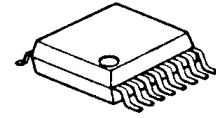


# PLL Synthesizer with I<sup>2</sup>C Bus for TV

## ■ GENERAL DESCRIPTION

The **NJW1504** is a PLL frequency synthesizer especially designed for TV and VCR tuning systems and consists of PLL circuit and a prescaler which operates up to 1.0GHz, built into one chip. The NJW1504 is controlled through an I<sup>2</sup>C-bus.

## ■ PACKAGE OUTLINE

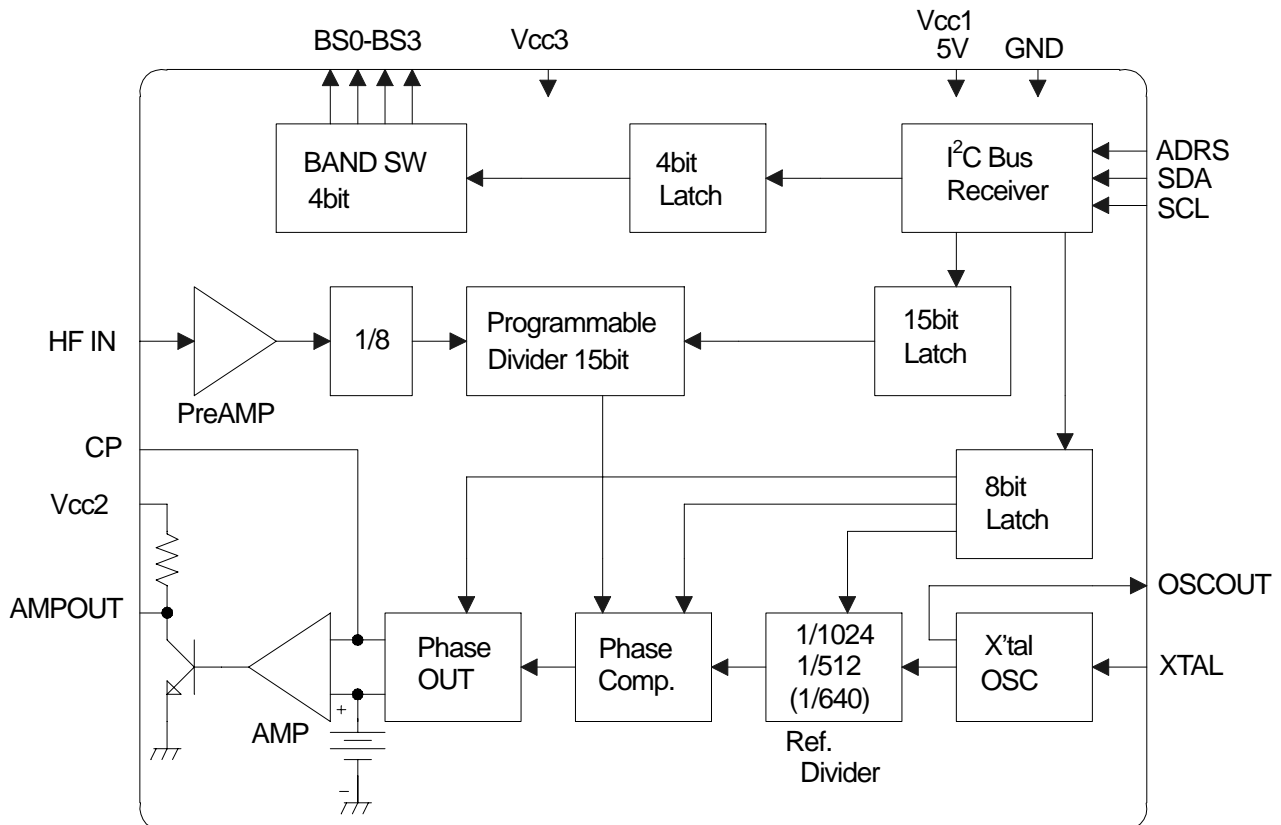


**NJW1504V**

## ■ FEATURES

- Operating Voltage                    5V
- Low Operating Current                15mA typ. @Vcc=5V
- Prescaler accepts frequencies up to 1GHz on chip
- Reference Signal Oscillator with peripheral of Xtal on chip
- 34V max. tuning voltage output
- Package Outline                        SSOP16

## ■ BLOCK DIAGRAM



(Note)

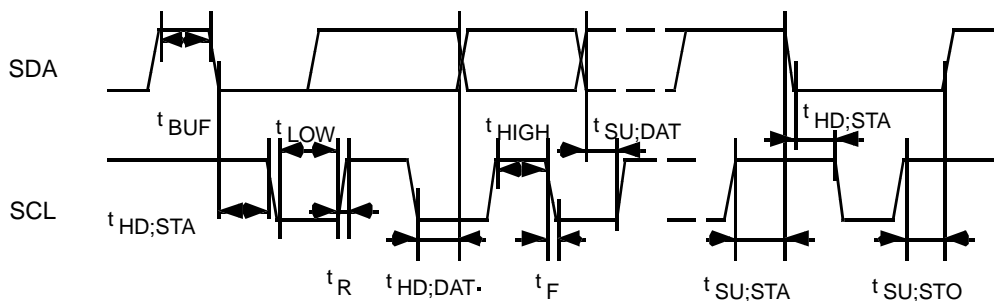
Purchase of I<sup>2</sup>C components of New Japan Radio Co.,Ltd or one of its sublicensed Associated Companies conveys a license under the Philips I<sup>2</sup>C Patent Rights to use these components in an I<sup>2</sup>C system, provided that the system conforms to the I<sup>2</sup>C standard specification as defined by Philips.

## ■ ABSOLUTE MAXIMUM RATINGS (T<sub>A</sub>=25°C)

Parameter	Symbol	Ratings	Unit
Supply Voltage (Vcc1, 3)	Vcc1, Vcc3	-0.3 to +6.5	V
Supply Voltage (Vcc2)	Vcc2	-0.3 to +36.0	V
Input Voltage (except I <sup>2</sup> C bus)	V <sub>i</sub>	-0.3 to Vcc + 0.3	V
Output Voltage (except I <sup>2</sup> C bus)	V <sub>o</sub>	-0.3 to Vcc + 0.3	V
I <sup>2</sup> C bus Input Voltage	V <sub>iiic</sub>	-0.3 to +6.5	V
Power Dissipation	P <sub>D</sub>	300	mW
Operating Temperature Range	T <sub>opr</sub>	-20 to +85	°C
Storage Temperature Range	T <sub>stg</sub>	-40 to +125	°C

## ■ RECOMMENDED OPERATING CONDITION (T<sub>A</sub>=25°C)

Parameter	Condition	Symbol	Min.	Typ.	Max.	Unit
Operating Voltage	Vcc1, Vcc3	Vcc1, Vcc3	4.5	5	5.5	V
Operating Voltage	Vcc2	Vcc2	0	-	34	V
X'tal Operating Range		f <sub>xtal</sub>	3.15	4	4.05	MHz
HF Input Frequency	Input= -20dBm	f <sub>HF</sub>	80	-	1000	MHz
Clock Frequency	Refer to I <sup>2</sup> C bus Timing Chart	f <sub>SCL</sub>	0	-	100	kHz
Bus Free Time		t <sub>BUF</sub>	4.7	-	-	us
Data Hold Time		t <sub>HDSTA</sub>	2	-	-	us
SCL Low Hold Time		t <sub>LOW</sub>	4.7	-	-	us
SCL High Hold Time		t <sub>HIGH</sub>	2	-	-	us
Set-up Time		t <sub>SUSTA</sub>	4.7	-	-	us
Data Hold Time		t <sub>HDDAT</sub>	0	-	-	us
Data Set-up Time		t <sub>SUDAT</sub>	250	-	-	ns
Rise Time		t <sub>R</sub>	-	-	1000	ns
Fall Time		t <sub>F</sub>	-	-	300	ns
Data Set-up Time		t <sub>SUSTO</sub>	4.0	-	-	us



I<sup>2</sup>C bus Timing Chart

V<sub>IHmin</sub> (0.7 Vcc1) and V<sub>ILmax</sub> (0.3 Vcc1)

**■ ELECTRICAL CHARACTERISTICS**

 (V<sub>CC1,3</sub>=5V, V<sub>CC2</sub>=34V, T<sub>A</sub>=25°C)

Parameter	Condition	Symbol	Min.	Typ.	Max.	Unit
Operating Current 1	f <sub>HF</sub> =100MHz	I <sub>CC</sub>	12	15	21	mA
Operating Current 2	AMPOUT: Low Level	I <sub>CC2</sub>	-	1.6	-	mA
AMP Input Current	Phase OUT: High Imp (2.5V)	I <sub>IN</sub>	(-50)	0.1	(50)	nA
AMP Output Current	ANP OUT: Low Level AMPOUT Input=5V	I <sub>OUT</sub>	-	-	-2.0	mA
AMP Gain	f=1KHz	AV	40	50	60	dB
Phase Comparator Output Current	Current Source	I <sub>source</sub>	190	280	400	uA
Phase Comparator Output Current	Current Sink	I <sub>sink</sub>	-400	-280	-190	uA
Band Switch						
"L" Output Current	BS0=BS1=0.3V	I <sub>OBS0-1L</sub>	-2.0	-1.0	0.0	mA
"H" Output Current	BS0=BS1=4.7V	I <sub>OBS0-1H</sub>	11.0	15.0	-	mA
"L" Output Current	BS2=BS3=0.3V	I <sub>OBS2-3L</sub>	-2.0	-1.0	0.0	mA
"H" Output Current	BS2=BS3=4.7V	I <sub>OBS2-3H</sub>	5.5	7.5	-	mA
I <sup>2</sup> C bus						
"H" Input Current	SCL, SDA Terminal	I <sub>INH</sub>	-5	0	5	uA
"L" Input Current		I <sub>INL</sub>	-5	0	5	uA
"H" Input Voltage Range		V <sub>IH</sub>	3.5	-	5.3	V
"L" Input Voltage Range		V <sub>IL</sub>	0	-	1.5	V
ACK Sink Current	ACK Output, SDA=0.4V	V <sub>ACK</sub>	3.0	-	-	mA

## ■ I<sup>2</sup>C bus Protocols

The input information, which consists of chip address and next two or four byte data, is received by I<sup>2</sup>C bus receiver. The allowable I<sup>2</sup>C bus protocols are as follows.

- (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

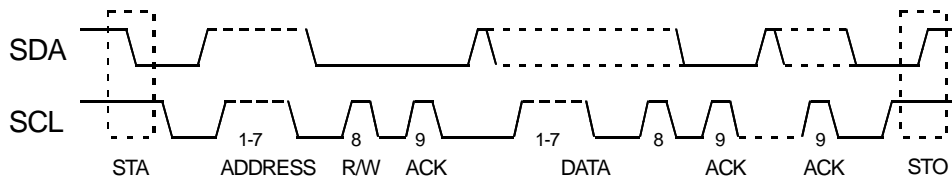
CB: Control Byte

BB: Band switch Byte

D1: Divider Byte 1

D2: Divider Byte 2

For suitable circuit operation, 5-byte data should have chip address, 2-byte control data, band data, and 2-byte divider byte. Following chip address, 2-byte data is received. For distinction of each data, first and third data byte has a function bit. As function bit, divider byte has "1" and control/band data has "0".



**■ Data Format**

Parameter	Symbol	MSB								LSB
Chip Address	CA	1	1	0	0	0	CA1	CA0	0	A
Divider Byte 1	D1	0	N14	N13	N12	N11	N10	N9	N8	A
Divider Byte 2	D2	N7	N6	N5	N4	N3	N2	N1	N0	A
Control Byte	CB	1	CP	T2	T1	T0	RD1	RD0	x	A
Band switch Byte	BB	x	x	x	x	BS3	BS2	BS1	BS0	A

- Data specifications

x : don't care ;"0" or "1"

CA1, CA0 : Programmable address bits

ADRS Voltage	CA1	CA0
Always valid	0	1
0 to 0.1 Vcc1	0	0
0.4 Vcc1 to 0.6 Vcc1	1	0
0.9 Vcc1 to Vcc1	1	1

BS0 to BS3 : Band switch buffers Control bits, BS<sub>n</sub>=1 then "ON"

N0 to N14 : Control of Programmable divider bits, N14=MSBN0=LSB

Dividing ratio :  $N=214 \times N14 + 213 \times N13 + \dots + 21 \times N1 + N0$

Maximum division ratio 32767

Minimum division ratio 256

CP : Charge Pump Current

CP	Charge Pump Current	Conditions
1	280uA	Normal, Default
0	60uA	Test

T0 to T2 : Test mode bits

T0, T1, T2 : Phase Comparator Output bits

T2	T1	T0	Phase Comparator, Band Switch	Conditions
0	0	x	Normal Output	Normal, Default
1	0	1	Phase Comparator (High Impedance)	Test
1	1	0	Phase Comparator (Sink)	
1	1	1	Phase Comparator (Source)	

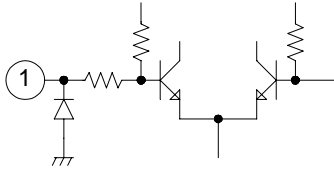
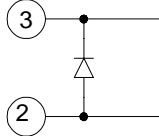
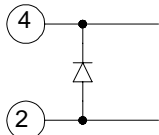
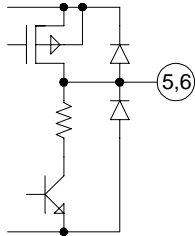
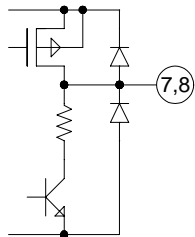
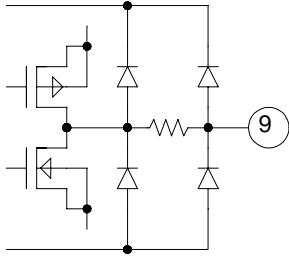
RD1, RD0 : Reference Divider bits

RD1	RD2	Reference Divider	Conditions
x	0	640	Default
1	1	512	
0	1	1024	

(Note)

Default : Power on reset

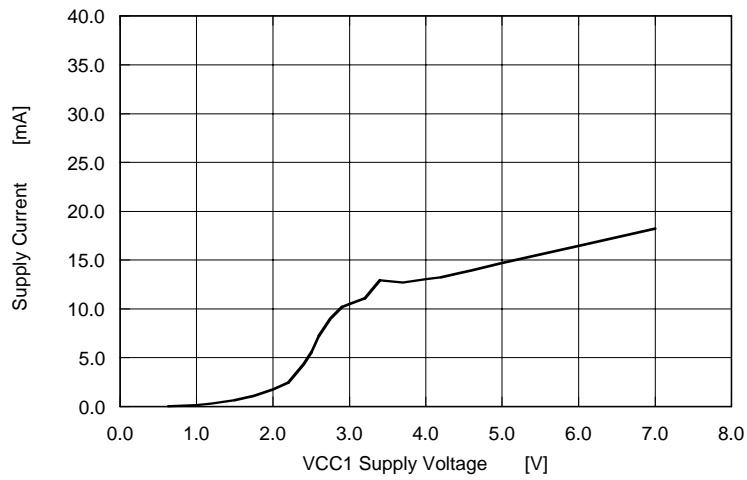
■ TERMINAL CHARACTERISTICS

No.	Symbol	Typ.DC Voltage (V)	Equivalent Circuit	Function
1	HF	3.2		High Frequency Signal Input
2	GND	0		GND
3	Vcc1	5		Power Supply
4	Vcc3	5		Band Switch Power Supply
5 6	BS3 BS2	0		Band Switch (Typ: 7.5mA)
7 8	BS1 BS0	0		Band Switch (Typ: 15mA)
9	CP	-		Charge Pump Output

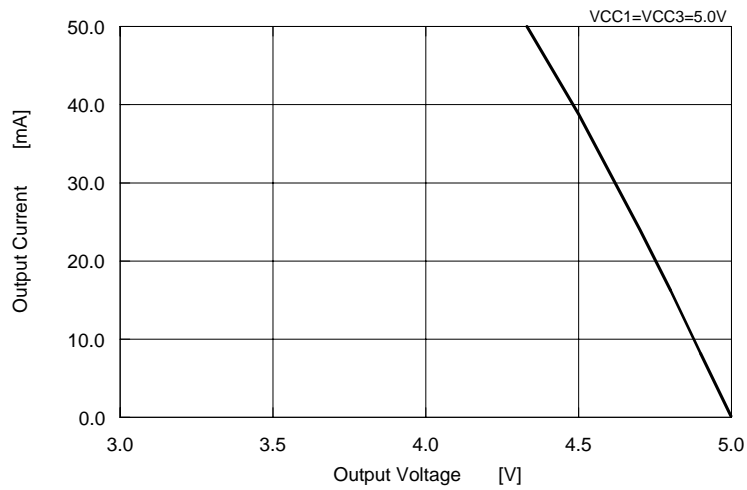
No.	Symbol	Typ.DC Voltage (V)	Equivalent Circuit	Function
10	AMPOUT	-		Amplifier Output
11	Vcc2	3.4		Amplifier Power Supply
12	OSCOUT	4.1		Reference Oscillator Output
13	SCL	-		SCL Input (I <sup>2</sup> C bus)
14	SDA	-		SDA Input (I <sup>2</sup> C bus)
15	ADRS	-		ADRS Input (I <sup>2</sup> C bus)
16	XTAL	3.3		Crystal Input

■ TYPICAL CHARACTERISTICS

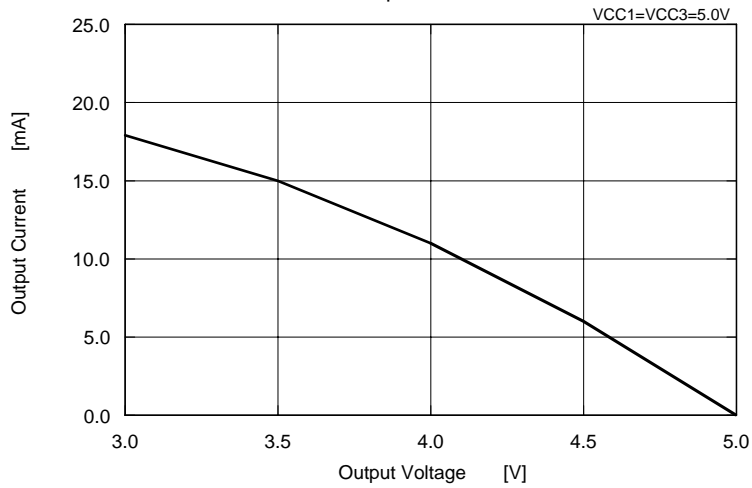
VCC1 Supply Current Curve



BS0-BS1 Output Current Curve

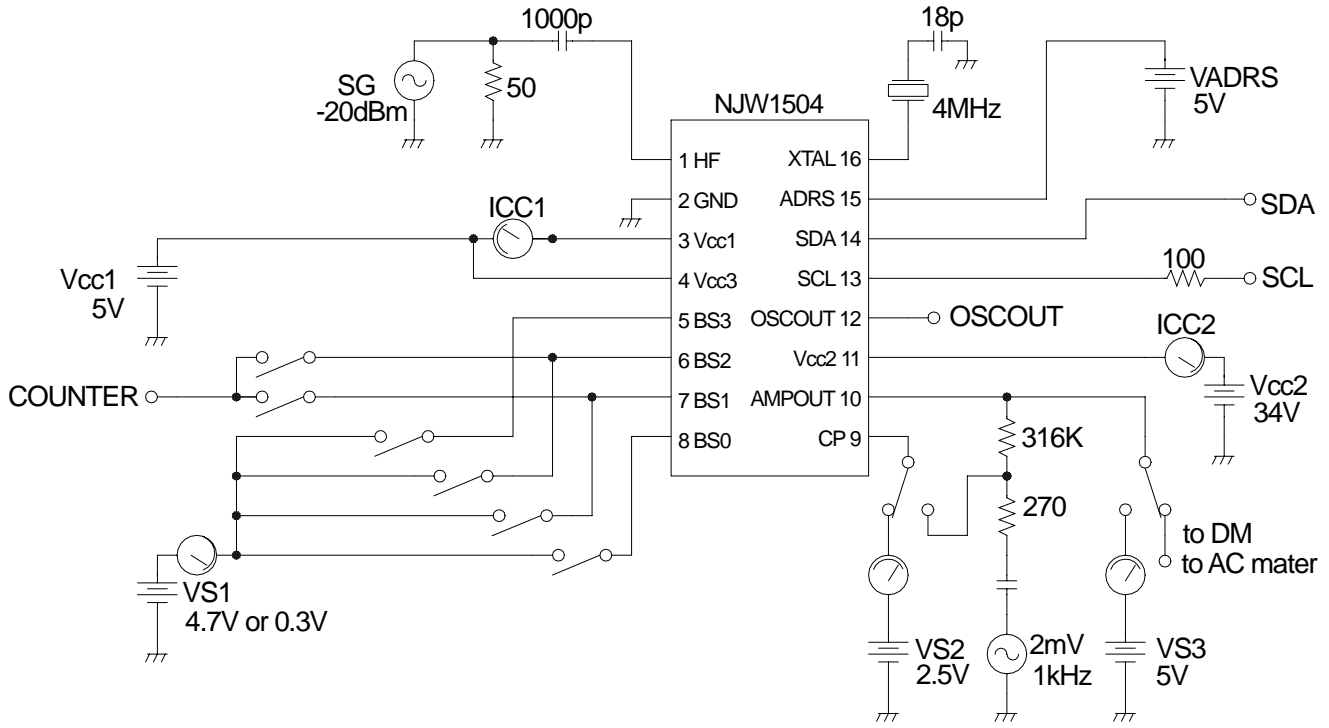


BS3 Output Current Curve





■ TEST CIRCUIT



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