



# LC35256FM, FT-55U/70U

256K (32768 words × 8 bits) SRAM  
Control Pins:  $\overline{OE}$  and  $\overline{CE}$

## Preliminary

### Overview

The LC35256FM and LC35256FT are asynchronous silicon-gate CMOS SRAMs with a 32K-word by 8-bit structure. These are full-CMOS devices with 6 transistors per memory cell, and feature low-voltage operation, a low operating current drain, and an ultralow standby current. Control inputs include  $\overline{OE}$  for fast memory access and  $\overline{CE}$  (chip enable) for power saving and device selection. This makes these devices optimal for systems that require low power or battery backup, and makes memory expansion easy. The ultralow standby current allows these devices to be used with capacitor backup as well.

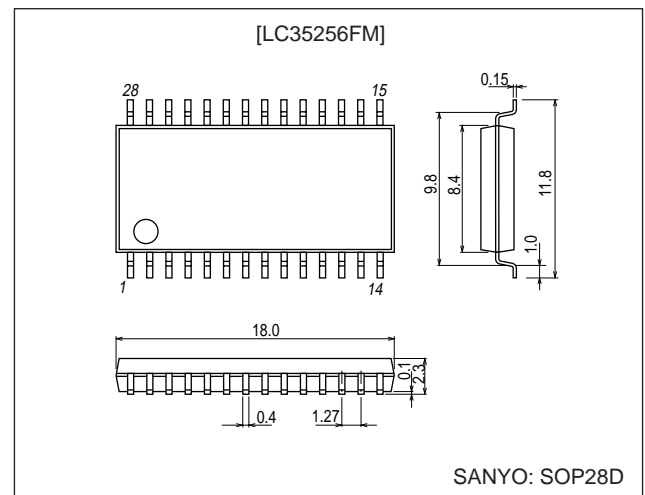
### Features

- Supply voltage range: 4.5 to 5.5 V
- Access time at 5 V operation:  
LC35256FM, FT-55U: 55 ns (maximum)  
LC35256FM, FT-70U: 70 ns (maximum)
- Standby current: 3.0  $\mu$ A ( $T_a \leq 70^\circ\text{C}$ )  
5.0  $\mu$ A ( $T_a \leq 85^\circ\text{C}$ )
- Operating temperature:  $-40$  to  $+85^\circ\text{C}$
- Data retention voltage: 2.0 to 5.5 V
- All I/O levels: TTL compatible
- Input/output shared function pins, 3-state output pins
- No clock required
- Package  
28-pin SOP (450 mil) plastic package: LC35256FM  
28-pin TSOP (8 × 13.4 mm) plastic package: LC35256FT

### Package Dimensions

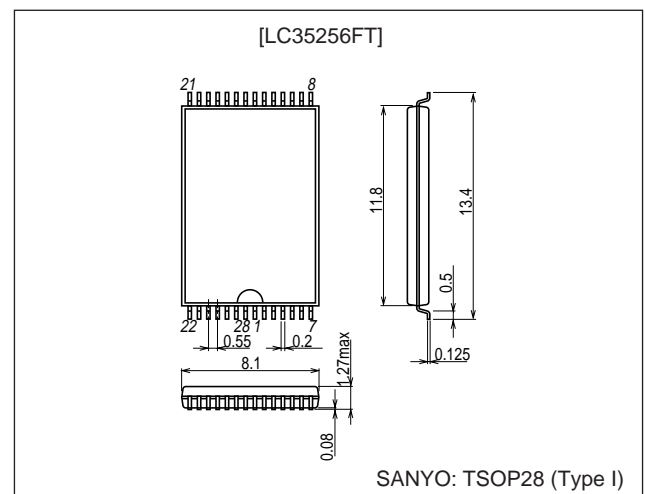
unit: mm

#### 3187A-SOP28D



unit: mm

#### 3221-TSOP28 (Type I)



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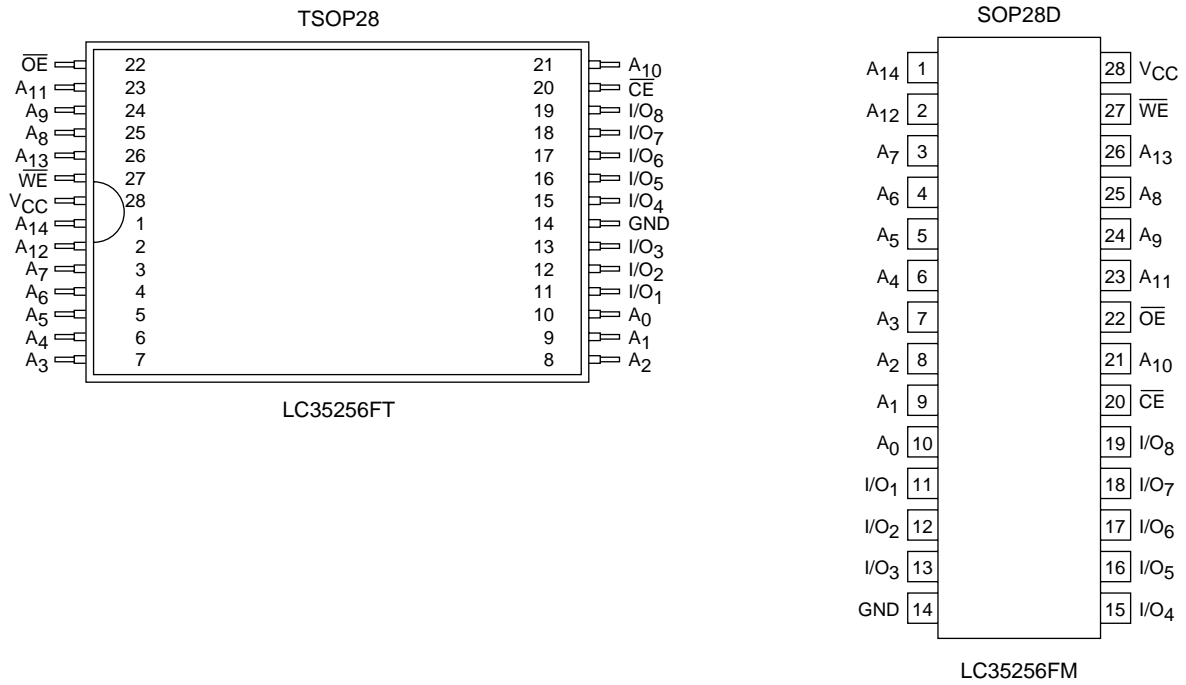
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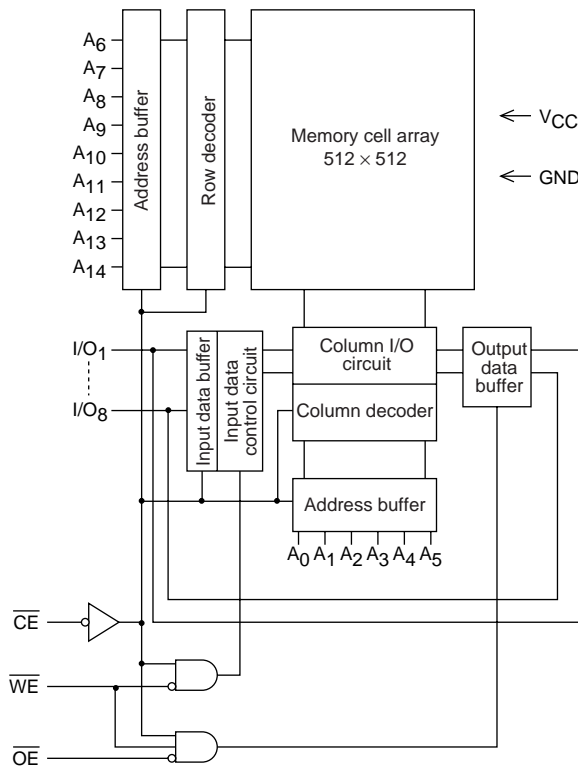
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# LC35256FM, FT-55U/70U

## Pin Assignment (Top view)



## Block Diagram



## LC35256FM, FT-55U/70U

### Pin Functions

A0 to A14	Address input
$\overline{WE}$	Read/write control input
$\overline{OE}$	Output enable input
$\overline{CE}$	Chip enable input
I/O1 to I/O8	Data I/O
$V_{CC}$ , GND	Power supply, ground

### Function Table

Mode	$\overline{CE}$	$\overline{OE}$	$\overline{WE}$	I/O	Supply current
Read cycle	L	L	H	Data output	$I_{CCA}$
Write cycle	L	X	L	Data input	$I_{CCA}$
Output disable	L	H	H	High impedance	$I_{CCA}$
Unselected	H	X	X	High impedance	$I_{CCS}$

## Specifications

### Absolute Maximum Ratings

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	$V_{CC\ max}$		7.0	V
Input pin voltage	$V_{IN}$		-0.3* to $V_{CC} + 0.3$	V
I/O pin voltage	$V_{I/O}$		-0.3 to $V_{CC} + 0.3$	V
Operating temperature	$T_{opr}$		-40 to +85	°C
Storage temperature	$T_{stg}$		-55 to +125	°C

Note: \* The minimum value is -3.0 V for pulse widths under 30 ns.

### I/O Capacitances at $T_a = 25^\circ\text{C}$ , $f = 1\ \text{MHz}$

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
I/O pin capacitance	$C_{I/O}$	$V_{I/O} = 0\ \text{V}$		6	10	pF
Input pin capacitance	$C_I$	$V_{IN} = 0\ \text{V}$		6	10	pF

Note: All units are not tested; only samples are tested.

### DC Allowable Operating Ranges at $T_a = -40\ \text{to}\ +85^\circ\text{C}$ , $V_{CC} = 4.5\ \text{to}\ 5.5\ \text{V}$

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Supply voltage	$V_{CC}$		4.5	5.0	5.5	V
Input voltage	$V_{IH}$		2.2		$V_{CC} + 0.3$	V
	$V_{IL}$		-0.3*		+0.8	V

Note: \* The minimum value is -3.0 V for pulse widths under 30 ns.

## LC35256FM, FT-55U/70U

### DC Electrical Characteristics at Ta = -40 to +85°C, VCC = 4.5 to 5.5 V

Parameter	Symbol	Conditions	Ratings			Unit		
			min	typ*	max			
Input leakage current	I <sub>LI</sub>	V <sub>IN</sub> = 0 to V <sub>CC</sub>	-1.0		+1.0	μA		
Output leakage current	I <sub>LO</sub>	V <sub>CE</sub> = V <sub>IH</sub> or V <sub>OE</sub> = V <sub>IH</sub> or V <sub>WE</sub> = V <sub>IL</sub> , V <sub>I/O</sub> = 0 to V <sub>CC</sub>	-1.0		+1.0	μA		
Output high-level voltage	V <sub>OH</sub>	I <sub>OH</sub> = -1.0 mA	2.4			V		
Output low-level voltage	V <sub>OL</sub>	I <sub>OL</sub> = 2.0 mA			0.4	V		
Operating current drain	TTL inputs	I <sub>CCA2</sub>	V <sub>CE</sub> = V <sub>IL</sub> , I <sub>I/O</sub> = 0 mA, V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>		5.0	mA		
		I <sub>CCA3</sub>	V <sub>CE</sub> = V <sub>IL</sub> , V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> , I <sub>I/O</sub> = 0 mA, Duty 100 %	Min. cycle	LC35256FM, FT-55U	40	45	mA
					LC35256FM, FT-70U	35	40	
		1 μs cycle			3.5	6.0		
Standby mode current drain	V <sub>CC</sub> - 0.2 V/ 0.2 V inputs	I <sub>CCS1</sub>	V <sub>CE</sub> ≥ V <sub>CC</sub> - 0.2 V, V <sub>IN</sub> = 0 to V <sub>CC</sub>	Ta ≤ 25°C	0.05		μA	
				Ta ≤ 60°C				1.5
				Ta ≤ 70°C				3.0
				Ta ≤ 85°C				5.0
	TTL inputs	I <sub>CCS2</sub>	V <sub>CE</sub> = V <sub>IH</sub> , V <sub>IN</sub> = 0 to V <sub>CC</sub>			1.0	mA	

Note: \* Reference values when V<sub>CC</sub> = 5 V and Ta = 25°C.

### AC Electrical Characteristics at Ta = -40 to +85°C, VCC = 4.5 to 5.5 V

AC test conditions

Input pulse voltage levels: V<sub>IH</sub> = 2.4 V, V<sub>IL</sub> = 0.6 V

Input rise and fall times: 5 ns

Input and output timing levels: 1.5 V

Output load: 30 pF + 1 TTL gate (including the jig capacitance)

#### Read Cycle

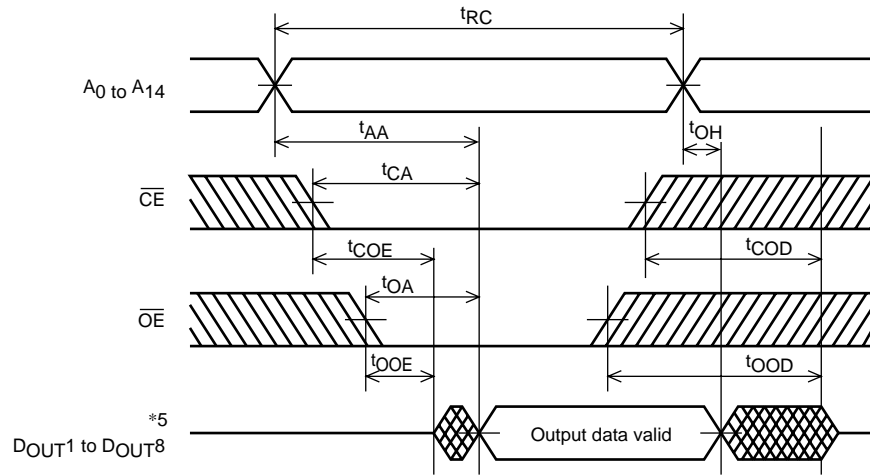
Parameter	Symbol	LC35256FM, FT				Unit
		-55U		-70U		
		min	max	min	max	
Read cycle time	t <sub>RC</sub>	55		70		ns
Address access time	t <sub>AA</sub>		55		70	ns
CE access time	t <sub>CA</sub>		55		70	ns
OE access time	t <sub>OA</sub>		30		35	ns
Output hold time	t <sub>OH</sub>	10		10		ns
CE output enable time	t <sub>COE</sub>	5		10		ns
OE output enable time	t <sub>OOE</sub>	5		5		ns
CE output disable time	t <sub>COD</sub>		20		30	ns
OE output disable time	t <sub>OOD</sub>		20		25	ns

#### Write Cycle

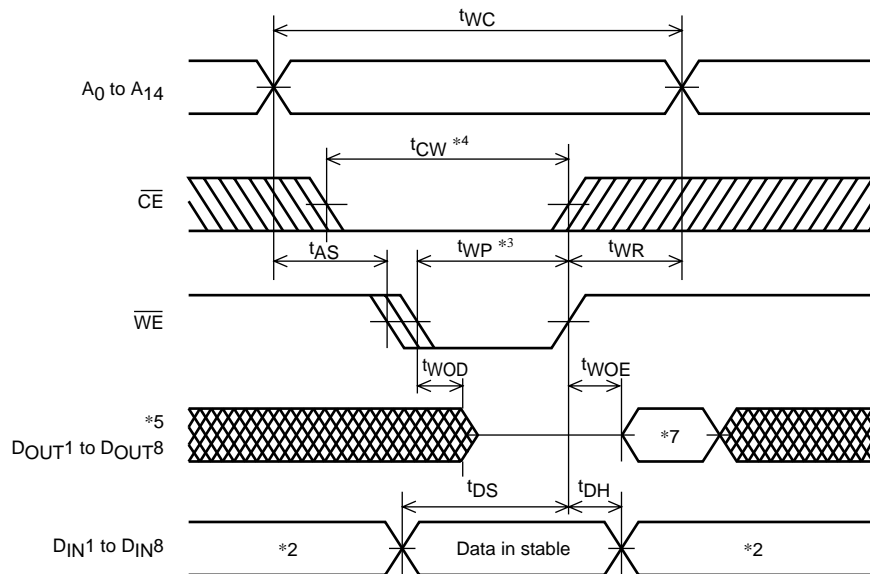
Parameter	Symbol	LC35256FM, FT				Unit
		-55U		-70U		
		min	max	min	max	
Write cycle time	t <sub>WC</sub>	55		70		ns
Address setup time	t <sub>AS</sub>	0		0		ns
Write pulse width	t <sub>WP</sub>	40		50		ns
CE setup time	t <sub>CW</sub>	50		60		ns
Write recovery time	t <sub>WR</sub>	0		0		ns
CE write recovery time	t <sub>WR1</sub>	0		0		ns
Data setup time	t <sub>DS</sub>	25		30		ns
Data hold time	t <sub>DH</sub>	0		0		ns
CE data hold time	t <sub>DH1</sub>	0		0		ns
WE output enable time	t <sub>WOE</sub>	5		5		ns
WE output disable time	t <sub>WOD</sub>		20		30	ns

Timing Charts

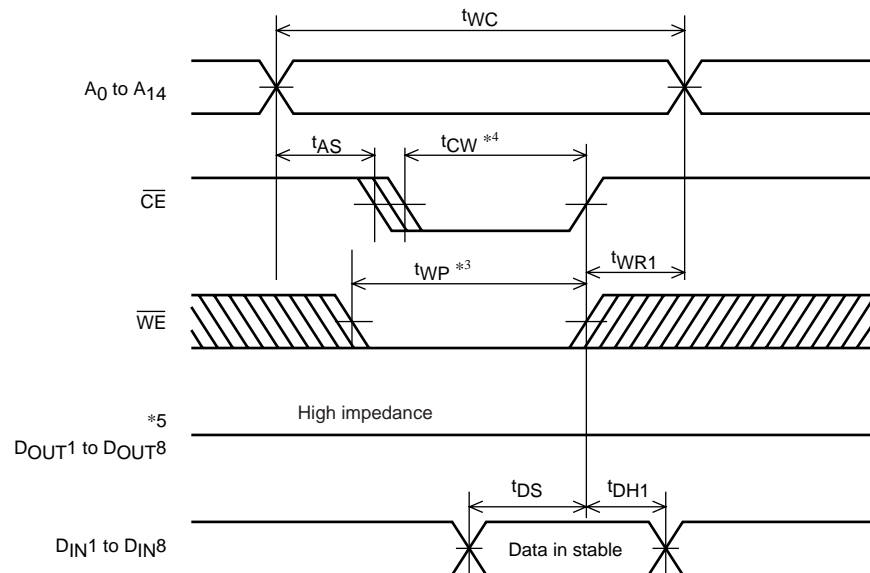
[Read cycle] \*1



[Write cycle 1] ( $\overline{WE}$  write) \*6



[Write cycle 2] ( $\overline{CE}$  write) \*6



## LC35256FM, FT-55U/70U

- Notes:
1.  $\overline{WE}$  must be held at the high level during the read cycle.
  2. Do not apply reverse phase signals to the  $D_{OUT}$  pins when those pins are in the output state.
  3. The time  $t_{WP}$  is the period when both  $\overline{CE}$  and  $\overline{WE}$  are low. It is defined as the time from the fall of  $\overline{WE}$  to the rise of  $\overline{CE}$  or  $\overline{WE}$ , whichever occurs first.
  4. The time  $t_{CW}$  is the period when both  $\overline{CE}$  and  $\overline{WE}$  are low. It is defined as the time from the fall of  $\overline{CE}$  to the rise of  $\overline{CE}$  or  $\overline{WE}$ , whichever occurs first.
  5. The  $D_{OUT}$  pins will be in the high-impedance state if any one of the following hold:  $\overline{OE}$  is at the high level,  $\overline{CE}$  is at the high level, or  $\overline{WE}$  is at the low level.
  6. The  $\overline{OE}$  pin must be either held high or held low during the write cycle.
  7.  $D_{OUT}$  has the same phase as the write data during this write cycle.

### Circuit Design Notes

When designing application circuits, always take the following into consideration and design the circuits so that the absolute maximum ratings are never exceeded.

- Supply voltage fluctuations
- Sample-to-sample variations in the electrical characteristics of the electronic components used, including semiconductor devices, resistors, and capacitors.
- Ambient temperature
- Variations in the input and clock signals
- The application of abnormal pulses

Furthermore, be sure to operate this device within the stipulated ranges of all parameters for which an allowable operating range is specified.

When CMOS IC input pins are left in the open state, through currents may occur in internal circuits to which intermediate voltage levels are applied, and this can result in incorrect circuit operation. Be sure to handle all unused input pins as specified in the device documentation.

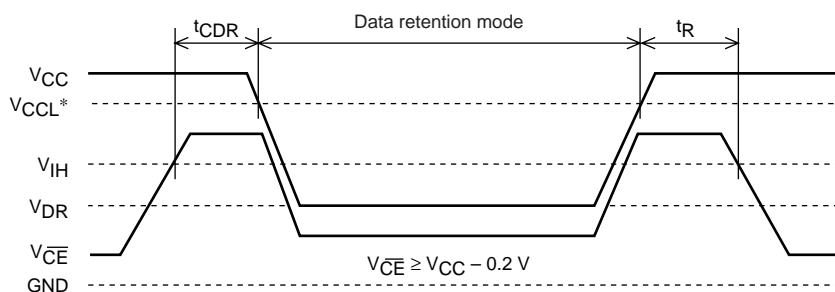
### Data Retention Conditions at $T_a = -40$ to $+85^\circ\text{C}$

Parameter	Symbol	Conditions	min	typ*	max	Unit	
Data retention supply voltage	$V_{DR}$	$V_{\overline{CE}} \geq V_{CC} - 0.2 \text{ V}$	2.0		5.5	V	
Data retention supply current	$I_{CCDR}$	$V_{CC} = 3.0 \text{ V}$ $V_{\overline{CE}} \geq V_{CC} - 0.2 \text{ V}$	$T_a \leq 25^\circ\text{C}$	0.02		$\mu\text{A}$	
			$T_a \leq 60^\circ\text{C}$				1.0
			$T_a \leq 70^\circ\text{C}$				2.0
			$T_a \leq 85^\circ\text{C}$				3.5
Chip enable setup time	$t_{CDR}$		0			ns	
Chip enable hold time	$t_R$		$t_{RC}^{**}$			ns	

Note: \* Reference values for  $V_{CC} = 3 \text{ V}$ ,  $T_a = 25^\circ\text{C}$ .

\*\*  $t_{RC}$ : Read cycle time

### Data Retention Waveforms



Note: \*  $V_{CCCL}$  5 V operation: 4.5 V

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