



**Atacama
Large
Millimeter
Array**

Interface Control Document Between ACA Correlator and ACA Spectrometer

ALMA-62.00.00.00-64.00.00.00-B-ICD

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Change Record

Version	Date	Affected section(s)	Reason/Initiation/Remarks
A.1	2019-06-17	all	Initial Release
A.2	2019-10-09	Section 5 and 6	Revise 5 Rack mounting and 6 Electric power
A.3	2020-07-27	4.1 and 4.2	Added the details of the connectors and the conversion cable for the 48 msec timing signal.
A.4	2020-08-01	3, 4.1, 4.2, 5, 6	Proofreading
A	2020-08-01	Signature Matrix, Status	Edit for Release Version
B	2021-11-26	6.1, 6.2	Correct the miscalculation in the power consumption of Q1 and of the total of 4Qs.
B	2021-12-09	Figure 4-2	Changed the pin assignment of Dsub9 due to the replacement of the RS485 card for ACA-CCC.



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1 Description

1.1 Purpose

The purpose of this document is to define the interface between ACA Correlator and ACA Spectrometer.

1.2 Scope

This ICD covers the electrical and mechanical interface between ACA Correlator and ACA Spectrometer, which includes 48ms timing event interface between ACA Correlator and ACA Spectrometer.

2 Related Documents and Drawings

2.1 Applicable Documents

2.2 Reference Documents

No	Document Title	Reference
RD01	ICD Between: Back End and ACA Spectrometer	ALMA-50.00.00.00-64.00.00.00-A-ICD
RD02	ALMA Monitor and Control Bus Interface Specification	ALMA-70.35.10.03-001-A-SPE
RD03	ICD Between Site (AOS Technical Building) and ACA Correlator	ALMA-20.01.02.00-62.00.00.00-C-ICD
RD04	ACA Spectrometer Structural Analysis Report	ALMA-64.00.00.00-0012-A-REP
RD05	Study Report on Cooling Capacity of ACA Correlator Room for ACA Spectrometer	CORL-64.00.00.00-0013-A-REP
RD06	Interface Control Document Between: ACA Correlator And: Computing / ACA Correlator Software	ALMA-62.00.00.00-70.42.00.00-B-ICD
RD07	ACA-FX Correlator System Maintenance Manual http://edm.alma.cl/forums/alma/dispatch.cgi/revsactive/doc/Profile/103506/d20130527065026/No	NF-ACACOR-2006-0056/11
RD08	Production DRXP Board User's Manual (Version 1.9.1)	Production_DRXP_board_User_sManual_ver1.9.1_200518
RD09	Production DRXP board for ACA Spectrometer Technical Specifications and Requirements (Version: 1.2)	production_DRXP_specification_version_1.2_20180727
RD10	ACA Spectrometer Assembly, Transportation, Integration and Verification Plan	CORL-64.00.00.00-0022-A-PLA



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3 Abbreviations and Acronyms

ACA	Atacama Compact Array
ALMA	Atacama Large Millimeter/submillimeter Array
AOS	Array Operations Site
ASC	ACA Spectrometer Control
ASM	ACA Spectrometer Module
ACA-CCC	ACA Correlator Control Computer
ACA-DMC	ACA DTS-R Monitor & Control Computer
DRXP	DTS-Rx board with PCI-express bus interface
ICD	Interface Control Document
JAO	Joint ALMA Observatory
KASI	Korea Astronomy and Space Science Institute
MCI	Monitor and Control Interface
NAOJ	National Astronomical Observatory of Japan
PDU	Power Distribution Unit
POWCON	Power Control
RS485	Recommended Standard 485

4 Reference Clock

ACA Correlator shall provide 48 msec timing signal to DRXP boards of the ASMs: a single 48 msec system cycle tick, which consists of 42 msec at low level and 6 msec at high level. The tolerance on this duty cycle is +/-1 msec. The leading edge of this signal (low to high) is used by the DRXP boards to measure the metaframe delay.

Regarding the time synchronization of ASMs, see section 4 of [RD01].

4.1 Signal Connector

The 48 msec timing signal shall be provided as electric signals which are conformable to RS485. The connector type of the 48 msec timing signal shall be one of industrial standards. The choice of the connector type, pin assignment and shielding shall comply with ALMA Monitor and Control Bus Interface Specification [RD02]. If not, adapters or conversion cables shall be provided to make connectors comply with [RD02].

The 48msec TE bracket connector of the DRXP board is RJ45 [RD08]. The conversion cable shall be provided as a deliverable of the ACA Spectrometer. See also Figure 4-2 for the details of the new conversion cable. The pin assignment of RJ45 connector of the DRXP board is specified as in Table 4-1.



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Table 4-1: 48ms TE in/out (external) connector pin assignment [RD08]

Pin	Signal	In/Out	Function
1	NC	-	Not Connected.
2	NC	-	Not Connected.
3	NC	-	Not Connected.
4	48ms_TE_p	In/Out	RS485 level signal. This signal is differential pair signal with 48ms_TE_n
5	48ms_TE_n	In/Out	RS485 level signal. This signal is differential pair signal with 48ms_TE_p
6	NC	-	Not Connected.
7	GND	In	Signal Ground
8	NC	-	Not Connected

4.2 Wiring

The 48 msec timing signal shall be provided by the POWCON card in the MCI module of the ACA Correlator.

P0 of the POWCON card of slot 6 in the MCI module of Q2 shall be used to provide the 48 msec timing signal to ACA-CCC and ACA-DMC. P1 of the POWCON card of slot 5 in the MCI module of Q2 shall be used to provide the 48 msec timing signal to the cold standby of ACA-CCC and ACA-DMC as described in [RD07]. Two custom made Dsub9-Dsub25 conversion cables are used to connect the 48 msec timing signal port of POWCON card in the MCI module of Q2, the RS485 interface card in the ACA-CCC and the 48 msec receiver port of the ACA-DMC. See also Table 4-2 and Figure 4-1 for more details. One cable is used for the usual operation and the other is for the standby.

DRXP#1 of ASM#3 should share the 48ms timing signal with ACA-CCC and ACA-DMC by replacing an existing Dsub9-Dsub25 conversion cable (Figure 4-1) with a new RJ45-Dsub9-Dsub25-RJ45 conversion Multi-drop cable (Figure 4-2).. See also Table 4-3 and Figure 4-2 for more details. The 48 msec timing signal distribution inside the ACA Spectrometer should be described in [RD10].



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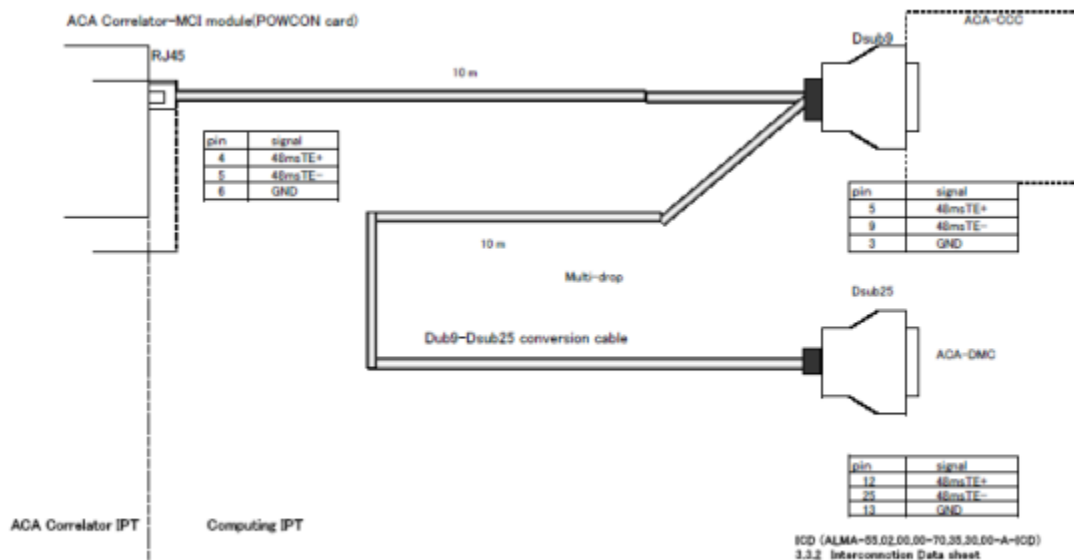
Table 4-2: Mechanical Interface of the 48 msec Timing Signal for Standby

Correlator Connector	Cable Connector (Corl end)	Cable Type	Cable Length	Cable Connector (ACA-DMC and CCC end)	ACA-DMC and CCC connector	Total Quantity
RJ45 jack	RD45 plug	CAT5e/RS-485	10mx2	D-sub 25pin and 9pin female	D-sub 25pin and 9pin male	1

Table 4-3: Mechanical Interface of the 48 msec Timing Signal for the Usual Operation

Correlator and DRXP Connector	Cable Connector (Corl and DRXP end)	Cable Type	Cable Length	Cable Connector (ACA-DMC and CCC end)	ACA-DMC and CCC connector	Total Quantity
RJ45 jack	RD45 plug	CAT6A [RD09] /RS-485	10mx3	D-sub 25pin and 9pin female	D-sub 25pin and 9pin male	1

Figure 4-1: 48ms TE Tick Cable and Connectors between the ACA correlator and ACA-DMC/CCC [RD06].

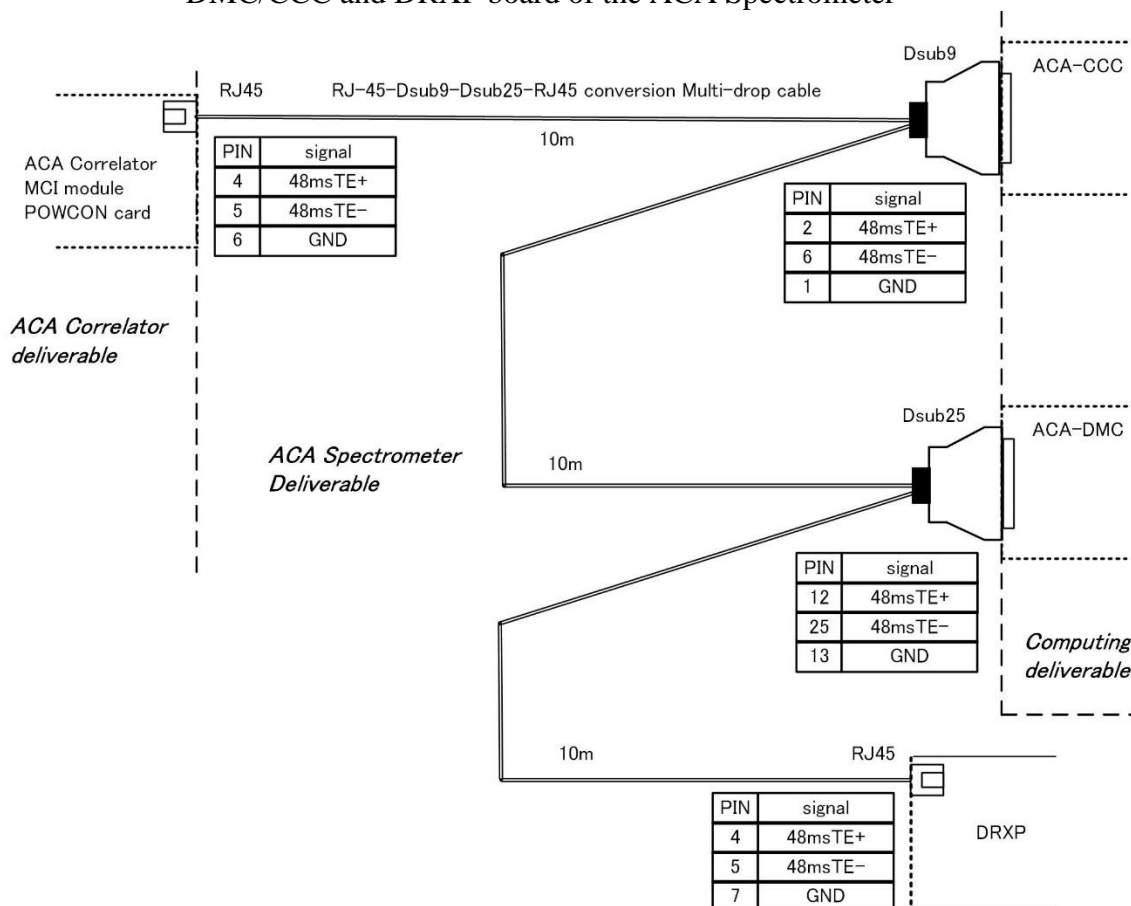




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Figure 4-2: 48ms TE Tick Cable and Connectors between the ACA correlator, ACA-DMC/CCC and DRXP board of the ACA Spectrometer



5 Rack Mounting Plan

ASMs, ASC, Network Switches for the ACA Spectrometer and Optical Splitters shall be installed on the four computer racks of the ACA Correlator. The rack mounting plan for each rack is shown as a diagram in each of the following subsections. The yellow hatched boxes indicate ASMs, ASC, Network Switches for the ACA Spectrometer and Optical Splitters. The Switched Rack PDUs of the computing racks shall be replaced with a new model at the same time due to the larger demand of electricity for the ASMs. The Switched Rack PDUs are also indicated as yellow hatched boxes in the diagrams. The gray hatched boxes indicate the blank space of the computing racks or the spares of existing ACA Correlator Computers and related equipment.

The seismic capacity of the computing racks shall be adequate to accommodate the additional ASMs, ASC, Network Switches for the ACA Spectrometer and Optical Splitters [RD04].



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5.1 Quadrant 0 rack

Quadrant #0

36	(Blank Space)
35	PDU#09 (7.36kVA, 16C13/IEC320 IEC309)
34	
33	PDU#01 (7.36kVA, 16C13/IEC320 IEC309)
32	
31	PDU#02 (7.36kVA, 16C13/IEC320 IEC309)
30	
29	Optical splitter
28	Cabling space
27	ASC (standby)
26	ASC
25	ACA-CCC (standby)
24	ACA-CCC
23	G9XE8#1 on a shelf plate
22	
21	
20	
19	
18	ACA-CDPC#08
17	ACA-CDPC#07
16	ACA-CDPC#06
15	ACA-CDPC#05
14	ACA-CDPC#04
13	ACA-CDPC#03
12	ACA-CDPC#02
11	ACA-CDPC#01
10	ASM#1
9	
8	
7	
6	ASM (spare#1)
5	
4	
3	
2	
1	



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5.2 Quadrant 1 rack

Quadrant #1

36	Dominion (KVM of COJ-OS-1)
35	COJ-OS-1
34	
33	PDU#03 (7.36kVA, 16C13/IEC320 IEC309)
32	
31	PDU#04 (7.36kVA, 16C13/IEC320 IEC309)
30	
29	Optical splitter
28	Cabling space
27	Spectrometer Network Switch #1
26	Cable holder
25	Spectrometer Network Switch #2
24	Cable holder
23	ACA-CDPM (standby)
22	ACA-CDPM
21	G9XE8#2 on a shelf plate
20	
19	
18	
17	
16	ACA-CDPC#16
15	ACA-CDPC#15
14	ACA-CDPC#14
13	ACA-CDPC#13
12	ACA-CDPC#12
11	ACA-CDPC#11
10	ACA-CDPC#10
9	ACA-CDPC#09
8	ACA-CDPC (spare#1)
7	ACA-CDPC (spare#2)
6	ACA-CDPC (spare#3)
5	ASM#2
4	
3	
2	
1	



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5.3 Quadrant 2 rack

Quadrant #2

36	G9XE8 (spare) on a shelf plate
35	
34	
33	
32	
31	PDU#05 (7.36kVA, 16C13/IEC320 IEC309)
30	
29	PDU#06 (7.36kVA, 16C13/IEC320 IEC309)
28	
27	Optical splitter
26	Cabling space
25	G9XE8#3 on a shelf plate
24	
23	
22	
21	
20	ACA-CDPC#24
19	ACA-CDPC#23
18	ACA-CDPC#22
17	ACA-CDPC#21
16	Service Drawer
15	Paragon user (KVM)
14	ACA-CDPC#20
13	ACA-CDPC#19
12	ACA-CDPC#18
11	ACA-CDPC#17
10	ACA-DMC
9	
8	
7	
6	
5	ASM#3
4	
3	
2	
1	



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5.4 Quadrant 3 rack

Quadrant #3

36	PDU#07 (7.36kVA, 16C13/IEC320 IEC309)
35	
34	PDU#08 (7.36kVA, 16C13/IEC320 IEC309)
33	
32	Optical splitter
31	Cabling space
30	AUATC#1/AUATC#2
29	Correlator Network Switch#2
28	Cable holder
27	Correlator Network Switch#1
26	Cable holder
25	Paragon Switch (KVM)
24	Cable holder
23	G9XE8#4 on a shelf plate
22	
21	
20	
19	
18	ACA-CDPC#32
17	ACA-CDPC#31
16	ACA-CDPC#30
15	ACA-CDPC#29
14	ACA-CDPC#28
13	ACA-CDPC#27
12	ACA-CDPC#26
11	ACA-CDPC#25
10	ACA-DMC (standby)
9	
8	
7	
6	
5	ASM#4
4	
3	
2	
1	



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6 Electric Power Distribution Plan

ASMs, ASCs and Network Switches for the ACA Spectrometer shall share the electric power with the ACA Correlator Computers and related equipment. The power distribution plan for each rack is shown as a table in each of the following subsections.

The yellow hatched boxes in unit column indicate ASMs, ASC and Network Switches for the ACA Spectrometer and the green hatched boxes in power demand column indicate the electricity required for them. The electricity required for the ACA Spectrometer is taken from [RD05]. Every ASMs have four redundant power supplies and two of four power supplies shall be enough for the ASM to work normally. ASCs, ACA Correlator Computers and Network Switches for the ACA Correlator Computers have two redundant power supplies.

Every Switched Rack PDU has 16 ports and shall supply up to 4600W (230V x 20A x 1.0 of power factor) in total. The PDU column and socket column of the tables give the power cable connections between the power supplies of every devices and the power port of Switched Rack PDUs. The supply column gives the maximum electricity demand for each Switched Rack PDU. The total electricity demand in each rack is given in the last (second last for Quadrant 0) row of the demand column. Note that the rack total electricity demand should be smaller than the sum of the maximum electricity demands of Switched Rack PDUs of the rack because of the redundancy of power supplies.

The total electricity demand of four computing racks is the sum of four rack total electricity demands and is given as 19298 W in the last row of the demand column for Quadrant 0.



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6.1 Quadrant 0 rack

unit	Power (W)		PS#1		PS#2	
	demand	supply	PDU	socket	PDU	socket
ACA-CCC (standby)	200		1	10	2	10
ACA-CCC	200		1	9	2	9
ACA-CDPC#08	200		1	8	2	8
ACA-CDPC#07	200		1	7	2	7
ACA-CDPC#06	200		1	6	2	6
ACA-CDPC#05	200		1	5	2	5
ACA-CDPC#04	200		1	4	2	4
ACA-CDPC#03	200		1	3	2	3
ACA-CDPC#02	200		1	2	2	2
ACA-CDPC#01	200		1	1	2	1
G9XE8#1	300		1	12		
ASC (standby)	450		1	13	9	12
ASC	450		9	11	2	14
ASM#1	900		1	15	9	15
	900		1	16	9	16
ASM (spare#1)	900		9	13	2	15
	900		9	14	2	16
PDU#01		4550				
PDU#02		4250				
PDU#09		4500				
Rack total (W)	6800					
Total (W)	20198					



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6.2 Quadrant 1 rack

unit	Power (W)		PS#1		PS#2	
	demand	supply	PDU	socket	PDU	socket
Dominion	6				4	12
COJ-OS-1	300		3	11	4	11
ACA-CDPM (standby)	200		3	10	4	10
ACA-CDPM	200		3	9	4	9
ACA-CDPC#16	200		3	8	4	8
ACA-CDPC#15	200		3	7	4	7
ACA-CDPC#14	200		3	6	4	6
ACA-CDPC#13	200		3	5	4	5
ACA-CDPC#12	200		3	4	4	4
ACA-CDPC#11	200		3	3	4	3
ACA-CDPC#10	200		3	2	4	2
ACA-CDPC#09	200		3	1	4	1
G9XE8#2	300		3	12		
Network Switch#Spectrometer	30		3	14		
Network Switch#Spectrometer	30				4	14
ASM#2	900		3	15	4	15
	900		3	16	4	16
PDU#03		4430				
PDU#04		4136				
Rack total (W)	4466					



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6.3 Quadrant 2 rack

unit	Power (W)		PS#1		PS#2	
	demand	supply	PDU	socket	PDU	socket
ACA-CDPC#24	200		5	8	6	8
ACA-CDPC#23	200		5	7	6	7
ACA-CDPC#22	200		5	6	6	6
ACA-CDPC#21	200		5	5	6	5
ACA-CDPC#20	200		5	4	6	4
ACA-CDPC#19	200		5	3	6	3
ACA-CDPC#18	200		5	2	6	2
ACA-CDPC#17	200		5	1	6	1
G9XE8#3	300		5	12		
Service Drawer	300				6	9
Paragon user	120				6	10
ACA-DMC	300		5	11		
ASM#3	900		5	15	6	15
	900		5	16	6	16
PDU#05		4000				
PDU#06		3820				
Rack total (W)	4420					



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6.4 Quadrant 3 rack

unit	Power (W)		PS#1		PS#2	
	demand	supply	PDU	socket	PDU	socket
AUATC#1/AUATC#2	40		7	9	8	9
Network Switch#2	176		7	10	8	10
Network Switch#1	176		7	13	8	13
Paragon Switch	120				8	14
ACA-CDPC#32	200		7	8	8	8
ACA-CDPC#31	200		7	7	8	7
ACA-CDPC#30	200		7	6	8	6
ACA-CDPC#29	200		7	5	8	5
ACA-CDPC#28	200		7	4	8	4
ACA-CDPC#27	200		7	3	8	3
ACA-CDPC#26	200		7	2	8	2
ACA-CDPC#25	200		7	1	8	1
G9XE8#4	300		7	12		
ACA-DMC (standby)	300		7	11		
ASM#4	900		7	15	8	15
	900		7	16	8	16
PDU#07		4392				
PDU#08		3912				
Rack total (W)	4512					



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7 Thermal Load

Regarding the thermal load, there is no direct interface between the ACA Correlator and the ACA Spectrometer. The total thermal load from ASMs, ASC and Network Switches shall be taken into account for the cooling requirement of the ICD between Site (AOS Technical Building) And ACA Correlator [RD 03].