

# TC83220-0029

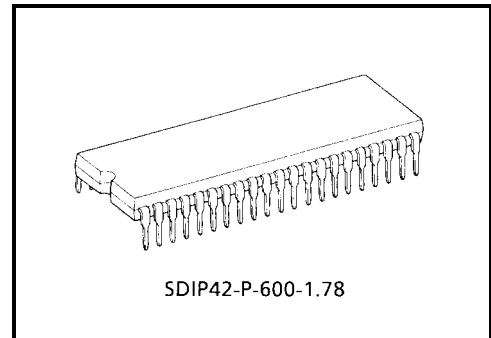
## TC83220-0029 CMOS Single-Chip LSI for FL (fluorescent) Calculator

The Toshiba printing/display calculator circuit TC83220-0029 is 10/12-digit calculator on single-chip CMOS LSI.

TC83220-0029 can drive the printing machine (M400A/M401A/M400E/M80\*; 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.

Note 1: Print font number:	M400A	001-300
	M401A	001-330
	M400E	001-310



Weight: 4.12 g (typ.)

### Features

#### Operational Features

- Print: 11/13 digits of data.  
(including decimal point 2 digit of operational symbol.)  
3 digits of commas.
- Display: 10/12 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 setting 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.  
Currency conversion calculation.  
Two-key rollover.
- Item counter: 0~999 count up or -999~0~999 count up/down by depressing of  $\boxed{+}$  or  $\boxed{+/-}$ ,  $\boxed{-}$  or  $\boxed{=-}$  key.
- Punctuation: Commas or space for thousands on display
- Kinds of touch key:  $\boxed{0} \sim \boxed{9}$ ,  $\boxed{\cdot}$ ,  $\boxed{00}$ ,  $\boxed{000}$ ,  $\boxed{C}$ ,  $\boxed{CE}$ ,  $\boxed{C/CE}$ ,  $\boxed{+/-}$ ,  $\boxed{\#/P}$ ,  $\boxed{\text{Feed}}$ ,  
 $\boxed{+}$  or  $\boxed{+/-}$ ,  $\boxed{-}$  or  $\boxed{=-}$ ,  $\boxed{\diamond}$ ,  $\boxed{*}$ ,  $\boxed{\times}$ ,  $\boxed{\div}$ ,  $\boxed{=}$ ,  $\boxed{\%}$ ,  $\boxed{MU/D}$ ,  $\boxed{M+}$ ,  
 $\boxed{M-}$ ,  $\boxed{M\diamond}$ ,  $\boxed{M*}$ ,  $\boxed{\Delta\%}$ ,  $\boxed{\rightarrow}$ ,  $\boxed{GT}$ ,  $\boxed{\sqrt{\quad}}$ ,  $\boxed{+TAX}$ ,  $\boxed{-TAX}$ ,  $\boxed{E \text{ to } H}$ ,  
 $\boxed{H \text{ to } E}$ ,  $\boxed{SET}$

- 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”, “ADD+”, “ADDX”.  
     “IC+” “IC±” item counter mode selectable switch.  
     “GT” grand total memory selectable switch.
- Duty of display: Duty = 1/16.5
- Leading zero suppression
- Trailing zero suppression
- Tax calculation: +TAX key is calculation for included tax.  
     -TAX key is calculation for excluded tax.  
     SET key is store the tax rate to memory.  
     Depression of +TAX or -TAX after clear function, recall tax rate and into the setting mode.  
     Depression of SET stores number of display to memory at the setting mode.  
     Depression of +TAX following data key performs the calculating included tax.  
     Depression of -TAX following data key performs the calculating excluded tax.
- Currency conversion  
     Calculation: E to H key is calculation for home currency.  
     H to E key is calculation for Euro currency.  
     SET key is store the currency rate for Euro to memory (ex. 1 Euro = 1.23456).  
     Depression of E to H or H to E after clear function.  
     Recall currency rate and into the setting mode.  
     Depression of SET stores number of display to memory at the setting mode.  
     Depression of E to H following data key performs the conversion Euro to Home currency.  
     Depression of H to E following data key performs the conversion Home to Euro currency.

## Electrical Features

- P-MOS output buffer with pull down resistor for direct driving of fluorescent display tube.
- Dual in line package.

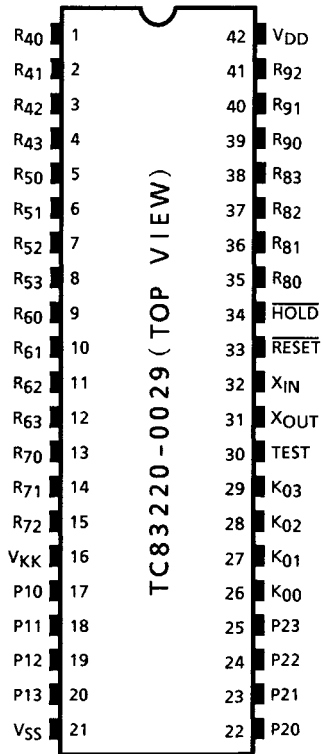
## Protection

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

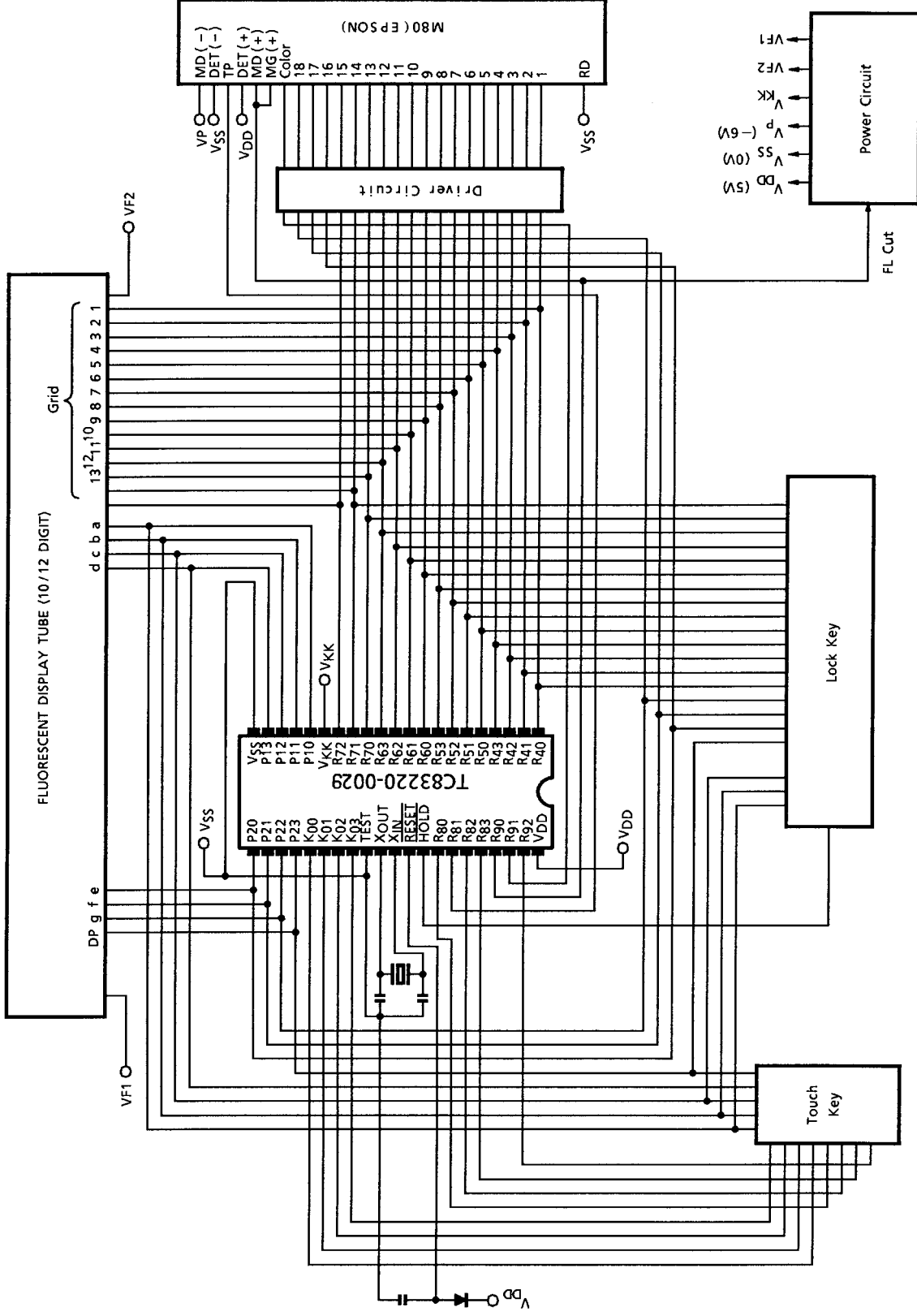
## Function Select

- (1) “10/12” selectable with auto power off mode
  - ON.....10-digit calculated
  - OFF.....12-digit calculated

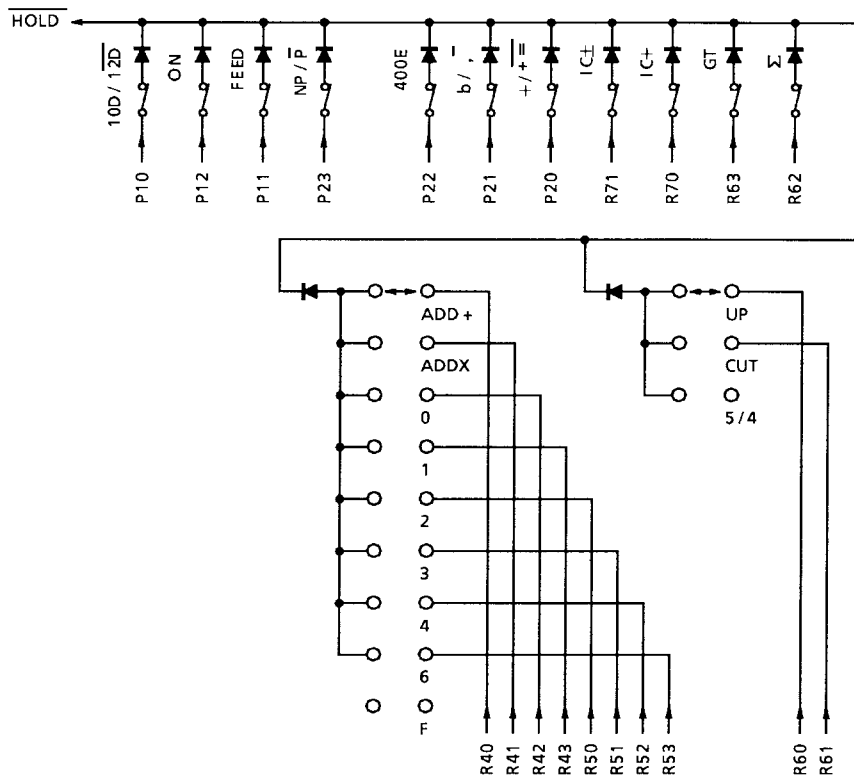
**Pin Assignment (top view)**



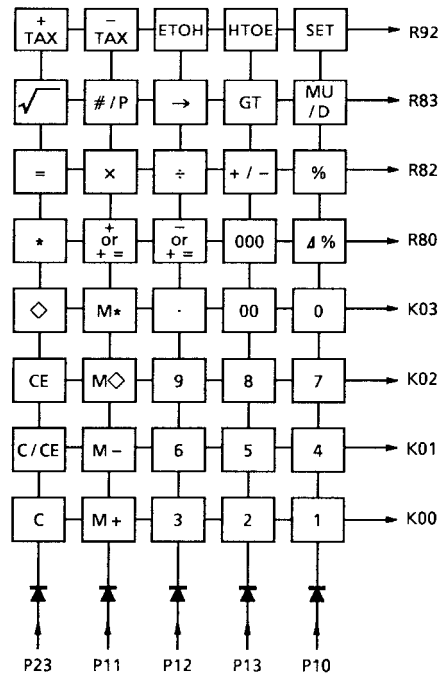
System Diagram



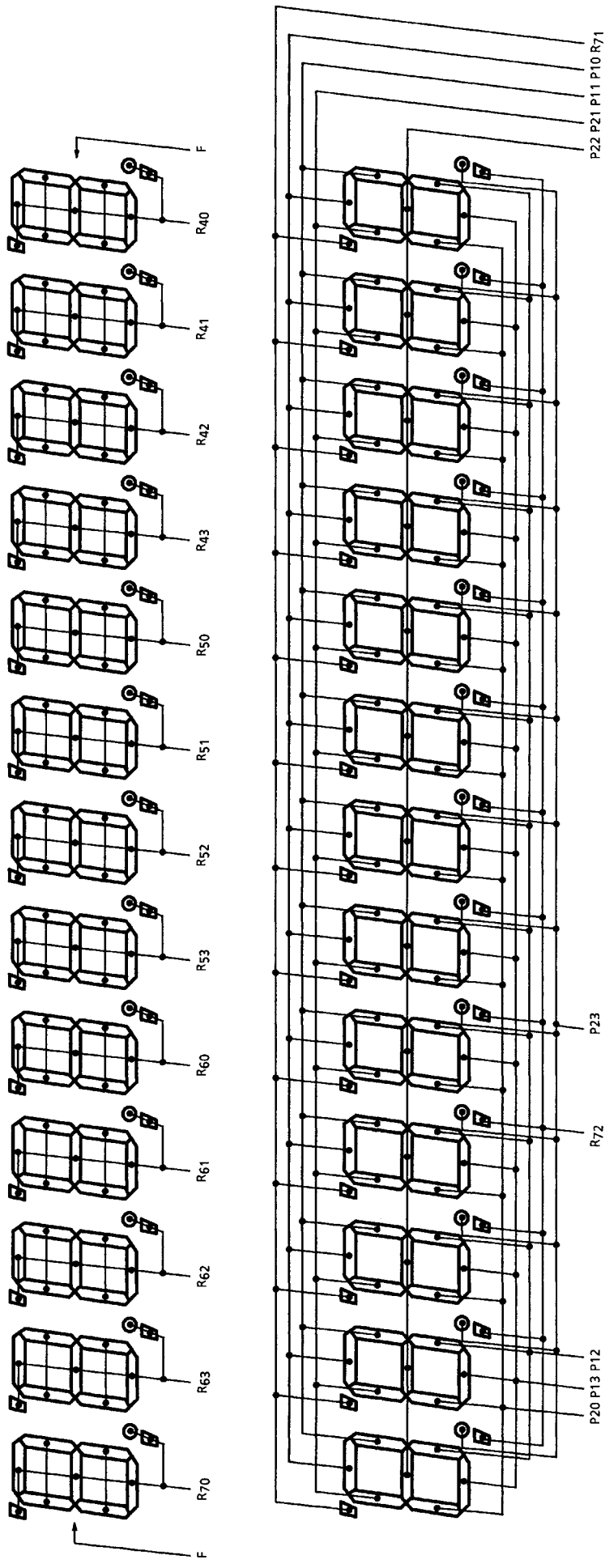
**Key Connection**



**Lock Key**



**Touch Key**

**Connection of FL**

Note 2: R70 digit (P20) of "E" data.

Note 3: R70 digit (P22) of "L" data.

Note 4: R70 digit (P23) of "M" data.

Note 5: R70 digit (P21) of "GT" data.

## Operation Example

Key						Touch	Print		Display
TAB	4/5	IC	10/12	Σ	GT				
F	4/5	OFF	10	OFF	OFF	POWER ON			
							<PF>		
								C	
							<PF>		0.
						1+	1.	+	1.
						2-	2.	-	-1.
						◇	1.	- ◇	-1.
						*	1.	- *	-1.
							<PF>		-1.
		IC+				1+	1.	+	1.
						2-	2.	-	-1.
						◇	002		
						*	002		
							1.	- ◇	-1.
							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.	M	2.
						3=	3.	%	
							0.06185567	Δ *	
							2.06185567	*	
							<PF>		2.06185567
						2Δ%	2.	Δ	2.
						3=	3.	=	
							1.	Δ *	
							50.	Δ %	50.
							<PF>		

Note 6: <PF> .....Paper feed

PRINT COLOR.....R: Red

.....No mark: Black

Key						Print			Display	
TAB	4/5	IC	10/12	Σ	GT	Touch				
F	4/5	OFF	10	Σ	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.	+		
							<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.	$\overline{G}$ + R		
							<PF>			-12.
						GT	7.	$\overline{G}$ ◊ R		-7.
						GT	7.	$\overline{G}$ * R		
							<PF>			-7.
		OFF				M+	-7.	$\overline{M}$ + R	M	-7.
						C	0.	C	M	0.

Note 6: <PF> .....Paper feed  
 PRINT COLOR.....R: Red  
 .....No mark: Black



Key						Touch	Print			Display		
TAB	4/5	IC	10/12	Σ	GT							
						M $\diamond$		<PF>			M	-7.
						M*		7. $\overline{M} \diamond$	R			
								7. $\overline{M} *$	R			
F	4/5	OFF	10	Σ	OFF			<PF>				-7.
						#/P		7. - $\diamond$	R			-7.
						2 #/P	#2					2.
						#/P		2. $\diamond$				2.
						0÷		0. ÷				0.
						=		0. =				
								ERROR				
								0. *				
								<PF>			E	0.
						C		0. C				
								<PF>				0.
F	CUT	OFF	12	OFF	OFF							
						C		0. C				0.
								<PF>				
						+TAX		0. %				0.
						5						5.
						SET		5. %				5.
								<PF>				
						C		0. C				0.
								<PF>				
						-TAX		5. %				5.
						3						3.
						SET		3. %				3.
								<PF>				
						1560						1,560.
						+TAX		1,560.				
								46.8 $\Delta$				
								1,606.8 *				
								<PF>				1,606.8
						+TAX		1,606.8 $\diamond$				
								48.204 $\Delta$				
								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. $\diamond$				
								3,692,520. $\Delta$				
								126,776,520. *				

Note 6: <PF> .....Paper feed  
 PRINT COLOR.....R: Red  
 .....No mark: Black

Key						Print	Display
TAB	4/5	IC	10/12	Σ	GT		
						<PF>	126,776,520.
						=	126,776,520.
						5	5.
						×	5.
						+TAX	5.
						=	5.
						25.	*
						<PF>	25.
F	CUT	OFF	12	OFF	OFF	+TAX	25.
						0.75	Δ
						25.75	*
						<PF>	25.75
						=	25.75
						C	0.
						<PF>	0.
2						1560	1,560.
						+	1,560.00
						1100	1,100.
						+	1,100.00
						+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
						ERROR	
						1.009400000000	*
						<PF>	E 1.009400000000
						C	0.
						<PF>	0.
						1560	1560.
						+/-	-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 6: <PF> .....Paper feed  
 PRINT COLOR.....R: Red  
 .....No mark: Black

Key						Touch	Print			Display
TAB	4/5	IC	10/12	Σ	GT					
F	CUT	OFF	12	OFF	OFF		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
F						C	0.	C		0.
							<PF>			
						ETOH	1.0000	R		1.00000
						1.92003				1.92003
						SET	1.92003	R *		1.92003
							<PF>			
						C	0.	C		0.
							<PF>			
						1500 HTOE	1,500.	K ÷		781.237793159
							1.92003	R =		
							781.237793159	*		
							<PF>			
ADD + CUT						1500 HTOE	1,500.	K ÷		781.23
							1.92003	R =		
							781.23	*		
							<PF>			
						HTOE				781.23
						ETOH	1,500.	K		1,500.
						+	1,500.00	+		1,500.00
4 CUT						HTOE	1,500.00	K ÷		781.2377
							1.92003	R =		
							781.2377	*		
							<PF>			
						=				781.2377
						HTOE				781.2377
						×	781.2377	×		781.2377
						HTOE	781.2377	K ÷		406.8882
							1.92003	R =		
							406.8882	*		
							<PF>			
						ETOH	781.2377	K		781.2377

Note 6: <PF> .....Paper feed  
 PRINT COLOR.....R: Red  
 .....No mark: Black

Key						Print	Display	
TAB	4/5	IC	10/12	Σ	GT			Touch
						HTOE	781.2377 K ÷ 1.92003 R = 406.8882 * <PF>	406.8882
						C	0. C <PF>	0.
						HTOE	1.92003 R	1.92003
						23.5308		23.5308
						SET	23.5308 R * <PF>	23.5308
F						200.5001 ETOH	200.5001 K × 23.5308 R = 4,717.92775308 * <PF>	4,717.92775308
						200.5001 ETOH	200.5001 K × 23.5308 R = 4,718. * <PF>	4,718.
0	4/5					=		4,718.
						ETOH		4,718.
						×	4,718. ×	4,718.
						ETOH	4,718. K × 23.5308 R = 111,018. * <PF>	111,018.

Note 6: <PF> .....Paper feed  
 PRINT COLOR.....R: Red  
 .....No mark: Black

## 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 7)	$T_{WCH}$	—	$V_{IN} = V_{IH}$	80	—	ns
Clock low pulse width (Note 7)	$T_{WCL}$	—	$V_{IN} = V_{IL}$	80	—	ns

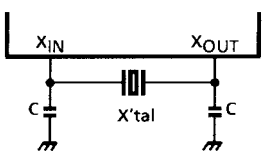
Note 7: In case of the external clock operation.

**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	—	k $\Omega$
Pull down resistor (source open drain)	$R_{KK}$	—		50	80	200	k $\Omega$
Operating supply current	$I_{DD 0}$	—	$V_{DD} (V_{DDH}) 5.5\text{ V}$ , $f_c = 4\text{ MHz}$ $V_{IN} = 5.3/0.2\text{ V}$	—	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	mA
Holding supply current	$I_{DD H}$	—	$V_{DD} = 5.5\text{ V}$	—	0.5	10	$\mu\text{A}$

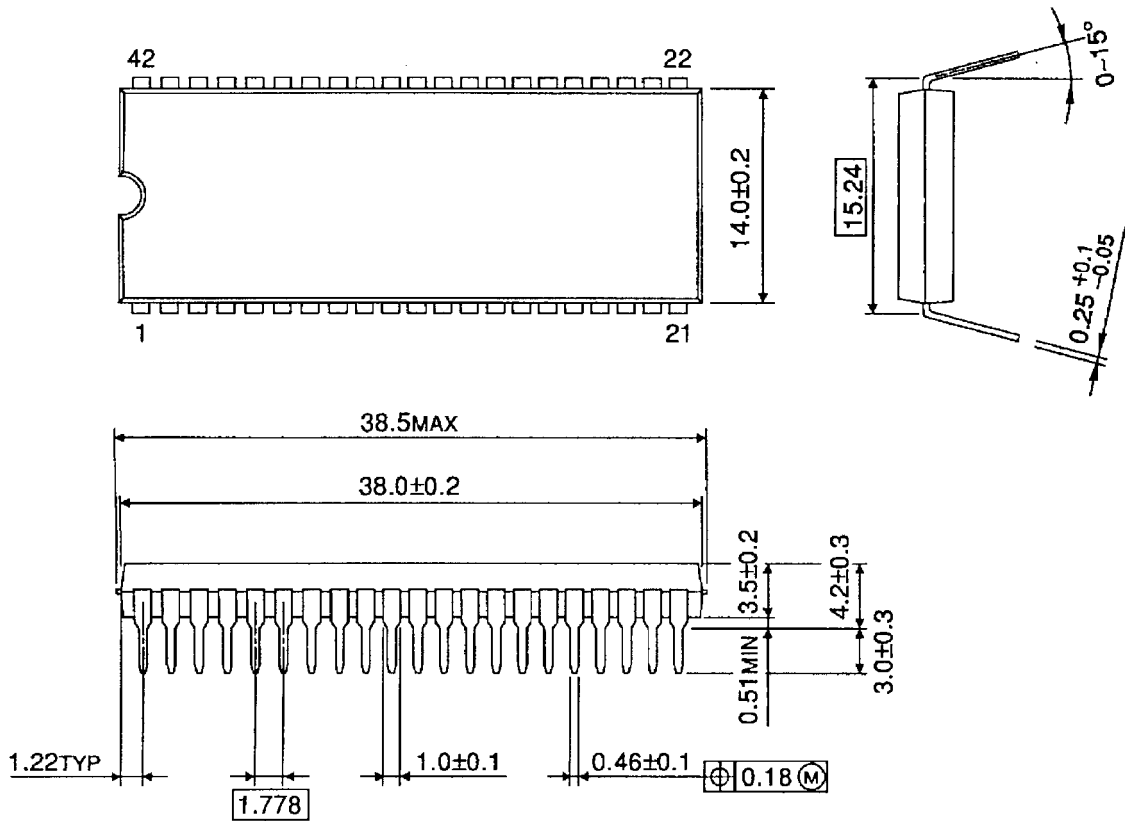
**Oscillation Characteristics ( $T_{opr} = 0\sim 40^\circ\text{C}$ ,  $V_{DD} = 4.5\sim 6.0\text{ V}$ )**

Circuit	Test Condition	Min	Typ.	Max	Unit
	$C = 10\text{ pF}$ $X'tal$ (or ceramic) = 4 MHz	—	4	—	MHz

**Package Dimensions**

SDIP42-P-600-1.78

Unit : mm



Weight: 4.12 g (typ.)

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000707EBA

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