UCTE data exchange format for load flow and three phase short circuit studies (UCTE-DEF)

Version 1 (coming into force: 2003.09.01)
Version 2 (coming into force: 2007.05.01)

From ENTSO-E Task Team: „Network Modelling and Forecasting Tools“

Contents

Introduction 3

1 Node code structure 5

1.1 Sign definition of nodes 5
1.2 X-nodes on tie lines 6
1.3 UCTE country codes currently used and soon-to-be-used 6

2 Element-specific record structure 8

2.1 ##N (NODES) 8
2.2 ##L (LINES) 9
2.3 ##T (2 WINDINGS TRANSFORMERS) 10
2.4 ##R (2 WINDINGS TRANSFORMERS REGULATION) 11
2.5 ##TT (2 WINDINGS TRANSFORMERS WITH SPECIFIED PARAMETERS DEPENDING ON THE TAP POSITION) optional 12
2.6 ##E (EXCHANGE POWERS) optional 13

3 Direction of the optional active power flow 13

4 Regulation 14

4.1 Angle regulation 15
4.1.1 Asymmetrical, $\Theta \neq 90°$ 15
4.1.2 Asymmetrical, $\Theta = 90°$ (TYPE = ASYM) 16
4.1.3 Symmetrical (Type = SYMM) 17

Introduction

This document describes the UCTE format adopted for data exchange and provides all the necessary instructions about its use. The data refer to load flow and three phase short circuit studies and describe the interconnected extra high voltage network. Equivalent network elements should be avoided as much as possible. **Appendix 1** contains instructions and explanations about how to use this format.

The data are contained in an unformatted standard US ASCII file without any control characters moreover it is strictly forbidden to use diacritic signs. Only the current published version of the UCTE format is to be used. It is not allowed to add non defined information into the described sections of the file. The file is divided into blocks in which determined data are put successively in a defined manner:

The following blocks are defined:

- COMMENTS (C)
- NODES (N)
- LINES (L)
- 2 WINDINGS TRANSFORMERS (T)
- 2 WINDINGS TRANSFORMERS REGULATION (R)
- 2 WINDINGS TRANSFORMERS SPECIAL DESCRIPTION (optional) (TT)
- EXCHANGE POWERS (optional) (E)

Each block is introduced by a key line consisting of the two characters “##” and of the character given above in brackets. The end of a block is given by the next key line or the end of the file. No “end command” is to be used. The sequence of the blocks in the file is recommended as above.

The information of the above defined blocks is written in lines and the contents are separated by a blank. This blank (empty space) has to be respected strictly.

The comment block “##C” at the top of data should describe at least the provider of the file and the reference point of the data. Additional comment blocks introduced by „##C“ and containing comment lines may be given at any place of the file.

Each description of a regulated 2 windings transformer (##T) needs a description of a 2 windings transformer regulation (##R). Three winding transformers, which are described with help of three independent two winding transformers can have the regulation on only one of them.

Format version identification

Inside the file it is necessary to have an identification of the used format version in order to ensure an automatic processing of the data. The key line of the comment block “##C” is extended with a supplementary information as follows:

##C YYYY.MM.DD

The date is the format version identification and has to be identical to the last date given in the title page (coming into force: YYYY.MM.DD).

For the format used before 01.09.2003 no date is to be given in the key line of the comment block (only ##C).

File name convention

The file name convention is:

<yyyymmdd>_<HHMM>_<TY><w>_<cc><v>.uct with

yyyymmdd: year, month and day,

HHMM: hour and minute,

TY. File type: FO = Forecast, SN = Snapshot, RE = Reference, LR = Long Term Reference,

w: day of the week, starting with 1 for Monday,

cc: the ISO country-code for national datasets, “UC” for UCTE-wide merged datasets without X nodes and “UX” for UCTE-wide merged datasets with X nodes,

v: version number starting with 0.

1 Node code structure

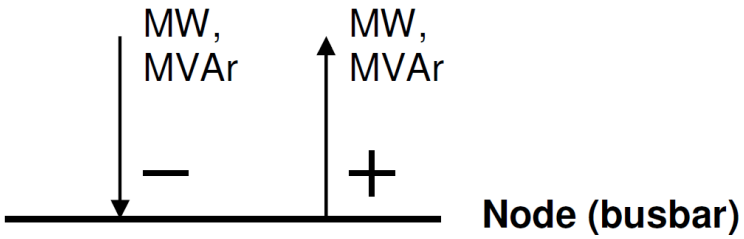
Within the „NODES“ block ”##N”, key lines consisting of the three characters „##Z“ and the ISO country identification (2 characters) must be introduced. Those key lines assign all following nodes to that country (e.g. ##ZAT for Austria).

The following 8-character alphanumeric code is used for identifying network nodes unequivocally.

1st character:	UCTE country code
2nd- 6th character:	short description of the geographical spot
7th character:	voltage level
8th character:	letter or figure for differentiating bus bars (optional)

It is recommended to choose an appropriate node name and to keep it for all the UCTE data exchanges.

1.1 Sign definition of nodes



Voltage level codes (7th character of the node)

0	750 kV
1	380 kV
2	220 kV
3	150 kV
4	120 kV
5	110 kV
6	70 kV
7	27 kV
8	330 kV
9	500 kV

1.2 X-nodes on tie lines

Fictitious nodes are located at the **electric middle** of each tie line. The defined Xnodes are binding for all users. **Appendix 2** describes all the X-nodes connecting the UCTE control blocks/areas. The Appendix 2 has its own version number because the X-nodes change more often and have to be updated independently of the UCTE format.
The X-nodes block starts with record ##ZXX.

1.3 UCTE country codes currently used and soon-to-be-used

Country code nodes (1st character of the node)

ISO code (to be used in the ##N section for ##Z and in the ##E section)

#	country	name	country code nodes	ISO code
1	A	Österreich (Austria)	O	AT
2	AL	Shqiperia (Albania)	A	AL
3	B	Belgique (Belgium)	B	BE
4	BG	Bulgarija (Bulgaria)	V	BG
5	BiH	Bosna i Hercegovina (Bosnia and Herzegovina)	W	BA
6			3	
7	CH	Schweiz (Switzerland)	S	CH
8	CZ	Ceska Republika (Czech Republic)	C	CZ
9	D	Deutschland (Germany)	D	DE
10	DK	Danmark (Denmark)	K	DK
11	E	Espana (Spain)	E	ES
12	F	France (France)	F	FR
13	GB	Great Britain (Great Britain)	5	GB
14	GR	Hellas (Greece)	G	GR
15	H	Magyarorszag (Hungary)	M	HU
16	HR	Hrvatska (Croatia)	H	HR
17	I	Italia (Italy)	I	IT
18	IRL	Ireland	4	IE
19	L	Luxembourg (Luxemburg)	1	LU
20	LT	Lietuva (Lithuania)	6	LT
21	MA	Maroc (Morocco)	2	MA
22	MD	Moldava (Moldavia)	7	MD
23	MK	Makedonija (FYROM)	Y	MK
24	N	Norge (Norway)	9	NO
25	NL	Nederland (Netherlands)	N	NL
26	P	Portugal (Portugal)	P	PT
27	PL	Polska (Poland)	Z	PL
28	RKS	Kosova (Kosovo)*	_	XK[1]
29	RO	Romania (Romania)	R	RO
30	S	Sverige (Sweden)	8	SE
31	SK	Slovensko (Slovakia)	Q	SK
32	SLO	Slovenija (Slovenia)	L	SI
33	TR	Türkiye (Turkey)	T	TR
34	UA	Ukraina (Ukraine)	U	UA
35	MNE	Crna Gora (Montenegro)	0	ME
36	SRB	Srbija (Serbia)	J	RS
37	--	Fictitious border node	X	XX

[1] *For the file name convention of Kosovo* the used code is “KS” – ex: 20260521_1030_FO4_KS0*

2 Element-specific record structure

2.1 ##N (NODES)

columns	type	length	contents
1-8	character	8	Node (code)
9	character	1	
10-21	character	12	Node (geographical name)
22	character	1	
23	integer	1	Status: 0 = real, 1 = equivalent
24	character	1	
25	integer	1	Node type code (0 = P and Q constant (PQ node); 1 = Q and θ constant, 2 = P and U constant (PU node), 3 = U and θ constant (global slack node, only one in the whole network))
26	character	1	
27-32	real	6	Voltage (reference value, 0 not allowed) (kV)
33	character	1	
34-40	real	7	Active load (MW)
41	character	1	
42-48	real	7	Reactive load (Mvar)
49	character	1	
50-56	real	7	Active power generation (MW)
57	character	1	
58-64	real	7	Reactive power generation (Mvar)
65	character	1	
66-72	real	7	Minimum permissible generation (MW) *
73	character	1	
74-80	real	7	Maximum permissible generation (MW) *
81	character	1	
82-88	real	7	Minimum permissible generation (Mvar) *
89	character	1	
90-96	real	7	Maximum permissible generation (Mvar) *
97	character	1	
98-102	real	5	Static of primary control (%) *
103	character	1	
104-110	real	7	Nominal power for primary control (MW) *
111	character	1	
112-118	real	7	Three phase short circuit power (MVA) **
119	character	1	
120-126	real	7	X/R ratio () **
127	character	1	
128	character	1	Power plant type * (H: hydro, N: nuclear, L: lignite, C: hard coal, G: gas, O: oil, W: wind, F: further)
129	character	1	

* optional ** only on demand

2.2 ##L (LINES)

columns	type	length	contents
1-8	character	8	Node 1 (code)
9	character	1	
10-17	character	8	Node 2 (code)
18	character	1	
19	character	1	Order code (1, 2, 3 ... 9, A, B, C ... Z)
20	character	1	
21	integer	1	Status (0, 1, 2 or 7, 8, 9) *
22	character	1	
23-28	real	6	Resistance R (Ω)
29	character	1	
30-35	real	6	Reactance X (Ω) **
36	character	1	
37-44	real	8	Susceptance B (µS)
45	character	1	
46-51	integer	6	Current limit I (A)
52	character	1	
53-64	character	12	Element name (optional) ***
65	character	1	

*) 0: real element **in** operation (R, X only positive values permitted)
8: real element **out** of operation (R, X only positive values permitted)

1: equivalent element **in** operation
9: equivalent element **out** of operation

2: busbar coupler **in** operation (definition: R=0, X=0, B=0)
7: busbar coupler **out** of operation (definition: R=0, X=0, B=0)

**) the absolute value of the reactance for lines has to be greater than or equal to 0.050 Ω (to avoid division by values near to zero in load flow calculation)

***) in case of tie line the element name has to be the same as used in Appendix 2

Remarks:

1. All nodes of the “LINES” description must be defined in the “NODES” block indifferently whether the line is declared out of operation or not.

2. All lines must be defined in the “LINES” block, indifferently whether the line is declared out of operation or not. In the “LINES” block, the tie lines are to be given grouped together in a section.

2.3 ##T (2 WINDINGS TRANSFORMERS)

columns	type	length	contents
1-8	character	8	Node 1 (code) (non-regulated winding)
9	character	1	
10-17	character	8	Node 2 (code) (regulated winding)
18	character	1	
19	character	1	Order code (1, 2, 3 ... 9, A, B, C ... Z)
20	character	1	
21	integer	1	Status (0, 1 or 8, 9) **
22	character	1	
23-27	real	5	Rated voltage 1: non-regulated winding (kV)
28	character	1	
29-33	real	5	Rated voltage 2: regulated winding (kV)
34	character	1	
35-39	real	5	Nominal power (MVA)
40	character	1	
41-46	real	6	Resistance R (Ω) *
47	character	1	
48-53	real	6	Reactance X (Ω) * ***
54	character	1	
55-62	real	8	Susceptance B (µS) *
63	character	1	
64-69	real	6	Conductance G (µS) *
70	character	1	
71-76	integer	6	Current limit I (A) *
77	character	1	
78-89	character	12	Element name (optional)
9	character	1	

*) pertaining to the rated voltage of the non-regulated winding 1 of the transformer

) 0: real element **in operation (R, X only positive values permitted)
8: real element **out** of operation (R, X only positive values permitted)

1: equivalent element **in** operation
9: equivalent element **out** of operation

**) the absolute value of the reactance for lines has to be greater than or equal to 0.050 Ω (to avoid division by values near to zero in load flow calculation)

***) the absolute value of the reactance for transformers has to be greater than or equal to 0.050 Ω (to avoid division by values near to zero in load flow calculation)

Remarks:

1. All nodes of the “TRANSFORMERS” description must be defined in the “NODES” block indifferently whether the transformer is declared out of operation or not.

2.4 ##R (2 WINDINGS TRANSFORMERS REGULATION)

columns	type	length	contents	
1-8	character	8	Node 1 (code) (non-regulated winding)	
9	character	1		
10-17	character	8	Node 2 (code) (regulated winding)	
18	character	1		
19	Integer	1	Order code (1, 2, 3 ... 9, A, B, C ... Z)	
20	character	1		
21-25	Real	5	δu (%)	
26	character	1		
27-28	integer	2	n	
29	character	1		Phase regulation
30-32	Integer	3	n’	
33	character	1		
34-38	real	5	U (kV) (optional)	
39	character	1		
40-44	real	5	δu (%)	
45	character	1		
46-50	real	5	Θ (°)	
51	character	1		
52-53	Integer	2	n	
54	character	1		Angle regulation
55-57	Integer	3	n’	
58	character	1		
59-63	real	5	P (MW) (optional)	
64	character	1		
65-68	character	4	Type (ASYM: asymmetrical, SYMM: symmetrical)	
69	character	1		

U (kV) (optional): On load tap changer voltage target for node 2 (V_2 or U_L).
P (MW) (optional): On load tap changer active power flow target.

Remarks:

1. For each transformer, columns 1 to 19 have to be the same in the ##R card as in the ##T card.

2. n = number of taps, counted the following way: it is the difference between the intermediate position (neutral) and the positive or negative ultimate position (e.g. a transformer with total 27 taps (+13, neutral, -13) is given as n = 13 in the UCTE format).

2.5 ##TT (2 WINDINGS TRANSFORMERS WITH SPECIFIED PARAMETERS DEPENDING ON THE TAP POSITION) optional

columns	type	length	contents
1-8	Character	8	Node 1 (code) (non-regulated winding)
9	Character	1	
10-17	Character	8	Node 2 (code) (regulated winding)
18	Character	1	
19	Character	1	Order code (1, 2, 3 ... 9, A, B, C ... Z)
20	Character	1	
23-25	Integer	3	Tap position (n’)
26	Character	1	
27-32	Real	6	Resistance R at tap n’ (Ω)*
33	Character	1	
34-39	Real	6	Reactance X at tap n’ (Ω)*
40	Character	1	
41-45	Real	5	Δu at tap n’ (%)
46	Character	1	
47-51	Real	5	Phase shift angle α at tap n’ (°) (0° for phase regulation)
52	Character	1	

*) pertaining to the rated voltage of the non-regulated winding 1 of the transformer

Remarks:

1. For each transformer, columns 1 to 19 have to be the same in the ##TT card as in the ##T card.

2. The parameters of all transformers given in this section (accurate modelling) are ALREADY defined in the ##T and ##R sections (simplified modelling).

    - In the simplified modelling, R and X do not depend on the tap position, and the additional voltage Δu is implicitly given by the formula Δu = n’ δu.

    - In the accurate modelling, R and X depend on the tap position and the additional voltage Δu is given explicitly for each tap position.

3. One line per tap position is needed in the ##TT section.

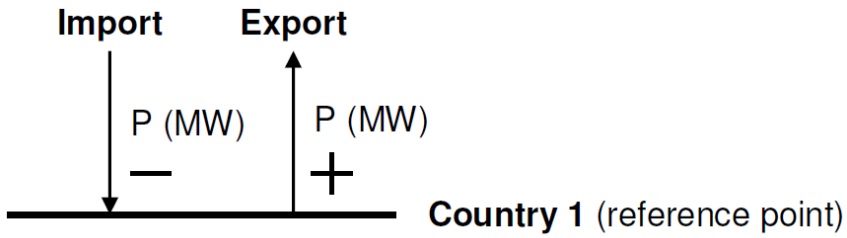
2.6 ##E (EXCHANGE POWERS) optional

columns	type	length	contents
1-2	Character	2	Country 1 * (ISO code)
3	Character	1	
4-5	Character	2	Country 2 ** (ISO code)
6	Character	1	
7-13	Real	7	P (MW) scheduled active power exchange ***
14	Character	1	
15-26	Character	12	Comments (optional)

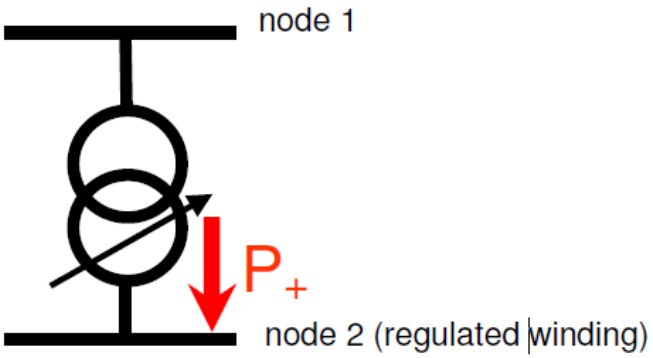
*) country 1 is provider of the data and the reference point for sign definition of P (MW)

**) one line for each bilateral scheduled active power exchange

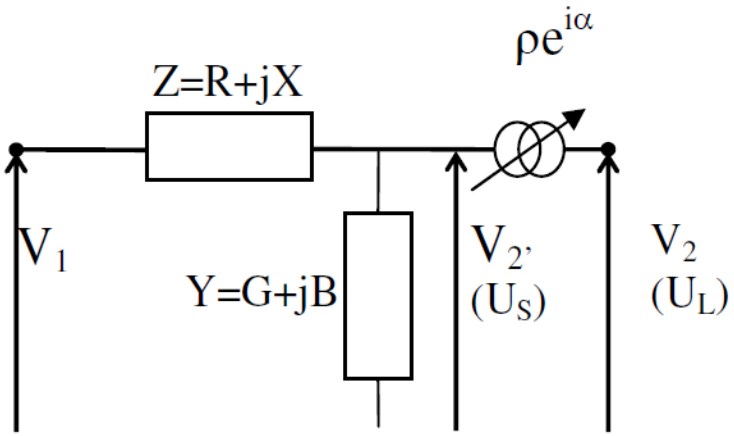
***) sign definition of Export / Import



3 Direction of the optional active power flow



4 Regulation



Node 2 contains the regulated winding.

$V_2' = \rho e^{i\alpha} V_2$

$U_S = \rho e^{i\alpha} U_L$

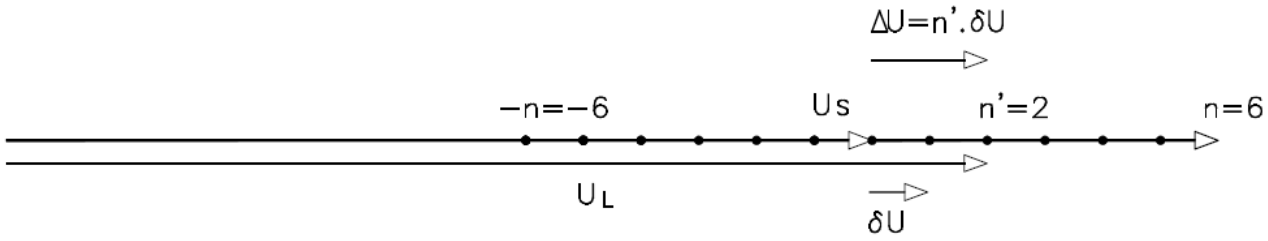
U_S : source voltage [kV]

U_L : load voltage [kV]

α : phase angle shifting

ρ: transformation ratio

Phase regulation

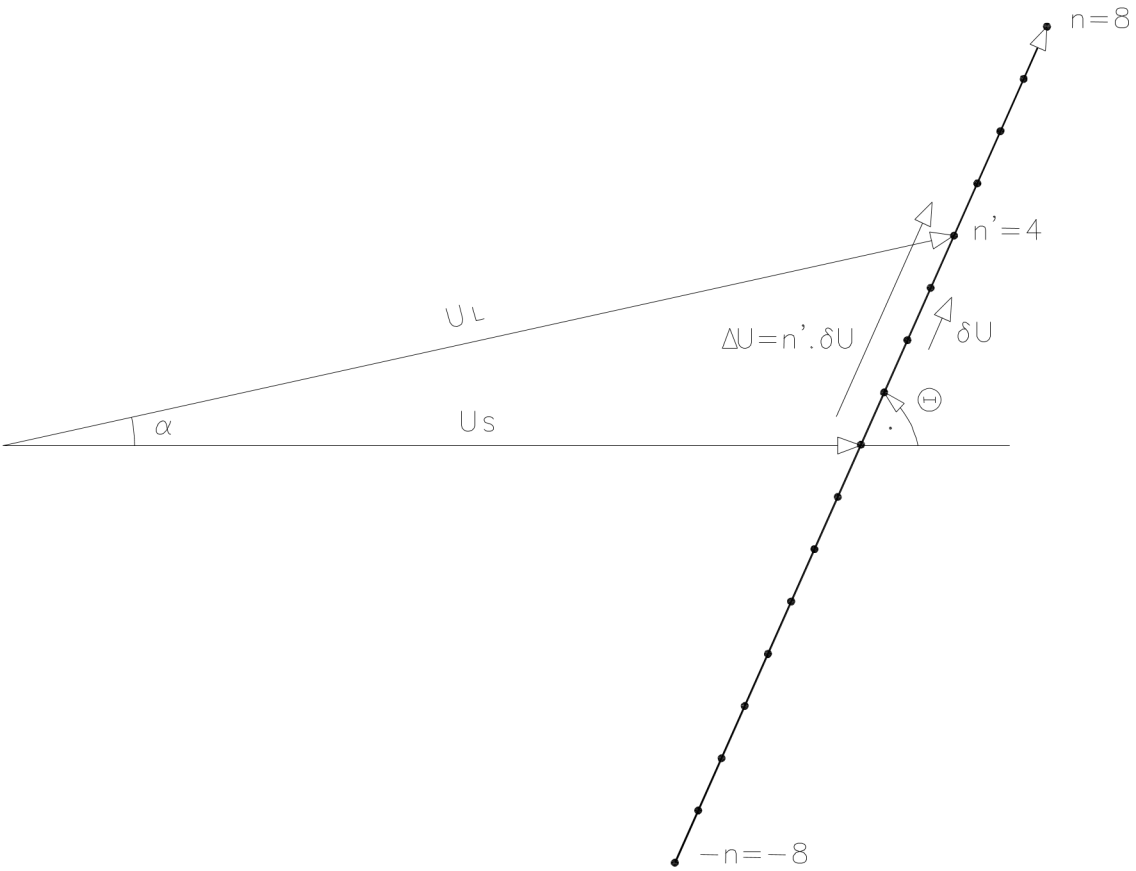


$\alpha = 0°$

$\rho = \frac{1}{1 + n'\delta u}$

4.1 Angle regulation

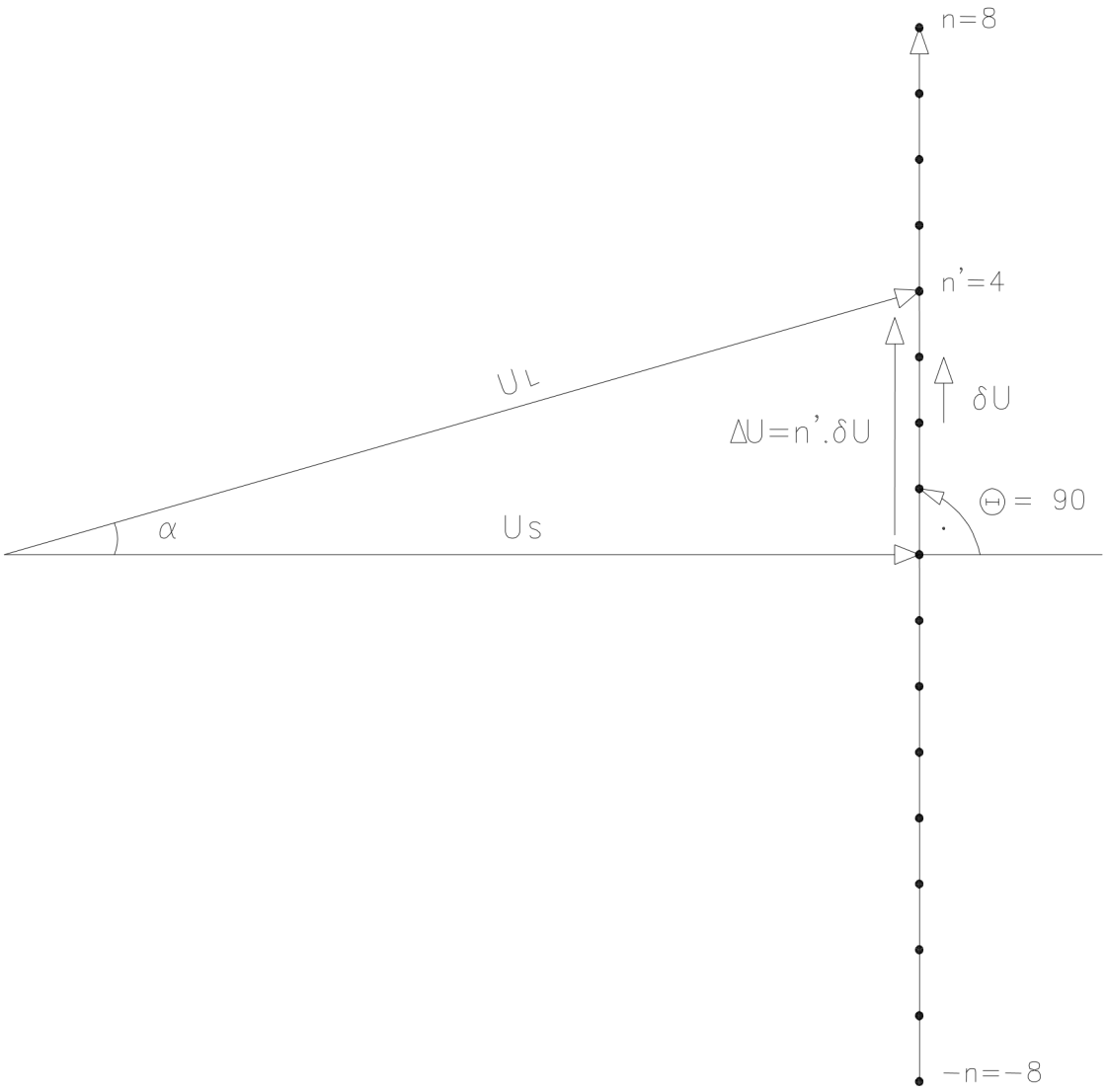
4.1.1 Asymmetrical, Θ ≠ 90°



$$\alpha = arctan\left(\frac{n'\delta u\ sin\ \Theta}{1 + n'\delta u\ cos\Theta}\right)$$

$$\rho = \frac{1}{\sqrt{(n'\delta u\ sin\Theta)^2 + (1 + n'\delta u\ cos\Theta)^2}}$$

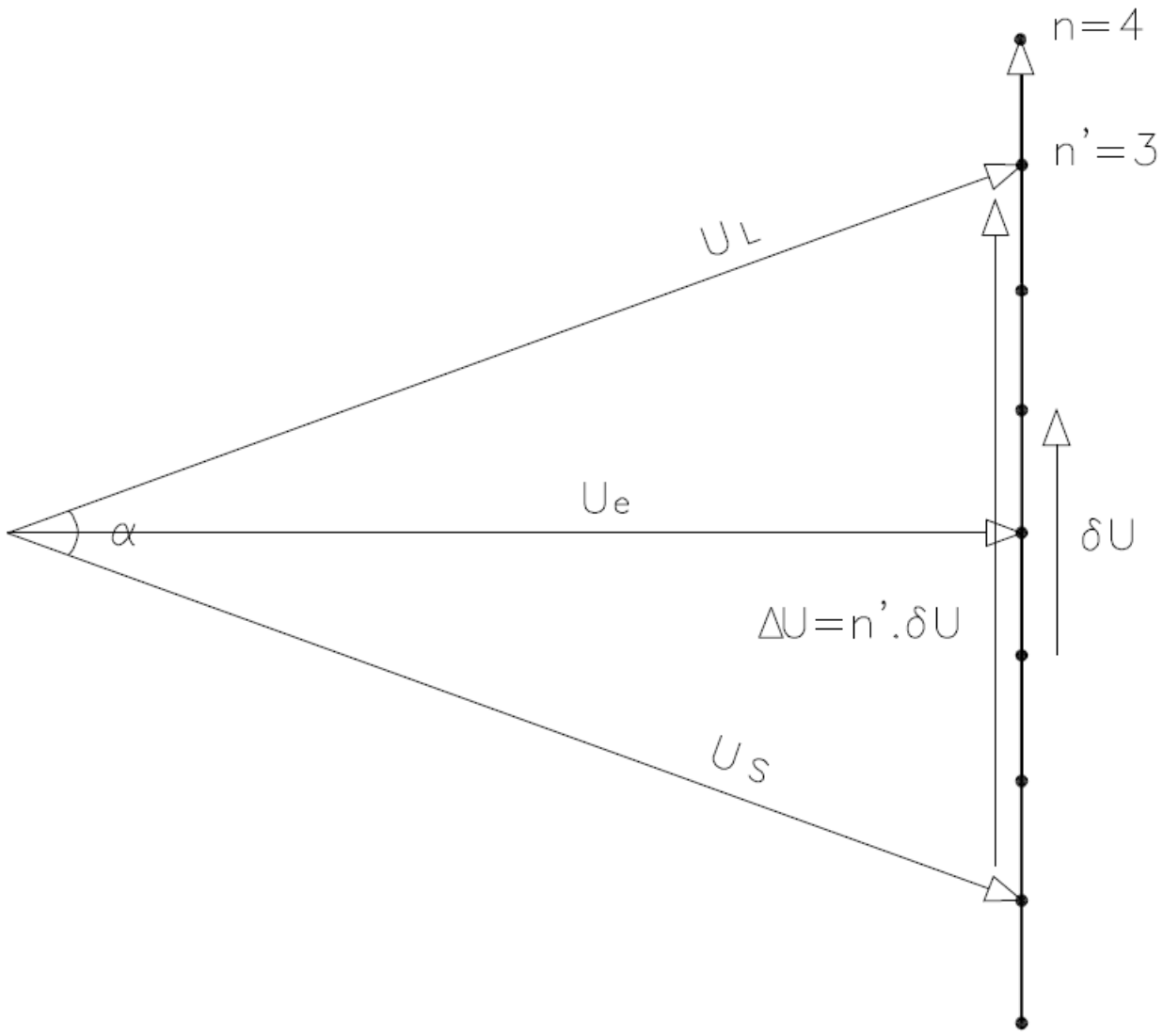
4.1.2 Asymmetrical, Θ = 90° (TYPE = ASYM)



$$\alpha = arctan(n'\delta u)$$

$$\rho = \frac{1}{\sqrt{(n'\delta u)^2 + 1}}$$

4.1.3 Symmetrical (Type = SYMM)



$$\alpha = 2arctan\frac{n'\delta U}{2U_e} = 2arctan\frac{n'\delta u}{2}$$

$$\rho = 1$$

U_e: central voltage [kV]