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[Guru Specifications]

**BDI FRONT END SOFTWARE GURU
SPECIFICATIONS FOR THE LEIR ORBIT
MEASUREMENT SYSTEM [BPNCO]**

Abstract

As part of the Beam Instrumentation Software Common Tools and Interfaces project (BISCoTI) [1], this document presents and explains the LEIR Orbit Front End Software Guru Specifications defined and implemented using FESA [2] (BPNCO class) following the standard interface for beam position measurements (BdiStdPosition) [3] and the document "Guidelines and conventions for defining interfaces of equipment developed using FESA" [4].

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1. INTRODUCTION

As part of the Beam Instrumentation Software Common Tools and Interfaces project (BISCoTI) [1], this document presents and explains the LEIR Orbit Front End Software Functional Specifications defined and implemented using FESA [2] (BPNCO class).

Every BDI instrument interfaces will inherit from 'virtual' interfaces corresponding to its main measured beam observable. The considered observables are the following:

- Beam Position [3],
- Beam Intensity,
- Beam Profile,
- Beam Losses,
- Tune & Chromaticity,
- ...

These virtual interfaces will themselves implement some standard custom types, properties and property fields relevant to every observable. These items will be grouped in the 'BDI standard interface' that will be inherited by every 'virtual' interface.

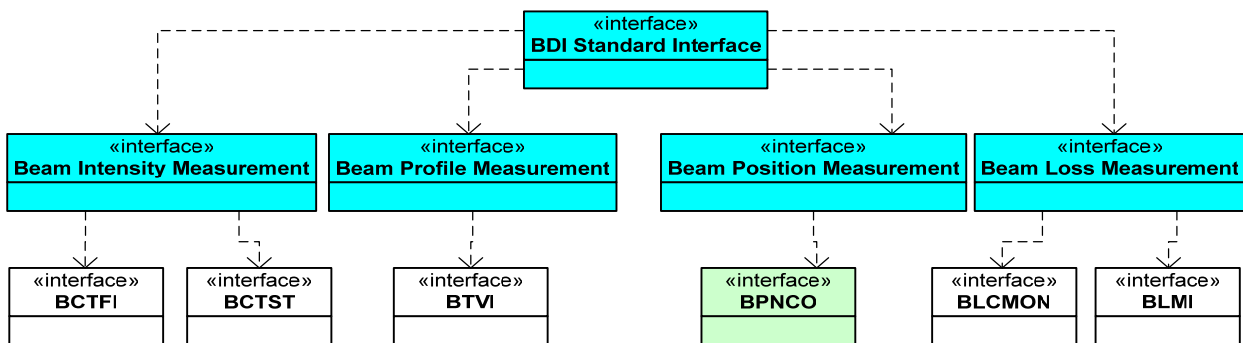


Figure 1: Inheritance Tree. Blue Boxes represent 'Virtual' interfaces. Green Box represents BPNCO interface.

The interface documentation for BPNCO class is published in "BDI Front End Software Interface for the LEIR Orbit Measurement System [BPNCO]" document.

The functional specifications for BPNCO class are published in "BDI Front End Software Functional Specifications for the LEIR Orbit Measurement System [BPNCO]" document.

The present document will provide additional information about:

- Instrument data allocation.
- Brief instrument actions overview.
- Test results.

2. INTERNAL INSTRUMENT SPECIFICATIONS

2.1 DEVICE DATA

Field name	Persistency	M-ng	Description
acqDesc	VOLATILE	USER	Dynamic acquisition description
acqMsg	VOLATILE	USER	Acquisition Status Report with Time Stamp
acqStamp	VOLATILE	USER	Acquisition Time Stamp (UTC in nanoseconds as double)
acqState	VOLATILE	USER	Acquisition Status Register
acqTime	VOLATILE	USER	Acquisition Time (local as String)
beamID	VOLATILE	USER	Unique identifier of a beam type
deviceDesc	FINAL	NONE	Static device description
deviceMsg	VOLATILE	NONE	Device Status Report with Time Stamp
calibratingDelay	PERSISTENT	NONE	Time in milliseconds to start measuring calibrating factors after switch on HW calibration
calibratingFactorZero	PERSISTENT	NONE	Calibrating factors for centered beam (cal_0 , $pos = unitFactor * (k * (V - cal_0) + offset)$), 2D array ($MAX_NB_OF_GAINS \times NB_OF_CHANNELS$) of raw MPV908 data)
calibratingFactorZero_acquired	VOLATILE	NONE	Acquired calibrating factors for centered beam (cal_0 , $pos = unitFactor * (k * (V - cal_0) + offset)$), 2D array ($MAX_NB_OF_GAINS \times NB_OF_CHANNELS$) of raw MPV908 data (averaging-out of chosen number values))
calibratingFactorMinus	PERSISTENT	NONE	Calibrating factors for maximum negative beam displacement (cal_- , $k = 2 * a_1 / (cal_+ - cal_-)$ [mm/V], 2D array ($MAX_NB_OF_GAINS \times NB_OF_CHANNELS$) of raw MPV908 data)
calibratingFactorMinus_acquired	VOLATILE	NONE	Acquired calibrating factors for maximum negative beam displacement (cal_- , $k = 2 * a_1 / (cal_+ - cal_-)$ [mm/V], 2D array ($MAX_NB_OF_GAINS \times NB_OF_CHANNELS$) of raw MPV908 data (averaging-out of chosen number values))
calibratingFactorPlus	PERSISTENT	NONE	Calibrating factors for maximum positive beam displacement (cal_+ , $k = 2 * a_1 / (cal_+ - cal_-)$ [mm/V], 2D array ($MAX_NB_OF_GAINS \times NB_OF_CHANNELS$) of raw MPV908 data)
calibratingFactorPlus_acquired	VOLATILE	NONE	Acquired calibrating factors for maximum positive beam displacement (cal_+ , $k = 2 * a_1 / (cal_+ - cal_-)$ [mm/V], 2D array ($MAX_NB_OF_GAINS \times NB_OF_CHANNELS$) of raw MPV908 data (averaging-out of chosen number values))
calibratingGain_acquired	VOLATILE	NONE	Current gain of calibrating mode
calibratingMode	PERSISTENT	NONE	Calibrating mode: no calibration (standard mode), maximum positive beam displacement, centered beam, maximum negative beam displacement, semi-automatic calibration (for chosen gain), automatic calibration (for all gains)

calibratingMode_acquired	VOLATILE	NONE	Acquired step of calibrating mode: no calibration (standard mode), maximum positive beam displacement, centered beam, maximum negative beam displacement, semi-automatic calibration (for chosen gain), automatic calibration (for all gains)
calibratingSelectionSize	PERSISTENT	NONE	Selection size for averaging calibrating factors
calibratingTime	PERSISTENT	NONE	Calibrating Time (local as String), last time when scaling factors and / or calibrating factors for centered beam / maximum negative beam displacement / maximum positive beam displacement were updated
calibratingTime_acquired	VOLATILE	NONE	Acquired Calibrating Time (local as String), last time when scaling factors and / or calibrating factors for centered beam / maximum negative beam displacement / maximum positive beam displacement were acquired
channelsMap	PERSISTENT	NONE	Channels map
clearingVoltage	PERSISTENT	NONE	Clearing voltage mode used (ON/OFF)
coefficientsPUTime	PERSISTENT	NONE	PU Coefficients Time (local as String), last time when PU sensitivities and / or position offsets were updated
control	PERSISTENT	NONE	Device control mode, describes whether the device can be controlled remotely
cycleName	VOLATILE	USER	Name of the cycle
cycleStamp	VOLATILE	USER	Cycle Time Stamp (UTC in nanoseconds as double)
cycleTime	VOLATILE	USER	Cycle Time (local as String)
exactTagging	PERSISTENT	NONE	Exact/late tagging
gain	PERSISTENT	NONE	Gain used (LOW/MEDIUM/HIGH)
initDevMsg	VOLATILE	NONE	Last Device Initialization Report with Time Stamp
initDevState	VOLATILE	NONE	Last Device Initialization Status Register
isConnected	PERSISTENT	NONE	Device connection state
measurementTimeShift	FINAL	NONE	Time shifts between adjoining measurements
mode	VOLATILE	NONE	Used to control the device mode
nbOfMeasurements	VOLATILE	USER	Number of measurements
offset	PERSISTENT	NONE	Position offsets (electrical offsets + mechanical offsets, offset, pos = unitFactor * (k * (V - cal0) + offset)), 1D array (NB_OF_CHANNELS))
pickupAngle	PERSISTENT	NONE	Angles of pickups (in degrees, 1D array (NB_OF_CHANNELS))
position	VOLATILE	USER	N position measurements for all channels
scalingFactor	PERSISTENT	NONE	Scaling factors (k, pos = k * (V - cal0) + offset), k = 2 * a1 / (cal+ - cal-) [mm/V], 2D array (MAX_NB_OF_GAINS x NB_OF_CHANNELS))
scalingFactor_acquired	VOLATILE	NONE	Acquired scaling factors (k, pos = k * (V - cal0) + offset), k = 2 * a1 / (cal+ - cal-) [mm/V], 2D array (MAX_NB_OF_GAINS x NB_OF_CHANNELS))
sensitivityPU	PERSISTENT	NONE	PU sensitivities (a1, k = 2 * a1 / (cal+ - cal-) [mm/V], 2D array (MAX_NB_OF_GAINS x NB_OF_CHANNELS))
status	VOLATILE	NONE	Summary of the device status
superCycleNb	VOLATILE	USER	SPS Super Cycle Number

2.2 CLASS DATA

Field name	Persistency	Description
channelNames	FINAL	A 2D array of the channel names
channelStatus	VOLATILE	State of the channels (connected, error, etc). ** Note that this will be an enumerated array eventually
classDesc	FINAL	Static Class Description
classUrl	FINAL	Web Page Address Describing This Class
initAllDevMsg	VOLATILE	Last Device Initialization Report with Time Stamp
initAllDevState	VOLATILE	Last Crate Initialization Status Register
measurementTimeShift_unit	FINAL	Measurement time shift unit
measurementTimeShift_unitExponent	FINAL	Measurement time shift unit exponent
measurementTimeShift_unitFactor	FINAL	Measurement time shift unit factor
nbADCChannels	FINAL	Number of ADC channels used
nbADCModules	FINAL	Number of ADC modules used
observables	FINAL	Main BDI Observables covered by this Class
position_unit	FINAL	Position unit
position_unitExponent	FINAL	Position unit factor
position_unitFactor	FINAL	Position unit exponent
ptrHWObject	VOLATILE	Pointer to the hardware object
simulatedHW	PERSISTENT	Devices connection state
simulatedTiming	PERSISTENT	Timing connection state
updateVMOD	VOLATILE	VMOD update state

2.3 SERVER AND REAL-TIME ACTIONS

Action name	Inheritance	Action type
Acquire	new	real-time
GetAcquisition	overloaded	server
GetDescription	default	server
GetExpertAcquisition	overloaded	server
GetExpertCalibration	new	server
GetExpertSetting	overloaded	server
GetGuruSetting	default	server
GetInit	default	server
GetInitAllDev	default	server
GetIntermediateAcquisition	not used	server
GetSetting	default	server
GetSingleAcquisition	new	server
GetStatus	overloaded	server
GetSummaryAcquisition	overloaded	server
Publish	new	real-time
Reset	not used	server
SetExpertCalibration	new	server
SetExpertSetting	overloaded	server
SetGuruSetting	default	server
SetSetting	overloaded	server

3. TESTS

3.1 PERFORMANCE TESTS

During performance tests on 18-08-2005 & 13-09-2005 it has been found that BPNCO instrument is working, but:

- sometimes EX.ACQ-RIPU is not triggered each 200 ms inside the instrument;
- a group of EX.STRIG-RIPU, EX.TRIG-RIPU and EX.ETRIG-RIPU is missed once per each cycle (at the end of each cycle, when EX.PUB-RIPU is triggered).

FEC **dleiripu** had following specific processes running:

Priority	Text	Data	Process
25	3722	663	/dsc/local/bin/FesaSharedServer
50	1450	523	/dsc/local/bin/LTIMRt
30	363	228	/dsc/local/bin/server
20	74	15	/usr/local/rt/doforever
25	4559	1807	/dsc/local/bin/BPNCOSingleProcessServer
25	3169	237	/dsc/local/bin/cmwserver
25	4565	13588	/dsc/local/bin/BQLEISingleProcessServer
100	256	100	/usr/local/dtm/dtmrt_ls

Additional information about EX.ACQ-RIPU and EX.PUB-RIPU timings occurrence for one long cycle (3.6 seconds) inside BPNCO instrument is shown in the table below:

Number of acquired values	Action type	Start time	Stop time	Processing time	Time between actions
	Publish	4.359109 s	4.363203 s		
6	Acquire	4.420306 s	4.420958 s	0.652 ms	061.20 ms
4	Acquire	4.459491 s	4.460008 s	0.517 ms	039.19 ms
20	Acquire	4.659498 s	4.660876 s	1.378 ms	200.01 ms
20	Acquire	4.859494 s	4.860873 s	1.379 ms	200.00 ms
20	Acquire	5.059508 s	5.060889 s	1.381 ms	200.01 ms
20	Acquire	5.259498 s	5.260875 s	1.377 ms	199.99 ms
20	Acquire	5.459495 s	5.460876 s	1.381 ms	200.00 ms
20	Acquire	5.659488 s	5.660832 s	1.344 ms	199.99 ms
20	Acquire	5.859496 s	5.860872 s	1.376 ms	200.01 ms
20	Acquire	6.059491 s	6.060838 s	1.347 ms	200.00 ms
20	Acquire	6.259512 s	6.260889 s	1.377 ms	200.02 ms
20	Acquire	6.459503 s	6.460882 s	1.379 ms	199.99 ms
20	Acquire	6.659505 s	6.660847 s	1.342 ms	200.00 ms
20	Acquire	6.859498 s	6.860843 s	1.345 ms	199.99 ms
20	Acquire	7.059489 s	7.060838 s	1.349 ms	199.99 ms
20	Acquire	7.259493 s	7.260836 s	1.343 ms	200.00 ms
68	Acquire	7.954953 s	7.958826 s	3.873 ms	695.46 ms
1	Publish	7.959174 s	7.965696 s	6.522 ms	004.22 ms
Total:				Total:	Total:
359				30.622 ms	3600.07 ms

3.2 HARDWARE TESTS

Initially it has been found that neither ADC MPV908 nor VMOD TTL were not installed correctly. The problems have been fixed by hardware responsible in six weeks. Now all hardware looks working correctly.

3.3 OPERATIONAL TESTS

There is no beam in LEAR orbit before 23-09-2005, so it's not possible to pass through operational tests. But with noise BPNCO instrument looks working.

3.4 CALIBRATING TESTS

Calibrating tests have been successively done on 04-08-2005 & 13-09-2005. Automatic calibration took several seconds to go through all gains and all calibrating modes & the received values have been verified by hardware expert.

4. REFERENCES

- [1] **Beam Instrumentation Software Common Tools and Interfaces Web Site**
[<http://project-biscoti.web.cern.ch/project-biscoti>]
- [2] **Front End Software Architecture Web Site** [<http://project-fesa.web.cern.ch/project-fesa>]
- [3] **BDI front end software Standard interface For Beam position Measurements**
[EDMS: 630857]
- [4] **Guidelines and conventions for defining interfaces of equipment developed using FESA** [EDMS: 581892]