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## nRF402 Loop Kit

## nRF402-LOOPKIT

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### 1. Introduction

The Loop Kit for the **nRF402** Single chip 433MHz RF transmitter has been developed to enable customers to get hands-on experience with the functionality of the device combined with loop antennas in their applications.

The **nRF402** Loop Kit is convenient for use in the prototyping phase when developing, testing and debugging PC software, microcontroller code and/or electronic circuitry for interfacing towards **nRF402** and a wireless communication link.

In order to enable customers to set up a complete wireless communication link, the **nRF402** Loop Kit includes both **nRF402** and **nRF401** Loop Modules. The **nRF402** Loop Modules are used as transmitter modules and the **nRF401** Loop Modules are used as receiver modules.

The **nRF402** Loop Kit consists of the following items:

- One **nRF402** Loop Board with the **nRF402** transmitter. The **nRF402** Loop Board consists of three **nRF402** Loop Modules with different loop antenna sizes
- One **nRF401** Loop Board with the **nRF401** transceiver. The **nRF401** Loop Board consists of three **nRF401** Loop Modules with different loop antenna sizes
- **nRF402** datasheet
- **nRF401** datasheet
- **nRF402-LOOPKIT** documentation

This document specifies the usage of **nRF402** Loop Modules and **nRF401** Loop Modules as complete radio modules in customer's development of short-range wireless communication systems.

For information about loop antennas, please refer to application note nAN400-03, "Small loop antennas", and application note nAN400-05, "nRF402 RF and antenna layout".

### 2. nRF402 Loop Module description

The **nRF402** Loop Module pin placement and description is shown in Figure 2.1. Figure A.1.1 in Appendix 1 shows the **nRF402** Loop Module circuit diagram, and the component list is given in Table A.2.1 in Appendix 2.

All digital control and signal lines are available for connection to customer's application circuitry at connector footprint J1. Connections to the **nRF402** Loop Module can be soldered directly to the connector footprint J1 solder pads. A via hole has been placed in each solder pad to get a more secure connection.

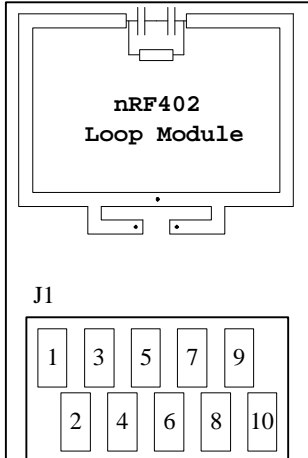


## nRF402 Loop Kit

Power and ground is applied to the **nRF402** Loop Module via connector footprint J1.

**Voltage range on this input must be restricted to +2.7V to +3.6V.**

If it is desirable to use a cable with a connector, an SMD connector can be mounted on connector footprint J1. The PCB footprint corresponds to the recommended PCB layout for the AMP Micro-MaTch SMD 10 pin female connector (AMP Part number 8(1)-188275-0). The corresponding cable connector is the AMP Micro-MaTch 10 pin male connector (AMP Part number 8(1)-215083-0).



Pin	Name	Description
1		Normally not connected. This pin is terminated to ground with an impedance common to twisted pair flat cables.
2	PWR_UP	Power on/off PWR_UP = "1" ⇒ Power up (Operating mode) PWR_UP = "0" ⇒ Power down (Standby mode)
3	GND	Ground (0V)
4	CS	Channel selection CS="0" ⇒ 433.92MHz (Channel#1) CS="1" ⇒ 434.33MHz (Channel#2)
5	GND	Ground (0V)
6	DIN	Data input
7	GND	Ground (0V)
8	GND	Ground (0V)
9	GND	Ground (0V)
10	VDD	Power supply (+3V DC)

Figure 2.1. nRF402 Loop Module pin placement and description

The applied 4.000MHz reference crystal X1 has an overall frequency tolerance (frequency tolerance at 25°C + temperature drift) that does not exceed ±35 ppm in the operating temperature range -25°C to +75°C.

The external bias resistor R3 connected between the RF\_PWR pin and VSS sets the output power. On the **nRF402** Loop Module R3=22K which sets the output power to +10dBm.

### 3. nRF401 Loop Module description

The **nRF401** Loop Module pin placement and description is shown in Figure 3.1. Figure A.1.2 in Appendix 1 shows the **nRF401** Loop Module circuit diagram, and the component list is given in Table A.2.2 in Appendix 2.

All digital control and signal lines are available for connection to customer's application circuitry at connector footprint J1.

Power and ground is applied to the **nRF401** Loop Module via connector footprint J1.

**Voltage range on this input must be restricted to +2.7V to +5.25V.**



## nRF402 Loop Kit

The PCB connector footprint J1 corresponds to the recommended PCB layout for the AMP Micro-MaTch SMD 10 pin female connector (AMP Part number 8(1)-188275-0).

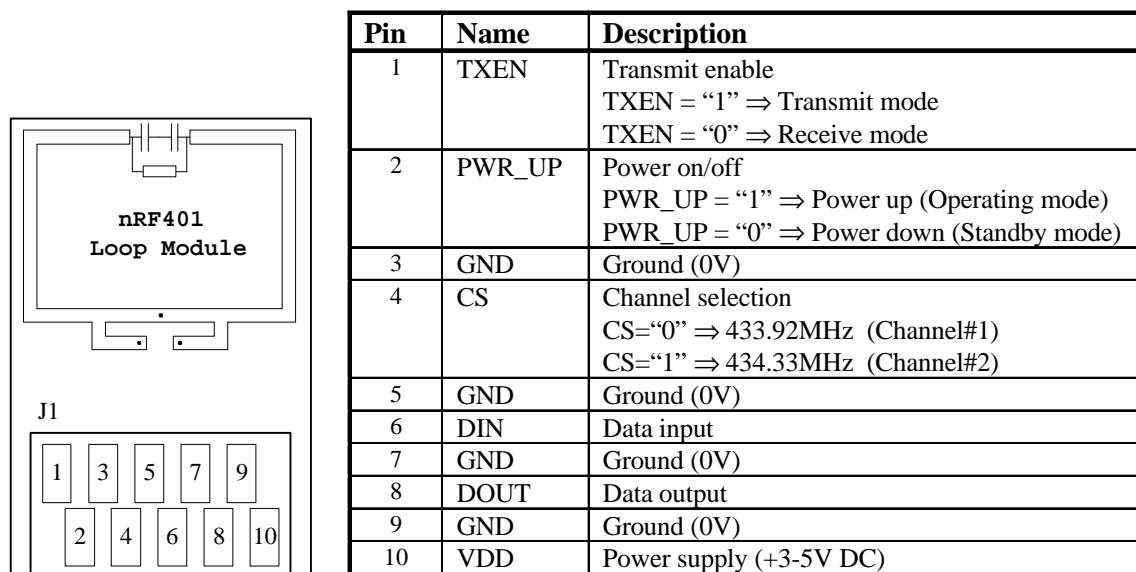


Figure 3.1. nRF401 Loop Module pin placement and description

The applied 4.000MHz reference crystal X1 has an overall frequency tolerance (frequency tolerance at 25°C + temperature drift) that does not exceed ±35 ppm in the operating temperature range -25°C to +75°C.

On the nRF401 Loop Module the external bias resistor R3 connected between the RF\_PWR pin and VSS has the value R3=22K, which sets the output power to +10dBm.



## nRF402 Loop Kit

### 4. Getting started

Before starting to use the **nRF402** Loop Kit, each **nRF402/nRF401** Loop Module should be snapped out from the **nRF402/nRF401** Loop Boards.

The **nRF402/nRF401** Loop Modules are complete radio modules with a digital interface for connection to the customer's application circuitry.

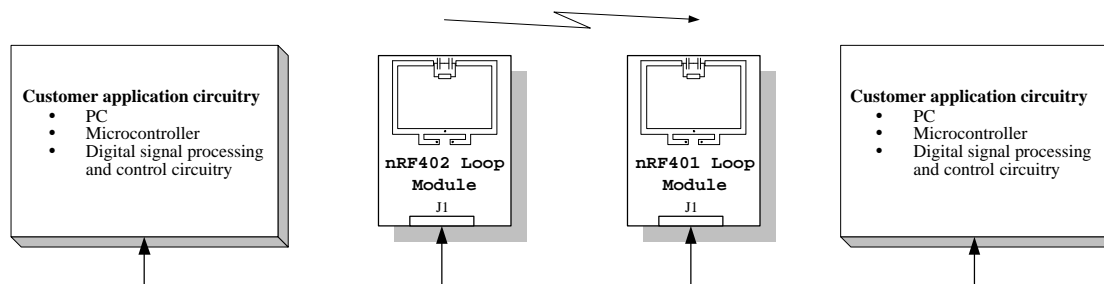


Figure 4.1. Set-up with **nRF402** Loop Module (transmitter) and **nRF401** Loop Module (receiver) connected to the customer's application circuitry

Figure 4.1 shows a typical set-up with an **nRF402** Loop Module and an **nRF401** Loop Module connected to the customer's application circuitry in order to develop and debug a complete wireless communication link. In this set-up the **nRF401** Loop Module is only used as a receiver to demodulate the transmitted signal from the **nRF402** Loop Module.

The DIN, PWR\_UP, CS and VDD signals available at connector footprint J1 on the **nRF402** Loop Module, and the TXEN, PWR\_UP, CS, DIN, DOUT and VDD signals available at connector footprint J1 on the **nRF401** Loop Module, should be connected to the customer's application circuitry. The following precautions should be taken when connecting to the Loop Modules:

- If the **nRF402/nRF401** Loop Module is to be connected to the customer's application circuitry with a cable via connector footprint J1, this cable should be a twisted pair flat cable. Each signal wire must be twisted together with the adjacent GND wire (that is VDD/GND, DIN/GND, CS/GND and so on). Do remember to connect the GND-wires in the twisted pair cable to both the **nRF402/nRF401** Loop Module and the customer's application circuitry. The cable length must be kept as short as possible.
- The power supply wire and the ground wire connected to the **nRF402/nRF401** Loop Module should be twisted together.
- Ensure that the peak-to-peak voltage level of the data input signal DIN and the control signals never exceed the **nRF402/nRF401** device power supply level.

Details regarding digital input/output voltage levels and timing requirements for control of the **nRF402/nRF401** device can be found in the **nRF402/nRF401** datasheet.



## **nRF402 Loop Kit**

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The **nRF402/nRF401** Loop Modules enable customers to find the combination of loop antenna sizes to use in their communication system that fulfils the application range requirements.

As mentioned in application note nAN400-05, it is recommended that a system should not be designed with a longer communication range than the application requires. Estimations on communication range with combinations of the antennas used on the **nRF402/nRF401** Loop Modules can be made based on the theory given in application note nAN400-03. Initial communication range tests should be carried out with the combination of the smallest antennas that, based on the estimations, satisfies the range requirements. If the achieved communication range does not satisfy the requirements, one or both of the Loop Modules in the communication link should be exchanged with a Loop Module with a larger antenna.

The **nRF402/nRF401** Loop Module should not be located inside a conductive or metal enclosure. Care should be taken to keep the loop antenna away from metal objects such as batteries, PCB ground plane and traces, or any other metal object. Generally, mounting the **nRF402/nRF401** Loop Module in front of a product with the loop antenna radiating into free space will yield the best result.

Be aware of that the layout of the rest of the communication system may influence the antenna tuning and require measurement of the antenna together with the complete system in order to find the values for the antenna tuning capacitors and Q reduction resistor for your system.

PRODUCT SPECIFICATION



APPENDIX 1 – nRF402 Loop Module Circuit Diagram

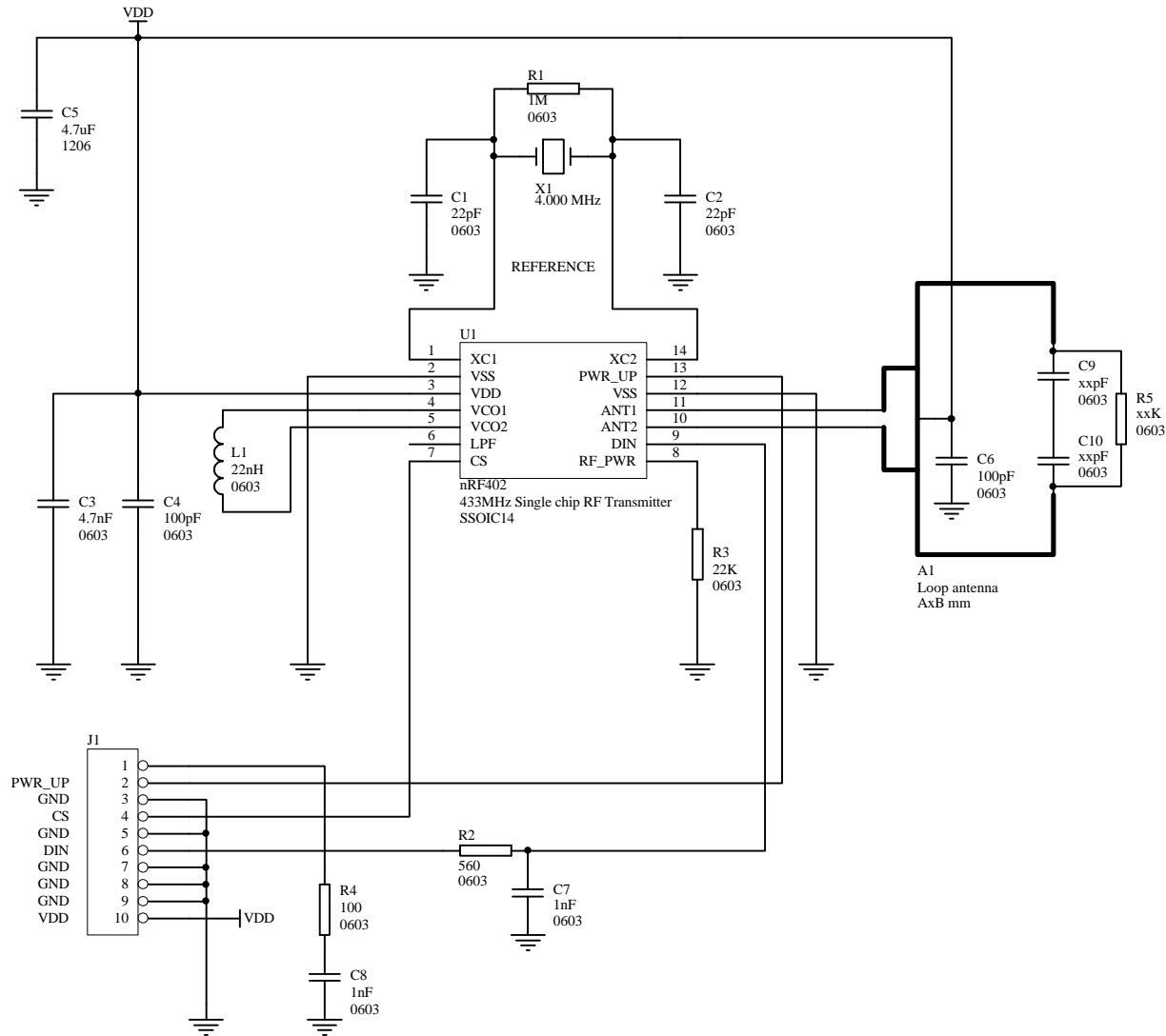


Figure A.1.1. nRF402 Loop Module Circuit Diagram

PRODUCT SPECIFICATION



APPENDIX 1 – nRF401 Loop Module Circuit Diagram

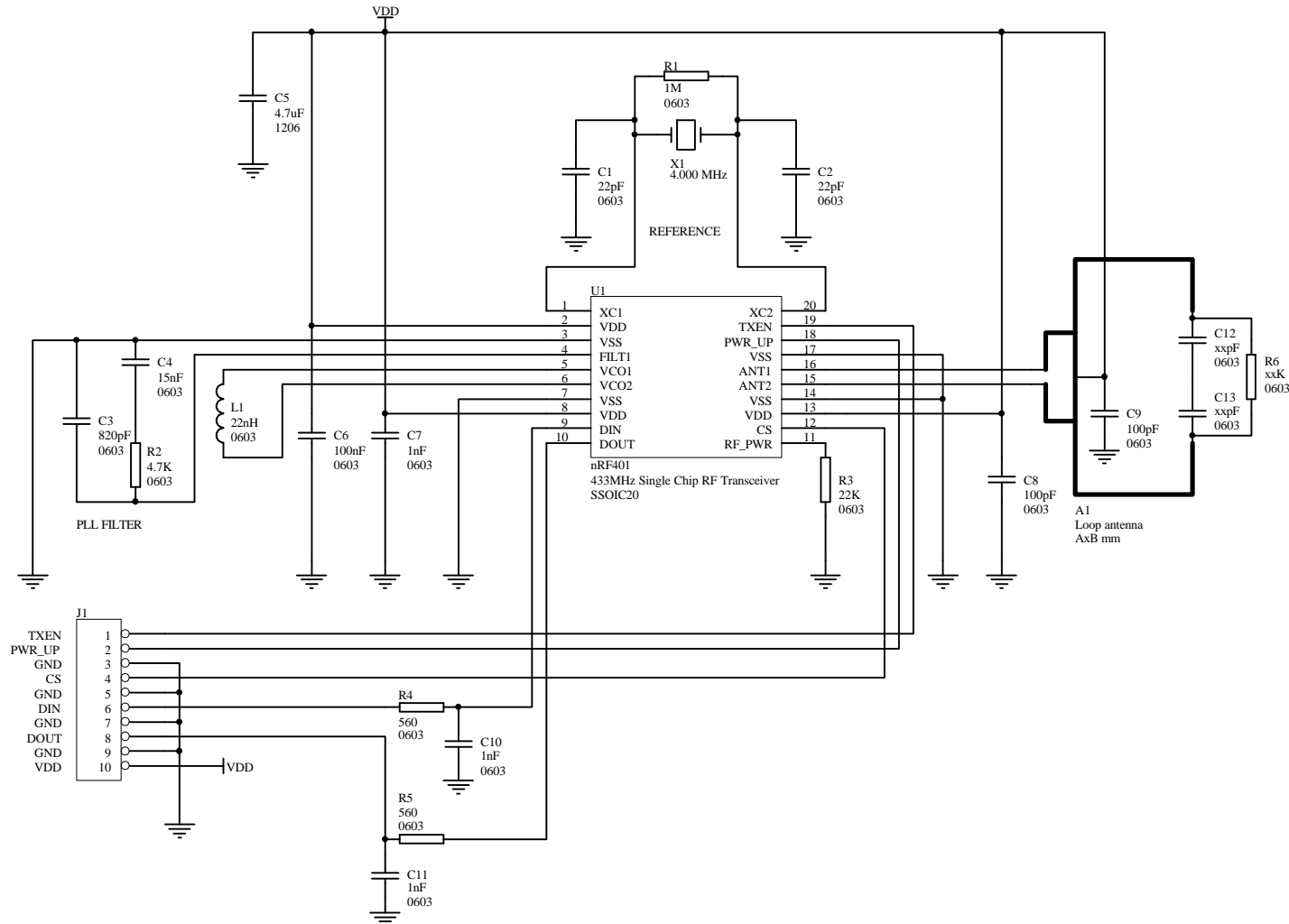


Figure A.1.2. nRF401 Loop Module Circuit Diagram

## PRODUCT SPECIFICATION



## APPENDIX 2 – nRF402 Loop Modules Component List

Component	Description	Value	Tolerance	Units
C1	NP0 Ceramic 0603 Chip Capacitor (Crystal oscillator)	22	± 5%	pF
C2	NP0 Ceramic 0603 Chip Capacitor (Crystal oscillator)	22	± 5%	pF
C3	X7R Ceramic 0603 Chip Capacitor (Supply decoupling)	4.7	± 10%	nF
C4	NP0 Ceramic 0603 Chip Capacitor (Supply decoupling)	100	± 5%	pF
C5	Y5V Ceramic 1206 Chip Capacitor (Supply decoupling)	4.7	+80% -20%	µF
C6	NP0 Ceramic 0603 Chip Capacitor (Supply decoupling)	100	± 5%	pF
C7	X7R Ceramic 0603 Chip Capacitor (EMI filter)	1	± 10%	nF
C8	X7R Ceramic 0603 Chip Capacitor (Termination)	1	± 10%	nF
C9	NP0 Ceramic 0603 Chip Capacitor (Antenna tuning)			
	18x10mm loop antenna	5.6	± 0.1	pF
	25x15mm loop antenna	3.3	± 0.1	pF
C10	NP0 Ceramic 0603 Chip Capacitor (Antenna tuning)			
	18x10mm loop antenna	10	± 1%	pF
	25x15mm loop antenna	5.6	± 0.1	pF
L1	0603 chip inductor (VCO)	22	± 2%	nH
			Q Min > 45@433MHz	
R1	0.1W 0603 chip resistor (Crystal oscillator)	1	± 1%	MΩ
R2	0.1W 0603 chip resistor (EMI filter)	560	± 1%	Ω
R3	0.1W 0603 chip resistor (Transmitter power setting)	22	± 1%	kΩ
R4	0.1W 0603 chip resistor (Termination)	100	± 1%	Ω
R5	0.1W 0603 chip resistor (Antenna Q reduction)			
	18x10mm loop antenna	18	± 1%	kΩ
	25x15mm loop antenna	18	± 1%	kΩ
X1	Crystal	4.000	<35 ppm (frequency tolerance at 25°C + temperature drift)	MHz
U1	<b>nRF402</b>			

Table A.2.1. nRF402 Loop Modules Component List



## PRODUCT SPECIFICATION



## APPENDIX 2 – nRF401 Loop Modules Component List

Component	Description	Value	Tolerance	Units
C1	NP0 Ceramic 0603 Chip Capacitor (Crystal oscillator)	22	± 5%	pF
C2	NP0 Ceramic 0603 Chip Capacitor (Crystal oscillator)	22	± 5%	pF
C3	X7R Ceramic 0603 Chip Capacitor (PLL loop filter)	820	± 10%	pF
C4	X7R Ceramic 0603 Chip Capacitor (PLL loop filter)	15	± 10%	nF
C5	Y5V Ceramic 1206 Chip Capacitor (Supply decoupling)	4.7	+80% -20%	µF
C6	X7R Ceramic 0603 Chip Capacitor (Supply decoupling)	100	± 10%	nF
C7	X7R Ceramic 0603 Chip Capacitor (Supply decoupling)	1	± 10%	nF
C8	NP0 Ceramic 0603 Chip Capacitor (Supply decoupling)	100	± 5%	pF
C9	NP0 Ceramic 0603 Chip Capacitor (Supply decoupling)	100	± 5%	pF
C10	X7R Ceramic 0603 Chip Capacitor (EMI filter)	1	± 10%	nF
C11	X7R Ceramic 0603 Chip Capacitor (EMI filter)	1	± 10%	nF
C12	NP0 Ceramic 0603 Chip Capacitor (Antenna tuning)			
	18x10mm loop antenna	5.6	± 0.1	pF
	25x15mm loop antenna	3.3	± 0.1	pF
	35x20mm loop antenna	1.8	± 0.1	pF
C13	NP0 Ceramic 0603 Chip Capacitor (Antenna tuning)			
	18x10mm loop antenna	10	± 1%	pF
	25x15mm loop antenna	5.6	± 0.1	pF
	35x20mm loop antenna	4.7	± 0.1	pF
L1	0603 chip inductor (VCO)	22	± 2% Q Min > 45@433MHz	nH
R1	0.1W 0603 chip resistor (Crystal oscillator)	1	± 1%	MΩ
R2	0.1W 0603 chip resistor (PLL loop filter)	4.7	± 1%	kΩ
R3	0.1W 0603 chip resistor (Transmitter power setting)	22	± 1%	kΩ
R4	0.1W 0603 chip resistor (EMI filter)	560	± 1%	Ω
R5	0.1W 0603 chip resistor (EMI filter)	560	± 1%	Ω
R6	0.1W 0603 chip resistor (Antenna Q reduction)			
	18x10mm loop antenna	18	± 1%	kΩ
	25x15mm loop antenna	18	± 1%	kΩ
	35x20mm loop antenna	68	± 1%	kΩ
X1	Crystal	4.000	<35 ppm (frequency tolerance at 25°C + temperature drift)	MHz
U1	<b>nRF401</b>			

Table A.2.2. nRF401 Loop Modules Component List

## PRODUCT SPECIFICATION



## nRF402 Loop Kit

**DEFINITIONS**

<b>Product specification</b>
This Loop Kit documentation contains final product specifications. Nordic VLSI ASA reserves the right to make changes at any time without notice in order to improve design and supply the best possible product.
<b>Limiting values</b>
Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Specifications sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.
<b>Application information</b>
Where application information is given, it is advisory and does not form part of the specification.

Table 1. Definitions.

Nordic VLSI ASA reserves the right to make changes without further notice to the product to improve reliability, function or design. Nordic VLSI does not assume any liability arising out of the application or use of any product or circuits described herein.

**LIFE SUPPORT APPLICATIONS**

These products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. Nordic VLSI ASA customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Nordic VLSI ASA for any damages resulting from such improper use or sale.

Product specification. Revision Date : 18.08.2000.

nRF402 Loop Kit order code : 180800-nRF402-LOOPKIT.

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## PRODUCT SPECIFICATION



### **nRF402 Loop Kit**

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## YOUR NOTES



**nRF402 Loop Kit**

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