

# OKI Semiconductor

## MSM5547

### Digital Clock

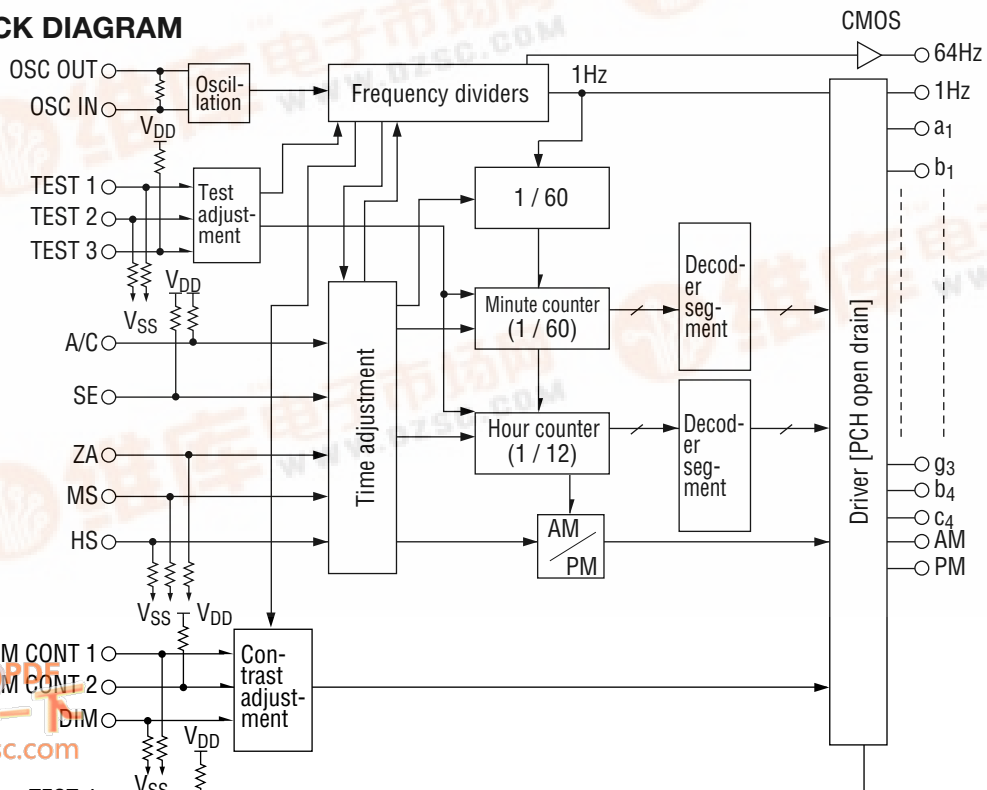
### GENERAL DESCRIPTION

MSM5547 is a clock IC featuring a wide power supply range with 4.194304 MHz original oscillation. MSM5547 is a 12 hour cycle AM/PM clock for a static fluorescent character display tube. Time correction is in hour, minute and 30 minute adjustments. Hour and minute are corrected by a 2 Hz fast-forward function. MSM 5547 also has a contrast adjustment function for the fluorescent character display tube, which can set four levels of contrast, including 100% duty.

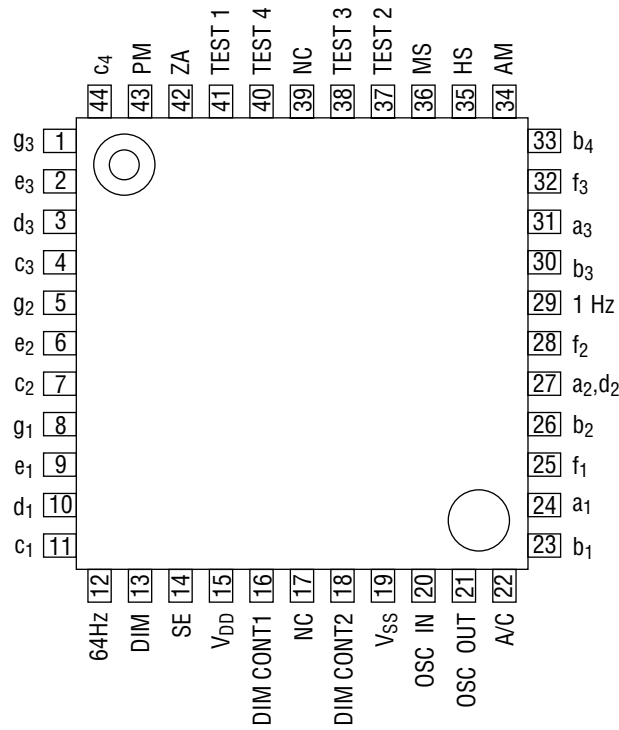
### FEATURES

- 12 hour clock (AM/PM)
- Applied for static fluorescent character display tube
- Wide power supply range: 4 to 16V
- 4.194304 MHz original oscillation
- 4 levels of contrast can be selected
- Package: 44-pin plastic QFP (QFP44-P-910-L2)  
(Product name: MSM 5547GS-L2)
- 42-pin plastic DIP (DIP42-P-600)  
(Product name: MSM 5547RS)

### BLOCK DIAGRAM

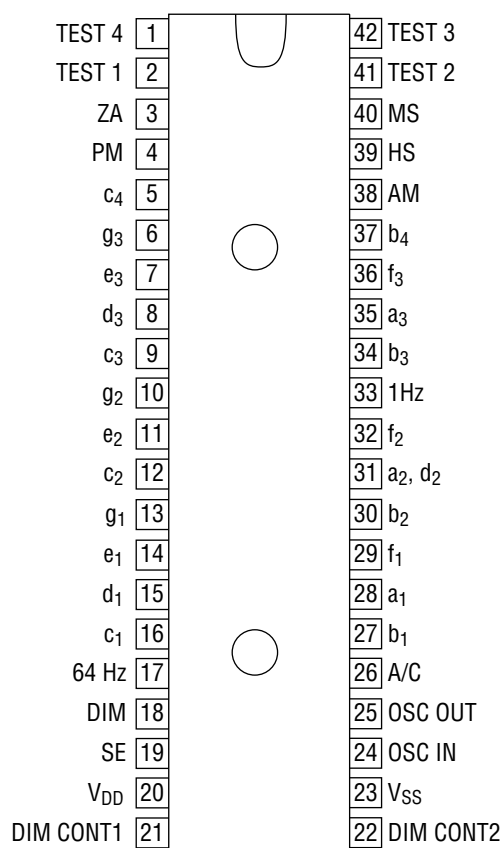


PIN CONFIGURATION (TOP VIEW)



44-pin plastic QFP

(Model name indicated on actual product is M 5547)



42-pin plastic DIP

**ABSOLUTE MAXIMUM RATING**

Parameter	Symbol	Condition	Rating	Unit
Power supply voltage	$V_{DD} - V_{SS}$	$T_a = 25^\circ\text{C}$	-0.3 to 18	V
Input voltage	$V_I$		$V_{SS} - 0.3 \leq V_I \leq V_{DD} + 0.3$	V
input current	$I_I$		$\pm 10$	mA
P channel open drain Output pin withstanding voltage	$V_O$		$V_{DD} - 26$	V
P channel open drain output current	$I_O$		-10	mA
Power dissipation	$P_D$		200	mW
Storage temperature range	$T_{STG}$	—	-55 to +150	$^\circ\text{C}$

**RCOMMENDED OPERATING CONDITIONS**

Parameter	Symbol	Condition	Range	Unit
Power supply voltage	$V_{DD} - V_{SS}$	—	4 to 16	V
operating temperature	$T_{OP}$	—	-30 to +85	$^\circ\text{C}$
Crystal frequency	$f(x'tal)$	—	4.194304	MHz

**ELECTRICAL CHARACTERISTICS****DC Characteristics** $(V_{DD} = 6.0\text{ V}, V_{SS} = 0\text{ V}, T_a = -30\text{ to }+85^\circ\text{C})$ 

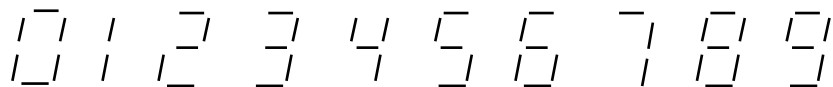
Parameter		Symbol	Condition	Min	Typ	Max	Unit
Input voltage	"1" level	V <sub>IH</sub>	—	4.3	—	—	V
	"0" level	V <sub>IL</sub>	—	—	—	1.0	
"H" input current	TEST 1 TEST 2 ZA,MS,HS,DIM DIM CONT1	I <sub>IH1</sub>	V <sub>I</sub> = V <sub>DD</sub>	30	—	150	μA
"L" input current	TEST 3,4	I <sub>IL1</sub>	V <sub>I</sub> = V <sub>SS</sub>	−120	—	−600	μA
"L" input current	A/C	I <sub>IL2</sub>		−3	—	−12	
"L" input current	SE,DIM,CONT2	I <sub>IL3</sub>		−30	—	−150	
Output voltage	"1" level (All output)	V <sub>OH</sub>	I <sub>OH</sub> = 0A	5.9	—	—	V
	"0" level (64 Hz output)	V <sub>OL</sub>	I <sub>OL</sub> = 0A	—	—	0.1	
Output current	1 Hz, a2, d2, AM, PM output pins	I <sub>OH1</sub>	V <sub>OH</sub> = 4.0 V	−2000	—	—	μA
		I <sub>OL1</sub>	V <sub>OL</sub> = 0 V	—	—	−1.0	
Output current	Other segment output pins except above	I <sub>OH2</sub>	V <sub>OH</sub> = 4.0 V	−1000	—	—	μA
		I <sub>OL2</sub>	V <sub>OL</sub> = 0 V	—	—	−1.0	
Output current	64 Hz output pin	I <sub>OH3</sub>	V <sub>OH</sub> = 5.5 V	−100	—	—	μA
		I <sub>OL3</sub>	V <sub>OL</sub> = 0.5 V	100	—	—	
Dynamic operating current		I <sub>DD</sub>	C <sub>IN</sub> = 39pF ±5% C <sub>OUT</sub> = 33pF ±5% C <sub>I</sub> = 70Ω ±5% f(x'tal) = 4.194304 MHz	—	—	2	mA

## FUNCTIONAL DESCRIPTION

### Time Base

- 4.194304 MHz crystal oscillator
- Internal crystal oscillation circuit (AMP, feedback resistance)

### 7 segment display format



### Display device

- 4 digit static fluorescent character display tube (with AM, PM, colon)
- Colon display blinks at 1 Hz with a 50% duty ratio

### Contrast selecting function

Selector pin name			Operation mode
DIM	DIM CONT1	DIM CONT2	
"0" (or open)	*	*	100% duty display
"1"	"0" (or open)	"1" (or open)	25% (1/4) duty display at 4096 Hz
"1"	"0" (or open)	"0"	12.5% (1/8) duty display at 4096 Hz
"1"	"1"	"1" (or open)	6.25% (1/16) duty display at 4096 Hz

"1": high level, "0": low level, \*: don't care

### Display Mode

- For 12 hour display, hour-minute 4-digit display  
Hour display: 1 to 12  
Minute display: 0 to 59
- 0 at highest digit is not displayed.  
(Highest digit zero suppress function)

## Time Correction

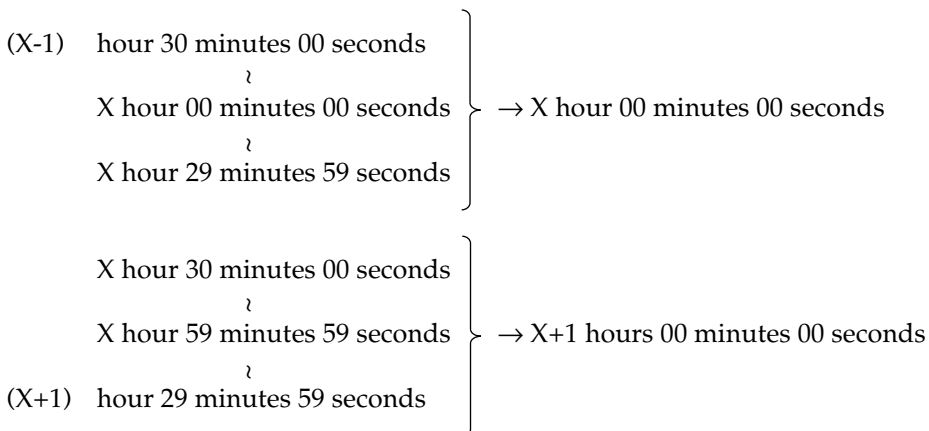
### Hour-minute fast-forward function

- Hour or minute can be fast-forwarded individually. The HS (hours set) pin fast-forwards the hour digit and the MS (minutes set) pin forwards the minute digit at 2 Hz.
- In open status, the HS and MS pins are held to "0" level by a pull-down resistor, and are in inactive status.  
These pins become active by being set to "1" level externally.
- It takes 0.242 ~ 0.5 sec from when the HS and MS pins become active to when +1 is counted. After a +1 count, time is counted in 0.5 sec (2 Hz) units.
- Hour digit and minute digits can be fast-forwarded in parallel.
- To fast-forward hour digit, the lower counter continues normal operation but does not carry from minute to hour digit.
- For fast-forwarding minute digit, the counter does not carry to the hour digit. The second digit continues normal operation but does not carry to the minute digit.

### Time Setting Function ( $\pm 30$ minutes reset to zero)

- In open status, the ZA (zero adjust) pin is held to "0" level by a pull-down resistor and is in inactive status. This pin becomes active and enables time setting by being set to "1" level externally.
- Time is set at Min. 0.00 sec to Max. 0.0312 sec after the ZA pin becomes "1" level.
- For time setting, minute and second digits are reset to 00' 00". The colon output starts with "1". If the minute digit is less than 30, minute and second digits are reset to 00' 00". The counters for seconds are reset up to 16 Hz.

### (Example of Setting)



**SE (set enable) Pin**

In open status, the SE pin is held to “1” level by a pull-up resistor, enabling input from MS, HS and ZA pins. These inputs become invalid by setting this pin to “0” level externally.

**A/C (all clear) Pin**

- In open status, the A/C pin is held to “1” level by a pull-up resistor, and is in inactive status. The time counter is set at 1 hour 00 minutes 00 seconds AM by setting this pin to “0” level externally. The counter for seconds is reset up to 16 Hz.
- If a capacitor is connected between this pin and the Vss pin, 1 hour 00 minutes AM is displayed when power is turned on. Connect a capacitor of 4700 pF or more.

**TEST Pin**

- In open status, TEST 1 and 2 pins are held to “0” level by a pull-down resistor.
- In open status, TEST 3 and 4 pins are held to “1” level by a pull-up resistor.

**TEST Select Function 1**

Selector pin name			Operation mode
TEST1	TEST2	TEST3	
"1"	$\phi$ (Pulse)	"1" (or open)	Inputs pulse to 16.384 kHz system of the circuit.
$\phi$ (Pulse)	"1" (or open)	"0"	Inputs pulse to 64 Hz system of the circuit.
"0" (or open)	$\phi$ (Pulse)		Inputs pulse to minute counter and hour counter, and advances 1 count with 1 pulse. (Does not carry hour and minute counters.)

**TEST Select Function 2**

Selector pin name				Operation mode
TEST4	DIM	DIM CONT1	DIM CONT2	
"0"	$\phi$ (Pulse)	*	*	Contrast (DC 100%) display
	"1"			Sets all segment outputs to high impedance

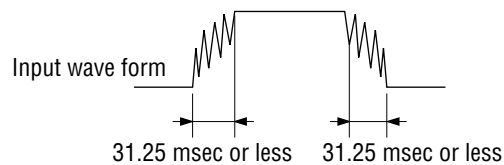
\* Indicates that input level can be “0” and “1”.

### 64 Hz Pin

This is the output pin for oscillation frequency adjustment, which constantly outputs 64 Hz.

### Chattering Removal

A chattering removal circuit is included on three input pins: MS, HS and ZA. Less than 31.25 msec chattering is neglected.



### Treatment of NC Pin

Since the NC pin of 17 pin and 39 pin in QFP products are connected to the substrate, set the pins to  $V_{DD}$  voltage or to open status.