7th meeting of the ad-hoc **Common Modem Working Group**

November 15, 2019 9-11 am PST Telecon/Webex

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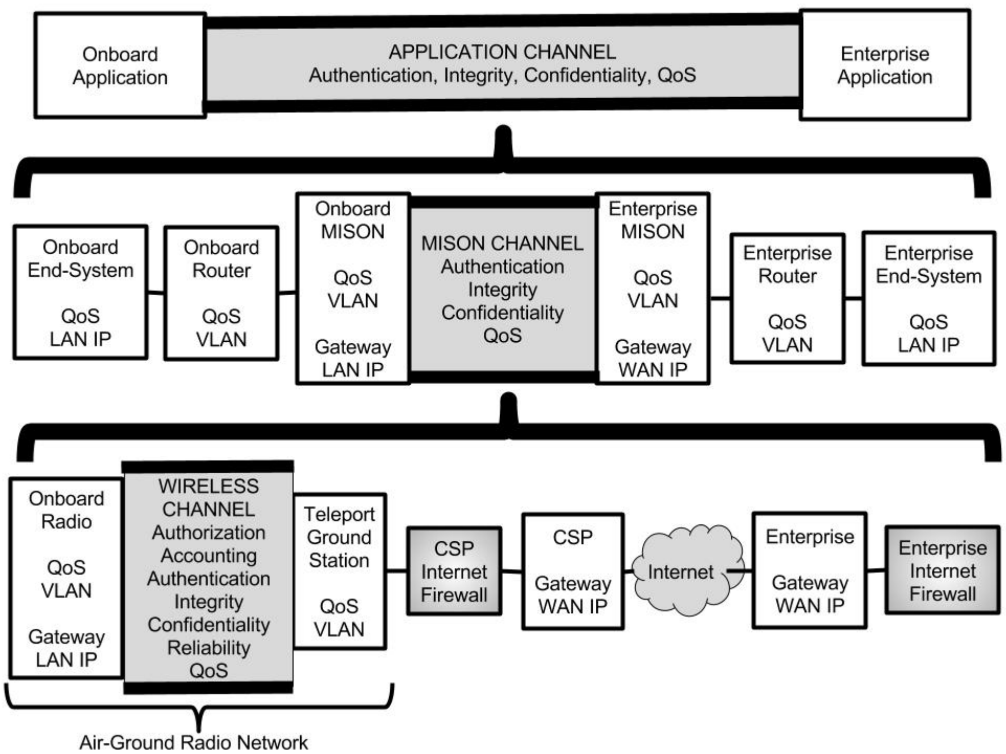
1) Invitees (Attendees in Bold)

Totaport (satcom.guru)	**Peter Lemme** (leader, secretary)
SAE-ITC AEEC	**Jose Godoy**
Airbus	Chris Schaupmann
Astronics	**Jonathon Epstein**, Tony Hamel
Boeing	John Rodgers, Michael Reinbold, Ryan Torgerson, **David Phillips**
Carlisle IT	Paul Ahlf, **Brad Purpus**
Collins Aerospace	Lee Paulson, Trevor Trinkhaus, Steve Atkins
Comtech	Robert Skuza, Scott Weber,
Delta	Mark Sorensen, Josey Harper
Gilat	Moti Goldshtein, Amir Yafe, Gil Elizov, Dor Snapir
Global Eagle	**Simon McLellan, Antonio Campobasso**
Gogo	Loren Ayotte, Mike Susedik
Gulfstream	Jorge Bolanos, Michael Wolf
Honeywell	**Josh Laing**, Monterey Elkins
Hughes	Peter Pardee, John Schmid, Tuomo Rutanen, **Ernest Seah,** Jack Lundstedt, **Kang Yuan**
iDirect	**Steve Moses**, Dan Asquin
Inmarsat	Dave Desch, Bill Rowell
Jet-Talk	Sharly Ben Chetrit
Mitsubishi	**Victor Gheorghian**
NXT Comm	Dave Horton, **Carl Novello**
OneWeb	David Nemeth, **Eric Liu**
Panasonic Avionics	**Anh Nguyen**
Phasor Solutions	John-Paul (JP) Szczepanik
Saint Gobain	Dave Stresing
Seamless Air Alliance	Jack Mandala
SES	Ashok Rao
Smiths Interconnnect	Dusty Dastidar, Doug LaFreniere, Dan Cordell, Shawn O'Brien
Thales	Arnaud Tonnerre
Thinkom	Greg Otto
United	Ben Wong
Viasat	Gary Echo, Mike Chao, **Eric Cross**

- Open/A791-AMIP reconciliation

Defer discussion to next meeting.
OPEN-AMIP is up to version 16, A791-AMIP was based on version 7.
How is Max PSD communicated for flat panel antennas? f (elev, skew)
Just have the antenna communicate max PSD?
Need to document how that is managed?
How is the criteria conveyed to the antenna – coordinated limits?
How are margins accounted for, in time or in threshold?
Telecon to be schedule for AMIP only
Eric, Steve, Josh, David Phillips

- PP848 - A791P2 COS/VLAN subnetworks



Each domain may support up to four 848 QoS levels:

Expedited Forwarding	• traffic operates with low latency and low jitter.
Assured Forwarding	• traffic is assured to be communicated within a criteria specificed in a service level agreement.
Default Forwarding	• (Best Effort) traffic is all other traffic. These communications may be delayed in precedence to higher priority traffic.
User Defined	• used by special applications with uniquely matching radio services as specified in a service level agreement. • Priority may be above or below other QoS levels independent

802.1q VLAN subnetwork by domain
ARINC 791 part 2

802.1p
Priority Code Point (PCP)
Class of Service (COS)
3 bit field, 8 layers

PCP value	Priority	Acronym	Traffic types
1	0 (lowest)	BK	Background
0	1 (default)	BE	Best effort
2	2	EE	Excellent effort
3	3	CA	Critical applications
4	4	VI	Video, < 100 ms latency and jitter
5	5	VO	Voice, < 10 ms latency and jitter
6	6	IC	Internetwork control
7	7 (highest)	NC	Network control

- Size 1 modem inserts

- Size 2 manager/modman inserts

- Interwiring - daisy chain modems

Mitsubishi does not support multiple modem (new) boxes connected using coax, would accept card level modems. Fiber is acceptable.

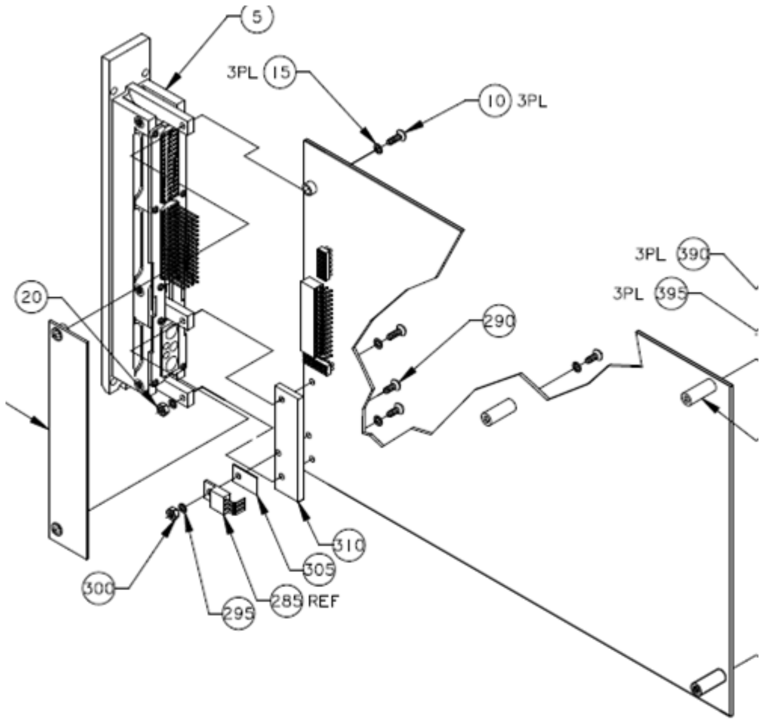
- Modem Digital interface to antenna data rate

Astronics 250 MHz, 12 bits x 2 (i,q) …6 Gbps (per carrier)
Multiple strands
12/24 strand
single-mode (diffused beam)

- Reference frequency interface

Dedicate a fiber to reference frequency as a digital cadence to set a local oscillator.

Dynamic range between analog ref (+5 dBm) and signal (-30 dBm) multiplexed on one fiber can be a challenge.



LRU CASE SIZE	MAX. PERMISSIBLE WEIGHT KG
1 MCU	2.5
2 MCU	5.0
3 MCU	7.5
4 MCU	10.0

Case Dimensions:

Standard LRU Sizes	Dimension W (millimeters) Minimum – Maximum	Dimension W (inches) Minimum – Maximum
1	25.15 – 25.65	.990 – 1.010
2	56.64 – 57.66	2.230 – 2.270
3	89.92 – 90.94	3.540 – 3.580
4	123.44 – 124.46	4.860 – 4.900

2) 2+1+1 and the 4 + 2 configuration

6 MCU total rack space

4 MCU Modman plus two 1 MCU modems (three modem)

3 MCU Modman plus three 1 MCU modems (four modems)

2 MCU Modman plus four 1 MCU modems (five modems)

3 MCU Manager plus three 1 MCU modems (three modems)

2 MCU Manager plus four 1 MCU modems (four modems)

5 MCU total rack space

4 MCU Modman plus one 1 MCU modem (two modems)

3 MCU Modman plus two 1 MCU modems (three modems)

2 MCU Modman plus three 1 MCU modems (four modems)

3 MCU Manager plus two 1 MCU modems (two modems)

2 MCU Manager plus three 1 MCU modems (three modems)

4 MCU total rack space

4 MCU Modman (one embedded modem)

3 MCU Modman plus one 1 MCU modem (two modems)

2 MCU Modman plus two 1 MCU modems (three modems)

3 MCU Manager plus one 1 MCU modem (one modem)

2 MCU Manager plus two 1 MCU modems (two modems)

3 MCU total rack space

3 MCU Modman (one embedded modem)

2 MCU Modman plus one 1 MCU modem (two modems)

2 MCU Manager plus one 1 MCU modem (one modem)

2 MCU total rack space

2 MCU Modman (one embedded modem)

AMU: modem LRU. Acts to switch / combine IF for AMU modem and Modman modem.

No Modman change to add IF input to secondary modem

Rack space is always a concern, can generally be accommodated along with excess cooling needs, but staying in the 4 MCU constraint is path of least resistance. Additional rack space is a lofty ambition

First objective is to create a modular modem, a stand-alone 1 MCU LRU.

A second objective is to create a modular manager, the master of one or more modular modems.

The third objective is to allow the 1 MCU Modem work as another modem to a traditional modman.

A quick vote at the end, where we asked if the preference was to work off of the existing modman and focus only on 2 MCU AMU, or to allow for a smaller modman (putting both modman/manager and AMU into play).

6 votes -> A 4+2 4 MCU Modman plus 2 MCU AMU

3 votes -> B 2/3 MCU Modman/Manager plus 1 MCU AMU

No clear majority, but shows clear market willingness to explore the 3+1 or 2+2 or 2+1+1 configuration.

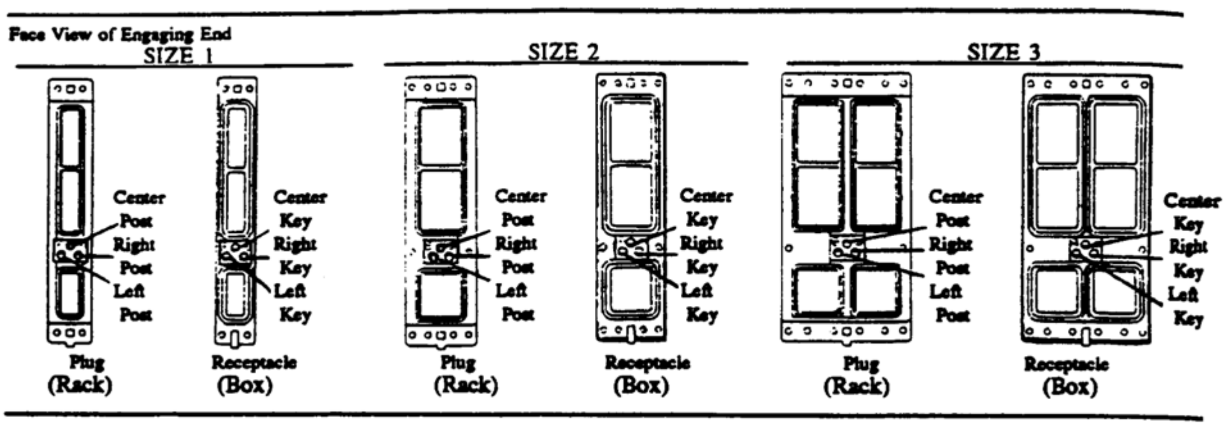
It would be simplest if the modman and the manager used the same connector, and allow the host LRU be either a 2, 3, or 4 MCU LRU.

<u>ARINC 600</u>

19.3.3 Form Factor Requirements

A minimum number of shell sizes and contact capacities as shown in the individual specification drawings and as discussed below should be provided:

- Shell size 1 should accommodate a 1 MCU-wide LRU with 120 low insertion force contacts on 0.100 inch center-to-center spacing, and provisions for power and coaxial contacts (conventional type).
- Shell size 2 should accommodate a 2 MCU-wide LRU, with 300 low insertion force contacts on 0.100 inch center-to-center spacing, physical barriers for circuit separation, and provisions for power and coaxial contacts (conventional type).
- Shell size 3 should accommodate a 3 MCU-wide LRU, with 600 low insertion force contacts on 0.100 inch center-to-center spacing, physical barriers for circuit separation, and provisions for power and coaxial contacts (conventional type).



→We agreed to work off of the size 2 connector as currently defined for the 792 Modman

(and preserving 791 as much as possible)

→Leave the Modman size of 2, 3 or 4 MCU to the side.

→size 1 connector as compatible with a 1 MCU AMU, it can be adapted to a 2 MCU enclosure.

→size 2 connector on the modman/manager and a size 1 connector on the AMU (or whatever we call it).

3) overcoming the challenges of a 1 MCU LRU

Tray will have to buttress the LRU to aid in vibration or shock.

4) power distribution between the LRUs

Power in the AMU – how is it switched?

How many are provided?

Discrete control, switched power.

Power supply in the AMU?

Modman/manager will have ships power.

Can we reuse the DC power pins for power out?

Will the power be daisy chained to a second AMU?

How will each AMU “turn-on” and how will that be commanded?

Power distribution – assume a 1 MCU assembly must run on conditioned power, but a 2 MCU assembly could take ship’s power.

Pin and Socket Power Contacts

Contacts should have the nominal electrical characteristics shown in Table 19.3.4.2.

Table 19.3.4.2 – Nominal Current Rating

Contact Size	Amperes
20	7.5
16	13.0
12	23.0
8	46.0

5) cooling distribution between the LRUs

50W for a 2 MCU AMU seems adequate.

25W for a 1 MCU AMU seems inadequate.

Requests for cooling above ARINC 600 are generally accommodated.

May be able to shift some cooling from the modman/manager in a 3+1, but may not be reasonable in a 2+1+1.

Cooling – for the 2 MCU AMU, assume ARINC 600 50W. for the 1 MCU AMU, it’s likely situation it is sharing a 4 MCU space with the modman/manager. Can it survive on twenty-five? Can the modman/manager live on say 60W and the AMU gets 40W – is there anyway to adjust the plenum as part of the installation, or ask for more cooling?

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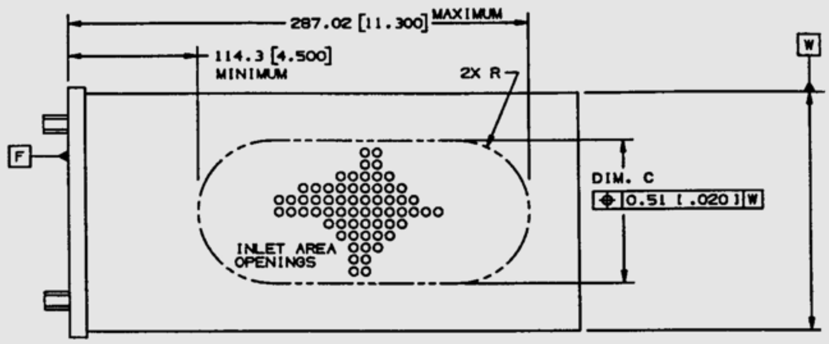
ATTACHMENT 9
COOLING APERTURES



1 THROUGH 4 MCU BOTTOM VIEW A-A

	MCU SIZE:	1	2	3	4	5	6
DIMENSION C Maximum	mm	12.7	15.75	45.21	66.04	99.06	132.08
	inch	.500	.620	1.780	2.600	3.900	5.200

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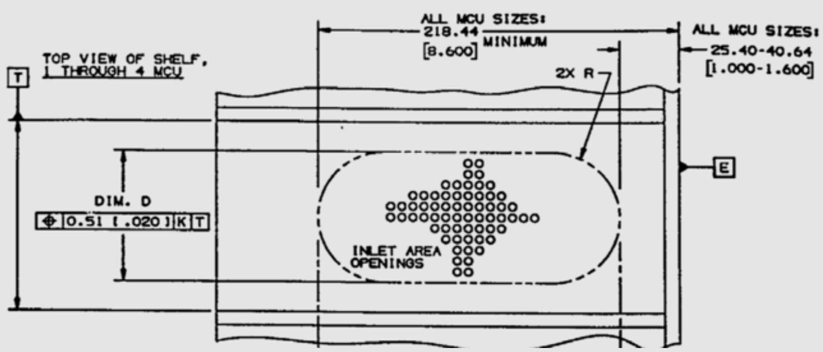
ATTACHMENT 9
COOLING APERTURES



	MCU SIZE:	1	2	3	4	5	6
DIMENSION D Minimum	mm	17.78	22.86	53.34	73.66	106.68	139.7
	inch	.700	.900	2.100	2.900	4.200	5.500

MAXIMUM LRU THERMAL DISSIPATION

LRU CASE SIZE	MAX. PERMISSIBLE POWER DISSIPATION (WATTS)	MAX. PERMISSIBLE POWER DISSIPATION FOR EQUIPMENT WITHOUT COOLING OPENINGS (WATTS) 1
1 MCU	25	7
2 MCU	50	10
3 MCU	75	12
4 MCU	100	15

6) Software loading API - waveform, network attachment, frequency/power/beam steering controls.

The suppliers are asked to propose an API with some means to assess the suitability of a given software defined radio to meet the waveform or other performance requirements for a given modem design.

The co-location of the modem inside the antenna has already moved some modems to adapt to loadable software implementations.

the loadable modem standard has emerged for application at the antenna itself.

The modem in the antenna changes the airplane interface to the modem essentially to power and ethernet.

The performance of the software defined modem is influenced by the complexity and features of the modulated signal. A standard includes loadable procedures and a performance assessment.

Software Defined Radios (SDR) are becoming the framework for modem designs. As much as possible, the marketplace desires a digital framework (rather than discrete components) that enables easy modification, upgrade, and re-purpose.

For the loadable modem option (Modman, OAE), one or more modem profiles could be stored, loading the applicable profile as the network demands. There may be other aspects, each of which should be documented in developing the standardization strategy. There was interest to study the benefits of alternative architectures, notably programmable SDR and alternative federation of functionality.

The LRU Modem can be either be a generic SDR or a specific supplier modem.

A federated modem hosted in the antenna is inherently an SDR.

Modman or Antenna hosted Software Defined Radio

Application Programming Interface (API)

Keeping the modem programming to operate properly (unacceptable emission)

Preload/inflight load, load on the ground only?

Reprogrammable Vs Loadable

(closed Vs Open)

Programmability standard (unique to SDR?)

Configuration control

7) Card-level standard for 4 MCU LRU.

A card-level standard would allow for re-use of any enclosure with compliant card interfaces, plug-n-play at the card level.

A card-level standard makes updating the existing 4 MCU modman simpler, and opens the option to host more than one modem card.

Awaiting a proposal.

8) number of RF carriers and symbol rates

Design issue relates to interconnectivity – how much bandwidth or data rate does the IF interconnect have to manage.

Basis assumption is one modulator and one demodulator.
Second demodulator may be embedded to support handoff – acquiring the incoming beam carrier.

Third demodulator may be embedded to support multicast.

Each demodulator is running off of some amount of bandwidth.

Assume one or more receive carriers that can be stacked, but only one tx carrier. (note, talk to Satixfy).

9) Daisy Chain wiring between multiple modems

- IF tx and rx (coax, fiber, IQ)
  - change IF from OAE to MM to go to AMU
  - Add IF coax wiring from AMU to MM
  - Daisy chain power loss – passive split.
  - The AMU interrupts the IF interface so that the modem/manager receives it as if the AMU were not there – need to consider power levels, what else?
  - We should consider how to account for fiber optic in general – does this give us more freedom, or do we want to make it work on coax “transparently”?
- Reference frequency
- Power control (AC/DC)
  - Add DC power wiring from MM to AMU
- Data in/out (GbE)
  - Add Eth wiring from MM to AMU
  - Propose using 1000BT qty 8 reserved to AIS and change reserved quad to AIS
- Tx Mute
- Shared Inputs/Outputs

<u>Connector (contacts)</u>

- (2) Power
- (4) Ethernet (signal)
- (4) Ethernet (management, A791-AMIP)

- (?) Ref. Frequency
- (4) Discretes (keyline, mute, pilot mute, power mute)
- (2) ARINC 429 airplane position attitude heading
- Digital I/Q OUT
- Digital I/Q IN

Support for two effective apertures simultaneously (dual beam).

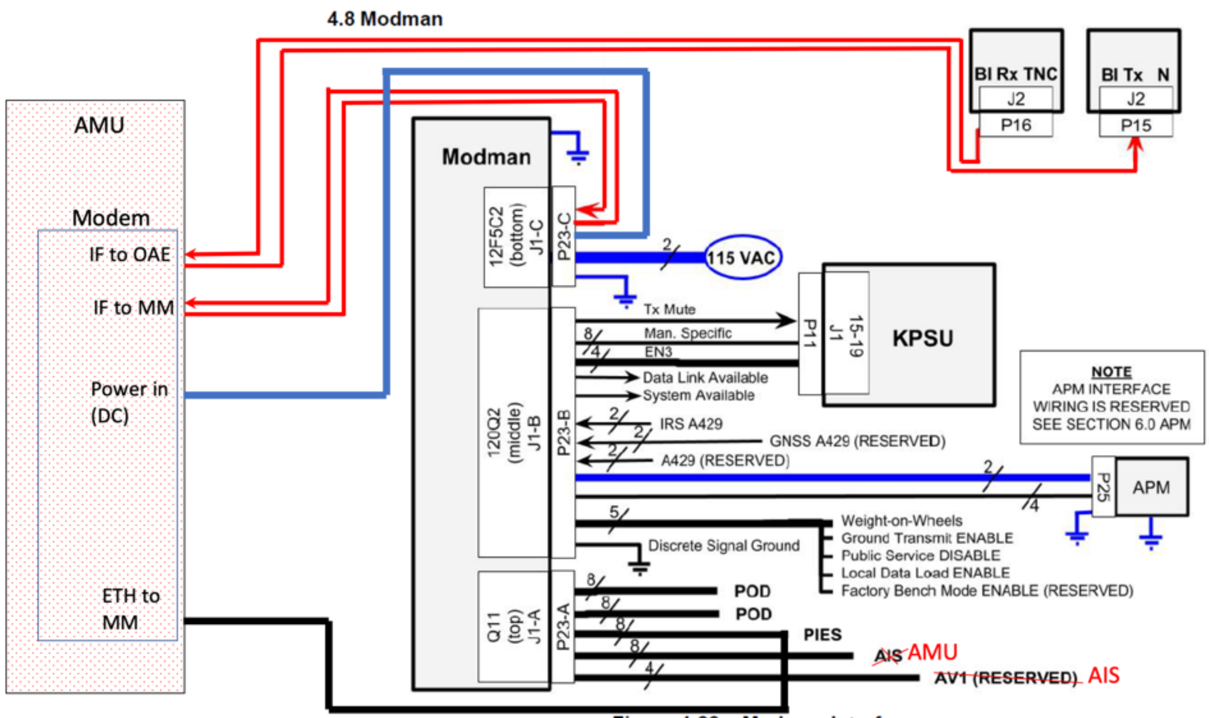
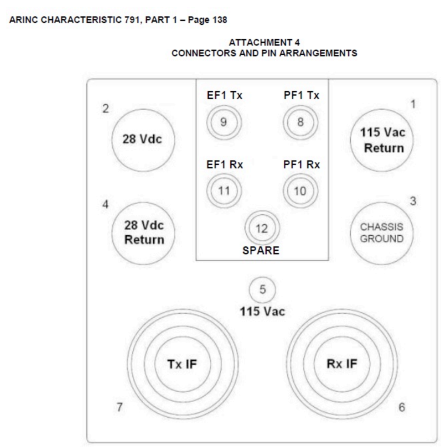


Figure 4-22 – Modman Interfaces



10) I/Q data rates

The advent of new solid-state antenna designs has further stimulated some division in the modem functionalities to allow for close-coupling a base-band modem within the antenna, rather than a remote antenna that communicates over an IF (L band) interface. It is conceivable that the management functions could be separated from the modulation and steering.

Alternatively, a high-performance fiber optic or copper link could be used to facilitate a digital connection between Modman and OAE.

Comtech to review the table carrier bandwidth to data rate

Digital I/Q Data Rate to support various signal bandwidths

	2.35	4	2
BW Mhz	Sampling Msps	Bits Mbps	signals Gbps
10	24	94	0.2
50	118	470	0.9
100	235	940	1.9
150	353	1410	2.8
200	470	1880	3.8
250	588	2350	4.7
300	705	2820	5.6
350	823	3290	6.6
400	940	3760	7.5
450	1058	4230	8.5
500	1175	4700	9.4
550	1293	5170	10.3
600	1410	5640	11.3

11) 12) time/freq reference

Selection, range, A791-AMIP negotiation, insertion loss

12) 13) multi beam operation

Extended IF bandwidth

13) 14) RF Tx power control

Discrete Power Control may be required when moving from an IF (P1dB) analog interface using linear power control (1 dB on IF is equal to 1 dB on RF).

The interface to communicate power level adjustments may be distributed between the manager function and the federated modem.

14) 15) AMIP-A791 revisions

To be assessed.

15) 16) A791P2 MIB, SNMP revisions

To be assessed.

16) 17) Processing power or other SDR specifications

Service providers prefer to retain confidential waveforms as a point of discriminating performance.

The means to program the conversion modcod from digital signal to RF signal may not rely entirely on open standards.

One method applies a catalog of pre-programmed modcods to select from (e.g. DVB-S2X).

Another method programs the modcods themselves, thus preserving the design aspects under a semi-open standard or programmability and performance.

Processing power (GPU), analog filter/bandwidth, what other performance parameters must be specified?

Performance aspects must include purity and accuracy of output signal based on purity of reference frequency input.

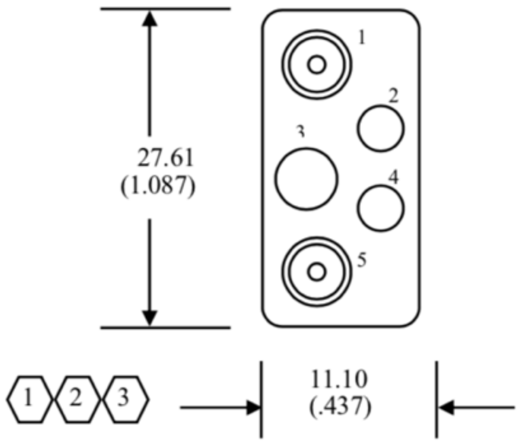
Simply speaking, the modcods operate at higher and higher symbol rates.

The performance is a way to measure the symbol rate available for an arbitrary modcod and the sensitivity to other factors such as reference frequency. (phase noise).

Viasat modem on a chip - 100s of Msps capable…

Performance standard – Open-standard waveforms are not adequate

17) Size 1 Connector Inserts



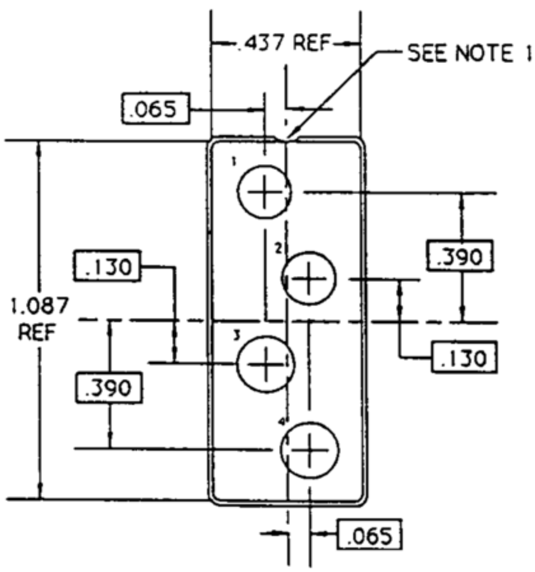
Applicability

Shell Size: 1
Insert: Lower

Contact Configuration

Type: Size 5 Coax
Quantity: 2
Type: Size 16 Signal
Quantity: 2
Type: Size 12 Signal
Quantity: 1
Type: Signal
Number: 100
Spacing: 0.100 in. centers

Figure 11-2 – Arrangement 03, Shell Size 1

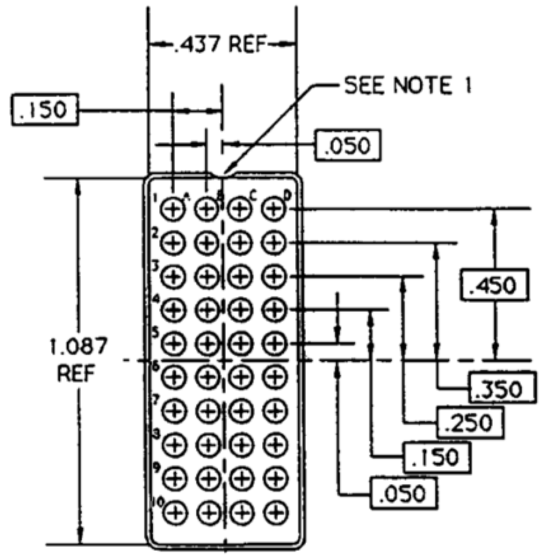


Receptacle Front Engaging Face

Contact Style	Quantity
#12 Power	4

Note: Alignment groove is on top of Insert for Receptacle Shell and Bottom of Insert for Plug Shell.

Figure 19-49.13 – Contact Arrangement 21, Size 12 Power Shell Size 1 Connector

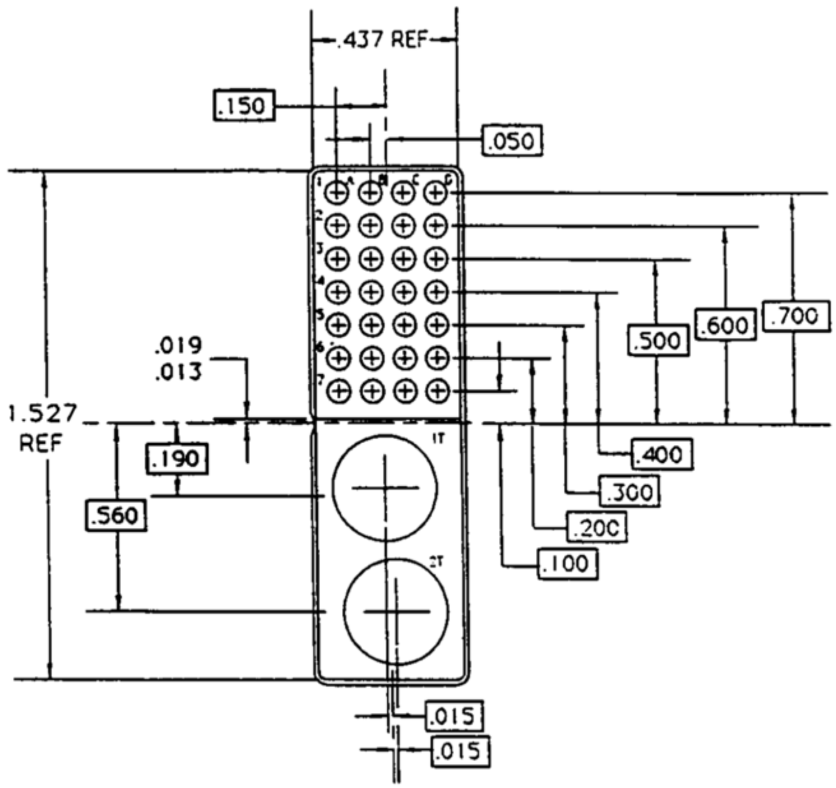


Receptacle Front Engaging Face

Contact Style	Quantity
#22 Signal	40

Note: Alignment groove is on Top of Insert for Receptacle Shell and Bottom of Insert for Plug Shell.

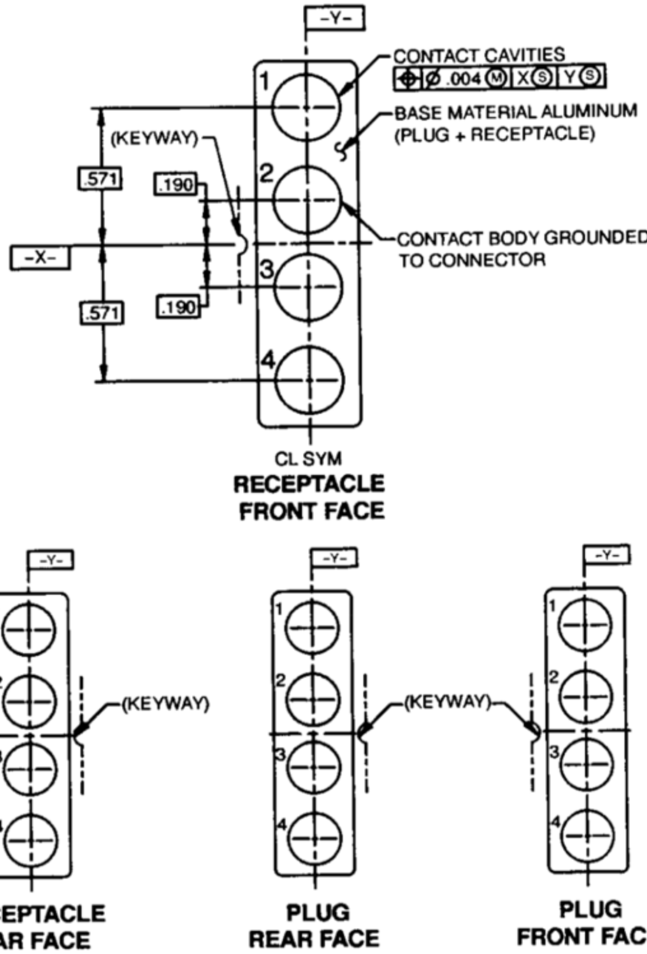
Figure 19-49.11 – Contact Arrangement 19, Size 22 Signal Shell Size 1 Connector



Receptacle Front Engaging Face

Contact Style	Quantity
#22 Signal	28
#8 Concentric	2
Twinax	
or	
Coaxial	

Note: Concentric Twinax/Coax Contacts shall be Grounded to Connector Plug and Receptacle Shell.



RECEPTACLE

NUMBER OF CONTACTS	CONTACT SIZE	INSERT CAVITY LOCATION
4 (PLUG)	5 (COAX)	1 THRU 4

Drawing/Notes updated by Supplement 11.

Figure 19-52.6 – Contact Arrangement 27, Size 5 Coaxial 1, Shell Size 1 Connectors

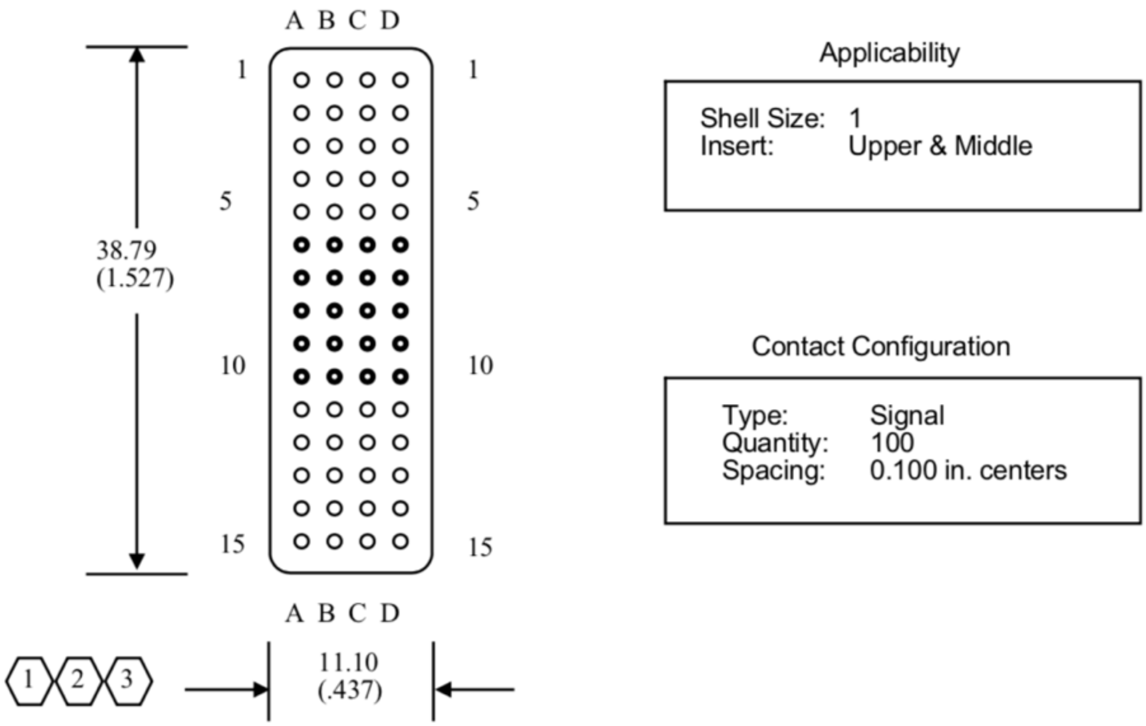


Figure 11-1 - Arrangement 01, Shell Size 1