**DISCRETE WIRING**

**JUMPER WIRES**

Jumper wires (a.k.a.: haywires) are used to facilitate minor circuit modifications to printed wiring assemblies (PWA), rather than redesign and manufacture a new board. While their use is an accepted practice, the customer must grant approval prior to their use and installation.

Jumper wires are usually solid, insulated copper conductor with tin/lead plating (i.e.: wire wrap wire), although jumpers less than 25mm (0.984 in.) may be uninsulated, provided the jumper is not liable to short between lands or component leads. Silver-plated and/or stranded wire shall not be used.

**PREFERRED COMPONENT TERMINATION SIDE**

Wire route is the shortest path. Wire does not cross component footprints or lands, except where unavoidable. Wire does not pass over any land or via used as a test point. Sufficient slack to allow relocation during component replacement.

Best Workmanship Practice

**PREFERRED SOLDIER TERMINATION SIDE**

Wire route is the shortest path. Wire does not cross component footprints or lands, except where unavoidable. Wire does not pass over any land or via used as a test point.

Best Workmanship Practice

**MANDATORY STAKING**

Jumper wire is staked at intervals specified by engineering documentation. The wire is staked at all changes of direction to restrict movement, and as close to the solder termination as possible.

NASA-STD-8739.1 [9.2.4]

**MANDATORY SOLID, INSULATED CONDUCTOR**

Jumper wires shall be solid, insulated copper conductor with tin/lead plating (i.e.: wire wrap wire). Stranded, silver-plated wire shall not be used.

Best Workmanship Practice

**NASA WORKMANSHIP STANDARDS**

**ACCEPTABLE LAP TERMINATION, SMT (MINIMUM)**

The jumper wire termination shall be parallel to the longest dimension of the pad, with the solder fillet ≥ 50% of the land width (L).

Best Workmanship Practice

**ACCEPTABLE LAP TERMINATION - VACANT LAND / PAD**

The jumper wire termination shall be parallel to the longest dimension of the pad (L), shall be a minimum of 50% of the dimension (L), and shall not overhang the pad.

Best Workmanship Practice

**ACCEPTABLE UNINSULATED WIRE**

Uninsulated jumper wires shall be less than 25mm (0.984 in.) long, and shall not violate minimum electrical spacing requirements. Silver-plated, stranded wire shall not be used.

Best Workmanship Practice

**ACCEPTABLE VIA TERMINATION**

Jumper wires may be terminated and soldered into a via hole.

Best Workmanship Practice

**UNACCEPTABLE IMPROPER LAP TERMINATION, PTH**

The lap joint is less than the required 75% of the lead length.

Best Workmanship Practice

**UNACCEPTABLE IMPROPER LAP TERMINATION**

The lap termination shall not overhang the land and/or violate minimum electrical spacing.

Best Workmanship Practice
UNACCEPTABLE
IMPROPER ROUTING
(OVER TEST POINTS)
Jumper wires shall not be routed over circuit patterns or vias that are used as test points.
Best Workmanship Practice

UNACCEPTABLE
IMPROPER LEAD TERMINATION
The termination wrap shall be a minimum of 90° and a maximum of 180°, with evidence of proper insulation gap, and without overhanging the component termination.
Best Workmanship Practice

UNACCEPTABLE
IMPROPER STAKING
The jumper wire is not staked as specified. The wire is loose and can extend above the height of adjacent components.
Best Workmanship Practice

UNACCEPTABLE
IMPROPER TERMINATION
(OCCUPIED PTH)
Jumper wires shall not be terminated and soldered into plated-through holes (PTH) occupied by a component lead.
Best Workmanship Practice

UNACCEPTABLE
IMPROPER LAP TERMINATION
The jumper wire termination shall be a minimum of 75% of the lead length, as measured between the toe and knee.
Best Workmanship Practice

UNACCEPTABLE
IMPROPER LAP TERMINATION, GULL WING SMT
The jumper wire termination length shall be equal to the lead height (L), and shall not extend past the top of the component body.
Best Workmanship Practice

UNACCEPTABLE
IMPROPER LAP TERMINATION, PTH
The termination shall exhibit a lap solder joint a minimum of 75% of lead length, proper insulation spacing, a discernable outline, and not violate minimum electrical spacing requirements.
Best Workmanship Practice

UNACCEPTABLE
IMPROPER LAP TERMINATION, J-LEAD SMT
The jumper wire termination length shall be a minimum of 75% of the lead height (L), and shall not extend past the top of the component body.
Best Workmanship Practice

UNACCEPTABLE
IMPROPER LAP TERMINATION, J-LEAD SMT (MINIMUM)
The jumper wire termination length shall be a minimum of 75% of the lead height (L), and shall not extend past the top of the component body.
Best Workmanship Practice

UNACCEPTABLE
IMPROPER LEAD TERMINATION
The termination wrap shall be a minimum of 90° and a maximum of 180°, with evidence of proper insulation gap, and without overhanging the component termination.
Best Workmanship Practice

UNACCEPTABLE
COMPONENT LEAD TERMINATION
The termination shall be wrapped a minimum of 90°, exhibit proper insulation clearance, the outline shall be evident in the fillet, and shall not violate minimum electrical spacing.
Best Workmanship Practice

ACCEPTABLE
COMPONENT LEAD TERMINATION
The jumper wires shall be terminated and soldered into plated-through holes (PTH) occupied by a component lead.
Best Workmanship Practice

ACCEPTABLE
LAP TERMINATION, J-LEAD SMT
The jumper wire termination length shall be a minimum of 75% of the lead length, as measured between the toe and knee, and shall not extend past the top of the component body.
Best Workmanship Practice

ACCEPTABLE
LAP TERMINATION, GULL WING SMT
The jumper wire termination length shall be equal to the lead height (L), and shall not extend past the top of the component body.
Best Workmanship Practice

ACCEPTABLE
LAP TERMINATION, PTH
The termination shall exhibit a lap solder joint a minimum of 75% of lead length, proper insulation spacing, a discernable outline, and not violate minimum electrical spacing requirements.
Best Workmanship Practice

ACCEPTABLE
LAP TERMINATION, SMT
The jumper wire termination shall be parallel to the longest dimension of the pad, with the solder fillet equal to the land width (L).
Best Workmanship Practice

接纳不合理的导线走线
导线不走线在测试点上
合格工作方法实践

接纳不合理的导线走线
导线不走线在电路图案或焊点(测试点)上
合格工作方法实践

接纳不合理的走线
走线不应超过电路图案或焊点且不通过器件
合格工作方法实践

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走线不应超过电路图案或焊点
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