

N588JP

Data Sheet

1-Channel Speech ***PowerSpeech*[®] Series**

The information described in this document is the exclusive intellectual property of Nuvoton Technology Corporation and shall not be reproduced without permission from Nuvoton.

Nuvoton is providing this document only for reference purposes of *PowerSpeech*[®] based system design. Nuvoton assumes no responsibility for errors or omissions.

All data and specifications are subject to change without notice.

For additional information or questions, please contact: Nuvoton Technology Corporation.

www.nuvoton.com

Table of Contents

1.	General Description.....	3
2.	Features	4
3.	Pin Description.....	5
4.	Block Diagram	6
5.	Electrical Characteristics.....	6
5.1	Absolute Maximum Ratings.....	6
5.2	D.C. Characteristics.....	7
5.3	A.C. Characteristics.....	7
6.	Application Circuit.....	8
6.1	2-battery Application:.....	8
6.2	3-battery Application with Normal Loading:	9
6.3	3-battery Application with Heavy Loading (Motor):.....	10
7.	PCB Layout Guide	11
8.	Package Information.....	12
8.1	PIN Assignment.....	12
8.2	Package Dimension	14
9.	Ordering Information	18
10.	Revision History.....	19

1. General Description

The N588JPxxx is an 8-bit 65C02 based, 1-ch Voice Synthesizer OTP, to implement sophisticated applications with high level of sound quality.

The N588JPxxx improves the structure to minimize the external components for various applications. In addition, it allows customers to use internal Rosc with precise frequency control to save BOM cost and gain lower frequency deviation.

Furthermore, the N588JPxxx provides lots of function includes 16 ~ 24 I/Os where one port with high drive current, 128 ~ 192 bytes RAM, H/W IR carrier, and Low Voltage Detection. Meanwhile, N588JPxxx builds in 3-pair output pins with 64-level control for the applications of motors tiny control. The N588JPxxx also build in Watch Dog Timer and Low Voltage Reset to prevent latch-up situation occurring.

The N588JPxxx family contains several items with different playback ROM size and duration as shown below table:

Part No.	ROM (KB)	Duration (Sec.)	CH	Fsys	Rosc	Audio	I/O Pins	H/W PWM	RAM (Byte)	IR Carrier	U_IO	WDT	LVR	LVD
		(6KHz)												
N588JP062	206	65	1	4,6,8MHz	TRIM	PWM	16 I/O	3-pair	128	Yes	Yes	Yes	Yes	2.2, 2.4, 2.7, 3.3V
N588JP082	254	80	1	4,6,8MHz	TRIM	PWM	16 I/O	3-pair	128	Yes	Yes	Yes	Yes	2.2, 2.4, 2.7, 3.3V
N588JP122	414	131	1	4,6,8MHz	TRIM	PWM	16 I/O	3-pair	128	Yes	Yes	Yes	Yes	2.2, 2.4, 2.7, 3.3V
N588JP172	510	162	1	4,6,8MHz	TRIM	PWM	16 I/O	3-pair	128	Yes	Yes	Yes	Yes	2.2, 2.4, 2.7, 3.3V
N588JP202	704	223	1	4,6,8MHz	TRIM	PWM	24 I/O	3-pair	192	Yes	Yes	Yes	Yes	2.2, 2.4, 2.7, 3.3V
N588JP252	830	263	1	4,6,8MHz	TRIM	PWM	24 I/O	3-pair	192	Yes	Yes	Yes	Yes	2.2, 2.4, 2.7, 3.3V
N588JP342	1022	324	1	4,6,8MHz	TRIM	PWM	24 I/O	3-pair	192	Yes	Yes	Yes	Yes	2.2, 2.4, 2.7, 3.3V

Note: The duration (Sec.) is based on 4-bit NM4 algorithm at 6KHz and deducted synthesis library

2. Features

- VDD range:
 - 4, 6, 8MHz: 2.0 ~ 5.5V
- System clock: 4, 6, 8MHz
- Oscillator: builds in internal Rosc (TRIM)
- RAM: 128B ~ 192B
- 16~24 bi-directional I/O pins
 - BP00 ~ BP07, BP10 ~ BP17 can be set as Input or Output status individually
- Provides 8-pin with high sink current capability to drive LEDs
- 3-pair H/W PWM I/O pins with 6-bit resolutions to control motor
 - BP00/02/04 are defined as 3 H/W PWM I/O pins. They can be paired with BP01/03/05 respectively by same (or opposite) phase of output waveform
- Builds in IR carrier generation circuit for simplifying firmware IR application
- Algorithm: 4-bit NM4, 4-bit MD4, 5-bit MDM, 8-bit LP8
- Audio output: 12-bit PWM
- Channel: 1-channel Voice
- Built-in Watch-Dog Timer (WDT)
- 3 voltage levels of Low Voltage Reset (LVR) by mask option
 - LVR: 2.0V, 2.2V, 2.7V
- Builds in Low Voltage Detection (LVD) with 4 voltage levels
 - LVD: 2.2V, 2.4V, 2.7V, 3.3V
- Support **PowerScript™** for developing codes in easy way
- Full-fledged development system
 - Source-level ICE debugger (Assembly & **PowerScript™** format)
 - **Ultra I/O™** tool for event synchronization mechanism

3. Pin Description

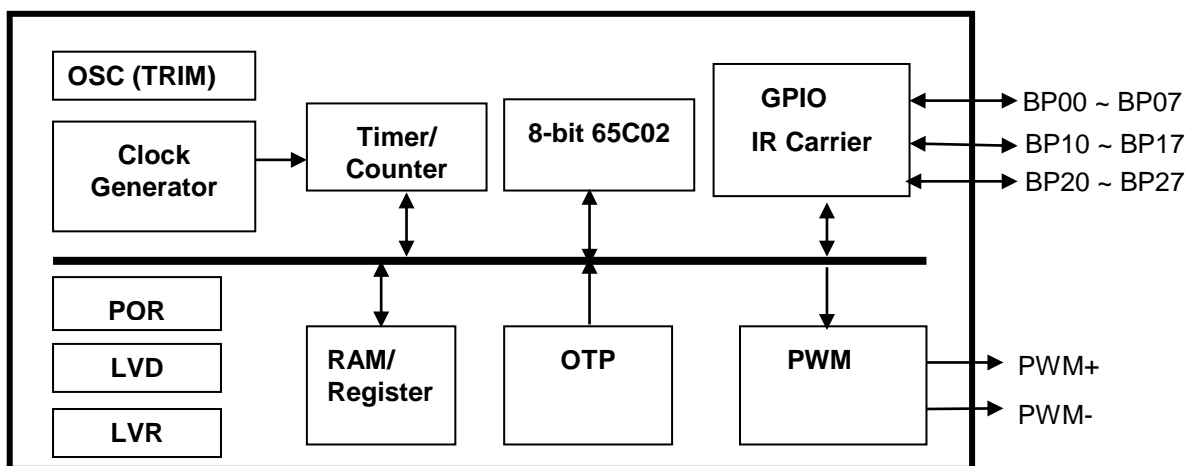
Pin Name	I/O	Function
/RESET	I	IC reset input, low active.
BP00 ~ BP07	I/O	<ul style="list-style-type: none"> General input/output pins. Each pin can be set as Input or Output individually. When the pin will be set output by BP0D, user needs to set BP0x value of 0/1 first. For output pin, BP0 provides high-sink current. For input pin, it can be set as pull-high or floating BP00/02/04 can be set as 3-pin H/W PWM output with 64-level resolution. They can be paired with BP01/03/05 (also H/W PWM output) respectively with same or opposite phase of output waveform BP07 can be configured as IR carrier output
BP10 ~ BP17	I/O	<ul style="list-style-type: none"> General input/output pins. Each pin can be set as Input or Output individually. When the pin will be set output by BP1D, user needs to set BP1x value of 0/1 first. For input pin, it can be set as pull-high or floating. BP1 can generate interrupt request to release IC from STOP mode BP11/12 can be writer interface (SCLK/SDIO) on writer mode
*BP20 ~ BP27	I/O	<ul style="list-style-type: none"> General input/output pins. Each pin can be set as Input or Output by group, BP20 ~ BP23 configured by BP2D[0], and BP24 ~ BP27 by BP2D[1]. When the pins will be set output by BP2D, user needs to set BP2x value of 0/1 first.
PWM+	O	PWM driver positive output to drive speaker directly
PWM-	O	PWM driver negative output to drive speaker directly
VDD	Power	Positive power supply for uP and peripherals
VSS	Power	Negative power supply for oscillation, uP and peripherals
VDD_IO	Power	Positive power supply for I/O

Pin Name	I/O	Function
VSS_IO	Power	Negative power supply for I/O
VDD_SPK	Power	Positive power supply for speaker driver
VSS_SPK	Power	Negative power supply for speaker driver
V33O	Power	3.3V Regulator output.
VPP	Power	8.5V input during program OTP memory on writer mode. Let it be NC for normal operation mode.

Note1: BP20 ~ BP27 only provides in N588JP202 ~ N588JP342

Note2: OTP program pad: BP11 (SCLK), BP12 (SDIO), VDD, VPP, VSS

4. Block Diagram



5. Electrical Characteristics

5.1 Absolute Maximum Ratings

Parameter	Symbol	Conditions	Rated Value	Unit
Power Supply	VDD–VSS	-	-0.3 to +7.0	V
Input Voltage	VIN	All Inputs	VSS -0.3 to VDD +0.3	V
Storage Temp.	TSTG	-	-55 to +150	°C
Operating Temp.	TOPR	-	0 to +70	°C

Note: Exposure to conditions beyond those listed under the Absolute Maximum Ratings table may adversely affect the life and reliability of the device.

5.2 D.C. Characteristics

(VDD – VSS = 4.5V, TA = 25° C, No Load unless otherwise specified)

Parameter	Sym	Conditions	Min	Typ	Max	Unit
Operating Voltage	V _{DD}	F _{OSC} = 4 MHz	2.0	-	5.5	V
		F _{OSC} = 6 MHz	2.0	-	5.5	V
		F _{OSC} = 8 MHz	2.0	-	5.5	V
Operating Current	I _{OP1}	No load, F _{OSC} = 8 MHz	-	8	10	mA
Standby Current (STOP)	I _{DD1}	No load	-	3	10	μA
Input Low Voltage	V _{IL}	All input pins	V _{SS}	-	0.3 V _{DD}	V
Input High Voltage	V _{IH}	All input pins	0.7 V _{DD}	-	V _{DD}	V
Output Current (BP0)	I _{OL}	V _{DD} = 3V, V _{OUT} = 0.4V	8	12	-	mA
	I _{OH}	V _{DD} = 3V, V _{OUT} = 2.6V	-4	-6	-	mA
	I _{OL}	V _{DD} = 4.5V, V _{OUT} = 1.0V	-	25	-	mA
	I _{OH}	V _{DD} = 4.5V, V _{OUT} = 3.5V	-	-12	-	mA
Output Current (BP1, BP2)	I _{OL}	V _{DD} = 3V, V _{OUT} = 0.4V	4	6	-	mA
	I _{OH}	V _{DD} = 3V, V _{OUT} = 2.6V	-4	-6	-	mA
	I _{OL}	V _{DD} = 4.5V, V _{OUT} = 1.0V	-	12	-	mA
	I _{OH}	V _{DD} = 4.5V, V _{OUT} = 3.5V	-	-12	-	mA
Output Current PWM+ / PWM-	I _{OL1}	RL= 8Ω	+250	-	-	mA
	I _{OH1}	[PWM+]---[RL]---[PWM-]	-250	-	-	mA
LVD detect voltage	V _{LVD}	2.2V Option	-	2.2	-	V
		2.4V Option		2.4		
		2.7V Option		2.7		
		3.3V Option		3.3		

5.3 A.C. Characteristics

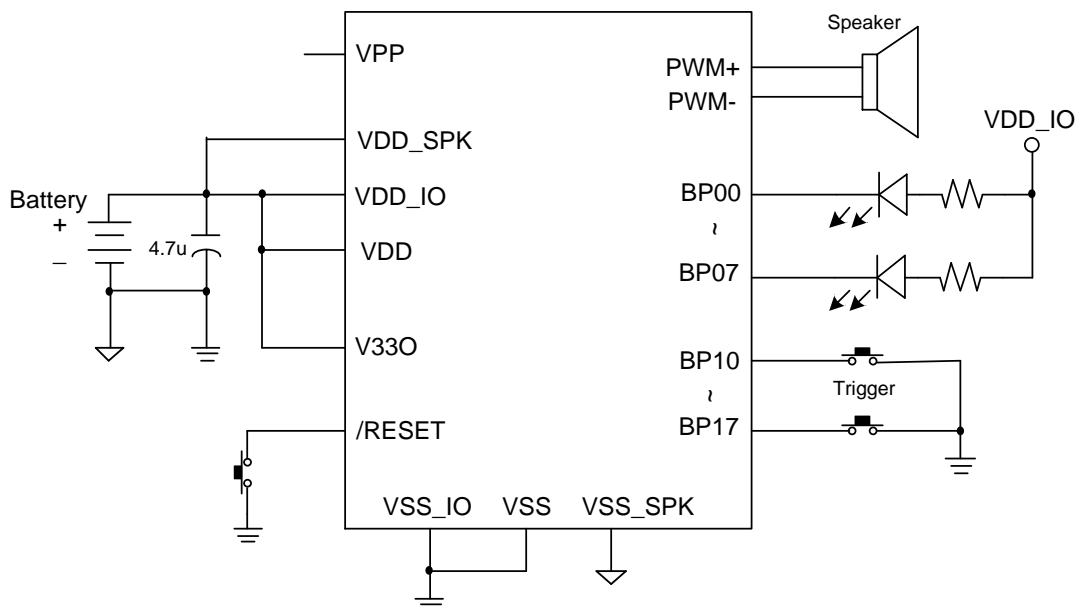
(VDD = 4.5V, TA = 25°C, No Load unless otherwise specified)

Parameter	Sym	Conditions	Min	Typ	Max	Unit
Main Clock Frequency	F _{OSC}	F _{OSC} = 4 MHz	3973	4096	4219	KHz
		F _{OSC} = 6 MHz	5960	6144	6328	
		F _{OSC} = 8 MHz	7946	8192	8438	
Frequency Deviation by Voltage Drop	$\frac{\Delta F_{OSC}}{F_{OSC}}$	(F _{max} – F _{min})/F _{min} @VDD: 2.4 ~ 4.5V	-	2	-	%

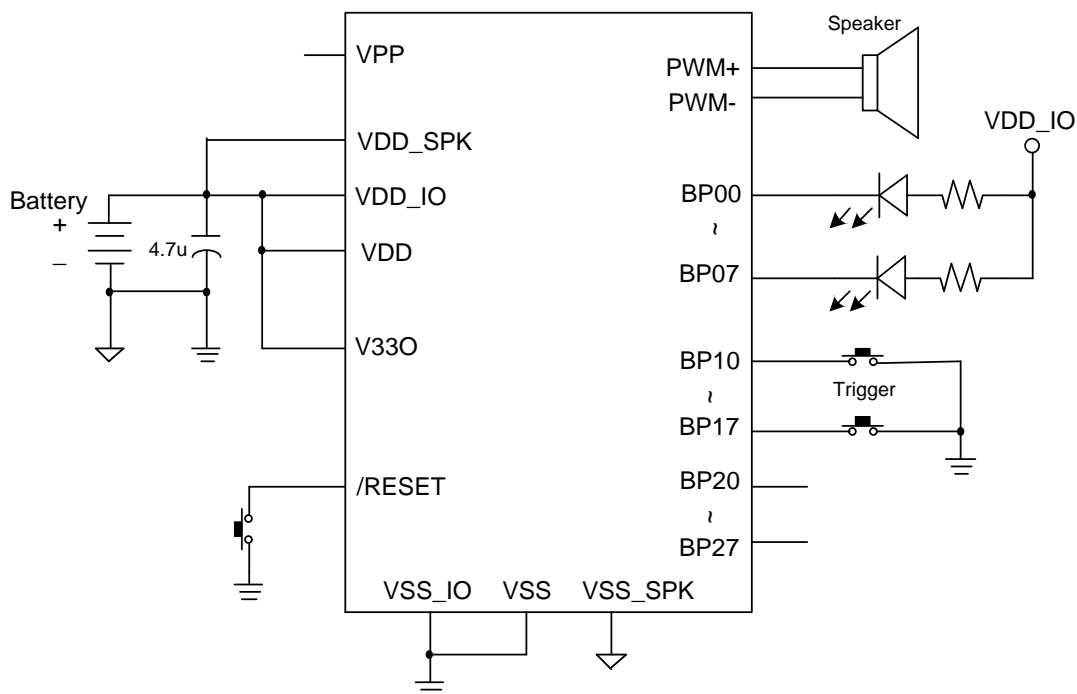
6. Application Circuit

6.1 2-battery Application:

N588JP062/082/122/172

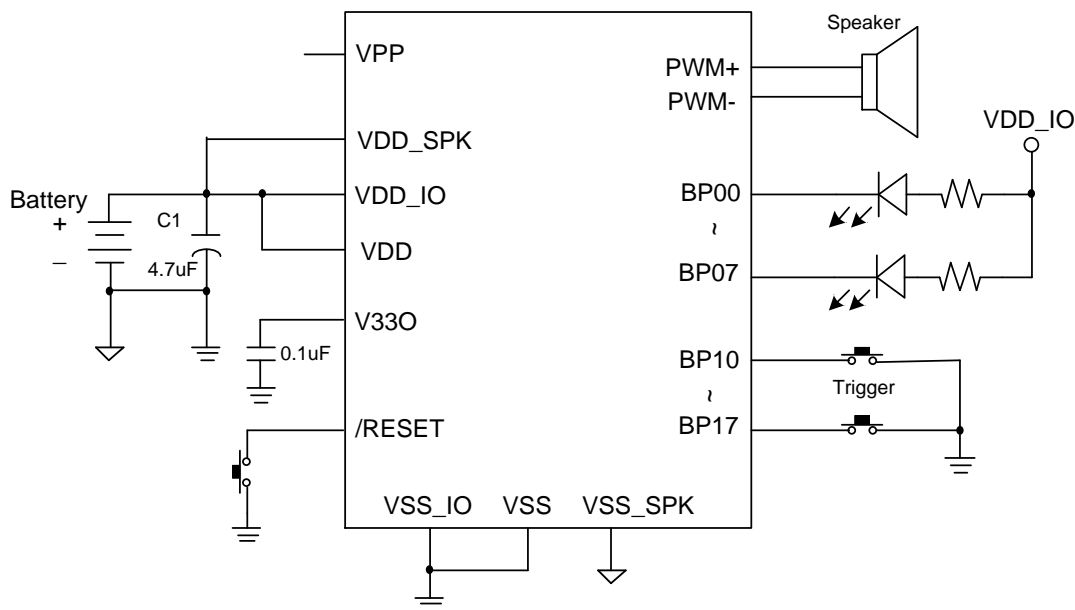


N588JP202/252/342

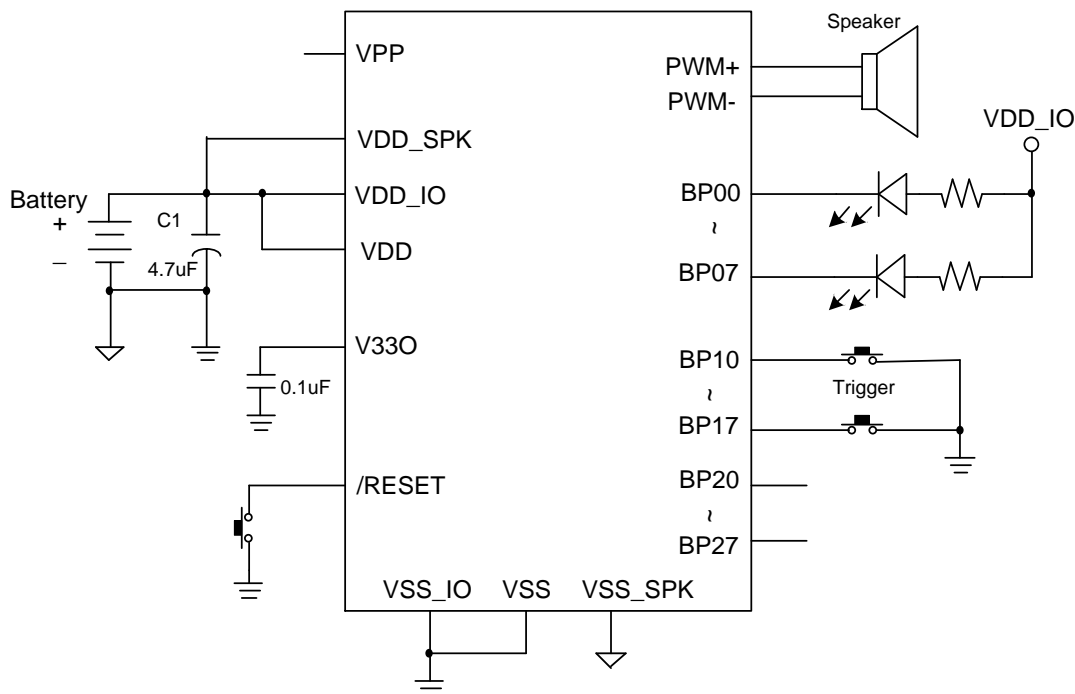


6.2 3-battery Application with Normal Loading:

N588JP062/082/122/172

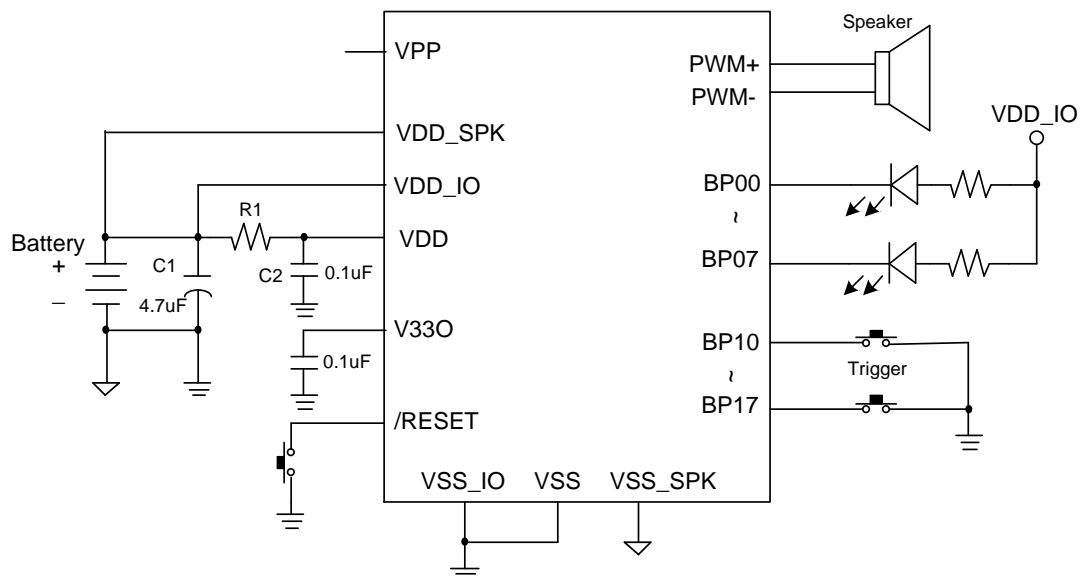


N588JP202/252/342

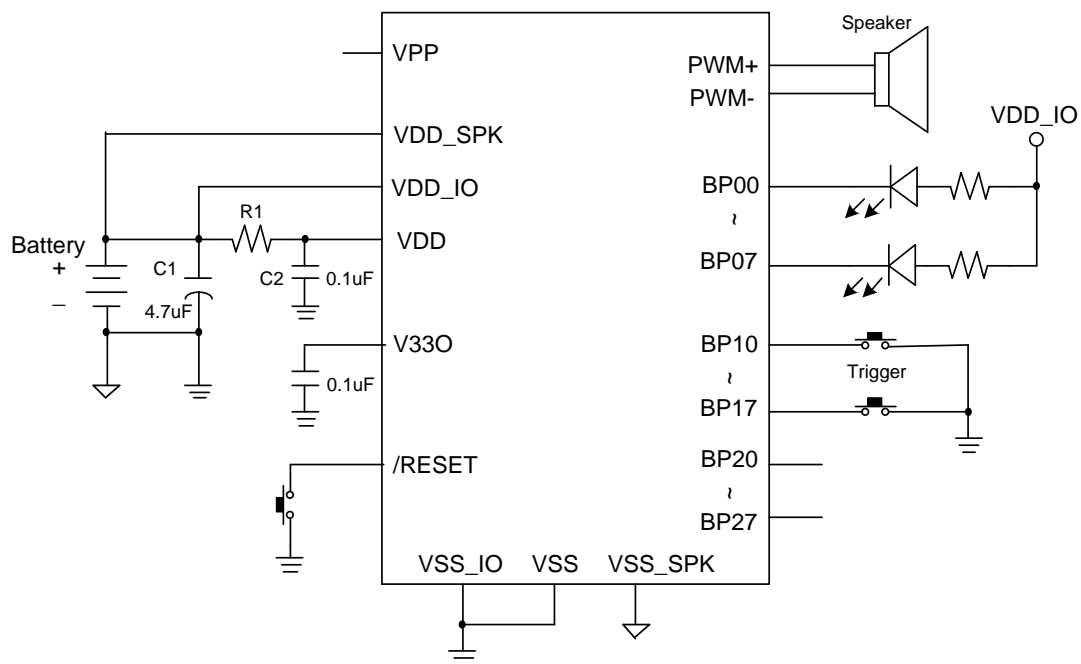


6.3 3-battery Application with Heavy Loading (Motor):

N588JP062/082/122/172



N588JP202/252/342



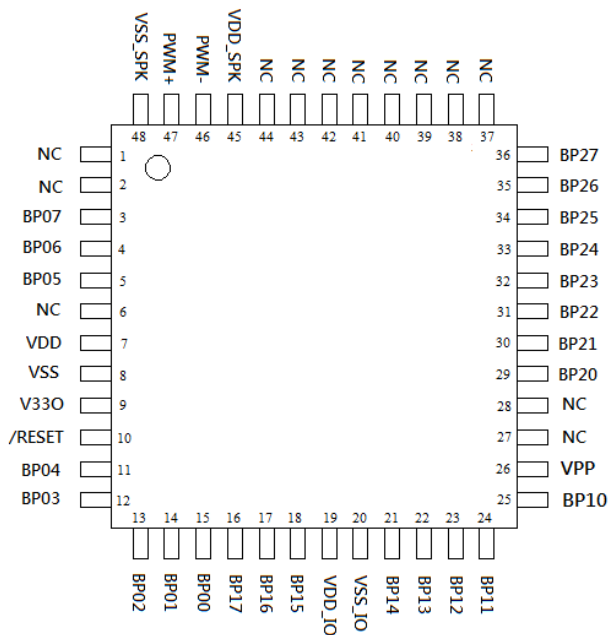
Note:

1. For general applications, C1 (4.7uF) is must to stable system power
2. For motor application, the C1 (4.7uF), C2 (0.1uF), and R1 (10Ω) are all necessary
3. C1 value need to be adjusted according to loading, such as motor control application

7. PCB LAYOUT GUIDE

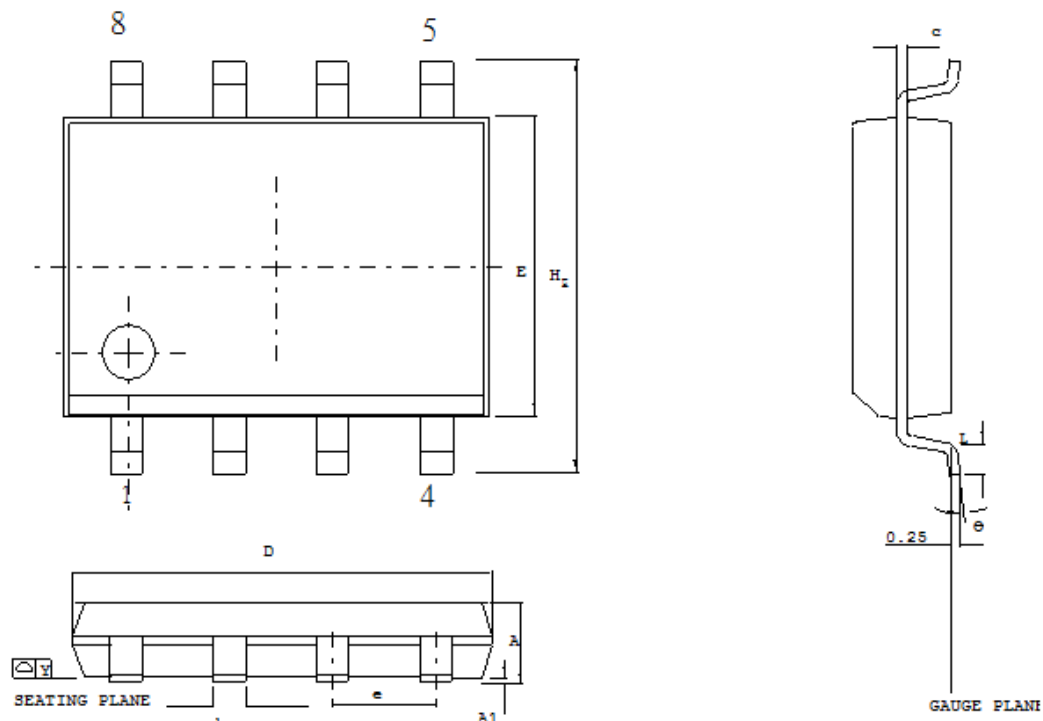
In PCB layout, the IC substrate should be connected to VSS, and VSS_SPK and VSS/VSS_IO should have its own path to connect with negative of battery; and VDD_SPK and VDD/VDD_IO should have its own path to connect with positive of battery also

N588JP202/252/342

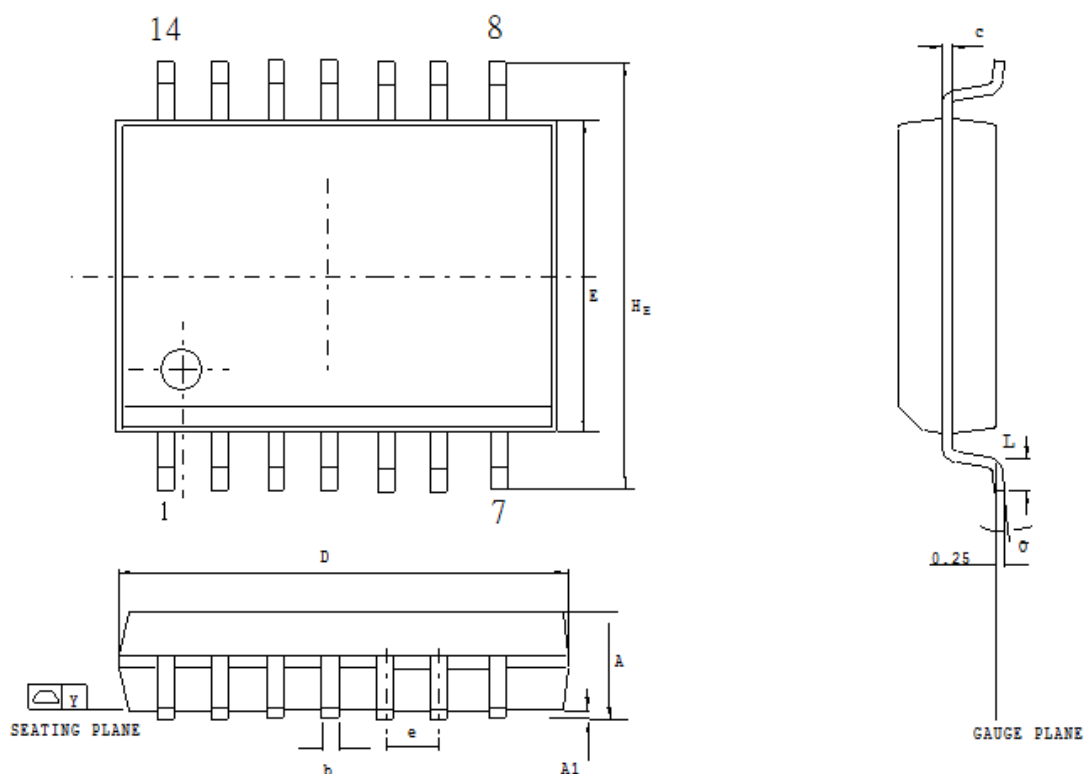
LQFP48 (7x7x1.4mm²), 24 x I/O

8.2 Package Dimension

SOP8, 150 mil



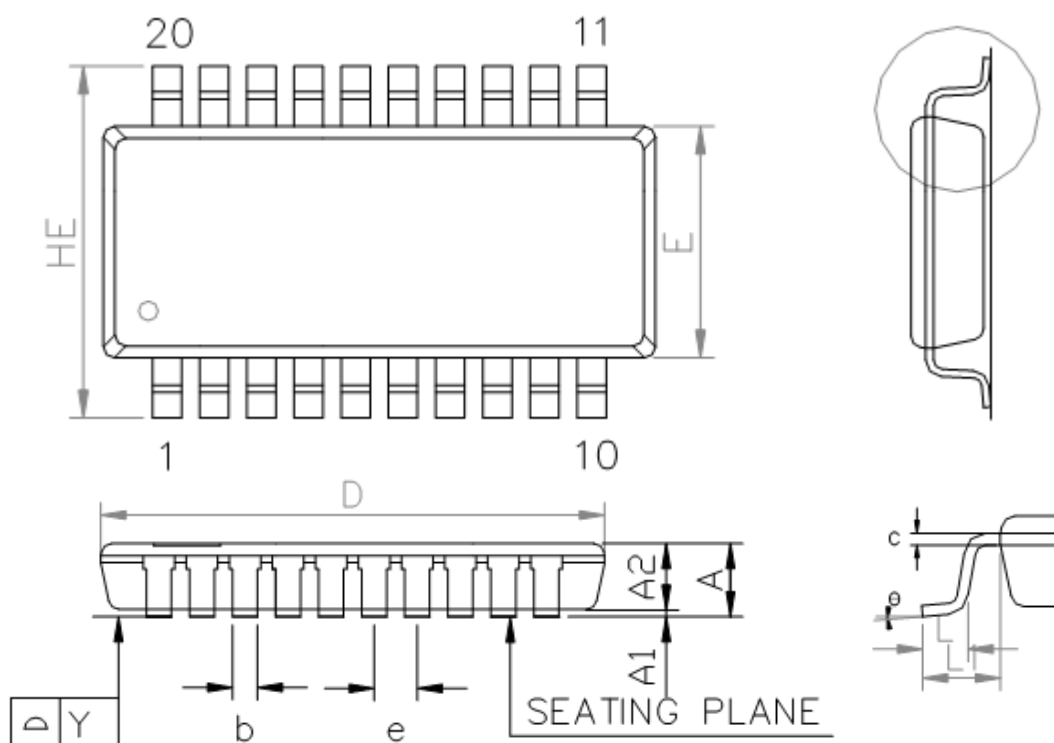
SYMBOL	DIMENSION IN MM		DIMENSION IN INCH	
	MIN.	MAX.	MIN.	MAX.
A	1.35	1.75	0.053	0.069
A1	0.10	0.25	0.004	0.010
b	0.33	0.51	0.013	0.020
c	0.19	0.25	0.008	0.010
E	3.80	4.00	0.150	0.157
D	4.80	5.00	0.188	0.196
e	1.27 BSC		0.050 BSC	
H _L	5.80	6.20	0.228	0.244
Y	—	0.10	—	0.004
L	0.40	1.27	0.016	0.050
θ	0	10	0	10

SOP14, 150 mil


Control demensions are in milimeters .

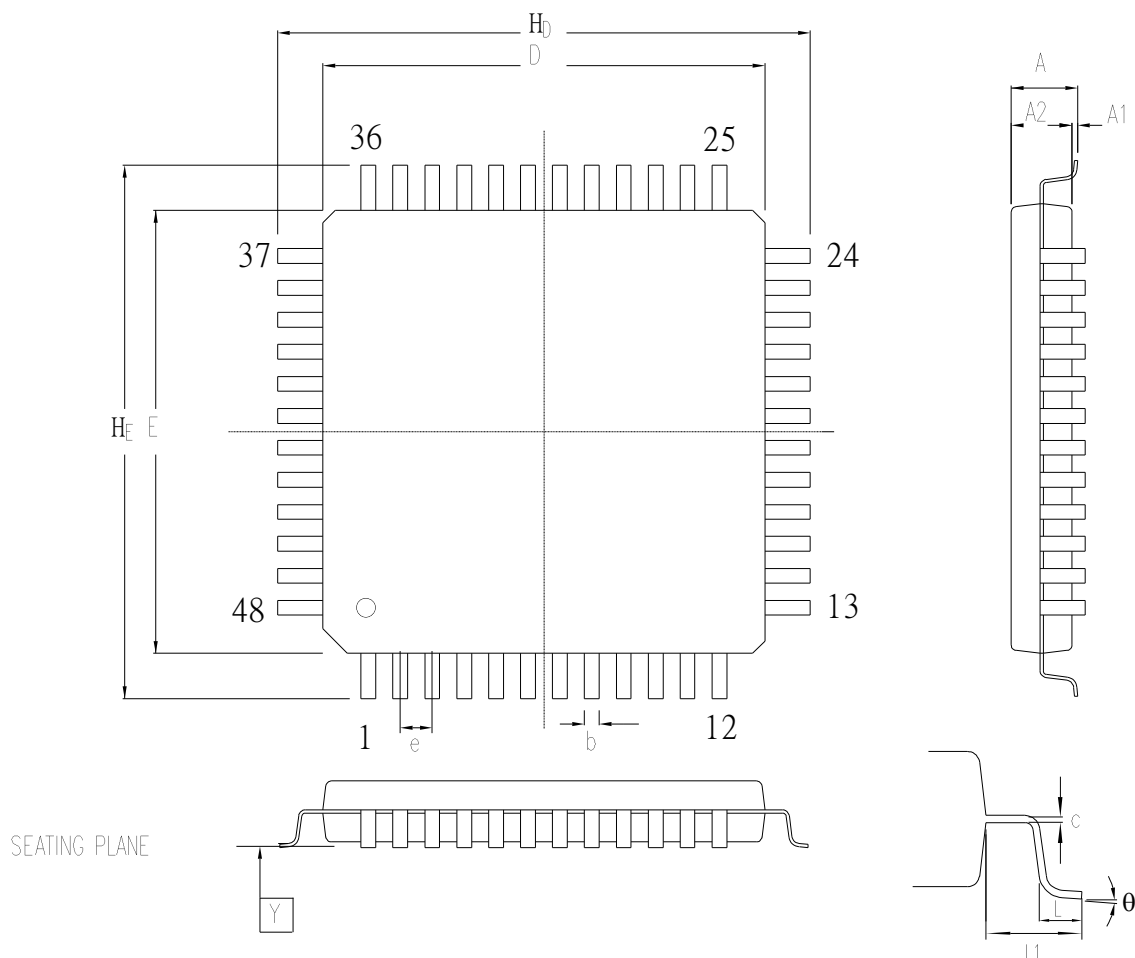
SYMBOL	DIMENSION IN MM		DIMENSION IN INCH	
	MIN.	MAX.	MIN.	MAX.
A	1.35	1.75	0.053	0.069
A1	0.10	0.25	0.004	0.010
b	0.33	0.51	0.013	0.020
c	0.19	0.25	0.008	0.010
E	3.80	4.00	0.150	0.157
D	8.55	8.75	0.337	0.344
e	1.27 BSC		0.050 BSC	
H _E	5.80	6.20	0.228	0.244
Y	—	0.10	—	0.004
L	0.40	1.27	0.016	0.050
θ	0	8	0	8

TSSOP20, 4.4 x 6.5mm



SYMBOL	DIMENSION (MM)			DIMENSION (INCH)		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	-	-	1.20	-	-	0.047
A1	0.05	-	0.15	0.002	-	0.006
A2	0.80	0.90	1.05	0.031	0.035	0.041
E	4.30	4.40	4.50	0.169	0.173	0.177
HE	6.40 BSC			0.252 BSC		
D	6.40	6.50	6.60	0.252	0.256	0.260
L	0.50	0.60	0.75	0.020	0.024	0.030
L1	1.00 REF			0.039 REF		
b	0.19	-	0.30	0.007	-	0.012
e	0.65 BSC			0.026 BSC		
c	0.09	-	0.20	0.004	-	0.008
θ	0°	-	8°	0°	-	8°
Y	0.10 BASIC			0.004 BASIC		

LQFP48, 7x7x1.4mm, footprint 2.0mm



Controlling dimension : Millimeters

Symbol	Dimension in inch			Dimension in mm		
	Min	Nom	Max	Min	Nom	Max
A	—	—	—	—	—	—
A₁	0.002	0.004	0.006	0.05	0.10	0.15
A₂	0.053	0.055	0.057	1.35	1.40	1.45
b	0.006	0.008	0.010	0.15	0.20	0.25
c	0.004	0.006	0.008	0.10	0.15	0.20
D	0.272	0.276	0.280	6.90	7.00	7.10
E	0.272	0.276	0.280	6.90	7.00	7.10
e	0.014	0.020	0.026	0.35	0.50	0.65
H_b	0.350	0.354	0.358	8.90	9.00	9.10
H_E	0.350	0.354	0.358	8.90	9.00	9.10
L	0.018	0.024	0.030	0.45	0.60	0.75
L₁	—	0.039	—	—	1.00	—
Y	—	—	0.004	—	—	0.10
θ	0°	—	7°	0°	—	7°

9. Ordering Information

Part No.	Shape	Type	Remark
N588JP062/082/122/172/202/252/342	W, H	Wafer Form, Die Form	Blank, 16~24 I/O
N588JP062/082/122/172/202/252/342XXX	W, H	Wafer Form, Die Form	Pre-code
N588JP062A/082A/122A/172A/202A/252A/342A	E	Package: SOP8 (150mil)	Blank, 2 I/O
N588JP062B/082B/122B/172B/202B/252B/342B	E	Package: SOP14 (150mil)	Blank, 6 I/O
N588JP062F/082F/122F/172F/202F/252F/342F	E	Package: TSSOP20 (4.4x6.5mm ²)	Blank, 12 I/O
N588JP062L/082L/122L/172L/202L/252L/342L	E	Package: LQFP48 (7x7mm ²)	Blank, 16~24 I/O
N588JP06A/08A/12A/17A/20A/25A/34AXXX	E	Package: SOP8 (150mil)	Pre-code, 2 I/O
N588JP06B/08B/12B/17B/20B/25B/34BXXX	E	Package: SOP14 (150mil)	Pre-code, 6 I/O
N588JP06F/08F/12F/17F/20F/25F/34FXXX	E	Package: TSSOP20 (4.4x6.5mm ²)	Pre-code, 12 I/O
N588JP06L/08L/12L/17L/20L/25L/34LXXX	E	Package: LQFP48 (7x7mm ²)	Pre-code, 16~24 I/O

10. Revision History

Version	Date	Substantial Changes	Page
A1.0	Feb. 2020	First version release	All
A1.1	Feb. 2020	Update TSSOP20, LQFP48 PIN name	12, 13

Important Notice

Nuvoton Products are neither intended nor warranted for usage in systems or equipment, any malfunction or failure of which may cause loss of human life, bodily injury or severe property damage. Such applications are deemed, "Insecure Usage".

Insecure usage includes, but is not limited to: equipment for surgical implementation, atomic energy control instruments, airplane or spaceship instruments, the control or operation of dynamic, brake or safety systems designed for vehicular use, traffic signal instruments, all types of safety devices, and other applications intended to support or sustain life.

All Insecure Usage shall be made at customer's risk, and in the event that third parties lay claims to Nuvoton as a result of customer's Insecure Usage, customer shall indemnify the damages and liabilities thus incurred by Nuvoton.

*Please note that all data and specifications are subject to change without notice.
All the trademarks of products and companies mentioned in this datasheet belong to their respective owners.*