1 Description

CambridgeIC's CAM502 Central Tracking Unit (CTU) chip is a high-speed single-chip processor for position measurement. It implements the electronic processing for resonant inductive position sensing technology.

The CAM502 measures the position of contactless, inductively coupled targets relative to sensors that are built from printed circuit boards manufactured to CambridgeIC's design. A selection of sensor geometries is possible, including rotary and linear.

The CAM502 Development Board is a PCB assembly including the CAM502 CTU chip and circuitry for Type 2 and 6 sensors, with SPI host interface.

The CAM502 and Peripherals Board also includes a regulator for optional 5V power supply input, a DAC, and a line driver for an optional asynchronous serial interface.

Please refer to the CAM502 datasheet for more details on features and specifications of the CAM502 chip, and to the appropriate sensor datasheet for sensor details and performance.

Applications

- Prototyping CAM502 chip based applications
- Processor board for high-speed position sensor systems

Product identification	
Part no.	**Description**
013-5036	CAM502 Development Board
013-5032	CAM502 and Peripherals Board

CAM502 Development Board

- CAM502 CTU chip
- Circuitry for Type 2 and Type 6 sensors
- 3.3V SPI interface with 5V tolerant inputs
- Operates from 3.3V

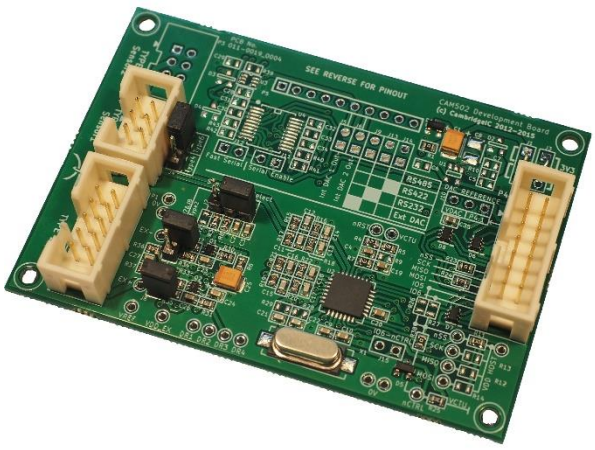

Figure 1 CAM502 Development Board

CAM502 and Peripherals Board

As CAM502 Development Board plus…

- Optional 5V supply with on-board regulator
- DAC for optional analog voltage interface
- Optional asynchronous serial interface

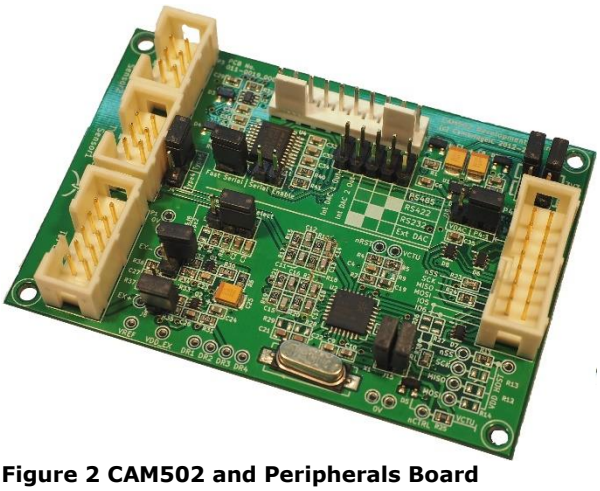

Figure 2 CAM502 and Peripherals Board

2 Specifications

2.1 Electrical Specifications

Table 1 Electrical Specifications

Parameter	Min	Max	Comments
Supply voltage range, VDD_3V3	3.0V	3.6V	J1, J3 as in Figure 7
Supply voltage range, VDD_5V0	3.8V	5.5V	Part 013-5032 only, J1, J3 as in Figure 8
DAC supply voltage range, VDD_DAC	2.7V	5.5V	Part 013-5032 only, see section 3.6
Baud rate, Fast Mode		2.5Mbit/s	Part 013-5032 only, J12 fitted
Baud rate, Slow Mode		250kbit/s	Part 013-5032 only, J12 not fitted

2.2 Environmental Specifications

Table 2 Environmental Specifications

Parameter	Value	Comments
Maximum ambient operating temperature, direct, 3.3V supply, 200mA board supply current	85°C	J1, J3 as in Figure 7
Maximum ambient operating temperature, regulated, 5V supply, 200mA board supply current	40°C	Part 013-5032 only, J1, J3 as in Figure 8

The CAM502 and Peripherals Board's maximum operating temperature is limited when using the on-board regulator to prevent it from overheating.

2.3 Connector Pin-Outs

Connector locations and pin numbering for both boards is shown in Figure 3. The CAM502 Development Board lacks P3 and P5.

Connector P4 is a 14-way header for the CAM502 chip's SPI interface signals and user IOs, and its pin-out is shown in Table 3. P1 connects to a Type 2 sensor, and its pin-out is in Table 4. P2 connects to a Type 6 sensor, and its pin-out is in Table 5. Connector P3 labeled "Type 4 sensor 2" is not used.

The CAM502 and Peripherals Board's P5 connector includes line driver IO signals, and its pin-out is in Table 6.

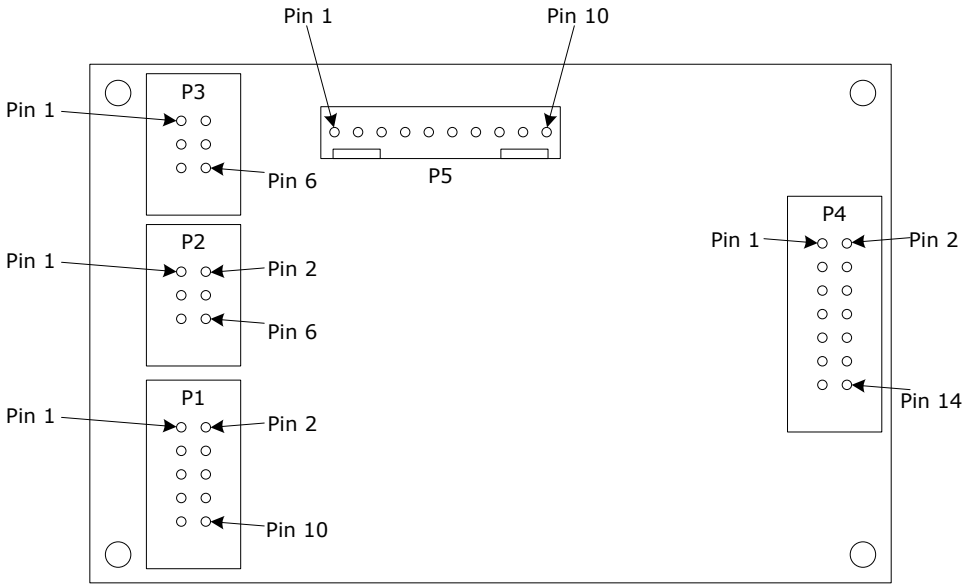

Figure 3 Connector locations and pin numbering

Table 3 Pin-Out of SPI Interface Connector P4

Pin	Signal	Description
1	VDD_HOST	Supply voltage input
2	GND	Supply voltage return (0V)
3	IO1	User IO outputs
4	IO2	
5	IO3	
6	IO4	
7	GND	Supply voltage return (0V)
8	MOSI	Master Out Slave In input
9	nSS	Slave Select input
10	SCK	Serial Clock input
11	MISO	Master In Serial Out output
12	IO5	User IO outputs
13	IO6	
14	nRST	CTU chip reset input

Table 4 Pin-Out of Type 2 Connector P1

Pin	Signal	Description
1	EX+	Excitation coil + connection
2	VREF	Common return for sensor coils
3	EX-	Excitation coil - connection
4	COS1	COSA sensor coil connection
5	VREF	Common return for sensor coils
6	SIN1	SINA sensor coil connection
7	VREF	Common return for sensor coils
8	COS2	COSB sensor coil connection
9	VREF	Common return for sensor coils
10	SIN2	SINB sensor coil connection

Table 5 Pin-Out of Type 6 Sensor Connector P2

Pin	Signal	Description
1	EX+	Excitation coil connection
2	COS2	COSB sensor coil connection
3	SIN2	SINB sensor coil connection
4	COS1	COSA sensor coil connection
5	VREF	Common return for all coils
6	SIN1	SINA sensor coil connection

Table 6 Pin-Out of Asynchronous Serial Connector P5

Pin	RS485 connections	RS422 connections	RS232 connections
1	VDD_HOST		
2	IO1		
3	GND		
4	VDD_5V0 regulator input		
5	VDD_DAC DAC supply/reference		
6	VO DAC output voltage		
7	Do not connect	Non-Inverting Rx input	Rx input
8	Do not connect	Inverting Rx input	CTS input
9	Non-Inverting Tx/Rx	Non-Inverting Tx output	RTS output
10	Inverting Tx/Rx	Inverting Tx output	Tx output

2.4 Mechanical

Figure 4 shows the overall dimensions and fixing centres for both boards.

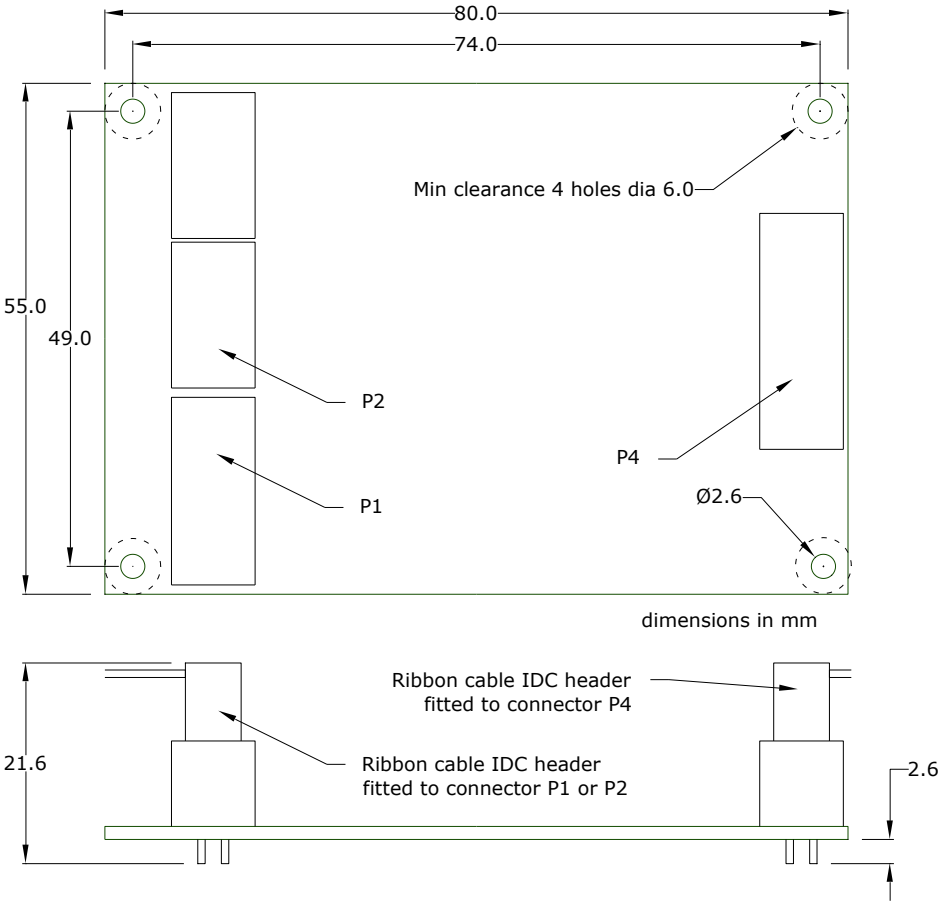

Figure 4 Board dimensions

The areas immediately around the mounting holes are connected to GND and coated in solder resist. The board should not be screwed to a metal object with metal (conductive) screws unless it is acceptable for that object to become connected to GND.

3 Configuring Links and Connections

This section illustrates how to configure board options.

3.1 Default Configuration, CAM502 Development Board

By default, the CAM502 Development Board is configured for operation with a Type 6 sensor using the link locations illustrated in Figure 5.

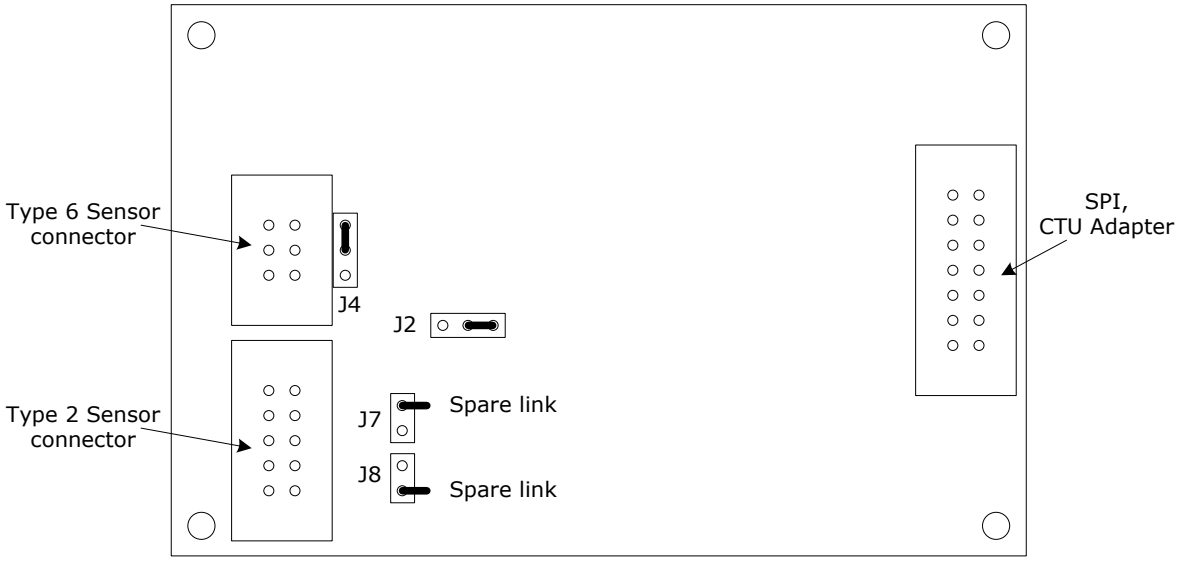

Figure 5 CAM502 Development Board Default link locations: Type 6 sensor

3.2 Type 2 Sensor

To operate with a Type 2 sensor, the link of J2 must be changed and links must be added to J7 and J8 as illustrated in Figure 6.

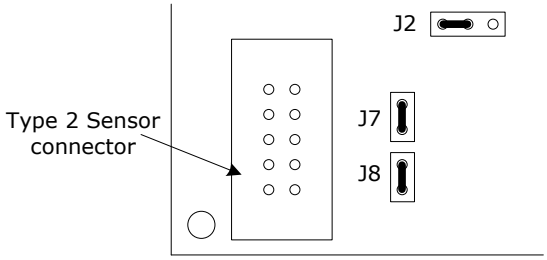

Figure 6 Link locations for Type 2 sensor

3.3 Default Configuration, CAM502 and Peripherals Board

By default, the CAM502 and Peripherals Board is configured for operation with a Type 6 sensor, the supply input (VDD_HOST) set for 3.3V, and for connection to the SPI interface only. Please see Figure 7. This configuration is suited to operation with a CambridgeIC CTU Adapter for connection to a PC.

When configured like this, the supply input VDD_HOST must **NOT** be connected to 5V, otherwise this will be applied directly to the CAM502 IC which is only rated to 3.6V and may be damaged.

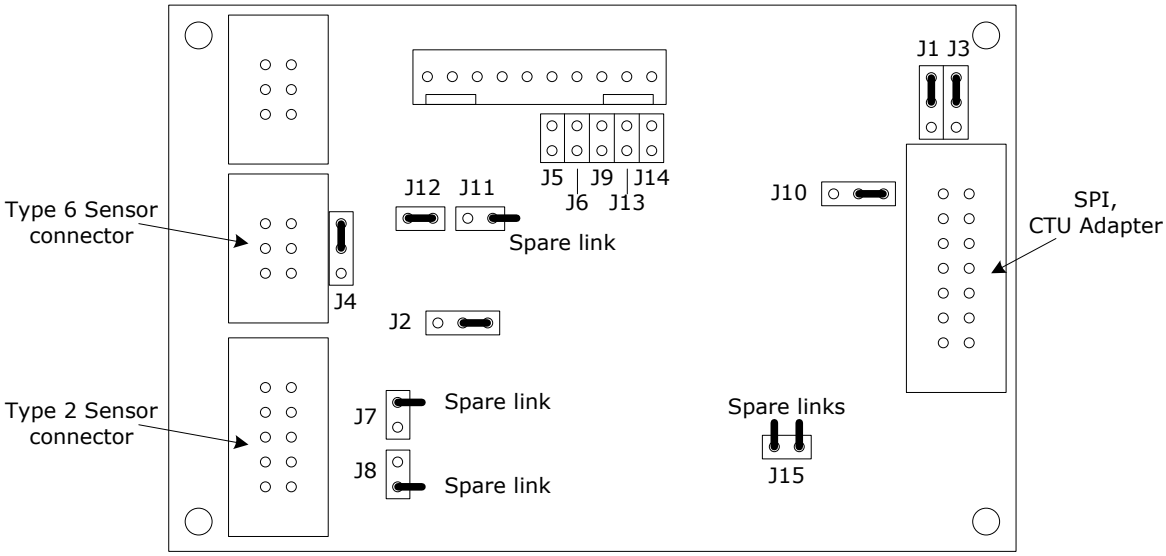

Figure 7 CAM502 and Peripherals Board Default link locations

To configure the CAM502 and Peripherals Board for use with a Type 2 sensor instead, modify J2, J7 and J8 links as in section 3.2.

3.4 External 5V Supply, CAM502 and Peripherals Board

For operation from a 5V power source supplied on VDD_HOST, the links of J1 and J3 must be swapped as illustrated in Figure 8. This connects VDD_HOST to the on-board regulator input (VDD_5V0), and the regulator output to VCTU, the board's main 3.3V supply rail.

In this configuration the CTU Adapter must NOT be connected unless its VDD_HOST (P4 pin 1) connection has been removed, otherwise the 5V signal will overload the CTU Adapter's internal circuitry and may cause damage.

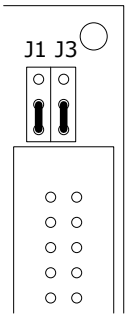

Figure 8 Link locations for VDD_HOST=5V

3.5 Asynchronous Serial Interface, CAM502 and Peripherals Board

By default, CAM502 Application Code does not support an asynchronous serial interface. Please contact CambridgeIC for its development status.

The CAM502 and Peripherals Board includes line driver interface circuitry for communication with the CAM502 over an asynchronous serial interface. To activate the line driver circuitry, add a link to J11. Three options are supported: RS485, RS422 and RS232, selected by J13 and J14 as in Figure 9.

J12 should normally be fitted, as shown. When not fitted, the line driver outputs are slew rate limited to minimise signal reflections for long transmission paths. This also limits the maximum baud rate as shown in Table 1.

Handshaking is not supported in RS232 mode, and CTS must be tied high, for example by connecting it to V_HOST as in Figure 9.

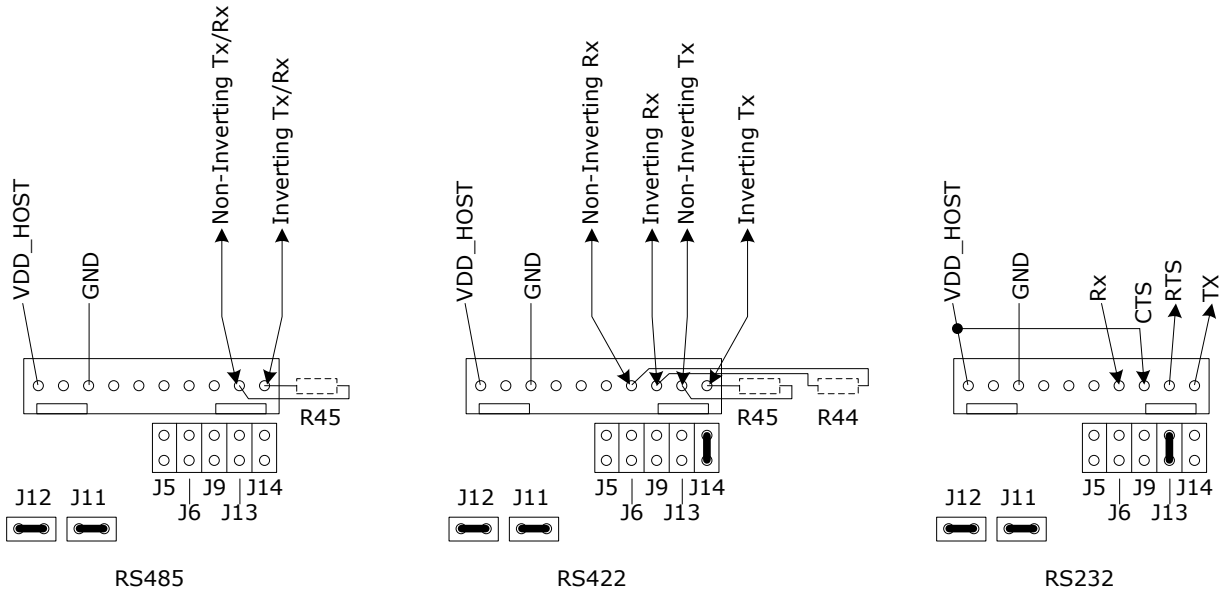

Figure 9 link locations and connections for line driver operation

Transmission lines used for signal transmission must be appropriately terminated to minimise reflections, especially where long lead lengths are used. The CAM502 and Peripherals Board includes 0805 size footprints for termination resistors R44 and R45 on its reverse side. R45 is for terminating RS485 line, and R44 and R45 for RS422. Resistor value(s) should be chosen to match the characteristic impedance of the transmission line(s). 120Ω is typical for twisted pair conductors.

Pipeline Mode delivers the highest CAM502 operating speeds. For pipeline measurement over an asynchronous serial interface, the CAM502's IO6 output must be connected to nCTRL using a link fitted to J15 as illustrated in Figure 10.

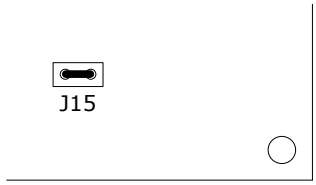

Figure 10 Link for asynchronous serial and pipeline mode

3.6 On-Board DAC, CAM502 and Peripherals Board

The CAM502 and Peripherals Board includes a DAC for generating an analog output voltage that depends on the position measured by the CAM502 chip. The DAC's output VO is referenced to its supply/reference voltage VDAC. The link J10 configures the source of this supply/reference voltage.

Figure 11 illustrates the configuration for connecting the supply/reference voltage VDAC to the main board supply VDD_HOST.

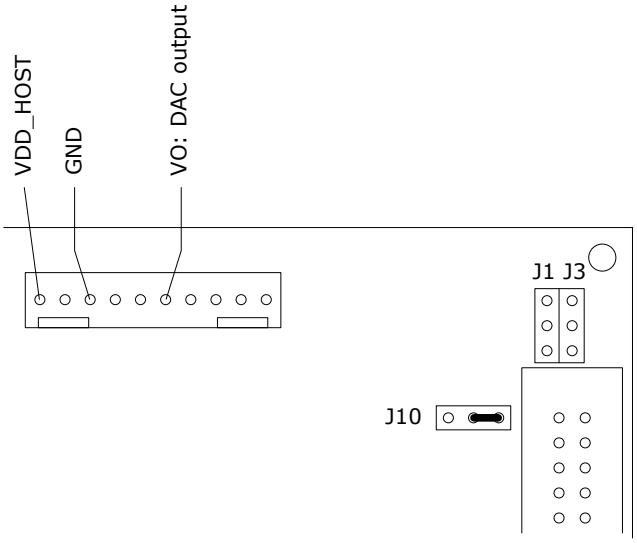

Figure 11 Link locations and connections for DAC supply/reference source equals main supply

Figure 12 illustrates the configuration for connecting the supply/reference voltage VDAC to a separate supply for the DAC alone, VDD_DAC. This configuration allows the DAC supply/reference voltage VDD_DAC to differ from VDD_HOST. It also delivers lower noise and greater accuracy, because the output voltage is then less influenced by supply voltage noise and voltage drops along connections and wires.

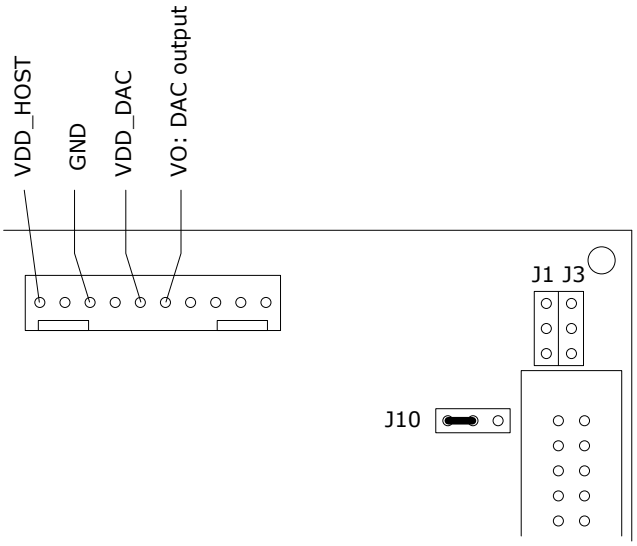

Figure 12 Link locations and connections for separate DAC supply/reference source

VDD_HOST may be 3.3V (J1 and J3 as in Figure 7) or 5V (Figure 8). Allowable voltage range of VDD_HOST and VDD_DAC are specified in Table 1.

4 Component Layout and Schematic

Figure 13 shows an overview of the CAM502 and Peripherals Board layout, labeling the functions of the main blocks of circuitry. The CAM502 Development Board is similar except with regulator, line driver and DAC circuitry removed.

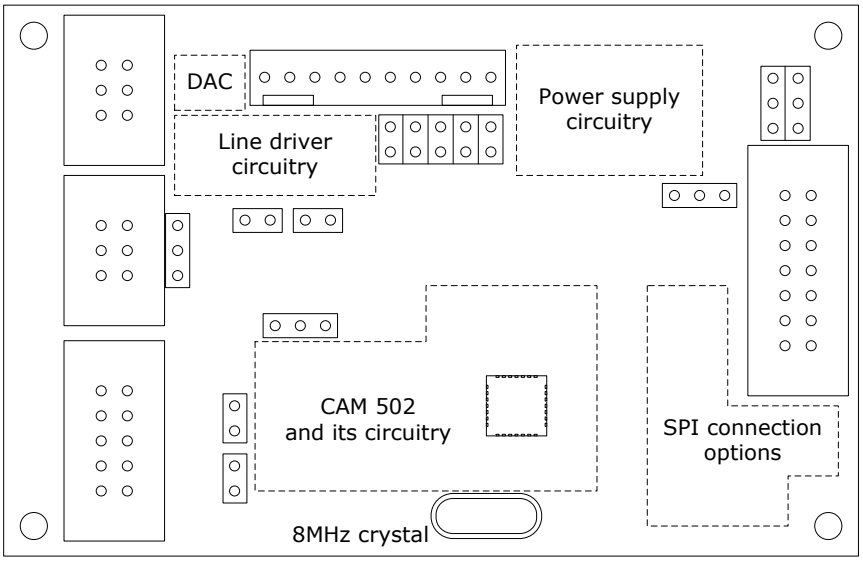

Figure 13 CAM502 Development Board layout overview

Figure 14 shows the location of the CAM502 and Peripherals Board's components. Figure 16 and Figure 17 show the board's schematic.

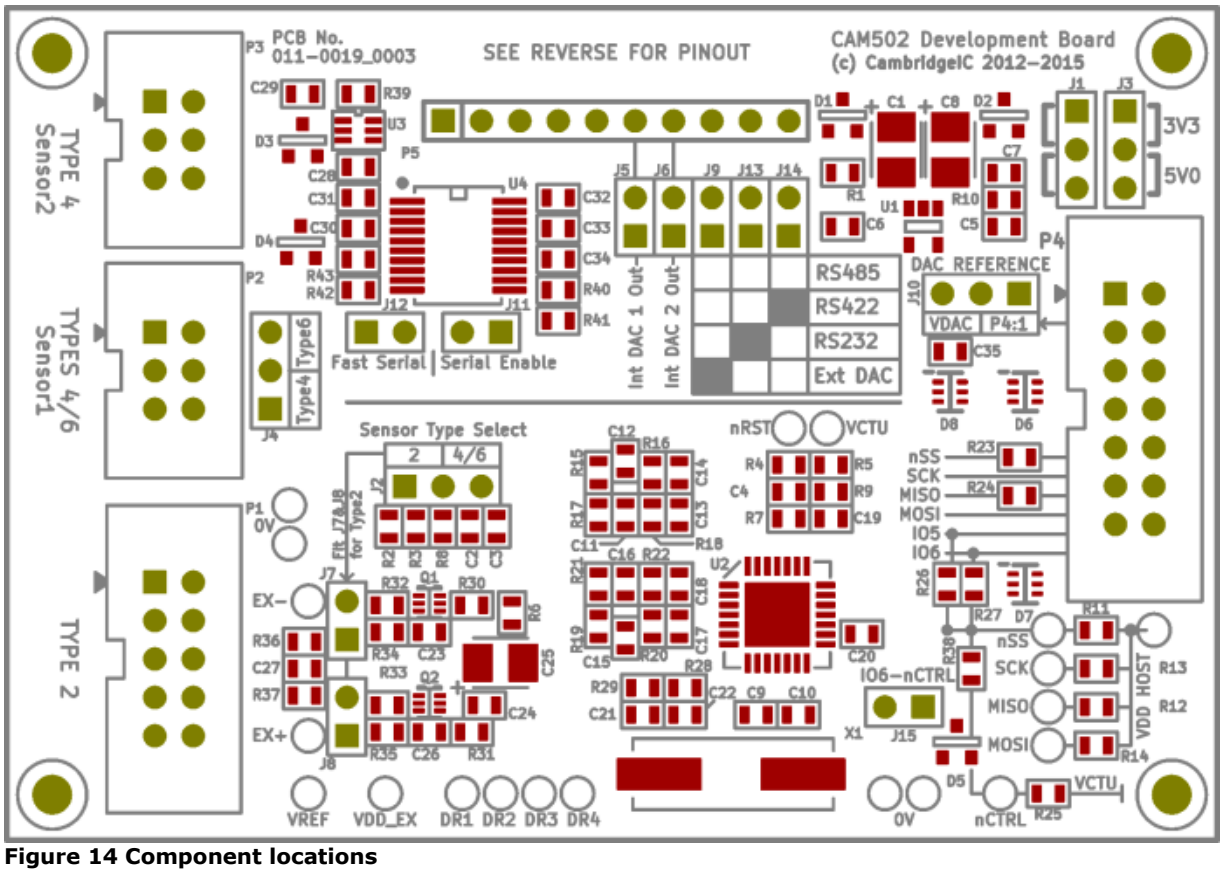

Figure 14 Component locations

The CAM502 Development Board uses the same PCB but with fewer parts fitted, see the schematic in Figure 15.

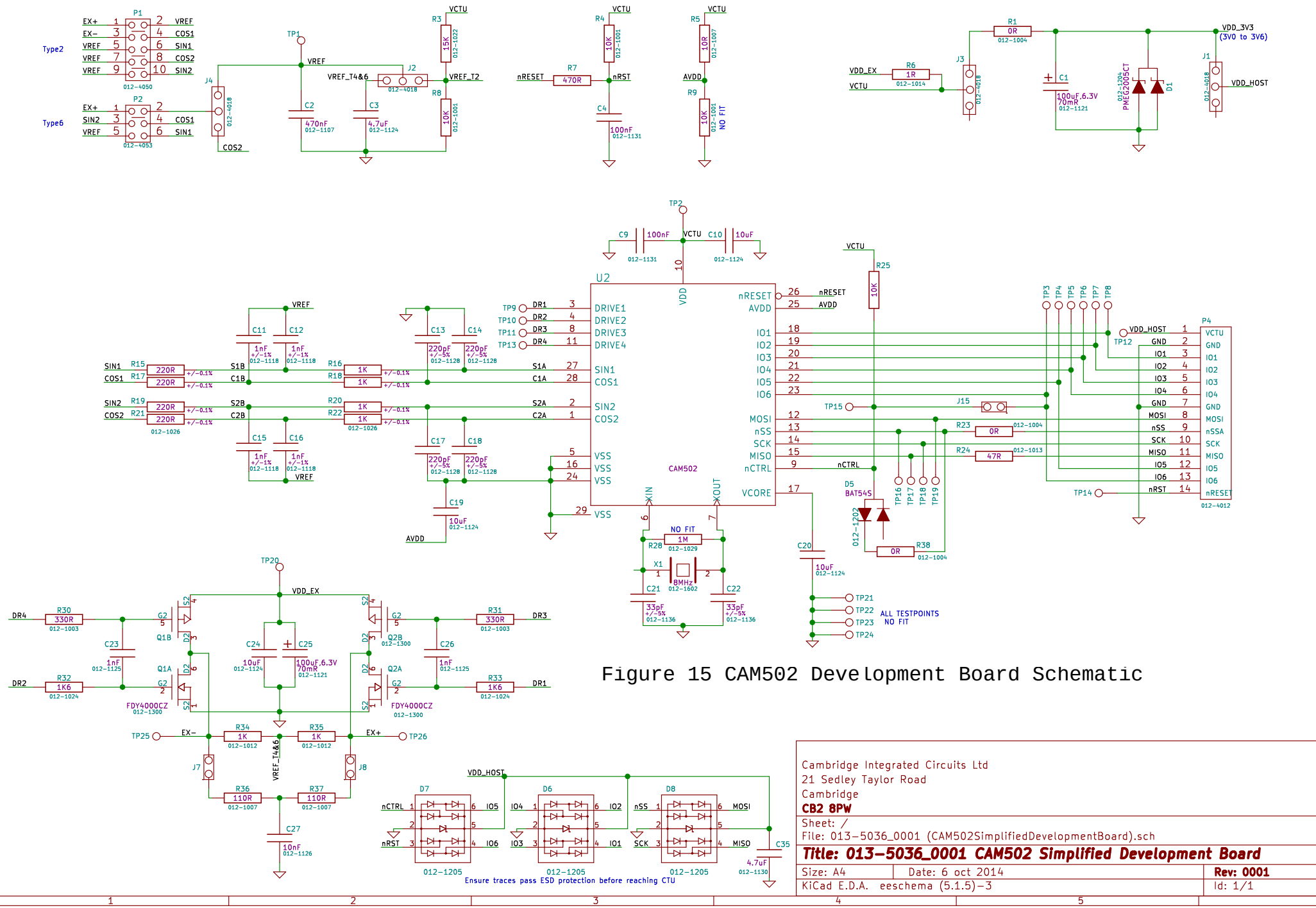

Figure 15 CAM502 Development Board Schematic

Cambridge Integrated Circuits Ltd 21 Sedley Taylor Road Cambridge **CB2 8PW**	
Sheet: / File: 013-5036_0001 (CAM502SimplifiedDevelopmentBoard).sch	
Title: 013-5036_0001 CAM502 Simplified Development Board	
Size: A4	Date: 6 oct 2014 — **Rev: 0001**
KiCad E.D.A. eeschema (5.1.5)-3	Id: 1/1

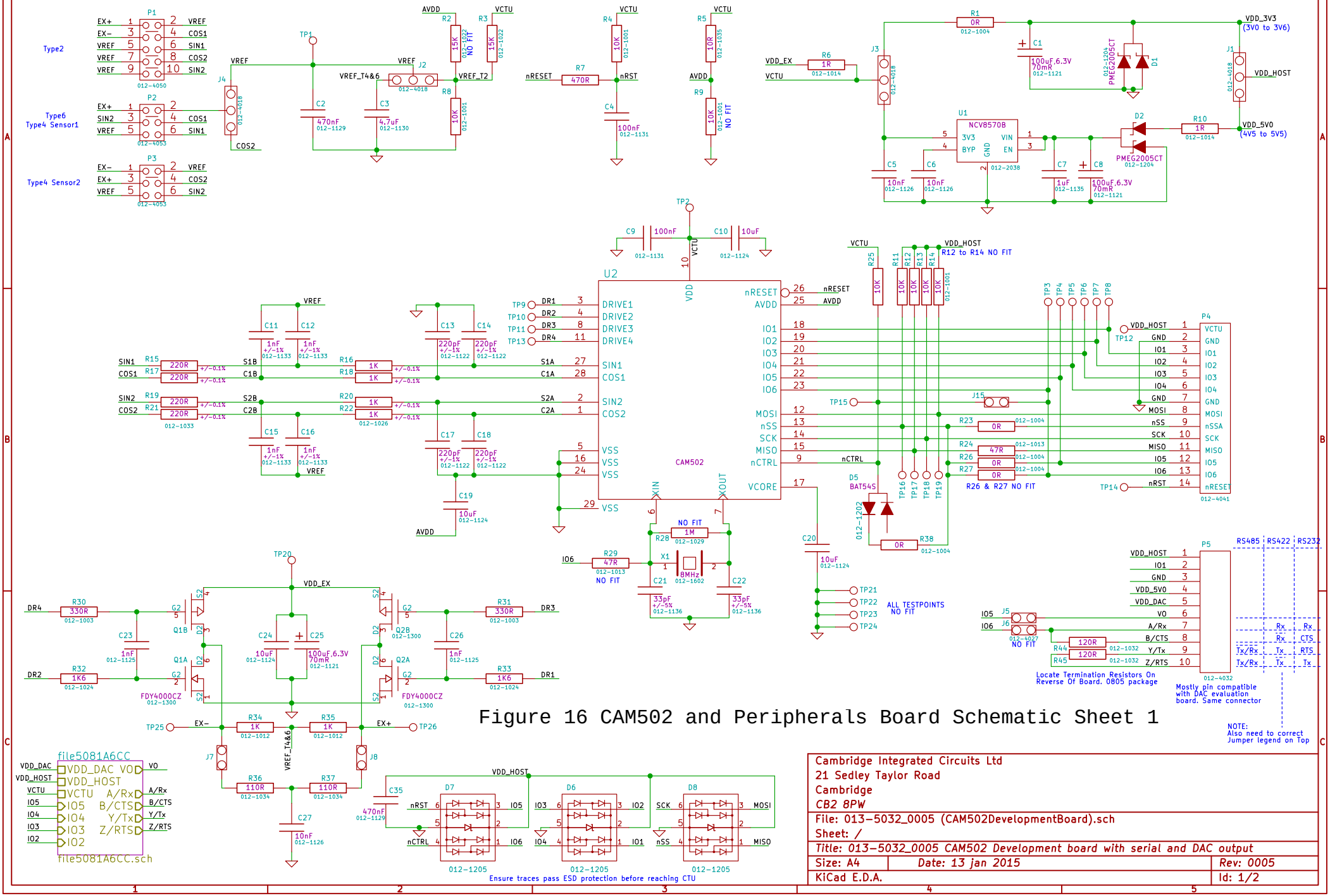

Figure 16 CAM502 and Peripherals Board Schematic Sheet 1

Cambridge Integrated Circuits Ltd 21 Sedley Taylor Road Cambridge CB2 8PW	
File: 013-5032_0005 (CAM502DevelopmentBoard).sch Sheet: /	
Title: 013-5032_0005 CAM502 Development board with serial and DAC output	
Size: A4	*Date: 13 jan 2015* — *Rev: 0005*
KiCad E.D.A.	Id: 1/2

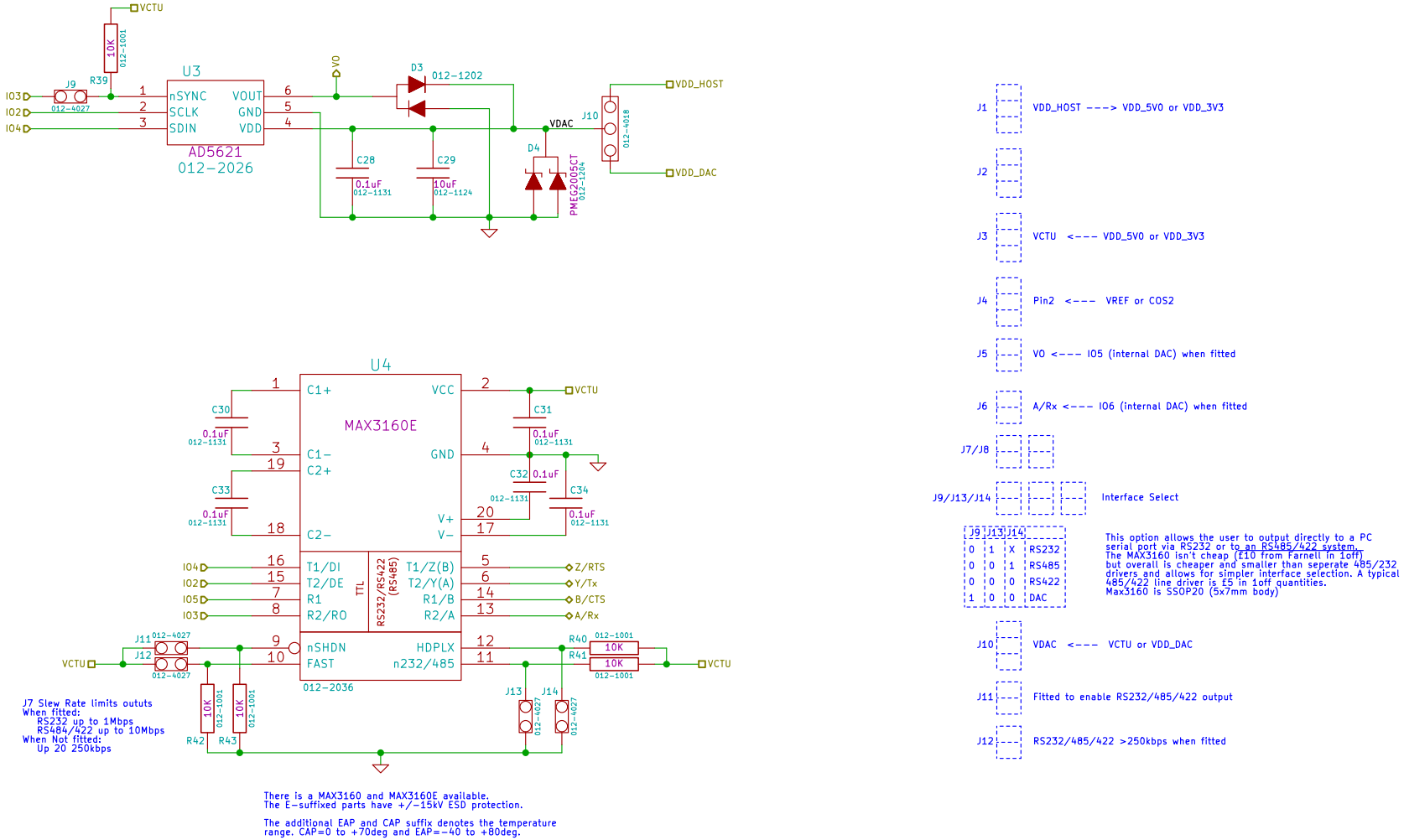

Figure 17 CAM502 and Peripherals Board Schematic Sheet 2

Cambridge Integrated Circuits Ltd 21 Sedley Taylor Road Cambridge CB2 8PW		
File: file5081A6CC.sch Sheet: /file5081A6CC/		
Title: 013-5032_0002 CAM502 Development board with serial and DAC output		
Size: A4	*Date: 13 jan 2015*	*Rev: 0005*
KiCad E.D.A.		Id: 2/2

5 Document History

Revision	Date	Reason
0001	1 March 2013	First draft
0002	29 March 2013	Added modifications for pipeline operation over asynchronous serial interface
0003	13 March 2015	Updated with board modifications from 013-5006_0006 onward
0004	3 February 2021	Renamed previous version of board 013-5032 "CAM502 and Peripherals Board" Added new part 013-5036 "CAM502 Development Board" with no peripherals

6 Contact Information

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7 Legal