Enabling the
Real-time Enterprise

SENSINODE

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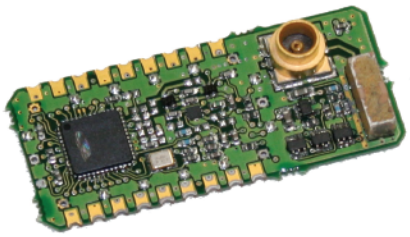
NanoModule™ N120

Features

- Open OEM radio module with programming tools for user firmware
- Powerful TI CC2430 32 MHz single-cycle low power 8051 MCU
- 2.4 GHz IEEE 802.15.4 compliant RF-transceiver with 250kbps data rate
- 128kB in-system programmable FLASH, 8kB SRAM
- Operating voltage of 2.0V – 3.6V
- TX/RX mode current 27mA-50mA typ.
- Sleep mode current 0.9uA typ.
- Efficient power amplifier with up to 300m range at 10mW and up to 800m range at 100mW LoS
- Resonator surface-mount antenna for superb near-object performance
- External antenna connector
- 18-pins with 2 x UART/SPI, programmer and digital/analogue IO signals
- Available in surface-mount (N120S) and DIP-pin (N120T) product versions
- Very compact size, 18 mm x 40 mm
- RoHS compatible
- Meets CE, ETSI and FCC requirements (Preliminary, not yet in Rev 1)



The NanoModule™ N120 is an integrated SoC radio module. The module runs a complete protocol stack and applications, eliminating the need for a separate application controller. The module requires only an external power source to operate as an independent communication node. Applications are programmable using an in-circuit serial interface through the Sensinode Devboard. It integrates a TI IEEE 802.15.4 radio capable and offers up to 800m extended transmit range. This radio is very flexible, offering a 250 kbps data rate and ad hoc communications with a wide variety of topologies. The module includes an RF power amplifier.

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1 ABSOLUTE MAXIMUM RATINGS

Absolute maximum values are those values beyond which permanent damage to the device may occur. Correct device operation is not guaranteed beyond the recommended values.

PARAMETER	SYMBOL	CONDITIONS	MIN	MAX	UNIT
Power supply voltage	V_{cc}	GND is at 0V	GND - 0.3	3.9	V
IO input voltage	V_{in}		GND - 0.3	V_{cc}+0.3 3.9V MAX	V
Operational temperature	$T_{operational}$		-40	+85	DEG C
Storage temperature	$T_{storage}$	Device not programmed	-50	+150	DEG C
Input current	I_{cc}	Maximum current		200	mA
IO pin current	I_{io}	Maximum current into or out from any IO pin		15	mA
Input RF level	P_{in}			+10	dBm
ESD		Charged Device Model, JEDEC STD22, method C101		200	V

This is an ESD sensitive device. ESD precautions must be used when handling the device.

2 RECOMMENDED OPERATING CONDITIONS

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Supply Voltage	V_{cc}	RF power amplifier in use	3.1		3.6	V
Supply Voltage	V_{cc}	RF power amplifier not used, board revision R1	3.1		3.6	V
Supply Voltage	V_{cc}	RF power amplifier not used, board revision later than R1	2.0		3.6	V
Operational temperature	$T_{operational}$			tbd		DEG C

3 ELECTRICAL SPECIFICATIONS

3.1 DC ELECTRICAL CHARACTERISTICS

T= 25°C, V_{cc}=3.0V if nothing else stated.

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Supply Voltage	Vcc		3.1		3.6	V
Supply current	Icc	MCU SLEED. RADIO OFF, RF VREG OFF, POWER MODE 1		0.2		mA
Supply current	Icc	MCU RUNNING, RADIO OFF, RF VREG OFF		12.3		mA
Supply current	Icc	MCU RUNNING, RADIO TX, PA OFF		30		mA
Supply current	Icc	MCU RUNNING, RADIO TX, PA 10dB			90	mA
Supply current	Icc	MCU RUNNING, RADIO TX, PA 20dB			90	mA
Supply current	Icc	MCU RUNNING, RADIO RX, PA OFF		28		mA
I/O pin pull-up and pull-down resistor				20		kOhm
Logic "0" input voltage					0.5	V
Logic "1" input voltage			V_{cc} - 0.5			V
Logic "0" output voltage					0.5	V
Logic "1" output voltage			V_{cc} - 0.5			V
Logic "0" input current		Input equals 0V			-1	uA
Logic "1" input current		Input equals V_{cc}			1	uA
Logic "0" output current					5	mA
Logic "1" output current					5	mA

3.2 AC ELECTRICAL CHARACTERISTICS

T= 25°C, V_{cc}=3.0V if nothing else stated.

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Clock freq			-20ppm	32	+20ppm	MHz
Reset pulse width			2.5			ns
Cpu clock	f_{sysclk}		16		32	MHz
Interrupt pulse width			t_{sysclk}			ns

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
IO pin rise time		10pf load		tbd		ns
IO pin fall time		10pf load		tbd		ns
IO pin input capacitance				tbd		pF

3.3 GENERAL CHARACTERISTICS

See CC2430 Datasheet Table 5.

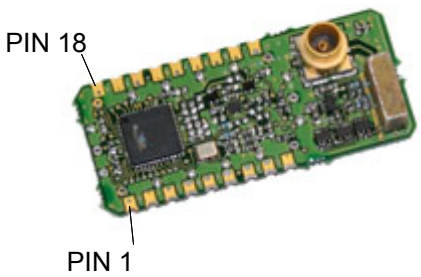
3.4 RF CHARASTERISTICS

Also see CC2430 Datasheet Tables 6 and 7.

T= 25°C, V_{cc}=3.0V if nothing else stated.

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
PA gain		low gain selected		10		dbm
PA gain		high gain selected		20		dbm

4 PINOUT



PIN	SIGNAL	TYPE	FUNCTION
1	VCC	POWER	+3V3 power input
2	RESET#	INPUT	Reset input, active low. External pull-up resistor recommended
3	P0.1	DIO,AI	Digital IO, Analog Input
4	P0.2	DIO,AI	Digital IO, Analog Input
5	P0.3	DIO,AI	Digital IO, Analog Input
6	P0.4	DIO,AI	Digital IO, Analog Input

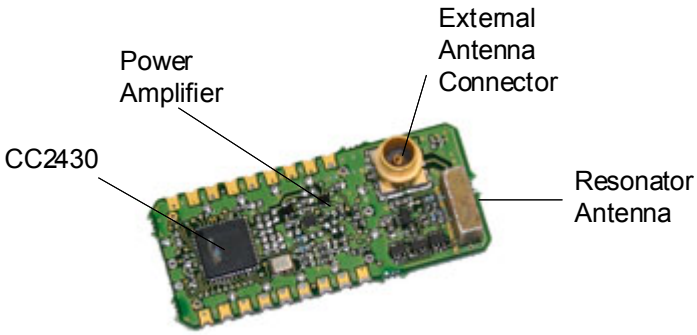
PIN	SIGNAL	TYPE	FUNCTION
7	P0.5	DIO,AI	Digital IO, Analog Input
8	P0.6	DIO,AI	Digital IO, Analog Input
9	P0.7	DIO,AI	Digital IO, Analog Input
10	P0.0	DIO	Digital IO
11	P1.0	DIO	Digital IO
12	P1.4	DIO	Digital IO
13	P1.5	DIO	Digital IO
14	P1.6	DIO	Digital IO
15	P1.7	DIO	Digital IO
16	P2.2	DIO,PROG	Digital IO, programming
17	P2.1	DIO,PROG	Digital IO, programming
18	GND	POWER	Ground

The digital IO pins can be used as general IO pins or as interface pins for the CC2430 integrated peripherals. For more details see the CC2430 datasheet. The following lists how the available interface pins are multiplexed on the N120 IO pins.

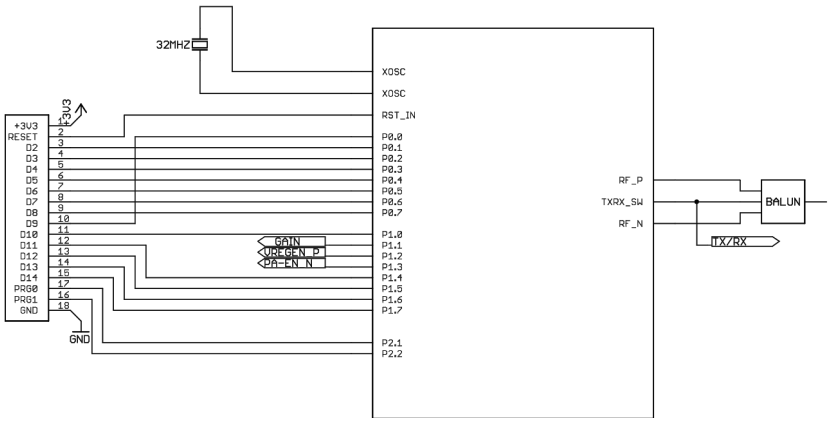
Function	P07	P06	P05	P04	P03	P02	P01	P00	P17	P16	P15	P14	P13	P12	P11	P10	P22	P21
N120 PIN	9	8	7	6	5	4	3	10	15	14	13	12	--	--	--	11	16	17
ADC	A7	A6	A5	A4	A3	A2	A1	A0										
SPI0			CLK	SS	MO	MI												
UART0			RT	CT	TX	RX												
SPI1			MI	MO	CLK	SS												
SPI1 ALT2									MI	MO	CLK	SS						
UART1			RX	TX	RT	CT												
UART1 ALT2									RX	TX	RT	CT						
TIMER1				2	1	0												
TIMER3 ALT2									1	0								
DEBUG																	DC	DD
GPIO	X	X	X	X	X	X	X	X	X	X	X	X	NA	NA	NA	X	X	X
RF CONTROL													PAEN	VREGEN	GAIN			

5 CIRCUIT DESCRIPTION

The N120 consists of the CC2430 system-on-a-chip radio from TI, containing both a full 8051 MCU and an IEEE 802.15.4 radio. In addition N120 has a matching circuit, controllable power amplifier, external antenna connector and resonator antenna.



5.1 MCU



The MCU on the NanoModule is a CC2430-F128 from TI. CC2430 port P0 and some signals from ports P1 and P2 are externally available from the N120 solder pads. For more information regarding the CC2430F128 microcontroller see the CC2430 datasheet.

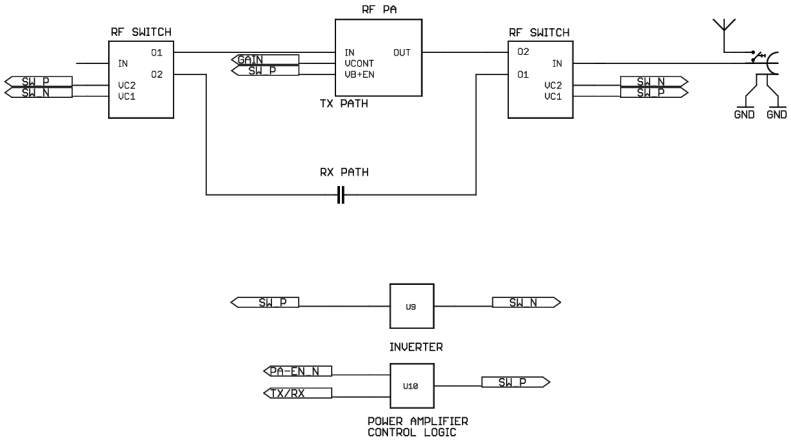
5.2 RADIO AND RF SUBSYSTEM

The N120 NanoModule has a selectable gain RF power amplifier on-board. The RF power amplifier can also be turned off when not needed.

RF power amplifier is controlled with the following control signals.

SIGNAL	TYPE	FUNCTION
P1.1	Output	RF PA gain select. High = 20 dB gain, low = 10 dB gain.
P1.2	Output	RF PA voltage regulator enable, active high.
P1.3	Output	RF PA enable. PA is enabled when this signal is high.

If the power amplifier is in use the RF PA voltage regulator must be enabled. Check your local radio regulations if the use of the power amplifier is allowed, and at which gain.



5.3 EXTERNAL ANTENNA

The external antenna connector on the N120 is a Radiall type R299137800 reverse MCX connector. An external antenna should be connected to the using an appropriate RF-cable. The external antenna must not have a DC path to ground.

Please note that using an external antenna will void FCC, ETSI and other radio certifications unless otherwise noted. If in doubt please contact Sensinode. Sensinode may have antennas available that do not require re-certification.

5.4 POWER SUPPLY

The power to the N120 is supplied through pins 1 and 18. The N120 has separate internal voltage regulators for digital and RF systems. If the RF subsystem is not in use the RF power amplifier power supply can be turned off to conserve power.

5.5 PROGRAMMING

The N120 NanoModule can be programmed using the Sensinode D200 Devboard or with an appropriate cable, with any CC2430-compatible programmer. The programming uses five pins: VCC, GND, RESET and the two debug pins 16 and 17.

6 ORDERING INFORMATION

Part Number	Part	Packaging
N120S-1	Nano2430PA surface mount	TUBE, 20/TUBE (contact Sensinode for availability)
N120S-2	Nano2430PA surface mount	BULK
N120T-2	Nano2430PA DIL pins	BULK

All N120 versions are RoHS compatible.

7 CONTACT INFORMATION

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8 FCC, ETSI, CE, ROHS CERTIFICATIONS

Revision 1 of the N120 is preliminary and does is not certified for CE, FCC or ETSI regulations.