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April 1st, 2010
Renesas Electronics Corporation

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M64897GP

PLL Frequency Synthesizer with DC/DC Converter for PC

REJ03F0167-0201
Rev.2.01
Jan 25, 2008

Description

The M64897GP is a semiconductor integrated circuit consisting of PLL frequency synthesizer for TV/VCR/PC using I^2C BUS control. It contains the prescaler with operating up to 1.3 GHz, 4 band drivers and DC/DC converter for Tuning voltage.

Features

- Built-in DC/DC converter for Tuning voltage
- 4 integrated PNP band drivers (I_O = 30 mA, Vsat = 0.2 V Typ.@V_{CC1} to 10 V)
- Built-in prescaler with input amplifier (f max = 1.3 GHz)
- PLL lock/unlock status display out put (Built-in pull up resistor)
- X'tal 4 MHz is used to realize 3 type of tuning steps (Divider ratio 1/512, 1/640, 1/1024)
- Software compatible with M64894
- Built-in Power on reset system
- Small Package (SSOP)

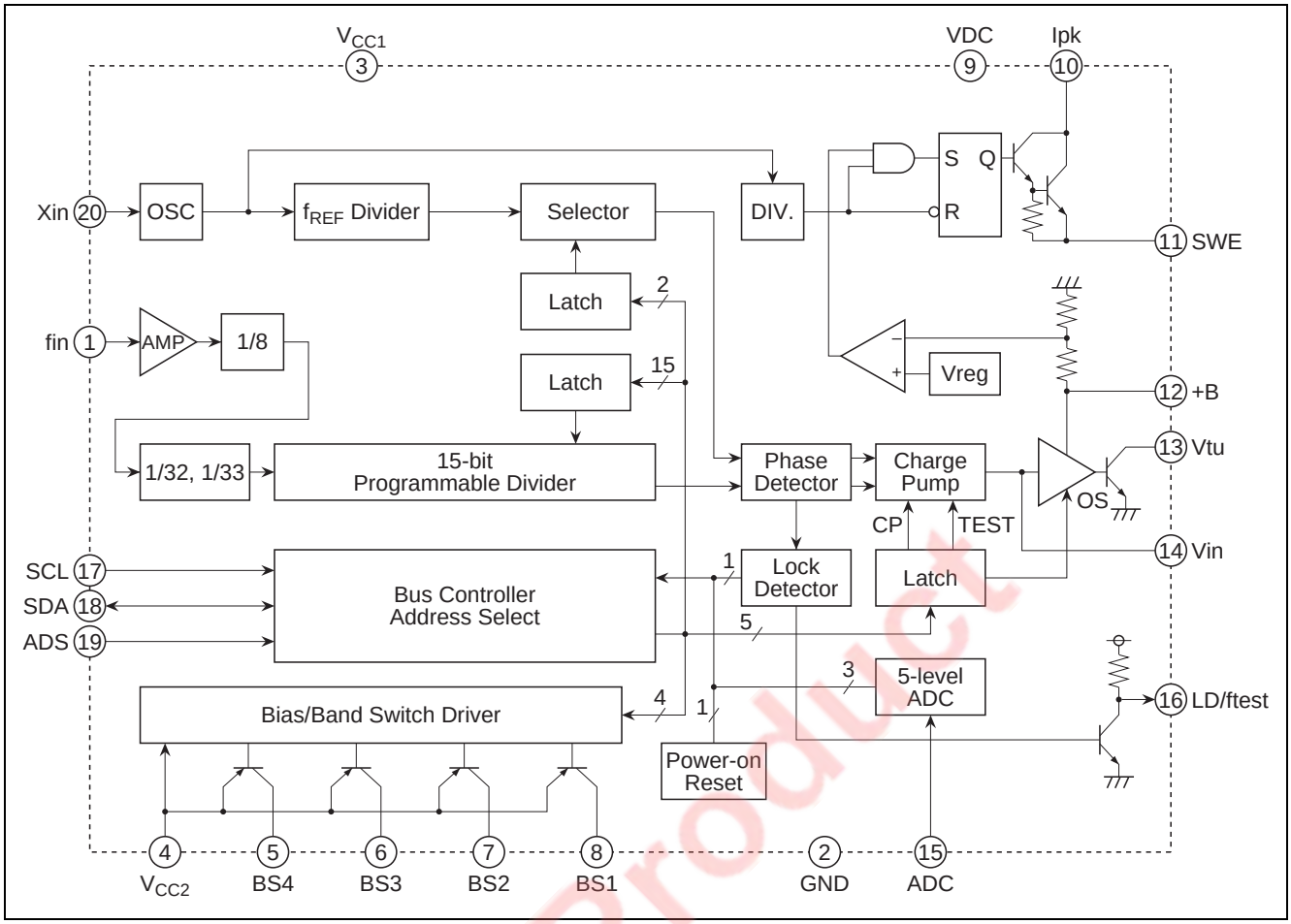
Application

PC, TV, VCR tuners

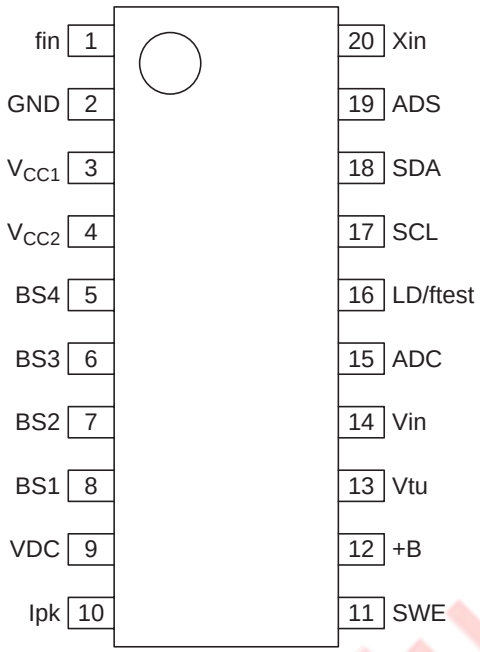
Recommended Operating Condition

- Supply voltage range
  - V_{CC1} = 4.5 to 5.5 V
  - V_{CC2} = V_{CC1} to 10 V
- Rated supply voltage
  - V_{CC1} = 5 V
  - V_{CC2} = V_{CC1}

Block Diagram



Pin Arrangement



(Top view)

Outline: PLSP0020JA-A (20P2E-A)

Pin Description

Pin No.	Symbol	Pin Name	Function
1	fin	Prescaler input	Input for the VCO frequency.
2	GND	GND	Ground to 0 V.
3	V_{CC1}	Power supply voltage 1	Power supply voltage terminal. 5.0 V ± 0.5 V
4	V_{CC2}	Power supply voltage 2	Power supply for band switching, V_{CC1} to 10 V
5	BS4	Band switching outputs	PNP open collector method is used. When the band switching data is “H”, the output is ON. When it is “L”, the output is OFF.
6	BS3		
7	BS2		
8	BS1		
9	VDC	DC/DC power supply voltage	DC/DC power supply voltage terminal. 5.0 V ± 0.5 V
10	Ipk	Peak current detect	When potential difference with VDC terminal becomes more than 0.33 V by current limiting detector of DC/DC converter, the listing rises with off.
11	SWE	Switching output	DC/DC converter oscillator output.
12	+B	Power supply voltage	Power supply voltage for tuning voltage.
13	Vtu	Tuning output	This supplies the tuning voltage.
14	Vin	Filter input (Charge pump output)	This is the output terminal for the LPF input and charge pump output. When the phase of the programmable divider output (f 1/N) is ahead compared to the reference frequency (f_{REF}), the “source” current state becomes active. If it is behind, the “sink” current becomes active. If the phases are the same, the high impedance state becomes active.
15	LD/ftest	Lock detect/Test port	Lock detector output. When loop of phase locked loop locked it, it rises with “H” level in “L” level or unlock. In control byte data input, the programmable freq. divider output and reference freq. output is selected by the test mode.
16	ADC	AD converter input	A/D conversion of the input voltage.
17	SCL	Clock input	Data is read into the shift register when the clock signal falls.
18	SDA	Data input	Input for band SW and programmable freq. divider set up. In lead mode, it outputs lock detector output and power down flag and a state of 5 level A/D converter.
19	ADS	Address switching input	Chip address sets it up with the input condition of terminal.
20	Xin	This is connected to the crystal oscillator	4.0 MHz crystal oscillator is connected.

Absolute Maximum Ratings

(Ta = −20°C to +75°C, unless otherwise noted)

Item	Symbol	Ratings	Unit	Conditions
Supply voltage 1	V_{CC1}	6.0	V	Pin 3
Supply voltage 2	V_{CC2}	10.8	V	Pin 4
Input voltage	V_I	6.0	V	Not to exceed V_{CC1}
Output voltage	V_O	6.0	V	f_{REF} output
Voltage applied when the band output is OFF	V_{BSOFF}	10.8	V	
Band output current	I_{BSON}	40.0	mA	Per 1 band output circuit
ON the time when the band output is ON	t_{BSON}	10	s	40 mA per 1 band output circuit 3 circuits are pn at same time.
Power dissipation	Pd	255	mW	Ta = 75°C
Operating temperature	Topr	−20 to +75	°C	
Storage temperature	Tstg	−40 to +125	°C	

Recommended Operating Conditions

(Ta = −20°C to +75°C, unless otherwise noted)

Item	Symbol	Ratings	Unit	Conditions
Supply voltage 1	V_{CC1}	4.5 to 5.5	V	Pin 3
Supply voltage 2	V_{CC2}	V_{CC1} to 10.0	V	Pin 4
Operating frequency (1)	f_{opr1}	4.0	V	Crystal oscillation circuit
Operating frequency (2)	f_{opr2}	80 to 1300	MHz	
Band output current 5 to 8	I_{BDL}	0 to 30	mA	Normally 1 circuit is on. 2 circuits on at the same time is max. It is prohibited to have 3 or more circuits turned on at the same time.

Electrical Characteristics

(Ta = –20°C to +75°C, unless otherwise noted, V_{CC1} = 5.0 V, V_{CC2} = 9.0 V)

Item		Symbol	Test Pin	Limits			Unit	Test Conditions
				Min	Typ	Max		
Input terminals	"H" input voltage	V_{IH}	17 to 18	3.0	—	V_{CC1} + 0.3	V	
	"L" input voltage	V_{IL}	17 to 18	—	—	1.5	V	
	"H" input current	I_{IH}	17 to 18	—	—	10	µA	V_{CC1} = 5.5 V, Vi = 4.0 V
	"L" input current	I_{IL}	17, 18	—	–4/–14	–10/–30	µA	V_{CC1} = 5.5 V, Vi = 0.4 V
SDA output	"L" output voltage	V_{OL}	18	—	—	0.4	µA	V_{CC1} = 5.5 V, I_C = 3 mA
	Leak current	I_{LO}	18	—	—	10	µA	V_{CC1} = 5.5 V, V_O = 5.5 V
Lock output	"H" output voltage	V_{OH}	16	5.0	—	—	V	V_{CC1} = 5.5 V
	"L" output voltage	V_{OL}	16	—	0.3	0.5	V	V_{CC1} = 5.5 V
Band SW	Output voltage	V_{BS}	5 to 8	11.6	11.8	—	V	V_{CC2} = 9 V, I_O = –30 mA
	Leak current	I_{olk1}	5 to 8	—	—	–10	µA	V_{CC2} = 9 V, Band SW is OFF V_O = 0 V
Tuning output	Output voltage "H"	V_{toH}	13	30.5	—	—	V	+B = 31 V
	Output voltage "L"	V_{toL}	13	—	0.2	0.4	V	+B = 31 V
Charge pump	"H" output current	I_{CPO}	14	—	270	370	µA	V_{CC1} = 5.0 V, V_O = 2.5 V
	Leakage current	I_{CPLK}	14	—	—	50	nA	V_{CC1} = 5.0 V, V_O = 2.5 V
Supply current 1		I_{CC1}	3	—	20	30	mA	V_{CC1} = 5.5 V
Supply current 2	4 circuits OFF	I_{CC2A}	4	—	—	0.3	mA	V_{CC2} = 9 V
	1 circuits ON, Output open	I_{CC2B}	4	—	4.0	6.0	mA	V_{CC2} = 9 V
	Output current 30 mA	I_{CC2C}	4	—	34.0	36.0	mA	V_{CC2} = 9 V, I_O = –30 mA
DC/DC Converter								
Supply current (action)		I_{CCdc}	9	—	1.3	3.0	mA	V_{CC1} = 5.5 V
Output voltage		Vdo	12	28	31	35	V	V_{CC1} = 5.5 V
OSC frequency		f_{OSC}	11	—	571	—	kHz	V_{CC1} = 5.5 V
Current limit detect voltage		Vipk	10	—	330	—	mV	V_{CC1} = 5.5 V

Note: The typical values are at V_{CC1} = 5.0 V, V_{CC2} = 9.0 V, Ta = +25°C.

Switching Characteristics

(Ta = –20°C to +75°C, unless otherwise noted, V_{CC1} = 5.0 V, V_{CC2} = 9.0 V)

Item	Symbol	Test Pin	Limits			Unit	Test Conditions	
			Min	Typ	Max			
Prescaler operating frequency	f_{opr}	1	80	—	1300	MHz	V_{CC1} = 4.5 to 5.5 V Vin = Vinmin to Vinmax	
Operation input voltage	Vin	1	–24	—	4	dBm	V_{CC1} = 4.5 to 5.5 V	850 to 100 MHz
			–27	—	4			100 to 950 MHz
			–15	—	4			950 to 1300 MHz
Clock pulse frequency	f_{SCL}	17	0	—	100	kHz	V_{CC1} = 4.5 to 5.5 V	
Bus free time	t_{BUF}	18	4.7	—	—	µs	V_{CC1} = 4.5 to 5.5 V	
Data hold time	t_{HDSTA}	17	4	—	—	µs	V_{CC1} = 4.5 to 5.5 V	
SCL low hold time	t_{LOW}	17	4.7	—	—	µs	V_{CC1} = 4.5 to 5.5 V	
SCL high hold time	t_{HIGH}	17	4	—	—	µs	V_{CC1} = 4.5 to 5.5 V	
Set up time	t_{SUSTA}	17, 18	4.7	—	—	µs	V_{CC1} = 4.5 to 5.5 V	
Data hold time	t_{HDDAT}	17, 18	0	—	—	s	V_{CC1} = 4.5 to 5.5 V	
Data set up time	t_{SUDAT}	17, 18	250	—	—	ns	V_{CC1} = 4.5 to 5.5 V	
Rise time	t_R	17, 18	—	—	1000	ns	V_{CC1} = 4.5 to 5.5 V	
Fall time	t_F	17, 18	—	—	300	ns	V_{CC1} = 4.5 to 5.5 V	
Set up time	t_{SUSTO}	17, 18	4	—	—	µs	V_{CC1} = 4.5 to 5.5 V	

Method of Setting Data

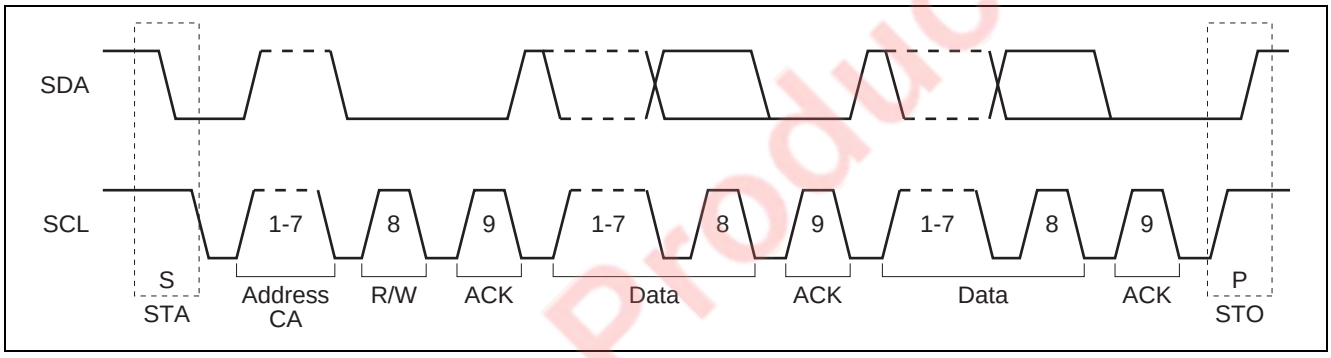
The input information to consist of 2 or data of 4 bytes to lead to chip address is received in I^2C bus receiver. It shows a definition of bus protocol admitted in the following.

1_STA	CA	CB	BB	STO		
2_STA	CA	D1	D2	STO		
3_STA	CA	CB	BB	D1	D2	STO
4_STA	CA	D1	D2	CB	BB	STO

STA : Start condition
STO : Stop condition
CA : Chip address
CB : Control data byte
BB : Band SW data byte
D1 : Divider data byte
D2 : Divider data byte

The information of 5 bytes necessary for circuit operation is chip address and control data, band SW data of 2 bytes and divider byte of 2 bytes. After the chip address input, 2 or data of 4 bytes are received.

Function bit is contained the first and the third data byte to distinguish between divider data and control data, band data, and "0" goes ahead of divider data, and "1" goes ahead of control data, band SW data.



Write Mode Format

Byte	MSB								LSB
Address byte	1	1	0	0	0	MA1	MA0	0	A
Divider byte 1	0	N14	N13	N12	N11	N10	N9	N8	A
Divider byte 2	N7	N6	N5	N4	N3	N2	N1	N0	A
Control byte 1	1	X	T2	T1	T0	RSa	RSb	OS	A
Band SW byte	X	X	X	X	BS4	BS3	BS2	BS1	A

Read Mode Format

Byte	MSB								LSB
Address byte	1	1	0	0	0	MA1	MA0	1	A
Status byte 1	POR	FL	X	X	X	A2	A1	A0	A

Data Cording Example

Write Mode Format Example

Byte	MSB								LSB	Condition in Data Setting
Address byte	1	1	0	0	0	1	1	0	1	ADS input V_{CC1}
Divider byte 1	0	1	0	0	0	0	0	0	1	Divider ratio N = 16544
Divider byte 2	1	0	1	0	0	0	0	0	1	
Control byte 1	1	1	0	0	0	0	1	0	1	f_{REF} divider ratio 1/1024
Band SW byte	0	0	0	0	1	0	0	0	1	BS4 output ON

Note: $f_{VCO} = N \cdot 8 \cdot f_{REF} = 16544 \cdot 8 \cdot (4\ MHz/1024) = 517\ MHz$

Read Mode Format Example (Loop locked)

Byte	MSB								LSB	Condition in Device
Address byte	1	1	0	0	0	1	1	1	1	ADS Applied voltage 0.9 V_{CC1} to V_{CC1}
Status byte	0	1	1	1	1	0	1	1	1	ADS Applied voltage 0.45 V_{CC1} to 0.6 V_{CC1}

Use data input for “1” so that the data of Read mode and Write mode return ACK signal “0” to micro computer in 9 bits of each byte.

Test Mode Data Set up Method

Test Mode Bit Set up

X : Random, 0 or 1. normal “0”

MA1, MA0 : Programmable address bit

Address Input Voltage	MA1	MA0
0 to 0.1 ± V_{CC1}	0	0
Always valid	0	1
0.4 ± V_{CC1} to 0.6 ± V_{CC1}	1	0
0.9 ± V_{CC1} to V_{CC1}	1	1

Note: N14 to N0: How to set dividing ratio of the programmable the divider

Dividing ratio = N14 (2^{14} = 16384) + + N0 (2^0 = 1)

Therefore, the range of divider N is 1,024 to 32,768

Example) $f_{VCO} = f_{REF} \cdot 8 \cdot N$

$= 3.90625 \cdot 8 \cdot N$

$= 31.25 \cdot N$ (kHz)

T2, T1, T0: Setting up for the Test Mode

T2	T1	T0	Charge Pump	Pin 12 Condition	Mode
0	0	X	Normal operation	ADC input	Normal operation
0	1	X	High impedance	ADC input	Test mode
1	1	0	Sink	ADC input	Test mode
1	1	1	Source	ADC input	Test mode
1	0	0	High impedance	f_{REF} output	Test mode
1	0	1	High impedance	f1/N output	Test mode

RSa, RSb: Set up for the Reference Frequency Divider Ratio

RSa	RSb	Divider Ratio
1	1	1/512
0	1	1/1024
X	0	1/640

OS: Set up the Tuning Amplifier

OS	Tuning Voltage Output	Mode
0	ON	Normal
1	OFF	Test

POR : Power on reset flag. “1” output at reset
FL : Lock detector flag. “1” output at locked, “0”output at unlocked

A2, A1, A0: 5 Level A/D Converter Output Data

ADC Input Voltage	A2	A1	A0
$0.6 \pm V_{CC1}$ to V_{CC1}	1	0	0
$0.45 \pm V_{CC1}$ to $0.6 \pm V_{CC1}$	0	1	1
$0.3 \pm V_{CC1}$ to $0.45 \pm V_{CC1}$	0	1	0
$0.15 \pm V_{CC1}$ to $0.3 \pm V_{CC1}$	0	0	1
0 to $0.15 \pm V_{CC1}$	0	0	0

Note: The voltage accuracy allowance range: $0.03 \pm V_{CC1}$ (V)

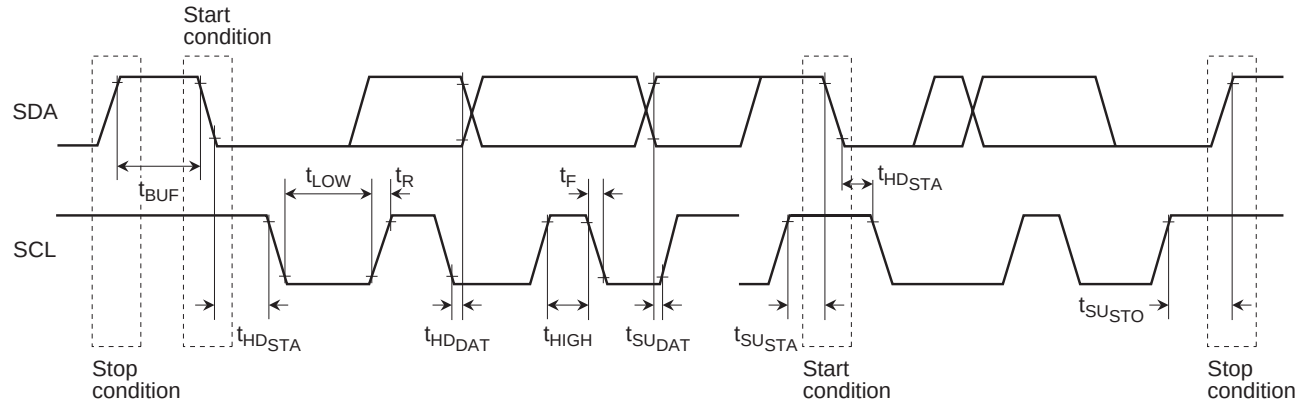
Power on Reset Operation

(Initial state the power is turned ON)

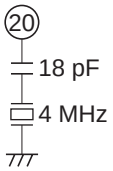
BS4 to BS1 : OFF
Charge pump : High impedance
Tuning amplifier : OFF
Charge pump current : 270 μA
Frequency division ratio : 1/1024
Lock detect : H

Charge pump current is replaced by 70 μA when locks it by automatic change facility.

Timing Diagram

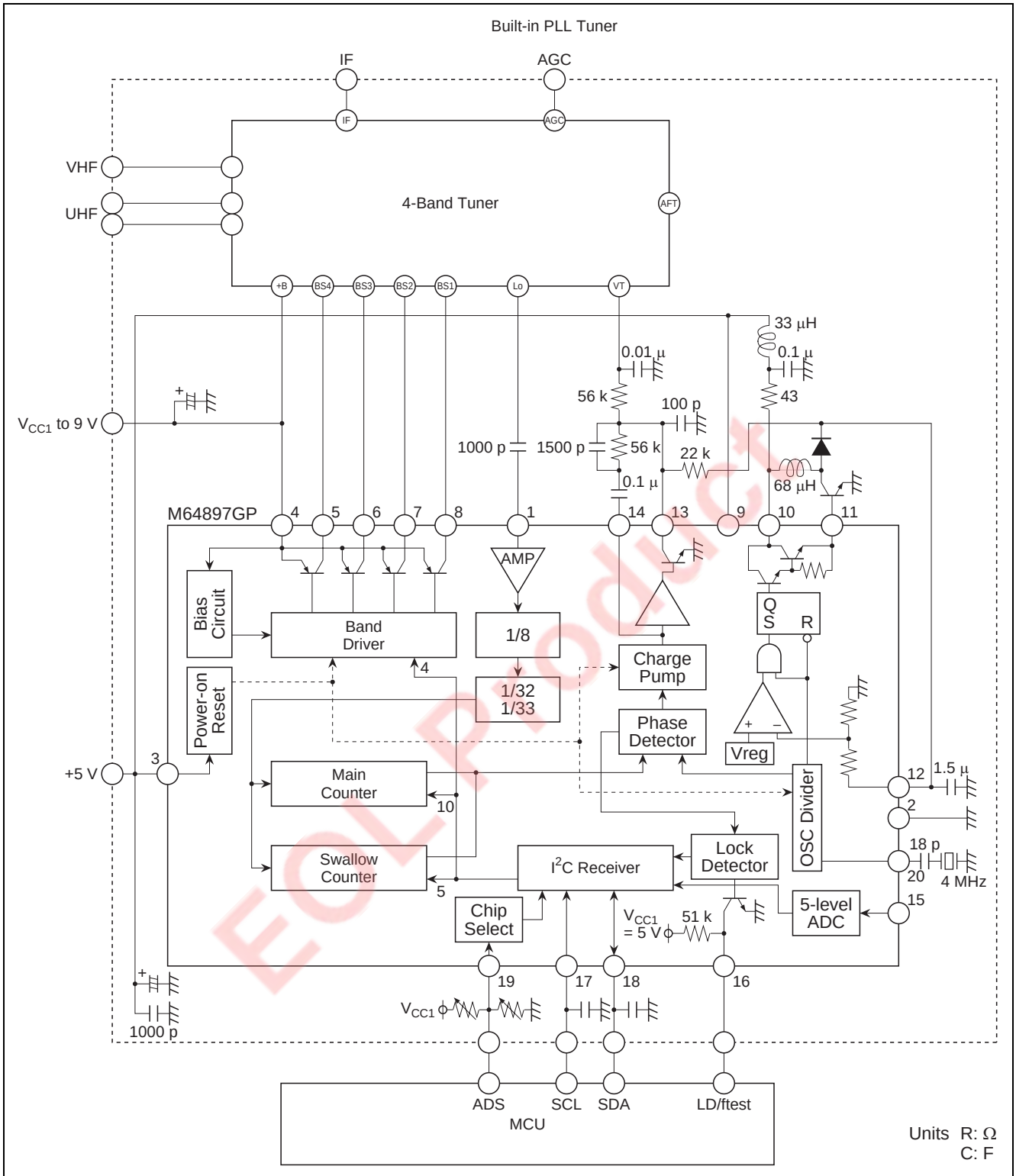


Crystal Oscillator Connection Diagram



Crystal oscillator characteristics
Actual resistance: less than 300 Ω
Load capacitance: 20 pF

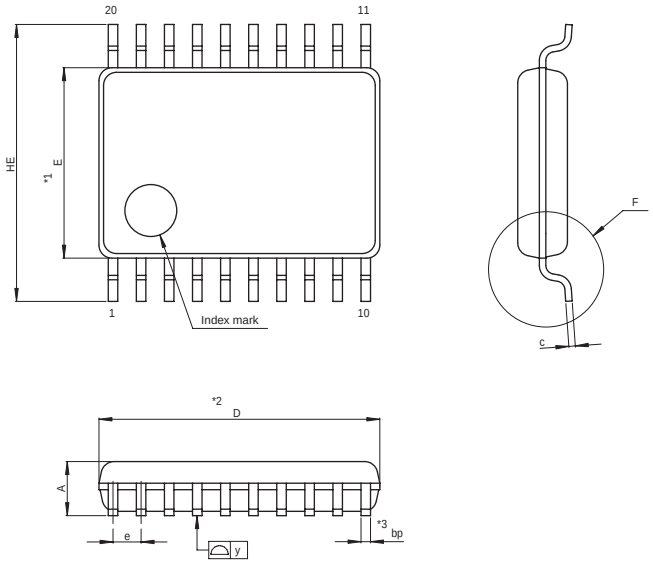
Application Example



Note: Filter constant is for reference.
Add a capacitor to stabilize the filter circuit.

Package Dimensions

JEITA Package Code	RENESAS Code	Previous Code	MASS[Typ.]
P-LSSOP20-4.4x6.5-0.65	PLSP0020JA-A	20P2E-A	0.08g



NOTE)
1. DIMENSIONS "*1" AND "*2" DO NOT INCLUDE MOLD FLASH.
2. DIMENSION "*3" DOES NOT INCLUDE TRIM OFFSET.

Reference Symbol	Dimension in Millimeters		
	Min	Nom	Max
D	6.4	6.5	6.6
E	4.3	4.4	4.5
A_2	—	1.15	—
A	—	—	1.45
A_1	0	0.1	0.2
b_p	0.17	0.22	0.32
c	0.13	0.15	0.2
θ	0°	—	10°
H_E	6.2	6.4	6.6
e	0.53	0.65	0.77
y	—	—	0.10
L	0.3	0.5	0.7

Renesas Technology Corp. Sales Strategic Planning Div. Nippon Bldg., 2-6-2, Ohte-machi, Chiyoda-ku, Tokyo 100-0004, Japan

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Renesas Technology America, Inc.
450 Holger Way, San Jose, CA 95134-1368, U.S.A
Tel: <1> (408) 382-7500, Fax: <1> (408) 382-7501

Renesas Technology Europe Limited
Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, U.K.
Tel: <44> (1628) 585-100, Fax: <44> (1628) 585-900

Renesas Technology (Shanghai) Co., Ltd.
Unit 204, 205, AZIACenter, No.1233 Lujiazui Ring Rd, Pudong District, Shanghai, China 200120
Tel: <86> (21) 5877-1818, Fax: <86> (21) 6887-7858/7898

Renesas Technology Hong Kong Ltd.
7th Floor, North Tower, World Finance Centre, Harbour City, Canton Road, Tsimshatsui, Kowloon, Hong Kong
Tel: <852> 2265-6688, Fax: <852> 2377-3473

Renesas Technology Taiwan Co., Ltd.
10th Floor, No.99, Fushing North Road, Taipei, Taiwan
Tel: <886> (2) 2715-2888, Fax: <886> (2) 3518-3399

Renesas Technology Singapore Pte. Ltd.
1 Harbour Front Avenue, #06-10, Keppel Bay Tower, Singapore 098632
Tel: <65> 6213-0200, Fax: <65> 6278-8001

Renesas Technology Korea Co., Ltd.
Kukje Center Bldg. 18th Fl., 191, 2-ka, Hangang-ro, Yongsan-ku, Seoul 140-702, Korea
Tel: <82> (2) 796-3115, Fax: <82> (2) 796-2145

Renesas Technology Malaysia Sdn. Bhd
Unit 906, Block B, Menara Amcorp, Amcorp Trade Centre, No.18, Jln Persiaran Barat, 46050 Petaling Jaya, Selangor Darul Ehsan, Malaysia
Tel: <603> 7955-9390, Fax: <603> 7955-9510

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