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EVK1000 USER MANUAL

HOW TO USE, CONFIGURE AND INTERFACE TO THE DW1000 EVALUATION KIT

This document is subject to change without notice

DOCUMENT INFORMATION

Disclaimer

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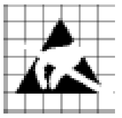

Caution! ESD sensitive device. Precaution should be used when handling the device in order to prevent permanent damage.

REGULATORY APPROVALS

This EVK1000 evaluation kit based on Decawave's DW1000 IC is intended solely for use by competent engineering personnel for the purposes of evaluating the use of Decawave's DW1000 IC in wireless location and communications systems.

The EVK1000, as supplied from Decawave, has not been certified for use in any particular geographic region by any regulatory body governing radio emissions in such regions.

The EVK1000 is supplied under the following conditions: -

- The distribution and sale of the EVK1000 is intended solely for use in future development of devices which may be subject to regulations or other authority governing radio emission.
- This EVK1000 may not be resold by users for any purpose.
- The EVK1000 as supplied by Decawave may not be incorporated directly into user devices or products unless such products undergo the appropriate certification.
- Operation of the EVK1000 in the development of future devices is at the discretion of the user and the user bears all responsibility for any compliance with regulations laid down by the authority governing radio emissions in the user's jurisdiction.

All products developed by the user incorporating the DW1000 must be approved by the relevant authority governing radio emissions in a jurisdiction prior to the marketing or sale of such products in that jurisdiction. User bears all responsibility for obtaining such approval.

If the user has obtained the EVK1000 for any purpose other than those listed above the user should return the EVK1000 to the supplier immediately.

FCC NOTICE: This kit is designed to allow (i) product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and (ii) software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the conditions that this device not cause harmful interference to licensed radio stations and that this device accept harmful interference. Unless the assembled kit is designed to operate under Part 15, Part 18 or Part 95 of the FCC Rules, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under Part 5 of the FCC Rules.

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1 INTRODUCTION

1.1 Overview

The EVK1000 consists of a pair of EVB1000 boards. Each of the pair of EVB1000 boards is configured to run a pre-programmed two-way ranging demonstration application. This "DecaRanging" application controls the DW1000 IC to exchange messages, calculate the time-of-flight, estimate the resultant distance between the two boards and display that result on the on-board display. Only external powering is required for this operation.

The boards may optionally be driven via USB interface using a PC version of the "DecaRanging" software, as described in section 4.3. Alternatively an external micro-controller system may drive the DW1000 IC directly through its SPI interface made available via the SPI header as described in section 4.4.

In addition to demonstrating two-way ranging this kit may be used to evaluate the following DW1000 features: -

- range
- ranging precision
- transmit spectrum
- power/current consumption
- multipath immunity
- blocking immunity
- antenna options

It can also be used as a development platform for the DW1000 allowing you develop your own software and applications.

1.2 Document Layout

- Section 2 describes the contents of the EVK1000 kit.
- Section 3 describes the on-board "DecaRanging" application.
- Section 4 describes using an external application to control the DW1000 on the EVB1000.
- Section 5 describes how to use the EVK1000 to evaluate the performance of the DW1000 IC.
- Section 6 is a brief troubleshooting guide while Section 7 provides detailed information on the functions and settings of all on-board switches, jumpers and headers.

If you are in any doubt about how to perform any of the steps illustrated in this manual or you are unsure how to proceed, please contact Decawave (sales@decawave.com) and we will be happy to advise you.

1.3 External References

Table 1: External references and publications

Reference	Title/Description
1	"DecaRanging" Demo Application (PC) User Guide
2	DW1000 Data Sheet
3	DW1000 User Manual

2 THE EVK1000 KIT DESCRIPTION

The kit comprises: -

- 2 x EVB1000 boards
- 2 x Antennae
- 2 x USB 2.0 cable
- 2 x Power leads
- 1 x Quick start guide
- 2 x Perspex stands

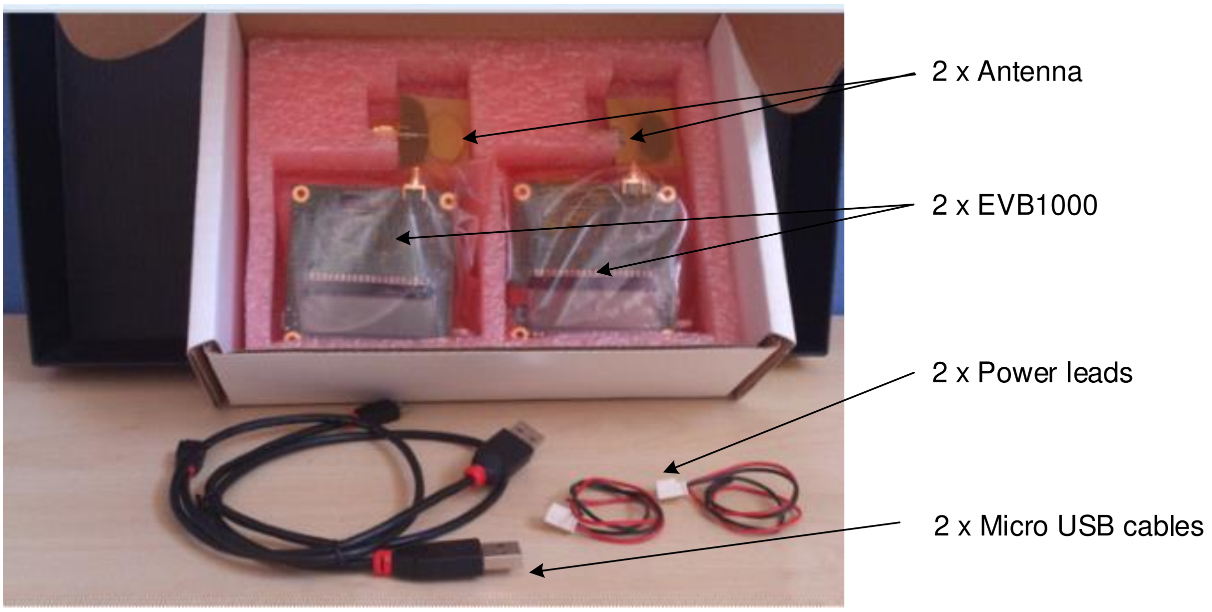

Figure 1: EVK1000 contents

Please contact Decawave immediately if any of these items is missing from your kit.

2.1 Description of the EVB1000 board

The EVB1000 evaluation board measures 7 cm x 7 cm. Its two sides, identifying the main components, are shown in Figure 2.

The front side contains the LCD display which is used to show ranging information and the mode in which the board is operating, the DIP switch (**S1**), which allows the user to set the mode of operation of the EVB1000 and there are also a number of LEDs.

The rear side contains the DW1000 IC, the ARM IC, the ARM reset button, two DIP switches (**S2** and **S3**), the JTAG connection header, the external SPI connection header, and various jumpers and power connectors for configuring the input powering mode. More details on all of these components are contained in section ?.

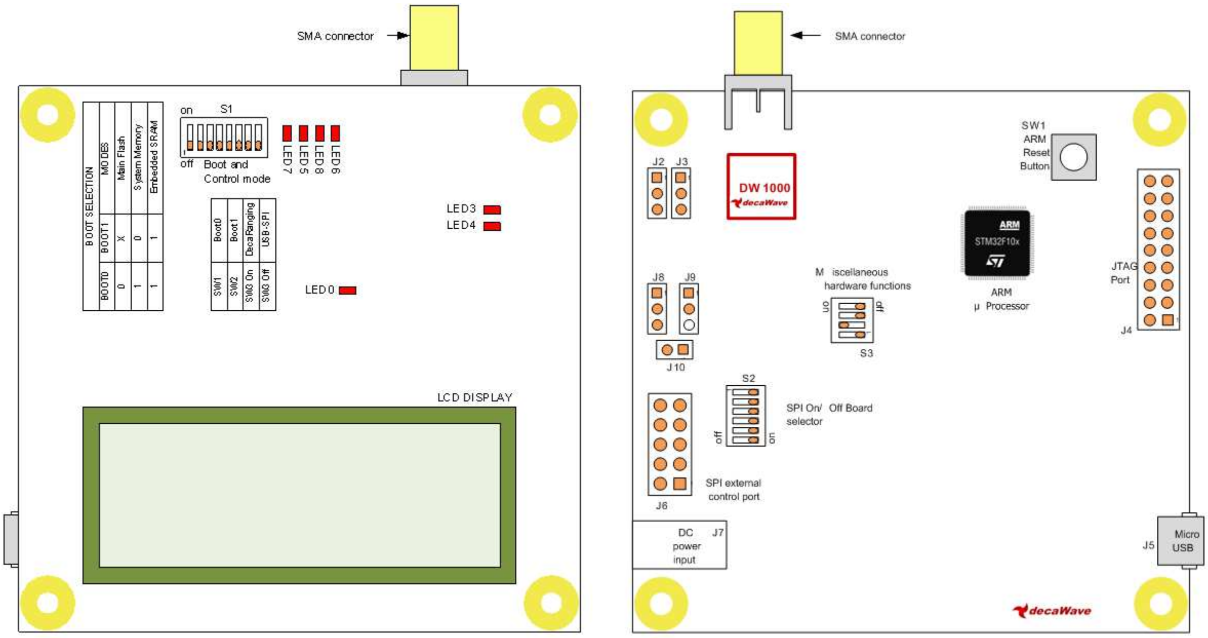

Figure 2: The two sides of the EVB1000 showing main components

2.2 Essential items that are not part of the kit

The following items are not included in the EVK1000 as delivered and are required to operate the kit: -

1. Power supply: No power supply units are supplied. The boards may be powered from a bench power supply using the supplied power supply leads, or via a USB power source using the supplied USB cables. These options are described in section 3.3.

2.3 Optional items that are not part of the kit

The following items are not included in the EVK1000 as delivered and may be required for further application development using the EVK1000:

1. JTAG interface module: In order to reprogram the on-board ARM Cortex microcontroller, a suitable JTAG adaptor is needed, (e.g. ST microelectronics ST-LINK/V2 in-circuit debugger/programmer).

3 EVB1000 ON-BOARD RANGING APPLICATION

3.1 Introduction

Each of the pair of the EVB1000 boards in the evaluation kit comes with a pre-programmed two-way ranging demonstration software application called "DecaRanging". This application controls the DW1000 IC to exchange messages, calculate the time-of-flight and estimate & display the resulting distance between two EVB1000 units.

Note that the functions of the switches on the EVK1000 depend on the version of the installed "DecaRanging" application. Where there are differences, these are pointed out in this manual.

To start running the "DecaRanging" demonstration, please follow the steps described below.

3.2 Antenna connection

The supplied antenna should be connected to the SMA connector (**J1**) shown in Figure 2. Best results will be achieved when the planes of the antennae at both ends of the radio link are parallel to each other. It is also possible to use other commercially available UWB antennae with the EVB1000. For references and application advice, please contact Decawave.

3.3 Powering the EVB1000

The EVB1000 can be powered either via an external DC power supply (or battery) through **J7** using the supplied power cable leads or via a standard 5 V 500 mA USB power supply through **J5**. To change between the two, jumper **J8** is used as shown in the Figure 3.

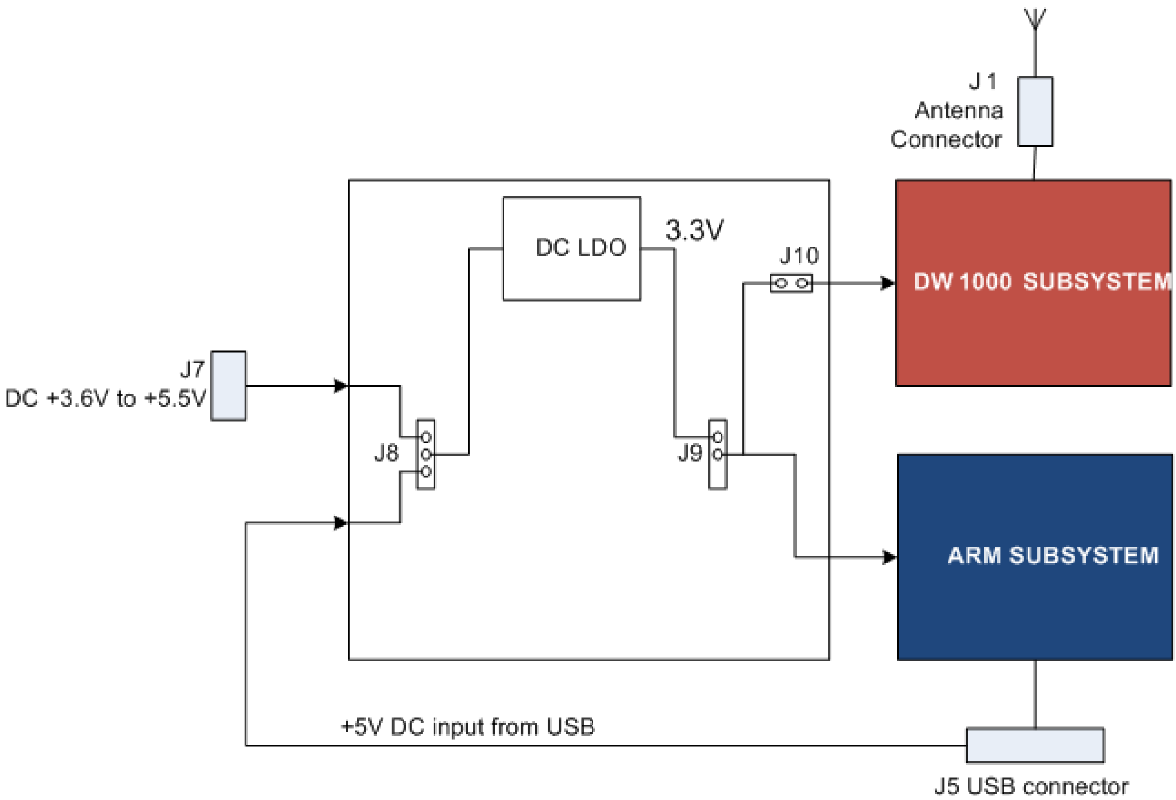

Figure 3: EVB1000 power supply options

Table 2: Power option settings

Power Source	J8 (Insert on pins)	Comment
USB	2 & 3	The USB port to which you connect the EVB1000 should be capable of supplying at least 250 mA
3.6 V to 5.5 V	1 & 2	In this mode the externally applied supply is indirectly connected to the on-board circuitry through an LDO regulator

Changes to jumper settings should only be made with the board powered down – under no circumstances should jumper settings be changed while power is applied to the board via any of the possible off-board connectors, or damage to the board may result.

For the two power source options the positions of the jumpers are shown in Figure 4. Jumpers **J2** and **J3** can be used to select whether sections of DW1000 are powered with 1.8 V or 3.3 V, for more details on this operation see Reference [2]. Jumper **J10** can be used to measure the current consumption of DW1000.

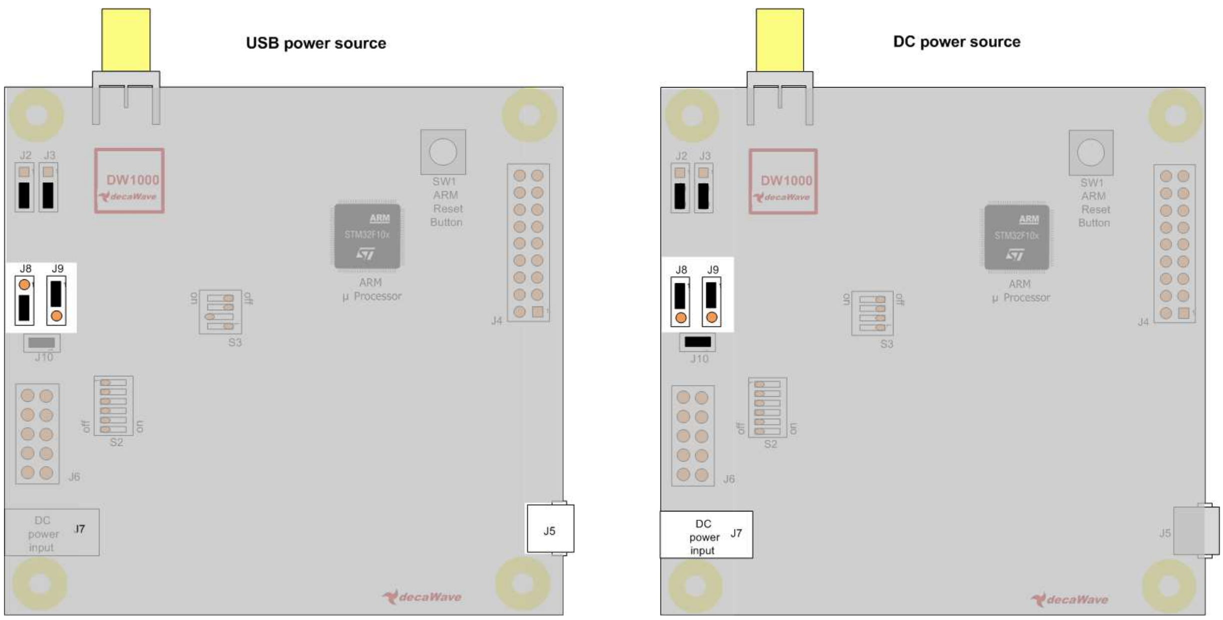

Figure 4: USB and DC 3.6 V to 5.5 V power source jumper connections

3.4 EVB1000 functional modes

The on-board "DecaRanging" application requires one unit to be configured as an "Anchor", and the other as a "Tag". These functional modes are controlled with switch, ***S1-4***, as indicated in Figure 5.

1. **S1-4** to **ON.** EVB1000 configured as an "Anchor".
2. **S1-4** to **OFF.** EVB1000 configured as a "Tag".

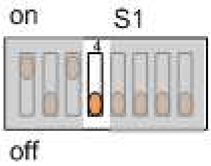

Figure 5: Switch S1-4 Tag / Anchor configuration

The EVK1000, by default, has one of the boards configured in Anchor mode and the other in Tag mode. Further details on each function can be found in Reference [1].

3.5 EVB1000 operational modes

The on-board DecaRanging application supports a number of different operational modes. These are chosen to demonstrate the DW1000's performance in high speed short range and lower speed longer range applications; these are described in detail in Reference [3]. Table 3 below shows the supported configurations; the default EVK1000 configuration, as delivered, is Mode 3. The mode setting is configured with the **S1** switches ***S1-5, S1-6*** and ***S1-7*** shown in Figure 6 below.

Table 3: Operational modes configuration details

S1-5	S1-6	S1-7	Mode	Channel	Data Rate	PRF	Preamble	Preamble Code	Non standard SFD
OFF	OFF	OFF	1	2	110 kbps	16	1024	3	Yes
ON	OFF	OFF	2	2	6.8 Mbps	16	128	3	No
OFF	ON	OFF	3[1]	2	110 kbps	64	1024	9	Yes
ON	ON	OFF	4	2	6.8 Mbps	64	128	9	No
OFF	OFF	ON	5[1]	5	110 kbps	16	1024	3	Yes
ON	OFF	ON	6	5	6.8 Mbps	16	128	3	No
OFF	ON	ON	7	5	110 kbps	64	1024	9	Yes
ON	ON	ON	8	5	6.8 Mbps	64	128	9	No

[1] These two modes are calibrated for transmit power and antenna delay during EVK production. Other modes are not and may give ranging measurements that are slightly different to the physical values.

NOTE: Antenna delay for the EVK1000 is calibrated by Decawave at the time of shipment and stored in the One Time Programmable (OTP) memory in the DW1000 ICs on each of the two EVB1000 boards in the kit. This antenna delay calibration is specific to the software version installed in the EVK1000 at the time of shipment. If you subsequently decide to reprogram the EVK1000 with a different version of software from Decawave, or your own software, then this original antenna delay calibration may no longer be appropriate and a compensation factor may need to be applied. See APS011 available on www.decawave.com.

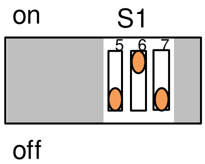

Figure 6: Mode configuration selection

3.6 Ready to go?

Once you have configured the power supply method of your choice and the desired modes of operation and configuration, the board can be powered up. LED 0 will illuminate to indicate that power is applied.

You and now ready to begin using your EVK1000 ranging demonstration. The two units will initialise and start the ranging exchange. The messages you will see on the LCD screen during this process are shown in Figure 7, Figure 8, Figure 9 and Figure 10 below. LED 5 will illuminate in Anchor mode whereas LED 6 will illuminate in Tag mode. After a few moments the calculated range will be displayed on the LCD. For more details on the “DecaRanging” application please consult Reference [1].

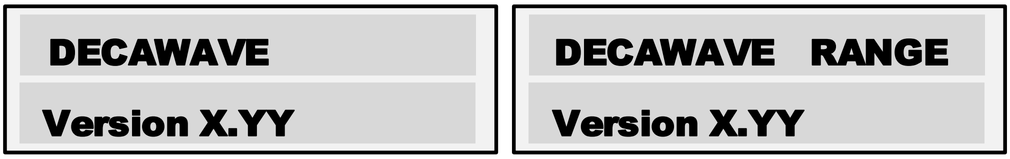

Figure 7: EVB1000 power on LCD screen messages showing software version

Note that the version of “DecaRanging” software programmed in the EVK1000 determines some of the switch functions of the kit.

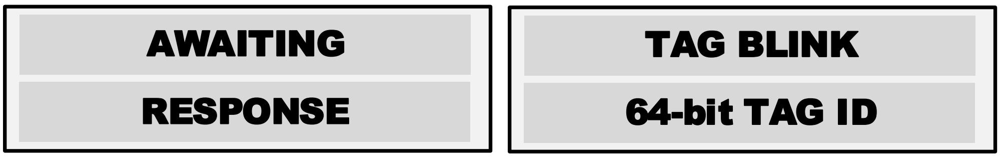

Figure 8: Tag power on LCD messages

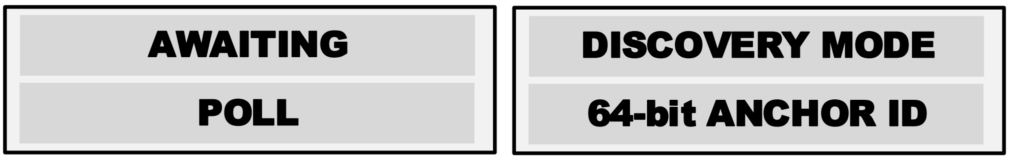

Figure 9: Anchor power on LCD messages

Figure 10: Tag / Anchor range display

4 EVB1000 CONTROL WITH AN EXTERNAL APPLICATION

4.1 Introduction

The EVB1000 has two configuration options which enable an external application to control the DW1000. These are:

1. Using the USB connection (**J5**). An external application (e.g. Decawave's "DecaRanging" PC application) can use the on-board USB to SPI application, to control the DW1000 IC. This is described in section 4.3.
2. Using the external SPI header (**J6**). This allows a software application running on an external microcontroller or a PC to directly interface with the DW1000 SPI bus. This is described in section 4.4.

As the DW1000 is controlled via an SPI interface any external controller wishing to control the DW1000 transceiver must use SPI for direct communication with the chip.

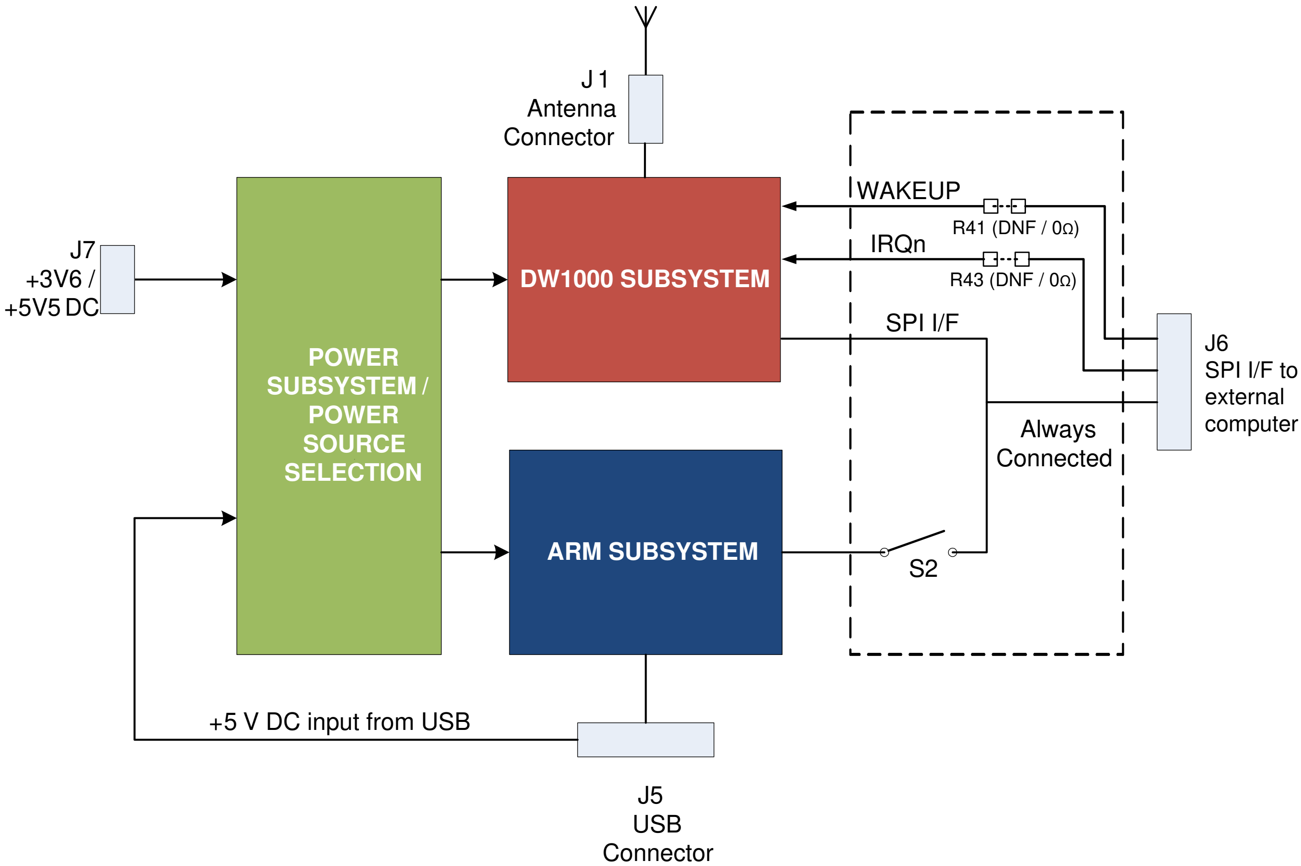

Figure 11: Logical view of the EVB1000

4.2 "DecaRanging" PC application

The on-board "DecaRanging" application that comes pre-programmed on the EVB1000 ARM microcontroller has an equivalent PC application which can be connected to the EVB1000 via the micro USB, to control the DW1000 from a PC.

The “DecaRanging” PC application is available from Decawave. The description of the “DecaRanging” application is beyond the scope of this manual and is described in Reference [1].

4.3 External application control of the DW1000 via the USB interface (J5)

In this mode of control the on-board USB to SPI application acts as a USB slave virtual COM port. It translates the COM port commands into SPI transactions to the DW1000. To enable the USB to SPI application the EVB1000 needs to have the **S1** switch ***S1-3*** set to the off position. The windows PC driver is available from the ST Microelectronics website, see DecaRanging PC Application User Guide for installation details.

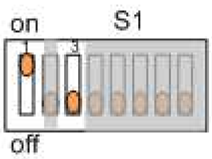

Figure 12: USB to SPI configuration

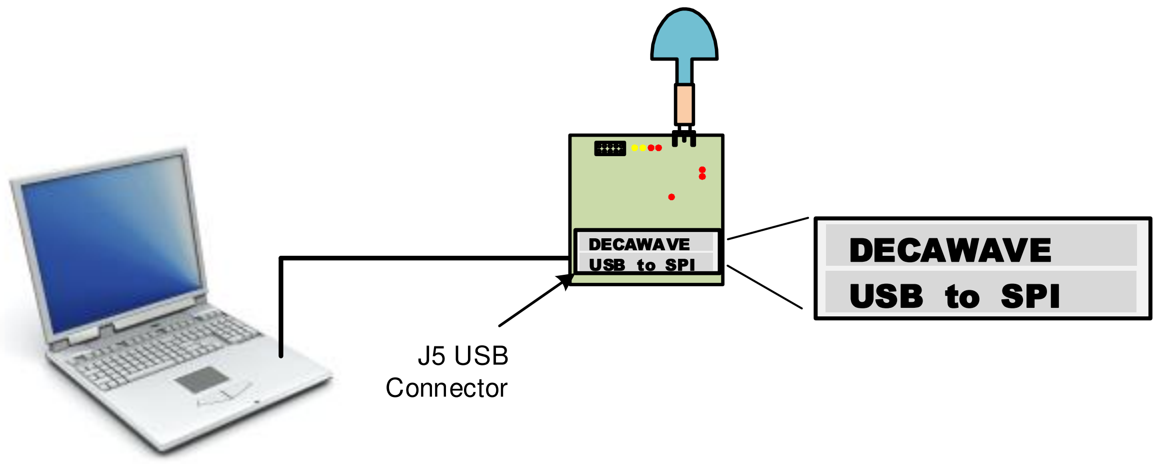

Figure 13: External application control using USB interface

4.4 External application control of the DW1000 via the external SPI header (J6)

In this mode of control the on-board ARM processor is not used and it should be disabled and disconnected from the DW1000 SPI bus (switch **S1** and **S2** should be all in the off position).

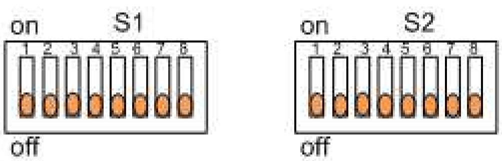

Figure 14: S1 and S2 configuration for external application control through USB

The pin-out of the external SPI connection header **J6** has been arranged to be compatible with that of the “Cheetah” series of SPI to USB converters provided by TotalPhase™. For more details on the external SPI connector pin out see section ?. Using one of these converters it is possible to control the DW1000 directly from a PC. The "DecaRanging" PC application supports this operation; further details are described in Reference [1].

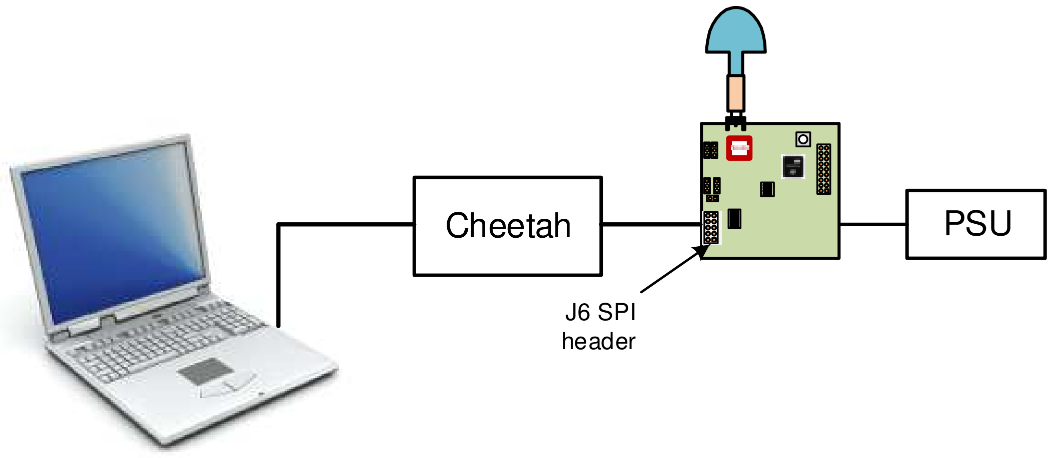

Figure 15: External application control using SPI external header

Other microprocessor platforms may also be used to control the DW1000 by connecting the appropriate SPI port on the microprocessor platform to the EVB1000 SPI header, **J6**. The DW1000 IRQ line may also be connected to the microprocessor platform if interrupt driven operation is required. For more details on the external SPI connector pin out see section 4.1.

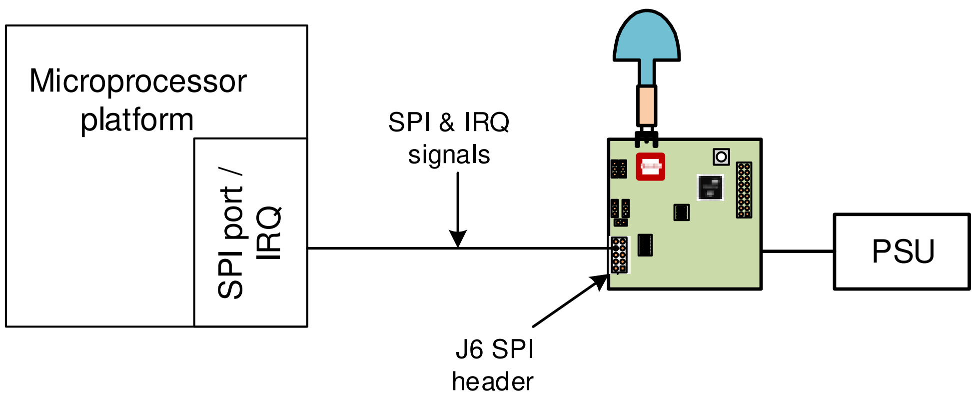

Figure 16: External application control with a microprocessor platform using SPI external header

Further information can be found in Appendix 1 EVB1000 EXTERNAL CONTROL CONNECTIVITY

4.5 EVB1000 options when using "DecaRanging" PC application

The hardware setup necessary to allow you use your EVB1000 with the "DecaRanging" PC application is covered in section 4 of this manual.

There are two options:

1. Using the external application to control both EVB1000 units.
2. Using the external application to control one of the pair of the EVB1000 units.

4.5.1 Using an external application to control both EVB1000 units

In this configuration both of the two EVB1000s are controlled by the "DecaRanging" PC application further details are described in Reference [1].

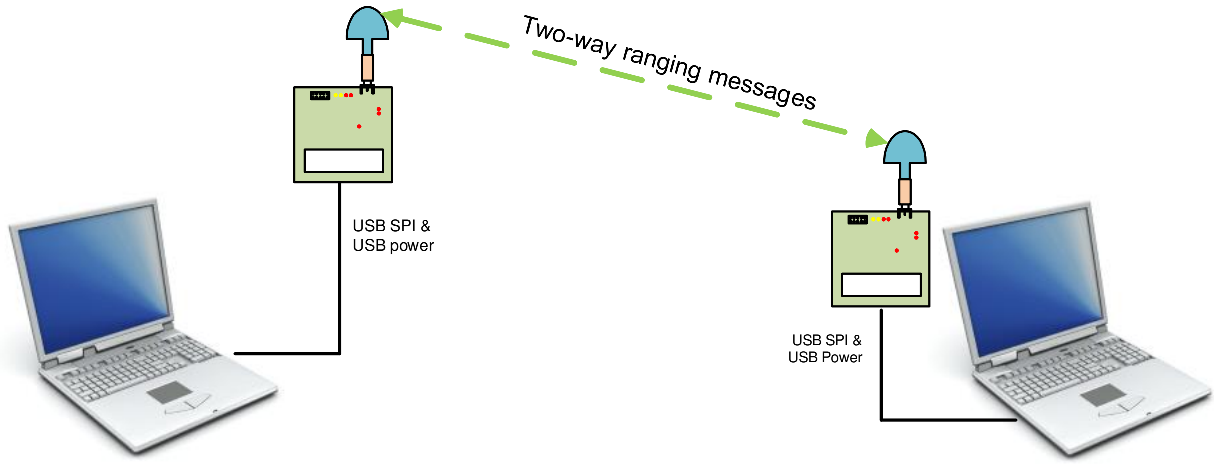

Figure 17: Both EVB1000's controlled by the external application

4.5.2 Using one externally controlled EVB1000 with one on-board controlled EVB1000

In this configuration one of the two EVB1000s in the "DecaRanging" demonstration runs the "DecaRanging" application from the on-board ARM microcontroller while the other EVB1000 is controlled from a PC which has "DecaRanging" Installed.

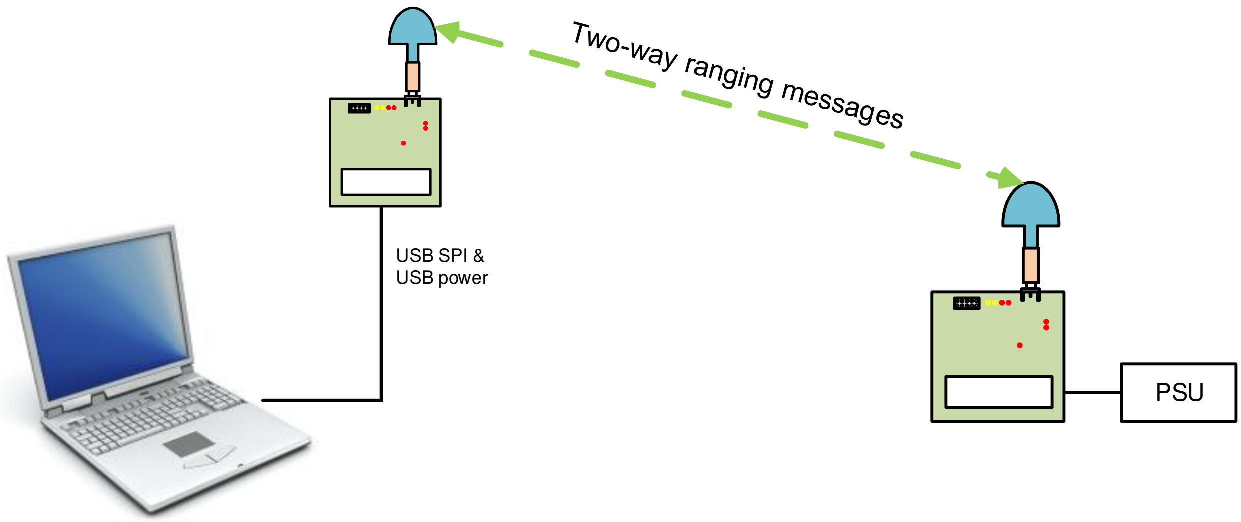

Figure 18: One EVB1000 controlled by the external application

Make sure that the channel configuration settings in the "DecaRanging" PC application are identical to the mode used on the other EVB1000.

5 EVALUATING THE PERFORMANCE OF THE DW1000 USING THE EVK1000

5.1 Introduction

There are three main parameters that evaluators of the DW1000 are typically interested in evaluating using the EVK1000: -

Table 4: Main evaluation parameters of interest

Parameter	Description
Communications range	What is the maximum range between the two nodes in the kit over which communications is successfully maintained and what operating mode yields that longest range?
Ranging accuracy	What is the accuracy of ranging measurements between the two nodes in the kit and how does this vary with operating parameters?
Power consumption	What is the power consumption of the DW1000 in various modes of operation and what mode yields the lowest power consumption?

Each of these is examined individually in the following sections.

5.2 Evaluating range performance

To evaluate the range performance of the DW1000 the most widely used approach is to: -

- First verify the line-of-sight (LOS) range where there is a clear line of sight between the two nodes. Do this by leaving one node stationary and moving the other node away from it until ranging updates stop
- Then investigate the non-line-of-sight (NLOS) performance by introducing various obstructions between the two nodes.

A more systematic approach can be adopted using the PC based DecaRanging software and monitoring the error counts as described in the DecaRanging user manual as the distance between the nodes is increased.

There are a number of factors that influence communications range. These are described in detail in the DW1000 data sheet & user manual so it's not necessary to go into them in great detail here. In summary, we can say: -

Table 5: Factors influencing communications range

Influencing factor	Effect
Channel center frequency	Lower frequencies propagate further than higher frequencies so to maximise range the lowest possible channel frequency should be selected (Channel 1: 3.5 GHz)
Channel bandwidth	A wider channel bandwidth allows more energy to be transmitted into the channel than a narrower bandwidth. To maximise range the widest channel bandwidth should be used. In reality in the DW1000, because the first wideband channel is at 4 GHz while the lowest frequency channel is at 3.5 GHz the benefit due to the increased bandwidth at 4 GHz is offset by the higher center frequency and better results are achieved at channel 1.

Influencing factor	Effect
Data rate	Lower data rates have longer range than higher data rates so to maximise range the lowest data rate (110 kbps) should be selected.
Preamble length	Generally speaking long range operation requires a long preamble length to give the receiver as long as possible to "train" to the incoming signal. The preamble length needs to be chosen in conjunction with the data rate. There is no point is using a very long preamble with a fast data rate at long range because the receiver will not be able to receive the data irrespective of the length of the preamble. However at slow data rates longer preambles give an increase in operating range. To maximize range, a slow data rate in conjunction with a long preamble (2048) should be chosen.
PRF	The pulse repetition frequency has a very small impact on communications range with 64 MHz PRF giving marginally better performance than 16 MHz PRF

As described in section 3.5 the EVK1000 has a number of preprogrammed modes of operation that are selectable via switch S1.

The EVK1000 comes pre-configured to **Mode 3**. **This is the pre-programmed mode of operation with the longest range.** It uses the lowest frequency pre-programmed channel (channel 2), the slowest data rate (110 kbps) and the longest pre-programmed preamble (1024).

Even longer range is possible when using the external DecaRanging PC application to control both nodes as described in section 4.5.1. To achieve the maximum range possible both nodes should be configured to channel 1 (3.5 GHz center frequency), 2048 preamble, 64 MHz PRF and 110 kbps data rate.

In a custom design using the DW1000 it is possible to further extend the range by making various choices in terms of hardware configuration including the use of TCXO clock sources, antennas with gain and so on. Please consult the DW1000 data sheet and DW1000 user manual for further information.

5.3 Evaluating ranging accuracy

In order to precisely determine the ranging accuracy of the DW1000 it is necessary to adopt a systematic approach to the evaluation.

The process normally used by Decawave to do this is to place the two nodes at a known physical distance apart, take multiple measurements using the logging function in DecaRanging PC software which is available on www.decawave.com (typically up to a 1000 ranges per physical distance), plot those measurements and calculate the mean and standard deviation of the measured values.

This process can be repeated for as many physical distances as are required for the intended application.

The logging function in the PC based DecaRanging software can be useful for the recording of data from multiple ranging exchanges.

Note: The EVK1000 has been calibrated during production in modes 3 & 5 only. This means that the transmit power level and antenna delay have been calibrated correctly for those modes. See Ref [2] and [3] for further explanations of these two items.

All other modes are un-calibrated. To achieve best possible range and ranging accuracy performance in those other modes it may be necessary to calibrate the EVK1000. Ref [3] provides general information on how to do this.

5.4 Evaluating DW1000 power consumption

The EVB1000 has been designed to allow the user to measure the current consumed by the DW1000 while operating. The supply to the DW1000 section of the EVB1000 has been isolated from the supply to the remainder of the board and these two sections are connected via a jumper at J10.

When operating the EVB1000 normally, a jumper is inserted at J10 to connect these two parts of the circuit together.

In order to measure the current consumption of the DW1000 then it is necessary to remove the jumper at J10 and either: -

1. Connect an Ammeter directly across the two pins of J10; or
2. Connect a low value resistor across the pins of J10 (typically this would be in the region of 0.5 to 1 Ohm) and use a Voltmeter across that resistor to derive the current passing through it.

Unless a sophisticated instrument is used in the measurement process (that can record currents / voltages in real time to a resolution of microseconds) then the current measured using the methods above will be the average operating current.

Current consumption of the DW1000 is very dependent on the operating state of the device. The lowest power pre-programmed mode on the EVK1000 is **mode 1.** This is not the lowest possible power consumption with the DW1000. The various operating states of the DW1000 are described in detail in the DW1000 data sheet and user manual and it is recommended that the user familiarize themselves with these various operating states, their associated current consumptions and the various ways they can be used to minimize the power consumption of the DW1000.

Using the EVK1000 with DecaRanging PC software is not power efficient because of the latencies involved in communicating with the PC. This means that the DW1000 is in an active state for longer than would be necessary in an embedded environment. Power consumption measurements made while a node is being controlled by PC based DecaRanging are not representative of power consumption in a real-world application.

6 TROUBLESHOOTING GUIDE

- No ranging when using "DecaRanging" PC application with one EVB1000 and ARM application on the other EVB1000.
  - Make sure that the channel configuration settings in the "DecaRanging" PC application are identical to the mode used on the other EVB1000.
  - For software versions prior to v3.05, if channel configuration settings are the same but the Anchor does not report any TX frames, a longer response time might be needed. Further details are described in Reference [1] (the ARM controlled EVB needs to have ***S1-2*** in the OFF position and ***S1-8*** in the ON position).

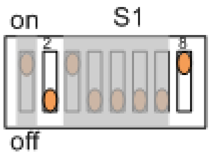

Figure 19: S1 S1-2 and S1-8 configuration for the longer response time

- LCD shows "ERROR INIT FAIL" message. Check that all switches in S2 are in the ON position.
- Range reads 0.00 m: press the reset button or disconnect and reconnect power.

  Note: To help investigate any potential issues the voltages on **J2** and **J3** should be either 3.3 V or 1.8 V after power up, depending on which configuration is used as specified in Reference [2]. The voltage on J9 should be 3.3 V.

- If the system does not operate as expected when the settings of any of the DIP switches are changed it may be necessary to operate the switches a number of times. They have been known to stick and not operate correctly. Toggling them a number of times generally resolves the issue.

7 EVB1000 BOARD DETAILS

This section gives further details of the EVB1000 including the pin-outs of all connectors and the function of all the on-board switches and Jumpers.

7.1 Off-board connector headers

7.1.1 J1 – SMA antenna connector

External antenna connector

Table 6: J1 pin out

Pin	Function
J1-Centre	RF signal
J1-Body	Ground

7.1.2 J4 – JTAG connector

The JTAG connector is intended for connection to an external ARM debug interface / development toolset. DIL Header, 20 pin, 0.1” pitch.

Table 7: J4 pin-out

Function	Pin	Pin	Function
VCC	1	2	VCC
JTRST	3	4	GND
J TDI	5	6	GND
J TMS	7	8	GND
J TCK	9	10	GND
Pulled to GND via 10kΩ resistor	11	12	GND
J TDO	13	14	GND
ARM_RESET	15	16	GND
Pulled to GND via 10kΩ resistor	17	18	GND
Pulled to GND via 10kΩ resistor	19	20	GND

7.1.3 J5 – Micro USB connector

This is the micro USB connector.

Table 8: Micro USB connector pin-out

Pin	Function
J5-1	VSUB +5 V IN
J5-2	USBDM to ARM GPIO PA11

Pin	Function
J5-3	USBDP to ARM GPIO PA12
J5-4	ID to ARM GPIO PA10
J5-5	GND

7.1.4 J6 – External SPI connector

The external SPI connector is intended for connection to an external microcontroller or to a PC via a USB to SPI converter (The pin-out of has been arranged to be compatible with that of the "Cheetah" series of SPI to USB converters provided by TotalPhase™), DIL Header, 10 pin, 0.1" pitch.

Table 9: J6 Pin-out

Function	Pin	Pin	Function
Not Connected	1	2	GND
WAKEUP (fit R41, 0Ω)- refer Figure 11	3	4	IRQ (fit R43, 0Ω)- refer Figure 11
MISO – SPI Data out to PC / External Micro	5	6	Not Connected
SCK – SPI Clock from PC / External Micro	7	8	MOSI – SPI Data in from PC / External Micro
SPI CSn – SPI Chip Select from PC / External Micro	9	10	GND

7.1.5 J7 – External DC supply

Optional external DC power supply pin. SIL 2 pin 0.1" pitch

Table 10: J7 pin-out

Pin	Function
J7-1 (GND)	Ground
J7-2 (+VE)	DC supply can be from +3.6 V to +5.5 V

7.2 On-board switch functions

7.2.1 S1

S1 is a SPST 8-way switch. Its various functions are described in the table below.

Table 11: S1 switch configuration descriptions

Switch	Off function	On function	Description
S1-1	Disables ARM booting	Enables ARM booting	If the onboard ARM functionality is not required this switch can be turned off to disable ARM booting.
S1-2	Disable fast onboard ranging	Enable fast onboard ranging	Only used for firmware versions prior to v3.05. When turned on the ranging response time is set to 5 ms. When turned off, the ranging response time is set to 150 ms. This switch is not used for software version v3.05 and above.
S1-3	Enable USB to SPI application	Disable USB to SPI application	When switched off, the USB to SPI application runs on the onboard ARM to enable "DecaRanging" PC application to control the DW1000.
S1-4	Enable DecaRanging Tag function	Enable DecaRanging Anchor function	Switches between on-board "DecaRanging" Anchor and Tag functionality.
S1-5	Operational mode selection	Operational mode selection	See **EVB1000 operational modes** for the functionality of this switch
S1-6	Operational mode selection	Operational mode selection	See **EVB1000 operational modes** for the functionality of this switch
S1-7	Operational mode selection	Operational mode selection	See **EVB1000 operational modes** for the functionality of this switch
S1-8	Disable remote response time configuration	Enable remote response time configuration	Only used for firmware versions prior to v3.05. When turned on, allows the "DecaRanging" PC application to modify the default 150 ms response time in the embedded DecaRanging application. When turned off, this functionality is not available. This switch is not used for software version v3.05 and above.

7.2.2 S2

S2 is a SPST 6-way switch. Its various functions are described in the table below. It disables the DW1000 SPI bus connections to the onboard ARM processor.

Table 12: S2 switch configuration descriptions

Switch	ALL Off function	All On function	Description
S2	Disables ARM SPI connection to DW1000	Enables ARM SPI connection to DW1000	If the onboard ARM functionality is not required this switch can be turned off to disable ARM SPI connection to the DW1000.

7.2.3 S3

S3 is a SPST 4-way switch. Its various functions are described in the table below.

Table 13: S3 switch configuration descriptions

Switch	Off function	On function	Description
S3-1	Disconnects onboard ARM PA0 GPIO to DW1000 RSTn pin	Connects onboard ARM PA0 GPIO to DW1000 RSTn pin	If used it allows ARM GPIO PA0 pin to connect to DW1000 RSTn pin. This allows ARM to reset the DW1000. **This should be on when running the onboard ARM application.**
S3-2	Disables LED 0	Enables LED 0	Can be used to enable or disable LED 0. (current consumption measurement)
S3-3	Selects DW1000 SPI mode	Selects DW1000 SPI mode	This switch can be used to select DW1000 SPI mode it is connected to DW1000 GPIO 5 pin. For more information see Reference [2].
S3-4	Selects DW1000 SPI mode	Selects DW1000 SPI mode	This switch can be used to select DW1000 SPI mode it is connected to DW1000 GPIO 6 pin. For more information see Reference [2].

7.2.4 SW1

This is the ARM reset button.

Table 14: SW1 ARM reset button

Switch	Pressed	Released	Description
SW1	Forces hardware reset of ARM processor	Allows ARM processor to operate normally	Is used to allow reset the ARM processor.

7.3 On-board 2-pin jumper functions

Table 15: J10 function

Jumper	In	Out	Description
J10	Connects main 3.3V power from DW1000	Disconnects main 3.3V power from DW1000	Enables DW1000 power/current measurement.

7.4 On-board 3-pin headers with jumper functions

7.4.1 J2 and J3 functions

Table 16: J2 and J3 functions

Jumper	In pins 1 & 2	In pins 2 & 3	Out	Description
J2	DW1000 uses 3.3 V supply for VDDLDO	DW1000 uses external DC-DC 1V8 supply for VDDLDO as current saving option	DW1000 VDDLDO power disconnected	For more information see Reference [2].
J3	DW1000 uses 3.3 V supply for VDDLDO2	DW1000 uses external DC-DC 1V8 supply for VDDLDO2 as current saving option	DW1000 VDDLDO2 power disconnected	For more information see Reference [2].

7.4.2 J8 and J9 functions

Table 17: J8 and J9 functions

Jumper	In pins 1 & 2	In pins 2 & 3	Out	Description
J8	Enables EVB1000 powering from J7	Enables EVB1000 powering from J5	EVB1000 is not powered	Enables different power configuration options.
J9	In this mode the externally applied supply is connected to the onboard circuitry through a 3.3V voltage regulator	n/a	Voltage regulator is disconnected – EVB1000 is not powered.	Must be connected for EVB1000 power.

7.5 On-board LED functions

Table 18: LED Functions

LED number on PCB	Colour	Function
LED0	Red	Indicates power is applied to the EVB1000

LED number on PCB	Colour	Function
LED3	Red	Connected to GPIO3 of the DW1000. Function is firmware dependent but is typically used to indicate that the DW1000 is in transmit mode
LED4	Red	Connected to GPIO2 of the DW1000. Function is firmware dependent but is typically used to indicate that the DW1000 is in receive mode
LED5	Yellow	Connected to PC6 of the on-board microcontroller. Function is firmware dependent. Consult product documentation.
LED6	Red	Connected to PC7 of the on-board microcontroller. Function is firmware dependent. Consult product documentation.
LED7	Yellow	Connected to PC8 of the on-board microcontroller. Function is firmware dependent. Consult product documentation.
LED8	Red	Connected to PC9 of the on-board microcontroller. Function is firmware dependent. Consult product documentation.