



STANDARDS FOR ASSESSMENT

SKILL 16 ELECTRONICS

This document will be used to provide guidance during evaluation of competitors work.



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CIRCUIT DESIGN SCHEMATIC QUALITY



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This document provides guidance for the assessment of Judgement aspects

ASPECT	POINTS	DESCRIPTOR	SUPPORTING PHOTO
Circuit Design Schematic Quality	3	<p>Schematic is very easy to follow.</p> <p>Signal flow from left to right (unless better clarity results from right to left signal flow).</p> <p>Component Number and Designations always in the same plane and place.</p> <p>+V at the top, GND and -V at the bottom.</p> <p>Unused inputs tied to gnd.</p> <p>Bypass Caps placed beside IC they belong to.</p> <p>Schematic is not crowded.</p> <p>Supply rail connections to ICs grouped together and easily found.</p> <p>No errors in price for component used</p> <p>schematic uses A4 paper and Frame</p>	See next page

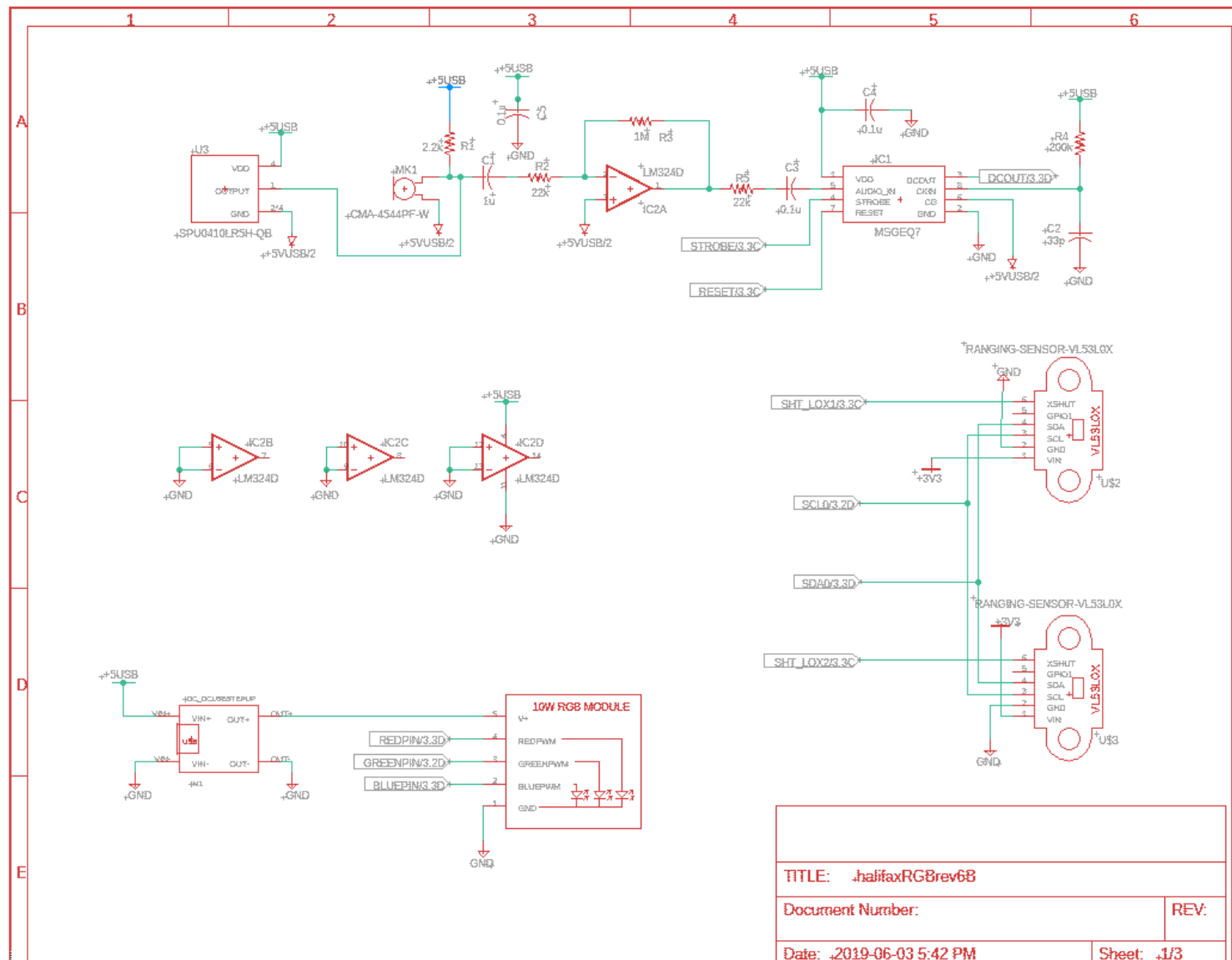


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This document provides guidance for the assessment of Judgement aspects

ASPECT	POINTS	DESCRIPTOR	SUPPORTING PHOTO
Circuit Design Schematic	2	<p>Schematic is easy to follow.</p> <p>Signal flow from left to right (unless better clarity results from right to left signal flow).</p> <p>Component Number and Designations mostly in the same plane and place.</p> <p>+V at the top, GND and -V at the bottom most of the time</p> <p>Unused inputs tied to gnd.</p> <p>Bypass Caps mostly placed beside IC they belong to.</p> <p>Schematic is not crowded.</p> <p>Supply rail connections for ICs shown.</p> <p>No errors in price of component</p> <p>Schematic use A4 Paper</p>	





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This document provides guidance for the assessment of Judgement aspects

ASPECT	POINTS	DESCRIPTOR	SUPPORTING PHOTO
Circuit Design Schematic	1	<p>Schematic is correct. Signal flow from left to right (unless better clarity results from right to left signal flow). +V at the top, GND and -V at the bottom most of the time Bypass Caps present on schematic though often not near IC. Schematic is crowded. Supply rail connections for ICs shown. Some Long connecting wires used making the schematic hard to follow.</p> <p>One error in price of component Schematic does not use A4 paper</p>	



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ASPECT	POINTS	DESCRIPTOR	SUPPORTING PHOTO
Circuit Design Schematic	0	<p>Schematic is incorrect.</p> <p>Signal flow from left to right (unless better clarity results from right to left signal flow).</p> <p>Component Number and Designations not used in many places</p> <p>+V at the bottom many times, GND and -V at the top many times</p> <p>Many bypass Caps missing.</p> <p>Schematic is crowded.</p> <p>Supply rail connections for ICs often missing.</p> <p>Many long connecting wires used making the schematic hard to follow.</p> <p>More than one error in price of component</p> <p>Schematic does not use A4 Paper</p>	



PCB LAYOUT: COMPONENT GROUPING AND PLACEMENT

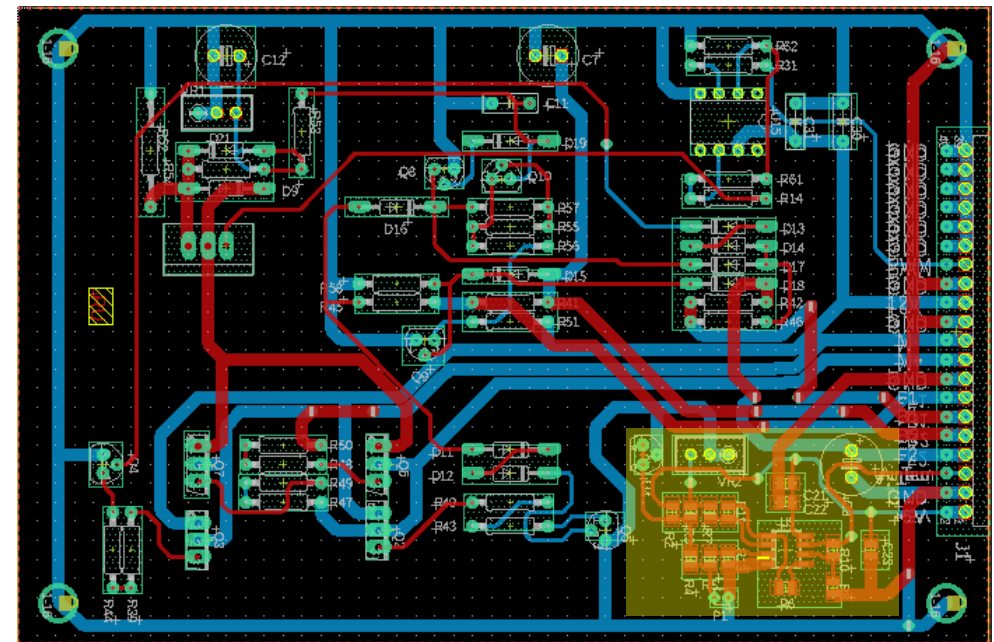
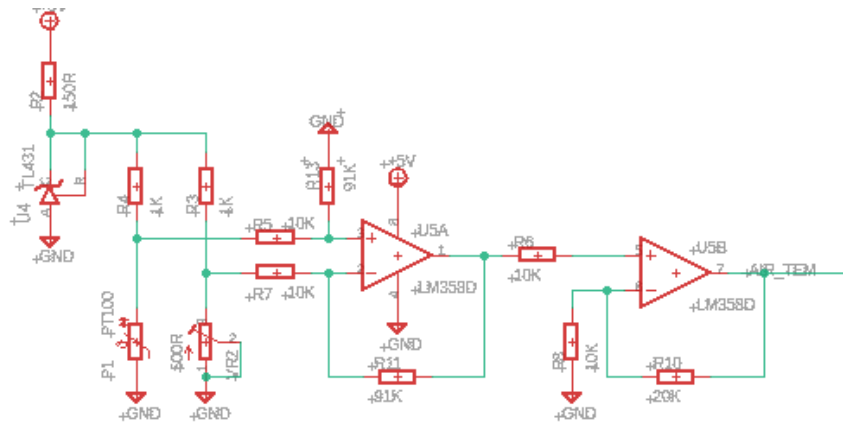


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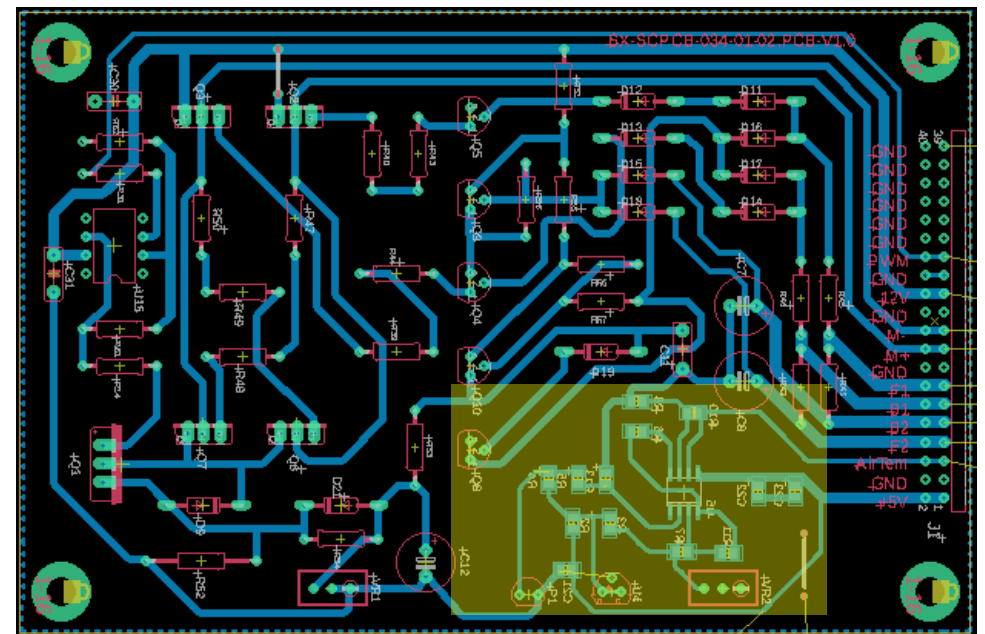
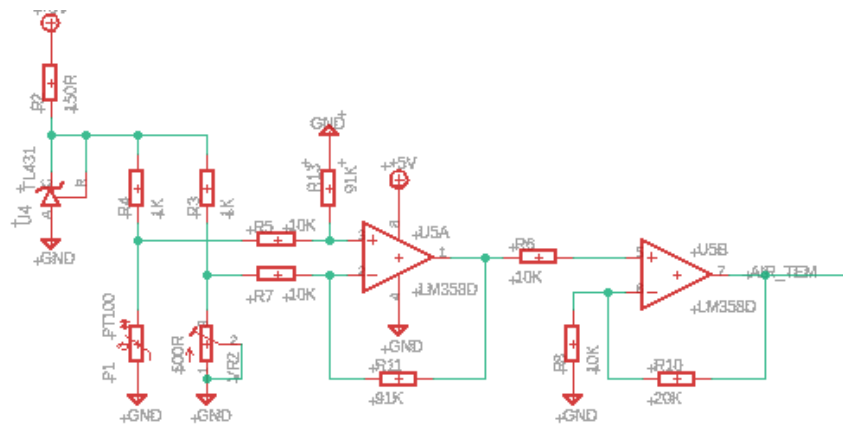
This document provides guidance for the assessment of Judgement aspects related to Prototype PCB Layout and Design. Prototype Layout and Design focuses first on ease of prototype assembly using PCB Milling Machines and does not initially involve Design For Manufacturing (DFM) issues.

ASPECT	POINTS	DESCRIPTOR	SUPPORTING PHOTO
Component Grouping and Placement	3	<p>Components are grouped together by function.</p> <p>Grouping minimizes trace length between components and functional blocks.</p>	Highlighted area shows the area(s) used by components by one group on schematic shown on left.



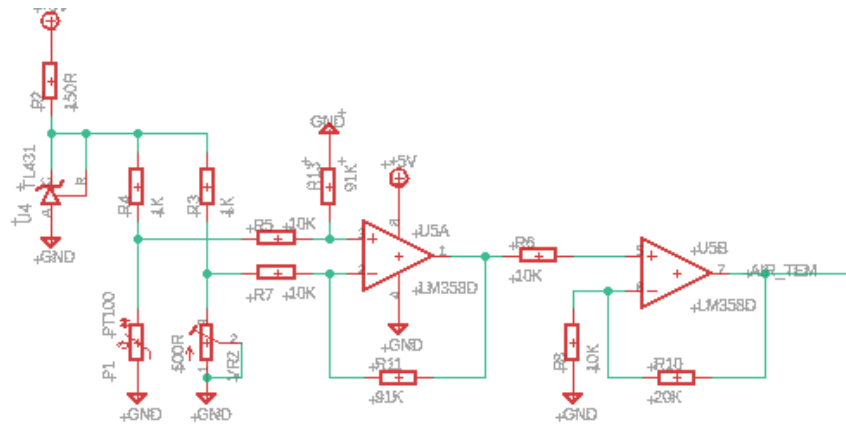


ASPECT	POINTS	DESCRIPTOR	SUPPORTING PHOTO
Component Grouping and Placement	2	<p>Most components grouped by function and optimally placed.</p> <p>Some noticeable variation in layout density.</p>	Highlighted area shows the area(s) used by components by one group on schematic shown on left.



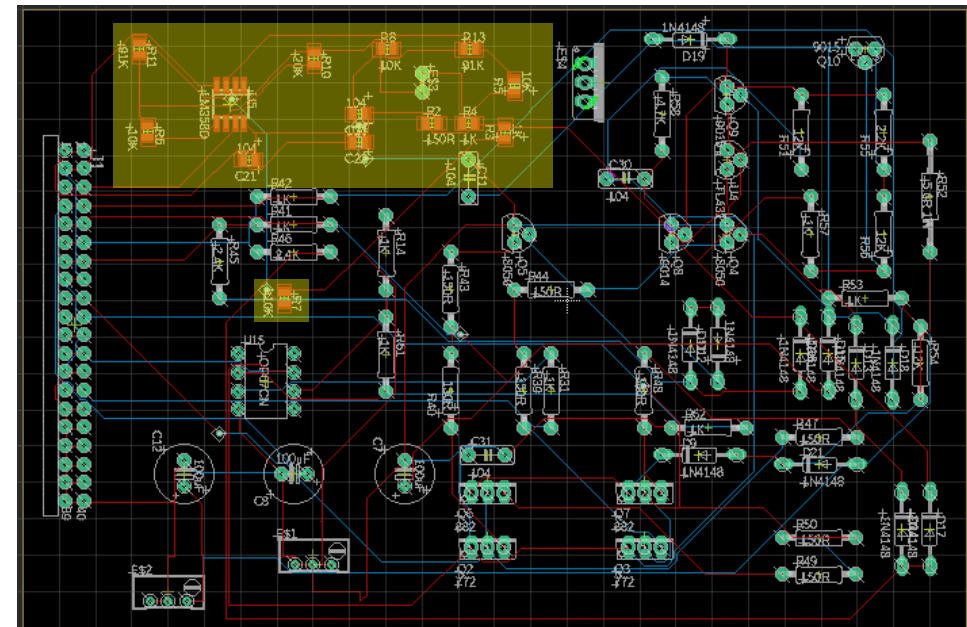
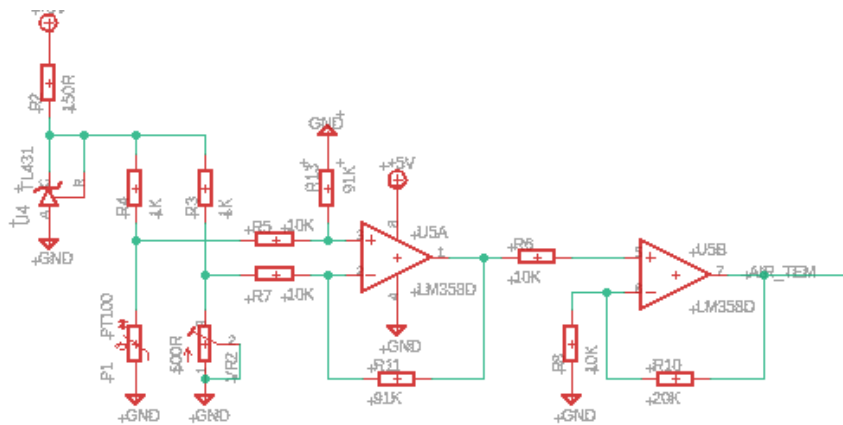


ASPECT	POINTS	DESCRIPTOR	SUPPORTING PHOTO
Component Grouping and Placement	1	<p>Some grouping by functional block</p> <p>Some components not placed to optimize conductor length.</p> <p>Wide variation in component layout density.</p>	Highlighted area shows the area(s) used by components by one group on schematic shown on left.





ASPECT	POINTS	DESCRIPTOR	SUPPORTING PHOTO
Component Grouping and Placement	0	No noticeable grouping or Pre-defined component positions are wrong.	Highlighted area shows the area(s) used by components by one group on schematic shown on left. Note mounting holes missing.





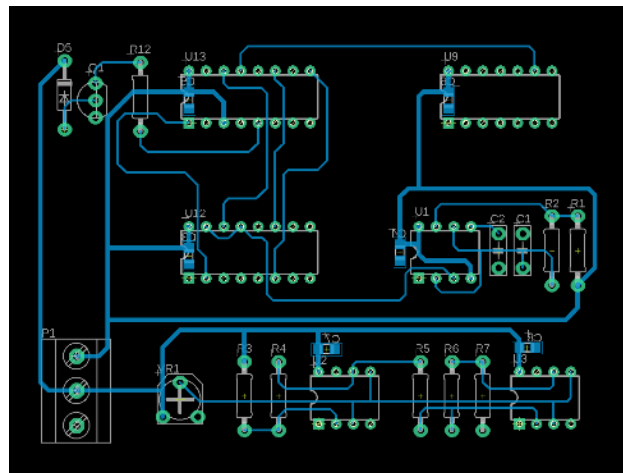
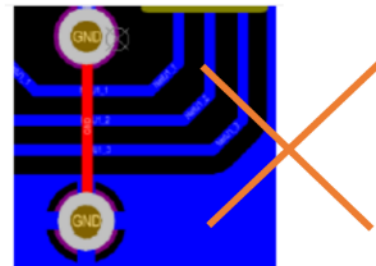
PCB LAYOUT: POWER SUPPLY ROUTING AND BYPASS CAPACITORS



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This document provides guidance for Judgement evaluation related to Power supply routing and bypass caps on PCB layout and design tasks

ASPECT	POINTS	DESCRIPTOR	SUPPORTING PHOTO
Power supply routing and bypass cap.	3	<p>Power supply and other high current traces are larger than signal traces. (The trace should at a minimum be able to handle the current through them according to IPC-2152.)</p> <p>Bypass cap has been placed in the right place.</p> <p>Jumpers to ground should be avoided if possible.</p> <p>No other problems.</p>	 



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This document provides guidance for Judgement evaluation related to Power supply routing and bypass caps on PCB layout and design tasks

ASPECT	POINTS	DESCRIPTOR	SUPPORTING PHOTO
Power supply routing and bypass cap.	2	<p>Some bypass-caps are placed too far from power pin.</p> <p>Some routing is daisy-chaining to the next component.</p>	



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This document provides guidance for Judgement evaluation related to Power supply routing and bypass caps on PCB layout and design tasks

ASPECT	POINTS	DESCRIPTOR	SUPPORTING PHOTO
Power supply routing and bypass cap.	1	<p>Many bypass-caps are placed too far from power pin.</p> <p>Many routing is daisy-chaining to the next component.</p> <p>Power is connected to a component without passing bypass-cap first.</p>	



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This document provides guidance for Judgement evaluation related to Power supply routing and bypass caps on PCB layout and design tasks

ASPECT	POINTS	DESCRIPTOR	SUPPORTING PHOTO
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<p>Power supply routing and bypass cap.</p>	<p>0</p>	<p>Wiring uses improper widths. Not used bypass-cap. Too many routing is daisy-chaining to the next component.</p>	
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PCB LAYOUT: ROUTING FOR EVERYTHING OTHER THAN POWER SUPPLY



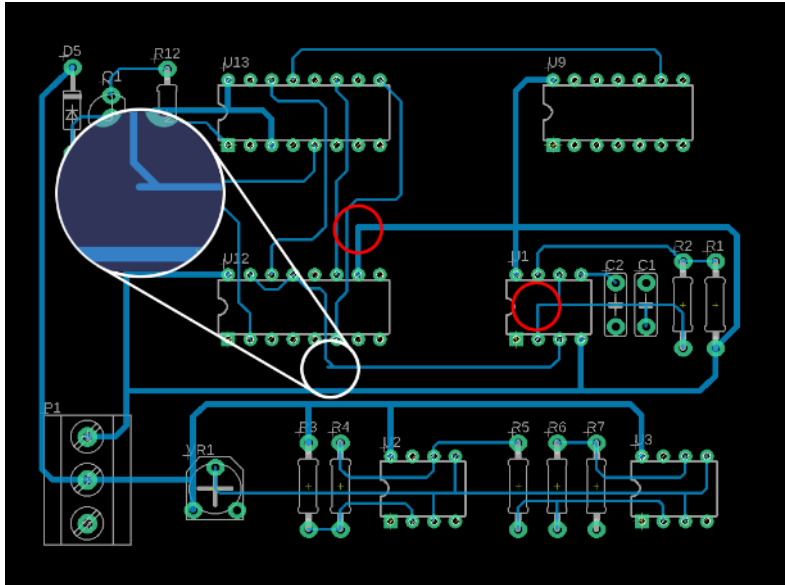
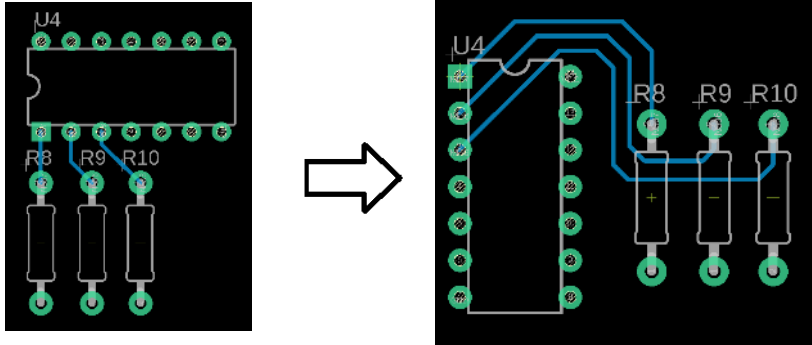
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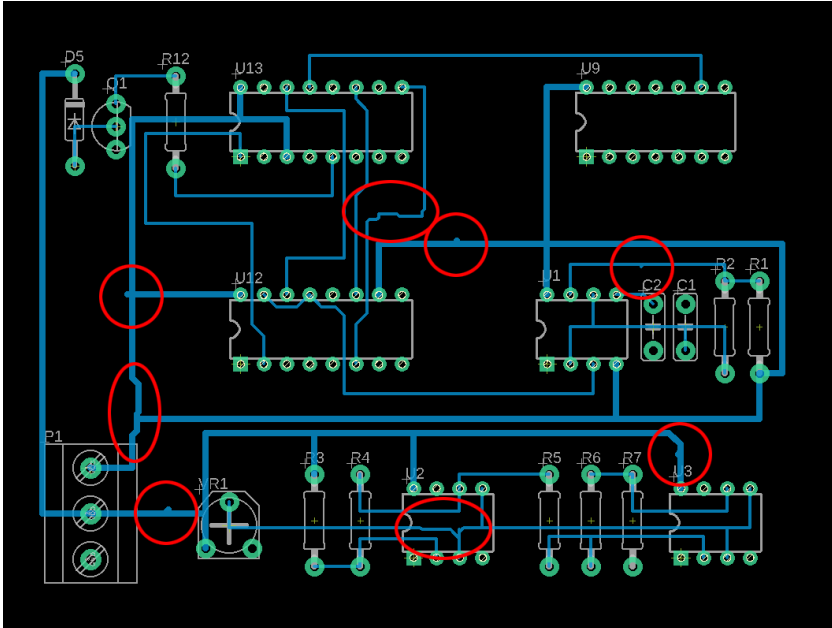
This document provides guidance for evaluating the stages of review related to PCB layout and design.

ASPECT	POINTS	DESCRIPTOR	SUPPORTING PHOTO
Routing for everything other than Power Supply.	3	<p>Traces are routed as short as possible.</p> <p>all corners are rounded or angled by 45 deg. ($L > W$)</p> <p>Jumpers are vertical or horizontal. No obvious unnecessary jumpers.</p> <p>No other problems.</p>	<p>The supporting photo contains several diagrams illustrating PCB routing standards. At the top is a complex PCB layout with various components labeled (e.g., D5, R12, J13, J10, J1, J2, J3, J4, J5, J6, J7, J8, J9, J11, J12, J13, J14, J15, J16, J17, J18, J19, J20, J21, J22, J23, J24, J25, J26, J27, J28, J29, J30, J31, J32, J33, J34, J35, J36, J37, J38, J39, J40, J41, J42, J43, J44, J45, J46, J47, J48, J49, J50, J51, J52, J53, J54, J55, J56, J57, J58, J59, J60, J61, J62, J63, J64, J65, J66, J67, J68, J69, J70, J71, J72, J73, J74, J75, J76, J77, J78, J79, J80, J81, J82, J83, J84, J85, J86, J87, J88, J89, J90, J91, J92, J93, J94, J95, J96, J97, J98, J99, J100). Below this are three corner routing examples: a 90-degree corner marked with a red 'X', a 45-degree corner marked with a green checkmark, and a rounded corner marked with a green checkmark. To the right is a diagram showing a corner with dimensions L and W, where L is the length of the lead-in and W is the width of the trace, with the condition $L > W$. At the bottom are two jumper examples: a vertical jumper marked with a green checkmark and a horizontal jumper marked with a red 'X'.</p>



ASPECT	POINTS	DESCRIPTOR	SUPPORTING PHOTO
Routing for everything other than Power Supply.	2	<p>Traces are routed a bit long.</p> <p>Some corners are sharp angled.</p> <p>There are some net antennae.</p>	 



ASPECT	POINTS	DESCRIPTOR	SUPPORTING PHOTO
Routing for everything other than Power Supply.	1	<p>A lot of unnecessary curve.</p> <p>Most corners are sharp angled.</p> <p>There are many net antennae.</p>	

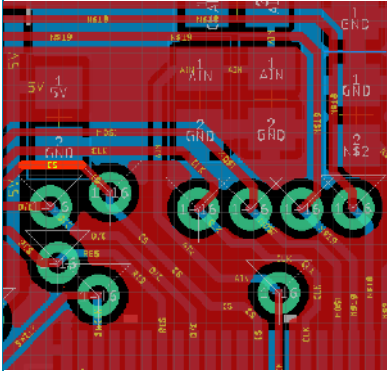
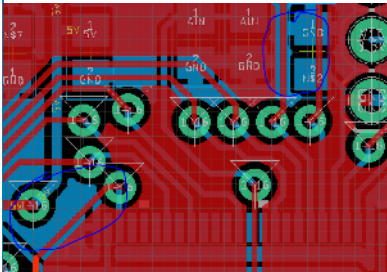


ASPECT	POINTS	DESCRIPTOR	SUPPORTING PHOTO
Routing for everything other than Power Supply.	0	There are many disconnected. Trace overlaps with trace or hole.	

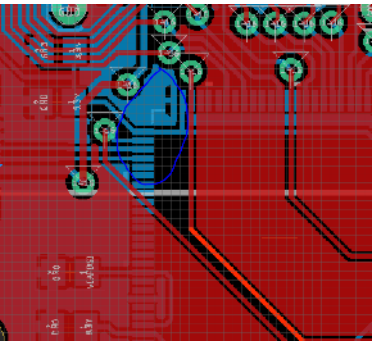
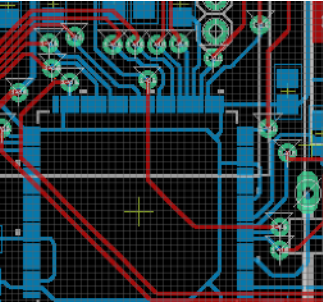
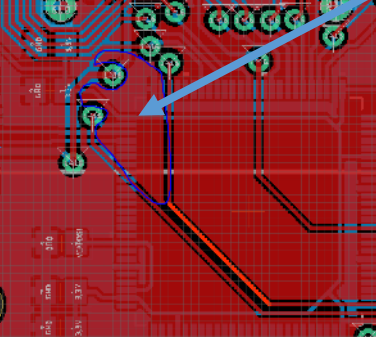
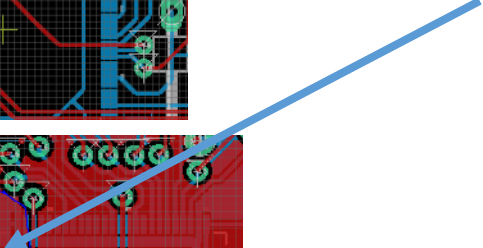


PCB LAYOUT: POLYGON ROUTING



ASPECT	POINTS	DESCRIPTOR	SUPPORTING PHOTO
Polygon Routing	3	There are no empty spaces without polygons and all polygon sections are connected to the appropriate nets	
	2	There are some little empty spaces without polygons but there are no polygon sections disconnected from the appropriate net.	



Polygon Routing	1	For the most part, there are no big empty spaces without polygons and polygon sections are connected to the appropriate nets	
	0	There are no polygons or there are many empty spaces or polygon sections not connected to the appropriate nets.	  <div data-bbox="1574 754 1906 834">Polygon not connected</div> 



PCB ASSEMBLY: THROUGH-HOLE SOLDERING - FILLETS





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This document provides guidance for the assessment aspects related to through-hole component placement and soldering

ASPECT	SCORE	DESCRIPTOR	SUPPORTING PHOTO
TH PCB soldering - Fillet	3	<ul style="list-style-type: none"> • Solder fillet appears generally smooth and exhibits good wetting of the solder to the parts being joined. • Outline of the parts is easily determined. • Solder at the part being joined creates a feathered edge. • Fillet is concave in shape. <p>Coverage is 100% of pad.</p> <p>No solder splashes, no shorts</p>	 







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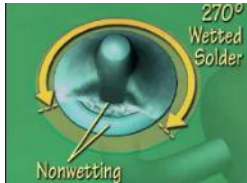


ASPECT	SCORE	DESCRIPTOR	SUPPORTING PHOTO
TH PCB soldering - fillet	2	<p>Some Blow holes, pin hole visibles</p> <p>Some Coverage of 75 – 100% of pad</p> <p>Some Small solder splashes evident but no shorts</p>	 



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ASPECT	POINTS DEDUCTED	DESCRIPTOR	SUPPORTING PHOTO
TH PCB soldering - fillet	1	<p>Many Coverage of 50% - 75% of pad</p> <p>Many Solder splashes evident but no shorts</p> <p>Some Poor wetting of joints</p>	  



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ASPECT	POINTS DEDUCTED	DESCRIPTOR	SUPPORTING PHOTO
TH PCB soldering	0	<p>Many Solder fillets do not appear smooth, good wetting of solder to the lead is not evident.</p> <p>Many joints have less than 50% pad coverage</p> <p>Solder splashes evident and shorting visible</p> <p>Cold joints present</p> <p>Insufficient wetting</p> <p>Too much solder</p> <p>Components missing</p>	



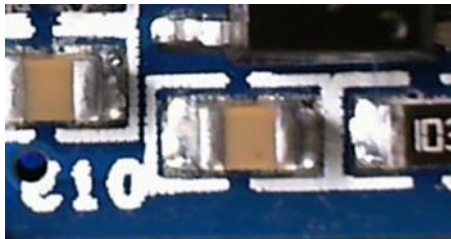



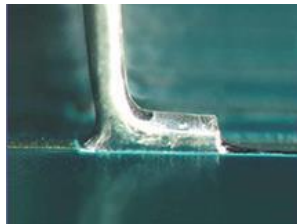
PCB ASSEMBLY: SURFACE MOUNT COMPONENT PLACEMENT AND SOLDERING



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This document provides guidance for the assessment aspects related to SMT component placement and soldering

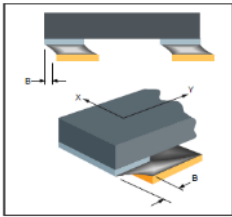
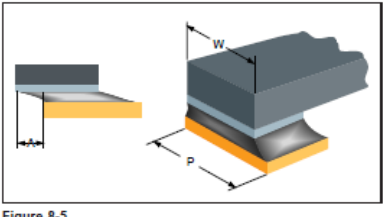

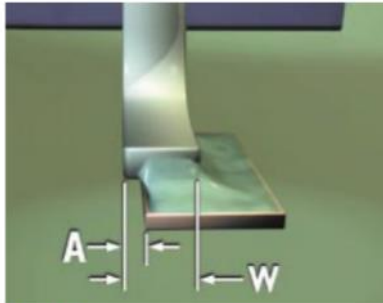
ASPECT	SCORE	DESCRIPTOR	SUPPORTING PHOTO
SMT component placement and soldering	3	<p>Component Centred on pads side to side and front to back</p> <p>Ideal amount of solder on leads</p> <p>No damage or discolouration on board</p> 	  <p>Figure 8-81</p>   <p>Figure 8-82</p>



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This document provides guidance for the assessment aspects related to SMT component placement and soldering

ASPECT	POINTS DEDUCTED	DESCRIPTOR	SUPPORTING PHOTO
SMT component placement and soldering	2	<p>Some slight Misalignment on pads front to back or side to side</p> <p>Acceptable - Class 3</p> <ul style="list-style-type: none"> Maximum overhang (A) is not greater than 25% lead width (W) or 0.5 mm [0.02 in], whichever is less. <p>Slight Misalignment on pads front to back or side to side. Side overhang (A) is less than 25% of the width (W) or 25% width of land (P)</p> <p>No End Overhang evident.</p> <div>   </div>	 



STANDARDS FOR ASSESSMENT

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This document provides guidance for the assessment aspects related to SMT component placement and soldering



ASPECT	POINTS DEDUCTED	POINTS	DESCRIPTOR	SUPPORTING PHOTO
SMT component placement and soldering	1		<p>Some Significant misalignment on pads front to back or side to side. Side overhang (A) is less than 50% of the width (W) or 50% width of land (P)</p> <p>Excessive solder but not touching other components or leads and “balling” not evident</p>	 

Figure 8-74



Side Overhang (A)

The component lead may overhang the side of the land a **maximum** of 50% of the width of the lead (W), or 0.5 mm (0.02 in.), whichever is less.

Toe Overhang (B)

The end or tip of the lead extending over the edge of the land must not violate minimum electrical clearance as a **maximum** condition.

End Joint Width (C)

The width of the solder joint at its narrowest point needs to be at least 50% the lead width (W), as a **minimum** requirement.

Side Joint Length (D)

Short Foot—If foot length (L) is less than 3 (W), then **minimum (D)** is 100% (L).
Note: Fine pitch leads—short and long foot—require (D) to be at least 0.5 mm (0.02 in.).

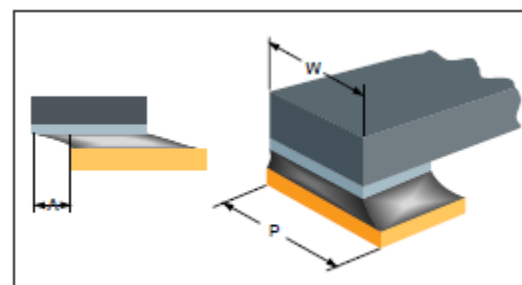


Figure 8-5



STANDARDS FOR ASSESSMENT

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This document provides guidance for the assessment aspects related to SMT component placement and soldering

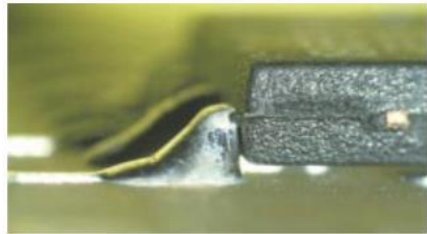
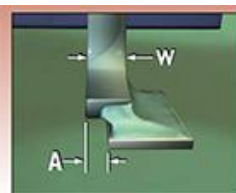
ASPECT	POINTS DEDUCTED	DESCRIPTOR	SUPPORTING PHOTO
SMT component placement and soldering	0	<p>Significant misalignment present</p> <p>Excessive soldering. “balling” evident</p> <p>Damage to PCB visible</p> <p>End Overhang evident</p> <p>Solder touching body.</p> <p>Solder touching other components or leads.</p> <p>Component missing</p>	

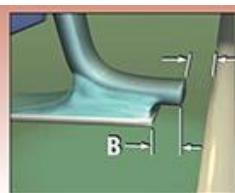


Figure 8-74



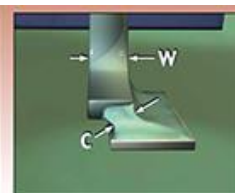
Side Overhang (A)

The component lead may overhang the side of the land a **maximum** of 50% of the width of the lead (**W**), or 0.5 mm (0.02 in.), whichever is less.



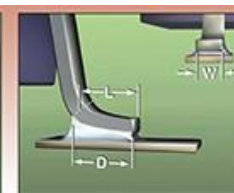
Toe Overhang (B)

The end or tip of the lead extending over the edge of the land must not violate minimum electrical clearance as a **maximum** condition.



End Joint Width (C)

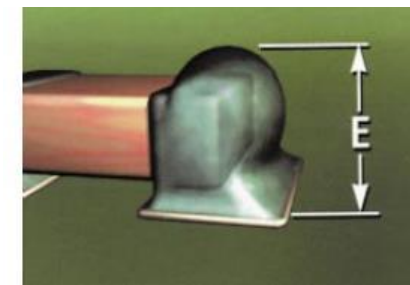
The width of the solder joint at its narrowest point needs to be at least 50% the lead width (**W**), as a **minimum** requirement.



Side Joint Length (D)

Short Foot—If foot length (**L**) is less than 3 (**W**), then **minimum (D)** is 100% (**L**).

Note: Fine pitch leads—short and long foot—require (**D**) to be at least 0.5 mm (0.02 in.).





PCB ASSEMBLY: THROUGH-HOLE COMPONENT PLACEMENT



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This document provides guidance for the assessment of aspects related to through hole component placement

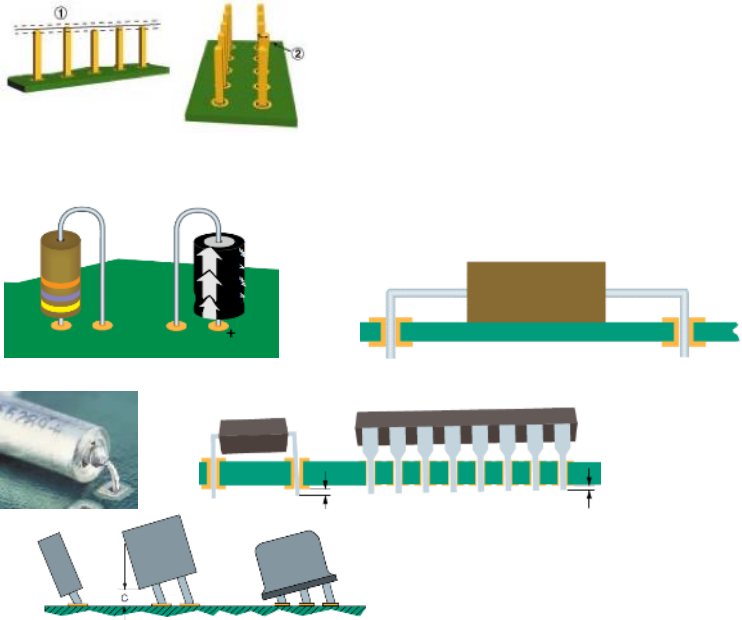
ASPECT	SCORE	DESCRIPTOR	SUPPORTING PHOTO
TH component placement	3	<p>Connector pins are straight, not twisted and properly seated. No visible damage.</p> <p>Components are centered between pads, markings are visible, non-polarized components are oriented so that all read the same way. (left to right or top to bottom.</p> <p>Polarized part is mounted with a long ground lead. Non-polarized parts read from top to bottom.</p> <p>Leads bent with minimum 1 diameter bend radius.</p> <p>Leads extend at one lead diameter but not less than 0.8mm from the body.</p> <p>All leads rest on standoff step for SIPs and DIPs</p> <p>Component is perpendicular and base is parallel to board.</p> <p>Component body is flat if designed to be in contact with board</p> <p>Connector sits flush to board</p>	<p>The supporting photo section contains several illustrations and photographs. At the top left is a schematic of a PCB with various components labeled. To its right is a photo of two electrolytic capacitors mounted on a green PCB. Below these are several diagrams showing lead bending techniques with labels for length (L), diameter (D), and radius (R). Further down are photos of a DIP component, a SIP component, and a connector being mounted on a PCB, illustrating the required orientation and placement.</p>



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This document provides guidance for the assessment of aspects related to through hole component placement

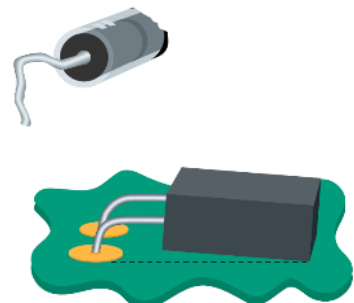
ASPECT	SCORE	DESCRIPTOR	SUPPORTING PHOTO
TH component placement	2	<p>Pins are slightly off by 50% pin thickness or less. Pin height varies no more than shown.</p> <p>Components are centered between pads, markings are visible, non-polarized components are not oriented so that all read the same way. (left to right or top to bottom.</p> <p>Polarized part is mounted with a long ground lead. Non-polarized parts read from bottom to top.</p> <p>Lead bend radius is not 1 diameter or Lead bend begins too early (<0.8mm)</p> <p>SIP or SIP tilted but lead protrude at a minimum length as shown.</p> <p>Component tilt causes space between component base and board to be between 0.3mm and 2.0mm</p>	



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This document provides guidance for the assessment of aspects related to through hole component placement

ASPECT	SCORE	DESCRIPTOR	SUPPORTING PHOTO
TH component placement	1	<p>Lead is damaged between 10% and 50% of the lead diameter or length</p> <p>Component body is not 100% in contact with the board if designed to be in contact with board</p>	



WSC2019 STANDARDS FOR ASSESSMENT

SKILL 16 ELECTRONICS

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ASPECT	SCORE	DESCRIPTOR	SUPPORTING PHOTO
TH component placement	0	<p>Polarized component is mounted backwards</p> <p>Lead is damaged more than 50% of the lead diameter</p> <p>Tilt of SIP or DIP does not allow lead protrusion.</p> <p>Connector does not sit flush on board.</p> <p>Component missing</p>	