

SYNCHRONISM UNIT 1PPS WITH LPC1768

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REVISION HISTORY

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1. Introduction

The following system is an improvement of OAY-11 Synchronism Unit with LPC1768 uController, for ending with original analog system errors. OAY-11 Synchronism Unit goal is the study of hydrogen maser stability by comparing with a GPS signal from Yebes Observatory's VLBA, and independent from STM (Station Timing Module).

Figure 1 diagram shows the basic operation of the system: 5MHz input from maser is introduced by P1.28 pin, that counts rising edges from input signal and determines low and high level times (100us high, that is GPS signal's level up time, and 999.9ms low, that is resting time) in P1.18 pin output by an internal clock from LPC1768 PWM register. GPS signal is introduced by P2.10 pin, that generates an interrupt every input's rising edge. Reset happens if P2.10 interrupt is generated and reset button (connected to P1.26 pin) is pressed. As GPS input frequency is 1Hz, is advisable to press the reset button more than one second.



Figure 1: Block diagram of the system.



2. Equipment

2.1. LPC1768

LPC1768-Mini-DK2 is a small evaluation board production by Haoyu electronic, it based on the NXP (NXP Semiconductors) LPC1700 series processors (Cortex-M3 core).

	H-TH Power	NCU
	HE:	
64		

Figure 2: Top view of LPC1768 board.

The reason to use this board, is that Cortex-M3 processor has an appropiate speed (max. CPU speed of the board is 100MHz) for the 5MHz input signal. Other boards like raspberry pi can't work with very high frequencies like this because it OS makes constant interrupts that slow down the CPU max. Speed, therefore this board lacks an OS. Is important not exceed 3.3V GPIO input value.

2.2. USB MINI-JTAG

	2 FOR 20 7 12 12 12 100
-	

Figure 3: Top view of USB MINI-JTAG debugger.

USB-MiniJTAG is an USB powered JTAG emulator supporting a large number of CPU cores. It can supported by all major IDEs such as IAR EWARM, Keil MDK, Rowley CrossWorks, Atollic TrueSTUDIO, IAR EWRX, Renesas HEW, Renesas e2studio, and many others.

2.3. Keil uVision5

Keil µVision combines project management, run-time environment, build facilities, source code editing, and program debugging in a single environment. The program has specific libraries for LPC1768, and initialize and load the code on the board. With the debugger (USB MINI-JTAG) possible to execute the code step by step.



3. Code explanation line by line

3.1. Initialization

-Lines 4 to 8: Functions declaration.

Config GPIO:

-Lines 13 and 14: P1.26 and P2.10 definition as inputs setting to low the pins. As is shown in Figure 5 P1.26 is default in GPIO mode, this mode is used because P1.26 is the synchronization button.

```
1 #include <LPC17xx.h>
 2
   //Declaración de las funciones
 3
 4 void initPWM(void);
 5 void config_GPIO (void);
 6 void inicioPINSEL(void);
 7 void inicioIRQs(void);
 8 void EINT0 IRQHandler(void);
 9
10
11 void config GPIO (void)
12 🖂 {
13
      LPC_GPIO1->FIODIR &= _{\sim}(1<<26); /* P1.26 definido como entrada */
14
      LPC_GPI02->FIODIR &= _{\rm C}\,(1<<10)\,; // P2.10 definido como entrada
15 }
```

PINSEL3	Pin name	Function when 00	Function when 01	Function when 10	Function when 11	Reset value
21:20	P1.26	GPIO Port 1.26	MCOB1	PWM1.6	CAP0.0	00

Figure 4: Initialization	part of the code.
--------------------------	-------------------

Figure 5: P1.26 functions from UM10360, page 120.

3.2. EINT interrupt

The objective is to define the input of GPS signal as an interrupt input that is accessed every time a rising edge on GPS signal takes place. If during an interrupt, synchronize button is pressed, the system restarts, therefore synchronize button should be pressed more tan 1 second, that is the period of GPS signal. The explanation of the functions is:

inicioPINSEL:

-Line 20: P2.10 definition as EINTO (external interrupt 0) setting to high pin 20 from PINSEL4, as is shown in Figure 7.

-Line 22: EINTO configured as edge sensitive setting to high bit 0 of EXTMODE register, as is shown in Figure 9.

-Line 23: EINTO configured as rising-edge sensitive setting to high bit 0 of EXTPOLAR register, as is shown in Figure 10 (every time a rising edge is read in P2.10 the interrupt is accessed).

inicioIRQs: Set priority and enable EINT0 interrupt.

EINTO_IRQHandler: This interrupt is accessed every time a rising edge is read in P2.10.

-Line 38: Clear the interrupt flag from EINTO setting to high bit 0 of EXTINT register, as is shown in Figure 8.

-Line 39: Check that P1.26 has a low level (synchronize button is pressed).

-Line 40: If P1.26 is pressed, initialize PWM function.

<pre>17 void inicioPINSEL(void) 18 19 19 10 10 10 10 10 10 10 10 10 10 10 10 10</pre>
AC_CONNECTION AND A A A A A A A A A A A A A A A A A
25
26 void inicioIRQs (void)
27 早 {
28 //Asignación de prioridades, esto se puede omitir, ya que solo hay una única interrupción 29 NVIC_SetPriorityGrouping(4); 30 NVIC_SetPriority(EINT0_IRQn, 0x2);
32 // Rabiitación de la interrupción
33 NVIC_ENADIEIKQ(EINIO_IKQI);
36 void EINTO IROHandler (void)
37 1
B LPC SC->EXTINT = (1): // Borrar el flag de la EINTO> EXTINT.0
39 if (((LPC GPIO1->FIOPIN>>26) & 0x01)==0){
40 initPWM(); //Si el pin pl.26 está a nivel bajo se ejecuta la funcion initPWM
41 - }
42 }

Figure 6: EINT configuration and intialization.

PINSEL4	Pin name	Function when 00	Function when 01	Function when 10	Function when 11	Reset value
21:20	P2.10	GPIO Port 2.10	EINT0	NMI	Reserved	00

Figure 7: P2.10 functions from UM10360, page 120.



Bit	Symbol	Description	Reset value
0	EINT0	In level-sensitive mode, this bit is set if the EINT0 function is selected for its pin, and the pin is in its active state. In edge-sensitive mode, this bit is set if the EINT0 function is selected for its pin, and the selected edge occurs on the pin.	0
		This bit is cleared by writing a one to it, except in level sensitive mode when the pin is in its active state. ^[1]	

Figure 8: EXTINT definition from UM10360, page 27.

Bit	Symbol	Value	Description	Reset value
0	EXTMODE0	0	Level-sensitivity is selected for EINTO.	0
		1	EINT0 is edge sensitive.	

Figure 9: EXTMODE definition from UM10360, page 28.

Bit	Symbol	Value	Description	Reset value	
0	EXTPOLAR0	EXTPOLAR0	0	EINT0 is low-active or falling-edge sensitive (depending on EXTMODE0).	0
		1	EINT0 is high-active or rising-edge sensitive (depending on EXTMODE0).	_	

Figure 10: EXTPOLAR definition from UM10360, page 28.

3.3. PWM Register

PWM Register introduces 5MHz input from maser by P1.28 pin, that counts rising edges from input signal and determines low and high level times (100us high, 999.9ms low) in P1.18 pin output. The code lines explain is:

-Line 46: Select PWM function with PCONP register.

-Line 48: P1.18 definition as PWM1.1 (PWM output) setting to high pin 5 from PINSEL3, as is shown in Figure 12.

-Line 49: P1.28 definition as PCAP1.0 (PWM input) setting to high pin 25 from PINSEL3, as is shown in Figure 12.

-Line 51: PCR register is used to enable and select the type of each PWM channel. The selection is Single Edge PWM by setting to low pins 0,1 from PCR register (the selection is single edge by default, so this line can be deleted), as is shown in Figure 16.

-Line 52: PWM1 configured as PCAP1.0's edge sensitive setting to high bit 0 of PWM1CTCR register, as is shown in Figure 14.





-Lines 53 and 54: MR1 selected at edge count value equivalent to 100us, and MR0 selected at edge count value equivalent to 1s. MR1 selects up level time, and MR0 the period of output signal. MR Register is shown in Figure 15.

-Line 55: MCR register reset edge count when MR0 happens (so reset at the end of every cycle for generate a new cycle again) by setting to high bit 1 from MCR register.

-Line 57: Enable PWM1.1 output by setting to high bit 9 from PCR register, as is shown in Figure 16.

-Lines 58 and 60: Enable PWM mode and reset TC after cycle count for generate new cycle by setting to high bits 0 and 1 from TCR register, as is shown in Figure 13.

```
44 void initPWM(void)
45 🖂 {
      LPC SC->PCONP |= 1 << 6; //seleccionar funcion PWM
46
47
      LPC_PWM1->TCR = (1<<1); //Reset del TC y PR de PWM1
      LPC_PINCON->PINSEL3 |= (1<<5); //P1.18 como salida PWM1.1
48
49
      LPC PINCON->PINSEL3 |= (0<<24) | (1<<25); //PCAP1.0 para pin p1.28
50
51
     LPC PWM1->PCR = 0x0; //Selección de Single Edge PWM
     LPC PWM1->CTCR = (0<<1) | (1<<0); //CONTAR EN FLANCOS DE SUBIDA de pcapl.0
52
53
     LPC PWM1->MR0 = 5000000; //Match0 cuando pase un segundo
     LPC_PWM1->MR1 = 5000000/10000; //Match1 cuando pasen 100us
54
55
      LPC PWM1->MCR = (1<<1); //Reset del TC de PWM cuando se alcanza el match 0
      LPC PWM1->LER = (1<<1) | (1<<0); //guardar valores en MR0 Y MR1
56
57
      LPC_PWM1->PCR = (1<<9); //activar salida PWM1.1
      LPC PWM1->TCR = (1<<1); //Reset del TC y PR de PWM1
58
59
60
      LPC_PWM1->TCR = (1<<0) | (1<<3); //Activar contadores y modo PWM
61 }
```

PINSEL3	Pin name	Function when 00	Function when 01	Function when 10	Function when 11	Reset value
5:4	P1.18	GPIO Port 1.18	USB_UP_LED	PWM1.1	CAP1.0	00
25:24	P1.28	GPIO Port 1.28	MCOA2	PCAP1.0	MAT0.0	00

Bit	Symbol	Value	Description	Reset Value
0	Counter Enable	1	The PWM Timer Counter and PWM Prescale Counter are enabled for counting.	0
		0	The counters are disabled.	-
1	Counter Reset	1	The PWM Timer Counter and the PWM Prescale Counter are synchronously reset on the next positive edge of PCLK. The counters remain reset until this bit is returned to zero.	0
		0	Clear reset.	_

o olda rosol.

Figure 13: PWM1TCR definition from UM10360, page 527.

Bit	Symbol	Value	Description	Reset Value
1:0	Counter/ Timer Mode	00	Timer Mode: the TC is incremented when the Prescale Counter matches the Prescale Register.	00
		01	Counter Mode: the TC is incremented on rising edges of the PCAP input selected by bits 3:2.	-
		10	Counter Mode: the TC is incremented on falling edges of the PCAP input selected by bits 3:2.	
		11	Counter Mode: the TC is incremented on both edges of the PCAP input selected by bits 3:2.	-
3:2	Count Input Select		When bits 1:0 of this register are not 00, these bits select which PCAP pin which carries the signal used to increment the TC.	00
		00	PCAP1.0	_
		01	PCAP1.1 (Other combinations are reserved)	
31:4	-		Reserved, user software should not write ones to reserved bits. The value read from a reserved bit is not defined.	NA

Figure 14: PWM1CTCR definition from UM10360, page 528.

Bit	Symbol	Valu e	Description	Reset Value
0	PWMMR0I	1	Interrupt on PWMMR0: an interrupt is generated when PWMMR0 matches the value in the PWMTC.	0
		0	This interrupt is disabled.	_
1	PWMMR0R	1	Reset on PWMMR0: the PWMTC will be reset if PWMMR0 matches it.	0
		0	This feature is disabled.	
2	PWMMR0S	1	Stop on PWMMR0: the PWMTC and PWMPC will be stopped and PWMTCR[0] will be set to 0 if PWMMR0 matches the PWMTC.	0
		0	This feature is disabled	

Figure 15: PWM1MR definition from UM10360, page 528.

Table 452: PWM Control Register (PWM1PCR - address 0x4001 804C) bit description

Bit	Symbol	Value	Description	Reset Value
1:0	Unused		Unused, always zero.	NA
9	PWMENA1	1	The PWM1 output enabled.	0
		0	The PWM1 output disabled.	

Figure 16: PWM1PCR definition from UM10360, page 530, 531.



3.4. Main

Main only call functions explained before.

```
63 int main(void)
64 □ {
65 config_GPIO ();
66 inicioPINSEL();
67 inicioIRQs();
68
69 while(1);
70 }
```

Figure 17: Main of the code.



Figure 18: P1.18 pin output signal. Is shown the signal frequency of 1Hz and pulse width of 100us. The two square input signals are introduced by a signal generator, and have the frequency values of 5MHz (maser) and 1Hz (GPS), with amplitude of 1.5Vpp.

4. Experimental results



5. References

- UM10360 LPC176x/5x User manual - NXP

6. Appendix1: Keil uVision environment:

6.1. Create Project with Keil uVision5 for LPC1768 device

1. First of all, download Keil uVision5 and LPC17xx pack from Keil.com.

2. Pulse Project-New uVison Project and save it in a file previusly created. Then a window like Figure 19 one appears. We are going to select our device, pulse NXP-LPC1700 series-LPC176x-LPC1768 as is shown in Figure 20 and pulse OK.

Select Device for Target 'Target 1'	×
Device Software Packs Vendor: <unknown> Device: <unknown></unknown></unknown>	
Toolset: <unknown> Search:</unknown>	
Description:	
ARM NXP	× >
OK Cancel	Help

Figure 19



Select Dev	ice for Target 'Target 1'		\times
Vendor: Device: Toolset: Search:	Software Packs NXP LPC1768 ARM	▼	
	NXP LPC1700 Series LPC175x LPC176x LPC1763 LPC1764 LPC1764 LPC1765 LPC1766 LPC1766 LPC1767 LPC1768	Description: NXP's LPC1700 series are high performance MCUs for embedded applications featuring a high level of integration and low power consumption. Typical applications include eMetering, Lighting, Industrial networking, Alarm systems, White goods and Motor control. Quadrature Encoder interface, Motor control PWM for three-phase motor 2 input plus 2-output I2S-bus interface Code Read Protection (CRP) with different security levels. Unique device serial number 	
		OK Cancel Help	

Figure 20



3. Then a window like Figure 21 one appears, is required to activate the cells CMSIS-CORE and Device-GPIO-Startup like in Figure 22.

oftware Component	Sel.	Variant		Version	Description	
💠 Board Support		MCB1700	1	1.0.0	Keil Development Board MCB1700	
🔸 💠 CMSIS					Cortex Microcontroller Software Interface Components	
💠 CMSIS Driver					Unified Device Drivers compliant to CMSIS-Driver Specifications	
💠 Compiler		ARM Compiler	1	1.6.0	Compiler Extensions for ARM Compiler 5 and ARM Compiler 6	
💠 Device					Startup, System Setup	
💠 File System		MDK-Plus	~ 6	6.13.8	File Access on various storage devices	
💠 Graphics		MDK-Plus	~ 6	6.10.8	User Interface on graphical LCD displays	
Network		MDK-Plus	~ 1	7.14.0	IPv4 Networking using Ethernet or Serial protocols	
🔶 USB		MDK-Plus	~ (6.14.1	USB Communication with various device classes	
1						
] bildation Output		Descriptic	on			
l alidation Output		Descriptic	on			

Figure 21

Sel.	variant		Version	Description	
	MCB1700		1.0.0	Keil Development Board MCB1700	
				Cortex Microcontroller Software Interface Components	
V			5.4.0	CMSIS-CORE for Cortex-M, SC000, SC300, ARMv8-M, ARMv8.1-M	
	Source	\sim	1.8.0	CMSIS-DSP Library for Cortex-M, SC000, and SC300	
			1.3.0	CMSIS-NN Neural Network Library	
_			1.0.0	CMSIS-RTOS API for Cortex-M, SC000, and SC300	
			2.1.3	CMSIS-RTOS API for Cortex-M, SC000, and SC300	
				Unified Device Drivers compliant to CMSIS-Driver Specifications	
	ARM Compiler	_	1.6.0	Compiler Extensions for ARM Compiler 5 and ARM Compiler 6	
		_		Startup, System Setup	
			1.2.0	GPDMA driver used by RTE Drivers for LPC1700 Series	
			1.1.0	GPIO driver used by RTE Drivers for LPC17xx Series	
Ē			1.0.0	Pin Connect driver used by RTE Drivers for LPC1700 Series	
			1.0.0	System Startup for NXP LPC1700 Series	
	MDK-Plus	\sim	6.13.8	File Access on various storage devices	
	MDK-Plus	~	6.10.8	User Interface on graphical LCD displays	
	MDK-Plus	~	7.14.0	IPv4 Networking using Ethernet or Serial protocols	
	MDK-Plus	V	6 14 1	USB Communication with various device classes	
	Description				_
		MCB1700 MCB1700 Source Source ARM Compiler MDK-Plus MDK-Plus MDK-Plus Description	MCB1700 MCB1700 Source V ARM Compiler MDK-Plus V MDK-Plus V MDK-Plus V MDK-Plus V	MCB1700 1.0.0 Source 1.8.0 Source 1.8.0 1.3.0 1.0.0 ARM Compiler 1.6.0 Image: Source 1.8.0 ARM Compiler 1.6.0 Image: Source 1.0.0 Image: Source 5.13.8 MDK-Plus 5.14.1 Image: Source 5.14.1 Image: Source Source Image: Source Source <td< td=""><td>MCB1700 1.00 Kall Development Board MCB1700 V S.4.0 Contex Microcontoller Software Interface Components V S.4.0 CMSIS-COBE for Contex M. SCOOL 2000, ABM/6-ML ABM/6-1.M Source 18.0 CMSIS-COBE for Contex M. SCOOL 2000, ABM/6-ML ABM/6-1.M Image: Source 18.0 CMSIS-COBE for Contex M. SCOOL 2000, ABM/6-ML ABM/6-1.M Image: Source 18.0 CMSIS-RDIS API for Contex-ML SCOOL 2000, and SC300 Image: Source 1.0.0 CMSIS-RDIS API for Contex-ML SCOOL 2000, and SC300 Image: Source 2.1.3 CMSIS-RDIS API for Contex-ML SCOOL 2000, and SC300 Image: Source 1.0.0 CMSIS-RDIS API for Contex-ML SCOOL 2000, and SC300 Image: Source 1.0.0 CMSIS-RDIS API for Contex-ML SCOOL 2000, and SC300 Image: Source 1.0.0 CMSIS-RDIS API for Contex-ML SCOOL 2000, and SC300 Image: Source 1.0.0 CMSIS-RDIS API for Contex-ML SCOOL 2000, and SC300 Image: Source 1.0.0 Complex companitor Contex compared Contex compared contex Image: Source 1.0.0 Complex complex compared contex Image: Source 1.0.0 Complex compared by RED Drivers for LPC1700 Series Image: Source 1.0.0 System Statup for NDP LPC1700 Series Image: MDK-Plus 1.0.0 System Instructon to strate dovice classes <!--</td--></td></td<>	MCB1700 1.00 Kall Development Board MCB1700 V S.4.0 Contex Microcontoller Software Interface Components V S.4.0 CMSIS-COBE for Contex M. SCOOL 2000, ABM/6-ML ABM/6-1.M Source 18.0 CMSIS-COBE for Contex M. SCOOL 2000, ABM/6-ML ABM/6-1.M Image: Source 18.0 CMSIS-COBE for Contex M. SCOOL 2000, ABM/6-ML ABM/6-1.M Image: Source 18.0 CMSIS-RDIS API for Contex-ML SCOOL 2000, and SC300 Image: Source 1.0.0 CMSIS-RDIS API for Contex-ML SCOOL 2000, and SC300 Image: Source 2.1.3 CMSIS-RDIS API for Contex-ML SCOOL 2000, and SC300 Image: Source 1.0.0 CMSIS-RDIS API for Contex-ML SCOOL 2000, and SC300 Image: Source 1.0.0 CMSIS-RDIS API for Contex-ML SCOOL 2000, and SC300 Image: Source 1.0.0 CMSIS-RDIS API for Contex-ML SCOOL 2000, and SC300 Image: Source 1.0.0 CMSIS-RDIS API for Contex-ML SCOOL 2000, and SC300 Image: Source 1.0.0 Complex companitor Contex compared Contex compared contex Image: Source 1.0.0 Complex complex compared contex Image: Source 1.0.0 Complex compared by RED Drivers for LPC1700 Series Image: Source 1.0.0 System Statup for NDP LPC1700 Series Image: MDK-Plus 1.0.0 System Instructon to strate dovice classes </td





4. Then, a project is created with Figure 23 files. We are going to create a mian.c file: pulse Source Group 1 with right botton of the mouse and select Add new ítem to Group "Source Group 1". Then in the pop-up window select C File, write the name of the file and pulse Add as ism shown in Figure 24. For ending we can see our new file in Figure 25, you can write the code in main.c and load it in LPC1768.





Add New Item to	Group 'Source Gro	oup 1'	Х
C File (.c)		Create a new C source file and add it to the project.	
C++ File (.cp	pp)		
A Asm File (.s))		
Asm File C-p	preprocessed (.S)		
h Header File	(.h)		
Text File (.t)	d)		
Image File (.*)		
User Code	Template		
Type:	C File (.c)		
Name:	main		
Location:	C:\Users\oanuser	\Desktop\tutorial	
		Add Close Help	

Figure 24





Figure 25

6.2. Drivers installation for USB MINI-JTAG Debugger use in uVision

Device Target Output Listing User	C/C++ (AC6) As	n Linker [Debug Utilities						
NXP LPC1768 Code Generation ARM Compiler: Use default compiler version 6									
Operating system: None									
System Viewer File: Use MicroLIB Big Endian LPC176x5x.svd Use Custom File									
Read/Only Memory Areas		Read/Write M	lemory Areas						
default off-chip Start S	iize Startup	default off-ch	ip Start	Size	NoInit				
ROM1:	0	RAM	1:						
□ ROM2:		RAM	2:						
□ ROM3:	o	RAM	3:						
on-chip		on-ch	iip						
IROM1: 0x0 0x80	• 000	IRAM	1: 0x1000000	0x8000					
IROM2:	С	IRAM.	2: 0x2007C000	0x8000					
	DK Cano	cel D	efaults		Help				

Figure 26: Pulse Target 1- Options for Target "Target 1"-Debug



Options for Target 'Target 1'	×			
Device Target Output Listing User C/C++ (AC6) A C Use Simulator with restrictions Settings Imit Speed to Real-Time Settings Settings	enn Einikei Dobag Utilities ⓒ Use: J-LINK / J-TRACE Cortex ▼ Settings			
Load Application at Startup Run to main() Initialization File: Edit	Load Application at Startup Run to main() Initialization File:			
Restore Debug Session Settings Breakpoints Toolbox Watch Windows & Performance Analyzer Memory Display System Viewer CPU DLL: Parameter: SARMCM3.DLL -MPU	Restore Debug Session Settings			
Dialog DLL: Parameter: DCM.DLL PCM3	Dialog DLL: Parameter: TCM.DLL pCM3			
Warn if outdated Executable is loaded Warn if outdated Executable is loaded Manage Component Viewer Description Files				
OK Car	ncel Defaults Help			

Figure 27: In debug, select J-LINK/J-TRACE Cortex in the rounded area for our USB-MINIJTAG and pulse Settings.



ortex JLink/JTrace Target Driver Setup						
Debug Trace Flash Download J-Link / J-Trace Adapter JTAG Device Chain SN: 4294967295 IDCODE Device: J-Link ARM-OB STM32 IDCODE						
HW : V7.00 dll : V6.86 FW : J-Link ARM-OB STM32 comp Port: Max Clock: JTAG 5 MHz Auto Clk						
Connect & Reset Options Cache Options Download Options Connect: Normal Cache Code Verify Code Download Reset after Connect Cache Memory Download to Flash						
Interface TCP/IP Image: State: ready Image: TCP/IP Image: TCP/IP Image: TCP/I						
Aceptar Cancelar Aplicar						

Figure 28: If in settings appear the text of the rounded area the JTAG has been selected fine, if not you must to install drivers from Figure 29.

🛃 J-Link V722b (32bit)	SEGGER	30/06/2021		7.22b
🕿 Paquete de controladores de Windows - Silicon Laboratories Inc. (silabser) Ports (01/08/2021 10.1.10.103)	Silicon Laboratories Inc.	30/06/2021		01/08/2021 10.1.10
🕿 Paquete de controladores de Windows - KEIL - Tools By ARM (WinUSB) USB (08/29/2013 1.0.0.3)	KEIL - Tools By ARM	30/06/2021		08/29/2013 1.0.0.3
≈ Paquete de controladores de Windows - SEGGER Microcontroller GmbH (WinUSB) USBDevice (06/14/2019 3.00.00.000)	SEGGER Microcontroller GmbH	30/06/2021		06/14/2019 3.00.00
🕿 Paquete de controladores de Windows - Segger (jlink) USB (08/02/2018 2.70.08.0)	Segger	30/06/2021		08/02/2018 2.70.08.0
Taquete de controladores de Windows - SEGGER (JLinkCDC) Ports (06/06/2019 1.34.0.44950)	SEGGER	30/06/2021		06/06/2019 1.34.0.4
🕿 Paquete de controladores de Windows - KEIL - Tools By ARM USBDevice (12/12/2017 1.0.1.0)	KEIL - Tools By ARM	29/06/2021		12/12/2017 1.0.1.0
📧 Microsoft Update Health Tools	Microsoft Corporation	21/06/2021	1,07 MB	2.81.0.0
闄Microsoft Visual C++ 2013 Redistributable (x86) - 12.0.30501	Microsoft Corporation	06/04/2021	17,1 MB	12.0.30501.0
岃Microsoft Visual C++ 2015-2019 Redistributable (x86) - 14.24.28127	Microsoft Corporation	06/04/2021	20,1 MB	14.24.28127.4
岃Microsoft Visual C++ 2012 Redistributable (x64) - 11.0.61030	Microsoft Corporation	06/04/2021	20,5 MB	11.0.61030.0
😹 Realtek High Definition Audio Driver	Realtek Semiconductor Corp.	06/04/2021		6.0.1.6070

Figure 29: Realtek high definition driver and J-LINK driver for correct selection of debugger.

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Figure 30: For execute the code with debugger pulse the button of rounded area.



7. Appendix2: input signal aconditioning board:

5MHz output signal from Hydrogen Maser has a 5V peak to peak voltage value. LPC1768 GPIO pins maximum voltaje is 3V3, and not accept negative voltages, so the input from the maser should be aconditioned. Design has been done in KiCad tool for it later printing on LPKF.

Schematic for signal aconditioning is shown in Figure 31, it consists on introducing Maser signal by Vin port, that is the non inverting input of LM360 comparator, and it compare Vin with ground from inverting input. LM360 is a comparator that compare twice input signals, when the non inverting input is higher than the inverting the output is set to high level, when is smaller the oputput is set to low. Is required to do a symmetric voltage supply. There are two 1uF capacitors for supply voltage, one 10nF capacitor for filtering at the input, a 50 ohms resistance in parallel at the input to match impedances with Maser signal, and a resistive divisor at the output that decreases comparator output voltage by half. In the schematic there are, too, a pull up 5Kohms resistor with a pulse connected to P1.26 pin from LPC1768, that is the push button to synchronize the system.



Figure 31: Schematic.





Figures 32 and 33 show the routing of the PCB and Figure 34 is the real PCB printed with LPKF.

Figure 32: PCB with ground plane.



Figure 33: PCB without ground plane.





Figure 34.



Figure 35: output value of the board, that is a 0 to 2 V 5MHz signal, as is required.