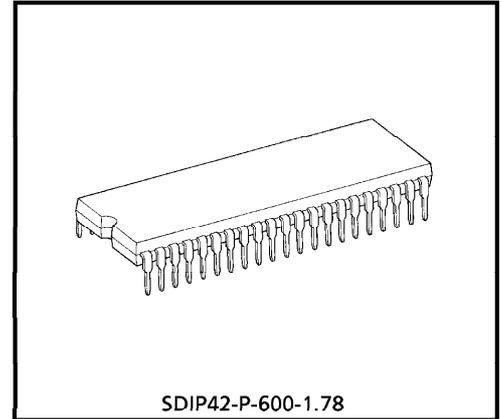


TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

**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.



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.

- 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**

- 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

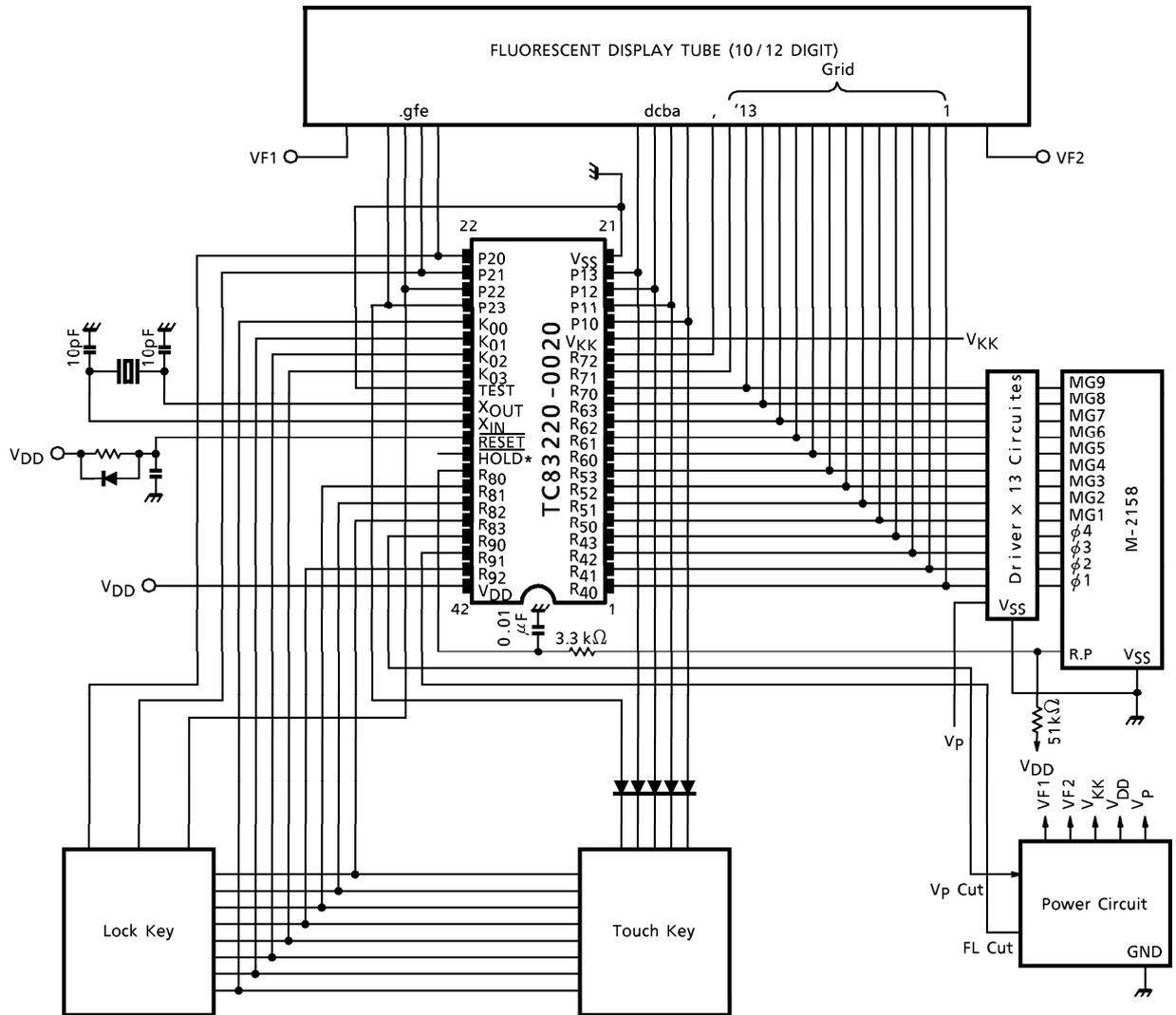
ON . . . . 10-digits calculated

OFF . . . 12-digits calculated

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

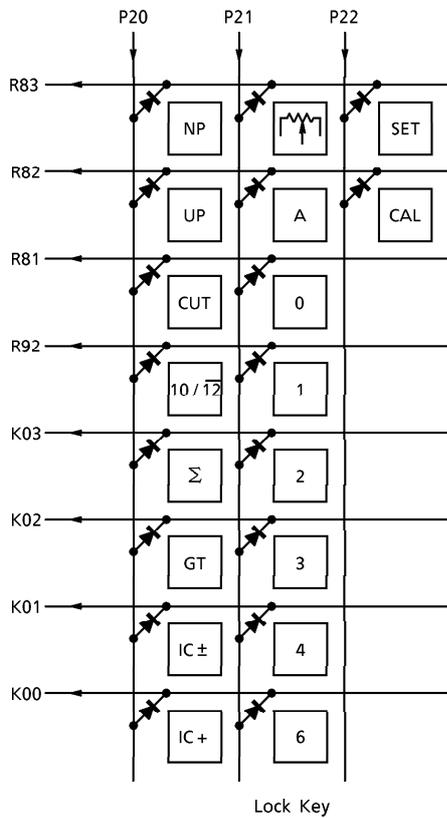
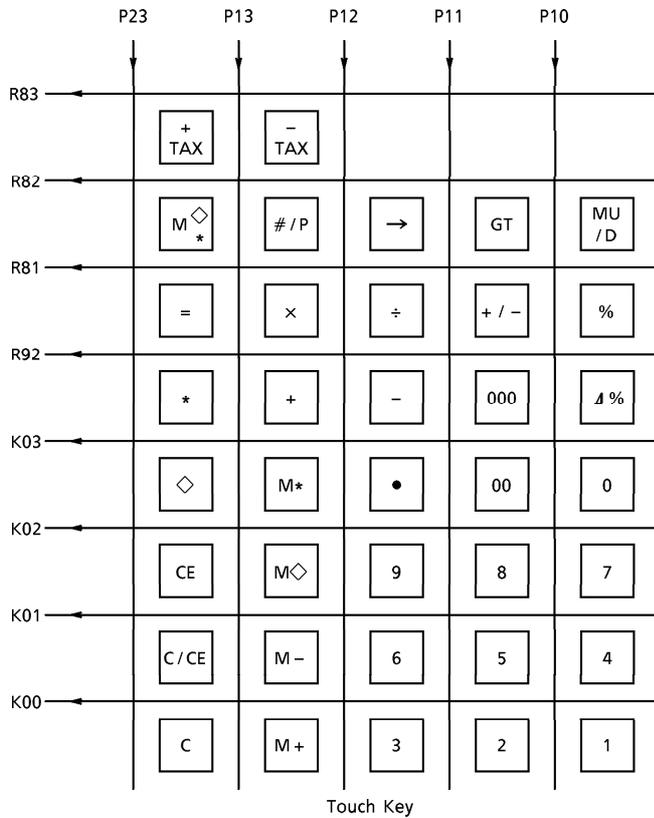
- i) Addition  $1 + 1 + 31.2 \text{ ms}$
- ii) Multiplication  $\times 9999999999 = 26.8 \text{ ms}$
- iii) Division  $9999999999 \div 1 = 100.6 \text{ ms}$
- iv) Memory calculation  $9999999999 \div 1 \text{ M} + 108.8 \text{ ms}$
- v) Percentage calculation  $1 \times 9999999999\% 35.2 \text{ ms}$

SYSTEM DIAGRAM



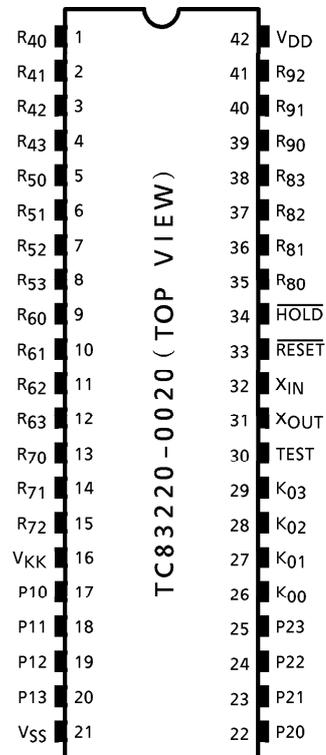
\* Connection to  $\overline{\text{HOLD}}$  pin is shown in the following page.

KEY CONNECTION





**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	2.
	3 =	3. % 0.06185567 Δ *	
		2.06185567 *	
		<PF>	2.06185567
	2Δ%	2. Δ	2.
	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	GT	0.	G ◇	0.
	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
	C	0. C			0.
		<PF>			0.
F CUT OFF 12 OFF OFF CAL	POWER ON		<PF>		
			C		
			<PF>		
SET			0. %		
			<PF>		0.
	3				3.
CAL			3. %		
			<PF>		0.
	C		0. C		
			<PF>		0.
SET			3. %		
			<PF>		3.
CAL					0.
	1560				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.
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	—	

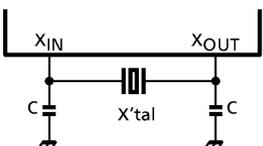
(Note 1) : In case of the external clock operation.

**ELECTRICAL CHARACTERISTICS**

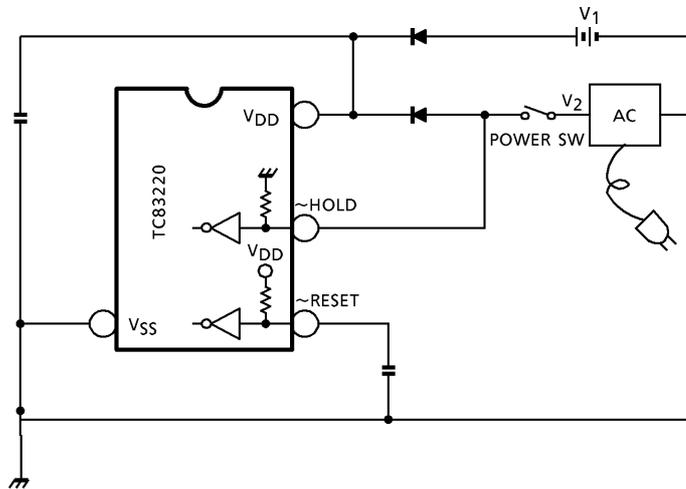
DC CHARACTERISTICS ( $V_{SS} = 0\text{ V}$ ,  $V_{DD} \pm 10\%$ ,  $T_{opr} = 0\sim 40^\circ\text{C}$ )

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 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  $V_{DD}$ .)

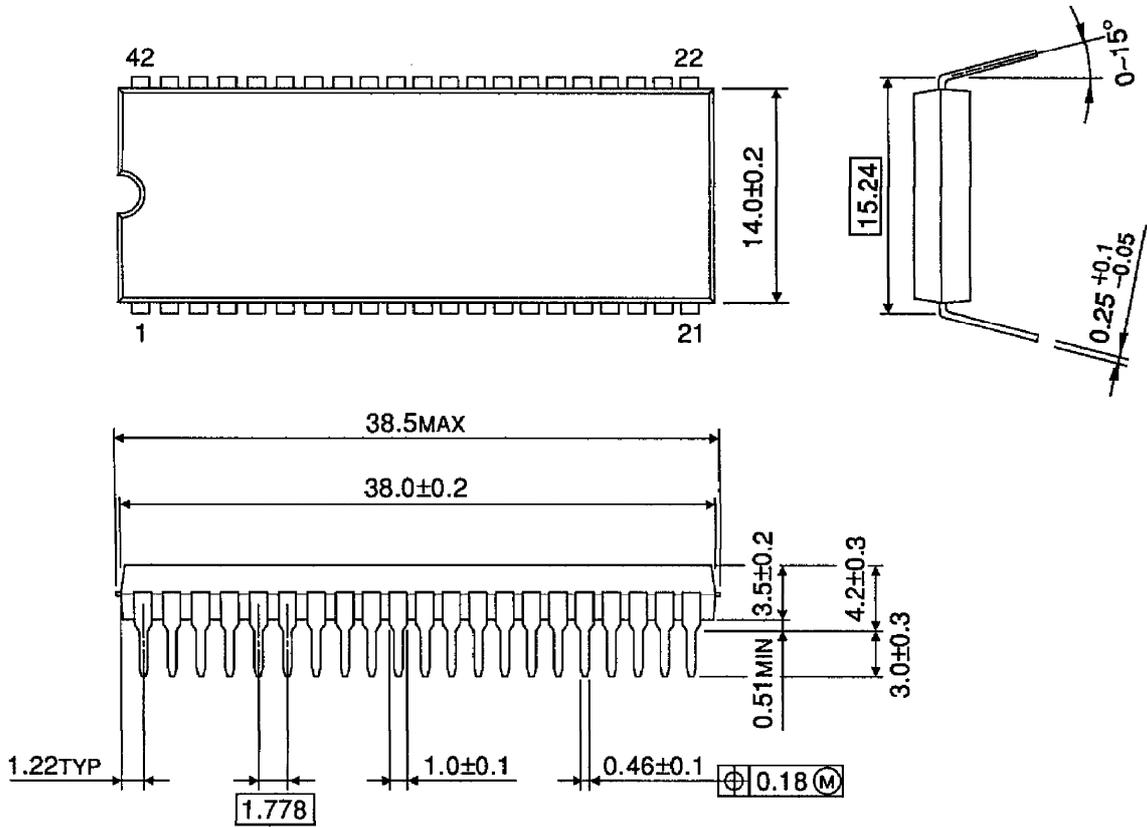
- ① Setting POWER SW to ON,  $V_2$  is supplied to  $V_{DD}$  pin, and also to HOLD pin.  
Then calculator operates normally.
- ② Setting POWER SW from ON to OFF,  $V_1$  is supplied to  $V_{DD}$  pin and VSS is supplied to HOLD pin.  
Under this connection, TAX RATE is held.
- ③ Setting POWER SW to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

**RESTRICTIONS ON PRODUCT USE**

000707EBA

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