AirBorn

a molex company

FOCUS®

Active Optical Connectors & Cables

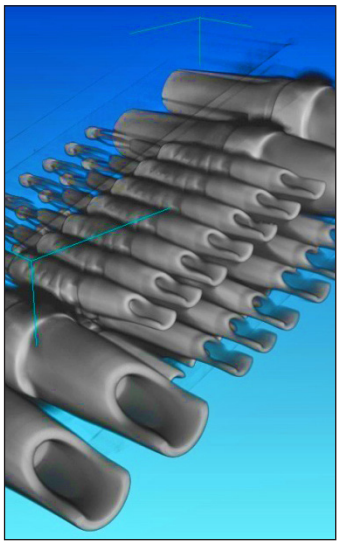
Complete Electronic Solutions

AirBorn is an employee owned company whose core business is engineering & manufacturing specialized connectors & electronic components for OEMs worldwide. We serve customers across many industries including: Commercial Air, Industrial, Medical, Military/Defense, & Space Exploration.

Companies today are looking for more than a supplier, they're looking for a strategic partner to collaborate & grow with. AirBorn products are trusted to perform in extreme conditions, where mission-critical reliability is vital to success. Customers trust AirBorn products, and have for over 60 years.

AirBorn Engineering = Problem Solved®

AirBorn's engineering group specializes in new product design and development for OEMs across the globe. Our team of 50+ degreed engineers are the most innovative and committed to solving our customer's challenges, but that's only the beginning of where we can help! Leverage our design and manufacturing expertise throughout the entire product development process. From conceptual design, prototyping, pilot-runs through to mass production, our teams work efficiently to cut down your program's time to market.

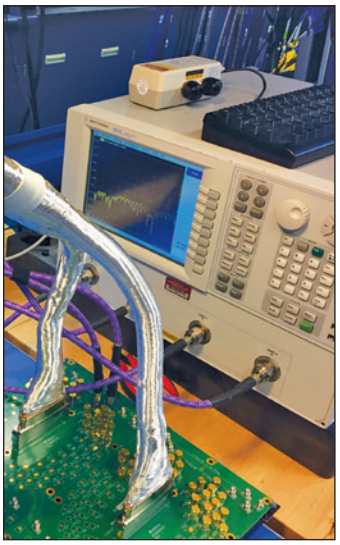


Solution Engineering

AirBorn has a dedicated team of experienced and degreed solution engineers on staff to help solve your most pressing electronic challenges.

Cable vs. Flex Assemblies

We manufacture cable and flex assemblies and can provide an impartial recommendation of which solution is best for your distinct application.



Signal Integrity Expertise

Whether a new design retrofit, or a field issue, let us help you design an end-to-end interconnect solution to support your high-speed signal integrity design.

Lab & Test Services

We'll test against the highest standards imaginable to ensure your products stand up to the rigors of space, military, commercial air, and industrial applications.

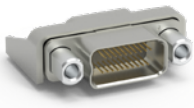
3500 AirBorn Circle — Georgetown, TX 78626 • p. 512.863.5585 • airborn.com

Connectors

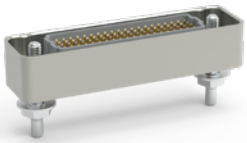
Micro D
M Series

High-Speed Micro D
microSI

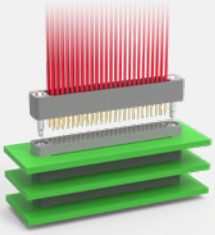
Nano D
N Series



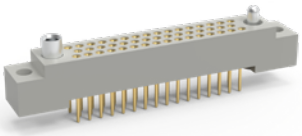
High-Speed Modular
SInergy



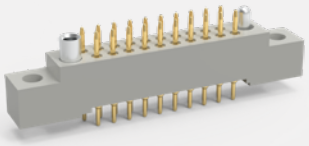
Rectangular 25Gbps
verSI



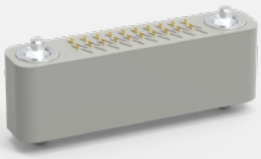
Stackable
RC Series



Rectangular
R Series



Rectangular
W Series



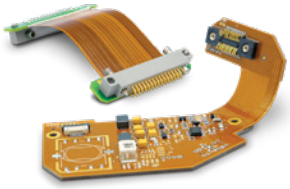
Z Axis Interposer
Z Series

Circular
Series 360

Strip Connector
AirStrip

Macro D
RocKet

Assemblies



Flexible Circuit Assemblies

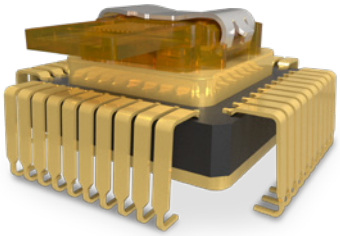
Cable Assemblies

FUZE Assemblies

Active Optical Assemblies

Embedded Systems

Rugged Power Systems



Photonics/Optoelectronics

AirBorn In Action

Voyager Program

AirBorn Solutions Are "In-Action" Inside Many Important & Famous Applications

AirBorn Inc. was founded in 1958 to manufacture electronic connectors for aviation applications — a name that reflects our heritage. By 1960, our 12 employees had engaged with customers such as Motorola Inc., Texas Instruments (now Raytheon), Lockheed Aircraft, Boeing, and Burroughs. Since our founding, we have participated in many significant projects in human history. The Voyager I and II program, launched in 1977 and still traversing interstellar space today, exemplifies how customers view AirBorn parts: rugged, reliable, and long-lasting.

We're proud to contribute to the expansive defense and security efforts of America and its allies. Our components have been integrated into a wide range of advanced aviation, ground, and naval systems, as well as key elements in cutting-edge missile programs. We excel at delivering exceptional quality for mission-critical applications.

Although aerospace, defense, and space applications are our specialties, we do not stop there. AirBorn parts are integral components of commercial aircraft, MRI machines, defibrillators, and pain management systems. From the depths of the sea to the far reaches of space, our connectors are engineered to overcome any challenge.

Mars Rovers

Commercial Airliners

Military Communications & Rifle Scopes

Pain Management Systems

Space Shuttle Program

FOCuS® Active Optical Cables

Overview

Revolutionary Data Communications

The FOCuS Active Optical Cable product line is designed to meet the requirements for high-speed/signal integrity applications while delivering the quality and reliability customers have come to expect from AirBorn.

FOCuS affords design flexibility by offering vertical board-mount, right angle board-mount, AOC cable I/O, and Copper Cable I/O. The copper and AOC cables have the exact same pin-out to offer the flexibility of using either a copper cable for shorter lengths and easily changed to an Active Optic cable as needed.

Key Features & Benefits:

- Patented design
- Distances capable to 100 meters
- Data rates of 12.5 Gbps/channel
- 4 Channels
- Rugged, light-weight, and low-profile cable
- EMI immune
- No fiber cleaning concerns
- Fast installation: mate & go
- No transceiver needed
- Evaluation kit available (see page 47)

Q: What Applications Are AOCs Best Suited For?

A: Any Application Requiring One Of These:

High Speed
Supports speeds up to 12.5Gbps per channel.

Hassle-Free Fiber
Installed the same way as a copper cable.

Longer Distances
Delivers reliable high speeds up to 100m.

Sealed & Protected Optical Path
AOCs eliminate the number one cause of link failure – FOD (dirt on optics).

Weight Savings
Significant weight savings over copper cables.

Easier Maintenance Than Fiber
Factory terminated reduces potential for fiber contamination.

Reduced Space
Much smaller cable bundles and no need for transceiver on PCB.

Multiple Environments
Radiation-hardened space-rated as well as ruggedized option.

Improved EMI Protection
Fiber cable and shell design are critical for EMI reduction.

Design Flexibility
Using the common FOCuS pinout, copper and fiber are interchangeable.

The Time Is NOW: Active Optical Connectors & Assemblies

We engineered these fiber cable assemblies with Space, Military, Industrial, and Commercial Aviation applications in mind — but their practical uses extend into many industries. When you need dependability as well as performance, AirBorn's FOCuS AOCs are the answer for your toughest applications.

Critical to Success
Applications

Ingenuity, Toughness, & Quality: Keys To Surviving Harsh Environments

Our FOCuS® active optical cable technology now embodies a fully-qualified, Space-Rated Active Optical Cable (SAOC®) and a Rugged Active Optical Cable (RAOC®). Built on our proven high-speed verSI connector platform, both versions exemplify all the benefits of fiber with the ease & reliability of copper. FOCuS® AOCs operate 4 channels at 12.5 Gbps per channel (50 Gbps aggregate).

The SAOC® utilizes radiation-hardened and non-outgassing components throughout the assembly to assure complete reliability. Optimizing size and weight factors in the design, we made certain the SAOC® is ideal for spaceflight and the extreme conditions that come to bear during a launch.

Features such as multiple points-of-contact, optimal material tensile strength, and metal backshells ensure that RAOC® is completely reliability when the ride is roughest, in industrial and mil/aero applications.

Applications

- Satellite Systems
- Launch Vehicles
- Missile Systems
- High-Speed Rail
- Commercial Aircraft
- Avionics
- Helicopters
- Submarines

FOCuS AOCs Are Designed Into:

Avionics

Helicopters

Satellites

And More...

Missiles

Launch Vehicles

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AV4M2 — Active Optical Cable Assembly

AirBorn's FOCuS Active Optical Cable is a 4 channel, 12.5 Gbps offering, available in both space-rated and rugged models. AV4M2 cables mate to the VTF and VTRAF board-mount connectors and VPD panel-mount cables.

Sample Part Number Format: AV4M2-RN2-010-LS00-000

AV	4	M	2	-		N		-		-			-	

Series
AV – AOC verSI Cable Assembly

Lanes
4 – 4 Bi-Directional Optical Links

Gender
M – Plug

Shell Material
2 – Nickel Plated Aluminum

Application
S – Space
R – Rugged

Optical Package
N – Non-Hermetic

Fiber Type
1 – Radiation Hardened, 50/125 OM3 Multimode Fiber
2 – Non-Radiation Hardened, 50/125 OM3 Multimode Fiber

Fiber Length
005 – 16.40 Feet (5 Meters)
010 – 32.81 Feet (10 Meters)
020 – 65.62 Feet (20 Meters)
030 – 98.43 Feet (30 Meters)

Hardware
JS – Jacking Screw
LS – Locking Screw

Keying Polarization*
00 – Option 'A' - Standard
01 – Option 'B'
02 – Option 'C'
03 – Option 'D'
04 – Option 'E'
05 – Option 'F'
06 – Option 'G'
07 – Option 'H'
*See pages 36-43 for keying details and dimensions

Testing Code
See page 32-33 for testing code matrix.
100
200
201
300
400
401
500
600
601

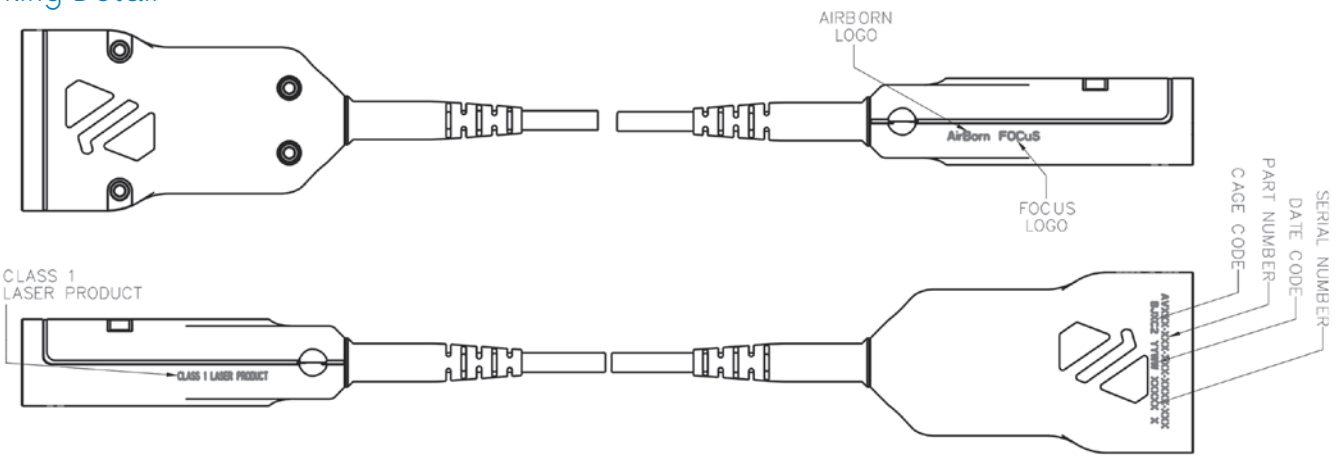
Notes:

- Mates with connector series: VTF, VTRAF, & VPD.
- Packaging: Cable to be packaged with dust cover installed (not shown). Cable supplied fully assembled in ESD safe box.
- AirBorn requires a non-disclosure agreement before purchasing of the Active Optic Cables.

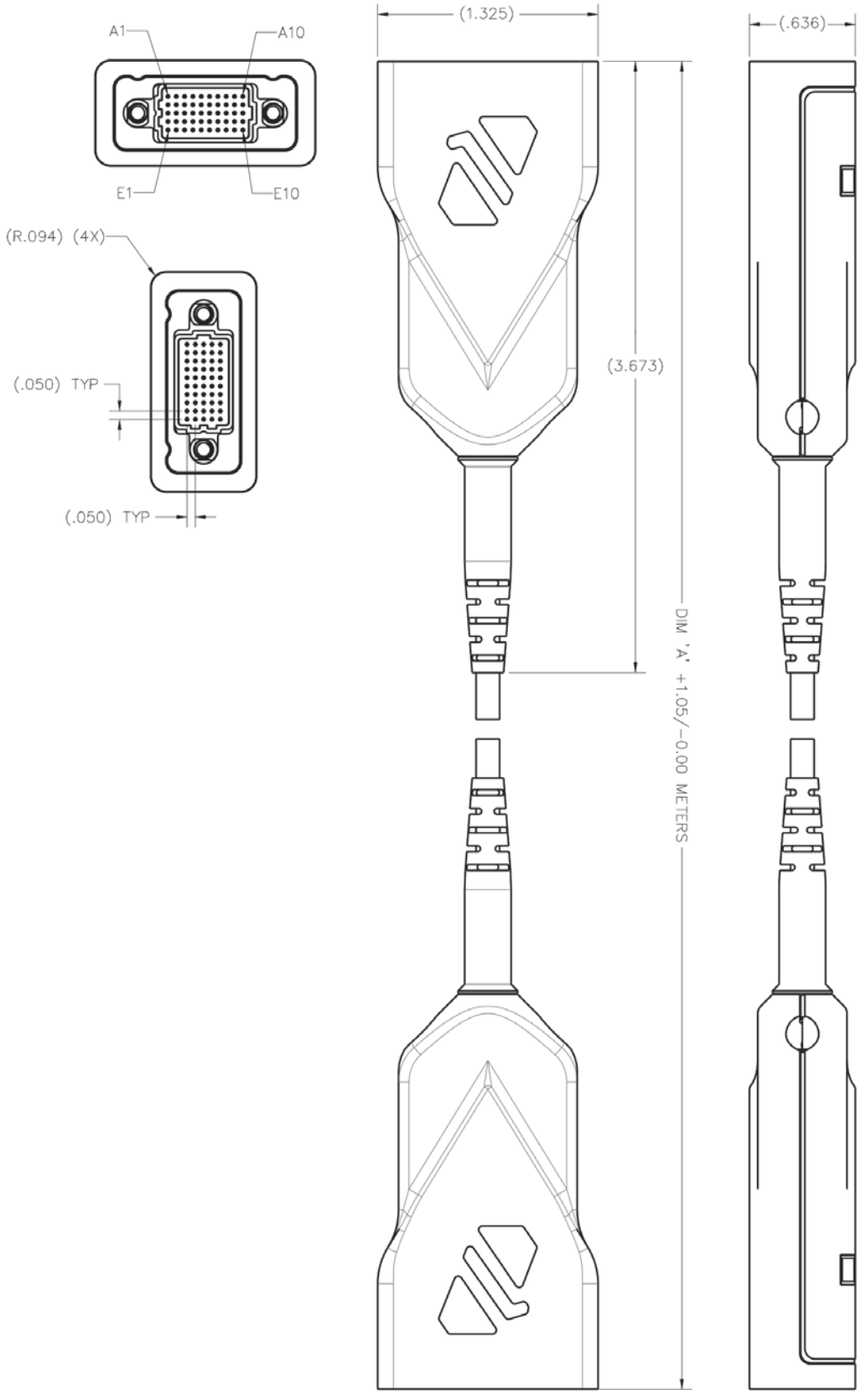
Please consult airborn.com to configure your part number and for the latest revision controlled drawing and technical data.

Class I laser product that complies with FDA performance standards for laser products except for conformance with IEC 60825-1 Ed. 3, as described in Laser Notice No. 56, dated May 8, 2019.

Marking Detail



Dimensions



Please consult the AirBorn website for the latest revision of this document prior to beginning any design work.

Class I laser product that complies with FDA performance standards for laser products except for conformance with IEC 60825-1 Ed. 3, as described in Laser Notice No. 56, dated May 8, 2019.

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VTF — Vertical Board-Mount Connector

VTF models are thermal interface connectors designed to mate with AV4M2 active optical cables and CV4M2 copper cables. VTF connectors are offered with multiple termination options including press-fit, paste-in-hole, and plated-thru-hole. EMI gaskets are standard with this model connector.

Sample Part Number Format: VTF-05-10-50-00-00-N

VTF	–	05	–	10	–	50	–	☐☐	–	☐☐	–	☐

Series
VTF – Vertical Thermal Female

Rows
05 – 5 Rows

Columns
10 – 10 Columns

Contact Plating
50 – 50µIN Au

Termination
00 – Press-Fit
01 – Paste-In-Hole (PIH)
02 – Plated-Thru-Hole (PTH) .078" Length
03 – PTH .109" Length
04 – PTH .140" Length
05 – PTH .156" Length
06 – PTH .172" Length

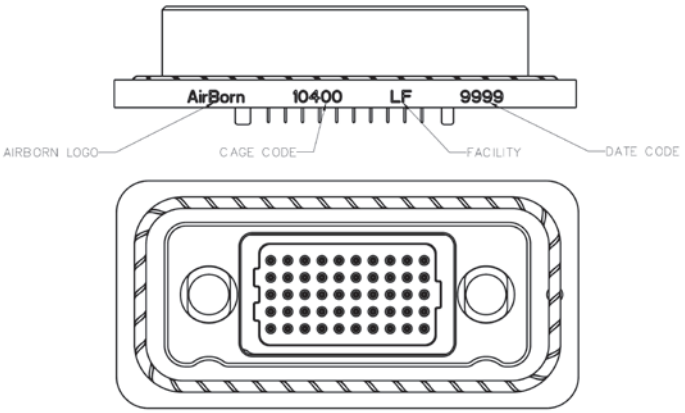
Keying Polarization*
00 – Option 'A' - Standard
01 – Option 'B'
02 – Option 'C'
03 – Option 'D'
04 – Option 'E'
05 – Option 'F'
06 – Option 'G'
07 – Option 'H'
*See pages 36-43 for keying details and dimensions

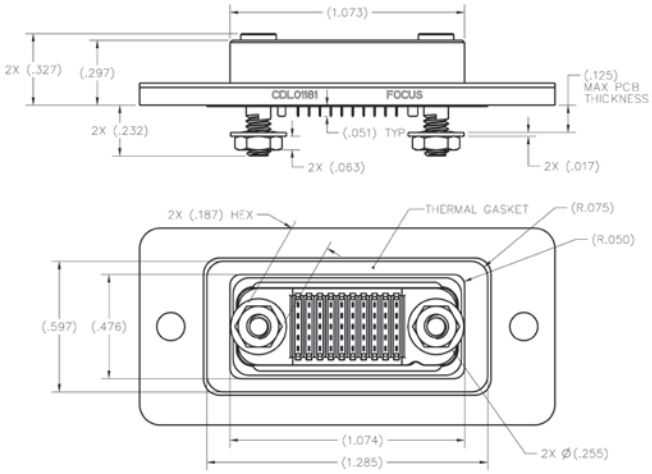
Hardware Options
N – Fixed Jacknut (.125" Max. Board Thickness)
N1 – Fixed Jacknut (.250" Max. Board Thickness)
NE – Fixed Jackset With Panel Mount

Notes:
- Mates with AV4MX & CV4MX cables
- Packaging: parts supplied in thermoformed trays, hardware supplied uninstalled
- See AirBorn spec ESL5001 for additional application information

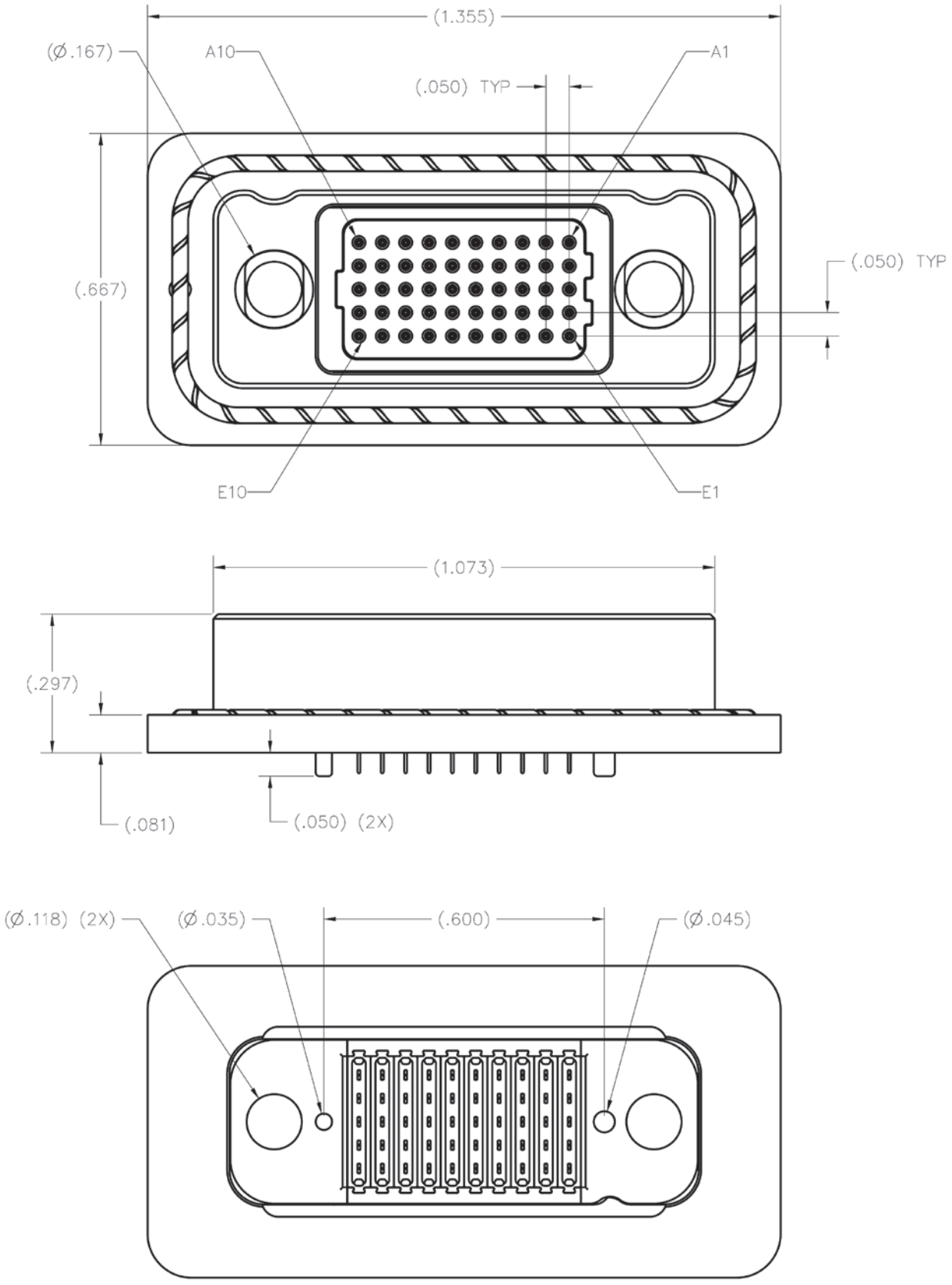
NOTE: Please consult airborn.com to configure your part number and for the latest revision controlled drawing and technical data.

Marking Detail





Dimensions



Please consult the AirBorn website for the latest revision of this document prior to beginning any design work.

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VTRAF — Right-Angle, Board-Mount Connector

VTRAF models are thermal interface connectors designed to mate with AV4M2 active optic cables and CV4M2 copper cables. VTRAF connectors are offered with multiple termination options including press-fit, paste-in-hole and plated-thru-hole options. EMI gaskets are standard with this model connector.

Sample Part Number Format: VTRAF-05-10-50-00-0-N

VTRAF – 05 – 10 – 50 – ☐ – ☐ – ☐

Series
VTRAF – Vertical Thermal Right-Angle Female

Rows
05 – 5 Rows

Columns
10 – 10 Columns

Contact Plating
50 – 50µIN Au

Termination
00 – Press-Fit
01 – Paste-In-Hole (PIH)
02 – Plated-Thru-Hole (PTH) .078" Length
03 – PTH .109" Length
04 – PTH .140" Length
05 – PTH .156" Length
06 – PTH .172" Length

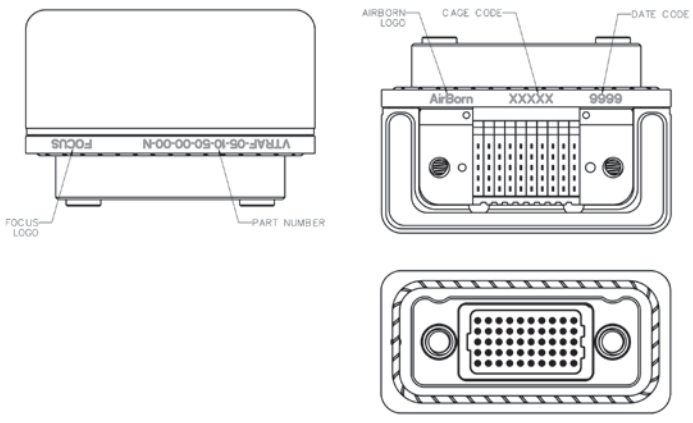
Keying Polarization*
00 – Option 'A' - Standard
01 – Option 'B'
02 – Option 'C'
03 – Option 'D'
04 – Option 'E'
05 – Option 'F'
06 – Option 'G'
07 – Option 'H'
*See pages 36-43 for keying details and dimensions

Hardware Options
N – Fixed Jacknut
NE – Fixed Jacknut With Panel Mount

Notes:
- Mates with cable series: AV4MX-XXX-XXX-XXXX-XXX & CV4MX-XXX-XXXX-X
- Packaging: parts supplied in thermoformed trays, hardware supplied uninstalled
- See AirBorn spec ESL5001 for additional application information

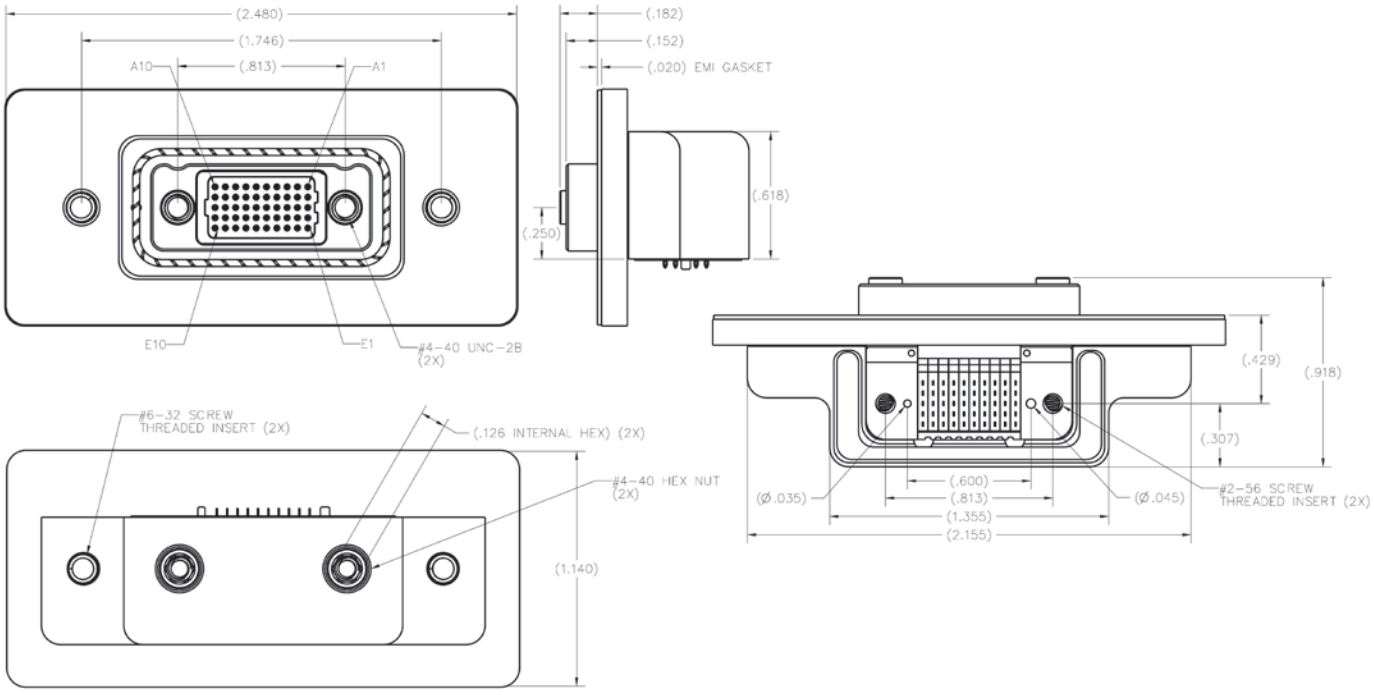
NOTE: Please consult airborn.com to configure your part number and for the latest revision controlled drawing and technical data.

Marking Detail

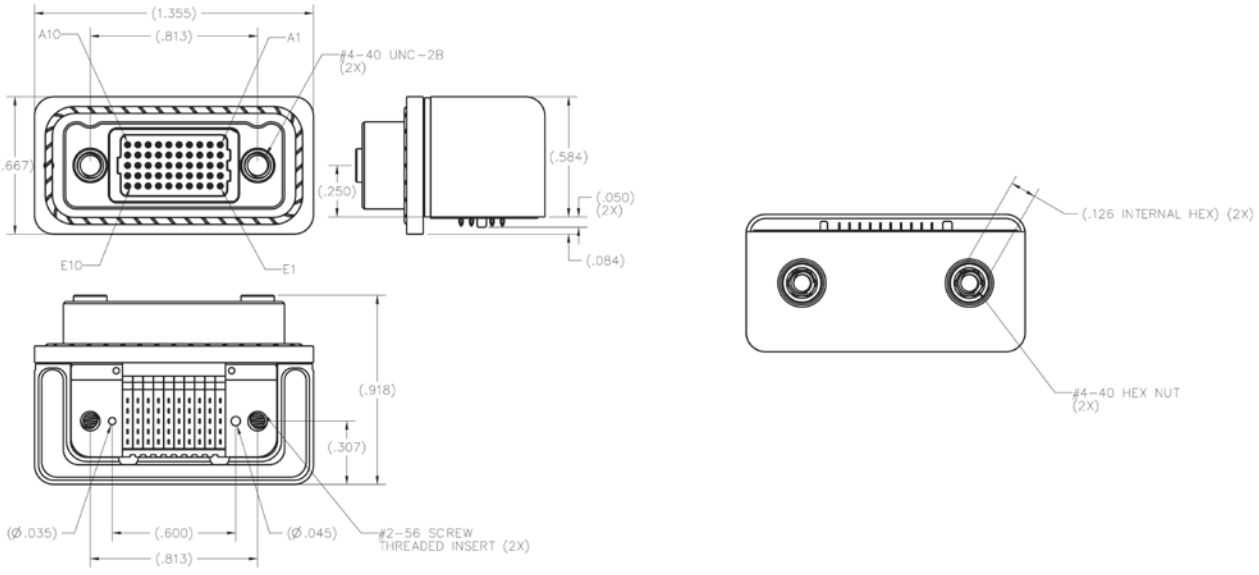


Dimensions

Panel Mount Option



Board Mount Option



Please consult the AirBorn website for the latest revision of this document prior to beginning any design work.

CV4M2 — Copper Cable Assembly

AirBorn's CV4M2 is a 4 channel, 12.5 Gbps copper verSI cable assembly. CV4M2 cables mate with VTF and VTRAF board-mount connects and VPD panel-mount cables.

Sample Part Number Format: CV4M2-040-JS00-1

CV	4	M	2	–	□□	–	□□	□□	–	□

Series
CV – Copper verSI Cable Assembly

Lanes
4 – 4 Bi-Directional Links

Gender
M – Plug

Shell Material
2 – Nickel Plated Aluminum

Length (Dim A)
030 – .98 Feet (0.30 Meters)
040 – 1.31 Feet (0.40 Meters)
050 – 1.64 Feet (0.50 Meters)
060 – 1.96 Feet (0.60 Meters)
070 – 2.29 Feet (0.70 Meters)
080 – 2.62 Feet (0.80 Meters)
090 – 2.95 Feet (0.90 Meters)
100 – 3.28 Feet (1.00 Meters)

Hardware
JS – Jacking Screw
LS – Locking Screw

Keying Polarization*
00 – Option 'A' - Standard
01 – Option 'B'
02 – Option 'C'
03 – Option 'D'
04 – Option 'E'
05 – Option 'F'
06 – Option 'G'
07 – Option 'H'
*See pages 36-43 for keying details and dimensions

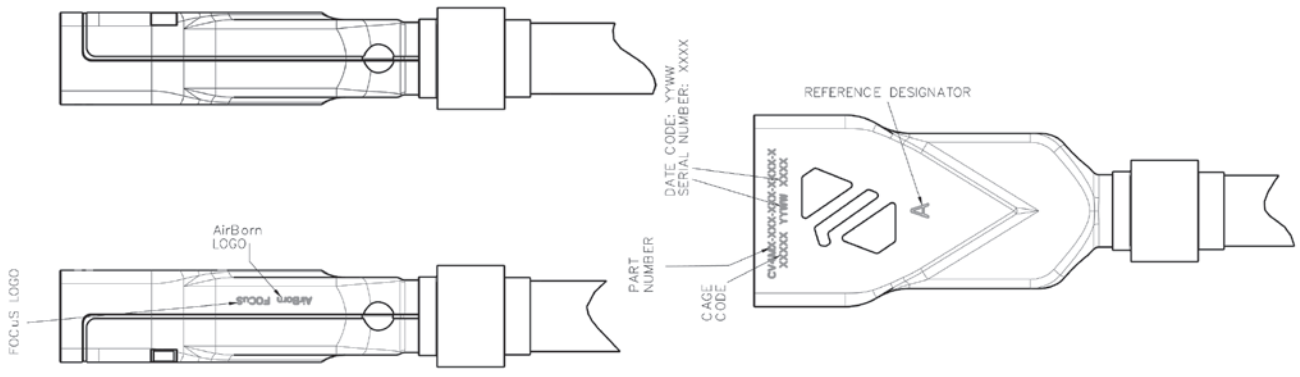
Braiding
1 – No Braid
2 – Metal Braid
3 – Halar Braid
4 – Halar Over Metal Braid

Notes:

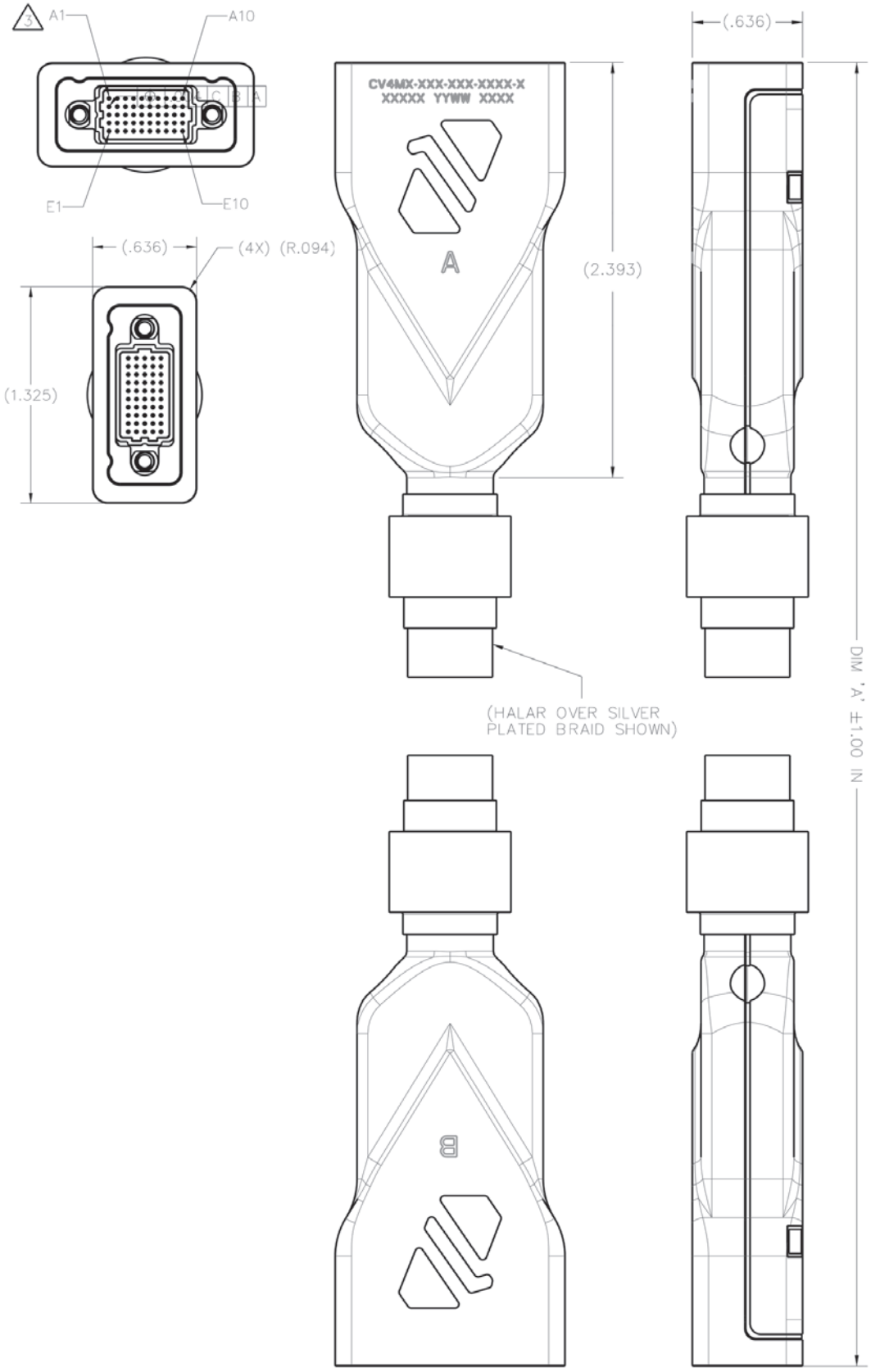
- Cable mates with connector series: VTF, VTRAF, & VPD.
- Packaging: Cable to be packaged with dust cover installed (not shown). Cable supplied fully assembled in ESD safe box.
- Cable ends A & B have identical pin outs and pin assignments.

NOTE: Please consult airborn.com to configure your part number and for the latest revision controlled drawing and technical data.

Marking Detail



Dimensions



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VPD — I/O Copper Cable

VPD models are single-ended, thermal interface, panel-mounted cables designed to mate with AV4M2 active optical cables and CV4M2 copper cables. Dust covers come standard with this model cable.

Sample Part Number Format: VPD-05-10-03N-000-00-1-030

VPD	–	05	–	10	–	03N	–	000	–		–		–	

Series
VPD – Vertical Panel-Mount Female

Rows
05 – 5 Rows

Columns
10 – 10 Columns

Connector 1: verSI Panel Mount
03N – Female With Threaded Jacknut #4-40

Connector 2
000 – Flying Leads

Keying Polarization*
00 – Option 'A' - Standard
01 – Option 'B'
02 – Option 'C'
03 – Option 'D'
04 – Option 'E'
05 – Option 'F'
06 – Option 'G'
07 – Option 'H'
*See pages 36-43 for keying details and dimensions

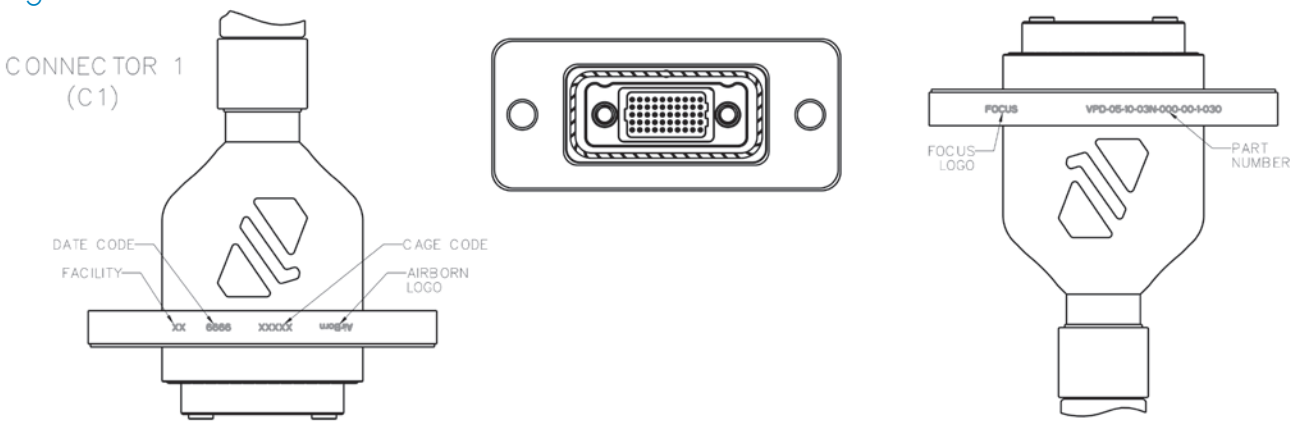
Braiding
1 – No Braid
2 – Braid

Length
030 – .98 Feet (0.30 Meters)
040 – 1.31 Feet (0.40 Meters)
050 – 1.64 Feet (0.50 Meters)
060 – 1.96 Feet (0.60 Meters)
070 – 2.29 Feet (0.70 Meters)
080 – 2.62 Feet (0.80 Meters)
090 – 2.95 Feet (0.90 Meters)
100 – 3.28 Feet (1.00 Meters)

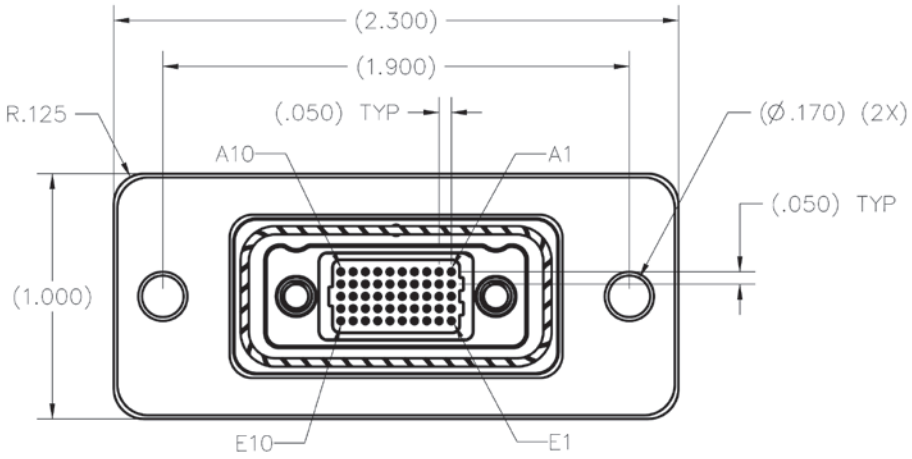
Notes:
- Mates with AV4MX & CV4MX cables
- Packaging: cable to be packaged with dust covered installed (not shown) and in ESD safe packaging

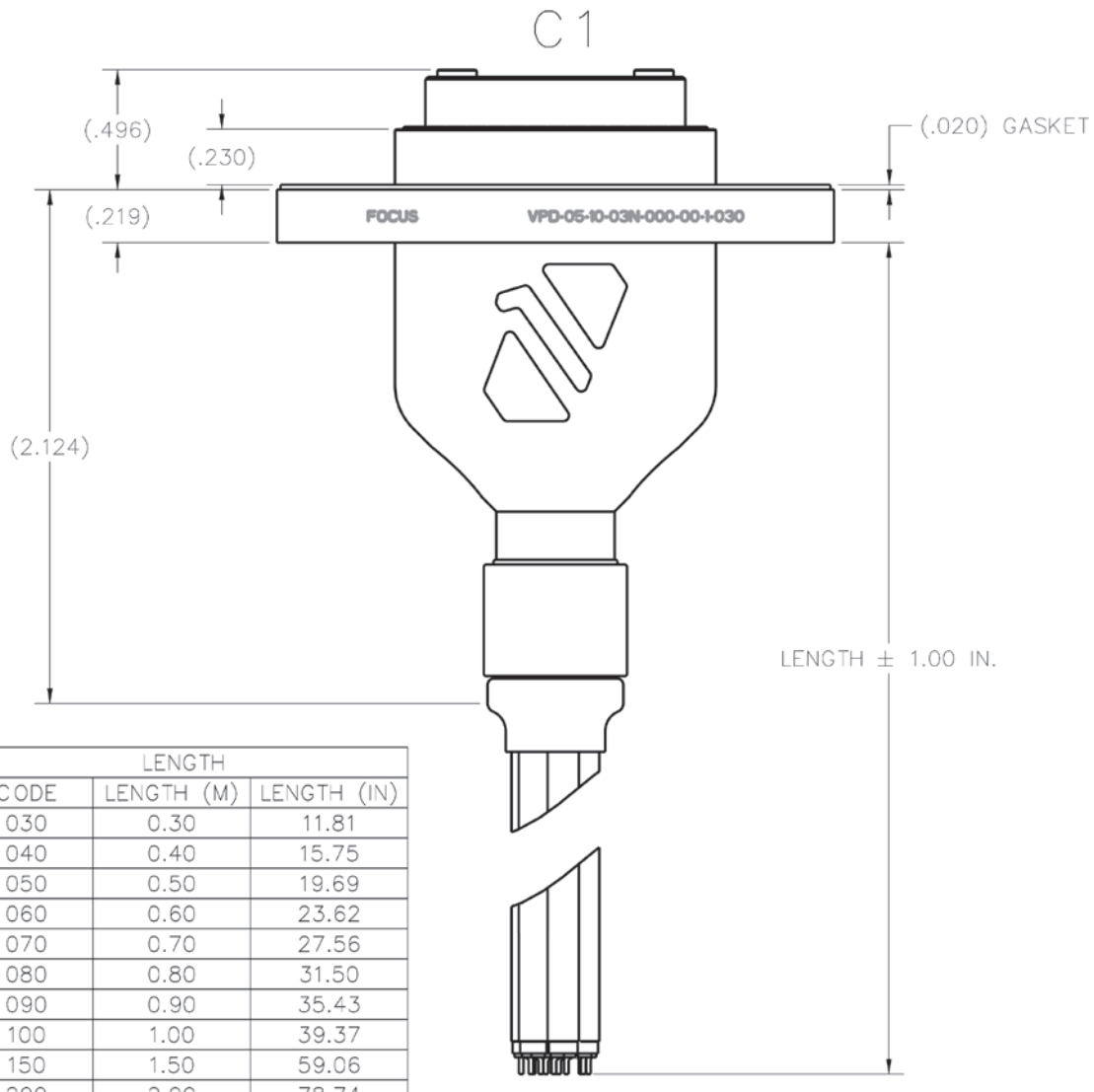
NOTE: Please consult airborn.com to configure your part number and for the latest revision controlled drawing and technical data.

Marking Detail



Dimensions





LENGTH		
CODE	LENGTH (M)	LENGTH (IN)
030	0.30	11.81
040	0.40	15.75
050	0.50	19.69
060	0.60	23.62
070	0.70	27.56
080	0.80	31.50
090	0.90	35.43
100	1.00	39.37
150	1.50	59.06
200	2.00	78.74
300	3.00	118.11

Please consult the AirBorn website for the latest revision of this document prior to beginning any design work.

Materials & Finishes

Pin Contacts (Male)	Material	BeCu per ASTM B194
	Finish	50µ IN min localized Au per ASTM B 488 Type 11, code C over SOµIN min Ni per ASTM B689 Type I
Molded Insulator	Material	Glass-filled liquid crystal polymer (LCP) per ASTM D5138
Shell	Material	Aluminum alloy 6061-T6 per SAE AMS-4027 or 6061-T6511 per SAE AMS-QQ-A-200/8
	Finish	500µ IN min electroless Ni per SAE AMS-2404, class 3
Hardware	Material	Stainless steel per ASTM A484/A484M, ASTM A582/A582M, or ASTM A320
	Finish	Passivate per SAE AMS-2700

Cable Performance

Parameter	Symbol	Unit	Min	Typical	Max
Storage Temperature Range	Ts	C	-55		125
Case Operating Temp. Range	Ta	C	-30		90
Operating Relative Humidity (Non-Condensing)		%	0		95
Pressurization		torr	10^{-9}		775
TID Radiation Hardening		krad		30 krad	
SEE MeVcm2/mg				>40	
Fiber Tension		N			30
Fiber Bend Radius		in	2.5		
Operating Voltage		Vdd	3.15	3.3	3.45
Data Rate Per Channel		Gbps	1.25		12.5
Power Consumption (Per End)		W		0.850	1.2
Bit Error Rate		BER			10^{-12}
Return Loss		dB		-8	
Rx Differential Output Voltage		mVp-p	250		780
Outgassing	Max TML of 1% and max CVCM of .1% per MIL-DTL-83513				

Please consult the AirBorn website for the latest revision of this document prior to beginning any design work.

Materials & Finishes

Socket Contacts	Material	BeCu per ASTM B194
	Finish Socket End	50µin min localized Au per ASTM B488 Type II, code C, over 50µin min Ni per ASTM B689 Type I
	Finish Termination End	PIH & PTH: 10µin min localized Au flash per ASTM B488 Type i, code A or C over 50µin min ni per ASTM B689 Type I Press-fit: 50µin min localized Au per ASTM B488 Type II, code C over 50µin min Ni per ASTM B689 Type I
Molded Insulators	Material	Glass-filled liquid crystal polymer (LCP) per ASTM D5138
Shell	Material	Aluminum alloy 6061-T6 per SAE AMS-4027 or 6051-t6511 Per SAE AMS-QQ-A-200/8
	Finish	500µin min electroless Ni per SAE AMS-2404, class 3
Embedment	Material	Frey Eng. Co. Insulating compound CF3003-80 or equivalent
Hardware	Material	Stainless steel per ASTM A484/A484m, ASTM A582/A582m, or ASTM A320
	Finish	Passivated per SAE AMS-2700
Washers	Material	Stainless steel per SAE NASM35333 (ASTM A240)
	Finish	Passivate per NASM35333 (SAE AMS-2700)
EMI Spira Gasket	Material	Beryllium copper
	Finish	Electroplated, 90% tin, 10% lead per AMS-P-81728

Performance

Contact Rating 2	2 Amperes Max, see AirBorn PTB66 for more info
Operating Temperature	-55°C TO 125°C, see AirBorn PTB66 for more info
Contact Engagement Force	6.0oz max*
Contact Separation Force	0.5oz min*
Connector Mating Force	10oz X (# of contacts) max tested per MIL-DTL-83513
Connector Unmating Force	10oz X (# of contacts) max tested per MIL-DTL-83513
Dwv (Sea Level)	600V, RMS, 60Hz, see AirBorn PTB61 for more info
Recommended Max Operating Voltage	200V, RMS, 60Hz, see AirBorn PTB61 for more info
Insulation Resistance	5,000 MEGAOHMS minimum @ 500 VDC, tested per MIL-DTL-83513
Durability	2,500 connector mating cycles, exceeds MIL-DTL-83513
Sinusoidal Vibration	20g, tested per MIL-DTL-83513
Shock	50g, tested per MIL-DTL-83513
Outgassing	Max TML of 1% and max CVCM of .1% per MIL-DTL-83513

*Max pin size used for contact engagement force and min pin size used for contact separation force.

Please consult the AirBorn website for the latest revision of this document prior to beginning any design work.

Materials & Finishes

Socket Contacts	Material	BeCu per ASTM B194
	Finish Socket End	50µin min localized Au per ASTM B488 type II, code C, over 50µin min Ni per ASTM B689 Type I
	Finish Termination End	PIH & PTH: 10µin min localized Au flash per ASTM B488 Type I, code A or C over 50µin min ni per ASTM B689 Type I Press-fit: 50µin min localized Au per ASTM B488 Type II, code C over 50µin min Ni per ASTM B689 Type I
Molded Insulators	Material	Glass-filled liquid crystal polymer (LCP) per ASTM D5138
Shell	Material	Aluminum alloy 6061-T6 per SAE AMS-4027 or 6051-t6511 Per SAE AMS-QQ-A-200/8
	Finish	500µin min electroless Ni per SAE AMS-2404, class 3
Embedment	Material	Frey Eng. Co. Insulating compound CF3003-80 or equivalent
Hardware	Material	Stainless steel per ASTM A484/A484m, ASTM A582/A582m, or ASTM A320
	Finish	Passivated per SAE MAS-2700
Washers	Material	Stainless steel per SAE NASM35333 (ASTM A240)
	Finish	Passivate per NASM35333 (SAE AMS-2700)
EMI Spira Gasket	Material	Beryllium copper
	Finish	Electroplated, 90% tin, 10% lead per AMS-P-81728
Thread Insert	Material	NAS1130-02-10
Thermal Electrical Gasket	Material	Silver-Copper filled silicon, acrylic, electrically conductive, pressure sensitive adhesive (PSA) backing

Performance

Contact Rating 2	2 Amperes max, see AirBorn PTB66 for more info
Operating Temperature	-55°C to 125°C, see AirBorn PTB66 for more info
Contact Engagement Force	6.0oz max*
Contact Separation Force	0.5oz min*
Connector Mating Force	10oz X (# of contacts) max tested per MIL-DTL-83513
Connector Unmating Force	10oz X (# of contacts) max tested per MIL-DTL-83513
DWV (Sea Level)	600V, RMS, 60Hz, see AirBorn PTB61 for more info
Recommended Maximum Operating Voltage	200V, RMS, 60Hz, see AirBorn PTB61 for more info
Insulation Resistance	5,000 MEGAOHMS minimum @ 500 VDC, tested per MIL-DTL-83513
Durability	10,000 connector mating cycles, exceeds MIL-DTL-83513
Sinusoidal Vibration	20g, tested per MIL-DTL-83513
Shock	50g, tested per MIL-DTL-83513
Outgassing	Max TML of 1% and max CVCM of .1% per MIL-DTL-83513

*Max pin size used for contact engagement force and min pin size used for contact separation force.

Please consult the AirBorn website for the latest revision of this document prior to beginning any design work.

CV4M2 Materials, Finishes, & Cable Performance

Materials & Finishes

Pin Contacts (Male)	Material	BeCu per ASTM B194
	Finish	Phos bronze per ASTM B103, 50µin min localized Au per ASTM B488 Type II, code C over 50µin min Ni per ASTM B689 Type I
Molded Insulator	Material	Glass-filled liquid crystal polymer (LCP) per ASTM D5138
Shell	Material	Aluminum alloy 6061-T6 per SAE AMS-4027 or 6051-T6511 Per SAE AMS-QQ-A-200/8
	Finish	500µin min electroless Ni per SAE AMS-2404, class 3
Hardware	Material	Stainless steel per ASTM A484/A484M, ASTM A582/A582M, or ASTM A320
	Finish	Passivated per SAE AMS-2700
Spira Gasket	Material	BeCu
	Finish	Electroplated, 90% tin, 10% lead per AMS-P-81728
Cable: 26 AWG Twinax	Parallel, 100 ohm impedance	
Cable: 26 AWG Buss Wire	Electroplated, 90% tin, 10% lead per AMS-P-81728	
Heatshrink Tubing	AA59551-H26S1B per A-A-59551, plating: eclectrodeposited tin alloy coating per ASTM B545, class C. 90 ± 5% tin, remainder lead	
Lacing (Braid Option Only)	Per A-A-52081	
Tape	Acrylic adheasive polymide film (Kaption)	
Metal Braid Only (Option 2)	Silver-plated copper braid per aa59569r30soxxx. Secured to backshell with micro band. Potting compound shall be frey engineering CF-3003-80 (fullpot) and L-II-49 (prepot) or equivalent.	
Halar Braid (Option 3)	Halar braid secured to backshell with micro band. Potting compound shall be frey engineering CF-3003-80 (fullpot) and L-II-49 (prepot) or equivalent.	
Halar Over Metal Braid (Option 4)	Halar over silver-plated copper braid per AA59569R30SOXXX secured to backshell with micro band. Potting compound shall be frey engineering CF-3003-80 (fullpot) and L-II-49 (prepot) or equivalent.	

Performance

Contact Rating	2 Amperes max, see AirBorn PTB66 for more info
Operating Temperature	-55°C to 125°C, see AirBorn PTB66 for more info
Contact Engagement Force	6.0oz max*
Contact Separation Force	5.0oz min*
Connector Mating Force	10oz X (# of contacts) max tested per MIL-DTL-83513
Connector Unmating Force	10oz X (# of contacts) max tested per MIL-DTL-83513
DWV (Sea Level)	600V, RMS, 60Hz, see AirBorn PTB61 for more info
Recommended Max. Operating Voltage	200V, RMS, 60Hz, see AirBorn PTB61 for more info
Insulation Resistance	5,000 MEGAOHMS minimum @ 500 VDC, tested per MIL-DTL-83513
Durability	2,500 connector mating cycles, exceeds MIL-DTL-83513
Sinusoidal Vibration	20g, tested per MIL-DTL-83513
Shock	50g, tested per MIL-DTL-83513
Outgassing	Max TML of 1% and max CVCM of .1% per MIL-DTL-83513

*Max pin size used for contact engagement force and min pin size used for contact separation force.

Please consult the AirBorn website for the latest revision of this document prior to beginning any design work.

Materials & Finishes

Shell	Material	6061-T6, 6061-T651, or 6061-T6511 aluminum SAE AMS 4027 or SAE AMS-QQ-A-200/8
	Finish	500µin min electroless Ni per SAE AMS-2404, class 3
Contacts	Socket Material	BeCu per ASTM B194
	Finish	50µin min localized gold finish per ASTM B488, over 50µin min Ni per ASTM B689 Type I
Cable	Finish	26 AWG, 100 OHM twinax cable
Wire	Material	24 AWG, M22759/33-24, black
Molded Insulator	Finish	Glass-filled liquid crystal polymer (LCP) per ASTM D5138
Hardware	Material	Stainless steel per ASTM A582/A582M or ASTM A320
	Finish	Passivate per SAE MAS-2700
Embedment	Material	Frey Eng. Co. Insulating compound CF3003-80 and L-II-49 or equivalent
Solder	Material	SN/PB solder, 63% PB, 37% SN
PCB	Material	ISOLA 185HR PCB laminate
	Finish	Electroless nickel immersion gold per IPS-6012/DS
Spira Gasket	Material	Beryllium copper
	Finish	Electroplated, 90% tin, 10% lead per AMS-P-81728
Thermal Electrical Gasket	Material	Silver-Copper filled silicon, acrylic, electrically conductive, pressure sensitive adhesive (PSA) backing

Performance

Contact Rating	2 Amperes max, see AirBorn PTB66 for more info
Operating Temperature	-55°C to 125°C, see AirBorn PTB66 for more info
Contact Engagement Force	6.0oz max*
Contact Separation Force	0.5oz min*
Connector Mating Force	10oz X (# of contacts) max tested per MIL-DTL-83513
Connector Unmating Force	10oz X (# of contacts) max tested per MIL-DTL-83513
DWV (Sea Level)	600V, RMS, 60Hz, see AirBorn PTB61 for more info
Recommended Maximum Operating Voltage	200V, RMS, 60Hz, see AirBorn PTB61 for more info
Insulation Resistance	5,000 MEGAOHMS minimum @ 500 VDC, tested per MIL-DTL-83513
Durability	10,000 connector mating cycles, exceeds MIL-DTL-83513
Sinusoidal Vibration	20g, tested per MIL-DTL-83513
Shock	50g, tested per MIL-DTL-83513
Outgassing	Max TML of 1% and max CVCM of .1% per MIL-DTL-83513

*Max pin size used for contact engagement force and min pin size used for contact separation force.

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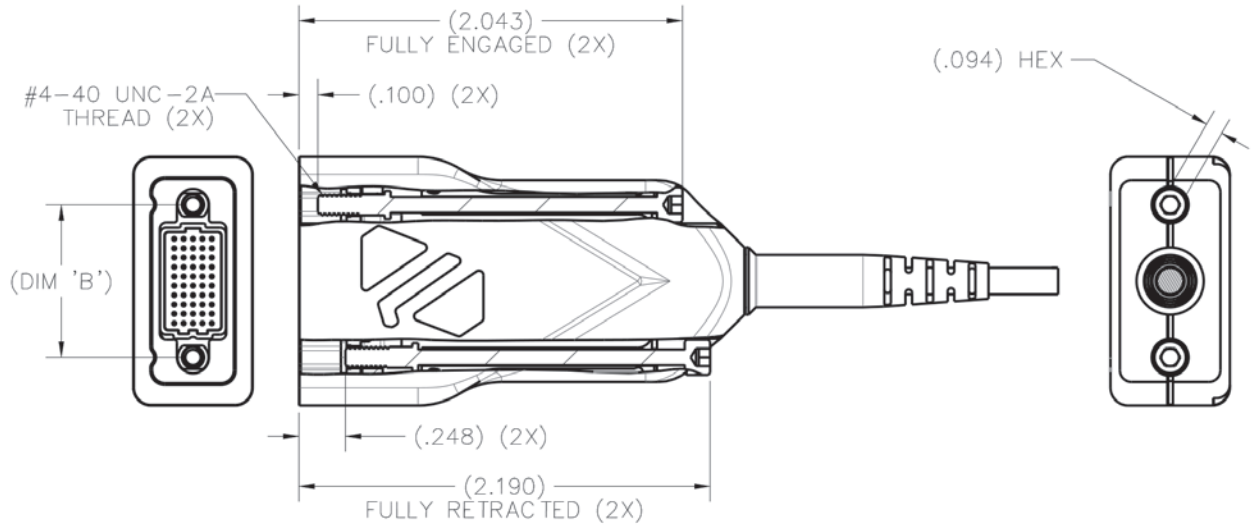
AVXXX–XXX–XXX–XXXX–XXX

HARDWARE OPTIONS	DESCRIPTION	DIM 'B'
JS	JACKING SCREW	.813
LS	LOCKING SCREW	

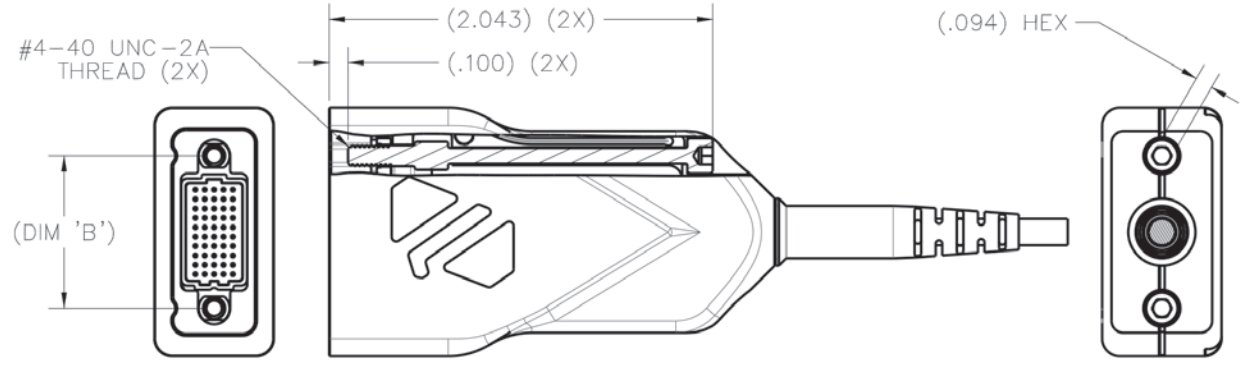
LOCKING SCREW DIMENSIONS (HARDWARE OPTION LS)



NOTE: TORQUE ALL HARDWARE OPTIONS TO 4.0 – 4.5 IN/LBS.

TURNING JACK SCREW DIMENSIONS (HARDWARE OPTION JS)

NOTE: TURN JACKING HARDWARE 1/2 REVOLUTION, ALTERNATELY PER SIDE UNTIL FULLY SEATED.

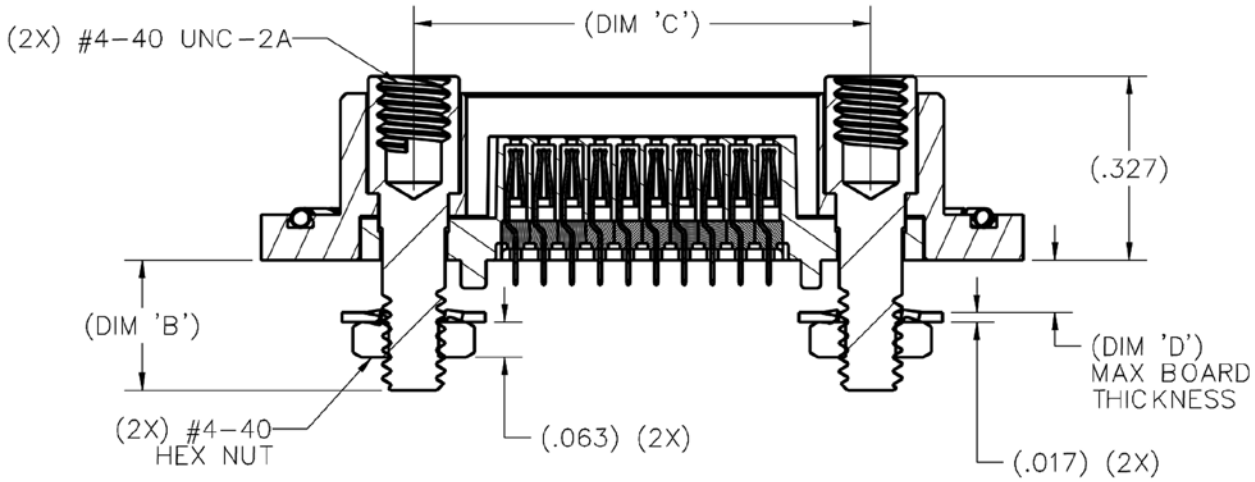


Please consult the AirBorn website for the latest revision of this document prior to beginning any design work.

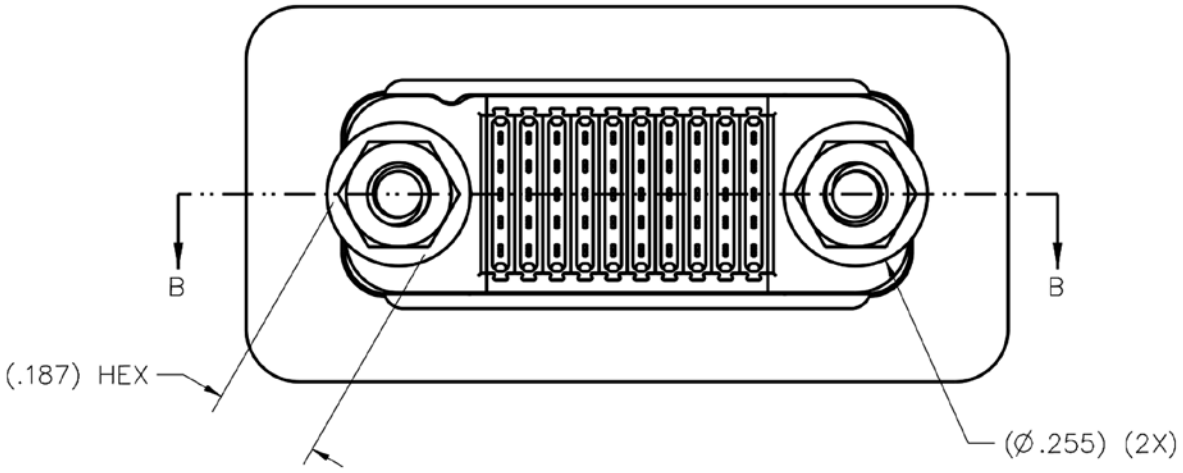
VTF–XX–XX–XX–XX–XX–XX

HARDWARE OPTION	DESCRIPTION	DIM 'B'	DIM 'C'	DIM 'D'
N	FIXED JACKNUT (.125" MAX BOARD THICKNESS)	.210	.813	.125
N1	FIXED JACKNUT (.250" MAX BOARD THICKNESS)	.335		.250

FIXED JACKNUT (HARDWARE OPTION N)



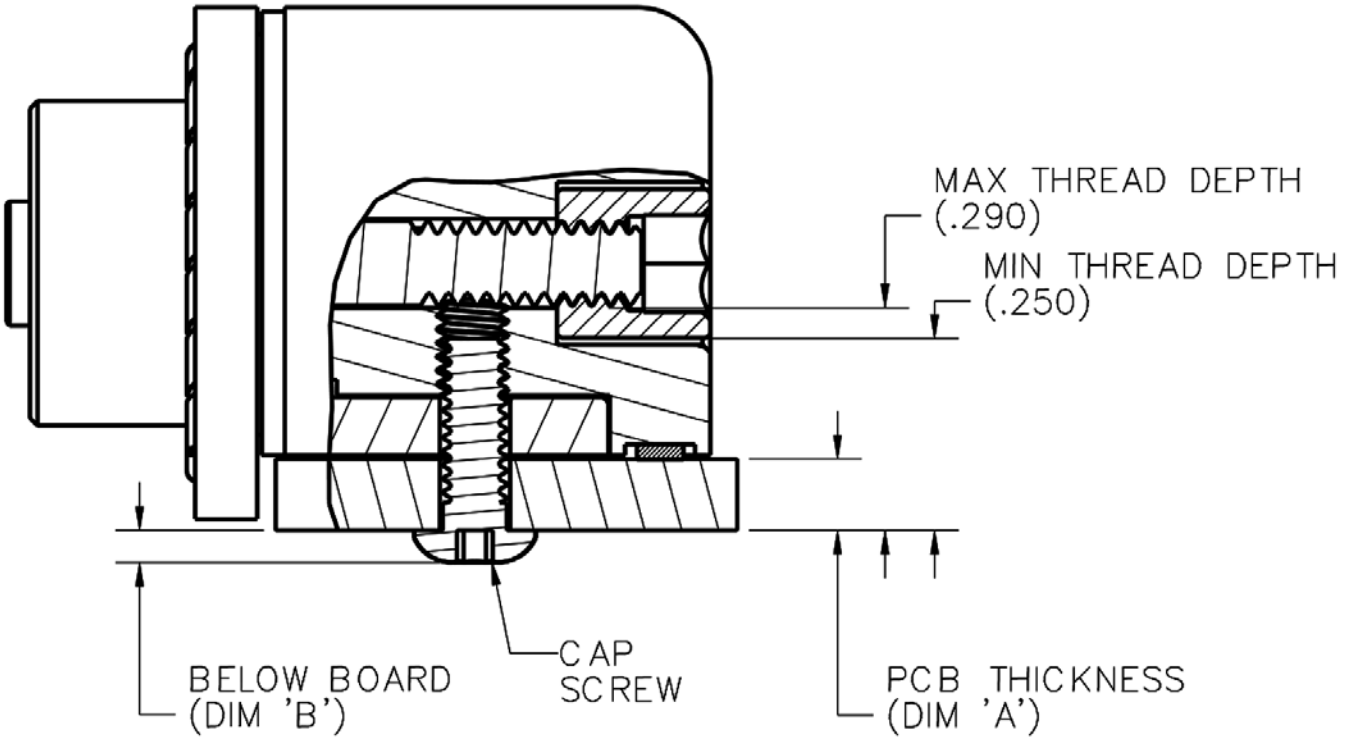
SECTION B–B



Please consult the AirBorn website for the latest revision of this document prior to beginning any design work.

VTRAF Recommended Hardware (Mounting Hardware Not Included)

PCB THICKNESS (DIM 'A')	BELOW BOARD (DIM 'B')	BUTTON HEAD CAP SCREW
.062	.046	#2–56 X 3/16"
.094		#2–56 X 1/4"



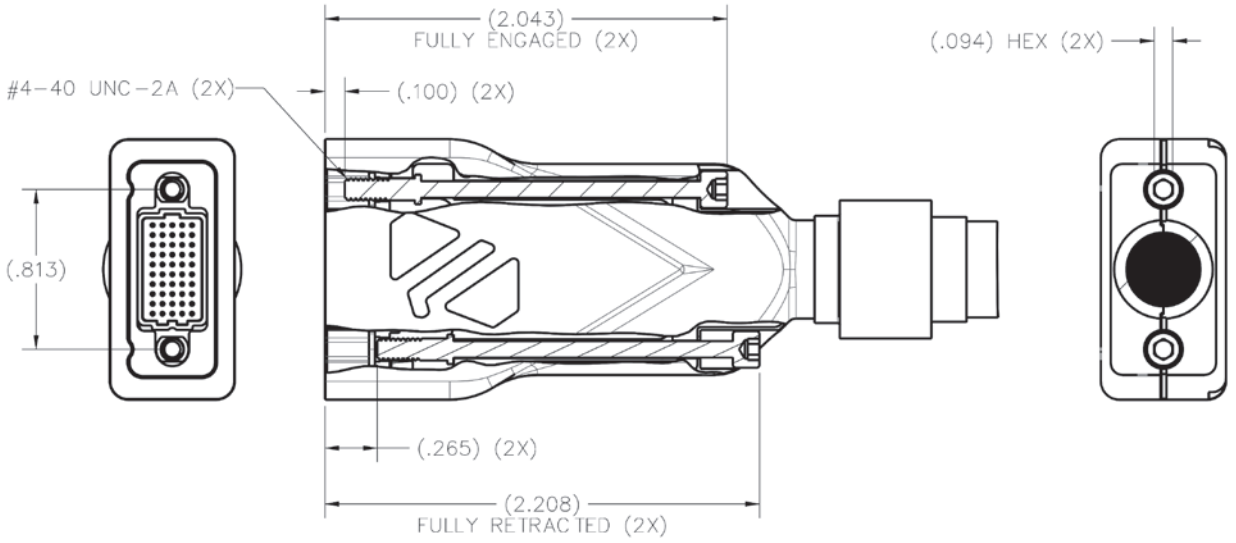
Please consult the AirBorn website for the latest revision of this document prior to beginning any design work.

NOTE: TORQUE ALL HARDWARE OPTIONS TO 4.0 – 4.5 IN/LBS

CV4MX–XXX–XXXX–X

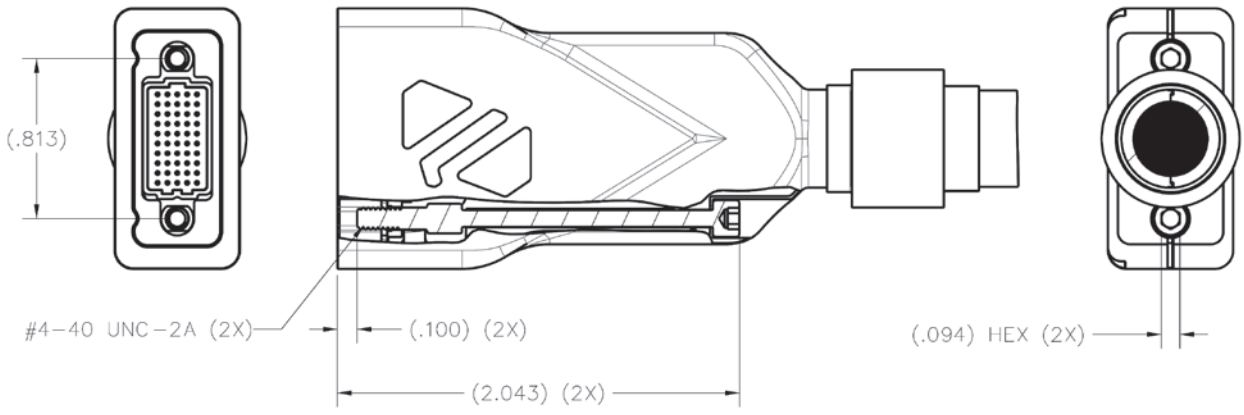
HARDWARE OPTIONS	DESCRIPTION
LS	LOCKING SCREW
JS	JACKING SCREW

LOCKING SCREW DIMENSIONS (HARDWARE OPTION LS)



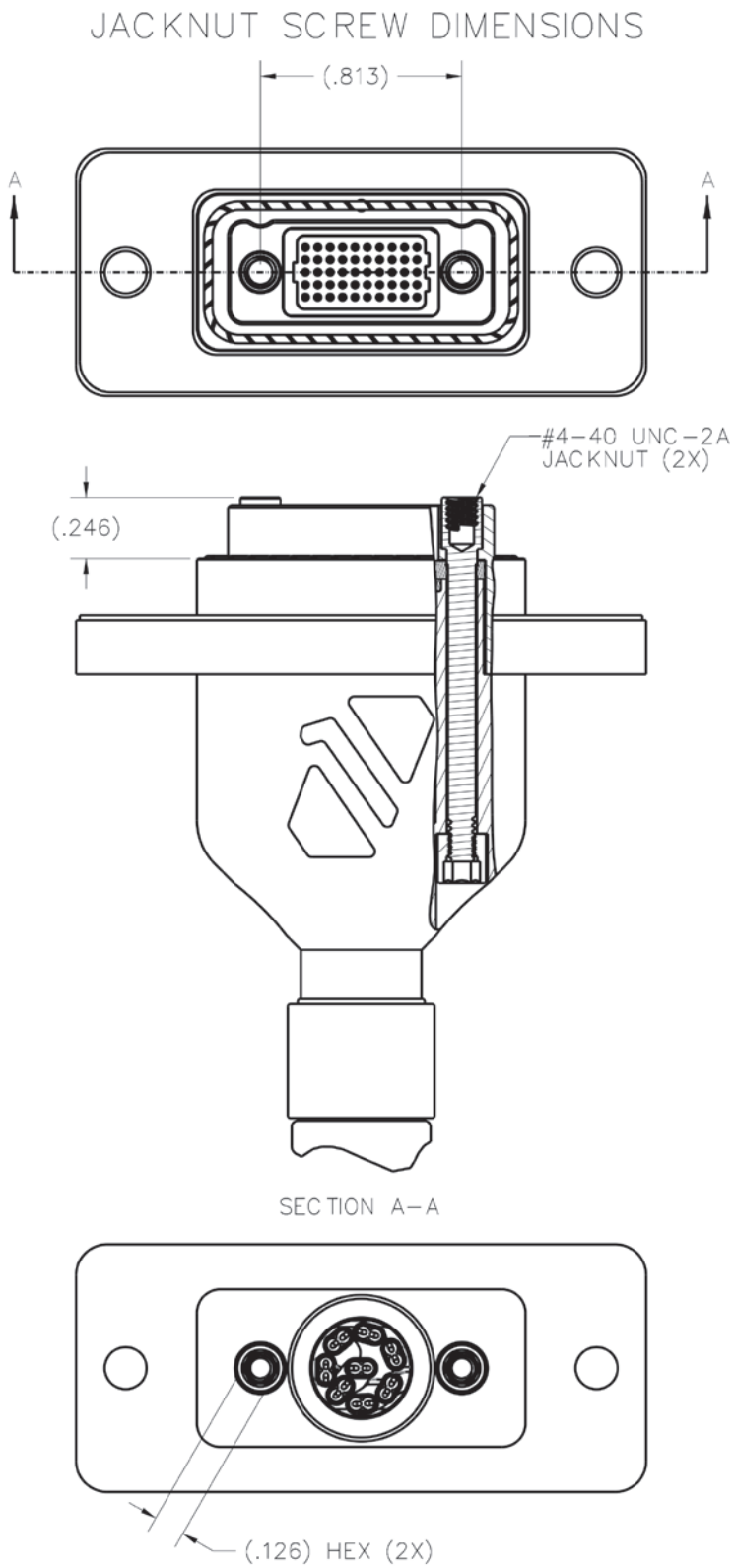
TURNING JACK SCREW DIMENSIONS (HARDWARE OPTION JS)

NOTE: TURN JACKING HARDWARE 1/2 REVOLUTION, ALTERNATELY PER SIDE UNTIL FULLY SEATED.



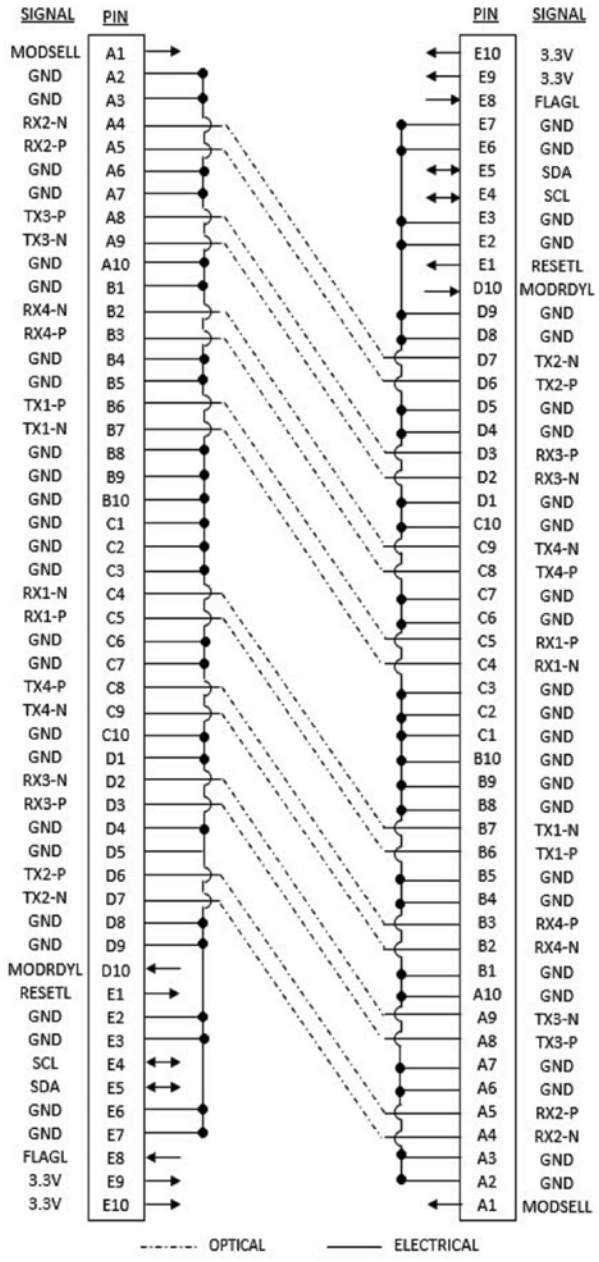
Please consult the AirBorn website for the latest revision of this document prior to beginning any design work.

VPD Connector 1 Hardware Options



Please consult the AirBorn website for the latest revision of this document prior to beginning any design work.

AV4M2 Wire Connect Chart & Pin Out

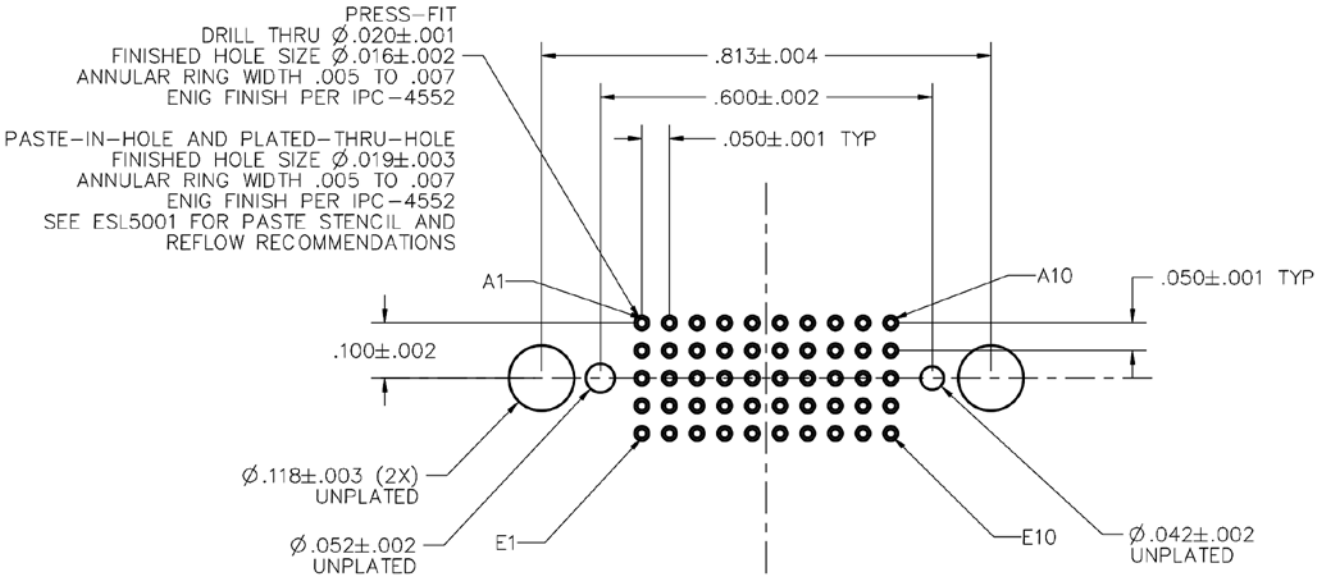


NOTE: PIN OUT REMAINS THE SAME FOR BOTH CABLE ENDS.

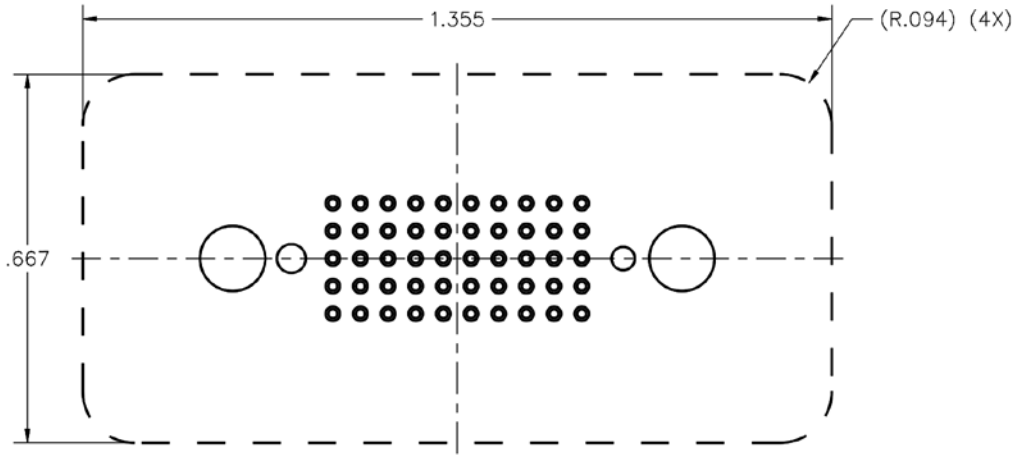
verSI Plug Pin-Out									
A1	A2	A3	A4	A5	A6	A7	A8	A9	A10
MODSELL	GND	GND	RX2-N	RX2-P	GND	GND	TX3-P	TX3-N	GND
B1	B2	B3	B4	B5	B6	B7	B8	B9	B10
GND	RX4-N	RX4-P	GND	GND	TX1-P	TX1-N	GND	GND	GND
C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
GND	GND	GND	RX1-N	RX1-P	GND	GND	TX4-P	TX4-N	GND
D1	D2	D3	D4	D5	D6	D7	D8	D9	D10
GND	RX3-N	RX3-P	GND	GND	TX2-P	TX2-N	GND	GND	MODRDYL
E1	E2	E3	E4	E5	E6	E7	E8	E9	E10
RESETL	GND	GND	SCL	SDA	GND	GND	FLAGL	3.3V	3.3V

Please consult the AirBorn website for the latest revision of this document prior to beginning any design work.

VTF Recommended PCB Layout



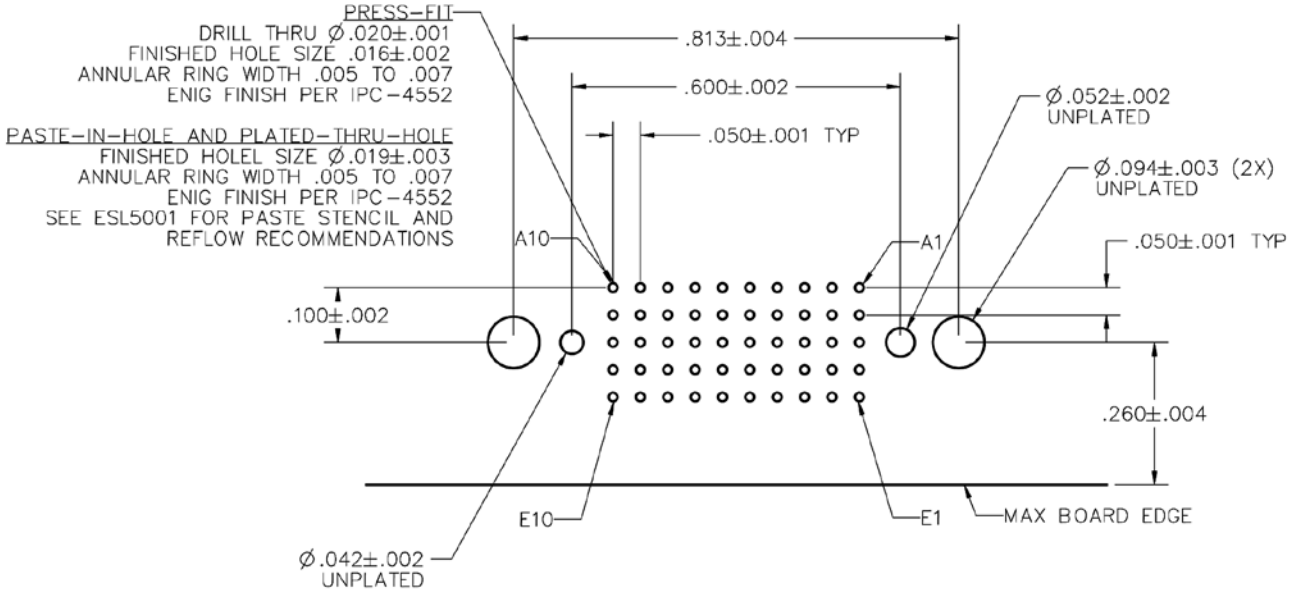
RECOMMENDED BOARD LAYOUT
COMPONENT SIDE



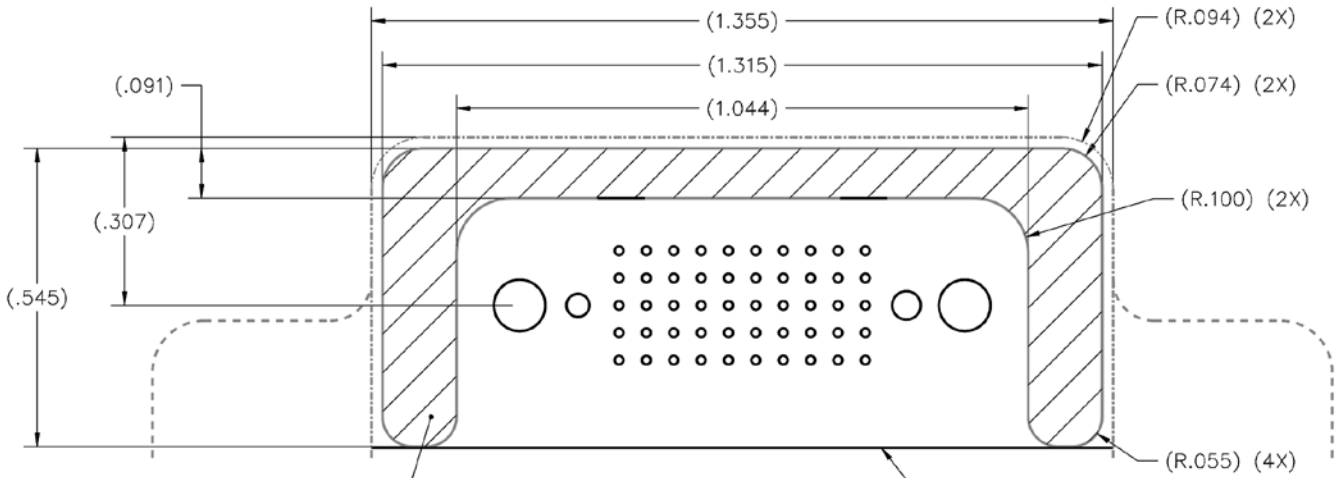
FOOTPRINT
COMPONENT SIDE

Please consult the AirBorn website for the latest revision of this document prior to beginning any design work.

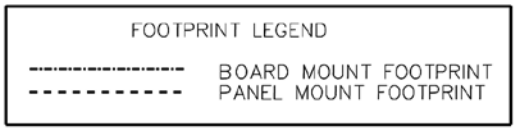
VTRAF Recommended PCB Layout



RECOMMENDED BOARD LAYOUT
COMPONENT SIDE



FOOTPRINT
COMPONENT SIDE



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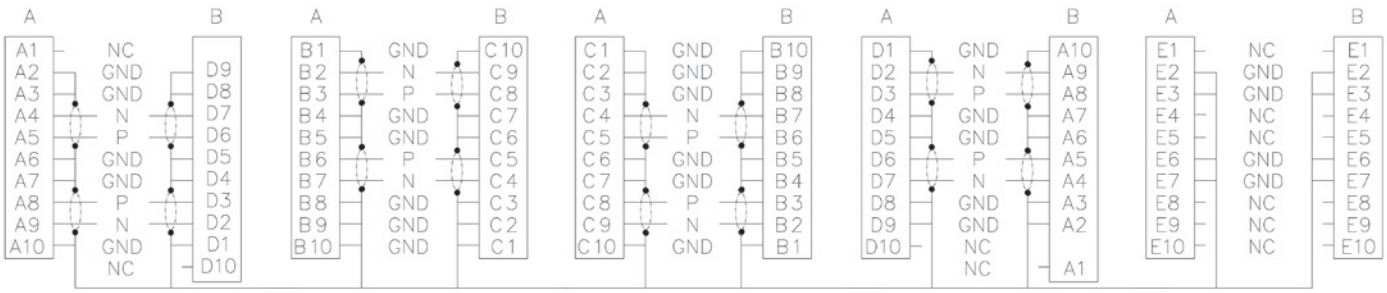
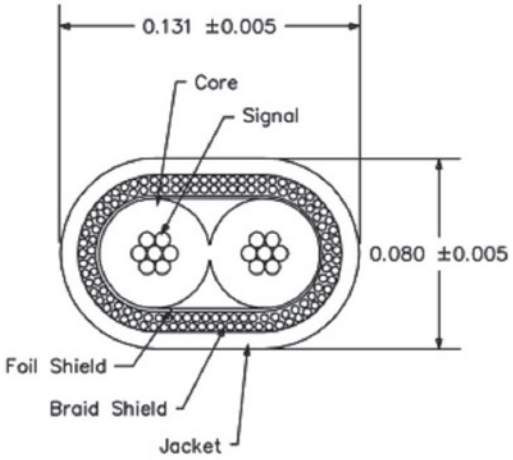
CV4MX Wire Chart





NOTES

Signal Conductor: 26 AWG, 7/34 SPC per ASTM B298
DC Resistance: 39.1 ohms/1000ft max @ 20C
Core: FEP, 1.4mm (0.055") OD
Color: One Blue, One Green
Braid Shield: 42 AWG SPC per ASTM B298, >85% Coverage
DC Resistance: 16.8 ohms/1000ft typical
Jacket: FEP, 0.005" Wall Thickness
Color: Gray
Impedance: 100 ±10 ohms
Capacitance: 47.6 pF/m (14.5 pF/ft) Ref
Inductance: 0.47 µH/M (0.145 µH/ft) Ref.
Propagation Delay: 4.76 ms/m (1.45 ns/ft) Ref.
Skew: < 82 ps/5m
Temperature Rating: −55C to 200C
Voltage Rating: 300V
Min. Bend Radius: 13 mm (0.5")
Packaging: 12" Plastic Spool
Footage per Spool: Up To 2500ft
Minimum Length: 10ft

Please consult the AirBorn website for the latest revision of this document prior to beginning any design work.

AOC Part Number Testing Code Guide

Testing Code									Inspection/Test	Test Methods, Conditions, and Requirements
100 (Standard)	200	201	300	400	401	500	600	601		
✓	✓	✓	✓	✓	✓	✓	✓	✓	PCBA Burn-In Testing	Environmental Conditions DUT Configuration Test Parameters Test Function Environmental Conditions
✓	✓	✓	✓	✓	✓	✓	✓	✓	Manufacturing Testing	DUT Configuration Test Parameters Test Function
✓	✓	✓	✓	✓	✓	✓	✓	✓	Final Production Testing	Environmental Conditions DUT Configuration Test Parameters Test Function Test Report
✓	✓	✓	✓	✓	✓	✓	✓	✓	Thermal Screening Testing	Environmental Conditions DUT Configuration Test Parameters Test Function
	✓	✓		✓	✓		✓	✓	Vibration Testing	 Sine Vibration Random Vibration Sine Vibration
			✓	✓	✓		✓	✓	X-Ray Screening	Screening Parameters
						✓	✓	✓	Thermal Vacuum Testing	Environmental Conditions DUT Configuration Test Parameters Test Function Test Report
		✓			✓			✓	In Situ Testing	

*Customer Specific Testing: Speak with your AirBorn Sales Representative about custom testing for your specific applications and environments. AirBorn can provide a wide suite of test services, including custom test fixture design and manufacturing.

Please consult the AirBorn website for the latest revision of this document prior to beginning any design work.

Test Methods, Conditions, and Requirements Continued

160 hours @ 85°C, ramp rate = 1°C/min	
PCBA in test socket, No optical fiber attached	
Supply Voltage: 3.3 VDC nominal, High VCSEL bias current: 11.5 mA	
Monitor continuous I2C communication and DUT status	
Ambient temperature, benchtop test	
Tested twice during the manufacturing process:	
1. Single-ended active optical cable, MPO terminated opposite end	
2. Double-ended active optical cable	
Supply Voltage: 3.3 VDC nominal, VCSEL bias current: 6.67 mA (Optical Power and Coupling) and 4-6 mA (Data Eye)	
Measure and record:	
1. Optical power	
2. RSSI	
3. Optical coupling	
4. Capture data eye.	
Ambient temperature, benchtop test	
Double ended active optical cable	
Supply Voltage: 3.3 VDC nominal, Standard VCSEL bias current: 4-6 mA	
Measure and record:	
1. Passive Mode Test	
2. Reset Mode Test	
3. Active Mode Test	
4. Serial Telemetry	
5. Discrete Telemetry	
6. Bit Error Rate Test	
7. Health Check	
Individual test report by serial number provided to customer	
5 thermal cycles, 95°C/-34°C, 1 hour dwells at all hot and cold holds	
Double-ended active optical cable	
Supply Voltage: 3.3 VDC nominal, Standard VCSEL bias current: 4-6 mA	
Measure and record:	
1. Passive Mode Test	
2. Reset Mode Test	
3. Active Mode Test	
4. Serial Telemetry	
5. Discrete Telemetry	
6. Bit Error Rate Test	
7. Health Check	
8. Max and Min DUT Temperatures	
Parameters	Pass/Fail Criteria
Frequency Range = 20 to 2,000 Hz,	No evidence of physical damage preventing proper function.
2 octaves per minute, each axis	Measure and record frequency response.
Peak level = .5 g_n	No evidence of physical damage preventing proper function.
60 seconds per axis	
Vibration Environments defined in Figures 5 and 6, Tables 5 and 6	
Frequency Range = 20 to 2,000 Hz,	No evidence of physical damage preventing proper function.
2 octaves per minute, each axis	Measure and record frequency response.
Peak level = .5 g_n	No change in frequency response greater than 5% from baseline.
FP-TD-034	
5 thermal vacuum cycles, 90°C/-29°C, 6 hour dwells at all hot plateaus and 1 hour dwells at all cold plateaus	
Ramp rate ≤ 6°C/min	
Vacuum Pressure $1x10^{-4}$ torr or less	
Double-ended active optical cable.	
Mated to test fixture, powered on.	
Supply Voltage: 3.135 – 3.465 VDC nominal	
Standard VCSEL bias current: 4-6 mA	
Measure and record:	
1. Serial Telemetry	
2. Discrete Telemetry	
3. Power Consumption	
4. Bit Error Rate Test	
5. Health Check	
6. Parametric Eye Data	
Individual test report by serial number provided to customer	
AirBorn has tahe capability of 'in situ' continuous monitoring of full Bit Error Rate, Telemetry, and Power during Vibration Testing. A test report is provided with each cable, documenting the test results.	

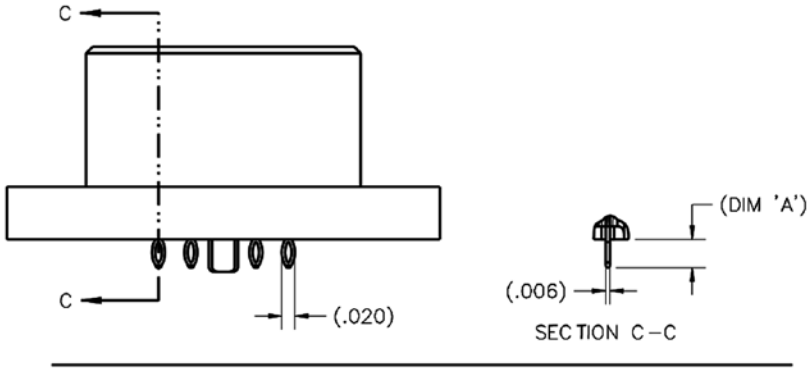
Please consult the AirBorn website for the latest revision of this document prior to beginning any design work.

VTF Termination Dimensions

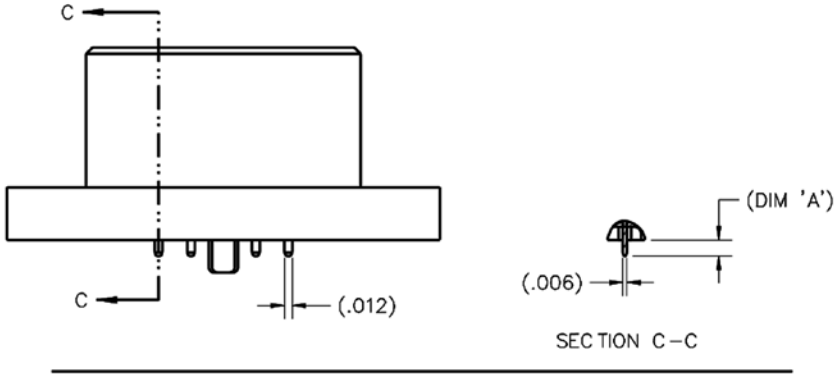
VTF–XX–XX–XX–XX–XX–XX

TERMINATION	RECOMMENDED PCB THICKNESS FOR EACH TERMINATION TYPE	(DIM 'A')
–00	.062" MIN	.044
–01	.025" MIN	.025
–02	.068" MAX	.078
–03	.099" MAX	.109
–04	.130" MAX	.140
–05	.145" MAX	.156
–06	.162" MAX	.172

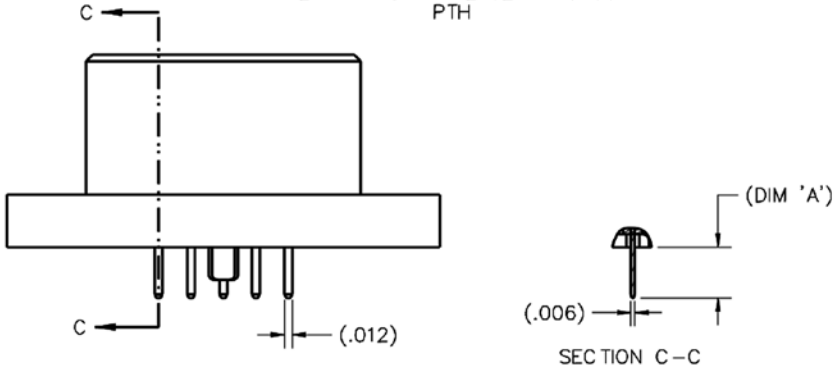
TERMINATION TYPE 00
PRESS–FIT



TERMINATION TYPE 01
PIH



TERMINATION TYPE 02 THRU 06
PTH



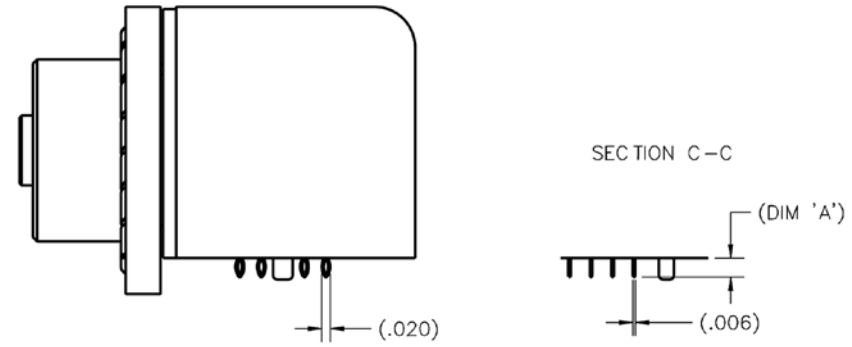
Please consult the AirBorn website for the latest revision of this document prior to beginning any design work.

VTRAF Termination Dimensions

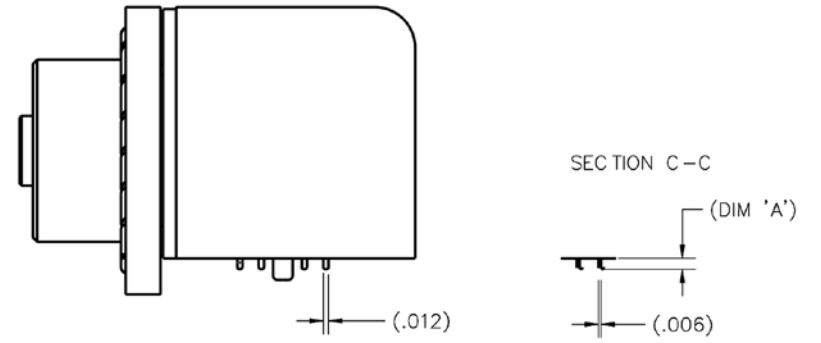
VTRAF–XX–XX–XX–XX–XX–XX

TERMINATION	RECOMMENDED PCB THICKNESS FOR EACH TERMINATION TYPE	DIM 'A'
–00	.062" MIN	.044
–01	.025" MIN	.025
–02	.068" MAX	.078
–03	.099" MAX	.109
–04	.130" MAX	.140
–05	.145" MAX	.156
–06	.162" MAX	.172

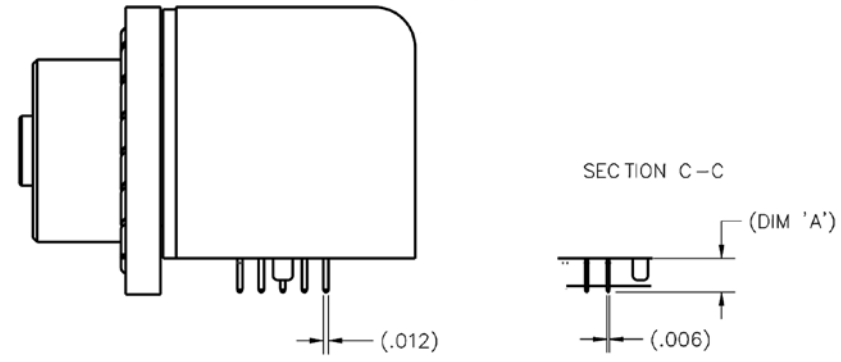
TERMINATION TYPE 00
PRESS–FIT



TERMINATION TYPE 01
PIH



TERMINATION TYPE 02 TO 06
PTH



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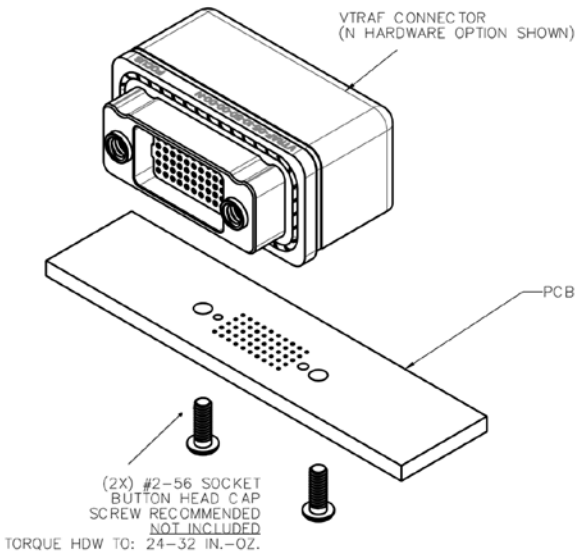
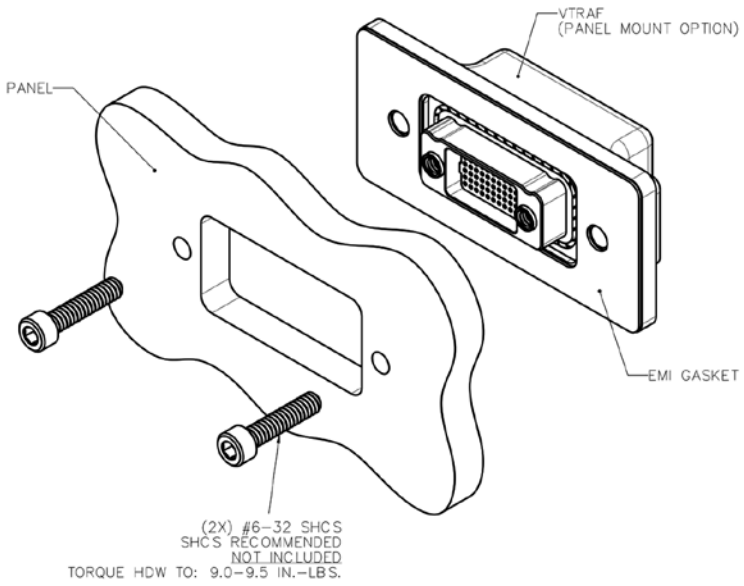
PCB MOUNTING INSTRUCTIONS

BOARD MOUNT AND PANEL MOUNT OPTIONS
(VRRAF-05-10-50-00-00-N SHOWN)
SHELLS AND HARDWARE COME INSTALLED

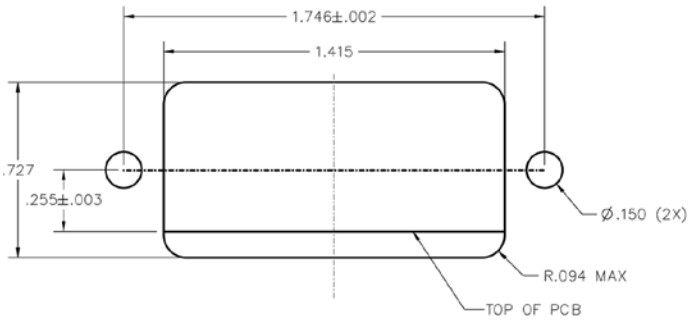


PANEL MOUNTING INSTRUCTIONS

PANEL MOUNT OPTION ONLY
(VRRAF-05-10-50-00-00-NE SHOWN)
SHELLS AND HARDWARE COME INSTALLED



RECOMMENDED PANEL CUTOUT

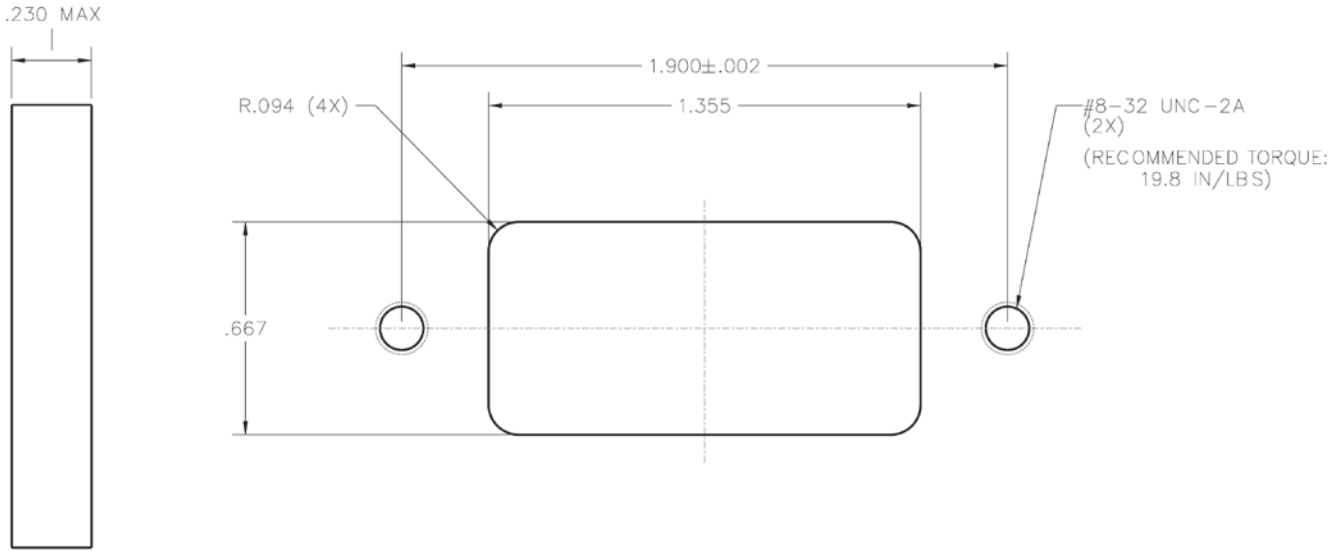


Please consult the AirBorn website for the latest revision of this document prior to beginning any design work.

CONNECTOR 1 PIN-OUT									
A10 GND	A9 TX3-N	A8 TX3-P	A7 GND	A6 GND	A5 RX2-P	A4 RX2-N	A3 GND	A2 GND	A1 MODSELL
B10 GND	B9 GND	B8 GND	B7 TX1-N	B6 TX1-P	B5 GND	B4 GND	B3 RX4-P	B2 RX4-N	B1 GND
C10 GND	C9 TX4-N	C8 TX4-P	C7 GND	C6 GND	C5 RX1-P	C4 RX1-N	C3 GND	C2 GND	C1 GND
D10 MODRDYL	D9 GND	D8 GND	D7 TX2-N	D6 TX2-P	D5 GND	D4 GND	D3 RX3-P	D2 RX3-N	D1 GND
E10 3.3V	E9 3.3V	E8 FLAGL	E7 GND	E6 GND	E5 SDA	E4 SCL	E3 GND	E2 GND	E1 RESETL

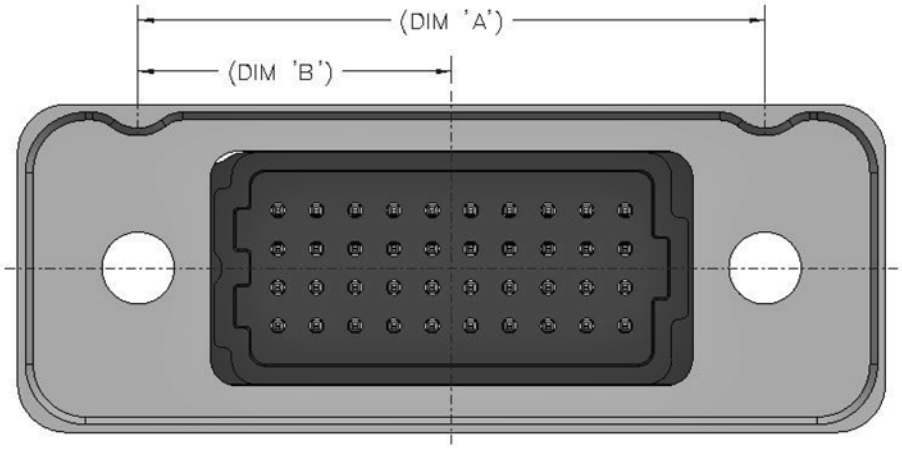
* ALL GNDS & TWINAX SHIELDS COMMON.
** POSITIONS A1, D8, D9, D10, E1, E3, E4, E5, E6, E8-E10 POPULATED WITH 24 AWG WIRE.
*** FOUR DISCRETE (A1, D10, E8, E1) AND FOUR TWISTED PAIR (D9/E10 D8/E9, E5/E6, E3/E4).

RECOMMENDED CONNECTOR 1 (C1) PANEL CUTOUT



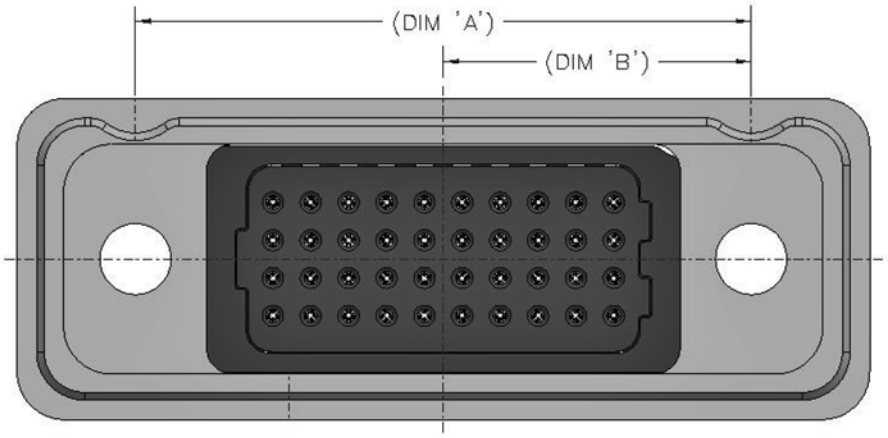
Please consult the AirBorn website for the latest revision of this document prior to beginning any design work.

Keying Option A - Standard



VerSI Male Connector Keying

(VRM-04-10-100-50-00 SHOWN FOR REFRENCE ONLY)



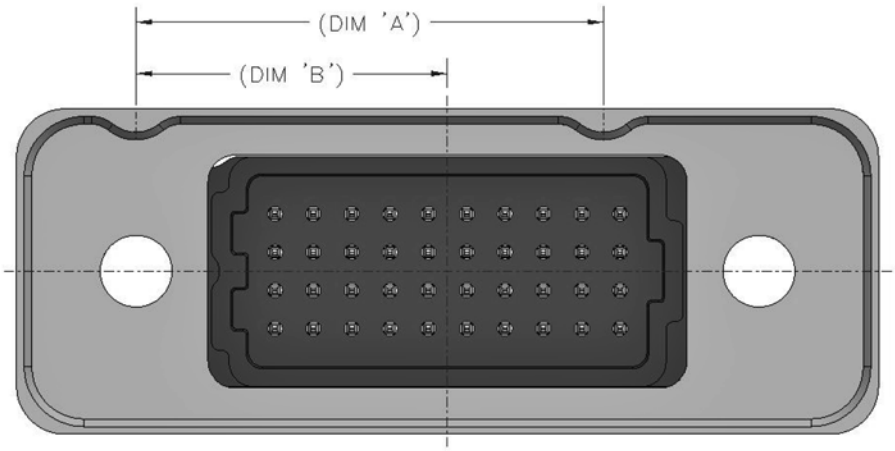
VerSI Female Connector Keying

(VRF-04-10-50-00 SHOWN FOR REFRENCE ONLY)

ROWS	DIM 'A' (INCHES)	DIM 'B' (INCHES)
10	.813	.407
20	1.313	.657
30	1.813	.907
40	2.313	1.157
50	2.813	1.407

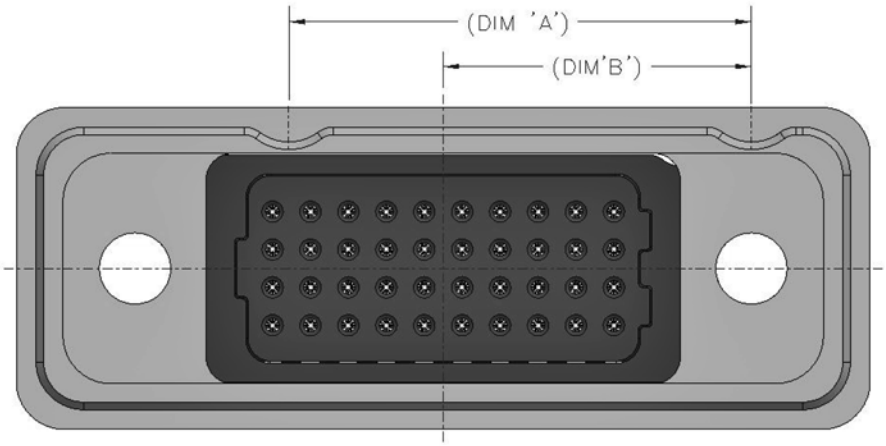
Please consult the AirBorn website for the latest revision of this document prior to beginning any design work.

Keying Option B



VerSI Male Connector Keying

(VRM-04-10-100-50-00 SHOWN FOR REFRENCE ONLY)



VerSI Female Connector Keying

(VRF-04-10-50-00 SHOWN FOR REFRENCE ONLY)

ROWS	DIM 'A' (INCHES)	DIM 'B' (INCHES)
10	.610	.407
20	.985	.657
30	1.360	.907
40	1.735	1.157
50	2.110	1.407

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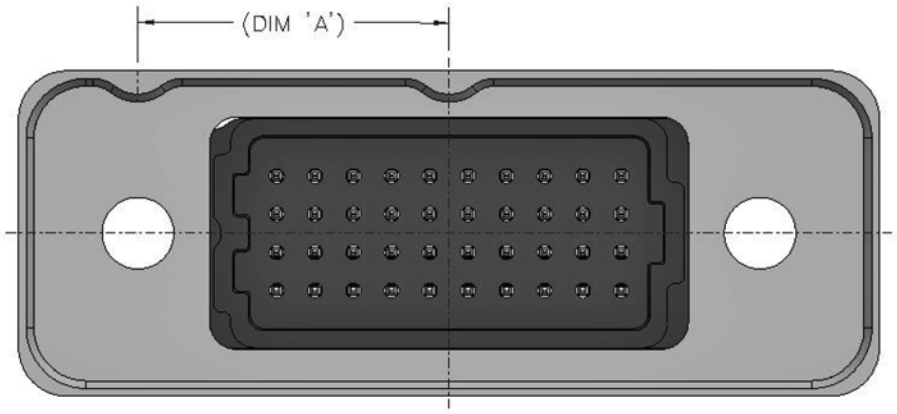
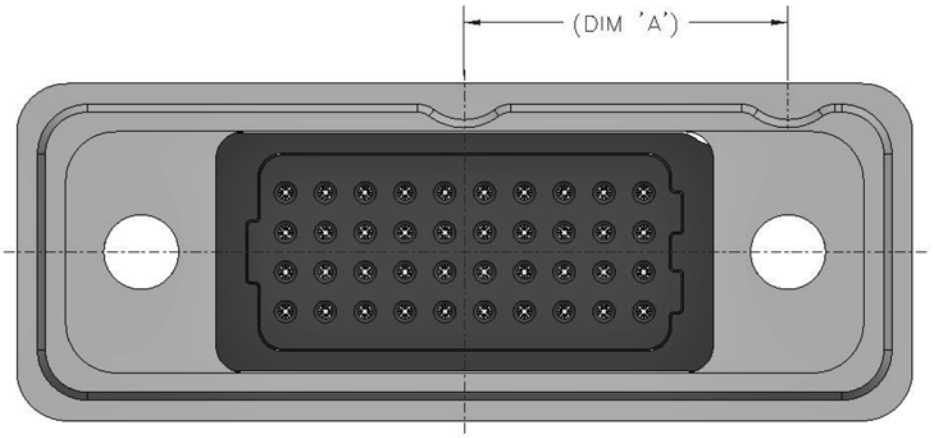
Keying Option C



VerSI Male Connector Keying

(VRM-04-10-100-50-00 SHOWN FOR REFRENCE ONLY)



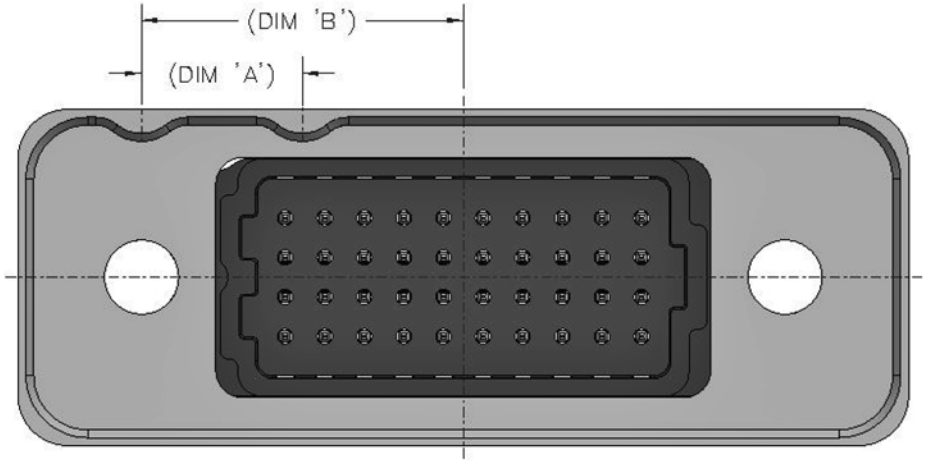
VerSI Female Connector Keying

(VRF-04-10-50-00 SHOWN FOR REFRENCE ONLY)

ROWS	DIM 'A' (INCHES)
10	.407
20	.657
30	.907
40	1.157
50	1.407

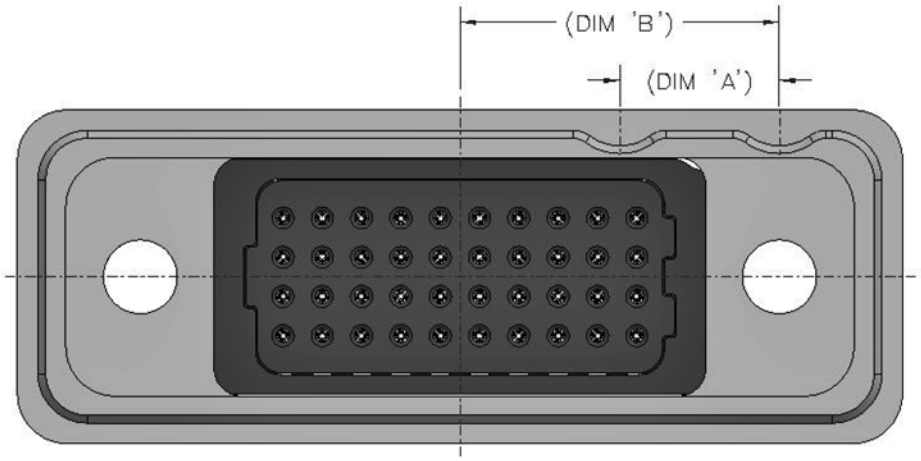
Please consult the AirBorn website for the latest revision of this document prior to beginning any design work.

Keying Option D



VerSI Male Connector Keying

(VRM-04-10-100-50-00 SHOWN FOR REFRENCE ONLY)



VerSI Female Connector Keying

(VRF-04-10-50-00 SHOWN FOR REFRENCE ONLY)

ROWS	DIM 'A' (INCHES)	DIM 'B' (INCHES)
10	.203	.407
20	.328	.657
30	.453	.907
40	.578	1.157
50	.703	1.407

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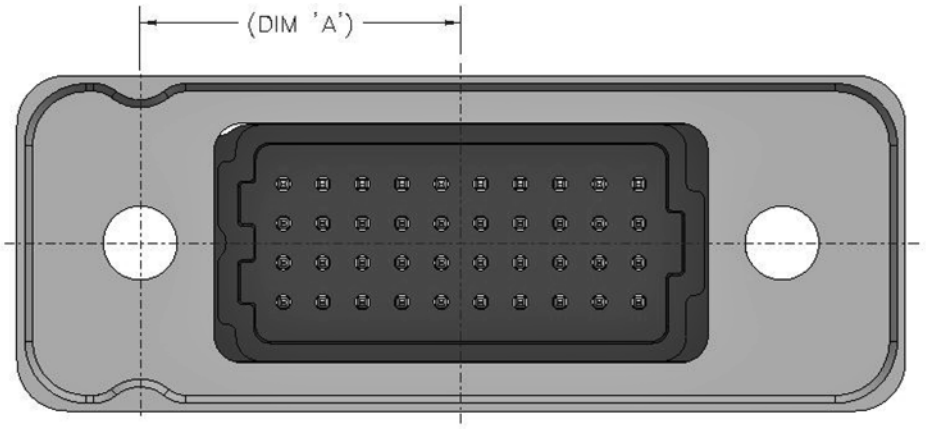
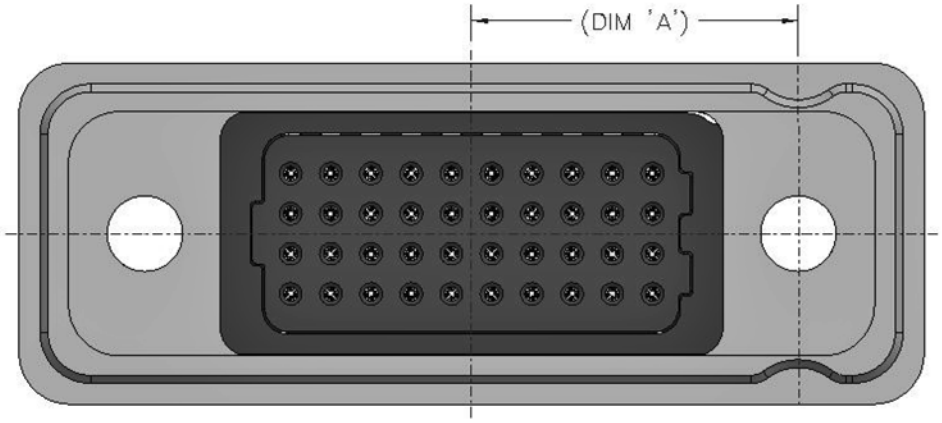
Keying Option E



VerSI Male Connector Keying

(VRM-04-10-100-50-00 SHOWN FOR REFRENCE ONLY)



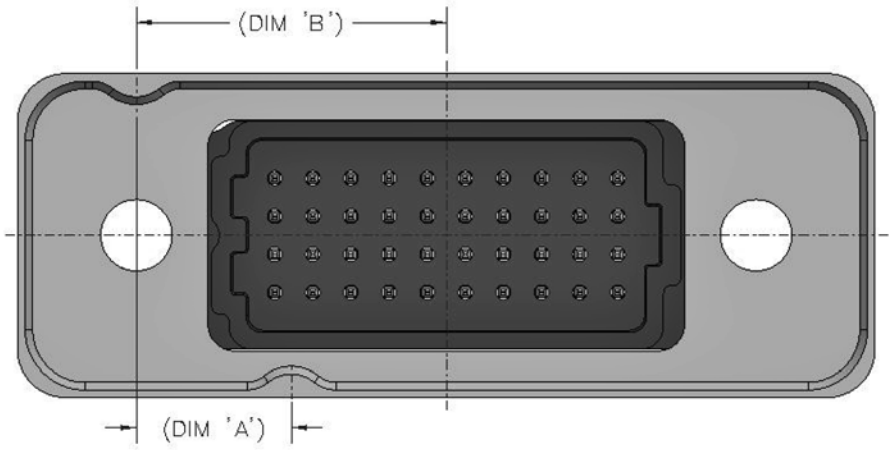
VerSI Female Connector Keying

(VRF-04-10-50-00 SHOWN FOR REFRENCE ONLY)

ROWS	DIM 'A' (INCHES)
10	.407
20	.657
30	.907
40	1.157
50	1.407

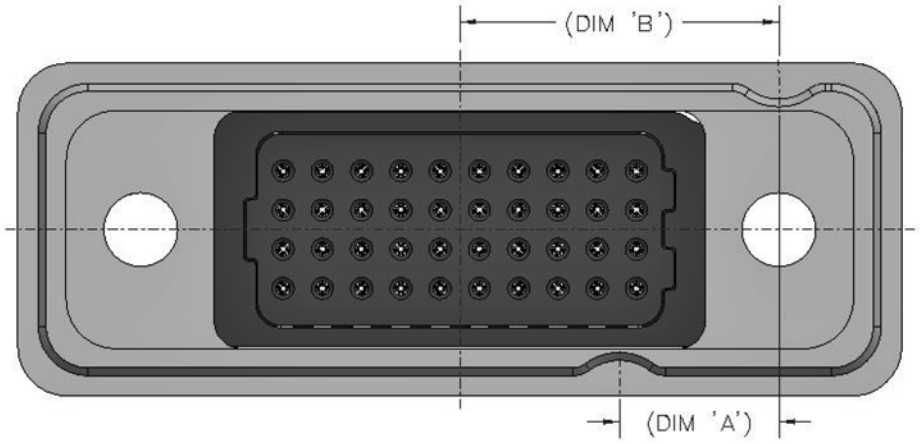
Please consult the AirBorn website for the latest revision of this document prior to beginning any design work.

Keying Option F



VerSI Male Connector Keying

(VRM-04-10-100-50-00 SHOWN FOR REFRENCE ONLY)



VerSI Female Connector Keying

(VRF-04-10-50-00 SHOWN FOR REFRENCE ONLY)

ROWS	DIM 'A' (INCHES)	DIM 'B' (INCHES)
10	.203	.407
20	.328	.657
30	.453	.907
40	.578	1.157
50	.703	1.407

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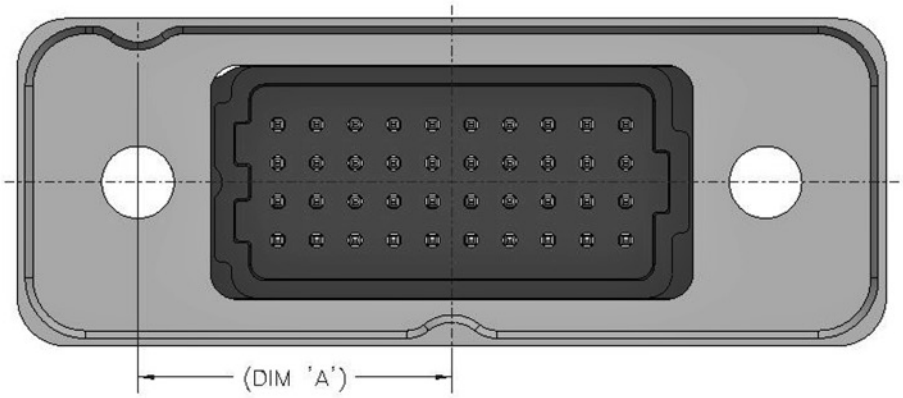
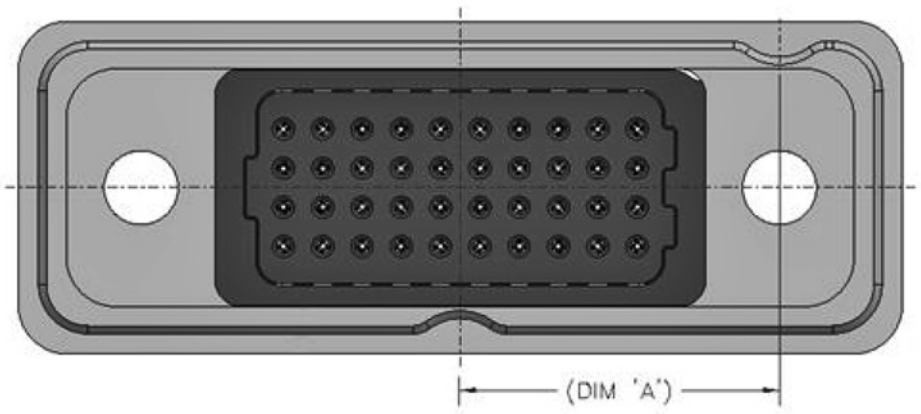
Keying Option G



VerSI Male Connector Keying

(VRM-04-10-100-50-00 SHOWN FOR REFRENCE ONLY)



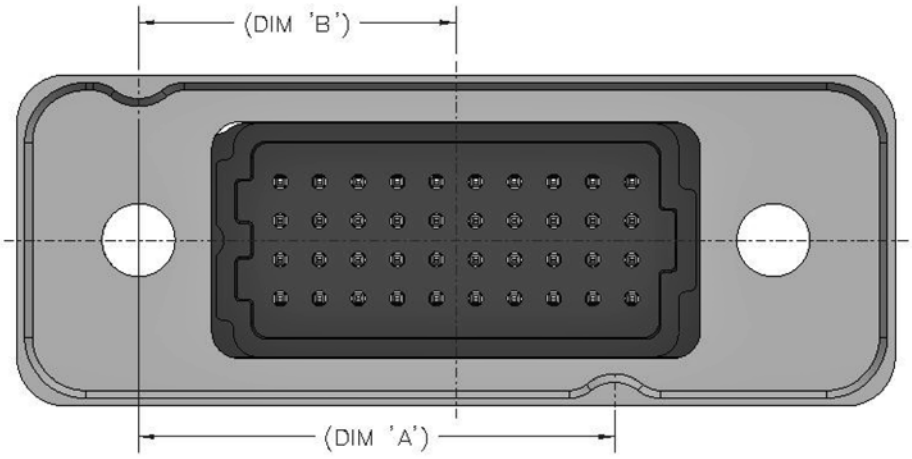
VerSI Female Connector Keying

(VRF-04-10-50-00 SHOWN FOR REFRENCE ONLY)

ROWS	DIM 'A' (INCHES)
10	.407
20	.657
30	.907
40	1.157
50	1.407

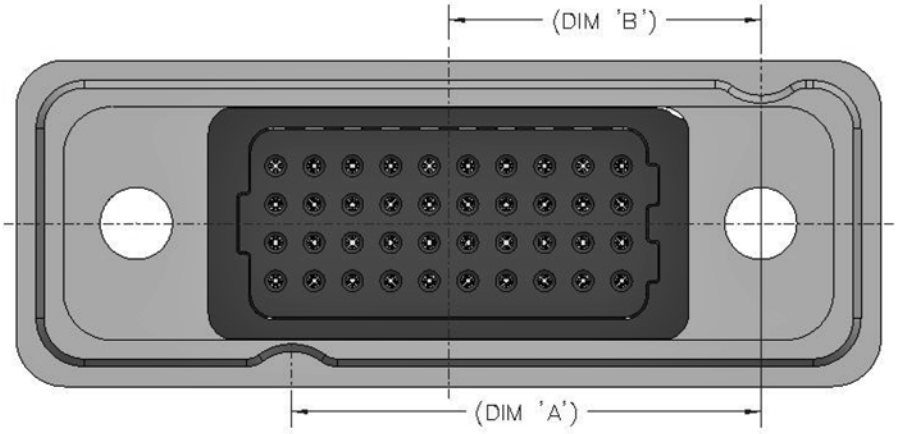
Please consult the AirBorn website for the latest revision of this document prior to beginning any design work.

Keying Option H



VerSI Male Connector Keying

(VRM-04-10-100-50-00 SHOWN FOR REFRENCE ONLY)



VerSI Female Connector Keying

(VRF-04-10-50-00 SHOWN FOR REFRENCE ONLY)

ROWS	DIM 'A' (INCHES)	DIM 'B' (INCHES)
10	.610	.407
20	.985	.657
30	1.360	.907
40	1.735	1.157
50	2.110	1.407

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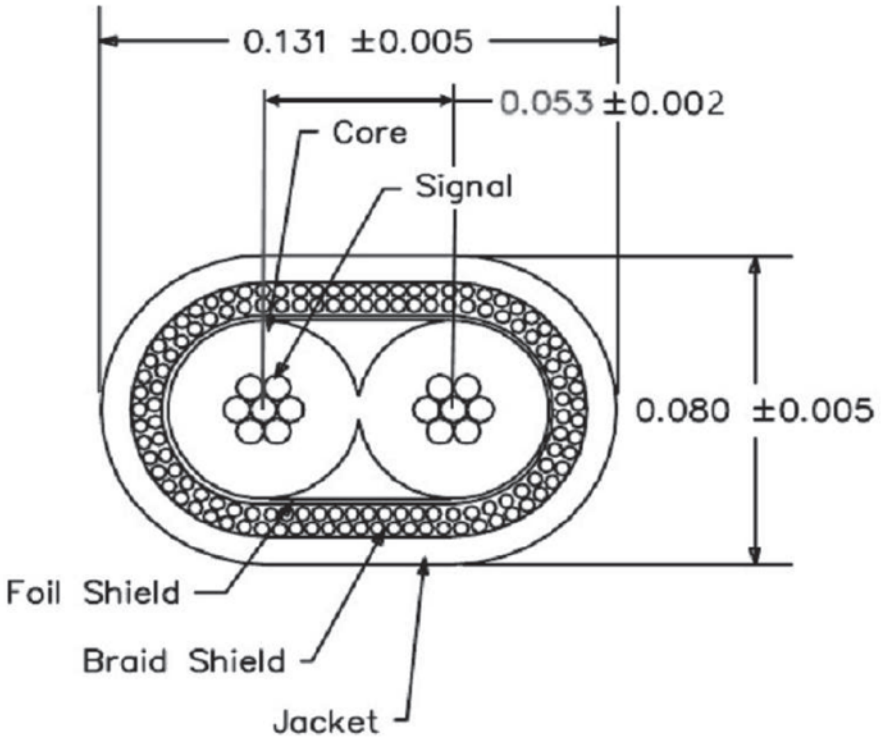
DESCRIPTION	
PARALLEL PAIR TWINAX CABLE	
CONSTRUCTION	
SIGNAL	26 AWG, 7/34 SPC. PER ASTM B298
CORE	FEP (ONE BLUE, ONE GREEN)
BRAID SHIELD	42 AWG SPC PER ASTM B298 SILVER PLATED COPPER, >85% COVERAGE
JACKET	FEP (GRAY)
PROPERTIES	
OPERATING TEMPERATURE	−55°C TO +200°C
DIFFERENTIAL IMPEDENCE	100±10 OHMS
MIN. BEND RADIUS	0.50"



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CDGV01649 Evaluation Kit

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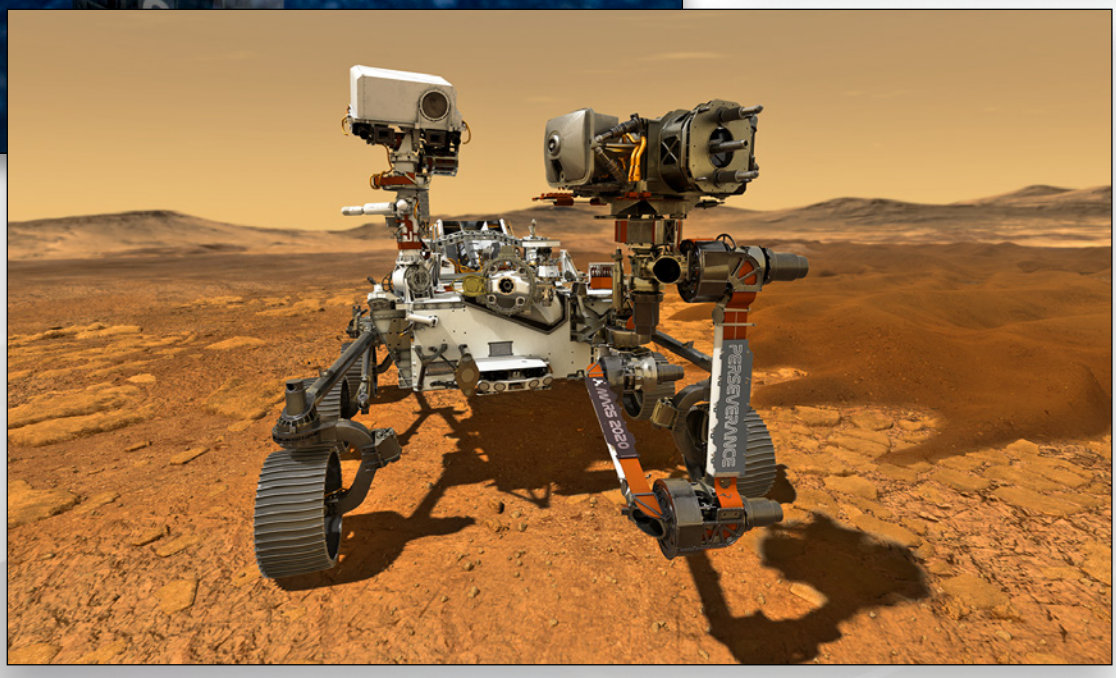
ULA


PERSEVERANCE
MARS 2020

FOCuS®

Space-Rated Active Optical Cable Qualifications Review

Class I laser product that complies with FDA performance standards for laser products except for conformance with IEC 60825-1 Ed. 3, as described in Laser Notice No. 56, dated May 8, 2019.

Qualification Testing

The cables in Qualification testing go through the following verification testing. Each cable is fully functional throughout all tests, with bit error monitoring, as well as power, and telemetry checks throughout. Passing criteria for each test includes: BER better than 1x10-12. Telemetry interface responds without error. No changes in current draw greater than 5% from baseline. No signs of physical damage.

Thermal Life Testing

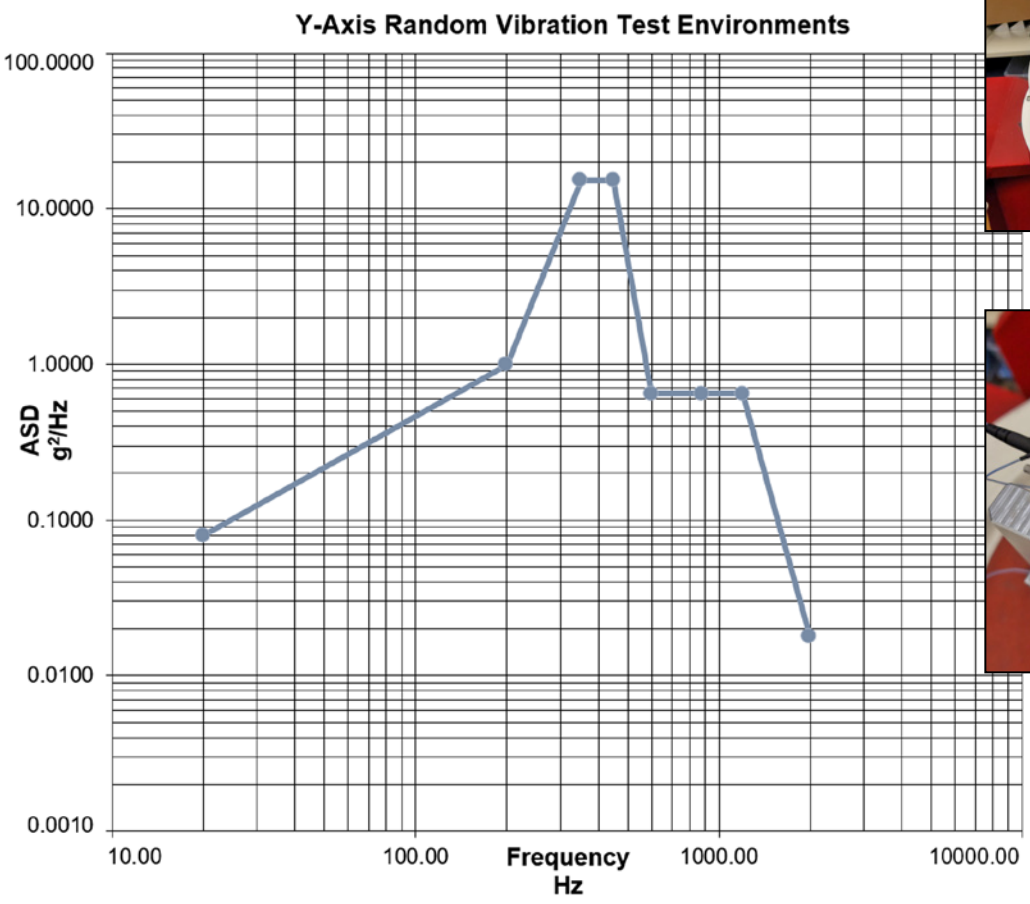
134 thermal cycles of +95°C to -34°C, 1 hour dwells on all plateaus, ramp rate ≤ 6°C.

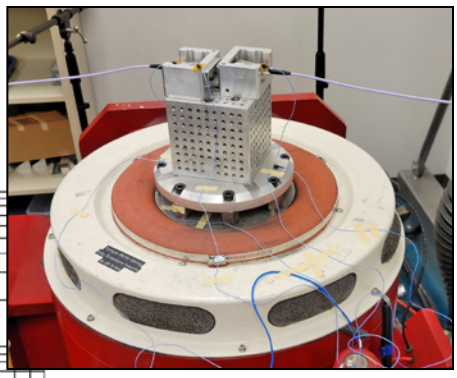
Thermal Vacuum Testing

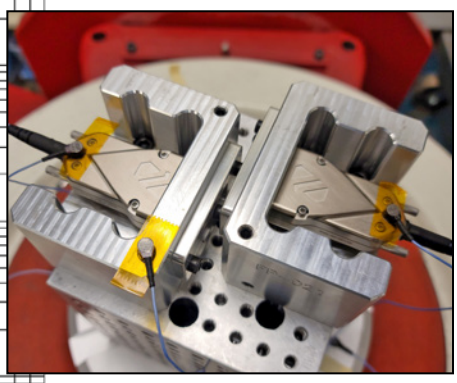
24 thermal cycles of +95°C to -34°C, 6 hour dwells on all hot plateaus, 1 hour dwells on all cold dwells, ramp rate ≤ 6°C, chamber pressure of 1x10-4 torr.

Vibration Testing

Vibration testing is meant to simulate the environment the cable would experience as it is rocketed into orbit. 60.26 Grms total, 3 minutes per axis. Vibration profile and test images shown below.





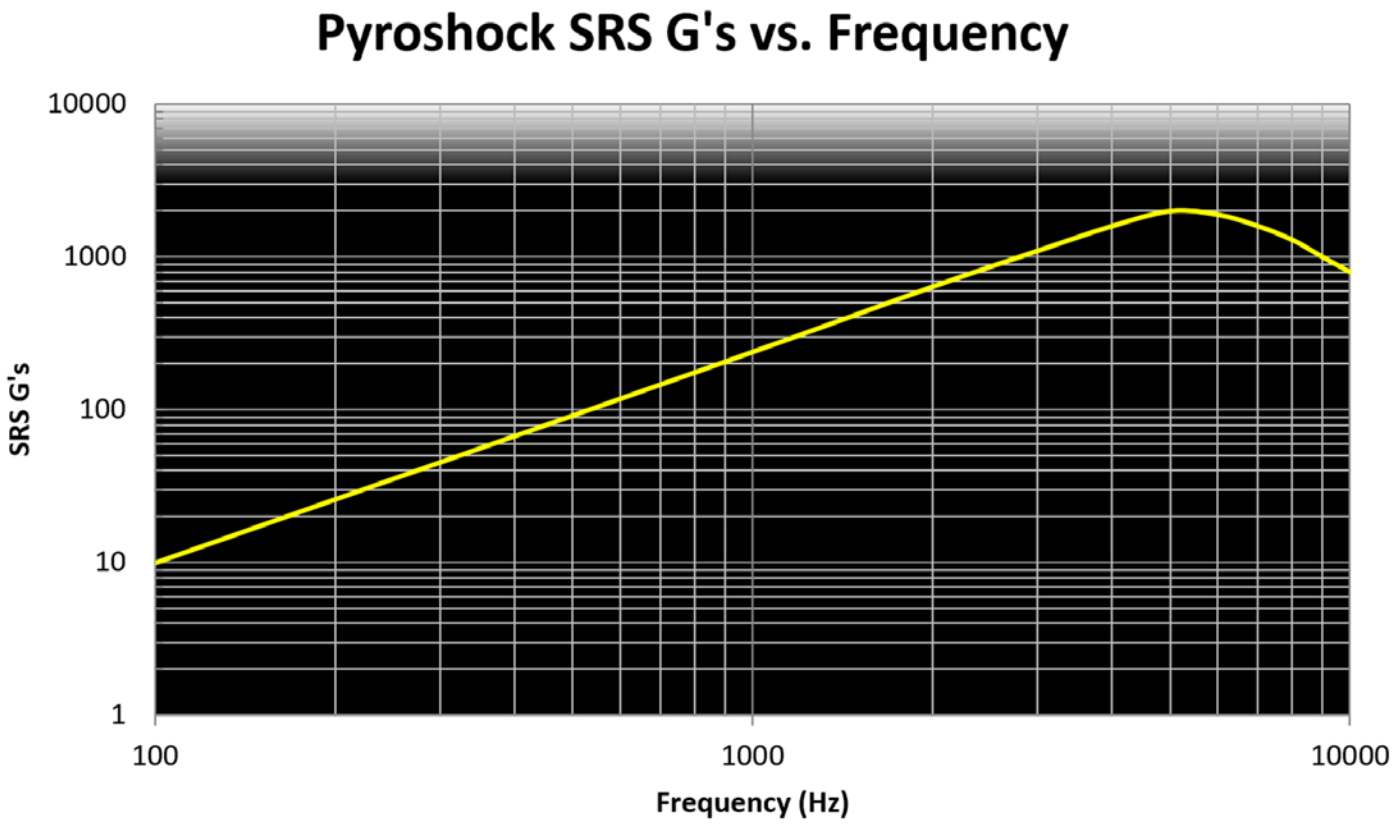


Vibration Testing

Class I laser product that complies with FDA performance standards for laser products except for conformance with IEC 60825-1 Ed. 3, as described in Laser Notice No. 56, dated May 8, 2019.

Pyroshock

Pyroshock testing is meant to simulate the high-magnitude shock waves propagated through a structure during an explosive event, such as when an explosive charge is used to separate a multistage rocket. Each cable undergoes the following pyroshock profile, applied three times in each direction of each orthogonal axis. The cables are not powered for this test.

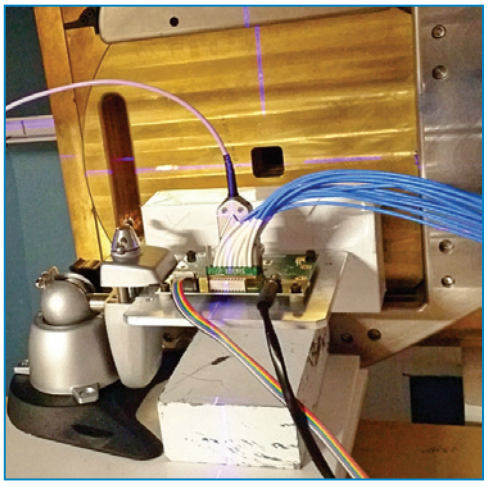


Additional Verification Testing

The following tests are performed outside of the official Qualification test plan, and verify that additional design criteria have been met.

Radiation Testing

Radiation testing has been performed on all AirBorn Active Optical Cable designs. A high flux, continuous 200MeV proton beam was focused on the cable end, while power, telemetry and bit error rate were measured and recorded for all four channels. No latchup events nor permanent degradation in functionality were observed, with a total ionizing dose of over 95 kRad (TID Si) delivered to the optical engine components. Test setup shown below.



Radiation Testing

EMC Testing

EMC testing per MIL-STD-461F has been performed on all legacy AirBorn Active Optical Cable designs. The test results indicate that the cable's external interfaces and enclosures successfully contained all EMC emissions. EMC testing will be performed on all future cable configurations. The same robust design features which made the legacy product so effective at mitigating EMC emissions are incorporated into each new product configuration.

Cable Pullout Testing

The FOCuS cables have been tested and verified to meet a 10lbf axial pull force on the cable jacket without separation from the cable end body. Test setup shown below.

Cable Pull Testing

VCSEL and Photodiode Extended Life Testing

Each unique VCSEL and Photodiode lot used in FOCuS production assemblies undergo extended life testing before they are approved for use. Three subgroups of 30 pieces each run through spectrum analysis, LIV curve testing, burn in, and a life test of up to 2,500hrs at 150°C. This testing provides confidence that our products will withstand extreme operating conditions over their lifespan.

Element Evaluation Testing

All microcircuit and semiconductor die lots used in the FOCuS product are tested per MIL-PRF-38534J, Appendix C, Table C-II, before being used in production assemblies. The testing is tailored to our exact usage case. Testing includes the following:

MIL-PRF-38534J APPENDIX C

TABLE C-II. Microcircuit and semiconductor dice evaluation requirements.

Subgroup	Class		Test	MIL-STD-883		Quantity (accept number)	Reference paragraph
	K	H		Method	Condition		
1	X	X	Element electrical			100 percent	C.3.3.1
2	X	X	Element visual	2010 1/ 2069 1/ 2070 1/ 2072 1/ 2073		100 percent	C.3.3.2
3	X	X	Internal visual	2010 1/ 2069 1/ 2070 1/ 2072 1/ 2073		10 (0)	C.3.3.3 C.3.3.4.2
4	X		Temperature cycling	1010	C	2/ 10 (0)	C.3.3.3
	X		Mechanical shock or Constant acceleration	2002 2001	B, Y1 direction 3,000 g's, Y1 direction		
	X		Interim electrical				C.3.3.4.3
	X		Burn-in	1015	240 hours minimum at +125°C		
	X		Post burn-in electrical				C.3.3.4.3
	X		Steady-state life	1005			
	X	X	Final electrical				C.3.3.4.3
5	X	X	Wire bond evaluation	2011		10 (0) wires or 20 (1) wires	C.3.3.3 C.3.3.5
6	X		SEM	2018 1/ 2077		See method 2018 of MIL-STD-883 or method 2077 of MIL-STD-750	C.3.3.6

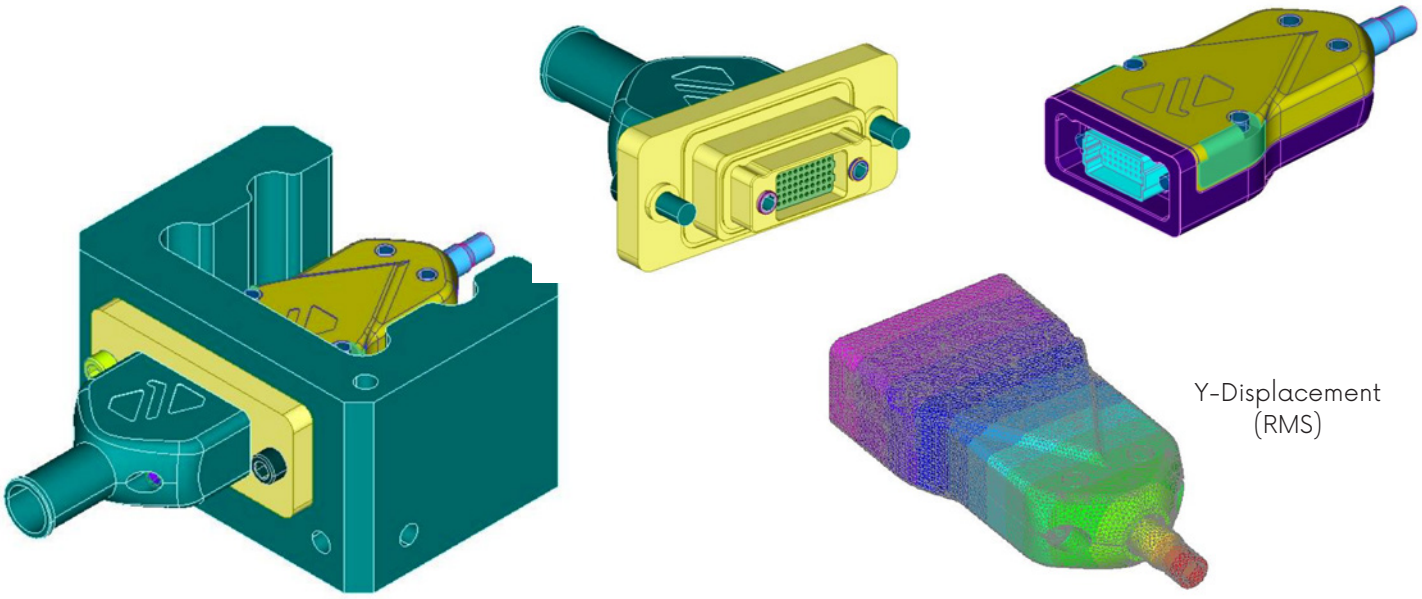
Class I laser product that complies with FDA performance standards for laser products except for conformance with IEC 60825-1 Ed. 3, as described in Laser Notice No. 56, dated May 8, 2019.

Design Analysis

Several design analyses were performed on the FOCuS 4X verSI cable throughout the design process, in order to provide insight for how to optimize the design. These optimizations greatly improve the ability of the cable to successfully pass Qualification testing and perform in the field.

FEA Modal and Stress Analysis

A finite-element analysis using Nastran has been performed on the cable and mating interface to determine natural frequencies and Von Mises stress levels developed during Vibration testing. Positive margins of safety are maintained throughout this test, both in Yield and Ultimate Strength, for all mechanical components. Additionally, fastener torque levels have been analyzed to assure preload is maintained. When paired with vibration testing, this analysis provides a high confidence level that the cable can withstand extreme vibration environments. An excerpt from the report can be seen below, as well as images of the FEA model.



Y-Displacement (RMS)

Margins of Safety

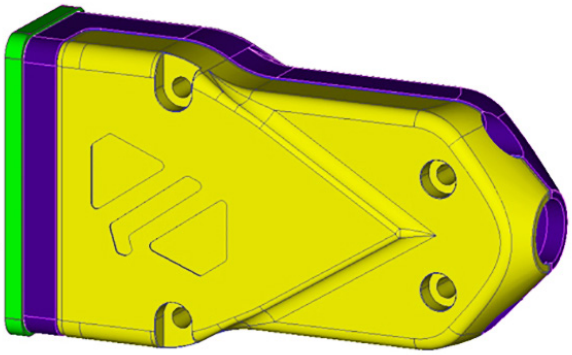
Part	Von Mises Stress (3σ) ksi	Yield Strength (ksi)	Ultimate Strength (ksi)	MOS-y FS – 1.0	MOS-u FS – 1.4
PWB – Cu	1.8	4.83	30.5	1.68	> 5
PWB – FR4	0.3	N/A	45.0	N/A	> 5
Flex Circuit - Polyimide	1.8	N/A	50.0	N/A	> 5
Flex Circuit – Cu	0.3	4.83	30.5	> 5	> 5
Cover	8.8	40.0	45.0	3.56	2.62
Backshell	12.9	40.0	45.0	2.09	1.46
Jackscrew	23.9	75.0	125.0	2.14	2.70
Jacknut	24.4	75.0	125.0	2.07	2.62
Fixture – Connector	7.7	40.0	45.0	4.20	3.13
Fixture – Backshell	5.6	40.0	45.0	> 5	4.69
Fixture - Block	1.5	40.0	45.0	> 5	> 5

Structural and Thermal Fatigue Analysis

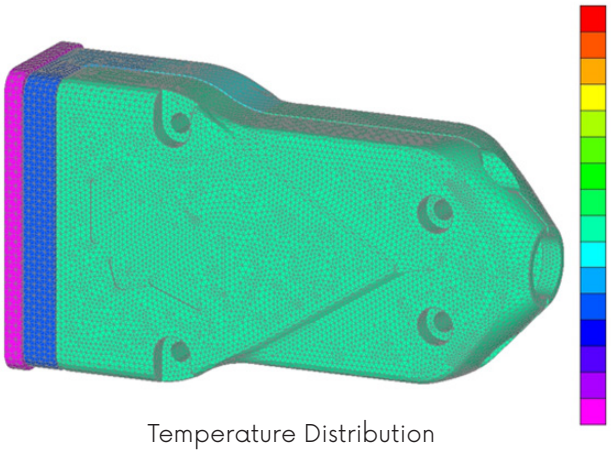
A structural and thermal fatigue analysis has been performed on all legacy AirBorn Active Optical Cable designs, to ensure structural integrity throughout the mission. The structural fatigue analysis accounted for damage due to vibration as well as thermal cycling.

Heat Transfer Analysis

The FOCuS PCBA has been optimized to enhance thermal transfer from high-power-consuming-die onboard, into the host assembly, thereby minimizing the temperature rise of these die. A complete finite element model of the PCBA and thermal path has been generated, to predict maximum case and junction temperatures for all onboard die. In conjunction with thermal vacuum testing, this analysis provides high confidence that the cable will continue to perform within our stated operating temperature range.



CAD Geometry



Temperature Distribution

Venting Analysis

A venting analysis has been performed of the cable backshell and all inner semi-enclosed cavities, to ensure the pressure change due to rapid ascent or descent through Earth's atmosphere does not cause structural damage. The analysis follows the approach of NASA Memorandum 85016 to determine pressure differentials, and utilizes structural FEA analysis to show margins of safety.

$$\Delta P = \frac{1}{2RTPe}\left(\frac{\dot{V}Pe}{AC_D}\right)^2$$

Parts & Materials list and Outgassing

A complete parts and materials list has been generated to identify every unique material utilized within the cable assembly, with the exception of board-mounted electronics. All non-metallic materials have been outgas tested per ASTM-E-595.

Class I laser product that complies with FDA performance standards for laser products except for conformance with IEC 60825-1 Ed. 3, as described in Laser Notice No. 56, dated May 8, 2019.

Failure Mode, Effects and Criticality Analysis

A Failure Mode, Effects and Criticality Analysis (FMECA) has been performed on all legacy AirBorn Active Optical Cable designs to identify and eliminate single point failures, in an effort to reduce the possibility of mission failure.

Reliability Analysis

A Reliability Analysis has been performed on all legacy AirBorn Active Optical Cable designs to calculate the predicted probability of success for a mission. This analysis accounts for all components in the data transfer path, from one end of the cable to the other.

Worst Case Analysis

A Worst Case Analysis has been performed on all legacy AirBorn Active Optical Cable designs. This analysis provides a method for analytically verifying circuit performance and derating requirements have been met over a program specified environment and design life. It is an effective tool in validating electrical circuit design stress and estimated performance margins, to a customer's specific operating environment.

The AirBorn Advantage

Model-To-Market Solutions

Custom Power Systems

VPX Power Supply

Flexible Circuit Assemblies

Cable Assemblies

FUZE Assemblies

Active Optical Assemblies

Rectangular W Series

Rectangular R Series

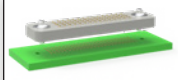
Micro D M Series

Nano D N Series

High-Speed Rectangular verSI

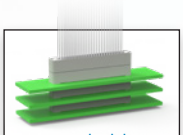
Modular Hybrid SInergy

Macro D RocKet



Z Axis Interposer Z Series

High-Speed Micro D microSI



Stackable RC Series

Circulars Series 360

Strip Connector AirStrip

PowerAmp 13A or 23A

Rugged Circulars TriMate

FAOCC-2.25

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