

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

Date: 3/16/2016

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

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.dscc.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**

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|---|--|---|
| MANUFACTURER INFORMATION: AC Universal Circuits LLC 8860 Zachary Lane North, Maple Grove, MN, 55369-4524 US | PLANT LOCATION: Same Address as Manufacturer | CAGE Code: 45032 Phone: 763-315-1709 Fax: 763-425-0999 E-Mail: 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
 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, 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
 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: VQE-11-021326, VQE-12-024534
 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: .062"
 Min. Hole Size: .0138" Drilled Plated-Through Hole Before Plating
 Aspect Ratio: 4.5:1 Through-Hole
 Min. Conductor Width/Space: .007"/.006"
 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: Foil Lamination

SECTION I
LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY

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|--|--|---|
| <p>MANUFACTURER INFORMATION: Accurate Circuit Engineering 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
 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

SECTION I
LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY

| | | |
|---|--|---|
| MANUFACTURER INFORMATION: Advanced Circuits - Tempe Division 229 S. Clark Drive, Tempe, AZ, 85281-3073 US | PLANT LOCATION: Same Address as Manufacturer | CAGE Code: 6RJS1 Phone: 480-966-5894 Fax: 480-966-5896 E-Mail: 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
 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
 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

**SECTION I
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| | | |
|---|--|---|
| MANUFACTURER INFORMATION: Airborn Flexible Circuits, Inc. 11 Dohme Avenue, Toronto, M4B 1Y7, Ontario Canada | PLANT LOCATION: Same Address as Manufacturer | CAGE Code: 38661 Phone: 416-285-3825 Fax: 416-752-6719 E-Mail: 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: Copper Core, 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-31032/3, 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: Copper Core, 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**

| | | |
|---|--|---|
| MANUFACTURER INFORMATION: American Standard Circuits 475 Industrial Drive, West Chicago, IL, 60185 US | PLANT LOCATION: Same Address as Manufacturer | CAGE Code: 4AA34 Phone: 603-639-5444 Fax: 603-293-1240 E-Mail: sales@asc-i.com |
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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

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

SECTION I
LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY

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|---|--|--|
| MANUFACTURER INFORMATION: Amphenol Printed Circuits 91 Northeastern Boulevard, Nashua, NH, 03062 US | PLANT LOCATION: 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-31032/1, MIL-PRF-31032/2
 Qualification Letters: VQE 10-020582, VQE-06-010054, VQE-09-017008, VQE-12-023765, VQE-15-029690, VQE-97-000649
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant
 Max. Panel Size: 24" x 42"
 Max. Number of Layers: 33
 Max. Board Thickness: .25"
 Min. Hole Size: .007" Laser Ablated Plated Hole Size Before Plating, .0098" Drilled Plated-Through Hole Before Plating
 Aspect Ratio: .6:1 Microvia, 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 / 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-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 / 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
 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: .013" Drilled Plated-Through Hole Before Plating
 Aspect Ratio: 8.2:1 Through-Hole
 Min. Conductor Width/Space: .004"/.003"
 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, Silk Screen
 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, Press Fit Mounting, Sequential Lamination
 Controlled Impedance: Differential, Single-Ended

SECTION I
LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY

| | | |
|---|--|---|
| MANUFACTURER INFORMATION: Amphenol Printed Circuits 91 Northeastern Boulevard, Nashua, NH, 03062 US | PLANT LOCATION: Same Address as Manufacturer | CAGE Code: 57034 Phone: 603-879-3268 Fax: 603-879-2818 E-Mail: |
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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
 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
 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 49"
 Max. Number of Layers: 22
 Max. Board Thickness: .14"
 Min. Hole Size: .0145" Drilled Plated-Through Hole Before Plating
 Aspect Ratio: 7.75:1 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
 Solder Resist: Dry Film, Liquid Photoimageable, Silk Screen
 Finish System: 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

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

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2
 Qualification Letters: VQE 12 023734, VQE-03-4657, VQE-04-6280, VQE-14-027692
 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: Electroless Copper
 Copper Plating: Direct Current Plate
 Solder Resist: Liquid Photoimageable
 Finish System: Electrolytic Ni / Hard Au, Electrolytic Ni / Soft Au, HASL
 Additional Fab Capabilities: Press Fit Mounting

CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2
 Qualification Letters: VQE 12 023734, VQE-03-4657, VQE-04-6280, VQE-13-026419
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame 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: Electroless Copper
 Copper Plating: Direct Current Plate
 Solder Resist: Liquid Photoimageable
 Finish System: Electrolytic Ni / Hard Au, Electrolytic Ni / Soft Au, HASL

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

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|--|--|---|
| MANUFACTURER INFORMATION: Cirexx International, Inc. 791 Nuttman Street, Santa Clara, CA, 95054 US | PLANT LOCATION: Same Address as Manufacturer | CAGE Code: 4MEG7 Phone: 408-988-3980 Fax: 408-988-4534 E-Mail: |
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CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2
 Qualification Letters: VQ(VQE-08-016602), VQE-14-028536
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant
 Max. Panel Size: 12" x 18"
 Max. Number of Layers: 22
 Max. Board Thickness: .125"
 Min. Hole Size: .01" Drilled Plated-Through Hole Before Plating
 Aspect Ratio: 12.5:1 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: 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-08-016602), VQE-14-028536
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant
 Max. Panel Size: 12" x 18"
 Max. Number of Layers: 22
 Max. Board Thickness: .125"
 Min. Hole Size: .01" Drilled Plated-Through Hole Before Plating
 Aspect Ratio: 12.5:1 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: 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-31032/3, MIL-PRF-31032/4
 Qualification Letters: VQ(VQE-07-014176), VQ(VQE-15-029356)
 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: .046" Drilled Plated-Through Hole Before Plating
 Aspect Ratio: 1.2:1 Through-Hole
 Min. Conductor Width/Space: .0058"/.01"
 Hole Preparation: Permanganate Etchback, Plasma Desmear
 Hole Wall Conductive Coating: Electroless Copper
 Copper Plating: Direct Current Plate
 Finish System: HASL
 Additional Fab Capabilities: Blind Vias, Sequential Lamination
 Flex Usage: Use A (Flex During Installation), Use B (Dynamic Flex)

SECTION I
LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY

| | | |
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| MANUFACTURER INFORMATION: Cirexx International, Inc. 791 Nuttman Street, Santa Clara, CA, 95054 US | PLANT LOCATION: 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: VQ(VQE-08-016602), VQE-14-028536
 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: 12.5:1 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: Liquid Photoimageable
 Finish System: ENIG, Electrolytic Ni / Hard Au, HASL
 Additional Fab Capabilities: Foil Lamination
 Controlled Impedance: Differential, Single-Ended
 Flex Usage: Use A (Flex During Installation)

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

| | | |
|---|--|--|
| MANUFACTURER INFORMATION: Colonial Circuits, Inc. 1026 Warrenton Road, Fredericksburg, VA, 22406-6200 US | PLANT LOCATION: Same Address as Manufacturer | CAGE Code: 6T499 Phone: 540-753-5511, x125 Fax: 540-752-2109 E-Mail: quality@colonialcircuits.com |
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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: G1: 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: Electroless Copper
 Copper Plating: Direct Current Plate
 Solder Resist: Liquid Photoimageable
 Finish System: HASL

CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2
 Qualification Letters: VQE-04-6002
 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: .127"
 Min. Hole Size: .015"
 Aspect Ratio: 8.5:1 Through-Hole
 Min. Conductor Width/Space: .008"/.005"
 Hole Preparation: Plasma Desmear, Plasma Etchback
 Hole Wall Conductive Coating: Electroless Copper
 Copper Plating: Direct Current Plate
 Solder Resist: Liquid Photoimageable
 Finish System: HASL

CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION

Specification: MIL-PRF-31032/5, MIL-PRF-31032/6
 Qualification Letters: VQE-04-6002, VQE-06-010192
 Rigid Base Material: Woven Glass Reinforced, Hydrocarbon Resin with Ceramic Fill
 Max. Panel Size: 12" x 18"
 Max. Number of Layers: 8
 Max. Board Thickness: .09"
 Min. Hole Size: .01" Drilled Plated-Through Hole Before Plating
 Aspect Ratio: 6.2:1 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
 Solder Resist: Liquid Photoimageable
 Finish System: HASL

SECTION I
LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY

| | | |
|---|--|--|
| MANUFACTURER INFORMATION: Colonial Circuits, Inc. 1026 Warrenton Road, Fredericksburg, VA, 22406-6200 US | PLANT LOCATION: Same Address as Manufacturer | CAGE Code: 6T499 Phone: 540-753-5511, x125 Fax: 540-752-2109 E-Mail: quality@colonialcircuits.com |
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CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION

Specification: MIL-PRF-31032/3, MIL-PRF-31032/4
 Qualification Letters: VQ (VQE-10-019425)
 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: 10
 Max. Board Thickness: .093"
 Min. Hole Size: .01"
 Aspect Ratio: 8.6:1 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
 Solder Resist: Liquid Photoimageable
 Finish System: HASL
 Flex Usage: Use A (Flex During Installation),

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: Electroless Copper
 Copper Plating: Direct Current Plate
 Solder Resist: Liquid Photoimageable
 Finish System: HASL
 Flex Usage: Use A (Flex During Installation),

CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION

Specification: MIL-PRF-31032/6
 Qualification Letters: VQE-04-6002
 Rigid Base Material: GT: Woven E-Glass, PTFE Resin; GT: Woven E-Glass, PTFE Resin; GX: Glass Base, Woven, Polytetrafluoroethylene Resin, Flame Resistant; With or without woven or non-woven E-glass, Polytetrafluoroethylene (PTFE) resin, ceramic filler
 Max. Panel Size: 12" x 18"
 Max. Number of Layers: 2
 Max. Board Thickness: .031"
 Min. Hole Size: .02" Drilled Plated-Through Hole Before Plating
 Aspect Ratio: 1.55:1 Through-Hole
 Min. Conductor Width/Space: .025"/.01"
 Hole Preparation: Plasma Desmear
 Hole Wall Conductive Coating: Electroless Copper
 Copper Plating: Direct Current Plate
 Solder Resist: Liquid Photoimageable
 Finish System: HASL

CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION

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

| | | |
|---|--|---|
| MANUFACTURER INFORMATION: Compunetics Inc. 700 Seco Rd, Monroeville, PA, 15146 US | PLANT LOCATION: Same Address as Manufacturer | CAGE Code: 30598 Phone: 412-858-1272 Fax: EMail: lhart@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
 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"
 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

SECTION I
LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY

| | | |
|---|--|---|
| MANUFACTURER INFORMATION: Cosmotronic, Inc. 16721 Noyes Avenue, Irvine, CA, 92606-5176 US | PLANT LOCATION: Same Address as Manufacturer | CAGE Code: 63695 Phone: 949-660-0740 Fax: 949-553-8371 E-Mail: Patricia_Alcantar@cosmotronic.com |
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CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2
 Qualification Letters: VQE-04-006966, VQE-05-009107, VQE-06-010085, VQE-06-011248
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant
 Max. Panel Size: 18" x 24"
 Max. Board Thickness: .335"
 Min. Hole Size: .014" Drilled Plated-Through Hole Before Plating
 Aspect Ratio: 15:1 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
 Solder Resist: Liquid Photoimageable
 Finish System: ENIG, HASL, Hot Oil Reflow of Plated Sn/Pb
 Additional Fab Capabilities: Blind Vias, Sequential Lamination
 Controlled Impedance: Single-Ended

CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2
 Qualification Letters: VQE-04-006966, VQE-05-009107, VQE-06-010085, VQE-06-011248
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant
 Max. Panel Size: 18" x 24"
 Max. Board Thickness: .335"
 Min. Hole Size: .014" Drilled Plated-Through Hole Before Plating
 Aspect Ratio: 15:1 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
 Solder Resist: Liquid Photoimageable
 Finish System: ENIG, HASL, Hot Oil Reflow of Plated Sn/Pb
 Additional Fab Capabilities: Blind Vias, Sequential Lamination
 Controlled Impedance: Single-Ended

CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION

Specification: MIL-PRF-31032/3, MIL-PRF-31032/4
 Qualification Letters: VQE-04-006966, VQE-05-009107, VQE-06-010085
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant; GI: Glass Base, Woven, Polyimide Resin, Heat Resistant; GM: Glass Base, Woven, Triazine and/or Bismaleimide Modified Epoxy Resin, Flame Resistant
 Flex Base Material: Copper Clad Adhesiveless Polyimide
 Max. Panel Size: 18" x 24"
 Max. Number of Layers: 22
 Max. Board Thickness: .165"
 Min. Hole Size: .012" Drilled Plated-Through Hole Before Plating
 Aspect Ratio: 8:1 Through-Hole
 Min. Conductor Width/Space: .006"/.008"
 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), Use B (Dynamic Flex)

SECTION I
LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY

| | | |
|---|--|--|
| MANUFACTURER INFORMATION: Cosmotronic, Inc. 16721 Noyes Avenue, Irvine, CA, 92606-5176 US | PLANT LOCATION: Same Address as Manufacturer | CAGE Code: 63695 Phone: 949-660-0740 Fax: 949-553-8371 EMail: Patricia_Alcantar@cosmotronic.com |
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CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION

Specification: MIL-PRF-31032/3, MIL-PRF-31032/4
 Qualification Letters: VQE-04-006966, VQE-05-009107, VQE-06-010085
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant; GI: Glass Base, Woven, Polyimide Resin, Heat Resistant; GM: Glass Base, Woven, Triazine and/or Bismaleimide Modified Epoxy Resin, Flame Resistant
 Flex Base Material: Copper Clad Polyimide with Acrylic Adhesive
 Max. Panel Size: 18" x 24"
 Max. Number of Layers: 22
 Max. Board Thickness: .165"
 Min. Hole Size: .012" Drilled Plated-Through Hole Before Plating
 Aspect Ratio: 8:1 Through-Hole
 Min. Conductor Width/Space: .006"/.008"
 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), Use B (Dynamic Flex)

CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION

Specification: MIL-PRF-31032/5, MIL-PRF-31032/6
 Qualification Letters: VQE-04-006966, VQE-05-009107, VQE-06-010085
 Composition: S - Homogenous thermosetting base material printed boards
 Rigid Base Material: Woven Glass Reinforced, Hydrocarbon Resin with Ceramic Fill
 Max. Panel Size: 12" x 18"
 Max. Number of Layers: 16
 Max. Board Thickness: .225"
 Min. Hole Size: .02" Drilled Plated-Through Hole Before Plating
 Aspect Ratio: 10:1 Through-Hole
 Min. Conductor Width/Space: .011"/.007"
 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: Blind Vias, Sequential Lamination

CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION

Specification: MIL-PRF-31032/5, MIL-PRF-31032/6
 Qualification Letters: VQE-04-006966, VQE-05-009107, VQE-06-010085
 Composition: S - Homogenous thermosetting base material printed boards
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant; Woven Glass Reinforced, Hydrocarbon Resin with Ceramic Fill
 Max. Panel Size: 12" x 18"
 Max. Number of Layers: 16
 Max. Board Thickness: .225"
 Min. Hole Size: .02" Drilled Plated-Through Hole Before Plating
 Aspect Ratio: 10:1 Through-Hole
 Min. Conductor Width/Space: .011"/.007"
 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: Blind Vias, Sequential Lamination

SECTION I
LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY

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| <p>MANUFACTURER INFORMATION: Dynamic & Proto Circuits, Inc. 869 Barton Street, Stoney Creek, L8E 5G6, Ontario Canada</p> | <p>PLANT LOCATION: Same Address as Manufacturer</p> | <p>CAGE Code: 38898 Phone: 905-643-9900 Fax: 905-643-9911 EMail: dynamicinfo@dapc.com</p> |
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CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2
 Qualification Letters: VQE-00-0007, VQE-01-0311, VQE-03-0818, VQE-98-1143
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant
 Max. Panel Size: 16" x 18"
 Max. Number of Layers: 16
 Max. Board Thickness: .125"
 Min. Hole Size: .0135" Drilled Plated-Through Hole Before Plating
 Aspect Ratio: 9.3:1 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
 Solder Resist: Dry Film, Liquid Photoimageable
 Finish System: HASL

CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2
 Qualification Letters: VQE-12-024252
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant
 Max. Panel Size: 16" x 18"
 Max. Number of Layers: 16
 Max. Board Thickness: .125"
 Min. Hole Size: .0135" Drilled Plated-Through Hole Before Plating
 Aspect Ratio: 9.3:1 Through-Hole
 Min. Conductor Width/Space: .025"/.025"
 Hole Preparation: Plasma Desmear
 Hole Wall Conductive Coating: Electroless Copper
 Copper Plating: Direct Current Plate, Pulse Plate
 Solder Resist: Dry Film, Liquid Photoimageable
 Finish System: HASL

SECTION I
LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY

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| MANUFACTURER INFORMATION: Electro Plate Circuitry, Inc. 1430 Century Drive, Carrollton, TX, 75006 US | PLANT LOCATION: Same Address as Manufacturer | CAGE Code: 79616 Phone: 972-466-0818 Fax: 972-466-9078 E-Mail: jimmm@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: 14
 Max. Board Thickness: .12"
 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-31032/1, 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 24"
 Max. Number of Layers: 6
 Max. Board Thickness: .18"
 Min. Hole Size: .008" 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**

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|---|--|---|
| MANUFACTURER INFORMATION: Electrotek Corp. 7745 S. 10th Street, Oak Creek, WI, 53154 US | PLANT LOCATION: Same Address as Manufacturer | CAGE Code: 66030 Phone: 414-762-1390 Fax: 414-762-1510 EMail: 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)
 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: .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

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)
 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: .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

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| MANUFACTURER INFORMATION: Firan Technology Group 250 Finchdene Square, Scarborough, M1X 1A5, Ontario Canada | PLANT LOCATION: Same Address as Manufacturer | CAGE Code: L2665 Phone: 416-299-4000 Fax: 416-292-4308 E-Mail: 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
 Rigid Base Material: BI: Aramid Fabric, Nonwoven, Polyimide Resin
 Max. Panel Size: 18" x 24"
 Max. Number of Layers: 14
 Max. Board Thickness: .101"
 Min. Hole Size: .013" Drilled Plated-Through Hole Before Plating
 Aspect Ratio: 6.9:1 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: Liquid Photoimageable
 Finish System: ENIG, HASL, Hot Oil Reflow of Plated Sn/Pb
 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
 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: .22"
 Min. Hole Size: .0059" Laser Ablated Plated Hole Size Before Plating, .0096" Drilled Plated-Through Hole Before Plating
 Aspect Ratio: 1.01:1 Microvia, 10.2:1 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: Liquid Photoimageable
 Finish System: ENIG, 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-05-009339, VQE-06-010764, VQE-06-010889, VQE-15-028987
 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: .13"
 Min. Hole Size: .0059" Laser Ablated Plated Hole Size Before Plating, .016" Drilled Plated-Through Hole Before Plating
 Aspect Ratio: 5.6:1 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: Liquid Photoimageable
 Finish System: ENIG, HASL, Hot Oil Reflow of Plated Sn/Pb
 Controlled Impedance: Differential, Single-Ended

SECTION I
LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY

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| <p>MANUFACTURER INFORMATION: Firan Technology Group 250 Finchdene Square, Scarborough, M1X 1A5, Ontario Canada</p> | <p>PLANT LOCATION: Same Address as Manufacturer</p> | <p>CAGE Code: L2665 Phone: 416-299-4000 Fax: 416-292-4308 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-05-009339, VQE-06-010764, VQE-06-010889, VQE-15-028987
 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: 14
 Max. Board Thickness: .097"
 Min. Hole Size: .023" Drilled Plated-Through Hole Before Plating
 Aspect Ratio: 3.4:1 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: Liquid Photoimageable
 Finish System: ENIG, HASL, Hot Oil Reflow of Plated Sn/Pb

CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION

Specification: MIL-PRF-31032/3, MIL-PRF-31032/4
 Qualification Letters: VQE-15-029018
 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
 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

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| <p>MANUFACTURER INFORMATION: FTG Circuits, Inc. (Chatsworth) 20750 Marilla Street, Chatsworth, CA, 91311 US</p> | <p>PLANT LOCATION: Same Address as Manufacturer</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-31032/3, MIL-PRF-31032/4
 Qualification Letters: VQE-16-030066
 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: 28
 Max. Board Thickness: .2"
 Min. Hole Size: .006" Laser Ablated Plated Hole Size Before Plating, .013" Drilled Plated-Through Hole Before Plating
 Aspect Ratio: 1.1:1 Microvia, 10:1 Through-Hole
 Min. Conductor Width/Space: .0035"/.004"
 Hole Preparation: Permanganate Etchback, 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 / 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)

SECTION I
LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY

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| <p>MANUFACTURER INFORMATION: Gorilla Circuits 1445 Old Oakland Rd, San Jose, CA, 95112 US</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
 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: 18:1 Through-Hole
 Min. Conductor Width/Space: .004"/.004"
 Hole Preparation: Permanganate Desmear, Plasma Desmear, Plasma Etchback
 Hole Wall Conductive Coating: Electroless Copper
 Copper Plating: Pulse Plate
 Hole Fill/Via Plug: Non-Conductive
 Solder Resist: Liquid Photoimageable
 Finish System: ENIG, Electrolytic Ni / Hard Au, HASL
 Additional Fab Capabilities: Blind Vias, Sequential 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
 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, .01" Laser Ablated Plated Hole Size Before Plating
 Aspect Ratio: 1:1 Microvia, 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: Blind Vias
 Controlled Impedance: Differential, Single-Ended

SECTION I
LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY

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| MANUFACTURER INFORMATION: Graphic Plc Lords Meadow Industrial Estate, Crediton, Devon, EX17 IHN UK | PLANT LOCATION: Same Address as Manufacturer | CAGE Code: U4538 Phone: 44-1363-774874 Fax: 44-1363-772265 EMail: |
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CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2
 Qualification Letters: VQE-11-023205, VQE-12-025118
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant
 Max. Panel Size: 12" x 18"
 Max. Number of Layers: 10
 Max. Board Thickness: .11" (2.79mm)
 Min. Hole Size: .012" Drilled Plated-Through Hole Before Plating
 Aspect Ratio: 8.4:1 Through-Hole
 Min. Conductor Width/Space: .004"/.004"
 Hole Preparation: Plasma Desmear
 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-12-025119
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant
 Max. Panel Size: 12" x 18"
 Max. Number of Layers: 10
 Max. Board Thickness: .11" (2.79mm)
 Min. Hole Size: .012" Drilled Plated-Through Hole Before Plating
 Aspect Ratio: 8.4:1 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
 Additional Fab Capabilities: Foil Lamination

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

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| <p>MANUFACTURER INFORMATION: Hamby Corporation 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: suesharp@hambycorp.com</p> |
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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

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| <p>MANUFACTURER INFORMATION: Hamby Corporation 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: suesharp@hambycorp.com</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

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|---|--|---|
| MANUFACTURER INFORMATION: Hans Brockstedt GmbH Clara-Immerwahr-Strabe 7, 24145 Kiel Germany | PLANT LOCATION: Same Address as Manufacturer | CAGE Code: C4831 Phone: 0049-431-71966-0, -30 Fax: 0049-431-71966-29 E-Mail: klammer@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: Hans Brockstedt GmbH 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: klammer@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

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| MANUFACTURER INFORMATION: Holiday Circuits, Inc. 11126 Bren Road West, Minnetonka, MN, 55343 US | PLANT LOCATION: Same Address as Manufacturer | CAGE Code: 59554 Phone: 952-988-8059 Fax: EMail: 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)
 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: .11"
 Min. Hole Size: .008" Drilled Plated-Through Hole Before Plating
 Aspect Ratio: 7.8:1 Through-Hole
 Min. Conductor Width/Space: .003"/.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: Liquid Photoimageable
 Finish System: ENIG, HASL, 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

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| MANUFACTURER INFORMATION: Hughes Circuits, Inc. 540 S. Pacific Street, San Marcos, CA, 92078-4056 US | PLANT LOCATION: Same Address as Manufacturer | CAGE Code: 1KXU6 Phone: 760-744-0300 Fax: 760-744-6388 EMail: joe@hughescircuits.com |
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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

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

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

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| <p>MANUFACTURER INFORMATION: ISU Petasys 12930 Bradley St., Sylmar, CA, 91342 US</p> | <p>PLANT LOCATION: Same Address as Manufacturer</p> | <p>CAGE Code: 1WFH9 Phone: 818-833-4832 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: 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**

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|--|--|---|
| MANUFACTURER INFORMATION: KCA Electronics, Inc. 223 N. Crescent Way, Anaheim, CA, 92801 US | PLANT LOCATION: Same Address as Manufacturer | CAGE Code: 1VUH8 Phone: 714-239-2433 Fax: 714-239-2455 E-Mail: |
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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: Non-Conductive
 Solder Resist: Liquid Photoimageable
 Finish System: HASL

CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION

Specification: MIL-PRF-31032/3, MIL-PRF-31032/4
 Qualification Letters: VQE-11-021796, VQE-14-027414
 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: 16
 Max. Board Thickness: .074"
 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: HASL
 Additional Fab Capabilities: Blind Vias, Sequential Lamination
 Controlled Impedance: Differential
 Flex Usage: Use A (Flex During Installation)

CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION

Specification: MIL-PRF-31032/3
 Qualification Letters: VQE-11-021796
 Flex Base Material: Copper Clad Polyimide with Acrylic Adhesive
 Max. Panel Size: 12" x 18"
 Max. Number of Layers: 1
 Max. Board Thickness: .008"
 Min. Conductor Width/Space: .004"/.006"
 Finish System: HASL
 Flex Usage: Use A (Flex During Installation), Use B (Dynamic Flex)

SECTION I
LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY

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| MANUFACTURER INFORMATION: KCA Electronics, Inc. 223 N. Crescent Way, Anaheim, CA, 92801 US | PLANT LOCATION: 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: VQE-11-022398, VQE-14-027414
 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: .092"
 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**

| | | |
|--|--|---|
| MANUFACTURER INFORMATION: Lockheed Martin Mission Systems & Training 1801 State Route 17C, Owego, NY, 13827 US | PLANT LOCATION: Same Address as Manufacturer | CAGE Code: 03640 Phone: 607-751-5395 Fax: 607-751-7714 EMail: renee.akers@lmco.com |
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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-99-000130
 Rigid Base Material: AF: Aramid Fabric, Woven, Majority Polyfunctional Epoxy Resin
 Max. Panel Size: 18" x 24"
 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-01-0539, VQE-15-029009, VQE-15-029561
 Rigid Base Material: BI: Aramid Fabric, Nonwoven, Polyimide Resin
 Max. Panel Size: 18" x 24"
 Max. Number of Layers: 14
 Max. Board Thickness: .095"
 Min. Hole Size: .014" Drilled Plated-Through Hole Before Plating
 Aspect Ratio: 6.8:1 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-99-000130
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant
 Max. Panel Size: 24" x 30"
 Max. Number of Layers: 24
 Max. Board Thickness: .104"
 Min. Hole Size: .018" 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
 Copper Plating: Pulse Plate
 Solder Resist: Dry Film, Liquid Photoimageable
 Finish System: ENIG, HASL, Hot Oil Reflow of Plated Sn/Pb

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

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| MANUFACTURER INFORMATION: Lockheed Martin Mission Systems & Training 1801 State Route 17C, Owego, NY, 13827 US | PLANT LOCATION: Same Address as Manufacturer | CAGE Code: 03640 Phone: 607-751-5395 Fax: 607-751-7714 E-Mail: renee.akers@lmco.com |
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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-99-000130
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant
 Max. Panel Size: 24" x 30"
 Max. Number of Layers: 16
 Max. Board Thickness: .082"
 Min. Hole Size: .018" 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
 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-31032/3, MIL-PRF-31032/4
 Qualification Letters: VQE-00-000684, VQE-07-013459, VQE-15-029009
 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: 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
 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: Permanganate Desmear, Permanganate 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

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| MANUFACTURER INFORMATION: Lone Star Circuits 901 Hensley Drive, Wylie, TX, 75098-4909 US | PLANT LOCATION: Same Address as Manufacturer | CAGE Code: 04RV5 Phone: 214-291-1427 Fax: EMail: sdiacont@lscpwb.com |
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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

CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION

Specification: MIL-PRF-31032/6
 Qualification Letters: VQE-11-021947
 Rigid Base Material: GY: Glass Base, Woven, Polytetrafluoroethylene Resin, Flame Resistant, for Microwave Application
 Max. Panel Size: 18" x 24"
 Max. Number of Layers: 2
 Max. Board Thickness: .031"
 Min. Hole Size: .039" Drilled Plated-Through Hole Before Plating
 Aspect Ratio: 1:1 Through-Hole
 Min. Conductor Width/Space: .19"/.9515"
 Hole Preparation: Sodium Treatment
 Hole Wall Conductive Coating: Electroless Copper
 Copper Plating: Direct Current Plate
 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

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| MANUFACTURER INFORMATION: Micom Corp. 475 Old Highway 8 NW, New Brighton, MN, 55112 US | PLANT LOCATION: Same Address as Manufacturer | CAGE Code: 34076 Phone: 651-604-2625 Fax: 651-636-1352 EMail: dboleym@micomcircuits.com |
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CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2
 Qualification Letters: VQE-02-002780, VQE-03-002980, VQE-12-023661
 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: .239"
 Min. Hole Size: .007" 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, 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, HASL, Hot Oil Reflow of Plated Sn/Pb
 Additional Fab Capabilities: Blind Vias, Buried Vias, Embedded Resistors, 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-02-002780, VQE-03-002980, VQE-12-023661
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant
 Max. Panel Size: 18" x 24"
 Max. Number of Layers: 28
 Max. Board Thickness: .239"
 Min. Hole Size: .007" 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, 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, 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

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| <p>MANUFACTURER INFORMATION: Midwest Printed Circuit Services 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-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-31032/1, MIL-PRF-31032/2
 Qualification Letters: VQE-12-024841, VQE-12-025070, VQE-13-025727, VQE-14-028088
 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, Permanganate 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: Controlled Depth Mechanically Drilled Low Aspect Ratio Blind Vias, Foil Lamination
 Controlled Impedance: Differential

SECTION I
LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY

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

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2
Qualification Letters: VQE-15-029521
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: .103"
Min. Hole Size: .012" Drilled Plated-Through Hole Before Plating
Aspect Ratio: 8:1 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
Solder Resist: Liquid Photoimageable
Finish System: ENIG, HASL
Additional Fab Capabilities: Foil Lamination
Controlled Impedance: Single-Ended

SECTION I
LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY

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| <p>MANUFACTURER INFORMATION: Pioneer Circuits, Inc. 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-31032/1, MIL-PRF-31032/2
 Qualification Letters: VQE-09-017323, VQE-09-017656
 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
 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

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)

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

| | | |
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| <p>MANUFACTURER INFORMATION: Pioneer Circuits, Inc. 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 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)

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**

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| <p>MANUFACTURER INFORMATION: PNC, Inc. 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, Differential

SECTION I
LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY

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| <p>MANUFACTURER INFORMATION: Printed Circuits, Inc. 1200 West 96th Street, Bloomington, MN, 55431-2606 US</p> | <p>PLANT LOCATION: Same Address as Manufacturer</p> | <p>CAGE Code: 65114 Phone: 952-886-9333 Fax: EMail: jsmith@printedcircuits.com</p> |
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CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2
 Qualification Letters: VQ(VQE-15-029290)
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant
 Max. Panel Size: 12" x 18", 18" x 24"
 Max. Number of Layers: 16
 Max. Board Thickness: .12"
 Min. Hole Size: .01"
 Aspect Ratio: 10:1
 Min. Conductor Width/Space: .004"/.005"
 Hole Preparation: Plasma Desmear, Plasma Etchback
 Hole Wall Conductive Coating: Carbon-based
 Copper Plating: Direct Current Plate, Pulse Plate
 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

CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2
 Qualification Letters: VQ(VQE-15-029290)
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant
 Max. Panel Size: 12" x 18", 18" x 24"
 Max. Number of Layers: 16
 Max. Board Thickness: .12"
 Min. Hole Size: .01"
 Aspect Ratio: 10:1
 Min. Conductor Width/Space: .004"/.005"
 Hole Preparation: Plasma Desmear, Plasma Etchback
 Hole Wall Conductive Coating: Carbon-based
 Copper Plating: Direct Current Plate, Pulse Plate
 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

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: 16
 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**

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| <p>MANUFACTURER INFORMATION: Pro-Tech Interconnect Solutions LLC 4300 Peavey Road, Chaska, MN, 55318 US</p> | | <p>CAGE Code: 3CP65 Phone: 952-442-2189 Fax: 952-442-2472 EMail: hkooda@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
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant
 Max. Panel Size: 12" x 24"
 Max. Number of Layers: 10
 Max. Board Thickness: .1"
 Min. Hole Size: .024" 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: Carbon-based
 Copper Plating: Direct Current Plate
 Solder Resist: Liquid Photoimageable
 Finish System: HASL

CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2
 Qualification Letters: VQE-11-021704, VQE-16-030058
 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: .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**

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| <p>MANUFACTURER INFORMATION: Sanmina-SCI (Costa Mesa) 2945 Airway Avenue, Costa Mesa, CA, 92626 US</p> | | <p>CAGE Code: 3BKL5 Phone: 714-371-2800 Fax: 714-371-2833 EMail: joann.medina@sanmina-sci.com</p> |
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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: .003"/.003"
 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: Electrolytic Ni / Soft Au, HASL
 Additional Fab Capabilities: Blind Vias, Buried Vias, 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: 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: .003"/.0035"
 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: Electrolytic Ni / Soft Au, HASL
 Additional Fab Capabilities: Foil Lamination
 Controlled Impedance: Single-Ended

SECTION I
LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY

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| <p>MANUFACTURER INFORMATION: Sanmina-SCI (Owego) 1200 Taylor Rd., Owego, NY, 13827 US</p> | | <p>CAGE Code: 4GZ84 Phone: 607-689-5543 Fax: EMail: rick.sylvain@sanmina-sci.com</p> |
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CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2
 Qualification Letters: VQE-11-21597
 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: .11"
 Min. Hole Size: .012" Drilled Plated-Through Hole Before Plating
 Aspect Ratio: 9.3:1 Through-Hole
 Min. Conductor Width/Space: .008"/.0045"
 Hole Preparation: Plasma Etchback
 Hole Wall Conductive Coating: Electroless Copper
 Copper Plating: Pulse Plate
 Solder Resist: Liquid Photoimageable
 Finish System: HASL
 Additional Fab Capabilities: Foil Lamination

CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2
 Qualification Letters: VQE-11-22386
 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: .095"
 Min. Hole Size: .007" Laser Ablated Plated Hole Size Before Plating, .01" Drilled Plated-Through Hole Before Plating
 Aspect Ratio: .59:1 Microvia, 9.7:1 Through-Hole
 Min. Conductor Width/Space: .0035"/.0032"
 Hole Preparation: Plasma Etchback
 Hole Wall Conductive Coating: Electroless Copper
 Copper Plating: Pulse Plate
 Hole Fill/Via Plug: Conductive, Non-Conductive
 Solder Resist: Liquid Photoimageable
 Finish System: 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

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| MANUFACTURER INFORMATION: Sanmina-SCI (San Jose) 2050 Bering Drive, San Jose, CA, 95131 US | PLANT LOCATION: Same Address as Manufacturer | CAGE Code: 3DR67 Phone: 408-964-6515 Fax: 408-964-6453 E-Mail: 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-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: 30
 Max. Board Thickness: .25"
 Min. Hole Size: .01" Drilled Plated-Through Hole Before Plating
 Aspect Ratio: 14:1 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, 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: 18" x 24"
 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, 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-31032/2, MIL-PRF-31032/6
 Qualification Letters: VQE-10-20921, VQE-10-21014
 Rigid Base Material: Woven Glass Reinforced, Hydrocarbon Resin with Ceramic Fill
 Max. Panel Size: 21" x 24"
 Max. Number of Layers: 2
 Max. Board Thickness: .062"
 Min. Hole Size: .0197" Drilled Plated-Through Hole Before Plating
 Aspect Ratio: 3.1:1 Through-Hole
 Min. Conductor Width/Space: .008"/.014"
 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: ENIG

SECTION I
LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY

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

Specification: MIL-PRF-31032/1, MIL-PRF-31032/5
 Qualification Letters: VQE-11-021514
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant; Woven Glass Reinforced, Hydrocarbon Resin with Ceramic Fill
 Max. Panel Size: 21" x 24"
 Max. Number of Layers: 7
 Max. Board Thickness: .066"
 Min. Hole Size: .01"
 Aspect Ratio: 7:1 Through-Hole
 Min. Conductor Width/Space: .005"/.004"
 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: Liquid Photoimageable
 Finish System: ENIG
 Additional Fab Capabilities: Blind Vias, Sequential Lamination
 Controlled Impedance: Differential, Single-Ended

CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2
 Rigid Base Material: BI: Aramid Fabric, Nonwoven, Polyimide Resin
 Max. Panel Size: 18" x 24"
 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

SECTION I
LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY

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| MANUFACTURER INFORMATION: Speedy Circuits, Inc. 5331 McFadden Avenue, Huntington Beach, CA, 92649-1204 US | PLANT LOCATION: Same Address as Manufacturer | CAGE Code: 66982 Phone: 714-898-4901 Fax: 714-891-0607 E-Mail: 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
 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: .11"
 Min. Hole Size: .015" 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: Electroless Copper
 Copper Plating: Direct Current Plate
 Solder Resist: Liquid Photoimageable
 Finish System: Electrolytic Ni (no Au), HASL, Hot Oil Reflow of Plated Sn/Pb
 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-08-016434, VQE-10-021007
 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: .11"
 Min. Hole Size: .015" 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: Electroless Copper
 Copper Plating: Direct Current Plate
 Solder Resist: Liquid Photoimageable
 Finish System: HASL, Hot Oil Reflow of Plated Sn/Pb
 Additional Fab Capabilities: Foil Lamination
 Controlled Impedance: Differential, Single-Ended

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
 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: 18
 Max. Board Thickness: .13"
 Min. Hole Size: .002" 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: Electroless Copper
 Copper Plating: Direct Current Plate
 Solder Resist: Dry Film, Liquid Photoimageable
 Finish System: Electrolytic Ni / Hard Au, Electrolytic Ni / Soft Au, HASL, Hot Oil Reflow of Plated Sn/Pb
 Additional Fab Capabilities: Foil 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

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| MANUFACTURER INFORMATION: Speedy Circuits, Inc. 5331 McFadden Avenue, Huntington Beach, CA, 92649-1204 US | PLANT LOCATION: Same Address as Manufacturer | CAGE Code: 66982 Phone: 714-898-4901 Fax: 714-891-0607 E-Mail: sales@speedycircuits.com |
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CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION

Specification: MIL-PRF-31032/6
 Qualification Letters: VQE-08-016434
 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: .036"
 Min. Hole Size: .02" Drilled Plated-Through Hole Before Plating
 Aspect Ratio: 2:1 Through-Hole
 Min. Conductor Width/Space: .005"/.005"
 Hole Wall Conductive Coating: Electroless Copper
 Copper Plating: Direct Current Plate
 Finish System: Hot Oil Reflow of Plated Sn/Pb

CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION

Specification: MIL-PRF-31032/5, MIL-PRF-31032/6
 Qualification Letters: VQE-09-018657
 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: 12" x 18"
 Max. Number of Layers: 10 Woven E-Glass, Hydrocarbon Resin, Ceramic Filler - Homogenous
 Max. Board Thickness: .1"
 Min. Hole Size: .01" Drilled Plated-Through Hole Before Plating
 Aspect Ratio: 10:1 Through-Hole
 Min. Conductor Width/Space: .005"/.005"
 Hole Preparation: Plasma Desmear
 Hole Wall Conductive Coating: Electroless Copper
 Copper Plating: Direct Current Plate
 Solder Resist: Liquid Photoimageable
 Finish System: Electrolytic Ni / Hard Au, Electrolytic Ni / Soft Au, HASL, Hot Oil Reflow of Plated Sn/Pb
 Controlled Impedance: Differential, Single-Ended

CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION

Specification: MIL-PRF-31032/5, MIL-PRF-31032/6
 Qualification Letters: VQE-09-018657
 Composition: S - Homogenous thermosetting base material printed boards
 Rigid Base Material: Woven Glass Reinforced, Hydrocarbon Resin with Ceramic Fill
 Max. Panel Size: 12" x 18"
 Max. Number of Layers: 10 With or Without Woven or Non-woven E-Glass, PTFE Resin, Ceramic Filler and Woven E-Glass, Epoxy Resin - Mixed
 Max. Board Thickness: .068"
 Min. Hole Size: .01" Drilled Plated-Through Hole Before Plating
 Aspect Ratio: 6:1 Through-Hole
 Min. Conductor Width/Space: .005"/.005"
 Hole Preparation: Plasma Desmear
 Hole Wall Conductive Coating: Electroless Copper
 Copper Plating: Direct Current Plate
 Solder Resist: Liquid Photoimageable
 Finish System: Electrolytic Ni / Hard Au, Electrolytic Ni / Soft Au, HASL, Hot Oil Reflow of Plated Sn/Pb
 Controlled Impedance: Differential, Single-Ended

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

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| MANUFACTURER INFORMATION: Teledyne Printed Circuit Technology 110 Lowell Road, Hudson, NH, 03051 US | PLANT LOCATION: Same Address as Manufacturer | CAGE Code: 22958 Phone: 603-889-6191 Fax: E-Mail: pctsales@teledyne.com |
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CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION

Specification: MIL-PRF-31032/3, MIL-PRF-31032/4
 Qualification Letters: VQE-15-029796
 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: 30
 Max. Board Thickness: .225"
 Min. Hole Size: .0295"
 Aspect Ratio: 7.5:1 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
 Solder Resist: Liquid Photoimageable
 Finish System: ENIG, HASL, Hot Oil Reflow of Plated Sn/Pb
 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-15-029796
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant
 Flex Base Material: Copper Clad Adhesiveless Polyimide
 Max. Panel Size: 24" x 30"
 Max. Number of Layers: 7
 Max. Board Thickness: .06"
 Min. Hole Size: .035" Drilled Plated-Through Hole Before Plating
 Aspect Ratio: 1.8:1 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
 Solder Resist: Liquid Photoimageable
 Finish System: ENIG, 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)

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

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

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2
 Qualification Letters: VQE-14-028079
 Rigid Base Material: GF: Woven E-Glass, Epoxy Resin, Flame Resistant
 Max. Panel Size: 12" x 18"
 Max. Number of Layers: 10
 Max. Board Thickness: .1"
 Min. Hole Size: .025" Drilled Plated-Through Hole Before Plating
 Aspect Ratio: 4:1 Through-Hole
 Min. Conductor Width/Space: .005"/.005"
 Hole Preparation: Permanganate Desmear
 Hole Wall Conductive Coating: Electroless Copper
 Copper Plating: Direct Current Plate
 Finish System: HASL
 Additional Fab Capabilities: Foil Lamination

CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2
 Qualification Letters: VQE-14-028079
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant
 Max. Panel Size: 12" x 18"
 Max. Number of Layers: 10
 Max. Board Thickness: .1"
 Min. Hole Size: .025" Drilled Plated-Through Hole Before Plating
 Aspect Ratio: 4:1 Through-Hole
 Min. Conductor Width/Space: .005"/.005"
 Hole Preparation: Permanganate Desmear
 Hole Wall Conductive Coating: Electroless Copper
 Copper Plating: Direct Current Plate
 Finish System: HASL
 Additional Fab Capabilities: Foil Lamination

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

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| MANUFACTURER INFORMATION: TTM Technologies (Santa Ana) 2630 South Harbor Boulevard, Santa Ana, CA, 92704 US | PLANT LOCATION: 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-05-8644, VQE-06-011211
 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: .2"
 Min. Hole Size: .013" Drilled Plated-Through Hole Before Plating
 Aspect Ratio: 14:1 Through-Hole, 1:1 Microvia
 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, Sequential Lamination

CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2
 Qualification Letters: VQE-05-8644, VQE-06-011211, VQE-12-023569
 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: .2"
 Min. Hole Size: .013" Drilled Plated-Through Hole Before Plating
 Aspect Ratio: 14:1 Through-Hole, 1:1 Microvia
 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: ENIG, HASL, Hot Oil Reflow of Plated Sn/Pb, ImmAg, OSP
 Additional Fab Capabilities: Blind Vias, Buried Vias, Sequential Lamination

SECTION I
LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY

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

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2
 Qualification Letters: VQE-13-026953, VQE-14-028262
 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
 Controlled Impedance: Differential

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
 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, 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: VQE-03-003888, VQE-10-020500, VQE-10-020581, VQE-11-022973, VQE-14-028240, VQE-14-028262
 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: .12"
 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, HASL
 Additional Fab Capabilities: Blind Vias, Foil Lamination, Sequential Lamination
 Controlled Impedance: Differential, Single-Ended

SECTION I
LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY

| | | |
|---|--|---|
| MANUFACTURER INFORMATION: TTM Technologies (Santa Clara) 407 Mathew Street, Santa Clara, CA, 95050 US | PLANT LOCATION: Same Address as Manufacturer | CAGE Code: 65916 Phone: 408-486-3184 Fax: 408-727-1003 E-Mail: |
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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
 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: 16
 Max. Board Thickness: .12"
 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, HASL
 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
 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: .031" 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
 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
 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: 18
 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
 Additional Fab Capabilities: Blind Vias, Sequential Lamination
 Controlled Impedance: Differential, Single-Ended

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

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| <p>MANUFACTURER INFORMATION: TTM Technologies (Santa Clara) 407 Mathew Street, Santa Clara, CA, 95050 US</p> | <p>PLANT LOCATION: Same Address as Manufacturer</p> | <p>CAGE Code: 65916 Phone: 408-486-3184 Fax: 408-727-1003 EMail:</p> |
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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
 Rigid Base Material: BI: Aramid Fabric, Nonwoven, Polyimide Resin
 Max. Panel Size: 18" x 24"
 Max. Number of Layers: 14
 Max. Board Thickness: .12"
 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

SECTION I
LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY

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|---|--|---|
| MANUFACTURER INFORMATION: TTM Technologies (Stafford) 4 Old Monson Road, Stafford, CT, 06075 US | PLANT LOCATION: Same Address as Manufacturer | CAGE Code: 5L706 Phone: 860-684-5881 Fax: 860-684-7425 E-Mail: |
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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
 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: .006" Laser Ablated Plated Hole Size Before Plating, .0079" Drilled Plated-Through Hole Before Plating
 Aspect Ratio: 14:1 Through-Hole, 1:1 Microvia
 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 Core, Embedded Resistors, 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
 Rigid Base Material: GI: Glass Base, Woven, Polyimide Resin, Heat Resistant
 Max. Panel Size: 24" x 36"
 Max. Number of Layers: 32
 Max. Board Thickness: .219"
 Min. Hole Size: .0079" 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, Copper Core, Copper Invar Copper, Embedded Resistors, 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
 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: .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

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| MANUFACTURER INFORMATION: TTM Technologies (Stafford) 4 Old Monson Road, Stafford, CT, 06075 US | PLANT LOCATION: Same Address as Manufacturer | CAGE Code: 5L706 Phone: 860-684-5881 Fax: 860-684-7425 EMail: |
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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
 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, 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-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
 Rigid Base Material: With or without woven or non-woven E-glass, Polytetrafluoroethylene (PTFE) resin, ceramic filler
 Max. Panel Size: 24" x 30"
 Max. Number of Layers: 16
 Max. Board Thickness: .11"
 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**

| | | |
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| MANUFACTURER INFORMATION: TTM Technologies (Stafford) 4 Old Monson Road, Stafford, CT, 06075 US | PLANT LOCATION: Same Address as Manufacturer | CAGE Code: 5L706 Phone: 860-684-5881 Fax: 860-684-7425 EMail: |
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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
 Composition: M - Mixed based material printed boards
 Rigid Base Material: Woven Glass Reinforced, Hydrocarbon Resin with Ceramic Fill
 Max. Panel Size: 24" x 42"
 Max. Number of Layers: 24
 Max. Board Thickness: .175"
 Min. Hole Size: .006" Laser Ablated Plated Hole Size Before Plating, .0098" Drilled Plated-Through Hole Before Plating
 Aspect Ratio: 1:1 Microvia, 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, Copper Core, Embedded Resistors, 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
 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 36"
 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, 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

| | | |
|---|--|---|
| <p>MANUFACTURER INFORMATION: TTM Technologies (Stafford) 4 Old Monson Road, Stafford, CT, 06075 US</p> | <p>PLANT LOCATION: Same Address as Manufacturer</p> | <p>CAGE Code: 5L706 Phone: 860-684-5881 Fax: 860-684-7425 EMail:</p> |
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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
 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: 18" x 24"
 Max. Number of Layers: 11
 Max. Board Thickness: .07"
 Min. Hole Size: .035" 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, 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**

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|---|--|---|
| MANUFACTURER INFORMATION: Unicircuit, Inc. 8192 Southpark Lane, Littleton, CO, 80120 US | PLANT LOCATION: Same Address as Manufacturer | CAGE Code: 66311 Phone: 303-730-0505, x110 Fax: EMail: blageman@unicircuit.com |
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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
 Rigid Base Material: G1: 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
 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**

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| MANUFACTURER INFORMATION: Viasystems Technologies Corp., LLC - Anaheim 3140 East Coronado Street, Anaheim, CA, 92806 US | PLANT LOCATION: Same Address as Manufacturer | CAGE Code: 0BSG1 Phone: 714-688-7296 Fax: E-Mail: |
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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: VQ(VQE-09-018147)
 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: .009" Drilled Plated-Through Hole Before Plating
 Aspect Ratio: 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: Conductive, Non-Conductive
 Solder Resist: Liquid Photoimageable
 Finish System: ENIG, HASL
 Additional Fab Capabilities: Blind Vias, Buried Vias, Foil Lamination
 Controlled Impedance: Differential, Single-Ended

SECTION I
LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY

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| MANUFACTURER INFORMATION: Viasystems Technologies Corp., LLC - Cleveland 7 Ascot Parkway, Cuyahoga Falls, OH, 44223 US | PLANT LOCATION: Same Address as Manufacturer | CAGE Code: 7Z463 Phone: 330-572-3400 Fax: 330-572-3434 E-Mail: |
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CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2
 Qualification Letters: VQE-00-000289, VQE-01-000910, VQE-05-008414, VQE-06-010963, VQE-15-028749
 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: .126"
 Min. Hole Size: .01" 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
 Solder Resist: Dry Film, 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-00-000289, VQE-01-000910, VQE-05-008414, VQE-06-010963, VQE-15-028749
 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: .126"
 Min. Hole Size: .013" 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
 Hole Fill/Via Plug: Non-Conductive
 Solder Resist: Dry Film, Liquid Photoimageable
 Finish System: HASL, Hot Oil Reflow of Plated Sn/Pb
 Additional Fab Capabilities: 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-01-000909, VQE-06-010963, VQE-14-027433
 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: 7
 Max. Board Thickness: .07"
 Min. Hole Size: .026" Drilled Plated-Through Hole Before Plating
 Aspect Ratio: 2.6:1 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: HASL
 Flex Usage: Use A (Flex During Installation)

SECTION I
LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY

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| MANUFACTURER INFORMATION: Viasystems Technologies Corp., LLC - Cleveland 7 Ascot Parkway, Cuyahoga Falls, OH, 44223 US | PLANT LOCATION: Same Address as Manufacturer | CAGE Code: 7Z463 Phone: 330-572-3400 Fax: 330-572-3434 EMail: |
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CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION

Specification: MIL-PRF-31032/3, MIL-PRF-31032/4
 Qualification Letters: VQE-01-000909, VQE-06-010963, VQE-14-027433, VQE-15-208749
 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: 12
 Max. Board Thickness: .126"
 Min. Hole Size: .013" Drilled Plated-Through Hole Before Plating
 Aspect Ratio: 10:1 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: Dry Film, Liquid Photoimageable
 Finish System: HASL
 Controlled Impedance: Differential, Single-Ended
 Flex Usage: Use A (Flex During Installation)

SECTION I
LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY

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| MANUFACTURER INFORMATION: Viasystems Technologies Corp., LLC - Denver 10570 Bradford Road, Littleton, CO, 80127-4211 US | PLANT LOCATION: Same Address as Manufacturer | CAGE Code: 75815 Phone: 303-972-4105 Fax: 303-933-2934 EMail: |
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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
 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, .0098" 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
 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: .14"
 Min. Hole Size: .005" Laser Ablated Plated Hole Size Before Plating, .0118" 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

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| MANUFACTURER INFORMATION: Viasystems Technologies Corp., LLC - North Jackson 12080 DeBartolo Drive, North Jackson, OH, 44451 US | PLANT LOCATION: Same Address as Manufacturer | CAGE Code: 0GN71 Phone: 330-538-3900 Fax: 330-538-3820 E-Mail: |
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CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2
 Qualification Letters: VQ(VQE-03-003121), VQ(VQE-03-003214), VQ(VQE-07-012925), VQ(VQE-10-020405)
 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/Au, HASL, ImmAg, Ni/Pd/Au, OSP
 Additional Fab Capabilities: Blind Vias, Buried 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-03-003121), VQ(VQE-03-003214), VQ(VQE-07-012925), VQ(VQE-10-020405)
 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: .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, HASL, ImmAg, Ni/Pd/Au, OSP
 Additional Fab Capabilities: Blind Vias, Buried Vias, Foil Lamination
 Controlled Impedance: Differential, Single-Ended

CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION

Specification: MIL-PRF-31032/3, MIL-PRF-31032/4
 Qualification Letters: VQ(VQE-03-003121), VQ(VQE-03-003214), VQ(VQE-07-012925), VQ(VQE-10-020405)
 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: .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: Non-Conductive
 Solder Resist: Dry Film, Liquid Photoimageable
 Finish System: ENIG, Electrolytic Ni/Au, HASL, ImmAg, OSP
 Additional Fab Capabilities: Blind Vias, Buried Vias, Foil Lamination
 Controlled Impedance: Differential, Single-Ended

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

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| MANUFACTURER INFORMATION: Viasystems Technologies Corp., LLC - San Jose 355 Turtle Creek Court, San Jose, CA, 95125-1316 US | PLANT LOCATION: Same Address as Manufacturer | CAGE Code: 0MHG5 Phone: 408-938-7219 Fax: 408-280-0641 EMail: arnold.amaral@viasystems.com |
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CAPABILITIES BY TECHNOLOGY/ASSOCIATED SPECIFICATION

Specification: MIL-PRF-31032/1, MIL-PRF-31032/2
 Qualification Letters: VQ(VQE-08-016481), VQ(VQE-08-016632)
 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: .13"
 Min. Hole Size: .004" Laser Ablated Plated Hole Size Before Plating, .008" Drilled Plated-Through Hole Before Plating
 Aspect Ratio: 0.8:1 Microvia, 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, Pulse Plate
 Hole Fill/Via Plug: Non-Conductive
 Solder Resist: Liquid Photoimageable
 Finish System: ENIG, Electrolytic Ni, Electrolytic Ni / Hard Au, HASL
 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: VQ(VQE-08-016481), VQ(VQE-08-016632)
 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: .13"
 Min. Hole Size: .008" Drilled Plated-Through Hole Before Plating, .008" Laser Ablated Plated Hole Size Before Plating
 Aspect Ratio: 0.8:1 Microvia, 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, Pulse Plate
 Hole Fill/Via Plug: Non-Conductive
 Solder Resist: Liquid Photoimageable
 Finish System: ENIG, Electrolytic Ni / Hard Au, HASL
 Additional Fab Capabilities: Blind Vias, Buried Vias, Sequential Lamination
 Controlled Impedance: Differential, Single-Ended

SECTION I
LIST OF MANUFACTURERS' QUALIFIED CAPABILITIES FOR EACH TECHNOLOGY

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| MANUFACTURER INFORMATION: Viasystems Technologies Corp., LLC - Sterling 1200 Severn Way, Sterling, VA, 20166-8904 US | PLANT LOCATION: 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)
 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: .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, 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)
 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, 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)
 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: 9
 Max. Board Thickness: .0844"
 Min. Hole Size: .0135" Drilled Plated-Through Hole Before Plating
 Aspect Ratio: 7.4:1 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

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

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| MANUFACTURER INFORMATION: Viasystems Toronto Inc. 8150 Sheppard Avenue East, Scarborough, M1B 5K2, Ontario Canada | PLANT LOCATION: Same Address as Manufacturer | CAGE Code: 3AF82 Phone: 416-208-2100 Fax: 416-208-2196 EMail: |
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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: .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: .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**

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| <p>MANUFACTURER INFORMATION: Westak of Oregon 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
 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: .11"
 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
 Solder Resist: Dry Film, Liquid Photoimageable
 Finish System: ENIG, HASL
 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
 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: .008" Drilled Plated-Through Hole Before Plating
 Aspect Ratio: 10.6:1 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
 Controlled Impedance: Differential, Single-Ended

SECTION II
LIST OF MANUFACTURERS AND ASSOCIATED SPECIFICATION

AC Universal Circuits LLC MIL-PRF-31032/1 MIL-PRF-31032/4 Custom
 8860 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

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

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

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

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

Cirexx International, Inc. MIL-PRF-31032/1 MIL-PRF-31032/4 Custom
 791 Nuttman 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

Colonial Circuits, 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

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

Cosmotronic, Inc. MIL-PRF-31032/1 MIL-PRF-31032/4 Custom
 16721 Noyes Avenue, Irvine, CA, 92606-5176 US MIL-PRF-31032/2 MIL-PRF-31032/5
 CAGE Code: 63695 MIL-PRF-31032/3 MIL-PRF-31032/6

Dynamic & Proto Circuits, Inc. MIL-PRF-31032/1 MIL-PRF-31032/4 Custom
 869 Barton Street, Stoney Creek, L8E 5G6, Ontario Canada MIL-PRF-31032/2 MIL-PRF-31032/5
 CAGE Code: 38898 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

SECTION II
LIST OF MANUFACTURERS AND ASSOCIATED SPECIFICATION

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, 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

Graphic Plc MIL-PRF-31032/1 MIL-PRF-31032/4 Custom
 Lords Meadow Industrial Estate, Crediton, Devon, EX17 IHN UK MIL-PRF-31032/2 MIL-PRF-31032/5
 CAGE Code: U4538 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

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

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

Micom Corp. MIL-PRF-31032/1 MIL-PRF-31032/4 Custom
 475 Old Highway 8 NW, New Brighton, MN, 55112 US MIL-PRF-31032/2 MIL-PRF-31032/5
 CAGE Code: 34076 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

SECTION II
LIST OF MANUFACTURERS AND ASSOCIATED SPECIFICATION

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

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

Sanmina-SCI (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 (Owego) MIL-PRF-31032/1 MIL-PRF-31032/4 Custom
 1200 Taylor Rd., Owego, NY, 13827 US MIL-PRF-31032/2 MIL-PRF-31032/5
 CAGE Code: 4GZ84 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

Speedy 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

Teledyne Printed Circuit Technology MIL-PRF-31032/1 MIL-PRF-31032/4 Custom
 110 Lowell Road, Hudson, NH, 03051 US MIL-PRF-31032/2 MIL-PRF-31032/5
 CAGE Code: 22958 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 (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 (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 (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

SECTION II
LIST OF MANUFACTURERS AND ASSOCIATED SPECIFICATION

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

Viasystems Technologies Corp., LLC - 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

Viasystems Technologies Corp., LLC - Cleveland MIL-PRF-31032/1 MIL-PRF-31032/4 Custom
 7 Ascot Parkway, Cuyahoga Falls, OH, 44223 US MIL-PRF-31032/2 MIL-PRF-31032/5
 CAGE Code: 7Z463 MIL-PRF-31032/3 MIL-PRF-31032/6

Viasystems Technologies Corp., LLC - 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

Viasystems Technologies Corp., LLC - 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

Viasystems Technologies Corp., LLC - San Jose MIL-PRF-31032/1 MIL-PRF-31032/4 Custom
 355 Turtle Creek Court, San Jose, CA, 95125-1316 US MIL-PRF-31032/2 MIL-PRF-31032/5
 CAGE Code: 0MHG5 MIL-PRF-31032/3 MIL-PRF-31032/6

Viasystems Technologies Corp., LLC - 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

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