

## Import data format for TFCCompanion software

Updated May 12, 2005

**Revision 1.5.** Original format specification: This format is fully supported from build 04182005. (April 14, 2005)

**Revision 1.6.** Added new parameters: Delta\_T, Psi\_T, Phase\_Rp, Phase\_Rs, Phase\_Tp, Phase\_Ts. Supported in build 05122005 (May 12, 2005)

### Introduction

This document defines the data format, herein after TFC\_format, for importing measured data (ellipsometry, reflectance, transmittance) in TFCCompanion software. TFC\_format is introduced for the convenience of the users; TFCCompanion software also supports import of the data in other widely used formats (Sopra, Woollam, Beaglehole Instruments, Rudolph, Jobin-Yvon). The purpose of TFC\_format is to give a flexible and convenient way to import measured data into TFCCompanion. This format is also used to export simulated data from TFCCompanion.

### File Encoding

Encoding does not need to be limited to ASCII (8-bit signed characters) except for reserved words as described in the next section. Comments can use Unicode encoding for formula, symbols etc. The data itself can use standard formatting or scientific notation. E.g. 0.36234E2 or 36.234 are both legal and represent the same value.

**Note.** *European convention of decimal comma instead of decimal point is not supported in this version because of the conflict with the csv (comma-separated values) format for Excel. (Data columns can be separated by either space or comma)*

### File Header

The header has the following format:

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TFC\_DATA

# This is a comment for testing

# Date: <measurement date>

# Location:<x,y coordinates>

# WaferId:<wafer name>

# WaferLot:<lot number>

# User: <user name>

<spec\_variable>:<spec fixed parameter>:<parameter\_1>:<parameter\_2>:sd\_<parameter1>:sd\_<parameter2>

<spec\_variable unit>-<spec\_fixed\_variable unit>

\*\*\*\*\*

Description:

1. **TFC\_DATA** is a reserved word. It should always be present and indicates the beginning of the header

2. The lines starting with # (pound) are comments but these are structured comments with the reserved words: Date:, Location:, WaferId:, WaferLot:, User:. If no reserved word is present – the text is considered a unstructured comment and saved as a regular text. The comments are optional – any or all comment lines can be skipped. When the data is imported -the header information is displayed in the WaferID panel in the main screen of TFC Companion.

3. Following line “# **This is a comment for testing**” has no reserved words and considered a regular text comment. This comment is read without parsing and displayed in the Comment text box (WaferID panel on the main screen)

4. In following line “# **Date: <measurement date>**” ‘**Date:**’ is a reserved word. Value <measurement date> is not currently parsed and may have free format. However it is recommended that format be consistent with ANSI-C strftime () function with the format specifier “%d %B %Y %H:%M:%S”(e.g. 14 April 2005 17:01:03).

5. Following line “# **Location:<x,y coordinates>**” indicate measurement location. ‘**Location:**’ is a reserved word. <x,y coordinates> has two values (doubles) separated by comma, these values correspond to x, y coordinates of the measurement point

6. Following line : “# **WaferId:<wafer name>**” indicate the wafer name. **WaferId:** is a reserved word, <wafer name> can be any string.

7. Following line : “# **WaferLot:<lot number>**” indicate wafer lot. **WaferLot:** is a reserved word, <lot number> can contain any string.

8. Following line : “# **User: <user name>**” indicate operator who took the measurement. **User:** is a reserved word, <user name> can be any string.

9. Following is the list of other reserved words **that are not currently implemented:** polarizer:<azimuth>, analyzer:<azimuth>, compensator:<azimuth>. These words will the position of polarization components in the cases when system specific measurement parameters are used

#### **Parameters markers.**

Following line give parameters markers, each marker correspond to a data column:

<spec\_variable>:<spec fixed parameter>:<parameter\_1>:<parameter\_2>:sd\_<parameter\_1>:sd\_<parameter2>

1. <spec\_variable> is a variable of the measured spectrum. It can be either **Wavelength** or **Angle**.
2. <spec fixed parameter> is a fixed parameters of the measured spectrum It can be either **Wavelength** or **Angle** (obviously <spec\_variable> and <spec fixed parameter> are complimentary – can not be the same parameter)
3. <parameter\_1>:<parameter\_2>:.....:<parameter\_n> are column separated markers for measured parameters. Number of parameters is unlimited. Following are reserved words for valid parameters: **Delta, Psi, CosDelta, TanPsi, X, Y, Reflectance, Normal Reflectance, Rp, Rs, Transmittance, Normal Transmittance, Tp, Ts,Phase\_Rp,Phase\_Rs,Phase\_Tp,Phase\_Ts,Delta\_T,Psi\_T**  
Almost all combinations of parameters are allowed the only limitation is that parameters represent “unique values”- different representation of the same value is not allowed. E.g. Delta and CosDelta are illegal in the same spectra, but Delta and Psi, or Delta and TanPsi are legal.
4. sd\_<parameter\_1>:sd\_<parameter\_2>:.....: sd\_<parameter\_n> are optional marker for standard deviations (s.d.) of measured parameters. No particular order is required – the attribution is in the name, e.g. sd\_Delta is s.d. of Delta
- 5.<spec\_variable unit>-<spec\_fixed\_variable unit> is the unit of the spectral variable and fixed variable (unit are separated by dash). If units are missing or invalid – the default units are used.  
For wavelength following units are supported: A, nm, um, eV, inv\_cm that correspond to (Angstrom, nanometer,micrometer,electron-volt, cm<sup>-1</sup>); for Angle – Rad, Deg that correspond to (radian, degree). If the unit is missing the default unit is assumed (nm for wavelength, deg. for angle).  
Example1: nm-deg Example2: nm The result of parsing for is the same for Examples1 and 2. Spectral variable

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is assumed in nm and fixed variable in deg

## Data

The data should be either space or comma separated. The number of columns should correspond the number of markers. Each line corresponds to one data point. Following units are used for data: Delta, Psi, Delta\_T, Psi\_T, Phase\_Rp, Phase\_Rs, Phase\_Tp, Phase\_Ts (**degrees**), Reflectance, Transmittance, Rp, Rs, Normal Reflectance, Normal Transmittance, Tp, Ts are **fractions**.

## General

All markers are case sensitive reserved words and should be reproduced exactly. Empty lines are allowed anywhere – they are skipped during parsing. Lines that contain '[' (open square bracket) are ignored like empty lines – they can be placed anywhere to keep personal comments

## Multiple spectra.

Multiple spectra can be concatenated in one file. There is no limitation on the number of spectra and each spectra can have different parameters. Each spectrum has it own header, markers and data. **It is expected that all spectra are having the same spectral variable (either wavelength or angle).**

Following is an example of the data file with one spectrum:

```
TFC_DATA
# This is a comment for testing
# Date: April 12,2005
# Location:10,5
# WaferId:TestWafer
# WaferLot:1
# User: Leo
[ This line is ignored by the parser because it has '[' symbol. You can insert these lines anywhere
Wavelength:Angle:Delta:Psi:sd_Delta:sd_Psi
[unit line below can be ignored because nm is a default unit, but it is a good practice to have it anyway
[full unit string would be 'nm-deg'
nm
240.1 70.00 93.931937 21.774168 0.2 0.1
242.3 70.00 143.497753 31.700100 0.2 0.1
277.9 70.00 88.559312 40.880459 0.2 0.1
313.5 70.00 62.057384 47.162740 0.2 0.1
349.1 70.00 92.054787 31.639227 0.2 0.1
384.8 70.00 146.911641 23.414678 0.2 0.1
420.4 70.00 165.730292 17.913739 0.2 0.1
456.0 70.00 127.284931 17.942006 0.2 0.1
491.6 70.00 100.333732 20.165835 0.2 0.1
```

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527.3	70.00	82.527480	22.826088	0.2	0.1
562.9	70.00	69.307711	25.692062	0.2	0.1
598.5	70.00	58.367353	28.778249	0.2	0.1
634.2	70.00	48.110483	32.008534	0.2	0.1
669.8	70.00	37.562377	35.072711	0.2	0.1
705.4	70.00	26.145824	37.700070	0.2	0.1
741.0	70.00	14.035120	39.409103	0.2	0.1
776.7	70.00	2.050270	39.907003	0.2	0.1
812.3	70.00	8.818438	39.262259	0.2	0.1
847.9	70.00	17.941343	38.000471	0.2	0.1
883.5	70.00	25.405193	36.433384	0.2	0.1
919.2	70.00	31.510164	34.776733	0.2	0.1
954.8	70.00	36.538703	33.171257	0.2	0.1
990.4	70.00	40.745241	31.678275	0.2	0.1
1026.0	70.00	44.329460	30.315294	0.2	0.1
1061.7	70.00	47.439311	29.078936	0.2	0.1
1097.3	70.00	50.182053	27.957401	0.2	0.1
1132.9	70.00	52.635146	26.936578	0.2	0.1
1168.5	70.00	54.854846	26.002771	0.2	0.1
1204.2	70.00	56.899952	25.153131	0.2	0.1

Following is what you see after importing the data above:

