INSTRUCTION MANUAL

TR5821/5822/5823

Universal Counter

Takeda Riken Industry Co., Ltd.

WARRANTY

Takeda Riken product is warranted against defects in material and workmanship for a period of one year from the date of delivery to original buyer.

LIMITATION OF WARRANTY

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by buyer, unauthorized modification or misuse, accident or abnormal conditions of operations.

No other warranty is expressed or implied. Takeda Riken specifically disclaims the implied warranties of merchantability and fitness for a particular purpose.

Takeda Riken shall not be liable for any special incidental or consequential damages, whether in contract, tort or otherwise.

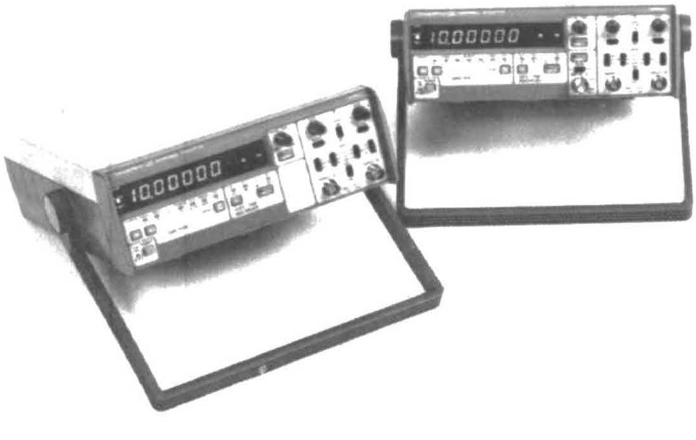
Takeda Riken Industry Co.,Ltd.

INSTRUCTION MANUAL

TR5821/5822/5823

Universal Counter

MANUAL NUMBER 0056/70/57 EC 302



CONTENTS

LIST OF FIGURES

LIST OF TABLE

SECTION 1
GENERAL INFORMATION

1-1. General

The **TR5821/5822/5823** are compact, inexpensive universal counters with the capabilities comparable to medium-scale counters. These are the first counters in this class to incorporate a microprocessor, enabling self-diagnostics and data manipulation (by the **TR1644**) by various arithmetic operations. The **TR5822** (standard) and **TR5823** (optional) incorporate a GPIB interface, enabling low-cost system configurations. BCD (TTL) output and analog output (D/A converter) interfaces are also available to make this system compatible with other systems. Configured around a microprocessor and two custom LSIs, this latest state of the art enables the realization of highly reliable low-cost universal counters.

The **TR5821**, the basic and least expensive universal counter in this series, can measure frequencies of up to 120 MHz. Measurement results can be displayed in any form by using the **TR1644** Calculation Unit (to be purchased separately) in combination.

The **TR5822** has the same functions as the **TR5821** plus a built-in GPIB interface, and the functions of the **TR5823** include an ultrahigh-frequency measurement (1.3 GHz) and a burst signal measurement in addition to the functions of the **TR5821.**

SECTION 2
SPECIFICATIONS

2-1. Electrical Performance

Frequency measurement (FREQ. A)

Range : 10 Hz to 120 MHz
Gate time : 10 ms, 0.1 s, 1 s, or 10 s
Unit display : Hz, kHz, or MHz
Accuracy : ± 1 count ± time base accuracy

Frequency measurement (FREQ. B)

Range : 1 mHz to 50 MHz
Gate time : 10 ms (9 ms to 0.1 s), or 1 period time of input frequency below 10 Hz. Five display digits.
0.1 s (90 ms to 1 s), or 1 period time of input frequency below 1 Hz. Six display digits.
1 s (0.9 s to 10 s), or 1 period time of input frequency below 0.1 Hz. Seven display digits.
10 s (9 s to 100 s), or 1 period time of input frequency below 10 mHz. Eight display digits.
Note: For a 10 ms or 0.1 s gate time, an automatic reset is activated approximately 1.3 s after the gate is opened. Measure frequencies below 0.8 Hz with a gate time of 1 s or 10 s.
Unit display : mHz, Hz, kHz, or MHz
Accuracy : ± (Trigger error/10^m) ± 1 count ± time base accuracy
Where 10^m is the number of periods. See 5-3-2.

Frequency measurement (FREQ. C) (TR5823)

Range : 100 MHz to 1300 MHz (1/20 prescaled)
Gate time : 20 ms, 0.2 s, 2 s, or 20 s
Unit display : Hz, kHz, MHz, or GHz
Accuracy : ± 1 count ± time base accuracy

Period measurement (PERIOD B)

Measurement range: 20 ns to 999.99999 s (including when averaged)
Multiplier (10^n) : 10^0, 10^1, 10^2, or 10^3
Time unit : 100 ns
Unit display : ns, μs, ms, or s
Accuracy : ± (Trigger error/10^n) ± 1 count ± time base accuracy

Time interval measurement (T.I. A → B)

Range : 200 ns to 999.99999 s
Multiplier (10^n) : 10^0, 10^1, 10^2, or 10^3
Time unit : 100 ns
Unit display : ns, μs, ms, or s
Accuracy : ± (Trigger error/$\sqrt{10^n}$) ± 1 count ± time base accuracy
Dead time : 50 ns

Frequency ratio measurement (RATIO A/B)

Range : DC to 50 MHz
Multiplier (10^n) : 10^0, 10^1, 10^2, or 10^3
Unit display : m, k, or M
Accuracy : ± (Input B trigger error/10^n) ± 1 count ± Input A accuracy

Totalize (TOT. A)

Range : DC to 50 MHz, 0 to 99999999

Input Specifications

INPUT A/B

Input sensitivity : 25 mVrms, DC to 100 MHz
55 mVrms, 100 MHz to 120 MHz
Sensitivity switching : x1, x10, and x100
Input voltage range : 25 mVrms to 500 mVrms (at x1)
Damaging input level : DC to 100 kHz: 100 Vrms (x1), 150 Vrms (x10 or x100)
100 kHz to 120 MHz: 5 Vrms (x1), 50 Vrms (x10 or x100)
Input coupling mode : DC or AC coupled, or AUTO (AC coupled)
Input impedance : Approx. 1 MΩ//30 pF, COM. A approx. 500 kΩ
Pulse resolution : 10 ns
Trigger level : Approximately −1 V to +1 V continuously variable. In the **AUTO** mode, the trigger level is automatically set to the half-amplitude of the peak value of the signal to be measured.
Trigger slope : +/− switchable
Common/Separate : **COM.** handles inputs A and B as common input.
SEP. handles inputs A and B separately.
Masking : Approx. 0.1 ms to 0.1 s. The masking time can be monitored at CHECK mode.
Noise rejection : 100 kHz low-pass filter

INPUT C (TR5823 only)

Input sensitivity : 20 mVrms, 100 MHz to 1300 MHz
Sensitivity switching : x1 and x10
Input voltage range : 20 mVrms to 500 mVrms (at x1)
Damaging input level : 5 Vrms (with protection fuse)
Input coupling mode : AC coupled
Input impedance : 50 Ω
Burst mode : **BURST** switch operation enables burst signal measurement.
Noise rejection : Automatically suppressed by ANS (Automatic Noise Suppressor) (ON-OFF switching)

Time Base

Internal reference frequency : 10 MHz
Frequency stability : Aging rate: $\pm 5 \times 10^{-7}$/month
Temperature stability: $\pm 5 \times 10^{-6}$ (0°C to ±40°C)
Line voltage: $\pm 2.5 \times 10^{-7}$ (100 V ± 10%)
Internal reference output: Frequency: 10 MHz
Output voltage: 1 $V_{p\text{-}p}$ to 2 $V_{p\text{-}p}$
Output impedance: approx. 500 Ω
External reference input: Frequency: 10 MHz
Input voltage: 1 $V_{p\text{-}p}$ to 10 $V_{p\text{-}p}$
Input impedance: approx. 500 Ω

2-2. General Specifications

Display : 8 decimal digits
Green, 7-segment LED, display storage method
Sample rate : 50 ms or hold
Self-check : Counting operation check by internal reference signals
Operating environment : Temperature: 0°C to +40°C
Relative humidity: 85% or less
Storage temperature : –20°C to +70°C
Power requirements : 100 V ac ±10% (120, 200, 220 V ac ±10%, 240 V ac $^{+4\%}_{-10\%}$), 50 Hz to 400 Hz,
25 VA or less (**TR5821**)
30 VA or less (**TR5822/5823**)
Dimensions : (W)240 x (H)88 x (D)280 mm approx.
Weight : 3.5 kg or less (**TR5821**)
4 kg or less (**TR5822/5823**)

2-3. Options

GPIB data output & remote control

Standard : IEEE STD. 488–1978
Interface functions : Source and acceptor handshake
Talker/listener
Service request
Device clear
Code used : ASCII code
Remote-programmable functions : Function
Gate time/Multiplier
Hold

BCD data output

Data : Digit parallel
Output digits : Mantissa 7 digits, exponent 1 digit
Output level : TTL, positive logic

D/A converter (requires TR1644)

Output voltage : 0.999 V full-scale
Conversion digits : Any 3 consecutive digits
Output terminal : Binding post
Output impedance : Approx. 1 kΩ

High-stability reference oscillator

Stability : Aging rate: 5×10^{-8}/day
Temperature characteristics: $\pm 1 \times 10^{-7}$, 0°C to +40°C

The internal reference output and external reference input specifications are the same as the standard time base.

TR1644 Calculation Unit

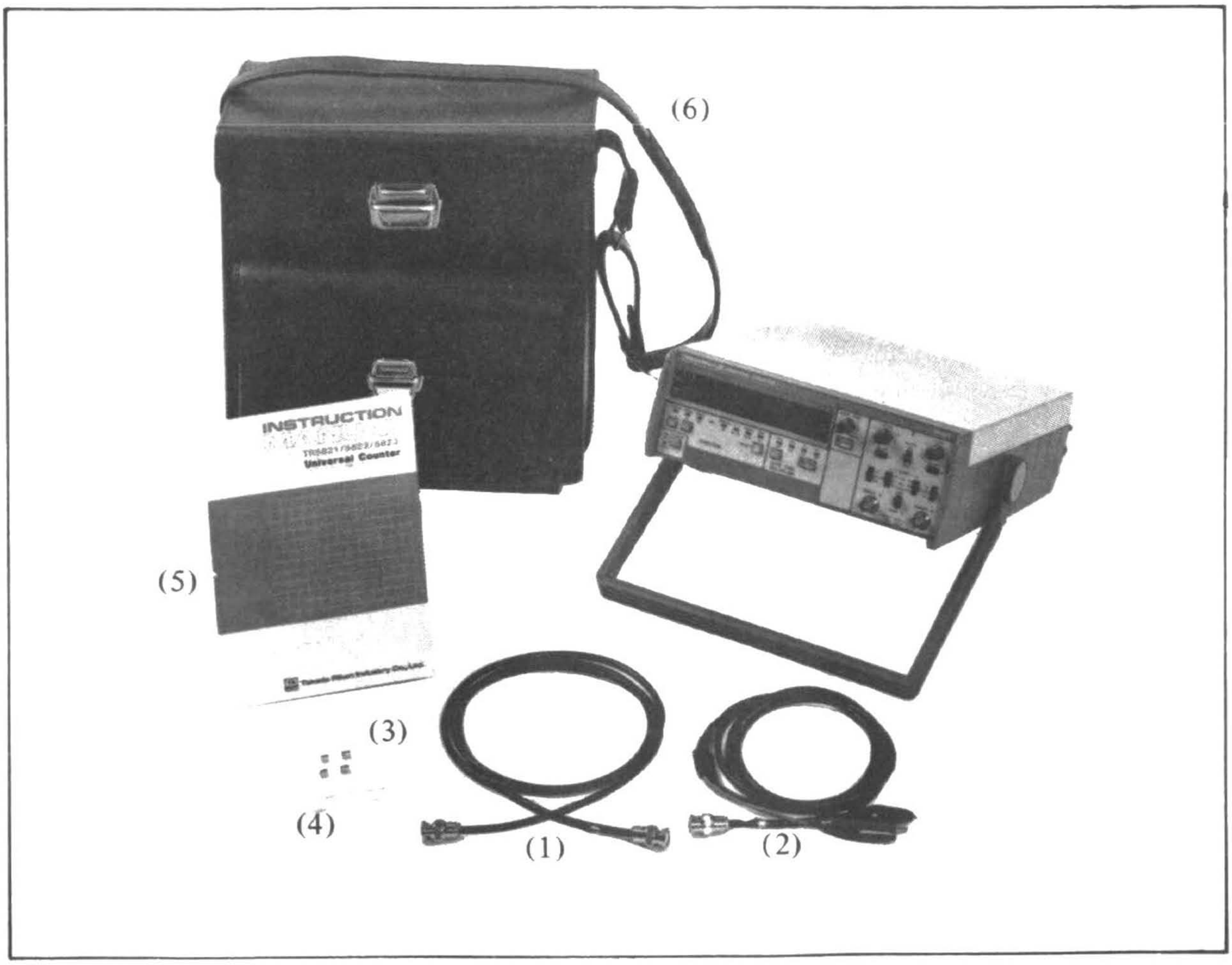
Math mode : ± (addition, subtraction), x (multiplication), ÷ (division), DAC (D/A converter mode), comparison, delta, Max., Min., %, scaling, arithmetic operation between set values by using = key (±, x, ÷)
Digit : Setting: Mantissa 8 digits, exponent 1 digit
Display: 8 digits

Option combinations

	TR5821	**TR5822**	**TR5823**	
GPIB	X	Basic	OP.	Only one of these can be selected.
BCD output	X	OP.*	OP.	
D/A converter	X	OP.*	OP.	
High-stability oscillator	X	X	OP.	**(TR5823H)**
TR1644	○	○	○	

* Either can be incorporated instead of GPIB.

2-4. Accessories Supplied



(1)	Input cable **(MI-02)**	1
(2)	Input cable **(MI-03)**	1
(3)	Slow-blow fuse (0.4 A) (100/120 V ac)*	2
(4)	High-frequency fuse (**TR5823/5823H** only)	2
(5)	Instruction Manual	1
(6)	Carrying Case (**TR16202**) (To be purchased separately)	1

* 0.2 A for 200, 220, 240 V ac

SECTION 3
OPERATIONS

3-1. Preparation and Cautions Before Use

3-1-1. Inspection

After receiving this unit, check it for any damages that may have occurred during transit, especially for damage of panel switches and terminals. Should any damage be found or if the unit does not operate as specified, contact your nearest Takeda Riken representative.

3-1-2. Storage

For long-term storage, place the unit in a vinyl cover or cardboard box and store it at low-humidity out of direct sunlight.

3-1-3. Transportation

To transport this unit, use the original packing. If the packing has been discarded, pack it as follows:

(1) Wrap the unit in a vinyl.

(2) Place the unit in a cardboard box having walls at least 5 mm thick. Place packing of 40 mm or thicker under, all around, and over the unit.

(3) After covering the unit with packing, fit the accessories in the box and place packing over them. Close the cardboard box, then secure the box with packing tape.

3-1-4. General Cautions Before Use

(1) Power supply

The power voltage has been set at factory; it is indicated above the power cable on the rear panel. Use a power supply of 100 V ac±10%, or 120/200/220 V ac ±10%, 240 V ac +4%, –10% at a frequency of 50 Hz to 400 Hz. Check that the **POWER** switch is set to **STBY** before connecting the power cable to the power source.

(2) Power cable

The power cable has a 3-prong plug; the round prong in the center is for ground. When connecting the plug to the power receptacle via an adapter (KPR-13), connect the wire leading out of the adapter to ground. (See Figure 3-1.)

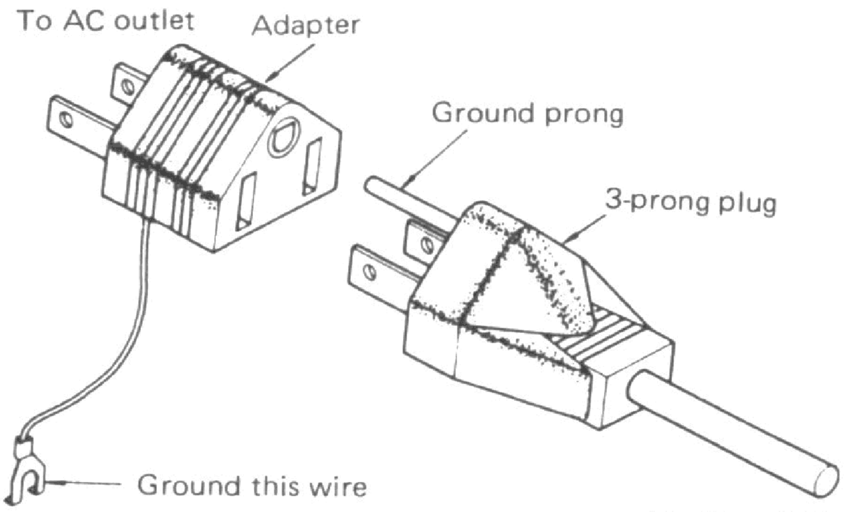


Fig. 3-1 Power cable plug and adapter

(3) Fuse replacement

The power fuse is on the rear panel of this unit. To remove the fuse for replacement, turn the fuse holder cap in the arrow direction.

Note

Disconnect the power cable from the power receptacle before replacing the fuse.

(4) Operating environment

Use this unit in a location free from dust, direct sunlight, and corrosive gases. The environmental conditions for use are a temperature of 0°C to +40°C and a relative humidity of 85% or lower.

(5) Shock

This unit has a crystal oscillator; so do not subject it to strong mechanical shock.

(6) **STBY**

When the power cable plug is connected to a power receptacle, the reference oscillation circuit starts operation and the unit enters the standby state; measurement is enabled immediately after the unit is

POWERed **ON**. Since the reference oscillator is not temperature compensated, the frequency fluctuates as shown in Figure 6-2 after **POWER ON**, even if the unit has been set to **STBY** with the power cable plug connected to a power receptacle.

(7) Selection of time base signal
Either the external or internal time base signal can be used by operating the **INT. STD OUT./EXT. STD IN.** switch on the rear panel. **INT. STD OUT.** selects the internal time base signal and outputs it. **EXT. STD IN.** allows input of an external time base signal (1 $V_{p\text{-}p}$ to 10 $V_{p\text{-}p}$, 500 Ω, 10 MHz).

3-2. Description of Panels

3-2-1. **TR5821/5822** Panels

① **Power**

The mainframe is not powered when the **POWER** switch is set to **STBY**, but the reference oscillator is activated in this state if the power cable plug is connected to a power receptacle. The mainframe is powered when the **POWER** switch is set to ▬ **ON.**

② **FUNCTION**

Every time ⇨ is pressed, the lamp indication changes **CHECK** → **FREQ.** → **PERIOD** → **T.I.** → **RATIO** → . . . cyclically, and the function indicated by the lighted lamp is selected; ⇦ key operation shifts the lamp indication in the opposite direction. When **TOT.** is selected, the gate opens/closes each time ON/OFF is pressed. For other functions, the ON/OFF switch operates as a **RESET** switch. (See ㉑ for **RESET.**)

③ **GATE**

Monitor lamp for counting operation. The lamp is on during counting (measurement).

④ **OVER**

This lamp goes on when the measurement result exceeds the counting capacity.

⑤ Numerical display section

Green, 7-segment LED display of 8 digits.

⑥ Unit display section

Displays the unit of the measurement result.

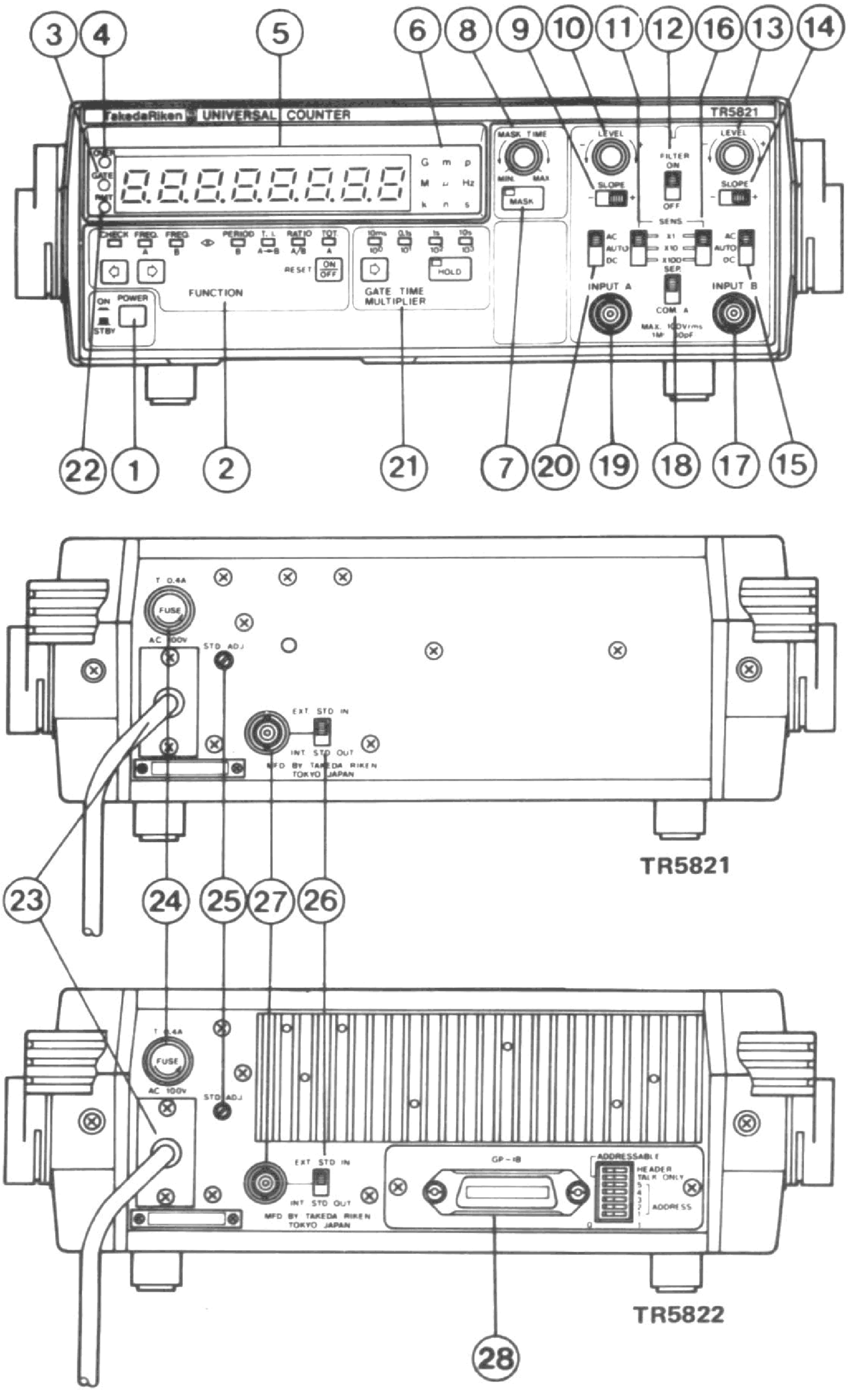


Fig. 3-2 Panels description

⑦ **MASK**
The signal to be measured is masked by pressing MASK to light the lamp within the switch. Set the masking time with control ⑧. (**FREQ. A** cannot be masked.)

⑧ **MASK TIME**
A control for setting the masking time.

⑨ **SLOPE**
Trigger point slope selector switch. + sets the trigger point at the positive slope and – sets it at the negative slope.

⑩ **LEVEL**
A control for triggering the signal to be measured at the proper level. The trigger voltage can be adjusted within a range of about –1 V to +1 V.

⑪ **SENS.**
Selects the input sensitivity.

⑫ **FILTER**
When the switch is set **ON**, the 100 kHz (approx.) low-pass filter is activated on both A and B channels.

⑬ **LEVEL**
See ⑩.

⑭ **SLOPE**
See ⑨.

⑮ **AC-AUTO-DC**
Input coupling selector switch. **AC** and **AUTO** cut out the DC component and routes the AC component into the input circuit. **AUTO** automatically sets the trigger voltage to the 50% level of the voltage to be measured. **DC** routes both AC and DC components into the input circuit.

⑯ **SENS.**
See ⑪.

⑰ **INPUT B**
Channel B input connector.

⑱ **SEP./COM. A**
SEP. is used for two separate inputs A and B, whereas with **COM. A** the signal to be measured on channel A is common to both channels.

⑲ **INPUT A**
Channel A input connector.

⑳ **AC-AUTO-DC**
See ⑮.

㉑ **GATE TIME/MULTIPLIER**
For setting the gate time (**CHECK**, **FREQ. A**, **FREQ. B**) or average measurement time multiplier (**PERIOD**, **T.I.**, **RATIO**). Each time ⇨ is pressed, the lamp indication shifts 10 ms/10^0 → 0.1 s/10^1 → 1 s/10^2 → 10 s/10^3 → 10 ms/10^0 → . . . cyclically, and the gate time or the multiplier is set to the value indicated by the lighted lamp. When HOLD is pressed (the lamp within the switch goes on), counting is made once, then stops. Each time **RESET** is pressed in the hold state, a counting is made, then stops. When HOLD is pressed again, the lamp within the switch goes off and the hold function is deactivated. **RESET** initializes the operation of this unit (without changing the functions).

㉒ **RMT**
The lamp goes on when this unit is in the remote state. In this case, no operation is made when a panel switch is pressed. (For GPIB remote control)

㉓ **AC 100 V**
Indicates the available voltage. Use 100/120/200/220 V ac at ±10%, or 240 V ac +4%, −10%.

㉔ **T 0.4 A**
Indicates the rating of the fuse in use. Use a 0.4 A slow-blow fuse for 100/120 V ac; use a 0.2A slow-blow fuse for 200/220/240 V ac.

㉕ **STD ADJ.**
Trimmer for adjusting the internal reference oscillator.

㉖ **INT. STD OUT./EXT. STD IN.**
Internal reference oscillator and external reference signal selector switch. **INT. STD OUT.** selects the internal reference oscillator and outputs the frequency value at ㉗. When **EXT. STD IN.** is selected, the external reference signal fed to ㉗ operates this unit.

㉗ Reference signal I/O connector. See ㉖.

㉘ **GPIB** connector
GPIB connector is used to connect this unit to the GPIB interface for externally controlling function, gate time/multiplier, hold of this unit.

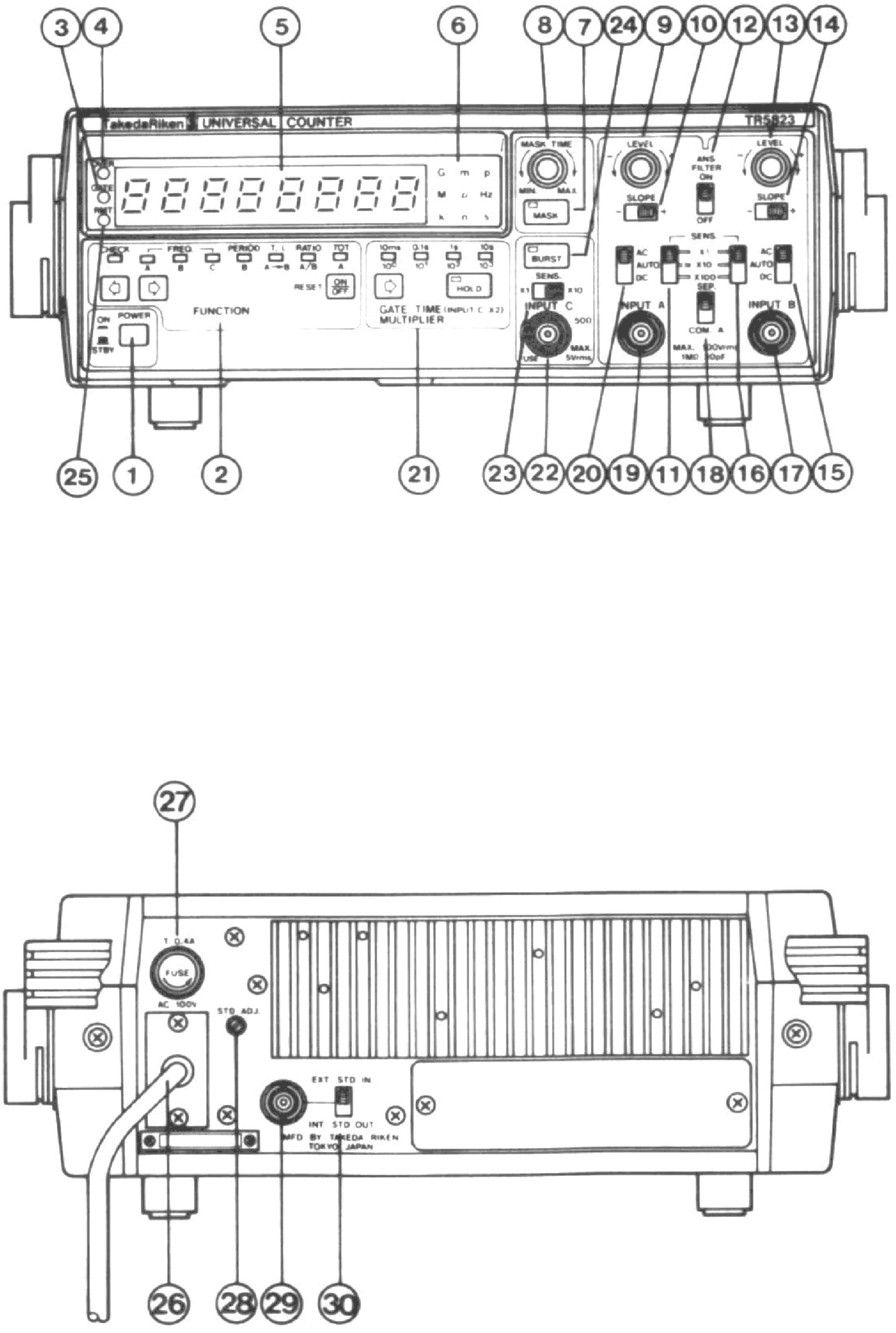


Fig. 3-3 Panels description (TR5823)

3-2-2. TR5823 Panels

① **POWER**
The mainframe is not powered when the **POWER** switch is set to ■ **STBY**, but the reference oscillator is activated in this state if the power cable plug is connected to a power receptacle. The mainframe is powered when the **POWER** switch is set to ▄ **ON.**

② **FUNCTION**
Each time ⇨ is pressed, the lamp indication changes **CHECK** → **FREQ.** → **PERIOD** → **T.I.** → **RATIO** → . . . cyclically, and the function indicated by the lighted lamp is selected; ⇦ key operation shifts the lamp indication in the opposite direction. When **TOT.** is selected, the gate opens/closes each time ON OFF is pressed. For other functions, the ON OFF switch serves as a **RESET** switch. (See ㉑ for **RESET.**)

③ **GATE**
Monitor lamp for counting operation. The **GATE** lamp is on during counting (measurement).

④ **OVER**
This lamp goes on when the measurement result exceeds the counting capacity.

⑤ Number display section
Green, 7-segment LED display of 8 digits.

⑥ Unit display section
Displays the unit of the measurement result.

⑦ **MASK**
The signal to be measured is masked by pressing MASK to light the lamp within the switch. Set the masking time with the control ⑧. (**FREQ. A** and **FREQ. C** cannot be masked.)

⑧ **MASK TIME**
A control for setting the masking time.

⑨ **LEVEL**
A control for triggering the signal to be measured at the proper level. The trigger voltage can be adjusted within a range of about –1V to +1V.

⑩ **SLOPE**
Trigger point slope selector switch. + sets the trigger point at the positive slope and – sets it at the negative slpe.

⑪ **SENS.**
Selects the input sensitivity.

⑫ **ANS/FILTER**
When this switch is set to **ON**, the 100 kHz (approx) low-pass filter is activated on both A and B channels, and ANS of channel C is set to ON.

⑬ **LEVEL**
See ⑨

⑭ **SLOPE**
See ⑩

⑮ **AC-AUTO-DC**
Input coupling selector switch. **AC** and **AUTO** cut out the DC component and routes the AC component into the input circuit. **AUTO** automatically sets the trigger voltage to the 50% level of the voltage to be measured. **DC** routes both AC and DC components into the input circuit.

⑯ **SENS.**
Selects the input sensitivity.

⑰ **INPUT B**
Channel B input connector.

⑱ **SEP./COM. A**
SEP. is used for two separate inputs A and B, whereas with **COM. A** the signal to be measured on channel A is common to both channels.

⑲ **INPUT A**
Channel A input connector.

⑳ **AC-AUTO-DC**
See ⑮.

㉑ **GATE TIME/MULTIPLIER**
Same as ㉑ in 3-2-1 "**TR5821/22** Panels." For **FREQ. C,** the gate time becomes twice as long.

㉒ **INPUT C**
Channel C input connector.

㉓ **SENS.**
See ⑯.

㉔ **BURST**
When BURST is pressed, the lamp within the switch goes on and burst signal measurement is enabled. The measurement starting point can be changed by using the **MASK** switch.

㉕ **RMT**
Same as ㉒ in 3-2-1 "**TR5821/5822** Panels."

㉖ to ㉚
Same as ㉓ to ㉗ in 3-2-1 "**TR5821/5822** Panels."

3-3. Basic Operating Procedure

This section explains how to use each function of the **TR5820** series. Check the model name before operation. For convenience, the **TR5823** is used in illustrations.

3-3-1. Self-diagnostics Function (CHECK)

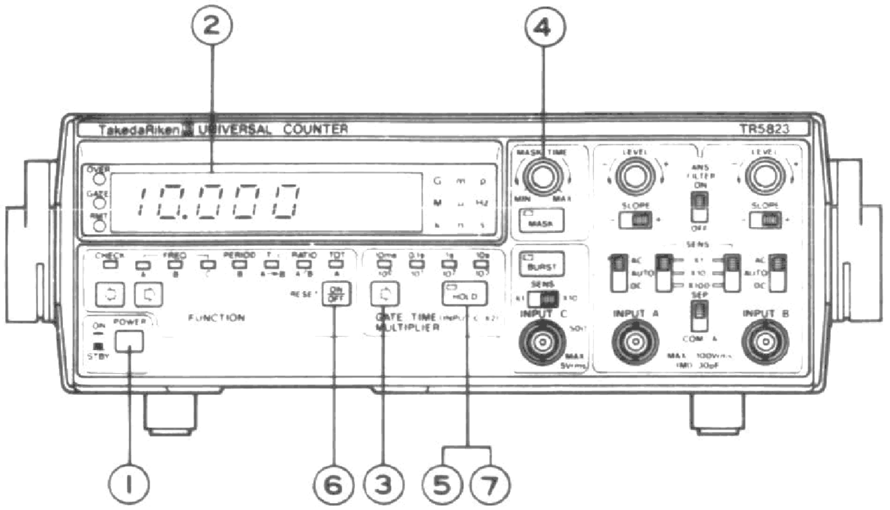


Fig. 3-4 Self-check routine

Check 3-1-4. "General Cautions Before Use" before powering the unit.

① **POWER ON** starts the self-diagnostics function which checks the micro-processor, two LSIs, and existence of the reference signals. When no error is found, all segments and indicator lamps (except the **RMT** lamp and decimal point) go on (about 2 seconds) for checking. Then, this unit is initialized to:

FUNCTION . . . . . . .CHECK
GATE TIME . . . . . .10 ms
Other functions . . . .OFF

② 10.000 MHz is displayed and the **GATE** lamp blinks.

③ Display readout changes as below with each press of **GATE TIME** ⇨ .

	10.000	MHz
⇨ 0.1s	10.0000	MHz
⇨ 1s	10.00000	MHz
⇨ 10 s	10.000000	MHz

Press ⇨ again to set **GATE TIME** to 10 ms.

④ Press MASK to light the lamp within the switch. Turn the **MASK TIME** control to see that the display changes approximately 100 μs to 100 ms. Press MASK to deactivate the masking function.

⑤ Press HOLD to light the lamp within the switch; the **GATE** lamp goes off.

⑥ Press **RESET**; the **GATE** lamp blinks once.

⑦ Press HOLD to release the hold; the **GATE** lamp starts blinking again.

3-3-2. Error Messages

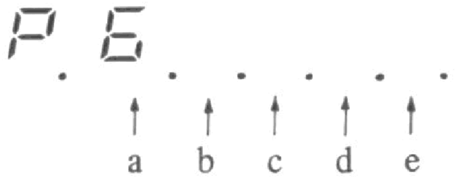
An error message is displayed when an error is found during self-diagnostics and when an arithmetic operation or data setting error is found. A self-diagnostics error message is displayed for about 2 seconds, and the operation shifts to CHECK (some errors may cause it inoperative). When an arithmetic operation or data setting error message is displayed, the operation stops. Table 3-1 lists the error messages; the cause of each message may be found in any other place than those listed below.

E 01	Microprocessor (ROM, RAM)	E 21	No EXP at DAC
E 02	Display data bus	E 22	A · exists at DAC
E 03	Data bus port	E 23	Display upper limit exceeded
E 04	LSI80-GC	E 24	Display lower limit exceeded
E 05	LSI80-GC	E 25	Measurement value or data is zero
E 06	LSI80-GC/SS data		
E 07	Crystal oscillator External reference signal is not provided with the selector switch being set to **EXT. STD IN.**		
E 08	LSI80-SS		
E 09	LSI80-SS		
E 10	Panel switch		

Table 3-1 Error message types and error locations

3-3-3. Panel Switch Check

When the **POWER** switch is set to **ON** while the **RESET** key is pressed, the following is displayed and the operation enters the panel switch check mode:



When each key is pressed, the number that corresponds to the key is displayed at the location indicated by a to e. If no number is displayed or a number that does not correspond to the key is displayed with press of a key, the cause is assumed to be a defective switch.

Digit / Display	a	b	c	d	e
0	**FUNCTION** ⇦	**0**	**5**	±	=
1	**FUNCTION** ⇨	**1**	**6**	×	**EXP**
2	**MASK**	**2**	**7**	÷	**SFT**
3	**BURST**	**3**	**8**	**DAC**	**C**
4	**GATE TIME** ⇨	**4**	**9**	**COM**	**RD**
5	**HOLD**	•	+/–	**OFF**	**EXE**
6	**RESET**				

TR1644 keys

3-3-4. Frequency Measurement

(1) **FREQ. A** (10 Hz to 120 MHz) **(TR5821/5822/5823)**

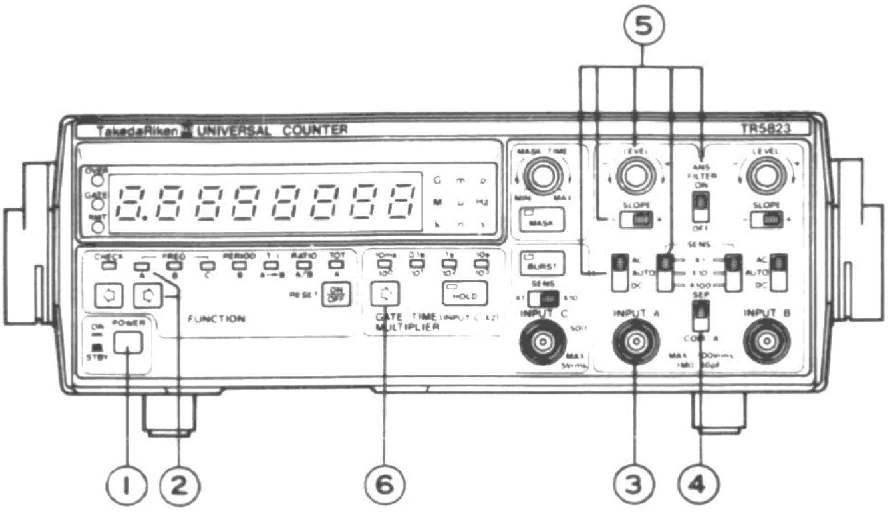


Fig. 3-5 Frequency measurement **(FREQ.A)**

① **POWER ON** and check for CHECK operation.
② Set **FUNCTION** to **FREQ. A**
③ Connect the signal to be measured to **INPUT A.**
④ Set the **SEP./COM. A** switch to **SEP.**
⑤ Set each switch according to the signal to be measured.
⑥ Select a **GATE TIME** according to the required precision.

(2) **FREQ. B** (1 mHz to 50 MHz) **(TR5821/5822/5823)**

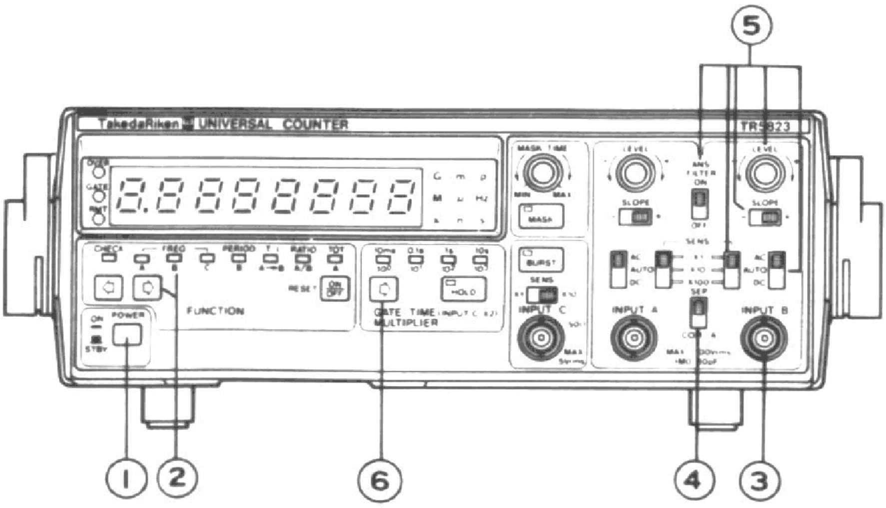


Fig. 3-6 Frequency measurement **(FREQ.B)**

① **POWER ON** and check for CHECK operation.
② Set **FUNCTION** to **FREQ. B.**
③ Connect the signal to be measured to **INPUT B.**
④ Set the **SEP./COM. A** switch to **SEP.**
⑤ Set each switch according to the signal to be measured.
⑥ Select a **GATE TIME** according to the required precision.

(3) **FREQ. C** (100 MHz to 1300 MHz) (**TR5823**)

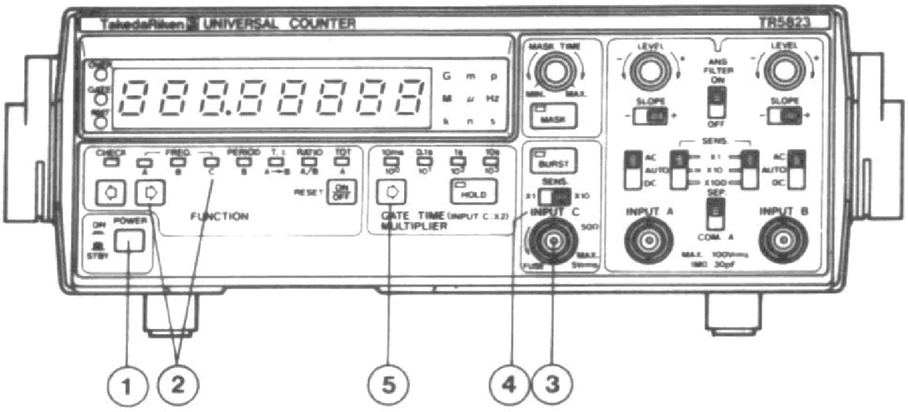


Fig. 3-7 Frequency measurement **(FREQ.C)**

① **POWER ON** and check for CHECK operation.
② Set **FUNCTION** to **FREQ. C.**
③ Connect the signal to be measured to **INPUT C.**
④ Set the input sensitivity according to the signal to be measured.
⑤ Select a **GATE TIME** according to the required precision. **GATE TIME** for **FREQ. C** will be 20 ms, 0.2 s, 2 s, 20 s, respectively.

(4) Burst measurement (FREQ. C) (TR5823)

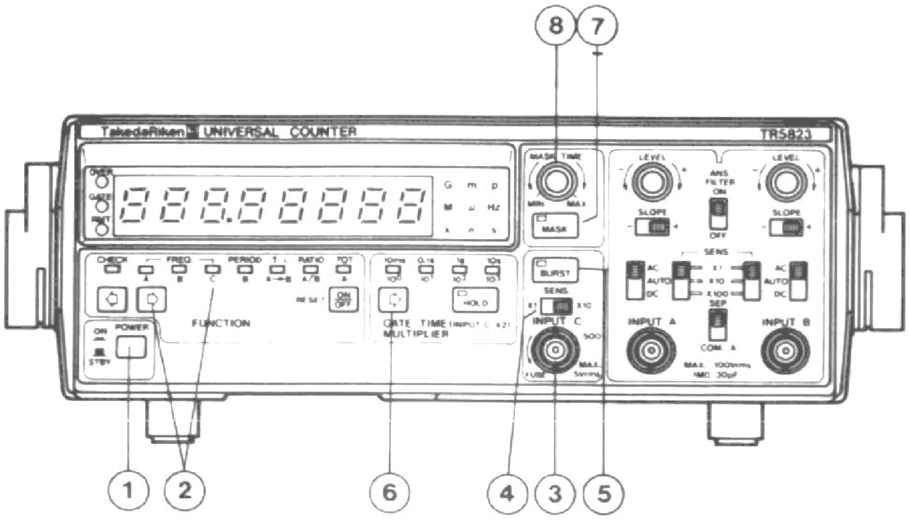


Fig. 3-8 Burst measurement

① **POWER ON** and check for CHECK operation.

② Set **FUNCTION** to **FREQ. C.**

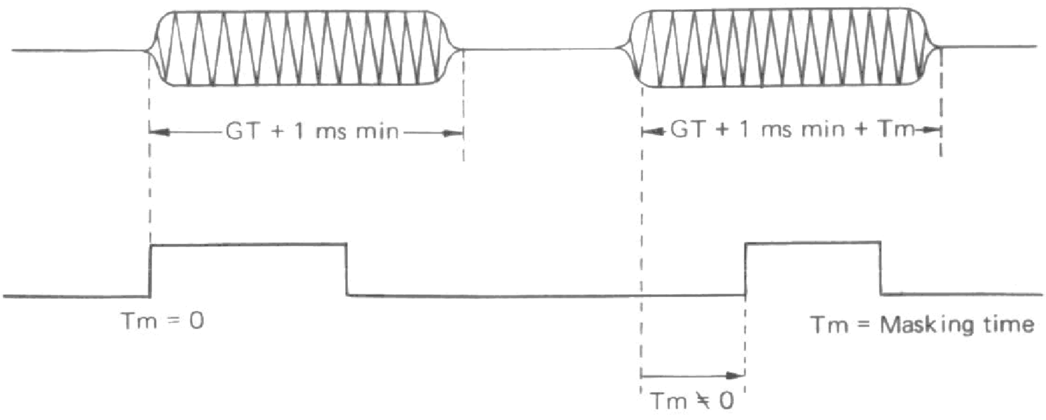
③ Connect the signal to be measured to **INPUT C.**

④ Set the input sensitivity according to the signal to be measured.

⑤ Check that the display fluctuates, then press the **BURST** switch.

⑥ Select a **GATE TIME** according to the required precision. The burst width must be longer than the **GATE TIME**.

⑦ Pressing the **MASK** switch enables delay start. Delay time can be set by **MASK TIME** control ⑧ to initiate a belated measurement.



3-3-5. Period Measurement (PERIOD B)

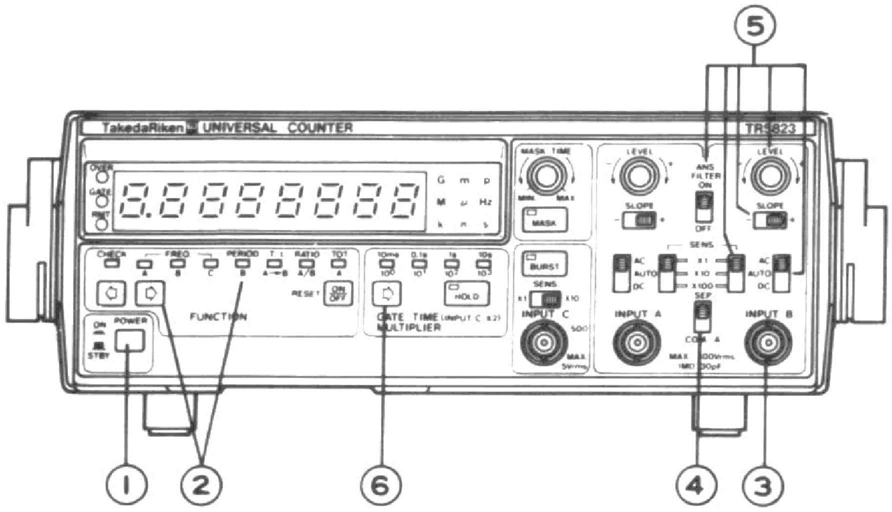


Fig. 3-9 Period measurement

① **POWER ON** and check for CHECK operation.

② Set **FUNCTION** to **PERIOD B**.

③ Connect the signal to be measured to **INPUT B**.

④ Set the **SEP./COM. A** switch to **SEP.**

⑤ Set each switch according to the signal to be measured.

⑥ Select a **MULTIPLIER** according to the required precision.

3-3-6. Time Interval Measurement (T.I. A → B)

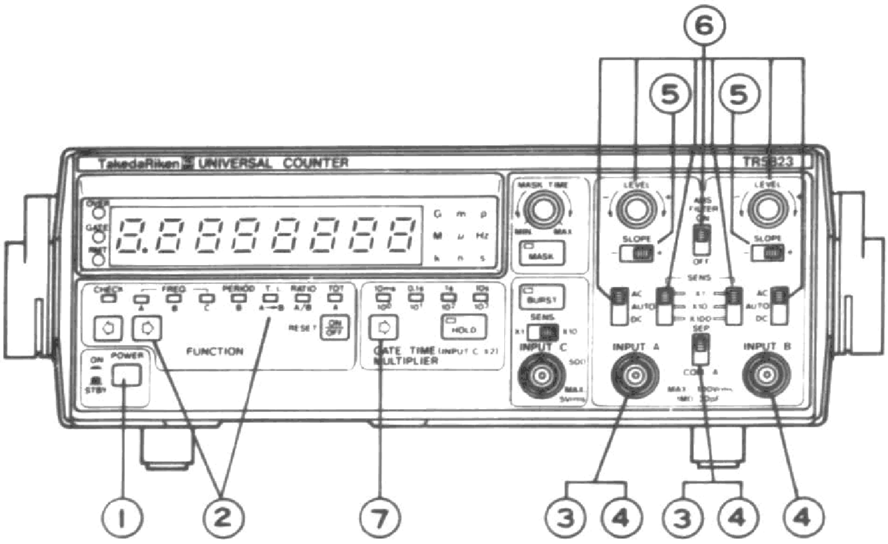


Fig. 3-10 Time interval measurement

① **POWER ON** and check·for CHECK operation.

② Set **FUNCTION** to **T.I. A → B**.

③ For single-signal measurement, set the **SEP./COM. A** switch to **COM. A** with the signal of interest connected to **INPUT A**.

④ When two signals are to be measured, connect the start signal (the signal generated first) to **INPUT A** and the stop signal (the signal generated later) to **INPUT B**, then set the **SEP./COM. A** switch to **SEP.**

⑤ Set the **SLOPE** switch according to the start and stop points on the slope.

⑥ Set each switch to suit the signal to be measured.

⑦ Select a **MULTIPLIER** according to the required precision.

3-3-7. Frequency Ratio Measurement (RATIO A/B)

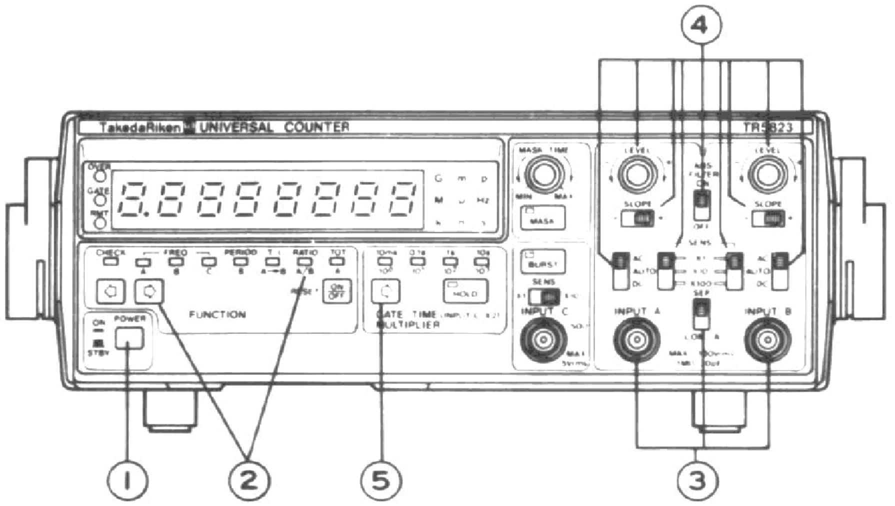


Fig. 3-11 Frequency ratio measurement

① **POWER ON** and check the CHECK operation.

② Set **FUNCTION** to **RATIO A/B**.

③ Set the **SEP./COM. A** switch to **SEP.**, then connect the signals to be measured to **INPUT A** and **INPUT B**.

④ Set each switch according to the signals to be measured.

⑤ Select a **MULTIPLIER** according to the required precision.

3-3-8. Totalize (TOT. A)

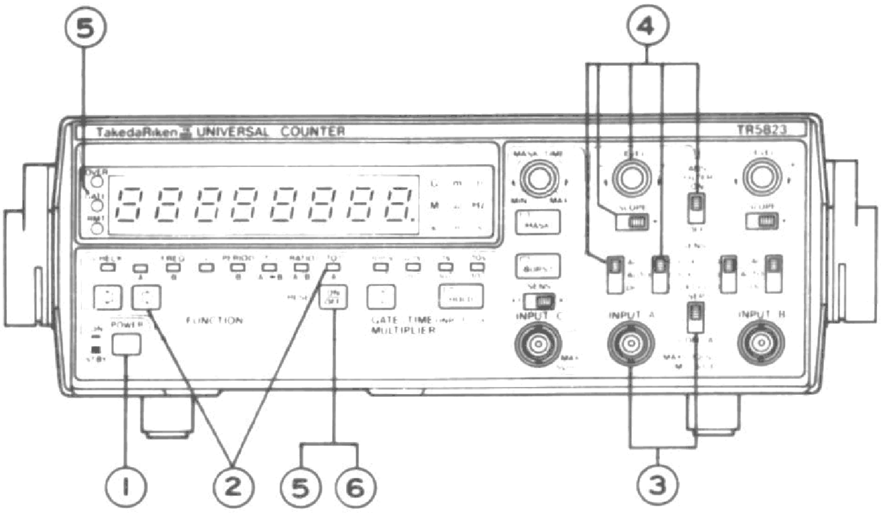


Fig. 3-12 Totalize measurement

① **POWER ON** and check for CHECK operation.

② Set **FUNCTION** to **TOT. A**.

③ Set the **SEP./COM. A** switch to **SEP.**, with the signal of intereset connected to **INPUT A**.

④ Set each switch according to the signal to be measured.

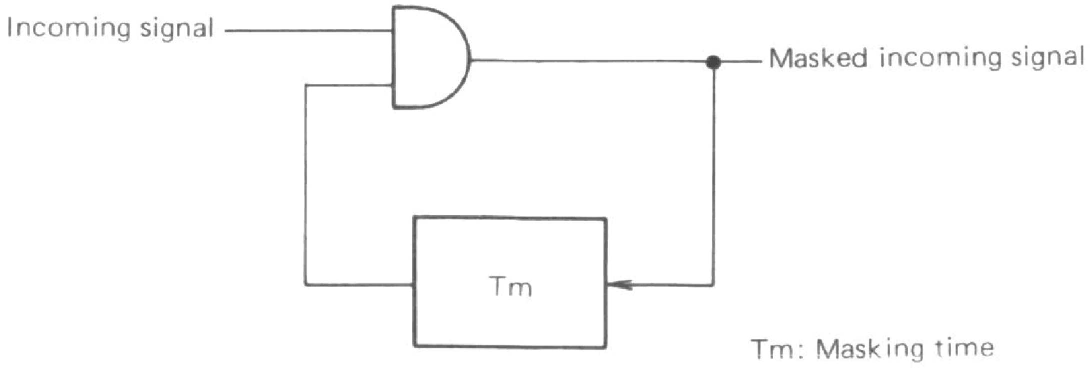
⑤ Press the ON OFF switch and release it, then the **GATE** lamp in the display section goes on and counting starts.

⑥ Press the ON OFF switch again, then counting stops (the **GATE** lamp remains on and internal counting is continued). Release the ON OFF switch, then the **GATE** lamp goes off and the final counting value is displayed.

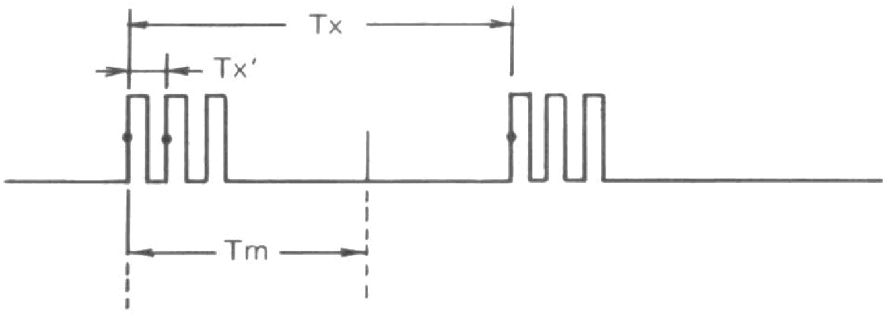
⑦ When the **HOLD** lamp is not on (HOLD), the previous totalized value is reset; when the **HOLD** lamp is on (HOLD), the previous totalized value is added to the current totalization. If the counting result exceeds the display capacity (8 digits), the **OVER** lamp in the display section goes on.

3-3-9. Masking

A masking circuit triggered by the signal to be measured inhibits the signal to be measured, thus ignoring the signal of interest for the period of masking time after being triggered by the signal.



Consider measuring Tx of the signal shown below. When **MASK** is OFF, Tx' is measured. Setting the masking time to Tm will enable the measurement of Tx.



Masking can be utilized in the **FREQ. B, PERIOD B, T.I. A →B, RATIO A/B,** and **TOT. A** functions.

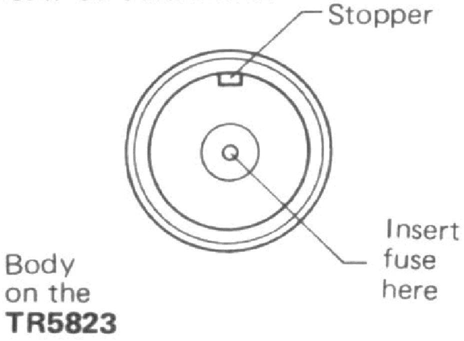
3-3-10. High-freqency Fuse Replacement

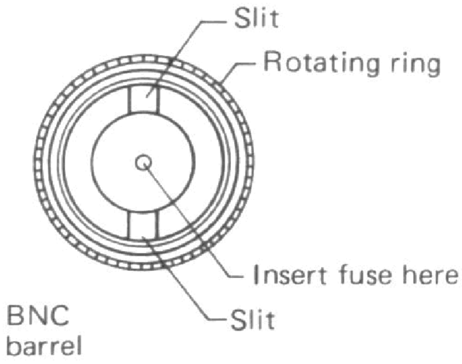
INPUT C connector of the **TR5823** is fuse protected. Use the following procedure to replace the fuse.

(1) Fuse rating

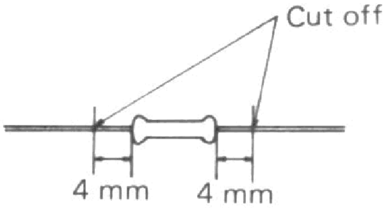
Part No.	Rating	Manufacturer
275.125	Axial lead 1/8A Subminiature picofuse	Littelfuse, Inc.

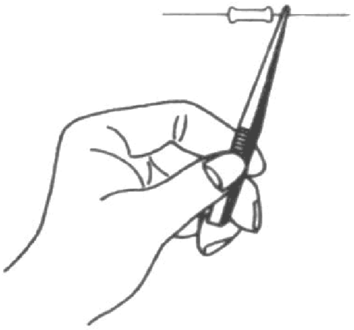
(2) External view of connector





(3) How to cut off the fuse





Use sharp pliers to cut the fuse. Avoid, by holding it with a pair of tweezers, exerting a stress on the fuse.

(4) Replacement procedures

① Remove the connector barrel by turning the outer ring counterclockwise.

② Remove the blown fuse.

③ Insert the fuse (which is cut out as described above) into the small hole in the center of the connector barrel. (Insertion is made easier by rotating the fuse or the connector.)

④ Guide the slit on the BNC barrel to the stopper on the **TR5823** connector body and insert the fuse into the central hole in the connector.

⑤ Gently turn the outer ring clockwise.

⑥ Tighten the ring. Care should be taken not to overtighten.

SECTION 4
GPIB INTERFACE

4-1. Introduction

Among the **TR5820** series, GPIB interface is standard on the **TR5822** and optional on the **TR5823**, enabling them to connect to a GPIB, IEEE Standard 488-1978. This section describes the GPIB specifications and functions. (GPIB: General Purpose Interface Bus)

4-2. General Outline of the GPIB

The GPIB is an interface system for simple cable (bus line) connections between measuring equipment and controller or peripheral devices.

The GPIB is much easier to use than conventional interface systems and includes a greater expansion capacity. And since it is compatible electrically, mechanically and functionally with other manufacturers' equipment, it is possible to construct a wide range of systems from relatively simple systems up to high-performance automatic measuring systems by using a single bus cable.

In GPIB systems, the "address" of individual component devices connected to the bus line should be first set. Each of these devices may have one or more of the controller, talker or listener roles. During system operation, only one "talker" can transmit data via the bus line, while several "listeners" can receive that data. The controller designates the "talker" and "listener" addresses and transfers data from the "talker" to the "listener", or the controller itself ("talker") may set measuring conditions for the "listener".

Eight bit-parallel byte-serial data lines are used for data transfer between different devices, bidirectional transmission being possible in asynchronous mode. Furthermore, in asynchronous systems, it is also possible to connect high-speed and low-speed devices together in any configuration.

The data (messages) transferred between devices includes measurement data, measuring conditions (program) and various different commands. ASCII code is employed.

In addition to the 8 data bus lines mentioned above, the GPIB also includes 3 handshake lines for control of asynchronous data transfer between devices, and 5 control lines for management of the data flow on the bus.

- The following signals are used on the handshake line.

DAV (Data Valid)	Signal indicating validity and availability of data.
NRFD (Not Ready For Data) .	Signal indicating the condition of readiness of device(s) to accept data.
NDAC (Not Data Accepted) . .	Signal indicating the condition of acceptance of data by device(s).

- And the following signals are used on the control line.

ATN (Attension).	Signal used to specify whether the data line signal is an address or command, or some other data.
IFC (Interface Clear)	Signal for clearing the interface.
EOI (End or Identify)	Signal used upon completion of data transfer.
SRQ (Service Request).	Signal used in making a request for controller service from any device.
REN (Remote Enable).	Signal used in remote control of devices with remote control capacity.

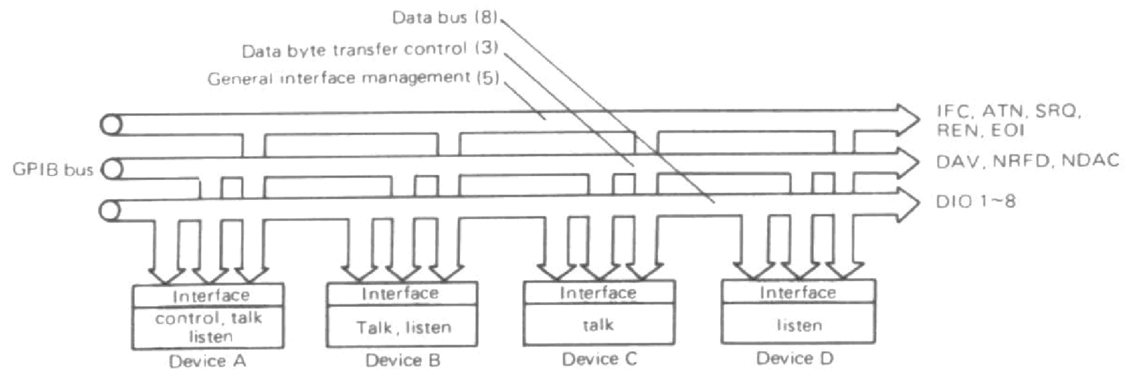


Fig. 4-1 GPIB outline

4-3. Specifications

4-3-1. GPIB Specifications

Standard : IEEE Standard 488-1978
Codes used : ASCII
Logic level : Logic 0: High, +2.4 V or higher
Logic 1: Low, +0.4 V or lower
Signal line terminal : The 16 bus lines are terminated as shown below.

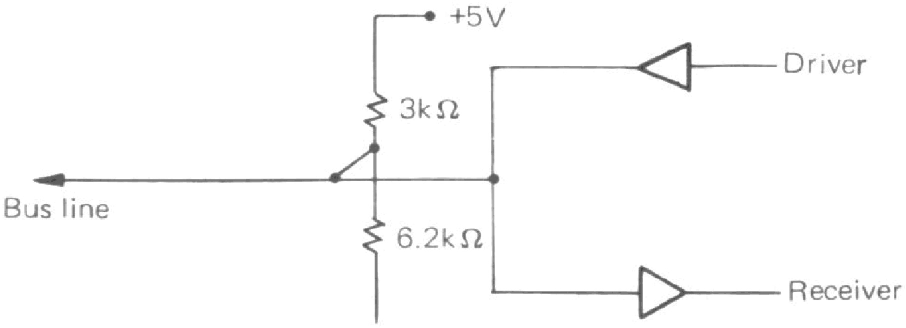
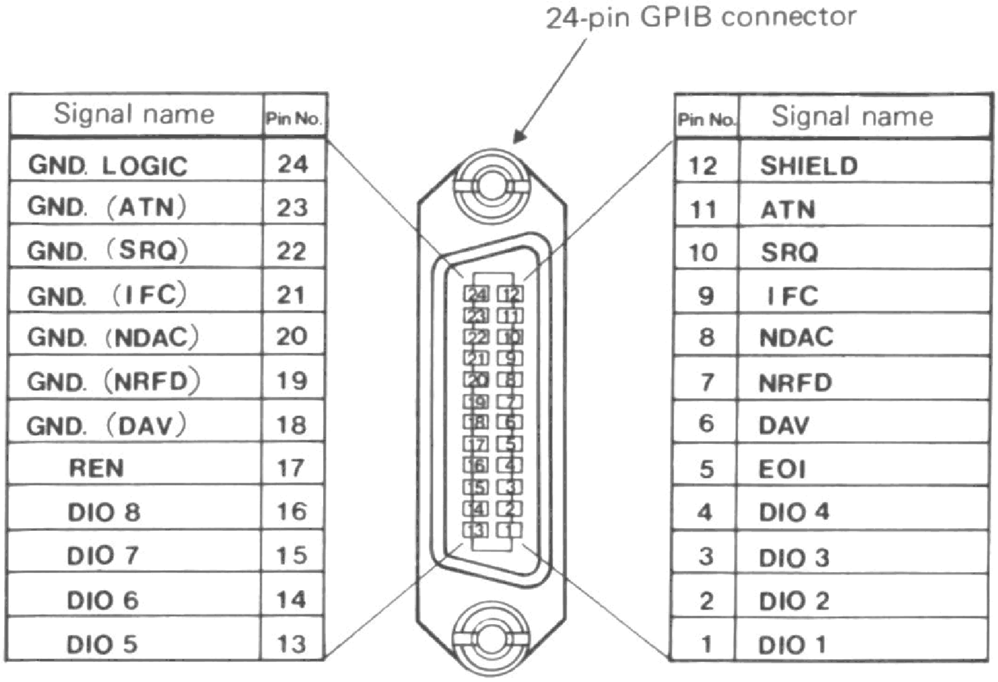


Fig. 4-2 Signal line termination

Driver : Open collector type
Low output voltage : +0.4 V or lower, 48 mA
High output voltage : +2.4 V or higher, –5.2 mA
Receiver : Low state : +0.6 V or lower
High state : +2.0 V or higher
Bus cable length : The total bus cable length must be (the number of devices connected to the bus) x 2 m or less, not exceeding 20 m.
Address specifications : Any of 31 talk/listen addresses can be set by operating the address selector switch on the rear panel. TALK ONLY mode can also be specified.
Connector : 24-pin GPIB connector
57-20240-D35 (Equivalent of Amphenol product)



Signal name	Pin No.	Pin No.	Signal name
GND. LOGIC	24	12	SHIELD
GND. (ATN)	23	11	ATN
GND. (SRQ)	22	10	SRQ
GND. (IFC)	21	9	IFC
GND. (NDAC)	20	8	NDAC
GND. (NRFD)	19	7	NRFD
GND. (DAV)	18	6	DAV
REN	17	5	EOI
DIO 8	16	4	DIO 4
DIO 7	15	3	DIO 3
DIO 6	14	2	DIO 2
DIO 5	13	1	DIO 1

Fig. 4-3 GPIB connector pin assignment

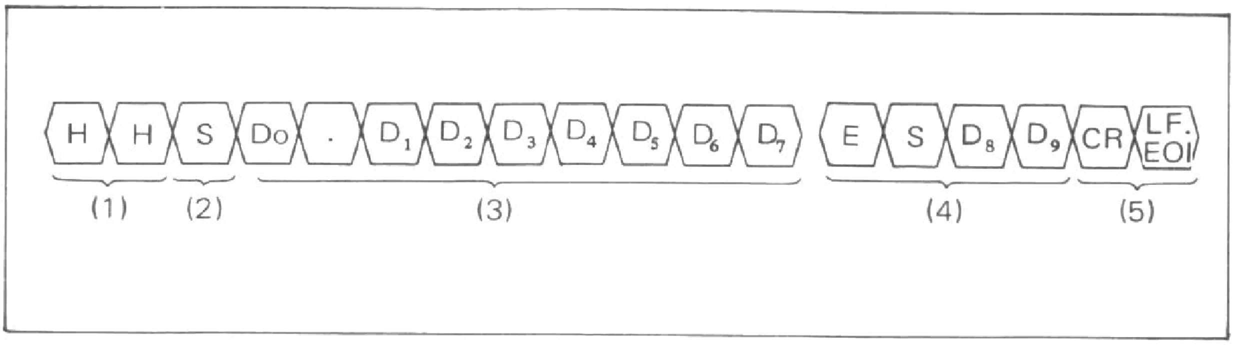
4-3-2. Interface Functions

Table 4-1 Interface functions

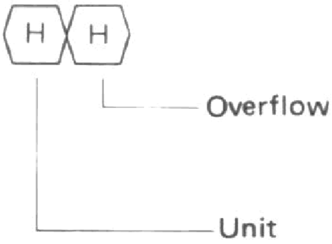
Code	Function
SH1	Source handshake
AH1	Acceptor handshake
T5	Basic talker, Serial poll, Talk only mode, Unaddressed to talk if addressed to listen
L4	Basic listener, Unaddressed to listen if addressed to talk
SR1	Service request
RL1	Remote function
PP0	No parallel poll function
DC1	Device clear (SDC and DCL commands can be used.)
DT1	Device trigger (GET command can be used.)
C0	No controller function
E1	Open collector driver

4-4. Data Formats

4-4-1. Talker Format (Data Output Format)



(1) Header



O : Overflow

␣ : No overflow.

F : Indicates that unit of output data is Hz.
This is output when the measurement function is any of the following:

CHECK
FREQ. A
FREQ. B
FREQ. C

S : Indicates that the unit of output data is s.
This is output when the measurement function is either PERIOD B or TIME INTERVAL.

␣ : Indicates that the output data has no unit.
This is output when the measurement function is either RATIO or TOTALIZE.

(2) Data sign

"␣" (space): for +

" – ": for –

(3) Data
Data (8 digits) + decimal point (1 digit)
The decimal point is fixed to the second position from the leftmost.

(4) Exponential sign and data

$$\left\{\begin{array}{l} E+15 \\ \wr \\ E+00 \\ \wr \\ E-12 \end{array}\right.$$

(5) Data delimiters

ⓐ : CR, LF, EOI
ⓑ : LF
ⓒ : EOI (synchronous with the last data)

Three types of delimiters (a to c) can be selected by programs.

* When **HEADER** of the address switch on the rear panel is set to **OFF**, two space codes are output in the header position.

4-4-2. **Listener Format** (Remote Code)

(1) Function setting code

Code	Function
F 0	CHECK
F 1	FREQ. A
F 2	FREQ. B
F 3(*)	FREQ. C
F 4	PERIOD
F 5	TIME INTERVAL
F 6	RATIO
F 7	TOTALIZE (OFF)
F 8	TOTALIZE (ON)

* F3, though settable, will not activate the operation in the **TR5822**, which is not provided with the FREQ. C.

(2) Gate time (multiplier) setting codes

Code	Gate time (multiplier)
G 0	10ms (X 1)
G 1	100ms (X 10)
G 2	1 s (X 100)
G 3	10s (X 1000)

(3) Delimiter setting codes (Output delimiters)

Code	Delimiter
DL 0	CR/LF, EOI
DL 1	LF
DL 2	EOI

(4) SRQ setting codes

Code	Function
S 0	Outputs SRQ.
S 1	Does not output SRQ.

(5) HOLD setting codes

Code	Function
S2	HOLD released
S3	HOLD

(6) Other codes

Code	Function
E	Trigger (same as GET)
C	Clear (same as DCL, SDC)

* GET (Group Execute Trigger)	. . . . . Measurement start
SDC (Selected Device Clear) DCL (Device Clear)	. . . . . Initialization of equipment

(7) Code recognition

Invalid characters in remote codes are ignored.

Examples:

○ **F9** – **9** is ignored and the next data is read (**F** is valid)
F90 – Recognized as **F0**.

○ **G510** – Recognized as **G1**.
With input of **5**, **G5** is not valid; **5** is ignored and the next **1** is read. Since **G1** is valid, **G1** is set as the remote code.

○ **FG32** – Recognized as **G3**.
FA32 – Recognized as **F3**.
If a valid letter (**F**) is followed by another valid letter (**G**) before the formation of the valid code (**F3**), the last entered letter (**G**) is made effective and the previous one (**F**) is ignored.

4-4-3. Initial Values

The following initial settings are made at **POWER ON** of this unit or when universal command DCL, address specification command SDC, or program code C is received from the controller:

Function : CHECK
Gate time : 10 ms
Delimiter : CR, LF, EOI
Service request : S1 (not to output SRQ)
HOLD : S2 (not to hold)

4-4-4. Input Delimiter

Input delimiter is LF or EOI. Program code **P** is also valid as a delimiter. When a controller that outputs CR alone is used, add **P** at the end of the program code.

Example: F1G1S3EP

4-4-5. Service Request

Service request is made when the data is output on completion of measurement.

Status byte:

When a service request is issued, this unit sends the status byte shown below to the controller in response to the serial polling from the controller.

(MSB)	D8	D7	D6	D5	D4	D3	D2	D1
	0	1	0	0	0	0	0	1

○ D1 = 1: Measurement completion bit

Note: In the S1 mode (SRQ OFF), D7 of this unit is not set to 1.

4-5. GPIB Operating Procedures

4-5-1. Connection to Component Devices

Since a GPIB system includes a number of component devices, pay special attention to the following points during preparation of the overall system.

(1) Before connecting up the component devices (as described in the respective instruction manuals for the **TR5820** Series, controller and peripheral devices), first check the preparation status (readiness) and operation of each device.

(2) The connecting cable for the measuring equipment and the bus calbe for controller connections should be no longer than necessary. The length of the bus cable in particular must not exceed the prescribed length. The total bus cable length is (number of devices connected to the bus) x 2 m max., and not in excess of 20 m. The following standard bus cables are available from Takeda Riken.

Table 4-2 Standard bus cables (To be purchased separately)

Length	Name	Stock No.
0.5 m	408J-1P5	9990-43A
1 m	408J-101	9990-43B
2 m	408J-102	9990-43C
4 m	408J-104	9990-43D

(3) When using bus cable connections, do not use 3 or more connectors in combination. Also check that the connector securing screws are properly tightened.
Bus cable connectors are "piggyback" types with both plug and socket sides, thereby enabling connectors to be stacked.

(4) Do not switch on the power for each of the component devices until power requirements, grounding condition and, if necessary, the setting conditions have been properly checked.
The power for all devices connected to the bus must be switched **ON**. If the power for even a single device is left off, the entire system may fail to properly operate.

(5) Be sure to disconnect power from the instrument when connecting or removing the bus cable.

4-5-2. Panel Description

(1) When the counter is set to Remote, the **RMT** lamp to the left of the front panel readout goes on.

(2) While the **RMT** lamp is on, the following switches are disabled:

FUNCTION selector switch
GATE TIME selector switch
RESET switch
HOLD switch
MASK switch
BURST switch
All switches on the **TR1644** Calculation Unit (accessory)

* The sliding switches and controls at the input section remain valid in the Remote State.

(3) The Remote settings (such as function) are retained when the state of the counter is changed from Remote to Local by the controller unless the **POWER** switch of the counter is set to **OFF**. When the counter is returned to the Remote state after altering the state to Local and changing the settings by operating the panel switches, the previous Remote settings are retained. (It appears that the settings such as function are also changed by simply changing the state from Local to Remote.) (See the positions indicated by the arrows in Figure 4-4.)

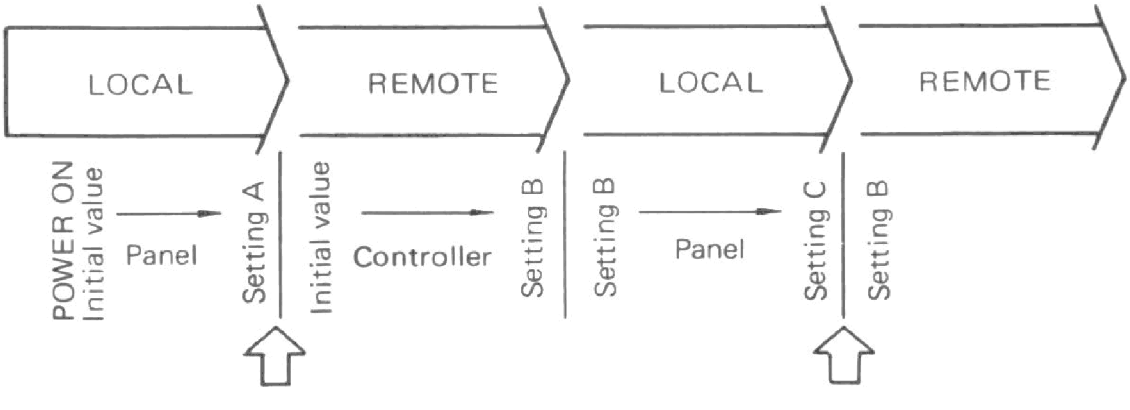


Fig. 4-4 Retention of remote setting

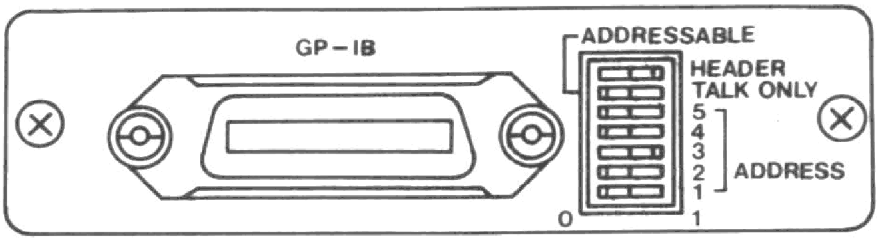


Fig. 4-5 GPIB interface panel

① **ADDRESS** switch

DIP switch for setting the counter bus address (talker or listener address). Bits 1 to 5 set the counter address code. If bit 6 is set to **ADDRESSABLE**, the counter can be addressed by the controller, while if set to TALK ONLY, the counter will act as a "talker" irrespective of the **ADDRESS** 1 to 5 settings. If bit 7 is set to "1", the header is transmitted during data transmission, but if set to "0", the header section becomes a space code.

② GPIB connector

The 24-pin connector for bus cable connections. Since this is a "piggy-back" type connector, standard bus cables can be used joined to each other. However, not more than 3 connectors should be stacked together in this fashion.

4-5-3. Address Setting

The universal counter talk address and listen address within the GPIB system are set by the rear panel **ADDRESS** switch.

This switch is a 7-bit (7-position) DIP switch where any of 31 different addresses may be set by bits 1 to 5 (positions 1 to 5).

The 00100 setting shown in Fig. 4-5, for example, corresponds to decimal "4". When expressed in ASCII code, this example corresponds to "D" for talker, and "$" for listener (see Table 4-3).

When bit 6 is set to **ADDRESSABLE,** the counter will respond only when the address designated by the controller matches the address set by the counter (ADDRESS 1 to 5). When set to **TALK ONLY**, the counter becomes a talker irrespective of the address set by **ADDRESS.**

When bit 7 is set to "1", the 2-character header is transmitted during the data transmission. When set to "0", however, the 2 characters become space codes.

Table 4-3 Address code table

ASCII code character		ADDRESS switches					Decimal code
LISTEN	TALK	A5	A4	A3	A2	A1	
SP	@	0	0	0	0	0	00
!	A	0	0	0	0	1	01
"	B	0	0	0	1	0	02
#	C	0	0	0	1	1	03
$	D	0	0	1	0	0	04
%	E	0	0	1	0	1	05
&	F	0	0	1	1	0	06
'	G	0	0	1	1	1	07
(	H	0	1	0	0	0	08
)	I	0	1	0	0	1	09
*	J	0	1	0	1	0	10
+	K	0	1	0	1	1	11
,	L	0	1	1	0	0	12
—	M	0	1	1	0	1	13
°	N	0	1	1	1	0	14
/	O	0	1	1	1	1	15
0	P	1	0	0	0	0	16
1	Q	1	0	0	0	1	17
2	R	1	0	0	1	0	18
3	S	1	0	0	1	1	19
4	T	1	0	1	0	0	20
5	U	1	0	1	0	1	21
6	V	1	0	1	1	0	22
7	W	1	0	1	1	1	23
8	X	1	1	0	0	0	24
9	Y	1	1	0	0	1	25
:	Z	1	1	0	1	0	26
;	[	1	1	0	1	1	27
<	\	1	1	1	0	0	28
=	]	1	1	1	0	1	29
>	~	1	1	1	1	0	30

4-5-4. General Precautions during Operation

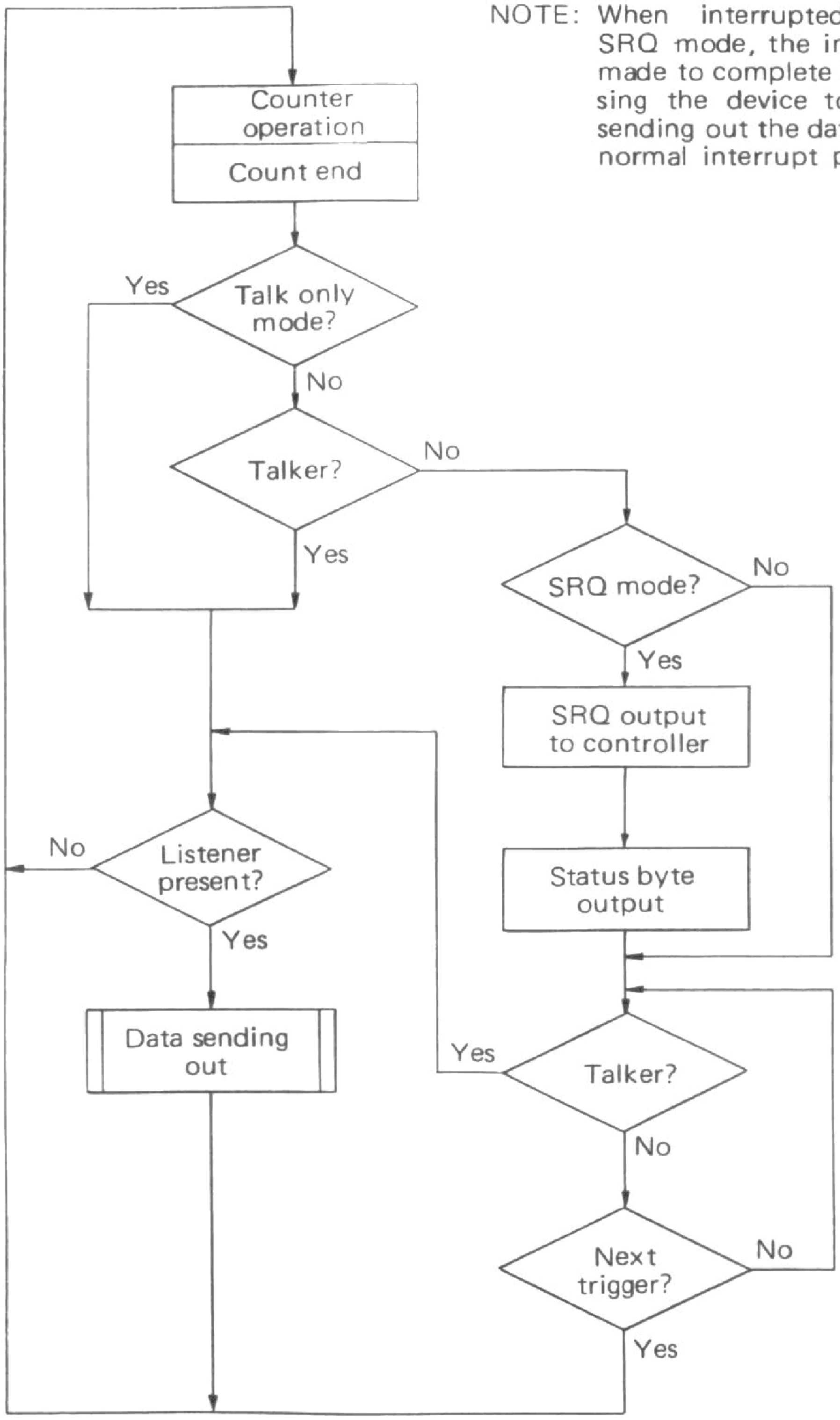
(1) To use the counter in only mode, the rear panel **ADDRESS** switch must be set to the **TALK ONLY** position, and the address mode of the other devices connected to the bus line should also be set to only mode. Note, however, that during only mode the controller should not be used. If the controller is operated during only mode, the controller command will be disregarded, and the counter may fail to operate properly.

(2) Power failure during operation
If there is a power failure (including momentary power failures) during operation of the GPIB system (including the universal counter), normal operation cannot be guaranteed after the power is restored. Normally, the complete system is initialized again. Power failure processing for the other devices included in the system must also be considered.

(3) Controller interrupt during data transfer between devices
In the GPIB system, data transfer between devices apart from the controller is also possible. If an interrupt is generated in order to add another listener or to switch the controller to serial polling mode during data transfer (handshake operation) between devices, the data transfer is suspended, and priority given to the controller interrupt operation. Upon completion of the interrupt process, the previous data transfer operation is resumed.
Usually, the system is to be programmed so that the controller will recognize the data transfer state.

4-6. Programming Notes

4-6-1. Simplified Operational Flow Chart (Data Sending)

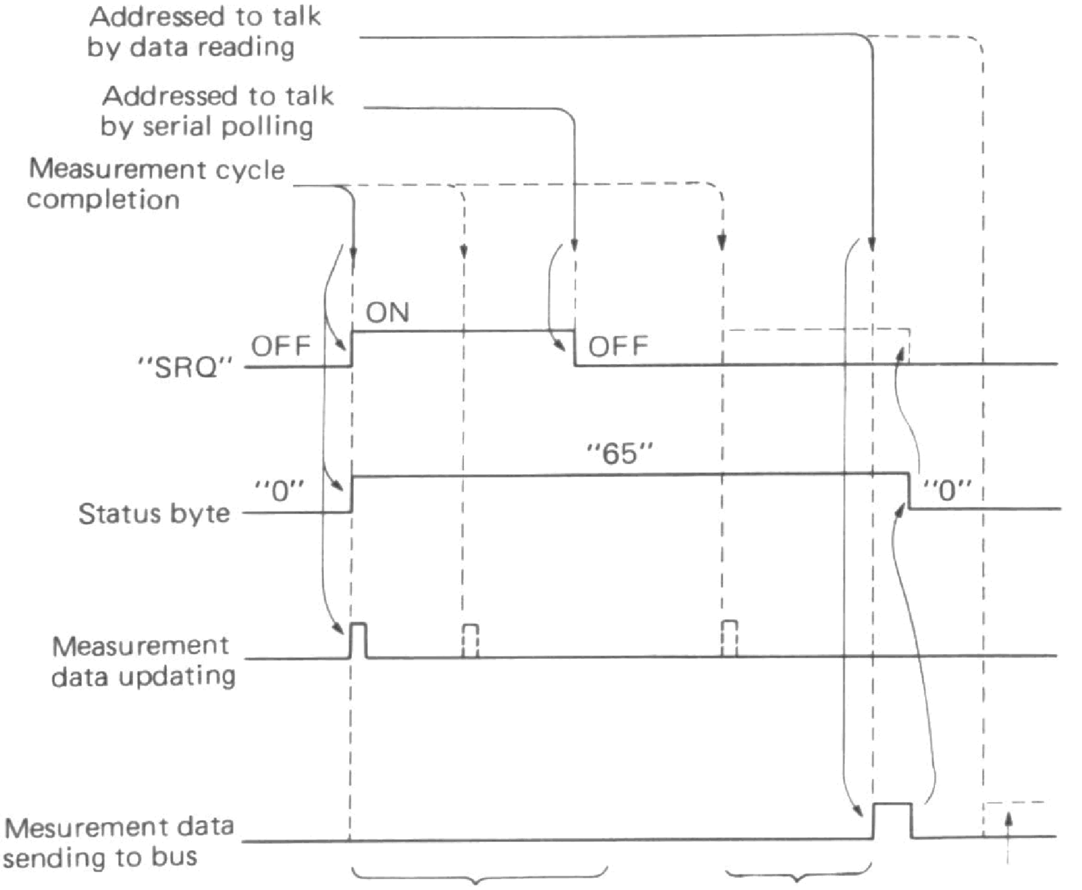


NOTE: When interrupted in the SRQ mode, the interrupt is made to complete by addressing the device to talk for sending out the data without normal interrupt processing.

4-6-2. Serivce Request Operation

The following operation is made when a service is requested on completing the measurement cycle. Keep this in mind at program preparation.

(1) With serial polling

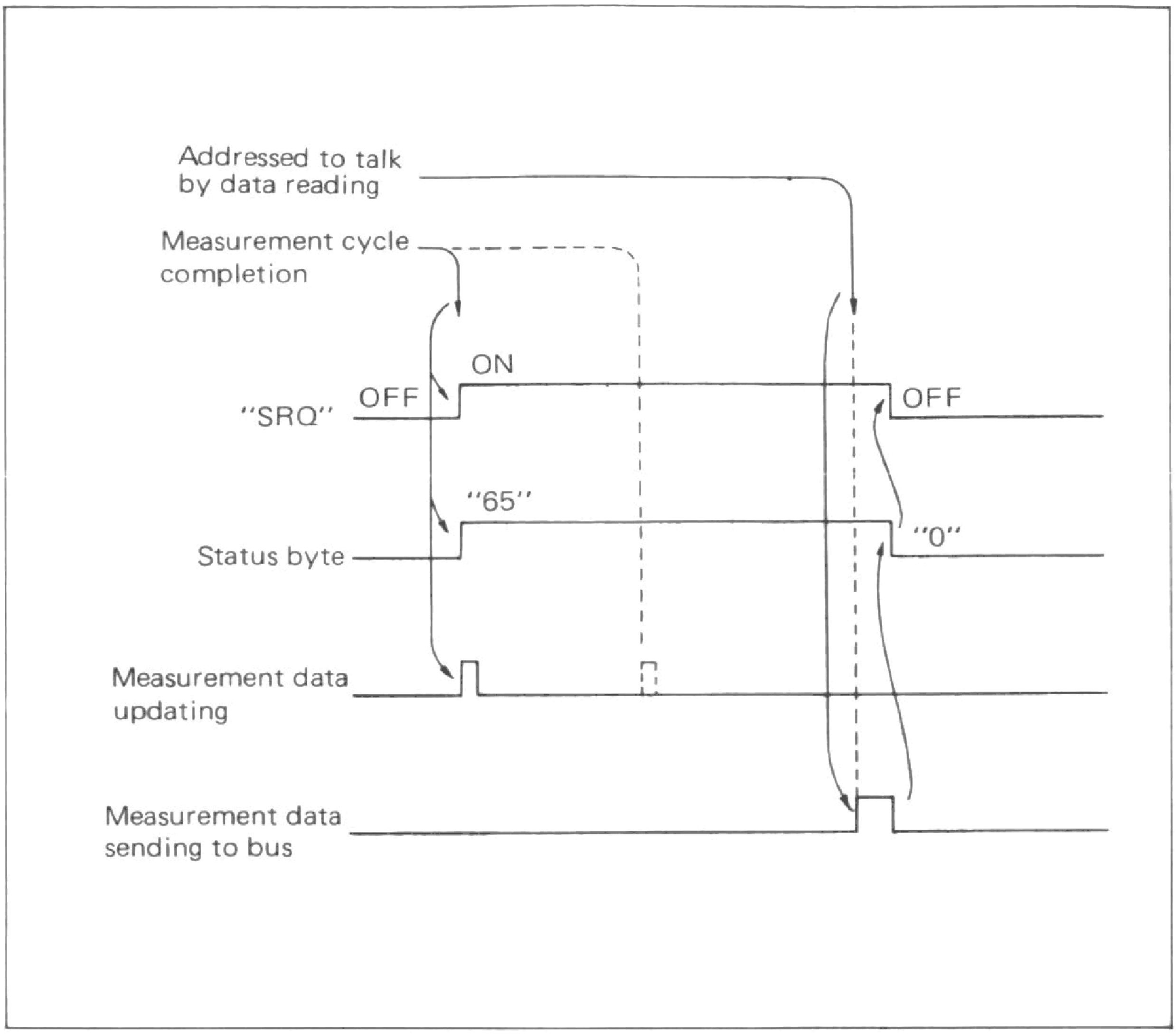


Data is updated if measurement cycle is completed during this period.

SRQ is set to ON, and data is updated.

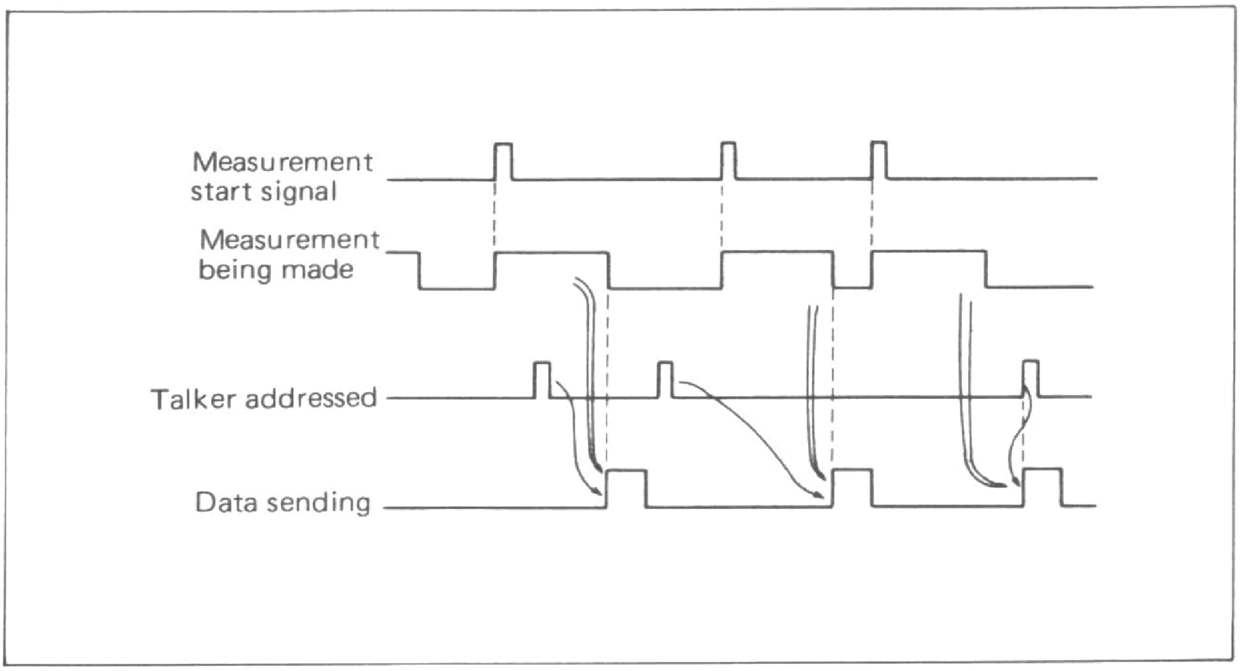
Data does not exist; operation waits for the next data.

(2) When serial polling is not used

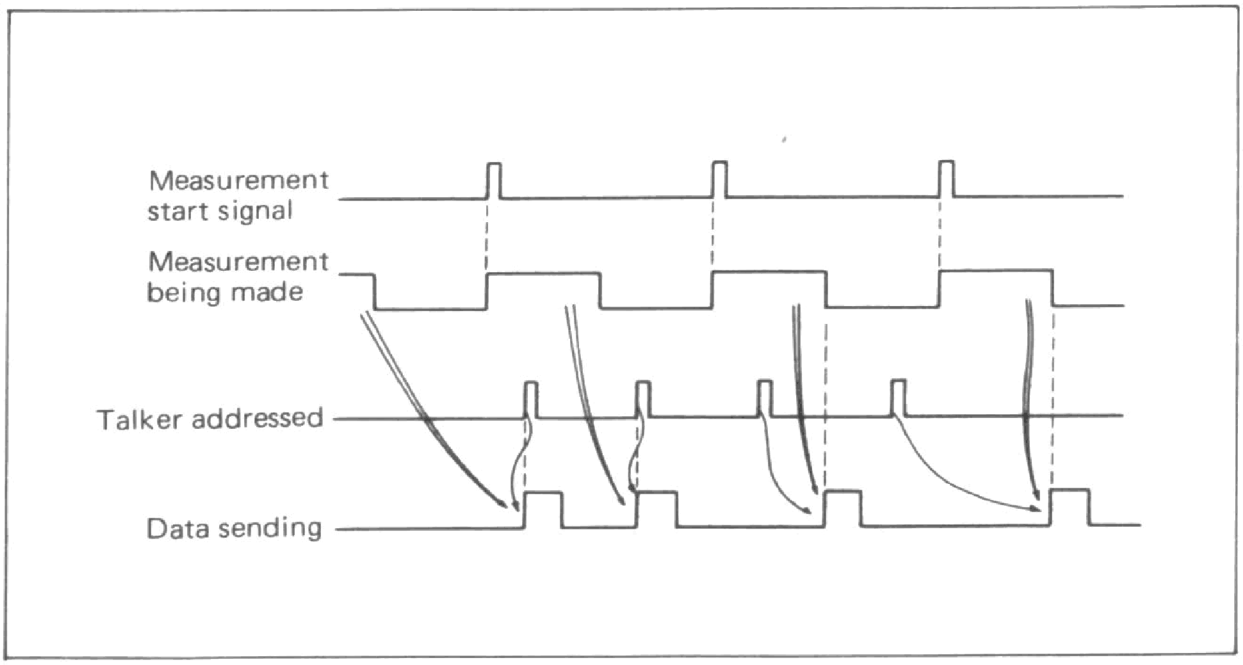


4-6-3. Data Sending Timing

(1) When measurement is started by program



(2) When measurement is started manually or by free-run



4-6-4. Programming Examples

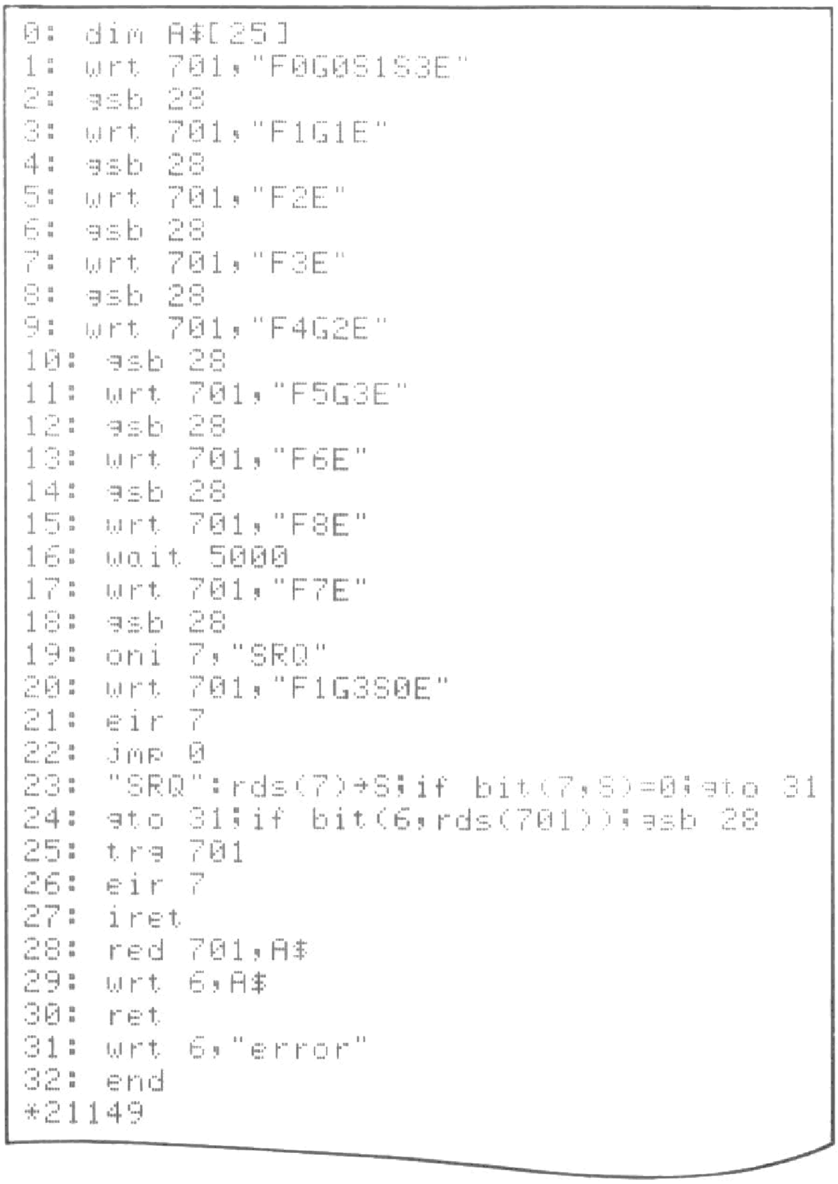
Program examples of the same operation using three different controllers are shown here. Since these programs cover all measurement function operations, they can be used as test programs.

The mainframe input setting is about 1 MHz at Input-A terminal and about 250 MHz at Input-C terminal.

SEP./COM.A switch is set to **COM. A**, and SLOPE is + for Channel A and – for Channel B.

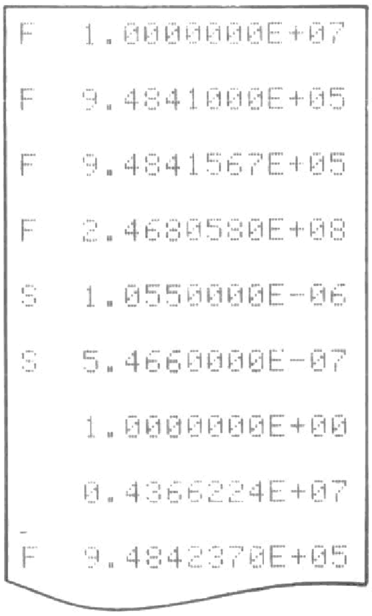
(1) Program for using HP9825

Program example



```
0: dim A$[25]
1: wrt 701,"F0G0S1S3E"
2: gsb 28
3: wrt 701,"F1G1E"
4: gsb 28
5: wrt 701,"F2E"
6: gsb 28
7: wrt 701,"F3E"
8: gsb 28
9: wrt 701,"F4G2E"
10: gsb 28
11: wrt 701,"F5G3E"
12: gsb 28
13: wrt 701,"F6E"
14: gsb 28
15: wrt 701,"F8E"
16: wait 5000
17: wrt 701,"F7E"
18: gsb 28
19: oni 7,"SRQ"
20: wrt 701,"F1G3S0E"
21: eir 7
22: jmp 0
23: "SRQ":rds(7)→S;if bit(7,S)=0;gto 31
24: gto 31;if bit(6,rds(701));gsb 28
25: trg 701
26: eir 7
27: iret
28: red 701,A$
29: wrt 6,A$
30: ret
31: wrt 6,"error"
32: end
*21149
```

Data example



```
F   1.0000000E+07

F   9.4841000E+05

F   9.4841567E+05

F   2.4680580E+08

S   1.0550000E-06

S   5.4660000E-07

    1.0000000E+00

    0.4366224E+07
-
F   9.4842370E+05
```

Program explanation

0 : Defines the measurement data storage area.
1 : Set function CHECK, gate time 10 ms, no SRQ, and HOLD. Start measurement (GET).
2 : Jump to the subroutine beginning at line 28.
3 : Set frequency measurement gate time 10 ms. GET. (S1 and S3 set at line 1 remain unchanged.)
5 : Set input-B frequency measurement. GET.
7 : Set input-C frequency measurement. GET.
9 : Set period measurement, multiplier x100. GET.
11 : Set time interval measurement and multiplier x1000. GET.
13 : Set frequency ratio measurement. GET.
15 : Set totalize and gate open. GET.
16 : Wait 5 seconds.
17 : Set totalize and gate closed. GET.
19 : Define the interrupt processing routine.
20 : Set frequency measurement, gate time 10 s, and SRQ output on completion of measurement cycle. GET.
21 : Enable an interrupt.
22 : Wait for an interrupt.
23 : Read port 7 connected to this universal counter, and check whether an interrupt occurred.
24 : Poll to see if an interrupt occurred from this unit; if so, go to line 28.
25 : GET.
26 : Enable an interrupt.
27 : Returns from the interrupt processing routine to the main routine.
28 : Read the measurement data.
29 : Print the measurement data.
30 : Return to the main routine.
31 : Print "error"

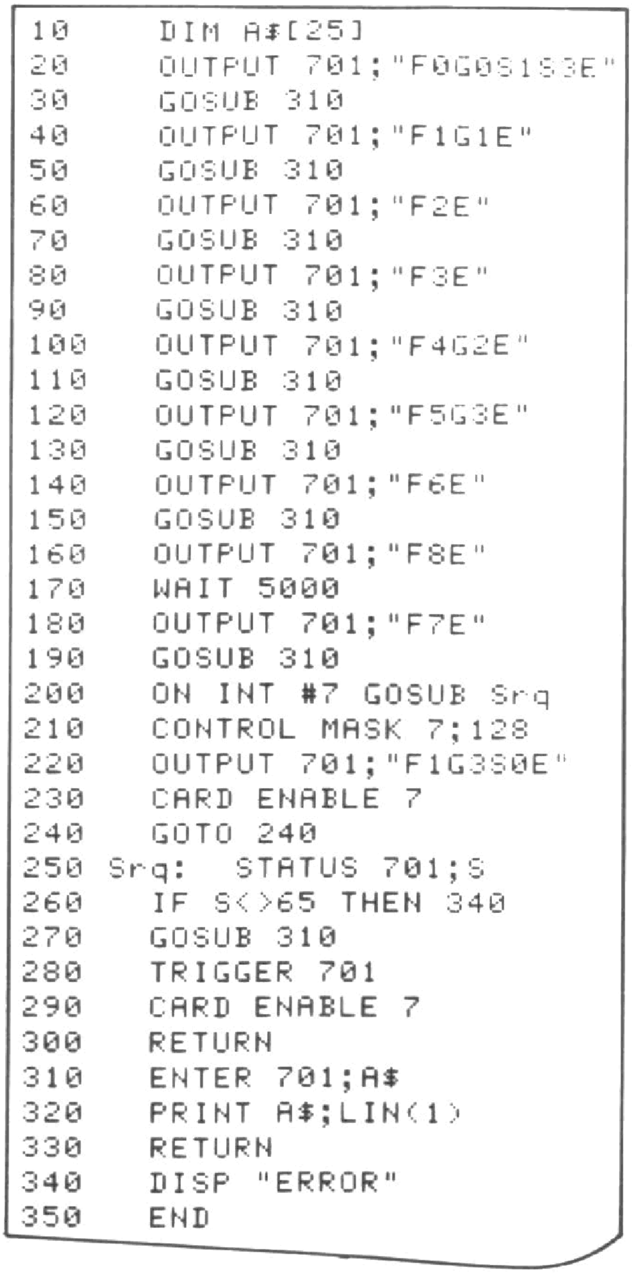
Data output description

F : Indicates that the unit is Hz.
1.0000000E + 07: 1×10^7, i.e., 10 MHz.
S : Indicates that the unit is s.
1.0550000E–06: 1.055×10^{-6}, i.e., 1.055 μs.

The output data is as follows, in order:

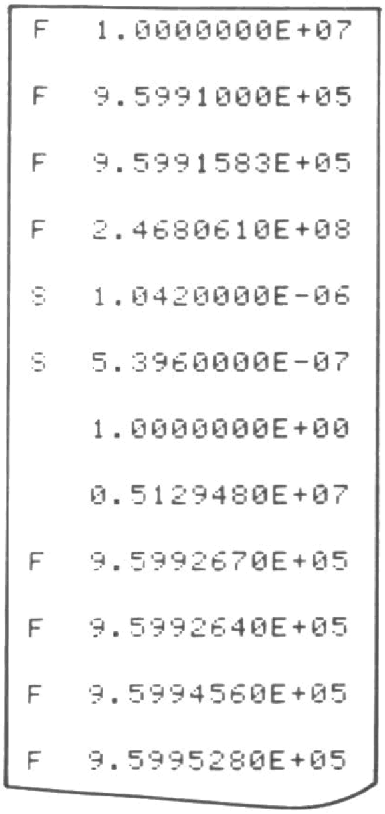
CHECK	10 MHz
Frequency A	948.41 kHz
Frequency B (reciprocal)	948.41567 kHz
Frequency C	246.8058 MHz
Period	1.055 μs
Time interval	0.5466 μs
Ratio	1
Totalize	4366224
Frequency A	948.4237 kHz

(2) Program for using HP9845



Program example

```
10      DIM A$[25]
20      OUTPUT 701;"F0G0S1S3E"
30      GOSUB 310
40      OUTPUT 701;"F1G1E"
50      GOSUB 310
60      OUTPUT 701;"F2E"
70      GOSUB 310
80      OUTPUT 701;"F3E"
90      GOSUB 310
100     OUTPUT 701;"F4G2E"
110     GOSUB 310
120     OUTPUT 701;"F5G3E"
130     GOSUB 310
140     OUTPUT 701;"F6E"
150     GOSUB 310
160     OUTPUT 701;"F8E"
170     WAIT 5000
180     OUTPUT 701;"F7E"
190     GOSUB 310
200     ON INT #7 GOSUB Srq
210     CONTROL MASK 7;128
220     OUTPUT 701;"F1G3S0E"
230     CARD ENABLE 7
240     GOTO 240
250 Srq:  STATUS 701;S
260     IF S<>65 THEN 340
270     GOSUB 310
280     TRIGGER 701
290     CARD ENABLE 7
300     RETURN
310     ENTER 701;A$
320     PRINT A$;LIN(1)
330     RETURN
340     DISP "ERROR"
350     END
```



Data example

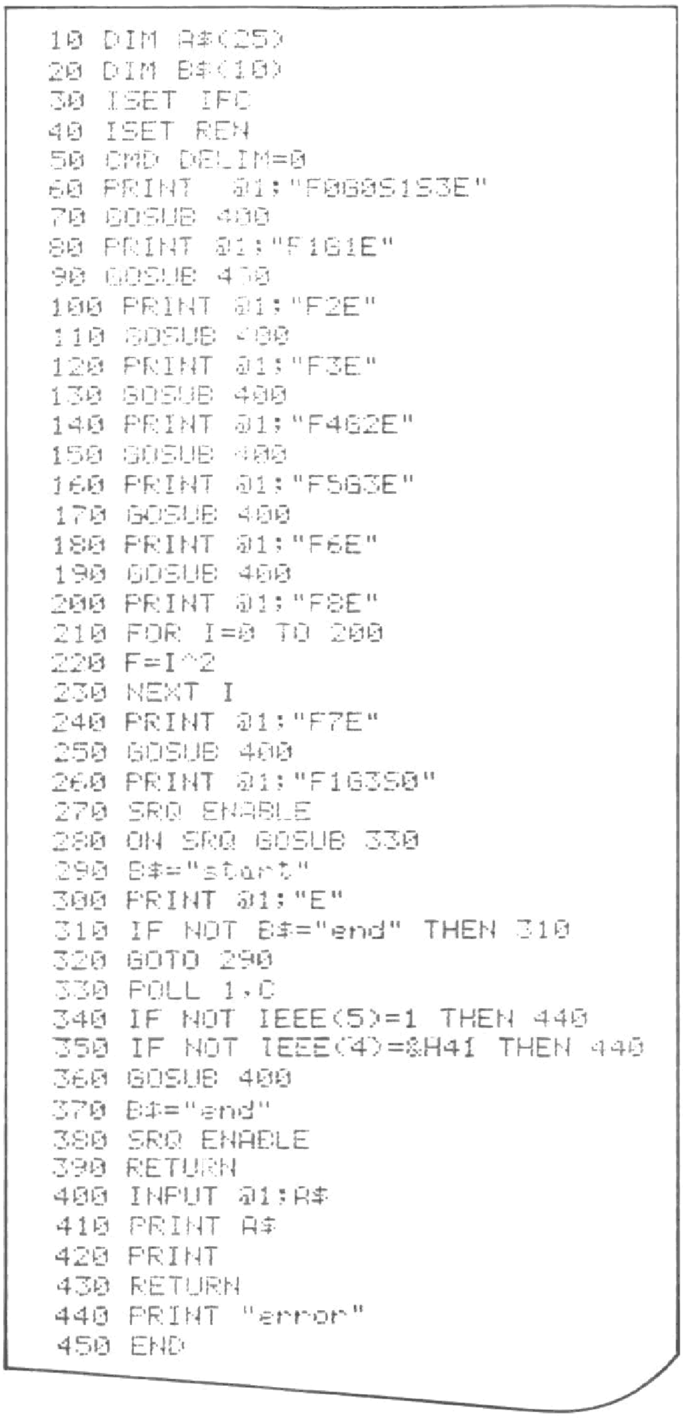
```
F   1.0000000E+07

F   9.5991000E+05

F   9.5991583E+05

F   2.4680610E+08

S   1.0420000E-06

S   5.3960000E-07

    1.0000000E+00

    0.5129480E+07

F   9.5992670E+05

F   9.5992640E+05

F   9.5994560E+05

F   9.5995280E+05
```

Program description

10 ~ 190 : Corresponds to lines 0 to 18 of the program for using HP9825.
200 : Go to subroutine Srq if an interrupt occurs in port 7.
210 : Remove the mask for the SRQ bit in the controller.
220 : Set frequency measurement, gate time 10 s, and SRQ output. GET.
230 : Enable an interrupt.
240 : Wait for an interrupt.
250 : Jump to this line on interrupt. Read the status byte of this unit.
260 : Go to 340 if the status is not 65.
280 : GET.
290 : Enable an interrupt.
300 : Return from the interrupt processing routine to the main routine.
310 : Read the measurement data.
320 : Print the measurement data. Skip a line.
330 : Return to the main routine.
340 : Displays ERROR.

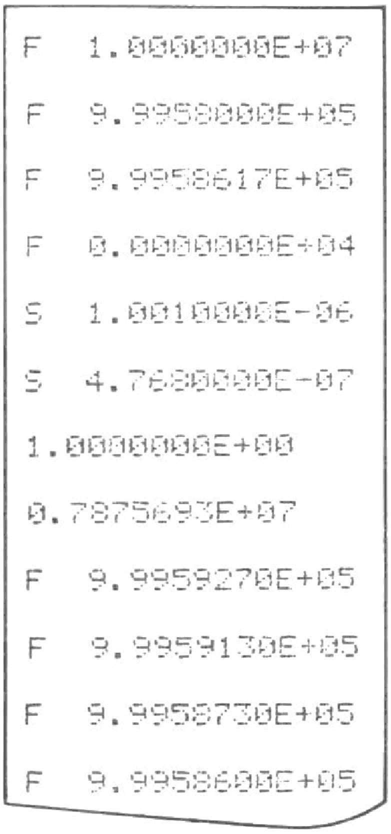
(3) Program for using NEC PC-8001

Program example



```
10 DIM A$(25)
20 DIM B$(10)
30 ISET IFC
40 ISET REN
50 CMD DELIM=0
60 PRINT  @1;"F0G0S1S3E"
70 GOSUB 400
80 PRINT @1;"F1G1E"
90 GOSUB 400
100 PRINT @1;"F2E"
110 GOSUB 400
120 PRINT @1;"F3E"
130 GOSUB 400
140 PRINT @1;"F4G2E"
150 GOSUB 400
160 PRINT @1;"F5G3E"
170 GOSUB 400
180 PRINT @1;"F6E"
190 GOSUB 400
200 PRINT @1;"F8E"
210 FOR I=0 TO 200
220 F=I^2
230 NEXT I
240 PRINT @1;"F7E"
250 GOSUB 400
260 PRINT @1;"F1G3S0"
270 SRQ ENABLE
280 ON SRQ GOSUB 330
290 B$="start"
300 PRINT @1;"E"
310 IF NOT B$="end" THEN 310
320 GOTO 290
330 POLL 1,C
340 IF NOT IEEE(5)=1 THEN 440
350 IF NOT IEEE(4)=&H41 THEN 440
360 GOSUB 400
370 B$="end"
380 SRQ ENABLE
390 RETURN
400 INPUT @1;A$
410 PRINT A$
420 PRINT
430 RETURN
440 PRINT "error"
450 END
```

Data example



```
F   1.0000000E+07

F   9.9958000E+05

F   9.9958617E+05

F   0.0000000E+04

S   1.0010000E-06

S  4.7680000E-07

1.0000000E+00

0.7875693E+07

F   9.9959270E+05

F   9.9959130E+05

F   9.9958730E+05

F   9.9958600E+05
```

Program description

10 : Define the measurement data storage area.
20 : Define the character data storage area.
30 : Initialize the interface.
40 : Set remote.
50 : Set delimiters to CR, LF, and EOI.
60 ~ 200 : Corresponds to lines 2 to 16 of the program for HP9825.
210 ~ 230 : Use as timer.
260 : Set frequency measurement, gate time 10 s, SRQ output.
270 : Enable SRQ interrupt.
280 : Go to line 330 by SRQ interrupt.
290 : Enter “start” in area B.
300 : GET.
310 : Wait for measurement completion.
330 : Read the status byte of this unit.
340 : Check to see whether the SRQ-sending device address is 1.
350 : Check the status of the SRQ-sending device.
370 : Enter “end” in area B.
380 : Enable an interrupt.
390 : Return to the main routine.
400 : Read the measurement data.
410 : Print the measurement data.
420 : Skip a line.
430 : Return to the main routine.
440 : Print “error”.

SECTION 5
PRINCIPLES OF OPERATIONS

5-1. Introduction

This counter consists of a central microprocessor, two LSIs, a display IC, and an input circuit. The central microprocessor controls the two LSIs for measurement, processes the obtained data, and routes the processed data to the display IC or the external interface circuit. It also controls the panel switches and changes the measurement function according to the information from the panel. Thus, the instrument is operated completely under control of the microprocessor. This counter also has a self-diagnostics function by means of the microprocessor itself. Figure 5-1 shows the block diagram.

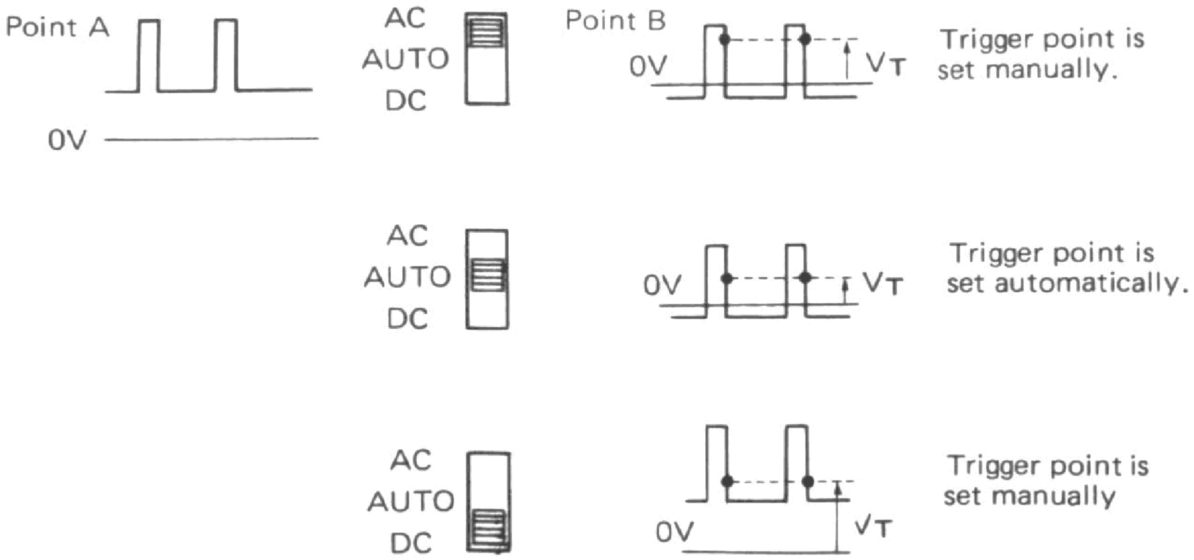
5-2. Operation of Each Block

5-2-1. Input Circuit

The input circuit shapes any signal to be measured into a waveform so the subsequent logic circuits can operate correctly. **AC-AUTO-DC, SENS., FILTER, LEVEL, SEP./COM. A, SLOPE** are provided for this purpose.

(1) **AC-AUTO-DC**

When the waveform at point A in Figure 5-1 is as shown below, the waveform is shaped as on the right side of the figure according to **AC-AUTO-DC** selection. **AC** rejects the DC components, **AUTO** suppresses the DC component and automatically sets the trigger point at the 50% level of the amplitude, and **DC** sends the input waveform as it is to the Schmitt trigger circuit.



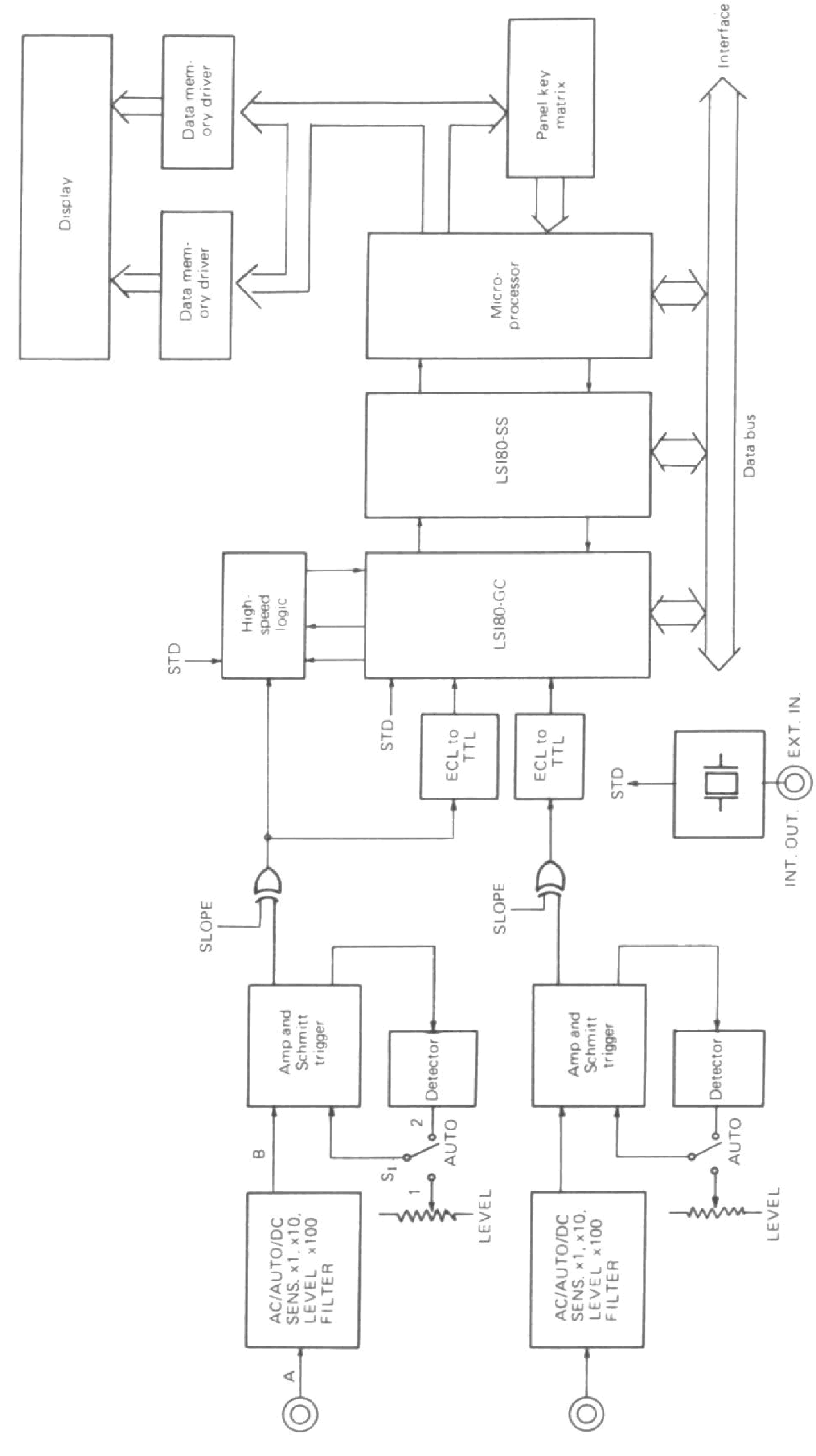
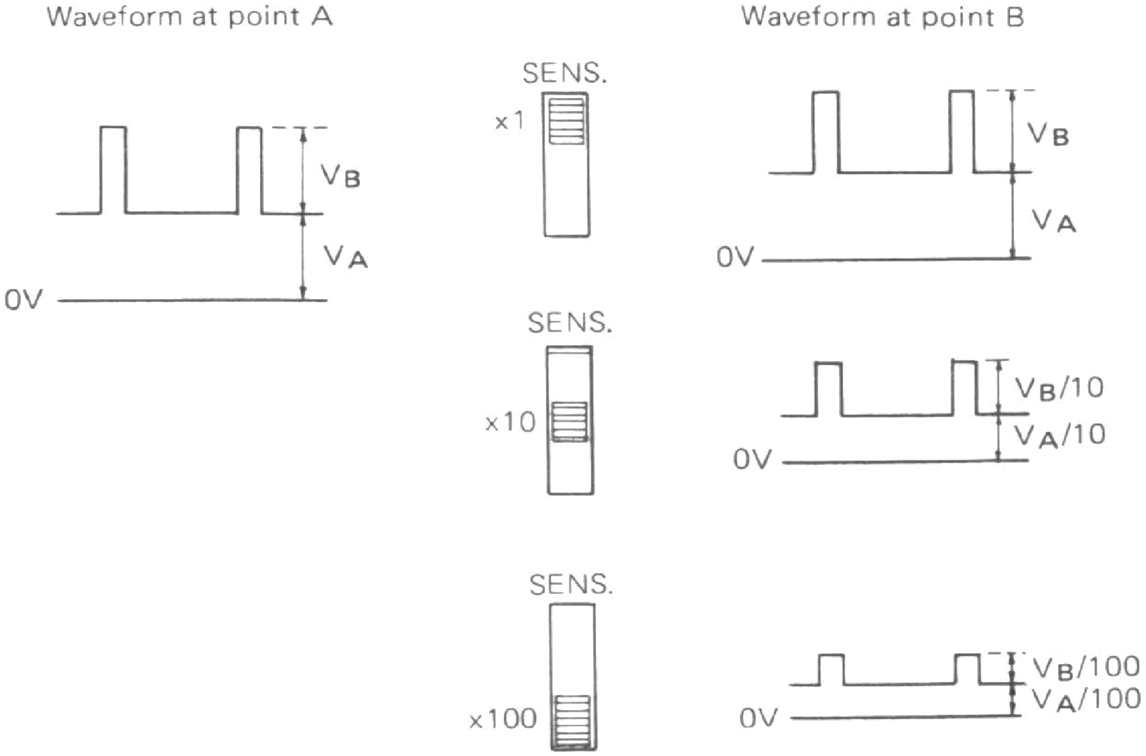


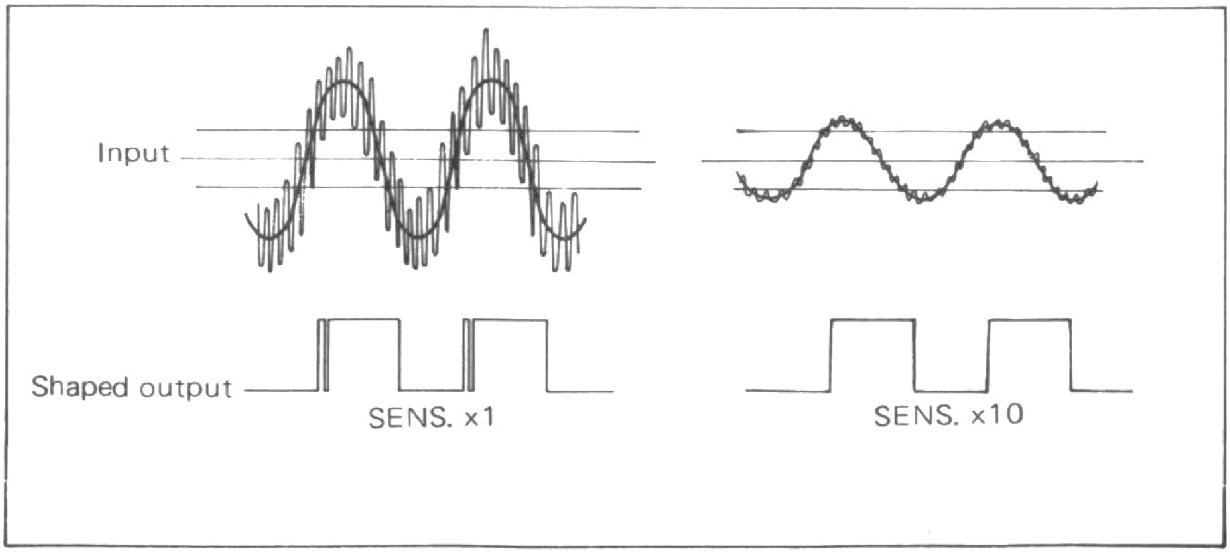
Fig. 5-1 **TR5821/5822/5823** block diagram

(2) **SENS.**

Attenuator for adjusting the amplitude of the waveform to be sent to the Schmitt trigger circuit between the sensitivity voltage and the maximum input voltage.

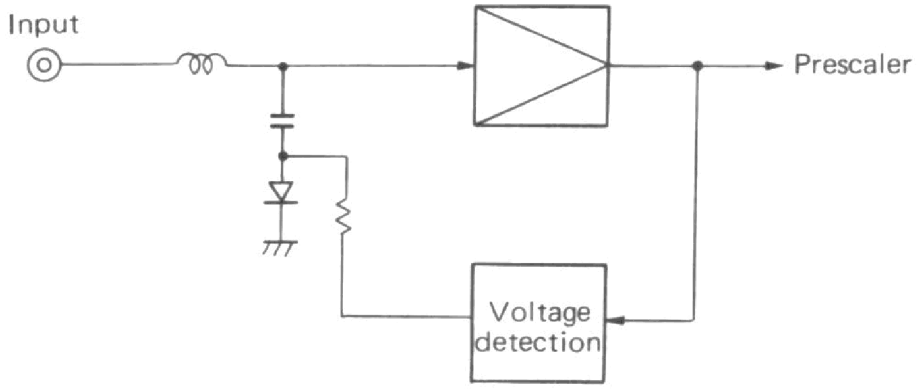


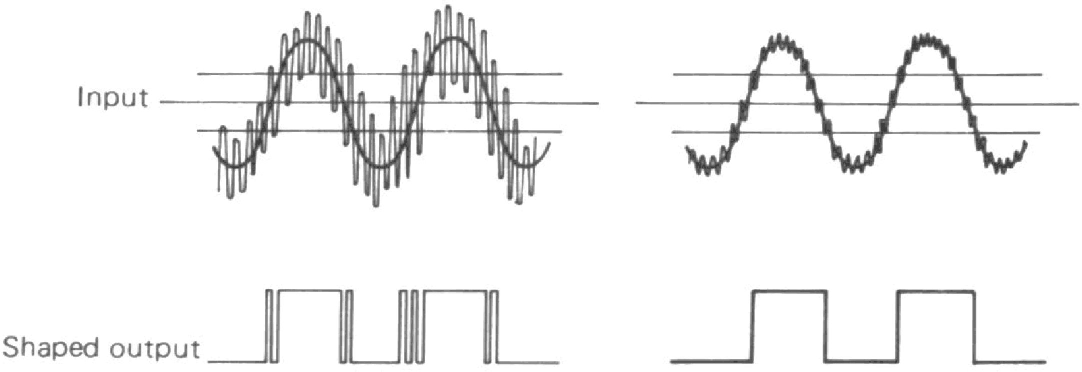
If appropriate **SENS.** is not selected, counting may fail or the trigger point may deviate when the input exceeds the maximum input voltage. The attenuator is also effective for noise rejection. (Frequency measurement FREQ. A, C)



(3) **FILTER**

Generally, a low-pass filter is used for counter input. The cutoff frequency is about 100 kHz for the **TR5821/22/23. TR5823 INPUT C** has the ANS (Automatic Noise Suppressor) capability, and a filter is changed in compliance with the signal to be measured.



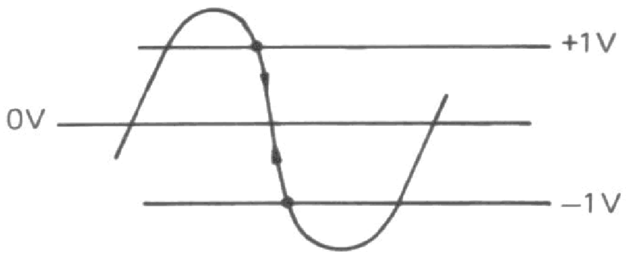


ANS/FILTER OFF

ANS/FILTER ON

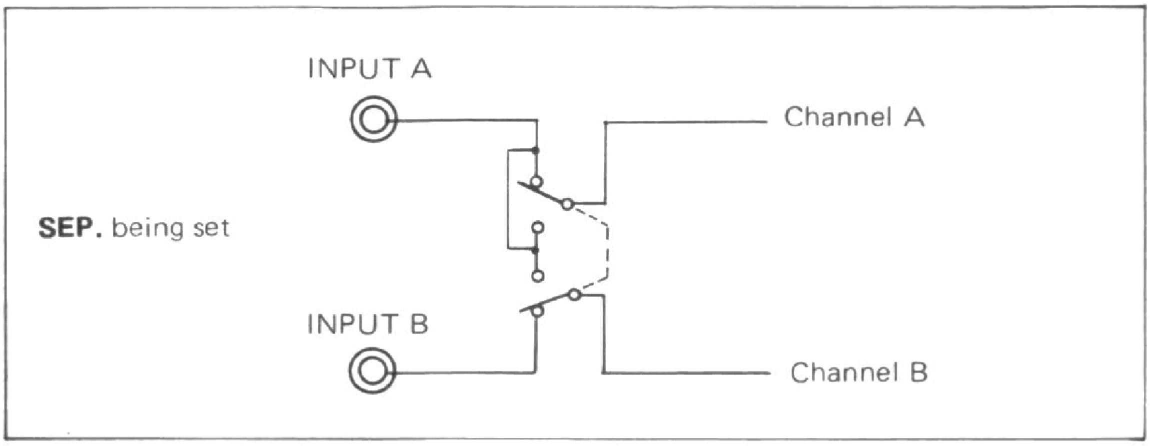
(4) **LEVEL**

The trigger level changes within a range of about +1 V to –1 V, that is, the trigger point can be set in the input voltage range of +1 V to –1 V. For **SENS.** x10 and x100, the input voltage range appears to vary between +10 to –10 V and +100 to –100 V respectively.



(5) **SEP./COM. A**

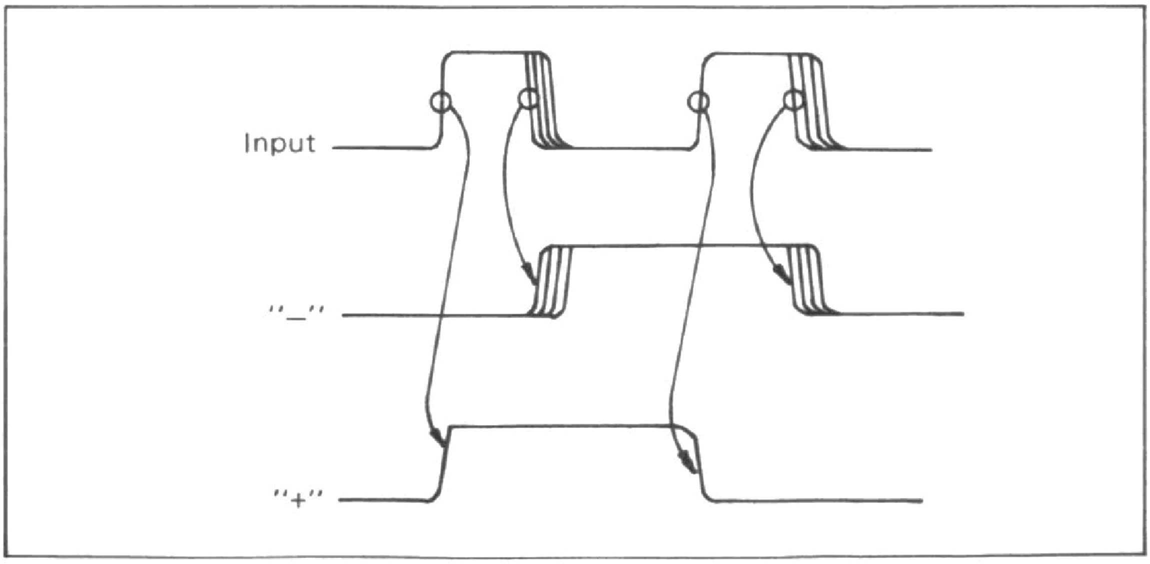
The counter has an input connector corresponding to each input channel. In measuring the time interval of a single signal, the same signal is input to both input connectors. If **SEP./COM. A** is set to **COM. A,** the signal at **INPUT A** connector is supplied to channels A and B; in **COM. A**, however, the input impedance will be about 500 kΩ and the shunt capacitance about 60 pF. The **TR5821/5822/5823** have two frequency modes, **FREQ. A** and **FREQ. B. FREQ. A** gives higher precision for frequencies above 1 MHz, and **FREQ. B** gives higher precision for frequencies below 1 MHz. High-precision measurement over a wide range of frequencies is enabled by switching between **FREQ. A** and **FREQ. B** at setting **COM. A.**



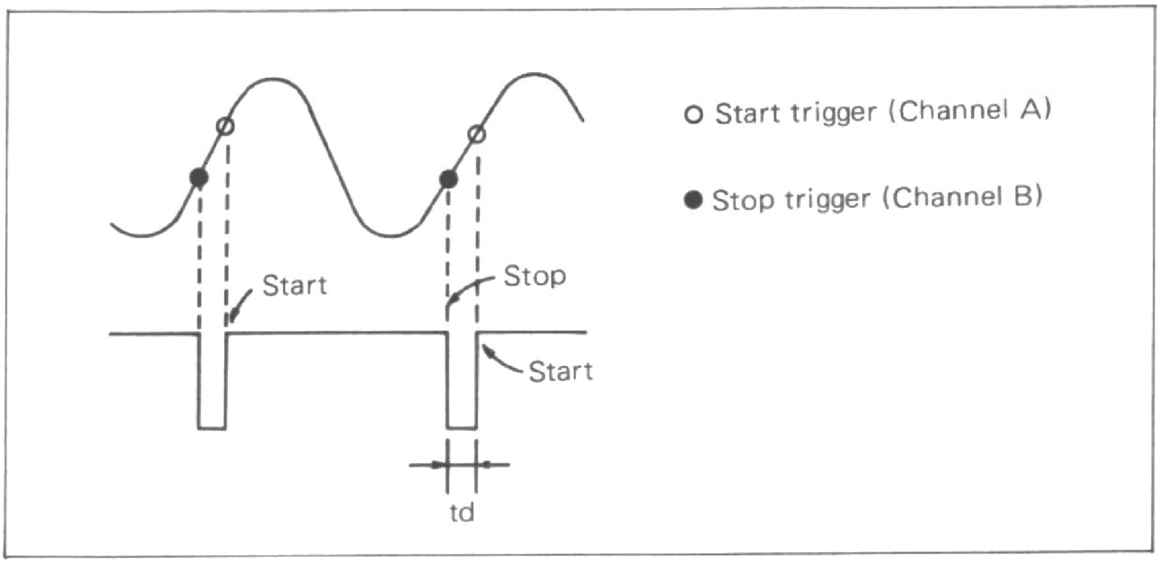
As shown above, this switching is made immediately after the input connector; therefore, **AC-AUTO-DC, SENS., SLOPE,** and **LEVEL** settings can be made independently for each channel.

(6) **SLOPE**

This is not used so much by functions other than time interval measurement; however, it is effective when the jitter varies with the slope. For example, the period measurement is actually the time interval measurement between the slopes of the same polarity, and if jitter exists, the measurement value is also unstable.



As shown in the preceding figure, stable mesaurement can be obtained by selecting either – or + slope.



The start and stop triggers can be determined as shown above according to the trigger level. The time between the stop trigger and start trigger (t_d; dead time = 50 ns) must be maintained.

5-2-2. LSI80-GC/SS

The basic section of the counter incorporates these two LSIs. The LSIs are controlled by the microprocessor via the data bus. LSI80-GC is an LS-TTL LSI having an integration scale of 500 gates. Its toggle frequency is 60 MHz or higher; the frequency of 120 MHz can be realized by externally connecting a 1/2 scaler. LSI80-SS, connected to LSI80-GC, is a CMOS LSI having an integration scale of 2,000 gates and toggle frequency of 12 MHz or higher.

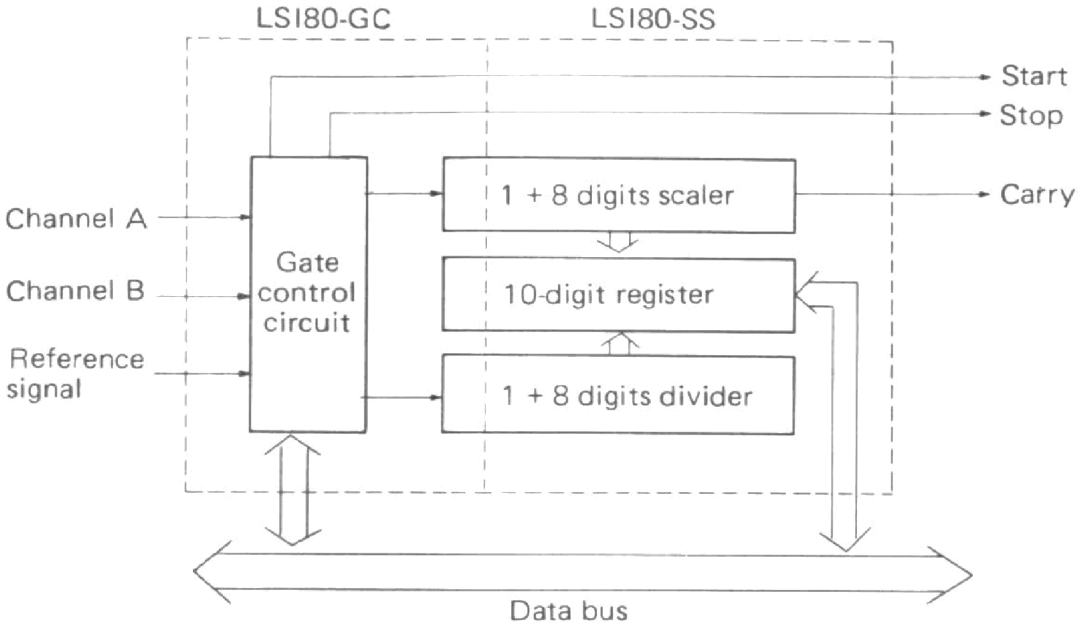


Fig. 5-2 LSI80-GC and LSI80-SS

5-2-3. Microprocessor

The microprocessor in this counter has the following functions:

(1) Self-diagnostics function
  a. ROM check
  b. RAM check
  c. I/O check
  d. LSI80-GC operation check
  e. LSI80-SS operation check
  f. Reference signal check
  g. Panel switch check

These checks are made when the **POWER** switch is turned on. If an error is found, an error message (see Table 3-1) is displayed to indicate where it is. If no error is found, all segments and all lamps (except the decimal point and the **RMT** lamp) go on.

(2) LSI80-GC/SS control
LSI80-GC/SS is connected to the microprocessor via the data bus and several control lines. Function data and measurement data are transferred via the data bus, and the microprocessor monitors the control lines to control LSI80-GC/SS.

(3) Data processing
The microprocessor performs various arithmetic operations (by the Calculation Unit) based on the result measured by LSI80-GC/SS in order to obtain the final data needed.

(4) Panel switch control
Upon change of the panel state (operator operates a switch), the microprocessor reads the change and executes a new function.

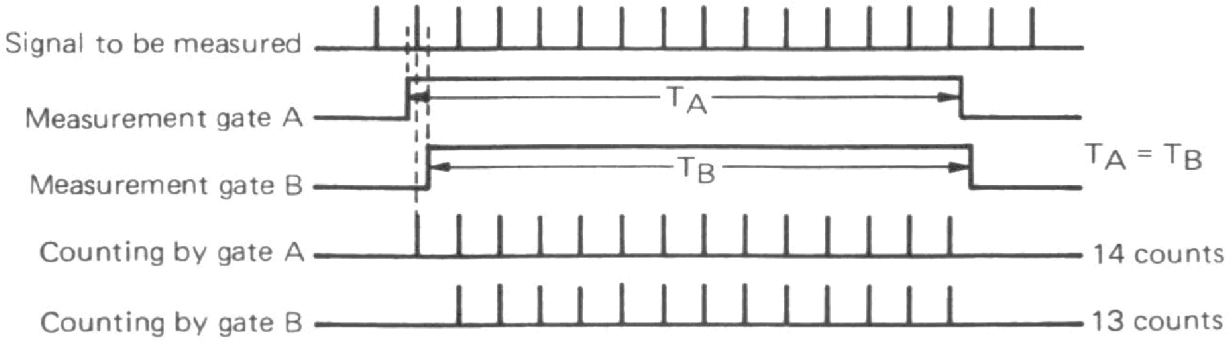
(5) Data transfer to display driver and interface section
Microprocessor transfers data to the display driver to display the result, and to the interface section for data transfer to external devices. Since these data are sent for different purposes, different data formats and control methods are used.

(6) Remote data reading from interface section
The GPIB interface is connected to the **TR5822/23**; remote data can be read from the external controller for function execution.

5-3. Measurement Accuracy

5-3-1. Frequency Measurement (**FREQ. A, C**)

The measurement method employed here counts the number of repetitions of the signal to be measured per unit time and displays it as the frequency (c/s = Hz). As a consequence, the quantization error of ±1 count as shown below occurs in the least significant digit.

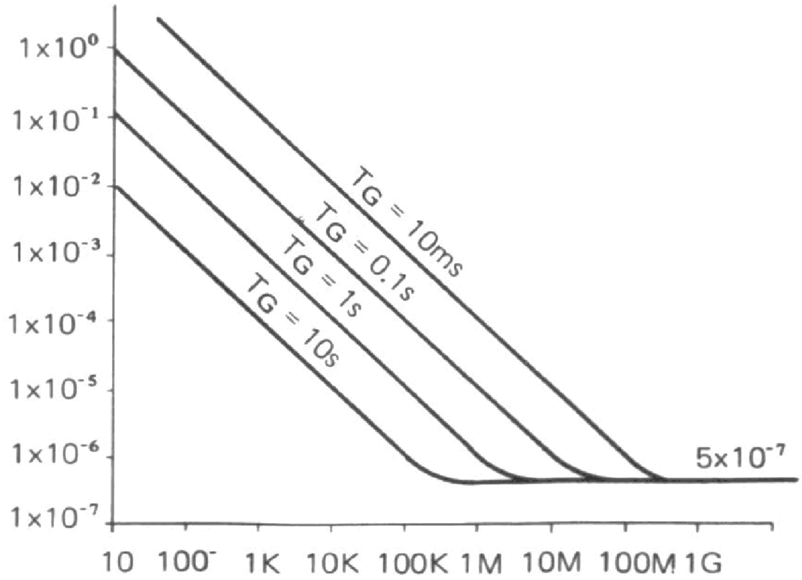


This is expressed as follows:

$$\frac{1}{f_X \times T_G} = \pm\text{LSD of the display}$$

where: f_X = Measured frequency (Hz)
T_G = Gate time (s)

The accuracies for different frequencies and gate times are shown below. **FREQ. C** uses a divide-by-twenty prescaler; the accuracy is reduced by 1 digit for the same gate time.

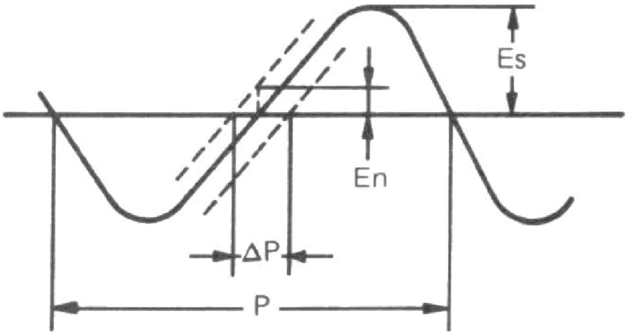


5-3-2. Frequency Measurement (FREQ. B)

The reciprocal scheme, which calculates the inverse of the period measurement result, is very economical and quick in response for measuring low frequencies with high precision. In this counter, the microprocessor, operating as a controller, performs inverse calculation and displays the frequency. The disadvantage of the reciprocal taking counters is that noise added to the signal directly affects the accuracy of the measured signal. Assume superimposed noise as illustrated below, and the error (called the trigger error) is as follows:

$$\text{Trigger error} = \frac{\Delta P}{P} = \frac{En}{\pi Es} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad ①$$

where: En = Noise voltage
Es = Voltage of the signal of interest



The lower the En/Es ratio, the greater the accuracy. The counter naturally contains internal noise which must also be considered in determining accuracy. The internal noise in this counter is 100 μVrms or less. Therefore, if the signal to be measured does not have any noise and the input voltage is 100 mVrms,

$$\text{Trigger error} = \frac{100 \times 10^{-6}}{\pi \times 100 \times 10^{-3}} \fallingdotseq 3.2 \times 10^{-4} \quad \ldots\ldots\ldots\ldots \quad ②$$

To obtain greater accuracy, an average measurement is needed. The trigger error is averaged by expanding P in the above figure by 10^n periods:

$$\text{Trigger error} = \frac{1}{10^n} \times \frac{En}{\pi Es} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad ③$$

The counter performs this automatically; therefore, the higher the frequency, the greater the measurement accuracy. The relationship between the frequency, measurement time and the number of periods is shown on the next page.

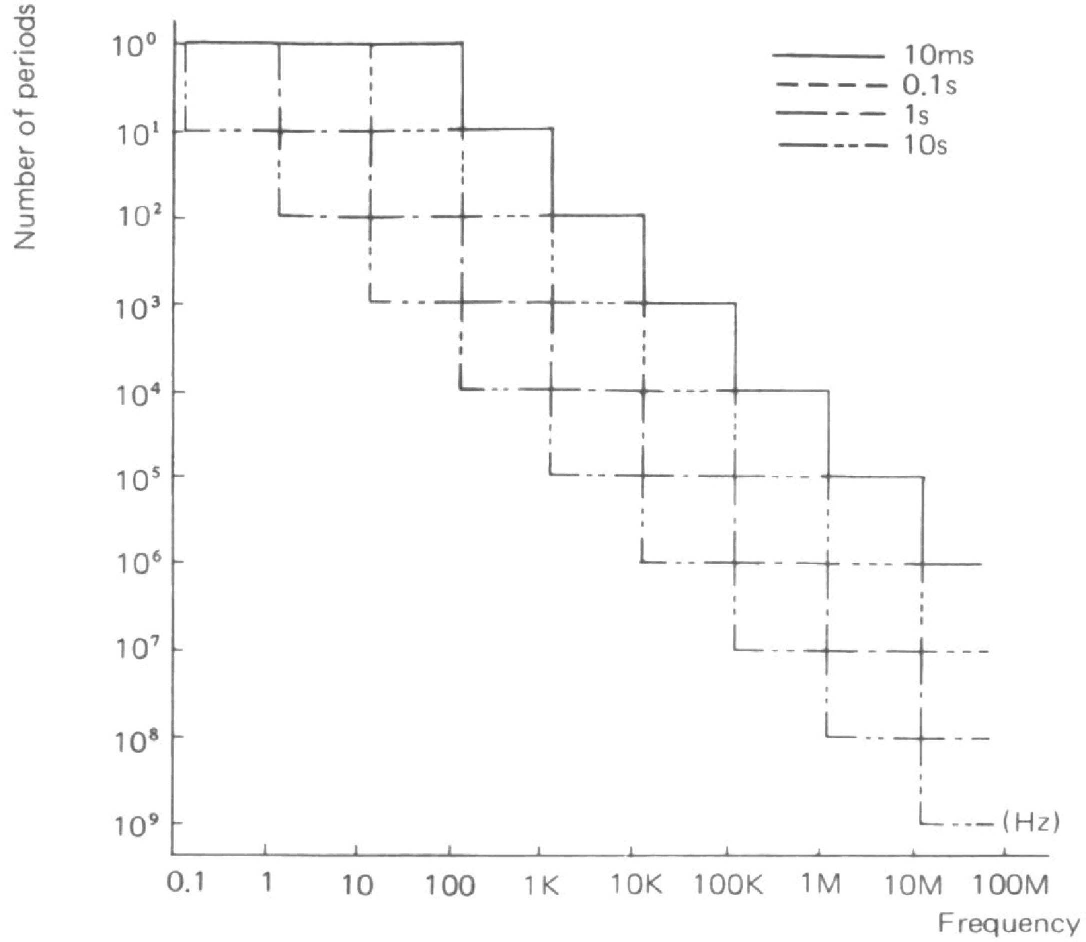


Fig. 5-3 Number of periods with time & frequency

The number of display digits is five for 10 ms, six for 0.1 s, seven for 1 s, and eight for 10 s.

5-3-3. Period Measurement (**PERIOD B**)

This is basically the same as the frequency measurement (**FREQ. B**). (See 5-3-2.)

5-3-4. Time Interval Measurement (**T.I. A → B**)

This is basically the same as the frequency measurement (**FREQ. B**) and period measurement (**PERIOD B**). The measurement time is dependent on the signal to be measured and noise riding along with it causes trigger error, which is calculated by equation ① in 5-3-2. Equation ① applies to a sine wave; for a pulse, however, the trigger error expressed with the slew rate (SR) would afford a better understanding:

$$\text{Trigger error} = \frac{1.4 \times \sqrt{(\text{counter internal noise})^2 + (\text{Noise on input})^2}}{\text{SR}} \ (\text{Srms})$$

The relationship between SR, amplitude, and frequency of a sine wave is shown below.

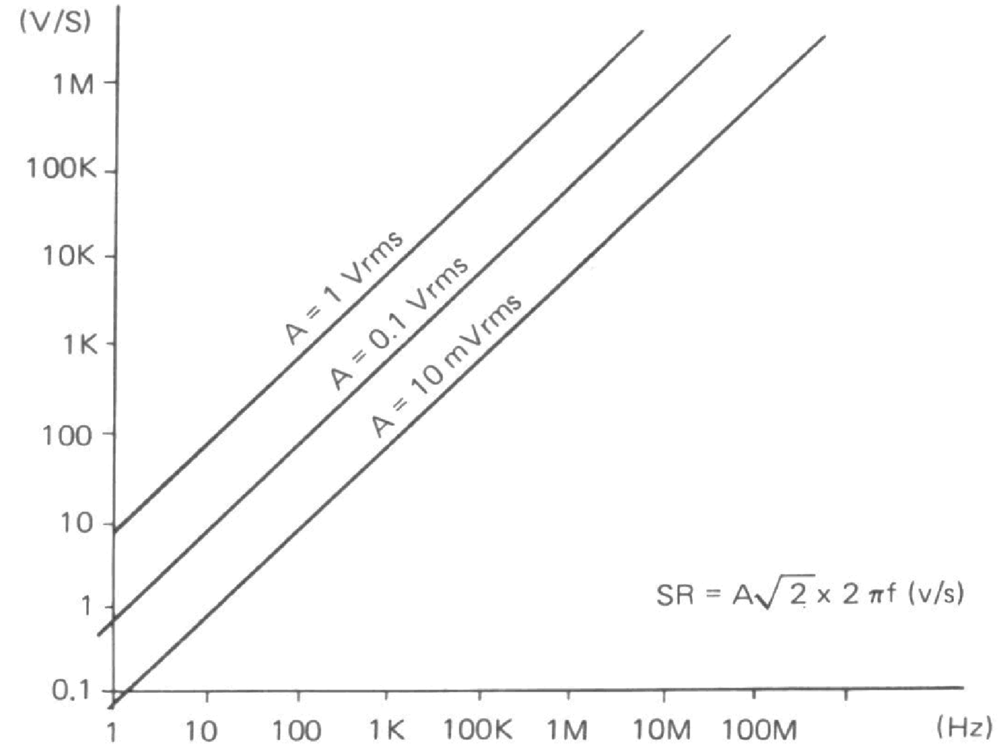


Fig. 5-4 Slew rate vs amplitude & frequency

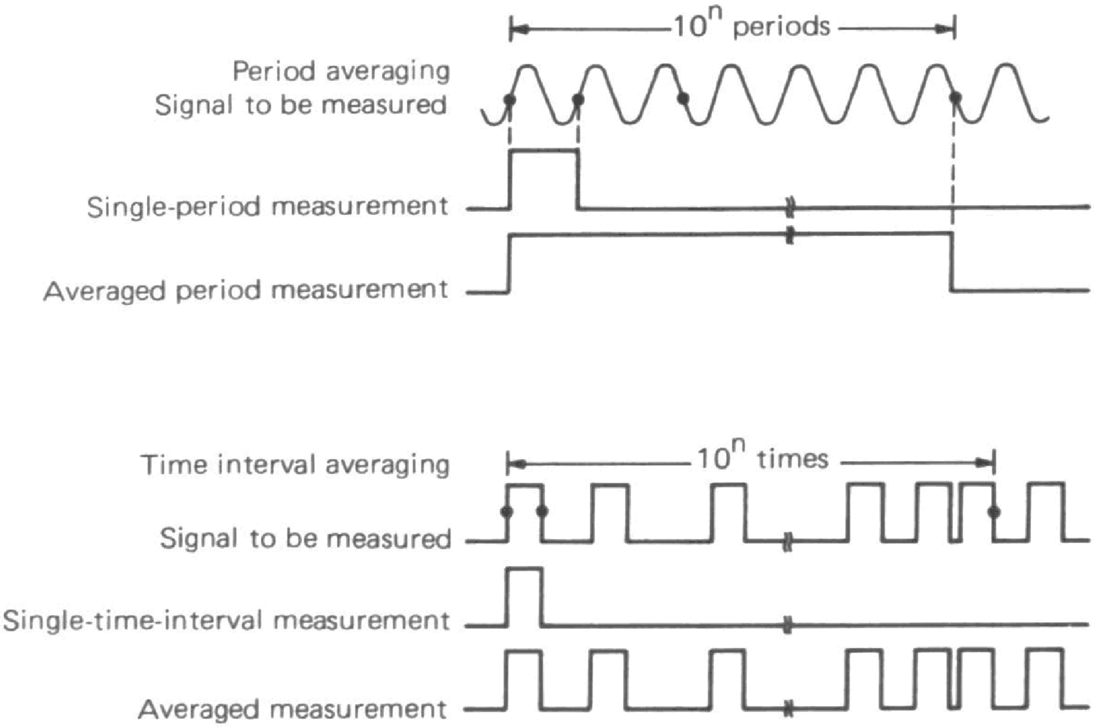


Fig. 5-5 Period/time interval averaging

In period measurement, the trigger error is reduced to $1/10^n$ for averaging number 10^n. In time interval measurement, on the other hand, the trigger error is reduced to only $1/\sqrt{10^n}$ for averaging number 10^n. This is because the averaging technique differs from that for the period measurement as shown; that is, counting is performed continuously from measurement start to end in period measurement whereas, in time interval measurement, counting is intermittent as shown in the figure on the preceding page and a ±1 count error occurs at each counting. Therefore, if the signal to be measured is very stable, the accuracy is not improved by averaging.

5-4. Principles of Operation of Each Board

5-4-1. Mother Board (BLG-010275) of TR5821/22

The INA signal from the dummy circuit is amplified and wave-shaped by IC6. The wave-shaped signal, whose trigger point is set either on the positive-going or negative-going slope by IC8 (exclusive-OR gate), is differentiated by IC5. On of the differentiated signals is converted to TTL level and sent to INA of LSI80-GC. The other differentiated signal is ANDed with the gate signal generated by the flip-flop circuit (IC4) and its frequency is divided by two by the scaler and converted to TTL level to be routed to EXI of LSI80-GC.

The INB signal from the dummy circuit is amplified and wave-shaped by IC7. The wave-shaped signal is converted to TTL level and sent to INB of LSI80-GC.

LSI80-GC/SS itself is a basic counter, which is controlled by the microprocessor. In addition to this, the microprocessor performs data processing, self-diagnostics, panel switch control and data transfer to the display driver.

The SLOPE switching circuit enables effective measurement when jitter component is on one side of the input signals, especially in time interval measurement. The signals amplified by IC6 and IC7 are detected by each detector circuit and automatically set so its trigger point is at about 50% of the amplitude. Masking is controlled by LSI80-GC.

5-4-2. Mother Board (BLG-010043) of TR5823

The INA signal from the dummy circuit is amplified and wave-shaped by IC6. The wave-shaped signal, whose trigger point is set either on the positive-going or negative-going slope by IC8 (exclusive-OR gate), is differentiated by IC5. One of the differentiated signals is converted to TTL level and sent to INA of LSI80-GC. The other differentiated signal is ANDed with the gate signal generated by the flip-flop circuit (IC4) and its frequency is divided by two by the scaler and converted to TTL level to be routed to EXI of LSI80-GC.

The INB signal from the dummy circuit is amplified and wave-shaped by IC7. The wave-shaped signal is converted to TTL level and sent to INB of LSI80-GC.

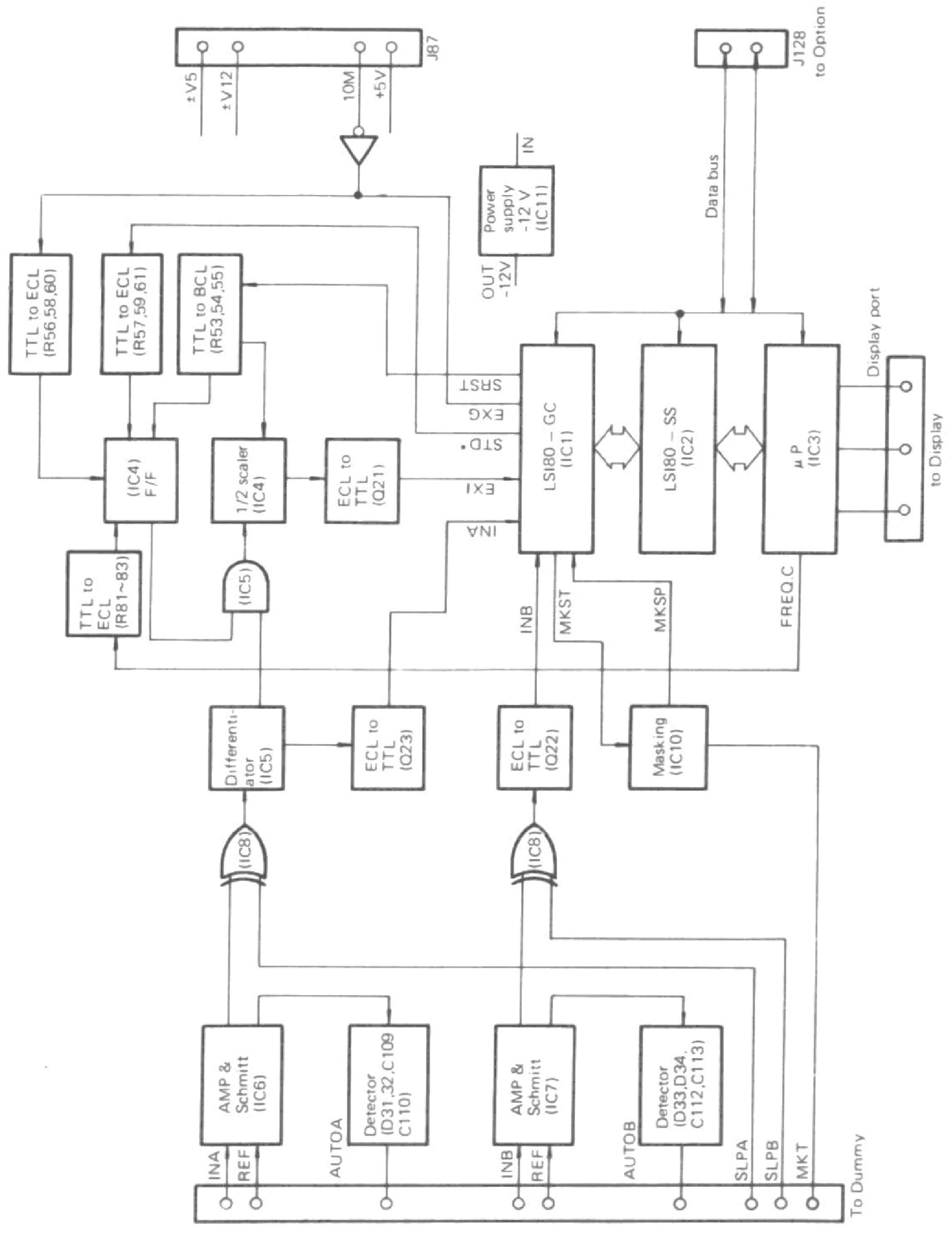


Fig. 5-6 Block diagram of **TR5821/22** mother board

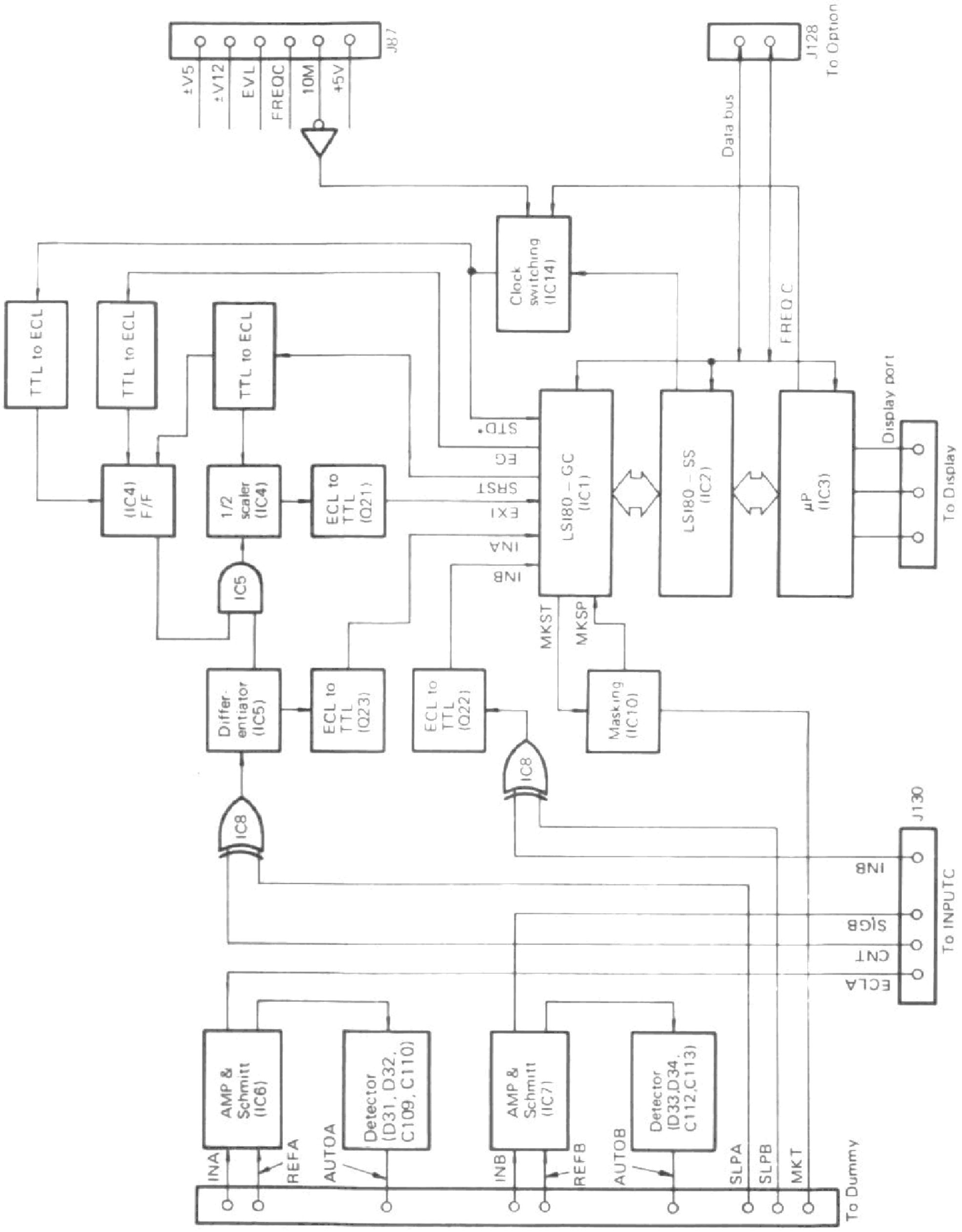


Fig. 5-7 Block diagram of **TR5823** mother board

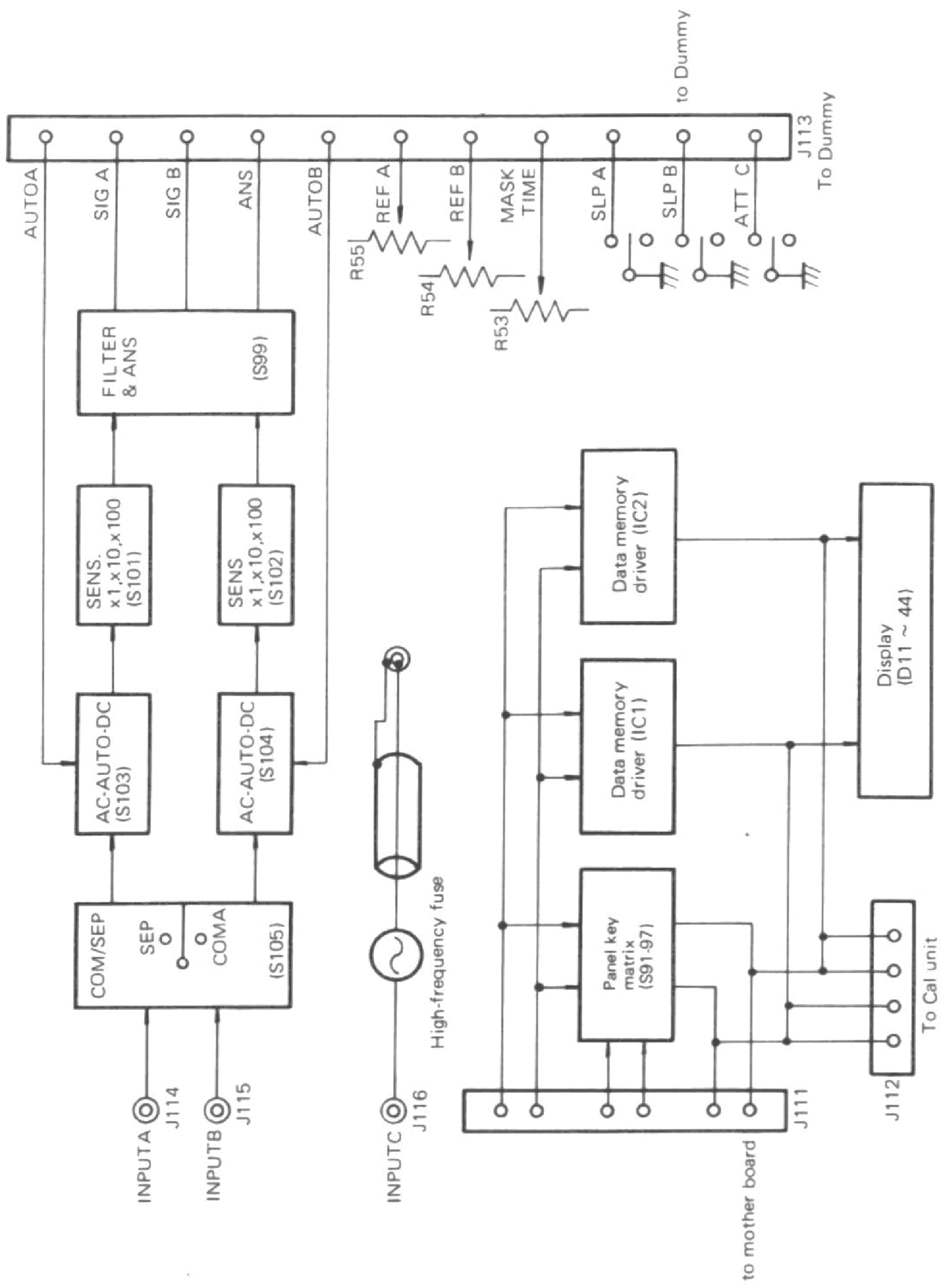


Fig. 5-8 Block diagram of operation board

LSI80-GC/SS itself is a basic counter, which is controlled by the microprocessor. In addition to this, the microprocessor performs data processing, self-diagnostics, panel switch control, and data transfer to the display driver.

The SLOPE switching circuit enables effective measurement when jitter component is on one side of the input signals, especially in time interval measurement.

The signals amplified by IC6 and IC7 are detected by each detector circuit and automatically set so its trigger point is on the 50% level of the amplitude.

For input C measurement, the time base frequency of LSI80-GC must be switched to 5 MHz from 10 MHz clock used for input A and B measurement. This switching is achieved by the clock selection circuit using the signal output from FRQC of IC3 when **INPUT C** is set.

High-frequency and burst wave signals from **INPUT C** are input to INA and INB of LSI80-GC as CNT and INB signals.

5-4-3. Operation Board (BLF-010044)

The signals to be measured which are input to **INPUT A** and **B** are routed to the dummy circuit via the **COM.A/SEP.** switching circuit, **AC-AUTO-DC** (input coupling mode switching circuit), **SENS.** (sensitivity switching) circuit, and **FILTER ANS ON/OFF** switching circuits. When the **COM.A/SEP.** switch is set to **COM.A,** the INPUT A signal is also provided to the INPUT B circuit. When the SLOPE circuit is used along with the COM. A, half-period measurement with a single input is possible.

When **AC-AUTO-DC** is set to **AC** or **DC,** the trigger level can be continuously varied in the range of about -1.0 to +1.0 V by varying REF (R54 or R55). The mask time can be varied in the range of about 100 μs to 100 ms by rotating mask time resistor R53. The signal to be measured which is applied to **INPUT C** is routed via the high-frequency fuse to the INPUT C board.

The calculated data is input via the display port to the data memory driver, which displays the measurement data. The calculation unit **TR1644** data and the panel switch data are sent to the mother board as setting data.

5-4-4. Dummy Board (BLB-010047)

The dummy circuit incorporates the impedance converter circuit to receive the signal to be measured with a high input impedance so the measurement can be made without influence of the impedance of the signal to be measured.

5-4-5. INPUT C Board (BLC-010050) (TR5823)

The voltage applied to **INPUT C** is routed via the ATT circuit and the ANS circuit to IC2 where it is amplified, then divided to 1/20 by the divider (IC3) and input to the multiplexer. The multiplexer gate is controlled by the FRQC signal, EVL and squelch signals. The squelch circuit detects the

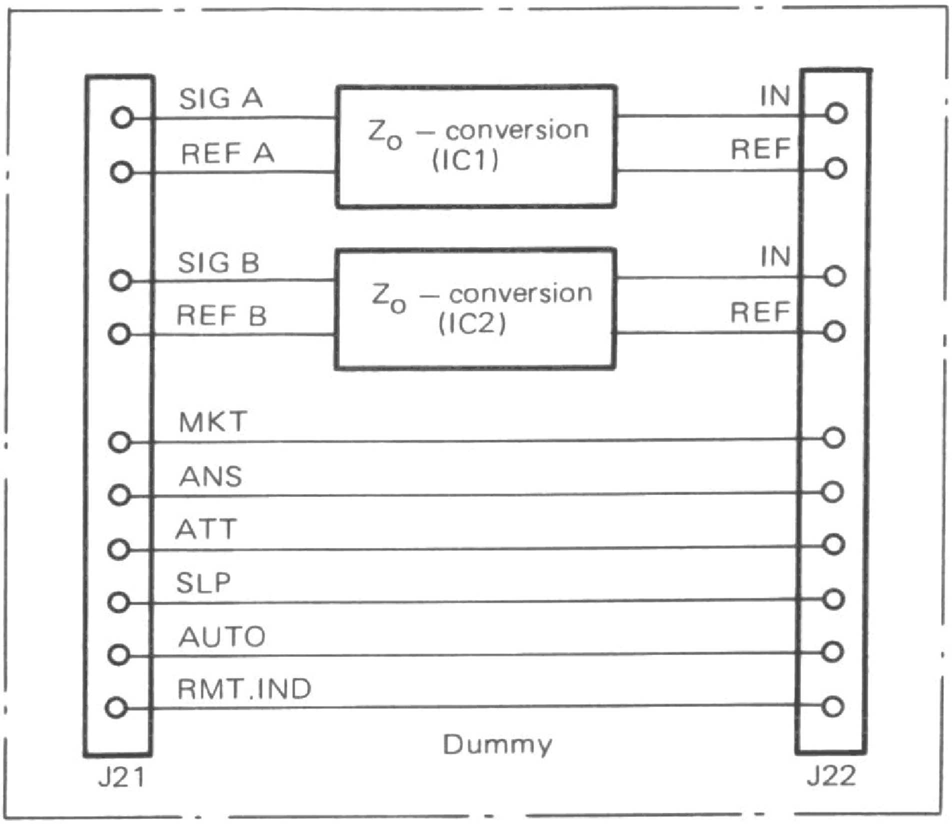


Fig. 5-9 Dummy board

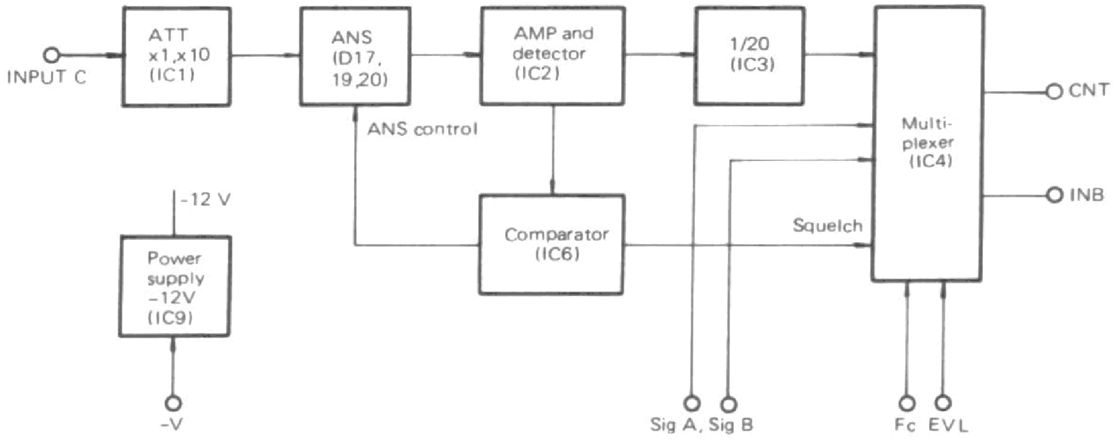


Fig. 5-10 Block diagram of Input C board

presence/absence of an input signal, whose output switches to high/low by the comparator to control the multiplexer gate. For input C, the comparator output is low when a signal is input. When **FREQ. C** is selected, the FRQC signal is output. When the signal to be measured is applied to **INPUT C**, the squelch signal is output to INB to control the burst wave measurement and, at the same time, a signal of 1/20 the period of the signal to be measured is output to CNT. Were it not for squelch or EVL signal, SIGA signal would be output to CNT and SIGB signal to INB. The **INPUT C** circuit incorporates the ANS circuit that eliminates the harmonic components superimposed on the input signal. The ANS circuit is controlled by varying cutoff frequencies which depend on the low-pass filter, whose bias voltage is controlled with the switching of the output voltage of comparator determined by the detector circuit.

SECTION 6
CALIBRATION

6-1. Introduction

In electronic counters, the most important factor affecting measurement accuracy is the frequency accuracy of the crystal oscillator that generates the internal time base. The frequency accuracy must be constant, or, if there is a slight variation, it must be negligible. To maintain the measurement accuracy of an electronic counter, periodically calibrate the counter to the frequency standard and care should be given to the operating environment.

6-2. Equipment Required for Calibration

Equipment	Specifications	Recommended model
Signal generator	Frequency: 10 ~ 1500 MHz Output voltage: 1 mVrms to 1 Vrms	
Pulse generator	Pulse width: 1 μs or less Output: 100 mVp-p to 5 Vp-p Period: 10 μs or more	
Digital voltmeter	Resolution: 1 mV or more	**TR6355**
~~Frequency standard~~	~~Stability: 5 × 10^{-9} or more~~	~~**TR3110**~~
Oscilloscope	Voltage: 10 mV/div. to 10 V/div. Sweep rate: 0.1 s/div. to 1 ns/div.	

NOTE: **TR5821/22/23/23H** should be warmed up for the specified time before operating.

TR5821/22/23: 15-25 minutes after power on
TR5823H: 24 hours after power on

6-3. Calibration for Each Section

6-3-1. Sensitivity

(1) **INPUT A**

① Setting

AC-AUTO-DC : AUTO
SLOPE : +
SENS. : X 1
SEP/COM : SEP
FILTER : OFF
GATE TIME : 10 ms

② Terminate **INPUT A** with 50 Ω, apply sine waves of 10 MHz, 25 mVrms from the signal generator, and set **FUNCTION** to **FREQ. A**.

③ Adjust R73 on the mother board so that a duty factor of the waveforms at TP10 is 1:1 on the oscilloscope.

(2) **INPUT B**

① Setting

AC-AUTO-DC : AUTO
SLOPE : +
SENS. : X 1
SEP/COM : SEP
FILTER : OFF
GATE TIME : 10 ms

② Terminate **INPUT B** with 50 Ω, apply sine waves of 50 MHz, 20 mVrms, and set **FUNCTION** to **FREQ.B.**

③ Adjust R78 on the mother board so that the waveforms at TP11 assume a duty factor of 1:1 on the oscilloscope.

6-3-2. Trigger Level

① Setting

AC-AUTO-DC : DC
SLOPE : +
SENS. : X 1
SEP/COM : COM
FILTER : OFF
GATE TIME : 10 ms

② Apply 10 MHz, 25 mVrms signal with the low-frequency signal generator to **INPUT A** terminated with 50 Ω.

③ Set **FUNCTION** to **FREQ. A**, set the **LEVEL** control (R54) of **INPUT A** in the center position, and rotate R80 on the mother board until count is obtained.

④ Set **FUNCTION** to **FREQ. B**, set the **LEVEL** control (R54) of **INPUT A** in the center position, and turn R79 on the mother board until count is obtained.

6-3-3. Squelch (TR5823 only)

① Setting

GATE TIME : 10 ms
FUNCTION : FREQ. C
SENS. : X 1
ANS : OFF

② Apply the signal of 600 MHz, 15 mVrms, through the signal generator to **INPUT C.**

③ Adjust R30 on the INPUT C board until the voltage at pin 7 of IC4 changes from high to low viewing the oscilloscope.

6-3-4. ANS

① Setting

GATE TIME : 10 ms
FUNCTION : FREQ. C
SENS. : X 1
ANS : ON

② Apply the signal of 1300 MHz, 17 mVrms to **INPUT C** with the signal generator.

③ Rotate R27 on the INPUT C board until count is obtained.

6-3-5. Time Base

① Setting

FUNCTION : FREQ. A
GATE TIME : 1 s
AC-AUTO-DC : AUTO
SLOPE : +
SENS. : X 1
SEP/COM : SEP
FILTER : OFF

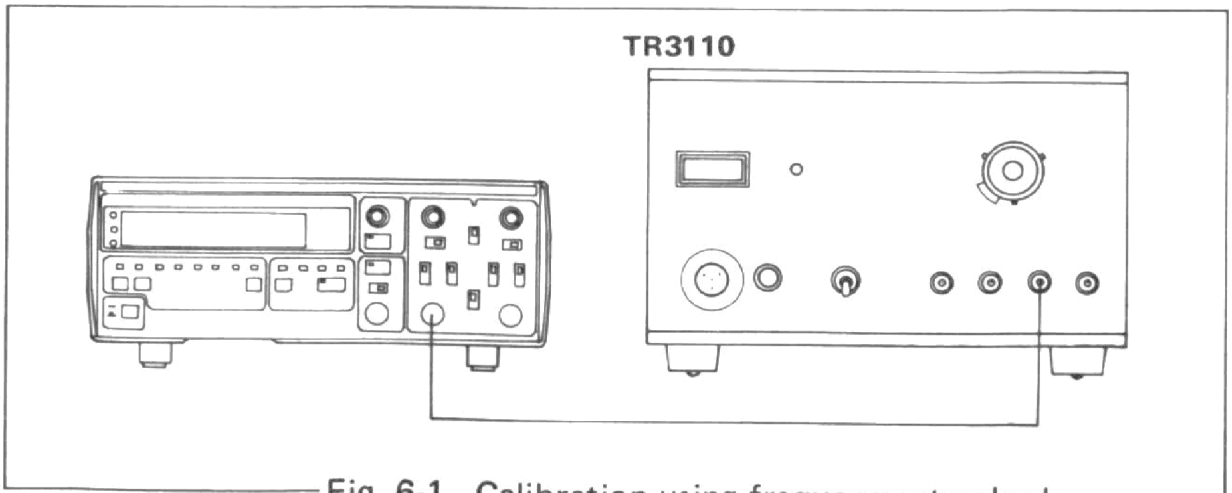


Fig. 6-1 Calibration using frequency standard

② Adjust **STD ADJ.** on the rear panel so the readout of 10.000000 MHz is obtained when the frequency standard output signal is 10 MHz.
The accuracy of this calibration is on the order of 1×10^{-7}. When **GATE TIME** is set to 10 S, a calibration accuracy is raised to the order of 1×10^{-8}.

6-3-6. Automatic Trigger

① Setting

AC-AUTO-DC : AUTO
SLOPE : +
SENS. : X 1
SEP/COM : COM
FILTER : OFF

② Apply the signal with the pulse generator of pulse width of 1 μs, duty factor of 1/10, and amplitude of +200 mVp-p to **INPUT A** terminated with 50 Ω.

③ Set **FUNCTION** to **FREQ A,** connect the digital voltmeter to pin 2 of J22 on the dummy board, and rotate R72 to adjust the voltage to 100 mV. (See Figure 6-2.)

④ Set **FUNCTION** to **FREQ. B,** connect the digital voltmeter to pin 3 of J22 on the dummy board, and rotate R77 to adjust the voltage to 100 mV. (See Figure 6-2.)

Fig. 6-2 Automatic trigger adjustment

6-4. Influence of Temperature and Line Voltage Variation on Stability

Since the reference oscillator used in this counter is not temperature compensated, the temperature rise caused by **POWER ON** and internal temperature change by power fluctuation affect the stability of the reference oscillator. Figure 6-2 shows the standard values of warm-up time and power fluctuation of this unit.

The warm-up time required (the time to reach a frequency deviation of ±5 x 10^{-7}) is 25 minutes for the **TR5821**, and 15 minutes for the **TR5822/5823.**

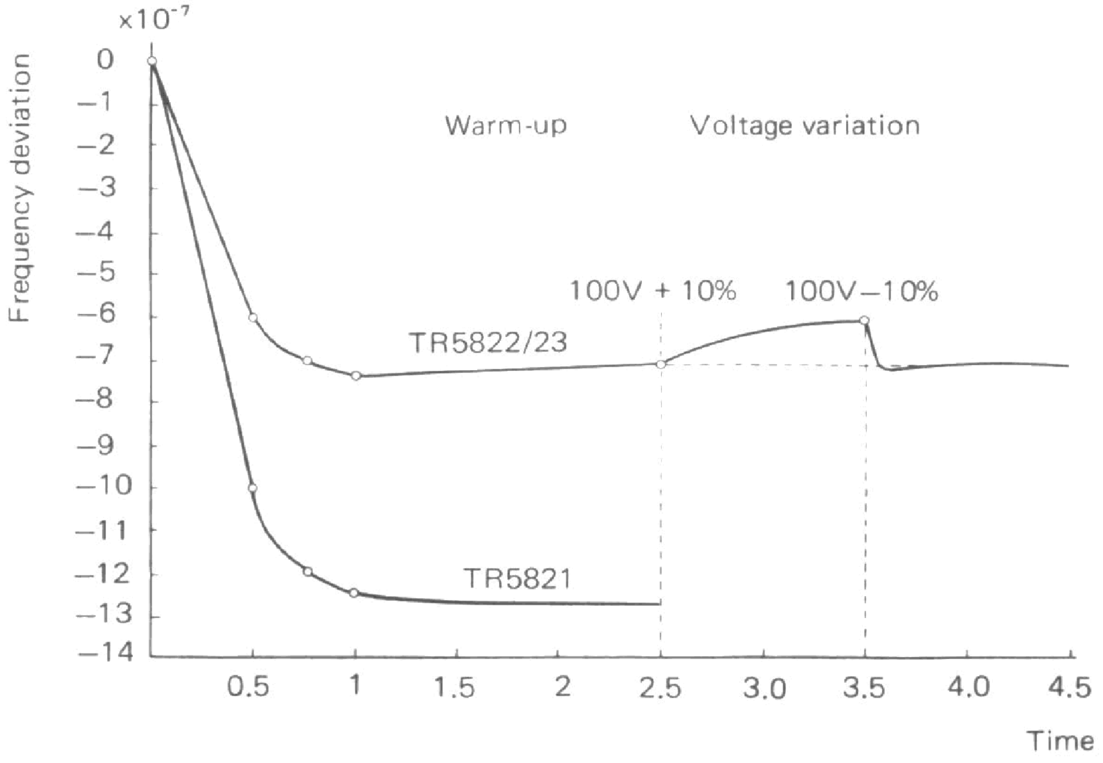


Fig. 6-3 Stability of reference oscillator

SECTION 7
CALCULATION UNIT TR1644 (ACCESSORY)

7-1. Name and Function of Keyboard

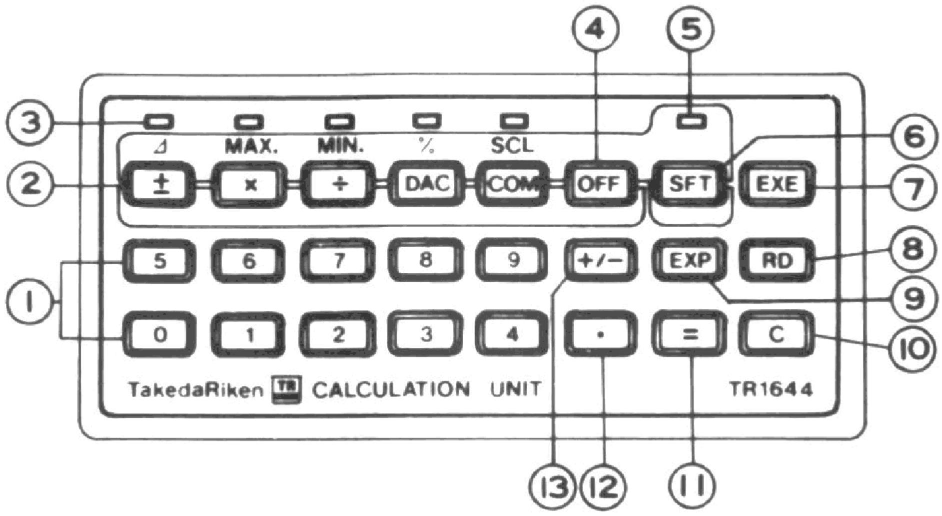


Fig. 7-1 Panel description

① Numeric keys : Keys for setting numeric values.

② Function keys : Press these keys as in the order of the calculation expression. The result is displayed by pressing $\boxed{\text{EXE}}$(arithmetic operation on measurement value) or $\boxed{=}$.

③ Function monitor : Displays the function being executed.

④ Function cancellation key : Cancels the calculation.

⑤ Shift monitor : Monitors the shift key operation.

⑥ **SFT** (SHIFT) key : Enables functions of labeling (sepia colored area) above the function keys.

⑦ **EXE** (EXECUTE) key : Executes calculation with the measurement value.

⑧ **RD** (READ) key : Reads out the data already loaded (contents of registers H and L).

⑨ **EXP** (EXPONENT) key : Sets the exponent.

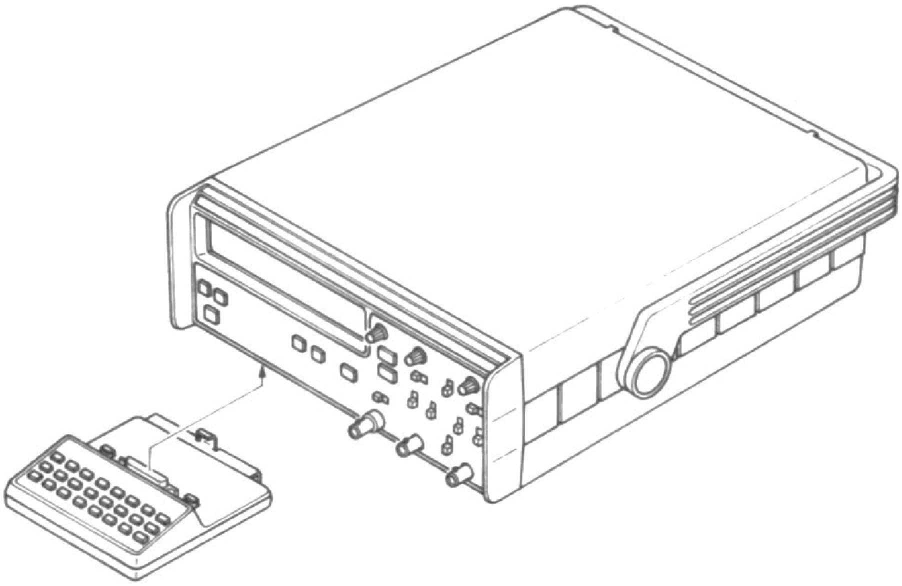
⑩ **C** (CLEAR) key : Clears the readout.

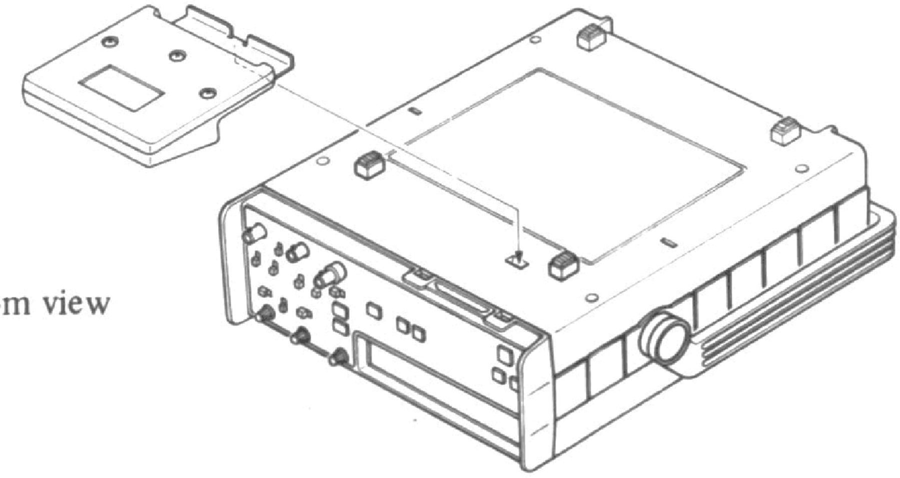
⑪ = key : Displays the result of manual calculation.

⑫ . key : Places a decimal point.

⑬ +/− key : Exchanges + and − with each press of the key.

7-2. Calculation Unit Installation



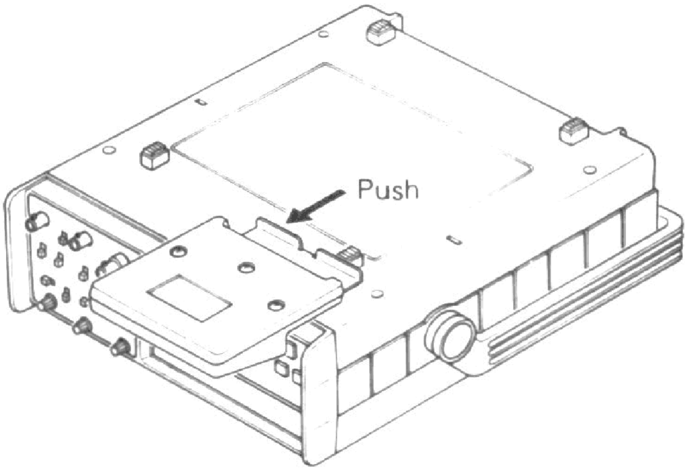


Bottom view

① Pull out the center hook of the metal plate.

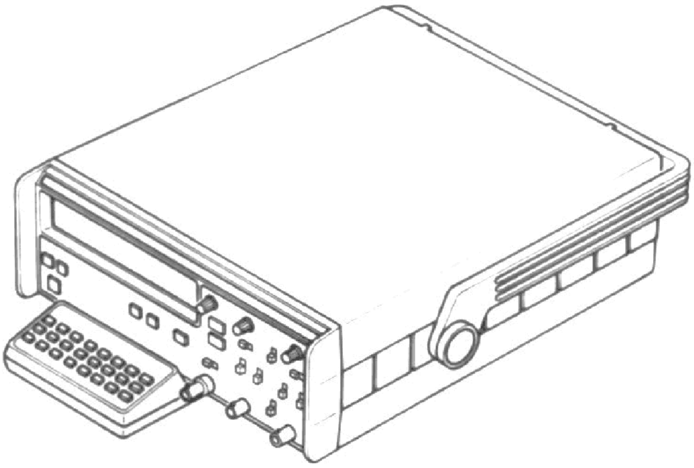
② Fit the hook of the metal plate into the square cavity at the bottom of the counter and the male connector to the female connector, then press down for secure mounting.

③ Press in the metal plate toward the **TR1644** and lock it.



Bottom view

TR1644 is mounted.



7-3. Operation Examples

① CAL is displayed when a calculation unit key is pressed during measurement. Display of CAL indicates that the calculation unit keys are ready for operation.

② Manual calculation execution

1. $12.3 \times 10^3 - 23 \times 10^2 = 10.0 \times 10^3$
   12.3 $\boxed{\text{EXP}}$ 3 $\boxed{\pm}$ $\boxed{+/-}$ 23 $\boxed{\text{EXP}}$ 2 $\boxed{=}$ 10.000000 k
2. $12 \times 6 = 72$
   12 $\boxed{\times}$ 6 $\boxed{=}$ 72.000000
3. $15 \div 0.3 = 50$
   15 $\boxed{\div}$ 0.3 $\boxed{=}$ 50.000000
4. $13.56 \div 12$ 13.56 $\boxed{\div}$ 12 $\boxed{=}$ 1.1300000
   $13.56 \div 3$ 3 $\boxed{=}$ 4.5200000

③ Calculation with measurement value (Provided **FUNCTION** is CHECK, **GATE TIME** 10 ms.)

$\boxed{\pm}$ Addition of measurement value (for subtraction, add a negative value). $\boxed{+/-}$ 1.23 $\boxed{\text{EXP}}$ 6 $\boxed{\pm}$ $\boxed{\text{EXE}}$ 8.770M

$\boxed{\times}$ Multiplication of measurement value by a constant
60 $\boxed{\times}$ $\boxed{\text{EXE}}$ 600.00M

$\boxed{\div}$ Division of a constant by measurement value
1 $\boxed{\div}$ $\boxed{\text{EXE}}$ 100.00 n

$\boxed{\text{DAC}}$ Resolution fixing and offset (D/A conversion mode)
–500 $\boxed{\text{EXP}}$ 4 $\boxed{\text{DAC}}$ $\boxed{\text{EXE}}$ 500.
Exponential digit of LSD

$\boxed{\text{COM}}$ Comparison with set values
$\underbrace{11\ \boxed{\text{EXP}}\ 6\ \boxed{\text{COM}}}_{\text{Stored in register H}}\ \underset{\text{H→L}}{\boxed{\text{C}}}\ \underbrace{9\ \boxed{\text{EXP}}\ 6\ \boxed{\text{COM}}}_{\text{Stored in register L}}\ \boxed{\text{EXE}}$ XXX In XXX
(In)

Hi, In, or Lo is displayed accordingly when the contents of registers H and L are changed around 10×10^6.

Hi	$H \leqq x$	Relationship between the set values displayed and the measurement value
In	$H > x \geqq L$	
Lo	$L > x$	

$\boxed{\Delta}$	Display of [new measurement data – old measurement data]	
	$\boxed{\pm}\ \boxed{\text{SFT}}\ \boxed{\text{EXE}}$	10.000M ↓ 0.00 ↓ 0.00 ↓ 0.00
$\boxed{\text{MAX}}$	Measurement of maximum value	
	$\boxed{\times}\ \boxed{\text{SFT}}\ \boxed{\text{EXE}}$	10.000M
$\boxed{\text{MIN}}$	Measurement of minimum value	
	$\boxed{\div}\ \boxed{\text{SFT}}\ \boxed{\text{EXE}}$	10.000M
$\boxed{\%}$	Measurement of % deviation (from 9 MHz)	
	$9\ \boxed{\text{EXP}}\ 6\ \boxed{\text{DAC}}\ \boxed{\text{SFT}}\ \boxed{\text{EXE}}$	11.11
$\boxed{\text{SCL}}$	Compound calculation (x ± L)/H (scaling)	
	$\underbrace{10\ \boxed{\text{COM}}}_{\text{Stored in register H}}\ \boxed{\text{C}}\ \boxed{+/-}\ \underbrace{9.5\ \boxed{\text{EXP}}\ 6}_{\text{Stored in register L}}\ \boxed{\text{COM}}\ \boxed{\text{SFT}}\ \boxed{\text{EXE}}$	50.00 k
$\boxed{\text{OFF}}$	Defeat of functional calculation	

7-4. Notes on Use

(1) Be sure to set a numerical value before executing another calculation after executing Δ, MAX, or MIN. In failure of numerical setting, turn off the power and on again.

(2) The setting range is ±9999.9999E ±9

(3) For $\boxed{\text{COM}}$ and $\boxed{\text{SCL}}$, registers H and L are selected by pressing the $\boxed{\text{C}}$ key. For other functions, register H alone is displayed.

(4) The set data, in 8 digits for mantissa and 1 digit for exponent, is displayed in the following format:

$$-\ 1\ 2\ 3\ 4\ 5\ \underbrace{6\ 7\ 8.\ E\ -\ 9\ H}_{\text{Displayed digits}}$$

Each time the $\boxed{\text{RD}}$ key is pressed, the numeric display part moves 1 digit to the right until the following display is obtained:

$$-\ 1\ 2\ 3\ 4\ 5\quad H$$

(5) The result display differs from the display of the set data explained in (4). The numeric part is a maximum 8 digits, or 7 digits when a minus sign is displayed. The decimal point is placed somewhere in the three significant digits and the suitable unit is selected from among G. M, k, m, μ, n and p, (equivalent to the order of 10^9, 10^6, 10^3, 10^{-3}, 10^{-6}, 10^{-9}, 10^{-12}).

For example, 123456.78 is displayed as

1 2 3.4 5 6 7 8 k
- 1 2 3.4 5 6 7 k

(6) For the SFT involved function, be sure to press the SFT key each time numerical value is set and function key is pressed since the shift capability is aborted (LED lamp goes off) by pressing a function key.

(7) The calculation capability is invalid when the counter is set to **CHECK** MASK , or **TOT.**

(8) When the **OVER** lamp goes on, the result is invalid. Set **GATE TIME/MULTIPLIER** so the **OVER** lamp does not go on.

(9) When the $(x \pm L)$ results in 0 in the SCL (compound calculation) capability, the counter comes to a halt displaying E 24. For the continuous measurement of such factors as a deviation (indicated in ppm), therefore, select the value of L so that $x \pm L \neq 0$ or set up the **GATE TIME/MULTIPLIER** to obtain smaller digits of measurement data (x) than the set value (L).

SECTION 8
OPTIONS

8-1. BCD Output

(1) Performance

Data capacity : Mantissa 7 digits, exponent 1 digit, unit
Data output : 8–4–2–1
Unit output : 8–4–2–1
Output level (TTL) : Low level: 0 V to +0.4 V
High level: +2.4 V to +5.25 V
Output connector : Amphenol 57-40500 or equivalent

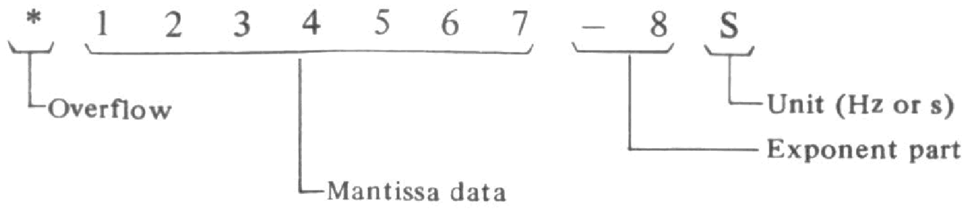
(2) Output signal table

1	GND (0 V)		26	2^0	$X10^4$
2	2^0	Exponent	27	2^1	
3	2^1		28	2^2	
4	2^2		29	2^3	
5	2^3		30	2^0	$X10^5$
6	2^0	Sign for exponent part	31	2^1	
7	2^1		32	2^2	
8	2^2		33	2^3	
9	2^3		34	2^0	$X10^6$
10	2^0	$X10^0$	35	2^1	
11	2^1		36	2^2	
12	2^2		37	2^3	
13	2^3		38	2^0	Function
14	2^0	$X10^1$	39	2^1	
15	2^1		40	2^0	Unit
16	2^2		41	2^1	
17	2^3		42	2^2	
18	2^0	$X10^2$	43	2^3	
19	2^1		44	2^0	Decimal point
20	2^2		45	2^1	
21	2^3		46	2^2	
22	2^0	$X10^3$	47	Print command signal	
23	2^1		48	Print end signal	
24	2^2		49	NC	
25	2^3		50	GND (0 V)	

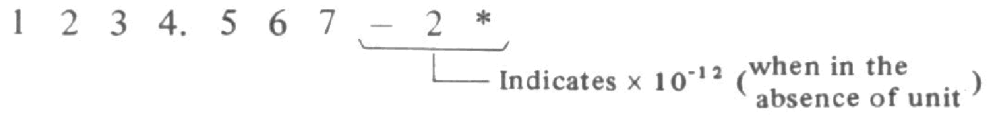
(3) Data output codes

Output	Character	Code			
		8	4	2	1
Data (Mantissa and exponent)	0	0	0	0	0
	1	0	0	0	1
	2	0	0	1	0
	3	0	0	1	1
	4	0	1	0	0
	5	0	1	0	1
	6	0	1	1	0
	7	0	1	1	1
	8	1	0	0	0
	9	1	0	0	1
	Space	1	1	1	1
	–	1	0	1	0
Decimal point	10^3		1	0	1
	10^4 (LOWER)	1	1	1	0
Function	* (Overflow)			0	1
	Space			1	1
Unit	Hz	1	1	1	0
	s	1	0	1	1
	Space	1	1	1	1
	rpm (exponential position at 10^1 in case of s)	1	0	0	0
	* (exponential position at 10^1 in the absence of unit)	1	1	0	0

(4) Print format

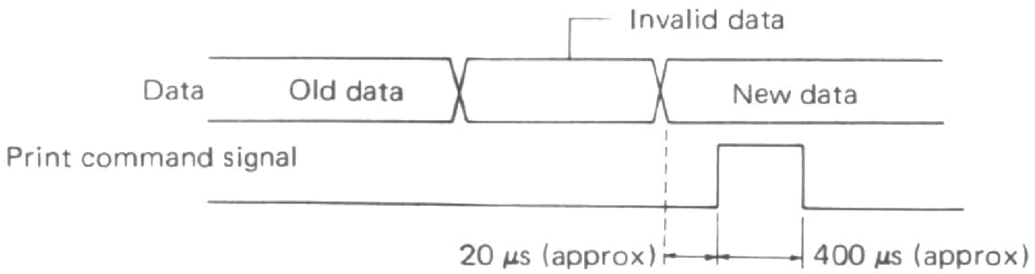


The mantissa part includes the 7 most significant digits of the display with decimal point at the fourth significant digit position. (When shorted to the LOWER side on the board BLF-010051, the 7 least significant digits of the display are mentissa with a decimal point at the third significant digit position.)
Only one digit position is provided for the exponent part. If the exponent part consists of two digits, an asterisk is printed at the unit position; when the unit is s, rpm is printed.

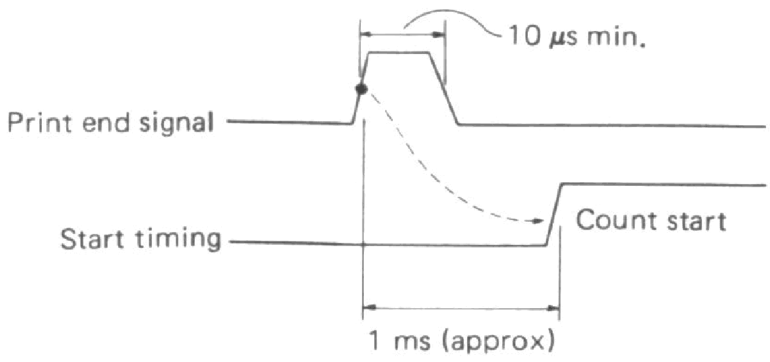


Note: For **FREQ. B**, the data is always printed in seven digits regardless of the number of digits in the readout.

(5) Print command signal (TTL level)



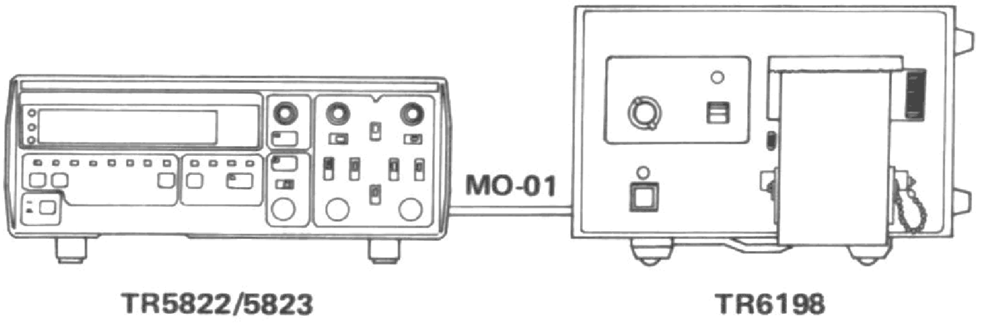
(6) Print end signal (TTL level)



(7) **COM** mode (with the **TR1644**)
Outputs an electric signal (digit of 10^6) for GO/NO-GO decision to activate the audible tone, without using the display of this unit. The electric signal (code) that corresponds to each display in the **COM** mode is shown below.

HI	0	0	0	1
In	0	0	1	0
Lo	0	1	0	0
	2^3	2^2	2^1	2^0

Digit of 10^6



Interface with the **TR6198** Digital Recorder

(8) Refer to the **TR6198** Instruction Manual for operation on the **TR6198** side.

(9) Use **MO-01** cable (supplied with the **TR6198**) for connecting the **TR6198** Digital Recorder.

(10) Use **MC-10** cable for connecting the **TR4120** Tracking Scope, and **MC-31** cable for connecting the **TR4110** Tracking Scope.

8-2. D/A CONVERTER (with TR1644)

(1) Peformance

Output voltage : 0.999 V full-scale
Number of digits converted : 3 digits
Conversion accuracy : ±0.2% of full-scale
Output impedance : 1 kΩ
Conversion speed : 1 ms or less
Output format : Binding post

(2) Operation method

Following explanation is given in CHECK mode with a gate time of 10 ms.

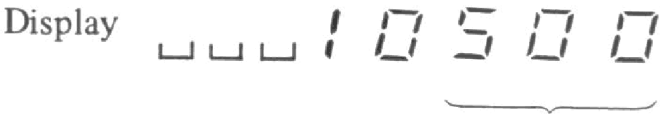
D/A conversion of the 3 least significant digits of CHECK display 10.000 MHz can be performed with the conversion resolution of 1 kHz (= 10^3) by setting the exponent part to 3.

0 $\boxed{\text{EXP}}$ 3 $\boxed{\text{DAC}}$ $\boxed{\text{EXE}}$

These 3 digits are D/A converted.

To add an offset (for example, 500) to this,

500 $\boxed{\text{EXP}}$ 3 $\boxed{\text{DAC}}$ $\boxed{\text{EXE}}$



These 3 digits are D/A converted.

The general format of the above is,

$\underbrace{\text{Offset}}_{\text{8 digits}}\ \boxed{\text{EXP}}\ \underbrace{\text{LSD of the 3 digits to be converted}}_{\text{1 digit}}\ \boxed{\text{DAC}}\ \boxed{\text{EXE}}$

Notes: ① Do not include a decimal point in the offset section.
② Specify the LSD position with $\boxed{\text{EXP}}$.
If notes ① and ② are not observed, an error message E 21 or 22 will occur.

8-3. High-stability Reference Oscillator (**TR5823** only)

(1) Performance

Internal time base : 10 MHz
Aging rate : 5×10^{-8}/day
Temperature stability : 1×10^{-7}, 0°C to +40°C
Internal reference output : Frequency: 10 MHz
Output voltage: 1 V_{p-p} to 2 V_{p-p}
Output impedance: 500 Ω (approx)
External reference input : Frequency: 10 MHz
Input voltage: 1 V_{p-p} to 10 V_{p-p}
Input impedance: 500 Ω (approx)

The high-stability reference oscillator is standard on the **TR5823H.**

SECTION 9
TROUBLESHOOTING

9-1. Introduction

This section explains troubleshooting procedures for the universal counter with the flowcharts. Always calibrate the **TR5821/5822/5823** after repair. Various parts numbers and symbols used in the text of this section are the same as those printed or marked on the relevant circuit diagrams and boards. (See **APPENDIX A** for abbreviations of the signals)

9-2. Preparations before Troubleshooting

The equipment needed for troubleshooting is listed in Table 9-1; prepare the instruments indicated or their equivalents.

Table 9-1 Equipment required for troubleshooting

Equipment	Performance	Recommended model
Signal generator	Frequency: 10 MHz to 1500 MHz Output voltage: 1 mVrms to 1 Vrms	
Voltmeter	Resolution: 1 mV or more	**TR6355** (Takeda Riken)
Oscilloscope	Sensitivity: 10 mV/div to 10 V/div Sweep rate: 0.1s to 1 ns/div	
Controller	GPIB capabilities	Model 9825/45 (HP) PC8001 (NEC)
Extender board	20-pin Pitch 2.54 mm	BLC-010548 (Takeda Riken)

9-3. General Precautions on Troubleshooting

(1) This troubleshooting guide is for skilled repair personnel experienced with the measuring instruments and electronic engineers who have adequate knowledge to understand the instructions in this troubleshooting guide.

(2) To be sure that the trouble to be remedied has not been caused by a basic operational error, read paragraph 3-3- Basic Operating Procedure again.

(3) The line voltage should be within 100 V ±10% (120 V, 200 V, 220 V ±10% or 240 V +4%, -10%) and the line frequency 50 or 60 Hz.

(4) The power cable has a 3-prong plug with the round center prong being for grounding. If the power cable is connected to the AC mains with a 2-prong adapter, connect the ground wire leading out of the adapter to an external ground. (See Figure 3-1.)

(5) Always perform troubleshooting in a place free from dust, vibration, and noise.

(6) Before checking inside this counter, set the **POWER** switch to **OFF**. Also set the switch to **OFF** for removal and insertion of circuit boards.

(7) When using an oscilloscope or a digital multimeter for measurements, take care to avoid shorting adjacent terminals or lead wires.

(8) For replacing defective parts on a board, use a soldering iron of 20 to 30 W. Soldering should be completed within the shortest time. If a soldering iron is left in contact with parts (semiconductors in particular) for a long time, such parts or printed circuit patterns may be damaged.

(9) When replacing parts, use parts listed in the attached parts list or their equivalents. For electrical or mechanical parts marked with an asterisk, contact Takeda Riken or the nearest representative.

(10) For handling of CMOS ICs, take the following precautions to prevent damage by static electricity.

a. Minimize the frequency of handling CMOS ICs.
b. When storing ICs, use cases made of a high-conductivity material which does not bear static electricity.
c. Before handling ICs, discharge the body and wear nonsynthetic clothing.
d. In handling ICs, do not directly touch their pins.
e. When carrying ICs, place them in a case which is not charged.
f. Never slide ICs on the surface of any type of material.
g. Keep chemical materials such as plastic and vinyl products away from the work table on which ICs are handled.
h. Ground the work table and chairs.
i. Use a soldering iron designed exclusively for use on CMOS ICs. Ground the soldering tip through a slow leak (insert a resistor of approximately 100 kΩ).

9-4. Locations of the Boards

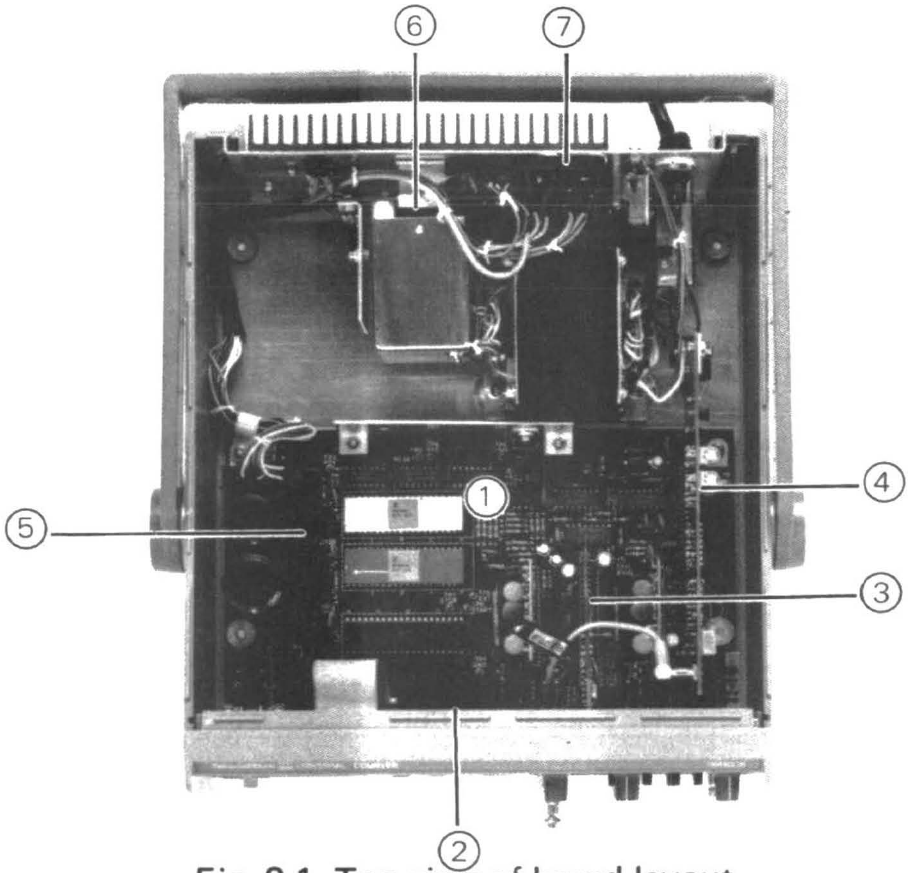


Fig. 9-1 Top view of board layout

Table 9-2 Name and stock number of the boards

	Name	Stock No.	Remarks
①	Mother board	BLG-010275/043	043: **TR5823** only
②	Operation board	BLF-010044	
③	Dummy board	BLB-010047	
④	Input C	BLC-010050	**TR5823** only
⑤	GPIB	BLF-010052	
	BCD Output	BLF-010051	
	D/A Converter	BLF-010053	
⑥	Xtal-1	BLB-010048	
	Xtal-2	BLB-010049	**TR5823/5823H**
⑦	Schematic Section		

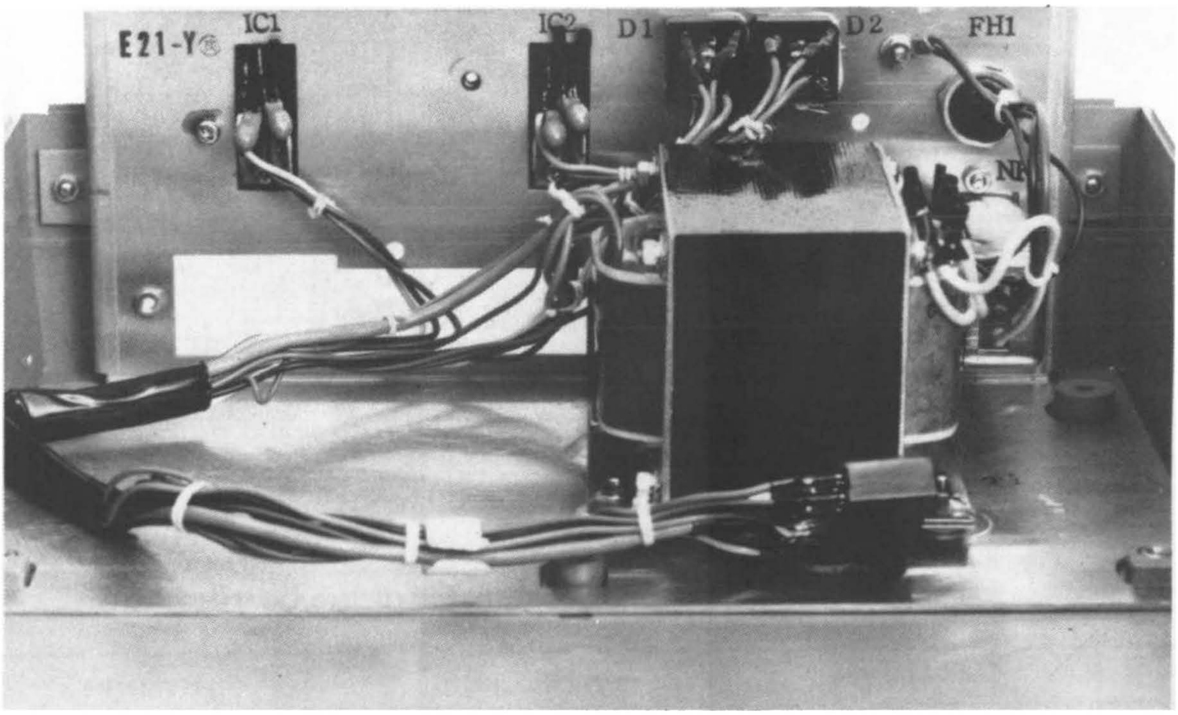
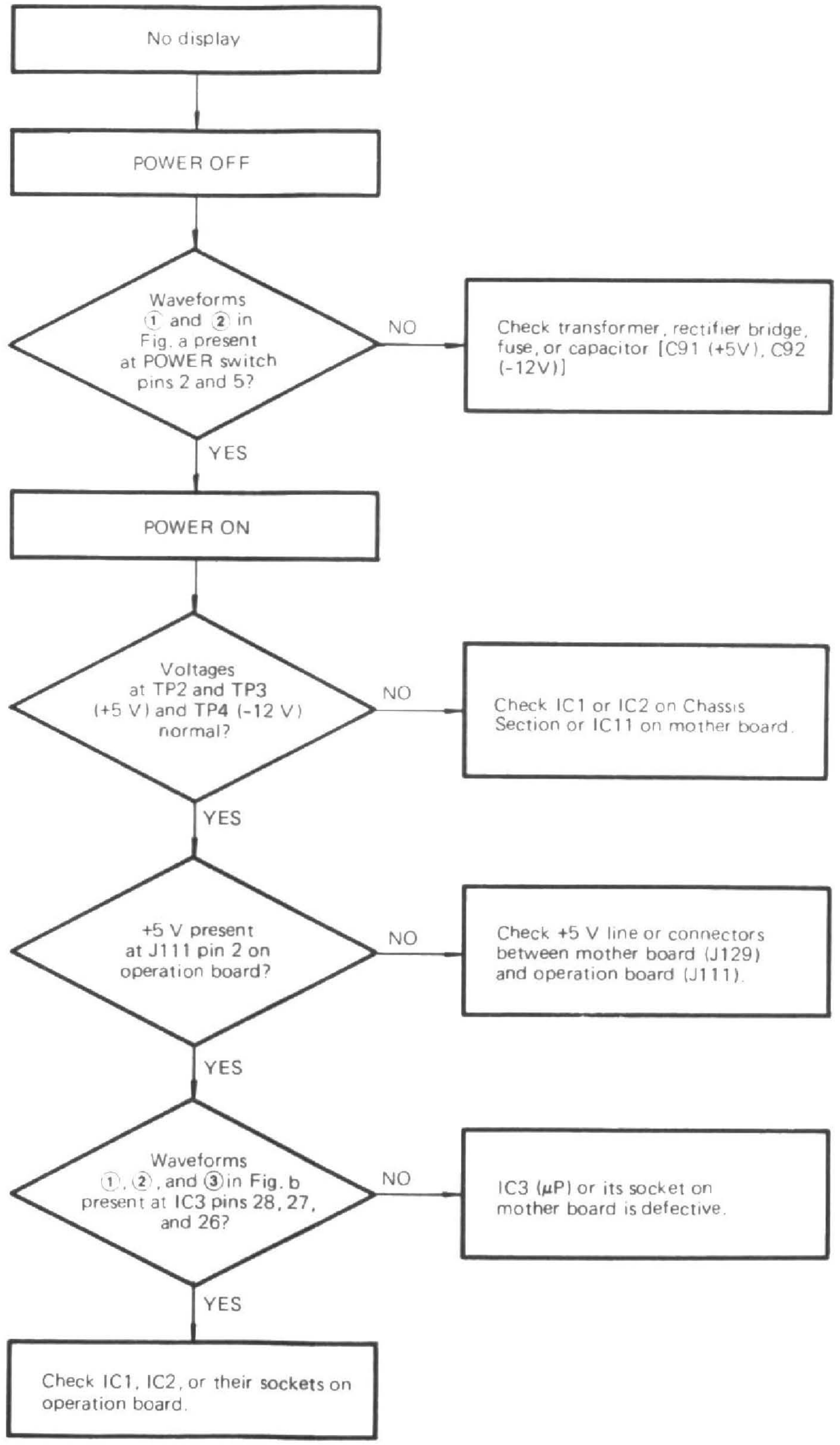
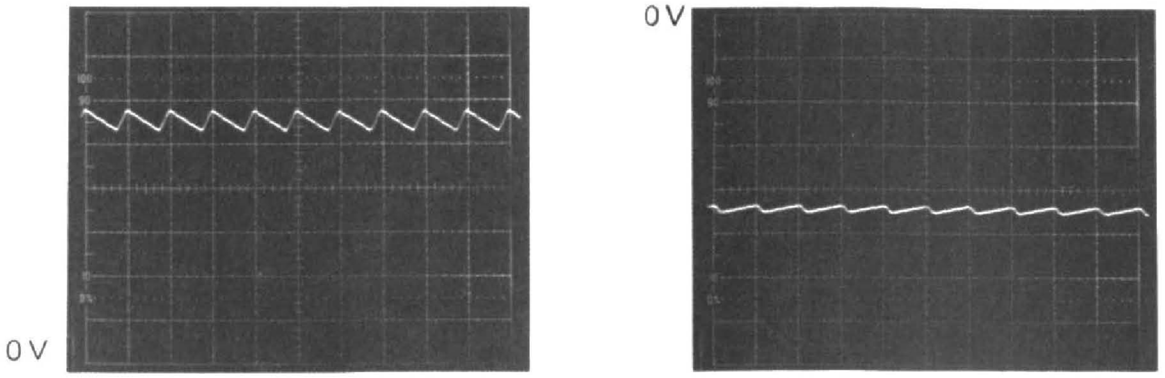


Fig. 9-2 Overview of chassis section

9-5. Troubleshooting of Mainframe

CHART-1 No Display

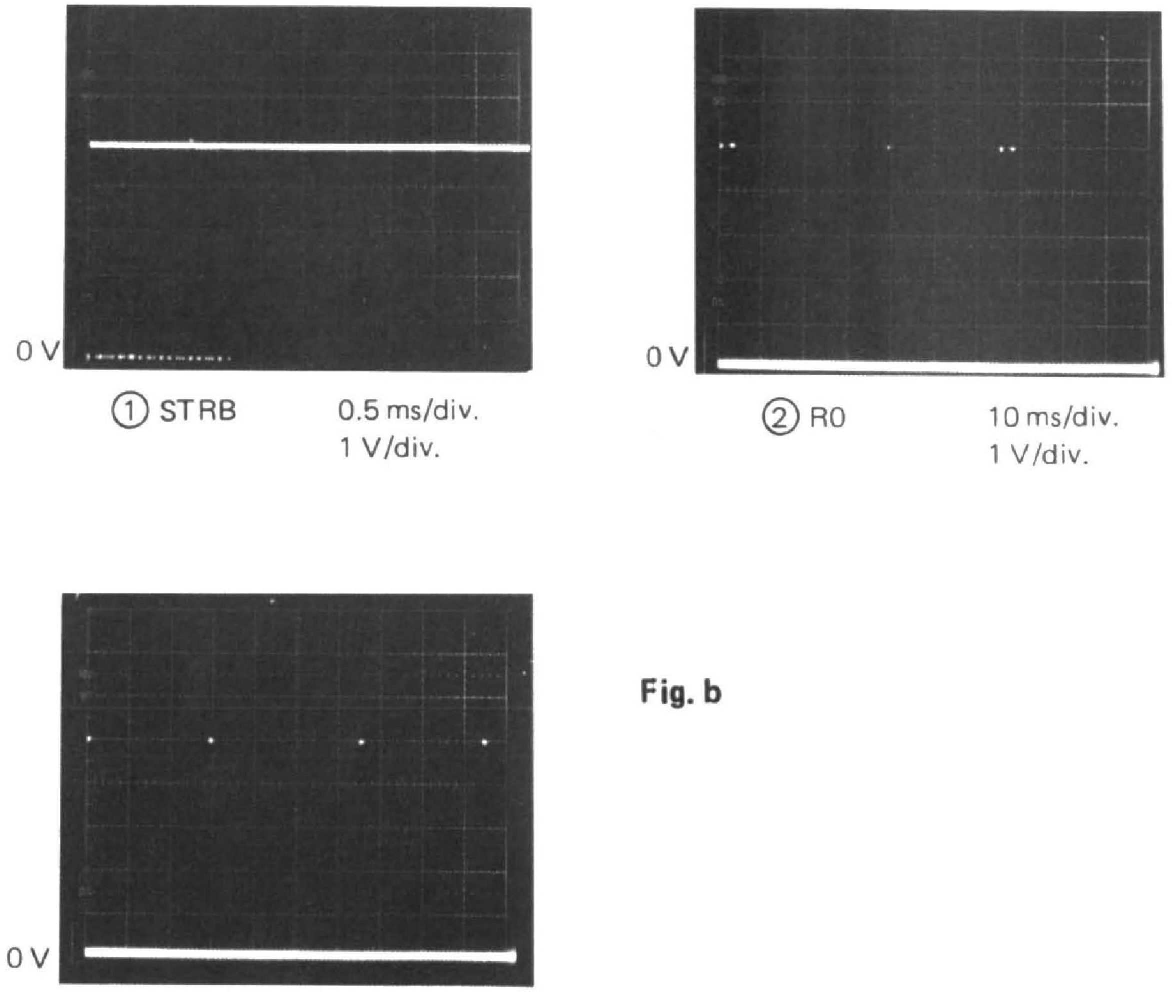




① Pin 2 10 ms/div. 2 V/div.

② Pin 5 10 ms/div. 5 V/div.

Fig. a Power Switch



① STRB 0.5 ms/div. 1 V/div.

② R0 10 ms/div. 1 V/div.

③ R1 10 ms/div. 1 V/div.

Fig. b

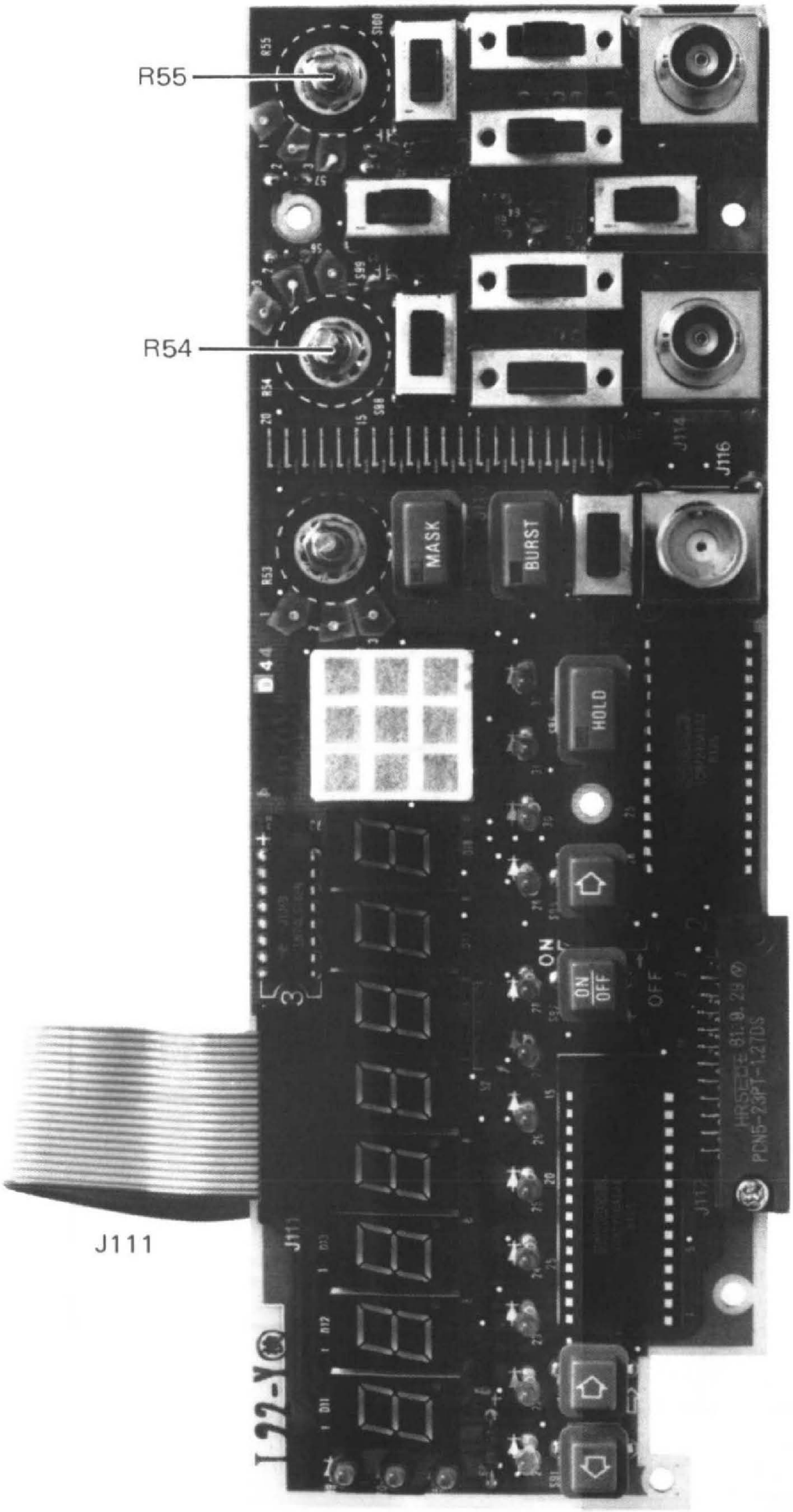
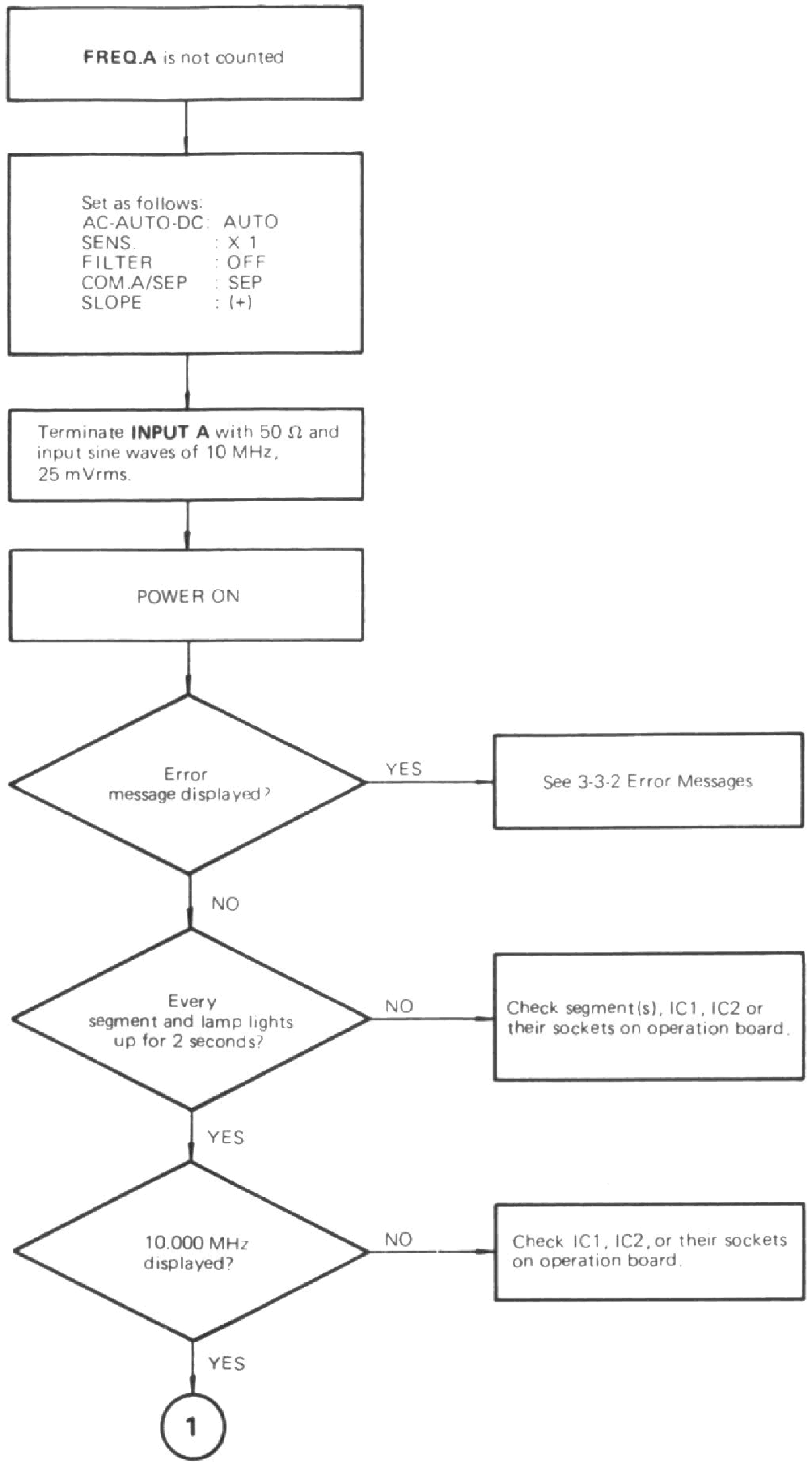
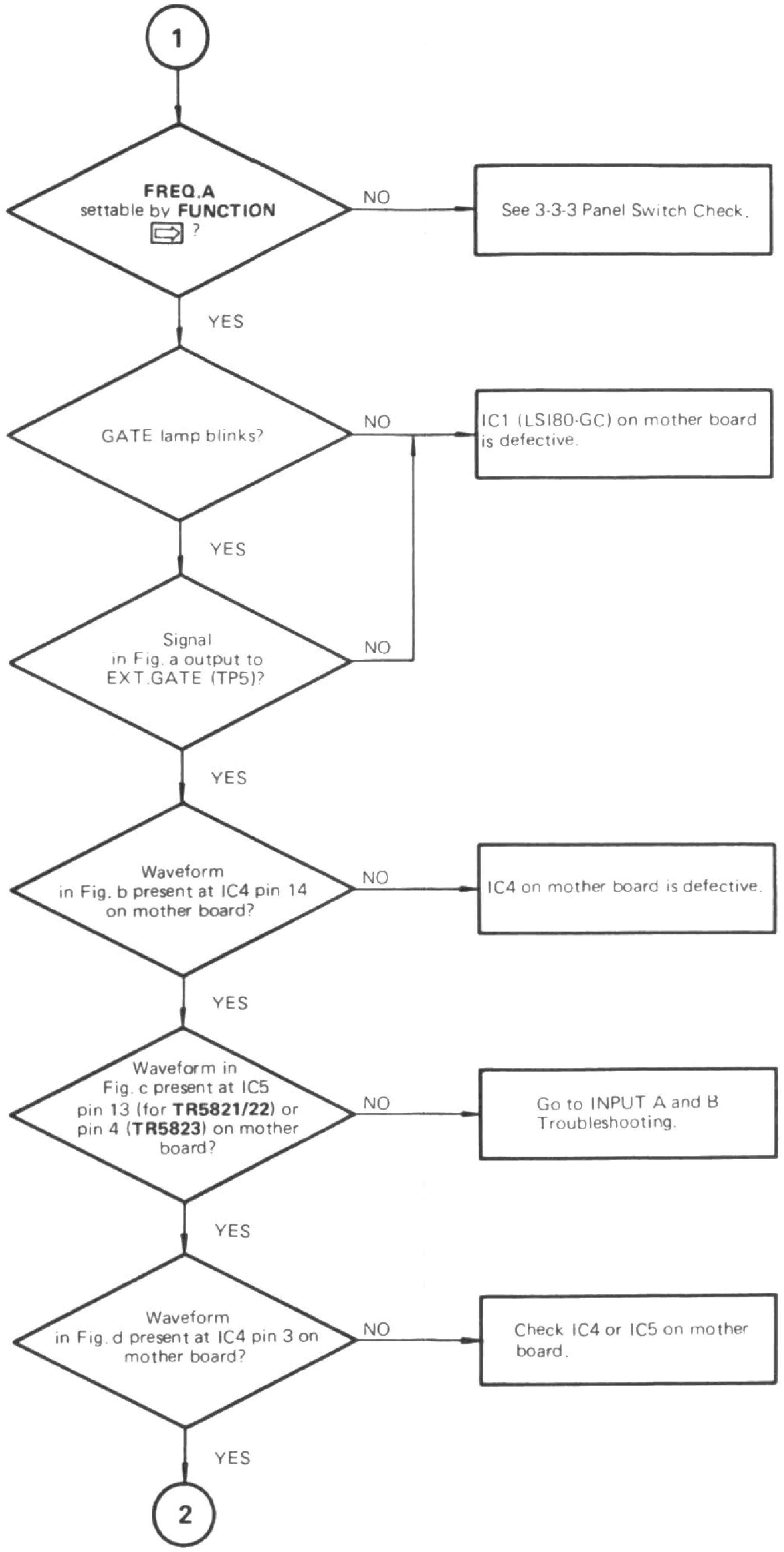


Fig. 9-3 Operation board (BLF-010044) check points

CHART-2 FREQ. A Troubleshooting





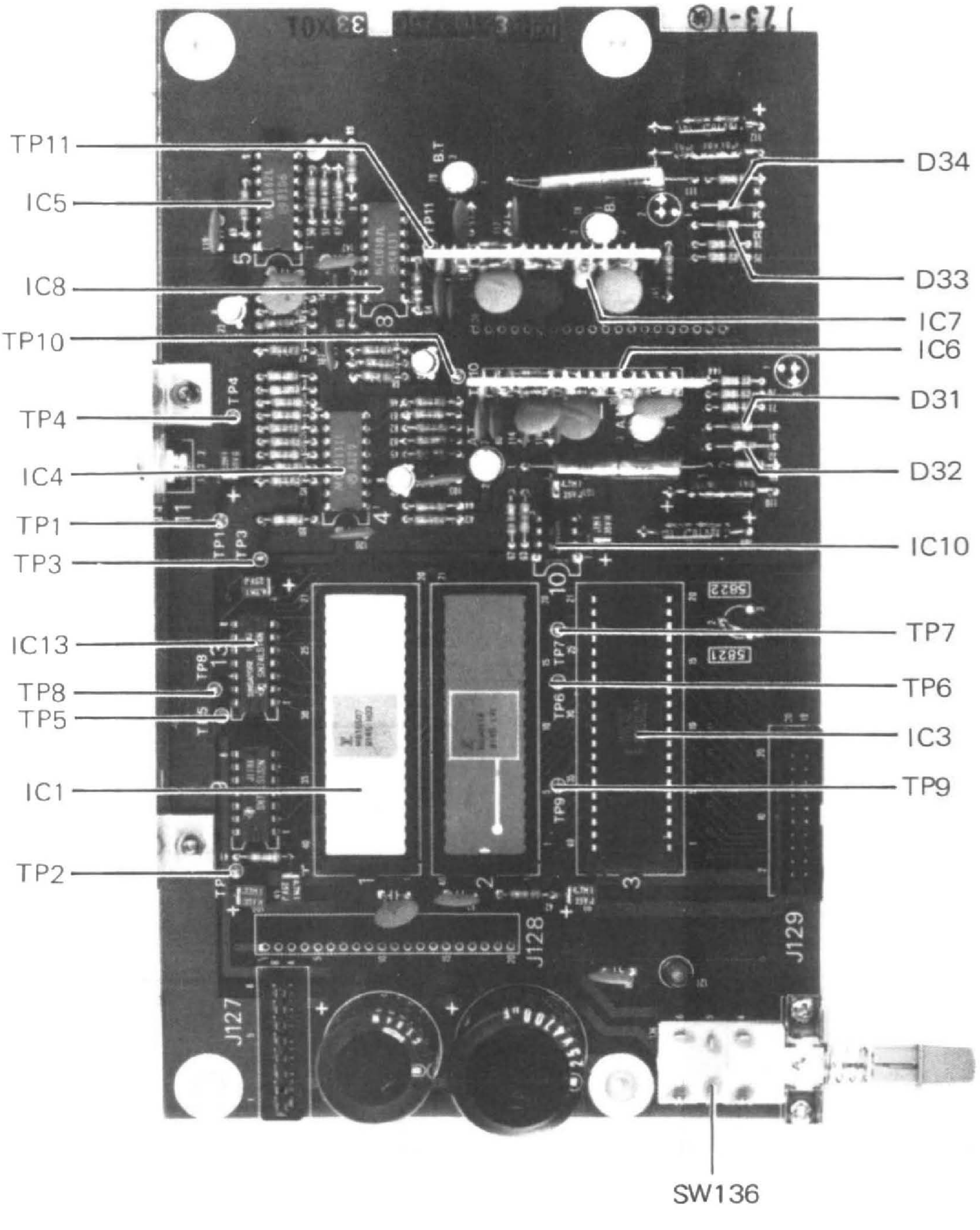
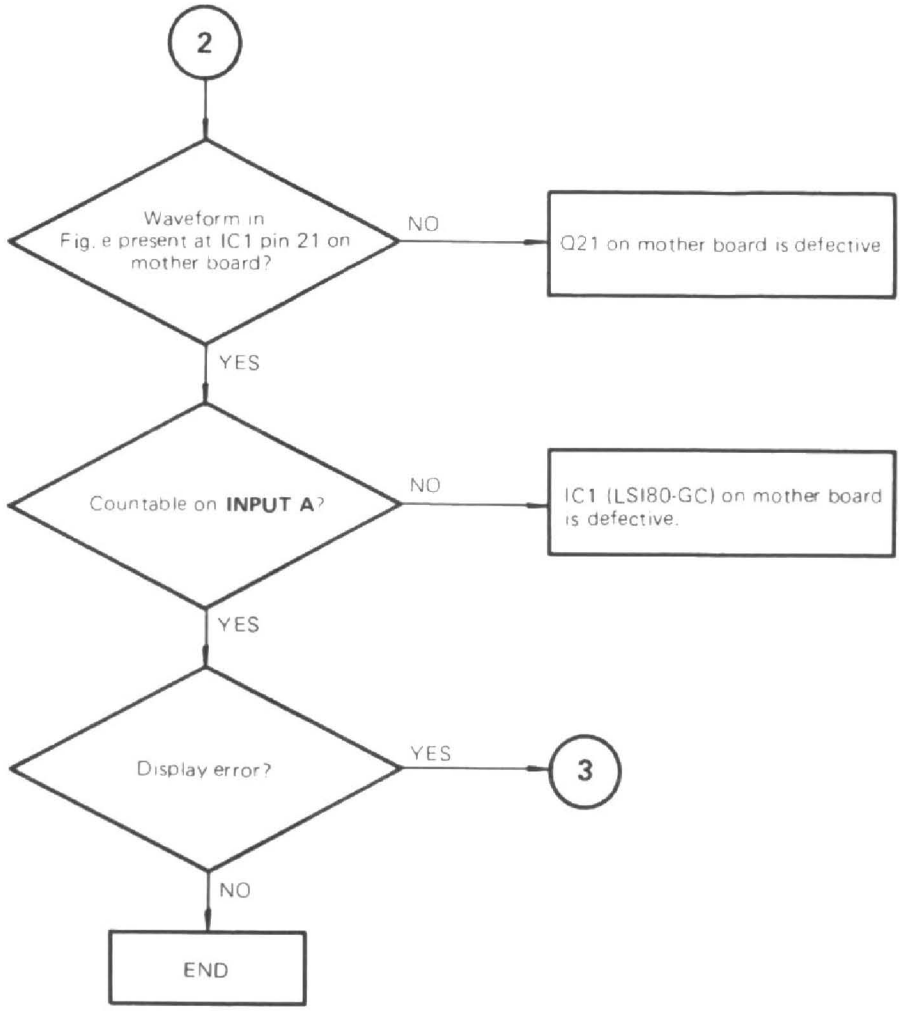
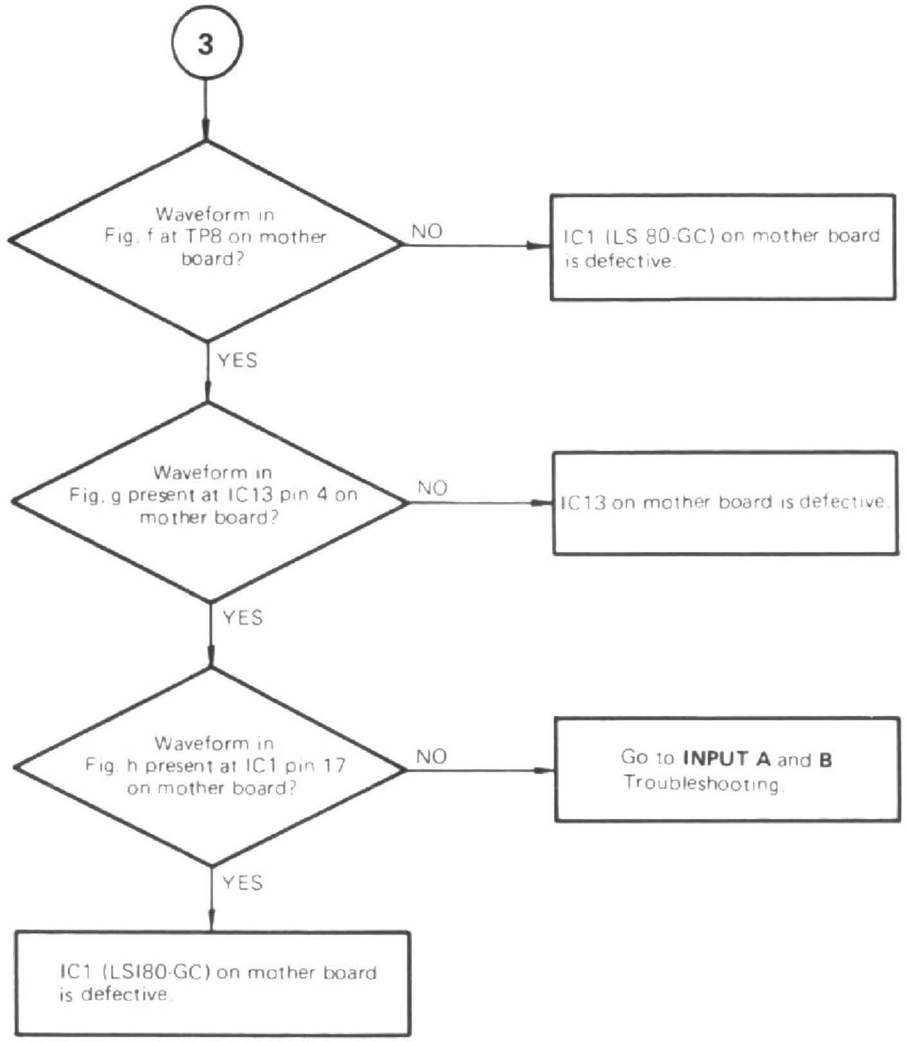


Fig. 9-4 Mother board (BLG-010275) check points (**TR5821/5822**)





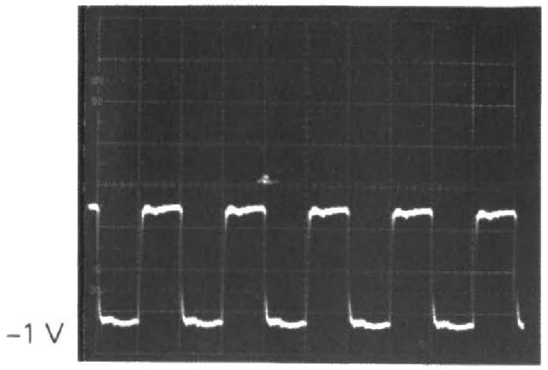


Fig. e 0.1 μs/div.
1 V/div.

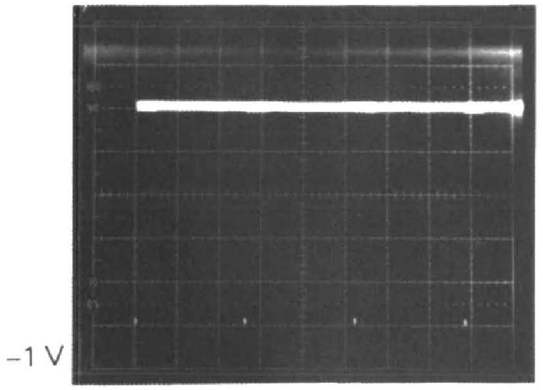


Fig. f 20 ms/div.
1 V/div.

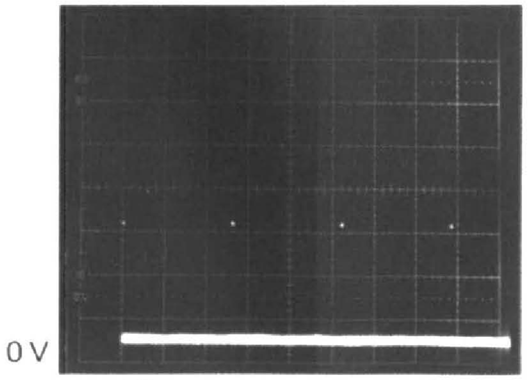


Fig. g 20 ms/div.
1 V/div.

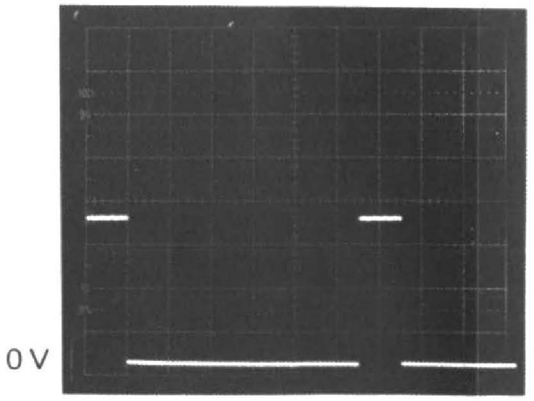


Fig. a 10 ms/div.
1 V/div.

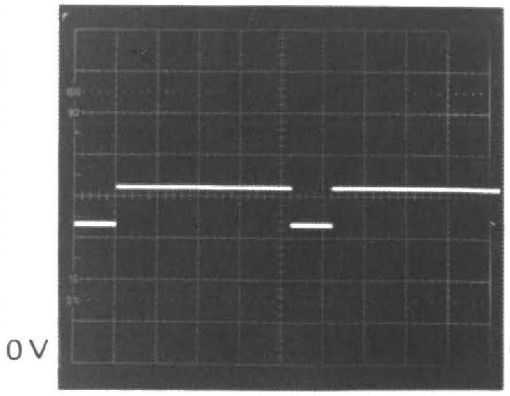


Fig. b 10 ms/div.
1 V/div.

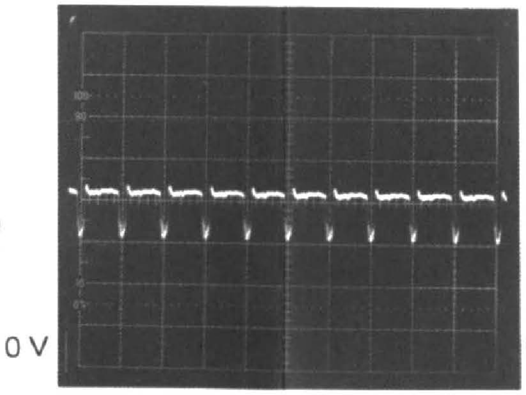


Fig. c 0.1 μs/div.
1 V/div.

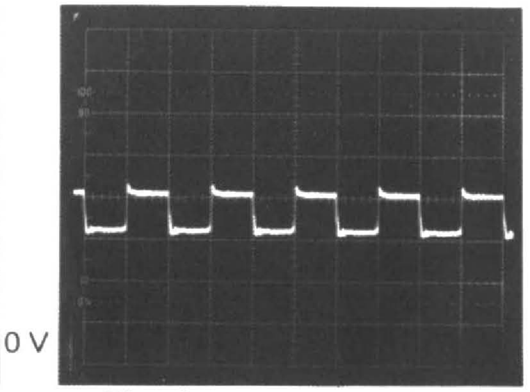


Fig. d 0.1 μs/div.
1 V/div.

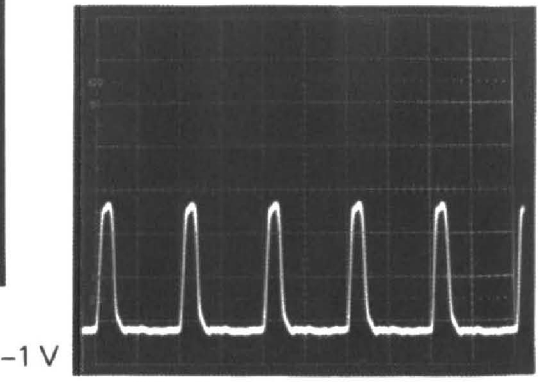
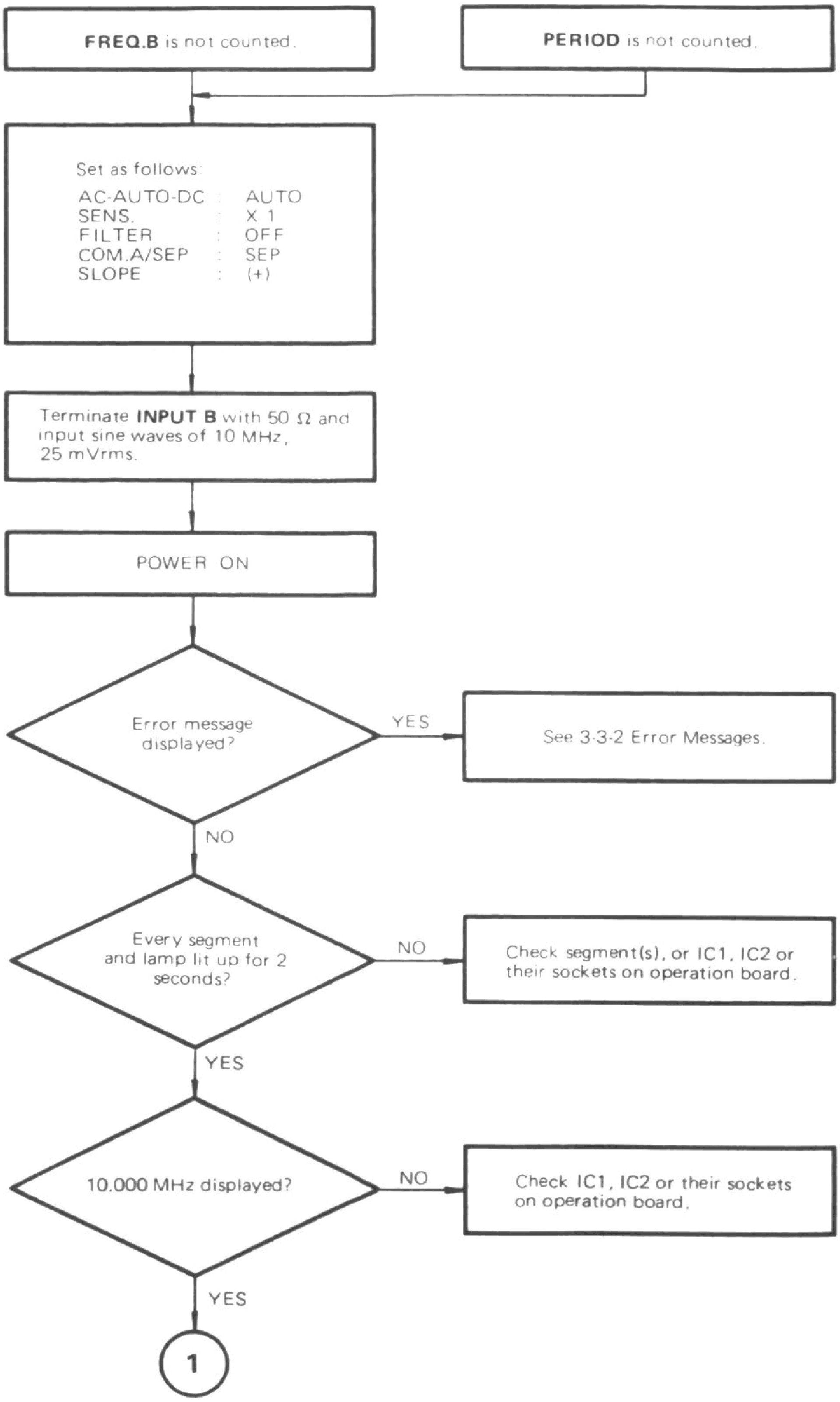


Fig. h 50 ms/div.
1 V/div.

CHART-3 FREQ. B and PERIOD Troubleshooting



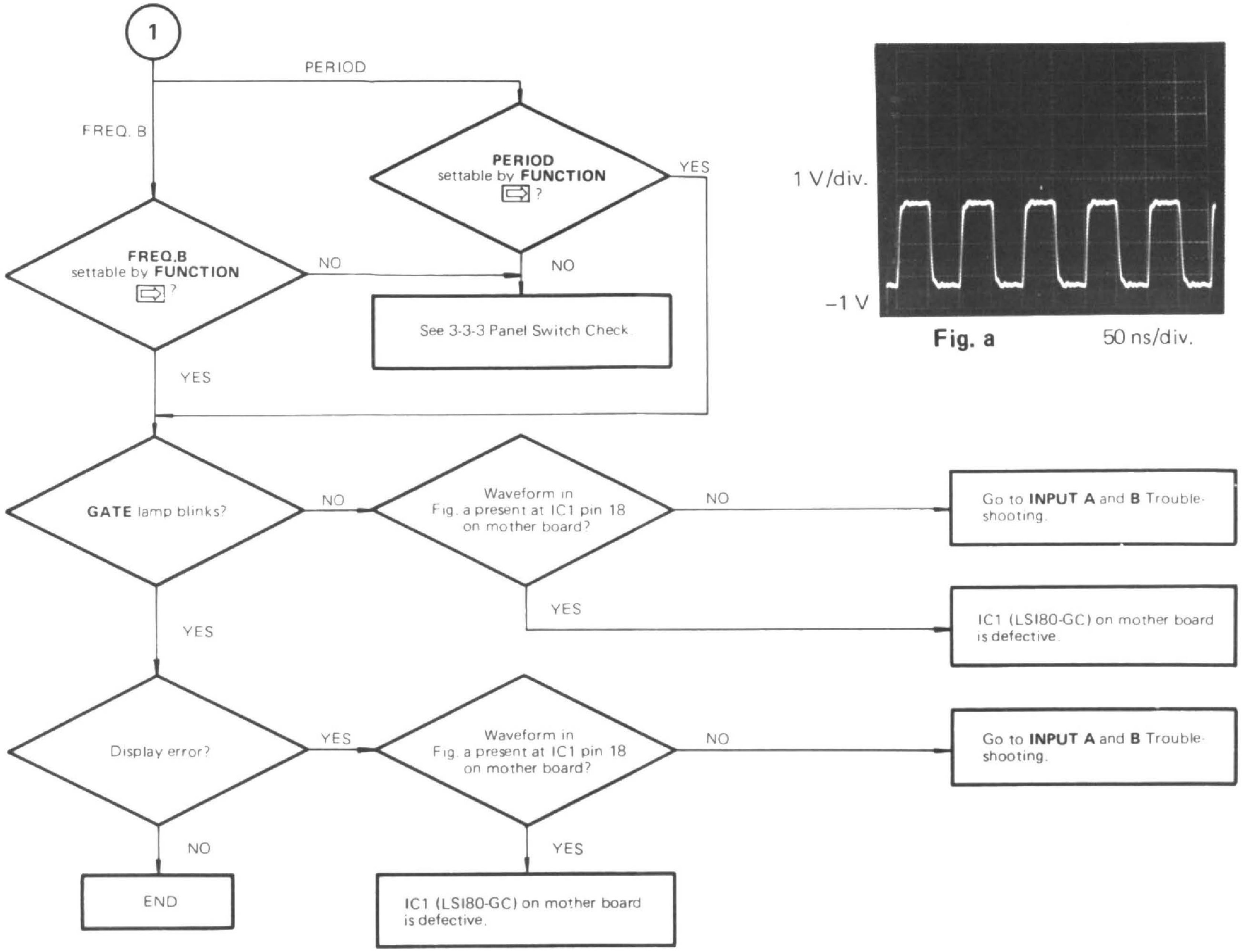
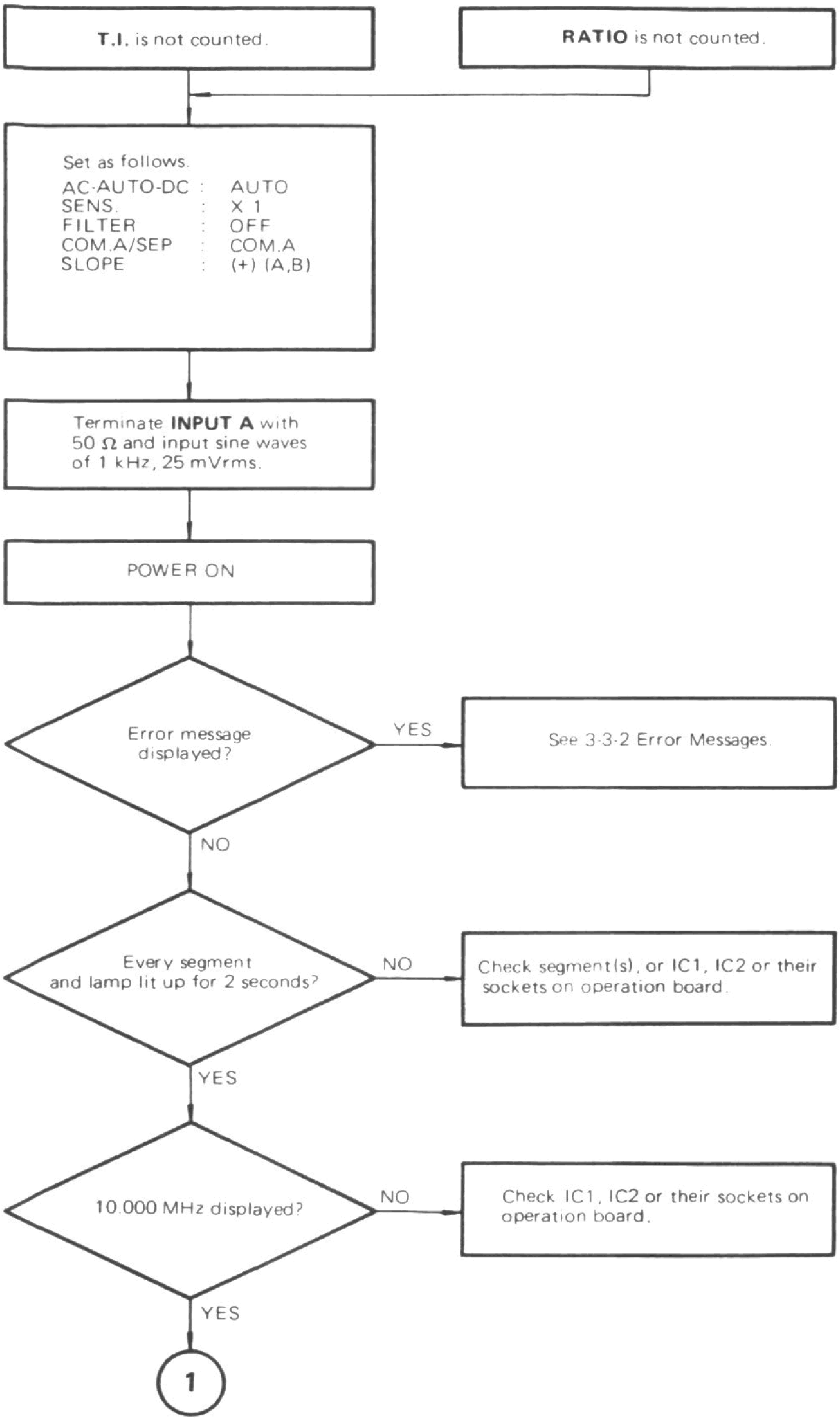
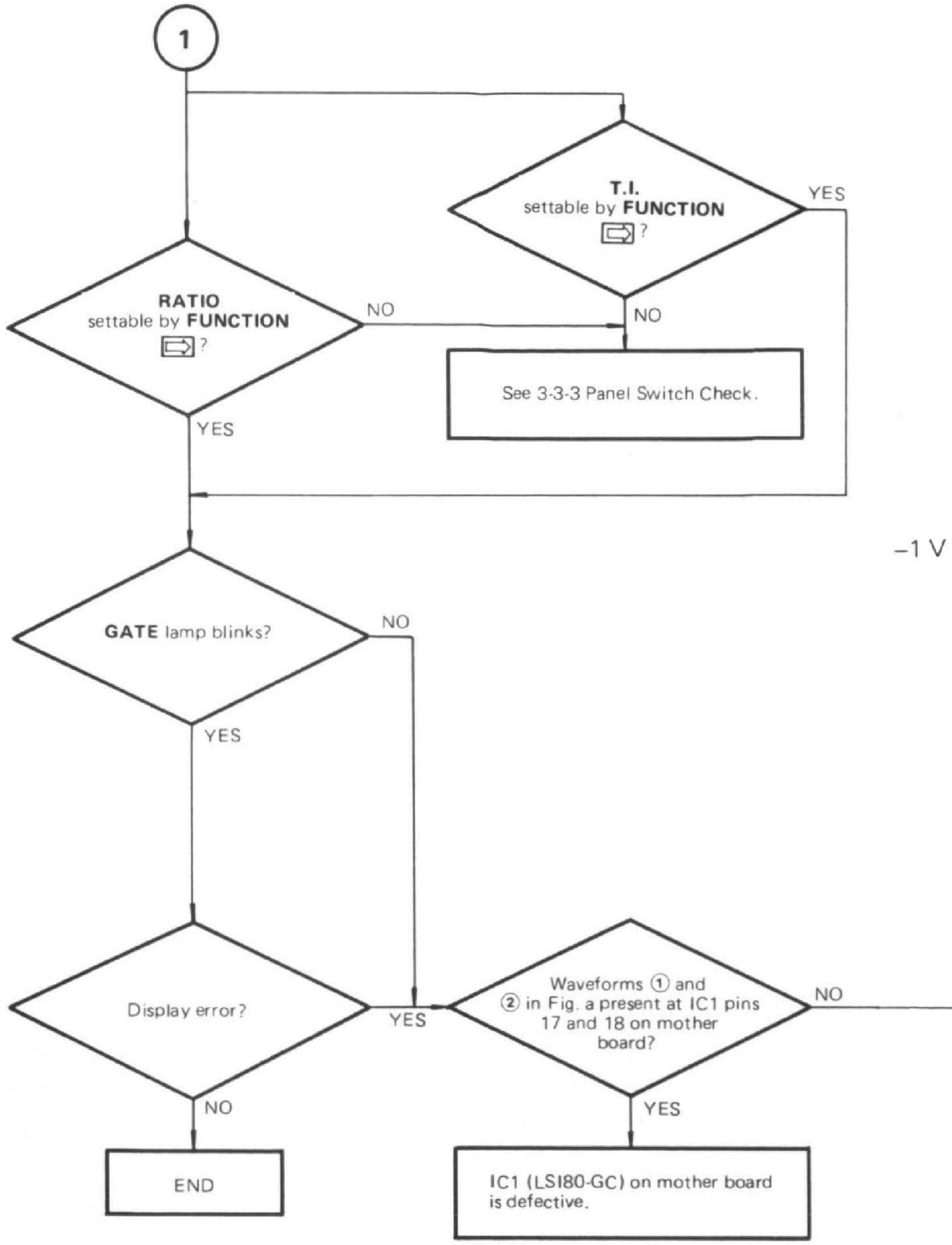

1
PERIOD
FREQ. B
PERIOD
settable by FUNCTION
⇨ ?
YES
FREQ.B
settable by FUNCTION
⇨ ?
NO
NO
See 3-3-3 Panel Switch Check
YES
GATE lamp blinks?
NO
Waveform in
Fig. a present at IC1 pin 18
on mother board?
NO
Go to INPUT A and B Trouble-
shooting.
YES
IC1 (LSI80-GC) on mother board
is defective.
YES
Display error?
YES
Waveform in
Fig. a present at IC1 pin 18
on mother board?
NO
Go to INPUT A and B Trouble-
shooting.
NO
YES
END
IC1 (LSI80-GC) on mother board
is defective.
1 V/div.
−1 V
50 ns/div.

Fig. a

CHART-4 T.I. and RATIO Troubleshooting





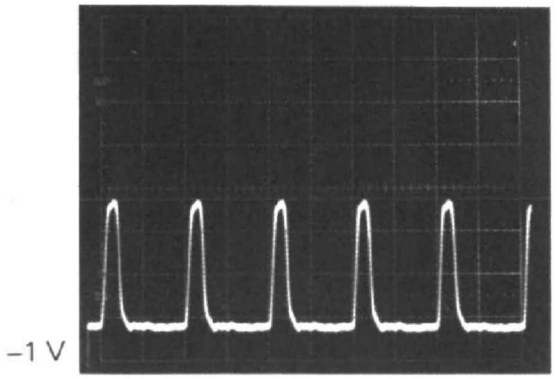


Fig. a ① INA 50 ms/div.
1 V/div.

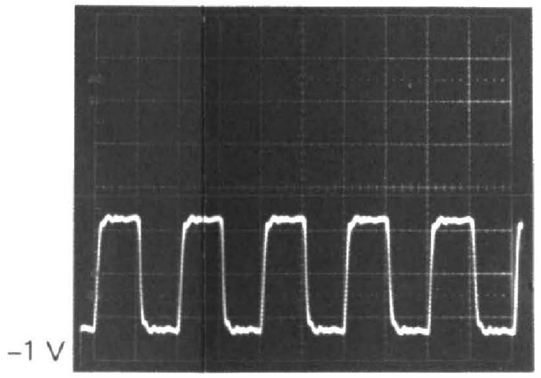
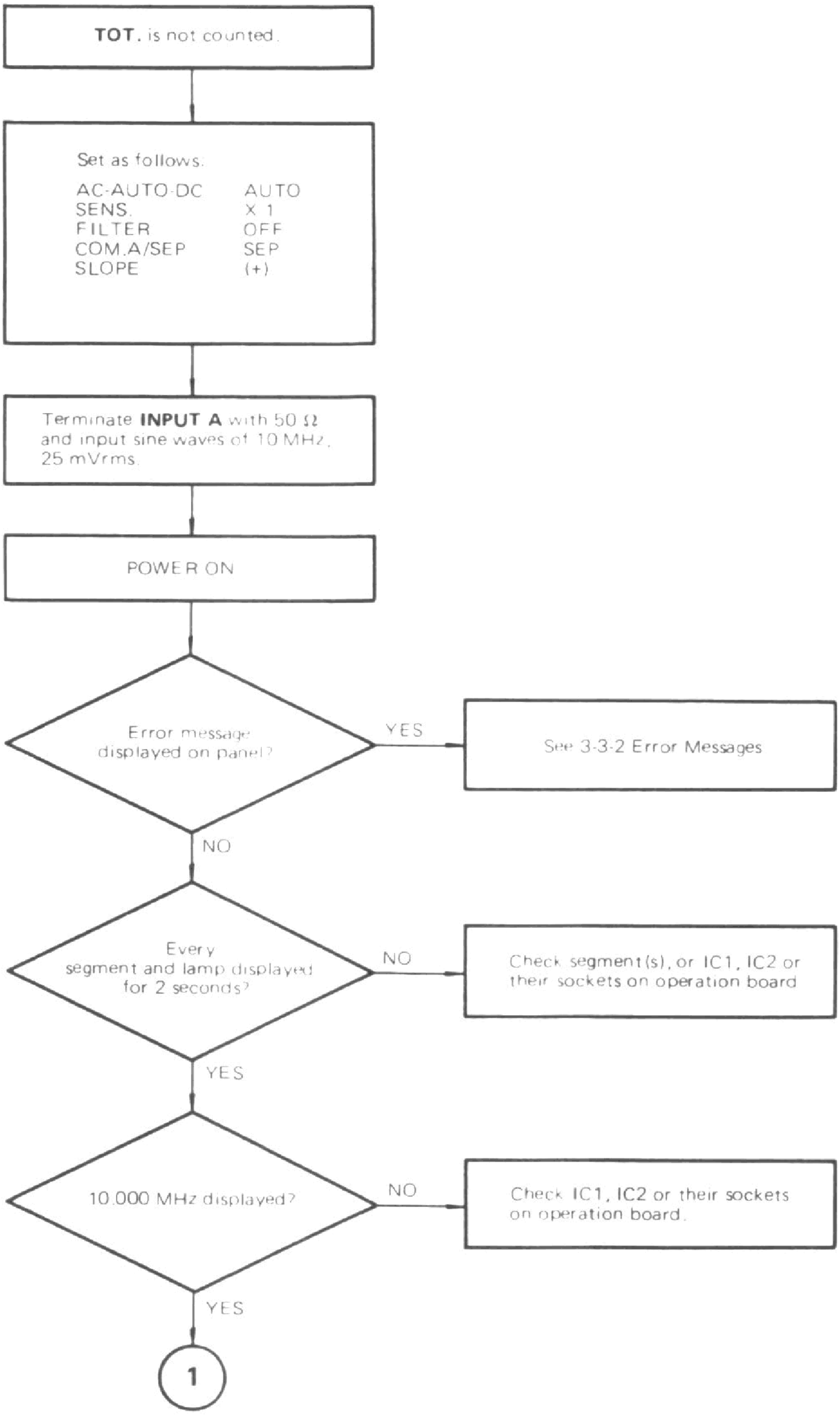
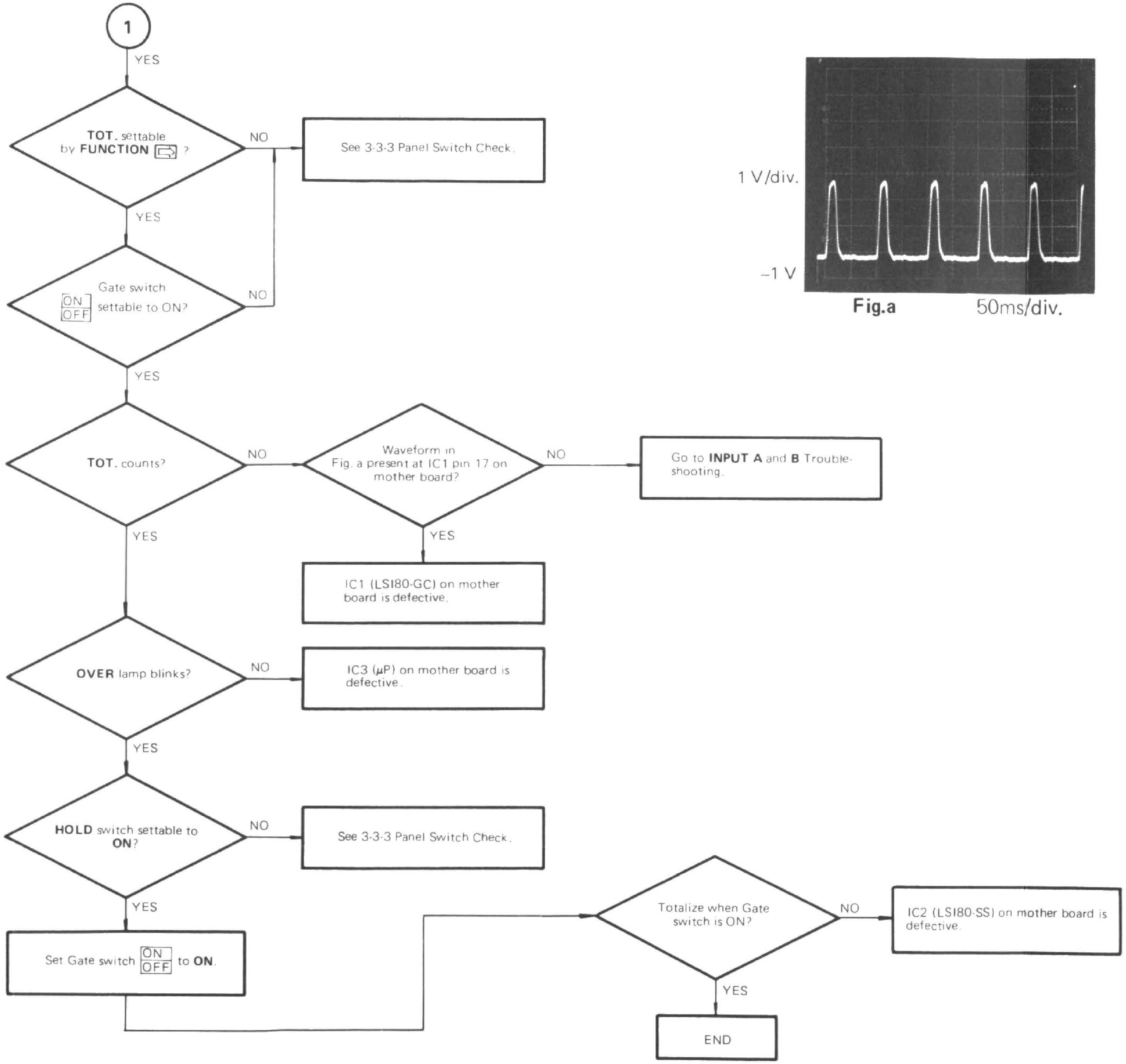


Fig. a ② INB 50 ns/div.
1 V/div.

CHART-5 TOT. Troubleshooting





1
YES
TOT. settable by FUNCTION ?
NO
See 3-3-3 Panel Switch Check.
YES
Gate switch ON OFF settable to ON?
NO
YES
TOT. counts?
NO
Waveform in Fig. a present at IC1 pin 17 on mother board?
NO
Go to INPUT A and B Trouble-shooting.
YES
YES
IC1 (LSI80-GC) on mother board is defective.
OVER lamp blinks?
NO
IC3 (μP) on mother board is defective.
YES
HOLD switch settable to ON?
NO
See 3-3-3 Panel Switch Check.
YES
Set Gate switch ON OFF to ON.
Totalize when Gate switch is ON?
NO
IC2 (LSI80-SS) on mother board is defective.
YES
END

1 V/div.
–1 V
50ms/div.

Fig.a

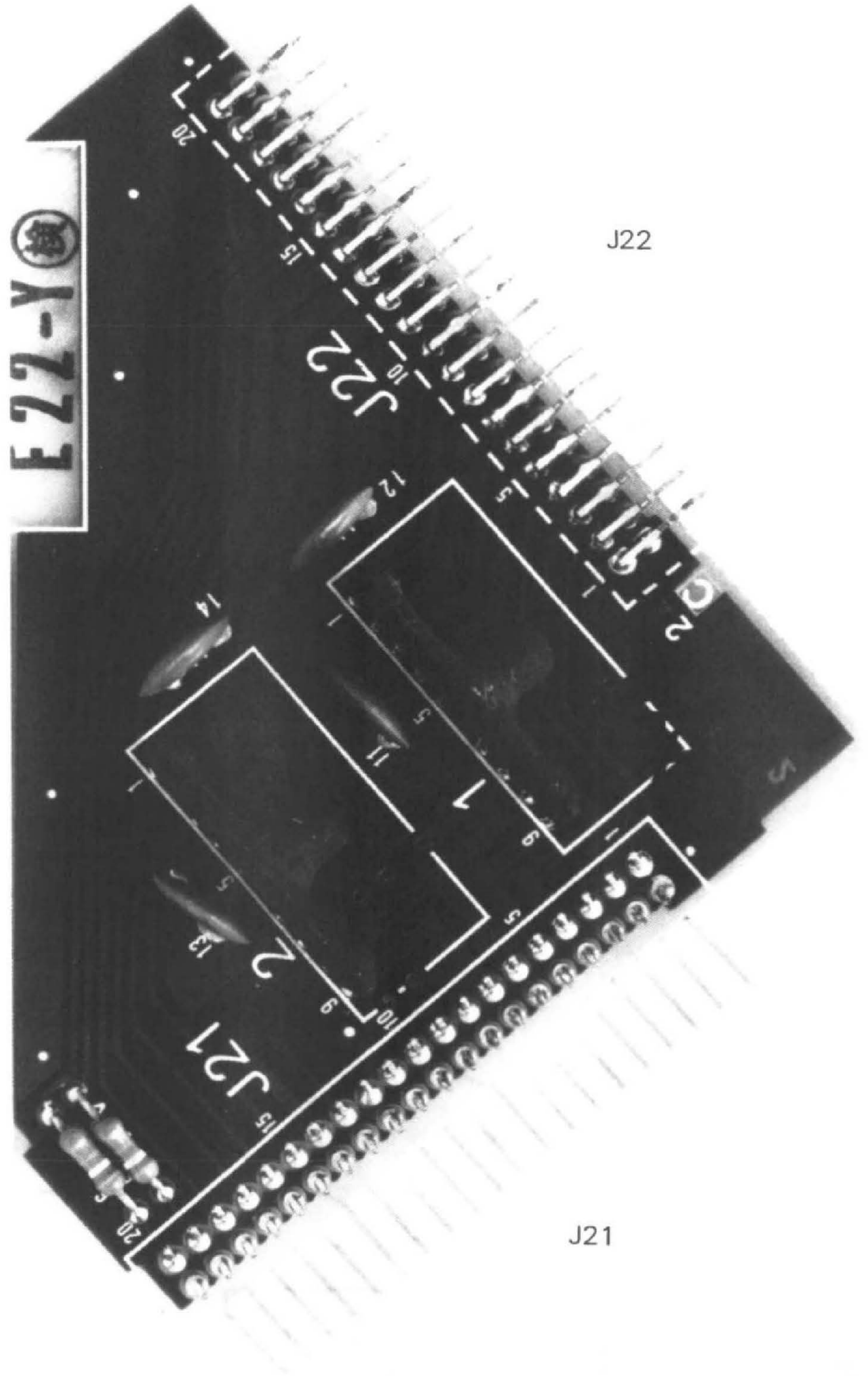
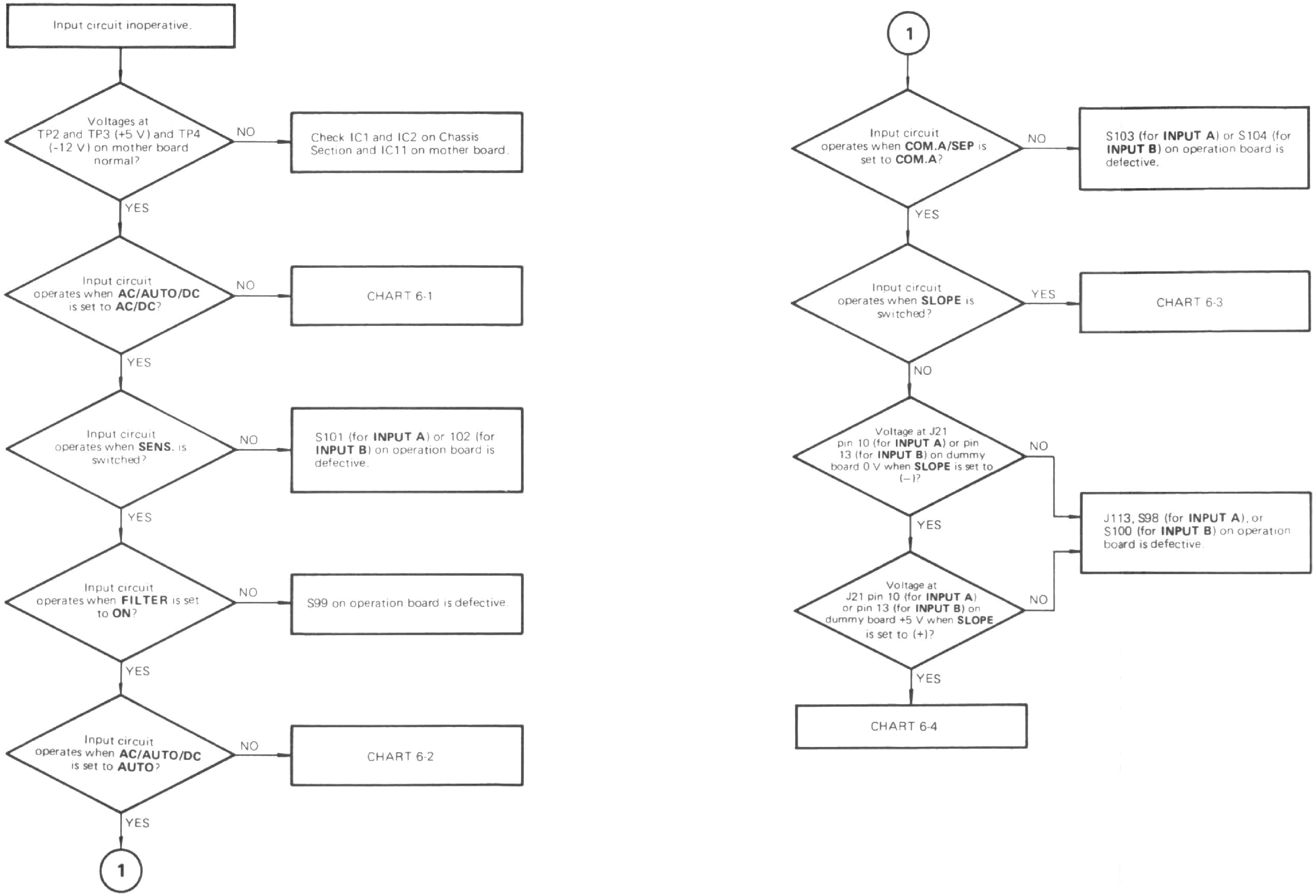


Fig. 9-5 Dummy board (BLB-010047) check points

CHART-6 INPUT A and B Circuit Troubleshooting



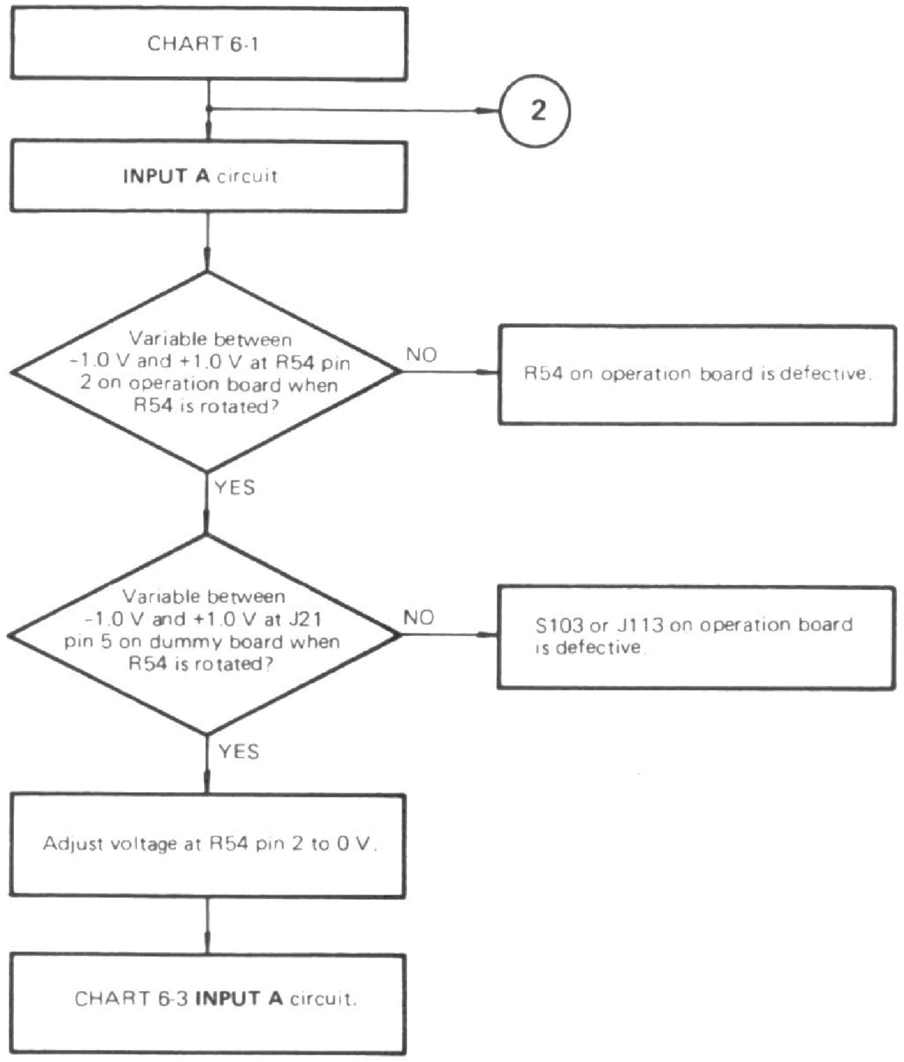
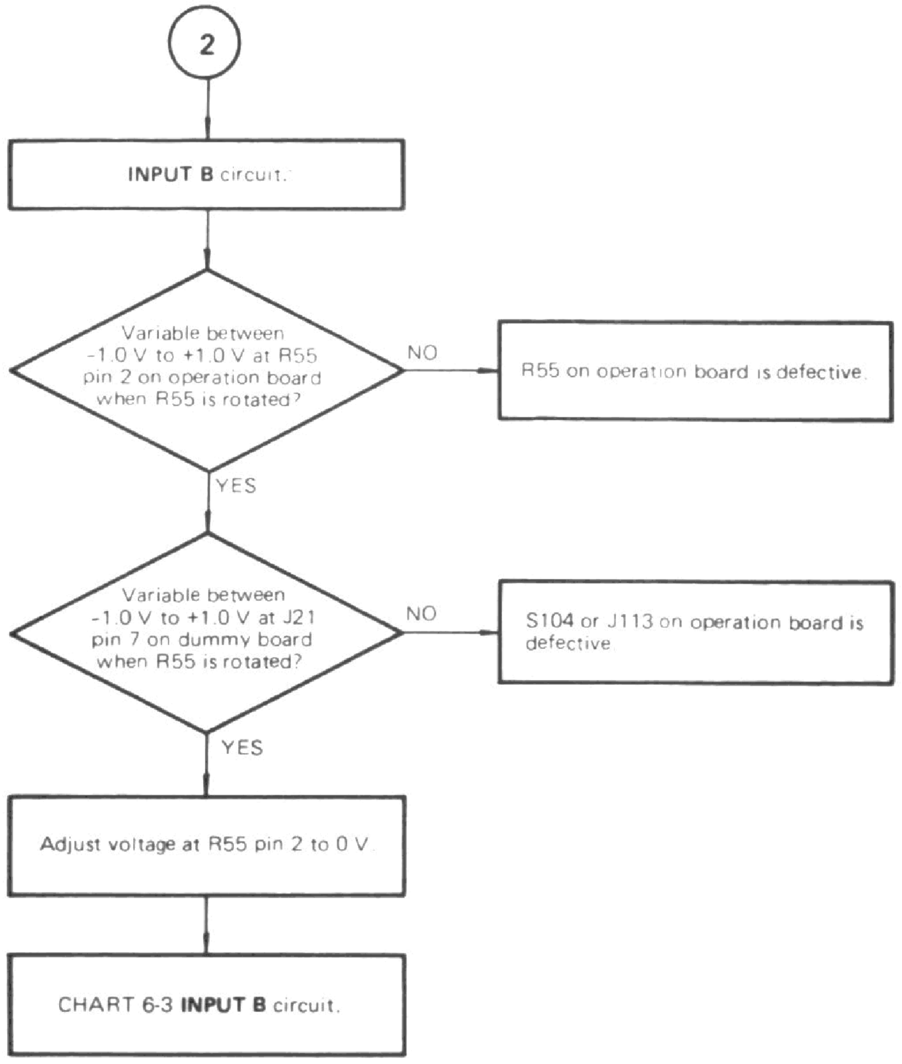


CHART 6-1
2
INPUT A circuit
Variable between -1.0 V and +1.0 V at R54 pin 2 on operation board when R54 is rotated?
NO
R54 on operation board is defective.
YES
Variable between -1.0 V and +1.0 V at J21 pin 5 on dummy board when R54 is rotated?
NO
S103 or J113 on operation board is defective.
YES
Adjust voltage at R54 pin 2 to 0 V.
CHART 6-3 INPUT A circuit.


2
INPUT B circuit.
Variable between -1.0 V to +1.0 V at R55 pin 2 on operation board when R55 is rotated?
NO
R55 on operation board is defective.
YES
Variable between -1.0 V to +1.0 V at J21 pin 7 on dummy board when R55 is rotated?
NO
S104 or J113 on operation board is defective.
YES
Adjust voltage at R55 pin 2 to 0 V
CHART 6-3 INPUT B circuit.

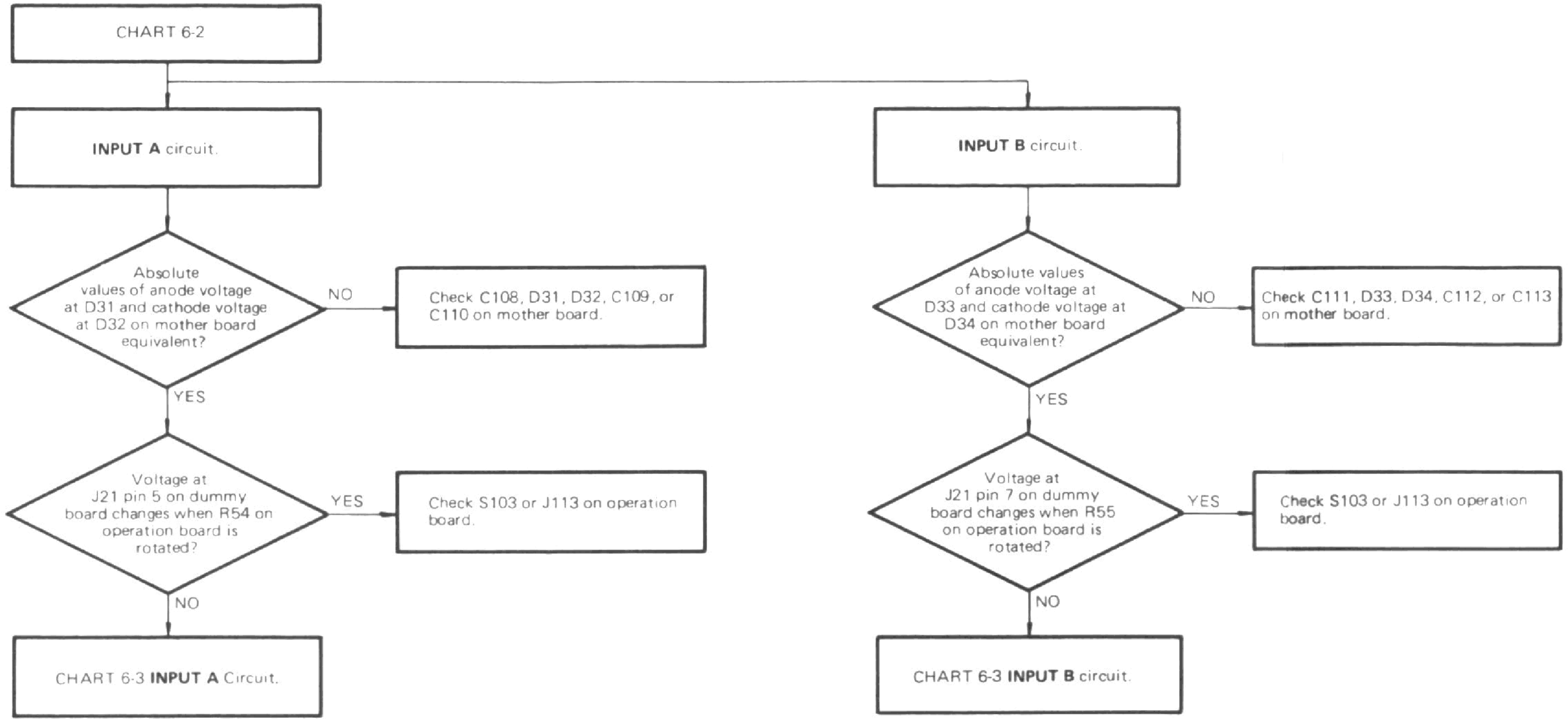


CHART 6-2
INPUT A circuit.
Absolute values of anode voltage at D31 and cathode voltage at D32 on mother board equivalent?
NO
Check C108, D31, D32, C109, or C110 on mother board.
YES
Voltage at J21 pin 5 on dummy board changes when R54 on operation board is rotated?
YES
Check S103 or J113 on operation board.
NO
CHART 6-3 INPUT A Circuit.
INPUT B circuit.
Absolute values of anode voltage at D33 and cathode voltage at D34 on mother board equivalent?
NO
Check C111, D33, D34, C112, or C113 on mother board.
YES
Voltage at J21 pin 7 on dummy board changes when R55 on operation board is rotated?
YES
Check S103 or J113 on operation board.
NO
CHART 6-3 INPUT B circuit.

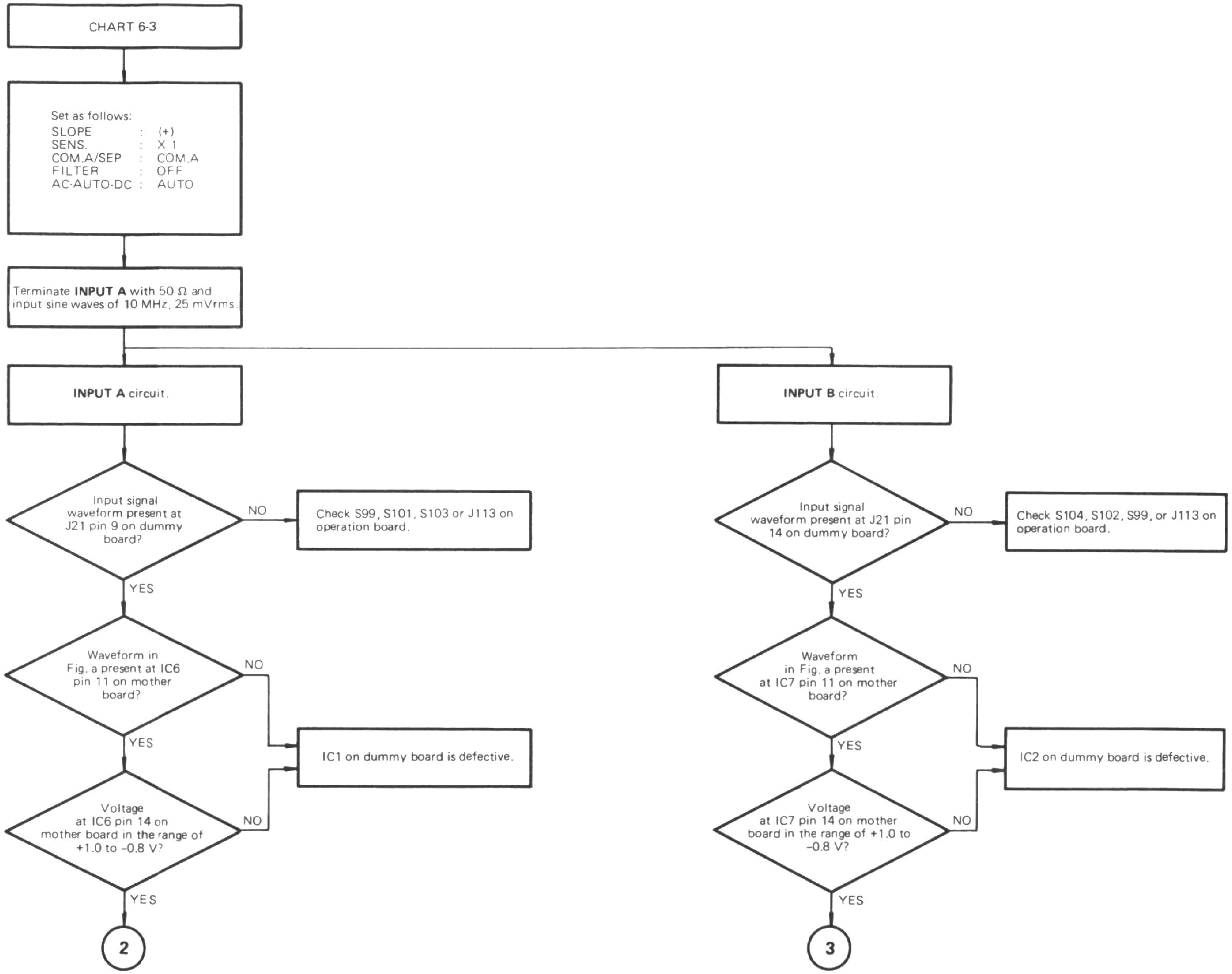
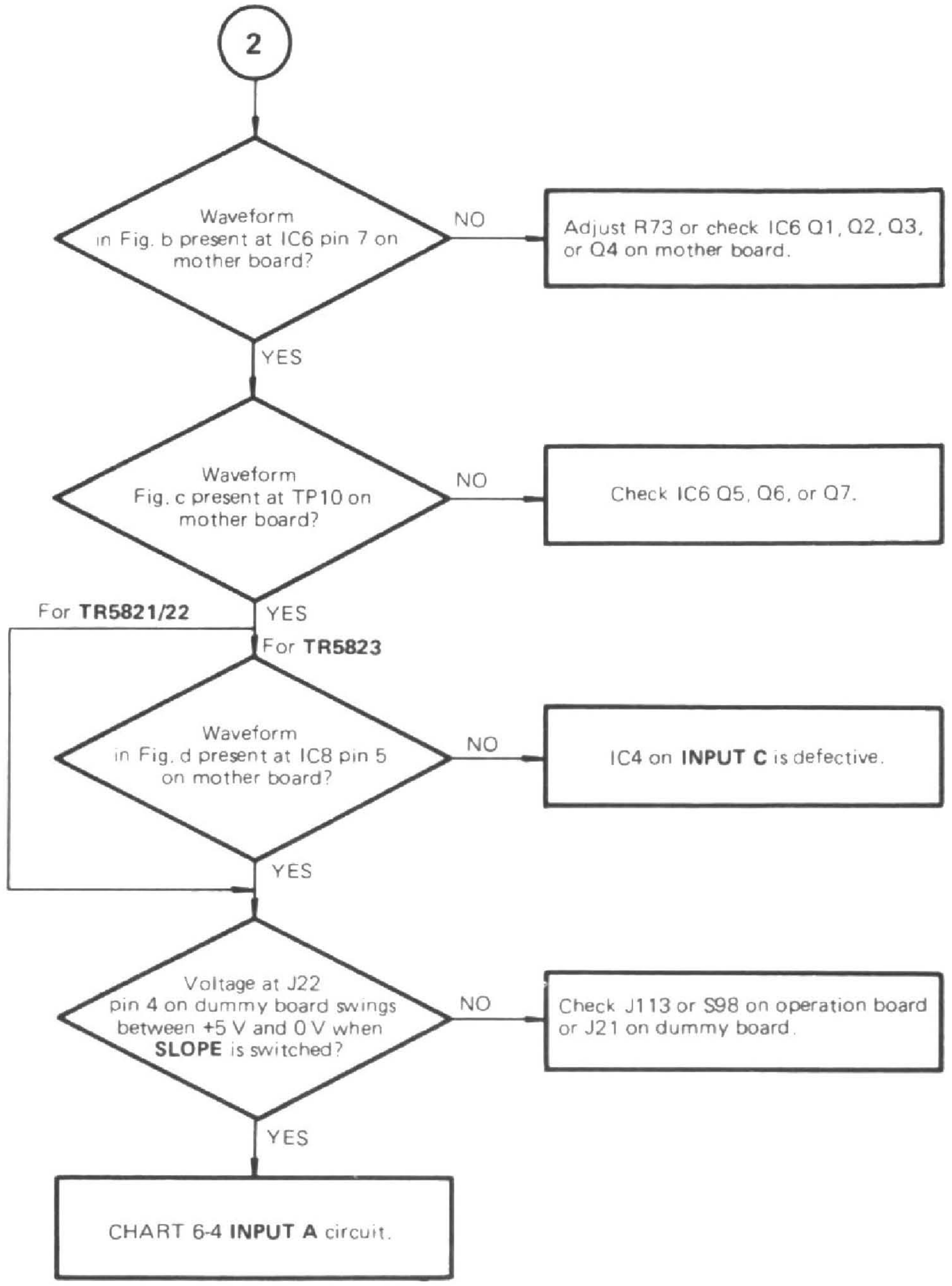
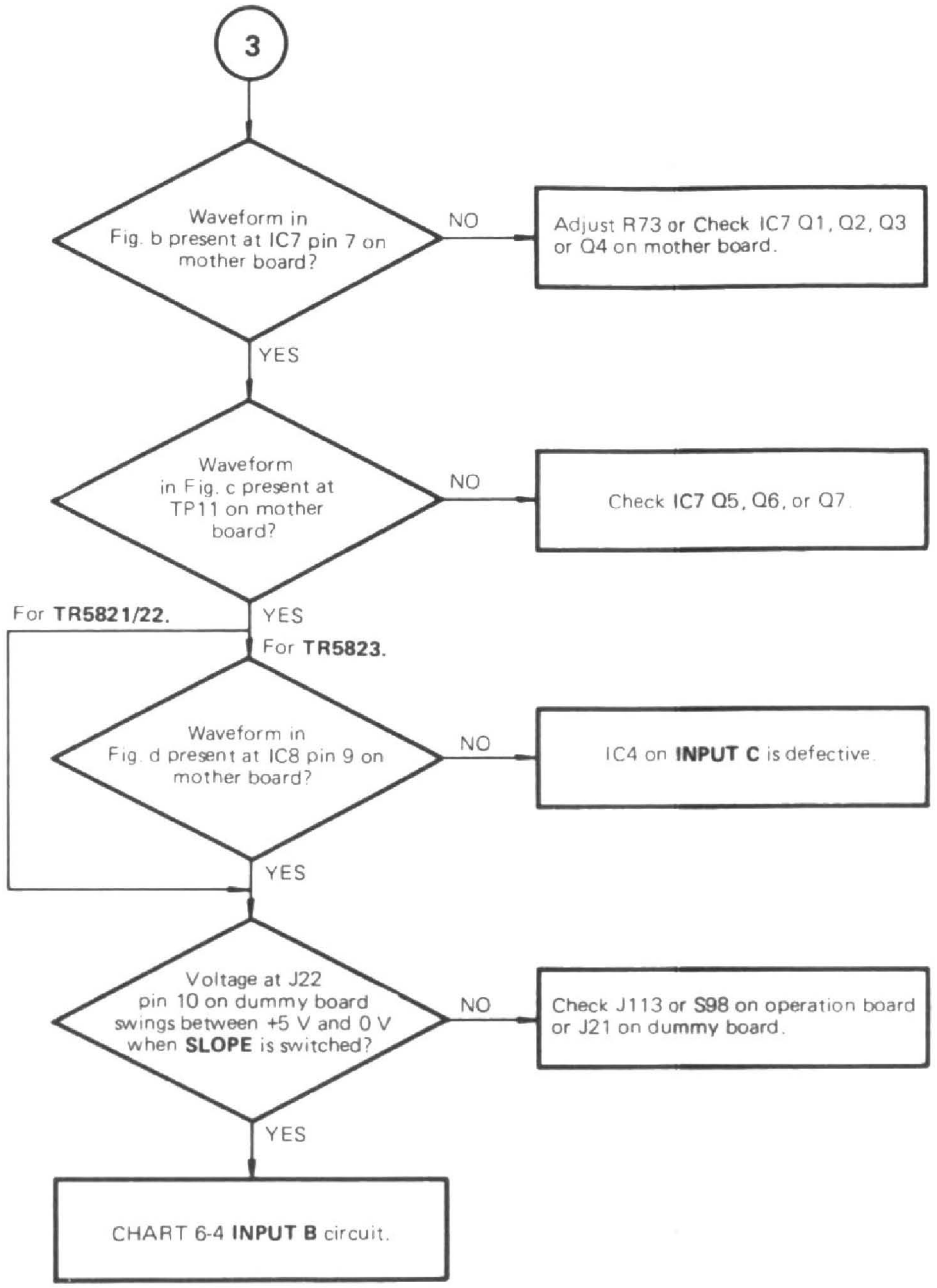


CHART 6-3
Set as follows:
SLOPE : (+)
SENS. : X 1
COM.A/SEP : COM.A
FILTER : OFF
AC-AUTO-DC : AUTO
Terminate INPUT A with 50 Ω and input sine waves of 10 MHz, 25 mVrms.
INPUT A circuit.
Input signal waveform present at J21 pin 9 on dummy board?
NO
Check S99, S101, S103 or J113 on operation board.
YES
Waveform in Fig. a present at IC6 pin 11 on mother board?
NO
YES
IC1 on dummy board is defective.
Voltage at IC6 pin 14 on mother board in the range of +1.0 to -0.8 V?
NO
YES
2
INPUT B circuit.
Input signal waveform present at J21 pin 14 on dummy board?
NO
Check S104, S102, S99, or J113 on operation board.
YES
Waveform in Fig. a present at IC7 pin 11 on mother board?
NO
YES
IC2 on dummy board is defective.
Voltage at IC7 pin 14 on mother board in the range of +1.0 to -0.8 V?
NO
YES
3





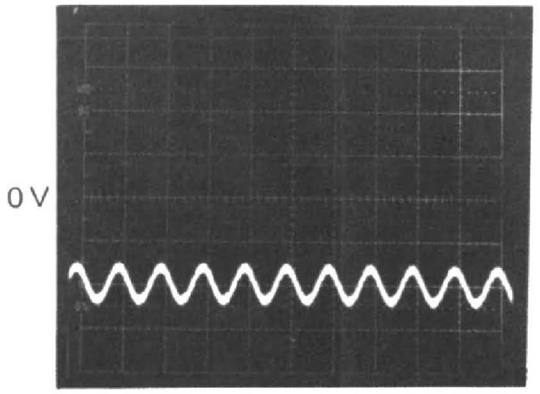


Fig. a 0.1 µs/div.
0.1 V/div.

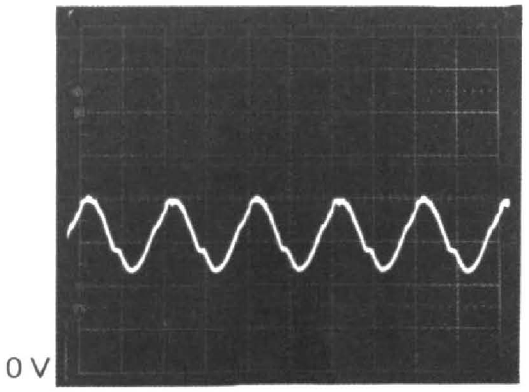


Fig. b 50 ns/div.
0.5 V/div.

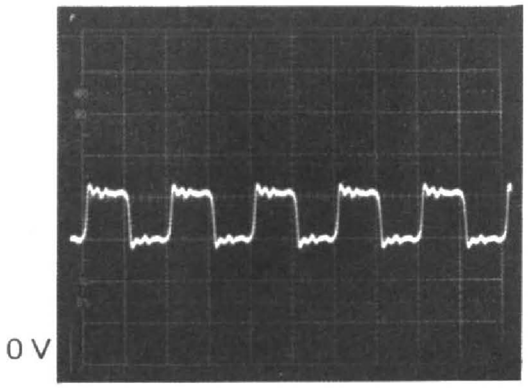


Fig. c 50 ns/div.
1 V/div.

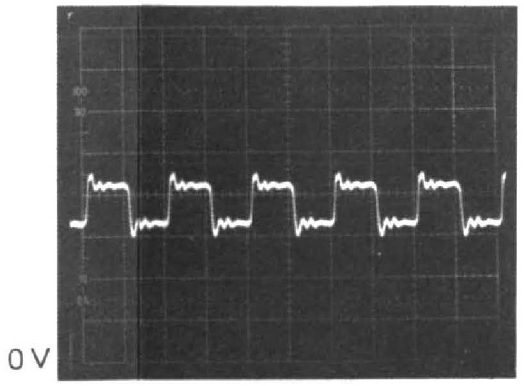
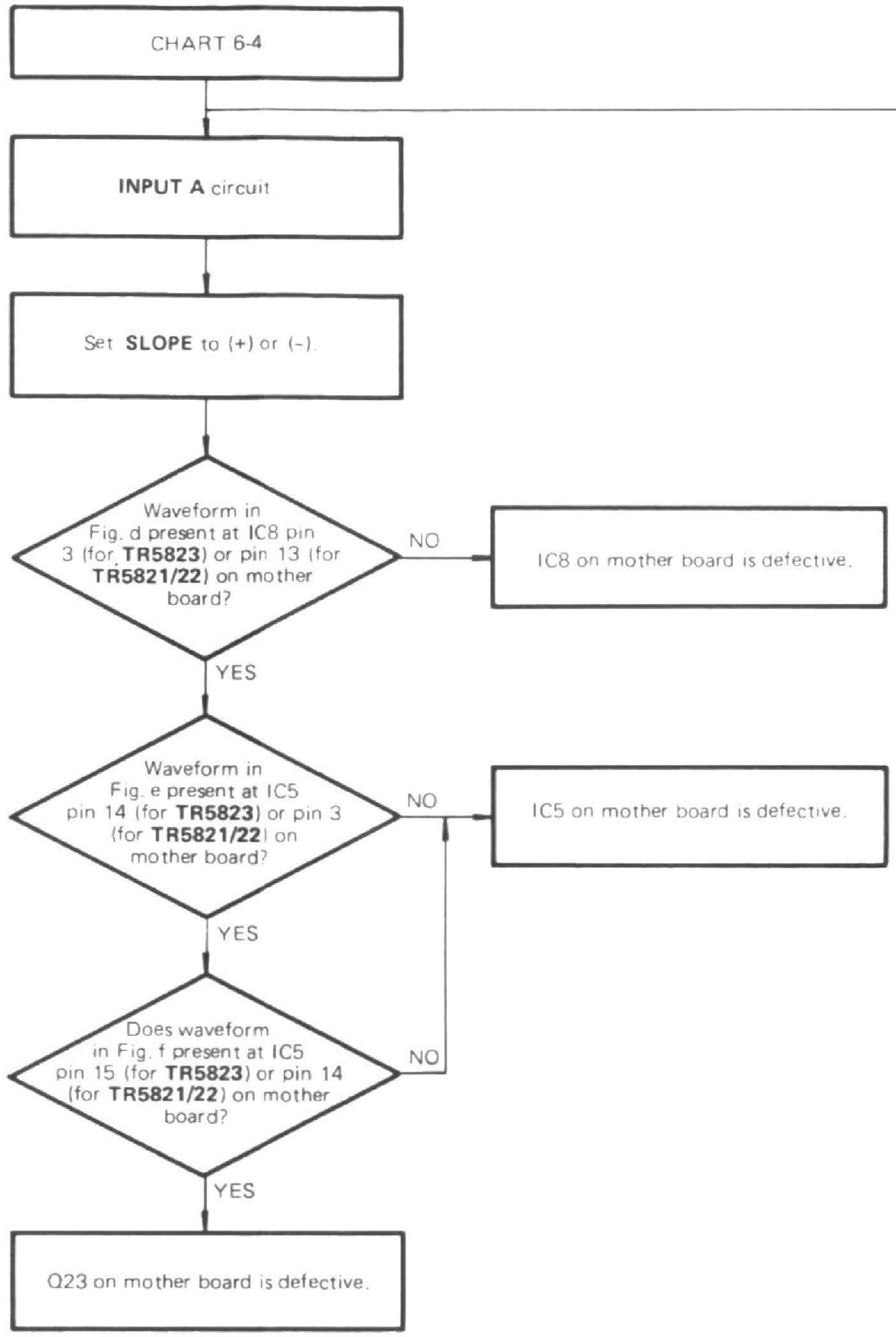


Fig. d 50 ns/div.
1 V/div.



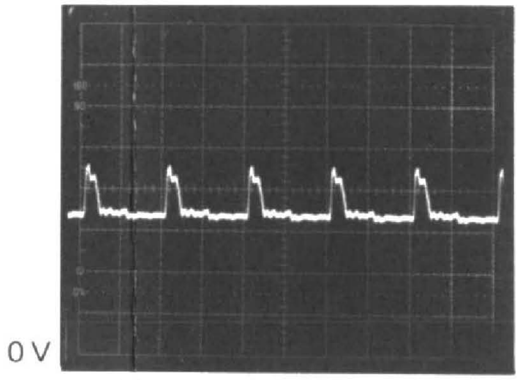


Fig. e 50 ns/div.
1 V/div.

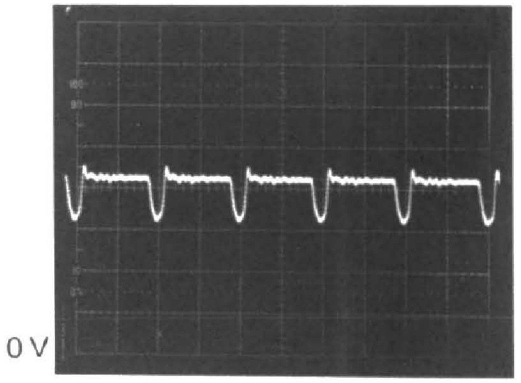
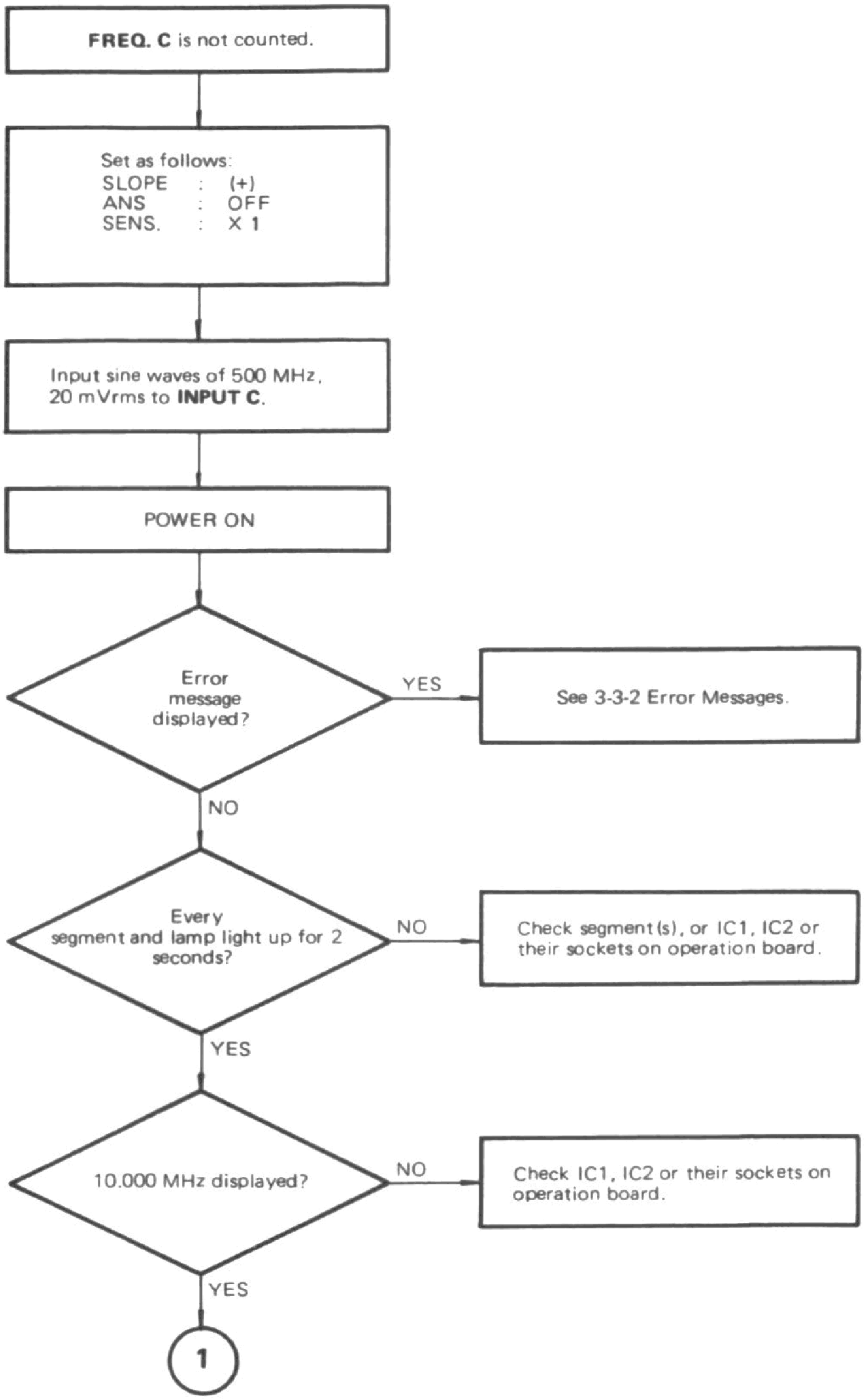


Fig. f 50 ns/div.
1 V/div.

CHART-7 FREQ.C Troubleshooting (TR5823)



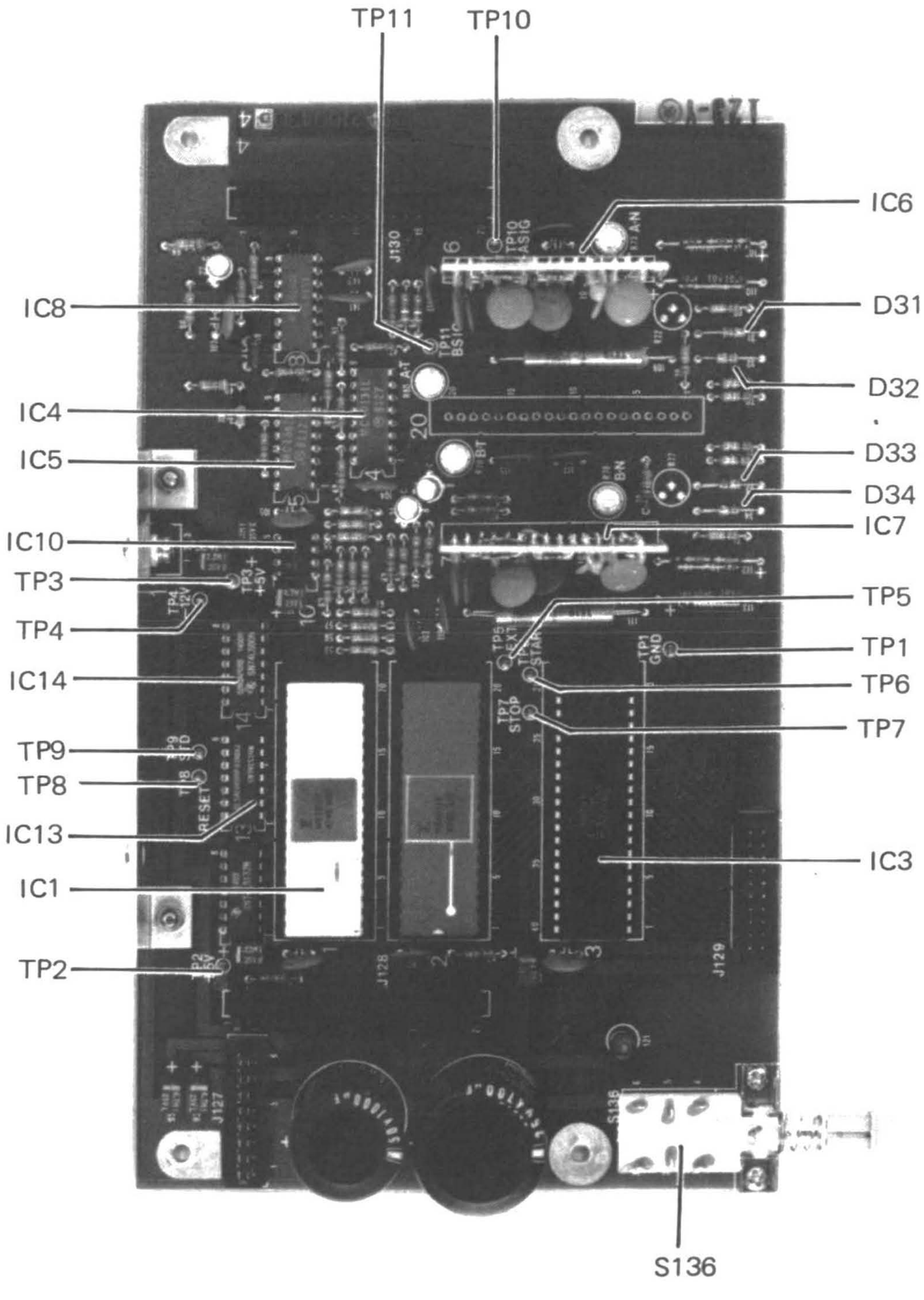
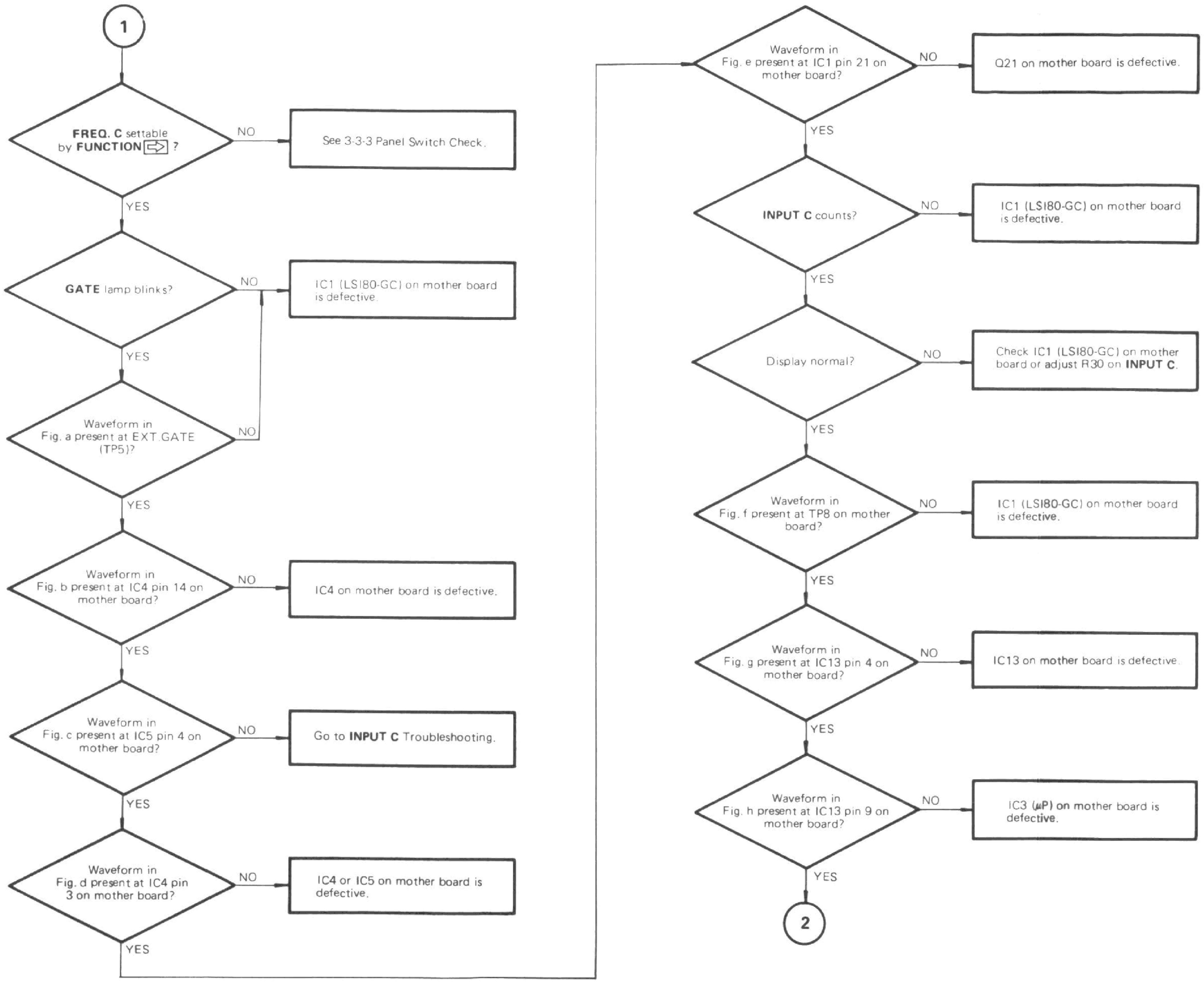
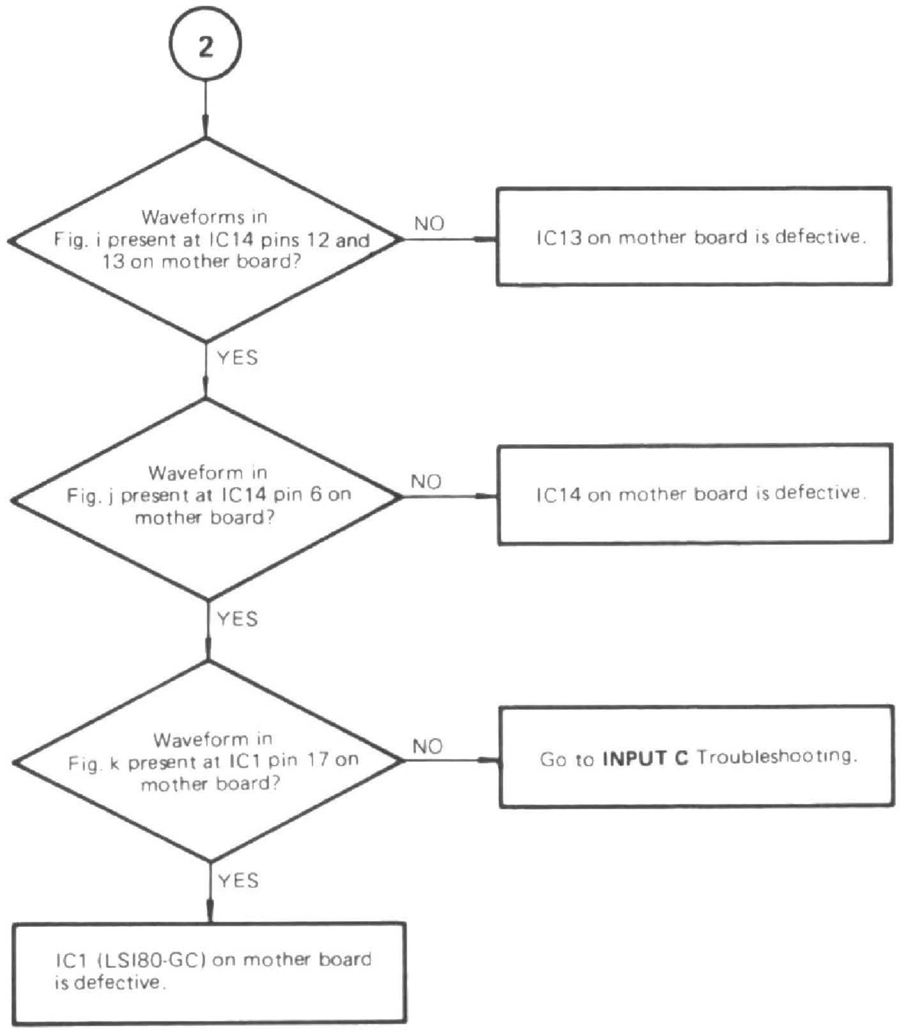


Fig. 9-6 Mother board (BLG-010043) check points (**TR5823**)


1
FREQ. C settable by FUNCTION ⇨ ?
NO
See 3-3-3 Panel Switch Check.
YES
GATE lamp blinks?
NO
IC1 (LSI80-GC) on mother board is defective.
YES
Waveform in Fig. a present at EXT GATE (TP5)?
NO
YES
Waveform in Fig. b present at IC4 pin 14 on mother board?
NO
IC4 on mother board is defective.
YES
Waveform in Fig. c present at IC5 pin 4 on mother board?
NO
Go to INPUT C Troubleshooting.
YES
Waveform in Fig. d present at IC4 pin 3 on mother board?
NO
IC4 or IC5 on mother board is defective.
YES
Waveform in Fig. e present at IC1 pin 21 on mother board?
NO
Q21 on mother board is defective.
YES
INPUT C counts?
NO
IC1 (LSI80-GC) on mother board is defective.
YES
Display normal?
NO
Check IC1 (LSI80-GC) on mother board or adjust R30 on INPUT C.
YES
Waveform in Fig. f present at TP8 on mother board?
NO
IC1 (LSI80-GC) on mother board is defective.
YES
Waveform in Fig. g present at IC13 pin 4 on mother board?
NO
IC13 on mother board is defective.
YES
Waveform in Fig. h present at IC13 pin 9 on mother board?
NO
IC3 (μP) on mother board is defective.
YES
2



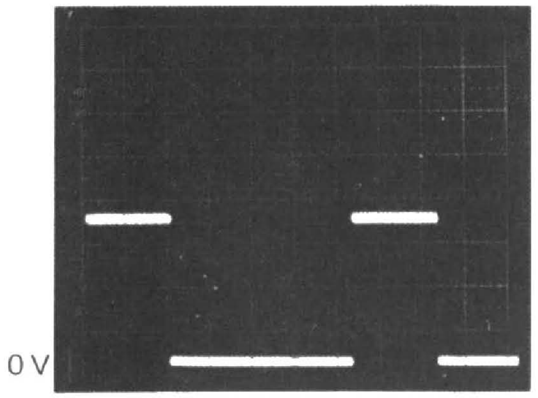


Fig. a 10 ms/div.
1 V/div.

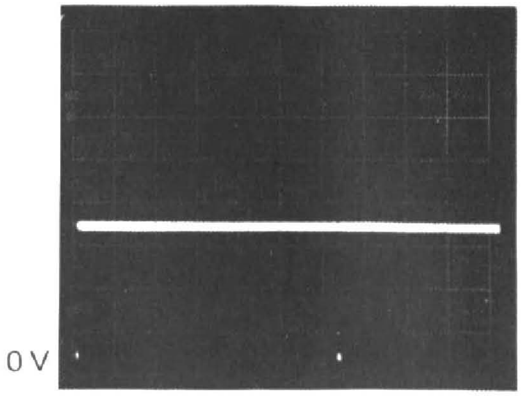


Fig. b 10 ms/div.
1 V/div.

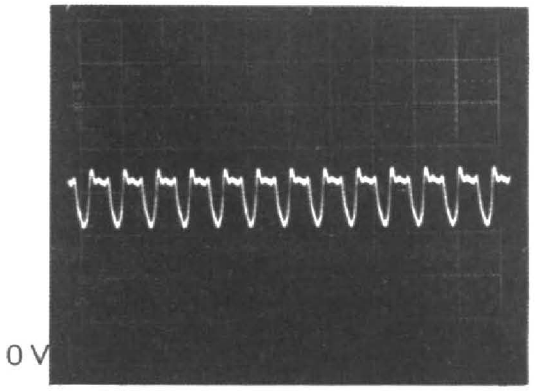


Fig. c 50 ns/div.
1 V/div.

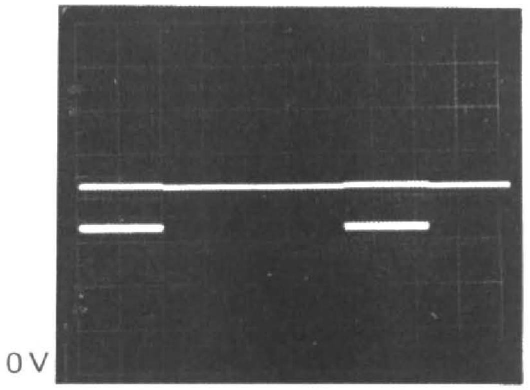


Fig. d 10 ms/div.
1 V/div.

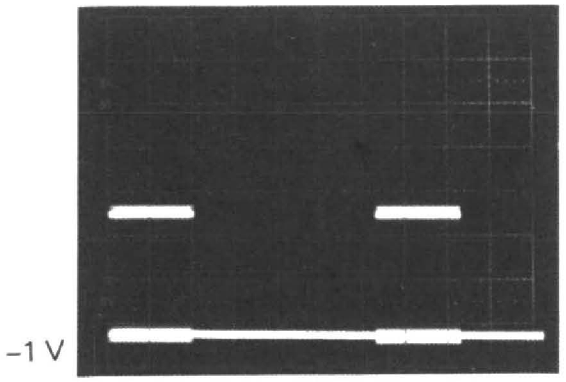


Fig. e 10 ms/div.
1 V/div.

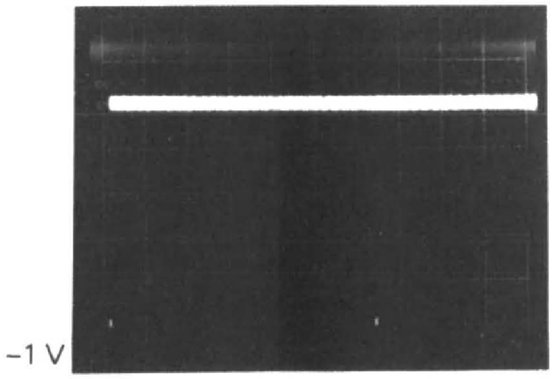


Fig. f 10 ms/div.
1 V/div.

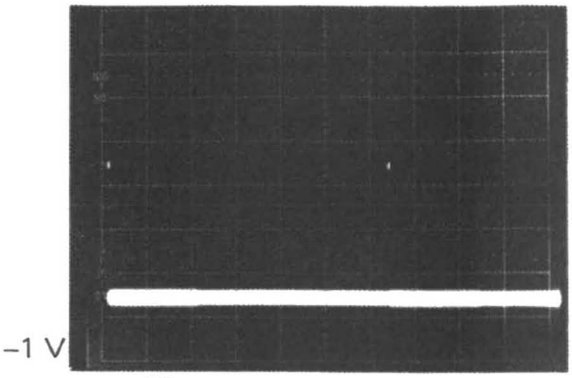


Fig. g 10 ms/div.
1 V/div.

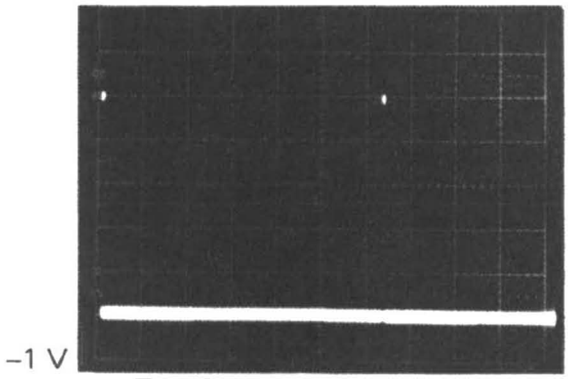


Fig. h 10 ms/div.
1 V/div.

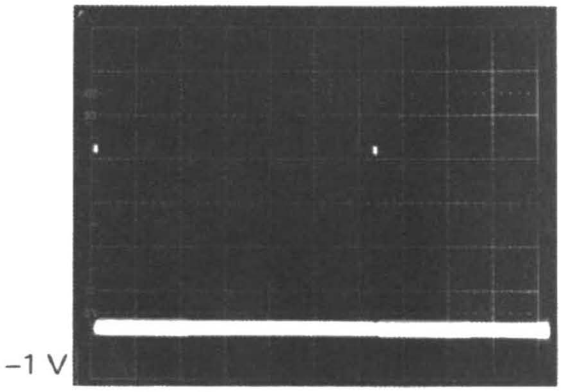


Fig. i 10 ms/div.
1 V/div.

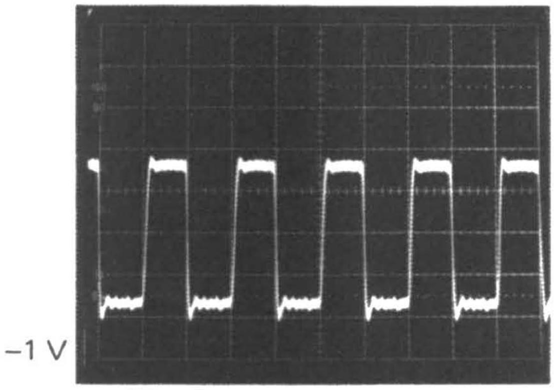


Fig. j 0.1 μs/div.
1 V/div.

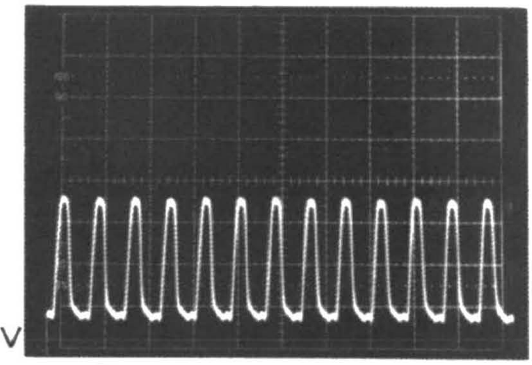


Fig. k 50 ns/div.
1 V/div.

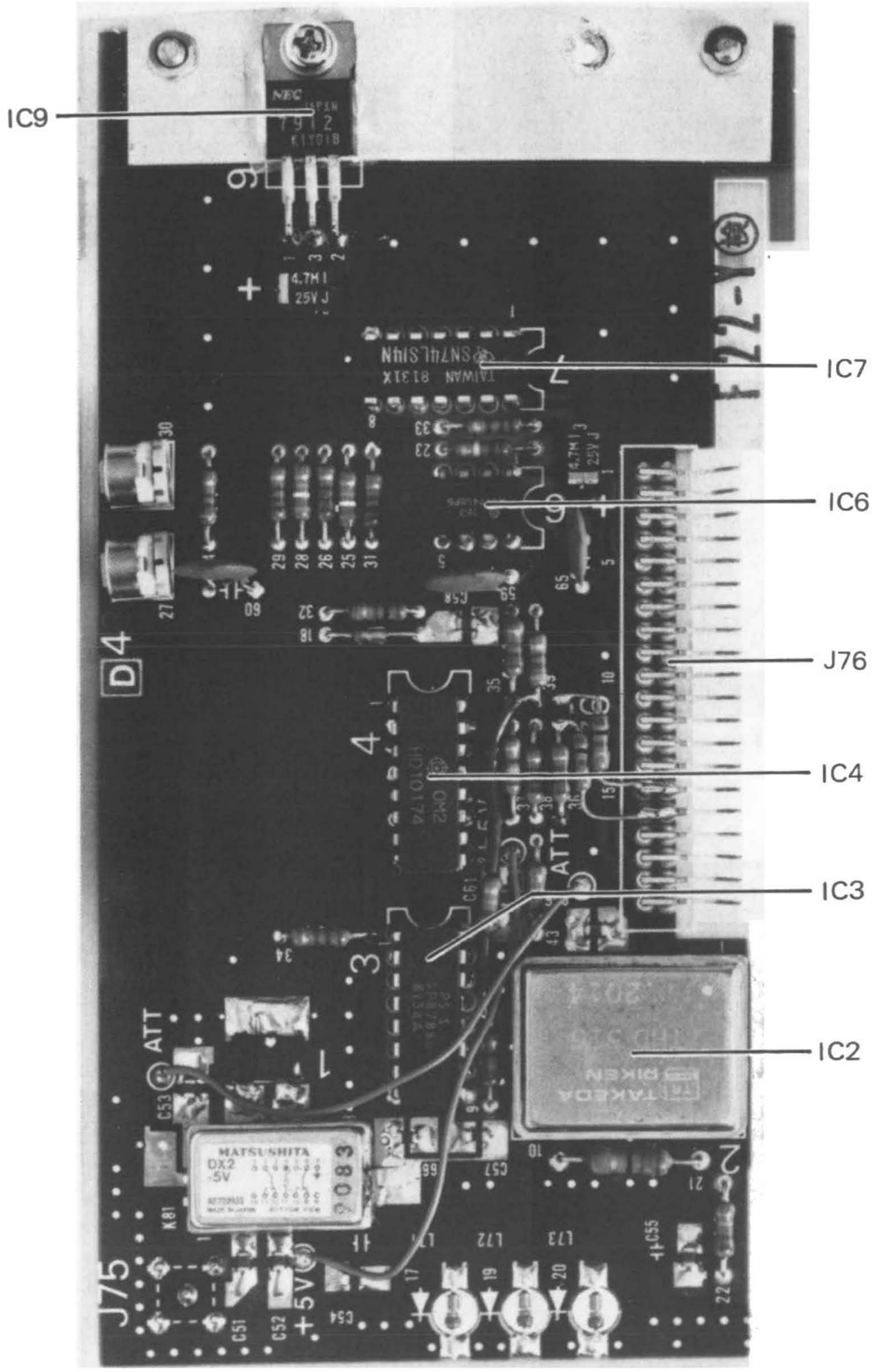
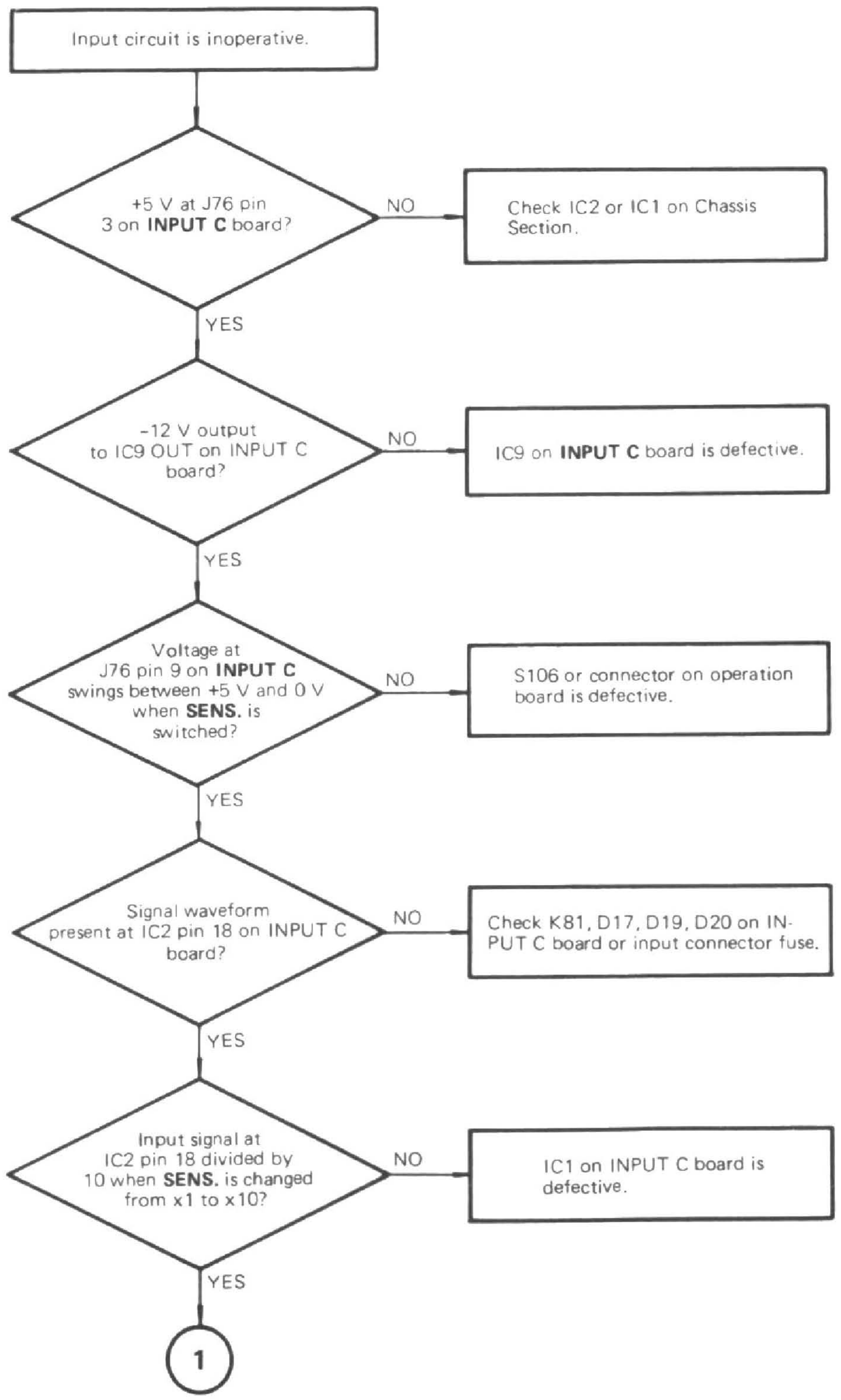
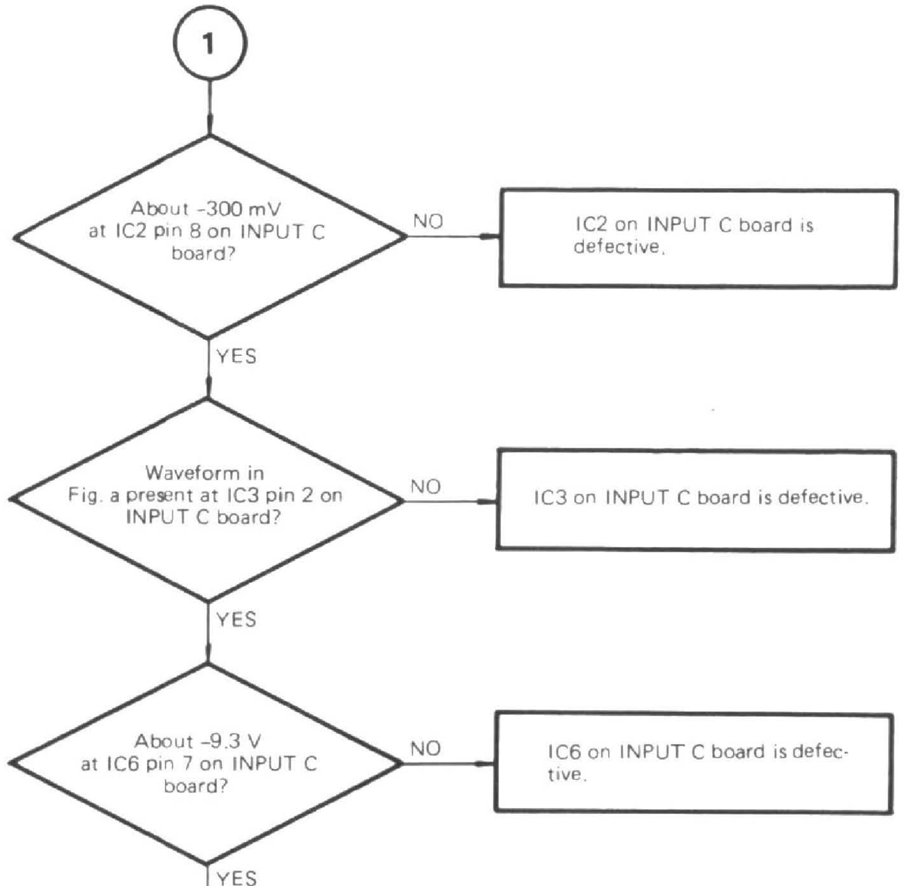


Fig. 9-7 **INPUT C** board (BLC-010050) check points **(TR5823)**

CHART-8 INPUT C Circuit Troubleshooting (TR5823) (BLC-010050)





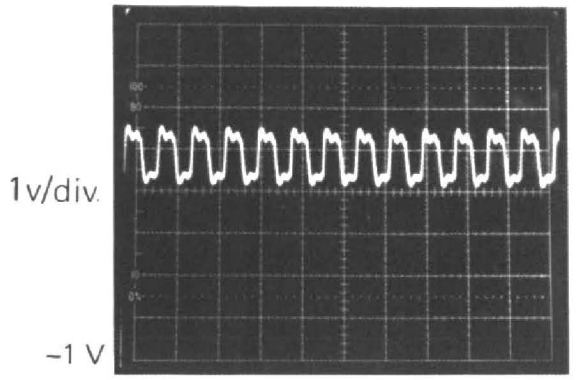
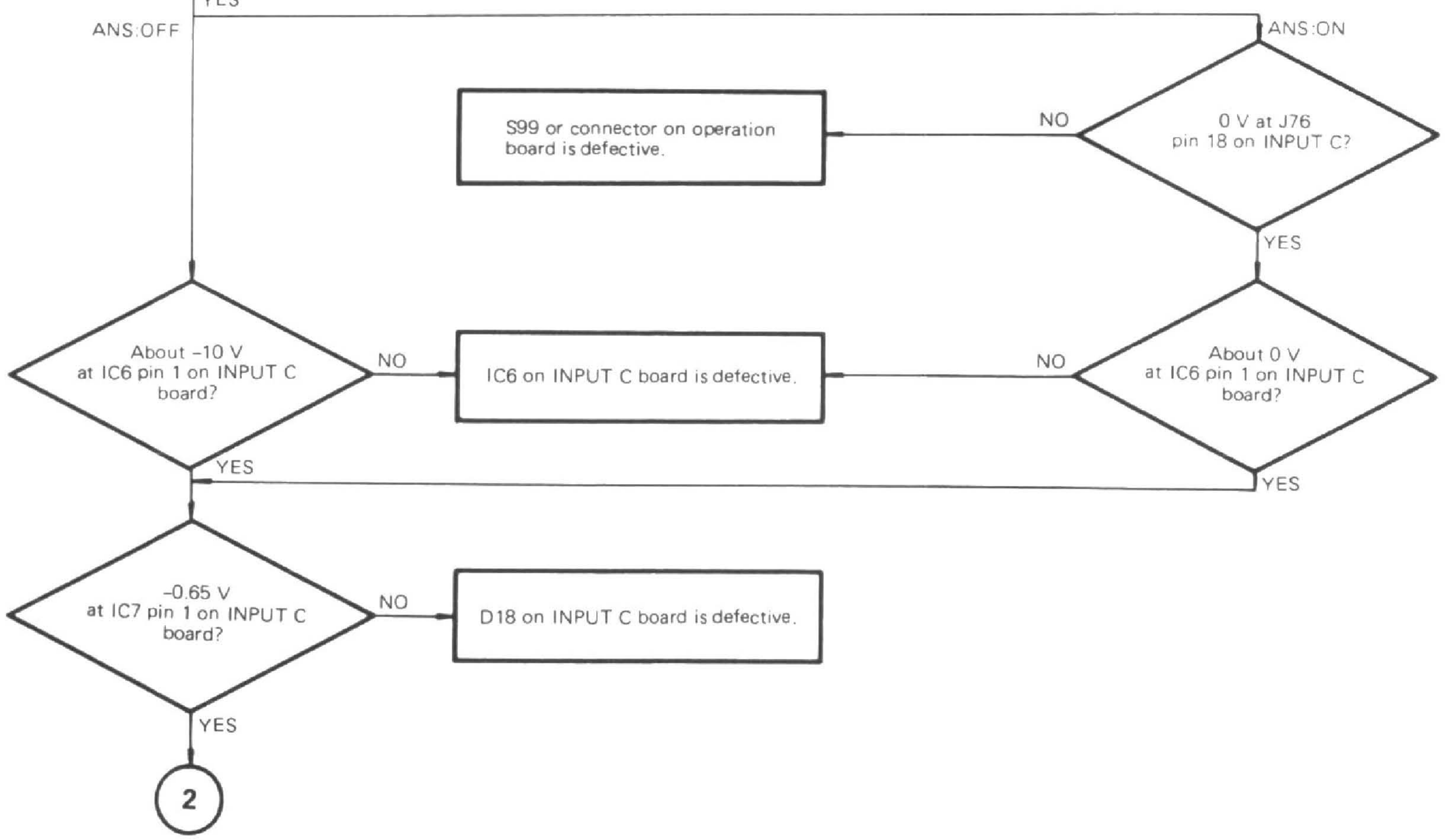
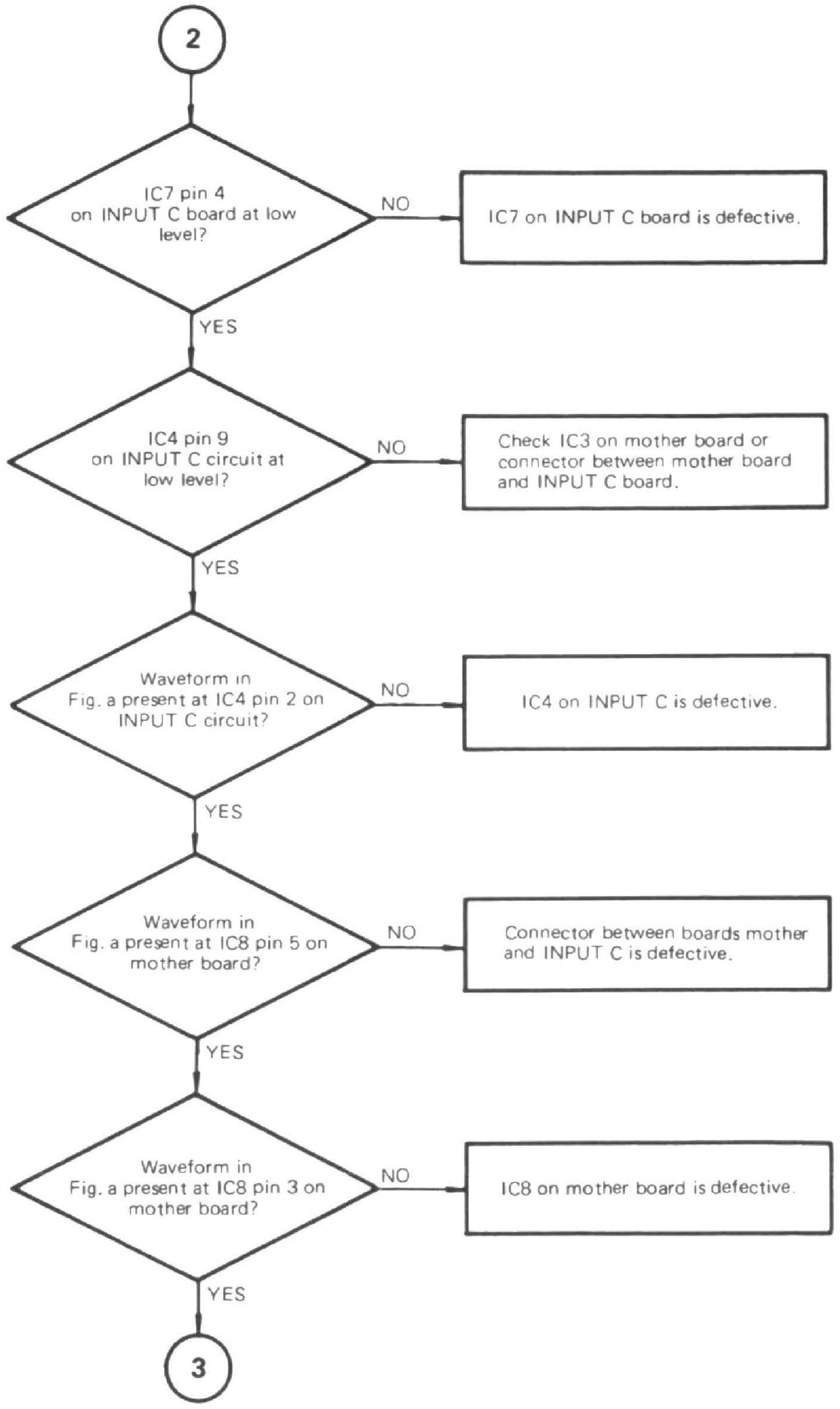
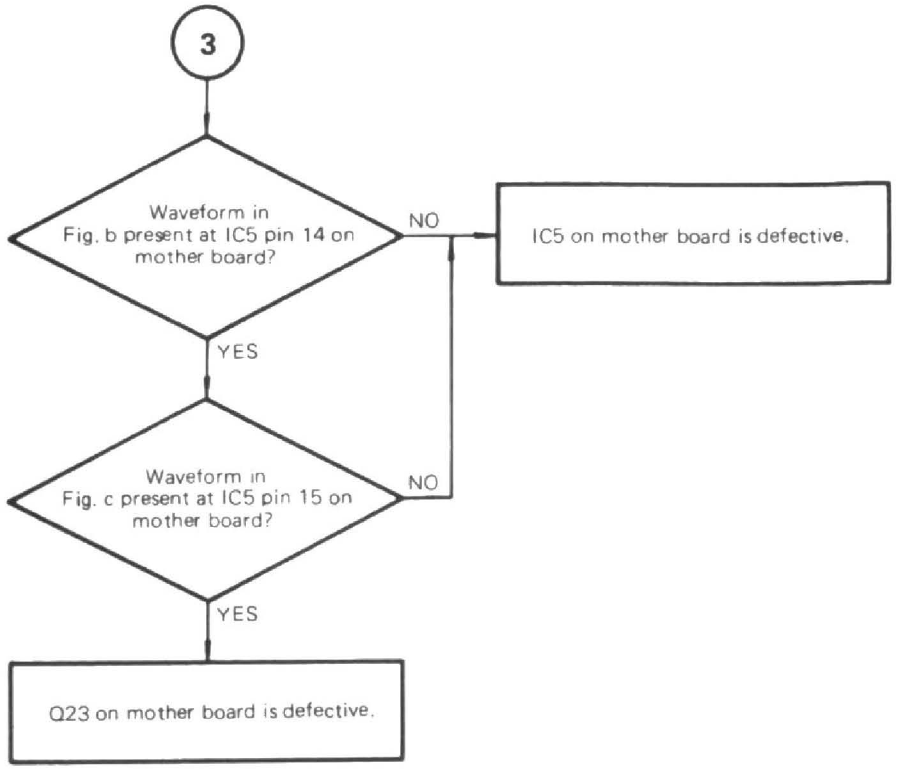


Fig. a







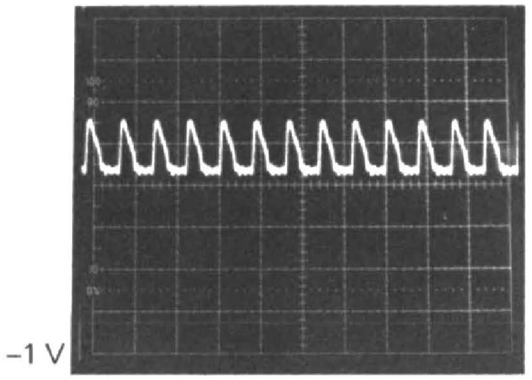


Fig. b 50 ns/div.
1 V/div.

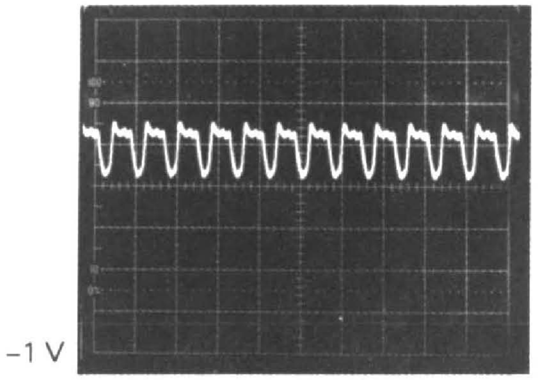


Fig. c 50 ns/div.
1 V/div.

CHART-9 **MASK TIME** Troubleshooting

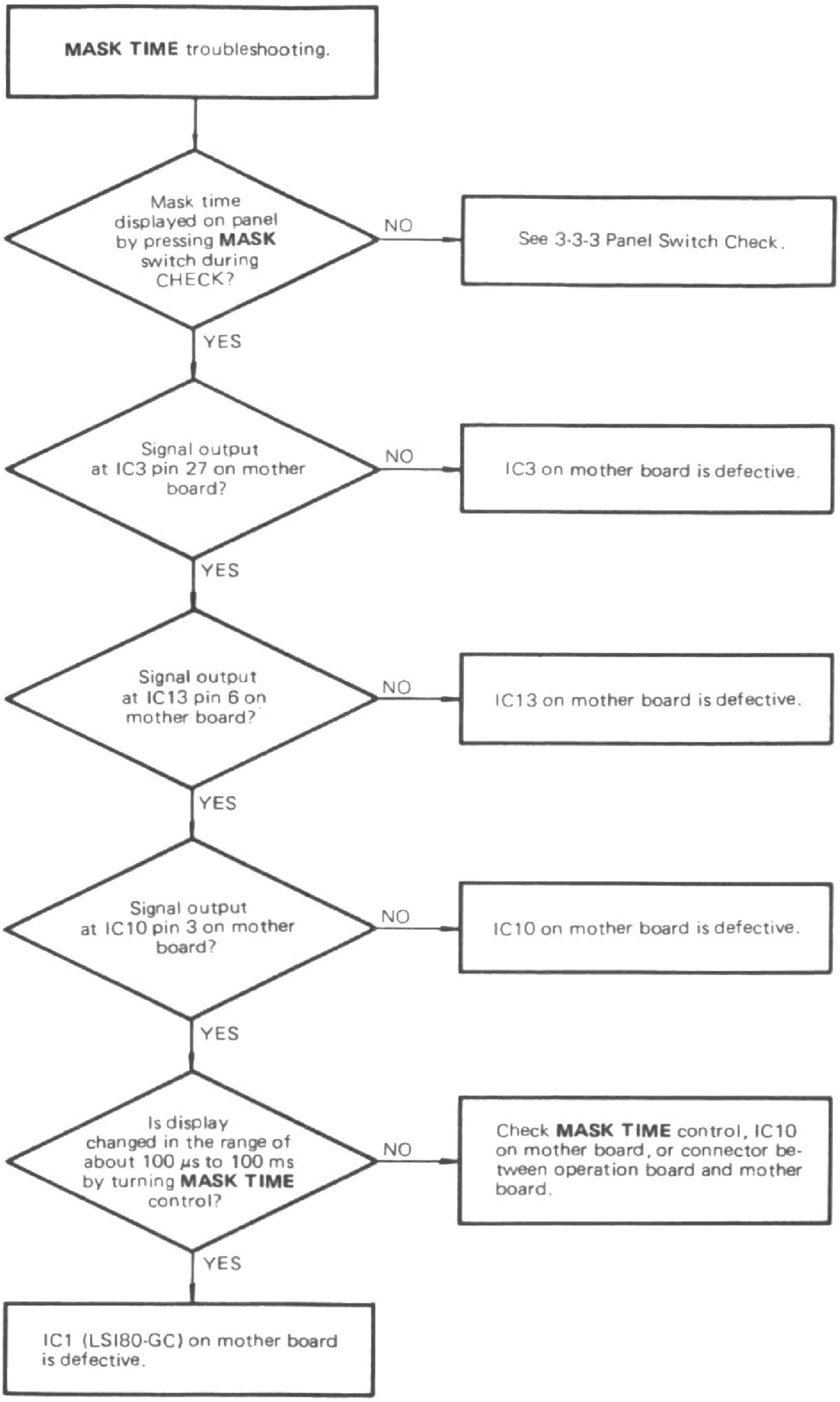
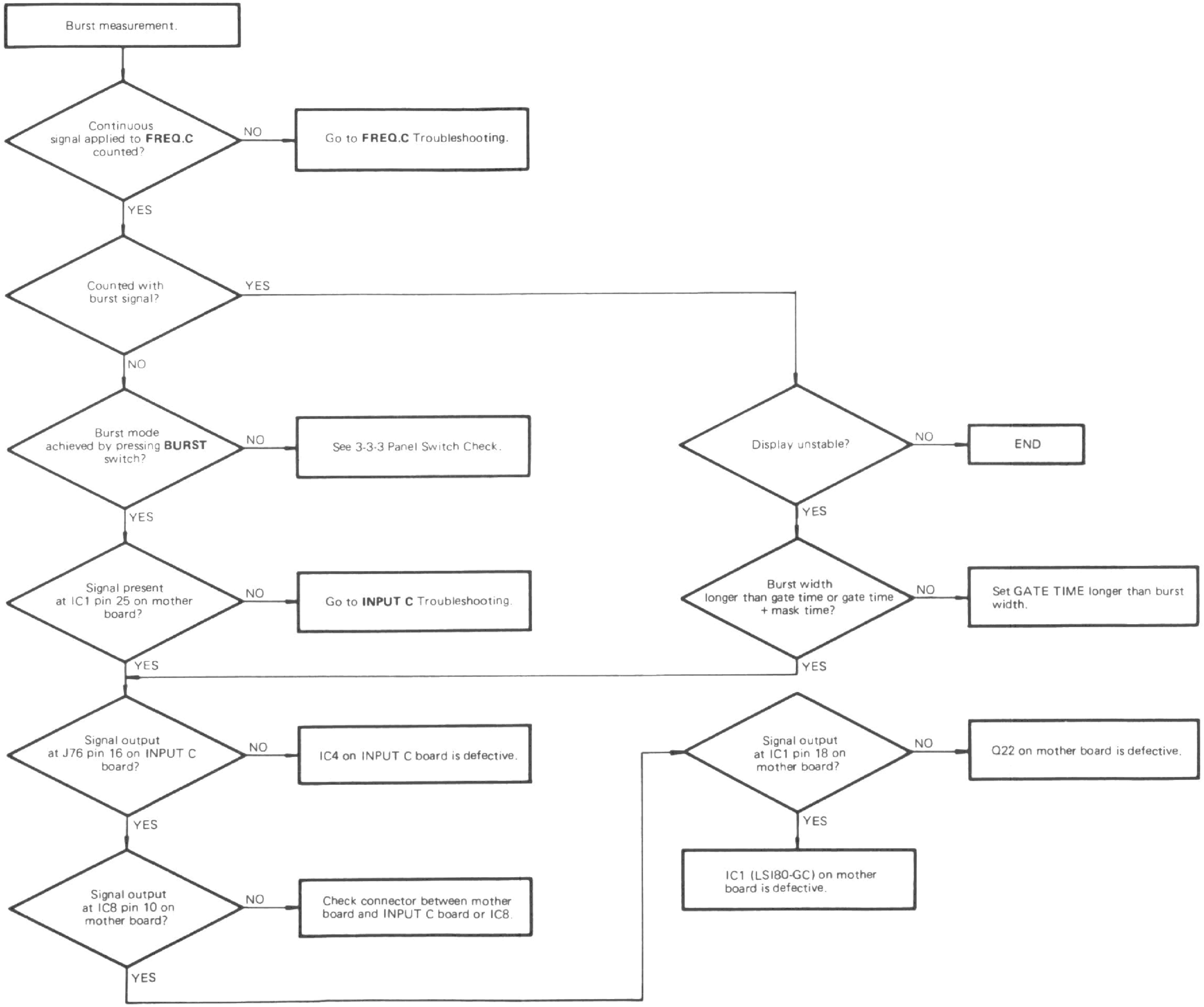


CHART-10 Burst Measurement (TR5823)



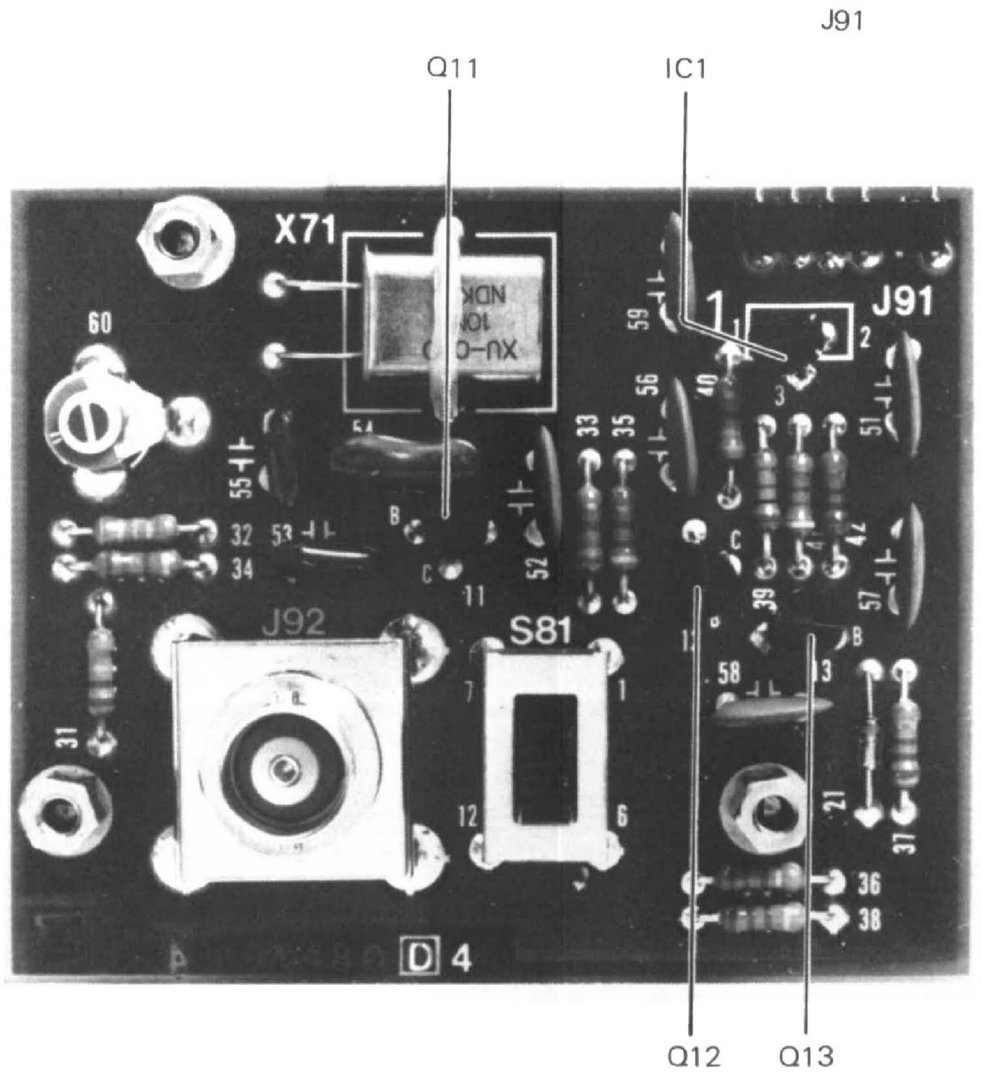
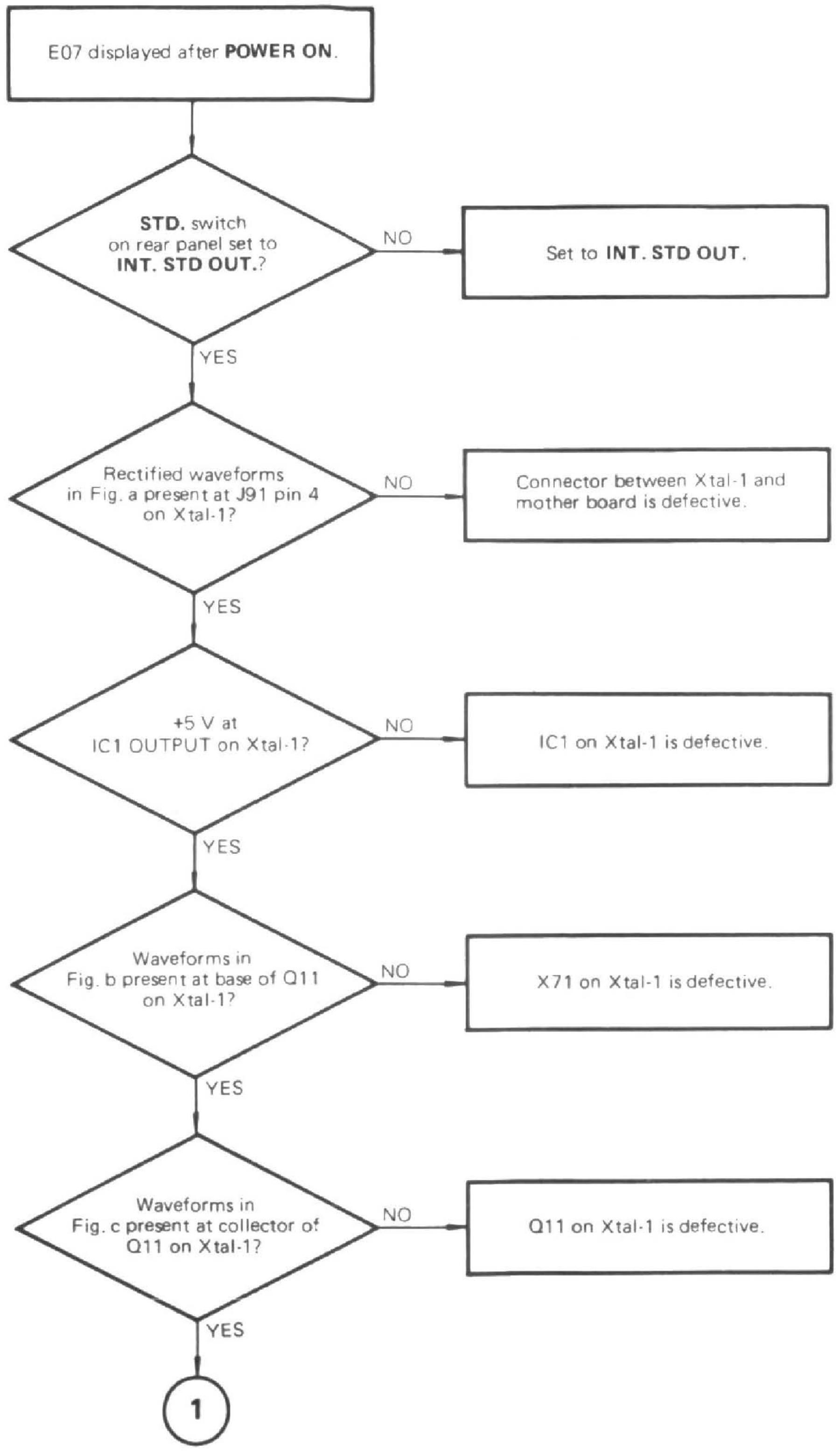
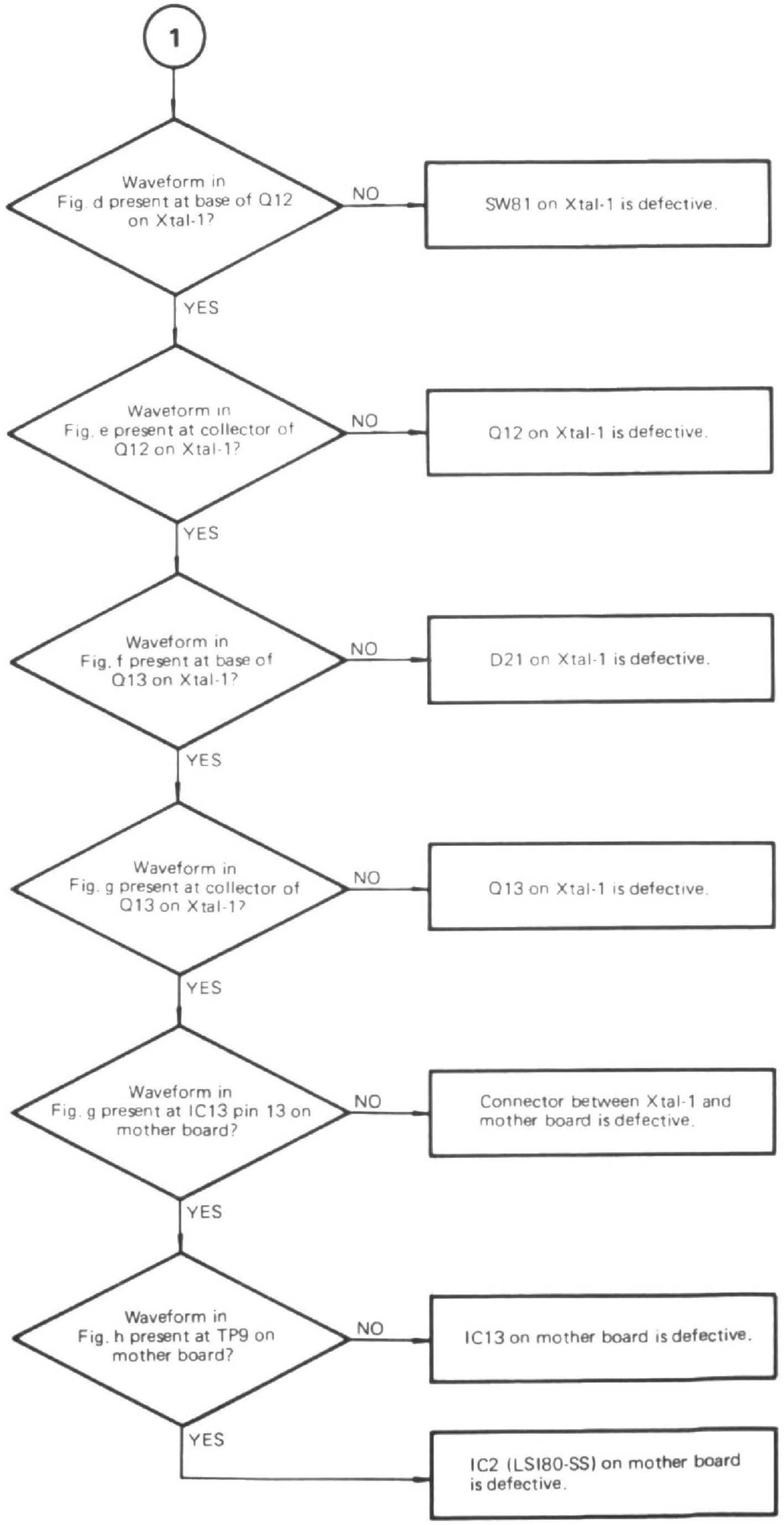


Fig. 9-8 Xtal-1 (BLF-010048) check points

CHART-11 Xtal-1 Troubleshooting (BLB-010048)





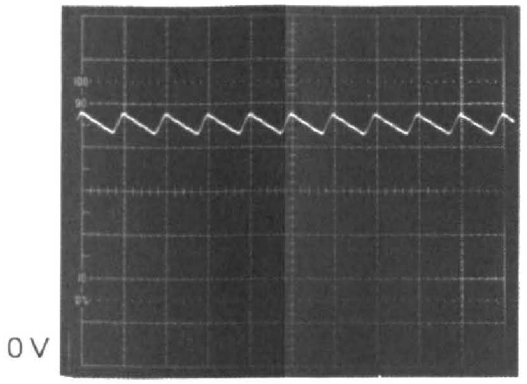


Fig. a 10 ms/div.
2 V/div.

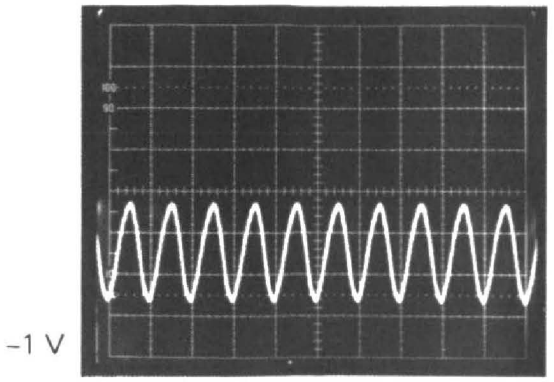


Fig. b 0.1 μs/div.
1 V/div.

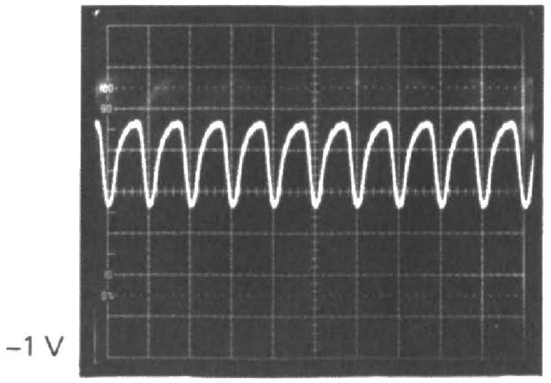


Fig. c 0.1 μs/div.
1 V/div.

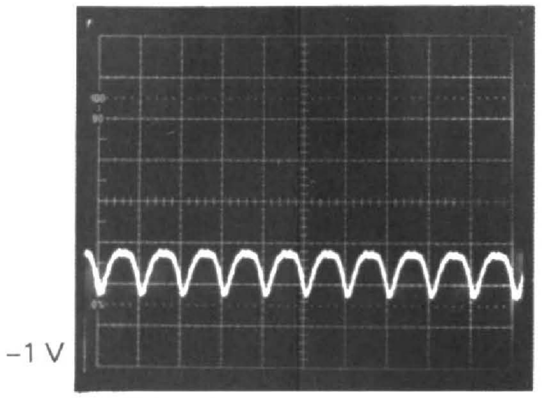


Fig. d 0.1 μs/div.
1 V/div.

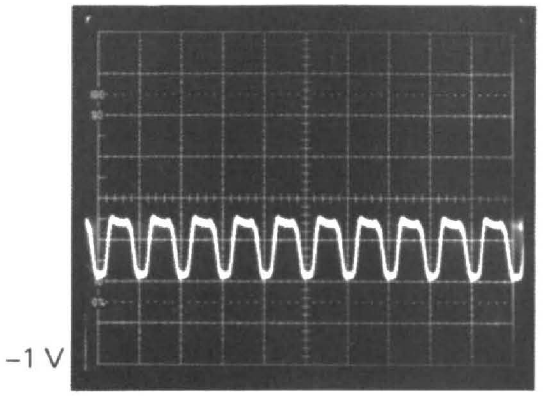


Fig. e 0.1 μs/div.
1 V/div.

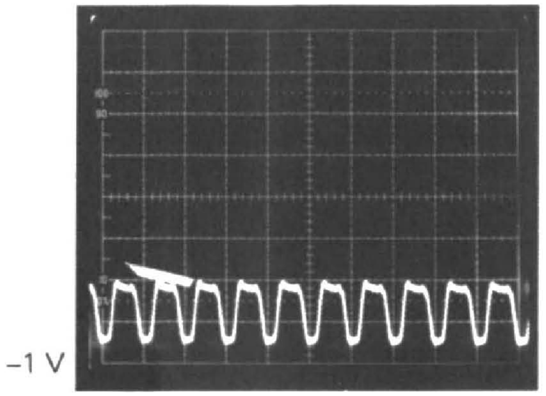


Fig. f 0.1 μs/div.
1 V/div.

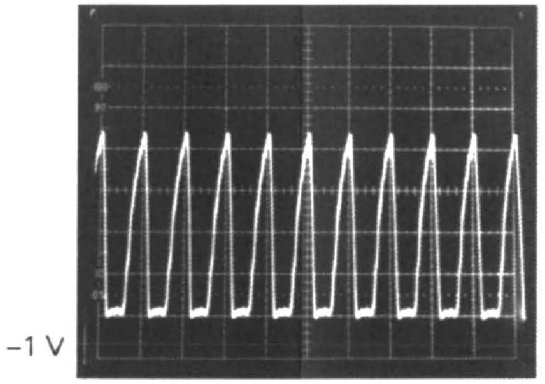


Fig. g 0.1 μs/div.
1 V/div.

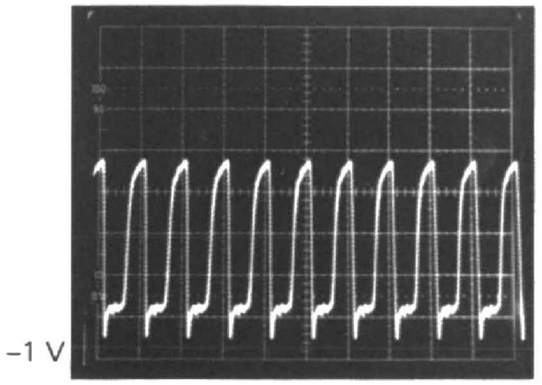


Fig. h 0.1 μs/div.
1 V/div.

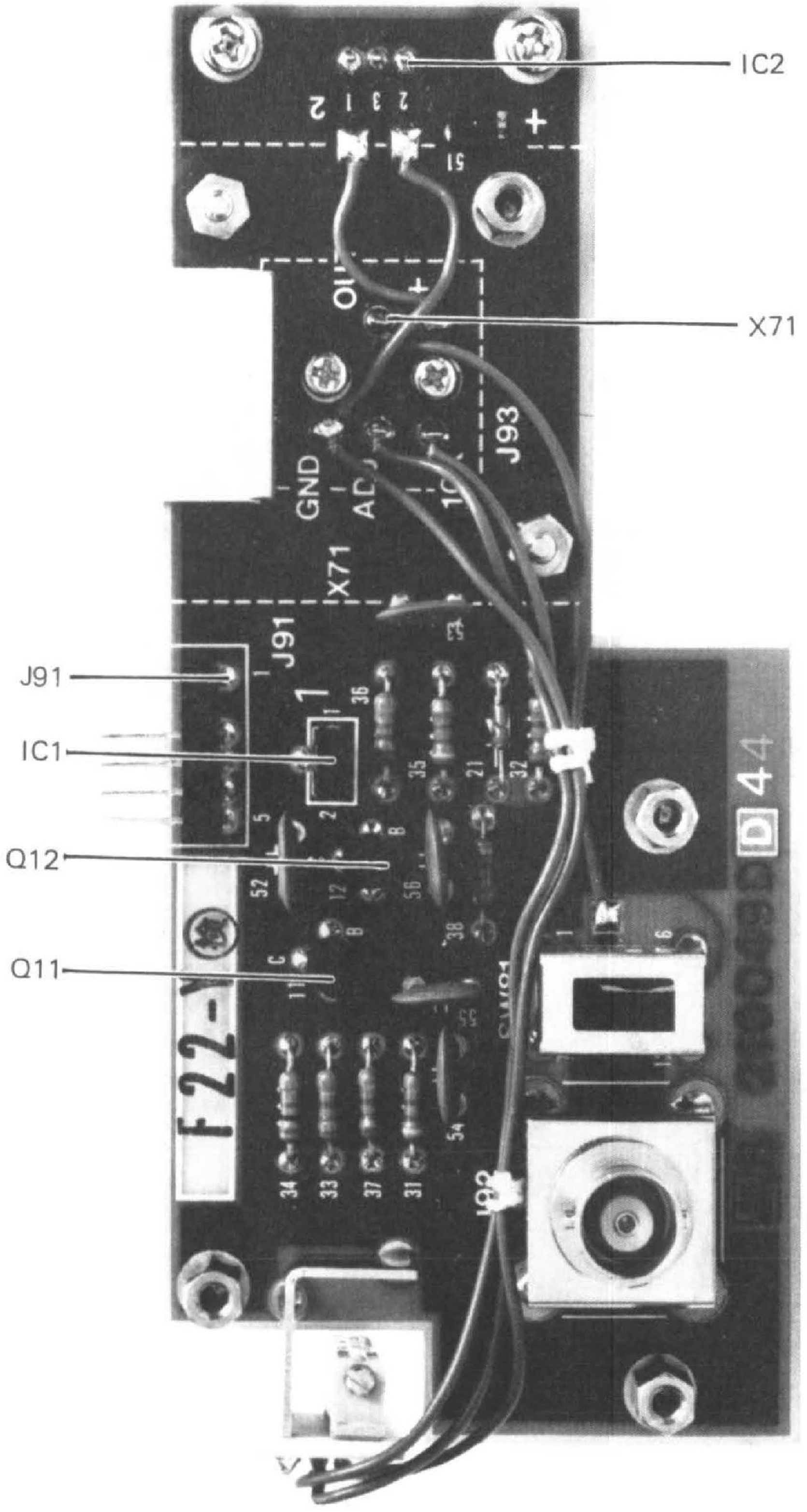
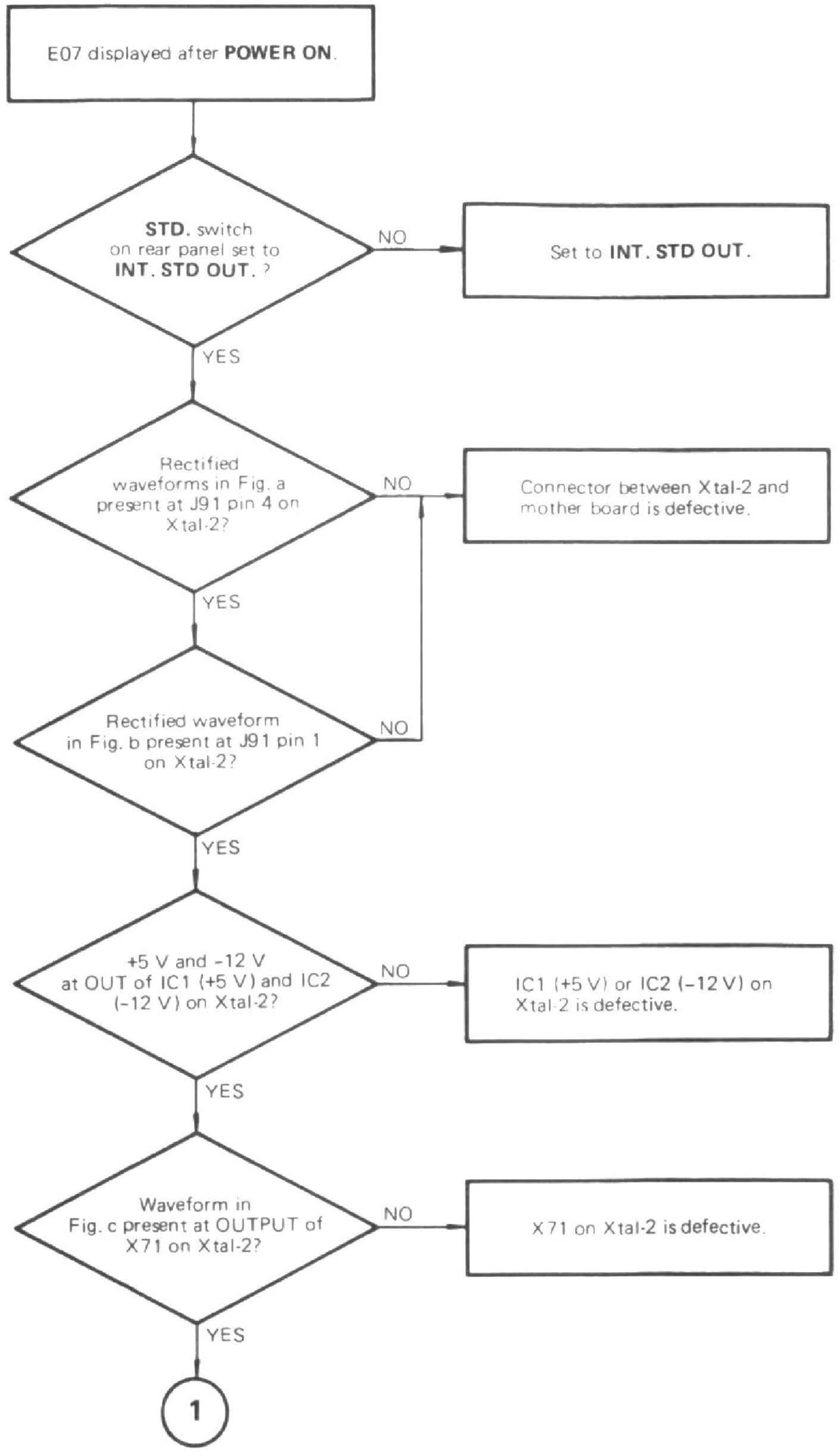
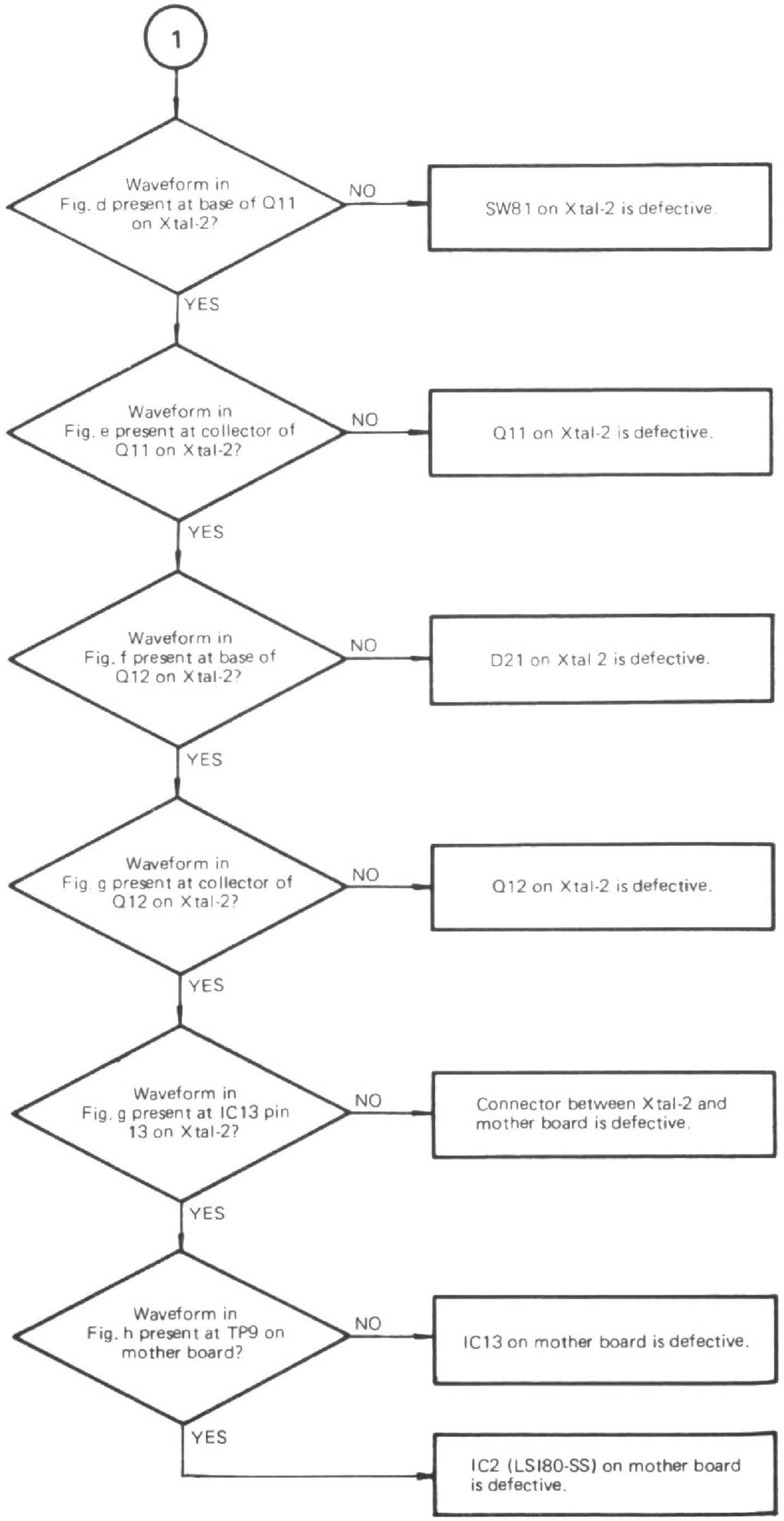


Fig. 9-9 Xtal-2 (BLB-010049) check points

CHART-12 Xtal-2 Troubleshooting (TR5823/23H) (BLB-010049)





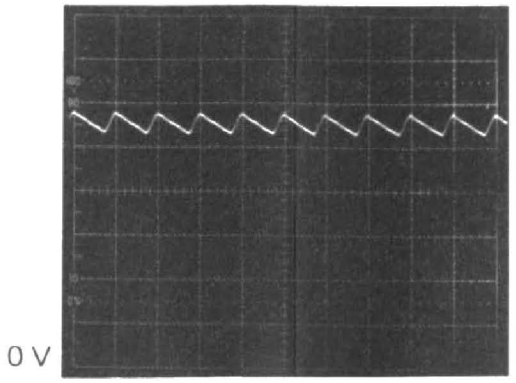


Fig. a 10 ms/div. 2 V/div.

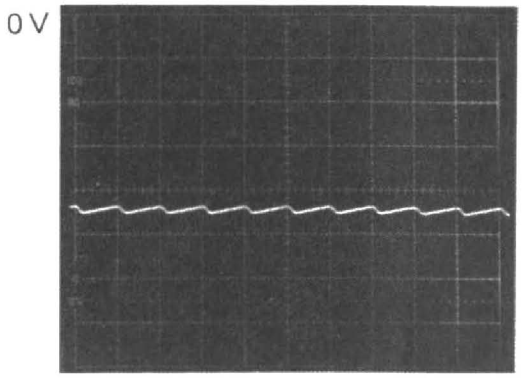


Fig. b 10 ms/div. 5 V/div.

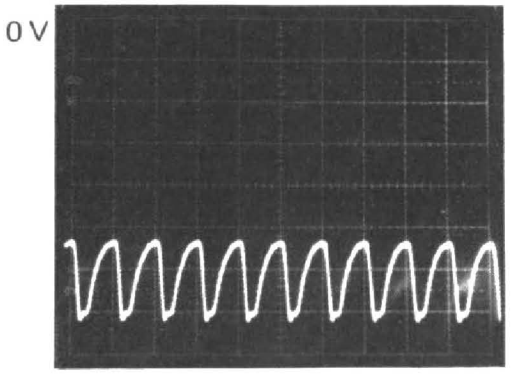


Fig. c 0.1 μs/div. 2 V/div.

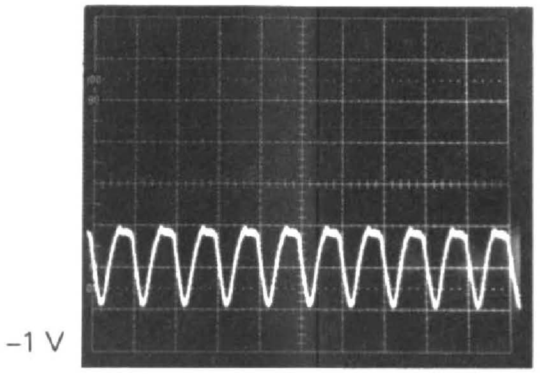


Fig. d 0.1 μs/div. 1 V/div.

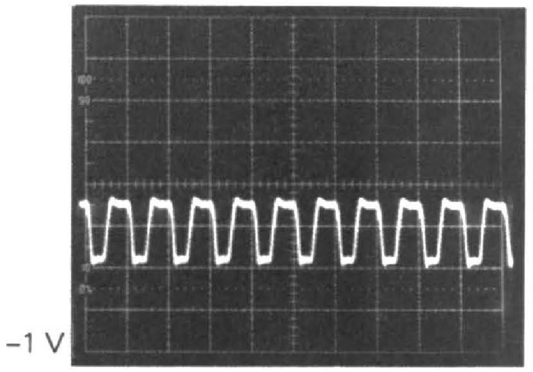


Fig. e 0.1 μs/div. 1 V/div.

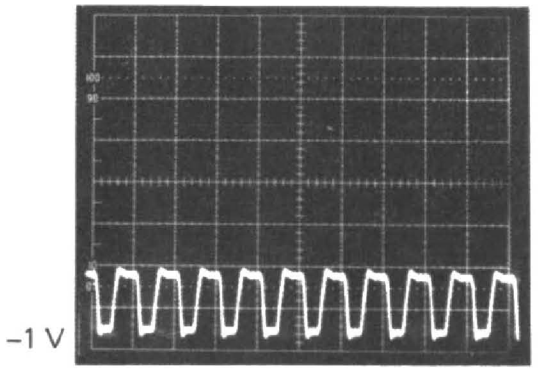


Fig. f 0.1 μs/div. 1 V/div.

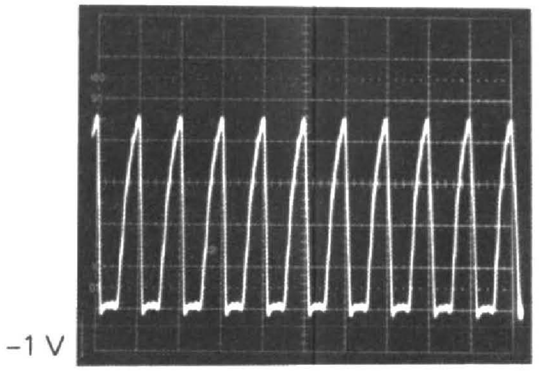


Fig. g 0.1 μs/div. 1 V/div.

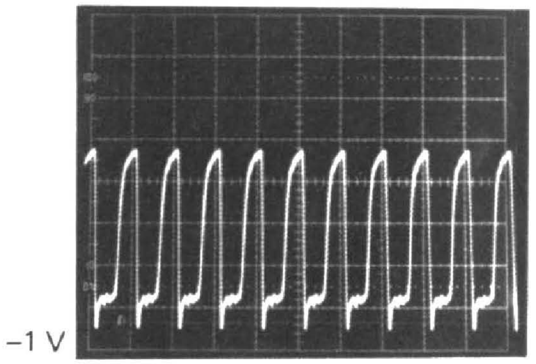


Fig. h 0.1 μs/div. 1 V/div.

9-6. GPIB Board

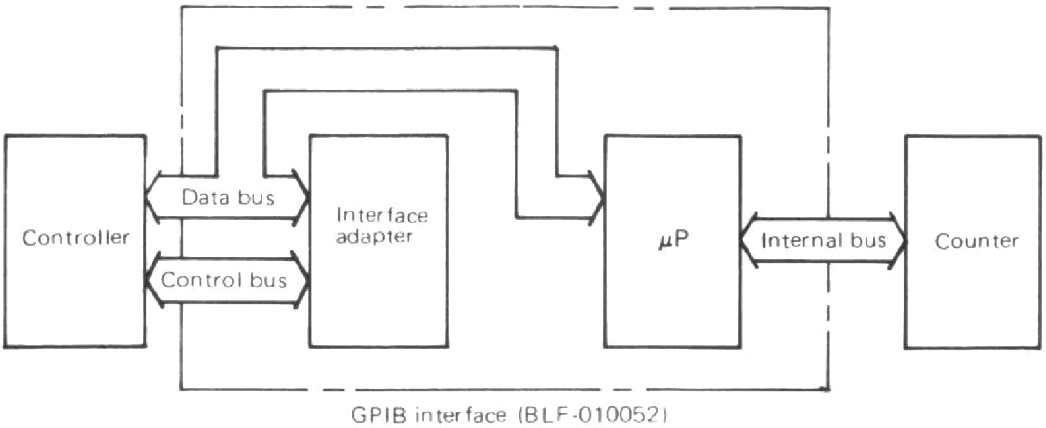


Fig. 9-2 Block diagram of GPIB

9-6-1. Introduction

The GPIB has the talker capability to transfer the counter measurement data to the controller and the listener capability for remote control of the counter through the controller. When the GPIB is not addressed to talk or listen, it keeps receiving measurement data from the counter and always holds the newest measurement data.

- TALKER
  When the address switch on the rear panel of the counter is set to TALK ONLY or the counter is addressed to talk by the controller, the microprocessor on the GPIB converts the measurement data routed from the counter to ASCII codes and sends the converted data to the controller. In this case, the interface adapter intermediates for the handshake between the controller and microprocessor.
- LISTENER
  When the counter is specified as listener by the controller, the microprocessor of the GPIB handshakes with the controller via the interface adapter to read the remote data from the data bus. Then it generates the remote code that corresponds the read data and sends the remote code to the counter.

9-6-2. Bus structure and data structure on buses

(1) GP IB bus

Refer to Section 4. GPIB Interface for the GPIB bus structure and data structure.

(2) Internal bus

The internal bus here means the bus between the counter and the GPIB interface.

① Bus structure

The GPIB internal bus consists of 6 lines:

$$\begin{cases} \text{Data lines (4)} & \\ \text{Control lines} & \begin{matrix} \text{Strobe line (1)} \\ \text{Select line (1)} \end{matrix} \end{cases}$$

When the select line is low, address is on the data line; when the select line is high, the data are on the data line.

② Data structure

a. Measurement data (Counter → GPIB interface)

- When data is generated, the microprocessor on the counter outputs address [5] on the bus.
- Data is D_0 to D_7 (8 digits).
- When D_0 is not 'A'(hex) (i.e., D_0: 0-9), the decimal point is positioned next to D_0.

  $D_0 . D_1 D_2$ ...
- When D_0 is 'A'(hex) it means that the sign of the mantissa is minus and the decimal point is placed next to D_1.

  $-D_1 . D_2 D_3$ ...

  where the significant digits of negative data is made less by one digit.
- Exponent data is expressed as follows:

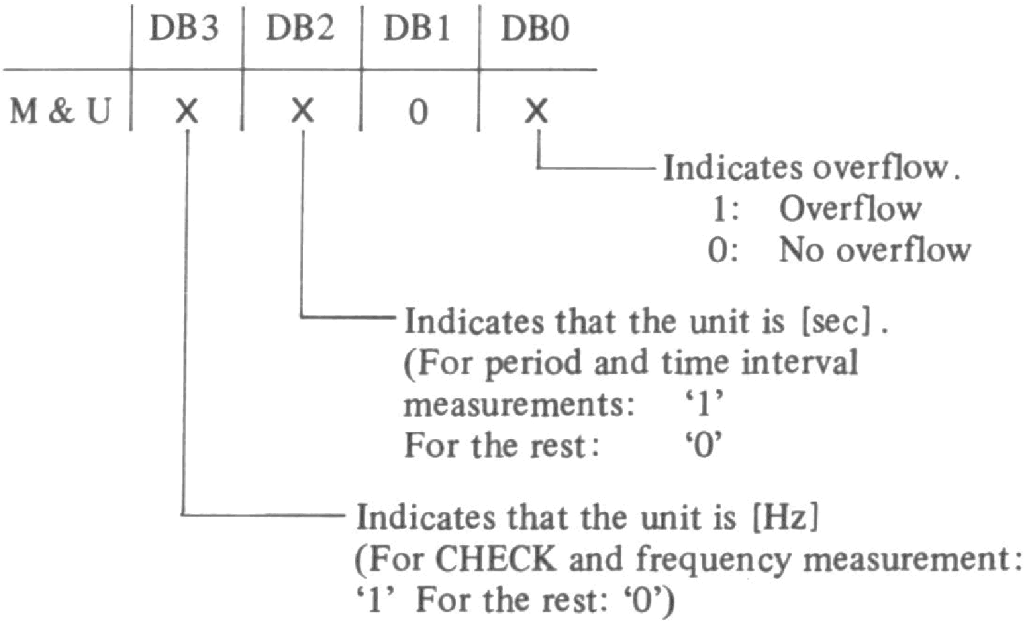
		DB3	DB2	DB1	DB0
High-order digits	EXP_0 (sign)	0	0	d_0	0
Low-order digits	EXP_1 (Numerical value)	X	X	X	X

d_0 = 1 : (+)
d_0 = 0 : (–)

Sign	Numerical value	Exponent data
1	1 1 1 1	→ 15
⋮	⋮	
1	0 0 0 1	→ 1
1	0 0 0 0	→ 0
0	1 1 1 1	→ -1
⋮		
0	0 1 0 0	→ -12

Exponent data range is +15 to -12.

- M&U indicates the message and unit.



	DB3	DB2	DB1	DB0
M & U	X	X	0	X

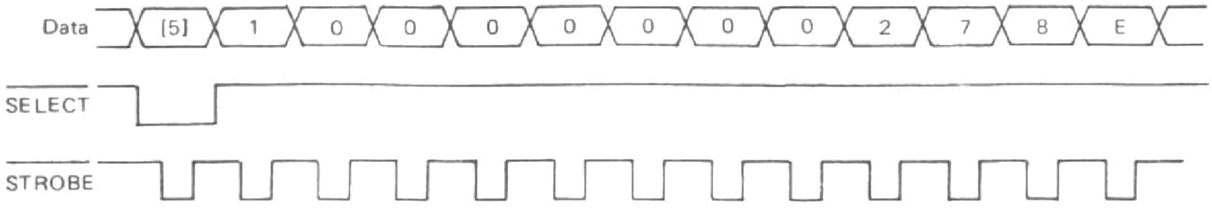
Indicates overflow.
1: Overflow
0: No overflow

Indicates that the unit is [sec].
(For period and time interval measurements: '1'
For the rest: '0'

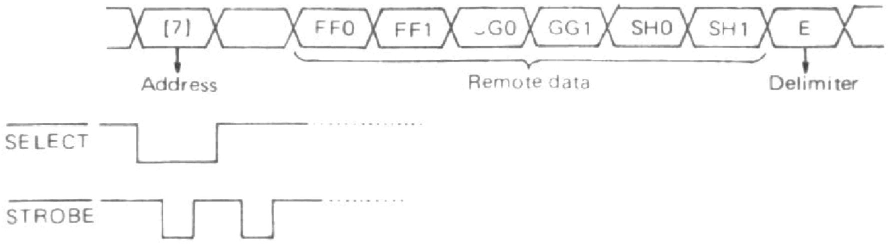
Indicates that the unit is [Hz]
(For CHECK and frequency measurement: '1' For the rest: '0')

Note: Negative logic is used for the internal bus, i.e., 1 is low.

Example: When the counter is set to **CHECK**, measurement data 10 MHz is as follows on the bus:



b. Remote data (GPIB interface → Counter)



- When the remote data from the controller enters the GPIB, the GPIB informs the counter that data exists.
  (The REM signal at pin 13 of J56 is made low and a negative pulse is sent out to the ERST signal line at pin 14.)
- When existence of remote data is informed from the GPIB, the microprocessor in the counter sets up address [7] on the bus and starts handshaking to receive data.
- Data on the bus is as follows:

FF0 and FF1:	Function data
GG0 and GG1:	Gate time data
SH0 and SH1:	Gate open/closed and Hold during totalize mode

- Function codes

Function	FF0	FF1	Gate time (multiplier)	GG0	GG1
CHECK	0	1	10 ms (X 1)	1	1
FREQ.A	0	2	100 ms (X 10)	2	2
FREQ.B	0	4	1 s (X 100)	4	4
FREQ.C	0	8	10 s (X 1000)	8	8
PERIOD B	1	0	* Data is all in hexadecimal notation.		
TIME INT.	2	0			
RATIO	4	0			
TOT.	8	0			

SH0 = 1 (0001): When TOT. is OFF
= 2 (0010): When TOT. is ON
SH1 = 8 (1000): When HOLD is enabled
= 0 (0000): When HOLD is disabled.

Example: The following data is output during initialization (FUNCTION: CHECK, GATE TIME: 10 ms, HOLD: OFF):

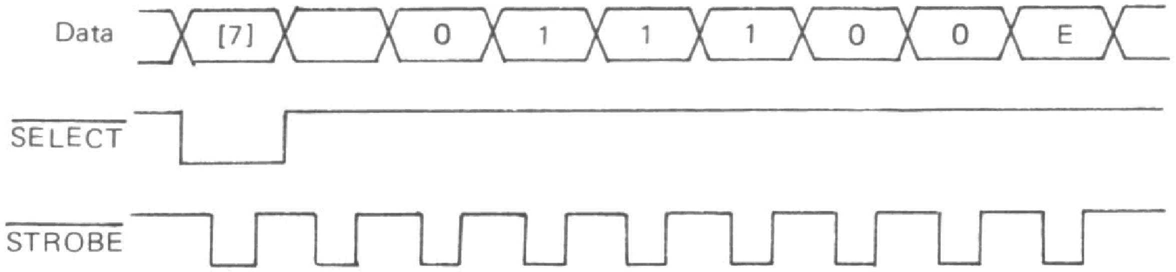
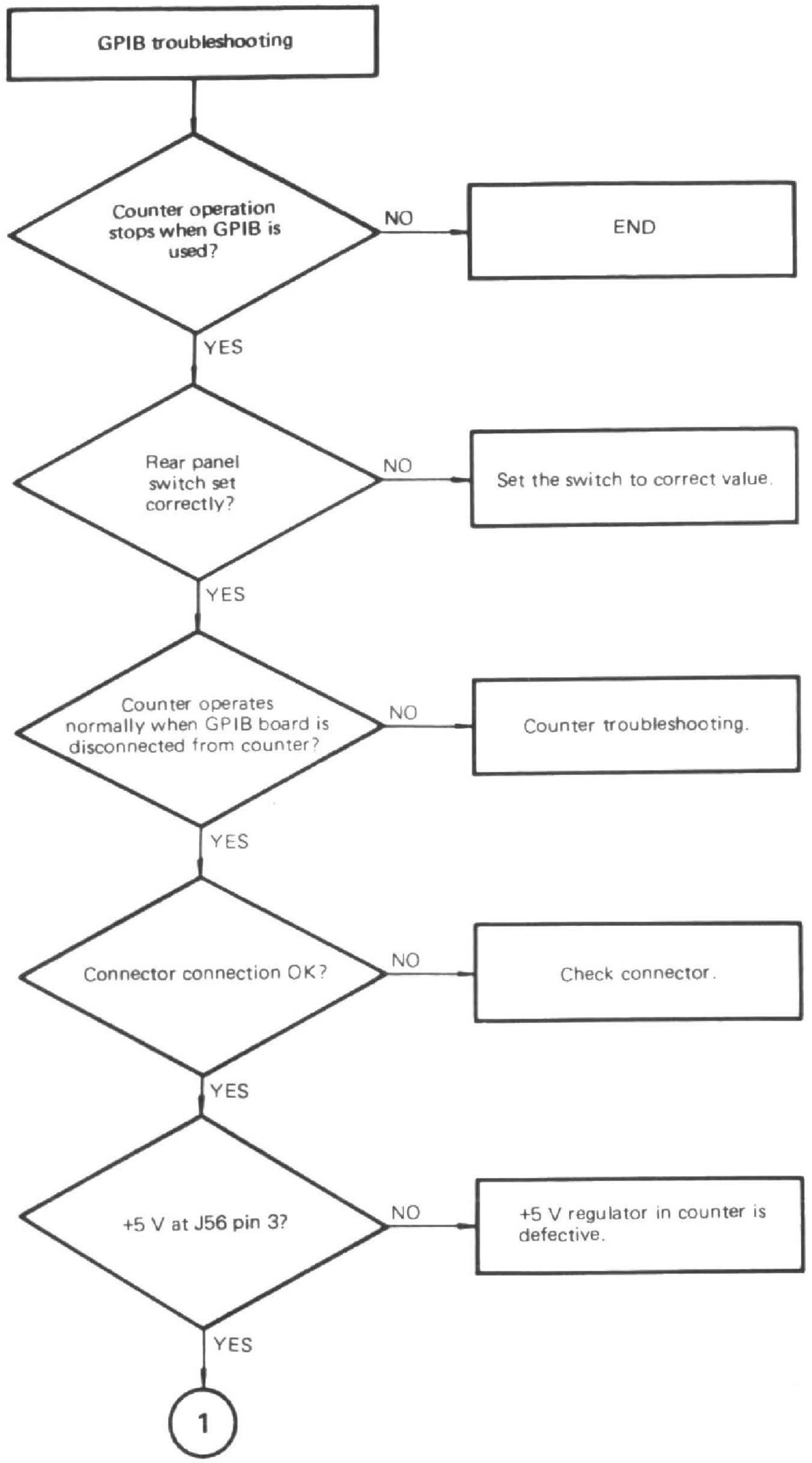


CHART-13 GPIB Troubleshooting (BLF-010052)



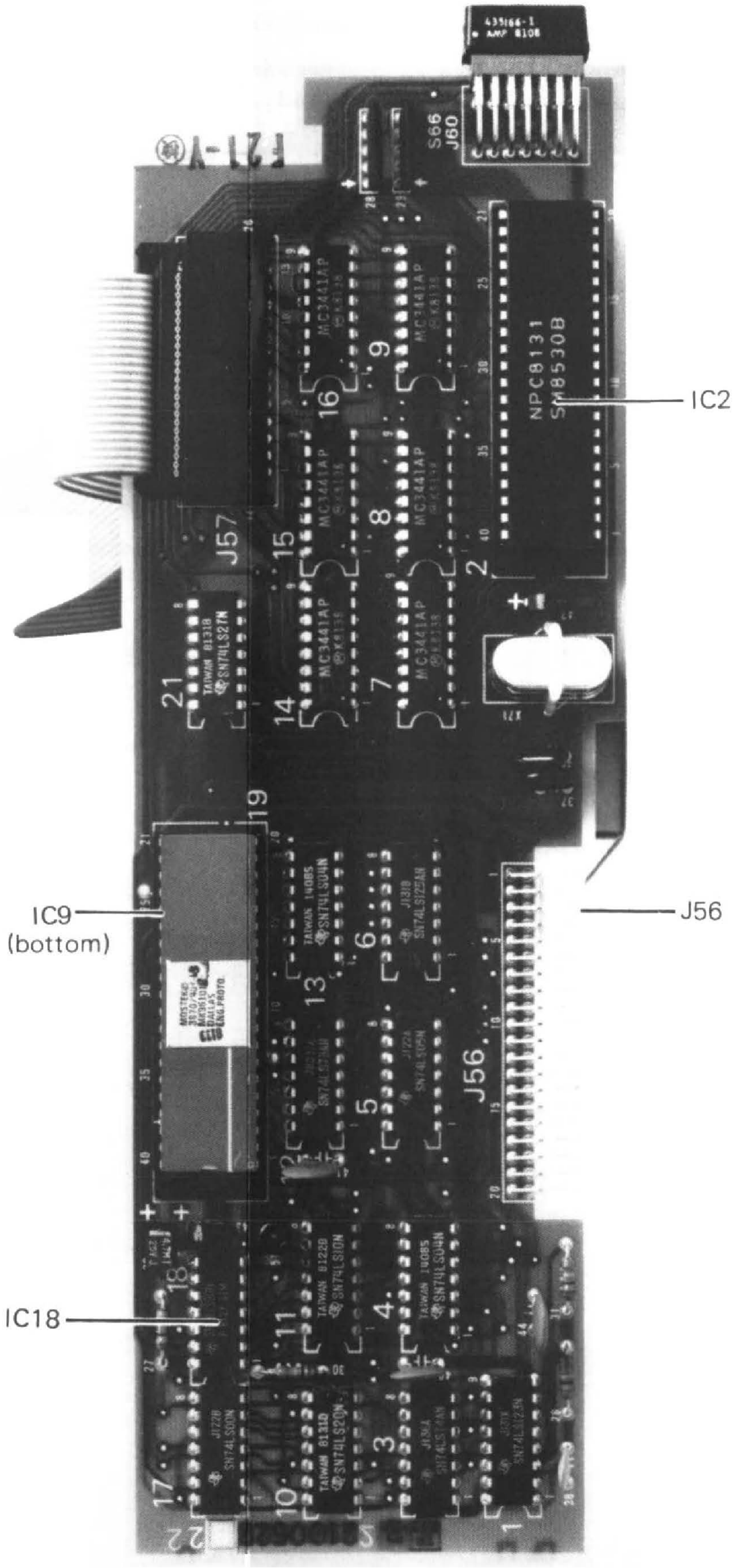
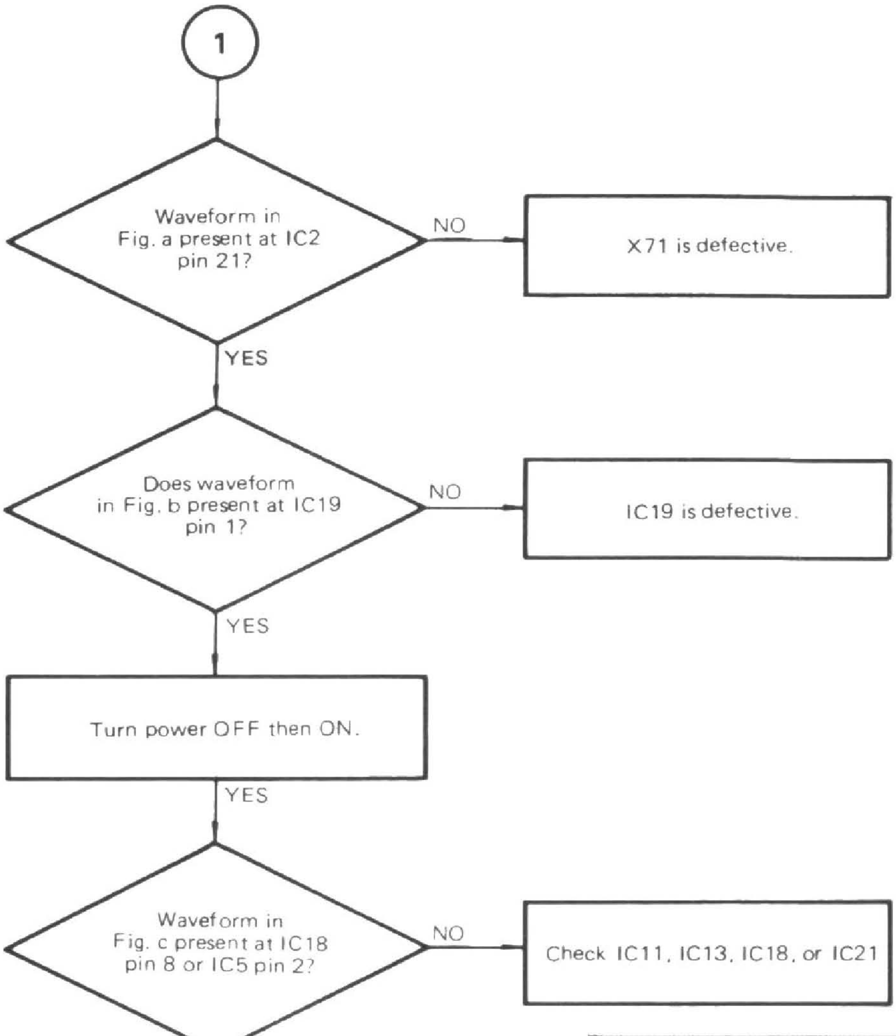
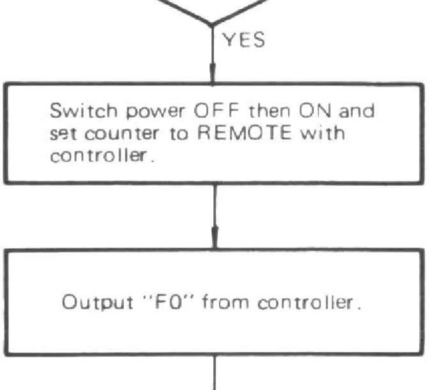


Fig. 9-11 GPIB interface board (BLF-010052) check points





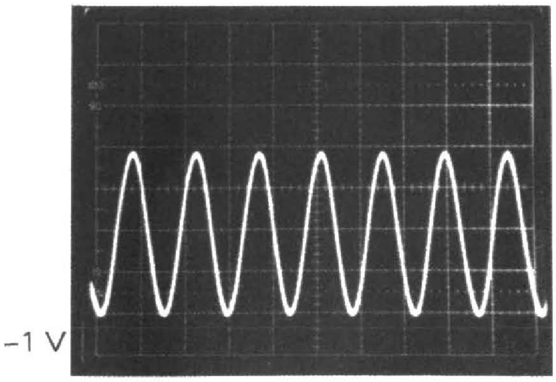
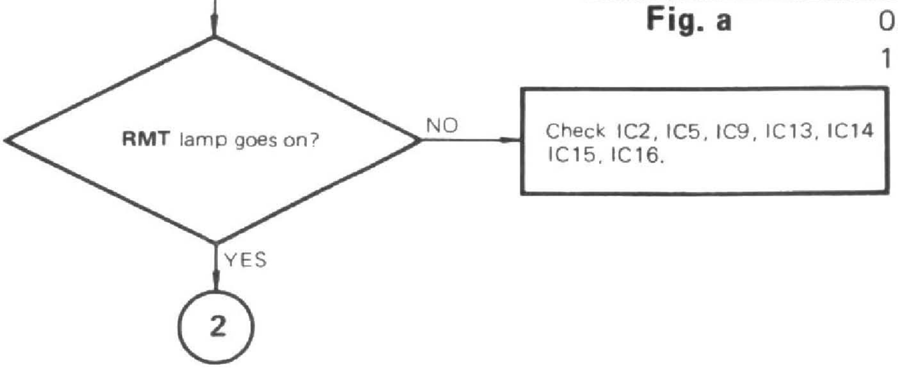
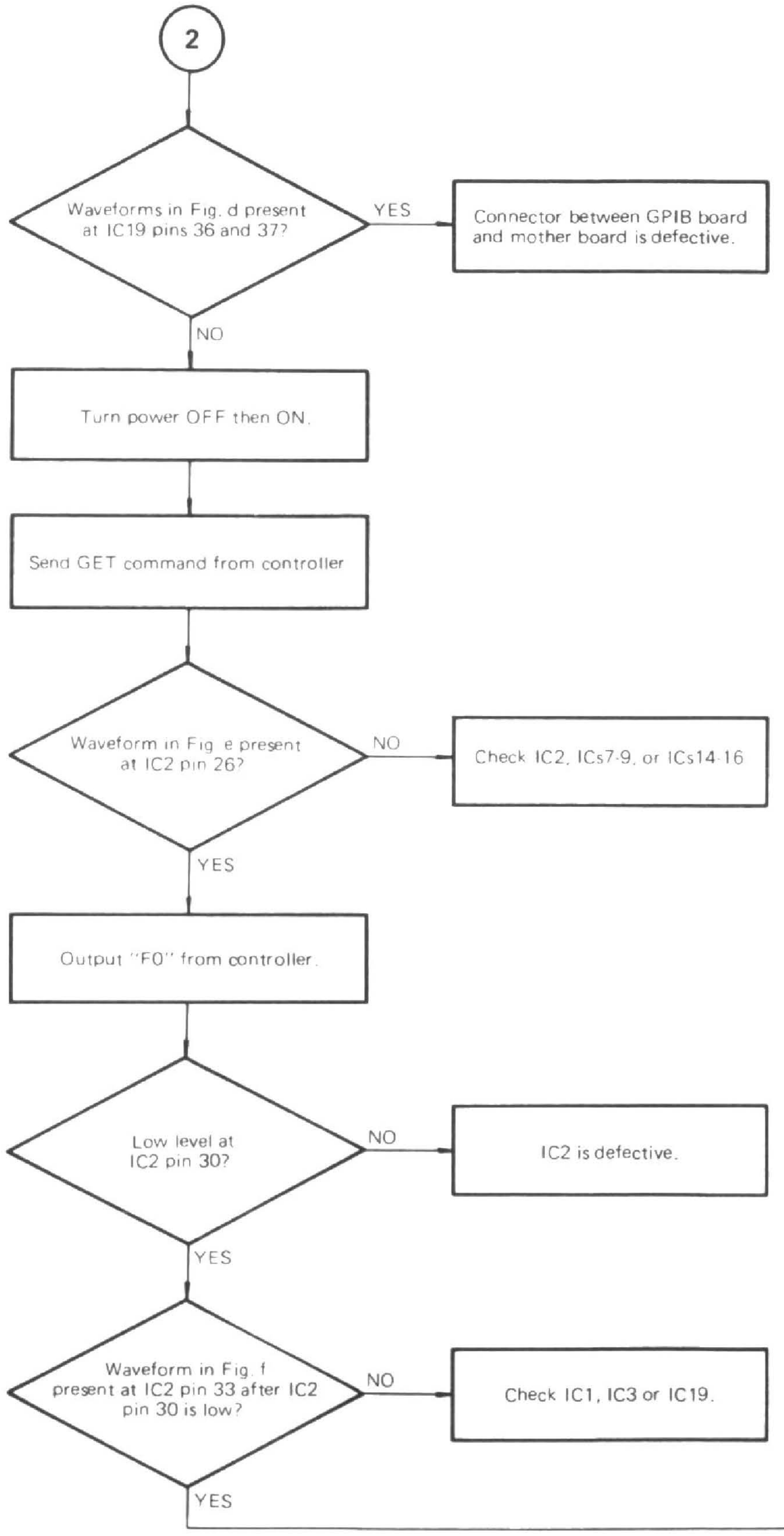
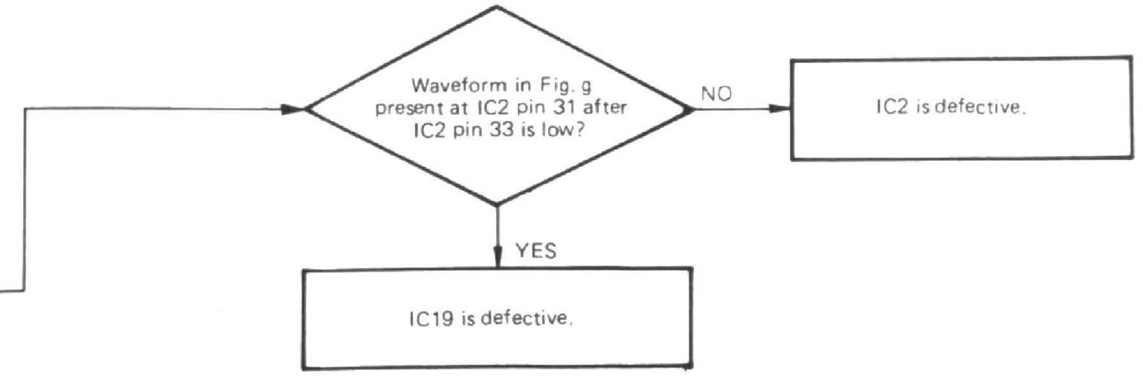


Fig. a

0.2 μs/div.
1 V/div.







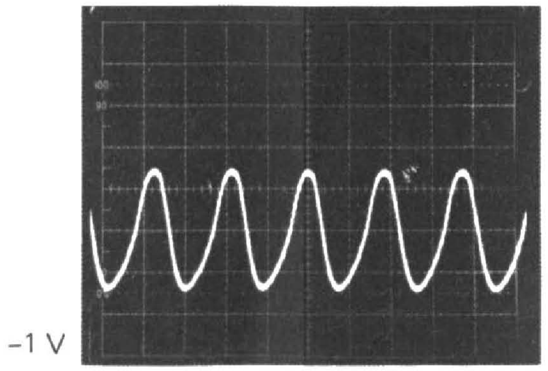


Fig. b 0.2 μs/div.
1 V/div.

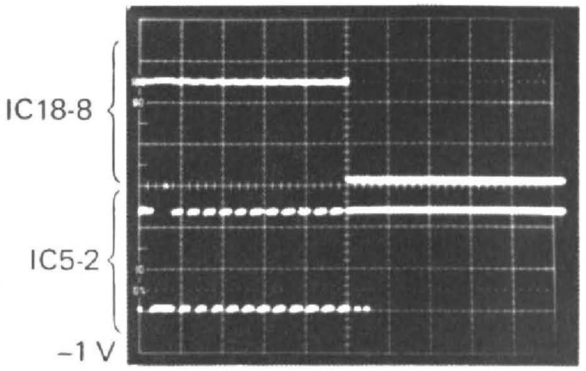


Fig. c 0.5 ms/div.
2 V/div.

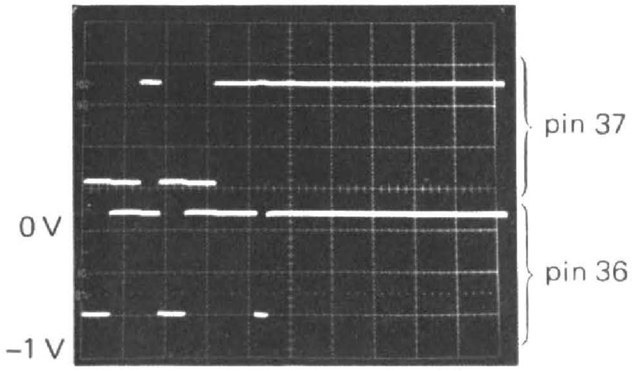


Fig. d 0.2 ms/div.
2 V/div.

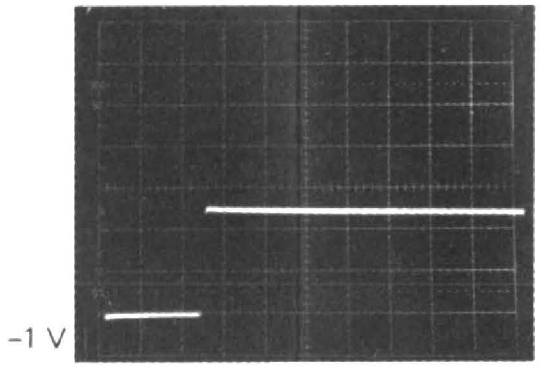


Fig. e 0.5 μs/div.
2 V/div.

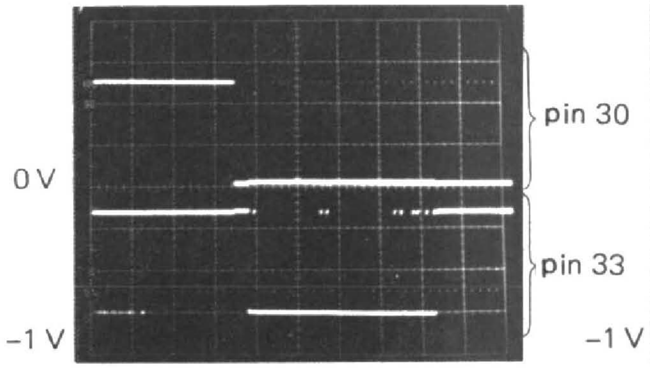


Fig. f 2 ms/div.
2 V/div.

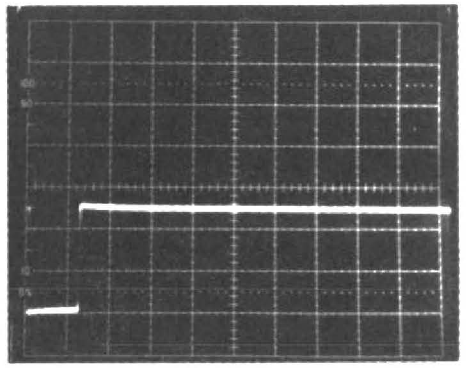


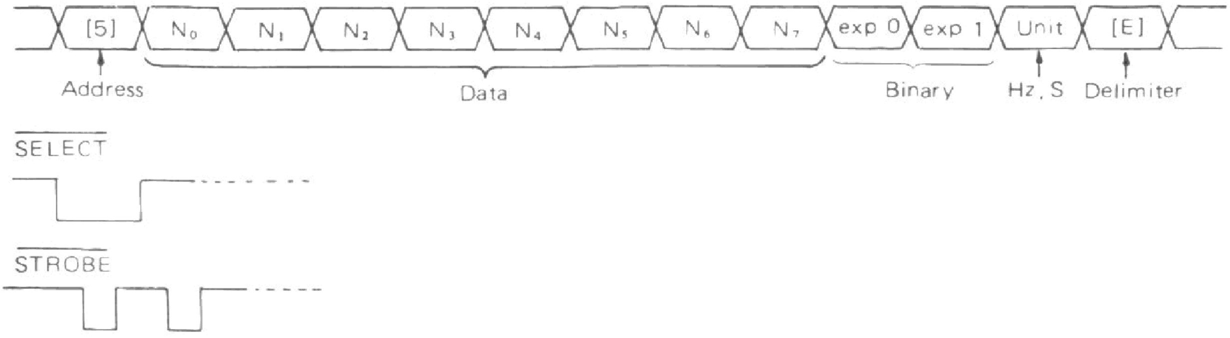
Fig. g 1 μs/div.
2 V/div.

9-7. BCD Output

(1) General description

The counter data output format is shown below.

When the output data is addressed to [5], SELECT pulse drops, generating the STROBE signal to fetch the data, ending up with [E] as one measurement data.



A block diagram of the BCD circuit is shown below.

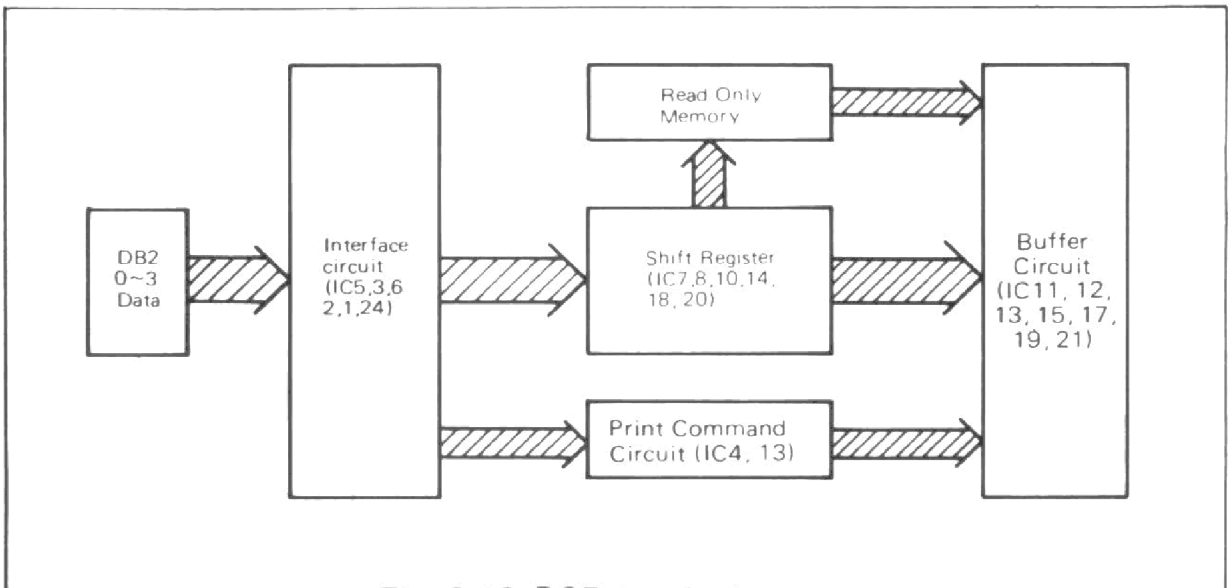
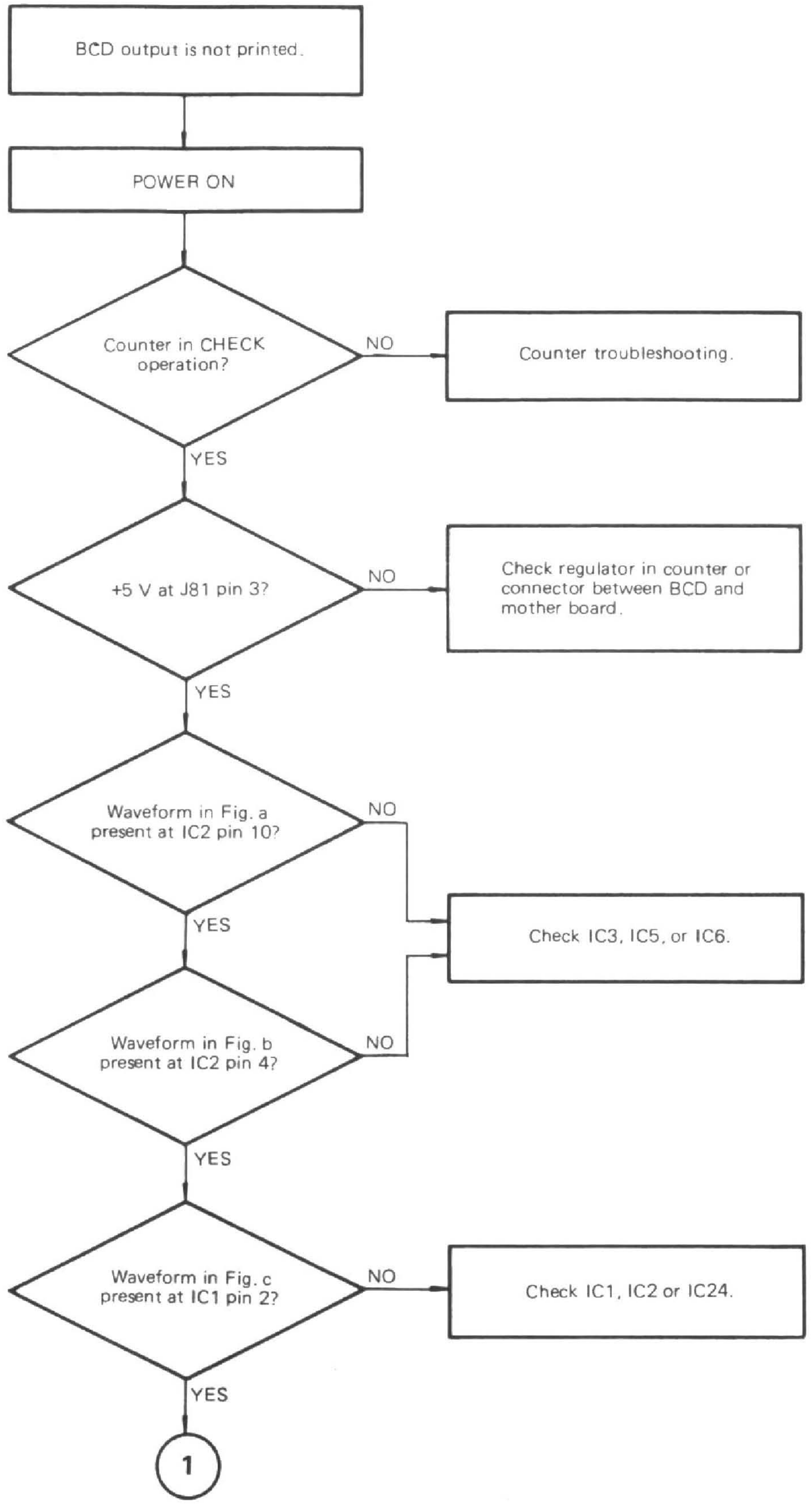


Fig. 9-12 BCD block diagram

The data, including 7 digits of mantissa and 2 digits of exponent, are provided to the shift register and print command circuit via the interface circuit. When a print signal is output by the print command circuit, the data held in the shift register is output via the buffer circuit. When the data ends, a print end signal is output at the last trailing edge of the data.

CHART-14 BCD Output Troubleshooting (BLF-010051)



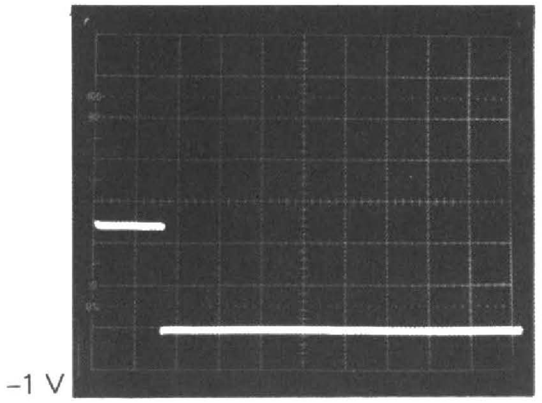


Fig. a 50 µs/div.
2 V/div.

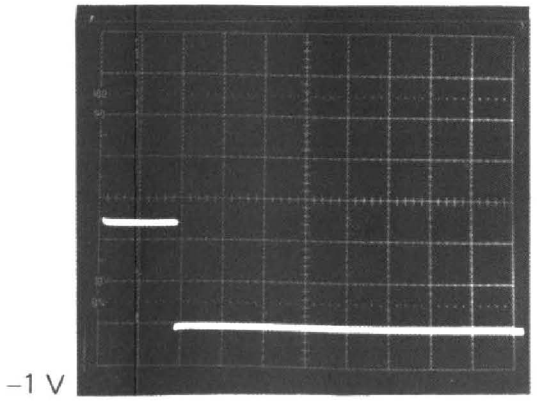


Fig. b 20 µs/div.
2 V/div.

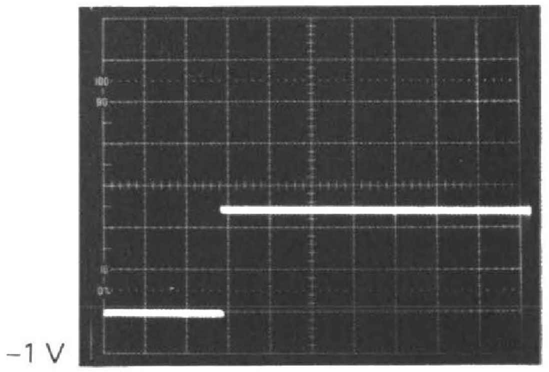


Fig. c 0.5 ms/div.
2 V/div.

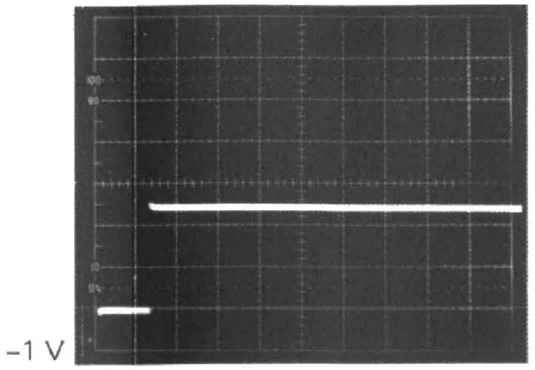


Fig. d 20 µs/div.
2 V/div.

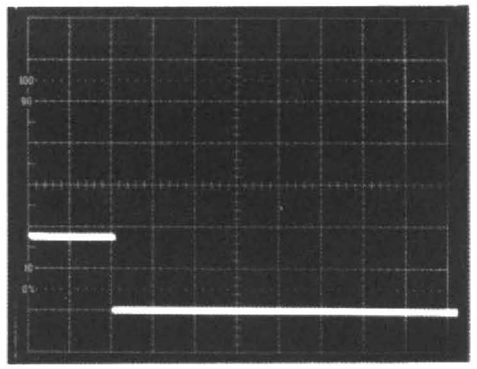


Fig. e 0.2 ms/div.
2 V/div.

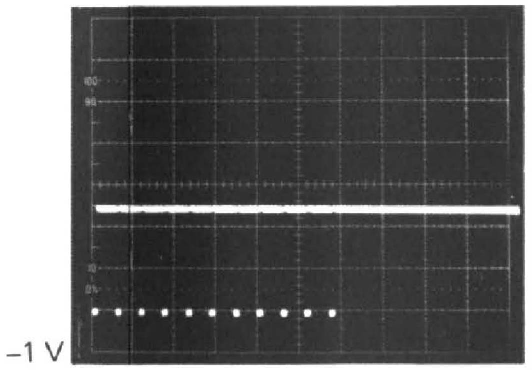


Fig. f 0.2 ms/div.
2 V/div.

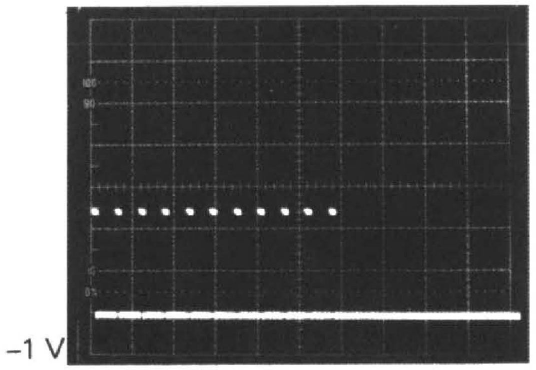


Fig. g 0.2 ms/div.
2 V/div.

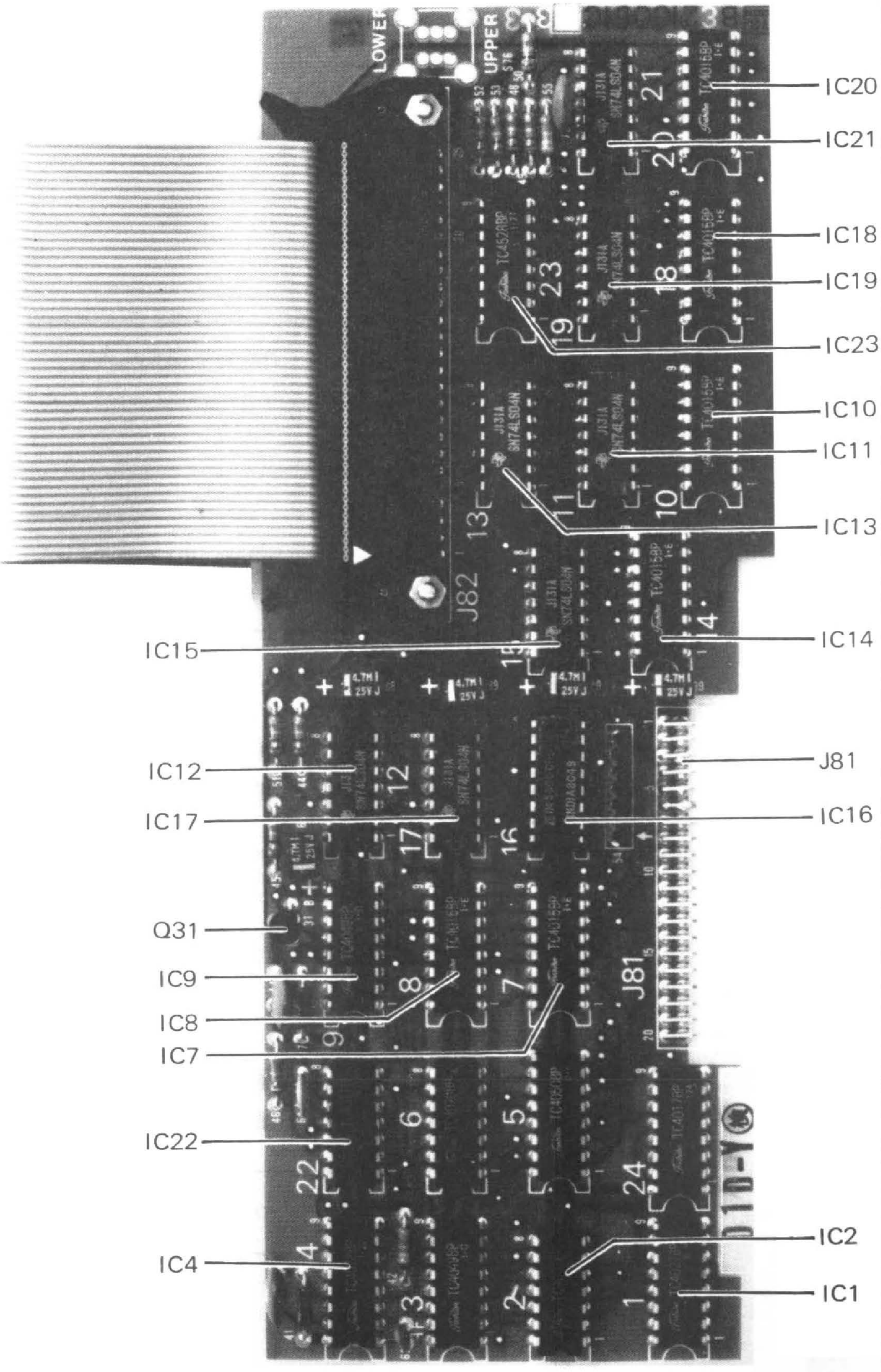
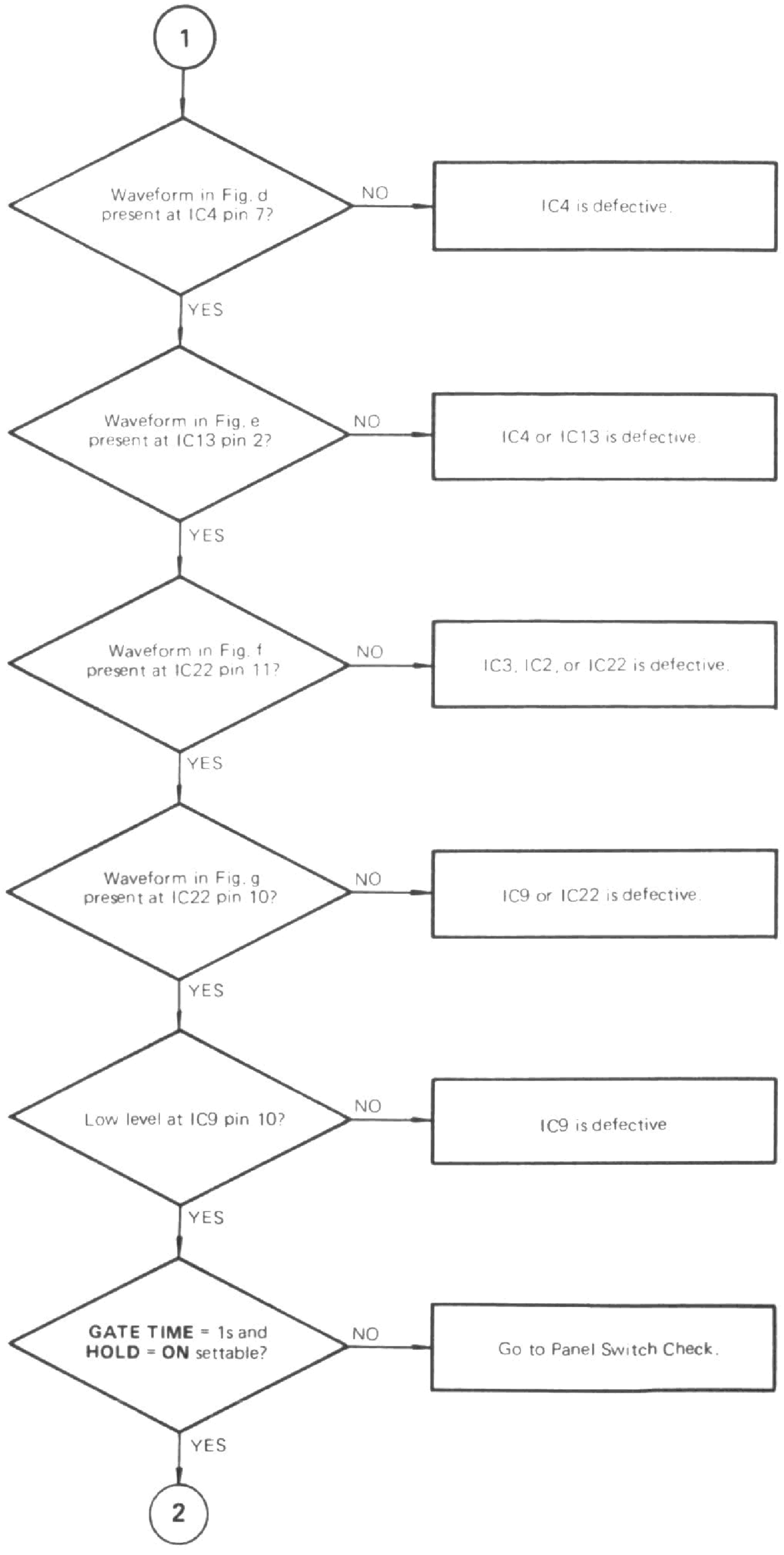
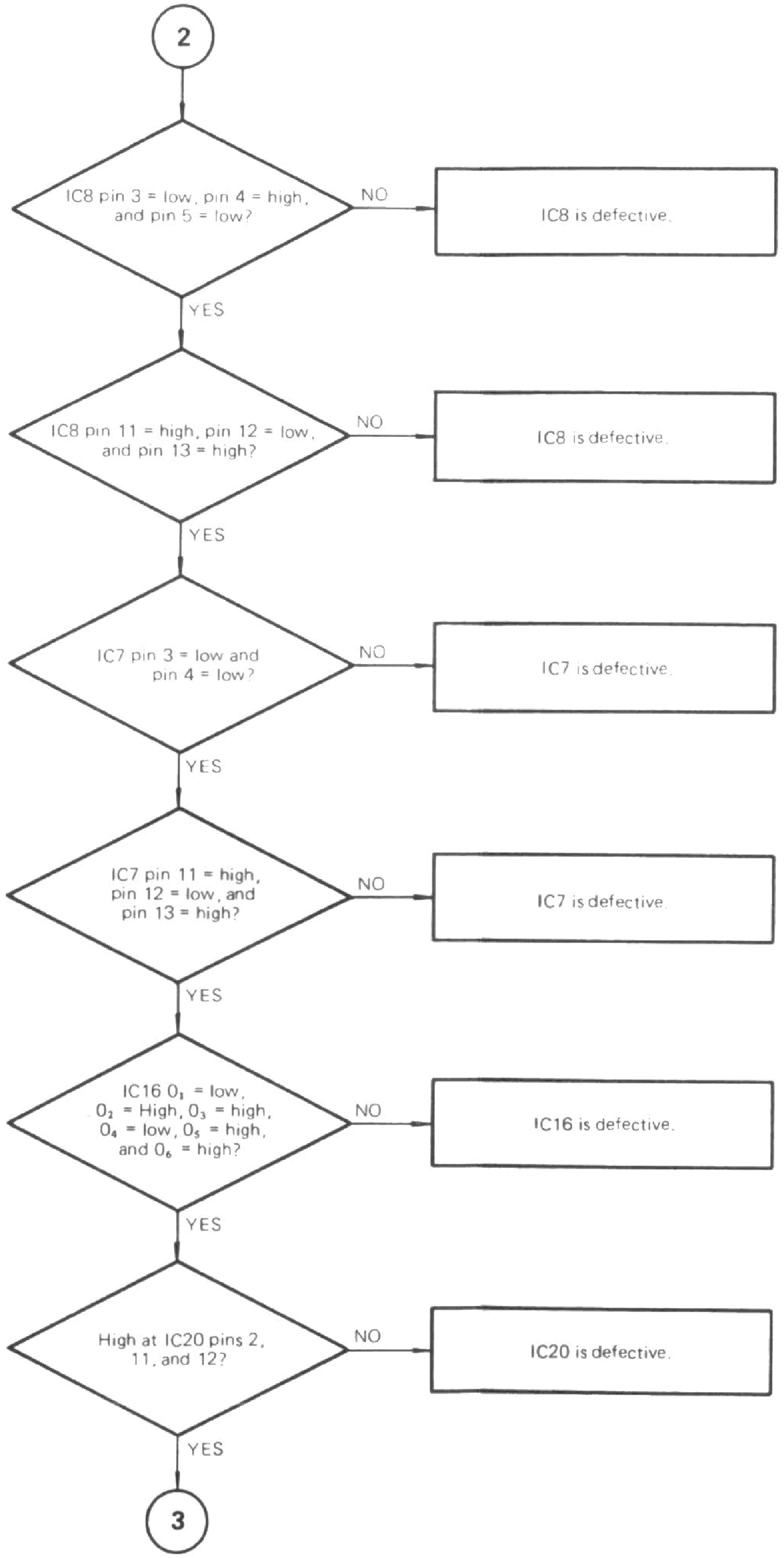
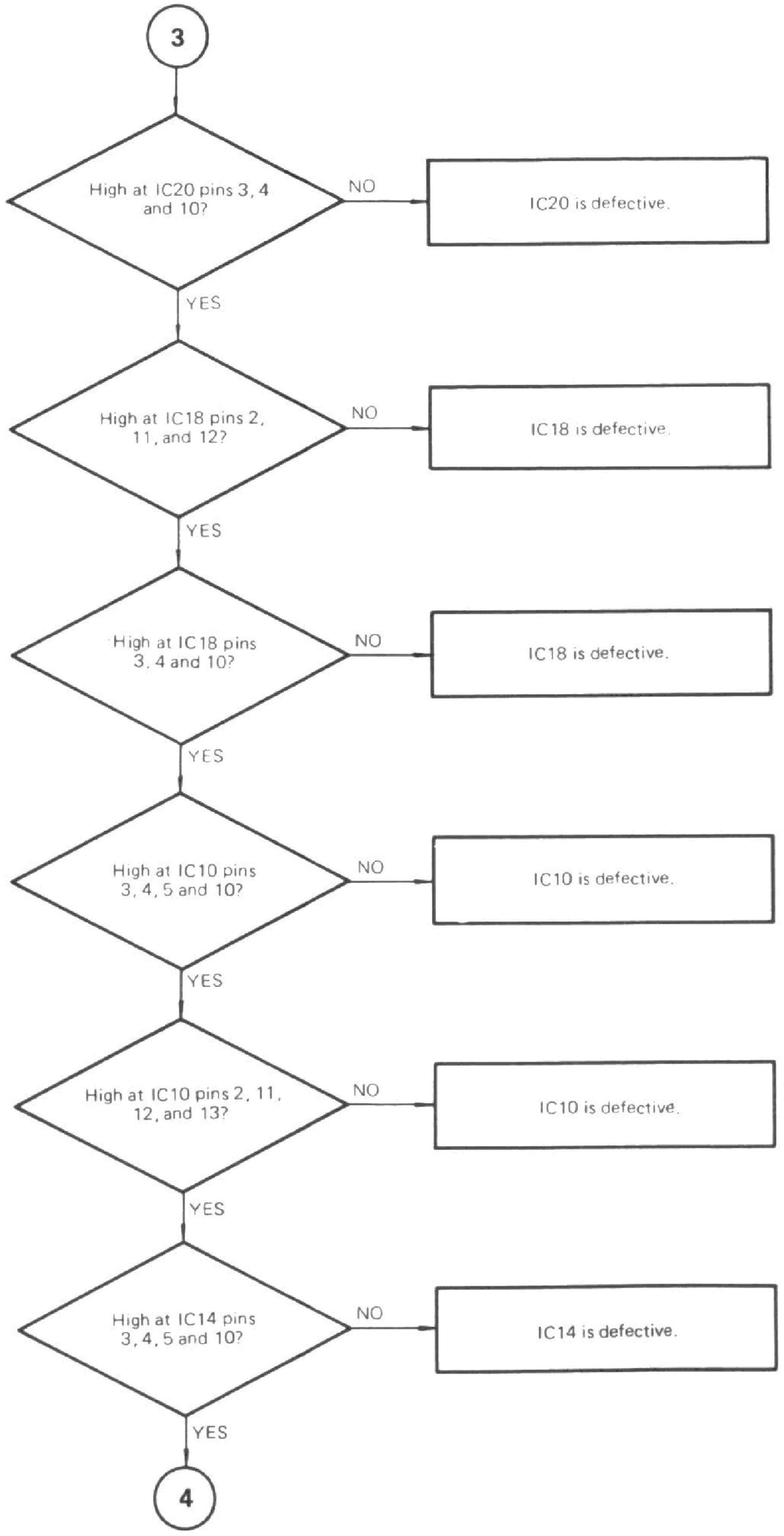
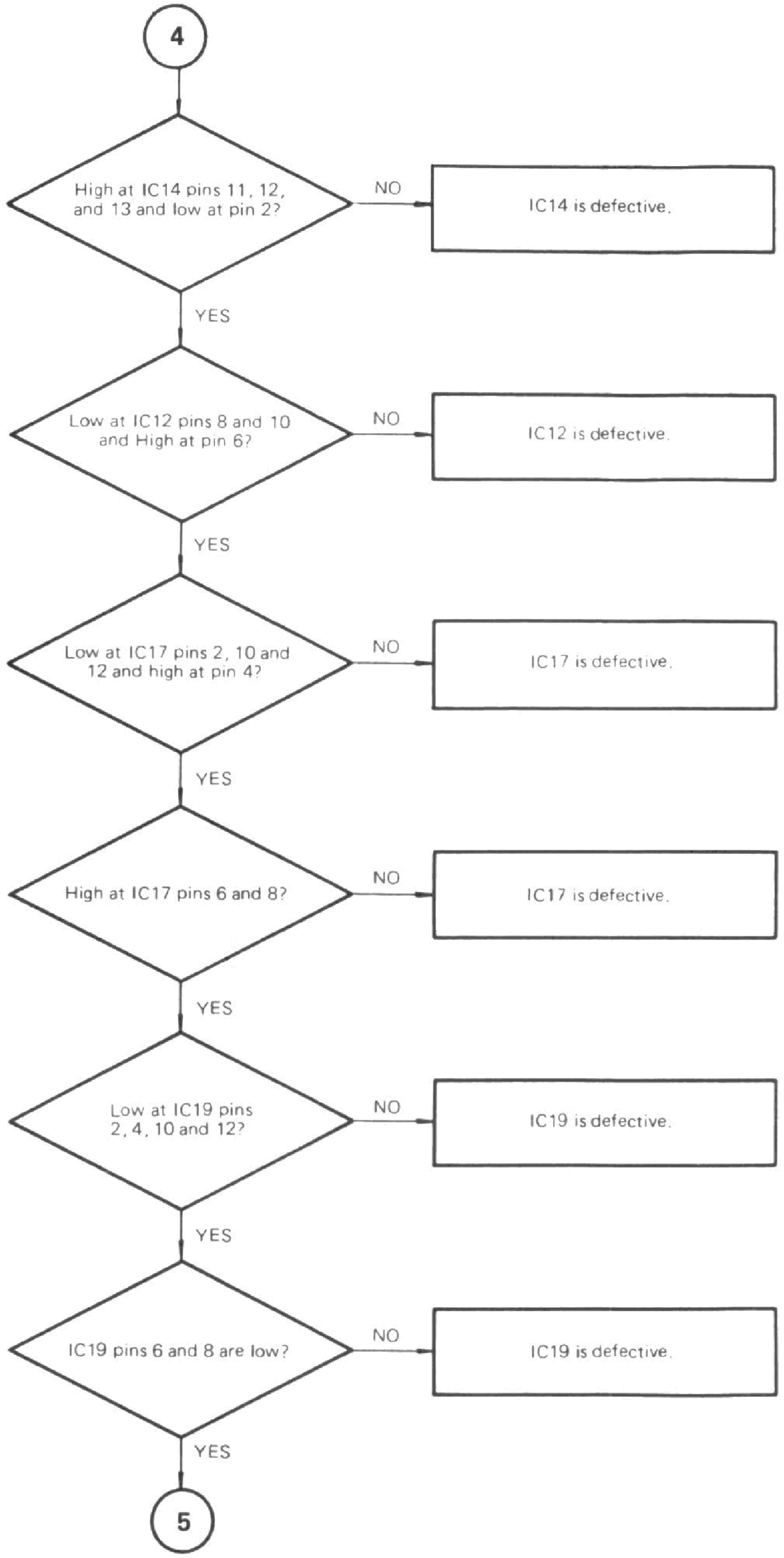


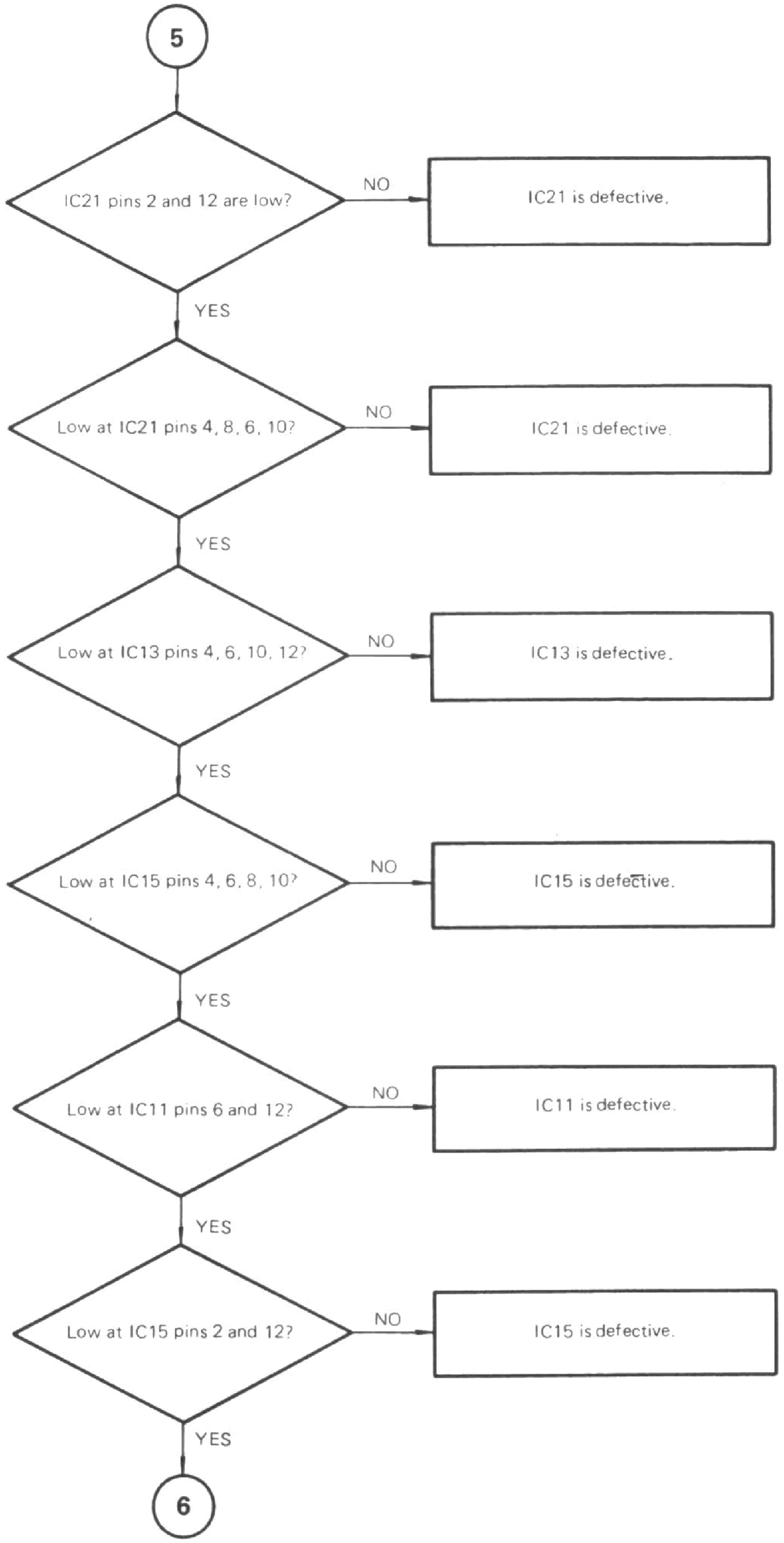
Fig. 9-13 BCD output (BLF-010051) check points

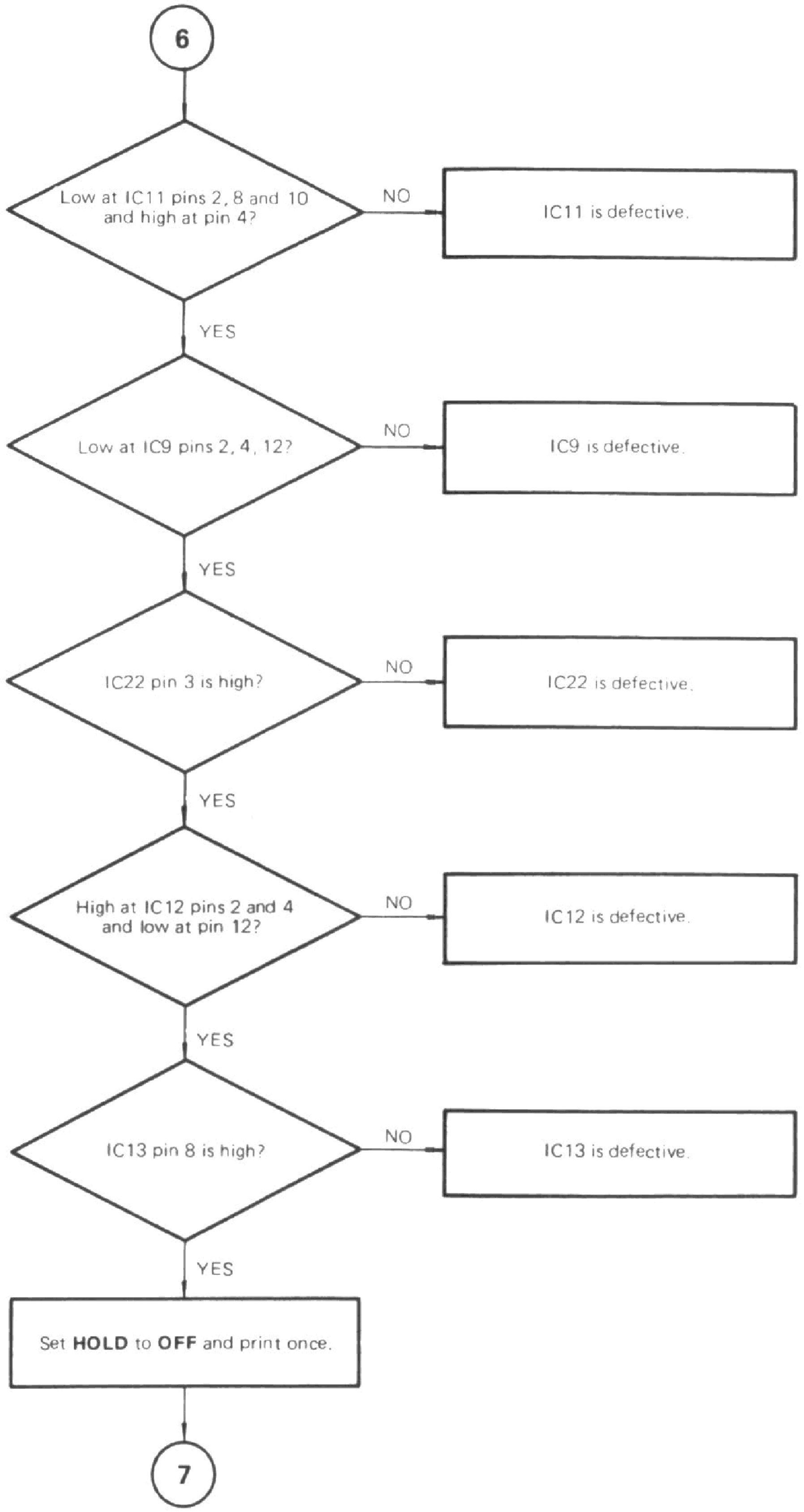

1
Waveform in Fig. d present at IC4 pin 7?
NO
IC4 is defective.
YES
Waveform in Fig. e present at IC13 pin 2?
NO
IC4 or IC13 is defective.
YES
Waveform in Fig. f present at IC22 pin 11?
NO
IC3, IC2, or IC22 is defective.
YES
Waveform in Fig. g present at IC22 pin 10?
NO
IC9 or IC22 is defective.
YES
Low level at IC9 pin 10?
NO
IC9 is defective
YES
GATE TIME = 1s and **HOLD** = **ON** settable?
NO
Go to Panel Switch Check.
YES
2

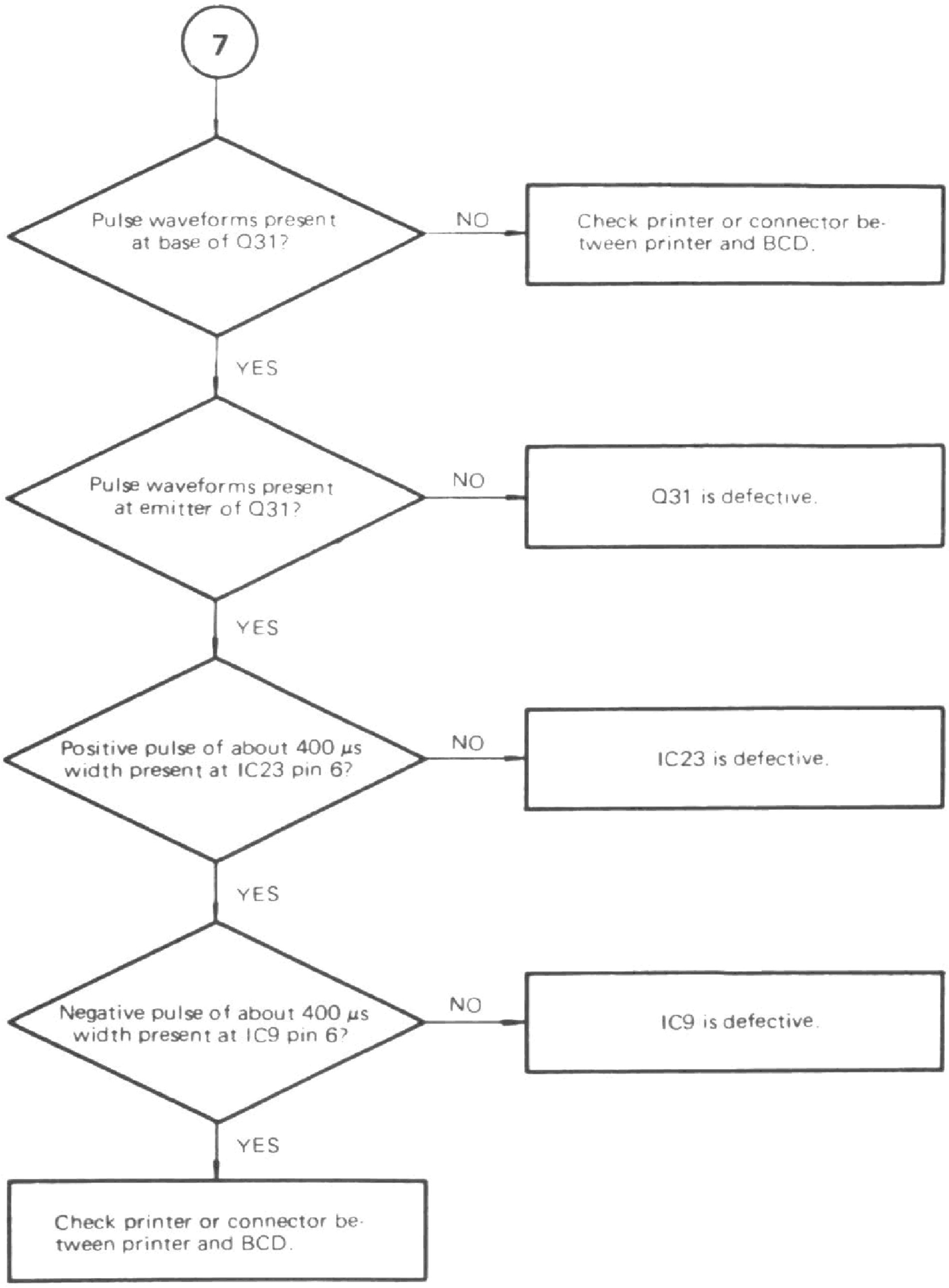

2
IC8 pin 3 = low, pin 4 = high, and pin 5 = low?
NO
IC8 is defective.
YES
IC8 pin 11 = high, pin 12 = low, and pin 13 = high?
NO
IC8 is defective.
YES
IC7 pin 3 = low and pin 4 = low?
NO
IC7 is defective.
YES
IC7 pin 11 = high, pin 12 = low, and pin 13 = high?
NO
IC7 is defective.
YES
IC16 O_1 = low, O_2 = High, O_3 = high, O_4 = low, O_5 = high, and O_6 = high?
NO
IC16 is defective.
YES
High at IC20 pins 2, 11, and 12?
NO
IC20 is defective.
YES
3


3
High at IC20 pins 3, 4 and 10?
NO
IC20 is defective.
YES
High at IC18 pins 2, 11, and 12?
NO
IC18 is defective.
YES
High at IC18 pins 3, 4 and 10?
NO
IC18 is defective.
YES
High at IC10 pins 3, 4, 5 and 10?
NO
IC10 is defective.
YES
High at IC10 pins 2, 11, 12, and 13?
NO
IC10 is defective.
YES
High at IC14 pins 3, 4, 5 and 10?
NO
IC14 is defective.
YES
4


4
High at IC14 pins 11, 12, and 13 and low at pin 2?
NO
IC14 is defective.
YES
Low at IC12 pins 8 and 10 and High at pin 6?
NO
IC12 is defective.
YES
Low at IC17 pins 2, 10 and 12 and high at pin 4?
NO
IC17 is defective.
YES
High at IC17 pins 6 and 8?
NO
IC17 is defective.
YES
Low at IC19 pins 2, 4, 10 and 12?
NO
IC19 is defective.
YES
IC19 pins 6 and 8 are low?
NO
IC19 is defective.
YES
5


5
IC21 pins 2 and 12 are low?
NO
IC21 is defective.
YES
Low at IC21 pins 4, 8, 6, 10?
NO
IC21 is defective.
YES
Low at IC13 pins 4, 6, 10, 12?
NO
IC13 is defective.
YES
Low at IC15 pins 4, 6, 8, 10?
NO
IC15 is defective.
YES
Low at IC11 pins 6 and 12?
NO
IC11 is defective.
YES
Low at IC15 pins 2 and 12?
NO
IC15 is defective.
YES
6


6
Low at IC11 pins 2, 8 and 10 and high at pin 4?
NO
IC11 is defective.
YES
Low at IC9 pins 2, 4, 12?
NO
IC9 is defective.
YES
IC22 pin 3 is high?
NO
IC22 is defective.
YES
High at IC12 pins 2 and 4 and low at pin 12?
NO
IC12 is defective.
YES
IC13 pin 8 is high?
NO
IC13 is defective.
YES
Set HOLD to OFF and print once.
7


7
Pulse waveforms present at base of Q31?
NO
Check printer or connector between printer and BCD.
YES
Pulse waveforms present at emitter of Q31?
NO
Q31 is defective.
YES
Positive pulse of about 400 μs width present at IC23 pin 6?
NO
IC23 is defective.
YES
Negative pulse of about 400 μs width present at IC9 pin 6?
NO
IC9 is defective.
YES
Check printer or connector between printer and BCD.

9-8. D/A Converter

Number of digits converted: 3 digits
A block diagram of the D/A converter circuit is shown below.

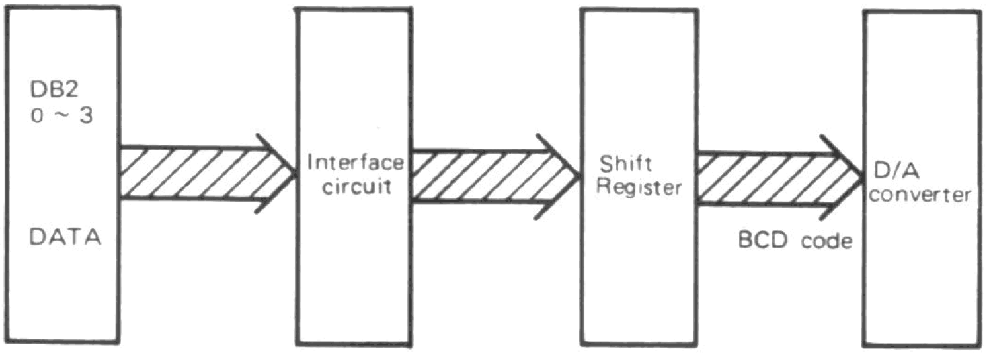


Fig. 9-14 D/A converter block diagram

Data DB2 0 to 3 input to the D/A converter circuit is routed via the interface circuit to the shift register where it is converted to BCD code. The BCD-converted data is converted to analog data by the D/A converter for the output.

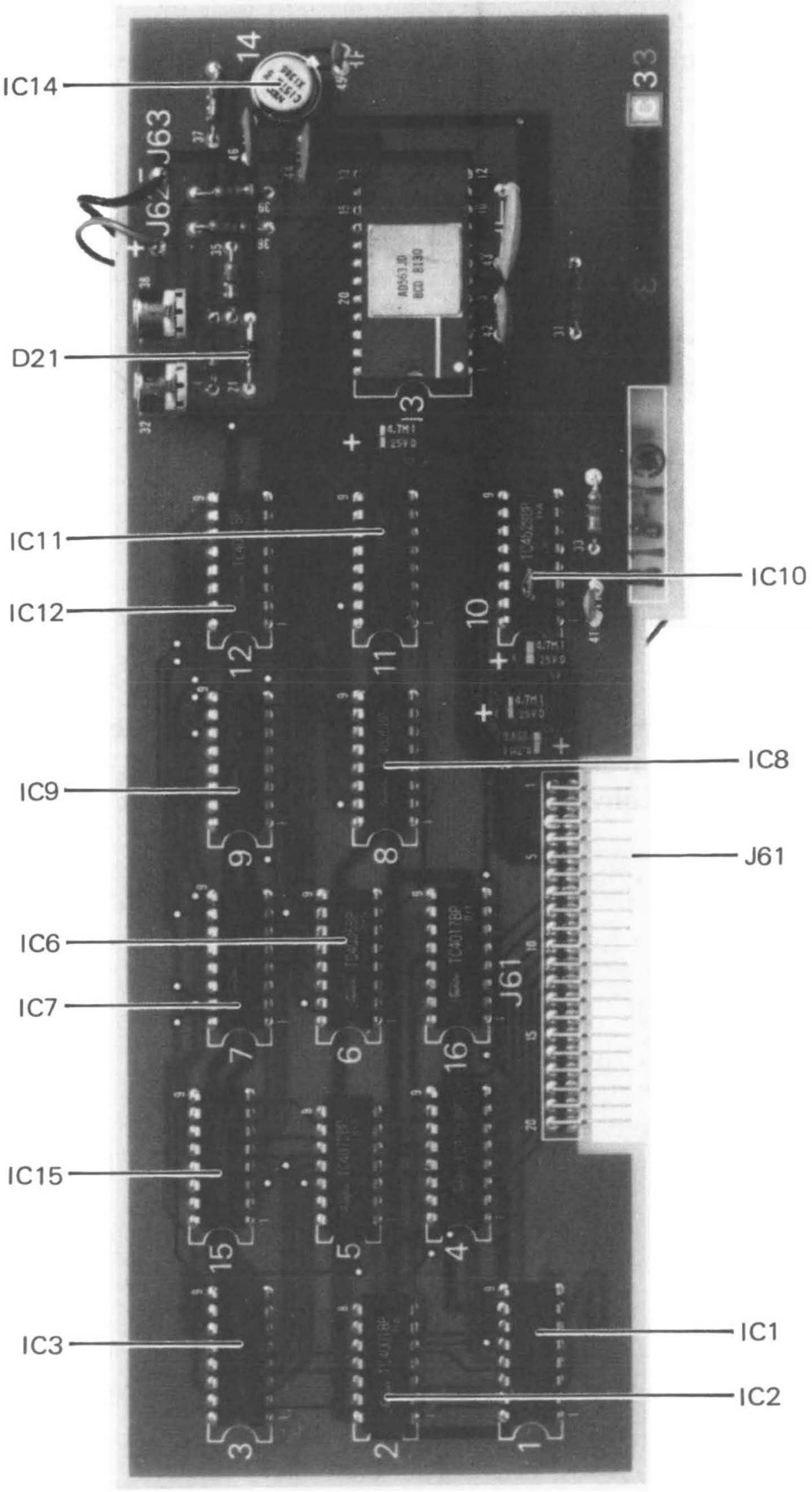
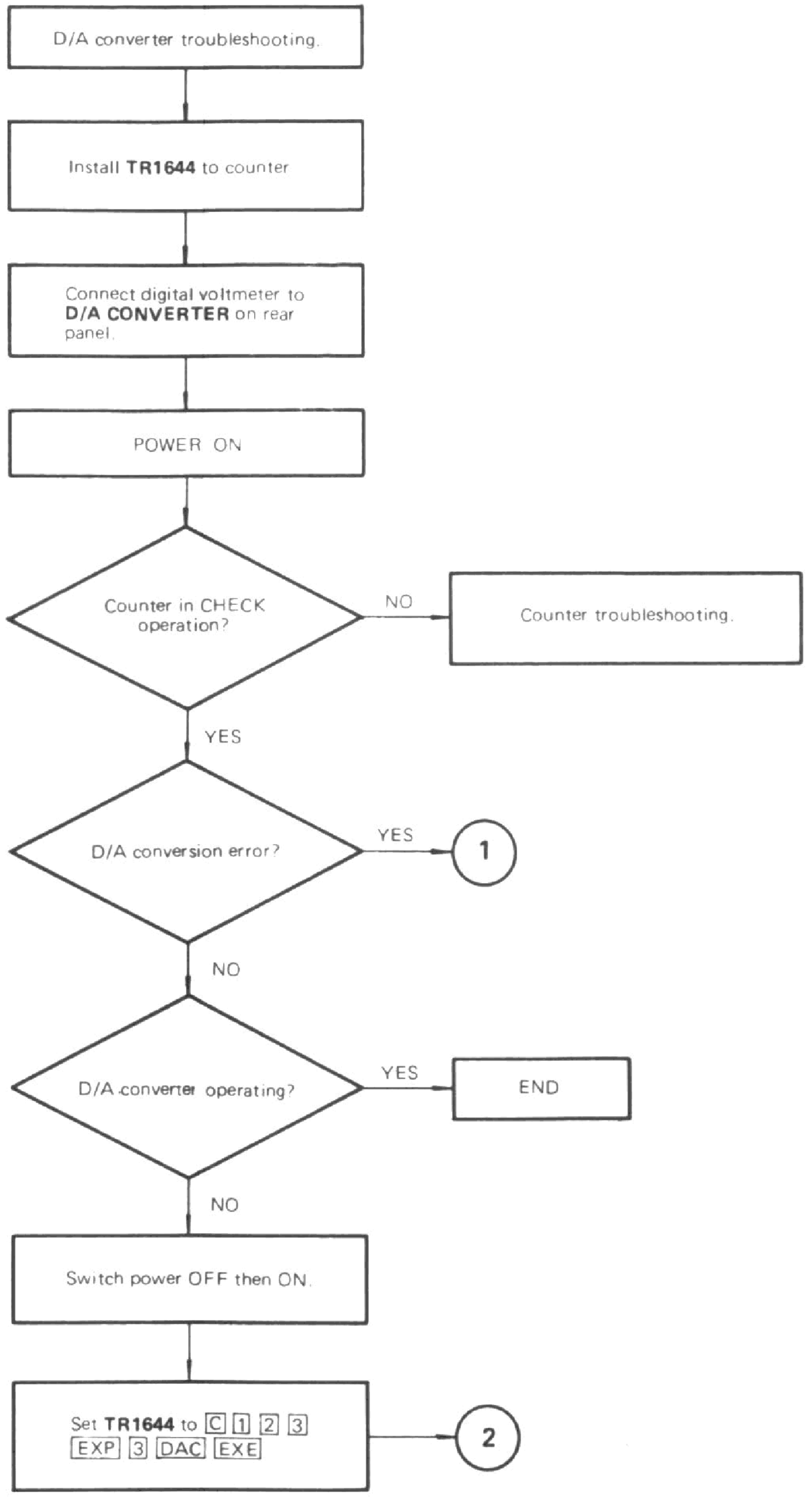
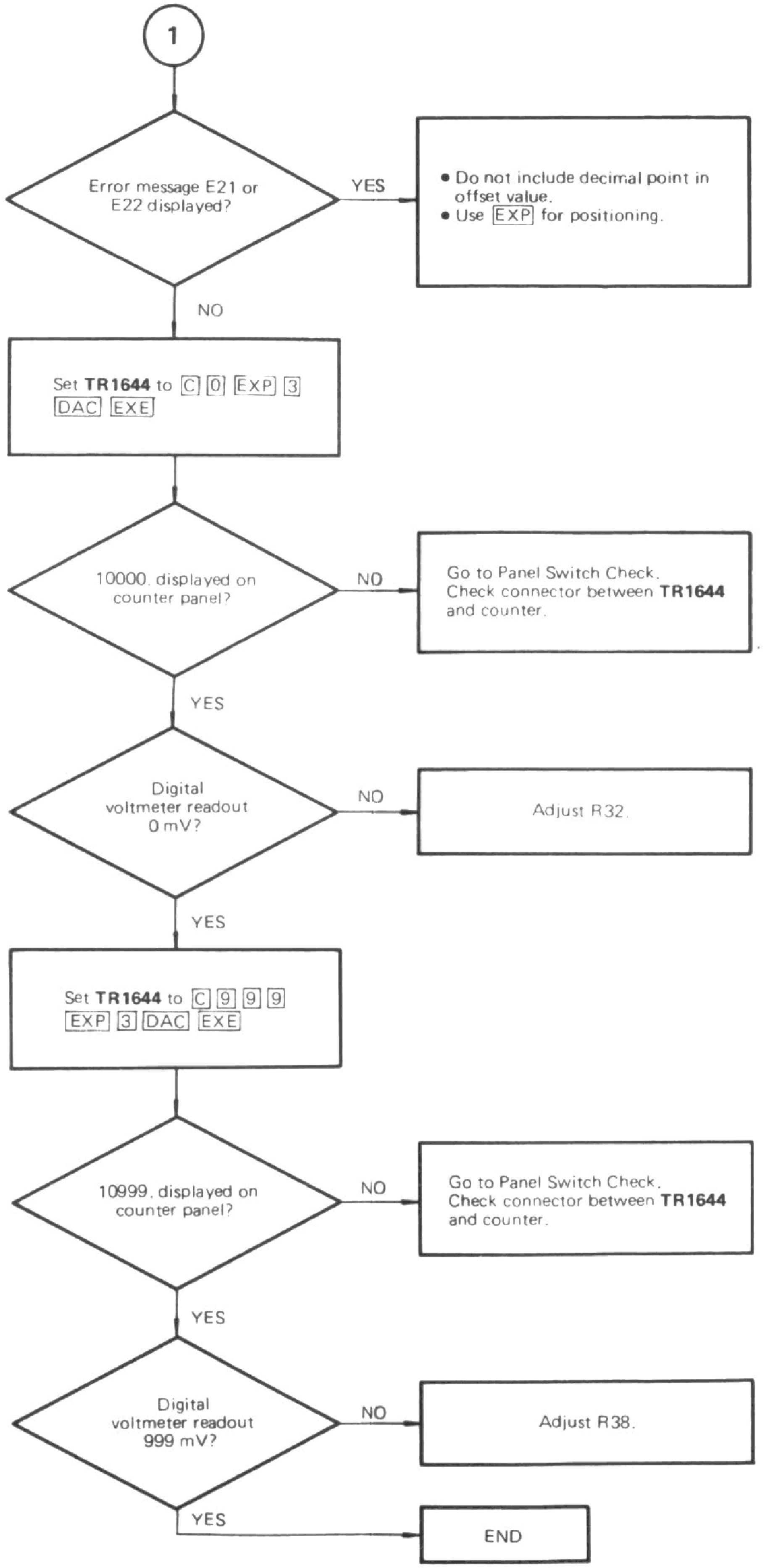
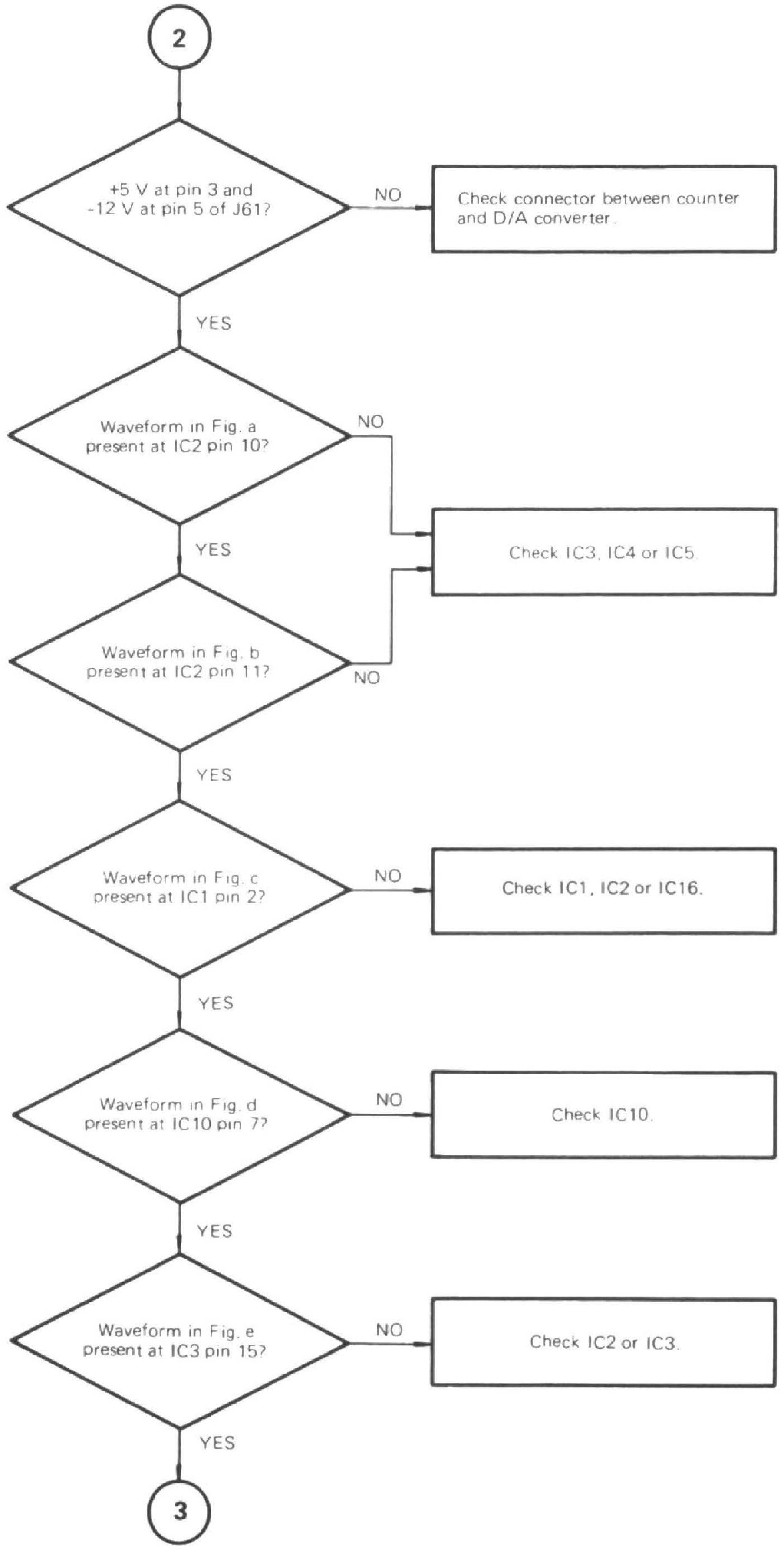


Fig. 9-15 D/A converter (BLF-010053) check points

CHART-15 D/A Converter Troubleshooting (BLF-010053)







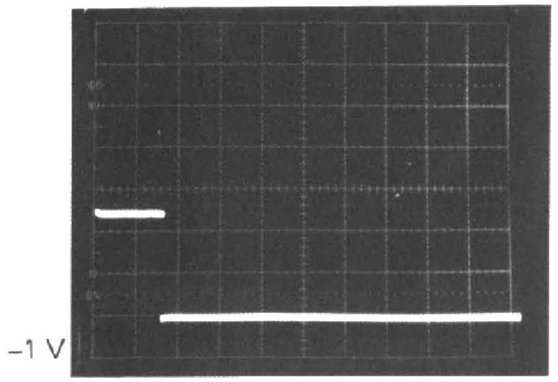


Fig. a 50 μs/div.
2 V/div.

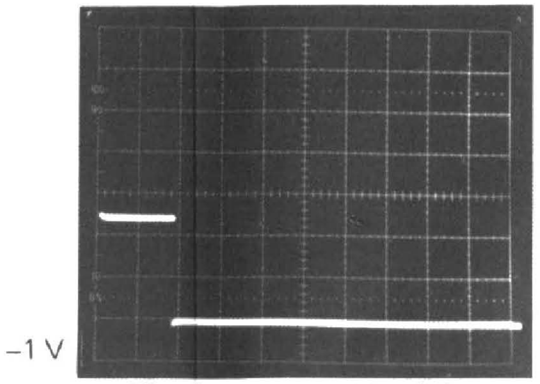


Fig. b 20 μs/div.
2 V/div.

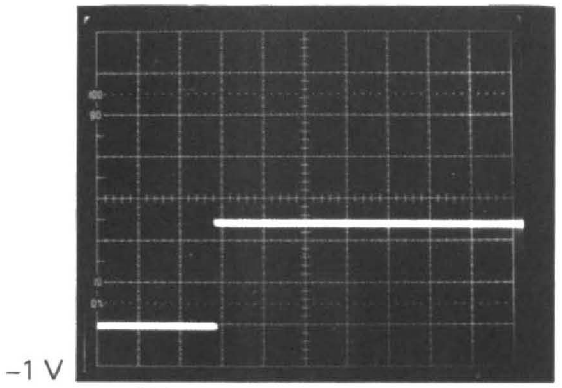


Fig. c 0.5 ms/div.
2 V/div.

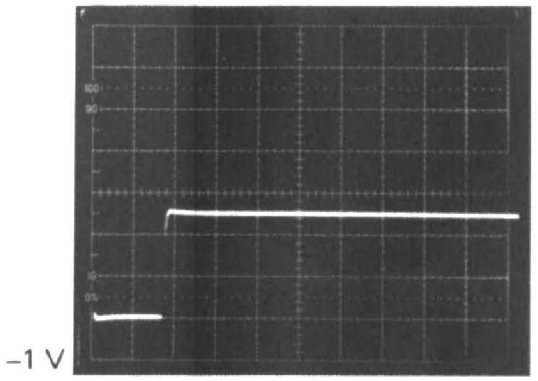


Fig. d 2 μs/div.
2 V/div.

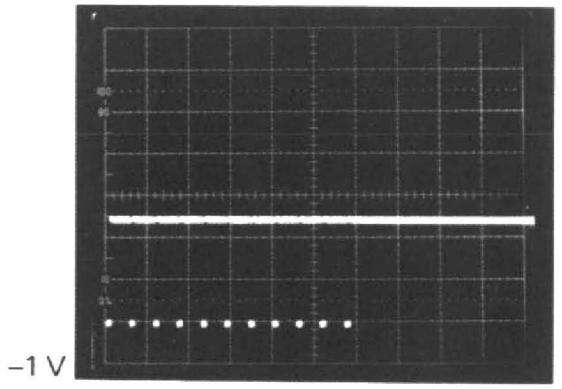
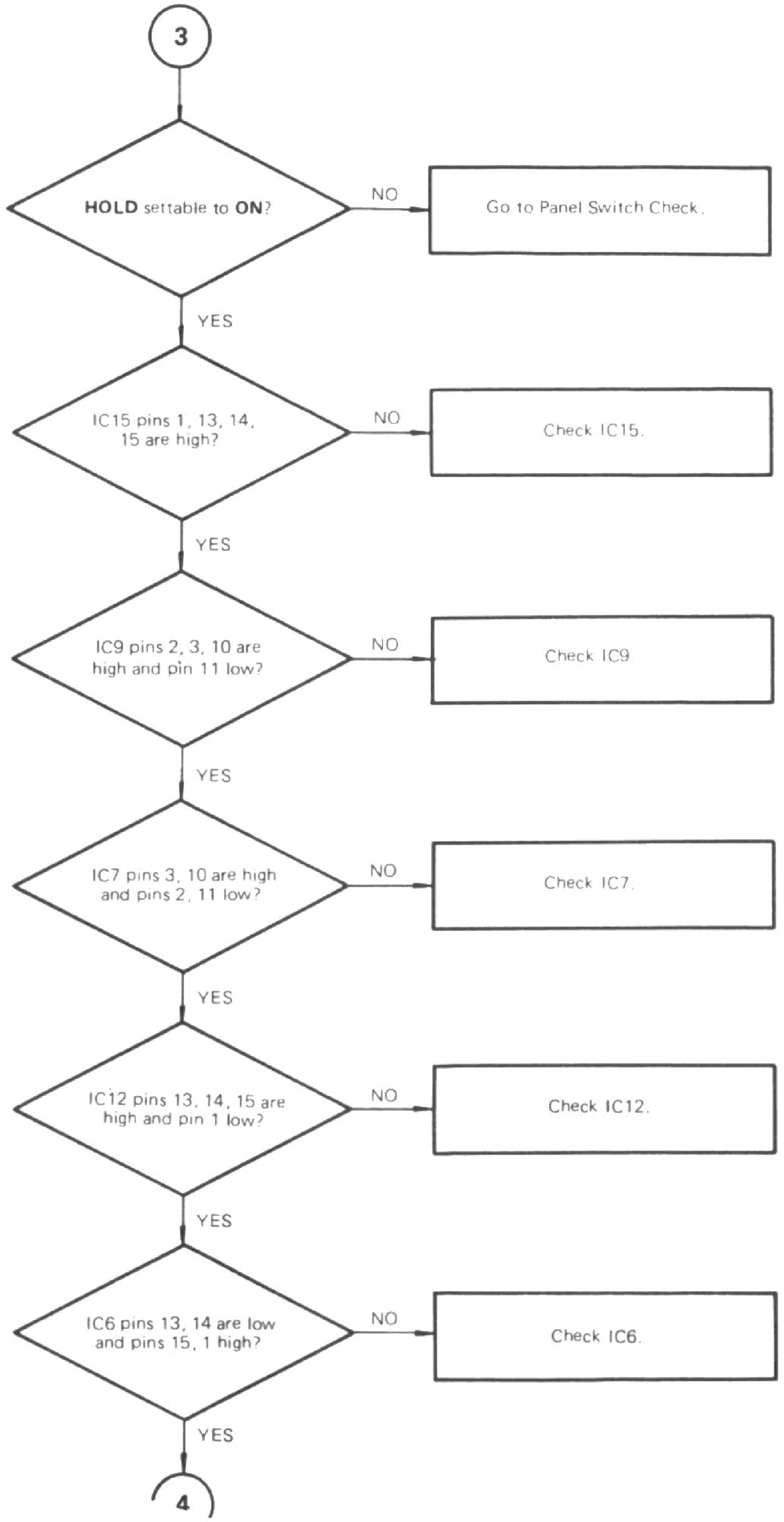
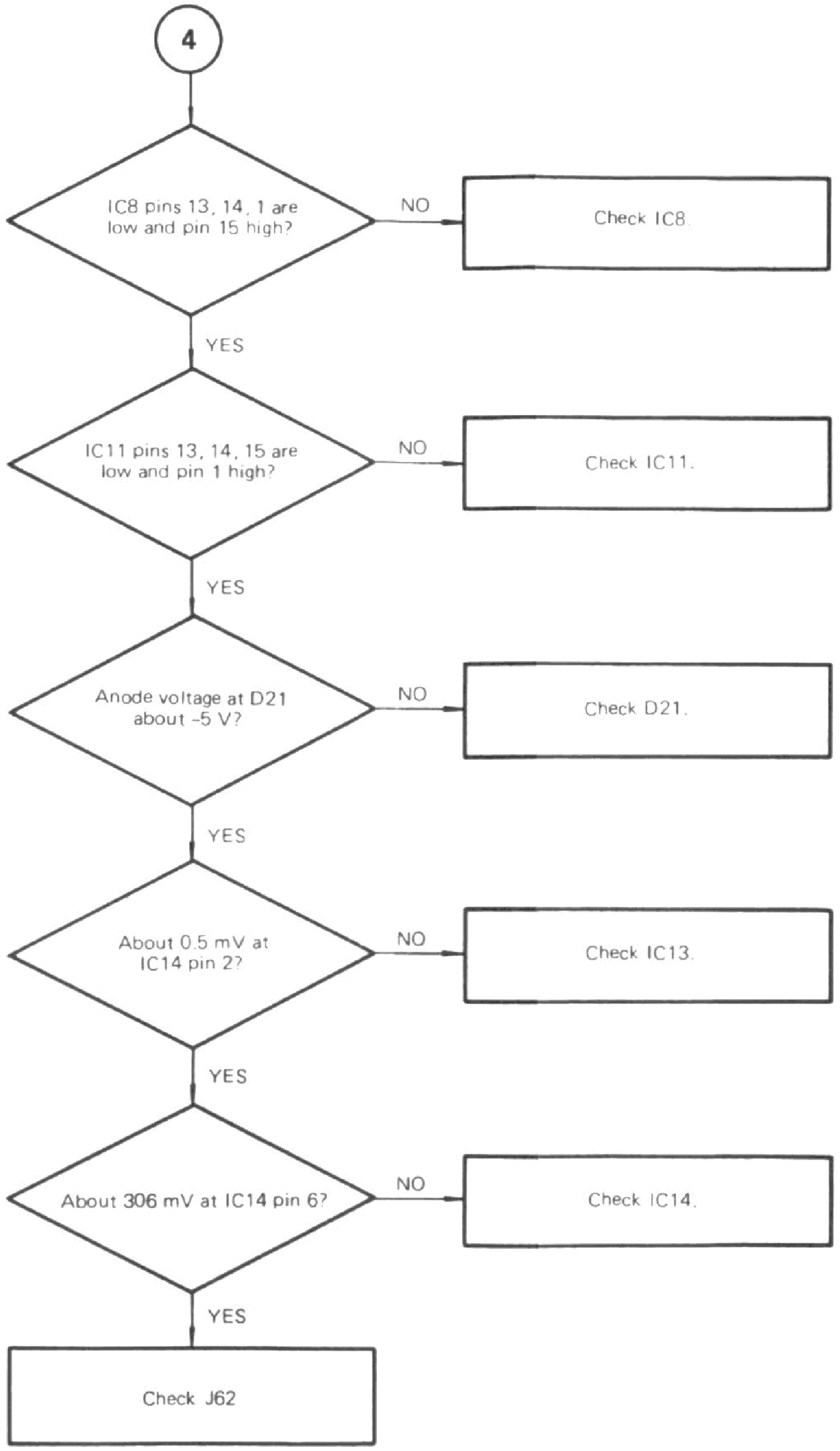


Fig. e 0.2 ms/div.
2 V/div.


3
HOLD settable to ON?
NO
Go to Panel Switch Check.
YES
IC15 pins 1, 13, 14, 15 are high?
NO
Check IC15.
YES
IC9 pins 2, 3, 10 are high and pin 11 low?
NO
Check IC9
YES
IC7 pins 3, 10 are high and pins 2, 11 low?
NO
Check IC7.
YES
IC12 pins 13, 14, 15 are high and pin 1 low?
NO
Check IC12.
YES
IC6 pins 13, 14 are low and pins 15, 1 high?
NO
Check IC6.
YES
4


4
IC8 pins 13, 14, 1 are low and pin 15 high?
NO
Check IC8
YES
IC11 pins 13, 14, 15 are low and pin 1 high?
NO
Check IC11.
YES
Anode voltage at D21 about -5 V?
NO
Check D21.
YES
About 0.5 mV at IC14 pin 2?
NO
Check IC13.
YES
About 306 mV at IC14 pin 6?
NO
Check IC14.
YES
Check J62

SECTION 10
PARTS LIST

CONTENTS

10-1. Introduction

This section provides listings of electrical and mechanical parts used in the TR5821/22/23 Universal Counter. If replacement of an electrical part is required, check its specifications and ratings by referring to the description of the parts list before replacing the defective part. If replacement of electrical or mechanical parts marked with an asterisk (*) is required, contact your nearest Takeda Riken representative. When ordering electrical parts, write their part and stock numbers. For mechanical part ordering write their part names and stock numbers.

NOTE

Specifications of parts are subject to change without notice to meet the users' demands or the requirements of our quality control.

10-2. Symbols and Abbreviations

The symbols and abbreviations used in the parts list, schematic diagrams and text are shown in Table 10-1. Negative logic signals are identified by an asterisk (*). For quick identification of the panel features of the product all references to them in the text are printed in boldface type.

REFERENCE DESIGNATIONS

C	Capacitor
Ca	Cable
F	Fuse
FH	Fuse Holder
IC	Integrated Circuit
J	Electrical Connector, Jack
L	Coil, Inductor
Q	Transistor
R	Resistor
S	Switch (Slide, Lever, Push Button, Rotary)
T	Transformer
TP	Test Point (Check Point)
X	Crystal

MULTIPLIERS

Abbreviation	Prefix	Multiple
G	giga	10^9
M	mega	10^6
k	kilo	10^3
m	milli	10^{-3}
μ	micro	10^{-6}
n	nano	10^{-9}
p	pico	10^{-12}

ABBREVIATIONS

A	ampere
AC	alternating current
ADJ.	adjustment
A/D	analog-to-digital
AMP.	amplifier
ATT.	attenuator
ASTIG.	astigmatism
ANT.	antenna
AUTO	automatic
BATT.	battery
BCD	binary coded decimal
B.P.F.	bandpass filter
B.W.	bandwidth
CAR	carbon
CAL.	calibration
CER	ceramic
cm	centimeter
COM.	common
CRT	cathode-ray tube
COMP.	comparator
CONT.	control
CONV.	converter
D/A	digital-to-analog
dB	decibel
dBm	decibel referred to 1mW
dBμ	decibel (0dBμ=1μVrms.)
DC	direct current
DET.	detector
DIV. (div.)	division
DISP.	dispersion
ELECT	electrolytic
EXT.	external
F	farad
FET.	field-effect transistor
FM	frequency modulation
FREQ.	frequency
FXD	fixed
FLM	film
f.s.	full scale
g	gram
GHz	gigahertz
GND	ground
H	henry
h	hour
HI	high
H.P.F.	high-pass filter
Hz	hertz
H.POSI.	horizontal position
H.GAIN	horizontal gain
IC	integrated circuit
IF	intermediate frequency
IN.	input
INT.	internal
kg	kilogram
kHz	kilohertz
kΩ	kilohm
kV	kilovolt
LED	light-emitting diode
LEV.	level
LIN.	linear
LO	low, local oscillator
LOG.	logarithm
L.P.F.	low-pass filter

Table 10-1 Abbreviations

m	meter
mA	milliampere
MAX.	maximum
MΩ	megohm
mg	milligram
MHz	megahertz
MIN.	minimum
min.	minute
mm	millimeter
MOD.	modulator
ms	millisecond
mV	millivolt
mVrms.	millivolt rms.
mW	milliwatt
μA	microampere
μF	micro farad
μH	microhenry
μs	microsecond
μV	microvolt
μVrms.	microvolt rms.
μW	microwatt
MANU.	manual
MIX.	mixer
NPN	negative-positive-negative
nA	nanoampere
NC	no connection
NORM.	normal
ns	nanosecond
nW	nanowatt
OPT.	option
OSC.	oscillator
Ω	ohm
OUT.	output
p	peak
pF	picofarad
PL	phase lock
PLO	phase lock oscillator
PM	phase modulation
p-p	peak-to-peak
PPM	pulse-position modulation
PRF	pulse-repetition frequency
ps	picosecond
POSI.	position
PNP	positive-negative-positive
QP.	quasi peak value
REF.	reference
RF	radio frequency
rms.	root-mean-square
rdg.	reading
REG.	regulator
SI	silicon
s	second (time)
S	switch
S.G.	signal generator
SSB	single sideband
S.W.R.	standing-wave ratio
T	timed (slow-blow fuse)
TTL	transistor-transistor logic
TV	television
TP	test point
VAR	variable
V	volt
VA	voltampere
VCO	voltage-controlled oscillator
VFO	variable-frequency oscillator
Vp-p	volts peak-to-peak
Vrms.	volts rms.
V.S.W.R.	voltage standing-wave ratio
V.POSI.	vertical position
V.GAIN	vertical gain
W	watt
WW	wire wound
YIG.	yttrium-iron-garnet

Table 10-1 Abbreviations

TR5821/22/23
SCHEMATIC SECTION

Parts No.	Takeda Riken Stock No.	Mfr Stock No.	Description
IC1	SIA-7805U-5	UPC7805H	IC: Voltage Regulator
IC2	SIA-7805U-5	UPC7805H	IC: Voltage Regulator
D1	SDS-RB402-2	S4VB10	Diode SI
D2	SDS-RB402-2	S4VB10	Diode SI
C1			Not assigned
C2 thru C5	CTA-AB10U25V-1	221M2502-106M	C: FXD ELECT TANTAL 10μF ±20% 25V
J1	JCB-AD016JX01-1	PBRS-16-A01	Connector
J2	DCB-QS0786X01A-1	*	Connector
NF1	DNF-000207-1	NF13502	Noise Filter
FH1	DFH-000192-1	FH-003	Fuse Holder
F1	DFT-AAR4A-1	EAWK 0.4A	Fuse 0.4A Slow-blow
T1	LTP-000377B-1	*	Power Transformer

TR5821/22
MOTHER BOARD
BLG-010275

Parts No.	Takeda Riken Stock No.	Mfr Stock No.	Description
IC1	SIT-15507-1	*	IC: LSI Counter Control Low Power
IC2	SIM-60114-1	*	IC: CMOS LSI Scaler, Divider & Register
IC3	SIM-96103-1	*	IC: 8-Bit Microprocessor
IC4	SIC-10131-1	*	IC: Dual type D Master-Slave Flip-Flop
IC5	SIC-1662-1	MC1662L	IC: Quadruple 2-Input NOR Gate
IC6	SHB-000373-1	*	IC: Amplifier and Waveform shaping circuit
IC7	SHB-000373-1	*	IC: Amplifier and Waveform shaping circuit
IC8	SIC-10107-1	MC10107L	IC: Triple 2-Input Exclusive OR Exclusive NOR Gate
IC9	SIT-74LS132-1	SN74LS132N	IC: Quadruple 2-Input Positive NAND Schmitt Trigger Low Power
IC10	SIA-555-7	HA17555PS	IC: Timer
IC11	SIA-7912U-5	UPC7912H	IC: Voltage Regulator
IC12			Not assigned
IC13	SIT-74LS14-1	SN74LS14N	IC: Hex Schmitt Trigger Inverter Low Power
Q21 thru Q23	STP-2N2894-1	2N2894	Transistor SI PNP
D31 thru D34	SDS-1SS16-1	1SS16	Diode SI
R41	RCB-AH330-1	RD25S 330ΩJ	R: FXD CAR 330Ω ±5% 1/4W
R42	RCB-AH10K-1	RD25S 10KΩJ	R: FXD CAR 10kΩ ±5% 1/4W
R43	RCB-AH120-1	RD25S 120ΩJ	R: FXD CAR 120Ω ±5% 1/4W
R44	RCB-AH2R7K-1	RD25S 2.7KΩJ	R: FXD CAR 2.7kΩ ±5% 1/4W
R45	RCB-AH33-1	RD25S 33ΩJ	R: FXD CAR 33Ω ±5% 1/4W
R46	RCB-AH560-1	RD25S 560ΩJ	R: FXD CAR 560Ω ±5% 1/4W
R47	RCB-AH560-1	RD25S 560ΩJ	R: FXD CAR 560Ω ±5% 1/4W
R48	RCB-AH560-1	RD25S 560ΩJ	R: FXD CAR 560Ω ±5% 1/4W
R49	RCB-AH560-1	RD25S 560ΩJ	R: FXD CAR 560Ω ±5% 1/4W
R50	RCB-AH270-1	RD25S 270ΩJ	R: FXD CAR 270Ω ±5% 1/4W
R51	RCB-AH1K-1	RD25S 1KΩJ	R: FXD CAR 1kΩ ±5% 1/4W
R52	RCB-AH560-1	RD25S 560ΩJ	R: FXD CAR 560Ω ±5% 1/4W
R53	RCB-AH820-1	RD25S 820ΩJ	R: FXD CAR 820Ω ±5% 1/4W
R54	RCB-AH270-1	RD25S 270ΩJ	R: FXD CAR 270Ω ±5% 1/4W
R55	RCB-AH180-1	RD25S 180ΩJ	R: FXD CAR 180Ω ±5% 1/4W
R56	RCB-AH820-1	RD25S 820ΩJ	R: FXD CAR 820Ω ±5% 1/4W
R57	RCB-AH820-1	RD25S 820ΩJ	R: FXD CAR 820Ω ±5% 1/4W
R58	RCB-AH270-1	RD25S 270ΩJ	R: FXD CAR 270Ω ±5% 1/4W
R59	RCB-AH270-1	RD25S 270ΩJ	R: FXD CAR 270Ω ±5% 1/4W
R60	RCB-AH180-1	RD25S 180ΩJ	R: FXD CAR 180Ω ±5% 1/4W
R61	RCB-AH180-1	RD25S 180ΩJ	R: FXD CAR 180Ω ±5% 1/4W
R62	RCB-AH100-1	RD25S 100ΩJ	R: FXD CAR 100Ω ±5% 1/4W
R63	RCB-AH820-1	RD25S 820ΩJ	R: FXD CAR 820Ω ±5% 1/4W
R64	RCB-AH3R9K-1	RD25S 3.9KΩJ	R: FXD CAR 3.9kΩ ±5% 1/4W
R65	RCB-AH3R9K-1	RD25S 3.9KΩJ	R: FXD CAR 3.9kΩ ±5% 1/4W

TR5821/22
MOTHER BOARD
BLG-010275

Parts No.	Takeda Riken Stock No.	Mfr Stock No.	Description
R66	RCB-AH33-1	RD25S 33ΩJ	R: FXD CAR 33Ω ±5% 1/4W
R67	RCB-AH120-1	RD25S 120ΩJ	R: FXD CAR 120Ω ±5% 1/4W
R68	RCB-AH2R7K-1	RD25S 2.7KΩJ	R: FXD CAR 2.7kΩ ±5% 1/4W
R69	RCB-AH10K-1	RD25S 10KΩJ	R: FXD CAR 10kΩ ±5% 1/4W
R70	RCB-AH100K-1	RD25S 100KΩJ	R: FXD CAR 100kΩ ±5% 1/4W
R71	RCB-AH100K-1	RD25S 100KΩJ	R: FXD CAR 100kΩ ±5% 1/4W
R72			Not assigned
R73	RVR-AK20-1	3321H-1-200	R: VAR CERMET 20Ω ±20% 1/2W
R74	RCB-AH10K-1	RD25S 10KΩJ	R: FXD CAR 10kΩ ±5% 1/4W
R75	RCB-AH100K-1	RD25S 100KΩJ	R: FXD CAR 100kΩ ±5% 1/4W
R76	RCB-AH100K-1	RD25S 100KΩJ	R: FXD CAR 100kΩ ±5% 1/4W
R77			Not assigned
R78	RVR-AK20-1	3321H-1-200	R: VAR CERMET 20Ω ±20% 1/2W
R79	RVR-AK10K-1	3321H-1-103	R: VAR CERMET 10kΩ ±20% 1/2W
R80	RVR-AK10K-1	3321H-1-103	R: VAR CERMET 10kΩ ±20% 1/2W
R81	RCB-AH820-1	RD25S 820ΩJ	R: FXD CAR 820Ω ±5% 1/4W
R82	RCB-AH270-1	RD25S 270ΩJ	R: FXD CAR 270Ω ±5% 1/4W
R83	RCB-AH180-1	RD25S 180ΩJ	R: FXD CAR 180Ω ±5% 1/4W
R84	RCB-AH33-1	RD25S 33ΩJ	R: FXD CAR 33Ω ±5% 1/4W
R85	RCB-AH120-1	RD25S 120ΩJ	R: FXD CAR 120Ω ±5% 1/4W
R86	RCB-AH2R7K-1	RD25S 2.7KΩJ	R: FXD CAR 2.7kΩ ±5% 1/4W
R87	RCB-AH270-1	RD25S 270ΩJ	R: FXD CAR 270Ω ±5% 1/4W
R88	RCB-AH1K-1	RD25S 1KΩJ	R: FXD CAR 1kΩ ±5% 1/4W
R89	RCB-AH4R7K-1	RD25S 4.7KΩJ	R: FXD CAR 4.7kΩ ±5% 1/4W
C91	CCK-AC4700U25V-1	25VP4700	C: FXD ELECT 4700μF 25V
C92	CCK-AC1000U50V-1	50VP1000	C: FXD ELECT 1000μF 50V
C93	CTA-AC4R7U25V-1	242M2502-475M	C: FXD ELECT TANTAL 4.7μF ±20% 25V
C94	CTA-AC2R2U35V-1	242M3502-225M	C: FXD ELECT TANTAL 2.2μF ±20% 35V
C95	CTA-AC4R7U25V-1	242M2502-475M	C: FXD ELECT TANTAL 4.7μF ±20% 25V
C96 thru C98	CSM-ACR01U50V-1	0.01UF 50WV	C: FXD CER 0.01μF +80, -20% 50V
C99	CTA-AC4R7U25V-1	242M2502-475M	C: FXD ELECT TANTAL 4.7μF ±20% 25V
C100	CTA-ACR22U35V-1	242M3502-224M	C: FXD ELECT TANTAL 0.22μF ±20% 35V
C101	CTA-AC4R7U25V-1	242M2502-475M	C: FXD ELECT TANTAL 4.7μF ±20% 25V
C102	CTA-ACR1U35V-1	242M3502-104M	C: FXD ELECT TANTAL 0.1μF ±20% 35V
C103	CSM-ACR01U50V-1	0.01UF 50WV	C: FXD CER 0.01μF +80, -20% 50V
C104			Not assigned
C105			Not assigned
C106	CSM-AC33P50V-1	33PF 50WV	C: FXD CER 33pF ±10% 50V
C107	CSM-ACR01U50V-1	0.01UF 50WV	C: FXD CER 0.01μF +80, -20% 50V
C108	CTA-AE10U10V-1	NP10ST100	C: FXD ELECT TANTAL 10μF 10V (Bipolar)
C109	CCK-AA10U10V-1	10T10	C: FXD ELECT 10μF 10V
C110	CCK-AA10U10V-1	10T10	C: FXD ELECT 10μF 10V
C111	CTA-AE10U10V-1	NP10ST100	C: FXD ELECT TANTAL 10μF 10V (Bipolar)
C112	CCK-AA10U10V-1	10T10	C: FXD ELECT 10μF 10V
C113	CCK-AA10U10V-1	10T10	C: FXD ELECT 10μF 10V

TR5821/22
MOTHER BOARD
BLG-010275

Parts No.	Takeda Riken Stock No.	Mfr Stock No.	Description
C114 thru C120	CSM-ACR01U50V-1	0.01UF 50WV	C: FXD CER 0.01μF +80, -20% 50V
L121	LCL-C00010-1	CSL0609-181K	L: FXD Coil 180μH
R122	RCB-AG4R7K-1	RD12S 4.7KΩJ	R: FXD CAR 4.7kΩ ±5% 1/8W
R123	RCB-AG4R7K-1	RD12S 4.7KΩJ	R: FXD CAR 4.7kΩ ±5% 1/8W
J127	JCB-AD016PX01-1	PBRS-16P	Connector
J128	JCP-AR020JX01-1	1-163680-9	Connector (TR5822 only)
J129	JCR-AF020PX01-1	HIF3F-20P-2.54DSA	Connector
S136	KSP-000035-1	MPS-17	Push Button Switch
C141	CSM-AGR1U50V-1	FD76AF1H104Z	C: FXD CER 0.1μF +80, -20% 50V
C142	CSM-ACR01U50V-1	0.01UF 50WV	C: FXD CER 0.01μF +80, -20% 50V
C143	CSM-ACR01U50V-1	0.01UF 50WV	C: FXD CER 0.01μF +80, -20% 50V
R144	RCB-AH10K-1	RD25S 10KΩJ	R: FXD CAR 10kΩ ±5% 1/4W
R145	RCB-AH10K-1	RD25S 10KΩJ	R: FXD CAR 10kΩ ±5% 1/4W
	JCI-AK040JX01-1	DILBQ40P-101	IC Socket (for IC1 to IC3)
	MBM-10372A-1	*	Terminal
	MBJ-18243B	*	Heat Sink A
	MMX-18108A	*	Key Top B

TR5823
MOTHER BOARD
BLG-010043

Parts No.	Takeda Riken Stock No.	Mfr Stock No.	Description
IC1	SIT-15507-1	*	IC: LSI Counter Control Low Power
IC2	SIM-60114-1	*	IC: CMOS LSI Scaler, Divider & Register
IC3	SIM-96103-1	*	IC: 8-Bit Microprocessor
IC4	SIC-10131-1	MC10131L	IC: Dual Type D Master-Slave Flip-Flop
IC5	SIC-1662-1	MC1662L	IC: Quadruple 2-Input NOR Gate
IC6	SHB-000373-1	*	IC: Amplifier and Waveform shaping circuit
IC7	SHB-000373-1	*	IC: Amplifier and Waveform shaping circuit
IC8	SIC-10107-1	MC10107L	IC: Triple 2-Input Exclusive OR Exclusive NOR
IC9	SIT-74LS132-1	SN74LS132N	IC: Quadruple 2-Input Positive NAND Schmitt Trigger
IC10	SIA-555-7	HA17555PS	IC: Timer
IC11	SIA-7912U-5	UPC7912H	IC: Voltage Regulator
IC12			Not assigned
IC13	SIT-74LS14-1	SN74LS14N	IC: Hex Schmitt-Trigger Inverter Low Power
IC14	SIT-74LS00-1	SN74LS00N	IC: Quadruple 2-Input NAND Gate Low Power
Q21 thru Q22	STP-2N2894-1	2N2894	Transistor SI PNP
D31 thru D34	SDS-1SS16-1	1SS16	Diode SI
R40	RCB-AH4R7K-1	RD25S 4.7KΩJ	R: FXD CAR 4.7kΩ ±5% 1/4W
R41	RCB-AH330-1	RD25S 330ΩJ	R: FXD CAR 330Ω ±5% 1/4W
R42	RCB-AH10K-1	RD25S 10KΩJ	R: FXD CAR 10kΩ ±5% 1/4W
R43	RCB-AH120-1	RD25S 120ΩJ	R: FXD CAR 120Ω ±5% 1/4W
R44	RCB-AH2R7K-1	RD25S 2.7KΩJ	R: FXD CAR 2.7kΩ ±5% 1/4W
R45	RCB-AH33-1	RD25S 33ΩJ	R: FXD CAR 33Ω ±5% 1/4W
R46	RCB-AH560-1	RD25S 560ΩJ	R: FXD CAR 560Ω ±5% 1/4W
R47	RCB-AH560-1	RD25S 560ΩJ	R: FXD CAR 560Ω ±5% 1/4W
R48	RCB-AH560-1	RD25S 560ΩJ	R: FXD CAR 560Ω ±5% 1/4W
R49	RCB-AH560-1	RD25S 560ΩJ	R: FXD CAR 560Ω ±5% 1/4W
R50	RCB-AH270-1	RD25S 270ΩJ	R: FXD CAR 270Ω ±5% 1/4W
R51	RCB-AH1K-1	RD25S 1KΩJ	R: FXD CAR 1kΩ ±5% 1/4W
R52	RCB-AH560-1	RD25S 560ΩJ	R: FXD CAR 560Ω ±5% 1/4W
R53	RCB-AH820-1	RD25S 820ΩJ	R: FXD CAR 820Ω ±5% 1/4W
R54	RCB-AH270-1	RD25S 270ΩJ	R: FXD CAR 270Ω ±5% 1/4W
R55	RCB-AH180-1	RD25S 180ΩJ	R: FXD CAR 180Ω ±5% 1/4W
R56	RCB-AH820-1	RD25S 820ΩJ	R: FXD CAR 820Ω ±5% 1/4W
R57	RCB-AH820-1	RD25S 820ΩJ	R: FXD CAR 820Ω ±5% 1/4W
R58	RCB-AH270-1	RD25S 270ΩJ	R: FXD CAR 270Ω ±5% 1/4W
R59	RCB-AH270-1	RD25S 270ΩJ	R: FXD CAR 270Ω ±5% 1/4W
R60	RCB-AH180-1	RD25S 180ΩJ	R: FXD CAR 180Ω ±5% 1/4W
R61	RCB-AH180-1	RD25S 180ΩJ	R: FXD CAR 180Ω ±5% 1/4W
R62	RCB-AH100-1	RD25S 100ΩJ	R: FXD CAR 100Ω ±5% 1/4W

TR5823
MOTHER BOARD
BLG-010043

Parts No.	Takeda Riken Stock No.	Mfr Stock No.	Description
R63	RCB-AH820-1	RD25S 820ΩJ	R: FXD CAR 820Ω ±5% 1/4W
R64	RCB-AH3R9K-1	RD25S 3.9KΩJ	R: FXD CAR 3.9kΩ ±5% 1/4W
R65	RCB-AH3R9K-1	RD25S 3.9KΩJ	R: FXD CAR 3.9kΩ ±5% 1/4W
R66	RCB-AH33-1	RD25S 33ΩJ	R: FXD CAR 33Ω ±5% 1/4W
R67	RCB-AH120-1	RD25S 120ΩJ	R: FXD CAR 120Ω ±5% 1/4W
R68	RCB-AH2R7K-1	RD25S 2.7KΩJ	R: FXD CAR 2.7kΩ ±5% 1/4W
R69	RCB-AH10K-1	RD25S 10KΩJ	R: FXD CAR 10kΩ ±5% 1/4W
R70	RCB-AH100K-1	RD25S 100KΩJ	R: FXD CAR 100kΩ ±5% 1/4W
R71	RCB-AH100K-1	RD25S 100KΩJ	R: FXD CAR 100kΩ ±5% 1/4W
R72			Not assigned
R73	RVR-AK20-1	3321H-1-200	R: VAR CERMET 20Ω ±20% 1/2W
R74	RCB-AH10K-1	RD25S 10KΩJ	R: FXD CAR 10kΩ ±5% 1/4W
R75	RCB-AH100K-1	RD25S 100KΩJ	R: FXD CAR 100kΩ ±5% 1/4W
R76	RCB-AH100K-1	RD25S 100KΩJ	R: FXD CAR 100kΩ ±5% 1/4W
R77			Not assigned
R78	RVR-AK20-1	3321H-1-200	R: VAR CERMET 20Ω ±20% 1/2W
R79	RVR-AK10K-1	3321H-1-103	R: VAR CERMET 10kΩ ±20% 1/2W
R80	RVR-AK10K-1	3321H-1-103	R: VAR CERMET 10kΩ ±20% 1/2W
R81	RCB-AH33-1	RD25S 33ΩJ	R: FXD CAR 33Ω ±5% 1/4W
R82	RCB-AH120-1	RD25S 120ΩJ	R: FXD CAR 120Ω ±5% 1/4W
R83	RCB-AH2R7K-1	RD25S 2.7KΩJ	R: FXD CAR 2.7kΩ ±5% 1/4W
R84	RCB-AH1K-1	RD25S 1KΩJ	R: FXD CAR 1kΩ ±5% 1/4W
R85	RCB-AH270-1	RD25S 270ΩJ	R: FXD CAR 270Ω ±5% 1/4W
C91	CCK-AC4700U25V-1	25VP4700	C: FXD ELECT 4700μF 25V
C92	CCK-AC1000U50V-1	50VP1000	C: FXD ELECT 1000μF 50V
C93	CTA-AC4R7U25V-1	242M2502-475M	C: FXD ELECT TANTAL 4.7μF ±20% 25V
C94	CTA-AC2R2U35V-1	242M3502-225M	C: FXD ELECT TANTAL 2.2μF ±20% 35V
C95	CTA-AC4R7U25V-1	242M2502-475M	C: FXD ELECT TANTAL 4.7μF ±20% 25V
C96 thru C98	CSM-ACR01U50V-1	0.01UF 50WV	C: FXD CER 0.01μF +80, -20% 50V
C99	CTA-AC4R7U25V-1	242M2502-475M	C: FXD ELECT TANTAL 4.7μF ±20% 25V
C100	CTA-ACR22U35V-1	242M3502-224M	C: FXD ELECT TANTAL 0.22μF ±20% 35V
C101	CTA-AC4R7U25V-1	242M2502-475M	C: FXD ELECT TANTAL 4.7μF ±20% 25V
C102	CTA-ACR1U35V-1	242M3502-104M	C: FXD ELECT TANTAL 0.1μF ±20% 35V
C103 thru C105	CSM-ACR01U50V-1	0.01UF 50WV	C: FXD CER 0.01μF +80, -20% 50V
C106	CSM-AC330P50V-1	330PF 50WV	C: FXD CER 330pF ±10% 50V
C107	CSM-ACR01U50V-1	0.01UF 50WV	C: FXD CER 0.01μF +80, -20% 50V
C108	CTA-AE10U10V-1	NP10ST100	C: FXD ELECT TANTAL 10μF 10V (Bipolar)
C109	CCK-AA10U10V-1	10T10	C: FXD ELECT 10μF 10V
C110	CCK-AA10U10V-1	10T10	C: FXD ELECT 10μF 10V
C111	CTA-AE10U10V-1	NP10ST100	C: FXD ELECT TANTAL 10μF 10V (Bipolar)
C112	CCK-AA10U10V-1	10T10	C: FXD ELECT 10μF 10V
C113	CCK-AA10U10V-1	10T10	C: FXD ELECT 10μF 10V
C114 thru C117	CSM-ACR01U50V-1	0.01UF 50WV	C: FXD CER 0.01μF +80, -20% 50V

TR5823
MOTHER BOARD
BLG-010043

Parts No.	Takeda Riken Stock No.	Mfr Stock No.	Description
C118	CSM-AGR1050V-1	FD76AF1H104Z	C: FXD CER 0.1μF +80, -20% 50V
C119	CSM-ACR01U50V-1	0.01UF 50WV	C: FXD CER 0.01μF +80, -20% 50V
L121	LCL-C00010-1	CSL0609-181K	L: FXD Coil 180μH
R124	RCB-AG4R7K-1	RD12S 4.7KΩJ	R: FXD CAR 4.7kΩ ±5% 1/8W
R125	RCB-AG4R7K-1	RD12S 4.7KΩJ	R: FXD CAR 4.7kΩ ±5% 1/8W
J127	JCB-AD016PX01-1	PBRS-16P	Connector
J128	JCP-AR020JX01-1	1-163680-9	Connector
J129	JCR-AF020PX01-1	HIF3F-20P-2.54DSA	Connector
J130	JCP-AR020JX01-1	1-163680-9	Connector
J132 thru J134	CSM-ACR01U50V-1	0.01UF 50WV	C: FXD CER 0.01μF +80, -20% 50V
S136	KSP-000035-1	MPS-17	Push Button Switch
C141	CSM-ACR01U50V-1	0.01UF 50WV	C: FXD CER 0.01μF +80, -20% 50V
C142	CSM-ACR01U50V-1	0.01UF 50WV	C: FXD CER 0.01μF +80, -20% 50V
	JCI-AK040JX01-1	DILBQ40P-101	IC Socket(for IC1 to IC3)
	MBM-10372A-1	*	Terminal
	MBJ-18243B	*	Heat Sink
	MMX-18108A	*	Key Top B

TR5821/22/23
OPERATION BOARD
BLF-010044

Parts No.	Takeda Riken Stock No.	Mfr Stock No.	Description
IC1	SIM-7218-1	ICM7218A	IC: Display Driver
IC2	SIM-7218-1	ICM7218A	IC: Display Driver
IC3	SIT-74LS148-1	SN74LS148N	IC: 8-Line-to-3-Line Octal Priority Encoder Low Power
D11 thru D18	NLD-000096-1	LN514GA	Light Emitting Diode
D19 thru D32	NLD-000010-1	PG3432SY	Light Emitting Diode
D33	NLD-000111-1	AA3432S	Light Emitting Diode
D34	NLD-000111-1	AA3432S	Light Emitting Diode (TR5823 only)
D35	NLD-000111-1	AA3432S	Light Emitting Diode
D36 thru D45	NLD-000010-1	PG3432SY	Light Emitting Diode
R51	RAY-AA10K4-1	TMR4-103	R: FXD COM 10kΩ
R52	RAY-AA10K4-1	TMR4-103	R: FXD COM 10kΩ
R53	RVR-CN1M-1	RV16YN25SB1MΩ	R: VAR WW 1MΩ
R54	RVR-CN10K-1	RV16YN25SB10KΩ	R: VAR WW 10kΩ
R55	RVR-CN10K-1	RV16YN25SB10KΩ	R: VAR WW 10kΩ
R56	RCB-AG15K-1	RD12S 15KΩJ	R: FXD CAR 15kΩ ±5% 1/8W
R57	RCB-AG15K-1	RD12S 15KΩJ	R: FXD CAR 15kΩ ±5% 1/8W
R58 thru R60	RCB-AG100K-1	RD12S 100KΩJ	R: FXD CAR 100kΩ ±5% 1/8W
R61	RCB-AG910K-1	RD12S 910KΩJ	R: FXD CAR 910kΩ ±5% 1/8W
R62	RCB-AG10K-1	RD12S 10KΩJ	R: FXD CAR 10kΩ ±5% 1/8W
R63	RCB-AG1M-1	RD12S 1MΩJ	R: FXD CAR 1MΩ ±5% 1/8W
R64	RCB-AG100K-1	RD12S 100KΩJ	R: FXD CAR 100kΩ ±5% 1/8W
R65	RCB-AG910K-1	RD12S 910KΩJ	R: FXD CAR 910kΩ ±5% 1/8W
R66	RCB-AG10K-1	RD12S 10KΩJ	R: FXD CAR 10kΩ ±5% 1/8W
R67	RCB-AG1M-1	RD12S 1MΩJ	R: FXD CAR 1MΩ ±5% 1/8W
R68	RCB-AG330-1	RD12S 330ΩJ	R: FXD CAR 330Ω ±5% 1/8W
R69	RCB-AG33-1	RD12S 33ΩJ	R: FXD CAR 33Ω ±5% 1/8W
C71 thru C73	CTA-AC1U50V-4	TA-050TN1R0-P	C: FXD ELECT TANTAL 1µF +100, -0% 50V
C74	CMC-AB220PR3K-4	DM10D221J3	C: FXD DIPPED MICA 220pF ±5% 300V
C75	CMC-AB220PR3K-4	DM10D221J3	C: FXD DIPPED MICA 220pF ±5% 300V
C76	CSM-AC1PR5K-1	1PF 500WV	C: FXD CER 1pF ±0.5pF 500V
C77	CSM-AC33P50V-1	33PF 50WV	C: FXD CER 33pF ±10% 50V
C78	CSM-AC1PR5K-1	1PF 500WV	C: FXD CER 1pF ±0.5pF 500V
C79	CSM-AC33P50V-1	33PF 50WV	C: FXD CER 33pF ±10% 50V
C80	CFM-AHR1U250V-1	ECQ-E2104KS	C: FXD Mylar 0.1µF ±10% 250V
C81	CFM-AHR1U250V-1	ECQ-E2104KS	C: FXD Mylar 0.1µF ±10% 250V
C82	CSM-AE1000P50V-1	FD52SL1H102K	C: FXD Laminated CER 1000pF ±10% 50V
C83	CSM-AE1000P50V-1	FD52SL1H102K	C: FXD Laminated CER 1000pF ±10% 50V
S91 thru S93	KSP-000250-1	1KSR001-00081-000	Push Button Switch

TR5821/22/23
OPERATION BOARD
BLF-010044

Parts No.	Takeda Riken Stock No.	Mfr Stock No.	Description
S94	KSP-000250-1	1KSR001-00081-000	Push Button Switch (TR5823 only)
S95 thru S97	KSP-000250-1	1KSR001-00081-000	Push Button Switch
S98 thru S100	KSL-000410-1	SSA042-L9	Slide Switch
S101 thru S104	KSL-000340-1	SSA043-L9	Slide Switch
S105	KSL-000410-1	SSA042-L9	Slide Switch
S106	KSL-000410-1	SSA042-L9	Slide Switch (TR5823 only)
J111	DCB-RR0749X01-1	*	Connector with Cable
J112	JCS-AZ023JX01-1	PCN5-23ST-1.27DS	Connector
J113	JCP-AR020JX02-1	1-163681-9	Socket
J114	JCF-AB001JX13-1	BNC-R-PC-3	Connector
J115	JCF-AB001JX13-1	BNC-R-PC-3	Connector
J116	JCF-AB001JX15-1	BNC-R(F)-PC1	Connector (TR5823 only)
J117			Not assigned
	JCI-AK028JX01-1	DILBQ28P-101	IC Socket
F121	DFS-ACR125A-1	275.125	Fuse 0.125A Normal blow (TR5823 only)
CB126			Coaxial Cable (TR5823 only)

TR5821/22/23
DUMMY BOARD
BLB-010047

Parts No.	Takeda Riken Stock No.	Mfr Stock No.	Description
IC1	SHB-000372-1	*	IC: Hybrid Impedance Converter
IC2	SHB-00372-1	*	IC: Hybrid Impedance Converter
R5	RCB-AH39K-1	RD25S 39K J	R: FXD CAR 39k ±5% 1/4W
R6	RCB-AH39K-1	RD25S 39K J	R: FXD CAR 39k 5% 1/4W
C11 thru C14	CSM-ACR01U50V-1	0.01UF 50WV	C: FXD CER 0.01 F +80, -20% 50V
J21	JCP-AR020PX03-1	1-164382-8	Connector
J22	JCP-AR020PX01-1	1-163740-9	Connector

TR5821/22/23
Xtal-1
BLB-010048

Parts No.	Takeda Riken Stock No.	Mfr Stock No.	Description
IC1	SIA-7805L-6	UPC78L05	LC: Voltage Regulator
Q11 thru Q13	STN-2SC1834-1	2SC1834	Transistor SI NPN
D21	SDS-1S953-1	1S953	Diode SI
R31	RCB-AH22K-1	RD25S 22KΩJ	R: FXD CAR 22kΩ ±5% 1/4W
R32	RCB-AH33K-1	RD25S 33KΩJ	R: FXD CAR 33kΩ ±5% 1/4W
R33	RCB-AH560-1	RD25S 560ΩJ	R: FXD CAR 560Ω ±5% 1/4W
R34	RCB-AH560-1	RD25S 560ΩJ	R: FXD CAR 560Ω ±5% 1/4W
R35	RCB-AH470-1	RD25S 470ΩJ	R: FXD CAR 470Ω ±5% 1/4W
R36	RCB-AH5R6K-1	RD25S 5.6KΩJ	R: FXD CAR 5.6kΩ ±5% 1/4W
R37	RCB-AH270-1	RD25S 270ΩJ	R: FXD CAR 270Ω ±5% 1/4W
R38	RCB-AH2R7K-1	RD25S 2.7KΩJ	R: FXD CAR 2.7kΩ ±5% 1/4W
R39	RCB-AH1K-1	RD25S 1KΩJ	R: FXD CAR 1kΩ ±5% 1/4W
R40	RCB-AH330-1	RD25S 330ΩJ	R: FXD CAR 330Ω ±5% 1/4W
R41	RCB-AH4R7K-1	RD25S 4.7KΩJ	R: FXD CAR 4.7kΩ ±5% 1/4W
R42	RCB-AH270-1	RD25S 270ΩJ	R: FXD CAR 270Ω ±5% 1/4W
C51	CSM-ACR01U50V-1	0.01UF 50WV	C: FXD CER 0.01μF +80, -20% 50V
C52	CSM-ACR01U50V-1	0.01UF 50WV	C: FXD CER 0.01μF +80, -20% 50V
C53	CMC-AB100PR3K-4	DM10D101J3	C: FXD DIPPED MICA 100pF ±5% 300V
C54	CMC-AC510PR3K-2	DM15D511J3	C: FXD DIPPED MICA 510pF ±5% 300V
C55	CMC-AB33PR5K-4	DM10D330J5	C: FXD DIPPED MICA 33pF ±5% 500V
C56 thru C59	CSM-ACR01U50V-1	0.01UF 50WV	C: FXD CER 0.01μF +80, 20% 50V
C60	CTM-AC20P-1	ECV1ZW20X32	C: VAR CER 20pF
X71	DXD-000153-1	XU-060	Crystal
S81	KSL-000410-1	SSA042-L9	Slide switch
J91	JCP-AA006PX03-1	A-1306	Connector
J92	JCF-AB001JX13-1	BNC-R-PC-3	Connector
	MKN-12024A-1	*	Spacer

TR5823
Xtal-2
BLB-010049

Parts No.	Takeda Riken Stock No.	Mfr Stock No.	Description
IC1	SIA-7805L-6	UPC78L05	IC: Voltage Regulator
IC2	SIA-7912U-5	UPC7912H	IC: Voltage Regulator
Q11	STN-2SC1834-1	2SC1834	Transistor SI NPN
Q12	STN-2SC1834-1	2SC1834	Transistor SI NPN
D21	SDS-1S953-1	1S953	Diode SI
R31	RCB-AH470-1	RD25S 470ΩJ	R: FXD CAR 470Ω ±5% 1/4W
R32	RCB-AH270-1	RD25S 270ΩJ	R: FXD CAR 270Ω ±5% 1/4W
R33	RCB-AH5R6K-1	RD25S 5.6KΩJ	R: FXD CAR 5.6kΩ ±5% 1/4W
R34	RCB-AH1K-1	RD25S 1KΩJ	R: FXD CAR 1kΩ ±5% 1/4W
R35	RCB-AH4R7K-1	RD25S 4.7KΩJ	R: FXD CAR 4.7kΩ ±5% 1/4W
R36	RCB-AH270-1	RD25S 270ΩJ	R: FXD CAR 270Ω ±5% 1/4W
R37	RCB-AH2R7K-1	RD25S 2.7KΩJ	R: FXD CAR 2.7kΩ ±5% 1/4W
R38	RCB-AH330-1	RD25S 330ΩJ	R: FXD CAR 330Ω ±5% 1/4W
R39	RVR-AD10K-1	RJ20P10KΩ	R: VAR CERMET 10kΩ
C51	CTA-AC2U50V-4	TA-050TN1R0-P	C: FXD ELECT TANTAL 1μF +100, -0% 50V
C52 thru C56	CSM-ACR01U50V-1	0.01UF 50WV	C: FXD CER 0.01μF +80, -20% 50V
X71	DXC-00566-1	*	Crystal
S81	KSL-000410-1	SSA042L9	Slide Switch
J91	JCP-AA06PX03-1	A-1306	Connector
J92	JCF-AB001JX13-1	BNC-R-PC-3	Connector
J93	JCI-AS005JX01-1	5X-203	Socket

TR5823
INPUT C
BLC-010050

Parts No.	Takeda Riken Stock No.	Mfr Stock No.	Description
IC1	DHB-000330-1	*	IC: Hybrid 20dB Attenuator
IC2	SHB-000374-1	*	IC: Hybrid High Frequency Amplifier
IC3	SIC-8786-1	SP8786B	IC: High-Speed Scaler
IC4	SIC-10174-2	HD10174	IC: Dual 4 to 1 Multiplexer
IC5			Not assigned
IC6	SIA-747C-8	HA17458P	IC: Dual Operational Amplifier
IC7	SIT-74LS14-1	SN74LS14N	IC: Hex Schmitt-Trigger Inverter Low Power
IC8			Not assigned
IC9	SIA-7912U-5	UPC7912H	IC: Voltage Regulator
D17 thru D20	SDS-1S953-1	1S953	Diode SI
R21	RCB-AK51-1	RD50S 51ΩJ	R: FXD CAR 51Ω ±5% 1/2W
R22	RCB-AH12K-1	RD25S 12KΩJ	R: FXD CAR 12kΩ ±5% 1/4W
R23	RCB-AH270K-1	RD25S 270KΩJ	R: FXD CAR 270kΩ ±5% 1/4W
R24			Not assigned
R25	RCB-AH39K-1	RD25S 39KΩJ	R: FXD CAR 39kΩ ±5% 1/4W
R26	RCB-AH220-1	RD25S 220ΩJ	R: FXD CAR 220Ω ±5% 1/4W
R27	RVR-CD1K-2	3321N-1-102	R: VAR CERMET 200Ω ±20% 1/2W
R28	RCB-AH39K-1	RD25S 39KΩJ	R: FXD CAR 39kΩ ±5% 1/4W
R29	RCB-AH220-1	RD25S 220ΩJ	R: FXD CAR 220Ω ±5% 1/4W
R30	RVR-CD1K-2	3321N-1-102	R: VAR CERMET 200Ω ±20% 1/2W
R31	RCB-AH1K-1	RD25S 1kΩJ	R: FXD CAR 1kΩ ±5% 1/4W
R32	RCB-AH1K-1	RD25S 1KΩJ	R: FXD CAR 1kΩ ±5% 1/4W
R33	RCB-AH1R5K-1	RD25S 1.5KΩJ	R: FXD CAR 1.5kΩ ±5% 1/4W
R34	RCB-AH1K-1	RD25S 1KΩJ	R: FXD CAR 1kΩ ±5% 1/4W
R35	RCB-AH560-1	RD25S 560ΩJ	R: FXD CAR 560Ω ±5% 1/4W
R36	RCB-AH560-1	RD25S 560ΩJ	R: FXD CAR 560Ω ±5% 1/4W
R37	RCB-AH180-1	RD25S 180ΩJ	R: FXD CAR 180Ω ±5% 1/4W
R38	RCB-AH270-1	RD25S 270ΩJ	R: FXD CAR 270Ω ±5% 1/4W
R39	RCB-AH820-1	RD25S 820ΩJ	R: FXD CAR 820Ω ±5% 1/4W
R40 thru R42			Not assigned
R43	RCB-AH18K-1	RD25S 18KΩJ	R: FXD CAR 18kΩ ±5% 1/4W
R44	RCB-AH8R2K-1	RD25S 8.2KΩJ	R: FXD CAR 8.2kΩ ±5% 1/4W
R45	RCB-AH68-1	RD25S 68ΩJ	R: FXD CAR 68Ω ±5% 1/4W
C51 thru C58	CCP-ACR01U50V-1	C35AF1H103Z	C: FXD CHIP 0.01μF +80, -20% 50V
C59	CSM-ACR01U50V-1	0.01UF 50WV	C: FXD CER 0.01μF +80, -20% 50V
C60	CSM-ACR01U50V-1	0.01UF 50WV	C: FXD CER 0.01μF +80, -20% 50V
C61	CCP-ACR01U50V-2	C35AF1H103Z	C: FXD CHIP 0.01μF +80, -20% 50V
C62			Not assigned
C63	CTA-AC4R7U25V-1	242M2502-475M	C: FXD ELECT TANTAL 4.7μF ±20% 25V
C64	CTA-AC4R7U25V-1	242M2502-475M	C: FXD ELECT TANTAL 4.7μF ±20% 25V
C65	CSM-ACR01U50V-1	0.01UF 50WV	C: FXD CER 0.01μF +80, -20% 50V
C66	CCP-ACR01U50V-2	C35AF1H103Z	C: FXD CHIP 0.01μF +80, -20% 50V

TR5823
INPUT C
BLC-010050

Parts No.	Takeda Riken Stock No.	Mfr Stock No.	Description
L71 thru L73			L: FXD Coil Pattern
J75	JCF-AC001JX04-1	UM-R-PC	Connector
J76	JCP-AR020PX01-1	1-163740-9	Connector
K81	KRL-000441-1	DX2-5V(AE7029)	Relay

TR5822/23
BCD OUTPUT
BLF-010051

Parts No.	Takeda Riken Stock No.	Mfr Stock No.	Description
IC1	SIM-402701	TC4027BP	IC: Dual J-K Master-Slave Flip-Flop
IC2	SIM-4001-1	TC4001BP	IC:Quad 2-Input NOR Gate
IC3	SIM-4049-1	TC4049BP	IC: Hex Buffer/Converter Inverting Type
IC4	SIM-4528-1	TC4528BP	IC: Dual Monostable Multivibrator
IC5	SIM-4050-1	TC4050BP	IC: Hex Buffer/Converter NON-Inverting Type
IC6	SIM-4072-1	TC4072BP	IC: Dual 4-Input Positive OR Gate
IC7	SIM-4015-1	TC4015BP	IC: Dual 4-Stage Static Shift Register
IC8	SIM-4015-1	TC4015BP	IC: Dual 4-Stage Static Shift Register
IC9	SIM-4049-1	TC4049BP	IC: Hex Buffer/Converter Inverting Type
IC10	SIM-4015-1	TC4015BP	IC: Dual 4-Stage Static Shift Register
IC11 thru IC13	SIT-74LS04-1	SN74LS04N	IC: Hex Inverter Low Power
IC14	SIM-4015-1	TC4015BP	IC: Dual 4-Stage Static shift Register
IC15	SIT-74LS04-1	SN74LS04N	IC: Hex Inverter Low Power
IC16	SMB-74S188-4	IM5600CPE	IC: 256-Bit ROM
IC17	SIT-74LS04-1	SN74LS04N	IC: Hex Inverter Low Power
IC18	SIM-4015-1	TC4015BP	ID: Dual 4-Stage Static Shift Register
IC19	SIT-74LS04-1	SN74LS04N	IC: Hex Inverter Low Power
IC20	SIM-4015-1	TC4015BP	IC: Dual 4-Stage Static Shift Register
IC21	SIT-74LS04-1	SN74LS04N	IC: Hex Inverter Low Power
IC22	SIM-4011-1	TC4011BP	IC: Quad 2-Input NAND Gate
IC23	SIM-4528-1	TC4528BP	IC: Dual Monostable Multivibrator
IC24	SIM-4017-1	TC4017BP	IC: Decade Counter/Divider
Q31	SIN-2SC1834-1	2SC1834	Transistor SI NPN
R41	RCB-AH33K-1	RD25S 33KΩJ	R: FXD CAR 33kΩ ±5% 1/4W
R42	RCB-AH33K-1	RD25S 33KΩJ	R: FXD CAR 33kΩ ±5% 1/4W
R43			Not assigned
R44	RCB-AH10K-1	RD25S 10KΩJ	R: FXD CAR 10kΩ ±5% 1/4W
R45	RCB-AH10K-1	RD25S 10KΩJ	R: FXD CAR 10kΩ ±5% 1/4W
R46	RCB-AH47K-1	RD25S 47KΩJ	R: FXD CAR 47kΩ ±5% 1/4W
R47	RCB-AH1K-1	RD25S 1KΩJ	R: FXD CAR 1kΩ ±5% 1/4W
R48 thru R53	RCB-AH10K-1	RD25S 10KΩJ	R: FXD CAR 10kΩ ±5% 1/4w
R54	RAY-AA10K6-1	TMR6-103	R: FXD COM 10kΩ
R55	RCB-AH33K-1	RD25S 33KΩJ	R: FXD CAR 33kΩ ±5% 1/4W
C61	CSM-ACR047U50V-1	0.047UF 50WV	C: FXD CER 0.047µF +80, -20% 50V
C62	CSM-AC1000P50V-1	0.001UF 50WV	C: FXD CER 0.001µF +80, -20% 50V
C63	CTA-AC4R7U25V-1	242M2502-475M	C: FXD ELECT TANTAL 4.7µF ±20% 25V
C64	CSM-AC220P50V-1	220PF 50WV	C: FXD CER 220pF ±10% 50V
C65	CSM-ACR01U50V-1	0.01UF 50WV	C: FXD CER 0.01µF +80, -20% 50V

TR5822/23
BCD OUTPUT
BLF-010051

Parts No.	Takeda Riken Stock No.	Mfr Stock No.	Description
C66 thru C69	CTA-AC4R7U25V-1	242M2502-475M	C: FXD ELECT TANTAL 4.7µF ±20% 25V
C70	CSM-ACR047U50V-1	0.047UF 50WV	C: FXD CER 0.047µF +80, -20% 50V
J81	JCP-AR020PX01-1	1-163740-9	Connector
J82	JCR-AF050PX02-1	HIF3-50P-2.54DS	Connector
J83	DCB-RR0739X01-1	*	Connector with Cable
	JCI-AD016JX01-2	DL2-16A	IC Socket

TR5822/23
GPIB
BLF-010052

Parts No.	Takeda Riken Stock No.	Mfr Stock No.	Description
IC1	SIT-74LS123-1	SN74LS123N	IC: Dual Retriggerable Monostable Multivibrator with Clear Low Power
IC2	SIM-SM8530-1	SM8530B	IC: C MOS IEC Interface Adapter
IC3	SIT-74LS74-1	SN74LS74N	IC: Dual D-Type Edge-Triggered Flip-Flop Low Power
IC4	SIT-74LS04-1	SN74LS04N	IC: Hex Inverter Low Power
IC5	SIT-74LS05-1	SN74LS05N	IC: Hex Inverter with Open-Collector Output Low Power
IC6	SIT-74LS125-1	SN74LS125N	IC: Quadruple bus Buffer gate with three-state output Low Power
IC7 thru IC9	SIT-3441-1	MC3441AP	IC: Quad Interface bus Transceiver
IC10	SIT-74LS20-1	SN74LS20N	IC: Dual 4-Input NAND Gate Low Power
IC11	SIT-74LS10-1	SN74LS10N	IC: Triple 3-Input NAND Gate Low Power
IC12	SIT-74LS73-1	SN74LS73N	IC: Dual J-K Master-Slave Flip Flop Low Power
IC13	SIT-74LS04-1	SN74LS04N	IC: Hex Inverter Low Power
IC14 thru IC16	SIT-3441-1	MC3441AP	IC: Quad Interface bus Transceiver
IC17	SIT-74LS00-1	SN74LS00N	IC: Quadruple 2-Input NAND Gate Low Power
IC18	SIT-74LS00-1	SN74LS00N	IC: Quadruple 2-Input NAND Gate Low Power
IC19	SMM-38P70-1	MK38P70	IC: 8-Bit 1-chip CPU
IC20	SMM-2716-2	*	IC: 16K Bit Memory
IC21	SIT-74LS27-1	SN74LS27N	IC: Triple 3-Input Positive-NOR Gate Low Power
R26	RCB-AH10K-1	RD25S 10KΩJ	R: FXD CAR 10kΩ ±5% 1/4W
R27	RCB-AH10K-1	RD25S 10KΩJ	R: FXD CAR 10kΩ ±5% 1/4W
R28	RAY-AA10K4-1	TMR 4-103	R: FXD COM 10kΩ
R29	RAY-AA10K4-1	TMR 4-103	R: FXD COM 10kΩ
R30	RCB-AH10K-1	RD25S 10KΩJ	R: FXD CAR 10kΩ ±5% 1/4W
R31	RCB-AH10K-1	RD25S 10KΩJ	R: FXD CAR 10kΩ ±5% 1/4W
C36	CMC-AB22PR3K-4	DM10D220J3	C: FXD DIPPED MICA 22pF ±5% 300V
C37	CMC-AB22PR3K-4	DM10D220J3	C: FXD DIPPED MICA 22pF ±5% 300V
C38	CSM-AC220P50V-1	220PF 50WV	C: FXD CER 220pF ±10% 50V
C39	CTA-AC4R7U25V-1	242M2502-475M	C: FXD ELECT TANTAL 4.7μF ±20% 25V
C40	CSM-ACR01U50V-1	0.01UF 50WV	C: FXD CER 0.01μF +80, -20% 50V
C41	CSM-ACR01U50V-1	0.01UF 50WV	C: FXD CER 0.01μF +80, -20% 50V
C42	CTA-AC1U50V-4	TA-050TN1R0-P	C: FXD ELECT TANTAL 1μF +100, -0% 50V
C43	CTA-AC1U50V-4	TA-050TN1R0-P	C: FXD ELECT TANTAL 1μF +100, -0% 50V
C44	CSM-ACR01U50V-1	0.01UF 50WV	C: FXD CER 0.01μF +80, -20% 50V
L51	LCL-C00010-1	CSL0609-181K	L: FXD Coil 180μH
J56	JCP-AR020PX01-1	1-163740-9	Connector
J57	JCR-AB026PX01-1	HIF3-26P-2.54DS	Connector

TR5822/23
GPIB
BLF-010052

Parts No.	Takeda Riken Stock No.	Mfr Stock No.	Description
J58	DCB-RR0740X01B-1	*	Connector with Cable
J59			Not assigned
J60	JCI-AH014JX01-1	514-AG7D	Socket
S66	KSA-000267-1	435166-1	Switch
X71	DXD-000137-1	XU-253.5MHZS 2492181	Crystal
	JCI-AK040JX01-1	DILBQ40P-101	IC Socket

TR5822/23
D/A CONVERTER
BLF-010053

Parts No.	Takeda Riken Stock No.	Mfr Stock No.	Description
IC1	SIM-4027-1	TC4027BP	IC: Dual J-K Master-Slave Flip-Flop
IC2	SIM-4001-1	TC4001BP	IC: Quad 2-Input NOR Gate
IC3	SIM-4049-1	TC4049BP	IC: Hex Buffer/Converter Inverting Type
IC4	SIM-4050-1	TC4050BP	IC: Hex Buffer/Converter NON-Inverting type
IC5	SIM-4072-1	TC4072BP	IC: Dual 4-Input Positive OR Gate
IC6	SIM-4035-1	TC4035BP	IC: 4-Bit Parallel IN/ Parallel OUT Shift Register
IC7	SIM-4015-1	TC4015BP	IC: Dual 4-Stage Static Shift Register
IC8	SIM-4035-1	TC4035BP	IC: 4-Bit Parallel IN/ Parallel OUT Shift Register
IC9	SIM-4015-1	TC4015BP	IC: Dual 4-Stage Static Shift Register
IC10	SIM-4528-1	TC4528BP	IC: Dual Monostable Multivibrator
IC11	SIM-4015-1	TC4035BP	IC: 4-Bit Parallel IN/ Parallel OUT Shift Register
IC12	SIM-4035-1	TC4035BP	IC: 4-Bit Parallel IN/ Parallel OUT Shift Register
IC13	SIA-563B-2	AD563JD/BCD	IC: Low Cost 10-Bit Monolithic D/A Converter
IC14	SIA-301A-1	LM301A	IC: Operational Amplifier
IC15	SIM-4035-1	TC4035BP	IC: 4-Bit Parallel IN/ Parallel OUT Shift Register
IC16	SIM-4017-1	TC4017BP	IC: Decade Counter Divider
D21	SDZ-W050-1	WZ-050	Zener Diode
R31	RCB-AH22-1	RD25S 22ΩJ	R: FXD CAR 22Ω ±5% 1/4W
R32	RVR-CD20K-1	RJ6X20KΩ	R: VAR CERMET 20kΩ
R33	RCB-AH33K-1	RD25S 33KΩJ	R: FXD CAR 33kΩ ±5% 1/4W
R34	RCB-AH1M-1	RD25S 1MΩJ	R: FXD CAR 1MΩ ±5% 1/4W
R35	RCB-AH560-1	RD25S 560ΩJ	R: FXD CAR 560Ω ±5% 1/4W
R36	RCB-AH1K-1	RD25S 1KΩJ	R: FXD CAR 1kΩ ±5% 1/4W
R37	RCB-AH6R8K-1	RD25S 6.8kΩJ	R: FXD CAR 6.8kΩ ±5% 1/4W
R38	RVR-CD500-1	RJ6X500Ω	R: VAR CERMET 500Ω
R39	RCB-AH470-1	RD25S 470ΩJ	R: FXD CAR 470Ω ±5% 1/4W
C41	CSM-AC100P50V-1	100PF 50WV	C: FXD CER 100pF ±10% 50V
C42	CSM-ACR01U50V-1	0.01UF 50WV	C: FXD CER 0.01µF +80, -20% 50V
C43	CSM-ACR1U25V-1	0.1UF 25WV	C: FXD CER 0.1µF +80, -20% 25V
C44	CSM-ACR01U50V-1	0.01UF 50WV	C: FXD CER 0.01µF +80, -20% 50V
C45	CSM-AC33P50V-1	33PF 50WV	C: FXD CER 33pF ±10% 50V
C46	CSM-ACR01U50V-1	0.01UF 50WV	C: FXD CER 0.01µF +80, -20% 50V
C47 thru C50	CTA-AC4R7U25V-1	242M2502-475M	C: FXD ELECT TANTAL 4.7µF ±20% 25V
J61	JCP-AR020PX01-1	1-163740-9	Connector
J62	JTB-AA001JX02-1	*	Binding Post
J63	JTB-AA001JX01-1	*	Binding Post

TR1644
SCHEMATIC SECTION

Parts No.	Takeda Riken Stock No.	Mfr Stock No.	Description
D1	NLD-000111-1	AA3432S	Light Emitting Diode
D2 thru D6	NLD-000010-1	PG3432SY	Light Emitting Diode
J11	JCS-AZ023JX01-1	PCN5-23ST-1.27DS	Connector

SS 1/1

TR5821/22/23
MECHANICAL PARTS LIST
FRAME & CABINET

Fig. & INDEX No.	Stock No.	Description	Qty
10-1 1	MMX-18228A	CABINET, top	1
2	MEE-18284A	CABINET, bottom	1
3	MNS-18929B	LABEL, caution	1

TR5821/22/23
MECHANICAL PARTS LIST
FRONT PANEL ASSEMBLY

Fig. & INDEX No.	Stock No.	Description	Qty
10-2 1	MNS-18235A001A	PLATE, front panel (TR5821/22)	1
	MNS-18234A001C	PLATE, front panel (TR5823)	1
2	MEE-18282A	PANEL, front	1
3	MNS-18252A	PLATE, name (TR5821)	1
	MNS-18253A	PLATE, name (TR5822)	1
	MNS-18254A	PLATE, name (TR5823)	1
4	MNS-12367A	CAP, knob	3
5	MMX-10463A	KNOB	3
6	BLF-010044	CIRCUIT BOARD, operation	1
7	MPX-18247A	SHEET, display	1
8	MBN-18639A	CASE, shield	1
9	MBN-18640C	COVER, shield	1
10	BLB-010047	CIRCUIT BOARD, dummy	1
11	BLG-010275	CIRCUIT BOARD, mother (TR5821/22)	1
	BLG-010043	CIRCUIT BOARD, mother (TR5823)	1

TR5821
MECHANICAL PARTS LIST
REAR PANEL ASSEMBLY

Fig. & INDEX No.		Stock No.	Description	Qty
10-3	1	DFH-000192-1	HOLDER, fuse	1
	2	DNF-000207-1	FILTER noise	1
	3	MNS-10528A	PLATE, serial no.	1
	4	SDS-RB402-2	DIODE	2
	5	BLB-010048	CIRCUIT BOARD, Xtal-1	1
	6	SIA-7805U-5	REGULATOR IC	2
	7	LTP-000377-1	TRANSFORMER	1
	8	MBS-19597A001A-1	CHASSIS	1
	9	YEE-000376-1	BUSHING	1

TR5822/23
MECHANICAL PARTS LIST
REAR PANEL ASSEMBLY

Fig. & INDEX No.		Stock No.	Description	Qty
10-4	1	DFH-000192-1	HOLDER, fuse	1
	2	DNF-000207-1	FILTER, noise	1
	3	MHA-18642A	HEAT SINK	1
	4	MNS-10528A	PLATE, serial no.	1
	5	SIA-7805U-5	REGULATOR IC	1
	6	MBT-18308A	PANEL, blank	1
	7	SDS-RB402-2	DIODE	2
	8	BLB-010048	CIRCUIT BOARD, Xtal-1	1
	9	LTP-000377-1	TRANSFORMER	1
	10	MBS-18232C001B	CHASSIS	1
	11	BLB-010049	CIRCUIT BOARD Xtal-2 (TR5823)	1
	12	MBS-18239A001A	BCD OUTPUT connector	1
	13	MBS-18238A001A	D/A CONVERTER connector	1
	14	MBS-18237A001A	GPIB connector	1
	15	MKX-18242A	HOLDER, connector	1

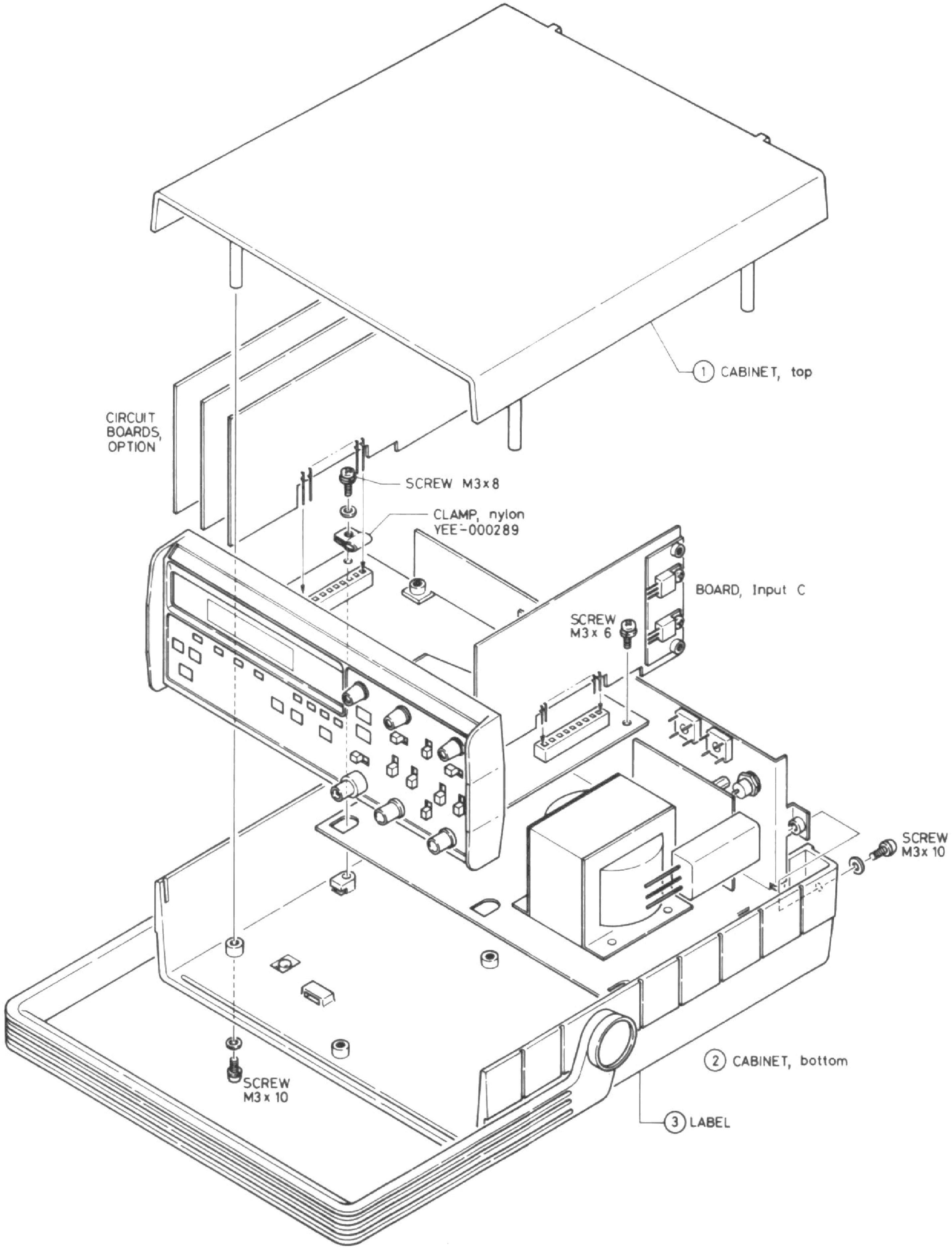


Fig. 10-1
TR5821/22/23
MECHANICAL PARTS
FRAME & CABINET

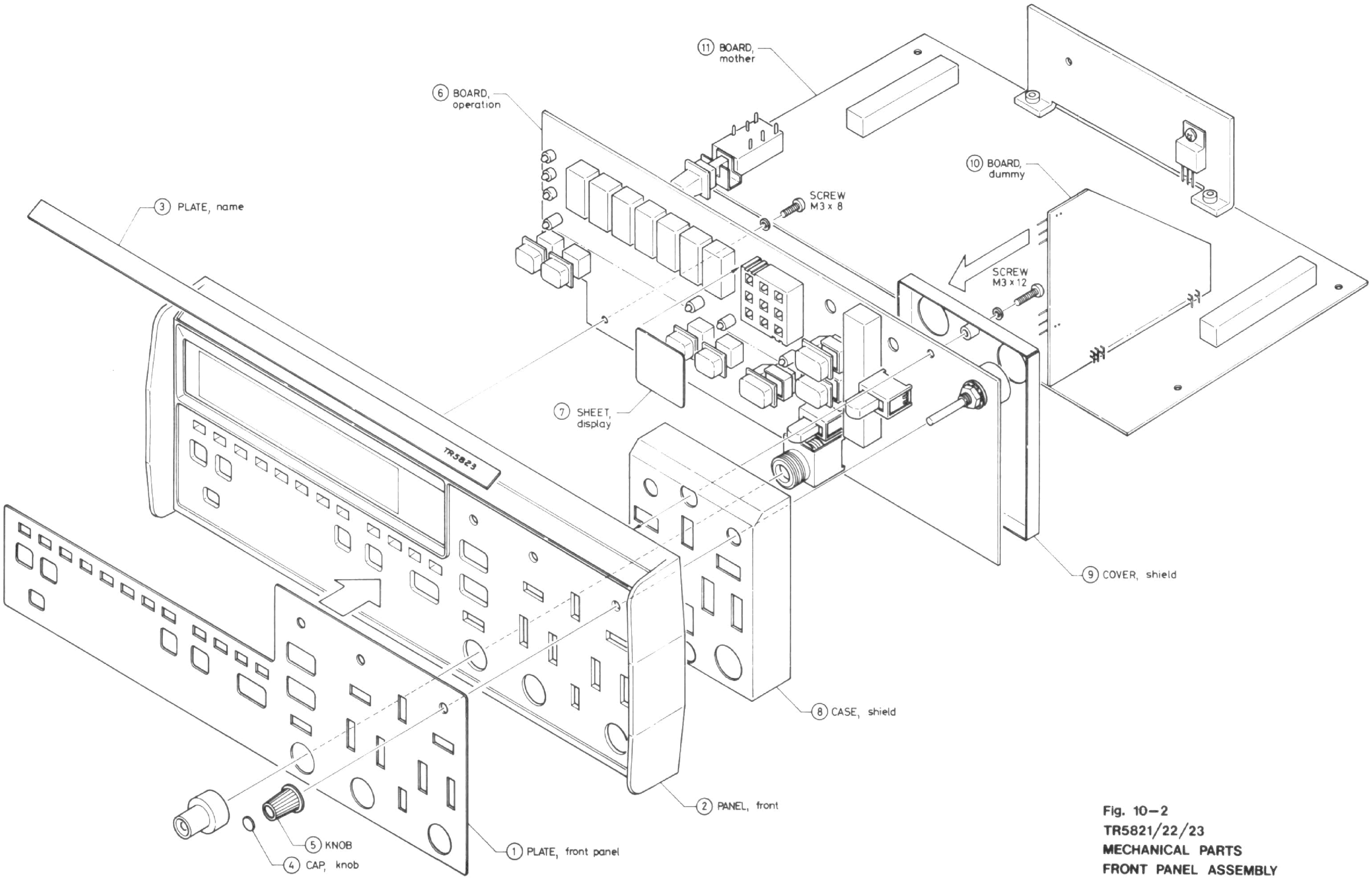


Fig. 10–2
TR5821/22/23
MECHANICAL PARTS
FRONT PANEL ASSEMBLY

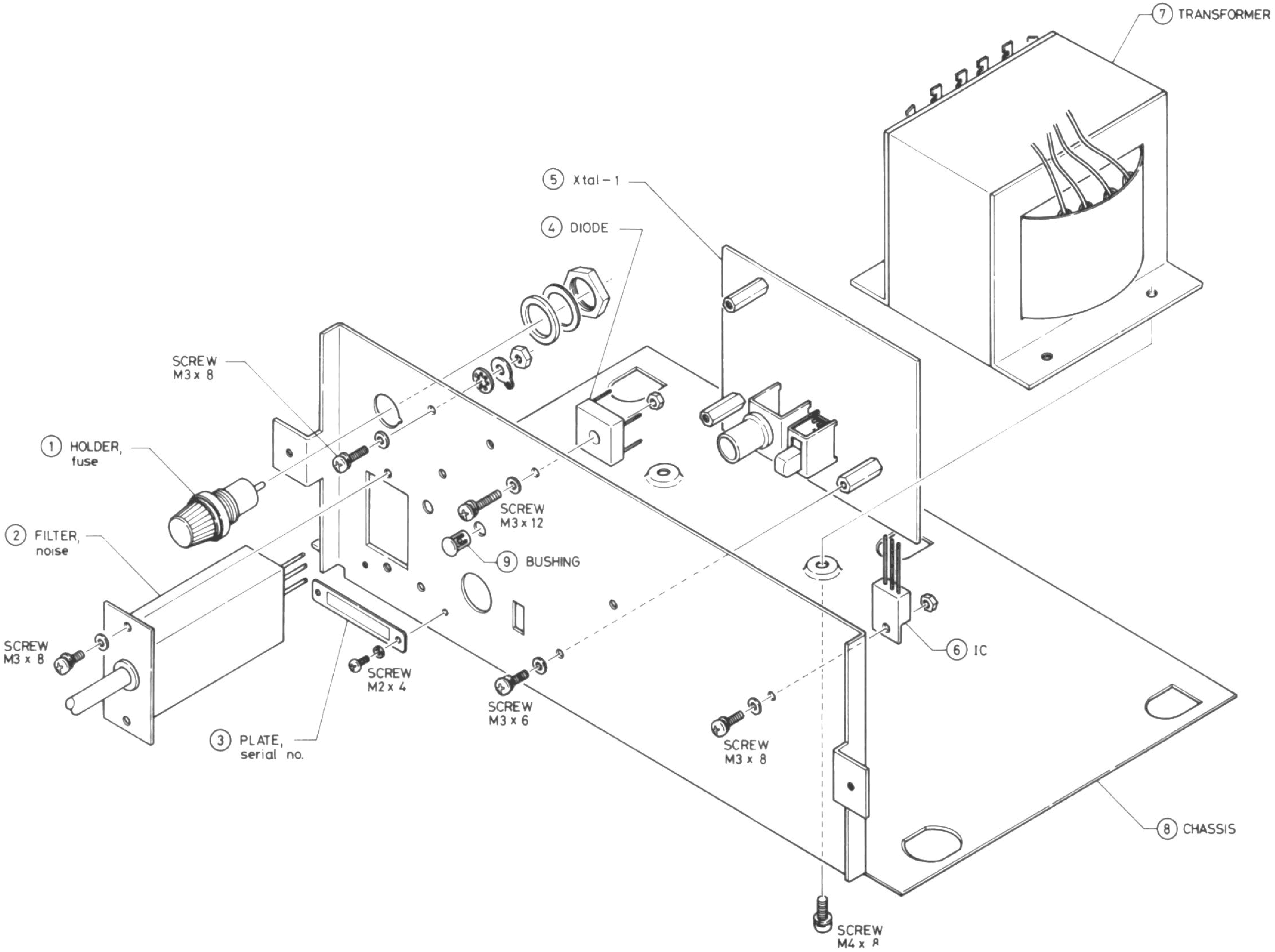


Fig. 10–3
TR5821
MECHANICAL PARTS
REAR PANEL ASSEMBLY

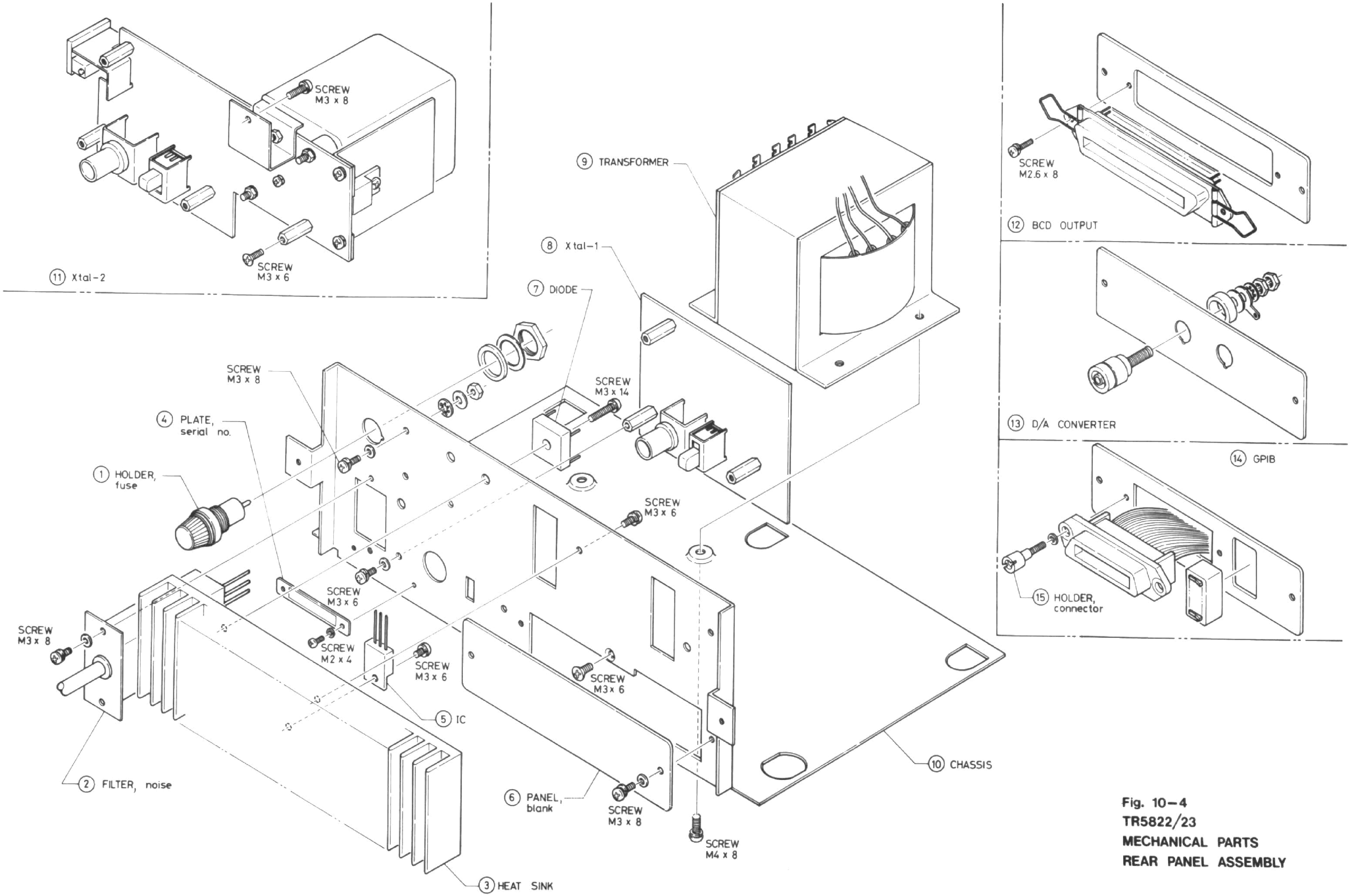
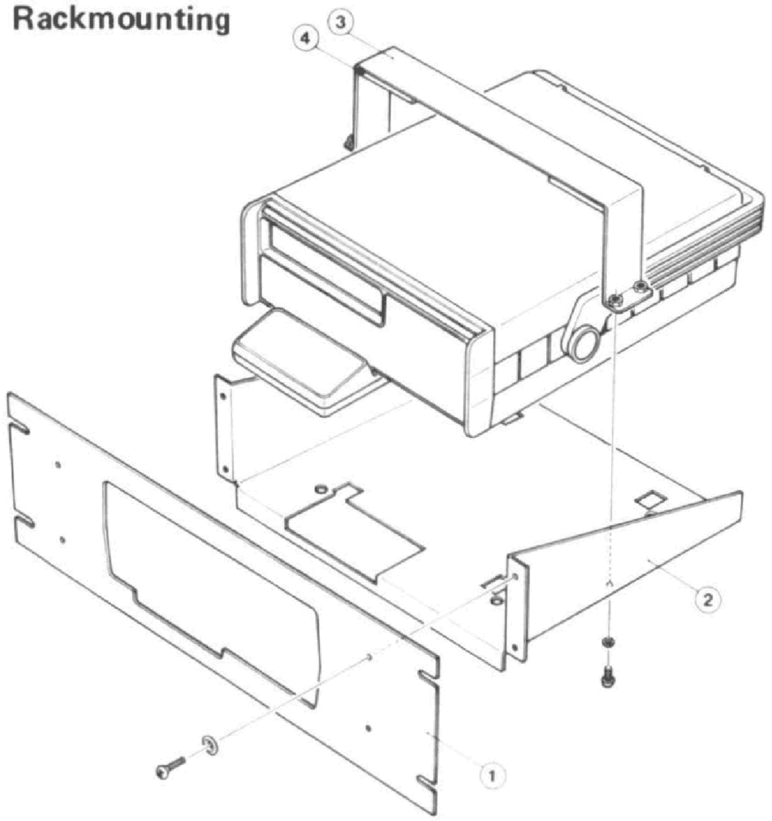
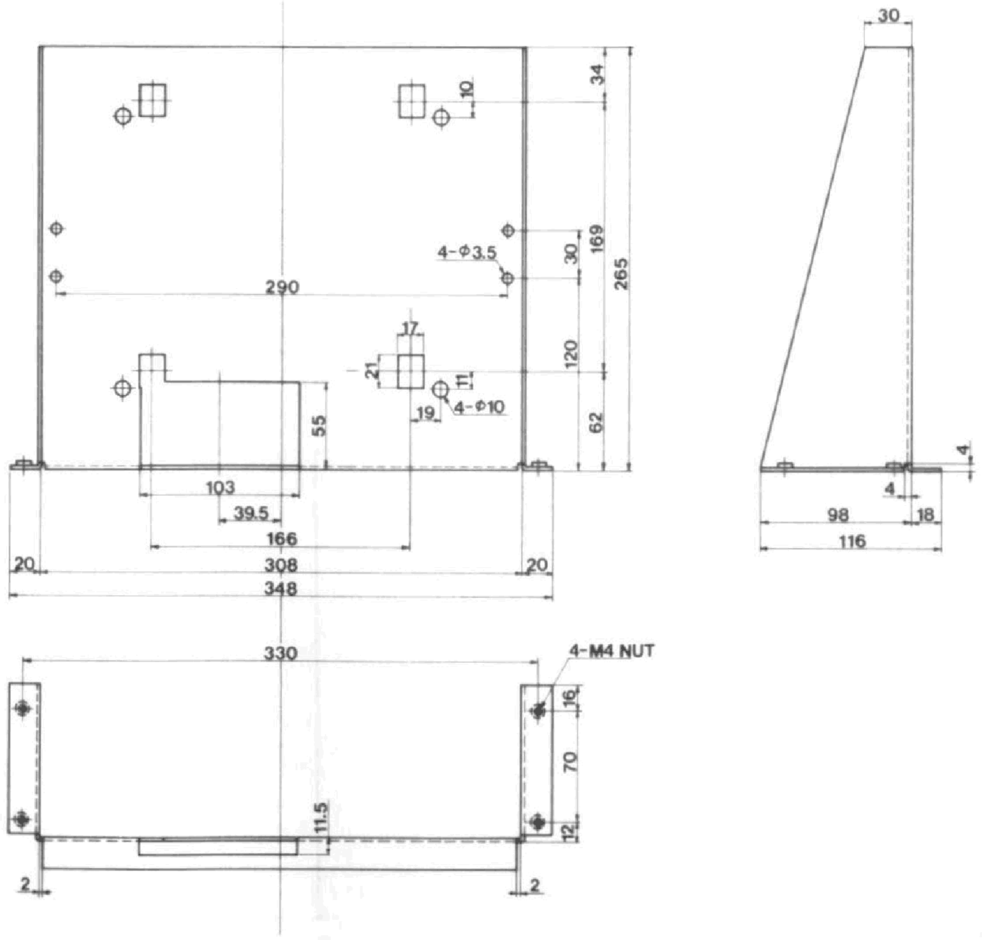


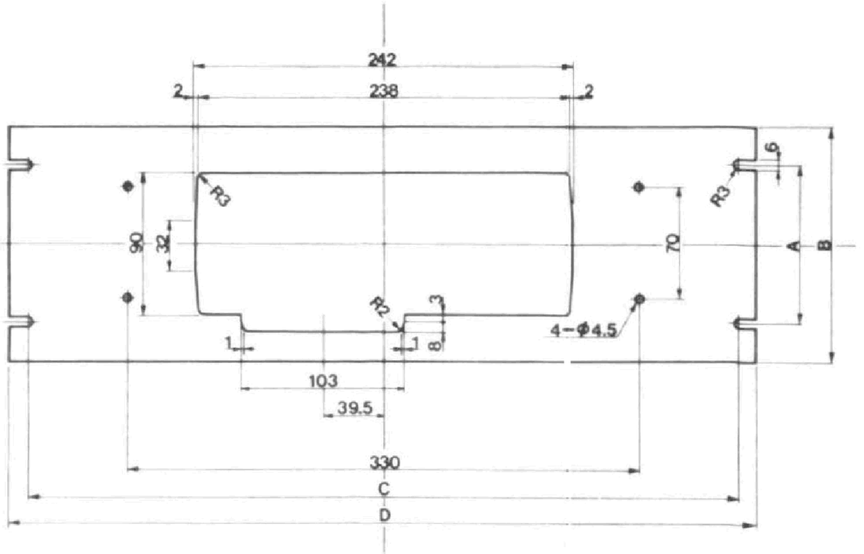
Fig. 10-4
TR5822/23
MECHANICAL PARTS
REAR PANEL ASSEMBLY

Rackmounting



Dimensions of chassis ②

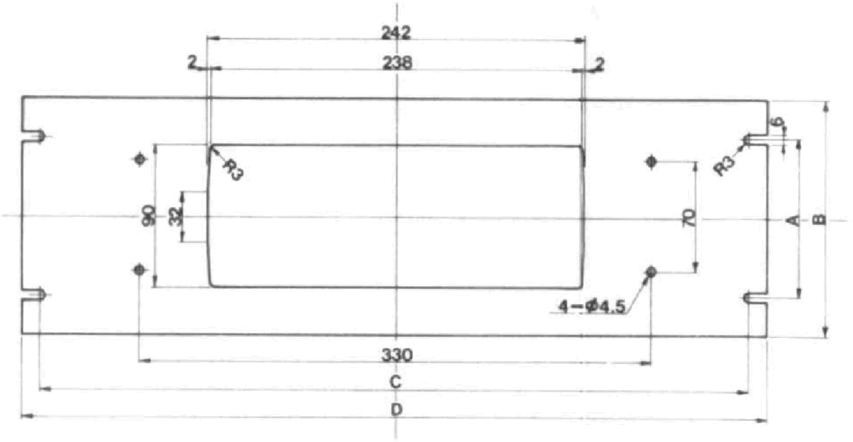




For installation with the **TR1644**

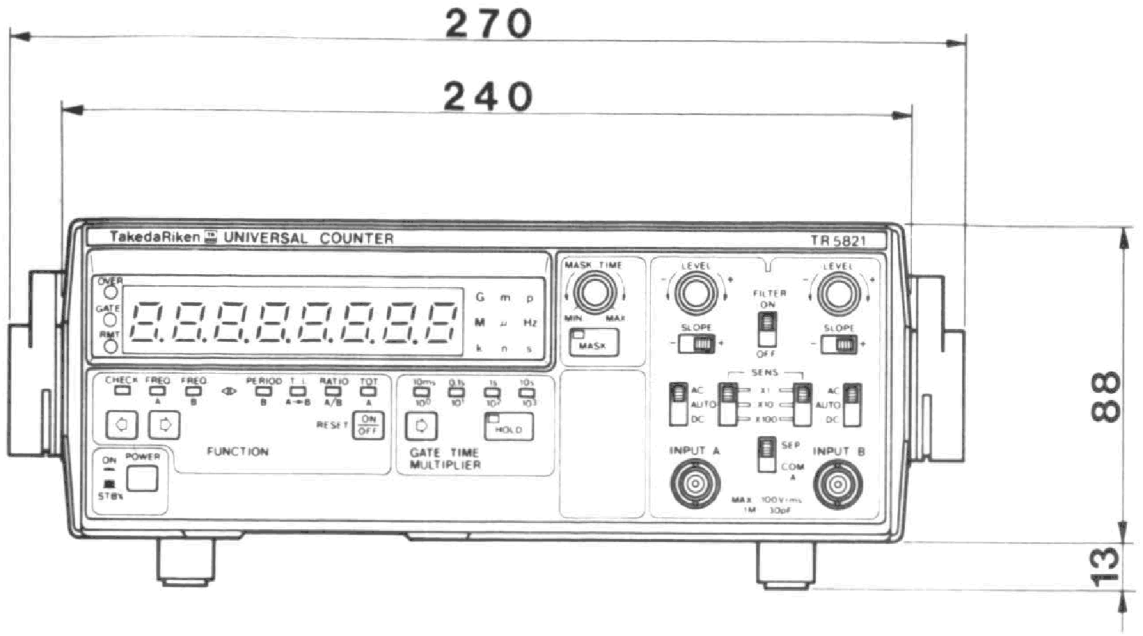
Dimensions of panel ①

For installation without the **TR1644**

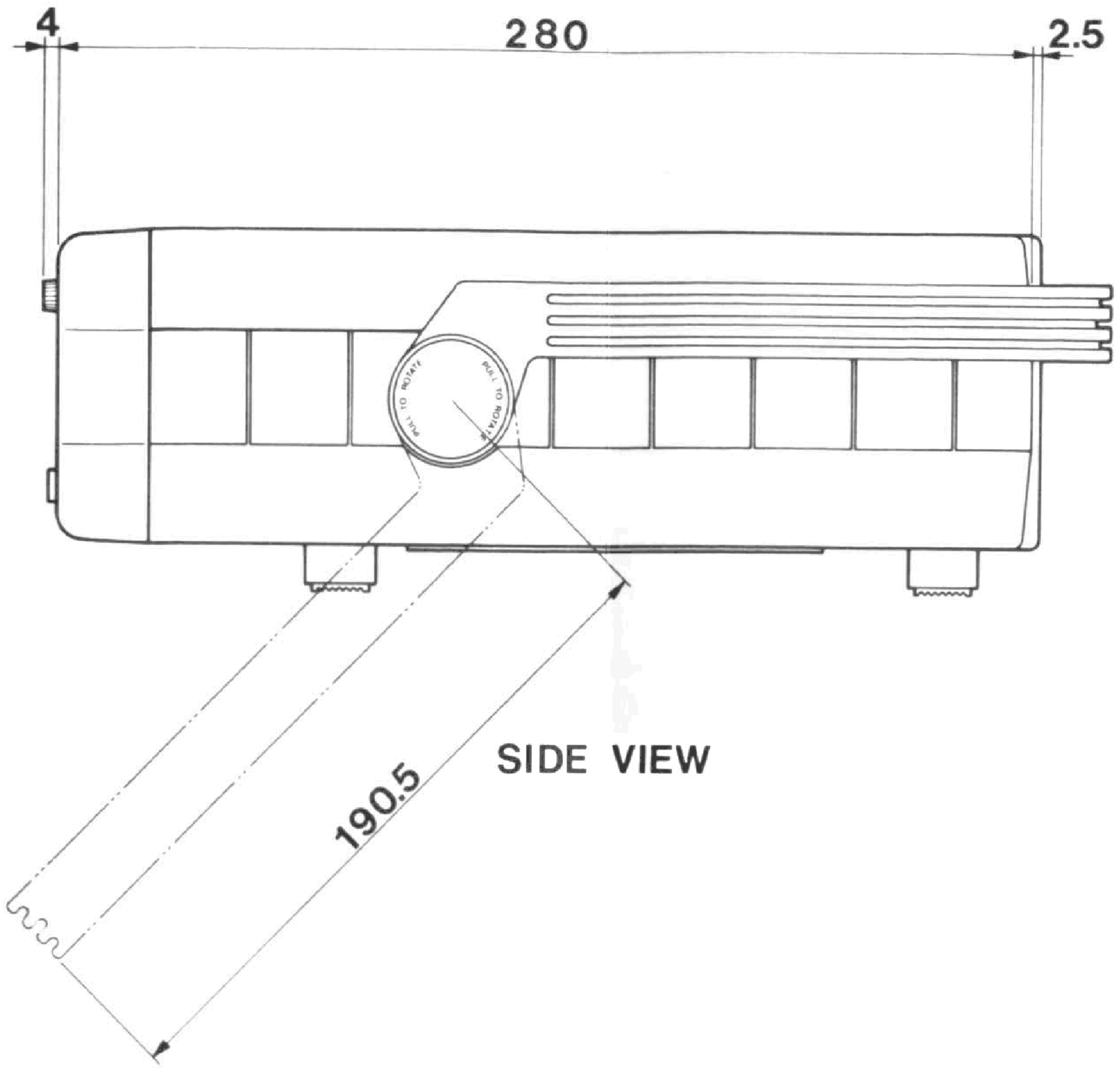


All dimensions in mm

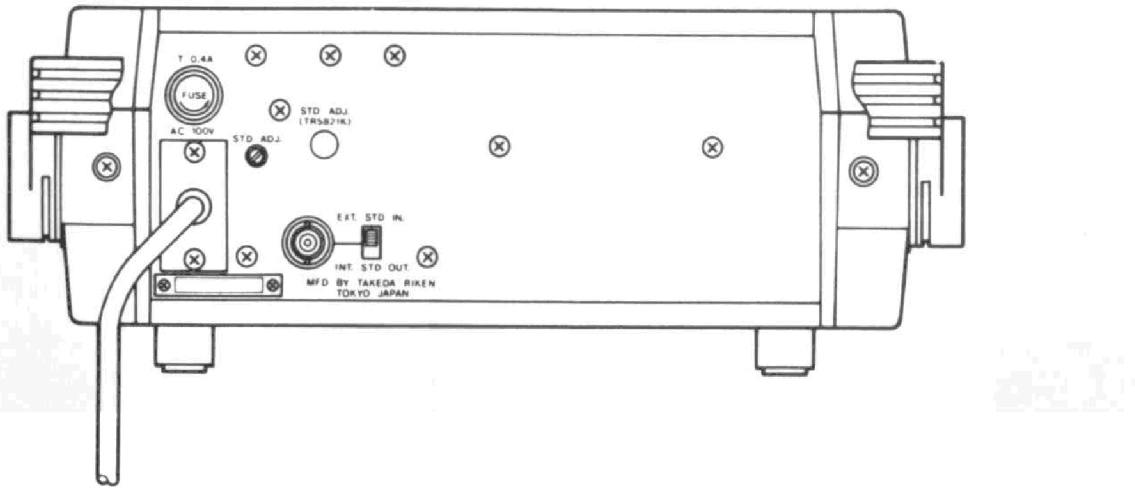
Name	Stock No.	A	B	C	D
Panel mount set (② + ③ + ④)	A02006				
Rackmounting panel (EIA specifications)	A02407	89	132	458	482
	A02408 (with the TR1644)				
Rackmounting panel (JIS specifications)	A02208	100	149	456	480
	A02209 (with the TR1644)				



FRONT VIEW

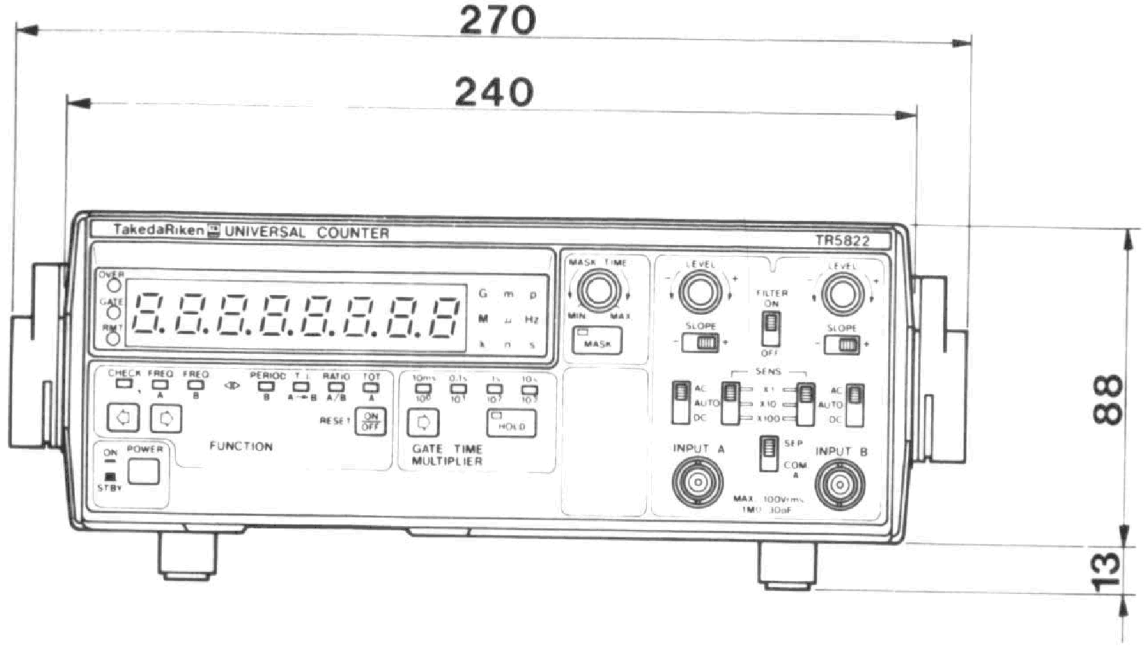


SIDE VIEW

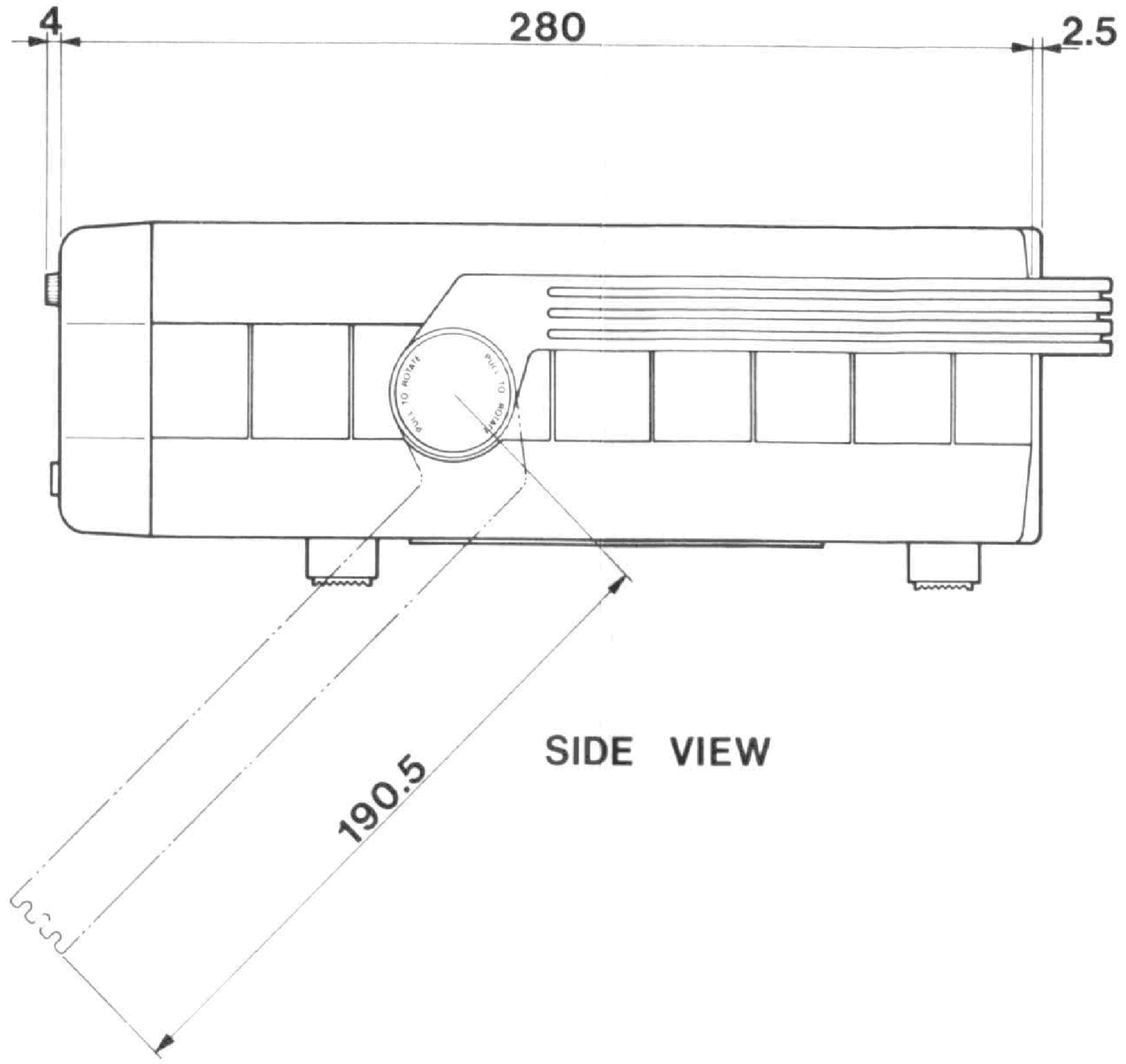


REAR VIEW

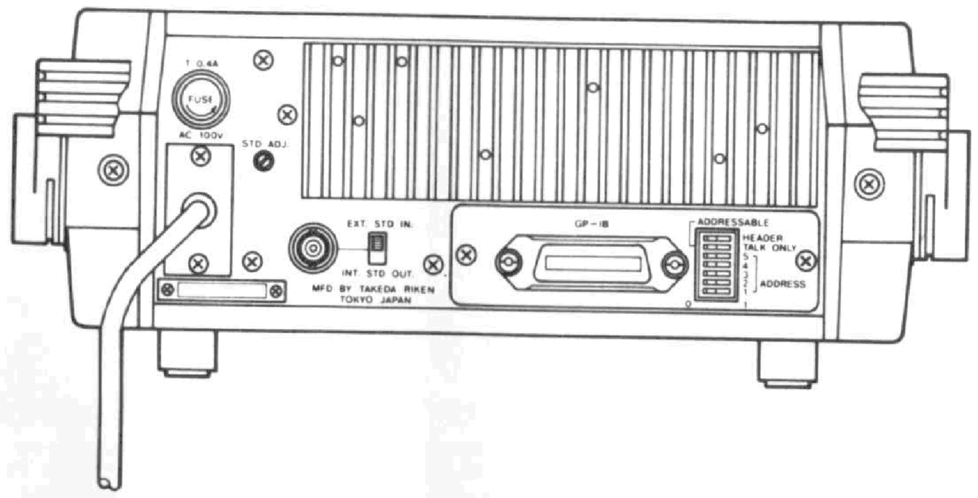
TR5821
EXTERNAL VIEW



FRONT VIEW

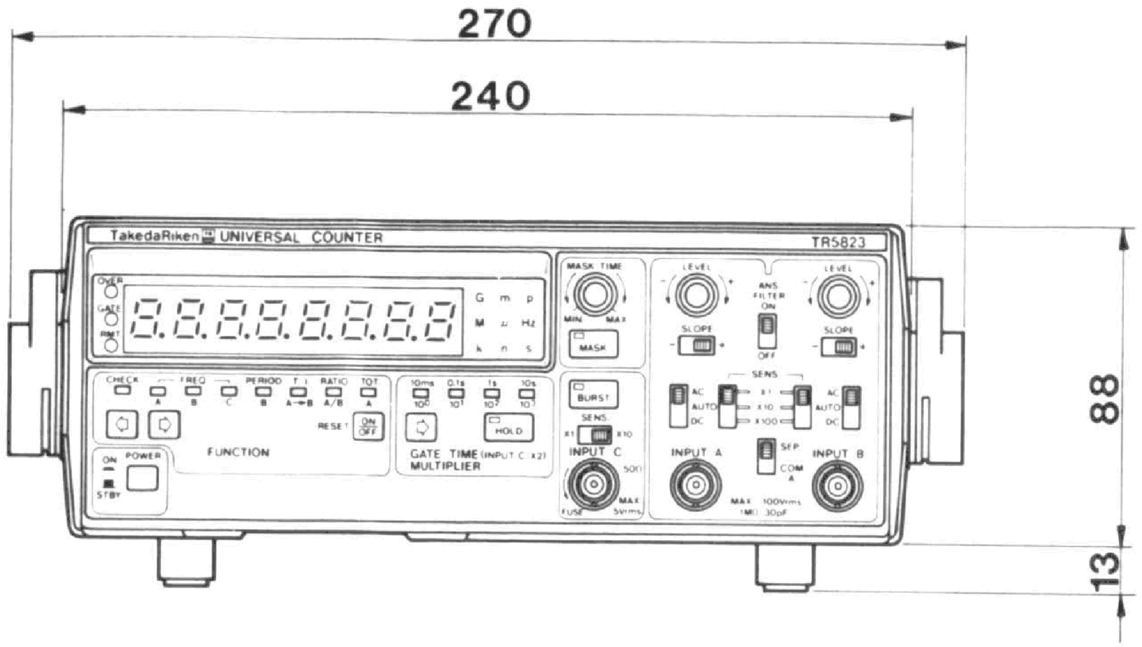


SIDE VIEW

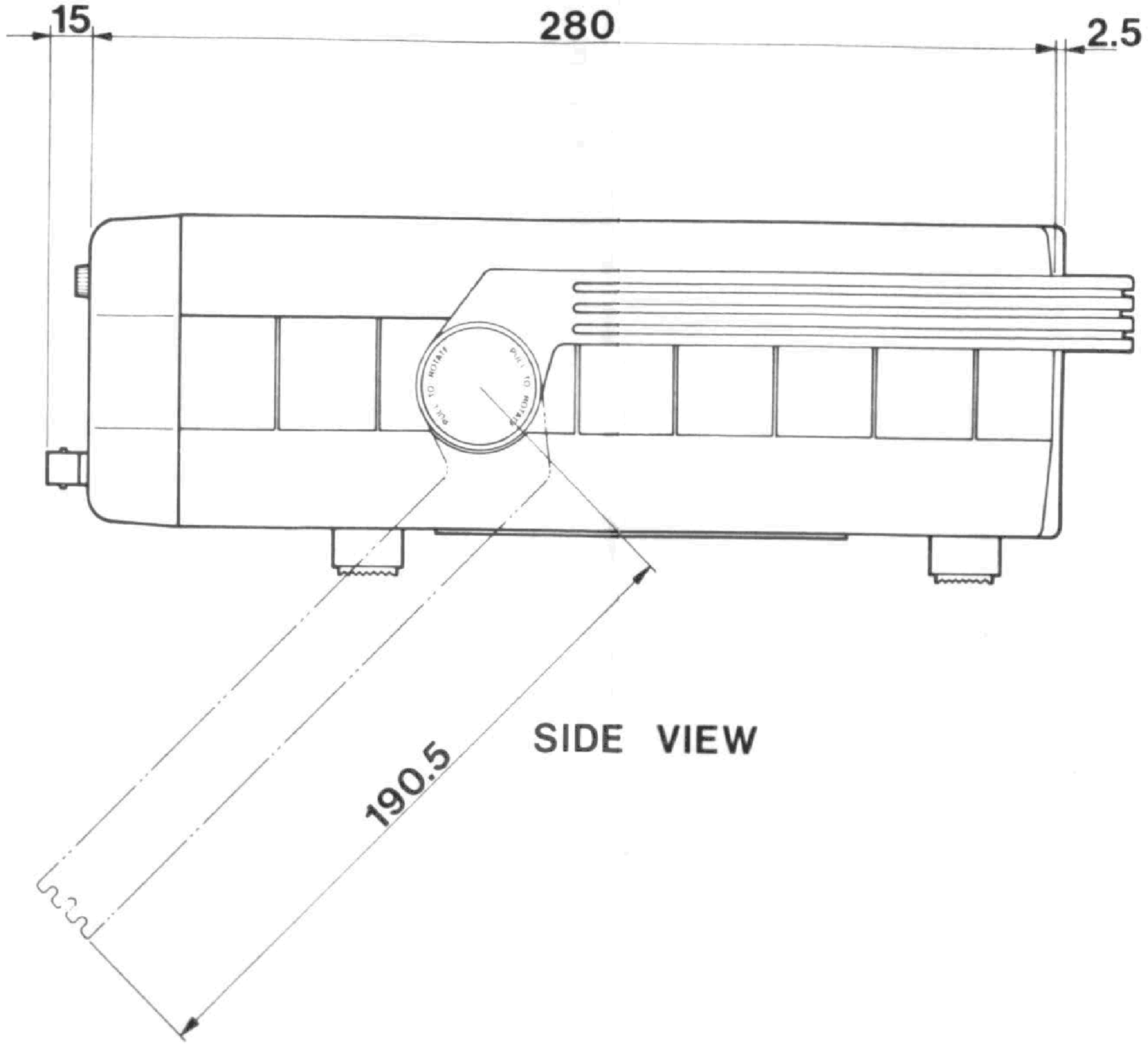


REAR VIEW

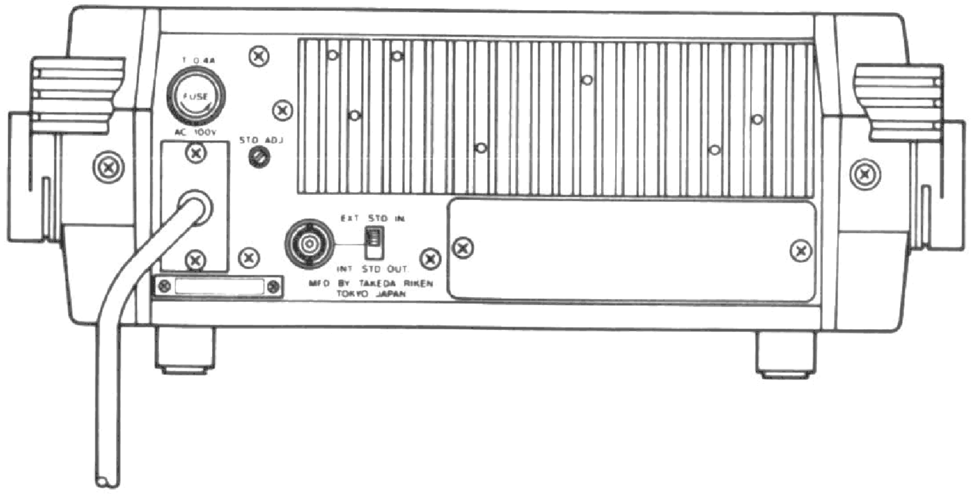
TR5822
EXTERNAL VIEW



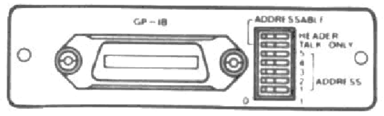
FRONT VIEW

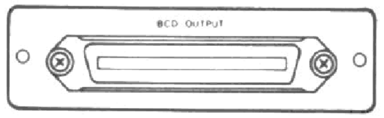


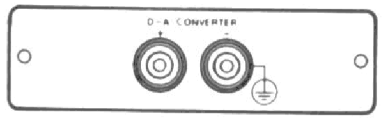
SIDE VIEW



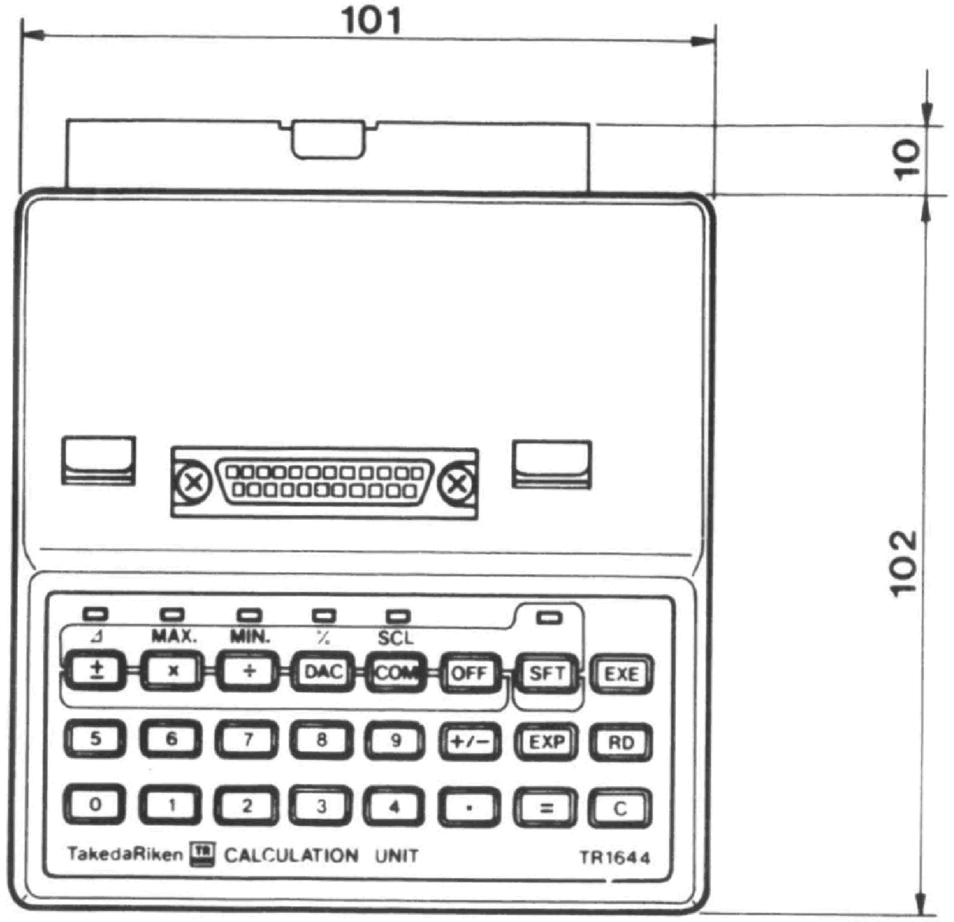
REAR VIEW



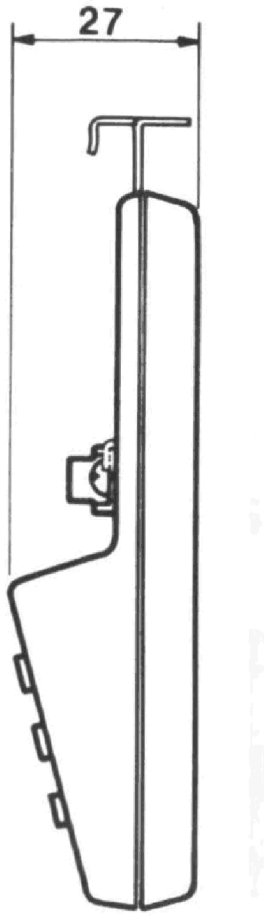




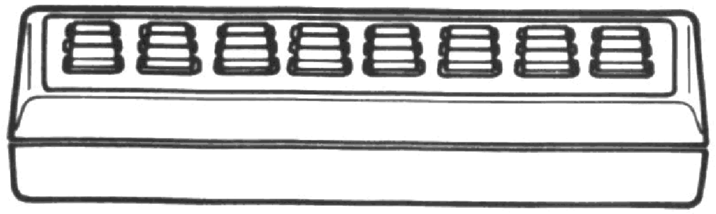
TR5823
EXTERNAL VIEW



TOP VIEW



SIDE VIEW



FRONT VIEW

TR1644
EXTERNAL VIEW

SECTION 11
PARTS LOCATIONS AND CIRCUIT DIAGRAMS

Parts Locations and Circuit Diagrams

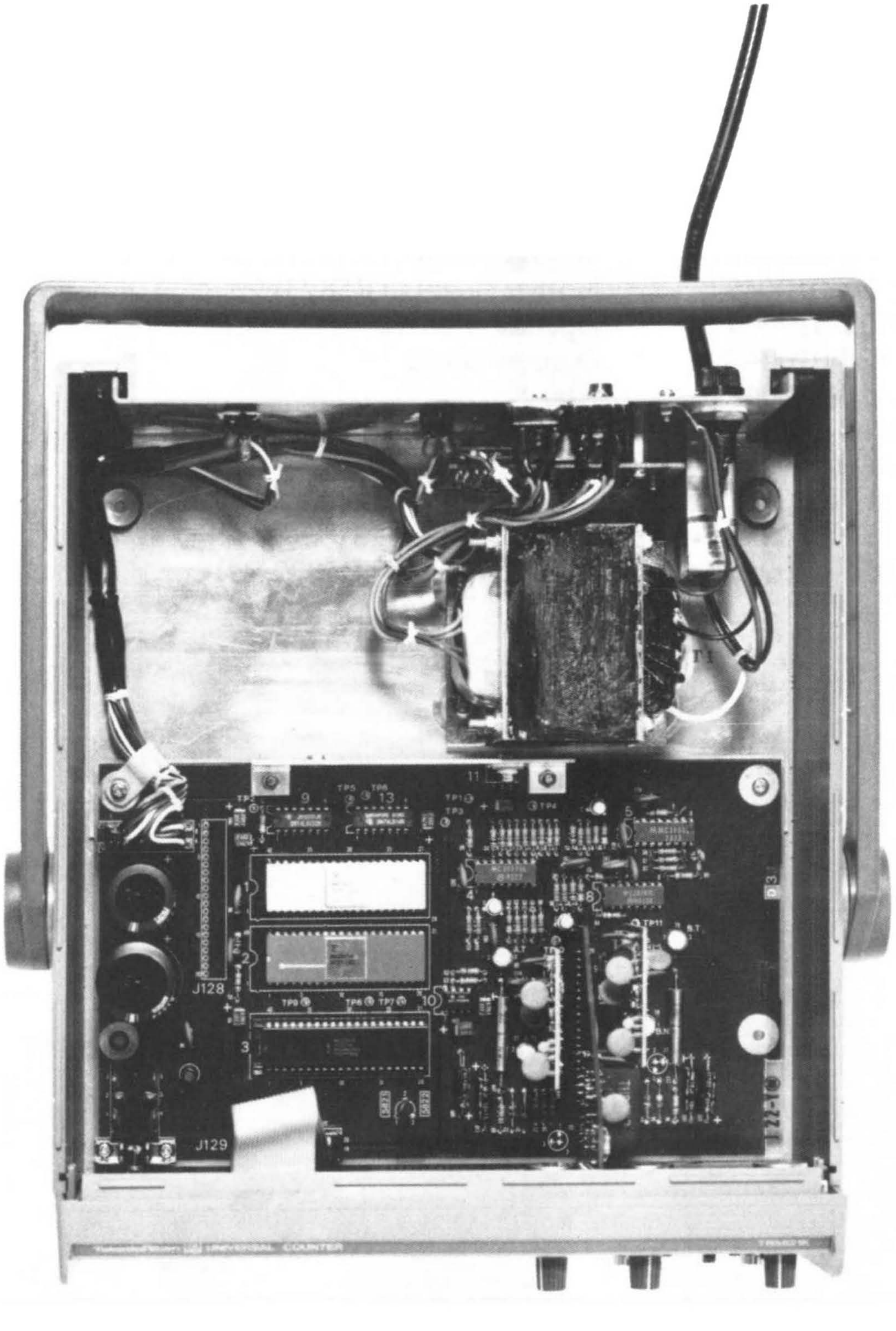


Fig. 11-1 Top view of TR5821/5822

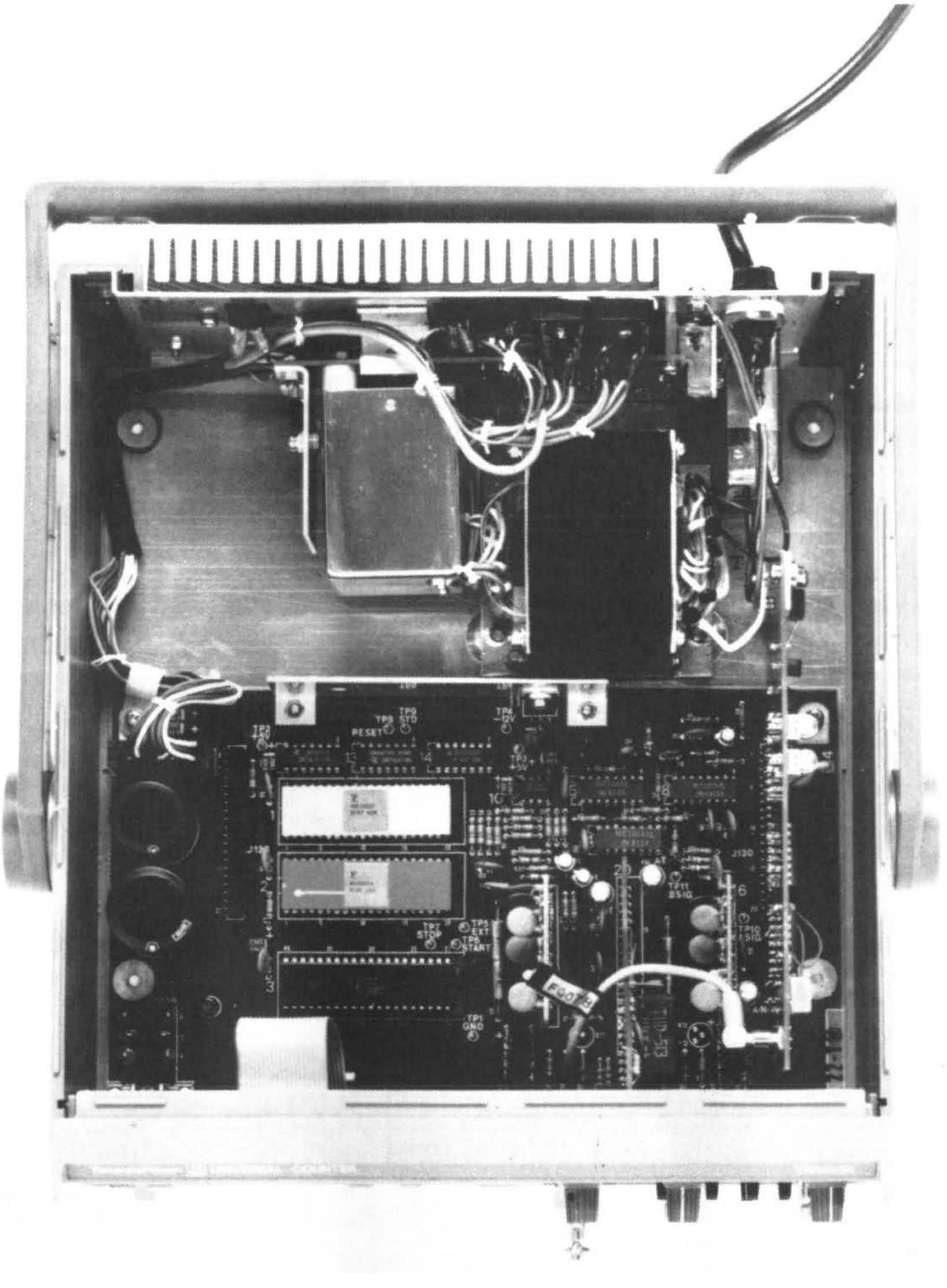


Fig. 11-2 Top view of TR5823

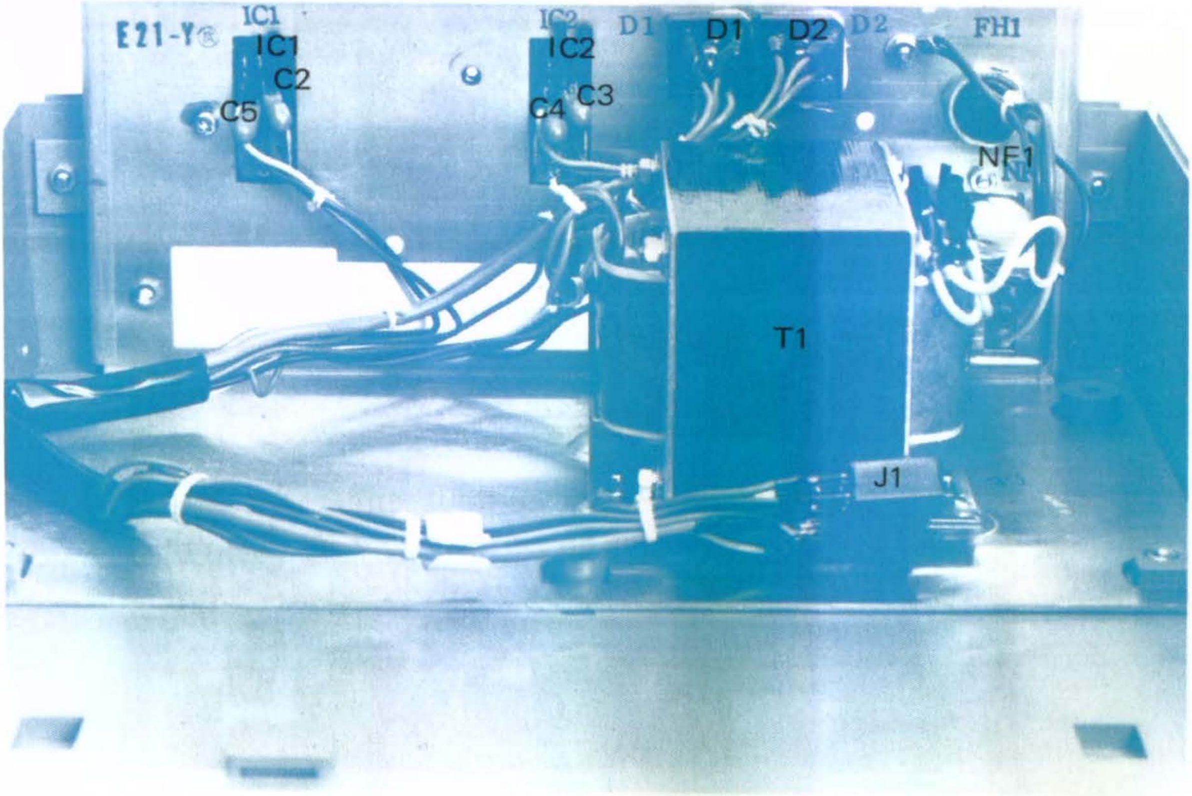
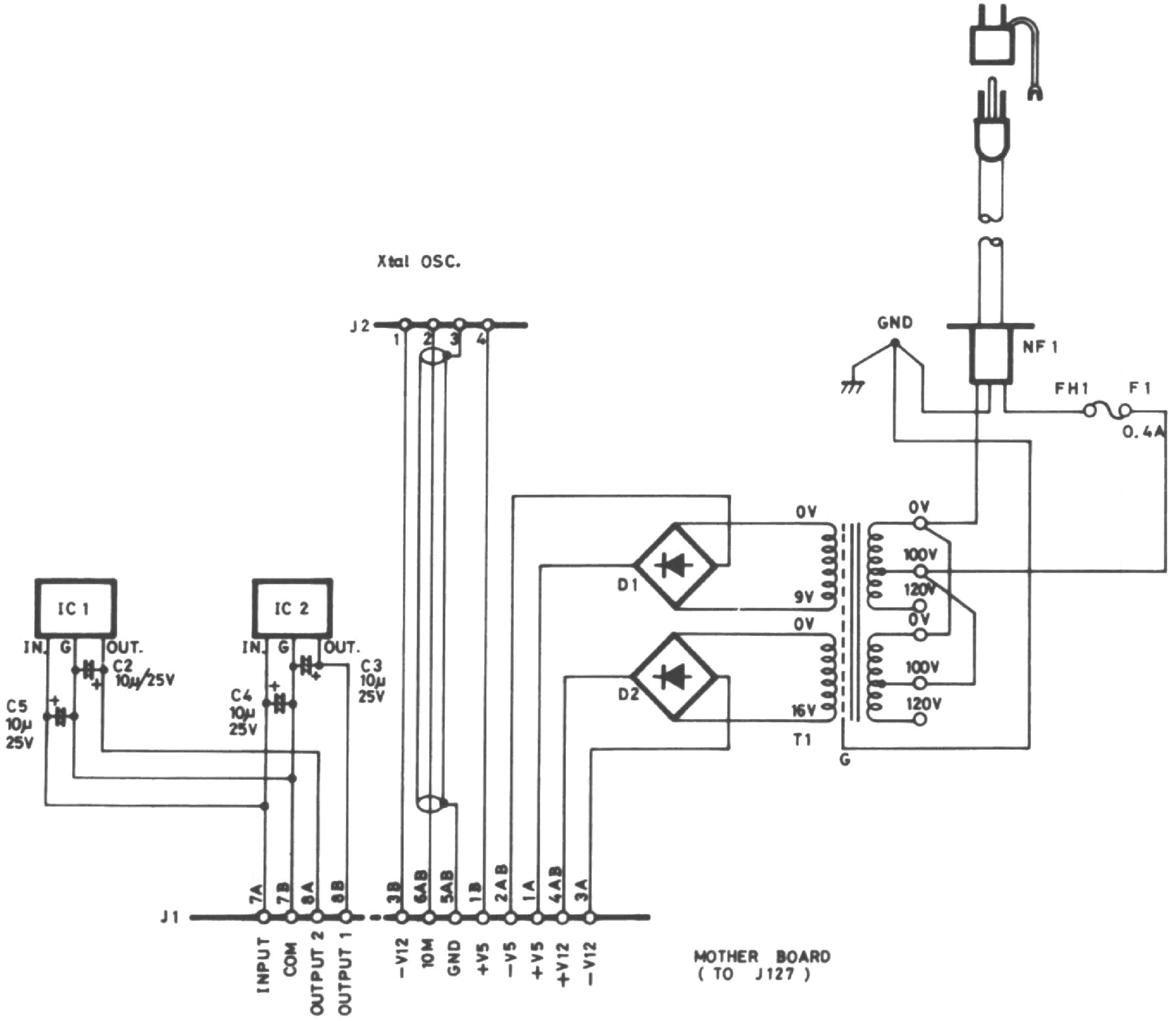


Fig. 11-3 Locations & diagram, chassis section



0067204-001 – A
0056204-001 – A
0070204-001 – A
0057204-001 – A

TR5820/5821/5822/5823
SCHEMATIC SECTION

MOTHER BOARD

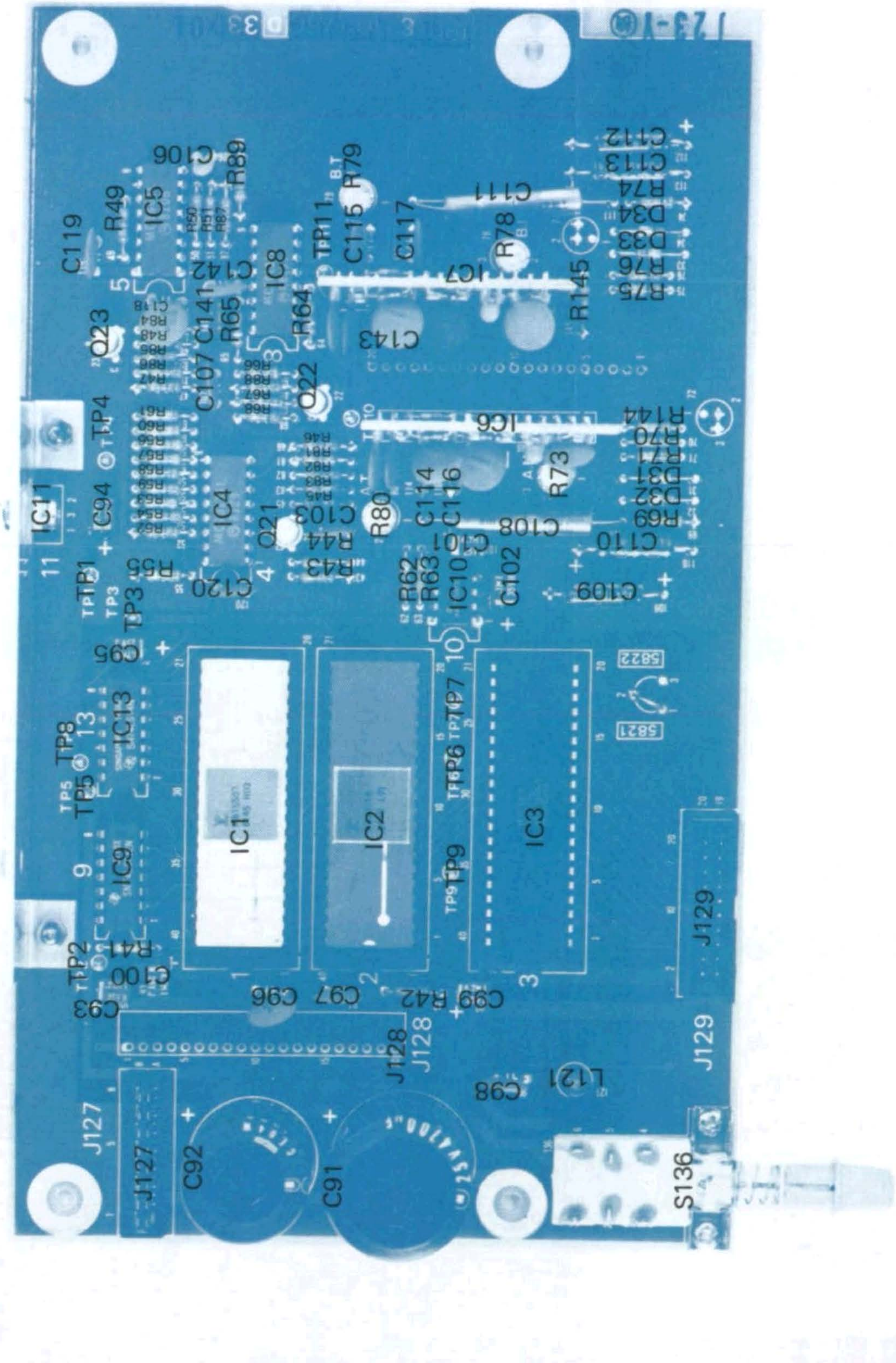
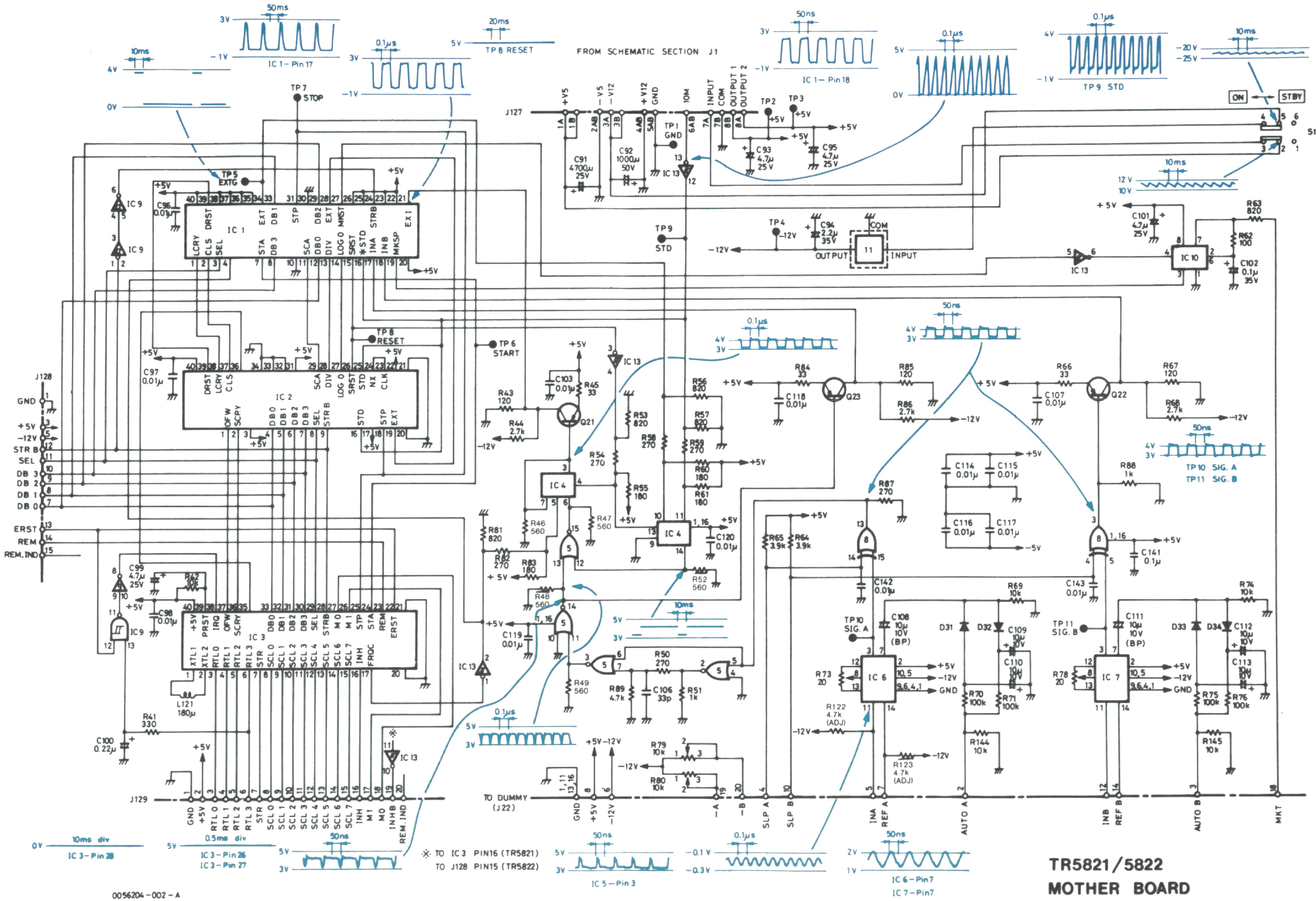


Fig. 11-4 Locations & diagram, BLG-010275



0056204 - 002 - A
0070204 - 002 - A

TR5821/5822
MOTHER BOARD
BLG - 010275

MOTHER BOARD

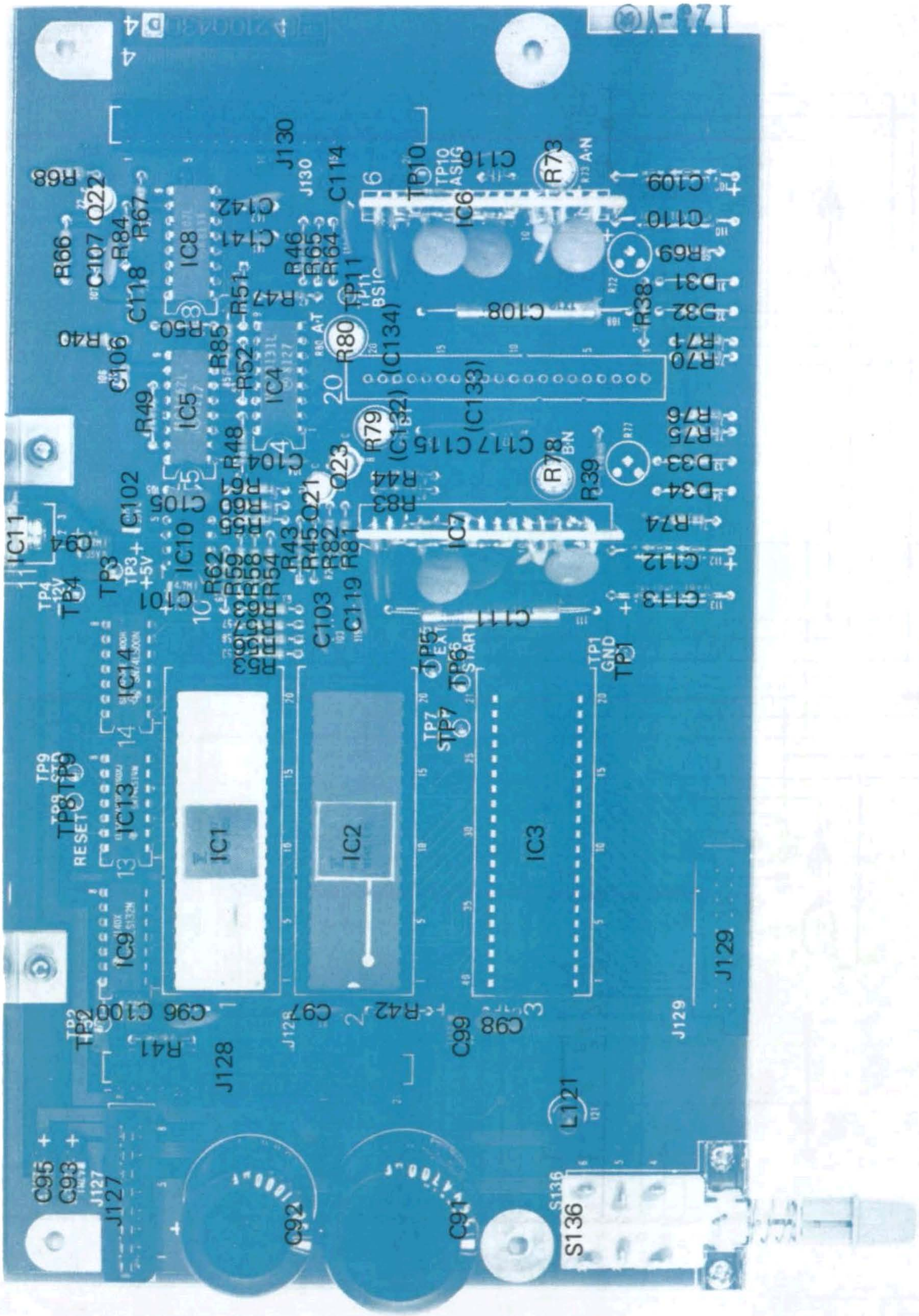
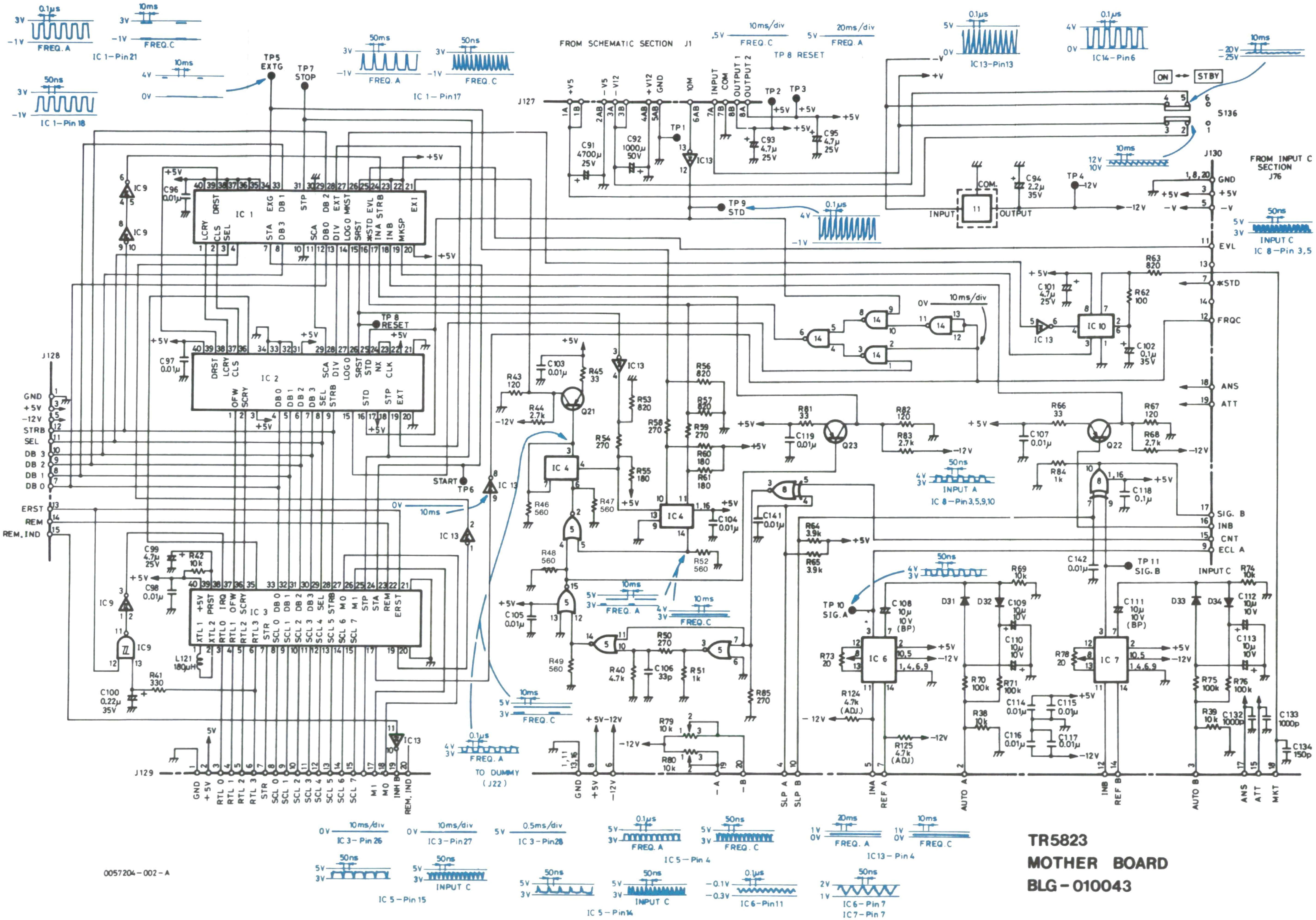


Fig. 11-5 Locations & diagram, BLG-010043



0057204-002-A

TR5823
MOTHER BOARD
BLG-010043

OPERATION BOARD

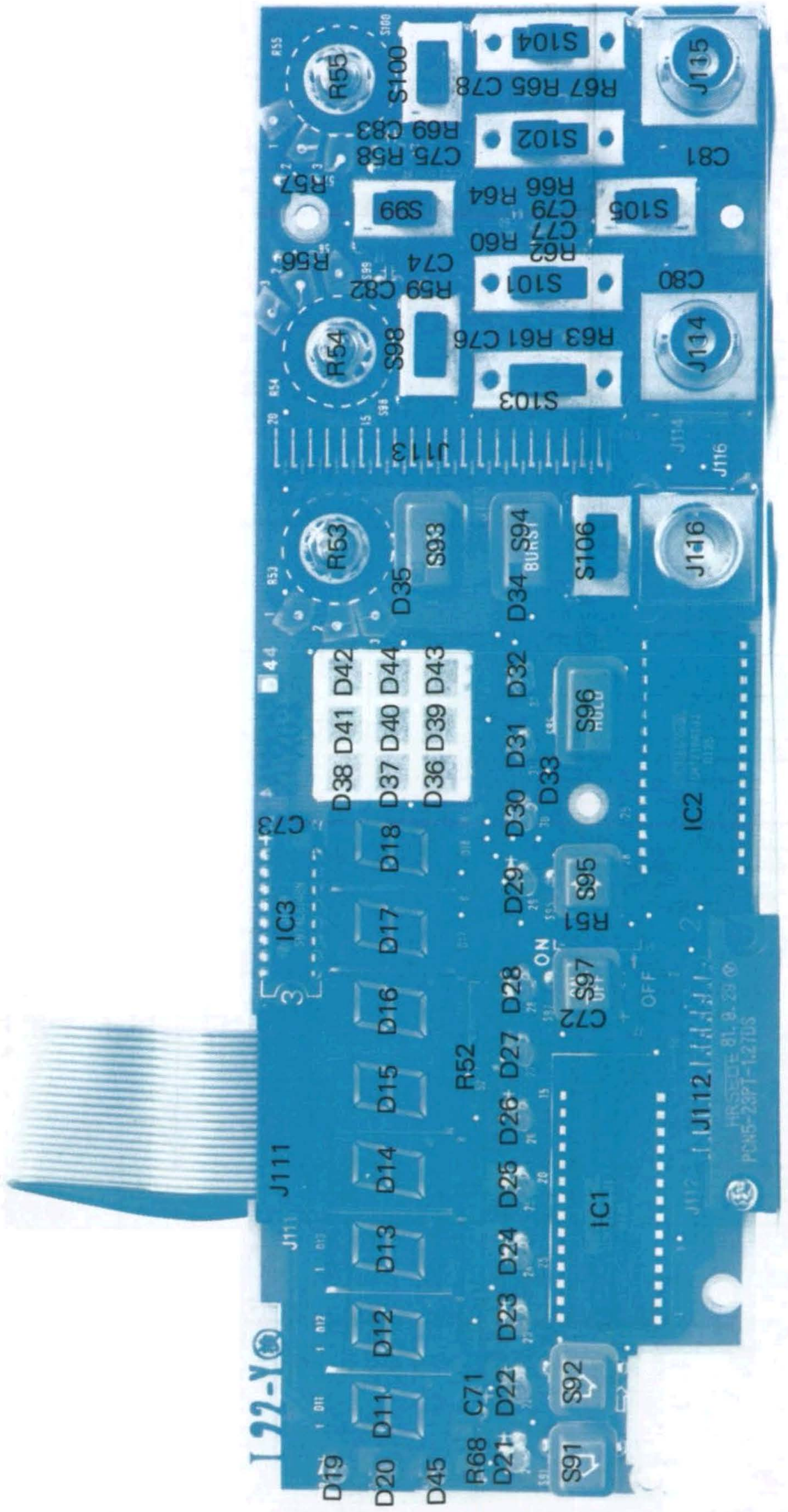
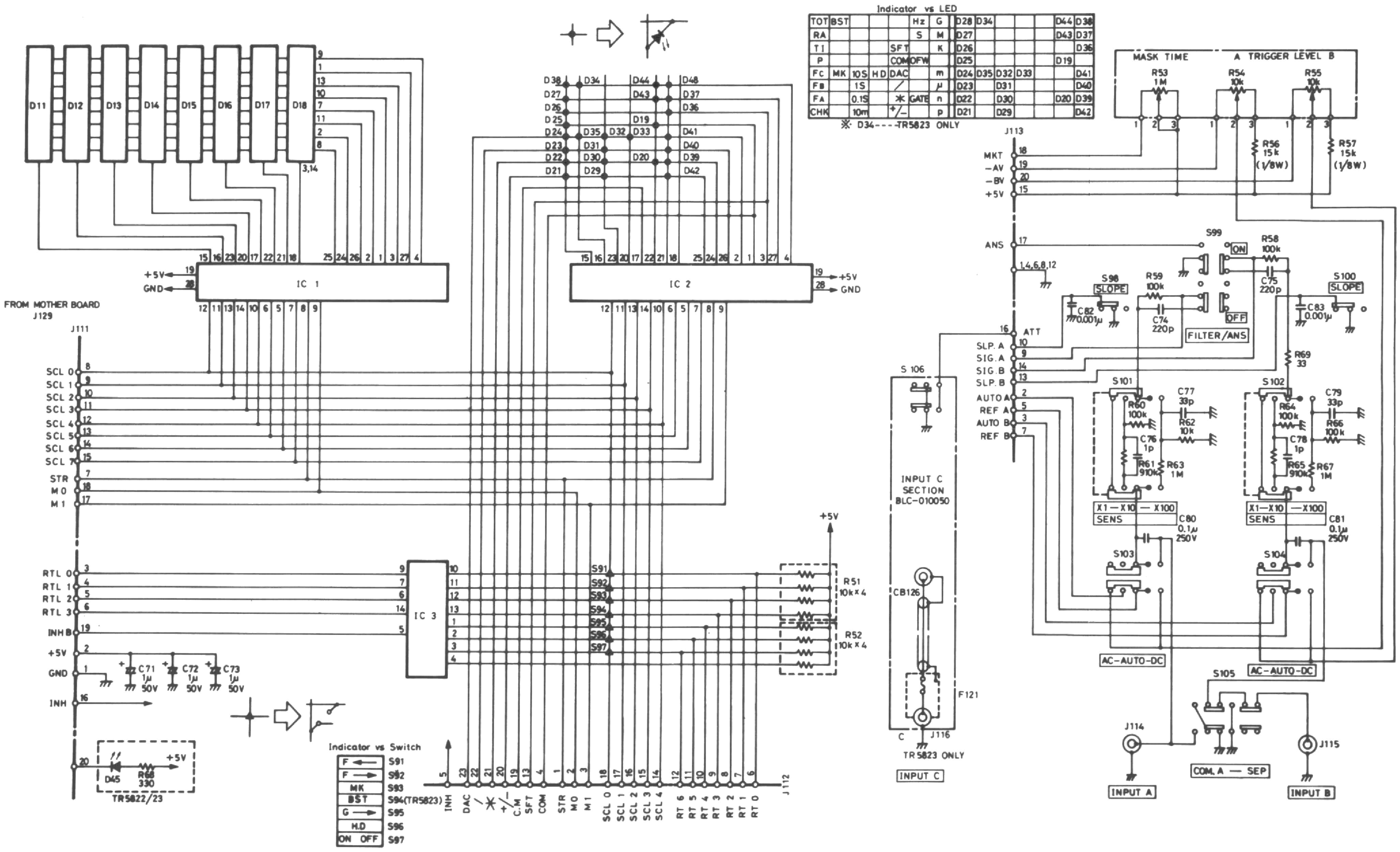


Fig. 11-6 Locations & diagram, BLF-010044



Indicator vs LED

TOT	BST				Hz	G	D28	D34				D44	D38
RA					S	M	D27					D43	D37
TI				SFT		K	D26						D36
P				COM	OFW		D25					D19	
Fc	MK	10S	HD	DAC		m	D24	D35	D32	D33			D41
FB		1S		/		μ	D23		D31				D40
FA		0.1S		*	GATE	n	D22		D30			D20	D39
CHK		10m		+/−		p	D21		D29				D42

※ D34----TR5823 ONLY

Indicator vs Switch

F ←	S91
F →	S92
MK	S93
BST	S94(TR5823)
G →	S95
H.D	S96
ON OFF	S97

0056204-003-A
0070204-003-A
0057204-003-A

TR5821/5822/5823
OPERATION BOARD
BLF-010044

DUMMY BOARD

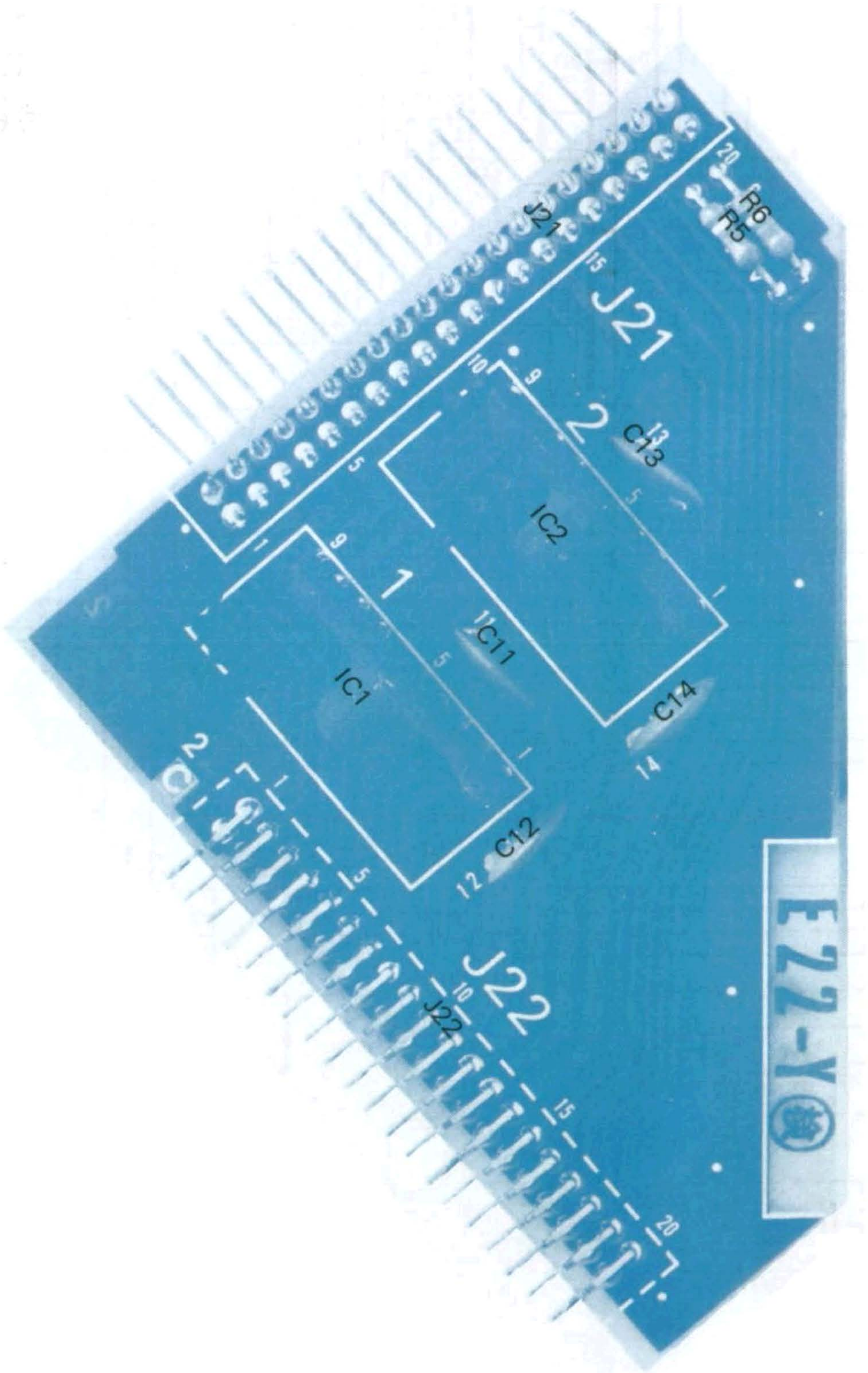
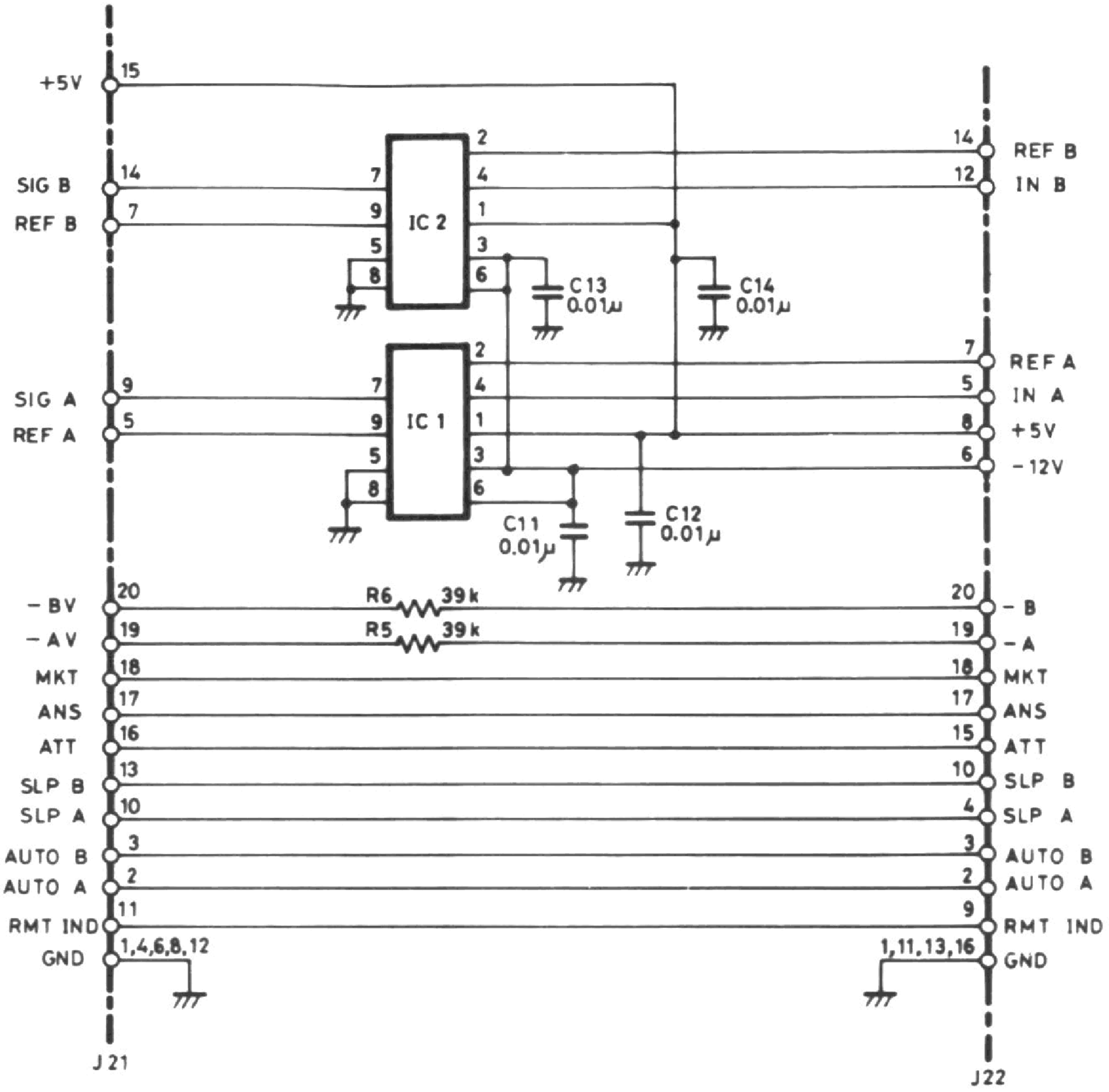


Fig. 11-7 Locations & diagram, BLB-010047



0056204-004-A
0070204-004-A
0057204-004-A

TR5821 / 5822 / 5823
DUMMY BOARD
BLB-010047

Xtal-1

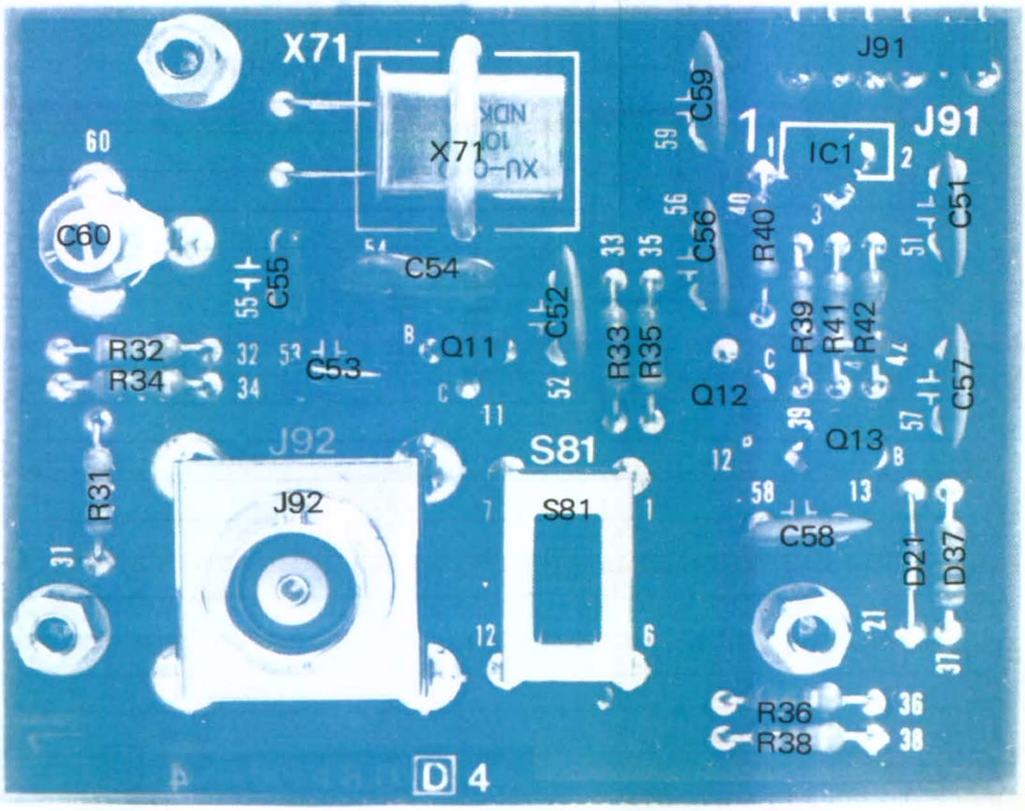
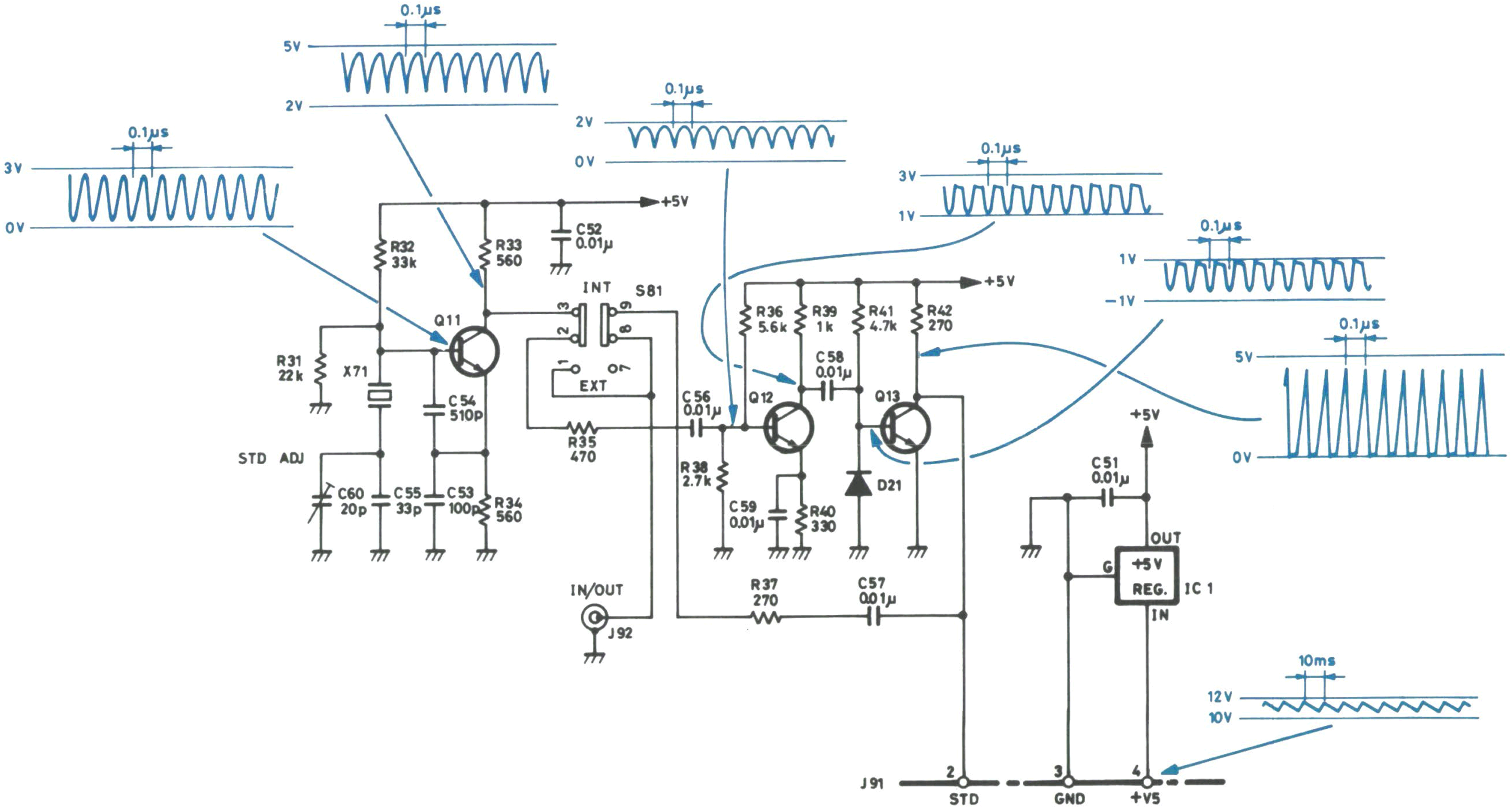


Fig. 11-8 Locations & diagram, BLB-010048



TR5820/5821/5822/5823
Xtal-1
BLB-010048

0067204-005-A
0056204-005-A
0070204-005-A
0057204-005-A

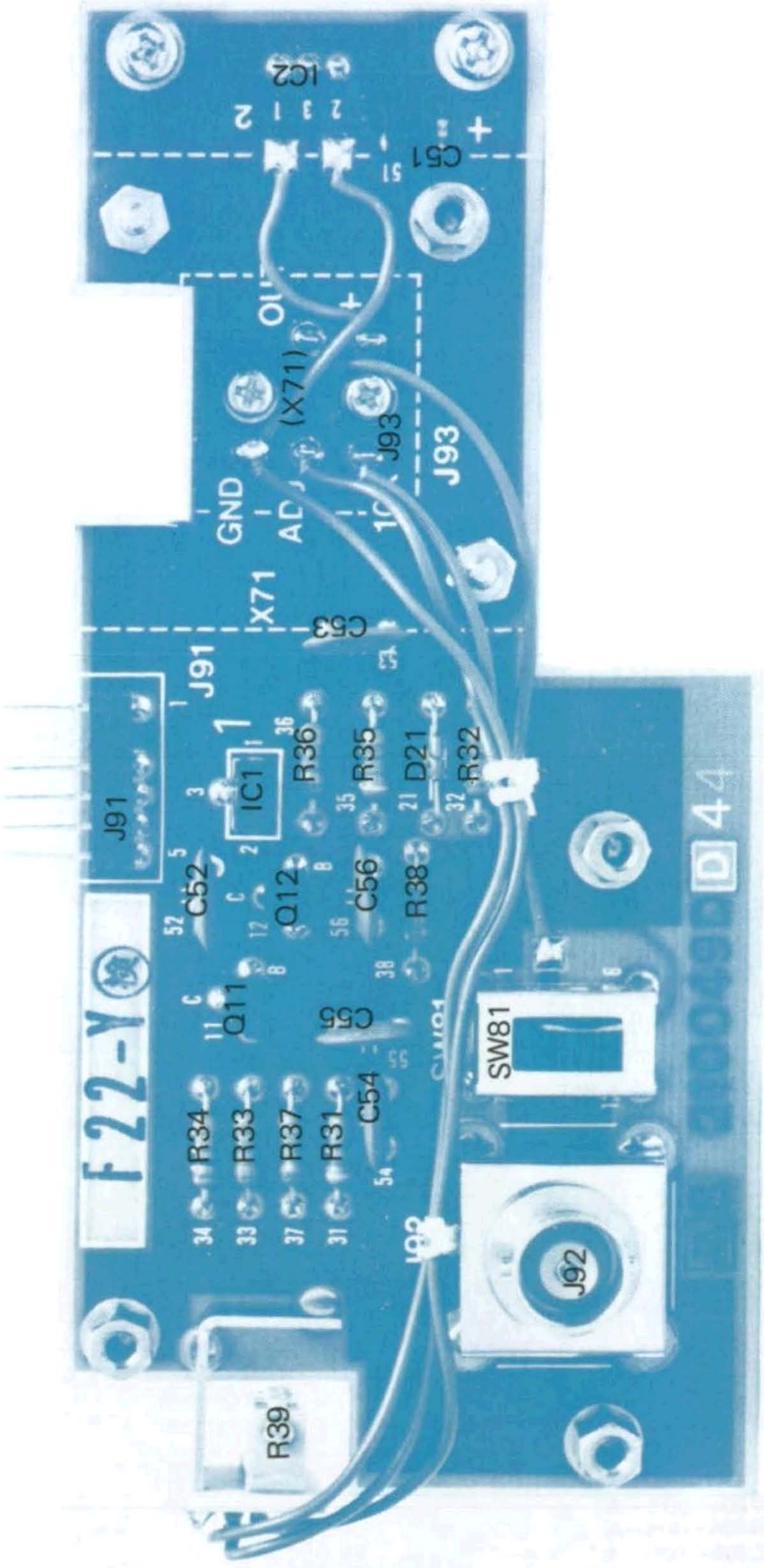
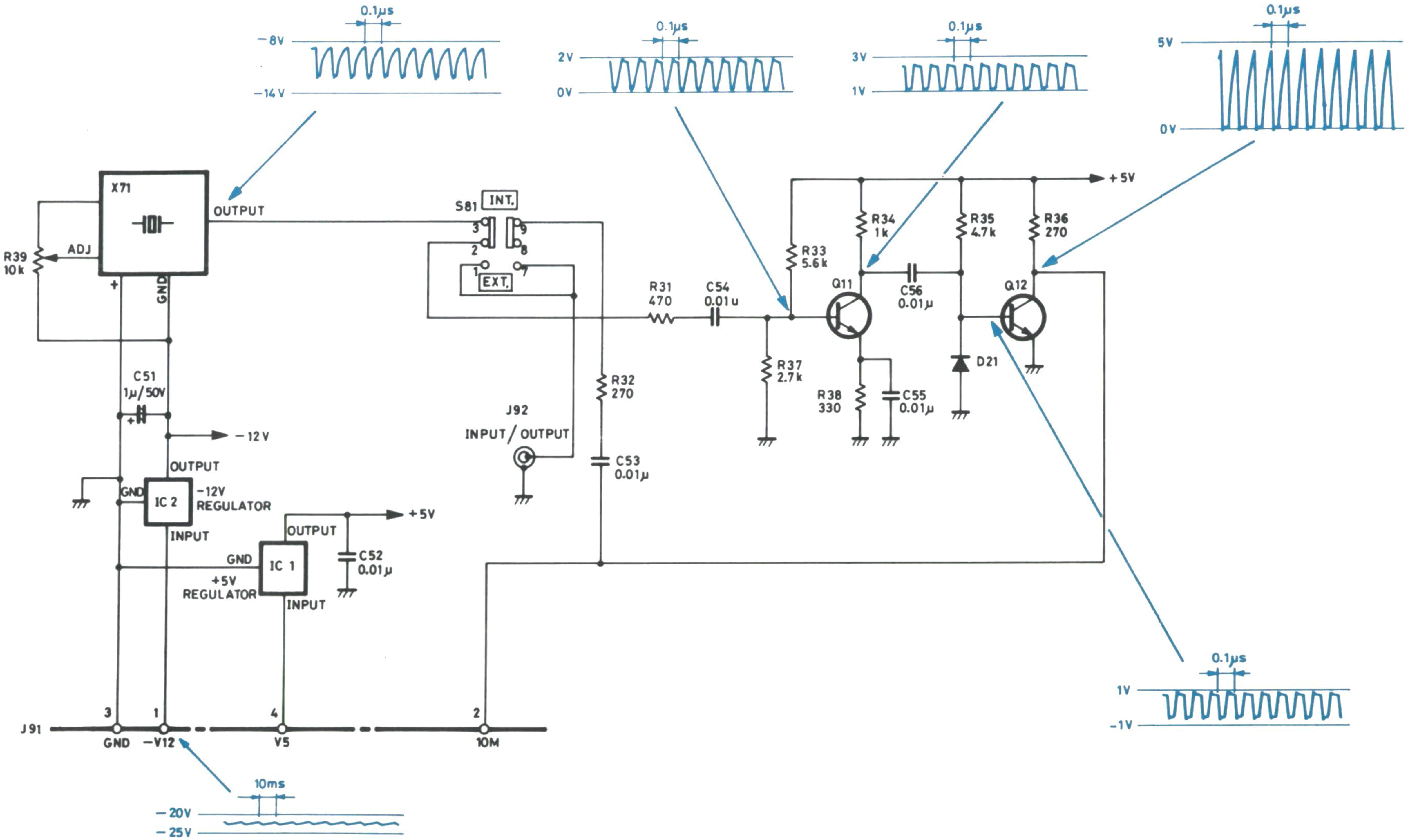


Fig. 11-9 Locations & diagram, BLB-010049



TR5823 /5823H
XTAL-2
BLB-010049

0057204-006-A

INPUT C

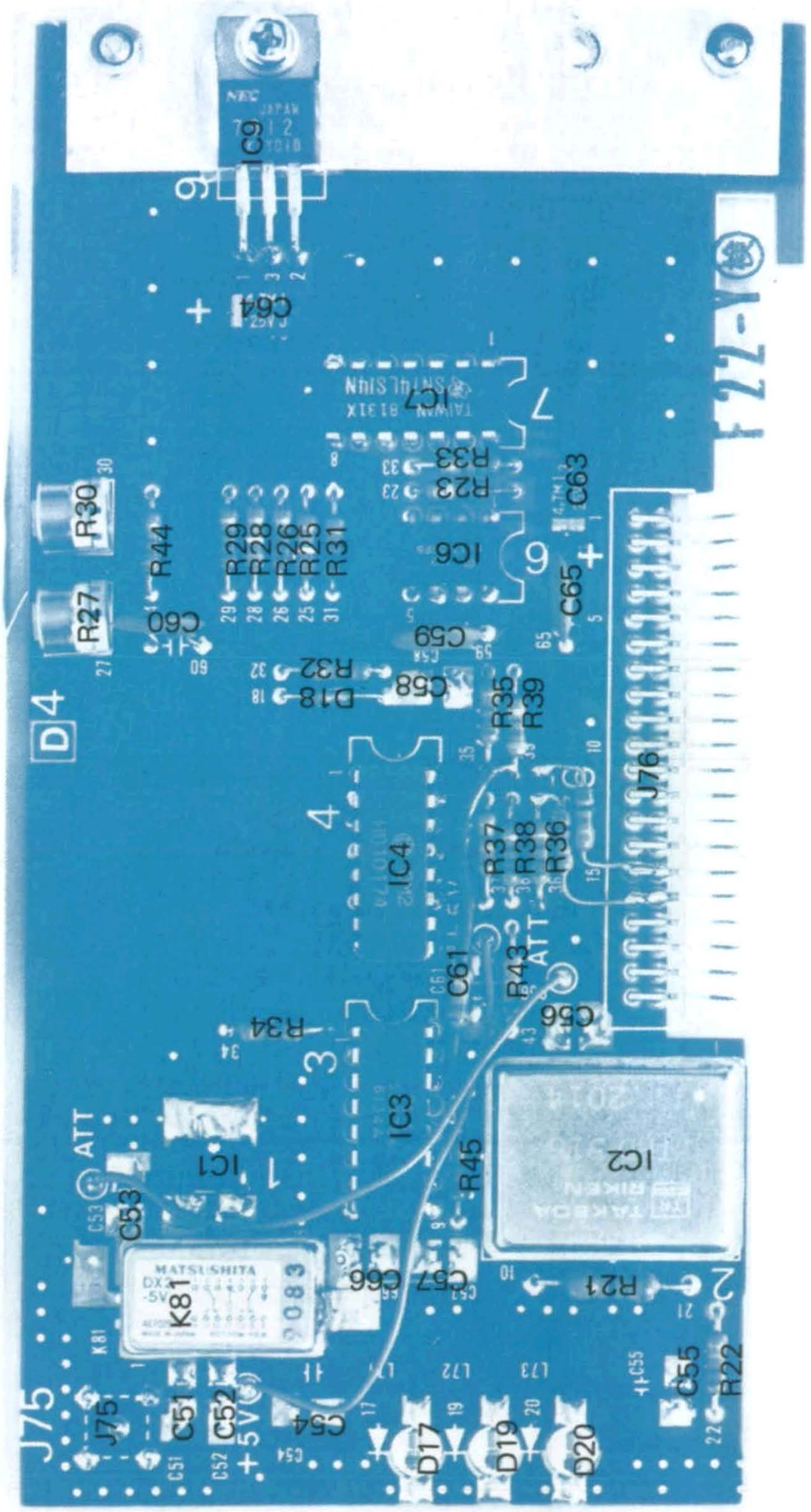
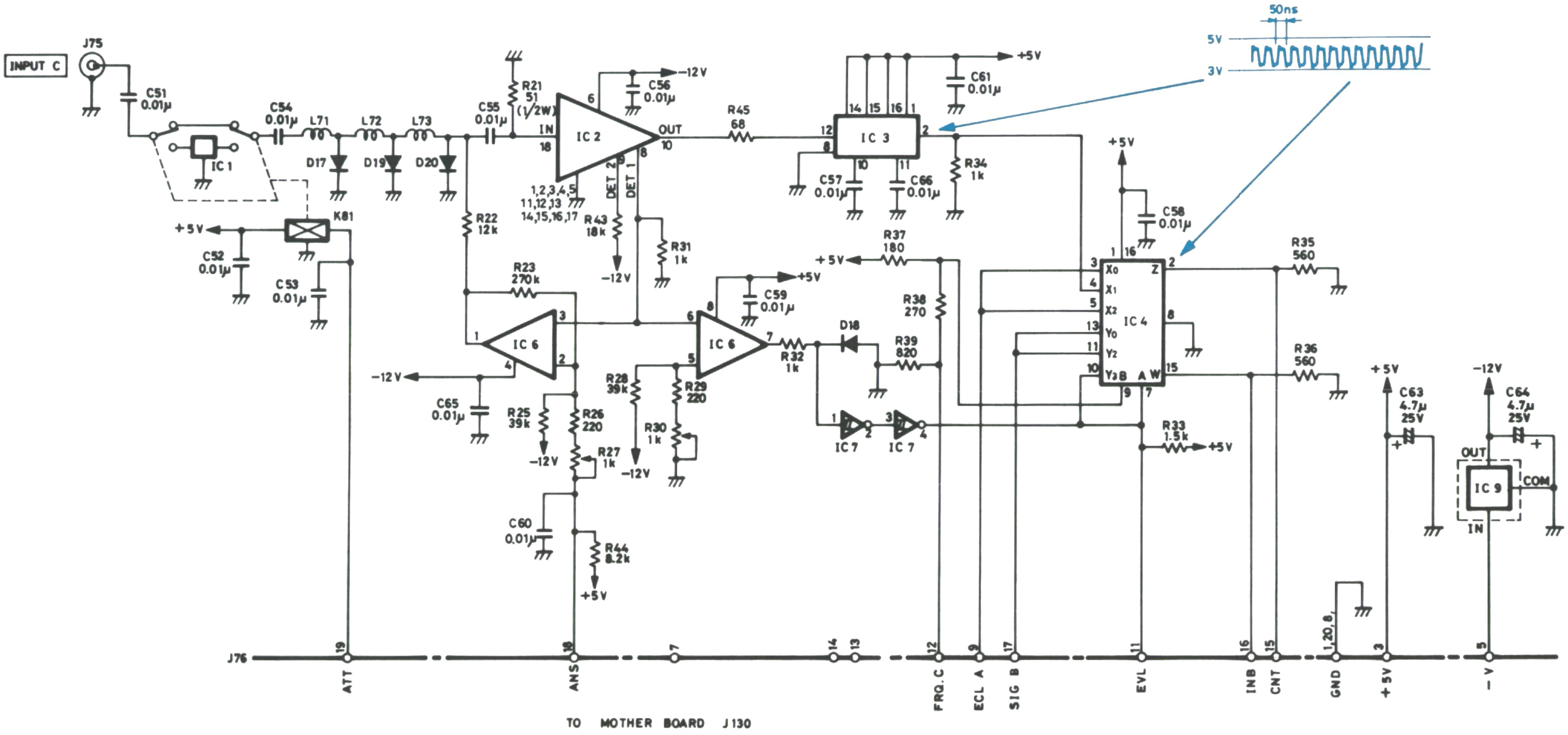


Fig. 11-10 Locations & diagram, BLB-010050



0057204-007-A

TR5823
INPUT C
BLC-010050

BCD OUTPUT

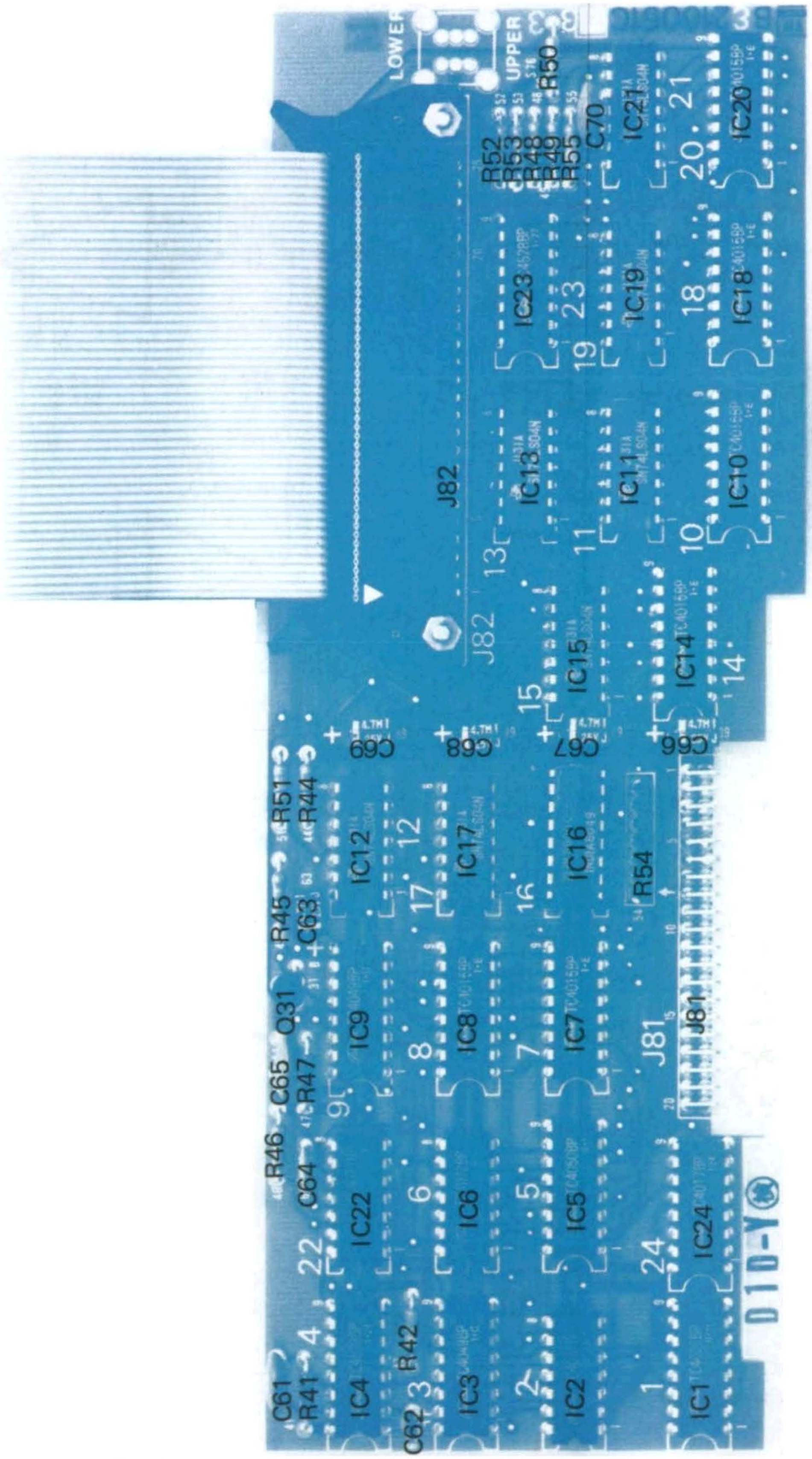
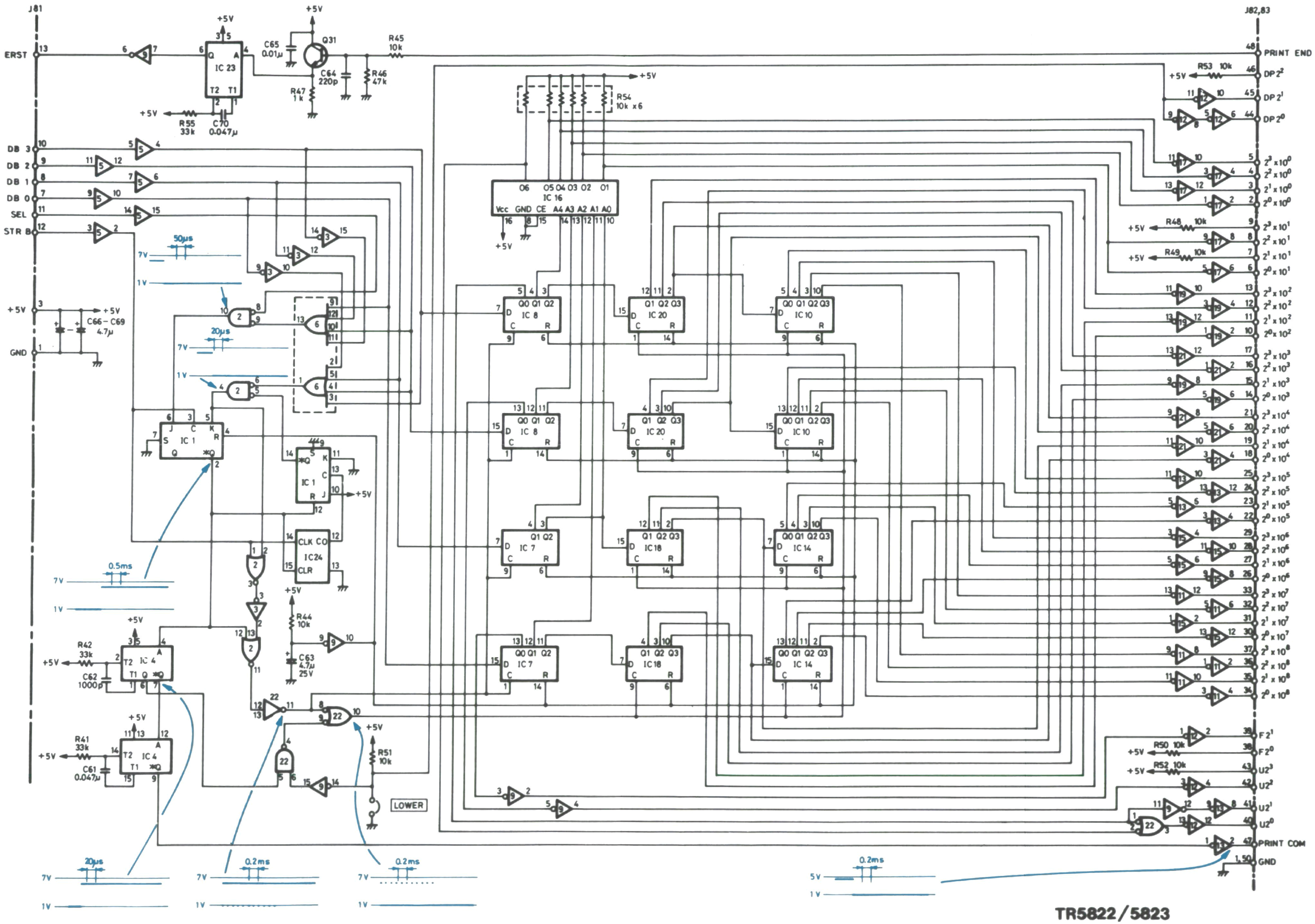


Fig. 11-11 Locations & diagram, BLF-010051



0070204-006-A
0057204-008-A

TR5822/5823
BCD OUTPUT
BLF-010051

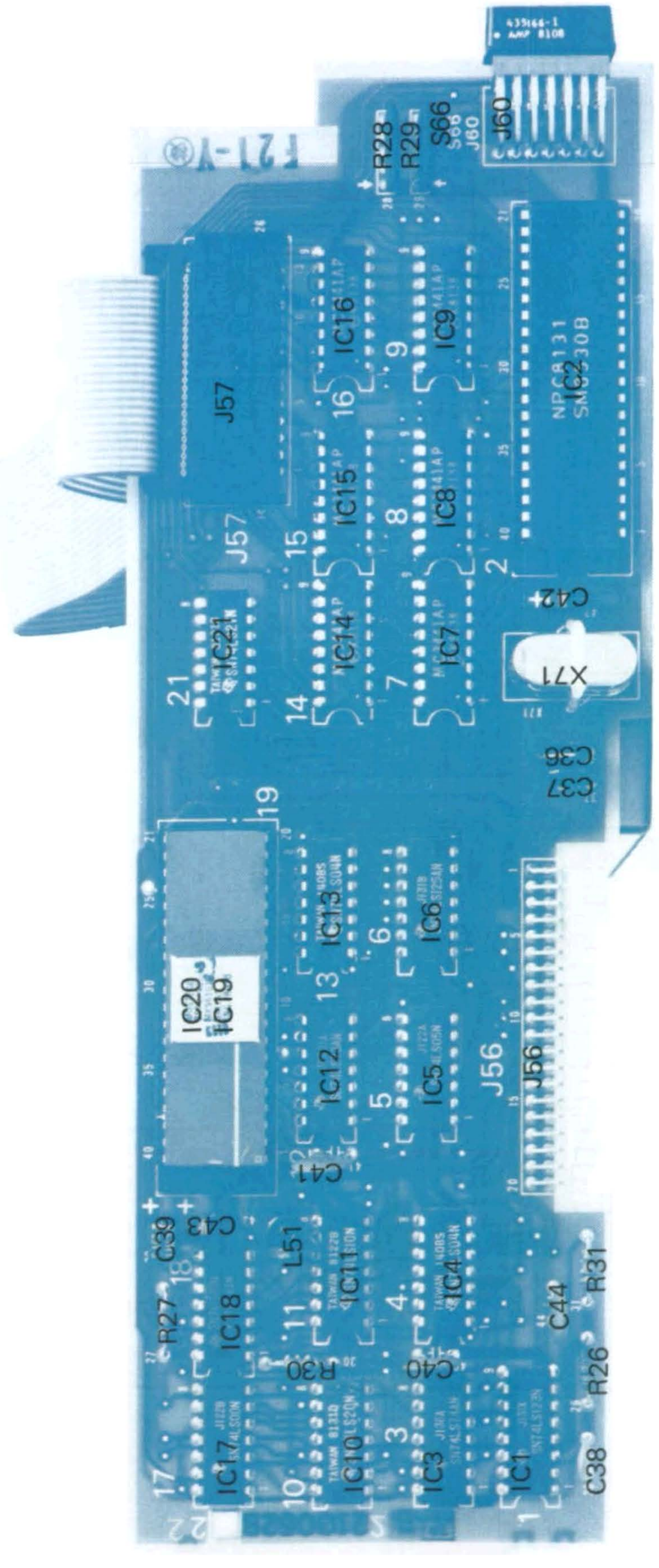
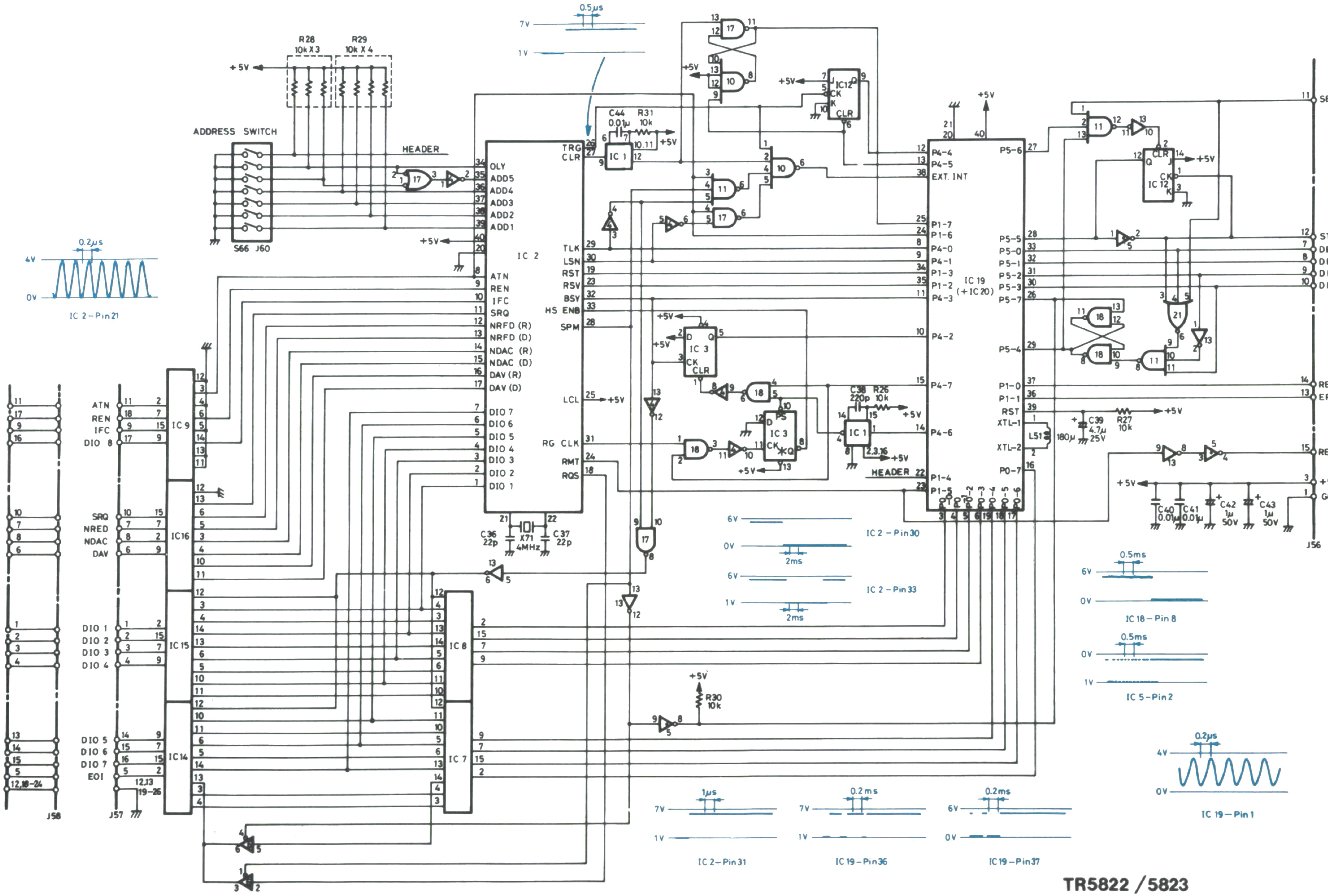


Fig. 11-12 Locations & diagram, BLF-010052



0070204-007-A
0057204-009-A

TR5822 / 5823
GP-IB
BLF-010052

D/A CONVERTER

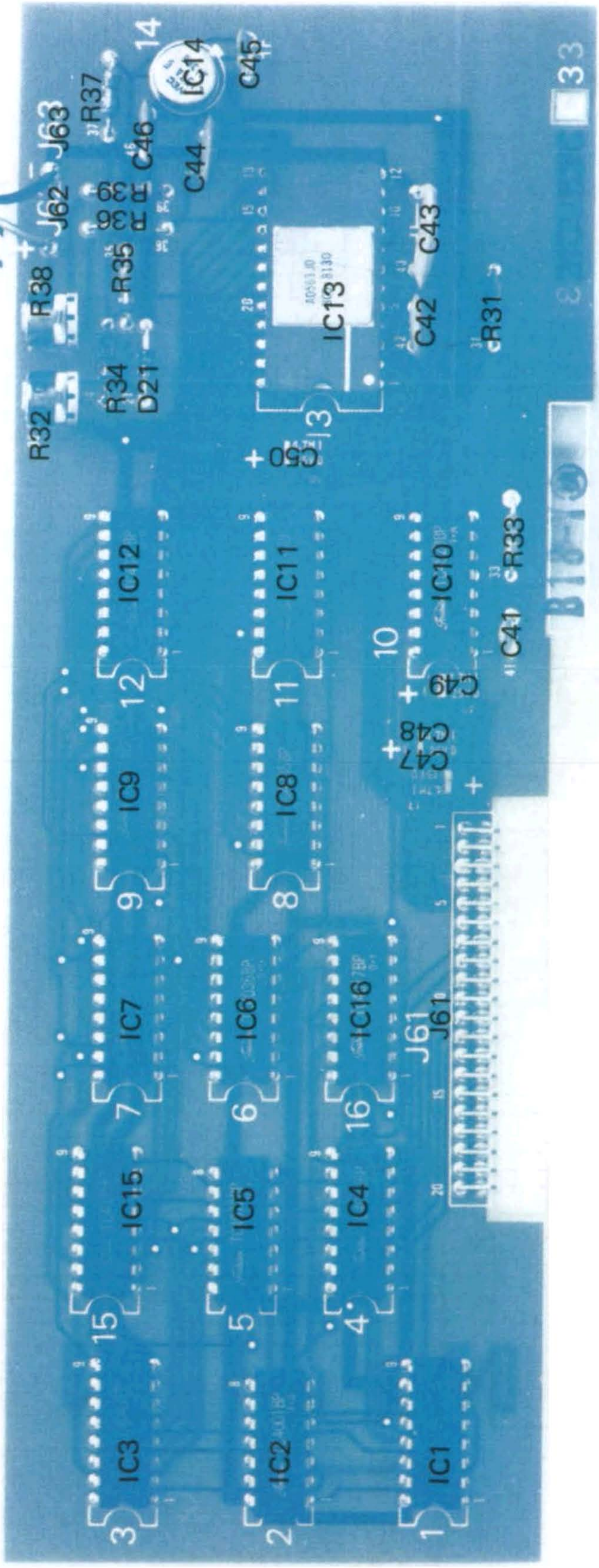
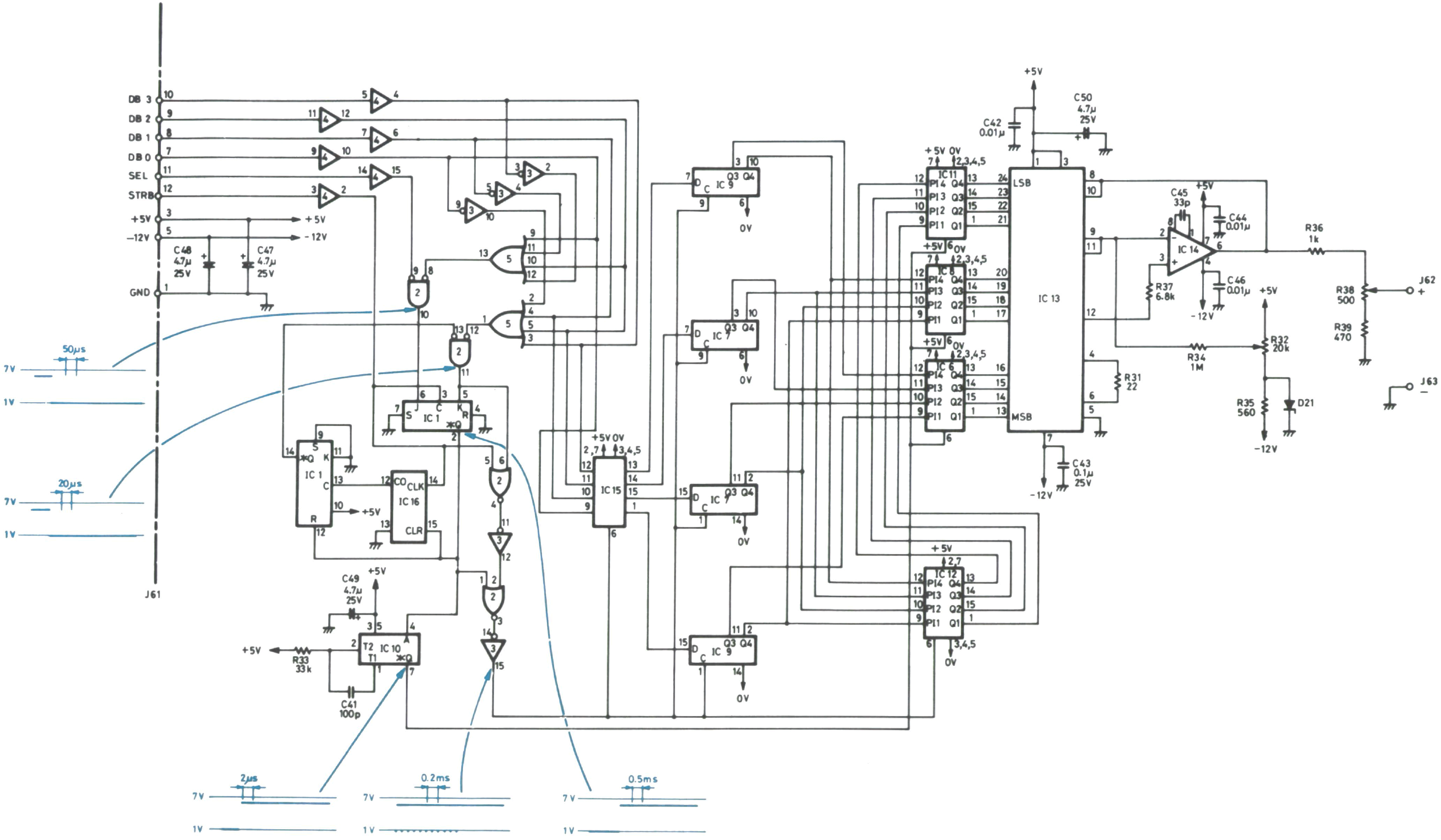


Fig. 11-13 Locations & diagram, BLF-010053



TR5822/5823
D/A CONVERTER
BLF-010053

0070204-008-A
0057204-010-A

APPENDIX A
TABLE OF SIGNALS

Signal	Meaning	Explanation
ANS	Automatic Noise Suppressor	Rejects superimposed harmonic noise
ATT	attenuator	Attenuates the incoming signal amplitude by a factor of 10 or 100
CLK	clock	Clock to control LSI80-SS (connected to NX)
CLS	closure	Command signal to close the gate
CNT	count	Counting signal from INPUT C board to mother board
DB	data bus	4-bit data bus
DIV	divider	
DRST	divider reset	
ERST	external reset	Reset for the peripheral circuits of LSI
EVL	envelope	Envelope signal for input C burst
EXI	external input	Data input to extend the digits for LSI
EXG	external gate	High-speed gate signal for LSI
FLT	filter	Low-pass filter to reject noise on low-frequency measurement
HV	high voltage	High-voltage signal for TR5820
INA	Input A	
INB	Input B	
IND	indicator	Blinks to indicate the triggered state
INH	inhibit	Panel switch operation inhibited (remote)
LCRY	log carry	Carry signal to control logarithmic signal
LOG	logarithmic signal	10^n period signal (to generate gate time)
MKSP	mask stop	Indicates termination of masking
MKT	masking time	Mask time signal (by charging C-R)
MKST	mask start	Indicates start of masking
NX	2^n of STD	Clock to control LSI80-SS
OFW	overflow	Condition in excess of the display capacity
REF	reference	DC voltage as a standard for incoming signal
REFA	reference A	DC voltage as a standard for INPUT A
REFB	reference B	DC voltage as a standard for INPUT B
REM	remote	Remotely controlled state via GPIB-compatible external controller
RTL	return line	Signal connected to panel switch
SCA	scaler	
SCL	scan line	Panel switch read signal

Signal	Meaning	Explanation
SEL	select	Selection of data on the data bus: address (low) or data (high)
SLPA	slope A	Triggers on the leading and trailing edges in the input A measurement
SLPB	slope B	Triggers on the leading and trailing edges in the Input B measurement
SRST	scaler reset	Reset signal output terminal for scaler
STA	start	
STP	stop	
STD	standard	
STR	strobe	Strobe signal for data bus
STRB	strobe	Strobe signal for display data
XTL	crystal	Internal time base for LSI connected to coil

APPENDIX B
GLOSSARY

Acquisition Time

Acquisition time means the time from counter resetting to the start of counter operation. The acquisition time of ordinary counters is virtually zero, whereas microwave-band counters require a certain acquisition time. For the **TR5200** series counters of Takeda Riken, the acquisition time refers to the time required until the internal oscillator is phase locked to the input signal.

ALC (Automatic Level Control)

A function to detect and correct the DC fluctuation in the circuit caused by temperature drift from the input terminal to the output of the wide-band amplifier.

ANS (Automatic Noise Suppressor)

Takeda Riken's patented technique.
A circuit that automatically suppresses the noise riding on the signal to be measured.

Automatic Filter

Cutoff frequency is automatically selected according to the incoming frequency to eliminate random noise or noise added on the input signal, thereby preventing errors associated with noise. Automatic filter makes up for the disadvantages that the ANS capability contributes little to the suppression of random noise, impulse noise or noise larger than the signal of interest while it serves well for suppression of the superimposed noise.

Automatic Trigger Setting

Trigger level setting is quite difficult and bothersome when the signal to be measured is small. This setting operation is simplified by the automatic trigger setting. Trigger level is automatically set at the 50% level between the maximum and minimum peaks of the input signal. This capability facilitates the trigger level setting on the pulsed signal with the offset voltage or of different duty cycles, and minimizes false counting.

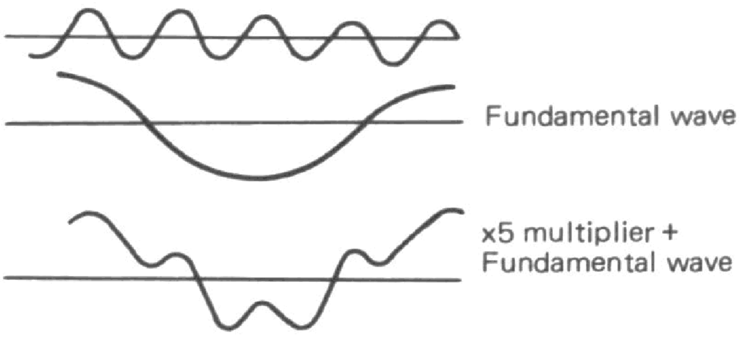
Averaging

Two circuit methods are usually used for averaging in electronic counters. One is used in the time interval measurement to count each time interval with the counting circuit and accummulate. Let N be the number of measurements, and ±1 count/$\sqrt{N}$ is part of measurement precision. The other method is the one used in period measurement to form a gate with the period signal to be measured to measure the gate time with the internal time base. One factor of measurement precision is ±1 count/N. Both averaging methods are used to enhance measurement precision of electronic counters; however, the inherent error factors inside the instrument (propagation delay time difference, Schmitt trigger circuit hysteresis band) cannot be improved. Therefore, the upper limit of the number of effective measurements accrues. In using the averaging function, the ±1 count error must be guaranteed to occur at random. A counter usually sends the signal to be measured to the counter gate circuit completely asynchronous with the internal time base and the error can be regarded to occur at random.

Bandwidth

For electronic counters, noise is a cause of counting errors and must be considered in relation to sensitivity.

The bandwidth switch is used to remove the high-frequency component (see figure below) with a low-pass filter of 10 MHz, 5 MHz, etc. This function is useful in measurement of oscillation and multiplied waves in a multiplier circuit.



COM-SEP Switch

A switch to be selected to suit the signal to be measured in time interval measurement. When this switch is set to COM., the start and stop signals are internally connected enabling a time interval measurement on a single signal. SEP. switch separates the start and stop signals, requiring the two signals, of start and stop, to be measured. (COM: Common; SEP: Separate)

Counting Resolution

The least significant digit on the readout. Counting resolution differs with gate time. At a gate time of 1 second, the resolution is 1 Hz with a typical counter.

Direct Counting

The direct counting is the most fundamental method to measure the frequency. (See the figure below.) This scheme is widely used from the audio frequency band to the UHF band. In the direct counting method, the upper limit of frequency measurement is determined by the gate time and the frequency resolution. Enhancement of the performance of the semiconductor devices and advanced circuit board technology have realized a counter of 1 GHz utilizing the direct counting techniques.

Expanding Reciprocal Method

The method used by electronic counters to measure a period, execute inverse calculation (1/period), and display the frequency is called the reciprocal method.
The main feature of this method is that, in period measurement, it enables frequency measurement of high-resolution and high-precision up to the order of the internal time base. For example, let the time base be 100 x 10^{-9}s, then 7-digit display is always possible when a frequency (10 MHz or less) is measured at a gate time of 1 second. To obtain a 10-digit display at a gate time of 1 second with this method, the internal time base must be 100 x 10^{-12}s (equivalent to 10 GHz). To realize a 10 GHz time base, the time expander method is used together with the reciprocal method, thus enabling a high-resolution high-precision frequency measurement. This method is called the expanding reciprocal method. (* See Time Expander Method.)

Gate Time

The time during which a counter measures the input signal. During this time, the GATE lamp usually goes on to notify the user that the input signal is being measured.

Input Coupling

There are two input coupling methods: the AC coupling that cuts out the DC input signal and passes the AC component alone, and the DC coupling to measure low frequencies.

Masking

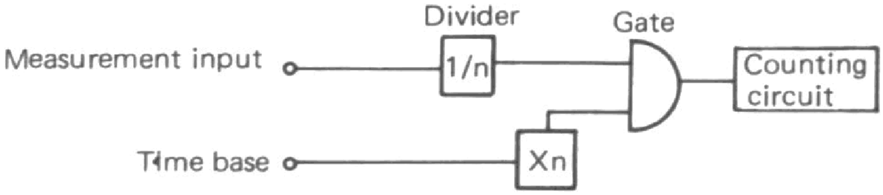
With a masking function, regardless of the magnitude of noise, desired signal alone is made available by inhibiting for a required period of time the wave-shaped output. By adjusting the masking time, this function makes possible the measurements of the signal in noise including a chattering noise or the modulated wave signal.

Oven Lamp

A lamp that indicates activation of the crystal-oven heater and the internal reference circuit when the counter is connected to the AC power source regardless of the POWER switch operation.

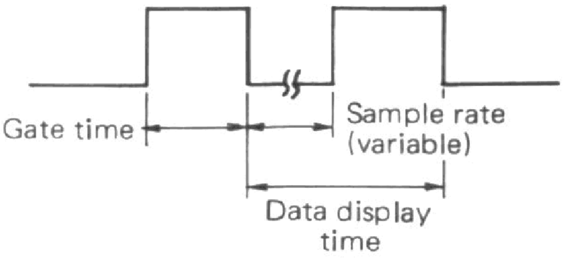
Prescaler

The prescaler divides the input frequencies by a factor of n with a divider for counting. (See the figure below.) In this case, the counting result is 1/n of the actual frequency; therefore, the time base is multiplied by n to display the frequency measurement. This requires a gate time equal to n times that required for the direct counting method; with the same gate time, the resolution is 1/n. In the prescaler, the upper limit of the measured frequency is determined by the frequency resolution of the divider. The gate is operated by the 1/n frequency, enabling measurement of higher frequencies than by the direct counting method. At present, a 1.5 GHz prescaling counter is available.



Sample Rate

A function to continuously vary the display time of the measurement result. As a matter of fact, the gate time is determined by the resolution of the counter. The display time can be changed by varying the time from the end of a measurement to the start of the next measurement by using the sample rate function. Thus, the data display time can be altered by varying the sample rate.



Data display time = Gate time + Sample rate time

Time Base, Internal/External

Frequency counters are used for measuring time or counting the number of pulses during a certain period of time. To obtain an accurate measurement result, a time base generator is needed to generate an accurate time. Most counters incorporate a crystal oscillator as the internal time base generator. The accuracy of this generator determines the accuracy of the frequency counter.

If a generator with greater accuracy than the built-in generator is externally available, greater measurement accuracy of the counter is obtained by replacing the internal generator with the output of the external generator. The output of this external generator is called the external time base.

Time Expander Method

The ± count error caused by the relationship between the electronic counter internal time base (for example, 10 MHz) and the time interval to be measured or 1-cycle time is used as a significant time value. Let the difference time occurring at the leading edge of the time to be measured be ΔT_1 and the difference time occurring at the trailing edge be ΔT_2, then the time to be measured $T_X = N \cdot T_0 \pm \Delta T_1 - \Delta T_2$ (where T_0 = internal time base, N = positive integer). $\Delta T_1 - \Delta T_2$ can be read at a better precision by a factor of 100 or 1,000 by converting the difference times to analog voltages by a high-speed time-voltage converter, then A/C converted with a high speed and high precision. Assuming the time base to be 100×10^{-9}s, T_X is equal to resolution 1×10^{-9}s or 100×10^{-12}s. This method of expanding the difference time is the time expander method.

Time Interval Average, Period Average

Counters can measure period and time interval. With a single measurement, the display is unstable and difficult to read or the measurement value is not reliable if the input signal is interfered with noise or unstable. To solve this problem, counters have a feature to average 10 or 100 measurement values to reduce the influence of noise and input variation. This function is called the time interval average and period average to distinguish from a single measurement. Time required for average measurement is as many times longer as the number of averages taken.

Trahet Method

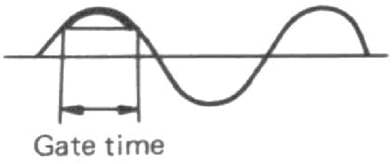
Takeda Riken's patented technique (US PAT. No. 3932814).
This method uses a YIG tuning oscillator with excellent linearity, taking advantage of the transfer oscillator and the heterodyne conversion techniques.

Trigger Level

When a signal is input to a frequency counter, the input signal must cross a certain level (also called the threshold value) for the counter to sense it as a signal and measure it. This level is called the trigger level. The level can usually be varied with a potentiometer, etc.

Trigger Monitor Output

A signal output from the trigger monitor circuit as an auxiliary means when a counter is measuring time interval. An osciloscope (with Z-axis modulation terminal) shows intensity modulation on the waveform for each gate time. The measured portion on the trace is intensified as shown below.



Trigger Slope

For a frequency counter to sense an input signal, the input signal should meet the two requirements. One is that the signal must cross the trigger level, and the other is that the slope of the input signal must match the preset trigger slope. With the trigger slope set to plus (+), the counter senses the input signal when the input signal crosses the trigger level from minus (–) to plus (+).

SERVICE

During the warranty period, Takeda Riken will, at its option, either repair or replace products which prove to be defective. When trouble occurs, buyer should contact his local supplier or Takeda Riken giving full details of the problem and the model name and serial number. For the products returned to Takeda Riken for warranty service, buyer shall prepay shipping and transportation charges to Takeda Riken and Takeda Riken shall pay shipping and transportation charges to return the product to buyer. However, buyer shall pay all charges, duties, and taxes incurred in his country for products returned from Takeda Riken. Repair service and supply of repair parts for a product purchased from Takeda Riken is guaranteed for 7 (seven) years.

CLAIM FOR DAMAGE IN SHIPMENT TO ORIGINAL BUYER

The product should be throughly inspected immediately upon original delivery to buyer. All material in the container should be checked against the enclosed packing list or the instruction manual alternatively. Takeda Riken will not be responsible for shortage unless notified immediately.

If the product is damaged in any way, a claim

MANUAL CHANGE

Please check for Change Information

Takeda Riken Industry Co., Ltd.

Address : 1-32-1, Asahi-cho, Nerima-ku, Tokyo 176, Japan
Telephone : Tokyo 930-4111 Cable Address : TRITRONICS TOKYO Telex : 272-2140

Printed in JAPAN