

SENtral™ M&M

Motion-Tracking & Measurement Modules

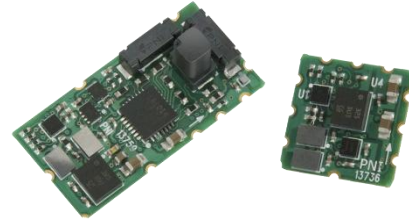
General Description

PNI's SENtral M&M motion-tracking and measurement modules provide highly accurate heading and orientation data, in a small, low-power-consumption, and easy-to-integrate package. A module incorporates the SENtral motion coprocessor, a magnetometer, an accelerometer, and a gyroscope, with different SENtral M&M versions comprising different model sensors.

Unlike other inertial measurement units (IMUs) requiring unexpected and extensive sensor fusion algorithm development and sensor calibration work, the SENtral M&M modules are pre-engineered to provide the highest accuracy motion tracking and heading measurement. And this is obtained at a fraction of the power consumption of any other solution on the market.

The SENtral M&M comes ready to integrate into a user's system. Designed with SMT bonding in mind, the pins are on an industry-standard 3 mm pitch. The on-board EEPROM contains SENtral's configuration file and this automatically uploads into SENtral RAM when powered up. Communication is via I²C protocol.

With the SENtral M&M modules you can quickly and easily incorporate industry-leading motion-tracking and orientation measurement in your mobile device. We're sure you'll be impressed.



Features

- All-in-one motion & orientation tracking module, incorporates the SENtral motion coprocessor, 3-axis gyroscope, 3-axis accelerometer, and 3-axis magnetometer.
- Low power consumption.
- 11x11 mm footprint and SMT design for ease of integration into a user's system
- Multiple test points for debugging and evaluating performance.
- Multiple versions with different sensors.

Applications

- Personal Navigation & LBS
- Gaming & Augmented Reality
- Movement Science & Fitness

Ordering Information

Item	Sensors	Part #
M&M White	none (Sentral only)	13734
M&M Orange	BMI055+AK8963	13771
M&M Red	MPU6500+AK8963	13763
M&M Green	LSM330+AK8963	13736
M&M Yellow	LSM9SD0	13738
M&M Blue	LSM330+RM3100	13759

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1. Electrical Characteristics

Table 1-1: Absolute Maximum Ratings

Parameter	Symbol	Minimum	Maximum	Units
Supply Voltage	V_{DD}	-0.3	+3.6	VDC
Input Pin Voltage	V_{IN}	GND - 0.3	$V_{DD} + 0.3$	VDC
Storage Temperature		-50°	+150°	C

CAUTION:

Exceeding the minimum or maximum limits listed above may cause permanent and irreversible damage to the device.

Table 1-2: Operating Conditions

Parameter	Symbol	Min	Typ	Max	Units
Supply Voltage – SENtral	DVDD	1.6		3.3	VDC
Digital Supply Voltage – Sensors & EEPROM	DVDD2	1.71		AVDD	VDC
Analog Supply Voltage – Sensors	AVDD	2.4		3.6	VDC
Power-On Reset Threshold	V_{POR}		1.0		VDC
High Level Input Voltage	V_{IH}	$0.7 \cdot V_{DD}$		V_{DD}	VDC
Low Level Input Voltage	V_{IL}	0		$0.3 \cdot V_{DD}$	VDC
High Level Output Current, $V_{OH} = V_{DD} - 0.3V$	I_{OH}			-1	mA
Low Level Output Current, $V_{OL} = 0.3V$	I_{OL}	1			mA
I ² C Interface Data Rate ¹	Host Bus			3400	kbits/sec
	Sensor Bus			1000	kbits/sec
	Pass-Through			400	kbits/sec
Operating Temperature	T_{OP}	-40	+25	+85	C

Footnote:

1. SENtral's I²C Host Interface supports Standard, Fast, Fast Plus, and High Speed Modes. High Speed Mode (3400 kHz) is supported with a reduced range of V_{DD} and bus capacitance. SENtral's I²C sensor bus interface supports Standard, Fast, and Fast Plus Modes. Pass-Through state, which connects the sensor bus and host bus, supports Standard and Fast Modes.

Table 1-3: SENtral M&M Module Pin Assignments

Pin Name	Description	White Pin #	Orange, Red, Green, & Yellow Pin#	Blue Pin #
DVDD	Supply Voltage – SENtral	D1	1	2
DVDD2	Digital Supply Voltage – Sensors & EEPROM	NA	2	2
AVDD	Analog Supply Voltage – Sensors	NA	7	7
GND	Ground	D2	8	8
SCLS	I ² C host bus SCL clock line	B1	3	3
SDAS	I ² C host bus SDA data line	A1	5	5
SDAM	I ² C sensor bus SDA data line	A4	9	9
SCLM	I ² C sensor bus SCL clock line	B4	10	10
GPIO[0]	General Purpose IO – Default SENtral Accelerometer Interrupt	D4	NA	NA
GPIO[1]	General Purpose IO – Default SENtral Magnetometer Interrupt	C4	NA	NA
GPIO[2]	General Purpose IO – Default SENtral Gyroscope Interrupt	A3	NA	NA
GPIO[3]	General Purpose IO – Default not used	B3	NA	NA
GPIO[4]	General Purpose IO – Default not used	A2	6	6
GPIO[5]	General Purpose IO – Default not used	B2	NA	NA
GPIO[6]	General Purpose IO – Default Host Event Interrupt	C1	4	4
SA0	Slave Address Pin 0	C3	NA	NA
VCAP	Regulator Capacitor	D3	NA	NA
Reserved	Reserved (not connected)	C2	NA	1, 12, 13
Test Point 1	Test Point – DVDD	NA	TP1	TP1
Test Point 2	Test Point – SDAS	NA	TP2	TP2
Test Point 3	Test Point – SCLS	NA	TP3	TP3
Test Point 4	Test Point – GND	NA	TP4	TP4
Test Point 5	Test Point – MagI2C Comparator	NA	NA	TP5

2. Package Information

Dimensions in [inches]
mm

PIN	FUNC
A1	SDAS
A2	GPIO4
A3	GP1O2
A4	SDAM
B1	SCLS
B2	GPIO5
B3	GPIO3
B4	SCLM
C1	GPIO6
C2	RES
C3	SA0
C4	GPIO1
D1	DVDD
D2	GND
D3	VCAP
D4	GPIO0

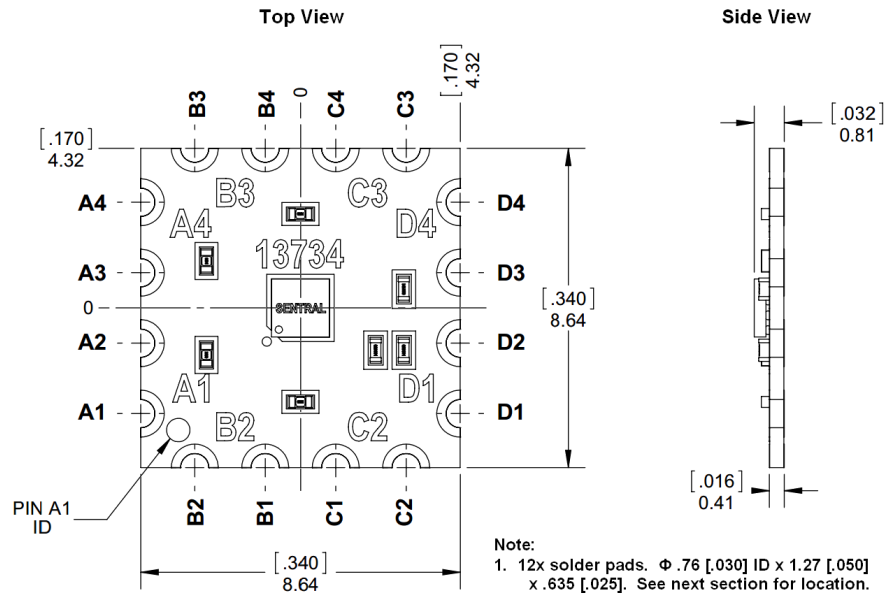


Figure 2-1: SENtral M&M White Mechanical Drawing

Dimensions in [inches]
mm

PIN	FUNC
1	DVDD
2	DVDD2
3	SCLS
4	GPIO6
5	SDAS
6	GPIO4
7	AVDD
8	GND
9	SDAM
10	SCLM
TP1	DVDD
TP2	SDAS
TP3	SCLS
TP4	GND

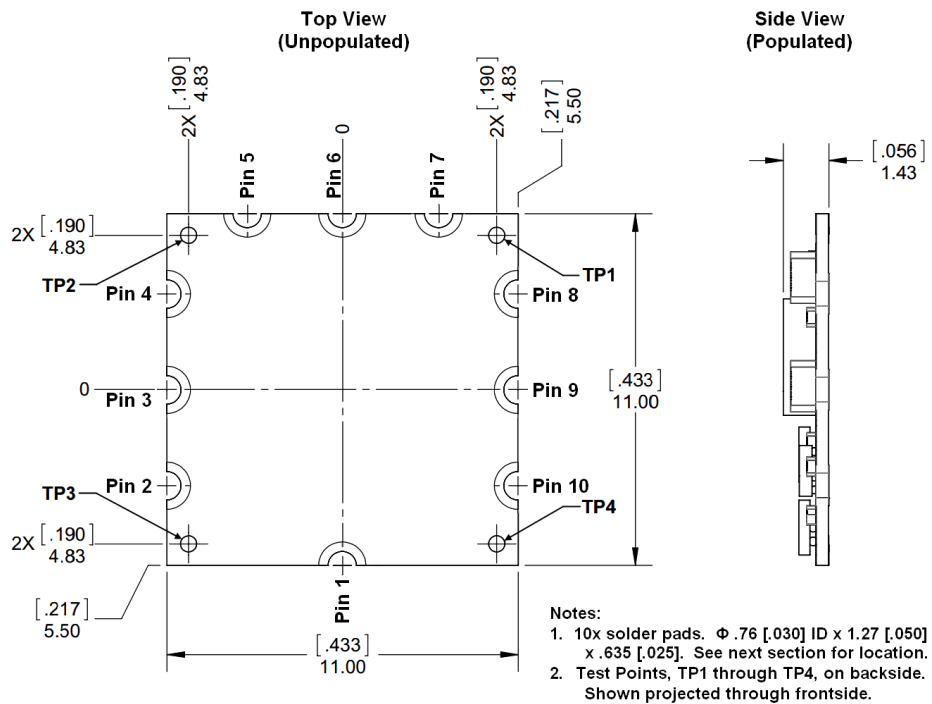
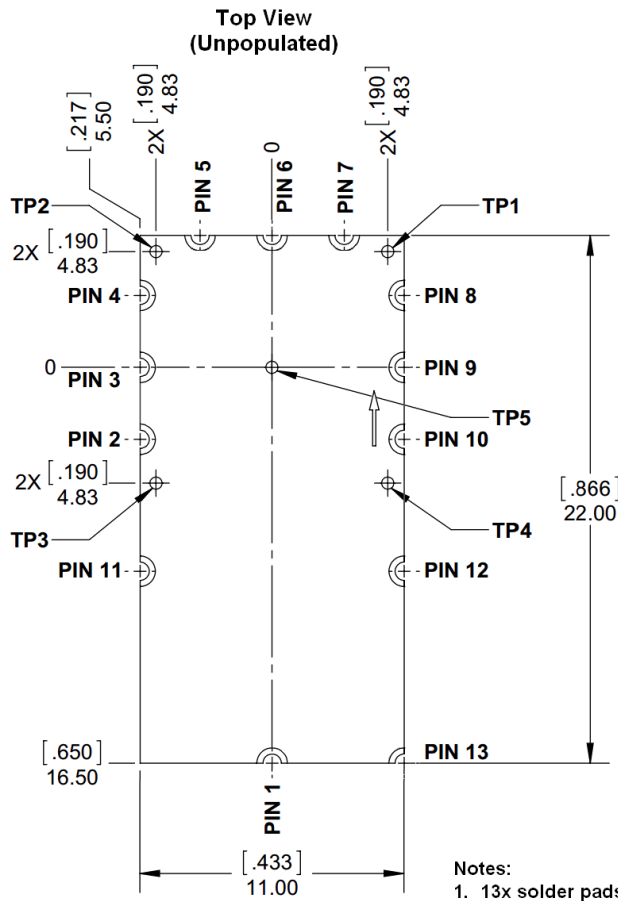


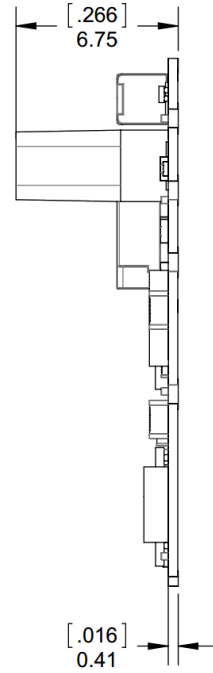
Figure 2-2: SENtral M&M Orange, Red, Green, & Yellow Mechanical Drawing

Dimensions in [inches]
mm

PIN	FUNC
1	N/C
2	HOST DVIO
3	SCLS
4	GPIO6
5	SDAS
6	GPIO4
7	VIN
8	GND
9	SDAM
10	SCLM
11	GND
12	N/C
13	N/C
TP1	DVDD
TP2	SDAS
TP3	SCLS
TP4	GND
TP5	COMP



Side View (Populated)



Notes:

1. 13x solder pads. Φ .76 [.030] ID x 1.27 [.050] x .635 [.025]. See next section for location.
2. Test Points, TP1 through TP5, on backside. Shown projected through frontside.

Figure 2-3: SENtral M&M Blue Mechanical Drawing

3. Recommended Solder Pad Layout

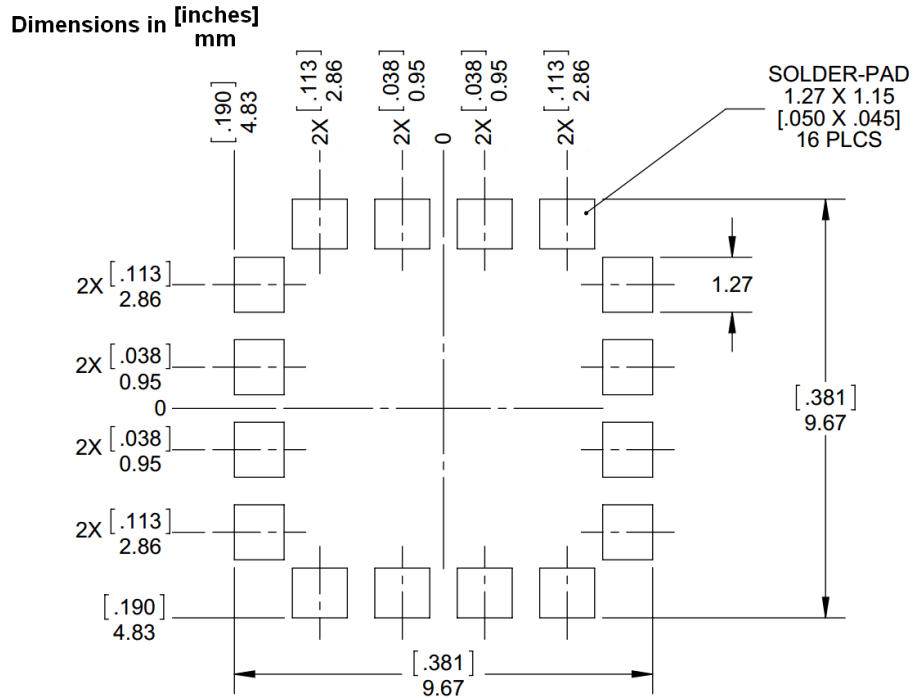


Figure 3-1: SENtral M&M White Solder Pad Layout

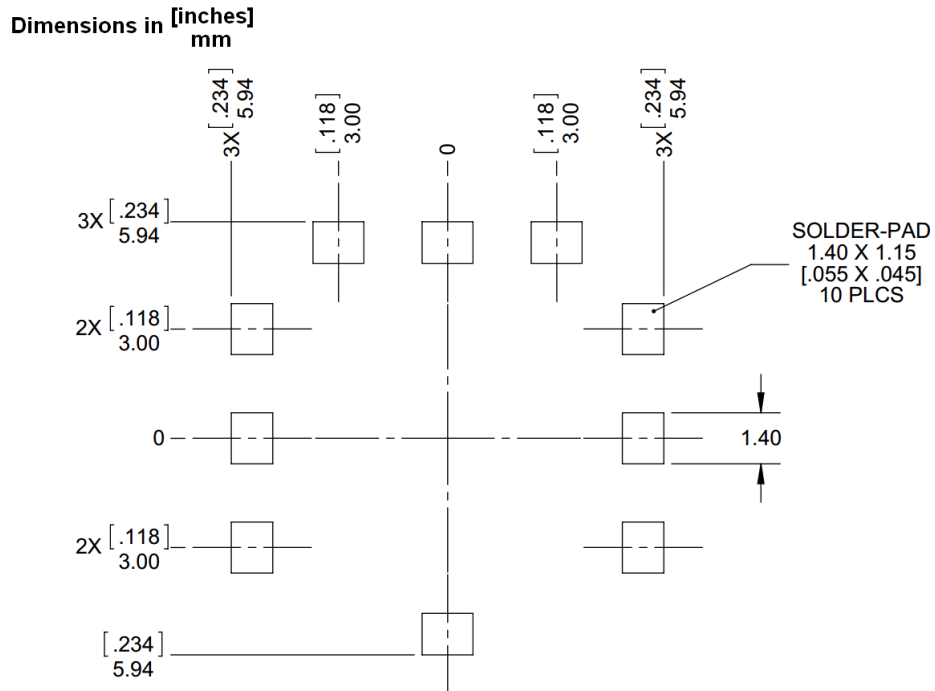


Figure 3-2: SENtral M&M Orange, Red, Green, & Yellow Solder Pad Layout

Dimensions in [inches]
mm

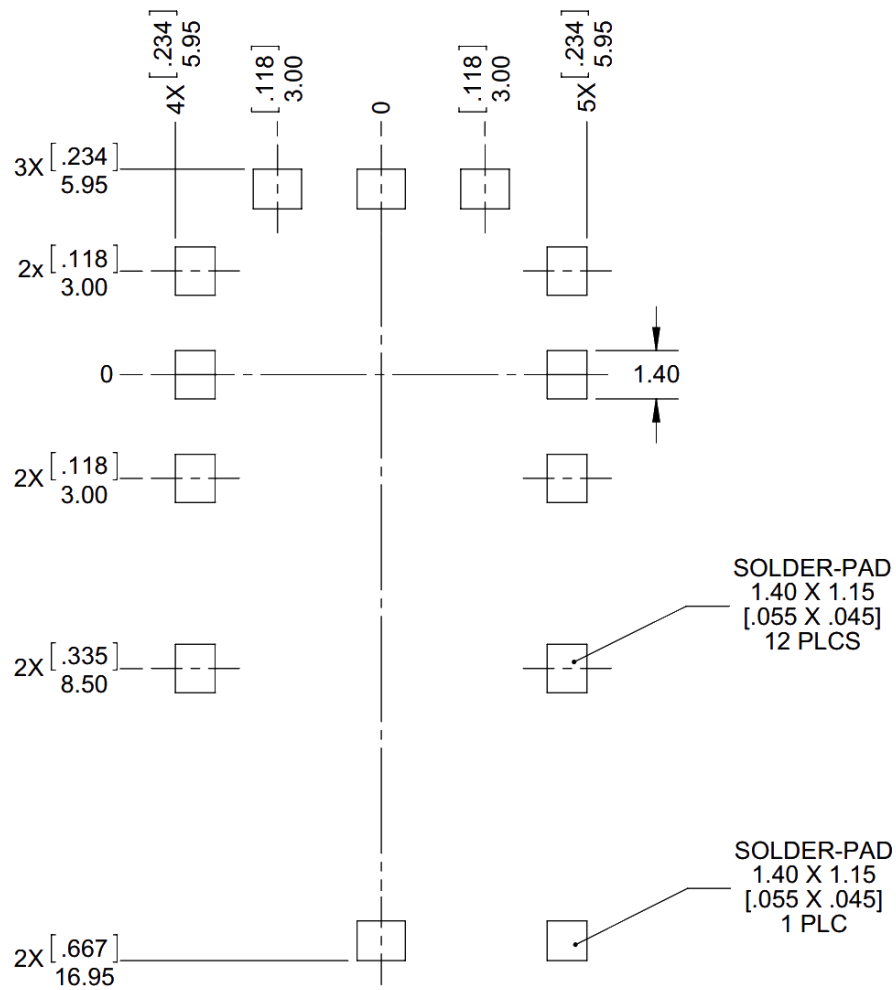


Figure 3-3: SENtral M&M Blue Solder Pad Layout

4. Schematics

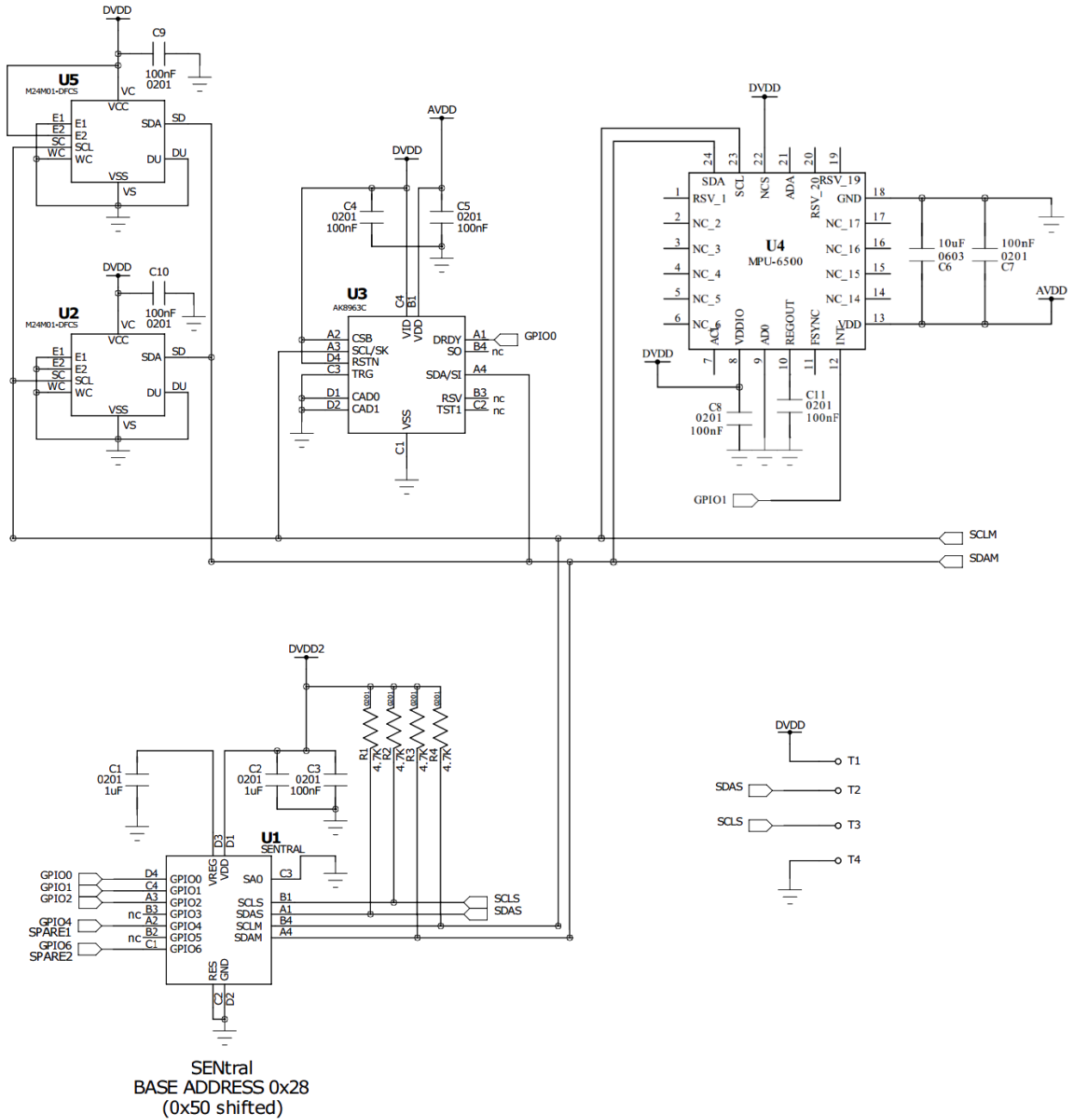
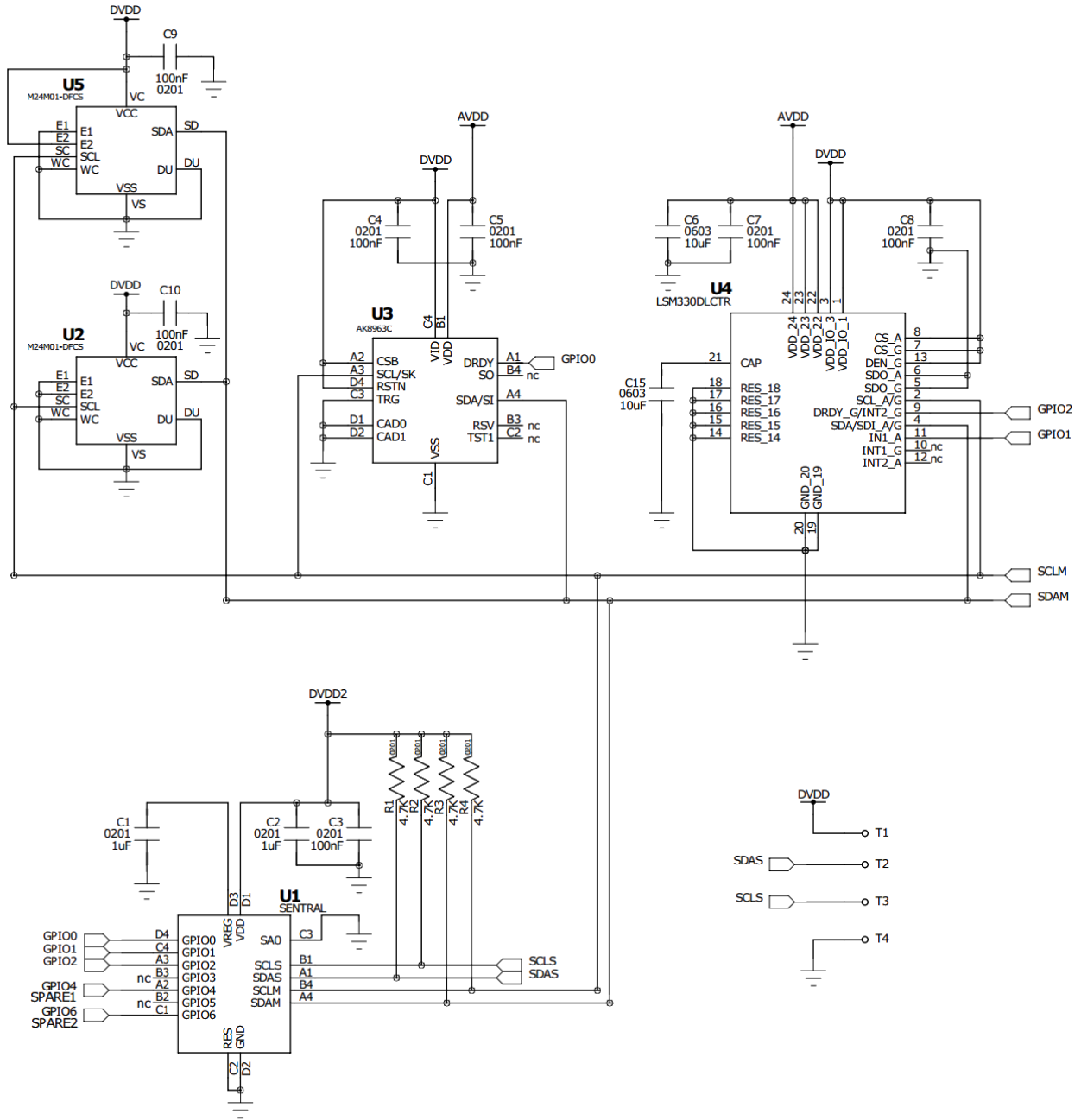
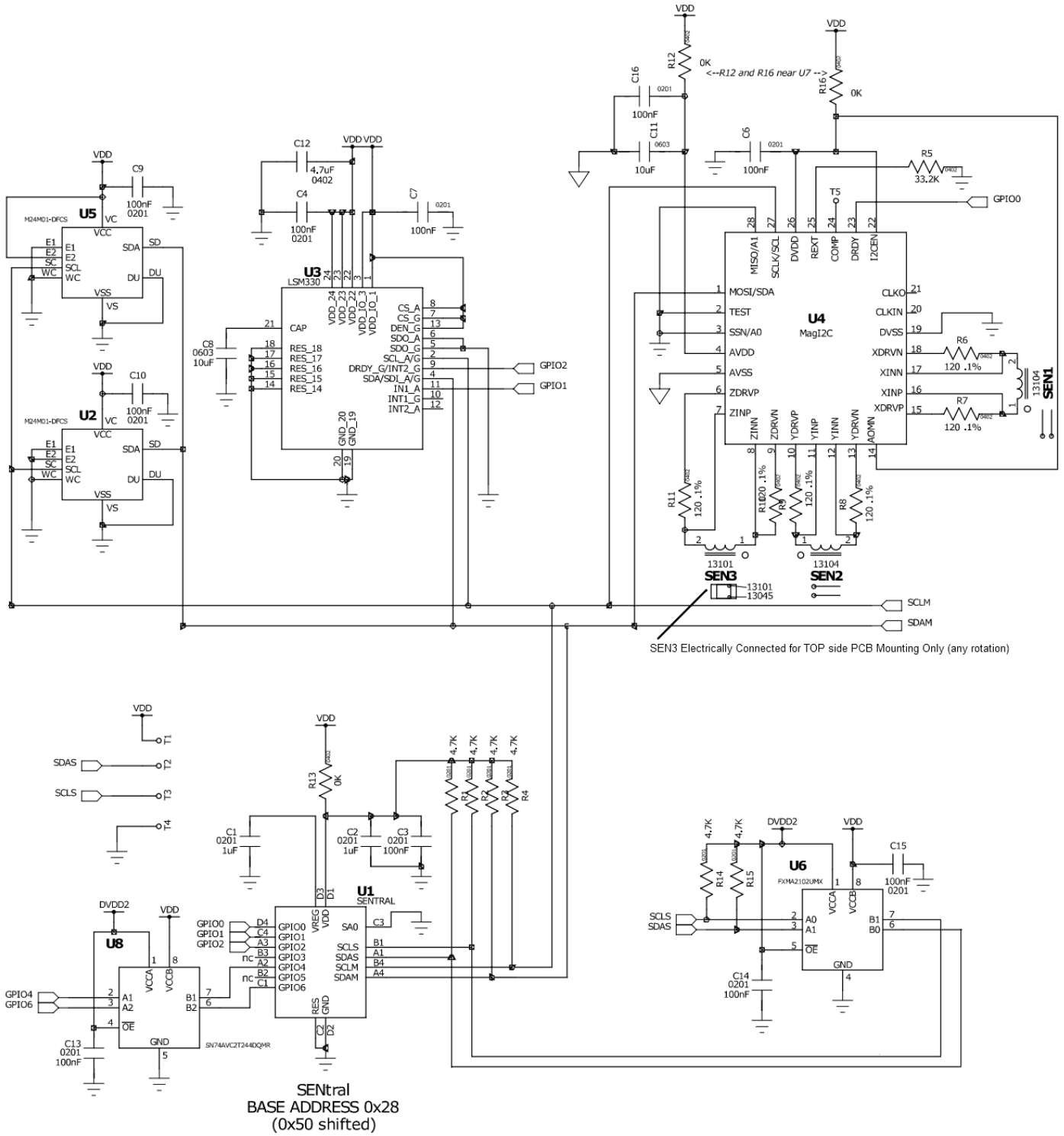


Figure 4-1: SENtral M&M Red Electrical Schematic



SENtral
 BASE ADDRESS 0x28
 (0x50 shifted)

Figure 4-2: SENtral M&M Green Electrical Schematic



SENtral
 BASE ADDRESS 0x28
 (0x50 shifted)

Figure 4-3: SENtral M&M Blue Electrical Schematic

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