

January 2015

Channel List for SXM Software

DAC Channels (Hardware Outputs & internally generated signals)

Explanation of the column names:

- **Channel Number:**
- **Use:** If “yes” is selected, this channel will can be utilized for data acquisition.
- **Name:** the name of the channel
- **Unit:** the physical unit of that channel
- **Scale:** the calibration scaling factor transferring the measured value in the corresponding physical unit
- **Min:** minimum value in physical units
- **Max:** maximum value in physical units
- **Offset:** if the output requires a permanent offset value it has to be set here
- **Inverted:** If “yes” is selected, the values of that channel will be multiplied by (-1).

Channel Number	Use	Name	Unit	Scale	Min	Max	Offset	Inverted
DAC1	yes	Topo	nm	-4,32E-006	-1,07E+009	1,07E+009	0	no

Meaning: z output voltage calibrated in nm

Hardware Accessibility: BNC output “Z”, 1st channel on 24-bit DAC board

Scaling Factor Origin: calculated from the entries Gain and HV-gain in the scanner file.

Additional Explanation:

- Controller Output “Z” (-10V .. 10 V) will be transformed by the HV amplifier to -70V .. +70V

DAC2	yes	Bias	mV	9,85E-006	-1,07E+009	1,07E+009	2,5	no
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Meaning: tip-sample bias. Accessible as “Bias” is software. Used fo U(X)-spectroscopy.

Hardware Accessibility: BNC output “Bias”

Scaling Factor: ~ 1E-5 [mV]

Additional Explanation:

DAC3	yes	x-direction	μm	5,32E-008	-1,00E+009	1,07E+009	0	no
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Meaning: internally generated scan generator output X

Hardware Accessibility: BNC monitor output “X” (and in case of tube scan control “-X”)

Scaling Factor Origin: based on the scanner file

DAC4	yes	y-direction	μm	6,01E-008	-1,00E+009	1,07E+009	0	no
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Meaning: internally generated scan generator output Y

Hardware Accessibility: BNC monitor output "Y"

Scaling Factor Origin: based on the scanner file entries

DAC5	no	OffsetX	V	7,00E-008	-1,07E+009	1,07E+009	0	yes
DAC6	no	OffsetY	V	7,00E-008	-1,07E+009	1,07E+009	0	yes

Meaning: DAC outputs for the 2nd scan generator (tip/head scanner or objective scanner)

Hardware Accessibility: BNC output "Offset X" and "OffsetY"

Scaling Factor Origin: scaling factors in a 2nd scanner file.

Additional Explanation:

DAC7	no	Z-Focus	V	7,00E-008	-1,07E+009	1,07E+009	0	no
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Meaning: control of the bottom objective

Hardware Accessibility: BNC output "Z-Focus"

Scaling Factor Origin: entry in [Options/Scale] – calculated in V considering the HV amplifier

DAC8	no	AUX8	mV	9,35E-006	-1,07E+009	1,07E+009	0	no
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Meaning: auxiliary

Hardware Accessibility: Signal of AUX 8 is added to BNC output "AUX 1" in GLIA operation

Scaling Factor Origin: entry in [Options/Scale]

DAC9	no	unknown	DAC9	1	-32000	32000	0	no
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Meaning: free channel

DAC10	no	Frequency	Hz	0	-10000	2,00E+009	0	no
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Meaning: frequency shift in AFM PLL feedback mode

Hardware Accessibility: none

Scaling Factor Origin: internal

Additional Explanation: is constant in all other feedback modes

DAC11	no	Drive	V	6,18E-010	-32000	32000	0	no
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Meaning: rms voltage amplitude of the sine reference output of the LIA0

Hardware Accessibility: output of the red cable on the PCI card

Scaling Factor Origin: ini-file entries in section [dnc]

Additional Explanation: used for the monitoring of the drive voltage for the cantilever oscillation in PLL feedback mode.

DAC12	no	unknown	DAC1	1	-32000	32000	0	no
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Meaning: free channel

DAC13	yes	Amplitude	V	3,94E-009	-1,00E+009	1,00E+009	0	no
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Meaning: measured rms amplitude of the LIA0 ("LIA0R")

Hardware Accessibility: signal has to be provided by the blue input cable of the PCI card

Scaling Factor Origin: ini-file section [DNC]

Additional Explanation: displayed in DNC resonance spectrum

DAC14	yes	Phase	°	0	-1,07E+009	1,07E+009	0	no
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Meaning: phase difference of measured signal to internal reference frequency

Hardware Accessibility: none

Scaling Factor Origin:

Additional Explanation: calculated by the signal of LIA0X and LIA0Y

DAC15	yes	Lia1X	V	6,49E-009	-1,07E+009	-1,07E+009	0	no
DAC16	yes	Lia1Y	V	6,49E-009	-1,07E+009	1,07E+009	0	no
DAC17	yes	Lia2X	V	6,49E-009	-1,07E+009	1,07E+009	0	no
DAC18	yes	Lia2Y	V	6,49E-009	-1,07E+009	1,07E+009	0	no
DAC19	yes	Lia3X	V	6,49E-009	-1,07E+009	1,07E+009	0	no
DAC20	yes	Lia3Y	V	6,49E-009	-1,07E+009	1,07E+009	0	no
DAC21	no	X	V	6,49E-009	-1,07E+009	1,07E+009	0	no
DAC22	no	Y	V	6,49E-009	-1,07E+009	1,07E+009	0	no
DAC23	yes	Lia1R	V	3,94E-009	-1,07E+009	1,07E+009	0	no
DAC24	yes	Lia2R	V	3,94E-009	-1,07E+009	1,07E+009	0	no
DAC25	yes	Lia3R	V	3,94E-009	-1,07E+009	1,07E+009	0	no

Meaning: Amplitude, X and Y signals of the LockIn Amplifiers 0 (DNC), 1, 2 and 3

Hardware Accessibility: none

Scaling Factor Origin: entries in the ini-file section [MultiLockin]

Additional Explanation: available on AMU2.6 and AMU2.9 systems, only

DAC26	no	unknown	DAC2	9,85E-006	-1,07E+009	1,07E+009	0	no
...								
DAC30	no	unknown	DAC3	1	-1,07E+009	1,07E+009	0	no

Meaning: not yet assigned to a function

DAC31	yes	GenLockR	V	1,77E-008	-1,07E+009	1,07E+009	0	no
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DAC32	yes	GenLockPhi	deg	1	-180000	180000	0	no
DAC33	yes	GenX	V	1,77E-008	-1,07E+009	1,07E+009	0	no
DAC34	yes	GenY	V	1,77E-008	-1,07E+009	1,07E+009	0	no

Meaning: Amplitude(X, Y, R) and phase (phi) signal of Generalized LockIn Amplifier (GLIA)

Hardware Accessibility: none

Scaling Factor Origin: provided internally. No adjustment possibility.

DAC35	yes	Gen2X	V	1,77E-008	-1,07E+009	1,07E+009	0	no
DAC36	yes	Gen2Y	V	1,77E-008	-1,07E+009	1,07E+009	0	no

Meaning:

Hardware Accessibility:

Scaling Factor Origin:

Additional Explanation:

DAC37	yes	GenX(2nd)	V	1,77E-008	-1,00E+009	1,00E+009	0	no
DAC38	yes	GenY(2nd)	V	1,77E-008	-1,00E+009	1,00E+009	0	no

Meaning:

Hardware Accessibility:

Scaling Factor Origin:

Additional Explanation:

ADC Channels

Explanation of the column names:

- **Channel Number:**
- **Use:** If "yes" is selected, this channel will can be utilized for data acquisition.
- **Fast:** If "yes" is selected, that channel can be utilized in the fast acquisition mode.
- **Port:** Gives the identification port number relevant for the software
- **Name:** the name of the channel
- **Unit:** the physical unit of that channel
- **Scale:** the calibration scaling factor transferring the measured value in the corresponding physical unit
- **Min:** minimum value in physical units
- **Max:** maximum value in physical units
- **Offset:** if the output requires a permanent offset value it has to be set here
- **Inverted:** If "yes" is selected, the values of that channel will be multiplied by (-1).

Channel Number	Use	Fast	Port	Name	Unit	Scale	Min	Max	Offset	Inverted
ADC1	yes	no	32	T-B	mV	1,00E-5	-1,07E+9	1,07E+9	0	no

Meaning: Signal of the 4-quadrant-diode monitoring the oscillation of the cantilever

Hardware Accessibility: BNC monitor input "T-B" at AD24-board (8-channels ADC)

Scaling Factor Origin: ~ 1E-5 [mV]

Additional Explanation: must be connected with a cable to PCI card input for dynamic mode operation.

ADC2	yes	no	33	L-R	mV	1,00E-5	-1,07E+9	1,07E+9	0	yes
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Meaning: Signal of the 4-quadrant-diode monitoring the deflection of the cantilever

Hardware Accessibility: BNC monitor input "L-R" at AD24-board (8-channels ADC)

Scaling Factor Origin: ~ 1E-5 [mV]

ADC3	yes	no	34	SUM	mV	1,00E-5	-1,07E+9	1,07E+9	0	yes
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Meaning: SUM signal of detector or 3rd ADC-channel of ADC24 board

Hardware Accessibility: BNC monitor input "SUM"

Scaling Factor Origin: ~ 1E-5 [mV]

ADC4	yes	no	35	AUX2	mV	1,06E-5	-1,07E+9	1,07E+9	5,6	yes
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Meaning: 4th ADC channel of ADC24 board

Hardware Accessibility: BNC input "AUX 2"

Scaling Factor Origin:

ADC5	yes	yes	8	fastTB(In A)	mV	3,14E-6	-1,07E+9	1,07E+9	0	no
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Meaning: monitor of the low pass filtered signal that is received by the blue input cable

Hardware Accessibility: blue input cable ("In A") of the PCI card

Scaling Factor Origin: ini-file

Additional Explanation: can be redirected inside the software to the inputs of all available lockin amplifiers.

ADC6	yes	yes	22	FastZ	nm	1,03E-6	-1,07E+9	1,07E+9	0	no
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Meaning: z output voltage

Hardware Accessibility: BNC output "Fast Z"

Scaling Factor Origin: calculated from HV amplification and Gain entry in the scanner file.

Additional Explanation:

This channels is a copy of the DAC-output at the FastDAC board.

For High-speed AFM controllers with one z-piezo, "FastZ" is the only Z-output.

If the hardware supports two z-piezo's and "DualZ" mode is enabled, the normal Z-output is provided at "Z" (DAC1 and ADC11), while "Fast Z" channel is used only, if the Fast Feedback mode is on.

ADC7	no	yes	9	FastLiaX	V	5,00E-9	-1,07E+9	1,07E+9	0	no
ADC8	no	yes	10	FastLiaY	V	5,00E-9	-1,07E+9	1,07E+9	0	no
ADC9	yes	yes	11	FastLiaR	V	2,80E-9	-1,07E+9	1,07E+9	0	no

Meaning: Amplitude, X and Y signals of the LockIn Amplifier 0 for fast feedback mode

Hardware Accessibility: none

Scaling Factor Origin:

Additional Explanation:

ADC10	yes	yes	12	LowInB	mV	3,14E-6	-1,07E+9	1,07E+9	0	no
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Meaning: monitor of the low pass filtered signal that is received by the green input cable

Hardware Accessibility: green input cable ("In B") of the PCI card

Scaling Factor Origin: ini-file

Additional Explanation: available in fast mode.

ADC11	yes	yes	20	SlowZ	nm	-4,32E-6	-1,07E+9	1,07E+9	0	no
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Meaning: copy of the output "Z" named "Topo" (DAC1), but accessible in Fast Feedback

Hardware Accessibility: BNC output "Z"

Scaling Factor Origin: calculated like "Topo" from Gain and HV-Gain in scanner file.

Additional Explanation: available in Fast Feedback mode

ADC12	no	no	2	empty	V	5,00E-9	-1,07E+9	1,07E+9	0	no
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Meaning: free channel

ADC13	no	no	23	WaveCounter	s	1,00E-3	-1,07E+9	1,07E+9	0	no
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Meaning: internal clock or time of the controller (wave counter)

Hardware Accessibility: none

Scaling Factor Origin: 1E-3

Additional Explanation: available with AMU2.9, only.

ADC14	yes	no	36	AUX3	mV	1,00E-5	-1,07E+9	1,07E+9	7,7	no
ADC15	yes	no	37	AUX4	mV	1,00E-5	-1,07E+9	1,07E+9	-2,4	no
ADC16	yes	no	38	AUX5	mV	1,00E-5	-1,07E+9	1,07E+9	8,4	no
ADC17	yes	no	39	AUX6	mV	1,00E-5	-1,07E+9	1,07E+9	4,9	no

Meaning: auxiliary inputs

Hardware Accessibility: BNC inputs "AUX ..."

Scaling Factor Origin:

Additional Explanation:

ADC18	yes	no	40	SG-X	mV	1,00E-5	-1,07E+9	1,07E+9	0	no
ADC19	yes	no	41	SG-Y	mV	1,00E-5	-1,07E+9	1,07E+9	0	no
ADC20	yes	no	42	SG-Z	mV	1,00E-5	-1,07E+9	1,07E+9	0	no

Meaning: ADC-inputs on the stepper board used for linearization

Hardware Accessibility: with stepper board version 2, only

Scaling Factor Origin:

Additional Explanation:

ADC21	yes	no	43	ADC4	mV	1,00E-5	-1,00E+9	1,00E+9	0	no
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Meaning: additional ADC channel on stepper board

Hardware Accessibility: with stepperboard version 2, only

Scaling Factor Origin: 1E-5 [mV]

ADC22	yes	no	47	minmax	A	3,35E-7	-1,00E+9	1,00E+9	0	no
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Meaning: difference between

Hardware Accessibility:

Scaling Factor Origin:

Additional Explanation:

ADC23	yes	yes	13	SyncAngle	deg	3,35E-7	0,00E+0	1,00E+9	0	no
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Meaning: Fast Phase calculated from FastLiaX and FastLiaY inside the FPGA

Hardware Accessibility:

Scaling Factor Origin:

Additional Explanation:

ADC24	yes	yes	14	FastLia1X	V	5,00E-9	-1,07E+9	1,07E+9	0	no
ADC25	yes	yes	15	FastLia1Y	V	5,00E-9	-1,07E+9	1,07E+9	0	no
ADC26	yes	yes	16	FastLia2X	V	5,00E-9	-1,07E+9	1,07E+9	0	no
ADC27	yes	yes	17	FastLia2Y	V	5,00E-9	-1,07E+9	1,07E+9	0	no
ADC28	yes	yes	18	FastLia3X	V	5,00E-9	-1,07E+9	1,07E+9	0	no
ADC29	yes	yes	19	FastLia3Y	V	5,00E-9	-1,07E+9	1,07E+9	0	no

Meaning: Amplitude signal X, Y of the LockIn Amplifiers 1, 2, 3 in fast mode

Hardware Accessibility: none

Scaling Factor Origin: generated internally

Additional Explanation: same information as for DAC channels 15 to 20, but also available in Fast Feedback mode.

ADC30	yes	no	276 / 28	PhaseMod	Cnt	1	-2000	2000	0	no
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Meaning: phase information of the modulation output for the GLIA

Hardware Accessibility: none

Scaling Factor Origin: generated internally

Additional Explanation: needed for operating the generalized LockIn (GLIA)

ADC31	yes	yes	24	FastLia1R	V	5,00E-9	-1,07E+9	1,07E+9	0	no
ADC32	yes	yes	25	FastLia1Phi	V	3,35E-7	0,00E+0	1,00E+9	0	no

Meaning: Amplitude (R) and phase (Phi) signal of the LockIn Amplifier 1 in fast mode

Hardware Accessibility: BNC output "Bias"

Scaling Factor Origin:

Additional Explanation:

ADC33	yes	no	275/ 27	PMT	Cnt	1	-32000	32000	0	no
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Meaning: Counter for photomultipliers

Hardware Accessibility: MVI-Controller, Pin 5 on 25-pin connector Digital I/O , Signal *DIn0*

Scaling Factor: 1

Additional Explanation: counts continuously up until overflow wraps the output

.....	no	no	281	PMCounter1	...	1	-32000	32000	0	no
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Meaning: 2nd Counter for photomultipliers

Hardware Accessibility: MVI-Controller, Pin 5 on 25-pin connector Digital I/O , Signal *DIn1*

Scaling Factor: 1

Additional Explanation: counts continuously up until overflow wraps the output

Math Channels

Channel	Use	Name	Unit	Math
Math1	yes	Z		"Topo + fastz"

Meaning: adds FastZ and SlowZ and generates a total Z , when two z-piezos are used

Additional Explanation: takes the two signals "Topo" from Channel DAC1 and "FastZ" from Channel ADC6 (Port 22) and adds them with their related scaling factors

Hardware ports for Read-Access

-- 0000 0000 00 Status
-- 0000 0000 01 DMA0 Offset (in DMA Buffer lockin)
-- 0000 001X xx Data_Buffer_Lockin (in DataBufferLockin)
-- 0000 01XX xx Data_Buffer_Lockin (in DataBufferLockin)
--- 0111 10 LiaModel
--- 0111 11 LiaVersion

-- 0001 0xxx xx Feedback
-- 0010 0xxx xx scan
-- 01xx xxxx xx CS2

Hardware Ports for Write-Access

-- 0000 0000 01 DMA0 Base
-- 0000 0000 10 Channel
-- 0000 0000 11 TimeBase
-- 0000 0001 00 DMA1 Base

-- 0000 0010 00 CPort
-- 0000 0010 01 f0
-- 0000 0010 10 Ampl1 & Ampl0
-- 0000 0010 11 HarmPhase
-- 0000 0011 00 f1
-- 0000 0011 01 f2
-- 0000 0011 10 f3
-- 0000 0011 11 phi3/phi2/phi1
-- 0000 0100 00 Sync in Mixer & LP Data
-- 0000 0100 01 Q control
-- 0000 0100 10 Ampl3 & Ampl2
-- 0000 0100 11 RamanCtrl (RamanLaser (LaserSource))
-- 0000 0101 00 RamanDutyFM1
-- 0000 0101 01 FineTuneFM1 (1st Raman laser)