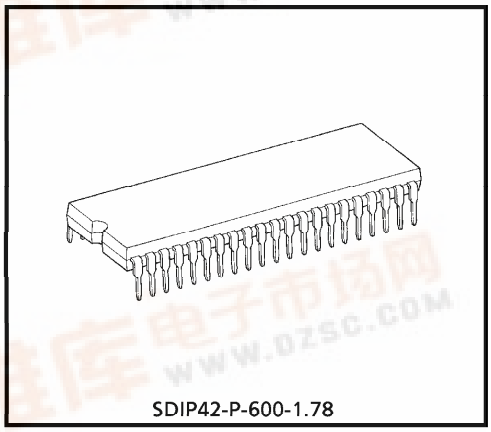
TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

TC83220-0028

TC83220-0028 SINGLE-CHIP CMOS LSI FOR FL (FLUORESCENT) CALCULATOR

The TOSHIBA printing / display calculator circuit TC83220-0028 is 14-digit calculator on single-chip CMOS LSI. TC83220-0028 can drive the printing machine (M-48T ; 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 : 15 digits of data. (including decimal point) 1 digit of minus sign. 2 digits of operational symbol. 3 digits of commas. 2-color printing. (black and red)
- Display : 14 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”, ”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 by depressing of [+], [−] key.
- Punctuation : Commas for thousands on display.
- Kinds of touch key : [0]~[9], [·], [00], [000], [C], [CE], [+/−], [#/P], [Feed], [+], [−], [◇], [*], [×], [÷], [=], [%], [MU/D], [M+], [M−], [IC], [M*], [⊿%], [→], [GT], [+TAX], [−TAX], [M◇]
- 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", "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. ("SET" : Set mode. "CAL" : Normal calculation mode.)
- Duty of display : Duty = $\frac{1}{17.77}$
- 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] selects set mode for tax rate.
  [CAL] selects normal calculation mode.
  Changing lock key from [SET] to [CAL] stores number of display to tax memory.
  Changing lock key from [CAL] to [SET] 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

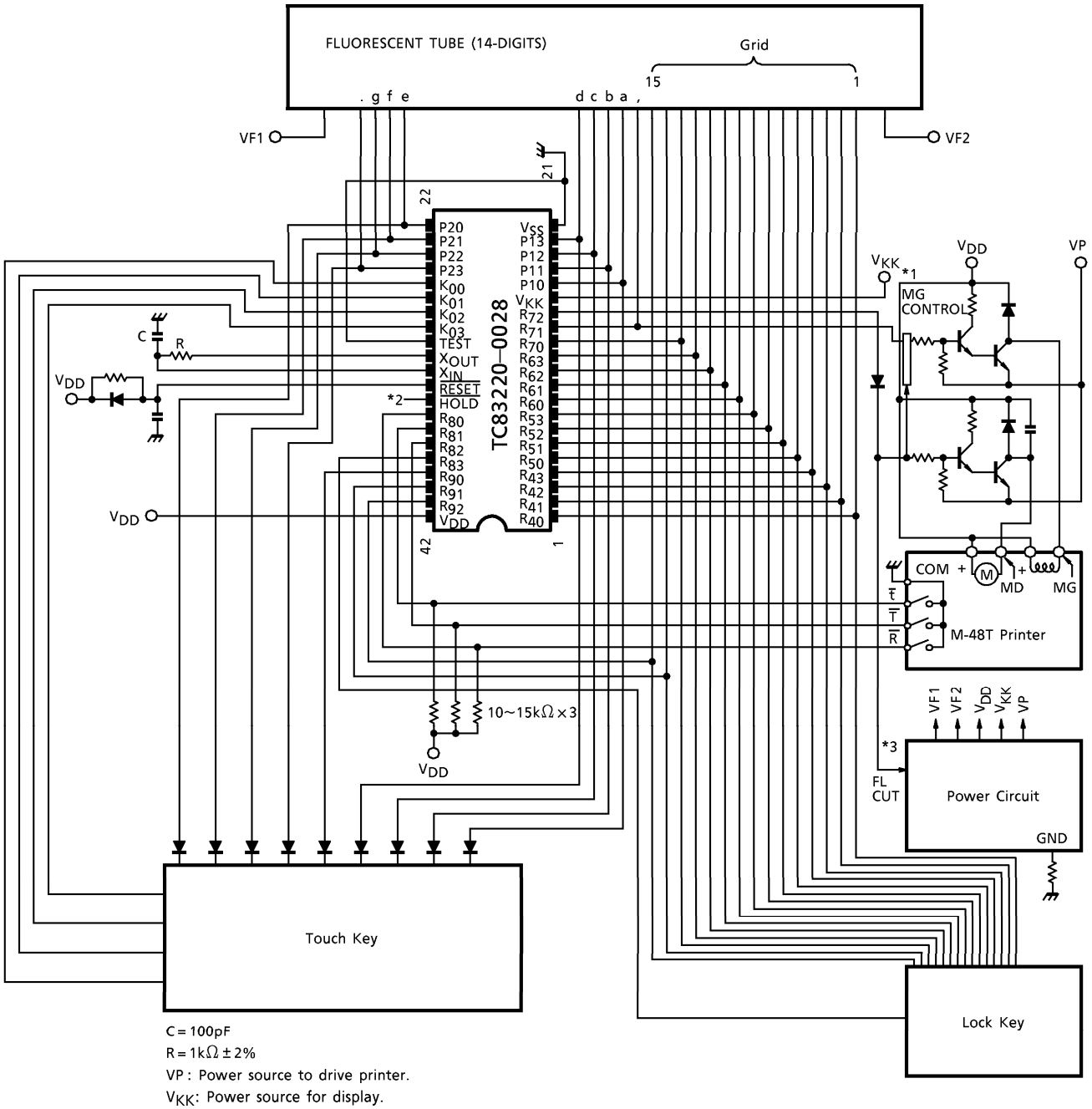
i) Double depression of keys will be inoperative.

ii) In the overflow condition, all key except "C", "CE", "Feed", "→" key are inoperative.

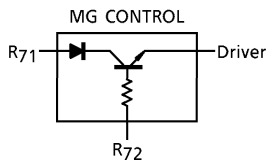
iii) Key bouncing protection (at 4MHz clock)

Key read in : 15ms
Key off : 40ms

SYSTEM DIAGRAM



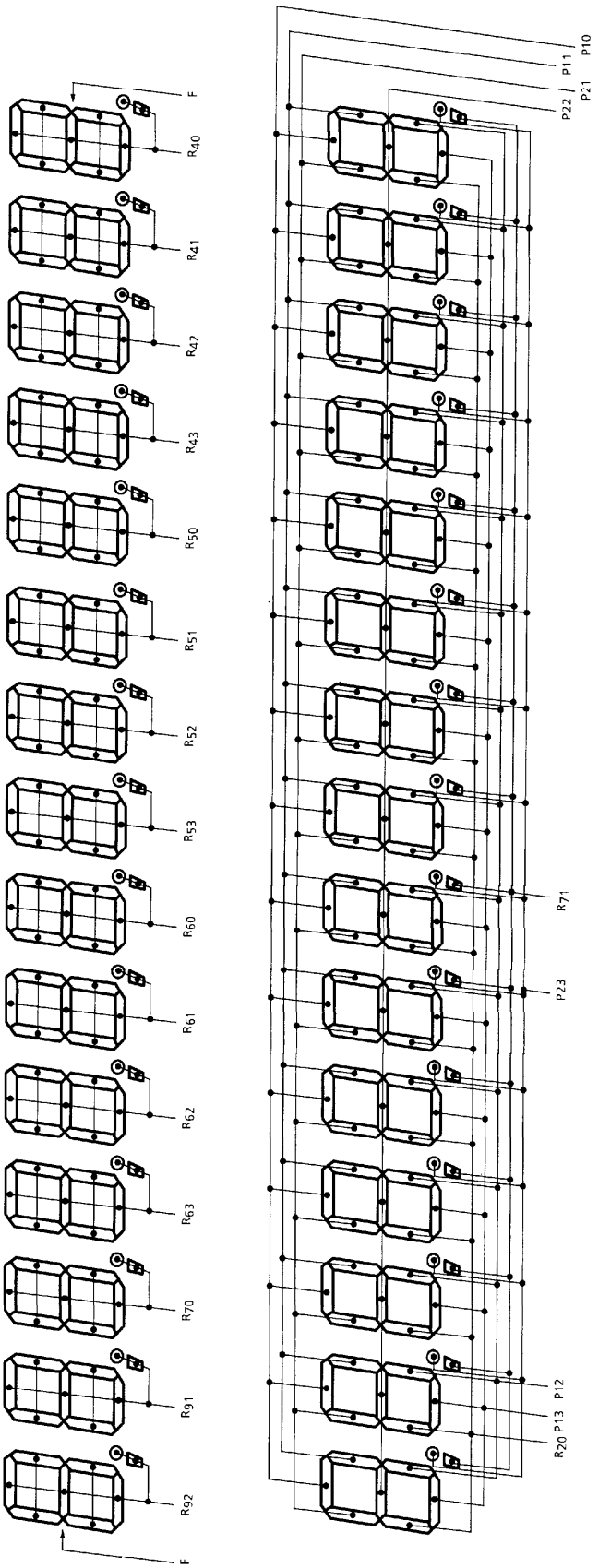
*1



*2 FL CUT (R_{72})
(VF1, VF2 Cut at printing)

*3 Connection to $\overline{\text{HOLD}}$ pin is shown in the following page 14.

CONNECTION OF FL



(Note 1) R_{92} digit (P10, P13, P20) of "E" Data.
(Note 2) R_{92} digit (P22) of "—" Data.
(Note 3) R_{92} digit (P23) of "M" Data.
(Note 4) R_{92} digit (P21) of "GT" Data.

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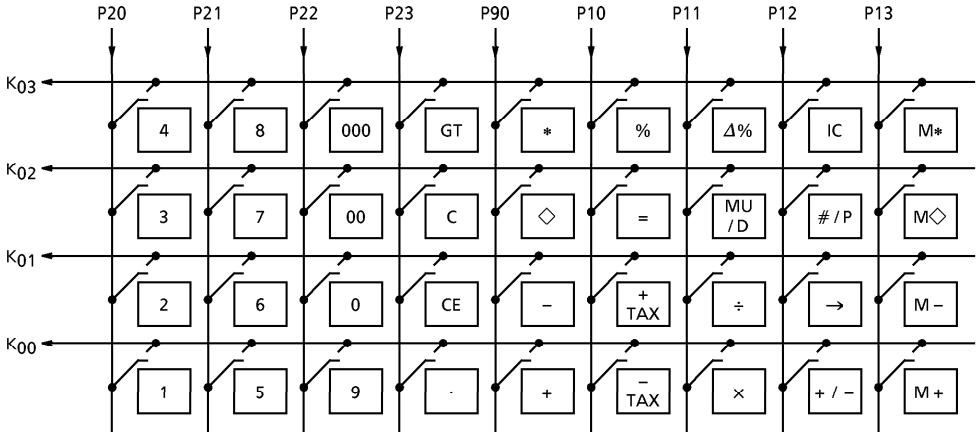
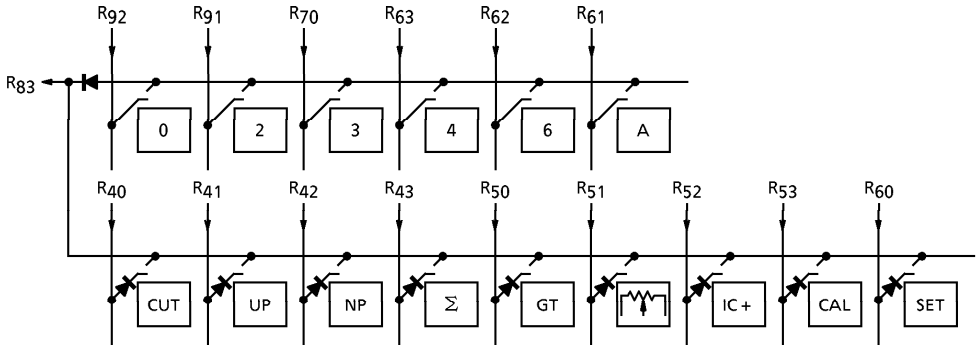
KEY CONNECTION



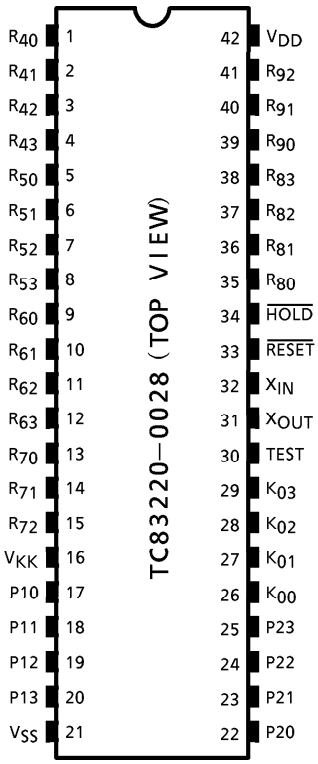
Touch Key



Lock Key

(Note) : Feed

PIN ASSIGNMENT (TOP VIEW)



OPERATION EXAMPLE

KEY TAB 4/5 IC Σ GT MOD	TOUCH	PRINT	PRINT COLOR	DISPLAY
F 4/5 IC+ OFF OFF CAL	POWER ON	<PF> C <PF>		0.
	C	0. 0 <PF>		0.
	00.78.09.04.9 955 #/P	#0·78·09·04·9955····		0.7809049955
	.123456789099 12 + ◇	0.1234567890991 + 001····· 0.1234567890991 ◇		0.1234567890991 0.1234567890991
	9999999999999 9 - ◇	99,999,999,999,999. - 001····· -99,999,999,999,999. ◇	R R	- 99,999,999,999,999. - 99,999,999,999,999.
	1111111111111 1 M- M◇	11,111,111,111,111. M - 001····· -11,111,111,111,111. M ◇	R R	M 11,111,111,111,111. M - 11,111,111,111,111.
	1111111111111 1 M- M*	11,111,111,111,111. M - 001····· -11,111,111,111,111. M * <PF>	R R	M 11,111,111,111,111. - 11,111,111,111,111.
3	1.23456 ÷ 789 =	1.23456 ÷ 789. = 0.002 * <PF>		1.23456 0.002
F	667.788 + #/P	667.788 + 667.788 ◇		667.788 667.788
	9999999999999 9 + 0.99999999999 99 +	99,999,999,999,999. + 0.9999999999999 +		99,999,999,999,999. 99,999,999,999,999.
	1000000000000 0 + 1 - .000000000000 1 -	10,000,000,000,000. + 1. - 0.0000000000001 -	 R R	10,000,000,000,000. 9,999,999,999,999. 9,999,999,999,999.
	123456789.8 + 1.2345678 +	123,456,789.8 + 1.2345678 +		123,456,789.8 123,456,791.03456

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

KEY							PRINT	PRINT COLOR	DISPLAY
TAB	4/5	IC	Σ	GT	MOD	TOUCH			
F	4/5	IC+	OFF	OFF	CAL	9999999999999			
						9 ×	99,999,999,999,999. ×		99,999,999,999,999.
						7777777777777			
						7 =	77,777,777,777,777. =		
							.....		
							77777777777776. *		
							<PF>		←77,777,777,777,776.
						9999999900000			
						0 +	99,999,999,000,000· +		99,999,999,000,000.
						1234567.8 +	1,234,567.8 +		
							.....		
							1.0000000023456 *		
							<PF>		← 1.0000000023456
						CE			0.
						789012.3 +	789,012.3 +		99,999,999,789,012.
						9999999999999			
						9 +	99,999,999,999,999. +		99,999,999,999,999.
						1 M+	1. M +		M 1.
						1 +	1. +		
							.....		
							1.0000000000000 *		
							<PF>		M← 1.0000000000000
						CE			M 0.
						9999999999999			
						9 +	99,999,999,999,999. +		
							.....		
							1.9999999999999 *		
							<PF>		M← 1.9999999999999
						3 ×	3. ×		3.
						÷	3. ÷		9.
						2 ÷	2. ÷		4.5
						×	2. ×		2.25
						4 ÷	4. ÷		9.
						-	9. -	R	-9.
						11 +	11. +		11.
						345 -	345. -	R	-334.
						M-	-334. M -		M -334.

KEY						TOUCH	PRINT		PRINT COLOR	DISPLAY
TAB	4/5	IC	Σ	GT	MOD					
F	4/5	IC+	ON	OFF	CAL	2 ×		2. ×		2.
						3 =		3. =		
								6. +		
							<PF>			6.
				OFF		2 MU/D		2. G M		2.
						3 =		3. %		
								0.061855670103 Δ *		
								2.061855670103 *		
							<PF>			2.061855670103
						2 ×		2. ×		2.
						3 %		3. %		
								0.06 *		
							<PF>			0.06
						+		2.06 + %		
							<PF>			2.06
						2 Δ%		2. Δ		2.
						3 =		3. =		
								1. Δ *		
								50. Δ %		
							<PF>			50.
						1111111111111				
						1 +/-				- 11,111,111,111,111.
						#/P	#11111111111111·····		R	- 11,111,111,111,111.
						2 ×		2. ×		2.
						3 %		3. %		
								0.06 *		
							<PF>			0.06
						-		1.94 - %		
							<PF>			1.94
					SET			0. %		
							<PF>			0.
						3				3.
					CAL			3. %		
							<PF>			0.
						1560				1,560.
						+TAX		1,560.		
								46.8 Δ		
								1,606.8 *		
							<PF>			1,606.8

KEY							PRINT	PRINT COLOR	DISPLAY
TAB	4/5	IC	Σ	GT	MOD	TOUCH			
F	4/5	IC+	OFF	OFF	CAL	5 ×	5. ×		5.
						=	5. =		
							25. *		
							<PF>		25.
						+TAX	25. ◇		
							0.75 Δ		
							25.75 *		
							<PF>		25.75
		OFF		GT		2 +	2. +		2.
						3 +	3. +		5.
						* (GT MODE)	5. G +		
							<PF>		5.
						GT	5. G ◇		5.
						GT	5. G *		
							<PF>		5.
		IC+		OFF		.123456789099			
						1 +	0.1234567890991 +		0.1234567890991
						*	001····· 0.1234567890991 *		
							<PF>		0.1234567890991
						2 -	2. -	R	-2.
						5 -	5. -	R	-7.
						IC	2.		2.

MAXIMUM RATINGS (V_{SS} = 0V)

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°C)	P_D	600	mW
Soldering Temperature, Time	T_{sld}	260 (10s)	°C
Storage Temperature	T_{stg}	− 55~125	°C
Operating Temperature	T_{opr}	0~40	°C

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

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

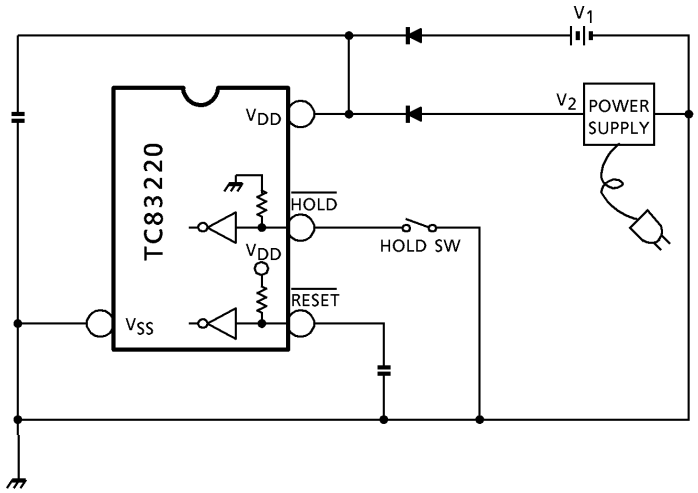
(Note) In case of the external clock operation.

ELECTRICAL CHARACTERISTICS

DC Characteristics (V_{SS} = 0 V, V_{DD} ± 10%, T_{opr} = 0~40°C)

CHARACTERISTICS	SYMBOL	TEST CIR-CUIT	CONDITION	MIN	TYP.	MAX	UNIT
Hysteresis Voltage (Schmitt circuit input)	V_{HS}	—	—	—	0.7	—	V
Input Current ($\overline{RESET}$, $\overline{HOLD}$, $\overline{TEST}$)	I_{IN}	—	V_{DD} = 5.5 V, V_{IN} = 5.5 / 0 V	—	—	± 50	μA
Output Leak Current (Source open drain)	I_{LO}	—	V_{DD} = 5.5 V, V_{OUT} = − 32 V	—	—	− 10	μA
Output High Voltage (P1~P2, R_4~R9)	V_{OH}	—	V_{DD} = 4.5 V, I_{OH} = − 6 mA	2.4	—	—	V
Input Pull Down Resistor (K_0, R_7~R9)	R_{IN}	—	V_{DD} = 5.5 V, V_{KK} = − 30 V	—	100	—	kΩ
Pull Down Resistor (Source open drain)	R_{KK}	—		50	80	200	
Operating Supply Current	I_{DD0}	—	V_{DD} (V_{DDH}) 5.5 V, f_c = 4 MHz, V_{IN} = 5.3 / 0.2 V	—	3	6	mA
Supply Current (after clear)	I_{KK1}	—	V_{KK} = − 30 V, f_c = 4 MHz	—	0.6	0.9	mA
Supply Current (Shown full digits)	I_{KK2}	—		—	3.5	6	
Holding Supply Current	I_{DDH}	—	V_{DD} = 5.5 V	—	0.5	10	μA
Oscillating Frequency	$F\phi$	—	V_{DD} = 5.0 V, C = 100 pF R = 1 kΩ ± 2%	2.4	4.0	5.6	MHz

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



(Note)
V_1 = 3V : battery supply
V_2 = 5V : DC supply

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

① Setting HOLD SW to OFF, the calculator operates normally under V_2 power supply.

② Setting HOLD SW to ON, the calculator will be in HOLD mode with TAX RATE that has already held, under V_2 power supply.

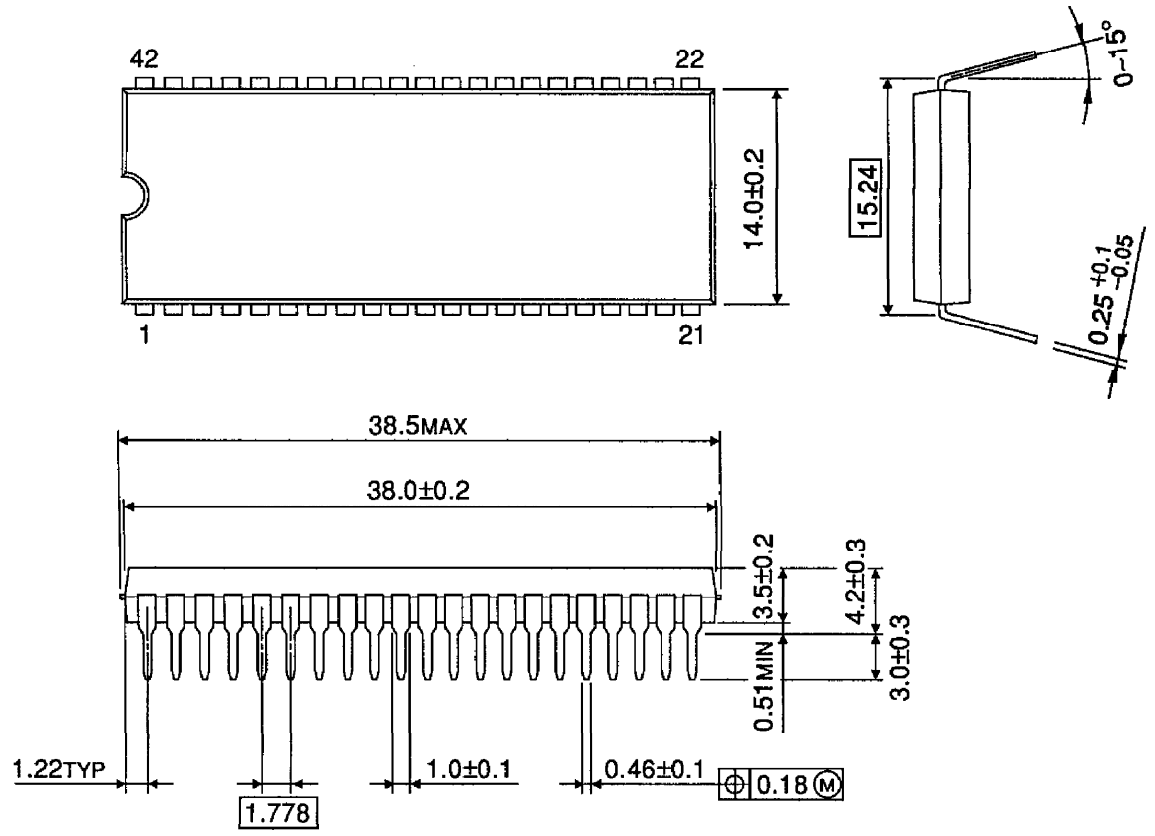
③ TAX RATE that has already held is still held under V_1 power supply, even if there is no V_2 power supply (no DC power supply).

<NOTE>

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



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