## 1. How to use x2ipi with Terrameter LS (ABEM, Sweden)

## 1.1. Creating protocol files for 4x21 cables set

Terrameter LS is 64-electrode instrument with two 32-pole connector for electrode cables (2x32). However the basic recommended set supplied with the equipment is the set of 4 cables with 21 electrodes each (4x21). Since the last and the first electrode take-outs shall overlap at the cable ends, the equipment allows to measure with 81 electrodes for the system layout (4x21 - 3). It provides increase the depth of ERT investigation up to 25%.

Protocol consists of two types of measurements. The first type - shallow measurements (small electrode spacings). The second type - measurements for deeper parts of the geoelectrical section (large electrode spacings). For example, having cables with 5m spacing between electrode takeouts, LONG32 type (41 electrode with 10m unit electrode spacing) and SHORT32 type (41 electrode with 5m unit electrode spacing) were applied. Two protocols with constant spacing between electrodes each.

*x2ipi* toolbox provide preparing ABEM protocols for 61-electrode measuring scheme. The example for Schlumberger array. **The first step** is create LONG protocol for long spacing.

1. Create a new protocol file for 41 electrodes with 5 meter spacing and save it **Electrell** txt format

New SEQ file		Configuration of array	
No al 41 5	AM/MN AB/2 (K_array/a) Yes/No N_reading		Delete Double
	45 75 105	<b>.</b>	* * * * * * * * * * * * *
Type of array	5 15 25 35	3.333- 6.667-	
Pole-dipole	25/25 37.5 (157.1) Yes	10-	
Half-Wenner     Switcher - AMN	30/25 42.5 (207.3) Yes 35/25 47.5 (263.9)	13.33- 16.67-	
🔘 Wenner-Alpha 👘 Fast gradient	▼ 40/25 52.5 (326.7) Yes 20	23.33- + + + + + + + + + + + + + + + + + +	* * * * * * * * *
🔘 Wenner-Beta 💿 Switcher-Short	▼ 50/25 62.5 (471.2) 16	26.67- + + + + + + + + + + + + + + + + + + +	* * * * * * * 1
<ul> <li>Schlumberger</li> </ul>	55/25 67.5 (552.9)     ✓ 60/25 72.5 (640.9)     12	33.33 36.67 36.67	* * * * * * + + + + + + + + + + + + + +
Dipole lengths	■ 65/25 77.5 (735.1) ▼ 70/25 82.5 (835.7) 8	40- 43.33- 49.00	+ + + + +
MN=5; nLines=9 MN=15; nLines=0 MN=25; nLines=5	75/25 87.5 (942.5) ✓ 80/25 92.5 (1056) 4 85/25 97.5 (1175) 90/25 102.5 (1301)	146.67           40.50           453.33           56.67	**
MN=35; nLines=0 MN=45; nLines=0	95/25 107.5 (1433) 100/25 112.5 (1571)	63.33 - + + + + + + + + + + + + + + + + + +	-
MN=75; nLines=0 MN=105; nLines=0	110/25 117.5 (1715) 110/25 122.5 (1866) 115/25 127.5 (2023)	73.33 - + + + + + + + + + + + + + + + + + +	-
nQuadropoles=328	120/25 132.5 (2187) 125/25 132.5 (2356)	80- 83.33- 86.67-	
Show	VOK ? Help		40 160 180

2. **Menu-Save-Seq-Make Long protocol**. It creates TXT protocol file with new numbers of electrodes and 10 meter inter-electrode spacing.



3. Shift X to have 0 coordinate for central electrode. Shift(m) = -200. Save it **Electrell** txt

format 🚾 again.

Input file r	eading	· 6.64 😁 .	5.529.68.) (		
Load Save	Exchange Options Cont	tours <u>A</u> bout			
🗅 🖻 🕶 😅	🗑 🧱 🎽 🛤 🗣 🔬 💕 !	🔐 🔲 🖉 🔫 🛛	📓 🚲 ⊱ የት	SP 🚊	
	new_a	amnb Modifie	<b>d</b> 768 0 0	1 Abs.	values
				Shift (m) -2	200
Operator	Arlene	Area 0	Line 0	last lines	0
SEQ - ne <sup>.</sup> R=AB/2	v_amnb Electrodes - Type of array - Schlum	41 Distar hberger (AMNB	nce 5, m )	first lines	0
AB/2 lengtł	13) from 7.5 to 92.5	5 Overla Quadripo	pping 1 bles 328	A MN	В
new_amnb				x=(M+N	)/2

The second step is create Short protocol for central part of profile.

1. C create a new protocol file for 41 electrodes with 5 meter spacing and save it in new file in *Electre II* txt format. We do not need big number of spacing - just 4 lines could be enough.

New SEQ file				_ 🗆 🗙	Configurat	ion of array	11 B. C.				and the second		4
	Step	AMAIN AB/2 (	( errevile) YociNo	N reading							Delete D	ouble	
No el. 41 🔤 5	▼	45	75	105			, , , , , , ,	******		, , , , , , , ,			
Type of array		5 15	25	35	1-								
Polo-dipolo	C Dipolo-Dipolo	F/F 7F (21.4)	20		2 -								Ш
- or ore-dipole	O Dibole-Dibole	10/5 125 (01.4)	0C 2F	<u>^</u>	3-							1	
Half-Wenner	Switcher - AMN	V 15/5 17.5 (188)	34		4-								
Wenner-Alpha	Fast gradient	20/5 22.5 (314)	32		-6								Ш
O Wannes Bata	Outrop Object	25/5 27.5 (471)		=	7								ш
vvenner-Beta	Switcher-Short	30/5 32.5 (660)			á +	+ + + + + +		* * * * * * * *	* * * * * *	* * * * * * *	* * * * *		
Schlumberger		40/E 42 E (1121)			9-								ш
		45/5 47.5 (1414)			10-								
Dipole lengths		50/5 52.5 (1728)			N 11-								
MN=5; nLines=4		55/5 57.5 (2073)			<b>a</b> 12-								1H
MN=15; nLines=0		60/5 62.5 (2450)			▲ 13-						• • • •		
MN=25; nLines=0		65/5 67.5 (2859)			14-								
MN=35; nLines=0		75/5 77.5 (3299)			15-								
MN=45; nLines=0		80/5 82.5 (4273)			16-								
MN=75; nLines=0		85/5 87.5 (4807)			17-	+ + + + -							
MN=105: nLines=0		90/5 92.5 (5372)			18-								
		95/5 97.5 (5969)			19-								
nQuadropoles=140		100/5 103 (6597	)	-	20-								
					21-								
<u>s</u> i	how	🗸 ОК	7 Help		22-	20			120		+ +   190	I	1
			•			20	-0 00	00 100	120	100 100	100		1

2. Shift X to have 0 coordinate for central electrode. Shift(m) = -100. Save it *Electrell* txt

format 🚾 again.

3. Add file with LONG protocol and save two files in one be **Menu-Save-Merge SEQ-Merge TXT**.

🖷 Read ElectreII sequence in TXT format	Configuration of array
Load Save Exchange Options Contours About	Delete
SEQ         Image: Seq and the second se	7.5 15 22.5
Remote electrode Save options       Area 0       Line 0       Delete         SEQ       Sorting       des - 61       Distance 5. m       first lines 0         AB/2       Merge SEQ       Merge SEQ       Merge SEQ       first lines 0         Reciprocal SEQ       Merge TXT       peles       328         new_a       IE2DP       ast markat       schumtoreast narkat	30- 37.5- 52.5- 60- 67.5- 75- 82.5- ₹397.5- ₹105- 113- 120- 120- 120- 120- 135-
Merge several SEQ files into one large one	-200 -167 -133 -100 -66.7 -33.3 0 33.3 66.7 100 133 167

Now we have protocol file for 4x21 cable set. We need to open it and optimize for multichannel receiver. The third step is optimization.

1. Make reciprocal Schlumberger array **Menu-Save-Reciprocal SEQ-Electrell (txt)**. Open result file.



2. Sorting quadripoles. Menu-Save-Sorting-Syscal-Pro or AB lengths.



Now we have optimized protocol file for 4x21 cable set. We need to convert it in XML protocol file for Terrameter LS. **The fourth step** is creating XML file.

1. We need to open protocol and Save in ORG format of ABEM.

Read ElectreII sequence in TXT format	Configuration of array
Load Save Exchange Options Contours About	
□ ● · · ●       ■ ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ●	2x21RemateC2 2x32
AB/2 length (1 /) from / 5 to 185 Overlappin Quadripoles Inerged R: bd - G /workdir/Hoeaa nanka/ Name of spead file (cable set)	4x21RemoteC2         4x16           8 DWN

We do not need change number of channels in Long or short Dialog. It was important for SAS4000 ABEM unit. But we have to indicate correct spread file in ORG file.

4x21.adr - 4 electrodes array for 4x21 cable set

- 4x21RemoteC2.adr pole-dipole array for 4x21 cable set
- 2x21.adr 4 electrodes array for 2x21 cable set
- 2x21RemoteC2.adr pole-dipole array for 2x21 cable set

The correct spread file depends on cable set (2x21, 4x21, 4x16, 2x32 etc) and four or three electrodes array.

		merg	ed.o	rg —	- Блок	нот			
	<u>Ф</u> а	йл <u>(</u>	<u>]</u> pae	зка	Фор <u>м</u>	<u>і</u> ат	<u>В</u> ид	<u>С</u> правка	
	10	Sch	lun	ıbeı	rger	(A	MNB)		
(	4x2	21.a	.dr						
	3	2	1	_7					
	5	- 7	1	11					
	5	- 7	3	9					
	7	9	1	15					
1	7	9	3	13					
	7	9	5	11					
	9	11	1	19					
	9	11	3	17					
			-	-					

We could also indicate correct spread file in ORG file on the second line of ORG file.

2. Use *Terrameter LS Toolbox* software to convert ORG file in XML file.



File 4x21.adr does not exist. It results that error messages will be issued, but it does not mean that there is any error in the protocol file. See "6.2 Conversion of ORG to XML Protocol file" in the manual of *Terrameter LS Toolbox*.

Terrameter LS Toolbox	X
ERROR: The address file 4x21.ADR not found!	
	ОК
Terrameter LS Toolbox	, X (
ERROR: Failed to read G:\workdir\Новая папк Cannot check that protocol matches address fi	a\4x21.ADR! le!
	ОК

Finally we received protocol XML file with correct spread name, which could be used with **Terrameter LS** and it could be read by *x2ipi* software also.

```
<?xml version="1.0" encoding="UTF-8"?>

    <Protocol>

     <Name> merged </Name>
     <Description> A description of the protocol can be written here </Description>
     <Arraycode> 7 </Arraycode>
     <SpreadFile> 4x21.xml </SpreadFile>
   - <Sequence>
       - <Measure>
            <Tx> 3 5 </Tx>
            <Rx> 1 7 </Rx>
        </Measure>
      - <Measure>
            <Tx> 5 7 </Tx>
            <Rx> 1 11 </Rx>
            <Rx> 3 9 </Rx>
         </Measure>

    <Measure>

            <Tx>79</Tx>
            <Rx> 1 15 </Rx>
            <Rx> 3 13 </Rx>
            <Rx> 5 11 </Rx>
         </Measure>
```

Note! There is not information about inter-electrode spacing in XML or ORG files.

## 1.2. Read field data of Terrameter LS

Terrameter LS Toolbox software can export field data txt format, which can be read by x2ipi software



Use Data from ABEM (txt) format to read data from Terrameter LS Toolbox software.

Syscal data (\*.0\*; \*.mod) Syscal sequences (\*.seq) Sens2Dinv (\*.ars;\*.imp;\*.ui) Res2dInv format (\*.dat; \*.inv) ABEM data (AMP format) (\*.amp) ABEM protocol (ORG) (\*.org;\*.up;\*.dwn) Data from Prosys (Iris Instruments) (\*.txt) SEQ from Electre II (Iris Instruments) (\*.txt) Data from Syscal-Pro (Prosys) (\*.txt) Data in Geosoft IPDATA format (\*.dat) Data from ABEM (txt) (\*.txt)