ICE^{PLUS}-ASIC
FOR
3D USX Platform

ASIC/DLL driver Specification
based on SVNREV : 2465

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1. Overview

1.1. Functionality

The USX ASIC driver is a precompiled dynamically link library (DLL) for 64-bit Windows, which can be used to access bare single ASICs or probes using 1-4 ASICs from a PC via a FPGA Board. It provides routines:

- to measure ASIC internal parameters
- put ASIC into a defined RX state
- transmit with given parameters
- Pulse/Echo Tests

To make sure execution is reliable and coherently the same in all setups:

- all communication/measurement sequences are handled by this driver,
- all their timing critical parts are controlled by the FPGA.
- all measured parameters are returned in SI units (or engineering units of it, e.g. pF)

Its scope is production testing and acoustic testing – not all functions are exposed, customer interface is not covered. More functions might be added upon needs. In case the FPGA needs to be changed as well, the driver checks automatically the compatibility with the FPGA version

1.2. Intended use

The intended use is to

- support the internal acoustic measurement group by providing an easy access library without in-depth knowledge about USX ASIC programming
- support the production and production engineering to run verified tests in a known sequence
- to support Oldelft Customers for quick development to prototype. This USX DLL serves as a guide to quickly integrate the functionality to control USX-based probes on their systems

1.3. Users

As the intended use proposes, the users are:

- Acoustic measurement group
- Production Engineering group
- Oldelft customers

1.4. Maintenance

As the USX DLL is built around the USX ASIC, it will need an update when there is an update/redesign of the USX ASIC. Additional reasons for change or maintenance is when new functionality is requested from the Users.

1.5. Bug Tracking and Repository

The USX DLL code is in a SVN repository, which is located at "electric/ICE_FPGA/sw", accessible from internal network

Project bug tracking and feature planning is done in Wrike, accessible via https://www.wrike.com/

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1.6. Release

A release of the driver includes:

- SVN Export of the driver's source code with revision number
- A precompiled dynamically linkable library for 64-bit Windows, including *.lib + *.h file
- FPGA Binary programming file for the latest HW platform.
- this document

The files are stored under SVN revision 2XXX. The reported numbers are:

- DLL: SVN 2465
- FPGA: SVN 2463

1.7. Revisions & Changes

Revision & Date	Changes
2044 (24 April 2019)	- Update on Get / SetParam List
2066 (11 July 2019)	- Bugfixes for FireAsicReceive Commands
2132 (15 Oct 2019)	- CWModeInit description - Update in Errorcodes - ChangeInterface description - SetParam updated (*ConfigCore, Setup)* - *New GroupTX/RXDisableElement function*
2263 (30 Nov 2019) (07 Jan 2020)	- Updated Software requirements - New Table : User Parameter List : Bmode Settings - New Command : BModeClearEntries - Renamed Command : BModeTriggerEntry - Update on InitializeAsic, ChangeInterface - New Commands TransmitCharge, MatrixCapacitance,SetHVIddq
2300 (19 June 2020)	- New Commands: BmodeQueueRepeat, ReadEEPROMID - New SetParam : QueueExtTriggerRepeat
2326 (28 Oct 2020)	- New Command : BmodeTriggerEntryExt,
2358 (01 Dec 2020)	- CWModeInit description - FireGroupReceive description - ReadTxDelays, ReadRxDelays work correctly in combination with queued B-mode - SetHVPSelect added - GetTalkBack added - Timing for TransmitCharge updated
2416 (13 Apr 2021)	- Corrected typos and inconsistencies examples - Removed 32-bit support and increased buffer size in examples to 64k
2444 (16 Jun 2021)	- Parameters of ChangeInterface - Command for changing VDD5/HVP_MINUS - New targets for Hexstrings
2465 (11 Oct 2021)	- Corrected typos and removed obsolete documentation (e.g. ASIC version 1) - Added forgotten SetParam ConfigCore,LNAAutoPowerDown - New SetParams : RepeatLastOnTrigger, ForceMeasure, UseTriggerGenerator

Table 1: Revisions and Changes

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2. How to use

2.1. General
Prior to usage the DLL must be loaded.

Then the DLL only exports one function **asic_call_parse :**

    int asic_call_parse(char * InString, char * OutString)

as parameters it takes two string pointers InString and OutString:

    InString is used to pass the Commands and Arguments to the Driver as NULL-terminated string
    OutString is used to return Results as NULL-terminated string

    Additionally, each call returns an ErrorCode (int) to indicate if the execution was successful. Any non-zero
    values indicate an error. See table in Appendix for more information.

Make sure to allocate enough memory for the OutString, recommended is at least 4 Kbytes.

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2.2. Example in C

This example shows the usage of the driver and implements a small Command line tool to be used under Windows.

```c
#include <windows.h>
#include <stdio.h>

typedef int (__stdcall *f_dllfunction)(char * InString, char * OutString);

int main(int argc, char** argv)
{
  printf("Hello World DLL:\n");
  HINSTANCE hGetProcIDDLL = LoadLibrary("asic_call_wrapper_dll.dll");
  if (!hGetProcIDDLL)
  {
    printf("could not load the dynamic library\n");
    return -1;
  }

  f_dllfunction asic_call_parse = (f_dllfunction)GetProcAddress(hGetProcIDDLL, "asic_call_parse");
  if (!asic_call_parse)
  {
    printf("could not locate the function\n");
    return -1;
  }

  char *return_string = (char*) malloc(65336);
  char *send_string   = (char*) malloc(65336);

  printf("Welcome to USX command line:\n\n");
  while (1)
  {  scanf("%65335s",send_string);
    if (!(strcmp(send_string,"quit"))) break;
    asic_call_parse(send_string, return_string);
    printf("%s\n",return_string);
  }
  free(return_string);
  free(send_string);
  return 0;
}
```

Figure 1 : Example in C

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2.3. Example in MATLAB

```
%% Load driver and assign buffer

loadlibrary('asic_call_wrapper_dll64.dll','asic_call_wrapper_dll.h');
if ~exist('asic_call_wrapper_dll64.m','file') % Create proto if not existing --> this is MUCH faster for loading the next time
    loadlibrary('asic_call_wrapper_dll64.dll','asic_call_wrapper_dll.h','mfilename','asic_call_wrapper_dll64');
else
    loadlibrary('asic_call_wrapper_dll64.dll',@asic_call_wrapper_dll64); % use proto .m file for faster loading
end

strOutSize=1024*64;
strOutPtr= libpointer('cstring',repmat(' ',1,strOutSize));

%% Initialize driver and ASIC
inStr='InitializeDriver:USB:*';
[status,~,outStr]=calllib('asic_call_wrapper_dll64','asic_call_parse',libpointer('cstring',inStr),strOutPtr);
fprintf([outStr,'\n']);

inStr='DriverVersion';
[status,~,outStr]=calllib('asic_call_wrapper_dll64','asic_call_parse',libpointer('cstring',inStr),strOutPtr);
fprintf([outStr,'\n']);

inStr='InitializeAsic:100';
[status,~,outStr]=calllib('asic_call_wrapper_dll64','asic_call_parse',libpointer('cstring',inStr),strOutPtr);
fprintf([outStr,'\n']);
```

Figure 2: Example in MATLAB

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2.4. Example in Delphi

```delphi
Type
  Tasic_call_parse = Function(InString: PansiChar; outstring: PansiChar): integer;
Stdcall;
Var
  asic_call_parse: Tasic_call_parse;
  DLLHandle : Thandle;
  myCharPtrIn, myCharPtrOut: PansiChar;
begin
DLLHandle:=0;
{$IFDEF WIN64}
DLLHandle := LoadLibrary(pchar('asic_call_wrapper_dll64.dll'));
{$ENDIF}
if DLLHandle <> 0
then
  @asic_call_parse := GetProcAddress(DLLHandle, 'asic_call_parse')
Else
  Begin
 Showmessage('DLL not loaded');
  Exit;
  End;
getmem(myCharPtrIn, 65536);
getmem(myCharPtrOut, 65536);
// Initialize driver and ASIC
myCharPtrIn   := 'InitializeDriver:USB:*';
status := asic_call_parse(myCharPtrIn, myCharPtrOut);
showmessage(myCharPtrOut);
myCharPtrIn := 'DriverVersion';
status := asic_call_parse(myCharPtrIn, myCharPtrOut);
showmessage(myCharPtrOut);
myCharPtrIn := 'InitializeAsic:100';
status:= asic_call_parse(myCharPtrIn, myCharPtrOut);
showmessage(myCharPtrOut);
FreeLibrary(DLLHandle);
End.
```

Figure 3: Example in Delphi

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2.5. System / Software requirements

This is a "ASIC/DLL driver", and as a DLL is a Dynamic-link library which is Microsoft's implementation of the shared library concept in the Microsoft Windows, it needs a Microsoft windows, and an Intel-based 64-bit System that runs Windows. It is tested and verified with Windows 10, but probably runs also on other Windows platforms.

Required installed DLLs for 64-bit:

- KERNEL32.dll (part of Windows installation)

- msvcrt.dll (part of Windows installation)

- ftd2xx.dll (runtime DLL : optional if USB is used)

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3. Command structure

Arguments are separated by ':', Parameters are separated by ',', Example:

ExampleCommand:Argument<String>:Argument<Number,Number,Number>

If an unknown command is called, a help string on the available commands is returned.

If a command is called without the right number or type of arguments, a help string on the required commands is returned.

Every command returns its command name: <RESULT or ERROR>: Return data

Return data is separated by ',' as arguments

** For list of GetParam and SetParam arguments see User Parameter List

*** Command uses the Trigger Input and Output

Trigger Out can be used for triggering a scope as time reference, it is issued when command gets executed

Trigger In can be used to repeat last command, e.g. Fire transmit pulses repeatedly.

When Trigger In is used, then still the Trigger Out is generated and should be used for triggering the scope to avoid synchronization jitter.

3.1. Examples

InString :	DriverVersion
OutString :	DriverVersion:RESULT:2.0

InString :	OutputCapacitance
OutString :	HELP: valid command "OutputCapacitance" found, but argument mismatch
	expecting 2 arguments, found 1 Arg 1 : expecting 1 parameters, found 0

InString :	OutputCapacitance:5000
OutString :	OutputCapacitance:ERROR: Channel 5000 is invalid, must be [-1 <= channel <= n*64]

InString :	OutputCapacitance:10
OutString :	OutputCapacitance:RESULT:10.000

InString :	OutputCapacitance:-1
OutString :	OutputCapacitance:RESULT: 0.000, 1.000, 2.000, 3.000, 4.000, 5.000, 6.000, 7.000, 8.000, 9.000,10.000,11.000,12.000,13.000,14.000,15.000,16.000,17.000,18.000,19.000, 20.000,21.000,22.000,23.000,24.000,25.000,26.000,27.000,28.000,29.000,30.000, 31.000,32.000,33.000,...,60.000,61.000,62.000,63.000

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3.2. Digital Test List

The following digital Tests can be run with the Digital Test command separately or grouped:

- TestAll
  - RegAll
    - RegConfig
    - RegTxCalcCoeff
    - RegRxDyn
    - RegRxCalcCoeff
    - RegBeamTiming
    - RegBist
    - RegCeRxTxConf
  - CoreAll
    - CoreTxDelay
    - CoreRxDelay
    - CoreXmitWF
    - CoreCWSel
    - CoreConfig
    - CoreDelayPointer
    - CoreSelect
  - PeriDRV

3.3. User Parameter List

For acoustic measurements some parameters are pre-configured to default values, in order to simplify usage of receive and transmit commands. These values can be read and written via the GetParam and SetParam commands. Sending the commands does not change ASIC values instantly, but they will overwrite the default settings, when the receive and transmit commands are used.

For description of the parameters please refer to the ASIC specification.

Name (→ Reference in ASIC specification)	Signed	Default	Used in / Comments
→ *REG_CONFIG*			
Config,TxClkDivider	U	20	*Fire-Commands
Config,TxDelayLSBOpt	U	0	*Fire-Commands
Config,TxDelayLSBRand	U	0	*Fire-Commands
Config,RxAssignmentOffset	U	0	Receive*Commands
Config,RxDelayLSBOpt	U	0	Receive*Commands
Config,RxDelayLSBRand	U	0	Receive*Commands
Config,UseAnalogReset	U	0	*Fire, *Receive-Commands
Config,BeamContRx	U	0	Receive*Commands
Config,BeamContTx	U	0	*Fire-Commands
Config,RandomizeDynUpdate	U	0	Receive*Commands
Config,ErrorStopMask	U	0	*Fire, *Receive-Commands
Config,ErrorMaskXmit	U	0	*Fire, *Receive-Commands
Config,LockDuringBeam	U	0	*Fire, *Receive-Commands

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Name (→ Reference in ASIC specification)	Signed	Default	Used in / Comments
Config,IbiasCal	S	0	All commands
Config,AsicEnabled	U	15	All commands - Mask Enable : ASIC0(1) ASIC1(2) ASIC2(4) ASIC3(8) **Change before InitializeAsic** **Note:** As the code is written today, you have to take either ASIC0, ASIC0 & ASIC1, ASIC0 & 1 & 2, or all 4 ASICs. The second one only is not supported.

Table 2 : User Parameter List : REG_CONFIG

Name (→ Reference in ASIC specification)	Signed	Default	Used in / Comments
→ *XMITWF_DFF*			
XmitWF,tx_startsample	U	6	Fire*Commands
XmitWF,tx_repsample	U	10	Fire*Commands
XmitWF,tx_endsample	U	13	Fire*Commands
XmitWF,tx_patternrep	U	0	Fire*Commands
XmitWF,precharge_mode	U	2	Fire*Commands
XmitWF,clamptime	U	8	Fire*Commands
XmitWF,prechargetime	U	8	Fire*Commands
XmitWF,chsel_pattern	U	0	Fire*Commands
XmitWF,tx_wf_setup	U	0xA0F0A002	Fire*Commands

Table 3 : User Parameter List : XMITWF_DFF

Name (→ Reference in ASIC specification)	Signed	Default	Used in / Comments
→ *CONFIG_DFF*			
ConfigCore,ISelLna	U	7	Receive*Commands
ConfigCore,ISelOdrv	U	8	Receive*Commands
ConfigCore,ISelResCntl	U	8	Receive*Commands
ConfigCore,ISelDcGND	U	8	Fire*Commands
ConfigCore,ISelPpHVP	U	8	Fire*Commands
ConfigCore,ResCal	U	4	Receive*Commands
ConfigCore,ResCntlOverwrite	U	0	Fire*Receive-Commands
ConfigCore,AnalogResetNoRx	U	0	Fire*Receive-Commands
ConfigCore,AnalogResetAuto	U	1	(not used)
ConfigCore,RxAlwaysEn	U	1	Fire*Receive-Commands
ConfigCore,TxPrechargeRandomIsrc	U	0	Fire*Commands

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Name (→ Reference in ASIC specification)	Signed	Default	Used in / Comments
ConfigCore,RandomUpdEn	U	0	Fire*Commands
ConfigCore, PcHVPPSEn	U	0	Fire*Commands
ConfigCore,DisableDisable	U	0	Fire*Receive-Commands
ConfigCore,MatrixOffsetVal(<num>)	U	0	Receive-Commands <num> is a group number 1 ASIC : 0-63, 2 ASICs : 0-127, 3 ASICs : 0-191 4 ASICs : 0-255
ConfigCore,GroupEnable(<num>)	U	1	Fire*Receive-Commands <num> is a group number. Per group disable of Bias_En.
ConfigCore, GroupTXDisableElement(<num>)	U	0	Per Element TX disable using CWSEL register. <num> is Element number
ConfigCore, GroupRXDisableElement(<num>)	U	0	Per Element RX disable using CWSEL register. <num> is Element number
ConfigCore, LNAAutoPowerDown	U	0	Automatic PowerDown when RX is not active.

Table 4 : User Parameter List : CONFIG_DFF

Name (→ Reference in ASIC specification)	Signed	Default	Used in / Comments
→ *REG_BEAMTIMING*			
BeamTiming,AnaResetStopTime	U	150 (12 us)	
BeamTiming,SetupRxTime	U	0 (0 us)	
BeamTiming,RunRxTime	U	150 (6 us)	
BeamTiming,RunTxTime	U	0 (0 us)	
BeamTiming,StopTxTime	U	200 (16 us)	
BeamTiming,StopRxTime	U	100 (256 us)	
BeamTiming,TGCIncrement	U	1 (0.64 us)	
BeamTiming,TGCStart	U	1 (1.28 us)	
BeamTiming,TGCDecrement	U	0	
BeamTiming,TGCDecrementCnt	U	0	
BeamTiming,ExtRxSetup	U	0	
BeamTiming,ExtTxRunTime	U	0	
BeamTiming,ExtRxSetupTime	U	0	

Table 5 : User Parameter List : REG_BEAMTIMING

Name (→ Reference in ASIC specification)	Signed	Default	Used in / Comments

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Name (→ Reference in ASIC specification)	Signed	Default	Used in / Comments
FPGA internal			
Setup,ExecuteTriggerOnce	U	1	*Fire,*Receive, except time- continuous single element
Setup,BISTCurrent	U	2	All Cap- and Voltage measurements
Setup,CWLineForTest	U	1	All BIST measurements
Setup,TestAveraging	U	3	Element measurements are averaged by (TestAveraging+1), Group and reference measurements are averaged by 4*(TestAveraging+1).
Setup,DisableLED	U	0	Disable LED
Setup,EnableTrigger	U	0	Enable external Trigger IN/OUT for Test purposes on JTAG connector
Setup,QueueExtTriggerRepeat	U	0	When external trigger is used, and value is '1' same beam gets triggered repeatedly, when value is '0' nest beam is triggered.
Setup,VoltageVDD5	U	0	Change VDD5/VDD10 Voltages (8-bit) 0 = 5V/10V (default), 255 = 2.5V/7.5V
Setup,VoltageHVPMinus	U	0	Change HVP_MINUS Voltage (8-bit) 0 = 5V (default), 255 = 2.5V (curve is non-linear in the beginning)
Setup,TSensorUpdate	U	0	Configure Temperature sensor sampling/update 0 = Never, 1= with Trigger, 2=continuous
Setup, RepeatLastOnTrigger	U	0	If set to '1' the last command can be repeated by external trigger
Setup, ForceMeasure	U	0	For production test, if set to '1' when using multiple ASICs, the data is not cached, but remeasured on each command
Setup, UseTriggerGenerator	U	0	Prepares internal logic for the use with the internal Trigger Generator.

Table 6 : User Parameter List : FPGA Internal

Name (→ Reference in ASIC specification)	Signed	Default	Used in / Comments
→ REG_RXDYN			
RxDynASIC2,Clk<num>Multiplier	U	0	Dyn. RX Timing (see ASIC spec.)
RxDynASIC2,Clk<num>Multsign	U	4x1, 4x0	All Receive*Commands
RxDynASIC2,Clk<num>Startphase	U	4	

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Name (→ Reference in ASIC specification)	Signed	Default	Used in / Comments
RxDynASIC2,Clk<seg>ClkMSlope	U	0	<num> is Clock number 0-7
RxDynASIC2,ClkMDuration<seg>	U	0	<seg> is a segment of a piecewise linear curve 0-7
RxDynASIC2,RandomOpt	U	0	

Table 7 : User Parameter List : REG_RXDYN

Name (→ Reference in ASIC specification)	Signed	Default	Used in / Comments
→ REG_CERXTXCONF			
CeRxTxConf,RxXMin	U	0	All Receive*Commands
CeRxTxConf,RxXMax	U	63	All Receive*Commands
CeRxTxConf,TxXMin	U	0	All Fire*Commands
CeRxTxConf,TxXMax	U	63	All Fire*Commands

Table 8 : User Parameter List : REG_CERXTXCONF

Name (→ Reference in ASIC specification)	Signed	Default	Used in / Comments
BModeSendBeam,SendBeamTiming	U	0	All BMode* Commands When set to 1 - send additional registers before every BMode Beam
BModeSendBeam,SendRxDyn	U	0	
BModeSendBeam,SendXmitWF	U	0	
BModeSendBeam,SendConfigCore	U	0	
BModeSendBeam,SendConfigDRV	U	0	
BModeSendBeam,Manual	U	0	When set to 1 all BMode commands are not queued up in a Table in FPGA Memory, instead they are executed directly
Note : BModeSendBeam gets reset after sending 'BmodeSendASICSettings'			

Table 9 : User Parameter List : Bmode Settings

Name	Signed	Default	Used in / Comments
BModeSendMode,Aperture	U	1	Update Aperture with 'BmodeSendASICSettings'' command
BModeSendMode,UpdateHVP	U	0	Update HVP with 'BmodeSendASICSettings'' command
BModeSendMode,SelectHVP	U	0	Value used to update HVP

Table 10 : User Parameter List : Bmode SendMode Settings

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Name (→ Reference in ASIC specification)	Signed	Default	Used in / Comments
→ **CONFIG_DRV**			
ConfigDRV,BiasSel	U	4	All Receive*Commands
ConfigDRV,FFen	U	0	All Receive*Commands
ConfigDRV,Enable	U	1	All Receive*Command

Table 11: User Parameter List : CONFIG_DRV

3.4. Multiple ASICs

The "InitializeAsic" command does an auto-detection of all (up to 4) ASICs within the connected probe and returns the number of ASICs.

For addressing a particular ASIC some commands (DigitalTest, SerialNumber) require an ASIC number (0 = 1. ASIC, 1 = 2. ASIC, etc.), most other commands, which require a group number are extended to accept 0 to (64*N)-1 as parameter.

3.5. Error Codes

Error Codes of the Driver

Every driver call returns an Error code. Any non-zero Error Code indicates that the executed command was not successful. The table below gives an idea what might have caused the error and helps debugging.

ERRORCODE_OK	0
ERRORCODE_FAILED	(1<<0)
ERRORCODE_PARAM	(1<<1)
ERRORCODE_PARAMSET	(1<<2)
ERRORCODE_STATUS	(1<<3)
ERRORCODE_USB_INIT	(1<<4)
ERRORCODE_USB_RECEIVE	(1<<5)
ERRORCODE_USB_SEND	(1<<6)
ERRORCODE_NOT_IMPLEMENTED	(1<<7)
ERRORCODE_CRC	(1<<8)
ERRORCODE_FPGA	(1<<9)
ERRORCODE_SWINTERNAL (Digilent)	(1<<10)
(optional) ERRORCODE_ASICERROR	(8-bit <<16)

Table 12: Error Codes Driver

Some commands check during execution the ASIC Error Bits. If these do not give the expected results, the test fails, and their value is given back additionally for debugging purposes.

FPGA Error Bits

More information can be queried with the "GetAsicError" command returning a 32-bit Error Bitfield from FPGA, and an 8-bit Error Bitfield from ASIC.

FPGA_OK	0
ASIC/Power Error Bits - Bits 7-0	
QSPI_NERROR (Asic Error line) (low active)	(1<<0)
Ref Clock not synced	(1<<3)
Powergood FPGA	(1<<4)
Power good HV	(1<<5)
Power good LV	(1<<6)
Power failure shutdown	(1<<7)
FPGA State machine Error bits - Bits 15-8	
FPGA_ERROR_COMMAND	(1<<8)
FPGA_ERROR_TRIGGER	(1<<9)
FPGA_ERROR_CLKBUSY	(1<<10)
Communication Interface Error bits - Bits 23-16	
OVERFULL	(1<<16)
FRAME_ERROR	(1<<17)
Reserved, read as 0 - Bits 31-24	

Table 13: Error Codes FPGA

ASIC Error Bits

ASIC Error Bits are obtained by reading the ASIC status register (BistGetErrorStatus), or using the command "GetAsicError"

ERRORFLAG_OK	0
ERRORFLAG_UNKNOWN_CMD	(1<<0)
ERRORFLAG_VALIDERROR	(1<<1)
ERRORFLAG_CHKSUMERROR	(1<<2)
ERRORFLAG_BUSY	(1<<3)
ERRORFLAG_LOCKED	(1<<6)
ERRORFLAG_EXTERNAL	(1<<7)

Table 14: Error Codes ASIC

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4. Detailed command description

In this chapter all commands of the DLL are presented and explained in a tabular format. For good consistency of documentation and DLL implementation this chapter is auto-generated and has therefore slightly different format. For understanding which information are available for each command and especially which arguments are needed here an example with explanation :

ReceiveGroup : Receive beamformed signal from a group			
Description	Time sampled receive for single group (infinitely) All Elements of a single group (group number between 0 and N*63) are beamformed with given Element delys and routed to any output channel within its RX/TX domain, including the output of its own group. Element delays must be between -1 and 31 to be valid, and between 2 and 25 to be 'useful'		
Return	Status		
Example	ReceiveGroup:1,1:0,0,0,0,2,2,2,2,4,4,4,4,6,6,6,6 ReceiveGroup:RESULT: OK		
Arg 1[2 F]	Group, Outchannel	Arg 2[16 F]	RxDelays
Arg 3[0 X]	None	Trigger [X]	UserParam : [X]

The Arg section at the bottom of the table shows that the command "ReceiveGroup" needs 2 arguments. The first argument (Arg 1) is expected to be 2 "Fixed integer numbers" ([2 F]), the first one the Group and the second one the Outchannel. The second argument (Arg 2) is expected to be 16 "Fixed integer numbers" ([16 F]) stating the 16 RxDelays. The third argument is not valid and therefore is not expected.

Arguments can be of the following type:

'X' = Don't care

'F' = Fixed integer number, as e.g. 0, -2, 4, +3

'M' = Multiple integer numbers. Number multiplied with the number of ASICs connected. E.g. [1024 M] for a Probe with 2 ASICs is an integer number 2048.

'S' = String

The Trigger checkbox indicates if this command can be used in conjunction with an external hardware trigger (dependent on hardware platform) to repeat last command.

The UserParam checkbox indicates if the command uses the parameters configured by the SetParam command. For some fixed routines this is disabled or not applicable.

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Command Name	Long Name	Page
BmodeSendASICSettings	Send Settings to the ASIC for B-Mode	28
BmodeQueueASICDelays	Queue ASICDelays for B-Mode	28
BmodeQueueASICCompCoeff	Queue ASICDelays for B-Mode using Coefficients	28
BmodeQueueOutMUX	Queue ASICDelays for B-Mode with different Output MUX setting	28
BmodeQueueRepeat	Queue a "Repeat beam", same delays	28
BmodeQueueUpload	Upload Queue for B-Mode	28
BmodeGetQueueEntries	Get number of entries in the B-mode queue	29
BmodeClearEntries	Clear all Entries for BMode	30
BmodeTriggerEntry	Trigger Entry from FPGA memory in B-mode	31
BmodeTriggerEntryExt	Like "BmodeTriggerEntry" but using external trigger line (Oldeft testboard only)	31
BmodeFreeze	Send ASIC to Low Power mode (Freeze) B-mode	32
CWmodeInit	Initialize CW-mode	32
SerialNumber	Write Serial number to ASIC	32
MatrixCapacitance	Measure uBeamformer capacitances	32
GetTalkback	Receive unasked bytes from Master	32
SetHVPSelect	HVP Selection in Connector	33
SetHVIddq	Initialize ASIC with static Driver state	33

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DriverVersion : Get driver version

Description	Get driver version
Return	Software Version as SVN Revision number
Example	DriverVersion
	DriverVersion:RESULT: SVN Build 2465

Arg 1[0 X]	None	**Arg 2[0 X]**	None
Arg 3[0 X]	None	**Trigger** [ ]	**UserParam** : [ ]

InitializeDriver : Initialize Driver

Description	Initialize Driver, open USB / SIM / Minimatrix (2 chip USX probe) Interface Checks FPGA communication (if applicable) and min. FPGA revision. Needs to be run before most other commands For USB Specifier can be : '*' for auto-detect, Descriptor;* or *;Serial For Hexstring use <target>:Hexstring Supported targets : ICEmatrix (1-Chip), Minimatrix (2-chip), Adultmatrix (3-chip), Quadmatrix (4-chip)
Return	Status
Example	InitializeDriver:USB:HappyCamper
	InitializeDriver:RESULT:OK

Arg 1[1 S]	Device, e.g. USB, SIM, Minimatrix	**Arg 2[1 X]**	SerialNumber or Specifier
Arg 3[0 X]	None	**Trigger** [ ]	**UserParam** : [ ]

FTDISetSerial : FTDISetSerial

Description	Write Descriptor and Serial for FTDI Chip (USB) Neso Board Descriptor must be programmed without Suffix B, Handleboard Descriptor with Suffix B
Return	Status
Example	FTDISetSerial:Oldelft 195F081 B:OLD10019
	FTDISetSerial:RESULT:OK

Arg 1[1 S]	Descriptor (max. 64 byte)	**Arg 2[1 X]**	Serial (max. 16 byte)
Arg 3[0 X]	None	**Trigger** [ ]	**UserParam** : [ ]

InitializeAsic : Initialize ASIC

Description	Initialize ASIC to default, set clock, read serialnumber With Argument 0, ASIC is de-initialize and powered off
Return	Number of ASICs found, ASIC revision number, Clock Speed and Serial Number(s)
Example	InitializeAsic:25
	InitializeAsic:RESULT:2 Asics found, Version 2, ClkSpeed 25 MHz, SerialNumber [0] 100, SerialNumber[1] 101

Arg 1[1 F]	Clock Speed: 25 or 100 0 = Power Off	**Arg 2[0 X]**	None
Arg 3[0 X]	None	**Trigger** [ ]	**UserParam** : [ ]

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DriverClose : Driver Close

Description	Close driver		
Return	Status		
Example	DriverClose		
	DriverClose:RESULT:OK		
Arg 1[0 X]	None	**Arg 2[0 X]**	None
Arg 3[0 X]	None	**Trigger** [ ]	**UserParam** : [ ]

ReadEEPROMID : Read IDs of EEPROMs

Description	Read IDs of EEPROMs, used for production chain tracking		
Return	Status		
Example	ReadEEPROMID		
	ReadEEPROMID:RESULT: ID 0:0x12345678 ID 1:0x00000000 ID 2:0x00000000 ID 3:0x00000000 ID 4:0x00000000 ID 5:0x00000000 ID 6:0x00000000 ID 7:0x00000000		
Arg 1[0 X]	None	**Arg 2[0 X]**	None
Arg 3[0 X]	None	**Trigger** [ ]	**UserParam** : [ ]

FPGAVersion : Read FPGA Version

Description	Get HW Revision, FPGA SVN Revision		
Return	Status		
Example	FPGAVersion		
	FPGAVersion:RESULT:HW 2, FPGA SVN 2465		
Arg 1[0 X]	None	**Arg 2[0 X]**	None
Arg 3[0 X]	None	**Trigger** [ ]	**UserParam** : [ ]

FPGAHardwareID : Get FPGA Hardware ID

Description	Get HW ID, either Solder ID (Testboard), Customer ID(Handleboard)		
Return	Status		
Example	FPGAHardwareID		
	FPGAHardwareID:RESULT:Hardware ID 1		
Arg 1[0 X]	None	**Arg 2[0 X]**	None
Arg 3[0 X]	None	**Trigger** [ ]	**UserParam** : [ ]

FPGADescription : Get FPGA Description of Interface

Description	Get the description and serial number of the Interface (USB, etc.)		
Return	Description		
Example	FPGADescription		
	FPGADescription:RESULT:BlackCat:AB0004		
Arg 1[0 X]	None	**Arg 2[0 X]**	None
Arg 3[0 X]	None	**Trigger** [ ]	**UserParam** : [ ]

GetAsicError : Get ASIC Error

Description	Get ASIC and FPGA Error bits (each bit indicates separate error, see 'Return Error Codes'
Return	Error codes

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Example	GetAsicError		
	GetAsicError:RESULT:ASIC Error Status: 00, FPGA Error Status: 00000000		
Arg 1[0 X]	None	**Arg 2[0 X]**	None
Arg 3[0 X]	None	**Trigger** [ ]	**UserParam** : [ ]

ChangeInterface : Change Customer Interface			
Description	Change SysFPGA protocol to emulate customer protocol.		
	Note: On improper setup FPGA is not responsive anymore and needs reset ! Testsystem ONLY !		
	- UseCase 0: Unconfigured - IN's and OUT's are undriven (startup - no mastermode)		
	- UseCase 1: sysfpga is driving as master, internal connection to pretop, IN's and OUT's are driven externally for scope connection		
	- UseCase 2: sysfpga is driving as master, NO internal connection to pretop (pretop is not active), IN's are driven externally for handleboard connection, OUT's are externally inputs and driven by the handleboard		
	- UseCase 3 (unused): sysfpga is not active, external connection to pretop, IN's are externally inputs driven by external master, OUT's are externally outputs to external master		
	CustomerID : Coding is same as the Customer select resistors (ID)		
	ComSpeed is customer interface dependent. 0=off		
	For ID=1 : 100MHz / N, with N>0, N<16		
	For ID=2-7 : 100/(2*(N+1)), with N>0, N< 127,		
	Option +128 for SPI clock always running		
	Power is Handleboard power		
	0=All Off, 1=LV/MV On, 2=LV/MV/HVP On 3= Argument 2, but with Overwrite of the detect pin for old HW		
	Note: After using the ChangeInterface command the EnableTrigger and DisableLED Parameter have to be send again.		
Return	Error codes		
Example	ChangeInterface:2,1,4,1		
	ChangeInterface:RESULT:OK		
Arg 1[4 F]	UseCase, CustomerID, ComSpeed, Power	**Arg 2[0 X]**	None
Arg 3[0 X]	None	**Trigger** [ ]	**UserParam** : [ ]

RunTriggerGenerator : Run Trigger generator			
Description	Run internal trigger generator. Testsystem ONLY !		
	Repetition of 0 = infinite, -1 is Stop		
Return	Error codes		
Example	RunTriggerGenerator:200,16		
	RunTriggerGenerator:RESULT:OK		
Arg 1[2 F]	Periode in us, Repetition	**Arg 2[0 X]**	None
Arg 3[0 X]	None	**Trigger** [ ]	**UserParam** : [ ]

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FPGAStatus : Get FPGA Status

Description	Get FPGA Status (Page 1) with Interpretation as Error bytes, PLL Value, Revision, etc.
Return	Error codes
Example	FPGAStatus
	FPGAStatus: RESULT: ASIC Error : 00, FPGAError : 00, ComErrorBits : 00 00, Clock Status : 00 00, FPGA Revision 2.1 SVN Revision 2183, Solder ID: 2 Button Status 00
	Note: Error Byte / FPGAError / ComErrorBits refer to the Error bits described in "Error Codes FPGA"

Arg 1[0 X]	None	**Arg 2[0 X]**	None
Arg 3[0 X]	None	**Trigger** [ ]	**UserParam** : [ ]

FPGAStatusPage : Get FPGA Status Page

Description	Get FPGA Status
Return	Status Page as 16 hex bytes. Interpretation by user.
Example	FPGAStatusPage:2
	FPGAStatusPage: RESULT:
	FPGAStatusPage [2] : 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

Arg 1[1 F]	Pagenumber	**Arg 2[0 X]**	None
Arg 3[0 X]	None	**Trigger** [ ]	**UserParam** : [ ]

GetSendString : Get Send string

Description	Get Send string as HEX, accumulated from last commands, to be send via customer interface. Can only be used with 2 chip USX probe interface
Return	String
Example	GetSendString
	GetSendString:0804EDAB

Arg 1[0 X]	None	**Arg 2[0 X]**	None
Arg 3[0 X]	None	**Trigger** [ ]	**UserParam** : [ ]

ClearSendString : Clear Send string

Description	Clear Send string, can only be used with 2 chip USX probe interface
Return	String
Example	ClearSendString
	BitStream cleared

Arg 1[0 X]	None	**Arg 2[0 X]**	None
Arg 3[0 X]	None	**Trigger** [ ]	**UserParam** : [ ]

OutputCapacitance : Measure Output capacitance

Description	Returns Output capacitance in pF for given Group.
	Group can be between 0 and N*64-1, or -1 for all Groups
Return	Capacitance in pF
Example	OutputCapacitance:10

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OutputCapacitance:RESULT:4.283

Arg 1[1 F]	Group	**Arg 2[0 X]**	None
Arg 3[0 X]	None	**Trigger** [ ]	**UserParam** : [ ]

OutputOpPoint : Measure Output operating point

Description	Returns Output operating point in V for given Group Group can be between 0 and N*64-1, or -1 for all Groups
Return	OpPoint in V
Example	OutputOpPoint:10
	OutputOpPoint:RESULT: 0.755

Arg 1[1 F]	Group	**Arg 2[0 X]**	None
Arg 3[0 X]	None	**Trigger** [ ]	**UserParam** : [ ]

ElementCapacitance : Measure element capacitance

Description	Returns all Element capacitances in pF for given group Group can be between 0 and N*64-1. Typical values are 2pF for an unpostprocessed ASIC, 4-7pF with Transducers. Values of 0pF or above 100pF indicate an internal short, or missing HVP supply.
Return	element capacitance in pF
Example	ElementCapacitance:10
	ElementCapacitance:RESULT: 5.783, 5.875, 5.792, 5.783, 5.658, 5.800, 5.817, 5.675, 5.650, 5.850, 5.750, 5.700, 5.642, 5.883, 5.767, 5.683

Arg 1[1 F]	Group	**Arg 2[0 X]**	None
Arg 3[0 X]	None	**Trigger** [ ]	**UserParam** : [ ]

ElementLNAInOpPoint : Measure element LNA input operating point

Description	Returns all Elements LNA input operating point in V for given group Group can be between 0 and N*64-1. Typical values are around 0.6V for ASIC V1, and 0.0V for ASIC V2
Return	LNA OpPoint in V
Example	ElementLNAInOpPoint:10
	ElementLNAInOpPoint:RESULT: 0.658, 0.656, 0.658, 0.657, 0.655, 0.655, 0.658, 0.658, 0.655, 0.655, 0.657, 0.657, 0.654, 0.654, 0.657, 0.658

Arg 1[1 F]	Group	**Arg 2[0 X]**	None
Arg 3[0 X]	None	**Trigger** [ ]	**UserParam** : [ ]

ElementLNAOutOpPoint : Measure element LNA output operating point

Description	Returns all Elements LNA output operating point in V for given group. Group can be between 0 and N*64-1. Typical values are around 0.6V
Return	LNA OpPoint in V
Example	ElementLNAOutOpPoint:10
	ElementLNAOutOpPoint:RESULT: 0.583, 0.583, 0.585, 0.585, 0.585, 0.586, 0.585, 0.585, 0.587, 0.584, 0.584, 0.583, 0.585, 0.585, 0.585, 0.588

Arg 1[1 F]	Group	**Arg 2[0 X]**	None

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Arg 3[0 X]	None	Trigger [ ]	UserParam : [ ]

CWCapacitance : Measure capacitance of the CW lines

Description	Measure capacitance of all 8 CW lines (+ offset capacitance by ADC) of given ASIC using 3 different currents
Return	Table with 3x9 Capacitances
Example	CWCapacitance:0 CWCapacitance:RESULT: 0.5 uA : 3.2 3.4 3.5 6.2 6.6 7.0 10.0 10.3 10.9 2.5 uA : 3.2 3.4 3.5 6.2 6.6 7.0 10.0 10.3 10.9 10 uA : 3.2 3.4 3.5 6.2 6.6 7.0 10.0 10.3 10.9

Arg 1[1 F]	AsicNr	Arg 2[0 X]	None
Arg 3[0 X]	None	Trigger [ ]	UserParam : [ ]

GetTemperature : Get internal temperature voltage

Description	Get internal temperature voltage
Return	Temperature voltage in V and deg C (22mV/K, approx 700mV at room temperature
Example	GetTemperature GetTemperature:RESULT: Bandgap Voltage: 1.12V

Arg 1[0 X]	None	Arg 2[0 X]	None
Arg 3[0 X]	None	Trigger [ ]	UserParam : [ ]

GetBandgap : Get bandgap voltage

Description	Get bandgap voltage in V
Return	Bandgap voltage in V
Example	GetBandgap GetBandgap:RESULT: Bandgap Voltage: 1.12V

Arg 1[0 X]	None	Arg 2[0 X]	None
Arg 3[0 X]	None	Trigger [ ]	UserParam : [ ]

ReceiveSingleElement : Receive single element

Description	Time continuous receive for single element (infinitely), no uBeamformer operation (bypassed) Single Element is specified with group number (between 0 and N*64-1) and element number (between 0 and 15). Output signal can be routed to any output channel within its RX/TX domain, including the output of its own group.
Return	Status
Example	ReceiveSingleElement:1,4,1 ReceiveSingleElement:RESULT: OK

Arg 1[3 F]	Group, ElementNumber, Outchannel	Arg 2[0 X]	None
Arg 3[0 X]	None	Trigger [X]	UserParam : [X]

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ReceiveGroup : Receive beamformed signal from a group

Description	Time sampled receive for single group (infinitely) All Elements of a single group (group number between 0 and N*64-1) are beamformed with given Element delays and routed to any output channel within its RX/TX domain, including the output of its own group. Element delays must be between -1 and 31 to be valid, and between 2 and 25 to be 'useful'
Return	Status
Example	ReceiveGroup:1,1:0,0,0,0,2,2,2,2,4,4,4,4,6,6,6,6
	ReceiveGroup:RESULT: OK

Arg 1[2 F]	Group, Outchannel	**Arg 2[16 F]**	RxDelays
Arg 3[0 X]	None	**Trigger** [X]	**UserParam** : [X]

EchoSingleElement : Single element echo test

Description	Transmit and Time continuous receive for echo test with single element, use GainOverwrite to adjust gain, TGC is not in place.
Return	Status
Example	EchoSingleElement:1,4,1
	EchoSingleElement:RESULT: OK

Arg 1[3 F]	Group, ElementNumber, Outchannel	**Arg 2[0 X]**	None
Arg 3[0 X]	None	**Trigger** [X]	**UserParam** : [X]

FireSingleElement : Transmit with single element

Description	Transmit with single element standard pulse of 50ns
Return	Status
Example	FireSingleElement:1,4
	FireSingleElement:RESULT: OK

Arg 1[2 F]	Group, Element	**Arg 2[0 X]**	None
Arg 3[0 X]	None	**Trigger** [X]	**UserParam** : [X]

FireGroup : Transmit with single Group

Description	Transmit with single Group
Return	Status
Example	FireGroup:3:[16 Tx Delays]
	FireGroup:RESULT: OK

Arg 1[1 F]	Group	**Arg 2[16 F]**	TxDelays
Arg 3[0 X]	None	**Trigger** [X]	**UserParam** : [X]

FireAsic : Transmit with complete ASIC / Probe

Description	Transmit with complete ASIC / Probe using N*1024 delays
Return	Status
Example	FireASIC: [N*1024 Tx Delays]
	FireASIC:RESULT: OK

Arg 1[1024 M]	TxDelays	**Arg 2[0 F]**	None
Arg 3[0 X]	None	**Trigger** [X]	**UserParam** : [X]

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FireGroupReceive : Transmit and receive with single group

Description	Transmit and Receive with single group		
Return	Status		
Example	FireGroupReceive:1,1,1:[16 Tx Delays]:[16 RxDelays] FireGroupReceive:RESULT: OK		
Arg 1[3 F]	TxGroup,RxGroup, OutChannel	**Arg 2[16 F]**	TxDelays
Arg 3[16 F]	RxDelays	**Trigger** [X]	**UserParam** : [X]

FireAsicReceive : Transmit and receive with complete ASIC / Probe

Description	Transmit and Receive with complete ASIC TX Element delay must be between 0 and 510. Split between group delays and element delays is done internally.		
Return	Status		
Example	FireAsicReceive:1,1:<N * 1024 Tx Delays]:[16 RxDelays] FireAsicReceive:RESULT: OK		
Arg 1[2 F]	Group, Outchannel	**Arg 2[1024 M]**	TxDelays
Arg 3[16 F]	RxDelays	**Trigger** [X]	**UserParam** : [X]

FireAsicReceiveUpd : Fire with complete ASIC, update receive delays

Description	Fire with complete ASIC as last Beam, and only update receive delays (for speed)		
Return	Status		
Example	FireAsicReceiveUpd:2,2:0,0,0,0,2,2,2,2,4,4,4,4,6,6,6,6 FireAsicReceiveUpd:RESULT: OK		
Arg 1[2 F]	RxGroup,Outchannel	**Arg 2[16 F]**	RxDelays
Arg 3[0 X]	None	**Trigger** [X]	**UserParam** : [X]

FireAsicReceiveCoeff : Fire and receive with complete ASIC using Delay decompression

Description	Fire and receive with complete ASIC / Probe using Rx / Tx Delay decompression (only ASIC V2). This includes calculation of dynamic curve assignments.		
Return	Status		
Example	FireAsicReceiveCoeff:54,54:0,0,0,0,0,0,0,0:0,0,0,0,0,0,0,0,0,0 FireAsicReceiveCoeff:RESULT: OK		
Arg 1[2 F]	RxGroup,Outchannel	**Arg 2[8 F]**	RxCoeff
Arg 3[10 F]	TxCoeff	**Trigger** [X]	**UserParam** : [X]

FireGroupReceiveDyn : Transmit and receive with single group

Description	Transmit and Receive with single group using dynamic Rx PhasesDynamic curves must be programmed via SetParam prior to command
Return	Status
Example	FireGroupReceiveDyn:1,1:[16 Tx Delays]:[16 RxDelays],[16 RxPhase] FireGroupReceiveDyn:RESULT: OK

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| **Arg 1[3 F]** | TxGroup,RxGroup,Outchannel | **Arg 2[16 F]** | TxDelays |
| **Arg 3[32 F]** | RxDelays/RxPhase | **Trigger** [X] | **UserParam** : [X] |

FireAsicReceiveDyn : Fire and receive with complete ASIC using dynamic receive delays

Description	Fire and receive with complete ASIC using dynamic receive delays		
Return	Status		
Example	FireAsicReceiveDyn:2,3:0,0,...,0,0: 14,14,14,14,14,14,14,14,14,14,14,14,14,14,14,0,0,0,0,1,1,1,1,2,2,2,2,3,3,3,3		
	FireAsicReceiveDyn:RESULT: OK		
Arg 1[2 F]	RxGroup,Outchannel	**Arg 2[1024 M]**	TxDelays
Arg 3[32 F]	RxDelays/Phases	**Trigger** [X]	**UserParam** : [X]

FireAsicReceiveUpdDyn : Fire with complete ASIC, update dynamic receive delays

Description	Fire with complete ASIC as last Beam, and only update dynamic receive delays (for speed)		
Return	Status		
Example	FireAsicReceiveUpdDyn:2,2:0,0,0,0,2,2,2,2,4,4,4,4,6,6,6,6, 1,1,1,1,1,1,1,1,2,2,2,2,2,2,2,2		
	FireAsicReceiveUpdDyn:RESULT: OK		
Arg 1[2 F]	RxGroup,Outchannel	**Arg 2[32 F]**	RxDelays
Arg 3[0 X]	None	**Trigger** [X]	**UserParam** : [X]

TestPulseMatrixRead : Send Testpulse and read uBeamformer

Description	Send Testpulse with given TxDelays and read uBeamformer RxDelays, and compare to the expected delays.		
Return	Errors		
Example	TestPulseMatrixRead		
	TestPulseMatrixRead:ReadErrors 0, Temperature voltage 1.22 V = 22 C, Status : 0		
Arg 1[1024 M]	Txdelays	**Arg 2[0 X]**	None
Arg 3[0 X]	None	**Trigger** [ ]	**UserParam** : [ ]

ReadTxDelays : Read TxDelays

Description	Read back TxDelays from ASIC from last Beam		
Return	TxDelays		
Example	ReadTxDelays		
	ReadTxDelays:RESULT[ASIC 0]: 4,5,6,7, ... <1024 delays>		
Arg 1[1 F]	None	**Arg 2[0 X]**	None
Arg 3[0 X]	None	**Trigger** [ ]	**UserParam** : [ ]

ReadRxDelays : Read RxDelays

Description	Read back RxDelays from ASIC from last Beam

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Return	RxDelays		
Example	ReadRxDelays		
	ReadRxDelays:RESULT[ASIC 0]: 14/4 13/5 12/6 ... <1024 x delay/clkphase>		
Arg 1[1 F]	None	**Arg 2[0 X]**	None
Arg 3[0 X]	None	**Trigger** [ ]	**UserParam** : [ ]

AsicConfigure : Configure ASIC

Description	Configure ASIC, only upload config fo specified group, or -1 for all groups		
Return	Status		
Example	AsicConfigure		
	AsicConfigure:RESULT:OK		
Arg 1[1 F]	group	**Arg 2[0 X]**	None
Arg 3[0 X]	None	**Trigger** [ ]	**UserParam** : [ ]

SetParam : Set Parameter

Description	Set user parameter, see list for available parameters		
Return	Status		
Example	SetParam:Config,TxClkDivider:16		
	SetParam:RESULT:OK		
Arg 1[2 S]	Parameter	**Arg 2[1 F]**	Value
Arg 3[0 X]	None	**Trigger** [ ]	**UserParam** : [ ]

GetParam : Get Parameter

Description	Get user parameter, see list for available parameters		
Return	Status		
Example	GetParam:Config,TxClkDivider		
	GetParam:RESULT:16		
Arg 1[2 S]	Parameter	**Arg 2[0 X]**	None
Arg 3[0 X]	None	**Trigger** [ ]	**UserParam** : [ ]

DigitalTest : Run Digital Test(s)

Description	Run Digital Test(s)		
Return	Status		
Example	DigitalTest:0:RegAll		
	DigitalTest:RESULT:RegAll[0]:Test passed		
Arg 1[1 F]	TestName	**Arg 2[1 S]**	None
Arg 3[0 X]	None	**Trigger** [ ]	**UserParam** : [ ]

TransmitCharge : Measure TransmitCharge on the ASIC

Description	Measure Transmit Charge Injection for every driver on the ASIC		
Return	Charge in pC		
Example	TransmitCharge:0		
	TransmitCharge:RESULT:6.00, 6.00, 6.00, 6.00, 6.00, 6.00, 6.00, 6.00, 6.00, 6.00, 6.00, 6.00, 6.00, 6.00, 6.00, 6.00		
Arg 1[1 F]	Group	**Arg 2[0 X]**	None

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Arg 3[0 X]	None	**Trigger** [ ]	**UserParam** : [ ]

BmodeSendASICSettings : Send Settings to the ASIC for B-Mode

Description	Send Settings to the ASIC for B-Mode -> Added to the Table with triggerable entries in FPGA UseCompression: 0 = Element Delays, 1 = Use Compression Coeffs
Return	None
Example	BmodeSendASICSettings:1 BmodeSendASICSettings:RESULT:OK

Arg 1[1 F]	UseCompression	**Arg 2[0 X]**	None
Arg 3[0 X]	None	**Trigger** [ ]	**UserParam** : [ ]

BmodeQueueASICDelays : Queue ASICDelays for B-Mode

Description	Queue ASICDelays for B-Mode -> Added to the Table with triggerable entries in FPGA
Return	None
Example	BmodeQueueASICDelays:0,20,20,20,20,20,20,20,20,20,20,20,20,20,20,20,-1,-1,...,-1,-1:14,14,14,...,14,14:0,0,...,0,0 BmodeQueueASICDelays:RESULT:OK

Arg 1[1024 M]	TxDelays	**Arg 2[1024 M]**	RxDelays
Arg 3[1024 M]	RxPhase	**Trigger** [ ]	**UserParam** : [X]

BmodeQueueASICCompCoeff : Queue ASICDelays for B-Mode using Coefficients

Description	Queue ASICDelays for B-Mode using Rx/Tx decompression coefficients -> Added to the Table with triggerable entries in FPGA
Return	None
Example	BmodeQueueASICCompCoeff:+180, +0,-104, +0, +0,-120, +0, +0: -1, -81, -23, -2, -90, -30, +20, +22, +7, +6 BmodeQueueASICCompCoeff:RESULT:OK

Arg 1[8 F]	TxCoeff	**Arg 2[10 F]**	RxCoeff
Arg 3[0 X]	None	**Trigger** [ ]	**UserParam** : [X]

BmodeQueueOutMUX : Queue ASICDelays for B-Mode with different Output MUX setting

Description	Queue ASICDelays for B-Mode with different Output MUX setting, same Rx and TxSettings -> Added to the Table with triggerable entries in FPGA
Return	None
Example	BmodeQueueOutMUX:0,8:3,19 BmodeQueueOutMUX:RESULT:OK

Arg 1[2 F]	RxGroup	**Arg 2[2 F]**	Outchannel
Arg 3[0 X]	None	**Trigger** [ ]	**UserParam** : [X]

BmodeQueueRepeat : Queue a "Repeat beam", same delays

Description	Queue ASICDelays for B-Mode with same delays as previous beam.

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Different beam timing, use for fast beam repeat (e.g. PW-mode)
It is repeating the last beam either on external trigger via
TriggerEntry:x command.
-> Added to the Table with triggerable entries in FPGA

Return	None		
Example	BmodeQueueRepeat		
	BmodeQueueRepeat:RESULT:OK		
Arg 1[0 X]	None	**Arg 2[0 X]**	None
Arg 3[0 X]	None	**Trigger** [ ]	**UserParam** : [X]

BmodeQueueUpload : Upload Queue for B-Mode

Description	Upload Queue for B-Mode		
Return	None		
Example	BmodeQueueUpload		
	BmodeQueueUpload:RESULT:OK		
Arg 1[0 X]	None	**Arg 2[0 X]**	None
Arg 3[0 X]	None	**Trigger** [ ]	**UserParam** : [ ]

BmodeGetQueueEntries : Get number of entries in the B-mode queue

Description	Get number of entries in the B-mode queue		
Return	None		
Example	BmodeGetQueueEntries		
	BmodeGetQueueEntries:RESULT:34 Entries		
Arg 1[0 X]	None	**Arg 2[0 X]**	None
Arg 3[0 X]	None	**Trigger** [ ]	**UserParam** : [ ]

BmodeClearEntries : Clear all entries in the B-mode queue

Description	Clear all entries in the B-mode queue		
Return	None		
Example	BmodeClearEntries		
	BmodeClearEntries:RESULT:OK		
Arg 1[0 X]	None	**Arg 2[0 X]**	None
Arg 3[0 X]	None	**Trigger** [ ]	**UserParam** : [ ]

BmodeTriggerEntry : Trigger Entry in B-mode

Description	Trigger Entry in B-mode		
Return	None		
Example	BmodeTriggerEntry:5		
	BmodeTriggerEntry:RESULT:OK		
Arg 1[1 F]	Beamnumber	**Arg 2[0 X]**	None
Arg 3[0 X]	None	**Trigger** [X]	**UserParam** : [ ]

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BmodeTriggerEntryExt : Trigger Entry in B-mode usgin trigger line

Description	Like "BmodeTriggerEntry" but using external trigger line (Oldeflt testboard only)		
Return	None		
Example	BmodeTriggerEntryExt:2,4		
	BmodeTriggerEntryExt:RESULT:OK		
Arg 1[1 F]	Beam 'from / 'to'	**Arg 2[0 X]**	None
Arg 3[0 X]	None	**Trigger** [X]	**UserParam** : [ ]

BmodeFreeze : Send ASIC to Low Power mode (Freeze) B-mode

Description	Send ASIC to Low Power mode (Freeze) B-mode, unfreezes after new command		
Return	None		
Example	BmodeFreeze		
	BmodeFreeze:RESULT:OK		
Arg 1[0 X]	None	**Arg 2[0 X]**	None
Arg 3[0 X]	None	**Trigger** [ ]	**UserParam** : [ ]

CWmodeInit : Initialize CW-mode

Description	Initialize CW-mode		
	-> Added to the Table with triggerable entries in FPGA ElementAssignments are the N*1024 x 2-bit (Asic V1) or 4 bits (Asic V2) per Element in the CWSEL_DFF register. OutputAssignments are 64 values 0-4 (4 is no assignment) translated into one-hot encoded value in CONFIG_DRV Mode selects either 0=passive CW or 1=active CW mode		
Return	None		
Example	CWmodeInit:0,1,2,3,0,1,2 ... <1024 element assignments>:0,1,2,3 ... <64 group assignments>:1		
	CWmodeInit:RESULT:OK		
Arg 1[1024 M]	ElementAssignments	**Arg 2[64 M]**	OutputAssignments
Arg 3[1 F]	Mode	**Trigger** [ ]	**UserParam** : [ ]

SerialNumber : Write Serial number to ASIC

Description	Write Serial number to ASIC		
Return	None		
Example	SerialNumber:0:2011		
	SerialNumber:RESULT:OK		
Arg 1[1 F]	ASIC	**Arg 2[1 X]**	SerialNumber
Arg 3[0 X]	None	**Trigger** [ ]	**UserParam** : [ ]

MatrixCapacitance : Measure uBeamformer capacitances

Description	Measure uBeamformer capacitances row by row. 14 Measurements per Group to detect shorts		
Return	14 capacitance values in pF		
Example	MatrixCapacitance:2		
	MatrixCapacitance:RESULT:3.00 3.00 3.20 3.00 3.00 3.20 3.00 3.00 3.20 3.00 3.00 3.20 3.00 3.00		
Arg 1[1 F]	Group	**Arg 2[0 X]**	None
Arg 3[0 X]	None	**Trigger** [ ]	**UserParam** : [ ]

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GetTalkback : Receive unasked bytes from Master

Description	Receive unasked bytes from Master (Oldelft testbox only)
Return	None
Example	GetTalkback
	GetTalkback: RESULT: Valid 1, Data 0x 04 AA

Arg 1[1 F]	None	**Arg 2[0 X]**	None
Arg 3[0 X]	None	**Trigger** [ ]	**UserParam** : [ ]

SetHVPSelect : HVP Selection in Connector

Description	Selects HVP Relais on Connector (where applicable)
Return	None
Example	SetHVPSelect:0
	SetHVPSelect:RESULT:OK

Arg 1[1 F]	Setting 0/1	**Arg 2[0 X]**	None
Arg 3[0 X]	None	**Trigger** [ ]	**UserParam** : [ ]

SetHVIddq : Initialize ASIC with static Driver state

Description	Initialize ASIC with static Driver state for given group
	6 testcases per group
Return	None
Example	SetHVIddq:1:3

Arg 1[1 M]	channel	**Arg 2[1 F]**	testcase
Arg 3[0 X]	none	**Trigger** [ ]	**UserParam** : [ ]

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