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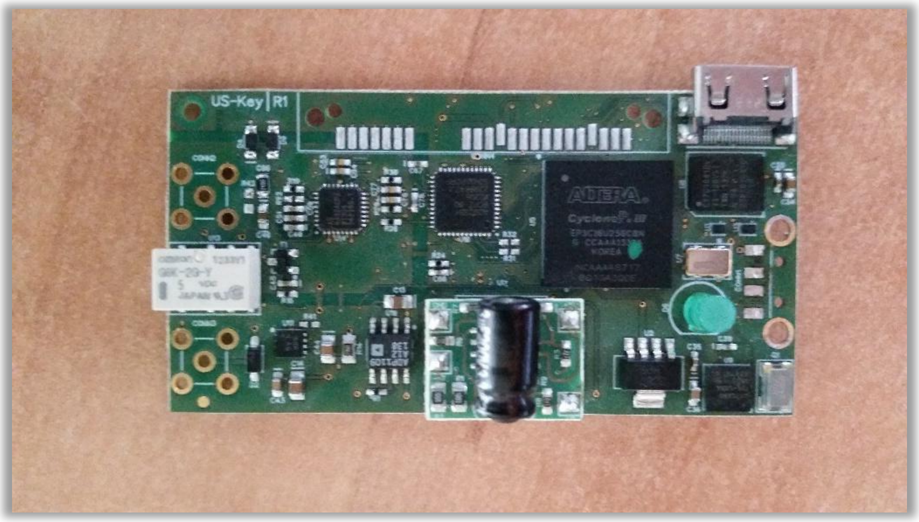
US-SPI

Révision 5.0 le 08/01/2019



1 DESCRIPTION

US-SPI is our new generation ultrasound devices with a single channel to transmit and receive ultrasonic waves.

All functions are available through a SPI bus at 1MHz. This makes the device compatible with any OS or embedded processor.

A single 5 Volts power supply is necessary.

It’s very small size and its advanced technology allows having a unique product for more applications like medical ultrasound imaging, the NDT and also for the research and university.

The transmitter can generate pulses with a voltage level and a width programmed by the user.

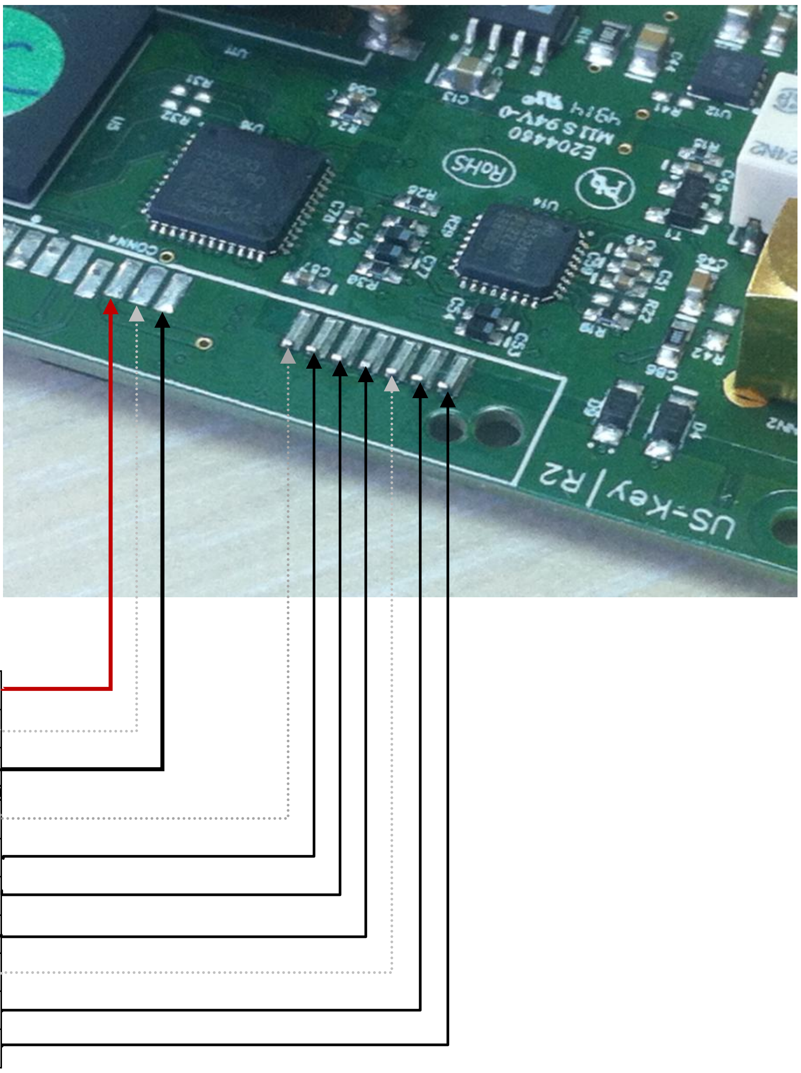
A low noise preamplifier combined to a VGA gives a gain range between 0 and 80 dB, a DAC curve is also available.

The bandwidth of the receiver is 0.5 MHZ to 18 MHz

A 12 bits analog digital converter with a sampling frequency of 80 MHz is used to digitize ultrasound signals (8 bits are only available in the first version).

The device has 2 working modes: Transmission or Reflection.

2 HARDWARE



10	+5VDC 500mA (IN)
9	+3.3 (out)
8	GND
7	X (not wired)
6	SCLK
5	Data MOSI
4	Data MISO
3	X (not wired)
2	/Enable MISO (SS1)
1	/Enable MOSI (SS0)

ATTENTION: Maximum input voltage for all logic signals is 3.3V

2.1 US_SPI print connector

It’s possible to sold a 22pins SATA female right angle connector on US_SPI

- 3M Ref.: 5622-1200-ML
- RS component Ref.: 212-543
- Farnell Ref.: 267-2275

2.2 Complete pin out US_SPI

1	/Enable MOSI	**SPI connection** 2 unidirectional SPI ports **3.3 VDC**
2	/enable MISO	
3	x	
4	Data MISO	
5	Data MOSI	
6	SCLK	
7	x	
8	GND	**Power supply** 5VDC-500mA
9	+3.3VDC (out)	
10	+5VDC (	
11	Analog output Gate 1	**Real Time outputs**
12	Analog output Gate 2	
13	Analog output Gate 3	
14	TTL alarm Gate 1	
15	TTL alarm Gate 2	
16	TTL alarm Gate 3	
17	x	
18	x	
19	x	
20	x	
21	x	
22	x	

3 SPI CONFIGURATION

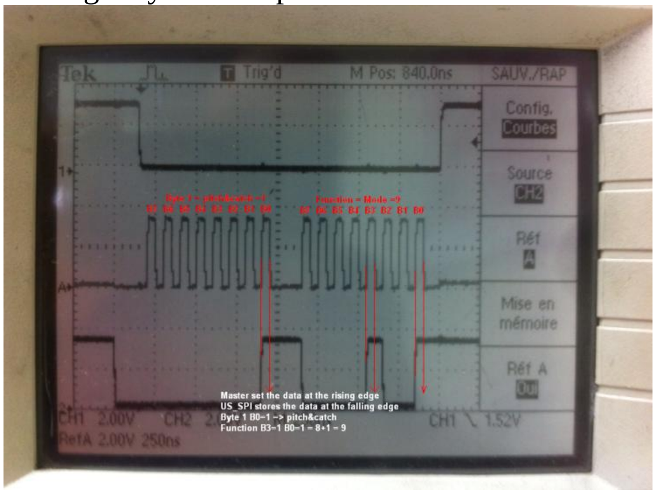
US_SPI uses 2 SPI lines: 1 for Writing and 1 for reading.

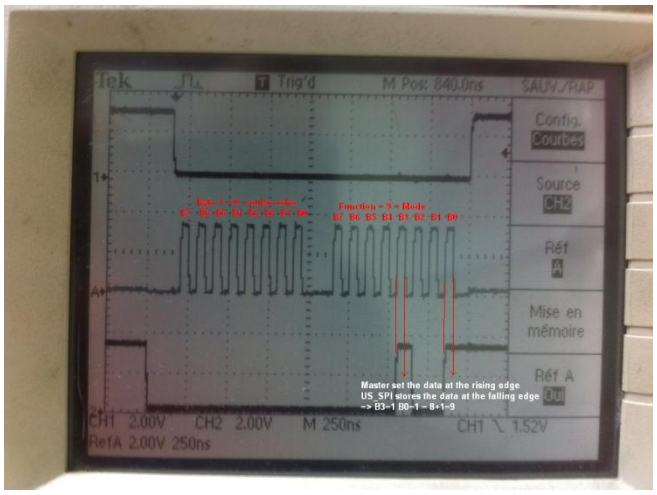
So, the number of wires necessary is 5:

- 2 for Writing (EnableMOSI/, DataMOSI)
- 2 for Reading (EnableMISO/, DataMISO)
- SCLK is common for the 2 ports at 10MHz.

Sleeping state for SCLK=0
Sleeping state for both Enable=1
DataMISO = Hi-Z when EnableMISO/=1

Writing 2 bytes example:





This example shows the function 9 because it needs only 1 byte DATA (0/1) and allows to ear the relay clicking when the program is ok

4 ***SOFTWARE***

To program US-Key SPI it’s necessary to send up to 5 byte.
1 Byte (the last one to send) is a function number that you want to program (CMDSPI).
Depends of this function, between 1 to 4 other byte should be sent.

CMDSPI		Byte 1	Byte 2	Byte 3	Byte 4
Value	Function				
0	Gain	Gain [7..0]	Gain[9..8]	Address[7..0]	-
1	-	-	-	-	-
2	Sampling request	-	-	-	-
3	Compression	Factor[7..0]	-	-	-
4	Automatic Sampling request	X LSB	X MSB	-	-
5	Scale delay	LSB	MSB	-	-
6	High voltage	Voltage [7..0]	-	-	-
7	Pulse width	Width[7..0]	-	-	-
8	PRF	PRF[7..0]	PRF[15..8]	PRF[19..16]	-
9	Mode	0/1	-	-	-
10	Scale	Scale [7..0]	Scale[15..8]	-	-
11	ONOFF DAC	**Bit 0 : 0=ON /1=OFF!!** **Bit 1 : 0=Read/1=Write**	-	-	-
12	Echo-start	Position[7..0]	Position[15..8]	Width[7..0]	Width[15..8]
13	Echo-start	Polarity [7..0]	-	-	-
14	Filter	Filter[2..0]	-	-	-
15	PosWidth G1	Position[7..0]	Position[15..8]	Width[7..0]	Width[15..8]
16	PosWidth G2	Position[7..0]	Position[15..8]	Width[7..0]	Width[15..8]
17	PosWidth G3	Position[7..0]	Position[15..8]	Width[7..0]	Width[15..8]
18	ThresholdAlFilter G1	AlFilter[7..0]	Threshold[7..0]	-	-
19	ThresholdAlFilter G2	AlFilter[7..0]	Threshold[7..0]	-	-
20	ThresholdAlFilter G3	AlFilter[7..0]	Threshold[7..0]	-	-
21	AlDelay	Duration[7..0]	Duration[15..8]	AlarmSet[2..0]	-
22	AnalogOutput	Analog1Set[1..0]	Analog2Set[1..0]	Analog3Set[1..0]	Polarity[1..0]
23	ReadingPortFunction	Port[2..0]	-	-	-
24	Sampling Freq	Sampling[1..0]	-	-	-

5 ***FUNCTIONS***

5.0 Gain (Fct 0):

The Gain value is only on 10bit → Gain[9..0]
You must convert Gain in dB to digital value with the formula: Gain[9..0] = 10*Gain(dB) + 65
For example 0 dB = 65 and 80dB=865

When DAC is OFF, Address[7..0]=0

See below DAC function description (§5.11)

5.1 Not used

5.2 Sampling Request (Fct 2):

When you send CMDSPI=2, the US-Key will store the current A-scan inside its FIFO (4k*12bit)

5.3 Compression (Fct 3):

No compression=0
Compression=1, the number of samples is divided by 2 because US_SPI return the tallest echo between 2
Compression=2, the number of samples is divided by 3 because US_SPI return the tallest echo between 3
Compression=3, the number of samples is divided by 4 because US_SPI return the tallest echo between 4
Etc.

Note:

- Compression is available only if Filter=4=NoFilter AND SamplingFreq=1=80MHz

5.4 Automatic Sampling Request (Fct 4)=Nb samples:

When you will read the Xth samples, the US-Key will store AUTOMATICALLY the current A-scan inside its FIFO. It's faster than recall Fct2 and read again.

5.5 Scale Delay (Fct 5):

Scale delay in step of 25ns !

5.6 Voltage (Fct 6):

Voltage[7..0]=(98/180)*X+81.777   230V<X<10V

5.7 Pulse width (Fct 7):

Pulse width by step of 6.25ns. If value=0 then width=18ns   up to 18+(255*6.25)=1600ns

5.8 Pulse Repetition Frequency (Fct 8):

PRF=Pulse Repetition Frequency → Period in step of 25ns !

5.9 Mode (Fct 9):

Mode 0=Pulse Echo / 1 = pitch & catch

5.10 Scale(Fct 10):

Scale of the A-scan in step of 25ns !
Note: To reduce electronic noise, the high voltage converter is switch off during Scale and restart after

5.11 DAC (Fct 11):

The DAC function is a memory of 256 Gain values read every 650ns.
When the DAC is ON (=0!) this memory is read and the gain is modified from the emission or the interface echo when Echo-start is ON, to 256*650ns=166µs

When the DAC is OFF (=1!), it's not necessary to program Address value in function Gain (Fct 0)

To Program the DAC function :

1- Send Fct 11 = 3 to switch the DAC off and set the memory mode to WRITE
   (3 = Bit0=1=DAC OFF, Bit1=1=Mode Write)
2- Send Fct 0 with 256 Gain[9..0] values and 0<=Address[7..0]<=255 (For loop)
3- Send Fct 11 = 0 to switch the DAC on and set the memory mode to READ
   (0 = Bit0=0=DAC ON, Bit1=0=Mode Read)

To stop the DAC function:

1- Send Fct 11 = 1 to switch the DAC off and let the memory mode to READ
   (1 = Bit0=1=DAC OFF, Bit1=0=Mode Read)
1- RECALL Fct 0 to reprogram the desired global Gain

Note:

- When the DAC is ON, the US_SPI read the complete 256 Gain values memory, so you must program these 256 gain values
- When you already programmed the 256 values, it's possible to reprogram only a part of them

Personal note:

5.12 Echo-Start (Fct 12):

Position[15..0] and width[15..0]by step of 25ns !

5.13 Echo-Start (Fct 13):

Polarity [7..0] !!!   = Echo-start threshold on 8bit.
You must convert Polarity in % to digital value with the formula: Polarity[7..0] = 1.27*Polarity(%) + 128
For example you want set the threshold at -40% → 77
For example you want set the threshold at +50% → 192

Note:
When you have a water path, it's possible to resynchronize the entire time base and gate measurement on the moving interface echo by using Echo-start function.
In this case, program an area where the interface echo should be detected. The beginning of this area = Echo-start position and the duration = Echo-start width.
If Echo-start position<>0 the function is On
If Echo-start position==0 the function is Off

When it's on, the 1st echo over the threshold will resynchronize the complete time base, scale, delay AND gates positions.

Personal note:

5.14 Filters (Fct 14):
Filter → 0=1.25MHz, 1=2.5MHz, 2=5MHz, 3=10MHz, 4=No filter

Note:
- Filters are only available at 80MHz sampling frequency
- They are based on FIR

5.15 Gate 1 position and width (Fct 15):
5.16 Gate 2 position and width (Fct 16):
5.17 Gate 2 position and width (Fct 16):
Hardware Gate measurement step of 25ns: Position[15..0]/Width[15..0]

5.18 Gate 1 threshold alarm filter (Fct 18):
5.19 Gate 2 threshold and alarm filter (Fct 19):
5.20 Gate 3 threshold and alarm filter (Fct 20):
Hardware Gate measurement: Threshold on 8bit=0..255=0..100% AlFilter[7..0]=0 !

5.21 AlDelay (Fct 21):
Duration[15..0] step of 800ns for Alarm and Analog output duration
AlarmSet[0]=AlG1, AlarmSet[1]=AlG2, AlarmSet[2]=AlG3 : 0=Alarm on appearance 1=Alarm on Disappearence

5.22 AnalogOutput (Fct 22):
AnalogχSet 0=OFF 1=TotalAmplitude 2=AmplitudeOverThreshold
Polarity[1..0] 0=Positive&Negative 1=Negative 2=Positive

5.23 ReadingPortFucntion (Fct 23):
ReadingPortFucntion[2..0] : 0=Ascan 8bit / 1=HardwareGateMeasurement / 2=AscanLSB

Note:
- For 8bit A-scan, the 3 1st byte are 10,10,1 else the A-scan is wrong
- HardwareGateMeasurement is a 16bytes frame : AmplG1, AmplG2, AmplG3, DistPeakG1LSB, DistPeakG1MSB, DistPeakG2LSB, DistPeakG2MSB, DistPeakG3LSB, DistPeakG3MSB, Alarm [2..0] , DistEdgeG1LSB, DistEdgeG1MSB, DistEdgeG2LSB, DistEdgeG2MSB, DistEdgeG3LSB, DistEdgeG3MSB

- Alarm[0]=G1, Alarm[1]=G2, Alarm[2]=G3, Alarm[3]=Echo-start

- Distance = step of current sampling frequency

- If ReadingPortFucntion[2..0]=0 The master will read an 8bit Ascan
- To Read an 12bit A-scan :
  - Set ReadingPortFucntion[2..0]=0 to read A-scan[11..4] !!!!
  - Set ReadingPortFucntion[2..0]=2 to read A-scan[3..0] !!!!

See ‘A-scan 12Bit reading

5.24 SamplingFreq (Fct 24):
Sampling Freq: 0=160MHz / 1=80MHz / 2=40MHz/ 3=20MHz

Note:
- Sampling Frequencies are available only if Filter=4=NoFilter AND compression=0

6 ***SOFTWARE PROGRAMMING***

PROGRAMMING US-SPI

This example is written in Basic language and given as a generic code to start development in other languages

In this language the access to SPI is done using this instruction:

```
spi.WriteRead(slave Select,wBuffer,nb of Byte To write,total number of Byte In transaction,rBuffer,number of Byte To read)
```

Where:

Slave Select is the number of the slave (0,1 is this example SS0 is the slave that write into US-SPI and SS1 is the slave that read US-SPI.

wBuffer is the buffer which will be written in US-SPI (bytes)

nb of Byte to write is the number of bytes to write from the wBuffer

number of Byte in transaction is the addition of read and write number of bytes.

rBuffer is the buffer which will be filled by the bytes red in US-SPI

number of Byte to read is the number of bytes to read from US-SPI and store in rBuffer

Example :

```
spi.WriteRead(0,wBuffercmd,3,3,rBuffercmd,0)

Write 3 bytes in US-SPI from wBuffercmd

spi.WriteReadasync(1,wBuffer,0,64,rBuffer,64)

Read 64 bytes from US-SPI and write them in rBuffer
```

6.1 ***Gain programming***

"Gainc" contains the value of gain to be sent to US-SPI (0 to 80 db)

```
calculation_gain = gainc*(875-65)/80+65


wBuffercmd(0)=Floor(calculation_gain/256) 'msb
wBuffercmd(1)=calculation_gain-Floor(calculation_gain/256)*256 'lsb
wBuffercmd(2)=0 'selection gain
spi.WriteRead(0,wBuffercmd,3,3,rBuffercmd,0)
```

<u>NOTES :</u>

6.2 ***Delay programming***

“Delayc” contains the value of the delay (beginning of sampling windows the width of the sampling windows is fix at 200 microseconds)

```
calculation_delay = delayc / 0.025 ' 25 nS step

wBuffercmd(0)=Floor(calculation_delay/256) 'msb
wBuffercmd(1)=calculation_delay-Floor(calculation_delay/256)*256 'lsb
wBuffercmd(2)=5 ' delay selection
spi.WriteRead(0,wBuffercmd,3,3,rBuffercmd,0)
```

NOTES :

6.3 ***Compression factor programming***

"Consfactorcomp" contains the compression factor

```
wBuffera(0)=consfactcomp
wBuffera(1)=3
spi.WriteRead(0,wBuffera,2,2,rBufferl,0)
```

The compression factor is used to modify the sampling frequency:

Compression factor =0 -> sampling frequency 80 MHz
Compression factor =1 -> sampling frequency 40 MHz
Compression factor =2 -> sampling frequency 20 MHz
……………..

The compression factor does not work as a simple sampling frequency divider. It returns the maximum amplitude of the echo in the sampling period.

NOTES :

6.4 ***<u>Transmitter voltage</u>***

Tensionc contains the voltage of the transmitter pulse (between 10 and 250 Volts)

```
wBuffera(0)=tensionc*(98/180)+81.7 'scalling
wBuffera(1)=6
spi.WriteRead(0,wBuffera,2,2,rBufferl,0)
```

<u>NOTES :</u>

6.5 ***Transmitter pulse width***

Conslargeur contains the frequency of the transmitter pulse in MHZ (between 1MHz and 20 MHz)

```
      nb= (1000/(2*conslargeur)-27)/6.5 'convert the pulse frequency in width and
scale it

      wBuffera(0)=nb
      wBuffera(1)=7
      spi.WriteRead(0,wBuffera,2,2,rBufferl,0)
```

NOTES :

6.6 ***Repetition frequency (PRF)***

Consfreqrec contains the frequency of the pulse repetition (between 100Hz and 2 KHz)

```
consfreqrec = (1000000/consfreqrec)/0.025

wBuffera(0)=Floor(consfreqrec/65536)
wBuffera(1)=Floor((consfreqrec-Floor(consfreqrec/65536)*65536)/256)
wBuffera(2)=consfreqrec-Floor((consfreqrec Floor(consfreqrec/65536)*65536)/256)*256
wBuffera(3)=8
spi.WriteRead(0,wBuffera,4,4,rBufferl,0)
```

NOTES :

6.7 ***Receiver Filter***

f contains the frequency of the filter (0=1.25MHz,   1=2.5MHz,   2=5MHz,   3=10MHz,   4=No filter)

```
wBuffercmd(0)=f
wBuffercmd(1)=14
spi.WriteRead(0,wBuffercmd,2,2,rBuffercmd,0)
```

NOTES :

6.8 Transmission/ reflexion (single or dual crystals)

```
   If consreftrans =True Then

      wBuffera(0)= 0
      wBuffera(1)=9
      spi.WriteRead(0,wBuffera,2,2,rBufferl,0)'single crystal
      Else

      wBuffera(0)= 1
      wBuffera(1)=9
      spi.WriteRead(0,wBuffera,2,2,rBufferl,0)'dual crystals

End If
```

NOTES :

6.9 ***Some initializations that must be done (not documented) for futures functions***

Consechascan = 4000

```
wBuffercmd(0)=Floor(consechascan/256) 'msb
wBuffercmd(1)=consechascan-Floor(consechascan/256)*256 'lsb
wBuffercmd(2)=10 'selectionechascan
spi.WriteRead(0,wBuffercmd,3,3,rBuffercmd,0)

      pos=0,duree=10000,polarite=50

      wBuffera(0)=Floor(duree/256)
      wBuffera(1)=duree-Floor(duree/256)*256
      wBuffera(2)=Floor(pos/256) 'msb
      wBuffera(3)=pos-Floor(pos/256)*256
      wBuffera(4)=12
      spi.WriteRead(0,wBuffera,5,5,rBufferl,0)

      wBuffera(0)=polarite
      wBuffera(1)=13
      spi.WriteRead(0,wBuffera,2,2,rBufferl,0)'polarite


      wBuffera(0)=0
      wBuffera(1)=11
      spi.WriteRead(0,wBuffera,2,2,rBufferl,0)

      nbpts=4000

      wBuffercmd(0)=Floor(nbpts/256)
      wBuffercmd(1)=nbpts-Floor(nbpts/256)*256
      wBuffercmd(2)=4
      spi.WriteRead(0,wBuffercmd,3,3,rBuffercmd,0)
```

NOTES :

6.10 ***Signal (RF) acquisition***

The more rapid method to acquire HF raw of samples is to set parameters described at points 1 to 9. Then you ask for a digitalization using:

```
wBuffera(0)=2
spi.WriteRead(0,wBuffera,1,1,rBufferl,0)'Initialise a new digitalisation
```

Then after a time value of PRF period the raw is available in a FIFO inside US-SPI, you just have to read them using:

```
spi.WriteReadasync(1,wBuffer,0,your nb of samples,rBuffer, your nb of samples)
```

rBuffer is filled with the RF raw :

header 1 : 10
header 2 : 10
header 3 : 1
Sample 4 : xx
Sample 5 : xx
Sample 6 : xx
Sample 7 : xx
…

Samples values are binary 0 to 255.

NOTES :

6.11 ***Hardware Gate Measurement***

There are 3 hardware gates which can measure amplitude in real time (PRF)
Each gate can be set by: position, width, threshold, AlarmFilter, AlarmSet and AnalogSet

Polarity, Alarm and Amplitude can be set with a common parameter

Ex:
Gate1: position=1µs → 40 step of 25ns
Gate1: width= 500ns → 20 step of 25ns
Gate1: threshold (8bit)=50% → 128
Gate1: AlarmFilter = 5 strikes before alarm
Gate1: AlarmSet1 = Alarm on Appearance=0
Gate1: AnalogSet1 = Total Amplitude=1

Gate2: position=3µs → 120 step of 25ns
Gate2: width= 800ns → 32 step of 25ns
Gate2: threshold (8bit)=20% → 51
Gate2: AlarmFilter = 0 strikes before alarm
Gate2: AlarmSet2 = Alarm on Appearance=0
Gate2: AnalogSet2 = Total Amplitude=1

Gate3: position=6µs → 240 step of 25ns
Gate3: width= 3µs → 120 step of 25ns
Gate3: threshold (8bit)=75% → 191
Gate3: AlarmFilter = 1 strike before alarm
Gate3: AlarmSet3 = Alarm on DisAppearance=1
Gate3: AnalogSet3 = AmplitudeOverTheshold=2

Common parameter : Polarity:Pos&Neg=0   Alarm&Analog duration 10ms

Programming :

```
' Gate 1
   Width1=500ns/25ns=20
   pos1=1µs=1000ns/25ns=40
   threshold1=50%=50*255/100=128
   AlFilter1=5

   wBuffera(0)= Floor(widht1/256)            'msb=0
   wBuffera(1)= widht1-Floor(widht1/256)*256 'lsb=20
   wBuffera(2)= Floor(pos1/256)              'msb=0
   wBuffera(3)= pos1-Floor(pos1/256)*256     'lsb=40
   wBuffera(4)= 15                           'PosWidth Gate1
   spi.WriteRead(0,wBuffera,5,5,rBufferl,0)

   wBuffera(0)= threshold1                   '=128
   wBuffera(1)= AlFilter1                    '=5 strikes before alarm
   wBuffera(2)= 18                           'Threshold AlFilter Gate1
   spi.WriteRead(0,wBuffera,3,3,rBufferl,0)
```

‘ Gate 2

```
Width2=800ns/25ns=32
Pos2=3µs=3000ns/25ns=120
Threshold2=20%=20*255/100=51
AlFilter2=0

wBuffera(0)= Floor(widht2/256)              ‘msb=0
wBuffera(1)= widht2-Floor(widht2/256)*256 ‘lsb=32
wBuffera(2)= Floor(pos2/256)                'msb=0
wBuffera(3)= pos2-Floor(pos2/256)*256       ‘lsb=120
wBuffera(4)= 16                             ‘PosWidth Gate2
spi.WriteRead(0,wBuffera,5,5,rBufferl,0)

wBuffera(0)= threshold2                     ‘=51
wBuffera(1)= AlFilter2                      ‘=0 strikes before alarm
wBuffera(2)= 19                             ‘Threshold AlFilter Gate2
spi.WriteRead(0,wBuffera,3,3,rBufferl,0)
```

‘ Gate 3

```
Width3=3µs=3000ns/25ns=120
Pos3=6µs=6000ns/25ns=240
Threshold3=75%=75*255/100=191
AlFilter3=1

wBuffera(0)= Floor(widht3/256)              ‘msb=0
wBuffera(1)= widht3-Floor(widht3/256)*256 ‘lsb=120
wBuffera(2)= Floor(pos3/256)                'msb=0
wBuffera(3)= pos3-Floor(pos3/256)*256       ‘lsb=240
wBuffera(4)= 17                             ‘PosWidth Gate2
spi.WriteRead(0,wBuffera,5,5,rBufferl,0)

wBuffera(0)= threshold3                     ‘=191
wBuffera(1)= AlFilter3                      ‘=1 strikes before alarm
wBuffera(2)= 20                             ‘Threshold AlFilter Gate3
spi.WriteRead(0,wBuffera,3,3,rBufferl,0)
```

‘ Common Parameters

```
Polarity=0
Tempo=10ms=10000000ns/800ns=12500
AlarmSetX=AlarmSet1+(AlarmSet2*2)+(AlarmSet3*4)=4

wBuffera(0)= Polarity                       ‘0=positive AND negative
wBuffera(1)= 2                              ‘2=Over Threshold Gate3
wBuffera(2)= 1                              '1=Total Amplitude Gate2
wBuffera(3)= 1                              ‘1=Total Amplitude Gate1
wBuffera(4)= 22                             ‘AnalogSetX Polarity
spi.WriteRead(0,wBuffera,5,5,rBufferl,0)

wBuffera(0)= AlarmSetX                      ‘=4
wBuffera(1)= Floor(Tempo/256)               ‘48
wBuffera(2)= Tempo-Floor(Tempo/256)*256     ‘212
wBuffera(3)= 21                             ‘AlarmSetX Duration
spi.WriteRead(0,wBuffera,4,4,rBufferl,0)
```

<u>NOTES :</u>

6.12 Reading Port Function

‘A-scan 8Bit reading

```
wBuffera(0)=0                           ‘0=A-scan
wBuffera(1)=23                          ‘ReadingPortFunction
spi.WriteRead(0,wBuffera,2,2,rBufferl,0)


wBuffera(0)=2
spi.WriteRead(0,wBuffera,1,1,rBufferl,0)'Initialise a new digitalisation
```

Then after a time value of PRF period the raw is available in a FIFO inside US-SPI, you just have to read them using:

```
spi.WriteReadasync(1,wBuffer,0,your nb of samples,rBuffer, your nb of samples)
```

‘Hardware Gate Measures reading

```
wBuffera(0)=1                           ‘0=Measures
wBuffera(1)=23                          ‘ReadingPortFunction
spi.WriteRead(0,wBuffera,2,2,rBufferl,0)

spi.WriteRead(0,wBuffera,0,10,rBufferl,10)

Ampl1=(Bit.AND(rBufferl(0),0xff))*100/255‘%
Ampl2=(Bit.AND(rBufferl(1),0xff))*100/255‘%
Ampl3=(Bit.AND(rBufferl(2),0xff))*100/255‘%
Dist1=(Bit.AND(rBufferl(3),0xff)+(256*Bit.AND(rBufferl(4),0xff)))*12.5/1000’µs
Dist2=(Bit.AND(rBufferl(5),0xff)+(256*Bit.AND(rBufferl(6),0xff)))*12.5/1000’µs
Dist3=(Bit.AND(rBufferl(7),0xff)+(256*Bit.AND(rBufferl(8),0xff)))*12.5/1000’µs
Alarme=(Bit.AND(rBufferl(9),0xff))
If (Bit.AND(Alarme,1)=1) then Alarme1=True Else Alarme1=False
If (Bit.AND(Alarme,2)=2) then Alarme2=True Else Alarme2=False
If (Bit.AND(Alarme,4)=4) then Alarme3=True Else Alarme3=False
```

NOTES :

6.13 ‘A-scan 12Bit reading

```
wBuffera(0)=2
spi.WriteRead(0,wBuffera,1,1,rBufferl,0)'Initialize a new digitalization

wBuffera(0)=2                                 ‘2=A-scan LSB  [3..0]
wBuffera(1)=23                                ‘ReadingPortFunction
spi.WriteRead(0,wBuffera,2,2,rBufferl,0)

spi.WriteReadasync(1,wBuffer,0,your nb of samples,rBuffer1, your nb of samples)

wBuffera(0)=0                                 ‘2=A-scan 8bit  [11..4]
wBuffera(1)=23                                ‘ReadingPortFunction
spi.WriteRead(0,wBuffera,2,2,rBufferl,0)

spi.WriteReadasync(1,wBuffer,0,your nb of samples,rBuffer2, your nb of samples)
```

```
For i=0 to “Your nb of samples”-1
      Tab(i)=(rBuffer1 and 0x0f) + 16*(rBuffer2 and 0xff)
Next i
```

NOTES :