

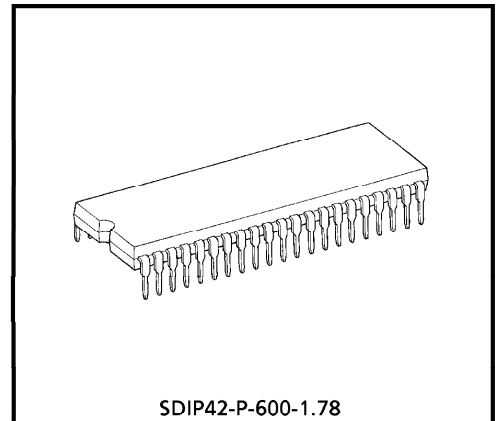
TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

**TC83220-0026****TC83220-0026 SINGLE-CHIP CMOS LSI FOR FL (FLUORESCENT)  
CALCULATOR**

The TOSHIBA printing /display calculator circuit TC83220-0026 is 10-digit calculator on single CMOS LSI chip.

TC83220-0026 can drive the printing machine (M-31 ; 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.



SDIP42-P-600-1.78

Weight : 4.12 g (Typ.)

**FEATURES**

## Operational Features

- Print : 11 digits of data.  
(including decimal point.) 1 digit of minus sign, operational symbol.  
1-color printing (black).
- Display : 10 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 : 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

980910EBA2

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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 :  $\boxed{0} \sim \boxed{9}$ ,  $\boxed{\cdot}$ ,  $\boxed{00}$ ,  $\boxed{000}$ ,  $\boxed{C}$ ,  $\boxed{CE}$ ,  $\boxed{C/CE}$ ,  $\boxed{+/-}$ ,  $\boxed{\#/P}$ ,  $\boxed{\text{Feed}}$   
 $\boxed{+}$ ,  $\boxed{-}$ ,  $\boxed{\diamond}$ ,  $\boxed{*}$ ,  $\boxed{\times}$ ,  $\boxed{\div}$ ,  $\boxed{=}$ ,  $\boxed{\%}$ ,  $\boxed{\text{MU/D}}$ ,  $\boxed{\text{M+}}$ ,  $\boxed{\text{M-}}$ ,  $\boxed{\text{IC}}$ ,  
 $\boxed{\text{M*}}$ ,  $\boxed{\Delta\%}$ ,  $\boxed{\text{M}\diamond}$ ,  $\boxed{\rightarrow}$ ,  $\boxed{\text{GT}}$ ,  $\boxed{+\text{TAX}}$ ,  $\boxed{-\text{TAX}}$ ,  $\boxed{\text{M}\diamond}$ ,  $\boxed{\pm}$ ,  $\boxed{=}$
- 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.)
- Duty of display : Duty =  $\frac{1}{16}$
- 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.  
 $\boxed{\text{SET}/\overline{\text{CAL}}}$  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  $\boxed{+\text{TAX}}$  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

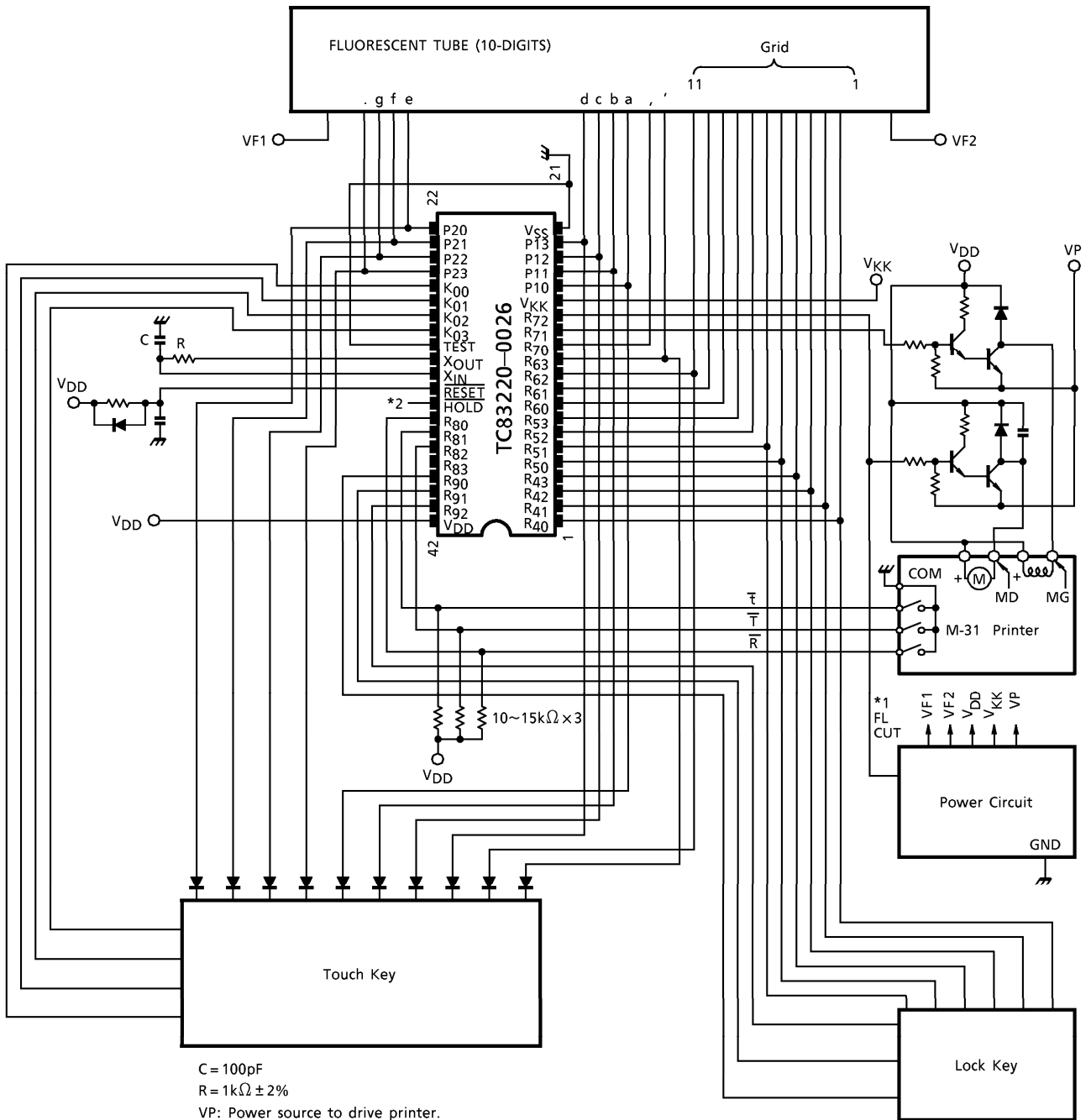
**Protection**

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

Key read in : 17ms

Key off : 41ms

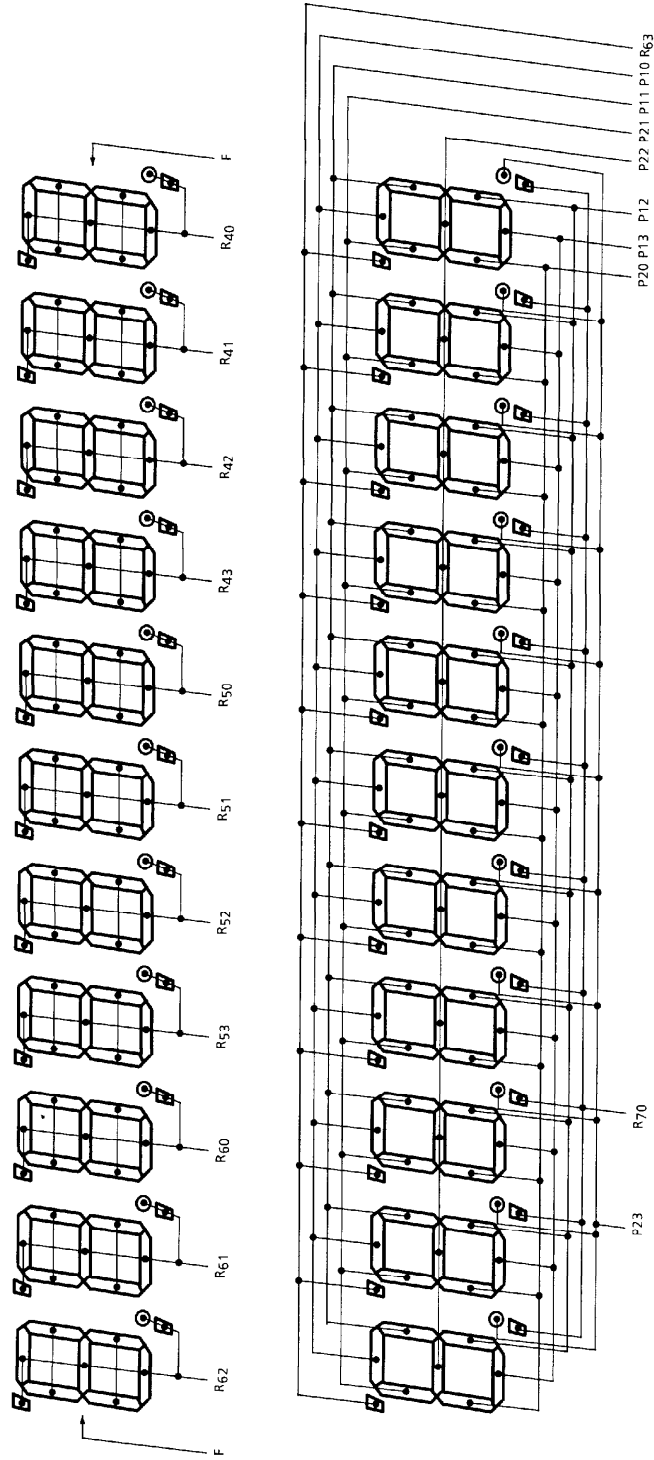
SYSTEM DIAGRAM



C = 100pF  
 R = 1kΩ ± 2%  
 VP: Power source to drive printer.  
 V<sub>KK</sub>: Power source for display.

- \*1 FL CUT (R72)  
 (VF1, VF2 Cut at printing)
- \*2 Connection to HOLD pin is shown in the following page 15.

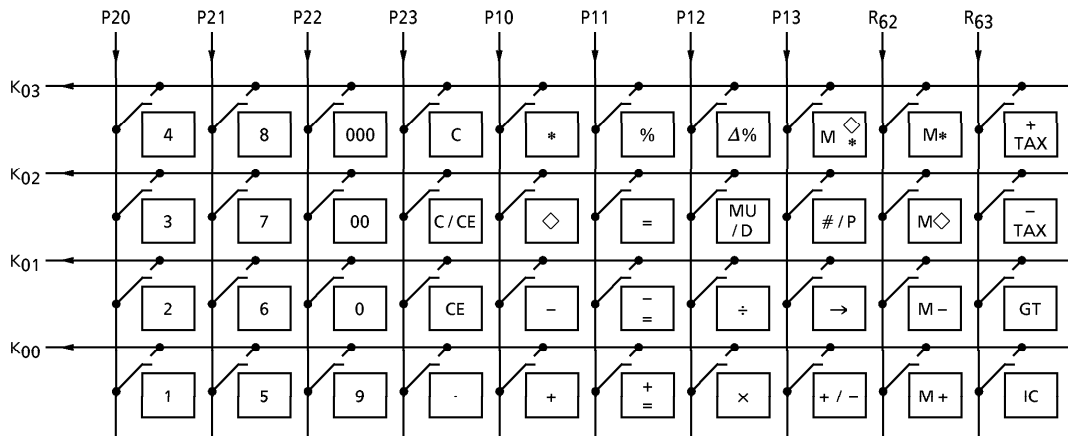
CONNECTION OF FL



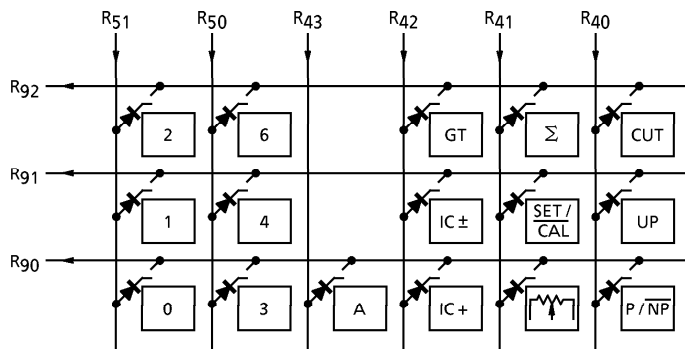
- (Note 1) R62 digit (P20) of "E" Data
- (Note 2) R62 digit (P22) of "—" Data
- (Note 3) R62 digit (P23) of "M" Data
- (Note 4) R62 digit (P21) of "GT" Data

TC83220-0026-5

KEY CONNECTION



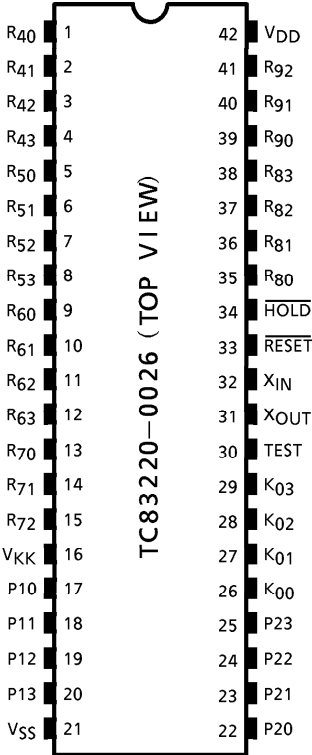
Touch Key



Lock Key

(Note) : Feed

PIN ASSIGNMENT (TOP VIEW)



OPERATION EXAMPLE

		KEY						PRINT	DISPLAY
TAB	4/5	IC	$\Sigma$	GT	MOD	TOUCH			
F	4/5	OFF	OFF	OFF	CAL	POWER ON		<PF>	
								C	
								<PF>	0.
						1+		1. +	1.
						2-		2. -	-1.
						◇		-1. ◇	-1.
						*		-1. *	
								<PF>	-1.
						IC		0.	0.
		IC+				1+		1. +	1.
						2-		2. -	-1.
						◇		002.....	
						*		-1. ◇	-1.
								002.....	
								-1. *	
								<PF>	-1.
						IC		0.	0.
						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. %	
								66.6666666 *	
								<PF>	66.6666666
						2 MU / D		2. M	2.
						3=		3. %	
								=	
								0.06185567 *	
								2.06185567 *	
								<PF>	2.06185567
						2Δ%		2. -	2.

(Note) <PF> ... Paper feed



KEY				TOUCH	PRINT		DISPLAY
TAB	4/5	IC	$\Sigma$ GT MOD				
				3=	3. %		
					=		
					1. *		
					50. *		
					<PF>		50.
F	4/5	OFF	$\Sigma$ OFF CAL	3x	3. x		3.
				4÷	4. ÷		12.
				=	4. =		
					3. +		
					<PF>		3.
				5x	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	2+	2. +		2.
				3+	3. +		5.
				*	T		
					5. +		
					<PF>		5.
				3-	3. -		-3.
				4-	4. -		-7.

KEY					PRINT		DISPLAY
TAB	4/5	IC	$\Sigma$	GT MOD	TOUCH		
					5-	5. -	-12.
					*	T	
						-12 +	
					GT	<PF>	-12.
						T	
					GT	-7. $\diamond$	-7.
						T	
						-7. *	
					M+	<PF>	-7.
			OFF			M	
F	4/5	OFF	$\Sigma$	OFF	CAL	-7. +	M -7.
					M $\diamond$	M	
						-7. $\diamond$	M -7.
					M*	M	
						-7. *	
					# / P	<PF>	-7.
					2 # / P	-7. $\diamond$	-7.
					# / P	#2.....	2.
					0 $\div$	2. $\diamond$	2.
					=	0. $\div$	0.
						0. =	
						.....	
						0. *	
					C	<PF>	E 0.
						0. C	
						<PF>	0.
CUT		OFF	SET			0. %	
					3	<PF>	0.
			CAL				3.
					C	3. %	
						<PF>	0.
			SET			0. C	
						<PF>	0.
			CAL			3. %	
						<PF>	3.
					1560		0.
					+TAX	1560.	1,560.
						%	
						46.8 $\diamond$	
						1606.8 *	

KEY				PRINT		DISPLAY
TAB 4/5	IC	Σ	GT MOD	TOUCH		
					<PF>	1,606.8
				+TAX	1606.8 ◇	
					%	
					48.204 ◇	
					1655.004 *	
					<PF>	1,655.004
				1560		1,560.
				x	1560. x	1,560.
				78900		78,900.
				+TAX	78900. =	
					123084000. ◇	
					%	
					3692520. ◇	
					126776520. *	
					<PF>	126,776,520.
				=		126,776,520.
				5		5.
				x	5. x	5.
F	CUT	OFF	OFF OFF CAL	+TAX		5.
				=	5. =	
					25. *	
					<PF>	25.
				+TAX	25. ◇	
					%	
					0.75 ◇	
					25.75 *	
					<PF>	25.75
				=		25.75
				C	0. C	
					<PF>	0.
2				1560		1,560.
				+	1560.00 +	1,560.00
				1100		1,100.
				+	1100.00 +	2,660.00
				+TAX	2660.00 ◇	
					%	
					79.80 ◇	
					2739.80 *	
					<PF>	2,739.80
F				+TAX	2739.80 ◇	
					%	
					82.194 ◇	
					2821.994 *	
					<PF>	2,821.994

KEY						PRINT		DISPLAY
TAB	4/5	IC	Σ	GT	MOD	TOUCH		
						98000000		
						00		9,800,000,000.
						+TAX	9800000000.	
							%	
							294000000. ◇	
							.....	
							1,009400000 *	
							<PF>	E 1,009400000
						C	0. C	
							<PF>	0.
						1560		1,560.
						+/-		-1,560.
						+TAX	-1560.	
							%	
							-46.8 ◇	
							-1606.8 *	
							<PF>	-1,606.8
						1560		1,560.
						-TAX	1560.	
							%	
							-45,436894 ◇	
							1514.563106 *	
							<PF>	1,514.563106
F	CUT	OFF	OFF	OFF	CAL	-TAX	1514.563106 ◇	
							%	
							-44.11348855 ◇	
							1470.449618 *	
							<PF>	1,470.449618
						SET	3. %	
							<PF>	3.
						C		0.
						CAL	0. %	
							<PF>	0.
						SET	0. %	
							<PF>	0.
						1234		1,234.
						CAL	1234. %	
							<PF>	0.
						98000000		9,800,000,000.
						00		
						+TAX	9800000000.	
							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	—	

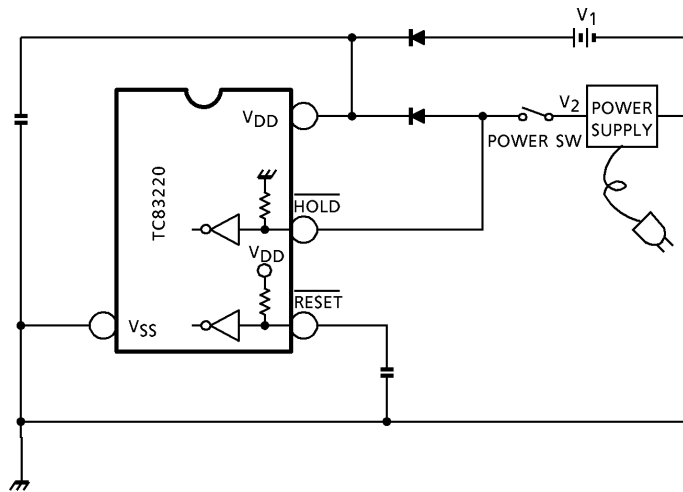
(Note) In case of the external clock operation.

## ELECTRICAL CHARACTERISTICS

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

CHARACTERISTICS	SYMBOL	TEST CIR-CUIT	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~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 $\Omega$
Pull Down Resistor (Source open drain)	$R_{KK}$	—		50	80	200	
Operating Supply Current	$I_{DD0}$	—	$V_{DD}$ ( $V_{DDH}$ ) $5.5\text{ V}$ , $f_c = 4\text{ MHz}$ , $V_{IN} = 5.3/0.2\text{ V}$	—	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<sub>1</sub> = 3V : battery supply

V<sub>2</sub> = 5V : DC supply

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

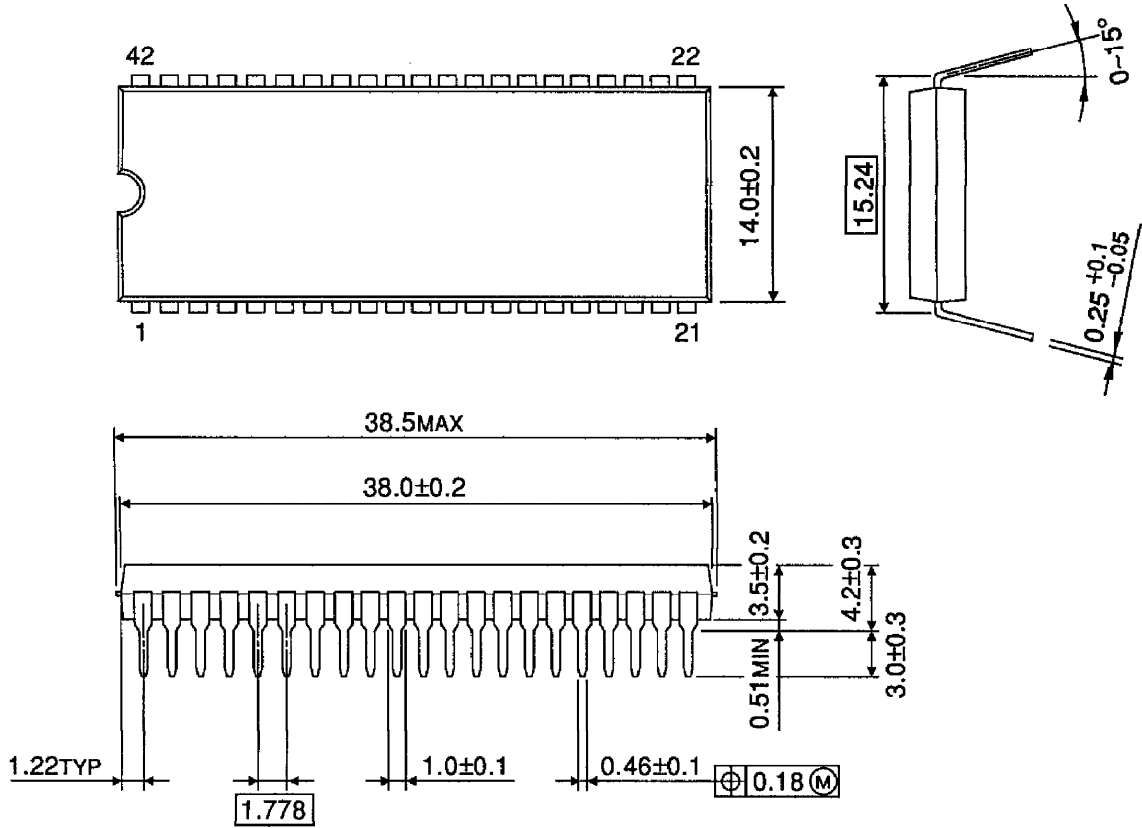
- ① Setting POWER SW to ON, V<sub>2</sub> is supplied to V<sub>DD</sub> pin, and also to  $\overline{\text{HOLD}}$  pin.  
Then calculator operates normally.
- ② Setting POWER SW from ON to OFF, V<sub>1</sub> is supplied to V<sub>DD</sub> pin and V<sub>SS</sub> is supplied to  $\overline{\text{HOLD}}$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

<NOTE>

V<sub>1</sub> (battery) should be supplied to the circuit after V<sub>2</sub> (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.)