

CRYSTAL Version 2.21  
**FILM★STAR**  
for Microsoft Windows

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*Advanced Optical Thin Film Technology from*



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# User Guide

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## Getting Started

FilmStar CRYSTAL manages the complex task of transferring multilayer optical thin film designs to Inficon *IC/4+*, *IC/5*, *IC/6* and Sycon *STC-200/SQ* film deposition controllers via RS-232 or IEEE-488 interfaces. In RS-232 operation checksums ensure the accuracy of transferred values.

CRYSTAL Version 2.20 uploads deposition processes (layer properties) in these instruments, with the IC/4+ supported in User Level 1 mode. In the IC/5 User Level 1 is emulated with Expert Mode off. CRYSTAL can also upload IC/4+ and IC5 Materials Parameters usually edited with the panel keypad.

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## Installation

FilmStar requires an IBM-PC compatible running 32-bit Microsoft Windows.

To install from CD-ROM, run `..install\setup32.exe` from Start... Run. A password is required. Users need Administrator privileges.

Use the same procedure to update old versions. Setup will not overwrite data files that were updated and re-stored with the same file names.

**See "[Configure Port](#)" on page 7 for information about configuring serial and GPIB (IEEE-488) ports.**

A Security ID Module must be attached to the parallel or USB port. Please report any problems when installing or running FilmStar.

# Tutorial

## Calculating the Worksheet

Double-click the FilmStar CRYSTAL icon. You should eventually see a screen similar to the one shown below. If you are using a Sycon STC-200/SQ deposition controller click **Setup...Controller...2** followed by **Setup...Controller...Resize <Ctrl+Z>**. In the Main Menu click **Recalculate <Alt+R>**.

|    | Film Design | Film Mat'l | Indx 1-24 | Rate Å/sec | Final Thick (kÅ) | Thick Limit (kÅ) | Time Limit (min) | Cruc 1-64 |
|----|-------------|------------|-----------|------------|------------------|------------------|------------------|-----------|
| 1  | .41816H     | TiO2       | 1         | 7.8        | 1.000            | 0.900            | 4.137            | 1         |
| 2  | .24631L     | SiO2       | 2         | 5.6        | 0.928            | 0.835            | 4.762            | 2         |
| 3  | .33618H     | TiO2       | 1         | 7.8        | 0.804            | 0.724            | 3.718            | 1         |
| 4  | .30916L     | SiO2       | 2         | 5.6        | 1.165            | 1.048            | 5.466            | 2         |
| 5  | .26791H     | TiO2       | 1         | 7.8        | 0.641            | 0.577            | 3.369            | 1         |
| 6  | .26843L     | SiO2       | 2         | 5.6        | 1.011            | 0.910            | 5.010            | 2         |
| 7  | .28503H     | TiO2       | 1         | 7.8        | 0.682            | 0.613            | 3.456            | 1         |
| 8  | .28159L     | SiO2       | 2         | 5.6        | 1.061            | 0.955            | 5.157            | 2         |
| 9  | .26635H     | TiO2       | 1         | 7.8        | 0.637            | 0.573            | 3.361            | 1         |
| 10 | .25448L     | SiO2       | 2         | 5.6        | 0.959            | 0.863            | 4.853            | 2         |
| 11 | .25458H     | TiO2       | 1         | 7.8        | 0.609            | 0.548            | 3.301            | 1         |
| 12 | .26144L     | SiO2       | 2         | 5.6        | 0.985            | 0.886            | 4.931            | 2         |

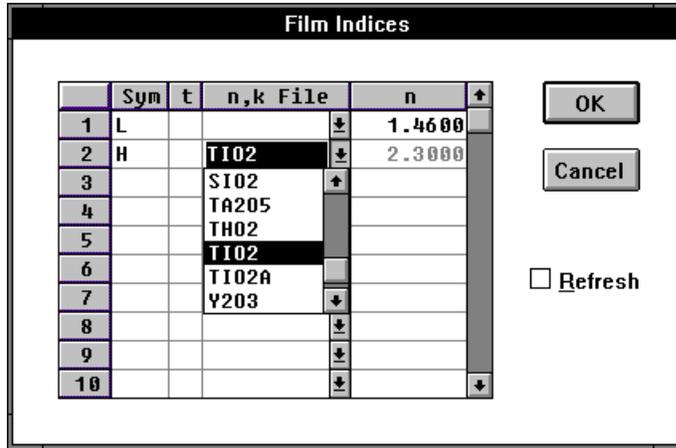
Inficon IC/4+ Worksheet

|    | Film Design | Film Mat'l | Film 1-9 | Final Thick (kÅ) | Deposit Mode |
|----|-------------|------------|----------|------------------|--------------|
| 1  | .41816H     | TiO2       | 1        | 1.000            | Auto         |
| 2  | .24631L     | SiO2       | 2        | 0.928            | Auto         |
| 3  | .33618H     | TiO2       | 1        | 0.804            | Auto         |
| 4  | .30916L     | SiO2       | 2        | 1.165            | Auto         |
| 5  | .26791H     | TiO2       | 1        | 0.641            | Auto         |
| 6  | .26843L     | SiO2       | 2        | 1.011            | Auto         |
| 7  | .28503H     | TiO2       | 1        | 0.682            | Auto         |
| 8  | .28159L     | SiO2       | 2        | 1.061            | Auto         |
| 9  | .26635H     | TiO2       | 1        | 0.637            | Auto         |
| 10 | .25448L     | SiO2       | 2        | 0.959            | Auto         |
| 11 | .25458H     | TiO2       | 1        | 0.609            | Auto         |
| 12 | .26144L     | SiO2       | 2        | 0.985            | Auto         |

Sycon STC-200/SQ Worksheet

Worksheets are generated by: 1. Calculation using indices, designs, and parameters in memory, 2. Downloading from the controller (useful for recording changes implemented during deposition), 3. Pasting from a spreadsheet.

Select **Setup...Film Indices <Ctrl+I>** to access the Film Indices editor.

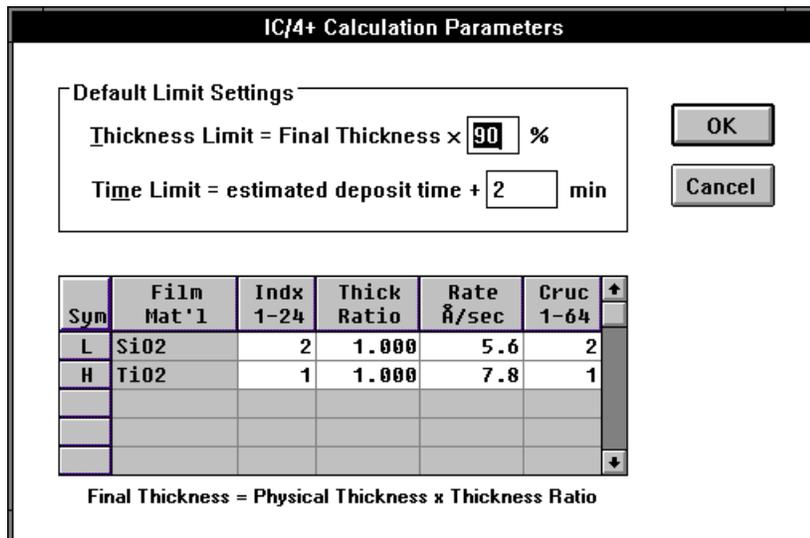


As in FilmStar DESIGN, type index symbols (A-Z) in the **Symbol** column. Enter '\*' (asterisk) under **t** if the symbol refers to layers with physical thickness units. Leave the entry blank for optical thickness.

*Hint: type the first letter in the file name for quick scrolling.*

Type a numerical value under **n** or select a dispersive file name under **n,k File**. The scrolling list includes the names of tables created in FilmStar INDEX and stored in "..\winfilm\index". When a file name is entered any numerical index value is dimmed to show that the dispersive file name has precedence.

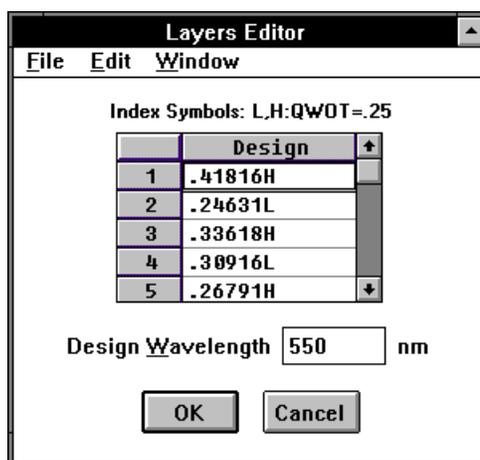
Select **Setup...Parameters <Ctrl+P>** for Calculation Parameters.



The grid in this screen displays index symbols previously defined in the Film Indices editor. *Since Film Material names are read from the IC/4+ the instrument must be on when the dialog box is activated.* Your entries under **Film Material** will match those currently programmed in your instrument. The STC-200/SQ does not store material names and you must edit the entries.

The **Index** column relates instrument Film values (1-24 or 1-9) to DESIGN's A-Z notation. Try changing a number. (IC/4+: If the corresponding material description is blank there is no entry in the material directory.) **Thickness Ratio** provides thickness adjustments independent of instrument tooling values.

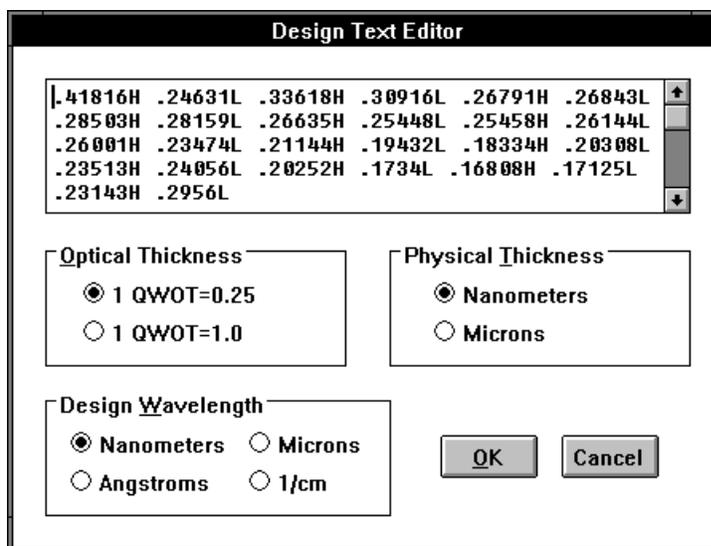
Click **Setup...Layers Editor <Ctrl+L>** for CRYSTAL's design viewer/editor.



*The ability to edit designs can be suppressed.*

The Layers Editor enables users to change designs. Users who believe that this capability is not desirable can turn the editor into a viewer. Designs may also be loaded from the Main Menu with **File...Open...Design <Alt+Ctrl+D>**.

Layers are deleted with **<Del>** or by clicking **Edit...Delete Row <Ctrl+D>**. Additional rows are inserted with **Edit...Insert Row <Ctrl+I>**. A text editor resembling DESIGN's Groups Mode editor is accessed via **Edit...Text <Ctrl+T>**.



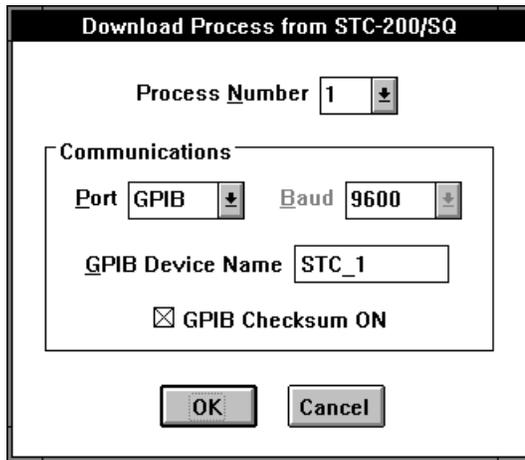
A design containing parentheses, *i.e.* (.25H .25L)10 .25H, is 'exploded' into individual layers upon returning to the Layers Editor with **OK**. Note that this dialog box includes optical and thickness convention choices. Usually there is no need to alter these settings since they are loaded with the design.

Returning to the Main Menu, click **Recalculate <Alt+R>** to generate a Worksheet based on new design, index and/or parameters values. Load some designs from disk and explore the way these are converted to Worksheets.

---

## Downloading and Uploading Layers

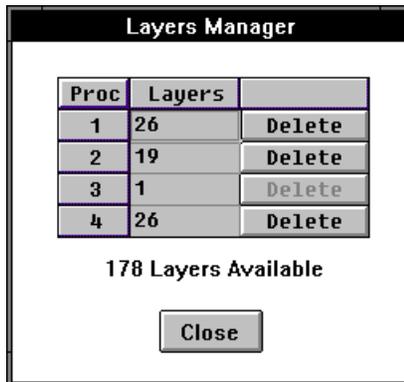
Click **Download <Alt+W>** to transfer values from your deposition controller to CRYSTAL. The following screen appears. Enter values appropriate for your configuration.



This screen also appears after clicking **Upload <Ctrl+U>** and can be accessed via **File...Communications...Port**. Note that **GPIB Checksum ON** applies only to the Sycon STC-200/SQ and is otherwise dimmed.

***Uploading deletes a Process from the controller's memory. If you need to retain any Process download it and store the Worksheet on disk before proceeding.***

Both controllers have a total capacity of 250 layers in four (IC/4+) or nine (STC-200/SQ) Processes. Obviously, it's impossible to upload 50 layers when only 20 are available. To view and modify layer distribution click **Process...Layers Manager <Ctrl+E>** for the screen shown below.



You should now examine the capabilities discussed above. If you have any problems please contact FTG Software.

# Reference

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## File Menu

Three files are utilized in CRYSTAL:

1. Calculation Parameters (see "[Calculation Parameters](#)" on page 10)
2. Design (see "[Layers Editor](#)" on page 12)
3. Worksheet (see "[Worksheet](#)" on page 12)

A Calculation Parameters file and a Design file are associated with a Worksheet file. That is, when a Worksheet is opened, the associated files are also opened.

### Open <Ctrl+F12>

The Worksheet automatically loads associated Parameters and Design files. A design can be loaded from a Design file or from a FILM Archive file. A design can also be opened from a FILM Archive database.

### Save As <F12>

This leads to the Save Files dialog box which provides Save and Save As functions for the all files.

### Save All

Quickly saves the Worksheet and associated files as 'work.\*' files. These are the same files stored upon exiting CRYSTAL and loaded at startup.

### Exit <Alt+F4>

Upon exiting configuration file "..\winfilm\config\design1.ini" is updated. Current data is saved in files "work.\*" (same as **Save All**). These files are automatically loaded upon starting CRYSTAL.

---

## Communications

### File...Communications <Ctrl+M>

This dialog box provides the means to adjust port parameters and communicate directly with the instrument.

When the dialog box is activated CRYSTAL immediately attempts to communicate with the controller. If communications are successful the instrument's ID is displayed.

### Command

Consult your deposition controller manual for a list of commands. Try 'H' for the IC/4+ or IC/5 and '@' for the STC-200/SQ.

### Port...

This is definitely the first place to look when CRYSTAL fails to communicate with the deposition controller.

## Reset

Attempt to establish communications. The instrument's ID should be displayed in the text box.

---

## Configure Port

### File...Communications...Port, Upload, Download

#### Instrument Settings

Users may need to adjust the following instrument communications parameters. Please refer to the manufacturer's manual for instructions.

1. **Inficon IC/4+, IC/5**...Set RS-232 *Checksum* to *YES*.
2. **Sycon STC-200/SQ**...Set *RS232 Protocol* to *SYCON*. GPIB users should set *IEEE488 Chksums* to *BOTH*. If your instrument does not support this setting, **GPIB Checksums ON** must not be checked.

#### Port

Select **Port** COM 1-4 (RS-232 serial) or GPIB (IEEE-488). If a serial port is selected choose **Baud** rate and ensure that this matches actual instruments settings. We have experienced no difficulties with 9600 baud.

***A straight-through (not null-modem) serial cable or adapter is required for IC/5 operation.***

Two types of serial cables are widely utilized in RS-232 communications: 1. *straight-through* and 2. *null-modem*. The straight-through cable connects to a modem; the null-modem cable (printer cable) is used when connecting two computers. A straight-through cable may be converted to a null-modem cable by adding a null-modem adapter.

#### GPIB Device Name

CRYSTAL requires the National Instruments GPIB-PCII/IIA card.

PCII/IIA cards communicate with Windows via software library "gpib.dll" supplied by National Instruments. Program "..\gpib-pcw\wibconf.exe" configures the card. The user provides a name for each device and specifies its address as well as other settings.

A screen dump of our WIBCONF screen is shown below for Device Name 'STC\_1'. The same settings work for the IC/4+. In that case we specified Device Name 'IC4\_1'.

```
National Instruments          STC_1 Configuration
Primary GPIB Address ..... 8
Secondary GPIB Address ..... NONE
Timeout setting ..... 3sec
Serial Poll Timeout ..... 1sec
Terminate Read on EOS ..... No
Set EOI with EOS on Writes .. No
Type of compare on EOS ..... 7-Bit
EOS byte ..... 0Ah
Send EOI at end of Write .... Yes
Enable Repeat Addressing .... No
```

These settings are actually stored in "..\windows\gpib.ini". Once familiar with the format, you might find it easier to modify the file directly. The section corresponding to the above settings appears as follows:

[STC\_1]  
Connect = GPIB0  
Pad = 8  
Sad = NONE  
Tmo = 3sec  
SPollTime = 1sec  
Eot = Yes  
Eos = 0x0A  
REos = No  
XEos = No  
Bin = 7-Bit  
ReAddr = No

### **GPIB Checksum**

This only applies to the Sycon STC-200/SQ which should be set to

IEEE488 CHKSUMS BOTH

If the box is not checked, the appropriate setting is

IEEE488 CHKSUMS NONE

Since the IC/4+ and older STC-200/SQ models do not support GPIB checksums, CRYSTAL verifies updated values.

---

## **Configuration - Directories**

### **File...Configuration...Directories**

Configuration changes are saved in "..\winfilm\config\design1.ini" upon exiting CRYSTAL. To keep changes respond **Yes** to "**Save new configuration?**"

### **User Name**

The User Name is not currently used in CRYSTAL.

### **Directories**

Files are stored in three default directories. While files can be loaded from any directory, they can only be stored in the default directories. (Exception: spectral data files can be stored anywhere.)

### **Data**

Calculation Parameters (.CPW) and Worksheet (.CWW).

### **Designs**

Thin film designs created in program DESIGN (.DEW).

### **n,k Tables**

Dispersion tables created in program INDEX (.ITW).

### **Database Configuration**

A FilmStar BASIC program can be assigned to the *DB Retrieve* menu command in the File menu. An example is the FileMaker Pro database solution included with FilmStar. The example shows how database technology and ActiveX provide means to sort and select designs. Users are not restricted to FileMaker Pro. MS Access programmers can develop similar functionality.

Enter file names of BASIC programs to be assigned to menu commands. Click **Edit...Select <F3>** to browse and select files.

---

## Configuration - Security

### File...Configuration...Security

#### ID Module

An FTG Software Security ID Module must be attached to the parallel (printer) or USB port. The printer can be attached to the parallel module. There are two parallel port module types: Activator (black case) and HASP (ivory case). The appropriate driver for each is loaded during installation. For added security HASP modules are embedded with company name. Users who experience difficulties should visit

<http://www.ftgsoftware.com/issues.htm>

and click *Security ID Module doesn't work* under Installation & Startup.

---

## Configuration - Preferences

### File...Configuration...Preferences

Preferences are saved in design1.ini and common.ini.

#### Message box format

Message boxes display **OK Cancel**, **Yes No** and similar messages. There are two types: Windows (default) and FTG-style. Windows message boxes may be centered in the screen or in the active dialog. Windows message box buttons utilize local languages; FTG-style message boxes are dialog-centered and buttons are in English.

FTG message boxes can be set to *topmost*, thereby remaining visible when covered by other programs. This setting may be useful in BASIC or ActiveX automation.

#### Cancel warning

Issues a warning message if you modify a data entry in a dialog box and then click **Cancel** to close the box.

#### Overwrite warning

Issues warning when opening or saving a file (*Save*) when relevant changes have been made.

The following changes, which are not included in menu selections, require that the user modify "`..\winfilm\config\design1.ini`" in Notepad or another text editor. Do not include comments starting with ';' on the same line.

#### File Shortcut Keys

The 'extra' file shortcut keys (*i.e.* **<Alt+Ctrl+P>** Parameters Open) can be suppressed by inserting the line

```
[Configuration]
ExtraKeys=0
```

The next time CRYSTAL (or DESIGN) is run the keys will be suppressed and the shortcut keys will not appear in the **File...Open** menu.

#### Layers Editor

The ability to edit designs in CRYSTAL is suppressed by inserting the line

```
[Crystal]
LayerEditAllow=0
```

---

# Setup Menu

## Calculation Parameters

### Setup...Parameters <Ctrl+P>

This instrument-dependent dialog box defines tooling factors and other default parameters used to calculate the Worksheet. Note that Thickness Ratios only adjust physical layer thicknesses sent to the instrument. CRYSTAL does not alter instrument tooling factor settings.

### Inficon IC/4+, IC/5, IC/6

In normal operation, Film Material names are read directly from the instrument. The IC/4+ must be connected when the dialog box is activated. Changing Film Index (1-24) values automatically updates displayed names.

When Extended Materials are enabled, the situation is different. Material names are loaded from disk with Calculation Parameters and the pull-down list of possible materials corresponds to the entries in the Extended Materials editor.

### Sycon STC-200/SQ

Since Film Material names cannot be read from the instrument, users must ensure that displayed names correctly correspond to parameters stored in the STC-200/SQ.

---

## Controller Type

### Setup...Controller Type

Worksheet formats are instrument-dependent. After selecting a new device the Worksheet grid is redrawn. The CRYSTAL window can be resized according to the size of the Worksheet grid. This setting is stored upon exiting CRYSTAL and saving the new configuration.

### Inficon IC/4+

CRYSTAL Version 1.4 supports IC/4+ User Level 1. From the IC/4+ front panel press **Program...Utility...Page Forward** to adjust this setting.

---

## Design Text Editor

### from Layers Editor: Edit...Text <Ctrl+T>

This dialog box makes it possible to enter and edit designs independently of DESIGN. Groups mode notation may be used. That is, designs such as

.25H (.25L .25H)20 .125L

are supported. Upon returning to the Layers Editor these are 'exploded' into individual layers.

CRYSTAL's ability to modify designs can be suppressed. It is not possible to edit designs loaded from FILM Archive files.

---

## Extended Materials Editor

### Setup...Extended Materials...Edit <Ctrl+T>

This dialog box provides advanced coating facilities with the means to create and maintain a list of materials beyond the 24 normally stored within the IC/4+, IC/5.

**If you are satisfied with a palette of 24 materials, we suggest that you do NOT use this facility because it is not possible to change the names of materials within the IC/4+.**

The list is stored in file ..\winfilm\ic4matl.bin (ic5matl.bin). Each time CRYSTAL is started the file is copied to ..\winfilm\ic4matl.bak (ic5matl.bak). Users are advised to regularly backup this file onto a floppy disk.

To prevent inadvertent modifications, the spreadsheet is locked. Columns can be unlocked in the Edit menu.

**When modifying data, the user must be sure to maintain the same format for each entry. If the format is incorrect, there will be an error during upload.**

### Download

Transfer material parameters from an IC/4+ Material Directory to the spreadsheet. There is also the option to transfer the IC/4+ Material Table (materials 0-255) to the Material Directory before downloading.

### Upload

Transfer material parameters from the spreadsheet to the IC/4+ materials editor. (This step is not actually required during normal operation since the user is prompted to upload materials before uploaded layer parameters.) Note that the material name cannot be updated in the IC/4+.

### Empty/Fill Materials Directory

If the IC/4+ Material Directory is filled, all entries will have name USER.

---

## Film Indices

### Setup...Film Indices <Ctrl+I>

The Film Indices editor lists the materials used in a thin film design. It is possible to list more materials than those actually used. Layer thicknesses are later specified in the Groups or Layers design editors. Film Indices are stored in the Parameters file.

**Materials must be defined before a thin film design can be loaded from disk.**

To enter new index values:

1. Define a symbol by entering a one letter index symbol 'A' to 'Z' in the **Symbol** column.
2. Specify film thickness convention:
  - a. **Optical thickness**...Select *Opt* in the *Type* column to enter layers in optical thickness. Thickness units (QWOT = .25 or QWOT = 1) are set when the thin film design is loaded.
  - b. **Physical thickness**...Enter *Phs* in the *Type* column for layers described by physical thickness. Thickness units (nanometers or microns) are set when the thin film design is loaded.
3. Specify film indices:
  - a. **Constant**...Leave the **n,k File** column blank and enter constant values for n.
  - b. **Table**...Under **n,k File** insert the name of a dispersive Index Table previously stored in INDEX. Table names are inserted with the pull-

down menu. Shortcut: type the first letter in the material to rapidly navigate the pull-down menu.

**Refresh** forces the reloading of dispersive index tables. Check this box if you have altered index data in INDEX while running CRYSTAL.

If all layers in the thin film design are specified in physical thickness (asterisks next to index symbols in the Film Indices editor), film index is not utilized in the calculation of thickness sent to the controller.

---

## Layers Editor

### Setup...Layers Editor <Ctrl+L>

This dialog box enables users to open, view and modify thin film designs created in DESIGN. Groups mode designs (containing repeated groups in parentheses) are 'exploded' into separate layers.

### File

These facilities are identical to those in the Main Menu, except that the loaded design may be instantly viewed.

### Edit

One row may be deleted or inserted at a time.

CRYSTAL's ability to modify designs can be suppressed by a FilmStar Administrator. The Layers Editor can still be activated in order to examine the design. It is not possible to edit designs loaded from FILM Archive files.

---

## Main Menu

### Button Bar

#### Download <Alt+D>

Transfer a Process from the deposition controller to the Worksheet. Any displayed Film Design (column 1) is erased from the screen since it was not stored in the instrument.

#### Upload <Alt+U>

Transfer the Worksheet Process to the selected deposition controller. If the Worksheet is blank nothing is transferred.

#### Recalculate <Alt+R>

Calculate and display a new Worksheet based on the design displayed in Layers Editor and data stored in Film Indices and Calculation Parameters.

---

## Worksheet

The Worksheet displays the current Process in memory. It may be downloaded from a deposition controller, computed from a thin film design, or pasted from the Windows clipboard.

Generally users will not need to modify worksheets, but it is possible to retype cells with white background. Note that changing Film Index automatically updates the Film Material column.

Worksheet entries cannot be deleted. To deposit fewer layers, it is necessary to adjust the design first and recalculate the Worksheet. To get around this

restriction, paste the Worksheet into a Windows spreadsheet such as Excel, delete layers and paste into CRYSTAL.

---

## Process Menu

### Copy/Paste Worksheet

**Process...Copy Worksheet <Ctrl+Ins>, Paste Worksheet <Shift+Ins>**

The worksheet can be copied to and pasted from the Windows clipboard. Worksheets can be pasted directly into a Windows spreadsheet such as *Microsoft Excel*. This is useful for printing Worksheets. In addition it provides an alternative method for storing CRYSTAL Worksheets on disk.

Users with ideas about thickness adjustments during deposition can easily develop Excel models which 'massage' CRYSTAL Worksheets. Contact FTG Software for further information.

---

### History (Process Accounting)

**Process...History <Ctrl+H> (STC-200/SQ)**

This command reads the STC-200/SQ Process History Accounting screen. This can be copied to the Windows clipboard and pasted into a Windows spreadsheet such as *Microsoft Excel*.

---

### Layers Manager

**Process...Layers Manager <Ctrl+E>**

Each instrument can hold a total of 250 layers distributed in Processes. It is sometimes necessary to delete old Processes in order to release memory for programming new ones.

***Since the number of layers in each Process is read directly from the instrument, the controller must be connected when the dialog box is activated.***

#### Inficon IC/4+, IC/5

Each Process holds 1 to 247 layers. (A Process cannot be empty). If there are a large number of layers in a Process, there will be a noticeable delay in displaying the number.

#### Sycon STC-200/SQ

Each Process holds 0 to 99 layers.

---

## FilmStar BASIC

FilmStar BASIC is a development environment for customizing FilmStar. Using Sax Basic, FilmStar BASIC adds the special commands and keywords discussed in this section. Two macro commands are supported: BasOpen and BasRun.

The FilmStar BASIC language is nearly 100% compatible with Microsoft VBA (Visual Basic for Applications). The IDE (Integrated Development Environment) (**Tools...BASIC Editor <F6>**) provides means to edit and test BASIC programs.

The purpose of BASIC in CRYSTAL is to enable users to [modify theoretical designs](#) in order to improve optical coating yields.

---

## FilmStar CRYSTAL Extensions

**Summary documentation for FilmStar extensions is provided in the BASIC editor (IDE). Click the Browse Object icon.**

A number of functions and subroutines are supported. Other functions are supported by the Macro function described below.

**Sub BasActivate()**...Return focus to BASIC's IDE (integrated development environment).

```
BasActivate
```

**Sub BasChain(file\$)**...Immediately run BASIC program from current program.

```
BasChain "c:\winfilm\basic32\eval1.bas"
```

**Sub Busy(k As Boolean)**...Turn hourglass cursor on/off

```
Busy False ' turn off hourglass cursor
```

**Sub DispBox(text\$, icon%, title\$)**...Display a message box without buttons. This is useful for status messages when no response is required. Use the following icon numbers: 16-Stop, 32-Question, 48-Attention, 64-Information. Use the BASIC MsgBox instruction when a user response is required.

```
DispBox "Waiting for stabilization", 48, "Heater"  
Wait 10 ' wait 10 seconds  
DispBox "", 0, "" ' remove the box
```

**Sub Display(text\$, title\$, wd%, ht%, FontName\$, FontSize!, FontBold%)**... Display a multiline text box in a dialog box with width wd% (twips) and height ht%.

```
Display "FTG Software Associates", "Princeton, New  
Jersey", 5000, 3000, "Arial", 18, 1
```

**Function FileOpen(file\$, Optional k) As Boolean**... Open file; optional path; use extension or k to specify type: k=1 Parameters (.cpw), 2 Design (.dew) or FILM Archive (.faw), 3 Worksheet (.cww). Returns True if successful. All of the following should work:

```
FileOpen "c:\winfilm\crystal\hpass.cpw"  
FileOpen "c:\winfilm\crystal\hpass", 1  
FileOpen "hpass.cpw" ' default path used  
FileOpen "hpass", 1 ' " " " "
```

```
If Not FileOpen("spec1.csv") Then  
MsgBox "Bad file name",vbCritical,"Open"  
Exit Sub  
End If
```

**Function fMsgBox%(text\$, icon%, title\$)**... Similar to BASIC's MsgBox but utilizes the format set in the Preferences tab. MsgBox is screen-centered; fMsgBox optionally centers in the active dialog window.

```
k% = fMsgBox("Do you want to proceed?", 36, "BASIC")
```

**Function FilmThick!(layer%)**...Returns film thickness in kÅ. Use after determining number of layers (rows) with NumLayers and after recalculating the worksheet. While the same information can also be obtained directly from the worksheet, this avoids roundoff errors.

```
x! = FilmThick(3)
```

**Sub MainActivate**...Return focus to CRYSTAL's Main Menu.

```
MainActivate
```

**Property MainEvents As Boolean**...By default, running a program from the BASIC editor (IDE) enables FilmStar keyboard and mouse events. By default, running a program via macro command *basrun* disables FilmStar keyboard and mouse events. This behavior may be changed in a BASIC program by setting *MainEvents* true or false.

```
MainEvents = True ' respond to keyboard/mouse  
                ' default in IDE
```

```
MainEvents = False ' do not respond to keyboard/mouse  
                ' default when run without IDE
```

Most importantly, setting *MainEvents = True* in a BASIC program run from *basrun* adds an **Abort BASIC** menu command.

**Property NumLayers**...Get the number of layers in the design

```
k% = NumLayers
```

**Function PadString\$(text\$, length%, align%)**...This function pads a string with spaces to return a string of given length. Spaces are added to the left (align=0) or right (align=2) or the string is centered (align=1). This function is useful for generating reports.

```
BasText0$ = PadString$(format$(x!,"0.000"),8,0)
```

**Sub sMsgBox(text\$, icon%, title\$)**... Similar to BASIC's MsgBox but utilizes the format set in the Preferences tab. MsgBox is screen-centered; sMsgBox optionally centers in the active dialog window.

```
sMsgBox "Get a cup of coffee!", 48, "Working Hard"
```

**Property ThickLimit**...Get the default thickness limit setting in percent as displayed in the IC/4+ Calculation Parameters dialog box.

```
t1! = ThickLimit
```

**Property TimeLimit**...Get the default time limit setting in minutes as displayed in the IC/4+ Calculation Parameters dialog box.

```
t2! = TimeLimit
```

**Sub WriteIniString\$(section\$, key\$, text\$)**...Store user-define initialization variables in design1.ini.

```
WriteIniString "Temp File", "LastFileName", "WW098909"
```

inserts/modifies the following entry in design1.ini:

```
[Temp File]  
LastFileName=WW098909
```

**Function WsGetNum!(i%, j%)**...Gets numeric value of the worksheet cell at row i, column j.

```
x! = WsGetNum(2, 5)
```

**Function WsGetText\$(i%, j%)**...Gets text in the worksheet cell at row i, column j.

```
s$ = WsGetText(2, 2)
```

**Sub WsRecalc()**...Recalculates worksheet.

```
WsRecalc
```

**Sub WsRedraw(k%)**...Zero value turns worksheet redraw off for faster recalculation time. Will not be apparent on fast computers.

```
WsRedraw 0 ' redraw off  
WsRedraw 1 ' redraw on
```

**Sub WsSetNum(i%, j%, v as Variant)**...Sets numeric value of the worksheet cell at row i, and column j.

```
WsSetNum 2, 5, 1.234
```

**Sub WsSetText(i%, j%, v\$)**...Sets text value of the worksheet cell at row i, and column j.

```
WsSetText 1, 2, "SiO2"
```

**Function XLcell(iRow&, iCol%) As Variant**...Extract data from the open Workbook. Provides means to import data, etc.

**Sub XLclose()**...Close Workbook object

```
XLclose
```

**Sub XLinfo(nRows&, Optional nCols%)**...Returns number of rows and columns in the open Worksheet.

**Function XLnew(mRows&, mCols%, Optional Sheet as Variant, Optional Font\$, Optional fSize!) As Boolean**...Opens new hidden Workbook object for writing. If the Workbook object is already open, a new Worksheet is added with name ShtName. Default font = Verdana 9 pt. Remember to add one row for the header.

**Function XLopen(file\$, Optional Sheet as Variant, Optional bView as Boolean) As Boolean**...Open Excel Workbook (\*.xls); required before Function XLcell. Optional Sheet number or name for multi-sheet Workbooks. *XLclose required before XLnew!*

**Function XLsave(file\$, Optional bProtect as Boolean) as Boolean**...Save Excel Workbook (\*.xls \*.xlsx \*.tab \*.txt). Tab-delimited saves the first sheet. If no extension then .xls or .xlsx is added.

```
XLsave "c:\Winfilm\Spectra\Test.xls, True ' Locked  
XLsave "c:\Winfilm\Spectra\Test.xls ' Unlocked  
XLsave "c:\Winfilm\Spectra\Test ' Adds .xls or .xlsx  
XLsave "c:\Winfilm\Spectra\Test.tab ' Tab-delimited  
XLsave "c:\Winfilm\Spectra\Test.txt ' Tab-delimited
```

**Sub XLview(Optional file\$)**...View Excel Workbook (\*.xls) in Microsoft Excel Viewer. See Updates page for links to installer and service pack. The following BASIC code closes the Viewer.

```
AppActivate "Microsoft Excel Viewer"  
SendKeys "%{F4}" ' <Alt+F4>
```

**Function XLwrite(iRow&, iCol%, Value as Variant, Optional Decimals%, Optional Justify%, Optional ForeColor&, Optional BackColor&) as Boolean**...Write number or text to open Worksheet. Default decimal places = 2; default justification = 1 (right) for numbers and 2 (center) for text. Left = 0. Decimals < 0 gives scientific notation.

## Sample Program

Some users modify crystal monitor thickness settings to compensate for nonlinearities, inhomogeneity, etc. Typically the compensation would be a function of thickness and material. The following program provides an outline for how to do this in FilmStar BASIC.

```
' CRYSTAL.BAS for FilmStar CRYSTAL
' Copyright 1995 FTG Software Associates
DefInt I-N
DefSng A-H, O-Z
Sub Main
  WsRecalc      ' recalculate worksheet
  WsRedraw 0   ' speeds operation a little
  t1 = ThickLimit ' default %
  t2 = TimeLimit  ' default minutes
  For i = 1 to NumLayers ' NumLayers is keyword
    q = FilmThick(i) ' in kA
    Select Case Ucase$(WsGetText(i, 2))
      Case "TI02"
        q = q * 1.05 ' modify thickness here
      Case "SI02"
        q = q * .95  ' modify thickness here
    End Select
    ' Final Thick column 5
    WsSetNum i, 5, q
    ' Thick Limit column 6
    WsSetNum i, 6, .01 * q * t1
    rate = WsGetNum(i, 4)
    ' Time Limit column 7
    WsSetNum i, 7, t2 + 1000 * q / (60 * rate)
  Next i
  WsRedraw 1
End Sub
```

---

## General

### File Manager

FilmStar file commands will be familiar from other Windows applications, but there are some differences because of the number of file types utilized.

#### More...Delete <Ctrl+D>

Only a highlighted file can be deleted. The current file cannot be deleted.

#### More...List Files <Ctrl+L>

To create a master list of all files, use the **Copy** command and paste the text into Notepad with <Shift+Ins>. Repeat for other file types. Lists can be printed.

---

## Keyboard Commands

Keyboard commands are generally identical with those in other Windows applications. But the spreadsheet control and our use of **Cancel** warrant some explanation.

### Cancel

Upon selecting **Cancel <Escape>** changes in the dialog box are lost. If you are constantly losing data in this manner try setting the cancel confirmation flag. See "[Configuration - Preferences](#)" on page 9.

### Grid Control

The custom grid control makes it possible to edit large data sets within a dialog box. The control is quickly navigated with the mouse.

**Mouse...**Click on the required cell. A single cell is selected when highlighted by a box. Note that the box is sometimes a pull-down list. Multiple cells are highlighted in black by holding down the mouse button.

**Keyboard...**Use **<Arrows>**, **<Home>**, **<End>**, **<Ctrl+Home>** and **<Ctrl+End>** to move the focus and scroll the grid. Hold down the shift key to select multiple cells. **<PgUp>** and **<PgDn>** also work. **<Tab>** navigates to the next available cell and moves the focus to the next control if there are no more editable cells. Most grids will not let you enter data more than one row below the last row containing data.

**<Ctrl+Tab>** always moves the focus to the next control in the dialog box. Press **<Del>** or **<BkSp>** to clear an entry or a selected region. Note that rows can be deleted, inserted and sorted by wavelength. To edit a cell without replacing it (*i.e.* overwrite mode), press **<F2>** or **<Insert>**.

The program attempts to prevent erroneous data. In most cases the offending data cell is highlighted in yellow. Additional checks are performed upon clicking the OK button.

### Shortcut Keys

There are a number of shortcut keys. Several dialog boxes contain their own shortcut keys (not shown here). File Save **<Shift+Ctrl+k>** and Save As **<Shift+Alt+k>** sequences are not displayed in menus.

|                              |                                |
|------------------------------|--------------------------------|
| <b>&lt;Ctrl+E&gt;</b>        | Process Layers Manager         |
| <b>&lt;Ctrl+H&gt;</b>        | Process History (STC-200/SQ)   |
| <b>&lt;Ctrl+I&gt;</b>        | Film Indices editor            |
| <b>&lt;Ctrl+L&gt;</b>        | Layers design editor           |
| <b>&lt;Ctrl+M&gt;</b>        | Communications                 |
| <b>&lt;Ctrl+N&gt;</b>        | Download Process to computer   |
| <b>&lt;Ctrl+P&gt;</b>        | Calculation Parameters         |
| <b>&lt;Ctrl+R&gt;</b>        | Recalculate Worksheet          |
| <b>&lt;Ctrl+U&gt;</b>        | Upload Process to controller   |
| <b>&lt;Ctrl+W&gt;</b>        | Open Worksheet                 |
| <b>&lt;F2&gt;</b>            | Retrieve design from database  |
| <b>&lt;F6&gt;</b>            | FilmStar BASIC                 |
| <b>&lt;F7&gt;</b>            | Print Worksheet                |
| <b>&lt;Shift+F1...F6&gt;</b> | Execute macro command #1 to #6 |
| <b>&lt;Alt+Ctrl+k&gt;</b>    | <b>Open</b>                    |
| <b>&lt;Shift+Ctrl+k&gt;</b>  | <b>Save</b>                    |

|                            |                        |
|----------------------------|------------------------|
| <b>&lt;Shift+Alt+k&gt;</b> | <b>Save As</b>         |
| <b>k = D</b>               | Design                 |
| <b>k = P</b>               | Calculation Parameters |
| <b>&lt;Ctrl+F12&gt;</b>    | File Open              |
| <b>&lt;F12&gt;</b>         | File Save As           |

---

## Printer Setup

Most importantly, select a **non-proportional font** such as Courier or Lucida Sans Typewriter. Specify Left Margin to add spaces at the left and Top Margin to add extra lines at the top of the page.

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