

CANON SERVICE MANUAL
Canola 130 S

CANON CAMERA CO., INC.
TOKYO, JAPAN

Canola 130S

P R E F A C E

This manual is the guide for service after sales with the main purpose of quality performance of our products which is also useful for marketing promotion as well as repair service.

It consists of five section, i.e. General of Canola 130S; Operation; How to Repair; Parts Catalog and Service Manual Report.

It is necessary that the principles and the equipment should be fully understood of the following sections General of Canola 130S and Operation, and that the proper service should be done by referring to How to Repair and Parts Catalog. For the general elementary principles of the electronic calculators, refer to the Summary of Service Manual for Canola 130 which was formerly issued.

When parts are needed, it is important to order them to the following address by referring to the diagrams in How to Repair and Parts Catalog.

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Unless there is need of a revised edition due to any major amendment, any minor amendment informations will be sent in a Service Manual Report.

Any comments and querries about this service manual would be greatly appreciated by us.

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HOW TO USE THE SERVICE MANUAL

This manual is consisted of five sections, i. e. General of Canola 130S; Operation; How to Repair; Parts Catalog and Service Manual Report.

GENERAL

Specifications and basic principle of Canola 130S is described in which you may understand the fundamental working principles of this electronic calculator.

OPERATION

The actual operation are described as based on the principles which are explained in General, so that you may understand the structural and performance operations accordingly.

HOW TO REPAIR

Operation Check Program; Detecting; Wiring Diagrams & Tables and Tools & Testing Equipment are described and gives instructions for actual repairs and maintenance.

PARTS CATALOG

Assembly Units and Parts are listed in this section and should be used in locating the physical positions for repair & maintenance.

SERVICE MANUAL REPORT

Reports of any modifications which should be known by all service personnels and agencies will be issued and forwarded as soon as published. It is important to keep them, so they should be filed in this section for future reference.

Canola 130S

CONTENTS

I. General

1. Specification	1
2. Characteristic of Canola 130S	3
2.1 Special Features	3
2.1-1 Quotient eight digits	3
2.1-2 Discount calculation	3
2.1-3 Clear-Indicator Key recalls the content of accumulator	4
2.1-4 Negative Sign (Negative value)	4
2.2 Key Operations Constant & Inverse	6
2.2-1 Key operation	6
2.2-2 Erroneous operation correction	7
2.3 Circuit	8
2.3-1 AND gate	8
2.3-2 Overflow lamp Lamp Lock circuit for double registration	8
3. Principle	9
3.1 Addition and Subtraction	9
3.2 Multiplication	9
3.3 Division	10

II. Operation

1. Block Diagram	1
1.1 Input Block	1
1.1-1 Encoder	1
1.1-2 Start circuit	1
1.2 Output Block	3
1.2-1 Numeral indicator	3
1.2-2 Decimal point indicator	3
1.2-3 Digit separator Line indicator	3
1.2-4 Overflow indicator	4
1.2-5 Negative sign indicator	4
1.3 Arithmetic Block	4
1.3-1 Indication register (IR)	4
1.3-2 Accumulator (ACC)	5
1.3-3 Shift pulse (SP-I and SP-A)	5

1.3-4	Gate circuit	6
1.4	Control Block	6
1.4-1	Pulse generator (PG)	6
1.4-2	Bit counter	6
1.4-3	Timing counter (TC)	8
1.4-4	Control counter (CC)	9
1.4-5	Tridecimal Subtraction Counter	10
1.4-6	Order Flip-flops	11
1.4-7	1-Sub circuit	13
2.	Flow Chart	15
2.1	Addition and Subtraction	15
2.2	Multiplication	16
2.2-1	Constant multiplication	18
2.2-2	Discount calculation	18
2.3	Division	18
2.3-1	Constant division	19
2.3-2	Inverse division	19
3.	Explanation of Arithmetic Operations	21
3.1	Addition or Subtraction	21
3.2	Multiplication	23
3.3	Constant multiplication	24
3.4	Division	24
3.5	Constant division	26
3.6	Discount calculation	26
3.7	Inverse division	26

III. How to Repair

1.	Operating Check Program	1
2.	Trouble-shooting	5
2.1	Power Supply System	5
2.1-1	No AC current when power source present	5
2.1-2	DC current present	5
2.1-3	DC voltage are not normal when the primary AC supply is	7
2.1-4	Other symptoms	8
2.2	Hints for detecting faults in arithmetic unit	9
2.2-1	No clearing when  key is pressed	9
2.2-2	Faulty registration	9
2.2-3	Erroneous addition or subtraction when  or  key pressed	10
2.2-4	Incorrect decimal point coordination of addition or subtraction	11

Canola 130S

2.2-5	Erroneous or no multiplication	11
2.2-6	Erroneous or no division	11
2.2-7	Erroneous or no constant multiplication	12
2.2-8	Erroneous constant division	12
2.2-9	Erroneous or no inverse division	12
3.	Wiring Diagrams and Tables	15
3.1	Block Wiring Diagram	15
3.2	Block Layout and Wiring (1)	15
3.3	Block Layout and Wiring (2)	17
3.4	Type of Wires	19
3.5	Terminal Diagram of Card Unit	20
3.6	Parts Layout in Card Unit	21
3.7	Main Panel Wiring	27
3.8	Signal Destination in Main Panel	28
3.9	Power Supply in Main Panel	30
3.10	Arithmetic Unit (1)	32
3.11	Arithmetic Unit (2)	33
3.12	Arithmetic Unit (3)	34
3.13	Arithmetic Unit (4)	35
3.14	Keyboard Unit (1)	36
3.15	Keyboard Unit (2)	37
3.16	Keyboard Unit (3)	39
3.17	Keyboard Unit (4)	39
3.18	Power Supply Unit (1)	40
3.19	Power Supply Unit (2)	41
3.20	Power Supply Unit (3)	42
3.21	Power Supply Unit (4)	43
3.22	Power Supply Unit (5)	44
3.23	Power Supply Unit (6)	45
3.24	Power Supply Unit (7)	46
3.25	Power Supply Unit (8)	47
3.26	Power Supply Unit (9)	48
4.	Tools and Testing Equipment	49
4.1	Service Checker	49

IV. Parts Catalog

1.	Indicator & Arithmetic Unit	2
1.1	G-X, G-Y, MSD-1, LAMP AMP and IR (Card Unit No. 1) .	4
1.2	Counter P, IR, LAMP AMP and IR (Card Unit No. 2)	5
1.3	F _H , F _Z , F _C and F _{Div} (Card Unit No. 3)	6
1.4	LAMP AMP, IR and ACC (Card Unit No. 4, No. 6, No. 8) ..	7
1.5	F _M and Control Counter (Card Unit No. 5)	8
1.6	Counter A (Card Unit No. 7)	9
1.7	PG, SP-A and Adder-Subtractor (Card Unit No. 9)	10
1.8	Counter D, LAMP AMP and IR (Card Unit No. 10)	11
1.9	OS and BIT Counter (Card Unit No. 11)	12
1.10	Timing Counter, F _{MLT} , LAMP AMP and IR (Card Unit No. 12)	13

1.11	F _{SUB} , F _O and F _C (Card Unit No. 13)	
2.	Keyboard Unit	18
3.	Power Supply Unit	20
3.1	Power Supply	22
4.	Casing	24

Canola 130S

CONTENTS

I. General

1. Specification	1
2. Characteristic of Canola 130S	3
2.1 Special Features	3
2.1-1 Quatient eight digits	3
2.1-2 Discount calculation	3
2.1-3 Clear-Indicator Key recalls the content of accumulator	4
2.1-4 Negative Sign (Negative value)	4
2.2 Key Operations Constant & Inverse	6
2.2-1 Key operation	6
2.2-2 Erroneous operation correction	7
2.3 Circuit	8
2.3-1 AND gate	8
2.3-2 Overflow Lamp Lock circuit for double registration	8
3. Principle	9
3.1 Addition and Subtraction	9
3.2 Multiplication	9
3.3 Division	10

I. General

Canola 130S, a general business calculator; is an improved version of Canola 130 which is one of the Canola series consisting of models 120, 130, 151, 161 and 167.

Canola 130S which is much smaller in size and weight than Canola 130, introduces two new conventional functions.

1. Specifications

Operation Addition, subtraction, multiplication, division, continuous multiplication, continuous division, accumulative multiplication, constant multiplication, constant division, inverse division, discount calculation and mixed calculation.

Digit Capacity

Addition & Subtraction	13 digits
Multiplication	Multiplicand + Multiplier = 13 digits
Division	Dividend 11 digits
	Divisor 11 digits
	Quotient 8 digits

Operation Time

Addition & Subtraction	0.08 sec (maximum)
Multiplication	0.7 sec (maximum)
Division	0.5 sec (maximum)

Decimal Point Automatic coordination

Operation Principle Series binary-coded decimal notation
(8-4-2-1 code)
Clock pulse of 10 kc

Operation Manual key operation

Circuit Elements Transistors and diodes

New Safety Functions Overflow lamp:

- i Prevent double registration.
- ii Prevent excess registration.
- iii To warn that the result of calculation has a carry-over in the 14th digit.
- iv To warn in decimal point coordination that the result is more than 13 digits and will not calculate.

Prevent the numeric from been erased when the division key has been pressed more than one time.

Interchange of the contents of registers by pressing RV (inverse) key in division.

Constant multiplication or division can be accomplished by using the constant key.

Mixed Calculation Operation is accomplished according to the sequence of the order keys.

Negative Numeric Negative (-) sign appears with the numeric.

Input Device 10 manually operated numeral keys; a decimal key and order keys. Key arrangement; shape of keys and key touch are designed for one-hand operation.

Output Device Luminous dotted figures

Order Keys

 (black)	Addition, accumulative multiplication and results. or
 (red)	Subtraction accumulative multiplication and results.
	Multiplication
	Division
	One-digit right shift
	Interchange of the contents in indication register and accumulator in division.
	Clearing of numeric in the indicator.
	Clearing of all calculations to start a new one.
	Accumulative multiplication lock key.
	Constant multiplication or division lock key

Dimensions

Width	344 mm (13.5 in.)
Depth	435 mm (17.1 in.)
Height	198 mm (7.8 in.)

Weight 11.5 kg (25.3lbs)

Power Input

- i Optional AC current of 100, 115, 220 or 240 Volts 50/60 cycle.
- ii Voltage fluctuation range allowance of +10 ~15 %.

iii Power consumption of 48 w

- Ambient Conditions i Temperature range of 0 ~ 40°C
ii Humidity range 30 ~ 90 %

2. Characteristic of Canola 130S

It is divided into three sections i.e., special features; key operation and circuit; so it is necessary to understand thoroughly the following operations, so as to be come well acquainted with this calculator for maintenance and repairs.

2.1 Special Features

2.1-1 Quotient eight digits.

The number of digits of the quotient obtained in division by Canola 130 or 161 is the number of digits of dividend minus the number of digits of divisor. When the number of digits of the divisor becomes greater, the number of digits of the quotient becomes smaller. To eliminate this demerit, Canola 130S is designed to give a quotient of eight digits. Operation is described in the Flow Chart.

Example: $99999999 \div 12345678.9876 \rightarrow 0$ (Canola 130)
 $99999999 \div 12345678.9876 \rightarrow 8.0999999$ (Canola 130S)

2.1-2 Discount calculation

(I) Discount equation $A(1-B)$

$A \times B \dots\dots\dots$ (i)

$A - A \times B \dots\dots\dots$ (ii)

The results of the above calculations (i) and (ii) is obtained by the following simple key operation:

The result of (i) appears when A $\times$ B $=$, keys are pressed, and the result of (ii) appears when the $\ominus$ (minus) key is then pressed.

(II) Discounting equation $AB(1-C)$

$A \times B \dots\dots\dots$ (i)

$A \times B \times C \dots\dots\dots$ (ii)

$A \times B - A \times B \times C \dots\dots\dots$ (iii)

A, B and C denote numerics values. When A $\times$ B $=$ keys are pressed, the result of (i) appears. Next, when $\times$ C $=$ keys are pressed, the result of (ii) appears. Then, when the $\ominus$ (minus) key is pressed the result of (iii) appears.

Example 1: Obtaining the amount with a 6% discount from a sale of ¥8,500.

Indicator

8,500 $\times$ 0.06 $=$ 510 (discount amount)

$\ominus$ 7990 (amount after discount)

Example 2: Obtaining the net payment to be received from a total sales when the unit price is ¥2,380 and the quantity sold is 50 with a discount rate of 3 %.

Indicator

2,380 $\times$ 50 $=$ 119,000 (total sale)

$\times$.03 $=$ 3,570 (discount amount)

$\ominus$ 115,430 (net amount to be received)

2.1-3 Clear-Indicator key recalls the content of accumulator

If the position of the decimal point in the indication register does not coincide with that in the accumulator when an addition, a subtraction or an accumulative multiplication is conducted, the calculator does not do any calculation of addition or subtraction and the overflow lamp lights up and then stops.

When this takes place, the content of the accumulator can be recalled by pressing $\square$ key. When $\square$ key is pressed, 0's appears in the indicator but the content of the accumulator appears in the indicator when the key has been released.

Example 1: 3333333+0.11111111 $\rightarrow$ Operation stops.

3333333 $=$ 0.11111111 $=$ 0 0 0 0.1 1 1 1 1 1 1 1

$\square$ pressing 0 0 0 0 0 0 0 0 0 0 0 0

$\square$ released 3 3 3 3 3 3 3.0 0 0 0 0

Example 2: 0.3333333+11111111 $\rightarrow$ Operation stops.

0.3333333 $=$ 11111111 $=$ 1 1 1 1 1 1 1 1.0 0 0 0

$\square$ pressing 0 0 0 0 0 0 0 0 0 0 0 0

$\square$ released 0 0 0 0 0.3 3 3 3 3 3 3

2.1-4 Negative Sign (negative value)

Canola 130S has a function for indicating a negative value result with an negative sign. When the calculation is necessary

to have a negative value for it numeric, press the $\ominus$ (minus) key once immediately after the registration of the first numeric.

Indicator

$\boxed{2}\boxed{5}\boxed{\ominus} \rightarrow -0000000000025$
 $\uparrow$ Negative sign

In constant multiplication or division, the constant (multiplier or dividend) is always positive in the calculation operation although negative sign may be affixed to variables. Indication of "-0" in addition, subtraction or accumulative multiplication operation signifies that the calculated result has become zero from a negative value side. Although the negative sign lamp is lit, it doesn't hamper the succeeding operation.

Example 1: Addition and subtraction

Indicator

$2 - 3 = -1$	$\boxed{2}\boxed{-}\boxed{3}\boxed{=}$	-1
$-2 + 3 = 1$	$\boxed{2}\boxed{\ominus}\boxed{3}\boxed{=}$	1
$-2 + 2 = 0$	$\boxed{2}\boxed{\ominus}\boxed{2}\boxed{=}$	-0

Example 2: Multiplication

Indicator

$2 \times (-3) = -6$	$\boxed{2}\boxed{\times}\boxed{3}\boxed{\ominus}$	-6
$(-2) \times 3 = -6$	$\boxed{2}\boxed{\ominus}\boxed{\times}\boxed{3}\boxed{=}$	-6
$(-2) \times (-3) = 6$	$\boxed{2}\boxed{\ominus}\boxed{\times}\boxed{3}\boxed{\ominus}$	6

Example 3: Division

Indicator

$1 \div (-3) = -0.3333333$	$\boxed{1}\boxed{\div}\boxed{3}\boxed{\ominus}$	-0.3333333
$(-1) \div 3 = -0.3333333$	$\boxed{1}\boxed{\ominus}\boxed{\div}\boxed{3}\boxed{=}$	-0.3333333
$(-1) \div (-3) = 0.3333333$	$\boxed{1}\boxed{\ominus}\boxed{\div}\boxed{3}\boxed{\ominus}$	0.3333333

Example 4: Constant multiplication (positive constant)

$\boxed{K}$ lock Indicator

$2 \times 3 = 6$	$\boxed{2}\boxed{\times}\boxed{3}\boxed{=}$	6
$2 \times (-4) = -8$	$\boxed{4}\boxed{\ominus}$	-8
$2 \times 5 = 10$	$\boxed{5}\boxed{=}$	10

Example 5: Constant multiplication (negative constant)

	$\boxed{K}$ lock	Indicator
$(-2) \times 3 = -6$	$\boxed{2} \boxed{\ominus} \boxed{\times} \boxed{3} \boxed{=}$	-6
$2 \times (-4) = -8$	$\boxed{4} \boxed{\ominus}$	-8
$2 \times 5 = 10$	$\boxed{5} \boxed{=}$	10

Note: $\boxed{K}$ key cannot remember the minus constant but only the numeric, so it is just the same as ordinary multiplication as shown in Example 2.

Example 6: Constant division (positive constant)

	$\boxed{K}$ lock	Indicator
$1 \div 3 = 0.3333333$	$\boxed{1} \boxed{\div} \boxed{3} \boxed{=}$	0.3333333
$(-4) \div 3 = -1.3333333$	$\boxed{4} \boxed{\ominus}$	-1.3333333
$5 \div 3 = 1.6666666$	$\boxed{5} \boxed{=}$	1.6666666

Example 7: Constant division (negative constant)

	$\boxed{K}$ lock	Indicator
$1 \div (-3) = -0.3333333$	$\boxed{1} \boxed{\div} \boxed{3} \boxed{\ominus}$	-0.3333333
$(-4) \div 3 = -1.3333333$	$\boxed{4} \boxed{\ominus}$	-1.3333333
$5 \div 3 = 1.6666666$	$\boxed{5} \boxed{=}$	1.6666666

Note: Since $\boxed{K}$ key cannot remember the minus constant, it is the same as positive constant after the first calculation as shown in Example 6.

2.2 Key Operations Constant & Inverse

2.2-1 Key operation

1) Constant key

a. Multiplication

If the multiplicand used in the preceding multiplication when $\boxed{K}$ key is not locked wished to be used for constant multiplication, it is only necessary to press the $\boxed{K}$ key after the calculation and to enter the multiplier.

When $\boxed{K}$ key is released after the constant multiplication has been completed then it will operate for ordinary multiplications.

b. Division

If the $\boxed{K}$ key is pressed after the division calculation, the divisor will not appear as a constant; but if $\boxed{K}$ key is pressed before $\boxed{=}$ or $\boxed{\ominus}$ key, then it can be used for constant division.

When $\boxed{K}$ key is released after the constant division has been completed, ordinary division will be conducted. $\boxed{K}$ key must always be pressed before the $\boxed{=}$ or $\boxed{\ominus}$ key for constant division.

2) Inverse key (RV)

The inverse key which is used for inverse division must not be pressed more than one time. If the key is pressed two or more times in succession, the position of the decimal point will differ when the result is indicated.

2.2-2 Erroneous operation correction

1) $\boxed{\times}$ or $\boxed{\div}$ key is pressed erroneously:

If $\boxed{\times}$ key is pressed instead of the $\boxed{\div}$ key, simply pressing the $\boxed{\div}$ key will correct the mistake. But if $\boxed{\div}$ key is erroneously pressed instead of the $\boxed{\times}$ key, it is necessary to press the $\boxed{\rightarrow}$ key before pressing the $\boxed{\times}$ key so as to shift the registered numeric to the right because the numeric was shifted to the highest digit position when the $\boxed{\div}$ key was pressed.

2) Dividend or divisor has more than 11 digits:

If the $\boxed{\div}$ key is pressed when all the 13 digit positions of the indication register are filled with a dividend, the overflow lamp will light up and stop. When this occurs, shift the numeric one digit to the right by pressing the $\boxed{\rightarrow}$ key and then press the $\boxed{\div}$ key again. Although the number of digits of the dividend is 12 digits after pressing the $\boxed{\rightarrow}$ key, the least significant digit of the 12 digits is automatically eliminated in the accumulator making it 11 digits for actual operation as specified.

If a divisor of 13 digits is entered and the $\boxed{=}$ or $\boxed{\ominus}$ key is pressed, the overflow lamp will light up and stop. Press the $\boxed{\rightarrow}$ key to shift the numeric one digit to the right and then press the $\boxed{=}$ or $\boxed{\ominus}$ key. After pressing the $\boxed{\rightarrow}$ key, the number of digits of the divisor is reduced to 12, and it automatically decreases to 11 by the gate control which cuts off the least significant digit.

3) Not entering the multiplier or divisor.

When the multiplier was forgotten to be entered for multiplication and the $\boxed{=}$ or $\boxed{\ominus}$ key is pressed, it does no calculation operation. Simply enter the multiplier and proceed. It is the same for the divisor when it was not entered for division.

4) Registering the wrong numeric.

$\boxed{CI}$ key is used to clear the indication register, so if a wrong divisor is entered, it can be corrected by pressing $\boxed{CI}$ key and only entering the correct numeric and proceeding without press-

ing the $\pm$ key again; but if a wrong multiplier, the multiplicand and multiplier must be entered again, after pressing the CI key.

5) Priority sequence of A and K keys:

If A and K keys are pressed simultaneously, the K key has priority and constant calculation is conducted.

2.3 Circuit

Canola 130S employs the negative logics similarly to Canola 130 and 161, as follows:

Signal 0 $\longrightarrow$ 0V
Signal 1 $\longrightarrow$ -10V

2.3-1 AND gate

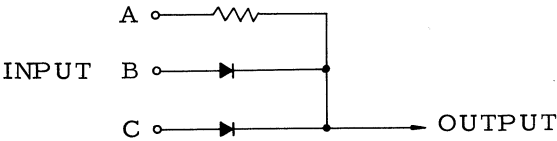


Fig. 1 AND Gate

Table 1. Truth Table

Input			Output	Input			Output
A	B	C		A	B	C	
0	0	0	0	1	0	0	0
0	0	1	0	1	0	1	0
0	1	0	0	1	1	0	0
0	1	1	0	1	1	1	1

2.3-2 Overflow Lamp Lock circuit for double registration

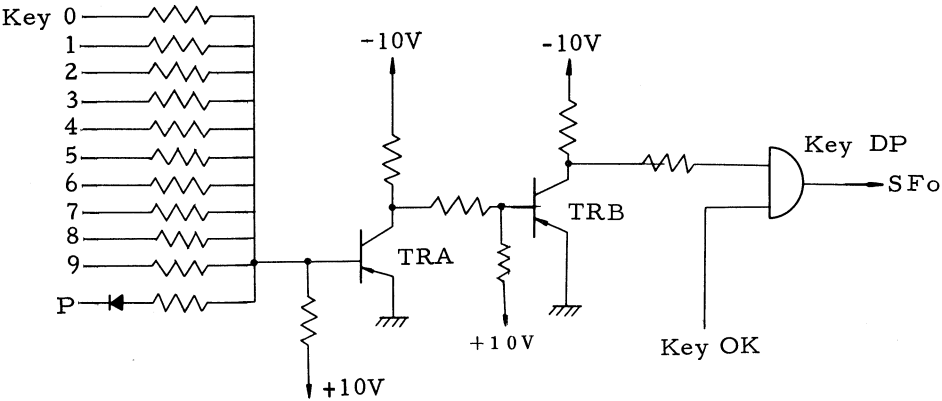


Fig. 2. Lock Circuit for Double Registration

When no key is pressed or only one numeral key or decimal point is pressed, transistor TRA is cutoff. If two keys are pressed at the same time, TRA becomes conduct. When TRA is cutoff (output 0), the transistor TRB is always conduct (output 1) or visa versa.

Since key DP is connected to SFo (Set Fo), Fo will be set when key DP output signal is 1 by a double entry and the overflow lamp lights up and stops the registration of the following numeral.

3. Principle

Canola 130S consists of two registers: indication register (IR) and accumulator (ACC). Both registers are designed for one word consisting of 13 digits with each digit being composed of four bits. The 13th digit of the accumulator is provided with an adder-subtractor. The registers employ the 8-4-2-1 binary code and the numeric are always shifted to the right (from the most significant digit toward the least significant digit) in both registers by shift pulses.

The register can shift the registered numeric one digit to the right; but if the numeric is shifted one digit to the left, the register must shift the numeric 12 digits to the right. The arithmetic block including these registers and the control block controls addition, subtraction, multiplication and division operations.

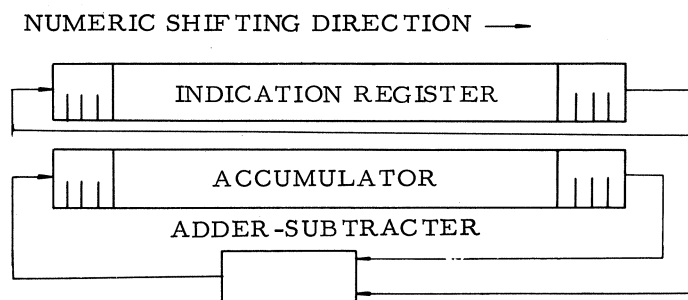


Fig. 3 Registers

3.1 Addition and Subtraction

Register the augend or minuend in the accumulator and the addend or subtrahend in the indication register. In addition or subtraction, the position of the decimal point of the contents of the accumulator must always coincide with that of the content of the indication register. P & A counter compares the number of digits below the decimal point of the content of the accumulator with that of the indication register and shifts to the left the content of the register which contains the least number of digits below the decimal point until the position of the decimal point coincides with that of the other register. Then the calculator conducts addition or subtraction of the contents of the accumulator and the indication register and registers the calculated result in the accumulator. If the content of the accumulator is a positive value, it is unchanged; but if it is a complement, it is transformed to its true value and indicates the proper sign. Then the content of the accumulator interchanges with that of the indication register and the sum or difference appears in the indicator.

3.2 Multiplication

After the $\square$ key is pressed, the contents of the indication register (IR) rotates to the right until the most significant digit of the multiplier

reaches the first digit position of indication register and instantaneously 1 is subtracted from it. While it is shifting to the right for the next operation, the multiplicand enters the accumulator (ACC) one time. When the most significant digit (MSD) in IR again comes to the first digit position, 1 is again subtracted and proceeds as formerly. This continues till it becomes zero. When the zero is shifting, the multiplicand enters ACC and also shifts one digit to the right in IR, which also means that ACC shifts one digit to the left. Since the second most significant digit of the multiplier becomes MSD in IR, the same procedure takes place and this continues until the multiplier becomes zero, so then the content of ACC is the final result. Since IR registers the numeric in the indicator by the decoder, the final result in the ACC must be transferred to IR. In the transferring, the content of IR (multiplicand) is interchanged with that in ACC. Since the multiplicand is now in ACC, if the constant multiplication order ($\boxed{K}$ key) is given, the multiplicand becomes the constant for constant multiplication.

3.3 Division

In division, it repeatedly subtracts the divisor in the indication register (IR) from the dividend in the accumulator (ACC), and registers the number of times of subtraction in the lowest digit position in ACC as the quotient which has either seven or eight digits. Both the dividend in ACC and the divisor in IR always shift left to the 12th digit in their registers at the beginning of division. Then the content of IR (divisor) is subtracted from the content of ACC (dividend). Every time a subtraction is performed, 1 is always added to the 1st digit of ACC until the content of ACC becomes negative. At that time, it adds the numeric of IR to the dividend in ACC and subtracts 1 from the least significant digit of the quotient in ACC and shifts the dividend one digit to the left for the succeeding subtraction and the quotient for the answer.

If there are 12 digits in the dividend or divisor, the least significant digit is dropped off before subtraction.

When the quotient shifts left and overlaps the dividend in ACC, the digit or digits it overlaps are omitted in subtraction till the quotient has eight digits, but the numeral or numerals are still memorized in IR.

At the end of the calculation, the quotient and remainder are registered in ACC and the divisor in IR, but the quotient must be transferred to IR before it can be registered in the indicator. In the transferring of the quotient in ACC, it interchanges with the divisor in IR and at the same time it eliminates the remainder, so that only the quotient registers in IR and the divisor in ACC. If constant division is desired, it can be easily obtained since the divisor is now in ACC.

The position of the decimal point in the quotient is determined before the calculating operation starts and coordinates to the most significant digit of the quotient. The decimal point always shifts to the right, so the position is obtained by the shifting from most significant digit toward the less significant digits the same number of times of the difference between the number of digits below the decimal point of the divisor and that of the dividend. The position of the decimal point always shifts with the quotient during the division.

CONTENTS

II. Operation

1. Block Diagram	1
1.1 Input Block	1
1.1-1 Encoder	1
1.1-2 Start circuit	1
1.2 Output Block	3
1.2-1 Numeral indicator	3
1.2-2 Decimal point indicator	3
1.2-3 Digit separator Line indicator	3
1.2-4 Overflow indicator	4
1.2-5 Negative sign indicator	4
1.3 Arithmetic Block	4
1.3-1 Indication register (IR)	4
1.3-2 Accumulator (ACC)	5
1.3-3 Shift pulse (SP-I and SP-A)	5
1.3-4 Gate circuit	6
1.4 Control Block	6
1.4-1 Pulse generator (PG)	6
1.4-2 Bit counter	6
1.4-3 Timing counter (TC)	8
1.4-4 Control counter (CC)	9
1.4-5 Tridecimal Subtraction Counter	10
1.4-6 Order Flip-flops	11
1.4-7 1-Sub circuit	13
2. Flow Chart	15
2.1 Addition and Subtraction	15
2.2 Multiplication	16
2.2-1 Constant multiplication	18
2.2-2 Discount calculation	18
2.3 Division	18
2.3-1 Constant division	19
2.3-2 Inverse division	19

3.	Explanation of Arithmetic Operations	21
3.1	Addition or Subtraction	21
3.2	Multiplication	23
3.3	Constant multiplication	24
3.4	Division	24
3.5	Constant division	26
3.6	Discount calculation	26
3.7	Inverse division	26

II. Operation

1. Block Diagram

The input block consists of numeral and order key circuit, encoder and start circuit. The output block consists of circuits for indicating numerals, digit separator line, decimal point, overflow and negative sign. The arithmetic block consists of two 13-digit registers as indication register and accumulator (the 13th digit of the accumulator is used as an adder), and various gate circuits for transferring numerics between the registers. The control block consists of a pulse generator, timing counter, control counter, order flip-flops, decimal point counter, auxiliary counter and digit counter, and the issued signals from them control the opening and closing of the gates in the arithmetic unit and the operation of the registers.

1.1 Input Block

1.1-1 Encoder

This circuit converts the numeral transmitted from the key into the equivalent binary number and registers it in the first digit of the indication register. The signal sent by the numeral key enters the encoder and control block simultaneously. The signal is converted into a binary number by the encoder and at the same time synchronizes with the Key OK signal transmitted from the control block, and then registers in the first digit of the indication register when it is triggered with the clock pulse (CP).

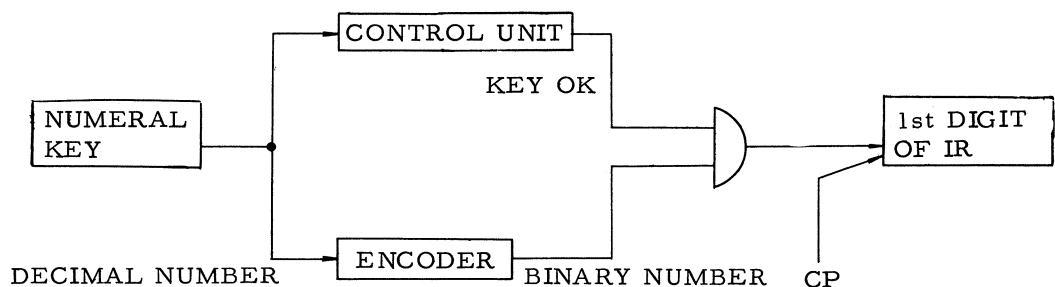


Fig. 2 Block Diagram of Numeral Registration in 1st Digit of Indication Register

1.1-2 Start circuit

This circuit starts the beginning of all operations and consists of monostable multivibrator Mk and flip-flop OS.

The monostable multivibrator Mk is of negative trigger system and has a 10ms time constant circuit. When it receives a signal from a key, it generates an output "1" for 10ms. Since the P8 trigger which is emitted by the bit counter, only enters the emitter of the transistor on the "1" side of the output of Mk; so that when the P8 trigger level becomes higher than the base level of the

transistor on the "1" side of Mk, then the MK output instantaneously becomes "0". The triggering by it depends on the rise time of the P8 pulse to the Mk discharge where the level is approximately 3 volts. The Mk output of "1" is emitted for a period of 7 ms, but rise time of Mk which enters the flip-flop OS is synchronized by P8.

Its set input is a "0" output of Mk passing through a condenser trigger circuit which sets the flip-flop OS. The reset input of OS is triggered by the rise time of CP. Thus, when Mk becomes "0", the output of OS is "1" at the rise time of Mk and immediately becomes "0" at the rise time of CP. Thus, the time period of OS output is $20\text{ }\mu\text{s}$ (1 bit time). Therefore, when any key except **[K]** or **[A]** key is pressed, Mk is always in operation and consequently OS which controls various circuits operates.

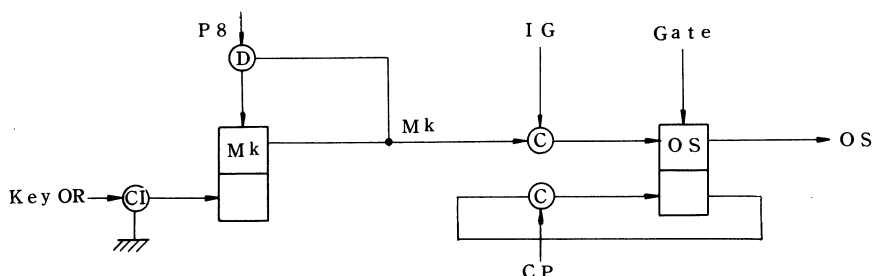


Fig. 3 Start Circuit

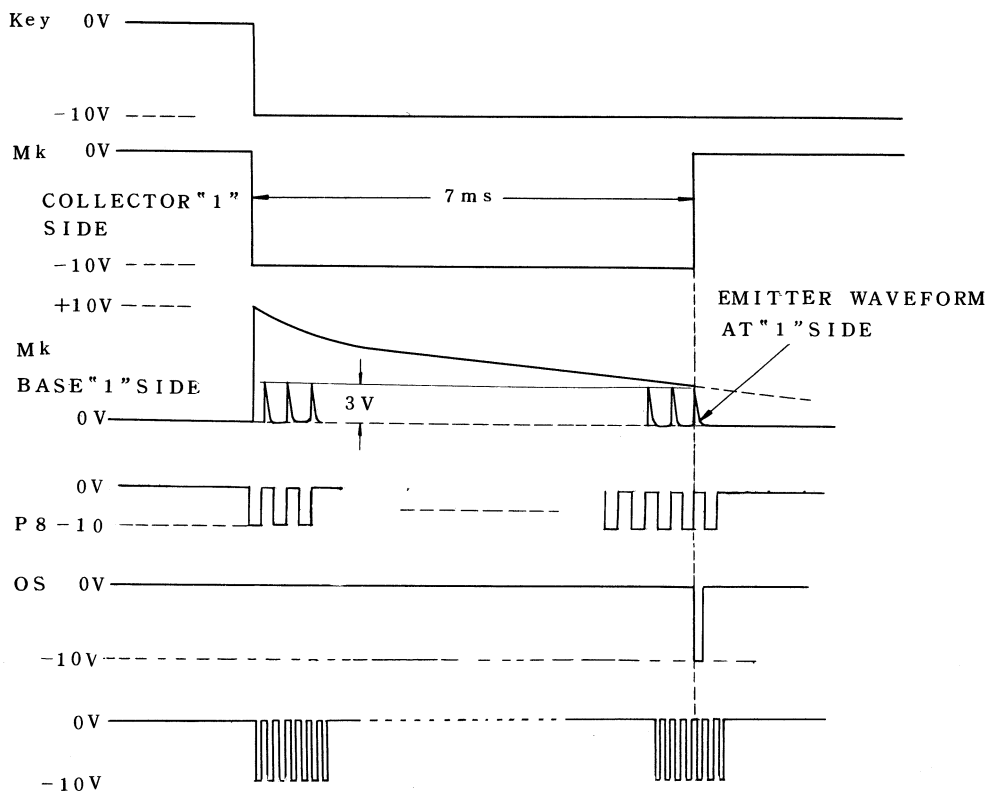
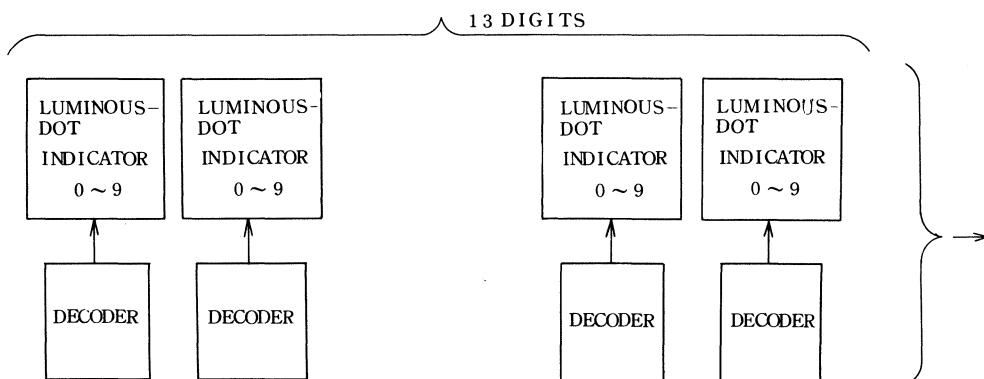


Fig. 4 Operation of Start Circuit

1.2 Output Block

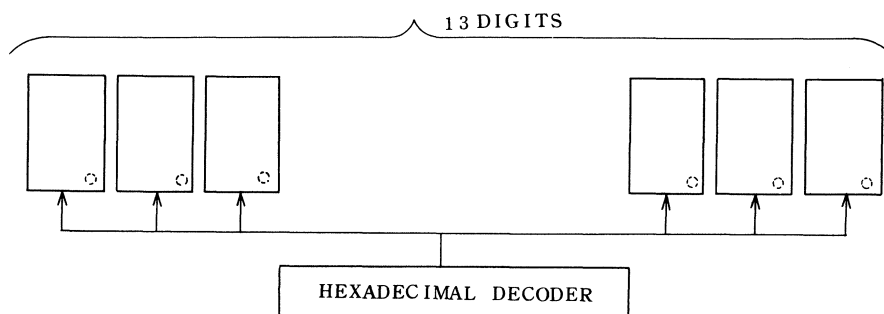
1.2-1 Numeral Indicator

The numeral indicator consists of decoders and luminous-dot indicators for 13 digits, as illustrated below. For each digit, a decoder and indicator boards of 0 ~ 9 are used.



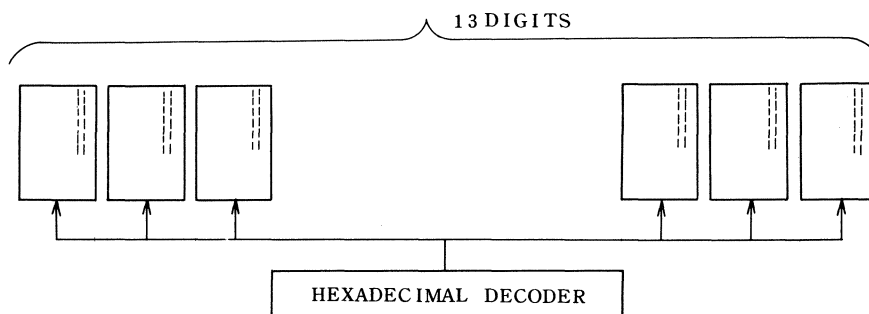
1.2-2 Decimal Point Indicator

This consists of a hexadecimal decoder and luminous-dot indicators as illustrated below.



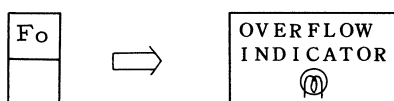
1.2-3 Digit Separator Line Indicator

This consists of a hexadecimal decoder and luminous-dot indicators as illustrated.



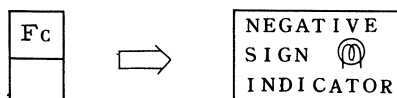
1.2-4 Overflow Indicator

This indicator consists of an overflow flip-flop (Fo) and lamp.



1.2-5 Negative Sign Indicator

This indicator consists of a negative sign flip-flop (Fc) and lamp.



1.3 Arithmetic Block

1.3-1 Indication register (IR)

The indication register (IR) contains 13 digits and each digit has four flip-flops (FF) with weights of 8, 4, 2 & 1 respectively. Therefore, IR consists of a total of $13 \times 4 = 52$ FF's as illustrated.

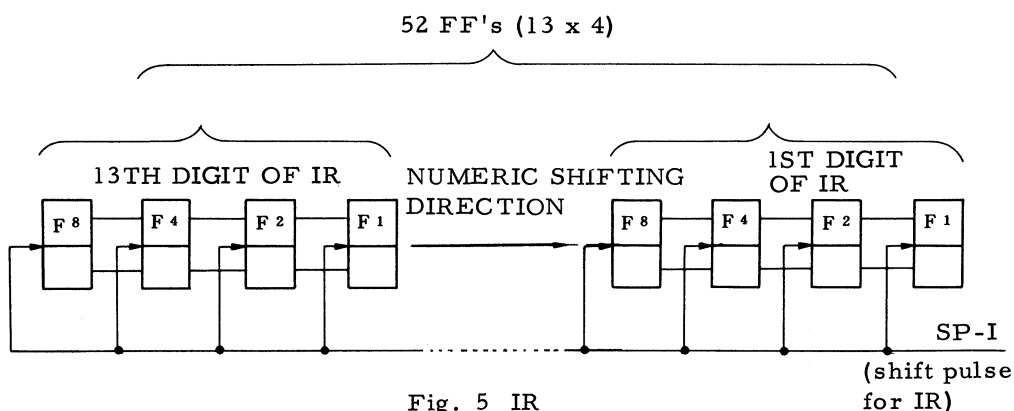


Fig. 5 IR

Since one digit is composed of four bits and one bit is shifted by one shift pulse, therefore one digit is shifted by four shift pulses. The numeric always shifts to the right, that is, from the 13th digit of IR toward the 1st digit of IR. The indication register controls decoders for indicating the numerals.

1.3-2 Accumulator (ACC)

The accumulator (ACC) is composed of FF's similarly to IR. The operation of its shift pulse SP-A and the numeric shifting direction are also similar to those of IR. The only exception is that the FF's of the 13th digit of ACC has the function of adder-subtractor, and the contents of IR and ACC must pass their respective gates to enter it. The calculation result is temporarily registered in ACC.

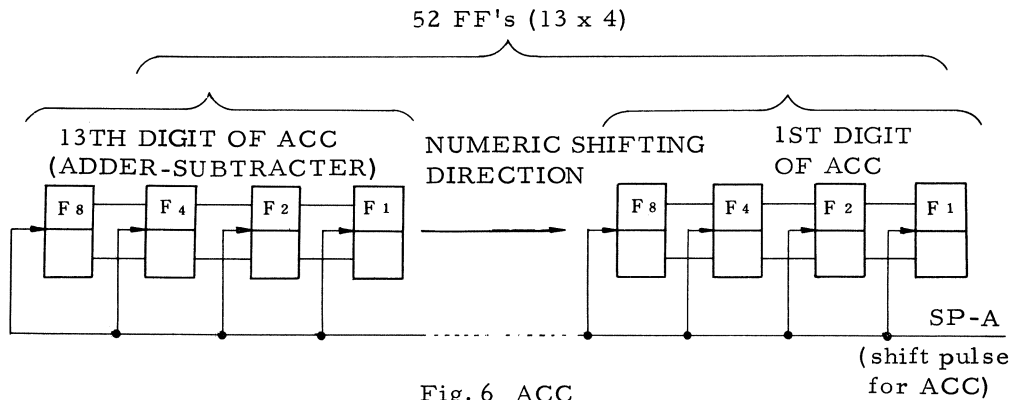
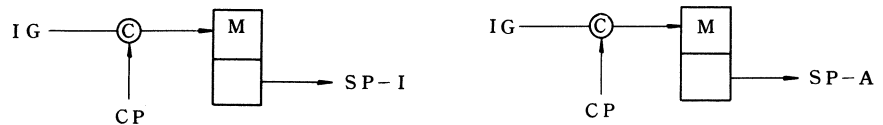


Fig. 6 ACC

1.3-3 Shift pulse (SP-I and SP-A)

Canola 130B uses two kinds of shift pulse which are SP-I for IR and SP-A for ACC. Signals of both SP-I and SP-A are controlled by CP and the time constant of 20 μ s of mono-multivibrator.



IG shown in the above is a gate for controlling the activities of SP-I and SP-A. It is an inhibit gate and when the signal "1" enters IG, the shift pulse SP-I or SP-A is not emitted.

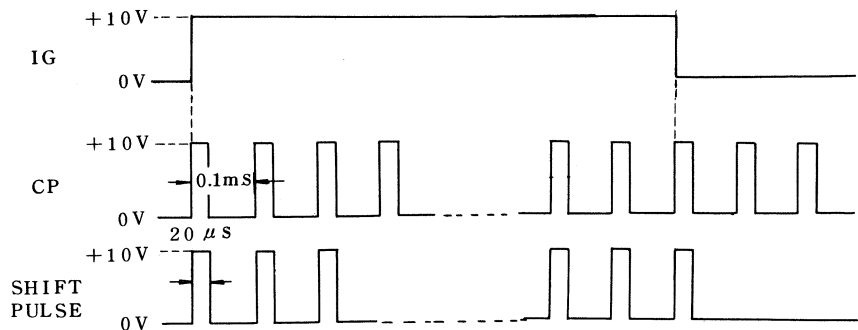


Fig. 7 Shift Pulse Timing Chart

1.3-4 Gate Circuits

The following briefly describes the performance of each gate:

G-N: Normally open but it closes only when G-JI opens.

G-JI: Opens to shift the multiplicand in multiplication one digit to the right.

G-II: Opens so that the content of IR rotates freely in IR.

G-AI: Opens so that the content of ACC transfer to IR.

G-AX: i) Opens so that the content of ACC rotates freely in ACC.

ii) Opens with G-IY or G-JY for addition or subtraction of the contents of ACC and IR.

G-JY: Opens with G-AX for addition or subtraction in multiplication.

G-IY: i) Opens to transfer the content of IR to ACC.

ii) Opens with G-AX for addition or subtraction of the contents of IR and ACC.

G-AY: Opens to covert the content of ACC to its complement.

1.4 Control Block

1.4-1 Pulse generator (PG)

This astable multivibrator generates the clock pulses (CP) of 10kc with duty factor 20% when the power supply is turned on and is always emitting and the emission of the fundamental pulse for the timing of all the functions of the calculator. The period of one cycle of CP is the time period of one bit. CP produces the timing and shift pulses, and also is the trigger pulses of various FF's.

1.4-2 Bit counter

Timing pulses (T-1, T-2, T-4, T-8 and P8) are obtained from the bit counter shown in Fig. 8 and their time relationship is shown as in Fig. 9.

T-1 is the pulse having a weight of 1. Similarly T-2, T-4 and T-8 are the pulses having weights of 2, 4 and 8 respectively. They correspond to the binary 8-4-2-1 code.

T-1 is obtained through the AND gate composed of F_1 & $\overline{F_2}$ and T-8 through the AND gate consisting of $\overline{F_1}$ & $\overline{F_2}$.

P8 has four timing pulses in its one cycle which signifies one

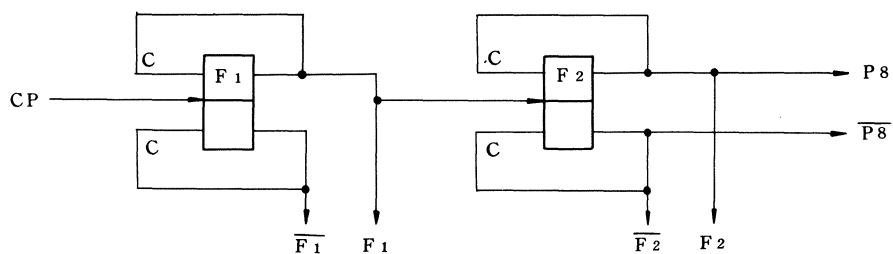


Fig. 8 Bit Counter

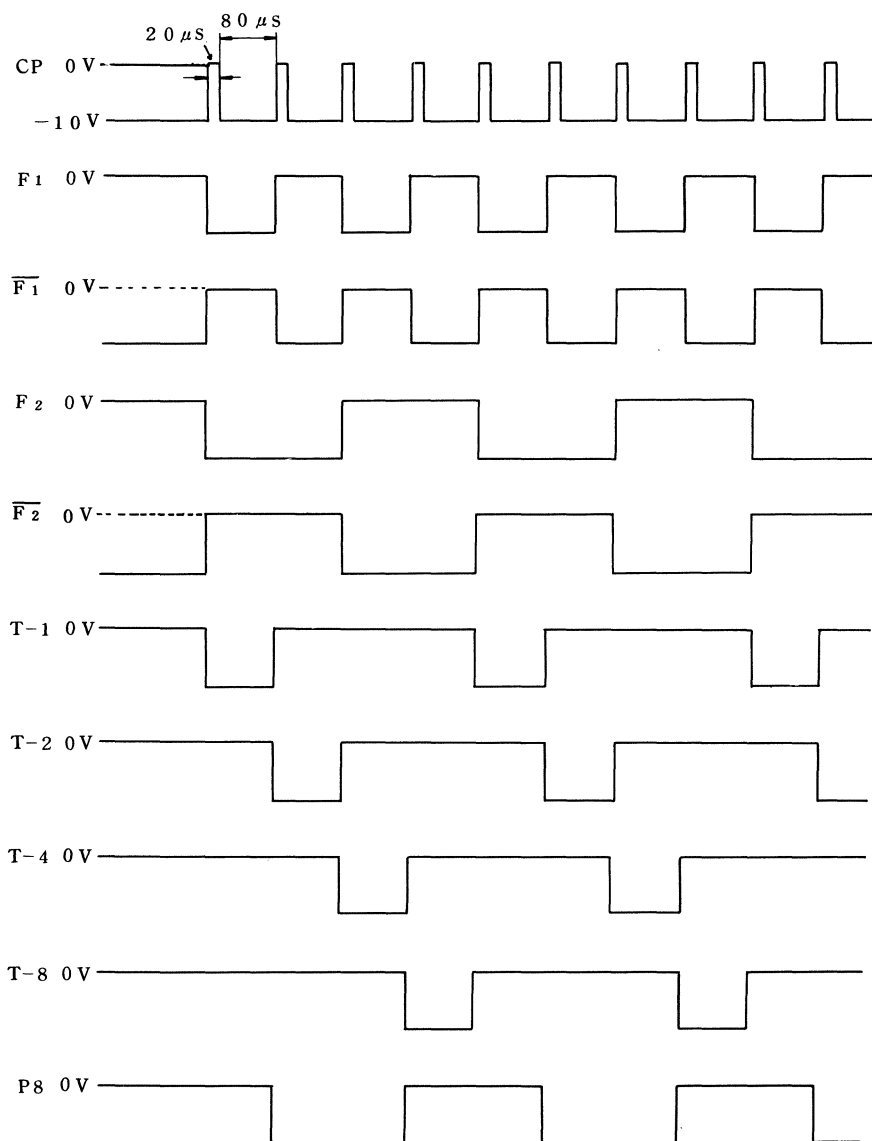


Fig. 9 Timing Chart of Bit Counter

1.4-3 Timing Counter (TC)

The timing counter is a hexadecimal counter. It counts the P8 pulses when a numeric moves within a register. At the rise of the first P8 after the numeric starts moving, the timing counter becomes TD1 and TD12 at the rise of 12th P8. In the registers the numeric always shifts to the right, therefore, the numeric has shifted one digit to the right when the timing counter is TD1. The numeric always shifts when FM is 1. Therefore, the timing counter is controlled by FM as to whether or not P8 pulses are counted.

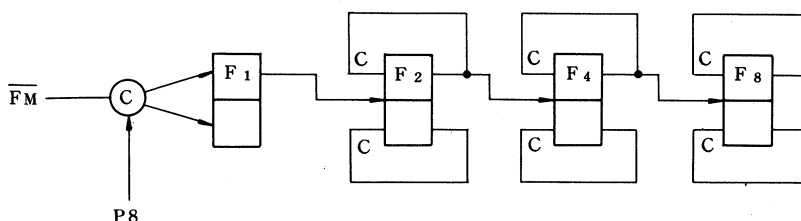


Fig.10 Timing Counter

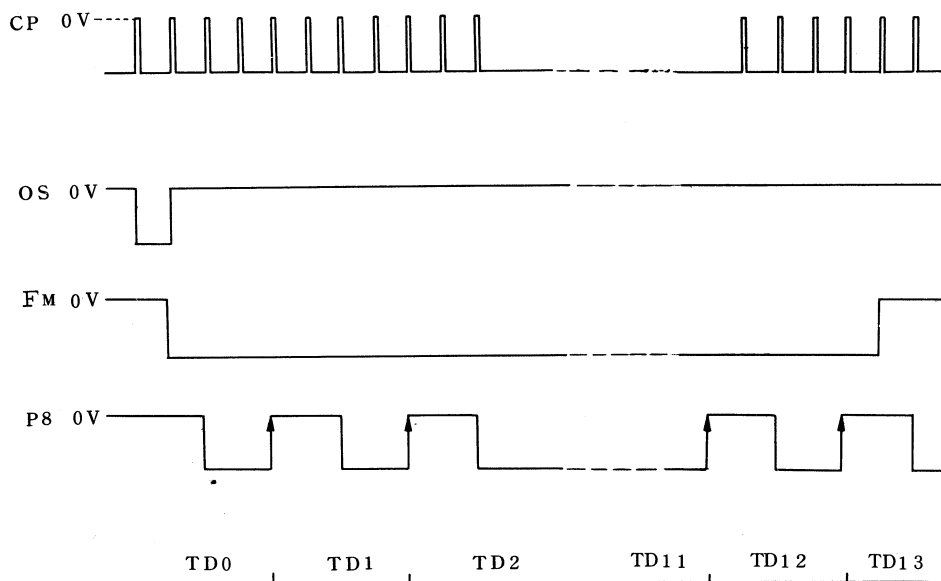


Fig.11 FM and Timing Pluse

1.4-4 Control Counter (CC)

The control counter has eight steps, (0 ~ 7) and the operation process at each step is described in the following Table 1.

Table 1. Relationship between Control Counter Step and Operation Process

STEP CC	Addition or Subtraction	Multiplication	Division
CC0	Ready	Ready	Ready
CC1	Registration	Registration and process of decimal point coordination	Registration and left shifting
CC2			Decimal point coordination & interchange of contents of IR & ACC of constant or inverse division
CC3	Decimal point coordination process	Decimal point coordination for accumulative multiplication	Decimal point coordination
CC4	Addition or subtraction	Addition or subtraction	Subtraction or addition
CC5		Shifting of multiplicand	Left shifting of remainder & quotient
CC6	Converting of complement	Converting of complement	Converting of complement
CC7	Indication	Indication	Indication

The control counter as shown in Fig. 12 consists of three FF's and several types of gates. Though it counts, it does not count all consecutive F_M pulses because of the interference of the signals from the different gates which set or reset the FF's for the different specified steps needed in the operation process.

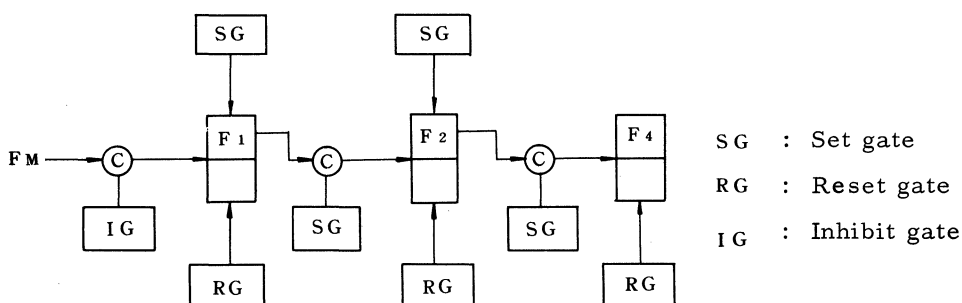


Fig. 12 Control Counter

1.4-5 Tridecimal Subtraction Counter

Canola 130S has three tridecimal subtraction counters for decimal point counter (P counter), auxiliary counter (A counter) and digit counter (D counter) which are each composed of four FF's and shows in Table 2 how the counter counts.

Table 2. Contents of Tridecimal Subtraction Counter

Input Pulse P8	1	2	3	4	5	6	7	8	9	10	11	12	13
Binary - Decimal	15	14	13	12	11	10	9	8	7	6	5	4	0
Tridecimal Counter	12	11	10	9	8	7	6	5	4	3	2	1	0

The reason the binary-decimal was omitted from 4 is because, at the 13th input pulse of P8, the counter resets automatically. These three counters only count when F_M is set.

1) P Counter (PC)

This counter is used to register the decimal point position of IR and to indicate it in the indicator by the decoder.

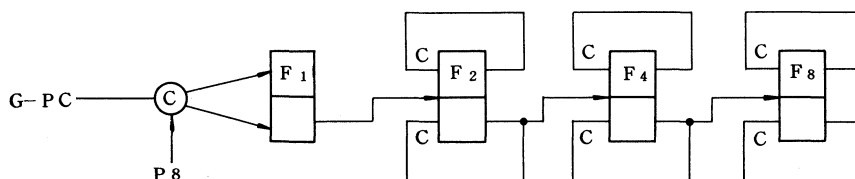


Fig. 13 P Counter

G-PC is an inhibit gate for controlling the operation of PC, so when it receives a signal "1", PC stops counting.

2) A Counter (AC)

This counter memorizes the difference of the decimal point positions of the contents of IR to ACC to coordinate the decimal points and also returns the decimal point to its correct position in the numeric constant for constant multiplication or division.

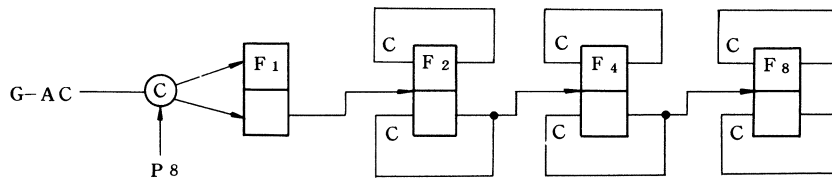


Fig. 14 A Counter

G-AC is an inhibit gate for controlling the operation of AC. When signal "1" is received by G-AC, AC stops counting.

3) D Counter (DC)

This counter identifies the boundary between the multiplicand and multiplier in multiplication and always used as an auxiliary counter of AC in division. The content of DC in multiplication passes through the decoder and the digit line appears in the indicator.

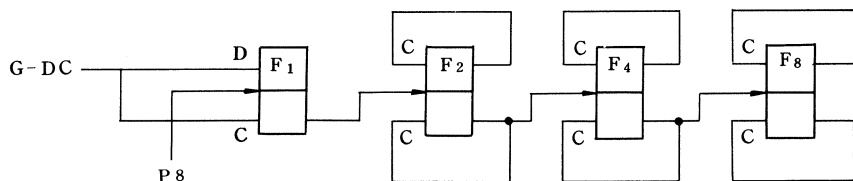


Fig. 15 D Counter

G-DC is the gate for controlling the operation of DC, but differs from G-PC and G-AC because DC starts counting when signal "1" is received.

1.4-6 Order Flip-flops

1) F_M

It is the main and most important flip-flop in the circuit since it is needed in all operations of IR & ACC and for various discriminations in the calculation. When F_M is in the condition of $\overline{F_M}$ and is not in the step of CC0, then it is the discriminating time.

2) F_P

It is used to memorize that the key for the decimal point was pressed and controls G-PC, G-AC & G-DC.

3) Fz

It discriminates and controls the opening and closing of the gates for the step of CC1 ~ CC4 and CC7 for multiplication, constant division and inverse division.

4) Fc

It discriminates and controls the opening and closing of the gate for the steps CC1, CC4 & CC5 to memorize the decimal point position of the quotient in division.

5) FH

It detects which has the greatest number of digits below the decimal point in the contents between IR and ACC. Besides, it controls subtraction and addition at CC4 in division and it also memorizes that the order is inverse division.

$$\left\{ \begin{array}{l} \text{No. of digits below decimal} \\ \text{point of contents of IR} \end{array} \right\} \geq \left\{ \begin{array}{l} \text{No. of digits below decimal} \\ \text{point of contents of ACC} \end{array} \right\} \quad F_H=1$$

$$\left\{ \begin{array}{l} \text{No. of digits below decimal} \\ \text{point of contents of IR} \end{array} \right\} < \left\{ \begin{array}{l} \text{No. of digits below decimal} \\ \text{point of contents of ACC} \end{array} \right\} \quad F_H=0$$

6) Fsub

Its function is to operate adder-subtractor as a subtracter.

7) Fc

It converts the complement to its true value and memorizes the negative sign of the result. Fc has a negative sign indication lamp circuit.

8) FMLT

It sets by the signal Key X and is used for various operations in multiplication.

9) Fdiv

It sets when the most significant digit of dividend has reached the 12th digit of IR after $\div$ key is pressed and is used for various operations in division.

10) Fo

It is to prevent a registration overflow in the indicator when two keys are simultaneously pressed or an overflow caused when the decimal points are not coordinating with each other in their registers or when the calculation result is over 13 digits, and when there is a Fo signal, the overflow lamp lights up and then all operation stops.

1.4-7 1-Sub Circuit

It is a circuit consisting of a flip-flop and gates as shown in Fig.16 for subtracting one from the most significant digit of the multiplier at CC4.

At the CC4 of multiplication, $\overline{Fz}$ is immediately set by signal MSD-1 (AND gate of CC4: $\overline{IR1D=0} \cdot \overline{FMLT \cdot DC=1} \cdot T-1$). As a result the rise pulse of $\overline{Fz}$ triggers Bo which remains set until a signal appears in G-Z. When a signal appears from G-Z, it triggers SP-I which resets Bo and during the resetting time, the subtraction of one is done by the AND and OR gates of G-I.

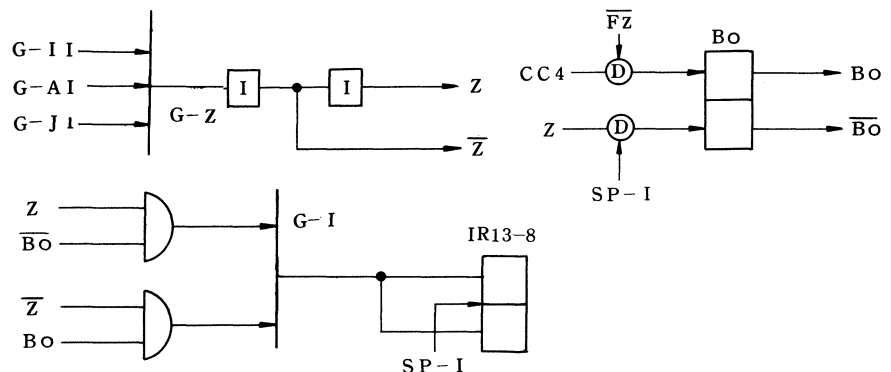
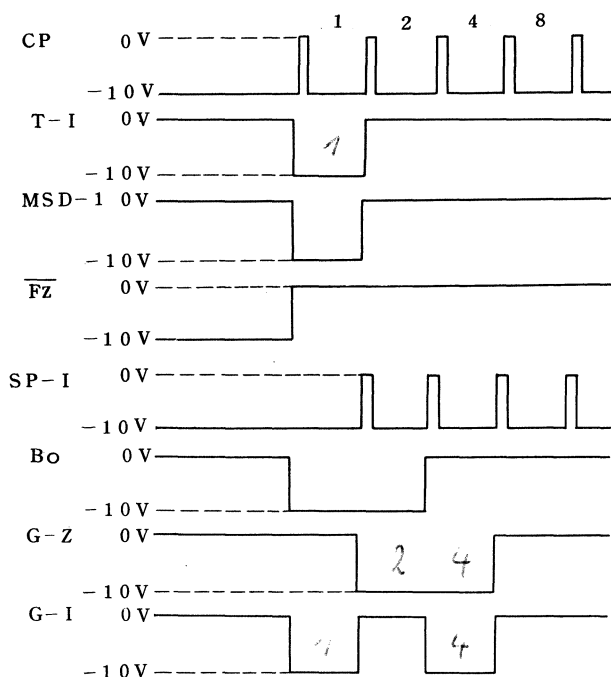


Fig. 16 1 Subtractor Circuit

Example: 6(0110) → 5(0101)



TRUTH TABLE

	G-Z	G-I
Weight 1	0	1
Weight 2	1	0
Weight 4	1	1
Weight 8	0	0
Decimal Number	(6)	(5)

Fig. 17 Timing Chart of 1-Sub Circuit

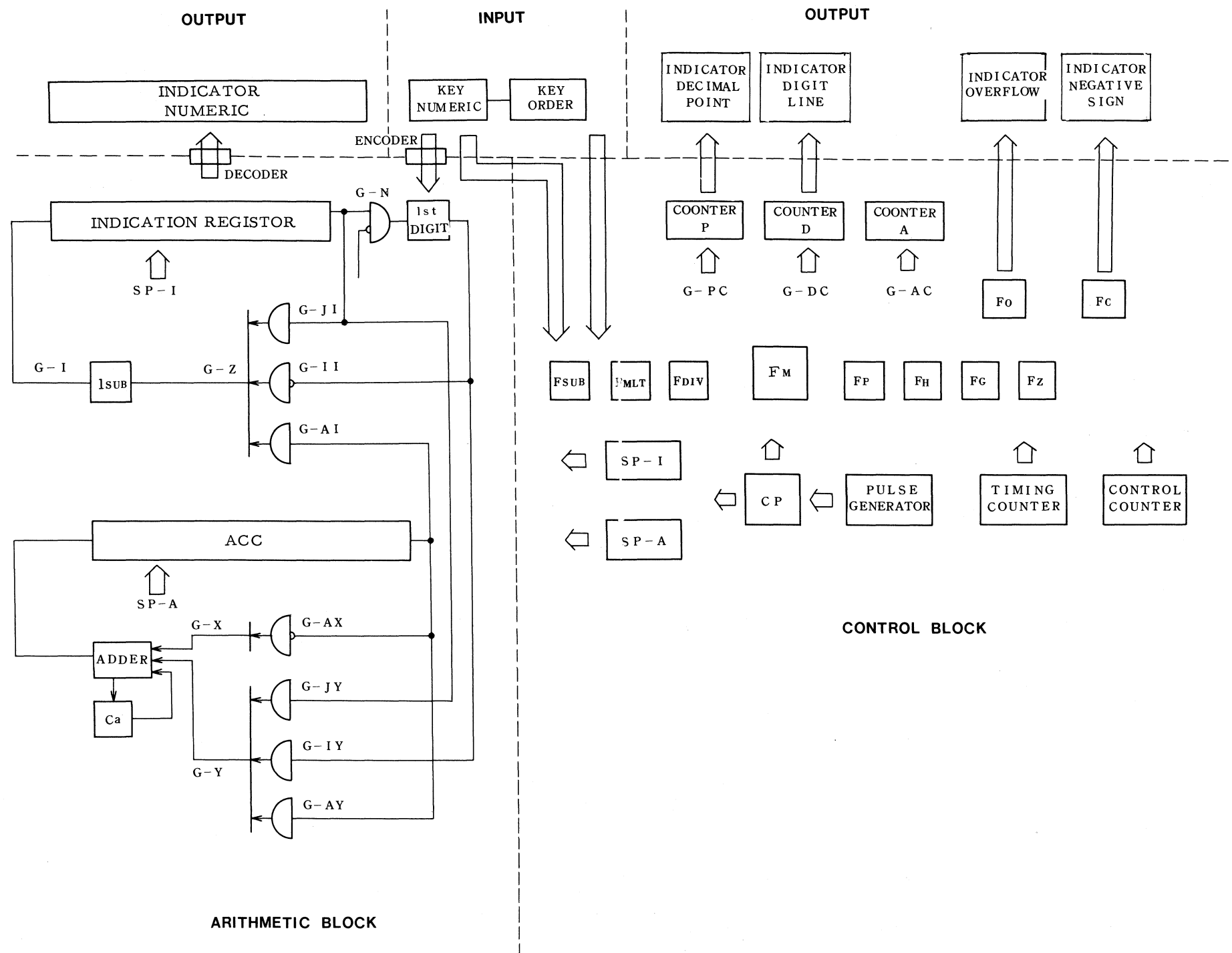


Fig. 1 Block Diagram

2. Flow Chart

All operations are conducted according to the steps of CC. The flow chart clearly illustrates the flow of each operation step. Understanding the flow chart greatly helps in comprehending the operation of Canola 130S.

2.1 Addition and Subtraction

When the first key n_1 is pressed at CC0 (Ready), all the contents of IR are transferred to ACC. After the transferring has ended, F_M is reset by TD13 which advances from CC0 to CC1 (Registration cycle).

At CC1, the number of the least significant digit of IR (0 in this case) shifts one digit to the left which ends at the timing of TD12. At TD12, the signal Key OK appears and then n_1 is registered in the first digit of IR. So, when n_1 is been registered a time period of approximately two words (10ms) is required from the starting at CC0 to the entering in IR. When key n_2 is pressed, the n_1 in the first digit of IR moves to the second digit (one-digit left shift) at TD12. Simultaneously, n_2 is registered in the first digit of IR by signal Key OK. Similarly, $n_3, n_4, \dots$ are registered at the timing of TD12.

When $\square$ or $\ominus$ key is pressed, CC2 shifts to CC3 which is the cycle for the decimal point coordination of the addend or subtrahend in IR and the augend or minuend in ACC. When $F_H=0$, the number of digits below the decimal point in the numeric of IR is less than that of the numeric in ACC, so the content of IR is shifted to the left (LSF). Since the decimal point difference between the numerics in IR and ACC is stored in A counter, the A counter is checked whether or not $AC=0$ every time the contents of IR are shifted one digit to the left. When the numeric of IR reaches the 13th digits and of the decimal point position of the numeric in ACC does not coincide with that of the numeric in IR, all operation for calculation stops. At this time, press $\square$ key to recall the content of ACC. As long as $\square$ key is been kept depressed, step CC3 is maintained where the content of IR are cleared and only the content of ACC circulates in ACC.

As soon as the $\square$ key is released, the signal for CC3 (the decimal point coordination of IR and ACC) stops and enters the cycles $CC4 \rightarrow CC5 \rightarrow CC6 \rightarrow CC7 \rightarrow CC0$ and then, the content of ACC enters IR where it appears in the indicator.

When $F_H=1$, the number of digits below the decimal point in the numeric of ACC is less than that of IR. The operation is identically the same as $F_H=0$, except that ACC shifts to the left instead of IR and then proceeds to CC4.

At CC4, the contents of both IR and ACC move one word where the adder-subtractor conducts $ACC \pm IR$ which is the adding or subtracting cycle.

At CC5, the contents of IR and ACC move one word but it has nothing to do with the calculation and is called the idle operation where it rotates freely within the registers and then enters CC6.

At CC6, if the calculated result of $ACC \pm IR$ is a complement, it is transformed to its true value and proceeds to CC7.

At CC7, the content of ACC which is the result of the calculation is transferred to IR for indication with the content of IR entering ACC. When CC7 finishes, the step is returned to CC0 (Ready) by F_M for the next calculation. In addition or subtraction one-word operation is always conducted at each step of CC4, CC5, CC6 & CC7.

2.2 Multiplication

In multiplication it is the repeating of addition in principle. That is, the product is obtained by adding the multiplicand as many times as the value of the multiplier.

The registration of the multiplicand is identically the same as the augend in addition or minuend in subtraction at the step CC0 → CC1.

When $\boxed{\times}$ key is pressed, the content of ACC is cleared and the step still remains in CC1, and simultaneously F_{MLT} sets with the multiplier signal or digit line appearing in the indicator. The multiplier is registered by the repetition of TD12. When $\boxed{=}$ or $\boxed{\ominus}$ key is pressed, it enters CC3 (decimal point coordination cycle). Since the decimal point coordination of the multiplicand and multiplier was done in the registration step, therefore the time of CC3 is only one bit and enters CC4 operation cycle to conduct ACC + IR. Because the multiplicand and multiplier are registered in IR, and DC memorizes the number of digits of the multiplier, the most significant digit of the multiplier is discriminated whether it is 0 or 1 while the numerics are being shifted to the right, and if the MSD is not 0, Fz sets. When Fz is set, G-JY opens and simultaneously the multiplicand and multiplier return to IR through G-II at the timing of G-JY opening, and then conducts MSD-1 of the multiplier. Since Fz resets at TD12, G-JY closes at TD12. Also when G-AX is open at the same time as G-JY, ACC + IR is conducted. If the MSD of the multiplier is zero, G-JY does not open so that MSD-1 is not conducted; however, gates G-II and G-AX open, so the numerics in IR and ACC merely circulate in their registers until the completion of one-word of addition or subtraction when MSD is 0. Then it immediately proceeds to CC5.

At CC5, "1" is subtracted from the content of DC and simultaneously only the multiplicand in IR passes through G-JI and shifts one digit to the right at the timing of TD13. Then it returns to CC4 and repeats the same operation till DC=0 where the step of CC4 ~ CC5 ends. Then it converts the complement to its true value by a shift pulse at CC6; interchanges the contents of IR and ACC at CC7 and then returns to CC0. The process CC6 → CC7 → CC0 is exactly the same as in addition or subtraction.

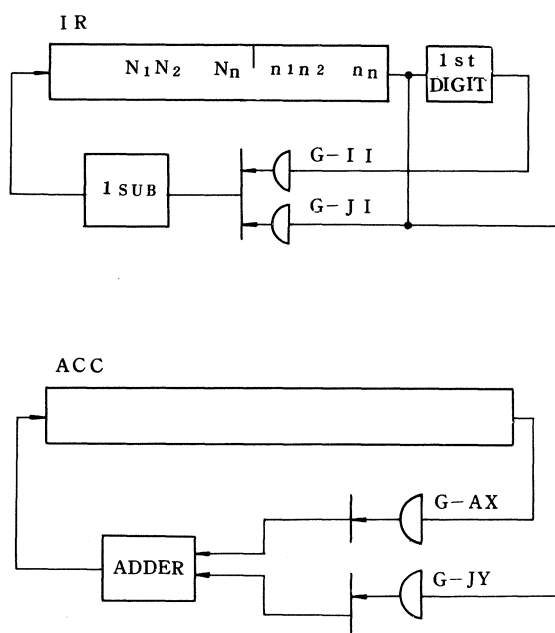


Fig. 3 Multiplication Gate

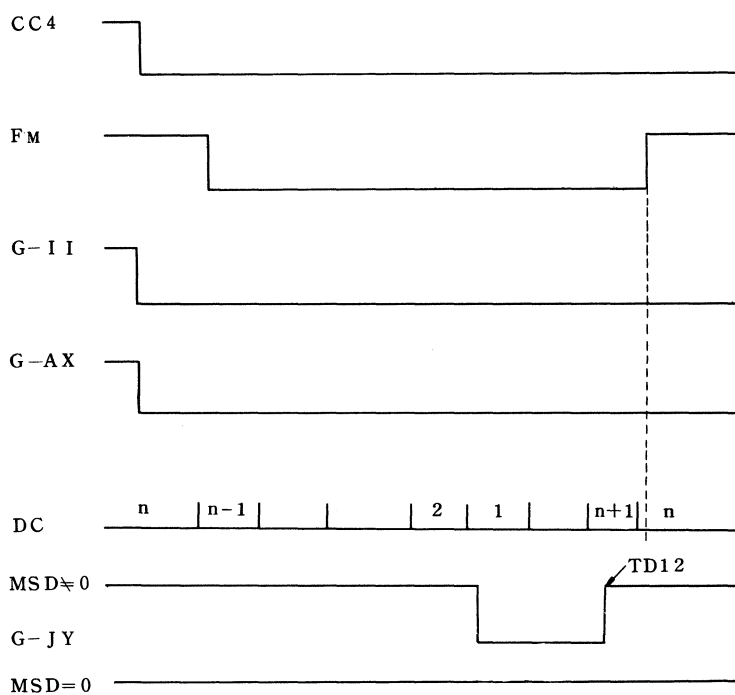


Fig. 4 Gates & Their Opening & Closing Timing

2.2-1 Constant multiplication

If $\boxed{K}$ key is locked, the multiplicand in ACC is recalled to IR and indicated when the multiplier is being registered.

2.2-2 Discount calculation

If $\boxed{\ominus}$ key is immediately pressed after a multiplication has been finished, it jumps from CC0 to CC3.

At CC3, the decimal point coordination of the multiplicand in ACC and the product in IR is done, and then at CC4, $ACC \pm IR$ is conducted. The following steps are exactly the same as that in the addition or subtraction.

2.3 Division

The registration of the dividend is exactly the same as that of addition or subtraction.

When $\boxed{\div}$ key is pressed after the dividend has been registered, the dividend shifts to the left (LSF) until its most significant digit reaches the 12th digits. When the LSF (left shift) is finished, instantaneously LSE (left shift end pulse) appears and sets F_{DIV} which returns the step to CC0. After entering the divisor, when $\boxed{=}$ or $\boxed{\ominus}$ key is pressed, the divisor in IR shifts to the left (LSF) like the dividend until its most significant digit reaches the 12th digit. The reason is that the quotient of division is obtained by the number of times the divisor is subtracted from the dividend and it always enters the 1st digit position of ACC. If the most significant digit of the dividend is less than that of divisor and both of them are shifted left (LSF) to the 13th digit, then in the operation when the divisor is subtracted from the dividend, the dividend must move one more digit to the left (14th digit) which cannot be done; so therefore, the MSD is only shifted to 12th digit in division. When the left shifting (LSF) of the divisor is finished, it proceeds to step CC3 where the decimal point coordination of the quotient is determined, and after the one-word operation ends, it enters step CC4.

At each subtraction cycle there is a signal where 9 is subtracted from the least significant digit of the quotient in ACC which is the same as adding 1 to that digit.

When subtraction passes beyond the limit where it should stop, then a carry signal (CA) appears which discriminates that the subtraction was carried too far and returns it back to its former last subtraction cycle by adding the divisor to the dividend one time and at the same time 9 is added to the least significant digit in ACC to subtract 1 from the quotient.

In step CC4, G-AX & G-II are always open, so as to hold the contents by circulating them until this step CC4 is completed and F_C which is controlled by AC, opens and closes G-IY for addition or subtraction.

Therefore, when AC=0, it shifts from CC3 to CC4 and when AC=12, F_C sets.

If G-IY is opened when F_C is set, it closes for one digit for the first digit of the quotient; the reason is that F_C resets at TD13 and G-IY also closes at the same time.

When the second digit of the quotient is obtained, G-IY closes for two digits and each time the digit increases in the quotient, G-IY closes for an extra digit until the quotient reaches the 8th digit position in ACC. The reason for the extra digit time for the 2nd digit is, in case, the numeric of the divisor in IR overlaps the MSD of the quotient, the LSD of the divisor is dropped or cut off in the calculation, but is still memorized in IR. If the numeric of the divisor is very large, there is a certain amount of error in the quotient due to the LSD of the divisor been dropped off when overlapping the quotient. When CA appears while addition is being done at CC4, it then advances to CC5.

The left shifting cycle of ACC starts at CC5. In this cycle, only the remainder and the quotient in ACC are shifted one digit to the left for the next addition or subtraction cycle. At the same time, the decimal point of the quotient also shifts one digit to the left and AC counts one. When the shifting at CC5 ends, it returns to CC4 and repeats addition or subtraction.

When AC=12 at TD8 of CC5 during the repetition of CC4 to CC5 cycle, the calculation operation ends and thus the quotient has obtained its eight digits. In relationship to $\overline{FM}$, it is the same as AC=7 at TD0. When AC=7 at the timing of TD8 of CC5, G-AX closes which erases the remainder and only the quotient remains in ACC. At the same time, since G-II is opened until the calculation operation is completed, therefore the divisor remains in IR.

When CC5 ends, it enters CC6 and CC7 for one word each and then returns to CC0 which is the same process as in ordinary addition or subtraction. At CC7, AC is corrected by DC.

2.3-1 Constant division

When $\boxed{K}$ key is locked in division, Fz sets at CC7 and F_{DIV} remains set even when it returns to CC0. Also, the divisor which is the constant remains in ACC. When the dividend is entered and $\boxed{=}$ or $\boxed{\ominus}$ key is pressed, the dividend in IR is shifted to the left to the 12th digit at CC1. When signal LSE appears, it advances from CC1 to CC2 since Fz is set. At CC2, the contents of IR and ACC are interchanged and the decimal points are coordinated in an one-word process. When CC2 ends, it enters CC3 and the following steps are conducted identically as those of ordinary division.

2.3-2 Inverse division

When $\boxed{RV}$ key is pressed after the divisor is registered, Fz and F_H set and the divisor shifts left to the 12th digit of IR at CC1. When signal LSE appears, it advances from CC1 to CC2 since Fz is set where the contents of IR and ACC are interchanged and the decimal points are coordinated. At the end of this one-word process, it returns to CC1 since F_H is set. When $\boxed{=}$ or $\boxed{\ominus}$ key is pressed at this time, it immediately jumps to CC3 and proceeds as in ordinary division.

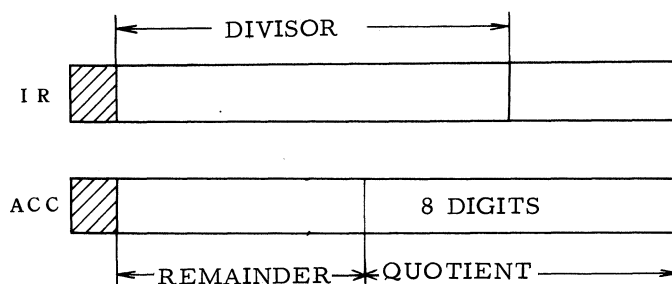


Fig. 5 Completion of Division

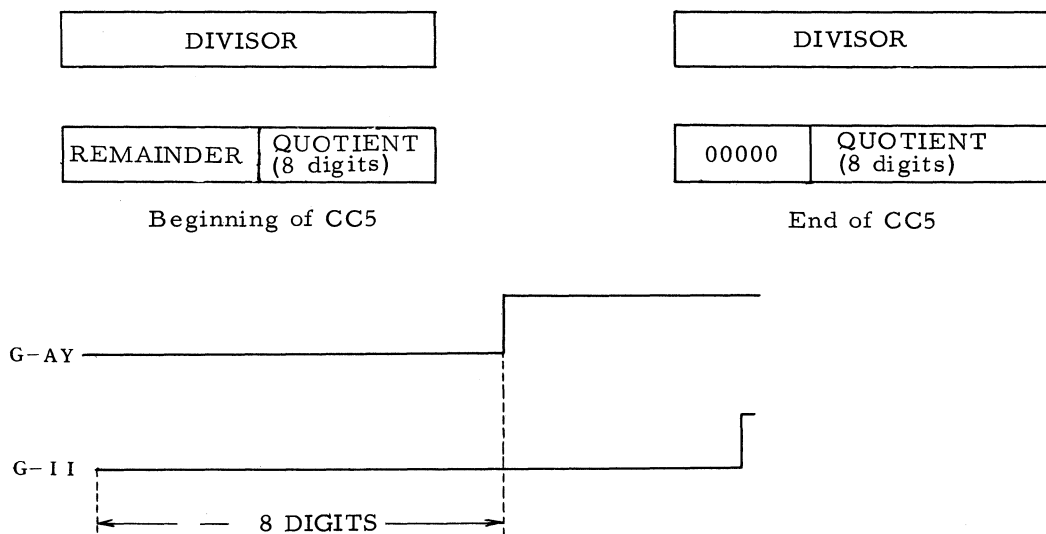


Fig. 6 Clearing of Remainder After Completion of Division

3. Explanation of Arithmetic Operations

This section describes the signal flow and various circuits for the different steps for calculation. It is necessary to always refer to the flow chart and to thoroughly understand the purposes of each FF, gate and counter as explained in the block diagram section when reading this section.

3.1 Addition or Subtraction

Example: $1.234 - 5.6 = -4.366$

After the [1] Key has been pressed, OS appears approximately 7ms later which opens G-31 that sets F_M which remains set for the duration of one word (52 bits for SP-I & SP-A) until the time of TD13. During this period, G-IY is opened by G-117 and the content of IR (0 in this case) are transferred to ACC. When it enters TD13, F_M resets and then the step proceeds from CC0 to CC1 (registration).

When it enters CC1, F_M is set again by G-20 and G-31. When the "0" in the first digit of IR shifts to the second digit, F_M is reset by G-33 and simultaneously G-14 opens which emits signal Key OK. When this signal appears at G-16, the numeral 1 is registered and also, F_H is set by G-57.

It is assumed that everything has been cleared before the operation; therefore PC, AC & DC is 0. DC is not used in addition or subtraction calculation.

Next, when [P] key is pressed, F_P set, but it is not related to the numeric figures. When [2] key is pressed, F_M is set by G-31 and reset by G-33. Numeral 2 is registered at the time of signal Key OK. Then PC & AC being 0 count one and become PC=1 & AC=1. Registration of numerals 3 & 4 is conducted similarly and PC & AC respectively becomes three. PC=3 & AC=3 signify the following:

PC = 3 Decimal point position in IR

AC = 3 Decimal point difference between IR and ACC

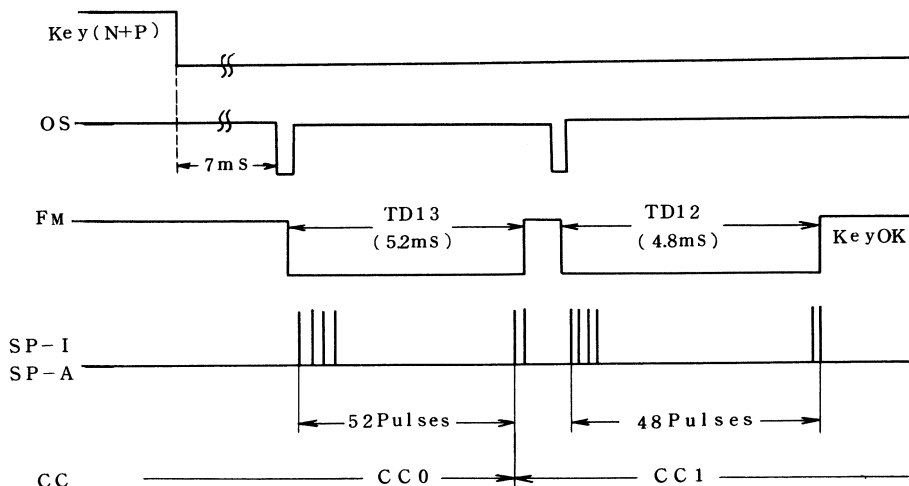


Fig. 1 Timing Chart of Registration

When $\boxed{=}$ key is pressed, it proceeds to CC3 by G-44. Step CC3 is the decimal point coordination cycle. In this example, $F_H=1$, therefore, the content of ACC is shifted to the left. When the content of ACC shifts left three times, AC becomes 0 again. Then it advances to CC4 (addition cycle) by G-39.

At CC4, the content (1.234) of IR passes G-IY opened by G-119 and the content (0) of ACC passes G-AX with both entering the adder-subtractor, and then 1.234 is registered in ACC. That is, addition of $0.000 + 1.234$ has been accomplished. When the one-word process of CC4 ends, the step is shifted to CC5 by F_M .

At CC5, the content (0) of IR and that (1.234) of ACC circulate for one word in their register and then it immediately proceeds to CC6.

Step CC6 is the cycle for converting the complement into its true value. In this case, the numeric is the true value; therefore, the contents of IR and ACC circulate one word in their register, and then, immediately proceeds to CC7.

Step CC7 is the indication cycle. Gates G-IY & G-AI open and the 0's in IR transfers to ACC through G-IY and 1.234 of ACC enters IR through G-AY. It then returns to CC0 by F_M and 1.234 appears in the indicator. Then F_M is reset by G-61.

Summarizing the registration of the first numeric of any calculation in the indicator is, as though the $\boxed{=}$ key has been pressed immediately after the numeric had been entered in the calculator because it entered the addition or subtraction cycle before it entered IR again to be registered in the indicator.

In the registration of the subtrahend when $\boxed{5}$ key is pressed, F_M is set by G-31, and by SP-I & SP-A, the content (1.234) in IR transfers to ACC through G-IY opened by G-116. Simultaneously, the content (3) of PC is memorized by AC in the form of complement; therefore, $PC=0$ and $AC=10$. When $PC=0$, AC is then reset by G-99. When the one-word process in step CC0 ends, F_M advances it to step CC1. F_M is again set by G-20 & G-31 and reset by G-33 which opens G-14 and then Key OK is emitted. The numeral (5) is then indicated. When $\boxed{P}$ key is pressed next, it only sets F_P and leaves the numeral intact. When $\boxed{6}$ key is pressed, F_M is set by G-31 and reset by G-33 which indicates the numeral (6) in the indicator. Also, PC becomes 1 and AC is 11.

When $\boxed{=}$ key is pressed, it opens G-44 which advances the step to CC3 where G-79 sets F_{SUB} .

In step CC3, the decimal point coordination of 1.234 and 5.6 is done. Since $F_H=0$, the content (5.6) of IR are shifted to the left and when shifted twice, AC becomes 0 which opens G-39 that advances the step to CC4. At this time PC is 3.

In CC4, subtraction is conducted since F_{SUB} was set when $\boxed{=}$ key was pressed. The content (5.600) of IR passes through G-IY opened by G-119 and the content (1.234) of ACC passes through G-AX with both entering the adder-subtractor and the complement 9999999995.634 is registered in ACC. Then F_0 sets which ends the step CC4 and proceeds the step to CC5.

In CC5, the one-word idling operation ($IR \rightarrow IR$ & $ACC \rightarrow ACC$) is done and then enters CC6.

In step CC6, G-116 opens G-AY where 0-9999999995.634 is conducted and 4.366 is registered in ACC. Simultaneously, Fc is set by G-65. When the one-word process CC6 ends, the indication cycle CC7 starts. At the start of CC7, Fsub is reset; so the content (5.600) of IR enters ACC through G-IY and the content (4.366) of ACC enter IR through G-AI. The step is then returned to CC0 by Fm and 4.366 is indicated in the indicator. Simultaneously, the negative sign indication lamp is lit by G-68, indicating that the calculated result is a negative value. (-4.366)

3.2 Multiplication

Example: $1.2 \times 3.21 = 3.852$

In the following explanation, operations which are identical the same as those in addition or subtraction are omitted.

When the **[1]** key is pressed, the content (1234555543.21) of IR which was the result of the previous calculation is transferred to ACC through G-IY opened by G-117. Subsequently, when **[P]** and **[2]** key are pressed in succession, the multiplicand (1.2) is registered.

Next when **[x]** key is pressed, Fmlt sets and G-31 sets Fm which holds for one-word time. Since G-II is open then, 1.2 circulates in IR and returns to its formal position. Also, since G-AX is closed, the contents of ACC are cleared; that is, an automatic clearance in multiplication has been conducted.

After the multiplier (3.21) is registered, PC, AC and DC become 3, 2 and 3 respectively. They signify the following:

PC-3: Number of digits below the decimal point of multiplicand plus that of the multiplier which is the decimal point position of the product.

AC=2: Number of digits below the decimal point of multiplier.

DC=3: Number of digits of multiplier.

When **[=]** key is pressed, it proceeds to the step CC3 by G-44 and then to CC4 by G-40 at the succeeding CP because of Key A.

In CC4, Fz is set by G-159 and simultaneously G-JY is opened by G-122. Since G-AX is open, $ACC + IR$ is conducted and 1200 enters ACC. When Fz is set, Bo is set by the rise time of $\overline{Fz}$ and then the 1-subtractor operates and the MSD (3) of the multiplier becomes 2. Since Fh was set when a signal was emitted by G-159, the CC4 cycle is kept intact by G-37, so it repeats the step CC4. When the MSD of the multiplier becomes 0, a signal is not emitted to G-159; so Fz & Fh are not set. Therefore G-JY does not open; so the contents of both IR and ACC pass through G-II and G-AX respectively and return to their original positions which is an idle operation. If there is no signal emitted to G-37, then the step proceeds from CC4 to CC5.

In CC5, DC becomes 2 by G-105 at the start of CC5. Since Fz is set by G-48 and G-JI is opened by G-155, the multiplicand (12) passes through G-JI but does not pass the first digit of IR but shifts 13 digits to the right at TD13. As a result, the multiplicand is shifted one digit to the right. Also, 021 is shifted 13 digits to the right at TD13, so it enters the correct position for multiplication for the second most significant digit of the result and returns to step CC4 where it repeats the same process as previously mentioned. When the multiplier (21) becomes 01, CC5 starts. In CC5, DC becomes 1 and again the multiplicand (12) is shifted one digit to the right after which it returns to CC4 and repeats the same process. When the multiplier 1 becomes 0, it enters CC5, and at this time DC becomes 0, where the step proceeds to CC6 by G-43 & G-45.

The steps CC6 and CC7 are exactly the same as those for addition or subtraction.

3.3 Constant multiplication

Constant

Example: $(1.2 \times) 2.1 = 2.52$

When $\boxed{K}$ key is pressed and locked after the previous multiplication calculation is completed and the MSD of the multiplier (2) is entered, FMLT is not reset by G-76; so the constant (12) in ACC passes through G-AI which is opened by G-149 to enter IR and indicated. At this time, the coordination counters PC, AC & DC are corrected, and then, they become 1, 0 & 1 respectively when 2 was registered. The subsequent processes are exactly the same as that for ordinary multiplication.

3.4 Division

Example: $1234567.89 \div 98765.43 = 12.50000$

Registration of the dividend is identical with the similar operation for augend, minuend or multiplicand.

When $\boxed{\div}$ key is pressed, Fc is set by G-22 and F_M is set by G-29. Then, the dividend is shifted to the left (LSF) until the most significant digit reaches the 12th digit. When IR12D=0, LSE is emitted by G-62. Then the step is returned from CC1 to CC0 by G-41 and F_{Div} sets.

Since PC and AC memorize the decimal point position of the dividend, PC=5 and AC=5 when LSF ends.

When the divisor is being entered, the content of IR passes G-IY and enters ACC and simultaneously, AC memorizes the complement of PC. As a result, PC=0 and AC=8. When the divisor has been registered, it becomes PC=2, AC=10 and DC=2 which signify the following:

PC=2: Decimal point position of divisor

AC=10: Decimal point difference (complement) between dividend and divisor

DC=2: Number of digits below the decimal point of divisor

When $\square$ key is then pressed, F_c is set by G-54 and F_M is set by G-29 which shifts the divisor to the left (LSF) until its most significant digit reaches the 12th digit. When $IR12D=0$, LSE is emitted by G-62, and then the step jumps from CC1 to CC3 by G-46. The condition of each counter is:

PC=7: Decimal point position of divisor

AC=2: Decimal point difference (complement) between dividend and divisor

DC=7: Number of digits below the decimal point of divisor

CC3 step is a one-word cycle where the decimal point is coordinated. When CC3 ends, each counter is as follows:

PC=11: Decimal point position of quotient

AC=0: One less than the number of digits of quotient

DC=9: Decimal point difference between quotient and divisor (This is transferred to AC in CC7)

Step CC4 is the cycle of addition or subtraction. Since F_{SUB} was set by G-79 in CC3, subtraction is carried out first in CC4. Then G-55 sets F_c which opens G-IY by G-118, and also G-123 opens which subtracts 9 from the least significant digit of ACC, i.e., 1 is added. When $ACC-IR$ has been completed as shown in Table 3 Division Operational Chart (line#20), then CA is emitted which resets F_{SUB} by G-82 which conducts $ACC+IR$. F_H controls whether subtraction or addition is conducted in CC4. If F_H is set by G-58 in CC4, subtraction is conducted. Also, F_H is always reset by G-59 in CC4 and then, the step advances to CC5 by F_M .

In CC5, the contents of ACC are shifted one digit to the left and then, F_{SUB} is set by G-80 for the next operation. When CC5 ends, the step is returned to CC4 by F_M , then $ACC-IR$ is repeated and when CA is emitted $ACC+IR$ is conducted which advances it to step CC5 and again to CC4. This cycle is repeated until it enters CC5 eight times or seven, i.e., when the most significant digit or digits of the divisor is greater than that of the dividend. At the end of the eighth CC5 step, F_c is set by G-56 and G-AX is closed by G-115. Therefore, the remainder is cleared and only the quotient remains in ACC, so the timing of $AC=12$ at TD8 of G-56 is exactly the same as $AC=7$ at TD0 which is the signal that indicates that the quotient has eight digits.

In steps CC6 and CC7, a one-word process is conducted respectively. Then, it returns to CC0 and ends the calculation.

In CC7, the decimal point coordination is conducted until DC becomes 0, so each counter is as follows:

PC=5: Decimal point position of quotient

AC=11: Decimal point difference (complement) of divisor & quotient

DC=0:

3.5 Constant division

Constant

Example: $999999.9 \div 98765.43 = 10.124990$

It is assumed that $\boxed{K}$ key was pressed before $\boxed{=}$ key was during the previous division operation.

Then, when the most significant digit(9) of the dividend is entered, Fz and FDiv are not reset by G-50 and G-63, so the counters at this time are as follows:

PC=0:

AC=6: Complement of the decimal point of the constant in ACC is memorized.

DC=0

When the dividend (999999.9) is registered and the $\boxed{=}$ key is pressed, 999999.9 is shifted left to IR12D (12th digit of IR) similarly as in ordinary division operation and since Fz is set, it enters step CC2 by G-42.

In CC2, G-IY and G-AI are opened to interchange the contents of IR and ACC. Simultaneously, the decimal point is coordinated, so each counter at this time is as follows:

PC=7: Decimal point position of constant (divisor)

AC=12: Decimal point difference (complement) between the constant (divisor) and variable (dividend)

DC=7: Decimal point position of constant (divisor)

The following procedure are identical with that for ordinary division.

3.6 Discount calculation

Example: $\$12 - 20\% \text{ discount} = \9.6 $12 \boxed{\times} 1.2 \boxed{=}$

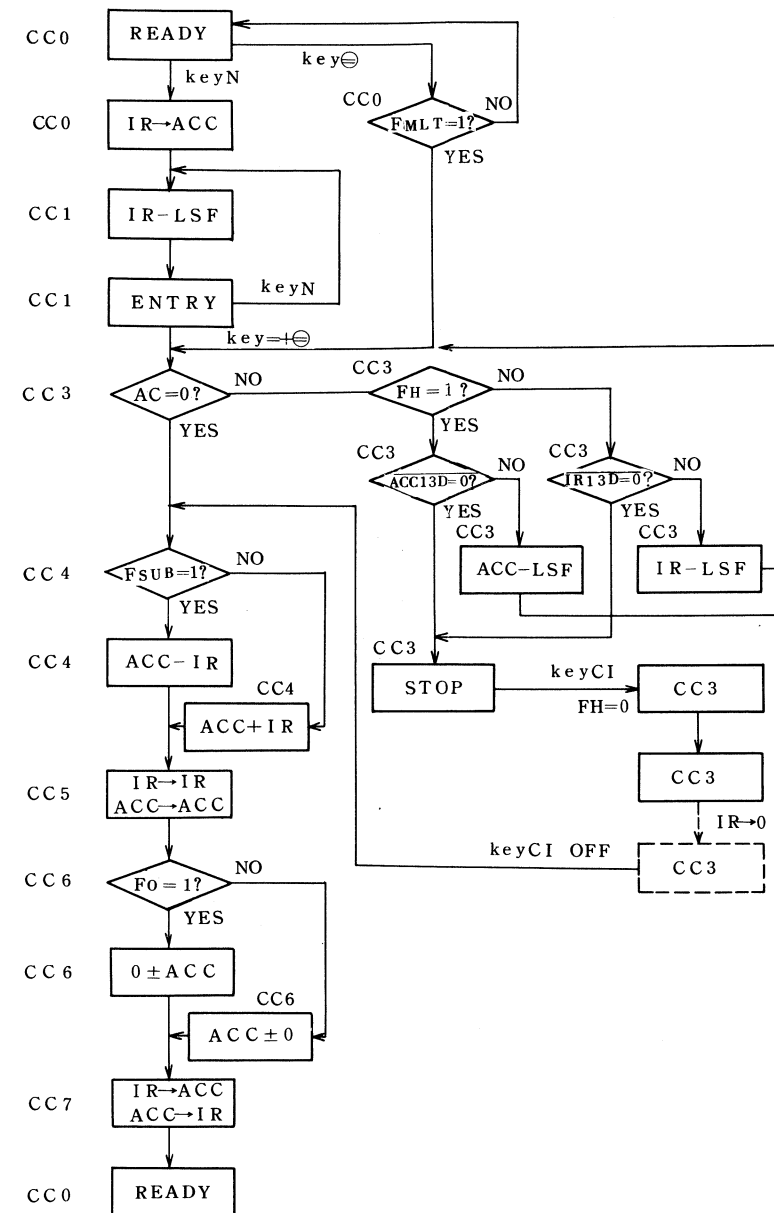
Operation of $12 \times 0.2 = 2.4$ is the same as in ordinary multiplication. Then, when $\boxed{=}$ key is pressed, the step jumps from CC0 to CC3 where Fh is set to conduct the decimal point coordination, and then, the subsequent operations are exactly the same as that of the addition or subtraction calculation operation.

3.7 Inverse division

Example: $1 \div (1+32) = 0.03030303$ $1 \boxed{=}$ $32 \boxed{=}$ $\boxed{+}$ $1 \boxed{RV}$ $\boxed{=}$

Operation of $1+32=33$ is the same as addition or subtraction operation. Operation of $\boxed{+}$ key and $\boxed{1}$ key is the same as for ordinary division. But when $\boxed{RV}$ key is pressed, Fz, Fc & Fh are set and then, 1 in IR is shifted left to the 12th digit of IR. Since Fz is set, it enters the step CC2 by G-42 where G-IY & G-AI are opened to interchange the contents of IR & ACC.

ADDITION & SUBTRACTION



MULTIPLICATION

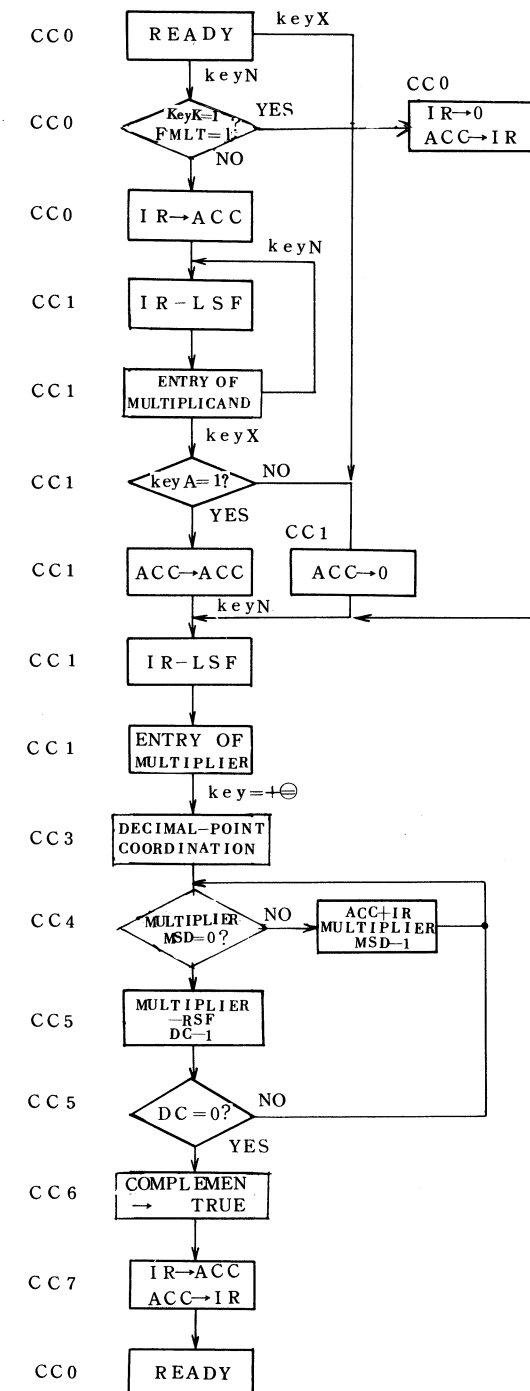


Fig. 1 Flow Chart (1)

DIVISION

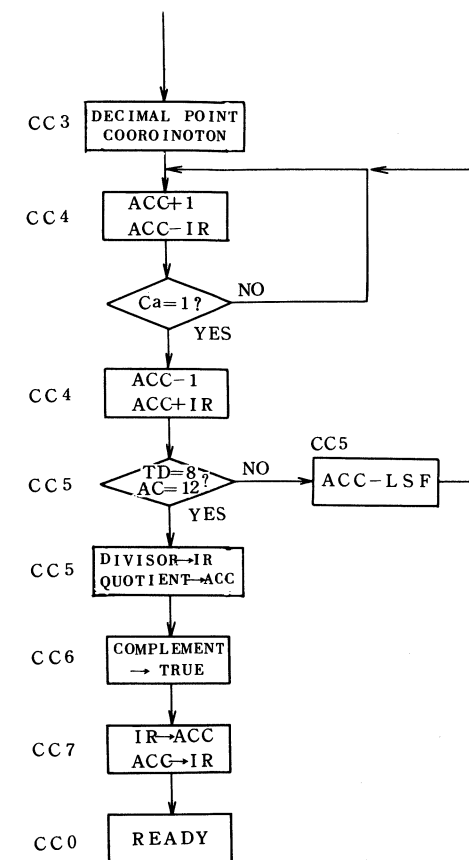
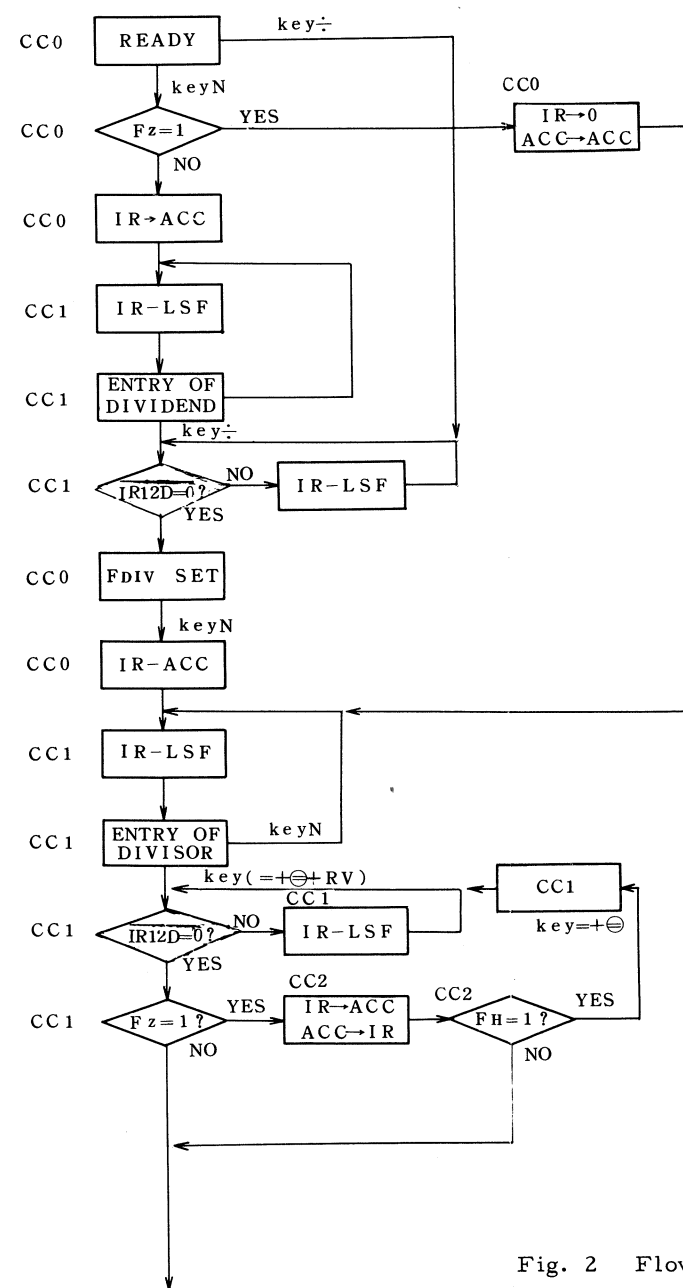


Fig. 2 Flow Chart (2)

Table 1 Addition of Subtraction 1.234 - 5.6 = -4.366

No.	IR													ACC													Counter PC,AC,DC			CC	Remarks	
	13	12	11	10	9	8	7	6	5	4	3	2	1	13	12	11	10	9	8	7	6	5	4	3	2	1	0	0	0	0		
1																											0	0	0	0		
2													1.														0	0	0	1	Key P, FH = 1	
3												1.	2														1	1	0	1		
4												1.	2	3													2	2	0	1		
5												1.	2	3	4												3	3	0	1		
6												1.	2	3	4												3	2	0	3	Key = ACC LSF	
7												1.	2	3	4												3	1	0	3		
8												1.	2	3	4												3	0	0	3		
9												1.	2	3	4									1.	2	3	4	3	0	0	4	
10												1.	2	3	4									1.	2	3	4	3	0	0	5	
11												1.	2	3	4									1.	2	3	4	3	0	0	6	
12												1.	2	3	4									1.	2	3	4	3	0	0	7	F _{SUB} Reset
13												1.	2	3	4									1.	2	3	4	3	0	0	0	
14																																
15													5.											1.	2	3	4	0	10	0	1	Key P, FH = 0
16													5.	6										1.	2	3	4	1	11	0	1	
17													5.	6	0									1.	2	3	4	2	12	0	3	Key ⊖, F _{SUB} , IR LSF
18													5.	6	0	0								1.	2	3	4	3	0	0	3	
19													5.	6	0	0								1.	2	3	4	3	0	0	4	F ₀ Set
20													5.	6	0	0								1.	2	3	4	3	0	0	5	
21													5.	6	0	0								4.	3	6	6	3	0	0	6	F _c Set
22													4.	3	6	6								5.	6	0	0	3	0	0	7	F ₀ , F _{SUB} Reset
23													4.	3	6	6								5.	6	0	0	3	0	0	9	

Table 2 Multiplication 1.2 x 3.21 = 3.852 (Key A = 0)
Constant Multiplication (1.2 x) 2.1 = 2.52 (Key K = 1)

No.	I R													A C C													Counter PC,AC,DC			CC	Remarks		
	13	12	11	10	9	8	7	6	5	4	3	2	1	13	12	11	10	9	8	7	6	5	4	3	2	1	2	0	0	0			
1	1	2	3	4	5	5	5	5	5	4	3	2	1														2	0	0	0	0		
2													1.	1	2	3	4	5	5	5	5	5	4	3	2	1	0	11	0	1	Key P		
3												1.	2	1	2	3	4	5	5	5	5	5	4	3	2	1	1	12	0	1			
4												1.	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	Key X		
5												1	2'	3													1	0	1	1	Key P		
6												1	2'	3	2												2	1	2	1			
7												1	2'	3	2	1											3	2	3	1			
8												1	2'	3	2	1											3	2	3	3	Key =		
9												1	2'	2	2	1											3	2	3	4	MSD-1		
10												1	2'	1	2	1											2	4	3	4	MSD-1		
11												1	2'	0	2	1											3	6	3	4	MSD-1		
12												1.	2	2	1												3	6	2	5	Multiplicand RSF DC-1		
13												1.	2	1	1												3	7	2	4	MSD-1		
14												1.	2	0	1												3	8	4	4	MSD-1		
15												.	1	2'	1												3	8	4	5	Multiplicand RSF DC-1		
16												.	1	2'	0												3	8	5	2	4	MSD-1	
17												.	1	2'													3	8	5	2	5	Multiplicand RSF DC-1	
18												.	1	2'													3	8	5	2	6		
19												3.	8	5	2												3		1	2'	7		
20												3.	8	5	2															1	2'	0	
21																																	
22													1	2'	2													1	0	1	1	Key K ON	
23													1	2'	2	1												2	1	2	1	Key P	
																													</				

Table 3 Division 1234567.89 ÷ 98765.43 = 12.50000
Constant Division (999999.9) ÷ 98765.43 = 10.124990 (Key K = 1)

No.	I R													ACC													Counter			CC	Remarks
	13	12	11	10	9	8	7	6	5	4	3	2	1	13	12	11	10	9	8	7	6	5	4	3	2	1	PC,AC,DC				
1													1.														0	0	0	1	
2												1	2.														0	0	0	1	
3											1	2	3.														0	0	0	1	
4										1	2	3	4.														0	0	0	1	
5									1	2	3	4	5.														0	0	0	1	
6								1	2	3	4	5	6.														0	0	0	1	
7							1	2	3	4	5	6	7.														0	0	0	1	Key P
8						1	2	3	4	5	6	7.	8														1	1	0	1	
9					1	2	3	4	5	6	7.	8	9														2	2	0	1	
10		1	2	3	4	5	6	7.	8	9																	5	5	0	0	Key ÷ F _C F _{DIV} Set
11													9.														0	8	0	1	
12												9	8.														0	8	0	1	
13											9	8	7.														0	8	0	1	
14										9	8	7	6.														0	8	0	1	
15									9	8	7	6	5.														0	8	0	1	
16							9	8	7	6	5.	4															1	9	1	1	
17							9	8	7	6	5.	4	3														2	10	2	1	
18		9	8	7	6	5	4	3																			7	2	7	1	Key =
19		9.	8	7	6	5	4	3																			11	0	9	3	F _{SUB} Set
20		9.	8	7	6	5	4	3																			11	0	9	4	CA = 1, F _{SUB} Reset
21		9	8	7	6	5	4	3																			11	0	9	4	
22		9	8	7	6	5	4	3																			12	1	9	5	F _{SUB} Set
23		9	8	7	6	5	4	3																			12	1	9	4	
24		9	8	7	6	5	4	3																			12	1	9	4	CA = 1, F _{SUB} Reset
25		9	8	7	6	5	4	3																			12	1	9	4	
26		9	8	7	6	5	4	3																			0	2	9	5	F _{SUB} Set
27		9	8	7	6	5	4	3																			0	2	9	4	
28		9	8	7	6	5	4	3																			0	2	9	4	
29		9	8	7	6	5	4	3																			0	2	9	4	CA = 1, F _{SUB} Reset
30		9	8	7	6	5	4	3																			0	2	9	4	
31		9	8	7	6	5	4	3																			1	3	9	5	F _{SUB} Set
32		9	8	7	6	5	4	3																			1	3	9	4	
33		9	8	7	6	5	4	3																			1	3	9	4	
34		9	8	7	6	5	4	3																			1	3	9	4	
35		9	8	7	6	5	4	3																			1	3	9	4	
36		9	8	7	6	5	4	3																			1	3	9	4	
37		9	8	7	6	5	4	3																			1	3	9	4	CA = 1, F _{SUB} Reset
38		9	8	7	6	5	4	3																			1	3	9	4	
39		9	8	7	6	5	4	3																			2	4	9	5	F _{SUB} Set
40		9	8	7	6	5	4	3																			2	4	9	4	CA = 1, F _{SUB} Reset
41		9	8	7	6	5	4	3																			2	4	9	4	
42		9	8	7	6	5	4	3																			3	5	9	5	F _{SUB} Set
43		9	8	7	6	5	4	3																			3	5	9	4	CA = 1, F _{SUB} Reset
44		9	8	7	6	5	4	3																			3	5	9	4	
45		9	8	7	6	5	4	3																			4	6	9	5	F _{SUB} Set
46		9	8	7	6	5	4	3																			4	6	9	4	CA = 1, F _{SUB} Reset
47		9	8	7	6	5	4	3																			4	6	9	4	
48		9	8	7	6	5	4	3																			5	7	9	5	F _{SUB} Set
49		9	8	7	6	5	4	3																			5	7	9	4	CA = 1, F _{SUB} Reset
50		9	8	7	6	5	4	3																			5	7	9	4	
51		9	8	7	6	5	4	3																			5	7	9	5	F _{SUB} Set, F _C Set
52																											5	7	9	6	
53							1	2.	5	0	0	0	0														5	11	0	7	F _S

Table 4	Discount Calculation	$12 - 12 \times 0.2 = 9.6$
	(Key Operation	$12 \times 0.2 = 2.4$)

	I R													A C C													Counter			CC	Remarks
No.	13	12	11	10	9	8	7	6	5	4	3	2	1	13	12	11	10	9	8	7	6	5	4	3	2	1	PC,AC,DC				
1																											0	0	0	0	
2													1.														0	0	0	1	
3												1	2.														0	0	0	1	
4												1	2'														0	0	0	1	
5												1	2'														0	0	0	1	Key P
6												1	2' 2														1	1	1	1	
7												1	2. 2														1	1	1	3	Ky =
8												1	2. 1												1	2	1	1	1	4	
9												1	2. 0												2	4	1	1	1	4	
10												1.	2												2	4	1	1	0	5	
11												1.	2												2	4	1	1	0	6	
12												2.	4												1	2	1	1	0	7	
13												2.	4												1	2	1	1	0	0	
14																															
15												2.	4												1	2 0	1	0	0	3	Ky ⊖, FH set
16												2.	4												9	6	1	0	0	4	
17												2.	4												9	1	1	0	0	5	
18												2.	4												9	6	1	0	0	6	
19												9.	6												2	4	1	0	0	7	
20												9.	6												2	4	1	0	0	0	
21																															

Table 5	Inverse Division	$1 \div (1 + 32) = 0.03030303$
	Key Operation	$1 \boxed{=}$ $32 \boxed{=}$ $\boxed{\div}$ $1 \boxed{\text{RV}}$ $\boxed{=}$

[illegible]

CONTENTS

III. HOW TO REPAIR

1. Operating Check Program	1
2. Trouble-shooting	5
2.1 Power Supply System	5
2.1-1 No AC current when power source present	5
2.1-2 DC current present	5
2.1-3 DC voltage are not normal when the primary AC supply is	7
2.1-4 Other symptoms	8
2.2 Hints for detecting faults in arithmetic unit	9
2.2-1 No clearing when ☐ key is pressed	9
2.2-2 Faulty registration	9
2.2-3 Erroneous addition or subtraction when ☐ or ☐ key pressed	10
2.2-4 Incorrect decimal point coordination of addition or subtraction	11
2.2-5 Erroneous or no multiplication	11
2.2-6 Erroneous or no division	11
2.2-7 Erroneous or no constant multiplication	12
2.2-8 Erroneous constant division	12
2.2-9 Erroneous or no inverse division	12
3. Wiring Diagrams and Tables	15
3.1 Block Wiring Diagram	15
3.2 Block Layout and Wiring (1)	15
3.3 Block Layout and Wiring (2)	17
3.4 Type of Wires	19
3.5 Terminal Diagram of Card Unit	20
3.6 Parts Layout in Card Unit	21
3.7 Main Panel Wiring	27
3.8 Signal Destination in Main Panel	28
3.9 Power Supply in Main Panel	30
3.10 Arithmetic Unit (1)	32
3.11 Arithmetic Unit (2)	33
3.12 Arithmetic Unit (3)	34

3.13	Arithmetic Unit (4)	35
3.14	Keyboard Unit (1)	36
3.15	Keyboard Unit (2)	37
3.16	Keyboard Unit (3)	39
3.17	Keyboard Unit (4)	39
3.18	Power Supply Unit (1)	40
3.19	Power Supply Unit (2)	41
3.20	Power Supply Unit (3)	42
3.21	Power Supply Unit (4)	43
3.22	Power Supply Unit (5)	44
3.23	Power Supply Unit (6)	45
3.24	Power Supply Unit (7)	46
3.25	Power Supply Unit (8)	47
3.26	Power Supply Unit (9)	48
4.	Tools and Testing Equipment	49
4.1	Service Checker	49

1. Operating Check Program

This checking program is used to detect any trouble in the calculator.

When a miscalculation or registering is found during the checking operation, refer to the remarks of the check program sheet and follow the detecting procedure for it.

- 1) Operation must be followed accordingly to the sequence in the check program.
- 2) Symbol $\boxed{0}^{12}$ means that the numeral key 0 is pressed 12 times.
- 3) Symbol $\boxed{\ominus}$ means nega-equal key.

Table 1 Operating check program

No.	OPERATION KEY	OVER- FLOW LAMP	NEGA- TIVE LAMP	INDICATION	REMARKS
1	Power switch ON				
2	$\boxed{C}$			0 0 0 0 0 0 0 0 0 0 0 0 0 0.	Clear
3	$\boxed{0} \boxed{2}$ Pressed simultaneously ON			0 0 0 0 0 0 0 0 0 0 0 0 0 2.	Double registration warning & lock, Over- flow lamp check
4	$\boxed{1} \boxed{2} \boxed{3}$			0 0 0 0 0 0 0 0 0 0 0 0 0 2.	$\boxed{1} \boxed{2} \boxed{3}$ No registration
5	$\boxed{=}$			0 0 0 0 0 0 0 0 0 0 0 0 0 0.	
6	$\boxed{\times} \boxed{0}^{12}$			0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1.	Digit line indication check
7	$\boxed{C}$			0 0 0 0 0 0 0 0 0 0 0 0 0 0.	Miscalculation check
8	$\boxed{1} \boxed{-} \boxed{2} \boxed{3} \boxed{4} \boxed{5} \boxed{6} \boxed{7} \boxed{8} \boxed{9}$ $\boxed{0} \boxed{1} \boxed{2} \boxed{3} \boxed{4} \boxed{5} \boxed{6} \boxed{7} \boxed{8} \boxed{9}$			1 2 3 4 5 6 7 8 9 0 1 2 3	Registration stop check Decimal point indication check (PC check)
9	$\boxed{\ominus}$			1 2 3 4 5 6 7 8 9 0 1 2 3	Negative lamp check
10	$\boxed{C}$			0 0 0 0 0 0 0 0 0 0 0 0 0 0.	
11	$\boxed{1}^{14}$	$\boxed{=}$		1 1 1 1 1 1 1 1 1 1 1 1 1 1.	IR Check, ACC Check
12	$\boxed{C}$			0 0 0 0 0 0 0 0 0 0 0 0 0 0.	Indication circuit check
13	$\boxed{2}^{14}$	$\boxed{=}$		2 2 2 2 2 2 2 2 2 2 2 2 2 2.	
14	$\boxed{C}$			0 0 0 0 0 0 0 0 0 0 0 0 0 0.	
15	$\boxed{3}^{14}$	$\boxed{=}$		3 3 3 3 3 3 3 3 3 3 3 3 3 3.	
16	$\boxed{C}$			0 0 0 0 0 0 0 0 0 0 0 0 0 0.	
17	$\boxed{4}^{14}$	$\boxed{=}$		4 4 4 4 4 4 4 4 4 4 4 4 4 4.	
18	$\boxed{C}$			0 0 0 0 0 0 0 0 0 0 0 0 0 0.	
19	$\boxed{5}^{14}$	$\boxed{=}$		5 5 5 5 5 5 5 5 5 5 5 5 5 5.	
20	$\boxed{C}$			0 0 0 0 0 0 0 0 0 0 0 0 0 0.	
21	$\boxed{6}^{14}$	$\boxed{=}$		6 6 6 6 6 6 6 6 6 6 6 6 6 6.	
22	$\boxed{C}$			0 0 0 0 0 0 0 0 0 0 0 0 0 0.	
23	$\boxed{7}^{14}$	$\boxed{=}$		7 7 7 7 7 7 7 7 7 7 7 7 7 7.	
24	$\boxed{C}$			0 0 0 0 0 0 0 0 0 0 0 0 0 0.	
25	$\boxed{8}^{14}$	$\boxed{=}$		8 8 8 8 8 8 8 8 8 8 8 8 8 8.	

No.	OPERATION KEY	OVER- FLOW LAMP	NEGA- TIVE LAMP	INDICATION	REMARKS
26				0 0 0 0 0 0 0 0 0 0 0 0 0 0	
27	¹⁴			9 9 9 9 9 9 9 9 9 9 9 9 9 9	
28	¹³			1 1 1 1 1 1 1 1 1 1 1 1 1 0	Operation result
29				0 0 0 0 0 0 0 0 0 0 0 0 0 0	OVER FLOW
30	⁹			0 0 0 0 1 1 1 1 1 1 1 1 1 1	
31	⁴			1 1 1 1 1 1 1 1 1 9 9 9 9 9	Addition (F _H =0)
32				1 2 3 4 5 6 7 8 9 9 9 9 9 9	" (F _H =1)
33	⁵			0 0 0 0 0 0 0 0 3 3 3 3 3 3	Stop at CC3 (F _H =0)
34	ON			0 0 0 0 0 0 0 0 0 0 0 0 0 0	Clearing of IR when CI key pressed.
35	OFF			1 2 3 4 5 6 7 8 9 9 9 9 9 9	Recall from ACC when CI key released.
36	¹⁰			3 3 3 3 3 3 3 3 3 0 0 0 0 0	Stop at CC3. (F _H =0)
37	ON			0 0 0 0 0 0 0 0 0 0 0 0 0 0	Clearing in IR when CI key pressed.
38	OFF			1 2 3 4 5 6 7 8 9 9 9 9 9 9	Recall from ACC when CI key released.
39	³			0 0 0 1 2 3 4 5 6 7 8 9 9 9	
40	¹⁰			0 0 9 8 7 6 5 4 3 2 1 0 1	Subtraction
41				0 0 0 0 0 1 2 3 4 5 6 7 9 1	Clearing in ACC automatically
42	⁵			1 2 3 4 5 5 5 5 5 4 3 2 1	Multiplication
43				0 0 0 0 0 1 2 3 4 5 6 7 9	Discount calculation
44				0 0 0 0 0 1 2 3 4 5 6 7 9	Does not operate when keys is pressed.
45	⁵			1 2 3 4 5 5 5 5 5 4 3 2 1	Continuous multiplication
46	ON				
47	⁵			1 2 3 4 5 5 5 5 5 4 3 2 1	Constant multiplication (The constant 123456789)
48	⁵			1 2 3 4 5 5 5 5 5 4 3 2 1	
49	OFF ON				
50				0 0 0 0 0 1 2 3 4 5 6 7 9 1	
51				0 1 2 3 4 4 4 4 4 4 3 2 1	Accumulation multiplication of difference
52				0 0 0 0 0 1 2 3 4 5 6 7 9 1	
53				1 2 3 4 5 5 5 5 5 4 3 2 1	Accumulation multiplication of sum
54	^{4 2}			1 2 3 4 5 6 7 8 9 0 0 0 0 0	Prevention of no registration when key is pressed twice in division.
55				0 1 2 3 4 5 6 7 8 9 0 0 0 0	
56	⁶			9 8 7 6 5 4 3 0 0 0 0 0 0 0	
57				0 0 0 0 0 0 1 2 5 0 0 0 0 0	

No.	OPERATION KEY	OVER- FLOW LAMP	NEGA- TIVE LAMP	INDICATION	REMARKS
58	[K] ON				Constant calculation is done when [A] & [K] key is pressed simultaneously.
59	[1][2][3][4][5][6][7][8][9] [÷]			0 1 2 3 4 5 6 7 8 9.0 0 0	Constant division (The constant 9876543)
60	[9][8][7][6][5][4][3] [=]			0 0 0 0 0 0 1 2 5 0 0 0 0	
61	[1][2][3][4][5][6][7][8][9] [=]			0 0 0 0 0 0 1 2 5 0 0 0 0	Continuous division
62	[÷]			0 1 2 5 0 0 0 0 0 0 0 0 0	
63	[.] [9] ¹⁰ [=]			0 0 0 0 0 0 1 2 5 0 0 0 0	
64	[C]				
65	[1] [=]			0 0 0 0 0 0 0 0 0 0 0 0 1.	Addition or subtraction calculation is conducted when [A] & [K] key is pressed.
66	[2] [=]			0 0 0 0 0 0 0 0 0 0 0 0 3.	
67	[÷]			0 3.0 0 0 0 0 0 0 0 0 0 0 0	
68	[1]			0 0 0 0 0 0 0 0 0 0 0 0 1.	
69	[RV]			0 3.0 0 0 0 0 0 0 0 0 0 0 0	Inverse constant division (% calculation)
70	[=]			0 0 0 0 0 0.3 3 3 3 3 3 3 3	
71	[2] [=]			0 0 0 0 0 0.6 6 6 6 6 6 6 6	

2. Trouble-Shooting

When any fault occurs, it is very important to always carefully examine the symptoms and conditions to find the correct and suitable remedial measure for it.

In this service manual, the trouble-shooting in respect of the power supply unit is described in detail; however, only the main key points or suggestions are noted regarding any trouble in the arithmetic unit.

Since Canola 130S is almost the same as Canola 120, 130, 151 and 161; so if there are any troubles, consult the service manuals regarding these models.

2.1 Power Supply System

2.1-1 No AC current when power source is present.

- 1) Lead-in cord is defective.
- 2) Break in the line between the primary of power transformer and power switch; faulty soldering of the connections or erroneous connections to terminals.
- 3) Circuit breaker breaks.
 - i. Circuit breaker closes when the button is pressed.
 - a. Check for a short-circuit or other causes on the load side.
 - b. Hold the circuit breaker closed for at least two minutes and notice the different calculation operational faults of the calculator.
 - ii. Circuit breaker does not close when the button is pressed.
 - a. Short-circuit exists on the load side.
 - b. When the circuit breaker closes by itself within two minutes after it breaks, the cause is an overload in the load. First check the primary circuit; next the secondary of the transformer and then the supply line to connecting board.
 - c. Check if the circuit breaker is defective which is very rare.

2.1-2 DC current present.

- 1) No -10.5V (No digit in indicator light up.)
 - i 2A fuse (F1) is burnt out.
 - ii D1 or D3 diode is defective.
 - iii Break in the choke coil.

- iv Damage in C1 or C2 condenser causing a short or a reverse bias.
 - v Break in the secondary coil between PS9 & PS10 of power transformer.
 - vi Break between the power transformer choke coil and terminal.
 - vii Break in the ground of the circuit to the main ground.
 - viii Break in the card unit circuit or faulty soldered connections.
 - ix Circuit breaks.
 - a. Red wire between PS9 & PS18 or PS10 & PS19
 - b. Orange wire between PS22 & PS23
 - c. Yellow wire between PS24 & PS27
 - d. Blue wire between PS25 & PS28 or PS28 & T4A
 - e. Green wire between PS32 & T8C
- 2) No +10.5V (Dim illumination and random numeral indication).
- i 0.5A fuse (F2) is burnt out.
 - ii D2 or D4 diode is defective.
 - iii Resistor (R1) is damaged.
 - iv Damage in C2 or C3 condenser causing a short or a reverse bias.
 - v Break in the coil between PS9 & PS10 of power transformer.
 - vi Break between the power transformer coil and terminal.
 - vii Break in the ground of the circuit to the main ground.
 - viii Break in the card unit circuit or faulty soldered connections.
 - ix Circuit breaks:
 - a. Red wire between PS4 & PS18; PS10 & PS19 or PS26 & PS29
 - b. Brown wire between PS30 & T5A
 - c. Green wire between PS32 & T8C
- 3) No -14V (No digit in indicator lights up).
- i 2A fuse (F3) is burnt out.
 - ii D5, D6, D7 or D8 diode is defective.

- iii Break in the coil between PS11 & PS12 of power transformer.
- iv Break between the power transformer coil and terminal.
- v Break in the ground of the circuit to the main ground.
- vi Break in the card unit circuit or faulty soldered connections.
- vii Circuit breaks.
 - a. Blue wire between PS11 & PS20 or PS12 & PS21
 - b. Light blue wire between PS31 & T6A
 - c. Green wire between PS32 and T8C

4) No -1.5V (Indicator does not light up, but if the resistor shorts it lights up very brightly)

- i Indicator circuit is faulty.
- ii R2 resistor is damaged.
- iii Break in the card unit circuit or faulty soldered connections.

2.1-3 DC voltages are not normal when the primary AC supply is.

1) All DC voltages are not normal:

- i When all voltages are low, the connections to the primary side of the power transformer are erroneous.
- ii When the voltage deviation of the coil of the transformer is too high or too low. There is an allowable factor of $\pm 4\%$ of the actual output.

	Rating	Allowable Voltage Range
Logic side	AC 10.2 V	AC 9.792 ~ 10.608 V
Indicator side	AC 12.8 V	AC 12.288 ~ 13.312 V

2) Individual DC voltage is not normal:

- i Over -10.5V
 - a. Voltage deviation in the power transformer is too high.
 - b. Short in the choke coil.
- ii Under -10.5V
 - a. Voltage deviation of the power transformer is too low.

- b. D1 or D3 diode is faulty or damaged.
- c. C1 or C2 condenser is faulty.
- iii Over +10.5V
 - a. Voltage deviation of the power transformer is too high.
 - b. R1 resistance became too small.
- iv Under -10.5V
 - a. Voltage deviation of the power transformer is too low.
 - b. D2 or D4 diode is faulty or damaged.
 - c. R1 resistance became too large.
 - d. C3 or C4 is faulty.
- v. Over -14V
 - a. Voltage deviation of the power transformer is too high.
- vi Under -14V
 - a. Voltage deviation of the power transformer is too low.
 - b. D5 ~ D8 diode is faulty or damaged.
 - c. C5 condenser is faulty.

2.1-4 Other symptoms

- 1) If temperature of rectifier diodes is abnormally high.

Power supply unit of Canola 130S uses a full-wave rectifier consisting of two diodes; so if one diode is faulty, it is the same as if the transformer is shorted and if both are overloaded an overcurrent occurs which overheats the diodes.

- 2) If electrolytic condenser generates heat.

- i Polarity terminals are reverse.
- ii The supplied voltage is higher than the rated voltage of the condenser.

- 3) If the fuse repeatedly blows out.

This is caused by an overload, so check the connector of the card unit to locate any short-circuit in the wiring of the power supply circuit.

- 4) If the power transformer generates abnormal heat.

Check all parts before the fuses of the secondary side of the

transformer for shorted or improper wiring; faulty diode or short-circuit in the transformer.

2.2 Hints for detecting faults in arithmetic unit

2.2-1 No clearing when ☐ key is pressed.

- 1) Numerals remain intact.
 - i Is CP emitted?
 - ii Is key signal emitted?
 - iii Is OS emitted?
 - iv Does F_M set?
 - v Is the step CC0?
 - vi Is SP-I emitted?
- 2) Incomplete clearing:
 - i Is the IR for the digit where it stopped normal?
 - ii Is SP-I emitted to the digit where it stopped?
- 3) Do not clear unless ☐ key is pressed more than once.
 - i Does F_M set for one-word period (5.2ms)?
 - ii Is SP-I emitted during the period F_M is set?
 - iii Does G-II close for the one-word period?
- 4) Continuous shifting of the numerals in the indicator.
 - i Does G-II close for the one word period?
- 5) Double figure of "0" and another in a digit.
 - i Check the indication decoder for that digit.

2.2-2 Faulty registration.

- 1) No registration.
 - i Does the numeral key emit a key signal?
 - ii Is OS emitted?
 - iii Does F_M set?
 - iv Does the step shift from CC0 to CC1?

- v Is Key OK emitted?
- vi Does FM reset at TD12 in CC1?
- vii Is the output of W1, W2, W3 & W4 normal?
- viii Is the flip-flop for the IR first digit normal?
- 2) Only the first digit position registers.
 - i Is IR normal?
 - ii Does G-II open?
- 3) Erroneous numerals register.
 - i Check the circuit for W1, W2, W4 & W8.
- 4) Erroneous numerals register when shifting.
 - i Check IR where the figure changed.
- 5) Two or more digits register when the key is pressed only once.
 - i Is FM normal?

2.2-3 Erroneous addition or subtraction when $\boxed{=}$ or $\boxed{-}$ key is pressed.

- 1) Numeric in the Indicator does not change.
 - i Does the step enter CC3 when $\boxed{=}$ or $\boxed{-}$ key is pressed?
 - ii Is AC normal?
- 2) Registered numeric is cleared.
 - i Does an output pulse from adder-subtractor appear at CC4 to ACC?
 - ii Is SP-I emitted at CC4, CC5, CC6 and CC7?
- 3) Double figure of 7 & 9 are indicated.
 - i Check to see if a flip-flop of ACC is faulty.
- 4) Resultant numerals change every time the $\boxed{=}$ or $\boxed{-}$ key is pressed more than one time.
 - i Check the signals in ACC.
- 5) Erroneous calculation.
 - i Are Ca, X, Y & binary-decimal converter circuit normal?

ii Is AC normal?

2.2-4 Incorrect decimal point coordination of addition or subtraction.

1) Decimal point does not move.

i Is FP set by $\boxed{P}$ key?

ii Is G-PC normal?

iii Is PC normal?

2) Erroneous calculation.

i Did the operation stop at CC3?

ii Is AC normal?

iii Is FH faulty?

2.2-5 Erroneous or no multiplication.

1) Multiplicand clears when $\boxed{x}$ key is pressed.

i Does G-II open?

2) Digit line does not light up when $\boxed{x}$ key is pressed.

i Does FMT set?

3) Digit line does not light up when the multiplier is registered.

i Is G-DC normal?

ii Is DC normal?

4) No calculation.

i Did it stop at CC4?

ii Is DC normal?

5) No decimal point indicated.

i Is G-DC normal?

ii Did the operation stop at CC3?

2.2-6 Erroneous or no division.

1) Most significant digit of the dividend does not shift to the 12th digit of IR when $\boxed{\div}$ key is pressed.

i Does Fc set?

- ii Does F_M set?
- iii Is LSE emitted?
- 2) No calculation.
 - i Did it stop at CC4?
 - ii Is F_H normal?
- 3) Quotient is indicated in more than eight digits.
 - i Is F_C normal?
 - ii Is AC normal?
- 4) Decimal point is in the wrong position.
 - i Are PC & AC normal at CC3?

2.2-7 Erroneous or no constant multiplication.

- 1) No constant is indicated when multiplier is entered.
 - i Does G-AI open?
 - ii Does F_{MLT} set?
 - iii Does G-II close?
- 2) Decimal point position is wrong.
 - i Is G-PA normal?
 - ii Are PC & AC normal?

2.2-8 Erroneous constant division.

- 1) Inverse division occurs.
 - i Does the operation enter CC2?
 - ii Does F_z set?
 - iii Does G-AI & G-IY open at CC2?
- 2) Decimal point is in the wrong position.
 - i Are PC, AC and DC normal?

2.2-9 Erroneous or no inverse division.

- 1) Content of ACC are not indicated when $\boxed{RV}$ key is pressed.

- i Does the step enter CC2?
 - ii Do Fz & F_H set?
 - iii Do G-AI & G-IY open at CC2?
- 2) Decimal point position is wrong.
- i Are PC, AC & DC normal?

3. Wiring Diagrams and Tables

3.1 Block Wiring Diagram

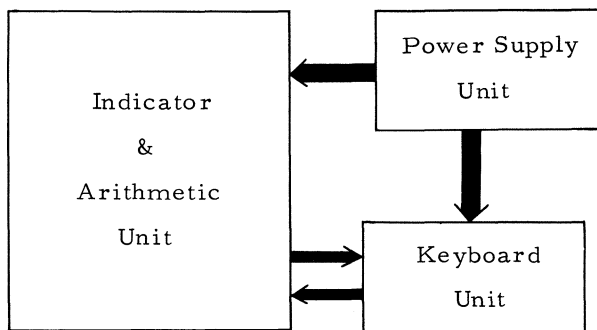


Fig. 1 Block Wiring Diagram

This calculator is divided into three units and interconnected as shown in the above.

3.2 Block Layout and Wiring (1)

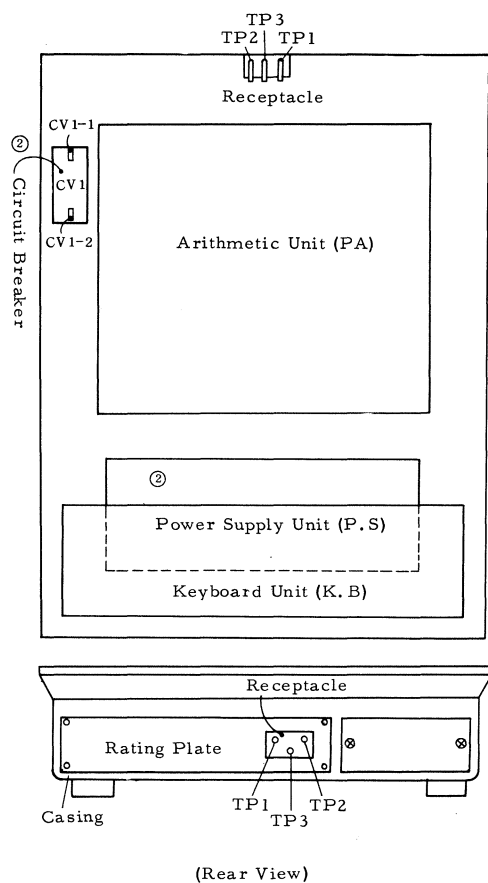


Fig. 2 Wiring between Units

KB ↔ PA

No.	Signal	Color	Wire	Terminal
1	Key 0	Black	C	KB4, 11B18
2	Key 1	Brown	C	KB6, 11B17
3	Key 2	Red	C	KB11, 11B16
4	Key 3	Orange	C	KB17, 11B15
5	Key 4	Yellow	C	KB10, 11B14
6	Key 5	Green	C	KB12, 11B13
7	Key 6	Blue	C	KB5, 11B11
8	Key 7	Purple	C	KB14, 11B10
9	Key 8	Gray	C	KB15, 11B9
10	Key 9	White	C	KB16, 11B8
11	Key P	Pink	C	KB20, 11B7
12	Key X	Yellow	B	KB21, 13A8
13	Key ÷	Green	B	KB22, 13A5
14	Key =	Red	B	KB23, 13A3
15	Key ⊖	Orange	B	KB24, 13A2
16	Key →	White	B	KB13, 13A9
17	Key RV	Gray	B	KB3, 11A6
18	Key CI	Sky blue	B	KB2, 13A7
19	Key C	Purple	B	KB1, 13A6
20	Key K	Brown	B	KB18, 06B9
21	Key A		B	KB9, 04B9

Note:

1)

Wire A: 20/0.18 Vinyl Wire

Wire B: 12/0.18 Vinyl Wire

Wire C: 10/0.12 Vinyl Wire

2)

KB: Keyboard Unit

PS: Power Supply Unit

PA: Arithmetic Unit

PS ↔ KB

No.	Signal	Color	Wire	Terminal
1	Key -10V	Blue	B	T4C, KB7
2	A, C	Black	A	T1A, SW1-3
3	A, C	White	A	T3B, SW1-4
4	A, C	White	A	T2A, SW1-6

PA ↔ PS

No.	Signal	Color	Wire	Terminal
1	+10V	Brown	A	08B5, T5B
2	-10V	Blue	A	08B6, T4B
3	E	Green	A	08B12, T8D
4	-1.5V	Purple	A	08B13, T7A
5	-14V	Sky blue	A	08B18, T6B

Receptacle ↔ KB.PS.CV1

No.	Signal	Color	Wire	Terminal
1	A.C	Black	A	TP1, SW1-1
2	A.C	White	A	TP2, CV1-1
3	E	Green	A	TP3, T8A
4	A.C	White	A	CV1-2, T3B

3.3 Block Layout and Wiring (2)

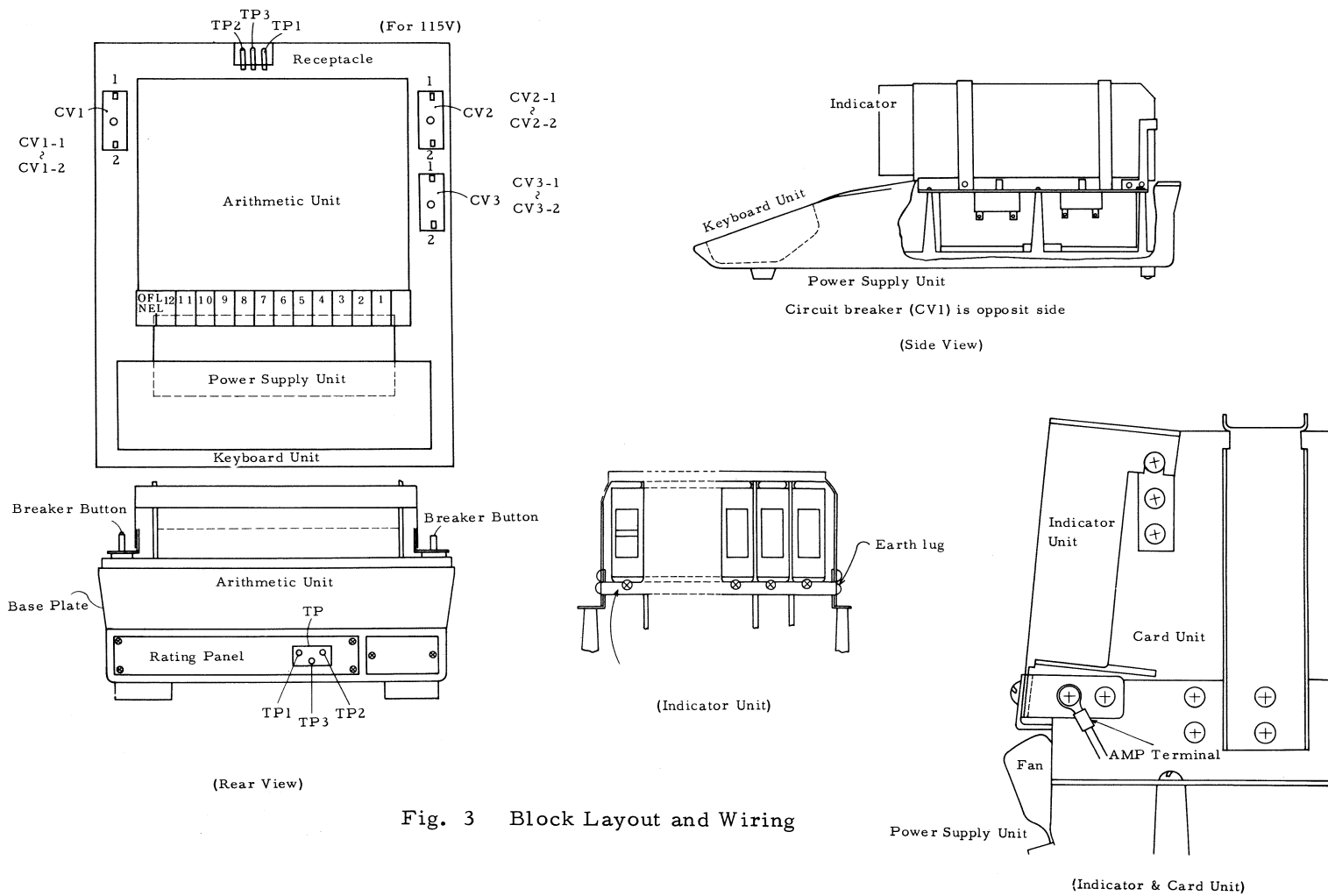


Fig. 3 Block Layout and Wiring

Power Supply Unit PS → Keyboard Unit KB

(For 115V)

No.	Terminal	Signal	Wire (UL)	Color	Destination	Origin	Remarks
1	T1A	AC115V	A	Black	T1A, SW1-3		UL Tube
2	T2A	AC 0V	A	White	T2A, SW1-6		UL Tube
3	T3B	AC 0	A	White	T3A, SW1-4		UL Tube
4	T4B	AC 0V	A	White	T4B, SW1-1		
5	PS28B	S-10V	B	Blue	PS28B, KB7		

Power Supply Unit PS → Arithmetic Unit PA

(For 115V)

No.	Terminal	Signal	Wire (UL)	Color	Destination	Origin	Remarks
6	PS28B	-10.5V	A	Blue	PS28B, 08B6		
7	PS30B	+10.5V	A	Brown	PS30B, 08B5		
8	PS31B	-14V	A	Skue blue	PS31B, 08B18		
9	T7B	-1.5V	A	Pink	T7B, 08B13		
10	T8D	E	A	Green	T8D, 08B12		
11							

Receptacle TP. → Circuit Breaker CV1. Power Supply Unit PS.

Circuit Breaker CV1. → Power Supply Unit PS.

(For 115V)

No.	Terminal	Signal	Wire (UL)	Color	Destination	Origin	Remarks
12	TP-1	AC 0V	A	White	TP1, T4A		UL Tube
13	TP2	AC115V	A	Black	TP2, CV1-1		UL Tube
14	TP3	E	A	Green	TP3, T8A		
15	CV1-2	AC115V	A	Black	CV1-2, T3A		UL Tube
16							

Keyboard KB → Arithmetic PA

(For 115V)

No.	Terminal	Signal	Wire	Color	Destination	Origin	Remarks
1	KB4	Key 0	UL-C	Black	KB4, 11B18		
2	KB6	Key 1	UL-C	Brown	KB6, 11B17		
3	KB11	Key 2	UL-C	Red	KB11, 11B16		
4	KB17	Key 3	UL-C	Orange	KB17, 11B15		
5	KB10	Key 4	UL-C	Yellow	KB10, 11B14		
6	KB12	Key 5	UL-C	Green	KB12, 11B13		
7	KB5	Key 6	UL-C	Blue	KB5, 11B11		
8	KB14	Key 7	UL-C	Purple	KB14, 11B10		
9	KB15	Key 8	UL-C	Gray	KB15, 11B9		
10	KB16	Key 9	UL-C	White	KB16, 11B8		
11	KB20	Key ·	UL-C	Pink	KB20, 11B7		
12	KB21	Key X	UL-B	Yellow	KB21, 13A8		
13	KB22	Key ÷	UL-B	Green	KB22, 13A5		
14	KB23	Key =	UL-B	Red	KB23, 13A3		
15	KB24	Key ⊖	UL-B	Orange	KB24, 13A2		
16	KB13	Key →	UL-B	White	KB13, 13A9		
17	KB3	Key RV	UL-B	Gray	KB3, 11A6		
18	KB2	Key CI	UL-B	Sky blue	KB2, 13A7		
19	KB1	Key C	UL-B	Purple	KB1, 13A6		
20	KB18	Key K	UL-B	Brown	KB18, 06B9		
21	KB9	Key A	UL-B	Black	KB9, 04B9		
22	SW1-1	AC 0V	UL-A	White		T4B	UL Tube
23	SW1-3	AC 0V	UL-A	White		T1A	UL Tube
24	SW1-4	AC115V	UL-A	Black		T3B	UL Tube
25	SW1-6	AC115V	UL-A	Black		T2A	UL Tube
26							

3.4 Type of Wires

Table 1 Type of Wires

(For 115V)

Wire Type	Parts No	AWG#	No. of Wires/Diameter	Coating
UL-A	X62-6189	20	Stranded wire AWG No.20 21/0.18	PVC, UL 1015 CSA TR-32 for heat proof wiring
UL-B	X62-6190	24	Stranded wire AWG No.24 12/0.16	PVC, UL 1007 CSA TR-64 for heat proof wiring
UL-C	X62-6191	26	Stranded wire AWG No.26 7/0.16	PVC, UL 1007 OSA TR-64 for heat proof wiring
UL-D	X62-6196	24	Stranded wire AWG No.24 1/0.55	PVC, UL 1007 OSA TR-64 for heat proof wiring
G	X62-6197	24	Stranded bare wire for grounding 12/0.18	

3.5 Terminal Diagram of Card Unit

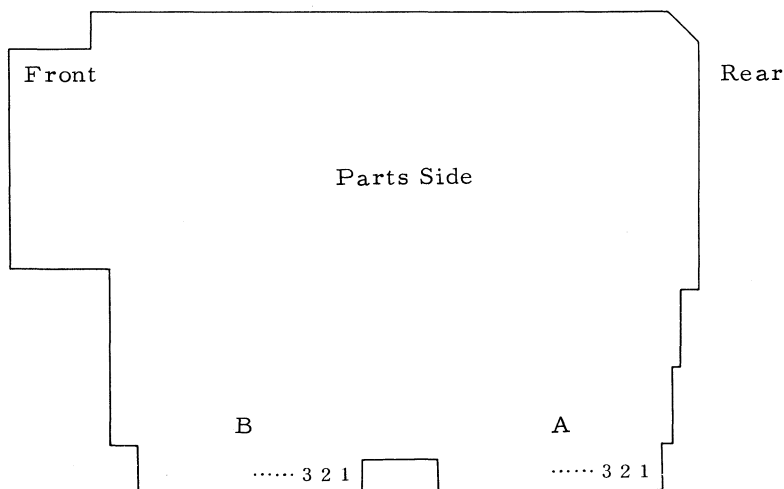


Fig. 4 Terminal Diagram

Table 2 Connector of Card Unit

Card Unit Position	Parts No.	A Connector	B Connector
01	88-0161	18	18
02	88-0162	18	18
03	88-0163	28	18
04	88-0160		18
05	88-0165	28	18
06	88-0160		18
07	88-0167	18	18
08	88-0160		18
09	88-0169	18	18
10	88-0170	18	18
11	88-0171	18	18
12	88-0172	18	18
13	88-0173	28	18

3.6 Parts Layout in Card Unit

88-0160 (04.06.08)

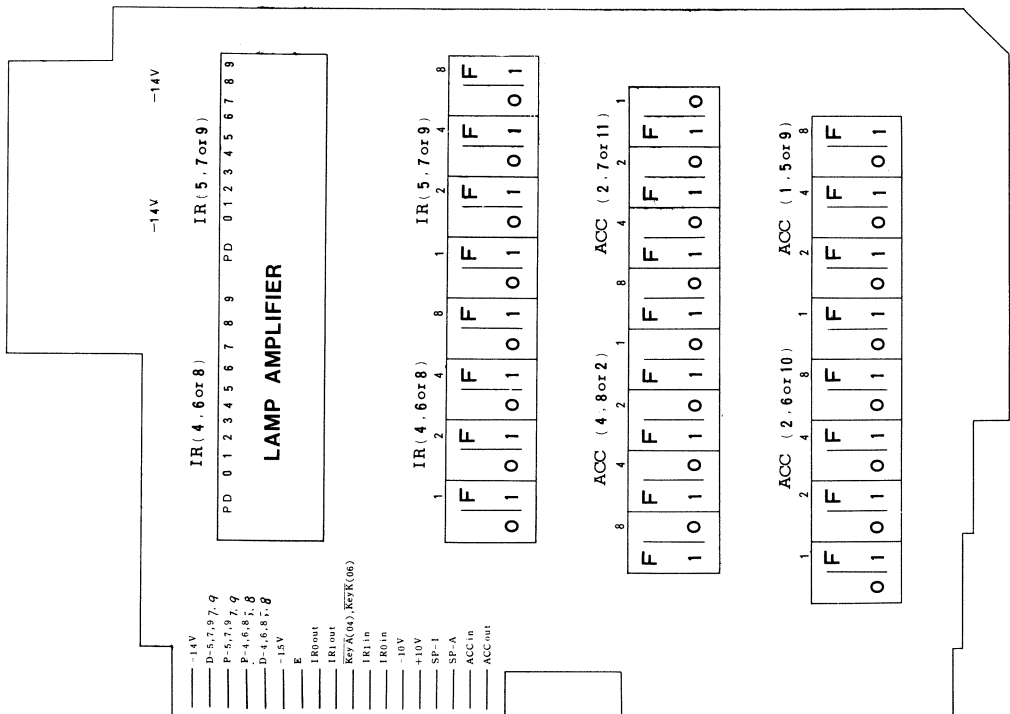


Fig. 5 Lamp AMP, IR and ACC

88-0161 (01)

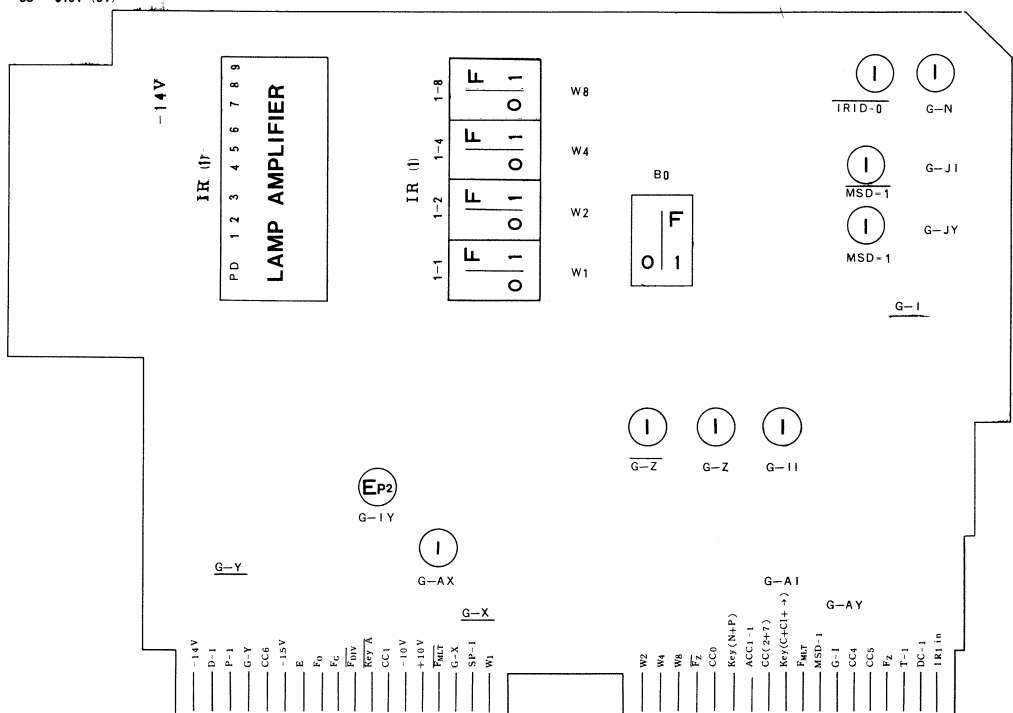


Fig. 6 G-X, G-Y, MSD-1, LAMP AMP and IR

88 — 0165 (05)

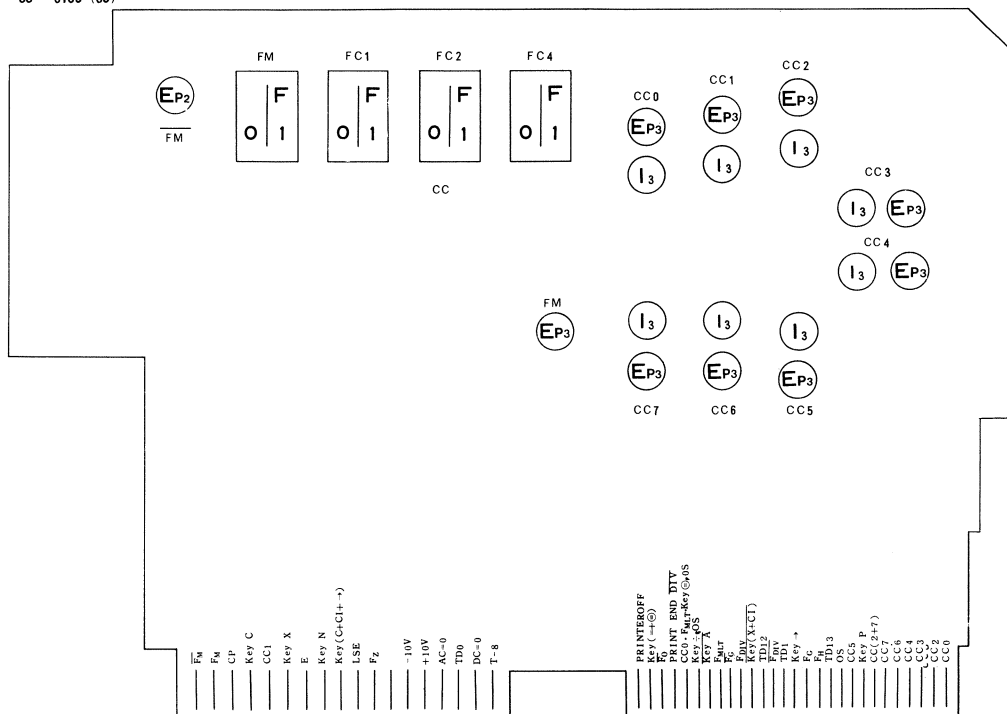


Fig. 9 FM and Control Counter

88 — 0167 (07)

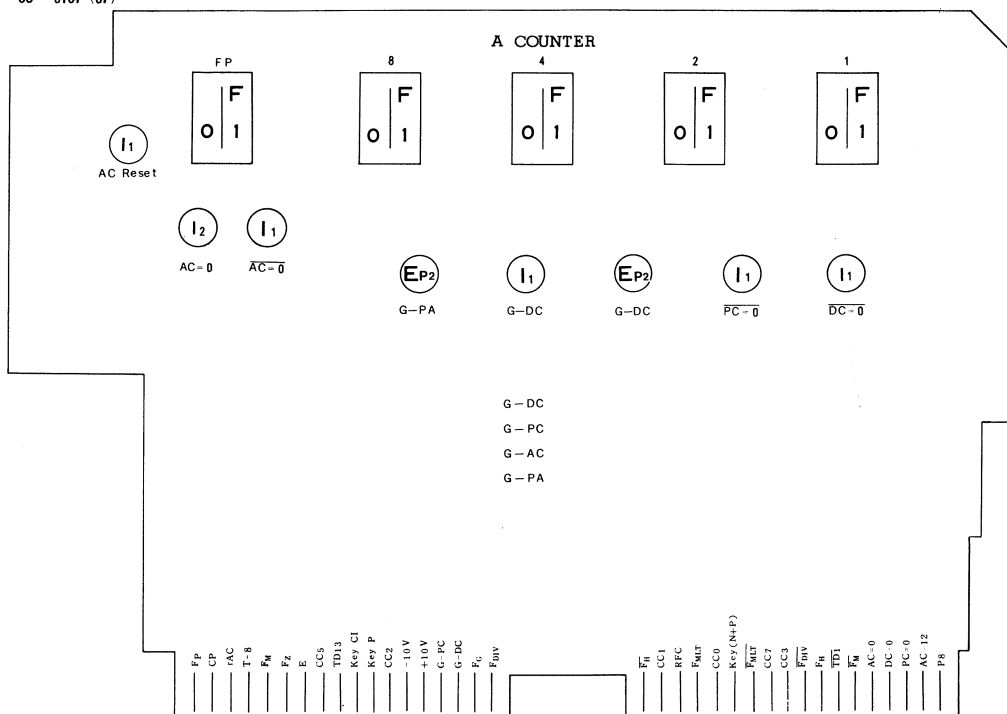


Fig. 10 Counter A

88-0169 (09)

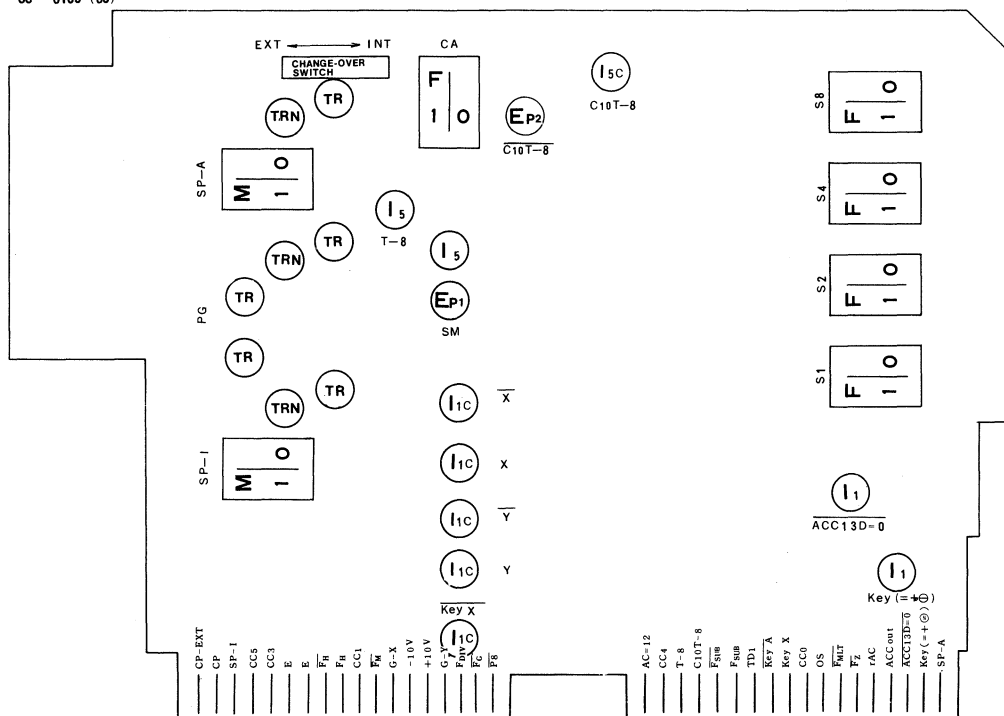


Fig. 11 PG, SP-I, SP-A and Adder-Subtractor

88-0170 (10)

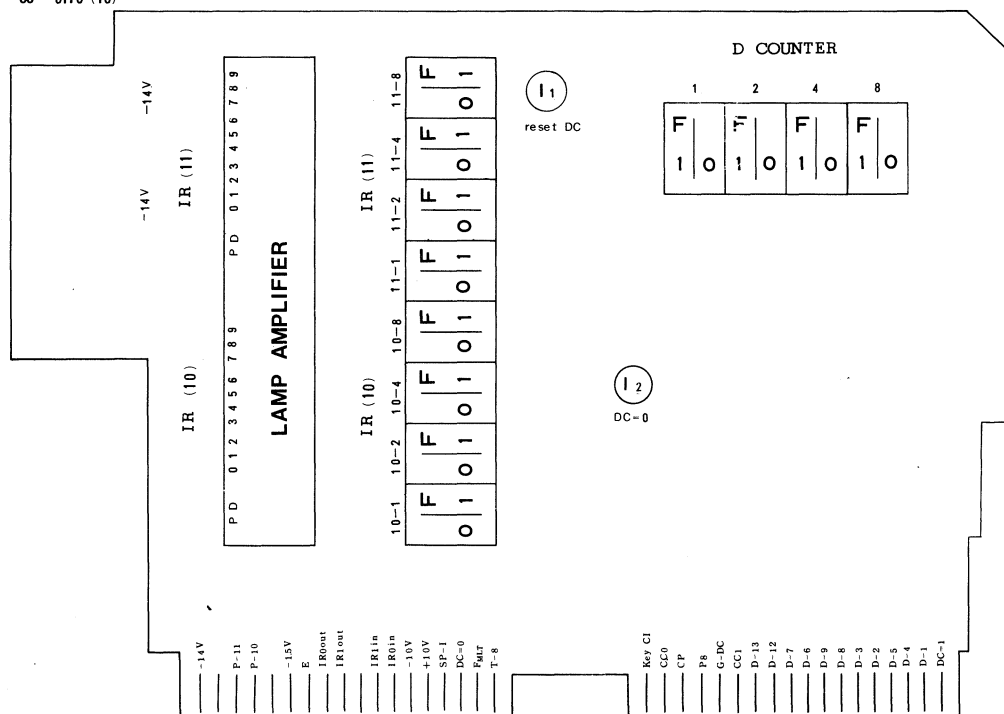


Fig. 12 Counter D, CAMP AMP and IR

88 - 0171 (11)

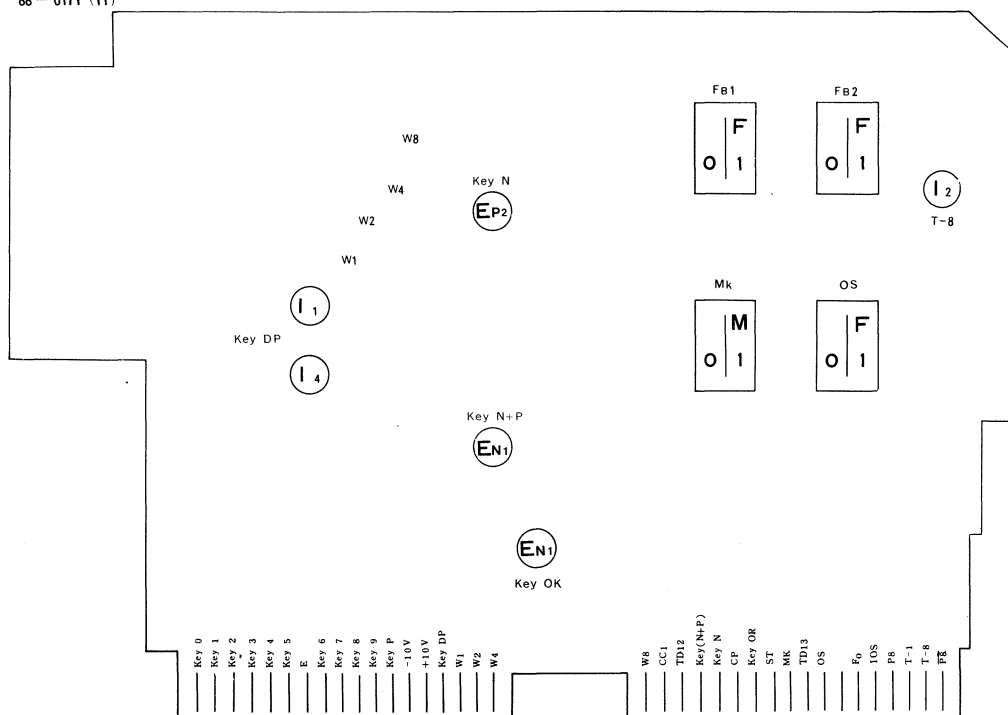


Fig. 13 OS and BIT Counter

88 - 0172 (12)

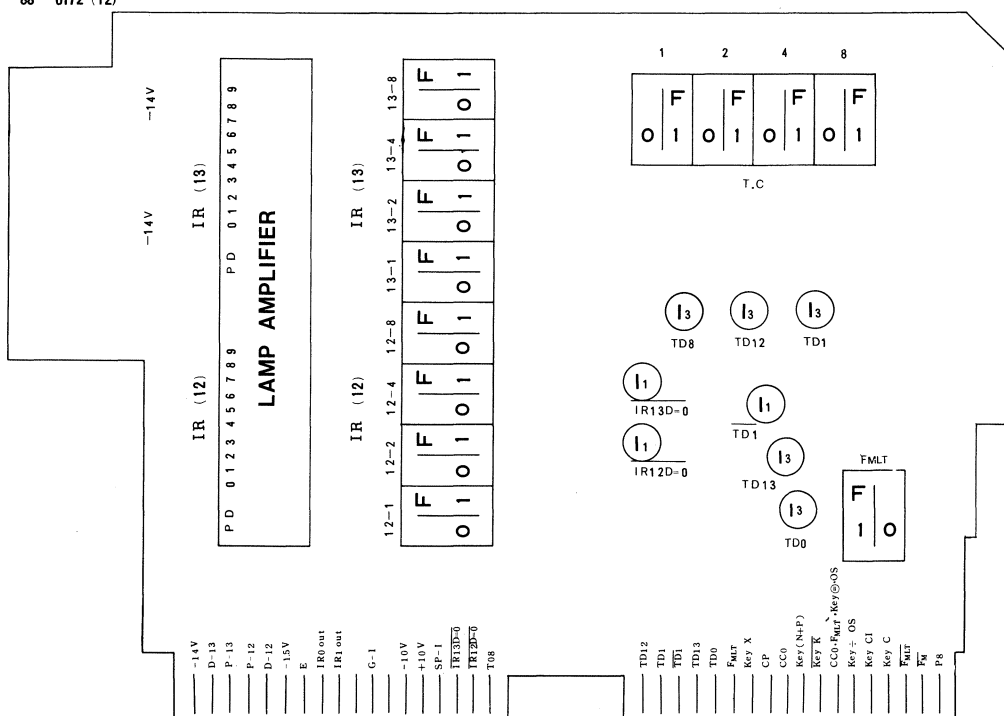


Fig. 14 Timing Counter F_{MLT}, ALAMP-AMP and IR

3.7 Main Panel Wiring

Table 3 Connector Terminals in Main Panel

		01	02	03	04	05	06	07	08	09	10	11	12	13	14
A	1	IR 1 in		Fz		CC0		P8		SP-A	DC=1	P8	P8	Key OR	F $\overline{M}$
	2	DC=1	P-1	F $\overline{G}$		CC2		AC=12		Key (= + $\ominus$)	D-1	T-8	F $\overline{M}$	Key $\ominus$	F $\overline{P}$
	3	T-1	P-4	F $\overline{G}$		CC3		PC=0		ACC 13D=0	D-4	T-1	F $\overline{M}$ LT	Key =	F $\overline{A}$
	4	Fz	P-5	LSE		CC4		DC=0		ACC out	D-5	P8	Key C	Key RV	AC=0
	5	CC5	P-8	Key(X+CI)		CC6		AC=0		r AC	D-2	IOS	Key CI	Key $\div$	DC=0
	6	CC4	P-9	F $\overline{D}$ IV		CC7		F $\overline{M}$		Fz	D-3	Fo	Key $\div$ OS	Key C	Fz
	7	G-I	P-6	F $\overline{D}$ IV		CC(2+7)		TD1		F $\overline{M}$ LT	D-8		CC0·F $\overline{M}$ LT·Key $\ominus$ OS	Key CI	F $\overline{G}$
	8	MSD-1	P-7	CC1		Key P		F $\overline{H}$		OS	D-9	OS	Key K	Key $\times$	F $\overline{H}$
	9	F $\overline{M}$ LT	P-10	IR12D=0		CC5		F $\overline{D}$ IV		CC0	D-6	TD13	Key(N+P)	Key $\rightarrow$	F $\overline{S}$ UB3
	10	Key(C+CI+ $\rightarrow$)	P-11	F $\overline{M}$		OS		CC3		Key X	D-7	MK	CC0	CC0	CC0
	11	CC(2+7)	P-12	Key K		TD13		CC7		Key A	D-12	ST	CP	F $\overline{D}$ IV	CC1
	12	ACC1-1	P-13	CC0		F $\overline{H}$		F $\overline{M}$ LT		TD1	D-13	Key OR	Key X	CC5	CC2
	13	Key N+P		Key CI		F $\overline{G}$		Key(N+P)		F $\overline{S}$ UB3	CC1	CP	F $\overline{M}$ LT	OS	CC3
	14	CC0	G-PC	Key X		Key $\rightarrow$		CC0		F $\overline{S}$ UB	G-DC	Key N	TPO	CC4	CC4
	15	Fz	CP	Key C		TD1		F $\overline{M}$ LT		C ₁₀ T-8	P8	Key(N+P)	TD13	TD13	CC5
	16	W8	F $\overline{M}$	Key $\div$ OS		F $\overline{D}$ IV		RFC		T-8	CP	TD12	TD1	C ₁₀ T-8	CC6
	17	W4	F $\overline{D}$ IV	PRINT END DIV		TD12		CC1		CC4	CC0	CC1	TD1	CC1	CC7
	18	W2	CC3	TD13		Key(X+CI)		F $\overline{H}$		AC=12	Key CI	W8	TD12	T-8	E
	19			Key(= + $\ominus$)		F $\overline{D}$ IV								MK	OS
	20			PRINTER OFF		F $\overline{G}$								IR13D=0	T-8
	21			OS		F $\overline{M}$ LT								CC7	CP INT
	22			CC4		Key A								CC6	CP EXT
	23			AC=12		Key $\div$ OS								CC3	
	24			TD8		CC0·F $\overline{M}$ LT·Key $\ominus$ OS								F $\overline{H}$	
	25			CC5		PRINT END DIV								F $\overline{M}$	
	26			CC1·F $\overline{D}$ IV·Key RV·OS		Fo								P8	
	27			DC=0		Key(= + $\ominus$)								F $\overline{H}$	
	28			CC7		PRINTER OFF								ACC 13D=0	
B	1	W1	Key C	F $\overline{M}$ LT	ACC1-1	T-8	ACC out	F $\overline{D}$ IV	ACC out	P8	T-8	W4	TD8	F $\overline{D}$ IV	
	2	SP-I	T-8	TD12	ACC in	DC=0	ACC in	F $\overline{G}$	ACC in	F $\overline{G}$	F $\overline{M}$ LT	W2	IR12D=0	Key DP	
	3	G-X	PC=0	CC2	SP-A	TD0	SP-A	G-DC	SP-A	F $\overline{D}$ IV	DC=0	W1	IR13D=0	F $\overline{S}$ UB3	
	4	F $\overline{M}$ LT	SP-I	F $\overline{S}$ UB3	SP-I	AC=0	SP-I	G-PC	SP-I	G-Y	SP-I	Key DP	SP-I	F $\overline{S}$ UB	
	5	+10V	+10V	+10V	+10V	+10V	+10V	+10V	+10V	+10V	+10V	+10V	+10V	+10V	
	6	-10V	-10V	-10V	-10V	-10V	-10V	-10V	-10V	-10V	-10V	-10V	-10V	-10V	
	7	CC1	IR0 in	MSD-1	IR 0 in	IR 0 in	IR 0 in	CC2	IR 0 in	G-X	IR0 in	Key P		CC1·F $\overline{D}$ IV·Key RV·OS	
	8	Key A	IR 1 in	Key $\rightarrow$	IR 1 in	Fz	IR 1 in	Key P	IR 1 in	F $\overline{M}$	IR1 in	Key 9	G-I	Key (= + $\ominus$)	
	9	F $\overline{D}$ IV		AC=0	Key A	LSE	Key K	Key CI		CC1		Key 8		CP	
	10	F $\overline{G}$	IR100T	Key $\ominus$	IR 1 out	Key(C+CI+ $\rightarrow$)	IR 1 out	TD13	IR 1 out	F $\overline{M}$	IR 1 out	Key 7	IR 1 out	Key(C+CI+ $\rightarrow$)	
	11	Fo		CP	IR 0 out	Key N	IR 0 out	CC5	IR 0 out	F $\overline{H}$	IR 0 out	Key 6	IR 0 out	Fo	
	12	E	E	E	E	E	E	E	E	E	E	E	E	E	
	13	-1.5V	-1.5V	IOS	-1.5V	Key X	-1.5V	Fz	-1.5V	E	-1.5V	Key 5	-2V	-2V	
	14	CC6	D-2	CC0·F $\overline{M}$ LT·Key $\ominus$ OS	D-4	CC1	D-6	F $\overline{M}$	D-8	CC3	P-10	Key 4	D-12	Fo	
	15	G-Y		F $\overline{H}$	P-4	Key C	P-6	T-8	P-8	CC5	P-11	Key 3	P-12	Key $\div$ OS	
	16	P-1		F $\overline{H}$	P-5	CP	P-7	rAC	P-9	SP-I		Key 2	P-13		
	17	D-1	D-3	Fz	D-5	F $\overline{M}$	D-7	CP	D-9	CP		Key 1	D-13	RFC	
	18	-14V	-14V		-14V	F $\overline{M}$	-14V	F $\overline{P}$	-14V	CP-EXT	-14V	Key 0	-14V	-14V	

Note; means signal source.

3.8 Signal Destination in Main Panel

Table 4 Signal Destination in Main Panel (1)

	01				02				03				04				05				06				07				
	No.	Signal	Destination	Origin	No.	Signal	Destination	Origin	No.	Signal	Destination	Origin	No.	Signal	Destination	Origin	No.	Signal	Destination	Origin	No.	Signal	Destination	Origin	No.	Signal	Destination	Origin	
A	1	IR 1 in		02B10	1				1	Fz	03A1,01A4,05B8,14A6,07B13						1	CC0	05A1,01A14,03A12,07A14,09A9,10A17,12A10,13A10,14A10					1	P8		11A4		
	2	DC=1		10A1	2	P-1	02A2, 01B16		2	Fc	03A2, 05A20, 09B2						2	CC2	05A2, 03B3, 07B7, 14A12					2	AC=12	07A2, 03A23, 09A18			
	3	T-1		11A3	3	P-4	02A3, 04B15		3	Fc	03A3,01B10,05A13,07B2,14A7						3	CC3	05A3,02A18,07A10,09B14,13A23,14A13					3	PC=0		02B3		
	4	Fz		03A1	4	P-5	02A4, 04B16		4	LSE	03A4, 05B9						4	CC4	05A4,01A6,03A22,09A17,13A14,14A14					4	DC=0		10B3		
	5	CC5		05A9	5	P-8	02A5, 08B15		5	Key(X+CT)	03A5, 05A18						5	CC6	05A5, 01B14, BA22, 14A16					5	AC=0	07A5, 03B9, 05B4, 14A4			
	6	CC4		05A4	6	P-9	02A6, 08B16		6	FDiv	03A6,01B9,05A16,07A9,13B1						6	CC7	05A6,03A28,07A11,13A21,14A17					6	FM		05B18		
	7	G-I	01A7, 12B8		7	P-6	02A7, 06B15		7	FDiv	03A7,02A17,05A19,07B1,09B3,13A11	05B14					7	CC(2+7)	05A7, 01A11					7	TD1		12A16		
	8	MSD=1	01A8, 03B7		8	P-7	02A8, 06B16		8	CC1	14A3	12B2					8	Key P		11B7					8	FH		03B16	
	9	FMLT		12A13	9	P-10	02A9, 10B15		9	IR12D=0		05B18					9	CC5	05A9,01A5,03A25,07B11,09B15,13A12,14A15					9	FDIV		03A6		
	10	Key(C+C1+→)		13B10	10	P-11	02A10, 10B16		10	FM		06B9					10	OS		11A8					10	CC3		05A3	
	11	CC(2+7)		05A7	11	P-12	02A11, 12B15		11	Key K		05A1					11	TD13		12A15					11	CC7		05A6	
	12	ACC1-1		04B1	12	P-13	02A12, 12B16		12	CC0		13A7					12	FH		03B16					12	FM		12A3	
	13	Key(N+P)		11A15	13	P8		11A4	13	Key CI		13A8					13	Fc		03A3					13	Key(N+P)		11A15	
	14	CC0		05A1	14	G-PC		07B4	14	Key X		13A6					14	Key →		13A9					14	CC0		05A1	
	15	Fz		03B17	15	CP		09B17	15	Key C		13B15					15	TD1		12A17					15	FMLT		12A13	
	16	W8		11A18	16	FM		05B18	16	Key+OS							16	FDIV		03A6					16	RFC	07A16, 13B17		
	17	W4		11B1	17	FDiv		03A7	17	PRINT END DIV		12A15					17	TD12		12A18					17	CC1		05B14	
	18	W2		11B2	18	CC3		05A3	18	TD13		13B8					18	Key(X+CT)		03A5					18	FM		03B15	
									19	Key(→+⊕)						19	FDiv		03A7										
									20	PRINTER OFF						20	FC		03A2										
									21	OS		11A8				21	FMLT		12A13										
									22	CC4		05A4				22	Key A		04B9										
									23	AC=12		07A2				23	Key+·OS		13B15										
									24	TD8		12B1				24	CC0·FMLT·Key⊕·OS		03B14										
									25	CC5		05A9				25	PRINT FND DIV												
									26	CC1·FDiv·Key RV·OS		13B7				26	F0		13B14										
									27	DC=0		10B3				27	Key(→+⊕)		13B8										
									28	CC7		05A6				28	PRINTER OFF												
B	No.	Signal	Destination	Origin	No.	Signal	Destination	Origin	No.	Signal	Destination	Origin	No.	Signal	Destination	Origin	No.	Signal	Destination	Origin	No.	Signal	Destination	Origin	No.	Signal	Destination	Origin	
	1	W1		11B3	1	Key C		13A6	1	FMLT		12A13	1	ACC1-1	04B,01A12		1	T-8		11A2	1	ACC out			1	FDiv		03A7	
	2	SP-I		09B16	2	T-8		11A2	2	TD12		12A18	2	ACC in		06B1	2	DC=0		10B3	2	ACC in		08B1	2	Fc		03A3	
	3	G-X	01B3, 09B7		3	PC=0	02B3, 07A3		3	CC2		05A2	3	SP-A		09A1	3	TD0		12A14	3	SP-A		09A1	3	G-DC	07B3, 10A14		
	4	FMLT		12A3	4	SP-I		09B16	4	FSub		13B8	4	SP-I		09B16	4	AC=0		07A5	4	SP-I		09B16	4	G-PC	07B4, 02A14		
	5	+10V			5	+10V			5	+10V			5	+10V			5	+10V			5	+10V			5	+10V			
	6	-10V			6	-10V			6	-10V			6	-10V			6	-10V			6	-10V			6	-10V			
	7	CC1		06B14	7	IR 0 in		04B11	7	MSD-1		01A8	7	IR 0 in		06B11	7							08B11	7	CC2		05A2	
	8	Key A		04B9	8	IR 1 in		04B10	8	Key →		13A9	8	IR 1 in		06B10	8	Fz						08B10	8	Key P		11B7	
	9	FDiv		03A6	9				9	AC=0		07A5	9	Key A	04B9,01B8,05A22,09A11	KB9	9	LSE		03A4	9	Key K	06B9,03A11,12A8	KB18	9	Key CI		13A7	
	10	Fc		03A3	10	IR 1 out	02B10,01A1		10	Key =		13A2	10	IR 1 out	04B10,02B8		10	Key(C+C1+→)		13B10	10	IR 1 out	06B10,04B8		10	TD13		12A15	
	11	F0		13B11	11				11	CP		09B17	11	IR 0 out	04B11,02B7		11	Key N		11A14	11	IR 0 out	06B11,04B7		11	CC5		05A9	
	12E				12	E			12	E			12	E			12	E			12	E			12	E			
	13	-2V			13	-2V			13	IOS	03B13,11A5		13	-2V			13	Key X		13A8	13	-2V			13	Fz		03A1	
	14	CC6		05A5	14	D-2		10A5	14	CC0·FMLT·Key⊕·OS	03B14,05A24,12A7		14	D-4		10A3	14	CC1	11A17,13A17,14A11,05B14,01B7,03A8,07A17,09B9,10A13			14	D-6		10A9	14	FM		05B17
	15	G-Y	01B15, 09B4		15				15	FM	03B15,07A18,09B10,13A24		15	P-4		02A3	15	Key C		13A6	15	P-6		02A7	15	T-8		11A2	
	16	P-1		02A2	16				16	FH	03B16,05A12,07A8,09B11,13A27,14A8		16	P-5		02A4	16	CP		09B17	16	P-7		02A8	16	rAC		09A5	
	17	D-1		10A2	17	D-3		10A6	17	FZ	03B17,01A15,09A6		17	D-5		10A4	17	FM	05B17,07B14			17	D-7		10A10	17	CP		09B17
18	-14V			18	-14V			18					18	-14V			18	FM	12A2,13A25,14A1,05B18,02A16,03A10,07A6,09B8			18	-14V			18	FP	07B18,14A2	

Table 4 Signal Destination in Main Panel (2)

	08				09				10				11				12					13				14			
					No.	Signal	Destination	Origin	No.	Signal	Destination	Origin	No.	Signal	Destination	Origin	No.	Signal	Destination	Origin	No.	Signal	Destination	Origin	No.	Signal	Destination	Origin	
A					1	SP-A	09A1, 04B3, 06B3, 08B3		1	DC=1	10A1, 01A2		1	P8	11A1, 09B1		1	P8		11A4	1	Key OR	13A1, 11A12		1	F _M		05B18	
					2	Key(=+⊕)		13B8	2	D-1	10A2, 01B17		2	T-8	11A2, 02B2, 05B1, 07B15, 09A16, 10AB1, 13A18, 14A20		2	F _H	12A3, 01B4, 07A12, 09A7	05B18	2	Key ⊖	13A2, 03B10	KB24	2	F _P		07B18	
					3	ACC13D=0	09A3, 13A28		3	D-4	10A3, 04B14		3	T-1	11A3, 01A3		3	F _{MLT}			3	Key =		KB23	3	F _{DIV}		03A7	
					4	ACC out	09A4, 08B2		4	D-5	10A4, 04B17		4	P8	11A4, 02A13, 07A1, 10A15, 12A1, 13A26		4	Key C		13A6	4	Key RV		KB3	4	AC=0		07A5	
					5	rAC	09A5, 07B16		5	D-2	10A5, 02B14		5	IOS		03B13		5	Key CI		13A7	5	Key ÷		KB22	5	DC=0		10B3
					6	F _Z		03B17	6	D-3	10A6, 02B17		6	Fo		13B11		6	Key C		13A7	6	Key C	13A6, 02B1, 03A15, 05B15, 12A4	KB1	6	F _Z		03A1
					7	F _{MLT}		12A3	7	D-8	10A7, 08B14		7					7	Key CI		13A7	7	Key CI	13A7, 03A13, 07B9, 10A18, 12A5	KB2	7	F _G		03A3
					8	OS		11A8	8	D-9	10A8, 08B17		8	OS	11A8, 03A21, 05A10, 09A8, 13A13, 14A19		8	Key K		03B15	8	Key X	13A8, 03A14, 05B13, 09A10, 12A12	KB21	8	F _H		03B16	
					9	CC0		05A1	9	D-6	10A9, 06B14		9	TD13		12A15		7	Key → OS		13B15	9	Key →	13A9, 03B8, 05A14	KB13	9	F _{SUB}		13B3
					10	Key X		13A8	10	D-7	10A10, 06B17		10	MK	11A10, 13A19		9	CC0·F _{MLT} ·Key⊖·OS		03B14	10	CC0		05A1	10	CC0		05A1	
					11	Key A		04B9	11	D-12	10A11, 12B14		11	ST			8	Key K		06B9	11	F _{DIV}		03A7	11	CC1		05B14	
					12	TD1		12A17	12	D-13	10A12, 12B17		12	Key OR		13A1		9	Key(N+P)		11A15	12	CC5		05A9	12	CC2		05A2
					13	F _{SUB}		13B3	13	CC1		05B14	13	CP		09B17		10	CC0		05A1	13	OS		11A8	13	CC3		05A3
					14	F _{SUB}		13B4	14	G-DC		07B3	14	Key N	11A14, 05B11		11	CP		09B17	13A8	14	CC4		05A4	14	CC4		05A4
					15	C ₁₀ T-8	09A15, 13A16		15	P8		11A4	15	Key(N+P)	11A15, 01A13, 07A13, 12A9		12	Key X			09B17	15	TD13		12A15	15	CC5		05A9
					16	T=8		11A2	16	CP		09B17	16	TD12		12A18		13	F _{MLT}	12A13, 01A9, 03B1, 05A21, 07B15, 10B2	13A8	16	C ₁₀ T-8		09A15	16	CC6		05A5
					17	CC4		05A4	17	CC0		05A1	17	CC1		05B14		14	TD0	12A14, 05B3		17	CC1		05B14	17	CC7		05A6
					18	AC=12		07A2	18	Key CI		13A7	18	W8	11A18, 01A16		15	TD13	12A15, 03A18, 05A11, 07B10, 11A9, 13A15		16	TD1	12A16, 07A7	22	CC6		05A5		
B					1	P8		11A1	1	T-8		11A2	1	W4	11B1, 01A17		16	TD1	12A17, 05A15, 09A12		17	F _H		03B15	23	CC3		05A3	
					2	F _G		03A2	2	F _{MLT}		12A13	2	W2	11B2, 01A18		17	TD1	12A18, 03B2, 05A17, 11A16		24	F _H		03B15	24	F _H		03B15	
					3	F _{DIV}		03A7	3	DC=0	10B3, 03A27, 05B2, 07A4, 14A5		3	W1	11B3, 01B1		18	TD12			25	F _M		05B18	25	F _M		05B18	
					4	G-Y		01B15	4	SP-I		09B16	4	Key DP	11B4, 13B2		18	W8	11A18, 01A16		26	P8		11A4	26	P8		11A4	
					5	+10V			5	+10V			5	+10V							27	F _H		03B16	27	F _H		03B16	
					6	-10V			6	-10V			6	-10V							28	ACC13D=0		09A3	28	ACC13D=0		09A3	
					7	G-X		01B3	7	IR 0 in		12B11	7	Key P	11B7, 05A8, 07B8	KB20	1	TD8	12B1, 03A24		18	Key K		06B9	18	Key(N+P)		11A15	
					8	F _M		05B18	8	IR 1 in		12B10	8	Key 9		KB16	12	Key X			09B17	19	CC1		05B14	19	CC1		05B14
					9	CC1		05B14	9	Key 8			9	Key 8		KB15	13	CP			13A8	20	CC5		05A9	20	CC2		05A2
					10	F _H		03B15	10	IR 1 out	10B10, 08B8		10	Key 7		KB14	14	Key X			09B17	21	OS		11A8	21	CC3		05A3
					11	F _H		03B16	11	IR 0 out	10B11, 08B7		11	Key 6		KB5	15	CP			13A8	22	CC4		05A4	22	CC4		05A4
					12	E			12	E			12	E			16	TD1	12A16, 07A7		19	CC1		05B14	19	CC1		05B14	
					13	E			13	-2V			13	Key 5		KB1?	15	TD13	12A15, 03A18, 05A11, 07B10, 11A9, 13A15		20	C ₁₀ T-8		09A15	20	CC7		05A6	
					14	CC3		05A3	14				14	Key 4		KB10	16	TD1	12A17, 05A15, 09A12		21	CC7		05A6	21	CC7		05A6	
					15	CC5		05A9	15	P-10		02A9	15	Key 3		KB17	17	TD1	12A18, 03B2, 05A17, 11A16		22	CC6		05A5	22	CC6		05A5	
					16	SP-I	09B16, 01B2, 02B4, 04B4, 06B4, 08B4, 10B4, 12B4		16	P-11		02A10	16	Key 2		KB11	17	TD1	12A17, 05A15, 09A12		23	CC3		05A3	23	CC3		05A3	
					17	CP	10A16, 11A13, 12A11, 13B9, 09B17		17				17	Key 1		KB6	18	TD1	12A18, 03B2, 05A17, 11A16		24	F _H		03B15	24	F _H		03B15	
					18	CP-EXT	02A15, 0B11, 05B16, 07B17	14A22	18	-14V			18	Key 0		KB4	18	TD12	12A18, 03B2, 05A17, 11A16		25	F _M		05B18	25	F _M		05B18	

3.9 Power Supply in Main Panel

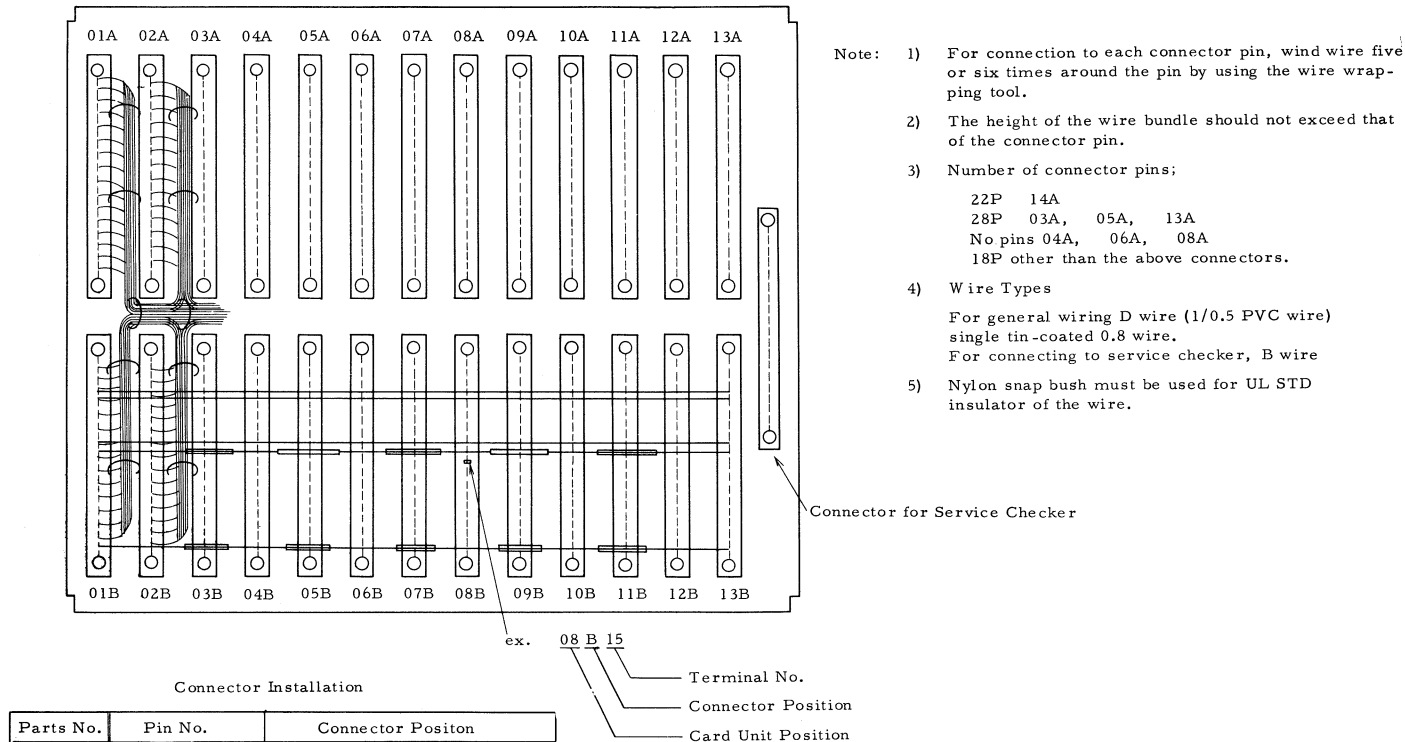


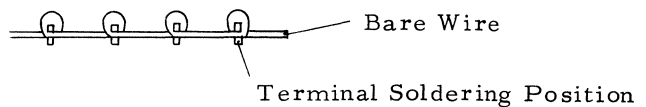
Fig. 16 Power Supply of Main Panel

Table 5 Power Supply Terminals in Main Panel

● mark means power supply terminals from power supply unit.

Signal	Color	Terminal
+10.5V	Red	01B5, 02B5, 03B5, 04B5, 05B5, 06B5, 07B5, 08B5, 09B5, 10B5, 11B5, 12B5, 13B5
-10.5V	Blue	01B6, 02B6, 03B6, 04B6, 05B6, 06B6, 07B6, 08B6, 09B6, 10B6, 11B6, 12B6, 13B6
E	Green	01B12, 02B12, 03B12, 04B12, 05B12, 06B12, 07B12, 08B12, 09B12, 10B12, 11B12, 12B12, 13B12, 14B12, 15B12, 16B12, 17B12, 18B12, 19B12, 20B12, 21B12, 22B12, 23B12, 24B12, 25B12, 26B12, 27B12, 28B12, 29B12, 30B12, 31B12, 32B12, 33B12, 34B12, 35B12, 36B12, 37B12, 38B12, 39B12, 40B12, 41B12, 42B12, 43B12, 44B12, 45B12, 46B12, 47B12, 48B12, 49B12, 50B12, 51B12, 52B12, 53B12, 54B12, 55B12, 56B12, 57B12, 58B12, 59B12, 60B12, 61B12, 62B12, 63B12, 64B12, 65B12, 66B12, 67B12, 68B12, 69B12, 70B12, 71B12, 72B12, 73B12, 74B12, 75B12, 76B12, 77B12, 78B12, 79B12, 80B12, 81B12, 82B12, 83B12, 84B12, 85B12, 86B12, 87B12, 88B12, 89B12, 90B12, 91B12, 92B12, 93B12, 94B12, 95B12, 96B12, 97B12, 98B12, 99B12, 100B12
-1.5V	Black	01B13, 02B13, 04B13, 06B13, 08B13, 10B13, 12B13, 13B13
-14V	Yellow	01B18, 02B18, 04B18, 06B18, 08B18, 10B18, 12B18, 13B18

Note: 1) Terminals of power supply unit must be used bare wire for soldering with 1 1/2 wind.



2) Colored Empire tube: -1.5V Black
-14V Yellow

3.10 Arithmetic Unit (1) {1}

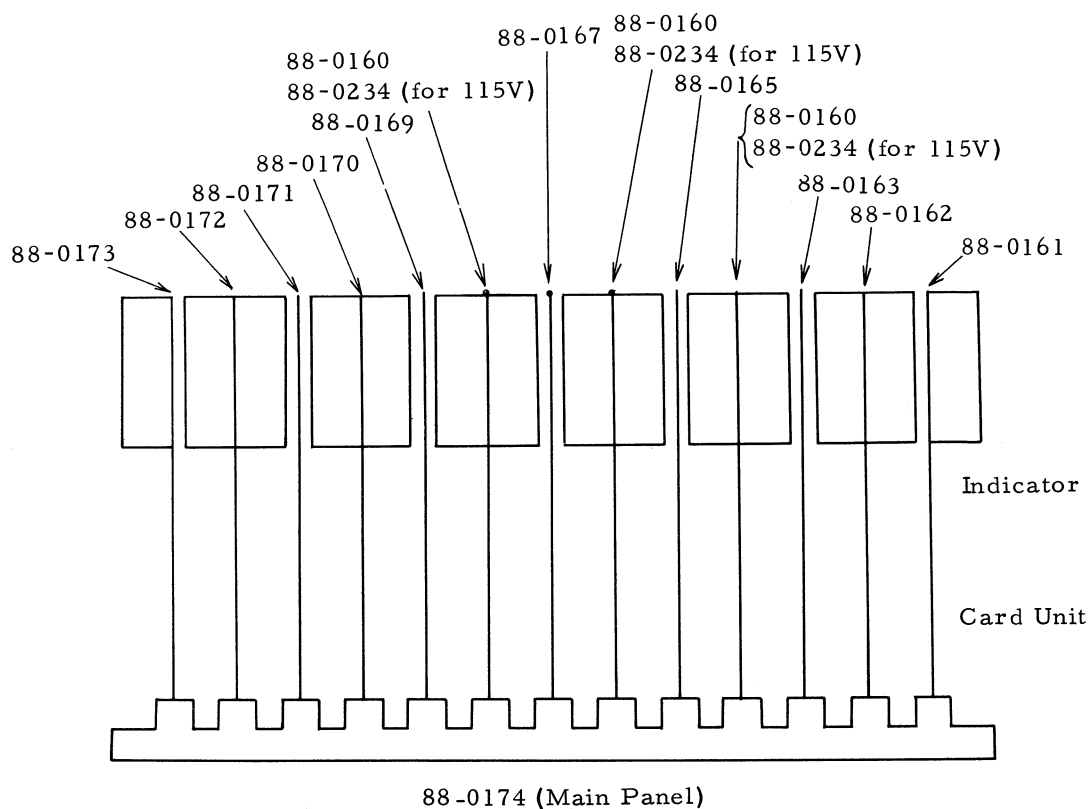
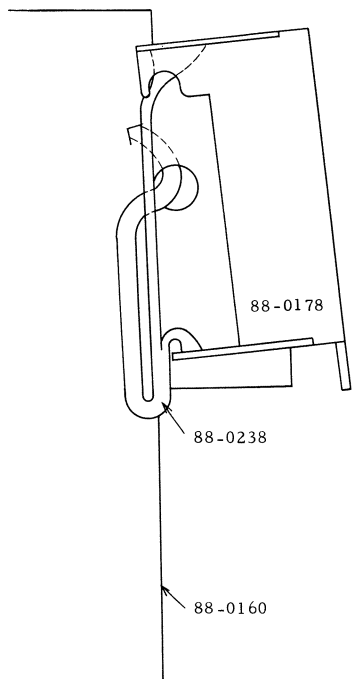


Fig. 17 Card Units Layout

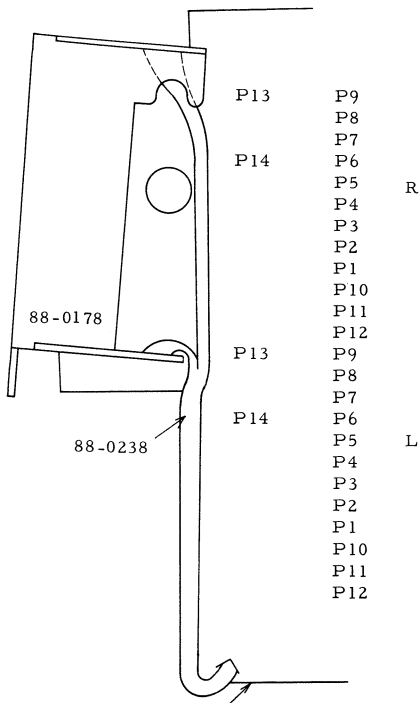
- Note:
- 1) The above diagram is the front view of the layout of the arithmetic card units and indicator units.
 - 2) The numeric indicator is the first 13 digits from right to left and the extreme left indicator is for overflow and negative sign indication.
 - 3) The right side of each card unit is the parts mounting face; the left side, the printed circuit.

3.11 Arithmetic Unit (2)

Indicator of Printed Circuit Side



Indicator of Parts Side



Signal	Color	Terminal
9	White	L9 · P9
8	Gray	L8 · P8
7	Purple	L7 · P7
6	Blue	L6 · P6
5	Green	L5 · P5
4	Yellow	L4 · P4
3	Orange	L3 · P3
2	Red	L2 · P2
1	Brown	L1 · P1
0	Black	L10 · P10
D		L11 · P11
P	Pink	L12 · P12
-14V	Sky blue	L13 · P13
-14V	Sky blue	L14 · P14
9	White	L9 · P9
8	Gray	L8 · P8
7	Purple	L7 · P7
6	Blue	L6 · P6
5	Green	L5 · P5
4	Yellow	L4 · P4
3	Orange	L3 · P3
2	Red	L2 · P2
1	Brown	L1 · P1
0	Black	L10 · P10
D		L11 · P11
P	Pink	L12 · P12
-14V	Sky blue	L13 · P13
-14V	Sky blue	L14 · P14

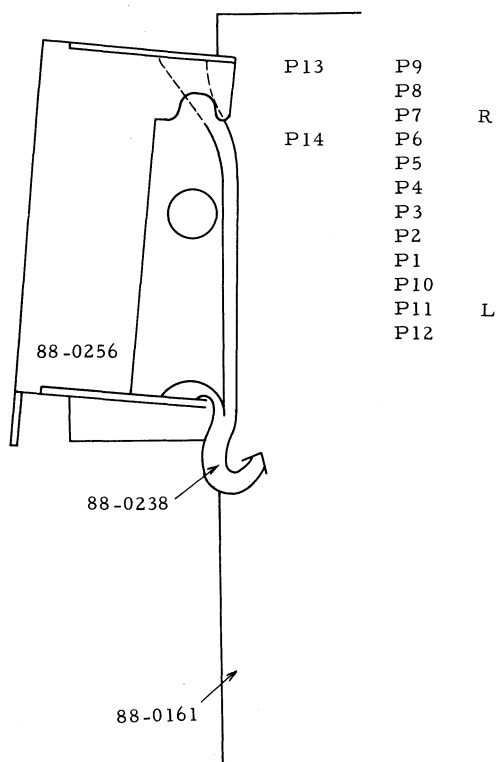
Wiring (7/0.6 vinyl wire)

- 1) L1 ~ 14 are terminals to the Indicator Units.
- 2) P1 ~ 14 are terminals to the Arithmetic Units.

The terminals of P1 ~ 14 on the arithmetic printed board side lead to the left (L) indicator, while the lower ones lead to the right (R) indicator. After connecting the wires to the terminals of the left side indicator, pass them through the 10mm hole in the board to the upper P1 ~ 14 and connect them to their proper terminals by passing the wire through the hole on the part mounting side of the card unit, bending the end over the pad on the pattern or printed side and soldering it firmly to the pad. For the right side indicator, the wires from it straight down to the lower P1 ~ 14.

Fig. 18 Numeric Indicator Installation

3.12 Arithmetic Unit (3)

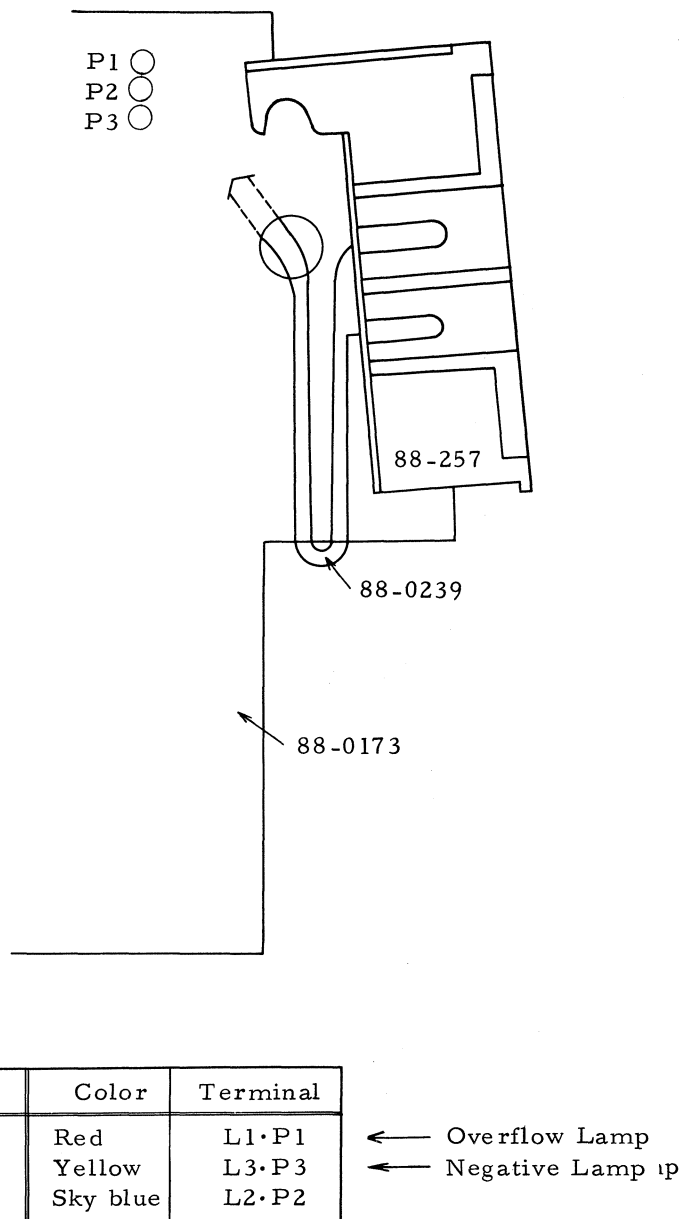


Signal	Color	Terminal
9	White	L9 · P9
8	Gray	L8 · P8
7	Purple	L7 · P7
6	Blue	L6 · P6
5	Green	L5 · P5
4	Yellow	L4 · P4
3	Orange	L3 · P3
2	Red	L2 · P2
1	Brown	L1 · P1
0	Black	L10 · P10
D		L11 · P11
P	Pink	L12 · P12
-14V	Sky blue	L13 · P13
-14V	Sky blue	L14 · P14

Note: 1) The terminals for indication of the arithmetic printed circuit board are numbered P1~P14 for the R side as shown in the diagram. Since there is only one right side indicator on the board, the upper terminals are only used.

Fig. 19 Numeric Indicator Installation

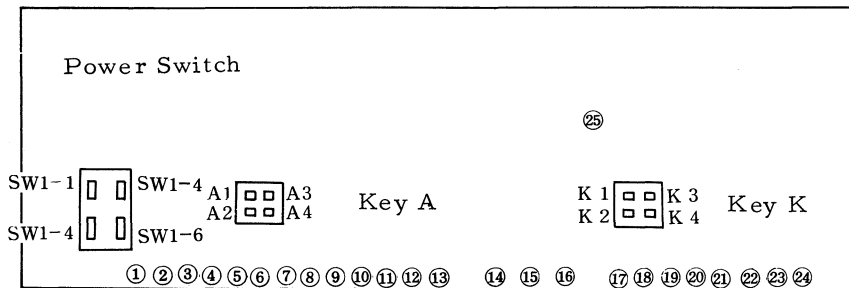
3.13 Arithmetic Unit (4)



There are only 3 terminals (P1 ~ P3) necessary for this card units and since the indicator is on the left side of the board it is necessary to pass the connecting wires through the 10mm hole.

Fig. 20 Sign Indicator Installation

3.14 Keyboard Unit (1)



- Note: 1) The above diagram shows the pattern of the keyboard printed circuit board!
- 2) Terminals are numbered as shown in the above diagram.
- Power switch SW-1, SW1-3, SW1-4, SW1-6
- Key A A1 ~ A4
- Key K K1 ~ K4
- Solder less ①~②⑤ which denote KB1 ~ KB25

Signal	Color	Terminal
Key A	Yellow green	A2, KB9
Key K	Brown	K2, KB18
Key K	Black	K4, KB19
-10V	Blue	A1, KB7
-10V	Blue	K1, KB25

Wire: D Wire (1/0.5 PVC wire)

- Note: 1) Terminals KB7, KB9, KB18, KB19 and KB25 must be soldered to its lug.

Fig. 21 Keyboard Card Unit Wiring

3.15 Keyboard Unit (2)

Table 6 Keyboard Unit Terminals

No.	Terminal	Signal	Wire	Color	Destination	Origin
1	KB4	Key 0	C	Black	KB4, 11B18	
2	KB6	Key 1	C	Brown	KB6, 11B17	
3	KB11	Key 2	C	Red	KB11, 11B16	
4	KB17	Key 3	C	Orange	KB17, 11B15	
5	KB10	Key 4	C	Yellow	KB10, 11B14	
6	KB12	Key 5	C	Green	KB12, 11B13	
7	KB15	Key 6	C	Blue	KB5, 11B11	
8	KB14	Key 7	C	Purple	KB14, 11B10	
9	KB15	Key 8	C	Gray	KB15, 11B9	
10	KB16	Key 9	C	White	KB16, 11B8	
11	KB20	Key P	C	Pink	KB20, 11B7	
12	KB21	Key X	B	Yellow	KB21, 13A8	
13	KB22	Key ÷	B	Green	KB22, 13A5	
14	KB23	Key =	B	Red	KB23, 13A3	
15	KB24	Key ⊖	B	Orange	KB24, 13A2	
16	KB13	Key →	B	White	KB13, 13A9	
17	KB3	Key RV	B	Gray	KB3, 11A6	
18	KB2	Key CI	B	Sky blue	KB2, 13A7	
19	KB1	Key C	B	Purple	KB1, 13A6	
20	KB2	Key K	B	Brown	KB18, 06B9	
21	KB9	Key A	B		KB9, KB19, 04B9	
22	KB7	-10.5V	B	Blue	KB7, T4C	
23	SW1-1	AC	A	White	SW1-1, TP1	
24	SW1-3	AC	A	White	SW1-3, T1A	
25	SW1-4	AC	A	Black	SW1-4, T3A	
26	SW1-6	AC	A	Black	SW1-6, T2A	

Note: 1) Wire A 21/0.18 Vinyl wire
 B 12/0.16 "
 C 7/0.16 "

Table 7 Keyboard Unit Terminals

(For 115V)

No.	Terminal	Signal	Wire	Color	Destination	Origin
1	KB1	Key C	UL-B	Purple	KB1, 13A6	KB9
2	KB2	Key CI	UL-B	Sky blue	KB2, 13A7	
3	KB3	Key RV	UL-B	Gray	KB3, 11A6	
4	KB4	Key O	UL-C	Black	KB4, 11B18	
5	KB5	Key 6	UL-C	Blue	KB5, 11B11	
6	KB6	Key 1	UL-C	Brown	KB6, 11B17	
7	KB7	S-10.5V	UL-B	Blue	KB7, T4C	
8	KB8					
9	KB9	Key A	UL-B	Black	KB9, KB19, 04B9	
10	KB10	Key 4	UL-C	Yellow	KB10, 11B14	
11	KB11	Key 2	UL-C	Red	KB11, 11B16	
12	KB12	Key 5	UL-C	Green	KB12, 11B13	
13	KB13	Key →	UL-B	White	KB13, 13A9	
14	KB14	Key 7	UL-C	Purple	KB14, 11B10	
15	KB15	Key 8	UL-C	Gray	KB15, 11B9	
16	KB16	Key 9	UL-C	White	KB16, 11B8	
17	KB17	Key 3	UL-C	Orange	KB17, 11B15	
18	KB18	Key K	UL-B	Brown	KB18, 06B9	
19	KB19					
20	KB20	Key P	UL-C	Pink	KB20, 11B7	
21	KB21	Key X	UL-B	Yellow	KB21, 13A8	
22	KB22	Key ÷	UL-B	Green	KB22, 13A5	
23	KB23	Key =	UL-B	Red	KB23, 13A3	
24	KB24	Key ⊖	UL-B	Orange	KB24, 13A2	
25	KB25					
26	SW1-1	AC OV	UL-A	White	SW1-1, T4B	
27	SW1-3	AC OV	UL-A	White	SW1-3, T1A	
28	SW1-4	AC115V	UL-A	Black	SW1-4, T3B	
29	SW1-6	AC115V	UL-A	Black	SW1-6, T2A	

Note: 1) Wire

UL-A AWG#20 (21/0.18)

UL-B AWG#24 (12/0.16)

UL-C AWG#26 (7/0.16)

2) The following wires must be covered with vinyl tube passed UL STD;

SW1-1 T4B

SW1-3 T1A

SW1-4 T3B

SW1-6 T2A

3.16 Keyboard Unit (3)

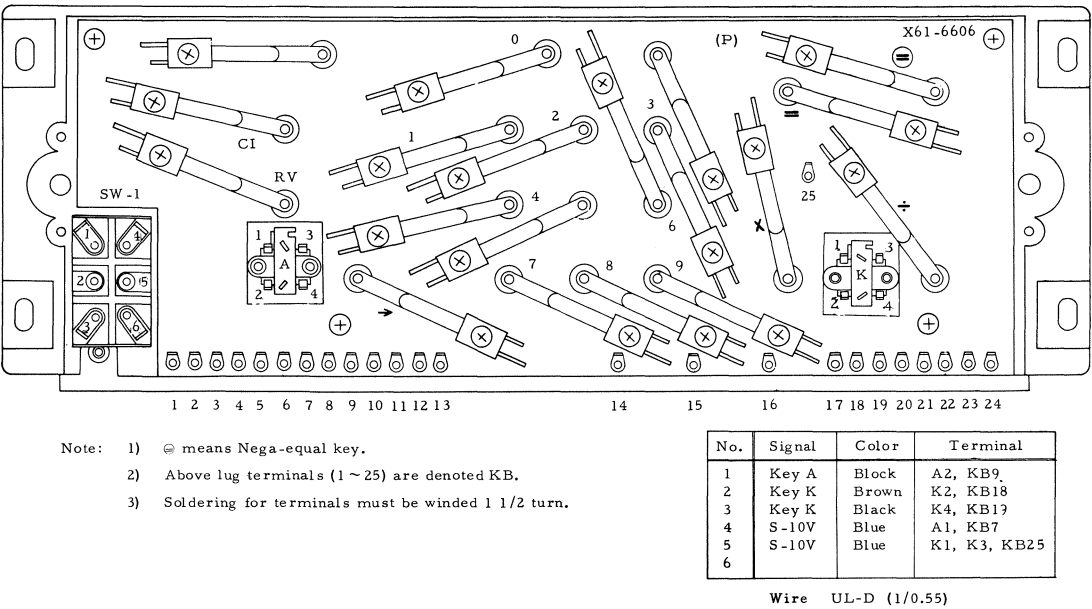


Fig. 22 Keyboard Parts Layout for 115V

3.17 Keyboard Unit (4) (4)

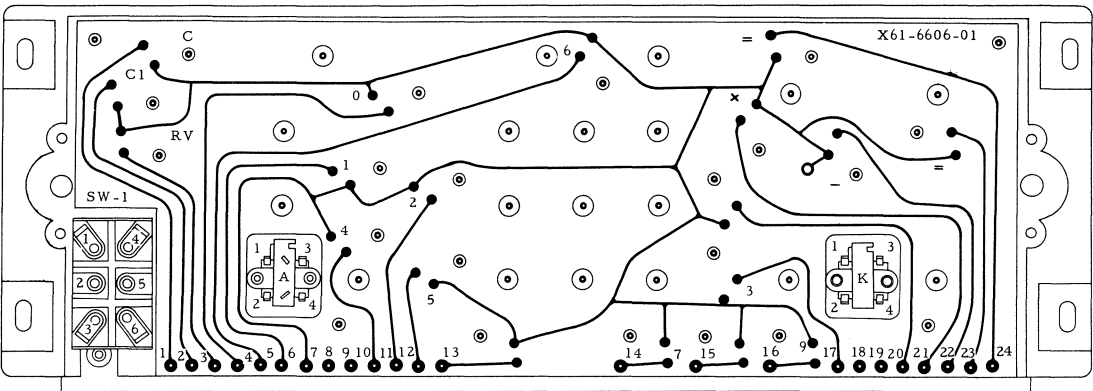


Fig. 23 Keyboard Unit Printed Circuit for 115V

3.18 Power Supply Unit (1)

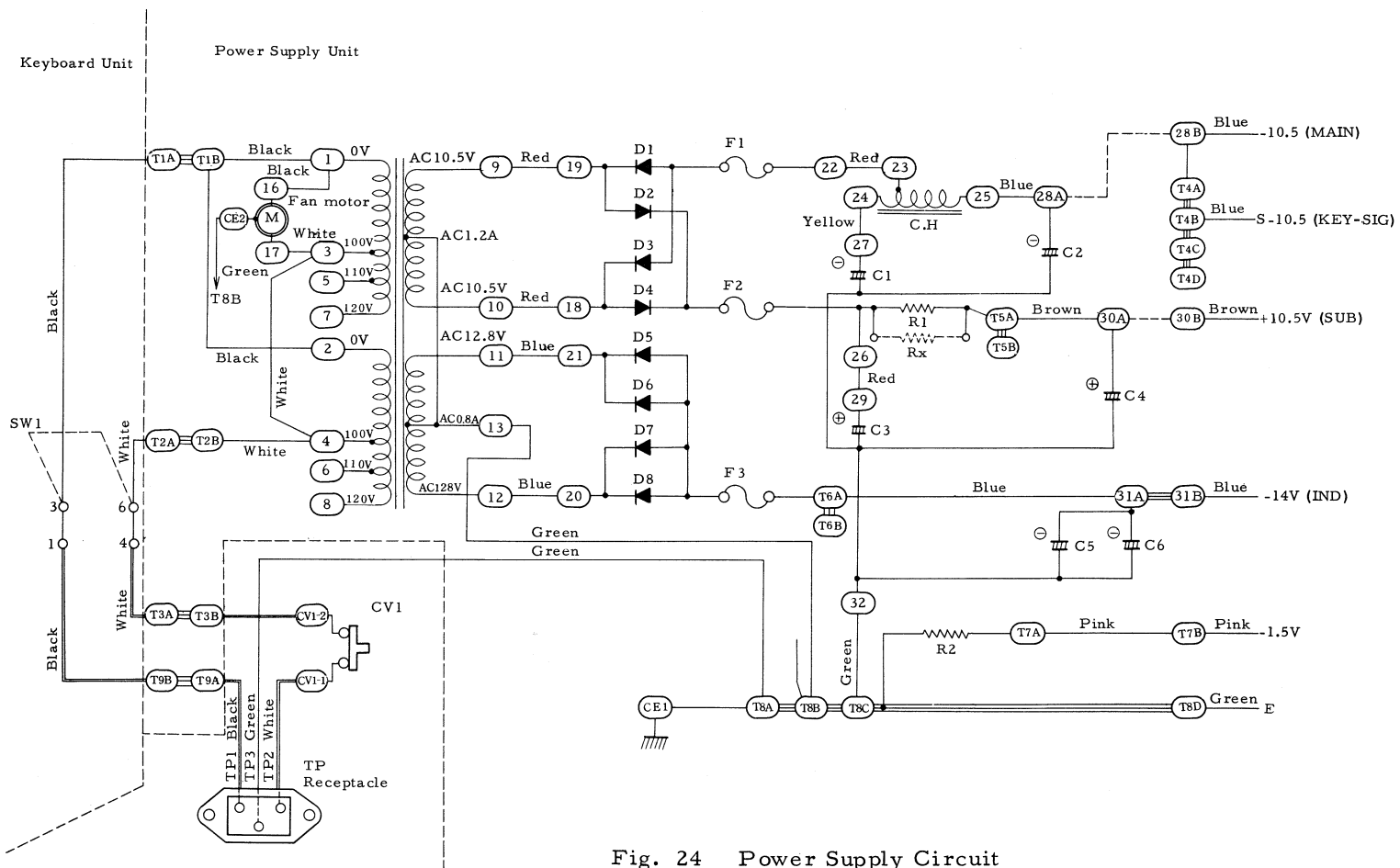


Fig. 24 Power Supply Circuit

3.19 Power Supply Unit (2)

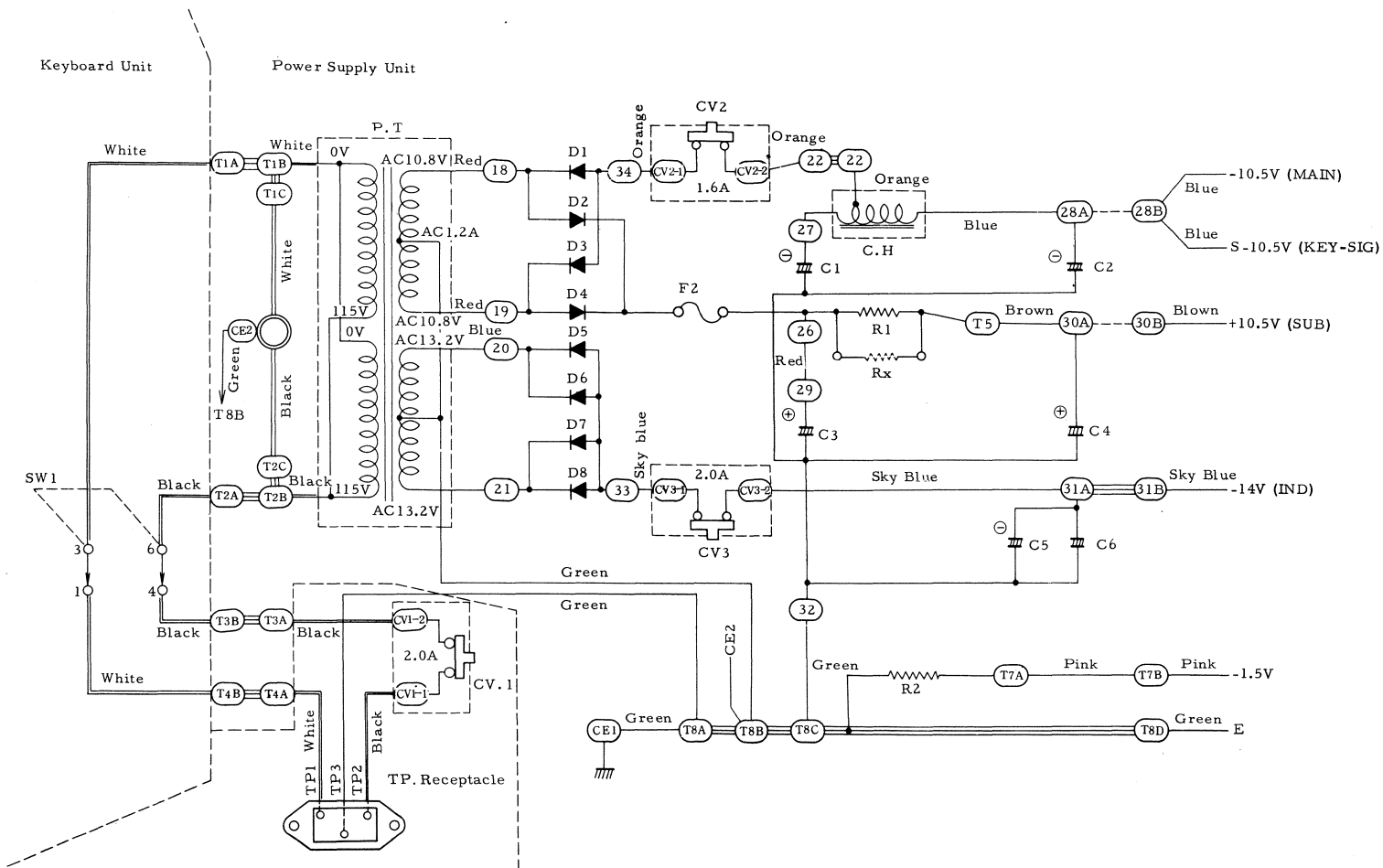
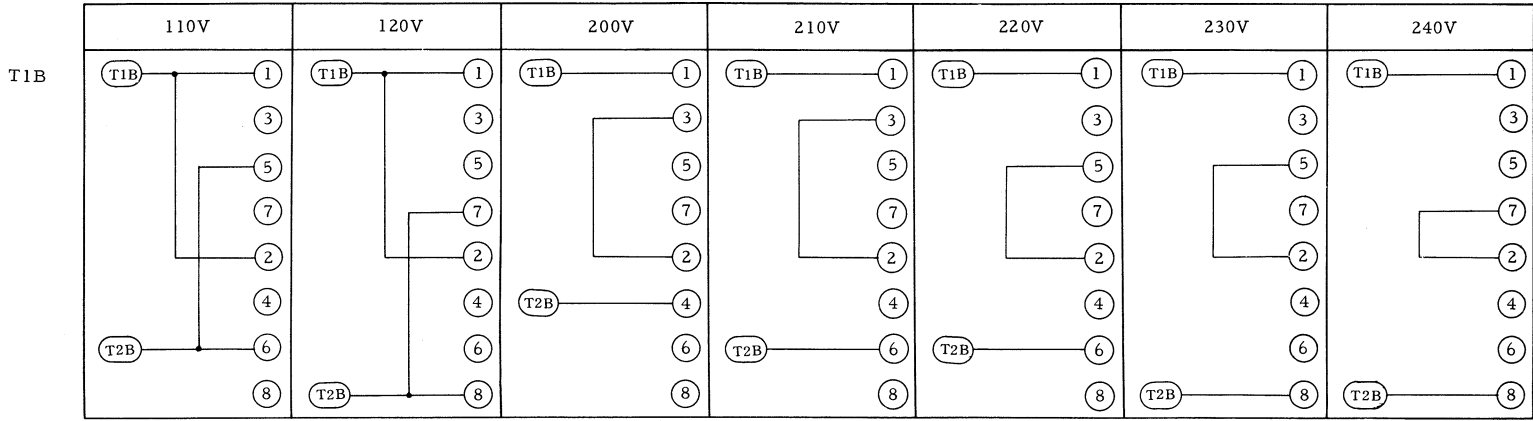


Fig. 25 Power Supply Circuit for 115V

3.20 Power Supply Unit (3)



- Note:
- 1) Encircled numbers denote terminal number respectively.
 - 2) Use wires having passed UL or CSA standard.
Type UL 1015: CSA TR-32 (X62-6189)
Size (21/1.18A), A type wire, AWG #20
 - 3) Use polyvinyl chloride tube having passed UL standard.
Type AWG #2; Temp. 105 °C (X62-6583)

Fig. 26 Primary Side Wiring of Power Transformer

3.21 Power Supply Unit (A)

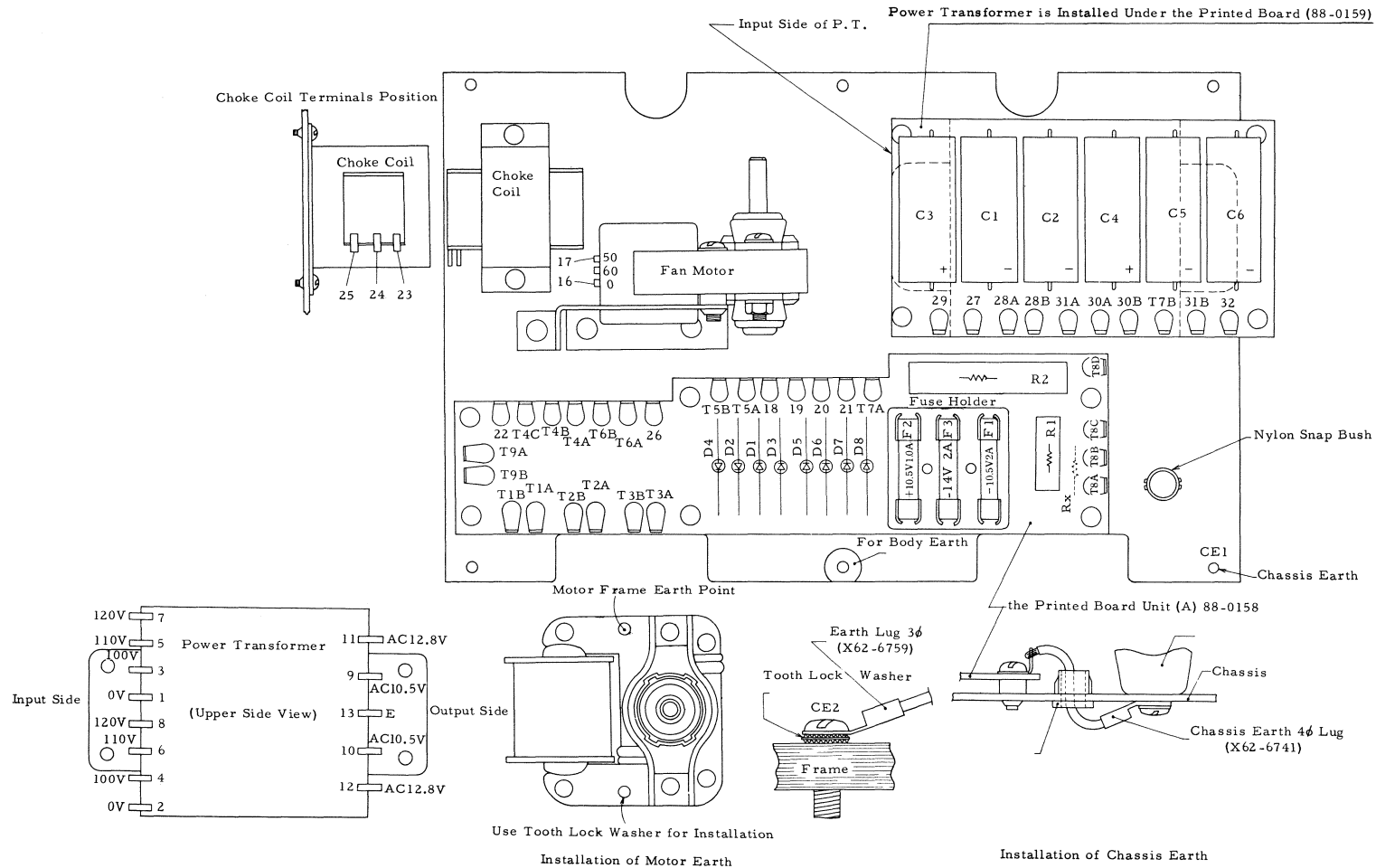


Fig. 27 Power Supply Unit Layout

3.22 Power Supply Unit (5)

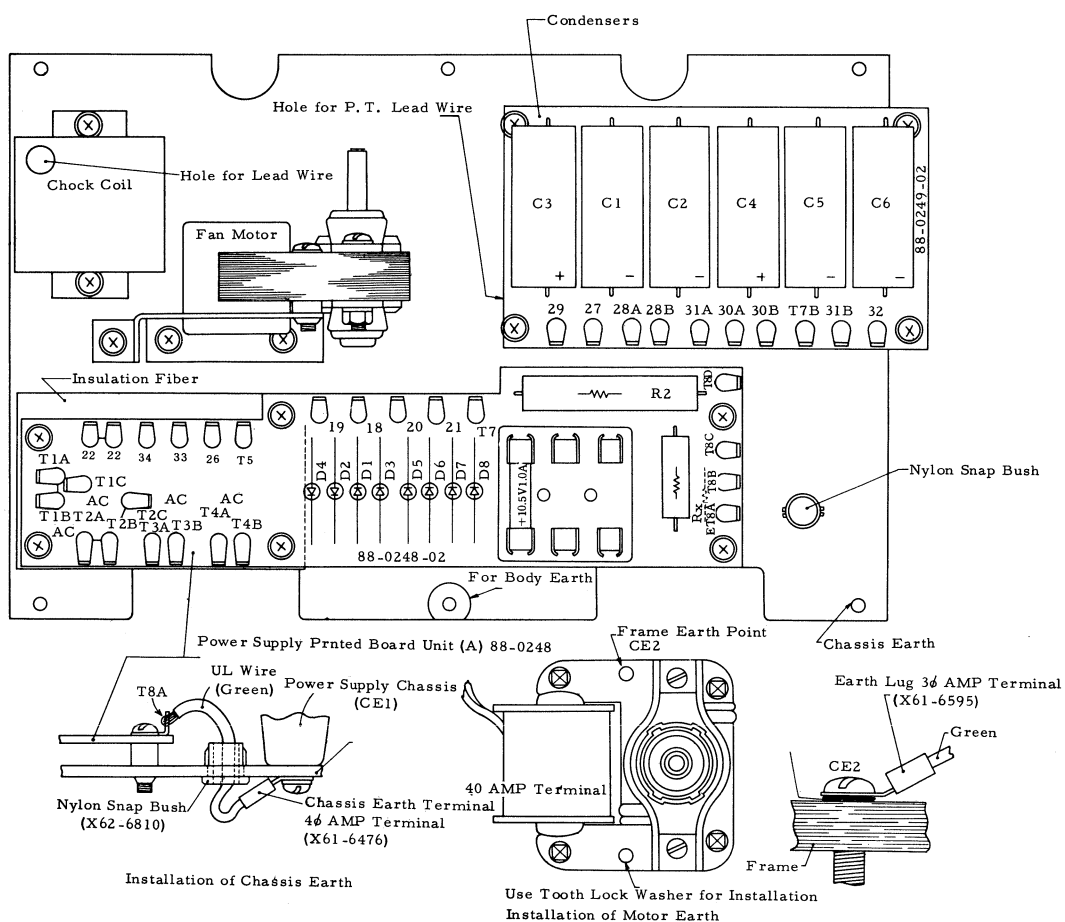


Fig. 28 Power Supply Unit Layout for 115V

3.23 Power Supply Unit (6)

Table 8 Power Supply Terminal Destination (1)

No.	Terminal	Signal	Wire	Color	Destination	Origin
1	T1A	AC Rating	A	Black	T1B, PS1, PS2 T2B, PS4 PS4, PS3	SW1-3
2	T2A	AC Rating	A	White		SW1-6
3						
4	T1B	AC100V	A	Black	T1B, PS1 T2B, PS6 PS2, PS5	
5	T2B	AC100V	A	White		
6	PS4	AC100V	A	White		
8	T1B	AC220V	A	Black	T1B, PS1 T2B, PS8 PS2, PS7	
9	T2B	AC220V	A	White		
10	PS2	AC220V	A	White		
11					T4A, PS28B	KB7
12	T1B	AC240V	A	Black		
13	T2B	AC240V	A	White		
14	PS2	AC240V	A	White	T5A, PS30A T6A, PS31A	
15						
16	T3A	AC Rating	A	White		
17	T3B	AC Rating	A	White	T5A, PS30A T6A, PS31A	
18	T4A	-10.5V	A	Blue		
19	T4B	S-10.5B	B	Blue		
20	T4C	-10.5V			T5A, PS30A T6A, PS31A	
21	T4D	-10.5V				
22	T5A	+10.5V	A	Brown		
23	T5B	+10.5V			T5A, PS30A T6A, PS31A	
24	T6A	-14V	A	Sky blue		
25	T6B	-14V				
26						

3.24 Power Supply Unit (7)

Table 9 Power Supply Terminal Destination (2)

No.	Terminal	Signal	Wire	Color	Destination	Origin
1	T7A	-1.5V	A	Pink	T7A, T7B	T7A
2	T7B	-1.5V	A	Pink		
3	T8A	E	A	Green	T8A, TP3, CE1	
4	T8C	E	A	Green	T8B, PS13, CE2	
5	T8C	E	A	Green	T8C, PS32	
6	T8D	E	A	Green	T8D, 08B12	T8A
7	CE1	E	A	Green		
8	CE2	E	A	Green		T8B
9						
10	PS9	AC10.5V	A	Red	PS9, PS19	T8B
11	PS10	AC10.5V	A	Red	PS10, PS18	
12	PS11	AC12.8V	A	Blue	PS11, PS21	
13	PS12	AC12.8V	A	Blue	PS12, PS20	
14	PS13	E	A	Green		
15						
16	PS16	AC100V	A	Black	PS16, PS1	PS9 PS10 PS11 PS12
17	PS17	AC100V	A	White	PS17, PS3	
18	PS18	AC10.5V	A	Red		
19	PS19	AC10.5V	A	Red		
20	PS20	AC12.8V	A	Blue		
21	PS21	AC12.8V	A	Blue		PS22
22	PS22	-10.5V	A	Red	PS22, PS23	
23	PS23	-10.5V	A	Red		
24	PS-24	-10.5V	A	Yellow	PS24, PS27	
25						
26						

3.25 Power Supply Unit (8)

Table 10 Power Supply Terminal Destination (3)

No.	Terminal	Signal	Wire	Color	Destination	Origin
1	PS25	-10.5V	A	Blue	PS25, PS28A	PS24
2	PS26	+10.5V	A	Red	PS26, PS29	
3	PS27	-10.5V	A	Yellow		
4	PS28A	-10.5V	A	Blue	PS28A, PS28B	
5	PS28B	-10.5V	A	Red	PS28B, 08B6	PS26
6	PS29	+10.5V	A	Red		
7	PS30A	+10.5V	A	Brown	PS30A, PS30B	
8	PS30B	+10.5V	A	Brown	PS30B, 08B5	
9	PS31A	-14V	A	Sky blue		T6A
10	PS31B	-14V	A	Sky blue	PS31B, 08B18	T8C
11	PS32	E	A	Green		
12						
13						
14						

3.26 Power Supply Unit (9)

Table 11 Power Supply Terminal Destination

(For 115V)

No.	Terminal	Signal	Color	Destination	Origin
1	T1A	AC Rating			SW1-3
2	T1B	AC Rating			P.T } White
3	T2A	AC Rating			M } SW1-6
4	T2B	AC Rating			P.T } Black
5	T3A	AC Rating			M } SW1-4
6	T3B	AC Rating	Black	T3B, PS15	
7	T4A	-10.5V	Blue	T4A, PS28	
8	T4B	-10.5V	Blue	T4B, 08B6	
9	T4C	-10.5V			KB7
10	T5A	+10.5V	Brown	T5A, PS30	
11	T5B	+10.5V	Brown	T5B, 08B5	
12	T6A	-14V	Sky blue	T6A, PS31	
13	T6B	-14V	Sky blue	T6B, 08B18	
14	T7A	-1.5V	Purple	T7A, 08B13	
15	T8A	E	Green	T8A, TP3, CE1	
16	T8B	E			P.T Green
17	T8C	E	Green	T8C, PS32	
18	T8D	E	Green	T8D, 08B12	
19					
20					
21	PS14	AC Rating	Black	PS14, TP2	
22	PS15	AC Rating			T3B
23	PS18	AC10.2V			P.T Red
24	PS19	AC10.2V			P.T Red
25	PS21	AC12.8V			P.T Blue
26	PS22	-10.5V			CH Orange
27	PS24	AC12.8V			PT Blue
28	PS26	+10.5V	Red	PS26, PS29	
29	PS27	-10.5V			CH Yellow
30	PS28	-10.5V			CH Blue
31	PS28	-10.5V			T4A
32	PS29	+10.5			PS26
33	PS30	+10.5V			T5A
34	PS31	-14V			T6A
35	PS32	E			T8C

4. Tools and Testing Equipment

4.1 Service Checker

No special service checker is made for Canola 130S; so, use the service checker for Canola 161 with the following precautions:

- 1) Insert the adapter to the connector by having "UP" facing toward the keyboard of Canola 130S.
- 2) The signal checks are the same except for *.

Terminal No.	Canola 161		Canola 130S
1	$\overline{F_M}$		$\overline{F_M}$
2	F _P		F _P
* 3	F _A	→	F _{DIV}
4	AC=0		AC=0
* 5	BC=0	→	DC=0
6	F _Z		F _Z
7	F _G		F _G
8	F _H		F _H
* 9	F _S	→	F _{SUB}
10	—		—
11	CC1		CC1
12	CC2		CC2
13	CC3		CC3
14	CC4		CC4
15	CC5		CC5
16	CC6		CC6
17	CC7		CC7
18	E		E
19	OS		OS
20	T-8		T-8
* 21	CP-INT	→	—
22	CP-EXT		CP-EXT

PARTS CATALOG

Canola 130S

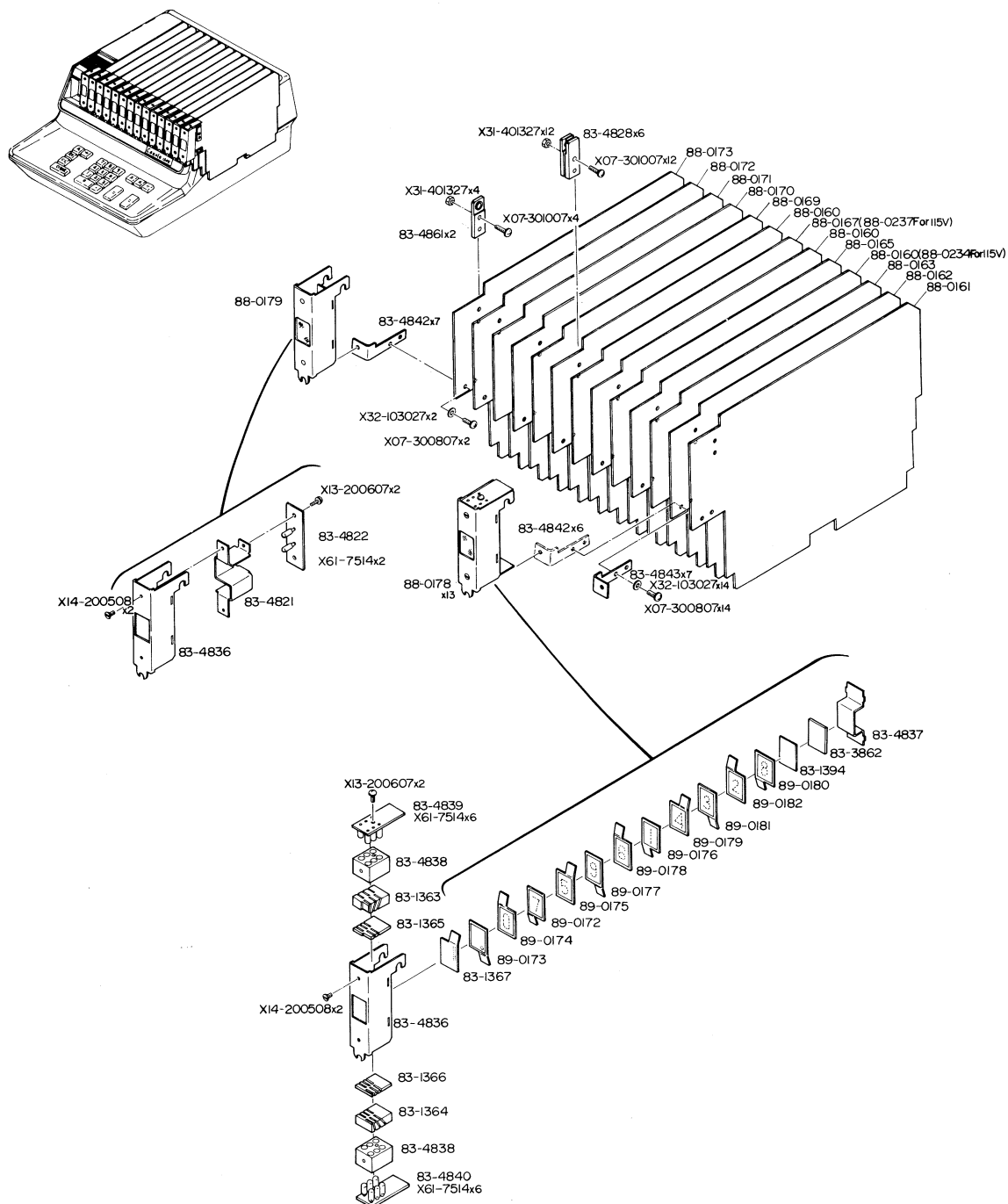
CONTENTS

IV. Parts Catalog

1. Indicator & Arithmetic Unit	2
1.1 G-X, G-Y, MSD-1, LAMP AMP and IR (Card Unit No.1)	4
1.2 Counter P, IR, LAMP AMP and IR (Card Unit No.2) ...	5
1.3 F _H , F _Z , F _C and F _{DIV} (Card Unit No.3)	6
1.4 LAMP AMP, IR and ACC (Card Unit No.4, No.6, No.8) .	7
1.5 F _M and Control Counter (Card Unit No.5)	8
1.6 Counter A (Card Unit No.7)	9
1.7 PG, SP-A and Adder-Subtractor (Card Unit No.9)	10
1.8 Counter D, LAMP AMP and IR (Card Unit No.10)	11
1.9 OS and BIT Counter (Card Unit No.11)	12
1.10 Timing Counter, F _{MLT} , LAMP AMP and IR (Card Unit No.12)	13
1.11 F _{SUB} , F _O and F _C (Card Unit No.13)	14
2. Keyboard Unit	18
3. Power Supply Unit	20
3.1 Power Supply	22
4. Casing	24

INDICATOR & ARITHMETIC UNIT(1)

演算部(1)



INDICATOR & ARITHMETIC UNIT(1)

演 算 部 (1)

PARTS NO.	DESCRIPTION	QUANT.
83-1363	Holder (Upper)	ホルダー (上) 13
83-1364	Holder (Lower)	ホルダー (下) 13
83-1365	Spacer (Upper)	スペーサー (上) 13
83-1366	Spacer (Lower)	スペーサー (下) 13
83-1367	Indicator Board (Digit)	表示板 (桁) 13
83-1394	Packing	パッキン 13
83-3862	Spacer	ボール紙 13
83-4821	Back Cover	シヤヘイ板 1
83-4822	Printed Board	ブリント板 1
83-4828	Holder Plate	保持板 6
83-4836	Case	ケース 14
83-4837	Back Cover	バックカバー 13
83-4838	Holder	ホルダー 26
83-4839	Printed Plate	ブリント板 13
83-4840	Printed Plate	ブリント板 13
83-4842	Indicator Holder	取付板 7
83-4843	Indicator Holder	取付板 7
83-4861	Holder Plate	保持板 2
88-0160	Card Unit (04, 06, 08)	(04, 06, 08) ユニット 3
88-0234	Card Unit (04, 06, 08) for 115V ..	カードユニット (04, 06, 08) 115V 用 3
88-0161	Card Unit (1)	カードユニット (1) 1
88-0162	Card Unit (2)	カードユニット (2) 1
88-0163	Card Unit (3)	カードユニット (3) 1
88-0165	Card Unit (5)	カードユニット (5) 1
88-0167	Card Unit (7)	カードユニット (7) 1
88-0237	Card Unit (7) for 115V	カードユニット (7) 115V 用 1
88-0169	Card Unit (9)	カードユニット (9) 1
88-0170	Card Unit (10)	カードユニット (10) 1
88-0171	Card Unit (11)	カードユニット (11) 1
88-0172	Card Unit (12)	カードユニット (12) 1
88-0173	Card Unit (13)	カードユニット (13) 1
88-0178	Numeric Indicator	数字表示器 13
88-0179	Sign Indicator Unit	記号表示器 1
89-0172	Indicator Board (7)	表示板 (7) 13
89-0173	Indicator Board (.)	表示板 (.) 13
89-0174	Indicator Board (0)	表示板 (0) 13
89-0175	Indicator Board (5)	表示板 (5) 13
89-0176	Indicator Board (1)	表示板 (1) 13
89-0177	Indicator Board (9)	表示板 (9) 13
89-0178	Indicator Board (6)	表示板 (6) 13
89-0179	Indicator Board (4)	表示板 (4) 13
89-0180	Indicator Board (8)	表示板 (8) 13
89-0181	Indicator Board (3)	表示板 (3) 13
89-0182	Indicator Board (2)	表示板 (2) 13
X13-200607 ...	Screw	小ネジ 16
X14-200508 ...	Screw	皿ネジ 28
X07-300807 ...	Screw	スクリユ 16
X07-301007 ...	Screw	スクリユ 58
X07-400807 ...	Screw	スクリユ 6
X31-401327 ...	Nut	ナット 28
X32-103027 ...	Spring Washer	スプリングワッシャ 16
X32-104027 ...	Spring Washer	スプリングワッシャ 6
X61-7514	Lamp	ランプ 158

88-0161 (01)

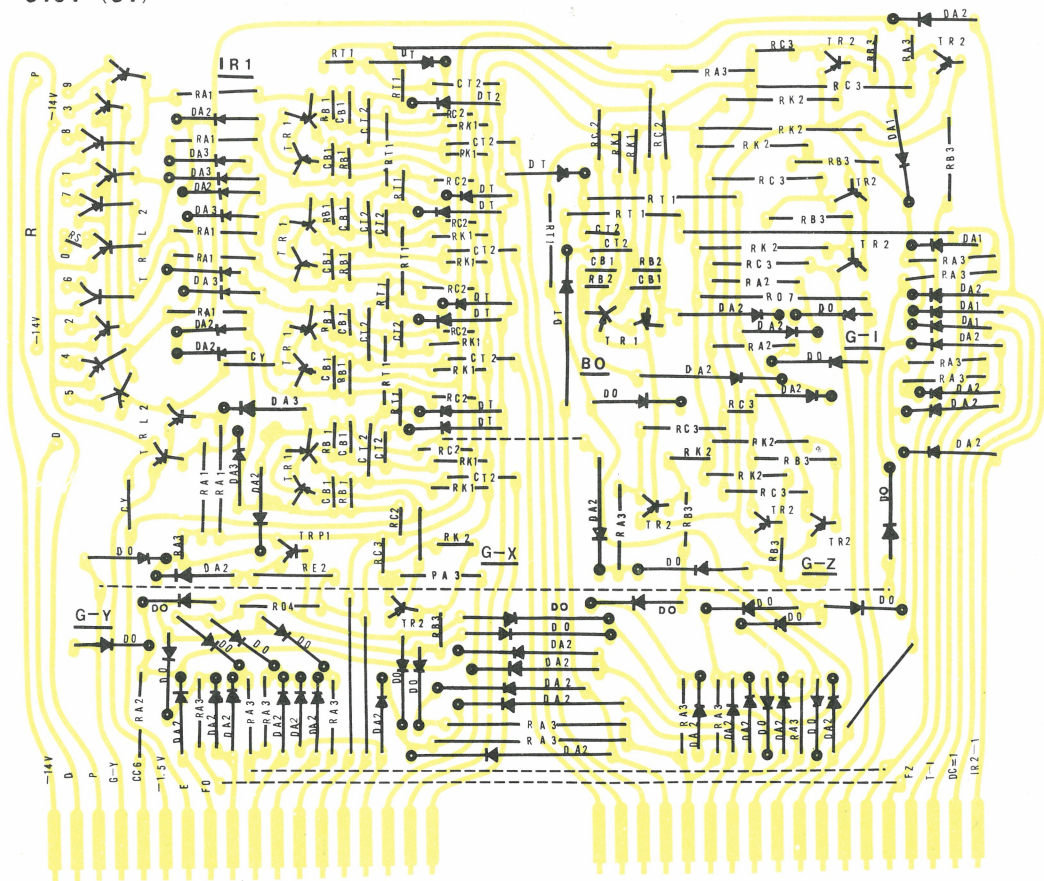


Fig. 1 G-X, G-Y, MSD-1, LAMP AMP and IR

NO.	PARTS NO.	DESCRIPTION				Q'TY	REMARKS
1	X65-6530	Transistor	トランジスタ	2SA538	1 Yellow	10	TR1
2	"	"	"	"	2 Red	8	TR2
3	X65-6536	"	"	2SB77	1 Yellow	3	TRL1, TRP1
4	"	"	"	"	2 Red	10	TRL2
5							
6	X65-5519	Diode	ダイオード	1N34A	1 Green	25	DO, DA1
7	"	"	"	"	2 Red	34	DA2
8	"	"	"	"	3 Yellow	7	DA3
9	X65-5521	"	"	"	Ⓚ	10	DT
10							
11	X64-0162	Resistor	抵抗	22Ω	V	1	RS
12	X64-0381	"	"	1.8K	V	10	RC2
13	X64-0820	"	"	2.7K	V	3	RC3
14	X61-8521	"	"	8.2K	V	8	RB1
15	X64-0464	"	"	10K	V	4	RA3, RB2
16	X64-0465	"	"	12K	V	4	RB3
17	X64-0480	"	"	22K	V	5	RT1
18	X64-0467	"	"	39K	V	10	RK1
19	X64-0469	"	"	56K	V	2	RK2
20							
21	X64-0819	"	"	2.7K	T	5	RC3
22	X64-0391	"	"	3.9K	T	7	RA1
23	X64-0281	"	"	4.7K	T	4	RE2, RA2
24	X64-0470	"	"	10K	T	16	RA3
25	X64-0471	"	"	12K	T	4	RB3
26	X64-0472	"	"	22K	T	5	RT1
27	X64-0476	"	"	56K	T	7	RK2, RO7
28	X64-0564	"	"	300K	T	1	RO4
29							
30	X62-8703	Condenser	コンデンサ	0.1μF		2	CY
31	X63-2517	"	"	270PF		14	CT2
32	X63-2508	"	"	680PF		10	CB1
33							
34							
35							

88 — 0162 (02)

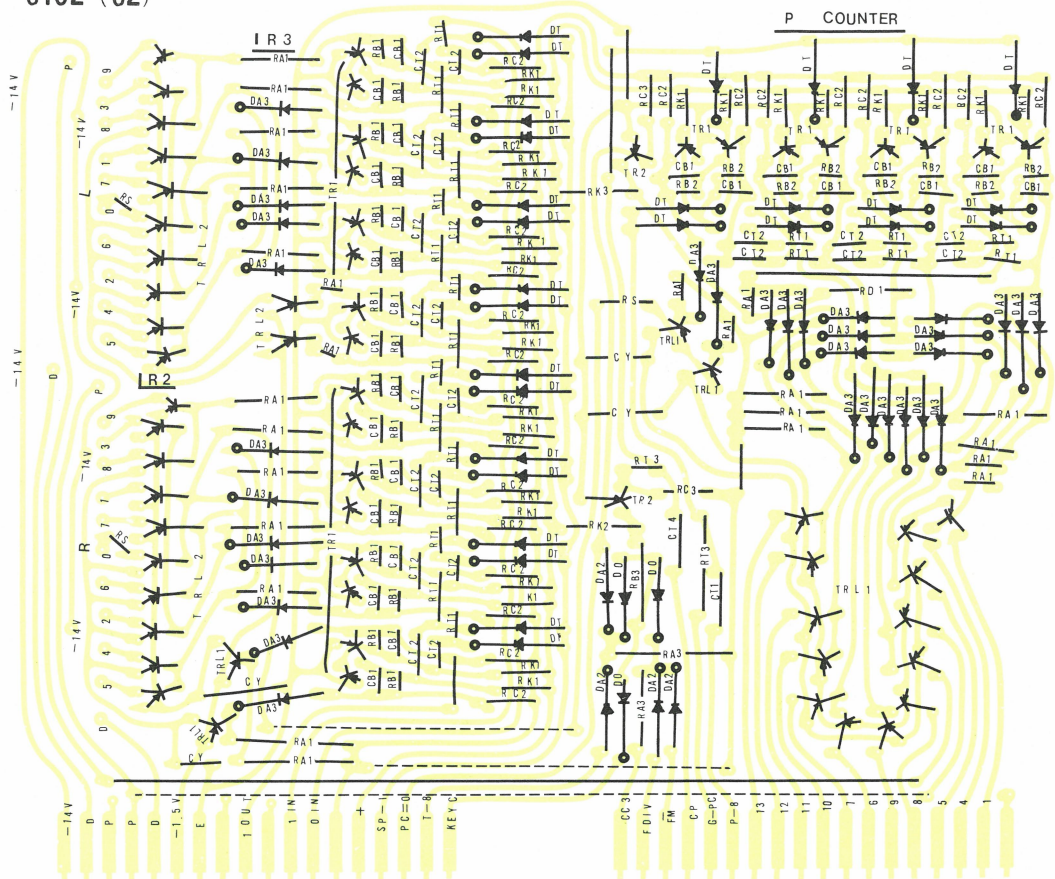


Fig. 2 Counter P, IR, LAMP AMP and IR

NO.	PARTS NO.	DESCRIPTION	Q'TY	REMARKS
1	X65-6530	Transistor トランジスタ 2SA538	1 Yellow	24 TR1
2	"	" " " "	2 Red	2 TR2
3	X65-6536	" " " " 2SB77	1 Yellow	17 TRL1
4	"	" " " " 2SB77	2 Red	22 TRL2
5				
6	X65-5519	Diode ダイオード 1N34A	1 Green	3 DO
7	"	" " " " " "	2 Red	4 DA2
8	"	" " " " " "	3 Yellow	32 DA3
9	X65-5521	" " " " " (K)		28 DT
10				
11	X64-0162	Resistor 抵抗 22Ω	V	3 RS
12	X64-0381	" " " " 1.8K	V	24 RC2
13	X64-0820	" " " " 2.7K	V	2 RC3
14	X64-0395	" " " " 3.9K	V	4 RA1
15	X64-0464	" " " " 10K	V	9 RT3
16	X64-0480	" " " " 22K	V	22 RT1, RD1
17	X64-0467	" " " " 39K	V	24 RK1
18	X61-8521	" " " " 8.2K	V	16 RB1
19	X64-0391	" " " " 3.9K	T	19 RA1
20	X64-0470	" " " " 10K	T	3 RA3, RT3
21	X64-0471	" " " " 12K	T	1 RB3
22	X64-0472	" " " " 22K	T	1 RD1
23	X64-0476	" " " " 56K	T	1 RK2
24	X64-0541	" " " " 100K	T	1 RK3
25	X63-2517	Condenser コンデンサ 220PF		1 CT1
26	X63-2518	" " " " 270PF		22 CT2
27	X63-2508	" " " " 680PF		25 CB1, CT4
28	X62-8703	" " " " 0.1μF		4 CY
29				
30				

88 — 0163 (03)

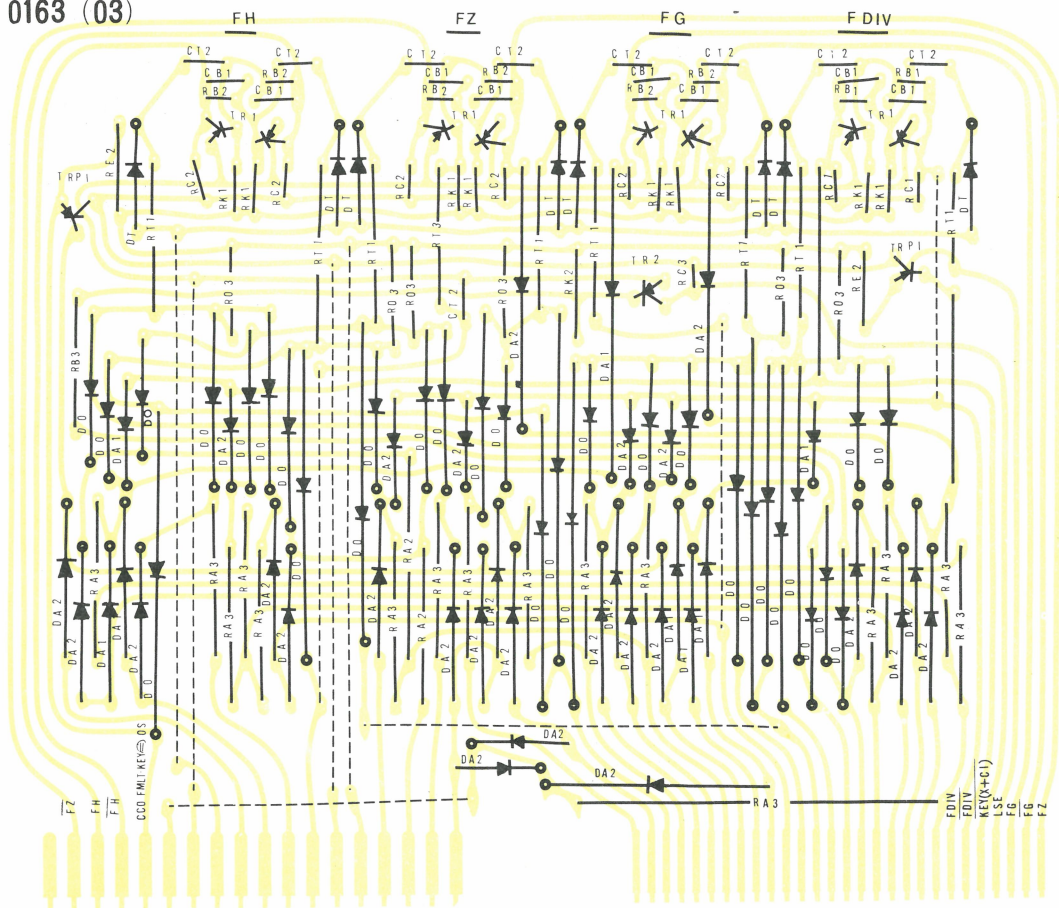


Fig. 3 FH, Fz, FG and FDiv

NO.	PARTS NO.	DESCRIPTION				Q'TY	REMARKS
1	X65-6530	Transistor	トランジスタ	2SA538	1 Yellow	8	TR1
2	"	"	"	"	2 Red	1	TR2
3	X65-6536	"	"	2SB77	1 Yellow	2	TRP1
4							
5	X65-5519	Diode	ダイオード	1N34A	1 Green	39	DO, DA1
6	"	"	"	"	2 Red	28	DA2
7	X65-5521	"	"	" (K)	"	8	DT
8							
9	X64-0380	Resistor	抵抗	1.5K	V	2	RC1
10	X64-0381	"	"	1.8K	V	6	RC2
11	X64-0820	"	"	2.7K	V	1	RC3
12							
13	X61-8521	"	"	8.2K	V	2	RB1
14	X64-0464	"	"	10K	V	6	RB2
15	X64-0467	"	"	39K	V	8	RK1
16	X64-0476	"	"	56K	T	1	RK2
17	X64-0821	"	"	4.7K	T	4	RA2, RE2
18	X64-0470	"	"	10K	T	17	RC2, RT3
19	X64-0471	"	"	12K	T	1	RB3
20	X64-0472	"	"	22K	T	8	RT1
21	X64-0563	"	"	130K	T	6	R03
22							
23	X63-2518	Condenser	コンデンサ	270P		9	CT2
24	X63-2508	"	"	680P		8	CB1
25							
26							

88 — 0160 (04, 06, 08)

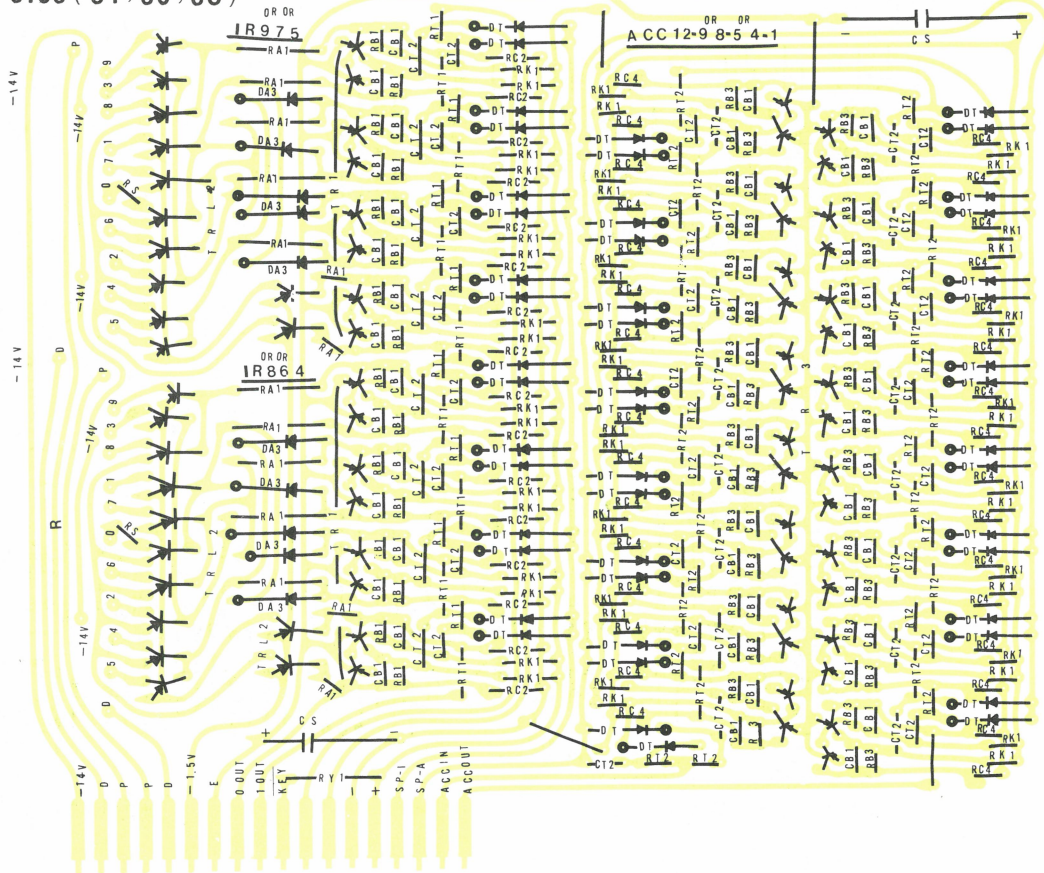


Fig. 4 LAMP AMP, IR and ACC

NO.	PARTS NO.	DESCRIPTION					Q'TY	REMARKS
1	X65-6530	Transistor	トランジスタ	2SA538	1	Yellow	48	TR1, TR3
2	X65-6536	"	"	2SB77	2	Red	24	TRL2
3								
4	X65-5519	Diode	ダイオード	1N34A	3	Yellow	10	DA3
5	X65-5521	"	"	" (R)			48	DT
6								
7	X64-0162	Resistor	抵抗	22Ω	V		2	RS
8	X64-0381	"	"	1.8K	V		16	RC2
9	X64-0383	"	"	3K	V		32	RC4
10	X64-0395	"	"	3.9K	V		4	RA1
11	X61-8521	"	"	8.2K	V		16	RB1
12	X64-0465	"	"	12K	V		32	RB3
13	X64-0480	"	"	22K	V		16	RT1
14	X64-0466	"	"	33K	V		32	RT2
15	X64-0467	"	"	39K	V		48	RK1
16	X64-0819	"	"	2.7K	T		1	RY1
17	X64-0391	"	"	3.9K	T		10	RA1
18								
19	X63-2518	Condenser	コンデンサ	270PF			48	CT2
20	X63-2508	"	"	680PF			48	CP1
21	X63-3527	"	"	100μ15V			2	CS
22								
23								
24								

88 — 0165 (05)

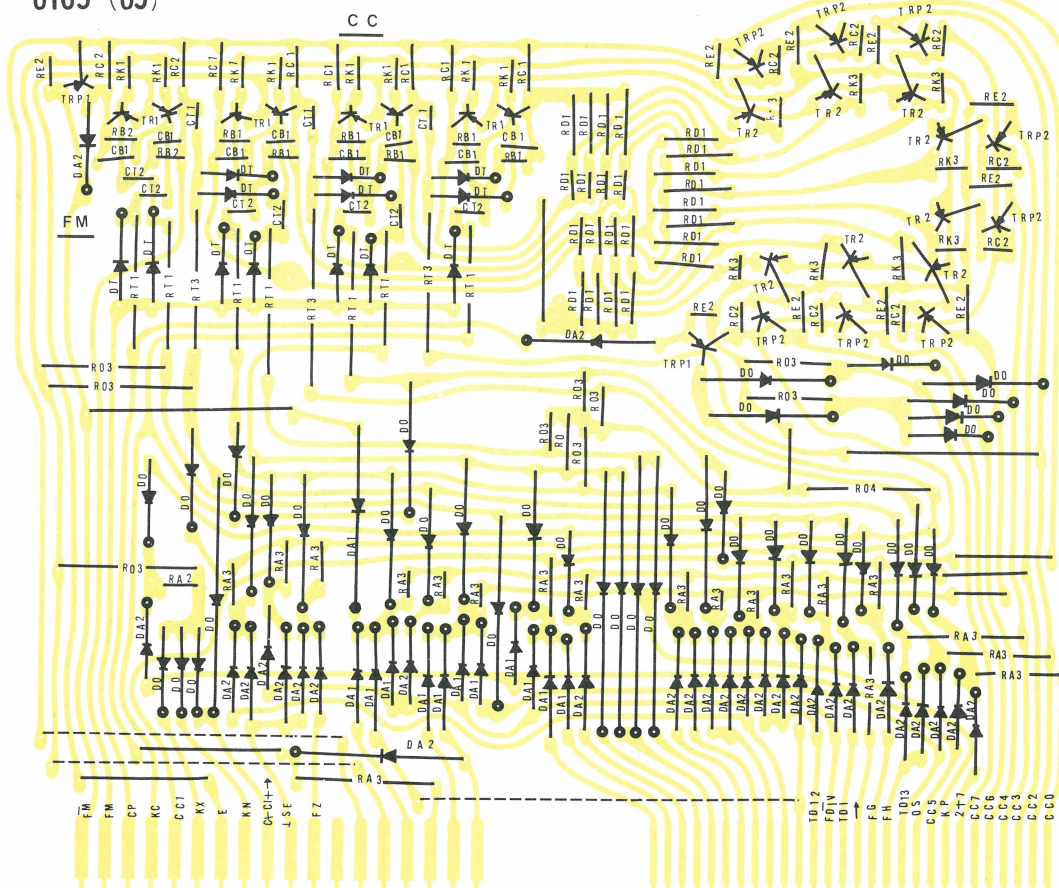


Fig. 5 Fm and Control Counter

NO.	PARTS NO.	DESCRIPTION	Q'TY	REMARKS
1	X65-6530	Transistor トランジスタ 2SA538	1 Yellow	8 TR1
2	"	" " " "	2 Red	8 TR2
3	X65-6536	" " " " 2SB77	1 Yellow	2 TRP1
4	"	" " " " " "	2 Red	8 TRP2
5	X65-5519	Diode ダイオード 1N34A	1 Green	51 DA1, DO
6	"	" " " " " "	2 Red	29 DA2
7	X65-5521	" " " " " (K)		13 DT
8				
9	X64-0380	Resistor 抵抗 1.5K	V	6 RC1
10	X64-0381	" " " " 1.8K	V	10 RC2
11	X64-0384	" " " " 4.7K	V	11 RA2, RE2
12	X61-8521	" " " " 8.2K	V	6 RB1
13	X64-0464	" " " " 10K	V	17 RB2, RA3
14	X64-0480	" " " " 22K	V	24 RD1
15	X64-0467	" " " " 39K	V	8 RK1
16	X64-0542	" " " " 100K	V	8 RK3
17	X64-0561	" " " " 130K	V	5 RO3
18	X64-0470	" " " " 10K	T	8 RA3, RT3
19	X64-0472	" " " " 22K	T	7 RT1
20	X64-0563	" " " " 130K	T	5 RO3
21	X64-0564	" " " " 300K	T	1 RO4
22				
23	X63-2517	Condenser コンデンサ 220P		3 CT1
24	X63-2518	" " " " 270P		7 CT2
25	X63-2508	" " " " 680P		8 CB1
26				
27				

88 — 0167 (07)

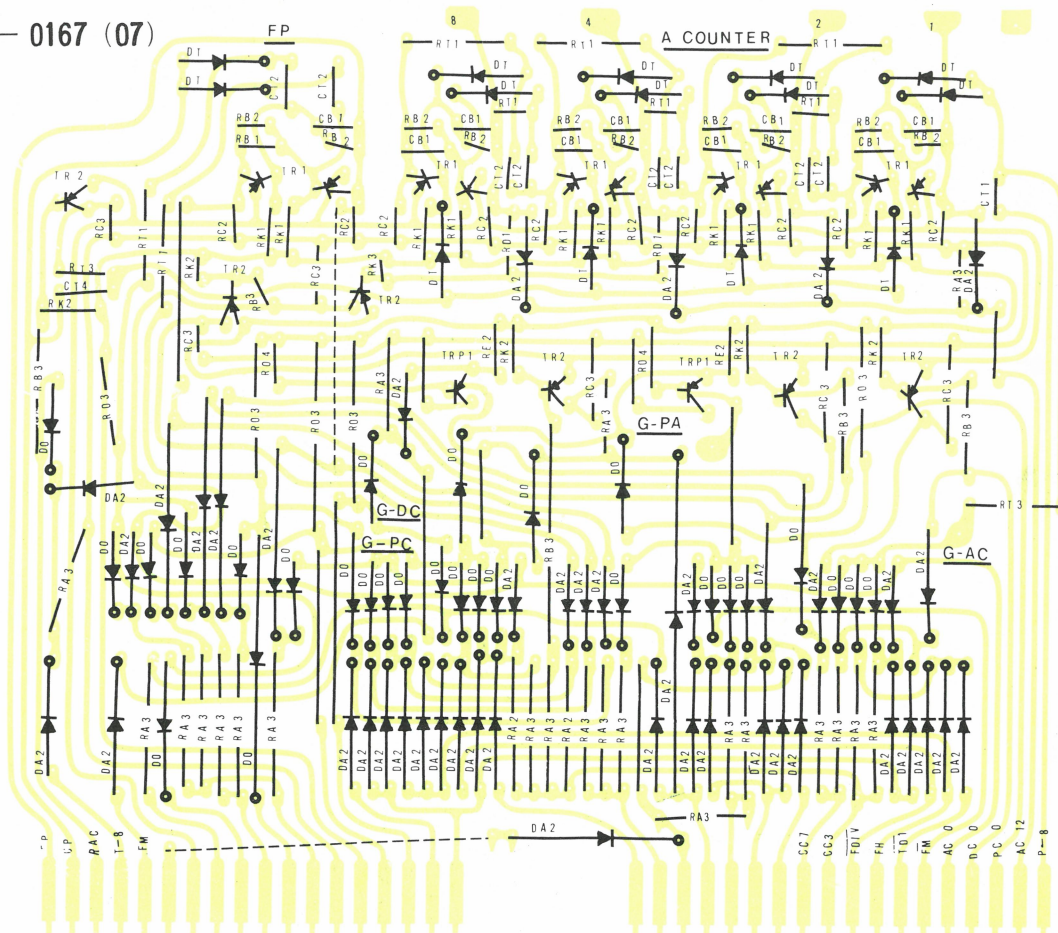


Fig. 6 Counter A

NO.	PARTS NO.	DESCRIPTION	Q'TY	REMARKS
1	X65-6530	Transistor トランジスタ 2SA538 1 Yellow	10	TR1
2	"	" " 2 Red	6	TR2
3	X65-6536	" " 2SB77 1 Yellow	2	TRP1
4				
5	X65-5519	Diode ダイオード 1N34A 1 Green	28	DO
6	"	" " " 2 Red	44	DA2
7	X65-5521	" " " (K)	14	DT
8				
9	X64-0381	Resistor 抵抗 1.8K V	10	RC2
10	X64-0820	" " 2.7K V	3	RC3
11	X64-0384	" " 4.7K V	2	RE2
12	X64-0464	" " 10K V	11	RB2, RT1
13	X64-0465	" " 12K V	1	RB3
14	X64-0480	" " 22K V	5	RT1, RD1
15	X64-0467	" " 39K V	10	RK1
16	X64-0469	" " 56K V	5	RK2
17	X64-0542	" " 100K V	1	RK3
18				
19	X64-0566	" " 300K V	2	RO4
20	X64-0819	" " 2.7K T	3	RC3
21	X64-0821	" " 4.7K T	2	RA2
22	X64-0470	" " 10K T	23	RA3, RT3
23	X64-0471	" " 12K T	4	RB3
24	X64-0472	" " 22K T	5	RT1
25	X64-0563	" " 130K T	5	RO3
26				
27	X63-2517	Condenser コンデンサ 220P	1	CT1
28	X63-2518	" " 270P	8	CT2
29	X63-2508	" " 680P	11	CB1, CT4
30				
31				

88-0169 (09)

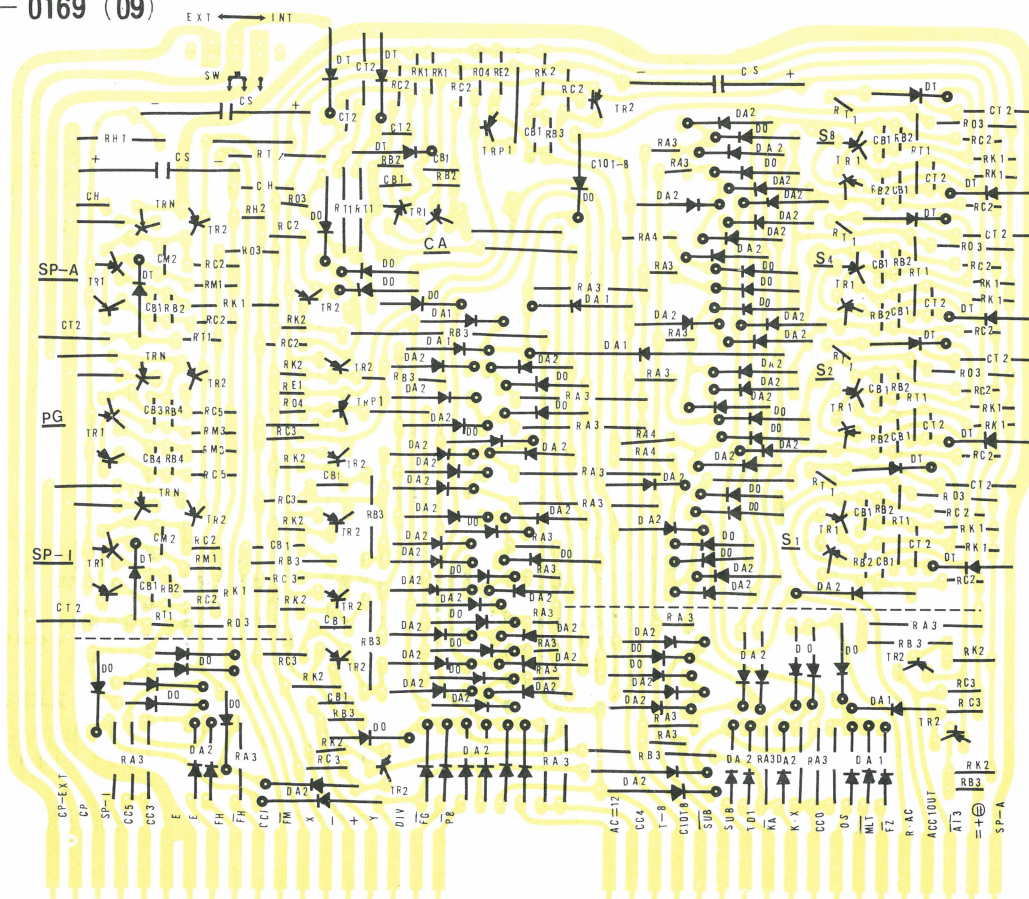


Fig. 7 PG, SP-A and Adder-Subtractor

NO.	PARTS NO.	DESCRIPTION	Q'TY	REMARKS
1	X65-6530	Transistor トランジスタ 2SA538	1 Yellow	16 TR1
2	"	" " " "	2 Red	13 TR2
3	X65-6536	" " " " 2SB77	1 Yellow	2 TRP1
4	X65-6525	" " " " " "	"	3 TRN
5				
6	X65-5519	Diode ダイオード 1N34A	1	45 DA1, DO
7	"	" " " " " "	2	63 DA2
8	X65-5521	" " " " " "	1	13 DT
9				
10	X64-0300	Resistor 抵抗 120Ω	V	1 RH2
11	X64-0228	" " " " 910Ω	V	2 RC5
12	X64-0381	" " " " 1.8K	V	17 RC2
13	X64-0820	" " " " 2.7K	V	8 RC3, RE1
14	X64-0384	" " " " 4.7K	V	1 RE2
15	X64-8521	" " " " 8.2K	V	3 RA4
16	X64-0464	" " " " 10K	V	25 RA3, RB2
17	X64-0465	" " " " 12K	V	5 RM1, RB3
18	X64-0480	" " " " 22K	V	6 RT1
19	X64-0467	" " " " 39K	V	10 RK1
20	X64-0469	" " " " 56K	V	10 RK2
21	X64-0822	" " " " 82K	V	4 RM3, RB4
22	X64-0561	" " " " 130K	V	2 RO3
23	X64-0566	" " " " 300K	V	2 RO4
24	X64-0122	" " " " 47Ω	T	1 RH1
25	X64-0470	" " " " 10K	T	16 RA3
26	X64-0471	" " " " 12K	T	7 RB3
27	X64-0472	" " " " 22K	T	7 RT1
28	X64-0474	" " " " 39K	T	2 RK1
29	X64-0563	" " " " 130K	T	5 RO3
30				
31				
32	X63-2518	Condenser コンデンサ 270P	13	CT2
33	X63-2508	" " " " 680P	17	CB1
34	X63-2505	" " " " 1500P	1	CH
35	X62-8151	" " " " 0.0005μ	2	CB3
36	X62-8152	" " " " 0.002μ	1	CB4, CM2
37	X63-3527	" " " " 100μF 15W V	3	CS
38				
39	X62-0173	Switch スイッチ FB-22	1	SW
40				

88 — 0170 (10)

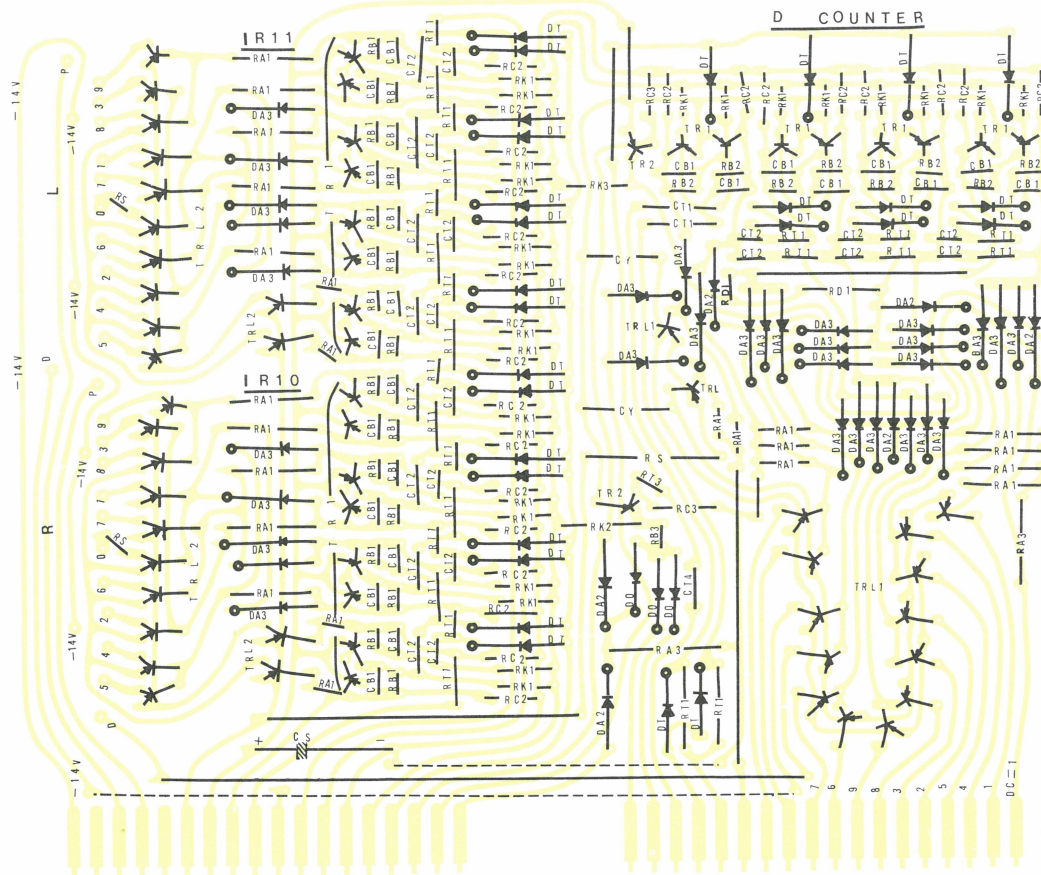


Fig. 8 Counter D, LAMP AMP and IR

NO.	PARTS NO.	DESCRIPTION				Q'TY	REMARKS
1	X65-6530	Transistor	トランジスタ	2SA538	1 Yellow	24	TR1
2	"	"	"	"	2 Red	2	TR2
3	X65-6536	"	"	2SB77	1 Yellow	15	TRL1
4	"	"	"	"	2 Red	24	TRL2
5							
6	X65-5519	Diode	ダイオード	1N34A	1 Green	3	DO
7	"	"	"	"	2 Red	6	DA2
8	"	"	"	"	3 Yellow	32	DA3
9	X65-5521	"	"	"	"	28	DT
10							
11	X64-0162	Resistor	抵抗	22 Ω	V	2	RS
12	X64-0381	"	"	1.8K	V	24	RC2
13	X64-0820	"	"	2.7K	V	2	RC3
14	X64-0395	"	"	3.9K	V	9	RA1
15	X64-0464	"	"	10K	V	9	RT3
16	X64-0465	"	"	12K	V	1	RB3
17	X64-0480	"	"	22K	V	23	RT1, RD1
18	X64-0467	"	"	39K	V	24	RK1
19	X61-8521	"	"	8.2K	V	16	RB1
20	X64-0121	"	"	22Ω	T	1	RS
21	X64-0391	"	"	39K	T	14	RA1
22	X64-0470	"	"	10K	T	2	RA3
23	X64-0472	"	"	22K	T	3	RT1, RD1
24	X64-0476	"	"	56K	T	1	RK2
25	X64-0541	Resistor	"	100K	T	1	RK3
26							
27	X63-2517	Condenser	コンデンサ	220P		2	CT1
28	X63-2518	"	"	270P		22	CT2
29	X63-2508	"	"	680P		25	CB1, CT4
30	X62-8703	"	"	0.1μ		2	CY
31	X63-3527	"	"	100μ		1	CS
32							
33							
34							

88 — 0171 (11)

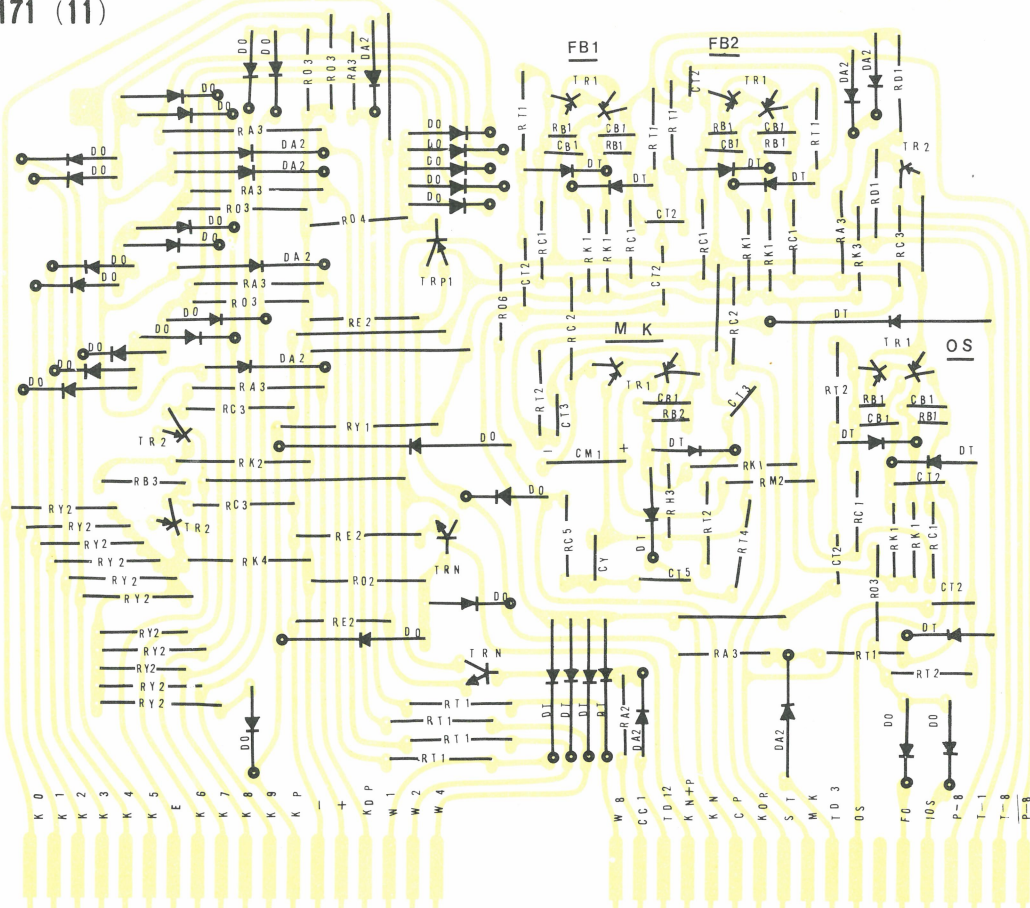


Fig. 9 OS and BIT Counter

NO.	PARTS NO.	DESCRIPTION				Q'TY	REMARKS
1	X65-6530	Transistor	トランジスタ	2SA538	1 Yellow	8	TR1
2	"	"	"	"	2 Red	3	TR2
3	X65-6536	"	"	2SB77	1 Yellow	1	TRP1
4	X65-6525	"	"	2SD77	"	2	TRN
5							
6	X65-5519	Diode	ダイオード	1N34A	1 Green	28	DO
7	"	"	"	"	2 Red	9	DA2
8	X65-5521	"	"	"	"	14	DT
9							
10	X61-8521	Resistor	抵抗	8.2K	V	6	RB1
11	X64-0464	"	"	10K	V	1	RB2
12	X64-0471	"	"	12K	T	1	RB3
13	X64-0265	"	"	100Ω	T	1	RH3
14	X64-0270	"	"	910Ω	T	1	RC5
15	X64-0387	"	"	1.5K	T	6	RC1
16	X64-0388	"	"	1.8K	T	2	RC2
17	X64-0819	"	"	2.7K	T	4	RC3, RY1
18	X64-0821	"	"	4.7K	T	4	RA2, RE2
19	X64-0393	"	"	8.2K	T	3	ⓈRK4
20	X64-0470	"	"	10K	T	18	RO6, RO2
21	X64-0472	"	"	22K	T	12	RA3, RT3
22	X64-0473	"	"	33K	T	4	RD1, RM2, RT
23	X64-0474	"	"	39K	T	4	RT2
24	X64-0476	"	"	56K	T	1	RK1
25	X64-0541	"	"	100K	T	1	RK2
26	X64-0563	"	"	130K	T	1	RK3
27	X64-0564	"	"	300K	T	6	RO3, TR4
28						1	RO4
29	X62-8851	Condenser	コンデンサ	0.68μ	"	1	CM1
30	X62-8703	"	"	0.1μ	"	2	CY, CT5
31	X63-2518	"	"	270P	"	7	CT2
32	X63-2508	"	"	680P	"	7	CB1
33	X63-2505	"	"	1500P	"	2	CT3
34							
35							
36							

88 - 0172 (12)

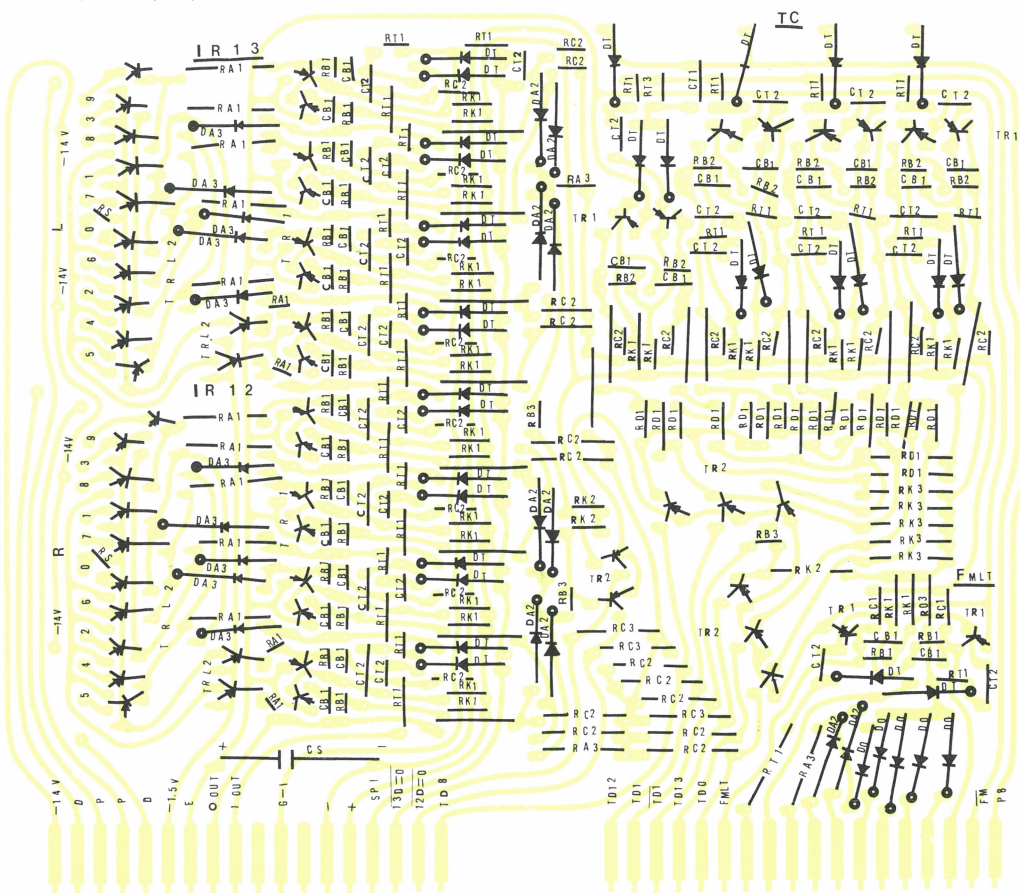


Fig. 10 Timing Counter, FMLT, LAMP AMP and IR

NO.	PARTS NO.	DESCRIPTION	Q'TY	REMARKS
1	X65-6530	Transistor トランジスタ 2SA538	1 Yellow	26 TR1
2	"	" " " "	2 Red	8 TR2
3	X65-6536	" " " " 25B77	2 Red	24 TRL2
4	"	" " " " "	"	"
5	X65-5519	Diode ダイオード 1N34A	1 Green	5 DO
6	"	" " " " "	2 Red	10 DA2
7	"	" " " " "	3 Yellow	10 DA3
8	X65-5521	" " " " (R)	"	30 DT
9	"	" " " " "	"	"
10	X64-0162	Resistor 抵抗 22 Ω	V	2 RS
11	X64-0380	" " " " 1.5K	V	2 RC1
12	X64-0381	" " " " 1.8K	V	20 RC2
13	X64-0395	" " " " 3.9K	V	4 RA1
14	X61-8521	" " " " 8.2K	V	18 RB1
15	X64-0464	" " " " 10K	V	10 RA3, RT3, RB2
16	X64-0465	" " " " 12K	V	3 RB3
17	X64-0480	" " " " 22K	V	43 RD1, RT1
18	X64-0467	" " " " 39K	V	26 RK1, RT5
19	X64-0469	" " " " 56K	V	2 RK2
20	X64-0561	" " " " 130K	V	1 RO3
21	X64-0388	" " " " 1.8K	T	9 RC2
22	X64-0819	" " " " 2.7K	T	3 RC3
23	X64-0391	" " " " 3.9K	T	10 RA1
24	X64-0821	" " " " 10K	T	2 RA3
25	X64-0472	" " " " 22K	T	2 RD1, RT1
26	X64-0476	" " " " 56K	T	1 RK2
27	X64-0541	" " " " 100K	T	5 RK3
28	"	" " " " "	"	"
29	X63-2517	Condenser コンデンサ 220P	1	CT1
30	X63-2518	" " " " 270P	28	CT2
31	X63-2508	" " " " 680P	26	CB1
32	X63-3527	" " " " 100μF	1	CS
33	"	" " " " "	"	"
34	X64-0474	Resistor 抵抗 39K	T	1 RT5
35	"	" " " " "	"	"
36	"	" " " " "	"	"
37	"	" " " " "	"	"

88 - 0173 (13)

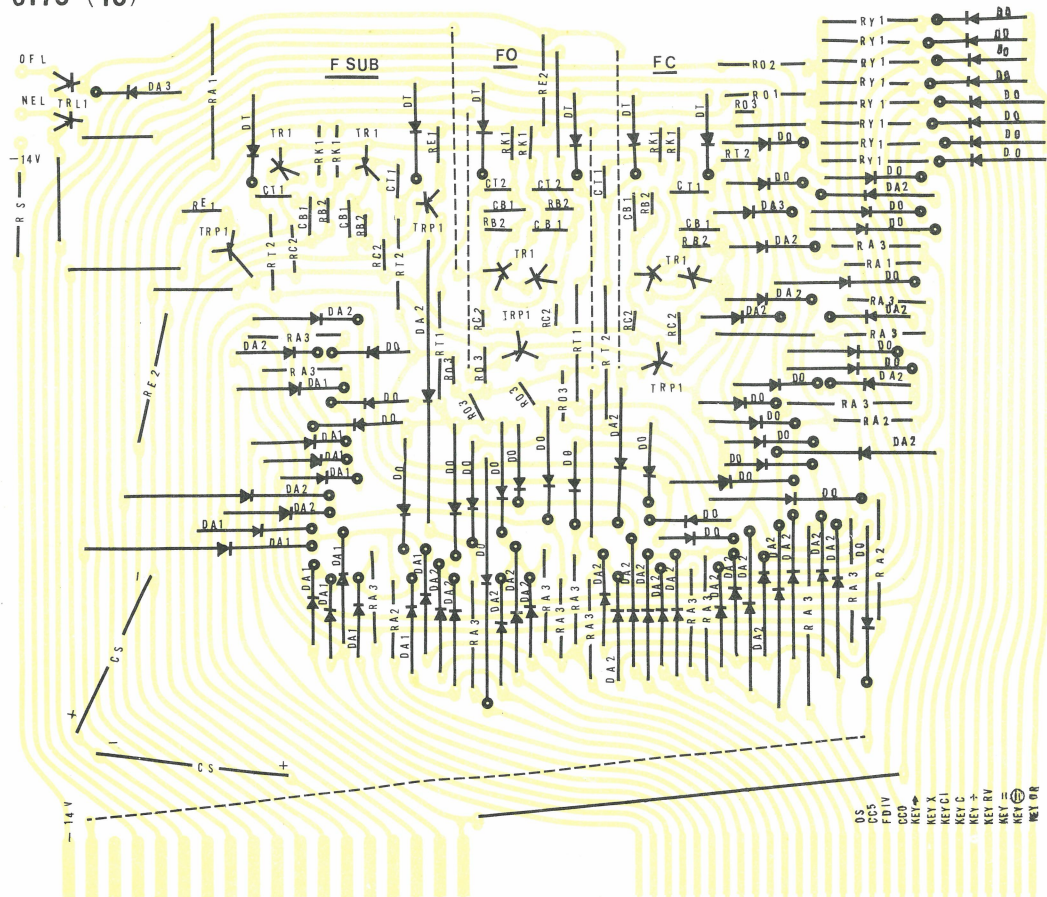
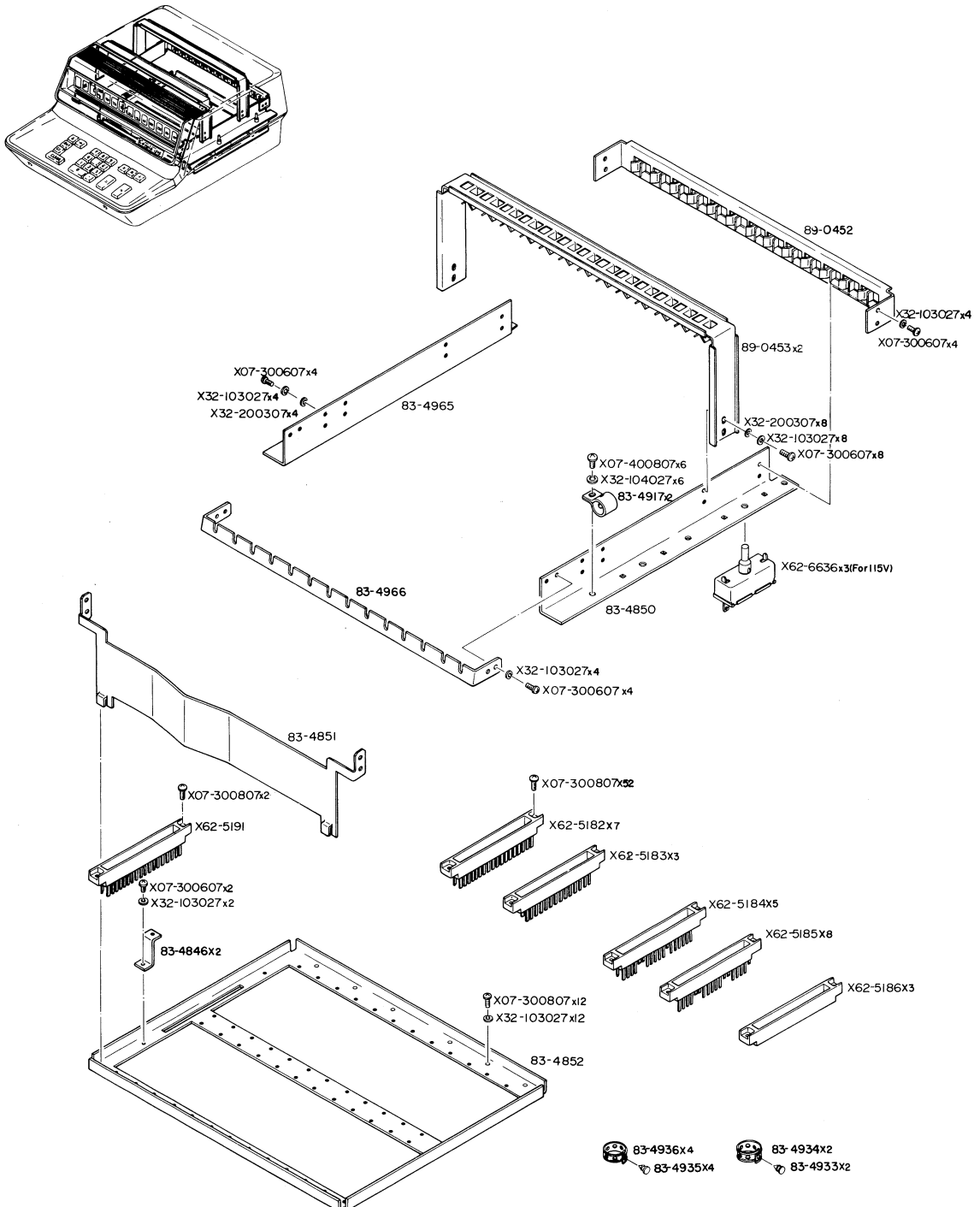


Fig. 11 F SUB, Fo and Fc

NO.	PARTS NO.	DESCRIPTION	Q'TY	REMARKS
1	X65-6530	Transistor トランジスタ 2SA538	1 Yellow	6 TR1
2	X65-6536	" " 2SB77	1 Yellow	6 TRP1, TRL1
3				
4	X65-5519	Diode ダイオード 1N34A	1 Green	50 DA1, DO
5	"	" " "	2 Red	32 DA2
6	"	" " "	3 Yellow	2 DA3
7	X65-5521	" " " (K)		6 DT
8				
9	X64-0381	Resistor 抵抗 1.8K	V	6 RC2
10	X64-0820	" " 2.7K	V	2 RE1
11	X64-0464	" " 10K	V	6 RB2
12				
13	X64-0466	" " 33K	V	1 RT2
14	X64-0467	" " 39K	V	6 RK1
15	X64-0561	" " 130K	V	6 RO3
16	X64-0819	" " 2.7K	T	8 RY1
17	X64-0391	" " 3.9K	T	2 RA1
18	X64-0821	" " 4.7K	T	6 RA2, RO1, RE2
19	X64-0393	" " 8.2K	T	1 RO2
20	X64-0470	" " 10K	T	16 RA3
21	X64-0472	" " 22K	T	2 RT1
22	X64-0473	" " 33K	T	3 RT2
23	X64-0121	" " 22Ω	T	1 RS
24	X63-2517	Condenser コンデンサ 220P		4 CT1
25	X63-2518	" " 270P		2 CT2
26	X63-2508	" " 680P		6 CB1
27	X63-3527	" " 100μ		2 CS
28				
29				

INDICATOR & ARITHMETIC UNIT(2)

演算部(2)



INDICATOR & ARITHMETIC UNIT(2)

演 算 部 (2)

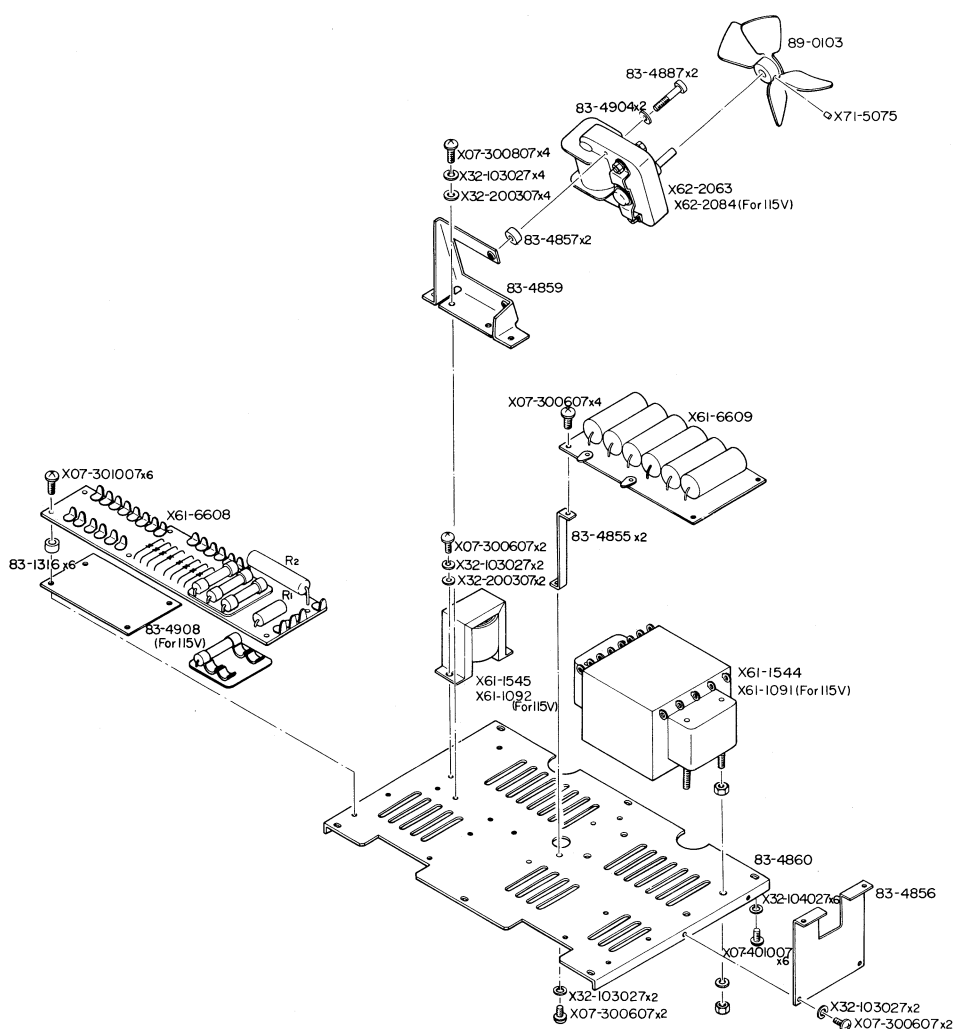
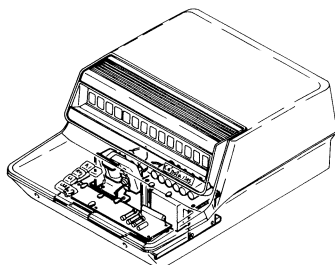
PARTS NO.	DESCRIPTION	QUANT.
83-4846	Supporter	止 め 板 2
83-4848	Card Unit Holder	カ ー ド 押 え 1
83-4850	Side Plate	止 め 板 1
83-4851	Diffusion Plate	拡 散 板 1
83-4852	Connector Unit Main Panel	結 線 板 1
83-4917	Wire Holder	束 線 抑 え 2
83-4933	Button	ボ タ ン 2
83-4934	Band	バ ン ド 2
83-4935	Button	ボ タ ン 4
83-4936	Band	バ ン ド 4
83-4965	Side Plate	止 め 板 1
83-4966	Indicator Unit Mounting Plate	表 示 器 止 め 板 1
89-0452	Card Holder	カ ー ド 押 え 1
89-0453	Card Holder	カ ー ド 押 え 1
X07-300607 ...	Screw	ス ク リ ュ 24
X07-300807 ...	Screw	ス ク リ ュ 66
X07-400807 ...	Screw	ス ク リ ュ 6
X32-103027 ...	Spring Washer	スプリングワッシャ 34
X32-200307 ...	Washer	ワ ッ シ ャ 16
X62-5182	Connector 18P	コネクター 18P 7
X62-5183	Connector 28P	コネクター 28P 3
X62-5184	Connector 18P	コネクター 18P 5
X62-5185	Connector 18P	コネクター 18P 8
X62-5186	Connector 18P	コネクター 18P 3
X62-5191	Connector 22P	コネクター 22P 1
X62-6636	Circuit Breaker	サーキットブレーカー 1
X62-6636	Circuit Breaker	サーキットブレーカー 3

KEYBOARD UNIT

(キーボード部)

PARTS NO.	DESCRIPTION	QUANT.
83-1607	Spring	19
83-3758	Felt Washer	1
83-3759	Felt Washer	19
83-4178	Felt Washer	19
83-4727	Reinforce Plate	1
83-4800	Accumulation Key	1
83-4801	Constant Key	1
83-4823	Felt Washer	2
83-4824	Felt Washer	1
83-4825	Key Cover	1
83-4835	Keyboard Base	1
88-0150	Keyboard Unit	1
89-0357	Contact Switch	19
89-0358	Keyboard & Felt Washer	1
89-0368	Shift Key	1
89-0369	RV (Inverse) Key	1
89-0370	Clear Indicator Key	1
89-0371	Decimal Point Key	1
89-0372	Numeral Key (1)	1
89-0373	Numeral Key (2)	1
89-0374	Numeral Key (3)	1
89-0375	Numeral Key (4)	1
89-0376	Numeral Key (5)	1
89-0377	Numeral Key (6)	1
89-0378	Numeral Key (7)	1
89-0379	Numeral Key (8)	1
89-0380	Numeral Key (9)	1
89-0381	Multiplication Key	1
89-0382	Division Key	1
89-0383	Clear Key	1
89-0384	Numeral Key (0)	1
89-0385	Equal Key	1
89-0386	Nega-equal Key	1
X07-401007	Screw	4
X13-260807	Screw	4
X32-102627	Spring Washer	4
X32-104027	Spring Washer	4
X32-200307	Washer	3
X61-6606	Printed Board	1
X62-0165	Power Switch	1
X62-0175	Push Switch	2
X71-5565	Tapping Screw	19
X71-5567	Tapping Screw	13
X98-030060	Washer	6
X98-030115	Washer	19
X98-040209	Washer	4

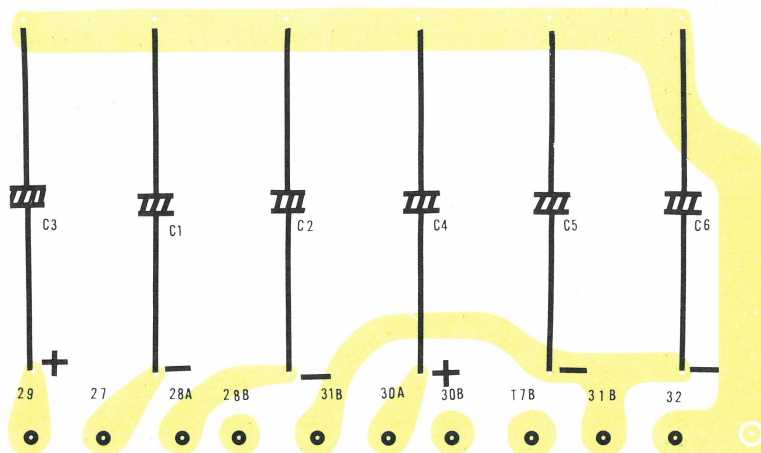
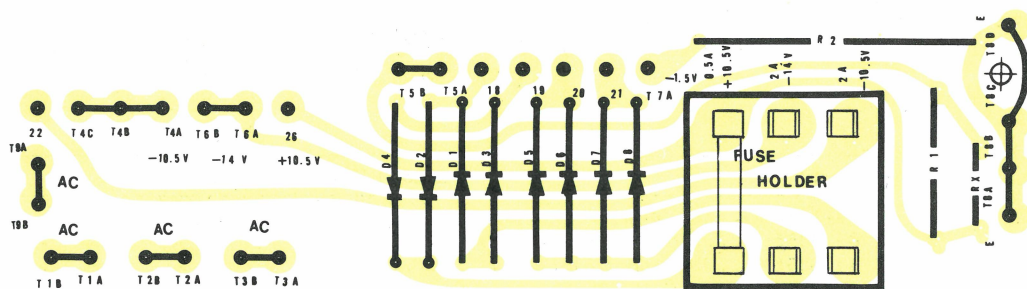
POWER SUPPLY UNIT (電源部)



POWER SUPPLY UNIT

(電 源 部)

PARTS NO.	DESCRIPTION	QUANT.
83-1316	Collar	6
83-4855	Supporter	2
83-4856	Supporter	1
83-4857	Collar	2
83-4859	Motor Mounting Plate	1
83-4860	Power Supply Chassis	1
83-4887	Screw	2
83-4904	Washer	2
83-4908	Insulator (for 115V)	2
89-0103	Fan	1
X61-1544	Power Transformer	1
X61-1091	Power Transformer (for 115V) ..	1
X61-1545	Choke Coil	1
X61-1092	Choke Coil (for 115V)	1
X61-6608	Printed Board	1
X61-6609	Printed Board	1
X62-2063	Motor	1
X62-2084	Motor (for 115V)	1
X07-300607...	Screw	10
X07-300807...	Screw	4
X07-301007...	Screw	6
X07-401007...	Screw	10
X32-103027...	Spring Washer	14
X32-104027...	Spring Washer	6
X32-200307...	Washer	6
X71-5075	Set Screw	1

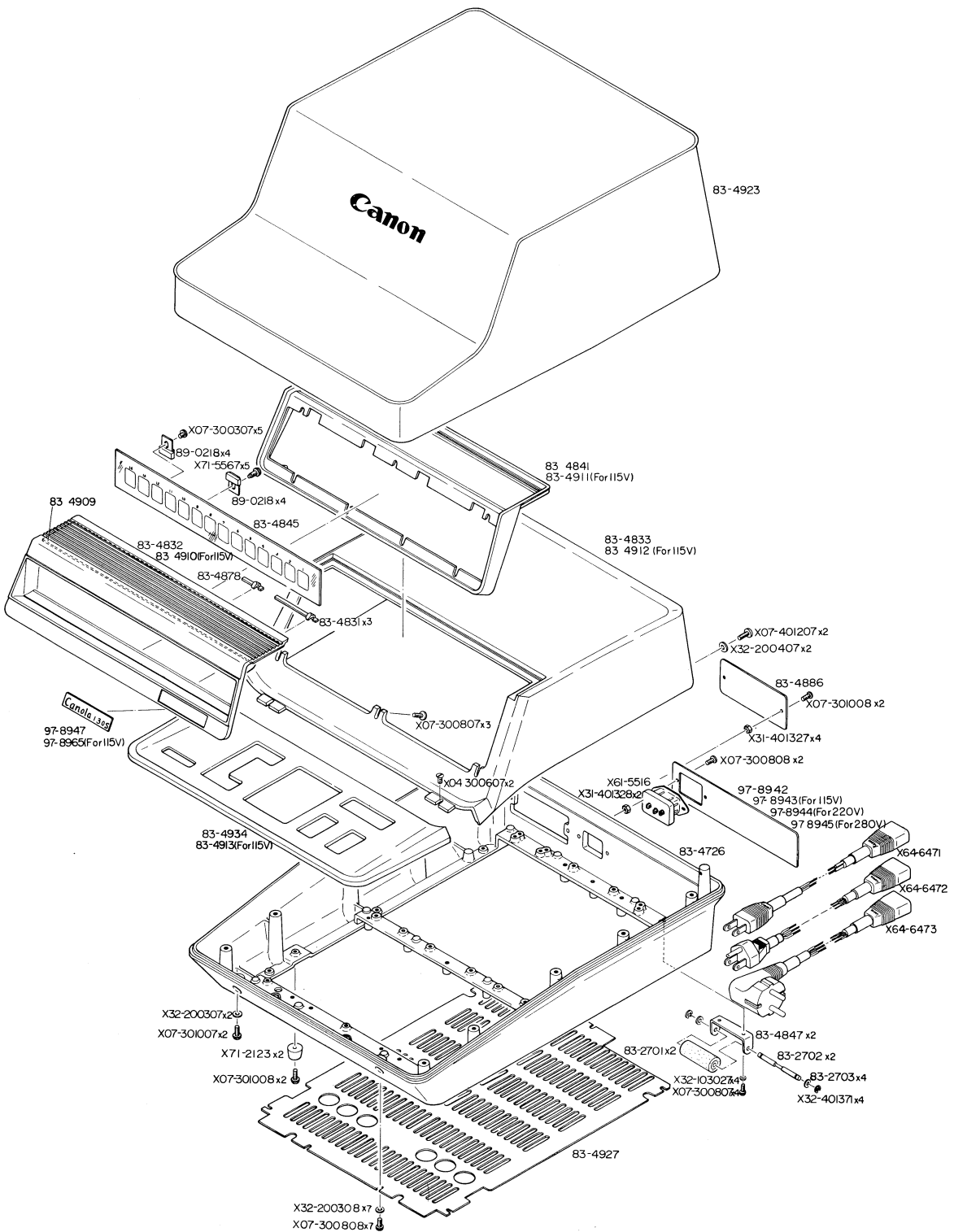


No.	Parts No.	Description				Q'ty
1	X62-6637	3P Fuse Holder	3 P ヒューズホルダー	Fuse Holder	3A 250V	1
2	X62-6651	Fuse	ヒューズ	1A+10.5V	0.5A 250V	1
3	X62-8310	Winding Resistor	巻線抵抗	R2	1.5Ω 5W	1
4	X62-8311	"	"	R1	22Ω 3W	1
5	X64-0122	Resistor	抵抗	Rx	47Ω 1/4W	n
6	X64-0265	"	"	Rx	100Ω 1/4W	n
7	X65-5542	Diode	ダイオード	D1~D8	VO3C	8
8	X61-6604	Printed Board	プリント板			1
9	X63-3568	Electrolytic Condenser	電解コンデンサ	C1, C2, C3,	2000μF	4
10	X63-3080	"	"	C4	15WV	2
				C5, C6	1000μF 25WV	

No.	Parts No.	Description				Q'ty
1	X62-6604	Fuse	ヒューズ	2A-10.5V	2A 125V	2
2	X62-6637	3P Fuse Holder	3 P ヒューズホルダー	Fuse Holder	3A 250V	1
3	X62-6606	Fuse	ヒューズ	1A+10.5V	1A 125V	1
4	X62-8310	Winding Resistor	巻線抵抗	R2	1.5Ω 5W	1
5	X62-8311	"	"	R1	22Ω 3W	1
6	X64-0122	Resistor	抵抗	Rx	47Ω 1/4W	n
7	X64-0265	"	"	Rx	100Ω 1/4W	n
8	X65-5542	Diode	ダイオード	D1~D8	VO3C	8
9	X61-6608	Printed Board	プリント板			1
10	X63-3568	Electrolytic Condenser	電解コンデンサ	C1, C2, C3,	2000μF	4
11	X63-3080	"	"	C4	15WV	2
				C5, C6	1000μF 25WV	

CASING

(外装部)



CASING

(外装部)

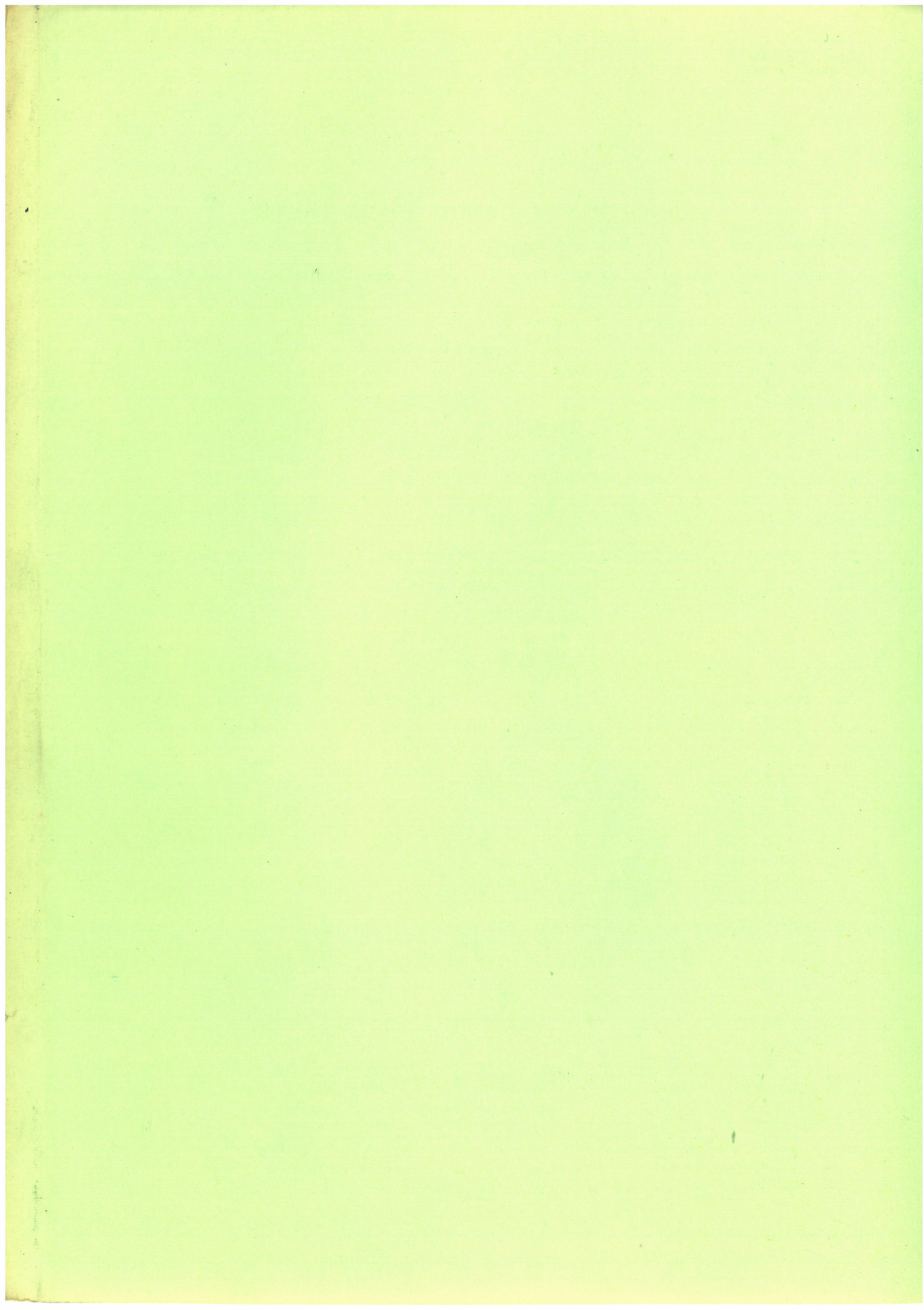
PARTS NO.	DESCRIPTION	QUANT.
83-2701	Rubber Roller	ゴムローラー 2
83-2702	Shaft	軸 2
83-2703	Collor	カラ 4
83-4726	Base Plate	底板 1
83-4831	Index	指標 3
83-4832	Hood (Upper) For 115V	フーード 1
83-4833	Cover	カバー 1
83-4834	Keyboard Cover	化粧板 1
83-4841	Hood (Lower) For 115V	フーード 1
83-4845	Glass	ガラス 1
83-4847	Roller Holder	止め板 2
83-4927	Base Cover	メクラ板 1
83-4878	Index	指標 1
83-4886	Connector Cover	メクラ板 1
83-4909	Heat-proof	断熱材 1
83-4910	Hood (Upper) For 115V	フーード (上部) 1
83-4911	Hood (Lower) For 115V	フーード (下部) 1
83-4912	Cover (For 115V)	カバー 1
83-4913	Keyboard Cover (For 115V)	化粧板 1
83-4917	Wire Holder	束線抑え 2
83-4923	Vinyl Cover	ビニールカバー 1
89-0218	Glass Holder	ガラス押え 8
97-8942	Rating Plate	銘板 (国内用) 1
97-8943	Rating Plate (For 115V)	銘板 (115V用) 1
97-8944	Rating Plate (For 220V)	銘板 (220V用) 1
97-8945	Rating Plate (For 240V)	銘板 (240V用) 1
97-8947	Name Plate	ネームプレート 1
97-8965	Name Plate (for 115V)	ネームプレート(115V用) 1
X61-5516	Receptacle	リセプタクル 1
X61-6471	Power Source Cord	電源コード 1
X61-6472	Power Source Cord	電源コード 1
X61-6473	Power Source Cord	電源コード 1
X71-2123	Rubber Pud	ゴム足 2
X71-5567	Tapping Screw	タッピングネジ 5
X04-300607...	Screw	小ネジ 2
X07-300307...	Screw	小ネジ 5
X07-300807...	Screw	小ネジ 7
X07-300808...	Screw	小ネジ 9
X07-301008...	Screw	小ネジ 4
X07-401207...	Screw	小ネジ 2
X31-401327...	Nut	ナット 4
X31-401328...	Nut	ナット 2
X32-103027...	Spring Washer	バネ座金 4
X32-200307...	Washer	ワッシャー 2
X32-200308...	Washer	ワッシャー 7
X32-200407...	Washer	ワッシャー 2
X32-401371...	Retaining Washer	緊定ワッシャー 2

PRICE LIST OF CANON SPARE PARTS
CANOLA 130S

n.b.

This Price List of Model 130S shows the repair parts listed up in Parts List. You are basically requested to order for screws, washers, resistors and other small repair parts as a set, conspicuously mentioning the numbers of the respective sets since our Price List is made accordingly.

CANON CAMERA CO., INC.
TOKYO, JAPAN



PRICE LIST

(1st Dec. 1967)

PARTS NO.	DESCRIPTION
83-1316	Collar (per 5 pieces)
83-1363	Holder (Upper)
83-1364	Holder (Lower)
83-1365	Spacer (Upper)
83-1366	Spacer (Lower)
83-1367	Indicator Board (Digit)
83-1394	Packing
83-1607	Spring (per 5 pieces)
83-2701	Rubber Roller
83-2702	Shaft (per 2 pieces)
83-2703	Collar (per 5 pieces)
83-3758	Felt Washer
83-3759	Felt Washer (per 10 pieces)
83-3862	Card Board
83-4178	Felt Washer (per 10 pieces)
83-4726	Base Plate
83-4727	Reinforce Plate
83-4800	Accumulation Key (A)
83-4801	Constant Key (K)
83-4821	Back Cover
83-4822	Printed Panel
83-4823	Felt Washer
83-4824	Felt Washer
83-4825	Key Cover
83-4828	Guide Case
83-4831	Index
83-4832	Hood
83-4833	Cover
83-4834	Keyboard Cover
83-4835	Keyboard Base
83-4836	Case
83-4837	Back Cover (per 2 pieces)
83-4838	Holder
83-4839	Printed Plate
83-4840	Printed Plate
83-4841	Hood
83-4842	Indicator Holder
83-4843	Indicator Holder
83-4845	Glass
83-4846	Plate
83-4847	Roller Holder
83-4850	Side Plate
83-4851	Diffusion Wall
83-4852	Connector Unit Main Panel
83-4853	Cover
83-4855	Supporter
83-4856	Supporter
83-4857	Collar
83-4859	Motor Mounting Plate

PARTS NO.	DESCRIPTION
83-4860	Power Supply Chassis
83-4861	Guide Case
83-4878	Index
83-4883	Angle Plate
83-4886	Connector Cover
83-4887	Screw
83-4888	Cover
83-4904	Washer (per 10 pieces)
83-4908	Insulator (for 115V)
83-4909	Heat-Proof
83-4910	Hood (Upper) For 115V
83-4911	Hood (Lower) For 115V
83-4912	Cover (for 115V)
83-4913	Keyboard Cover (for 115V)
83-4917	Wiring Holder
83-4923	Vinyl Cover
83-4965	Side Plate
83-4966	Indicator Unit Mounting Plate
88-0160	Card Unit (04, 06, 08)
88-0161	Card Unit (01)
88-0162	Card Unit (02)
88-0163	Card Unit (03)
88-0165	Card Unit (05)
88-0167	Card Unit (07)
88-0169	Card Unit (09)
88-0170	Card Unit (10)
88-0171	Card Unit (11)
88-0172	Card Unit (12)
88-0173	Card Unit (13)
88-0174	Connector Unit
88-0178	Numeric Indicator Unit
88-0179	Sign Indicator Unit
88-0234	Card Unit (04, 06, 08) For 115V
88-0237	Card Unit (07) For 115V
89-0103	Fan
89-0172	Indicator Board 7
89-0173	Indicator Board
89-0174	Indicator Board 0
89-0175	Indicator Board 5
89-0176	Indicator Board 1
89-0177	Indicator Board 9
89-0178	Indicator Board 6
89-0179	Indicator Board 4
89-0180	Indicator Board 8
89-0181	Indicator Board 3
89-0182	Indicator Board 2
89-0218	Glass Holder
89-0357	Contact Switch
89-0358	Felt Washer & Keyboard
89-0368	Shift Key (→)
89-0369	Inverse Key (RV)

PARTS NO.	DESCRIPTION
89-0370	Clear Indicator Key (CI)
89-0371	Decimal Point Key (.)
89-0372	Numeral Key (1)
89-0373	Numeral Key (2)
89-0374	Numeral Key (3)
89-0375	Numeral Key (4)
89-0376	Numeral Key (5)
89-0377	Numeral Key (6)
89-0378	Numeral Key (7)
89-0379	Numeral Key (8)
89-0380	Numeral Key (9)
89-0381	Multiplication Key (X)
89-0382	Division Key (÷)
89-0383	Clear Key (Clear)
89-0384	Numeral Key (0)
89-0385	Equal Key (=)
89-0386	Nega-equal Key (⊖)
89-0452	Card Holder
89-0453	Card Holder
97-8942	Rating Plate
97-8943	Rating Plate (for 115V)
97-8944	Rating Plate (for 220V)
97-8945	Rating Plate (for 240V)
97-8947	Name Plate
97-8965	Name Plate (for 115V)
X04-300607	Screw (per 10 pieces)
X07-300307	Screw (per 10 pieces)
X07-300607	Screw (per 10 pieces)
X07-300807	Screw (per 10 pieces)
X07-300808	Screw (per 10 pieces)
X07-301007	Screw (per 10 pieces)
X07-301008	Screw (per 10 pieces)
X07-301207	Screw (per 10 pieces)
X07-400807	Screw (per 10 pieces)
X07-401007	Screw (per 10 pieces)
X07-401207	Screw (per 10 pieces)
X13-200607	Screw (per 10 pieces)
X13-200608	Screw (per 10 pieces)
X13-260807	Screw (per 10 pieces)
X14-200508	Screw (per 10 pieces)
X31-401327	Nut (per 10 pieces)
X31-401328	Nut (per 10 pieces)
X32-102627	Spring Washer (per 10 pieces)
X32-103027	Spring Washer (per 10 pieces)
X32-104027	Spring Washer (per 10 pieces)
X32-200307	Washer (per 10 pieces)
X32-200308	Washer (per 10 pieces)
X32-200407	Washer (per 10 pieces)
X32-401371	Retaining Washer (per 10 pieces)
X61-1544	Power Transformer

PARTS NO.	DESCRIPTION
X61-1545	Choke Coil
X61-1091	Power Transformer (for 115V)
X61-1092	Choke Coil (for 115V)
X61-2084	Motor (for 115V)
X61-5516	Receptacle
X61-6471	Power Source Cord
X61-6472	Power Source Cord
X61-6473	Power Source Cord
X61-6606	Printed Board
X61-6608	Printed Board
X61-6609	Printed Board
X61-7514	Lamp
X61-8521	Resistor 8.2K
X62-0165	Power Switch
X62-0173	Slide Switch
X62-0175	Push Switch
X62-2063	Motor
X62-2084	Motor (for 115V)
X62-5182	Connector 18P
X62-5183	Connector 28P
X62-5184	Connector 18P
X62-5185	Connector 18P
X62-5186	Connector 18P
X62-5191	Connector 22P
X62-6604	Fuse 2A
X62-6606	Fuse 1A
X62-6636	Circuit Breaker
X62-6637	3P Fuse Holder
X62-6810	Nylon Bush
X62-6811	Rubber Bush (per 5 pieces)
X62-8151	Condenser (per 2 pieces)
X62-8152	Condenser (per 2 pieces)
X62-8310	Winding Resistor 1.5 Ω
X62-8311	Winding Resistor 2.2 Ω
X62-8703	Condenser 0.1 μ F
X62-8851	Condenser 0.68 μ F
X63-2505	Condenser 1500PF
X63-2508	Condenser 680PF
X63-2517	Condenser 220PF (per 2)
X63-2518	Condenser 270PF (per 2)
X63-3080	Electrolytic Condenser 1000 μ F
X63-3527	Condenser 100 μ 15V
X63-3568	Electrolytic Condenser 2000 μ F
X64-0121	Resistor 22 Ω T (per 5)
X64-0122	Resistor 47 Ω T (per 5)
X64-0162	Resistor 22 Ω V (per 5)
X64-0228	Resistor 910 Ω V (per 5)
X64-0265	Resistor 100 Ω T (per 5)
X64-0270	Resistor 910 Ω T (per 5)
X64-0300	Resistor 120 Ω V (per 5)
X64-0380	Resistor 1.5KV (per 5)

PARTS NO.	DESCRIPTION
X64-0381	Resistor 1.8KV (per 5)
X64-0383	Resistor 3KV (per 5)
X64-0384	Resistor 4.7KV (per 5)
X64-0387	Resistor 1.5KT
X64-0388	Resistor 1.8KT (per 5)
X64-0391	Resistor 3.9KT
X64-0393	Resistor 8.2KT
X64-0395	Resistor 3.9KV (per 5)
X64-0464	Resistor 10KV (per 5)
X64-0465	Resistor 12KV (per 5)
X64-0466	Resistor 33KV (per 5)
X64-0467	Resistor 39KV (per 5)
X64-0469	Resistor 56KV (per 5)
X64-0470	Resistor 10KT (per 5)
X64-0471	Resistor 12KT
X64-0472	Resistor 22KT
X64-0473	Resistor 33KT
X64-0474	Resistor 39KT (per 5)
X64-0476	Resistor 56KT (per 5)
X64-0480	Resistor 22KV (per 5)
X64-0541	Resistor 100KT (per 5)
X64-0542	Resistor 100KV (per 5)
X64-0561	Resistor 130KV (per 5)
X64-0563	Resistor 130KT (per 5)
X64-0564	Resistor 300KT (per 5)
X64-0566	Resistor 300KV (per 5)
X64-0819	Resistor 2.7KT (per 5)
X64-0820	Resistor 2.7KV (per 5)
X64-0821	Resistor 4.7KT (per 5)
X64-0822	Resistor 82KV (per 5)
X65-5519	Diode 1N34A
X65-5521	Diode 1N34A K
X65-5542	Diode VO3C
X65-6525	Transistor 2SD77
X65-6530	Transistor 2SA538
X65-6536	Transistor 2SB77C
X71-2123	Rubber Pud (per 2 pieces)
X71-5075	Setscrew (per 10 pieces)
X71-5565	Tapping Screw (per 10 pieces)
X71-5567	Tapping Screw (per 10 pieces)
X98-030060	Washer (per 10 pieces)
X98-030115	Washer (per 10 pieces)
X98-040209	Washer (per 10 pieces)

