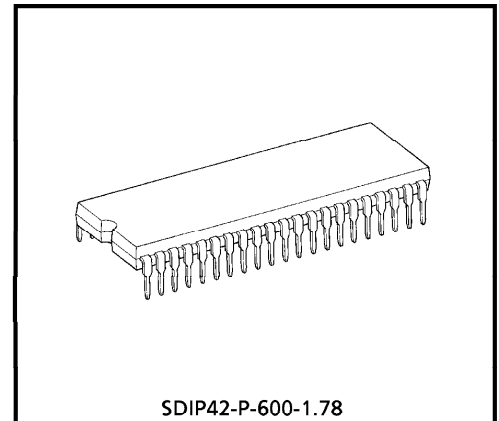


TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

TC83220-0027**TC83220-0027 SINGLE-CHIP CMOS LSI FOR FL (FLUORESCENT)
CALCULATOR**

The TOSHIBA printing /display calculator circuit TC83220-0027 is 10- or 12-digit calculator on single-chip CMOS LSI. TC83220-0027 can drive the printing machine (M41TAV / M42TV / M42V ; 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.

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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} , $\boxed{C/CE}$, $\boxed{+/-}$, $\boxed{\#/P}$, $\boxed{\text{Feed}}$, $\boxed{+}$, $\boxed{-}$, $\boxed{\diamond}$, $\boxed{*}$, $\boxed{\times}$, $\boxed{\div}$, $\boxed{=}$, $\boxed{\%}$, $\boxed{\text{MU/D}}$, $\boxed{\text{M+}}$, $\boxed{\text{M-}}$, $\boxed{\text{M}\diamond}$, $\boxed{\text{M*}}$, $\boxed{\text{1}\%}$, $\boxed{\text{M}\diamond*}$, $\boxed{\rightarrow}$, $\boxed{\text{GT}}$, $\boxed{+\text{TAX}}$, $\boxed{-\text{TAX}}$, $\boxed{\pm}$, $\boxed{\equiv}$
- 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+" 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 : $\boxed{+\text{TAX}}$ 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

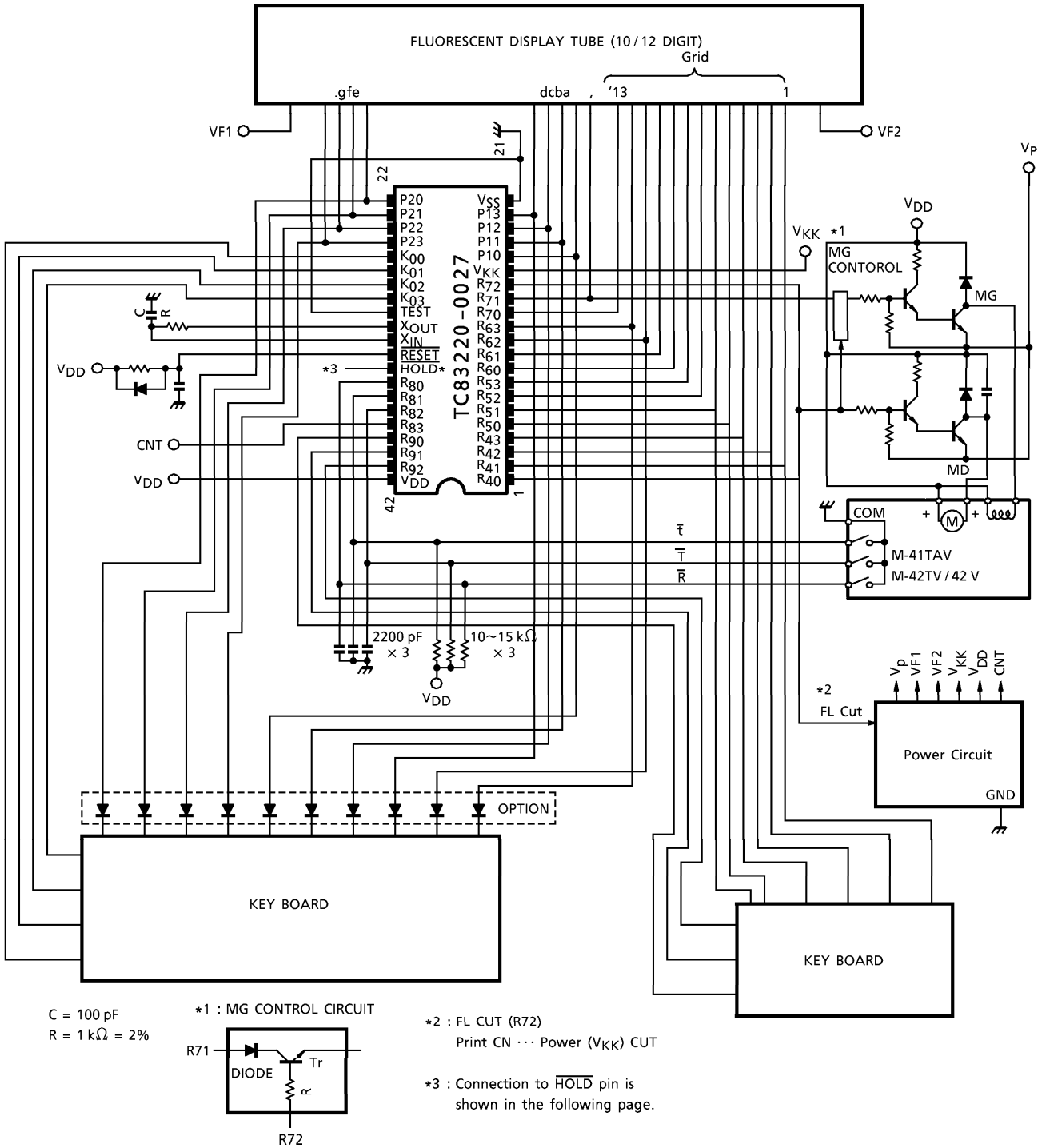
ON 10-digits calculated

OFF 12-digits calculated

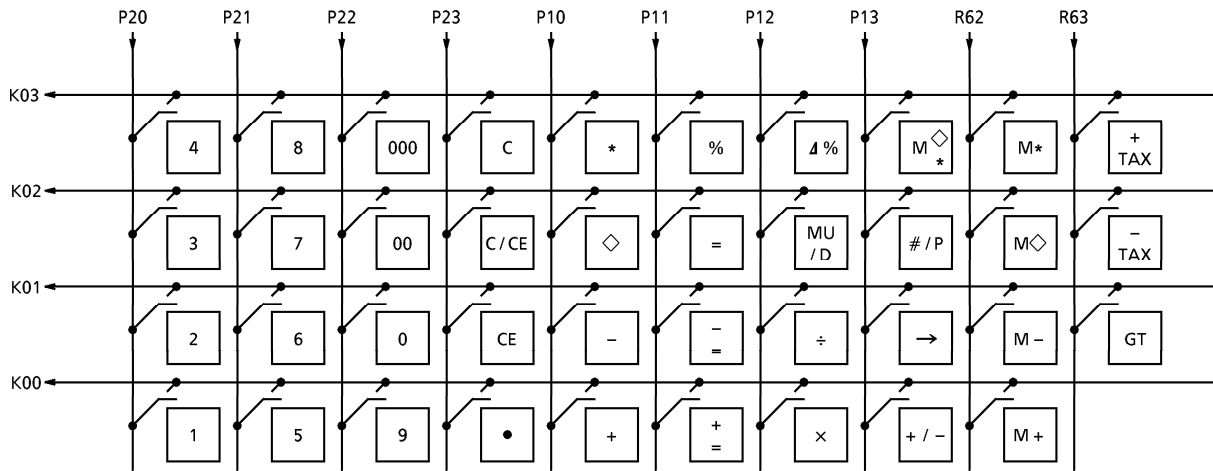
Speed of Calculation (at 4 MHz clock)

- i) Addition $1 + 1 +$ 31.2 ms
- ii) Multiplication $\times 99999999999 =$ 26.8 ms
- iii) Division $99999999999 \div 1 =$ 100.6 ms
- iv) Memory calculation $99999999999 \div 1 M +$ 108.8 ms
- v) Percentage calculation $1 \times 99999999999\%$ 35.2 ms

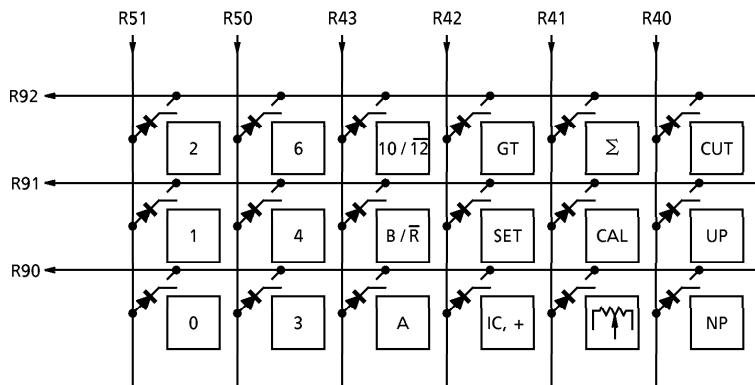
SYSTEM DIAGRAM



KEY CONNECTION

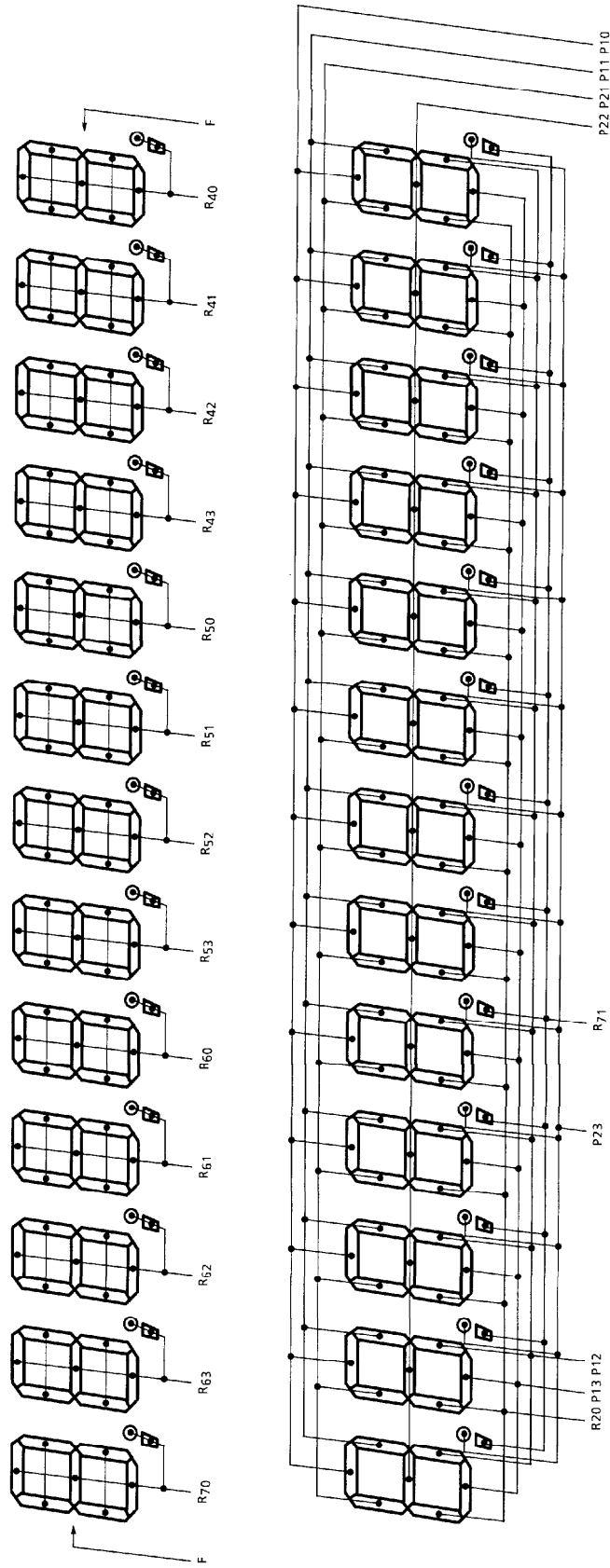


Touch Key



Lock Key

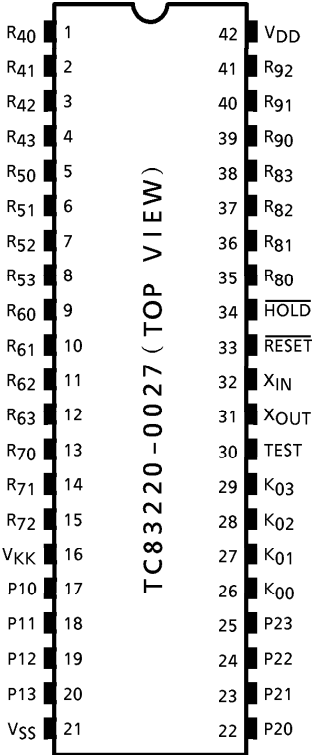
CONNECTION OF FL



(Note 1) : R70 digit (P20) of "E" Data.
 (Note 2) : R70 digit (P22) of "—" Data.
 (Note 3) : R70 digit (P23) of "M" Data.

TC83220-0027-06

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 +	1. +	0. 1.
	2 -	2. -	-1.
	◇	-1. ◇	-1.
	*	-1. *	-1.
		<PF>	-1.
IC +	1 +	1. +	1.
	2 -	2. -	-1.
	◇	002 -1. ◇	-1.
	*	002 -1. *	-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. GM	
	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
 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	+ %	
		<PF>		5.3
	2 ÷	2.	÷	2.
	3%	3.	%	
		66.66666666	+	
		<PF>		66.66666666
	2 MU/D	2.	GM	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.	- 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	M+	-7.	M + R	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 ◇	R		
		-7. M *	R		
		<PF>			-7.
	# / P	-7. ◇	R		-7.
	2 # / P	#2.....			2.
	# / P	2. ◇			2.
	0 ÷	0. ÷			0.
	=	0. =			
				
	0. *				
	<PF>			E	0.
	0. C				0.
	<PF>				
F CUT OFF 12 OFF OFF CAL	POWER ON	<PF>			
		<PF> C			
SET		0. %			
	3	<PF>			0.
CAL		3. %			3.
	C	<PF>			0.
		0. C			0.
SET		<PF>			0.
		3. %			3.
CAL		<PF>			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.	=	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.	R	
		- 46.8 Δ	R	
		- 1,606.8	*	
		<PF>	R	- 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	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. %		3.
		<PF>		0.
	C	0. %		0.
CAL		<PF>		0.
SET		0. %		0.
		<PF>		0.
	1234	1,234. %		1,234.
CAL		<PF>		0.
	980000000000	980,000,000,000.		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	—	

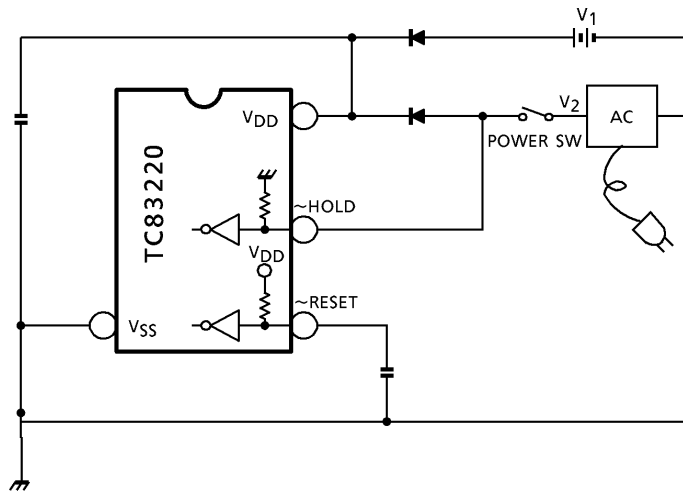
(Note 1) : In case of the external clock operation.

ELECTRICAL CHARACTERISTICS

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

PARAMETER	SYMBOL	TEST 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}	—	$V_{DD} = 5.5\text{ V}$, $V_{IN} = 5.5/0\text{ V}$	—	—	± 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 Ω
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
Oscillating Frequency	F_ϕ	—	$V_{DD} = 5.0\text{ V}$, $C = 100\text{ pF}$ $R = 1\text{ k}\Omega \pm 2\%$	2.4	4.0	5.6	MHz

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



(note)

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

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

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

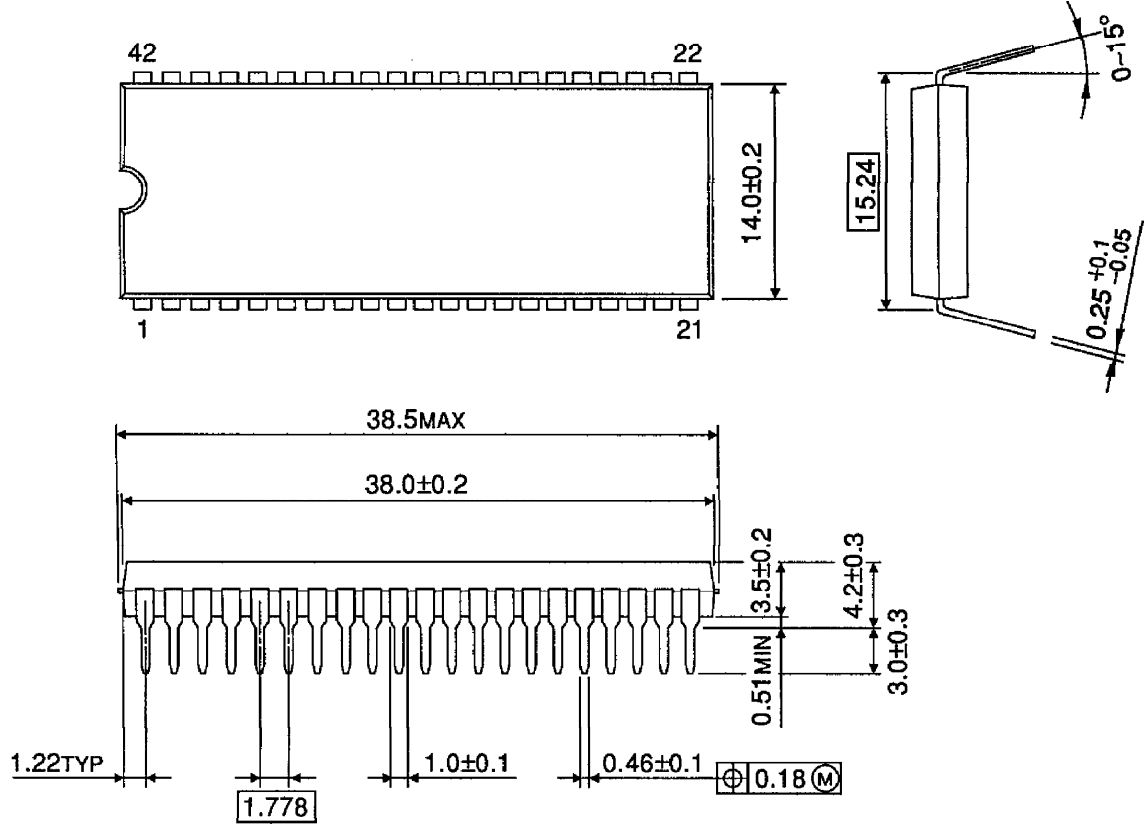
- ① Setting POWER SW to ON, V_2 is supplied to V_{DD} pin, and also to HOLD pin.
Then calculator operates normally.
- ② Setting POWER SW from ON to OFF, V_1 is supplied to V_{DD} pin and V_{SS} is supplied to HOLD pin.
Under this connection, TAX RATE is held.
- ③ Setting POWER SW to ON, V_2 is supplied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