



# SANYO Semiconductors DATA SHEET

## LV24003LP — Bi-CMOS IC Ultra-compact FM tuner IC for mobile set

### Overview

The LV24003LP is FM tuner IC's that requires absolutely no external components.

They incorporates not only the FM tuner functions but master volume control, tone control, buzzer, source selector, Headphone amp and other functions as well in a compact VQLP package with dimensions of only 5mm×5mm×0.8mm. These IC's are simply ideal for incorporating FM tuner functions into mobile phones and other small mobile set where space is always at a premium.

### Functions

- FM FE
- FM IF
- MPX Stereo Decoder
- Tuning
- Volume control
- Tone control
- Buzzer
- Source selector
- Headphone amp

### Features

- No external components
- No alignments necessary
- Fully integrated low IF selectivity and demodulation
- Built-in adjacent channel interference total reduction (no 114kHz, no 190kHz)
- Due to new tuning concept, the tuning is independent of the channel spacing
- Very high sensitivity due to integrated low noise RF input amplifier
- Very low power Standby mode. No power switch circuitry required
- MPX output for RDS application
- 3-wire bus interface (Data, Clock, NR-W)
- Digital AFC - Tuner locks to frequency after tuning sequence
- 8 level programmable Soft Mute
- 8 level programmable Stereo Blend
- In combination with the host, fast, low power operation of preset mode, manual search, automatic search and automatic preset store are possible
- Covers all Japanese, European and US bands

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**SANYO Semiconductor Co., Ltd.**

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# LV24003LP

## Specifications

### Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	V <sub>CC</sub> max	Analog block supply voltage	5.0	V
	V <sub>DD</sub> max	Digital block supply voltage	4.5	V
Digital input voltage	V <sub>IN1</sub> max	Clock, Data, NR_W	V <sub>DD</sub> +0.3	V
	V <sub>IN2</sub> max	External_clk_in	V <sub>DD</sub> +0.3	V
Allowable power dissipation	Pd max	Ta≤70°C	140	mW
		Ta≤70°C*	450	mW
Operating temperature	Topr		-20 to +70	°C
Storage temperature	Tstg		-40 to +125	°C

\* 40mm×50mm×0.8mm Material : glass epoxy resin

### Operating Condition at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Recommended supply voltage	V <sub>CC</sub>	Analog block supply voltage	3.0	V
	V <sub>DD</sub>	Digital block supply voltage	3.0	V
Operating supply voltage range	V <sub>CC</sub> op		2.7 to 5.0	V
	V <sub>DD</sub> op		2.5 to 4.0	V
	V <sub>IO</sub> op	Interface supply voltage	1.8 to 4.0	V

Note: Power supply voltage V<sub>IO</sub> equal V<sub>DD</sub>, or V<sub>IO</sub> < V<sub>DD</sub> (V<sub>IO</sub> ≤ V<sub>DD</sub>)

### Interface Conditions at Ta = -20 to +70°C, V<sub>SS</sub> = 0V

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Supply voltage	V <sub>DD</sub>		2.5		4.0	V
Digital part input	V <sub>IH</sub>	High level input voltage range	0.7V <sub>DD</sub>		V <sub>DD</sub>	V
	V <sub>IL</sub>	Low level input voltage range	0		0.6	V
Digital part output	I <sub>OL</sub>	Low level output current	2.0			mA
	V <sub>OL</sub>	Low level output voltage I <sub>OL</sub> =2mA			0.6	V
Clock input frequency	fclk	3wire_bus (29pin) clock frequency			0.7	MHz
External clock frequency	fclk_ext	CLK_IN (31pin) frequency	32k		14M	Hz

Note: CLK\_IN (31pin) can input sign wave.

## LV24003LP

**Operating Characteristics** at Ta = 25°C, VCC=3.0V, VDD=3.0V, VOL=15, Soft Mute / Stereo=off

VOL=15 –Block2 register09h Volume\_Bit 3-0 = 0001

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Operational supply current	ICCA	Analog Block at 60dBμ input The 23pin is measured	15	19	24	mA
	ICCD	Digital Block at 60dBμ input The 27, 40 pins are measured.	0.2	0.4	0.8	mA
Standby supply current	ICCA	Analog standby mode The 23 pin is measured.		3	30	μA
	ICCD	Digital standby mode The 27, 40 pins are measured.		3	30	μA
FM coverd frq	F_range		76		108	MHz
[FM receiving characteristics ; MONO]: fc=80MHz, fm=1kHz, 22.5kHzdev. soft_stereo, soft_mute, Buss, Treble are all OFF.						
Input limiting voltage	-3dB LS	VIN=60dBμ standard for a -3dB input		13	22	dBμV EMF
Practical sensitivity	QS1	for 30dB signal to noise ratio input De-emphasis is 75μs SG open		10	17	dBμV EMF
Practical sensitivity	QS2	for 26dB signal to noise ratio input De-emphasis is 75μs SG close		1.25		μV
Demodulator output level	VO	VIN=60dBμ, 11pin output level	60	100	140	mV
Channel balance	CB	VIN=60dBμ, ratio of 11pin to 12pin output level	-2	0	2	dB
Signal to noise ratio	S/N	VIN=60dBμ, 11pin output level	48	58		dB
Total harmonic distortion 1(MONO)	THD1	VIN=60dBμ, 22.5kHzdev, 11pin output		0.4	1.5	%
Total harmonic distortion 2(MONO)	THD2	VIN=60dBμ, 75kHzdev, 11pin output		1.3	3	%
Field strength level	FS	Input level for FS1 to FS2	8	18	27	dBμ
Muting attenuation	Mute-Att	VIN=60dBμ, 11pin output level	60	70		dB
[FM receiving characteristics ; STEREO]: fc=80MHz, fm=1kHz, VIN=60dBμV, L+R=30% (22.5kHzdev), Pilot=10% (7.5kHzdev)						
Separation	SEP	L-mod, 11pin→12pin output level	20	35		dB
Total harmonic distortion (STEREO)	THD-ST	Main-mod (L+R), 11pin/12pin output, IHF_BPF		0.6	1.8	%

**Headphone power characteristics ; LV24003LP** at Ta = 25°C, VCC=3.0V, VDD=3.0V, fc=1kHz, RL=16Ω,

VOL= 20 (Max) Line input

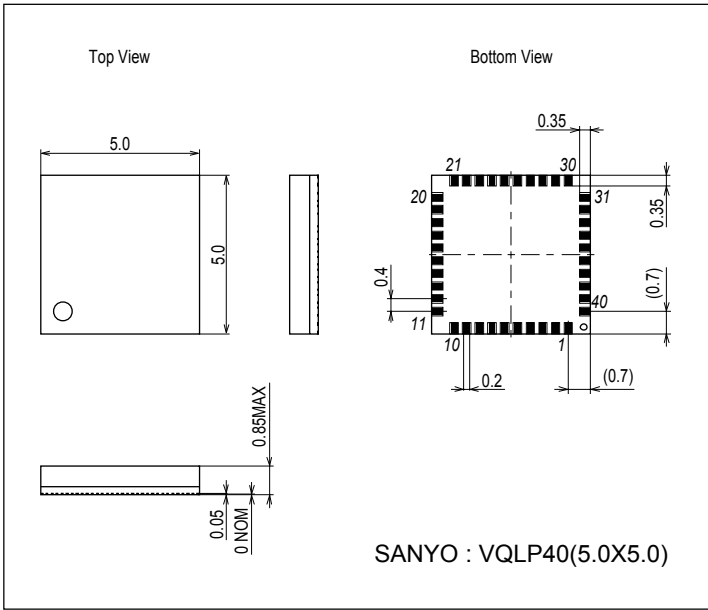
Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Headphone amp operation supply current	ICC_HPA1	Line input mode. no input		3	6	mA
Headphone amp standby supply current	ICC_HPA2	Headphone power off mode the 10 pin is measured.		3	40	μA
HPA power	PO_HPA	THD=10% VR=MAX	6	10		mW
Total harmonic distortion	THD-HPA	PO=1mW		0.6	3	%
Output noise voltage	VNO	Rg=10kΩ, BPF=200Hz to 15kHz, VR=14		0.03	0.3	mV

\* VR=Max : Block2 register 09h Volume\_Bit3-0 = 0000 setting and Block2 register 07h Volume sgift,bit6= 1 setting

Package Dimensions

unit : mm (typ)

3302A



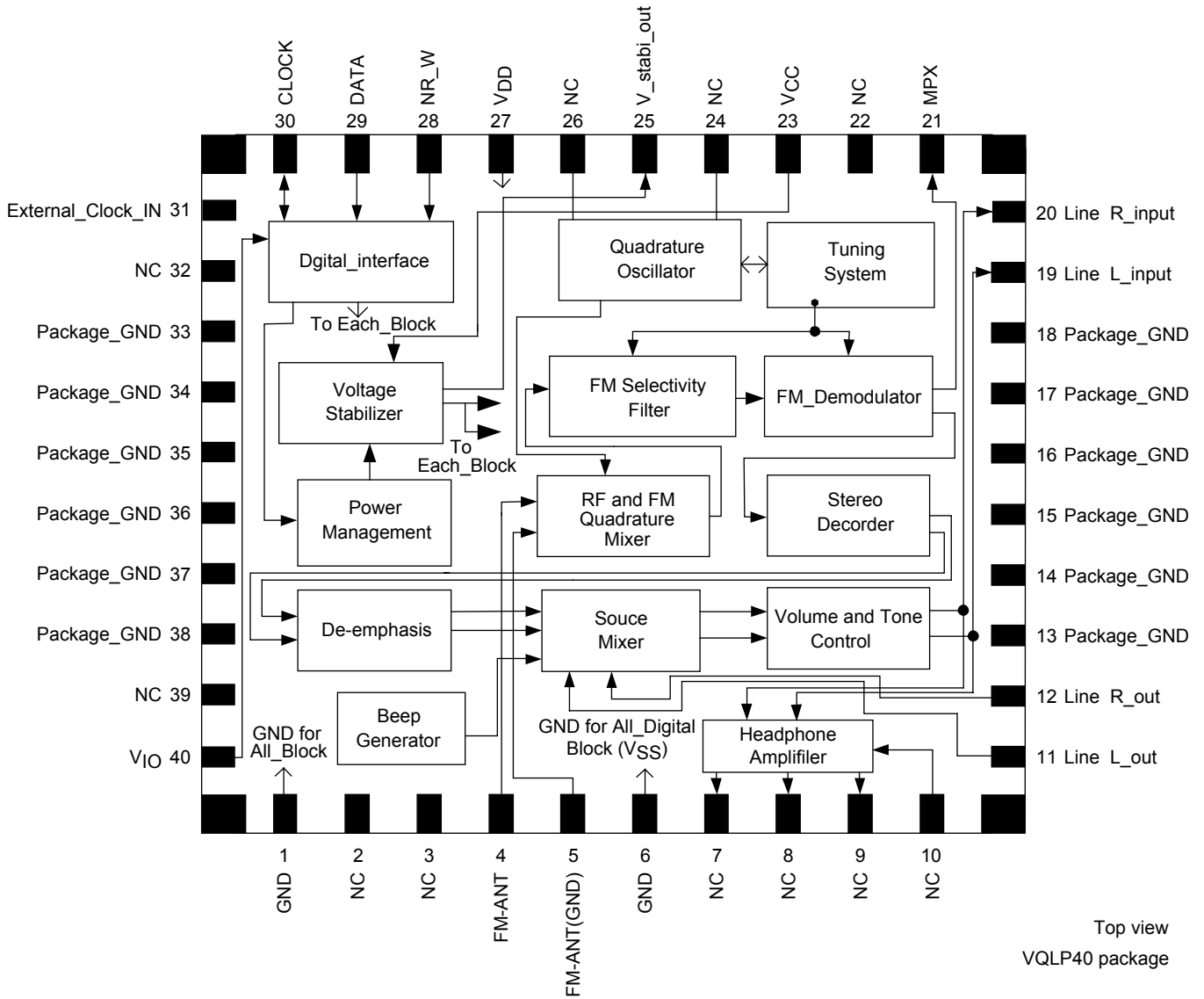
## LV24003LP

### VQLP40 package Pin Description

Pin	LV24003LP	Description	Remark	DC_bias
1	GND	GND (Analog and Digital GND)		
2	NC		Do not connect	
3	NC			
4	FM-ANT1	Antenna input		
5	FM-ANT2	Antenna GND	Connect to GND	
6	GND	GND (Analog and Digital GND)		
7	HEADPH_R	Headphone Rch output		1.2V
8	HEADPH_C	Headphone common	Not DC GND	1.2V
9	HEADPH_L	Headphone Lch output		1.2V
10	V <sub>CC2</sub>	Headphone supply voltage		
11	LINE-OUT-L	Radio Lch Line-output		1.2V
12	LINE-OUT-R	Radio Rch Line-output		1.2V
13	Package-GND	GND for Package-shield		
14	Package-GND	GND for Package-shield		
15	Package-GND	GND for Package-shield		
16	Package-GND	GND for Package-shield		
17	Package-GND	GND for Package-shield		
18	Package-GND	GND for Package-shield		
19	LINE-IN-R	Rch Line-input		1.4V
20	LINE-IN-L	Lch Line-input		1.4V
21	MPX	MPX-signal output		V <sub>CC</sub> -0.3V
22	NC			
23	V <sub>CC</sub>	Analog supply voltage		
24	NC(L2)	Internal coil2	Do not connect	2.7V
25	V <sub>stabi.</sub>	Stabilizer voltage		2.7V
26	NC(L1)	Internal coil1	Do not connect	2.7V
27	V <sub>DD</sub>	Digital supply voltage		
28	NR_W	Digital interface Read/Write		
29	DATA	Digital interface DATA		
30	CLOCK	Digital interface Clock		
31	CLK_IN	Reference clock-source input for measurement	Connect to GND if not used	
32	NC			
33	Package-GND	GND for Package-shield		
34	Package-GND	GND for Package-shield		
35	Package-GND	GND for Package-shield		
36	Package-GND	GND for Package-shield		
37	Package-GND	GND for Package-shield		
38	Package-GND	GND for Package-shield		
39	NC			
40	V <sub>I/O</sub>	Digital interface supply voltage		

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## Block Diagram

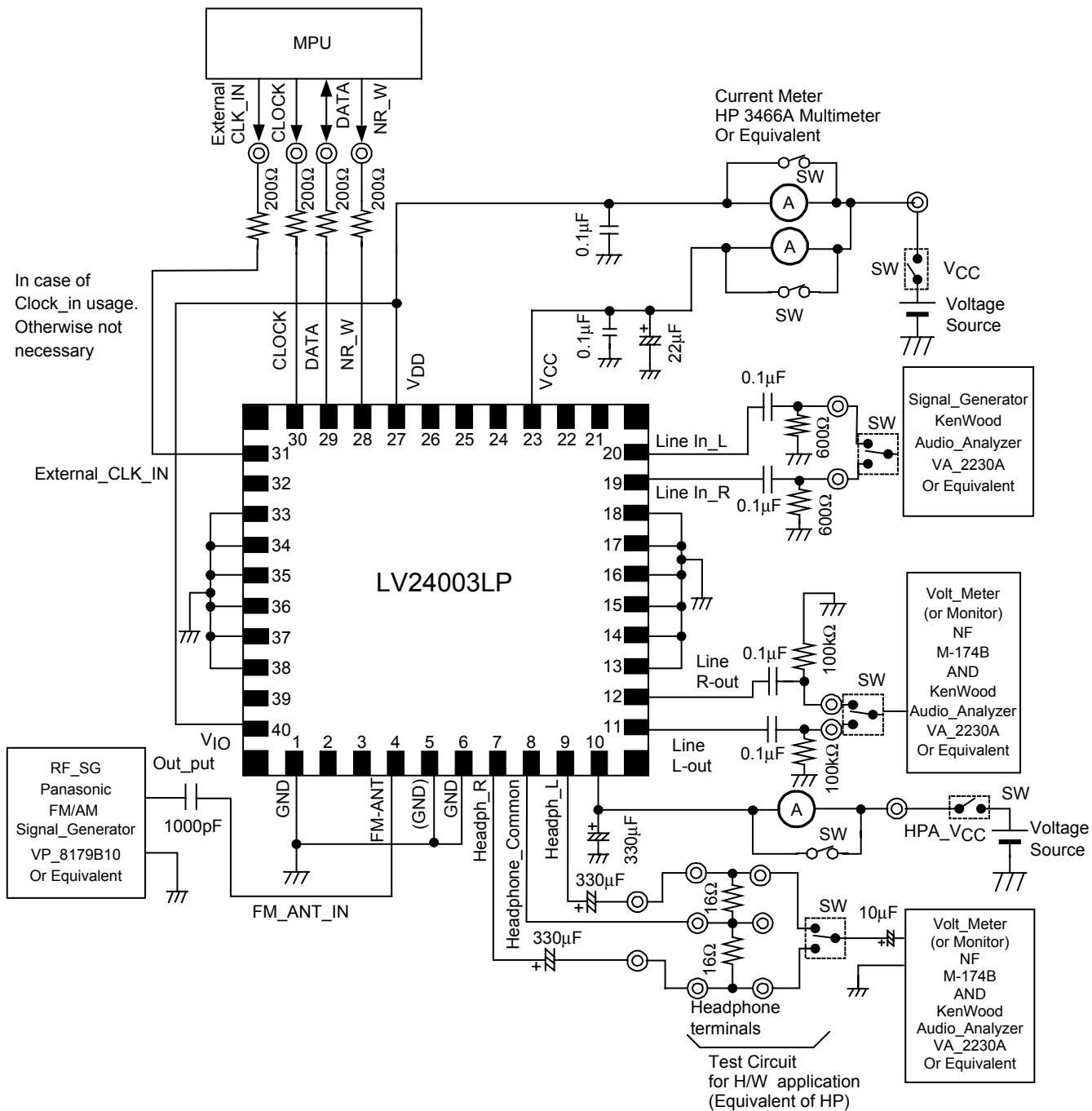


Top view  
VQLP40 package

IL.V000220

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## Measurement Circuit



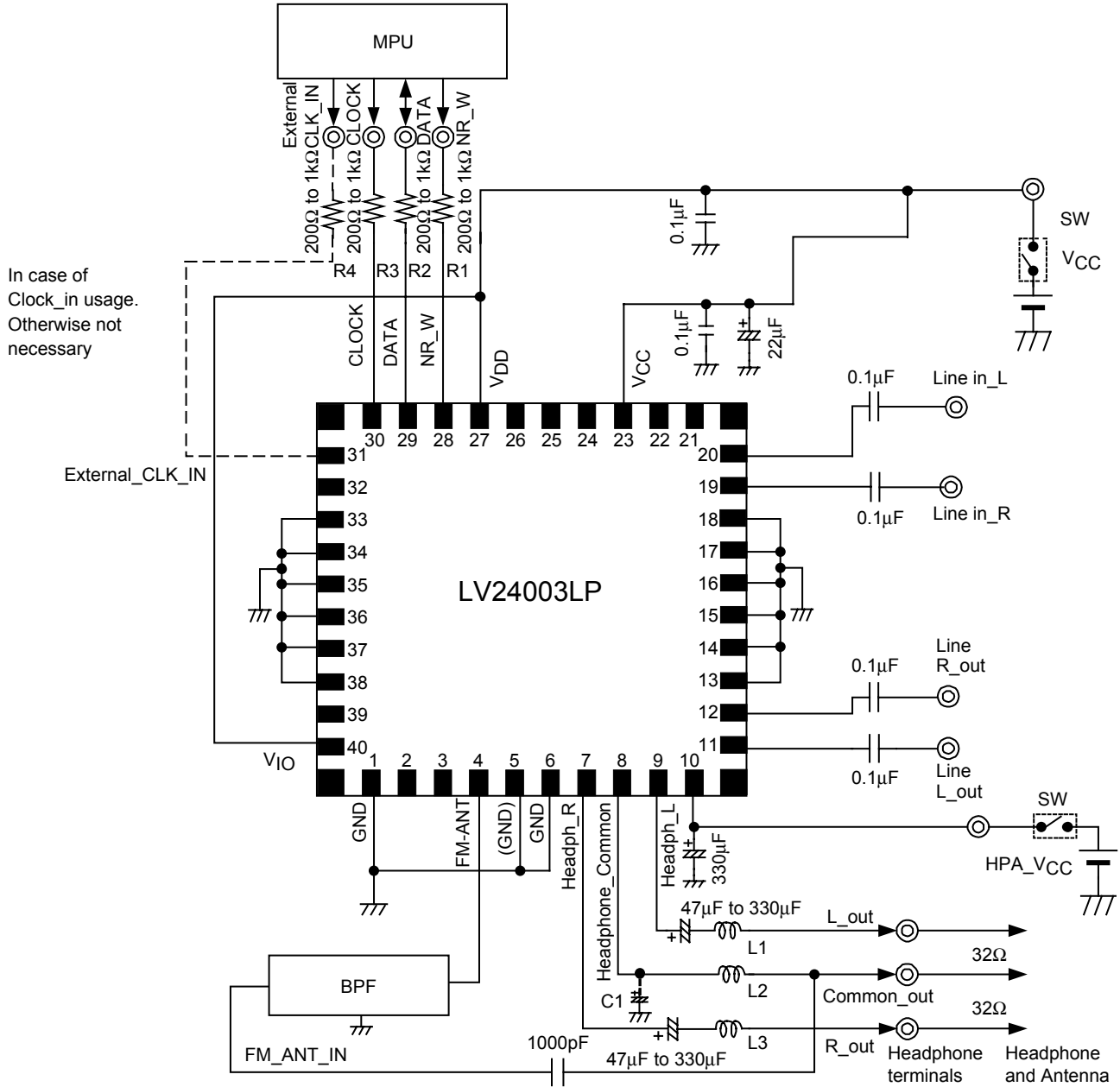
Top view  
VQLP40 package

IL.V000221

Note: Pin 13, 14, 15, 16, 17, 18 and Pin 33, 34, 35, 36, 37, 38 are for shield layer-GND of Bottom of Package

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## Application Circuit



Top view  
VQLP40 package

ILV000222

Note1: Recommend to use 32Ω Headphone

Note2: Recommend to use Value of Inductor (L1, L2, L3) over 820nH for Headphone\_output (pin 7, 8, 9)

Note3: In case of not use Headphone for ANT, Please Put Antenna Circuit sepatly.

Note4: Vale of Extenal Component is just reference. Please set most sutable value under Acutual\_operation.

Note5: In case of necessary BPF, Please put Between FM\_ANT and HPA

Note6: We recommend to put C1 (100μF to 220μF) to Pin 9 for AC\_GND

Note7: We recommend to put R1, R2, R3, R4 for interface\_wire.

Note8: Please put Capacitor Between VDD and GND also, put Capacitor Between VCC and GND as shown on application.

Note9: Pin 13, 14, 15, 16, 17, 18 and Pin 33, 34, 35, 36, 37, 38 are for shield layer-GND of Bottom of Package



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