LMP91300PNP User’s Guide

1. Introduction

The Texas Instruments LMP91300PNP evaluation board allows a designer to use the LMP91300 in an inductive sensor. The LMP91300SWIFEVM can be used with the LMP91300PNP to program and burn the registers of the LMP91300 using the SWIF (Single Wire InterFace) protocol.

2. Setup

Supply and Ground – Power and ground from the LMP91300SWIFEVM are connected to the right side of the board. See the Board Layout section. If another method besides the LMP91300SWIFEVM is used to power the LMP91300PNP board, the supply must be <36V as D3 is a 36V zener.

Load – A load can be connected to the middle pad on the right side of the board.

LC Tank – The left side of the board has pads for mounting a capacitor and coil to form an LC tank.

3. Quick Start

When a new sensor is being used the registers should be setup using the following procedure. Instructions on how to determine the value to put in each register are described in the Register Information section of the LMP91300 datasheet.
1. Set RP_MAX in the OSC_CONFIG_0 register.
2. Set PADC_TIMEC and RP_MIN in the OSC_CONFIG_1 register.
3. Set RESONATOR_MIN_FREQ in the OSC_CONFIG_2 register.
4. Set UNDER_RANGE_SWITCH_EN, OSC_AMP, and RESPONSE_TIME in the OSC_CONFIG_3_INIT and OSC_CONFIG_3_FNL registers. The same values should be written to both registers. Setting OSC_AMP to 4V and RESPONSE_TIME to 6144 should give the most accurate results. Note that the power on default for OSC_AMP is 11:Reserved so OSC_AMP must be changed to either 1V, 2V, or 4V.
5. Select the value of the CF capacitor:
    a. Start with a default value of 10nF for CF.
    b. Move the metal target far away from the LC tank.
    c. Connect a scope probe to the INB (pin 21) and CFB (pin 17) pins. Since the CFB pin is very sensitive to capacitive loading, it is recommended to use an active probe. As an alternative, a passive probe with a 1kΩ series resistance between the tip and the CFB pin can be used.

d. Set the time scale of the oscilloscope so that many periods of the signal on the INA pin can be seen. See Figure 1.
f. Set the CF capacitor value so that the AC portion of the waveform is about $1V_{PP}$ maximum. Decreasing the capacitor value will make the AC portion of the waveform larger. This signal scales linearly with the reciprocal of the filter capacitance. For example, if a 100pF filter capacitor is used and the signal observed on the CFB pin has a peak-to-peak value of 200mV, the desired 1V peak-to-peak value is obtained using a 200mV / 1V × 100pF = 20pF filter capacitor. Figure 1 shows the waveforms on CFB and INA and Figure 2 shows the waveforms using a zoomed in horizontal scale. Note that the waveforms on CFB and INA are not a constant amplitude. The waveform on CFB should be adjusted so that the maximum value is $1V_{PP}$.

6. Set the values in the OUT_CONFIG_INIT and OUT_CONFIG_FNL registers as needed. The same values should be written to both registers.
7. Put the sensor at the target distance that the switch is supposed to turn on. Read the PROXIMITY_MSB and PROXIMITY_LSB multiple times. If needed, RP_MAX or RP_MIN can be adjusted up or down one step at a time to determine the combination that gives the most accurate setting for this specific sensor.
8. Put the sensor at the target distance that the switch is supposed to turn on. Read the PROXIMITY_MSB and PROXIMITY_LSB multiple times, take an average, and write this value into the DET_H_MSB_INIT and DET_H_LSB_INIT and DET_H_MSB_FNL and DET_H_LSB_FNL registers. This value may need to be adjusted.
9. Put the sensor at the target distance that the switch is supposed to turn off. Read the PROXIMITY_MSB and PROXIMITY_LSB multiple times, take an average, and write this value into the DET_L_MSB_INIT and DET_L_LSB_INIT and DET_L_MSB_FNL and DET_L_LSB_FNL registers. This value may need to be adjusted.

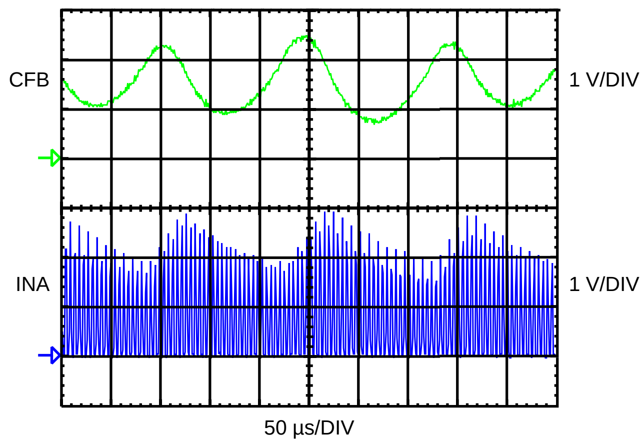


Figure 1. Determining the Value of CF

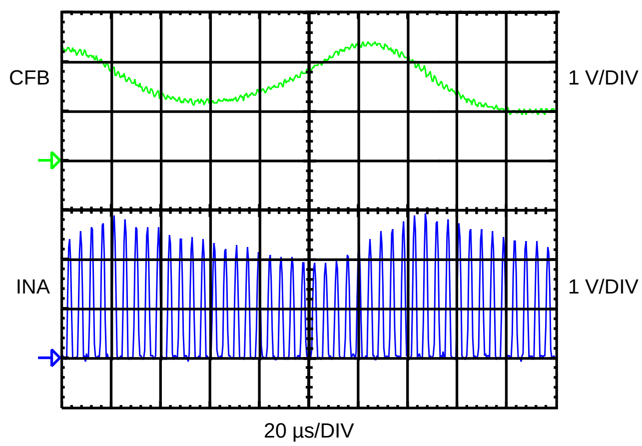
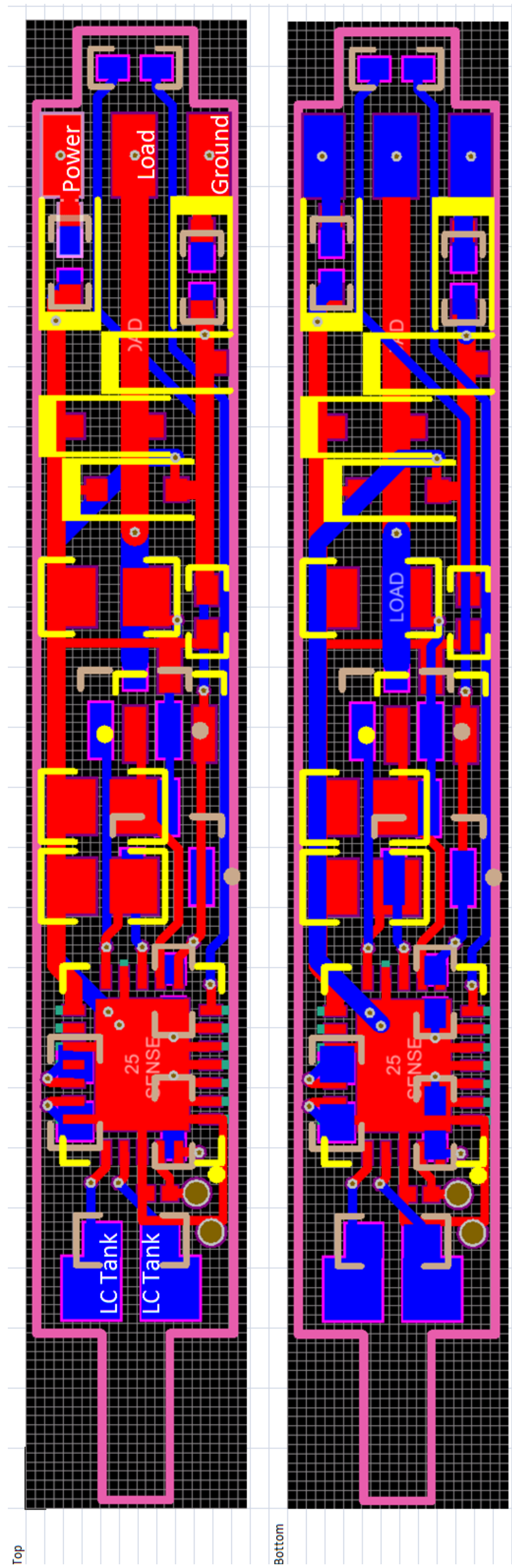
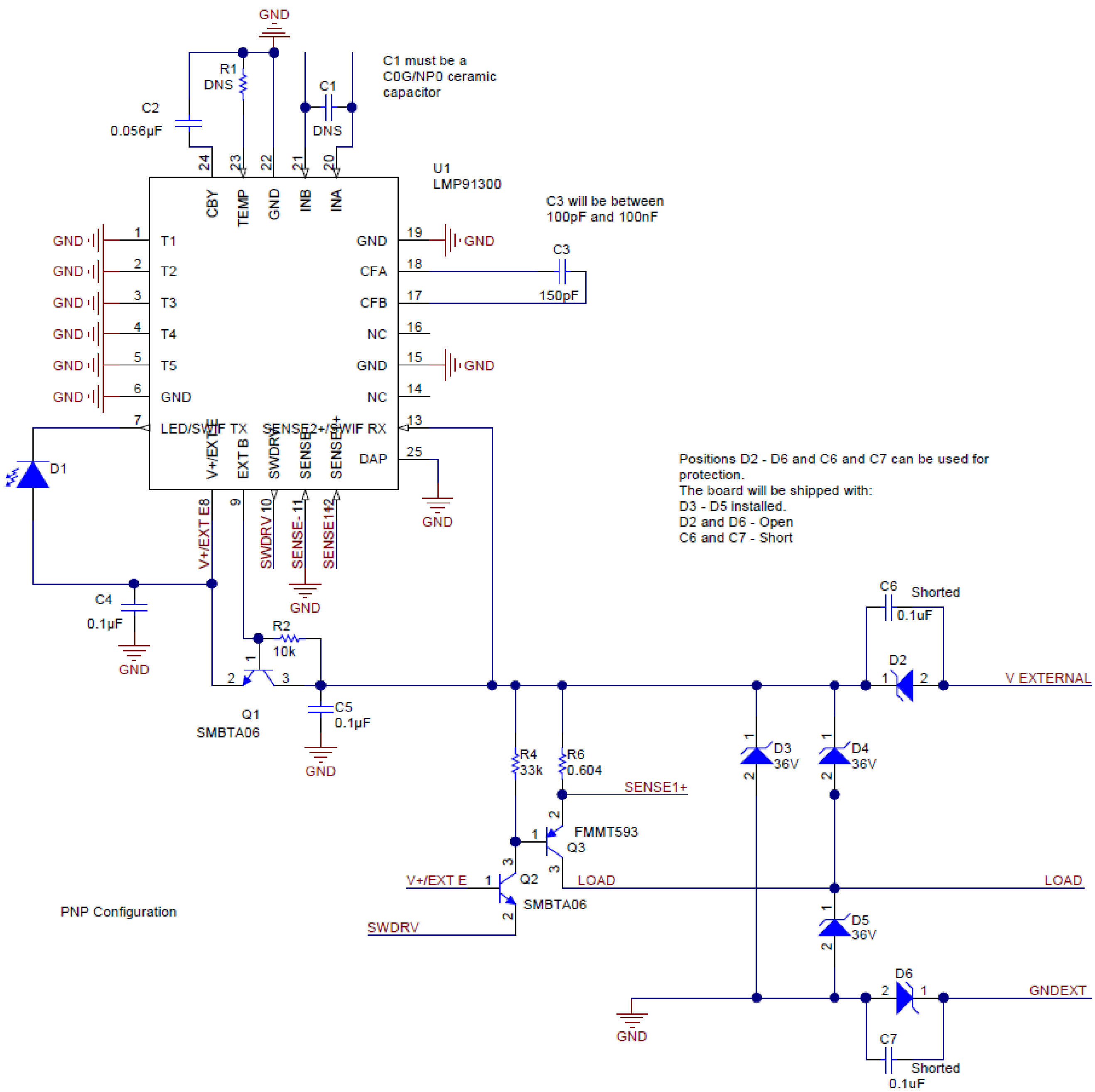


Figure 1. Determining the Value of CF

4. Board Layout



5. Schematic



GND
R1
DNS
C1
C1 must be a
C0G/NP0 ceramic
capacitor
C2
0.056μF
DNS
U1
LMP91300
C3 will be between
100pF and 100nF
CBY
TEMP
GND
INB
INA
T1
T2
T3
T4
T5
GND
LED/SWIF TX
SENSE2+/SWIF RX
CFA
CFB
NC
DAP
C3
150pF
D1
V+/EXT E
EXT B
SWDRV
SENSE-
SENSE1+
Positions D2 - D6 and C6 and C7 can be used for
protection.
The board will be shipped with:
D3 - D5 installed.
D2 and D6 - Open
C6 and C7 - Short
C4
0.1μF
R2
10k
Q1
SMBTA06
C5
0.1μF
C6
Shorted
0.1uF
D2
V EXTERNAL
R4
33k
R6
0.604
SENSE1+
D3
36V
D4
36V
FMMT593
Q3
V+/EXT E
Q2
SMBTA06
LOAD
SWDRV
PNP Configuration
D5
36V
D6
GNDEXT
C7
Shorted
0.1uF

6. Bill of Materials

Designator	Description	Supplier	Supplier Part Number	Manufacturer	Manufacturer Part Number
C2	CAP, CERM, 0.056uF, 16V, +/-10%, X7R, 0402	Digi-Key	399-4901-1-ND	Kemet	C0402C563K4RACTU
C3	CAP CER 150PF 50V 5% NP0 0603	Digi-Key	478-1177-1-ND	AVX	06035A151JAT2A
C4	CAP, CERM, 0.1uF, 10V, +/-10%, X7R, 0402	Digi-Key	399-3520-1-ND	Kemet	C0402C104K8RACTU
C5	CAP, CERM, 0.1uF, 50V, +/-20%, X7R, 0402	Digi-Key	445-5933-1-ND	TDK	C1005X7R1H104M050BB
C6, C7	RES 0.0 OHM 1/16W JUMP 0402 SMD	Digi-Key	541-0.0JCT-ND	Vishay-Dale	CRCW04020000Z0ED
D1	LED GREEN RECTANGLE SMD	Digikey	LNJ347W83RACT-ND	Panasonic	LNJ347W83RA
D3, D4, D5	Diode, Zener, 36V, 200mW, SOD-323	Digi-Key	MMSZ5258BS-FDICT-ND	Diodes Inc.	MMSZ5258BS-7-F
Q1, Q2	Transistor, NPN, 80V, 0.5A, SOT-23	Mouser	726-SMBTA06E6327	Infineon	SMBTA 06 E6327
Q3	Transistor, PNP, 100V, 1A, SOT-23	Mouser	FMMT593TA	Diodes Inc.	FMMT593
R1	NTC, 100kohm, 1%, [0201]			Murata	NCP03WF104F05RL
R2	RES, 10k ohm, 1%, 0.25W, 0805	Digi-Key	RNCP0805FTD10K0CT-ND	Stackpole	RNCP0805FTD10K0
R4	RES, 33k ohm, 5%, 0.125W, 0805	Digi-Key	541-33KACT-ND	Vishay-Dale	CRCW080533K0JNEA
R6	RES, 0.604 ohm, 1%, 0.25W, [0805]	Mouser	660-SR732ATTER604F	KOA Speer	SR732ATTDR604F
U1	LMP91300	TI		TI	LMP91300

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