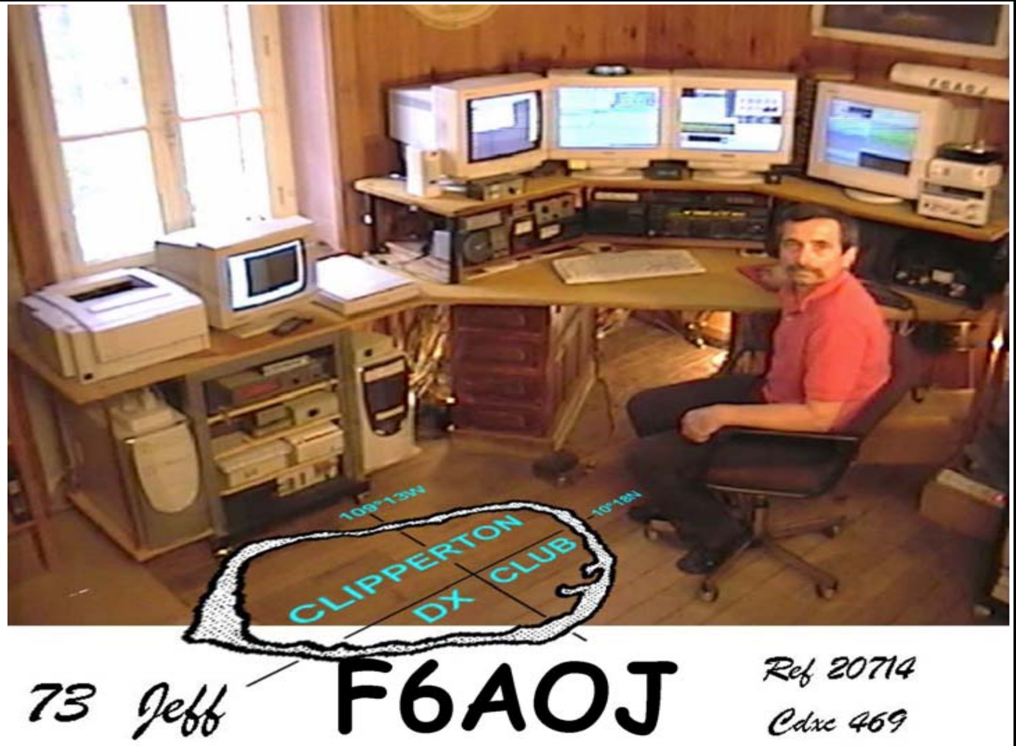
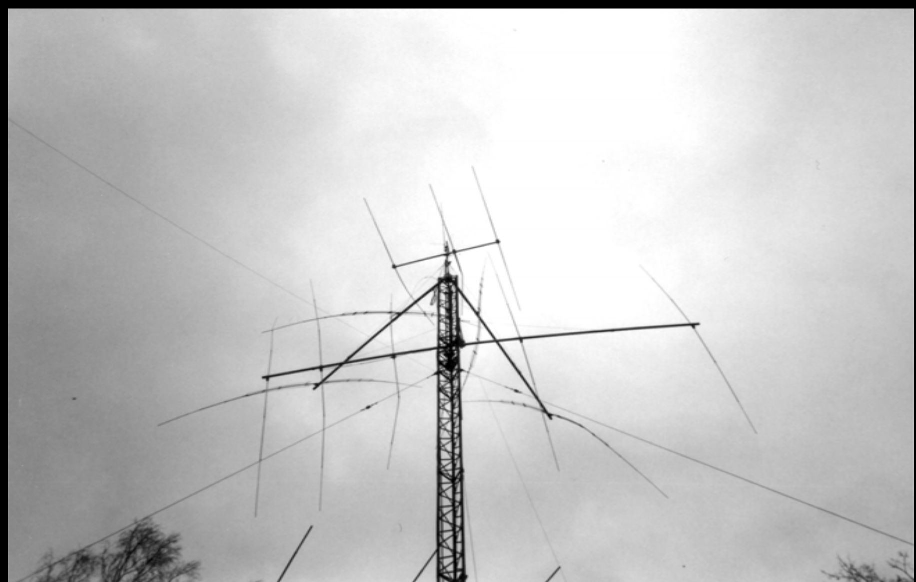
1973

2002



Évolutions du système de Réception depuis décembre 1999

Décembre 99
reset avant le nouveau millénaire ?



3 el 12m 4el 40m   5 el 20m

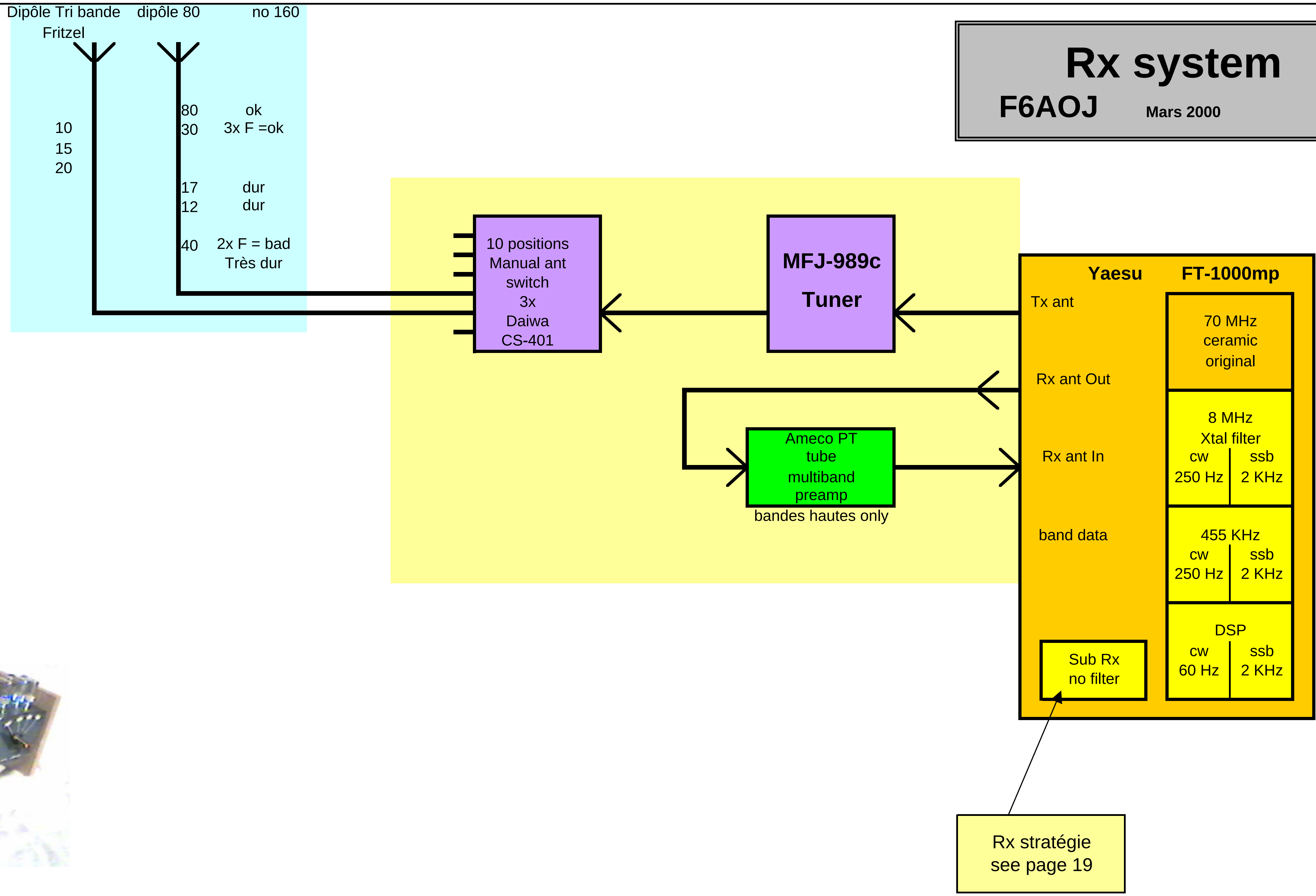
verticale 80 / 160

" Cent fois sur le métier remettez votre ouvrage " (Jean De La Fontaine)

Yapuka…

Rx system

F6AOJ **Mars 2000** 1



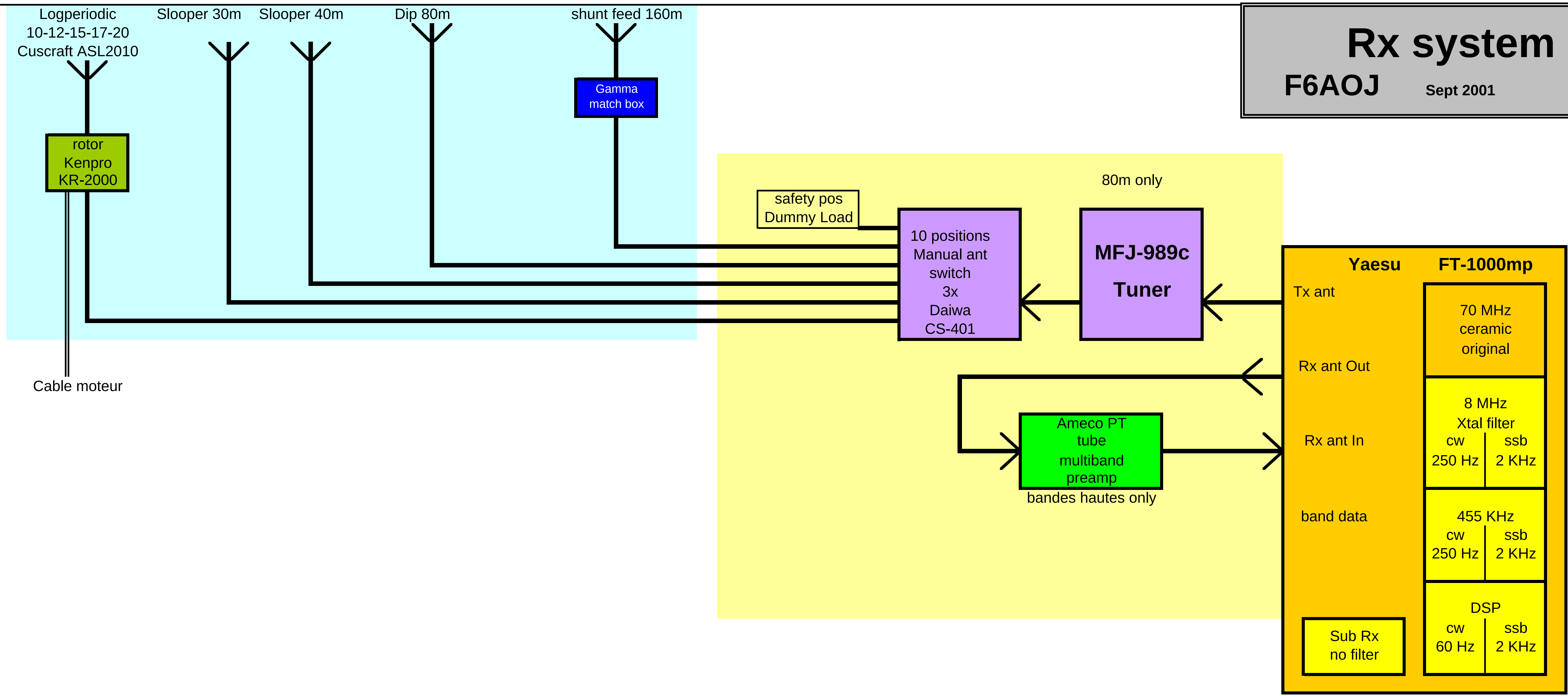
Ameco PT

Juste après
LA Tempête

Le radeau
de la méduse….

Rx system

F6AOJ **Sept 2001**

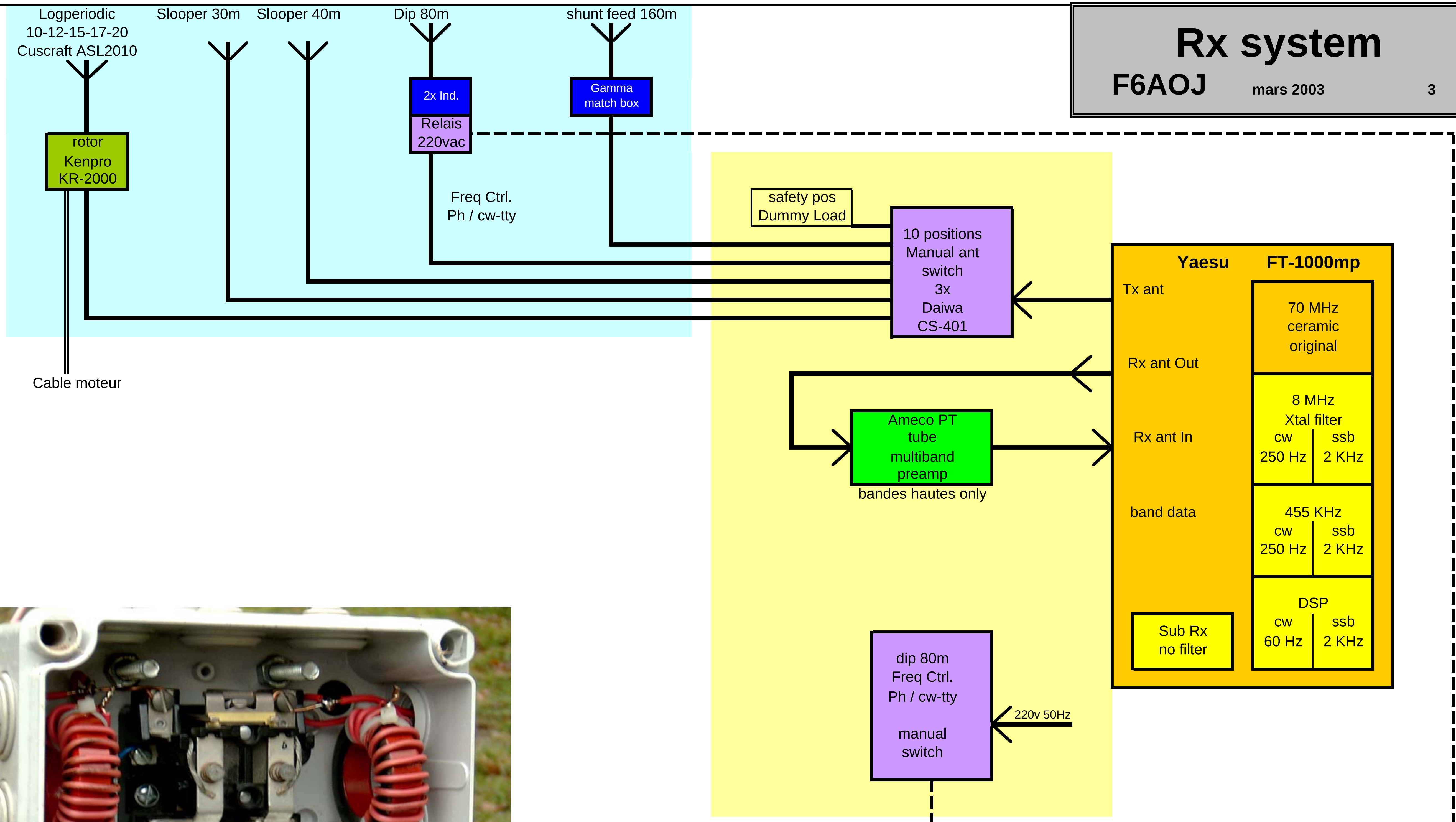


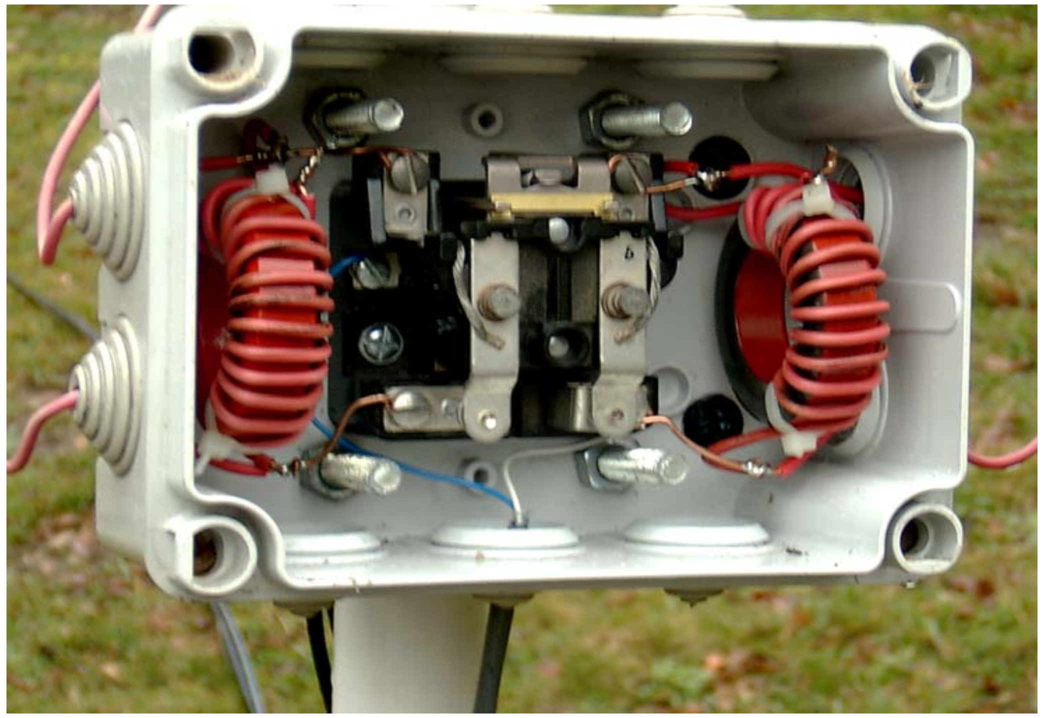
Config Basic
très fiable

photo p 21, 22, 23

Rx system

F6AOJ **mars 2003** **3**



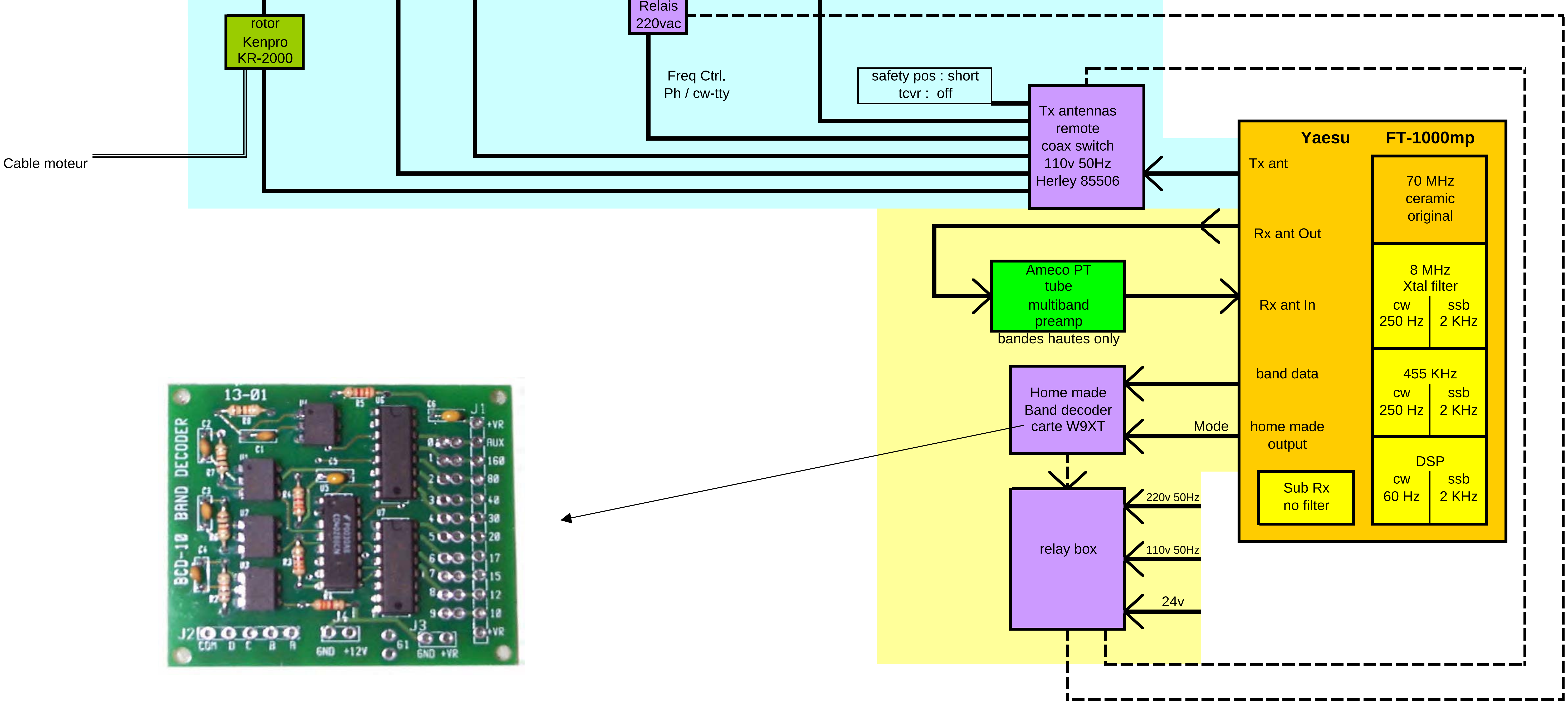


Plus de
Boite de Couplage
enfin

détails P 31 & 32

Rx system

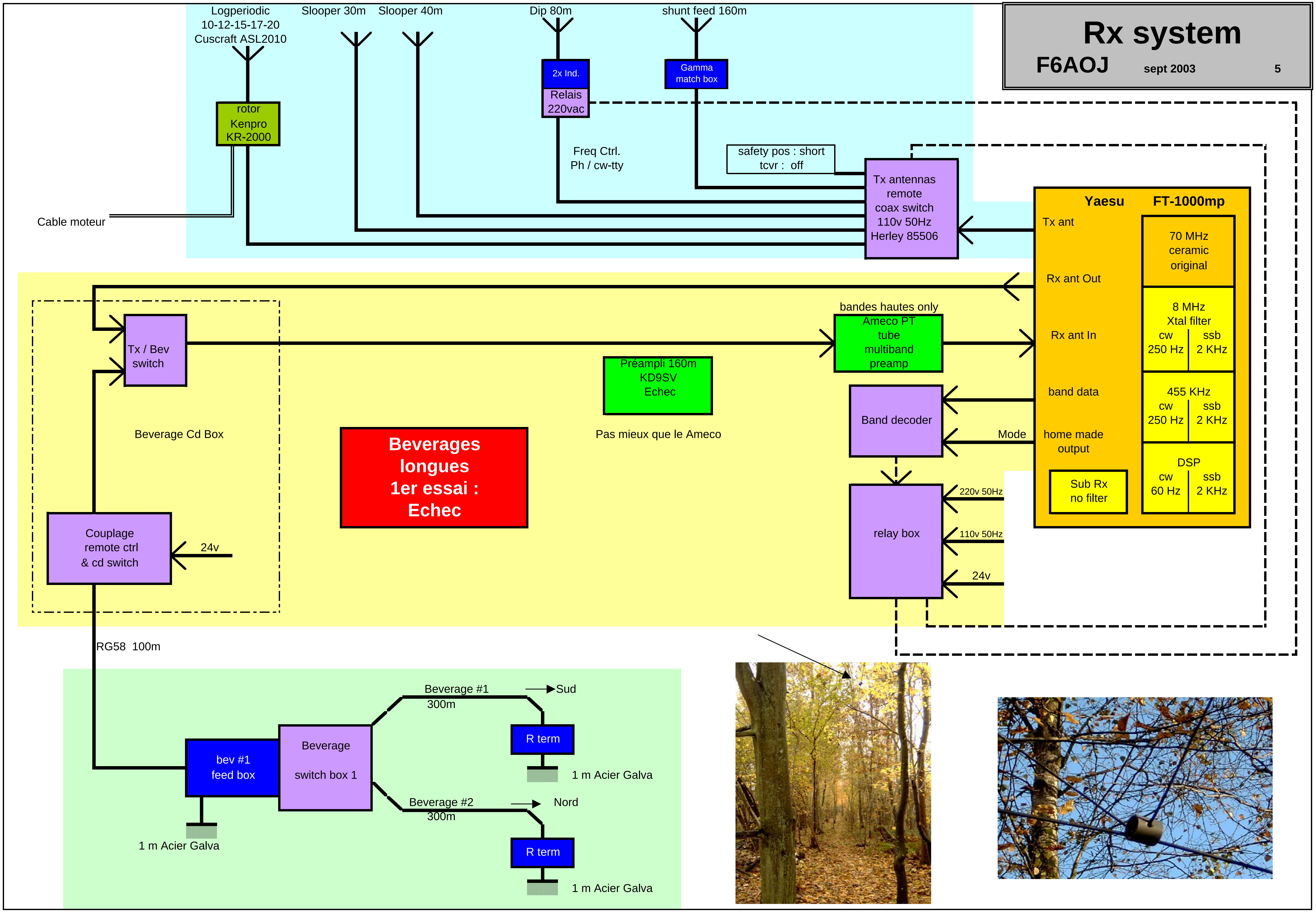
F6AOJ avril 2003

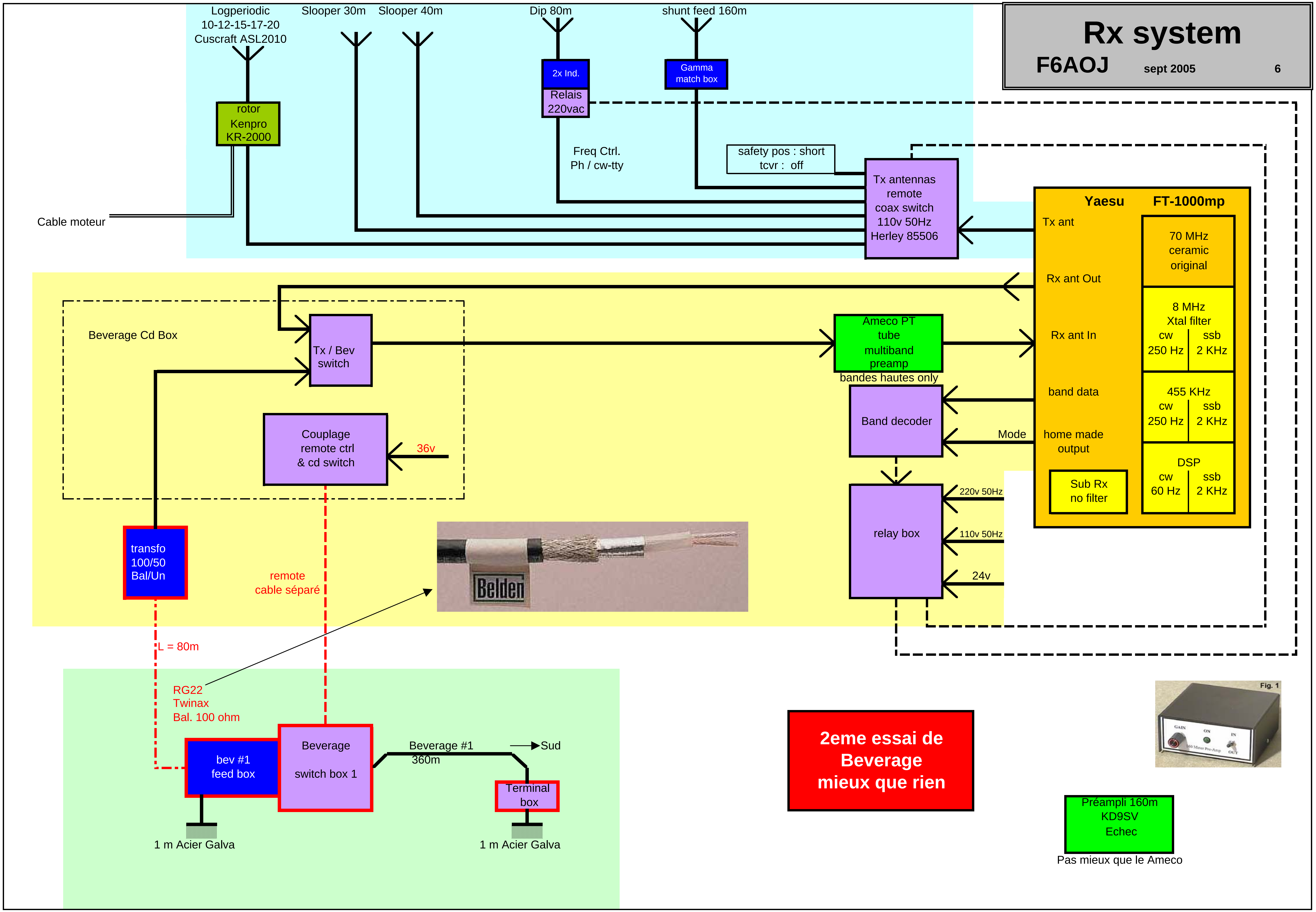


http://www.unifiedmicro.com/decoder.html

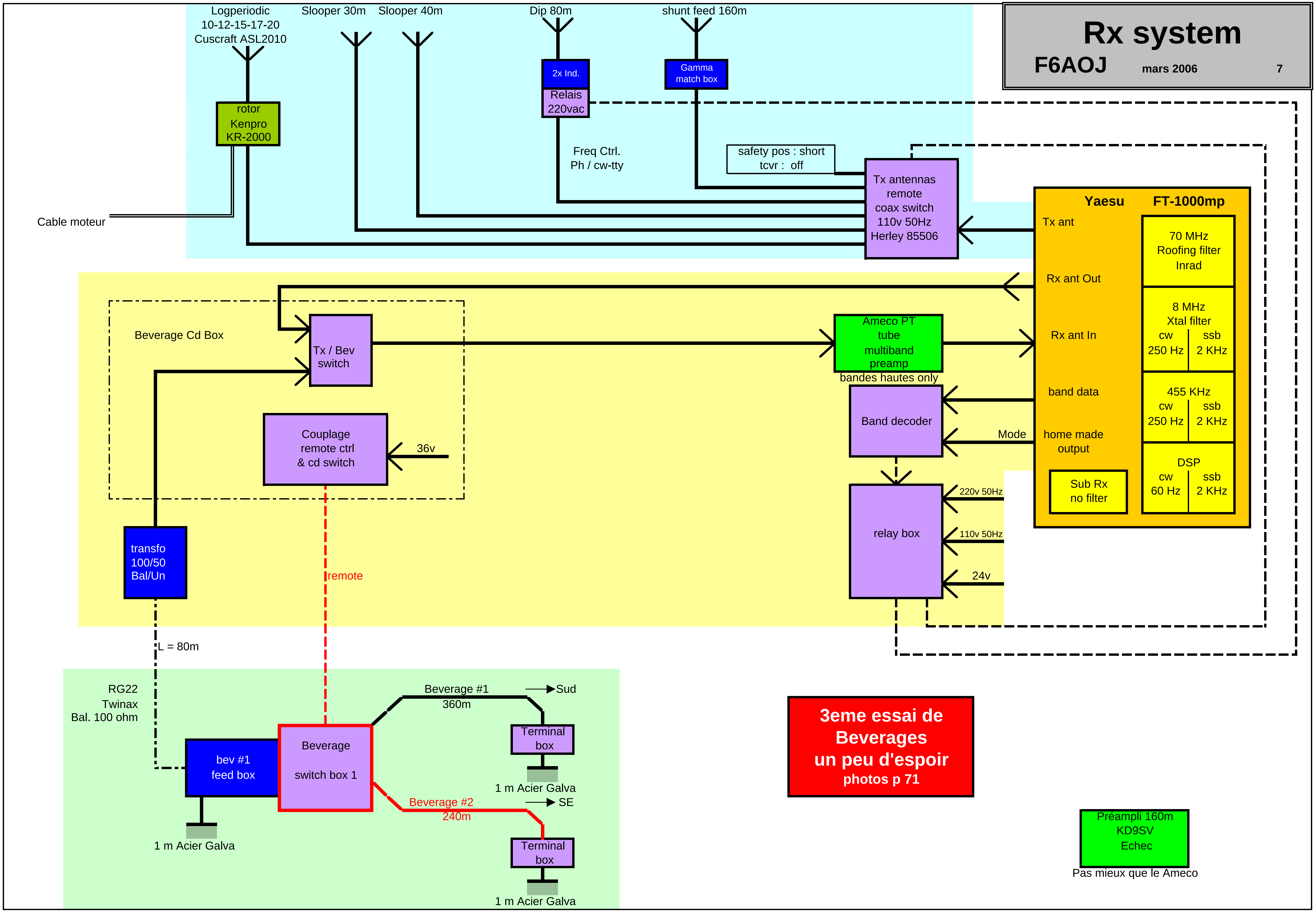
Changement de Bande et Mode automatique

photos page 41


Rx system
F6AOJ
sept 2003
5
Logperiodic
10-12-15-17-20
Cuscraft ASL2010
Slooper 30m
Slooper 40m
Dip 80m
shunt feed 160m
rotor
Kenpro
KR-2000
2x Ind.
Relais
220vac
Gamma
match box
Cable moteur
Freq Ctrl.
Ph / cw-tty
safety pos : short
tcvr : off
Tx antennas
remote
coax switch
110v 50Hz
Herley 85506
Yaesu
FT-1000mp
Tx ant
Rx ant Out
Rx ant In
band data
home made
output
70 MHz
ceramic
original
8 MHz
Xtal filter
cw
250 Hz
ssb
2 KHz
455 KHz
cw
250 Hz
ssb
2 KHz
DSP
cw
60 Hz
ssb
2 KHz
Sub Rx
no filter
Tx / Bev
switch
bandes hautes only
Ameco PT
tube
multiband
preamp
Préampli 160m
KD9SV
Echec
Pas mieux que le Ameco
Band decoder
Mode
relay box
220v 50Hz
110v 50Hz
24v
Beverage Cd Box
Beverages
longues
1er essai :
Echec
Couplage
remote ctrl
& cd switch
24v
RG58 100m
Beverage #1
300m
Sud
R term
1 m Acier Galva
bev #1
feed box
Beverage
switch box 1
Beverage #2
300m
Nord
R term
1 m Acier Galva
1 m Acier Galva

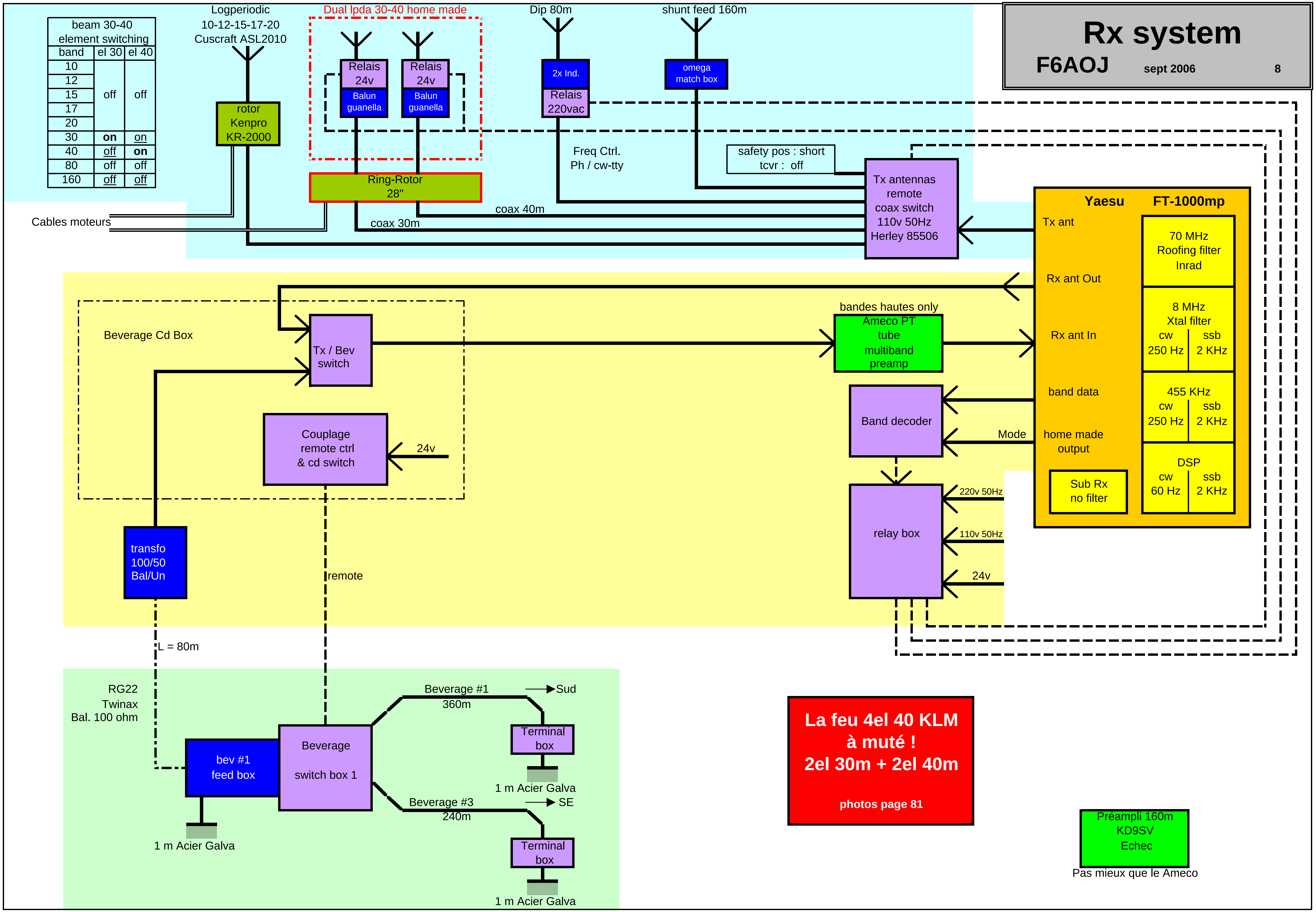


Rx system
F6AOJ
sept 2005
6
Logperiodic
10-12-15-17-20
Cuscraft ASL2010
Slooper 30m
Slooper 40m
Dip 80m
shunt feed 160m
rotor
Kenpro
KR-2000
2x Ind.
Relais
220vac
Gamma
match box
Freq Ctrl.
Ph / cw-tty
safety pos : short
tcvr : off
Tx antennas
remote
coax switch
110v 50Hz
Herley 85506
Cable moteur
Yaesu
FT-1000mp
Tx ant
Rx ant Out
Rx ant In
band data
home made
output
70 MHz
ceramic
original
8 MHz
Xtal filter
cw
250 Hz
ssb
2 KHz
455 KHz
cw
250 Hz
ssb
2 KHz
DSP
cw
60 Hz
ssb
2 KHz
Sub Rx
no filter
Beverage Cd Box
Tx / Bev
switch
Couplage
remote ctrl
& cd switch
36v
Ameco PT
tube
multiband
preamp
bandes hautes only
Band decoder
Mode
relay box
220v 50Hz
110v 50Hz
24v
transfo
100/50
Bal/Un
remote
cable séparé
Belden
L = 80m
RG22
Twinax
Bal. 100 ohm
bev #1
feed box
Beverage
switch box 1
Beverage #1
360m
Sud
Terminal
box
1 m Acier Galva
1 m Acier Galva
2eme essai de
Beverage
mieux que rien
Fig. 1
Préampli 160m
KD9SV
Echec
Pas mieux que le Ameco


Rx system
F6AOJ
mars 2006
7
Logperiodic
10-12-15-17-20
Cuscraft ASL2010
Slooper 30m
Slooper 40m
Dip 80m
shunt feed 160m
rotor
Kenpro
KR-2000
2x Ind.
Relais
220vac
Gamma
match box
Freq Ctrl.
Ph / cw-tty
safety pos : short
tcvr : off
Tx antennas
remote
coax switch
110v 50Hz
Herley 85506
Cable moteur
Yaesu FT-1000mp
Tx ant
Rx ant Out
Rx ant In
band data
home made
output
Mode
70 MHz
Roofing filter
Inrad
8 MHz
Xtal filter
cw
250 Hz
ssb
2 KHz
455 KHz
cw
250 Hz
ssb
2 KHz
DSP
cw
60 Hz
ssb
2 KHz
Sub Rx
no filter
Beverage Cd Box
Tx / Bev
switch
Couplage
remote ctrl
& cd switch
36v
Ameco PT
tube
multiband
preamp
bandes hautes only
Band decoder
relay box
220v 50Hz
110v 50Hz
24v
transfo
100/50
Bal/Un
remote
L = 80m
RG22
Twinax
Bal. 100 ohm
bev #1
feed box
1 m Acier Galva
Beverage
switch box 1
Beverage #1
360m
Sud
Terminal
box
1 m Acier Galva
Beverage #2
240m
SE
Terminal
box
1 m Acier Galva
3eme essai de
Beverages
un peu d'espoir
photos p 71
Préampli 160m
KD9SV
Echec
Pas mieux que le Ameco

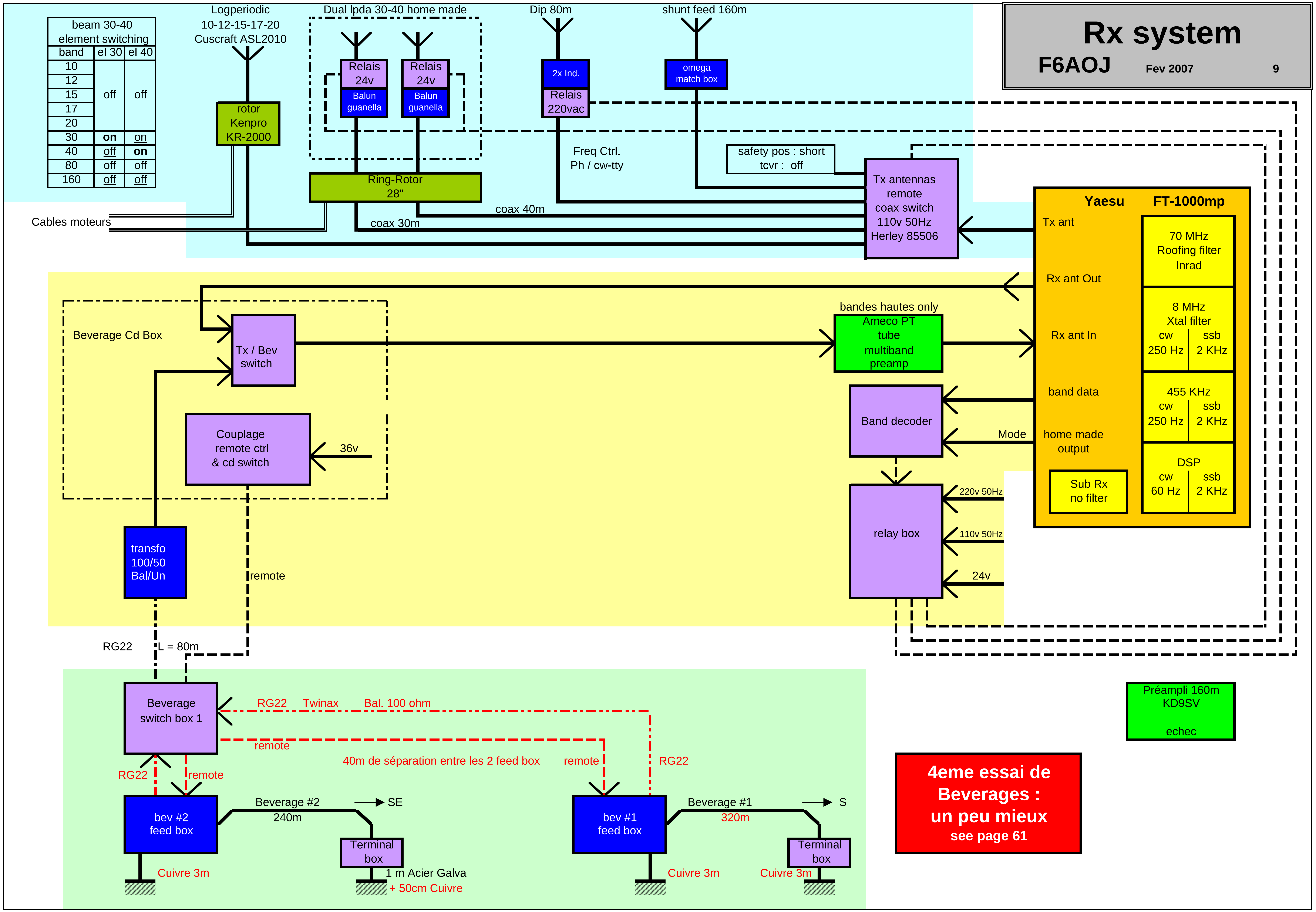
Rx system

F6AOJ sept 2006 8



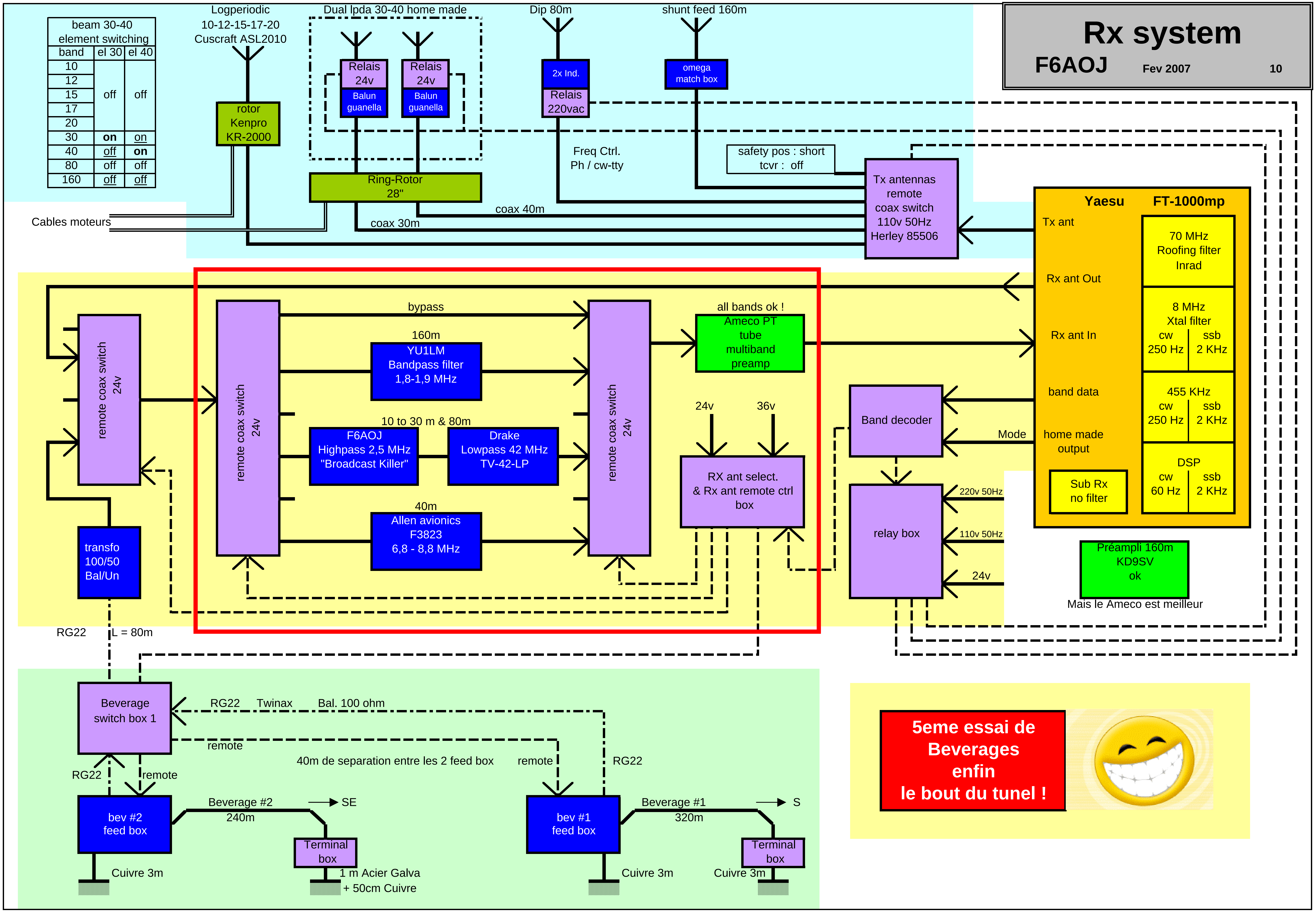
beam 30-40 element switching

band	el 30	el 40
10	off	off
12		
15		
17		
20		
30	**on**	on
40	off	**on**
80	off	off
160	off	off



beam 30-40 element switching

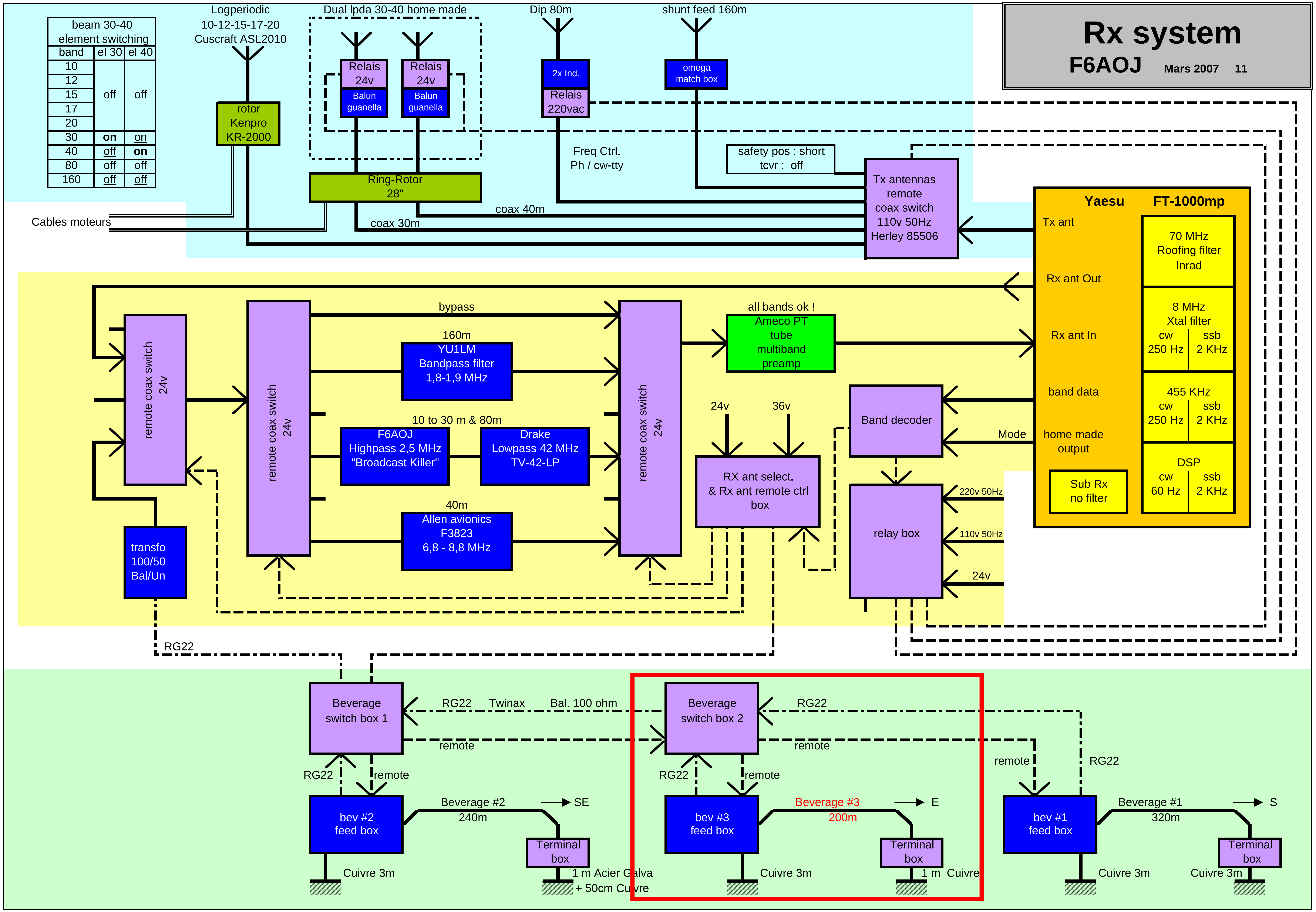
band	el 30	el 40
10	off	off
12		
15		
17		
20		
30	**on**	on
40	off	**on**
80	off	off
160	off	off

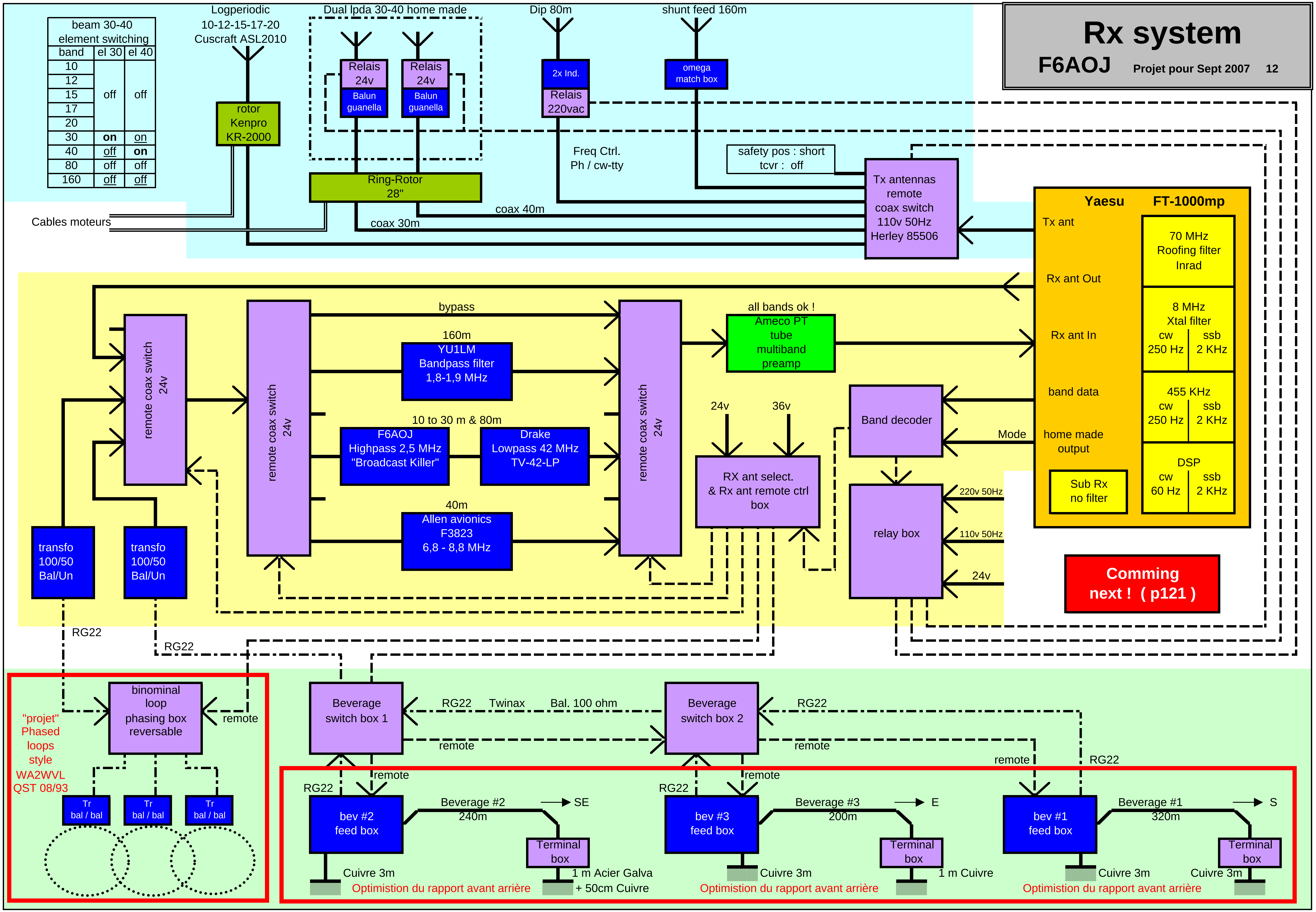


band	el 30	el 40
10		
12		
15	off	off
17		
20		
30	**on**	on
40	off	**on**
80	off	off
160	off	off

Rx system

F6AOJ Mars 2007 11

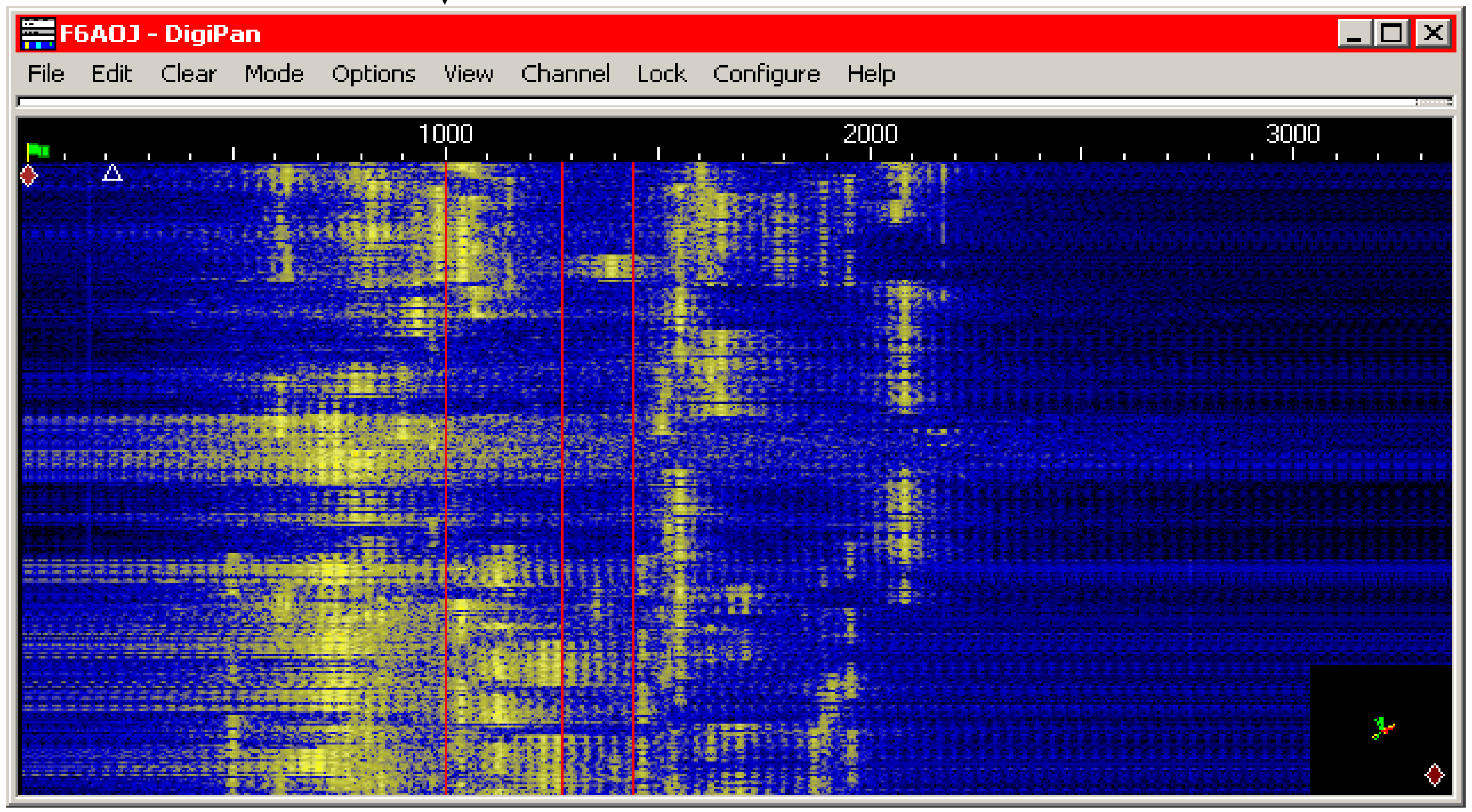




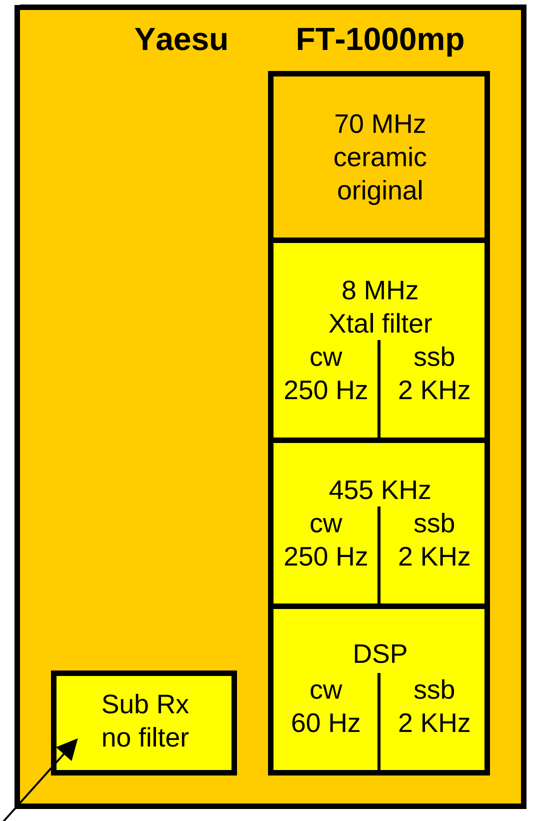
Rx system
F6AOJ
Projet pour Sept 2007
12
beam 30-40 element switching
band | el 30 | el 40
10 / 12 / 15 / 17 / 20 | off | off
30 | on | on
40 | off | on
80 | off | off
160 | off | off
Logperiodic 10-12-15-17-20 Cuscraft ASL2010
Dual lpda 30-40 home made
Dip 80m
shunt feed 160m
Relais 24v
Balun guanella
Relais 24v
Balun guanella
2x Ind.
Relais 220vac
omega match box
rotor Kenpro KR-2000
Ring-Rotor 28"
Freq Ctrl. Ph / cw-tty
safety pos : short tcvr : off
Tx antennas remote coax switch 110v 50Hz Herley 85506
coax 40m
coax 30m
Cables moteurs
Yaesu FT-1000mp
Tx ant
Rx ant Out
Rx ant In
band data
home made output
Mode
70 MHz Roofing filter Inrad
8 MHz Xtal filter
cw 250 Hz
ssb 2 KHz
455 KHz
cw 250 Hz
ssb 2 KHz
DSP
cw 60 Hz
ssb 2 KHz
Sub Rx no filter
remote coax switch 24v
remote coax switch 24v
remote coax switch 24v
bypass
160m
YU1LM Bandpass filter 1,8-1,9 MHz
10 to 30 m & 80m
F6AOJ Highpass 2,5 MHz "Broadcast Killer"
Drake Lowpass 42 MHz TV-42-LP
40m
Allen avionics F3823 6,8 - 8,8 MHz
all bands ok !
Ameco PT tube multiband preamp
24v
36v
RX ant select. & Rx ant remote ctrl box
Band decoder
relay box
220v 50Hz
110v 50Hz
24v
Comming next ! (p121)
transfo 100/50 Bal/Un
transfo 100/50 Bal/Un
RG22
RG22
"projet" Phased loops style WA2WVL QST 08/93
binominal loop phasing box reversable
remote
Tr bal / bal
Tr bal / bal
Tr bal / bal
Beverage switch box 1
RG22
Twinax
Bal. 100 ohm
Beverage switch box 2
RG22
remote
remote
remote
RG22
remote
remote
RG22
RG22
bev #2 feed box
Beverage #2 240m
SE
Terminal box
Cuivre 3m
1 m Acier Galva + 50cm Cuivre
Optimistion du rapport avant arrière
bev #3 feed box
Beverage #3 200m
E
Terminal box
Cuivre 3m
1 m Cuivre
Optimistion du rapport avant arrière
bev #1 feed box
Beverage #1 320m
S
Terminal box
Cuivre 3m
Cuivre 3m
Optimistion du rapport avant arrière

Rx stratégie

CW pitch 1000 Hz Marker

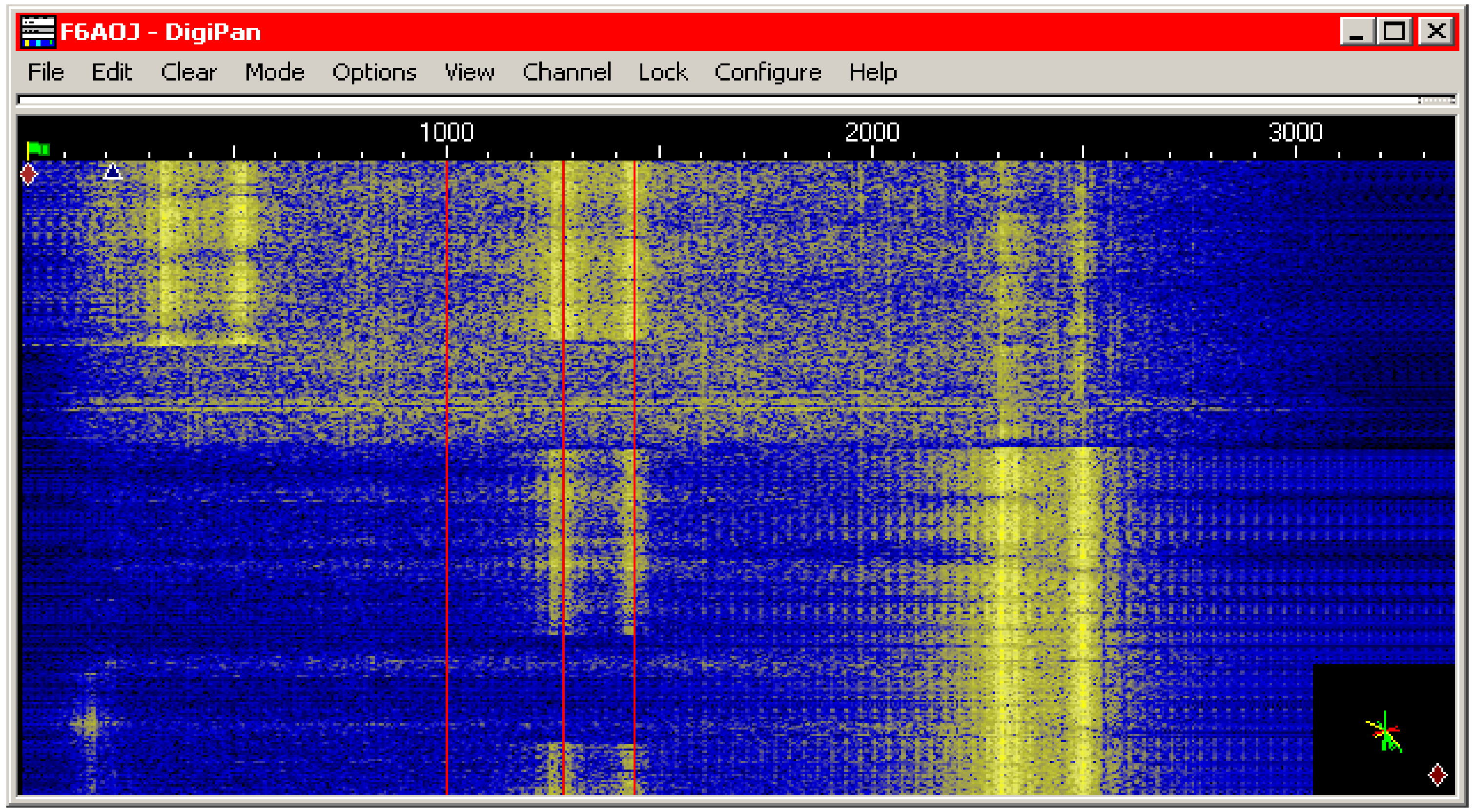


LOCK (external key)



PSK Marker

Rtty low tones Markers



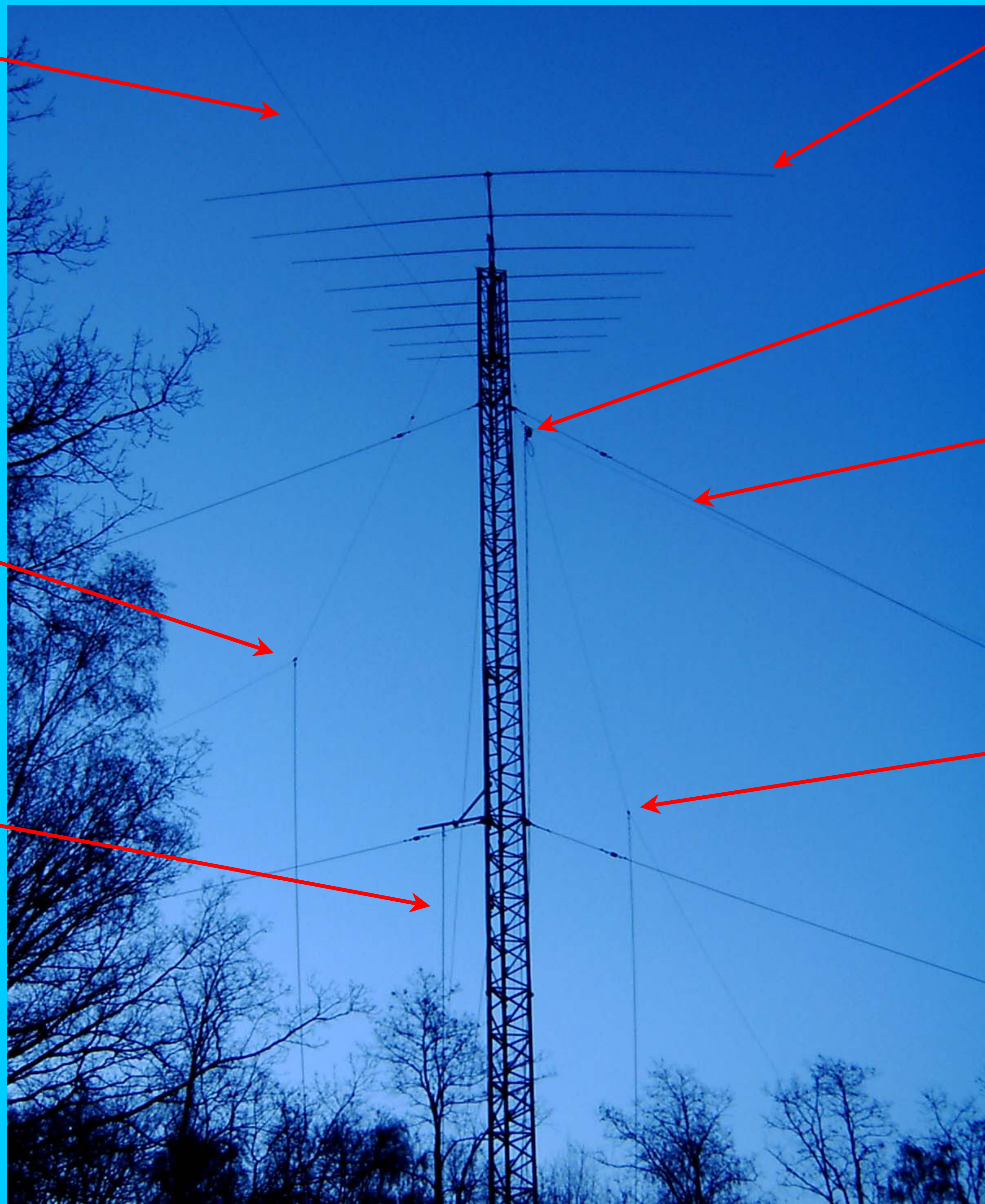
En transceiver,
Le récepteur auxiliaire est utilisé
comme un analyseur de spectre .
Digipan affichage le spectre au format "chute d'eau"

Un bouton supplémentaire externe
en parallèle sur pla touche Lock permet
d'asservir les 2 vfo, auxiliaire et principal
sans monopoliser la 2ème main de l'opérateur

On peut alors balayer la bande (cw et digital)
en écoutant très étroit
tout en visualisant la bande sur 3KHz
cd: A=B ,(split =0), LOCK (external key)

En split,
idem mais en plus,
les markers sont exactement sur la fréquence d'émission,
et la zone de plus est lisible !

Cette méthodologie nécessite
un transceiver à double réception simultanée.



1/2 dipole 80m

Slooper 30m

Shunt feed 160m

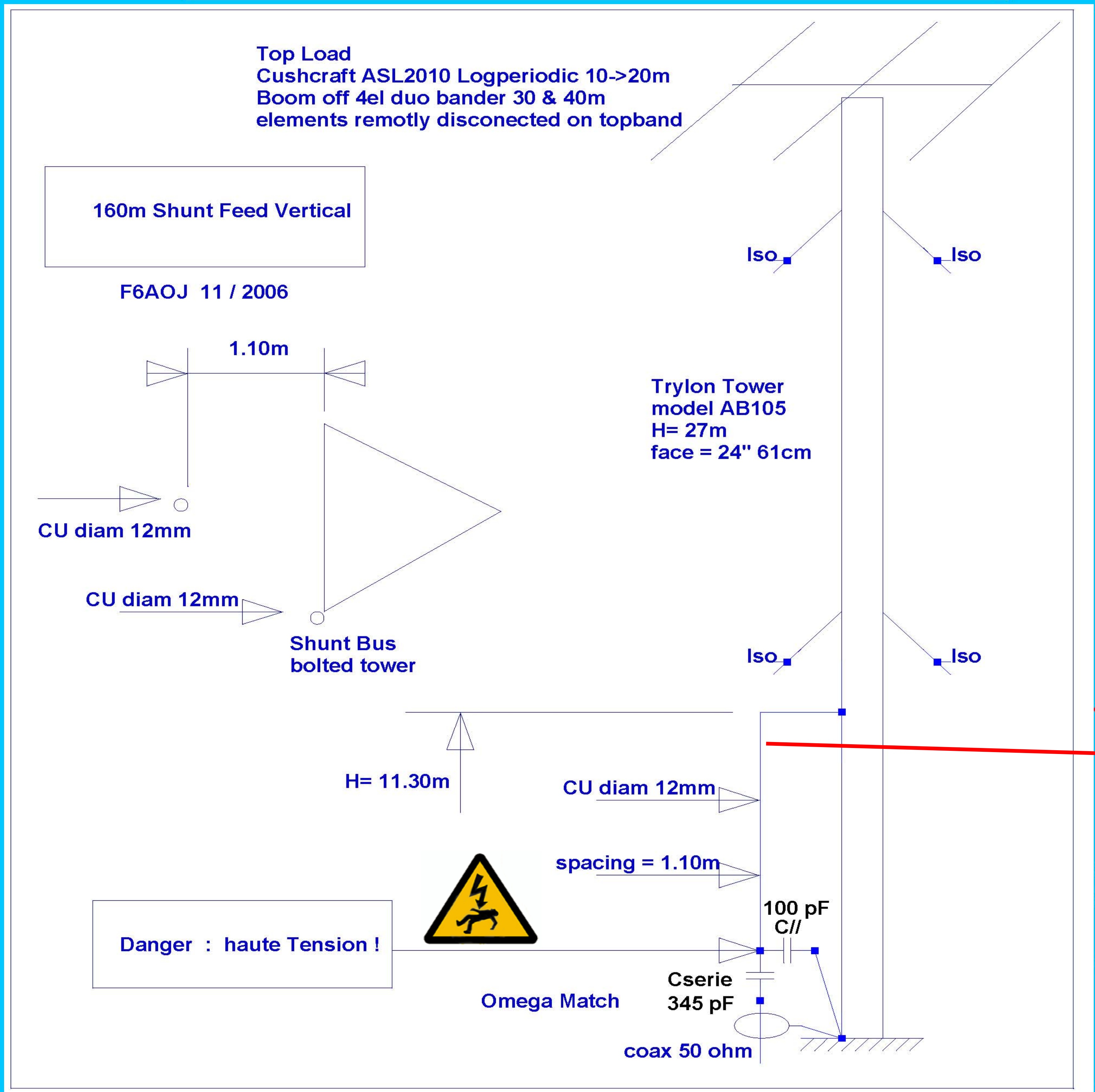
Logperiodic
Cushcraft ASL2010
- 10 -12 -15 -17 - 20 -

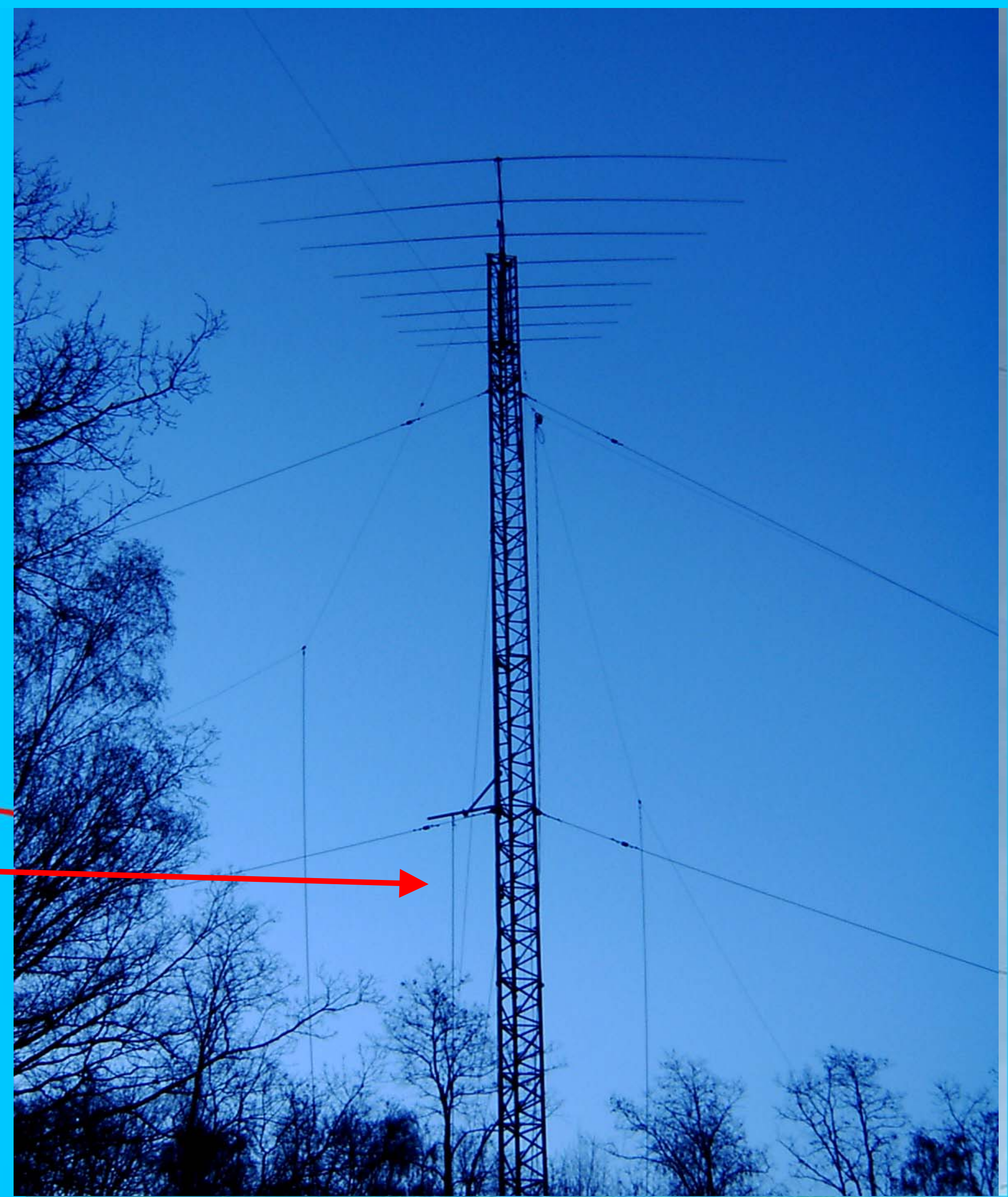
Diplole 80m
angle au centre 120°
hauteur au centre 22m
hauteur des extrémités 18m
Balun

1/2 dipole 80m

Slooper 40m

Shunt feed

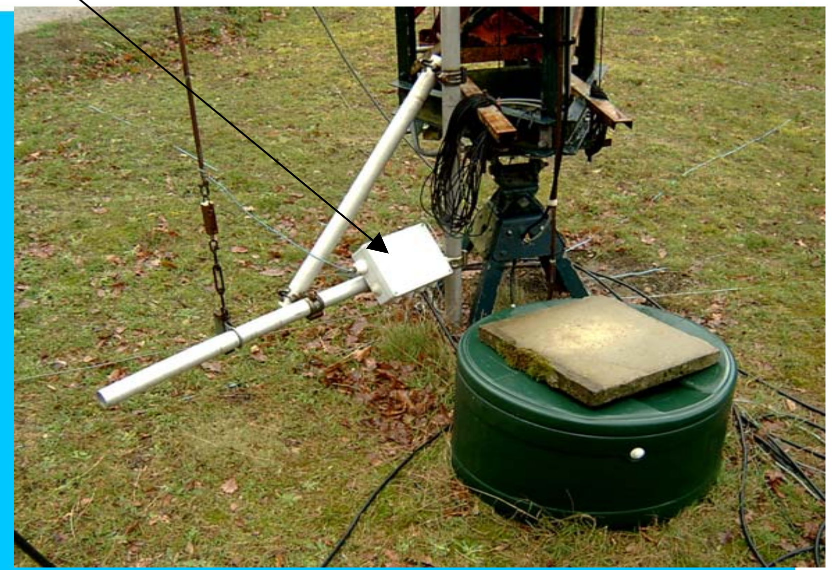


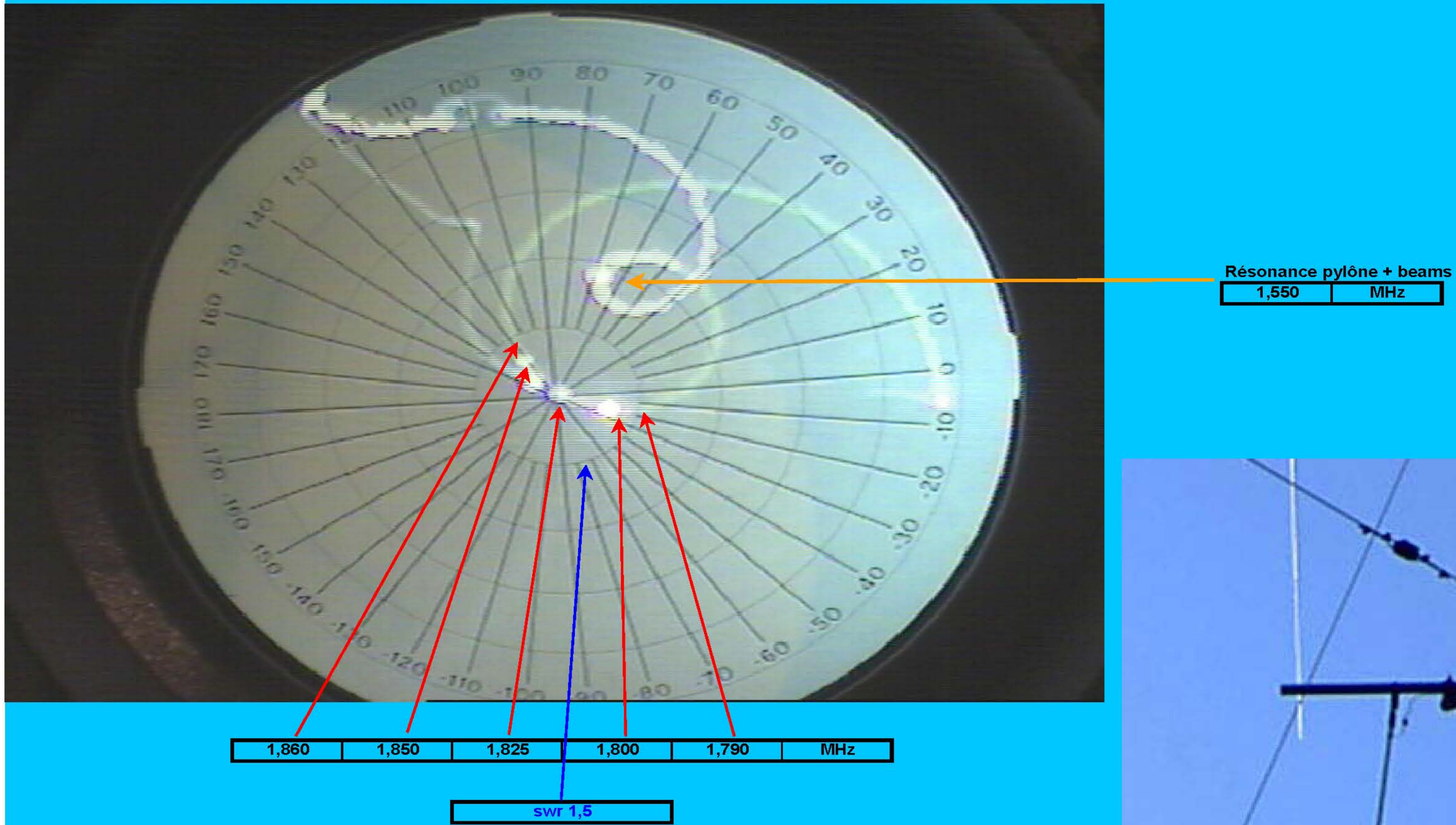


F resonant	1,550
F design	1,825
L in degrees	106

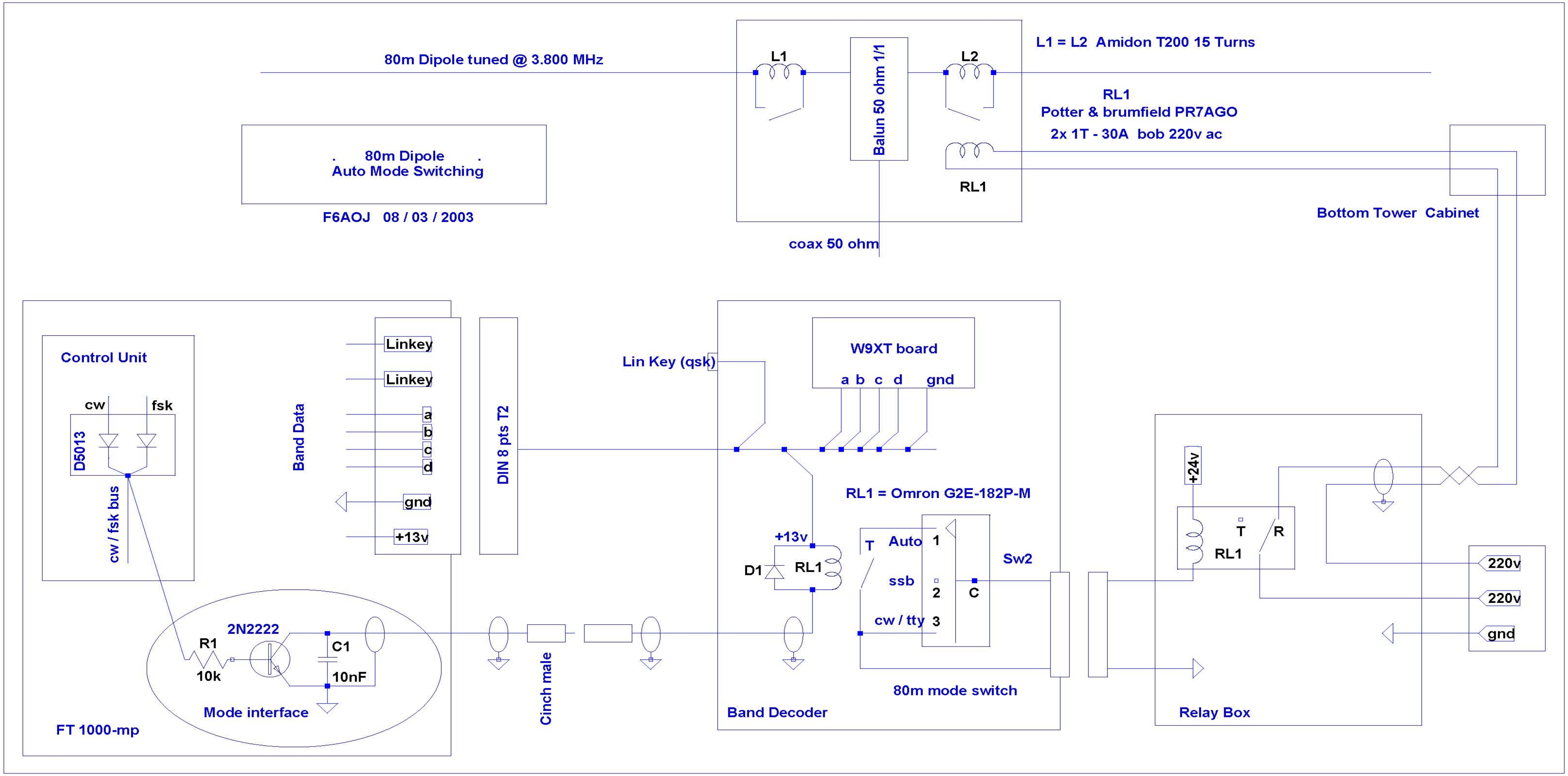
Omega match	
C serie	345 pF
C //	100 pF
Cond disque ceramique HT	

- les demi-eléménts de la beam 30/40 sont deconnectés sur 160m
- avec la logperiodique seule, la frequence est de 1,600 Mhz





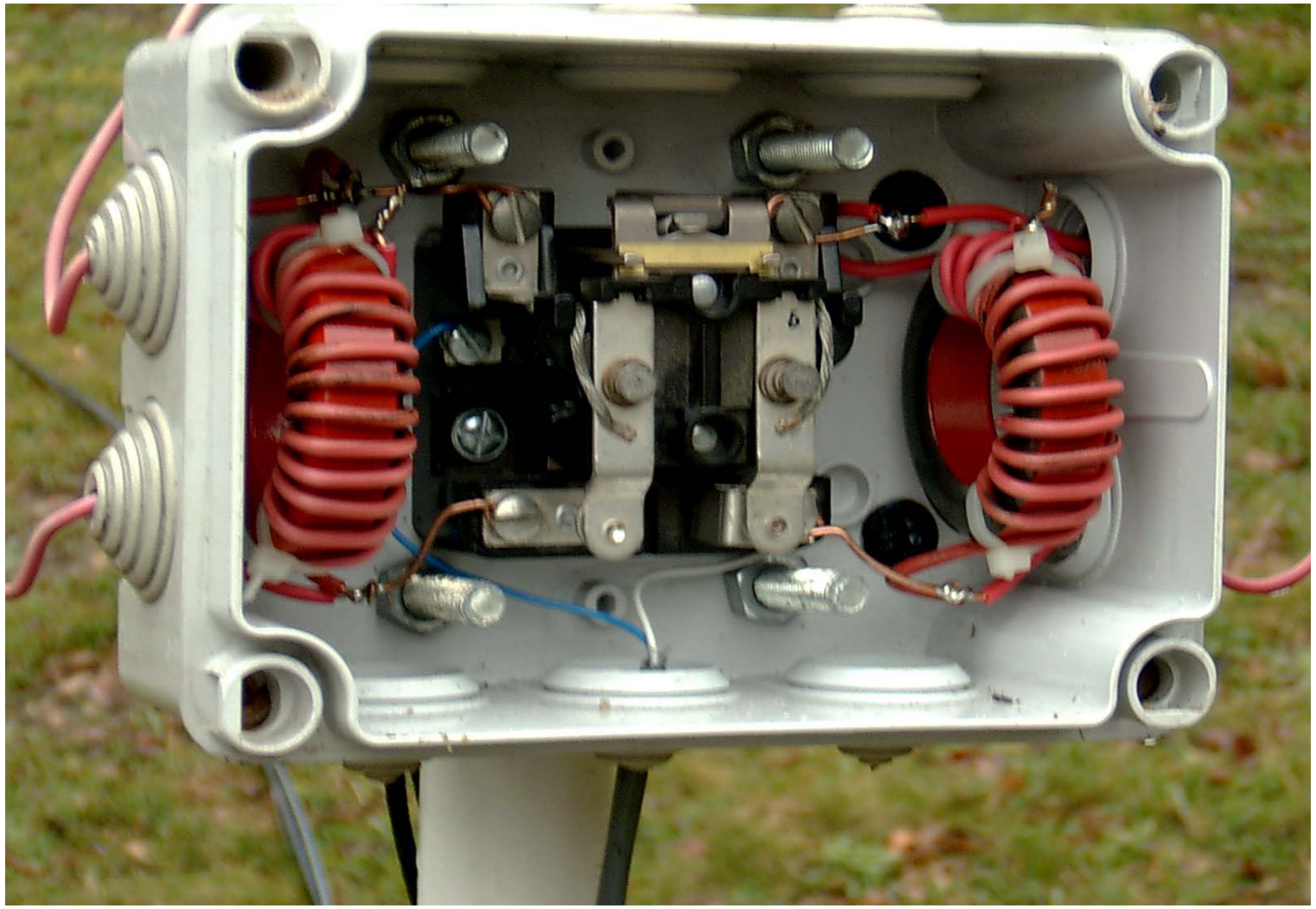
Application directe du concept décrit dans
Low band Dxing par ON4UN
chapitre 9 pages 9-70à 9-76 (3rd édition)

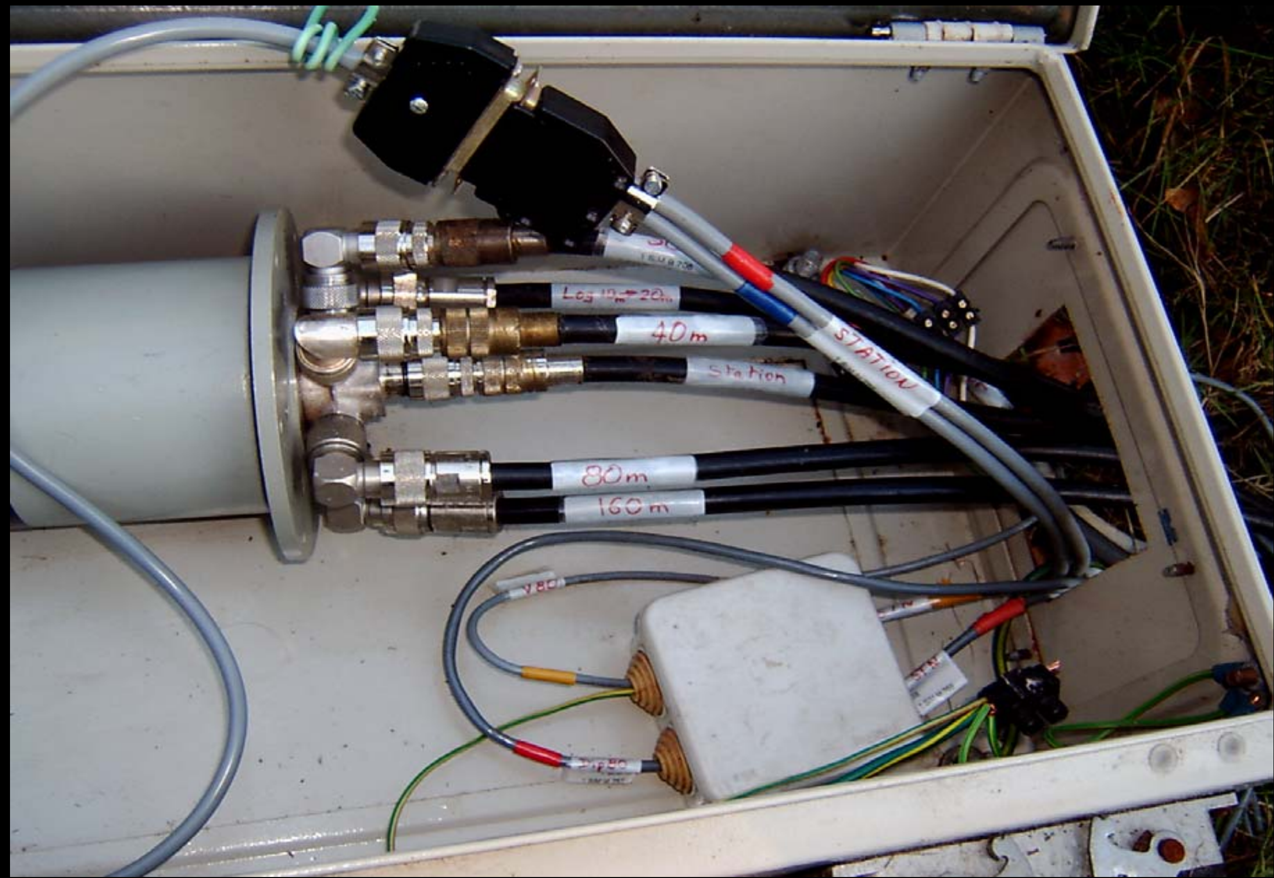


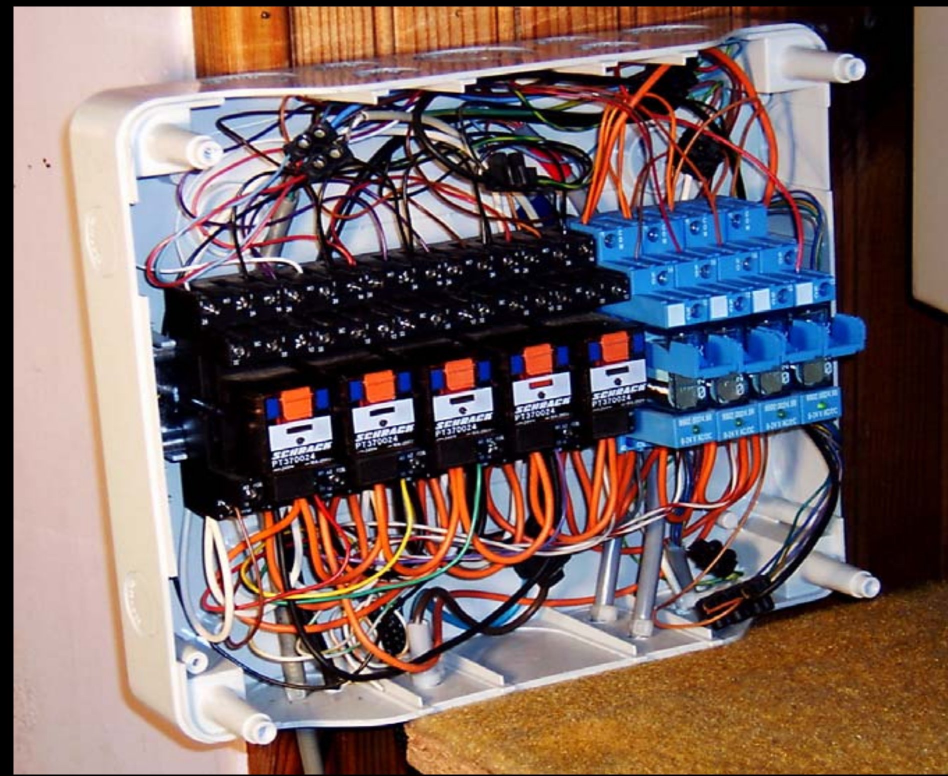
les 2 selfs ne supportent chacune au maximum que 4.3%

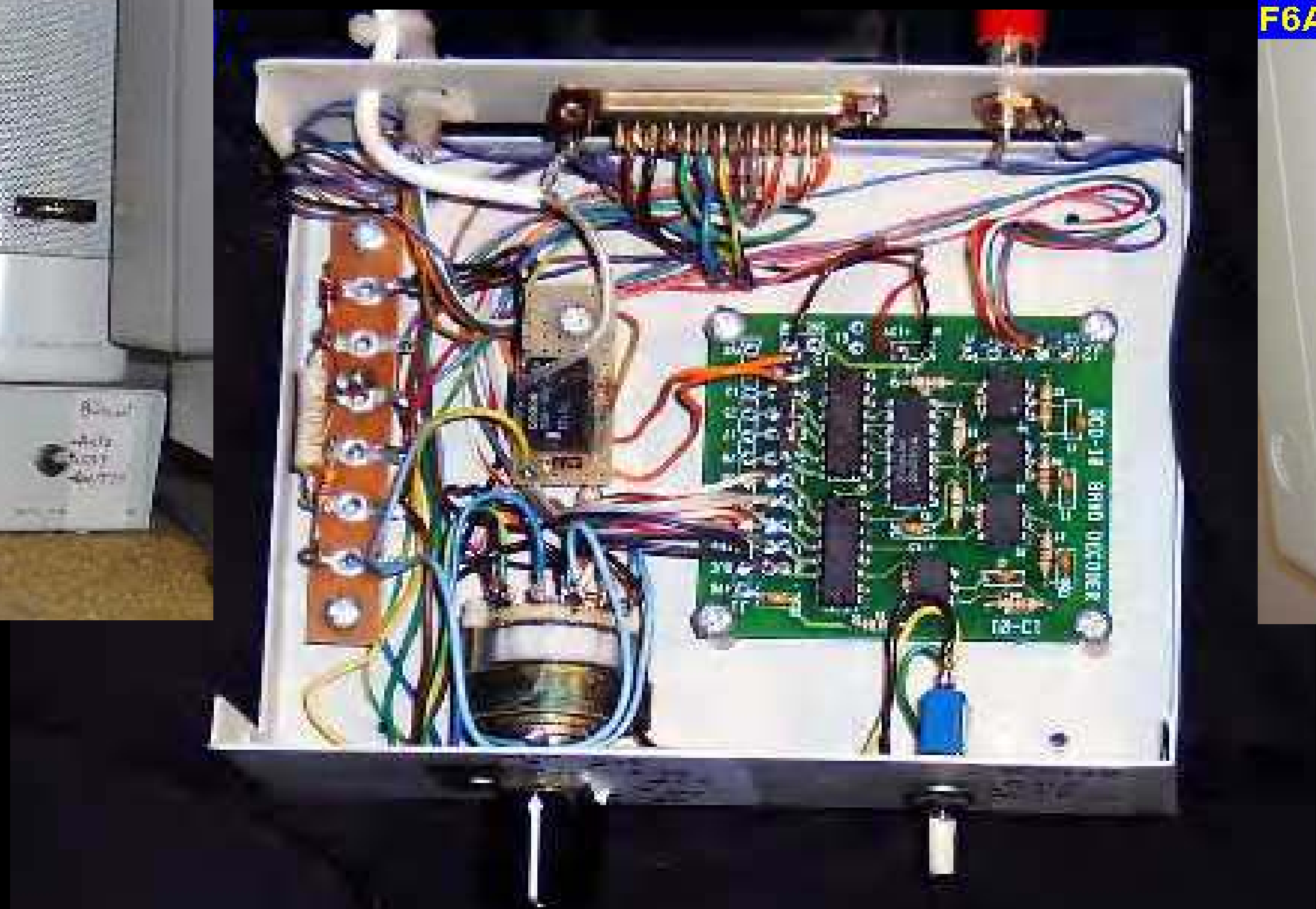
de la puissance à transmettre (3.8 / 3.5) / 2 ,

un T200 est donc plus que suffisant dans cette fonction.

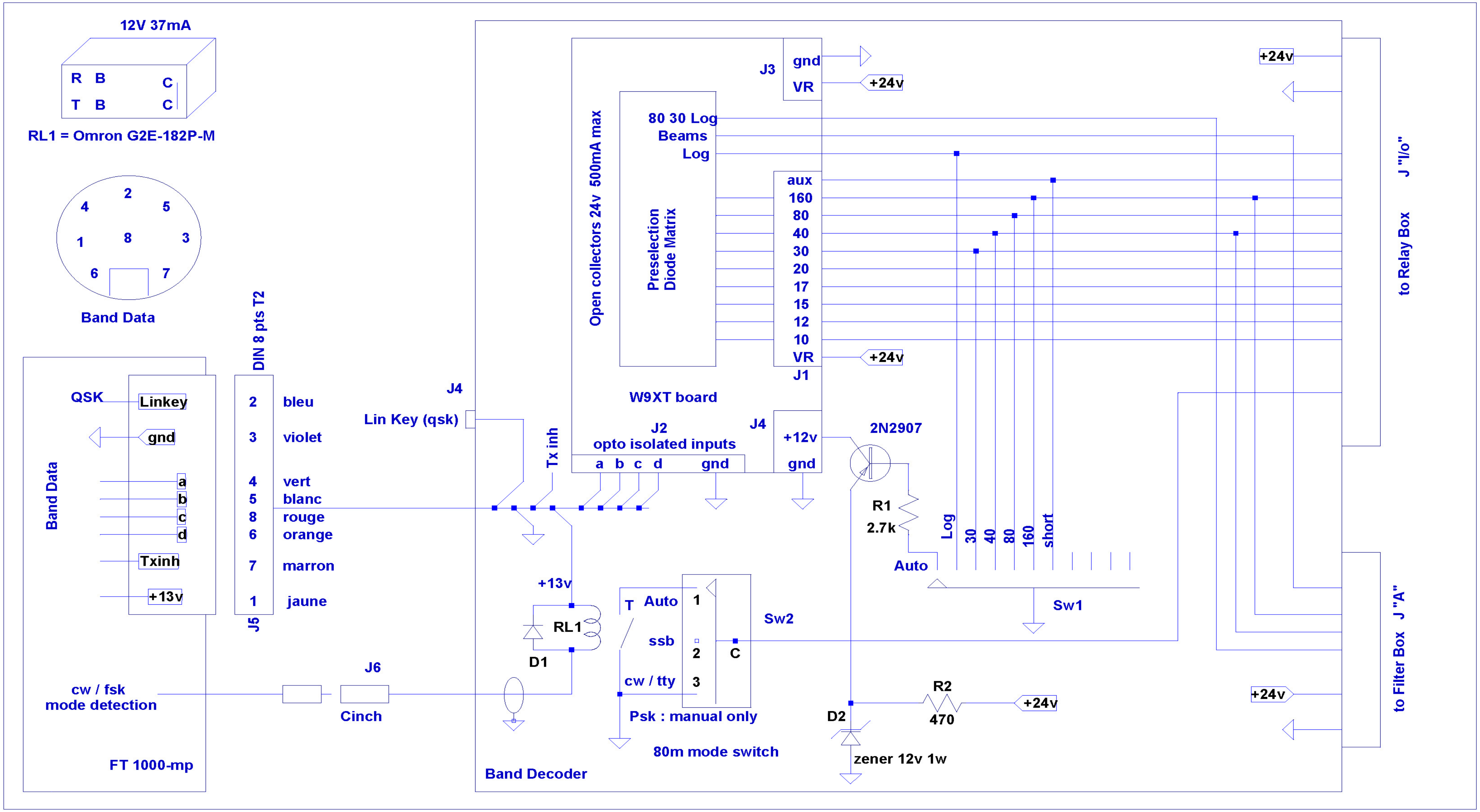



40 m
Station
STATION
80 m
160 m

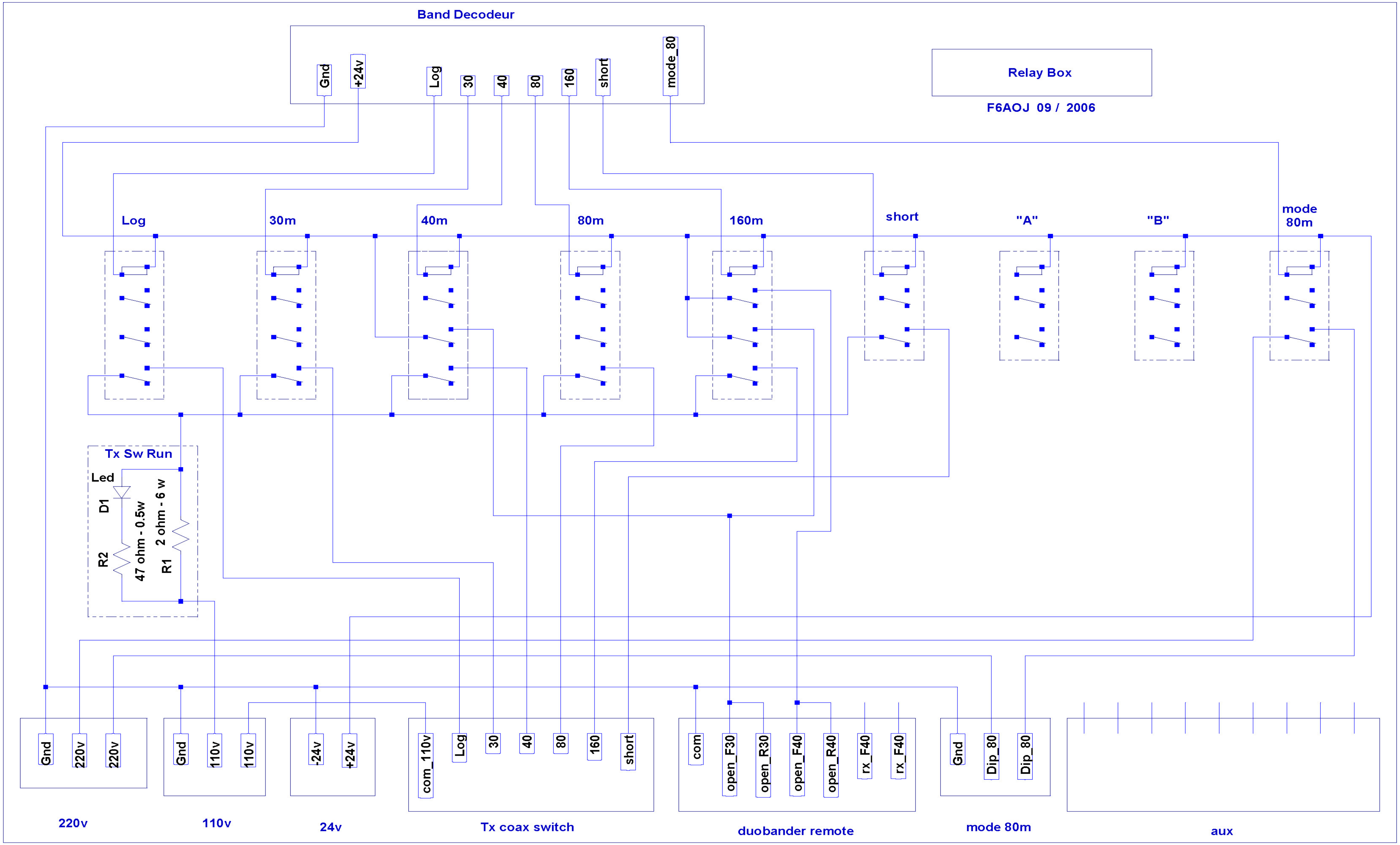


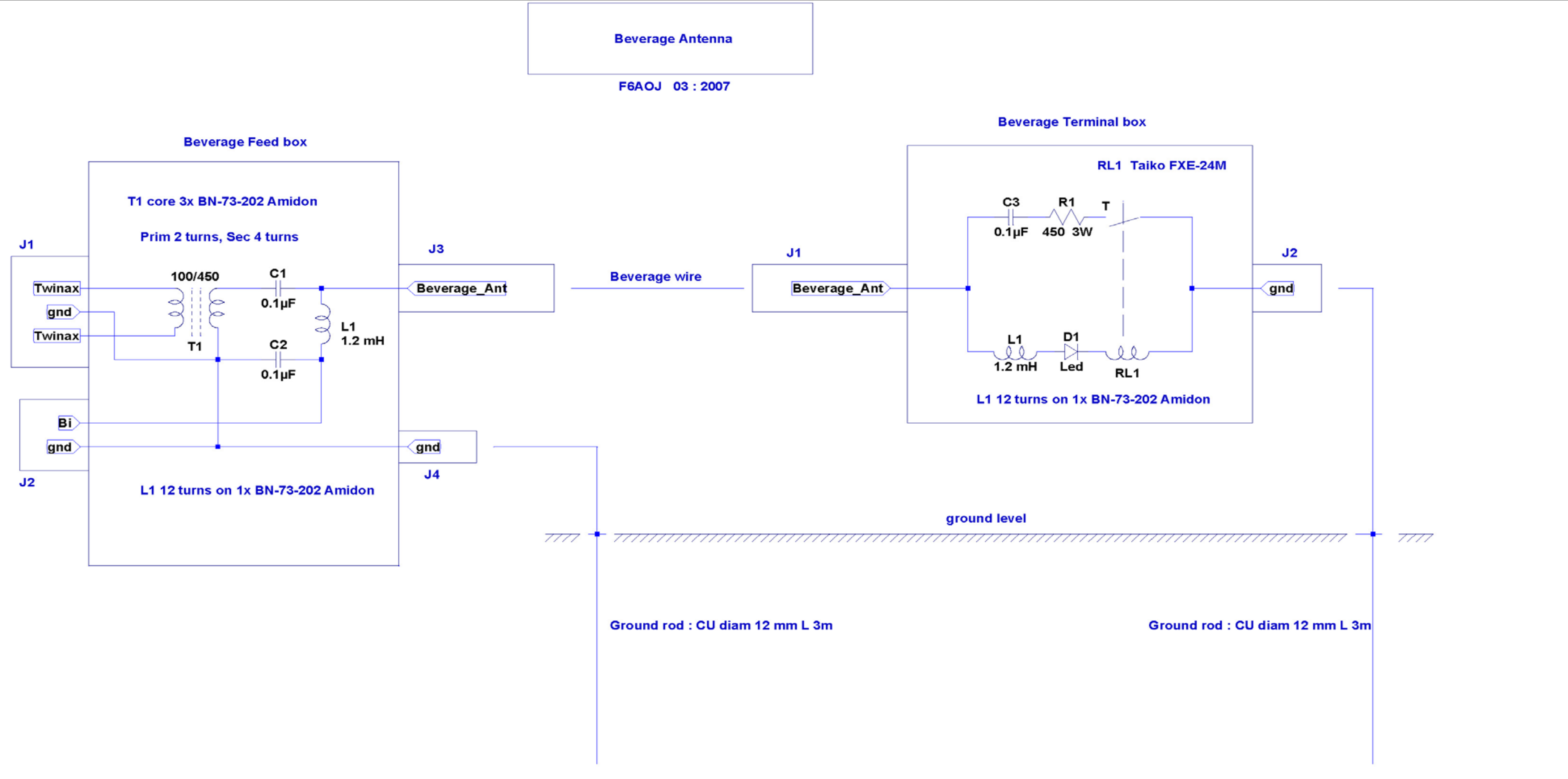


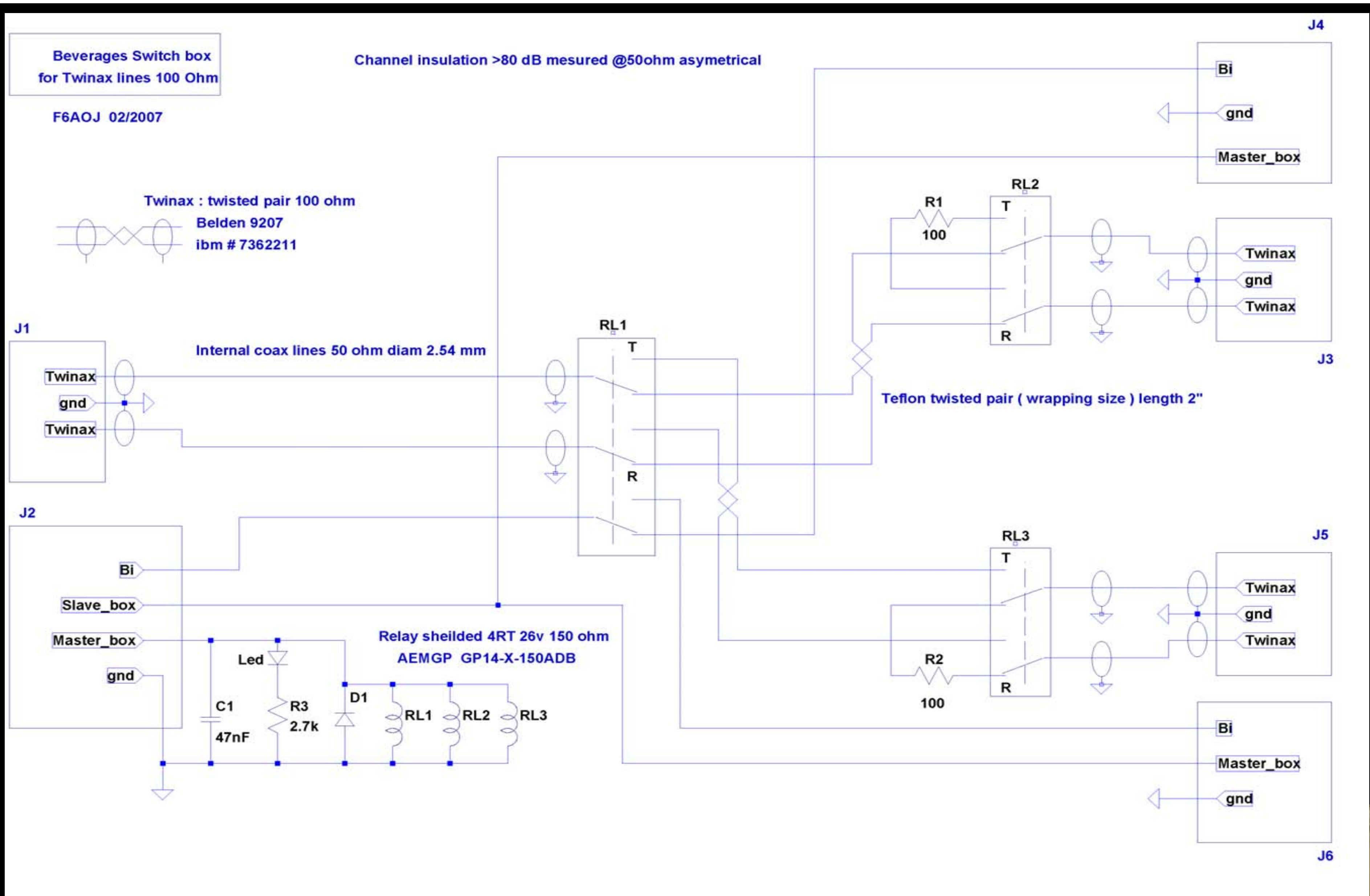

F6AOJ
Log
30
40
80
160
Ant switchhs control relays box



12V 37mA
R B C
T B C
RL1 = Omron G2E-182P-M
2 4 5 1 8 3 6 7
Band Data
DIN 8 pts T2
QSK
Linkey
gnd
Band Data
a
b
c
d
Txinh
+13v
2 bleu
3 violet
4 vert
5 blanc
8 rouge
6 orange
7 marron
1 jaune
J5
cw / fsk
mode detection
FT 1000-mp
J6
Cinch
J4
Lin Key (qsk)
Tx inh
+13v
RL1
D1
Open collectors 24v 500mA max
Preselection
Diode Matrix
80 30 Log
Beams
Log
J3
gnd
VR
+24v
aux
160
80
40
30
20
17
15
12
10
VR
J1
W9XT board
J2
opto isolated inputs
a b c d gnd
J4
+12v
gnd
2N2907
R1
2.7k
Log 30 40 80 160 short
Auto
Sw1
T Auto 1
ssb 2 C
cw / tty 3
Sw2
Psk : manual only
80m mode switch
D2
zener 12v 1w
R2
470
+24v
Band Decoder
+24v
J "I/o"
to Relay Box
to Filter Box J "A"


Band Decodeur
Gnd
+24v
Log
30
40
80
160
short
mode_80
Relay Box
F6AOJ 09 / 2006
Log
30m
40m
80m
160m
short
"A"
"B"
mode 80m
Tx Sw Run
Led
D1
R2
47 ohm - 0.5w
2 ohm - 6 w
R1
Gnd
220v
220v
Gnd
110v
110v
-24v
+24v
com_110v
Log
30
40
80
160
short
com
open_F30
open_R30
open_F40
open_R40
rx_F40
rx_F40
Gnd
Dip_80
Dip_80
220v
110v
24v
Tx coax switch
duobander remote
mode 80m
aux

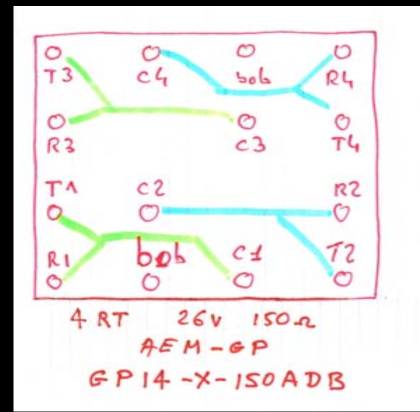

Beverage Antenna
F6AOJ 03 : 2007
Beverage Feed box
T1 core 3x BN-73-202 Amidon
Prim 2 turns, Sec 4 turns
J1
Twinax
gnd
Twinax
100/450
T1
C1
0.1µF
C2
0.1µF
L1
1.2 mH
J3
Beverage_Ant
Bi
gnd
J2
gnd
J4
L1 12 turns on 1x BN-73-202 Amidon
Beverage wire
Beverage Terminal box
RL1 Taiko FXE-24M
C3
0.1µF
R1
450 3W
T
J1
Beverage_Ant
L1
1.2 mH
D1
Led
RL1
J2
gnd
L1 12 turns on 1x BN-73-202 Amidon
ground level
Ground rod : CU diam 12 mm L 3m
Ground rod : CU diam 12 mm L 3m

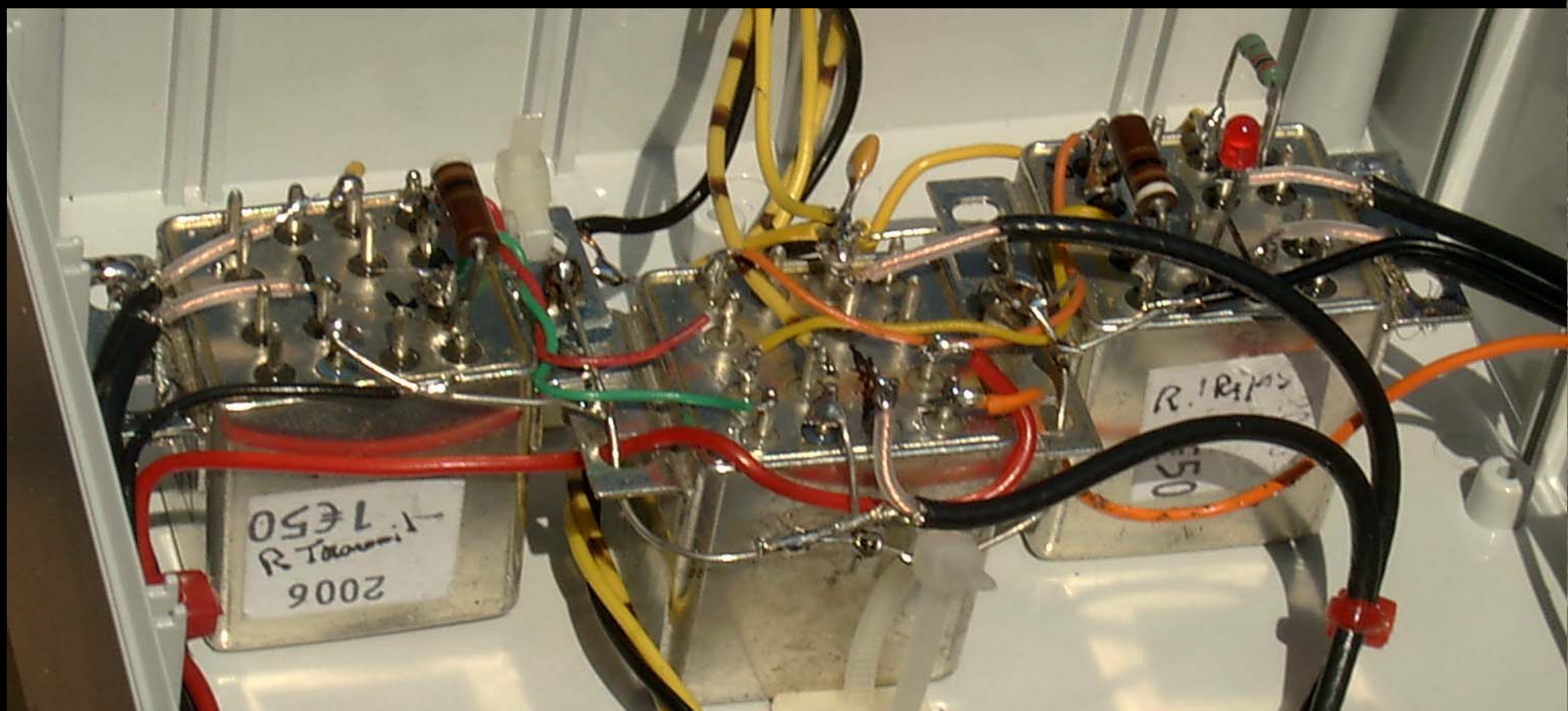


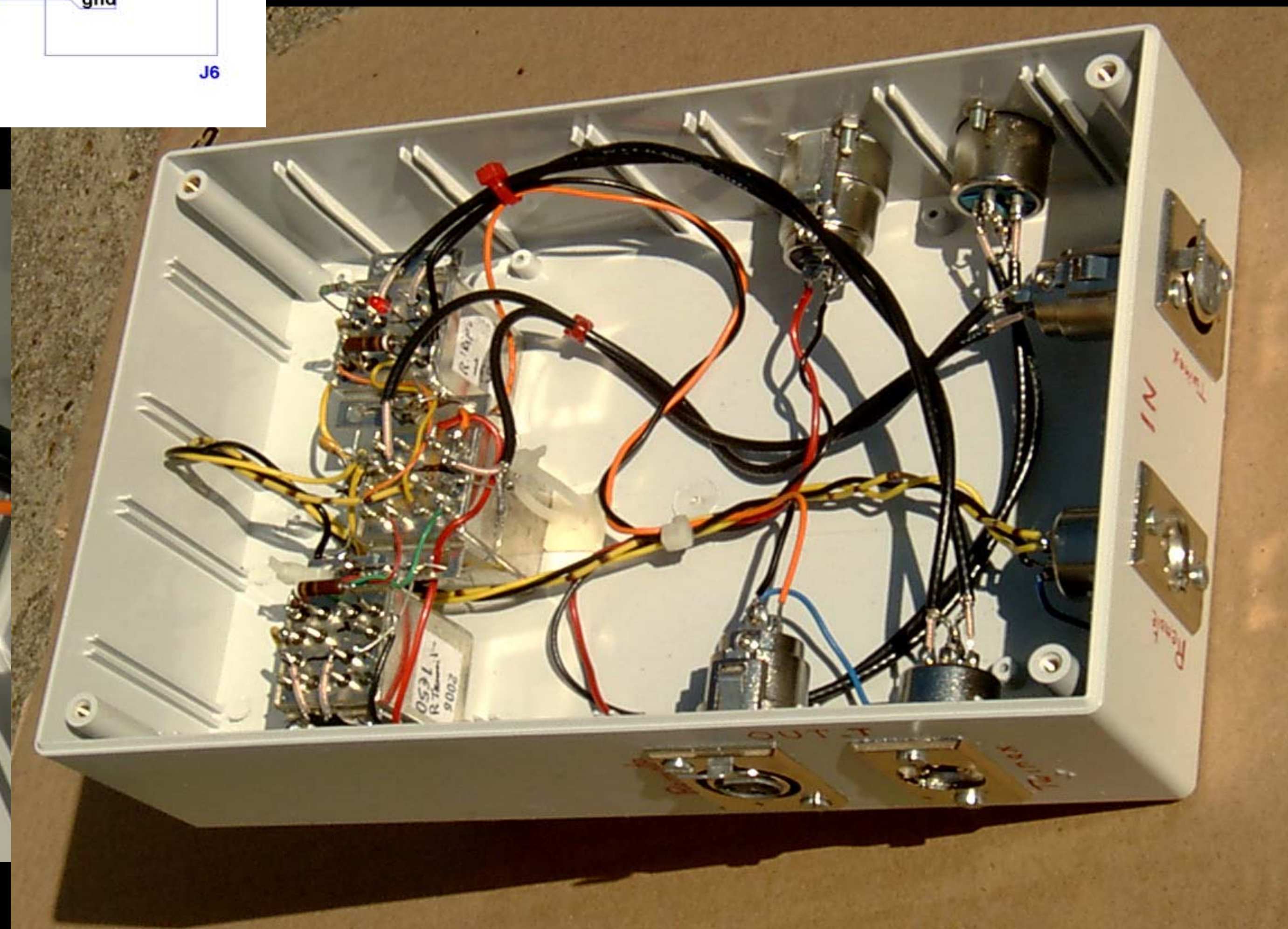
Isolement > 80dB @ 7 MHz

mesuré en assymétrique 50 ohm

Beverages switch box







40 30 40 30

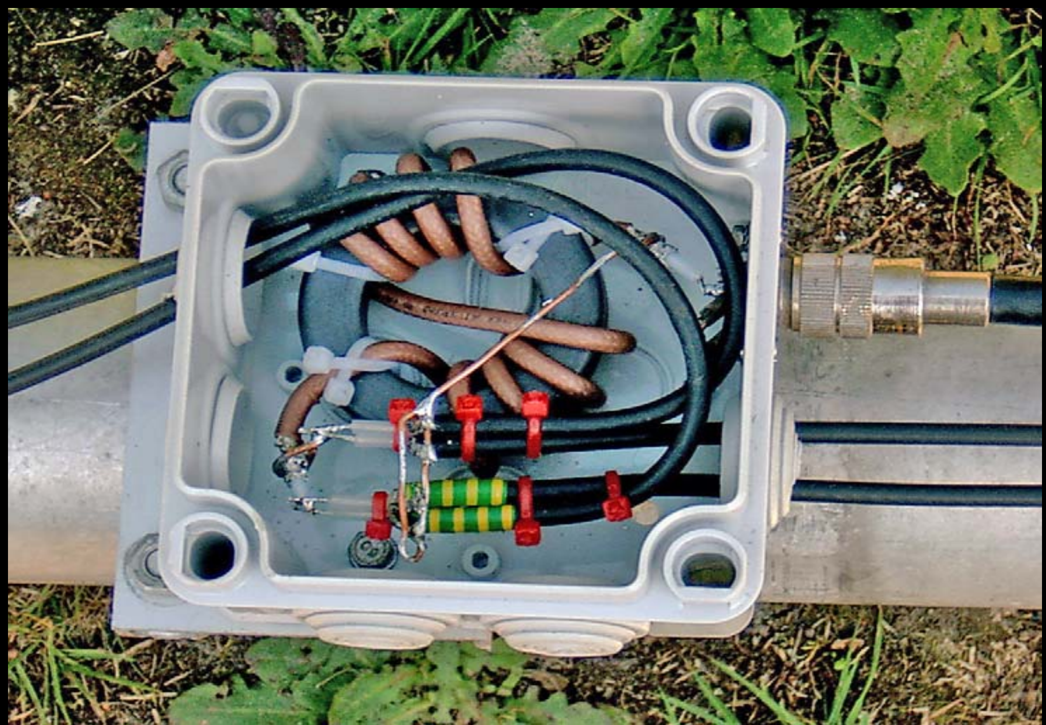
2 ant lpda entrelacées sur un seul boom

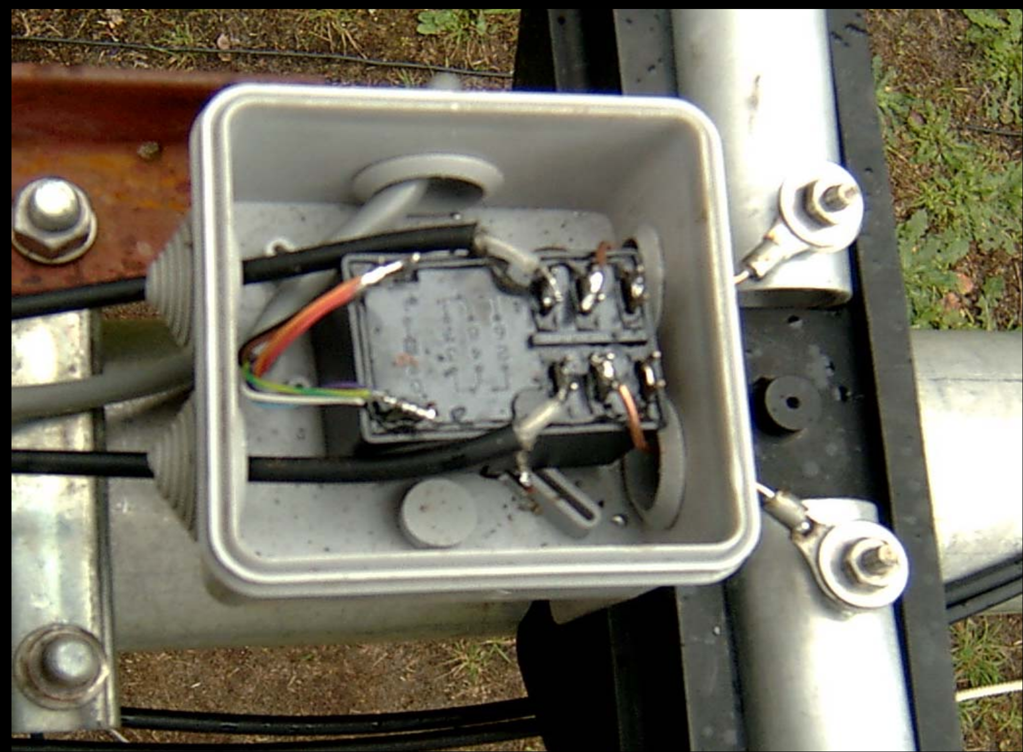
Duo-Bander LPDA 30-40m

Ring-Rotor = Danger
Une bonne idée , un produit raté
Carl Anderson owner et mgr de Tic inc est un escroc

Balun Guanella

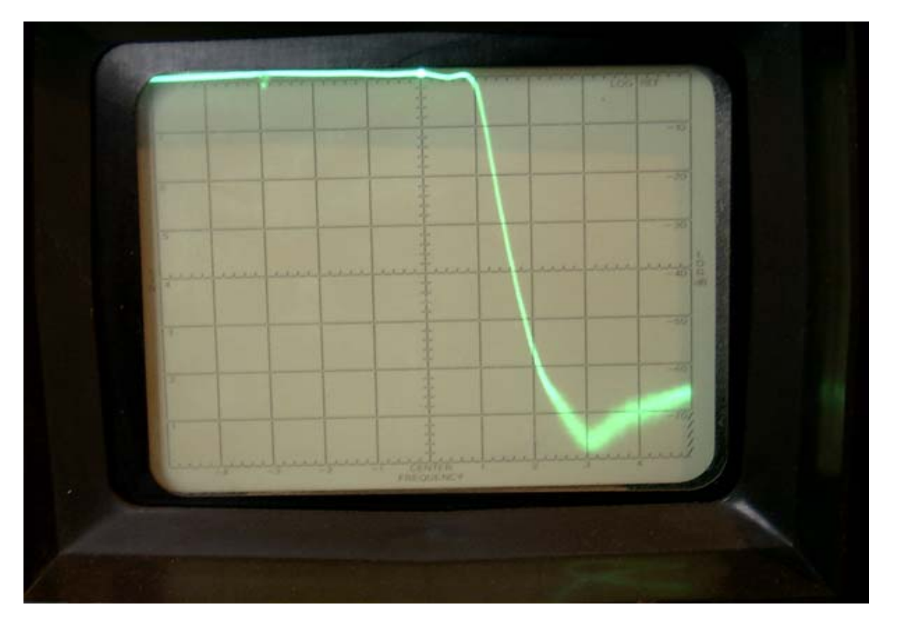
relais d'isolement des 1/2 elements



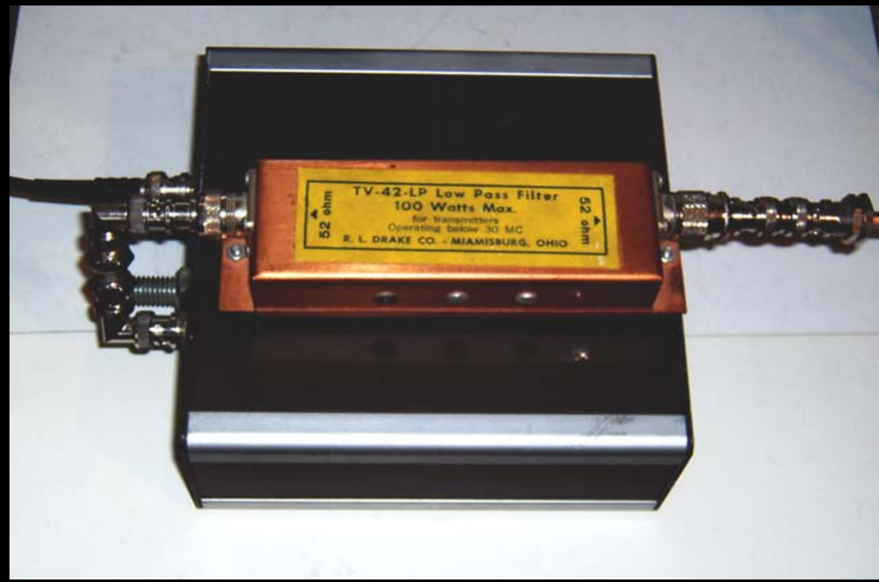


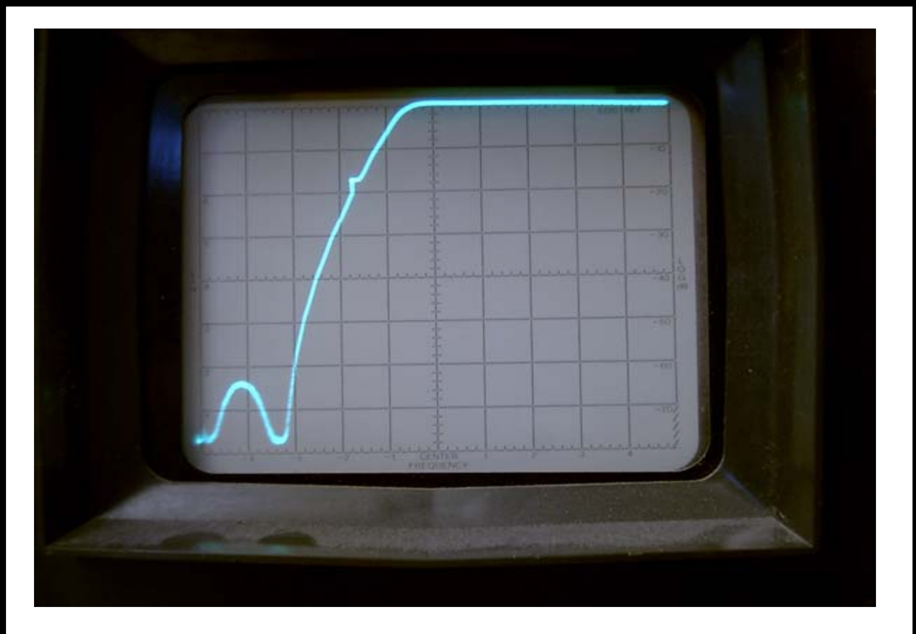
Filtres Rx

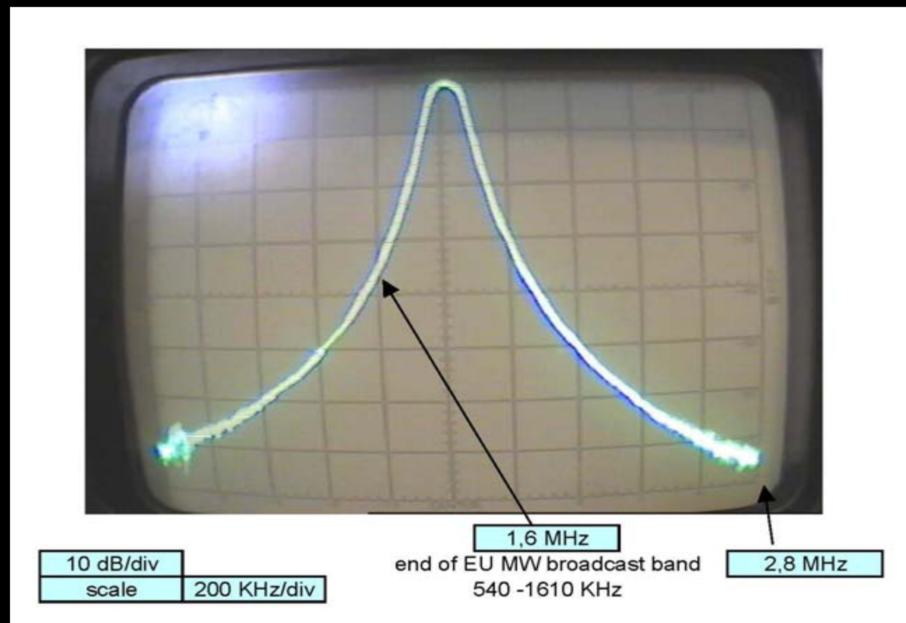
Drake TV-LP-42



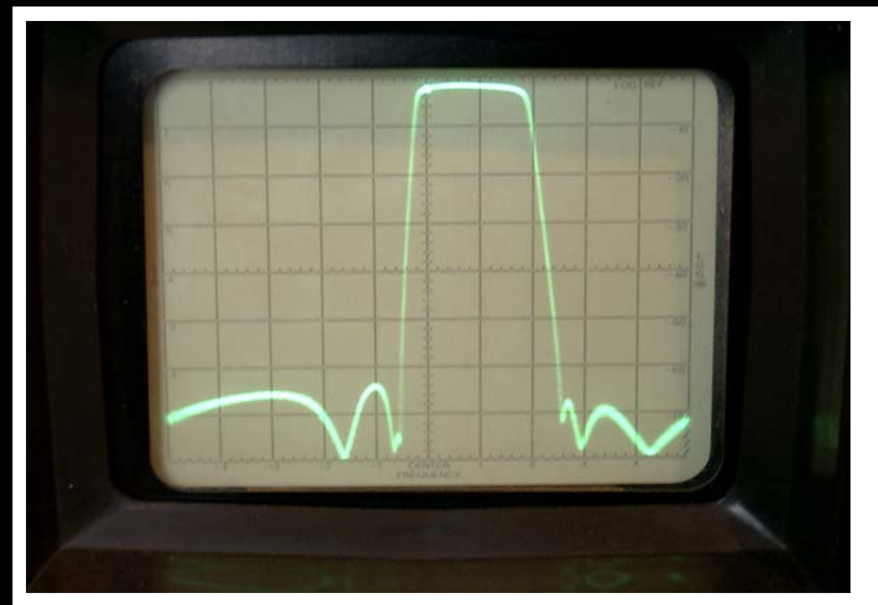
Passe Haut + Passe Bas 10-12-15-17-20 - 30 - 80 -







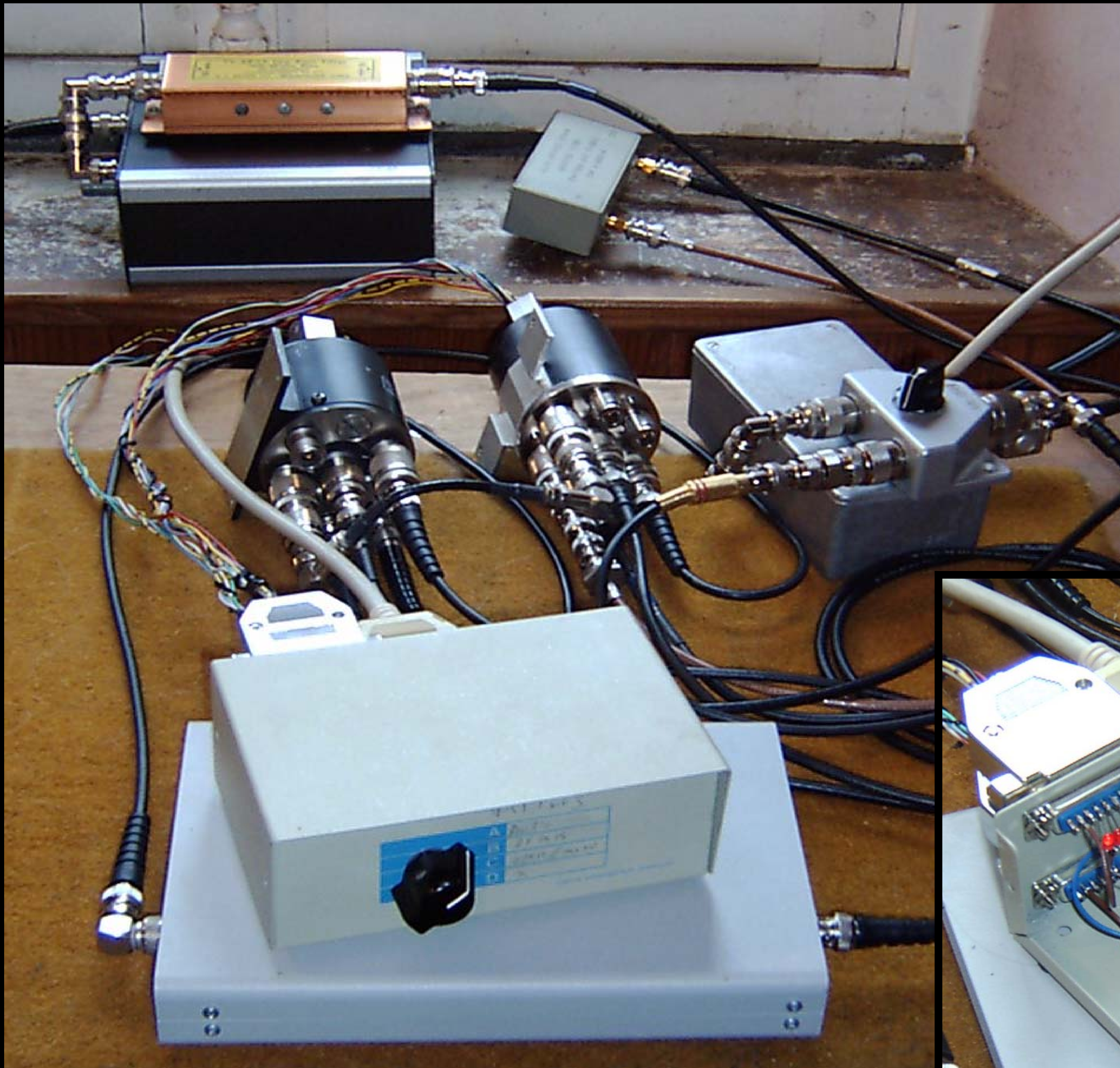
Filtre 40m Allen Avionics (surplus)

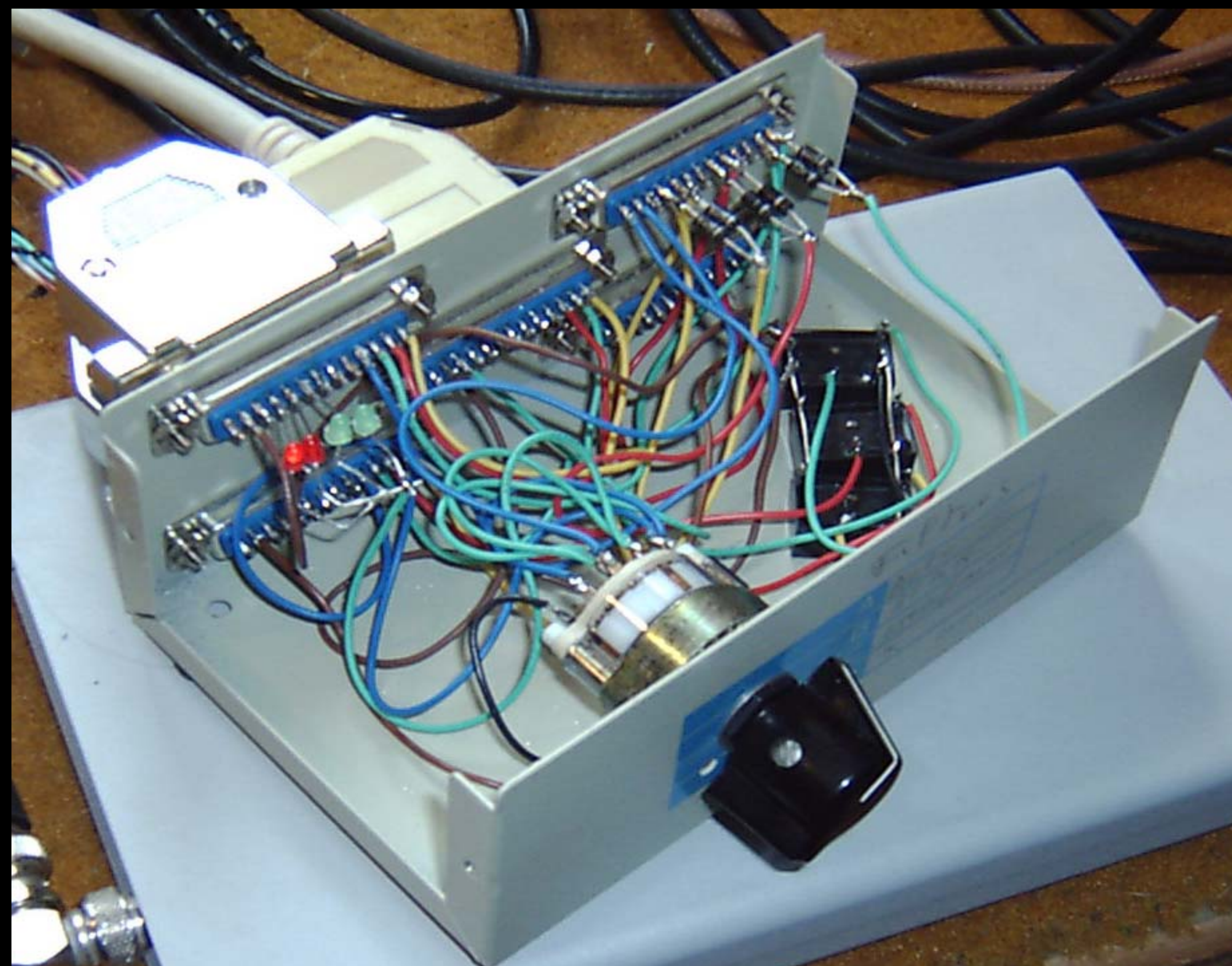


Passe Haut " anti broadcast " F6AOJ

Filtre 160m YU1LM

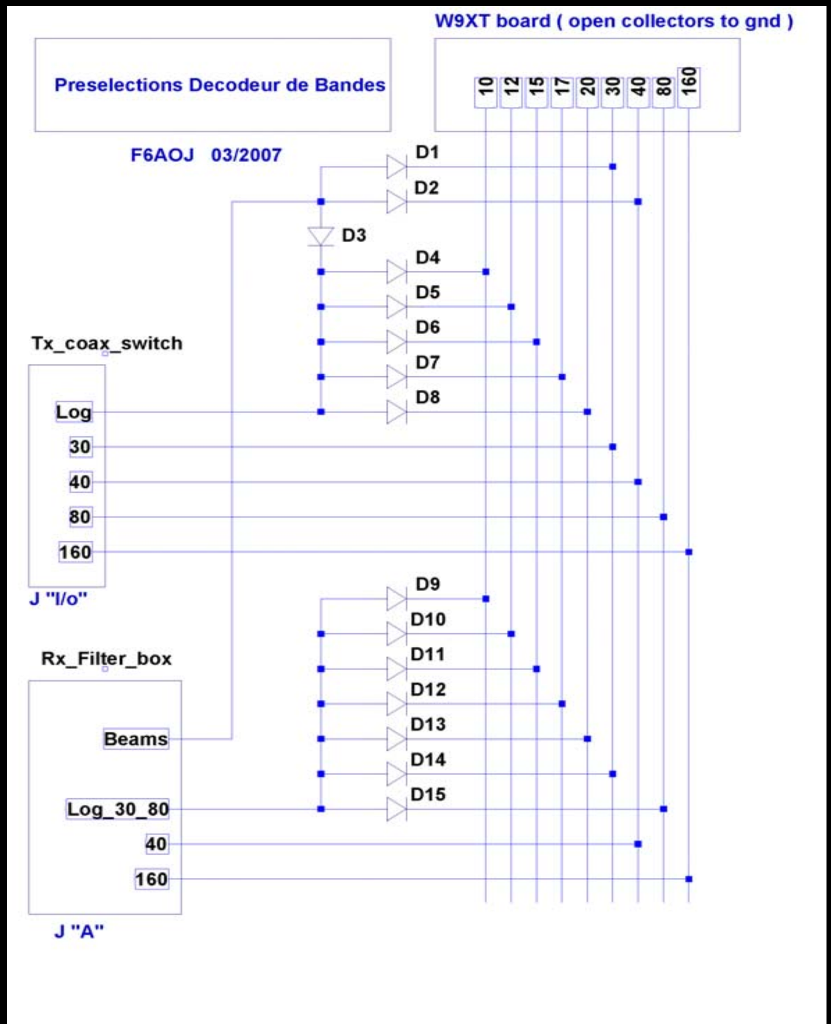
Interface
decodeur de bande
commutateurs coaxiaux rx

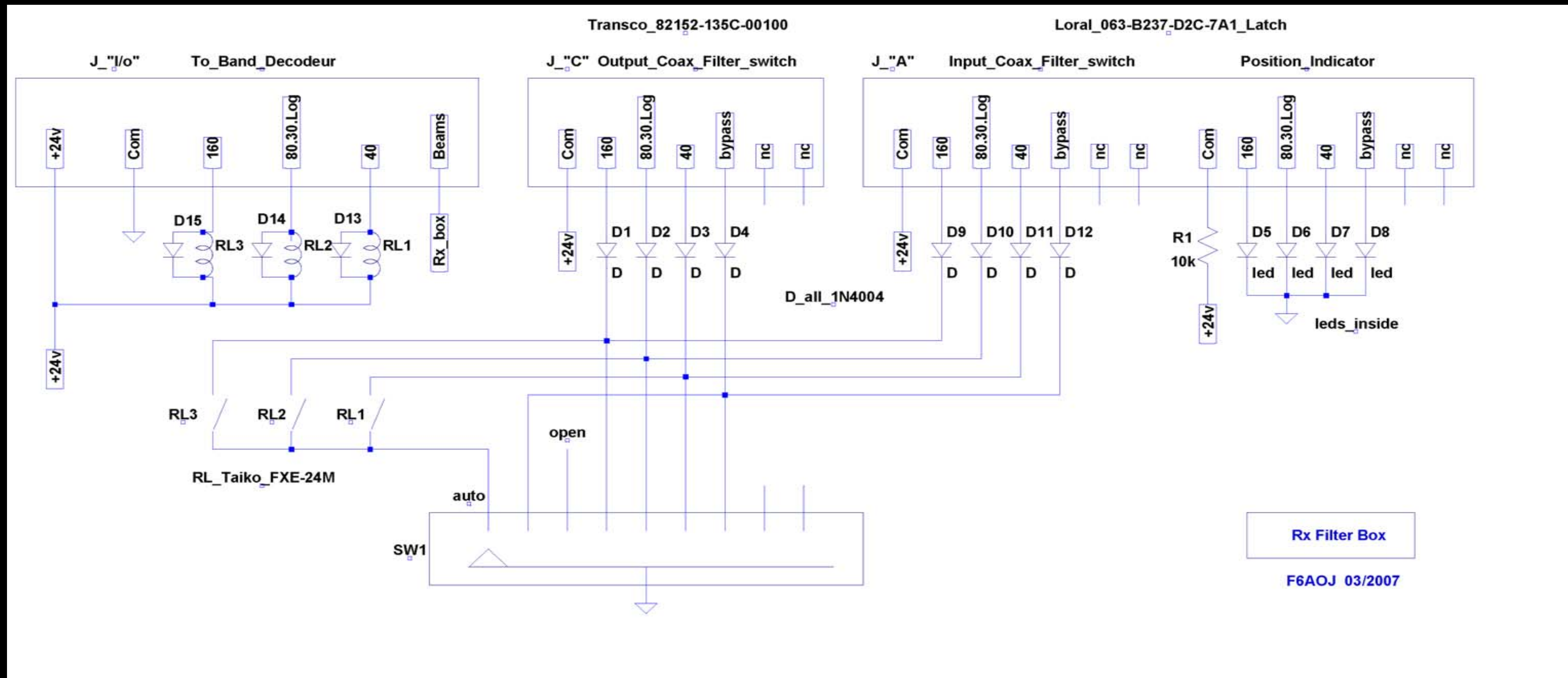


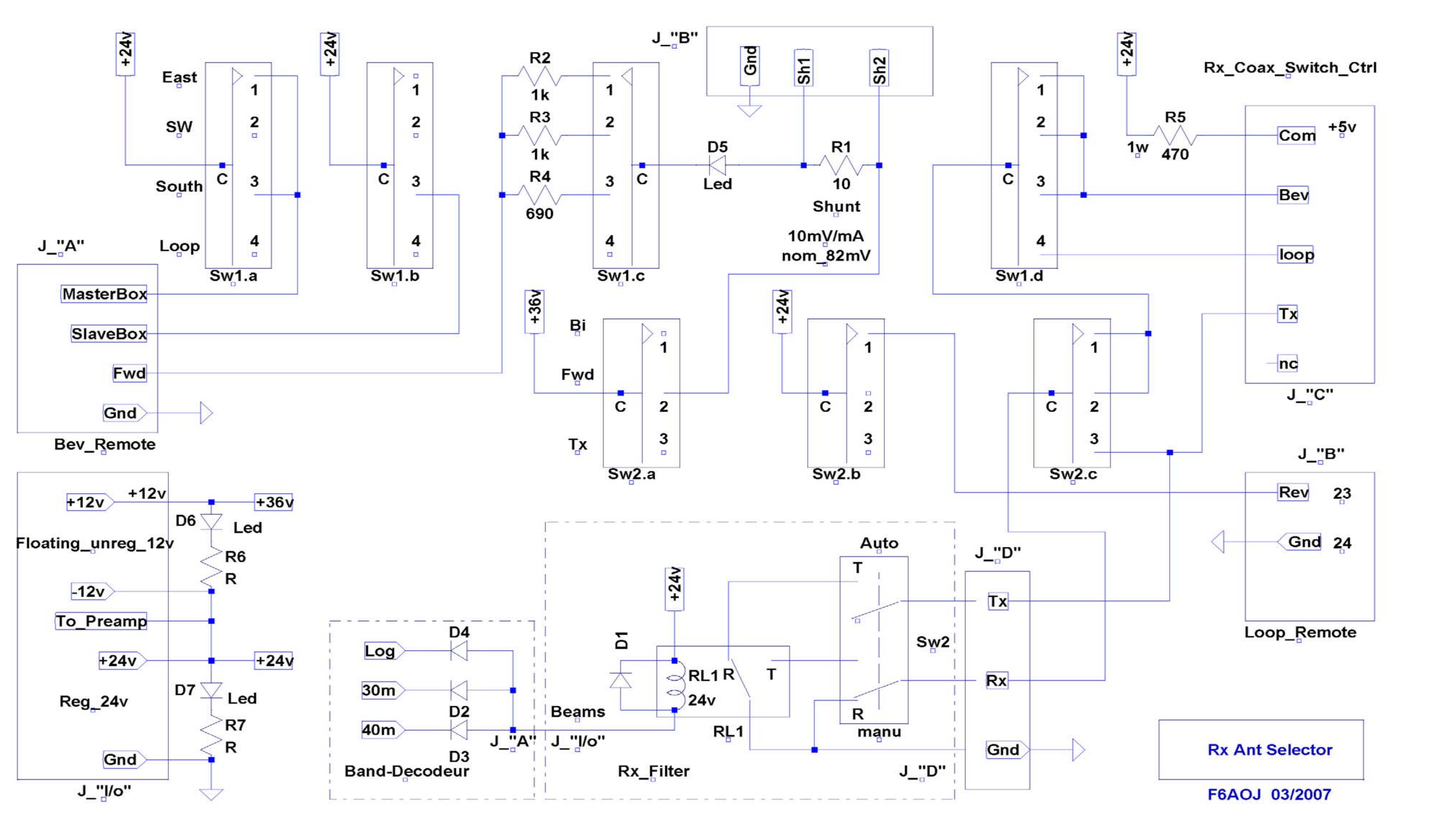


Interface décodeur de bande commutateurs coaxiaux rx

Nécessite de modifier le décodeur de bande

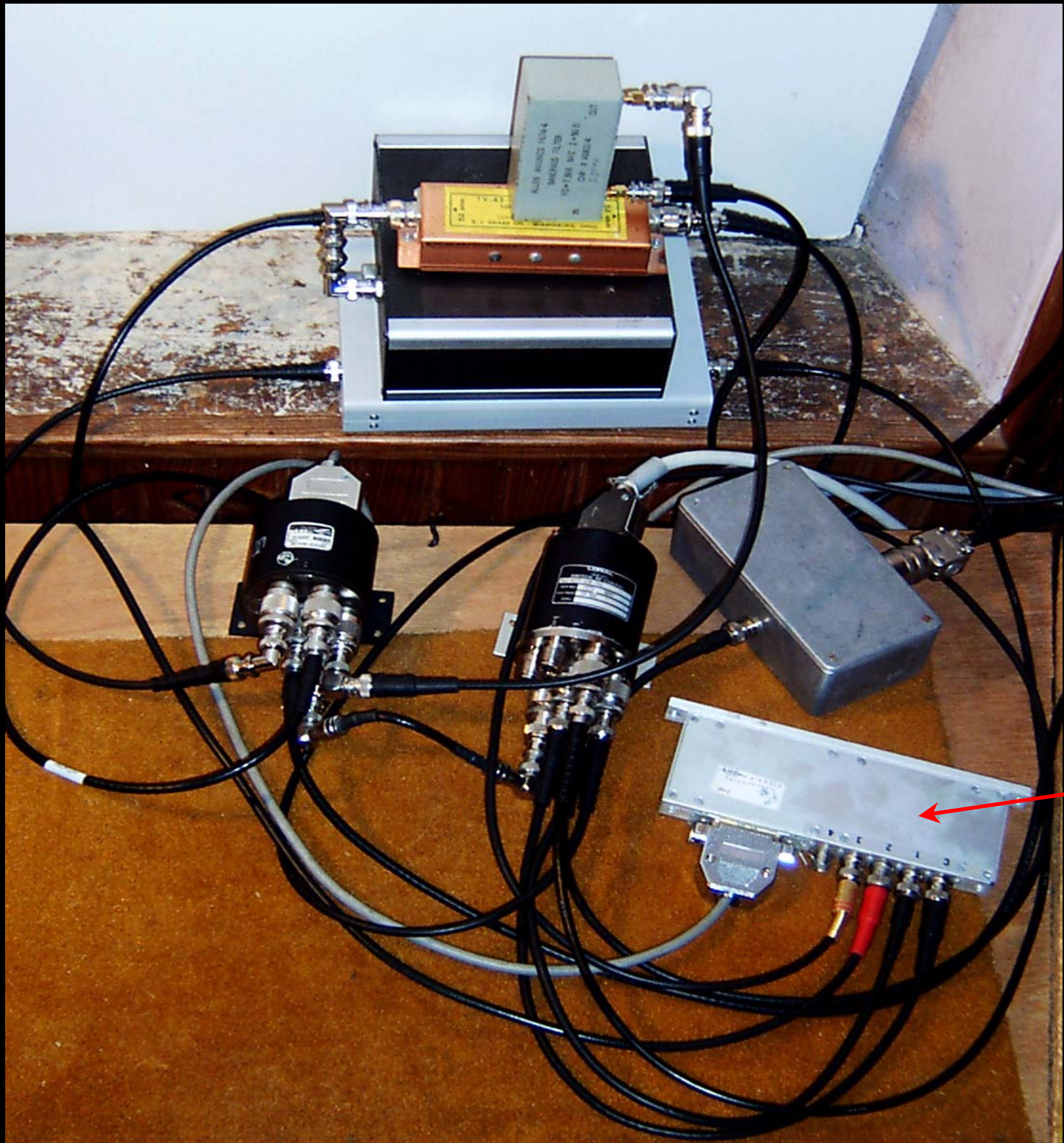





+24v
East
SW
South
Loop
C
1
2
3
4
Sw1.a
Sw1.b
R2
1k
R3
1k
R4
690
Sw1.c
J_"B"
Gnd
Sh1
Sh2
D5
Led
R1
10
Shunt
10mV/mA
nom_82mV
Sw1.d
R5
1w
470
Rx_Coax_Switch_Ctrl
Com
+5v
Bev
loop
Tx
nc
J_"C"
J_"A"
MasterBox
SlaveBox
Fwd
Gnd
Bev_Remote
+36v
Bi
Fwd
Tx
Sw2.a
Sw2.b
Sw2.c
Rev
23
Gnd
24
Loop_Remote
+12v
+36v
D6
Led
Floating_unreg_12v
R6
R
-12v
To_Preamp
+24v
D7
Led
Reg_24v
R7
Gnd
J_"I/o"
Log
30m
40m
D4
D2
D3
Band-Decodeur
J_"A"
Beams
J_"I/o"
D1
RL1
24v
T
RL1
Rx_Filter
Auto
Sw2
manu
J_"D"
Tx
Rx
Gnd
Rx Ant Selector
F6AOJ 03/2007

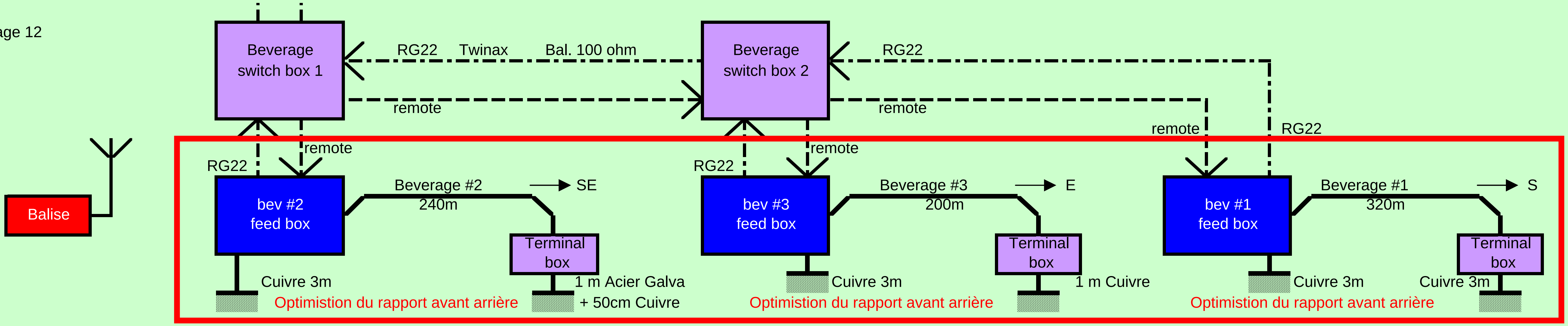
Decodeur de bande
Selecteur automatique de Filtres Rx
Selecteur d'antenne Rx
Préampli Ameco PT
(Très modifié)

le recyclage des " Data Tansfer switch " box évite de faire de la mécanique.



Beverages , Filtres, Préampli, raccordement et commutation : plus de 120 connecteurs ! (sans compter les equipements OEM)

from page 12



Optimistion du rapport avant arrière

Phase 1: détermination de la charge terminale

poser une balise à plus de 1 Km derrière l'antenne

soit en fixe chez des amis , ici coté nord à 4km
soit en mode temporaire style chasse au renard

balise à 2 fréquences quartz commutable 1,825 et 3,525 ev

placer un stepping relay avec des resistances au pas de 50 ohm
et un commutateur avec des talons

passer la commande du "stepping relay" par le fil de l'antenne

Phase 2 : optimisation du rapport de transformation

au reflectometre pour un mimimum de SWR

Phase 3 : itération

Refaire un cycle Phase 1 et 2

tout recommencer pour la 2eme bande
car les resultats ne sont valables que pour
la fréquence et la longeur lors des mesures

Points en suspend :

Longeur de l'antenne ? Voir les commentaires de W8JI et W3LPL

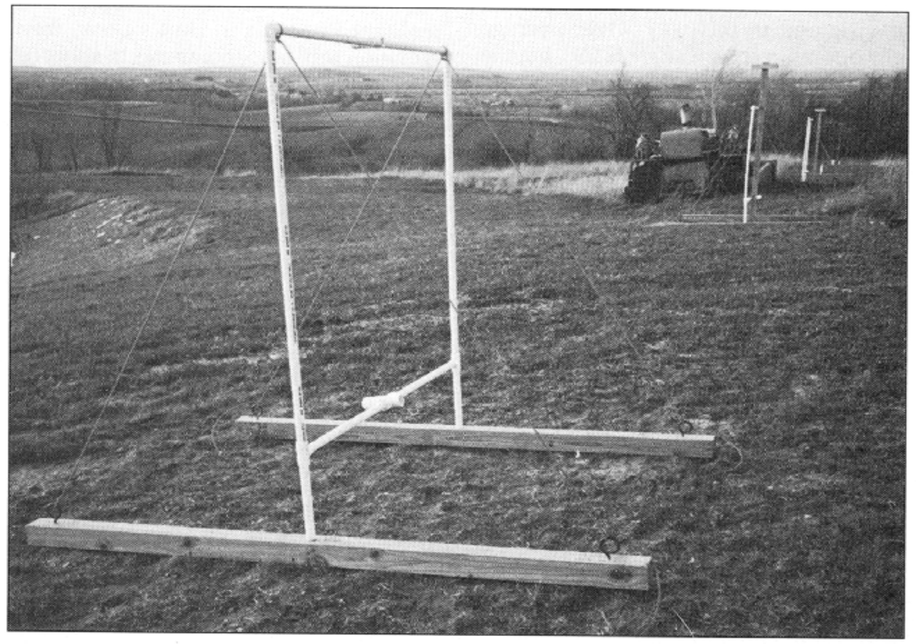
Faut 'il commuter des composants en fonction de la bande ?

http://www.surplussales.com/Switches/SWLedex-1.html

A High-Directivity Receiving Antenna for 3.8 MHz

How about a front-to-back ratio of 25 to 45 dB? Three tuned, phased, ground-mounted loops can provide it in less than 100 feet of linear space.

By Floyd Koontz, WA2WVL
6842 Wheeler Rd
Holcomb, NY 14469


(photos by WA2WVL)

The old saying that you can't work them if you can't hear them certainly applies to 75 meters. Seventy-five-meter DXing from western New York is challenging for this reason. It has been estimated that European DX stations are typically 20 dB weaker in this area than they are near the Atlantic Ocean; farther inland, they are even weaker. Since signal and static levels are generally high at 3.8 MHz, one solution to copying weak European signals is to improve their signal-to-noise ratio with receiving-antenna directivity.

A 400-foot Beverage receiving antenna, directed to Europe, allowed me to work many stations that were not copiable on a ¼-wavelength vertical. Improving my transmitting antenna to a pair of phased verticals reduced the Beverage's advantage to slight. I decided to use Brian Beezley's *MN* antenna analysis program[1] to determine if a better ground-mounted receive antenna could be built.

Nearly all directive antennas have unwanted responses—often less than 20 dB down—on the sides or back of their patterns. Noise and interference contributed by these responses limit the receiving signal-to-noise that can be obtained. In this way, a Beverage antenna's side lobes work against the achievement of high directivity (see Fig 1).

After I reviewed several antenna textbooks,[2-4] the most likely candidate seemed to be the *end-fire binomial array*—an arrangement in which three or more elements are fed with an ever-increasing phase delay (from back to front), with the element currents diminishing from the center element outward. A three-element antenna of this type has appeared in several amateur publications,[5] and usually has ¼-wave spacing with a progressive 90° delay per element and a 1:2:1 current distribution. Computer analysis shows that this antenna can give excellent directivity with an optimized spacing somewhat less than ¼ wavelength and progressive phase delays of 135°.

But what type of element should be used? Mathematicians analyze binomial arrays using what are called *isotropic* elements—idealized radiation sources so small that their dimensions are insignificant relative to wavelength. At 3.8 MHz, a wavelength is about 259 feet, so, seeking practical performance at par with that predicted by theory, and not wanting to put down a large ground system, I chose to use tuned loops instead of vertical elements. The receiving loop has many advantages over monopoles, as discussed by Hart.[6] In addition to being a low-noise antenna, the loop is easily tuned and matched to 50 Ω and requires no ground system. I chose to use square loop elements, each 5 feet per side and mounted 2 feet above ground. Small loops have a null broadside to their plane, so these loops are oriented edge to edge, toward the target.

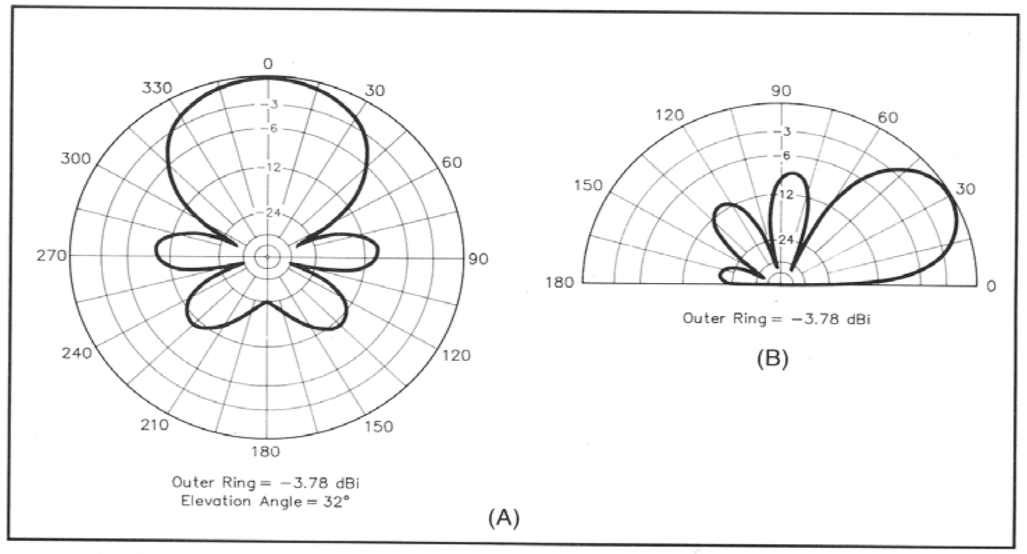
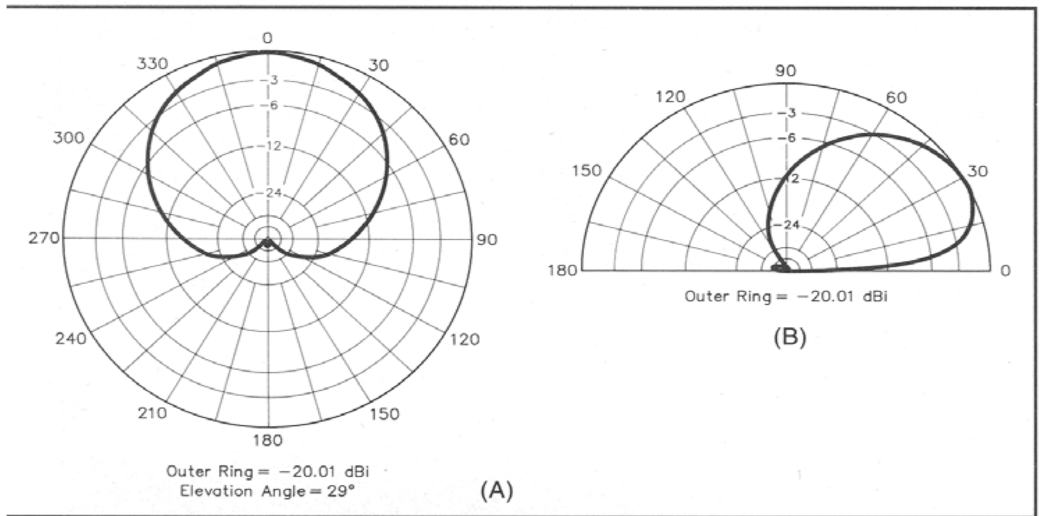


Fig 1—A 400-foot, 8-foot-high terminated Beverage antenna displays significant side lobes that compromise its ability to reject noise and interference in the horizontal plane (A). Evaluating the Fig 1 antenna in the vertical plane (B) tells a similar story. The secondary vertical lobes bring in interference and noise from near-vertical-incidence signals—that is, from sources that are relatively local. (*patterns modeled over average earth at 3.8 MHz with* MN)

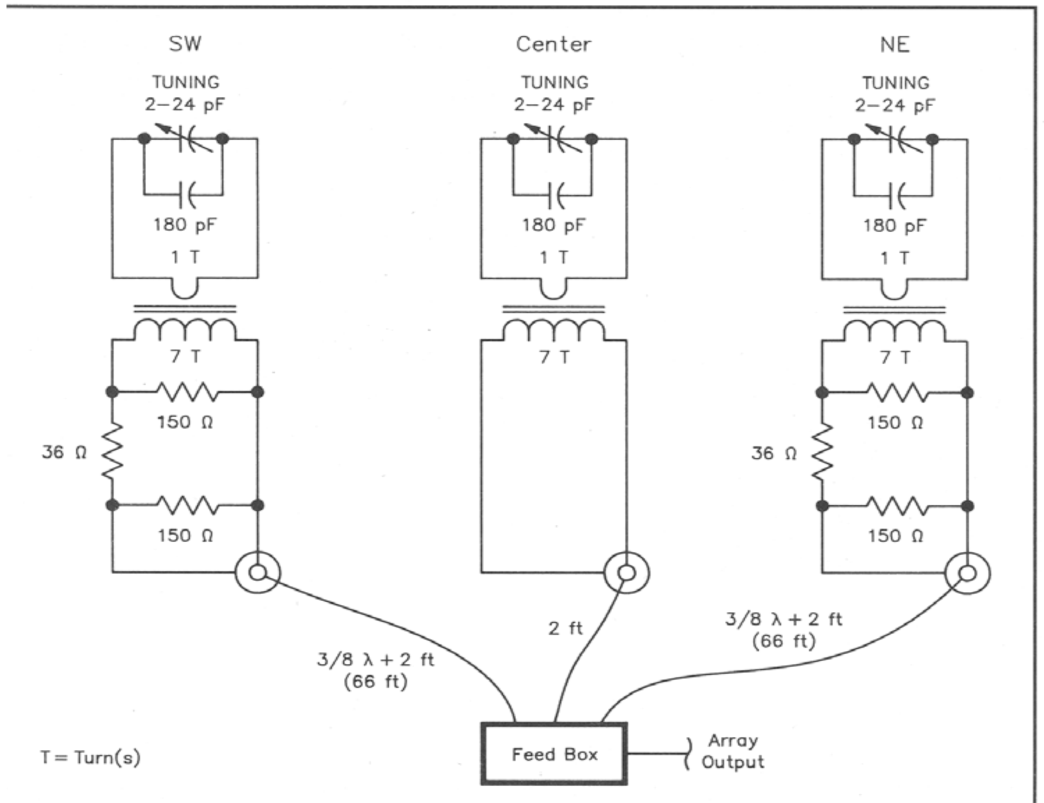
[1]Notes appear on page 34.

'attern Predictions

I wanted the array's pattern to be easily :versible, so I picked element phase delays of 0° or 135° to simplify the feed system. A 1:2:1 lement current ratio gave optimum directiv-y with 40-foot (center-to-center) element pacing. Fig 2 shows the predicted azimuth nd elevation patterns obtainable with an an-:nna configured in this way. Over average arth, the optimum arrival angle is 29°, but the ntenna has an excellent pattern at low and high angles (typical of loops, per Hart). Its horizontal 3-dB beamwidth is 78°.



ig 2—Properly spaced, phased and driven, three ground-mounted loops configured as a *inomial end-fire array* can provide an almost perfect *cardioid* (heart-shaped) horizontal esponse (A), with a beamwidth almost identical to that of the Beverage modeled in Fig 1. he loop array's lower gain (at least 16 dB lower than that of the Beverage) requires reamplification, but does not compromise weak-signal performance at 3.8 MHz. In the ertical plane (B), the loop array provides *much* better rearward-signal discrimination than ie Beverage.



ig 3—Each loop resonates at 3.8 MHz with a tuning capacitance of about 190 pF; the oops are spaced 40 feet apart (center-to-center). A transformer (turns ratio 7:1) matches ach loop to 50-Ω line; 6-dB pads (use noninductive resistors) reduce the current ontributed by the outer loops to half that contributed by the center one. The feed-line engths shown are for RG-58A cable. Fig 5 details the feed-box circuitry.

Electrical Loop Design

Fig 3 shows the schematic of the loops. Small, tuned loops generally have low efficiency, but this is not an important factor for receiving at 3.8 MHz. Using the radiation resistance formula in Hart's book, the loops' radiation resistance computes to about 0.005 Ω each. Measurements have shown that the total feed resistance, which includes the wire loss, transformer and capacitor losses, is about 1 Ω. Based on these numbers, the efficiency works out to 0.5%, or −23 dB. Although a low-noise, high-dynamic-range preamplifier is required to preserve system sensitivity, the normal QRN level at 75 meters, not the array's inefficiency, limits system performance.

The array's bandwidth (its region of highest performance) computes to about 20 kHz, although it can be used over most of the 80-meter band. Tuning each loop is accomplished with a low-value trimmer capacitor across a fixed 180-pF capacitor, for a total capacitance of about 190 pF per loop. I recommend using high-quality fixed capacitors, such as those made by ATC, JFD or Vitramon. Ordinary "receiving" variables and dipped micas can be used if *low*-level RF is applied to the array during adjustment. I applied 5 W to my array during adjustment—a level at which more than *700 V* appears across the loop tuning capacitors. (A sudden SWR or return-loss change during loop adjustment indicates probable capacitor failure.)

Each loop's ferrite matching transformer has a one-turn primary consisting of a brass tube passed through stacked toroidal ferrite cores. Seven turns of insulated wire wound through the tubing form the secondary. The primary connects to the loop; the secondary, to 50-Ω coax via coaxial fittings. My transformers are based on commercial assemblies,[7] but you can build your own using hobby brass stock as shown for transistor-final transformers on page 60 of *Solid State Design for the Radio Amateur*.[8] I suggest using four 0.5-inch-OD -43 (μ = 850) toroidal ferrite cores per transformer. PC-board material can serve as tube end plates as shown in *Solid State Design*.

Construction

Each loop consists of #14 copper wire housed in a PVC-pipe frame. About 13 feet of wire is needed per loop half—in all, roughly 80 feet for a three-element array. The loops are tuned at their tops and fed at their bottoms.

Fig 4 and the title photo show the loop partially assembled and completed. One-inch PVC pipe forms each loop frame. PVC pipe comes in 10-foot lengths, so my loop dimension of 5 feet per side allows the use of standard-length sections without waste. Each loop's tuning capacitors mount in a 1-inch cross centered in the loop top. Each loop's feed (a 7:1 transformer and BNC coaxial connector) mounts in an assembly centered in the loop bottom. This assembly consists of 1½- to 1-inch reducers, a 1½-inch cross, a 2- to 1½-inch reducer, a 1½-inch cap and a 2-inch cap. The 2-inch cap holds the loop feed components; the 1½-inch cap closes the uncommitted cross port. The 1½-inch-to-1-inch reducers can be seen on the ends of the two pipes in Fig 4. The necessary PVC cement, crosses, elbows, pipe, reducers and **T**s are available where plumbing supplies are sold.

Elbows form the loops' upper corners; **T**s, the lower. Sixteen-inch pieces of 1-inch pipe (not visible in Fig 4) cemented into the bottom of the **T**s allow the loops to be ground-mounted on timbers.

A Five-Element, End-Fire Binomial Array Design

The three-element end-fire binomial array described in this article easily fits into the space previously occupied by my 400-foot Beverage antenna. A *five-element* array would also fit into that space, so I designed one with the dimensions shown in Table A. Modeling predicts that all of its side and back lobes should down at least 50 dB at all angles of elevation (see Figs A and B). Pattern attenuations of this magnitude may not be achievable in practice because highly precise phasing and element drive are required, but it's comforting to know that there is no *theoretical* reason why directivity exceeding 50 dB cannot be achieved.
—*WA2WVL*

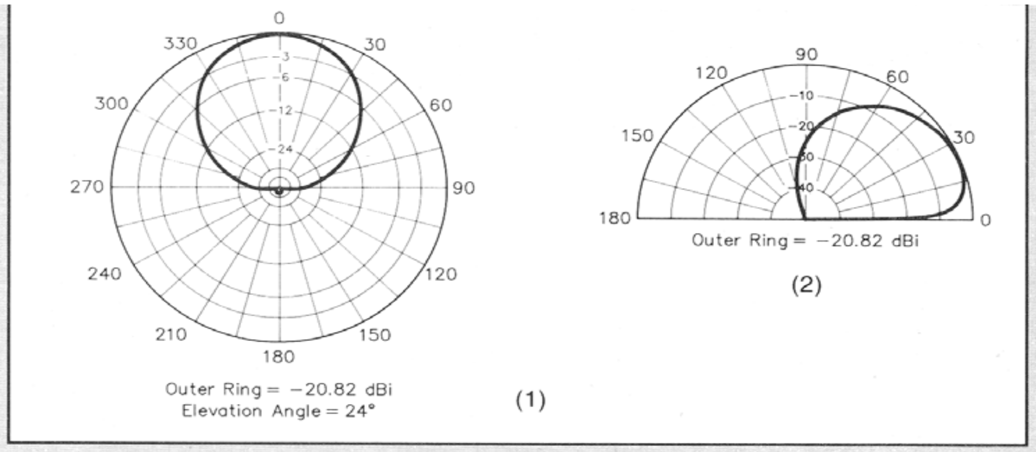


Fig A—Predicted horizontal (1) and vertical (2) performance of a five-element end-fire binomial array. Unlike the other polar plots in this article, which use *QST*'s standard log-periodic scale, the vertical-plane plot uses a linear-decibel scale to highlight the antenna's clean pattern at high attenuations.

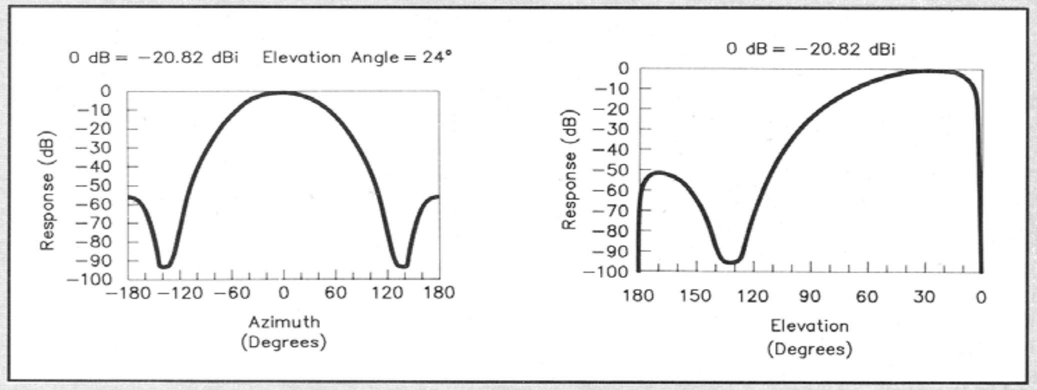


Fig B—Plotting the five-element array's horizontal performance with rectangular coordinates (1) shows its higher pattern attenuations better than the polar plots in Fig A. Critical adjustment of element current and phasing is necessary to approach such attenuations in a practical system. A rectangular-coordinate plot of the five-element array's vertical performance appears at 2.

Table A
Vital Statistics for a Five-Element, End-Fire Binomial Array

Element Position	*Relative Current*	*Relative Phase*
Rear	1	270° (or −90°)
	4	135° (or −225°)
Center	6	0°
	4	−135°
Front	1	−270°

The elements are spaced 50 feet apart (center-to-center) for optimum side-lobe performance.

Build your loops on a flat surface, such as a garage floor, to ensure that the loop sides are in line. Run the wire through each loop's PVC pieces *before* assembling them so you won't have to push the wire through.

Build each loop in halves, cementing all of its fittings except the center crosses. Once the halves' cement has dried, set the halves upright. *Without using PVC cement*, slip the center crosses on to complete the loop, bringing the loop wires out through the back of the crosses. Tap the sides of the **T**s with a block of wood to seat the PVC pipes in the crosses.

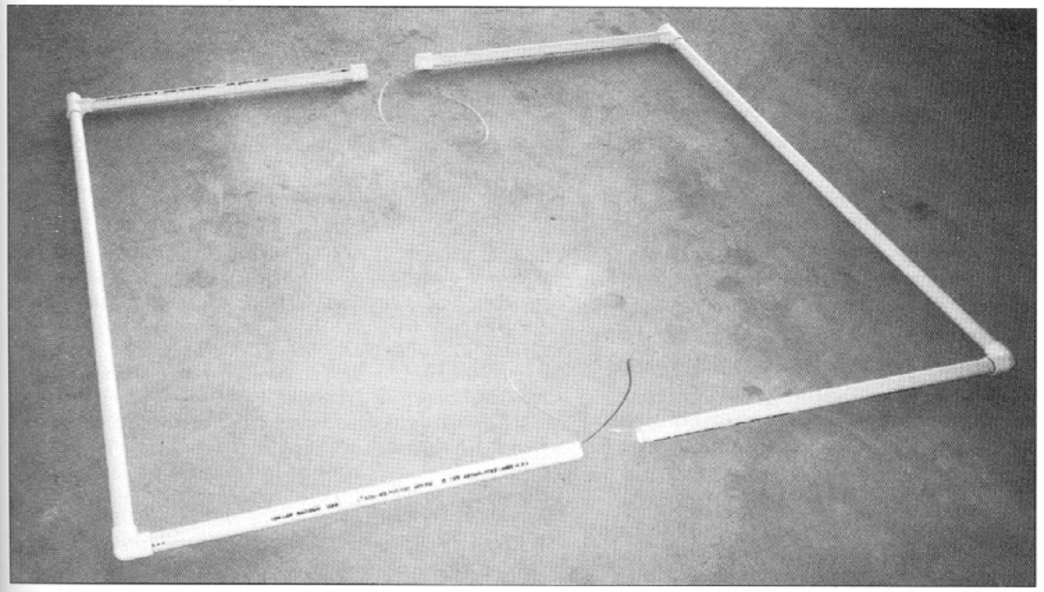


Fig 4—This loop is ready to receive its center crosses—1-inch for the loop top (foreground) and 1½-inch for the loop bottom (background, via 1- to 1½-inch adapters).

I drilled small holes in the crosses to secure the loop-wire ends and create tie points. "Flying lead" construction of the transformer/connector and tuning capacitor assemblies allows them to be easily installed or removed. (Be careful not to reverse any of the transformer connections, as this would add an extra 180° of phase lag in that element and spoil your antenna's performance.)

Ground Mounting

Initially, I considered this antenna to be experimental, so I took a mounting approach that allows the loops to be easily repositioned. The local farm-and-garden store had a sale on pressure-treated 4 × 4 timbers, so I used two of these per loop as bases. A 1-inch hole drilled in the center of each timber takes a 16-inch-long piece of 1-inch hardwood doweling. To mount each loop, just slip its legs over the dowels. If you live in a windy area, you can add rope guys down to the base timbers to help support the loops, as shown in the title photo.

Phasing-System Design

The array requires relative element phasing as follows:

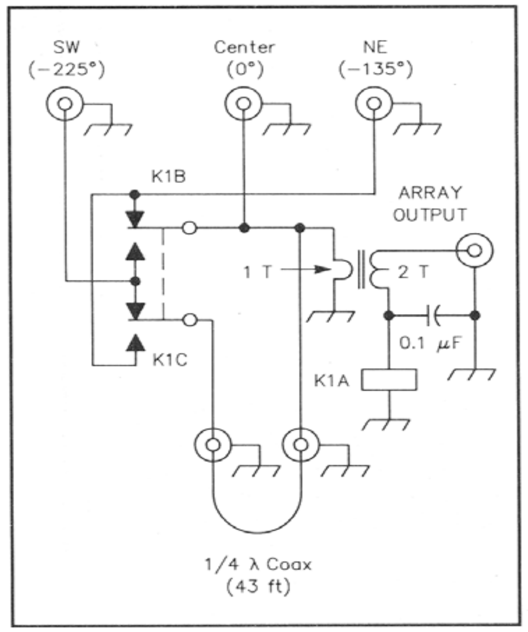


Fig 5—The feed box includes relay switching to reverse the array's pattern. The ¼-wavelength RG-58A section shown is *essential* and works in conjunction with the feed-line lengths shown in Fig 3 to provide proper element phasing. The phase angles shown are for normal operation (northeastern pattern, K1 off); energizing K1 flips the pattern to the southwest by phasing the northeastern loop at −225° and the southeastern loop at −135° relative to the center loop. The transformer (turns ratio, 2:1) is constructed similarly to the 7:1 units used in the loop; see text.

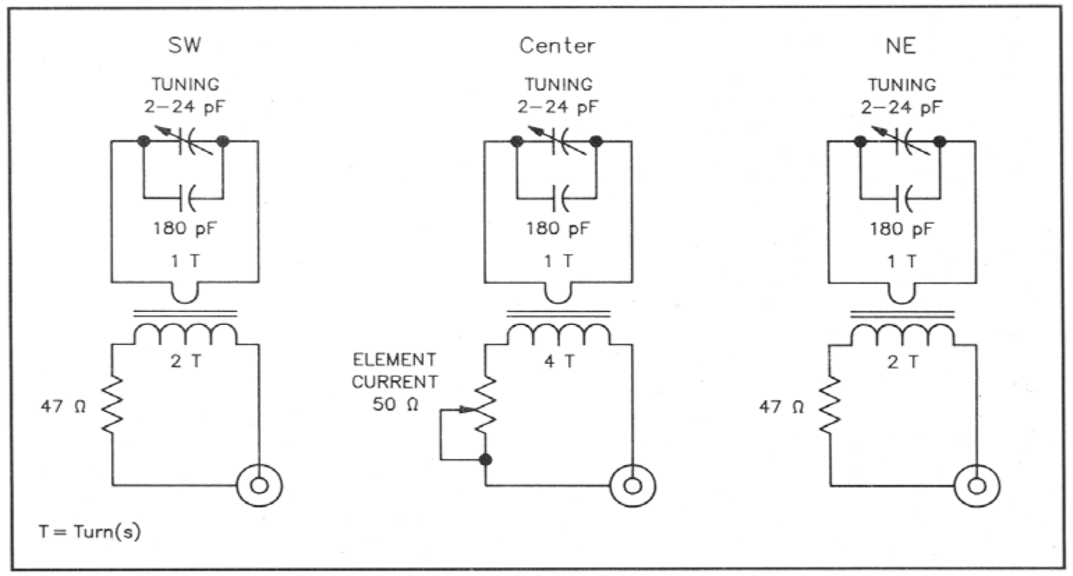


Fig 6—This alternative feed method uses noninductive series resistors and 2:1 and 4:1 matching transformers to allow precise adjustment of element currents for improved front-to-back ratio. Careful adjustment of this system has achieved a peak improvement of 20 dB over the simpler feed method shown in Fig 3. Fig 7 plots its front-to-back ratio versus frequency.

Rear	+135° (or −225°)
Center	0°
Front	−135°

Transposing the front- and rear-element feeds reverses the array's pattern. Fig 5, the schematic of the array's feed box, includes a method of multiplexing the pattern-control relay drive over the box-to-station coax.

Equal lengths of RG-58A coax run from the feed box to the front and rear elements. These cables are ⅜ wavelength long, plus 2 feet. The center element is fed through 2 feet of cable, thus resulting in a differential phase between the center and end elements of 135°. (Assuming that the cables operate at a low SWR, this technique can be used in other phased-array designs where a ¼-wavelength coax is too short to span the physical distance between elements.) Then insert a ¼-wavelength piece of coax (with RG-58A, 43 feet at my array's design frequency of 3795 kHz) in series with the rear element to give a total delay of 225°. A 2:1 ferrite-core transformer matches the three paralleled feed lines to 50 Ω in the feed box.

Adjustment and Measurements

Computer modeling shows virtually no coupling between the loops, so each can be tuned to resonance while ignoring the others. A sensitive SWR meter or return-loss bridge should be used to adjust the variable capacitor for the best impedance match—that is, minimum reflected power or highest return loss. Adjust the loop trimmer via a long, non-metallic shaft or large plastic knob. Be careful not to get RF burns from the capacitor—high RF voltages appear across it even with only a few watts applied to the loop.

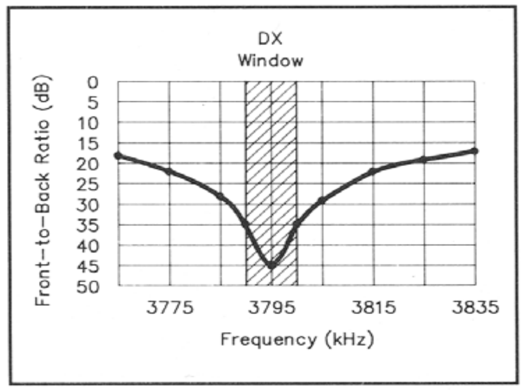


Fig 7—Adjusted for peak performance at 3795 kHz using the feed method shown in Fig 6, the three-element loop array provides a front-to-back ratio of at least 35 dB across the 75-meter DX window.

The loops give less than 1.09:1 SWR (a return loss of 27 dB) when fed via 7:1 transformers. The first three-element array I built used 6-dB attenuators in the feeds to the 1st and 3rd elements to set those elements' current at half that of the center element. After the loops were tuned and hooked to the feed box, a front-to-back ratio (F/B) of 25 dB was measured without further adjustment.

The second three-element array I built used series-resistor feed (Fig 6) to enable precise adjustment of the element current. I varied the outer elements' feed-transformer turns ratio to set their current; then added resistors to bring their input impedance up to 50 Ω. (The resistors also add 7 dB of loss.) I adjusted this array for maximum F/B using a remote test signal. The element trimmers can be used for fine adjustment of the element phase. (If you can't adjust your antenna with a remote test signal, use 7:1 transformers at all three elements and set the outer elements' currents with 6-dB-pads. A 25-dB front-to-back ratio is well worth achieving at 75 meters!)

Fig 7 plots the system's measured front-to-back ratio using series-resistor feed. I consider this performance to be well worth the effort necessary to achieve it.

Notes

[1]*MN 4.0* by Brian Beezley, K6STI.
[2]J. Kraus, *Antennas* (New York: McGraw-Hill, 1950), pp 90-97 and 510.
[3]H. Jasik, *Antenna Engineering Handbook*, 1st ed (New York: McGraw-Hill, 19), pp 5-20 to 5-28.
[4]W. L. Weeks, *Antenna Engineering* (New York: McGraw-Hill, 1968), pp 84-97.
[5]J. Devoldere, *Low-Band DXing* (Newington: ARRL, 1986).
[6]T. Hart, *High Efficiency Antennas alias The Loop* (Melbourne, FL 32902: W5QJR Antenna Products).
[7]Transformer assembly #CN20-AT8, manufactured by Ceramic Magnetics, 16 Law Dr, Fairfield, NJ 07004, tel 201-227-4222, fax 201-227-6735. Attn: Jim Florance.
[8]W. Hayward and D. DeMaw, *Solid State Design for the Radio Amateur* (Newington: ARRL, 1986).

Floyd Koontz holds a BSEE in Electrical Engineering and is currently a senior scientist working for Harris Corporation, RF Communications Division, Rochester, New York. He has 35 years experience in the design of high-power transmitters and antenna systems.

For many years, he was active on the bands from 50 through 3456 MHz, including moonbounce communication at 144 and 432 MHz. Prior to moving to New York in 1961, he was licensed in Missouri as KØLTV and, in the late 1950s, as W9JQA in Illinois. In 1965, he was one of the DXpedition operators at XE5L, Revilla Gigedo.

Recently, he has concentrated on 75 meters, operating with various receiving antennas and a six-element phased vertical array for transmitting.

QST