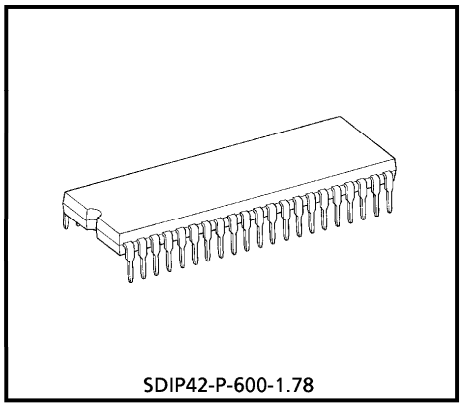
TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

TC83220-0006

TC83220-0006 SINGLE-CHIP CMOS LSI FOR FL (FLUORESCENT) CALCULATOR

The TOSHIBA printing / display calculator circuit TC83220-0006 is 10-digit calculator on single-chip CMOS LSI. TC83220-0006 can drive the printing machine (M-41V ; 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 : 12 digits of data.
  (including decimal point and minus signs.) 1 digit of operational symbol.
  3 digits of commas.
- Display : 10 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 calculations.
  Memory calculation.
  Automatic accumulating calculation.
  Gross margin profit calculation.
  Delta percent calculation.
  Tax calculation and grand total calculation are selectable.
  Two-key rollover

- Item counter : 0~999 count up or −999~0~999 count up/down by depressing of [+], [−], [±=], [−=] key.
- Punctuation : Commas for thousands on display.
- Kinds of touch key : [0]~[9], [·], [00], [000], [C], [CE], [C/CE], [+/−], [#/P], [Feed], [+], [−], [◇], [*], [×], [÷], [=], [%], [MU/D], [M+], [M−], [M◇], [M*], [Δ%], [M◇*], [IC], [→], [ON], [OFF], [±=], [−=], [GT], [+TAX], [−TAX], [SHIFT]
- 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", "AM".
  "IC+", "IC±" Item counter mode selectable switch.
  "GT" Grand total memory selectable switch.
- Duty of display : $\text{Duty} = \frac{1}{14.9}$
- Leading zero suppression
- Trailing zero suppression

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) Double depression of keys will be scan of fast key.

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

iii) Key bouncing Protection (at 4 MHz clock)

Key read in : 15ms
Key off : 40ms

Function Select

i) "$\overline{\text{TMR}}$" Selectable with auto power off mode

OFF ... Auto power off mode

ii) "TAX/$\overline{\text{GT}}$" Selectable with TAX RATE function or GT Mode

ON .... TAX RATE function

OFF ... GT function

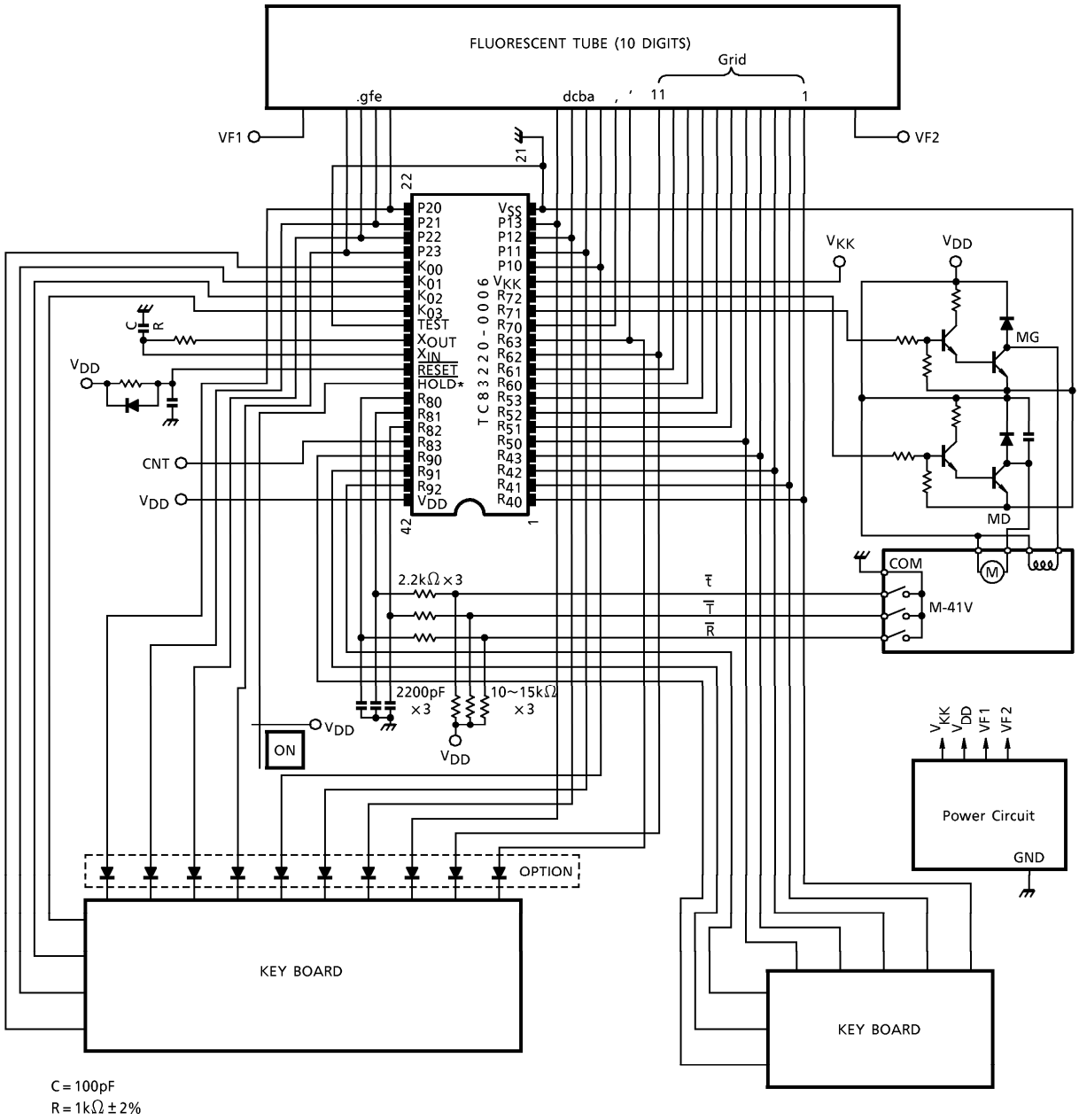
iii) "$\overline{\text{COMP}}$" Selectable with Commas Print

OFF ... Commas Print

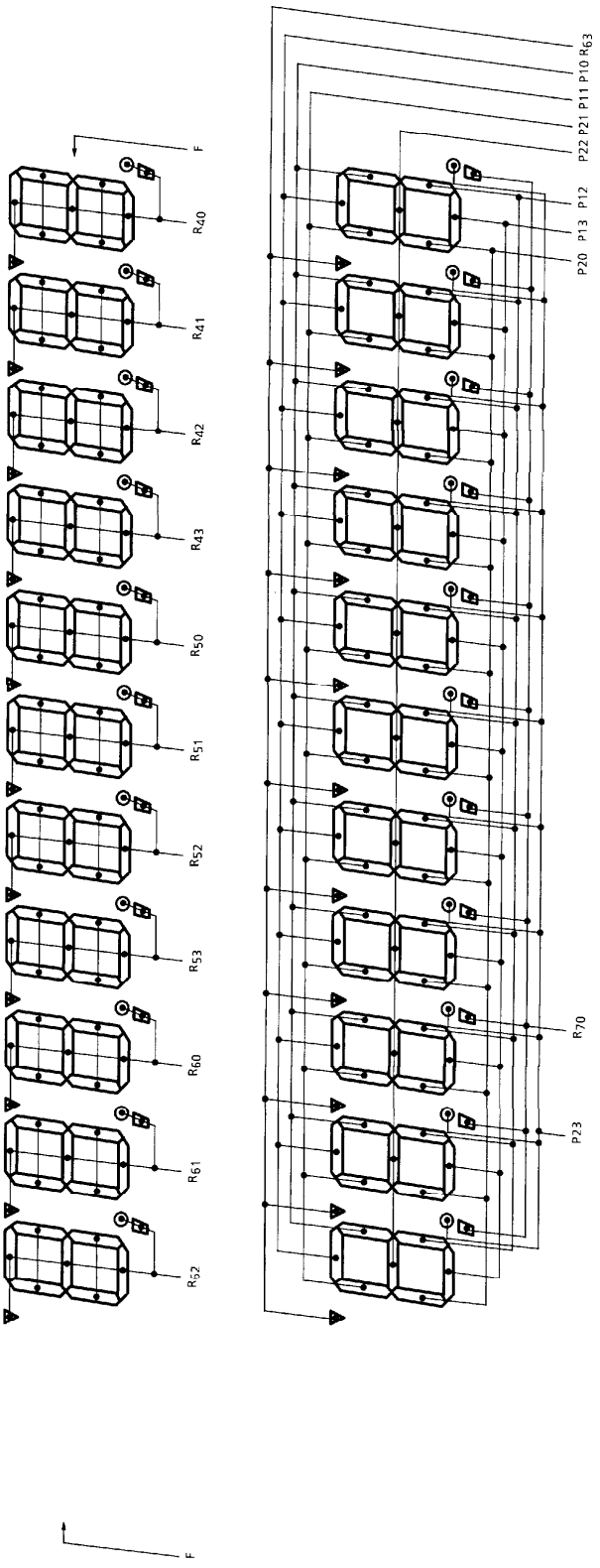
Speed of Calculation

i) Addition	1 + 1 +	31.2ms
ii) Multiplication	1 × 999999999999 =	26.8ms
iii) Division	999999999999 ÷ 1 =	100.6ms
iv) Memory calculation	999999999999 ÷ 1M +	108.8ms
v) Percentage calculation	1 × 999999999999%	35.2ms

SYSTEM DIAGRAM



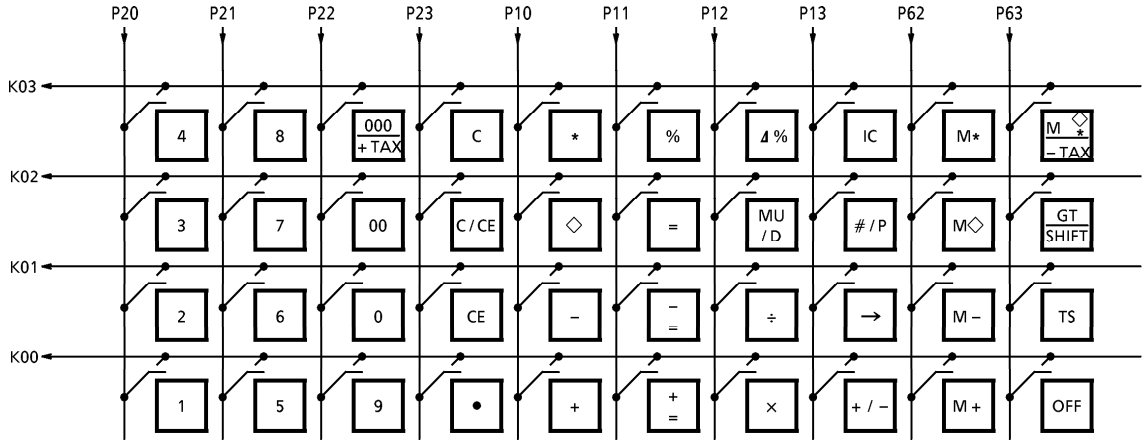
CONNECTION OF FL



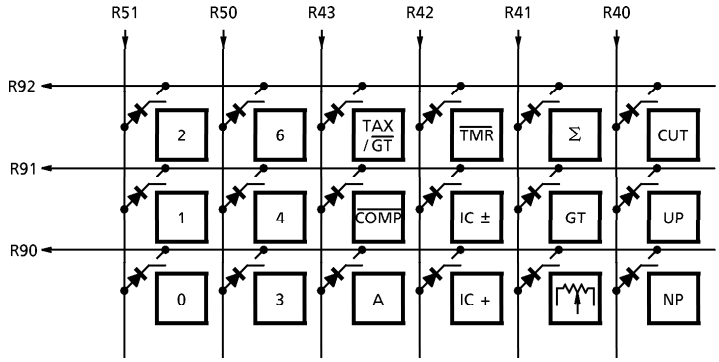
(Note 1) R_{62} digit (P10, P13, P20) of "E" Data.
(Note 2) R_{62} digit (P22) of "—" Data.
(Note 3) R_{62} digit (P23) of "M" Data.
(Note 4) R_{62} digit (P21) of "GT" Data.
(Note 5) R_{62} digit (P11) of "SHIFT" Flag.

TC83220-0006—05

KEY CONNECTION



Touch Key

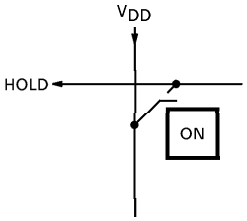


Lock Key

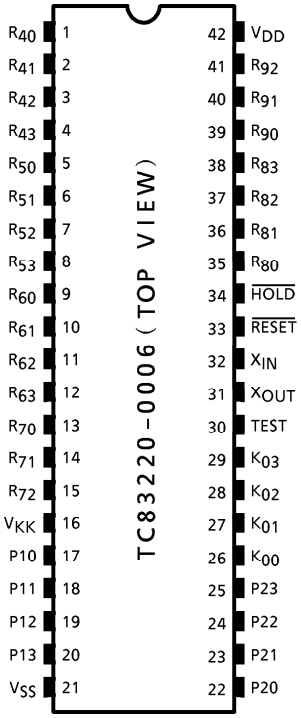
TAX / GT ··· SELECTABLE WITH TAX RATE FUN OR GT MODE

ON ··· TAX RATE FUNCTION
- TOUCH KEY is +TAX, –TAX, SHIFT

OFF ··· GT FUNCTION
- AVAILABLE ON LOCK KEY GT
- TOUCH KEY is M ◇ *, GT, 000



PIN ASSIGNMENT (TOP VIEW)



OPERATION EXAMPLE

KEY					TOUCH	PRINT			DISPLAY
TAB	4/5	IC	Σ	GT					
F	4/5	OFF	OFF	OFF					
					<ACL>	<PF>			
							C		
						<PF>			0.
					1 +	1.	+		1.
					2 –	2.	–		– 1.
					◇	– 1.			– 1.
					*	– 1.	*		
						<PF>			– 1.
					IC	2.			2.
		IC +			1 +	1.	+		1.
					2 –	2.	–		– 1.
					◇	002			
						– 1.	◇		– 1.
					*	002			
						– 1.	*		
						<PF>			– 1.
					IC	2.			2.
		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		M		
						2.	%		2.
					3 =	3.	=		
							–		
						0.06185567	*		
						2.06185567	*		2.06185567
						<PF>			
					2 ◢ %		–		
						2.	%		2.
					3 =	3.	=		
							–		
						1.	*		
						50.	*		50.
						<PF>			

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

KEY						PRINT			DISPLAY	
TAB	4/5	IC	Σ	GT	TOUCH					
F	4/5	OFF	Σ	OFF	3 ×	3.	×			3. X
					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
							M			
					2 MU/D	2.	%			2.
					3 =	3.	=			
							−			
						0.06185567	*			
						2.06185567	+			2.06185567
						<PF>	−			
					2 ⊿ %	2.	%			2.
					3 =	3.	=			
							−			
						1.	*			
						50.	+			
						<PF>				50.
					*	122.0285223	*			
						<PF>				122.0285223
					GT		T			
						0.	◇			0.
							T			
					*	5.	+			
						<PF>			G	5.
					3 −	3.	−		G	− 3.
					4 −	4.	−		G	− 4.
					5 −	5.	−		G	− 5.
					*		T			
						− 12.	+			
						<PF>			G	− 12.
							T			
					GT	− 7.	◇		G	− 7.
							T			
					GT	− 7.	*			

KEY				PRINT			DISPLAY	
TAB 4/5 IC	Σ	GT	TOUCH					
F	Σ	OFF		<PF>				–7.
		OFF	M+		M			
			OFF	–7.	+		M	–7.
			ON				M	0.
				<PF>				
					M			
			M◇	–7.	◇		M	–7.
					M			
			M*	–7.	*			

KEY					TOUCH	PRINT			DISPLAY	
TAB	4/5	IC	Σ	GT						
F	4/5	OFF	Σ	OFF						
						<PF>				−7.
					#/P	−7.				−7.
					2 #/P	#2				2.
					#/P	2.				2.
					0 ÷	0.	÷			0.
					=	----------				
						0.	*			
						<PF>			E	0.
					C	0.	C			
						<PF>				0.

Functional Operation

1 : Set Mode (TAB = F, 5 / 4 = ON)

KEY-IN	DISPLAY	PRINT (M-41V)	COMMENT
3	3.		
SHIFT	3.		
+TAX		S	SET TAX RATE.
	3.	3. %	

2 : Calculating on +TAX Mode

1560	1560.		
+TAX		1560.	
		46.8 ◇	TAX CHARGE.
		%	
		1606.8 +	
	1606.8	1 LINE SPACE	
+TAX	1606.8		
1560	1560.		
SHIFT	1560.		
SHIFT	1560.		
+TAX		1560.	
		46.8 ◇	TAX CHARGE.
		%	
		1606.8 +	
	1606.8	1 LINE SPACE	
1560	1560.		
×	1560.	1560. ×	
78900	78900.		
+TAX		78900.	
		2367. ◇	
		%	
		81267. +	
	81267.	1 LINE SPACE	

KEY-IN	DISPLAY	PRINT (M-41V)	COMMENT
5	5.		
×	5.	5. ×	
SHIFT	5.		
=		5. =	
		25. *	
	25.	1 LINE SPACE	
+TAX		25.	
		0.75 ◇	TAX CHARGE.
		%	
		25.75 +	
	25.75	1 LINE SPACE	
=	25.75		NOP.
1560	1560.		
+	1560.	1560. +	
1100	1100.		
+	2660.	1100. +	
+TAX		2660.	
		79.8 ◇	TAX CHARGE.
		%	
		2739.8 +	
	2739.8	1 LINE SPACE	
9800000000	9800000000.		
+TAX		9800000000.	
		294000000.	
		.....	
		1.009400000 *	ERROR.
	E 1.009400000	1 LINE SPACE	
1560	1560.		
+ / −	−1560.		
+TAX		−1560.	
		−46.8 ◇	TAX CHARGE.
		%	
		−1606.8 +	
	−1606.8	1 LINE SPACE	

3 : Check Mode

KEY-IN	DISPLAY	PRINT (M-41V)	COMMENT
1560	1560.		
SHIFT	1560.		
– TAX		T	
	3.	3. %	CHECK TAX RATE.
5	5.		
×	5.	5. ×	
SHIFT	5.		
– TAX		T	
	3.	3. %	CHECK TAX RATE.
=		3. =	
		15. *	
	15.	1 LINE SPACE	

4 : Calculating on – TAX Mode

1560	1560.		
– TAX		1560.	
		45.436894 ◇	TAX CHARGE.
		%	
		1514.563106 –	
	1514.563106	1 LINE SPACE	
– TAX	1514.563106		NOP.
1560	1560.		
SHIFT	1560.		
SHIFT	1560.		
– TAX		1560.	
		45.436894 ◇	TAX CHARGE.
		%	
		1514.563106 –	
	1514.563106	1 LINE SPACE	
1560	1560.		
×	1560.	1560. ×	
78900	78900.		
– TAX		78900.	
		2298.05826 ◇	TAX CHARGE.
		%	
		76601.94174 –	
	76601.94174	1 LINE SPACE	

KEY-IN	DISPLAY	PRINT (M-41V)	COMMENT
5	5.		
×	5.	5. ×	
SHIFT	5.		
=		5. =	
		25. *	
	25.	1 LINE SPACE	
– TAX		25.	
		0.72815534 ◇	TAX CHARGE.
		%	
		24.27184466 –	
	24.27184466	1 LINE SPACE	
	24.27184466		NOP.
1560	1560.		
+	1560.	1560. +	
1100	1100.		
+	2660.	1100. +	
– TAX		2660.	
		77.475729 ◇	TAX CHARGE.
		%	
		2582.524271 –	
	2582.524271	1 LINE SPACE	
1560	1560.		
+ / –	– 1560.		
– TAX		– 1560.	
		– 45.436894 ◇	TAX CHARGE.
		%	
		– 1514.563106 –	
	– 1514.563106	1 LINE SPACE	

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}	—	$V_{DD} \geqq 4.5V$	$V_{DD} \times 0.7$	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}	—	$V_{DD} \geqq 4.5V$	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

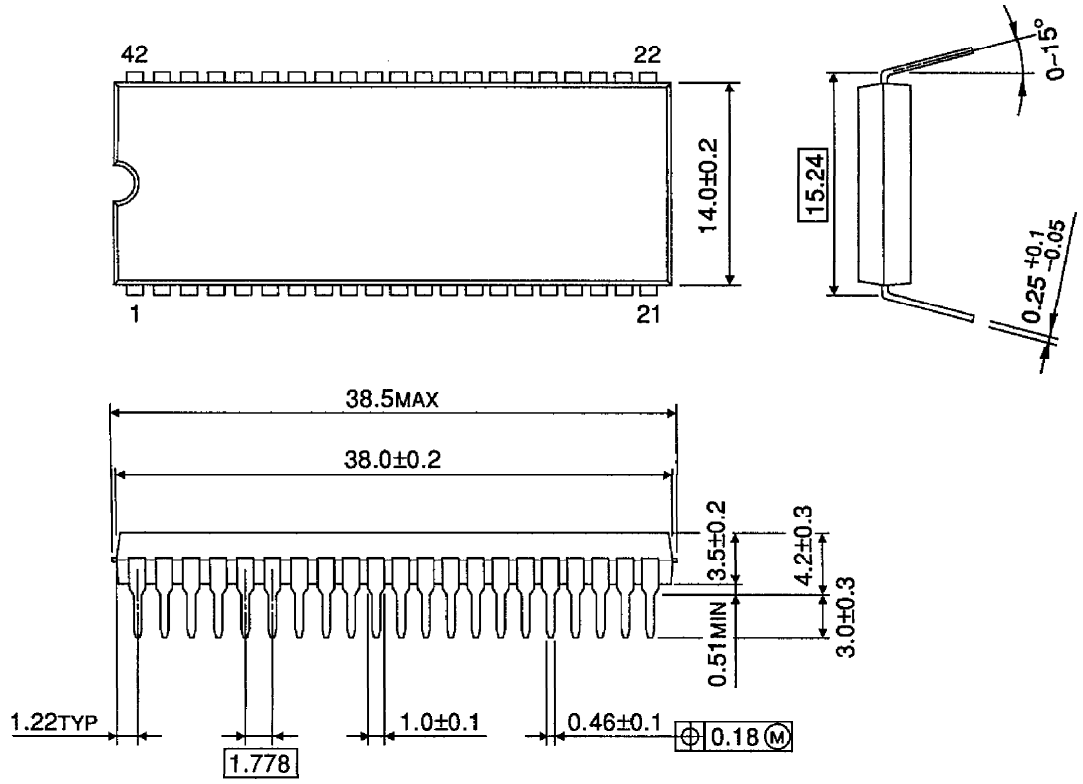
DC Characteristics (V_{SS} = 0 V, V_{DD} ± 10%, T_{opr} = 0~40°C)

PARAMETER	SYMBOL	TEST CIR-CUIT	CONDITION	MIN	TYP.	MAX	UNIT
Hysteresis Voltage (Schmitt circuit input)	V_{HS}	—	—	—	0.7	—	V
Input Current ($\overline{RESET}$, $\overline{HOLD}$, $\overline{TEST}$)	V_{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~R_9)	V_{OH}	—	V_{DD} = 4.5 V, V_{OH} = − 6 mA	2.4	—	—	V
Input Pull Down Resistor (K_0, R_7~R_9)	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_{DD} 0	—	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_{KK} 1	—	V_{KK} = − 30 V, f_c = 4 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 V	—	0.5	10	μA
Oscillating Frequency	Fφ	—	V_{DD} = 5.0 V, C = 100 pF R = 1 kΩ ± 2%	2.4	4.0	5.6	MHz

PACKAGE DEMENSIONS

SDIP42-P-600-1.78

Unit : mm



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