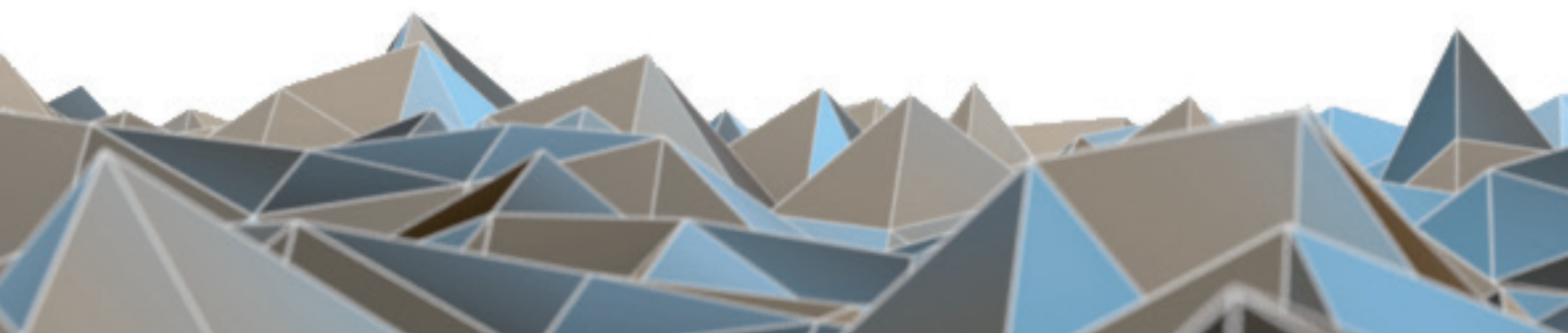
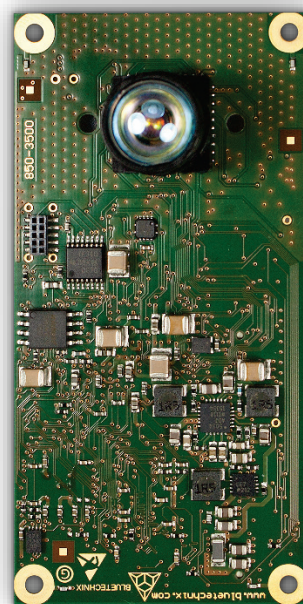


BLUETECHNIX
Embedding Ideas

TIM-UP – 19k-S3-Spartan 6

Software User Manual

Version 2



Contact

Bluetechnix

Waidhausenstraße 3/19

A-1140 Vienna

AUSTRIA

office@bluetechnix.com

<http://www.bluetechnix.com>

Date: 2014-05-27

Table of Contents

1	General Information.....	5
1.1	Symbols Used.....	5
2	Overview.....	6
3	Interfacing.....	7
3.1	General Data Format.....	7
3.2	USB Interface.....	8
3.3	ISM / I ² C Interface.....	8
3.3.1	I ² C Configuration Interface	8
3.3.2	ISM Data Interface	9
4	Hardware Connectors	10
4.1	TIM Connector ISM Version.....	10
4.2	TIM Connector USB Version.....	12
5	Register Description.....	15
5.1	General Registers.....	15
5.2	Sequence Registers	16
6	Support.....	17
6.1	General Support.....	17
6.2	Software Packages	17
6.2.1	Related Products	17
7	Product History	18
7.1	Version Information	18
7.1.1	TIM ^{uP} – 19k-S3-Spartan6-USB	18
7.1.2	TIM ^{uP} – 19k-S3-Spartan6-ISM	18
7.2	Anomalies.....	18
7.3	Document Revision History	18
8	List of Abbreviations.....	19
A	List of Figures and Tables	20

© Bluetechnix GmbH 2014

All Rights Reserved.

The information herein is given to describe certain components and shall not be considered as a guarantee of characteristics.

Terms of delivery and rights of technical change reserved.

We hereby disclaim any warranties, including but not limited to warranties of non-infringement, regarding circuits, descriptions and charts stated herein.

Bluetechnix makes and you receive no warranties or conditions, express, implied, statutory or in any communication with you. Bluetechnix specifically disclaims any implied warranty of merchantability or fitness for a particular purpose.

Bluetechnix takes no liability for any damages and errors causing of the usage of this board. The user of this board is responsible by himself for the functionality of his application. He is allowed to use the board only if he has the qualification. More information is found in the General Terms and Conditions (AGB).

Information

For further information on technology, delivery terms and conditions and prices please contact Bluetechnix (<http://www.bluetechnix.com>).

Warning

Due to technical requirements components may contain dangerous substances.

1 General Information

This guide applies to the TIM^{UP} - 19k-S3-Spartan6 module from Bluetechnix GmbH. Follow this guide chapter by chapter to set up and understand your product. If a section of this document only applies to certain camera parts, this is indicated at the beginning of the respective section.

1.1 Symbols Used

This guide makes use of a few symbols and conventions:



Warning

Indicates a situation which, if not avoided, could result in minor or moderate injury and/or property damage or damage to the device.



Caution

Indicates a situation which, if not avoided, may result in minor damage to the device, in malfunction of the device or in data loss.



Note

Notes provide information on special issues related to the device or provide information that will make operation of the device easier.

Procedures

A procedure always starts with a headline

1. The number indicates the step number of a certain procedure you are expected to follow. Steps are numbered sequentially.

This sign ➤ indicates an expected result of your action.

References

↪ This symbol indicates a cross reference to a different chapter of this manual or to an external document.

2 Overview

The document describes the necessary steps and settings to work with the TIM^{UP} - 19k-S3-Spartan6 module and describes the firmware dependent interfaces.

This document applies to firmware version 0x11042014

For a hardware compatibility list please refer to our support site.

Software and documentation

 <https://support.bluetechnix.at/wiki/TIM-UP-19k-S3-Spartan6>

3 Interfacing

The TIM^{UP} - 19k-S3-Spartan6 module can be used with two different firmware versions which either provide a USB data and control interface or an ISM parallel sensor interface and I²C control interface. All interfaces are exposed on the 100pin board to board connector.

The interfaces are split into a control and data interface. The control interface is used to set and read the configuration of the TIM^{UP} - 19k-S3-Spartan6 module using a set of registers. For a complete register description refer to:

 5 Register Description

The data interface provides a stream of configurable containers and sequences. For a detailed description of the data output container description refer to our Support Wiki.

 <https://support.bluetechnix.com/wiki/PMDSDK / PMDMDK User Manual#pmdGetSourceData>

3.1 General Data Format

The data output format on both, the USB and the ISM interface, is divided into four containers where each container has its own header. The content of the four containers can be configured using the calculation mode register.

For a complete register description refer to:

 5 Register Description



Figure 3-1 Data Containers



Each header consists of 128 32bit double words of data stored in high byte first order, whereas the data container comes in low byte first order. For a complete description of the header data refer to our support site.

 <https://support.bluetechnix.at/wiki/PMDSDK / PMDMDK User Manual#Source Data Container Header>

The data containers hold the pixel information configured in the calculation mode register. By default, three data containers are configured.

- Data container 0: distances
- Data container 1: amplitudes
- Data container 2: plausibility flags

3.2 USB Interface

For interfacing the TIM^{uP} - 19k-S3-Spartan6 module over USB, a powerful Software Development Kit is provided. The SDK runs under Linux and Windows. Refer to our support site for downloading the SDK and for additional information and documentation.

Software and documentation

 <https://support.bluetechnix.at/wiki/TIM-UP-19k-S3-Spartan6>

3.3 ISM / I²C Interface

3.3.1 I²C Configuration Interface

The TIM^{uP} - 19k-S3-Spartan6 module with the ISM Firmware loaded can be configured using an I²C connection. The I²C control interface of the TIM^{uP} - 19k-S3-Spartan6 module is listening on the following I²C slave address:

- **I²C Address:** 0x5D
- **SCL Frequency:** up to 400kHz

The TIM^{uP} - 19k-S3-Spartan6 module has a set of 32bit registers and is addressed by a 16bit address pointer. Following two figures show the timing diagrams of the I²C read and write.

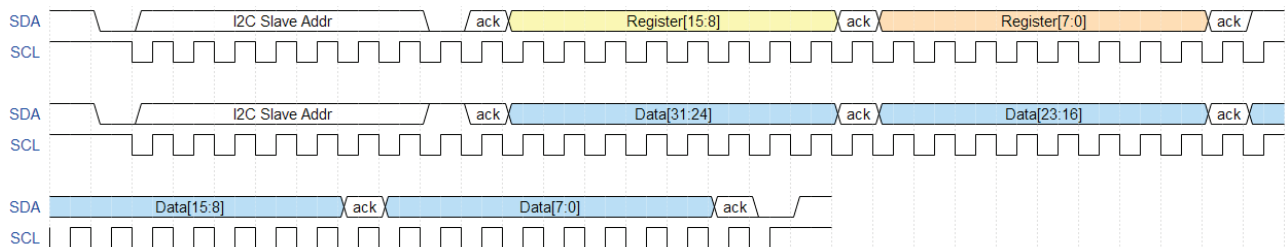


Figure 3-2 I²C register read timing diagram

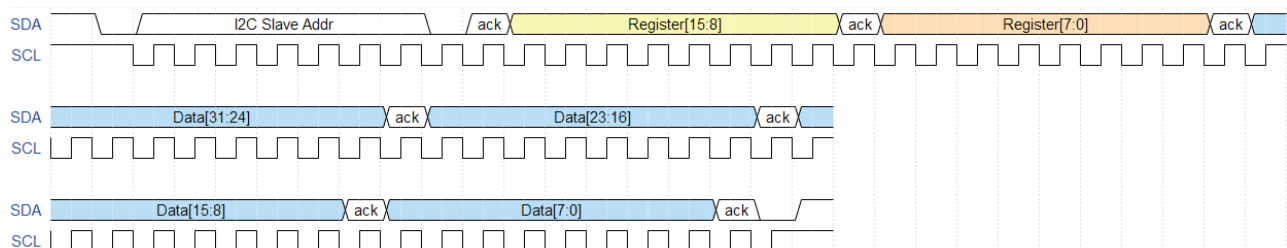


Figure 3-3 I²C register write timing diagram

For a complete register description refer to:

 5 Register Description

3.3.2 ISM Data Interface

In freerun mode, the TIM^{UP} - 19k-S3-Spartan6 module starts transferring frames automatically over ISM and can only be interrupted by switching to manual trigger mode.

Each frame starts with a rising edge on the VSYNC signal followed by a rising edge of the HSYNC signal. With the first HSYNC signal, the first data block is transmitted as shown in Figure 3-4 Timing diagram of the ISM data interface. Every data block contains 512bytes and starts with a HSYNC.

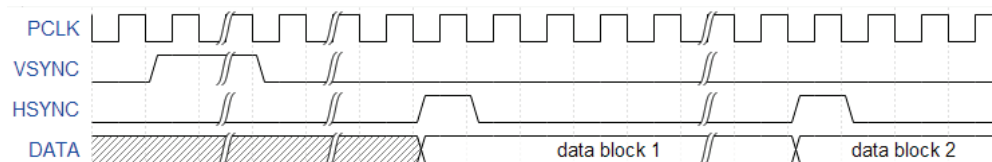


Figure 3-4 Timing diagram of the ISM data interface

Data comes low byte first and has to be captured on every rising edge starting with the rising edge of the HSYNC signal.

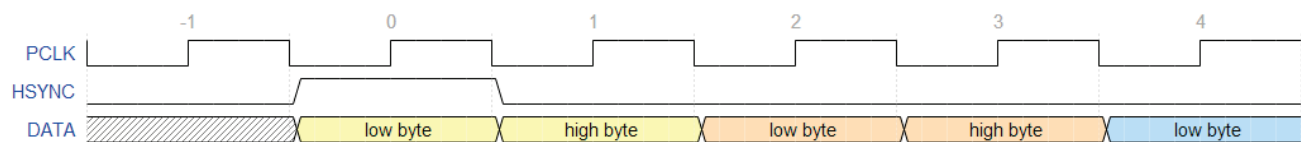


Figure 3-5 Byte order of the ISM data interface



The data stream during one frame is continuous, there is no horizontal blanking before the next HSYNC. The vertical blanking period varies depending on frame rate. Once ISM.nDE is low, the pixel clock never stops. ISM.PCLK stays constant at 48MHz.

4 Hardware Connectors

4.1 TIM Connector ISM Version

The following table shows the pin-out of the 100-pin TIM connector:

Pin #	Type	Signal name	Description
1	I	ISM.nDE	ISM Output enable: 0: ISM bus enabled, 1: ISM bus high Z
2	NC		
3	NC		
4	NC		
5	NC		
6	PWR	GND	Power ground
7	O	ISM.D7	ISM Data Bit 7 (MSB)
8	O	ISM.D6	ISM Data Bit 6
9	O	ISM.D5	ISM Data Bit 5
10	O	ISM.D4	ISM Data Bit 4
11	PWR	GND	Power ground
12	NC		
13	O	ISM.D3	ISM Data Bit 3
14	O	ISM.D2	ISM Data Bit 2
15	O	ISM.D1	ISM Data Bit 1
16	O	ISM.D0	ISM Data Bit 0 (LSB)
17	O	ISM.STROBE	ISM Strobe signal: high during LED modulation
18	I	ISM.TRIGGER	ISM Trigger signal: trigger on rising edge
19	O	ISM.HSYNC	ISM Line Sync (HSYNC)
20	O	ISM.VSYNC	ISM Frame Sync (VSYNC)
21	O	ISM.PCLK	ISM Pixel clock
22	PWR	GND	Power ground
23	NC		
24	I/O	ISM.SDA	ISM Configuration bus data signal
25	I	ISM.SCL	ISM Configuration bus clock signal
26	I	nRESET	Reset signal: hardware reset on low
27	NC		
28	I	ISM.SADDR	ISM Slave address (currently not supported)
29	PWR	GND	Power ground
30	NC		
31	NC		
32	PWR	GND	Power ground
33	NC		
34	NC		
35	PWR	GND	Power ground
36	NC		
37	NC		
38	PWR	GND	Power ground
39	NC		
40	NC		
41	PWR	GND	Power ground
42	NC		
43	NC		
44	NC		



Pin #	Type	Signal name	Description
45	NC		
46	I	UART.RX ⁽¹⁾	UART Receive
47	O	UART.TX ⁽¹⁾	UART Transmit
48	NC		
49	NC		
50	NC		
51	O	LED.SMOD	LIM Single ended mod signal
52	I/O	LED.IO	LIM one-wire communication bus (currently not supported)
53	PWR	GND	Power ground
54	O	LED.MOD_N	LIM Differential pair mod signal – negative
55	O	LED.MOD_P	LIM Differential pair mod signal – positive
56	PWR	GND	Power ground
57	O	GPIO.3	GPIO 3: status signal (toggle on every frame capture)
58	I	GPIO.2	Factory Default Reset: 4sec on low while reboot to delete register map from flash and boot default configuration
59	I	GPIO.1	GPIO 1: not used – internal pull up
60	NC		
61	NC		
62	NC		
63	PWR	GND	Power ground
64	NC		
65	NC		
66	NC		
67	NC		
68	PWR	GND	Power ground
69	NC		
70	NC		
71	PWR	GND	Power ground
72	NC		
73	NC		
74	I	PEN	Module power enable
75	NC		
76	O	SPI.SCLK	Not used – high Z
77	I/O	SPI.SIO0	Not used – high Z
78	I/O	SPI.SIO1	Not used – high Z
79	O	SPI.nCS	Not used – high Z
80	NC		
81	NC		
82	NC		
83	PWR	GND	Power ground
84	NC		
85	NC		
86	NC		
87	NC		
88	PWR	GND	Power ground
89	I/O	USB.D_N	Not used – high Z
90	I/O	USB.D_P	Not used – high Z
91	NC		
92	NC		
93	O	I2CM.SCL	I2C Master Clock signal: connect I2C bus from LIM



Pin #	Type	Signal name	Description
94	O	I2CM.SDA	I2C Master Data signal: connect I2C bus from LIM
95	PWR	GND	Power ground
96	PWR	GND	Power ground
97	PWR	VIN	5V Power supply
98	PWR	VIN	5V Power supply
99	PWR	VIN	5V Power supply
100	PWR	VIN	5V Power supply
101	PWR	GND	Power ground
102	PWR	GND	Power ground
103	PWR	GND	Power ground
104	PWR	GND	Power ground
105	PWR	GND	Power ground
106	PWR	GND	Power ground
107	PWR	GND	Power ground
108	PWR	GND	Power ground
109	PWR	GND	Power ground
110	PWR	GND	Power ground

Table 4-1 Pin-out of the TIM^{UP} – 19k-S3-Spartan6 connector

4.2 TIM Connector USB Version

The following table shows the pin-out of the 100-pin TIM connector:

Pin #	Type	Signal name	Description
1	I	ISM.nDE	Not used – pull down
2	NC		
3	NC		
4	NC		
5	NC		
6	PWR	GND	Power ground
7	O	ISM.D7	Not used – high-Z
8	O	ISM.D6	Not used – high-Z
9	O	ISM.D5	Not used – high-Z
10	O	ISM.D4	Not used – high-Z
11	PWR	GND	Power ground
12	NC		
13	O	ISM.D3	Not used – high-Z
14	O	ISM.D2	Not used – high-Z
15	O	ISM.D1	Not used – high-Z
16	O	ISM.D0	Not used – high-Z
17	O	ISM.STROBE	Not used – high-Z
18	I	ISM.TRIGGER	Not used – high-Z
19	O	ISM.HSYNC	Not used – high-Z
20	O	ISM.VSYNC	Not used – high-Z
21	O	ISM.PCLK	Not used – high-Z
22	PWR	GND	Power ground
23	NC		
24	I/O	ISM.SDA	Not used – high-Z
25	I	ISM.SCL	Not used – high-Z
26	I	nRESET	Reset signal: hardware reset on low



Pin #	Type	Signal name	Description
27	NC		
28	I	ISM.SADDR	Not used – pull down
29	PWR	GND	Power ground
30	NC		
31	NC		
32	PWR	GND	Power ground
33	NC		
34	NC		
35	PWR	GND	Power ground
36	NC		
37	NC		
38	PWR	GND	Power ground
39	NC		
40	NC		
41	PWR	GND	Power ground
42	NC		
43	NC		
44	NC		
45	NC		
46	I	UART.RX	UART Receive: pullup
47	O	UART.TX	UART Transmit
48	NC		
49	NC		
50	NC		
51	O	LED.SMOD	LIM Single ended mod signal
52	I/O	LED.IO	LIM one-wire communication bus (currently not supported)
53	PWR	GND	Power ground
54	O	LED.MOD_N	LIM Differential pair mod signal – negative
55	O	LED.MOD_P	LIM Differential pair mod signal – positive
56	PWR	GND	Power ground
57	O	GPIO.3	status signal (toggle on every frame capture)
58	I	GPIO.2	Factory Default Reset: 4sec on low while reboot to delete register map from flash and boot default configuration
59	I	GPIO.1	not used – internal pull up
60	NC		
61	NC		
62	NC		
63	PWR	GND	Power ground
64	NC		
65	NC		
66	NC		
67	NC		
68	PWR	GND	Power ground
69	NC		
70	NC		
71	PWR	GND	Power ground
72	NC		
73	NC		
74	I	PEN	Module power enable
75	NC		



Pin #	Type	Signal name	Description
76	O	SPI.SCLK	Not used – high Z
77	I/O	SPI.SIO0	Not used – high Z
78	I/O	SPI.SIO1	Not used – high Z
79	O	SPI.nCS	Not used – high Z
80	NC		
81	NC		
82	NC		
83	PWR	GND	Power ground
84	NC		
85	NC		
86	NC		
87	NC		
88	PWR	GND	Power ground
89	I/O	USB.D_N	USB D- Signal: high Z on reset
90	I/O	USB.D_P	USB D+ Signal: high Z on reset
91	NC		
92	NC		
93	O	I2CM.SCL	I2C Master Clock signal: connect I2C bus from LIM
94	O	I2CM.SDA	I2C Master Data signal: connect I2C bus from LIM
95	PWR	GND	Power ground
96	PWR	GND	Power ground
97	PWR	VIN	5V Power supply
98	PWR	VIN	5V Power supply
99	PWR	VIN	5V Power supply
100	PWR	VIN	5V Power supply
101	PWR	GND	Power ground
102	PWR	GND	Power ground
103	PWR	GND	Power ground
104	PWR	GND	Power ground
105	PWR	GND	Power ground
106	PWR	GND	Power ground
107	PWR	GND	Power ground
108	PWR	GND	Power ground
109	PWR	GND	Power ground
110	PWR	GND	Power ground

Table 4-2 Pin-out of the TIM^{uP} – 19k-S3-Spartan6 connector

5 Register Description

Note



Some critical registers are password protected. To enable the functionality, a specific value must be written to the FlashMagic register (0x0014) prior to enable the functionality. This should prevent from unattended enabling of certain functions.

5.1 General Registers

Addr (hex)	Register Name	Default Value (hex)	R/W	Description
01	SerialNumber ¹⁾	-	R	Bit[0:19]: Serial Number Bit[20:31]: Device Type
02	ReleaseDate	-	R	Release date, hex value interpreted as date
03	FrameSize	1C800	R	Frame size in bytes
0B	SequenceLength	1	R/W	Number of sequences to be calculated
0F	CalculationMode ³⁾	22E9F7DF	R/W	Bit[21:22]: Content of container 0 0.. Intensities 1.. corr phase 2.. Amplitudes 3.. Raw phase 0 Bit[23:24]: Content of container 1 0.. Distances 1.. Distances plaus 2.. Plausibility flags 3.. Raw phase 1 Bit[25:26]: Content of container 2 0.. Amplitudes 1.. Amplitudes plaus 2.. Phase Frequency 1 3.. Raw phase 2 Bit[27:28]: Content of container 3 0.. Plausibility flags 1.. Distances 2.. Phase Frequency 2 3.. Raw phase 3
10	TempMainboard	-	R	Temperature of Mainboard in fixedpoint 9.4 [°C]
11	TempIllumination	-	R	Temperature of Illumination in fixedpoint 9.4 [°C]
16	ChipSizeColumns	A0	R	Horizontal count of pixels
17	ChipSizeRows	78	R	Vertical count of pixels
19	TriggerMode	0	R/W	Bit[0]: 0.. free run mode 1.. manual trigger mode
1B	TempLimit	46	R/W	Temperature limit for over temperature protection
30	ModLedEnable ²⁾	11011	R/W	Bit[0]: reserved Bit[1]: enable differential LED mod signal Bit[2]: enable single ended LED mod signal Bit[3]: reserved Bit[4]: enable ISM.STROBE signal during modulation
31	StatusLedEnable ²⁾	0	R/W	Bit[0]: 0.. Status LED disabled 1.. Status LED enabled

Table 5-1 Pin-out of the TIM^{UP} – 19k-S3-Spartan6 connector

¹⁾ The Serial Number field contains the device type code and the serial number. For a list of all device type codes refer to:

 <https://support.bluetechnix.at/wiki/PMDSDK / PMDMDK User Manual#No. Serial.2FCustomer>

²⁾ For detailed information on hardware pins refer to:

 **4 Hardware Connectors** [Hardware Connectors](#)

³⁾ For a detailed description of the calculation mode register refer to:

 <https://support.bluetechnix.at/wiki/PMDSDK / PMDMDK User Manual#Camera Registers>

5.2 Sequence Registers

Addr (hex)	Register Name	Default Value (hex)	R/W	Description
81	Seq0IntegrationTime	1F4	R/W	Integration time of sequence 0 in μ s
82	Seq0ModFreq	1C9C380	R/W	Modulation frequency of sequence 0 in Hz
83	Seq0FrameTime	C350	R/W	Frame Time in μ s of sequence 0
86	Seq0DistOffset	-	R/W	Distance offset in mm of sequence 0
87	Seq0AmpMin		R/W	
8B	Seq1IntegrationTime	1F4	R/W	Integration time of sequence 1 in μ s
8C	Seq1ModFreq	B71B00	R/W	
8D	Seq1FrameTime	C350	R/W	
90	Seq1DistOffset	-	R/W	
91	Seq1AmpMin		R/W	

Table 5-2 Pin-out of the TIM^{UP} – 19k-S3-Spartan6 connector



6 Support

6.1 General Support

General support for products can be found at Bluetechnix' support site

Support Link

 <https://support.bluetechnix.at/wiki/TIM-UP-19k-S3-Spartan6>

6.2 Software Packages

Software packages and software downloads are for registered customers only

Support Link

 <https://support.bluetechnix.at/wiki/TIM-UP-19k-S3-Spartan6>

6.2.1 Related Products

- LIM-U-LED-850

7 Product History

7.1 Version Information

7.1.1 TIM^{uP} – 19k-S3-Spartan6-USB

Version	Release date	Changes
0x28042014	April 2014	First preliminary version

Table 7-1: Overview TIM^{uP} – 19k-S3-Spartan6-USB firmware changes

7.1.2 TIM^{uP} – 19k-S3-Spartan6-ISM

Version	Release date	Changes
0x11042014	April 2014	First preliminary version

Table 7-2: Overview TIM^{uP} – 19k-S3-Spartan6-ISM firmware changes

7.2 Anomalies

Version	Date	Description
V1.0	2014 04 28	No anomalies reported yet.

Table 7-3 – Product anomalies

7.3 Document Revision History

Version	Date	Document Revision
1	2014 04 28	First release V1.0 of the Document
2	2014 05 16	Unused Pins changed from pulldown to high-Z

Table 7-4: Revision history



8 List of Abbreviations

Abbreviation	Description
DC	Direct Current
EBI	External Bus Interface
ESD	Electrostatic Discharge
FPN	Fixed Pattern Noise
FPPN	Fixed Phase Pattern Noise
GPIO	General Purpose Input Output
I	Input
I ² C	Inter-Integrated Circuit
I/O	Input/Output
ISM	Image Sensor Module
NC	Not Connected
O	Output
OS	Operating System
PPI	Parallel Peripheral Interface
PWR	Power
ROI	Region Of Interest
SPI	Serial Peripheral Interface
SPORT	Serial Port
UART	Universal Asynchronous Receiver Transmitter
USB	Universal Serial Bus

Table 8-1: List of abbreviations

A List of Figures and Tables

Figures

Figure 3-1 Data Containers	7
Figure 3-2 I ² C register read timing diagram	8
Figure 3-3 I ² C register write timing diagram	8
Figure 3-4 Timing diagram of the ISM data interface	9
Figure 3-5 Byte order of the ISM data interface	9

Tables

Table 4-1 Pin-out of the TIM ^{uP} – 19k-S3-Spartan6 connector	12
Table 4-2 Pin-out of the TIM ^{uP} – 19k-S3-Spartan6 connector	14
Table 5-1 Pin-out of the TIM ^{uP} – 19k-S3-Spartan6 connector	15
Table 5-2 Pin-out of the TIM ^{uP} – 19k-S3-Spartan6 connector	16
Table 7-1: Overview TIM ^{uP} – 19k-S3-Spartan6-USB firmware changes	18
Table 7-2: Overview TIM ^{uP} – 19k-S3-Spartan6-ISM firmware changes	18
Table 7-3 – Product anomalies	18
Table 7-4: Revision history	18
Table 8-1: List of abbreviations	19