LCLS-II LLRF Naming Conventions

Names are broken down into the standard parts, **DeviceType** : **Area** : **Position : <*Instance*>:Attribute**

Device Type

Name	Description
ACCL	Used for everything in the RF system that is part of the general physics and operations interface at the cavity level
GUN	Used for everything in the gun

Area, Subset of Accelerator With RF Devices

See https://slacspace.slac.stanford.edu/sites/lcls/lcls-2/wd/dsg/Forms/AllItems.aspx, Naming Convention section 6.1.2.2

Area	Physical Location
GUNB	LCLS-II Gun
L0B	LCLS-II L0 Accelerator Region
L1B	LCLS-II L1 Accelerator Region
BC1B	LCLS-II Bunch Compressor 1
L2B	LCLS-II L2 Accelerator Region
BC2B	LCLS-II Bunch Compressor 2
L3B	LCLS-II L3 Accelerator Region
SYS2	Full LCLS-II Accelerator scope, e.g. global phase offset

Position

See https://slacspace.slac.stanford.edu/sites/lcls/lcls-2/wd/dsg/Forms/AllItems.aspx, Naming Convention section 6.1.2.3.2

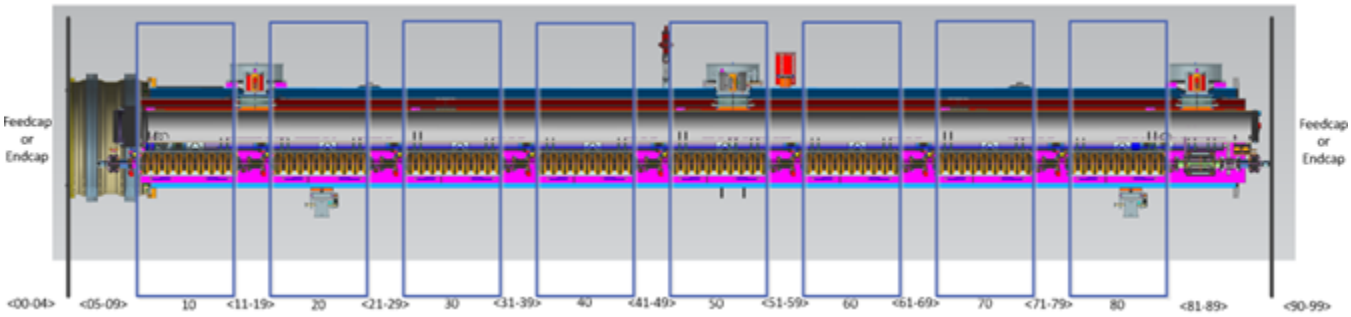
The position of the gun is 100. The position of the buncher is 455.

The position of a superconducting cavity is 4 numbers where the first two indicate the cryomodule and the second two the cavity. For example, 0430 is cryomodule 4, cavity 3.

Each cryomodule has 8 cavities. Cavities 1-4 are instrumented in LLRF Rack A. Cavities 5-8 are instrumented in LLRF Rack B.

Cryo Module #	Description
01-35	CM01-CM35, 1.3GHz cavity
H1	3.9GHz Cryomodule 1, located in L1B and follows CM03
H2	3.9GHz Cryomodule 2, located in L1B and follows H1

Numbering of cavities within a cryomodule:



Instance

The instance field is optional. When used, it specifies a sub-category of signals associated with the device.

Attribute

Attributes that comprise the physics interface. Scalar unless otherwise specified

R/W	Name	Description	SRF Example (CM 2 Cavity 1)	Gun/Buncher Example
R/W	RFMODECTRL	RF mode control (SEL, SELA, SELAP, SEL Raw, Pulse, Chirp)	ACCL:L1B:0210:RFMODECTRL	N/A
R	RFMODE	Readback of current RF mode (SEL, SELA, SELAP, SEL Raw, Pulse, Chirp, Tone)	ACCL:L1B:0210:RFMODE	
R/W	RFCTRL	Cavity on/off control. Off = LLRF drive set to 0. (SSA control will be different.)	ACCL:L1B:0210:RFCTRL	
R	RFSTATE	Readback of cavity RF on/off state	ACCL:L1B:0210:RFSTATE	N/A
R	RFREADYFORBEAM	Indicates cavity is in an okay state for beam operation. Possible states: Ready (numerical 1) = cavity RF is On and mode is SELAP Not ready (numerical 0) = Ready criteria not met	ACCL:L1B:0210: RFREADYFORBEAM	
R/W	ADES	Operation amplitude setpoint (MV) (For SRF, this setting is used in SEL, SELA, SELAP modes.)	ACCL:L1B:0210:ADES	
R/W	ACON	Configuration amplitude (MV)	ACCL:L1B:0210:ACON	
W	ACONTODES	Push configuration amplitude value to ADES. To do this, write 1 to ACONTODES	ACCL:L1B:0210:ACONTODES	
R	GDES	Gradient setpoint (MV/m) - readback only	ACCL:L1B:0210:GDES	N/A
R	SEL_ASET	SRF amplitude setpoint in SEL Raw, Pulse, Chirp modes. Is in units of % of full drive scale.	ACCL:L1B:0210:SEL_ASET	N/A
R	AACTMEAN	Measured amplitude from cavity probe (MV), averaged over LLRF waveform. Identical to CAV:AMEAN. Typically averaged over ~350 ms, but this can vary depending on waveform settings.	ACCL:L1B:0210:AACTMEAN	
R	GACTMEAN	Measured gradient from cavity probe (MV/m), averaged over LLRF waveform. Typically averaged over ~350 ms, but this can vary depending on waveform settings.	ACCL:L1B:0210:GACTMEAN	
R	ADES_MAX	Maximum allowable amplitude (MV). Minimum of SRF, RF, and Ops limits (below).	ACCL:L1B:0210:ADES_MAX	
R/W	ADES_MAX_SRF	SRF maximum allowable amplitude, set by SRF experts (MV)	ACCL:L1B:0210:ADES_MAX_SRF	
R/W	ADES_MAX_RF	RF maximum allowable amplitude, set by RF experts (MV)	ACCL:L1B:0210:ADES_MAX_RF	
R/W	ADES_MAX_OPS	Ops maximum allowable amplitude, set by Operations experts (MV)	ACCL:L1B:0210:ADES_MAX_OPS	
R	PACTMEAN	Measured phase from cavity probe (degrees), averaged over LLRF waveform. Identical to CAV:PMEAN. Typically averaged over ~350 ms, but this can vary depending on waveform settings.	ACCL:L1B:0210:PACTMEAN	
R/W	PDES	Operation phase setpoint (degrees, where 0 is on-crest by convention). Range -180 to 180.	ACCL:L1B:0210:PDES	
R/W	PCON	Configuration phase (degrees)	ACCL:L1B:0210:ACON	
W	PCONTODES	Push configuration phase value to PDES. To do this, write 1 to PCONTODES	ACCL:L1B:0210:PCONTODES	
R/W	CKP	Cavity needs to be phased with respect to beam. Phasing program should set this to 0 when phasing is complete. It is set to 1 automatically when someone accepts a new Phase Reference Line offset. Okay (numerical 0) Check phase (numerical 1) - cavity needs to be phased	ACCL:L1B:0210:CKP	

R	CKPSUM	Alarm status for: cavity needs to be phased with respect to beam. Takes into account whether cavity is parked. Okay (numerical 0) Check phase (numerical 2)	ACCL:L1B:0210:CKPSUM	
W	GOLD_PDES	'Golds' PDES. It will cause PREF to be updated and leave PDES at zero. How to use: 1. Find maximum energy by adjusting PDES 2. Set GOLD_PDES to 1 Doing so will cause: a. PREF to be set to (PREF-PDES) b. PDES will then be set to 0	ACCL:L1B:0210:GOLD_PDES	
R/W	PREF	Do not set PREF directly. Instead, use GOLD_PDES above. Phase offset (degrees) used by LLRF to convert measured phase to one relative to on-crest operation, adjusted by (gold) beam phasing. Recommend not setting PREF directly, but using GOLD_PDES (above). PREF is subtracted from PDES before writing phase to hardware. PREF is added to the raw phase readback from hardware.	ACCL:L1B:0210:PREF	
R/W	PTOF	Phase offset (degrees) used to adjust for changes in beam time-of-arrival, in particular for changes in bunch compressor path length. Unlike PREF, changing PTOF will immediately change the cavity phase. PTOF is subtracted from PDES before writing phase to hardware. PTOF is added to the raw phase readback from hardware.	ACCL:L1B:0210:PTOF	
R/W	SEL_POFF	SEL phase offset setpoint	ACCL:L1B:0210:SEL_POFF	N/A
R	SEL_POFF_RBV	SEL phase offset readback	ACCL:L1B:0210:SEL_POFF_RBV	N/A
R	DFACT	Measured detune frequency (Hz)	N/A	
R	DF	Measured detune frequency (Hz) using state space equation, cavity and forward signals - used to drive piezos	ACCL:L1B:0210:DF	N/A
R	DFVALID	Measured detune frequency (Hz) using state space equation, cavity and forward signals is valid. If it is not valid, its value cannot be used and the resonance system will not automatically change the piezo setting. In order for it to be valid, there must be sufficient cavity signal and it must be within +/- a couple hundred Hz.	ACCL:L1B:0210:DFVALID	N/A
R	DF_FC	Measured detune frequency (Hz) using frequency counter method - not used in resonance control, larger operating range than DF	ACCL:L1B:0210:DF_FC	N/A
R	CHIRP:DF	Measured detune frequency (Hz) using chirp method - only active in Chirp and Pulsed modes, primarily for use when cavity is many kHz out of tune, operating range of tens of kHz or more	ACCL:L1B:0210:CHIRP:DF	N/A
R/W	ALEM	LEM computed integrated RF amplitude (MV) per cavity and per cryomodule	ACCL:L1B:0210:ALEM	
R/W	PLEM	LEM computed phase (deg)	ACCL:L1B:0210:PLEM	
R/W	EGLEM	LEM computed energy gain (MeV)	ACCL:L1B:0210:EGLEM	
R/W	CHLEM	LEM computed chirp (MeV)	ACCL:L1B:0210:CHLEM	
R/W	CAV:FUDGE	Beam-based scale factor applied to cavity probe amplitude readback. Nominal value of 1. CAV:SCALE = cavity_preliminary_scaling * CAV:FUDGE CAV:SCALE is applied at the waveform level and so FUDGE is included in scalars like AACT, CAV:AMEAN, CAV:AMIN, CAV:AMAX, etc. and waveforms like CAV:IWF, CAV:QWF, CAV:AWF, etc. Example: Cavity ADES and AACTMEAN are 10 MV, but measured energy gain is 11 MV. Set CAV:FUDGE to 1.1. This will cause the RF drive level to be adjusted by 1/1.1 new_drive = original_drive / 1.1 and the cavity amplitude readback to be adjusted by 1.1.	ACCL:L1B:0210:CAV:FUDGE	
R	L	Cavity design length - constant	ACCL:L1B:0210:L	N/A
R	FREQ	Cavity design frequency - constant	ACCL:L1B:0210:FREQ	N/A
R	IMPED	Cavity design shunt impedance - constant	ACCL:L1B:0210:IMPED	N/A
R	PWRDISS	Cavity dissipated power (W). Calculated by LLRF from Q0 and cavity amplitude. Sent by LLRF to cryo controls.	ACCL:L1B:0210:PWRDISS	
R	Q0	Cavity Q0 (unitless), including user fudge factor. This is the value used by HaLO, LLRF calculation of dissipated power, etc. Formula: Q0 = Q0:MEAS * Q0:FUDGE	ACCL:L1B:0210:Q0	
R/W	Q0:MEAS	Last measured cavity Q0 (unitless)	ACCL:L1B:0210:Q0:MEAS	
R/W	Q0:FUDGE	Cavity Q0 fudge factor (unitless). Nominal value of 1. Can be used to adjust Q0 if suspect actual Q0 is not Q0:MEAS, for example due to recent quench.	ACCL:L1B:0210:Q0:FUDGE	
SRF Interlocks - Per Cavity				

W	INTLK_RESET_ALL	Reset all latched faults from RFS and Resonance/Interlock chassis	ACCL:L1B:0210: INTLK_RESET_ALL	
R	RFS:INTLK_FIRST	Bit mask indicating which interlock fault was first detected by RFS.	ACCL:L1B:0210:RFS:INTLK_FIRST	N/A
R	RFS:FLTINTLK_FIRST	For last captured fault waveform, bit mask indicating which interlock fault was first detected by RFS	ACCL:L1B:0210:RFS: FLTINTLK_FIRST	N/A
R	QUENCH_FLT	Cavity quench fault, from RFS chassis. Current status, latched status, bypass command, bypass status, counts of today's faults, yesterday's faults, total faults, a resettable counter's faults.	ACCL:L1B:0210:QUENCH_FLT	
R	QUENCH_LTCH		ACCL:L1B:0210:QUENCH_LTCH	
W	QUENCH_BYP		ACCL:L1B:0210:QUENCH_BYP	
R	QUENCH_BYP_RBV		ACCL:L1B:0210: QUENCH_BYP_RBV	
R	QUENCH_CNTT		ACCL:L1B:0210:QUENCH_CNTT	
R	QUENCH_CNTY		ACCL:L1B:0210:QUENCH_CNTY	
R	QUENCH_CNT		ACCL:L1B:0210:QUENCH_CNT	
R	QUENCH_CNTU		ACCL:L1B:0210:QUENCH_CNTU	
R	STEPTEMP_FLT	Stepper temperature fault, from Interlock chassis. Current status, latched status, bypass command, bypass status, counts of today's faults, yesterday's faults, total faults, a resettable counter's faults.	ACCL:L1B:0210:STEPTEMP_FLT	
R	STEPTEMP_LTCH		ACCL:L1B:0210:STEPTEMP_LTCH	
W	STEPTEMP_BYP		ACCL:L1B:0210:STEPTEMP_BYP	
R	STEPTEMP_BYP_RBV		ACCL:L1B:0210: STEPTEMP_BYP_RBV	
R	STEPTEMP_CNTT		ACCL:L1B:0210:STEPTEMP_CNTT	
R	STEPTEMP_CNTY		ACCL:L1B:0210:STEPTEMP_CNTY	
R	STEPTEMP_CNT		ACCL:L1B:0210:STEPTEMP_CNT	
R	STEPTEMP_CNTU		ACCL:L1B:0210:STEPTEMP_CNTU	
R	CPLRTEMP1_FLT	Coupler temperature 1 fault, from Interlock chassis. Current status, latched status, bypass command, bypass status, counts of today's faults, yesterday's faults, total faults, a resettable counter's faults.	ACCL:L1B:0210:CPLRTEMP1_FLT	
R	CPLRTEMP1_LTCH		ACCL:L1B:0210: CPLRTEMP1_LTCH	
W	CPLRTEMP1_BYP		ACCL:L1B:0210:CPLRTEMP1_BYP	
R	CPLRTEMP1_BYP_RBV		ACCL:L1B:0210: CPLRTEMP1_BYP_RBV	
R	CPLRTEMP1_CNTT		ACCL:L1B:0210: CPLRTEMP1_CNTT	
R	CPLRTEMP1_CNTY		ACCL:L1B:0210: CPLRTEMP1_CNTY	
R	CPLRTEMP1_CNT		ACCL:L1B:0210:CPLRTEMP1_CNT	
R	CPLRTEMP1_CNTU		ACCL:L1B:0210: CPLRTEMP1_CNTU	
R	CPLRTEMP2_FLT	Coupler temperature 2 fault, from Interlock chassis. Current status, latched status, bypass command, bypass status, counts of today's faults, yesterday's faults, total faults, a resettable counter's faults.	ACCL:L1B:0210:CPLRTEMP2_FLT	
R	CPLRTEMP2_LTCH		ACCL:L1B:0210: CPLRTEMP2_LTCH	
W	CPLRTEMP2_BYP		ACCL:L1B:0210:CPLRTEMP2_BYP	
R	CPLRTEMP2_BYP_RBV		ACCL:L1B:0210: CPLRTEMP2_BYP_RBV	
R	CPLRTEMP2_CNTT		ACCL:L1B:0210: CPLRTEMP2_CNTT	
R	CPLRTEMP2_CNTY		ACCL:L1B:0210: CPLRTEMP2_CNTY	
R	CPLRTEMP2_CNT		ACCL:L1B:0210:CPLRTEMP2_CNT	
R	CPLRTEMP2_CNTU		ACCL:L1B:0210: CPLRTEMP2_CNTU	
R	PLL_FLT	FPGA PLL lock fault, from RFS chassis. Current status, latched status, counts of today's faults, yesterday's faults, total faults, a resettable counter's faults. Cannot be bypassed.	ACCL:L1B:0210:PLL_FLT	
R	PLL_LTCH		ACCL:L1B:0210:PLL_LTCH	
R	PLL_CNTT		ACCL:L1B:0210:PLL_CNTT	
R	PLL_CNTY		ACCL:L1B:0210:PLL_CNTY	
R	PLL_CNT		ACCL:L1B:0210:PLL_CNT	
R	PLL_CNTU		ACCL:L1B:0210:PLL_CNTU	
R	IOCWDOG_FLT	EPICS IOC watchdog fault, from RFS chassis. Current status, latched status, bypass command, bypass status, counts of today's faults, yesterday's faults, total faults, a resettable counter's faults.	ACCL:L1B:0210:IOCWDOG_FLT	
R	IOCWDOG_LTCH		ACCL:L1B:0210:IOCWDOG_FLT	
W	IOCWDOG_BYP		ACCL:L1B:0210:IOCWDOG_BYP	
R	IOCWDOG_BYP_RBV		ACCL:L1B:0210: IOCWDOG_BYP_RBV	
R	IOCWDOG_CNTT		ACCL:L1B:0210:IOCWDOG_CNTT	
R	IOCWDOG_CNTY		ACCL:L1B:0210:IOCWDOG_CNTY	

R	IOCWDOG_CNT		ACCL:L1B:0210:IOCWDOG_CNT	
R	IOCWDOG_CNTU		ACCL:L1B:0210:IOCWDOG_CNTT	
R	SSA_FLT	SSA permit fault, from RFS chassis. Current status, latched status, bypass command, bypass status, counts of today's faults, yesterday's faults, total faults, a resettable counter's faults.	ACCL:L1B:0210:SSA_FLT	
R	SSA_LTCH		ACCL:L1B:0210:SSA_LTCH	
W	SSA_BYP		ACCL:L1B:0210:SSA_BYP	
R	SSA_BYP_RBV		ACCL:L1B:0210:SSA_BYP_RBV	
R	SSA_CNTT		ACCL:L1B:0210:SSA_CNTT	
R	SSA_CNTY		ACCL:L1B:0210:SSA_CNTY	
R	SSA_CNT		ACCL:L1B:0210:SSA_CNT	
R	SSA_CNTU		ACCL:L1B:0210:SSA_CNTU	
SRF Interlocks - Per Rack (A or B)				
R	CPLRVAC[A,B]_FLT	Coupler vacuum fault, from Interlock chassis. Current status, latched status, bypass command, bypass status, counts of today's faults, yesterday's faults, total faults, a resettable counter's faults.	ACCL:L1B:0200:CPLRVACA_FLT	
R	CPLRVAC[A,B]_LTCH		ACCL:L1B:0200:CPLRVACA_LTCH	
W	CPLRVAC[A,B]_BYP		ACCL:L1B:0200:CPLRVACA_BYP	
R	CPLRVAC[A,B] _BYP_RBV		ACCL:L1B:0200: CPLRVACA_BYP_RBV	
R	CPLRVAC[A,B]_CNTT		ACCL:L1B:0200:CPLRVACA_CNTT	
R	CPLRVAC[A,B]_CNTY		ACCL:L1B:0200:CPLRVACA_CNTY	
R	CPLRVAC[A,B]_CNT		ACCL:L1B:0200:CPLRVACA_CNT	
R	CPLRVAC[A,B]_CNTU		ACCL:L1B:0200:CPLRVACA_CNTU	
R	BMLNVAC[A,B]_FLT	Beamline vacuum fault, from Interlock chassis. Current status, latched status, bypass command, bypass status, counts of today's faults, yesterday's faults, total faults, a resettable counter's faults.	ACCL:L1B:0200:BMLNVACA_FLT	
R	BMLNVAC[A,B]_LTCH		ACCL:L1B:0200:BMLNVACA_LTCH	
W	BMLNVAC[A,B]_BYP		ACCL:L1B:0200:BMLNVACA_BYP	
R	BMLNVAC[A,B] _BYP_RBV		ACCL:L1B:0200: BMLNVACA_BYP_RBV	
R	BMLNVAC[A,B]_CNTT		ACCL:L1B:0200:BMLNVACA_CNTT	
R	BMLNVAC[A,B]_CNTY		ACCL:L1B:0200:BMLNVACA_CNTY	
R	BMLNVAC[A,B]_CNT		ACCL:L1B:0200:BMLNVACA_CNT	
R	BMLNVAC[A,B]_CNTU		ACCL:L1B:0200:BMLNVACA_CNTU	
R	CRYOSUM[A,B]_FLT	Cryo summary fault, from local Cryo PLC. Current status, latched status, bypass command, bypass status, counts of today's faults, yesterday's faults, total faults, a resettable counter's faults.	ACCL:L1B:0200:CRYOSUMA_FLT	
R	CRYOSUM[A,B]_LTCH		ACCL:L1B:0200: CRYOSUMA_LTCH	
W	CRYOSUM[A,B]_BYP		ACCL:L1B:0200:CRYOSUMA_BYP	
R	CRYOSUM[A,B] _BYP_RBV		ACCL:L1B:0200: CRYOSUMA_BYP_RBV	
R	CRYOSUM[A,B]_CNTT		ACCL:L1B:0200: CRYOSUMA_CNTT	
R	CRYOSUM[A,B]_CNTY		ACCL:L1B:0200: CRYOSUMA_CNTY	
R	CRYOSUM[A,B]_CNT		ACCL:L1B:0200:CRYOSUMA_CNT	
R	CRYOSUM[A,B]_CNTU		ACCL:L1B:0200: CRYOSUMA_CNTU	
SRF Interlocks - Per Cryomodule - Tentative				
R	CRYOSUM_FLT	Cryo summary status from local Cryo PLC. Current status	ACCL:L1B:0200:CRYOSUM_FLT	
R	HELEVEL_FLT	Cryo Helium level status from local Cryo PLC. Current status	ACCL:L1B:0200:HELEVEL_FLT	
R	HEPRES_FLT	Cryo Helium pressure status from local Cryo PLC. Current status	ACCL:L1B:0200:HEPRES_FLT	
R	CRYOHEARTBEAT_FLT	Cryo PLC heartbeat fault. Generated by RF software when cryo data stops updating or updates too slowly	ACCL:L1B:0200: CRYOPLC_HEARTBEAT	
SRF Cavity Characterization and Expert Settings				
R	QLOADED	Loaded Q	ACCL:L1B:0210:QLOADED	
R	LDCOEF	Lorentz detuning coefficient	ACCL:L1B:0210:LDCOEF	
R	BCOEFM	State space B coefficient magnitude	ACCL:L1B:0210:BCOEFM	
R	BCOEFP	State space B coefficient phase	ACCL:L1B:0210:BCOEFP	
R	SSA:SLOPE	SSA curve parameter - slope	ACCL:L1B:0210:SSA:SLOPE	
R	SSA:PED	SSA curve parameter - pedestal	ACCL:L1B:0210:SSA:PED	
R	SSA:MINX	SSA curve parameter - min x	ACCL:L1B:0210:SSA:MINX	
R	SSA:DRV_MAX	Maximum drive to SSA, range 0 to 1. Do not change this directly. It is set by SSA calibration script.	ACCL:L1B:0210:DRV_MAX	

Waveform Signals

Each SRF cavity has the following waveform signals:

Description	*PV name, <SIG> in following section*	*Amplitude Units*	*Power Units*	*Phase Units*
Forward Power	FWD	sqrt(W)	W	degrees
Reverse/Reflected Power	REV	sqrt(W)	W	degrees
Cavity Probe	CAV	MV	mW	degrees
DAC (FPGA internal, input to DAC that drives SSA)	DAC	% of full DAC scale	(% of full DAC scale)^2	degrees
Detune (see below)	*DF*	*Hz*	*N/A*	*N/A*
Drive (RFS chassis loopback) - waveform disabled by default	DRV	sqrt(W)	W	degrees

For SRF systems, these PVs are provided for CAV, FWD, REV, DAC (and DRV only during expert diagnostics/troubleshooting.) Example PVs are for CAV.

R	<SIG>:AWF	Signal amplitude waveform	ACCL:L1B:0210:CAV:AWF	
R	<SIG>:AMEAN	Mean of <SIG>:AWF	ACCL:L1B:0210:CAV:AMEAN	
R	<SIG>:ASTD	Standard deviation of <SIG>:AWF	ACCL:L1B:0210:CAV:ASTD	
R	<SIG>:ARSTD	Standard deviation of <SIG>:AWF divided by mean of <SIG>:AWF	ACCL:L1B:0210:CAV:ARSTD	
R	<SIG>:AMIN	Minimum of <SIG>:AWF	ACCL:L1B:0210:CAV:AMIN	
R	<SIG>:AMAX	Maximum of <SIG>:AWF	ACCL:L1B:0210:CAV:AWF	
R	<SIG>:PWF	Signal phase waveform	ACCL:L1B:0210:CAV:PWF	
R	<SIG>:PMEAN	Mean of <SIG>:PWF	ACCL:L1B:0210:CAV:PMEAN	
R	<SIG>:PSTD	Standard deviation of <SIG>:PWF	ACCL:L1B:0210:CAV:PSTD	
R	<SIG>:PRSTD	Standard deviation of <SIG>:PWF divided by mean of <SIG>:PWF	ACCL:L1B:0210:CAV:PRSTD	
R	<SIG>:PMIN	Minimum of <SIG>:PWF	ACCL:L1B:0210:CAV:PMIN	
R	<SIG>:PMAX	Maximum of <SIG>:PWF	ACCL:L1B:0210:CAV:PMAX	
R	<SIG>:PWRWF	Signal power waveform	ACCL:L1B:0210:CAV:PWRWF	
R	<SIG>:PWRMEAN	Mean of <SIG>:PWRWF	ACCL:L1B:0210:CAV:PWRMEAN	
R	<SIG>:PWRSTD	Standard deviation of <SIG>:PWRWF	ACCL:L1B:0210:CAV:PWRSTD	
R	<SIG>:PWRRSTD	Standard deviation of <SIG>:PWRWF divided by mean of <SIG>:PWRWF	ACCL:L1B:0210:CAV:PWRRSTD	
R	<SIG>:PWRMIN	Minimum of <SIG>:PWRWF	ACCL:L1B:0210:CAV:PWRMIN	
R	<SIG>:PWRMAX	Maximum of <SIG>:PWRWF	ACCL:L1B:0210:CAV:PWRMAX	
R	<SIG>:IWF	Signal I waveform	ACCL:L1B:0210:CAV:IWF	
R	<SIG>:QWF	Signal Q waveform	ACCL:L1B:0210:CAV:AWF	
R	<SIG>:FLTAWF	Fault waveform - signal amplitude	ACCL:L1B:0210:CAV:FLTAWF	
R	<SIG>:FLTPWF	Fault waveform - signal phase	ACCL:L1B:0210:CAV:FLTPWF	
Other SRF Waveform Signals:				
R	DF:WF	Detune frequency waveform. Calculated by software from cavity and forward signals. [Hz]	ACCL:L1B:0210:DF:WF	
R	DF:MEAN	Mean of DF:WF	ACCL:L1B:0210:DF:MEAN	
R	DF:STD	Standard deviation of DF:WF	ACCL:L1B:0210:DF:STD	
R	DF:MIN	Minimum of DF:WF	ACCL:L1B:0210:DF:MIN	
R	DF:MAX	Maximum of DF:WF	ACCL:L1B:0210:DF:MAX	
R	BW:WF	Cavity bandwidth waveform. Calculated by software from cavity and forward signals. [Hz]	ACCL:L1B:0210:BW:WF	
R	CTRL:IWF	P/I Controller Output I waveform. Calculated by software from cavity and DAC signals. [% of full scale, range -1 to 1]	ACCL:L1B:0210:CTRL:IWF	
R	CTRL:QWF	P/I Controller Output Q waveform. Calculated by software from cavity and DAC signals. [% of full scale, range -1 to 1]	ACCL:L1B:0210:CTRL:QWF	
R	CTRL:AWF	P/I Controller Output amplitude waveform. Calculated by software from cavity and DAC signals. [% of full scale, range -1 to 1]	ACCL:L1B:0210:CTRL:AWF	
R	CTRL:FLTAWF	Fault waveform - P/I Controller Output amplitude	ACCL:L1B:0210:CTRL:FLTAWF	
R	CTRL:FLTPWF	Fault waveform - P/I Controller Output phase	ACCL:L1B:0210:CTRL:FLTPWF	
R/W	ACQ_FLT_DELAY	Fault data trigger control. In % of total waveform data duration. 0% = all data is pre-fault, 100% = all data is post-fault	ACCL:L1B:0210:ACQ_FLT_DELAY	
Feedback				
R	AMPFB_GAIN_P_RBV	Amplitude feedback proportional gain readback (units not yet determined)	ACCL:L1B:0210: AMPFB_GAIN_P_RBV	
R/W	AMPFB_GAIN_P	Amplitude feedback proportional gain setting (units not yet determined)	ACCL:L1B:0210:AMPFB_GAIN_P	
R	AMPFB_GAIN_I_RBV	Amplitude feedback integral gain readback (units not yet determined)	ACCL:L1B:0210: AMPFB_GAIN_I_RBV	

R/W	AMPFB_GAIN_I	Amplitude feedback integral gain setting (units not yet determined)	ACCL:L1B:0210:AMPFB_GAIN_I	
R	PHAFB_GAIN_P_RBV	Phase feedback proportional gain readback (units not yet determined)	ACCL:L1B:0210: AMPFB_GAIN_P_RBV	
R/W	PHAFB_GAIN_P	Phase feedback proportional gain setting (units not yet determined)	ACCL:L1B:0210:AMPFB_GAIN_P	
R	PHAFB_GAIN_I_RBV	Phase feedback integral gain readback (units not yet determined)	ACCL:L1B:0210: AMPFB_GAIN_I_RBV	
R/W	PHAFB_GAIN_I	Phase feedback integral gain setting (units not yet determined)	ACCL:L1B:0210:AMPFB_GAIN_I	
R	AMPFB_LSUM	Amplitude feedback is at lower limit while feedback is active. 0 if true (alarm state), 1 if false (good state)	ACCL:L1B:0210:AMPFB_LSUM	
R	AMPFB_HSUM	Amplitude feedback is at upper limit while feedback is active. 0 if true (alarm state), 1 if false (good state)	ACCL:L1B:0210:AMPFB_HSUM	
R	AMPFB_SUM	Amplitude feedback is at either lower or upper limit while feedback is active. 0 if true (alarm state), 1 if false (good state)	ACCL:L1B:0210:AMPFB_SUM	
R	PHAFB_LSUM	Phase feedback is at lower limit while feedback is active. 0 if true (alarm state), 1 if false (good state)	ACCL:L1B:0210:PHAFB_LSUM	
R	PHAFB_HSUM	Phase feedback is at upper limit while feedback is active. 0 if true (alarm state), 1 if false (good state)	ACCL:L1B:0210:PHAFB_HSUM	
R	PHAFB_SUM	Phase feedback is at either lower or upper limit while feedback is active. 0 if true (alarm state), 1 if false (good state)	ACCL:L1B:0210:PHAFB_SUM	
R	FB_SUM	Amplitude or phase feedback is at either lower or upper limit **while** RFREADYFORBEAM is active. 0 if true (alarm state), 1 if false (good state). This summary's counts of today's faults, yesterday's faults, total faults, a resettable counter faults.	ACCL:L1B:0210:FB_SUM	
R	FB_SUM_CNTT		ACCL:L1B:0210:FB_SUM_CNTT	
R	FB_SUM_CNTY		ACCL:L1B:0210:FB_SUM_CNTY	
R	FB_SUM_CNT		ACCL:L1B:0210:FB_SUM_CNT	
R	FB_SUM_CNTU		ACCL:L1B:0210:FB_SUM_CNTU	

Resonance control

	Name	**DescriptionDescription**	**SRF Example** **(CM2 Cavity 1)SRF Example**	**Gun/Buncher Example**
R/W	STEP:NSTEPS	Stepper tuner number of steps per move	ACCL:L1B:0210:STEP: NSTEPS	
W	STEP: MOV_REQ_NEG	Request stepper tuner move negative STEP:NSTEPS. Write 1 to request	ACCL:L1B:0210:STEP: MOV_REQ_NEG	
W	STEP: MOV_REQ_POS	Request stepper tuner move positive STEP:NSTEPS. Write 1 to request	ACCL:L1B:0210:STEP: MOV_REQ_POS	
R	STEP: STATWRD	Stepper controller status word readback	ACCL:L1B:0210:STEP: STATWRD	
R	STEP: STATWRD.B0	Stepper controller status bit: motor moving; 1 = moving, 0 = not	ACCL:L1B:0210:STEP: STATWRD.B0	
R	STEP: STATWRD.B2	Stepper controller status bit: motor done; 1 = done, 0 = not	ACCL:L1B:0210:STEP: STATWRD.B2	
R	STEP: STATWRD.B3	Stepper controller status bit: at limit B; 1 = at limit, 0 = not. (The limit should never be reached.)	ACCL:L1B:0210:STEP: STATWRD.B3	
R	STEP: STATWRD.B4	Stepper controller status bit: at limit A; 1 = at limit, 0 = not. (The limit should never be reached.)	ACCL:L1B:0210:STEP: STATWRD.B4	
R	STEP: CTRLWRD	Stepper controller status word readback	ACCL:L1B:0210:STEP: CTRLWRD	
R	STEP: CTRLWRD.B5	Stepper controller status bit: move direction; 1 if negative, 0 if positive	ACCL:L1B:0210:STEP: STATWRD.B0	
R	STEP: STATMSG	High-level status message from stepper controller software	ACCL:L1B:0210:STEP: STATMSG	
W	PZT:ENABLE	Piezo enable/disable control; set to 1 to enable, 0 to disable	ACCL:L1B:0210:PZT: ENABLE	
R	PZT: ENABLESTAT	Piezo enable/disable status; 1 = enabled, 0 = disabled	ACCL:L1B:0210:PZT: ENABLESTAT	
W	PZT: MODECTRL	Piezo mode control; set to 1 for Integrator (feedback driven by RFS measured detune), 0 for DC control. Integrator is the correct mode for normal operations.	ACCL:L1B:0210:PZT: MODECTRL	
R	PZT: MODESTAT	Piezo mode status; 1 = Integrator, 0 = DC	ACCL:L1B:0210:PZT: MODESTAT	

R	PZT:V	Calculated piezo voltage	ACCL:L1B:0210:PZT:V	
R	PZT:DF_RFS	Detune measurement sent from RFS to Resonance chassis. This drives the piezo while in Integrator mode.	ACCL:L1B:0210:PZT:DF_RFS	
R	PZT:DFVALID_RFS	Detune measurement sent from RFS to Resonance chassis is valid. If it is not valid, the Integrator will not change the piezo setting	ACCL:L1B:0210:PZT:DFVALID_RFS	
R/W	PZT:DAC_SP	DC voltage offset setting. Only used while in DC mode.	ACCL:L1B:0210:PZT:DAC_SP	
R/W	PZT:INTEG_SP	Optional Integrator setpoint. Can be used to compensate for observed systematic detune offset while in Integrator mode.	ACCL:L1B:0210:PZT:INTEG_SP	
R	PZT:INTEG_SP_RBV	Readback of optional Integrator setpoint.	ACCL:L1B:0210:PZT:INTEG_SP_RBV	
R/W	PZT:BIAS	Piezo bias voltage setting. Nominally 25 V. Used to operate piezo away from range limits. This should not change during normal operations.	ACCL:L1B:0210:PZT:BIAS	
R	PZT:BIAS_RBV	Readback of piezo bias voltage setting.	ACCL:L1B:0210:PZT:BIAS_RBV	
R	PZT:INTEG_AT_LIM	Piezo integrator (feedback) is at a limit of its range. This may require moving the stepper to re-center the piezo.	ACCL:L1B:0210:PZT:INTEG_AT_LIM	

Deployment and calibration attributes

By default, these should be write-protected during operation

	Name	Description	SRF Example (CM 2 Cavity 1)	Gun /Buncher Example
R	AT:GMAX	During acceptance testing, maximum gradient. [MV/m]	ACCL:L1B:0210:AT:GMAX	N/A
R	AT:AMAX	During acceptance testing, maximum amplitude. [MV]	ACCL:L1B:0210:AT:AMAX	N/A
R	AT:GUSE	During acceptance testing, usable gradient. [MV/m]	ACCL:L1B:0210:AT:GUSE	N/A
R	AT:AUSE	During acceptance testing, usable amplitude. [MV]	ACCL:L1B:0210:AT:AUSE	N/A
R	AT:FEON_GACT	During acceptance testing, gradient at which field emission begins. [MV/m]	ACCL:L1B:0210:AT:FEON_GACT	N/A
R	AT:FEON_AACT	During acceptance testing, amplitude at which field emission begins. [MV]	ACCL:L1B:0210:AT:FEON_AACT	N/A
R	AT:LIMIT	During acceptance testing, cavity limiting factor. 0 = Undefined, 1 = Quench, 2 = FE, 3 = SSA trip, 4 = Admin, 5 = RF power, 6 = Other	ACCL:L1B:0210:AT:LIMIT	N/A
R	AT:Q0	During acceptance testing, cavity Q0 measured at 16 MV/m	ACCL:L1B:0210:AT:Q0	N/A
R	AT:QPROBE	During acceptance testing, cavity probe Q external, cold	ACCL:L1B:0210:AT:QPROBE	N/A
R	AT:QHOM_CPLR	During acceptance testing, Higher Order Mode coupler Q external, cold	ACCL:L1B:0210:AT:QHOM_CPLR	N/A
R	AT:QHOM_PICKUP	During acceptance testing, Higher Order Mode pickup Q external, cold	ACCL:L1B:0210:AT:QHOM_PICKUP	N/A

		(from Chris Adolfsen. Garth wonders should this be a calibration attribute rather than physics interface?) Slow tuner start-up position prior to rf turn on - with the piezo voltages zeroed, the cavity would be tuned close to 1.3 GHz after the operating gradient is established - thus the initial detuning with rf off relative to 1.3 GHz is K*(operating gradient)^2		
		(from Chris Adolfsen. Garth wonders should this be a calibration attribute rather than physics interface?) Slow tuner park position - this is the position the tuner would be set if one wants to detune the cavity so it does not interact with the beam.		
		Calibration of the slow tuner (Hz/step) measured in-situ		
		Calibration of the piezo tuners (Hz/volt) measured in-situ		
Per Cryomodule				
R	SN	Cryomodule serial number	ACCL:L1B:0200:SN	N/A
Signal calibration. **For SRF cavities, the PVs below are provided for CAV, FWD, REV, DRV signals. The SRF PV name examples below use CAV.**				
Measured values				
R/W	<SIG>:CAL_ADC_10DBM	ADC counts at 10 dBm. EPICS software uses this to calculate RF power at full scale.	ACCL:L1B:0210:CAV:CAL_ADC_10DBM	
R/W	<SIG>:CAL_LOSS_CABLE	Measured cable losses used in signal calibration. Positive value in dB.	ACCL:L1B:0210:CAV:CAL_LOSS_CABLE	
R/W	<SIG>:CAL_LOSS_CPLR	Measured coupler loss used in signal calibration. Positive value in dB.	ACCL:L1B:0210:CAV:CAL_LOSS_CPLR	
R/W	<SIG>:CAL_LOSS_ATTEN	Fixed attenuator used in signal calibration. Positive value in dB.	ACCL:L1B:0210:CAV:CAL_LOSS_ATTEN	
R/W	<SIG>:CAL_LOSS_OTHER	Unattributed measured loss used in signal calibration. Positive value in dB.	ACCL:L1B:0210:CAV:CAL_LOSS_OTHER	
EPICS-calculated values				
R	<SIG>:CAL_REF_PWR	RF power at ADC full scale. [dBm]	ACCL:L1B:0210:CAV:CAL_REF_PWR	
R	<SIG>:CAL_LOSS_TOTAL	Total (of cable, coupler, atten, other) loss used in signal calibration. Positive value in dB.	ACCL:L1B:0210:CAV:CAL_LOSS_TOTAL	
R	<SIG>:SCALE	Final calibration scale factor to convert raw ADC counts to amplitude. This also include the beam-based fudge factor	ACCL:L1B:0210:CAV:SCALE	
For SRF, the signal calibration for Cavity Probe (CAV) can be calculated 2 ways: (1) using the above system losses, power at ADC full scale, and cavity probe Q or (2) calculated from the reverse signal decay. Experts can choose which method they would like to use per cavity				
R/W	CAVSCALE_SEL	Select between calibration methods: 0 = Qprobe, 1 = RevCal	ACCL:L1B:0210:CAVSCALE_SEL	
R/W	QPROBE	Cavity probe Q. Used in Qprobe calibration method.	ACCL:L1B:0210:QPROBE	

Other attributes for operations - Tentative

Name	Description
V	Chassis power supply voltage
T	Chassis board temperature

DC	SSA enable/disable internal DC power
	SSA RF enable, how to distinguish from global RF enable?
PzVout	Output voltage to the piezo tuning motor
PzHz	Expected tuning change from PzVout

Expert attributes, not for use on operations screens

Name	Description
	Firmware MD5
	BMB7 board serial #
	Digitizer board serial #
	Chassis serial # and/or Depot number