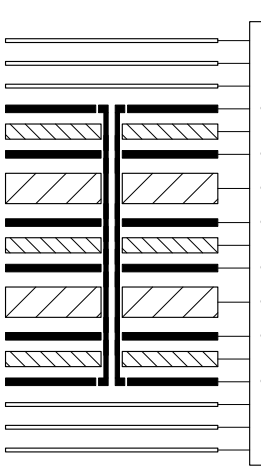
# Amulet Motion Controller Fabrication Document

## Layer Stack Legend



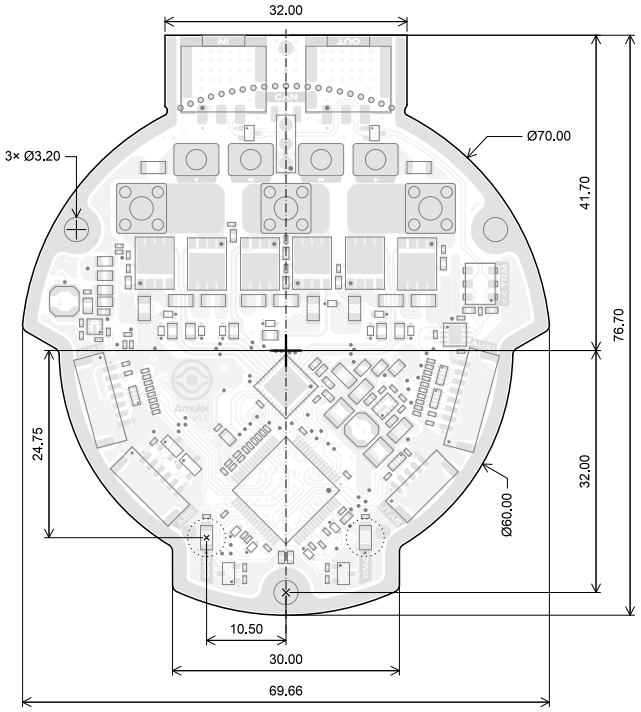
| Material | Layer | Thickness | Dielectric | Type | Gerber |
|---|---|---|---|---|---|
| | F.Paste | | | Paste Mask | |
| | F.Silkscreen | | Direct Printing | Legend | GBR |
| | F.Mask | 0.02mm | Solder Resist | Solder Mask | GBR |
| Copper | L1 (Sig, PWR) | 0.07mm (2oz) | | Signal | GBR |
| Prepreg | | 0.18mm | FR4_7628 | Dielectric | |
| Copper | L2 (GND) | 0.035mm (1oz) | | Plane | GBR |
| Core | | 0.4mm | FR4 | Dielectric | |
| Copper | L3 (Sig, PWR) | 0.035mm (1oz) | | Signal | GBR |
| Prepreg | | 0.18mm | FR4_7628 | Dielectric | |
| Copper | L4 (Sig, PWR) | 0.035mm (1oz) | | Signal | GBR |
| Core | | 0.4mm | FR4 | Dielectric | |
| Copper | L5 (GND) | 0.035mm (1oz) | | Plane | GBR |
| Prepreg | | 0.18mm | FR4_7628 | Dielectric | |
| Copper | L6 (Sig, PWR) | 0.07mm (2oz) | | Signal | GBR |
| | B.Mask | 0.02mm | Solder Resist | Solder Mask | GBR |
| | B.Silkscreen | | Direct Printing | Legend | GBR |
| | B.Paste | | | Paste Mask | |

Total thickness: 1.66mm
Note: external layer thicknesses are specified after plating

## Impedance Table

| Transmission Line | Impedance [ohms] | Tolerance [ohms] | Layer | Trace Width [mm] | Gap [mm] | Ref. Layers |
|---|---|---|---|---|---|---|
| Edge-Coupled Coated Microstrip | 100 | ±10 % | L1 | 0.2032 | 0.28 | L2 |

## Top Fabrication (Scale 1:1)




All dimensions are in millimeters unless otherwise specified.

FABRICATION NOTES (UNLESS OTHERWISE SPECIFIED)

1) FABRICATE PER IPC-6012A CLASS 2.

2) OUTLINE DEFINED IN SEPARATE GERBER FILE WITH "Edge_Cuts.GBR" SUFFIX.

   DIMENSIONS OF CIRCUMSIZED RECTANGLE SHOWN ON THIS DRAWING FOR REFERENCE ONLY.

3) SEE SEPARATE DRILL FILES WITH ".DRL" SUFFIX FOR HOLE LOCATIONS.

   SELECTED HOLE LOCATIONS SHOWN ON THIS DRAWING FOR REFERENCE ONLY.

4) SURFACE FINISH: IMMERSION GOLD

5) SOLDERMASK ON BOTH SIDES OF THE BOARD SHALL BE LPI, COLOR BLACK.

6) SILK SCREEN LEGEND TO BE APPLIED PER LAYER STACKUP USING YELLOW NON-CONDUCTIVE EPOXY INK.

7) ALL VIAS ARE TENTED ON BOTH SIDES UNLESS SOLDERMASK OPENED IN GERBER.

8) VENDOR SHOULD FOLLOW ROHS COMPLIANT PROCESS AND Pb FREE FOR MANUFACTURING

9) PCB MATERIAL REQUIREMENTS:

   A. FLAMMABILITY RATING MUST MEET OR EXCEED UL94V-0 REQUIREMENTS.
   B. Tg 170 C OR EQUIVALENT.
   C. EQUIVALENT MATERIAL SHALL BE RoHS COMPLIANT, HALOGEN FREE AND APPROVED BY EPFL XPLORE RESEARCH.

10) DESIGN GEOMETRY MINIMUM FEATURE SIZES:

| | |
|---|---|
| BOARD SIZE | 69.666 × 76.700 mm |
| BOARD THICKNESS | 1.660 mm |
| TRACE WIDTH | 0.200 mm |
| TRACE TO TRACE | 0.200 mm |
| MIN. HOLE (PTH) | 0.250 mm |
| MIN. HOLE (NPTH) | 0.700 mm |
| ANNULAR RING | 0.150 mm |
| COPPER TO HOLE | 0.254 mm |
| COPPER TO EDGE | 0.250 mm |
| HOLE TO HOLE | 0.254 mm |

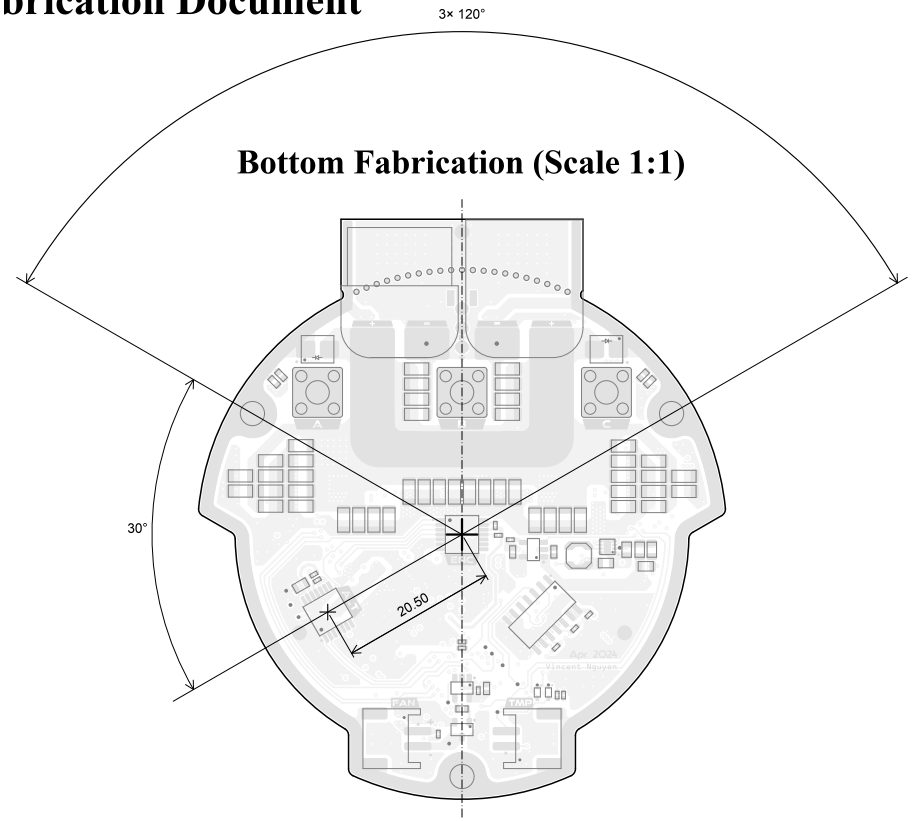
11) REFER TO IMPEDANCE TABLE FOR IMPEDANCE CONTROL REQUIREMENTS.

12) CONFIRM SPACE WIDTHS AND SPACINGS.

| | | | | |
|---|---|---|---|---|
| Comments: | Company: EPFL Xplore Research | | Variant: CHECKED | Git Hash: 84449e5 |
| | Board Name: Amulet Motion Controller | | Project Name: Chienpanzé | |
| Sheet Title: Top Fabrication (Scale 1:1) | File Name: amulet_controller.kicad_pcb | Designer: Vincent Nguyen | Date: 2024-04-13 | Revision: 1.1.1+ (Unreleased) |
| Sheet Path: | | Reviewer: | Size: A4 | Sheet: 1 of 10 |

# Amulet Motion Controller Fabrication Document

## Bottom Fabrication (Scale 1:1)

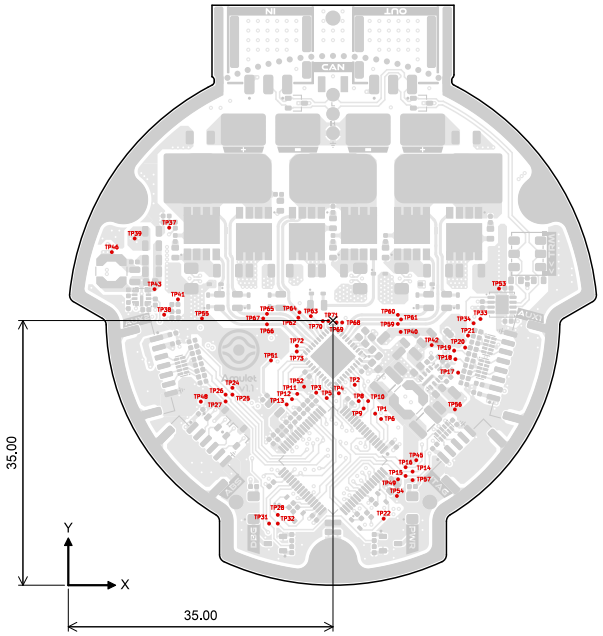



All dimensions are in millimeters unless otherwise specified.

| | | | | | |
|---|---|---|---|---|---|
| | Comments: | Company: EPFL Xplore Research | | Variant: CHECKED | Git Hash: 84449e5 |
| | | Board Name: **Amulet Motion Controller** | | Project Name: **Chienpanzé** | |
| | Sheet Title: Bottom Fabrication (Scale 1:1) | File Name: amulet_controller.kicad_pcb | Designer: Vincent Nguyen | Date: 2024-04-13 | Revision: 1.1.1+ (Unreleased) |
| | Sheet Path: | | Reviewer: | Size: **A4** | Sheet: **2** of **10** |

# Amulet Motion Controller Fabrication Document

## Top Test Points (Scale 1:1)




| Ref. | Net | X [mm] | Y [mm] |
|---|---|---|---|
| TP1 | MOTOR_ENABLE | 40.58 | 22.69 |
| TP2 | MOTOR_HIZ | 37.88 | 26.50 |
| TP3 | MOTOR_FAULT | 32.78 | 25.46 |
| TP4 | DRV_SCLK | 35.77 | 25.38 |
| TP5 | DRV_MISO | 34.17 | 24.75 |
| TP6 | DRV_MOSI | 41.36 | 21.98 |
| TP8 | PWM_PHASEA | 38.40 | 24.35 |
| TP9 | PWM_PHASEB | 39.05 | 23.37 |
| TP10 | PWM_PHASEC | 39.65 | 24.35 |
| TP11 | SOA | 30.28 | 25.30 |
| TP12 | SOB | 29.58 | 24.60 |
| TP13 | SOC | 28.88 | 23.90 |
| TP14 | SWDIO | 45.53 | 15.02 |
| TP15 | SWCLK | 44.60 | 14.45 |
| TP16 | NRST | 44.60 | 15.60 |
| TP17 | AUX1_A | 51.55 | 28.11 |
| TP18 | AUX1_B | 51.19 | 29.89 |
| TP19 | AUX1_C | 51.02 | 31.02 |
| TP20 | AUX1_D | 52.47 | 31.42 |
| TP21 | AUX1_E | 52.86 | 33.02 |
| TP22 | AUX1_I2C_PULLUP | 41.70 | 8.80 |
| TP24 | AUX2_A | 21.70 | 26.10 |
| TP25 | AUX2_B | 21.70 | 25.20 |
| TP26 | AUX2_C | 20.80 | 25.20 |
| TP27 | AUX2_D | 20.80 | 24.30 |
| TP28 | AUX2_I2C_PULLUP | 27.70 | 9.30 |
| TP31 | LED_DBG | 26.55 | 8.15 |
| TP32 | LED_PWR | 27.70 | 8.15 |
| TP33 | FDCAN_RX | 54.50 | 35.20 |
| TP34 | FDCAN_TX | 53.59 | 34.64 |
| TP37 | SENSE_TEMP_FET | 13.34 | 47.28 |
| TP38 | SENSE_VBAT | 12.67 | 35.77 |

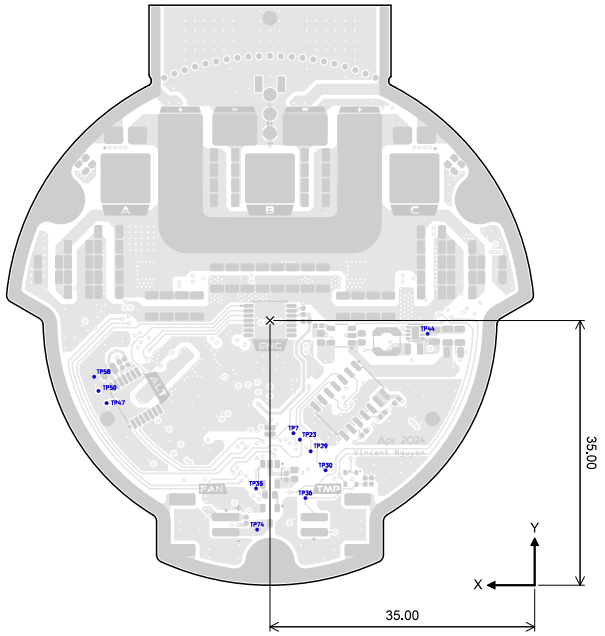
| Ref. | Net | X [mm] | Y [mm] |
|---|---|---|---|
| TP39 | +VBAT | 8.78 | 45.85 |
| TP40 | +VBAT | 43.95 | 33.50 |
| TP41 | +VBAT | 14.50 | 37.80 |
| TP42 | F_VIN_12V | 48.05 | 31.75 |
| TP43 | F_VIN_5V | 11.40 | 39.15 |
| TP45 | +12V | 46.01 | 16.53 |
| TP46 | +5V | 5.75 | 44.05 |
| TP48 | +3V3 | 17.52 | 24.28 |
| TP49 | +3V3 | 43.60 | 14.00 |
| TP51 | +A3V3 | 26.80 | 29.72 |
| TP52 | GND | 31.17 | 26.25 |
| TP53 | GND | 56.95 | 39.22 |
| TP54 | GND | 43.45 | 11.80 |
| TP55 | GND | 17.68 | 35.27 |
| TP56 | GND | 51.12 | 23.25 |
| TP57 | GND | 45.53 | 13.90 |
| TP59 | GHA | 43.58 | 34.55 |
| TP60 | GLA | 43.58 | 35.75 |
| TP61 | SHA | 44.00 | 35.15 |
| TP62 | GHB | 30.42 | 35.38 |
| TP63 | GLB | 32.07 | 35.58 |
| TP64 | SHB | 30.57 | 36.08 |
| TP65 | GHC | 26.27 | 35.88 |
| TP66 | GLC | 26.27 | 34.50 |
| TP67 | SHC | 25.77 | 35.27 |
| TP68 | SA_P | 36.22 | 34.74 |
| TP69 | SA_N | 35.47 | 34.74 |
| TP70 | SB_P | 33.65 | 34.93 |
| TP71 | SB_N | 34.40 | 34.93 |
| TP72 | SC_P | 30.21 | 31.65 |
| TP73 | SC_N | 30.21 | 30.90 |

All dimensions are in millimeters unless otherwise specified.

| | | | | |
|---|---|---|---|---|
| | Comments: | Company: EPFL Xplore Research | Variant: CHECKED | Git Hash: 84449e5 |
| | | Board Name: Amulet Motion Controller | Project Name: Chienpanzé | |
| | Sheet Title: Top Test Points (Scale 1:1) | File Name: amulet_controller.kicad_pcb | Designer: Vincent Nguyen | Date: 2024-04-13 / Revision: 1.1.1+ (Unreleased) |
| | Sheet Path: | | Reviewer: | Size: A4 / Sheet: 3 of 10 |

# Amulet Motion Controller Fabrication Document

## Bottom Test Points (Scale 1:1)




| Ref. | Net | X [mm] | Y [mm] |
|---|---|---|---|
| TP7 | DRV_CS | 31.90 | 20.10 |
| TP23 | POS_SENSOR_CS | 31.05 | 19.25 |
| TP29 | RS422_RE | 29.63 | 17.71 |
| TP30 | RS422_DE | 27.65 | 15.20 |
| TP35 | FAN_CTRL | 36.84 | 12.79 |
| TP36 | SENSE_TEMP_MOT | 30.31 | 11.52 |
| TP44 | F_VIN_3V3 | 14.15 | 33.25 |
| TP47 | +5V | 56.61 | 24.08 |
| TP50 | +3V3 | 57.68 | 25.69 |
| TP58 | GND | 58.25 | 27.56 |
| TP74 | FAN_SW | 36.70 | 7.35 |

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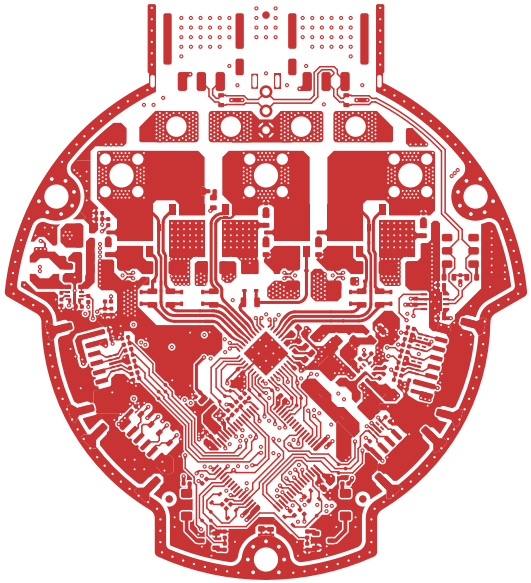
| | | | | |
|---|---|---|---|---|
| | Comments: | Company: EPFL Xplore Research | Variant: CHECKED | Git Hash: 84449e5 |
| | | Board Name: Amulet Motion Controller | Project Name: Chienpanzé | |
| | Sheet Title: Bottom Test Points (Scale 1:1) | File Name: amulet_controller.kicad_pcb | Designer: Vincent Nguyen | Date: 2024-04-13 / Revision: 1.1.1+ (Unreleased) |
| | Sheet Path: | | Reviewer: | Size: A4 / Sheet: 4 of 10 |

# Amulet Motion Controller Fabrication Document

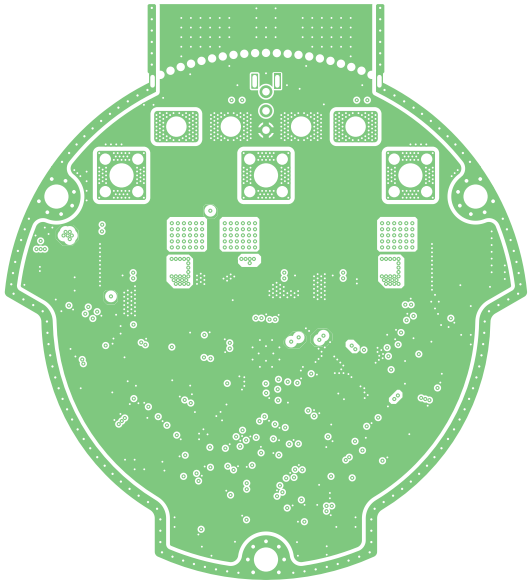
## L1 (Sig, PWR) (Scale 1:1)



| | | | | |
|---|---|---|---|---|
| Comments: | Company: EPFL Xplore Research | | Variant: CHECKED | Git Hash: 84449e5 |
| | Board Name: Amulet Motion Controller | | Project Name: Chienpanzé | |
| Sheet Title: L1 (Sig, PWR) (Scale 1:1) | File Name: amulet_controller.kicad_pcb | Designer: Vincent Nguyen | Date: 2024-04-13 | Revision: 1.1.1+ (Unreleased) |
| Sheet Path: | | Reviewer: | Size: A4 | Sheet: 5 of 10 |

# Amulet Motion Controller Fabrication Document

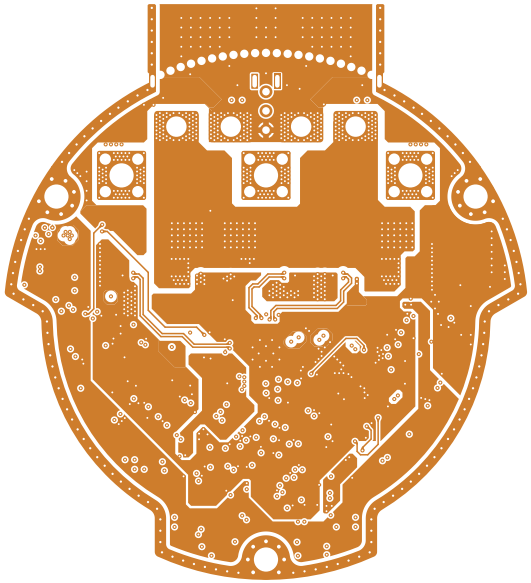
## L2 (GND) (Scale 1:1)



| | | | | | |
|---|---|---|---|---|---|
| | Comments: | Company: EPFL Xplore Research | | Variant: CHECKED | Git Hash: 84449e5 |
| | | Board Name: Amulet Motion Controller | | Project Name: Chienpanzé | |
| | Sheet Title: L2 (GND) (Scale 1:1) | File Name: amulet_controller.kicad_pcb | Designer: Vincent Nguyen | Date: 2024-04-13 | Revision: 1.1.1+ (Unreleased) |
| | Sheet Path: | | Reviewer: | Size: A4 | Sheet: 6 of 10 |

# Amulet Motion Controller Fabrication Document

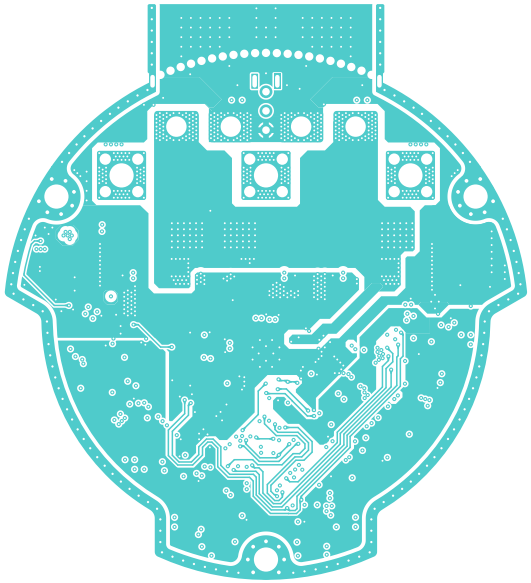
## L3 (Sig, PWR) (Scale 1:1)



| | | | | | |
|---|---|---|---|---|---|
| | Comments: | Company: EPFL Xplore Research | | Variant: CHECKED | Git Hash: 84449e5 |
| | | Board Name: **Amulet Motion Controller** | | Project Name: **Chienpanzé** | |
| | Sheet Title: L3 (Sig, PWR) (Scale 1:1) | File Name: amulet_controller.kicad_pcb | Designer: Vincent Nguyen | Date: 2024-04-13 | Revision: 1.1.1+ (Unreleased) |
| | Sheet Path: | | Reviewer: | Size: **A4** | Sheet: **7** of **10** |

# Amulet Motion Controller Fabrication Document

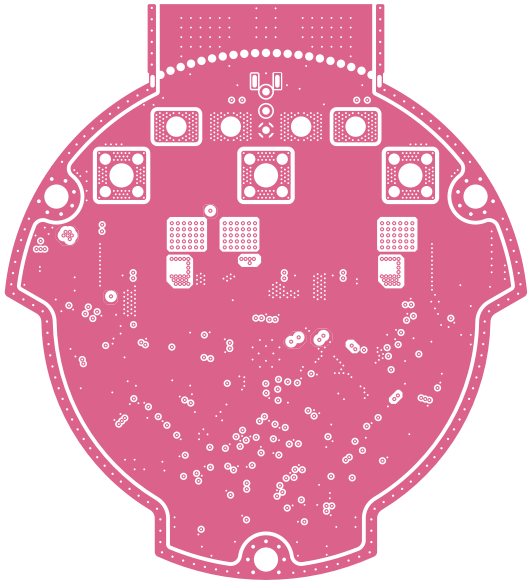
## L4 (Sig, PWR) (Scale 1:1)



| | | | | |
|---|---|---|---|---|
| Comments: | Company: EPFL Xplore Research | | Variant: CHECKED | Git Hash: 84449e5 |
| | Board Name: Amulet Motion Controller | | Project Name: Chienpanzé | |
| Sheet Title: L4 (Sig, PWR) (Scale 1:1) | File Name: amulet_controller.kicad_pcb | Designer: Vincent Nguyen | Date: 2024-04-13 | Revision: 1.1.1+ (Unreleased) |
| Sheet Path: | | Reviewer: | Size: A4 | Sheet: 8 of 10 |

# Amulet Motion Controller Fabrication Document

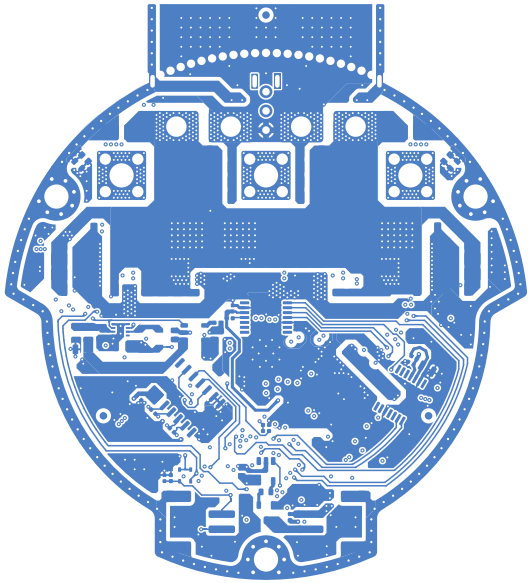
## L5 (GND) (Scale 1:1)



| | | | | | |
|---|---|---|---|---|---|
| | Comments: | Company: EPFL Xplore Research | | Variant: CHECKED | Git Hash: 84449e5 |
| | | Board Name: Amulet Motion Controller | | Project Name: Chienpanzé | |
| | Sheet Title: L5 (GND) (Scale 1:1) | File Name: amulet_controller.kicad_pcb | Designer: Vincent Nguyen | Date: 2024-04-13 | Revision: 1.1.1+ (Unreleased) |
| | Sheet Path: | | Reviewer: | Size: A4 | Sheet: 9 of 10 |

# Amulet Motion Controller Fabrication Document

## L6 (Sig, PWR) (Scale 1:1)



| | | | | | |
|---|---|---|---|---|---|
| | Comments: | Company: EPFL Xplore Research | | Variant: CHECKED | Git Hash: 84449e5 |
| | | Board Name: Amulet Motion Controller | | Project Name: Chienpanzé | |
| | Sheet Title: L6 (Sig, PWR) (Scale 1:1) | File Name: amulet_controller.kicad_pcb | Designer: Vincent Nguyen | Date: 2024-04-13 | Revision: 1.1.1+ (Unreleased) |
| | Sheet Path: | | Reviewer: | Size: A4 | Sheet: 10 of 10 |