

T-49-13-02  
**UM3150**

PRELIMINARY

**10/12-Digit Calculator**

**Features**

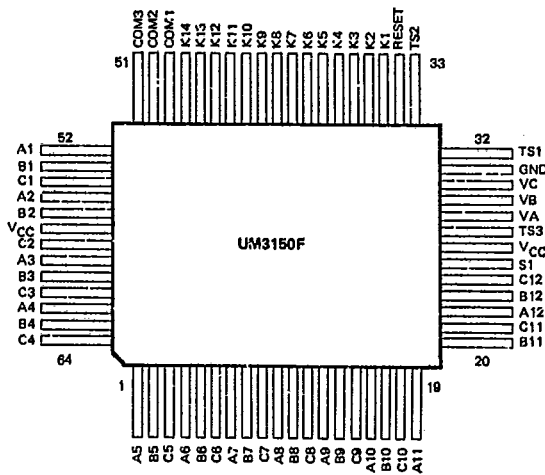
- Display: 10 or 12 digits (pin-programmable) with sign; error and memory load symbols
- Standard four functions (+, -, x, ÷)
- Change sign function
- Chain calculation
- Constant calculation
- Square and reciprocal calculations
- Automatic percentage operation with add-on, discount
- Automatic delta percentage, mark-up and mark-down operations
- Square root
- Floating point or momentary mode
- Fixed point ("0", "1", "2", "3", "4" or "6" format) or floating point (switch selectable)
- Add point mode (switch selectable)
- Rounding switches (rounding up, down and off)
- Leading zero and trailing zero suppression
- Punctuation for display, commas for thousands
- Memory and grand total (GT) calculations
- Accumulating GT memory register with count up (down) item counter
- Memory and GT memory contents Indicator, turned on with non-zero in the memory or GT memory
- Registration overflow indicating. (too many digits entered)
- Result overflow indicating
- Memory overflow indicating (with flashing)
- Direct driving of LCD
- Built-in RC oscillator
- Auto-power-off function
- Available in quad in-line flat package (64 pin) or chip form

**General Description**

The UM3150 is a single-chip CMOS calculator LSI with 10/12 digit capacity, two memories. Keyboard encoding and debouncing are internal to chip. It is designed for LCD operation with a 1.5V power supply. Single power

supply operation, wide operating voltage range and low power consumption make it suitable for battery or solar battery operated calculators.

**Pin Configuration**

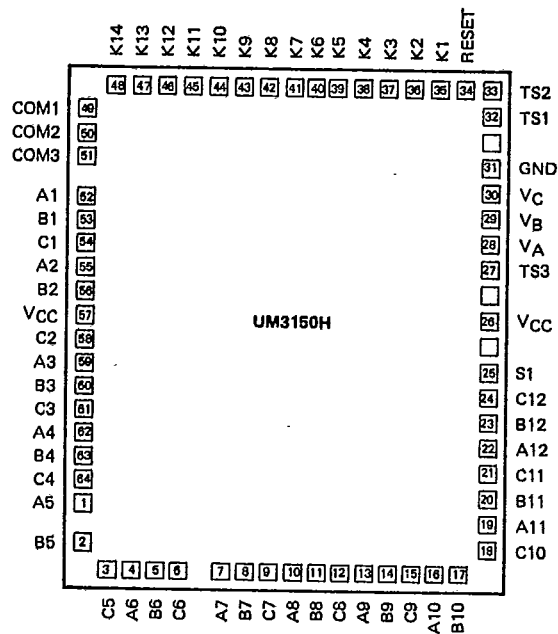




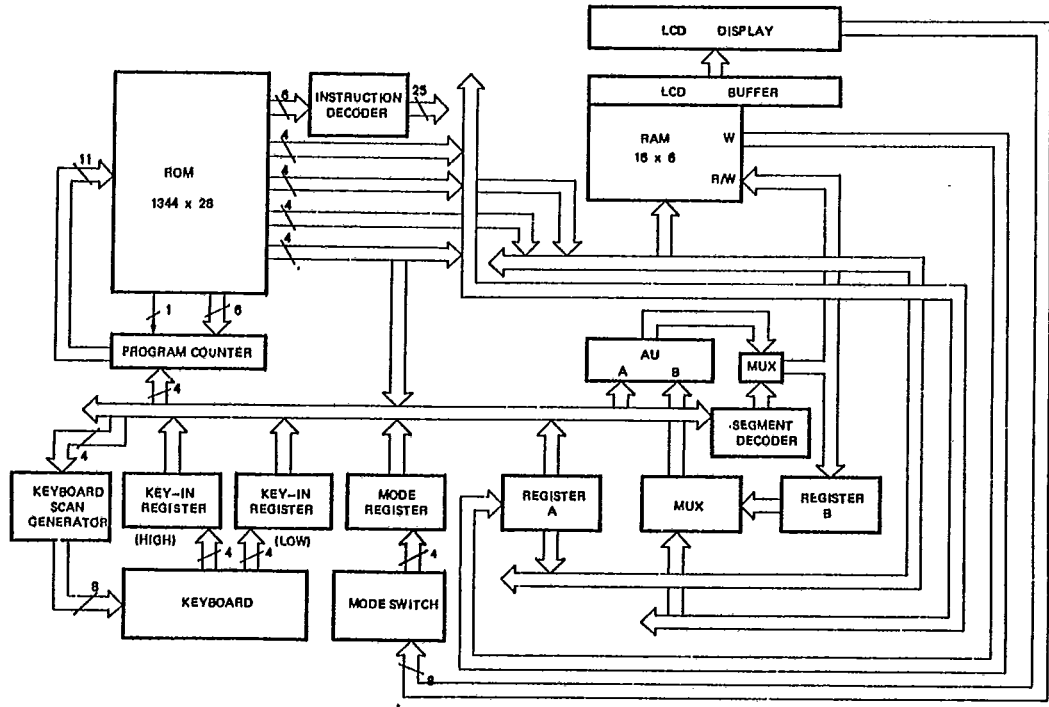
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Pad Configuration



Block Diagram





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**Absolute Maximum Ratings \***

Terminal Voltage,  $V_{DD}$  .....  $-0.3 \sim +2.3V^*$   
 Terminal Voltage,  $V_{IN}$ : .....  $-0.3 \sim V_{DD} + 0.3V$   
 Operating Temperature:  $T_{opr}$  .....  $0 \sim +50^{\circ}C$   
 Storage Temperature:  $T_{stg}$  (Chip Form) ...  $-40 \sim +90^{\circ}C$   
 Storage Temperature:  $T_{stg}$  (Package Form)  $-55 \sim +125^{\circ}C$   
 \*Maximum voltage on any pin with respect to GND.

**\*Comments**

Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied and exposure to absolute maximum rating conditions for extended periods may affect device reliability.

**D.C. Electrical Characteristics** ( $V_{DD} = 1.5V, T_A = 25^{\circ}C$ , unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Condition	Note
$V_{DD}$	Supply Voltage	1.2	1.5	1.8	V		1
$V_{IH}$	Input Voltage	$V_{DD} - 0.4$		$V_{DD}$	V		2
$V_{IL}(1)$		0		0.4	V		3
$V_{IL}(2)$		$V_{EE}$		$V_{EE} + 0.4$	V		4
$I_{IH}(1)$	Input Current		5	10	$\mu A$		5
$I_{IH}(2)$		1	2	3	$\mu A$		4
$I_{IL}$		1.9	2.5	3.8	$\mu A$		6
$V_{OH}$	Output Voltage	$V_{DD} - 0.2$		$V_{DD}$	V		7
$V_{EE}$			-1.5	-1.2	V		8
$V_{OL}(1)$		0		0.2	V		9
$V_{OL}(2)$		$V_{EE}$		$V_{EE} + 0.2$	V		10
$I_{OH}$	Output Current			70	k $\Omega$	$V_O = V_{EE} + 0.5V$	10
$I_{OL}$				70	k $\Omega$	$V_O = V_{DD} - 0.5V$	10
$I_{WAIT}$	Supply Current		2	3.5	$\mu A$		11
$I_{OPR}$			7	11	$\mu A$		12
$I_{OFF}$					1	$\mu A$	

**A.C. Characteristics** ( $V_{DD} = 1.5V, T_A = 25^{\circ}C$ , unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Condition	Note
$F_{wait}$	Oscillator	12	20	26	kHz		
$F_{opr}$	Frequency	60	100	130	kHz		
$F_{disp}$	Display Frequency	59	94	130	Hz		10
$T_{off}$	Power Off Timer Times	450	600	800	sec		

- Notes: 1. Applies to terminals  $V_{DD}$ .  
 2. Applies to terminals K1 ~ K14, RESET.  
 3. Applies to terminals K3 ~ K10, RESET.  
 4. Applies to terminals K11 ~ K14.  
 5. Applies to terminal RESET.  
 6. Applies to terminals K3 ~ K10.  
 7. Measured by terminals K1 ~ K8, H1 ~ H3, A1 ~ C12.  
 8. Measured by terminal  $V_C$ .  
 9. Measured by terminals K1 ~ K8.  
 10. Measured by terminals H1 ~ H3, A1 ~ C12.  
 11. "0" is displayed and no key is depressed.  
 12. When depressing the "ON" key.  
 13. "OFF" key is depressed.



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Pin Description

Pin No.	Symbol	I/O	Description
1	A5	O	LCD segment output
2	B5	O	LCD segment output
3	C5	O	LCD segment output
4	A6	O	LCD segment output
5	B6	O	LCD segment output
6	C6	O	LCD segment output
7	A7	O	LCD segment output
8	B7	O	LCD segment output
9	C7	O	LCD segment output
10	A8	O	LCD segment output
11	B8	O	LCD segment output
12	C8	O	LCD segment output
13	A9	O	LCD segment output
14	B9	O	LCD segment output
15	C9	O	LCD segment output
16	A10	O	LCD segment output
17	B10	O	LCD segment output
18	C10	O	LCD segment output
19	A11	O	LCD segment output
20	B11	O	LCD segment output
21	C11	O	LCD segment output
22	A12	O	LCD segment output
23	B12	O	LCD segment output
24	C12	O	LCD segment output
25	S1	O	LCD segment output
26	V <sub>CC</sub>	I	Power supply
27	TS3	I	Test
28	V <sub>A</sub>	O	Voltage doubler terminal
29	V <sub>B</sub>	O	Voltage doubler terminal
30	V <sub>C</sub>	O	Voltage doubler terminal
31	GND	I	Ground
32	TS1	I	Test

Pin No.	Symbol	I/O	Description
33	TS2	I	Test
34	RESET	I	System reset
35	K1	O	Keyboard output
36	K2	O	Keyboard output
37	K3	I/O	Keyboard I/O
38	K4	I/O	Keyboard I/O
39	K5	I/O	Keyboard I/O
40	K6	I/O	Keyboard I/O
41	K7	I/O	Keyboard I/O
42	K8	I/O	Keyboard I/O
43	K9	I	Keyboard input
44	K10	I	Keyboard input
45	K11	I	Mode switch input
46	K12	I	Mode switch input
47	K13	I	Mode switch input
48	K14	I	Mode switch input
49	COM1	O	LCD common output
50	COM2	O	LCD common output
51	COM3	O	LCD common output
52	A1	O	LCD segment output
53	B1	O	LCD segment output
54	C1	O	LCD segment output
55	A2	O	LCD segment output
56	B2	O	LCD segment output
57	V <sub>CC</sub>	I	Power supply
58	C2	O	LCD segment output
59	A3	O	LCD segment output
60	B3	O	LCD segment output
61	C3	O	LCD segment output
62	A4	O	LCD segment output
63	B4	O	LCD segment output
64	C4	O	LCD segment output



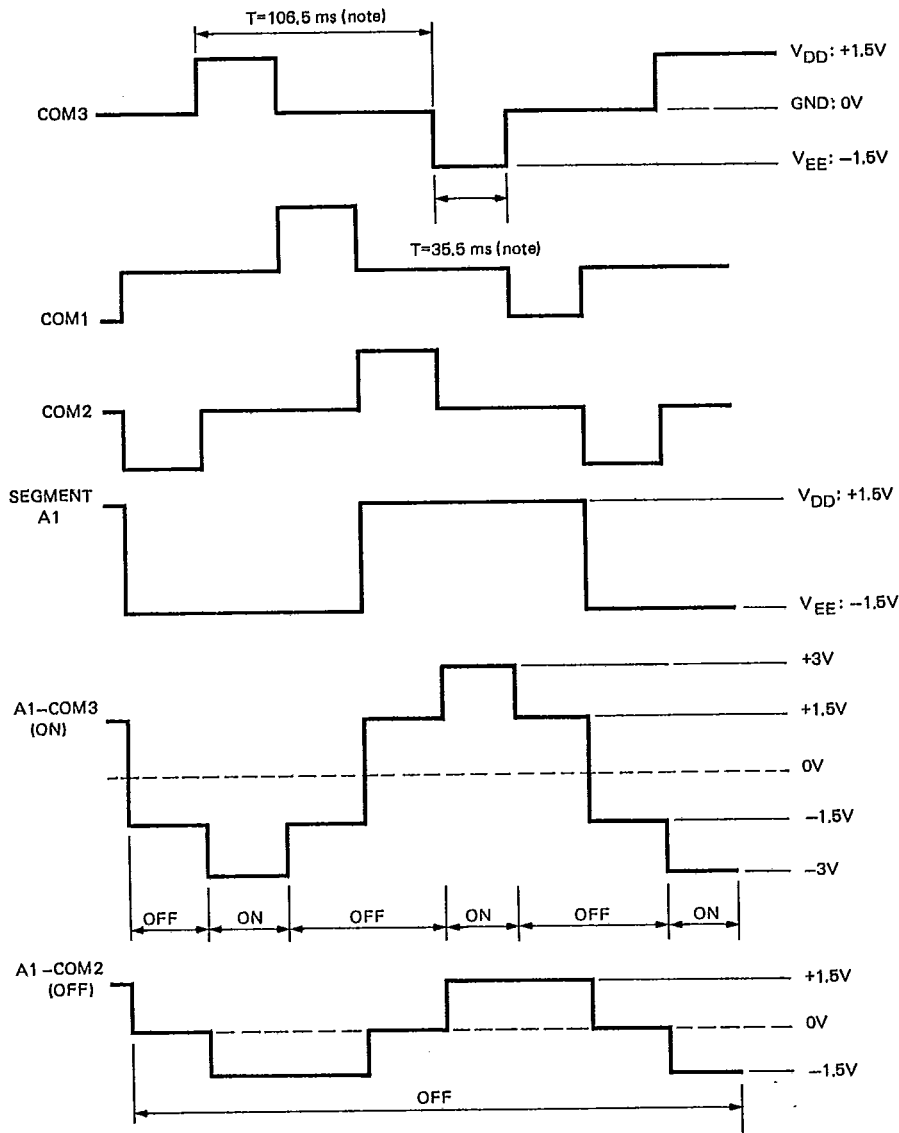


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Timing Waveform

- LCD Driving Waveform



note: at  $F_{walt} = 20 \text{ KHz}$



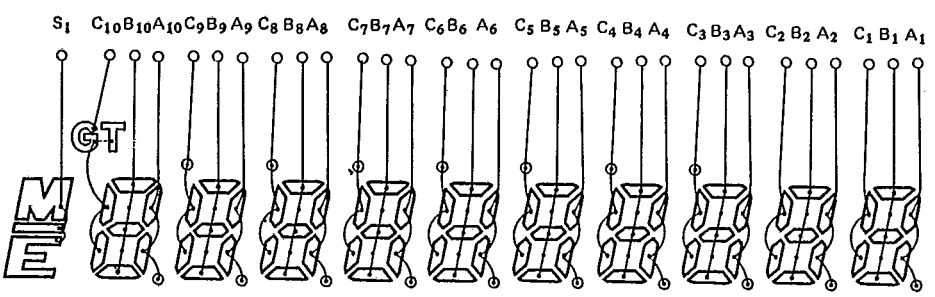
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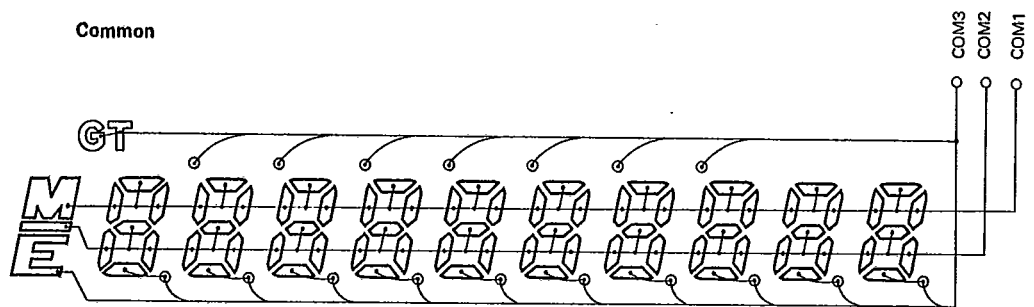
Display Configuration

(1) Select of 10-digits

Segment

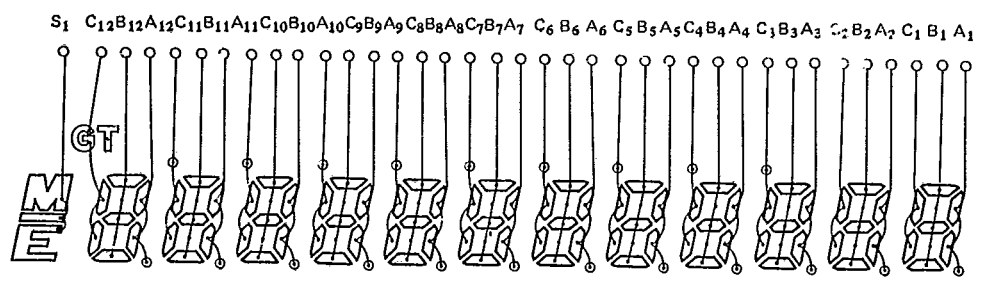


Common

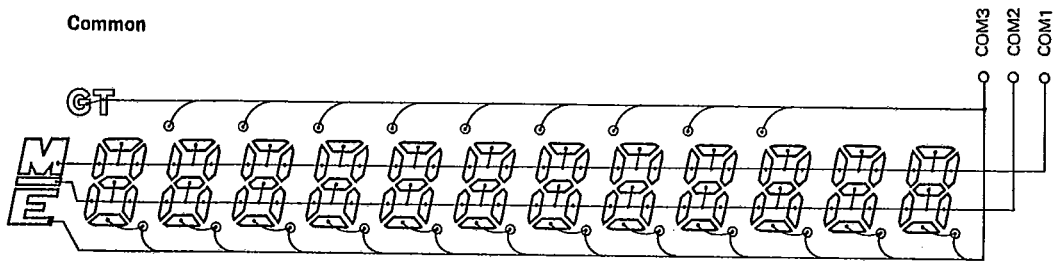


(2) Select of 12-digits

Segment



Common





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**Functional Description**

**Keyboard Description**

**Number Key (00, 0 ~ 9, .)**

The first number key in a sequence will clear the display and enter the digit in the display. Successive entries will shift the display left and enter data in the display register. The first decimal point is effective. An attempted entry of more than 12 digits will cause a register overflow error.

**Change Sign Key (±)**

During digit entry, depressing this key will change the sign of the entered numeric.

**Equal Key (=)**

Performs previous operation and maintains that operation for possible use. Establishes power/reciprocatation calculation.

**Multiplication Key (X)**

Enters multiplicand.  
Performs previous operation and displays result.

**Division Key (÷)**

Enter dividend.  
Performs previous operation and displays result.

**Addition Key (+)**

Performs previous operation and displays result.  
Conditions machine for an addition.

**Subtraction Key (−)**

Performs previous operation and displays result.  
Conditions machine for a subtraction.

**Square Root Key ( $\sqrt{\quad}$ )**

The square root key extracts the square root of a positive number being displayed in the entry register.

**Percent Key (%)**

The purpose of the percent key is to allow for calculation of add-on and discount.

**Delta Percent Key (Δ%)**

Performs mark-up, mark-down operation.

**Memory Plus Key (M+)**

Adds the current display to the content of memory.  
M+ will terminate a number entry.

**Memory Minus Key (M−)**

Subtracts the current display from content of memory.  
M− will terminate a number entry.

**Grand Total Plus Key (GT+)**

Adds the current display to the content of grand total memory.  
GT+ will terminate a number entry.

**Grand Total Minus Key (GT−)**

Subtracts the current display from the content of grand

total memory.

GT− will terminate a number entry.

**Clear Memory Key (CM)**

Clears the memory content.

**Recall Memory Key (RM)**

Transfers the content of the memory register into the display register.

**Recall and Clear Memory Key (RCM)**

The first push transfers the content of the grand total memory register into the display register. The second push, as CM key, clears the memory content.

**Recall and Clear Memory Key (RCGT)**

The first push transfers the content of the grand total memory register into the display register. The second push clears the grand total memory content.

**Exchange Key (EX)**

Exchanges the contents of two operands (Ex. multiplicand and multiplier)

**Shift Key (→)**

Shifts the display register right and clears the least significant digit.

**Item Count Key (IC)**

Recalls the item number which has been input into the grand total memory.

**Clear Entry Key (CE)**

During digit entry, one depression will clear the entry register to zero.

**Clear Entry/Clear On Key (  $\begin{matrix} \text{CE/C} \\ \text{ON} \end{matrix} \text{ )}$**

When off, pushing this key will turn on the power and display 0. During digit entry, pushing will clear the entry. Otherwise, pushing the key will clear all the operating registers.

**Clear On Key (  $\begin{matrix} \text{C} \\ \text{ON} \end{matrix} \text{ )}$**

When off, pushing this key will turn on the power and display 0. When on, pushing the key will clear all the operating registers.

**Off Key (OFF)**

Turns off the system.

**System Reset Key (AC)**

Resets the system.  
Clears all the registers including memories.



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Arithmetic Operations

Fixed Point calculations

Adding Point mode calculations

Key	Display	Fixed Point Place
$\boxed{C}$	0	DP = 3(5/4)
2	2	
$\boxed{\div}$	2	
3	3	
$\boxed{=}$	0.667	
2	2	
$\boxed{\cdot}$	2	
3	2.3	
$\boxed{+}$	2.3	
4	4	
$\boxed{M+}$	6.300	
1	1	
$\boxed{\cdot}$	1	
2	1.2	
$\boxed{M+}$	1.200	
$\boxed{RM}$	7.5	
$\boxed{C}$	0	DP = 0 ( $\downarrow$ )
1	1	
$\boxed{\cdot}$	1	
2	1.2	
3	1.23	
$\boxed{+}$	1.23	
1	1	
$\boxed{\cdot}$	1	
1	1.1	
$\boxed{=}$	3	
9	9	
$\boxed{\sqrt{\quad}}$	3	
$\boxed{\times}$	3	
1	1	
$\boxed{\cdot}$	1	
1	1.1	DP = F
$\boxed{=}$	3.3	

Key	Display
$\boxed{C}$	0
1	1.
23	123.
$\boxed{+}$	1.23
3	3.
$\boxed{=}$	1.26
3	3.
2	32.
$\boxed{\times}$	32.
3	3.
$\boxed{\cdot}$	3.
000	3.000
$\boxed{=}$	96.00
2	2.
$\boxed{M+}$	0.02M
3	3.M
$\cdot$	3.M
123	3.123M
$\boxed{M+}$	3.12M
$\boxed{RM}$	3.14M
$\boxed{C}$	0.M
1	1.M
23	123.M
$\boxed{-}$	1.23M
3	3.M
4	34.M
$\boxed{\cdot}$	34.M
5	34.5M
$\boxed{=}$	33.27M-
2	2.M
$\boxed{+}$	0.02M
9	9.M
$\boxed{\cdot}$	9.M
$\boxed{\sqrt{\quad}}$	3.M
$\boxed{=}$	3.02M







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Constant Calculations

Key

Display

Constant

Constant Calculations	Key	Display	Constant
	k	k	
Multiplication	$\boxed{\times}$	k	
	a	a	
	$\boxed{=}$	$k \cdot a$	kx
Division	b	b	
	$\boxed{=}$	$k \cdot b$	kx
	a	a	
Addition	$\boxed{\div}$	a	
	k	k	
	$\boxed{=}$	a/k	$\div k$
Subtraction	b	b	$\div k$
	$\boxed{=}$	b/k	$\div k$
	a	a	
Percentage	$\boxed{+}$	a	
	k	k	
	$\boxed{=}$	a+k	+k
Percentage	b	b	+k
	$\boxed{=}$	b+k	+k
	a	a	
Percentage	$\boxed{-}$	a	
	k	k	
	$\boxed{=}$	a-k	-k
Percentage	b	b	-k
	$\boxed{=}$	b-k	-k
	a	a	
Percentage	$\boxed{\times}$	k	
	a	k	
	$\boxed{\%}$	$k \cdot a/100$	kx
Percentage	b	b	kx
	$\boxed{\%}$	$k \cdot b/100$	kx
	a	a	
Add-on	$\boxed{\div}$	a	
	k	k	
	$\boxed{\%}$	$100 \cdot a/k$	+k
Discount	b	b	$\div k$
	$\boxed{\%}$	$100 \cdot b/k$	$\div k$
	a	a	
Add-on	$\boxed{+}$	k	
	a	k	
	$\boxed{\%}$	$k \cdot (1+a/100)$	k+
Discount	b	b	k+
	$\boxed{\%}$	$k \cdot (1+b/100)$	k+
	k	k	
Discount	$\boxed{-}$	k	
	a	a	
	$\boxed{\%}$	$k \cdot (1-a/100)$	k-
Discount	b	b	k-
	$\boxed{\%}$	$k \cdot (1-b/100)$	k-



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	Key	Display
<b>Δ% Calculations</b>	a	a
	$\boxed{+}$	a
	b	b
	$\boxed{\Delta\%}$	$100 \cdot (a+b)/b$
	a	a
<b>Mark-up, Mark-down Calculations</b>	$\boxed{-}$	a
	b	b
	$\boxed{\Delta\%}$	$100 \cdot (a-b)/b$
	a	a
	$\boxed{\div}$	a
<b>Mark-up</b>	b	b
	$\boxed{\Delta\%}$	$a/(1-b/100)$
	$\boxed{\Delta\%}$	$ a/(1-b/100)-a $
	a	a
	$\boxed{\div}$	a
<b>Mark-down</b>	b	b
	$\boxed{+/-}$	-b
	$\boxed{\Delta\%}$	$a/(1+b/100)$
	$\boxed{\Delta\%}$	$ a/(1+b/100)-a $
	a	a
<b>Add-on, Discount Calculations</b>	$\boxed{\times}$	a
	b	b
	$\boxed{\%}$	$a \cdot b/100$
	$\boxed{+}$	$a + b/100$
	$\boxed{=}$	$a(1+b/100)$
<b>Add-on</b>	a	a
	$\boxed{\times}$	a
	b	b
	$\boxed{\%}$	$a \cdot b/100$
	$\boxed{+}$	$a + b/100$
<b>Discount</b>	$\boxed{=}$	$a(1+b/100)$
	a	a
	$\boxed{\times}$	a
	b	b
	$\boxed{\%}$	$a \cdot b/100$
	-	$a \cdot b/100$
	$\boxed{=}$	$a(1-b/100)$





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Item Counter

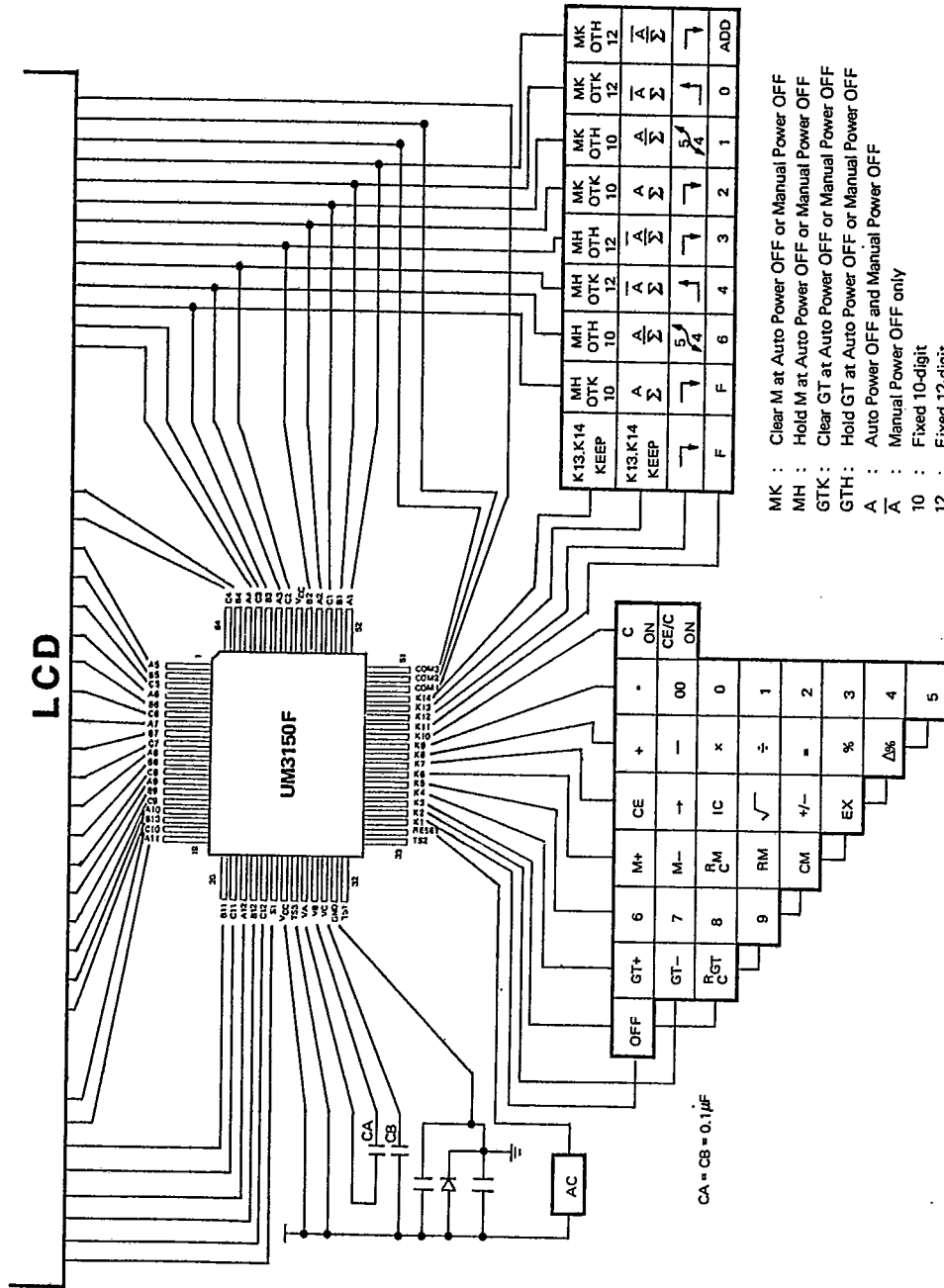
	Key	Display	Item Counter
Add-on	a	a	
	$\boxed{+}$	a	
	b	b	
Discount	$\boxed{\%}$	$a(1+b/100)$	
	a	a	
	$\boxed{-}$	a	
Add-on	b	b	
	$\boxed{\%}$	$a(1-b/100)$	
	a	a	
Discount	$\boxed{\times}$	a	
	b	b	
	$\boxed{\Delta\%}$	$a(1+b/100)$	
Average Operation use of the Item Counter	a	a	
	$\boxed{\times}$	a	
	b	b	
	$\boxed{+/-}$	-b	
	$\boxed{\Delta\%}$	$a(1-b/100)$	
	A	A	0
	$\boxed{+}$	A	1
	B	B	1
	$\boxed{+}$	A+B	2
	C	C	2
	$\boxed{+}$	A+B+C	3
	D	D	3
	$\boxed{+}$	A+B+C+D	4
	$\boxed{-}$	A+B+C+D	2
	D	D	2
	$\boxed{+}$	A+B+C	3
	E	E	3
	$\boxed{=}$	A+B+C+E	4
	$\boxed{\div}$	A+B+C+E	4
	$\boxed{IC}$	4	4
	$\boxed{=}$	$(A+B+C+E)/4$	5



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Application Circuit (UM3150F)

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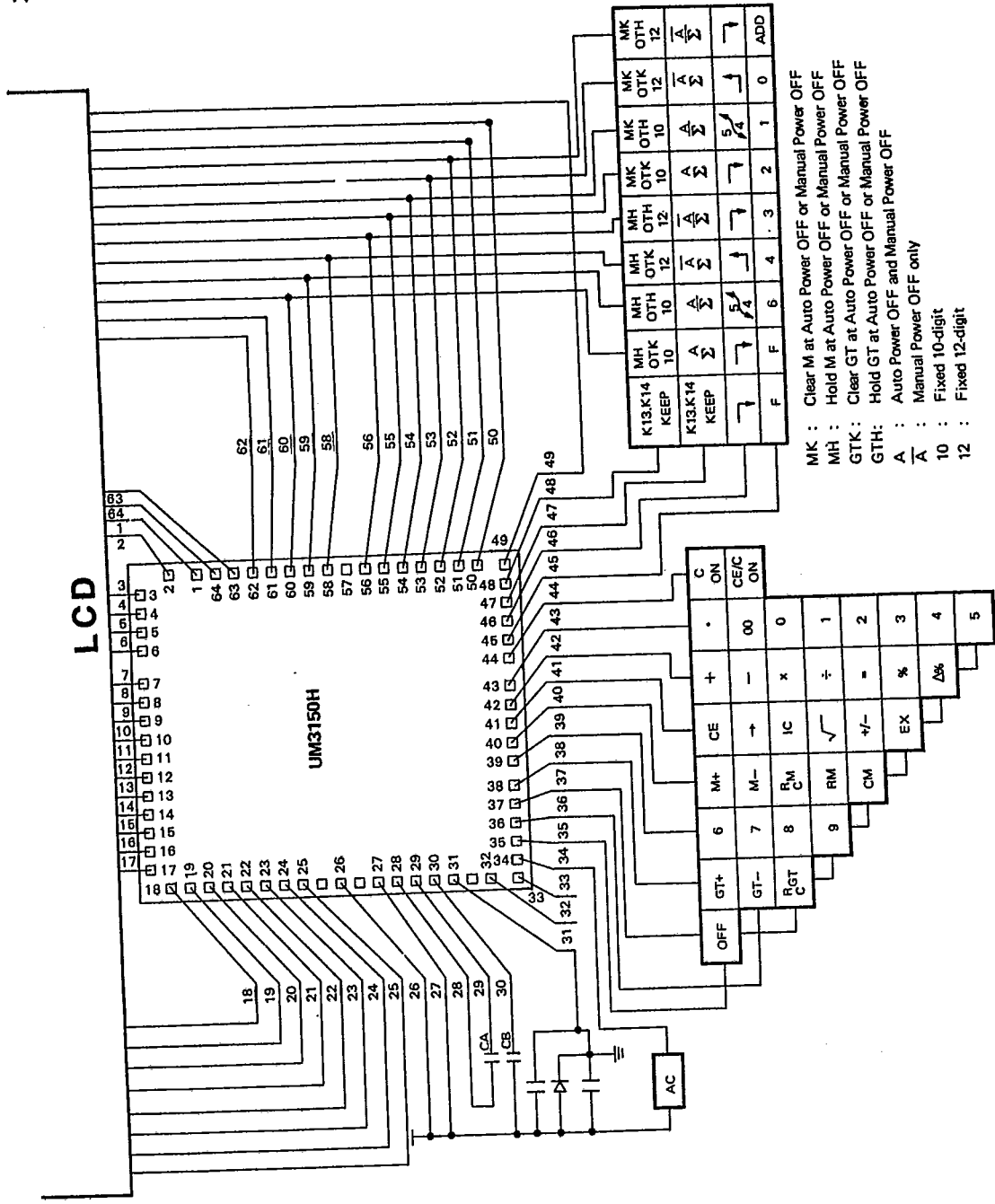




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Application Circuit (UM3150H)



K13.K14 KEEP	MH OTK 10	MH OTH 10	MH OTK 12	MH OTH 12	MK OTK 10	MK OTH 10	MK OTK 12	MK OTH 12
F	A	A	A	A	A	A	A	A
F	5/4	5/4	5/4	5/4	5/4	5/4	5/4	5/4
F	6	4	3	2	1	0	ADD	

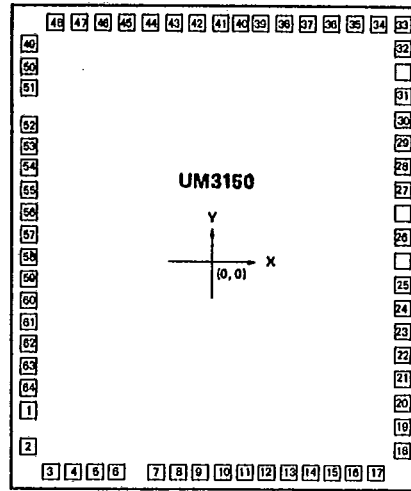
MK : Clear M at Auto Power OFF or Manual Power OFF  
 MH : Hold M at Auto Power OFF or Manual Power OFF  
 GTK : Clear GT at Auto Power OFF or Manual Power OFF  
 GTH : Hold GT at Auto Power OFF or Manual Power OFF  
 A : Auto Power OFF only  
 10 : Fixed 10-digit  
 12 : Fixed 12-digit



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Bonding Diagram



No.	Designation	X	Y	No.	Designation	X	Y
1	A5	-1647	-1283	33	TS2	1644	1850
2	B5	-1647	-1617	34	RESET	1464	1850
3	C5	-1442	-1857	35	K1	1280	1850
4	A6	-1261	-1857	36	K2	1085	1850
5	B6	-1081	-1857	37	K3	904	1850
6	C6	-901	-1857	38	K4	664	1850
7	A7	-399	-1836	39	K5	478	1850
8	B7	-219	-1836	40	K6	237	1850
9	C7	-39	-1836	41	K7	50	1850
10	A8	141	-1836	42	K8	-190	1850
11	B8	321	-1836	43	K9	-377	1850
12	C8	502	-1836	44	K10	-596	1850
13	A9	682	-1836	45	K11	-792	1850
14	B9	862	-1836	46	K12	-988	1850
15	C9	1042	-1836	47	K13	-1170	1850
16	A10	1222	-1836	48	K14	-1366	1850
17	B10	1402	-1836	49	COM1	-1647	1797
18	C10	1644	-1638	50	COM2	-1647	1599
19	A11	1644	-1457	51	COM3	-1647	1393
20	B11	1644	-1278	52	A1	-1647	1070
21	C11	1644	-1097	53	B1	-1647	890
22	A12	1644	-917	54	C1	-1647	709
23	B12	1644	-737	55	A2	-1647	529
24	C12	1644	-556	56	B2	-1647	349
25	S1	1644	-376	57	VCC	-1647	157
26	VCC	1644	-16	58	C2	-1647	-23
27	TS3	1644	345	59	A3	-1647	-203
28	VA	1644	525	60	B3	-1647	-383
29	VB	1644	705	61	C3	-1647	-563
30	VC	1644	885	62	A4	-1647	-743
31	GND	1644	1064	63	B4	-1647	-923
32	TS1	1644	1507	64	C4	-1647	-1103



(unit: μm)

Ordering Information

Part No.	Package
UM3150H	Chip
UM3150F	64 FP