

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

# TC83220-0025

TC83220-0025 Single-Chip CMOS LSI for FL (fluorescent) Calculator

The TOSHIBA printing/display calculator circuit TC83220-0025 is 10- or 12-digit calculator on single-chip CMOS LSI.

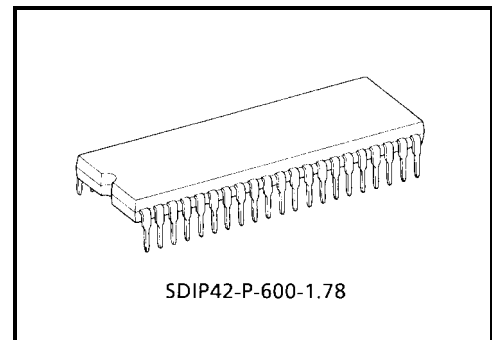
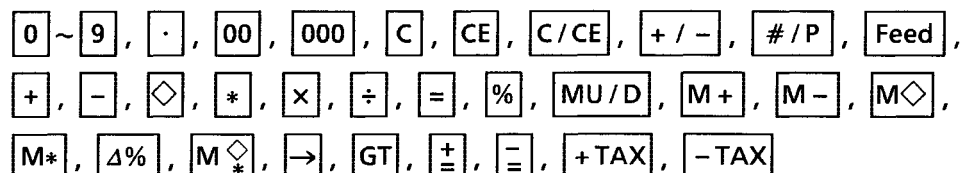
TC83220-0025 can drive the printing machine (M-72T; EPSON) with magnet driver circuit, and can drive the fluorescent display tube with DC-DC converter.

It contains a 4 K-word ROM, a 256 × 4-bit RAM.

## Features

### Operational Features

- Print: 11 or 13 digits of data.  
 (including decimal point) 1 digit of minus sign.  
 2 digits of operational symbol.  
 3 digits of commas. 2-colors printing. (black and red)
- Display: 10 or 12 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
- Item counter: 0~999 count up by depressing of,  $\boxed{+}$ ,  $\boxed{-}$  key.
- Punctuation: Commas for thousands on display.
- Kinds of touch key:



SDIP42-P-600-1.78

Weight: 4.12 g (typ.)

- Kinds of lock key (refer to page 5.): “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”, “1”, “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. (ON: set mode. OFF: normal calculation mode.)  
 “10/12” display digits selectable switch. (refer to page 3.)
- Duty of display: Duty = 1/17.7
- Leading zero suppression
- Trailing zero suppression
- Tax calculation (refer to page 5.): +TAX key is calculation for included tax.  
-TAX key is calculation for excluded tax.  
SET/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 +TAX following data key at normal calculation mode performs the calculating included tax.  
 Depression of -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.

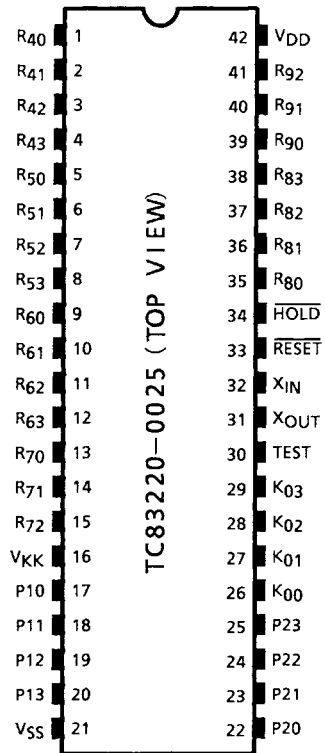
## Protection

- (1) Double depression of keys will be inoperative.
- (2) In the overflow condition, all key except “C”, “C/CE”, “CE” “Feed”, “→” key are inoperative.
- (3) Key bouncing protection (at 4 MHz clock)  
 Key read in: 15 ms  
 Key off: 40 ms

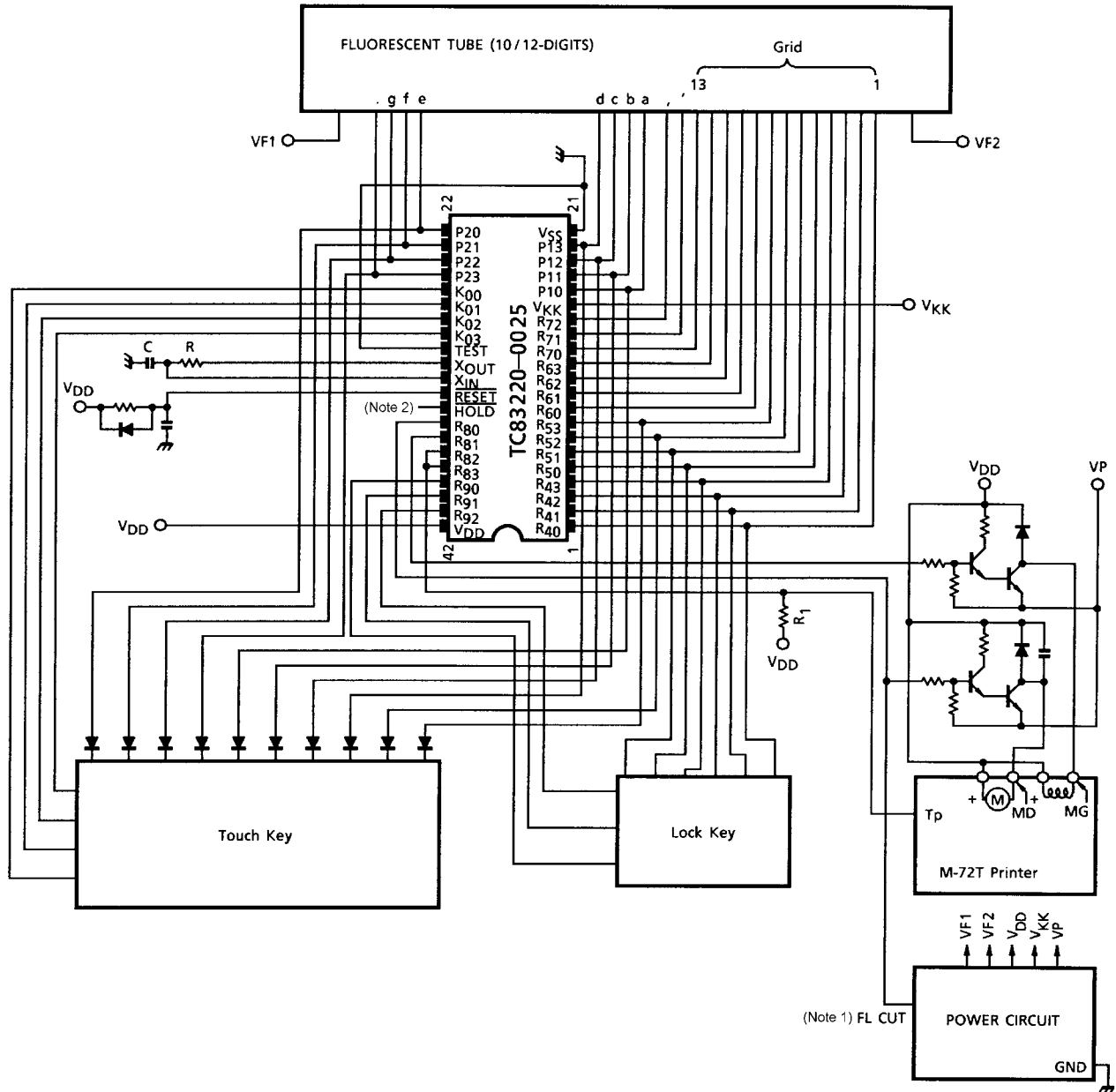
## Function Select

- (1) “10/12” selectable with calculated digits (lock key).  
 ON..... 10-digit calculation  
 OFF..... 12-digit calculation

## Pin Assignment (top view)



**System Diagram**



C = 100 pF

R = 1 kΩ ± 2%

R<sub>1</sub> = 10~15 kΩ

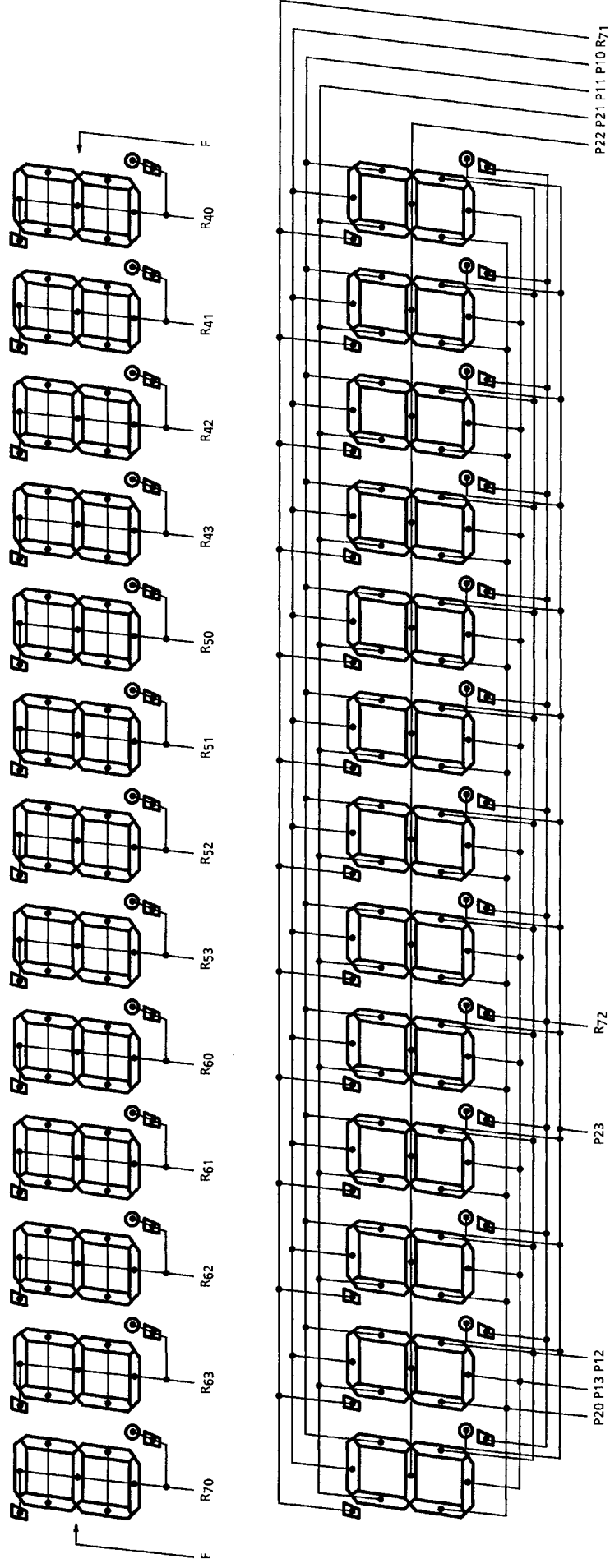
VP: Power source to drive printer.

V<sub>KK</sub>: Power source for display.

Note 1: FL CUT (R<sub>80</sub>)

(VF<sub>1</sub>, VF<sub>2</sub> cut at printing)

Note 2: Connection to  $\overline{\text{HOLD}}$  pin is shown in the following page 15.

**Connection of FL**

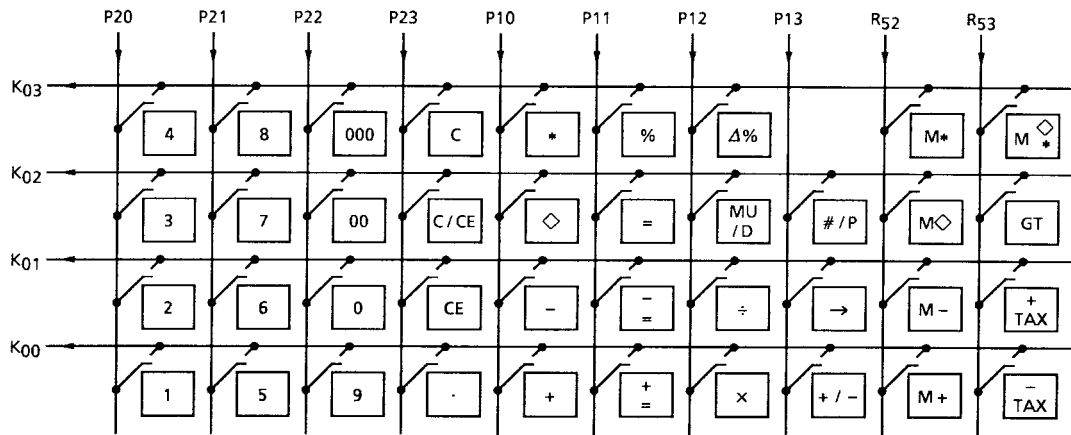
Note 3: R70 digit (P20) of "E" data

Note 4: R70 digit (P22) of "L" data

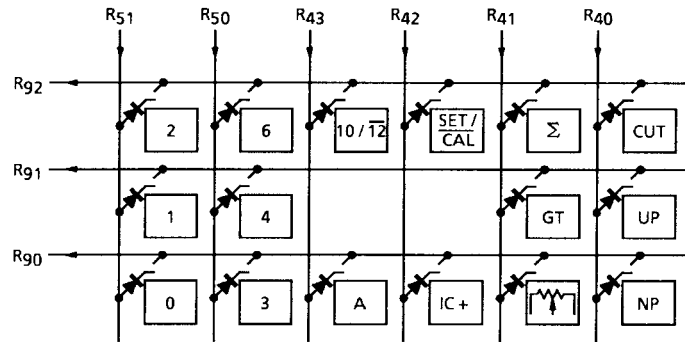
Note 5: R70 digit (P23) of "M" data

Note 6: R70 digit (P21) of "GT" data


**Key Connection**



**Touch Key**



**Lock Key**

Note 7: : Feed

## Operation Example

Key		Print	Print Color	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.
	∅	002.....		
		-1. ∅	R	-1.
	*	002.....		
		-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. G 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 8: PRINT COLOR.....R: Red

No mark: Black

<PF> .....Paper feed

Key		Print	Print Color	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. G 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.
	3+	3. +		5.
	*	5. G +		
		<PF>		5.
	3-	3. -	R	-3.
	4-	4. -	R	-7.
	5-	5. -	R	-12.
	*	-12. G +	R	
		<PF>		-12.
	GT	-7. G ∅	R	-7.
	GT	-7. G *	R	
		<PF>		-7.
	OFF	-7. M +	R	M
				-7.
	C	0. C		M
				0.

Note 8: PRINT COLOR.....R: Red

No mark: Black

<PF> .....Paper feed



Key		Print	Print Color	Display
TAB 4/5 IC 10/12 Σ GT MOD	Touch			
		<PF>		M -7.
	M $\diamond$	-7. M $\diamond$	R	
	M*	-7. M *	R	
		<PF>		-7.
F 4/5 OFF 10 Σ OFF CAL	#/P	-7. $\diamond$	R	-7.
	2 #/P	#2.....		2.
	#/P	2. $\diamond$		2.
	0÷	0. ÷		0.
	=	0. =		
		.....		
		0. *		
		<PF>		E 0.
	C	0. C		
		<PF>		0.
F CUT OFF 12 OFF OFF CAL	POWER ON	<PF>		
		C		
		<PF>		0.
	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 $\diamond$		
		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. $\diamond$		
		3,692,520. Δ		
		126,776,520. *		

Note 8: PRINT COLOR.....R: Red

No mark: Black

<PF> .....Paper feed

Key		Print	Print Color	Display
TAB 4/5 IC 10/12 Σ 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		
		.....		
		1,00940000000 *		
		<PF>	E	1.00940000000
	C	0. C		
		<PF>		0.
	1560			1,560.
	+/-			-1,560.
	+TAX	-1,560.	R	
		-46.8 Δ	R	
		-1,606.8 *	R	
		<PF>		-1,606.8
	1560			1,560.
	-TAX	1,560.		

Note 8: PRINT COLOR.....R: Red

No mark: Black

<PF> .....Paper feed

Key		Print	Print Color	Display
TAB 4/5 IC 10/12 Σ GT MOD	Touch			
F CUT OFF 12 OFF OFF CAL		-45,43689321 Δ	R	
		1,514.56310679 *		
		<PF>		1,514.56310679
	-TAX	1,514.56310679 ◊		
		-44.11348855 Δ	R	
		1,470.44961824 *		
		<PF>		1,470.44961824
	SET	3. %		
		<PF>		3.
	C			0.
	CAL	0. %		
		<PF>		0.
	SET	0. %		
		<PF>		0.
	1234			1,234.
	CAL	1,234. %		
		<PF>		0.
	980000000000			980,000,000,000.
	+TAX	980,000,000,000.		
		.....		
		0. *		
		<PF>	E	0.
	C	0. C		
		<PF>		0.

Note 8: PRINT COLOR.....R: Red  
 No mark: Black  
 <PF> ..... Paper feed

## Maximum Ratings ( $V_{SS} = 0\text{ V}$ )

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

Characteristics	Symbol	Test Circuit	Test 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	V
Supply voltage (hold)	$V_{DDH}$	—	—	2	6	V
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)	$V_{IH2}$	—		$V_{DD} \times 0.75$	$V_{DD}$	V
Input high voltage	$V_{IH3}$	—	$V_{DD} < 4.5\text{ V}$	$V_{DD} \times 0.9$	$V_{DD}$	V
Input low voltage (except schmitt circuit input)	$V_{IL1}$	—	$V_{DD} \geq 4.5\text{ V}$	$V_{KK}$	$V_{DD} \times 0.3$	V
Input low voltage (schmitt circuit input)	$V_{IL2}$	—		$V_{KK}$	$V_{DD} \times 0.25$	V
Input low voltage	$V_{IL3}$	—	$V_{DD} < 4.5\text{ V}$	$V_{KK}$	$V_{DD} \times 0.1$	V
Output voltage (source open drain)	$V_{OUT}$	—	—	$V_{DD} - 35$	$V_{DD}$	V
Clock high pulse width (Note 9)	$T_{WCH}$	—	$V_{IN} = V_{IH}$	80	—	ns
Clock low pulse width (Note 9)	$T_{WCL}$	—	$V_{IN} = V_{IL}$	80	—	ns

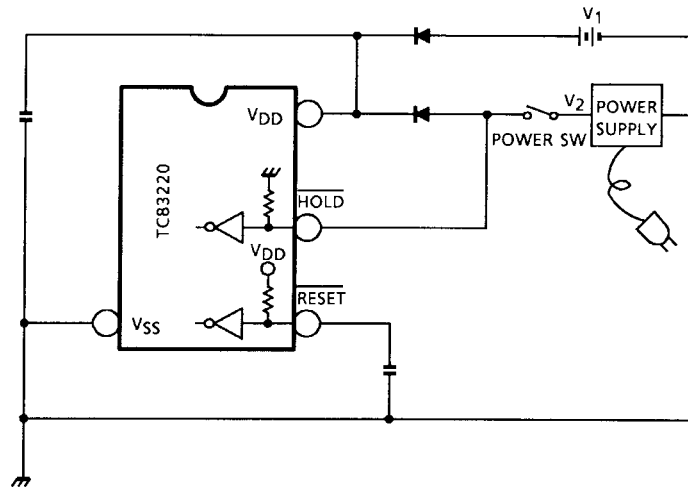
Note 9: In case of the external clock operation.

## 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	Test 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	—	$\text{k}\Omega$
Pull down resistor (source open drain)	$R_{KK}$	—		50	80	200	$\text{k}\Omega$
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	mA
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 10:  $V_1 = 3\text{ V}$ : Battery supply

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

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

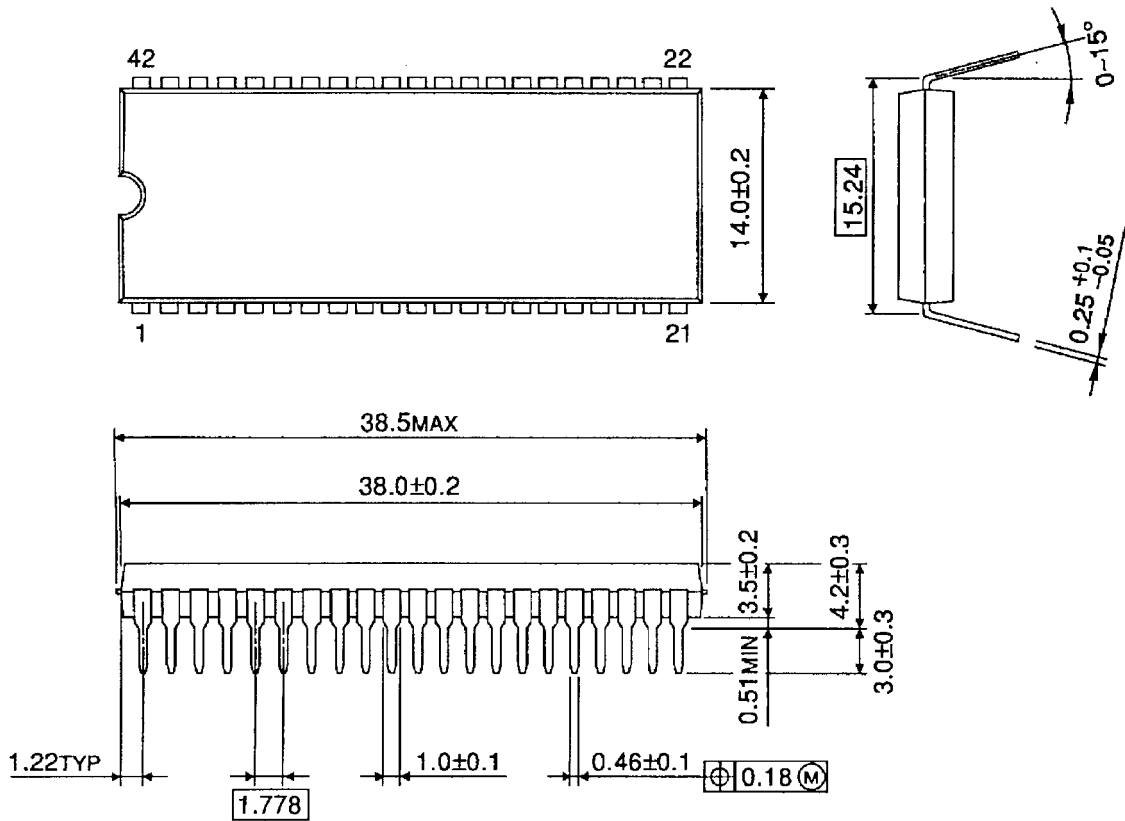
- (1) Setting POWER SW to ON,  $V_2$  is supplied to  $V_{DD}$  pin, and also to  $\overline{\text{HOLD}}$  pin. Then calculator operates normally.
- (2) Setting POWER SW from ON to OFF,  $V_1$  is supplied to  $V_{DD}$  pin and  $V_{SS}$  is supplied to  $\overline{\text{HOLD}}$  pin. Under this connection,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

Note 11:  $V_1$  (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: 4.12 g (typ.)

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