TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT   SILICON MONOLITHIC

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 4K-word ROM, a 256 × 4-bit RAM.
* Print font number : M400A   001-300
                       M401A   001-330
                       M400E   001-310
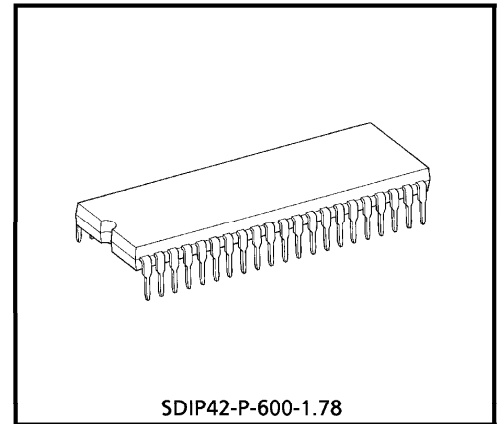
SDIP42-P-600-1.78

Weight : 4.12 g (Typ.)

FEATURES

Operational Features

- Print   : 11 / 13 digits of data.
                    (including decimal point. 2 digits 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 function (+, −, ×, ÷).
                    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.

980910EBA1

● Item counter   : 0~999 count up or −999~0~999 count up / down by depressing of ⊞+⊟ or

                    $\boxed{\frac{+}{=}}$, $\boxed{-}$ or $\boxed{\frac{-}{=}}$ key.

● Punctuation   : Commas or space for thousands on display

● Kinds of touch key : $\boxed{0}$ ~ $\boxed{9}$, $\boxed{\cdot}$, $\boxed{00}$, $\boxed{000}$, $\boxed{C}$, $\boxed{CE}$, $\boxed{C/CE}$, $\boxed{+/-}$, $\boxed{\#/P}$, $\boxed{Feed}$,

                     $\boxed{+}$ or $\boxed{\frac{+}{=}}$, $\boxed{-}$ or $\boxed{\frac{-}{=}}$, $\boxed{\diamondsuit}$, $\boxed{*}$, $\boxed{\times}$, $\boxed{\div}$, $\boxed{=}$, $\boxed{\%}$, $\boxed{MU/D}$, $\boxed{M+}$,

                     $\boxed{M-}$, $\boxed{M\diamondsuit}$, $\boxed{M*}$, $\boxed{\Delta\%}$, $\boxed{\rightarrow}$, $\boxed{GT}$, $\boxed{\sqrt{\ }}$, $\boxed{+TAX}$, $\boxed{-TAX}$, $\boxed{E\ to\ H}$,

                     $\boxed{H\ to\ E}$, $\boxed{SET}$

● 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 = $\dfrac{1}{16.5}$

● Leading zero suppression

● Trailing zero suppression

● Tax calculation   : $\boxed{+TAX}$ key is calculation for included tax.

                   $\boxed{-TAX}$ key is calculation for excluded tax.

                   $\boxed{SET}$ key is store the tax rate to memory.

                   Depression of $\boxed{+TAX}$ or $\boxed{-TAX}$ after clear function, recall tax rate and into the setting mode.

                   Depression of $\boxed{SET}$ stores number of display to memory at the setting mode.

                   Depression of $\boxed{+TAX}$ following data key performs the calculating included tax.

                   Depression of $\boxed{-TAX}$ following data key performs the calculating excluded tax.

● Currency conversion

Calculation   :   &boxed;E to H&boxed; key is calculation for home currency.

&boxed;H to E&boxed; key is calculation for Euro currency.

&boxed;SET&boxed; key is store the currency rate for Euro to memory (ex. 1 Euro = 1.23456).

Depression of &boxed;E to H&boxed; or &boxed;H to E&boxed; after clear function.

Recall currency rate and into the setting mode.

Depression of &boxed;SET&boxed; stores number of display to memory at the setting mode.

Depression of &boxed;E to H&boxed; following data key performs the conversion Euro to Home currency.

Depression of &boxed;H to E&boxed; 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

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

SYSTEM DIAGRAM
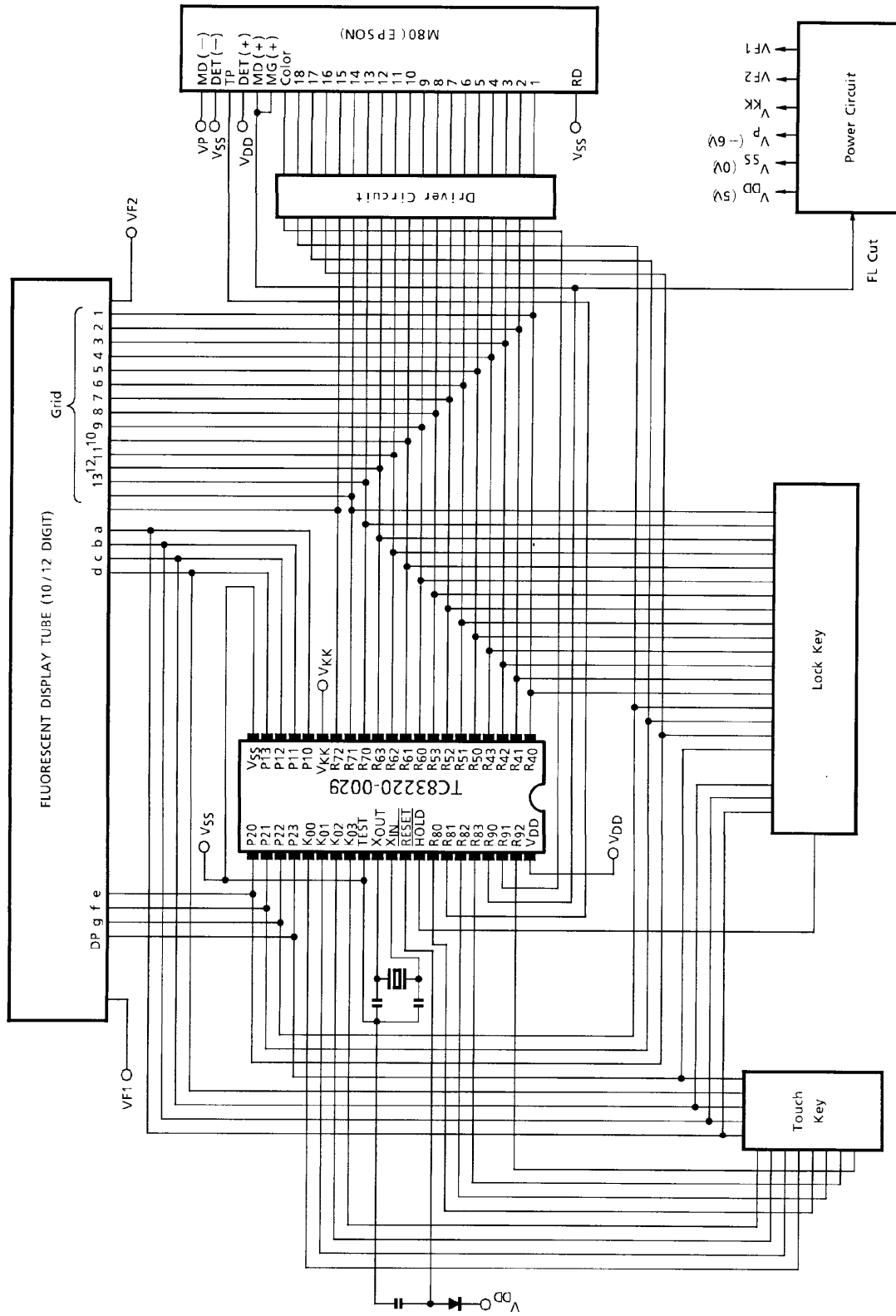
TC83220-0029—04

KEY CONNECTION
LOCK KEY
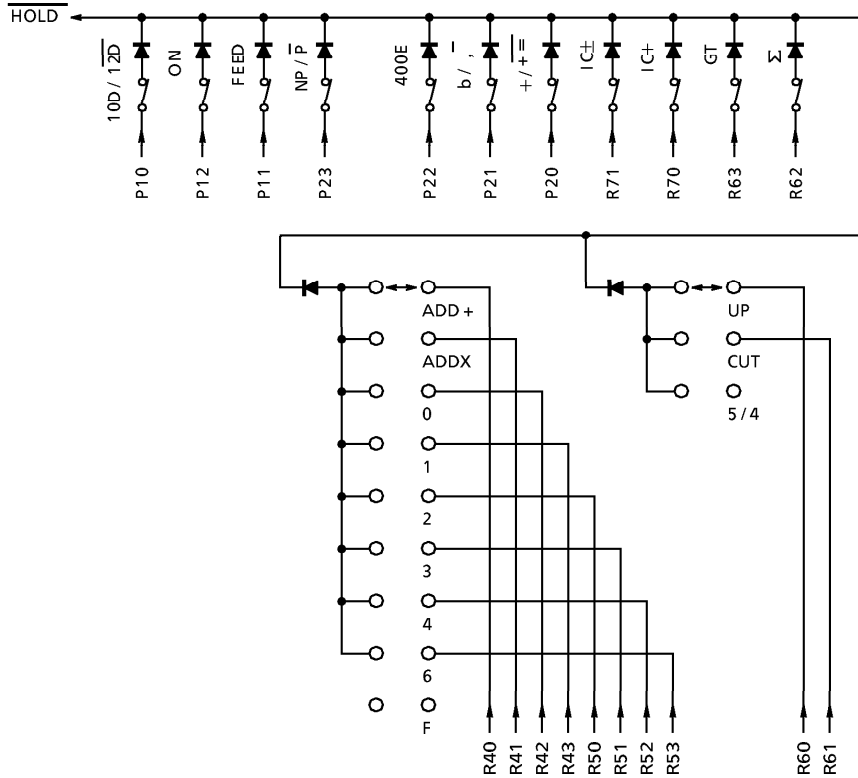
TOUCH KEY
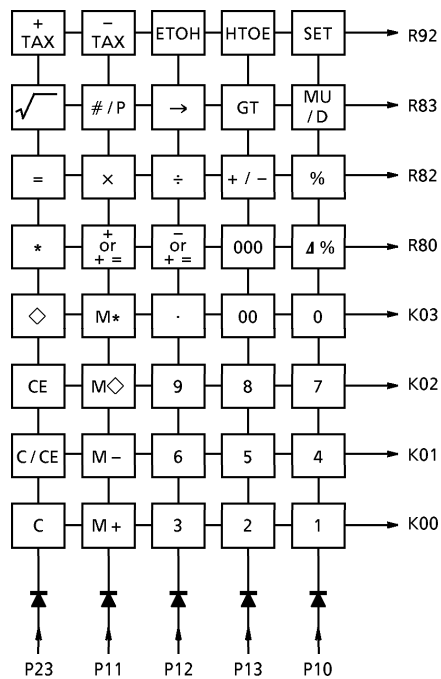
CONNECTION OF FL
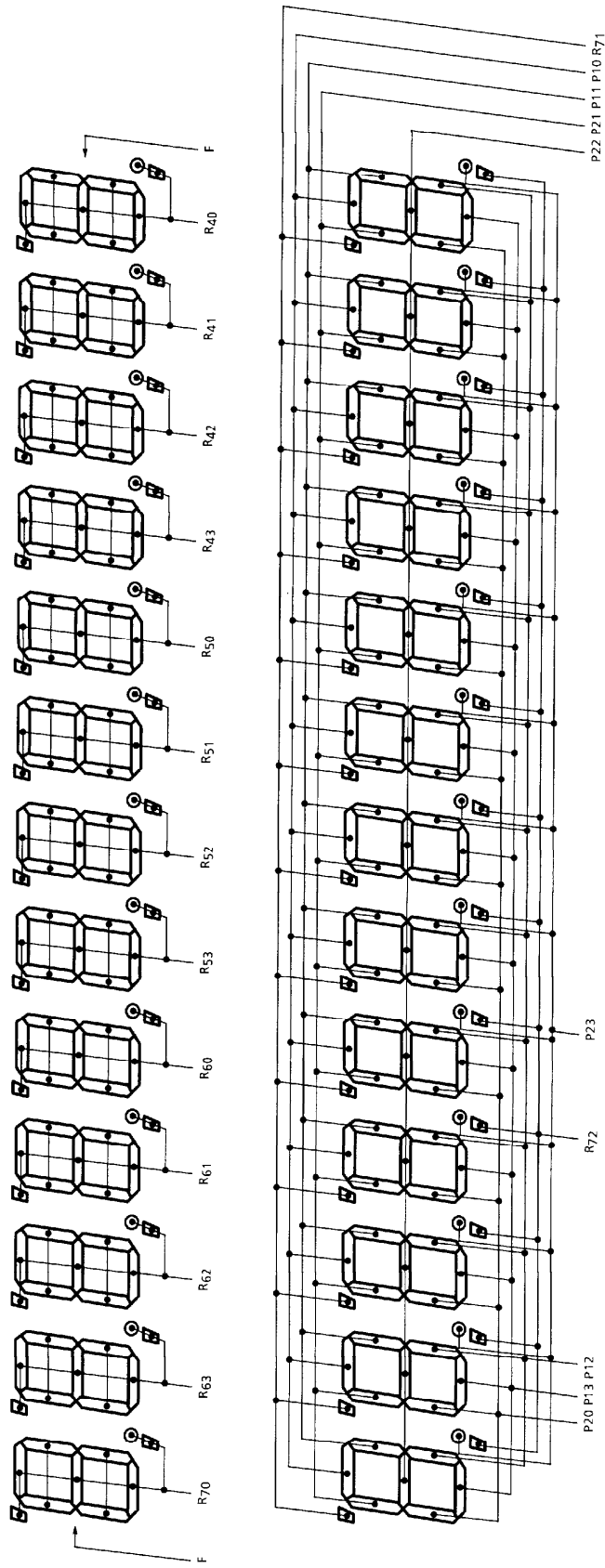
(Note 1) R70 digit (P20) of "E" Data.
(Note 2) R70 digit (P22) of "—" Data.
(Note 3) R70 digit (P23) of "M" Data.
(Note 4) R70 digit (P21) of "GT" Data.

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PIN ASSIGNMENT (TOP VIEW)

```
              ┌────⌣────┐
   R40  ──│ 1        42 │── VDD
   R41  ──│ 2        41 │── R92
   R42  ──│ 3        40 │── R91
   R43  ──│ 4        39 │── R90
   R50  ──│ 5        38 │── R83
   R51  ──│ 6        37 │── R82
   R52  ──│ 7        36 │── R81
   R53  ──│ 8        35 │── R80
   R60  ──│ 9        34 │── HOLD
   R61  ──│ 10       33 │── RESET
   R62  ──│ 11       32 │── XIN
   R63  ──│ 12       31 │── XOUT
   R70  ──│ 13       30 │── TEST
   R71  ──│ 14       29 │── K03
   R72  ──│ 15       28 │── K02
   VKK  ──│ 16       27 │── K01
   P10  ──│ 17       26 │── K00
   P11  ──│ 18       25 │── P23
   P12  ──│ 19       24 │── P22
   P13  ──│ 20       23 │── P21
   VSS  ──│ 21       22 │── P20
              └─────────┘
        TC83220-0029 (TOP VIEW)
```
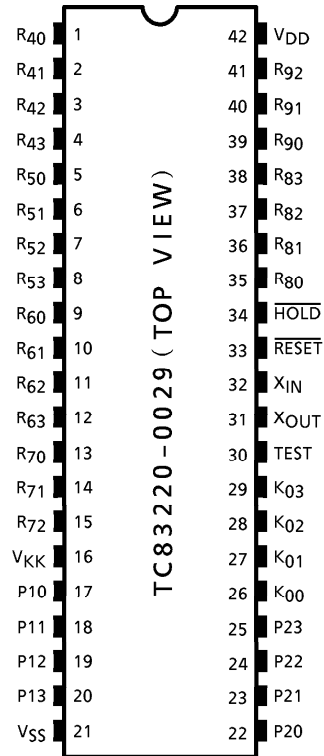
OPERATION EXAMPLE

KEY						PRINT		DISPLAY
TAB 4/5	IC 10/12 Σ	GT	TOUCH					
F 4/5	OFF 10	OFF	OFF	POWER ON				
						<PF>		
						C		
						<PF>		0.
				1 +		1. +		1.
				2 −		2. −	R	− 1.
				◇		1. − ◇	R	− 1.
				*		1. − *	R	− 1.
						<PF>		− 1.
	IC +			1 +		1. +		1.
				2 −		2. −	R	− 1.
				◇	002	1. − ◇	R	− 1.
				*	002	1. − *	R	− 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 + %		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
				2 Δ %		2. Δ		2.
				3 =		3. =		
						1. Δ *		
						50. Δ %		50.
						<PF>		

(Note) : <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		GT	0. G ◇		0.
						2 +	2. +		2.
						3 +	3. +		5.
						*	5. G +		
							<PF>		5.
						3 −	3. −	R	− 3.
						4 −	4. −	R	− 7.
						5 −	5. −	R	− 12.
						*	12. G̅ +	R	
							<PF>		− 12.
						GT	7. G̅ ◇	R	− 7.
						GT	7. G̅ *	R	− 7.
							<PF>		− 7.
				OFF		M +	− 7. M̅ +	R	M − 7.
						C	0. C		M 0.

KEY							PRINT		DISPLAY	
TAB	4/5	IC	10/12	Σ	GT	TOUCH				
						M◇	<PF>		M	−7.
						M*	7. M̄ ◇	R		
							7. M̄ *	R		
F	4/5	OFF	10	Σ	OFF		<PF>			−7.
						#/P	7. − ◇	R		−7.
						2 #/P	#2			2.
						#/P	2. ◇			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 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.
						×	1,560. ×			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	TOUCH			
		< PF >		126,776,520.
	=			126,776,520.
	5			5.
	×	5.	×	5.
	+ TAX			5.
	=	5.	=	
		25.	*	
		< PF >		25.
F CUT OFF 12 OFF OFF	+ TAX	25.	◇	
		0.75	⊿	
		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	⊿	
		2,739.80	*	
		< PF >		2,739.80
F	+ TAX	2,739.80	◇	
		82.194	⊿	
		2,821.994	*	
		< PF >		2,821.994
	980000000000			980,000,000,000.
	+ TAX	980,000,000,000.		
		29,400,000,000.	⊿	
		ERROR		
		1.00940000000	*	
		< PF >		E 1.00940000000
	C	0.	C	
		< PF >		0.
	1560			1560.
	+ / −			− 1,560.
	+ TAX	1,560.	−	R
		46.8	⁻⊿	R
		1,606.8 −	*	R
		< PF >		− 1,606.8
	1560			1,560.
	− TAX	1,560.		

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>		
Aᴅᴅ + 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

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

MAXIMUM RATINGS (V_{SS} = 0 V)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage 1	V_{DD}	$-0.5 \sim 7$	V
Supply Voltage 2	V_{KK}	$-40 \sim +0.5$	V
Input Voltage	V_{IN}	$-35 \sim V_{DD} + 0.5$	V
Output Voltage	V_{OUT}	$-35 \sim V_{DD} + 0.5$	V
Output Current	I_{OUT}	-10	mA
Power Dissipation (T_{opr} = 70°C)	P_D	600	mW
Soldering Temperature, Time	T_{sld}	260 (10 s)	°C
Storage Temperature	T_{stg}	$-55 \sim 125$	°C
Operating Temperature	T_{opr}	$0 \sim 40$	°C

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

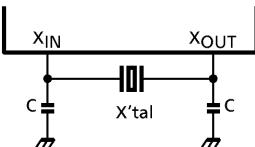| CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	CONDITION	MIN	MAX	UNIT
Operating Temperature	T_{opr}	—	—	0	40	°C
Supply Voltage	V_{DD}	—	—	4.5	6	V
Supply Voltage (FL)	V_{KK}	—	—	-30	-15	
Supply Voltage (Hold)	V_{DDH}	—	—	2	6	
Input High Voltage (Except Schmitt circuit input)	V_{IH1}	—	$V_{DD} \geqq 4.5\,V$	$V_{DD} \times 0.7$	V_{DD}	V
Input High Voltage (Schimitt circuit input)	V_{IH2}	—		$V_{DD} \times 0.75$	V_{DD}	
Input High Voltage	V_{IH3}	—	$V_{DD} < 4.5\,V$	$V_{DD} \times 0.9$	V_{DD}	
Input Low Voltage (Except Schimitt circuit input)	V_{IL1}	—	$V_{DD} \geqq 4.5\,V$	V_{KK}	$V_{DD} \times 0.3$	
Input Low Voltage (Schimitt circuit input)	V_{IL2}	—		V_{KK}	$V_{DD} \times 0.25$	
Input Low Voltage	V_{IL3}	—	$V_{DD} < 4.5\,V$	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)	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
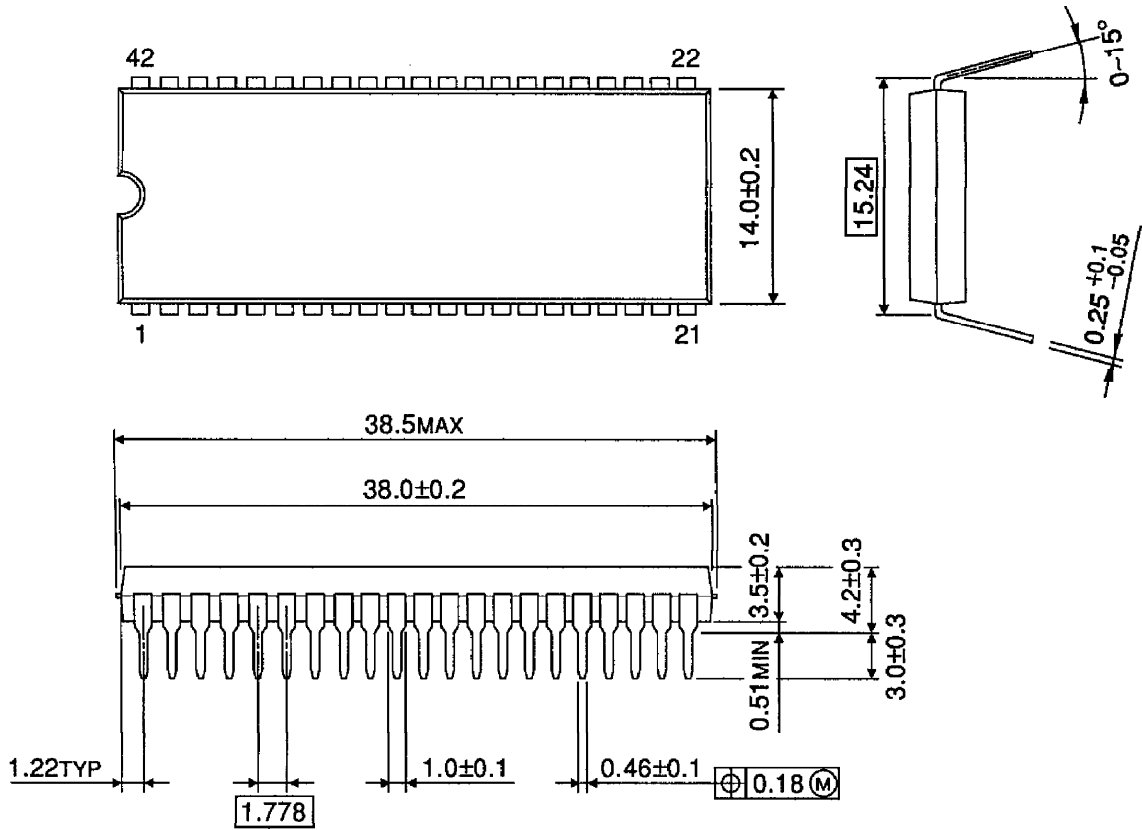D.C. CHARACTERISTICS (V_{SS} = 0 V, $V_{DD} \pm 10\%$, T_{opr} = 0~40°C)

PARAMETER	SYMBOL	TEST CIR-CUIT	CONDITION	MIN	TYP.	MAX	UNIT
Hysteresis Voltage (Schimitt 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~R_9)	V_{OH}	—	V_{DD} = 4.5 V, I_{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	—	$k\Omega$
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

OSCILLATION CHARACTERISTICS (T_{opr} = 0~40°C, V_{DD} = 4.5~6.0 V)

CIRCUIT	CONDITION	MIN	TYP.	MAX	UNIT
	C = 10 pF X'tal (or Ceramic) = 4 MHz	—	4	—	MHz

PACKAGE DIMENSIONS

SDIP42-P-600-1.78

Unit : mm

Weight : 4.12 g (Typ.)