

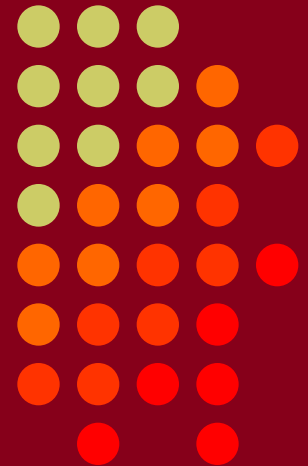
Antenna distribution systems in modern contesting

• CTU •
CONTEST
UNIVERSITY

 Centro Fiera del Garda
Montichiari (Bs)

CTU Italy 2016,
revised

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When we call CQ Contest ...

- We need:
 - more QSO!
 - more multipliers!
- And we have to make them as fast as possible.
- And we have to be the first, in the growing pileup on a new mult.
- **EVERYTHING SHOULD BE QUICK!**



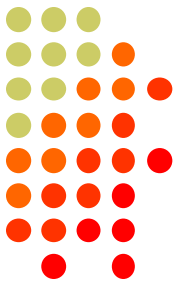
New technologies is already here, and it is XXI century...

- Last year`s records, big scores, is the result of new technologies:
 - SO2R;
 - Simultaneous transmittion in 2 or even 3 azimuthal directions with directive antennas;
 - DUAL CQ on different band;
 - IN BAND operation;
- More stations is “ON LINE”!
- And no more straight CW keyers and paper dupe sheets!



Some of the modern winning techniques :

- **For single ops:**
 - SO2R, to work MULTS on other bands and move them to next band QUICKLY:
 - Good filtering, smart switching for antennas and TRX+PA is a mast!
 - TX and RX in 2-3 directions simultaneously
 - Separate antennas in different directions, power splitting, and again smart control is a must!
 - Dual CQ on 2 different bands se sei uomo di ferro!
- **For multitis:**
 - IN BAND stations;
 - TX and RX in 2-3 directions simultaneously;
 - 2-3 run ops + 2-3 ops INBAND + 2 MULT stations;



We need nowadays:

- More antennas;
- And more separation between main, in-band and RX antennas;
- Better filtering, both on RX and TX chains, and on the low and high power sides of PA;
- More relay switches to be more flexible in operation;
- Smart controllers, precise timings and lock out;
- EXPERIENCED TEAM of tech guys and operators!
- Some amount of Luck and sleeping Murphy ...



Very important:

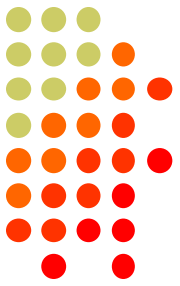
- Safe **Tx / Rx** switching;
- Smart, flexible lockout for multis station;
- Remote relay switching with good cross port isolation;
- Pre- contest power levels measurements of your transmitted signal in your own Receivers, as we don't need smoke in the first night of the contest;
- RX-TX isolation measurements must be done in all possible antennas configuration, on all bands, on a quiet, midday conditions;



MOST important:

Same attention to Receive and Transmit capabilities!





Some notes on antennas. The most important “Element”!

- If you love Mono band antennas, then you need many of them,
+ many towers and coax cables, large property to install and more time for maintenance!
- Single coax feed, multiband antennas, is a way to go on a modest budget, restricted property or when on DX pedition;



Some notes on In-Band Antennas:

- It is good to have BIG antennas for in-band;
- But any simple antennas is very useful too!
 - Simple Multiband Vertical or 2-2-3 el. Yagi;
 - Verticals and sloping Dipoles on 160-40;
 - You may be surprised, how useful are simple antennas!
- As we need as much isolation as possible, then we must use:
 - As much spacing between all antennas as possible!
 - Terrain profiles for better isolation;
 - Cross polarization (another 15-20db);
 - Careful planning on antenna layout, counting on direction of transmission and reception;



Some notes on receive antennas:

- On 160 – 40, where most of us using dedicated, receive only antennas:
 - ❑ we can share the same TX antenna for all the radios (RUN – IN BAND – MULT), and it will be busy almost constantly;
 - ❑ so, we have to use each of our receive antennas on the same or different bands, same or different directions at the same time, by a number of receivers;
- The beverages (or any other RX array), should be placed at least 200 meters from TX antennas;
- They should be pointed out off TX antenna, so everyone need careful planning on towers and receive antennas layout;
- Using a special receive only antennas on 20-10 is a way to go!



Some typical Multi station layout:

- **Single band stations (desks), at least SIX**
FIXED layout:
 - 1 to 2 TRX on the same desk;
 - Each “band station” shares same antennas and amplifier;
 - This is very simple, inexpensive, old proven design, but with some limitations:
 - No way to quickly reconfigure station to some other contest instead of major ones;
 - Any single failure, of Amp for example, and you may lost your contest!

Some typical station layout:



- **“Any Band Station”**, usually from 2 to 6:
 - **RUN station**: as many as 2 operators, listening into 2-3 different directions, using different transceivers and antennas:
 - **IN BAND** stations, up to 4 on winning Multi Op station:
 - Separate INBAND towers with big antennas, well spaced, properly oriented to RUN towers;
 - Sometimes a very modest antennas, just separated well to minimize mutual QRM;
 - Smart use of terrains as a shield for extra isolation from RUN antennas;
 - **Mult** station, up to 2 on winning Multi Op station:
 - Can use all the antennas not busy by RUN band;

What is needed most of all in this layout:

- **Matrix switches for TX and RX antennas:**
Any antenna to any station, rule;

= DISTRIBUTION of antennas



KEY ELEMENT #1, for TX distribution:

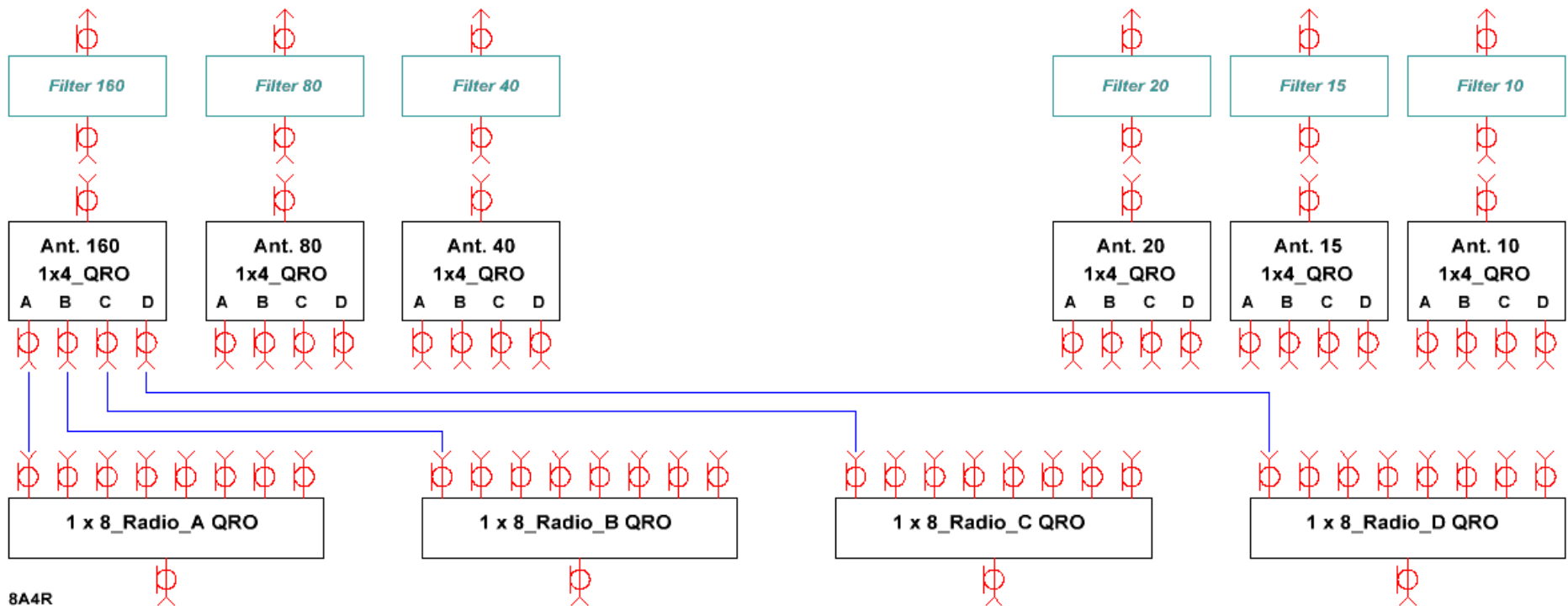
Matrix switches:

- based on simple 1x2, 1x4, 1x6 remote relay switches;

- Benefits:
 - FLEXIBLE, Any further improvements can be done easily;
 - Easy to replace a broken “cell”;
- Possible weak points:
 - Jumpers – bad connectors
- Hardware lockout is a must!
 - Don't try to save few Euros on security
 - Every piece of electronics, software can malfunction
- Smart controller is a must!

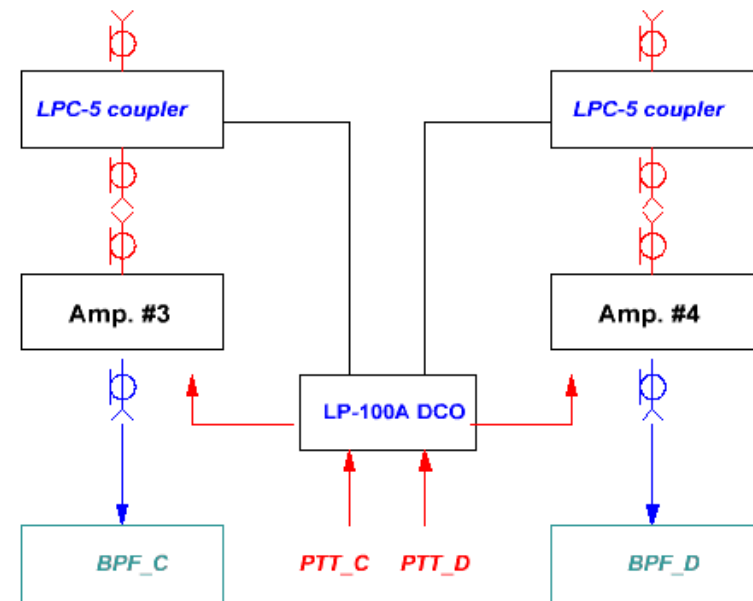
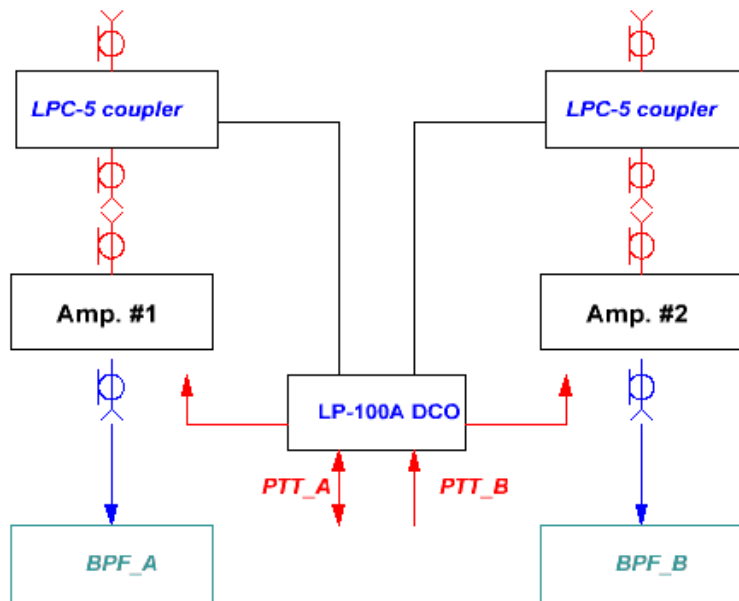


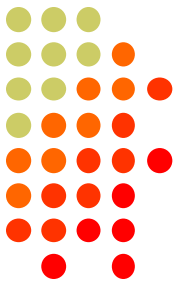
Layout example #1, 4 stations, Only one antenna on a band, no controller is needed, just BandDecoder and LockOut devices





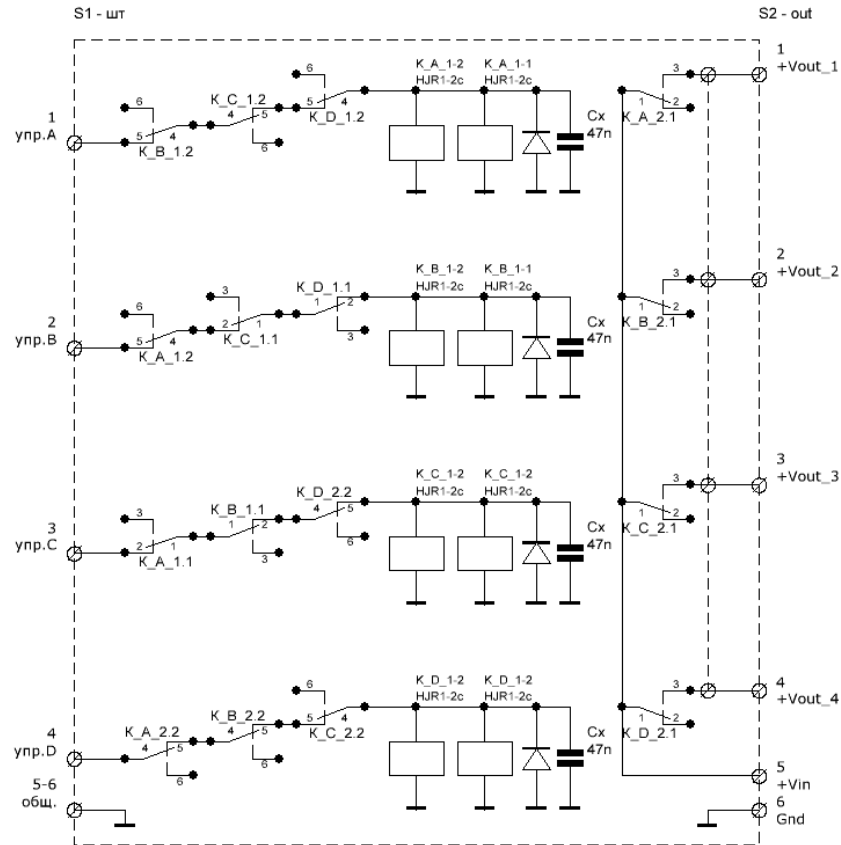
Layout example #1, Amplifiers part:





Layout example #1,

KISS LockOut scheme:





KEY ELEMENTS #2 for TX distribution:

- **Filters + harmonic Stubs:**
 - 90db of isolation is your target figure for 1500Watts;
 - Low and high power side of PA;



KEY ELEMENT #2.1 for TX distribution:

Low power filters

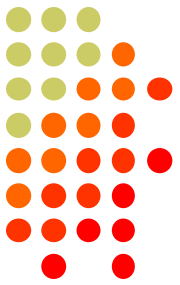




KEY ELEMENT #2.2 for TX distribution:

High (*medium in some countries*) power filters





KEY ELEMENT #2.3 for TX distribution:

DI-, Tri-, QUAD-, Plexers:

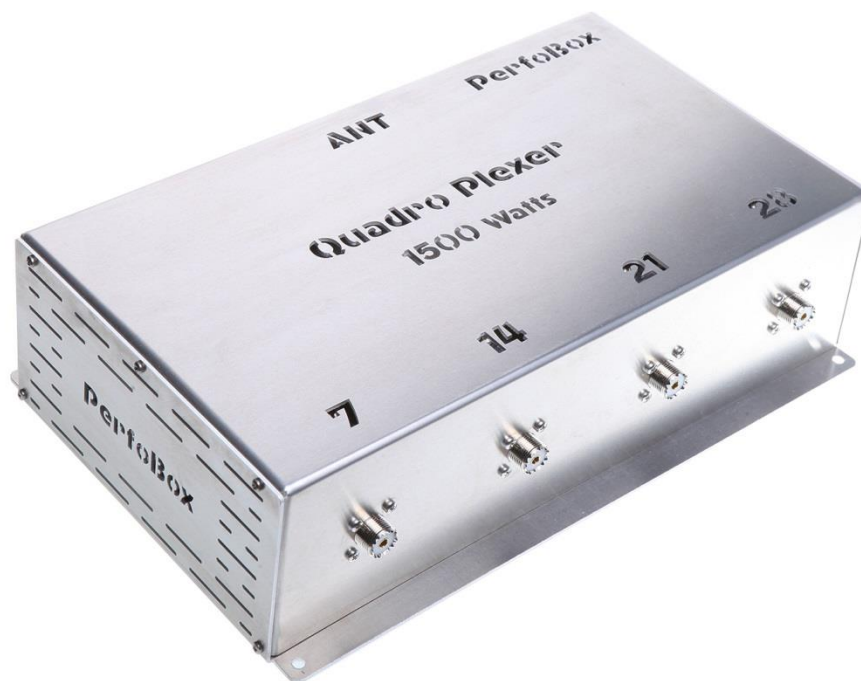
You can use multiband antennas with N
radios:

- Only one antenna
- + one feed line
- + one N-way Plexer

= few stations on different bands!



KEY ELEMENT #2.3 for TX distribution:





KEY ELEMENT #2.3 for TX distribution:





KEY ELEMENT #2.3 for TX distribution:





Summury on transmit lauout:

- More antennas;
- Matrix switches;
- Filters, Plexers;
- SMART Controllers;



KEY ELEMENTS for RX distribution:

- 1) Remote relay switch;
- 2) BPF and Amplifiers;
- 3) Splitters and N-way Plexers;
- 4) Combiners;
- 5) Controller;



KEY ELEMENTS for RX distribution:

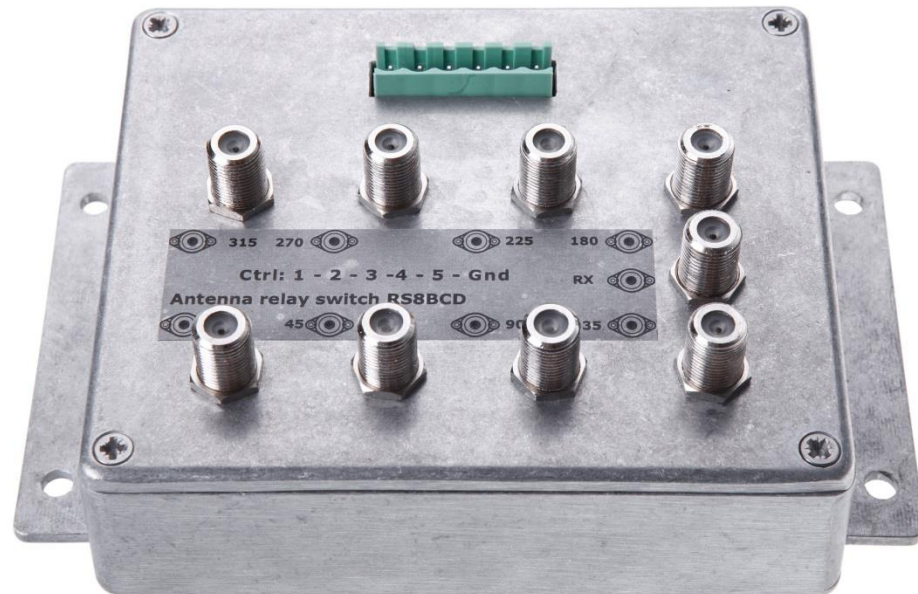
#1 - Remote relay switch requirements:

- Unselected antenna ports should be loaded to 50 or 75 ohms;
- Cross talk ≥ 60 db ;
- Some form of protection against statics, lightning etc.
- BCD control lines;
- F or UHF (SO239) connectors only;



KEY ELEMENT #1 for RX distribution:

relay switch RS8BCD





KEY ELEMENTS for RX distribution:

#2 - BPF and Amplifiers!

Requirements:

- Bypassed;
- 160 – 80 – 40 BPF at least;
- It is preferably to have 2 cascaded preamplifiers, like Norton design, +11db each, giving +22db total for low gain antennas;
- Voltage inject;
- TX protection!



KEY ELEMENTS for RX distribution:

LowBandSuper III:

- 8 inputs;
- 160-80-40 BPFs;
- 2 x 11db, Norton preamps.





KEY ELEMENTS for RX distribution:

LBA II -

2 Amps. in a single case:

- 160-80 BPF;
- +18db Pre Amps.





KEY ELEMENTS for RX distribution:

#3 SPLITTERS

possible solutions:

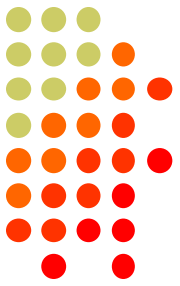
Hybrid Splitter:

- wideband
- every $1/2$ split, is -3db losses;

N way plexers:

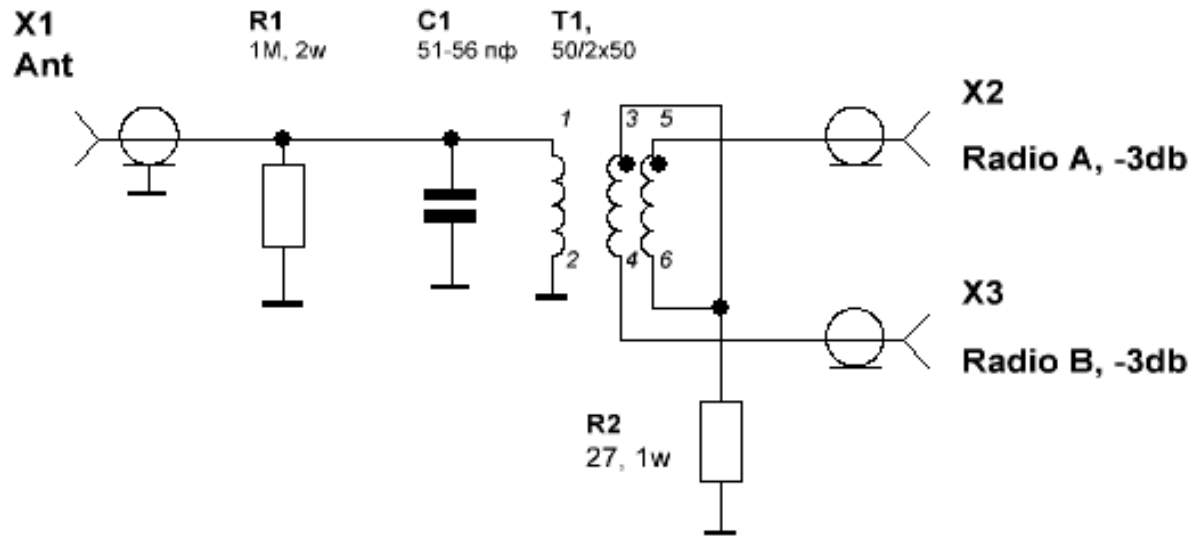
- low loss;
- frequency dependent;





DISTRIBUTION:

Simplest, 2 way hybrid splitter, **BASIC BLOCK**, wideband, -25db. isolation between receiver`s ports





DISTRIBUTION:

Simplest, 2 way hybrid splitter, wideband

**We can combine them,
to the very convenient pack of 8 !**



DISTRIBUTION:

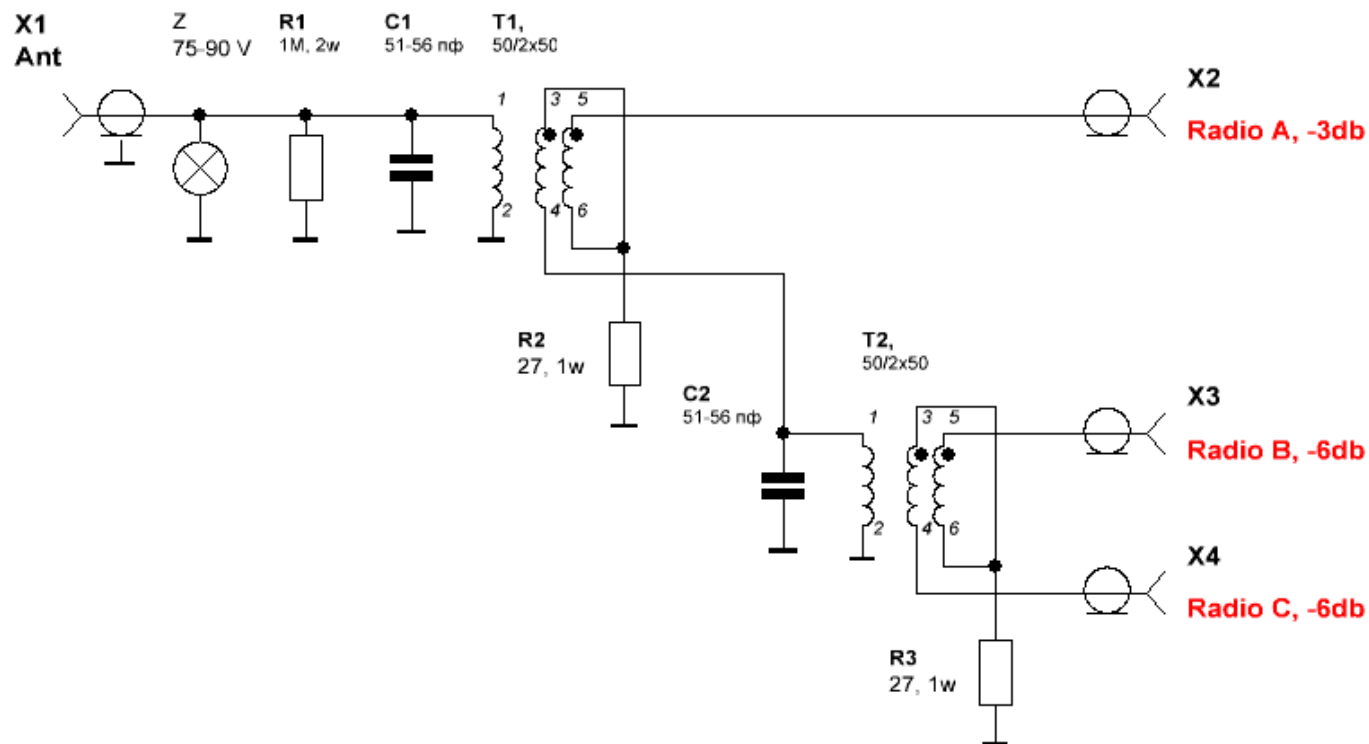
switch 8A2R + 2 x LBC8ARD controllers

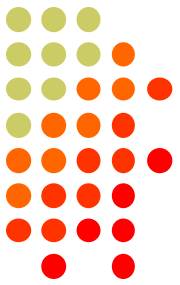




DISTRIBUTION:

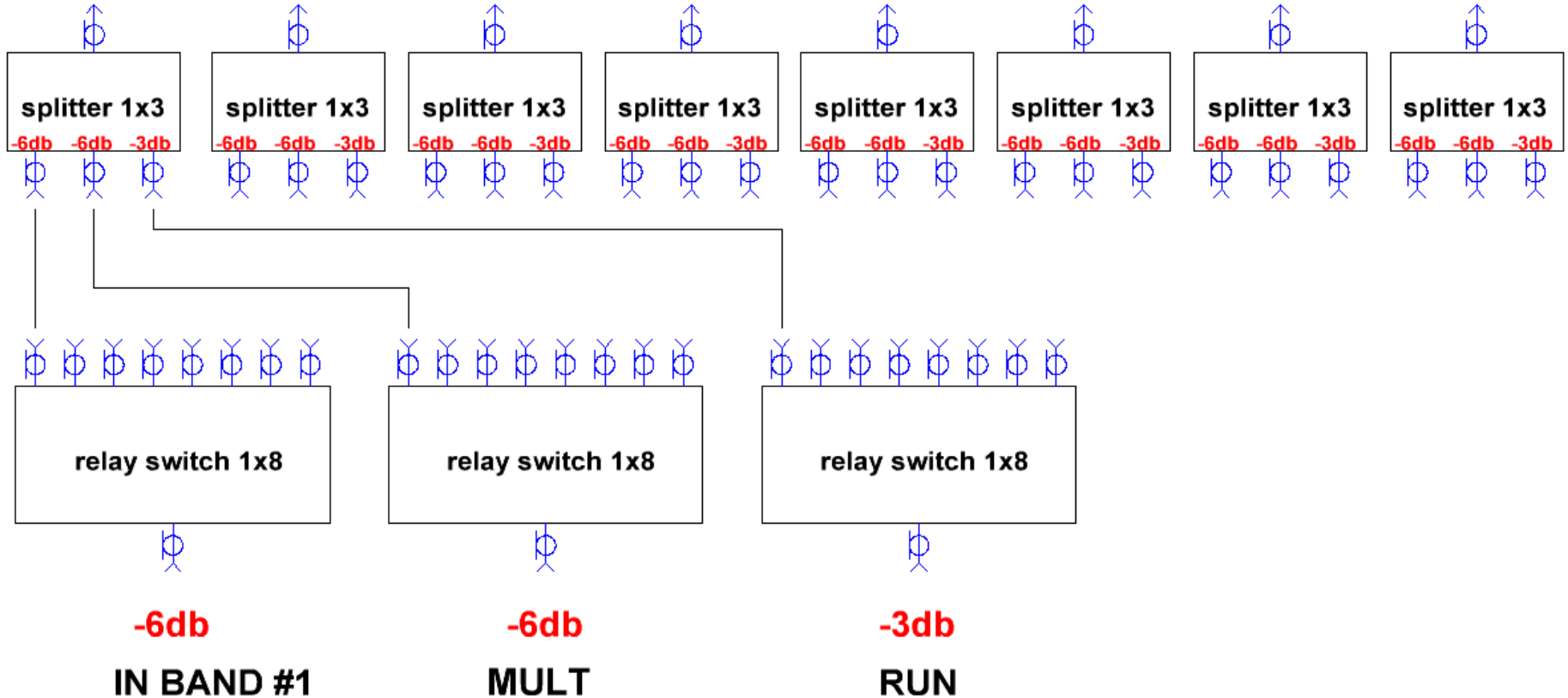
3 way, same splitters used, wideband





DISTRIBUTION:

3 way layout, wideband, -3db and -6db outputs





DISTRIBUTION:

3 way layout, wideband, -3db and -6db outputs

And not only Beverage antennas!

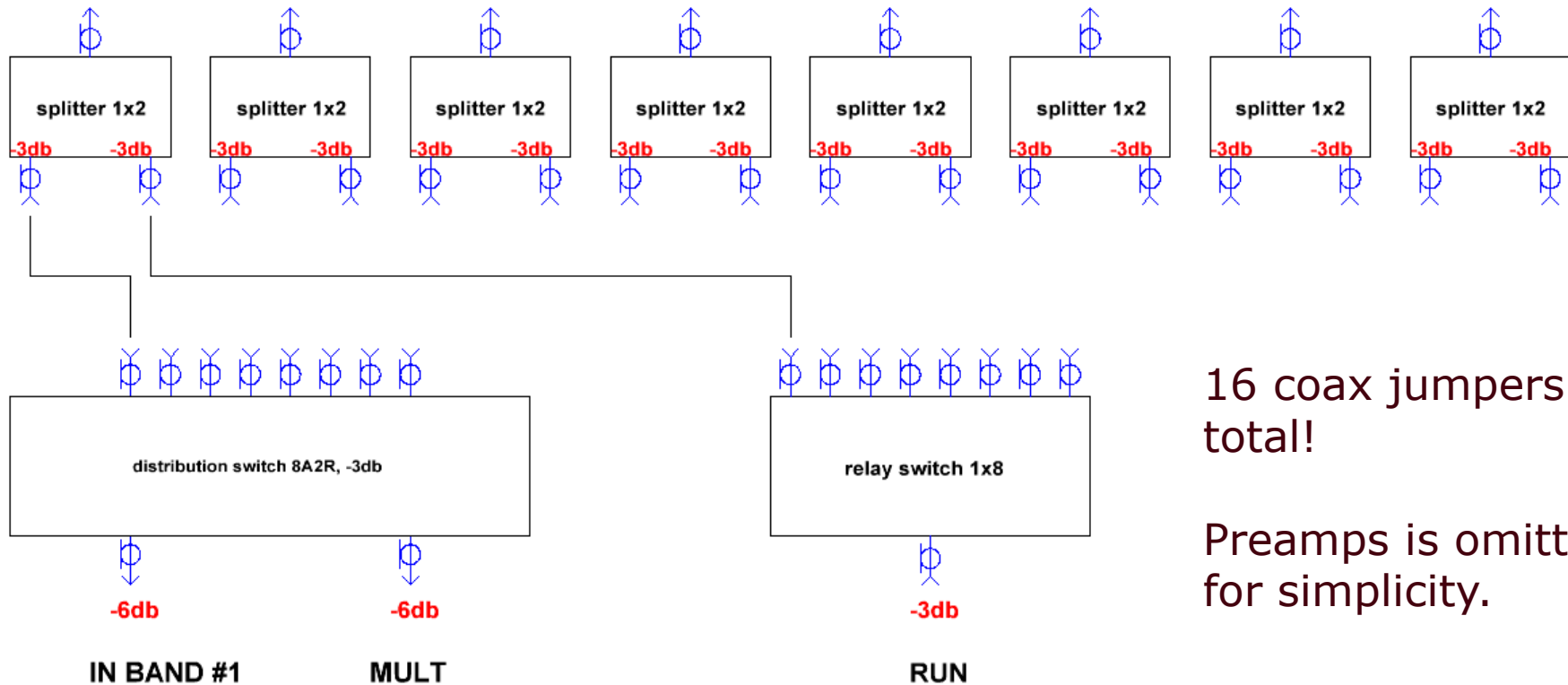
Any, receive only antenna!

Phased arrays, multiband verticals etc.



DISTRIBUTION:

3 way, one of the best layouts



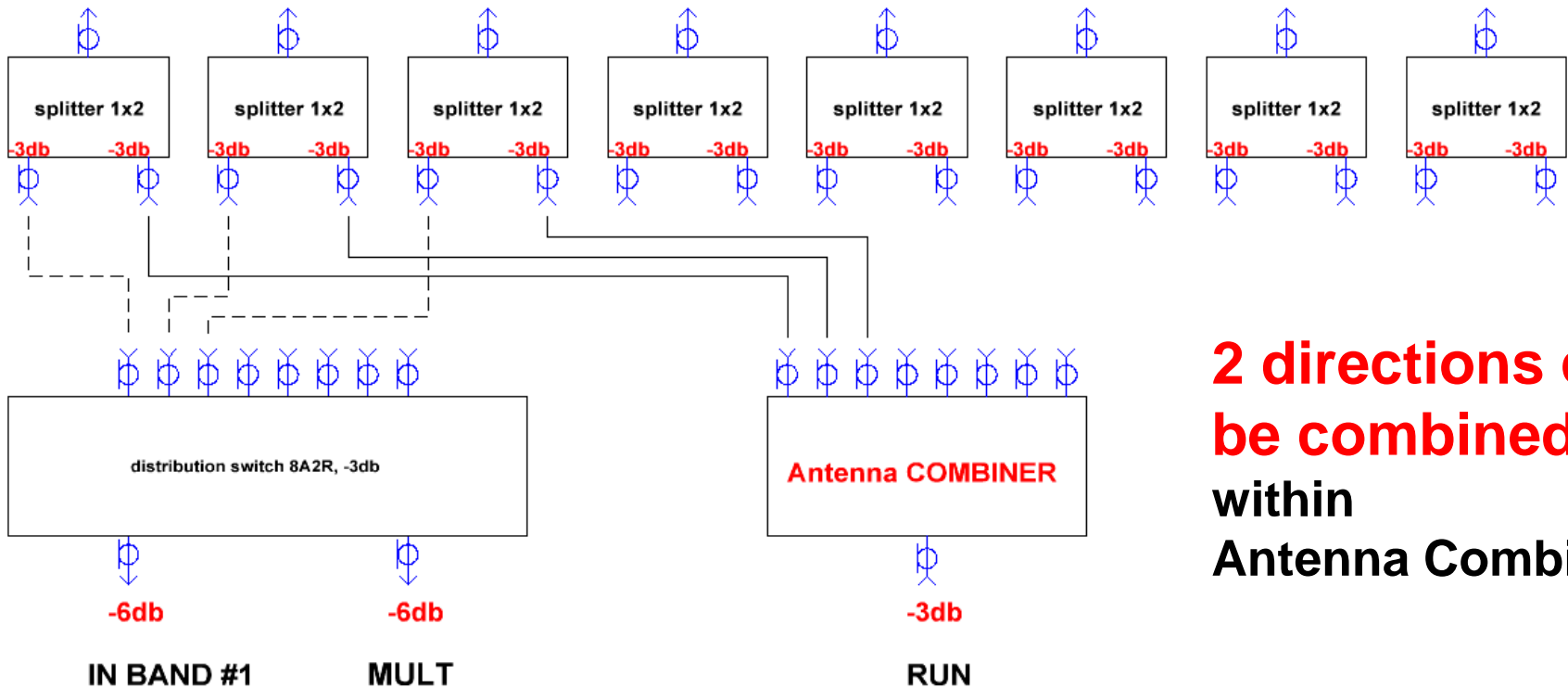
16 coax jumpers in total!

Preamps is omitted for simplicity.



DISTRIBUTION:

3 way, greatly improved!



**2 directions can
be combined
within
Antenna Combiner!!**



DISTRIBUTION:

Antenna combiner for RUN station:

Why do you need it?

RUN station, while transmitting to several directions, should listen also to several directions at the same time occasionally!

There are times when stations answering from quite opposite directions at the same time!

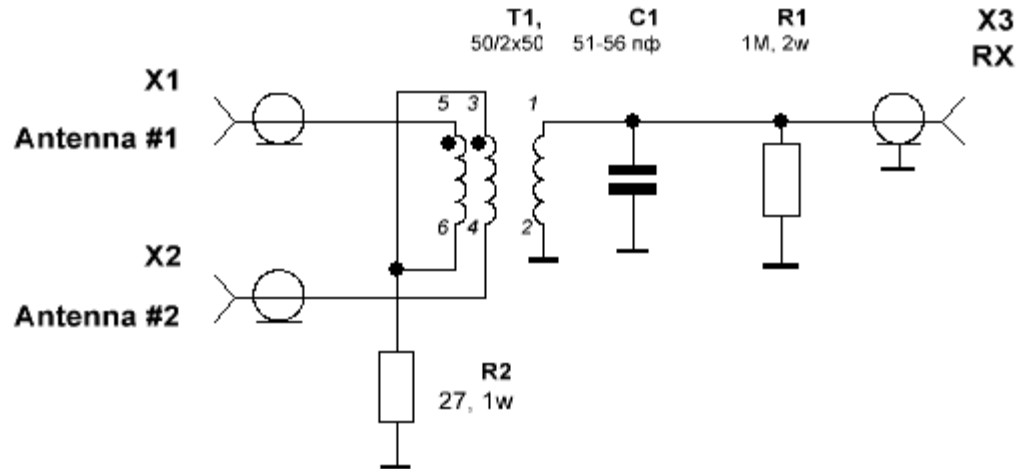
And you wont miss them!





DISTRIBUTION:

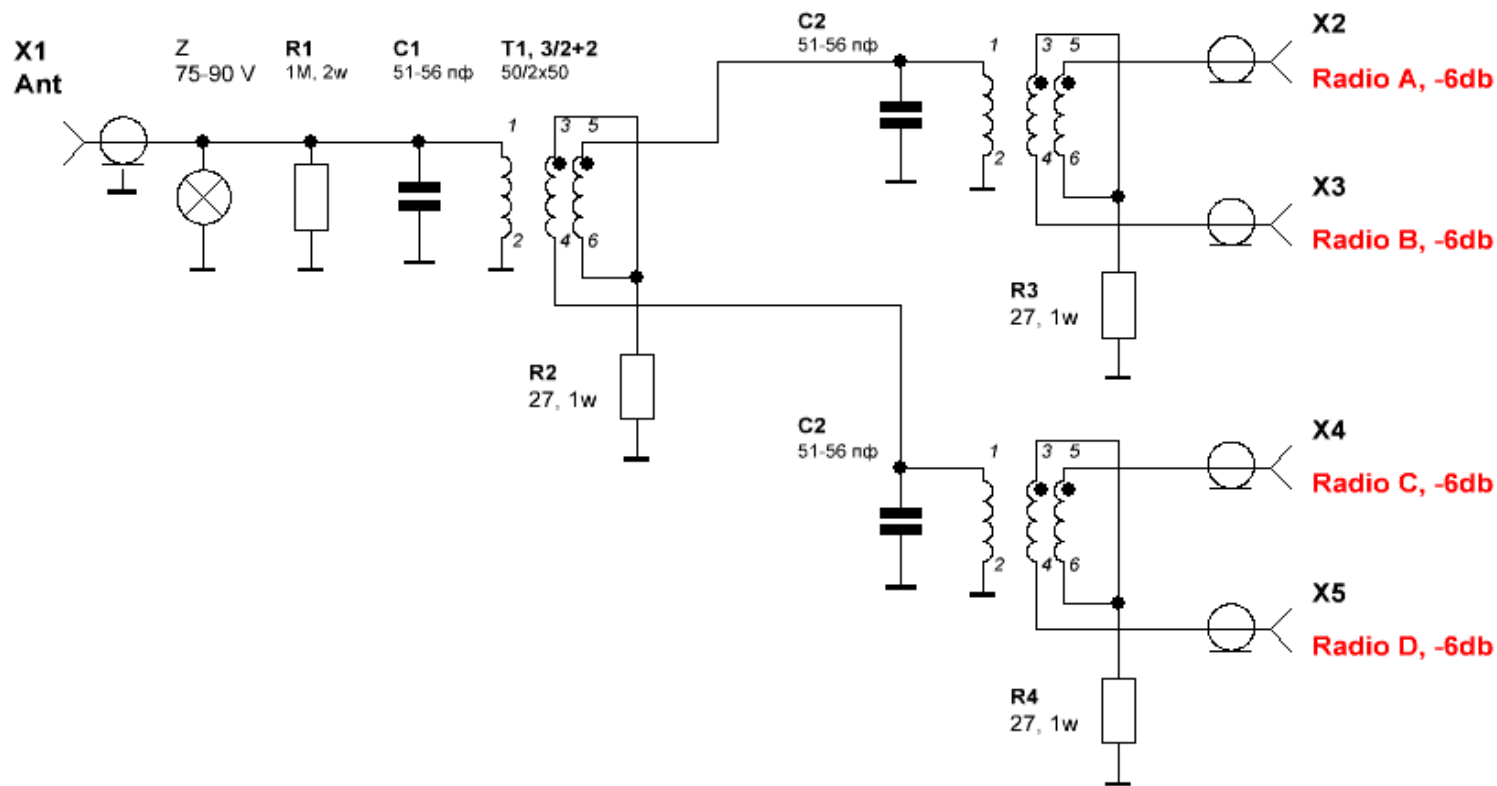
Antenna combiner for RUN,
BASIC BLOCK is the same:





DISTRIBUTION:

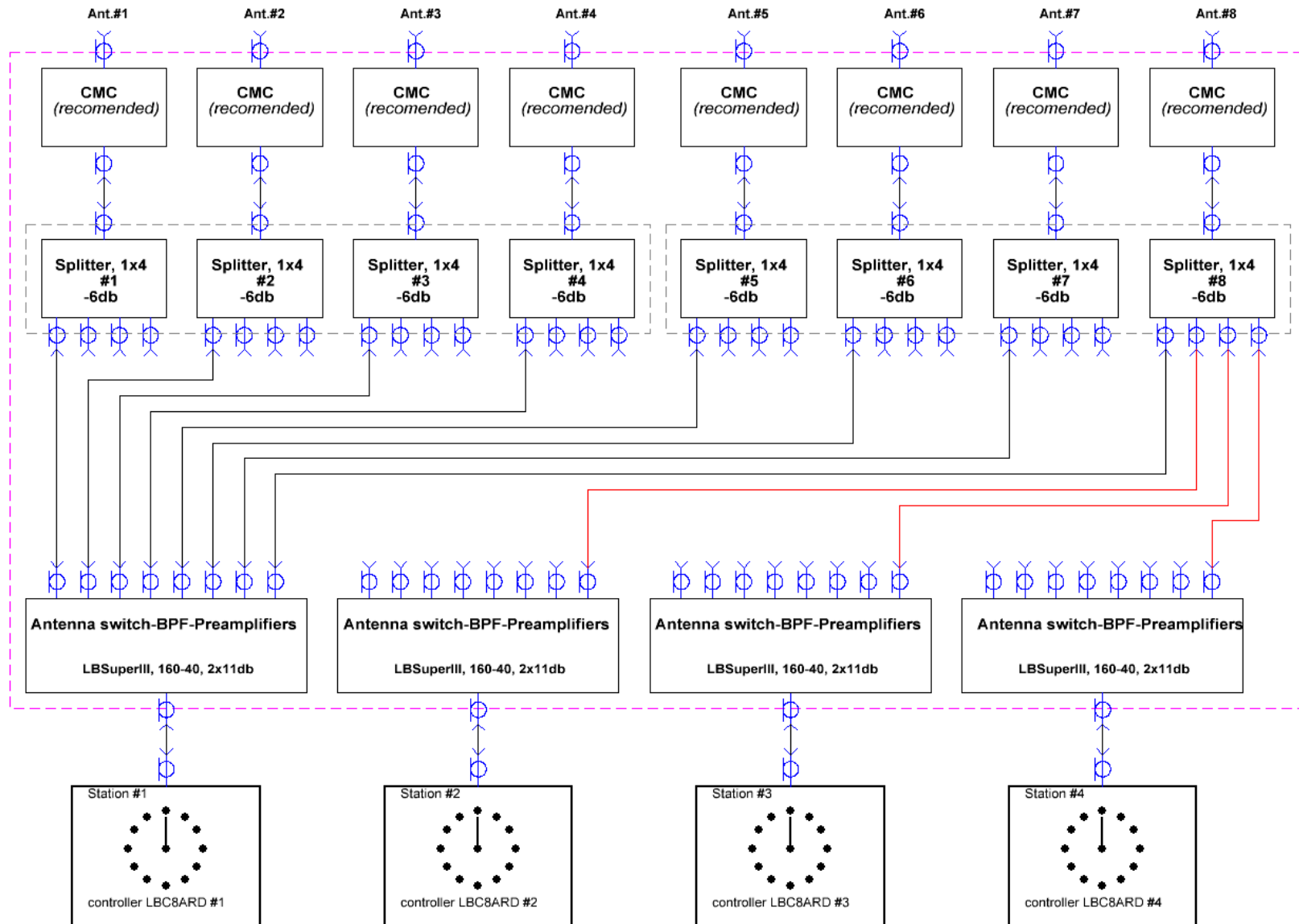
4 way distribution, wideband





DISTRIBUTION:

8 antennas to 4 station distribution, wideband



Only few coax connections shown on diagramm



DISTRIBUTION:

**weak points and problems,
on more than 2-way wideband splitters:**

- at minimum -6,3db. in a 4 way splitters;
- at minimum -9,5db. in a 6 way splitters;
 - *and sometimes that's too much depending on a length of coax runs and its additional losses;*
- wide band nature (IMD, QRM);



DISTRIBUTION, 4 ports:

Another way to split is to have a Receive only N-Plexer before distribution switch:

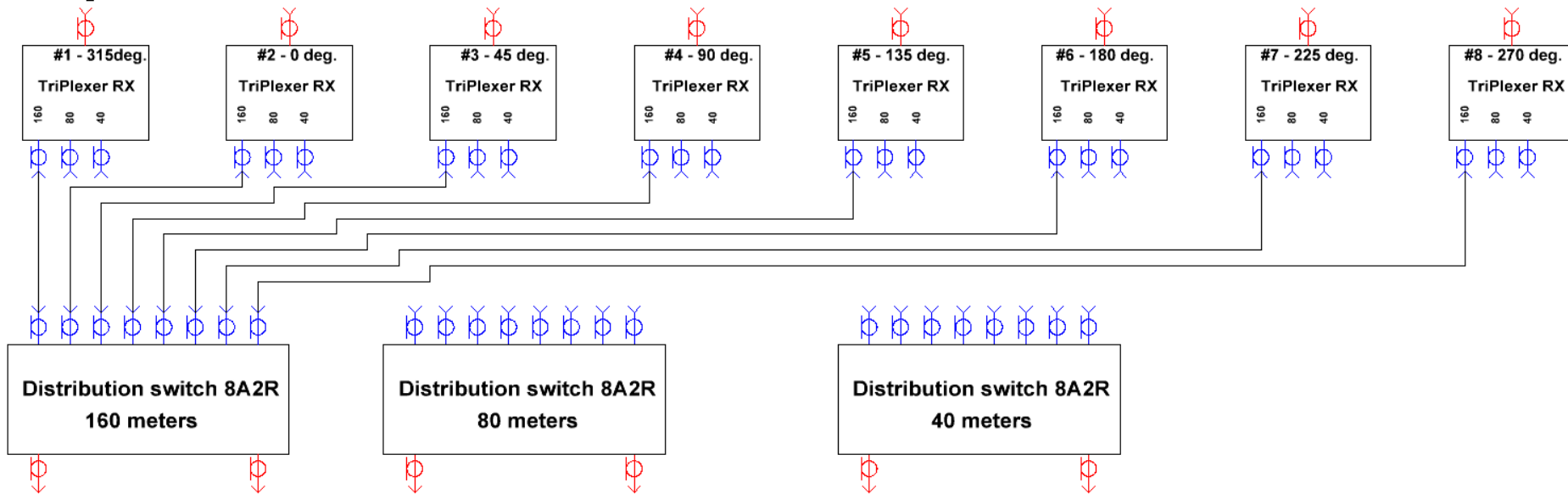




DISTRIBUTION



with receive only TRI-Plexers and wideband splitters:

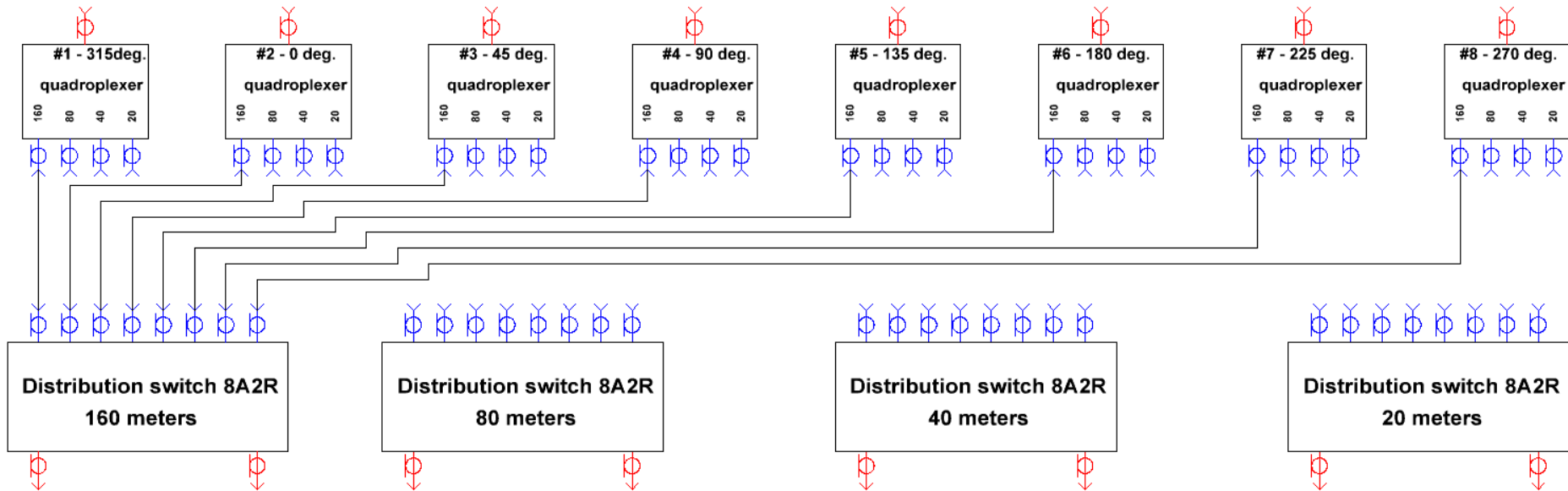


**-4db. only loses in distribution to 6 radios !
Compare to 2x(-6db.) + 4x(-9db.) using wide band
splitters.**



DISTRIBUTION

with receive only QUAD-Plexers:



**Still -4db. total loses,
now in distribution to 8 radios !**



DISTRIBUTION

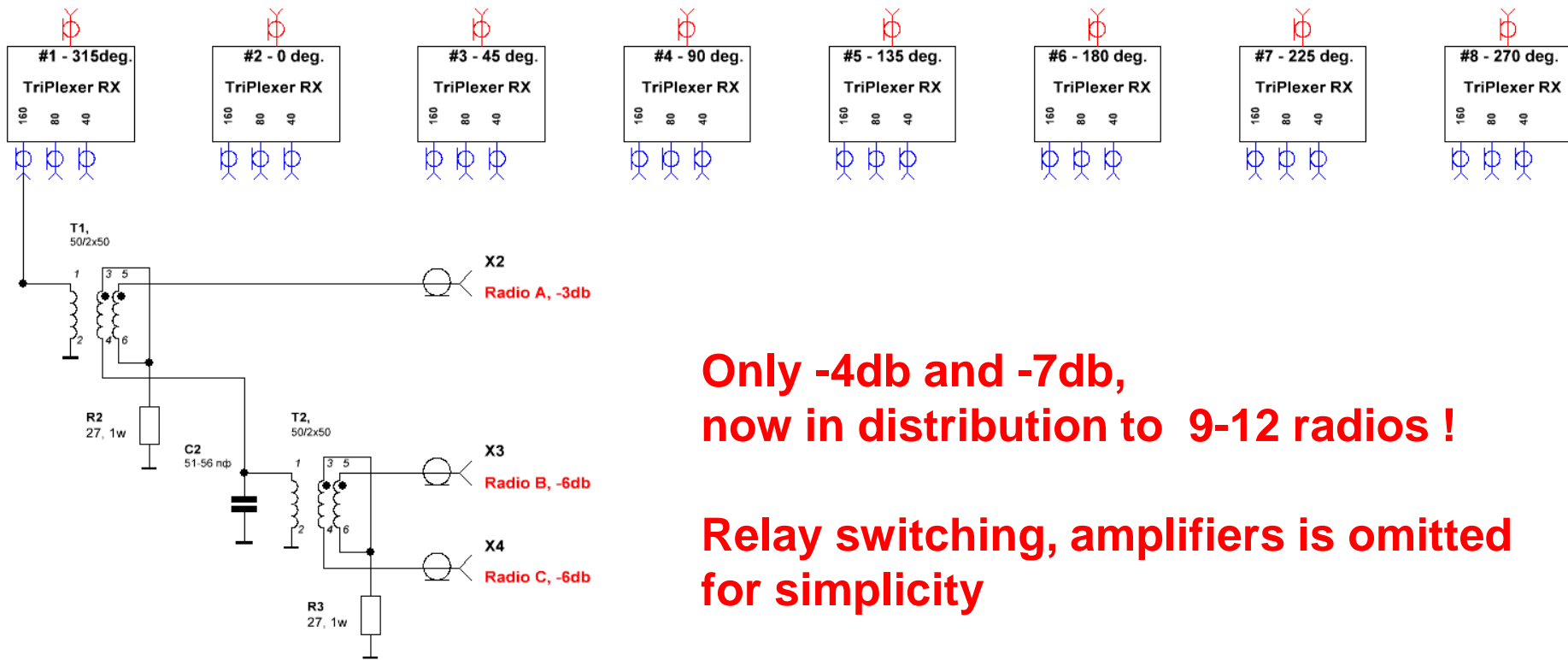
And what is we need more then 2 station on the band?

**We can combine best properties of hybrid splitters
and N-way plexers!**



DISTRIBUTION:

3 way, almost perfect solution for most serious MULTI - MULTI entry in CQ WW



**Only -4db and -7db,
now in distribution to 9-12 radios !**

**Relay switching, amplifiers is omitted
for simplicity**



Controller – is the only equipment operator must see



something from wish - list:

- Good ergonomics;
- Tired, guest operator friendly – AZ MAP is needed;
- Controlling:
 - Directions;
 - Bands – manual or using decoded BandData;
 - Amplifiers;
 - Extra antennas or futures;
- Different control logics for different arrays and switches;
- TX-ON protection: antennas outputs loaded, filters bypassed, preamplifiers OFF;
- Flexible for your next steps on improving your station.



Controller LBC8ARD





Controller LBC12ARD



Please note bands and type of receive only antennas we built in Russia!



Come contattarmi...

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www.lowbandsystems.com



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