

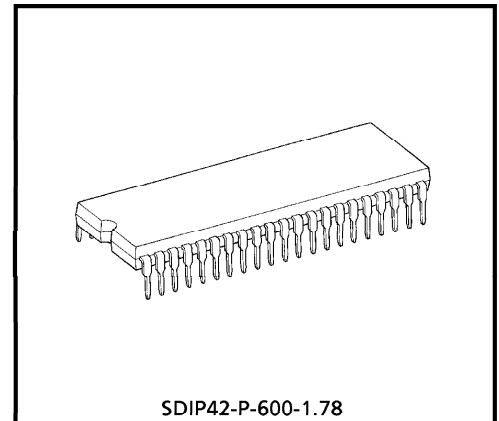
TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

**TC83220-0028****TC83220-0028 SINGLE-CHIP CMOS LSI FOR FL (FLUORESCENT)  
CALCULATOR**

The TOSHIBA printing / display calculator circuit TC83220-0028 is 14-digit calculator on single-chip CMOS LSI. TC83220-0028 can drive the printing machine (M-48T ; EPSON) with magnet driver circuit, and can drive the fluorescent display tube with DC-DC converter. It contains a 4 K-word ROM, a 256 x 4-bit RAM.

**FEATURES****Operational Features**

- **Print** : 15 digits of data.  
(including decimal point) 1 digit of minus sign. 2 digits of operational symbol. 3 digits of commas.  
2-color printing. (black and red)
- **Display** : 14 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", "2", "3", "4", "6"), full floating decimal, and ADD mode.
- **Key input buffer** : 8 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.  
Two-key rollover



SDIP42-P-600-1.78

Weight : 4.12 g (Typ.)

980910EBA2

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- Item counter : 0~999 count up by depressing of  $\boxed{+}$ ,  $\boxed{-}$  key.
- Punctuation : Commas for thousands on display.
- Kinds of touch key :  $\boxed{0} \sim \boxed{9}$ ,  $\boxed{\cdot}$ ,  $\boxed{00}$ ,  $\boxed{000}$ ,  $\boxed{C}$ ,  $\boxed{CE}$ ,  $\boxed{+/-}$ ,  $\boxed{\#/P}$ ,  $\boxed{\text{Feed}}$ ,  $\boxed{+}$ ,  $\boxed{-}$ ,  $\boxed{\diamond}$ ,  $\boxed{*}$ ,  $\boxed{\times}$ ,  $\boxed{\div}$ ,  $\boxed{=}$ ,  $\boxed{\%}$ ,  $\boxed{\text{MU/D}}$ ,  $\boxed{\text{M+}}$ ,  $\boxed{\text{M-}}$ ,  $\boxed{\text{IC}}$ ,  $\boxed{\text{M*}}$ ,  $\boxed{\Delta\%}$ ,  $\boxed{\rightarrow}$ ,  $\boxed{\text{GT}}$ ,  $\boxed{+\text{TAX}}$ ,  $\boxed{-\text{TAX}}$ ,  $\boxed{\text{M}\diamond}$
- Kinds of lock key : "NP" Printing mode selectable switch. (ON : Nonprinting mode. OFF : Printing 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", "2", "3", "4", "6", "F", "A". ("A" : ADD mode. "F" : Full floating mode, all decimal setting lock key off.)  
 "IC+" Item counter mode selectable switch.  
 "GT" Grand total memory selectable switch.  
 "SET", "CAL" Tax memory selectable switch. ("SET" : Set mode. "CAL" : Normal calculation mode.)
- Duty of display :  $\text{Duty} = \frac{1}{17.77}$
- Leading zero suppression
- Trailing zero suppression
- Tax calculation :  $\boxed{+\text{TAX}}$  key is calculation for included tax.  
 (Refer to page 5.)  $\boxed{-\text{TAX}}$  key is calculation for excluded tax.  
 $\boxed{\text{SET}}$  selects set mode for tax rate.  
 $\boxed{\text{CAL}}$  selects normal calculation mode.  
 Changing lock key from  $\boxed{\text{SET}}$  to  $\boxed{\text{CAL}}$  stores number of display to tax memory.  
 Changing lock key from  $\boxed{\text{CAL}}$  to  $\boxed{\text{SET}}$  recalls tax rate to display from tax memory.  
 Depression of  $\boxed{+\text{TAX}}$  following data key at normal calculation mode performs the calculating included tax.  
 Depression of  $\boxed{-\text{TAX}}$  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

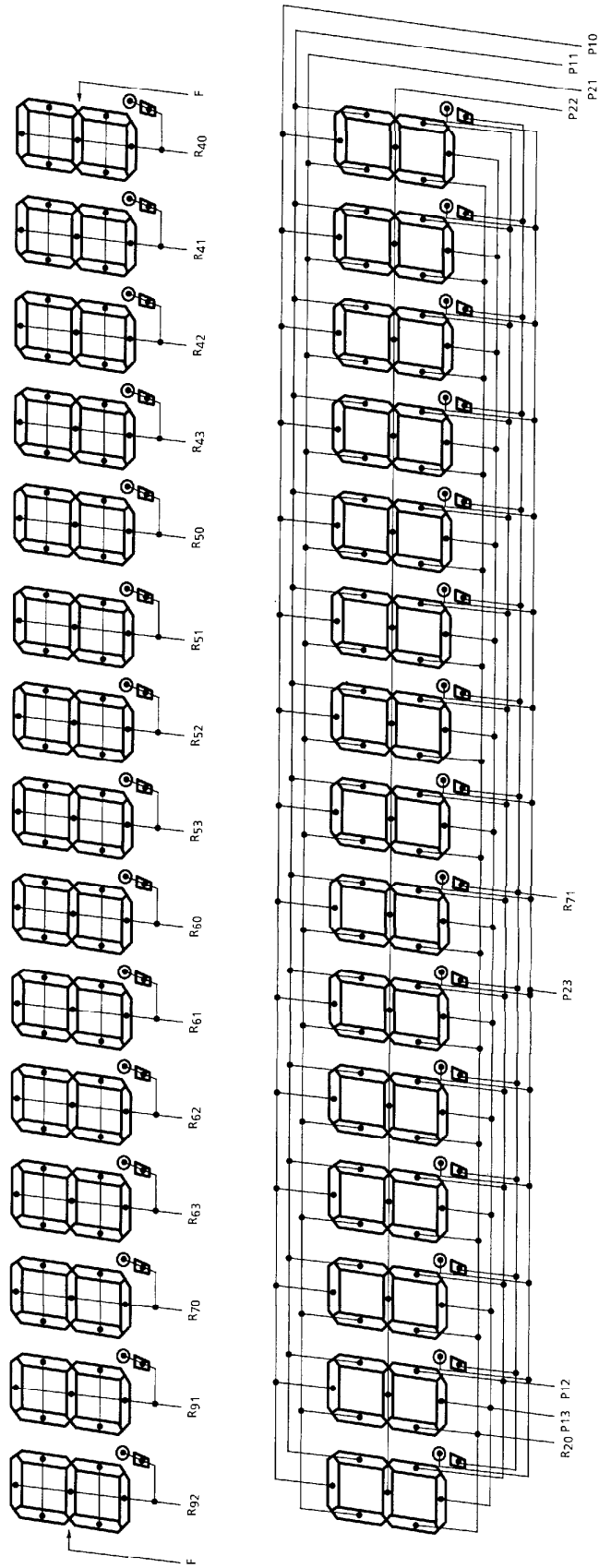
- i) Double depression of keys will be inoperative.
- ii) In the overflow condition, all key except "C", "CE", "Feed", "→" key are inoperative.
- iii) Key bouncing protection (at 4MHz clock)

Key read in : 15ms

Key off : 40ms



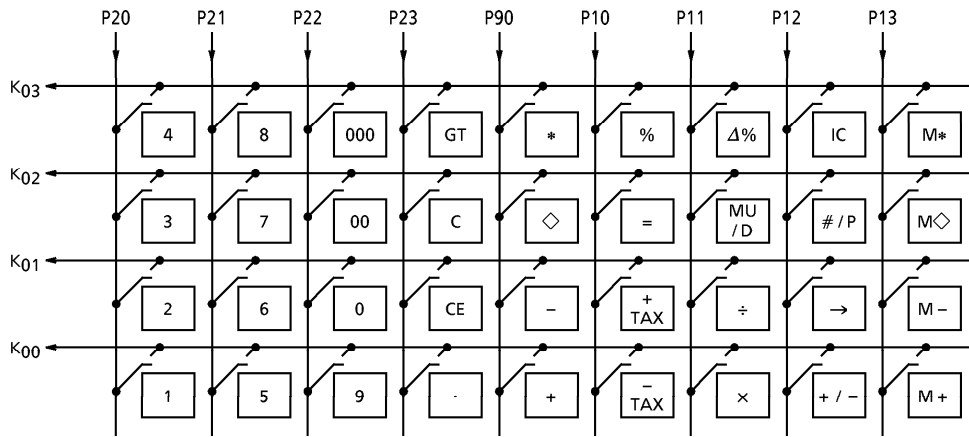
CONNECTION OF FL



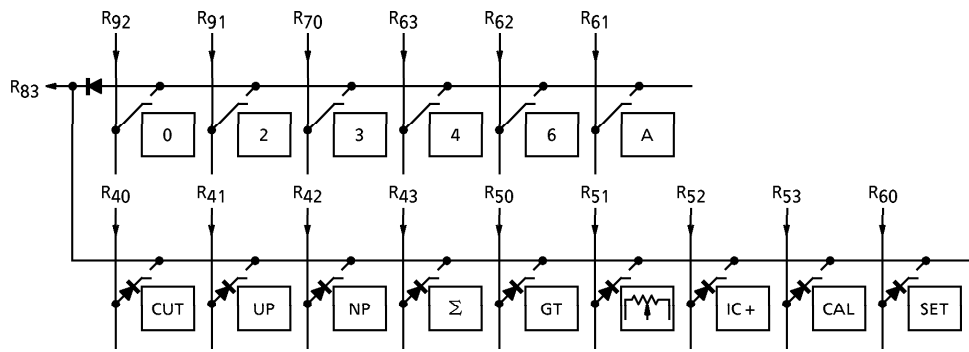
- (Note 1) R92 digit (P10, P13, P20) of "E" Data.
- (Note 2) R92 digit (P22) of "-" Data.
- (Note 3) R92 digit (P23) of "M" Data.
- (Note 4) R92 digit (P21) of "GT" Data.

TC83220-0028-05


KEY CONNECTION



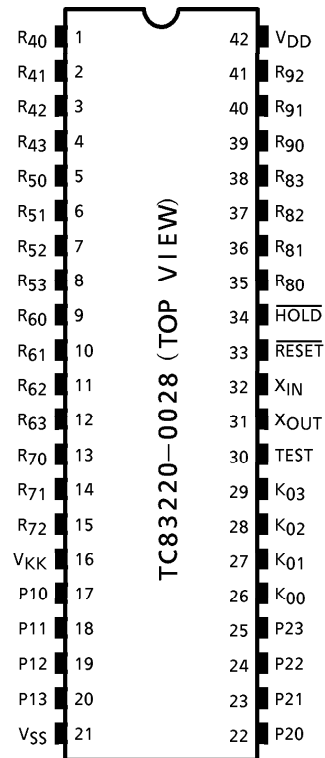
Touch Key



Lock Key

(Note)  : Feed

**PIN ASSIGNMENT (TOP VIEW)**



OPERATION EXAMPLE

KEY		PRINT	PRINT COLOR	DISPLAY
TAB 4/5 IC Σ GT MOD	TOUCH			
F 4/5 IC+ OFF OFF CAL	POWER ON	<PF>		
			C	0.
	C	0.	0	0.
	00.78.09.04.9 955 # / P	#0.78.09.04.9955.....		0.7809049955
	.123456789099 12 + ◇	0.1234567890991 + 001..... 0.1234567890991 ◇		0.1234567890991 0.1234567890991
	9999999999999 9 - ◇	99,999,999,999,999. - 001..... -99,999,999,999,999. ◇	R R	- 99,999,999,999,999. - 99,999,999,999,999.
	1111111111111 1 M- M◇	11,111,111,111,111. M - 001..... -11,111,111,111,111. M ◇	R R	M 11,111,111,111,111. M - 11,111,111,111,111.
	1111111111111 1 M- M*	11,111,111,111,111. M - 001..... -11,111,111,111,111. M * <PF>	R R	M 11,111,111,111,111. - 11,111,111,111,111.
3	1.23456 ÷ 789 =	1.23456 ÷ 789. = 0.002 *		1.23456 0.002
F	667.788 + # / P	667.788 + 667.788 ◇		667.788 667.788
	9999999999999 9 + 0.999999999999 99 +	99,999,999,999,999. + 0.9999999999999 +		99,999,999,999,999. 99,999,999,999,999.
	1000000000000 0 + 1 - .000000000000 1 -	10,000,000,000,000. + 1. - 0.0000000000001 -	R R	10,000,000,000,000. 9,999,999,999,999. 9,999,999,999,999.
	123456789.8 + 1.2345678 +	123,456,789.8 + 1.2345678 +		123,456,789.8 123,456,791.03456

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



KEY		PRINT	PRINT COLOR	DISPLAY
TAB 4/5 IC $\Sigma$ GT MOD	TOUCH			
F 4/5 IC+ OFF OFF CAL	999999999999 9 x 777777777777 7 = ..... 7777777777776. <PF>	99,999,999,999,999. x  77,777,777,777,777. = ..... 7777777777776. * <PF>		99,999,999,999,999.     ←77,777,777,777,776.
	9999999900000 0 + 1234567.8 +  CE 789012.3 +	99,999,999,000,000. + 1,234,567.8 + ..... 1.0000000023456 * <PF>  789,012.3 +		99,999,999,000,000.    ← 1.0000000023456 0. 99,999,999,789,012.
	9999999999999 9 + 1 M+ 1 +  CE 9999999999999 9 +	99,999,999,999,999. + 1. M + 1. + ..... 1.0000000000000 * <PF>  99,999,999,999,999. + ..... 1.9999999999999 * <PF>		99,999,999,999,999. M 1.   M← 1.0000000000000 M 0.  M← 1.9999999999999
	3 x ÷ 2 ÷ x 4 ÷ -	3. x 3. ÷ 2. ÷ 2. x 4. ÷ 9. -		3. 9. 4.5 2.25 9. -9.
	11 + 345 - M-	11. + 345. - -334. M -		11. -334. -334.

KEY					PRINT	PRINT COLOR	DISPLAY	
TAB	4/5	IC	Σ	GT MOD				TOUCH
F	4/5	IC+	ON	OFF	CAL	2 x 3 =	2. x 3. = 6. +  <PF>	2.   6.
			OFF			2 MU / D 3 =	2. G M 3. % 0.061855670103 Δ * 2.061855670103 *  <PF>	2.   2.061855670103
						2 x 3 %  +	2. x 3. % 0.06 *  <PF> 2.06 + %  <PF>	2.   0.06  2.06
						2 Δ% 3 =	2. Δ 3. = 1. Δ * 50. Δ %  <PF>	2.   50.
						111111111111 1 +/- # / P	#1111111111111111.....	R - 11,111,111,111,111. - 11,111,111,111,111.
						2 x 3 %  -	2. x 3. % 0.06 *  <PF> 1.94 - %  <PF>	2.   0.06  1.94
			SET			3	0. %  <PF>  3. %  <PF>  1,560. 46.8 Δ 1,606.8 *	0. 3.  0. 1,560.
			CAL			1560 +TAX	<PF>      <PF>	1,606.8

KEY						PRINT	PRINT COLOR	DISPLAY
TAB	4/5	IC	Σ	GT MOD	TOUCH			
F	4/5	IC+	OFF	OFF	CAL	5 × =  +TAX	5. × 5. = 25. *  <PF>  25. ◇ 0.75 Δ 25.75 *	5.       25.75
	OFF			GT	2 + 3 + * (GT MODE)  GT GT	2. + 3. + 5. G +  5. G ◇ 5. G *	<PF>    <PF>	2. 5.  5. 5. 5.
		IC+		OFF	.123456789099 1 + *	0.1234567890991 + 001..... 0.1234567890991 *	<PF>	0.1234567890991  0.1234567890991
					2 - 5 - IC	2. - 5. - 2.	R R	-2. -7. 2.

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	—	

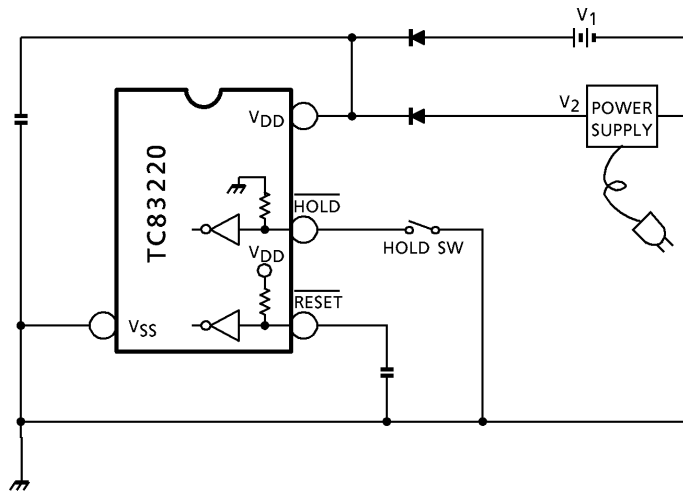
(Note) In case of the external clock operation.

## ELECTRICAL CHARACTERISTICS

DC 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 ( $\overline{\text{RESET}}$ , $\overline{\text{HOLD}}$ , $\overline{\text{TEST}}$ )	$I_{IN}$	—	$V_{DD} = 5.5\text{ V}$ , $V_{IN} = 5.5/0\text{ V}$	—	—	$\pm 50$	$\mu\text{A}$
Output Leak Current (Source open drain)	$I_{LO}$	—	$V_{DD} = 5.5\text{ V}$ , $V_{OUT} = -32\text{ V}$	—	—	-10	$\mu\text{A}$
Output High Voltage (P1~P2, R4~Rg)	$V_{OH}$	—	$V_{DD} = 4.5\text{ V}$ , $I_{OH} = -6\text{ mA}$	2.4	—	—	V
Input Pull Down Resistor (K0, R7~Rg)	$R_{IN}$	—	$V_{DD} = 5.5\text{ V}$ , $V_{KK} = -30\text{ V}$	—	100	—	k $\Omega$
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	$\mu\text{A}$
Oscillating Frequency	$F_\phi$	—	$V_{DD} = 5.0\text{ V}$ , $C = 100\text{ pF}$ $R = 1\text{ k}\Omega \pm 2\%$	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 up in the LSI.)  
 ( $\overline{\text{RESET}}$  pin is pulled up to  $V_{DD}$ .)

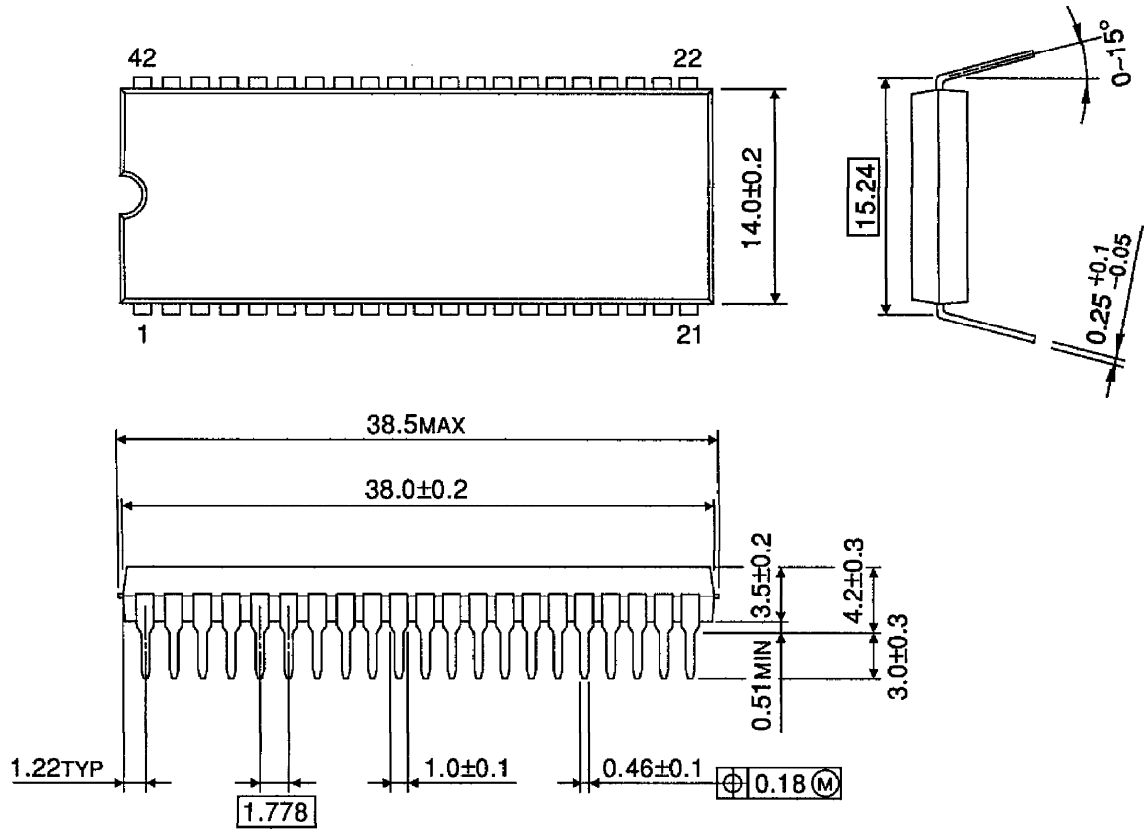
- ① Setting HOLD SW to OFF, the calculator operates normally under  $V_2$  power supply.
- ② Setting HOLD SW to ON, the calculator will be in HOLD mode with TAX RATE that has already held, under  $V_2$  power supply.
- ③ TAX RATE that has already held is still held under  $V_1$  power supply, even if there is no  $V_2$  power supply (no DC power supply).

<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.)