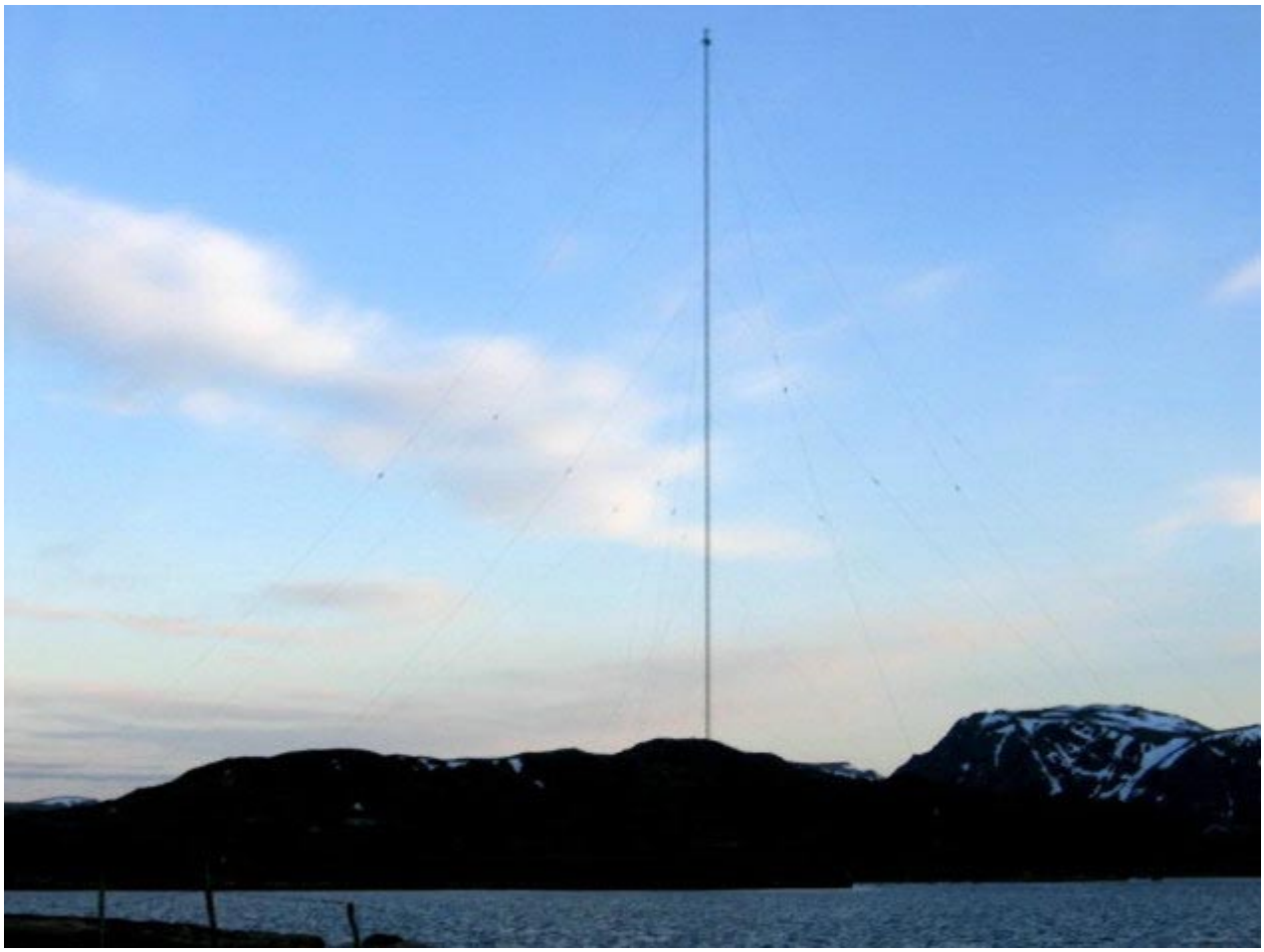
TELEFUNKEN
SenderSysteme Berlin

Berlin, 31.10.2000

Description of
ATU of Long Wave Antenna
Ingøy 100 kW 153 kHz

Technical report



Contents:

Description of ATU of Long Wave Antenna Ingøy 100 kW 153 kHz

1. Introduction and General

The geographical coordinates of the LW antenna on the island of Ingøy in Norway are 71°4'N and 24° 5'E.

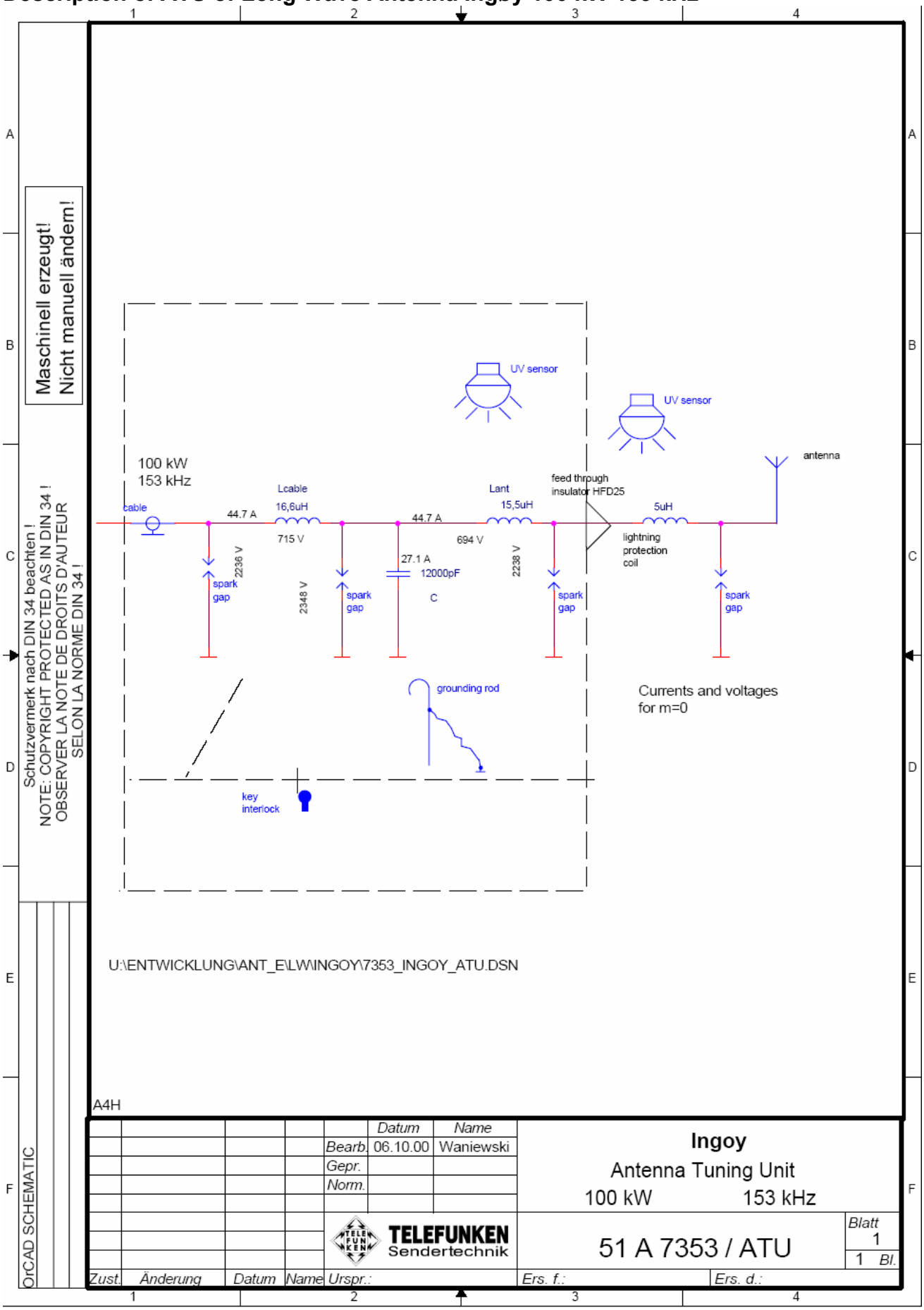
The antenna tuning unit consists of a low pass filter for 153 kHz with the power capability of 100 kW.

The measured locus of the antenna impedance is close to the values which have been calculated theoretically by using a computer model. This antenna impedance being close to 50 ohms is transformed to the characteristic impedance of the power cable which is 50 ohms.

All relevant measurements, readings and settings are stated in this document.

The drawing 51 A 7353 / ATU shows details of the antenna tuning unit. The given voltages and currents are calculated for m = 0 (no modulation).

Description of ATU of Long Wave Antenna Ingøy 100 kW 153 kHz

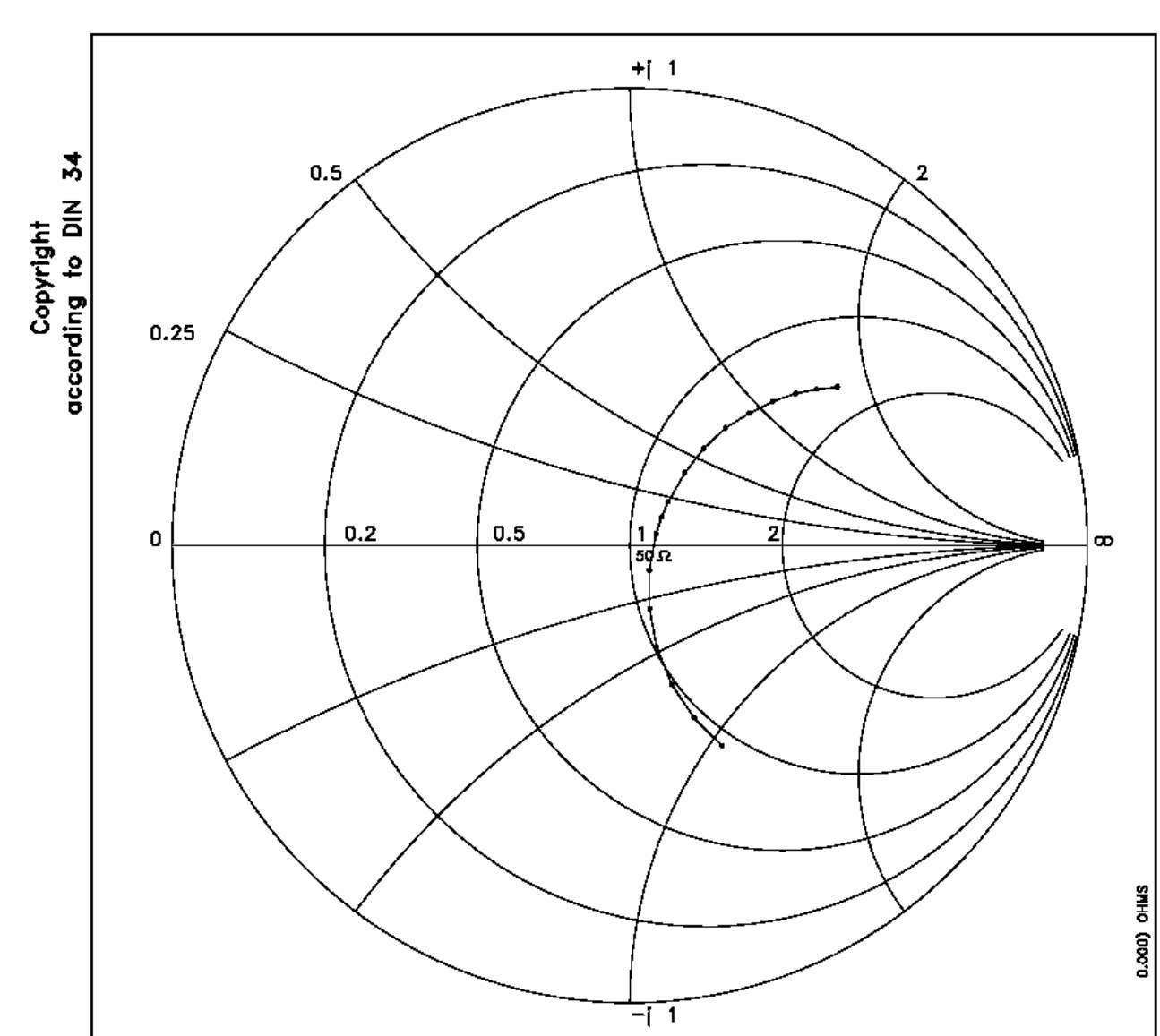


2. Antenna impedance measured at feed through insulator inside the antenna tuning hut

f /MHz	Re(Z)	Im(Z)
0.140000	46.30	-52.80
0.140500	46.80	-50.30
0.142000	47.60	-42.80
0.144000	49.00	-33.20
0.146000	50.60	-23.80
0.148000	52.40	-14.80
0.150000	54.10	-5.90
0.152000	56.00	2.80
0.153000	57.00	7.10
0.154000	58.00	11.30
0.156000	60.10	19.90
0.158000	62.10	28.40
0.160000	64.40	37.20
0.161900	67.30	45.90
0.164000	70.20	55.00
0.166000	73.30	64.20
0.168000	76.70	73.10
0.170000	80.60	82.80

The values are plotted in Smith chart on drawing 51 A 7353/S_ant_input.

Description of ATU of Long Wave Antenna Ingøy 100 kW 153 kHz



f /MHz	Re(Z)	Im(Z)	Re(Z)/ZL	Im(Z)/ZL	Re(r)	Im(r)	SWR	r/dB
0.140000	45.30	−52.80	0.926E+00	−0.106E+01	0.20	−0.44	2.8 5	−6.3
0.142000	47.60	−42.80	0.952E+00	−0.856E+00	0.14	−0.38	2.3 5	−7.9
0.144000	49.00	−33.20	0.980E+00	−0.664E+00	0.09	−0.30	1.9 3	−9.9
0.146000	50.60	−23.80	0.101E+01	−0.476E+00	0.06	−0.22	1.6 0	−12.7
0.148000	52.40	−14.80	0.105E+01	−0.296E+00	0.04	−0.14	1.3 4	−16.7
0.150000	54.10	−5.90	0.108E+01	−0.118E+00	0.04	−0.05	1.1 5	−23.2
0.152000	56.00	2.80	0.112E+01	0.560E−01	0.06	0.02	1.1 3	−24.0
0.153000	57.00	7.10	0.114E+01	0.142E+00	0.07	0.06	1.2 1	−20.6
0.154000	58.00	11.30	0.116E+01	0.226E+00	0.08	0.10	1.2 9	−17.8
0.156000	60.10	19.90	0.120E+01	0.398E+00	0.12	0.16	1.5 0	−14.0
0.158000	62.10	28.40	0.124E+01	0.568E+00	0.16	0.21	1.7 3	−11.4
0.160000	64.40	37.20	0.129E+01	0.744E+00	0.21	0.26	1.9 9	−9.5
0.161900	67.30	45.90	0.135E+01	0.918E+00	0.26	0.29	2.2 8	−8.1
0.164000	70.20	55.00	0.140E+01	0.110E+01	0.31	0.31	2.5 9	−7.0
0.166000	73.30	64.20	0.147E+01	0.128E+01	0.36	0.33	2.9 3	−6.1
0.168000	76.70	73.10	0.153E+01	0.146E+01	0.41	0.34	3.2 7	−5.4
0.170000	80.60	82.80	0.161E+01	0.166E+01	0.45	0.35	3.6 6	−4.8

Copyright according to DIN 34

29. 8.2003 17:06:56 SMITH-CHART 0 DB M:\SMITH\INGOY\Ingoy_an.imp 29. 8.00 P 16:18:30

INPUT IMPEDANCE AT POS.:(3) 0.000) OHMS
REFERENCE IMPEDANCE: ZL=(50.000;

				2003	date	name	Ingoy 153	
				expert	29.8.	Wan	measured Imped. ant. base	
				approv.				
				city				
				depart.		E1		T-Nr.
				TELEFUNKEN SenderSysteme Berlin			51 A 7353_S_ant_input	sheet
								Bl.
index	modification	date	name	Ursprung:			Ers. fuer:	Ers. durch:

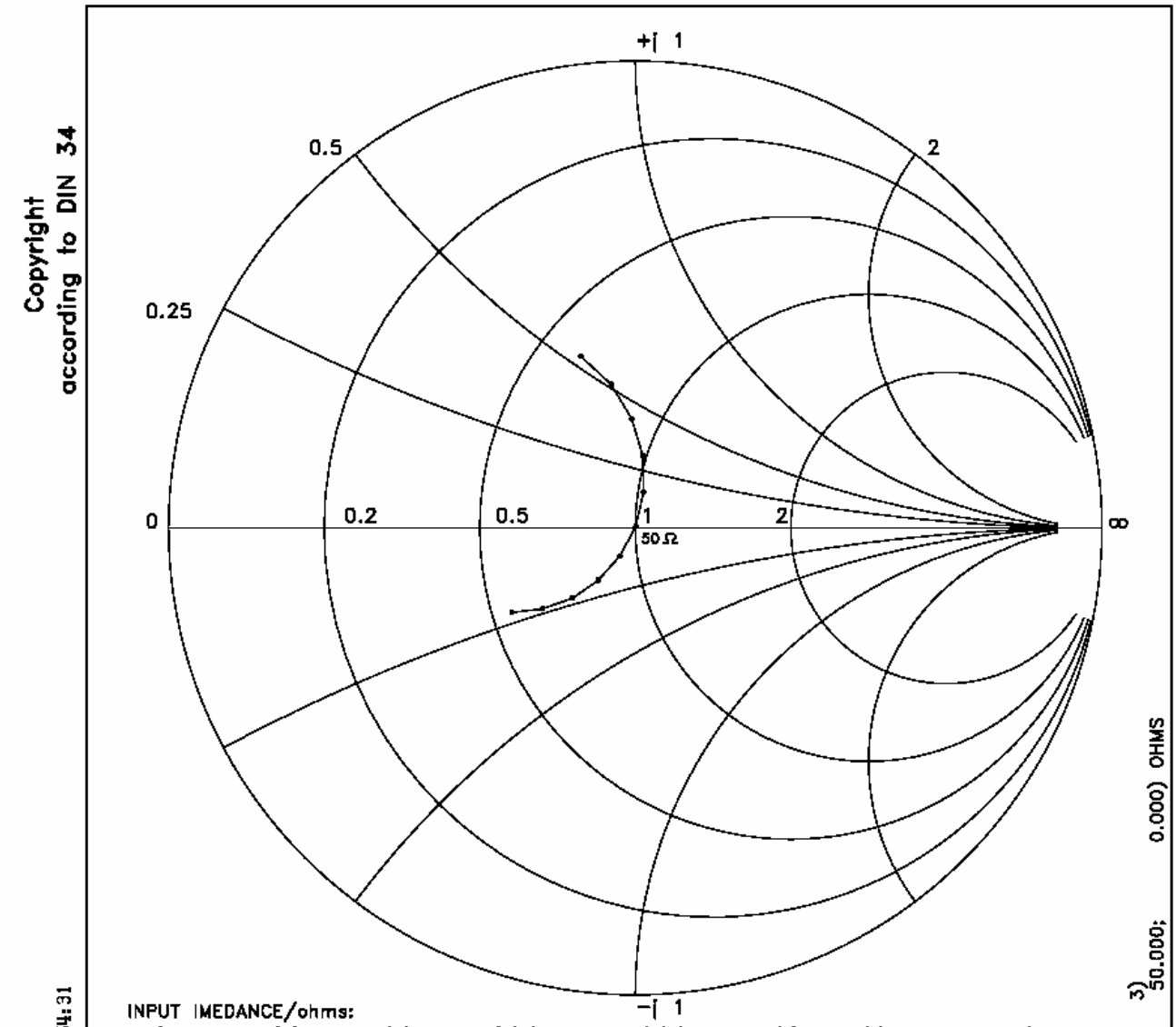
Description of ATU of Long Wave Antenna Ingøy 100 kW 153 kHz

3. Impedance measured at output of transmitter (cable 50 Ohm) with ATU and antenna connected

f /MHz	Re(Z)	Im(Z)
0.143000	30.80	26.60
0.145000	37.60	25.60
0.147000	44.20	21.80
0.149000	49.20	15.60
0.151000	51.20	7.80
0.153000	50.10	0.30
0.155000	46.50	-5.60
0.157000	41.70	-9.50
0.159000	36.60	-11.50
0.161000	31.70	-11.80
0.163000	27.50	-11.10

The values are plotted in Smith chart on drawing 51 A 7353/S_tx_output.

Description of ATU of Long Wave Antenna Ingøy 100 kW 153 kHz



INPUT IMEDANCE/ohms:

f /MHz	Re(Z)	Im(Z)	Re(Z)/ZL	Im(Z)/ZL	Re(r)	Im(r)	SWR	r/dB
0.143000	30.80	26.60	0.616E+00	0.532E+00	−0.12	0.37	2.2 6	−8.2
0.145000	37.60	25.60	0.752E+00	0.512E+00	−0.05	0.31	1.9 1	−10.1
0.147000	44.20	21.80	0.884E+00	0.436E+00	−0.01	0.23	1.6 1	−12.6
0.149000	49.20	15.60	0.984E+00	0.312E+00	0.02	0.15	1.3 7	−16.1
0.151000	51.20	7.80	0.102E+01	0.156E+00	0.02	0.08	1.1 7	−22.1
0.153000	50.10	0.30	0.100E+01	0.600E−02	0.00	0.00	1.0 1	−50.0
0.155000	46.50	−5.60	0.930E+00	−0.112E+00	−0.03	−0.06	1.1 5	−23.3
0.157000	41.70	−9.50	0.834E+00	−0.190E+00	−0.08	−0.11	1.3 2	−17.2
0.159000	36.60	−11.50	0.732E+00	−0.230E+00	−0.13	−0.15	1.5 1	−13.8
0.161000	31.70	−11.80	0.634E+00	−0.236E+00	−0.20	−0.17	1.7 2	−11.5
0.163000	27.50	−11.10	0.550E+00	−0.222E+00	−0.26	−0.18	1.9 4	−9.8

INPUT IMPEDANCE AT POS.:(0.000) OHMS
REFERENCE IMPEDANCE: ZL=(50.000; 3)

29. 8.2003 15:55:40 SMITH-CHART 0 DB M:\SMITH\INGOY\Ingoy_tx.imp F143.IMP 29. 8.00 P 15:54:31

				2003	date	name	LW-Ingoy 153 kHz
				expert	29.8.	Waniewski	measured impedances at
				approv.			output of transmitter (cable 50 Ohm)
				city			+- 10 kHz
				depart.		E1	T-Nr.
				TELEFUNKEN SenderSysteme Berlin			51 A 7353_S_tx_output
							sheet
index	modification	date	name	Ursprung:			Bl.
				Ers. fuer:			Ers. durch:

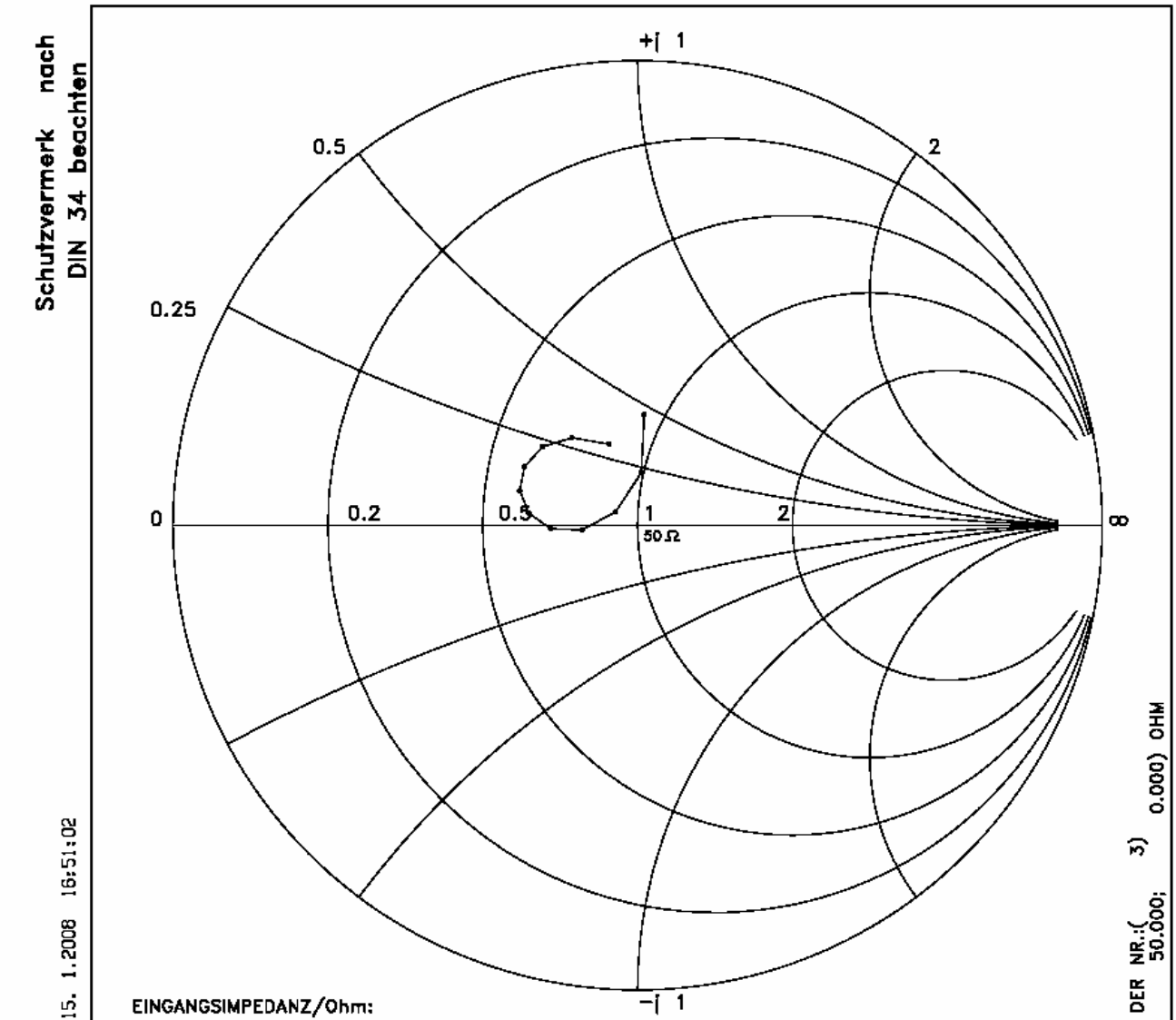
Description of ATU of Long Wave Antenna Ingøy 100 kW 153 kHz

4. Impedance measured at input of transmitter filter with ATU and antenna connected

f /MHz	Re(Z)	Im(Z)
0.143000	45.90	23.10
0.145000	49.50	11.40
0.147000	45.40	2.60
0.149000	39.30	-0.80
0.151000	34.20	-0.50
0.153000	31.00	1.70
0.155000	29.50	4.70
0.157000	29.60	8.00
0.159000	31.40	11.40
0.161000	35.30	14.10
0.163000	41.70	15.10

The values are plotted in Smith chart on drawing 51 A 7353/S_fi_input.

Description of ATU of Long Wave Antenna Ingøy 100 kW 153 kHz



Schutzvermerk nach DIN 34 beachten

EINGANGSIMPEDANZ/Ohm:

f /MHz	Re(Z)	Im(Z)	Re(Z)/ZL	Im(Z)/ZL	Re(r)	Im(r)	SWR	r/dB
0.14300	45.90	23.10	0.918E+00	0.462E+00	0.01	0.24	1.62	−12.4
0.14500	49.50	11.40	0.990E+00	0.228E+00	0.01	0.11	1.26	−18.8
0.14700	45.40	2.60	0.908E+00	0.520E−01	−0.05	0.03	1.12	−25.1
0.14900	39.30	−0.80	0.786E+00	−0.160E−01	−0.12	−0.01	1.27	−18.4
0.15100	34.20	−0.50	0.684E+00	−0.100E−01	−0.19	−0.01	1.46	−14.5
0.15300	31.00	1.70	0.620E+00	0.340E−01	−0.23	0.03	1.62	−12.5
0.15500	29.50	4.70	0.590E+00	0.940E−01	−0.25	0.07	1.72	−11.5
0.15700	29.60	8.00	0.592E+00	0.160E+00	−0.24	0.12	1.75	−11.2
0.15900	31.40	11.40	0.628E+00	0.228E+00	−0.20	0.17	1.72	−11.5
0.16100	35.30	14.10	0.706E+00	0.282E+00	−0.14	0.19	1.62	−12.5
0.16300	41.70	15.10	0.834E+00	0.302E+00	−0.06	0.17	1.46	−14.6

IMPEDANZ AM SPEISEPUNKT MIT DER NR.:(3) 0.000) OHM
NORMIERUNGSWIDERSTAND: ZL=(50.000;

15. 1.2008 16:56:47 SMITH-CHART 0 DB U:\ENTWIC~1\ANT_EV\LWXINGOY\ABSTIM~1\F143.imp F143.IMP 15. 1.2008 16:51:02

				2008	Datum	Name	LW Norway Ingoy 100 kW, 153 kHz measuring values at input of transmitter filter with ATU and antenna connected	
				Bearb.	15.1.	Waniewski		
				Gepr.				
				Ort				T-Nr.
				Abt.		E1		Blatt
				TRANSRADIO SenderSysteme Berlin			51 A 7353_S_fi_input	Bl.
AE	Aenderung	Datum	Name	Ursprung:			Ers. fuer:	Ers. durch:

Description of ATU of Long Wave Antenna Ingøy 100 kW 153 kHz

5. ATU settings and settings of spark gaps

The design of the antenna tuning elements after tuning is shown on 51 A 7353 / ATU. The given currents and voltages are for m = 0.

ATU settings:

Lcable:	active: n = 10 ½ at the top of the coil plus n = 0.5 at the bottom of the coil passive: 9 turns size of coil: D=300 mm, d=15mm, n=20
Lant:	active: n = 4 ½ passive: 15 3/4 turns size of coil: D=300 mm, d=15mm, n=20
C:	2 x 6000 pF = 12000 pF

Settings of spark gaps:

Base of antenna (tripode) :	30 mm
Feed through insulator:	14 mm
Capacitor:	10 mm
Cable termination:	13 mm

6. Measurement equipment

Network analyser HP 4195A plus coaxial directional coupler for long frequencies (LF) by TELEFUNKEN.