Data Bus In-Line Coupler and In-Line Terminator Requirements Document

DC-1001-A

Revision B

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1. Introduction

1.1. Scope. The scope of this document is to describe the design, performance and qualification test requirements of Phoenix Logistics, Inc. manufactured data bus in-line couplers and in-line terminators with shielded twisted pair data bus cables, as equivalent to Raychem D-500-04XX and D-500-L4XX series spliced in couplers and D-500-04XX series spliced in terminators.

1.2. Description. Couplers and terminators covered in this document are EMI-shielded, environmentally sealed, non-repairable assemblies, which are installed as integral parts of a data bus harness. These couplers and terminators are designed to meet or exceed MIL-STD-1553B couplers and terminators referenced in US Air Force Drawing 8340707

1.3. Cable accommodation. Couplers and terminators specified in this document are able to accommodate the following cable types:

- 1.3.1. Single shield twinaxial cable, 24-26 AWG; reference Phoenix Logistics part number C24612
- 1.3.2. Double shield twinaxial cable; reference Phoenix Logistics part number C24613
- 1.3.3. EMP Hardened cable; reference Phoenix Logistics part number C24614
- 1.3.4. MIL-C-17/176-00002, RF cable, flexible and semi-rigid
- 1.3.5. Customer defined cable

1.4. Classification.

- 1.4.1. Couplers:
  - 1.4.1.1. Micro, including types with integral terminators
  - 1.4.1.2. Lightweight Micro, including types with integral terminators
- 1.4.2. Terminators:
  - 1.4.2.1. Spliced in type

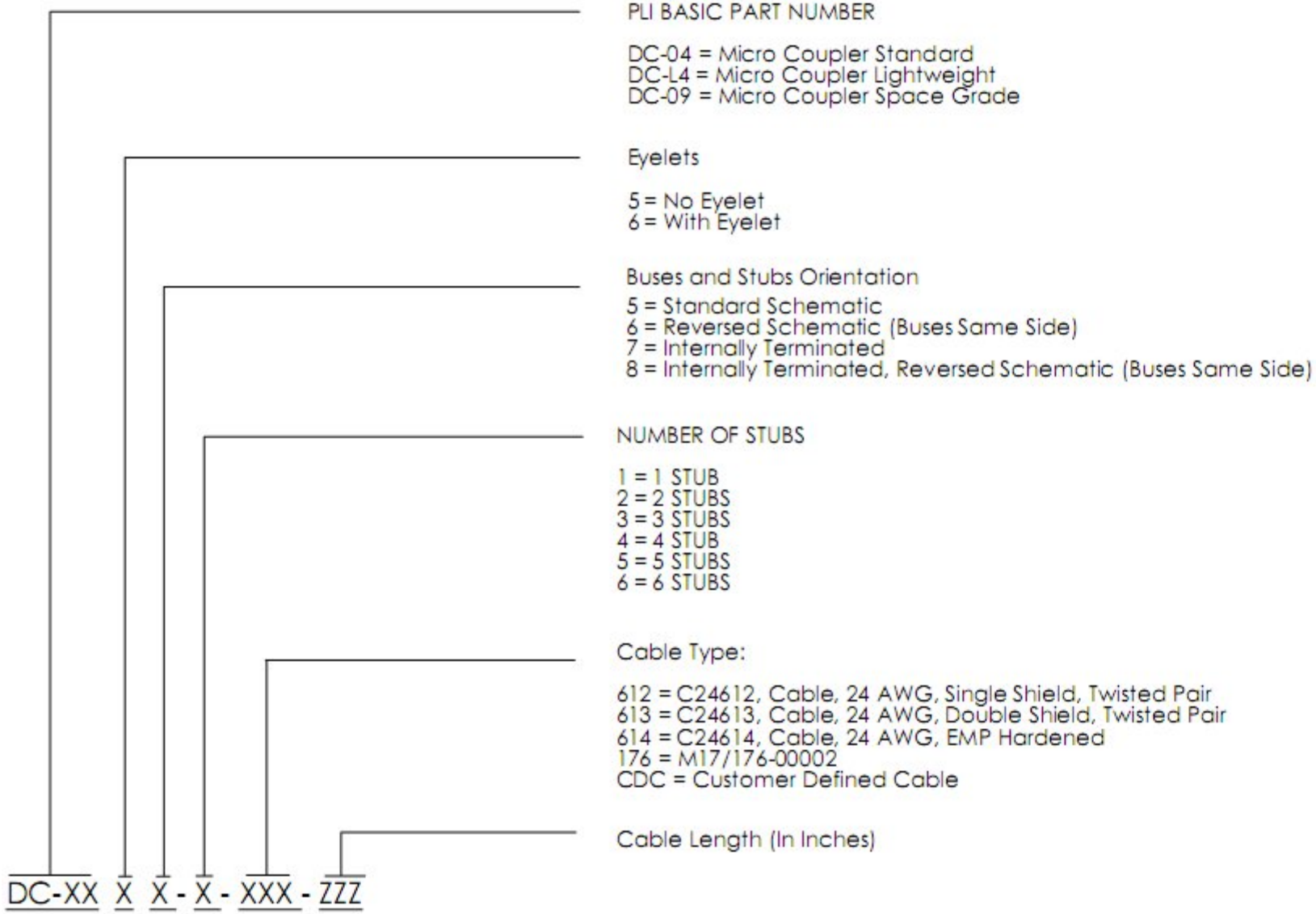
1.5. Material and Finishes.

- 1.5.1. Transformer: MIL-PRF-21038 and MIL-STD-1553B
- 1.5.2. Isolation Resistors: MIL-PRF-39007/9, 56.60 – 58.90 ohms, 1 Watt minimum, non inductive, or equivalent
- 1.5.3. Coupler Termination Resistors: MIL-PRF-39007/8, 76.8 Ohms, ± 1%, 2 W minimum, non-inductive, or equivalent
- 1.5.4. In-line Terminator Resistors: MIL-PRF-39007/X, XXX Ohms, ± 1%, 2 W minimum, non-inductive, or equivalent
- 1.5.5. Coupler Housing: BeCu per ASTM B194, tin over copper plating per ASTM B545, or Brass per ASTM B16, tin over copper plating per ASTM B545, or Cold Rolled Steel per ASTM A1008; tin over copper plating per ASTM B545
- 1.5.6. Terminator Housing: Brass per ASTM B16, tin over copper plating per ASTM B545
- 1.5.7. Housing Cover, coupler and terminator: Environmentally sealed fluoroelastomer VITON GLT®, or equivalent

1.6. Temperature Range. Couplers and terminators covered in this specification are suitable for use over the temperature range -65° to +150° C. Operating temperature is the maximum temperature reached at any point as a result of electrical current and ambient temperature.

Figure 1

In-Line Coupler Part Numbering System



Example:

DC-0456-2-612-120 = Coupler, In-Line, No Eyelet , Reversed Schematic, (Buses Same Side), 2 Stubs

Figure 2

1 STUB STANDARD CONFIGURATIONS

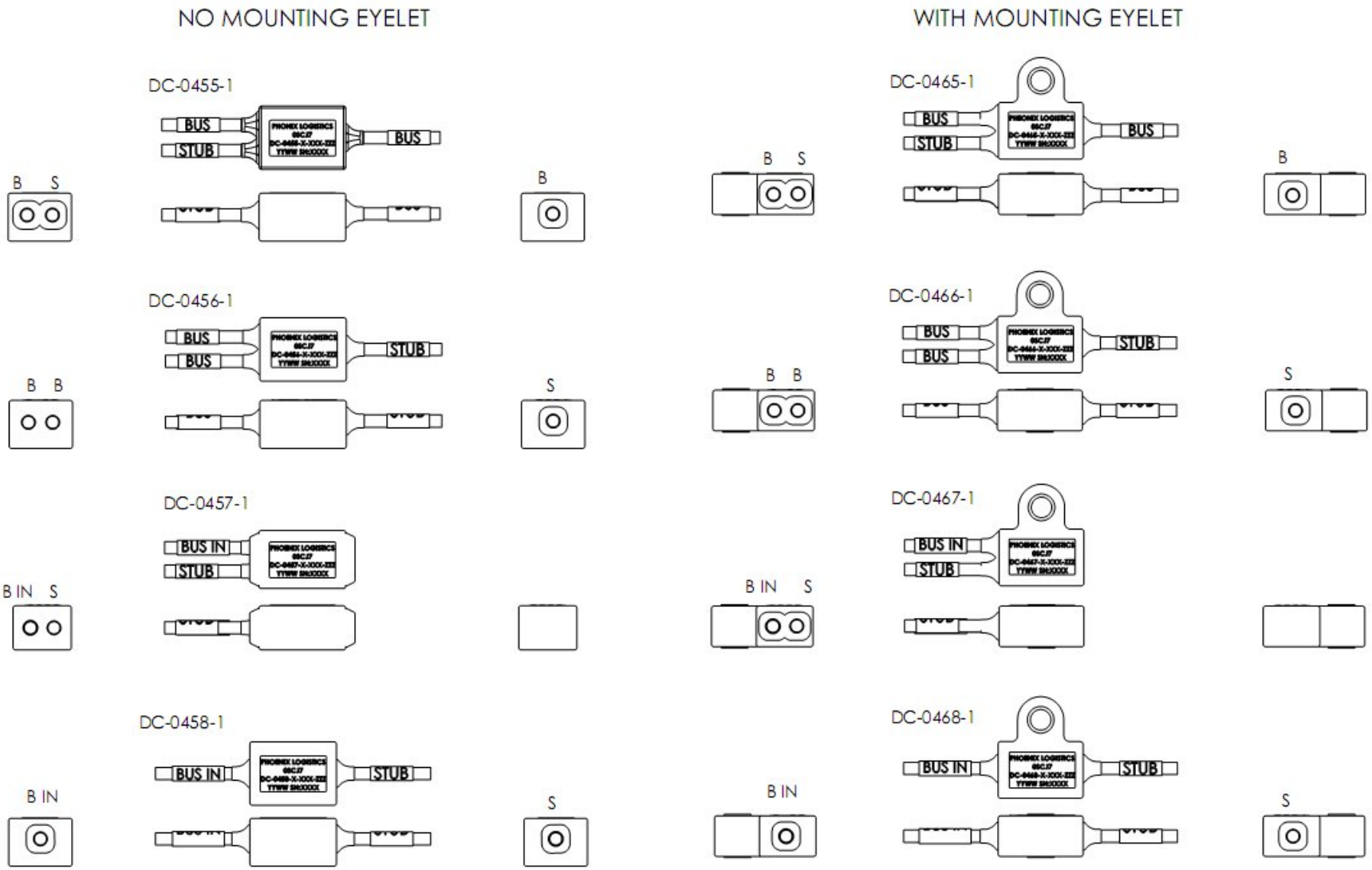


Figure 3

2 STUB STANDARD CONFIGURATIONS

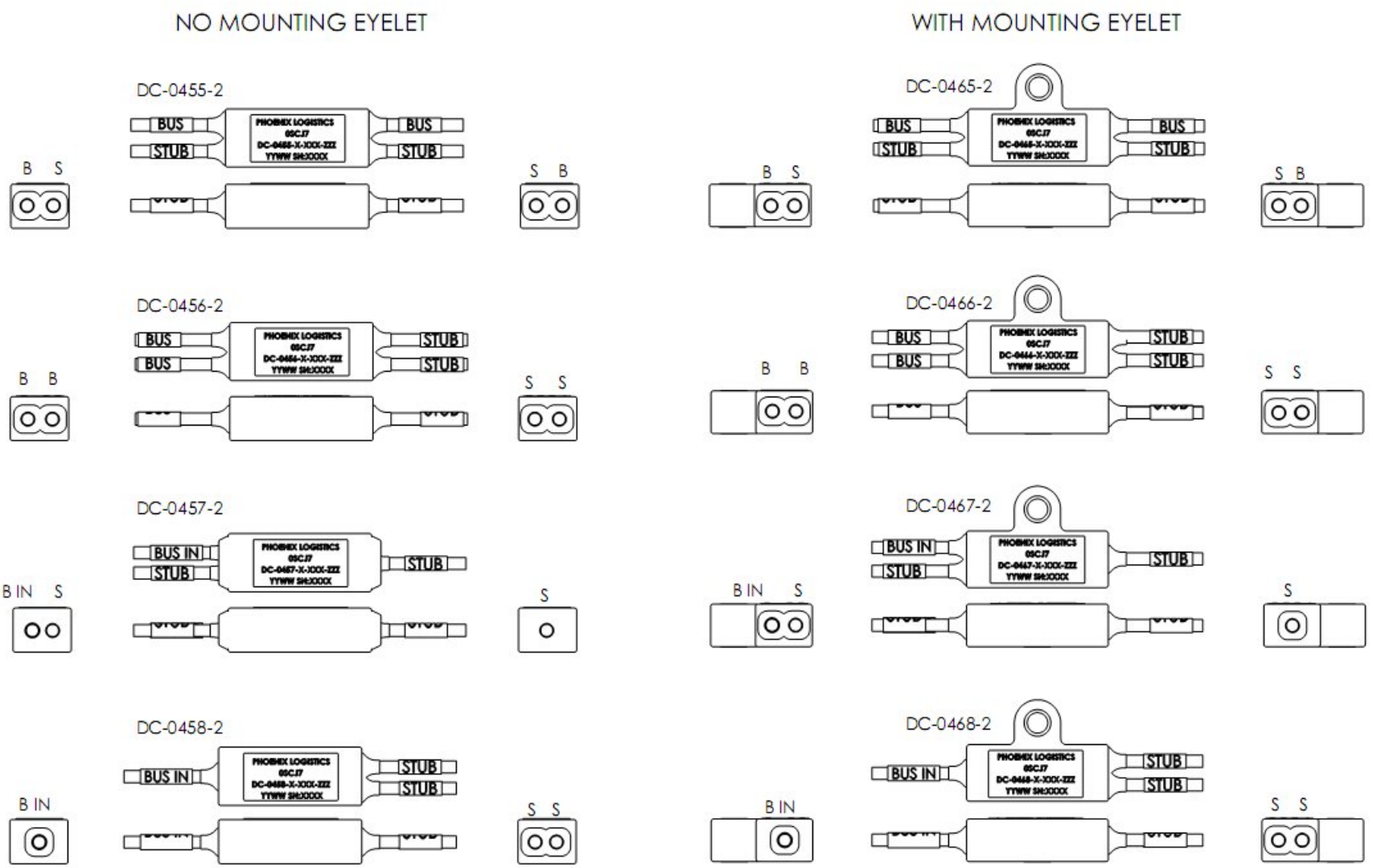


Figure 4

3 STUB STANDARD CONFIGURATIONS

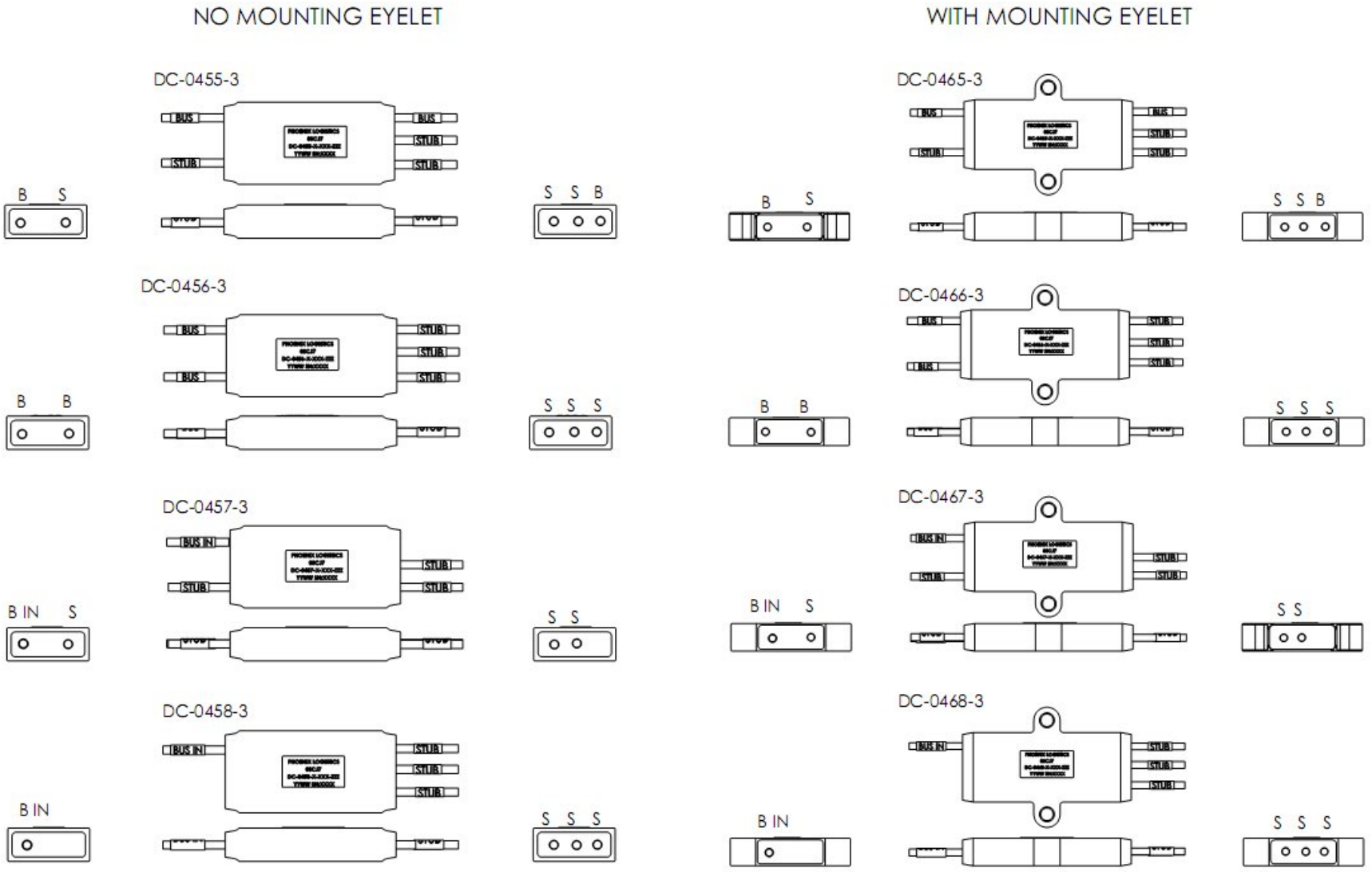


Figure 5

4 STUB STANDARD CONFIGURATIONS

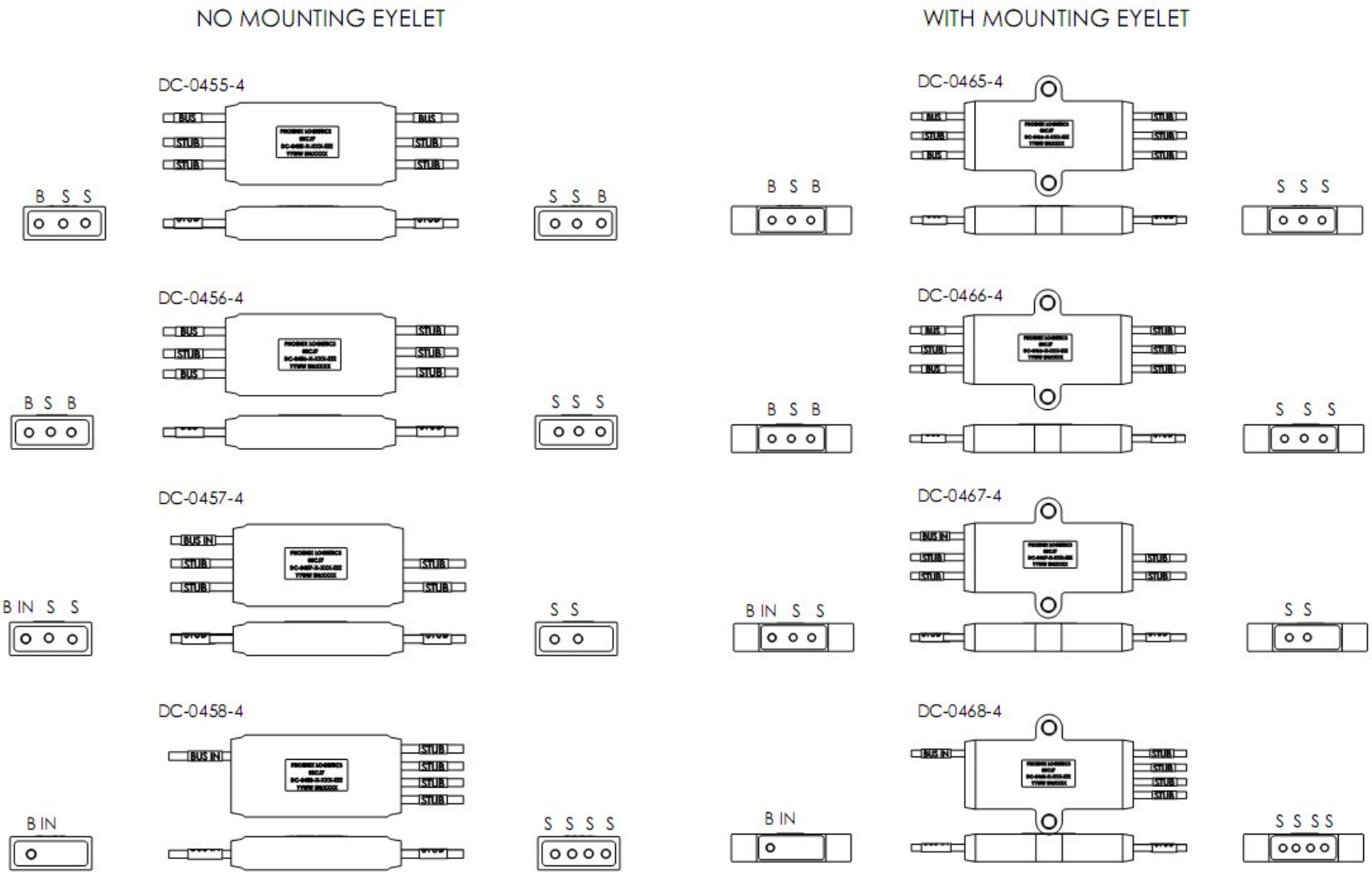


Figure 6

5 STUB STANDARD CONFIGURATIONS

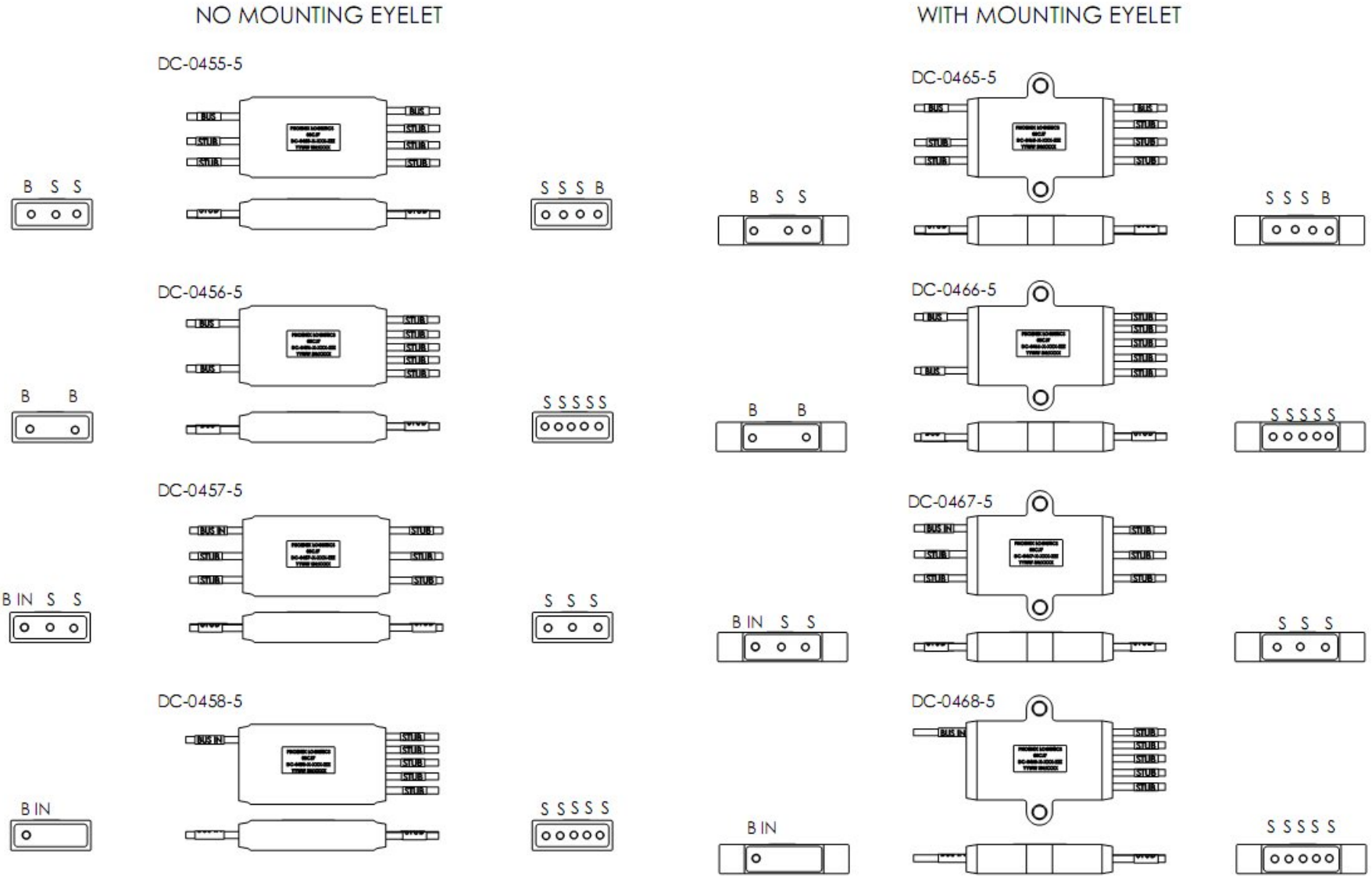


Figure 7

6 STUB STANDARD CONFIGURATIONS

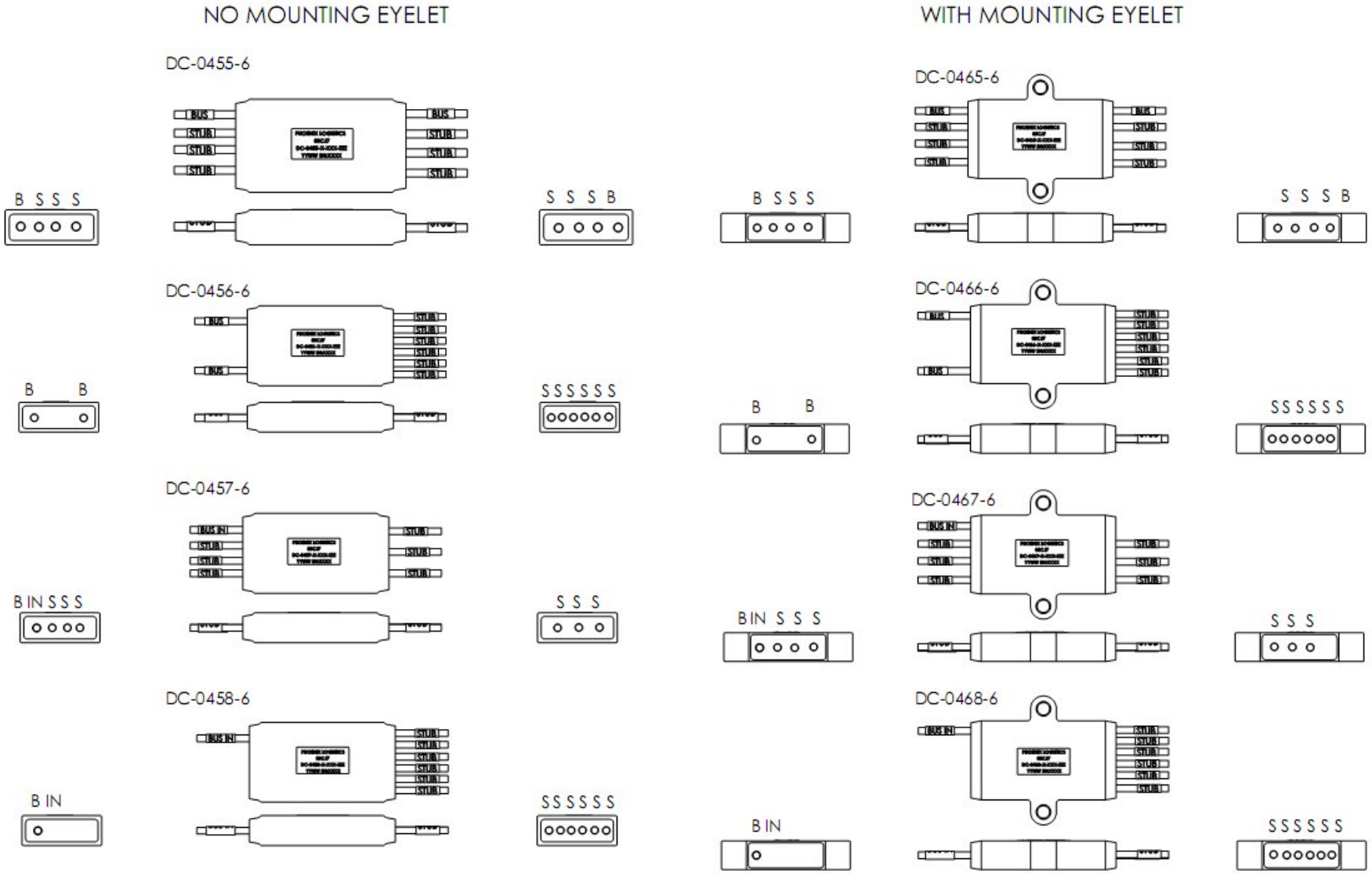


Figure 8

1 STUB LIGHTWEIGHT CONFIGURATIONS

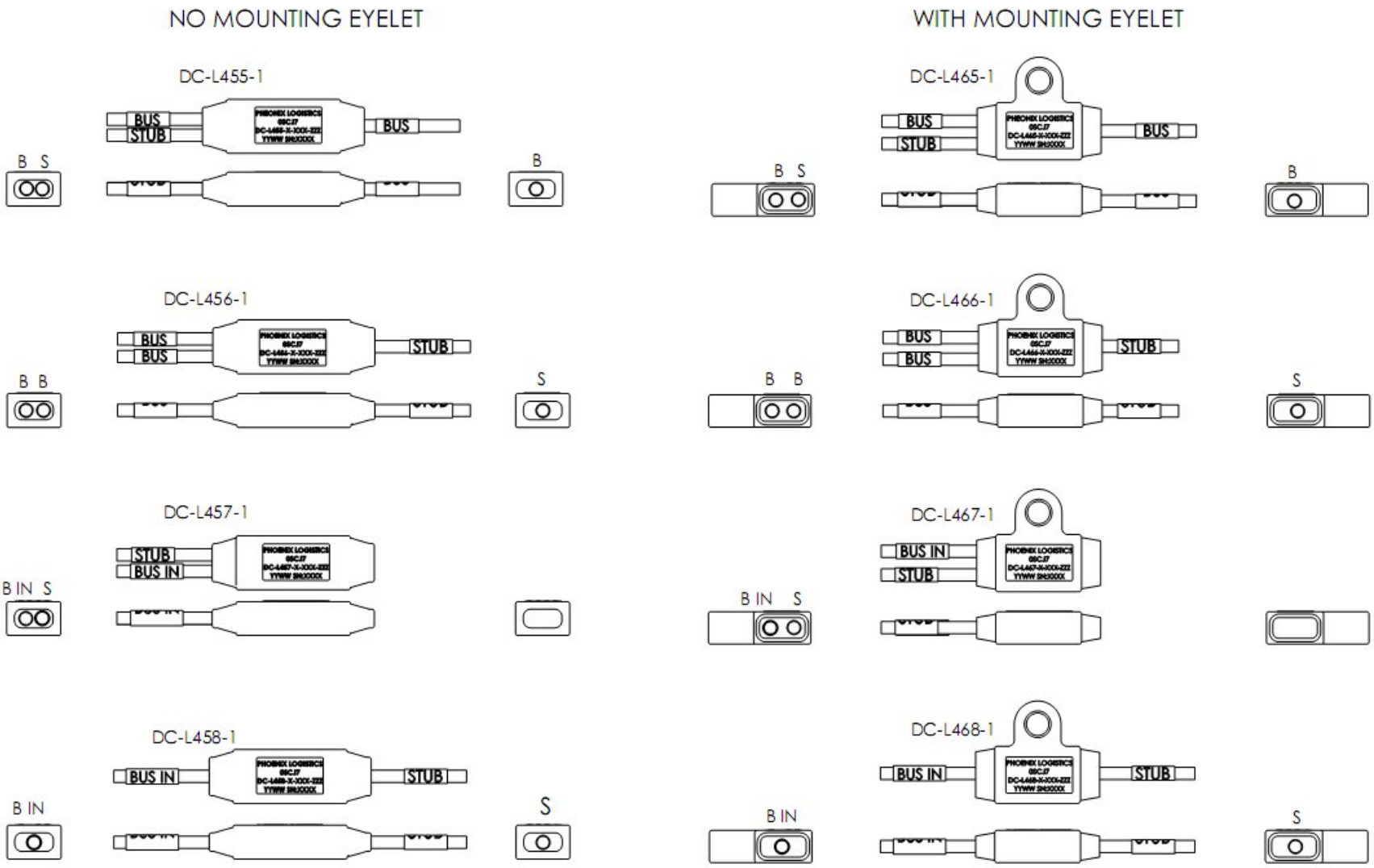


Figure 9

2 STUB LIGHTWEIGHT CONFIGURATIONS

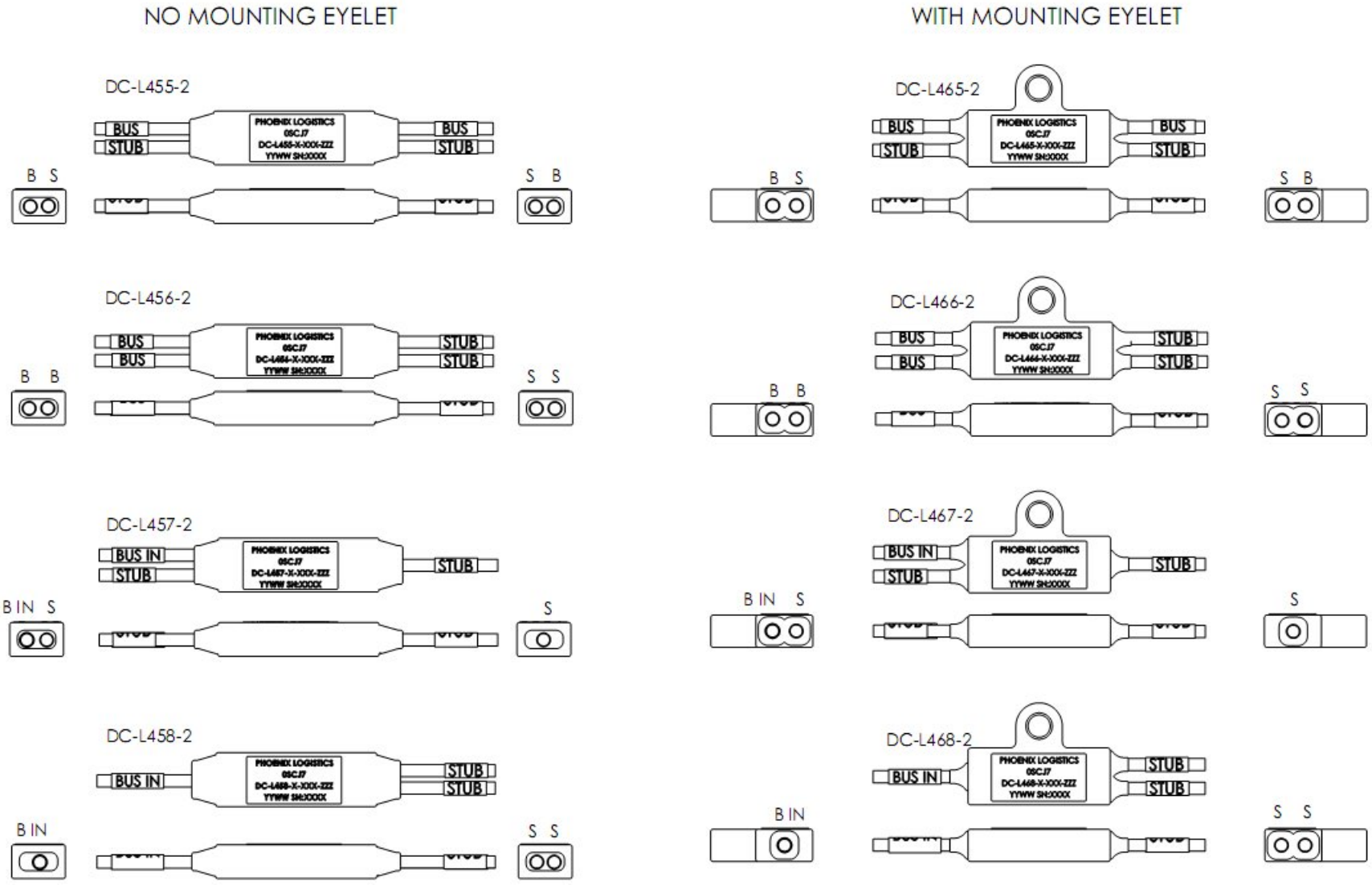
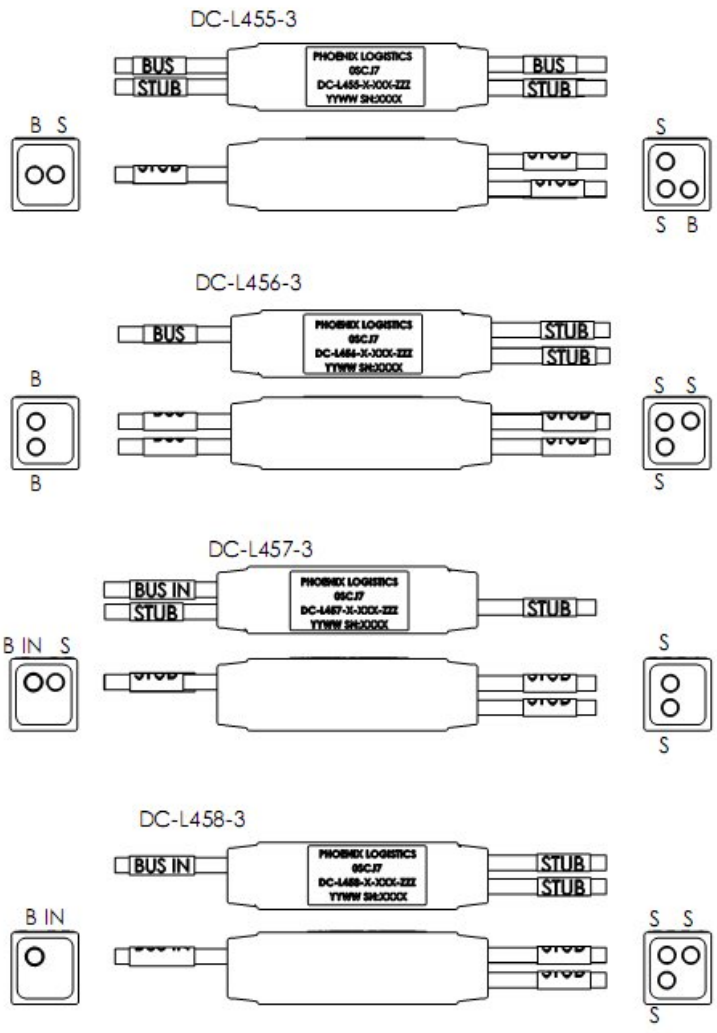


Figure 10

3 STUB LIGHTWEIGHT CONFIGURATIONS

NO MOUNTING EYELET



WITH MOUNTING EYELET

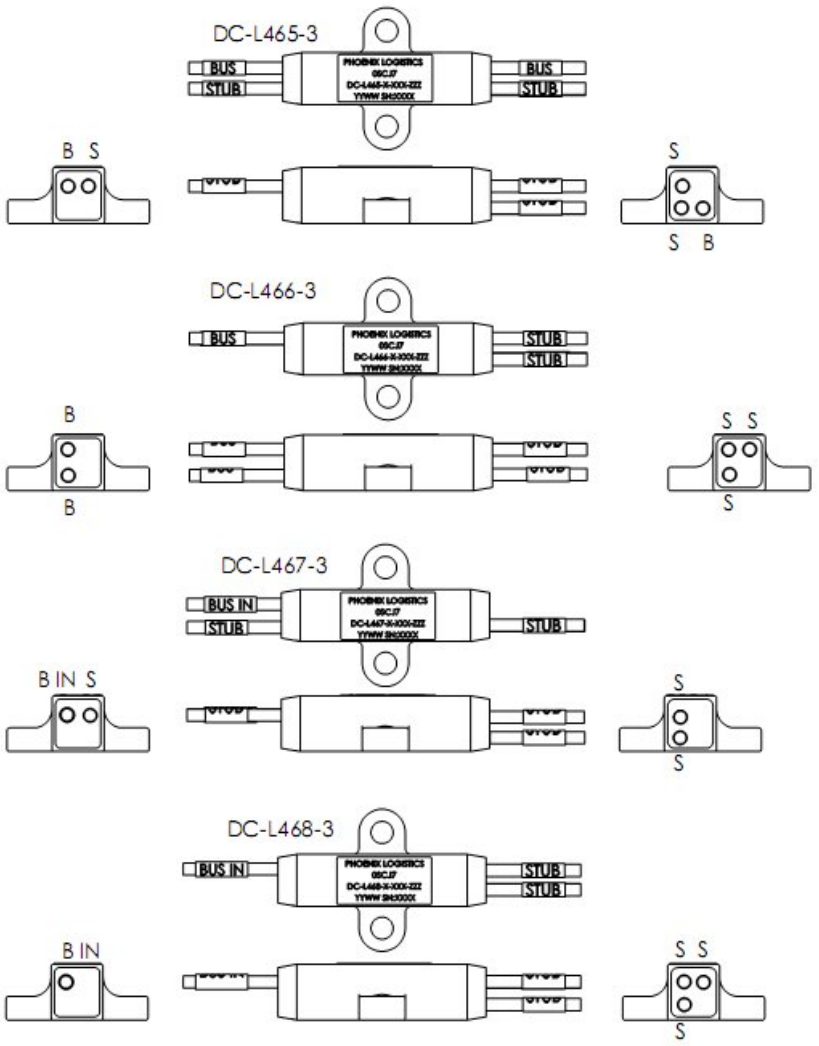


Figure 11

4 STUB LIGHTWEIGHT CONFIGURATIONS

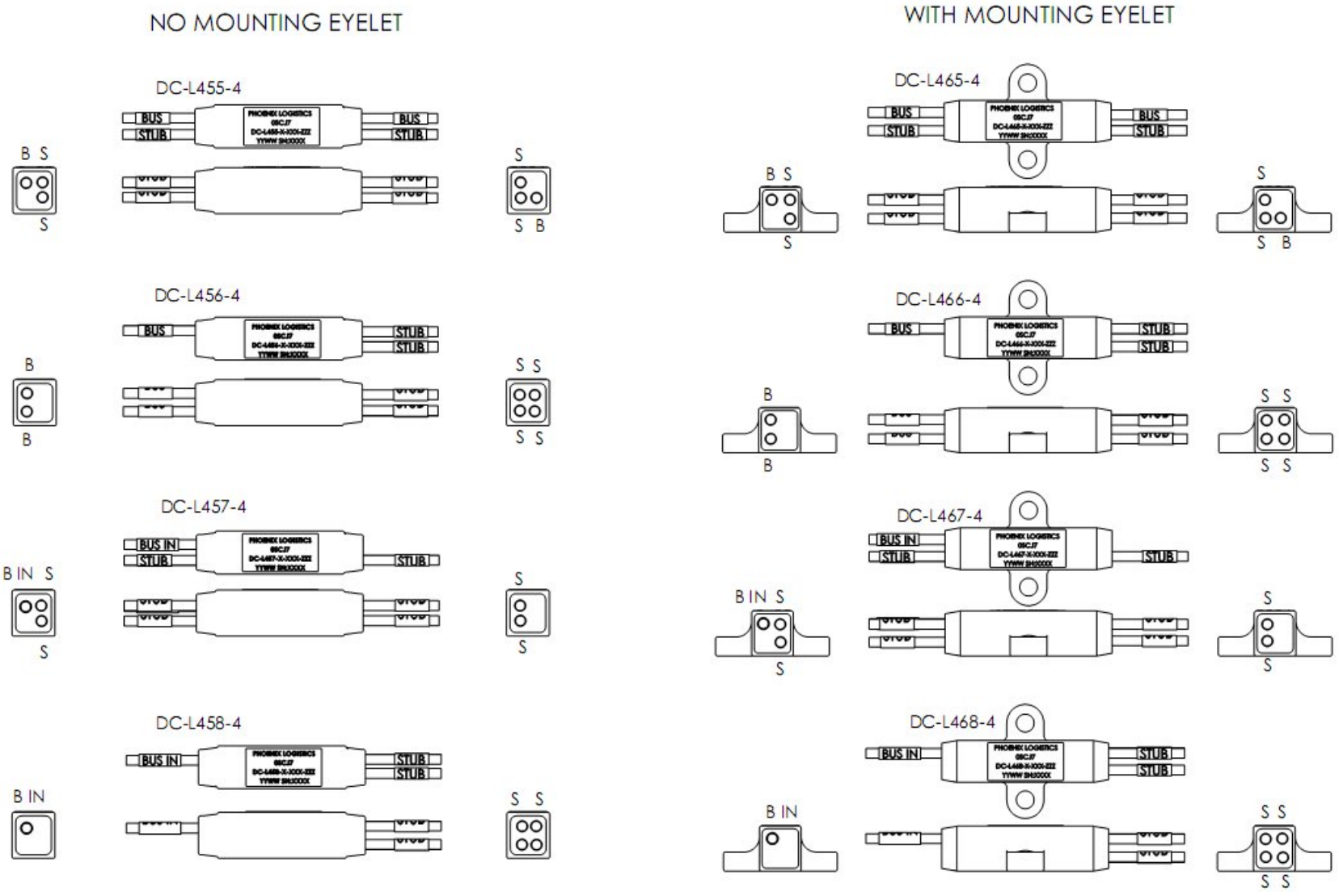
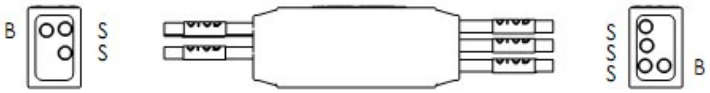


Figure 12

5 STUB LIGHTWEIGHT CONFIGURATIONS

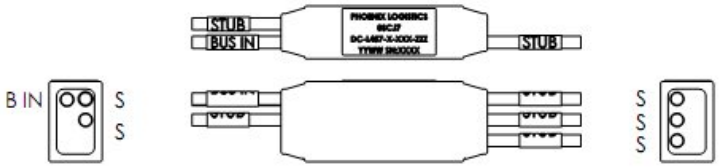
NO MOUNTING EYELET

DC-L455-5



DC-L456-5

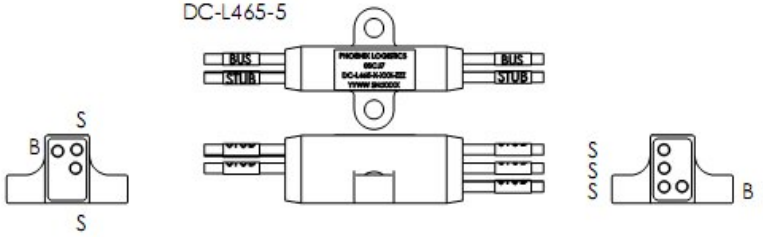
DC-L457-5



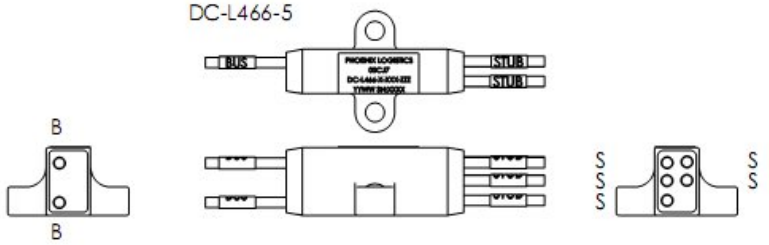
DC-L458-5

WITH MOUNTING EYELET

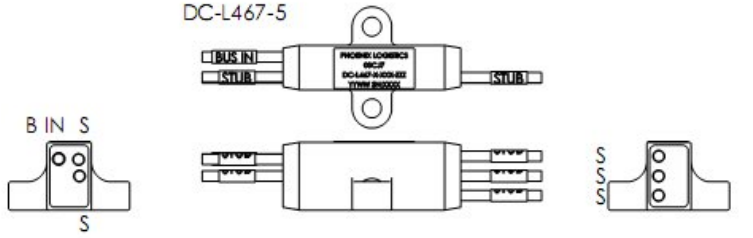
DC-L465-5



DC-L466-5



DC-L467-5



DC-L468-5

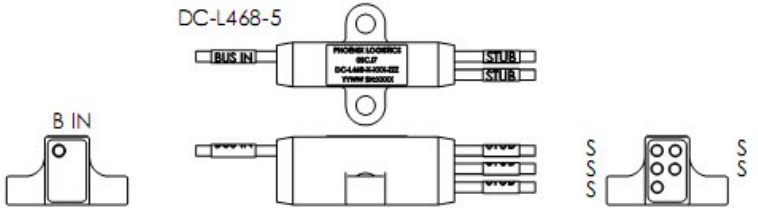
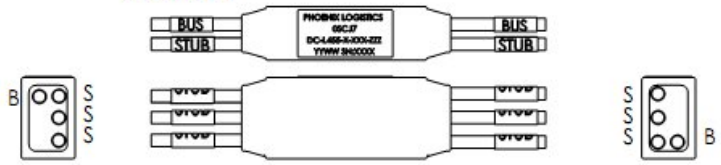


Figure 13

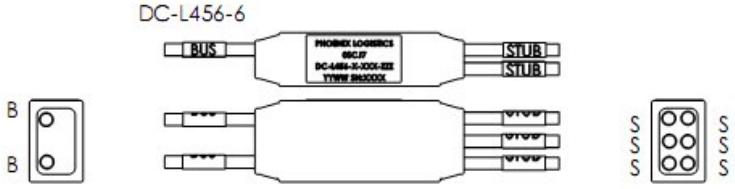
6 STUB LIGHTWEIGHT CONFIGURATIONS

NO MOUNTING EYELET

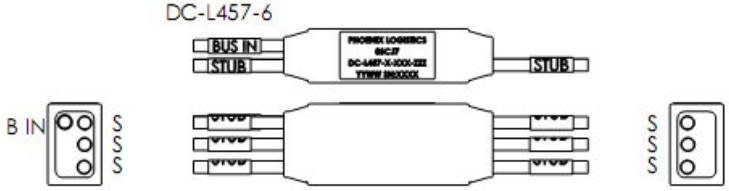
DC-L455-6



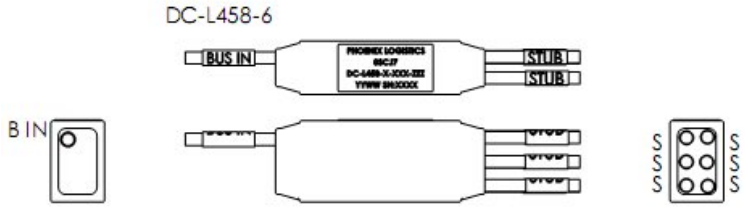
DC-L456-6



DC-L457-6

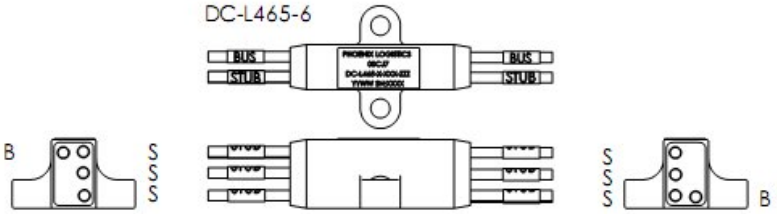


DC-L458-6

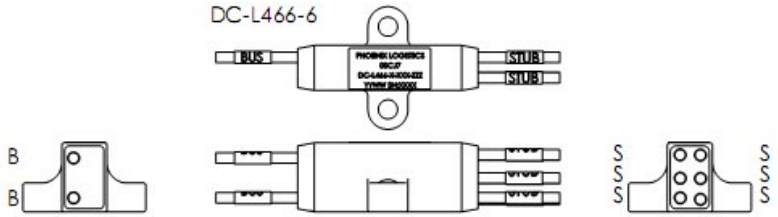


WITH MOUNTING EYELET

DC-L465-6



DC-L466-6



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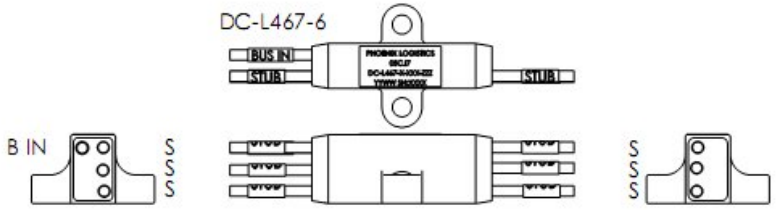

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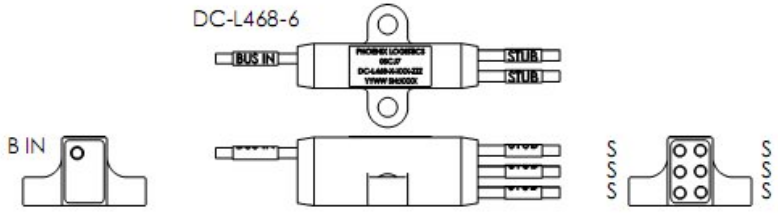
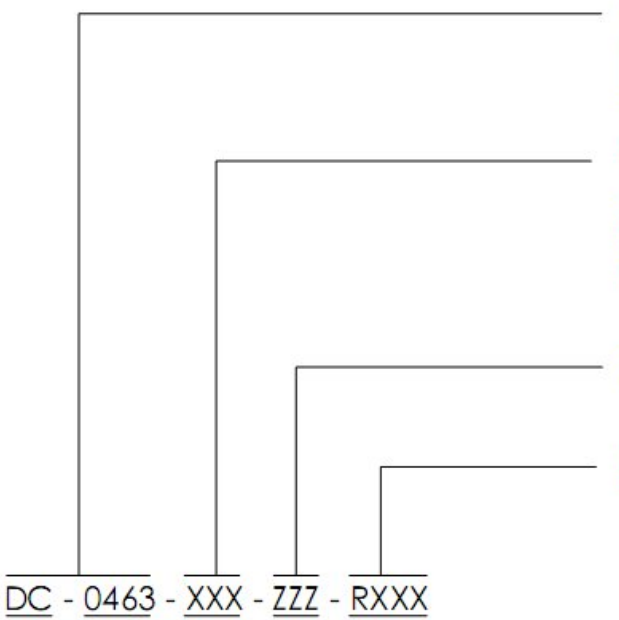
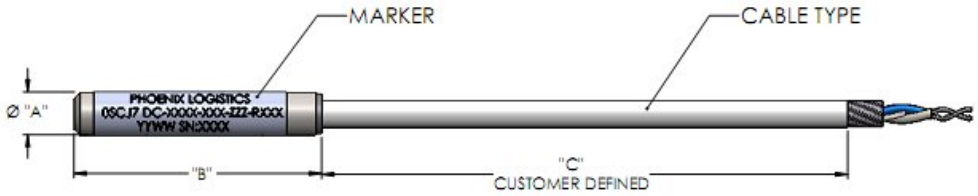


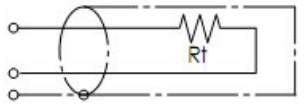
Figure 14

IN-LINE TERMINATOR



PART NUMBER	"A" MAX	"B" MAX	"C" MAX
DC-0263	Ø 0.55	2.70	12.0 MIN.
DC-0463	Ø 0.375	1.60	12.0 MIN.
DC-9463	Ø 0.260	1.20	12.0 MIN.





Example:

DC-0463-612-012-120 = In-Line, Terminator, Cable=C24612, Length=12.0", Resistor=120 Ohm.

Figure 15

CABLE TYPES

612 = C24612, Cable, 24 AWG, Single Shield, Twisted Pair

613 = C24613, Cable, 24 AWG, Double Shield, Twisted Pair

614 = C24614, Cable, 24 AWG, EMP hardened

176= M17/176-00002

CDC = Customer Defined Cable

2 Standards and Specifications

2.1 Order of Precedence. This document forms part of a specification to the extent specified herein. In the event that the requirements stated in this document conflict with the applicable drawing, the drawing shall take precedence. If this document and the referenced specifications or standards listed herein conflict, this document shall take precedence.

J-STD-004	Soldering Fluxes
J-STD-006	Electronic Grade Solder Alloys and Fluxed or Non-Fluxed Solid Solders
ASTM B16	Brass, Rod, Free-Cutting, Bar and Shapes for use in Screw Machines
ASTM B196	Copper-Beryllium Alloy, Rod and Bar
ASTM B545	Coatings, Electrodeposited Tin
ASTM E595	Standard Test Method for TML and CVCM from Outgassing in a Vacuum Environment
NASA Ref 1124	Outgassing Data for Selecting Spacecraft Materials
MIL-STD-1553B	Aircraft Internal Time Division Command/ Response Multiplex Data Bus
SAE AS85485	Cable, Electric, Filter Line, Radio Frequency Absorptive
USAF 8340707	MIL-STD-1553 Data Bus System Components
MIL-PRF-21038	Transformer, Pulse, Low Power
MIL-PRF-39007	Resistors, Fixed, Wire-Wound
MIL-STD-129	Marking for Shipment and Storage
MIL-STD-130	Identification Marking of U.S. Military Property
ISO10012-1	Calibration System Requirements
ANSI/ASQ Z1.4	Sampling Procedure
MIL-STD-202	Test Methods for Electronic and Electrical Component Parts
MIL-HDBK-454	General Guidelines for Electronic Equipment
MIL-STD-810	Environmental Engineering Considerations and Laboratory Tests
ANSI/EIA 364	Electrical Connector Test Procedure

3 Requirements

3.1 Material Requirements. All materials used in the manufacture of couplers and terminators shall be of quality and form best suited for the intended purpose.

3.1.1 Dissimilar Materials shall be in accordance with Guideline 16 of MIL-HDBK-454.

3.1.2 Fungus Resistance shall be in accordance with Guideline 4 of MIL-HDBK-454 for fungus species listed in Method 508.6 of MIL-STD-810.

3.1.3 Materials and finishes for specific components of the couplers and terminators shall be as shown on the applicable component specification drawing.

3.1.4 Couplers and terminators manufactured for Space applications: Materials and finishes used shall meet outgassing requirements of less than 1.00% Total Mass Loss (TML) and less than 0.10% Collected Volatile Condensable Material (CVCM) when tested in accordance ASTM E595 or NASA Reference Publication 1124.

3.2 Design and Construction Requirements. Couplers and terminators shall be designed and constructed to withstand handling during installation and maintenance. They shall consist of electrical components attached to data bus cables, within an EMI shielded housing that is solder sealed, then covered with environmentally sealed fluoroelastomer VITON GLT®.

3.2.1 Weight, configuration, and dimensions. These attributes shall be as shown in the applicable coupler or terminator specification drawing.

3.2.2 Interchangeability. All assemblies having the same part number shall be completely interchangeable with each other for both installation and during use.

3.3 Product Identification. Couplers and terminators shall be labeled on an external surface with manufacturer name, part number, and serial number and/or date code. Marking shall remain legible after completion of all testing specified herein.

3.4 Workmanship. Couplers and terminators shall be processed to be uniform in quality and shall be free from defects that would adversely affect life or performance.

3.5 Performance Requirements. Coupler and terminator assemblies shall conform to the requirements specified herein and the applicable coupler and terminator specification drawing. Room temperature shall be 25 ± 5 ˚C unless otherwise specified. The nominal characteristic impedance of the data bus cable is 77 Ohms.

ELECTRICAL TESTS; INTERNAL COMPONENTS

3.5.1 Transformer Turns Ratio. When tested as specified in 4.7.2 the turns ratio of the transformer shall meet the requirements of MIL-STD-1553B, paragraph 4.5.1.5.1.1.

3.5.2 Transformer Input Impedance. When tested as specified in 4.7.3 the input impedance of the transformer shall meet the requirements of MIL-STD-1553B, paragraph 4.5.1.5.1.1.1.

3.5.3 Transformer Waveform Integrity. When tested as specified in 4.7.4 the waveform integrity of the transformer shall meet the requirements of MIL-STD-1553B, paragraph 4.5.1.5.1.1.2.

3.5.4 Transformer Common Mode Rejection. When tested as specified in 4.7.5 the common mode rejection of the transformer shall meet the requirements of MIL-STD-1553B, paragraph 4.5.1.5.1.1.3.

ELECTRICAL TESTS; COUPLERS AND TERMINATORS

3.5.5 Electrical Performance Test. When tested as specified in 4.7.6 there shall be no detected errors. This test may be used instead of discontinuity monitoring during environmental testing.

3.5.6 Dielectric Withstanding Voltage. When tested as specified in 4.7.7 there shall be no arcing or breakdown between each conductor and shield of the attached cables, or between Bus and Stub conductors.

3.5.6.1 Dielectric Withstanding Voltage (Water Bath). When tested as specified in 4.7.7 there shall be no arcing or breakdown between the cable shield and the water bath in which the specimen is immersed.

3.5.7 Insulation Resistance. When tested as specified in 4.7.8 the insulation resistance between each conductor and shield shall be 1000 M Ohms minimum.

3.5.7.1 Insulation Resistance (Water Bath). When tested as specified in 4.7.8 the insulation resistance shall be 1000 M Ohms minimum.

3.5.8 Surface Transfer Impedance. When tested as specified in 4.7.9 the surface transfer impedance shall not exceed the limits of Table 1.

Table 1: Surface Transfer Impedance

Cable shield style	USAF 8340707 Class (PLI P/N)	Zt @ 1 MHz (milliohms / meter), maximum
Optimized Single Braid	C (C24612)	50
Optimized Double Braid	D (C24613)	10
EMP Hardened	E (C24614)	1.0

ENVIRONMENTAL TESTS; Couplers and terminators shall meet electrical performance and dielectric withstanding voltage test requirements following each environmental test and shall be visually examined at 3X magnification for any evidence of damage that could impair proper functioning.

3.5.9 Temperature Shock (-65 ˚C to +150 ˚C). When tested as specified in 4.7.10 there shall be no visual evidence of functional damage. There shall be no discontinuities during the test and test specimen shall pass electrical performance test requirements at both high and low temperatures.

3.5.10 Altitude Immersion (75,000 ft). When tested as specified in 4.7.11 there shall be no visual evidence of functional damage and following immersion test specimen shall pass insulation resistance test requirements of 3.5.7.

3.5.11 Moisture Resistance (10 day cyclic humidity). When tested as specified in 4.7.12 there shall be no visual evidence of functional damage, and following immersion specimens shall meet insulation resistance test requirements of 3.5.7.

3.5.12 Salt Atmosphere (1000 hrs). When tested as specified in 4.7.13 there shall be no visual evidence of functional damage.

3.5.13 Sinusoidal Vibration (0.06-in double amplitude). When tested as specified in section 4.7.14 there shall be no electrical discontinuities greater than 1 microsecond during the test and no visual evidence of functional damage.

3.5.14 Random Vibration (34g rms). When tested as specified in section 4.7.15 there shall be no electrical discontinuities greater than 1 microsecond during the test and no visual evidence of functional damage.

3.5.15 Mechanical Shock (100g, 6 msec). When tested as specified in section 4.7.16 there shall be no electrical discontinuities greater than 1 microsecond during the test and no visual evidence of functional damage.

3.5.16 Fluids Resistance (39 ˚C and 135 ˚C). When tested as specified in 4.7.17 there shall be no visual evidence of functional damage.

4 Quality Assurance

4.1 Responsibility. Phoenix Logistics, Inc. shall be ultimately responsible for performance of all inspection requirements as specified herein. Inspection records shall be kept complete and available to the buyer as specified in the contract or order.

4.1.1 A contracted testing facility may be utilized for any or all qualification test requirements stated in this document as specified in the contract or purchase order to the contracted testing facility. The contracted testing facility may use its own or any other suitable testing facilities. Test records shall be kept complete and available to Phoenix Logistics, Inc. as specified in the contract or order.

4.2 Calibration. A calibration system in accordance with ISO 10012-1shall be utilized on all test and measurement equipment to control the accuracy of the tests performed.

4.3 Material Inspection. Unless otherwise specified, Phoenix Logistics, Inc. will maintain materials inspection and control, consisting of certification that the materials used are in accordance with the applicable engineering control drawing prior to the assembly of the couplers or terminators.

4.4 Acceptance Inspection. Shall be performed as indicated in Table 2 on every lot manufactured. In-process inspection may be used to fulfill acceptance inspections.

4.4.1 Acceptance Inspection shall be performed using sampling inspection per ANSI/ASQ Z1.4 as indicated in Table 2.

4.4.1.1 Rejected lots may be reworked or replaced and be resubmitted. Resubmitted lots shall be inspected using tightened inspection. Resubmitted lots shall include records of details of the rejection and action taken.

4.4.1.2 Inspection data shall be kept on record and be available for customers.

Table 2: Acceptance Inspections

Inspection / Test	Requirement Paragraph	Method Paragraph	Inspection Level *	AQL *
Material Requirements	3.1	4.7.1	II	1.0
Design & Construction	3.2	4.7.1	II	1.0
Product Identification	3.3	4.7.1	II	1.0
Workmanship	3.4	4.7.1	II	1.0
Electrical Performance Test	3.5.5	4.7.6	100%	100%
Dielectric Withstanding Voltage	3.5.6	4.7.7	100%	100%
Insulation Resistance	3.5.7	4.7.8	100%	100%

*Per ANSI/ASQC Z1.4

4.5 Qualification Inspection. Items furnished under this specification shall be products that are qualified to this specification by testing, by engineering analysis, by similarity to already qualified product, or by a combination of these methods.

4.5.1 Testing shall be performed as defined in Table 3, in the order shown. To determine order - go to the Test Specimen Group columns first, and then perform each test for that Test Specimen Group in the order of the numbers listed.

4.5.2 Qualification Test Specimens. Sufficient test specimens shall be selected to enable performance of all qualification tests listed. They shall be representative of product produced under normal production processes and equipment.

4.6 Qualification Test Report (QTR). Qualification testing is documented in the following Qualification Test Reports, and is available upon request:

4.6.1 D15195; by similarity - QTR for the In-Line Micro-Coupler (DC-04XX) and In-Line Terminator

4.6.2 D15242 - QTR for the In-Line Lightweight Micro-Coupler (DC-L4XX)

Table 3: Qualification Inspection; List and Performance Sequence								
Requirement Paragraph	Procedure Paragraph	Examination or Test	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6
			Specimens Tested & Sequence					
3.1	4.7.1	Material Requirements	1					
3.2	4.7.1	Design & Construction	2	1	1	1	1	
3.3	4.7.1	Product Identification	3	2	2	2	2	
3.4	4.7.1	Workmanship	4	3	3	3	3	
3.5.1	4.7.2	Transformer Turns Ratio	5					
3.5.2	4.7.3	Transformer Input Impedance	6					
3.5.3	4.7.4	Transformer Waveform Integrity	7					
3.5.4	4.7.5	Transformer Common Mode Rejection	8					
3.5.5	4.7.6	Electrical Performance Test	9	4	4	4	4	
3.5.6	4.7.7	Dielectric Withstanding Voltage	10	5	5	5	5	
3.5.7	4.7.8	Insulation Resistance	11	6	6	6	6	
3.5.8	4.7.9	Surface Transfer Impedance	12					
3.5.9	4.7.10	Temperature Shock	13					
3.5.10	4.7.11	Altitude Immersion	14					
3.5.11	4.7.12	Moisture Resistance				7		
3.5.12	4.7.13	Salt Atmosphere					7	
3.5.13	4.7.14	Sinusoidal Vibration		7				
3.5.14	4.7.15	Random Vibration		8				
3.5.15	4.7.16	Mechanical Shock (Specified Pulse)		9				
3.5.16	4.7.17	Fluid Immersion			7			

4.7 METHODS OF INSPECTION

4.7.1 Material, Design & Construction, Product ID & Workmanship (3.1 - 3.4). Couplers and terminators shall be examined to verify that the material, design & construction, product ID, and workmanship are in accordance with the requirements specified herein and the applicable engineering control drawings.

4.7.2 Transformer Turns Ratio (3.5.1). Testing shall be performed in accordance with MIL-PRF-21038. Transformer turns ratio shall be 1:1.41 ± 3% and the polarity of the transformer. During testing the output shall be between 0.6880 and 0.7300, with 0.7090 being nominal and the output voltage shall have the same instantaneous polarity as the input voltage, be in phase.

4.7.3 Transformer Input Impedance (3.5.2). Testing shall be performed in accordance with MIL-PRF-21038. Transformer input impedance shall be greater than 3000 Ohms.

4.7.4 Transformer Waveform Integrity (3.5.3). Testing shall be performed in accordance with MIL-PRF-21038. Transformer output waveform integrity shall be verified and shall include waveform droop, overshoot, and ringing. Droop shall be 20% max and Overshoot/Ringing shall be less than ±1.0 V.

4.7.5 Transformer Common Mode Rejection (3.5.4). Testing shall be performed in accordance with MIL-PRF-21038. Transformer common mode rejection ratio shall be greater than 45 dB at 1 MHz

4.7.6 Electrical Performance (3.5.5). Electrical Performance testing shall be performed utilizing a network tester that includes normal transmission testing using simulated 1553 data bus signals, testing for phase throughout the network, measuring insertion loss, testing for continuity on Bus and Stubs, and detecting shorts between conductors, conductors and shields, or bus terminating resistors.

4.7.7 Dielectric Withstanding Voltage (3.5.6). DWV testing shall be performed in accordance with MIL-STD-202, Method 301. Apply 500 VAC between each conductor and shield for one minute. Apply 100 VAC between bus and stub conductors for one minute.

4.7.7.1 Dielectric Withstanding Voltage; water bath (3.5.6.1). DWV testing shall be performed in accordance with MIL-STD-202, Method 301. Immerse the test specimen in a water bath, leaving six inches of cable above the water. Apply 500 VAC between the cable shield and the water bath for one minute.

4.7.8 Insulation Resistance (3.5.7). IR testing shall be performed in accordance with MIL-STD-202, Method 302, Condition B. Measure resistance between each conductor and shield between bus and stub conductors.

4.7.8.1 Insulation Resistance; water bath (3.5.7.1). IR testing shall be performed in accordance with MIL-STD-202, Method 302, Condition B. Immerse the test specimen in a water bath, leaving six inches of cable above the water. Measure resistance between the cable shield and the water bath.

4.7.9 Surface Transfer Impedance (3.5.8). Testing shall be performed in accordance with SAE AS85485. Assemble a coupler test specimen measuring four feet overall (including coupler and cables), with the coupler approximately centered. Prepare ends of the test specimen as detailed in SAE-AS85485, paragraph 4.7.24.2.

4.7.10 Temperature Shock (3.5.9). Testing shall be performed in accordance with MIL-STD-202, Method 107, Condition F. During testing the specimen shall be monitored for discontinuities greater than 1 microsecond and shall have electrical performance testing at both high and low temperatures.

4.7.11 Altitude Immersion (3.5.10). Testing shall be performed in accordance with EIA-364-03B. Keep at least six inches of the attached cables out of the water bath.

4.7.12 Moisture Resistance (3.5.11). Testing shall be performed in accordance with MIL-STD-202, Method 106, omitting Step 7b and paragraph 3.6.

4.7.13 Salt Atmosphere (3.5.12). Testing shall be performed in accordance with MIL-STD-202, Method 101. The exposure time shall be 1,000 hours.

4.7.14 Sinusoidal Vibration (3.5.13). Testing shall be performed in accordance with MIL-STD-202, Method 201, except that the frequency limits shall be 5 and 50 Hz. During testing the specimen shall be monitored for discontinuities greater than 1 microsecond.

4.7.15 Random Vibration (3.5.14). Testing shall be performed in accordance with MIL-STD-202, Method 214, Test Condition II, Test Letter H, for 8 hours in each of the

three perpendicular axes. During testing the specimen shall be monitored for discontinuities greater than 1 microsecond.

4.7.16 Mechanical Shock (Specified Pulse) (3.5.15). Testing shall be performed in accordance with MIL-STD-202, Method 213, Test Condition A. During testing the specimen shall be monitored for discontinuities greater than 1 microsecond.

4.7.17 Fluid Resistance (3.5.16). Specimens shall be conditioned for 30 minutes in a thermal chamber at the temperature detailed in Table 4. After conditioning, specimens shall be immerse in test fluids as detailed in Table 4, for 5 minutes at room temperature, then drained for one hour at room temperature. Each specimen shall be subjected to 3 of these cycles.

Table 4: Fluids Resistance Test Parameters

TEST FLUID	TEMPERATURE
Coolanol 25, Coolant	+135 ˚C
MIL-DTL-5624, JP-8 Jet Fuel	+ 39 ˚C
MIL-DTL-5624, JP-5 Jet Fuel	+ 39 ˚C
JET-A1 Fuel	+ 39 ˚C
MIL-H-5606, Hydraulic Fluid	+135 ˚C
MIL-PRF-7808, Lubricating Oil	+135 ˚C