MW- antenna
873 kHz, 20 kW

Lakihegy/ Budapest
(Hungary)

Technical Documentation

of acceptance tests

February 2007

MW Lakihegy (Hungary) 873 kHz, 20 kW
Technical Documentation for acceptance tests Feb. 2007

Contents

MW Lakihegy (Hungary) 873 kHz, 20 kW
Technical Documentation for acceptance tests Feb. 2007

1.0 Introduction

The Lakihegy Radio Station, South of Budapest is one of the main MW and LW broadcasting sites in Hungary with transmitters operating on four fequencies: 135.6 kHz, 540 kHz, 810 kHz, and 873 kHz. Three masts are available:

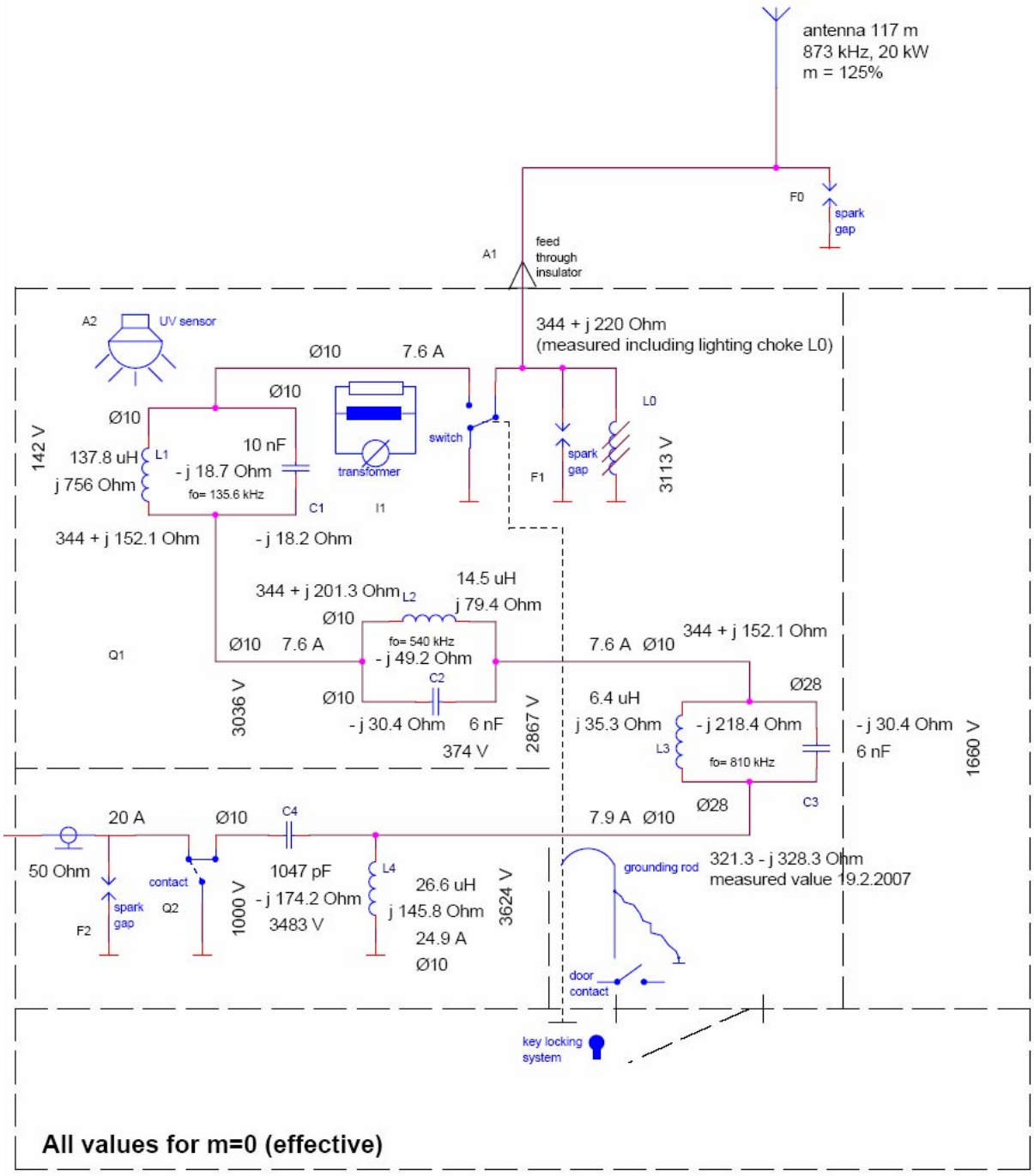
- the Blaw-Knox radiator, constructed in 1933 with it's height of 314 meters radiating 135.6 and 540 kHz
- a mast of 120 m for 810 kHz
- a mast of 117 m for 873 kHz

The antenna tuning unit for the mast of 117 m and 873 kHz was designed for a power of 20 kW. Due to the other frequencies radiated from the same site it was necessary to provide filters for 135.6, 540 and 810 kHz.
The antenna tuning unit replaces an old one, which did not include all trap and absorption circuits which are needed for the present situation on the site of Lakihegy.

2.0 Design of antenna tuning unit and operational values

The design of the antenna tuning unit as diplexer is shown below.
The same document is given as file 51-8920-815-00 WSP_LAKIHEGY_873_AE02.pdf (A4 format) in the appendix.

MW Lakihegy (Hungary) 873 kHz, 20 kW
Technical Documentation for acceptance tests Feb. 2007



The lighting choke was part of the old antenna tuning unit.

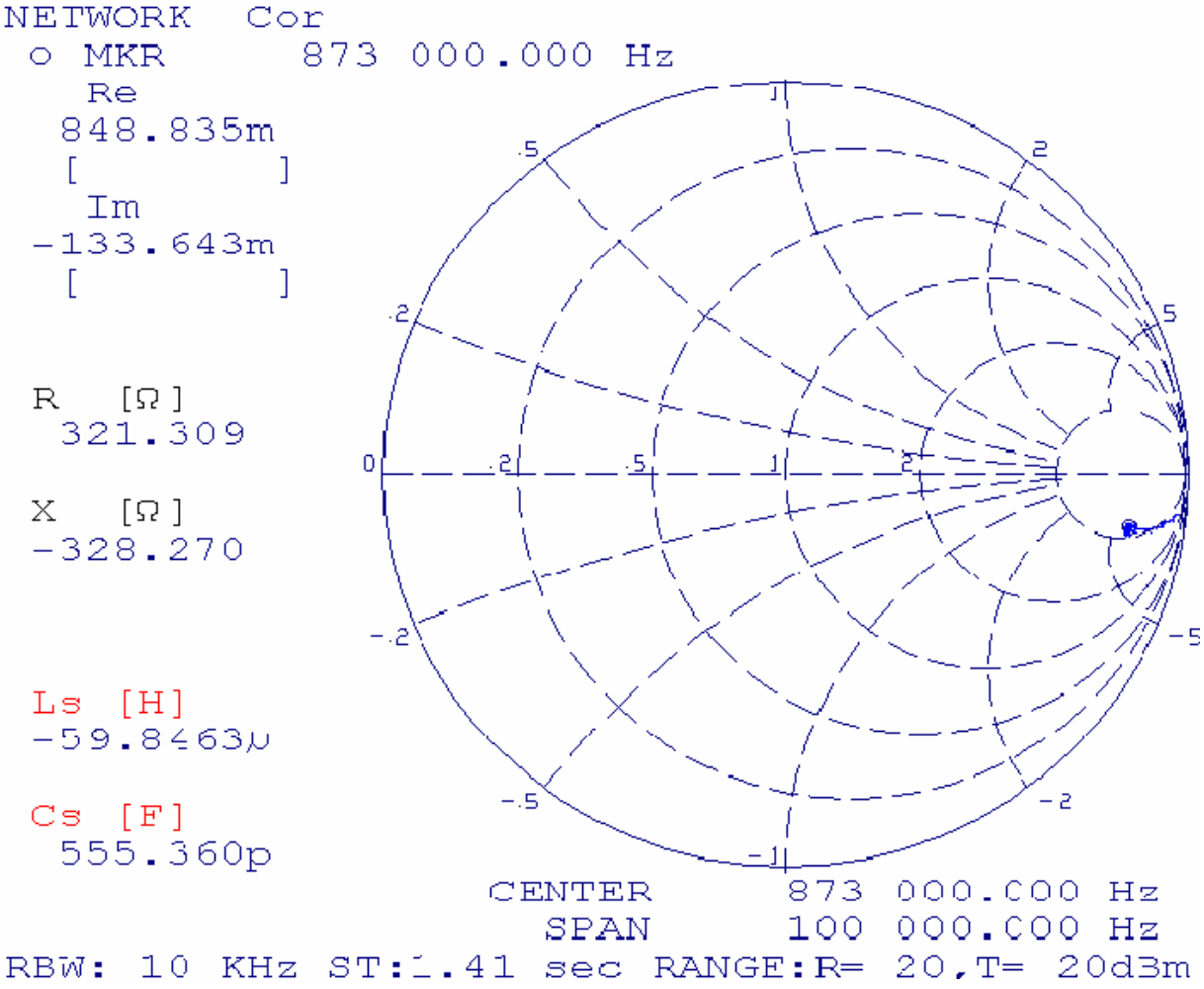
The drawing contains also operational values as currents and voltages.

3.0 Measured value of antenna impedances for 873 kHz +- 50 kHz behind filters

In order to protect the measuring instruments against high voltages occurring at the base of the antenna - caused by the frequencies 135.6 kHz, 540 kHz, and 810 kHz which also radiated from the site in Lakihegy - the antenna impedance was measured behind the filters for 135.6, 540, and 810 kHz.

MW Lakihegy (Hungary) 873 kHz, 20 kW
Technical Documentation for acceptance tests Feb. 2007

Antenna impedances for 873 kHz measured behind filters for 135.6, 540, and 810 kHz:



The same document is given as file “Impedanz_Antenne_873kHz_PrintCapture0012.bmp” in the appendix.

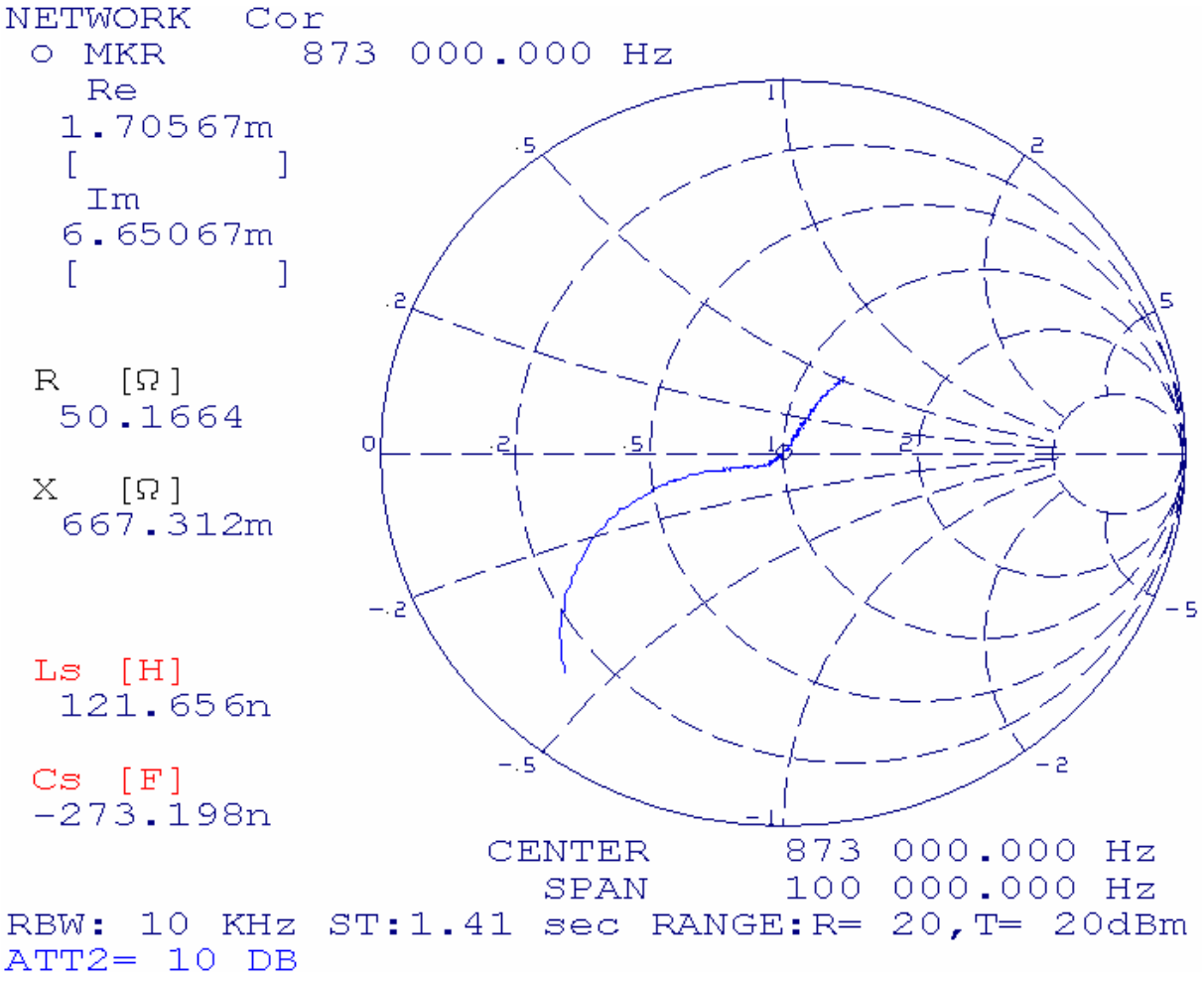
Table of impedances of antenna measured behind the filters for 135.6, 540, and 810 kHz:

f/ kHz	Z/ Ohm	
	Real- part	Imag- part
823	217,93	-890,23
828	245,46	-685,70
833	266,65	-562,48
838	294,24	-486,19
843	300,34	-426,50
848	303,21	-386,07
853	307,06	-364,88
858	322,17	-346,32
863	323,24	-330,94
868	318,06	-329,06
873	**320,49**	**-328,78**

878	322,75	-311,41
883	328,31	-315,26
888	323,16	-313,74
893	323,95	-318,46
898	312,20	-320,14
903	309,33	-315,84
908	298,69	-323,79
913	295,30	-310,77
918	278,70	-316,22
923	278,88	-322,52

4.0 Measured values of impedances for 873 kHz +- 50 kHz at cable output

The measured values of impedances for 873 kHz +- 50 kHz at the cable output are given in the following table and the plot below.



The same document is given as file “Impedanz_Kabel_873kHz_PrintCapture0016.bmp” in the appendix.

MW Lakihegy (Hungary) 873 kHz, 20 kW
Technical Documentation for acceptance tests Feb. 2007

Table of impedances measured at cable 50 ohms:

f/ kHz	Z/ Ohm		
	Real- part	Imag- part	VSWR
823	6,65	-21,28	8,90
828	12,81	-13,27	4,20
833	20,30	-7,39	2,53
838	27,76	-4,34	1,82
843	34,55	-3,18	1,46
848	39,26	-3,06	1,29
853	42,70	-2,85	1,18
858	45,48	-2,47	1,11
863	47,29	-2,06	1,07
868	48,99	-0,67	1,02
873	**50,17**	**0,67**	**1,01**
878	51,26	2,17	1,05
883	52,21	4,25	1,10
888	52,92	6,38	1,15
893	54,07	9,09	1,21
898	55,41	11,35	1,27
903	56,16	14,34	1,34
908	57,24	17,47	1,42
913	58,63	20,80	1,51
918	60,28	23,94	1,60
923	61,12	27,22	1,69

5.0 Coils and condensors, operational settings

Coils in alphabetic order:

coil	**D/mm**	**d/mm**	**windings total**	**windings active**
L0	250	existing lighting choke		
L1	245	5	46	37 1/2
L2	300	15	10	8 1/3
L3	300	28	8	6 2/3
L4	300	15	15	12 2/3

Condensors in alphabetic order:

C1	pF	pF	pF	pF		pF	pF	pF
	front	**front**	**front**	**front**		**rear**	**rear**	**rear**
	1000	1000	1000	1000		1000	1000	1000
	Total :	**7000 pF**						

MW Lakihegy (Hungary) 873 kHz, 20 kW
Technical Documentation for acceptance tests Feb. 2007

C2	pF	pF	pF		pF	pF	pF
	front	**front**	**front**		**rear**	**rear**	**rear**
	1000	1000	1000		1000	1000	1000
	Front and rear are in parallel						
	Total :	**6000 pF**					

C3	pF	pF	pF		pF	pF	pF
	front	**front**	**front**		**rear**		**rear**
	1000	1000	1000		1000	1000	1000
	Front and rear are in parallel						
	Total :	**6000 pF**					

C4	pF	pF
	2200	2200
	In series	
	Total :	**1100 pF**

6.0 Decoupling by filters

In addition to the necessary decoupling of the two frequencies of the diplexer 135.6 kHz and 540 kHz filter is needed for the frequency 810 kHz which is induced in the antenna from masts nearby on the same site of Lakihegy.

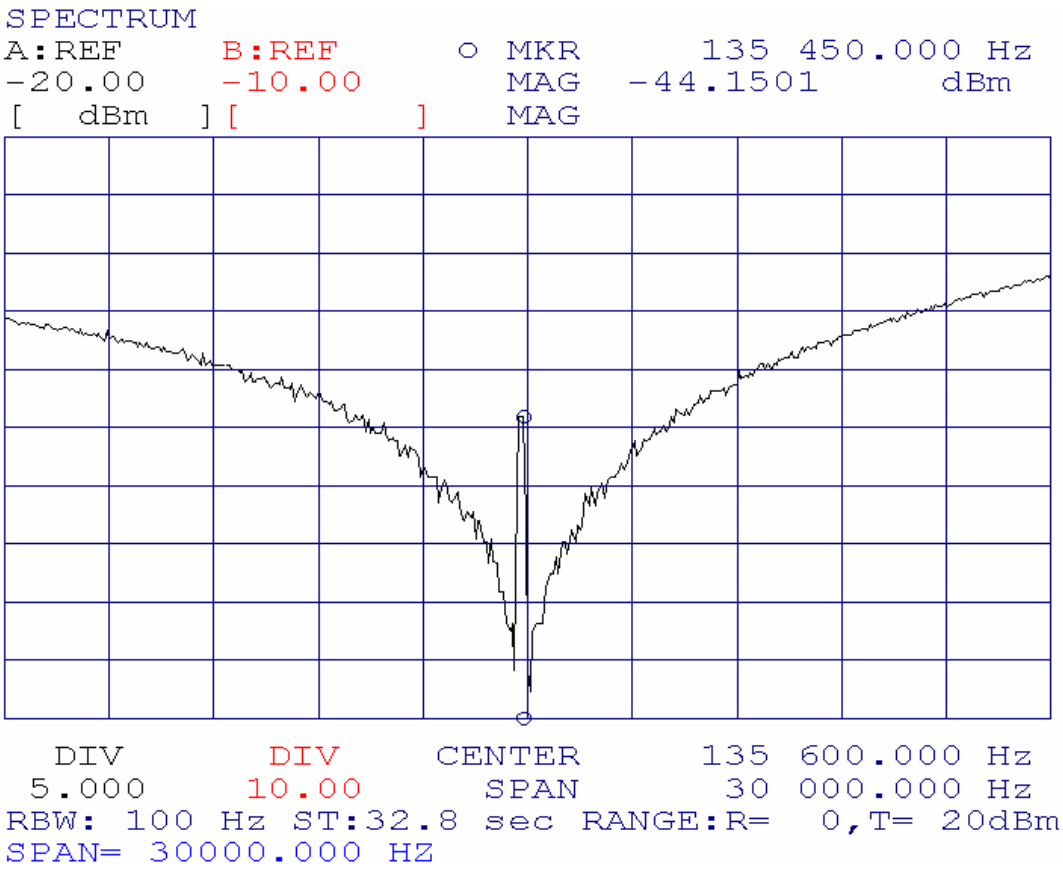
The measurement of the following filters has been carried out:

- **Filters for 135.6 kHz**

  Tuning elements L1/ C1 in parallel (rejection)

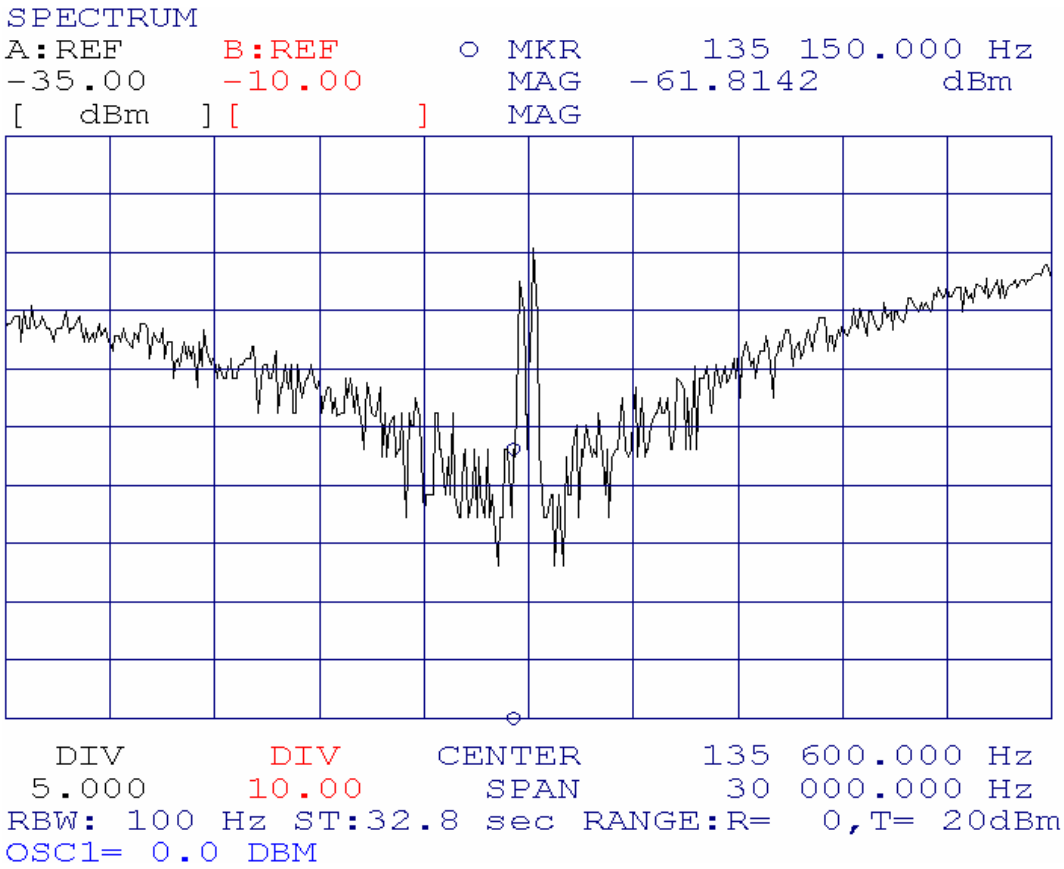
The transmission measurement could not be carried out without the distortion of the frequency 135.6 kHz. The following two measurements show that the attenuation of this filter is between 60 and 65 dB.

MW Lakihegy (Hungary) 873 kHz, 20 kW
Technical Documentation for acceptance tests Feb. 2007



The same document is given as file “Filter 135_6 kHz_PrintCapture0001.bmp” in the appendix.

MW Lakihegy (Hungary) 873 kHz, 20 kW
Technical Documentation for acceptance tests Feb. 2007



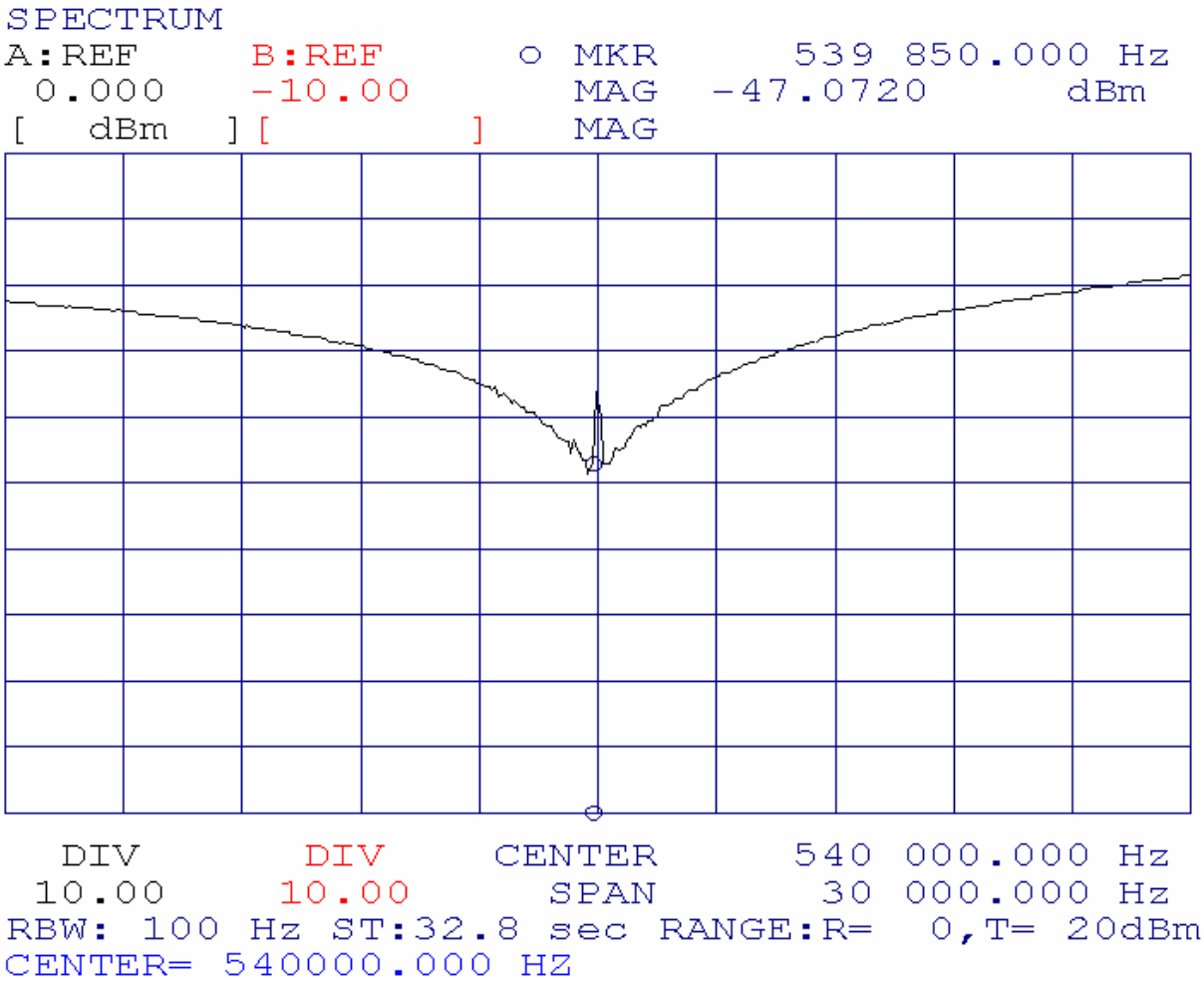
The same document is given as file “Filter 135_6 kHz_PrintCapture0002.bmp” in the appendix.

- **Rejection Circuit for 540 kHz**

Tuning elements L2/ C2 in parallel (rejection)

The transmission measurement could not be carried out without the distortion of the frequency 540 kHz.

MW Lakihegy (Hungary) 873 kHz, 20 kW
Technical Documentation for acceptance tests Feb. 2007



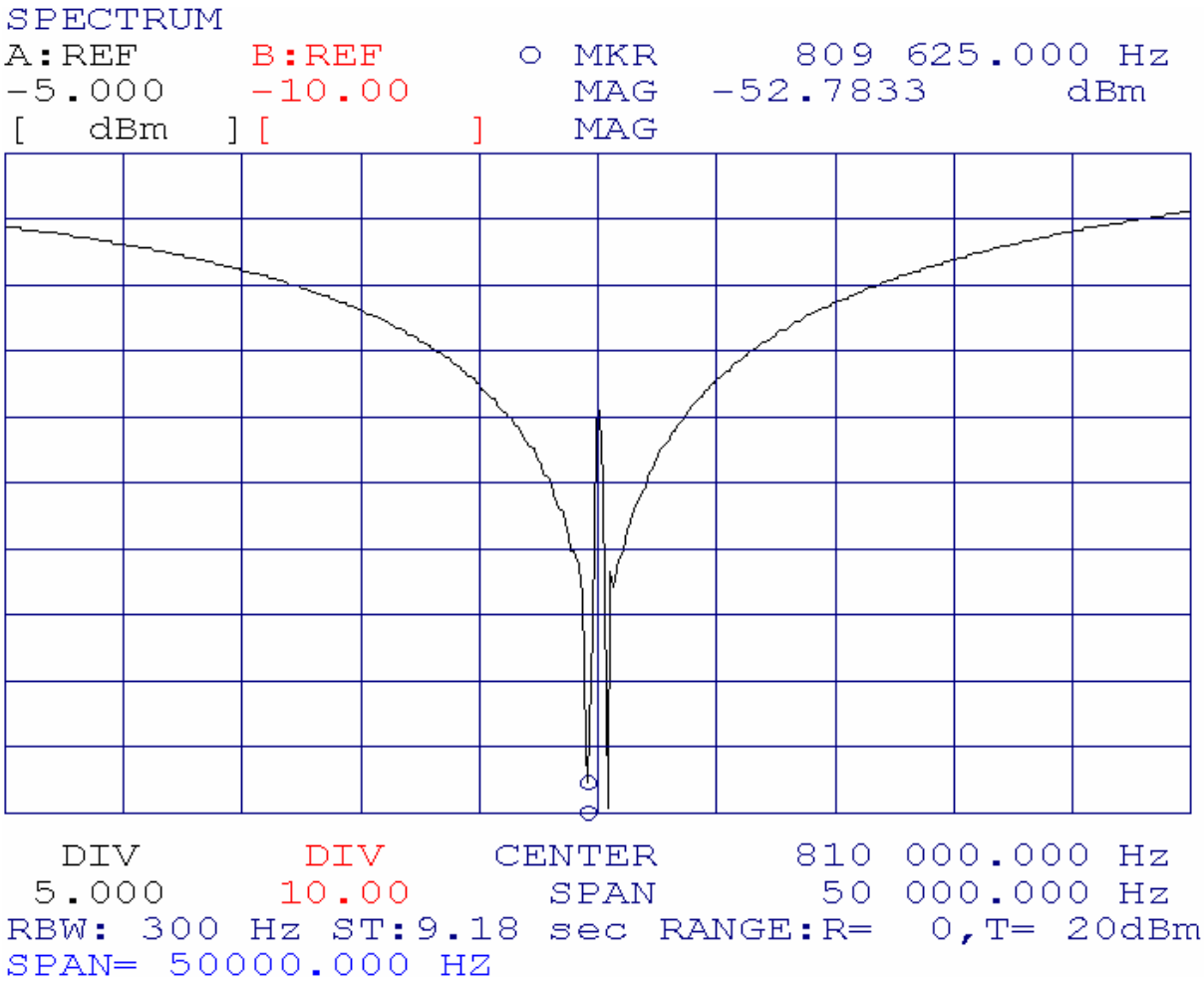
The same document is given as file “Filter 540 kHz_PrintCapture0003.bmp” in the appendix.

Rejection circuit for 810 kHz

Tuning elements L3/ C3 in parallel (rejection) for 810 kHz

The transmission measurement could not be carried out without the distortion of the frequency 810 kHz.

MW Lakihegy (Hungary) 873 kHz, 20 kW
Technical Documentation for acceptance tests Feb. 2007



The same document is given as file “Filter 810 kHz_PrintCapture0009.bmp” in the appendix.

7.0 Spark gaps

The setting of the spark gaps can be seen below:

Spark gap	sphere diameter mm	Spacing mm
F0 base of mast	60	55
F1 feed through insulator HFD25 at grounding switch	50	12
F2 cable 873 kHz	50	14

MW Lakihegy (Hungary) 873 kHz, 20 kW
Technical Documentation for acceptance tests Feb. 2007

8.0 Measuring instruments

Measurements were carried out using equipment of TRANSRADIO.

The equipment of TRANSRADIO consists of:

Network- Analyzer:	HP 4195A
Directional coupler :	TELEFUNKEN/TRANSRADIO
Amplifier:	EIN Model A150
PC Hardware for plots:	GPIB-UDB-B National Instruments

9.0 Appendixes

Appendix	Document	Bmp/ Pdf- file	Contents
1	Dwg. 51-8920-815-00 WSP, AE02	51-8920-815-00 WSP_LAKIHEGY_873_AE02.pdf	Design of a.t.u. and operational values
2	Plot	Impedanz_Antenne_873kHz_PrintCapture0012.bmp	Impedance of antenna behind filters
3	Plot	Impedanz_Kabel_873kHz_PrintCapture0016.bmp	Impedance at cable
4	Plots	Filter 135_6 kHz_PrintCapture0001.bmp and Filter 135_6 kHz_PrintCapture0002.bmp	Attenuation by filter
5	Plot	Filter 540 kHz_PrintCapture0003.bmp	Attenuation by filter
6	Plot	Filter 810 kHz_PrintCapture0009.bmp	Attenuation by filter