

TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

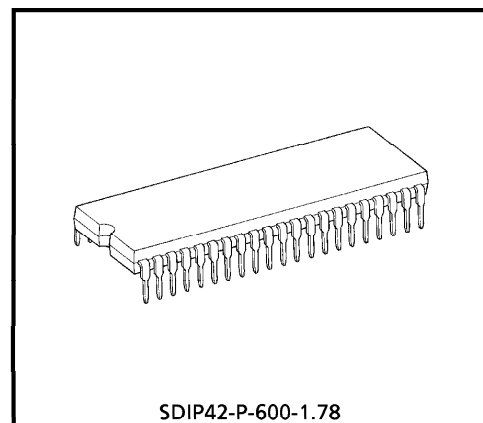
TC83220-0021**TC83220-0021 SINGLE-CHIP CMOS LSI FOR FL (FLUORESCENT)
CALCULATOR**

The TOSHIBA printing / display calculator circuit TC83220-0021 is 10- or 12-digit calculator on single-chip CMOS LSI. TC83220-0021 can drive the printing machine (M400A / M401A / M400E* ; 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.

* PRINT FONT NO : M400A ... 001-300
M401A ... 001-330
M400E ... 001-310

FEATURES**Operational Features**

- Print : 11 or 13 digits of data.
(including decimal point. 2 digits of operational symbol.)
3 digits of commas.
- Display : 10 or 12 digits of data. (including punctuation in each digit.)
1 digit of floating minus sign, memory load, error symbol.
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.



Weight : 4.12 g (Typ.)

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 : $\boxed{0} \sim \boxed{9}$, $\boxed{\cdot}$, $\boxed{00}$, $\boxed{000}$, $\boxed{C}$, $\boxed{CE}$, $\boxed{C/CE}$, $\boxed{+/-}$, $\boxed{\#/P}$, $\boxed{\text{Feed}}$,
 $\boxed{+}$, $\boxed{-}$, $\boxed{\diamond}$, $\boxed{*}$, $\boxed{\times}$, $\boxed{\div}$, $\boxed{=}$, $\boxed{\%}$, $\boxed{\text{MU/D}}$, $\boxed{M+}$, $\boxed{M-}$, $\boxed{M\diamond}$,
 $\boxed{M*}$, $\boxed{\Delta\%}$, $\boxed{M\diamond*}$, $\boxed{\rightarrow}$, $\boxed{GT}$, $\boxed{+TAX}$, $\boxed{-TAX}$
- Kinds of lock key : "NP" Printing mode selectable switch.
 "Σ" Summation mode selectable switch.
 "5/4" "CUT" "UP" Rounding switch.
 Fixed point mode selectable switch.
 "0", "1", "2", "3", "4", "6", "F", "A".
 "IC+" "IC±" Item counter mode selectable switch.
 "GT" Grand Total memory selectable switch.
 "SET", "CAL" Tax memory selectable switch.
- Duty of display : Duty = $\frac{1}{17.77}$
- Leading zero suppression
- Trailing zero suppression
- Tax calculation : $\boxed{+TAX}$ key is calculation for included tax.
 $\boxed{-TAX}$ key is calculation for excluded tax.
 $\boxed{SET}$ selects set mode for tax rate.
 $\boxed{CAL}$ selects normal calculation mode.
 Changing lock key from $\boxed{SET}$ to $\boxed{CAL}$ stores number of display to tax memory.
 Changing lock key from $\boxed{CAL}$ to $\boxed{SET}$ recalls tax rate to display from tax memory.
 Depression of $\boxed{+TAX}$ following data key at CAL mode performs the calculating included tax.
 Depression of $\boxed{-TAX}$ following data key at CAL 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.
- Dual in line package.

Protection

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

Key read in : 15 ms

Key off : 40 ms

Function Select

- i) "10/12" Selectable with auto power off mode

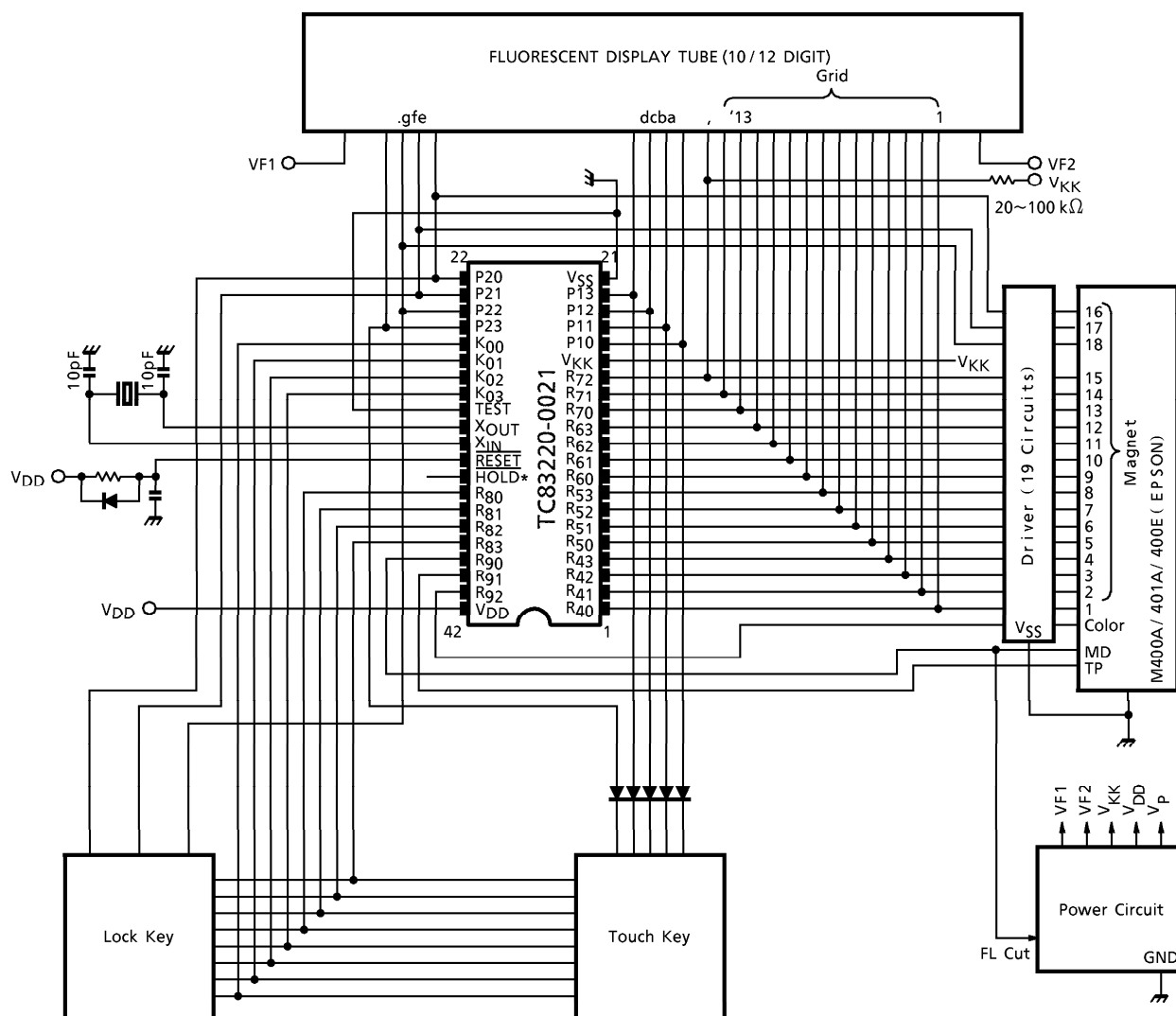
ON 10-digits calculated

OFF ... 12-digits calculated

Speed of Calculation (at 4 MHz clock)

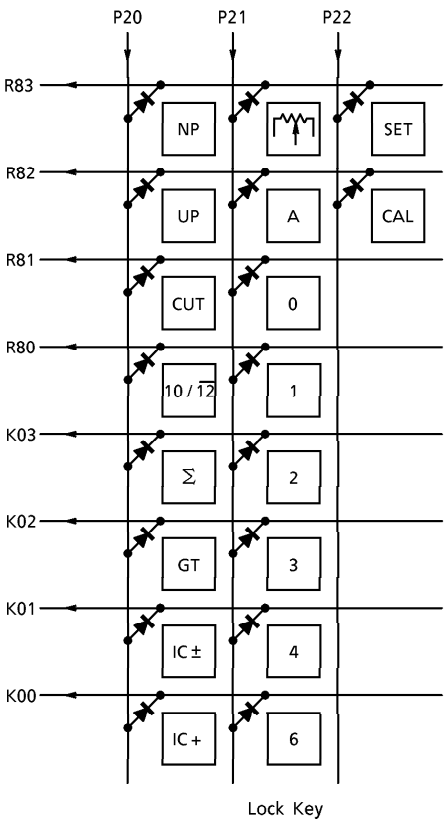
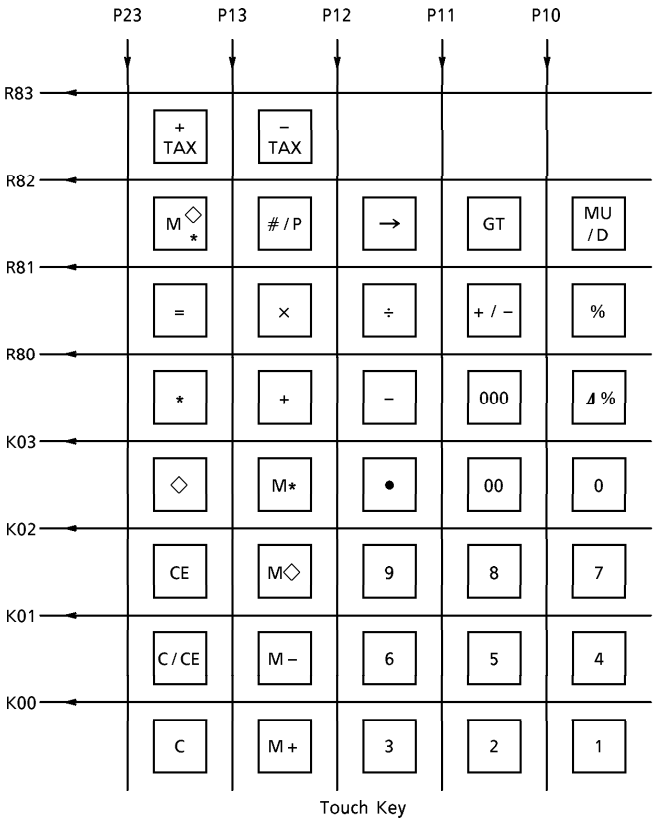
- i) Addition $1 + 1 + 31.2 \text{ ms}$
- ii) Multiplication $\times 9999999999 = 26.8 \text{ ms}$
- iii) Division $9999999999 \div 1 = 100.6 \text{ ms}$
- iv) Memory calculation $9999999999 \div 1 \text{ M} + 108.8 \text{ ms}$
- v) Percentage calculation $1 \times 9999999999\% 35.2 \text{ ms}$

SYSTEM DIAGRAM

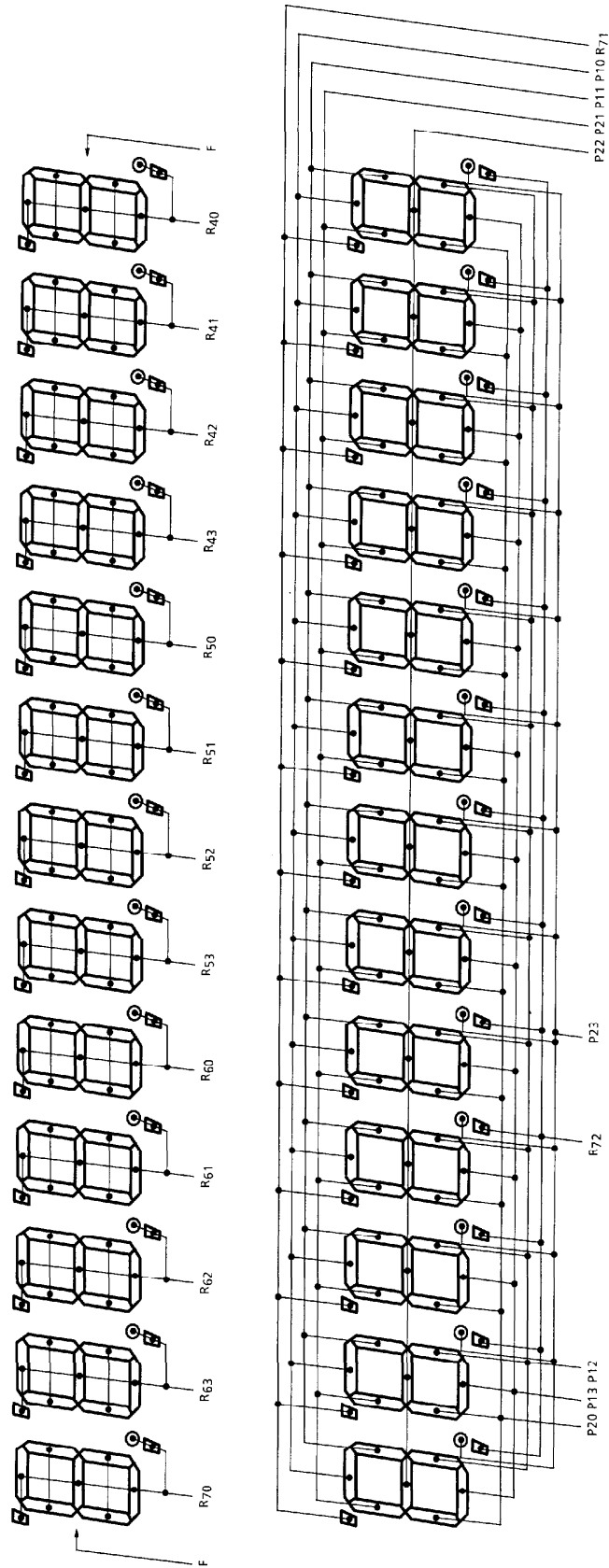


* Connection to HOLD pin is shown in the following page.

KEY CONNECTION

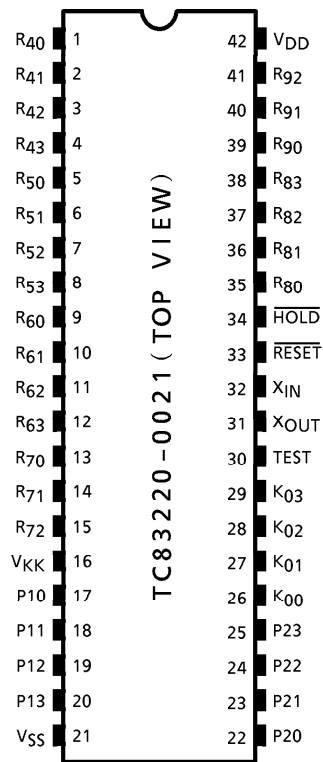


CONNECTION OF FL



- (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.

PIN ASSIGNMENT (TOP VIEW)



OPERATION EXAMPLE

KEY		PRINT		DISPLAY
TAB 4/5 IC 10/12 Σ GT MOD	TOUCH			
F 4/5 OFF 10 OFF OFF CAL	POWER ON			
		<PF>		
		C		
		<PF>		0.
	1 +	1. +		1.
	2 -	2. -	R	-1.
	◇	1. - ◇	R	-1.
	*	1. - *	R	
		<PF>		-1.
IC +	1 +	1. +		1.
	2 -	2. -	R	-1.
	◇	1. - ◇	R	-1.
	*	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 Δ *		
		2.06185567 *		
		<PF>		2.06185567
	2Δ%	2. Δ		2.
	3 =	3. =		
		1. Δ *		
		50. Δ %		50.
		<PF>		

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

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

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

KEY		PRINT		DISPLAY
TAB 4/5 IC 10/12 ∑ GT MOD	TOUCH			
		<PF>		126,776,520.
	=			126,776,520.
	5			5.
	×	5.	×	5.
	+ TAX			5.
	=	5.	=	
		25.	*	
		<PF>		25.
F CUT OFF 12 OFF OFF CAL	+ TAX	25.	◇	
		0.75 Δ		
		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 Δ		
		2,739.80	*	
		<PF>		2,739.80
F	+ TAX	2,739.80	◇	
		82.194 Δ		
		2,821.994	*	
		<PF>		2,821.994
	980000000000			980,000,000,000.
	+ TAX	980,000,000,000.		
		29,400,000,000. Δ		
		ERROR		
		1.00940000000	*	
		<PF>		E 1.00940000000
	C	0.	C	
		<PF>		0.
	1560			1560.
	+ / -			- 1,560.
	+ TAX	1,560.	- R	
		46.8 -Δ	R	
		1,606.8 - *	R	
		<PF>		- 1,606.8
	1560			1,560.
	- TAX	1,560.		

KEY		PRINT		DISPLAY
TAB 4/5 IC 10/12 ∑ GT MOD	TOUCH			
F CUT OFF 12 OFF OFF CAL		45,43689321 ^{-Δ}	R	
		1,514.56310679 *		1,514.56310679
		<PF>		
	- TAX	1,514.56310679 ◇		
		- 44.11348855 ^{-Δ}	R	
		1,470.44961824 *		1,470.44961824
		<PF>		
SET		3. %		
		<PF>		3.
	C			0.
CAL		0. %		
		<PF>		0.
SET		0. %		
		<PF>		0.
	1234			1,234.
CAL		1,234. %		
		<PF>		0.
	98000000000000			980,000,000,000.
	+ TAX	980,000,000,000.		
		ERROR		
		0. *		
		<PF>		E 0.
	C	0. C		
		<PF>		0.

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

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

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

CHARACTERISTIC	SYMBOL	TEST CIRCUIT	CONDITION	MIN	MAX	UNIT
Operating Temperature	T_{opr}	—	—	0	40	$^\circ\text{C}$
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}	—	$V_{DD} \geq 4.5\text{ V}$	$V_{DD} \times 0.7$	V_{DD}	V
Input High Voltage (Schmitt circuit input)	V_{IH2}	—		$V_{DD} \times 0.75$	V_{DD}	
Input High Voltage	V_{IH3}	—	$V_{DD} < 4.5\text{ V}$	$V_{DD} \times 0.9$	V_{DD}	
Input Low Voltage (Except Schmitt circuit input)	V_{IL1}	—	$V_{DD} \geq 4.5\text{ V}$	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}	—	$V_{DD} < 4.5\text{ V}$	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 1)	T_{WCH}	—	$V_{IN} = V_{IH}$	80	—	ns
Clock Low Pulse Width (Note 1)	T_{WCL}	—	$V_{IN} = V_{IL}$	80	—	

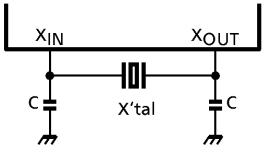
(Note 1) : In case of the external clock operation.

ELECTRICAL CHARACTERISTICS

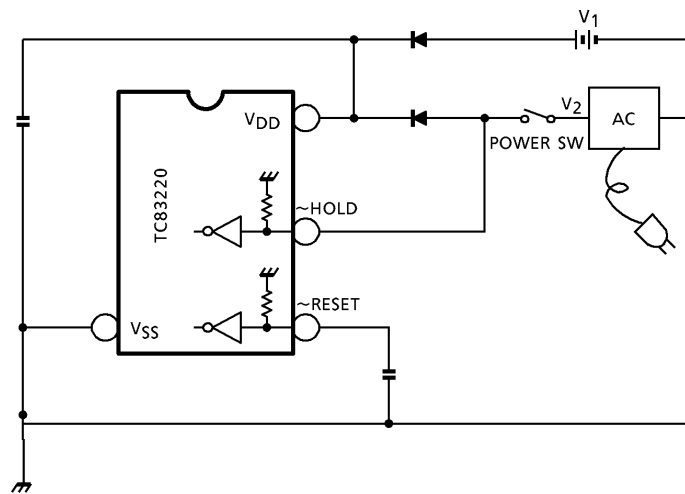
D.C. CHARACTERISTICS ($V_{SS} = 0\text{ V}$, $V_{DD} \pm 10\%$, $T_{opr} = 0\sim 40^\circ\text{C}$)

PARAMETER	SYMBOL	TEST CIR- CUIT	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~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	$I_{DD\ 0}$	—	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)	$I_{KK\ 1}$	—	$V_{KK} = -30\text{ V}$, $f_c = 4\text{ MHz}$	—	0.6	0.9	mA
Supply Current (Shown full digits)	$I_{KK\ 2}$	—		—	3.5	6	
Holding Supply Current	$I_{DD\ H}$	—	$V_{DD} = 5.5\text{ V}$	—	0.5	10	μA

OSCILLATION CHARACTERISTICS ($T_{opr} = 0\sim 40^\circ\text{C}$, $V_{DD} = 4.5\sim 6.0\text{ V}$)

CIRCUIT	CONDITION	MIN	TYP.	MAX	UNIT
	$C = 10\text{ pF}$ $X'tal$ (or Ceramic) $= 4\text{ MHz}$	—	4	—	MHz

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



(note)

$V_1 = 3\text{ V}$: battery supply

$V_2 = 5\text{ V}$: AC supply

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

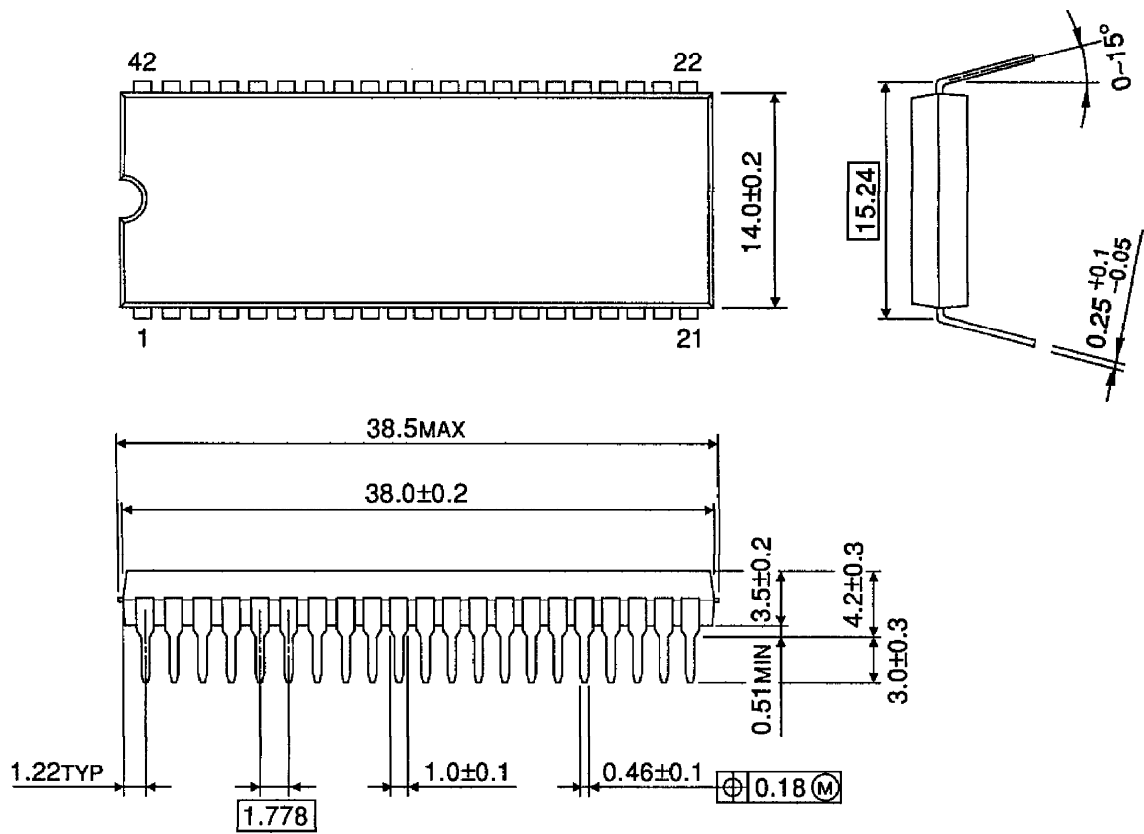
- ① Setting POWER SW to ON, V_2 is supplied to V_{DD} pin, and also to HOLD pin.
Then calculator operates normally.
- ② Setting POWER SW from ON to OFF, V_1 is supplied to V_{DD} pin and V_{SS} is supplied to HOLD pin.
Under this connection, TAX RATE is held.
- ③ Setting POWER SW to ON, V_2 is supplied to V_{DD} pin, and also to 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 (AC) supply, because of prevention from exhaustion of battery and abnormal operation.

PACKAGE DIMENSIONS
SDIP42-P-600-1.78

Unit : mm



Weight : 4.12 g (Typ.)