

**TENTATIVE**

TOSHIBA BIPOLAR DIGITAL INTEGRATED CIRCUIT  
SILICON MONOLITHIC

## TD7626F,TD7626FN

### 2.7GHz FREQUENCY SYNTHESIZER FOR SATELLITE TV

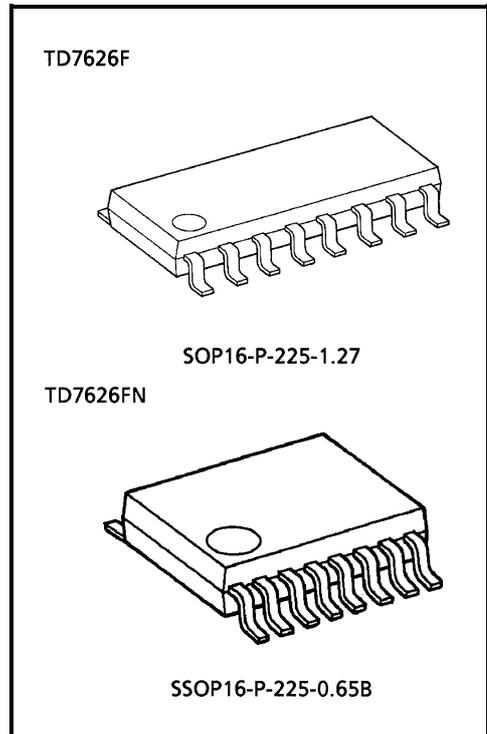
TD7626F and TD7626FN are single-chip frequency synthesizer ICs that can be combined with a  $\mu$ CPU to configure an advanced-function frequency synthesizer system. TD7626FN comes in a more compact package, pitch 0.65mm.

#### FEATURES

- High input sensitivity  
 $f_{in} = 0.5\sim 2.7\text{GHz} : -15\text{dBmW} (50\Omega) (\text{Min.})$
- Built-in 1 / 16 prescaler
- Built-in 5-level AD converter
- Built-in simple comparators $\times 3$
- Simple control bus (I<sup>2</sup>C bus)
- Four-address selectable by address selector
- Frequency divider ratio settings : 1 / 512, 1 / 1024
- Built-in power-on reset circuit
- Small flat package version
  - : TD7626F : SOP16 (1.27mm pitch)
  - TD7626FN : SSOP16 (0.65mm pitch)

Note: These devices are easy to be damaged by high static voltage or electric fields.  
In regards to this, please handle with care.

- Status after power-on reset
  - Band drive P7~P0 : OFF
  - Tuning amp : ON
  - Tuning voltage output ( $V_t$ ) : Low level
  - Charge pump output current : 50 $\mu$ A
  - Reference frequency divider ratio : 1 / 512

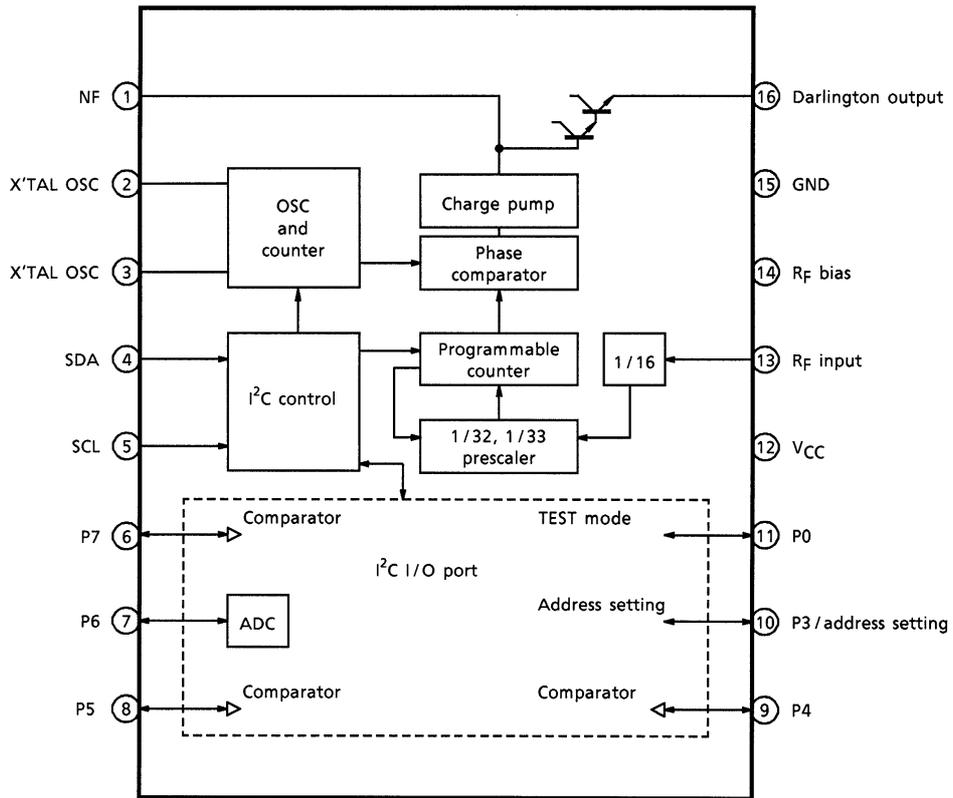


Weight  
SOP16-P-225-1.27 : 0.16g (Typ.)  
SSOP16-P-225-0.65B : 0.07g (Typ.)

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**BLOCK DIAGRAM**



## TERMINAL FUNCTIONS

PIN No.	PIN NAME	FUNCTION	INTERFACE CIRCUIT
1	NF	Compares the phase of the input R <sub>F</sub> signal against the frequency data and feeds back its difference output from the current pump.	
16	Charge pump output		
2	X'tal OSC <sub>in</sub>	Crystal oscillator pins to generate the reference signal for the phase comparator. Consist of the inverter amp.	
3	X'tal OSC <sub>out</sub>		
4	SDA	Normally used as input / output pins for the I <sup>2</sup> C bus serial data. In TEST mode, used as the input pin for the signal to be compared by the phase comparator.	
5	SCL	Normally used as the I <sup>2</sup> C bus serial clock input. In TEST mode, used to input the reference signal of the phase comparator.	
6	P7	Output can be controlled by setting the band switch data. The circuit configuration is open collector output. Each pin has a built-in comparator. The status of the comparator can be checked in READ mode. In TEST mode, P7 is a counter output which allows counter operation to be checked.	
8	P5		
9	P4		

PIN No.	PIN NAME	FUNCTION	INTERFACE CIRCUIT
7	P6	Output can be controlled by setting the band switch data. The circuit configuration is open collector output. An A / D converter is built in. In READ mode, five levels of applied voltage can be read. In TEST mode, outputs the reference signal derived by dividing the crystal OSC signal by the set divider ratio. This allows operation to be checked.	
10	P3	Basically used as the address setting pin. The sub-address can be changed by applied voltage. Can be used as a band switch as well, but incorporates resistance (12kΩ) for limiting current.	
11	P0	Output can be controlled by setting the band switch data. Incorporates resistance (12kΩ) for limiting current. (Can also be used for setting the prescaler in TEST mode.) (Open collector output)	
12	VCC	Power supply pin	—
13 14	R <sub>F</sub> input R <sub>F</sub> bias	Prescaler input pins. The circuit configuration is differential input. Differential reference bias pin 14 has a built-in 15pF capacitor.	
15	GND	Ground pin	—

**MAXIMUM RATINGS (Ta = 25°C)**

CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage 1	V <sub>CC1</sub>	6.0	V
Power Dissipation	P <sub>D</sub>	(Note 1)	mW
Operating Temperature	T <sub>opr</sub>	-20~85	°C
Storage Temperature	T <sub>stg</sub>	-55~150	°C

Note 1: F-type : 540mW, FN-type : 560mW

Note 2: When using the device at temperatures higher than 25°C, maximum power dissipation decreases for every 1°C as follows : 4.3mW with F-type : 4.5mW with FN-type.

Note 3: Do not set the port pins (Pins 6, 7, 8, 9, 10, and 11) at or lower than the level of the GND pin.

Note 4: These devices are easy to be damaged by high static voltage or electric fields.  
In regards to this, please handle with care.

**RECOMMENDED SUPPLY VOLTAGE**

PIN No.	PIN NAME	MIN	TYP.	MAX	UNIT
12	V <sub>CC</sub>	4.5	5.0	5.5	V

## ELECTRICAL CHARACTERISTICS (Unless otherwise stated, $V_{CC} = 5V$ , $T_a = 25^\circ C$ ) AC CHARACTERISTICS

CHARACTERISTIC	SYMBOL	TEST CIRCUIT	TEST CONDITION	MIN	TYP.	MAX	UNIT
Supply Current	$I_{CC1}$	1	Band switch : OFF OS : [ 1]	20	35	52	mA
Prescaler Input Sensitivity	$V_{in}$	2	$f = 500\sim 2700MHz$	-15	—	+3	dBmW
Logic Input High Voltage	$V_{IH}$	3	Logic pins (SDA, SCL) In the test circuit, transfer P5 data and determine reception from the lighting of the LED lamp. Measure the output using a logic analyzer.	3.0	—	—	V
Logic Input Low Voltage	$V_{IL}$			—	—	0.8	
Logic Output High Voltage	$V_{OH}$			3.8	—	—	
Logic Output Low Voltage	$V_{OL}$			—	—	0.5	
Logic Input High Current	$I_{IH}$	3	Apply 5V to input pin.	—	—	10	$\mu A$
Logic Input Low Current	$I_{OL}$		Apply 0V to input pin.	—	—	-20	
External OSC Input Amplitude	$OSC_{in}$	3	OSCin (Pin 2)	350	—	1000	MV <sub>p-p</sub>
OSC Operating Frequency	$OSC_{fin}$	3	Pins 2, 3	3.0	4.0	4.5	MHz
Crystal Negative Resistance	$X_{tR}$	3	TEST mode, frequency divided crystal signal output, P6 monitor	—	1.5	—	k $\Omega$
Output Port Flow Current	$IP_{in}$	3	P4, P5, P6, P7	5	—	—	mA
Output Port Leakage Current	$IP_{lk}$	3	Apply 12V as pull-up voltage.	—	—	10	$\mu A$
Output Port Built-In Resistance	$R_{port}$	—	P0 and P3	—	12	—	k $\Omega$
Output Port MAX Voltage	$V_{port}$	—	P0, P3, P4, P5, P6, P7	—	—	13.2	V
A / D Converter Input Voltage	$V_{ADC}$	—	P6	0.0	—	13.2	V
Comparator Pin Input Voltage	$V_{CMP}$	3	P4, P5, and P7	0.0	—	13.2	V
Comparator High Voltage	$V_{HCMP}$	3	P4, P5, and P7	2.0	—	13.2	V
Comparator Low Voltage	$V_{LCMP}$	3	P4, P5, and P7	0.0	—	0.8	V
Charge Pump Output Current	$I_{chg0}$	—	CP : [0]	—	50	—	$\mu A$
			CP : [1]	—	170	—	

## DATA FORMAT

### a) WRITE MODE

BYTE		MSB							LSB	
1	ADDRESS Byte	1	1	0	0	0	MA1	MA0	R / W = 0	ACK
2	DIVIDER Byte (1)	0	$2^{14}$	$2^{13}$	$2^{12}$	$2^{11}$	$2^{10}$	$2^9$	$2^8$	ACK
3	DIVIDER Byte (2)	$2^7$	$2^6$	$2^5$	$2^4$	$2^3$	$2^2$	$2^1$	$2^0$	ACK (L)
4	CONTROL Byte	1	CP	T <sub>1</sub>	T <sub>0</sub>	TS2	TS1	TS0	OS	ACK
5	BAND SW Byte	P7	P6	P5	P4	P3	X	X	P0	ACK (L)

(L) : DATA LATCH

x : DON'T Care

ACK : Acknowledgment

### b) READ MODE

BYTE		MSB							LSB	
1	ADDRESS Byte	1	1	0	0	0	MA1	MA0	R / W = 1	ACK
2	STATUS Byte	0	FL	IP7	IP5	IP4	A <sub>2</sub>	A <sub>1</sub>	A <sub>0</sub>	ACK

ACK : Acknowledgment

## DATA DETAILS

- MA1, MA0 :Programmable address bits  
(Indicate applied voltage of pin 10 and corresponding address setting.)

ADDRESS PIN APPLIED VOLTAGE	MA1	MA0
0~0.2×V <sub>CC</sub>	0	0
0.3×V <sub>CC</sub> ~0.7×V <sub>CC</sub>	1	0
0~V <sub>CC</sub>	0	1
0.8×V <sub>CC</sub> ~V <sub>CC</sub>	1	1

- CP : Charge pump current setting  
[0] : 50μA (Typ.)  
[1] : 170μA (Typ.)
- T<sub>1</sub> : Test mode switching  
[0] : NORMAL mode  
[1] : TEST mode
- T<sub>0</sub> : Charge pump control setting  
[0] : Charge pump ON  
[1] : Charge pump OFF

● TS2, TS1, TS0 : TEST mode settings

CHARACTERISTIC	T <sub>1</sub>	TS2	TS1	TS0	FREQUENCY DIVIDER RATIO	REMARKS	
Normal State	0	×	×	0	1 / 1024	—	
Normal State	0	×	×	1	1 / 512	—	
Charge Pump	Sink	1	1	0	0	1 / 1024	FL = 0 : Charge pump output sink side only on
	Source	1	1	0	1	1 / 512	FL = 1 : Charge pump output source side only on
Output Port OFF	1	1	1	0	1 / 1024	P7~P4 = OFF	
Phase Comparator Test	1	1	1	1	1 / 512	SDA: Input of signal to be compared SCL: Reference signal input	
Crystal Divider Counter Output	1	0	×	0	1 / 1024	P6 : Crystal divider output P7 : Counter output (1 / 16×32×count data) P0 : Prescaler settings ... [0] : ON [1] : OFF P7~P4 = OFF	
	1	0	×	1	1 / 512		

× : DON'T Care

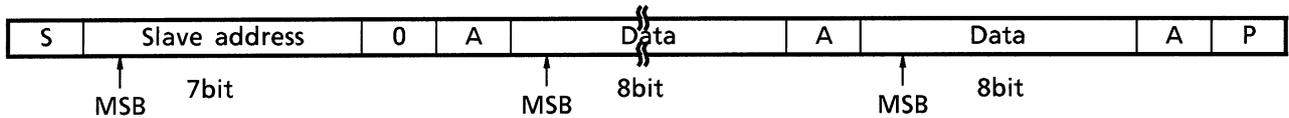
- OS : Tuning amp control settings  
 [0] : Tuning on (Normal state)  
 [1] : Tuning off (Fixes charge pump output at 0.0~0.2V)
- FL : Lock detect flag  
 [0] : Unlocked  
 [1] : Locked
- IP7, IP5, IP4 : Comparator output (P7, P5, P4)  
 [0] : Applied voltage.....0.0~0.8V  
 [1] : Applied voltage.....2.0~13.2V
- A2, A1, A0 : 5-level A / D converter (P6)

ADC PIN APPLIED VOLTAGE	A <sub>2</sub>	A <sub>1</sub>	A <sub>0</sub>
0.60×V <sub>CC</sub> ~13.2V	1	0	0
0.45×V <sub>CC</sub> ~0.60×V <sub>CC</sub>	0	1	1
0.30×V <sub>CC</sub> ~0.45×V <sub>CC</sub>	0	1	0
0.15×V <sub>CC</sub> ~0.30×V <sub>CC</sub>	0	0	1
0~0.15×V <sub>CC</sub>	0	0	0

## I<sup>2</sup>C BUS CONTROLLED FORMAT SUMMARY

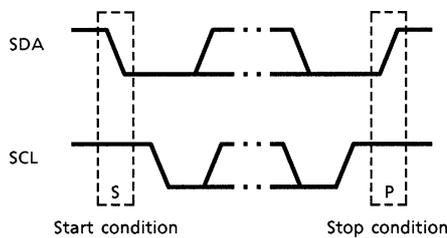
Bus controlled format of TD7626F, TD7626FN are based on I<sup>2</sup>C Bus Control format of Philips.

Data transfer format

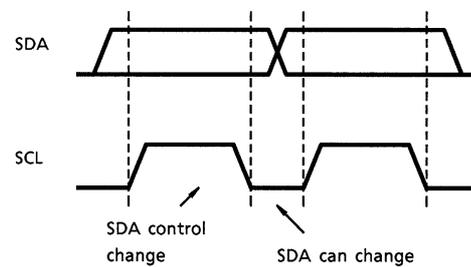


S : Start conditions  
 P : Stop conditions  
 A : Acknowledge

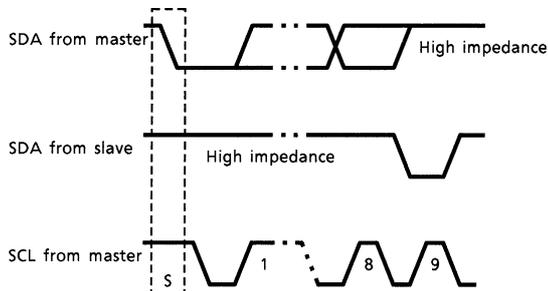
(1) Start condition and stop condition



(2) Bit transfer



(3) Acknowledgement

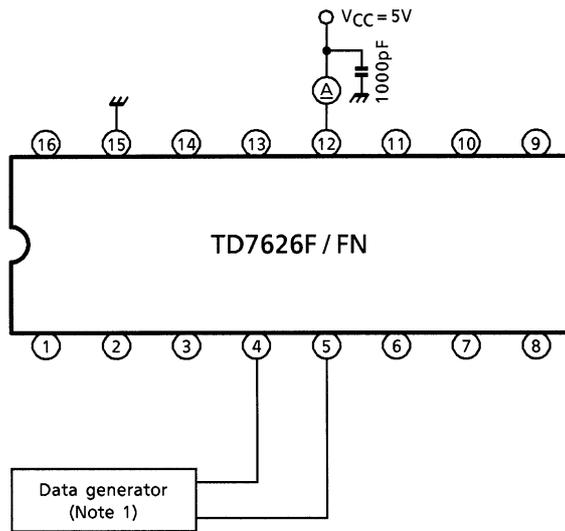


(4) Slave addresses

A <sub>6</sub>	A <sub>5</sub>	A <sub>4</sub>	A <sub>3</sub>	A <sub>2</sub>	A <sub>1</sub>	A <sub>0</sub>	R / $\bar{W}$
1	1	0	0	0	X	X	0

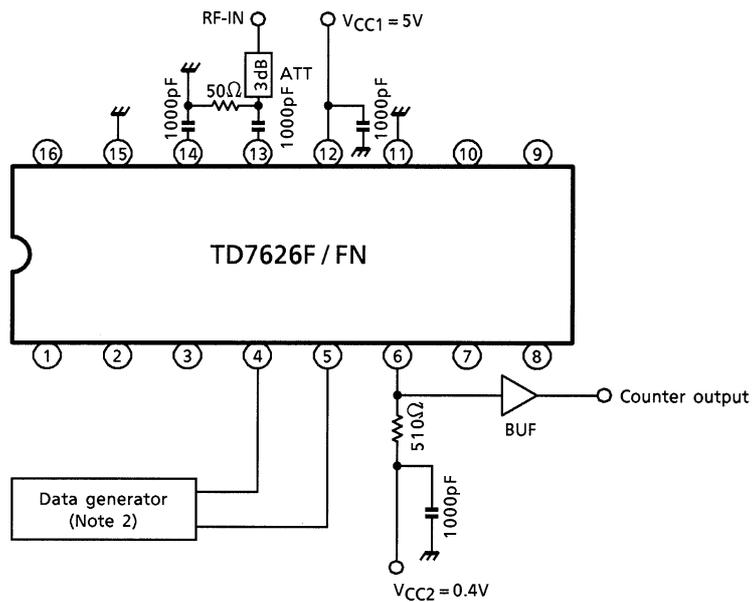
Purchase of TOSHIBA I<sup>2</sup>C components conveys a license under the Philips I<sup>2</sup>C Patent Rights to use these components in an I<sup>2</sup>C system, provided that the system conforms to the I<sup>2</sup>C Standard Specification as defined by Philips.

**TEST CIRCUIT 1**



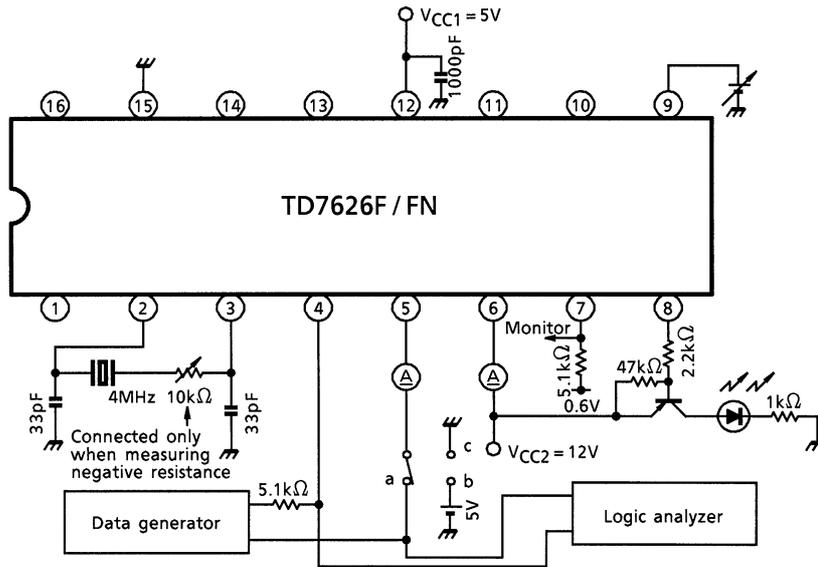
Note 1: Band switch...OFF, tuning amp...OFF

**TEST CIRCUIT 2**

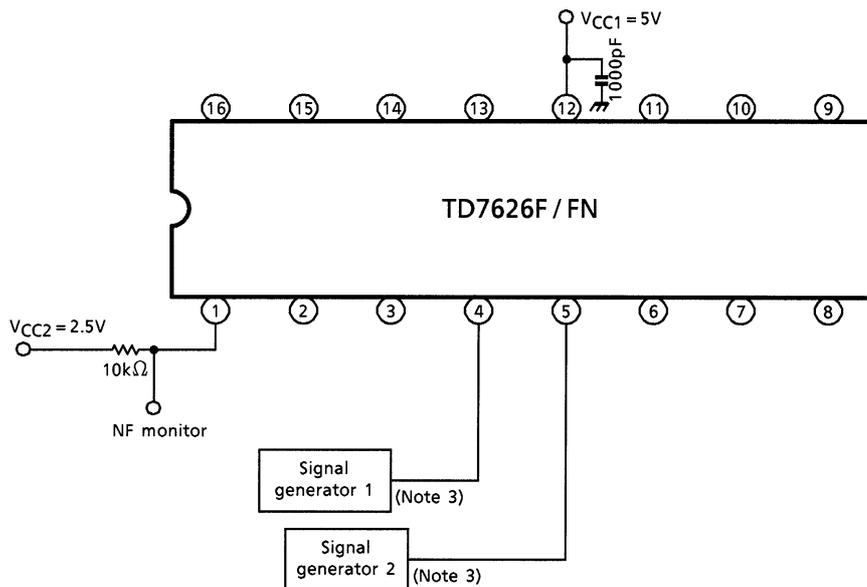


Note 2: See TEST mode settings (Counter output)

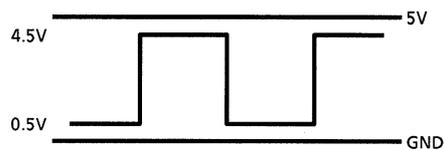
## TEST CIRCUIT 3



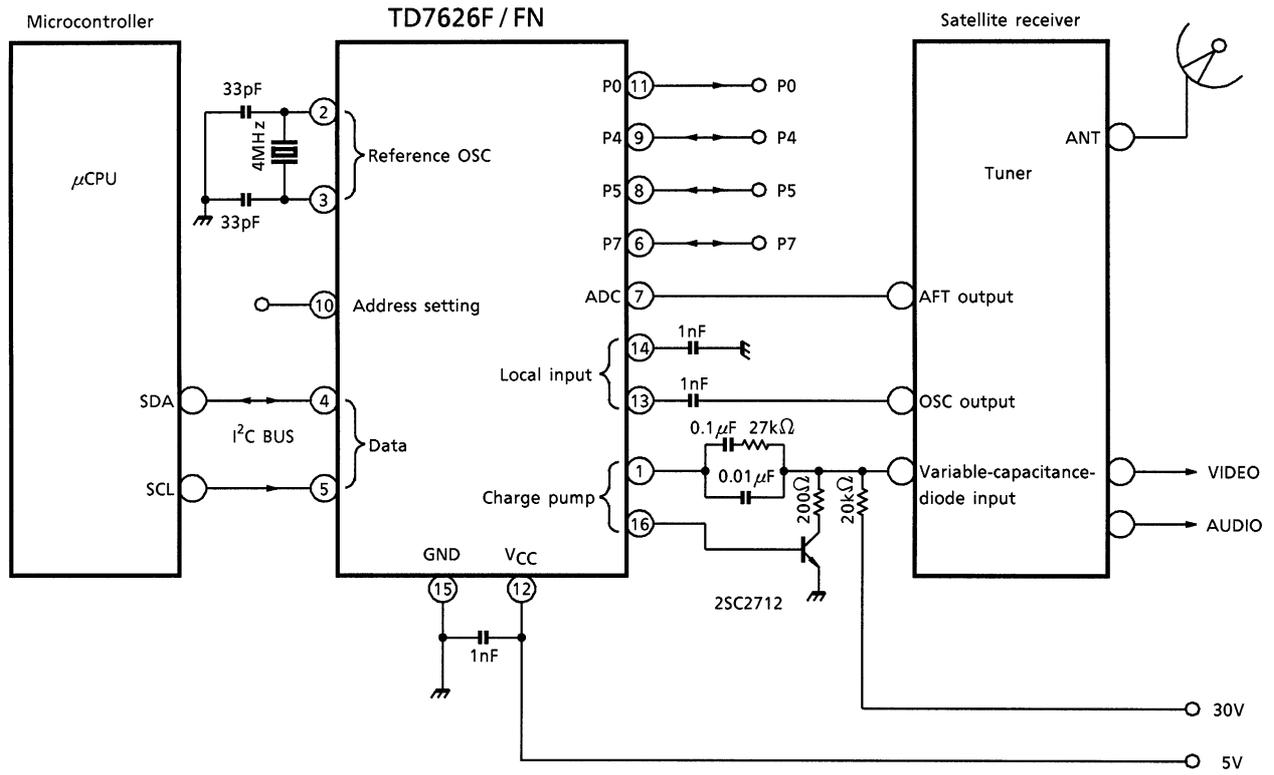
## TEST CIRCUIT 4



Note 3: Phase comparator input level



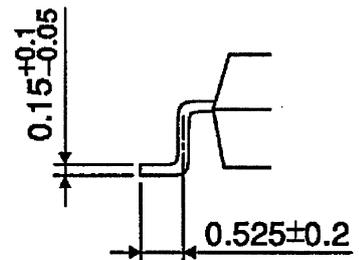
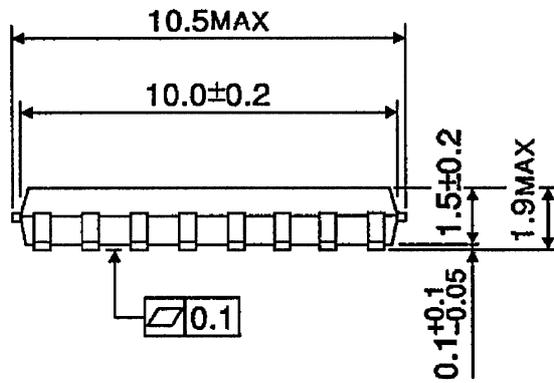
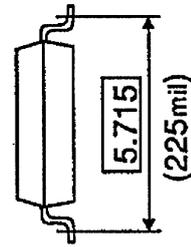
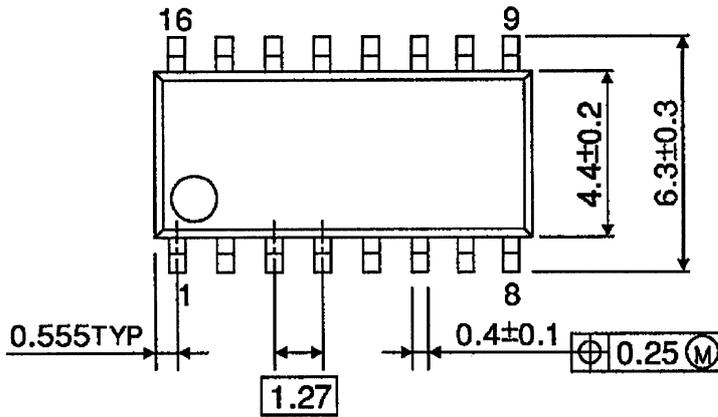
**EXAMPLE OF FREQUENCY SYNTHESIZER APPLICATION CIRCUIT**



## PACKAGE DIMENSIONS

SOP16-P-225-1.27

Unit : mm

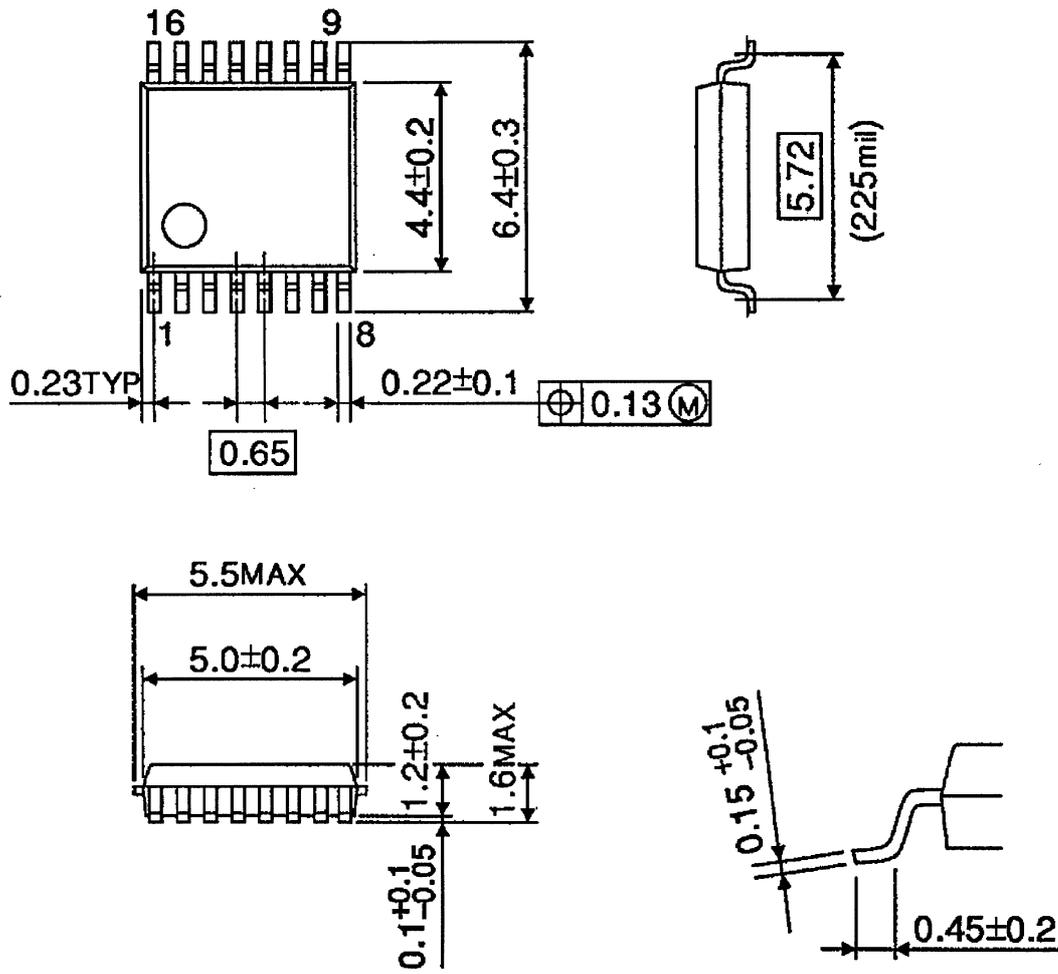


Weight: 0.16g (Typ.)

**PACKAGE DIMENSIONS**

SSOP16-P-225-0.65B

Unit : mm



Weight: 0.07g (Typ.)