STDES-MONARCH

Data brief

Sigfox Monarch reference design based on S2-LP and BlueNRG-2

Features

- Sigfox Verified (M_0021_459D_01) design with Monarch capability so IoT devices can determine the appropriate RC configuration for the local area
- S2-LP narrow band ultra-low power Sub-1 GHz transceiver in a standalone RF module tuned for 860-940 MHz frequency bands with external power amplifier
- BlueNRG-2 low power Bluetooth® SoC with 256 KB Flash, 24 KB RAM, compliant with Bluetooth® v5.0 specification
- Excellent receiver sensitivity (up to -130 dBm)
- Modulation schemes: 2-FSK, 2-GFSK, 4-FSK, 4-GFSK, OOK, and ASK
- Air data rate from 0.1 to 500 kbps
- Programmable RF output power up to +27 dBm
- Low duty cycle RX/TX operation mode
- 50 Ω ports for Sub-1 GHz radio and optional BLE radio
- Automatic acknowledgment, retransmission and timeout protocol engine

Description

This reference design represents a complete dual radio Sub-1 GHz and BLE solution for Sigfox and LPWAN protocols.
The design features the S2-LP transceiver, the BlueNRG-248 wireless processor, and an external power amplifier which allows the application to achieve +27 dBm (500 mW) output power.

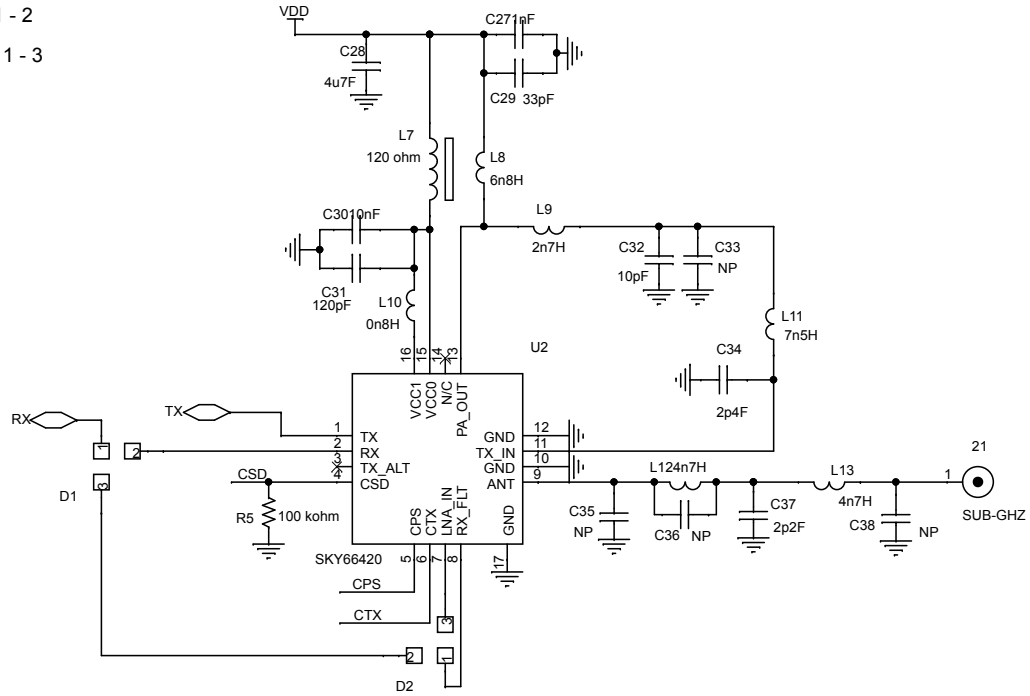
STDES-MONARCH is Sigfox Verified and is provided free of charge with all the necessary design documents. ST also provides several relevant software development kits and environments to help you customize your application.

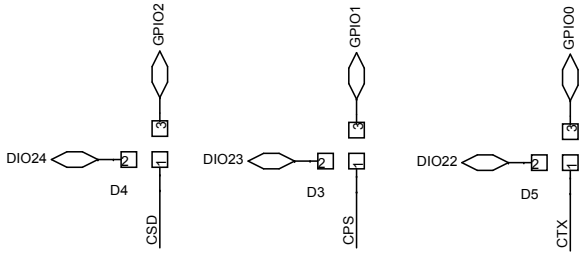
Product summary	
Dual radio BLE and Sub-1GHz reference design solution for Sigfox and LPWAN protocols	STDES-MONARCH
ultra-low power, high performance, sub-1GHz transceiver	S2-LP
Bluetooth low energy wireless system-on-chip	BlueNRG-2
ST development environments	STSW-S2LP-DK STSW-S2LP-SFX-DK STSW-BNRG-S2LP
Applications	Sigfox

1 Schematic diagrams

Figure 1. STDES-MONARCH schematic diagram - S2-LP

LNA ON: D1 soldered a 100 pF cap between 1 - 2
D2 soldered a 100 pF cap between 1 - 3
LNA OFF: D1 soldered a 100 pF cap between 1 - 3
D2 soldered a 100 pF cap between 1 - 2





PA under control of MCU (requires three GPIOs from MCU):
D3 soldered a 0 ohm between 1 - 2
D4 soldered a 0 ohm between 1 - 2
D5 soldered a 0 ohm between 1 - 2
PA under control of S2-LP:
D3 soldered a 0 ohm between 1 - 3
D4 soldered a 0 ohm between 1 - 3
D5 soldered a 0 ohm between 1 - 3

Figure 2. STDES-MONARCH schematic diagram - BLUENRG-248

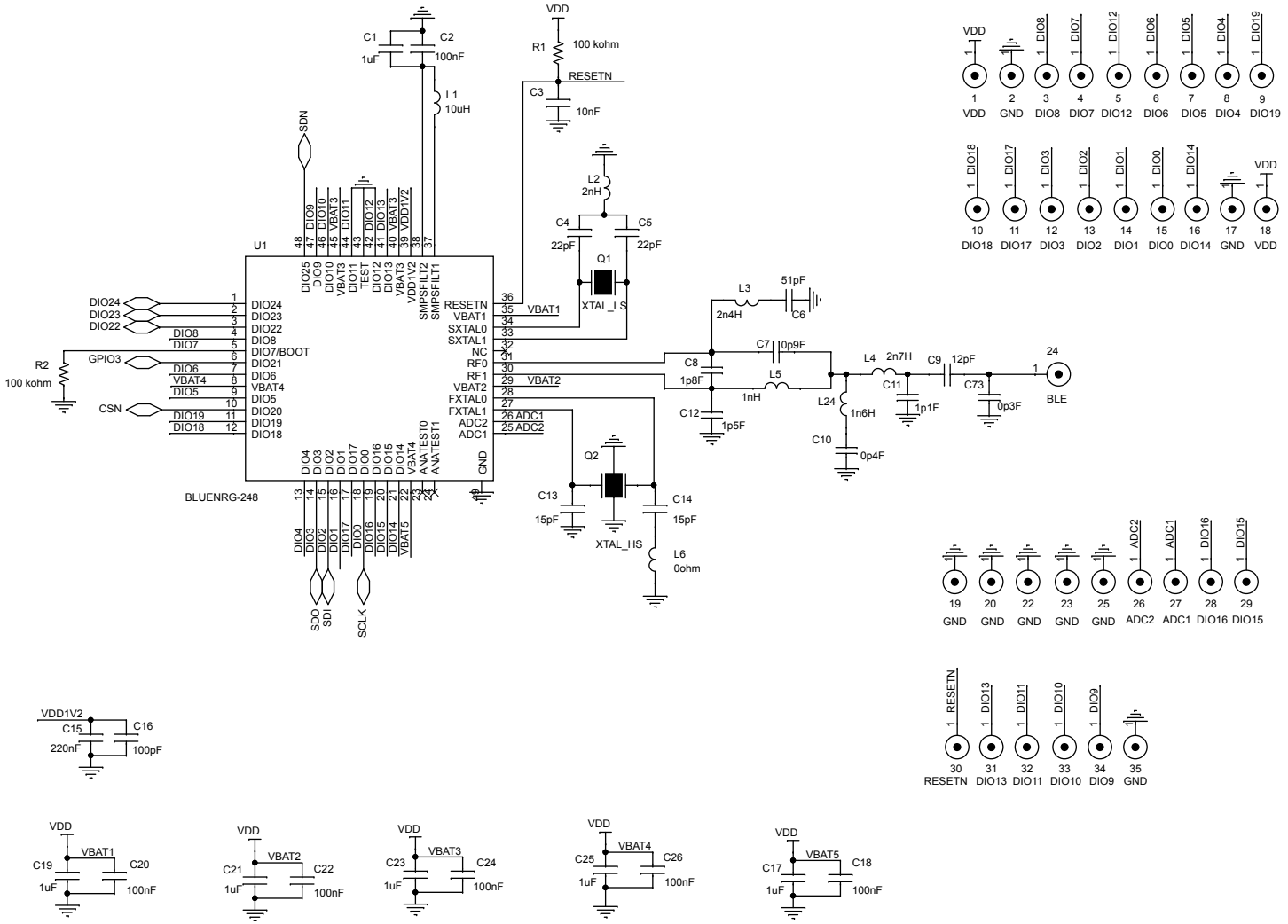
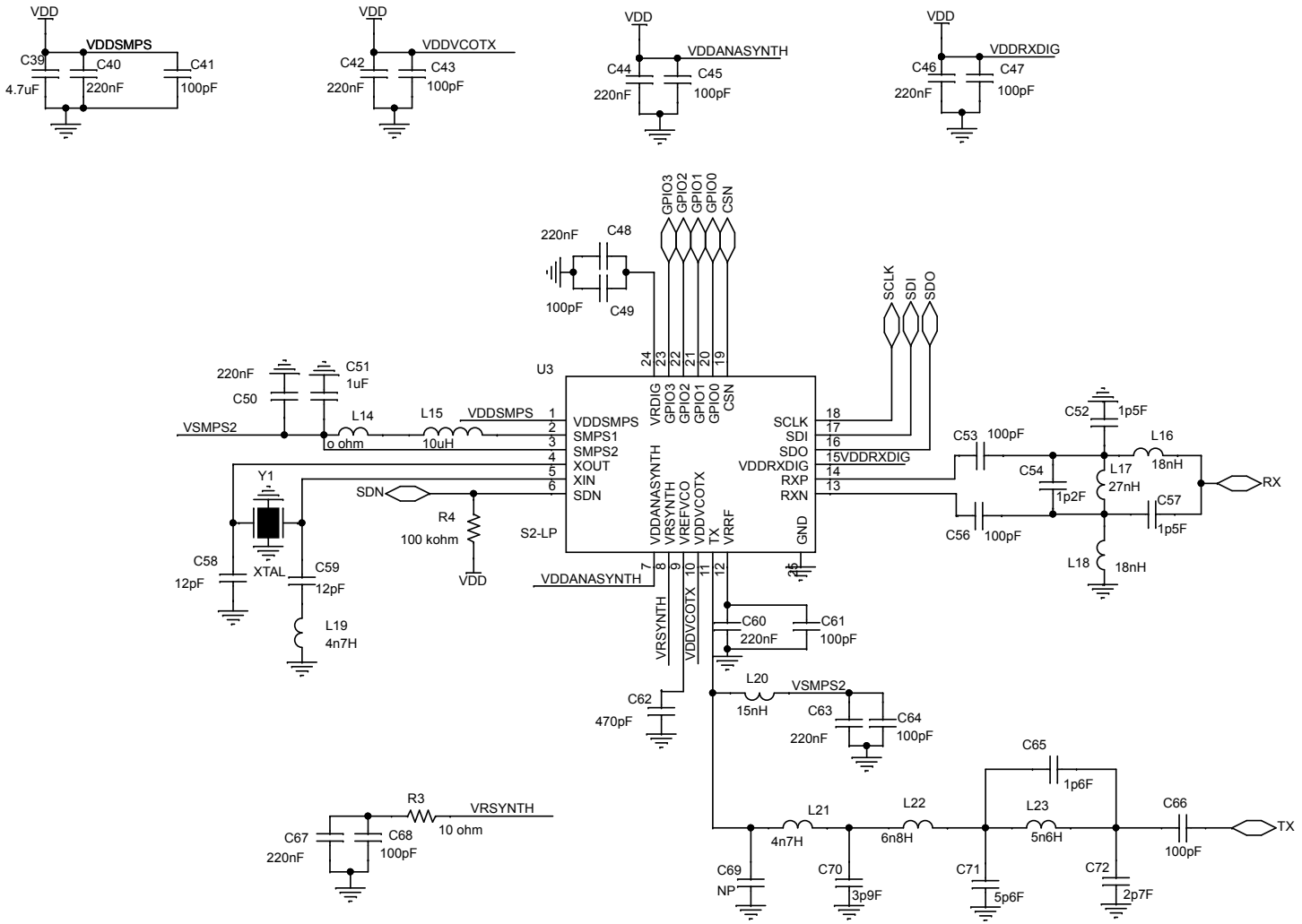


Figure 3. STDES-MONARCH schematic diagram - Front End Module



2 Bill of materials

Table 1. **STDES-MONARCH bill of materials**

Item	Q.ty	Ref.	Part / Value	Description	Manufacturer	Order code
1	7	C1, C17, C19, C21, C23, C25, C51	1µF	VBAT & SMPS OUT filter cap SM/ C_0201	Murata	GRM033C80J105ME05
2	6	C2, C18, C20, C22, C24, C26	100nF	VBAT & SMPS OUT filter cap SM/ C_0201	Murata	GRM033R61A104KE84
3	1	C3	10nF	Filtering cap SM/ C_0201	Murata	GRM033R71A103KA01
4	1	C30	10nF	Filtering cap SM/ C_0402	Murata	GRM155R71C103KA01
5	2	C4, C5	22pF	LSXTAL load cap SM/C_0201	Murata	GRM033C1H220GA01
6	1	C6	51pF	Balun/filtering cap SM/C_0402	Murata	GRM1555C1H510JZ01
7	1	C7	0p9F	Balun/filtering cap SM/C_0402	Johanson	500R07S0R9BV4S
8	1	C8	1p8F	Balun/filtering cap SM/C_0402	Murata	GRM1555C1H1R8CZ01
9	1	C9	12pF	Balun/filtering cap SM/C_0402	Murata	GRM1555C1H120JZ01
10	1	C10	0p4F	Balun/filtering cap SM/C_0402	Johanson	500R07S0R4AV4S
11	1	C11	1p1F	Balun/filtering cap SM/C_0402	Murata	GRM1555C1H1R1CZ01
12	1	C12	1p5F	Balun/filtering cap SM/C_0402	Murata	GRM1555C1H1R5CZ01
13	2	C13, C14	15pF	HSXTAL load cap SM/C_0201	Murata	GRM0335C1E150JD01
14	10	C15, C40, C42, C44, C46, C48, C50, C60, C63, C67	220nF	VBAT/LDO filter cap SM/C_0201	Murata	GRM033R61A224ME90
15	12	C16, C41, C43, C45, C47, C49, C53, C56, C61, C64, C66, C68	100 pF	VBAT/LDO filter cap SM/C_0201	Murata	GRM033R11E101KA01
16	1	C27	1nF	VBAT filter cap SM/ C_0402	Murata	GRM155R71H102KA01
17	1	C28	4µ7F	VBAT filter cap SM/ C_0402	Murata	GRM155R61A475MEAA
18	1	C29	33pF	VBAT filter cap SM/ C_0402	Murata	GRM1555C1E100JA01D
19	1	C31	120pF	VBAT filter cap SM/ C_0402	Murata	GRM1555C1H121GA01
20	1	C32	10pF	FEM filter cap SM/ C_0402	Murata	GRM1555C1E100JA01D

Item	Q.ty	Ref.	Part / Value	Description	Manufacturer	Order code
21	4	C33, C35, C36, C38	not mounted	FEM filter cap SM/C_0402	-	-
22	1	C34	2p4F	FEM filter cap SM/C_0402	Murata	GRM1555C1H2R4CA01
23	1	C39	4µ7F	VBAT filter cap SM/C_0201	Murata	GRM035R60J475ME15
24	2	C52, C57	1p5F	RX balun cap SM/C_0201	Murata	GRM0334C1H1R5BA01
25	1	C54	1p2F	RX balun/TX filter cap SM/C_0201	Murata	GRM0334C1H1R2BA01
26	1	C65	1p6F	RX balun/TX filter cap SM/C_0201	Murata	GRM0334C1H1R6BA01
27	2	C58, C59	12pF	XTAL cap SM/C_0201	Murata	GRM0332C1H120GA01
28	1	C62	470pF	VREF cap SM/C_0201	Murata	GRM0335C1E471GA01
29	1	C69	(not mounted)	TX filter cap SM/C_0201	-	-
30	1	C70	3p9F	TX filter cap SM/C_0201	Murata	GRM0333C1H3R9WA01
31	1	C71	5p6F	TX filter cap SM/C_0201	Murata	GRM0332C1H5R6BA01
32	1	C72	2p7F	TX filter cap SM/C_0201	Murata	GRM0333C1H2R7BA01
33	1	C73	0p3F	Balun/filtering cap SM/C_0402	Murata	GRM1555C1HR30CZ01
34	4	R1, R2, R4, R5	100 kΩ	Pull resistor SM/R_0201	Tyco Electronics	-
35	1	R3	10 Ω	LDO resistor SM/R_0201	Tyco Electronics	-
36	2	L1, L15	10µH	SMPS inductor SM/L-0603	Kemet	L0603B100KPWFT
37	1	L2	2nH	LSXTAL inductor SM/L_0201	Murata	LQP03TN2N0B04
38	1	L3	2n4H	Balun/filtering inductor SM/L_0402	Murata	LQG15HS2N4S02
39	1	L4	2n7H	Balun/filtering inductor SM/L_0402	Murata	LQG15AN2N7C00
40	1	L5	1nH	Balun/filtering inductor SM/L_0402	Murata	LQG15HS1N0S02
41	2	L6, L14	0 Ω	HSXTAL inductor SM/L_0201	Tyco Electronics	-
42	1	L7	120 Ω	VBAT filter inductor SM/L_0402	Taiyo Yuden	BK1005HM121
43	1	L8	6n8H	VBAT filter inductor SM/L_0402	Murata	LQW15AN6N8J00D
44	1	L9	2n7H	FEM filter inductor SM/L_0402	Murata	LQG15WZ2N7S02D
45	1	L10	0n8H	VBAT filter inductor SM/L_0201	Murata	LQP03TN0N8B02D

Item	Q.ty	Ref.	Part / Value	Description	Manufacturer	Order code
46	1	L11	7n5H	FEM filter inductor SM/L_0402	Murata	LQG15HN7N5J02
47	2	L12, L13	4n7H	FEM filter inductor SM/L_0402	Murata	LQG15HN4N7S02
48	2	L16, L18	18nH	RX balun inductor SM/L_0201	Murata	LQP03TN18NH04
49	1	L17	27nH	RX balun inductor SM/L_0201	Murata	LQP03TN27NH04
50	2	L19, L21	4n7H	XTAL/TX filter inductor SM/L_0201	Murata	LQP03TN4N7H04
51	1	L20	15nH	TX choke inductor SM/L_0201	Murata	LQP03TN15NH04
52	1	L22	6n8H	TX filter inductor SM/L_0201	Murata	LQP03TN6N8H04
53	1	L23	5n6H	TX filter inductor SM/L_0201	Murata	LQP03TN5N6H04
54	1	L24	1n6H	Balun/filtering inductor SM/L_0402	Murata	LQP15MN1N6B02
55	1	D1	Switch	RX switch SM/C_0201 (Soldered the 100 pF between 1 and 2)	Murata	GRM033R11E101KA01
56	1	D2	Switch	RX switch SM/C_0201 (Soldered the 100 pF between 1 and 3)	Murata	GRM033R11E101KA01
57	1	D3	Switch	PA control switch SM/R_0201 (Soldered the 0 Ω between 1 and 3)	Tyco Electronics	-
58	1	D4	Switch	PA control switch SM/R_0201 (Soldered the 0 Ω between 1 and 3)	Tyco Electronics	-
59	1	D5	Switch	PA control switch SM/R_0201 (Soldered the 0 Ω between 1 and 3)	Tyco Electronics	-
60	1	Q1	-	XTAL-LS NX3215SA	NDK	NX3215SA-32.768kHz-EXS00A-MU00003
61	1	Q2	-	XTAL-HS NX2016SA	NDK	NX2016SA -32.000MHz-EXS00A-CS06654
62	1	U1	-	BlueNRG QFN48	ST	BlueNRG-248
63	1	U2	-	FEM MCM 16 pin	Skyworks	SKY66420
64	1	U3	-	RF_IC QFN24	ST	S2-LP
65	1	Y1	-	XTAL NX1612SA	NDK	NX1612SA 50MHz EXS00A-CS08403

Revision history

Table 2. Document revision history

Date	Version	Changes
03-Mar-2020	1	Initial release.