

Wiring, Printed - Component

COMPANY

ES&S SOLUTIONS GMBH
 GEWERBERING 2
 VIERSEN, Nordrhein-Westfalen 41751 Germany

E328445

Type	Cond Width		Cond Thk	SS/DSO	Max Area Diam	Report Date After	Surface Mount Technology	Assembly Solder Process Temp °C	Solder Process Cycles	Solder Limits °C	Solder sec	Max Oper		Meets UL796	C T
	Min mm	Edge mm										Temp °C	Flame Class		
Mass laminated (multilayered) printed wiring boards, flammability only Recognition															
XML-4	0.1	0.31	17	DS	50.8	No	-	-	-	280	20	130	V-0	All	*
Multilayer printed wiring boards															
FY-4	0.075	0.12	17 Int:68	DS	50.8	No	-	-	-	280	15	130	V-0	All	*
STM-1, JJ-02	0.09	0.17	17 Int:34	DS	25.4	No	-	-	-	260	20	130	V-0	All	*
STM-2	0.10	0.20	17 Int:204	DS	76.2	No	-	-	-	288	20	125	V-0	All	*
STM-3	0.18	0.18	34 Int:136	DS	50.8	No	-	-	-	288	20	130	V-0	All	*
XML-M	0.1	0.1	17 Int:68	DS	50.8	No	-	-	-	288	20	130	V-0	All	*
Single layer printed wiring boards															
FY-2	0.075	0.12	17	DS	25.4	No	-	-	-	280	15	130	V-0	All	*
STD-1, JJ-03	0.09	0.17	17	DS	25.4	No	-	-	-	260	20	130	V-0	All	*
STD-2, JJ-01	0.09	0.17	17	DS	25.4	No	-	-	-	260	20	130	V-0	All	*
XML-2	0.1	0.31	17	DS	50.8	No	-	-	-	280	20	130	V-0	All	3

* - CTI marking is optional and may be marked on the printed wiring board.

Marking: Company name or file number and type designation. May be followed by a suffix to denote factory identification or flammability classification.

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Wiring, Printed - Component

The devices covered under this category are incomplete in certain constructional features or restricted in performance capabilities and are intended for use as components of equipment submitted for investigation rather than for direct separate installation in the field. THE FINAL ACCEPTANCE OF THE COMPONENT IS DEPENDENT UPON ITS INSTALLATION AND USE IN EQUIPMENT SUBMITTED TO UL

GENERAL

The category covers printed wiring boards intended for use as components in devices or appliances. The boards may use organic or inorganic base materials in a single or multilayer, rigid or flexible form. Circuitry construction may include etched, die-stamped, precut, flush press, additive, and plated-conductor techniques. Printed-component parts may be used.

This category covers flexible printed wiring defined by the cross-sectional configuration, including right-angle conductors, mid-point connections, etc. This category does not cover flexible printed wiring where the cross-sectional configuration is the same for the entire length of the product. The latter construction is covered under Appliance Wiring Material (AVLV2).

The tests may include the determination of material flammability (burning characteristics), conductor adhesion, delamination, and silver migration. In addition, the effect of long-term exposure to elevated temperature (air-oven aging) on property retention may be investigated. Levels of performance characteristics required for a particular end-product application are intended to be in accordance with the requirements of the end-product standard. Due to space limitations, only a limited number of property values may be presented in the individual Recognitions. Additional properties may be found in the individual Reports.

Minimum Cladding Conductor Width — The minimum width of any conductor spaced more than 0.4 mm from the edge of the printed wiring board.

Minimum Edge Cladding Conductor Width — The minimum width of any conductor parallel with and not spaced more than 0.4 mm from the edge of the printed wiring board.

Cladding Conductor Thickness — The minimum metallic cladding thickness of the conductor. The cladding thickness represents the copper conductor thickness only, unless otherwise noted.

Number of Clad Sides — Indicates whether the printed wiring boards have a pattern on one side (denoted as single sided [SS]) or on both sides (denoted as double sided [DS]).

Maximum Area Diameter — The maximum unpierced conductor area of a printed wiring board is judged by the diameter of the largest circle that can be inscribed within the pattern.

Solder Limits — Unless designed for hand-soldering only, each printed wiring board construction is assigned a maximum temperature and dwell time. The tabulated levels are the maximum temperature and cumulative time conditions to which the boards may be subjected during assembly of components. Multiple solder limits are used to represent surface-mount technology (SMT) soldering process maximum temperature and time profiles.

Maximum Operating Temperature — The maximum continuous-use temperature to which the printed wiring board may be exposed under normal operating conditions in the end product.

Flammability Classification — Processed printed wiring boards with or without applied coatings, finishes, etc., as supplied to the device or appliance manufacturer, may be classified based on burning tests conducted in accordance with ANSI/UL 94, "Tests for Flammability of Plastic Materials for Parts in Devices and Appliances," at the option of the manufacturer.

Where such testing has been conducted, the printed wiring board is classified as HB, V-0, V-1, V-2, VTM-0, VTM-1 and/or VTM-2.

Conductor Finishes — Metallic plating on conductors, contact fingers, plated thru-holes, etc., may be tested at the option of the manufacturer.

Direct Support of Current-carrying Parts — A printed wiring board that meets the minimum ANSI/UL 796, "Printed-Wiring Boards," levels of direct support of current-carrying parts is identified to enable the OEM to select appropriate printed wiring boards for use in products. Direct support is not investigated for "Flammability Only" boards and should be considered during the end-product investigation.

The required performance levels are shown below:

PERFORMANCE PROFILE LEVELS OF BASE MATERIAL OF PRINTED WIRING BOARDS THAT PROVIDE DIRECT SUPPORT OF CURRENT-CARRYING PARTS

Test#	Unit	V-0, V-1, V-2, HB	Thkns, in.+
High-current-arc ignition	Max PLC	3	Actual@
Hot-wire ignition	Max PLC	4	Actual@
Volume resistivity - dry	Min meg-ohm cm	50	1/16
Volume resistivity - wet	Min meg-ohm cm	10	1/16
Dielectric strength - dry	kV per mm	6.89	1/16
Dielectric strength - wet	—	6.89	1/16
Comparative Tracking Index	Max PLC	4	1/16
Heat deflection	°C	*	1/8

Testing is intended to be as described in ANSI/UL 746A, "Polymeric Materials - Short Term Property Evaluations."

+ Test sample thickness on which the index is to be based.

@ Actual thickness or minimum thickness of material being considered.

* Not required for thermoset; for thermoplastics, at least 10°C (18°F) above rated operating temperature with 90°C (194°F) minimum value.

Comparative Tracking Index (CTI; ASTM D3638) — Expressed as that voltage which causes tracking on a printed wiring board base material after 50 drops of a 0.1% ammonium chloride solution has fallen on the material. CTI is not investigated for "Flammability Only" boards and should be considered during the end-product investigation.

CTI Range-tracking Index (TI in Volts)	Assigned PLC
600 and greater	0
400 and up to 600	1
250 and up to 400	2
175 and up to 250	3
100 and up to 175	4
Less than 100	5

The CTI Performance Level Category (PLC) of a printed wiring board is dependent on the CTI PLC of the base material used to make the board. The CTI PLC may be identified to facilitate OEM selection of printed wiring boards for applications in which the CTI rating is significant.

The above electrical properties may be determined by means of the applicable ASTM and/or UL specification in [ANSI/UL 746A](#).

CONDITIONS OF ACCEPTABILITY

Unless specified otherwise in the individual Reports, consideration is to be given to the following Conditions of Acceptability when these components are employed in the end-use equipment:

- 1. Printed Wiring Board Identification** — The printed wiring board is identified in accordance with the **UL MARKING** requirements noted below, and it can be determined that the part is made from the material specified.
- 2. Pattern Limits** — The narrowest conductor width shall not be less than the indicated minimum width mid-board or edge conductor depending upon operating temperature conditions, as indicated in the end-product Report. "Flammability Only" boards are not investigated to determine the minimum acceptable conductor widths, maximum area conductor diameter, and/or the silver conductor limitations, and shall be considered during the end-product investigation.
- 3. Conductor Maximum Area Diameter** — The maximum area diameter of conductors shall not be greater than the indicated maximum.
- 4. Conductor Thickness** — Thickness or weight of conductors shall not be less than the indicated minimum.
- 5. Silver Conductors** — The minimum spacing between any two silver conductors of different potential must not be less than that indicated. The silver conductors have been found suitable only for circuits that do not require a dielectric strength potential greater than that indicated between adjacent parts and conductors. "Flammability Only" boards are not investigated to determine if silver conductors are present on the board, and the effect of silver conductors on the board shall be considered during the end-product investigation.
- 6. Solder Limits** — The temperature and dwell-time exposure during wave, flow, dip or an equivalent soldering operation for assembly-soldering processes shall not exceed the indicated maximum. The maximum dwell time is the cumulative time for all soldering operations when the soldering is done in different steps. During SMT soldering, the temperature and dwell time of each reflow zone shall not exceed the indicated maximum multiple solder-limit steps. The solder-limit temperature and dwell times do not apply to hand-soldering.
- 7. Maximum Operating Temperature** — The maximum operating temperature of the metal-clad material shall not exceed the indicated maximum. The maximum operating temperature is not investigated for "Flammability Only" boards and shall be considered during the end-product investigation.
- 8. Flammability Classification** — The flammability classification, with consideration to solder limits during the assembly process, shall comply with the flammability level acceptable for the applicable UL end-product standard. Coatings shall not be employed unless so indicated in the specified process. If the board assembler or end-product manufacturer applies any coating, the effect of the coating on the flammability of the board shall be determined in the end product.
- 9. Voltage Rating** — No voltage rating is assigned. The suitability of the base material as insulation between live-metal parts and dead-metal parts shall be determined in the end product.
- 10. Minimum Spacing** — Minimum required spacing between conductors of different potential and between these conductors and dead-metal parts. Cupping, twisting, bowing and/or warping of the board has not been investigated.
- 11. Minimum Dielectric Thickness** — Minimum required dielectric/insulation thickness (distance through) between conductor layers has not been investigated regarding dielectric strength requirements in the end-product design.

Additional Conditions of Acceptability may be included in the Report available from the manufacturer.

COLUMN HEADING ABBREVIATIONS

The following abbreviations or symbols are used in the column headings in the individual Recognitions:

Abbreviation	Term
Cond Width	Conductor Width
DS	Double or single sided
Max Area Diam	Maximum Area Diameter
Max Oper Temp	Maximum Operating Temperature
Min	Minimum
Min Edge	Minimum Edge Conductor Width
SS	Single sided
Secs	Seconds
Sold Lts	Soldering Limits
Cond Thk	Conductor Thickness
Flame Class	ANSI/UL 94 Flammability Classification
Dir. Sup.	Direct Support of Current-carrying Parts
CTI	Comparative Tracking Index

A triangle symbol ▲ is marked on those products within a given type designation that comply with direct support of current-carrying parts performance level requirements of [ANSI/UL 796](#). "All" is used to indicate that all base materials under that type designation comply with direct support of current-carrying parts performance level requirements of [ANSI/UL 796](#).

The CTI PLC rating of a printed wiring board may be marked on the board or a CTI rating may be assigned to a type designation.

RELATED PRODUCTS

See the following:

- Plastics ([QMFZ2](#))
- Polymeric Materials - Filament-wound Tubing, Industrial Laminates, Vulcanized Fiber, and Materials for Use in Fabricating Recognized Printed Wiring Boards ([QMTS2](#))
- Coatings for Use on Recognized Printed Wiring Boards ([QM1U2](#))
- Wiring, Printed - Flexible Material Constructions ([ZPXK2](#))

REQUIREMENTS

The basic standard used to investigate products in this category is [ANSI/UL 796](#), "Printed-Wiring Boards," and [ANSI/UL 796F](#), "Flexible Materials Interconnect Constructions."

UL MARKING

Printed wiring boards Recognized under UL's Component Recognition Program are identified by significant markings consisting of the Recognized company's identification, the factory identification (if the printed wiring board is produced at more than one location), and the Recognized type designation that correspond with the marking specified in UL's published records. Only those components that actually bear the "Marking" shown in the individual Recognitions should be considered as being covered under the Component Recognition Program.

The Listing or Classification Mark of UL is not authorized for use on, or in connection with, Recognized Components.

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