


Title: <i>EMBRACE</i> LO distribution system		Doc.id: IRA 426/08	
Authors: G. Bianchi, J. Morawietz, F. Perini, M. Schiaffino	Verified by: S. Montebugnoli	Kind of issue: internal report	


***EMBRACE* LO distribution system**

G. Bianchi ¹, J. Morawietz ², F. Perini ¹, M. Schiaffino ¹

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1. Introduction.

EMBRACE (Electronic Multi-Beam Radio Astronomy ConcEpt) is planned as about 300 square metre aperture array with multiple large independent Field of View (FoV) capabilities. It will operate in the frequency band 400-1600MHz and it will have two independent and steerable beams (figure 1). In order to obtain that feature, the analogue receiver chains are split by 2 somewhere at the tile level, just before the first beam former stage. Due to its large operational bandwidth, the receiver chains adopt a double conversion scheme [1] (figure 2); this implies that the system needs two Local Oscillators (LO). The first conversion shifts the RF band to the first intermediate frequency (IF1), centred at 3000MHz and 100MHz wide. This operation requires a variable LO whose frequency sweeps from 1400MHz to 2600MHz. The second conversion shifts IF1 to the second intermediate frequency (IF2) at 150MHz (i.e. IF2 band is 100-200MHz). This operation requires a fixed LO at 2850MHz. Both LOs must drive mixers located in the receiver boards, named Control and DownConversion board (CDC), where the requested input power level is in the range between +2 to +5dBm. Since EMBRACE works as a phased array, it's extremely important to guarantee the same phase relation among the receivers. For that reason, to distribute the LOs from the synthesizers to the receiver boards, a Christmas tree architecture has been planned [2] (figure 3) for each LO chains. In this document is reported the design and the description of the Embrace LO distribution system.

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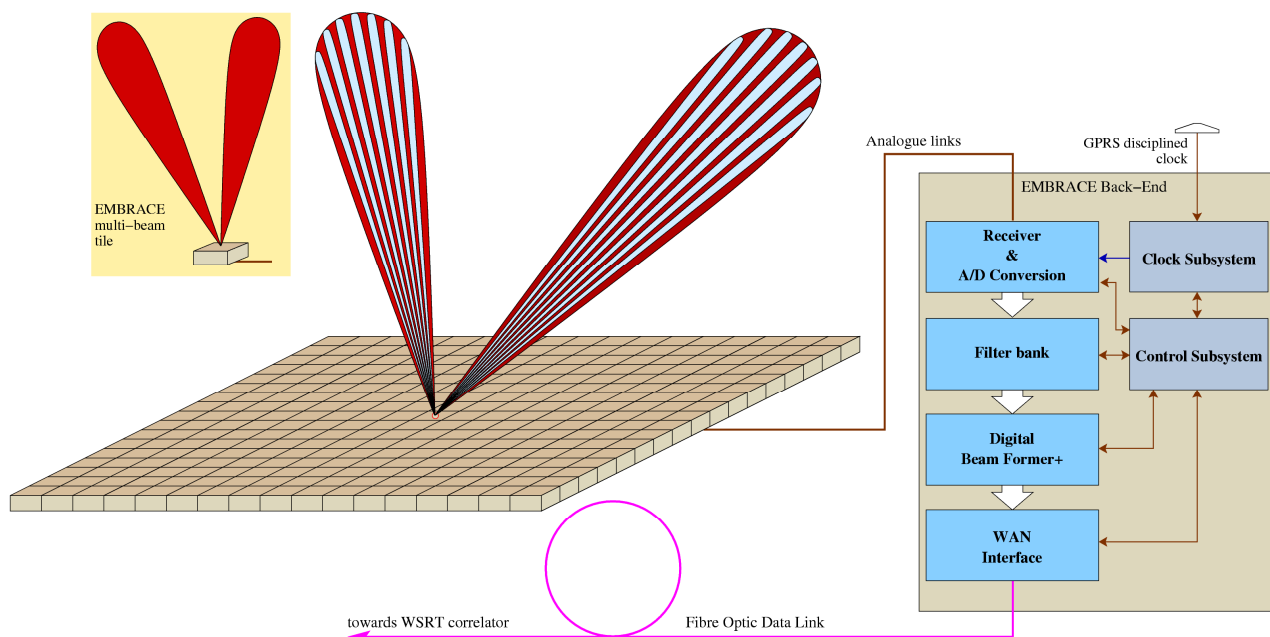


Fig. 1. A system level block diagram of EMBRACE showing the formation of independent multiple fields-of-view at both the tile and station level, with processing at the back-end.

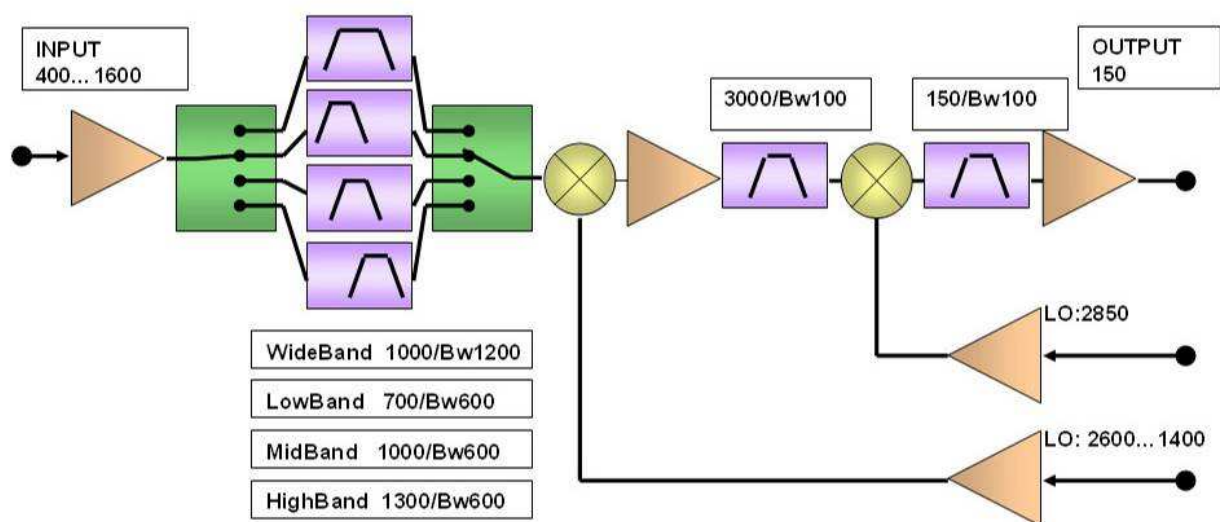



Fig. 2. EMBRACE receiver general architecture.

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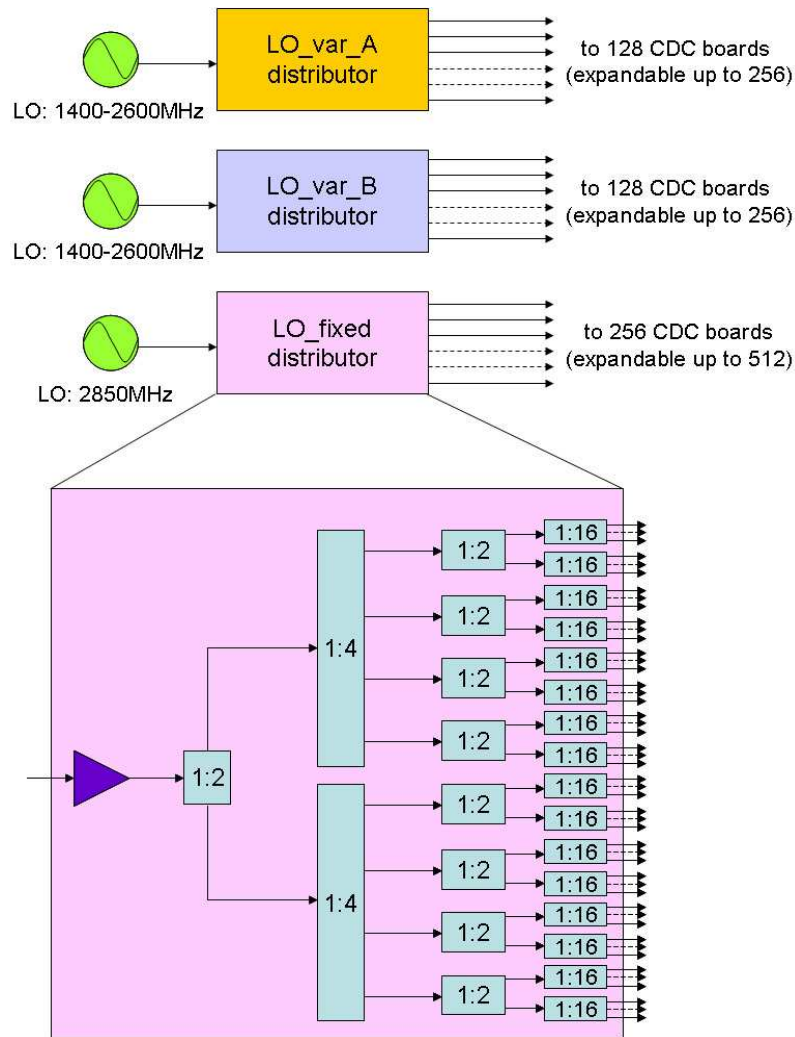



Fig. 3. LO Christmas trees architecture.

2. System description.

In figure 4 is reported a sketch of the planned LO distribution system within the racks in the Westerbork Array Test Station (WATS) container. There are five racks. The central one is equipped with power supply, GPS receiver and will also contain the three synthesizers and the LO-amplifiers. “Rack A”, on the left, will contain the ReCeiver Unit (RCU) boards and the CDC units for beam A and “Rack B”, on the right, the same for beam B. Both racks consist of three so called 'sub-rack' which one can contain up to 32 CDCs and the associated RCUs.

Beams A and B have distinct first variable LOs (LO_var_A and LO_var_B) and a common fixed second LO (LO_fixed). To obtain the hardware compatibility among the three LO chains, the system has been designed with the same architecture for all the LOs. Moreover some splitter outputs are free for possible future expansions of the system (at this level they are closed with 50Ω loads). The splitters will be located as follows: the 1:2 splitters and the 1:4 splitters will take place in the central rack, meanwhile all the 1:32 splitters (each one is composed of one 1:2 splitter and two 1:16 splitters) will be placed on the backside of the CDC sub-racks, as depicted in the "Sideview Sub-rack" in figure 4.

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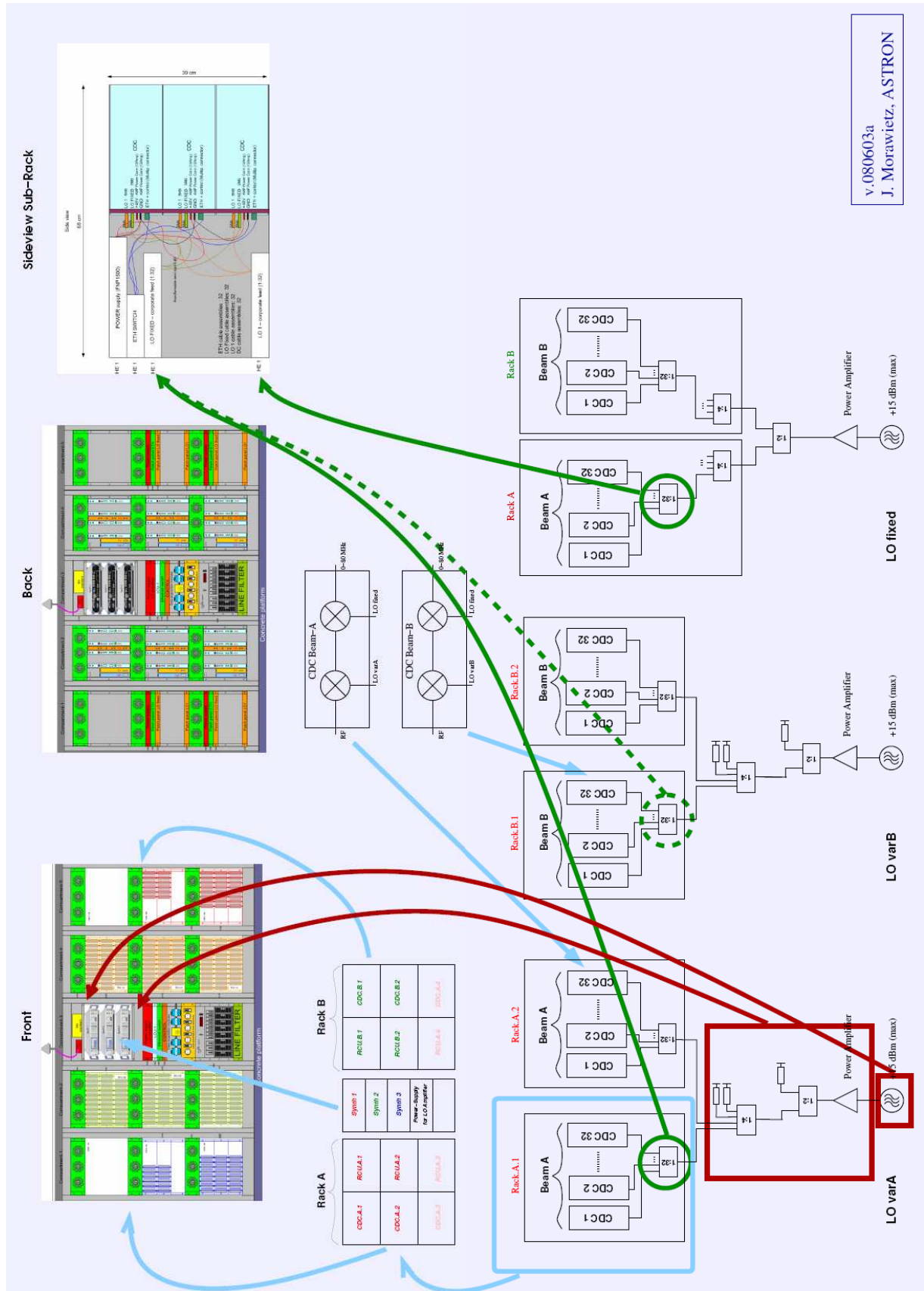



Fig.4. LO distribution system.

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3. Design of the LO distribution system.

3.1 - The Synthesizers.

For the synthesizers, a market survey has been done [3], and the Rohde & Schwarz SMA100A, with option B22 (lower phase noise specification), has been chosen for its good performance and reasonable costs [4]. Its maximum output power level is +18dBm.


3.2 - Power amplifier and power supply.

Considering the number of the levels of the Christmas tree and the attenuation of filters and cables, a minimum power of +34dBm at the beginning of the chain is required. For that reason a high power amplifier is needed since it should operate well below its 1dB compression level (P1dB). This should be true also for all the other devices which compose the Christmas tree chain, but the active devices, as the amplifiers, are the most critical ones for the generation of unwanted harmonics and the AM to PM conversion, when working closing to the compression point. A market survey has been done (table 1) and the selected amplifier has been the AM003040SF-2H from Amcom [5] (yellow highlighted). It guarantees an output power level of +40dBm (P1dB) with 21dB of gain in the 1400-2850MHz band. This means the amplifier will work 6dB below its P1dB.

Brand	Part number	Frequency (MHz)	Gain (dB)	P1dB (dBm)	Noise figure (dB)	OIP3 (dBm)	Price without VAT
Aethercomm	SSPA 0.5-3.0-50	1500 - 2850	33,5	48			
Aethercomm	SSPA 0.002-6.000-10	1500 - 2850	44,5	39			
Aethercomm	SSPS 0.8-3.2-10	1500 - 2850	34	36,5	5	46	
Empower	1013-BBM3Q6AE5	800 - 3000	12	43	7	53	
Empower	1046-BBM3Q7ECK	800 - 4200	42	41			
Empower	1033-BBM3Q7EEL	800 - 4200	44	44			
DJM Electronics	5054	1000 - 3000	42	40			
DJM Electronics	5058	1000 - 3000	41	40			
DJM Electronics	5141	700 - 3000	43	41			
DJM Electronics	5161	800 - 4200	43	41			
DJM Electronics	5171	1000 - 3000	43	41			
AMCOM	AM042644SF-3H	1400 - 2600	32	42,5	9	48	€ 3.000
		300 - 2600	32	41	9	46	
AMCOM	AM003040SF-2H	1400 - 2850	21	40	9	47	€ 2.200
		10 - 3000	20	39	9	46	
Cernex	CBPU8034443	800 - 3000	44	43	10	53	

Table 1. Amplifiers (market survey).

If this condition will be considered not enough, a second option has been identified from Amcom: the model AM042644SF-3H (green highlighted in the table 1). It guarantees an output power level of +42.5dBm (P1dB) with 32dB of gain from 1400 to 2600MHz [6]. This could be a good solution for the variable LOs (LO_var_A and LO_var_B), but not for the fixed LO, due to its bandwidth limitation. Amcom factory has been contacted and they are able to redesign the power amplifier to extend its performance up to 2850MHz. However, in this case, there will be a considerable increase both of cost and delivery time. If the second solution will be preferred, the output power of the

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synthesizer will have to be decreased to +3dBm due to higher gain of the amplifier (no other changes are needed in the chain).

To feed both the selected amplifiers, linear power supplies from Power-One has been identified. They are: for the first amplifier, the model HN24-3.6-AG (24V-3.6) [15] and for the second one, the model HN28-3-AG (28V-3A) [16].

3.3 - Filters.

In order to avoid or reduce spurious and harmonic components, it is extremely important to put a filter at the output of the high power amplifier. Due to the difference in the operative frequency band of the two LO chains, different filtering design considerations have been done. In the LO_fixed chain, the frequency is set at 2850MHz, so the second harmonic is at 5700MHz. In this case a low pass filter with 3000MHz of cut frequency is adequate. Considering cost and performance, the VLF-3000 filter from Mini-Circuits [7] has been chosen. It presents an insertion loss of 50dB@5700MHz. Concerning the variable LO chain, the frequency sweeps from 1400 to 2600MHz, so the lowest second harmonic is at 2800MHz. In this case, the frequency range where the LO can sweep is wide and only 200MHz separate the maximum LO frequency from the lowest second harmonic. For this reason, it is very difficult to obtain satisfying filtering performances. A good compromise is given by the VLF-2500 filter from Mini-Circuits [8]. It has the following insertion losses: 1.34dB@2800MHz and 43dB@5200MHz.

3.4 - Power splitters.


The most critical devices are the 2-way splitters placed right after the high power amplifier. There the power level is about +33dBm. A market survey has been done and in the table 2 a list of possible devices is reported. The ZN2PD2-63+ from Mini-Circuits [9] seems to be the best solution. It exhibits good performance and low cost in comparison to the other devices. It will work about 7dB below its maximum input power level.

A second option for the first power splitter has been identified if more power margin, as for the power amplifier, will be requested. The model PS2-08-450/4S (green highlighted in the table), from Pulsar Microwave Corporation, has a maximum input power level of +44dBm. So it will work 11dB below its maximum input power, 4dB better than the Minicircuits one.

Regarding the other splitters that compose the chain, the input power is not so critical because they will be placed where the power level is lower. For this reason, the model ZN2PD2-63+ (2-way) [9] and the model ZN4PD1-50+ (4-way) [10] from Mini-Circuits (yellow highlighted in the table 2) have been selected. At the end of the chain, a 16-way power splitter is needed. An excellent device is the 10A3BBD-16S from Renaissance Electronics Corporation [11] (yellow highlighted in the table 2); it presents a very low insertion loss.


3.5 - Terminations.

In order to expand the system in future upgrades, it is important to have some open arm of the Christmas tree. For this reason, some power splitters have some output free. For matching reasons, these outputs have to be loaded with 50Ω termination. At the output of the first power divider, the power level is 1W. The TS060M-5W termination [12] from Aeroflex presents 5W of maximum power dissipation which has been considered adequate. At the output of the second power divider, the power level is 0.16W. The ANNE-50L+ termination [13] from Mini-Circuits it is sufficient since its maximum power dissipation is 1W.

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Part number	N. of ways	Frequency band (GHz)	Insert. loss (dB)	Isolat.	Amplif. Balance (±dB)	Phase Balan. (±Deg)	Max input power (W)	Price (Qty. 1-9) without VAT	Price (Qty 10-24) without VAT	Price (Qty. 25-49) without VAT
MINICIRCUITS										
ZN2PD2-50+	x 2	0.5 - 5	0,8	25	0,5	4	10	75 \$	65 \$	
ZN2PD2-63+	x 2	0.35 - 6	0,6	25	0,1	2	10	80 \$	70 \$	
ZN4PD1-50+	x 4	0.5 - 5	0,9	23	0,6	8	10	100 \$	97 \$	
UMCC										
PS-3000-2S	x 2	0.02 - 3	2,4	18	0,4	3	8			
PS-CD00-2S	x 2	1.5 - 3	0,3	22	0,1	2	20			
PS-K000-2S	x 2	1 - 4	0,4	23	0,2	2	10		170 €	164 €
PS-5000-2S	x 2	0.45 - 5	0,5	21	0,15	2	10			
PS-3000-4S	x 4	0.02 - 3	2,5	18	0,5	4	8	365 \$		
PS-R000-4S	x 4	1 - 12.4	1,5	17	0,3	8	10			
PS-K000-4S	x 4	1 - 4	0,8	21	0,3	3	10		293 €	283 €
PS-3000-8S	x 8	0.02 - 3	4,4	18	0,8	8	8	590 \$		
MIDISCO										
MDC2245A	x 2	0.5 - 4	0,5	20	0,2	4	30	289 \$		231 \$
M8P46	x 8	0.5 - 4	1,8	20	0,5	2	30	1350 \$		900 \$
MITEQ										
PD2-500/4000-30S	x 2	0.5 - 4	0,6	15	0,3	4	30	304 €	285 €	275,50 €
PD04-00500400	x 4	0.5 - 4	1,5	17	0,8	7	30	285 €	270,75 €	256,50 €
INSTOCK										
PD1120	x 2	0.7 - 2.7	0,4	22	0,2	2	40	45 \$	40 \$	
PD3120	x 2	0.7 - 2.7	0,4	22	0,2	2	40	45 \$	40 \$	
PD1140	x 4	0.7 - 2.7	0,8	22	0,2	4	40	67 \$	60 \$	
PD1180	x 8	0.7 - 2.7	1,3	22	0,5	6	40	146 \$	136 \$	
MECA ELECTRONICS										
802-2-2.500	x 2	1 - 4	0,5	25	0,2	2	20			
816-S-1.900-M01	x 16	0.8 - 3	1,6	25	0,5	12	20			
RENAISSANCE ELECTRONICS CORPORATION										
10A3BAW-2S	x 2	1 - 3	0,5	16	0,2	5	20	467 €		
10A3BAY-4S	x 4	1 - 3	0,5	16	0,3	3	20	567 €		
10A3BBA-8S	x 8	1 - 3	0,5	16	0,3	3	20	975 €		
10A3BBD-16S	x 16	1 - 3	0,5	16	0,3	5	20	1.200 €		
PULSAR MICROWAVE CORPORATION										
PS2-08-450/4S	x 2	1.5 - 3	0,3	20	0,2	2	30		210,80 €	
PS4-05-452/6S	x 4	1.5 - 3	0,9	18	0,5	6	30	370,00 €	351,35 €	
PS4-15-452/6S	x 4	0.5 - 3.5	0,8	20	0,4	8	30	666,00 €	632,40 €	
PS8-04-454/1S	x 8	1.5 - 3	1	16	0,6	8	30		527,00 €	
CERNEX										
CDP0104U502T	x 2	1 - 4	0,5	20			20			
CDP0104U804T	x 4	1 - 4	0,8	20			20			
CDP01040108T	x 8	1 - 4	1,5	20			20			
CDP01030116R	x 16	1.5 - 3	1,5	20			10			

Table 2. Power splitters (market survey)

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3.6 – Cables, connectors and adapters.

In order to choose the right cables, it is necessary to consider: work frequency, attenuation, shielding, mechanical characteristics and cost. The RG223 coaxial cable is a good solution for the rack to rack connections [14]. It has a maximum insertion loss of 0.823dB/mt@2850MHz and a shielding effectiveness of 65dB. For the devices assembling inside the racks, a hand-formable cable like the 141 is preferable [14]. It has a maximum insertion loss of 0.7dB/mt@2850MHz and a shielding effectiveness of 90dB. In the table 3, the loss of the coaxial cables has been estimated, just to have an idea of the maximum attenuation of the overall chain. The exact lengths, and so the exact attenuations, of each coax paths, has to be established when all the devices will be located in the racks. In order to assemble the power amplifier to the rack front panel, a SMA jack - SMA jack bulkhead adapter and a SMA plug – SMA plug adapter are recommended, for example the R125720000 and R125703000 from Radiall [17] [18]. A complete description of cables type, connectors, adapters and mechanical assembling is reported in table 4 and in the appendix B and C.

4. Schemes.

Following the description of the project above explained; in figures 5 and 6 the block diagrams of both the variable and fixed LO distribution system are shown.

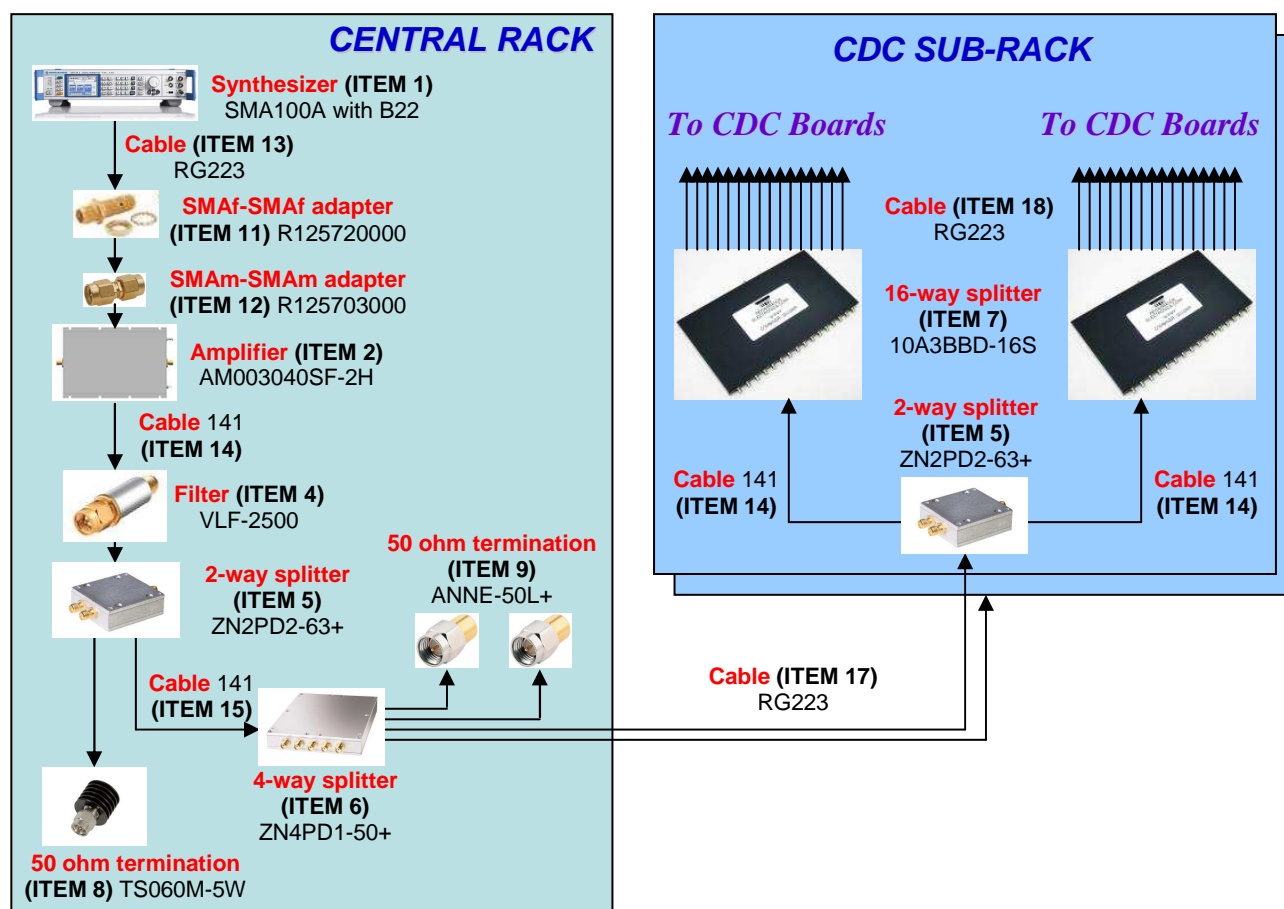



Fig. 5. Block diagram of the variable LO distribution system.

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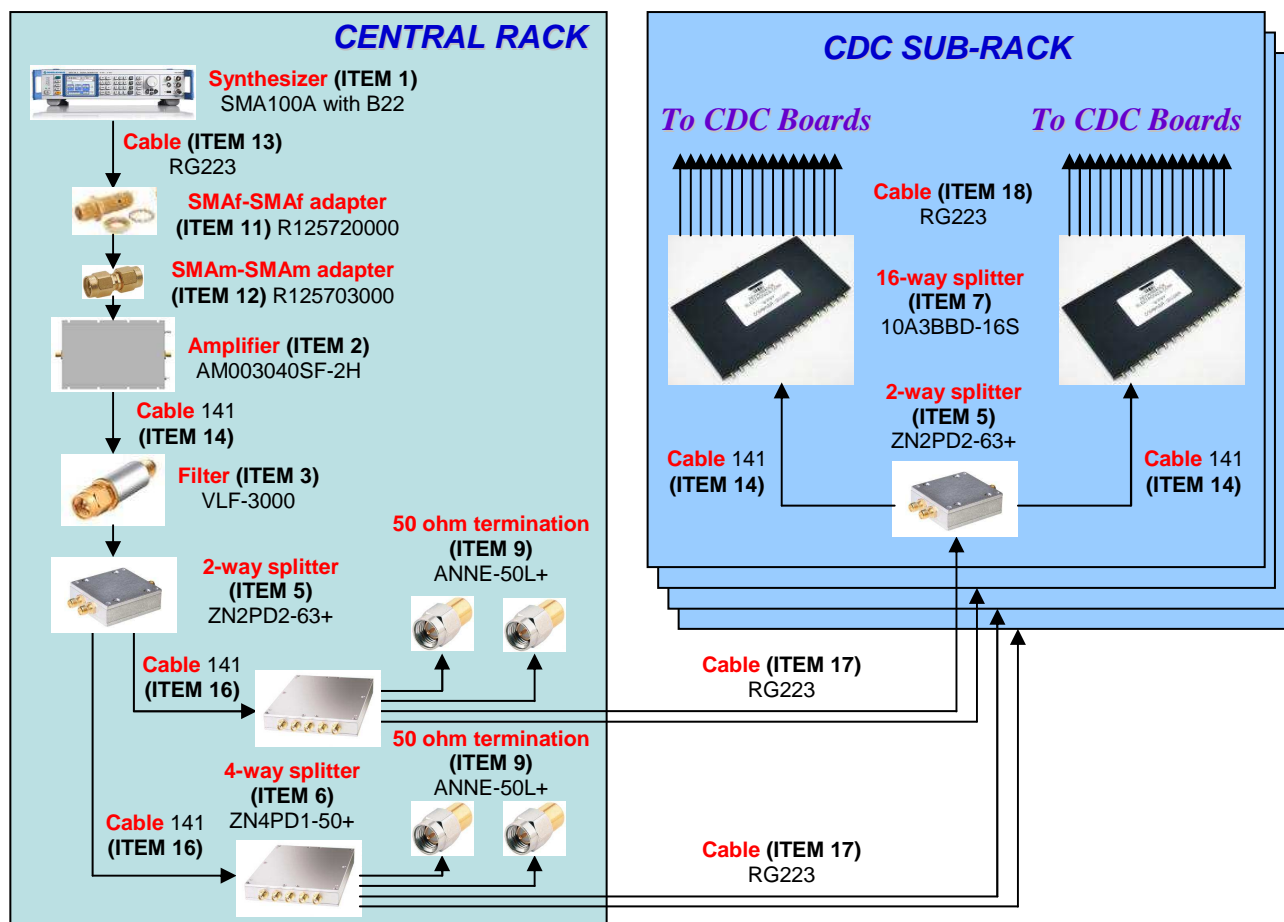



Fig. 6. Block diagram of the fixed LO distribution system.

More details are reported in the table 3 and in the figures 7, 8 and 9.

In Particular, in table 3, starting from the left to the right, it is described the project of the two distribution systems (for the variable and fixed LO), with a list of devices, features and costs. The total cost is about 80K€ (without VAT).

In the figures 7, 8 and 9, the electrical schematics are reported.

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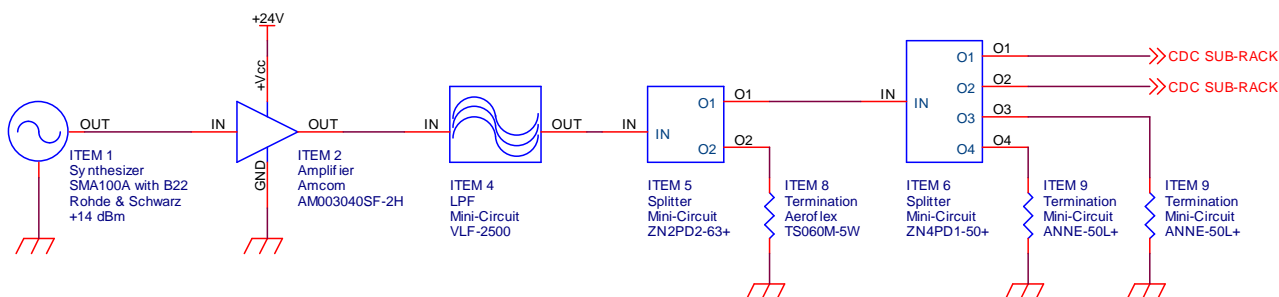


Fig. 7. Central rack LO_var: electrical circuit.

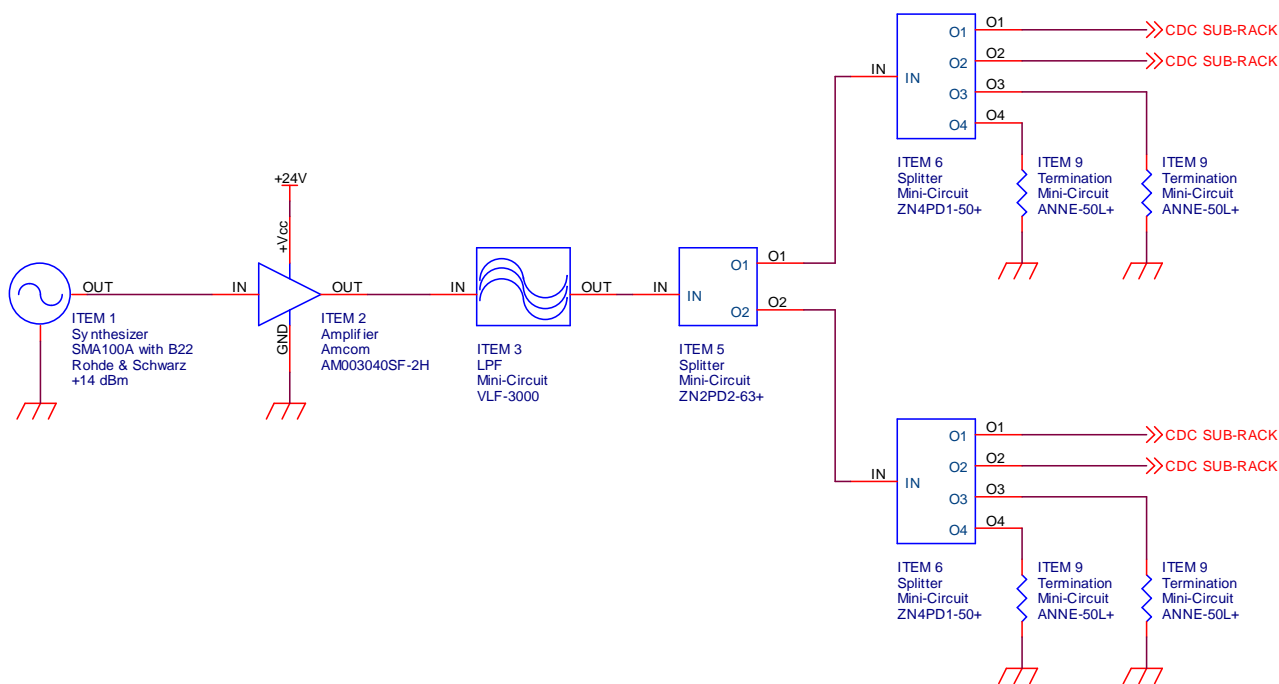



Fig. 8. Central rack LO_fixed: electrical circuit.

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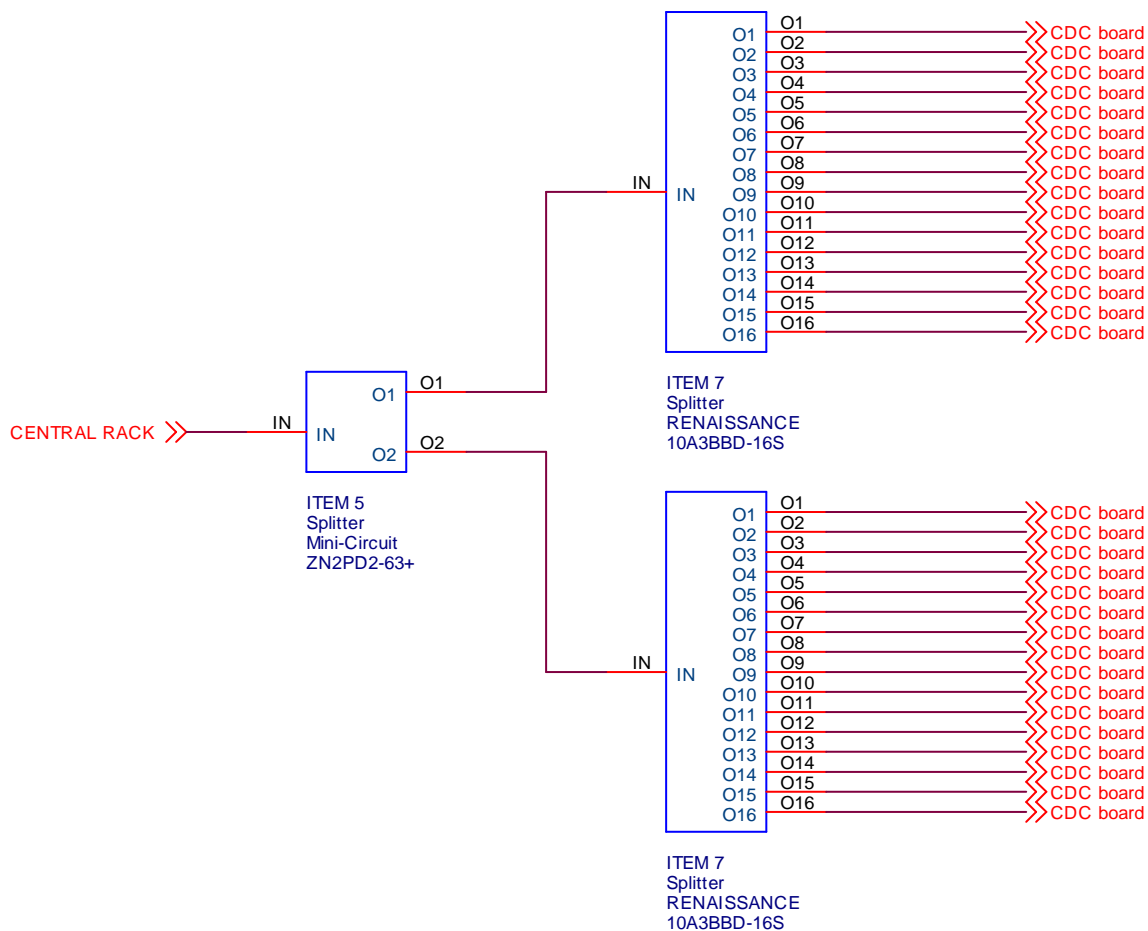



Fig. 9. CDC sub-rack (LO_var and LO_fixed): electrical circuit.


In the table 4, there is the bill of materials.

In appendix B, there is a list of devices order number and suppliers.

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Item	Q.ty	Device	Part number	Brand	Delivery Time (weeks)	Image	Price each without VAT
1	3	Synthesizer	SMA100A with B22	Rohde & Schwarz	Not specified		16.178 €
2	3	Power amplifier	AM003040SF-2H	Amcom	10		2.200 €
3	1	Filter	VLF-3000	Mini-Circuits	In stock		22 €
4	2	Filter	VLF-2500	Mini-Circuits	In stock		22 €
5	11	2-way splitter	ZN2PD2-63+	Mini-Circuits	In stock		70 €
6	4	4-way splitter	ZN4PD1-50-S+	Mini-Circuits	4		100 €
7	16	16-way splitter	10A3BBD-16S	Renaissance	12		1.200 €
8	2	Termination	TS060M-5W	Aeroflex	In stock		40 €
9	8	Termination	ANNE-50L+	Mini-Circuits	In stock		7 €
10	3	Power supply	HN24-3.6-AG	Power-One	In stock		70 €
11	3	Adapter	R125720000	Radiall	In stock		18 €
12	3	Adapter	R125703000	Radiall	In stock		15 €
13	3	Coaxial cable	Flexible RG223 N_m – SMA_m	Radiall	5		15 €
14	19	Coaxial cable	Hand-formable .141" SMA_m – SMA_m	Radiall	4		13 €
15	2	Coaxial cable	Hand-formable .141" SMA_m – SMA_m	Radiall	4		11 €
16	2	Coaxial cable	Hand-formable .141" SMA_m – SMA_m	Radiall	4		12 €
17	8	Coaxial cable	Flexible RG223 SMA_m – SMA_m	Radiall	5		27 €
18	256	Coaxial cable	Flexible RG223 SMA_m – SMA_m	Radiall	5		14 €

Table 4. Bill of materials.


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5. References

- [1] IRA N. 414/08 technical report.
EMBRACE RECEIVER (SKADS Task DS5-TI-WP4)
J. Monari, F. Perini, S. Mariotti, S. Montebugnoli, G. Bianchi
<http://www.ira.inaf.it/Library/rapp-int/414-08.pdf>
- [2] IRA 407/07 technical report.
Added Phase Noise measurement for EMBRACE LO distribution system
<http://www.ira.inaf.it/Library/rapp-int/407-07.pdf>
G. Bianchi, S. Mariotti, J. Morawietz
- [3] 150508JR
Inquiry on EMBRACE LO-signal generator
Jan Roosjen
- [4] Rohde & Schwarz SMA100A with B22 option, model detailed technical information
<http://www2.rohde-schwarz.com/product/SMA100A.html>
- [5] AM003040SF-2H data sheet
<http://www.amcomusa.com/downloads/datasheets/Hybrid-series/AM003040SF-2H.pdf>
- [6] AM042644SF-3H data sheet
<http://www.amcomusa.com/downloads/datasheets/Hybrid-series/AM042644SF-3H.pdf>
- [7] VLF-3000 model detailed technical information
<http://www.minicircuits.com/cgi-bin/modelsearch?model=VLF-3000&x=13&y=10>
- [8] VLF-2500 model detailed technical information
<http://www.minicircuits.com/cgi-bin/modelsearch?model=VLF-2500+&x=0&y=0>
- [9] ZN2PD2-63+ model detailed technical information
<http://www.minicircuits.com/cgi-bin/modelsearch?model=ZN2PD2-63%2B+&x=4&y=12>
- [10] ZN4PD1-50+ model detailed technical information
<http://www.minicircuits.com/cgi-bin/modelsearch?model=ZN4PD1-50%2B+&x=17&y=8>
- [11] 10A3BBD-16S data sheet
<http://www.rec-usa.com/catalog/divcomb/CombinerDividerCatalogWeb.pdf>
- [12] TS060M-5W data sheet
<http://www.aeroflex.com/AMS/inmet/PDFILES/TS180-5W.PDF>
- [13] ANNE-50L+ detailed technical information
<http://www.minicircuits.com/cgi-bin/modelsearch?model=ANNE-50L%2B&x=23&y=12>
- [14] Radiall coaxial cables
<http://www.radiall.com/radiall/easysite/go/03r-00000a-004/categoryId/1232279>

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- [15] HN24-3.6-AG data sheet
<http://www.power-one.com/resources/products/datasheet/lin.pdf>
- [16] HN28-3-AG
<http://www.power-one.com/resources/products/datasheet/lin.pdf>
- [17] R125720000
<http://radiall.applixia.net/catalogue/object.do?dsn=dmsDS&action=datasheet&object=1229245>
- [18] R125703000
<http://radiall.applixia.net/catalogue/object.do?dsn=dmsDS&action=datasheet&object=1229234>

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6. Appendix.

A. Cumulative noise.

The cumulative noise of the LO_var and LO_fixed chains are shown, respectively, in figures 10 and 11.

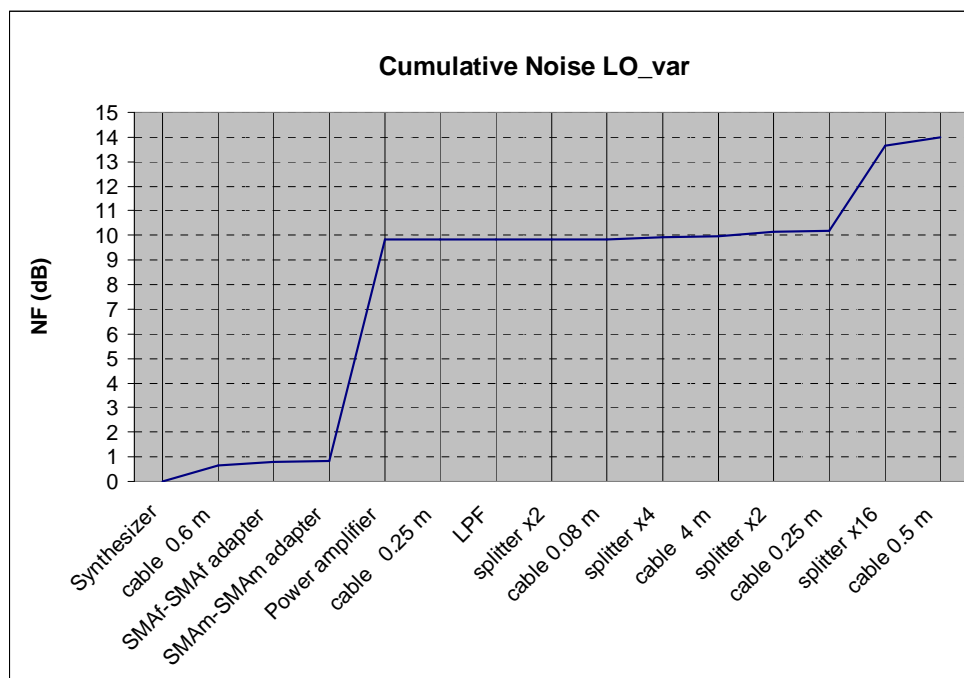


Fig. 10. Cumulative Noise LO_var.

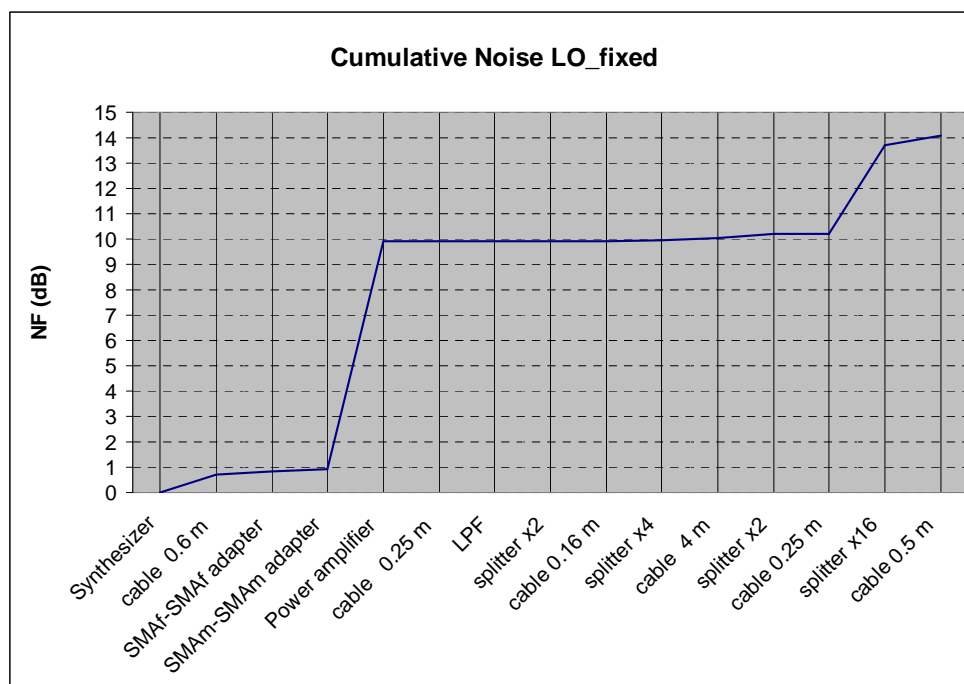



Fig. 11. Cumulative Noise LO_fixed.

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B. Devices order number and supplier.

To order the items listed in tables 3 and 4, and reported also in figures 5 and 6, a list of order numbers and suppliers are indicated below.

ITEM 1

Synthesizer SMA100A with option B22 (Rohde & Schwarz)

Order number: **1405.1805.02**

Contact: http://www2.rohde-schwarz.com/en/about/rohde_and_schwarz_worldwide/netherlands-sales_locations.html

ITEM 2

Power amplifier (Amcom)

Order number: **AM003040SF-2H**

Italian supplier:

Nexos Electronic Systems srl, www.nexoselsys.it

Italian sales manager: Antonio Eramo, aeramo@nexoselsys.it

Mobile phone: +393357438403

Fixed phone: +39068103831

Fax: +39068103848

ITEM 3

Filter (Mini-Circuits)

Order number: **VLF-3000**

Contact: <http://www.minicircuits.com/>

ITEM 4

Filter (Mini-Circuits)

Order number: **VLF-2500**

Contact: <http://www.minicircuits.com/>

ITEM 5

2-way splitter (Mini-Circuits)

Order number: **ZN2PD2-63+**


Contact: <http://www.minicircuits.com/>

ITEM 6

4-way splitter (Mini-Circuits)

Order number: **ZN4PD1-50-S+**

Contact: <http://www.minicircuits.com/>

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ITEM 7

16-way splitter (Renaissance)

Order number: **10A3BBD-16S**

Italian supplier:

Nexos Electronic Systems srl, www.nexoselsys.it

Sales manager: Mario Tamburello mtamburello@nexoselsys.it

Mobile phone: +393351376468

ITEM 8

Termination (Aeroflex)

Order number: **TS060M-5W**

Contact: <http://www.aeroflex.com/>

ITEM 9

Termination (Mini-Circuits)

Order number: **ANNE-50L+**

Contact: <http://www.minicircuits.com/>

ITEM 10

Power supply 24V – 3.6A (Power-One)

Order number: **HN24-3.6-AG**

Contact: RS <http://nl.rs-online.com/web/>

RS code: **2508381956**

ITEM 11

Adapter SMA female – SMA female (Radiall)

Order number: **R125720000**


Contact: see note 1.

ITEM 12

Adapter SMA male – SMA male (Radiall)

Order number: **R125703000**

Contact: see note 1.

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ITEM 13

Flexible RG223 coaxial cable, 0.6 mt length, with N plug right-angle and SMA plug right-angle connectors (Radiall).

Order numbers for assembled coaxial cables:

Coaxial cable: RG223, order number **C291330000**

Connector 1: N, plug, right-angle, order number: **R161183000**

Optional heatshrink sleeve 1: order number **R280637030**

Connector 2: SMA, plug, right-angle, order number **R124176120**

Optional heatshrink sleeve 2: order number **R280637030**

Length: **0.6 mt ± 2%** (note 2)

Connectors have to be mounted in the same direction.

Contact: see note 1.

ITEM 14

Hand-formable 141 coaxial cable, 0.25 mt length, with SMA, plug, straight and SMA, plug, right-angle connectors (Radiall).

Order numbers for assembled coaxial cables:

Coaxial cable: 141, order number **C291864065**

Connector 1: SMA, plug, right-angle, order number **R124154003**

Connector 2: SMA, plug, straight, order number: **R124055003**

Length: **0.25 mt ± 1%** (note 2)

Contact: see note 1.

ITEM 15

Hand-formable 141 coaxial cable, 0.08 mt length, with both SMA, plug, straight connectors (Radiall).

Order numbers for assembled coaxial cables:

Coaxial cable: 141, order number **C291864065**

Connector 1: SMA, plug, straight, order number: **R124055003**

Connector 2: SMA, plug, straight, order number: **R124055003**

Length: **0.08 mt ± 2%** (note 2)

Contact: see note 1.

ITEM 16

Hand-formable 141 coaxial cable, 0.16 mt length, with both SMA, plug, right-angle connectors (Radiall).

Order numbers for assembled coaxial cables:

Coaxial cable: 141, order number **C291864065**


Connector 1: SMA, plug, right-angle, order number **R124154003**

Connector 2: SMA, plug, right-angle, order number **R124154003**

Length: **0.16 mt ± 2%** (note 2)

Connectors have to be mounted in the same direction.

Contact: see note 1.

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ITEM 17

Flexible RG223 coaxial cable, 4 mt length, with SMA, plug, straight and SMA, plug, right-angle connectors (Radiall).

Order numbers for assembled coaxial cables:

Coaxial cable: RG223, order number **C291330000**

Connector 1: SMA, plug, right-angle, order number **R124176120**

Optional heatshrink sleeve 1: order number **R280637030**

Connector 2: SMA, plug, straight, order number **R124076320**

Optional heatshrink sleeve 2: order number **R280637030**

Length: **4 mt ± 1%** (note 2)

Contact: see note 1.

ITEM 18

Flexible RG223 coaxial cable, 0.5 mt length, with SMA, plug, straight and SMA, plug, right-angle connectors (Radiall).

Order numbers for assembled coaxial cables:

Coaxial cable: RG223, order number **C291330000**

Connector 1: SMA, plug, right-angle, order number **R124176120**

Optional heatshrink sleeve 1: order number **R280637030**

Connector 2: SMA, plug, straight, order number **R124076320**

Optional heatshrink sleeve 2: order number **R280637030**

Length: **0.5 mt ± 1%** (note 2)

Contact: see note 1.

Note1. Netherlands supplier:

RADIALL NEDERLAND BV


Hogebrinkerweg 15b, 3871 KM HOEVELAKEN, The Netherlands.

Tel: +31 (0)332534009, Fax: +31 (0)332534512

<http://www.radiall.nl>

infonl@radiall.com

Note2. Check the right cable length when the device will be installed on the rack.

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C. *Mechanical assembling.*

In order to optimize the location of the devices inside the racks and also to have an estimation of the cable lengths, a mechanical assembling has been designed. The central rack for both the variable (see figures from 12 to 15) and fixed (see figures from 16 to 19) LO is a 2U - 19" - 340mm depth module. The CDC sub-rack containing one 2-way splitter and two 16-way splitters is a 1U - 19" - 280mm depth module (see figures from 20 to 22).

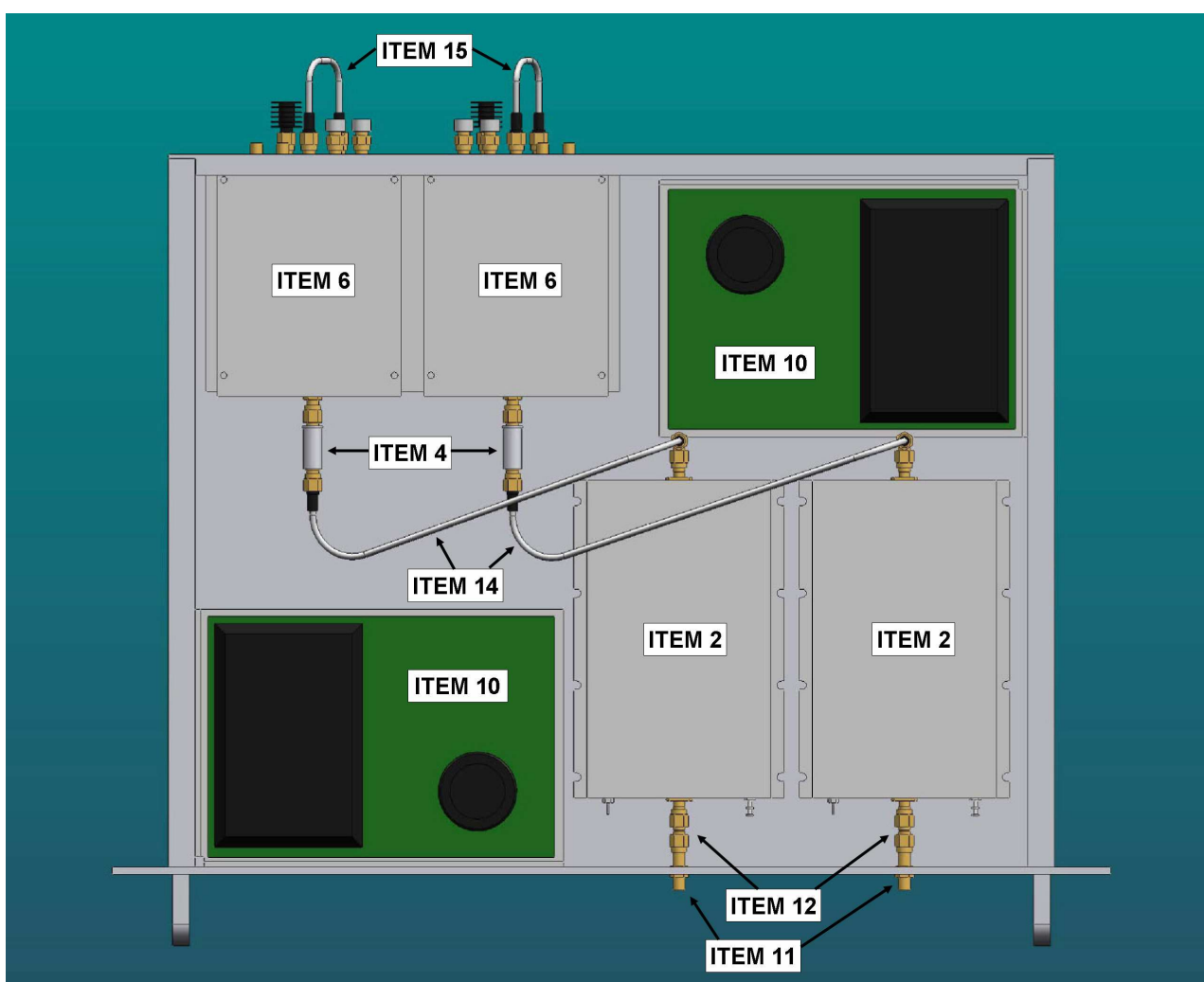



Fig. 12. Variable LO: central rack mechanical assembling (top view).

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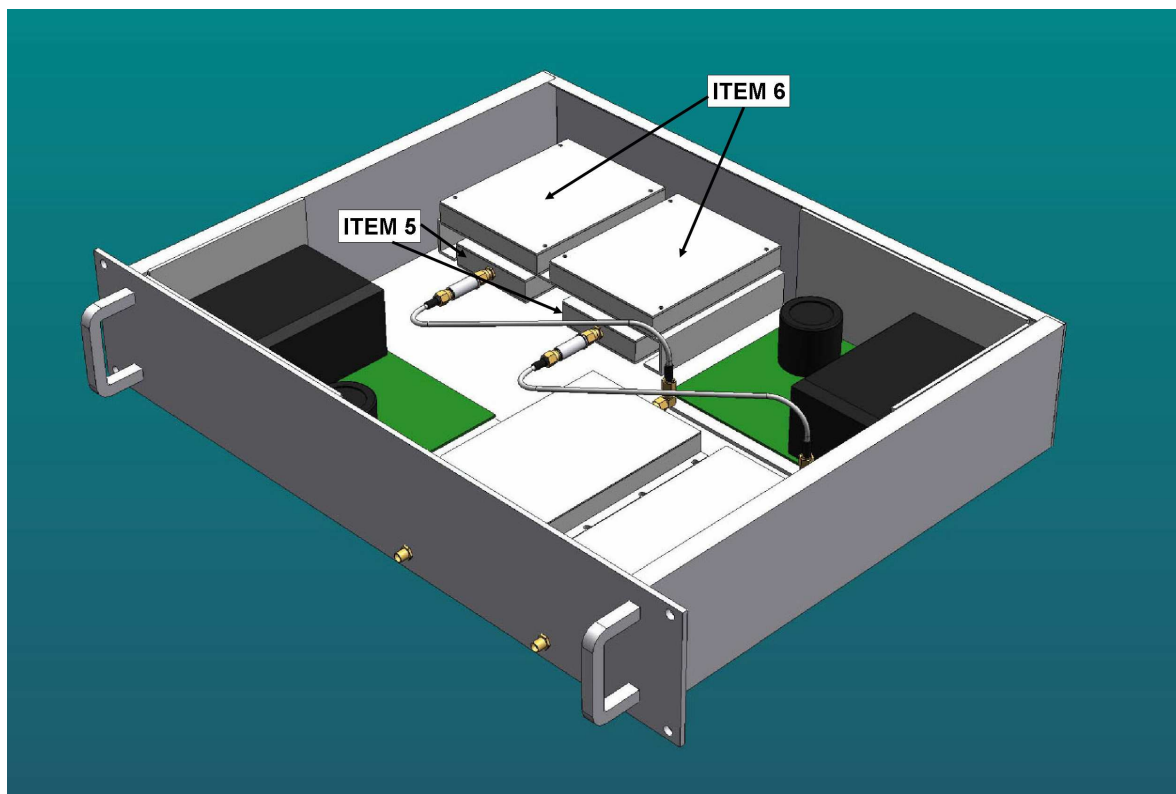


Fig. 13. Variable LO: central rack mechanical assembling (front view).

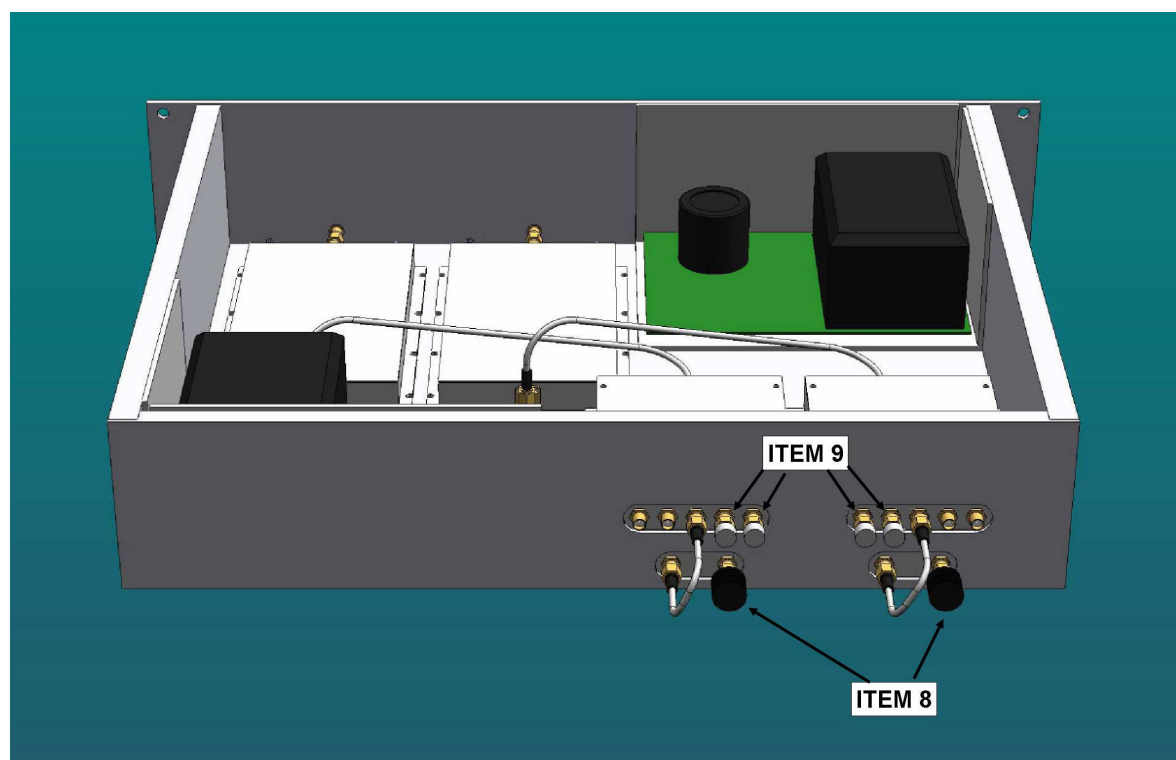



Fig. 14. Variable LO: central rack mechanical assembling (back view).

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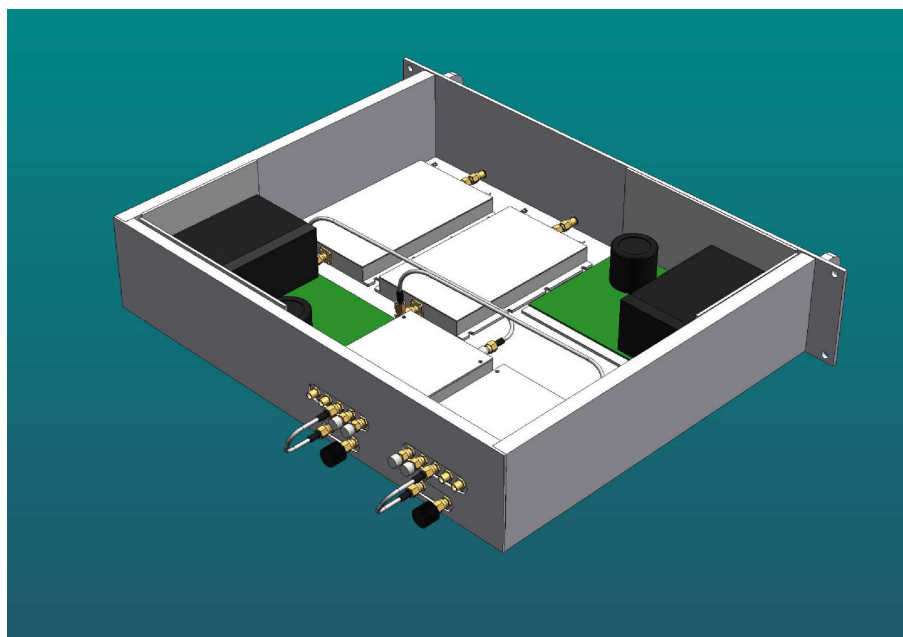


Fig. 15. Variable LO: central rack mechanical assembling (back view).

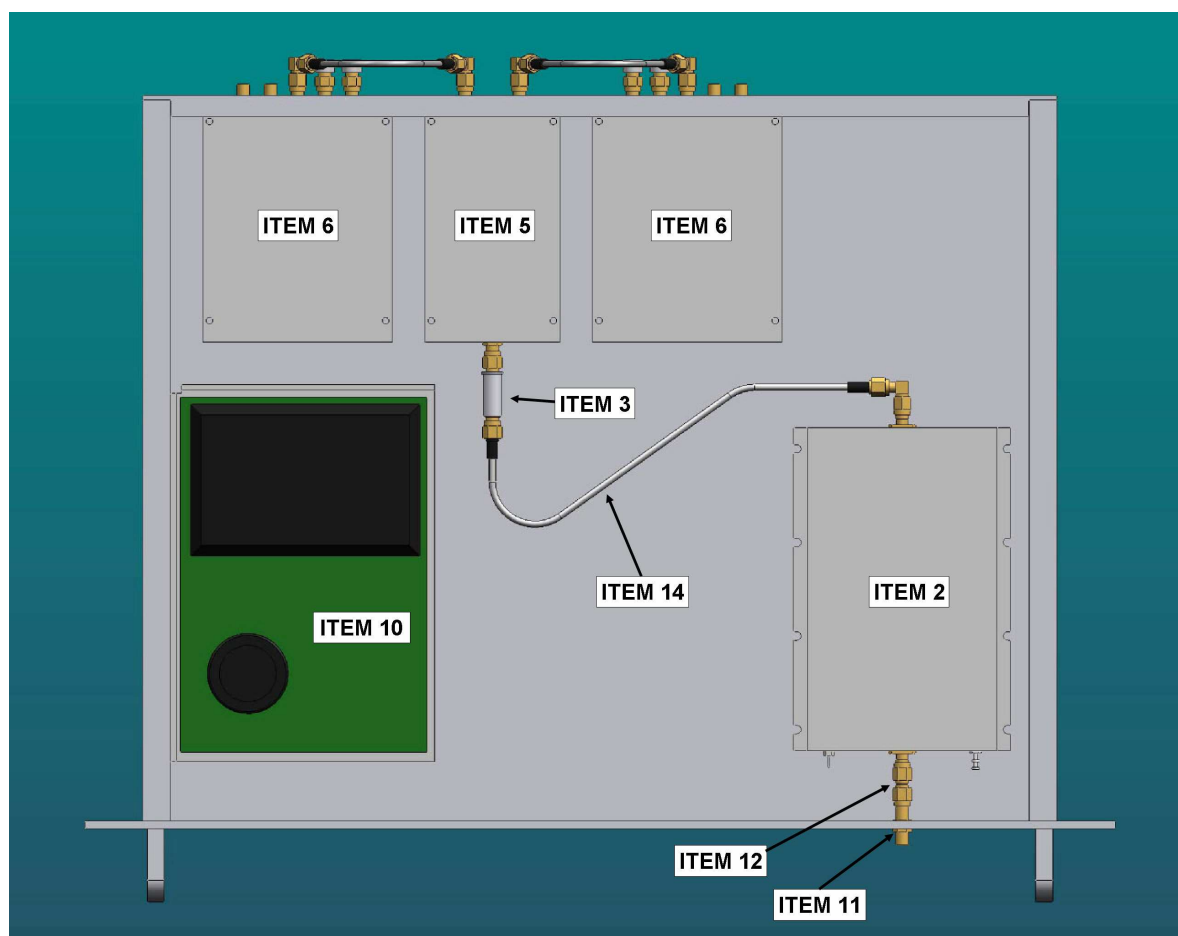



Fig. 16. Fixed LO: central rack mechanical assembling (top view).

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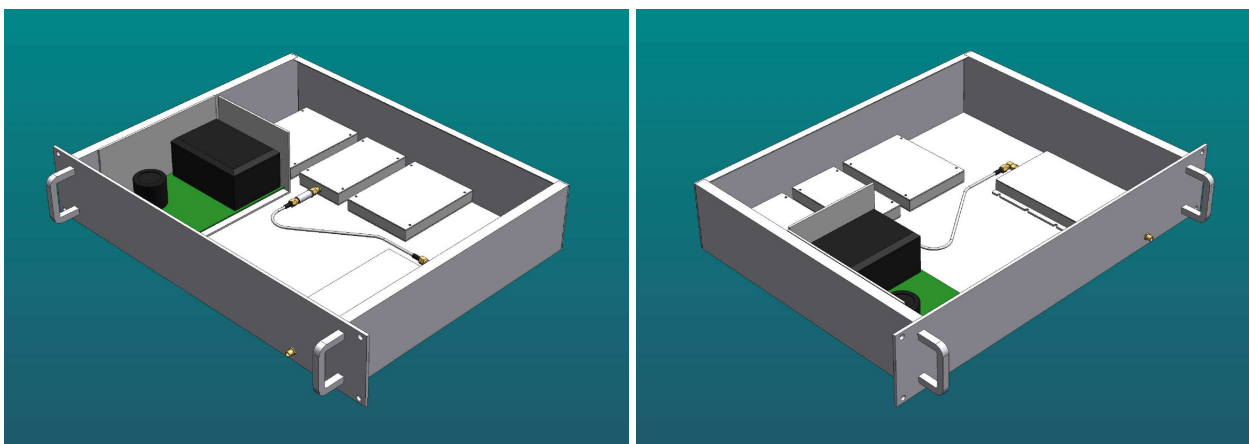


Fig. 17. Fixed LO: central rack mechanical assembling (front view).

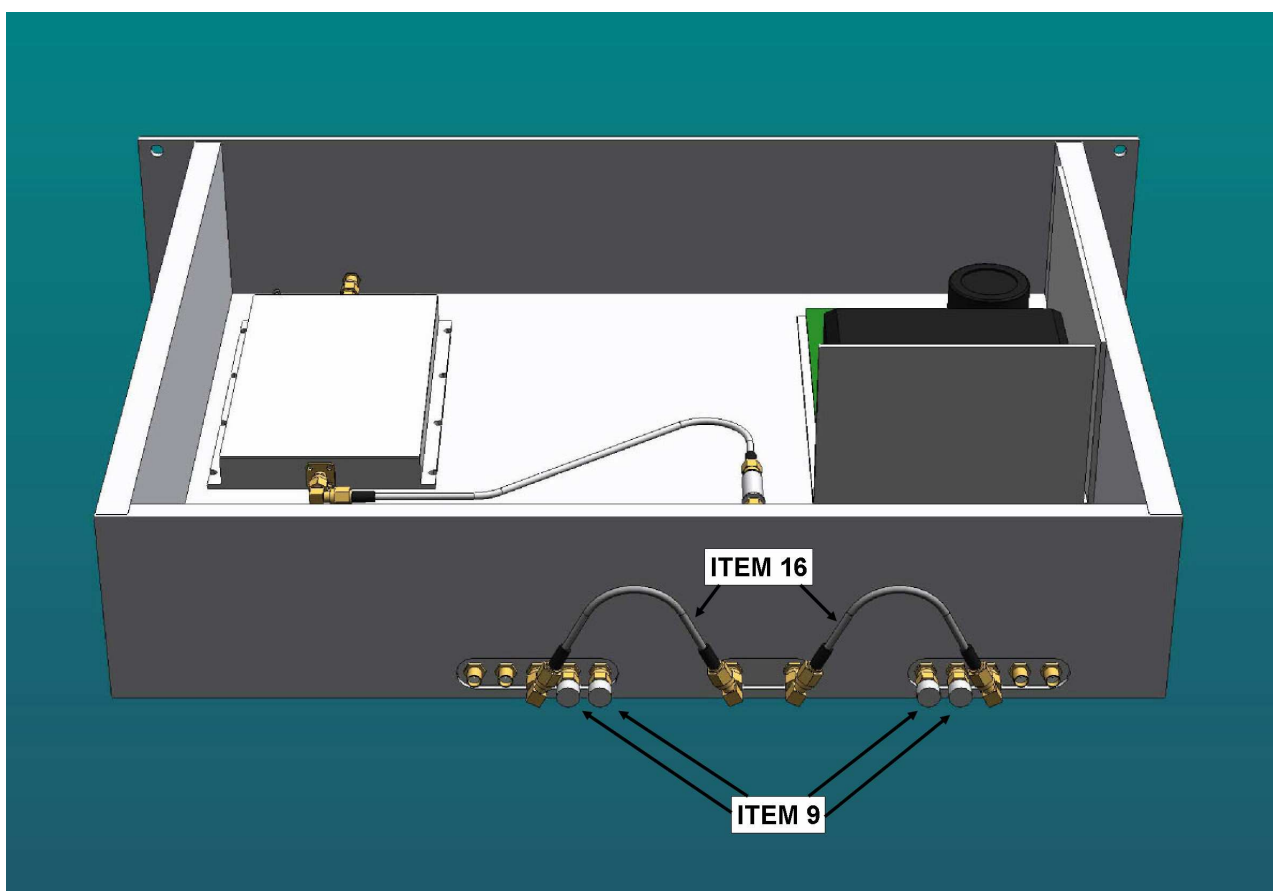



Fig. 18. Fixed LO: central rack mechanical assembling (back view).

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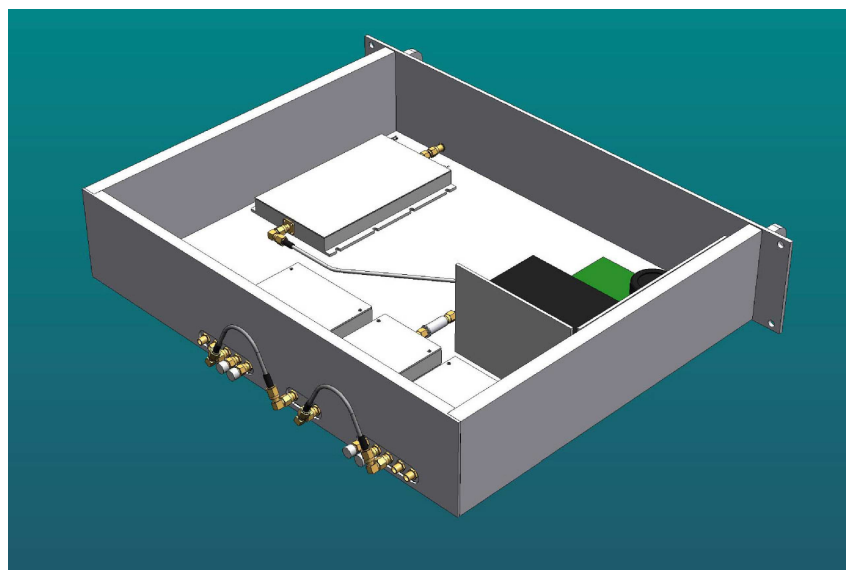


Fig. 19. Fixed LO: central rack mechanical assembling (back view).

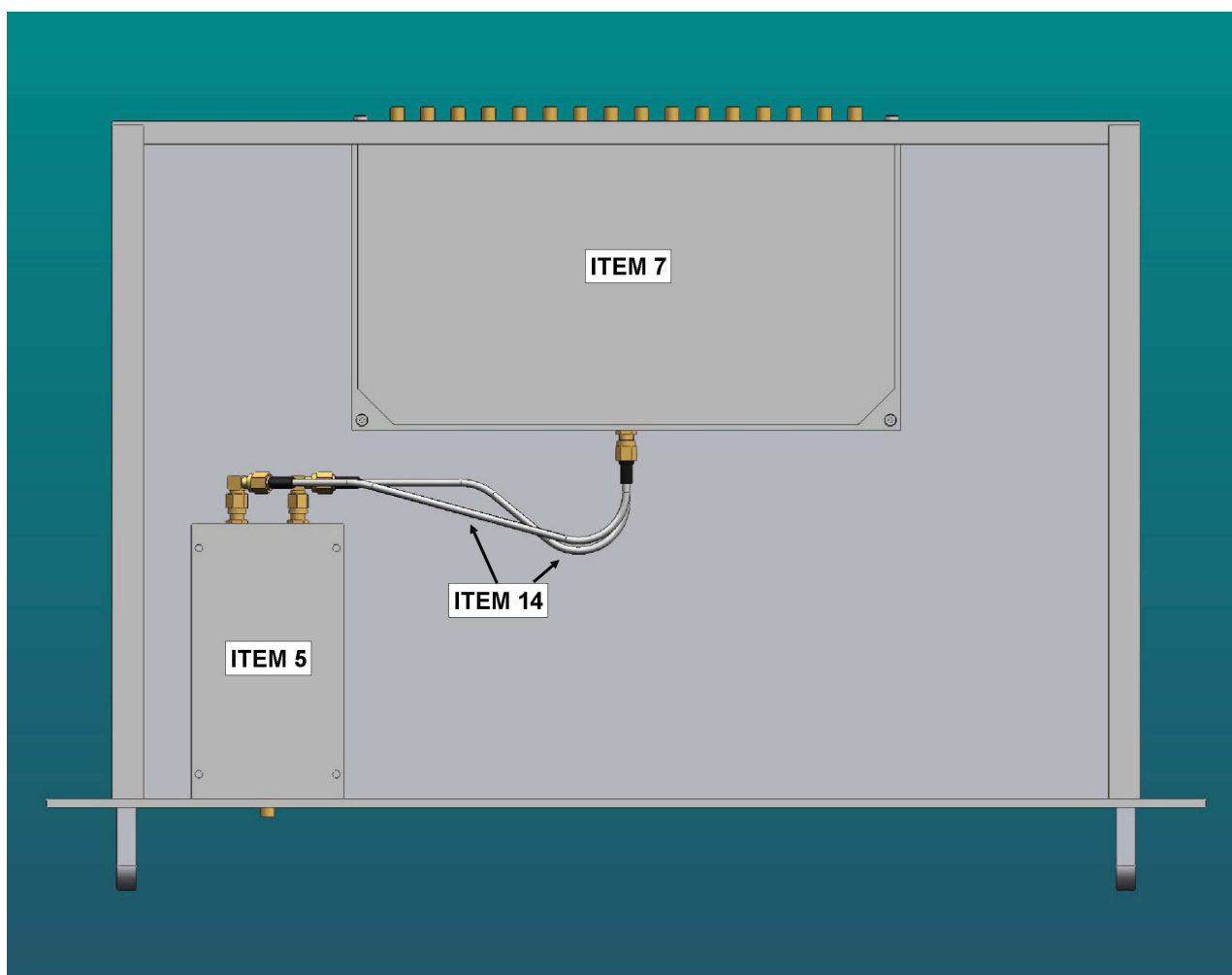



Fig. 20. Fixed and variable LO: CDC sub-rack mechanical assembling (top view).

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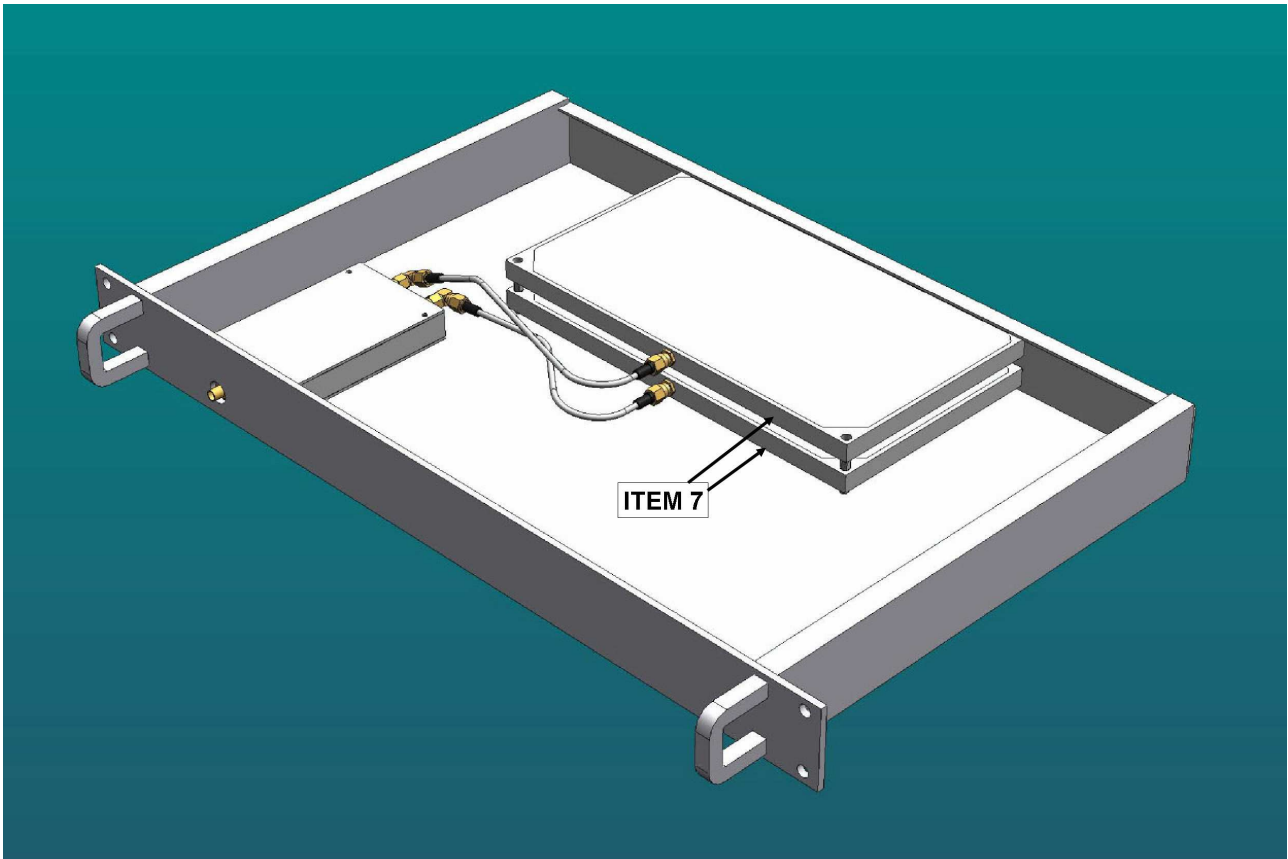


Fig. 21. Fixed and variable LO: CDC sub-rack mechanical assembling (front view).

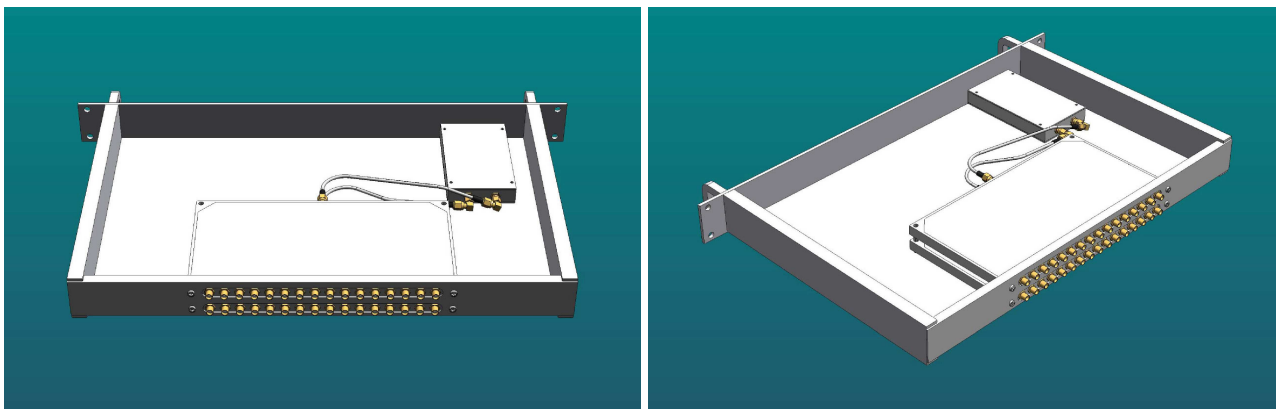


Fig. 22. Fixed and variable LO: CDC sub-rack mechanical assembling (back view).