Preliminary
Notice,this is not a final specification.
Some parametric limits are subject to change.

MITSUBISHI ICs (Cordless Telephone)

M64884FP

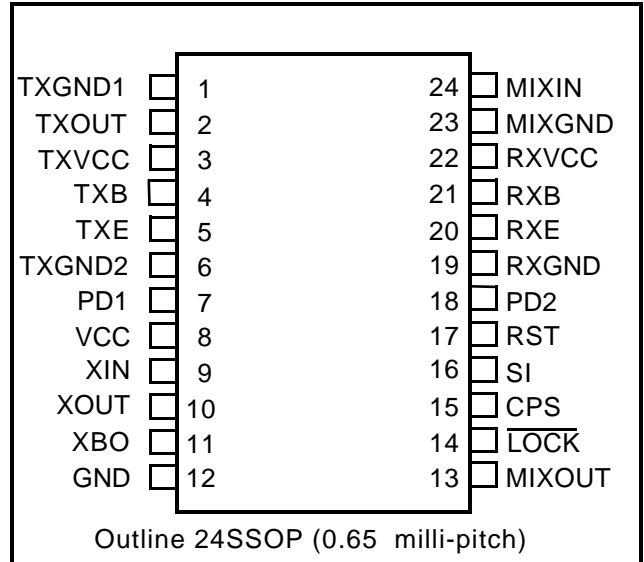**Transistor for VCO,1st IF MIX,2-multiple circuit built-in 500MHz/1GHz Dual PLL Synthesizer**

1.DESCRIPTION

The M64884FP is a 2-system 1-chip PLL frequency synthesizer IC designed of Analog cordless telephone for North America (ISM band) that can directly enter signal up to 500-MHz in the TX and up to 1GHz in the RX.

Adoption of high performance Bi-CMOS process enables low power consumption type 2-modulus prescaler to be built in the IC to directly signal enter up to 500MHz in the TX and up to 1GHz in the RX.This IC also contains VCO oscillation-Tr in the TX and RX,2-multiple circuit for transmission output and double balance type mixer for the 1st intermediate frequency (1st IF).
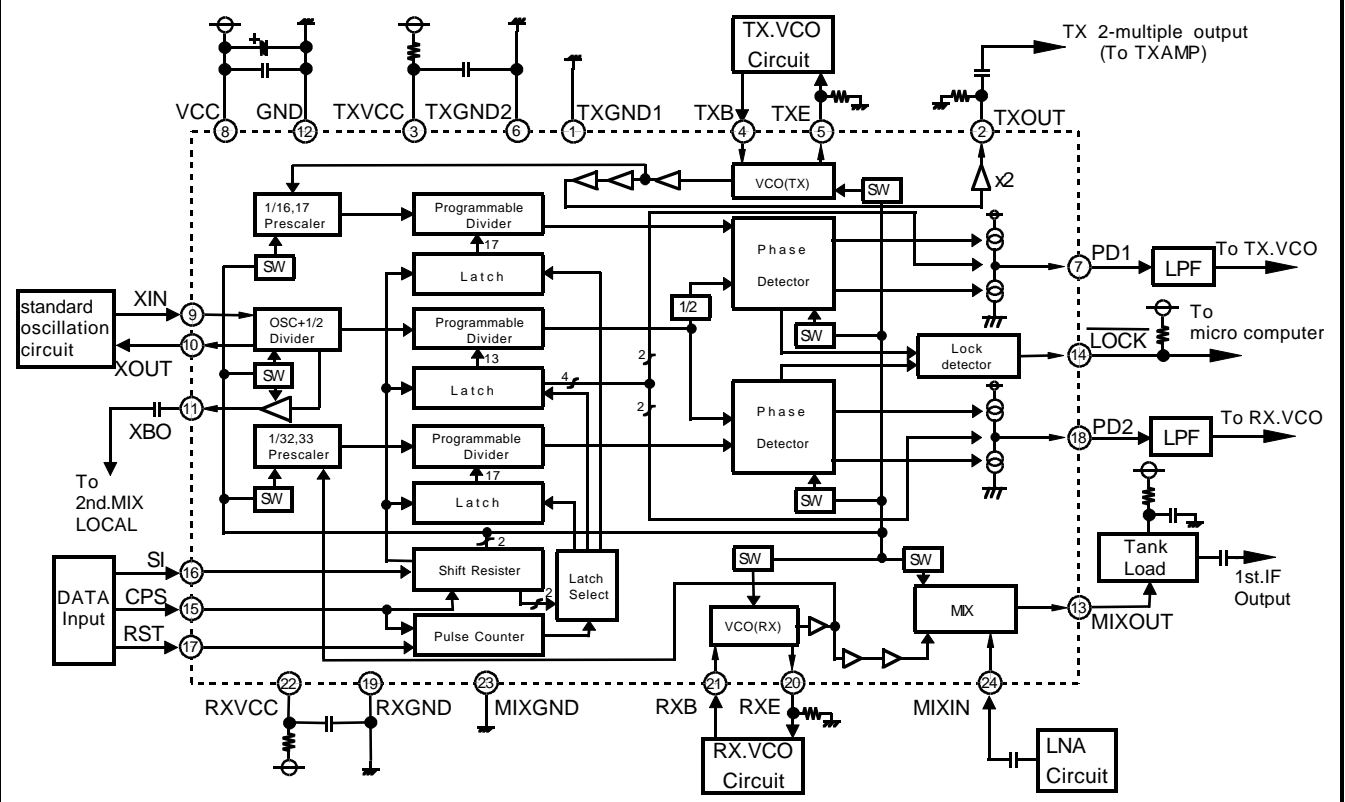
2.FEATURES

- Low power current Icc=24mA. (@Vcc=3.0V,at TX/RX VCO and 2-multiple circuit output current=2mA setting)
- Built-in 2-modulus prescaler.
  - input frequency --- TX:350~500MHz,RX:700~1000MHz.
  - input sensitivity --- -15 ~ -5dBm.
- Built-in buffer-Tr for oscillation circuit in the TX and RX.
- Built-in 2-multiple circuit for transmission output.
- Built-in double balance type mixer for the 1st IF.
- Rated current output type charge pump. Output current can be set with serial data. (100,300,500,700μA)
- Built-in B-E Colpitts type oscillation circuit for standard oscillation.
- Software is compatible with M64084AGP.

TXGND1	1	24	MIXIN
TXOUT	2	23	MIXGND
TXVCC	3	22	RXVCC
TXB	4	21	RXB
TXE	5	20	RXE
TXGND2	6	19	RXGND
PD1	7	18	PD2
VCC	8	17	RST
XIN	9	16	SI
XOUT	10	15	CPS
XBO	11	14	$\overline{\text{LOCK}}$
GND	12	13	MIXOUT

Outline 24SSOP (0.65 milli-pitch)

APPLICATION

900MHz analog cordless telephone (ISM band)

3.BLOCK DIAGRAM

Preliminary
Notice,this is not a final specification.
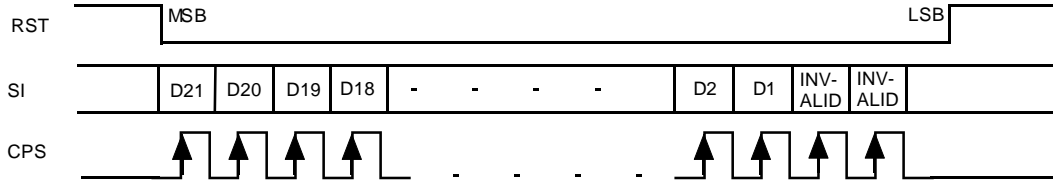Some parametric limits are subject to change.

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Transistor for VCO,1st IF MIX,2-multiple circuit built-in 500MHz/1GHz Dual PLL Synthesizer

4. PIN Description

Pin No.	Symbol	Pin Name	Functions
1	TXGND1	Transmission system ground 1	1st ground for transmission system. 0V.
2	TXOUT	Transmission output	Output frequency that multiples the oscillation frequency of the transmission system by 2, and outputs an open emitter.
3	TXVCC	Transmission system power supply	Power supply pin for transmission VCO circuit. TXVCC = 2.7~3.6V.
4	TXB	Transmission circuit base	Base pin of the transmission VCO transistor.
5	TXE	Transmission circuit emitter	Emitter pin of the transmission VCO transistor. Set the current of the transmission oscillation circuit by pull-down resistance.
6	TXGND2	Transmission system ground 2	2nd ground for transmission system. 0V.
7	PD1	Transmission system Charge Pump output	Output the set current according to the difference in phase between Charge Pump output pins in the PLL1(TX) system. HiZ with the power supply turned off.
8	VCC	Power supply	Power supply pin for the PLL system. VCC = 2.7~3.6V.
9	XIN	Crystal oscillator input	Inputs 4 to 25MHz output from the base oscillator to the XIN . External crystal oscillator is available for oscillation.
10	XOUT		
11	XBO	Buffer output	Buffer output pin of base oscillation.
12	GND	Ground	Ground pin for the PLL system. 0V.
13	MIXOUT	Mixer Output	Extracts IF frequencies.
14	$\overline{\text{LOCK}}$	Lock detection output	Judgment is made in a system turned on when the other system is turned off.
15	CPS	Clock pulse input	Operates at the rising edge of the clock pulse of the shift resistor.
16	SI	Data input	Inputs serial data.
17	RST	Reset pulse input	Inputs the reset pulse of 21 pulse counters.
18	PD2	Reception system Charge Pump Output	Output the set current according to the difference in phase between Charge Pump output pins in the PLL2(RX) system. HiZ with the power supply turned off.
19	RXGND	Reception system ground	Ground for reception system. 0V.
20	RXE	Reception circuit emitter	Emitter pin of the reception VCO transistor. Set the current of the reception oscillation circuit by pull-down resistance.
21	RXB	Reception circuit base	Base pin of the reception VCO transistor.
22	RXVCC	Reception system power supply	Power supply pin for reception VCO circuit. TXVCC = 2.7~3.6V.
23	MIXGND	Mixer system ground	Ground for mixer system. 0V.
24	MIXIN	Mixer input	Mixer signal input pin.

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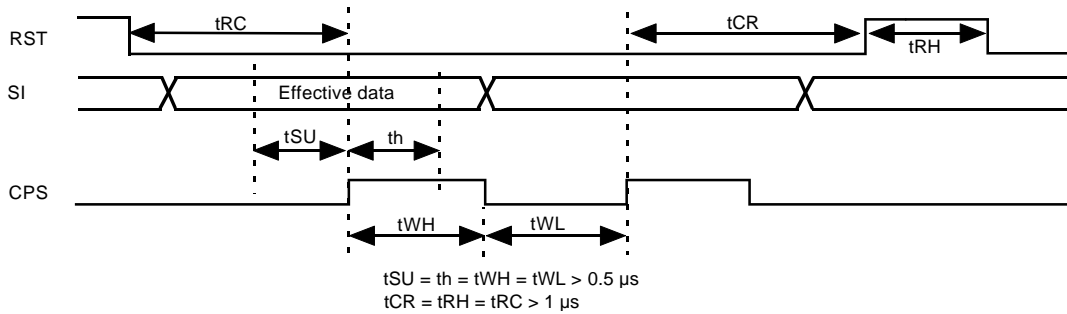
5. Functional Description

(1) Data Entry

Note 1) At the positive edge of CPS input, SI input status is read into the shift resistor in sequence.
Note 2) All data is set at the positive edge of the 21st pulse. After that, CPS is invalid.
Note 3) While RST is set to "H", neither CPS nor SI is received.
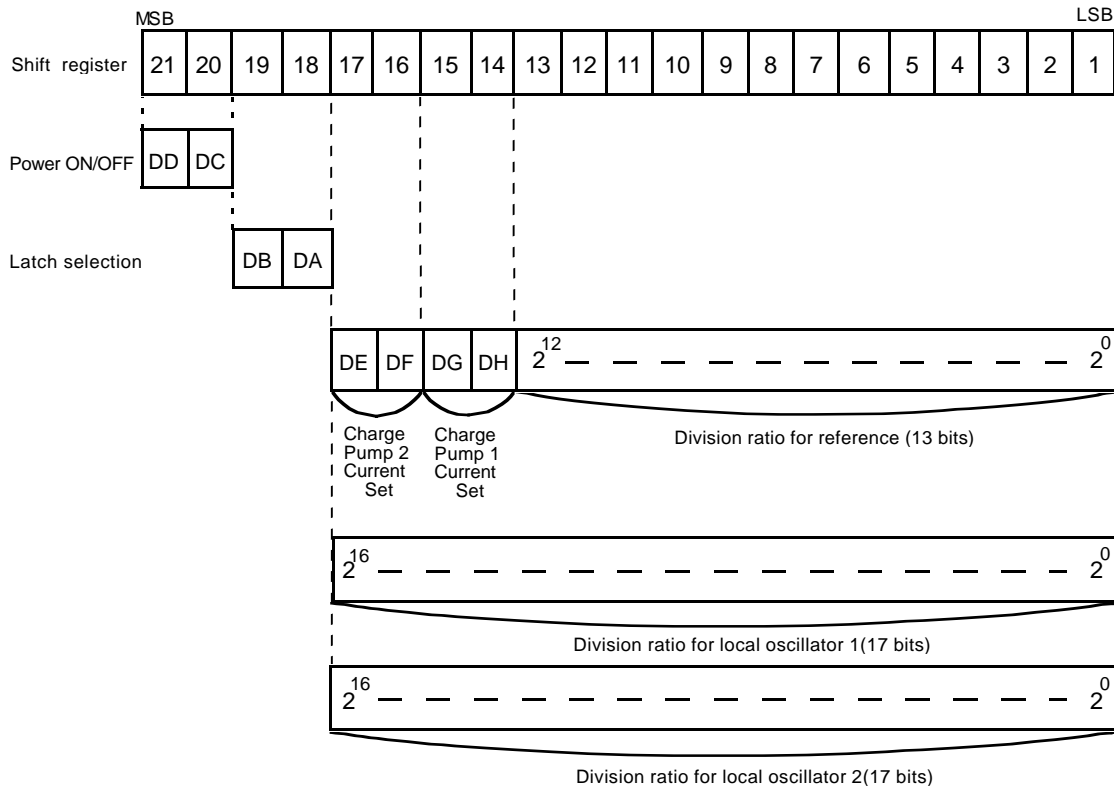
(2) Input Signal Timing

$tSU = th = tWH = tWL > 0.5\ \mu s$
$tCR = tRH = tRC > 1\ \mu s$

(3) Input Voltage

$VIH = 0.7*VCC \sim 3.6\ (V)$
$VIL = -0.2 \sim 0.3*VCC\ (V)$

(4) Shift Resister Bit Configuration

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Note 4) DD and DC are used to turn on/off the power supply to the PLL system.

Data		Description
DD	DC	
L	L	Both two PLLs are on.
L	H	Only PLL of local oscillator 1 is on.
H	L	Only PLL of local oscillator 2 is on.
H	H	Both two PLLs are off.

Note 5) DB and DA are used to select data latch to be updated.

Data		Description
DB	DA	
L	L	Testing mode only. Inhibited from use.
L	H	Updates data of local oscillator 1.
H	L	Updates data of local oscillator 2.
H	H	Updates data for comparison frequency.

Note 6) DE/DF and DG/DH are used to set the current of charge pump.

DE DG	DF DH	Output current value of charge pump
L	L	100µA
L	H	300µA
H	L	500µA
H	H	700µA

Note 7) Current supplied to the charge pump for local oscillators 1 and 2 can be set independently in systems. However,when power supply is turned off, the charge pump output is placed in "HiZ" status regardless of set value.

Note 8) The division ratio of the programmable divider for comparison frequency is given in 13-bit binary code.
For transmission local oscillator N(Fref) = 4 * P However, P = 20 to 8191
For reception local oscillator   N(Fref) = 2 * P However, P = 20 to 8191

Note 9) The division ratio of programmable divider for local oscillators 1 and 2 are given in 17-bit binary code.
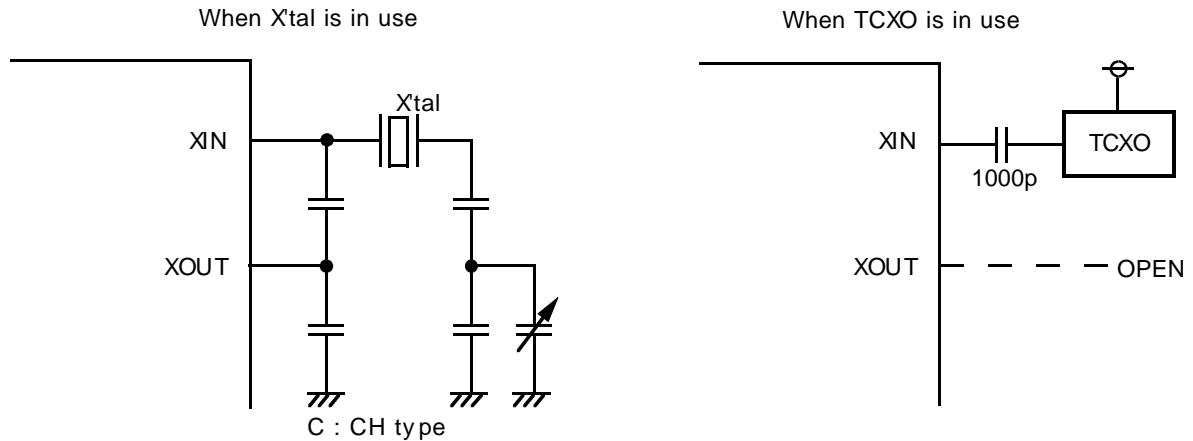For transmission local oscillator N(FvcoTX) = 256 to 131071
For reception local oscillator   N(FvcoRX) = 1024 to 131071

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MITSUBISHI ICs (Cordless Telephone)

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Transistor for VCO,1st IF MIX,2-multiple circuit built-in 500MHz/1GHz Dual PLL Synthesizer

6. X'tal OSCILLATION CIRCUIT

Connection of oscillation block.

Built-in buffer transistor for oscillation enables direct oscillation at X'tal.

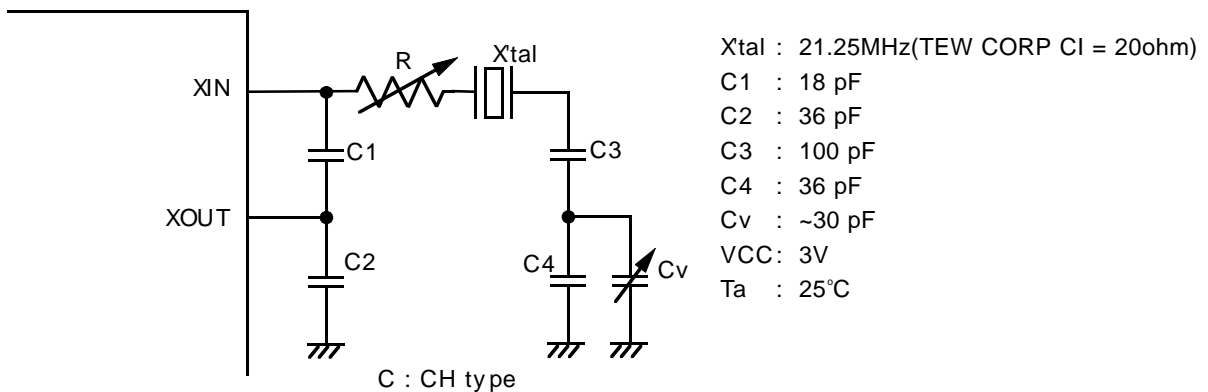Connections of X'tal and TCXO are shown below.(recommended circuit)

When X'tal is in use

When TCXO is in use

XIN

X'tal

XOUT

C : CH type

XIN

1000p

TCXO

XOUT — — — OPEN

7. Connection of Buffer Block

As the 2nd mixer local oscillator, the buffer output pin(XBO) is set to share X'tal. The pin is available as follows.

When the pin is shared

2nd MIX ◄ —| |— XBO
1000p

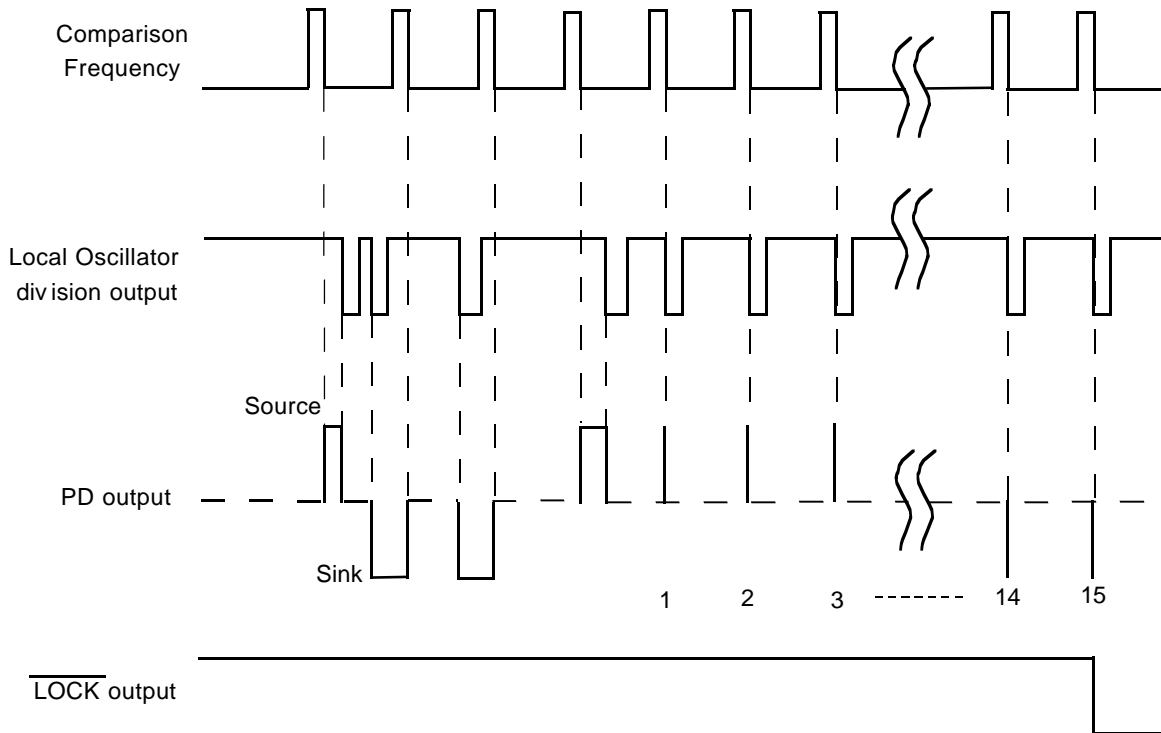When the pin is not shared

1000p
—| |— XBO

8. Negative Resister Evaluation Circuit

Negative resistor in the oscillation circuit are measured with the conditions and coefficients shown in drawing below.

XIN

R X'tal

C1   C3

XOUT

C2   C4   Cv

C : CH type

X'tal : 21.25MHz(TEW CORP CI = 20ohm)
C1   : 18 pF
C2   : 36 pF
C3   : 100 pF
C4   : 36 pF
Cv   : ~30 pF
VCC : 3V
Ta   : 25℃

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Transistor for VCO,1st IF MIX,2-multiple circuit built-in 500MHz/1GHz Dual PLL Synthesizer

9. Lock Detection, PD Output

Note 10) The PD output is placed in the "Source" status when the phase of local oscillator division output is behind the phase comparison frequency. It is placed in the "Sink" status when the phase of local oscillator division output advances.

11) " ------- " means high impedance status.

12) When the phase difference that is 8 times or less* of the OSC frequency continues 15 or more cycles of comparison frequency (Fref), LOCK output is placed in the "L" status.
(*625ns when a 12.8MHz oscillator is used)

13) When the power supply of each system is turned off, the $\overline{\text{LOCK}}$ output status goes to "H".

14) The $\overline{\text{LOCK}}$ output circuit is an open drain output of the N channel MOS transistor. Use this circuit with pull-up.

Preliminary
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Transistor for VCO,1st IF MIX,2-multiple circuit built-in 500MHz/1GHz Dual PLL Synthesizer

10. INPUT OUTPUT EQUIVALENT CIRCUIT

Preliminary
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Transistor for VCO,1st IF MIX,2-multiple circuit built-in 500MHz/1GHz Dual PLL Synthesizer
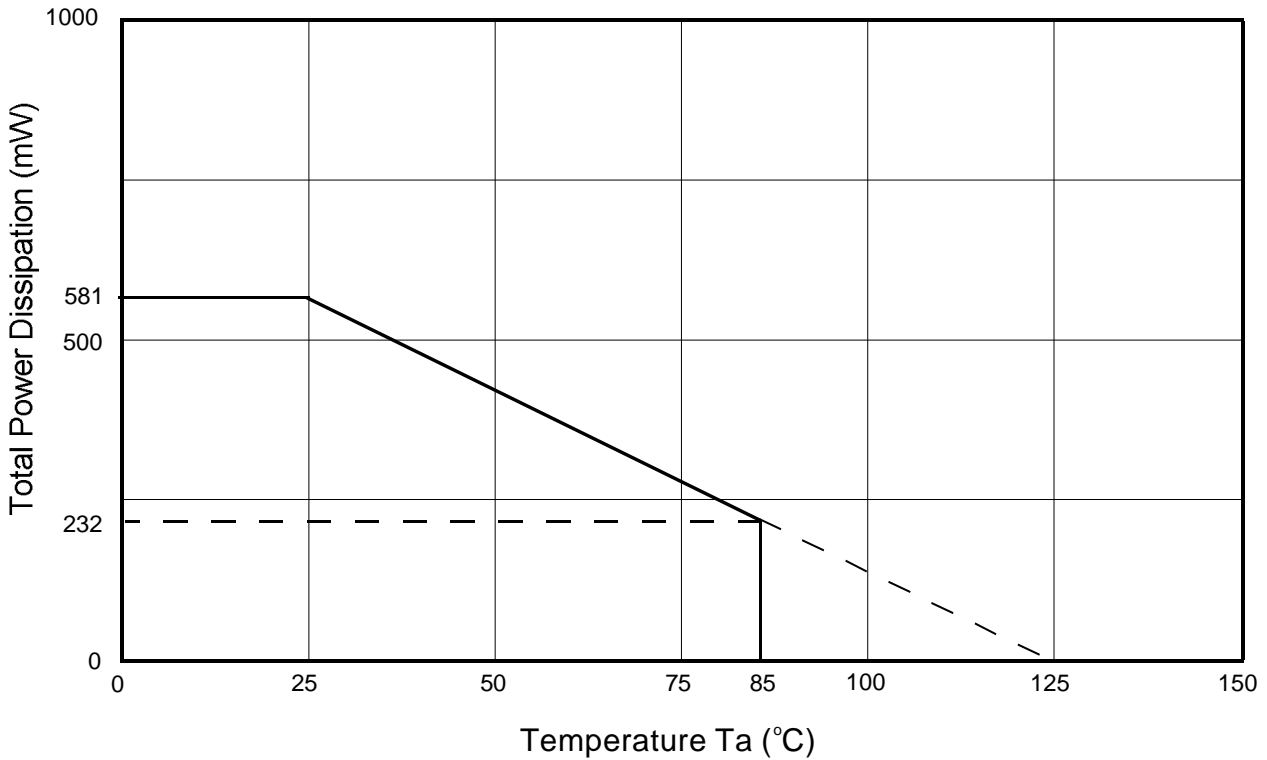
11. ABSOLUTE MAXIMUM RATINGS (Ta=-30°C to +85°C, unless otherwise noted)

Symbol	Parameter	Test Condition	Ratings Min.	Ratings Max.	Unit	Remarks
Vcc	Supply Voltage	GND=0V	-0.3	4.5	V	
Vo	Output Voltage	$\overline{LOCK}$, MIXOUT	0	4.5	V	
Io	Output Current	TXE, RXE, TXOUT	0	6.0	mA	
Vi	Input Voltage	SI, CPS, RST	-0.3	4.5	V	
Ii	Input Current	$\overline{LOCK}$, GND=0V	0	1.0	mA	
Pd	Power Consumption	Ta=85°C, Tj=125°C		232	mW	Package Allowable Power
Tj	Junction Temperature			125	°C	
Topr	Operating Ambient Voltage		-30	85	°C	
Tstg	Storage Ambient Voltage		-40	125	°C	

Total Power Dissipation Delating Curve

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12. RECOMMENDED OPERATING CONDITIONS
(Vcc=2.7 to 3.6V, Ta=-30°C to +85°C, unless otherwise noted)

Symbol	Parameter	Test Condition	Recommended Values			Unit	Pin
			Min.	Typ.	Max.		
Vcc	Supply Voltage	GND=0V	2.7	3.0	3.6	V	VCC TXVCC RXVCC
PLoTX	Transmission Local Oscillation Amplitude	FLoTX= 350~500MHz	-15	-10	-5	dBm	TXE
PLoRX	Reception Local Oscillation Amplitude	FLoRX= 700~1000MHz	-15	-10	-5	dBm	RXE
FLoTX	Transmission Local Oscillation Frequency	PLoTX= -15 ~ -5dBm	350		500	MHz	TXE
FLoRX	Reception Local Oscillation Frequency	PLoRX= -15 ~ -5dBm	700		1000	MHz	RXE
VXIN	XIN Input Amplitude	Fosc=4~25MHz	0.4		1.0	Vpp	XIN
VXOUT	XOUT Input Amplitude	Fosc=4~25MHz	0.4		1.0	Vpp	XOUT
Fosc	Reference Oscillation Frequency	VXIN= 0.4~1.0Vpp	4		25	MHz	XIN
PRFin	MIXIN Input Amplitude	Input Frequency= 700~1000MHz			0	dBm	MIXIN
IOL	"L" Output Current				1	mA	$\overline{\text{LOCK}}$
	Electric Potential between VCC and TXVCC		0		0.2	V	VCC, TXVCC
	Electric Potential between VCC and RXVCC		0		0.2	V	VCC, RXVCC

13-1. ELECTRICAL CHARACTERISTICS 1
(Ta= -30°C to +85°C, unless otherwise noted)

Symbol	Block	Parameter	Application pin	Test Condition	Limits			Unit
					Min.	Typ.	Max.	
IccOff	Supply current	Standby Current	VCC TXVCC RXVCC	Vcc=3.0V, Ta=25°C, when 2 PLLs are turned off			50	µA
IccOn		Operating Current	VCC TXVCC RXVCC	Vcc=3.0V, Ta=25°C, when 2 PLLs are turned on, MIXOUT tank load, TXE R load = 390ohm, RXE R load = 390ohm, TXOUT R load = 900ohm		24		mA

13-2. ELECTRICAL CHARACTERISTICS (Ta= -30°C to +85°C, unless otherwise noted)

Symbol	Block	Parameter	Application pin	Test Condition	Limits Min.	Limits Typ.	Limits Max.	Unit
VIH	PLL	"H" input voltage	SI, RST, CPS	Vcc=2.7~3.6V	-0.3		3.6	V
VIL		"L" input voltage	SI, RST, CPS	Vcc=2.7~3.6V	-0.2		0.3	V
IIH		"H" input current	SI, RST, CPS	Vcc=3.6V, VIH=3.6V			2	µA
IIL		"L" input current	SI, RST, CPS	Vcc=3.6V, VIL=0V	-2			µA
VOL		"L" output voltage	LOCK	Vcc=3.0V, Io=1.0mA			0.2	V
ICPO		CP output current (Source & Sink current)	PD1, PD2	Vcc=3.0V, Ta=25°C, VPD=1.5V (1)	70	100	130	µA
				(2)	210	300	390	
				(3)	350	500	650	
				(4)	490	700	910	
ICPLK		CP output leak current	PD1, PD2	Vcc=3.6V,VPD=1.8V, Vo=HiZ(OFF)	-100		100	nA
ILDLK		LOCK output leak current	LOCK	Vcc=3.6V, VOH=3.6V			5	µA
IBIAS1	OSC	OSC bias current	XIN	Vcc=3.0V, Ta=25°C, VIH=3.0V	35	50	65	µA
IBIAS2		OSC bias current	XOUT	Vcc=3.0V, Ta=25°C, VIH=3.0V	175	250	325	µA
IBIAS3		OSC bias current	XBO	Vcc=3.0V, Ta=25°C, VIH=3.0V	175	250	325	µA
VBIAS1		OSC bias voltage	XIN	Vcc=3.0V, IIF=0µA		2.8		V
VBIAS2		OSC bias voltage	XOUT	Vcc=3.0V, IIF=0µA		2.0		V
VBIAS3		OSC bias voltage	XBO	Vcc=3.0V, IIF=0µA		2.0		V
VSW		Buffer output amplitude	XBO	Vcc=3.0V, Ta=25°C, FOSC=4~25MHz, VXIN=0.4~1.0Vpp, at XBO non load	0.2		1.0	Vpp
NR		Negative Resister	XIN	Vcc=3.0V, Ta=25°C (Shown in Page 5)	100			ohm

For the ICPO parameter, the Data conditions are:

Data	DE / DG	DF / DH
(1)	L	L
(2)	L	H
(3)	H	L
(4)	H	H

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13-3. ELECTRICAL CHARACTERISTICS (Ta= -30°C to +85°C, unless otherwise noted)

Symbol	Block	Parameter	Application pin	Test Condition	Limits Min.	Limits Typ.	Limits Max.	Unit
VBBT	TX/RX VCO	Base bias voltage	TXB	Vcc=3.0V, IIF=0µA		1.6		V
VBBR			RXB	Vcc=3.0V, IIF=0µA		1.6		V
IEBT		Emitter bias current	TXE	Vcc=3.0V, Ta=25°C, R load = 390ohm		2.3		mA
IEBR			RXE	Vcc=3.0V, Ta=25°C, R load = 390ohm		2.3		mA
PvcoT		Oscillation Amplitude	TXE	Vcc=3.0V, Ta=25°C, R load = 390ohm, FLoTX=450MHz		-10		dBm
PvcoR			RXE	Vcc=3.0V, Ta=25°C, R load = 390ohm, FLoRX=960MHz		-10		dBm
HSTX		Harmonics Amplitude (2nd)	TXE	Vcc=3.0V, Ta=25°C, R load = 390ohm, FLoTX=450MHz		-25		dBm
HSRX			RXE	Vcc=3.0V, Ta=25°C, R load = 390ohm, FLoRX=960MHz		-25		dBm
IBMIX	MIX	Bias current	MIXIN	Vcc=3.0V, VIL=0V		-300		µA
VBMIX		Bias voltage	MIXIN	Vcc=3.0V, IIL=0µA		1.6		V
CG		Conversion gain	MIXIN MIXOUT RXE	Vcc=3.0V, Ta=25°C, FLoRX=960MHz, PLoRX=-10dBm, FRFin=981.4MHz PRFin=-30dBm, MIXOUT tank load		10		dB
IIP3		Intercept point	MIXIN MIXOUT RXE	Vcc=3.0V, Ta=25°C, FLoRX=960MHz, PLoRX=-10dBm, FRFin=981.4MHz PRFin=-30dBm, MIXOUT tank load		-10		dBm
NF		Noise Figure	MIXIN MIXOUT RXE	Vcc=3.0V, Ta=25°C, FLoRX=960MHz, PLoRX=-10dBm, FRFin=981.4MHz PRFin=-30dBm, MIXOUT tank load		13		dB (SSB)
IEbias	2-multiple	Emitter bias current	TXOUT	Vcc=3.0V, Ta=25°C, R load = 900ohm		2.1		mA
PRFout		2-multiple Transmission Output Power	TXOUT	Vcc=3.0V, Ta=25°C, R load = 900ohm, PLoTX=-10dBm, FLoTX=960MHz		-15		dBm

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14. Application Circuit Connection Diagram

TxVCO:463MHz(7.9MHz/V)
RxVCO:892MHz(10.3MHz/V)
TxOUT:926MHz

Cautions for Handling Application Board

- For the achievement of high performances in the MIX system, the 50ohm-matching is necessary in the MIXIN port.
- Please place external elements connected to the RF line, near the pins.
  (Especially, resisters of TXOUT, TXE, and RXE)
- The VCC/TXVCC/RXVCC decoupling capacitances are important for the achievement of high performances. Please place these elements near the pins.
- In this diagram, coefficients of the X'tal oscillation circuit are merely examples. Please ask X'tal unit vendor about the best values of customer's specification.
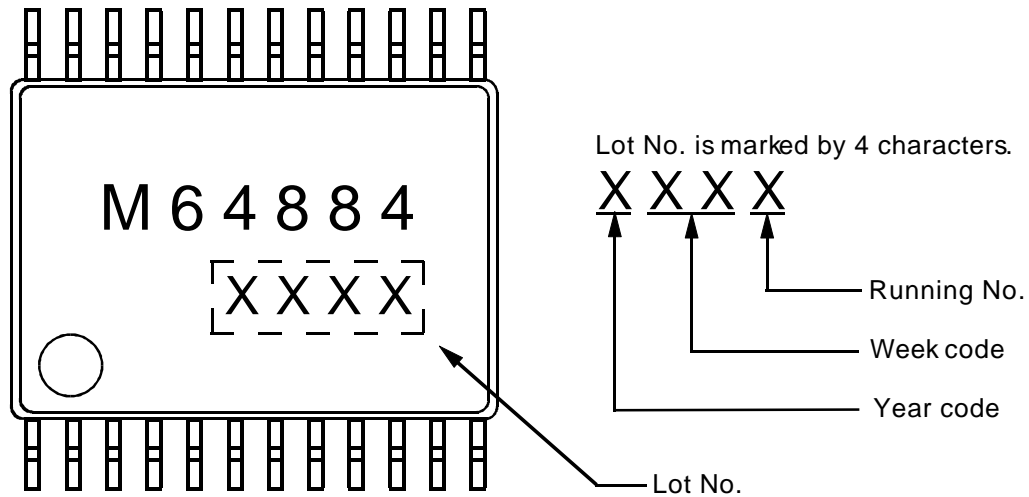
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15. Symbol on Package

M 6 4 8 8 4

X X X X

Lot No. is marked by 4 characters.

X X X X

Running No.

Week code

Year code

Lot No.

Cautions for Handling

- For the achievement of high performances, fine structure elements are used in this IC.
  To prevent surge voltage from being applied to the IC due to static electricity, take great care for handling.
- For system not to be used, set PLL to off by transferring data.