Plataforma de hardware reconfigurable
Armado - Testeo y Documentación de las placas de prototipaje

Luis A. Guanuco

Agosto 2012

1. Introducción

La documentación que se presenta en éste reporte describe los pasos a seguir para el *armado, testéo y depuración* de las distintas placas que conformarán la *Plataforma de Hardware Reconfigurable – PHR*. Se presenta un esquema general de tres etapas, sin embargo, cada una de ellas presenta una complejidad diferente.

Figura 1: Esquema de trabajo a seguir.

2. Armado

2.1. Placas

Actualmente se dispone de cuatro placas PCB, ellas son:

- OT-CPLD

- OOCD Links (USB/JTAG)

- S3Power (INTI)

- FPGA (PHR version BETA)

Cada una de éstas placas se encuentra en una versión de *Prototipaje*, lo que implica que su finalidad es únicamente de *testéo* y generar *documentación* que permitan el desarrollo de sus versiones finales, con las correcciones pertinentes.

2.2. Recursos

Se adjunta a la presente documentación la lista de componentes a utilizar.

2.3.   Placas

Los esquemáticos se adjuntan al final del documento pero aquí se hace presente a modo de ilustración y que se pueda relacionar con sus correspondientes esquemas PCB.

Se recomienda tener cuidado en el proceso de ensamblado/soldado de los componentes. La mayoría de los mismos son SMD, por lo que puede prestarse a confusiones la polarización de capacitores y diodos, como así también la magnitud de cada uno.

Se presentan las figuras de cada placa, haciendo énfasis en diferentes vistas con la finalidad de facilitar el armado de las mismas.

2.3.1.   OT-CPLD

La placa *OT-CPLD* tan solo realiza la adaptación de los pines de un CPLD (XC9572XL) a un formato DIP-40 (40 pines) a fines de ser utilizado en cualquier protoboard. Junto a las dos hileras de pines, la placa contiene un regulador de tensión para el dispositivo lógico; y un puerto de conexión al interface JTAG del CPLD.


Figura 2: Esquemático

(a) Top

(b) Botton

(c) Top & Botton
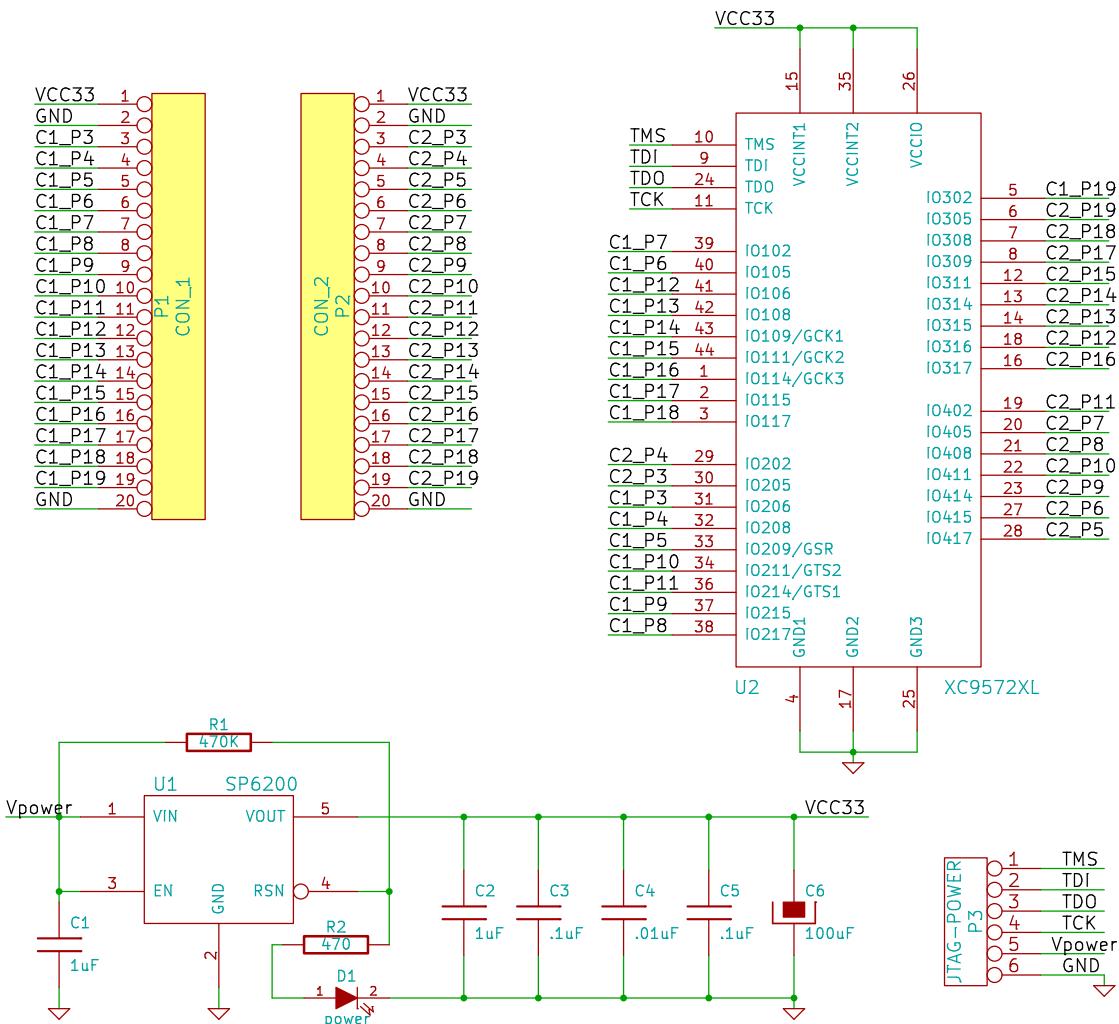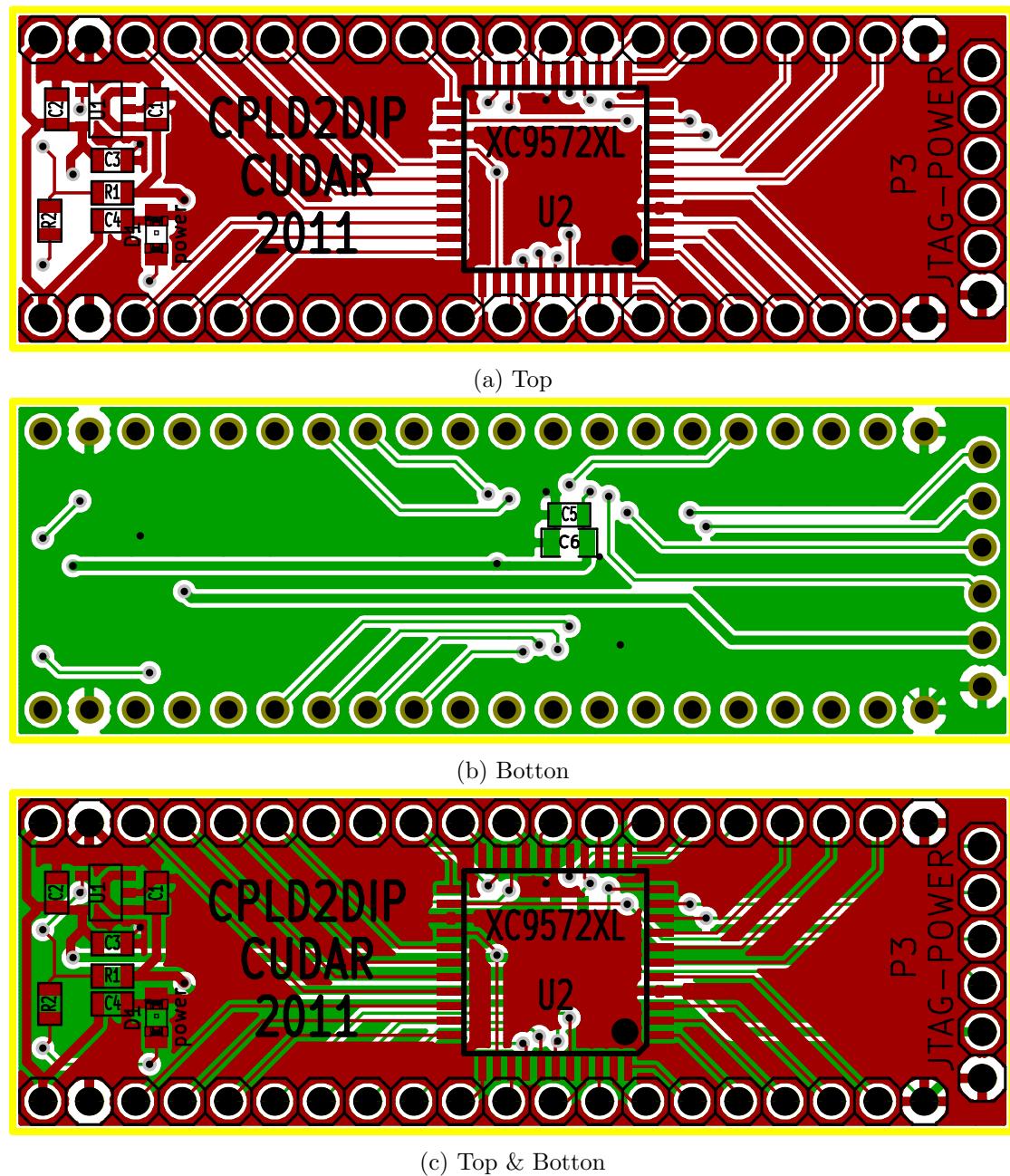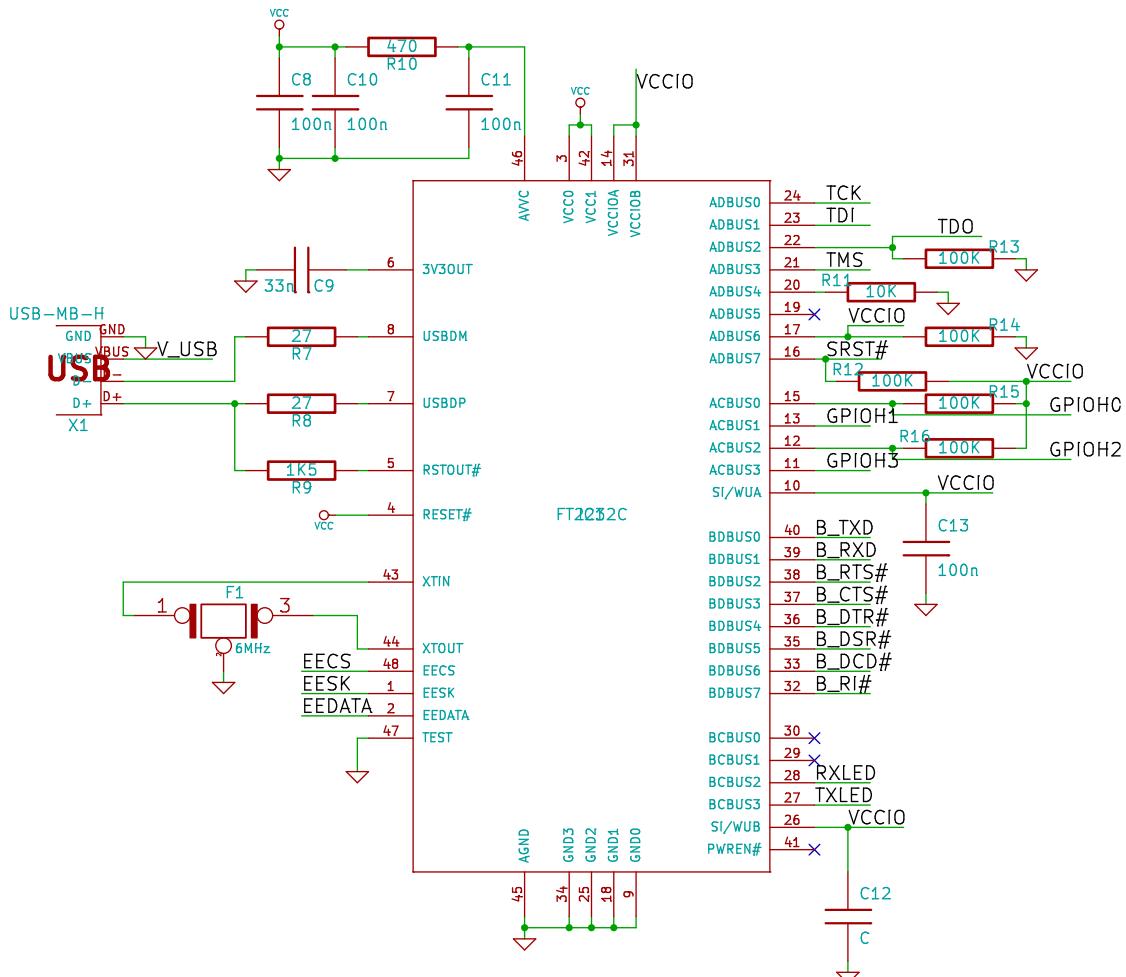
Figura 3: PCB
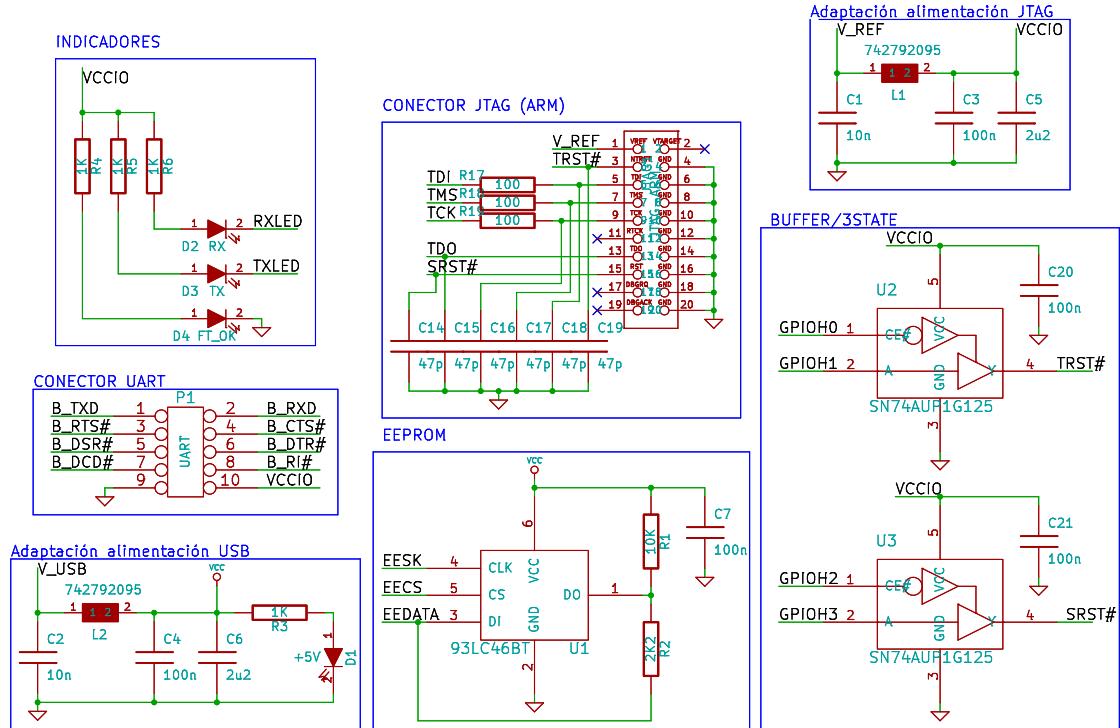
2.3.2.   OOCD Links

La placa *OOCD Links* permite acceder a un interface JTAG mediante un puerto USB (hardware & software). Nacido como un interface para el testéo de hardware mediante software, JTAG se ha convertido en un core clave en la programación de muchos dispisi-tivos actuales como son FPGAs, CPLDs, μCs, μPs, etc. La placa contiene un dispositivo central (FT2232), quién realiza la conversión de los protocolos en forma bidireccional. Los demás bloque simplemente hacen al funcionamiento del FT2232.

(a) FT2232, IC dispositivo interface USB/JTAG

Figura 4: Esquemático

(b) Periféricos

Figura 4: Esquemático (Continuación)

(a) Top

(b) Botton
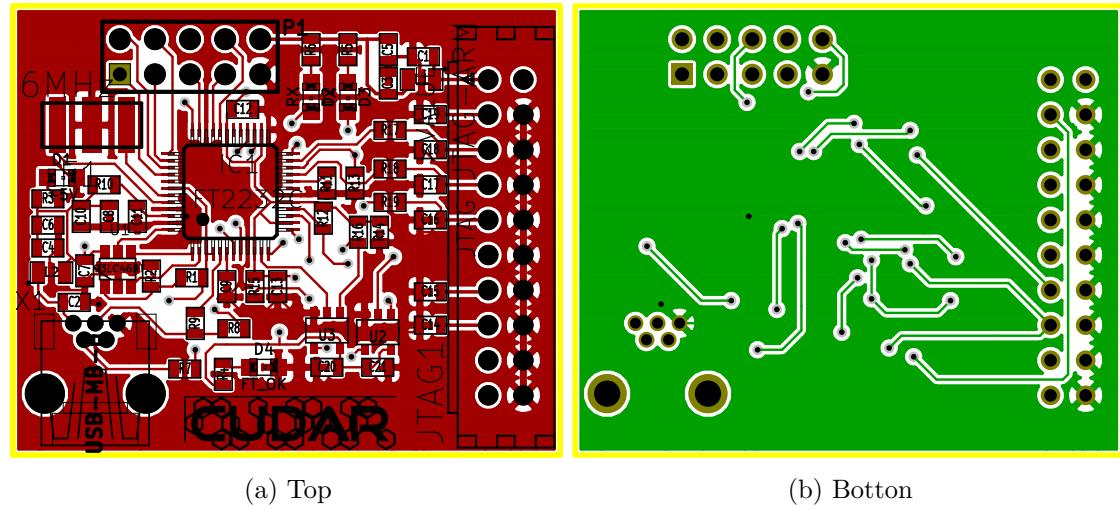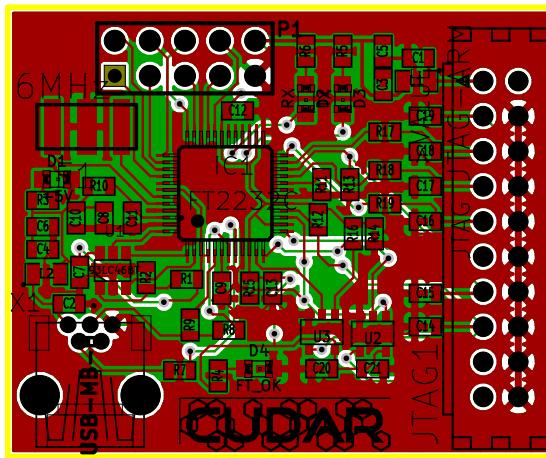
Figura 5: PCB

(c) Top & Botton

Figura 5: PCB (Continuación)

2.3.3.   S3Power

La placa *S3Power* fue diseñada por un los miembros del **INTI**, originalmente destinada a la placa **S3Proto**, y liberada con licencia *GPL (General Public License)* en la web `fpgalibre.sourceforce.net`. Las características eléctricas, en particular, de potencia son muy importantes debido a los distintos niveles de tensión que manejan las FPGAs que se utilizarán. Texas Instruments ha desarrollado un IC (TPS75003) específico para la familia de las FPGA de Xilinx (Spantan 3 - Xilinx Inc). Aquí se resuelven los tiempos de encendido como la regulación en el consumo de potencia de la FPGA.


Figura 6: Esquemático

(a) Top

(b) Botton

(c) Top & Botton
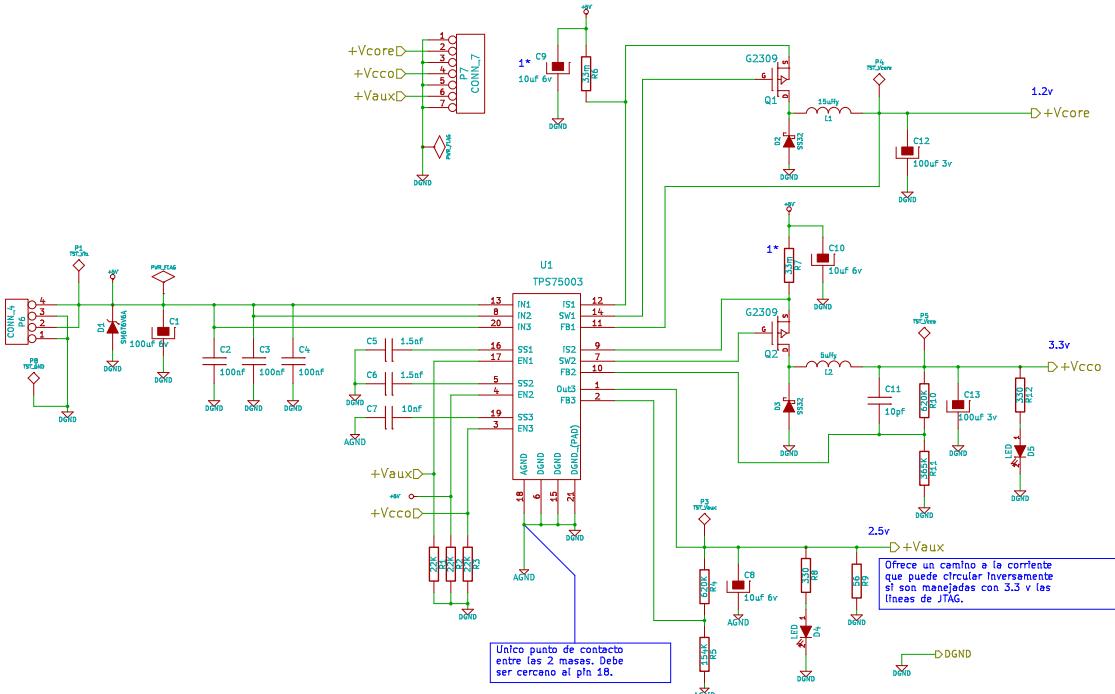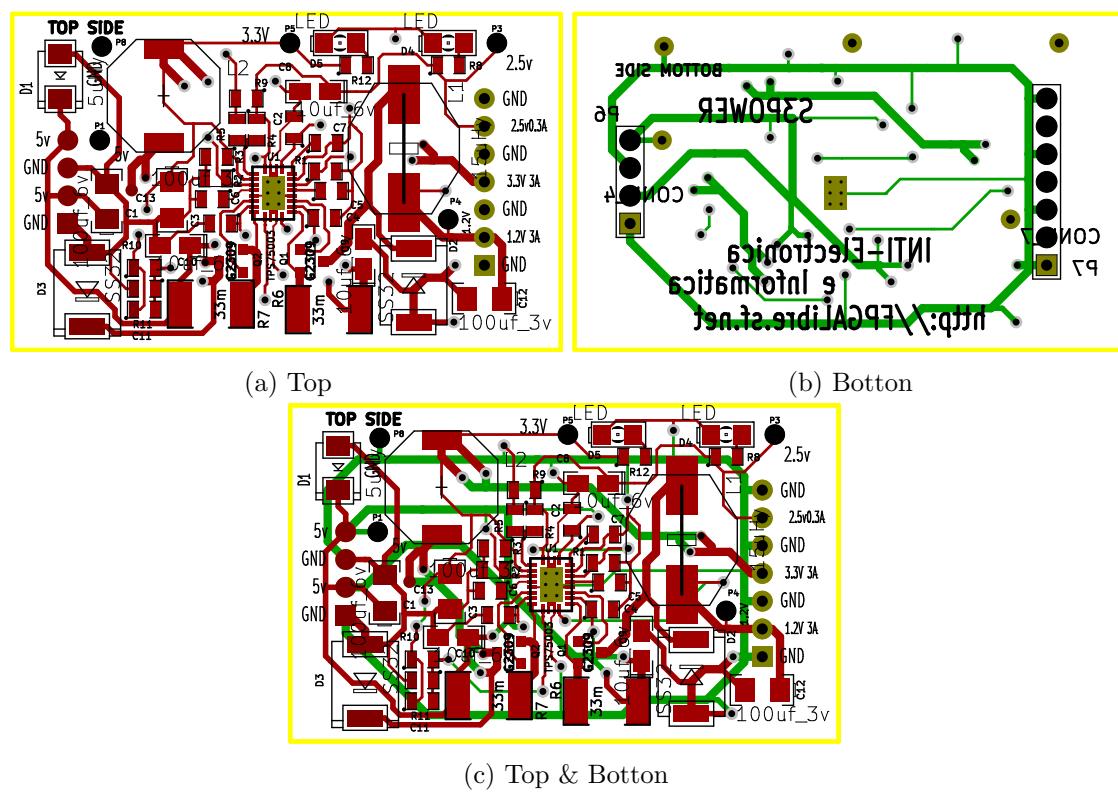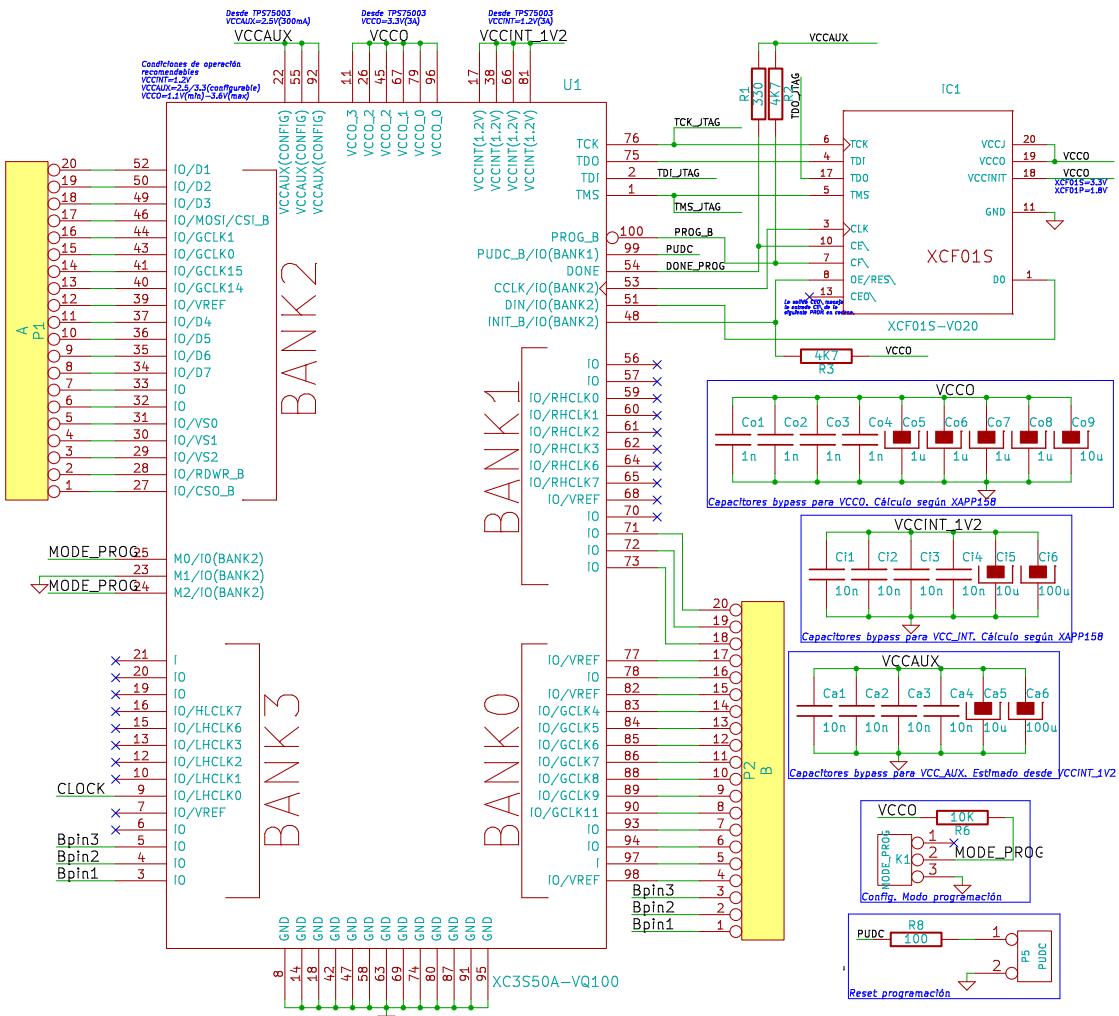
Figura 7: PCB
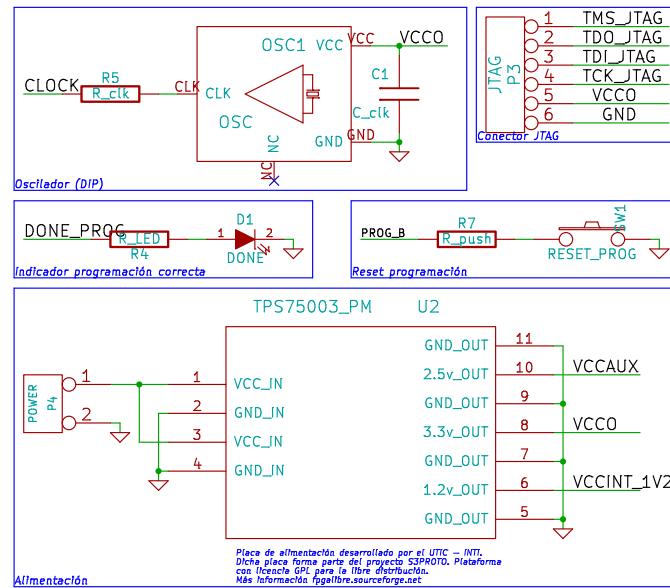
2.3.4.   FPGA (PHR version BETA)

La placa *FPGA* que se presenta a continuación, es una versión prototipo que de la placa **PHR** final. La versión BETA pretende realizar un testeo de las características de potencia y el interface al puerto JTAG que dispone el dispositivo programable. Para la alimentación del mismo, se utiliza la placa **S3power** que se ha descrito en puntos anteriores.
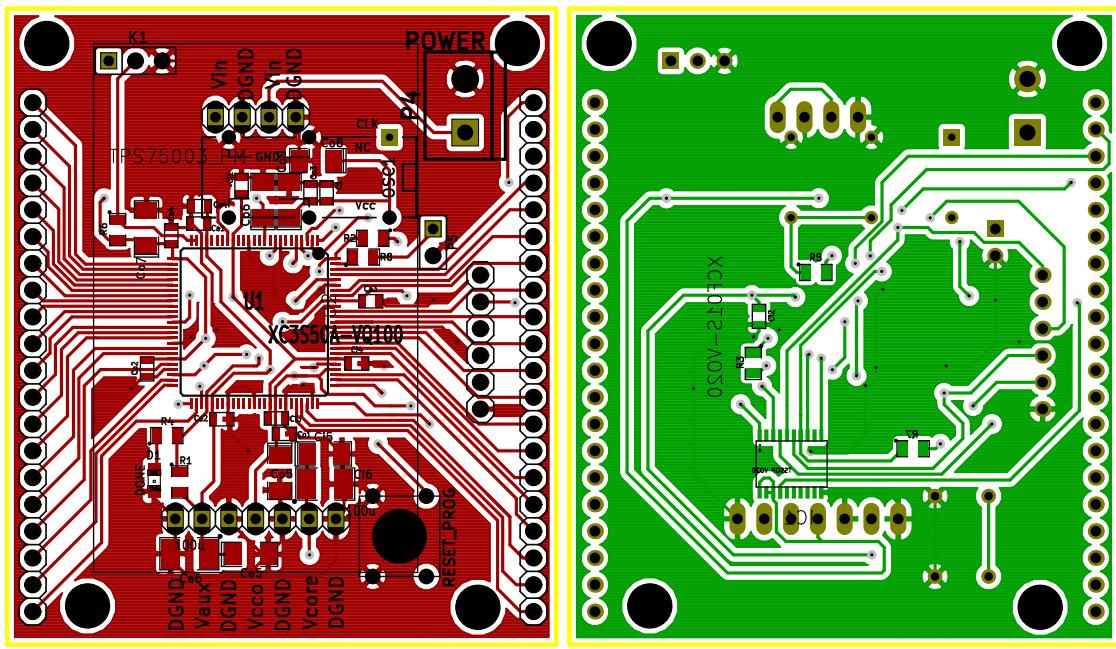
(a) FPGA (XC3S50A) & Memoria de programación (XCF01S)

Figura 8: Esquemático

(b) Circuito de potencia (Placa S3power)
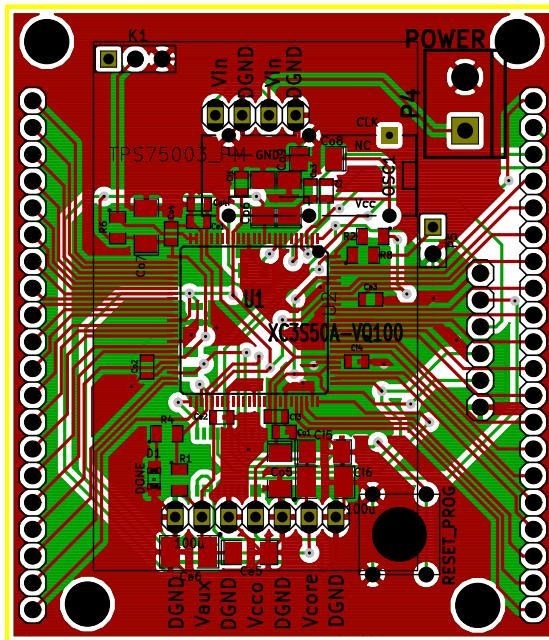
Figura 8: Esquemático (Continuación)

(a) Top

(b) Botton

Figura 9: PCB

(c) Top & Botton

Figura 9: PCB (Continuación)

3.   Documentación

La documentación resulta fundamental en ésta etapa del desarrollo. Si bien se quiere lograr el correcto funcionamiento de las placas, la documentación sirve para realizar correciones a las versiones futuras de cada placa. Otro objetivo es documentar el funcionamiento de cada dispositivo que sirvan al reporte final como así también a los usuarios de la *Plataforma de Hardware Reconfigurable*.

A. Repositorio de proyecto

El proyecto se encuentra alojado en los servidores de *OpenCores*. Por lo que se puede acceder a los repositorios mediante el siguiente link, `http://opencores.org/project,phr` De todas formas se pueden comunicar por correo, `guanucoluis@gmail.com`.

B. Archivos a conciderar

Se dispone de varios archivos relacionados con esta etapa de ensamblado y testeo.

```
luis@luis-laptop:to_print$ ls -lX
total 2872
-rw-r--r-- 1 luis luis    1421 jul 10 16:38 cpld.cmp
-rw-r--r-- 1 luis luis    4599 jul 10 17:09 fpga.cmp
-rw-r--r-- 1 luis luis    6126 ago 28 21:34 OOCD_placa.cmp
-rw-r--r-- 1 luis luis    4159 jul 10 16:40 S3Proto_Power.cmp
-rw-r--r-- 1 luis luis  234181 ago 28 21:29 fpga_brd.pdf
-rw-r--r-- 1 luis luis  137037 ago 28 21:55 fpga_sch.pdf
-rw-r--r-- 1 luis luis  177723 ago 28 21:23 OOCD-Links_brd.pdf
-rw-r--r-- 1 luis luis   88397 ago 28 21:55 OOCD-Links_sch.pdf
-rw-r--r-- 1 luis luis  145699 ago 28 21:04 ot-cpld_brd.pdf
-rw-r--r-- 1 luis luis   55105 ago 28 21:55 ot-cpld_sch.pdf
-rw-r--r-- 1 luis luis  121516 ago 28 21:17 S3Proto_Power_brd.pdf
-rw-r--r-- 1 luis luis   63912 ago 28 00:40 S3Proto_Power_sch.pdf
-rw-r--r-- 1 luis luis 1520722 ago 28 20:39 schedule.pdf
-rw-r--r-- 1 luis luis   57478 ago 28 21:35 cpld.png
-rw-r--r-- 1 luis luis   86035 ago 28 21:37 fpga.png
-rw-r--r-- 1 luis luis   66724 ago 28 21:33 OOCD_placa.png
-rw-r--r-- 1 luis luis   70647 ago 28 21:36 S3Proto_Power.png
```

En estos archivos se tiene las figuras presentadas en las anteriores secciones pero con mejor resolución, estos terminan en `_sch` o `_brd` correspondientes a si se trata del esquemático o el PCB, respectivamente. También se tiene los archivos `.cmp`, los que contienen la lista de componentes a utilizar y su referencia en el esquemático como así también el encapsulado. Los archivos `.png` son las distintas placas vista en 3D para tener una idea de como debería quedar al finalizar el desarrollo.

C.   Lista de componentes

C.1.   OT-CPLD

```
BeginCmp
TimeStamp = /4EA65376;
Reference = C1;
ValeurCmp = 1uF;
IdModule  = SM0603;
EndCmp

BeginCmp
TimeStamp = /4EA6543A;
Reference = C2;
ValeurCmp = 1uF;
IdModule  = SM0603;
EndCmp

BeginCmp
TimeStamp = /4EA882B4;
Reference = C3;
ValeurCmp = .1uF;
IdModule  = SM0603;
EndCmp

BeginCmp
TimeStamp = /4EA882BB;
Reference = C4;
ValeurCmp = .01uF;
IdModule  = SM0603;
EndCmp

BeginCmp
TimeStamp = /4EA882C2;
Reference = C5;
ValeurCmp = .1uF;
IdModule  = SM0603;
EndCmp

BeginCmp
TimeStamp = /4EA882CF;
Reference = C6;
ValeurCmp = 100uF;
IdModule  = SM0805;
EndCmp

BeginCmp
TimeStamp = /4EA654D2;
```

```
Reference = D1;
ValeurCmp = power;
IdModule  = LED-0805;
EndCmp

BeginCmp
TimeStamp = /4EA74DB8;
Reference = P1;
ValeurCmp = CON_1;
IdModule  = 1X20;
EndCmp

BeginCmp
TimeStamp = /4EA74DAC;
Reference = P2;
ValeurCmp = CON_2;
IdModule  = 1X20;
EndCmp

BeginCmp
TimeStamp = /4EA1F196;
Reference = P3;
ValeurCmp = JTAG-POWER;
IdModule  = 1X06;
EndCmp

BeginCmp
TimeStamp = /4EA653DA;
Reference = R1;
ValeurCmp = 470K;
IdModule  = SM0603;
EndCmp

BeginCmp
TimeStamp = /4EA654AE;
Reference = R2;
ValeurCmp = 470;
IdModule  = SM0603;
EndCmp

BeginCmp
TimeStamp = /4EA652AE;
Reference = U1;
ValeurCmp = SP6200;
```

```
IdModule  = SOT23-5;              ValeurCmp = XC9572XL;
EndCmp                            IdModule  = TQFP44;
                                  EndCmp
BeginCmp
TimeStamp = /4EA62E7A;            EndListe
Reference = U2;
```

C.2.   OOCD Links

```
 BeginCmp                            IdModule  = LED-0805;
TimeStamp = 4EB85B2D                 EndCmp
Path = /4EAE3B06
Reference = X1;                      BeginCmp
ValeurCmp = USB-MB-H;                TimeStamp = 4EAEBF69
IdModule  = con-usb-USB-MB-H;        Path = /4EAE3DC9
EndCmp                               Reference = JTAG1;
                                     ValeurCmp = JTAG-ARM;
BeginCmp                             IdModule  = nxp-JTAG-ARM;
TimeStamp = 4EAEBF60                  EndCmp
Path = /4EAB3FF2
Reference = IC1;                     BeginCmp
ValeurCmp = FT2232C;                 TimeStamp = 4EAEBF6A
IdModule  = ft2232c-LQFP;            Path = /4EAE5354
EndCmp                               Reference = P1;
                                     ValeurCmp = UART;
BeginCmp                             IdModule  = PIN_ARRAY_5x2;
TimeStamp = 4EAEBF62                  EndCmp
Path = /4EAE3363
Reference = D4;                      BeginCmp
ValeurCmp = FT_OK;                   TimeStamp = 4EAEBF6B
IdModule  = LED-0805;                Path = /4EAE495A
EndCmp                               Reference = R19;
                                     ValeurCmp = 100;
BeginCmp                             IdModule  = SM0603;
TimeStamp = 4EB0CE47                  EndCmp
Path = /4EAE3357
Reference = D3;                      BeginCmp
ValeurCmp = TX;                      TimeStamp = 4EAEBF6D
IdModule  = LED-0805;                Path = /4EAE4953
EndCmp                               Reference = R18;
                                     ValeurCmp = 100;
BeginCmp                             IdModule  = SM0603;
TimeStamp = 4EAEBF66                  EndCmp
Path = /4EAE3349
Reference = D2;                      BeginCmp
ValeurCmp = RX;                      TimeStamp = 4EAEBF6F
IdModule  = LED-0805;                Path = /4EAE4946
EndCmp                               Reference = R17;
                                     ValeurCmp = 100;
BeginCmp                             IdModule  = SM0603;
TimeStamp = 4EAEBF68                  EndCmp
Path = /4EAE32A1
Reference = D1;                      BeginCmp
ValeurCmp = +5V;                     TimeStamp = 4EAEBF71
```

```
Path = /4EAE4FF4
Reference = R16;
ValeurCmp = 100K;
IdModule  = SM0603;
EndCmp

BeginCmp
TimeStamp = 4EAEBF73
Path = /4EAE4ED6
Reference = R15;
ValeurCmp = 100K;
IdModule  = SM0603;
EndCmp

BeginCmp
TimeStamp = 4EAEBF75
Path = /4EAE4DA5
Reference = R14;
ValeurCmp = 100K;
IdModule  = SM0603;
EndCmp

BeginCmp
TimeStamp = 4EAEBF77
Path = /4EAE4D2D
Reference = R13;
ValeurCmp = 100K;
IdModule  = SM0603;
EndCmp

BeginCmp
TimeStamp = 4EAEBF79
Path = /4EAE4E0E
Reference = R12;
ValeurCmp = 100K;
IdModule  = SM0603;
EndCmp

BeginCmp
TimeStamp = 4EAEBF7B
Path = /4EAE3F20
Reference = R11;
ValeurCmp = 10K;
IdModule  = SM0603;
EndCmp

BeginCmp
```

```
TimeStamp = 4EAEBF7D
Path = /4EAE3201
Reference = R10;
ValeurCmp = 470;
IdModule  = SM0603;
EndCmp

BeginCmp
TimeStamp = 4EAEBF7F
Path = /4EAE3B8F
Reference = R9;
ValeurCmp = 1K5;
IdModule  = SM0603;
EndCmp

BeginCmp
TimeStamp = 4EAEBF81
Path = /4EAE3B4B
Reference = R8;
ValeurCmp = 27;
IdModule  = SM0603;
EndCmp

BeginCmp
TimeStamp = 4EAEBF83
Path = /4EAE3B44
Reference = R7;
ValeurCmp = 27;
IdModule  = SM0603;
EndCmp

BeginCmp
TimeStamp = 4EAEBF85
Path = /4EAE346C
Reference = R6;
ValeurCmp = 1K;
IdModule  = SM0603;
EndCmp

BeginCmp
TimeStamp = 4EB0CE4A
Path = /4EAE3468
Reference = R5;
ValeurCmp = 1K;
IdModule  = SM0603;
EndCmp
```

```
BeginCmp
TimeStamp = 4EAEBF89
Path = /4EAE3464
Reference = R4;
ValeurCmp = 1K;
IdModule  = SM0603;
EndCmp

BeginCmp
TimeStamp = 4EAEBF8B
Path = /4EAE3297
Reference = R3;
ValeurCmp = 1K;
IdModule  = SM0603;
EndCmp

BeginCmp
TimeStamp = 4EAEBF8D
Path = /4EAE2459
Reference = R2;
ValeurCmp = 2K2;
IdModule  = SM0603;
EndCmp

BeginCmp
TimeStamp = 4EAEBF8F
Path = /4EAE2494
Reference = R1;
ValeurCmp = 10K;
IdModule  = SM0603;
EndCmp

BeginCmp
TimeStamp = 4EAEBF91
Path = /4EAE516F
Reference = C21;
ValeurCmp = 100n;
IdModule  = SM0603;
EndCmp

BeginCmp
TimeStamp = 4EAEBF93
Path = /4EAE5167
Reference = C20;
ValeurCmp = 100n;
IdModule  = SM0603;
EndCmp
```

```
BeginCmp
TimeStamp = 4EAEBF95
Path = /4EAE4AF1
Reference = C19;
ValeurCmp = 47p;
IdModule  = SM0603;
EndCmp

BeginCmp
TimeStamp = 4EAEBF97
Path = /4EAE4B24
Reference = C18;
ValeurCmp = 47p;
IdModule  = SM0603;
EndCmp

BeginCmp
TimeStamp = 4EAEBF99
Path = /4EAE4B2F
Reference = C17;
ValeurCmp = 47p;
IdModule  = SM0603;
EndCmp

BeginCmp
TimeStamp = 4EAEBF9B
Path = /4EAE4B56
Reference = C16;
ValeurCmp = 47p;
IdModule  = SM0603;
EndCmp

BeginCmp
TimeStamp = 4EAEBF9D
Path = /4EAE4B6A
Reference = C15;
ValeurCmp = 47p;
IdModule  = SM0603;
EndCmp

BeginCmp
TimeStamp = 4EAEBF9F
Path = /4EAE4B76
Reference = C14;
ValeurCmp = 47p;
IdModule  = SM0603;
```

```
EndCmp                                    IdModule  = SM0603;
                                          EndCmp
BeginCmp
TimeStamp = 4EAEBFA1                      BeginCmp
Path = /4EAE3EE0                          TimeStamp = 4EAEBFAD
Reference = C13;                          Path = /4EAE24AC
ValeurCmp = 100n;                         Reference = C7;
IdModule  = SM0603;                       ValeurCmp = 100n;
EndCmp                                    IdModule  = SM0603;
                                          EndCmp
BeginCmp
TimeStamp = 4EAEBFA3                      BeginCmp
Path = /4EAE384B                          TimeStamp = 4EAEBFAF
Reference = C12;                          Path = /4EAE30A8
ValeurCmp = C;                            Reference = C6;
IdModule  = SM0603;                       ValeurCmp = 2u2;
EndCmp                                    IdModule  = SM0603;
                                          EndCmp
BeginCmp
TimeStamp = 4EAEBFA5                      BeginCmp
Path = /4EAE31EE                          TimeStamp = 4EAEBFB1
Reference = C11;                          Path = /4EAE3C52
ValeurCmp = 100n;                         Reference = C5;
IdModule  = SM0603;                       ValeurCmp = 2u2;
EndCmp                                    IdModule  = SM0603;
                                          EndCmp
BeginCmp
TimeStamp = 4EAEBFA7                      BeginCmp
Path = /4EAE31F7                          TimeStamp = 4EAEBFB3
Reference = C10;                          Path = /4EAE308F
ValeurCmp = 100n;                         Reference = C4;
IdModule  = SM0603;                       ValeurCmp = 100n;
EndCmp                                    IdModule  = SM0603;
                                          EndCmp
BeginCmp
TimeStamp = 4EAEBFA9                      BeginCmp
Path = /4EAE3A16                          TimeStamp = 4EAEBFB5
Reference = C9;                           Path = /4EAE3C53
ValeurCmp = 33n;                          Reference = C3;
IdModule  = SM0603;                       ValeurCmp = 100n;
EndCmp                                    IdModule  = SM0603;
                                          EndCmp
BeginCmp
TimeStamp = 4EAEBFAB                      BeginCmp
Path = /4EAE31FD                          TimeStamp = 4EAEBFB7
Reference = C8;                           Path = /4EAE2C55
ValeurCmp = 100n;                         Reference = C2;
```

```
ValeurCmp = 10n;
IdModule  = SM0603;               BeginCmp
EndCmp                            TimeStamp = 4EAEBFBF
                                  Path = /4EAE4848
                                  Reference = U2;
BeginCmp                          ValeurCmp = SN74AUP1G125;
TimeStamp = 4EAEBFB9              IdModule  = SOT23-5;
Path = /4EAE3C56                  EndCmp
Reference = C1;
ValeurCmp = 10n;
IdModule  = SM0603;               BeginCmp
EndCmp                            TimeStamp = 4EAEBFC0
                                  Path = /4EAE22F9
                                  Reference = U1;
BeginCmp                          ValeurCmp = 93LC46BT;
TimeStamp = 4EAEBFBA              IdModule  = SOT23_6;
Path = /4EAE3061                  EndCmp
Reference = L2;
ValeurCmp = 742792095;
IdModule  = SM0805;               BeginCmp
EndCmp                            TimeStamp = 4EAEBF61
                                  Path = /4EAE26A6
                                  Reference = F1;
BeginCmp                          ValeurCmp = 6MHz;
TimeStamp = 4EAEBFBC              IdModule  = -CSTCC;
Path = /4EAE3C54                  EndCmp
Reference = L1;
ValeurCmp = 742792095;
IdModule  = SM0805;               BeginCmp
EndCmp                            TimeStamp = 4EB863DD
                                  Path =
                                  Reference = ref;
BeginCmp                          ValeurCmp = logo_min;
TimeStamp = 4EAEBFBD              IdModule  = ;
Path = /4EAE4851                  EndCmp
Reference = U3;
ValeurCmp = SN74AUP1G125;
IdModule  = SOT23-5;              EndListe
EndCmp
```

C.3.   S3Power

```
BeginCmp
TimeStamp = 48FC941B;
Reference = C1;
ValeurCmp = 100uf_6v;
IdModule  = -B/3528-21W;
EndCmp

BeginCmp
TimeStamp = 48FC9514;
Reference = C2;
ValeurCmp = 100nf;
IdModule  = SM0805;
EndCmp

BeginCmp
TimeStamp = 48FC9531;
Reference = C3;
ValeurCmp = 100nf;
IdModule  = SM0805;
EndCmp

BeginCmp
TimeStamp = 48FC9532;
Reference = C4;
ValeurCmp = 100nf;
IdModule  = SM0805;
EndCmp

BeginCmp
TimeStamp = 48FC94F6;
Reference = C5;
ValeurCmp = 1.5nf;
IdModule  = SM0805;
EndCmp

BeginCmp
TimeStamp = 48FCB2A9;
Reference = C6;
ValeurCmp = 1.5nf;
IdModule  = SM0805;
EndCmp

BeginCmp
TimeStamp = 48FC94AF;
Reference = C7;
```

```
ValeurCmp = 10nf;
IdModule  = SM0805;
EndCmp

BeginCmp
TimeStamp = 48FC948C;
Reference = C8;
ValeurCmp = 10uf_6v;
IdModule  = -A/3216-18R;
EndCmp

BeginCmp
TimeStamp = 48FC948A;
Reference = C9;
ValeurCmp = 10uf_6v;
IdModule  = -A/3216-18R;
EndCmp

BeginCmp
TimeStamp = 48FDDDFF;
Reference = C10;
ValeurCmp = 10uf_6v;
IdModule  = -A/3216-18R;
EndCmp

BeginCmp
TimeStamp = 48FC9564;
Reference = C11;
ValeurCmp = 10pf;
IdModule  = SM0805;
EndCmp

BeginCmp
TimeStamp = 48FC9463;
Reference = C12;
ValeurCmp = 100uf_3v;
IdModule  = -B/3528-21W;
EndCmp

BeginCmp
TimeStamp = 48FDDDFE;
Reference = C13;
ValeurCmp = 100uf_3v;
IdModule  = -B/3528-21W;
EndCmp
```

```
                                          IdModule  = wuerth_elektronik_v5-WE-TPC_XL/XLH;
BeginCmp                                  EndCmp
TimeStamp = 48FC939B;
Reference = D1;                           BeginCmp
ValeurCmp = SM6T6V6A;                     TimeStamp = 4907220B;
IdModule  = DO_214AA;                     Reference = P1;
EndCmp                                    ValeurCmp = TST_Vin;
                                          IdModule  = PINTST;
BeginCmp                                  EndCmp
TimeStamp = 48FC97B2;
Reference = D2;                           BeginCmp
ValeurCmp = SS32;                         TimeStamp = 48FDE089;
IdModule  = DO214AB;                      Reference = P3;
EndCmp                                    ValeurCmp = TST_Vaux;
                                          IdModule  = PINTST;
BeginCmp                                  EndCmp
TimeStamp = 48FDDE02;
Reference = D3;                           BeginCmp
ValeurCmp = SS32;                         TimeStamp = 48FDDD65;
IdModule  = DO214AB;                      Reference = P4;
EndCmp                                    ValeurCmp = TST_Vcore;
                                          IdModule  = PINTST;
BeginCmp                                  EndCmp
TimeStamp = 4900D275;
Reference = D4;                           BeginCmp
ValeurCmp = LED;                          TimeStamp = 48FDDE09;
IdModule  = -1206;                        Reference = P5;
EndCmp                                    ValeurCmp = TST_Vcco;
                                          IdModule  = PINTST;
BeginCmp                                  EndCmp
TimeStamp = 4900C810;
Reference = D5;                           BeginCmp
ValeurCmp = LED;                          TimeStamp = 491C3ECB;
IdModule  = -1206;                        Reference = P6;
EndCmp                                    ValeurCmp = CONN_4;
                                          IdModule  = header_1x4;
BeginCmp                                  EndCmp
TimeStamp = 48FC9598;
Reference = L1;                           BeginCmp
ValeurCmp = 15uHy;                        TimeStamp = 49256388;
IdModule  = wuerth_elektronik_WE-PD4;Reference = P7;
EndCmp                                    ValeurCmp = CONN_7;
                                          IdModule  = header_1x7;
BeginCmp                                  EndCmp
TimeStamp = 48FDDE00;
Reference = L2;                           BeginCmp
ValeurCmp = 5uHy;                         TimeStamp = 499DB3E3;
```

```
Reference = P8;                          BeginCmp
ValeurCmp = TST_GND;                     TimeStamp = 48FDE06B;
IdModule  = PINTST;                      Reference = R5;
EndCmp                                   ValeurCmp = 154K;
                                         IdModule  = SM0805;
BeginCmp                                 EndCmp
TimeStamp = 48FC9789;
Reference = Q1;                          BeginCmp
ValeurCmp = G2309;                       TimeStamp = 48FDD021;
IdModule  = SOT23GDS;                    Reference = R6;
EndCmp                                   ValeurCmp = 33m;
                                         IdModule  = SM2512;
BeginCmp                                 EndCmp
TimeStamp = 48FDDE01;
Reference = Q2;                          BeginCmp
ValeurCmp = G2309;                       TimeStamp = 48FDDE03;
IdModule  = SOT23GDS;                    Reference = R7;
EndCmp                                   ValeurCmp = 33m;
                                         IdModule  = SM2512;
BeginCmp                                 EndCmp
TimeStamp = 48FDE587;
Reference = R1;                          BeginCmp
ValeurCmp = 22K;                         TimeStamp = 4900D274;
IdModule  = SM0805;                      Reference = R8;
EndCmp                                   ValeurCmp = 330;
                                         IdModule  = SM0805;
BeginCmp                                 EndCmp
TimeStamp = 48FDE584;
Reference = R2;                          BeginCmp
ValeurCmp = 22K;                         TimeStamp = 48FDE2B6;
IdModule  = SM0805;                      Reference = R9;
EndCmp                                   ValeurCmp = 56;
                                         IdModule  = SM0805;
BeginCmp                                 EndCmp
TimeStamp = 48FDE56A;
Reference = R3;                          BeginCmp
ValeurCmp = 22K;                         TimeStamp = 48FDDF37;
IdModule  = SM0805;                      Reference = R10;
EndCmp                                   ValeurCmp = 620K;
                                         IdModule  = SM0805;
BeginCmp                                 EndCmp
TimeStamp = 48FDE06A;
Reference = R4;                          BeginCmp
ValeurCmp = 620K;                        TimeStamp = 48FDDF3E;
IdModule  = SM0805;                      Reference = R11;
EndCmp                                   ValeurCmp = 365K;
                                         IdModule  = SM0805;
```

```
EndCmp                              BeginCmp
                                   TimeStamp = 48FC9227;
BeginCmp                           Reference = U1;
TimeStamp = 4900C7F6;              ValeurCmp = TPS75003;
Reference = R12;                   IdModule  = TPS75003;
ValeurCmp = 330;                   EndCmp
IdModule  = SM0805;
EndCmp                             EndListe
```

C.4. FPGA

```
BeginCmp
TimeStamp = /4F4D3964;
Reference = C1;
ValeurCmp = C_clk;
IdModule  = SM0603_Capa;
EndCmp

BeginCmp
TimeStamp = /4F58A802;
Reference = Ca1;
ValeurCmp = 10n;
IdModule  = SM0603_Capa;
EndCmp

BeginCmp
TimeStamp = /4F69141B;
Reference = Ca2;
ValeurCmp = 10n;
IdModule  = SM0603_Capa;
EndCmp

BeginCmp
TimeStamp = /4F69141F;
Reference = Ca3;
ValeurCmp = 10n;
IdModule  = SM0603_Capa;
EndCmp

BeginCmp
TimeStamp = /4F691428;
Reference = Ca4;
ValeurCmp = 10n;
IdModule  = SM0603_Capa;
EndCmp

BeginCmp
TimeStamp = /4F58BF85;
Reference = Ca5;
ValeurCmp = 10u;
IdModule  = SM1206POL;
EndCmp

BeginCmp
TimeStamp = /4F69144A;
Reference = Ca6;
```

```
ValeurCmp = 100u;
IdModule  = SM1210L;
EndCmp

BeginCmp
TimeStamp = /4F6913AD;
Reference = Ci1;
ValeurCmp = 10n;
IdModule  = SM0603_Capa;
EndCmp

BeginCmp
TimeStamp = /4F6913AC;
Reference = Ci2;
ValeurCmp = 10n;
IdModule  = SM0603_Capa;
EndCmp

BeginCmp
TimeStamp = /4F6913AA;
Reference = Ci3;
ValeurCmp = 10n;
IdModule  = SM0603_Capa;
EndCmp

BeginCmp
TimeStamp = /4F6913AB;
Reference = Ci4;
ValeurCmp = 10n;
IdModule  = SM0603_Capa;
EndCmp

BeginCmp
TimeStamp = /4F6913A7;
Reference = Ci5;
ValeurCmp = 10u;
IdModule  = SM1206POL;
EndCmp

BeginCmp
TimeStamp = /4F6913A9;
Reference = Ci6;
ValeurCmp = 100u;
IdModule  = SM1210L;
EndCmp
```

```
                                                 IdModule  = SM1206POL;
BeginCmp                                         EndCmp
TimeStamp = /4F58BBF5;
Reference = Co1;
ValeurCmp = 1n;                                  BeginCmp
IdModule  = SM0603_Capa;                         TimeStamp = /4F58BF17;
EndCmp                                           Reference = Co8;
                                                 ValeurCmp = 1u;
                                                 IdModule  = SM1206POL;
BeginCmp                                         EndCmp
TimeStamp = /4F58BC49;
Reference = Co2;
ValeurCmp = 1n;                                  BeginCmp
IdModule  = SM0603_Capa;                         TimeStamp = /4F58BF30;
EndCmp                                           Reference = Co9;
                                                 ValeurCmp = 10u;
                                                 IdModule  = SM1206POL;
BeginCmp                                         EndCmp
TimeStamp = /4F58BC4C;
Reference = Co3;
ValeurCmp = 1n;                                  BeginCmp
IdModule  = SM0603_Capa;                         TimeStamp = /4E4D4DD3;
EndCmp                                           Reference = D1;
                                                 ValeurCmp = DONE;
                                                 IdModule  = LED-0805;
BeginCmp                                         EndCmp
TimeStamp = /4F58BC4F;
Reference = Co4;
ValeurCmp = 1n;                                  BeginCmp
IdModule  = SM0603_Capa;                         TimeStamp = /4F4D2E32;
EndCmp                                           Reference = H1;
                                                 ValeurCmp = PCB_HOLE;
                                                 IdModule  = HOLE;
BeginCmp                                         EndCmp
TimeStamp = /4F58BEE2;
Reference = Co5;
ValeurCmp = 1u;                                  BeginCmp
IdModule  = SM1206POL;                           TimeStamp = /4F4D2E38;
EndCmp                                           Reference = H2;
                                                 ValeurCmp = PCB_HOLE;
                                                 IdModule  = HOLE;
BeginCmp                                         EndCmp
TimeStamp = /4F58BF10;
Reference = Co6;
ValeurCmp = 1u;                                  BeginCmp
IdModule  = SM1206POL;                           TimeStamp = /4F4D2E36;
EndCmp                                           Reference = H3;
                                                 ValeurCmp = PCB_HOLE;
                                                 IdModule  = HOLE;
BeginCmp                                         EndCmp
TimeStamp = /4F58BF12;
Reference = Co7;
ValeurCmp = 1u;                                  BeginCmp
                                                 TimeStamp = /4F4D2E3A;
```

```
Reference = H4;                         BeginCmp
ValeurCmp = PCB_HOLE;                   TimeStamp = /4F47FC62;
IdModule  = HOLE;                       Reference = P4;
EndCmp                                  ValeurCmp = POWER;
                                        IdModule  = bornier2;
BeginCmp                                EndCmp
TimeStamp = /4E178DD4;
Reference = IC1;                        BeginCmp
ValeurCmp = XCF01S-VO20;                TimeStamp = /4F4810C2;
IdModule  = xilinx_virtexii-xc2v80&flashprom-VO20;  Reference = P5;
EndCmp                                  ValeurCmp = PUDC;
                                        IdModule  = PIN_ARRAY_2X1;
BeginCmp                                EndCmp
TimeStamp = /4E178908;
Reference = K1;                         BeginCmp
ValeurCmp = MODE_PROG;                  TimeStamp = /4F46B535;
IdModule  = PIN_ARRAY_3X1;              Reference = R1;
EndCmp                                  ValeurCmp = 330;
                                        IdModule  = SM0805;
BeginCmp                                EndCmp
TimeStamp = /4F4D2E41;
Reference = OSC1;                       BeginCmp
ValeurCmp = OSC;                        TimeStamp = /4F46B5A2;
IdModule  = DIP4-8_OSC;                 Reference = R2;
EndCmp                                  ValeurCmp = 4K7;
                                        IdModule  = SM0805;
BeginCmp                                EndCmp
TimeStamp = /4F4807B3;
Reference = P1;                         BeginCmp
ValeurCmp = A;                          TimeStamp = /4F46B626;
IdModule  = 1X20_MOD;                   Reference = R3;
EndCmp                                  ValeurCmp = 4K7;
                                        IdModule  = SM0805;
BeginCmp                                EndCmp
TimeStamp = /4F480E3E;
Reference = P2;                         BeginCmp
ValeurCmp = B;                          TimeStamp = /4E4D4DC9;
IdModule  = 1X20_MOD;                   Reference = R4;
EndCmp                                  ValeurCmp = R_LED;
                                        IdModule  = SM0805;
BeginCmp                                EndCmp
TimeStamp = /4F4D2C3A;
Reference = P3;                         BeginCmp
ValeurCmp = JTAG;                       TimeStamp = /4F4D3968;
IdModule  = PIN_ARRAY-6X1;              Reference = R5;
EndCmp                                  ValeurCmp = R_clk;
                                        IdModule  = SM0805;
```

```
EndCmp                                BeginCmp
                                      TimeStamp = /4F4801A4;
BeginCmp                              Reference = SW1;
TimeStamp = /4E4D5328;                ValeurCmp = RESET_PROG;
Reference = R6;                       IdModule  = SW_PUSH_SMALL;
ValeurCmp = 10K;                      EndCmp
IdModule  = SM0805;
EndCmp                                BeginCmp
                                      TimeStamp = /4F4675A1;
BeginCmp                              Reference = U1;
TimeStamp = /4F4801C9;                ValeurCmp = XC3S50A-VQ100;
Reference = R7;                       IdModule  = VQFP100;
ValeurCmp = R_push;                   EndCmp
IdModule  = SM0805;
EndCmp                                BeginCmp
                                      TimeStamp = /4F47E8FD;
BeginCmp                              Reference = U2;
TimeStamp = /4F481067;                ValeurCmp = TPS75003_PM;
Reference = R8;                       IdModule  = TPS75003_PM_INV;
ValeurCmp = 100;                      EndCmp
IdModule  = SM0805;
EndCmp                                EndListe
```