

4.2.15 Target Hall Instrumentation

Instrumentation of the target hall is described in this section. The instrumentation consists of environmental sensors, beam synchronous sensors and motion control devices. They are summarized according to the three categories in **Table 4.2-17**, below. A detailed instrumentation list is shown in **Table 4.2-18**.

Environmental sensors are used to measure temperature, humidity and pressure in various locations of the hall and on some of the beam line elements. These sensors are connected to either a PLC or an Analog Entry Box (AEB). The PLC digitizes input signals and transmits this data to ACNET via an Ethernet connection. The AEB transmits signals to an MADC, where signals are digitized and transmitted to ACNET via CAMAC. In parallel, the AEB transmits data to a Process Channel Interface (PCI) with output signals to the Beam Permit. If any specified AEB input signal falls outside the allowed range the PCI signal will drop Beam Permit. At this time there are five Beam Permit inputs: three baffle temperature sensors, one air supply temperature sensor and one air supply fan differential pressure sensor. A block diagram of the signal paths is shown in **Figure 4.2-47**.

Beam-synchronous sensors are used to measure the horn current pulse, the horn magnet fields (with “Bdot” pickup coils), beam on target (Budal monitor) and residual radiation into the Beam Loss Monitors (BLMs). The BLMs will be used with low-intensity beams to locate the optimal beam path through the horns. They may also be used for beam timing measurements. All signals from beam-synchronous sensors are connected to AEB inputs.

Note: The timing of the beam as derived from Budal or BLM signals will be compared to the timing of the pulsed horn, as derived from the B-dot detectors or the transducer output from the horn power supply system. In the event the relative timing changes significantly (>1% field decrease from maximum) an ACNET alarm will be set. This translates to a 133-microsecond window of coincidence (beam starts 76.5 μ sec before maximal horn current or beam starts 66.5 msec after maximal horn current: 143- μ sec window).

Horn 1 and the baffle/target positions are adjustable via motor controls. All motors are located on top of the modules, shielded from the primary radiation. Vertical and horizontal angle and position will be adjustable for horn 1 and target/baffle. In addition, target/baffle has 100 inches of longitudinal motion (along the beamline) to facilitate changes to the neutrino beam energy. Limit switches, including those for longitudinal motion, are placed on top of the modules.

Position readback will be obtained with precision LVDTs, also located on top of the modules. Motion parameters are summarized in **Table 4.2-19**. ACNET is used for motion control via ethernet-VME-ACS communication, as shown in **Figure 4.2-48**.

Note: Motion of the target/baffle must be interlocked so that it is not possible for the target to collide with the horn.

Table 4.2-17. Instrumentation Summary

ENVIRONMENT	Input Channels		Synchronous with Beam	Input	MOTION Controls	
Readout frequency~ 0.1Hz	AEB	PLC	Measured during beam spill	Channels	and Readback	ACS
				AEB		Quantity
Temperature			Budal Monitor		Motor Control	
<u>Baffle: also to Beam Permit</u>	3		Target (x, y)	2	Tgt mod; trans & angle	4
Baffle/Target Carrier		2		Total 2	Tgt/baffle motion in Z	1
Horn #1 Module support		4			Hrn #1 mod trans&angle	4
Horn #1 Carriage		2	Bdot		Total	9
Horn #1 Body		6	Hrn #1 Field	3		
Horn #2 Module support		4	Hrn #2 Field	3		
Horn #2 Body		6				
Target pile shielding		6		Total 6		
Air Temp(pile supply/return)	1	2				
Fan Temp (inlet/outlet)		2				
Total	4	34			LVDT	
					Tgt mod; trans & angle	4
			Horn Currents		Hrn #1 mod trans&angle	4
Pressure			Striplines	4	Tgt/baffle motion in Z	1

Filter bank in/out differential		2	Sum of striplines	1	Total	9
<u>Fan i/o diff ; Beam Permit</u>	1	1	Total	5		
Evaporator coil		1				
Total	1	4				

Target Pressure

Pirani Vacuum Gauge	1
He Pressure Gauge	1
Total	2

Beam Loss Monitor

Horn 1	1
Horn 2	1
Total	2

Limit Switch Circuits

Tgt module	10
Hrn #1 module	8
Total	18

(Note: Limit switches may be doubled up for

Humidity

Air (supply/return) & Tgt hall	3
Total	3

Timing

Bdot & Budal, possibly more	1
Budal, Stripline Current	0
Total	1

redundancy)
Interlock switch 1
or more

Other

Fan Current	1
Target - Ground Impedance	1
Total	1

Subtotal: Channel Count	7	42	Subtotal: Channel Count	16
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Table 4.2-18 Detailed List of Instrumentation

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Component	Quantity	Device	#	Detail	ACNET Alarm	Range	Error	ACNET Readout/ Control
Target Pile	Pre-filter, High-eff. filter	Pressure differential	2		A	3"	0.25%	PLC/ethern
	Fan in/out	Pressure differential	1	Permit	A	13"	0.25%	AEB
	Fan in/out	Pressure differential	1		A	13"	0.25%	PLC/ethern
	Humidity, Supply/Return	Rel Humidity Transmitter	2			100%		PLC/ethern
	Humidity, Target Hall	Rel Humidity Transmitter	1			100%		PLC/ethern
	Evaporator coil	Pressure	1					PLC/ethern
	Fan Curent	Transducer	1			100%		PLC/ethern
	Pit Temperatures	Thermocouple	6		A	50°C	1°C	PLC/ethern
	Air Temp (supply to pile)	Thermocouple	1	Permit	A	50°C	1°C	AEB
	Air Temp (supply to pile)	RTD	1		A	30°C	0.25°C	PLC/ethern
	Air Temp (return from pile)	RTD	1		A	30°C	0.25°C	
	Fan Inlet Temperature	RTD	1		A	30°C	0.25°C	PLC/ethern
	Fan Discharge Temp	RTD	1		A	30°C	0.25°C	PLC/ethern
Baffle	Temperature	Thermocouple (2 + 1 spare)	3	Permit	A	50°C	1°C	AEB
Target	Beam on target	Budal Monitor; current	2	1X, 1Y				AEB
	Target-ground impedance	To be decided	1		A			AEB
	Vacuum	Pirani Gauge	1		A			AEB
	He Pressure	Pressure Gauge	1		A			AEB
Tgt/Bffl Carrier	Temperature	Thermocouple	2		A	50°C	1°C	PLC/ethern
Target	Space Frame angle	Motor Control	4	2X, 2Y		*	*	ACS

Module	and transverse motion	LVDT (pos'n readback)	4	2X, 2Y		*	*	ACS
		Limit Switch Circuits	8			*	*	ACS
	Target Motion - Z axis	Motor Control	1	Z only		*	*	ACS
		Scaled-motion LVDT	1			*	*	ACS
		Z-Limit Switch Circuits	2			*	*	ACS
	Motion Interlock	Limit Switch	1			*	*	
Horn 1								
Module	Horn angle and Transverse Motion	Motor Control	4	2X,2Y		*	*	ACS
		LVDT (pos'n readback)	4	2X,2Y		*	*	ACS
		Limit Switch Circuits	8			*	*	ACS
	Support temperature	Thermocouple	4		A	50°C	1°C	PLC/ethern
	Carriage temperature	Thermocouple	2		A	50°C	1°C	PLC/ethern
Shielding Block	Horn alignment	Beam loss monitor	1				AEB	
Horn 2								
Module	Suport temperature	Thermocouple	4		A	50°C	1°C	PLC/ethern
Shielding Block	Horn Aligment	Beam loss monitor	1				AEB	
Horn 1	Magnetic Field Temperature	Bdot coil	3		A'		0.40%	AEB
		Thermocouple	6		A	50°C	1°C	PLC/ethern
Horn 2	Magnetic Field Temperature	Bdot coil	3		A'		0.40%	AEB
		Thermocouple	6		A	50°C	1°C	PLC/ethern
Power Supply								
	Stripline Currents	Summing Module	4					AEB
		Total Current	1					AEB
Timing	Horn Current/ Beam Spill	Bdot coil & Budal Monitor	1		A'	200 us	10 us	AEB
		BLM & Stripline current, or etc				200 us	10 us	AEB

Table 4.2-19 Motion Control

Device	Motion	Motion	Motion	Motion	Motion
	Vertical Upstream	Vertical Downstream	Transverse Upstream	Transverse Downstream	Longitudinal
Horn 1					
Motor	Superior KMT063S09	Superior KMT063S09	Superior KMT063S09	Superior KMT063S09	Superior KMT063S09
Gearbox ratio	40:1	40:1	100:1	100:1	100:1
LVDT range	1" (.004") 2 (+/- 3mm) <i>strip</i>	1" (.004") 2 (+/- 3mm) <i>strip</i>	1" (.004")	1" (.004")	1" (.004")
Limit Switches	<i>line</i>	<i>line</i>	2 (+/- 3mm) <i>strip line</i>	2 (+/- 3mm) <i>strip line</i>	
Target/Baffle					
Motor	To be specified	To be specified	To be specified	To be specified	To be specified
Gearbox ratio	To be specified	To be specified	100:1	100:1	1:1 ~10"
LVDT range	8" (.004") *	8" (.004") *	1" (.004")	1" (.004")	(.040")**
Limit Switches	2 (+0.3/-7.5")	2 (+0.3/-7.5")	2 (+/-0.3")	2 (+/-0.3")	4 redundant
1" LVDT at top Or 8"LVDT if possible geared down from 100"	100" (linear gear)				

- a) to ACNET via AEB & MADC
- b) to Beam Permit via PCI
- c) to ACNET via the PLC

Instrumentation Data to ACNET

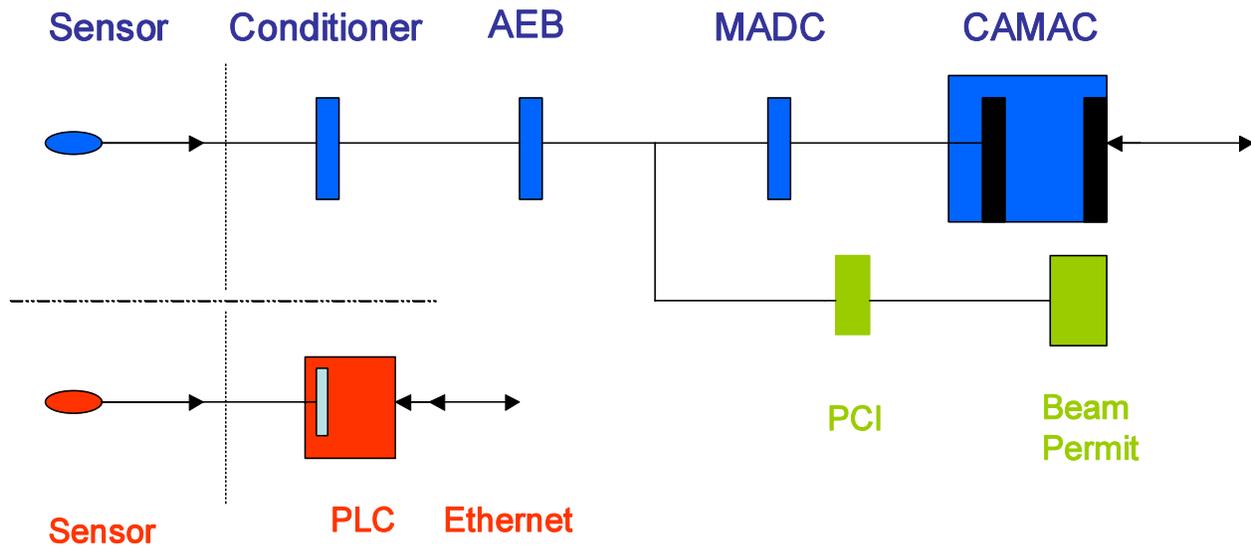


Figure 4.2-47 Instrumentation Readout Paths

Motor Controls

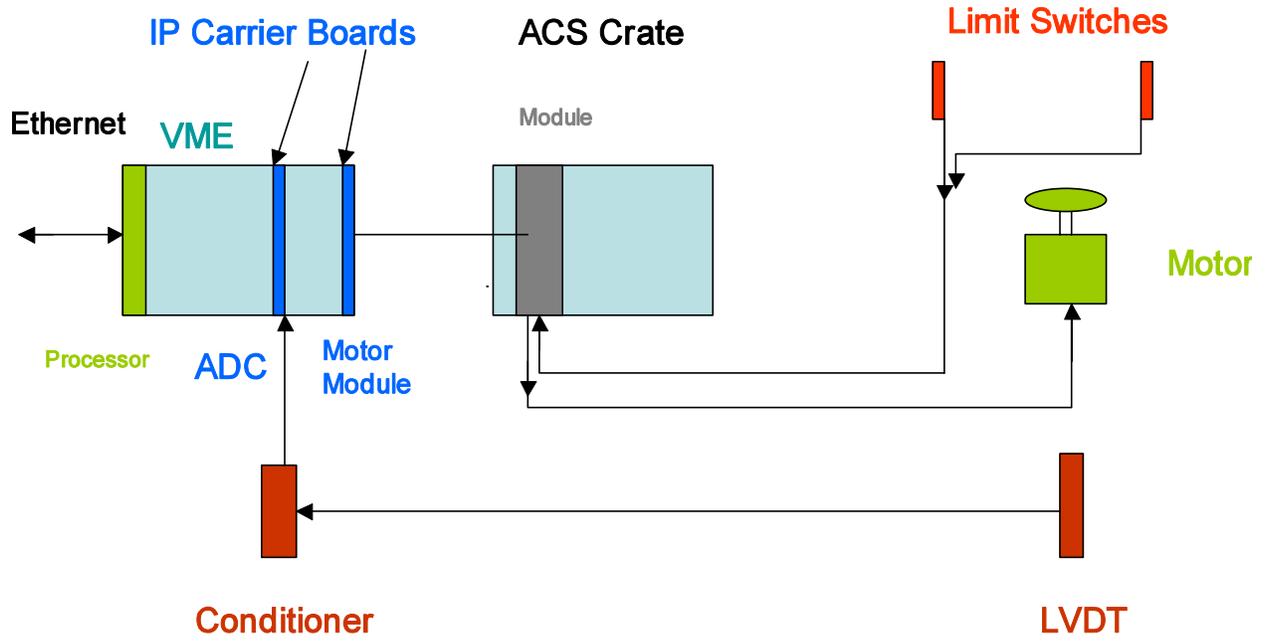


Figure 4.2-48 Instrumentation Readout Paths Motor Controls