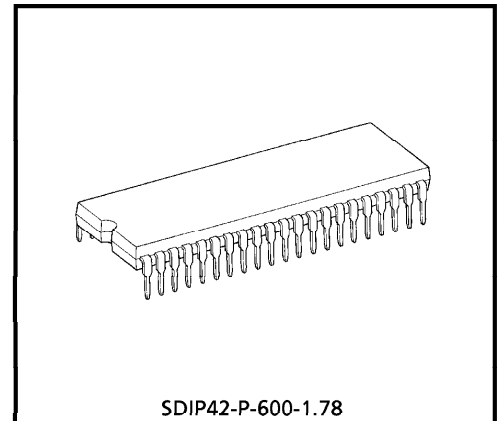


TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

**TC83220-0020****TC83220-0020 SINGLE-CHIP CMOS LSI FOR FL (FLUORESCENT)  
CALCULATOR**

The TOSHIBA printing /display calculator circuit TC83220-0020 is 10- or 12-digit calculator on single-chip CMOS LSI. TC83220-0020 can drive the printing machine (M2158II / M2156II ; 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 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.

980910EBA2

- TOSHIBA is continually working to improve the quality and the reliability of its products. Nevertheless, semiconductor devices in general can malfunction or fail due to their inherent electrical sensitivity and vulnerability to physical stress. It is the responsibility of the buyer, when utilizing TOSHIBA products, to observe standards of safety, and to avoid situations in which a malfunction or failure of a TOSHIBA product could cause loss of human life, bodily injury or damage to property. In developing your designs, please ensure that TOSHIBA products are used within specified operating ranges as set forth in the most recent products specifications. Also, please keep in mind the precautions and conditions set forth in the TOSHIBA Semiconductor Reliability Handbook.
- The products described in this document are subject to the foreign exchange and foreign trade laws.
- The information contained herein is presented only as a guide for the applications of our products. No responsibility is assumed by TOSHIBA CORPORATION for any infringements of intellectual property or other rights of the third parties which may result from its use. No license is granted by implication or otherwise under any intellectual property or other rights of TOSHIBA CORPORATION or others.
- The information contained herein is subject to change without notice.

- 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 :  $\boxed{0} \sim \boxed{9}$ ,  $\boxed{\cdot}$ ,  $\boxed{00}$ ,  $\boxed{000}$ ,  $\boxed{C}$ ,  $\boxed{CE}$ ,  $\boxed{C/CE}$ ,  $\boxed{+/-}$ ,  $\boxed{\#/P}$ ,  $\boxed{\text{Feed}}$ ,  $\boxed{+}$ ,  $\boxed{-}$ ,  $\boxed{\diamond}$ ,  $\boxed{*}$ ,  $\boxed{\times}$ ,  $\boxed{\div}$ ,  $\boxed{=}$ ,  $\boxed{\%}$ ,  $\boxed{\text{MU/D}}$ ,  $\boxed{\text{M+}}$ ,  $\boxed{\text{M-}}$ ,  $\boxed{\text{M}}$ ,  $\boxed{\text{M*}}$ ,  $\boxed{\Delta\%}$ ,  $\boxed{\text{M}\diamond}$ ,  $\boxed{\rightarrow}$ ,  $\boxed{\text{GT}}$ ,  $\boxed{+\text{TAX}}$ ,  $\boxed{-\text{TAX}}$
- 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 :  $\text{Duty} = \frac{1}{17.77}$
- Leading zero suppression
- Trailing zero suppression
- Tax calculation :  $\boxed{+\text{TAX}}$  key is calculation for included tax.  
 $\boxed{-\text{TAX}}$  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 CAL mode performs the calculating included tax.  
 Depression of  $\boxed{-\text{TAX}}$  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**

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

Key read in : 15 ms

Key off : 40 ms

**Function Select**

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

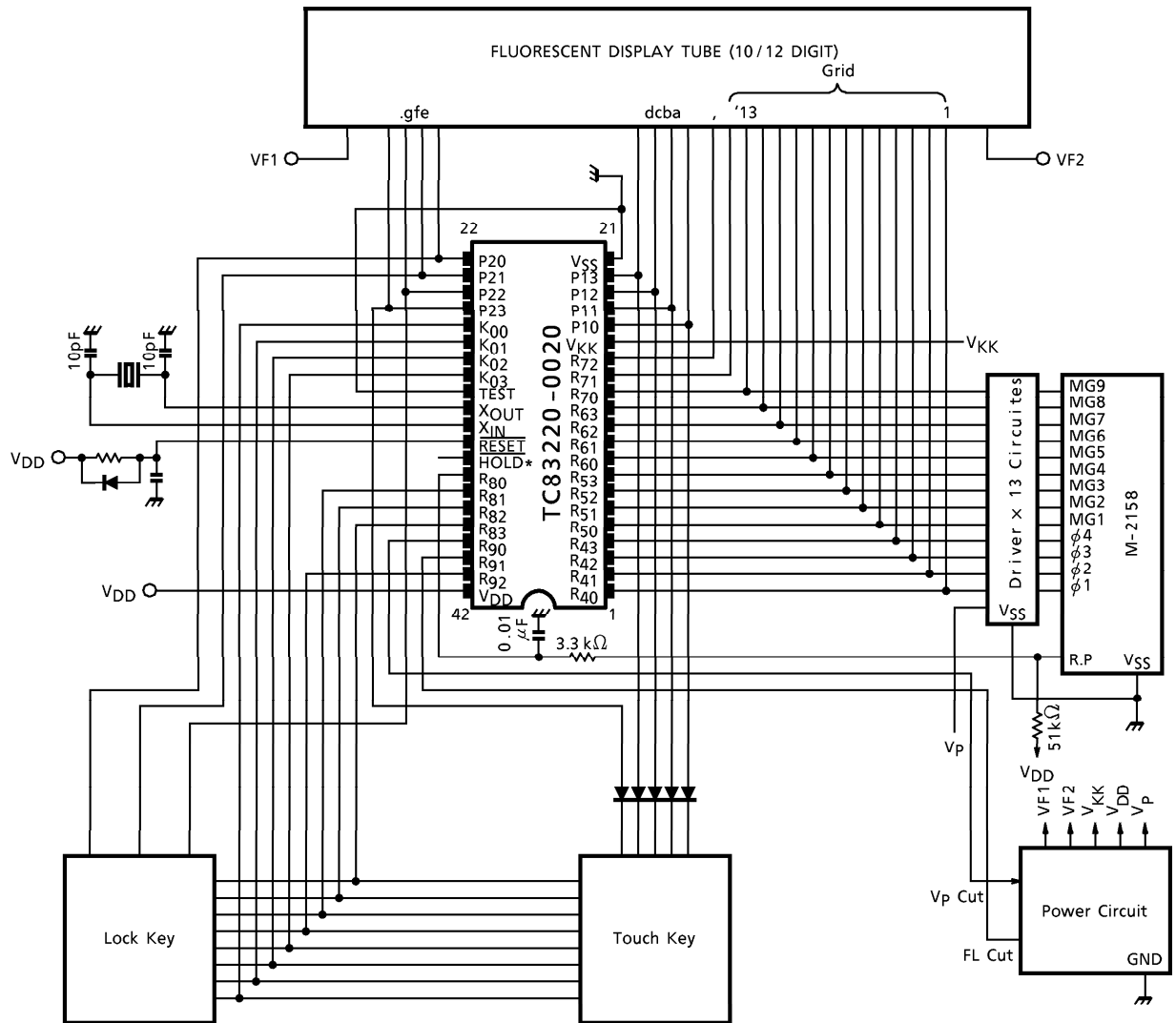
ON . . . . 10-digits calculated

OFF . . . 12-digits calculated

**Speed of Calculation (at 4 MHz clock)**

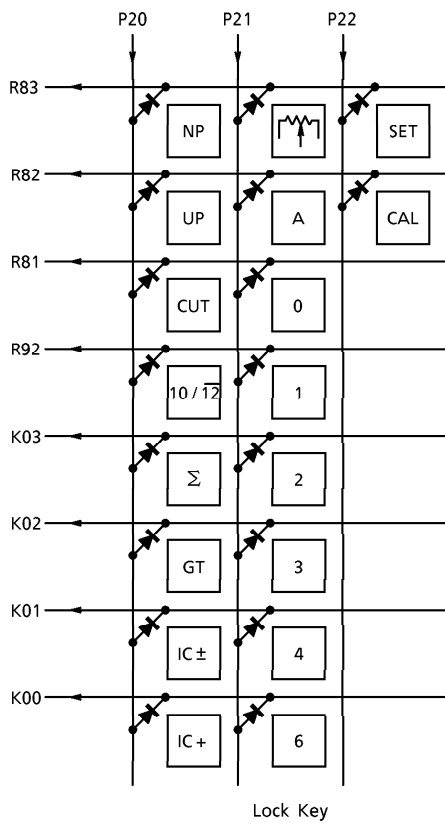
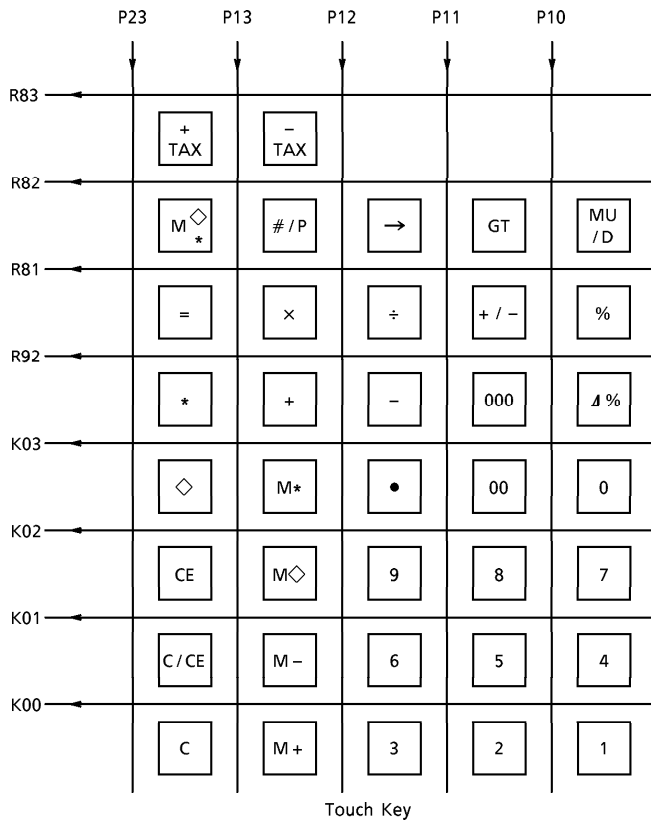
- Addition  $1 + 1 + 31.2 \text{ ms}$
- Multiplication  $\times 9999999999 = 26.8 \text{ ms}$
- Division  $9999999999 \div 1 = 100.6 \text{ ms}$
- Memory calculation  $9999999999 \div 1 \text{ M} + 108.8 \text{ ms}$
- Percentage calculation  $1 \times 9999999999\% 35.2 \text{ ms}$

SYSTEM DIAGRAM

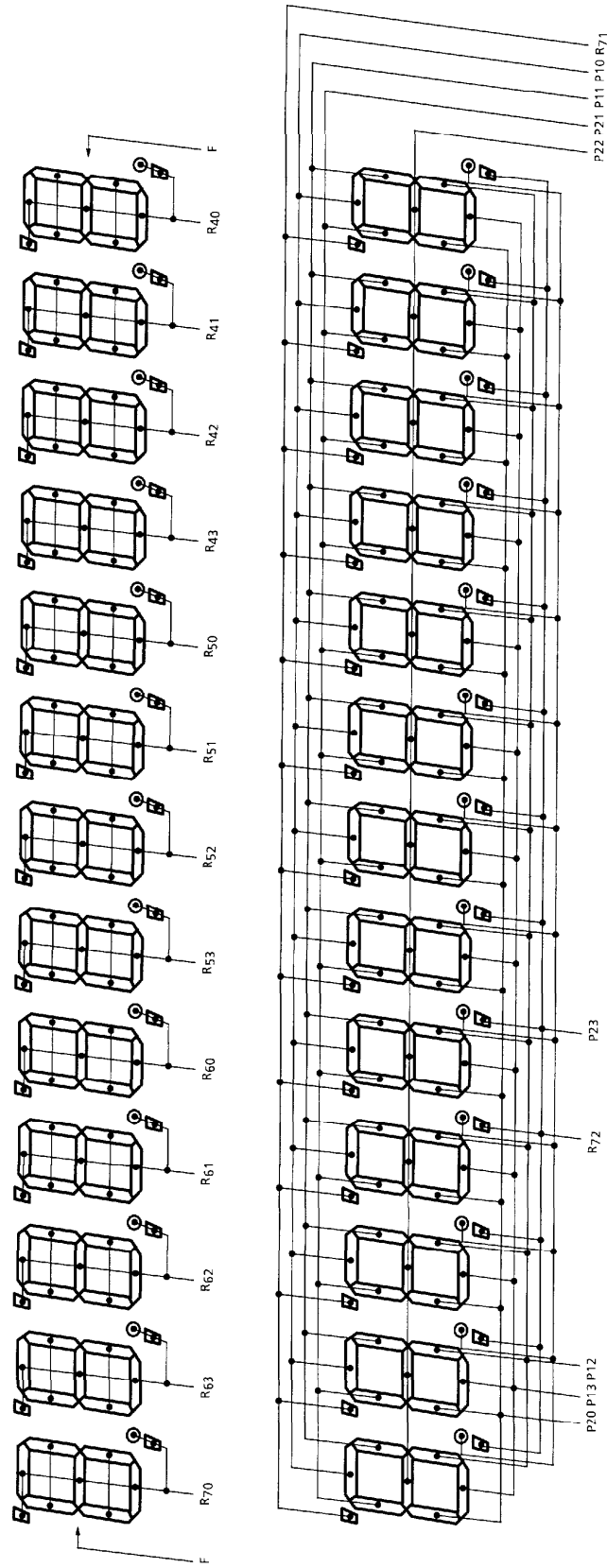


\* Connection to  $\overline{\text{HOLD}}$  pin is shown in the following page.

KEY CONNECTION



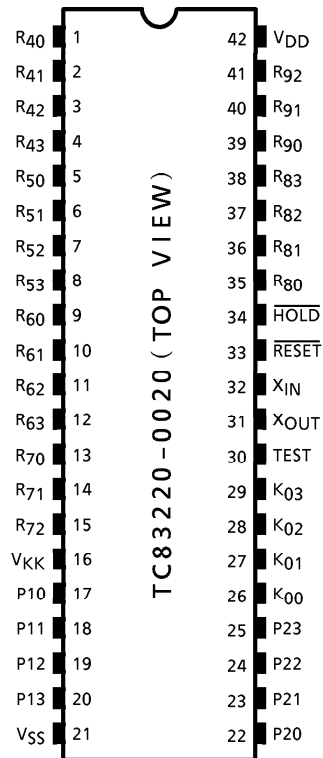
CONNECTION OF FL



- (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.

TC83220-0020-06

**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	
	1+	<PF> 1. +	0. 1.
	2-	2. -	-1.
	◇	-1. ◇	-1.
	*	-1. *	
		<PF>	-1.
IC+	1+	1. +	1.
	2-	2. -	-1.
	◇	002 -1. ◇	-1.
	*	002 -1. *	
		<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	
	3 =	3. % 0.06185567 Δ *	
		2.06185567 *	
		<PF>	2.06185567
	2Δ%	2. Δ	
	3 =	3. = 1. Δ *	
		50. Δ %	
		<PF>	50.

(Note) : <PF> ... Paper feed



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	+ %	
		<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.	+	
		<PF>		50.
	*	122.0285223	*	
		<PF>		122.0285223
	GT	0.	G ◇	0.
GT	2+	2.	+	2.
	3+	3.	+	5.
	*	5.	G +	
		<PF>		5.
	3-	3.	-	-3.
	4-	4.	-	-7.
	5-	5.	-	-12.
	*	-12.	G +	
		<PF>		-12.
	GT	-7.	G ◇	-7.
	GT	-7.	G *	
		<PF>		-7.
OFF	M+	-7.	M +	M -7.
	C	0.	C	M 0.

KEY		PRINT		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 ◇		
			-7. M *		
			<PF>		-7.
	# / P		-7. ◇		-7.
	2 # / P	#2			2.
	# / P		2. ◇		2.
	0 ÷		0. ÷		0.
	=		0. =		
			.....		
		0. *			
		<PF>		E	0.
	C	0. C			0.
		<PF>			0.
F CUT OFF 12 OFF OFF CAL	POWER ON		<PF>		
			C		
SET			<PF>	0. %	
			<PF>		0.
	3			3.	3.
CAL			3. %		
			<PF>		0.
	C		0. C		0.
SET			<PF>	3. %	
			<PF>		3.
CAL				0.	0.
	1560			1,560.	1,560.
+ TAX			1,560.		
			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.
x			1,560. x		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 Σ GT MOD	TOUCH			
		<PF>		126,776,520.
	=			126,776,520.
	5			5.
	x	5.	x	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		
		.....		
		1.009400000000	*	
		<PF>		E 1.009400000000
	C	0.	C	
		<PF>		0.
	1560			1560.
	+ / -			- 1,560.
	+ TAX	- 1,560.		
		- 46.8 Δ		
		- 1,606.8	*	
		<PF>		- 1,606.8
	1560			1,560.
	- TAX	1,560.		

KEY		PRINT		DISPLAY
TAB 4/5 IC 10/12 Σ GT MOD	TOUCH			
F CUT OFF 12 OFF OFF CAL		- 45,43689321 Δ		
		1,514.56310679 *		1,514.56310679
		<PF>		
	- TAX	1,514.56310679 ◇		
		- 44.11348855 Δ		
		1,470.44961824 *		1,470.44961824
		<PF>		
SET		3. %		3.
		<PF>		0.
	C			
CAL		0. %		0.
		<PF>		0.
SET		0. %		0.
		<PF>		0.
	1234			1,234.
CAL		1,234. %		0.
		<PF>		980,000,000,000.
	9800000000000	980,000,000,000.		
	+ TAX	.....		
		0. *		
		<PF>		E 0.
	C	0. C		
		<PF>		0.

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

CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage 1	$V_{DD}$	-0.5~7	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 ( $T_{opr} = 70^{\circ}\text{C}$ )	$P_D$	600	mW
Soldering Temperature, Time	$T_{sld}$	260 (10 s)	$^{\circ}\text{C}$
Storage Temperature	$T_{stg}$	-55~125	$^{\circ}\text{C}$
Operating Temperature	$T_{opr}$	0~40	$^{\circ}\text{C}$

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	—	

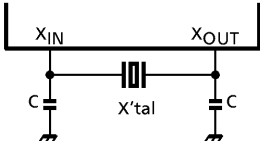
(Note 1) : In case of the external clock operation.

**ELECTRICAL CHARACTERISTICS**

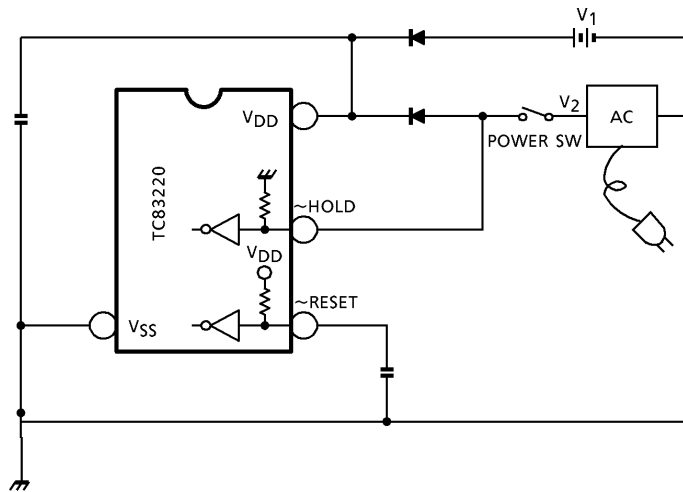
DC CHARACTERISTICS ( $V_{SS} = 0\text{ V}$ ,  $V_{DD} \pm 10\%$ ,  $T_{opr} = 0\sim 40^\circ\text{C}$ )

PARAMETER	SYMBOL	TEST CIRCUIT	CONDITION	MIN	TYP.	MAX	UNIT
Hysteresis Voltage (Schmitt circuit input)	$V_{HS}$	—	—	—	0.7	—	V
Input Current (RESET, HOLD, TEST)	$I_{IN}$	—	$V_{DD} = 5.5\text{ V}$ , $V_{IN} = 5.5/0\text{ V}$	—	—	$\pm 50$	$\mu\text{A}$
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	$I_{DD\ 0}$	—	$V_{DD}$ ( $V_{DDH}$ ) $5.5\text{ V}$ , $f_c = 4\text{ MHz}$ , $V_{IN} = 5.3/0.2\text{ V}$	—	3	6	mA
Supply Current (after clear)	$I_{KK\ 1}$	—	$V_{KK} = -30\text{ V}$ , $f_c = 4\text{ MHz}$	—	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	$\mu\text{A}$

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  $V_{DD}$ .)

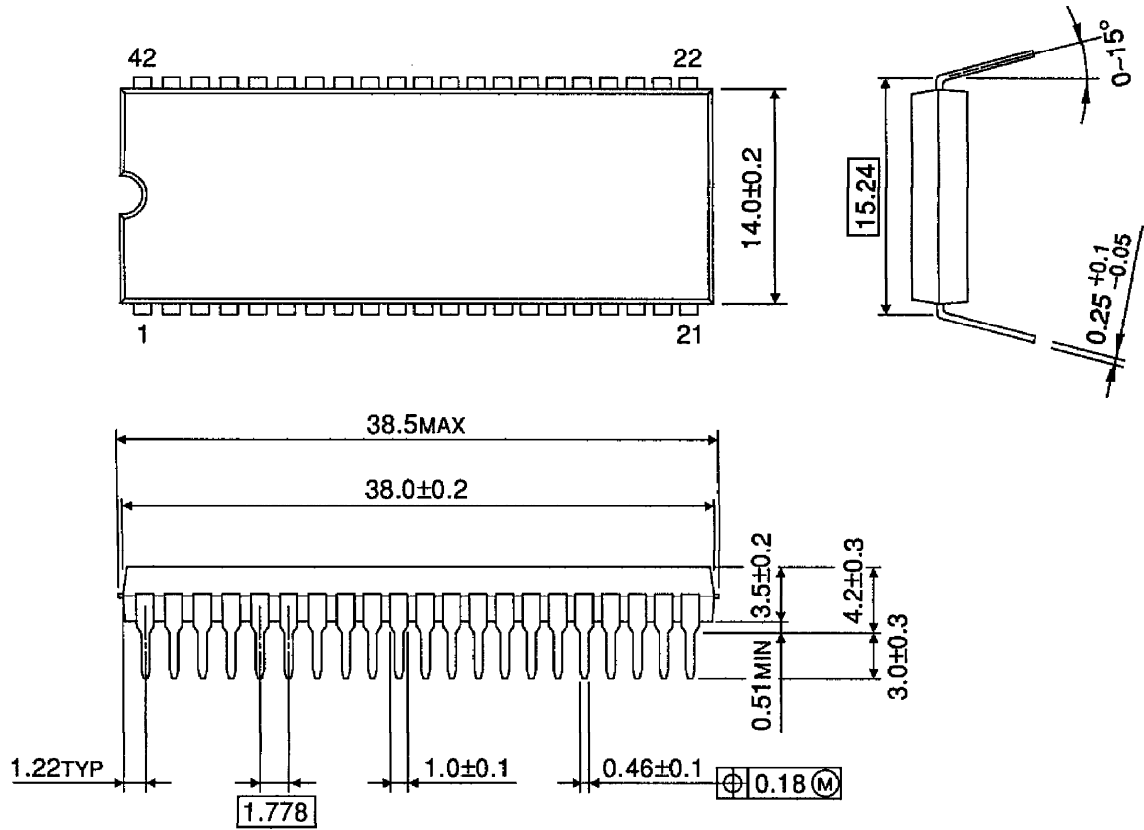
- ① Setting POWER SW to ON,  $V_2$  is supplied to  $V_{DD}$  pin, and also to HOLD pin.  
Then calculator operates normally.
- ② Setting POWER SW from ON to OFF,  $V_1$  is supplied to  $V_{DD}$  pin and VSS is supplied to HOLD pin.  
Under this connection, TAX RATE is held.
- ③ Setting POWER SW to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