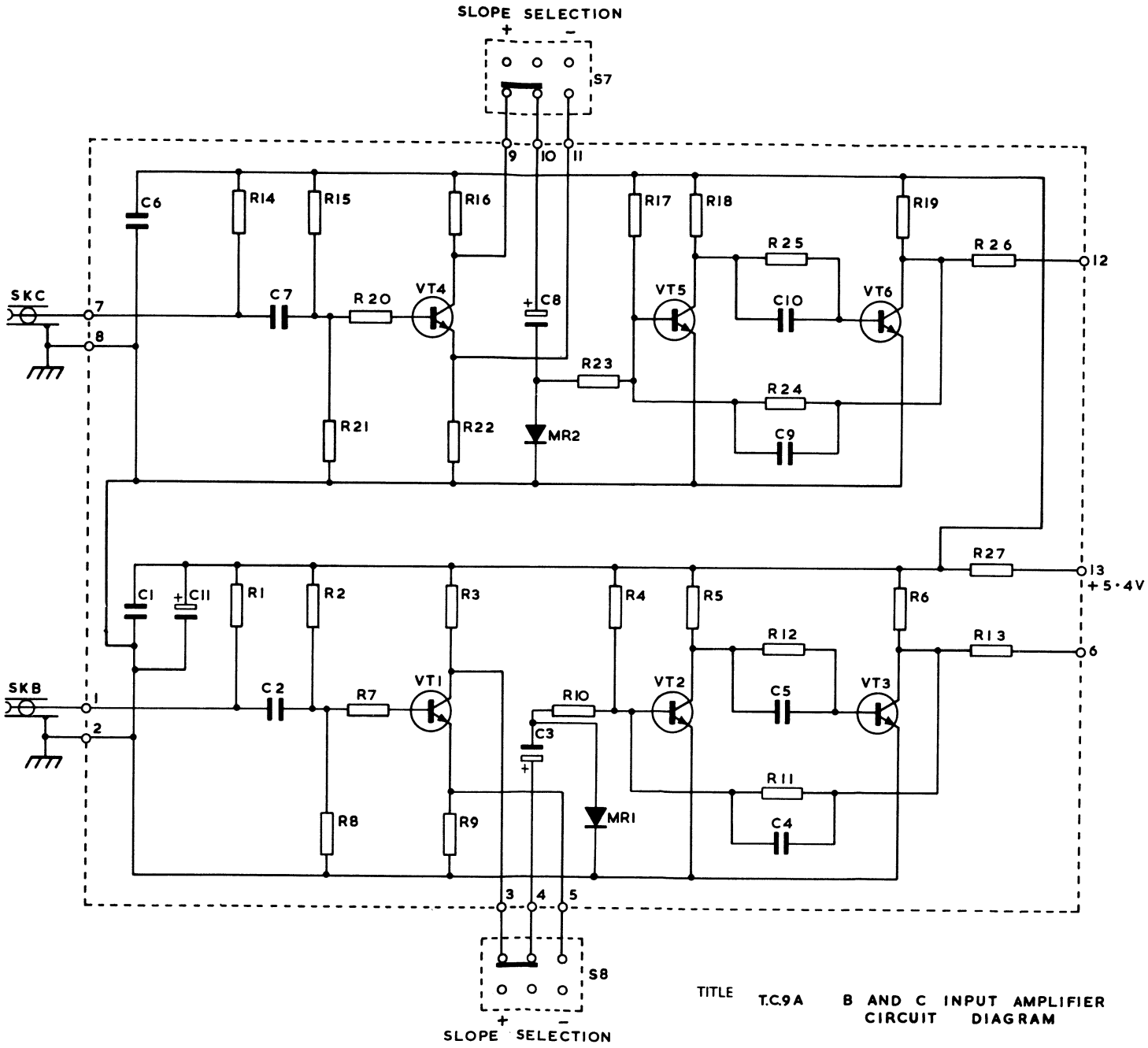
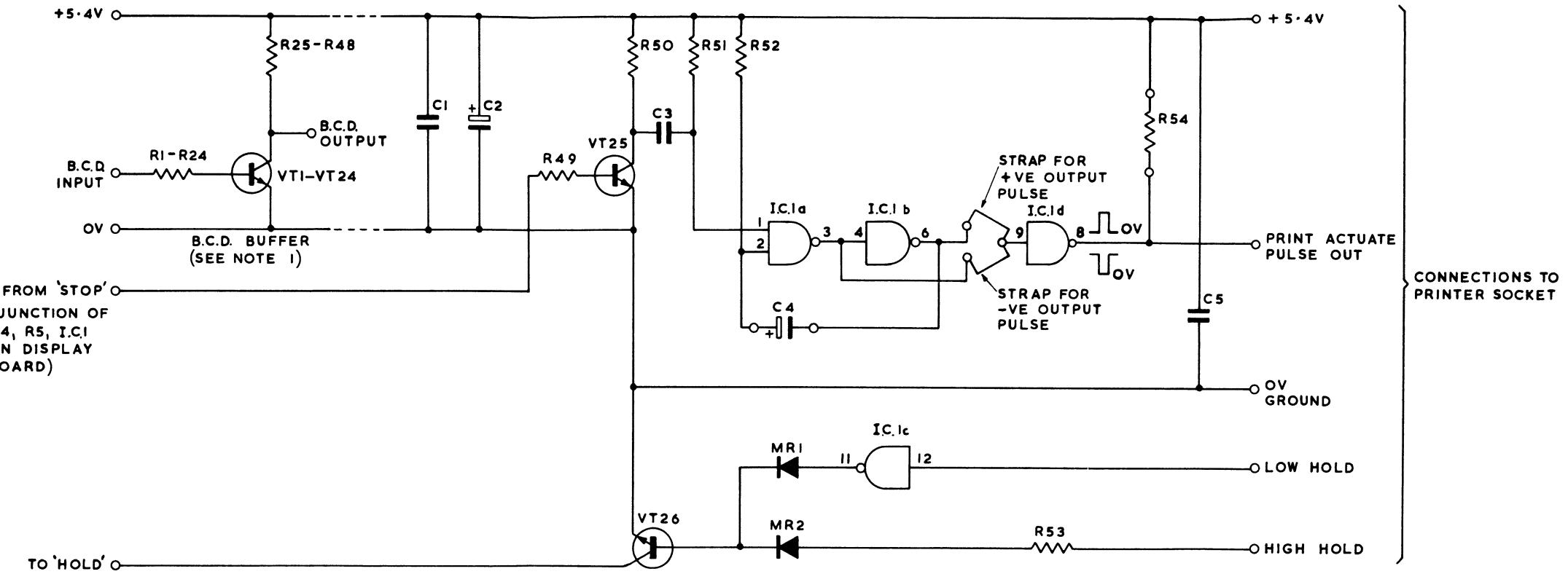


TITLE
TC9A: INTERCONNECTION DIAGRAM



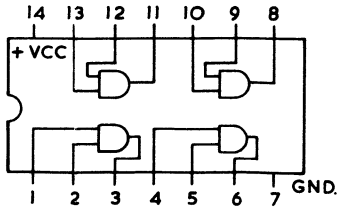
TITLE T.C.9A B AND C INPUT AMPLIFIER CIRCUIT DIAGRAM



SKA

PIN No.	1 2 3 4	5-8	9-12	-----	21-24	32	33	34	35	36
	1 2 4 8 'B C D' DECADE 10^0	10^1	10^2	-----	10^5	+5·4V	PRINTER ACTUATE PULSE	HIGH HOLD	LOW HOLD	0V GROUND

OUTPUT CONNECTIONS



I.C.1. TOP VIEW

TITLE

T.C.9. PRINTER

Supplement For TC9A and TC9AP

To be used with TC9 Manual

TC9A

PAGES 4, 5 & 6
See new Introduction and Specification.

PAGE 8
OPERATION
Para. 3. 3 DISPLAY AND RESET
Line 3 after 'external reset socket' add 'which is located on the back panel'.

PAGE 10
OPERATION
Replace present paragraphs with those below:-

3.6 TIME MEASUREMENTS
In addition to the TIME A-A function, time measurements can be made in three modes:-
(a) TIME B-B
The TIME UNITS selected are counted between the first and second positive or negative going signals at the 'B' INPUT socket as selected by the SLOPE switch.
Subsequent pulses have no effect until reset has been applied.

(b) TIME B-C
In this position of the FUNCTION SWITCH the selected TIME UNITS are counted between the application of a negative or positive going signal at the 'B' INPUT socket and a subsequent negative or positive going signal at the 'C' input. The SLOPE switches selects either negative or positive going signals to trigger the counter, as required.

The counter does not respond to any signal at the 'C' input before the signal at 'B' or any subsequent signals before the next reset is applied.

Both 'B' and 'C' inputs can be activated by a closed contact to ground and contact bounce may be suppressed by a capacitor of the order of 0.01μF and connected across the contacts. The 'B' and 'C' inputs are AC coupled and therefore waveforms having a very uneven mark-space ratio may not trigger the counter on the

positive edge of a narrow negative pulse or the negative edge of a narrow positive pulse.

(c) Paragraph (c) unaltered.

PAGE 12
Diagrams should be headed:
(a) Check
(b) Frequency

PAGE 13
(c) Time
(d) Multi-Period
(e) Count

A block labelled 'Amplifier and trigger' should be inserted in the B input and C input lines in diagrams (c) and (e).

PAGE 14
4.1 GENERAL
Last line should read section 3.

PAGE 14
CIRCUIT DESCRIPTION
Para 4.2 should now read INPUT CIRCUITS and should then be divided into:-

4.2(a) 'A' input circuit (Fig. 3)
This paragraph to be as 4.2 at present.
4.2(b) 'B' and 'C' input circuits (Fig. 6)
The B and C input amplifiers and trigger circuits are identical and therefore only the B input circuit will be described.

Transistor VT1 forms a buffer and phase splitting circuit giving approximately unity gain. The SLOPE switch selects either the inverted signal from the collector or non inverted signal from the emitter to drive the bistable trigger circuit formed by VT2 and VT3. This circuit is normally held by R4 with VT2 on and VT3 off so that a negative going signal on the base of VT2 triggers the bistable. This gives a negative going edge at the collector of VT3 which is fed to the Start/stop bistable circuit.

SECTION 6
Add Fig. 6 B + C input circuit and components list. The present

Fig. 6 will become Fig. 7 (change Fig. 6 to Fig. 7 in section 5. 3).

Replace the present interconnection diagram (Fig. 5) with new diagram.

DECADE & DISPLAY CIRCUIT DIAGRAM FIG. 4.
Note: Serial numbers up to 570 have the common connection to the start/stop buttons taken to ground instead of +3. 8V, and the Manual Start and Manual Stop connection are made to the outputs, Pin 14 and Pin 8 respectively, of IC1, Fig. 4.

Serial numbers from 571 onwards have modified circuitry to the Start/Stop Bistables Fig. 4 as follows:-

Two separate integrated circuits are fitted replacing IC1 and a resistor capacitor network connect Manual Start and Stop to the 'Direct Clear' inputs of the Bistables.

PAGE 17
Para. 4.4 (Fig. 3) should read (Fig. 2)
Sub. Para 4.4b (Fig. 3) should read (Fig. 2)

PAGE 21
Column 'Possible cause'. Test 4, Fig. 3 should read Fig. 2

PAGE 23
Add table 5.3 under illustrations.

PAGE 41
Amend circuit diagram as follows:

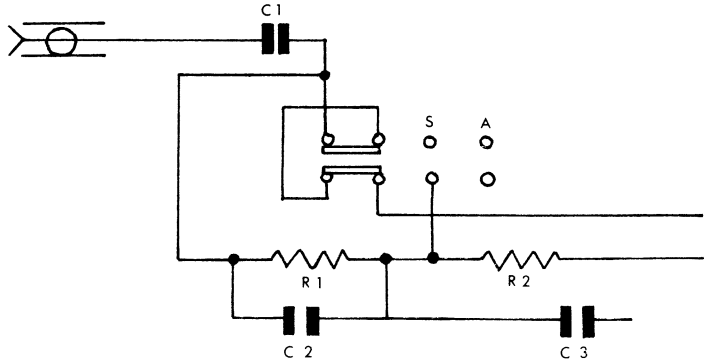


Fig. 1

i.e. Join R1, C2 to C1, not to bottom row of contacts of S1.

The TC9A Timer Counter is a six digit instrument capable of measuring frequencies up to at least 32MHz with a maximum resolution of 0.1Hz. For higher resolution at frequencies up to 100kHz, a multiple period measurement facility is provided.

Input sensitivity is 10mV, RMS, with a three position attenuator giving alternative sensitivities of 100mV and 1V. The input impedance is 1MΩ is parallel with 18pF, enabling the instrument to be used with standard oscilloscope probes.

The internal 1MHz crystal standard enables a resolution of 1μS to be achieved on timing measurements, and positive or negative slope selection on the B & C inputs allows direct measurements to be made of many waveforms (E.g pulse widths). The B & C inputs may also be operated by contacts.

The indicator tubes used provide an extremely bright clear display, and the instrument uses integrated circuits for maximum reliability and space utilisation.

A version providing buffered 1248 BCD output is also available (TC9A/P).

DISPLAY
Six in-line neon numerical indicators with decimal points for frequency and multiple period.

FREQUENCY MEASUREMENT
2Hz to 32MHz via input A with gate time of 1mS to 10S in decade steps. Decimal point automatically positioned to indicate KHz.

TIME MEASUREMENT
Timing units from 1μS to 10S in decade steps. Start and stop inputs can be A to A (equivalent to single period), B to B or B to C, or by push button.

MULTIPLE PERIOD
From 10 to 10^6 periods in decade steps within frequency range 2Hz to 100KHz.

COUNT
2Hz to 32MHz via input A, with start and stop controls via inputs B to B or B to C, or by push button.

INPUT A

SENSITIVITY
Three position attenuator providing 10mV, 100mV and 1V RMS sensitivities.
INPUT IMPEDANCE
1MΩ/approx. 18pf, suitable for use with oscilloscope type probes. In 10mV position, protective limiting reduces input impedance to 200KΩ/approx. 120pf with signals over 1V RMS.
MAXIMUM INPUT

Up to 20KHz	250V DC, 250V AC RMS
Over 20KHz	30V AC RMS in 100mV and 1V position
	3V AC RMS in 10mV position

INPUTS B AND C

INPUT
AC coupled, switched positive or negative slope selection.
SENSITIVITY
1.5V pk. Maximum Input 50V RMS
INPUT IMPEDANCE
>5kΩ
FREQUENCY RANGE
100Hz to 1MHz

CONTACT OPERATION

These inputs may be operated by contact closure (corresponding to a negative slope) or opening (corresponding to a positive slope).

FREQUENCY STANDARD

INTERNAL

1MHz crystal oscillator, oven controlled at +65°C. Set to 1 in 10^6 at +25°C. Stability ± 5 in 10^6 from 0°C to +50°C after one hour warm-up period.

EXTERNAL

Via rear panel jack socket, coupled through 400V pk. working blocking capacitor.

SENSITIVITY

Sine Wave	0.5V to 10V RMS within frequency range 10KHz to 2MHz.
Pulse	1V to 20V pk. pk. within frequency range 10Hz to 2MHz. The negative duration must not be greater than ten times the positive duration.

CHECK FACILITY

The 1MHz Standard is counted for the gate time selected.

DISPLAY TIME

Continuously adjustable from 0.1S to 4S, or infinite.

RESET

INTERNAL

Automatically at end of display period.

EXTERNAL

By push button or external contact closure to ground. Open circuit voltage +18V maximum. Short circuit current limited to 15mA peak.

TIME UNITS OUTPUT

Pulses are available at rear panel socket derived from frequency standard via decade dividers. Time units of 1μS to 10S are selected by time units switch. Amplitude approximately 3V pk. pk. from non-linear high impedance. A separate 1MHz output is also provided, via a further rear panel socket, of approximately 2V pk. pk. from high impedance and is available at all counter settings.

PRINTER OUTPUT VERSION

PRINTER OUTPUT VERSION

MODEL TC9A/P provides buffered BCD 1248 output at a rear panel socket. Format is positive going, positive true and levels are 0V and +5V. Print command and counter hold facilities are also provided.

POWER SUPPLY

100 to 125V, 200 to 250V, 45 to 65Hz, 30VA.

OPERATING TEMPERATURE RANGE

0 to +50°C.

ACCESSORIES SUPPLIED

One 50Ω BNC/BNC Connector PL43
Two 50Ω BNC/Clips Connector PL44
One minature Jack Plug Part No 2727
Four 4mm Plugs Part No 1244
One Instruction Manual Part No 25883

DIMENSIONS AND WEIGHT

11 in (28cm) wide, $5\frac{3}{4}$ in (15cm) high, $9\frac{7}{8}$in (25cm) deep overall
$10\frac{1}{2}$lb (4.8kg)

TC9AP

PAGE 2
Add Section 3.10 as follows:-

3.10 'Printer Adaptor PR1'.

Add Section 4.5 as follows:-

'Printer Adaptor PR1'.

PAGE 11
Add section 3.10 as follows:-

3.10 PRINT OUT
The displayed data is available at a multi-way socket at the rear of the instrument when a suitable buffer unit is fitted. This information is in parallel BCD form and external serialisation must be fitted when required. The display may be held during PRINT OUT by a signal applied to the inhibit line of the printer output. A PRINT COMMAND signal is generated by the counter at the end of each counting cycle.

PAGE 18
Add Section 4.5 as follows:-

4.5 PRINTER ADAPTOR (Optional)
Transistors VT1 to VT24 act as buffering inverters, presenting a light load to the counting circuits and providing a positive logic output.

IC1(a) and (b) form a monostable print command pulse generator and the value of C4 may be adjusted if necessary to vary the length of the pulse; $t \simeq 0.7C$, t in mS, C in μF.

IC1(d) is used to buffer out the pulse, either positive going or negative going (from +5 volts) as required. R54 may be altered to give faster pull up depending on the load (min value 200Ω).

During print out the counter may be held from making a measurement by a grounding or positive signal at the low or high hold inputs, which clamp the display timer.

See new circuit diagram plus components list for Printer Adaptor PR1.

CIRCUIT COMPONENT LIST FOR TC9A INTERCONNECTION DIAGRAM

ITEM	CIRCUIT REF.	DESCRIPTION	VALUE	TOL.	RATING	REMARKS	PART NO.
		RESISTORS					
	R75	CRACKED CARBON	3.7K	5%	1/8W		311
	R76					WITH 86	
	R80	CRACKED CARBON	270K	5%	1/8W		1679
	R81	CRACKED CARBON	10K	5%	1/8W		11503
		CAPACITORS					
	C73	ERIE K350011/C08	5000pF	-20 +80			1514
	C74	ERIE K350011/C08	5000pF	-20 +80			1514
	C75	CAP. FEED THRO' ERIE K2600/361	1000pF				3313
	C76	CAP. FEED THRO' ERIE K2600/361	1000pF				3313
	L1	CHOKE 1A TV DUBILIER 666					11212
	L2	CHOKE 1A TV DUBILIER 666					11212
	T1	TRANSFORMER					MT598

CIRCUIT COMPONENT LIST FOR TC9A INTERCONNECTION DIAGRAM

ITEM	CIRCUIT REF.	DESCRIPTION	VALUE	TOL.	RATING	REMARKS	PART NO.
	ILP7	INDICATOR NEON HI-VAC 3L					12781
	ILP8	INDICATOR NEON HI-VAC 3L					12781
	ILP9	INDICATOR NEON HI-VAC 3L					12781
	ILP10	INDICATOR NEON HI-VAC 3L					12781
	VT1	TRANSISTOR 2N3055					3813
		SWITCHES					
	S1	TIME UNITS					25664
	S2	FUNCTION					25665
	S3	PBS1M RENDAR					4881
	S4	PBS1M RENDAR					4881
	S5	PBS1M RENDAR					4881
	S6	CONTROL POT 5MΩ REV. LOG. WITH SWITCH A.B.M. AV45				WITH R76	25877
	S7	SLIDER 2P2W ARIEL PRESSINGS RA2302					24545
	S8	SLIDER 2P2W ARIEL PRESSINGS RA2302					24545

CIRCUIT COMPONENT LIST FOR TC9A INTERCONNECTION

ITEM	CIRCUIT REF.	DESCRIPTION	VALUE	TOL.	RATING	REMARKS	PART NO.
		SOCKETS					
	SKB	B.N.C. UG1094/U			50Ω	INPUT 'B'	1222
	SKC	B.N.C. UG1094/U			50Ω	INPUT 'C'	1222
	SKD	B/L L1413 4mm BLACK				RESET	25878
	SKE	B/L L1413 4mm BLACK				1MHz	25878
	SKF	B/L L1413 4mm BLACK				TIME UNITS OUT	25878
	SKG	B/L L1413 4mm BLACK				EARTH	25878
	SKH	RENDAR MJ600/A				EXT. STD.	2726
	SKJ	BNC UG1094/U			50Ω	INPUT A	1222
	SKK	B/L L143G/S					3302
		FUSES					
	FS1	B/L L562			2·5A		21189
	FS3	B/L L562			2·5A		21189

CIRCUIT COMPONENT LIST FOR BUFFER P.C. ASSY. FOR TC9 PR1 & TC13 PR1

ITEM	CIRCUIT REF.	DESCRIPTION	VALUE	TOL.	RATING	REMARKS	PART NO.
		RESISTORS					
	R1	CR. CARBON	4·7K	5%	1/8W		386
	R2	CR. CARBON	4·7K	5%	1/8W		386
	R3	CR. CARBON	4·7K	5%	1/8W		386
	R4	CR. CARBON	4·7K	5%	1/8W		386
	R5	CR. CARBON	4·7K	5%	1/8W		386
	R6	CR. CARBON	4·7K	5%	1/8W		386
	R7	CR. CARBON	4·7K	5%	1/8W		386
	R8	CR. CARBON	4·7K	5%	1/8W		386
	R9	CR. CARBON	4·7K	5%	1/8W		386
	R10	CR. CARBON	4·7K	5%	1/8W		386
	R11	CR. CARBON	4·7K	5%	1/8W		386
	R12	CR. CARBON	4·7K	5%	1/8W		386
	R13	CR. CARBON	4·7K	5%	1/8W		386
	R14	CR. CARBON	4·7K	5%	1/8W		386
	R15	CR. CARBON	4·7K	5%	1/8W		386
	R16	CR. CARBON	4·7K	5%	1/8W		386
	R17	CR. CARBON	4·7K	5%	1/8W		386
	R18	CR. CARBON	4·7K	5%	1/8W		386
	R19	CR. CARBON	4·7K	5%	1/8W		386
	R20	CR. CARBON	4·7K	5%	1/8W		386
	R21	CR. CARBON	4·7K	5%	1/8W		386
	R22	CR. CARBON	4·7K	5%	1/8W		386
	R23	CR. CARBON	4·7K	5%	1/8W		386
	R24	CR. CARBON	4·7K	5%	1/8W		386
	R25	CR. CARBON	2·7K	5%	1/8W		311
	R26	CR. CARBON	2·7K	5%	1/8W		311
	R27	CR. CARBON	2·7K	5%	1/8W		311
	R28	CR. CARBON	2·7K	5%	1/8W		311
	R29	CR. CARBON	2·7K	5%	1/8W		311
	R30	CR. CARBON	2·7K	5%	1/8W		311
	R31	CR. CARBON	2·7K	5%	1/8W		311
	R32	CR. CARBON	2·7K	5%	1/8W		311
	R33	CR. CARBON	2·7K	5%	1/8W		311
	R34	CR. CARBON	2·7K	5%	1/8W		311
	R35	CR. CARBON	2·7K	5%	1/8W		311
	R36	CR. CARBON	2·7K	5%	1/8W		311

CIRCUIT COMPONENT LIST FOR BUFFER P.C. ASSY. FOR TC9 PR1 & TC13 PR1.

ITEM	CIRCUIT REF.	DESCRIPTION	VALUE	TOL.	RATING	REMARKS	PART NO.
		RESISTORS CONT'D.					
	R37	CR. CARBON	2·7K	5%	1/8W		311
	R38	CR. CARBON	2·7K	5%	1/8W		311
	R39	CR. CARBON	2·7K	5%	1/8W		311
	R40	CR. CARBON	2·7K	5%	1/8W		311
	R41	CR. CARBON	2·7K	5%	1/8W		311
	R42	CR. CARBON	2·7K	5%	1/8W		311
	R43	CR. CARBON	2·7K	5%	1/8W		311
	R44	CR. CARBON	2·7K	5%	1/8W		311
	R45	CR. CARBON	2·7K	5%	1/8W		311
	R46	CR. CARBON	2·7K	5%	1/8W		311
	R47	CR. CARBON	2·7K	5%	1/8W		311
	R48	CR. CARBON	2·7K	5%	1/8W		311
	R49	CR. CARBON	2·7K	5%	1/8W		311
	R50	CR. CARBON	2·7K	5%	1/8W		311
	R51	CR. CARBON	4·7K	5%	1/8W		386
	R52	CR. CARBON	4·7K	5%	1/8W		386
	R53	CR. CARBON	2·7K	5%	1/8W		311
	R54	CR. CARBON	1K	5%	1/8W		384

CIRCUIT COMPONENT LIST FOR BUFFER P.C. ASSY. FOR TC9 PR1 & TC13 PR1

ITEM	CIRCUIT REF.	DESCRIPTION	VALUE	TOL.	RATING	REMARKS	PART NO.
		CAPACITORS					
	C1	MURATA	.05μF	20%	12V		19657
	C2	ELECTROLYTIC	12.5μF	-10% +50%	25V		20725
	C3	GP. CERAMIC	470pF	+10%	500V DC		22383
	C4	ELECTROLYTIC	5μF		64V		20773
	C5	MURATA	.05μF	20%	12V		19657
		DIODES					
	MR1	DIODE 1N914					23802
	MR2	DIODE 1N914					23802

CIRCUIT COMPONENT LIST FOR BUFFER P.C. ASSY. FOR TC9 PR1 & TC13 PR1.

ITEM	CIRCUIT REF.	DESCRIPTION	VALUE	TOL.	RATING	REMARKS	PART NO.
		TRANSISTORS					
	VT1	TRANSISTOR BSX20					23307
	VT2	TRANSISTOR BSX20					23307
	VT3	TRANSISTOR BSX20					23307
	VT4	TRANSISTOR BSX20					23307
	VT5	TRANSISTOR BSX20					23307
	VT6	TRANSISTOR BSX20					23307
	VT7	TRANSISTOR BSX20					23307
	VT8	TRANSISTOR BSX20					23307
	VT9	TRANSISTOR BSX20					23307
	VT10	TRANSISTOR BSX20					23307
	VT11	TRANSISTOR BSX20					23307
	VT12	TRANSISTOR BSX20					23307
	VT13	TRANSISTOR BSX20					23307
	VT14	TRANSISTOR BSX20					23307
	VT15	TRANSISTOR BSX20					23307
	VT16	TRANSISTOR BSX20					23307
	VT17	TRANSISTOR BSX20					23307
	VT18	TRANSISTOR BSX20					23307
	VT19	TRANSISTOR BSX20					23307
	VT20	TRANSISTOR BSX20					23307
	VT21	TRANSISTOR BSX20					23307
	VT22	TRANSISTOR BSX20					23307
	VT23	TRANSISTOR BSX20					23307
	VT24	TRANSISTOR BSX20					23307
	VT25	TRANSISTOR BSX20					23307
	VT26	TRANSISTOR BSX20					23307
	IC1	69-946-59 FERRANTI					26109
	SKA	CONNECTOR SOCKET 36 WAY AMPHENOL 57-40360.					27513

CIRCUIT COMPONENT LIST FOR B & C INPUT AMPL. FOR TC9A.

ITEM	CIRCUIT REF.	DESCRIPTION	VALUE	TOL.	RATING	REMARKS	PART NO.
		RESISTORS					
	R1	CR. CARBON	47KΩ	5%	1/8W		318
	R2	CR. CARBON	39KΩ	5%	1/8W		1639
	R3	CR. CARBON	680Ω	5%	1/8W		309
	R4	CR. CARBON	33KΩ	5%	1/8W		317
	R5	CR. CARBON	2·7KΩ	5%	1/8W		311
	R6	CR. CARBON	470Ω	5%	1/8W		1373
	R7	CR. CARBON	10KΩ	5%	1/8W		11503
	R8	CR. CARBON	27KΩ	5%	1/8W		316
	R9	CR. CARBON	560Ω	5%	1/8W		308
	R10	CR. CARBON	3·9KΩ	5%	1/8W		312
	R11	CR. CARBON	33KΩ	5%	1/8W		317
	R12	CR. CARBON	4·7KΩ	5%	1/8W		386
	R13	CR. CARBON	1KΩ	5%	1/8W		384
	R14	CR. CARBON	47KΩ	5%	1/8W		318
	R15	CR. CARBON	39KΩ	5%	1/8W		1639
	R16	CR. CARBON	680Ω	5%	1/8W		309
	R17	CR. CARBON	33KΩ	5%	1/8W		317
	R18	CR. CARBON	2·7KΩ	5%	1/8W		311
	R19	CR. CARBON	470Ω	5%	1/8W		1373
	R20	CR. CARBON	10KΩ	5%	1/8W		11503
	R21	CR. CARBON	27KΩ	5%	1/8W		316
	R22	CR. CARBON	560Ω	5%	1/8W		308
	R23	CR. CARBON	3·9KΩ	5%	1/8W		312
	R24	CR. CARBON	33KΩ	5%	1/8W		317
	R25	CR. CARBON	4·7KΩ	5%	1/8W		386
	R26	CR. CARBON	1KΩ	5%	1/8W		384
	R27	CR. CARBON	68Ω	5%	1/8W		1640

CIRCUIT COMPONENT LIST FOR B & C INPUT AMPL. FOR TC9A.

ITEM	CIRCUIT REF.	DESCRIPTION	VALUE	TOL.	RATING	REMARKS	PART NO.
		CAPACITORS					
	C1	MURATA	.05μF		12V		19657
	C2	MET/POLY	0.15μF		160V		4538
	C3	C426	12.5μF		25V		20775
	C4	GP CERAMIC	18pF				22367
	C5	GP CERAMIC	18pF				22367
	C6	LEMLAC	0.1μF	+80 −20	30V		19647
	C7	MET/POLY	0.15μF		160V		4538
	C8	C426	12.5μF		25V		20775
	C9	GP CERAMIC	18pF				22367
	C10	GP CERAMIC	18pF				22367
	C11	C426	320μF		6.4V		23591
		TRANSISTORS					
	VT1	TRANSISTOR BC108					26110
	VT2	TRANSISTOR BSX20					23307
	VT3	TRANSISTOR BSX20					23307
	VT4	TRANSISTOR BC108					26110
	VT5	TRANSISTOR BSX20					23307
	VT6	TRANSISTOR BSX20					23307
		DIODES					
	MR1	DIODE 1N914					23802
	MR2	DIODE 1N914					23802