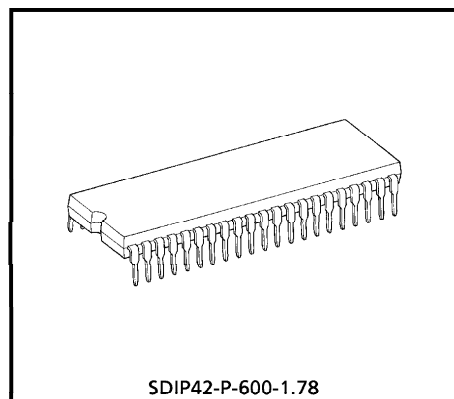


TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

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 × 4-bit RAM.



Weight : 4.12 g (Typ.)

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

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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} , $\boxed{+/-}$, $\boxed{\#/P}$, $\boxed{\text{Feed}}$, $\boxed{+}$, $\boxed{-}$, $\boxed{\diamond}$, $\boxed{*}$, $\boxed{\times}$, $\boxed{\div}$, $\boxed{=}$, $\boxed{\%}$, $\boxed{\text{MU/D}}$, $\boxed{\text{M+}}$, $\boxed{\text{M-}}$, $\boxed{\text{IC}}$, $\boxed{\text{M*}}$, $\boxed{\Delta\%}$, $\boxed{\rightarrow}$, $\boxed{\text{GT}}$, $\boxed{+TAX}$, $\boxed{-TAX}$, $\boxed{\text{M}\diamond}$
- 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 : $\boxed{+TAX}$ key is calculation for included tax.
 (Refer to page 5.) $\boxed{-TAX}$ 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 $\boxed{+TAX}$ 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.

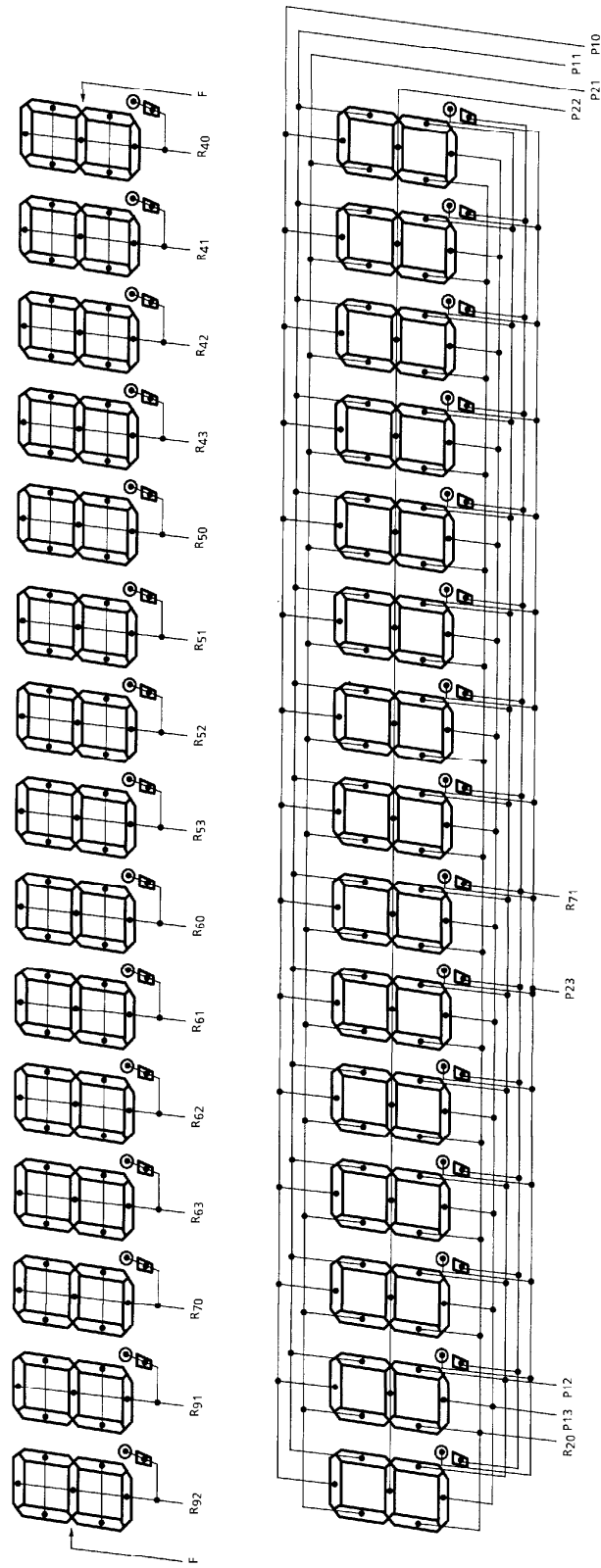
Protection

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

Key read in : 15ms

Key off : 40ms

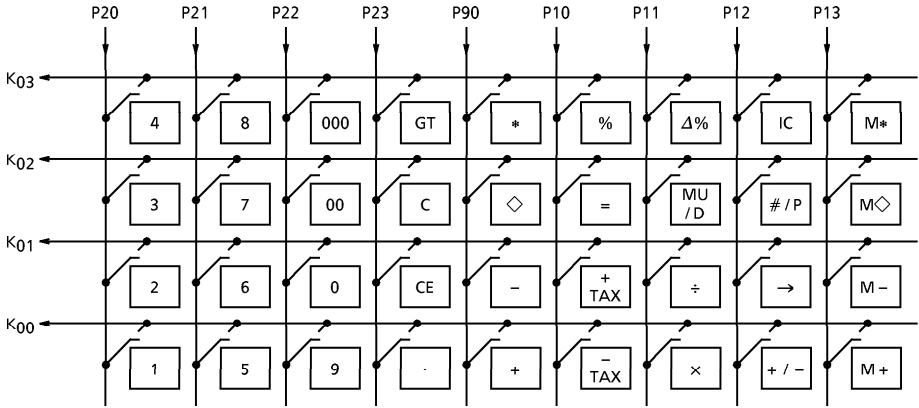
CONNECTION OF FL



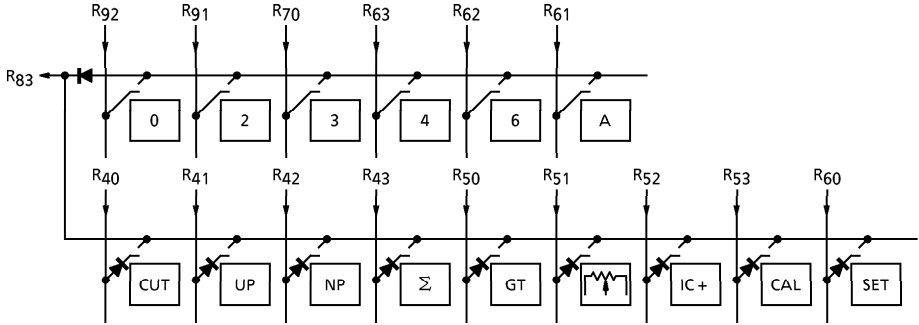
- (Note 1) R92 digit (P10, P13, P20) of "E" Data.
- (Note 2) R92 digit (P22) of "-" Data.
- (Note 3) R92 digit (P23) of "M" Data.
- (Note 4) R92 digit (P21) of "GT" Data.

TC83220-0028-05

KEY CONNECTION



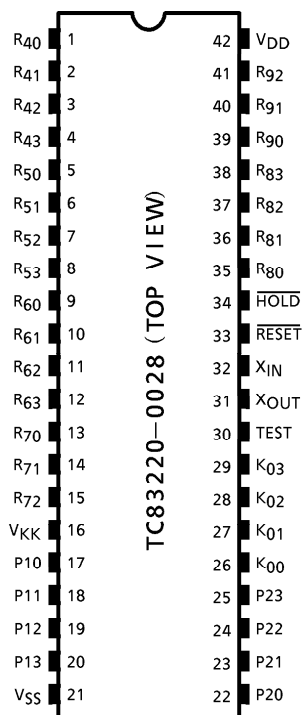
Touch Key



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.
		<PF>		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
	999999999999 9 - ◇	99,999,999,999,999. - 001..... -99,999,999,999,999. ◇	R R	- 99,999,999,999,999. - 99,999,999,999,999.
	111111111111 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.
	111111111111 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
		<PF>		0.002
F	667.788 + # / P	667.788 + 667.788 ◇		667.788 667.788
	999999999999 9 + 0.9999999999 99 +	99,999,999,999,999. + 0.999999999999 +		99,999,999,999,999. 99,999,999,999,999.
	100000000000 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 Σ GT MOD	TOUCH			
F 4/5 IC+ OFF OFF CAL	999999999999 9 × 777777777777 7 =	99,999,999,999,999. × 77,777,777,777,777. = 77777777777776. * <PF>		99,999,999,999,999. ←77,777,777,777,776.
	999999990000 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.
	999999999999 9 + 1 M+ 1 + CE 999999999999 9 +	99,999,999,999,999. + 1. M + 1. + 1.0000000000000 * <PF> 99,999,999,999,999. + 1.999999999999 * <PF>	M M← M	99,999,999,999,999. 1. 1.0000000000000 0. 1.999999999999
	3 × ÷ 2 ÷ × 4 ÷ - -	3. × 3. ÷ 2. ÷ 2. × 4. ÷ 9. - R		3. 9. 4.5 2.25 9. -9.
	11 + 345 - M-	11. + 345. - -334. M -	R M	11. -334. -334.

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

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

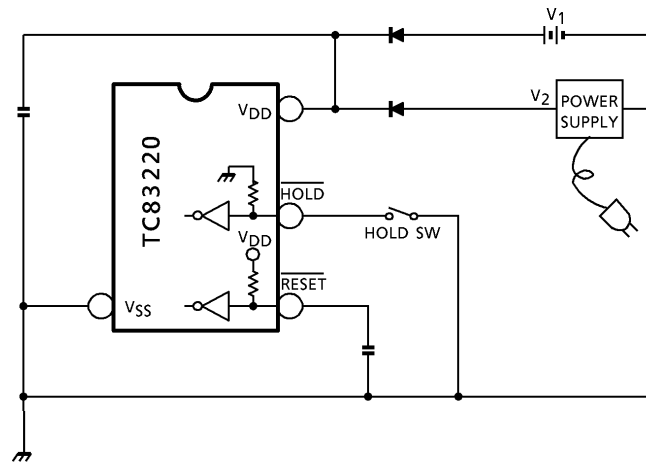
(Note) In case of the external clock operation.

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

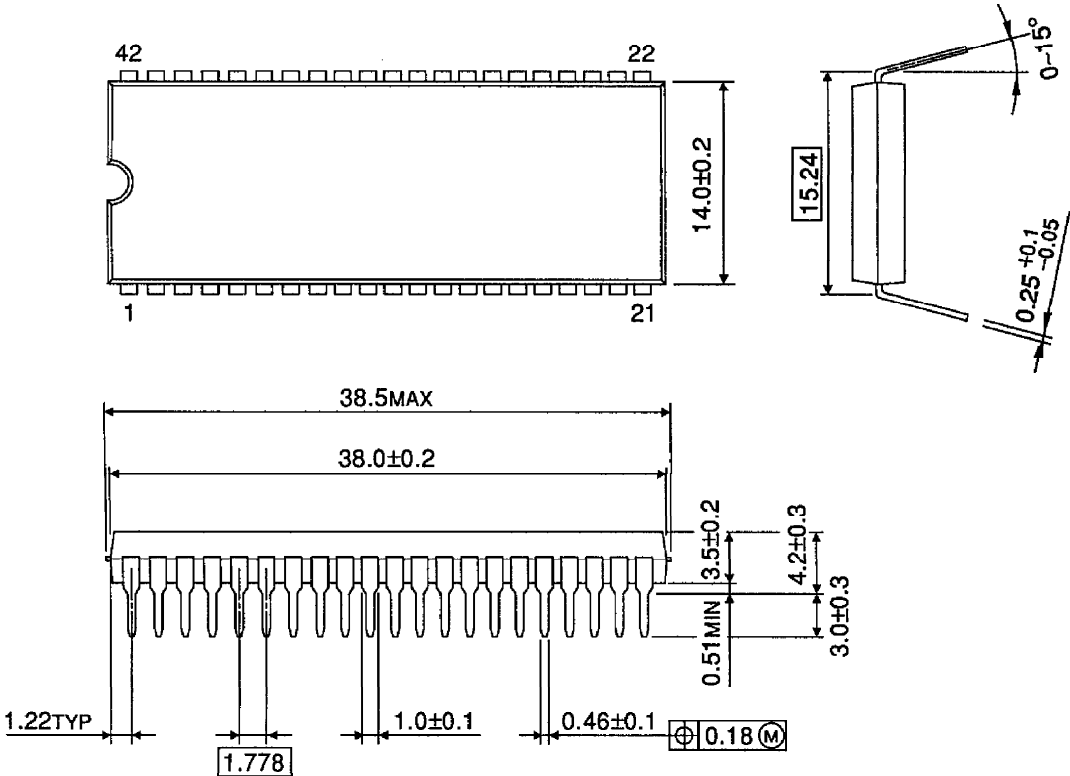
- ① Setting HOLD SW to OFF, the calculator operates normally under V_2 power supply.
- ② Setting HOLD SW to ON, the calculator will be in HOLD mode with TAX RATE that has already held, under V_2 power supply.
- ③ TAX RATE that has already held is still held under V_1 power supply, even if there is no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