SEMTECH

WIRELESS AND SENSING PRODUCTS

Shielding removed for clarity

DP1283 – C433 / 868 / C915

433, 868 and 915MHz Drop-In Module
UHF transceiver with low power 8-bit microcontroller

GENERAL DESCRIPTION

The DP1283 is a radio module based on the XE1283 combining a UHF transceiver and a low power dedicated microcontroller in one chip. The DP1283 is a 23 mm x 33.5 mm shielded module for use in the 433.92 ISM band, 868-870MHz ISM band or 902-928MHz ISM band. The device is suitable for circuit applications which have to satisfy either European (ETSI EN300-220-1, EN301-489-3) or the North American (FCC part 15.247, 15.249) regulatory standard.

Virtually no RF knowledge is required to use this RF microcontroller module; only an antenna needs to be added to create wireless communication. The DP1283 fulfils a very large number of application requirements, ranging from basic point-to-point communication to more complex multipoint process control functions where high level of integration and small form factor are key success. Semtech provides basic firmware routines for controlling the module and typical applications.

The module can be surface mounted/ re-flowed or hand soldered.

APPLICATIONS

- Automatic Meter Reading (AMR)
- High Quality Speech, Music and Data over RF
- Home automation and access control
- Process and building control

KEY PRODUCT FEATURES

- No RF knowledge required
- Small size 23 mm x 33.5 mm
- Supply Voltage down to 2.4V
- Output power: up to 15 dBm
- High reception sensitivity down to -113 dBm
- Low current consumption
- Data rate from 1.2 kbit/s to 153.2 kbit/s
- 8-bits microcontroller, RISC core
- Up to 6 MIPS, 300uA at 1MIPS operation
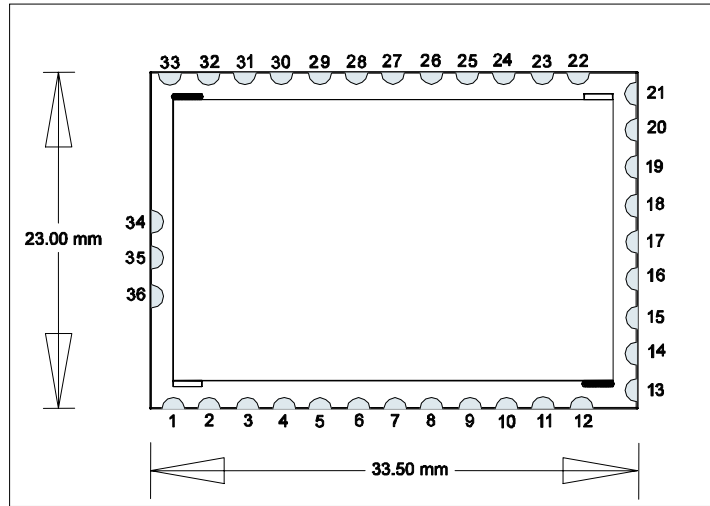- Up to 22 kByte (8kW) MTP, 512 Byte RAM

DEVICE OPTIONS

Part Number	Description	Pin-package
DP1283C433	433-435MHz, Module on Tape and reel	Board
DP1283C868	868-870MHz, Module on Tape and reel	Board
DP1283C915	902-928MHz, Module on Tape and reel	Board

Table of Contents

1 PIN DESCRIPTION

PIN	NAME	I/O	DESCRIPTION
1	RX	IN	Receiver selection of the antenna switch (not connected by default)
2	TX	IN	Transmitter selection of the antenna switch (not connected by default)
3	PA(0)	IN	Input port A pin
4	PA(1)	IN	Input port A pin
5	PA(2)	IN	Input port A pin
6	PA(3)	IN	Input port A pin
7	PA(4)	IN	Input port A pin
8	PA(5)	IN	Input port A pin
9	PA(6)	IN	Input port A pin
10	PA(7)	IN	Input port A pin
11	GND	IN	Ground
12	VDD_RF	IN	VDD for the RF
13	GND	IN	Ground
14	PB(7)	IN/OUT	Input / Output port B pin
15	PB(6)	IN/OUT	Input / Output port B pin
16	PB(5)	IN/OUT	Input / Output port B pin
17	PB(4)	IN/OUT	Input / Output port B pin
18	PB(3)	IN/OUT	Input / Output port B pin
19	PB(2)	IN/OUT	Input / Output port B pin
20	PB(1)	IN/OUT	Input / Output port B pin
21	PB(0)	IN/OUT	Input / Output port B pin
22	VDD_UP	IN	VDD for the uC
23	SWITCH	IN/OUT	RF mode selection / indication
24	SCK	OUT	Output clock of the 3-wire interface
25	SI	OUT	Data output of the 3-wire interface
26	SO	IN	Data input of the 3-wire interface
27	CLKOUT	OUT	Output clock at 9.75, 4.875, 2.4375 or 1.21875 MHz
28	XIN	IN	Programming Signal
29	XOUT	IN	Programming Signal
30	FLASH_HV	IN	High voltage supply for flash memory programming
31	TEST	IN	Set the pin to flash programming mode

PIN	NAME	I/O	DESCRIPTION
32	NRESET	IN	Reset of the circuit, active when low
33	FLASH_FR	IN	uC mode selection ('0'=XE88LC07A '1'=XE88LC06A)
34	GND	IN	Ground
35	RF IN/OUT	IN/OUT	RF input / output terminal
36	GND	IN	Ground

2   ELECTRICAL CHARACTERISTICS

2.1   ABSOLUTE MAXIMUM OPERATING RANGES

Description	Min	Max	Unit
Supply voltage	2.4	3.6	V
Operating temperature	-40	85	^{o}C
Storage temperature (un-programmed flash device)	-55	125	^{o}C
Storage temperature (programmed flash device)	-40	85	^{o}C
Soldering temperature (max 15 sec)		260	^{o}C

These devices have limited built-in ESD protection

Life Support Policy and Use in Safety Critical Applications

SEMTECH PRODUCTS ARE NOT DESIGNED, INTENDED, AUTHORIZED OR WARRANTED TO BE SUITABLE FOR USE IN LIFE-SUPPORT APPLICATIONS, DEVICES OR SYSTEMS OR OTHER CRITICAL APPLICATIONS. INCLUSION OF SEMTECH PRODUCTS IN SUCH APPLICATIONS IS UNDERSTOOD TO BE UNDERTAKEN SOLELY AT THE CUSTOMER'S OWN RISK.

2.2   SPECIFICATIONS

The table below gives the electrical specifications of the transceiver under the following conditions:
Tamb =25 ^{o}C; VDD = 3.3V, fc = 915 MHz, frequency deviation = 55 kHz, Rate: DR = 4.8 kbit/s pseudo random bit sequence unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Units
FR	Synthesizer Frequency Range	DP1283-C868	868	-	870	MHz
		DP1283-C915	902	-	928	MHz
		DP1283-C433	433	-	435	MHz
IDDSL	Supply current in sleep mode			0.2	1	uA
IDDST	Supply current in standby mode	39MHz running		0.85	1.1	mA
IDDR	Supply current in receiver mode			14	17	mA
IDDT	Supply current in transmitter mode	RFOP = 5dBm		33	40	mA
		RFOP = 15dBm		72	85	mA
RFS	RF Sensitivity	DR = 4.8kbps / Mode A BER<0.1%		-113	-110	dBm
FDA	Frequency Deviation	Programmable	1	-	255	kHz
DR	Bit rate	Programmable	1.2	-	152.3	kbit/s
RFOP	RF output power (50 Ohm load)	Programmable				
		RFOP max	12	15	-	dBm
TS_TR	Transmitter wake-up time	From oscillator running	-	150	250	us
TS_RE	Receiver base-band wake up time	From oscillator running	-	0.5	0.8	ms
TS_OS	Quartz oscillator wake up time	Fundamental	-	0.3	0.5	ms
XTAL	Quartz oscillator frequency	Fundamental		39		MHz
VIH	Digital input level high	In % VDD	75	-	-	%
VIL	Digital input level low	In % VDD	-	-	25	%
VOH	Digital output level high	In % VDD	75	-	-	%
VOL	Digital output level low	In % VDD	-	-	25	%

[1] RF consumption only. Microcontroller consumption is highly software dependant (down to 1.9 uA in time keeping mode).

## 3   FUNCTIONAL DESCRIPTION

The DP1283 is a cost effective high performance RF-Microcontroller module designed for wireless transmission applications where the level of integration is critical.

The DP1283 highlights most of the advantages of the RF transceiver XE1283 by combining an ultra low power high performance RF transceiver and its dedicated microcontroller on a single chip. For more information on the XE1283, please refer to the Semtech web site: http://www.semtech.com

All high and low frequencies circuits, as mentioned in the XE1283 application circuit, as well as a reference 39 MHz crystal for the radio transceiver and a 32.768 kHz for the microcontroller are enclosed inside a shield can. The 39 MHz crystal can also be used as a reference clock for an external application through the CLKOUT pin; the user can select the division ratio (4,8,16 or 32) depending on its application.

The DP1283 offers the possibility to directly drive a SPI (Synchronous Peripheral Interface) interface. Two microcontrollers ports are available, an input port (PA [0..7]) and a bidirectional port (PB [0..7]). The module incorporates an antenna switch driven by two microcontroller pins (PB4 and PB5).

The 8-bit microcontroller embedded in the DP1283 can be programmed directly with a Semtech Prostart via the programming pins available on the DP1283. For more information please refer to the chapter the "Programming On-Board" chapter.
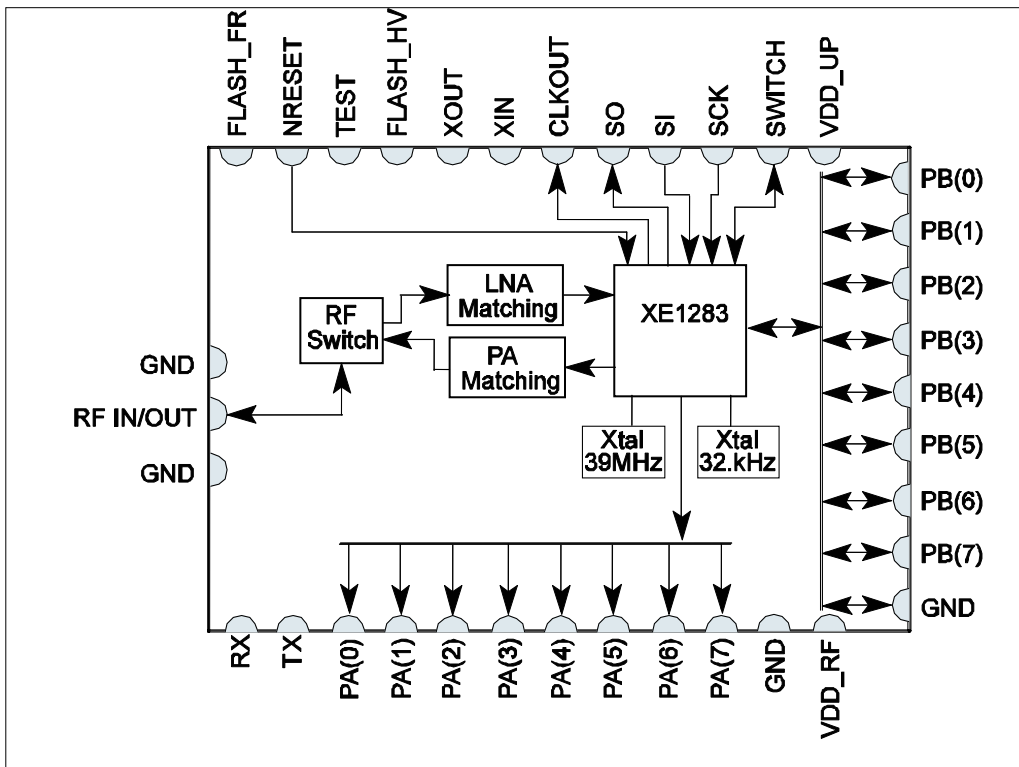
3.1 TRANSCEIVER DESCRIPTION

The transceiver includes a receiver, a transmitter and a frequency synthesizer. The module operates in three frequency bands (433MHz, 868MHz and 915MHz) and uses 2-level FSK modulation. In a typical application, the transceiver's registers are programmed by the embedded microcontroller through the 3-wire serial bus: SI, SO and SCK. The serial bus is also used to read back the transceiver configuration.

On the receiver side, the bandwidth of the base-band filters, the frequency deviation of the expected incoming FSK signal and the bit rate of the bit stream are programmable. On the transmitter side, the output power can be programmed, choosing between 4 possible values. The frequency deviation and the bit rate for the transmit signal are the same as those programmed in the receiver section. The frequency synthesizer frequencies, the frequency band and the center frequency (with a step of 500Hz) are also programmable.

Fore more information please refer to the XE1283 Datasheet or XE1203F Datasheet:

3.2 MICROCONTROLLER DESCRIPTION

The microcontroller core is based on a CoolRISC™ 816 CPU (Central Processing Unit). For more information about the microcontroller please refer to the XE1283 Datasheet or XE88LC06/7A Datasheet.

Port A is an 8-bit parallel input port. It can also generate interrupts, events or a reset. It can be used to input external clocks for the timer/counter/ PWM block.

Port B is an 8-bit parallel Input/Output port with analog capabilities. On the DP1283, only PB4 and PB5 are internally pre-routed and used to control the antenna switch embedded in the module. For more information about the antenna switch, please refer to the chapter *4.2: Antenna Switch Sequence.*

Port D is not available on the DP1283; it is used to interconnect the RF transceiver to the 8-bit microcontroller, the Bit Jockey™ peripheral.

3.3 INTERNAL CONNECTIONS

The core of the DP1283 is the XE1283. The XE1283 consists of two Semtech circuits; the XE88LC06/7A and the XE1203F which are connected together. Pre-routed internal connections and available API (Application Program Interface) greatly simplifies the development while the Bit Jockey™ leaves the microcontroller resources quasi completely available to implement the application layer.

The connection is described below and is compatible with the Semtech API.
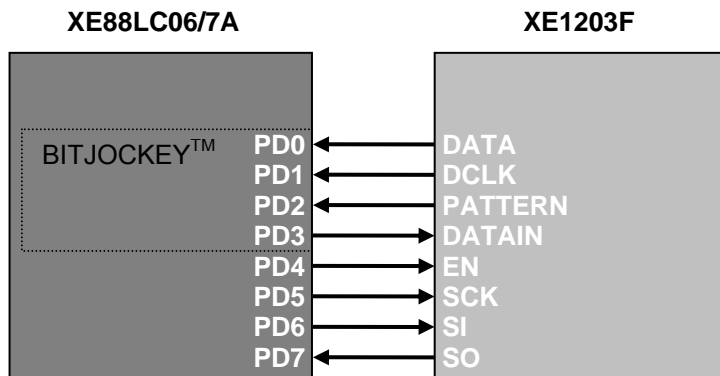
The internal connections enable the user to send and receive data from the RF through the Bit Jockey™ and also to write and read the transceiver configuration registers.

4   OPERATING MODES

The DP1283 RF transceiver has 2 main operating modes (Mode 1, Mode 2); each mode is then divided into 4 modes as shown on the table below. Switching between Mode1 and Mode 2 can be done either by the 8-bit microcontroller through the 3-wire bus (Chip_config register) or by using the pin SWITCH. The selection depends on the Switch_ext which is an XE1283 register (RF circuit).

Switch_ext Bit 3, Address 00010	Chip_config Bit 0, Address 00000	SWITCH (pin)	Mode selected
0	0	Set in Output - "1" DP1283 is in transmitter - "0" DP1283 other modes	Mode 1 Bit 7-6, Address 00110 - 0 0 : sleep mode - 0 1 : standby mode - 1 0 : receiver mode - 1 1 : transmitter mode
0	1	Set in Output - "1" DP1283 is in transmitter - "0" DP1283 other modes	Mode 2 Bit 7-6, Address 01001 - 0 0 : sleep mode - 0 1 : standby mode - 1 0 : receiver mode - 1 1 : transmitter mode
1	X	0	Mode 1 Bit 7-6, Address 00110 - 0 0 : sleep mode - 0 1 : standby mode - 1 0 : receiver mode - 1 1 : transmitter mode
1	X	1	Mode 2 Bit 7-6, Address 01001 - 0 0 : sleep mode - 0 1 : standby mode - 1 0 : receiver mode - 1 1 : transmitter mode

For more information about the DP1283 operating modes, please refer to the XE1283 Datasheet on the Semtech website.

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4.1 STANDARD SEQUENCE FOR SWITCHING BETWEEN RECEIVER AND TRANSMITTER

The drop-in module DP1283 can be programmed using the 3-wire bus or the pin SWITCH. This section describes the switching sequence from Mode 1 to Mode 2.
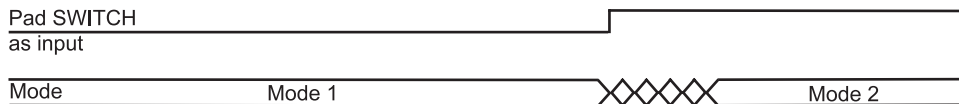
Switching sequence using the 3-wire bus

Switch_ext = 0 (Bit 3, Address 00010)

SCK

SI   A4 A3 A2 A1 A0 D7=1

EN

Mode   Mode 1 : Transmitter   Mode 2: Receiver

Pad SWITCH
as output
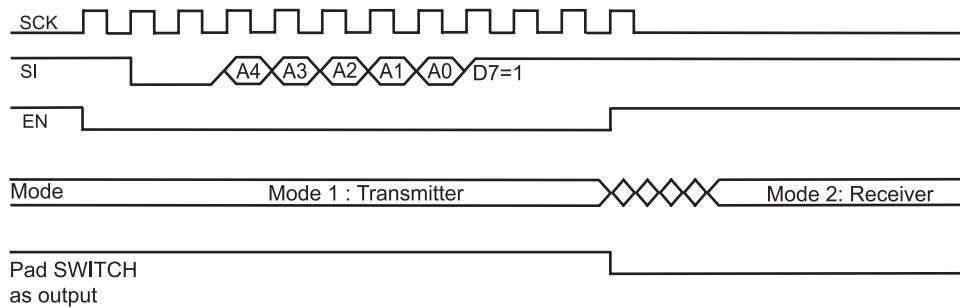
Switching sequence using pad SWITCH

Switch_ext = 1 (Bit 3, Address 00010)

Pad SWITCH
as input

Mode   Mode 1   Mode 2

4.2 MICROCONTROLLER CLOCK

In most applications, the CPU clock will be given by the on-chip RC oscillator combined with the pre-mounted 32 kHz oscillator for calibration (connected between pins XIN and XOUT).
For specific applications where an external clock is required, the 32 kHz crystal has to be removed and the external CPU clock signal can be injected on XIN pin.

4.3 ANTENNA SWITCH

In both cases the Antenna switch embedded on the DP1283 is by default driven by the microcontroller through PB4 and PB5.

Truth Table:

PB4	PB5	
1	0	Receiver mode
0	1	Transmitter mode

However, it is possible to drive the antenna switch externally via RX and TX pins. In this case, two resistors have to be moved as explained on the following table:

|	Switch driven internally (PB4 & PB5)	Switch driven externally (RX & TX pins)
R4, R5	0 Ω	NC
R1, R3	NC	0Ω

5   PROGRAMMING ON BOARD

Programming of the DP1283's integrated 8-bit microcontroller can be done with the XE8000MP board through one of its "In Circuit Programming Connectors".

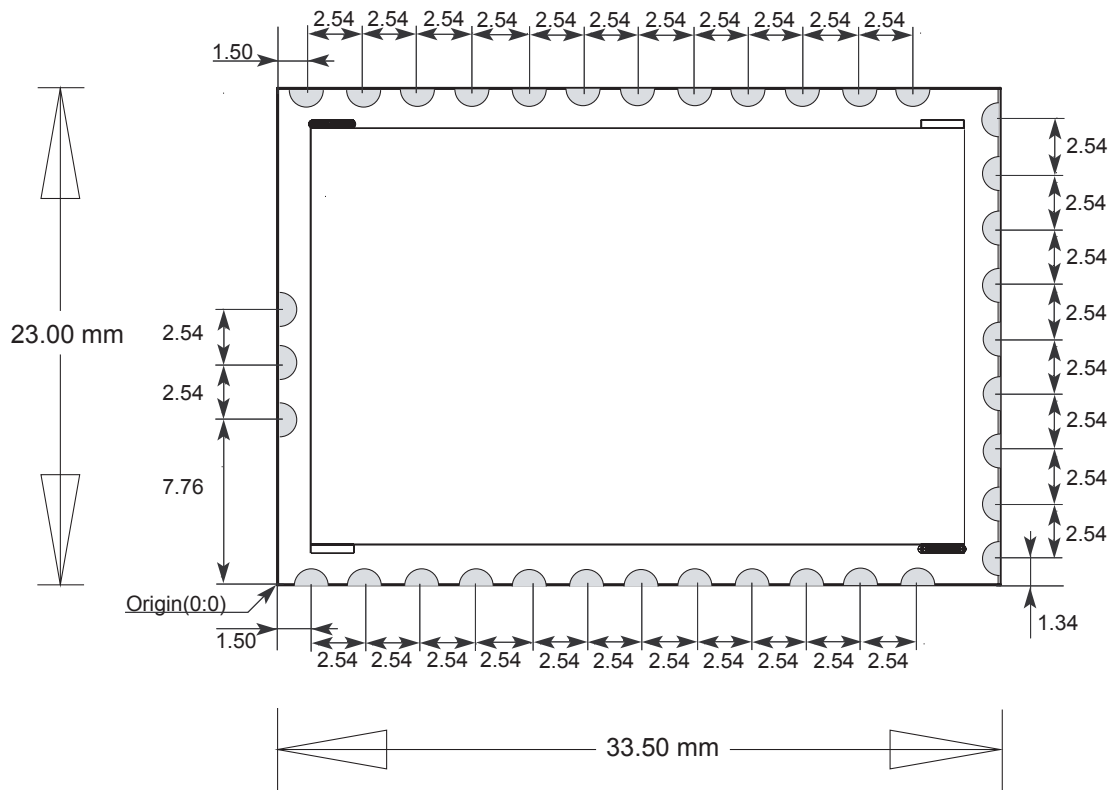The DP1283 target board requires the programming connector described below:
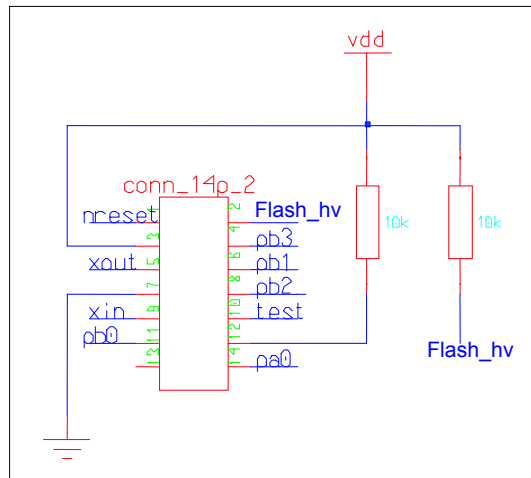
6   TYPICAL APPLICATION

The following schematic shows a typical application with a DP1283. In this application, the pad SWITCH is used as an output:
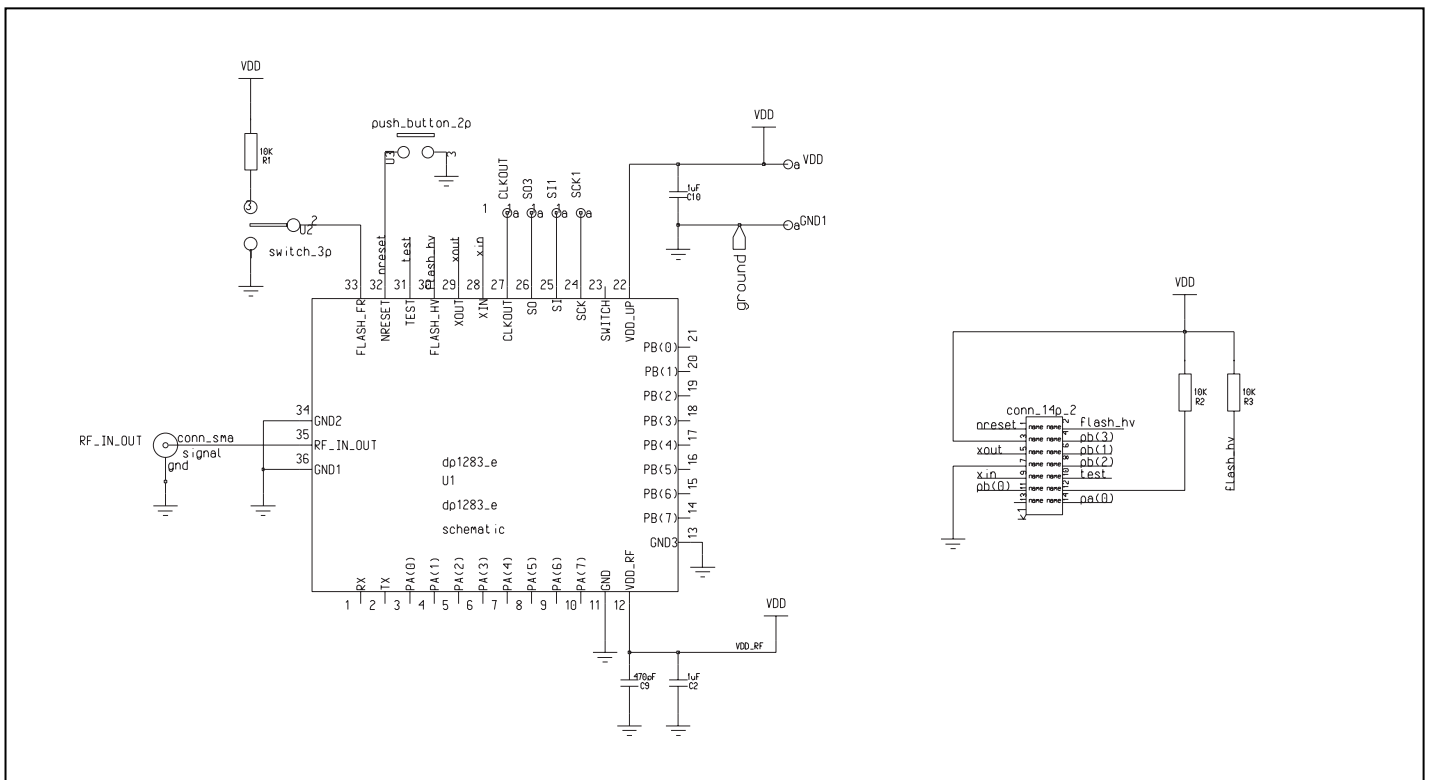
7   MECHANICAL DIMENSIONS

The following diagram shows the physical footprints and dimensions of the DP1283 drop-in module, which should be implemented on the mother board.

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