

**DLA Land and Maritime - VQ  
Supplemental Information Sheet for Electronic QML-31032**

**Date: 2/18/2020**

**Specification Details:**

Specification: MIL-PRF-31032  
Title: Printed Circuit Board/Printed Wiring Board  
Federal Supply Class (FSC): 5998  
Conventional: No  
Specification contains quality assurance program: Yes  
MIL-STD-790 Established Reliability & High Reliability: No  
MIL-STD-690 Failure Rate Sampling Plans & Procedures: No  
Weibull Graded: Yes  
Specification contains space level reliability requirements: No  
Specification allows test optimization: Yes

**Contact Information:**

Office of Primary Involvement: Electronic Devices Branch, DLA Land and Maritime - VQE  
Primary Qualifying Activity Contact: 614-692-0627, e-mail: vqe.ls@dla.mil  
Secondary Qualifying Activity Contact: 614-692-0625, e-mail: vqe.rp@dla.mil

**Notes:**

If a manufacturer desires to have test data considered for qualification, it must be certified and meet all qualification test requirements of MIL-PRF-31032 and the applicable associated specification.

The listing of printed board manufacturing lines in the QML applies only to printed boards produced in the plant(s) specified herein. Therefore, only those printed boards that have been manufactured and tested on the certified/qualified lines listed herein can be supplied as QML printed boards.

The DLA Land and Maritime - VQE contacts for QML companies can be located in the file "31032 main points-of-contact" at website: [http://www.dsc.dla.mil/offices/sourcing\\_and\\_qualification/offices.asp?section=VQE](http://www.dsc.dla.mil/offices/sourcing_and_qualification/offices.asp?section=VQE)

QML is a definition of a manufacturer's verified capabilities. Manufacturers may use the add-on qualification process to qualify capabilities that are not currently listed on the QML. The user is encouraged to contact the manufacturer or Qualifying Activity to make arrangements for QML availability.

The following abbreviations are used in this listing:

Ag: Silver  
Au: Gold  
CAGE: Commercial and Government Entity (Code)  
Cu: Copper  
ENIG: Electroless Nickel Immersion Gold  
HASL: Hot Air Solder Level  
ImmAg: Immersion Silver  
IR: Infrared  
LPI: Liquid Photoimageable  
MIX: Mix of SMT and THM  
Ni: Nickel  
OSP: Organic Surface Protection  
Pb: Lead  
Pd: Palladium  
PTH: Plated Thru Hole  
SMOBC: Solder Mask Over Bare Copper  
SMT: Surface-Mount Technology  
Sn: Tin  
THM: Through-Hole Mounting

**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<p>MANUFACTURER INFORMATION:  <b>Accurate Circuit Engineering</b>          3019 S. Kilson Drive, Santa Ana, CA, 92707 US</p>	<p>PLANT LOCATION:          Same Address as Manufacturer</p>	<p>CAGE Code: 0MNN9          Phone: 714-546-2162          Fax: 714-433-7418          EMail: quality@ace-pcb.com</p>
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2, Custom  
 Qualification Letters: VQE-06-012150, VQE-07-012577, VQE-09-018384, VQE-10-020411, VQE-11-022279, VQE-13-026528, VQE-13-026662  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
 Max. Panel Size: 20" x 26"  
 Max. Number of Layers: 24  
 Max. Board Thickness: .22"  
 Min. Hole Size: .008" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 11:1 Through-Hole  
 Min. Conductor Width/Space: .003"/.003"  
 Hole Preparation: Permanganate Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Hole Fill/Via Plug: Conductive, Non-Conductive  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, Electrolytic Ni / Hard Au, HASL, ImmAg  
 Additional Fab Capabilities: Blind Vias, Buried Vias, Foil Lamination, Sequential Lamination  
 Controlled Impedance: Differential, Single-Ended

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**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<b>MANUFACTURER INFORMATION:</b> <b>Advanced Circuits - Tempe Division</b> 229 S. Clark Drive, Tempe, AZ, 85281-3073 US	<b>PLANT LOCATION:</b> Same Address as Manufacturer	CAGE Code: 6RJS1 Phone: 480-966-5894 Fax: 480-966-5896 EMail: tempesales@4pcb.com
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-12-024291, VQE-12-024631, VQE-12-025042, VQE-13-025402, VQE-13-025881,  
 Composition: S - Homogenous thermosetting base material printed boards  
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 24  
 Max. Board Thickness: .125"  
 Min. Hole Size: .004" Laser Ablated Plated Hole Size Before Plating, .01" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: .8:1 Microvia, 12.5:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.0033"  
 Hole Preparation: Permanganate Desmear, Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate, Periodic Reverse Plate  
 Hole Fill/Via Plug: Conductive, Non-Conductive  
 Solder Resist: Dry Film, Liquid Photoimageable  
 Finish System: ENIG, Electrolytic Ni / Hard Au, HASL, ImmAg  
 Additional Fab Capabilities: Blind Vias, Buried Vias, Foil Lamination, Sequential Lamination  
 Controlled Impedance: Differential, Single-Ended

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-12-024291, VQE-12-024631, VQE-12-025042, VQE-13-025402, VQE-13-025881, VQE-15-029681,  
 Composition: S - Homogenous thermosetting base material printed boards  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 24  
 Max. Board Thickness: .125"  
 Min. Hole Size: .004" Laser Ablated Plated Hole Size Before Plating, .01" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 1.1:1 Microvia, 12.5:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.0033"  
 Hole Preparation: Permanganate Desmear, Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate, Periodic Reverse Plate  
 Hole Fill/Via Plug: Conductive, Non-Conductive  
 Solder Resist: Dry Film, Liquid Photoimageable  
 Finish System: ENIG, Electrolytic Ni / Hard Au, HASL, ImmAg  
 Additional Fab Capabilities: Blind Vias, Buried Vias, Foil Lamination, Sequential Lamination  
 Controlled Impedance: Differential, Single-Ended

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**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<b>MANUFACTURER INFORMATION:</b> <b>Advanced Circuits Minnesota</b> 886 Zachary Lane North, Maple Grove, MN, 55369-4524 US	<b>PLANT LOCATION:</b> Same Address as Manufacturer	CAGE Code: 45032 Phone: 763-315-1719 Fax: 763-425-0999 EMail: MG_Quality@4pcb.com
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-10-019530, VQE-10-020323, VQE-12-024534  
 Composition: S - Homogenous thermosetting base material printed boards  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 18  
 Max. Board Thickness: .125"  
 Min. Hole Size: .008" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 8.88:1 Through-Hole  
 Min. Conductor Width/Space: .0032"/.0032"  
 Hole Preparation: Permanganate Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Carbon-based  
 Copper Plating: Direct Current Plate  
 Hole Fill/Via Plug: Conductive, Non-Conductive  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, Electrolytic Ni / Hard Au, HASL, Hot Oil Reflow of Plated Sn/Pb, ImmAg  
 Additional Fab Capabilities: Foil Lamination  
 Controlled Impedance: Differential, Single-Ended

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-10-019530, VQE-10-020323, VQE-12-024534  
 Composition: M - Mixed based material printed boards  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant; Woven Glass Reinforced, Hydrocarbon Resin with Ceramic Fill  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 18  
 Max. Board Thickness: .18"  
 Min. Hole Size: .021" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 8.57:1 Through-Hole  
 Min. Conductor Width/Space: .005"/.005"  
 Hole Preparation: Permanganate Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Carbon-based  
 Copper Plating: Direct Current Plate  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, Electrolytic Ni / Hard Au, HASL, ImmAg,  
 Additional Fab Capabilities: Blind Vias, Foil Lamination, Sequential Lamination  
 Controlled Impedance: Differential, Single-Ended

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQ (VQE-20-034383), VQE-11-021326, VQE-12-024534  
 Composition: S - Homogenous thermosetting base material printed boards  
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 8  
 Max. Board Thickness: .07"  
 Min. Hole Size: .0138" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 5.1:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.004"  
 Hole Preparation: Permanganate Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Carbon-based  
 Copper Plating: Direct Current Plate  
 Hole Fill/Via Plug: Non-Conductive  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, Electrolytic Ni / Hard Au, HASL, Hot Oil Reflow of Plated Sn/Pb, ImmAg  
 Additional Fab Capabilities: Foil Lamination

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<b>MANUFACTURER INFORMATION:</b> <b>Airborn Flexible Circuits, Inc.</b> 11 Dohme Avenue, Toronto, M4B 1Y7, Ontario Canada	<b>PLANT LOCATION:</b> Same Address as Manufacturer	<b>CAGE Code:</b> 38661 <b>Phone:</b> 416-285-3825 <b>Fax:</b> 416-752-6719 <b>E-Mail:</b> pialisp@airbornflex.com
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/3, MIL-PRF-31032/4  
 Qualification Letters: VQE-04-005354, VQE-08-015729  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant; GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
 Flex Base Material: Copper Clad Polyimide with Acrylic Adhesive  
 Max. Panel Size: 12" x 18"  
 Max. Number of Layers: 7  
 Max. Board Thickness: " Not Specified  
 Aspect Ratio: 3:1 Through-Hole  
 Min. Conductor Width/Space: .007"/.007"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Direct Metalization  
 Copper Plating: Direct Current Plate  
 Solder Resist: Dry Film, Liquid Photoimageable, Silk Screen  
 Finish System: HASL  
 Additional Fab Capabilities: Foil Lamination, Metal Core, Sequential Lamination  
 Controlled Impedance: Differential, Single-Ended  
 Flex Usage: Use A (Flex During Installation), Use B (Dynamic Flex)

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/3, MIL-PRF-31032/4  
 Qualification Letters: VQE-04-005354, VQE-08-015729  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
 Flex Base Material: Copper Clad Adhesiveless Polyimide  
 Max. Panel Size: 12" x 18"  
 Max. Number of Layers: 12  
 Max. Board Thickness: .094"  
 Min. Hole Size: .008" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 12:1 Through-Hole  
 Min. Conductor Width/Space: .006"/.004"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Direct Metalization  
 Copper Plating: Direct Current Plate  
 Solder Resist: Dry Film, Liquid Photoimageable, Silk Screen  
 Finish System: HASL  
 Additional Fab Capabilities: Foil Lamination, Metal Core, Sequential Lamination  
 Controlled Impedance: Differential, Single-Ended  
 Flex Usage: Use A (Flex During Installation), Use B (Dynamic Flex)

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**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<b>MANUFACTURER INFORMATION:</b> <b>All Flex, Inc.</b> 1705 Cannon Lane, Northfield, MN, 55057-3605 USA	<b>PLANT LOCATION:</b> Same Address as Manufacturer	<b>CAGE Code:</b> 0ZGB2 <b>Phone:</b> (800) 959-0865 <b>Fax:</b> (844) 274-3970 <b>EMail:</b> tbladstad@allflexinc.com
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/3, MIL-PRF-31032/4  
 Qualification Letters: VQ(VQE-19-033269), VQ(VQE-19-033661)  
 Flex Base Material: Copper Clad Polyimide with Acrylic Adhesive  
 Max. Panel Size: 18" x 107"  
 Max. Number of Layers: 6  
 Max. Board Thickness: .029"  
 Min. Hole Size: .0118" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 2:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.004"  
 Hole Preparation: Permanganate Desmear, Plasma Desmear  
 Hole Wall Conductive Coating: Graphite-based  
 Copper Plating: Direct Current Plate  
 Solder Resist: Dry Film, Liquid Photoimageable  
 Finish System: ENIG, HASL  
 Flex Usage: Use A (Flex During Installation), Use B (Dynamic Flex)

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/3, MIL-PRF-31032/4  
 Qualification Letters: VQ(VQE-19-033269), VQ(VQE-19-033661)  
 Flex Base Material: Copper Clad Adhesiveless Polyimide  
 Max. Panel Size: 18" x 54"  
 Max. Number of Layers: 6  
 Max. Board Thickness: .029"  
 Min. Hole Size: .0118" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 2:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.004"  
 Hole Preparation: Permanganate Desmear, Plasma Desmear  
 Hole Wall Conductive Coating: Graphite-based  
 Copper Plating: Direct Current Plate  
 Solder Resist: Dry Film, Liquid Photoimageable  
 Finish System: ENIG, HASL  
 Flex Usage: Use A (Flex During Installation)

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**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<p>MANUFACTURER INFORMATION:  <b>American Standard Circuits</b>          475 Industrial Drive, West Chicago, IL, 60185 US</p>	<p>PLANT LOCATION:          Same Address as Manufacturer</p>	<p>CAGE Code: 4AA34          Phone: 603-639-5444          Fax: 603-293-1240          EMail: sales@asc-i.com</p>
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/3, MIL-PRF-31032/4  
 Qualification Letters: VQE-17-031437  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
 Flex Base Material: Copper Clad Adhesiveless Polyimide  
 Max. Panel Size: 12" x 18"  
 Max. Number of Layers: 14  
 Max. Board Thickness: .095"  
 Min. Hole Size: .01" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 10:1 Through-Hole  
 Min. Conductor Width/Space: .0033"/.006"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, Electrolytic Ni / Hard Au, HASL, ImmAg  
 Additional Fab Capabilities: Foil Lamination  
 Flex Usage: Use A (Flex During Installation)

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-08-015934, VQE-11-021830, VQE-11-023138, VQE-13-025323, VQE-13-025791, VQE-13-025834  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 14  
 Max. Board Thickness: .09" (for /1, Type 3 - Multilayer), .125" (for /2, Type /2 - Double-sided only)  
 Min. Hole Size: .009" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 7:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.004"  
 Hole Preparation: Permanganate Desmear, Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Hole Fill/Via Plug: Conductive  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, Electrolytic Ni / Hard Au, HASL, ImmAg  
 Additional Fab Capabilities: Blind Vias, Foil Lamination

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-11-022358, VQE-11-023138  
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 10  
 Max. Board Thickness: .125"  
 Min. Hole Size: .02" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 5:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.004"  
 Hole Preparation: Permanganate Desmear, Plasma Desmear  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, Electrolytic Ni / Hard Au, HASL, ImmAg

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**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<p>MANUFACTURER INFORMATION:  <b>American Standard Circuits</b>          475 Industrial Drive, West Chicago, IL, 60185 US</p>	<p>PLANT LOCATION:          Same Address as Manufacturer</p>	<p>CAGE Code: 4AA34          Phone: 603-639-5444          Fax: 603-293-1240          EMail: sales@asc-i.com</p>
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-16-029852  
 Composition: M - Mixed based material printed boards, S - Homogenous thermosetting base material printed boards  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant; Woven Glass Reinforced, Hydrocarbon Resin with Ceramic Fill  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 10  
 Max. Board Thickness: .095"  
 Min. Hole Size: .017" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 6:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.004"  
 Hole Preparation: Permanganate Desmear  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, Electrolytic Ni / Hard Au, HASL, ImmAg



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<b>MANUFACTURER INFORMATION:</b> <b>Amitron Corporation</b> 2001 Landmeier Road, Elk Grove Village, IL, 60007 USA		CAGE Code: 1LHP6 Phone: 847-290-9800 Fax: 847-290-9823 EMail: kammrad@amitroncorp.com
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-19-033935  
 Composition: H - Homogenous thermoplastic base material printed boards  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 18  
 Max. Board Thickness: .08"  
 Min. Hole Size: .01" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 8:1  
 Min. Conductor Width/Space: .004"/.004"  
 Hole Preparation: Permanganate Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Graphite-based  
 Copper Plating: Direct Current Plate  
 Hole Fill/Via Plug: Non-Conductive  
 Solder Resist: Liquid Photoimageable, Silk Screen  
 Finish System: ENIG, HASL  
 Additional Fab Capabilities: Blind Vias, Foil Lamination  
 Controlled Impedance: Differential, Single-Ended

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**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<b>MANUFACTURER INFORMATION:</b> <b>Amphenol Printed Circuits</b> 91 Northeastern Boulevard, Nashua, NH, 03062 US	<b>PLANT LOCATION:</b> Same Address as Manufacturer	<b>CAGE Code:</b> 57034 <b>Phone:</b> 603-879-3268 <b>Fax:</b> 603-879-2818 <b>E-Mail:</b>
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE 10-020582, VQE-06-010054, VQE-09-017008, VQE-12-023765, VQE-15-029690, VQE-17-031637, VQE-97-000649  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
 Max. Panel Size: 24" x 36"  
 Max. Number of Layers: 33  
 Max. Board Thickness: .25"  
 Min. Hole Size: .0098" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 11:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.004"  
 Hole Preparation: Permanganate Desmear, Permanganate Etchback, Plasma Desmear  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate, Pulse Plate  
 Hole Fill/Via Plug: Conductive, Non-Conductive  
 Solder Resist: Dry Film, Liquid Photoimageable, Silk Screen  
 Finish System: ENIG, Electrolytic Ni (no Au), Electrolytic Ni / Hard Au, Electrolytic Ni / Soft Au, HASL, Hot Oil Reflow of Plated Sn/Pb  
 Additional Fab Capabilities: Blind Vias, Foil Lamination, Press Fit Mounting, Sequential Lamination  
 Controlled Impedance: Differential, Single-Ended

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE 10-020582, VQE-06-010054, VQE-09-017008, VQE-12-023765, VQE-15-029626, VQE-17-031637, VQE-97-000649  
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
 Max. Panel Size: 30" x 36"  
 Max. Number of Layers: 28  
 Max. Board Thickness: .18"  
 Min. Hole Size: .006" Laser Ablated Plated Hole Size Before Plating, .0118" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: .8:1 Microvia, 11:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.004"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate, Pulse Plate  
 Hole Fill/Via Plug: Conductive, Non-Conductive  
 Solder Resist: Dry Film, Liquid Photoimageable, Silk Screen  
 Finish System: ENIG, Electrolytic Ni (no Au), Electrolytic Ni / Hard Au, Electrolytic Ni / Soft Au, HASL, Hot Oil Reflow of Plated Sn/Pb  
 Additional Fab Capabilities: Blind Vias, Foil Lamination, Press Fit Mounting, Sequential Lamination  
 Controlled Impedance: Differential, Single-Ended

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE 10-020582, VQE-06-010054, VQE-09-017008, VQE-12-023765, VQE-15-029690, VQE-19-033889  
 Composition: M - Mixed based material printed boards, S - Homogenous thermosetting base material printed boards  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant; Woven Glass Reinforced, Hydrocarbon Resin with Ceramic Fill  
 Max. Panel Size: 24" x 31"  
 Max. Number of Layers: 12  
 Max. Board Thickness: .101"  
 Min. Hole Size: .04" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 2.6:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.004"  
 Hole Preparation: Plasma Desmear  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate, Pulse Plate  
 Hole Fill/Via Plug: Non-Conductive  
 Solder Resist: Liquid Photoimageable, Silk Screen  
 Finish System: ENIG, Electrolytic Ni (no Au), Electrolytic Ni / Hard Au, Electrolytic Ni / Soft Au, HASL, Hot Oil Reflow of Plated Sn/Pb  
 Additional Fab Capabilities: Blind Vias, Foil Lamination, Press Fit Mounting, Sequential Lamination  
 Controlled Impedance: Differential, Single-Ended

**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<b>MANUFACTURER INFORMATION:</b> <b>Amphenol Printed Circuits</b> 91 Northeastern Boulevard, Nashua, NH, 03062 US	<b>PLANT LOCATION:</b> Same Address as Manufacturer	CAGE Code: 57034 Phone: 603-879-3268 Fax: 603-879-2818 EMail:
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/3, MIL-PRF-31032/4  
 Qualification Letters: VQE-10-019533, VQE-12-023765, VQE-15-029690  
 Composition: S - Homogenous thermosetting base material printed boards  
 Flex Base Material: Copper Clad Polyimide with Acrylic Adhesive  
 Max. Panel Size: 24" x 36"  
 Max. Number of Layers: 4 (types 1, 2, and 3 only)  
 Max. Board Thickness: .035"  
 Min. Hole Size: .0145"  
 Aspect Ratio: 1.75:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.004"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Palladium-based  
 Copper Plating: Direct Current Plate, Pulse Plate  
 Finish System: HASL, Hot Oil Reflow of Plated Sn/Pb  
 Flex Usage: Use A (Flex During Installation)

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/3, MIL-PRF-31032/4  
 Qualification Letters: VQE-10-019533, VQE-12-023765, VQE-15-029690  
 Composition: M - Mixed based material printed boards, S - Homogenous thermosetting base material printed boards  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant; GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
 Flex Base Material: Copper Clad Adhesiveless Polyimide  
 Max. Panel Size: 24" x 36"  
 Max. Number of Layers: 22  
 Max. Board Thickness: .14"  
 Min. Hole Size: .0197" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 8:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.004"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper, Palladium-based  
 Copper Plating: Direct Current Plate, Pulse Plate  
 Solder Resist: Dry Film, Liquid Photoimageable, Silk Screen  
 Finish System: ENIG, Electrolytic Ni (no Au), Electrolytic Ni / Hard Au, Electrolytic Ni / Soft Au, HASL, Hot Oil Reflow of Plated Sn/Pb  
 Additional Fab Capabilities: Foil Lamination, Press Fit Mounting, Sequential Lamination  
 Controlled Impedance: Differential, Single-Ended  
 Flex Usage: Use A (Flex During Installation)

**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<b>MANUFACTURER INFORMATION:</b> <b>Calumet Electronics Corp.</b> 25830 Depot Street, Calumet, MI, 49913-1985 US	<b>PLANT LOCATION:</b> Same Address as Manufacturer	<b>CAGE Code:</b> 65337 <b>Phone:</b> 906-337-1305 <b>Fax:</b> 906-337-5359 <b>EMail:</b> quality@calumetelectronics.com
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQ(VQE-19-033358), VQE 12 023734, VQE-03-4657, VQE-04-6280, VQE-14-027692, VQE-17-030995, VQE-18-032747, VQE-18-033030  
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
 Max. Panel Size: 21" x 24"  
 Max. Number of Layers: 14  
 Max. Board Thickness: .125"  
 Min. Hole Size: .016" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 8:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.003"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Carbon-based, Electroless Copper  
 Copper Plating: Direct Current Plate  
 Hole Fill/Via Plug: Non-Conductive  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, Electrolytic Ni / Hard Au, Electrolytic Ni / Soft Au, HASL, ImmAg  
 Additional Fab Capabilities: Blind Vias, Foil Lamination, Press Fit Mounting, Sequential Lamination

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQ(VQE-19-033358), VQE 12 023734, VQE-03-4657, VQE-04-6280, VQE-13-026419, VQE-17-030995, VQE-18-032747  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
 Max. Panel Size: 21" x 24"  
 Max. Number of Layers: 24  
 Max. Board Thickness: .125"  
 Min. Hole Size: .0079" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 8:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.003"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Hole Fill/Via Plug: Non-Conductive  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, Electrolytic Ni / Hard Au, Electrolytic Ni / Soft Au, HASL, ImmAg  
 Additional Fab Capabilities: Foil Lamination  
 Controlled Impedance: Differential, Single-Ended

**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<p>MANUFACTURER INFORMATION:  <b>CIMULEC</b>          , Z.I. Les Jonquieres, 57365 ENNERY France</p>	<p>PLANT LOCATION:          Same Address as Manufacturer</p>	<p>CAGE Code: FB1Y2          Phone: (33) 3 87 73 63 19          Fax:          EMail: sketterer@cimulecgroup.com</p>
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQ (VQE-20-034642)  
 Composition: S - Homogenous thermosetting base material printed boards  
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 20  
 Max. Board Thickness: .157"  
 Min. Hole Size: .019" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 8:1 Through-Hole  
 Min. Conductor Width/Space: .003"/.003"  
 Hole Preparation: Permanganate Desmear  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG  
 Additional Fab Capabilities: Foil Lamination

**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<p>MANUFACTURER INFORMATION:  <b>Circuit-Tech, Inc.</b>          399 Denison Street, Markham, ON, L3R 1B7 Canada</p>	<p>PLANT LOCATION:          Same Address as Manufacturer</p>	<p>CAGE Code: L4387          Phone: 905-474-9227          Fax: 416 497-4953          EMail: sales@circuittech.com</p>
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-19-033355  
 Composition: S - Homogenous thermosetting base material printed boards  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 18  
 Max. Board Thickness: .125"  
 Min. Hole Size: .0098" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 12:1 Through-Hole  
 Min. Conductor Width/Space: .0035"/.0035"  
 Hole Preparation: Permanganate Desmear, Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Hole Fill/Via Plug: Non-Conductive  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, HASL  
 Additional Fab Capabilities: Blind Vias, Buried Vias, Foil Lamination, Sequential Lamination  
 Controlled Impedance: Differential, Single-Ended

**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<b>MANUFACTURER INFORMATION:</b> <b>Cirex International, Inc.</b> 791 Nuan Street, Santa Clara, CA, 95054 US	<b>PLANT LOCATION:</b> Same Address as Manufacturer	<b>CAGE Code:</b> 4MEG7 <b>Phone:</b> 408-988-3980 <b>Fax:</b> 408-988-4534 <b>EMail:</b>
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-08-016602, VQE-14-028536, VQE-18-032748, VQE-19-034045  
 Composition: S - Homogenous thermosetting base material printed boards  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 22  
 Max. Board Thickness: .185"  
 Min. Hole Size: .01" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 14.2:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.004"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Hole Fill/Via Plug: Conductive, Non-Conductive  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, Electrolytic Ni / Hard Au, HASL, ImmAg, Ni/Pd/Au  
 Additional Fab Capabilities: Blind Vias, Buried Vias, Foil Lamination, Sequential Lamination  
 Controlled Impedance: Differential, Single-Ended

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-08-016602, VQE-14-028536, VQE-18-032748, VQE-19-034045  
 Composition: S - Homogenous thermosetting base material printed boards  
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 22  
 Max. Board Thickness: .185"  
 Min. Hole Size: .01" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 14.2:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.004"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Hole Fill/Via Plug: Conductive, Non-Conductive  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, Electrolytic Ni / Hard Au, HASL, ImmAg, Ni/Pd/Au  
 Additional Fab Capabilities: Blind Vias, Buried Vias, Foil Lamination, Sequential Lamination  
 Controlled Impedance: Differential, Single-Ended

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/3, MIL-PRF-31032/4  
 Qualification Letters: VQE-07-014176, VQE-15-029356, VQE-19-033333, VQE-19-034045  
 Composition: S - Homogenous thermosetting base material printed boards  
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
 Flex Base Material: Copper Clad Polyimide with Acrylic Adhesive  
 Max. Panel Size: 12" x 18"  
 Max. Number of Layers: 5  
 Max. Board Thickness: .056"  
 Min. Hole Size: .016" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 3.5:1 Through-Hole  
 Min. Conductor Width/Space: .0058"/.01"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Finish System: ENIG, Electrolytic Ni / Hard Au, HASL, ImmAg, Ni/Pd/Au  
 Flex Usage: Use A (Flex During Installation), Use B (Dynamic Flex)

**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<b>MANUFACTURER INFORMATION:</b> <b>Cirexx International, Inc.</b> 791 Nuan Street, Santa Clara, CA, 95054 US	<b>PLANT LOCATION:</b> Same Address as Manufacturer	CAGE Code: 4MEG7 Phone: 408-988-3980 Fax: 408-988-4534 EMail:
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/3, MIL-PRF-31032/4  
 Qualification Letters: VQE-08-016602, VQE-14-028536, VQE-19-033333, VQE-19-034045  
 Composition: M - Mixed based material printed boards, S - Homogenous thermosetting base material printed boards  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant; GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
 Flex Base Material: Copper Clad Adhesiveless Polyimide  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 20  
 Max. Board Thickness: .125"  
 Min. Hole Size: .01" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 8.3:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.004"  
 Hole Preparation: Permanganate Desmear, Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, Electrolytic Ni / Hard Au, HASL, ImmAg, Ni/Pd/Au  
 Additional Fab Capabilities: Foil Lamination  
 Controlled Impedance: Differential, Single-Ended  
 Flex Usage: Use A (Flex During Installation), Use B (Dynamic Flex)

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2, MIL-PRF-31032/5, MIL-PRF-31032/6  
 Qualification Letters: VQE-19-033722, VQE-19-034045  
 Composition: M - Mixed based material printed boards, S - Homogenous thermosetting base material printed boards  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant; Woven Glass Reinforced, Hydrocarbon Resin with Ceramic Fill  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 18  
 Max. Board Thickness: .175"  
 Min. Hole Size: .0145" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 12.14:1 Through-Hole  
 Min. Conductor Width/Space: .005"/.006"  
 Hole Preparation: Permanganate Desmear, Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Hole Fill/Via Plug: Conductive, Non-Conductive  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, Electrolytic Ni / Hard Au, HASL, ImmAg, Ni/Pd/Au  
 Additional Fab Capabilities: Blind Vias, Buried Vias, Foil Lamination, Sequential Lamination  
 Controlled Impedance: Differential, Single-Ended



**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<b>MANUFACTURER INFORMATION:</b> <b>Cirtech, Inc.</b> 250 E. Emerson Ave., Orange, CA, 92865-3303	<b>PLANT LOCATION:</b> Same Address as Manufacturer	CAGE Code: 8K616 Phone: 714-921-0860 Fax: EMail: dennisw@apctinc.com
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQ(VQE 19 033331)  
 Composition: S - Homogenous thermosetting base material printed boards  
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 16  
 Max. Board Thickness: .125"  
 Min. Hole Size: .016"  
 Aspect Ratio: 8:1 Through-Hole  
 Min. Conductor Width/Space: .008"/.006"  
 Hole Preparation: Plasma Desmear  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Solder Resist: Liquid Photoimageable  
 Finish System: HASL, Hot Oil Reflow of Plated Sn/Pb

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/3, MIL-PRF-31032/4  
 Qualification Letters: VQ (VQE-19-033575)  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
 Flex Base Material: Copper Clad Adhesiveless Polyimide  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 12  
 Max. Board Thickness: .08"  
 Min. Hole Size: .0098" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 8.5:1 Through-Hole  
 Min. Conductor Width/Space: .005"/.006"  
 Hole Preparation: Plasma Desmear  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, HASL, Hot Oil Reflow of Plated Sn/Pb  
 Flex Usage: Use A (Flex During Installation)

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQ (VQE-19-033573), VQ (VQE-19-034352)  
 Composition: S - Homogenous thermosetting base material printed boards  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 14  
 Max. Board Thickness: .1"  
 Min. Hole Size: .011" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 9:1 Through-Hole  
 Min. Conductor Width/Space: .006"/.006"  
 Hole Preparation: Plasma Desmear  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Hole Fill/Via Plug: Non-Conductive  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, HASL, Hot Oil Reflow of Plated Sn/Pb  
 Additional Fab Capabilities: Foil Lamination

**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<b>MANUFACTURER INFORMATION:</b> <b>Coast to Coast Circuits, Inc.</b> 5331 McFadden Avenue, Huntington Beach, CA, 92649-1204 US	<b>PLANT LOCATION:</b> Same Address as Manufacturer	<b>CAGE Code:</b> 66982 <b>Phone:</b> 714-898-4901 <b>Fax:</b> 714-891-0607 <b>EMail:</b> sales@speedycircuits.com
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-08-016434, VQE-10-021007, VQE-18-33028  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 16  
 Max. Board Thickness: .083"  
 Min. Hole Size: .01" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 8:1 Through-Hole  
 Min. Conductor Width/Space: .005"/.005"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Hole Fill/Via Plug: Non-Conductive  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, Electrolytic Ni (no Au), Electrolytic Ni / Hard Au, Electrolytic Ni / Soft Au, HASL, Hot Oil Reflow of Plated Sn/Pb, Ni/Pd/Au  
 Additional Fab Capabilities: Blind Vias, Buried Vias, Foil Lamination, Sequential Lamination  
 Controlled Impedance: Differential, Single-Ended

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-08-016434, VQE-10-021007, VQE-18-033028  
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 8  
 Max. Board Thickness: .088"  
 Min. Hole Size: .018" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 4:1 Through-Hole  
 Min. Conductor Width/Space: .005"/.005"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Hole Fill/Via Plug: Non-Conductive  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, Electrolytic Ni / Hard Au, Electrolytic Ni / Soft Au, HASL, Hot Oil Reflow of Plated Sn/Pb, Ni/Pd/Au  
 Additional Fab Capabilities: Blind Vias, Buried Vias, Foil Lamination, Sequential Lamination  
 Controlled Impedance: Differential, Single-Ended

**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<b>MANUFACTURER INFORMATION:</b> <b>Coast to Coast Circuits, Inc.</b> 5331 McFadden Avenue, Huntington Beach, CA, 92649-1204 US	<b>PLANT LOCATION:</b> Same Address as Manufacturer	<b>CAGE Code:</b> 66982 <b>Phone:</b> 714-898-4901 <b>Fax:</b> 714-891-0607 <b>EMail:</b> sales@speedycircuits.com
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/3, MIL-PRF-31032/4  
 Qualification Letters: VQE-08-016434, VQE-10-019157, VQE-10-021007, VQE-18-033028  
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
 Flex Base Material: Copper Clad Adhesiveless Polyimide  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 8  
 Max. Board Thickness: .088"  
 Min. Hole Size: .018" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 4:1 Through-Hole  
 Min. Conductor Width/Space: .005"/.005"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Hole Fill/Via Plug: Non-Conductive  
 Solder Resist: Dry Film, Liquid Photoimageable  
 Finish System: ENIG, Electrolytic Ni / Hard Au, Electrolytic Ni / Soft Au, HASL, Hot Oil Reflow of Plated Sn/Pb, Ni/Pd/Au  
 Additional Fab Capabilities: Blind Vias, Buried Vias, Foil Lamination, Sequential Lamination  
 Controlled Impedance: Differential, Single-Ended  
 Flex Usage: Use A (Flex During Installation), Use B (Dynamic Flex)

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/6  
 Qualification Letters: VQE-08-016434, VQE-18-033028  
 Composition: H - Homogenous thermoplastic base material printed boards  
 Rigid Base Material: GR: Glass Base, Nonwoven, Polytetrafluoroethylene Resin, Flame Resistant; GY: Glass Base, Woven, Polytetrafluoroethylene Resin, Flame Resistant, for Microwave Application  
 Max. Panel Size: 12" x 18"  
 Max. Number of Layers: 2  
 Max. Board Thickness: .028"  
 Min. Hole Size: .03" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 1:1 Through-Hole  
 Min. Conductor Width/Space: .005"/.005"  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Finish System: ENIG, Electrolytic Ni / Hard Au, Electrolytic Ni / Soft Au, Hot Oil Reflow of Plated Sn/Pb, Ni/Pd/Au

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/5  
 Qualification Letters: VQE-09-018657, VQE-18-033028  
 Composition: M - Mixed based material printed boards  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant; With or without woven or non-woven E-glass, Polytetrafluoroethylene (PTFE) resin, ceramic filler  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 7  
 Max. Board Thickness: .055"  
 Min. Hole Size: .012" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 5:1 Through-Hole  
 Min. Conductor Width/Space: .005"/.005"  
 Hole Preparation: Plasma Desmear  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Hole Fill/Via Plug: Non-Conductive  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, Electrolytic Ni / Hard Au, Electrolytic Ni / Soft Au, HASL, Hot Oil Reflow of Plated Sn/Pb, Ni/Pd/Au  
 Additional Fab Capabilities: Blind Vias, Buried Vias, Foil Lamination, Sequential Lamination  
 Controlled Impedance: Differential, Single-Ended

**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<p>MANUFACTURER INFORMATION:  <b>Coast to Coast Circuits, Inc.</b>                      5331 McFadden Avenue, Huntington Beach, CA, 92649-1204 US</p>	<p>PLANT LOCATION:                      Same Address as Manufacturer</p>	<p>CAGE Code: 66982                      Phone: 714-898-4901                      Fax: 714-891-0607                      EMail: sales@speedycircuits.com</p>
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/5  
 Qualification Letters: VQE-09-018657, VQE-18-033028  
 Composition: S - Homogenous thermosetting base material printed boards  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 7  
 Max. Board Thickness: .055"  
 Min. Hole Size: .012" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 5:1 Through-Hole  
 Min. Conductor Width/Space: .005"/.005"  
 Hole Preparation: Plasma Desmear  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Hole Fill/Via Plug: Non-Conductive  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, Electrolytic Ni / Hard Au, Electrolytic Ni / Soft Au, HASL, Hot Oil Reflow of Plated Sn/Pb, Ni/Pd/Au  
 Additional Fab Capabilities: Foil Lamination  
 Controlled Impedance: Differential, Single-Ended

**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<b>MANUFACTURER INFORMATION:</b> <b>Compunetics Inc.</b> 700 Seco Rd, Monroeville, PA, 15146 US	<b>PLANT LOCATION:</b> Same Address as Manufacturer	CAGE Code: 30598 Phone: 412-858-1272 Fax: EMail: sales@compunetics.com
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQ(VQE-13-026082), VQ(VQE-15-029422)  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 32  
 Max. Board Thickness: .26"  
 Min. Hole Size: .0098" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 10.8:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.004"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Periodic Reverse Plate  
 Hole Fill/Via Plug: Conductive, Non-Conductive  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, HASL  
 Additional Fab Capabilities: Foil Lamination  
 Controlled Impedance: Differential, Single-Ended

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-15-029722  
 Composition: M - Mixed based material printed boards  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant; Woven Glass Reinforced, Hydrocarbon Resin with Ceramic Fill  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 18  
 Max. Board Thickness: .177"  
 Min. Hole Size: .017" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 10.4:1 Through-Hole  
 Min. Conductor Width/Space: .0047"/.006"  
 Hole Preparation: Plasma Desmear  
 Copper Plating: Periodic Reverse Plate  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, HASL  
 Additional Fab Capabilities: Blind Vias, Sequential Lamination  
 Controlled Impedance: Differential, Single-Ended

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/3, MIL-PRF-31032/4  
 Qualification Letters: VQ (VQE-17-031349)  
 Flex Base Material: Copper Clad Adhesiveless Polyimide  
 Max. Panel Size: 24" x 18"  
 Max. Number of Layers: 4  
 Max. Board Thickness: .024"  
 Min. Hole Size: .018" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 1.3 Through-Hole  
 Min. Conductor Width/Space: .004"/.004"  
 Hole Preparation: Plasma Desmear  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Periodic Reverse Plate  
 Finish System: HASL  
 Flex Usage: Use A (Flex During Installation)

**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<b>MANUFACTURER INFORMATION:</b> <b>Electro Plate Circuitry, Inc.</b> 1430 Century Drive, Carrollton, TX, 75006 US	<b>PLANT LOCATION:</b> Same Address as Manufacturer	<b>CAGE Code:</b> 79616 <b>Phone:</b> 972-466-0818 <b>Fax:</b> 972-466-9078 <b>EMail:</b> jim@eplate.com
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQ(VQE-06-010333), VQ(VQE-06-011433), VQ(VQE-10-020352)  
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
 Max. Panel Size: 18" x 16", 18" x 24"  
 Max. Number of Layers: 10  
 Max. Board Thickness: .12"  
 Min. Hole Size: .012" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 9.3:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.004"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Hole Fill/Via Plug: Conductive, Non-Conductive  
 Solder Resist: Dry Film, Liquid Photoimageable  
 Finish System: ENIG, Electrolytic Ni / Hard Au, HASL  
 Additional Fab Capabilities: Foil Lamination, Sequential Lamination, ,  
 Controlled Impedance: Differential, Single-Ended

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQ(VQE-06-010333), VQ(VQE-06-011433), VQ(VQE-10-020352)  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
 Max. Panel Size: 18" x 16", 18" x 24"  
 Max. Number of Layers: 18  
 Max. Board Thickness: .17"  
 Min. Hole Size: .008" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 9.3:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.004"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Hole Fill/Via Plug: Conductive, Non-Conductive  
 Solder Resist: Dry Film, Liquid Photoimageable  
 Finish System: ENIG, Electrolytic Ni / Hard Au, HASL  
 Additional Fab Capabilities: Blind Vias, Buried Vias, Foil Lamination, Sequential Lamination  
 Controlled Impedance: Differential, Single-Ended

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/5, MIL-PRF-31032/6  
 Qualification Letters: VQ(VQE-10-021161)  
 Rigid Base Material: GT: Woven E-Glass, PTFE Resin; GX: Glass Base, Woven, Polytetrafluoroethylene Resin, Flame Resistant; GY: Glass Base, Woven, Polytetrafluoroethylene Resin, Flame Resistant, for Microwave Application; With or without woven or non-woven E-glass, Polytetrafluoroethylene (PTFE) resin, ceramic filler  
 Max. Panel Size: 12" x 18", 18" x 12"  
 Max. Number of Layers: 6  
 Max. Board Thickness: .18"  
 Min. Hole Size: .039" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 6:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.004"  
 Hole Preparation: Plasma Desmear  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Hole Fill/Via Plug: Conductive, Non-Conductive  
 Solder Resist: Dry Film, Liquid Photoimageable  
 Finish System: ENIG, Electrolytic Ni / Hard Au, Electrolytic Ni / Soft Au, HASL, Hot Oil Reflow of Plated Sn/Pb  
 Additional Fab Capabilities: Blind Vias, Foil Lamination, Sequential Lamination  
 Controlled Impedance: Differential, Single-Ended

**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<b>MANUFACTURER INFORMATION:</b> <b>Electrotek Corp.</b> 7745 S. 10th Street, Oak Creek, WI, 53154 US	<b>PLANT LOCATION:</b> Same Address as Manufacturer	<b>CAGE Code:</b> 66030 <b>Phone:</b> 414-762-1390 <b>Fax:</b> 414-762-1510 <b>EMail:</b> sales@boards4u.com
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQ(VQE-06-011451), VQ(VQE-08-014513), VQ(VQE-09-018692), VQ(VQE-12-024024), VQ(VQE-12-024411), VQ(VQE-17-031008), VQ(VQE-19-033298), VQ(VQE-19-033627)  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
 Max. Panel Size: 21" x 24"  
 Max. Number of Layers: 24  
 Max. Board Thickness: .115"  
 Min. Hole Size: .0098" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 9.7:1 Through-Hole  
 Min. Conductor Width/Space: .003"/.003"  
 Hole Preparation: Permanganate Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Hole Fill/Via Plug: Conductive, Non-Conductive  
 Solder Resist: Dry Film, Liquid Photoimageable  
 Finish System: Carbon Ink, ENIG, Electrolytic Ni/Au, HASL, ImmAg  
 Additional Fab Capabilities: Foil Lamination  
 Controlled Impedance: Differential, Single-Ended

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQ(VQE-06-011451), VQ(VQE-08-014513), VQ(VQE-09-018692), VQ(VQE-12-024024), VQ(VQE-12-024411), VQ(VQE-19-033298)  
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
 Max. Panel Size: 21" x 24"  
 Max. Number of Layers: 18  
 Max. Board Thickness: .115"  
 Min. Hole Size: .012" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 9:1 Through-Hole  
 Min. Conductor Width/Space: .003"/.003"  
 Hole Preparation: Permanganate Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Hole Fill/Via Plug: Conductive, Non-Conductive  
 Solder Resist: Dry Film, Liquid Photoimageable  
 Finish System: Carbon Ink, ENIG, Electrolytic Ni/Au, HASL, ImmAg  
 Additional Fab Capabilities: Foil Lamination  
 Controlled Impedance: Differential, Single-Ended

**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<b>MANUFACTURER INFORMATION:</b> <b>Firan Technology Group</b> 250 Finchdene Square, Scarborough, M1X 1A5, Ontario, Canada	<b>PLANT LOCATION:</b> Same Address as Manufacturer	<b>CAGE Code:</b> L2665 <b>Phone:</b> 416-299-4000 <b>Fax:</b> 416-292-4308 <b>EMail:</b> info@ftgcorp.com
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-05-009339, VQE-06-010764, VQE-06-010889, VQE-15-028987, VQE-16-030295, VQE-17-031083, VQE-17-031084  
 Rigid Base Material: BI: Aramid Fabric, Nonwoven, Polyimide Resin  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 14  
 Max. Board Thickness: .106"  
 Min. Hole Size: .02" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 5.1:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.004"  
 Hole Preparation: Permanganate Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate, Pulse Plate  
 Solder Resist: Dry Film, Liquid Photoimageable  
 Finish System: ENIG, HASL, Hot Oil Reflow of Plated Sn/Pb, ImmAg  
 Additional Fab Capabilities: Foil Lamination  
 Controlled Impedance: Differential, Single-Ended

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-05-009339, VQE-06-010764, VQE-06-010889, VQE-15-028987, VQE-16-030295, VQE-17-031083  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 30  
 Max. Board Thickness: .245"  
 Min. Hole Size: .005" Laser Ablated Plated Hole Size Before Plating, .008" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 1.01:1 Microvia, 15.9:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.003"  
 Hole Preparation: Permanganate Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate, Pulse Plate  
 Hole Fill/Via Plug: Non-Conductive  
 Solder Resist: Dry Film, Liquid Photoimageable  
 Finish System: ENIG, HASL, Hot Oil Reflow of Plated Sn/Pb, ImmAg  
 Additional Fab Capabilities: Blind Vias, Buried Vias, Foil Lamination, Sequential Lamination  
 Controlled Impedance: Differential, Single-Ended

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-05-009339, VQE-06-010764, VQE-06-010889, VQE-15-028987, VQE-16-030295, VQE-17-031083  
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
 Max. Panel Size: 21" x 24"  
 Max. Number of Layers: 20  
 Max. Board Thickness: .17"  
 Min. Hole Size: .0059" Laser Ablated Plated Hole Size Before Plating, .01" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 0.6:1 Microvia, 9.6:1 Through-Hole  
 Min. Conductor Width/Space: .0035"/.003"  
 Hole Preparation: Permanganate Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate, Pulse Plate  
 Hole Fill/Via Plug: Non-Conductive  
 Solder Resist: Dry Film, Liquid Photoimageable  
 Finish System: ENIG, HASL, Hot Oil Reflow of Plated Sn/Pb, ImmAg  
 Additional Fab Capabilities: Blind Vias, Foil Lamination, Sequential Lamination  
 Controlled Impedance: Differential, Single-Ended



**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<b>MANUFACTURER INFORMATION:</b> <b>Firan Technology Group</b> 250 Finchdene Square, Scarborough, M1X 1A5, Ontario, Canada	<b>PLANT LOCATION:</b> Same Address as Manufacturer	<b>CAGE Code:</b> L2665 <b>Phone:</b> 416-299-4000 <b>Fax:</b> 416-292-4308 <b>E-Mail:</b> info@ftgcorp.com
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-05-009339, VQE-06-010764, VQE-06-010889, VQE-15-028987, VQE-16-030295, VQE-17-031083  
 Rigid Base Material: GM: Glass Base, Woven, Triazine and/or Bismaleimide Modified Epoxy Resin, Flame Resistant  
 Max. Panel Size: 21" x 24"  
 Max. Number of Layers: 24  
 Max. Board Thickness: .137"  
 Min. Hole Size: .01" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 9.3:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.0037"  
 Hole Preparation: Permanganate Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate, Pulse Plate  
 Hole Fill/Via Plug: Non-Conductive  
 Solder Resist: Dry Film, Liquid Photoimageable  
 Finish System: ENIG, HASL, Hot Oil Reflow of Plated Sn/Pb, ImmAg  
 Additional Fab Capabilities: Blind Vias, Foil Lamination, Sequential Lamination

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/3, MIL-PRF-31032/4  
 Qualification Letters: VQE-15-029018, VQE-16-030295  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
 Flex Base Material: Copper Clad Adhesiveless Polyimide  
 Max. Panel Size: 12" x 18"  
 Max. Number of Layers: 12  
 Max. Board Thickness: .086"  
 Min. Hole Size: .008" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 10:1  
 Min. Conductor Width/Space: .004"/.004"  
 Hole Preparation: Plasma Desmear  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate, Pulse Plate  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, HASL, Hot Oil Reflow of Plated Sn/Pb, ImmAg  
 Flex Usage: Use A (Flex During Installation)

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**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<p>MANUFACTURER INFORMATION:  <b>FTG Circuits Fredericksburg Inc.</b>          1026 Warrenton Road, Fredericksburg, VA, 22406-6200          US</p>	<p>PLANT LOCATION:          Same Address as Manufacturer</p>	<p>CAGE Code: 6T499          Phone: 540-753-5511, x177          Fax: 540-752-2109          EMail: quality@colonialcircuits.com</p>
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-04-6002  
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 14  
 Max. Board Thickness: .088"  
 Min. Hole Size: .021" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 4.2:1 Through-Hole  
 Min. Conductor Width/Space: .006"/.005"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Carbon-based  
 Copper Plating: Direct Current Plate  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, HASL

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-04-6002, VQE-20-034719  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 16  
 Max. Board Thickness: .127"  
 Min. Hole Size: .015"  
 Aspect Ratio: 8.5:1 Through-Hole  
 Min. Conductor Width/Space: .005"/.004"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Carbon-based  
 Copper Plating: Direct Current Plate  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, HASL

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/3, MIL-PRF-31032/4  
 Qualification Letters: VQE-04-6002  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant; GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
 Flex Base Material: Copper Clad Polyimide with Acrylic Adhesive  
 Max. Panel Size: 12" x 18"  
 Max. Number of Layers: 10  
 Max. Board Thickness: .093"  
 Min. Hole Size: .025" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 3.7:1 Through-Hole  
 Min. Conductor Width/Space: .005"/.005"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Carbon-based  
 Copper Plating: Direct Current Plate  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, HASL  
 Flex Usage: Use A (Flex During Installation),

**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<p>MANUFACTURER INFORMATION:  <b>FTG Circuits, Inc. - Chatsworth</b>                  20750 Marilla Street, Chatsworth,, CA, 91311 US</p>		<p>CAGE Code: 30803                  Phone: 818-407-4024                  Fax: 818-407-4034                  EMail: info@ftgcorp.com</p>
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-19-033705  
 Composition: S - Homogenous thermosetting base material printed boards  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 20  
 Max. Board Thickness: .165"  
 Min. Hole Size: .016" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 8.9:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.004"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Hole Fill/Via Plug: Non-Conductive  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, Electrolytic Ni / Soft Au, HASL, Hot Oil Reflow of Plated Sn/Pb, Ni/Pd/Au  
 Additional Fab Capabilities: Blind Vias, Foil Lamination, Metal Core, Sequential Lamination  
 Controlled Impedance: Differential, Single-Ended

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/3, MIL-PRF-31032/4  
 Qualification Letters: VQE-19-033708  
 Composition: M - Mixed based material printed boards, S - Homogenous thermosetting base material printed boards  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant; GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
 Flex Base Material: Copper Clad Adhesiveless Polyimide  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 20  
 Max. Board Thickness: .18"  
 Min. Hole Size: .0197" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 10:1 Through-Hole  
 Min. Conductor Width/Space: .0035"/.004"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, Electrolytic Ni / Soft Au, HASL, Hot Oil Reflow of Plated Sn/Pb, Ni/Pd/Au  
 Controlled Impedance: Differential, Single-Ended  
 Flex Usage: Use A (Flex During Installation)

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/3, MIL-PRF-31032/4  
 Qualification Letters: VQE-19-033709  
 Composition: M - Mixed based material printed boards  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
 Flex Base Material: Copper Clad Polyimide with Acrylic Adhesive  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 18  
 Max. Board Thickness: .165"  
 Min. Hole Size: .0256" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 6.5:1 Through-Hole  
 Min. Conductor Width/Space: .007"/.005"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Finish System: ENIG, Electrolytic Ni / Soft Au, HASL, Hot Oil Reflow of Plated Sn/Pb, Ni/Pd/Au  
 Flex Usage: Use A (Flex During Installation)

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**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<p>MANUFACTURER INFORMATION:  <b>FTG Circuits, Inc. - Chatsworth</b>                  20750 Marilla Street, Chatsworth,, CA, 91311 US</p>		<p>CAGE Code: 30803                  Phone: 818-407-4024                  Fax: 818-407-4034                  EMail: info@ftgcorp.com</p>
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-19-033706  
 Composition: S - Homogenous thermosetting base material printed boards  
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 32  
 Max. Board Thickness: .201"  
 Min. Hole Size: .005" Laser Ablated Plated Hole Size Before Plating, .01" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 11.3:1 Through-Hole, 1:1 Microvia  
 Min. Conductor Width/Space: .004"/.004"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Hole Fill/Via Plug: Non-Conductive  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, Electrolytic Ni / Soft Au, HASL, Hot Oil Reflow of Plated Sn/Pb, Ni/Pd/Au  
 Additional Fab Capabilities: Blind Vias, Buried Vias, Foil Lamination, Metal Core, Sequential Lamination  
 Controlled Impedance: Differential, Single-Ended

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-19-033707  
 Composition: S - Homogenous thermosetting base material printed boards  
 Rigid Base Material: BI: Aramid Fabric, Nonwoven, Polyimide Resin  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 16  
 Max. Board Thickness: .095"  
 Min. Hole Size: .0079" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 12:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.004"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Hole Fill/Via Plug: Non-Conductive  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, Electrolytic Ni / Soft Au, HASL, Hot Oil Reflow of Plated Sn/Pb, Ni/Pd/Au  
 Additional Fab Capabilities: Foil Lamination  
 Controlled Impedance: Differential, Single-Ended

**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<p>MANUFACTURER INFORMATION:  <b>Gorilla Circuits</b>          1445 Old Oakland Rd, San Jose, CA, 95112 US</p>	<p>PLANT LOCATION:          Same Address as Manufacturer</p>	<p>CAGE Code: 3C7D2          Phone: 408-294-9897          Fax: 408-297-1540          EMail: info@gorillacircuits.com</p>
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: 11-022314, 14-028138, 17-031452, 17-031462, 18-032591  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 18  
 Max. Board Thickness: .18"  
 Min. Hole Size: .01" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 10:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.004"  
 Hole Preparation: Permanganate Desmear, Plasma Desmear  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Pulse Plate  
 Hole Fill/Via Plug: Conductive, Non-Conductive  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, Electrolytic Ni / Hard Au, HASL  
 Additional Fab Capabilities: Foil Lamination  
 Controlled Impedance: Differential, Single-Ended

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: 11-022314, 14-028138, 17-031452, 17-031462  
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 18  
 Max. Board Thickness: .093"  
 Min. Hole Size: .01" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 9.3:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.005"  
 Hole Preparation: Plasma Desmear  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Pulse Plate  
 Hole Fill/Via Plug: Non-Conductive  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, Electrolytic Ni / Hard Au, HASL  
 Additional Fab Capabilities: Foil Lamination  
 Controlled Impedance: Differential, Single-Ended

**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<b>MANUFACTURER INFORMATION:</b> <b>Hamby Corporation</b> 27704 Avenue Scott, Valencia, CA, 91355-1218 US	<b>PLANT LOCATION:</b> Same Address as Manufacturer	CAGE Code: 07284 Phone: 661-257-1924 Fax: 661-257-1213 EMail: susharp@hambycorp.com
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-09-017349  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
 Max. Panel Size: 12" x 18"  
 Max. Number of Layers: 6  
 Max. Board Thickness: .035"  
 Min. Hole Size: .02" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 2:1 Through-Hole  
 Min. Conductor Width/Space: .009"/.009"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Finish System: Electrolytic Ni / Hard Au, HASL

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/3, MIL-PRF-31032/4  
 Qualification Letters: VQE-08-14596  
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
 Flex Base Material: Copper Clad Adhesiveless Polyimide  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 11  
 Max. Board Thickness: .085"  
 Min. Hole Size: .018" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 5:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.004"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Finish System: Electrolytic Ni / Hard Au, HASL  
 Controlled Impedance: Differential, Single-Ended  
 Flex Usage: Use A (Flex During Installation), Use B (Dynamic Flex)

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-09-017349  
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
 Max. Panel Size: 12" x 18"  
 Max. Number of Layers: 6  
 Max. Board Thickness: .035"  
 Min. Hole Size: .02" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 2:1 Through-Hole  
 Min. Conductor Width/Space: .009"/.009"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Finish System: Electrolytic Ni / Hard Au, HASL

**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<p>MANUFACTURER INFORMATION:  <b>Hamby Corporation</b>                  27704 Avenue Scott, Valencia, CA, 91355-1218 US</p>	<p>PLANT LOCATION:                  Same Address as Manufacturer</p>	<p>CAGE Code: 07284                  Phone: 661-257-1924                  Fax: 661-257-1213                  EMail: <a href="mailto:suesharp@hambycorp.com">suesharp@hambycorp.com</a></p>
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/3, MIL-PRF-31032/4  
 Qualification Letters: VQE-08-14596  
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
 Flex Base Material: Copper Clad Polyimide with Acrylic Adhesive  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 11  
 Max. Board Thickness: .095"  
 Min. Hole Size: .018" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 5:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.004"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Finish System: Electrolytic Ni / Hard Au, HASL  
 Controlled Impedance: Differential, Single-Ended  
 Flex Usage: Use A (Flex During Installation), Use B (Dynamic Flex)

**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<b>MANUFACTURER INFORMATION:</b> <b>Hans Brockstedt GmbH</b> Clara-Immerwahr-Strabe 7, 24145 Kiel Germany	<b>PLANT LOCATION:</b> Same Address as Manufacturer	<b>CAGE Code:</b> C4831 <b>Phone:</b> 0049-431-71966-0, -30 <b>Fax:</b> 0049-431-71966-29 <b>EMail:</b> Joerg.Kremer@brockstedt.de
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-03-2619, VQE-05-7480  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
 Max. Panel Size: 9" x 13", 13" x 20", 15" x 21", 18" x 24"  
 Max. Number of Layers: 12  
 Max. Board Thickness: .2"  
 Min. Hole Size: .004" Laser Ablated Plated Hole Size Before Plating, .01" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 1:1 Microvia, 7:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.004"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, Electrolytic Ni / Hard Au, HASL, Hot Oil Reflow of Plated Sn/Pb  
 Additional Fab Capabilities: Blind Vias, Buried Vias, Foil Lamination

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/3, MIL-PRF-31032/4  
 Qualification Letters: VQE-03-2619, VQE-05-7480,  
 Composition: S - Homogenous thermosetting base material printed boards  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant; GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
 Flex Base Material: Copper Clad Adhesiveless Polyimide  
 Max. Panel Size: 9" x 13", 13" x 20"  
 Max. Number of Layers: 12  
 Max. Board Thickness: .2"  
 Min. Hole Size: .004" Laser Ablated Plated Hole Size Before Plating, .01" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 1:1 Microvia, 7:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.004"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, Electrolytic Ni / Hard Au, HASL, Hot Oil Reflow of Plated Sn/Pb  
 Additional Fab Capabilities: Blind Vias, Buried Vias, Foil Lamination  
 Flex Usage: Use A (Flex During Installation), Use B (Dynamic Flex)

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/3  
 Qualification Letters: VQE-03-2619, VQE-05-7480, VQE-13-25594  
 Composition: S - Homogenous thermosetting base material printed boards,  
 Flex Base Material: Copper Clad Polyimide with Acrylic Adhesive  
 Max. Panel Size: 9" x 13", 13" x 20"  
 Max. Number of Layers: 2  
 Max. Board Thickness: .01"  
 Min. Hole Size: .01" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 1:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.004"  
 Hole Preparation: Plasma Desmear  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, Electrolytic Ni / Hard Au, HASL, Hot Oil Reflow of Plated Sn/Pb  
 Flex Usage: Use A (Flex During Installation), Use B (Dynamic Flex)



**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<p>MANUFACTURER INFORMATION:  <b>Hans Brockstedt GmbH</b>                  Clara-Immerwahr-Strabe 7, 24145 Kiel Germany</p>	<p>PLANT LOCATION:                  Same Address as Manufacturer</p>	<p>CAGE Code: C4831                  Phone: 0049-431-71966-0, -30                  Fax: 0049-431-71966-29                  EMail: Joerg.Kremer@brockstedt.de</p>
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-03-2619, VQE-05-7480  
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
 Max. Panel Size: 9" x 13", 13" x 20", 15" x 21", 18" x 24"  
 Max. Number of Layers: 12  
 Max. Board Thickness: .2"  
 Min. Hole Size: .004" Laser Ablated Plated Hole Size Before Plating, .01" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 1:1 Microvia, 7:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.004"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, Electrolytic Ni / Hard Au, HASL, Hot Oil Reflow of Plated Sn/Pb  
 Additional Fab Capabilities: Blind Vias, Buried Vias, Foil Lamination

**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<b>MANUFACTURER INFORMATION:</b> <b>Holiday Circuits, Inc.</b> 11126 Bren Road West, Minnetonka, MN, 55343 US	<b>PLANT LOCATION:</b> Same Address as Manufacturer	<b>CAGE Code:</b> 59554 <b>Phone:</b> 952-988-8059 <b>Fax:</b> <b>EMail:</b> MarwanR@Holiday.com
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQ(VQE-15-028707), VQ(VQE-18-032982), VQ(VQE-19-033858)  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 24  
 Max. Board Thickness: .136"  
 Min. Hole Size: .007" Laser Ablated Plated Hole Size Before Plating, .012" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 0.56:1 Microvia, 6.75:1 Through-Hole  
 Min. Conductor Width/Space: .0035"/.0045"  
 Hole Preparation: Permanganate Desmear, Plasma Desmear  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate, Pulse Plate  
 Hole Fill/Via Plug: Non-Conductive  
 Solder Resist: Dry Film, Liquid Photoimageable  
 Finish System: ENIG, Electrolytic Ni / Hard Au, HASL, Hot Oil Reflow of Plated Sn/Pb  
 Additional Fab Capabilities: Blind Vias, Buried Vias, Foil Lamination, Sequential Lamination  
 Controlled Impedance: Differential, Single-Ended

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQ(VQE-15-028707), VQ(VQE-18-032982), VQ(VQE-19-033858)  
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant;  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 20  
 Max. Board Thickness: .122"  
 Min. Hole Size: .014" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 6.66:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.0037"  
 Hole Preparation: Permanganate Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate, Pulse Plate  
 Hole Fill/Via Plug: Non-Conductive  
 Solder Resist: Dry Film, Liquid Photoimageable  
 Finish System: ENIG, Electrolytic Ni / Hard Au, HASL, Hot Oil Reflow of Plated Sn/Pb  
 Additional Fab Capabilities: Blind Vias, Buried Vias, Foil Lamination, Sequential Lamination  
 Controlled Impedance: Differential, Single-Ended

**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<p>MANUFACTURER INFORMATION:  <b>Hughes Circuits, Inc.</b>          540 S. Pacific Street, San Marcos, CA, 92078-4056 US</p>	<p>PLANT LOCATION:          Same Address as Manufacturer</p>	<p>CAGE Code: 1KXU6          Phone: 760-744-0300          Fax: 760-744-6388          EMail: Trevor@hughescircuits.com</p>
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQ(VQE-07-014018), VQ(VQE-14-028093), VQE-12-24783  
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 10  
 Max. Board Thickness: .08"  
 Min. Hole Size: .012" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 7:1 Through-Hole  
 Min. Conductor Width/Space: .005"/.005"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Graphite-based  
 Copper Plating: Direct Current Plate, Pulse Plate  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, HASL

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQ(VQE-08-015865), VQ(VQE-14-028093), VQE-12-24783  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 10  
 Max. Board Thickness: .08"  
 Min. Hole Size: .012" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 7:1 Through-Hole  
 Min. Conductor Width/Space: .005"/.005"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Graphite-based  
 Copper Plating: Direct Current Plate, Pulse Plate  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, HASL

**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

MANUFACTURER INFORMATION: <b>IMI, Inc.</b> 140 Hilldale Avenue, Haverhill, MA, 01832		CAGE Code: 78259 Phone: 978-373-9190 Fax: 978-521-1846 EMail: elaine@imipcb.com
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
Qualification Letters: VQ(VQE-17-031308)  
Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
Max. Panel Size: 16" x 18"  
Max. Number of Layers: 10  
Max. Board Thickness: .11"  
Min. Hole Size: .01" Drilled Plated-Through Hole Before Plating  
Aspect Ratio: 12.5:1 Through-Hole  
Min. Conductor Width/Space: .005"/.005"  
Hole Preparation: Permanganate Desmear  
Hole Wall Conductive Coating: Electroless Copper  
Copper Plating: Direct Current Plate  
Solder Resist: Liquid Photoimageable  
Finish System: HASL

**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<p>MANUFACTURER INFORMATION:  <b>ISU Petasys</b>                  12930 Bradley St, Sylmar, CA, 91342 US</p>		<p>CAGE Code: 1WFH9                  Phone:                  Fax:                  EMail: simeonr@isupetasys.com</p>
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQ(VQE-15-028813)  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 18  
 Max. Board Thickness: .15"  
 Min. Hole Size: .0098"  
 Aspect Ratio: 12.5:1 Through-Hole  
 Min. Conductor Width/Space: .003"/.004"  
 Hole Preparation: Permanganate Desmear, Permanganate Etchback, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate, Periodic Reverse Plate  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, Electrolytic Ni / Hard Au, HASL, ImmAg  
 Additional Fab Capabilities: Buried Vias, Foil Lamination, Sequential Lamination  
 Controlled Impedance: Differential, Single-Ended

**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<p>MANUFACTURER INFORMATION:  <b>ITL Circuits</b>            90 Don Park Road, Markham, L3R 1C4, Ontario, Canada</p>		<p>CAGE Code: 38747            Phone: 905-475-6658            Fax: 905-475-5097            EMail: sales@itlcircuits.com</p>
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-17-031450  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 14  
 Max. Board Thickness: .08"  
 Min. Hole Size: .012" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 5.7:1 Through-Hole  
 Min. Conductor Width/Space: .005"/.005"  
 Hole Preparation: Permanganate Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Pulse Plate  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, HASL  
 Additional Fab Capabilities: Foil Lamination

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-18-032695  
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 14  
 Max. Board Thickness: .08"  
 Min. Hole Size: .012" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 6.7:1 Through-Hole  
 Min. Conductor Width/Space: .005"/.005"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Pulse Plate  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, HASL  
 Additional Fab Capabilities: Foil Lamination

**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<b>MANUFACTURER INFORMATION:</b> <b>KCA Electronics, Inc.</b> 223 N. Crescent Way, Anaheim, CA, 92801 US	<b>PLANT LOCATION:</b> Same Address as Manufacturer	CAGE Code: 1VUH8 Phone: 714-239-2433 Fax: 714-239-2455 EMail:
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQ(VQE-19-033897)  
 Rigid Base Material: AF: Aramid Fabric, Woven, Majority Polyfunctional Epoxy Resin  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 10  
 Max. Board Thickness: .076"  
 Min. Hole Size: .02" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 3.8:1 Through-Hole  
 Min. Conductor Width/Space: .008"/.007"  
 Hole Preparation: Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Hole Fill/Via Plug: Conductive  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/3, MIL-PRF-31032/4  
 Qualification Letters: VQE-11-021796, VQE-14-027414, VQE-16-030557, VQE-16-030789  
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
 Flex Base Material: Copper Clad Adhesiveless Polyimide  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 16  
 Max. Board Thickness: .133"  
 Min. Hole Size: .01" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 7:1 Through-Hole  
 Min. Conductor Width/Space: .005"/.004"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Hole Fill/Via Plug: Non-Conductive  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, HASL  
 Controlled Impedance: Differential, Single-Ended  
 Flex Usage: Use A (Flex During Installation)

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-11-022398, VQE-14-027414, VQE-17-031406  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 22  
 Max. Board Thickness: .187"  
 Min. Hole Size: .004" Laser Ablated Plated Hole Size Before Plating, .0079" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 0.75:1 Microvia, 7:1 Through-Hole  
 Min. Conductor Width/Space: .0048"/.004"  
 Hole Preparation: Permanganate Etchback, Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Hole Fill/Via Plug: Conductive, Non-Conductive  
 Solder Resist: Liquid Photoimageable  
 Finish System: HASL  
 Controlled Impedance: Differential, Single-Ended

**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<b>MANUFACTURER INFORMATION:</b> <b>KCA Electronics, Inc.</b> 223 N. Crescent Way, Anaheim, CA, 92801 US	<b>PLANT LOCATION:</b> Same Address as Manufacturer	<b>CAGE Code:</b> 1VUH8 <b>Phone:</b> 714-239-2433 <b>Fax:</b> 714-239-2455 <b>EMail:</b>
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
Qualification Letters: VQE-11-022964, VQE-14-027414, VQE-16-030045  
Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
Max. Panel Size: 18" x 24"  
Max. Number of Layers: 16  
Max. Board Thickness: .117"  
Min. Hole Size: .0135" Drilled Plated-Through Hole Before Plating  
Aspect Ratio: 8.67:1 Through-Hole  
Min. Conductor Width/Space: .0098"/.0044"  
Hole Preparation: Plasma Desmear, Plasma Etchback  
Hole Wall Conductive Coating: Electroless Copper  
Copper Plating: Direct Current Plate  
Hole Fill/Via Plug: Conductive, Non-Conductive  
Solder Resist: Liquid Photoimageable  
Finish System: HASL



**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<b>MANUFACTURER INFORMATION:</b> <b>Lockheed Martin Mission Systems &amp; Training</b> 1801 State Route 17C, Owego, NY, 13827 US	<b>PLANT LOCATION:</b> Same Address as Manufacturer	<b>CAGE Code:</b> 03640 <b>Phone:</b> 607-751-5395 <b>Fax:</b> 607-751-7714 <b>EMail:</b>
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-00-000961, VQE-15-029009, VQE-15-029561, VQE-16-030240, VQE-18-032427, VQE-99-000130  
 Rigid Base Material: AF: Aramid Fabric, Woven, Majority Polyfunctional Epoxy Resin  
 Max. Panel Size: 12" x 18"  
 Max. Number of Layers: 16  
 Max. Board Thickness: .075"  
 Min. Hole Size: .02" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 3.6:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.004"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Pulse Plate  
 Solder Resist: Dry Film, Liquid Photoimageable  
 Finish System: ENIG, HASL, Hot Oil Reflow of Plated Sn/Pb

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-00-000961, VQE-07-013268, VQE-07-013459, VQE-11-022596, VQE-15-029009, VQE-15-029561, VQE-16-030240, VQE-16-030354, VQE-18-032427, VQE-99-000130  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 9  
 Max. Board Thickness: .104"  
 Min. Hole Size: .018" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 4:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.004"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Pulse Plate  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, HASL, Hot Oil Reflow of Plated Sn/Pb  
 Additional Fab Capabilities: Blind Vias

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-00-000961, VQE-07-013459, VQE-15-029009, VQE-15-029561, VQE-16-030240, VQE-18-032427, VQE-99-000130  
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 12  
 Max. Board Thickness: .082"  
 Min. Hole Size: .0256" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 4:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.004"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Pulse Plate  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, HASL, Hot Oil Reflow of Plated Sn/Pb

**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<b>MANUFACTURER INFORMATION:</b> <b>Lockheed Martin Mission Systems &amp; Training</b> 1801 State Route 17C, Owego, NY, 13827 US	<b>PLANT LOCATION:</b> Same Address as Manufacturer	CAGE Code: 03640 Phone: 607-751-5395 Fax: 607-751-7714 EMail:
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/3, MIL-PRF-31032/4  
 Qualification Letters: VQE-00-000684, VQE-07-013459, VQE-15-029009, VQE-18-032427  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant; GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
 Flex Base Material: Copper Clad Adhesiveless Polyimide  
 Max. Panel Size: 12" x 18"  
 Max. Number of Layers: 18  
 Max. Board Thickness: .11"  
 Min. Hole Size: .016" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 6:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.004"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Pulse Plate  
 Solder Resist: Liquid Photoimageable  
 Finish System: HASL, Hot Oil Reflow of Plated Sn/Pb  
 Flex Usage: Use A (Flex During Installation)

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/3, MIL-PRF-31032/4  
 Qualification Letters: VQE-00-000684, VQE-07-013459, VQE-15-029009, VQE-15-029562, VQE-18-032427  
 Flex Base Material: Copper Clad Polyimide with Acrylic Adhesive  
 Max. Panel Size: 12" x 18"  
 Max. Number of Layers: 4 (types 1, 2, and 3 only)  
 Max. Board Thickness: .022"  
 Min. Hole Size: .0413"  
 Aspect Ratio: .5:1 Through-Hole  
 Min. Conductor Width/Space: .009"/.01"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Pulse Plate  
 Finish System: HASL, Hot Oil Reflow of Plated Sn/Pb  
 Flex Usage: Use A (Flex During Installation)

**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<b>MANUFACTURER INFORMATION:</b> <b>Lone Star Circuits</b> 901 Hensley Drive, Wylie, TX, 75098-4909 US	<b>PLANT LOCATION:</b> Same Address as Manufacturer	<b>CAGE Code:</b> 04RV5 <b>Phone:</b> 214-291-1427 <b>Fax:</b> <b>EMail:</b> sdiacont@lscpwb.com
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/6  
 Qualification Letters: VQ(VQE-15-029714), VQE-11-021947  
 Rigid Base Material: GR: Glass Base, Nonwoven, Polytetrafluoroethylene Resin, Flame Resistant; GY: Glass Base, Woven, Polytetrafluoroethylene Resin, Flame Resistant, for Microwave Application  
 Max. Panel Size: 9" x 16", 18" x 24"  
 Max. Number of Layers: 2, 2  
 Max. Board Thickness: .031", .098"  
 Min. Hole Size: .031", .039" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 1:1 Through-Hole, 3.2:1  
 Min. Conductor Width/Space: .013"/.005", .19"/.005"  
 Hole Preparation: Sodium Treatment, Sodium Treatment  
 Hole Wall Conductive Coating: Electroless Copper, Electroless Copper  
 Copper Plating: Direct Current Plate, Direct Current Plate  
 Solder Resist: Liquid Photoimageable, Liquid Photoimageable  
 Finish System: ENIG, Electrolytic Ni / Hard Au, Fused Tin Lead, HASL, Hot Oil Reflow of Plated Sn/Pb, ImmAg  
 Controlled Impedance: Differential, Single-Ended

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-03-4341, VQE-04-5599, VQE-04-5891, VQE-05-7288  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 18  
 Max. Board Thickness: .119"  
 Min. Hole Size: .01" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 7.5:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.005"  
 Hole Preparation: Permanganate Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Solder Resist: Dry Film, Liquid Photoimageable  
 Finish System: ENIG, Electrolytic Ni / Hard Au, Fused Tin Lead, HASL, Hot Oil Reflow of Plated Sn/Pb, ImmAg  
 Additional Fab Capabilities: Foil Lamination  
 Controlled Impedance: Differential, Single-Ended

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-04-4957, VQE-05-7288  
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 12  
 Max. Board Thickness: .074"  
 Min. Hole Size: .012" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 6.2:1 Through-Hole  
 Min. Conductor Width/Space: .007"/.007"  
 Hole Preparation: Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, Electrolytic Ni / Hard Au, Fused Tin Lead, HASL, Hot Oil Reflow of Plated Sn/Pb, ImmAg  
 Controlled Impedance: Differential, Single-Ended

**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

MANUFACTURER INFORMATION: <b>Mass Design, Inc.</b> 41 Simon St., Nashua, NH, 03060		CAGE Code: 35ZD0 Phone: (603) 886-6460 Fax: (603) 886-1208 EMail: info@massdesign.com
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQ(VQE-20-034397)  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 6  
 Max. Board Thickness: .062"  
 Min. Hole Size: .015" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 10:1 Through-Hole  
 Min. Conductor Width/Space: .008"/.007"  
 Hole Preparation: Permanganate Desmear  
 Hole Wall Conductive Coating: Palladium-based  
 Copper Plating: Direct Current Plate  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, HASL  
 Additional Fab Capabilities: Foil Lamination

**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<p>MANUFACTURER INFORMATION:  <b>Metaplast Circuits Ltd.</b>          180 Hymus Road, Scarborough, M1L 2E1, Ontario,          Canada</p>		<p>CAGE Code: 3AD63          Phone: 416-285-5000          Fax:          EMail: sales@metaplast.ca</p>
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-18-032032  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 20  
 Max. Board Thickness: .113"  
 Min. Hole Size: .008" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 14:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.004"  
 Hole Preparation: Permanganate Desmear  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Periodic Reverse Plate  
 Hole Fill/Via Plug: Non-Conductive  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, HASL  
 Additional Fab Capabilities: Foil Lamination  
 Controlled Impedance: Differential, Single-Ended

**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<p>MANUFACTURER INFORMATION:  <b>Micropack Limited</b>  , Plot No. 16, Jigani Industrial Area, Anekal Taluk,  Bangalore District 560105 India</p>	<p>PLANT LOCATION:  Same Address as Manufacturer</p>	<p>CAGE Code: SAL28  Phone: 91-80-27825223  Fax: 91-80-27825225  EMail: process@micropack.in</p>
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/3, MIL-PRF-31032/4  
Qualification Letters: VQE-17-031413  
Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
Flex Base Material: Copper Clad Adhesiveless Polyimide  
Max. Panel Size: 18" x 24"  
Max. Number of Layers: 20  
Max. Board Thickness: .1"  
Min. Hole Size: .01" Drilled Plated-Through Hole Before Plating  
Aspect Ratio: 10:1 Through-Hole  
Min. Conductor Width/Space: .004"/.004"  
Hole Preparation: Permanganate Desmear, Plasma Desmear, Plasma Etchback  
Hole Wall Conductive Coating: Electroless Copper  
Copper Plating: Direct Current Plate  
Hole Fill/Via Plug: Non-Conductive  
Solder Resist: Liquid Photoimageable  
Finish System: ENIG, HASL  
Controlled Impedance: Differential, Single-Ended  
Flex Usage: Use A (Flex During Installation)

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
Qualification Letters: VQE-17-031258  
Composition: S - Homogenous thermosetting base material printed boards  
Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
Max. Panel Size: 18" x 24"  
Max. Number of Layers: 20  
Max. Board Thickness: .1"  
Min. Hole Size: .01" Drilled Plated-Through Hole Before Plating  
Aspect Ratio: 10:1 Through-Hole,  
Min. Conductor Width/Space: .004"/.004"  
Hole Preparation: Permanganate Desmear, Plasma Desmear, Plasma Etchback  
Hole Wall Conductive Coating: Electroless Copper  
Copper Plating: Direct Current Plate  
Hole Fill/Via Plug: Non-Conductive  
Solder Resist: Liquid Photoimageable  
Finish System: ENIG, HASL  
Additional Fab Capabilities: Foil Lamination, Metal Core  
Controlled Impedance: Differential, Single-Ended

**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<p>MANUFACTURER INFORMATION:  <b>Micropack Limited</b>  , Plot No. 16, Jigani Industrial Area, Anekal Taluk,  Bangalore District 560105 India</p>	<p>PLANT LOCATION:  Same Address as Manufacturer</p>	<p>CAGE Code: SAL28  Phone: 91-80-27825223  Fax: 91-80-27825225  EMail: process@micropack.in</p>
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
Qualification Letters: VQE-17-031258  
Composition: S - Homogenous thermosetting base material printed boards  
Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
Max. Panel Size: 18" x 24"  
Max. Number of Layers: 20  
Max. Board Thickness: .1"  
Min. Hole Size: .01" Drilled Plated-Through Hole Before Plating  
Aspect Ratio: 10:1 Through-Hole,  
Min. Conductor Width/Space: .004"/.004"  
Hole Preparation: Permanganate Desmear, Plasma Desmear, Plasma Etchback  
Hole Wall Conductive Coating: Electroless Copper  
Copper Plating: Direct Current Plate  
Hole Fill/Via Plug: Non-Conductive  
Solder Resist: Liquid Photoimageable  
Finish System: ENIG, HASL  
Additional Fab Capabilities: Foil Lamination, Metal Core  
Controlled Impedance: Differential, Single-Ended

**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<p>MANUFACTURER INFORMATION:  <b>Midwest Printed Circuit Services</b>          1741 Circuit Drive, Round Lake Beach, IL, 60073 US</p>		<p>CAGE Code: 0YYS4          Phone: 847-740-4120          Fax: 847-740-4187          EMail:</p>
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-12-024841, VQE-12-025070, VQE-13-025727, VQE-14-028088, VQE-16-030296  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 12  
 Max. Board Thickness: .1"  
 Min. Hole Size: .012" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 7.92:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.004"  
 Hole Preparation: Permanganate Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Solder Resist: Dry Film, Liquid Photoimageable  
 Finish System: ENIG, HASL  
 Additional Fab Capabilities: Controlled Depth Mechanically Drilled Low Aspect Ratio Blind Vias, Foil Lamination  
 Controlled Impedance: Differential

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-13-025705, VQE-14-028088  
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 10  
 Max. Board Thickness: .1"  
 Min. Hole Size: .038" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 2.5:1 Through-Hole  
 Min. Conductor Width/Space: .01"/.01"  
 Hole Preparation: Permanganate Desmear, Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, HASL

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/3, MIL-PRF-31032/4  
 Qualification Letters: VQE-16-030690  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
 Flex Base Material: Copper Clad Adhesiveless Polyimide  
 Max. Panel Size: 12" x 18"  
 Max. Number of Layers: 10  
 Max. Board Thickness: .094"  
 Min. Hole Size: .016" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 5.8:1 Through-Hole  
 Min. Conductor Width/Space: .01"/.01"  
 Hole Preparation: Plasma Desmear  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Solder Resist: Dry Film, Liquid Photoimageable, Silk Screen  
 Finish System: ENIG, HASL  
 Flex Usage: Use A (Flex During Installation), Use B (Dynamic Flex)



**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

MANUFACTURER INFORMATION: <b>Multicircuits Inc.</b> 2301 Universal St, Oshkosh, WI, 54904		CAGE Code: 1BQS8 Phone: 920-385-7537 Fax: EMail: cgauthier@multicircuits.com
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQ(VQE-19-033227)  
 Composition: H - Homogenous thermoplastic base material printed boards  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
 Max. Panel Size: 21" x 24"  
 Max. Number of Layers: 16  
 Max. Board Thickness: .127"  
 Min. Hole Size: .0079" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 9:1 Through-Hole  
 Min. Conductor Width/Space: .0035"/.003"  
 Hole Preparation: Permanganate Desmear, Permanganate Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, Electrolytic Ni / Hard Au, HASL  
 Additional Fab Capabilities: Foil Lamination  
 Controlled Impedance: Differential, Single-Ended

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQ(VQE-19-033870)  
 Composition: S - Homogenous thermosetting base material printed boards  
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 16  
 Max. Board Thickness: .093"  
 Min. Hole Size: .01" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 9:3:1 Through-Hole  
 Min. Conductor Width/Space: .003"/.003"  
 Hole Preparation: Permanganate Desmear, Permanganate Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, Electrolytic Ni / Hard Au, HASL  
 Additional Fab Capabilities: Foil Lamination  
 Controlled Impedance: Differential, Single-Ended

**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

MANUFACTURER INFORMATION: <b>Multilayer Technology</b> 3835 West Conflans Road, Irving, TX, 75061		CAGE Code: 0JKV9 Phone: 972-790-0062 Fax: EMail: rick@multilayer.com
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE(VQ-20-034746)  
 Composition: H - Homogenous thermoplastic base material printed boards  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 16  
 Max. Board Thickness: .102"  
 Min. Hole Size: .005" Laser Ablated Plated Hole Size Before Plating, .008" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 11.625:1 Through-Hole, 1:1 Microvia  
 Min. Conductor Width/Space: .00325"/.0049"  
 Hole Preparation: Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Hole Fill/Via Plug: Conductive, Non-Conductive  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, HASL  
 Additional Fab Capabilities: Blind Vias, Buried Vias, Foil Lamination, Sequential Lamination  
 Controlled Impedance: Differential, Single-Ended

**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<p>MANUFACTURER INFORMATION:  <b>Murrietta Circuits, Inc.</b>          5000 E. Landon Drive, Anaheim, CA, 92807 US</p>	<p>PLANT LOCATION:          Same Address as Manufacturer</p>	<p>CAGE Code: 0EJD7          Phone: 714-970-2430          Fax: 714-970-2406          EMail:</p>
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-15-029521, VQE-18-032565,  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 18  
 Max. Board Thickness: .11"  
 Min. Hole Size: .011" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 10:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.004"  
 Hole Preparation: Permanganate Etchback, Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Hole Fill/Via Plug: Non-Conductive  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, HASL, Ni/Pd/Au  
 Additional Fab Capabilities: Foil Lamination  
 Controlled Impedance: Single-Ended

**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<p>MANUFACTURER INFORMATION:  <b>Pioneer Circuits, Inc.</b>          3000 S. Shannon Street, Santa Ana, CA, 92704-6321          US</p>		<p>CAGE Code: 65723          Phone: 714-641-3132          Fax: 714-641-3120          EMail: Quality@pioneer-circuits.com</p>
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-09-017323, VQE-09-017656  
 Composition: S - Homogenous thermosetting base material printed boards  
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 22  
 Max. Board Thickness: .177"  
 Min. Hole Size: .0135" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 11:1 Through-Hole  
 Min. Conductor Width/Space: .0035"/.0035"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate, Periodic Reverse Plate  
 Hole Fill/Via Plug: Conductive, Non-Conductive  
 Solder Resist: Dry Film, Liquid Photoimageable  
 Finish System: ENIG, Electrolytic Ni/Au, HASL, Hot Oil Reflow of Plated Sn/Pb  
 Additional Fab Capabilities: Blind Vias, Buried Vias, Sequential Lamination  
 Controlled Impedance: Differential, Single-Ended

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-09-017323, VQE-09-017656  
 Composition: S - Homogenous thermosetting base material printed boards  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 20  
 Max. Board Thickness: .275"  
 Min. Hole Size: .012" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 11:1 Through-Hole  
 Min. Conductor Width/Space: .0035"/.0035"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate, Periodic Reverse Plate  
 Hole Fill/Via Plug: Conductive, Non-Conductive  
 Solder Resist: Dry Film, Liquid Photoimageable  
 Finish System: ENIG, Electrolytic Ni/Au, HASL, Hot Oil Reflow of Plated Sn/Pb  
 Additional Fab Capabilities: Blind Vias, Buried Vias, Sequential Lamination  
 Controlled Impedance: Differential, Single-Ended

**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<p>MANUFACTURER INFORMATION:  <b>Pioneer Circuits, Inc.</b>          3000 S. Shannon Street, Santa Ana, CA, 92704-6321          US</p>		<p>CAGE Code: 65723          Phone: 714-641-3132          Fax: 714-641-3120          EMail: Quality@pioneercircuits.com</p>
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/3, MIL-PRF-31032/4  
 Qualification Letters: VQE-09-017323, VQE-09-017656, VQE-10-029651  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
 Flex Base Material: Copper Clad Adhesiveless Polyimide  
 Max. Panel Size: 18" x 26"  
 Max. Number of Layers: 22  
 Max. Board Thickness: .231"  
 Min. Hole Size: .02" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 8.5:1 Through-Hole  
 Min. Conductor Width/Space: .003"/.003"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate, Periodic Reverse Plate  
 Hole Fill/Via Plug: Conductive, Non-Conductive  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, Electrolytic Ni/Au, HASL, Hot Oil Reflow of Plated Sn/Pb  
 Additional Fab Capabilities: Blind Vias, Buried Vias, Sequential Lamination  
 Controlled Impedance: Differential, Single-Ended  
 Flex Usage: Use A (Flex During Installation)

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/3, MIL-PRF-31032/4  
 Qualification Letters: VQE-09-017323, VQE-09-017656  
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
 Flex Base Material: Copper Clad Polyimide with Acrylic Adhesive  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 10  
 Max. Board Thickness: .1"  
 Min. Hole Size: .016" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 6:1 Through-Hole  
 Min. Conductor Width/Space: .0035"/.0035"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate, Periodic Reverse Plate  
 Hole Fill/Via Plug: Conductive, Non-Conductive  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, Electrolytic Ni/Au, HASL, Hot Oil Reflow of Plated Sn/Pb  
 Additional Fab Capabilities: Blind Vias, Book Binder, Buried Vias, Sequential Lamination  
 Controlled Impedance: Differential, Single-Ended  
 Flex Usage: Use A (Flex During Installation), Use B (Dynamic Flex)

**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<p>MANUFACTURER INFORMATION:  <b>Pioneer Circuits, Inc.</b>          3000 S. Shannon Street, Santa Ana, CA, 92704-6321          US</p>		<p>CAGE Code: 65723          Phone: 714-641-3132          Fax: 714-641-3120          EMail: Quality@pioneercircuits.com</p>
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/3, MIL-PRF-31032/4  
 Qualification Letters: VQE-09-017323, VQE-09-017656  
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
 Flex Base Material: Copper Clad Adhesiveless Polyimide  
 Max. Panel Size: 24" x 36"  
 Max. Number of Layers: 26  
 Max. Board Thickness: .185"  
 Min. Hole Size: .013" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 11:1 Through-Hole  
 Min. Conductor Width/Space: .0035"/.0035"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate, Periodic Reverse Plate  
 Hole Fill/Via Plug: Conductive, Non-Conductive  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, Electrolytic Ni/Au, HASL, Hot Oil Reflow of Plated Sn/Pb  
 Additional Fab Capabilities: Blind Vias, Book Binder, Buried Vias, Sequential Lamination  
 Controlled Impedance: Differential, Single-Ended  
 Flex Usage: Use A (Flex During Installation), Use B (Dynamic Flex)

**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<p>MANUFACTURER INFORMATION:  <b>PNC, Inc.</b>          115 East Centre Street, Nutley, NJ, 07110 US</p>	<p>PLANT LOCATION:          Same Address as Manufacturer</p>	<p>CAGE Code: 66766          Phone: 973-284-1600          Fax:          EMail: carmela@pnconline.com</p>
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-10-19440, VQE-15-029233  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 16  
 Max. Board Thickness: .12"  
 Min. Hole Size: .012" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 10:1 Through-Hole  
 Min. Conductor Width/Space: .003"/.003"  
 Hole Preparation: Permanganate Desmear  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Hole Fill/Via Plug: Non-Conductive  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, HASL  
 Additional Fab Capabilities: Foil Lamination  
 Controlled Impedance: Differential, Single-Ended

**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<p>MANUFACTURER INFORMATION:  <b>Printed Circuits, Inc.</b>                  1200 West 96th Street, Bloomington, MN, 55431-2606                  US</p>	<p>PLANT LOCATION:                  Same Address as Manufacturer</p>	<p>CAGE Code: 65114                  Phone: 952-888-7900                  Fax:                  EMail: wdrinken@printedcircuits.com</p>
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/3, MIL-PRF-31032/4  
 Qualification Letters: VQE-01-000024  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant; GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
 Flex Base Material: Copper Clad Adhesiveless Polyimide  
 Max. Panel Size: 12" x 18", 18" x 24"  
 Max. Number of Layers: 7  
 Max. Board Thickness: .12"  
 Min. Hole Size: .01" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 10:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.005"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate, Pulse Plate  
 Solder Resist: Dry Film, Liquid Photoimageable  
 Finish System: ENIG, Electrolytic Ni / Hard Au, Electrolytic Ni / Soft Au, HASL, Hot Oil Reflow of Plated Sn/Pb  
 Additional Fab Capabilities: Sequential Lamination  
 Flex Usage: Use A (Flex During Installation), Use B (Dynamic Flex)



**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<p>MANUFACTURER INFORMATION:  <b>Pro-Tech Interconnect Solutions LLC</b>          4300 Peavey Road, Chaska, MN, 55318 US</p>		<p>CAGE Code: 3CP65          Phone: 952-442-2189          Fax: 952-442-2472          EMail: stum@protechmn.com</p>
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-11-021704, VQE-19-033101  
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
 Max. Panel Size: 12" x 24"  
 Max. Number of Layers: 16 ,  
 Max. Board Thickness: .1"  
 Min. Hole Size: .005" Laser Ablated Plated Hole Size Before Plating, .0079" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 1.8:1 Microvia, 12:1 Through-Hole  
 Min. Conductor Width/Space: .005"/.003"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Carbon-based  
 Copper Plating: Direct Current Plate  
 Hole Fill/Via Plug: Conductive, Non-Conductive  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, Electrolytic Ni / Hard Au, HASL, ImmAg, OSP  
 Additional Fab Capabilities: Blind Vias, Buried Vias, Sequential Lamination  
 Controlled Impedance: Differential, Single-Ended

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-11-021704, VQE-16-030058, VQE-19-033101  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 20  
 Max. Board Thickness: .1"  
 Min. Hole Size: .005" Laser Ablated Plated Hole Size Before Plating, .0059" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 15:1 Through-Hole, 1:1 Microvia  
 Min. Conductor Width/Space: .003"/.002"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Carbon-based  
 Copper Plating: Direct Current Plate  
 Hole Fill/Via Plug: Conductive, Non-Conductive  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, Electrolytic Ni / Hard Au, HASL, ImmAg, OSP  
 Additional Fab Capabilities: Blind Vias, Buried Vias, Sequential Lamination  
 Controlled Impedance: Differential, Single-Ended

**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<p>MANUFACTURER INFORMATION:  <b>Prototron Circuits, Inc.</b>          3760 East 43rd Place, Tucson, AZ, 58713 US</p>		<p>CAGE Code: 66108          Phone: 520-745-8515          Fax: 520-747-8334          EMail:</p>
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-17-030991  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 12  
 Max. Board Thickness: .112"  
 Min. Hole Size: .012" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 10:1 Through-Hole  
 Min. Conductor Width/Space: .005"/.005"  
 Hole Preparation: Permanganate Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, Electrolytic Ni / Hard Au, HASL  
 Additional Fab Capabilities: Foil Lamination  
 Controlled Impedance: Differential, Single-Ended

**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

MANUFACTURER INFORMATION: <b>Sanmina (Costa Mesa)</b> 2945 Airway Avenue, Costa Mesa, CA, 92626 US		CAGE Code: 3BKL5 Phone: 714-371-2800 Fax: 714-371-2833 EMail: terry.lichte@sanmina.com
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQ(VQE-19-033984)  
 Rigid Base Material: Woven Glass Reinforced, Hydrocarbon Resin with Ceramic Fill  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 6  
 Max. Board Thickness: .12"  
 Min. Hole Size: .0159"  
 Aspect Ratio: 7.59  
 Min. Conductor Width/Space: .005"/.005"  
 Hole Preparation: Permanganate Desmear  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Hole Fill/Via Plug: Conductive  
 Solder Resist: Liquid Photoimageable  
 Finish System: ImmAu

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-12-024031  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
 Max. Panel Size: 12" x 18"  
 Max. Number of Layers: 8  
 Max. Board Thickness: .063"  
 Min. Hole Size: .005" Laser Ablated Plated Hole Size Before Plating, .013" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 1:1 Microvia, 5:1 Through-Hole  
 Min. Conductor Width/Space: .008"/.008"  
 Hole Preparation: Permanganate Desmear, Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Hole Fill/Via Plug: Non-Conductive  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, HASL  
 Additional Fab Capabilities: Foil Lamination, Press Fit Mounting, Sequential Lamination, ,  
 Controlled Impedance: Single-Ended

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQ(VQE-19-033984), VQE-12-24471  
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant;  
 Max. Panel Size: 12" x 18"  
 Max. Number of Layers: 18 ,  
 Max. Board Thickness: .093"  
 Min. Hole Size: .013" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 7 : 1 Through-Hole,  
 Min. Conductor Width/Space: .008"/.008"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Hole Fill/Via Plug: Non-Conductive,  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG  
 Additional Fab Capabilities: Foil Lamination  
 Controlled Impedance: Single-Ended

**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<b>MANUFACTURER INFORMATION:</b> <b>Sanmina-SCI (San Jose)</b> 2050 Bering Drive, San Jose, CA, 95131 US	<b>PLANT LOCATION:</b> Same Address as Manufacturer	<b>CAGE Code:</b> 3DR67 <b>Phone:</b> 408-964-6515 <b>Fax:</b> 408-964-6453 <b>EMail:</b> darrell.myers@sanmina-sci.com
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQ(VQE-18-031913), VQ(VQE-19-033467)  
 Composition: S - Homogenous thermosetting base material printed boards  
 Rigid Base Material: Woven Glass Reinforced, Hydrocarbon Resin with Ceramic Fill  
 Max. Panel Size: 21" x 27"  
 Max. Number of Layers: 20  
 Max. Board Thickness: .221"  
 Min. Hole Size: .0157" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 14.1:1 Through-Hole  
 Min. Conductor Width/Space: .00735"/.004"  
 Hole Preparation: Plasma Desmear  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Hole Fill/Via Plug: Conductive  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, HASL, IR Reflow of Plated Sn/Pb, ImmAg, ImmAu, Ni/Pd/Au, OSP  
 Additional Fab Capabilities: Blind Vias  
 Controlled Impedance: Differential, Single-Ended

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-06-11137, VQE-10-19381, VQE-11-22038  
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
 Max. Panel Size: 21" x 27"  
 Max. Number of Layers: 8  
 Max. Board Thickness: .062"  
 Min. Hole Size: .01" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 6.32:1 Through-Hole  
 Min. Conductor Width/Space: .003"/.003"  
 Hole Preparation: Plasma Desmear  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate, Pulse Plate  
 Hole Fill/Via Plug: Conductive, Non-Conductive  
 Solder Resist: Dry Film, Liquid Photoimageable  
 Finish System: ENIG, HASL, Hot Oil Reflow of Plated Sn/Pb, ImmAg, ImmAu, Ni/Pd/Au, OSP  
 Additional Fab Capabilities: Buried Vias, Foil Lamination, Sequential Lamination  
 Controlled Impedance: Differential, Single-Ended

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-06-11137  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
 Max. Panel Size: 21" x 27"  
 Max. Number of Layers: 30  
 Max. Board Thickness: .25"  
 Min. Hole Size: .005" Laser Ablated Plated Hole Size Before Plating, .008" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 15:1 Through-Hole, 1:2 Microvia  
 Min. Conductor Width/Space: .003"/.003"  
 Hole Preparation: Plasma Desmear  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate, Pulse Plate  
 Hole Fill/Via Plug: Conductive, Non-Conductive  
 Solder Resist: Dry Film, Liquid Photoimageable  
 Finish System: ENIG, HASL, Hot Oil Reflow of Plated Sn/Pb, ImmAg, ImmAu, Ni/Pd/Au, OSP  
 Additional Fab Capabilities: Blind Vias, Buried Vias, Foil Lamination, Sequential Lamination  
 Controlled Impedance: Differential, Single-Ended

**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<b>MANUFACTURER INFORMATION:</b> <b>Sanmina-SCI (San Jose)</b> 2050 Bering Drive, San Jose, CA, 95131 US	<b>PLANT LOCATION:</b> Same Address as Manufacturer	<b>CAGE Code:</b> 3DR67 <b>Phone:</b> 408-964-6515 <b>Fax:</b> 408-964-6453 <b>EMail:</b> darrell.myers@sanmina-sci.com
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-16-030024  
 Rigid Base Material: BI: Aramid Fabric, Nonwoven, Polyimide Resin  
 Max. Panel Size: 21" x 27"  
 Max. Number of Layers: 12  
 Max. Board Thickness: .088"  
 Min. Hole Size: .0138"  
 Aspect Ratio: 5.4:1 Through-Hole  
 Min. Conductor Width/Space: .0064"/.0068"  
 Hole Preparation: Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, HASL, Hot Oil Reflow of Plated Sn/Pb, ImmAg, ImmAu, Ni/Pd/Au, OSP  
 Controlled Impedance: Differential, Single-Ended

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQ(VQE-18-031913)  
 Composition: M - Mixed based material printed boards  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant; GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
 Max. Panel Size: 21" x 27"  
 Max. Number of Layers: 24  
 Max. Board Thickness: .111"  
 Min. Hole Size: .0079" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 14.1:1 Through-Hole  
 Min. Conductor Width/Space: .003"/.0025"  
 Hole Preparation: Plasma Desmear  
 Hole Wall Conductive Coating: Carbon-based  
 Copper Plating: Direct Current Plate  
 Hole Fill/Via Plug: Conductive  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, HASL, Hot Oil Reflow of Plated Sn/Pb, ImmAg, ImmAu, Ni/Pd/Au, OSP  
 Additional Fab Capabilities: Blind Vias  
 Controlled Impedance: Differential, Single-Ended

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQ(VQE-18-031913)  
 Composition: M - Mixed based material printed boards  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant; Woven Glass Reinforced, Hydrocarbon Resin with Ceramic Fill  
 Max. Panel Size: 21" x 27"  
 Max. Number of Layers: 28  
 Max. Board Thickness: .227"  
 Min. Hole Size: .0157" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 14.5:1 Through-Hole  
 Min. Conductor Width/Space: .0046"/.0035"  
 Hole Preparation: Plasma Desmear  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Hole Fill/Via Plug: Conductive  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, HASL, Hot Oil Reflow of Plated Sn/Pb, ImmAg, ImmAu, Ni/Pd/Au, OSP  
 Additional Fab Capabilities: Blind Vias  
 Controlled Impedance: Differential, Single-Ended

**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<p>MANUFACTURER INFORMATION:  <b>Sierra Circuits Inc.</b>          1108 West Evelyn Ave, Sunnyvale, CA, 94086 USA</p>		<p>CAGE Code: 0ZHS4          Phone: 800-763-7503          Fax: 408-735-0175          EMail: estrelitam@protoexpress.com</p>
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQ(VQE-18-032408)  
 Composition: H - Homogenous thermoplastic base material printed boards  
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 20  
 Max. Board Thickness: .1"  
 Min. Hole Size: .007" Laser Ablated Plated Hole Size Before Plating, .01" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 0.6:1 Microvia, 10:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.004"  
 Hole Preparation: Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Periodic Reverse Plate  
 Hole Fill/Via Plug: Non-Conductive  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, HASL  
 Additional Fab Capabilities: Blind Vias, Foil Lamination  
 Controlled Impedance: Differential, Single-Ended

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQ(VQE-18-032408)  
 Composition: H - Homogenous thermoplastic base material printed boards  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 20  
 Max. Board Thickness: .1"  
 Min. Hole Size: .007" Laser Ablated Plated Hole Size Before Plating, .01" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 0.6:1 Microvia, 10:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.004"  
 Hole Preparation: Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Periodic Reverse Plate  
 Hole Fill/Via Plug: Non-Conductive  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, HASL  
 Additional Fab Capabilities: Blind Vias, Foil Lamination  
 Controlled Impedance: Differential, Single-Ended

**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<p>MANUFACTURER INFORMATION:  <b>Streamline Circuits</b>                  1410 Martin Ave., Santa Clara, CA, 95050</p>		<p>CAGE Code: 3WUY3                  Phone: 408-727-1418                  Fax: 408-727-8971                  EMail: trb@streamlinecircuits.com</p>
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-17-031750  
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 14  
 Max. Board Thickness: .093"  
 Min. Hole Size: .024" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 3.6:1 Through-Hole  
 Min. Conductor Width/Space: .009"/.006"  
 Hole Preparation: Permanganate Desmear, Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate, Pulse Plate  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG  
 Additional Fab Capabilities: Foil Lamination  
 Controlled Impedance: Single-Ended

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/3, MIL-PRF-31032/4  
 Qualification Letters: VQE-18-031873  
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
 Flex Base Material: Copper Clad Adhesiveless Polyimide  
 Max. Panel Size: 12" x 18"  
 Max. Number of Layers: 10  
 Max. Board Thickness: .063"  
 Min. Hole Size: .012" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 5.02:1 Through-Hole  
 Min. Conductor Width/Space: .008"/.003"  
 Hole Preparation: Permanganate Desmear, Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate, Pulse Plate  
 Solder Resist: Liquid Photoimageable  
 Finish System: Electrolytic Ni (no Au), HASL  
 Additional Fab Capabilities: Sequential Lamination  
 Flex Usage: Use B (Dynamic Flex)

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-18-031945  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 28  
 Max. Board Thickness: .16"  
 Min. Hole Size: .0225" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 7.2:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.00475"  
 Hole Preparation: Permanganate Desmear, Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate, Pulse Plate  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG  
 Additional Fab Capabilities: Blind Vias, Buried Vias, Foil Lamination, Sequential Lamination  
 Controlled Impedance: Differential, Single-Ended

**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<p>MANUFACTURER INFORMATION:  <b>Technologies, Inc. (Anaheim)</b>          3140 East Coronado Street, Anaheim, CA, 92806 US</p>	<p>PLANT LOCATION:          Same Address as Manufacturer</p>	<p>CAGE Code: 0BSG1          Phone: 714-688-7382          Fax:          EMail:</p>
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQ(VQE-09-018147), VQ(VQE-14-028542), VQE-14-028660, VQE-16-029908  
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 14  
 Max. Board Thickness: .1"  
 Min. Hole Size: .02" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 5:1 Through-Hole  
 Min. Conductor Width/Space: .01"/.01"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, HASL  
 Additional Fab Capabilities: Foil Lamination  
 Controlled Impedance: Differential, Single-Ended

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-09-018147, VQE-17-031347, VQE-18-031989  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 22  
 Max. Board Thickness: .115"  
 Min. Hole Size: .007" Laser Ablated Plated Hole Size Before Plating, .009" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 0.6:1 Microvia, 10:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.006"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Hole Fill/Via Plug: Non-Conductive  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, HASL  
 Additional Fab Capabilities: Buried Vias, Foil Lamination  
 Controlled Impedance: Differential, Single-Ended



**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<b>MANUFACTURER INFORMATION:</b> <b>Thales Nederland B.V.</b> Haaksbergerstraat 49, 7554PA Hengelo The Netherlands	<b>PLANT LOCATION:</b> Same Address as Manufacturer	<b>CAGE Code:</b> H0203 <b>Phone:</b> 31 0 742482880 <b>Fax:</b> 31 0 742484124 <b>EMail:</b> jan.bokhove@nl.thalesgroup.com
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-14-028079, VQE-19-034061  
 Composition: S - Homogenous thermosetting base material printed boards  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 12  
 Max. Board Thickness: .1"  
 Min. Hole Size: .014" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 5.7:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.004"  
 Hole Preparation: Permanganate Desmear  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Hole Fill/Via Plug: Non-Conductive  
 Solder Resist: Dry Film  
 Finish System: HASL  
 Additional Fab Capabilities: Blind Vias, Foil Lamination, Sequential Lamination

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-14-028079, VQE-19-034062  
 Composition: S - Homogenous thermosetting base material printed boards  
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 12  
 Max. Board Thickness: .1"  
 Min. Hole Size: .014" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 5.7:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.004"  
 Hole Preparation: Permanganate Desmear  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Hole Fill/Via Plug: Non-Conductive  
 Solder Resist: Dry Film  
 Finish System: HASL  
 Additional Fab Capabilities: Blind Vias, Foil Lamination, Sequential Lamination

**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<b>MANUFACTURER INFORMATION:</b> <b>TTM Technologies, Inc. (Denver)</b> 10570 Bradford Road, Littleton, CO, 80127-4211 US	<b>PLANT LOCATION:</b> Same Address as Manufacturer	<b>CAGE Code:</b> 75815 <b>Phone:</b> 303-972-4105 <b>Fax:</b> 303-933-2934 <b>E-Mail:</b>
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-02-000317, VQE-05-007627, VQE-05-009014, VQE-09-018719, VQE-10-020224, VQE-12-024984, VQE-13-026251, VQE-13-026429, VQE-15-029639, VQE-17-031662  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 24  
 Max. Board Thickness: .125"  
 Min. Hole Size: .005" Laser Ablated Plated Hole Size Before Plating, .0091" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 10:1 Through-Hole, 1:1 Microvia  
 Min. Conductor Width/Space: .004"/.004"  
 Hole Preparation: Permanganate Desmear, Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Hole Fill/Via Plug: Non-Conductive  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, HASL, Hot Oil Reflow of Plated Sn/Pb  
 Additional Fab Capabilities: Blind Vias, Buried Vias, Foil Lamination, Sequential Lamination  
 Controlled Impedance: Differential, Single-Ended

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-02-000317, VQE-05-007627, VQE-05-009014, VQE-09-018719, VQE-10-020224, VQE-12-024984, VQE-13-026251, VQE-13-026429, VQE-15-029639, VQE-17-031662  
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 24  
 Max. Board Thickness: .15"  
 Min. Hole Size: .005" Laser Ablated Plated Hole Size Before Plating, .0091" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 10:1 Through-Hole, 1:1 Microvia  
 Min. Conductor Width/Space: .004"/.004"  
 Hole Preparation: Permanganate Desmear, Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Hole Fill/Via Plug: Non-Conductive  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, HASL, Hot Oil Reflow of Plated Sn/Pb  
 Additional Fab Capabilities: Blind Vias, Buried Vias, Foil Lamination, Sequential Lamination  
 Controlled Impedance: Differential, Single-Ended

**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<b>MANUFACTURER INFORMATION:</b> <b>TTM Technologies, Inc. (Forest Grove)</b> 1521 Poplar Lane, Forest Grove, OR, 97116-2033	<b>PLANT LOCATION:</b> Same Address as Manufacturer	<b>CAGE Code:</b> 01KV9 <b>Phone:</b> (503) 992-4336 <b>Fax:</b> <b>EMail:</b> alan.preston@ttmtech.com
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQ(VQE 19-033918), VQ(VQE-19-033180)  
 Composition: S - Homogenous thermosetting base material printed boards  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
 Max. Panel Size: 21" x 24"  
 Max. Number of Layers: 31  
 Max. Board Thickness: .156"  
 Min. Hole Size: .005" Laser Ablated Plated Hole Size Before Plating, .0098" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 0.84:1 Microvia, 11.9:1 Through-Hole  
 Min. Conductor Width/Space: .0032"/.0025"  
 Hole Preparation: Permanganate Desmear, Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Pulse Plate  
 Hole Fill/Via Plug: Non-Conductive  
 Solder Resist: Dry Film, LDI, Liquid Photoimageable  
 Finish System: ENIG, HASL, Hot Oil Reflow of Plated Sn/Pb, ImmAg  
 Additional Fab Capabilities: Blind Vias, Buried Vias, Foil Lamination, Sequential Lamination  
 Controlled Impedance: Differential, Single-Ended

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQ(VQE 19-033919), VQ(VQE-19-033181)  
 Composition: S - Homogenous thermosetting base material printed boards  
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 18  
 Max. Board Thickness: .099"  
 Min. Hole Size: .005" Laser Ablated Plated Hole Size Before Plating, .0098" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 0.84:1 Microvia, 8.4:1 Through-Hole  
 Min. Conductor Width/Space: .0032"/.004"  
 Hole Preparation: Permanganate Desmear, Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Pulse Plate  
 Hole Fill/Via Plug: Non-Conductive  
 Solder Resist: Dry Film, LDI, Liquid Photoimageable  
 Finish System: ENIG, HASL, Hot Oil Reflow of Plated Sn/Pb, ImmAg  
 Additional Fab Capabilities: Blind Vias, Buried Vias, Foil Lamination, Sequential Lamination  
 Controlled Impedance: Differential, Single-Ended

**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<p>MANUFACTURER INFORMATION:  <b>TTM Technologies, Inc. (Forest Grove)</b>          1521 Poplar Lane, Forest Grove, OR, 97116-2033</p>	<p>PLANT LOCATION:          Same Address as Manufacturer</p>	<p>CAGE Code: 01KV9          Phone: (503) 992-4336          Fax:          EMail: alan.preston@ttmtech.com</p>
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/3, MIL-PRF-31032/4  
 Qualification Letters: VQ(VQE20-034650)  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
 Flex Base Material: Copper Clad Adhesiveless Polyimide  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 16  
 Max. Board Thickness: .11"  
 Min. Hole Size: .0138" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 8:1 Through-Hole  
 Min. Conductor Width/Space: .012"/.005"  
 Hole Preparation: Permanganate Desmear, Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Pulse Plate  
 Solder Resist: LDI  
 Finish System: ENIG  
 Additional Fab Capabilities: Sequential Lamination  
 Flex Usage: Use A (Flex During Installation), Use B (Dynamic Flex)

**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<b>MANUFACTURER INFORMATION:</b> <b>TTM Technologies, Inc. (North Jackson)</b> 12080 DeBartolo Drive, North Jackson, OH, 44451 US	<b>PLANT LOCATION:</b> Same Address as Manufacturer	<b>CAGE Code:</b> 0GN71 <b>Phone:</b> 330-538-3900 <b>Fax:</b> 330-538-3820 <b>EMail:</b>
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/2  
 Qualification Letters: VQE-18-032965  
 Rigid Base Material: Woven Glass Reinforced, Hydrocarbon Resin with Ceramic Fill  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 2  
 Max. Board Thickness: .117" (with Bonded Copper Backer)  
 Min. Hole Size: .01" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 4.1:1 Through-Hole  
 Min. Conductor Width/Space: .0152"/.009"  
 Hole Preparation: Permanganate Desmear, Plasma Desmear  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Hole Fill/Via Plug: Non-Conductive  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG  
 Additional Fab Capabilities: Metal Core

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/3, MIL-PRF-31032/4  
 Qualification Letters: VQE-17-030811  
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
 Flex Base Material: Copper Clad Polyimide with Acrylic Adhesive  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 4  
 Max. Board Thickness: .044"  
 Min. Hole Size: .035" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 1.08:1 Through-Hole  
 Min. Conductor Width/Space: .015"/.008"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Finish System: HASL  
 Flex Usage: Use A (Flex During Installation), Use B (Dynamic Flex)

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-03-003121, VQE-03-003214, VQE-07-012925, VQE-10-020405, VQE-19-033261  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 24  
 Max. Board Thickness: .25"  
 Min. Hole Size: .008" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 15:1 Through-Hole  
 Min. Conductor Width/Space: .003"/.003"  
 Hole Preparation: Permanganate Desmear, Permanganate Etchback, Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Hole Fill/Via Plug: Conductive, Non-Conductive  
 Solder Resist: Dry Film, Liquid Photoimageable  
 Finish System: ENIG, Electrolytic Ni (no Au), Electrolytic Ni/Au, HASL, Hot Oil Reflow of Plated Sn/Pb, ImmAg, Ni/Pd/Au, OSP  
 Additional Fab Capabilities: Blind Vias, Buried Vias, Foil Lamination, Metal Core, Sequential Lamination  
 Controlled Impedance: Differential, Single-Ended

**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<b>MANUFACTURER INFORMATION:</b> <b>TTM Technologies, Inc. (North Jackson)</b> 12080 DeBartolo Drive, North Jackson, OH, 44451 US	<b>PLANT LOCATION:</b> Same Address as Manufacturer	<b>CAGE Code:</b> 0GN71 <b>Phone:</b> 330-538-3900 <b>Fax:</b> 330-538-3820 <b>E-Mail:</b>
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-03-003121, VQE-03-003214, VQE-07-012925, VQE-10-020405, VQE-19-033261  
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 24  
 Max. Board Thickness: .25"  
 Min. Hole Size: .0075" Laser Ablated Plated Hole Size Before Plating, .008" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 0.53:1 Microvia, 15:1 Through-Hole  
 Min. Conductor Width/Space: .003"/.003"  
 Hole Preparation: Permanganate Desmear, Permanganate Etchback, Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Hole Fill/Via Plug: Conductive, Non-Conductive  
 Solder Resist: Dry Film, Liquid Photoimageable  
 Finish System: ENIG, Electrolytic Ni (no Au), HASL, Hot Oil Reflow of Plated Sn/Pb, ImmAg, Ni/Pd/Au, OSP  
 Additional Fab Capabilities: Blind Vias, Buried Vias, Foil Lamination, Sequential Lamination  
 Controlled Impedance: Differential, Single-Ended

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/3, MIL-PRF-31032/4  
 Qualification Letters: VQE-03-003121, VQE-03-003214, VQE-07-012925, VQE-10-020405, VQE-19-033261  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant; GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
 Flex Base Material: Copper Clad Adhesiveless Polyimide  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 24  
 Max. Board Thickness: .25"  
 Min. Hole Size: .0075" Laser Ablated Plated Hole Size Before Plating, .008" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 0.53:1 Microvia, 15:1 Through-Hole  
 Min. Conductor Width/Space: .003"/.003"  
 Hole Preparation: Permanganate Desmear, Permanganate Etchback, Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Hole Fill/Via Plug: Conductive, Non-Conductive  
 Solder Resist: Dry Film, Liquid Photoimageable  
 Finish System: ENIG, Electrolytic Ni (no Au), Electrolytic Ni/Au, HASL, Hot Oil Reflow of Plated Sn/Pb, ImmAg, OSP  
 Additional Fab Capabilities: Blind Vias, Buried Vias, Foil Lamination, Sequential Lamination  
 Controlled Impedance: Differential, Single-Ended  
 Flex Usage: Use A (Flex During Installation), Use B (Dynamic Flex)

**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<b>MANUFACTURER INFORMATION:</b> <b>TTM Technologies, Inc. (Santa Ana)</b> 2630 South Harbor Boulevard, Santa Ana, CA, 92704 US	<b>PLANT LOCATION:</b> Same Address as Manufacturer	CAGE Code: 1WQ42 Phone: 714-241-0303 Fax: 714-241-0708 EMail:
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-05-008644, VQE-06-011211, VQE-16-030524  
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 22  
 Max. Board Thickness: .135"  
 Min. Hole Size: .006" Laser Ablated Plated Hole Size Before Plating, .0118" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: .75:1 Microvia, 11.5:1 Through-Hole  
 Min. Conductor Width/Space: .003"/.003"  
 Hole Preparation: Permanganate Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Hole Fill/Via Plug: Non-Conductive  
 Solder Resist: Dry Film, Liquid Photoimageable  
 Finish System: ENIG, HASL, Hot Oil Reflow of Plated Sn/Pb, ImmAg, OSP  
 Additional Fab Capabilities: Blind Vias, Buried Vias, Foil Lamination, Sequential Lamination  
 Controlled Impedance: Differential, Single-Ended

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-05-008644, VQE-06-011211, VQE-12-023569, VQE-16-030524  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 24  
 Max. Board Thickness: .135"  
 Min. Hole Size: .005" Laser Ablated Plated Hole Size Before Plating, .0098" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: .75:1 Microvia, 11.5:1 Through-Hole  
 Min. Conductor Width/Space: .003"/.003"  
 Hole Preparation: Permanganate Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Hole Fill/Via Plug: Non-Conductive  
 Solder Resist: Dry Film, Liquid Photoimageable  
 Finish System: ENIG, HASL, Hot Oil Reflow of Plated Sn/Pb, ImmAg, OSP  
 Additional Fab Capabilities: Blind Vias, Buried Vias, Foil Lamination, Sequential Lamination  
 Controlled Impedance: Differential, Single-Ended

**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<b>MANUFACTURER INFORMATION:</b> <b>TTM Technologies, Inc. (Santa Clara)</b> 407 Mathew Street, Santa Clara, CA, 95050 US	<b>PLANT LOCATION:</b> Same Address as Manufacturer	<b>CAGE Code:</b> 65916 <b>Phone:</b> 408-486-3184 <b>Fax:</b> 408-727-1003 <b>EMail:</b>
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-17-030872, VQE-18-032677,  
 Rigid Base Material: GM: Glass Base, Woven, Triazine and/or Bismaleimide Modified Epoxy Resin, Flame Resistant  
 Max. Panel Size: 18.5" x 24.5"  
 Max. Number of Layers: 10  
 Max. Board Thickness: .079"  
 Min. Hole Size: .023" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 2:1 Through-Hole  
 Min. Conductor Width/Space: .02"/.007"  
 Hole Preparation: Plasma Desmear  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Solder Resist: Liquid Photoimageable  
 Finish System: Hot Oil Reflow of Plated Sn/Pb  
 Additional Fab Capabilities: Foil Lamination

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-03-003888, VQE-10-020500, VQE-10-020581, VQE-11-022973, VQE-14-028240, VQE-14-028262, VQE-15-029137, VQE-15-029683, VQE-16-030610, VQE-18-032677  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
 Max. Panel Size: 21.5" x 24.5"  
 Max. Number of Layers: 28  
 Max. Board Thickness: .19"  
 Min. Hole Size: .0098" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 11:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.004"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Hole Fill/Via Plug: Conductive, Non-Conductive  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, Electrolytic Ni (no Au), HASL, Hot Oil Reflow of Plated Sn/Pb  
 Additional Fab Capabilities: Blind Vias, Foil Lamination  
 Controlled Impedance: Differential, Single-Ended

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-03-003888, VQE-10-020500, VQE-10-020581, VQE-11-022973, VQE-14-028240, VQE-14-028262, VQE-16-030610, VQE-18-032677  
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 33  
 Max. Board Thickness: .19"  
 Min. Hole Size: .012" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 9:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.004"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Hole Fill/Via Plug: Conductive, Non-Conductive  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, Electrolytic Ni (no Au), HASL, Hot Oil Reflow of Plated Sn/Pb  
 Additional Fab Capabilities: Blind Vias, Foil Lamination, Sequential Lamination  
 Controlled Impedance: Differential, Single-Ended



**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<b>MANUFACTURER INFORMATION:</b> <b>TTM Technologies, Inc. (Santa Clara)</b> 407 Mathew Street, Santa Clara, CA, 95050 US	<b>PLANT LOCATION:</b> Same Address as Manufacturer	CAGE Code: 65916 Phone: 408-486-3184 Fax: 408-727-1003 EMail:
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/3, MIL-PRF-31032/4  
 Qualification Letters: VQE-03-003895, VQE-10-020500, VQE-10-020581, VQE-11-022973, VQE-14-028240, VQE-14-028262, VQE-16-030610, VQE-18-032677, VQE-18-032893  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant; GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
 Flex Base Material: Copper Clad Adhesiveless Polyimide  
 Max. Panel Size: 18.5" x 24.5"  
 Max. Number of Layers: 20  
 Max. Board Thickness: .17"  
 Min. Hole Size: .012" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 9:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.004"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Hole Fill/Via Plug: Conductive  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, Electrolytic Ni (no Au), HASL, Hot Oil Reflow of Plated Sn/Pb  
 Additional Fab Capabilities: Sequential Lamination  
 Controlled Impedance: Differential, Single-Ended  
 Flex Usage: Use A (Flex During Installation), Use B (Dynamic Flex)

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/3, MIL-PRF-31032/4  
 Qualification Letters: VQE-03-003895, VQE-10-020500, VQE-10-020581, VQE-11-022973, VQE-14-028240, VQE-16-030610, VQE-18-032677  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant; GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
 Flex Base Material: Copper Clad Polyimide with Acrylic Adhesive  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 6  
 Max. Board Thickness: .043"  
 Min. Hole Size: .0118" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 1:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.004"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Finish System: ENIG, HASL, Hot Oil Reflow of Plated Sn/Pb  
 Flex Usage: Use A (Flex During Installation), Use B (Dynamic Flex)

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-07-013211, VQE-11-022973, VQE-14-028240, VQE-14-028262, VQE-16-030611, VQE-17-030871, VQE-18-032677  
 Composition: H - Homogenous thermoplastic base material printed boards, M - Mixed based material printed boards  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant; Woven Glass Reinforced, Hydrocarbon Resin with Ceramic Fill  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 10  
 Max. Board Thickness: .109"  
 Min. Hole Size: .0118" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 9:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.004"  
 Hole Preparation: Permanganate Etchback, Plasma Desmear  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Hole Fill/Via Plug: Conductive, Non-Conductive  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, HASL, Hot Oil Reflow of Plated Sn/Pb  
 Additional Fab Capabilities: Blind Vias, Sequential Lamination  
 Controlled Impedance: Differential, Single-Ended

**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<b>MANUFACTURER INFORMATION:</b> <b>TTM Technologies, Inc. (Santa Clara)</b> 407 Mathew Street, Santa Clara, CA, 95050 US	<b>PLANT LOCATION:</b> Same Address as Manufacturer	<b>CAGE Code:</b> 65916 <b>Phone:</b> 408-486-3184 <b>Fax:</b> 408-727-1003 <b>E-Mail:</b>
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-03-003888, VQE-10-020500, VQE-10-020581, VQE-11-022973, VQE-14-028240, VQE-14-028262, VQE-16-030610, VQE-18-032677  
 Rigid Base Material: BI: Aramid Fabric, Nonwoven, Polyimide Resin  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 14  
 Max. Board Thickness: .182"  
 Min. Hole Size: .012" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 6.45:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.004"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Hole Fill/Via Plug: Conductive  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, HASL, Hot Oil Reflow of Plated Sn/Pb

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-13-026953, VQE-14-028262, VQE-17-030872, VQE-18-032677  
 Rigid Base Material: BF: Aramid Fabric, Nonwoven, Epoxy Resin  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 14  
 Max. Board Thickness: .076"  
 Min. Hole Size: .0118" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 7:1 Through-Hole  
 Min. Conductor Width/Space: .0088"/.008"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Hole Fill/Via Plug: Conductive  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, HASL, Hot Oil Reflow of Plated Sn/Pb  
 Controlled Impedance: Differential

**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<b>MANUFACTURER INFORMATION:</b> <b>TTM Technologies, Inc. (Stafford)</b> 4 Old Monson Road, Stafford, CT, 06075 US	<b>PLANT LOCATION:</b> Same Address as Manufacturer	<b>CAGE Code:</b> 5L706 <b>Phone:</b> 860-684-5881 <b>Fax:</b> 860-684-7425 <b>E-Mail:</b>
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-03-003348, VQE-09-018855, VQE-11-023287, VQE-12-023366, VQE-17-031350  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant; Woven E-Glass, Epoxy Resin, Flame Resistant, with Inorganic Filler  
 Max. Panel Size: 30" x 54"  
 Max. Number of Layers: 50  
 Max. Board Thickness: .4"  
 Min. Hole Size: .0079" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 14:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.003"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate, Pulse Plate  
 Hole Fill/Via Plug: Conductive, Non-Conductive  
 Solder Resist: Dry Film, Liquid Photoimageable, Silk Screen  
 Finish System: ENIG, Electrolytic Ni / Hard Au, Electrolytic Ni / Soft Au, HASL, Hot Oil Reflow of Plated Sn/Pb, Ni/Pd/Au  
 Additional Fab Capabilities: Blind Vias, Buried Vias, Embedded Resistors, Foil Lamination, Metal Core, Press Fit Mounting, Sequential Lamination  
 Controlled Impedance: Differential, Single-Ended

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-03-003348, VQE-09-018855, VQE-11-023287, VQE-12-023366, VQE-16-030095, VQE-17-031350  
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
 Max. Panel Size: 24" x 36"  
 Max. Number of Layers: 33  
 Max. Board Thickness: .219"  
 Min. Hole Size: .0079" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 14:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.003"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate, Pulse Plate  
 Hole Fill/Via Plug: Conductive, Non-Conductive  
 Solder Resist: Dry Film, Liquid Photoimageable, Silk Screen  
 Finish System: ENIG, Electrolytic Ni / Hard Au, Electrolytic Ni / Soft Au, HASL, Hot Oil Reflow of Plated Sn/Pb, Ni/Pd/Au  
 Additional Fab Capabilities: Blind Vias, Buried Vias, Copper Invar Copper, Embedded Resistors, Foil Lamination, Metal Core, Press Fit Mounting, Sequential Lamination  
 Controlled Impedance: Differential, Single-Ended

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-03-003348, VQE-09-018855, VQE-11-023287, VQE-16-030095, VQE-17-031350  
 Rigid Base Material: AF: Aramid Fabric, Woven, Majority Polyfunctional Epoxy Resin  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 12  
 Max. Board Thickness: .1"  
 Min. Hole Size: .0138" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 5:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.003"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate, Pulse Plate  
 Hole Fill/Via Plug: Conductive, Non-Conductive  
 Solder Resist: Dry Film, Liquid Photoimageable, Silk Screen  
 Finish System: ENIG, Electrolytic Ni / Hard Au, Electrolytic Ni / Soft Au, HASL, Hot Oil Reflow of Plated Sn/Pb, Ni/Pd/Au  
 Additional Fab Capabilities: Blind Vias, Foil Lamination,  
 Controlled Impedance: Differential, Single-Ended

**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<b>MANUFACTURER INFORMATION:</b> <b>TTM Technologies, Inc. (Stafford)</b> 4 Old Monson Road, Stafford, CT, 06075 US	<b>PLANT LOCATION:</b> Same Address as Manufacturer	<b>CAGE Code:</b> 5L706 <b>Phone:</b> 860-684-5881 <b>Fax:</b> 860-684-7425 <b>E-Mail:</b>
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-03-003348, VQE-09-018855, VQE-11-023287, VQE-12-023366, VQE-16-030095, VQE-17-031350  
 Rigid Base Material: BI: Aramid Fabric, Nonwoven, Polyimide Resin  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 22  
 Max. Board Thickness: .129"  
 Min. Hole Size: .0118" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 11:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.003"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate, Pulse Plate  
 Hole Fill/Via Plug: Conductive, Non-Conductive  
 Solder Resist: Dry Film, Liquid Photoimageable, Silk Screen  
 Finish System: ENIG, Electrolytic Ni / Hard Au, Electrolytic Ni / Soft Au, HASL, Hot Oil Reflow of Plated Sn/Pb, Ni/Pd/Au  
 Additional Fab Capabilities: Blind Vias, Buried Vias, Embedded Resistors, Foil Lamination, Metal Core, Sequential Lamination  
 Controlled Impedance: Differential, Single-Ended

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-03-003348, VQE-09-018855, VQE-11-023287  
 Rigid Base Material: GM: Glass Base, Woven, Triazine and/or Bismaleimide Modified Epoxy Resin, Flame Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 10  
 Max. Board Thickness: .1"  
 Min. Hole Size: .032" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 3:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.003"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate, Pulse Plate  
 Hole Fill/Via Plug: Conductive, Non-Conductive  
 Solder Resist: Dry Film, Liquid Photoimageable, Silk Screen  
 Finish System: ENIG, Electrolytic Ni / Hard Au, Electrolytic Ni / Soft Au, HASL, Hot Oil Reflow of Plated Sn/Pb, Ni/Pd/Au  
 Controlled Impedance: Differential, Single-Ended

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: Custom  
 Qualification Letters: VQE-03-003348, VQE-10-019855, VQE-11-023287, VQE-16-030095, VQE-17-031350  
 Rigid Base Material: With or without woven or non-woven E-glass, Polytetrafluoroethylene (PTFE) resin, ceramic filler  
 Max. Panel Size: 30" x 36"  
 Max. Number of Layers: 16  
 Max. Board Thickness: .16"  
 Min. Hole Size: .0098" Drilled Plated-Through Hole Before Plating, .012" Laser Ablated Plated Hole Size Before Plating  
 Aspect Ratio: .5:1 Microvia, 7.6:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.003"  
 Hole Preparation: Plasma Desmear  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate, Pulse Plate  
 Hole Fill/Via Plug: Conductive, Non-Conductive  
 Solder Resist: Dry Film, Liquid Photoimageable, Silk Screen  
 Finish System: ENIG, Electrolytic Ni / Hard Au, Electrolytic Ni / Soft Au, HASL, Hot Oil Reflow of Plated Sn/Pb, Ni/Pd/Au  
 Additional Fab Capabilities: Blind Vias, Buried Vias, Embedded Resistors, Sequential Lamination  
 Controlled Impedance: Differential, Single-Ended

**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<b>MANUFACTURER INFORMATION:</b> <b>TTM Technologies, Inc. (Stafford)</b> 4 Old Monson Road, Stafford, CT, 06075 US	<b>PLANT LOCATION:</b> Same Address as Manufacturer	<b>CAGE Code:</b> 5L706 <b>Phone:</b> 860-684-5881 <b>Fax:</b> 860-684-7425 <b>EMail:</b>
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2, Custom  
 Qualification Letters: VQE-03-003348, VQE-10-019855, VQE-11-023287, VQE-16-030095, VQE-17-031350  
 Composition: M - Mixed based material printed boards  
 Rigid Base Material: Woven Glass Reinforced, Hydrocarbon Resin with Ceramic Fill  
 Max. Panel Size: 30" x 36"  
 Max. Number of Layers: 30  
 Max. Board Thickness: .216"  
 Min. Hole Size: .0098" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 9:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.003"  
 Hole Preparation: Plasma Desmear  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate, Pulse Plate  
 Hole Fill/Via Plug: Conductive, Non-Conductive  
 Solder Resist: Dry Film, Liquid Photoimageable, Silk Screen  
 Finish System: ENIG, Electrolytic Ni / Hard Au, Electrolytic Ni / Soft Au, HASL, Hot Oil Reflow of Plated Sn/Pb, Ni/Pd/Au  
 Additional Fab Capabilities: Blind Vias, Buried Vias, Embedded Resistors, Foil Lamination, Metal Core, Sequential Lamination  
 Controlled Impedance: Differential, Single-Ended

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/3, MIL-PRF-31032/4  
 Qualification Letters: VQE-03-003349, VQE-09-018855, VQE-10-019456, VQE-11-023287, VQE-12-023366, VQE-16-030095, VQE-17-031350  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant; GI: Glass Base, Woven, Polyimide Resin, Heat Resistant; Woven E-Glass, Epoxy Resin, Flame Resistant, with Inorganic Filler  
 Flex Base Material: Copper Clad Adhesiveless Polyimide  
 Max. Panel Size: 24" x 48"  
 Max. Number of Layers: 24  
 Max. Board Thickness: .275"  
 Min. Hole Size: .0079" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 9:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.003"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate, Pulse Plate  
 Hole Fill/Via Plug: Conductive, Non-Conductive  
 Solder Resist: Dry Film, Liquid Photoimageable, Silk Screen  
 Finish System: ENIG, Electrolytic Ni / Hard Au, Electrolytic Ni / Soft Au, HASL, Hot Oil Reflow of Plated Sn/Pb, Ni/Pd/Au  
 Additional Fab Capabilities: Blind Vias, Buried Vias, Embedded Resistors, Foil Lamination, Sequential Lamination  
 Flex Usage: Use A (Flex During Installation), Use B (Dynamic Flex)

**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<b>MANUFACTURER INFORMATION:</b> <b>TTM Technologies, Inc. (Stafford)</b> 4 Old Monson Road, Stafford, CT, 06075 US	<b>PLANT LOCATION:</b> Same Address as Manufacturer	<b>CAGE Code:</b> 5L706 <b>Phone:</b> 860-684-5881 <b>Fax:</b> 860-684-7425 <b>E-Mail:</b>
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/3, MIL-PRF-31032/4  
 Qualification Letters: VQE-03-003349, VQE-10-019456, VQE-11-023287, VQE-17-031350  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant; GI: Glass Base, Woven, Polyimide Resin, Heat Resistant; Woven E-Glass, Epoxy Resin, Flame Resistant, with Inorganic Filler  
 Flex Base Material: Copper Clad Polyimide with Acrylic Adhesive  
 Max. Panel Size: 24" x 36"  
 Max. Number of Layers: 11  
 Max. Board Thickness: .082"  
 Min. Hole Size: .0225" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 2:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.003"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate, Pulse Plate  
 Hole Fill/Via Plug: Conductive, Non-Conductive  
 Solder Resist: Dry Film, Liquid Photoimageable, Silk Screen  
 Finish System: ENIG, Electrolytic Ni / Hard Au, Electrolytic Ni / Soft Au, HASL, Hot Oil Reflow of Plated Sn/Pb, Ni/Pd/Au  
 Additional Fab Capabilities: Blind Vias, Buried Vias, Foil Lamination, Sequential Lamination  
 Controlled Impedance: Differential, Single-Ended  
 Flex Usage: Use A (Flex During Installation), Use B (Dynamic Flex)

**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<b>MANUFACTURER INFORMATION:</b> <b>TTM Technologies, Inc. (Sterling)</b> 1200 Severn Way, Sterling, VA, 20166-8904 US	<b>PLANT LOCATION:</b> Same Address as Manufacturer	CAGE Code: 0K703 Phone: 703-652-2200 Fax: 703-652-2272 EMail:
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQ(VQE-03-003545), VQ(VQE-09-018207), VQ(VQE-14-028500), VQ(VQE-14-028501), VQ(VQE-17-031087), VQ(VQE-20-034480)  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 26  
 Max. Board Thickness: .192"  
 Min. Hole Size: .005" Laser Ablated Plated Hole Size Before Plating, .009" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 10:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.003"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Hole Fill/Via Plug: Non-Conductive  
 Solder Resist: LDI, Liquid Photoimageable  
 Finish System: ENIG, Electrolytic Ni (no Au), Electrolytic Ni / Hard Au, Electrolytic Ni / Soft Au, HASL, Hot Oil Reflow of Plated Sn/Pb, Ni/Pd/Au  
 Additional Fab Capabilities: Blind Vias, Buried Vias, Foil Lamination, Resistors  
 Controlled Impedance: Differential, Single-Ended

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQ(VQE-03-003545), VQ(VQE-09-018207), VQ(VQE-14-028500), VQ(VQE-14-028501), VQ(VQE-17-031087)  
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 26  
 Max. Board Thickness: .11"  
 Min. Hole Size: .005" Laser Ablated Plated Hole Size Before Plating, .009" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 10:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.003"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Hole Fill/Via Plug: Non-Conductive  
 Solder Resist: LDI, Liquid Photoimageable  
 Finish System: ENIG, Electrolytic Ni (no Au), Electrolytic Ni / Hard Au, Electrolytic Ni / Soft Au, HASL, Hot Oil Reflow of Plated Sn/Pb, Ni/Pd/Au  
 Additional Fab Capabilities: Blind Vias, Buried Vias, Foil Lamination, Resistors  
 Controlled Impedance: Differential, Single-Ended

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQ(VQE-11-021244), VQ(VQE-14-028500), VQ(VQE-15-028809), VQ(VQE-20-034478)  
 Composition: H - Homogenous thermoplastic base material printed boards  
 Rigid Base Material: Woven glass, reinforced, hydrocarbon resin, with ceramic fill  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 12  
 Max. Board Thickness: .0877"  
 Min. Hole Size: .01" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 8.2:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.003"  
 Hole Preparation: Plasma Desmear  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate, Pulse Plate  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, HASL  
 Controlled Impedance: Differential, Single-Ended

**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<p>MANUFACTURER INFORMATION:  <b>Unicircuit, Inc.</b>              8192 Southpark Lane, Littleton, CO, 80120 US</p>	<p>PLANT LOCATION:              Same Address as Manufacturer</p>	<p>CAGE Code: 66311              Phone: 303-730-0505, x110              Fax:              EMail: blageman@unicircuit.com</p>
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-07-13789, VQE-09-17422, VQE-11-23044  
 Composition: S - Homogenous thermosetting base material printed boards  
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
 Max. Panel Size: 12" x 18"  
 Max. Number of Layers: 16  
 Max. Board Thickness: .12"  
 Min. Hole Size: .006" Laser Ablated Plated Hole Size Before Plating, .02" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 6:1 Through-Hole  
 Min. Conductor Width/Space: .005"/.005"  
 Hole Preparation: Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate, Pulse Plate  
 Hole Fill/Via Plug: Conductive, Non-Conductive  
 Solder Resist: Liquid Photoimageable  
 Finish System: HASL, Hot Oil Reflow of Plated Sn/Pb  
 Additional Fab Capabilities: Blind Vias, Buried Vias, Foil Lamination, Sequential Lamination  
 Controlled Impedance: Differential, Single-Ended

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-09-17422, VQE-12-24296  
 Composition: S - Homogenous thermosetting base material printed boards  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
 Max. Panel Size: 20" x 26"  
 Max. Number of Layers: 16  
 Max. Board Thickness: .12"  
 Min. Hole Size: .008" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 15:1 Through-Hole  
 Min. Conductor Width/Space: .005"/.005"  
 Hole Preparation: Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate, Pulse Plate  
 Hole Fill/Via Plug: Conductive, Non-Conductive  
 Solder Resist: Liquid Photoimageable  
 Finish System: HASL, Hot Oil Reflow of Plated Sn/Pb  
 Controlled Impedance: Differential, Single-Ended



**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<p>MANUFACTURER INFORMATION:  <b>US Circuit</b>                  2071 Wineridge Place, Escondido, CA, 92029</p>		<p>CAGE Code: 66483                  Phone: 760-489-1413                  Fax:                  EMail: jmcintosh@uscircuit.com</p>
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQ(VQE-19-033743)  
 Composition: H - Homogenous thermoplastic base material printed boards  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 10  
 Max. Board Thickness: .11"  
 Min. Hole Size: .012" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 9:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.004"  
 Hole Preparation: Plasma Etchback  
 Hole Wall Conductive Coating: Graphite-based  
 Copper Plating: Periodic Reverse Plate  
 Solder Resist: Liquid Photoimageable  
 Finish System: HASL

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQ(VQE-19-033744)  
 Composition: H - Homogenous thermoplastic base material printed boards  
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 10  
 Max. Board Thickness: .11"  
 Min. Hole Size: .012" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 9:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.004"  
 Hole Preparation: Plasma Etchback  
 Hole Wall Conductive Coating: Graphite-based  
 Copper Plating: Periodic Reverse Plate  
 Solder Resist: Liquid Photoimageable  
 Finish System: HASL

**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<b>MANUFACTURER INFORMATION:</b> <b>Viasystems Toronto Inc.</b> 8150 Sheppard Avenue East, Scarborough, M1B 5K2, Ontario Canada	<b>PLANT LOCATION:</b> Same Address as Manufacturer	<b>CAGE Code:</b> 3AF82 <b>Phone:</b> 416-208-2100 <b>Fax:</b> 416-208-2196 <b>E-Mail:</b>
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-04-006240, VQE-08-015407, VQE-09-018857, VQE-11-022676, VQE-12-023550  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 18  
 Max. Board Thickness: .088"  
 Min. Hole Size: .0069" Laser Ablated Plated Hole Size Before Plating, .0098" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 1:1 Microvia, 8.4:1 Through-Hole  
 Min. Conductor Width/Space: .0037"/.0028"  
 Hole Preparation: Permanganate Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper,  
 Copper Plating: Direct Current Plate  
 Hole Fill/Via Plug: Conductive, Non-Conductive  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, HASL, ImmAg, Ni/Pd/Au  
 Additional Fab Capabilities: Blind Vias, Buried Vias, Foil Lamination, Sequential Lamination  
 Controlled Impedance: Differential, Single-Ended

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-04-006240, VQE-08-015407, VQE-09-018857, VQE-11-022676, VQE-12-023550  
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
 Max. Panel Size: 18" x 24"  
 Max. Number of Layers: 20  
 Max. Board Thickness: .093"  
 Min. Hole Size: .0069" Laser Ablated Plated Hole Size Before Plating, .0091" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 1:1 Microvia, 9.6:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.003"  
 Hole Preparation: Plasma Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Hole Fill/Via Plug: Conductive, Non-Conductive  
 Solder Resist: Liquid Photoimageable  
 Finish System: ENIG, HASL, ImmAg, Ni/Pd/Au  
 Additional Fab Capabilities: Blind Vias, Buried Vias, Foil Lamination, Sequential Lamination  
 Controlled Impedance: Differential, Single-Ended

**SECTION I**  
**LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY**

<p>MANUFACTURER INFORMATION:  <b>Westak of Oregon</b>          3941 24th Avenue, Forest Grove, OR, 97116 US</p>	<p>PLANT LOCATION:          Same Address as Manufacturer</p>	<p>CAGE Code: 65745          Phone: 503-359-3593          Fax: 503-357-5332          EMail: or-qa@westak.com</p>
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**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-13-026434, VQE-14-027108, VQE-17-030915  
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant  
 Max. Panel Size: 21" x 24", " x "  
 Max. Number of Layers: 18  
 Max. Board Thickness: .18"  
 Min. Hole Size: .01" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 9.3:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.004"  
 Hole Preparation: Permanganate Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Hole Fill/Via Plug: Non-Conductive  
 Solder Resist: Dry Film, Liquid Photoimageable  
 Finish System: ENIG, Electrolytic Ni (no Au), Electrolytic Ni / Hard Au, HASL  
 Additional Fab Capabilities: Blind Vias, Foil Lamination, Sequential Lamination  
 Controlled Impedance: Differential, Single-Ended

**CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION**

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2  
 Qualification Letters: VQE-13-026434, VQE-14-027109, VQE-17-030915  
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant  
 Max. Panel Size: 21" x 26"  
 Max. Number of Layers: 10  
 Max. Board Thickness: .11"  
 Min. Hole Size: .006" Drilled Plated-Through Hole Before Plating  
 Aspect Ratio: 15:1 Through-Hole  
 Min. Conductor Width/Space: .004"/.004"  
 Hole Preparation: Permanganate Desmear, Plasma Etchback  
 Hole Wall Conductive Coating: Electroless Copper  
 Copper Plating: Direct Current Plate  
 Solder Resist: Dry Film, Liquid Photoimageable  
 Finish System: ENIG, Electrolytic Ni (no Au), Electrolytic Ni / Hard Au, HASL  
 Controlled Impedance: Differential, Single-Ended

**SECTION II**  
**LIST OF MANUFACTURERS AND ASSOCIATED SPECIFICATION**

**Accurate Circuit Engineering**  MIL-PRF-31032/1  MIL-PRF-31032/4  Custom  
 3019 S. Kilson Drive, Santa Ana, CA, 92707 US  MIL-PRF-31032/2  MIL-PRF-31032/5  
 CAGE Code: 0MNN9  MIL-PRF-31032/3  MIL-PRF-31032/6

**Advanced Circuits - Tempe Division**  MIL-PRF-31032/1  MIL-PRF-31032/4  Custom  
 229 S. Clark Drive, Tempe, AZ, 85281-3073 US  MIL-PRF-31032/2  MIL-PRF-31032/5  
 CAGE Code: 6RJS1  MIL-PRF-31032/3  MIL-PRF-31032/6

**Advanced Circuits Minnesota**  MIL-PRF-31032/1  MIL-PRF-31032/4  Custom  
 886 Zachary Lane North, Maple Grove, MN, 55369-4524 US  MIL-PRF-31032/2  MIL-PRF-31032/5  
 CAGE Code: 45032  MIL-PRF-31032/3  MIL-PRF-31032/6

**Airborn Flexible Circuits, Inc.**  MIL-PRF-31032/1  MIL-PRF-31032/4  Custom  
 11 Dohme Avenue, Toronto, M4B 1Y7, Ontario Canada  MIL-PRF-31032/2  MIL-PRF-31032/5  
 CAGE Code: 38661  MIL-PRF-31032/3  MIL-PRF-31032/6

**All Flex, Inc.**  MIL-PRF-31032/1  MIL-PRF-31032/4  Custom  
 1705 Cannon Lane, Northfield, MN, 55057-3605 USA  MIL-PRF-31032/2  MIL-PRF-31032/5  
 CAGE Code: 0ZGB2  MIL-PRF-31032/3  MIL-PRF-31032/6

**American Standard Circuits**  MIL-PRF-31032/1  MIL-PRF-31032/4  Custom  
 475 Industrial Drive, West Chicago, IL, 60185 US  MIL-PRF-31032/2  MIL-PRF-31032/5  
 CAGE Code: 4AA34  MIL-PRF-31032/3  MIL-PRF-31032/6

**Amitron Corporation**  MIL-PRF-31032/1  MIL-PRF-31032/4  Custom  
 2001 Landmeier Road, Elk Grove Village, IL, 60007 USA  MIL-PRF-31032/2  MIL-PRF-31032/5  
 CAGE Code: 1LHP6  MIL-PRF-31032/3  MIL-PRF-31032/6

**Amphenol Printed Circuits**  MIL-PRF-31032/1  MIL-PRF-31032/4  Custom  
 91 Northeastern Boulevard, Nashua, NH, 03062 US  MIL-PRF-31032/2  MIL-PRF-31032/5  
 CAGE Code: 57034  MIL-PRF-31032/3  MIL-PRF-31032/6

**Calumet Electronics Corp.**  MIL-PRF-31032/1  MIL-PRF-31032/4  Custom  
 25830 Depot Street, Calumet, MI, 49913-1985 US  MIL-PRF-31032/2  MIL-PRF-31032/5  
 CAGE Code: 65337  MIL-PRF-31032/3  MIL-PRF-31032/6

**CIMULEC**  MIL-PRF-31032/1  MIL-PRF-31032/4  Custom  
 , Z.I. Les Jonquieres, 57365 ENNERY France  MIL-PRF-31032/2  MIL-PRF-31032/5  
 CAGE Code: FB1Y2  MIL-PRF-31032/3  MIL-PRF-31032/6

**Circuit-Tech, Inc.**  MIL-PRF-31032/1  MIL-PRF-31032/4  Custom  
 399 Denison Street, Markham, ON, L3R 1B7 Canada  MIL-PRF-31032/2  MIL-PRF-31032/5  
 CAGE Code: L4387  MIL-PRF-31032/3  MIL-PRF-31032/6

**Cirexx International, Inc.**  MIL-PRF-31032/1  MIL-PRF-31032/4  Custom  
 791 Nuan Street, Santa Clara, CA, 95054 US  MIL-PRF-31032/2  MIL-PRF-31032/5  
 CAGE Code: 4MEG7  MIL-PRF-31032/3  MIL-PRF-31032/6

**Cirtech, Inc.**  MIL-PRF-31032/1  MIL-PRF-31032/4  Custom  
 250 E. Emerson Ave., Orange, CA, 92865-3303  MIL-PRF-31032/2  MIL-PRF-31032/5  
 CAGE Code: 8K616  MIL-PRF-31032/3  MIL-PRF-31032/6

**SECTION II**  
**LIST OF MANUFACTURERS AND ASSOCIATED SPECIFICATION**

**Coast to Coast Circuits, Inc.**  MIL-PRF-31032/1  MIL-PRF-31032/4  Custom  
 5331 McFadden Avenue, Huntington Beach, CA, 92649-1204 US  MIL-PRF-31032/2  MIL-PRF-31032/5  
 CAGE Code: 66982  MIL-PRF-31032/3  MIL-PRF-31032/6

**Compunetics Inc.**  MIL-PRF-31032/1  MIL-PRF-31032/4  Custom  
 700 Seco Rd, Monroeville, PA, 15146 US  MIL-PRF-31032/2  MIL-PRF-31032/5  
 CAGE Code: 30598  MIL-PRF-31032/3  MIL-PRF-31032/6

**Electro Plate Circuitry, Inc.**  MIL-PRF-31032/1  MIL-PRF-31032/4  Custom  
 1430 Century Drive, Carrollton, TX, 75006 US  MIL-PRF-31032/2  MIL-PRF-31032/5  
 CAGE Code: 79616  MIL-PRF-31032/3  MIL-PRF-31032/6

**Electrotek Corp.**  MIL-PRF-31032/1  MIL-PRF-31032/4  Custom  
 7745 S. 10th Street, Oak Creek, WI, 53154 US  MIL-PRF-31032/2  MIL-PRF-31032/5  
 CAGE Code: 66030  MIL-PRF-31032/3  MIL-PRF-31032/6

**Firan Technology Group**  MIL-PRF-31032/1  MIL-PRF-31032/4  Custom  
 250 Finchdene Square, Scarborough, M1X 1A5, Ontario, Canada  MIL-PRF-31032/2  MIL-PRF-31032/5  
 CAGE Code: L2665  MIL-PRF-31032/3  MIL-PRF-31032/6

**FTG Circuits Fredericksburg Inc.**  MIL-PRF-31032/1  MIL-PRF-31032/4  Custom  
 1026 Warrenton Road, Fredericksburg, VA, 22406-6200 US  MIL-PRF-31032/2  MIL-PRF-31032/5  
 CAGE Code: 6T499  MIL-PRF-31032/3  MIL-PRF-31032/6

**FTG Circuits, Inc. - Chatsworth**  MIL-PRF-31032/1  MIL-PRF-31032/4  Custom  
 20750 Marilla Street, Chatsworth,, CA, 91311 US  MIL-PRF-31032/2  MIL-PRF-31032/5  
 CAGE Code: 30803  MIL-PRF-31032/3  MIL-PRF-31032/6

**Gorilla Circuits**  MIL-PRF-31032/1  MIL-PRF-31032/4  Custom  
 1445 Old Oakland Rd, San Jose, CA, 95112 US  MIL-PRF-31032/2  MIL-PRF-31032/5  
 CAGE Code: 3C7D2  MIL-PRF-31032/3  MIL-PRF-31032/6

**Hamby Corporation**  MIL-PRF-31032/1  MIL-PRF-31032/4  Custom  
 27704 Avenue Scott, Valencia, CA, 91355-1218 US  MIL-PRF-31032/2  MIL-PRF-31032/5  
 CAGE Code: 07284  MIL-PRF-31032/3  MIL-PRF-31032/6

**Hans Brockstedt GmbH**  MIL-PRF-31032/1  MIL-PRF-31032/4  Custom  
 Clara-Immerwahr-Strabe 7, 24145 Kiel Germany  MIL-PRF-31032/2  MIL-PRF-31032/5  
 CAGE Code: C4831  MIL-PRF-31032/3  MIL-PRF-31032/6

**Holiday Circuits, Inc.**  MIL-PRF-31032/1  MIL-PRF-31032/4  Custom  
 11126 Bren Road West, Minnetonka, MN, 55343 US  MIL-PRF-31032/2  MIL-PRF-31032/5  
 CAGE Code: 59554  MIL-PRF-31032/3  MIL-PRF-31032/6

**Hughes Circuits, Inc.**  MIL-PRF-31032/1  MIL-PRF-31032/4  Custom  
 540 S. Pacific Street, San Marcos, CA, 92078-4056 US  MIL-PRF-31032/2  MIL-PRF-31032/5  
 CAGE Code: 1KXU6  MIL-PRF-31032/3  MIL-PRF-31032/6

**IMI, Inc.**  MIL-PRF-31032/1  MIL-PRF-31032/4  Custom  
 140 Hilldale Avenue, Haverhill, MA, 01832  MIL-PRF-31032/2  MIL-PRF-31032/5  
 CAGE Code: 78259  MIL-PRF-31032/3  MIL-PRF-31032/6

**SECTION II**  
**LIST OF MANUFACTURERS AND ASSOCIATED SPECIFICATION**

**ISU Petasys**  MIL-PRF-31032/1  MIL-PRF-31032/4  Custom  
 12930 Bradley St, Sylmar, CA, 91342 US  MIL-PRF-31032/2  MIL-PRF-31032/5  
 CAGE Code: 1WFH9  MIL-PRF-31032/3  MIL-PRF-31032/6

**ITL Circuits**  MIL-PRF-31032/1  MIL-PRF-31032/4  Custom  
 90 Don Park Road, Markham, L3R 1C4, Ontario, Canada  MIL-PRF-31032/2  MIL-PRF-31032/5  
 CAGE Code: 38747  MIL-PRF-31032/3  MIL-PRF-31032/6

**KCA Electronics, Inc.**  MIL-PRF-31032/1  MIL-PRF-31032/4  Custom  
 223 N. Crescent Way, Anaheim, CA, 92801 US  MIL-PRF-31032/2  MIL-PRF-31032/5  
 CAGE Code: 1VUH8  MIL-PRF-31032/3  MIL-PRF-31032/6

**Lockheed Martin Mission Systems & Training**  MIL-PRF-31032/1  MIL-PRF-31032/4  Custom  
 1801 State Route 17C, Owego, NY, 13827 US  MIL-PRF-31032/2  MIL-PRF-31032/5  
 CAGE Code: 03640  MIL-PRF-31032/3  MIL-PRF-31032/6

**Lone Star Circuits**  MIL-PRF-31032/1  MIL-PRF-31032/4  Custom  
 901 Hensley Drive, Wylie, TX, 75098-4909 US  MIL-PRF-31032/2  MIL-PRF-31032/5  
 CAGE Code: 04RV5  MIL-PRF-31032/3  MIL-PRF-31032/6

**Mass Design, Inc.**  MIL-PRF-31032/1  MIL-PRF-31032/4  Custom  
 41 Simon St., Nashua, NH, 03060  MIL-PRF-31032/2  MIL-PRF-31032/5  
 CAGE Code: 35ZD0  MIL-PRF-31032/3  MIL-PRF-31032/6

**Metaplast Circuits Ltd.**  MIL-PRF-31032/1  MIL-PRF-31032/4  Custom  
 180 Hymus Road, Scarborough, M1L 2E1, Ontario, Canada  MIL-PRF-31032/2  MIL-PRF-31032/5  
 CAGE Code: 3AD63  MIL-PRF-31032/3  MIL-PRF-31032/6

**Micropack Limited**  MIL-PRF-31032/1  MIL-PRF-31032/4  Custom  
 , Plot No. 16, Jigani Industrial Area, Anekal Taluk, Bangalore District 560105 India  MIL-PRF-31032/2  MIL-PRF-31032/5  
 CAGE Code: SAL28  MIL-PRF-31032/3  MIL-PRF-31032/6

**Midwest Printed Circuit Services**  MIL-PRF-31032/1  MIL-PRF-31032/4  Custom  
 1741 Circuit Drive, Round Lake Beach, IL, 60073 US  MIL-PRF-31032/2  MIL-PRF-31032/5  
 CAGE Code: 0YYS4  MIL-PRF-31032/3  MIL-PRF-31032/6

**Multicircuits Inc.**  MIL-PRF-31032/1  MIL-PRF-31032/4  Custom  
 2301 Universal St, Oshkosh, WI, 54904  MIL-PRF-31032/2  MIL-PRF-31032/5  
 CAGE Code: 1BQS8  MIL-PRF-31032/3  MIL-PRF-31032/6

**Multilayer Technology**  MIL-PRF-31032/1  MIL-PRF-31032/4  Custom  
 3835 West Conflans Road, Irving, TX, 75061  MIL-PRF-31032/2  MIL-PRF-31032/5  
 CAGE Code: 0JKV9  MIL-PRF-31032/3  MIL-PRF-31032/6

**Murrietta Circuits, Inc.**  MIL-PRF-31032/1  MIL-PRF-31032/4  Custom  
 5000 E. Landon Drive, Anaheim, CA, 92807 US  MIL-PRF-31032/2  MIL-PRF-31032/5  
 CAGE Code: 0EJD7  MIL-PRF-31032/3  MIL-PRF-31032/6

**Pioneer Circuits, Inc.**  MIL-PRF-31032/1  MIL-PRF-31032/4  Custom  
 3000 S. Shannon Street, Santa Ana, CA, 92704-6321 US  MIL-PRF-31032/2  MIL-PRF-31032/5  
 CAGE Code: 65723  MIL-PRF-31032/3  MIL-PRF-31032/6

**SECTION II**  
**LIST OF MANUFACTURERS AND ASSOCIATED SPECIFICATION**

**PNC, Inc.**  MIL-PRF-31032/1  MIL-PRF-31032/4  Custom  
 115 East Centre Street, Nutley, NJ, 07110 US  MIL-PRF-31032/2  MIL-PRF-31032/5  
 CAGE Code: 66766  MIL-PRF-31032/3  MIL-PRF-31032/6

**Printed Circuits, Inc.**  MIL-PRF-31032/1  MIL-PRF-31032/4  Custom  
 1200 West 96th Street, Bloomington, MN, 55431-2606 US  MIL-PRF-31032/2  MIL-PRF-31032/5  
 CAGE Code: 65114  MIL-PRF-31032/3  MIL-PRF-31032/6

**Pro-Tech Interconnect Solutions LLC**  MIL-PRF-31032/1  MIL-PRF-31032/4  Custom  
 4300 Peavey Road, Chaska, MN, 55318 US  MIL-PRF-31032/2  MIL-PRF-31032/5  
 CAGE Code: 3CP65  MIL-PRF-31032/3  MIL-PRF-31032/6

**Prototron Circuits, Inc.**  MIL-PRF-31032/1  MIL-PRF-31032/4  Custom  
 3760 East 43rd Place, Tucson, AZ, 58713 US  MIL-PRF-31032/2  MIL-PRF-31032/5  
 CAGE Code: 66108  MIL-PRF-31032/3  MIL-PRF-31032/6

**Sanmina (Costa Mesa)**  MIL-PRF-31032/1  MIL-PRF-31032/4  Custom  
 2945 Airway Avenue, Costa Mesa, CA, 92626 US  MIL-PRF-31032/2  MIL-PRF-31032/5  
 CAGE Code: 3BKL5  MIL-PRF-31032/3  MIL-PRF-31032/6

**Sanmina-SCI (San Jose)**  MIL-PRF-31032/1  MIL-PRF-31032/4  Custom  
 2050 Bering Drive, San Jose, CA, 95131 US  MIL-PRF-31032/2  MIL-PRF-31032/5  
 CAGE Code: 3DR67  MIL-PRF-31032/3  MIL-PRF-31032/6

**Sierra Circuits Inc.**  MIL-PRF-31032/1  MIL-PRF-31032/4  Custom  
 1108 West Evelyn Ave, Sunnyvale, CA, 94086 USA  MIL-PRF-31032/2  MIL-PRF-31032/5  
 CAGE Code: 0ZHS4  MIL-PRF-31032/3  MIL-PRF-31032/6

**Streamline Circuits**  MIL-PRF-31032/1  MIL-PRF-31032/4  Custom  
 1410 Martin Ave., Santa Clara, CA, 95050  MIL-PRF-31032/2  MIL-PRF-31032/5  
 CAGE Code: 3WUY3  MIL-PRF-31032/3  MIL-PRF-31032/6

**Technologies, Inc. (Anaheim)**  MIL-PRF-31032/1  MIL-PRF-31032/4  Custom  
 3140 East Coronado Street, Anaheim, CA, 92806 US  MIL-PRF-31032/2  MIL-PRF-31032/5  
 CAGE Code: 0BSG1  MIL-PRF-31032/3  MIL-PRF-31032/6

**Thales Nederland B.V.**  MIL-PRF-31032/1  MIL-PRF-31032/4  Custom  
 Haaksbergerstraat 49, 7554PA Hengelo The Netherlands  MIL-PRF-31032/2  MIL-PRF-31032/5  
 CAGE Code: H0203  MIL-PRF-31032/3  MIL-PRF-31032/6

**TTM Technologies, Inc. (Denver)**  MIL-PRF-31032/1  MIL-PRF-31032/4  Custom  
 10570 Bradford Road, Littleton, CO, 80127-4211 US  MIL-PRF-31032/2  MIL-PRF-31032/5  
 CAGE Code: 75815  MIL-PRF-31032/3  MIL-PRF-31032/6

**TTM Technologies, Inc. (Forest Grove)**  MIL-PRF-31032/1  MIL-PRF-31032/4  Custom  
 1521 Poplar Lane, Forest Grove, OR, 97116-2033  MIL-PRF-31032/2  MIL-PRF-31032/5  
 CAGE Code: 01KV9  MIL-PRF-31032/3  MIL-PRF-31032/6

**TTM Technologies, Inc. (North Jackson)**  MIL-PRF-31032/1  MIL-PRF-31032/4  Custom  
 12080 DeBartolo Drive, North Jackson, OH, 44451 US  MIL-PRF-31032/2  MIL-PRF-31032/5  
 CAGE Code: 0GN71  MIL-PRF-31032/3  MIL-PRF-31032/6

**SECTION II**  
**LIST OF MANUFACTURERS AND ASSOCIATED SPECIFICATION**

**TTM Technologies, Inc. (Santa Ana)**  MIL-PRF-31032/1  MIL-PRF-31032/4  Custom  
 2630 South Harbor Boulevard, Santa Ana, CA, 92704 US  MIL-PRF-31032/2  MIL-PRF-31032/5  
 CAGE Code: 1WQ42  MIL-PRF-31032/3  MIL-PRF-31032/6

**TTM Technologies, Inc. (Santa Clara)**  MIL-PRF-31032/1  MIL-PRF-31032/4  Custom  
 407 Mathew Street, Santa Clara, CA, 95050 US  MIL-PRF-31032/2  MIL-PRF-31032/5  
 CAGE Code: 65916  MIL-PRF-31032/3  MIL-PRF-31032/6

**TTM Technologies, Inc. (Stafford)**  MIL-PRF-31032/1  MIL-PRF-31032/4  Custom  
 4 Old Monson Road, Stafford, CT, 06075 US  MIL-PRF-31032/2  MIL-PRF-31032/5  
 CAGE Code: 5L706  MIL-PRF-31032/3  MIL-PRF-31032/6

**TTM Technologies, Inc. (Sterling)**  MIL-PRF-31032/1  MIL-PRF-31032/4  Custom  
 1200 Severn Way, Sterling, VA, 20166-8904 US  MIL-PRF-31032/2  MIL-PRF-31032/5  
 CAGE Code: 0K703  MIL-PRF-31032/3  MIL-PRF-31032/6

**Unicircuit, Inc.**  MIL-PRF-31032/1  MIL-PRF-31032/4  Custom  
 8192 Southpark Lane, Littleton, CO, 80120 US  MIL-PRF-31032/2  MIL-PRF-31032/5  
 CAGE Code: 66311  MIL-PRF-31032/3  MIL-PRF-31032/6

**US Circuit**  MIL-PRF-31032/1  MIL-PRF-31032/4  Custom  
 2071 Wineridge Place, Escondido, CA, 92029  MIL-PRF-31032/2  MIL-PRF-31032/5  
 CAGE Code: 66483  MIL-PRF-31032/3  MIL-PRF-31032/6

**Viasystems Toronto Inc.**  MIL-PRF-31032/1  MIL-PRF-31032/4  Custom  
 8150 Sheppard Avenue East, Scarborough, M1B 5K2, Ontario Canada  MIL-PRF-31032/2  MIL-PRF-31032/5  
 CAGE Code: 3AF82  MIL-PRF-31032/3  MIL-PRF-31032/6

**Westak of Oregon**  MIL-PRF-31032/1  MIL-PRF-31032/4  Custom  
 3941 24th Avenue, Forest Grove, OR, 97116 US  MIL-PRF-31032/2  MIL-PRF-31032/5  
 CAGE Code: 65745  MIL-PRF-31032/3  MIL-PRF-31032/6