



TELENOR

SPECIFICATION

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Requirements for equipment to be connected to the local sub-loop in the access network of Telenor. Equipment providing VDSL or VDSL2 and PSTN or ISDN Basic Access services, full unbundled access (service type F_{DF})

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Abstract : Requirements for the equipment of an Operator leasing copper pairs in the access network of Telenor in order to provide VDSL services

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TELENOR SPECIFICATION		
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1 Scope

This specification gives requirements for equipment owned by Operator intended for connection to copper pairs in the access network of Telenor. The requirements apply for equipment supplying VDSL, VDSL2 or G.fast and PSTN or ISDN Basic Access (BA) services on one copper pair.

The Operator is responsible that the equipment is in conformance to this specification.

For equipment to be installed in Telelosji the formulary 'Statement of Compliance' in annex 2 shall be completed and forwarded to Telenor.

2 References

This specification incorporates by dated or undated references, provisions from other publications/standards. These normative references are cited at the appropriate places in the text and the references are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this specification only when incorporated in it by amendment or revision. For undated references, including amendments, the last edition of the document referred to applies.

2.1 Normative references

- [1] ITU-T Recommendation G.993.2 Very high speed digital subscriber line transceivers 2 (VDSL2)
- [2] ETSI TS 101270-1 V1.4.1 (2005-10): "*Transmission and Multiplexing (TM); Access transmission systems on metallic access cables; Very high speed Digital Subscriber Line (VDSL); Part 1: Functional requirements*"
- [3] ETSI TS 101270-2 V1.4.1 (2005-10): "*Transmission and Multiplexing (TM); Access transmission systems on metallic access cables; Very high speed Digital Subscriber Line (VDSL); Part 2: Transceiver specification*"
- [4] ETSI TS 101 952-2 V1.1.1 (2010-11) "Access, Terminals, Transmission and Multiplexing (ATTM); Access network xDSL splitters for European deployment; Part 2: Generic specification of xDSL over ISDN splitters and xDSL universal splitters"
- [5] Telenor Specification OA 100: "*General requirements for equipment to be connected to the local loop in the access network of Telenor and/or material and equipment to be installed and operated in Telelosji*"
- [6] Telenor Specification OA 101: "*Requirements for equipment to be connected to the local loop in the access network of Telenor. Equipment providing PSTN services, full unbundled access (service type A_{AF})*"
- [7] Telenor Specification OA 102: "*Requirements for equipment to be connected to the local loop in the access network of Telenor. Equipment providing ISDN Basic Access services or 160 kbit/s digital transmission, full unbundled access (service type B_{AF})*"
- [8] Telenor Specification OA 106: "*Requirements for equipment to be connected to the local loop in the access network of Telenor. Equipment providing VDSL services, full*"

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unbundled access (Service type F_{AF})”

- [9] ITU-T G.997.1 Recommendation Physical layer management for digital subscriber line transceivers
- [10] ITU-T G.993.5 Self-FEXT cancellation (vectoring) for use with VDSL2 transceivers
- [11] ITU-T G.9700 Fast access to subscriber terminals (G.fast) - Power spectral density specification
- [12] ITU-T G.9701 Fast access to subscriber terminals (G.fast) - Physical layer specification

2.2 Informative references

- [13] Telenor Specification OA 206: *“Requirements for equipment to be connected to the local loop in the access network of Telenor. Equipment providing VDSL and PSTN or ISDN Basic Access services, shared access (Service type F_{AD})”*
- [14] Telenor Specification OA 406: *“Requirements for equipment to be connected to the local sub-loop in the access network of Telenor. Equipment providing VDSL and PSTN or ISDN Basic Access services, shared access (Service type F_{DD})”*
- [15] Telenor Nett Specification A59 (2001-05): *“Access to copper pairs in the access network of Telenor. Specification of the network side of the user-network interface”*

3 Definitions and abbreviations

Teleloşji	Colocation at the premises of Telenor
Operatøraksess	Operators’ access to the access network of Telenor
ADSL	Asymmetric Digital Subscriber Line
DMT	Discrete Multi-Tone
DPBO	Downstream Power Back Off
SCM	Single Carrier Multiplexing
DB	Distribution Box
MDF	Main Distribution Frame
NTP	Network Termination Point
NTU	Network Termination Unit
UPBO	Upstream Power Back Off
VDSL	Very high-speed Digital Subscriber Line
VTU-O	VDSL transceiver unit located at telecommunication centre
VTU-R	VDSL transceiver unit at subscriber

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4 Application

This specification applies to VDSL or G.fast systems provided by an Operator. The access node is placed in the vicinity of a distribution box (DB) and the VDSL transceiver unit (VTU-R) at the subscriber's premises as shown in figure 1. Internal connections and cables within the distribution box owned by Telenor must be established by use of the Telelosji service (co-location).

A one pair transmission system shall be used. The system shall be designed to allow for simultaneous transmission of PSTN or ISDN Basic Access (BA) services on the same pair. However, it is optional to the Operator whether he wants to deliver these services or not. (The stippled line between MDF and DB in figure 1 is indicating the main cable infrastructure. This is for information only).

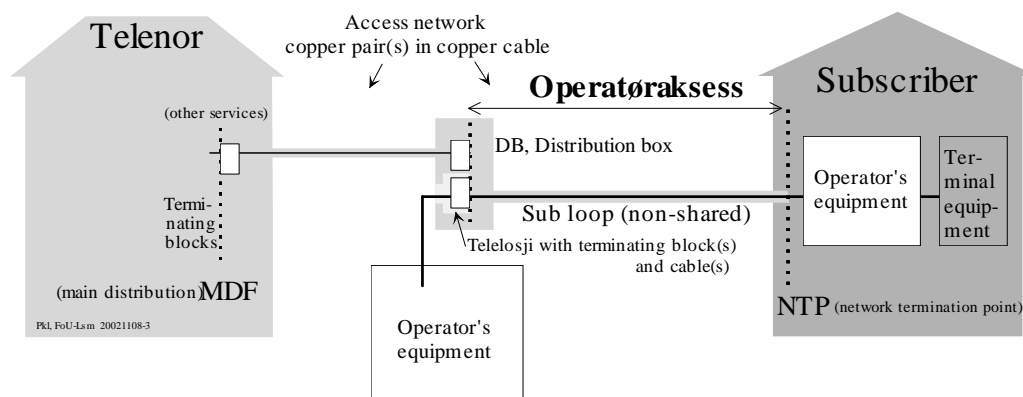


Figure 1 Configuration of the access network.

5 General requirements

All installed equipment operating in Telelosji or used for Operatøraksess shall fulfill requirements stated in Telenor Specification OA 100 [4] related to:

- Safety
- Environmental conditions
- Documentation.

6 Transmission system

The transmission system shall be based on ITU-T G.993.2 [1]. The transmission method of the VDSL transceivers utilizes a frequency division multiplex for simplex transmission in separate frequency windows. Moreover the lowest frequency band may be used either for PSTN (see 6.2) or for ISDN basic access (see 6.3).

6.1 Use of frequency bands for the VDSL transceivers.

The band plans to be applied to the access network of Telenor Norway is defined according to ITU-T G.993.2 Annex B (European specifications) with a specific frequency range defined by frequency plan 998.

The frequency usage should be allocated as:

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*) If 17MHz bandplan is implemented upper band edge of DS3 is 17664 kHz

***) If Annex M is implemented lower band of U0 is 25.875kHz

Direction: VTU-O to VTU-R	
DS1	2208 – 3750 kHz
DS2	5200 – 8500 kHz
DS3	120000 – 24890 kHz *)
Direction: VTU-R to VTU-O	
US0	120 – 276 kHz **)
US1	3750 – 5200 kHz
US2	8500 – 12000 kHz
US3	24890 – 30000 kHz

Table 1 Frequency bands for VDSL transceivers.

6.1.1 Multi-carrier modulation method of VDSL transceivers

ITU-T G993.2 clause 10, details a transmission method utilizing many carriers with a spacing of 4,3125 kHz in each frequency band (8,625 kHz for some profiles).

6.2 Requirements for a base-band PSTN service

If PSTN services (service type A) are present on the same cable pair, the requirements given in Telenor Specification OA 101 [6] apply. The requirements apply at the interface between the splitter and the copper cable of Telenor. Any splitter used shall comply with requirements in 7.6.

6.3 Requirements for a base-band ISDN basic access service

If ISDN Basic Access or 160 kbit/s digital transmission services (service type B) are present on the same cable pair, the requirements given in Telenor Specification OA 102 [7] apply. The requirements apply at the interface between the equipment and the splitter. The splitter shall comply with the requirements given in 7.6.

7 Electrical characteristics

7.1 Remote feeding

Remote feeding of the VDSL equipment at the subscriber's premises is not allowed.

7.2 Transmitter/receiver impedance and return loss

A reference impedance according to ETSI TS 101270-1 [2], sub-clause 8.1.1, shall be used to measure the return loss of the VDSL modem. The return loss shall be at least 12 dB for all VDSL frequencies (refer to ETSI TS 101270-1 [2], sub-clause 8.1.2) when separate (successive) measurements are done with both:

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- 135 ohms
- 100 ohms.

For a limited period the requirements may be accepted with qualified measurements done only with 135 ohms reference.

7.3 Transmit spectral masks

Transmit spectral masks are given in 7.3.1 and 7.3.2.

The frequency domain used for VDSL2 overlaps with some of the frequency bands allocated for amateur radio. Information is given in ITU-T G.993.2 [1]. Any observed and conflicting electromagnetic interference originating from VDSL systems – most likely to be present where aerial cables are deployed – should be brought to Telenor’s attention.

7.3.1 Transmit spectral mask of VTU-O

The transmit mask for VTU-O shall comply with ITU-T G.993.2 [1] Table B-7 – optional PSD-mask B8-5, B8-6, B8-10, B8-12, B8-15 and B8-17 is only allowed in the frequency area above 2208 kHz. **Be aware, no downstream PSD is allowed in the frequency area below 2208 kHz in sub-loop implementations unless DPBO as described in 8.1 is applied.**

7.3.2 Transmit spectral mask of VTU-R

The transmit mask for VTU-R shall comply with ITU-T G.993.2 [1] Table B-7 – optional PSD-mask B8-5, B8-6, B8-10, B8-12, B8-15 and B8-17.

Upstream power back-off (UPBO) shall be enabled and performed by the VTU-R to improve spectral compatibility between VDSL2 systems on loops of different lengths deployed in the same binder according to the Power back-off mechanism procedure defined in ITU-T G.993.2 [1], sub-clause 7.2.1.3.

Two methods for upstream power back-off methods are defined:

- the Reference PSD UPBO method
- the Equalized FEXT UPBO method (optional)

The equalized FEXT UPBO method is for further considerations.

The Alien crosstalk profile referred as ETSI C as defined by ETSI TS 101 270 [2] sub-clause 8.1.6.1 Table 13 shall be used.

The following values of *a* and *b* are set for spectrum profile definition,

dBm/Hz	<i>A</i>	<i>b</i>
US0	40	0
US1	47,3	21,14
US2	54	16,29
US3	56,5	6,3

Table 7-1 UBPO PSD references

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7.4 Wideband launch power

The wideband launch power of VTU-O and for VTU-R shall comply with ITU-T G.993.2 [1] Table 6-1 – VDSL2 profile defined by 8d, 8c, 12a, 12b, 17a and 30a, +14.5 dBm.

7.5 Unbalance about earth, transmitter/receiver

The unbalance about earth, measured as longitudinal conversion loss (LCTL), shall be in accordance with ETSI TS 101 270-1 [1], sub-clause 8.1.3.

7.6 Requirements for universal splitter, PSTN/ISDN basic access

The splitter shall be in accordance with ETSI TS 101 952-2 [4].

8 Optional

8.1 Downstream Power Back Off

For deployment of VDSL systems on sub-loop DPBO according to G.997.1

7.3.1.2.13 Downstream power back-off – Shaped (DPBOSHAPED) [9] can be applied using measured ESEL and constants found in Table 2. See G.997.1 Appendix II [9] for details.

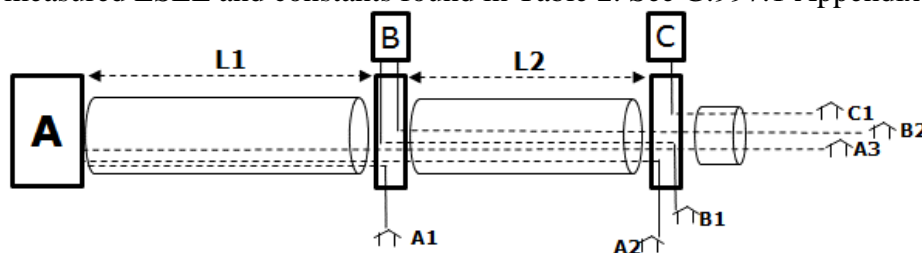


Figure 2 DPBO network model

Node A Central Office, B and C distribution points. L_x is the electrical length (@1MHz) between the distribution points.

ESEL (dB/1MHz) shall be measured for cables from Central Office (A) passing through the remote cabinet (B).

8.1.1 Values for DPBO modelling

Parameter	Value	Description
DPBOPSDMASKds	998ADE17-M2x-B	PSD [dBm/Hz] to be protected, VDSL2 Annex B, Type B.
DPBOESEL		Measured cable insertion loss [dB] / 1 MHz.
DPBOESCMA	0.0694599	E-side cable model parameter A.
DPBOESCMB	0.9019061	E-side cable model parameter B.
DPBOESCMC	0.0237878	E-side cable model parameter C.
DPBOMUS	-102	Assumed min. usable PSD mask of exchange signals at remote.(dBm/Hz)
DPBOFMIN	276	The lower bound on the DPBO frequency span. (kHz)
DPBOFMAX	17664	The upper bound on the DPBO frequency span. (kHz)

Table 2 DPBO values

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8.1.2 Multiple cables from CO to remote cabinet.

If ESEL in cables going from Central Office (A) and through the remote cabinet differ (L1a \neq L1b) by more than the values in Table 3 contact Telenor. In this case, loops from A passing through the remote cabinet must be moved to one of the cables.

If the difference is within the limits in table Table 3 Allowed ESEL difference the average ESEL for all cables shall be used.

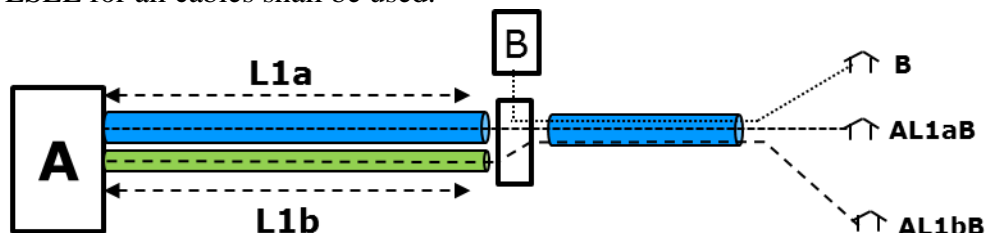


Figure 3 Multiple cables

ESEL (Highest ESEL)	Allowed difference dB/ 1 MHz
ESEL <12	2
12 > ESEL < 20	3
ESEL >20	5

Table 3 Allowed ESEL difference

8.1.3 Multiple nodes in a row

Multiple nodes in a row (such as VDSL2 from both node B and C in figure Figure 2) shall be avoided.

Multiple nodes in a row is only allowed when a single operator controls all nodes in the row.

All loops must be terminated on the closest upstream node.

Shaping shall be applied with regard to CO on all remote nodes.

8.2 Vectoring

In order to facilitate vectoring, G.993.5 [10], only a single vectoring entity can be placed in each node (B or C).

8.3 G.Fast

G.fast can only be deployed from remote node with full-unbundled access.

Only a single G.fast entity allowed in each node. Several G.fast nodes cannot share a binder due to vectoring, and TDD.

8.3.1 Transmission system.

The transmission system shall be in accordance with ITU-T G.9700 [11], G.9701[12] and their Amendments.

The lowest allowed frequency for G.fast, *f_{tr1}* is 23 MHz.

8.3.2 Transmit spectral masks

The frequency domain used for G.Fast overlaps with some of the frequency bands allocated for amateur radio. Information is given in ITU-T G.9700 [11]. Any observed and conflicting

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electromagnetic interference originating from G.fast systems – most likely to be present where aerial cables are deployed – shall be brought to Telenor’s attention.

The transmit mask for shall comply with ITU-T G.9700 Amendment 1. 7.2, [11]. 106 MHz (106a and 106b) and 212 MHz profiles as defined in G.9700 Amendment 1. Table 7.2 and Table 7.3.

8.3.3 UPBO

Use of UPBO and its setting is up to the operator to decide.

8.3.4 Time Division duplexing (TDD)

Selecting TDD parameters is up to the operator to decide.

8.3.5 Multiple nodes in a row

Multiple G.fast nodes in a row (such as G.fast from both node B and C in Figure 2) shall be avoided.

Multiple nodes in a row is only allowed when a single operator controls all nodes in the row.

All loops must be terminated on the closest upstream node.

Shaping shall be applied with regard to CO on all remote nodes.

8.4 REVERSE POWER

Use of reverse power is for further study.



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Annex 1: Document history

Edition	Published	Comments
1.0	01.07.26	First interim version
1.2	01.11.01	Kjell E. Sterten, TTS-NL-I-P
2.0	01.02.02	Kjell E. Sterten, TTS-NL-I-P
3.0	31.12.02	Jon Weberg, NL-I-AN
4.0	01.01 2004	Kjell E. Sterten, TN-NL-U-T
4.1	01.05 2004	Kjell E. Sterten, TN-NL-U-T
4.2	01.01 2005	Heidi Eide, TN-SMP
4.3	01.03 2005	Kjell E. Sterten, TN-NL-U-T
4.4	31.10 2005	Kjell E. Sterten, TNO-FX-PT-I&P
5.0	01.07 2007	Vidar Skovli, TNO-FX-BBP/A
5.1	26.08 2010	Vidar Skovli, SIT
5.2	01.02.2012	Erik Meltzer, SIT
5.3	01.10.2012	Erik Meltzer, SIT
5.4	31.01.2019	Erik Meltzer

STATEMENT OF COMPLIANCE

**TELENOR
Specification OA 306**

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Annex 2

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Date:

Operator:

System identification (vendor, model, type):

Connection to the access network of Telenor: Yes (direct) Indirect (aux. equip.).....

The given information is valid.

Date/Signature: _____

(sign.)

FC = Fully compliant NC = Non-compliance

Clause no.	Description	Statement of Compliance		Remarks and additional information	For internal use
		FC	NC		
1	Scope	<input type="checkbox"/>	<input type="checkbox"/>		
2	References				
2.1	Normative references	<input type="checkbox"/>	<input type="checkbox"/>		
2.2	Informative references	<input type="checkbox"/>	<input type="checkbox"/>		
3	Definitions and abbreviations	<input type="checkbox"/>	<input type="checkbox"/>		
4	Application	<input type="checkbox"/>	<input type="checkbox"/>		
5	General requirements	<input type="checkbox"/>	<input type="checkbox"/>		
6	Transmission system	<input type="checkbox"/>	<input type="checkbox"/>		
6.1	Use of frequency bands for the VDSL transceivers	<input type="checkbox"/>	<input type="checkbox"/>		
6.1.1	Multi-carrier modulation method of VDSL transceivers	<input type="checkbox"/>	<input type="checkbox"/>		
6.1.2	Single-carrier modulation method of VDSL transceivers	<input type="checkbox"/>	<input type="checkbox"/>		N/A
6.2	Requirements for a base-band PSTN service	<input type="checkbox"/>	<input type="checkbox"/>		
6.3	Requirements for a base-band ISDN basic access service	<input type="checkbox"/>	<input type="checkbox"/>		
7	Electrical characteristics				
7.1	Remote feeding	<input type="checkbox"/>	<input type="checkbox"/>		
7.2	Transmitter/receiver impedance and return loss	<input type="checkbox"/>	<input type="checkbox"/>		
7.3	Transmit spectral masks	<input type="checkbox"/>	<input type="checkbox"/>		
7.3.1	Transmit spectral mask of VTU-O	<input type="checkbox"/>	<input type="checkbox"/>		
7.3.2	Transmit spectral mask of VTU-R	<input type="checkbox"/>	<input type="checkbox"/>		
7.4	Wideband launch power	<input type="checkbox"/>	<input type="checkbox"/>		
7.5	Unbalance about earth, transmitter/receiver	<input type="checkbox"/>	<input type="checkbox"/>		
7.6	Requirements for universal splitter, PSTN/ISDN basic access (integrated or external)	<input type="checkbox"/>	<input type="checkbox"/>		
8	Optional				
8,1	Downstream Power Back Off	<input type="checkbox"/>	<input type="checkbox"/>		
8.1.1	Values for DPBO modelling	<input type="checkbox"/>	<input type="checkbox"/>		
8.1.2	Multiple cables from CO	<input type="checkbox"/>	<input type="checkbox"/>		

UPBO PSD-MASK LIMITS

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		FC	NC		
8.1.3	Multiple nodes in a row	<input type="checkbox"/>	<input type="checkbox"/>		
8.2	Vectoring	<input type="checkbox"/>	<input type="checkbox"/>		
8.3	G.Fast	<input type="checkbox"/>	<input type="checkbox"/>		
8.3.1	Transmission system	<input type="checkbox"/>	<input type="checkbox"/>		
8.3.2	Transmit spectral masks	<input type="checkbox"/>	<input type="checkbox"/>		
8.3.3	UPBO	<input type="checkbox"/>	<input type="checkbox"/>		
8.3.4	Time Division duplexing	<input type="checkbox"/>	<input type="checkbox"/>		
8.3.5	Multiple nodes in a row	<input type="checkbox"/>	<input type="checkbox"/>		

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UPBOMASK _{us}	U1		U2		U3	
998ADE Breakpoints (MHz)	3,75	5,2	8,5	12	25	30
Electrical length dB at 1 MHz	(dBm/Hz)	(dBm/Hz)	(dBm/Hz)	(dBm/Hz)	(dBm/Hz)	(dBm/Hz)
0	-84,7	-92,0	-98,0	-110,4	-84,5	-91,0
1	-82,8	-89,7	-95,1	-106,5	-79,5	-85,2
2	-80,9	-87,4	-92,2	-102,6	-74,5	-79,4
3	-78,9	-85,2	-89,2	-98,6	-69,5	-73,6
4	-77,0	-82,9	-86,3	-94,7	-64,5	-67,9
5	-75,1	-80,6	-83,4	-90,7	-59,5	-62,1
6	-73,1	-78,3	-80,5	-86,8	-56,5	-56,5
7	-71,2	-76,0	-77,6	-82,9	-56,5	-56,5
8	-69,2	-73,8	-74,7	-78,9	-56,5	-56,5
9	-67,3	-71,5	-71,8	-75,0	-56,5	-56,5
10	-65,4	-69,2	-68,8	-71,1	-56,5	-56,5
11	-63,4	-66,9	-65,9	-67,1	-56,5	-56,5
12	-61,5	-64,6	-63,0	-63,2	-56,5	-56,5
13	-59,6	-62,4	-60,1	-59,2	-56,5	-56,5
14	-57,6	-60,1	-57,2	-55,5	-56,5	-56,5
15	-55,7	-57,8	-54,8	-55,5	-56,5	-56,5
16	-53,8	-55,5	-54,8	-55,5	-56,5	-56,5
17	-51,8	-53,2	-54,8	-55,5	-56,5	-56,5
18	-51,2	-52,7	-54,8	-55,5	-56,5	-56,5
19	-51,2	-52,7	-54,8	-55,5	-56,5	-56,5
20	-51,2	-52,7	-54,8	-55,5	-56,5	-56,5
21					-56,5	-56,5
...					-56,5	-56,5