Rev 0.7

LMP91200 Evaluation Board User Guide (551600628-001 RevB)

The LMP91200 evalboard (LMP91200EVAL) can be used as stand-alone or as part of SensorAFE eval platform (refer to SensorAFE platform http://www.national.com/en/industrial/sensing/sensor_afe/tools.html for software and required hardware). It allows configuring the LMP91200 through a 3-wire SPI interface and testing the device with real PH probe. Moreover the eval board allows the connection of external RTD (for instance Pt100, Pt1000).

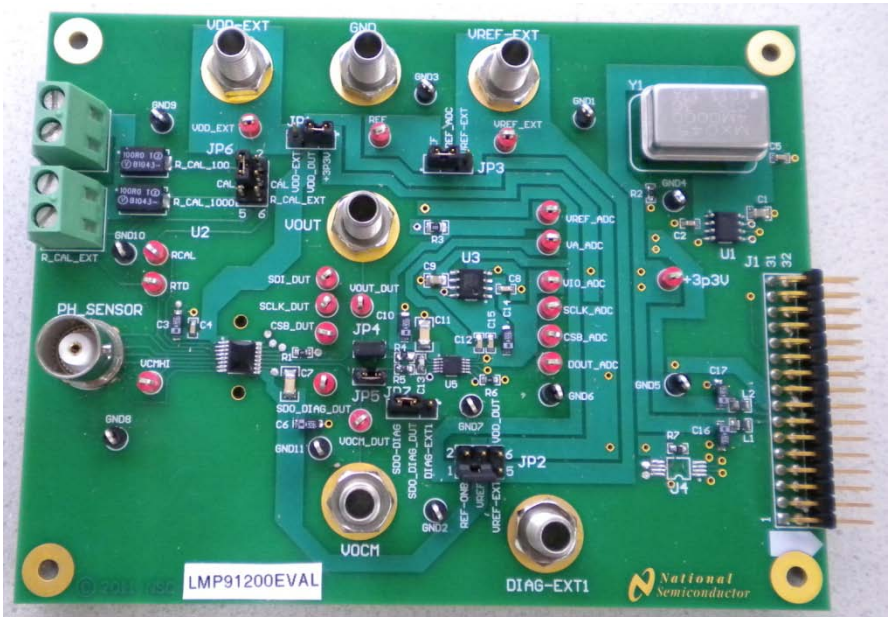


Figure 1 LMP91200EVAL

1. PH probe and RTD connection

The LMP91200 evalboard is not provided with any PH probe and RTD.

The PH probe can be connected to the BNC connector labeled PH_SENSOR.
The footprint of PH_SENSOR allows the connection of a Triaxial BNC. So in case of need replace the BNC soldered on the eval board with a triaxial BNC (refer to Schematic section to check the pinout of the Triaxial BNC).

The external RTD can be connected to the RTD_IN connector. The eval board is already provided with two reference resistors labeled R_CAL_100 and R_CAL_1000, but in case of need an external reference resistor can be connected to the T_CAL_EXT connector.

After the connection of the RTD, configure the JP6 according to the table below

Jumper name	Configuration		Description
JP6	Select one of the three options	1-3 shorted	Reference resistor = 100ohm, when a Pt100 is connected to the board
		3-5 shorted	Reference resistor = 1000ohm, when a Pt1000 is connected to the board
		4-6 shorted	External reference resistor

2. Stand alone usage

2.1 JUMPERS

In order to use the LMP91200EVAL in standalone mode, the following jumpers need to be configured as follow:

Jumper name	Configuration	Description
JP1	2-3 shorted	Supply voltage of LMP91200 provided trough VDD-EXT banana connector
JP2	3-5 shorted	Connect the external voltage reference to the VREF pin of LMP91200
	4-6 shorted	In case the supply voltage is used as reference. Do not short pin 3-5 of JP2.
JP3	2-3 shorted	External voltage reference provided trough VREF-EXT banana connector
JP4	open	Disconnect the VOUT pin of the LMP91200 from the ADC input
JP5	open	Disconnect the VCM pin of the LMP91200 from the ADC input

The SPI bus is accessible from GPSI16 connector. Connect the external microcontroller to GPSI16 as the pin out below. The supply voltage of the SPI signal generated by the microcontroller needs to be equal to the supply voltage applied at VDD-EXT pin.

GPSI16 pin out table

SCLK	Pin 3
MOSI	Pin 7
MISO	Pin 5
CSB	Pin 1
GND	Pin 2

Jumper name	Configuration	Description
JP7	2-3 shorted	Connect the SDO_DIAG pin to the bidirectional MUX U4

The SDO_DIAG pin of the LMP91200 is an I/O digital pin. When the LMP91200 is not in diagnostic mode that pin is an Output pin (MISO of SPI bus), while it becomes an Input pin when the LMP91200 is in diagnostic mode. ***Refer to the Datasheet of the LMP91200 for further details.***

2.2 POWER SUPPLY

Connect a supply voltage (1.8V to 5.5V) between VDD-EXT and GND banana plugs.

2.3 VOLTAGE REFERENCE

Connect a supply voltage (1.8V to 5.5V) between VREF-EXT and GND banana plugs. The Reference voltage cannot be bigger than the voltage applied at VDD-EXT.

2.4 CONFIGURATION OF THE LMP91200

Before configuring the LMP91200, be sure that the jumpers have been configured according the previous tables, the PH probe and the RTD are connected to the board, the power supplies are connected to the board and they are powered on, the microcontroller for SPI is connected to the board. ***Refer to the Datasheet of the LMP91200 for timing information and register meaning.***

3. Using as part of Sensor AFE evaluation platform

3.1 EVALBOARDS CONNECTION

In this case the LMP91200EVAL is part of the evaluation platform (LMP91000EVAL + SPIO4 board), the 2 boards need to be connected as follow:

- LMP91200EVAL through the SPIO-GPSI16 connector (note the white arrow on the boards to align the boards);

Then the SPIO4 needs to be connected to a PC via USB cable

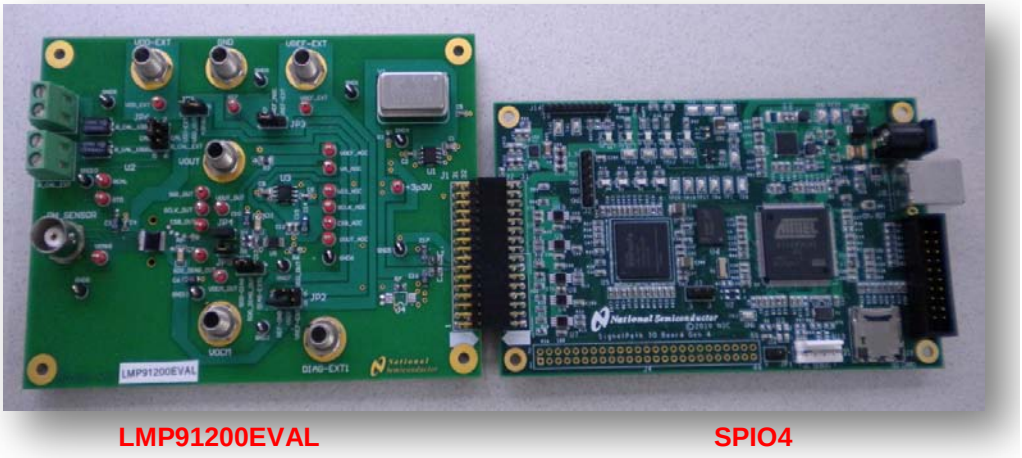


Figure 2 Sensor AFE evaluation platform

3.2 JUMPERS

In order to use the LMP91200EVAL in the evaluation platform the following jumpers need to be configured as follow:

Jumper name	Configuration	Description
JP1	1-2 shorted	Supply voltage (3.3V) of LMP91200 provided by SPIO4 board
JP2	1-3 shorted	Connect the onboard voltage reference (2.5V) to the VREF pin of LMP91200
JP3	1-2 shorted	Voltage reference provided by onboard Voltage reference
JP4	shorted	Connect the VOUT pin of the LMP91200 to the ADC input
JP5	shorted	Connect the VCM pin of the LMP91200 to the ADC input
JP7	2-3 shorted	Connect the SDO_DIAG pin to the bidirectional MUX U4

3.3 POWER SUPPLY

All the required power supplies are provided by the SPIO4 board once connected to a PC via USB cable.

3.4 VOLTAGE REFERENCE

The voltage reference is provided by the SPIO4 board once connected to a PC via USB cable.

3.5 CONFIGURATION OF THE LMP91200

Refer to LMP91200 Datasheet for further information.

4. Connectors, Jumpers, Test Point

4.1 POWER SUPPLY

VDD-EXT	banana plug for the positive power supply of the LMP91200 and bidirectional MUX (U4).
GND	banana plug for ground connection.

4.2 SIGNAL CONNECTORS

Reference Signals

PH_SENSOR	BNC connector (alternatively remove this connector and solder a triaxial BNC) to connect PH probe.
DIAG-EXT1	Banana connector to provide diagnostic pulses
R_CAL_EXT	Terminal block to connect external calibration resistor
R_RTD_IN	Terminal block to connect external RTD

Output signals

VOUT	Banana plug for the output of the LMP91200.
VOCM	Banana plug for the output common mode voltage of the LMP91200.

4.3 JUMPERS

The evalboard has 7 jumpers

JP1	It is a 3 pin header which selects the supply voltage sources.
JP2	It is a 6 pin header which multiplexes the Voltage reference sources to the VREF pin of the LMP91200.
JP3	It is a 3 pin header which selects the voltage reference source.
JP4	It is a simple jumper which connect the VOUT pin of the LMP91200 to the +IN input of the ADC (ADC141S628).
JP5	It is a simple jumper which connect the VOCM pin of the LMP91200 to the –IN input of the ADC (ADC141S628).
JP6	It is a 6pin header which multiplexes the calibration resistors to the CAL pin of the LMP91200.
JP7	It is 3 pin header which select the source of the Diagnostic pulses

4.4 TEST POINTS

The test points are connected as follows.

VDD_EXT	External supply voltage
GND1 to GND10	Ground
+3p3V	Supply voltage provided by SPIO4 (3.3V)
RTD	RTD pin of LMP91200
RCAL	RCAL pin of LMP91200
VCMHI	VCMHI pin of LMP91200
VREF-EXT	External Voltage supply
VOUT_DUT	VOUT pin of LMP91200
VOCM_DUT	VOCM pin of LMP91200

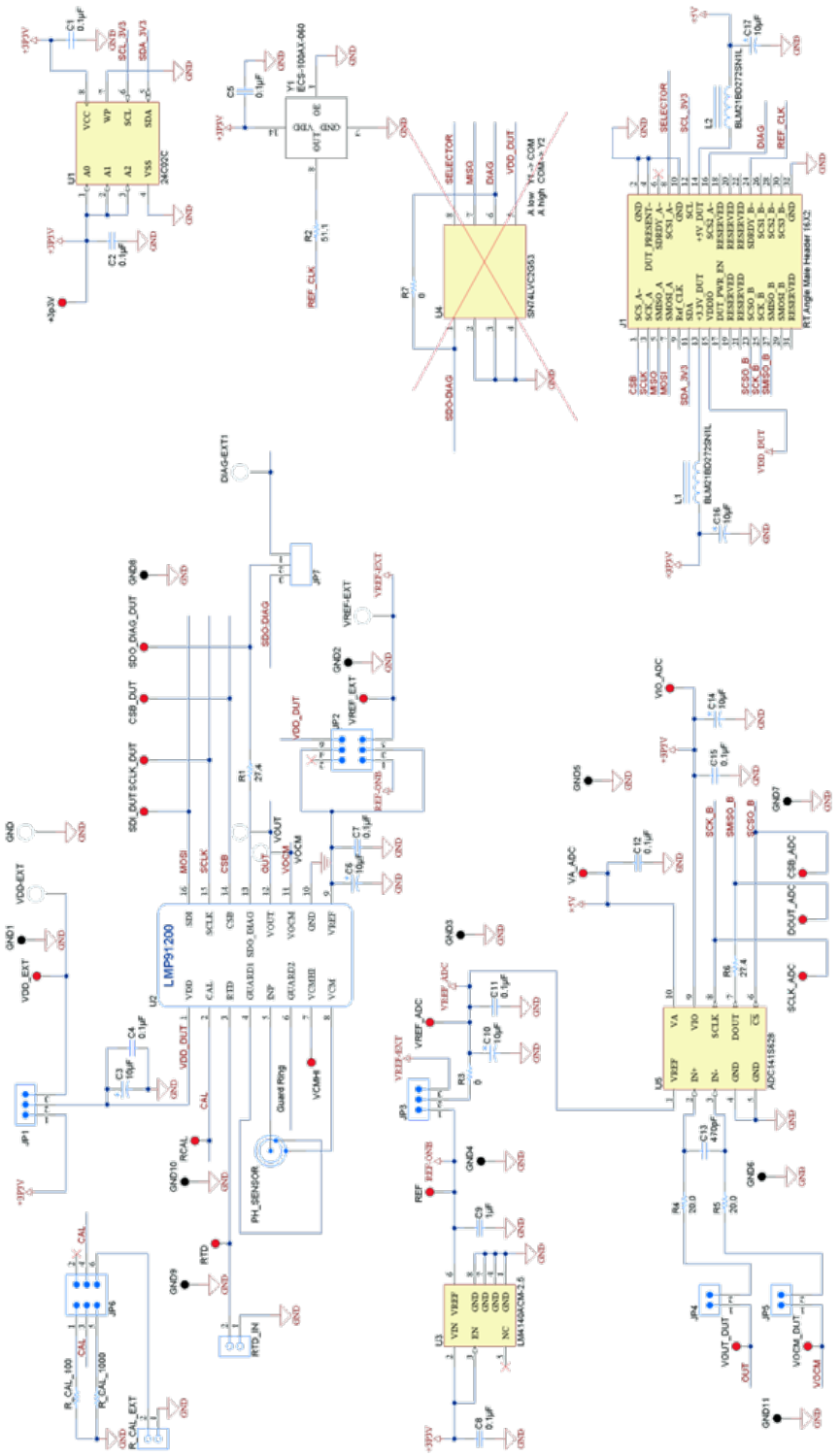
REF	Onboard Voltage reference
VREF_ADC	VREF pin of U5 (ADC141S628)
VA_ADC	Supply voltage of U5 (ADC141S628)
VIO_ADC	Digital supply voltage of U5 (ADC141S628)
SDI_DUT	Data in of LMP91200
SCLK_DUT	Clock of LMP91200
CSB_DUT	Chip select of LMP91200
SDO_DIAG_DUT	Data out/DIAGNOSTIC of LMP91200
SCLK_ADC	Clock of ADC
DOUT_ADC	Data out of ADC
CSB_ADC	Chip select of ADC

4.5 SPECIAL CONNECTORS

For NSC's data capture boards

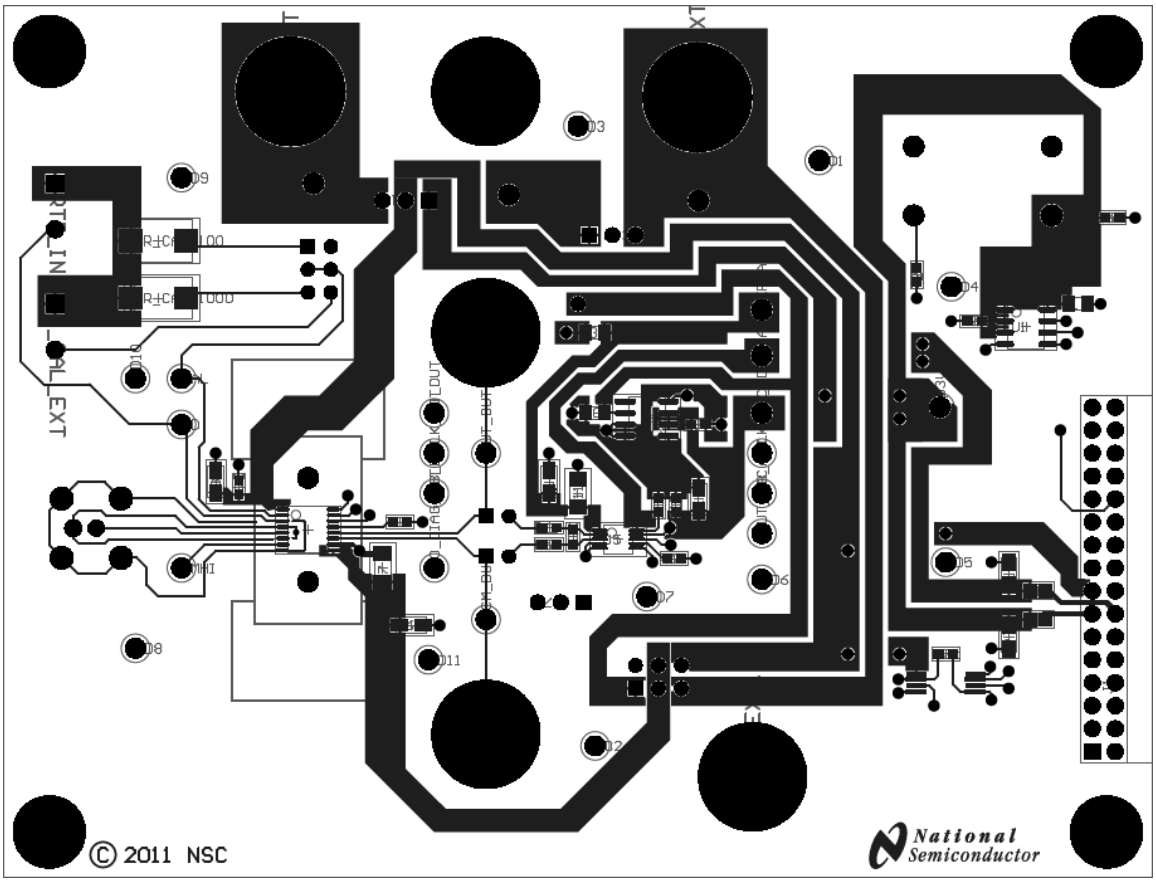
GPSI16	16 pin header for USI2, SPIO4 and ADC1x1S626 boards interface

5. Schematic

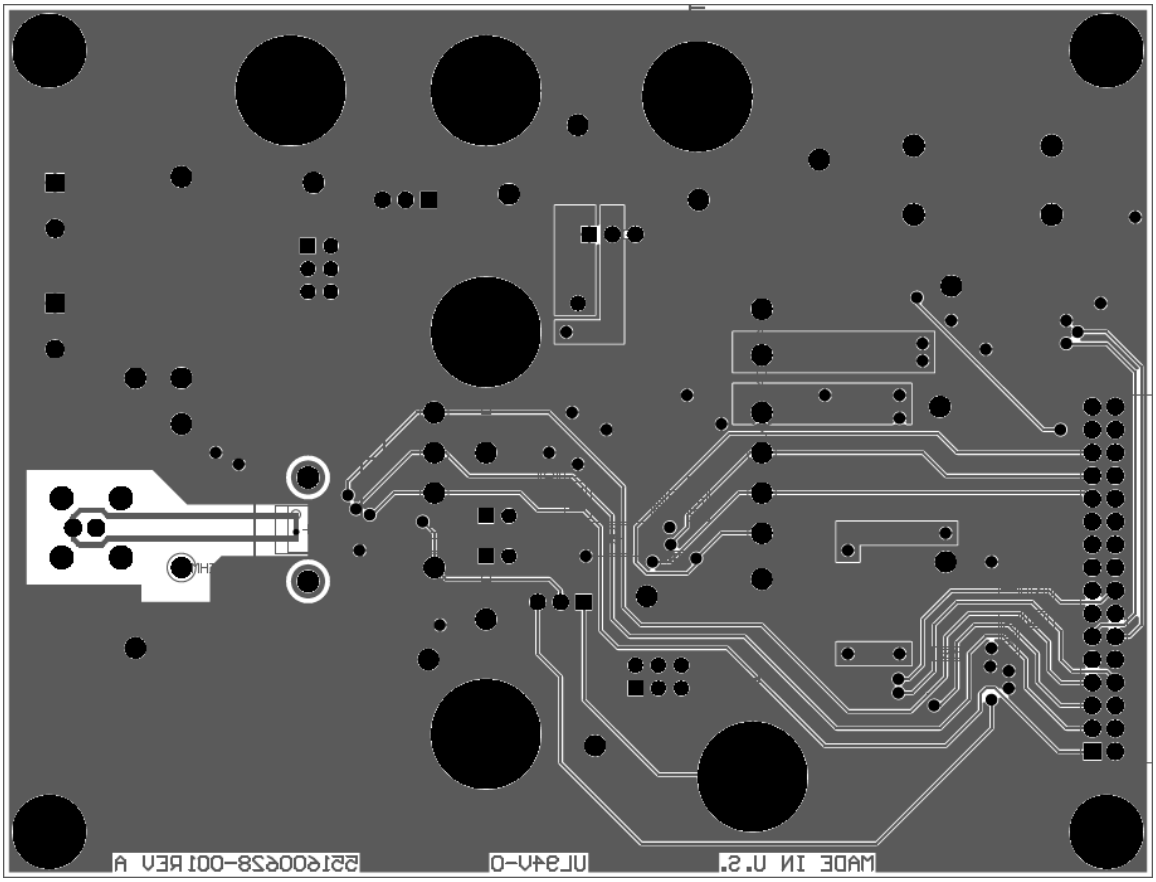

LMP91200
ADC141S626
LM4140ACM-2.5
SN74LVC2G53
24C02C
ECS-100AX-060
BLM21BD272SN1L
Guard Ring
PH_SENSOR
RT Angle Male Header 16X2
SELECTOR
DIAG
REF_CLK
SDO-DIAG
VDD_DUT
VDD_ADC
VA_ADC
VREF_EXT
VDD_EXT
VOUT
VOCM
RTD
CAL
R_CAL_100
R_CAL_1000
R_CAL_EXT

6. Board Layout

6.1 Top Layer



6.2 Bottom Layer



7. BOM

Item	Designator	Description	Manufacturer	Part Number	Quantity
1	+3p3V, CSB_ADC, CSB_DUT, DOUT_ADC, RCAL, REF, RTD, SCLK_ADC, SCLK_DUT, SDI_DUT, SDO_DIAG_DUT, VA_ADC, VCMHI, VDD_EXT, VIO_ADC, VOCM_DUT, VOUT_DUT, VREF_ADC, VREF_EXT	Test Point, TH, Compact, Red	Keystone Electronics	5005	19
2	C1	CAP, CERM, 0.1uF, 25V, +/-10%, X7R, 0805	AVX	08053C104KAT2A	1
3	C2, C4, C5, C8, C12, C15	CAP, CERM, 0.1uF, 16V, +/-5%, X7R, 0603	AVX	0603YC104JAT2A	6
4	C3, C6, C10, C14, C16, C17	CAP, TANT, 10uF, 10V, +/-20%, 3.4 ohm, 3216-18 SMD	Vishay-Sprague	293D106X0010A2TE3	6
5	C7, C11	CAP, CERM, 0.1uF, 100V, +/-5%, X7R, 1206	AVX	12061C104JAT2A	2
6	C9	CAP, CERM, 1uF, 10V, +/-10%, X7R, 0805	AVX	0805ZC105KAT2A	1
7	C13	CAP, CERM, 100pF, 50V, +/-5%, C0G/NP0, 0603	AVX	06035A101JAT2A	1
8	DIAG-EXT1, GND, VDD-EXT, VOCM, VOUT, VREF-EXT	Standard Banana Jack, Uninsulated, 15A	Johnson Components	108-0740-001	6
9	GND1, GND2, GND3, GND4, GND5, GND6, GND7, GND8, GND9, GND10, GND11	Test Point, TH, Compact, Black	Keystone Electronics	5006	11
10	N/A	BUMPON HEMISPHERE .44X.20 BLACK	3M	SJ-5003 (BLACK)	4
11	J1	SPIO-GPSI16 Header, 16-Pin, Dual row, Right Angle	Sullins Connector Solutions	PBC36DGAN	1
12	JP1, JP3	Header, TH, 100mil, 1x3, Gold plated, 230 mil above insulator	Samtec Inc.	TSW-103-07-G-S	2
13	JP2, JP6	Header, TH, 100mil, 3x2, Gold plated, 230 mil above insulator	Samtec Inc.	TSW-103-07-G-D	2
14	JP4, JP5	Header, TH, 100mil, 2x1, Gold plated, 230 mil above insulator	Samtec Inc.	TSW-102-07-G-S	2
15	JP7	Header, TH, 100mil, 1x3, Gold plated, 230 mil above	Sullins Electronics	PBC03SAAN	1

		insulator			
16	L1, L2	Ferrite, Chip, 200mA, .080 ohm, SMD	Wurth Elektronik eiSos	BLM21BD272SN1L	2
17	PH_SENSOR	Triax BNC, Right Angle, 3 Lug, Trompeter 70 series	Trompeter-Emerson	CBJR70A	1
18	R1, R6	RES, 27.4 ohm, 1%, 0.1W, 0603	Vishay-Dale	CRCW060327R4FKEA	2
19	R2	RES, 51.1 ohm, 1%, 0.1W, 0603	Vishay-Dale	CRCW060351R1FKEA	1
20	R3	RES, 0 ohm, 5%, 0.125W, 0805	Vishay-Dale	CRCW08050000Z0EA	1
21	R4, R5	RES, 1K ohm, 1%, 0.1W, 0603	Vishay-Dale	CRCW06031K00FKEA	2
22	R7	RES, 0 ohm, 5%, 0.1W, 0603	Rohm	MCR03EZPJ000	1
23	R_CAL_100	SMR3DZ Foil resistor,600mW,0.01%,100R	VISHAY	Y1746100R000T9R	3
24	R_CAL_1000	SMR3DZ Foil resistor,600mW,0.01%,1K		Y17461K00000T9R	
25	R_CAL_EXT, RTD_IN	Conn Term Block, 2POS, 5.08mm PCB	Phoenix Contact	1715721	2
26	U3	Precision Micropower Low Dropout Voltage Reference	National Semiconductor	LM4140ACM-2.5	1
27	U4	N/P			
28	U5	14-Bit, 50 to 250 kSPS, Differential Input, MicroPower ADC, 10-pin Mini SOIC, Pb-Free	National Semiconductor	ADC141S628	1
29	Y1	Osc 4.000Mhz 5.0V Full Size	CTS	MXO45-3C-4M0000	1
30	U1	2K 5.0V I2C Serial EEPROM	Microchip	24C02C/SN	1
31	U2	Configurable AFE for Low-Power Chemical Sensing Applications	National Semiconductor	LMP91200	1

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