Correction Data

ROHDE&SCHWARZ

Subject: This document describes how to store antenna correction data sets within the flash file system.

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1. Important Note

This document refers to the following devices and firmware versions.

Device	**Version**
ESMD	V3.70 and later
DDF255	V3.70 and later
DDF550	V1.10 and later

2. History

2010-03-10 Creation

2011-05-04 Add DDF550 to devices.

2011-07-05 Azimuth correction (USERBLK_AZIMUT) can depend from the polarization now.
(version of ESMD/DDF255 >= V3.70 / DDF550 >= V1.10)
Added antenna codes for ADD_207, ADD_253_AP, ADD_295_AP

3. Correction Data

Correction data is used to compensate for certain factors which have their origins outside the device and affect the device's measurement results. The correction data is stored within the flash file system of the device.

Correction data comprises the following:

- Antenna factors

  Antenna factors are required to convert an antenna's measured level into field strength level.
  The correction data for the standard R&S DF and RX antennas are provided as part of the firmware. In the case of a user defined antenna, you can generate the required antenna factors yourself and store them within the flash file system.

- Cable attenuation

  Where higher frequencies and longer RF cables between the antenna and the device are involved, there is an additional attenuation of the antenna level. This additional attenuation can be corrected to allow for a precise field strength measurement.

- Azimuth correction

  In the case of a mobile direction finder, the carrier vehicle's reflection characteristics near the DF antenna result in a more or less pronounced disturbance of the wave field. To a certain extent, this disturbance is of a systematic nature. The vehicle's interference can largely be compensated for. The required correction data depends on the antenna, the frequency and the measured azimuth.

- Omni phase correction

  With antennas working on the Watson Watt principle, the carrier vehicle may cause an additional phase shift between the omni elements and the DF elements due to its reflection characteristics near the DF antenna. If the resulting phase difference exceeds +/- 90°, the DF value will be off by 180°. This kind of influence is of a systematic nature and can be corrected.

3.1. Generation of Correction Data

The generation of correction data is based on a set of ASCII files and a configuration file. The ASCII files are converted to a binary format with the "ASC2BIN32" tool and subsequently transferred to the device via FTP. The configuration file is used to combine a set of correction files to form a "correction set".

3.1.1. ASCII Files

ASCII files carry the extension ".asc" and contain human readable correction data of a specific type (e.g. antenna factors) for an antenna.

A comment is introduced by the '#' sign and ends at the end of a line.

Comments after a keyword (e.q. ID:, ALIGNMENT:, FORMAT:, …) are forbidden.

The max. length of a line is 76 characters.

Correction data is divided into individual blocks. Each file contains three mandatory blocks and one or more user blocks which depend on the type of correction data.

The following are mandatory blocks:

IDENTIFICATION_BLOCK :	the first block in a file
USERBLK_ANTENNA_IDENT:	the second block in a file
END_BLOCK:	the last block in a file

A detailed description of these blocks can be found in the next chapter.

Example correction files are included on the *firmware & utility* CD in the folder *Utilities*.

Do not use this files for regular operation !

3.1.1.A. ASCII File Structure

In terms of blocks, the ASCII files are structured as follows:

A) Antenna factors

In addition to the mandatory blocks, an ASCII correction data file containing antenna factors for an antenna includes one or more blocks of type USERBLK_ANT_FACTOR_RXDF for different antenna configurations.

```
# --------------------
# IDENTIFICATION_BLOCK
# --------------------

# ---------------------
# USERBLK_ANTENNA_IDENT
# ---------------------

# -----------------------
# USERBLK_ANT_FACTOR_RXDF
# -----------------------
```

```
# PASSIV, DF, VERT
# ----------------------

# ----------------------
# USERBLK_ANT_FACTOR_RXDF
# ----------------------
# ACTIVE, DF, VERT
# ----------------------
```

…

```
# ---------
# END BLOCK
# ---------
```

B) Cable attenuation

In addition to the mandatory blocks, an ASCII correction data file containing cable attenuation data for an antenna generally includes one block of type USERBLK_CABLE_ATTENUATION.

```
# --------------------
# IDENTIFICATION_BLOCK
# --------------------

# ---------------------
# USERBLK_ANTENNA_IDENT
# ---------------------

# --------------------------
# USERBLK_ CABLE_ATTENUATION
# --------------------------
# ALL, ALL, ALL
# ----------------------

# ---------
# END BLOCK
# ---------
```

C) Omni phase

In addition to the mandatory blocks, an ASCII correction data file containing omni phase data for an antenna includes one or more blocks of type USERBLK_OMNI_PHASE for different antenna configurations.

```
# --------------------
# IDENTIFICATION_BLOCK
# --------------------

# ---------------------
# USERBLK_ANTENNA_IDENT
# ---------------------

# ----------------------
# USERBLK_OMNI_PHASE
# ----------------------
# PASSIV, DF, VERT
```

```
# -----------------------

# -----------------------
# USERBLK_OMNI_PHASE
# -----------------------
# ACTIVE, DF, VERT
# -----------------------
```

…

```
# ---------
# END BLOCK
# ---------
```

D) Azimuth correction

In addition to the mandatory blocks, an ASCII correction data file for azimuth correction of an antenna includes exactly one block of type USERBLK_AZIMUT for each frequency point.

There must be at least two blocks of type USERBLK_AZIMUT: one to mark the beginning of the frequency range to be corrected, and one to mark its end.

```
# --------------------
# IDENTIFICATION_BLOCK
# --------------------

# ---------------------
# USERBLK_ANTENNA_IDENT
# ---------------------

# -----------------------
# USERBLK_AZIMUT
# -----------------------
# 20 MHz
# -----------------------

# -----------------------
# USERBLK_AZIMUT
# -----------------------
# 30 MHz
# -----------------------
```

…

```
# -----------------------
# USERBLK_AZIMUT
# -----------------------
# 1300 MHz
# -----------------------

# ---------
# END BLOCK
# ---------
```

3.1.1.B. Structure of the Data Blocks in an ASCII File

A) Identification block

The identification block marks the beginning of the data blocks. It contains information of a general nature.

Example:

```
# --------------------
# IDENTIFICATION_BLOCK
# --------------------

ID:                 IDENT_2            # unique identification of block type, do not change
ALIGNMENT:          32                 # bit alignment of data structure, do not change
EEPROMSIZE:         0                  # size of eeprom, not used, do not change
PARTNUMBER:         5007.7848.02       # rohde & schwarz part number of antenna, not used
HWCODE:             1                  # HW revision for FW, not used
PRODUCTINDEX:       01.00              # official HW revision, not used
SN:                 100001/001         # serial number of antenna
PRODUCTDATE:        2009-04-01         # production date of antenna, not used
READCODE:           1                  # internal flag, do not change
TESTINSTRUCTION:    03.00              # revision of test instruction for end test, not used
NAME:               ZT255              # name of antenna, not used
```

B) Antenna identification block

The antenna identification block forms the second block. It describes the antenna to which the correction data is to be applied.

Example:

```
# ---------------------
# USERBLK_ANTENNA_IDENT
# ---------------------

ID:                 USER_18300         # unique identification of block type, do not change
FORMAT:             UINT16             # format flag, do not change
1                                      # antenna code
2009                                   # year of correction data generation
4                                      # month of correction data generation
1                                      # day of correction data generation
FORMAT:             DOUBLE             # format flag, do not change
20000000.0                             # begin frequency of correction data
6000000000.0                           # end frequency of correction data
FORMAT:             UINT16             # format flag, do not change
1                                      # antenna type 0: RX, 1:DF antenna
0                                      # reserved
FORMAT:             UINT32             # format flag, do not change
0                                      # reserved
0                                      # reserved
0                                      # reserved
0                                      # reserved
FORMAT:             STRING             # format flag, do not change
#max      1 2 length"
"ZT255              "                  # name of antenna model
FORMAT:             STRING             # format flag, do not change
"Rohde&Schwarz      "                  # name of manufacturer of antenna
```

Antenna code:	Not required for RX antennas. For DF antennas, see table 1.
Antenna type:	0: RX antenna 1: DF antenna

Name of antenna model:	The name of the antenna model must be exactly 19 characters in length. If necessary, it must be filled with blanks.
Name of manufacturer of antenna:	The name of the antenna manufacturer must be exactly 19 characters in length. If necessary, it must be filled with blanks.

```
ZT255=             1,
ADD_115=           3,
ADD_010=           4,
ADD_011=           5,
ADD_155=           6,
ADD_150=           7,
ADD_050=           8,
ZT660=             9,
ADD_070=          10,
ADD_071=          11,
ADD_190=          12,
GX060=            13,
GX060P=           14,
GX060D=           15,
VKE=              16,
ADD_012_1=        17,
ADD_012_2=        18,
ADD_119=          19,
ADD_170=          20,
ADD_070_2GHZ=     21,
ADD_RESERVED1=    22,
ADD_195=          23,
ADD_153=          24,
ADD_255=          25,
ADD_215=          26,
ADD_216=          27,
ADD_090_S=        28,
ADD_090=          29,
ADD_090_M=        30,
GX090C=           31,
ADD_090_VAR12=    32,
ADD_090_M_VAR14=  33,
ADD_110=          34,
ADD_153SR=        35,
ADD_050SR=        36,
ADD_011SR=        37,
ADD_011SR_100M=   38,
ADD_157=          39,
ADD_197=          40,
ADD_078SR=        41,
ADD_075=          42,
ADD_253=          43,
ADD_295=          44,
ADD_196=          45,
GX153_5=          46,
GX153_9=          47,
ADD_011_100M=     48,
ADD_007=          49,
ADD_175=          50,
ADD_011SR_150M=   51,
ADD_207=          52,
ADD_253_AP=       53,
ADD_295_AP=       54,
```

table 1

C) Antenna factors

Antenna factors for an antenna are defined as frequency points. Between these points, a linear interpolation is performed. At least two such points are required: one to mark the beginning of the frequency range to be corrected, and one to mark its end.

Within the correction data block, these frequency points are entered as frequency value pairs.

Example:

```
# -----------------------
# USERBLK_ANT_FACTOR_RXDF
# -----------------------
# PASSIV, DF, VERT
# -----------------------

ID:                 USER_18310         # unique identification of block type, do not change
FORMAT:             UINT8              # format flag, do not change
1                                      # antenna preamplifier: 1:PASSIVE, 2:ACTIVE
2                                      # antenna mode: 1:AF, 2:DF
1                                      # antenna polarization: 1:VERT, 2:HOR, 4:LEFT, 8:RIGHT
0                                      # reserved
0                                      # reserved
0                                      # reserved
FORMAT:             COUNT16            # format flag, do not change
28                                     # number of frequency points * 2
FORMAT:             DOUBLE             # format flag, do not change
30000000.0                             # frequency of 1st frequency point [Hz]
0.0                                    # antenna factor of 1st frequency point [dB]
31000000.0                             # frequency of 2nd frequency point [Hz]
10.0                                   # antenna factor of 2nd frequency point [dB]
32000000.0                             # ...
16.0
33000000.0
22.0
34000000.0
28.0
35000000.0
0.0
36000000.0
-10.0
37000000.0
-10.0
38000000.0
10.0
39000000.0
0.0
50000000.0
10.0
50000001.0
0.0
1270000000.0
0.0
1280000000.0
20.0
```

Antenna preamplifier:	Some antennas have an internal amplifier which affects the antenna factors. This flag indicates the amplifier setting to which the following correction data applies. 1: amplifier passive 2: amplifier active

	0: any amplifier setting These flags can be combined in binary form.
Antenna mode:	DF antennas can also be used for reception. Depending on the operating mode, the antenna factors may differ. This flag indicates the antenna mode to which the following correction data applies. 1: antenna in receive mode 2: antenna in direction finding mode 0: any antenna mode These flags can be combined in binary form.
Antenna polarization:	Some antennas may be capable of more than one polarization, which may affect the antenna factors. This flag indicates the antenna polarization to which the following correction data applies. 1: linear vertical polarization 2: linear horizontal polarization 4: left-hand circular polarization 8: right-hand circular polarization 0: any polarization These flags can be combined in binary form.
Number of frequency points:	Number of frequency points multiplied by 2.

D) Cable attenuation

Cable attenuation for an antenna is defined as a number of frequency points between which a linear interpolation is performed. There must be at least two frequency points: one to mark the beginning of the frequency range to be corrected, and one to mark its end.

Within the correction data block, the frequency points are entered as frequency value pairs.

Example:

```
# --------------------------
# USERBLK_ CABLE_ATTENUATION
# --------------------------
# ALL, ALL, ALL
# -----------------------

ID:                 USER_18330         # unique identification of block type, do not change
FORMAT:             UINT8              # format flag, do not change
0                                      # antenna preamplifier: 1:PASSIVE, 2:ACTIVE
0                                      # antenna mode: 1:AF, 2:DF
0                                      # antenna polarization: 1:VERT, 2:HOR, 4:LEFT, 8:RIGHT
0                                      # reserved
0                                      # reserved
0                                      # reserved
FORMAT:             COUNT16            # format flag, do not change
4                                      # number of frequency points * 2
FORMAT:             DOUBLE             # format flag, do not change
60000000.0                             # frequency of 1st frequency point [Hz]
0.0                                    # cable attenuation of 1st frequency point [dB]
70000000.0                             # frequency of 2nd frequency point [Hz]
10.0                                   # attenuation of 2nd frequency point [dB]
```

The data block structure is the same as for the antenna factors.

As cable attenuation is normally independent of the antenna's preamplifier, mode and polarization, these flags should be set to 0 (applies to all).

E) Omni phase correction

Omni phase correction for an antenna is defined as a number of frequency points between which a linear interpolation is performed. There must be at least two frequency points: one to mark the beginning of the frequency range to be corrected, and one to mark its end.

Within the correction data block, the frequency points are entered as frequency value pairs.

Example:

```
# -----------------------
# USERBLK_OMNI_PHASE
# -----------------------
# ALL, ALL, ALL
# -----------------------

ID:                 USER_18320         # unique identification of block type, do not change
FORMAT:             UINT8              # format flag, do not change
0                                      # antenna preamplifier: 1:PASSIVE, 2:ACTIVE
0                                      # antenna mode: 1:AF, 2:DF
0                                      # antenna polarization: 1:VERT, 2:HOR, 4:LEFT, 8:RIGHT
0                                      # reserved
0                                      # reserved
0                                      # reserved
FORMAT:             COUNT16            # format flag, do not change
10                                     # number of frequency points * 2
FORMAT:             DOUBLE             # format flag, do not change
10000000.0                             # frequency of 1st frequency point [Hz]
0.0                                    # omni phase of 1st frequency point [grad]
11000000.0                             # frequency of 2nd frequency point [Hz]
100.0                                  # omni phase of 2nd frequency point [grad]
12000000.0                             # ...
200.0
13500000.0
350.0
13700000.0
10.0
```

The data block structure is the same as for the antenna factors.

F) Azimuth correction

A data block contains the correction values of an antenna for a frequency point. There must be at least two frequency points: one to mark the beginning of the frequency range to be corrected, and one to mark its end.

A data block contains the correction values for the entire azimuth range, i.e. from 0 <= azimuth < 360 degrees.

For this azimuth range, a fixed number N of azimuth points can be defined. The azimuth points are spread in a linear way over 360 degrees, i.e. at a spacing of 360/N.

Example:
N= 9 azimuth points
→ azimuth points are located at 0, 40, 80, 120, 160, 200, 240, 280, 320 degrees

There is a linear interpolation between these azimuth points, including the last point (in the example, 320 degrees) and 0 degrees.

In the correction data block, the azimuth points are entered as a list of N values.

There is a linear interpolation between the frequency points as well.

Example:

```
# ---------------------
# USERBLK_AZIMUT
# ---------------------
# 15 MHz
# ---------------------

ID:                 USER_18340         # unique identification of block type, do not change
FORMAT:             DOUBLE             # format flag, do not change
15000000.0                             # frequency point of azimuth correction [Hz]
FORMAT:             UINT8              # unique identification of block type, do not change
0                                      # antenna polarization: 1:VERT, 2:HOR, 4:LEFT, 8:RIGHT
0                                      # reserved
FORMAT:             COUNT16            # format flag, do not change
8                                      # number of azimuth correction values
FORMAT:             FLOAT              # format flag, do not change
0.0                                    # new azimuth value for   0° [degrees]
55.0                                   # new azimuth value for  45° [degrees]
90.0                                   # new azimuth value for  90° [degrees]
135.0                                  # new azimuth value for 135° [degrees]
180.0                                  # new azimuth value for 180° [degrees]
225.0                                  # new azimuth value for 225° [degrees]
270.0                                  # new azimuth value for 270° [degrees]
315.0                                  # new azimuth value for 315° [degrees]


# ---------------------
# USERBLK_AZIMUT
# ---------------------
# 16 MHz
# ---------------------

ID:                 USER_18340         # unique identification of block type, do not change
FORMAT:             DOUBLE             # format flag, do not change
16000000.0                             # frequency point of azimuth correction [Hz]
FORMAT:             UINT8              # unique identification of block type, do not change
0                                      # antenna polarization: 1:VERT, 2:HOR, 4:LEFT, 8:RIGHT
0                                      # reserved
FORMAT:             COUNT16            # format flag, do not change
4                                      # number of azimuth correction values
FORMAT:             FLOAT              # format flag, do not change
350.0                                  # new azimuth value for   0° [degrees]
80.0                                   # new azimuth value for  90° [degrees]
180.0                                  # new azimuth value for 180° [degrees]
270.0                                  # new azimuth value for 270° [degrees]
```

Antenna polarization:	Some antennas may be capable of more than one polarization, which may affect the antenna factors. This flag indicates the antenna polarization to which the following correction data applies. 1: linear vertical polarization 2: linear horizontal polarization 4: left-hand circular polarization 8: right-hand circular polarization

0: any polarization
These flags can be combined in binary form.

G) End block

The end block marks the end of the data blocks.

```
# ---------
# END BLOCK
# ---------
ID:                 END                # unique identification of block type, do not change
```

The format of the ASCII files depends on the type of correction data involved. It is explained in the following section.

3.2. Conversion to Binary Files

Prior to saving the correction data to the device's flash file format, the ASCII files must be converted to binary format.

The conversion is done with the "ASCI2BIN32.EXE" command line tool.

Example:

ASCI2BIN32 ADD119-azim-TEST.asc

```
C:\WINNT\system32\cmd.exe

Y>asci2bin32.exe azim-ADD119-TEST.asc
*******************************************************************************

Converting ASCII file: azim-ADD119-TEST.asc to BIN file: azim-ADD119-TEST.bin
*******************************************************************************


Info: 4812 characters to convert, 139 lines read.
Parsing IDENT block 2 ok
Parsing USER block 18300 ok
Parsing USER block 18340 ok
Parsing USER block 18340 ok
Parsing USER block 18340 ok
Parsing USER block 18340 ok
Parsing END block  ok
Info: 300 Bytes converted

Conversion PASSED

returncode: <0>
Y>_
```

The name of a binary file must not include any blanks. Its extension must be ".bin".

3.3. Configuration File

The configuration file combines one or more binary correction data files to form a "correction set".

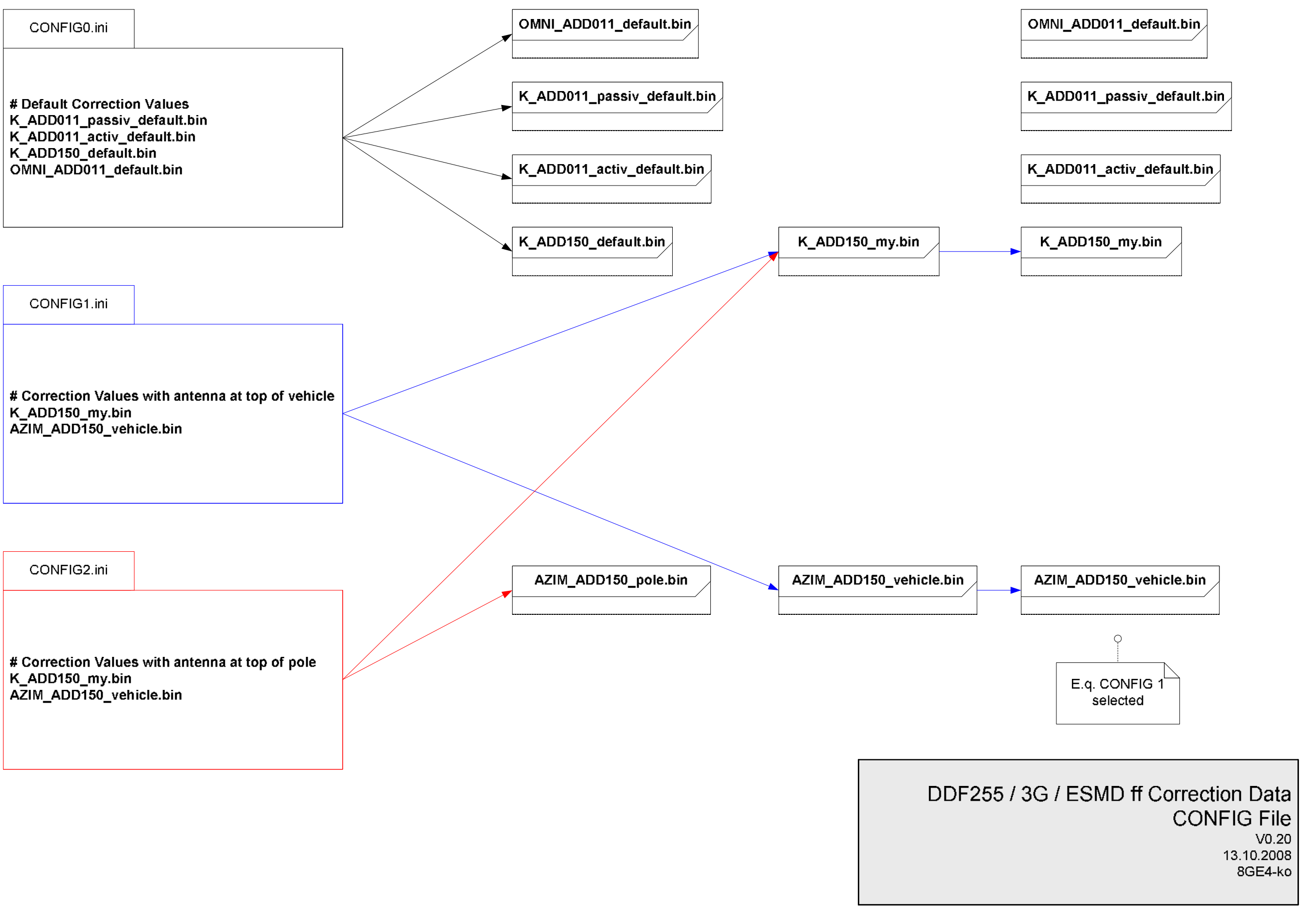
This is necessary as different correction data may depend on one another. The use of several correction sets makes it possible to generate azimuth correction data for different antenna positions (mast extended or retracted) or antenna locations.

The configuration file lists, in binary format, all correction data files to be used for a correction set.

Each file name must be entered on a separate line. Comments are introduced by the '#' sign.

A particular correction data file may be listed in more than one configuration file.

The following figure shows this in more detail.



The configuration file name must be "CorrSetxx.ini", where xx stands for the number of the correction set. It may range from 01 to 99.

FW version V3.00 supports only the correction set "CorrSet01.ini".

Example:

```
# test data for FW V3.00
# Antenna factors
k-ZT255-TEST.bin
# cable attenuation
cable-ZT255-TEST.bin
# Omni-Phase
omni-ADD119-TEST.bin
# Azimuth correction
azim-ADD119-TEST.bin
```

3.4. Storing the Correction Data in the Device

Together with the binary correction data files, the configuration file must be transferred to the device's flash file system and stored in folder *\user\antenna*.

This can be done from the Windows command line.

Example:

```
ftp <IP address of device>
User name:     ESMD
Password:      ESMD
cd user
cd antenna
binary
put CorrSet01.ini
put cable-ZT255-TEST.bin
put k-ZT255-TEST.bin
put omni-ADD119-TEST.bin
put azim-ADD119-TEST.bin
…
bye
```

In order for the correction data to take effect, the device must be restarted.