Layout Implementation guide for SMA Camera Actuators

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Thermistor

Advice for correct placement and layout of the thermistor:

- It must be placed close to the screening can, or inside the actuator. Ideally close to the actuator pins.

- It must not be covered by adhesive or other materials that might insulate it.

- It cannot be placed close to any electronics that might increase its temperature such as the driver IC. The minimum distance between thermistor and drive IC should be 5mm
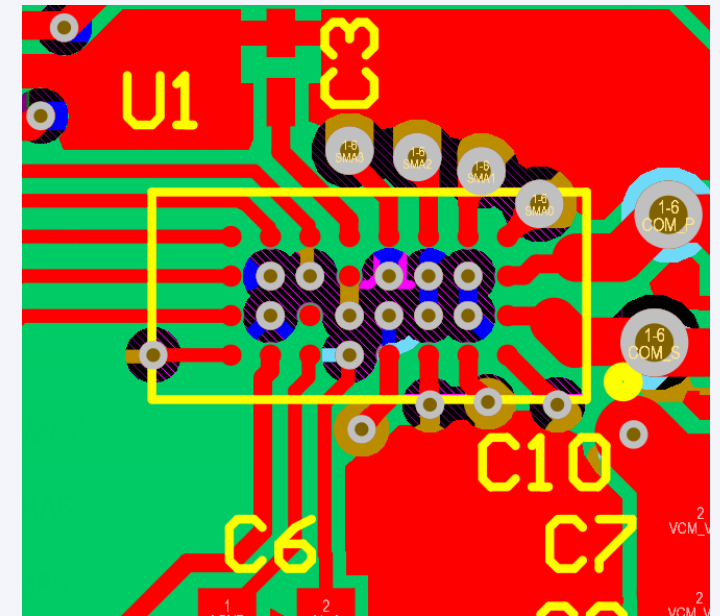
SMA Track Recommendations - 1

- Care needs to be taken to ensure the PWM power switching traces are kept away from sensitive analog traces to avoid unwanted interference

- EMC noise can be caused by a range of mechanisms, the following design rules should be followed to mitigate these effects:

  - Avoid routing the SMA power traces close to the image sensor, or any sensitive analogue power traces used by the image sensor.

  - Any electromagnetic emissions from the SMA drive traces must be minimised, by eliminating current loops in the power delivery path – See the example trace arrangements on the next slides.

  - The PCB must be robust to any electromagnetic emissions from the SMA actuator. Upper and lower layers of the PCB must be flooded, as much as is possible, with DGND to shield the image sensor from the actuator drive

SMA Track Recommendations - 2

The layout priorities for the board are:

- The resistance of VM, and its return path, is very important, because it affects the resistance measurement and power delivery
  - The trace between the camera connector and the controller IC must be < 0.1 Ohms.
  - Minimal inductance around VM → COM → actuator → OUTx → PGND loop to aid quick settling time for resistance measurement.
    - Reducing the loop size by putting tracks on adjacent layers will help to minimise inductance.
  - Minimal inductance between the actuator and decoupling capacitors, to reduce high frequency conducted noise.
  - The traces OUT0~OUTn and COM must be kept as short as possible and must be wide enough to carry the average current for the design.
  - Keep these traces as far as possible from the image sensor. Particularly the image sensor analog power and ground - use a DGND guard track as separation.
  - It is recommended that OUTn and COM traces are routed on two different (internal) layers, kept as close as possible, and surrounded by DGND.

SMA Track Recommendations – 3

- 8-wire example, where the actuator connections are on opposite sides of the actuator.

- Routing a 4-wire actuator follows the same principles as the 8-wire design.

- DGND does not need to be between SMA tracks.

- For example: –

Layer 1:	DGND				
Layer 2:	DGND	OUT0	OUT1	OUT2	OUT3	DGND
Layer 3:	DGND	COM1			DGND
Layer 4:	DGND				

Layer 1:	DGND				
Layer 2:	DGND	OUT4	OUT5	OUT6	OUT7	DGND
Layer 3:	DGND	COM2			DGND
Layer 4:	DGND				

OUTn pin allocation depends on the actuator pin configuration.

Some applications require COM1 and COM2 are connected to each other which can be done close to the driver IC.


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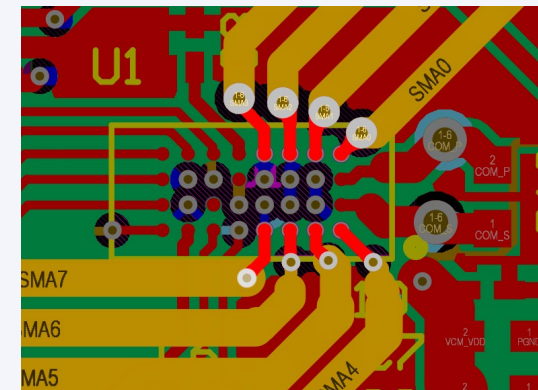
Gyro layout advice

- Tracks from the gyro should be straight out for 0.8mm before turning or joining a plane

- Tracks out from gyro should all be equal width

  (Some gyros require thick tracks and good ground connections as well)

- No copper or solder resist below the gyro or within the 0.8mm exclusion area around the gyro

- No vias placed below the gyro or within the 0.8mm exclusion area around the gyro

Please contact the gyro manufacturer for the latest information on layout guidelines!
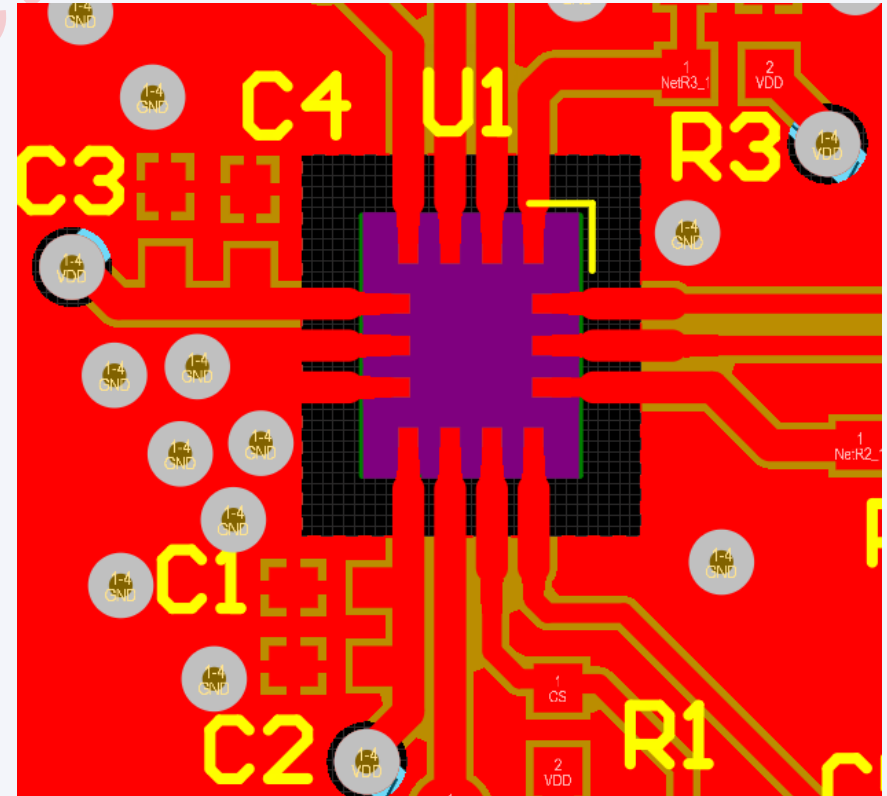
MCLK Routing

- MCLK should be routed as one continual track between the connector, image sensor and SMA driver
- Forks should be avoided as this creates a risk of clock reflections

Fork – NG

No Fork – OK
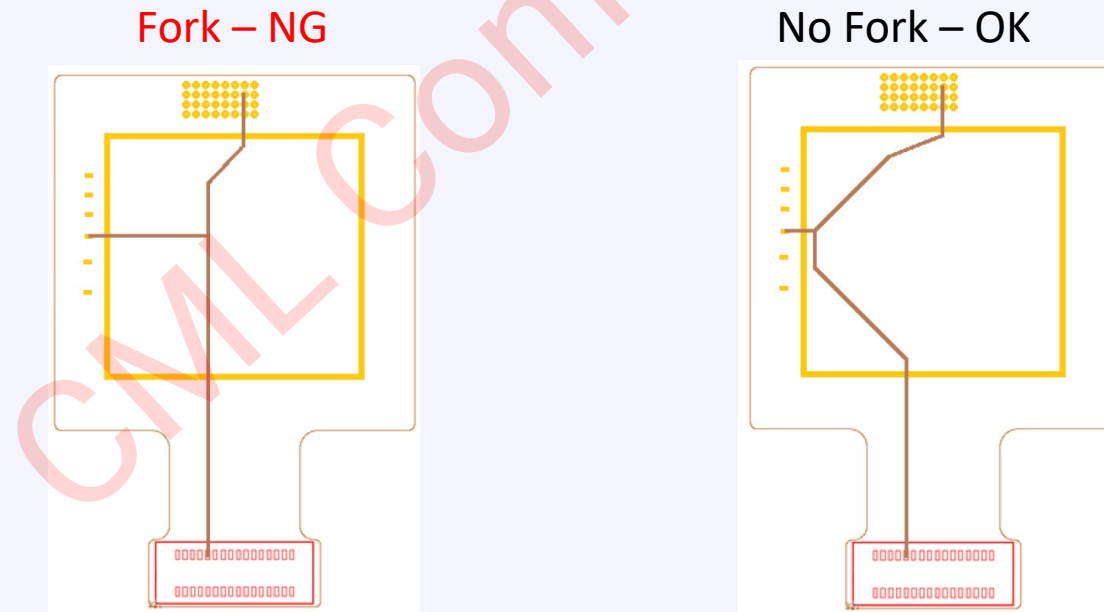
Camera Rating Guide

CML Camera Rating[1]	MCLK Routing	Minimum DGND Guard track width	Maximum SMA OUT & COM Track Resistance[2]	Maximum SMA Track Variation	SMA Routing Layers	Maximum VM and VM GND Track Resistance
10	MCLK routing contains no forks	0.25mm	60mΩ	15mΩ	Completely routed on inner layers	60mΩ
9		0.2mm	80mΩ	20mΩ		80mΩ
8		0.15mm	100mΩ	30mΩ		90mΩ
7		0.1mm	120mΩ	35mΩ	Some top or bottom layer routing	100mΩ
6		0.05mm	140mΩ	40mΩ		110mΩ
5	MCLK routing contains fork	0.02mm	150mΩ	45mΩ	Significant top or bottom layer routing	120mΩ
< 4		< 0.02mm	> 150mΩ	> 50mΩ		> 120mΩ

1) Higher rating indicates expected higher performance. Lower rating indicates higher risk.
2) SMA resistance guide is for 8 wire actuators, 4 wire actuators expect much lower resistances

Document revision history

Revision	Date	Author	Comments
1.0	30/08/2023	J Carter	Initial release
2.0	29/09/2023	D McMillan	Added camera rating table
3.0	12/03/2024	D McMillan	Updated gyro implementation requirements