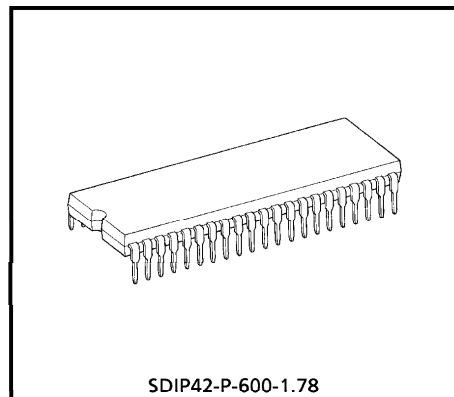


TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

TC83220-0019**TC83220-0019 : SINGLE-CHIP CMOS LSI FOR FL (FLUORESCENT)
CALCULATOR WITH PRINTERS**

The TOSHIBA printing / display calculator circuit TC83220-0019 is 10- or 12-digit calculator on single-chip CMOS LSI. TC83220-0019 can drive the printing machine (PTMFL-76 / 77, PTMFL-86 / 87 ; ALPS) with magnet driver circuit, and can drive the fluorescent display tube with DC-DC converter.

It contains a 4K-word ROM, a 256×4-bit RAM.



Weight : 4.12 g (Typ.)

FEATURES**Operational Features**

- **Print** : 11 or 13 digits of data.
(including decimal point) 1 digit of minus sign. 2 digits of operational symbol.
3 digits of commas. 1-color (black) or 2-colors (black and red) printing.
- **Display** : 10 or 12 digits of data. (including punctuation in each digit.)
1 digit of floating minus sign, memory load, error symbol, grand total memory load, 3 digits of commas.
- **Decimal output** : Decimal set lock key controls output format.
Fixed decimal setting ("0", "1", "2", "3", "4", "6"), full floating decimal, and ADD mode.
- **Key input buffer** : 12 stages
- **Function** : 4 basic arithmetic functions (+, -, ×, ÷).
Repeat addition and subtraction.
Automatic constants in multiplication, division, percent calculation, calculations.
Automatic percent add-on and percent discount calculation.
Memory calculation.
Automatic accumulating calculation.
Gross margin profit calculation.
Delta percent calculation.
Tax calculation.
Grand total calculation.

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- Item counter : 0~999 count up or -999~0~999 count up/down by depressing of $\boxed{+}$, $\boxed{-}$ key.
- Punctuation : Commas for thousands on display.
- Kinds of touch key : $\boxed{0} \sim \boxed{9}$, $\boxed{\cdot}$, $\boxed{00}$, $\boxed{000}$, \boxed{C} , \boxed{CE} , $\boxed{C/CE}$, $\boxed{+/-}$, $\boxed{\#/P}$, $\boxed{\text{Feed}}$, $\boxed{+}$, $\boxed{-}$, $\boxed{\diamond}$, $\boxed{*}$, $\boxed{\times}$, $\boxed{\div}$, $\boxed{=}$, $\boxed{\%}$, $\boxed{\text{MU/D}}$, $\boxed{\text{M+}}$, $\boxed{\text{M-}}$, $\boxed{\text{M}\diamond}$, $\boxed{\text{M*}}$, $\boxed{\Delta\%}$, $\boxed{\text{M}\diamond*}$, $\boxed{\rightarrow}$, $\boxed{\text{GT}}$, $\boxed{\pm}$, $\boxed{=}$, $\boxed{=}$, $\boxed{\text{IC}}$, $\boxed{+TAX}$, $\boxed{-TAX}$
- Kinds of lock key : "P/ $\overline{\text{NP}}$ " Printing mode selectable switch. (ON : Printing mode. OFF : Nonprinting mode.)
 "Σ" Summation mode selectable switch.
 "5/4" "CUT" "UP" Rounding switch. ("5/4" : "CUT" and "UP" lock key off.)
 Fixed point mode selectable switch.
 "0", "1", "2", "3", "4", "6", "F", "A". ("A" : ADD mode. "F" : Full floating mode, all decimal setting lock key off.)
 "IC+" "IC±" Item counter mode selectable switch.
 "GT" Grand total memory selectable switch.
 "SET/ $\overline{\text{CAL}}$ " Tax memory selectable switch. (ON : Set mode. OFF : Normal calculation mode.)
 "10/ $\overline{12}$ " Display digits selectable switch. (Refer to page 3.)
 "B/ $\overline{\text{R}}$ " Printing colors selectable switch. (Refer to page 3.)
- Duty of display : $\text{Duty} = \frac{1}{16.5}$
- Leading zero suppression
- Trailing zero suppression
- Tax calculation : $\boxed{+TAX}$ key is calculation for included tax.
 (Refer to page 5.) $\boxed{-TAX}$ key is calculation for excluded tax.
 $\boxed{\text{SET/CAL}}$ Lock key selects set mode or normal calculation mode.
 Changing lock key from set mode to normal calculation mode stores number of display to tax memory.
 Changing lock key from normal calculation mode to set mode recalls tax rate to display from tax memory.
 Depression of $\boxed{+TAX}$ following data key at normal calculation mode performs the calculating included tax.
 Depression of $\boxed{-TAX}$ following data key at normal calculation mode performs the calculating excluded tax.

Electrical Features

- P-MOS output buffer with pull down resistor for direct driving of fluorescent display tube.
- Oscillator/clock generator internal to chip.
- Key board encoding internal to chip.
- Shrink dual in line package.

Protection

- i) Double depression of keys will be inoperative.
- ii) In the overflow condition, all key except "C", "C/CE", "CE" "Feed", "→" key are inoperative.
- iii) Key bouncing protection (at 4MHz clock)

Key read in : 15ms

Key off : 40ms

Function Select

- i) "10/12" Selectable with calculated digits (Lock key).

ON 10-digits calculated

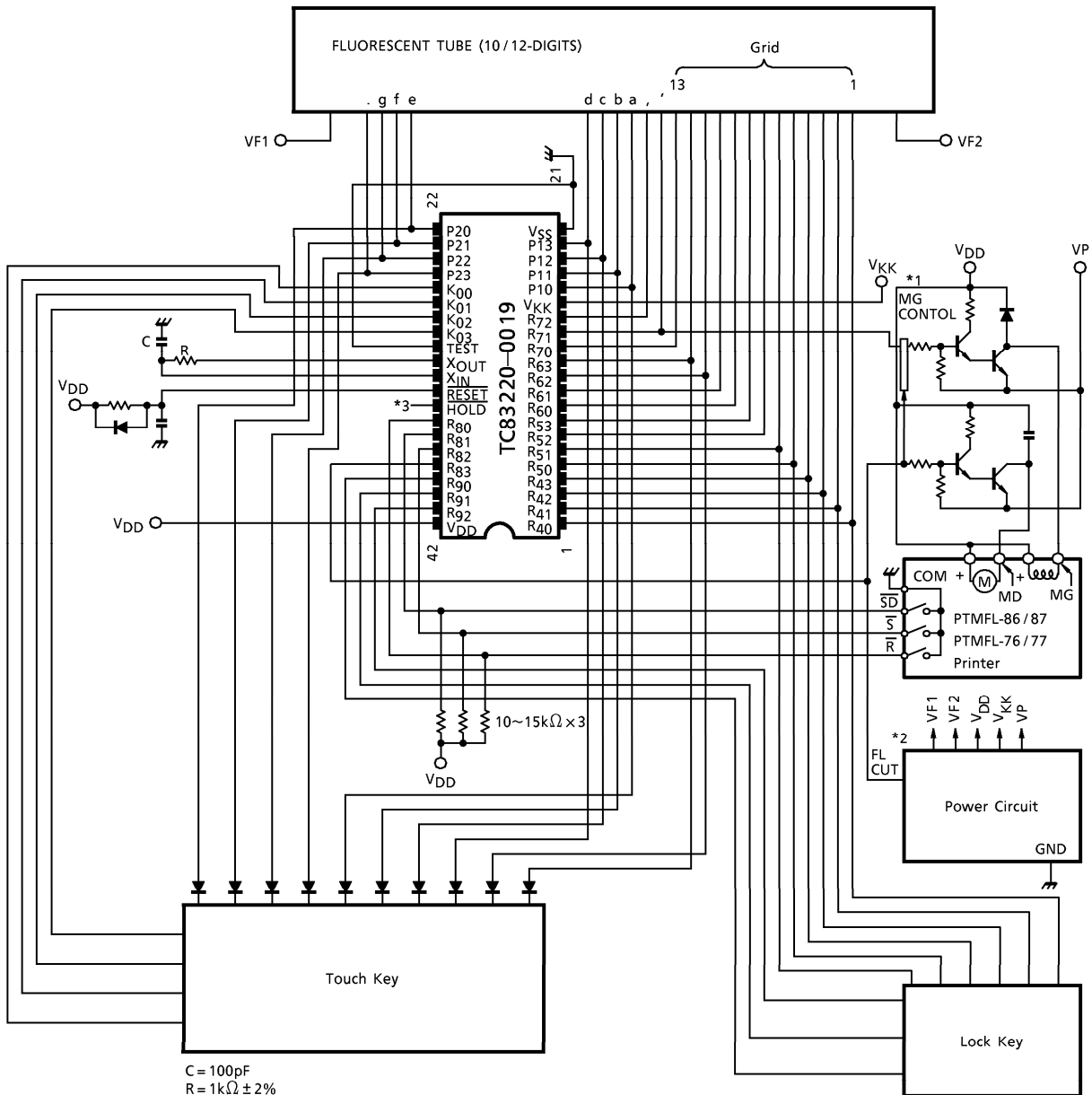
OFF 12-digits calculated

- ii) "B/R" Selectable with printer heads (Lock key).

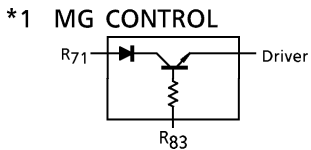
ON PTMFL-76/86 (1 COLOR)

OFF PTMFL-77/87 (2 COLOR)

SYSTEM DIAGRAM

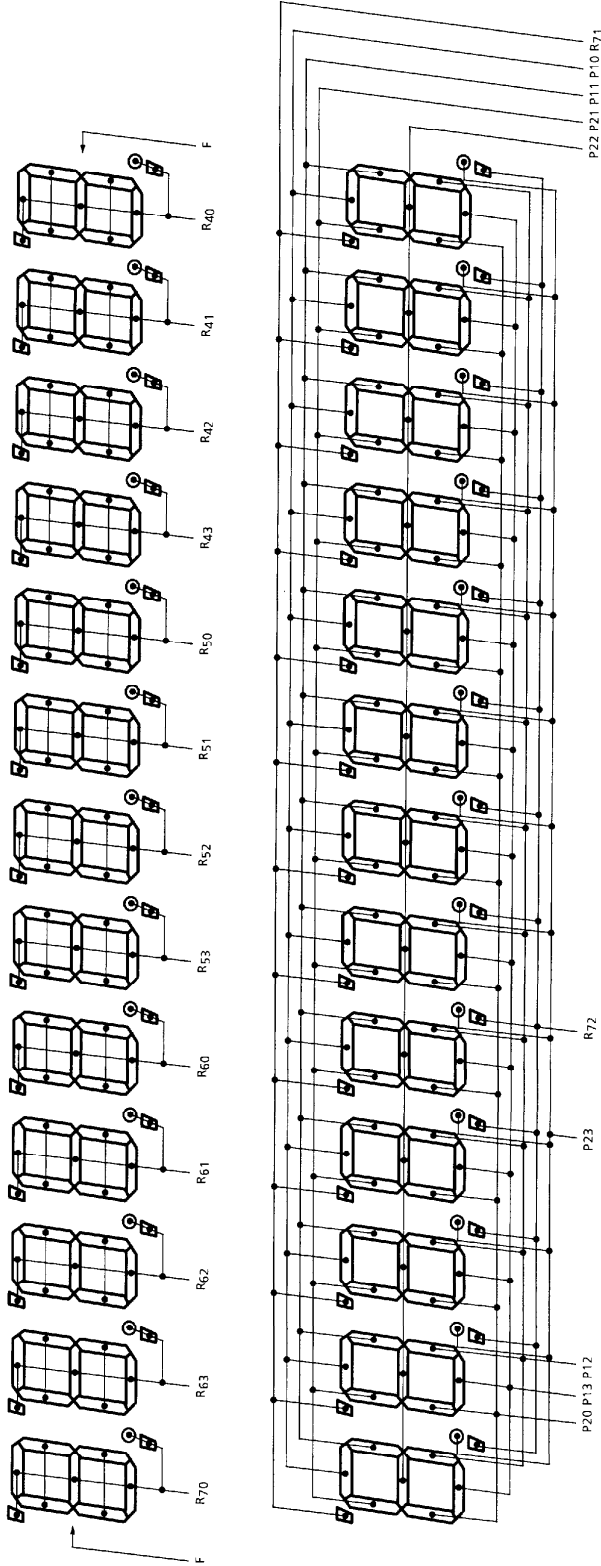


C = 100pF
 R = 1kΩ ± 2%
 VP: Power source to drive printer.
 V_{KK}: Power source for display.



- *2 FL CUT (R83)
(VF1, VF2 Cut at printing)
- *3 Connection to HOLD pin is shown in the following page 15.

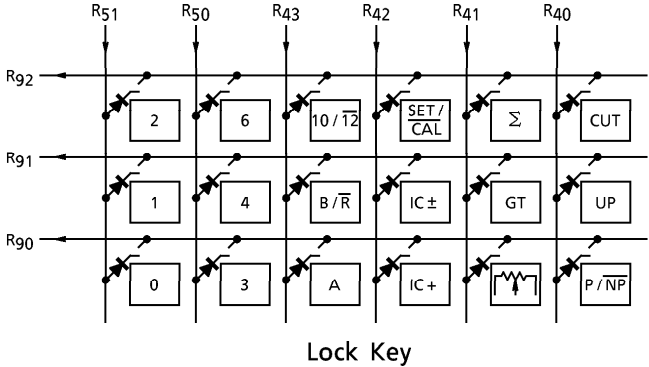
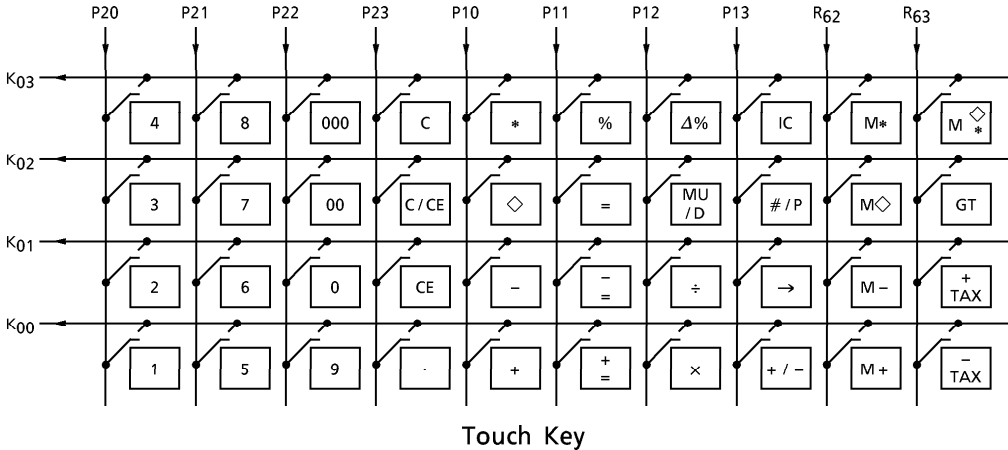
CONNECTION OF FL



- (Note 1) R70 digit (P20) of "E" Data
- (Note 2) R70 digit (P22) of "—" Data
- (Note 3) R70 digit (P23) of "M" Data
- (Note 4) R70 digit (P21) of "GT" Data

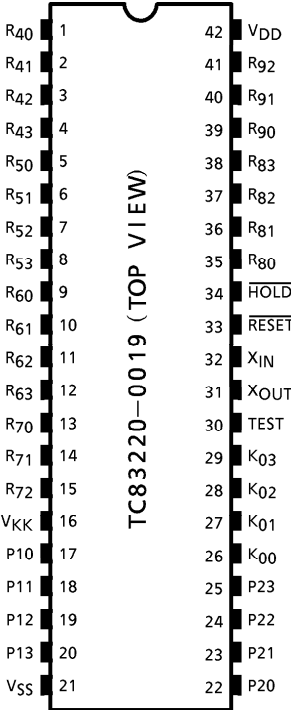
TC83220-0019-5

KEY CONNECTION



(Note)  : Feed

PIN ASSIGNMENT (TOP VIEW)



OPERATION EXAMPLE

| KEY | | PRINT | PRINT COLOR | DISPLAY |
|----------------------------------|----------|----------------|-------------|-------------|
| TAB 4/5 IC 10/12 Σ GT MOD | TOUCH | | | |
| F 4/5 OFF 10 OFF OFF CAL | POWER ON | <PF> | | |
| | | C | | |
| | 1+ | <PF> | | 0. |
| | 2- | 1. + | | 1. |
| | ◇ | 2. - | R | -1. |
| | * | -1. ◇ | R | -1. |
| | | -1. * | R | |
| | | <PF> | | -1. |
| IC+ | 1+ | 1. + | | 1. |
| | 2- | 2. - | R | -1. |
| | ◇ | 002 | | |
| | * | -1. ◇ | R | -1. |
| | | 002 | | |
| | | -1. * | R | |
| | | <PF> | | -1. |
| OFF | 3× | 3. × | | 3. |
| | 4÷ | 4. ÷ | | 12. |
| | = | 4. = | | |
| | | 3. * | | |
| | | <PF> | | 3. |
| | 5× | 5. × | | 5. |
| | 6% | 6. % | | |
| | | 0.3 * | | |
| | | <PF> | | 0.3 |
| | + | 5.3 + % | | |
| | | <PF> | | 5.3 |
| | 2÷ | 2. ÷ | | 2. |
| | 3% | 3. % | | |
| | | 66.66666666 * | | |
| | | <PF> | | 66.66666666 |
| | 2 MU/D | 2. M | | 2. |
| | 3= | 3. % | | |
| | | 0.06185567 ◇ * | | |
| | | 2.06185567 * | | |
| | | <PF> | | 2.06185567 |
| | 2Δ% | 2. ◇ | | 2. |
| | 3= | 3. = | | |
| | | 1. ◇ * | | |
| | | 50. ◇ % | | |
| | | <PF> | | 50. |

(Note) PRINT COLOR ... R : Red
 No mark : Black
 <PF> Paper feed

| KEY | | PRINT | PRINT COLOR | DISPLAY |
|---------------------------|----------|----------------|----------------|-------------|
| TAB 4/5 IC 10/12 Σ GT MOD | TOUCH | | | |
| F 4/5 OFF 10 Σ OFF CAL | 3× | 3. x | | 3. |
| | 4÷ | 4. ÷ | | 12. |
| | = | 4. = | | |
| | | 3. + | | |
| | | <PF> | | 3. |
| | 5× | 5. x | | 5. |
| | 6% | 6. % | | |
| | | 0.3 + | | |
| | | <PF> | | 0.3 |
| | + | 5.3 + % | | |
| | | <PF> | | 5.3 |
| | 2÷ | 2. ÷ | | 2. |
| | 3% | 3. % | | |
| | | 66.66666666 + | | |
| | | <PF> | | 66.66666666 |
| | 2 MU / D | 2. M | | 2. |
| | 3= | 3. % | | |
| | | 0.06185567 ◇ * | | |
| | | 2.06185567 + | | |
| | | <PF> | | 2.06185567 |
| | 2Δ% | 2. ◇ | | 2. |
| | 3= | 3. = | | |
| | | 1. ◇ * | | |
| | | 50. + | | |
| | | <PF> | | 50. |
| | * | 122.0285223 * | | |
| | | <PF> | | 122.0285223 |
| | GT | 0. * ◇ | | 0. |
| GT | 2+ | 2. + | | 2. |
| | 3+ | 3. + | | 5. |
| | * | 5. * + | | |
| | | <PF> | | 5. |
| | 3- | 3. - R | | -3. |
| | 4- | 4. - R | | -7. |
| | 5- | 5. - R | | -12. |
| | * | -12. * + R | | |
| | | <PF> | | -12. |
| | GT | -7. * ◇ R | | -7. |
| | GT | -7. * * R | | |
| | | <PF> | | -7. |
| OFF | M+ | -7. M + R | M | -7. |
| | C | 0. C | M | 0. |

| KEY | | PRINT | PRINT COLOR | DISPLAY |
|---------------------------|----------|----------------|-------------|-----------|
| TAB 4/5 IC 10/12 Σ GT MOD | TOUCH | | | |
| F 4/5 OFF 10 Σ OFF CAL | M◇ | <PF> | | M -7. |
| | M* | -7. M ◇ | R | |
| | | -7. M * | R | |
| | | <PF> | | -7. |
| | # / P | -7. ◇ | R | -7. |
| | 2 # / P | #2 | | 2. |
| | # / P | 2. ◇ | | 2. |
| | 0÷ | 0. ÷ | | 0. |
| | = | 0. = | | |
| | | | | |
| | 0. * | | | |
| | <PF> | | E 0. | |
| | C | 0. C | | |
| | <PF> | | 0. | |
| F CUT OFF 12 OFF OFF CAL | POWER ON | <PF> | | |
| | | C | | |
| SET | | <PF> | | 0. |
| | | 0. % | | |
| | 3 | <PF> | | 0. |
| CAL | | 3. % | | 3. |
| | C | <PF> | | 0. |
| | | 0. C | | |
| SET | | <PF> | | 0. |
| | | 3. % | | |
| CAL | | <PF> | | 3. |
| | | | | 0. |
| | 1560 | | | 1,560. |
| +TAX | | 1,560. | | |
| | | 46.8 ◇ | | |
| | | 1,606.8 * | | |
| | | <PF> | | 1,606.8 |
| +TAX | | 1,606.8 ◇ | | |
| | | 48.204 ◇ | | |
| | | 1,655.004 * | | |
| | | <PF> | | 1,655.004 |
| 1560 | | | | 1,560. |
| x | | 1,560. x | | 1,560. |
| 78900 | | | | 78,900. |
| +TAX | | 78,900. = | | |
| | | 123,084,000. ◇ | | |
| | | 3,692,520. ◇ | | |
| | | 126,776,520. * | | |

| KEY | | PRINT | PRINT COLOR | DISPLAY |
|---------------------------|--------------|-------------------|-------------|------------------|
| TAB 4/5 IC 10/12 Σ GT MOD | TOUCH | | | |
| | = | <PF> | | 126,776,520. |
| | 5 | | | 126,776,520. |
| | x | 5. x | | 5. |
| | +TAX | | | 5. |
| | = | 5. = | | 5. |
| | | 25. * | | |
| | | <PF> | | 25. |
| F CUT OFF 12 OFF OFF CAL | +TAX | 25. ◇ | | |
| | | 0.75 ◇ | | |
| | | 25.75 * | | |
| | | <PF> | | 25.75 |
| | = | | | 25.75 |
| | C | 0. C | | |
| | | <PF> | | 0. |
| 2 | 1560 | | | 1,560. |
| | + | 1,560.00 + | | 1,560.00 |
| | 1100 | | | 1,100. |
| | + | 1,100.00 + | | 2,660.00 |
| | +TAX | 2,660.00 ◇ | | |
| | | 79.80 ◇ | | |
| | | 2,739.80 * | | |
| | | <PF> | | 2,739.80 |
| F | +TAX | 2,739.80 ◇ | | |
| | | 82.194 ◇ | | |
| | | 2,821.994 * | | |
| | | <PF> | | 2,821.994 |
| | 980000000000 | | | 980,000,000,000. |
| | +TAX | 980,000,000,000. | | |
| | | 29,400,000,000. ◇ | | |
| | | | | |
| | | 1,00940000000 * | | |
| | | <PF> | E | 1.00940000000 |
| | C | 0. C | | |
| | | <PF> | | 0. |
| | 1560 | | | 1,560. |
| | +/- | | | -1,560. |
| | +TAX | -1,560. | R | |
| | | -46.8 ◇ | R | |
| | | -1,606.8 * | R | |
| | | <PF> | | -1,606.8 |
| | 1560 | | | 1,560. |
| | -TAX | 1,560. | | |

| KEY | | PRINT | PRINT COLOR | DISPLAY |
|---------------------------|--------------|------------------|----------------|------------------|
| TAB 4/5 IC 10/12 Σ GT MOD | TOUCH | | | |
| F CUT OFF 12 OFF OFF CAL | | -45,43689321 ◇ | R | |
| | | 1,514.56310679 * | | |
| | | <PF> | | 1,514.56310679 |
| | -TAX | 1,514.56310679 ◇ | | |
| | | -44.11348855 ◇ | R | |
| | | 1,470.44961824 * | | |
| | | <PF> | | 1,470.44961824 |
| SET | | 3. % | | |
| | | <PF> | | 3. |
| | C | | | 0. |
| CAL | | 0. % | | |
| | | <PF> | | 0. |
| SET | | 0. % | | |
| | | <PF> | | 0. |
| | 1234 | | | 1,234. |
| CAL | | 1,234. % | | |
| | | <PF> | | 0. |
| | 980000000000 | | | 980,000,000,000. |
| | +TAX | 980,000,000,000. | | |
| | | | | |
| | | 0. * | | |
| | | <PF> | E | 0. |
| | C | 0. C | | |
| | | <PF> | | 0. |

MAXIMUM RATINGS ($V_{SS} = 0V$)

| CHARACTERISTIC | SYMBOL | RATING | UNIT |
|---|-----------|---------------------|-------------|
| Supply Voltage 1 | V_{DD} | -0.5~7 | V |
| Supply Voltage 2 | V_{KK} | -40~+0.5 | V |
| Input Voltage | V_{IN} | -35~ $V_{DD} + 0.5$ | V |
| Output Voltage | V_{OUT} | -35~ $V_{DD} + 0.5$ | V |
| Output Current | I_{OUT} | -10 | mA |
| Power Dissipation ($T_{opr} = 70^{\circ}C$) | P_D | 600 | mW |
| Soldering Temperature, Time | T_{sld} | 260 (10s) | $^{\circ}C$ |
| Storage Temperature | T_{stg} | -55~125 | $^{\circ}C$ |
| Operating Temperature | T_{opr} | 0~40 | $^{\circ}C$ |

RECOMMENDED OPERATING CONDITIONS ($V_{SS} = 0V$)

| CHARACTERISTIC | SYMBOL | TEST CIRCUIT | CONDITION | MIN | MAX | UNIT |
|---|-----------|--------------|-------------------|----------------------|----------------------|-------------|
| Operating Temperature | T_{opr} | — | — | 0 | 40 | $^{\circ}C$ |
| Supply Voltage | V_{DD} | — | — | 4.5 | 6 | V |
| Supply Voltage (FL) | V_{KK} | — | — | -30 | -15 | |
| Supply Voltage (Hold) | V_{DDH} | — | — | 2 | 6 | |
| Input High Voltage (Except Schmitt circuit input) | V_{IH1} | — | $V_{DD} \geq 4.5$ | $V_{DD} \times 0.7$ | V_{DD} | V |
| Input High Voltage (Schmitt circuit input) | V_{IH2} | — | | $V_{DD} \times 0.75$ | V_{DD} | |
| Input High Voltage | V_{IH3} | — | $V_{DD} < 4.5V$ | $V_{DD} \times 0.9$ | V_{DD} | |
| Input Low Voltage (Except Schmitt circuit input) | V_{IL1} | — | $V_{DD} \geq 4.5$ | V_{KK} | $V_{DD} \times 0.3$ | |
| Input Low Voltage (Schmitt circuit input) | V_{IL2} | — | | V_{KK} | $V_{DD} \times 0.25$ | |
| Input Low Voltage | V_{IL3} | — | $V_{DD} < 4.5V$ | V_{KK} | $V_{DD} \times 0.1$ | |
| Output Voltage (Source open drain) | V_{OUT} | — | — | $V_{DD} - 35$ | V_{DD} | V |
| Clock High Pulse Width (Note) | T_{WCH} | — | $V_{IN} = V_{IH}$ | 80 | — | ns |
| Clock Low Pulse Width (Note) | T_{WCL} | — | $V_{IN} = V_{IL}$ | 80 | — | |

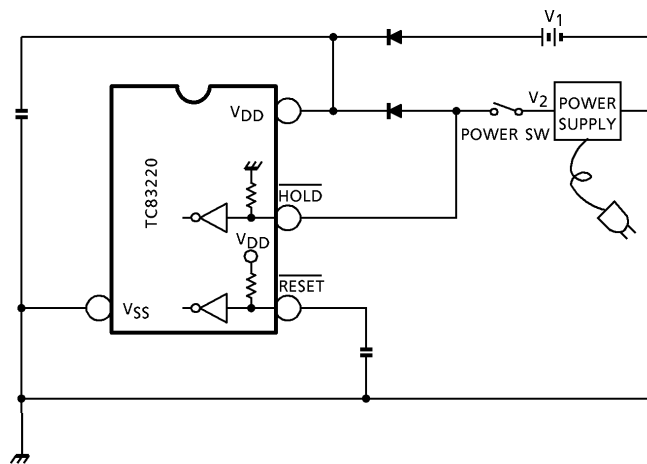
(Note) In case of the external clock operation.

ELECTRICAL CHARACTERISTICS

D.C. Characteristics ($V_{SS} = 0\text{ V}$, $V_{DD} \pm 10\%$, $T_{opr} = 0\sim 40^\circ\text{C}$)

| CHARACTERISTICS | SYMBOL | TEST CIRCUIT | CONDITION | MIN | TYP. | MAX | UNIT |
|--|-----------|--------------|--|-----|------|----------|---------------|
| Hysteresis Voltage (Schmitt circuit input) | V_{HS} | — | — | — | 0.7 | — | V |
| Input Current ($\overline{\text{RESET}}$, $\overline{\text{HOLD}}$, $\overline{\text{TEST}}$) | I_{IN} | — | $V_{DD} = 5.5\text{ V}$, $V_{IN} = 5.5/0\text{ V}$ | — | — | ± 50 | μA |
| Output Leak Current (Source open drain) | I_{LO} | — | $V_{DD} = 5.5\text{ V}$, $V_{OUT} = -32\text{ V}$ | — | — | -10 | μA |
| Output High Voltage (P1~P2, R4~R9) | V_{OH} | — | $V_{DD} = 4.5\text{ V}$, $I_{OH} = -6\text{ mA}$ | 2.4 | — | — | V |
| Input Pull Down Resistor (K0, R7~R9) | R_{IN} | — | $V_{DD} = 5.5\text{ V}$, $V_{KK} = -30\text{ V}$ | — | 100 | — | k Ω |
| Pull Down Resistor (Source open drain) | R_{KK} | — | | 50 | 80 | 200 | |
| Operating Supply Current | I_{DD0} | — | V_{DD} (V_{DDH}) 5.5 V, $f_c = 4\text{ MHz}$, $V_{IN} = 5.3/0.2\text{ V}$ | — | 3 | 6 | mA |
| Supply Current (after clear) | I_{KK1} | — | $V_{KK} = -30\text{ V}$, $f_c = 4\text{ MHz}$ | — | 0.6 | 0.9 | mA |
| Supply Current (Shown full digits) | I_{KK2} | — | | — | 3.5 | 6 | |
| Holding Supply Current | I_{DDH} | — | $V_{DD} = 5.5\text{ V}$ | — | 0.5 | 10 | μA |
| Oscillating Frequency | F_ϕ | — | $V_{DD} = 5.0\text{ V}$, $C = 100\text{ pF}$ $R = 1\text{ k}\Omega \pm 2\%$ | 2.4 | 4.0 | 5.6 | MHz |

THE PROPOSAL OF OUTER CIRCUIT FOR TAX RATE HOLDING WITH BACK-UP BATTERY.



(Note)

$V_1 = 3V$: battery supply

$V_2 = 5V$: DC supply

($\overline{\text{HOLD}}$ pin is pulled down in the LSI, but normally pulled up to V_{DD} .
 $\overline{\text{RESET}}$ pin is pulled up to V_{DD} .)

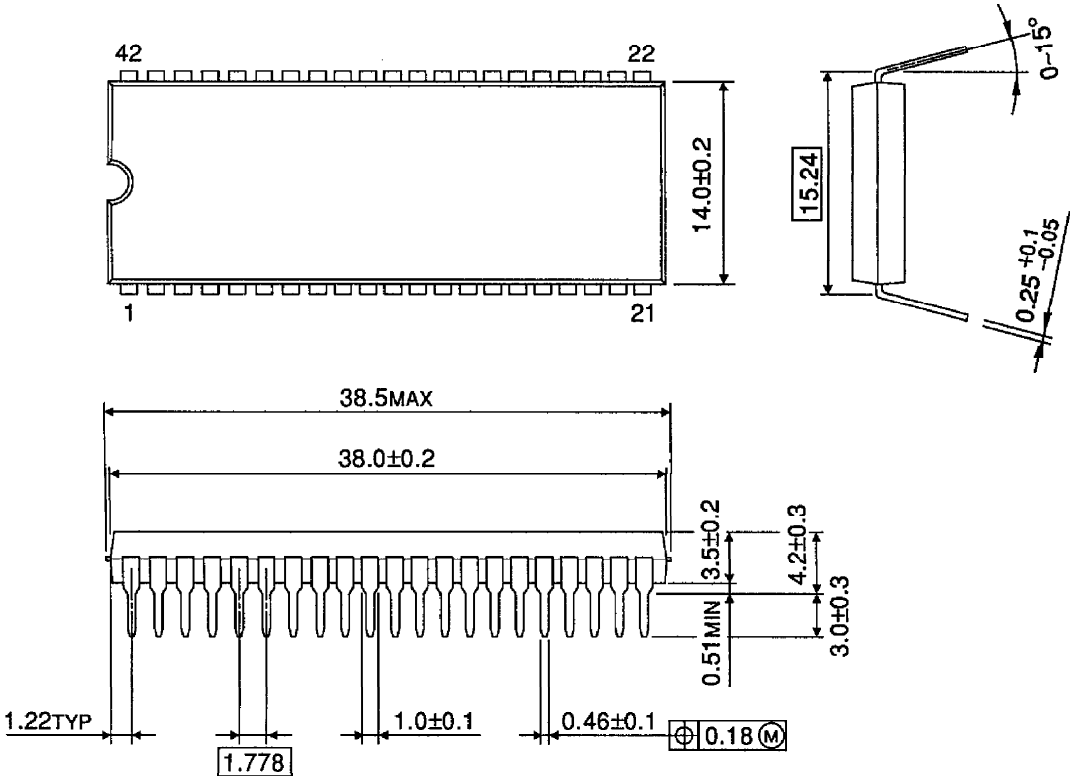
- ① Setting POWER SW to ON, V_2 is supplied to V_{DD} pin, and also to $\overline{\text{HOLD}}$ pin.
Then calculator operates normally.
- ② Setting POWER SW from ON to OFF, V_1 is supplied to V_{DD} pin and V_{SS} is supplied to $\overline{\text{HOLD}}$ pin.
Under this connection, TAX RATE is held.
- ③ Setting POWER SW to ON, V_2 is supplied to V_{DD} pin, and also to $\overline{\text{HOLD}}$ pin.
Then calculator operates normally with TAX RATE to be held.

<NOTE>

V_1 (battery) should be supplied to the circuit after V_2 (DC) supply, because of prevention from exhaustion of battery and abnormal operation.

PACKAGE DIMENSIONS
SDIP42-P-600-1.78

Unit : mm



Weight : 4.12g (Typ.)