

**N571P032**  
**Data Sheet**  
**32-BIT VOICE PROCESSOR**  
**(NuVoice™)**

# Table of Contents

<b>1. General Description</b> .....	<b>3</b>
<b>2. Features</b> .....	<b>3</b>
<b>3. Functional Block Diagram</b> .....	<b>5</b>
<b>4. Pin Configuration</b> .....	<b>6</b>
4.1 Pin Diagram .....	6
4.2 Pad Description .....	6
4.3 Alternate Function List of GPIO .....	8
<b>5. Typical Application Circuit</b> .....	<b>9</b>
5.1 Playback.....	9
5.2 Recording and Playback .....	10
5.3 Application without SPI-Flash.....	11
<b>6. Supported Codec</b> .....	<b>12</b>
<b>7. Electrical Characteristics</b> .....	<b>13</b>
7.1 Absolute Maximum Ratings.....	13
7.2 DC Electrical Characteristics .....	13
7.3 AC Electrical Characteristics .....	14
7.3.1 Internal 46MHz RC Oscillator .....	14
7.4 Analog Characteristics .....	14
7.4.1 10-bit SAR ADC .....	15
7.4.2 Programmable Gain Control (for Voice Recorder) .....	15
7.4.3 Voutx (3.3V LDO) for External Driving .....	15
7.4.4 Low Voltage Reset .....	16
7.4.5 Voltage Detector .....	16
7.4.6 Power Amplifier .....	16
<b>8. Ordering Information</b> .....	<b>17</b>
<b>9. Revision History</b> .....	<b>18</b>

## 1. General Description

N571P032 is a basic version of *NuVoice*, makes a cost-effective member of N572F065, N572F072/P072 series. CPU is Cortex™-M0, the same core as that of the whole series, but running in a lower frequency at 23MHz. The system resource is 32KB OTP and 4KB SRAM. Integrating analog peripherals, like pre-amplifier, ADC, hardware mixer, and DAC with PA, this chip saves a lot of system design effort and cost.

For N571, the major application is recording and long duration in this version. Regarding voice change or other algorithms running in N572, N571 could run the algorithms of simplified and single features by modification based on requirements of MIPS and SRAM.

Following is a brief table of all Part No. of N571 and N572 Series:

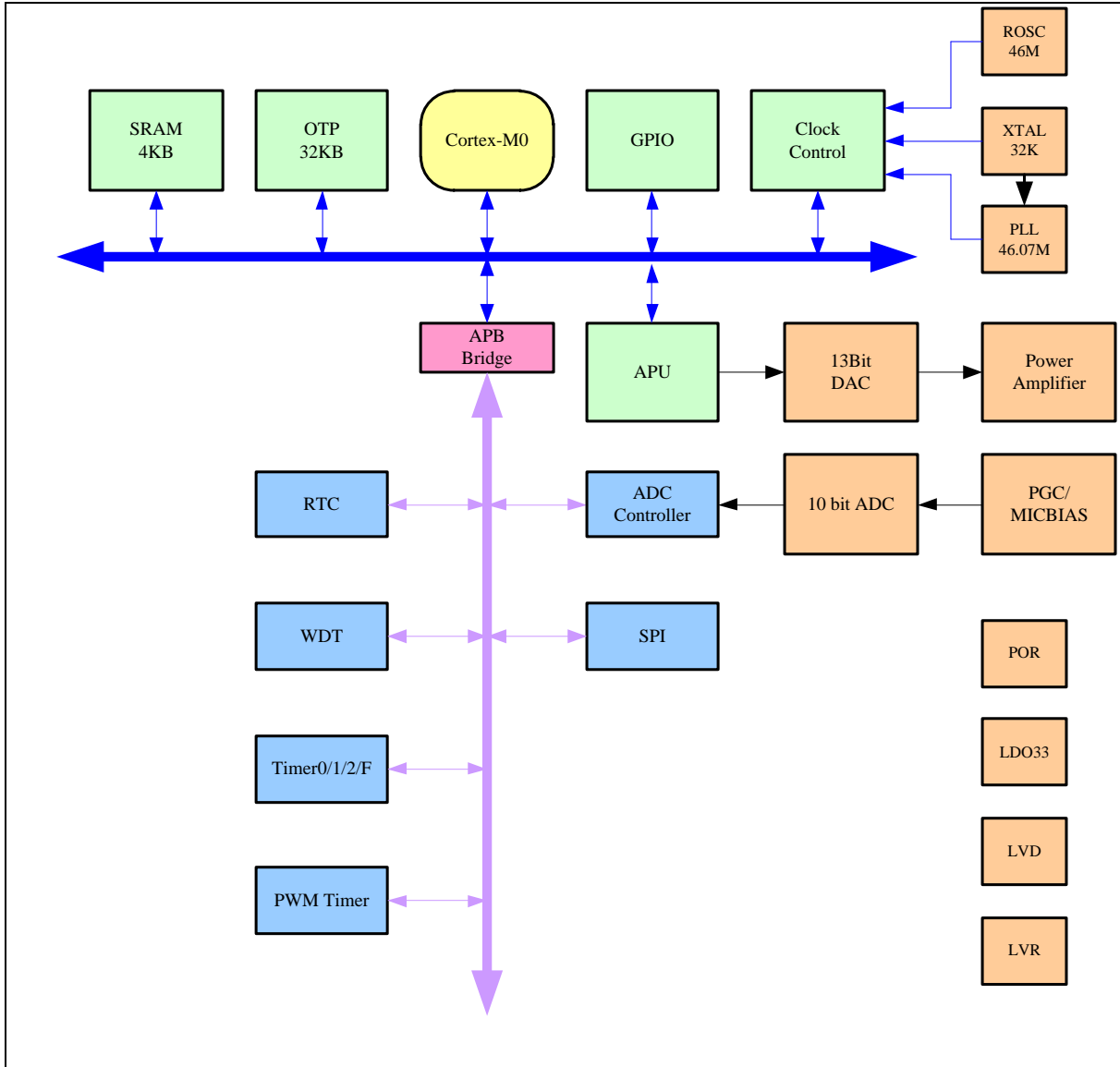
Part No.	N571P032	N572F072	N572P072	N572F065
Program ROM	32KB OTP	72KB Flash	64KB OTP + 8KB Flash	64KB Flash
SRAM	4KB	8KB	8KB	8KB
CPU freq	23MHz	48MHz	48MHz	48MHz
SPI interface	Master/Slave 23MHz, 1 set	Master/Slave mode 12MHz, 1 set Master mode 36MHz (3.3V), 1 set		Master mode 12MHz, 2 sets
GPIO	24	32	32	32
USB	N/A	N/A	N/A	FS/12Mbps

## 2. Features

- **Core**
  - ARM® Cortex™-M0 core runs up to 23MHz
  - Support low power sleep mode
  - Single-cycle 32-bit hardware multiplier
  - NVIC for the 16 interrupt inputs, each with 4-level of priority
  - Serial Wire Debug supports
- **Widely operating voltage range from 2.4V to 5.5V**
- **PROM Memory**
  - 32KB OTP
- **SRAM Memory**
  - 4KB embedded SRAM
- **Clock Control**
  - Support PLL, up to 46MHz from 32768Hz Crystal
  - External 32KHz crystal input for RTC function and system clock
  - Internal 46MHz RC oscillator
- **GPIO**
  - 24 GPIO
- **Timers**
  - 3 sets of the timer with 8-bit pre-scalar and 16-bit timer.

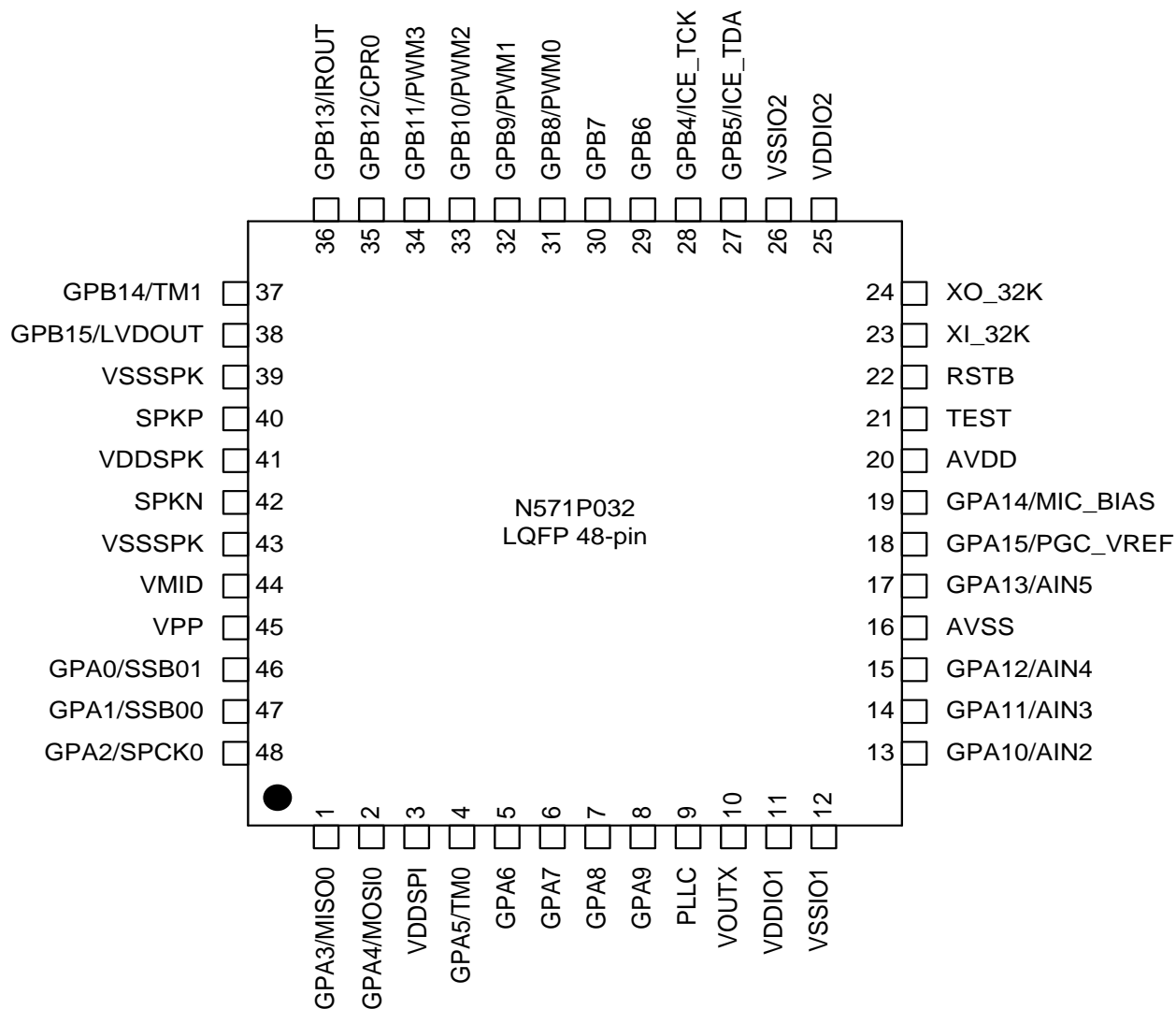
- Counter auto reload.
- IR carrier generator
- One fixed frequency timer
- **Watch Dog Timer**
  - Multiple clock sources
  - 8 selectable time out period (around 30ms~8s based on selecting 32K crystal oscillation as clock source)
  - Able to wake up power down/sleep
  - Interrupt or reset selectable on watchdog time-out
- **RTC**
  - Support time out interrupt
  - Support wake up function
- **PWM/Capture/Compare Timer**
- **SPI**
  - One sets of SPI device
  - Master mode up to 23MHz (3.3V)
  - Support master/slave mode
  - Two 32-bit buffers
- **ADC**
  - 10-bit with 220K conversion rate
  - 1 differential pair input for microphone input
  - Build in H/W DC remove filter
  - Build in up to 16 times up\_sampling/filtering/decimation HW to get around additional 2 bits SNR
  - Build in Programmable Gain Control for microphone input
  - Additional 2 inputs for general ADC
  - Build in LDO for PGC/ADC bias
- **APU**
  - 13-bit DAC+PA
  - H/W mixer with 2 channel PCM inputs
  - Build in H/W 4 times PCM repeater and image cancellation filter to remove “metal sound” liked noise
  - Embedded power amplifier
  - 7-level volume control
- **Voltage Detector**
  - with 2 levels: 3.0V/2.7V
- **Voltage Output**
  - Built-in 3.3V regulator power supply Voutx (LDO33) support chip core power and driving external spi-flash
- **Low Voltage Reset 2.2V typical**
- **Operating Temperature: 0°C~70°C**
- **Package**
  - All Green package (RoHS)
  - LQFP 48-pin
  - COB

### 3. Functional Block Diagram



## 4. Pin Configuration

### 4.1 Pin Diagram



### 4.2 Pad Description

Name	Type	Power	Description
1. GPIO			
GPA0 ~ GPA15	I/O		Bidirectional general purpose I/O ports. Most of these pins have alternate function, refer to section 0 for detail.

GPB6 ~ GPB15	I/O		Bidirectional general purpose I/O ports. Most of these pins have alternate function, refer to section 0 for detail.
2. Oscillator			
XI_32K	I	VDDIO2	32KHz crystal input
XO_32K	O	VDDIO2	32KHz crystal output
PLL (VCP)	A	LDO33	Capacitor connection for built-in PLL
3. PGC and ADC			
AVDD	P	-	3.0V LDO output for driving ADC and PGC
AVSS	P	-	Analog ground
MIC_BIAS	A	-	Microphone bias output, can be GPA14 by multi-function-pin setting
PGCVREF	A	-	AVDD/2 for PGC. A 4.7uF (or higher) capacitor for low pass filter to filter power noise is needed. can be GPA15 by multi-function-pin setting
4. Speaker Driver			
SPKP	O	VDDSPK	Speaker positive output pin.
SPKN	O	VDDSPK	Speaker negative output pin.
VDDSPK*2	P	-	Analog power supply for DAC/PA, double bond in LQFP48.
VSSSPK*2	P	-	Analog ground for DAC/PA.
VMID	A	-	Connect a capacitor to VSSSPK.
5. Power			
VDDIO2 (VDDIOB)	P	-	Power supply for I/O port
VSSIO2 (VSSIOB)	P	-	Ground pin, connect to 0V.
VDDIO1 (VDDIOA)	P	-	Power supply for I/O port LVR, LVD and Voutx(LDO33)
VSSIO1 (VSSIOA)	P	-	Ground pin, connect to 0V.
VDDSPI	P	-	Power supply for GPA0~GPA4 (shared with SPI interface).
Voutx (LDO33)	P	-	3.3V LDO output for driving outside device, internal logic and POR
VPP	P	-	Power supply for OTP programming.
6. SWD			
ICE_TCK	I	VDDIO2	Serial Wired Debugger Clock, can be GPB4 pin by multi-function-pin setting
ICE_TDA	I/O	VDDIO2	Serial Wired Debugger Data, can be GPB5 pin by multi-function-pin

			setting
7. Other			
RSTB	I	VDDIO2	Reset input pin, low active. Internal pull-high.
TEST	I	VDDIO2	Test Pin

**4.3 Alternate Function List of GPIO**

GPIO	Power	Alternate	I/O of Alternate	Function Description
GPA0	VDDSPI	SSB01	O	SPI0 2 <sup>nd</sup> chip select output pin
GPA1	VDDSPI	SSB00	I/O	SPI0 1 <sup>st</sup> chip select output/input pin
GPA2	VDDSPI	SPCK0	I/O	SPI0 serial clock output/input pin
GPA3	VDDSPI	MISO0	I/O	SPI0 master data input, slave data output pin
GPA4	VDDSPI	MOSI0	I/O	SPI0 master data output, slave data input pin
GPA5	VDDIO1	TM0	I	Timer0 counter external input
GPA6	VDDIO1			
GPA7	VDDIO1			
GPA8	VDDIO1			
GPA9	VDDIO1			
GPA10	VDDIO1	AIN2	A	ADC analog input 2
GPA11	VDDIO1	AIN3	A	ADC analog input 3
GPA12	VDDIO1	AIN4	A	Mic. IN+
GPA13	VDDIO1	AIN5	A	Mic. IN-
GPA14	VDDIO1	MIC_BIAS	A	MIC Bias
GPA15	VDDIO1	PGC_VREF	A	PGC Reference Voltage
GPB4	VDDIO2	ICE_TCK	I	Serial Wired Debugger Clock
GPB5	VDDIO2	ICE_TDA	I/O	Serial Wired Debugger Data
GPB6	VDDIO2	-		
GPB7	VDDIO2	-		
GPB8	VDDIO2	PWM0/HCLK	O	PWM output pin 0
GPB9	VDDIO2	PWM1	O	PWM output pin 1
GPB10	VDDIO2	PWM2	O	PWM output pin 2
GPB11	VDDIO2	PWM3	O	PWM output pin 3
GPB12	VDDIO2	CPR0	I	Capture input
GPB13	VDDIO2	IROUT	O	IR carrier output
GPB14	VDDIO2	TM1	I	Timer1 counter external clock input
GPB15	VDDIO2	LVDOOUT	O	LVD output

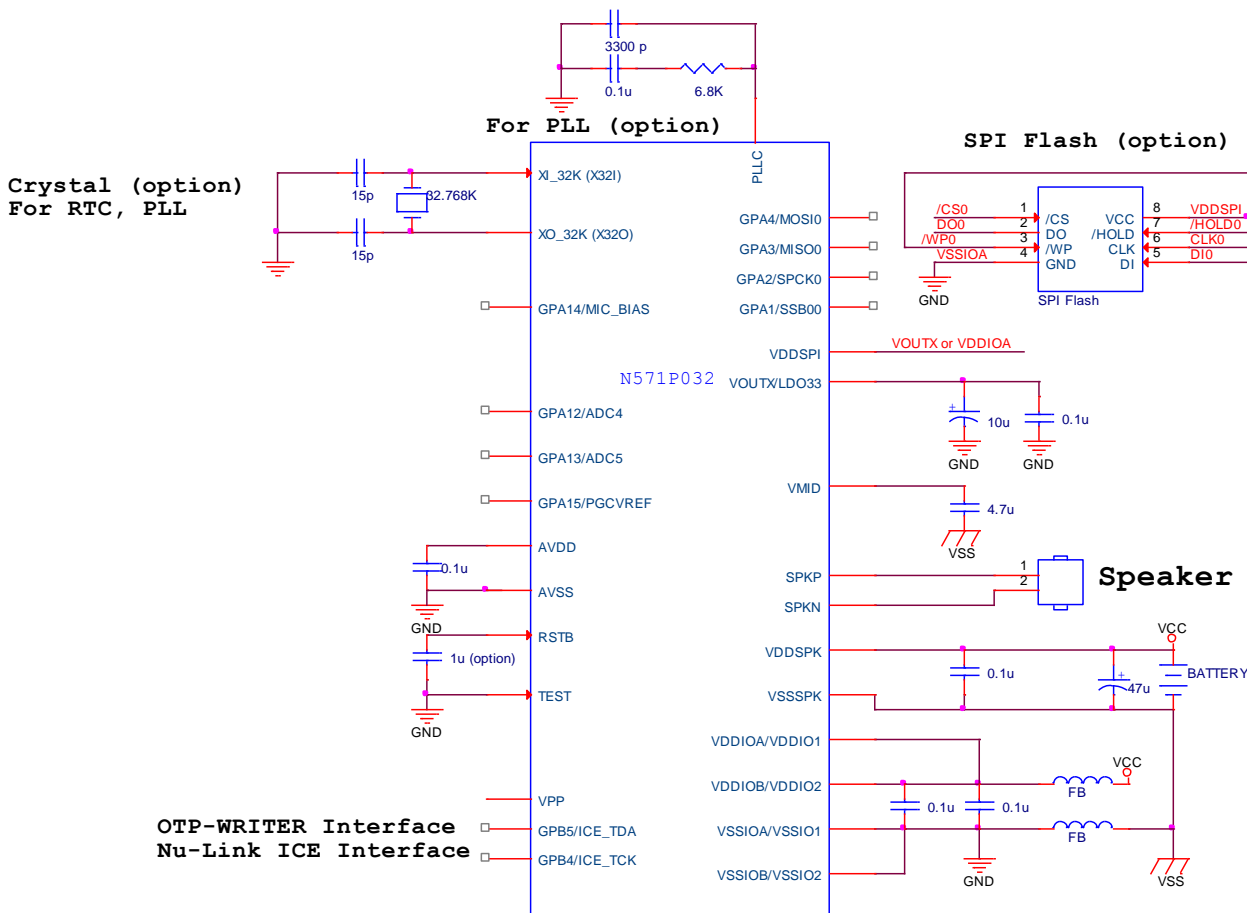


## 5. Typical Application Circuit

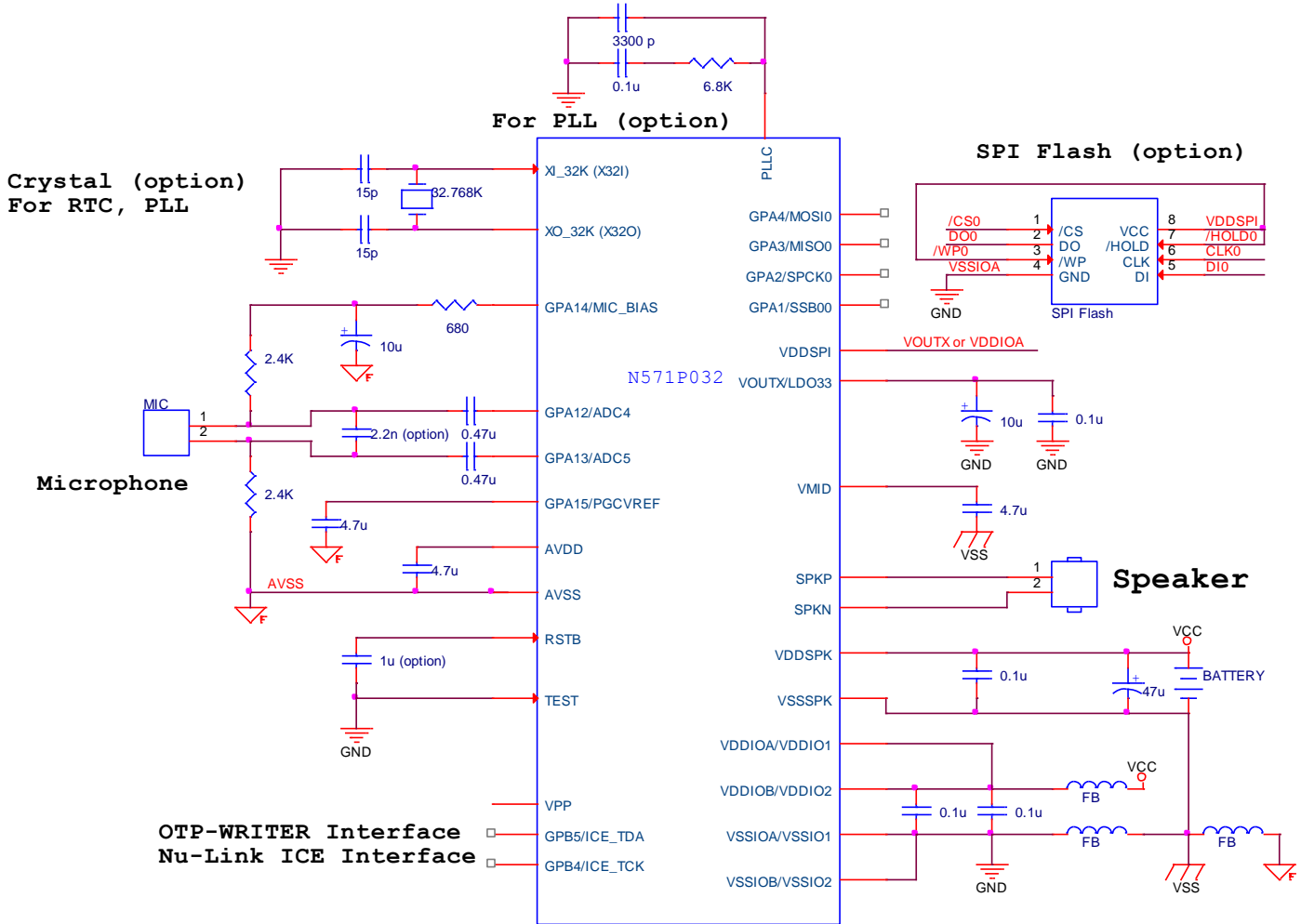
The followings are for general reference.

1. **Crystal is optional**, it is for RTC timer or for the reference clock of internal PLL. XI\_32K and XO\_32K are no connection for the application without crystal oscillator.
2. **PLL is optional**, it works with crystal oscillation to support higher accuracy system clock. PLLC is no connection for the application does not use PLL.
3. **Do not make VDDSPI spare**, it has to connect to LDO33 (Voutx) or connect to VDDIO based on application's request even if GPA0~4 (share with SPI interface) are spare.
4. **Bypass cap is must for LDO33 (Voutx)** to support chip core power even if the application does not use LDO33 to drive external device.
5. **Bypass cap is must for AVDD**, the power output pad of internal 3V LDO specific for ADC/PGC part, it can use a smaller cap if the application does not use ADC/PGC.
6. **For 2-battery (2\*1.5V) and 3-battery (3\*1.5V)**, the application circuits can be the same, but connecting VDDSPI to VDDIO can gain higher voltage for 2-battery application with SPI-Flash.

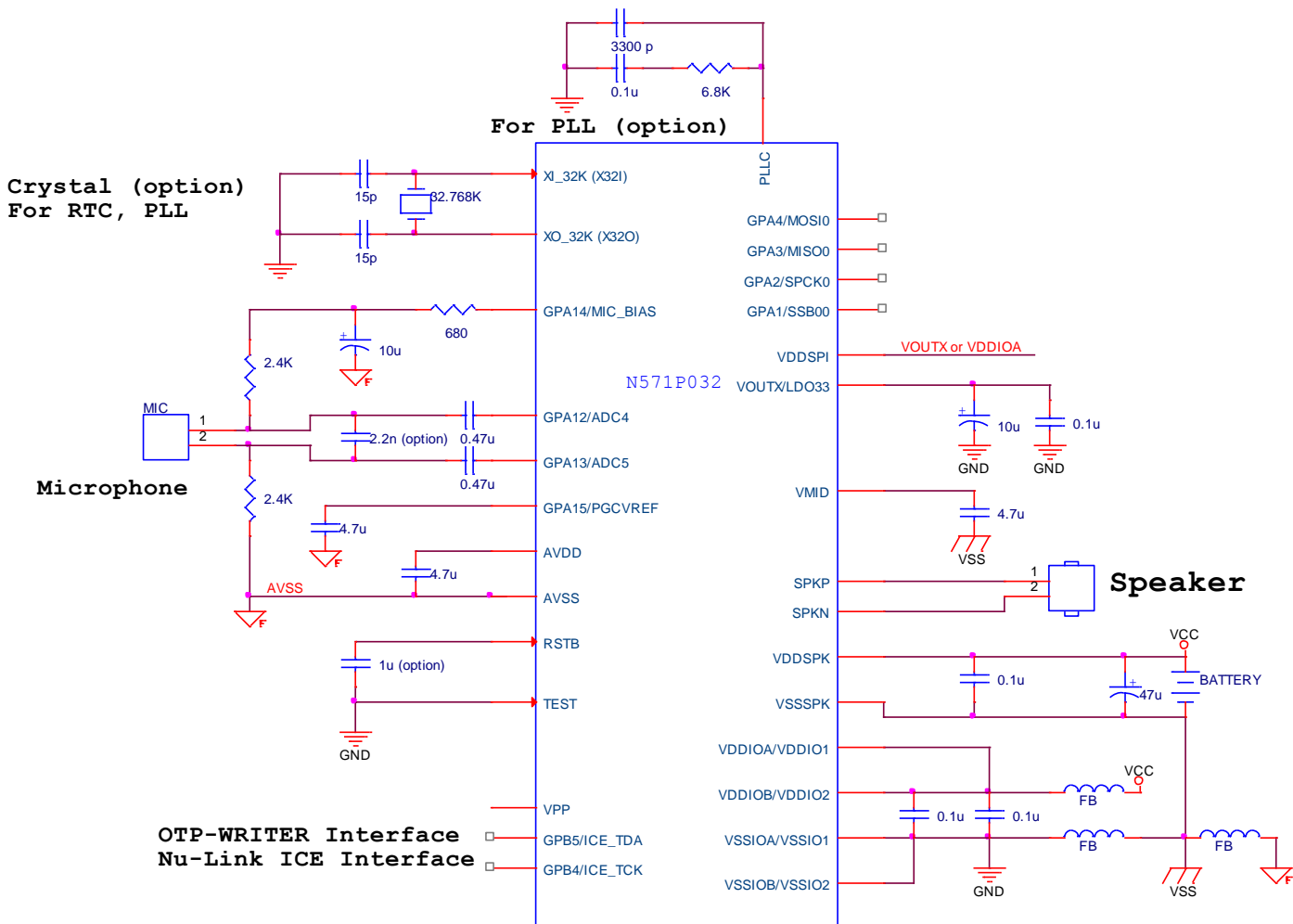
### 5.1 Playback



## 5.2 Recording and Playback



### 5.3 Application without SPI-Flash



## 6. Supported Codec

Following table shows the supported codec and suggested sample rate and corresponding bit rate. The Bit Rate of NuOne, NuLite, and NuSound could be configurable. For example, using 8K sample rate, the bit rate could be 8Kbps (1bit per sample) or 12Kbps (1.5 bit per sample) or 16Kbps (2 bit per sample). Details please refer to document in SDS.

<b>Codec</b>	<b>Sample Rate (Hz)</b>	<b>Bit Rate (bps)</b>	<b>For</b>	<b>Availability</b>
NuOne	16K	16K	Speech, Music	Codec
NuLite	8K	12K	Speech, Music	Codec
NuSound	16K	32K	Speech, Music	Decoder
MD4	16K	68.8K	Speech, Music	Decoder
IMAADPCM	16K	64K	Speech, Music	Codec
LP8	16K	128K	Speech, Music	Codec
NuVox53/63	8K	5.3K/6.3K	Speech	Decoder

## 7. Electrical Characteristics

### 7.1 Absolute Maximum Ratings

SYMBOL	PARAMETER	MIN	MAX	UNIT	
	DC Power Supply	VDD-VSS	-0.3	+7.0	V
	Input Voltage	VIN	VSS-0.3	VDD+0.3	V
	CPU Frequency	1/tCLK	0	23	MHz
	Operating Temperature	TA	0	70	°C
	Storage Temperature	TST	-55	+150	°C
	Maximum Current into VDD		-	120	mA
	Maximum Current out of VSS			120	mA
	Maximum Current sunk by an I/O pin			35	mA
	Maximum Current sourced by an I/O pin			35	mA
	Maximum Current sunk by total I/O pins			100	mA
	Maximum Current sourced by total I/O pins			100	mA

### 7.2 DC Electrical Characteristics

VDD-VSS=4.5V, TA=25°C, unless otherwise specified.

PARAMETER	SYM	SPECIFICATION				TEST CONDITIONS
		MIN.	TYP.	MAX.	UNIT	
Operation voltage	VDD	2.4		5.5	V	
Power Ground	VSS AVSS	-0.3			V	
Analog Operating Voltage	AVDD	0		VDD	V	
Analog Reference Voltage	Vref	0		AVDD	V	
Operating Current at Normal Run Mode	IDD1		14		mA	VDD=5.5V@46MHz, enable all IPs
	IDD3		14		mA	VDD=3V@46MHz, enable all IPs
Operating Current at Idle Mode	IDLE2		8.5		mA	VDD=5.5V@46MHz, disable all IPs
	IDLE4		8.5		mA	VDD=3V@46MHz, disable all IPs
Operating Current at Power-down Mode	IPWD1			6	μA	VDD = 5.5V, No load, disable all IPs
	IPWD2			5	μA	VDD = 3.3V, No load, disable all IPs
Input Current GPA/GPB (Quasi-bidirection Mode)	IIN1	-60	-65	-70	μA	VDD = 5.5V, VIN = 0V
Input Current GPA/GPB	IIN1	0.1	0.5	1	μA	VDD = 5.5V, VIN=VDD

**Release Date: January, 2015**  
**Version 1.4**

(Quasi-bidirection Mode)						
Input Current at RSTB <sup>[1]</sup>	I <sub>IN2</sub>	-60	-80	-100	μA	V <sub>DD</sub> = 5.5V, V <sub>IN</sub> = 0.45V
Input Leakage Current GPA/GPB	I <sub>LK</sub>	-2	-	+2	μA	V <sub>DD</sub> = 5.5V, 0 < V <sub>IN</sub> < V <sub>DD</sub>
Input negative going Low Transfer Voltage GPIO (Schmitt trigger input)	V <sub>IL1</sub>	-0.5	-	1.35	V	V <sub>DD</sub> = 4.5V
		-0.5	-	0.9		V <sub>DD</sub> = 3.0V
Input positive going High Transfer Voltage GPIO (Schmitt trigger input)	V <sub>IH1</sub>	3.15	-	5	V	V <sub>DD</sub> = 4.5V
		2.1	-	3.5		V <sub>DD</sub> = 3.0V
Source Current GPA/GPB (Quasi-bidirectional Mode)	I <sub>SR11</sub>	-35	-36	-38	μA	V <sub>DD</sub> = 4.5V, V <sub>S</sub> = 2.4V
	I <sub>SR12</sub>	-5	-7	-9		V <sub>DD</sub> = 2.7V, V <sub>S</sub> = 2.2V
Source Current GPA/GPB (Push-pull Mode)	I <sub>SR21</sub>	-28	-29	-30	mA	V <sub>DD</sub> = 4.5V, V <sub>S</sub> = 3.0V
	I <sub>SR22</sub>	-6	-7	-8		V <sub>DD</sub> = 2.7V, V <sub>S</sub> = 2.2V
Sink Current GPA/GPB (Quasi-bidirectional and Push-pull Mode)	I <sub>SK1</sub>	10	11	12	mA	V <sub>DD</sub> = 4.5V, V <sub>S</sub> = 0.45V
	I <sub>SK2</sub>	6	7.5	9		V <sub>DD</sub> = 2.7V, V <sub>S</sub> = 0.45V

Notes: 1. RSTB pin is a Schmitt trigger input.

### 7.3 AC Electrical Characteristics

The following data are measured under VDD-VSS=4.5V, TA=25°C, unless otherwise specified.

#### 7.3.1 Internal 46MHz RC Oscillator

PARAMETER	CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Voltage VDD		2.4	3.3	3.6	V
Center Frequency			46.0		MHz
Calibrated Internal Oscillator Frequency	+25°C; VDD = 3.3V	-2		+2	%
	0°C ~+70°C; VDD=2.7V~3.6V	-5		+5	%

### 7.4 Analog Characteristics

The following data are measured under VDD-VSS=4.5V, TA=25°C, unless otherwise specified.

**7.4.1 10-bit SAR ADC**

PARAMETER	SYM.	MIN.	TYP.	MAX.	UNIT
Resolution	-	-	-	10	Bit
Differential nonlinearity error	DNL	-	±1	-	LSB
Integral nonlinearity error	INL	-	±1	-	LSB
Offset error	EO	-	±1	-	LSB
Gain error (Transfer gain)	EG	-	1	-	-
Monotonic	-	Guaranteed			-
ADC clock frequency	FADC	0.5	-	2.64	MHz
Sample & Conversion time	TADC	12	-	-	Clock
Sample rate	FS	-	-	220	Ksps
Supply voltage	VDD	2.7	-	5.5	V
	AVDD	2.7	3.3	3.6	V
Supply current (Avg.)	IDD	-	0.7	-	mA
Reference voltage	VREFP	-	AVDD	-	V

**7.4.2 Programmable Gain Control (for Voice Recorder)**

Parameter	Sym.	Condition	Min.	Typ.	Max.	Unit
Operation Voltage	VDDA	AVDD	2.7	3.3	3.6	V
Operation Current	IDD			1.5		mA
Preamp Gain	PreG		0		20	dB
Post Gain	PostG		14		34	dB
Offset Bit	OS	6-bit Control	-64		64	mV
THD+N	THD+N	Gain=40dB,		-50		dB

**7.4.3 Voutx (3.3V LDO) for External Driving**

Parameter	Condition	Min.	Typ.	Max.	Unit
Input Voltage		3.3	-	5.5	V
Output Voltage		-10%	3.3	+10%	V
I <sub>load</sub>	VDD = 4.5V		50		mA

**7.4.4 Low Voltage Reset**

PARAMETER	CONDITION	MIN.	TYP.	MAX.	UNIT
Threshold voltage	Temperature=25°C	2.1	2.2	2.5	V

**7.4.5 Voltage Detector**

PARAMETER	CONDITION	MIN.	TYP.	MAX.	UNIT
Detected Voltage	LVD_VL = 0	2.43	2.7	3.0	V
	LVD_VL = 1	2.7	3.0	3.3	V

**7.4.6 Power Amplifier**

PARAMETER	CONDITION	MIN.	TYP.	MAX.	UNIT
Operation voltage	VDDSPK	2.4	4.5	5.5	V
Output Power	VDDSPK=4.5V, 8Ω BTL load, 0dB gain		450		mW
Total Harmonic Distortion	VDDSPK=4.5V, 8Ω BTL load, 0dB gain, 400mW		-41		dB
Power Amplifier Gain		-18		0	dB
Power Amplifier Quiescent Current	DAC fine-tuned, VDDSPK=4.5V		11		mA
Power Down Current	DAC fine-tuned, VDDSPK=4.5V			0.1	μA
Operation Current	VDDSPK=4.5V, 400mW		250		mA



**8. Ordering Information**

<b>PART NUMBER</b>	<b>PACKAGE</b>	<b>SPECIAL FEATURE</b>	<b>PB FREE + HALOGEN FREE (GREEN)</b>	<b>RELEASE DATE</b>
N571P032	NA (Die Form)	OTP	Yes	Dec, 2012
N571P032G	LQFP 48pin 7mmx7mm	OTP	Yes	Dec, 2012

## 9. Revision History

VERSION	DATE	PAGE/CHAH.	DESCRIPTIONS
1.0	Oct., 2012		Preliminary draft
1.1	Nov., 2012		With ver-A AC/DC characteristics
1.2	Jan., 2013		Update Operating Temperature, $V_{IL1}$ , $V_{IH1}$ .
1.3	Apr., 2013		Update DC parameter Remove 'Preliminary'
1.4	Jan., 2015		Update Application Circuit. Update Electrical Characteristic: Power-Down current, Voltage Detector, Program Gain Control Offset/THD+N, $V_{outx}$ (LDO33). Change Software and Development Environment to Supported Codec and remove the others..

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