LABORATOIRE DE PHYSIQUE DES LASERS

Atelier d'électronique

Générateur YIG

Description

Réf. : GeneYIG
Equipe : MMTF
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DESCRIPTION

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A simple approach to YIG oscillators

YIG oscillators have been in use for several decades now, mainly in relation to equipment for professionals from well-known manufacturers. However, we radio amateurs have been prohibited from enjoying their outstanding characteristics for many years, owing to the high prices involved. But for some years now, YIG oscillators have been obtainable at reasonable prices on the surplus market. Most of the equipment available has already been taken out of service, but this poses no problems as a rule, since YIG oscillators have a very long service life and are of excellent quality. This article is intended to provide some practical help regarding a simple approach to these high-quality oscillators.

1
Advantages of YIG oscillators

YIG oscillators have some advantages over normal VCO's. It is above all their good signal quality, with a low level of phase jitter, and their broad band characteristics (with a very linear tuning curve) which make them interesting, or even obligatory, for many measurement applications. Anyone who has become acquainted with the advantages of these oscillators will no longer want to do without them.

The normal frequency ranges are 2 - 4GHz, 4 - 8GHz, 8 - 12GHz, 12 - 18GHz and 2 - 8GHz. However, the usable frequency range usually goes beyond the specified limit frequencies, so that a YIG which is specified for 2 - 4GHz can be used at 1.8 or 1.9GHz, and can frequently also still function at a few 100MHz above 4GHz, but this varies from type to type.

2
YIG resonator

Fig. 1 shows the core of a YIG oscillator. The YIG ball, which sits at the tip of a short ceramic rod, is positioned in the middle of a coupling coil (U bolt). This YIG resonator is influenced by the magnetic field that is generated by the tuning coils. This allows the YIG to be tuned to its frequency.

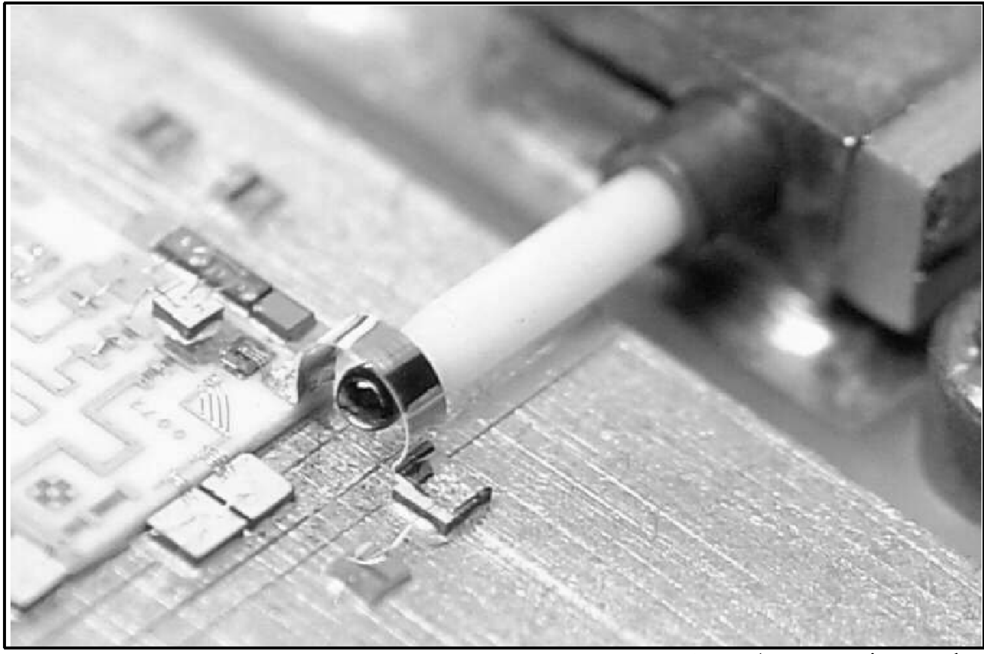


Fig 1: The core of a YIG oscillator.

3

YIG oscillator connections

The connections of a YIG oscillator are shown in the circuit. They have a standard pin configuration, which is almost always the same (Fig. 2).

3.1 Operating voltage

These "standard YIG's" always require + 15V(approximately 150 - 300mA) and frequently also – 5V as operating voltages. But there are also some manufacturers who depart from this norm, and their YIG oscillators need completely different voltages. For example, Hewlett Packard, whose YIG's frequently need + 20.5V and – 5.1V, or + 20V and – 10V.

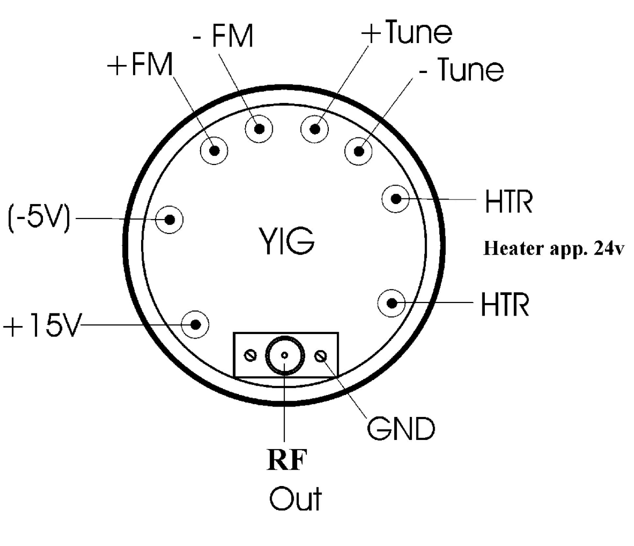


Fig 2: The standard pin connections for a YIG oscillator.

There are also oscillators from Watkin-J that require a negative operating voltage of – 14.2V. But the good thing about this is that these voltage specifications are almost always printed on the oscillator. Fig. 3 shows three YIG's with + 15V and – 5V as operating voltages. Fig. 4 shows three examples from different manufacturers with an operating voltage of + 15V alone. In spite of differences in shape and size, the "standard" pin configuration has been retained.

3.2 Heating

There are usually two connections for heating. These lead to a small PTC plate inside the oscillator, which serves to keep the YIG element at a uniform temperature. The voltage for heating is not critical, and is normally about 24V. A relatively high starting current of several hundred mA falls off markedly after a few seconds, and then oscillates around a value of < 100mA. Fig. 5 shows a small heating plate of this kind on the YIG ball

Fig 3 Examples of YIG oscillators with operating voltages of +15v and -5v.

mounting.

3.3 Main tuning coil

The main tuning coil is usually indicated by "+ tune" and "– tune". In contrast to a VCO, where the frequency is controlled using a tuning voltage, a YIG is "current controlled" i.e. the frequency of the YIG oscillator depends on the current which flows through the tuning coil. The great thing about this is that the frequency response curve is very linear in relation to the current fed in. 20MHz/mA is a typical value.

The main tuning coil consists of thick enamelled copper wire and is very powerful. Even currents exceeding 1A can be coped with for a short time. Incidentally, the tuning current should always be fed in to the correct pin. This coil's resistance is approximately 10Ω, but it can lie in a range between 5 and 15Ω. The thick main tuning coil can easily be recognised in Fig. 6. It runs around the metal plate

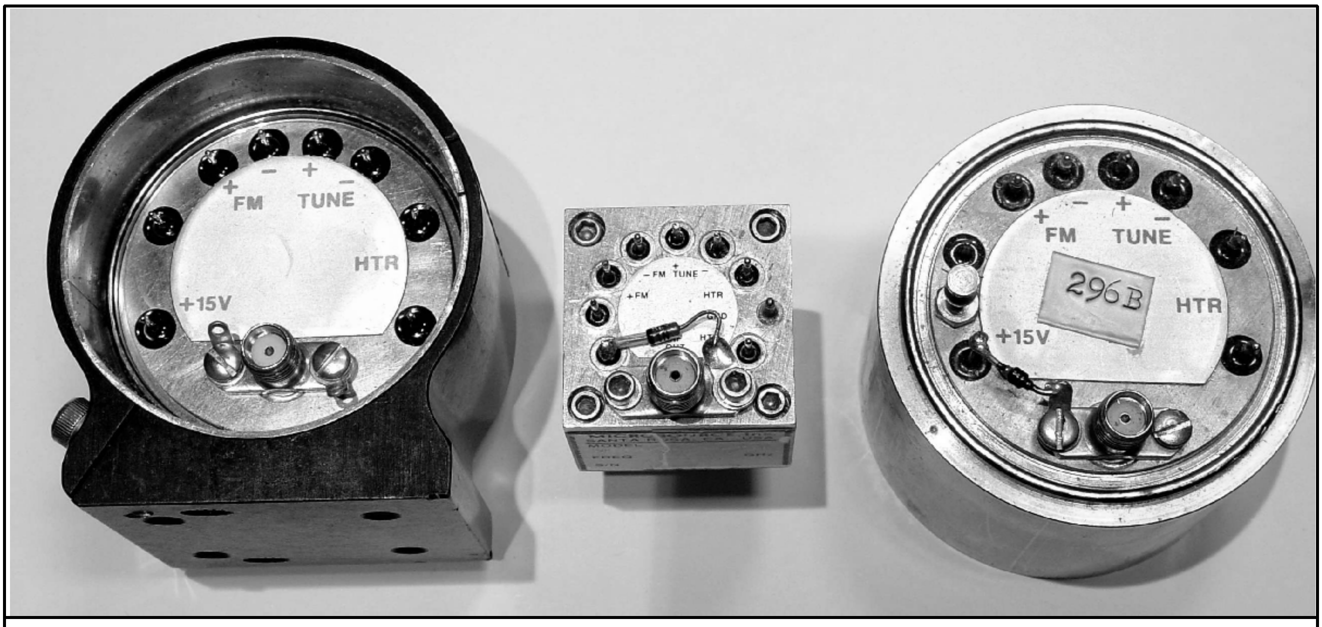


Fig 4: Examples of YIG oscillators with operating voltages of +15v.

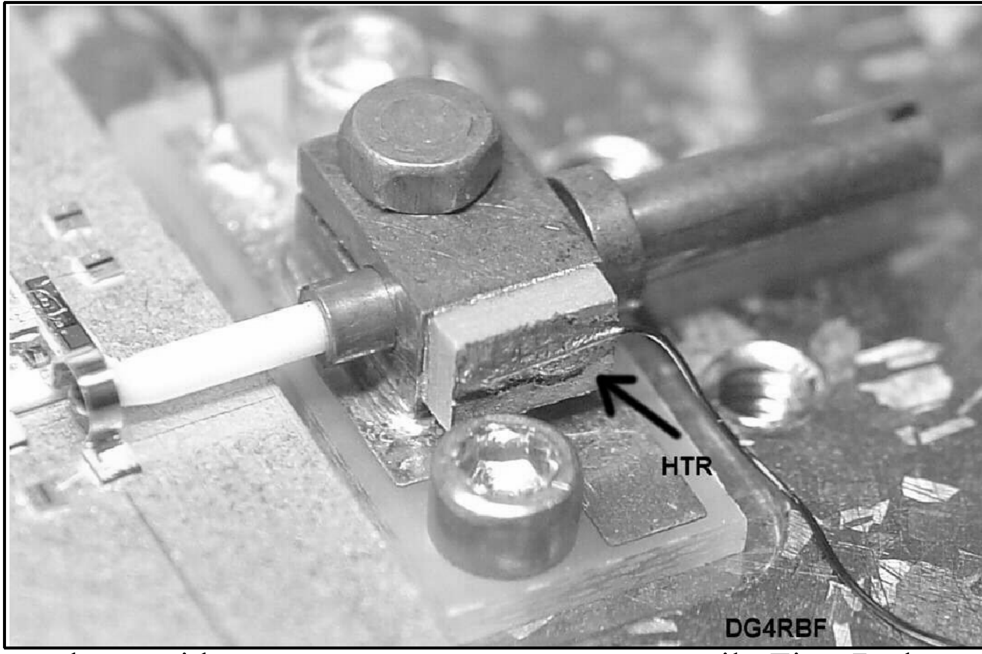


Fig 5: The PTC heating plate in a YIG oscillator.

on the outside.

3.3 FM coil

A second tuning coil is used for fine tuning or the FM modulation of the oscillator. It is indicated by "+ FM" and "– FM".

This small coil consists of very thin wire, has a resistance of only approximately 1Ω, and could be destroyed by currents exceeding 200mA. So care must be exercised here.

The small coil on the plate is the FM coil and can be seen in the middle of Fig. 6. But there are also models without an FM coil. Fig. 7 shows a unit of this type. Although this YIG has no connections for the FM coil, the other pins correspond to the standard layout.

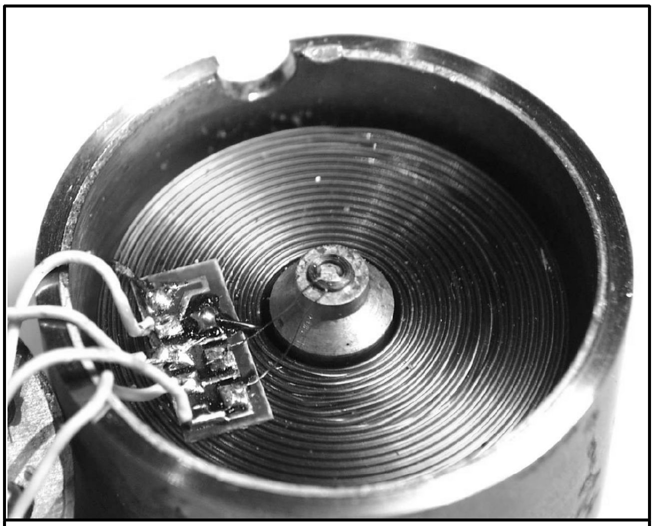


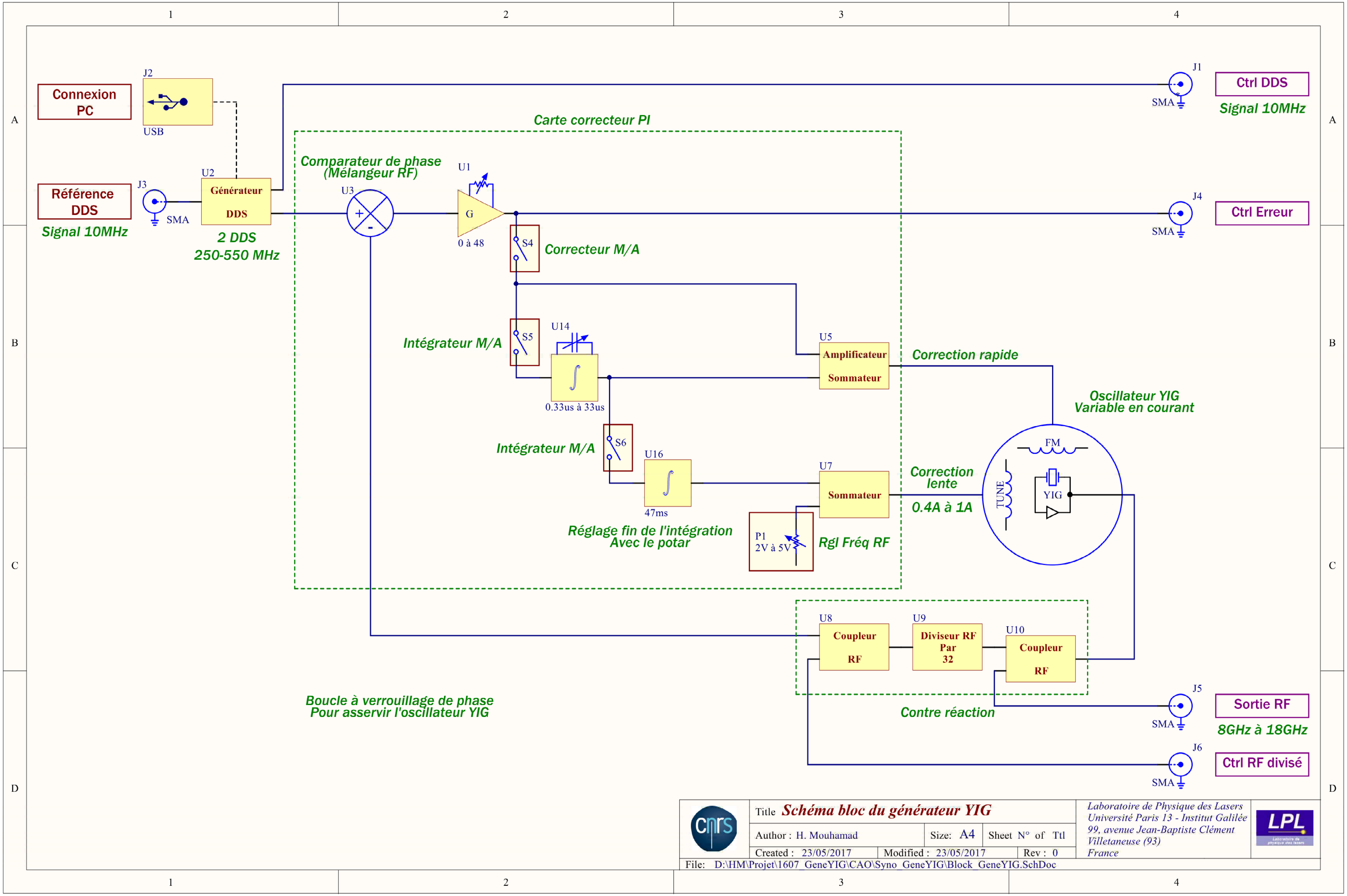
Fig 6: The tuning coils.

So there's no need to be scared of YIG oscillators! Using them is really quite simple and not critical. If you have a YIG that has the connections laid out in the circuit as described, everything is really clear, even if the pins are not labelled. As a precaution, you can check the connections for the two tuning coils with an ohmmeter. Zener diodes are frequently fitted as a protection against an over voltage on the pins caused by the operating voltages.

Care must be exercised with YIG oscillators from HP, as most have unlabelled connections which do not correspond to the "standard" and often also need decidedly unusual voltages. The connections here should be known, or you should obtain a connection diagram. Figs. 8 and 9 show two examples from Hewlett Packard.

3.4 Output of YIG oscillators

The output to be expected lies in the range between + 10dBm and + 15dBm. For many examples, it can even extend to + 20dBm. Depending on the frequency range, the output can vary by a few dB's.


Connexion PC
J2
USB
Référence DDS
Signal 10MHz
J3
SMA
U2
Générateur DDS
2 DDS
250-550 MHz
Carte correcteur PI
Comparateur de phase (Mélangeur RF)
U3
U1
G
0 à 48
S4
Correcteur M/A
Intégrateur M/A
S5
U14
0.33us à 33us
U5
Amplificateur Sommateur
Correction rapide
Intégrateur M/A
S6
U16
47ms
U7
Sommateur
Réglage fin de l'intégration Avec le potar
P1
2V à 5V
Rgl Fréq RF
Correction lente
0.4A à 1A
Oscillateur YIG Variable en courant
FM
TUNE
YIG
U8
Coupleur RF
U9
Diviseur RF Par 32
U10
Coupleur RF
Contre réaction
Boucle à verrouillage de phase Pour asservir l'oscillateur YIG
J1
SMA
Ctrl DDS
Signal 10MHz
J4
SMA
Ctrl Erreur
J5
SMA
Sortie RF
8GHz à 18GHz
J6
SMA
Ctrl RF divisé
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Modified : 23/05/2017
Rev : 0
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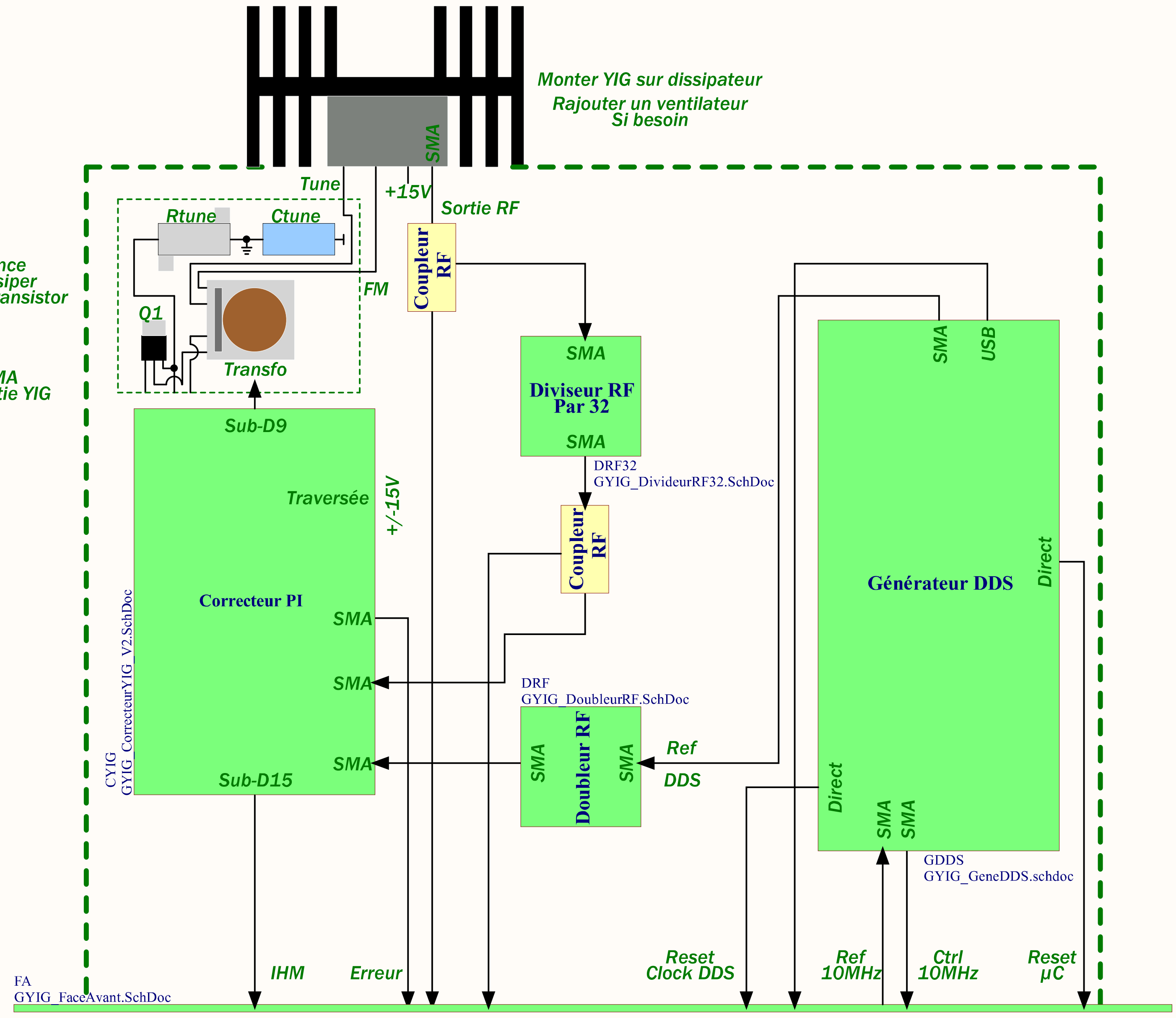
Laboratoire de Physique des Lasers
Université Paris 13 - Institut Galilée
99, avenue Jean-Baptiste Clément
Villetaneuse (93)
France

Composant étage de puissance
A monter sur le rack pour dissiper
Attention mettre isolant pour le transistor

Tous les connexions RF en SMA
Câble coaxiale rigide pour RF sortie YIG

Générateur DDS
Alimenté +/-15V et +5V

Diviseur et doubleur RF
Etage de sortie DDS
Alimenté +12V



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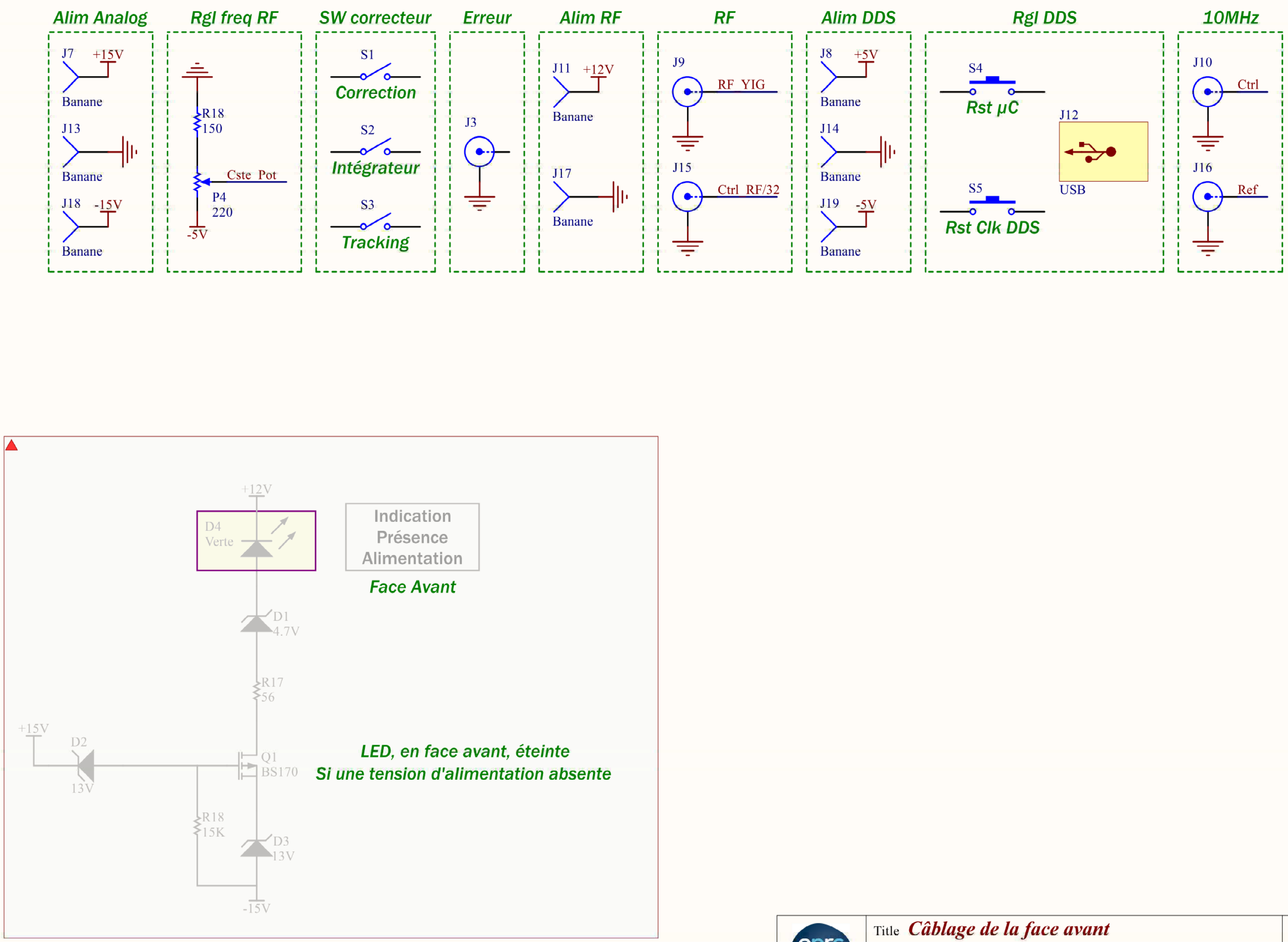

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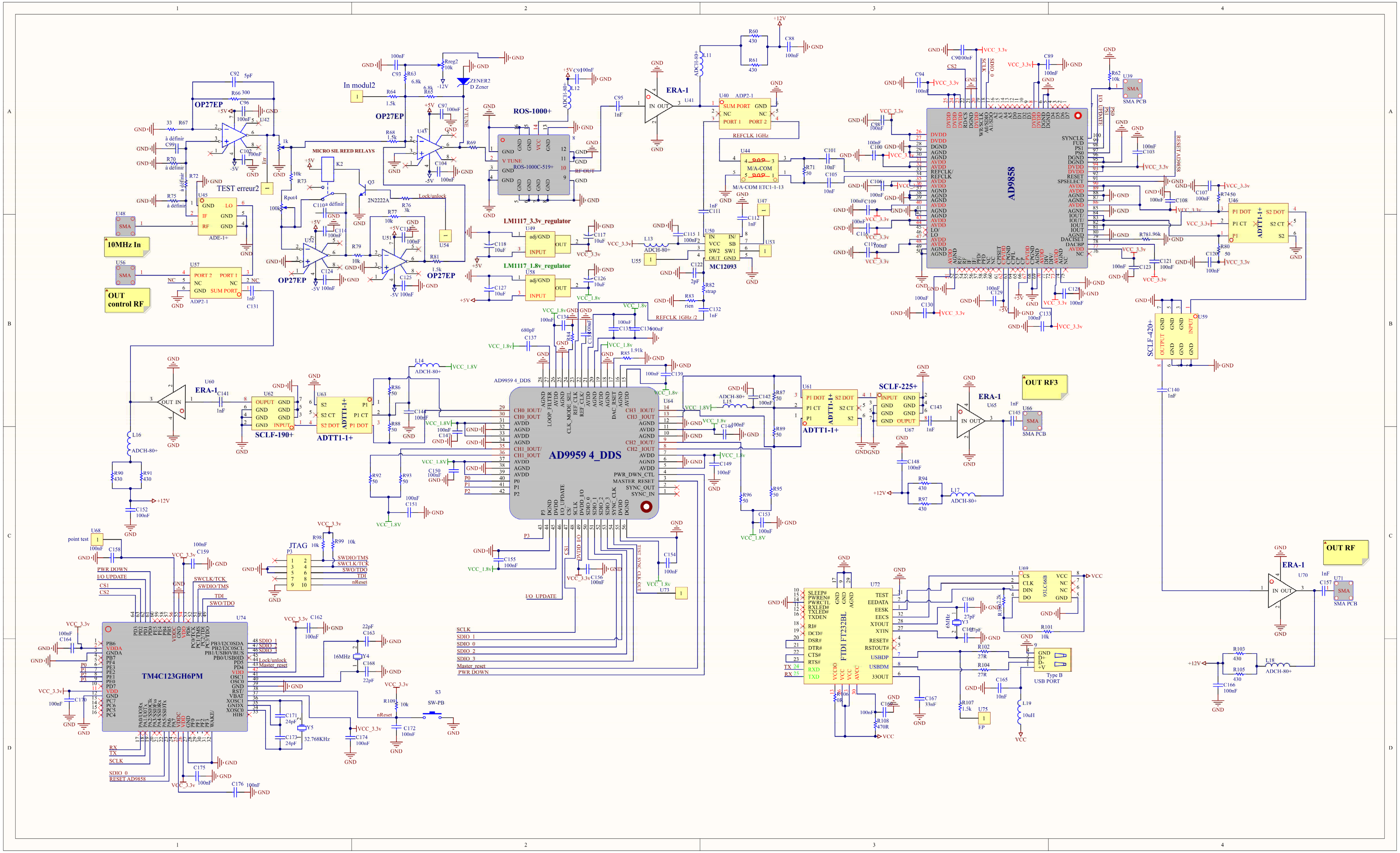

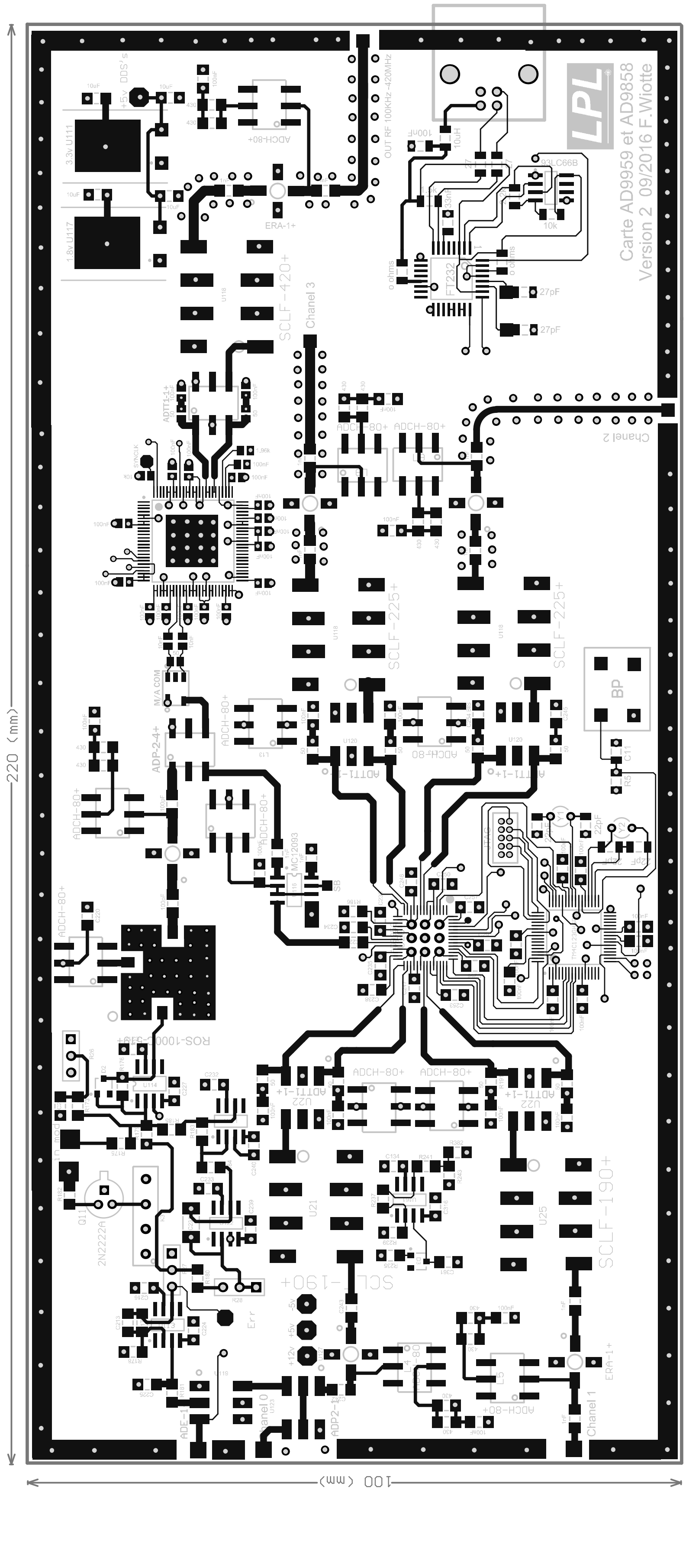
Carte AD9959 et AD9858
Version 2 09/2016 F.Wiotte
LPL
220 (mm)
100 (mm)
OUT RF 100KHz -420MHz
Chanel 1
Chanel 2
Chanel 3
SCLF-420+
SCLF-225+
SCLF-190+
ERA-1+
ADCH-80+
ADTT1-1+
ADP-2-4+
ROS-1000
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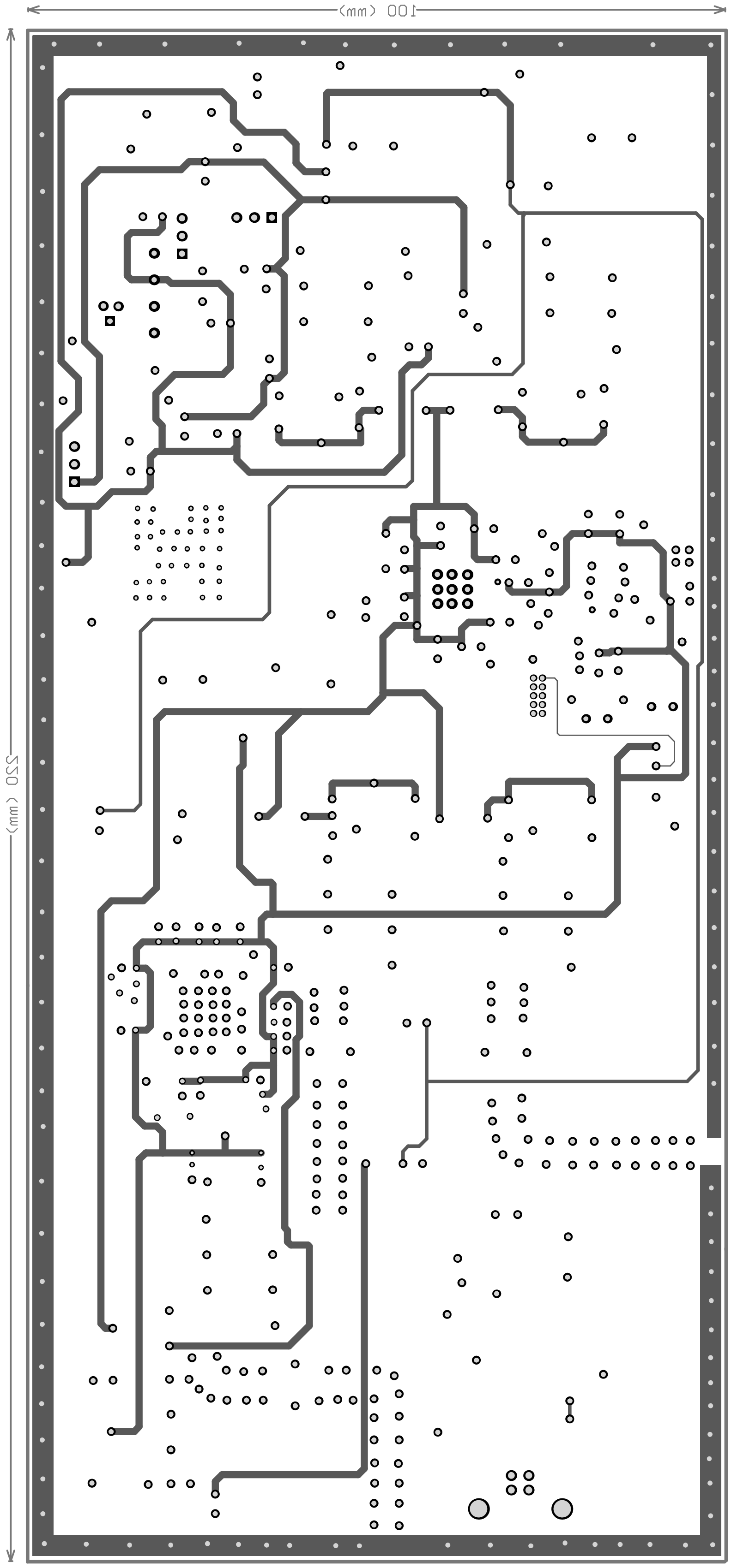
BP
FT232
93LC66B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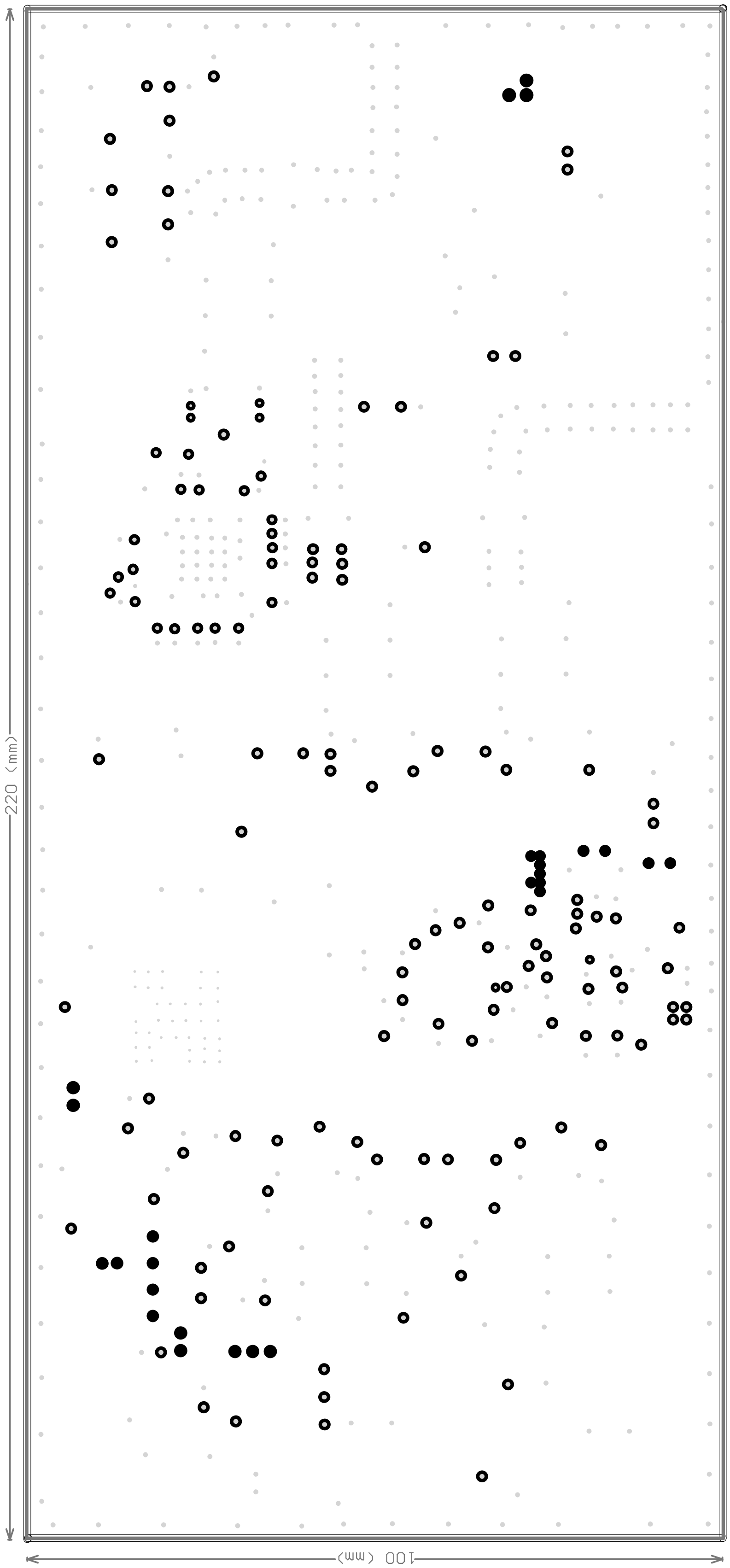
220 (mm)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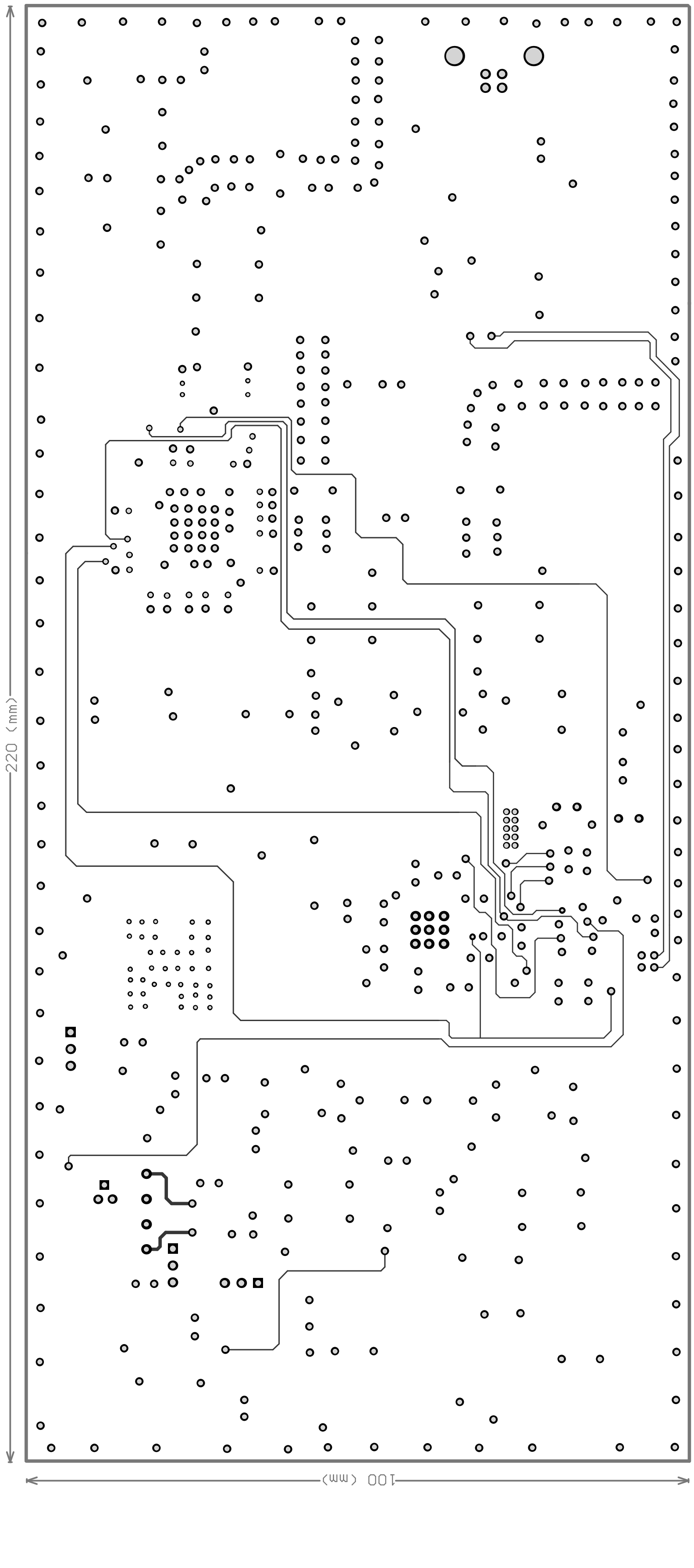
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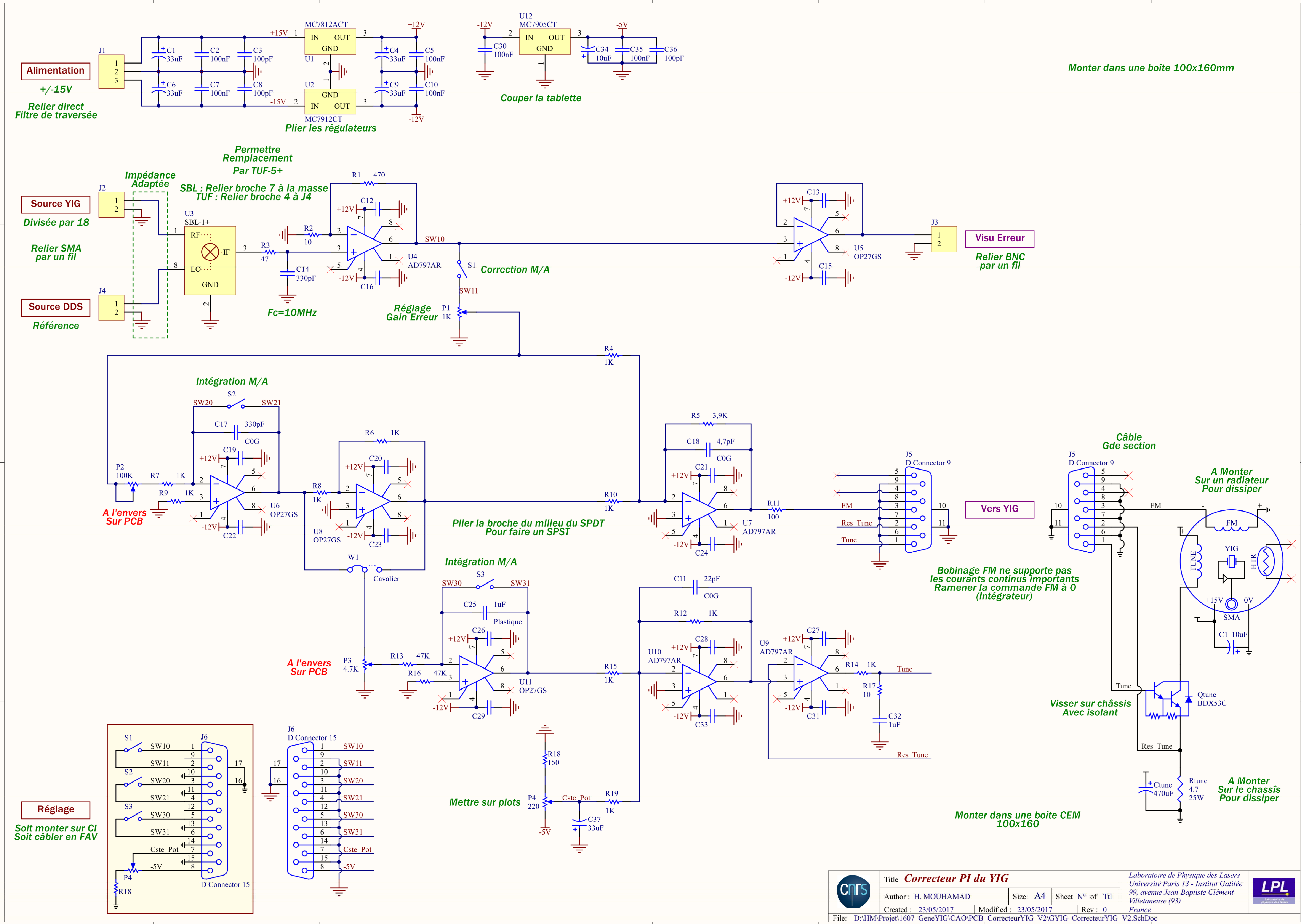
100 (mm)


Alimentation
+/-15V
Relier direct
Filtre de traversée
Plier les régulateurs
Couper la tablette
Monter dans une boîte 100x160mm
Source YIG
Divisée par 18
Relier SMA
par un fil
Source DDS
Référence
Impédance
Adaptée
Permettre
Remplacement
Par TUF-5+
SBL : Relier broche 7 à la masse
TUF : Relier broche 4 à J4
Fc=10MHz
Réglage
Gain Erreur
Correction M/A
Visu Erreur
Relier BNC
par un fil
Intégration M/A
A l'envers
Sur PCB
Plier la broche du milieu du SPDT
Pour faire un SPST
Vers YIG
Câble
Gde section
A Monter
Sur un radiateur
Pour dissiper
Bobinage FM ne supporte pas
les courants continus importants
Ramener la commande FM à 0
(Intégrateur)
Intégration M/A
A l'envers
Sur PCB
Visser sur châssis
Avec isolant
A Monter
Sur le chassis
Pour dissiper
Mettre sur plots
Monter dans une boîte CEM
100x160
Réglage
Soit monter sur CI
Soit câbler en FAV
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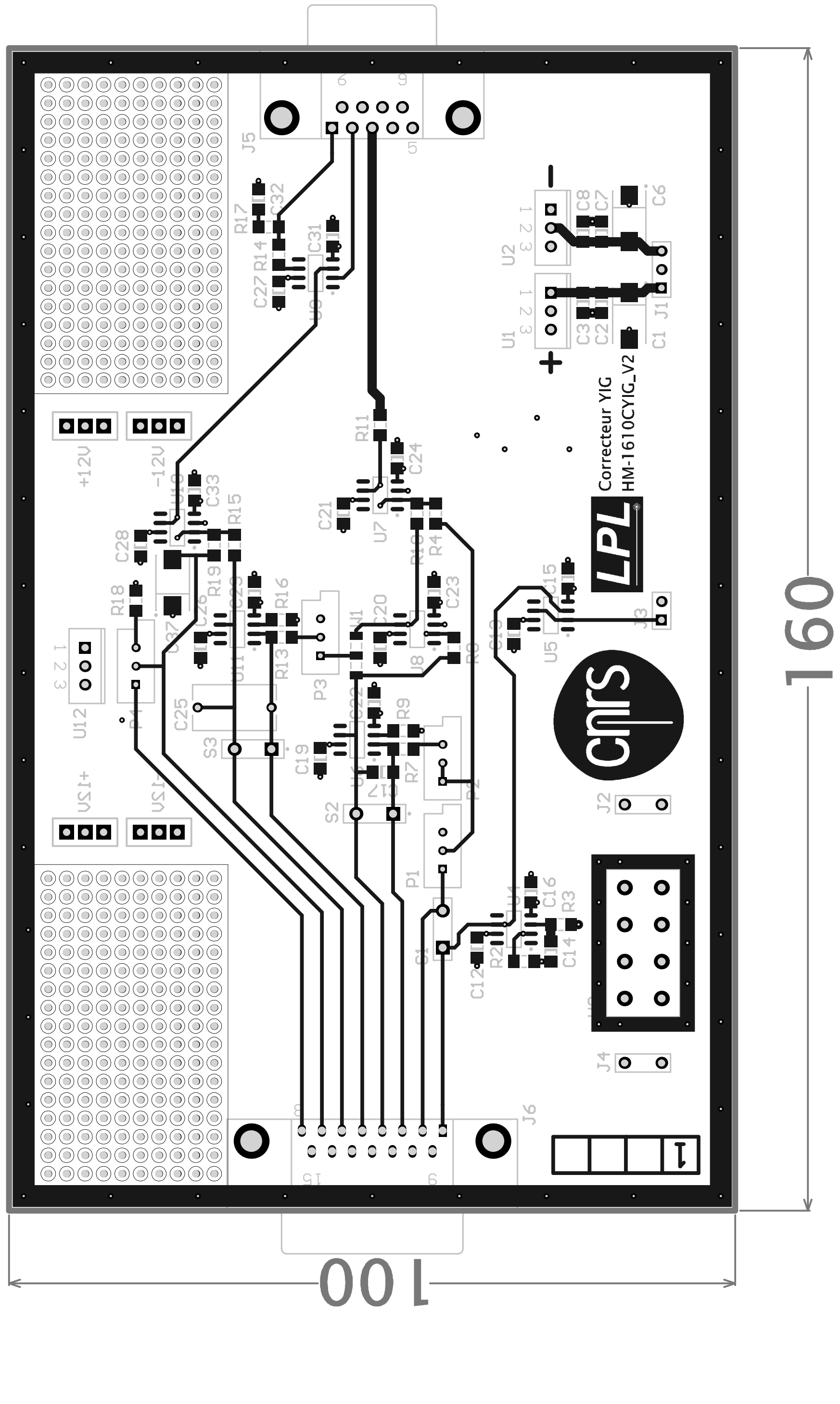
Villetaneuse (93)
France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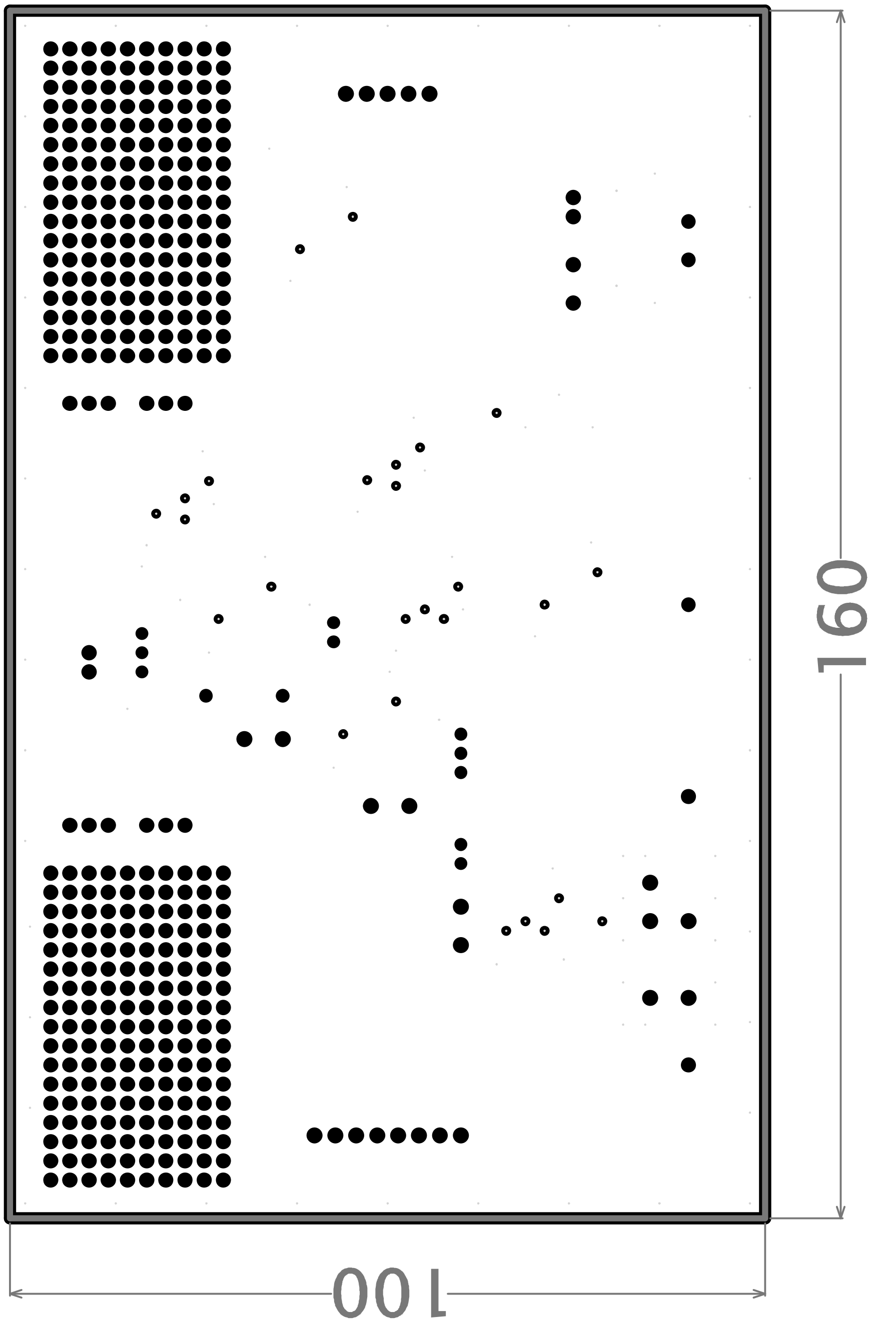
HM-1610CYIG_V2
160
100
+12V
-12V
J5
J6
U12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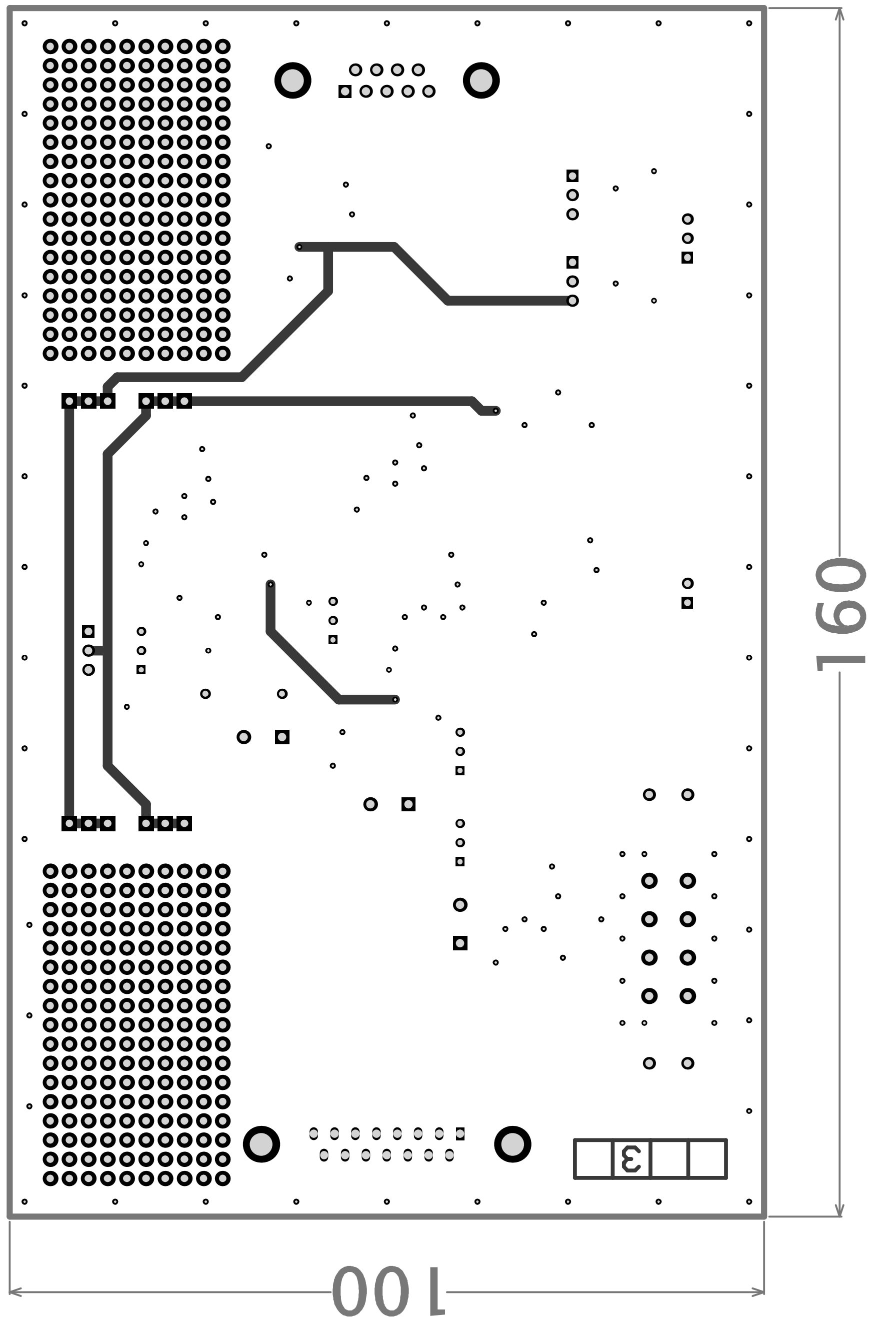
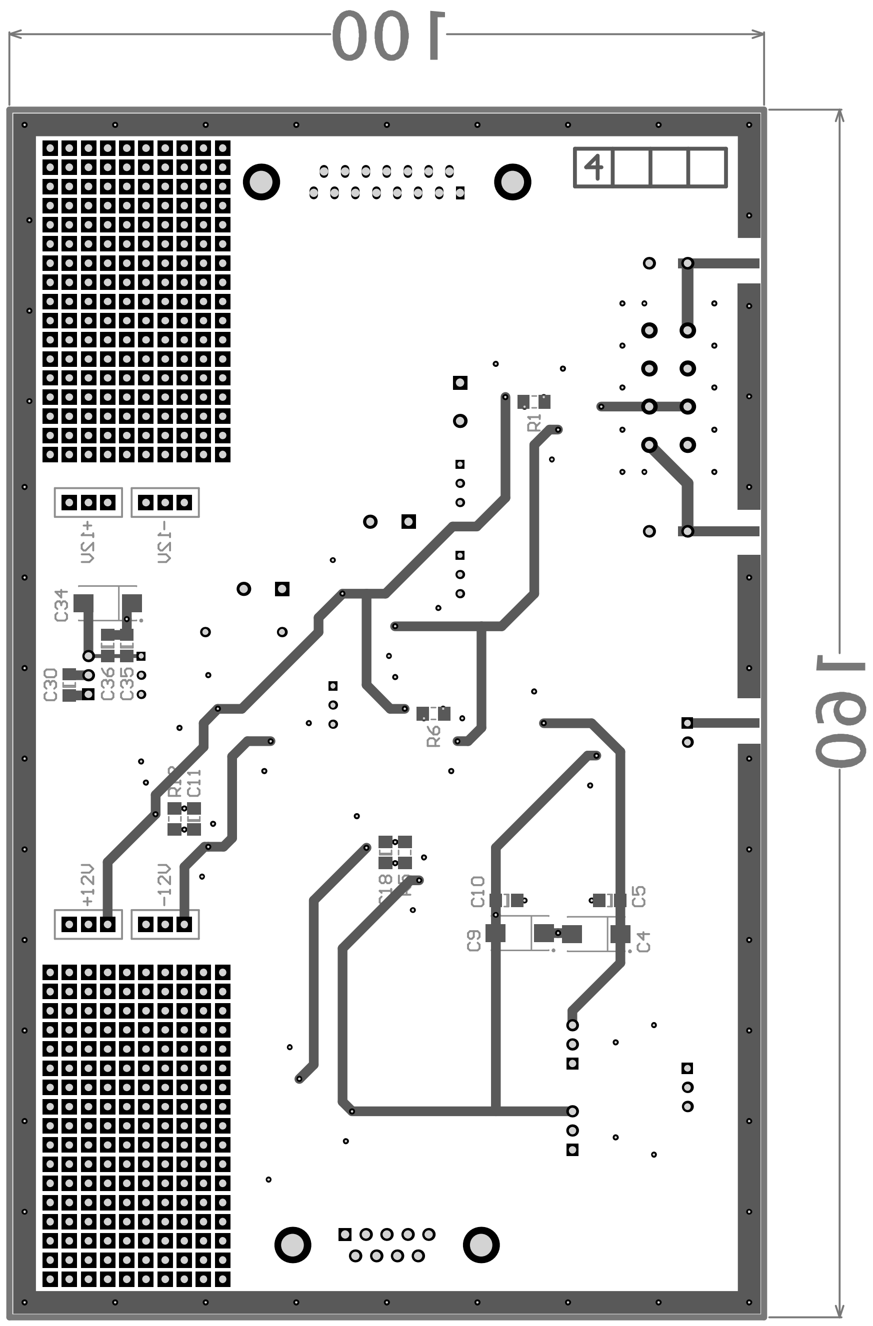
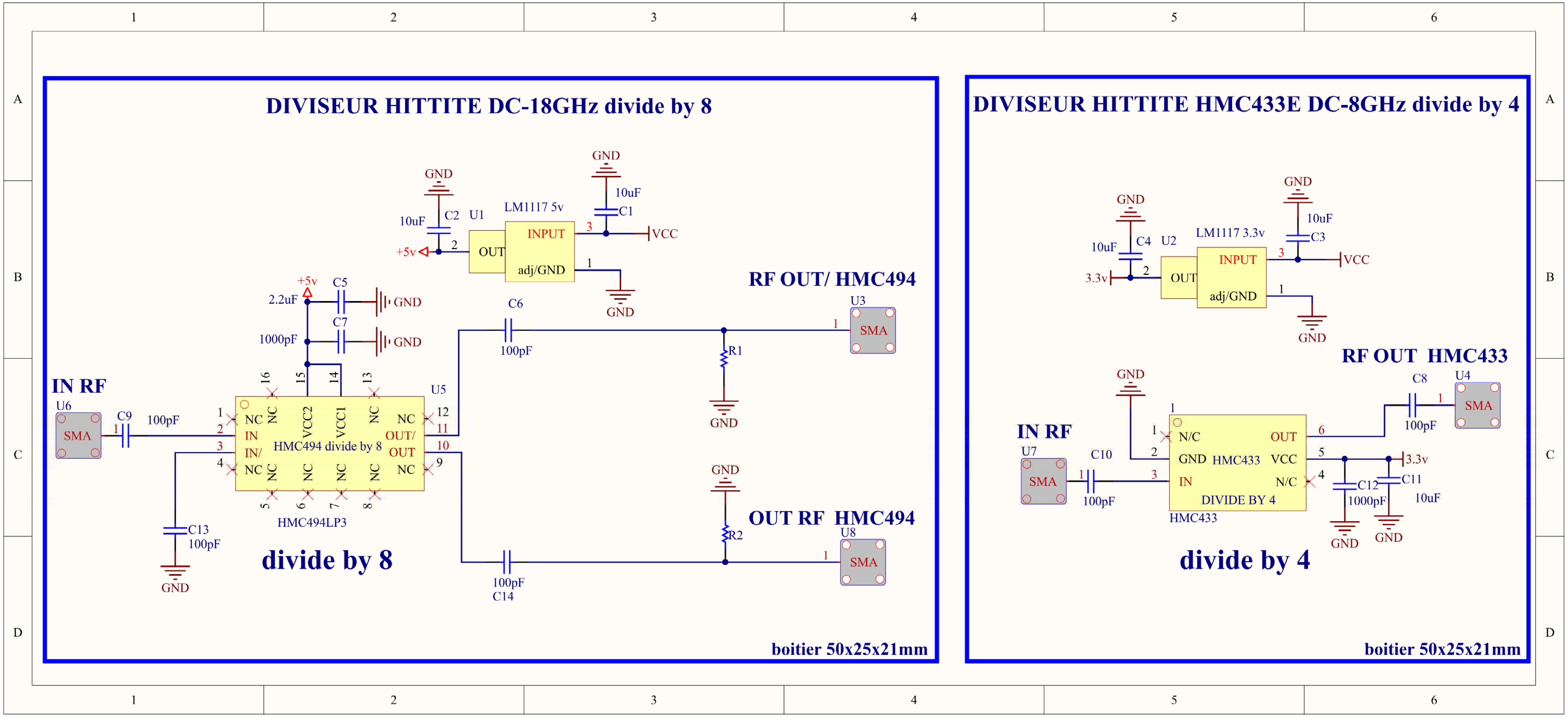
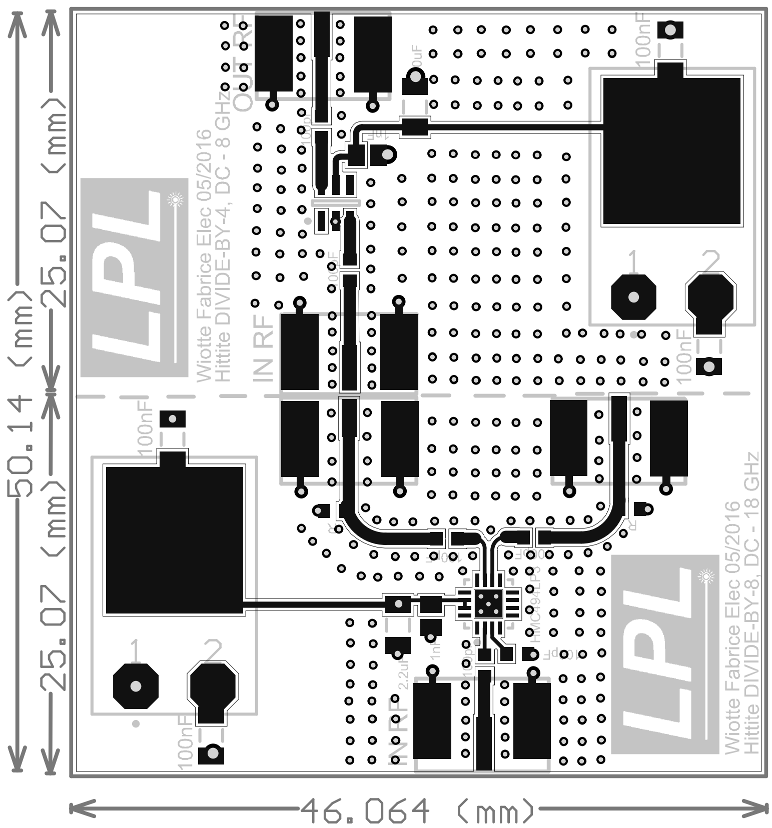
100

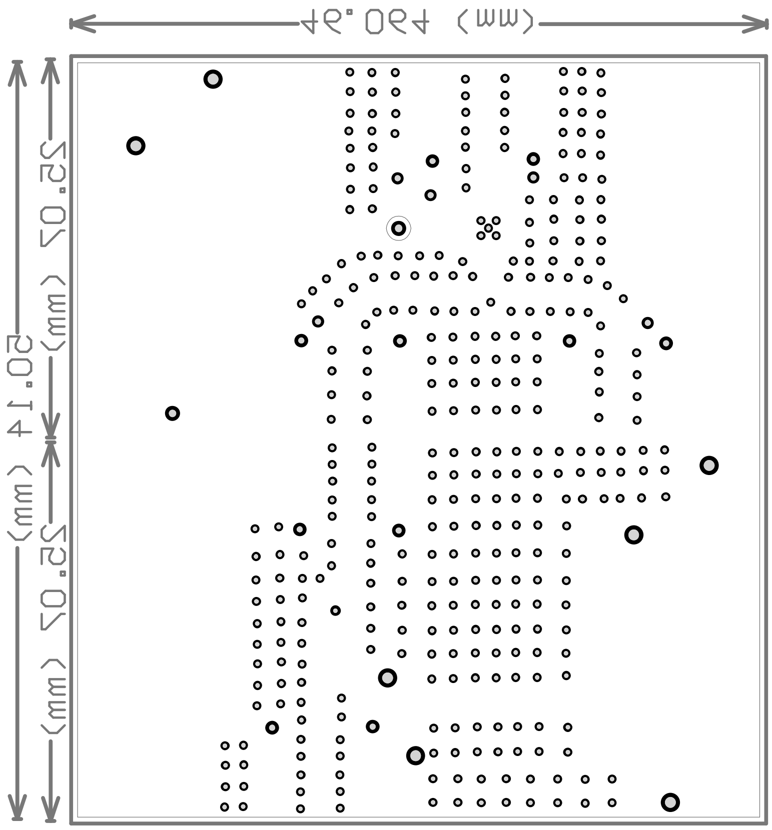

160
100



100
160
+12V
-12V
C34
C36
C35
C30
R1
R6
C11
C18
C10
C9
C5
C4


DIVISEUR HITTITE DC-18GHz divide by 8
IN RF
U6
SMA
C9
100pF
GND
C2
10uF
U1
LM1117 5v
+5v
OUT
INPUT
adj/GND
10uF
C1
VCC
+5v
C5
2.2uF
C7
1000pF
C6
100pF
U5
NC
IN
IN/
VCC2
VCC1
OUT/
OUT
HMC494 divide by 8
HMC494LP3
C13
100pF
RF OUT/ HMC494
U3
R1
OUT RF HMC494
U8
R2
C14
divide by 8
boitier 50x25x21mm
DIVISEUR HITTITE HMC433E DC-8GHz divide by 4
C4
U2
LM1117 3.3v
3.3v
C3
RF OUT HMC433
C8
U4
IN RF
U7
C10
N/C
GND
HMC433
DIVIDE BY 4
C12
C11
3.3v
divide by 4
boitier 50x25x21mm


50.14 (mm)
25.07 (mm)
25.07 (mm)
46.064 (mm)
LPL
Wiotte Fabrice Elec 05/2016
Hittite DIVIDE-BY-4, DC - 8 GHz
OUT RF
IN RF
100nF
1
2
LPL
Wiotte Fabrice Elec 05/2016
Hittite DIVIDE-BY-8, DC - 18 GHz
IN RF
100nF
1
2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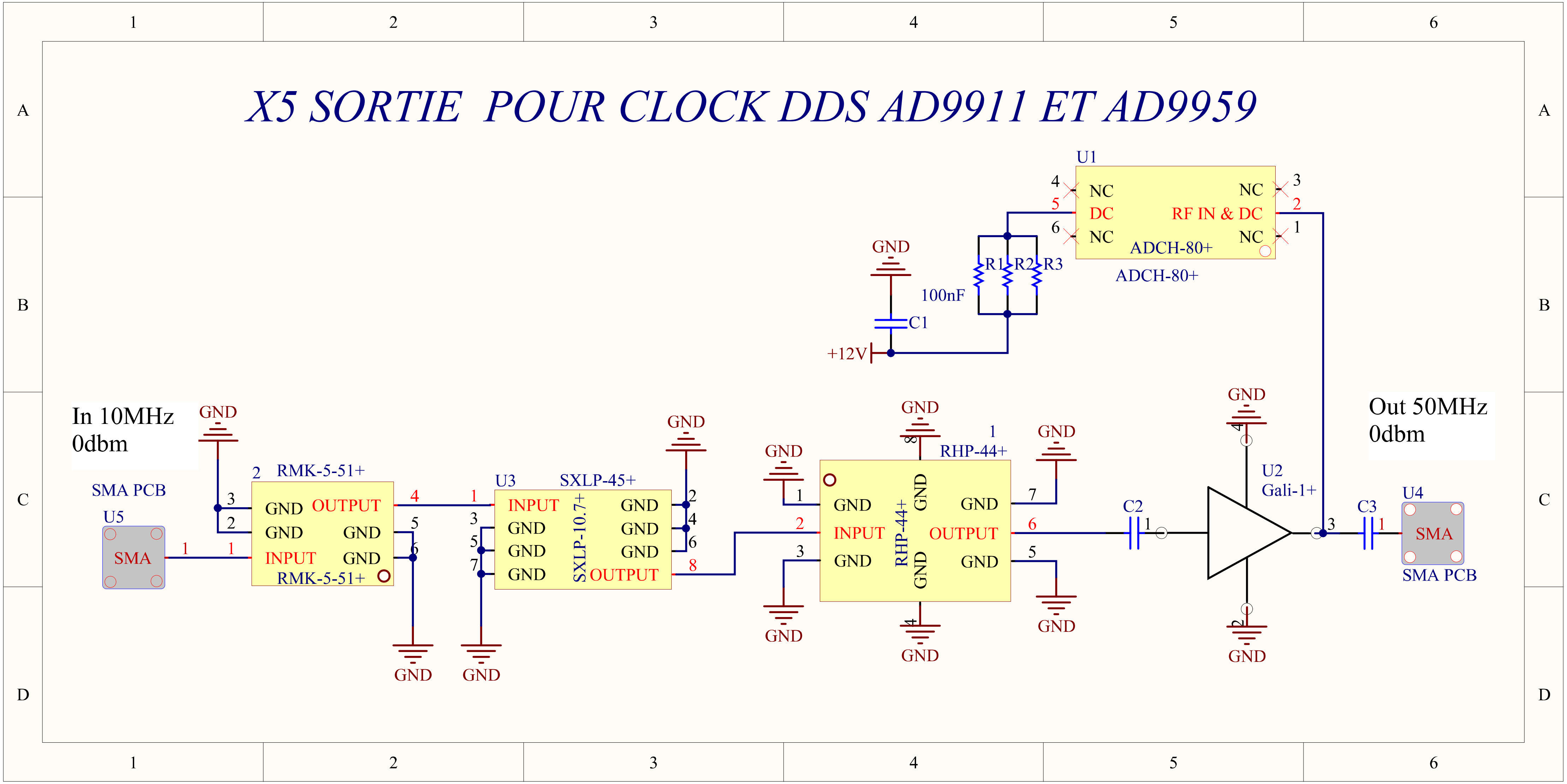
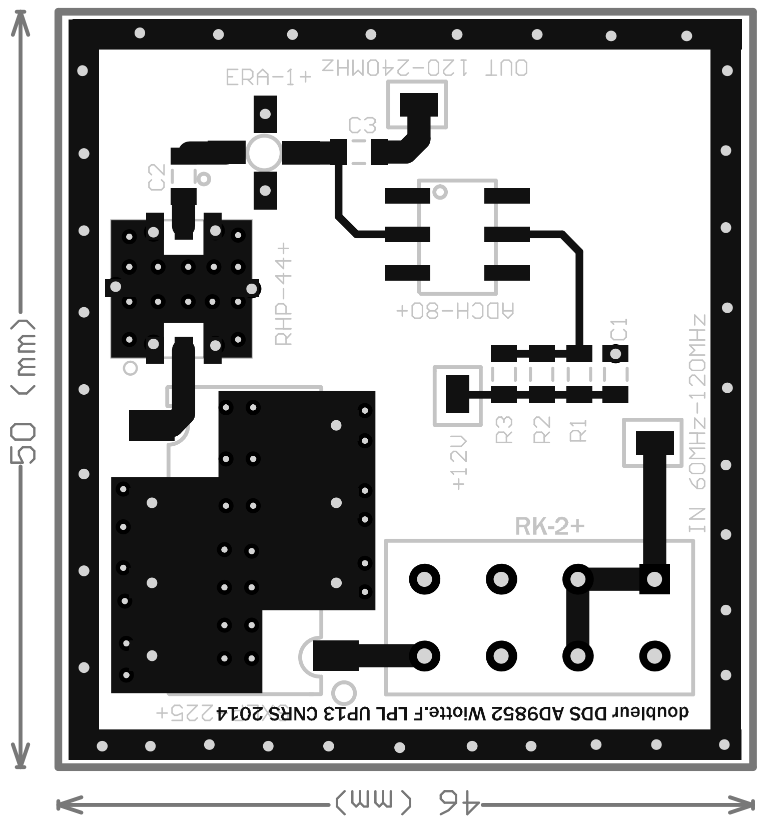
50.14 (mm)
25.07 (mm)
25.07 (mm)



X5 SORTIE POUR CLOCK DDS AD9911 ET AD9959
In 10MHz
0dbm
Out 50MHz
0dbm
U5
SMA PCB
SMA
RMK-5-51+
U3
SXLP-45+
SXLP-10.7+
RHP-44+
U1
ADCH-80+
NC
DC
RF IN & DC
R1
R2
R3
100nF
C1
+12V
C2
C3
U2
Gali-1+
U4
SMA PCB
INPUT
OUTPUT
GND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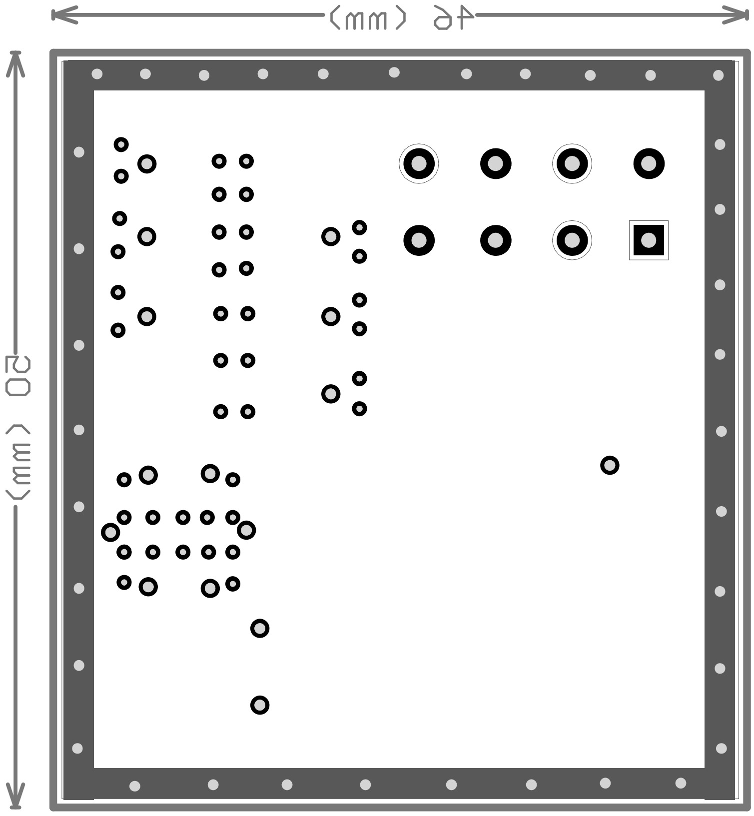
OUT 120-240MHz
C3
C2
RHP-44+
ADCH-80+
C1
IN 60MHz-120MHz
+12V
R3
R2
R1
RK-2+
doubleur DDS AD9852 Wiotte.F LPL UP13 CNRS 2014
50 (mm)
46 (mm)


46 (mm)
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