

ASSP for DTS

BIPOLAR

Prescaler with VCO (Dual-Modulus, 1.0 GHz)**MB551****DESCRIPTION**

The MB551 is a dual-modulus prescaler incorporating a voltage controlled oscillator (VCO) used for 900-MHz band frequency synthesizers. The MB551 consists of: a Colpitts oscillator with grounded base capacitor, a buffer amplifier with collector open output, a prescaler interface circuit, and a dual-modulus prescaler operating at frequencies divided by 128/129. The oscillator block accommodates external components such as a capacitor, a dielectric oscillator (resonator), and a variable capacitor, making up the VCO.

The VCO and the prescaler are connected by an internal control circuit, minimizing the effects of prescaler input load variation on VCO characteristics such as a C/N ratio.

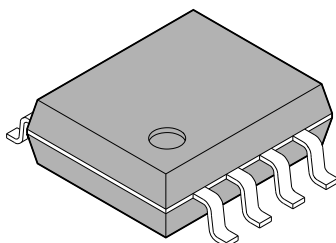
The MB551 operates at 5 V (typical) and draws 16 mA of current (typical).

FEATURES

- Oscillator frequency: 1 GHz (Max)
- Low power consumption: $I_{cc} = 16$ mA (Typical)
- Oscillator output power: 0 dBm (Typical)
- C/N ratio: 70 dB (Typical) Measurement conditions: $\Delta f = 50$ kHz, BW = 15 kHz
65 dB (Typical) Measurement conditions: $\Delta f = 25$ kHz, BW = 15 kHz
- S/N ratio: 45 dB (Typical) Measurement conditions: BW = 0.3 to 3 kHz, 3 kHz.Dev, 1 kHz Tone
- Stable oscillator output
- Supply voltage dependence: ± 200 kHz/V (Typical)
Frequency stability: 35 ppm/ $^{\circ}$ C (Typical)

*(Continued)***PACKAGE**

8 pin Plastic SOP



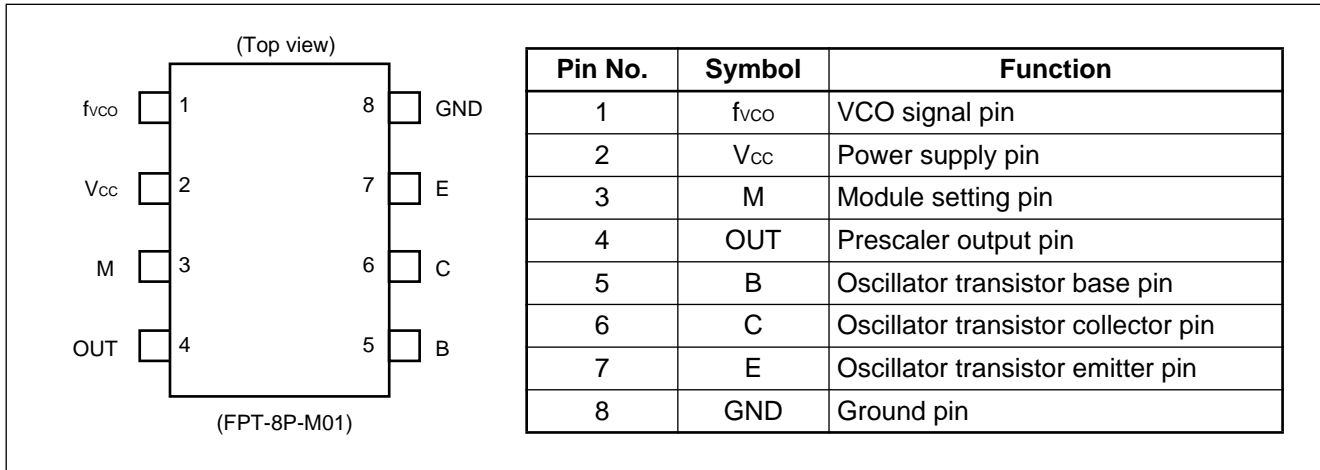
(FPT-8P-M01)

MB551

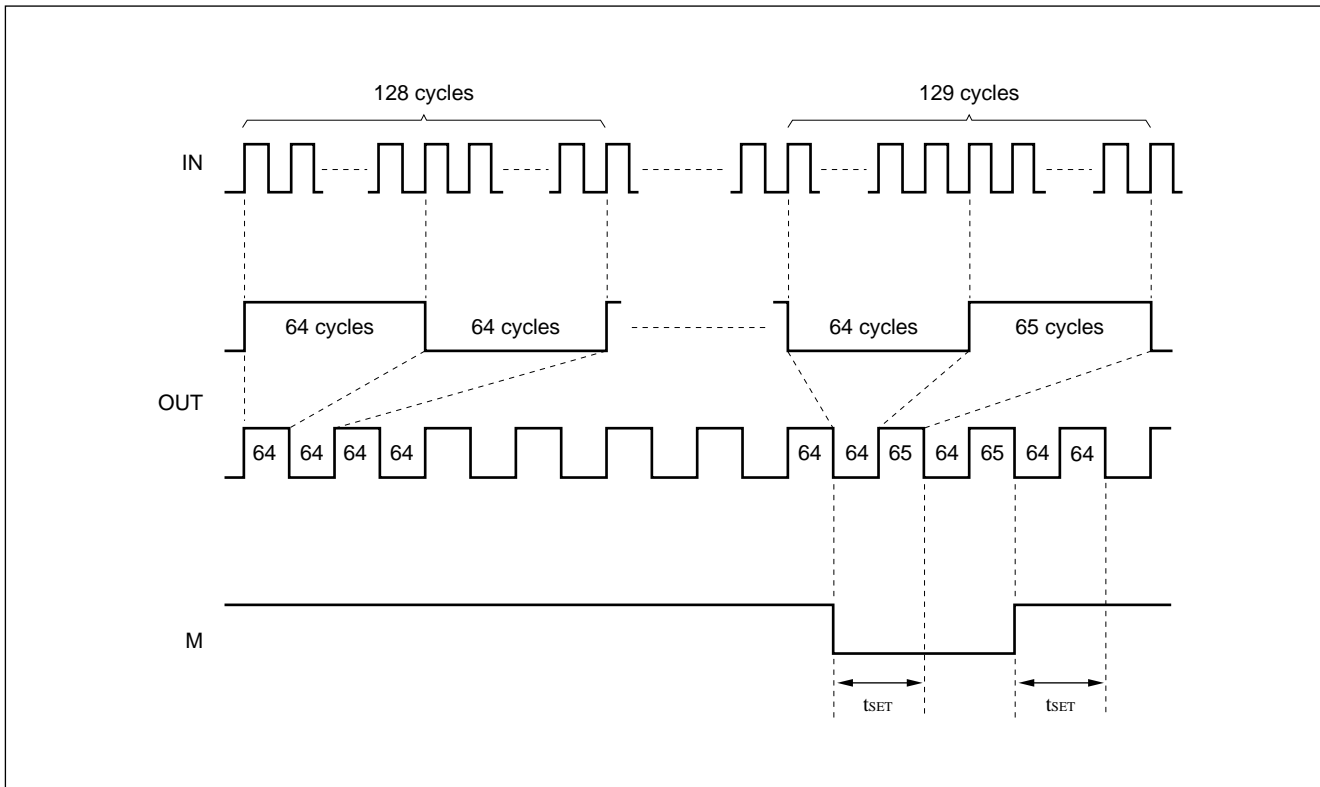
(Continued)

- Pulse swallow method: Division-by-128/129 prescaler
- Prescaler output with termination circuit: $V_I = 1.6 V_{P-P}$

PIN ASSIGNMENT

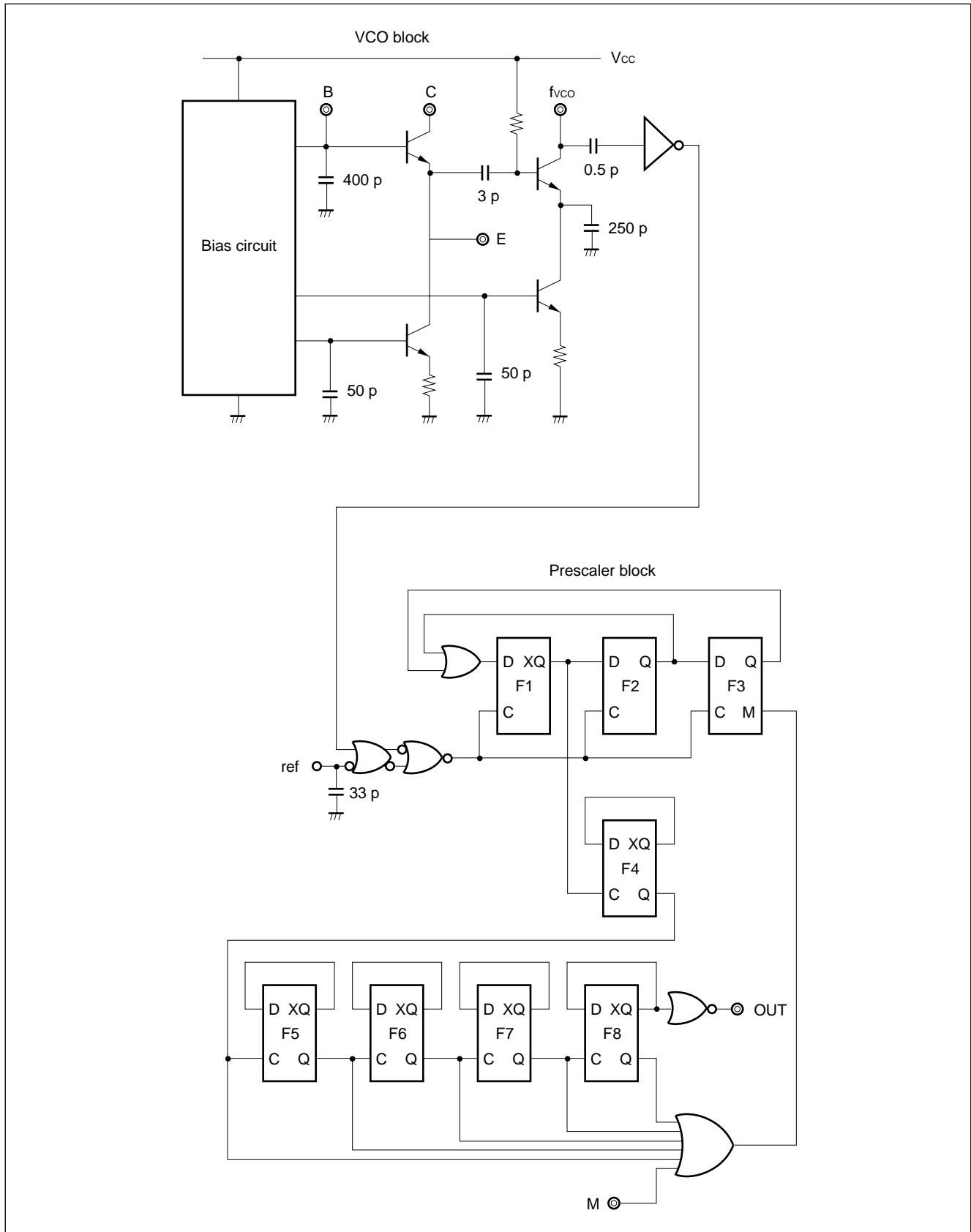


TIMING DIAGRAM (Example of Dual-modulus, division-by-128/129 type)



- M pin = High: Division by 128
M pin = Low: Division by 129
($V_{IH} = 2.0 V$ min, $V_{IL} = 0.8 V$ max.)
- Division plus one makes the high-to-low transition longer by one cycle of the frequency-divided signal.
- Setup time (t_{SET}) from input of the M signal to change in the divide ratio of the prescaler is 16 ns (typical).

■ BLOCK DIAGRAM



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■ ABSOLUTE MAXIMUM RATINGS (See WARNING)

Parameter	Symbol	Rating	Unit	Remarks
Power supply voltage	V_{CC}	-0.5 to +7.0	V	
Oscillator transistor base/emitter applied voltage	V_B, V_E	—	—	Do not apply external DC voltage to the base or emitter pin.
M/OUT (Pin 3/4) applied voltage	V_{P1}	-0.5 to $V_{CC} + 0.5$	V	
f_{VCO}/C (Pin 1/6) applied voltage	V_{P2}	$V_{CC} \leq V_{P2} < +7.0$	V	
Applied current	I_P	± 10	mA	
Storage temperature	T_{stg}	-55 to +125	°C	

WARNING: Permanent device damage may occur if the above **Absolute Maximum Ratings** are exceeded. Functional operation should be restricted to the conditions as detailed in the operational sections of this data sheet. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

■ RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Value			Unit	Remarks
		Min.	Typ.	Max.		
Power supply voltage	V_{CC}	4.5	5.0	5.5	V	
External variable capacitor control voltage	V_T	1.5	—	4.5	V	
Operating temperature	T_a	-40	—	+85	°C	
Prescaler output load	CL	—	—	8	pF	

■ ELECTRICAL CHARACTERISTICS

1. VCO Block

Parameter	Symbol	Value			Unit	Remarks
		Min.	Typ.	Max.		
Oscillator frequency	f_{osc}	—	—	1000	MHz	
Oscillator output	P_{out}	—	0	—	dBm	
C/N ratio	C/N	—	70	—	dB	Df = 50 kHz, BW = 15 kHz
			65	—	dB	Df = 25 kHz, BW = 15 kHz
S/N ratio	S/N	—	45	—	dB	BW = 0.3 to 3 kHz, 3 kHz, Dev, Tone 1 kHz
Fundamental/1st harmonic ratio	SP-1	—	-10	—	dB	
Frequency stability	Δf_t	—	35	—	ppm/°C	-40 to 85°C, 25°C (Typical)
Supply voltage variation	Δf_r	—	±200	—	kHz/V	5 V ±10%
Conversion gain	Δf_{osc}	—	4	—	MHz/V	Control range: 1.0 to 4.0 V

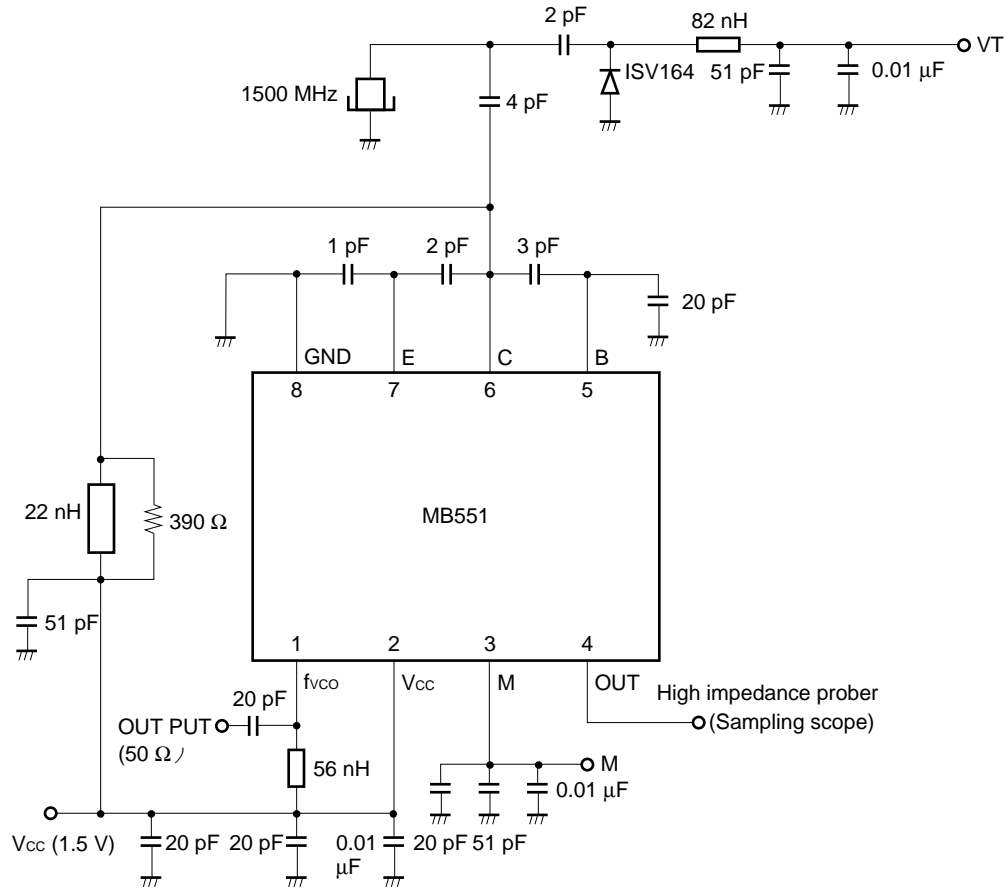
Note: Electrical characteristics depend on external components and mounting conditions. These values are reference values assuming the test circuit examples on pages 6 and 7.

2. Prescaler Block

Parameter	Symbol	Value			Unit	Remarks
		Min.	Typ.	Max.		
Power supply current	I_{CC}	—	16.0	—	mA	
Output amplitude	V_{OUT}	1.0	1.6	—	V_{P-P}	Load capacitance when internal termination pin is used: 8 pF or less
Response frequency	f_{in}	—	—	1000	MHz	
Allowable input power	V_{in}	-4	—	+10	dBm	
High-level input voltage (MC)	V_{IH}	2.0	—	—	V	
	V_{IL}	—	—	0.8	V	
High-level input current (MC)	I_{IH}	—	—	0.4	mA	
	I_{IL}	-0.2	—	—	mA	
Module setup time	t_{SET}	—	16	26	ns	

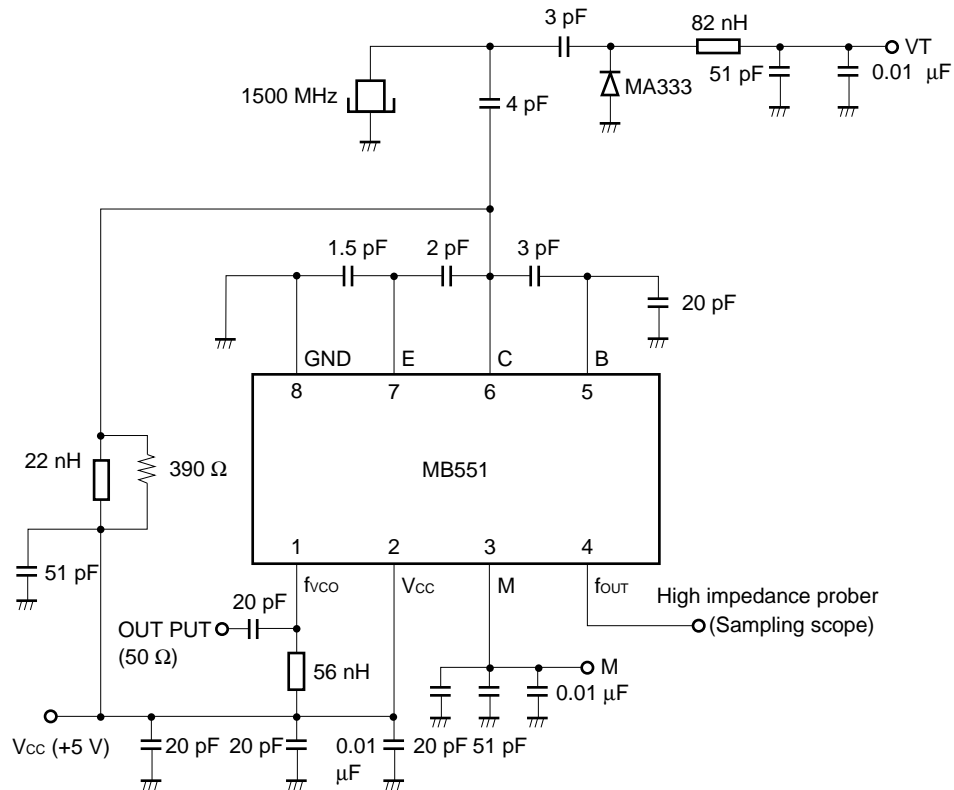
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TEST CIRCUIT EXAMPLE 1



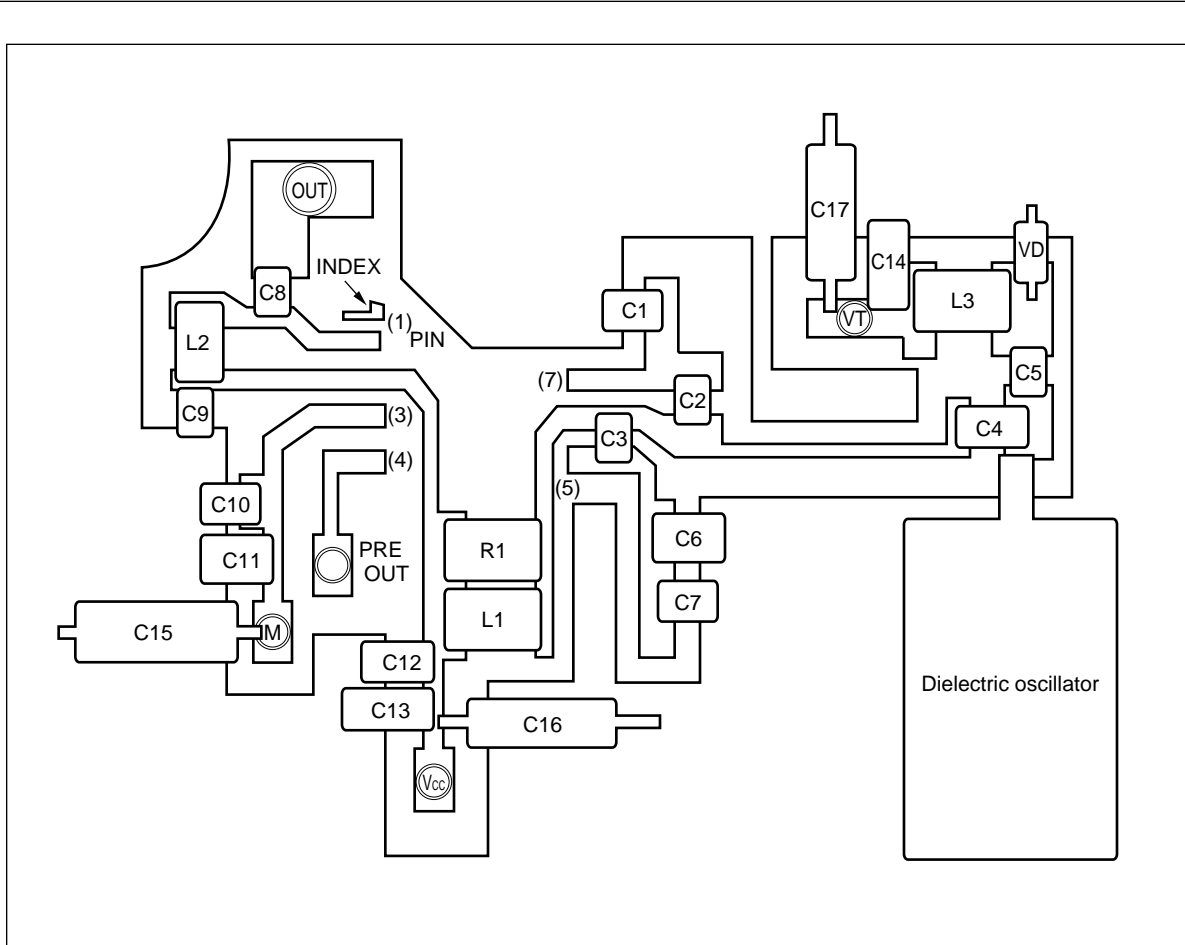
- Chip capacitor: UMK316C, UMK212C, UCN103C Series (Taiyo Yuden)
- Chip coil: LQN2A Series (Murata Works)
- Dielectric oscillator: DRR060UE (Murata Works)
- Varicap: ISV164 (NEC)

■ TEST CIRCUIT EXAMPLE 2



Chip capacitor: UMK316C Series (Taiyo Yuden)
 Chip coil: LQN2A Series (Murata Works)
 Dielectric oscillator: DRR060UE (Murata Works)
 Varicap: MA333 (Mitsubishi Electric)

RECOMMENDED PC BOARD PATTERN



[Mounted component list]

C1: 1 pF (Taiyo Yuden UMK212C)
 C2: 2 pF (Taiyo Yuden UCN103C)
 C3: 3 pF (Taiyo Yuden UMK212C)
 C4: 4 pF (Taiyo Yuden UMK212C)
 C5: 2 pF (Taiyo Yuden UMK212C)
 C6: 20 pF (Taiyo Yuden UMK316C)
 C7: 51 pF (Taiyo Yuden UMK212C)
 C8: 20 pF (Taiyo Yuden UMK316C)
 C9: 20 pF (Taiyo Yuden UMK316C)
 C10: 51 pF (Taiyo Yuden UMK212C)
 C11: 20 pF (Taiyo Yuden UMK316C)
 C12: 51 pF (Taiyo Yuden UMK212C)
 C13: 20 pF (Taiyo Yuden UMK316C)
 C14: 51 pF (Taiyo Yuden UMK212C)
 C15: 0.01 μ F (Film capacitor)

C16: 0.01 μ F (Film capacitor)
 C17: 0.01 μ F (Film capacitor)

R1: 390 Ω (Rohm MCR25)

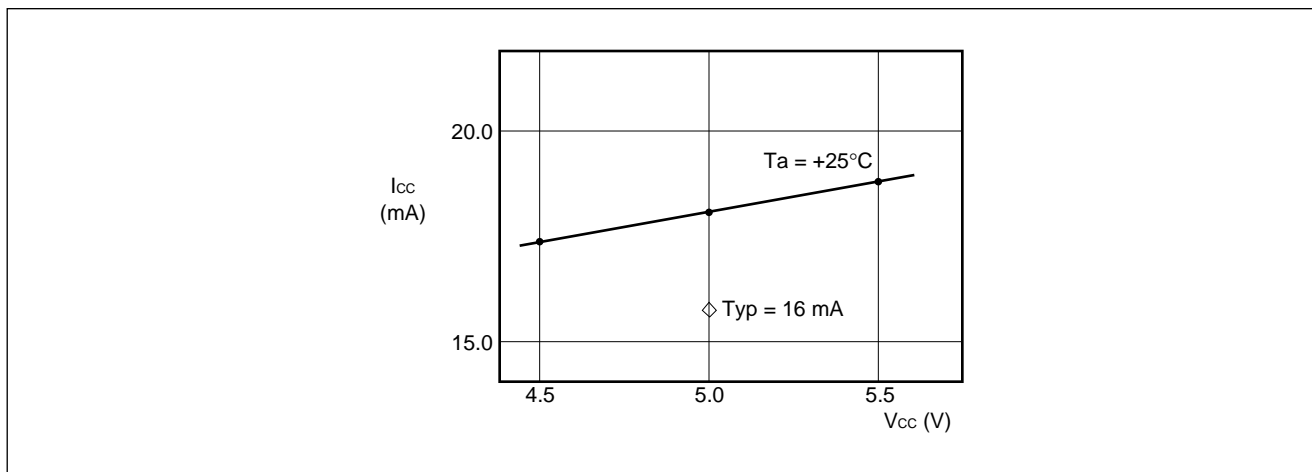
L1: 22 nH (Murata Works LQN2A)
 L2: 56 nH (Murata Works LQN2A)
 L3: 82 nH (Murata Works LQN2A)

VD: 1SV164 (NEC)

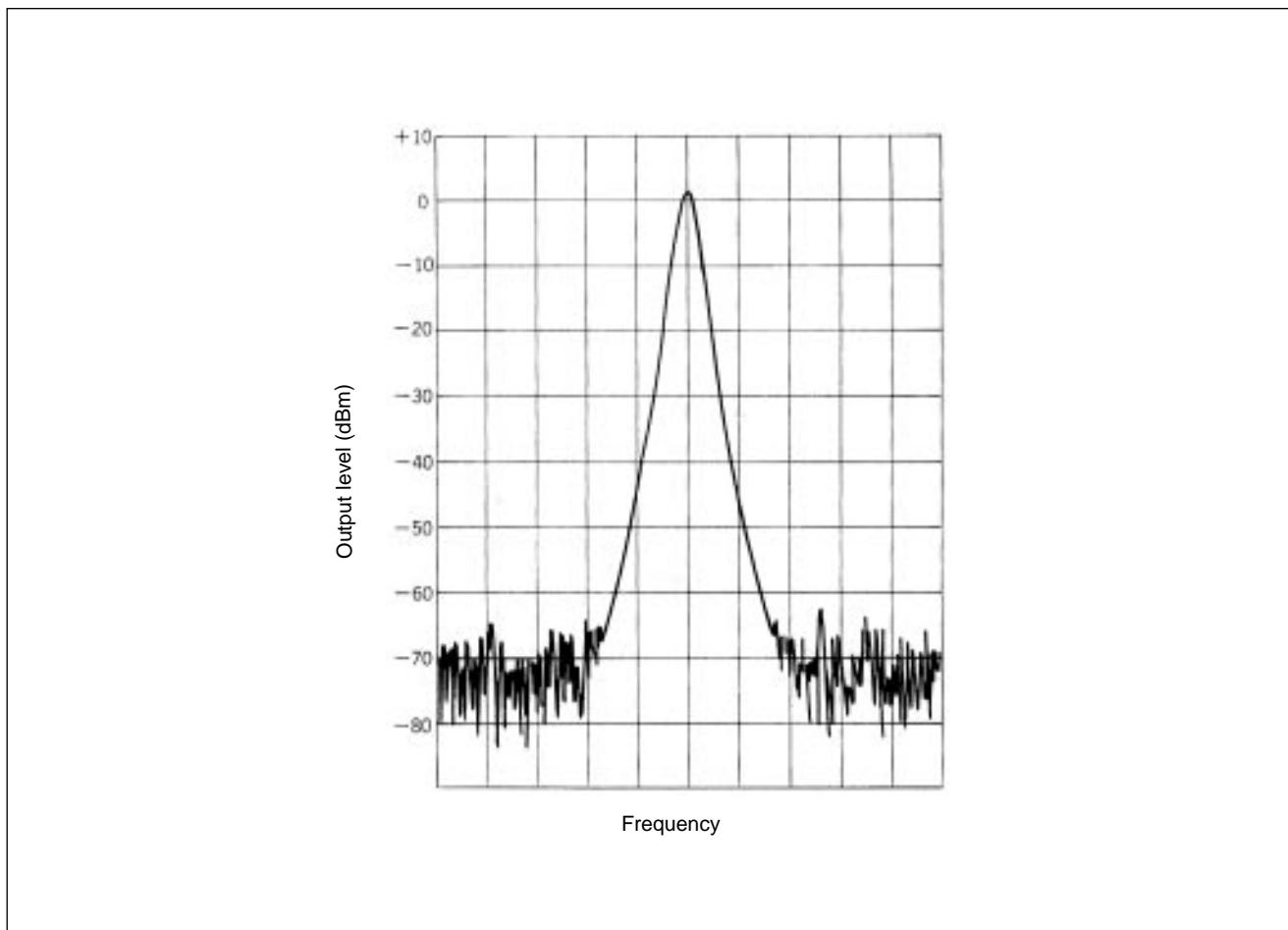
Dielectric oscillator: (Murata Works DRR060 Series, 1.5 GHz)

■ MEASUREMENT RESULTS

(1) Supply Current



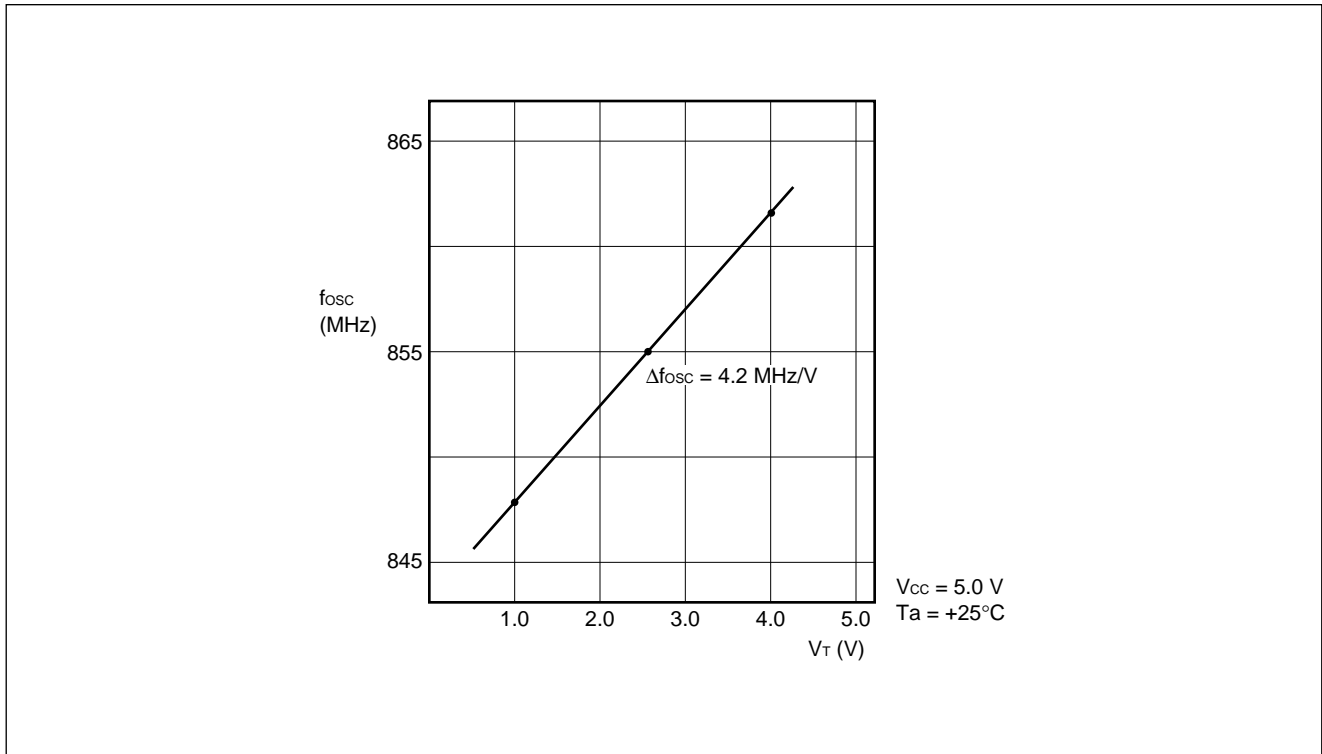
(2) Oscillation Waveform (50-kHz span)



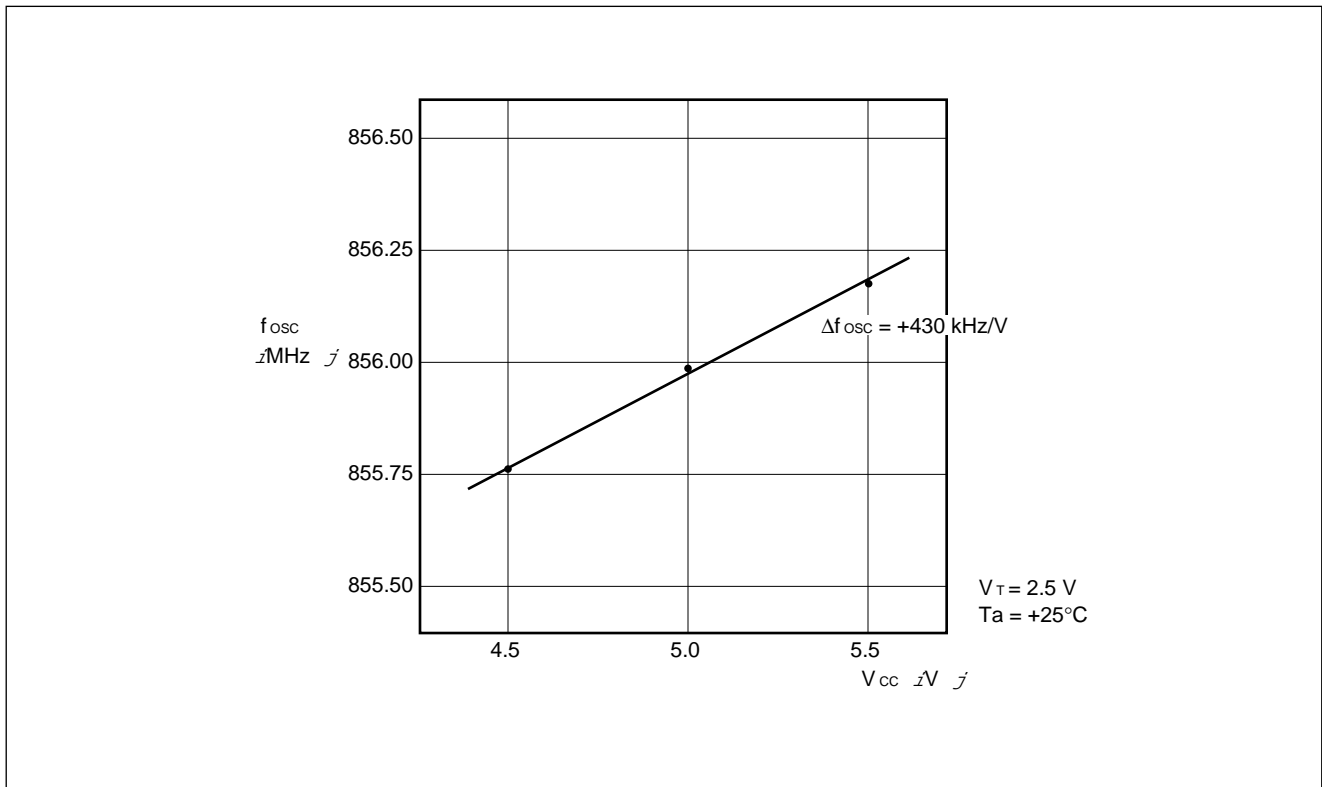
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■ MEASUREMENT RESULTS (Test Circuit 1 on Recommended PC Board)

(1) Conversion Gain

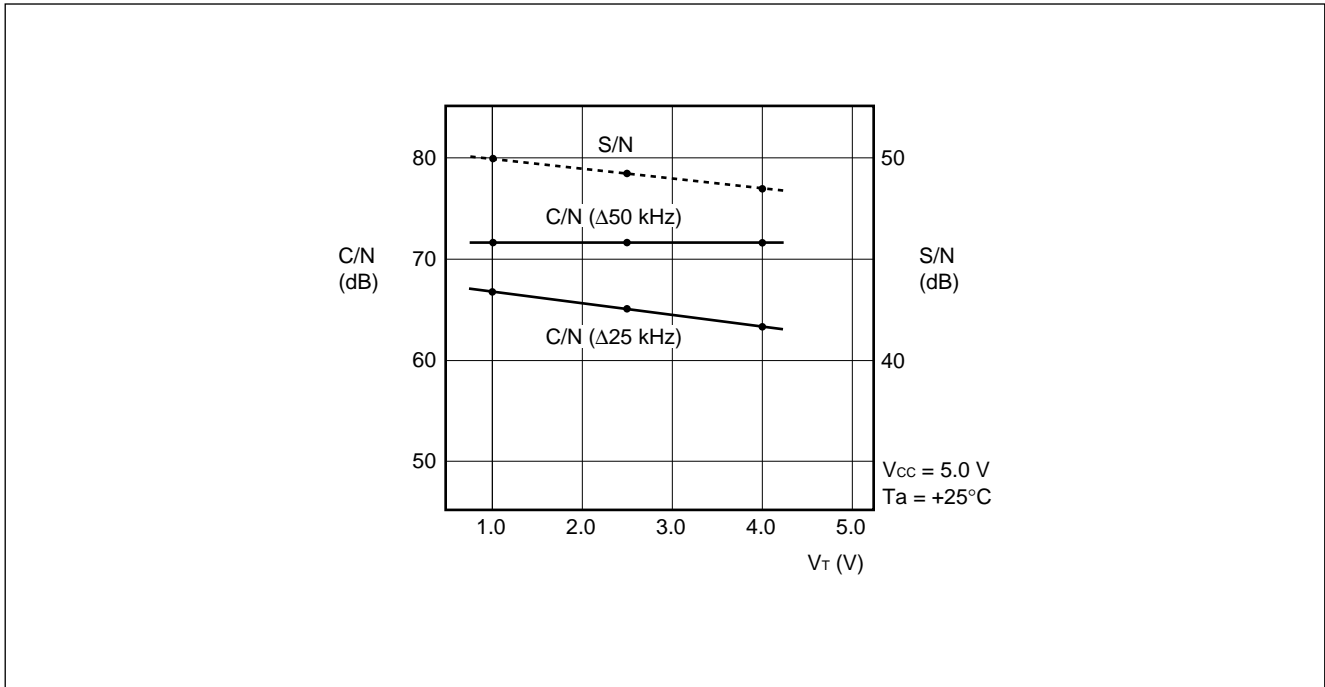


(2) Supply Voltage Variation

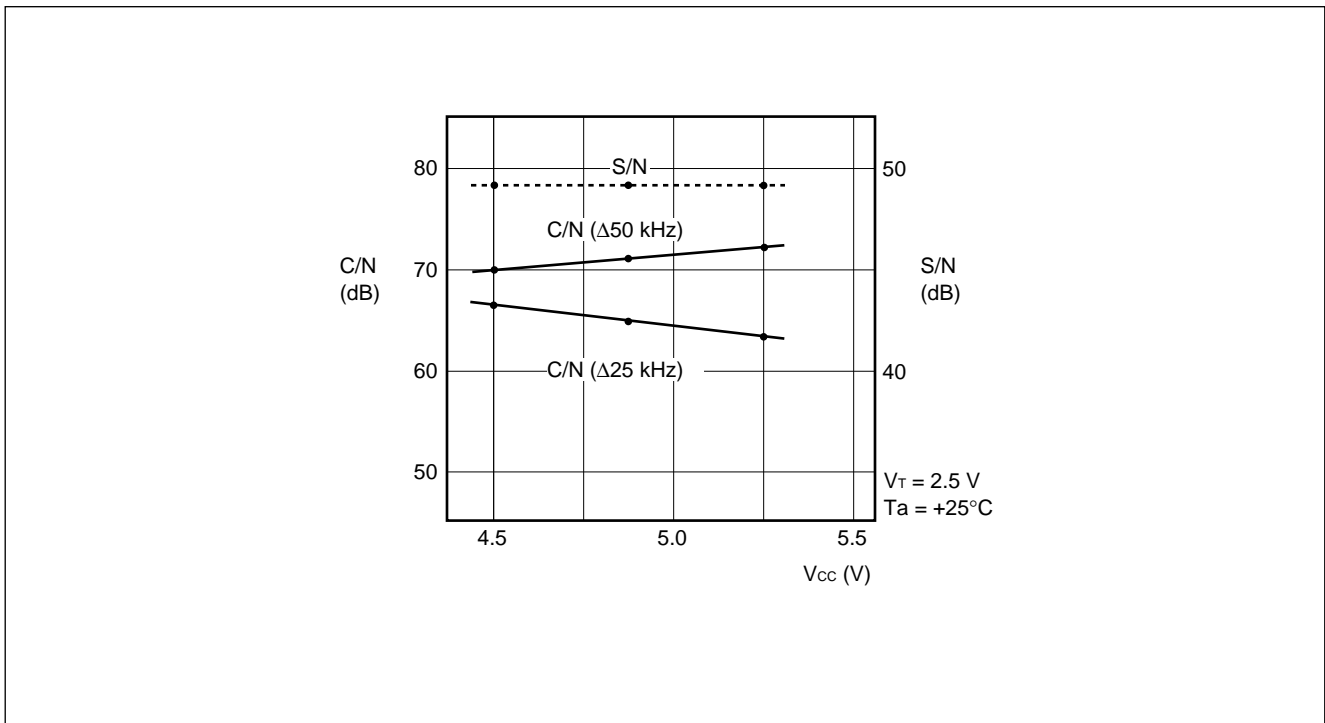


(3) C/N, S/N

• Control Voltage Dependence



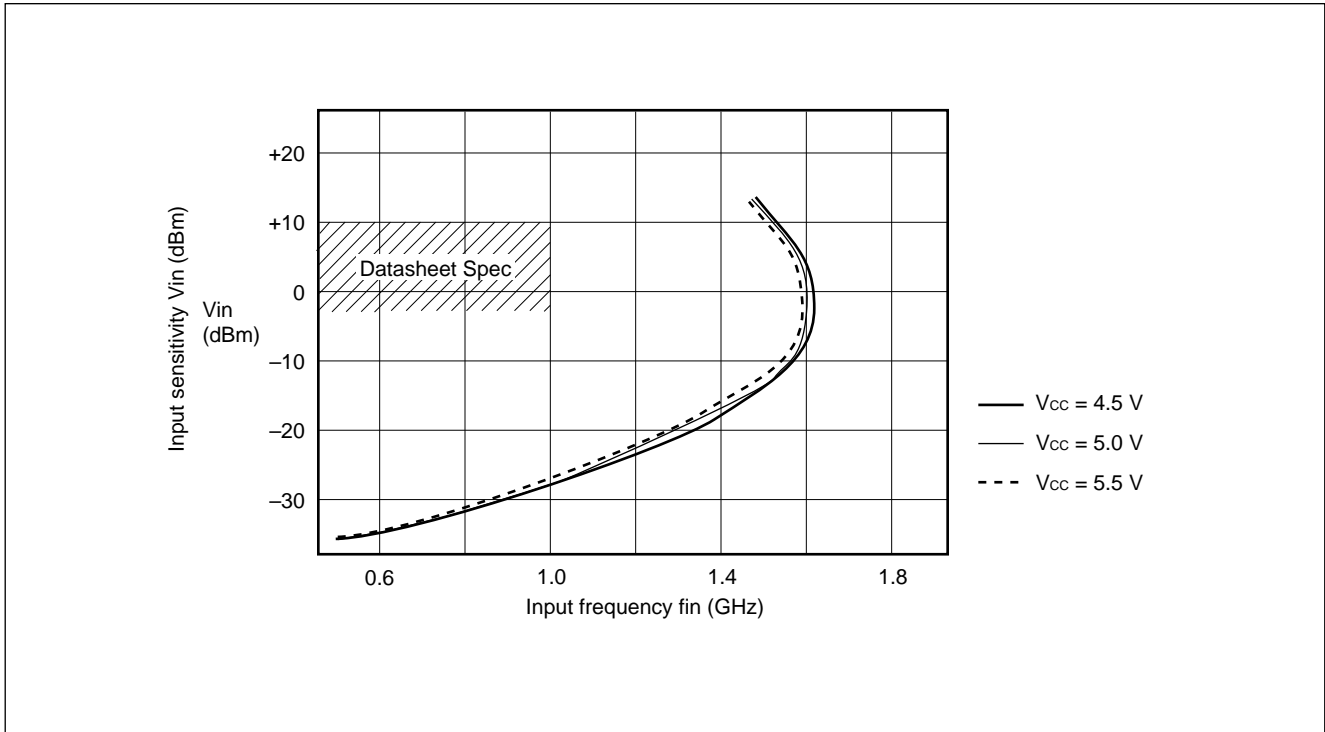
• Supply Voltage Dependence



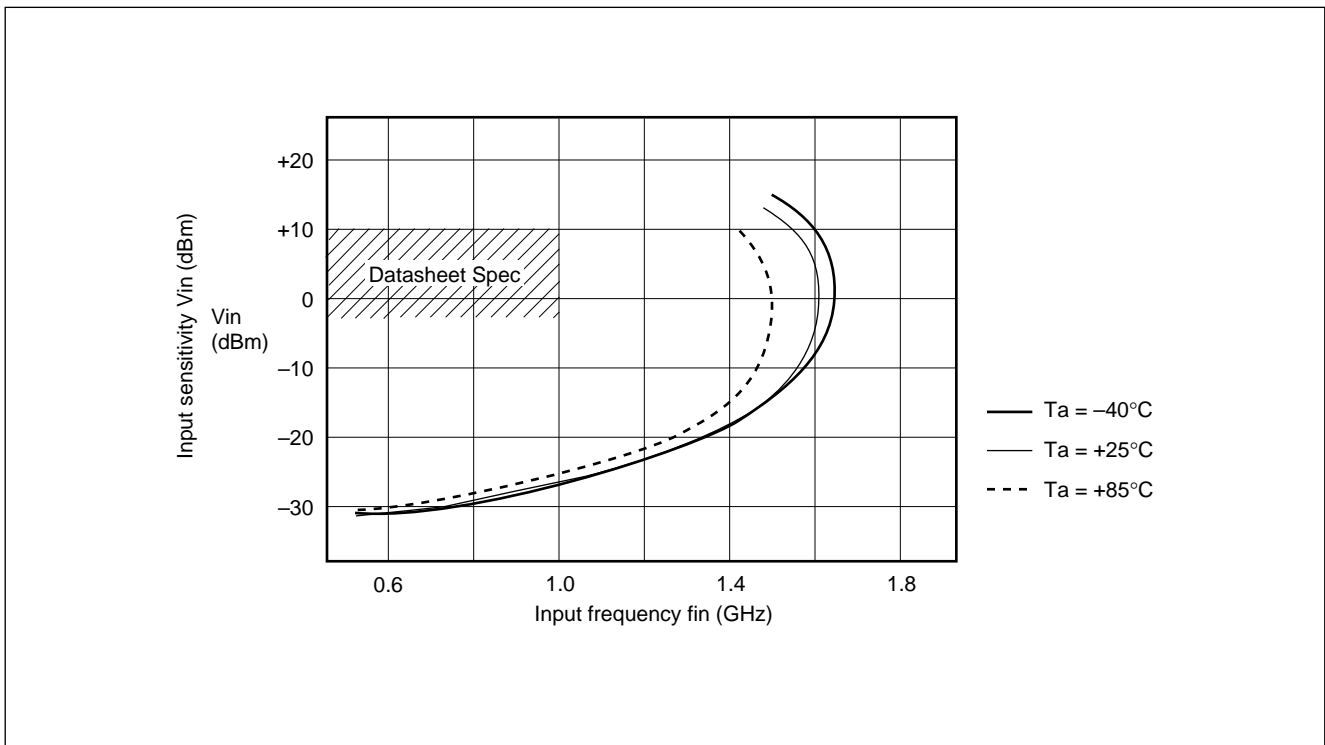
MEASUREMENT RESULTS

(1) Prescaler Input Sensitivity Curve

- Supply Voltage Dependence ($T_a = +25^\circ\text{C}$)

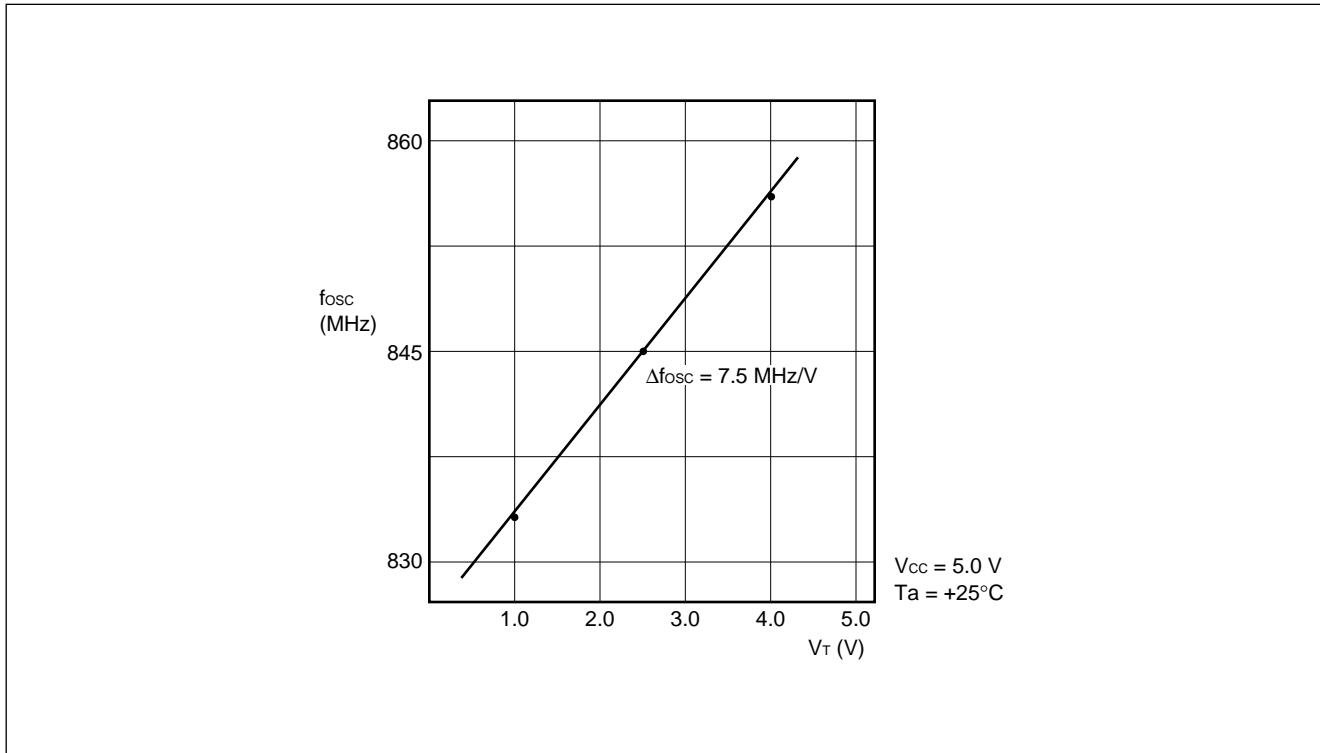


- Temperature Dependence ($V_{CC} = 5\text{ V}$)



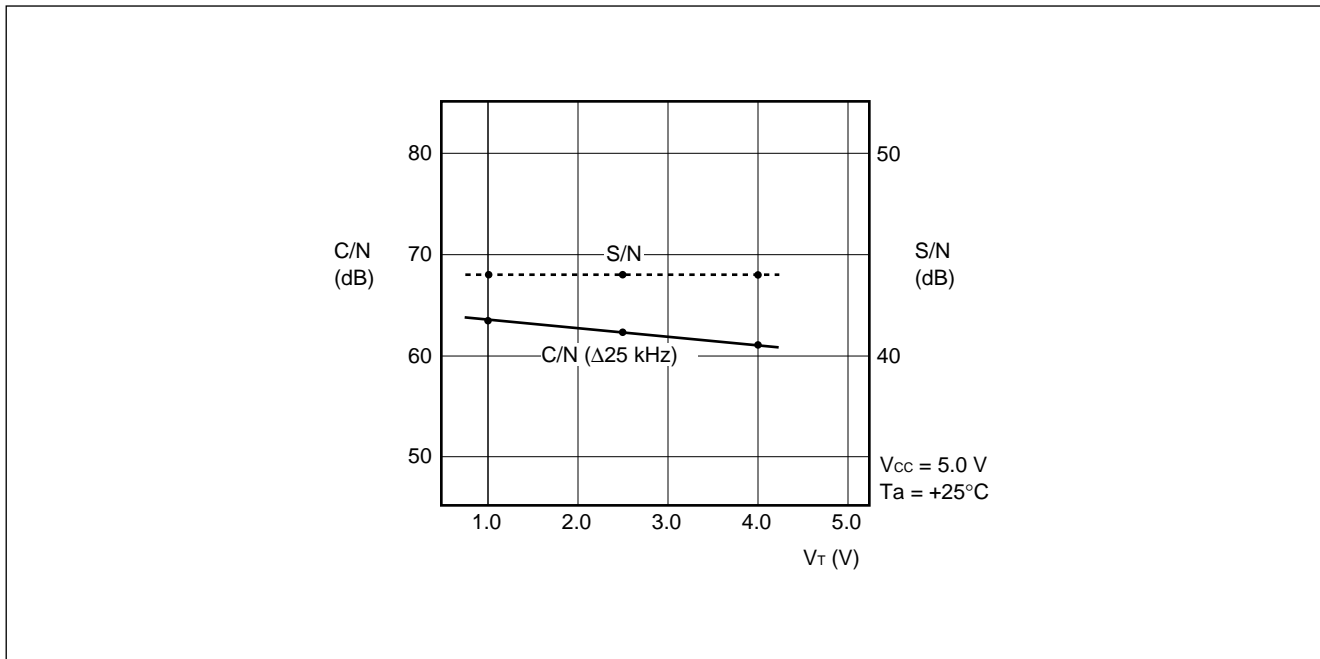
■ MEASUREMENT RESULTS (TEST CIRCUIT 2)

(1) Conversion Gain



(2) C/N, S/N

• Control Voltage Dependence



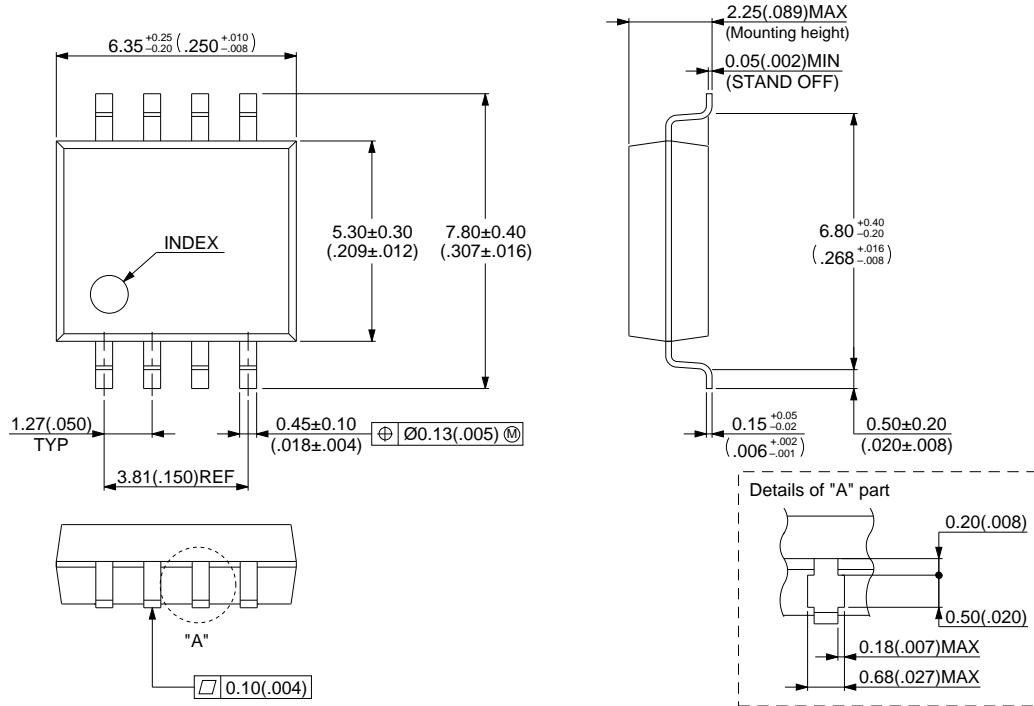
■ ORDERING INFORMATION

Part number	Package	Remarks
MB551PF	8 pin Plastic SOP (FPT-8P-M01)	

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■ PACKAGE DIMENSION

8 pin Plastic SOP
(FPT-8P-M01)



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Dimensions in mm (inches)

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