Appendix

Appendix A: Files Used in HPD-TA

The program uses several kinds of files for data storage, export and parameter storage. There are several different programs (such as "HiPic", "HiPic/EM", "HIPIC", "HPD-TA") offered by Hamamatsu which share the same file formats. These programs can easily exchange data. Sometimes the identification keyword "HiPic" is used to identify these common file formats independent of the program which created the file. The file format is also defined by a version identifier because the format may change to support new features of new program versions. The current file format identifier is 5.0.

Following files are used:

- Configuration files like: DIGITAL.CNF, CCIR.CNF and EIA.CNF. These files are used to correctly initialise the frame grabber board for certain operation modes, cameras and monitors. Refer to your frame grabber hardware reference manual and your ITEX programmers manual for details (if you have purchased the ITEX library).
- Image files: *.IMG. An ITEX compatible file format is used. The image status is stored in the comment string of an ITEX file (see Appendix E for details). Either 8, 16 or 32 bit files are generated in non compressed form.
- TIFF image files. 8 and 16 bit grey-scale TIFF images are used to save the data. 8 bit TIFF images are used to save the display.
- Profile files: Profiles are stored in ASCII format. See Appendix C for details.
- Dynamic photon counting image filed *.dpc: This is a special file format used for recording dynamic photon counting images. See Appendix G for details.
- The WINDOWS initialisation file: HIPIC32r.INI. It automatically stores parameter settings which are re-used the next time the program is started.

Appendix B: Image File Format

The .IMG file format used in **HPD-TA** is compatible to the ITEX format. It is described in the Appendix A of the ITEX documentation. We reproduce it here:

Bytes	Content
0-1	Characters IM

2-3	Comment length (byte)
4-5	Width of the image in pixels
6-7	Height of the image in lines
8-9	X-Offset
10-11	Y-Offset
12-13	File type:
	0=8 Bit, 1=Compressed (Not used by **HPD-TA**), 2=16 Bit
14-64	Reserved
64-nnn	Comment area containing the status string (see Appendix E)
nnn+1-End	Data Area (one or two orn four bytes per pixel stored in row order from the top to the bottom of the image)

TIFF images are stored using TIFF format version 6.0. When scaling tables are used, these are appended to the normal data according to the status string which is saved in the comment tag (see Appendix D).

Appendix C: Profile File Format

The format of the profiles files written by **HPD-TA** is as follows:

```
;"HiPic 6.0 Profile"                                          1.)
;"HiPic,5.0,1,4.0,3,6,3,3,373,3868,1,01-28-1994..."           2.)
;585,70,799,411                                               3.)
;342,0,3                                                      4.)
;1,1.515152,"ps       ","scal1   "                           5.)
0,357.4605
1.515152,360.8232
3.030303,354.1535
4.545455,352.8047
```

1) Identification line (contains ;"HiPic 6.0 Profile").
2) Status string in "" (see Appendix D), preceded by semicolon.
3) Start and end position of the profiles in the form:
   StartX, StartY, EndX, EndY. For Integrated profiles it indicates the position of two opposite corners of the rectangle used for integration, preceded by semicolon.
4) Number of data points, X-Offset (always 0) and Profile Type:
   1=line, 2=Integrated horizontal, 3=Integrated vertical, preceded by semicolon.
5) Scaling Type (1=Linear, 2=Table), Scaling Factor (linear scaling only), Unit in "", Scaling file without extension (table scaling only), preceded by semicolon.

6) Data in subsequent lines, as many lines as number of data points. Format: X, Y value

Appendix D: Status String Format

The status string is a string which is attached to an image and to profiles derived from an image. It contains all information about the image. The following is a sample string and the description of the different information. The status string contains only ASCII strings separated by comma.

The image status in this version is formatted differently from former versions.

The image status is still saved as one string but it is organized like a *.INI file. It contains different sections where every section can contain tokens with assigned values. This method is much more flexible than the method used in previous versions.

As an example we take the following status string (It was created when acquiring an image from the C4880):

```
[Application],Date="05-11-2000",Time="15:41:51",Software="HiPic",Application=1,ApplicationTitle="High
Performance Image Control System",SoftwareVersion="6.0.0",SoftwareDate="9.5.2000"
[Cam-
era],SSP=H,SAG=H,SMD=N,SHA=F,SVO=0,SVW=1018,SVB=2,SHB=2,SPX=2,SOP=I,AET=20ms,ASH=
A,AMD=I,ATP=N,ATN=1,ACN=1,CSW=F,PSW=O,SHC=F,TST=-
30,CEG=0,CEO=0,CEC=F,SHC=F,Temperature=
27.2,CVG=0,CVO=31,CameraName="C4880",Type=1,SubType=1
[Acquisi-
tion],NrExposure=1,NrTrigger=0,ExposureTime=0,AcqMode=1,DataType=2,DataTypeOfSingleImage=2,B
acksub-
Corr=0,ShadingCorr=0,CurveCorr=0,areSource="0,0,1000,1018",areGRBScan="8,0,1000,1018",pntOrigC
h="0,0",pntOrigFB="0,0",pntBinning="1,1",BytesPerPixel=2
[Grabber],ConfigFile="D:\Program
Files\HiPic32\digital.cnf",Type=2,SubType=1,ICPMemSize=0,ComPort=1
[DisplayLUT],EntrySize=2,LowerValue=0,UpperValue=1024,BitRange="10
bit",Color=1,LUTType=0,Gamma=1,First812OvlCol=1
[Scaling],ScalingXType=1,ScalingXScale=1,ScalingXUnit="No
unit",ScalingXScalingFile="",ScalingYType=1,ScalingYScale=1,ScalingYUnit="No
unit",ScalingYScalingFile=""
```

The name of every section is enclosed in brackets []. Every token is separated from it's value with a "=" character. The tokens are separated from each other with comma. After one section there can be a Carriage Return – Line Feed combination, but this is optional.

As an example we take the "SoftwareVersion" token with the "Application" section. It's value is "6.0.0". The value can be enclosed by quotes if necessary, but this is optional. Lets take the "EntrySize" token from the "DisplayLUT" section. It's value is "2" (But no quotes are used). When quotes are used the value can even contain commas like the "pntOrigCh" token within the "Acquisition" section. Section and token names are case sensitive which means "camera" and "Camera" are different.

Images created from the HiPic and the HPD-TA can contain the following sections with the following tokens:

[Application]

Token	Type	Description	Example
Date	String	Image creation date	05-11-2000
Time	String	Image creation time	15:41:51
Software	String	Creating software	HiPic
Application	Integer	Creating software (see Appli-	1

		cationType)	
ApplicationTitle	String	Title of creating software	High Performance Image Control System
SoftwareVersion	String	Version of creating software	6.0.0
SoftwareDate	String	Version date of creating software	9.5.2000

[Camera]
This section can have different values depending on the camera used for acquisition:

In the case of an Analog Camera it has the following tokens:

Token	Type	Description	Example
CameraName	String	Name of the camera	Analog camera
Type	Integer	Camera type (see CameraType)	3
SubType	Integer	Camera subtype (see CameraSubType)	0
VideoInput	Integer	Video input	0
FrameTime	String	Video frame time	40ms
ExternalSync	Integer	External Sync (flag)	0
StartAcquisitionField	Integer	Starting acquisition field in sequence mode ICP_EVEN=0 ICP_ODD=1 ICP_NEXT=2	0

In the case of a C4742-95 it has the following tokens:

Token	Type	Description	Example
AMD	String	Acquire mode (N=Normal, E=External)	N
NMD	String	Normal mode (N=Normal, S=Electrical Shutter, F=Frame Blanking)	F
EMD	String	External mode (E=Edge Trigger, L=Level Trigger)	L
SMD	String	Scan mode	S
ADS	String	AD select (possible values are 8 10 or 12)	12
SHT	String	Shutter (number of lines, possible values are depening on superpixel settings)	1
EST	String	External shutter (number of lines, possible values are depening on superpixel settings)	1
SHA	String	Scan horizontal area (F=Full, K=Kilo)	K
SFD	String	Scan front dummy (flag)	F
SPX	String	Superpixel (possile values are depending on camera version)	2
ATP	String	Acquire trigger polarity (P=Positiv, NB=Negativ)	N
CEG	String	Contrast enhancement gain	0
CEO	String	Contrast enhancement offset	0
ESC	String	External source (B=BNC, D=D-Sub, I=Digital I/F)	I
TimingMode	String	Timing mode	Internal timing
TriggerMode	String	Trigger mode	Level trigger

TriggerSource	String	Trigger source	Digital I/F
TriggerPolarity	String	Trigger polarity	neg.
CCDArea	String	CCD area	1024 x 1024
Binning	String	Binning mode	2 x 2
CameraName	String	Camera name	C4742-95
Type	integer	Camera type (see Camera-Type)	7
SubType	integer	Camera subtype (see CameraSubType)	7

In the case of a C4880 it has the following tokens:

Token	Type	Description	Example
SSP	String	Scan speed (H=High, S=Slow)	H
SAG	String	Scan amplitude gain (L=Low, H=High, SH=Super High)	H
SMD	String	Scan mode (N=Normal, A=Subarrary, S=Superpixel, B=Binning)	N
SHA	String	Scan horizontal area (F=Full, HC=Half-center, HL=Half-left, HR=Half-right, QC=Quarter-center, QL=Quarter-left, QR=Quarter-Right, EC-Eight-center)	F
SVO	String	Scan vertical offset	0
SVW	String	Scan vertical width	1018
SVB	String	Scan vertical binning	2
SHB	String	Scan horizontal offset	2
SPX	String	Superpixel	2
SOP	String	Scan optical black (flag)	I
AET	String	Acquire exposure time	20ms
ASH	String	Acquire shutter (A=Auto, C=Close, O=Open)	A
AMD	String	Acquire mode (I=Internal, E=External Event, T=External Time, S=External Stop, L=External Level)	I
ATP	String	Acquire trigger polarity (N=Negativ, P=Positiv)	N
ATN	String	Acquire number	1
ACN	String	Acquire cycle number	1
CSW	String	Cooler switch (O=On, F=Off)	F
PSW	String	Panel switch (O=On, F=Off)	O
SHC	String	Shading control (O=On, F=Off)	F
TST	String	Temperature set	-30
CEG	String	Contrast enhancement gain	0
CEO	String	Contrast enhancement offset	0
CEC	String	Contrast enhancement control (V=Volume, E=through CEG and CEO commands, F=Off)	F
IGC	String	Image intensifier gain control	O
IIG	String	Image intensifier gain	0
TDY	String	Trigger delay	0
AGT	String	Acquire gate time	0
Temperature	String	Temperature	-27.7
CVG	String	Contrast volume gain 0	

CVO	String	Contrast volume offset 31	
CameraName	String	Camera name	C4880
Type	Integer	Camera type (see Camera-Type)	1
SubType	Integer	Camera subtype (see CameraSubType)	1

In the case of a C4880-8X it has the following tokens:

Token	Type	Description	Example
ACN	String	Acquire cycle number	1
AET	String	Acquire exposure time	0
AMD	String	Acquire mode (I=Internal, E=External)	I
ATP	String	Acquire trigger polarity (P=Positiv, N=Negativ)	N
CEC	String	Contrast enhancement control (V=Volume, E=through CEG and CEO commands, F=Off)	V
CEG	String	Contrast enhancement gain	0
CEO	String	Contrast enhancement offset	0
SAG	String	Scan ampitude gain	H
SAR	String	Scan area	0,0,659,493,1
SHT	String	Shutter (number of lines)	500
SMD	String	Scan mode (N=Normal, E=Extended)	N
SSP	String	Scan speed (H=High, S=Slow)	H
Chip	String	Chip	ICX074
VolGain	String	Volume gain	0
VolOffset	String	Volume offset	0
ROM	String	ROM version	2.1D
Version	String	Firmware version	2.5C
Gain	String	Gain 0	
Offset	String	Offset	0
ContrastEnhancement	String	Contrast enhancement	Potentiometer
CameraName	String	Camera name	C4880-81
Type	integer	Camera type (see Camera-Type)	8
SubType	integer	Camera subtype (see CameraSubType)	3

In the case of a C4742-98 it has the following tokens:

Token	Type	Description	Example
SSP	String	Scan speed (H=High, S=Slow)	H
AET	String	Acquire exposure time	20ms
AMD	String	Acquire mode (N=Normal, E=External)	N
SMD	String	Scan mode (N=Normal, S=Super-Pixel, A=Subarray)	N
SPX	String	Superpixel (1, 2, 4, 8)	2
SHA	String	Scan horizontal area (F=Full, HC=Half-center, HL=Half-left, HR=Half-right, QC=Quarter-center, QL=Quarter-left, QR=Quarter-Right, EC-Eight-center)	F

CEG	String	Contrast enhancement gain	0
CEO	String	Contrast enhancement offset	0
EMD	String	External mode (E=Edge, L=Level)	L
SFD	String	Scan front dummy (O=On, F=Off)	F
ATP	String	Acquire trigger polarity (P=Positiv, N=Negativ)	N
SVO	String	Scan vertical offset	0
SVW	String	Scan vertical width	1024
SHO	String	Scan horizontal offset	0
SHW	String	Scan horizontal width	1024
Temperature	String	Temperature	50.0
TimingMode	String	Timing mode	Internal timing
TriggerMode	String	Trigger mode	Level trigger
TriggerPolarity	String	Trigger polarity	neg.
CameraName	String	Camera name	C4742-98
Type	integer	Camera type (see Camera-Type)	10
SubType	integer	Camera subtype (see CameraSubType)	11

In the case of a C7300-10 it has the following tokens:

Token	Type	Description	Example
AMD	String	Acquire mode (N=Normal, E=External)	N
NMD	String	Normal mode (N=Normal, S=Shutter, F=Frame blanking)	F
EMD	String	External mode (E=Edge, L=Level)	L
SMD	String	Scan mode (N=Normal, S=Superpixel, A=Subarray)	N
ADS	String	AD select (8, 10 or 12)	12
SHT	String	Shutter (number of lines)	1
FBL	String	Frame blanking mode (number of frames)	1
EST	String	External shutter (number of lines)	1
SHA	String	Scan horizontal area (F=Full, K=Kilo)	K
SFD	String	Scan front dummy (O=On, F=Off)	F
ATP	String	Acquire trigger polarity (P=Positiv, N=Negativ)	N
CEG	String	Contrast enhancement gain	0
CEO	String	Contrast enhancement offset	0
ESC	String	External source (B=BNC, D=D-Sub, I=Digital I/F)	I
SVW	String	Scan vertical width	1024
SVO	String	Scan vertical offset	0
TimingMode	String	Timing mode	Internal timing
TriggerMode	String	Trigger mode	Level trigger
TriggerSource	String	Trigger source	Digital I/F
TriggerPolarity	String	Trigger polarity	neg.
CameraName	String	Camera name	C7300-10-12NRP
Type	integer	Camera type (see Camera-Type)	19
SubType	integer	Camera subtype (see Came-	12

		raSubType)	

[Acquisition]

Token	Type	Description	Example
NrExposure	Integer	Number of exposures (integrated in memory)	1
NrTrigger	Integer	Number of trigger	1
ExposureTime	String	Exposure time	20ms
AcqMode	Integer	Acquisition mode (see AcqMode)	1
DataType	Integer	Data type (see DataType)	2
DataTypeOfSingleImage	Integer	Data type of a single exposure (see DataType)	2
BacksubCorr	Integer	Background corrected (flag)	0
ShadingCorr	Integer	Shading corrected (flag)	0
CurveCorr	Integer	Curvature corrected (flag)	0
areSource	String	Source area (valid image, X, Y, DX, DY)	0,0,1000,1018
areGRBScan	String	Scan area (for grabber, X, Y, DX, DY)	8,0,1000,1018
pntOrigCh	String	Origin on chip (X, Y)	0,0
pntOrigFB	String	Origin on frame buffer, (X, Y)	0,0
pntBinning	String	Binning (X, Y)	1,1
BytesPerPixel	Integer	Bytes per pixel	1

[Grabber]

Token	Type	Description	Example
ConfigFile	String	Configuration file	D:\Program Files\HiPic32\digital.cnf
Type	Integer	Grabber type (see FrameGrabber)	2
SubType	Integer	Acquisition module type (See AcquisitionModule)	1
ICPMemSize	Integer	ICP memory size (ICP_2M = 0 ICP_4M = 1)	0
ComPort	Integer	Com port	1

[DisplayLUT]

Token	Type	Description	Example
EntrySize	Integer	Size of LUT (see LUTSize)	2
LowerValue	String	Lower value (lower cursor)	0
UpperValue	String	Lower value (upper cursor)	1024
BitRange	String	Bit range	10 bit
Color	Integer	Color (See LUTColor)	1
LUTType	Integer	LUT Type (See LUTtype)	0
Gamma	String	Gamma value	1
First812OvlCol	Integer	First overlay color in 812 bit mode (overlayed images only)	1

[Scaling]

Token	Type	Description	Example
ScalingXType	Integer	Scaling type in X direction (see ScalingType)	SCALING_LINEAR
ScalingYType	Integer	Scaling type in X direction (see ScalingType)	SCALING_LINEAR
ScalingXScale	String	Scaling factor in X direction	1.57
ScalingYScale	String	Scaling factor in Y direction	1.57
ScalingXUnit	String	Scaling unit in X direction	mm

ScalingYUnit	String	Scaling unit in Y direction	mm
ScalingXScalingFile	String	Scaling file in X direction	scaling1
ScalingYScalingFile	String	Scaling file in Y direction	scaling2

[Comment]

Token	Type	Description	Example
UserComment	String	Comment string inputted by the user	This is my comment

Used constants:

ApplicationType:
- APPLICATIONHIPIC = 1
- APPLICATIONTA = 2
- APPLICATIONEM = 3

CameraType:
- NOCAMERA = 0
- C4880 = 1
- C4742 = 2
- ANALOG0 = 3
- ANALOG1 = 4
- ANALOG2 = 5
- ANALOG3 = 6
- C474295 = 7
- C488080 = 8
- C474298 = 10
- C7300-10 = 19
- C8000-10=20
- C8000-20=21

CameraSubType:
- C4880_00 = 1
- C4880_60 = 2
- C4880_80 = 3
- C4880_91 = 4
- C4880_92 = 5
- C4880_93 = 6
- C4742_95 = 7
- C4880_60OU = 8
- C4880_1K2K = 9
- C4742_98 = 11
- C7300-10_10 = 12
- C4880_10 = 13
- C4880_20 = 14
- C4880_21 = 15
- C4880_30 = 16
- C4880_40 = 17
- C7190_10 = 18
- C8000_20=19
- C4742-95ER=20
- C4880-31=21
- C4880-50=22
- C8000-20=23

AcqMode:
- LIVE = 1
- ACQUIRE = 2
- PHOTONCOUNTING = 3
- ANALOGINTEGRATION = 4

DatType:
- DAT8 = 1
- DAT10 = 2
- DAT12 = 3
- DAT16 = 4
- DAT812 = 5
- DAT14 = 6
- DAT16=7
- DAT32=8

FrameGrabber:
- grbNone = 0
- grbAFG = 1
- grbICP = 2
- grbPC=3

AcquisitionModule:
- AMDIG = 1
- AMVS = 2

LUTSize:
- LUTSize8 = 1
- LutSize10 = 2
- LutSize12 = 3
- LUTSize16 = 4
- LUTSize812 = 5
- LUTSize14 = 6
- LUTSize16x=9

LUTColor:
- LUTColorBW = 1
- LUTColorRainbow = 2
- LUTColorBWwithoutColor = 3

LUTType:
- LUTTypeLinear
- LUTTypeGamma
- LUTTypeSigmoid

ScalingType:
- SCALING_LINEAR = 1
- SCALING_TABLE = 2

Note:

The scaling data is directly written to the image file if the scaling type is table. The tokens ScalingXScalingFile and ScalingYScalingFile contains an address where the scaling table is written in the file. An asterisk "*" or a plus "+" indicates the address. The asterisk indicates that the scaling has 1024 entries, the plus indicates 1280 entries. If it contains e.g. the entry *473533 the scaling data is written in the image file at an offset of 473533 bytes.

Appendix E: Scaling File Format

Scaling files are used to provide nonlinear or special scaling (see section “Scaling Set-up" in this manual). They contain a list of 1280 entries of floating point numbers (4 byte type, called float or single). Each number corresponds to one pixel on the chip. The scaling file does not contain a unit nor the information

for which direction the scaling is applied. Scaling files must always have the extension **.SCL**. The floating point numbers must be strictly monotonous (ascending or descending), otherwise the file is not accepted by the system as a valid scaling file. The format of the file is as follows:

```
Byte:
0,1,2,3,4,5,6,7,8,9,10,11,12...4092,4093,4094,4095
      Value0  Value1  Value2  ...    Value1023
```

Appendix F: DPC File Format

Dynamic photon counting images are saved in the DPC file format. In a DPC file the x-y coordinate of each photon and the time when it has been detected are recorded.

Bytes	**Content**
0-1	Characters IM
2-3	Comment length in bytes (ComLen)
4-5	Width of the image in pixels (iDX)
6-7	Height of the image in lines (iDY)
8-9	X-Offset (iX)
10-11	Y-Offset (iY)
12-13	File type: 2=16 Bit
14-64	Reserved
64-nnn	Comment area can contain any information. It is used by the to store the status string and the scaling tables (if any)
nnn+1-End	Data Area (Starts at address 64+ ComLen)

The **Data Area** looks like:

```
Content:
Time-Frame0   x0    y0    x1    y1   0xFFFFFFFF
Byte:
    00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16
17 18 19...

Where:
Time-Frame0:
TimeGetTime value of the frame 0 (32 bit value).
X0, y0:
x,y coordinates of photon 0 within frame 0 (two 16 bit
values)
0xFFFFFFFF:
Delimiter (32 bit value, all ones)
```

Appendix H: Cameras and Peripheral systems supported

OS: Windows95/Windows NT/Windows 98/Windows 2000/Windows ME