# SR Lite RX V6.2 40/30m 04_Operational Amplifiers

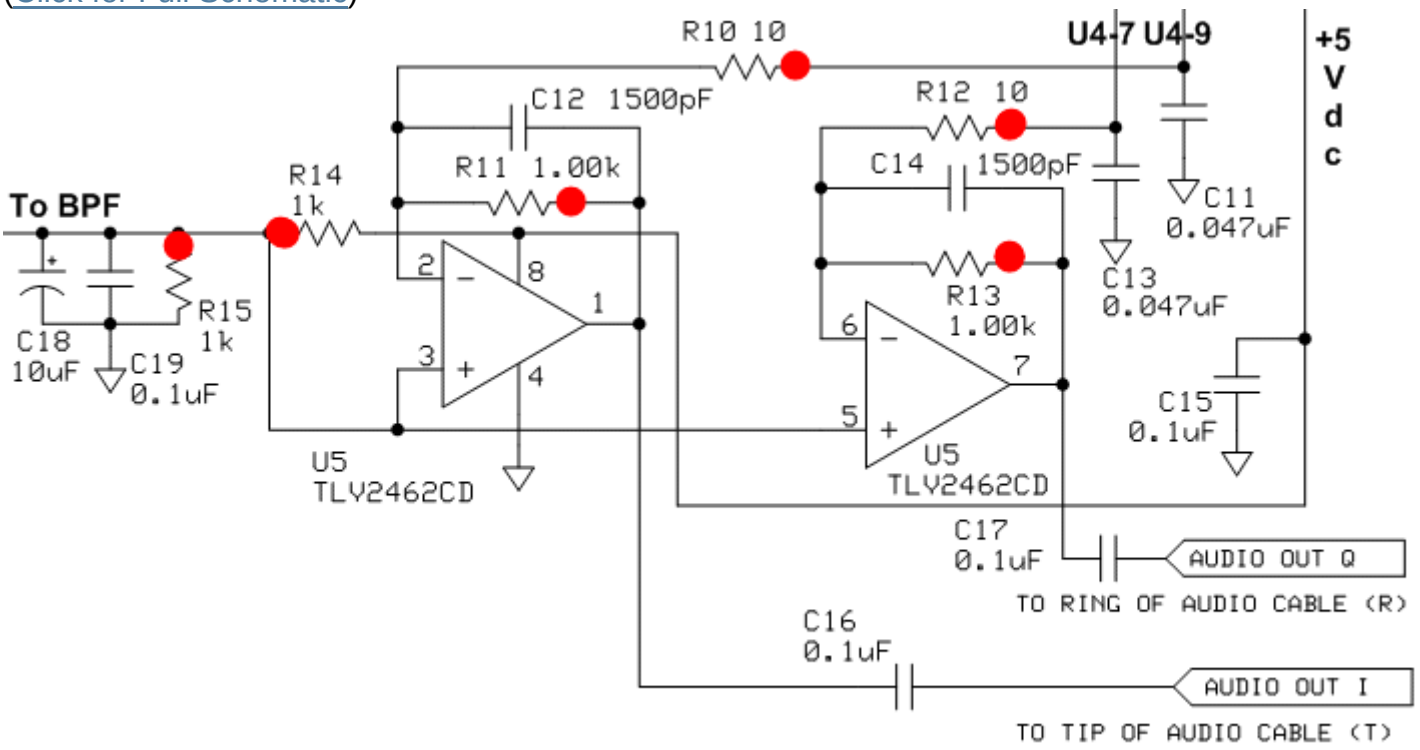


## Operational Amplifiers Introduction

## Operational Amplifiers Schematic

(Resistor testpoints (hairpin, top, or left-hand lead), as physically installed on the board, are marked in the schematic with red dots)

(Click for Full Schematic)




## Operational Amplifiers Bill of Materials

### Detailed Bill of Materials

| Check | Designation | Component | Marking | Category | Orientation | Notes | Circuit |
|---|---|---|---|---|---|---|---|

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| ❑ | C11 | 0.047 uF 5% | 473 | Ceramic | | | Operational Amplifiers |
| ❑ | C12 | 1500 pF 10% | 152 | Ceramic | | | Operational Amplifiers |
| ❑ | C13 | 0.047 uF 5% | 473 | Ceramic | | | Operational Amplifiers |
| ❑ | C14 | 1500 pF 10% | 152 | Ceramic | | | Operational Amplifiers |
| ❑ | C15 | 0.1 uF | black stripe  | SMT 1206 | | | Operational Amplifiers |
| ❑ | C16 | 0.1 uF | black stripe  | SMT 1206 | | | Operational Amplifiers |
| ❑ | C17 | 0.1 uF | black stripe  | SMT 1206 | | | Operational Amplifiers |
| ❑ | C18 | 10uF/16 VDC | | Electrolytic | | | Operational Amplifiers |
| ❑ | C19 | 0.1 uF | black stripe  | SMT 1206 | | | Operational Amplifiers |
| ❑ | Cxx | 4.7 uF 10% | 475 | Ceramic | | for audio test | Operational Amplifiers |
| ❑ | R10 | 10 ohm 1/4W 1% | br-blk-blk-gl-br  | 1/4W | W-E | | Operational Amplifiers |
| ❑ | R11 | 1 k 1/4W 1% | br-blk-blk-br-br  | 1/4W | E-W | | Operational Amplifiers |
| ❑ | R12 | 10 ohm 1/4W 1% | br-blk-blk-gl-br  | 1/4W | S-N | | Operational Amplifiers |
| ❑ | R13 | 1 k 1/4W 1% | br-blk-blk-br-br  | 1/4W | E-W | | Operational Amplifiers |
| ❑ | R14 | 1 k 1/4W 1% | br-blk-blk-br-br  | 1/4W | W-E | | Operational Amplifiers |
| ❑ | R15 | 1 k 1/4W 1% | br-blk-blk-br-br  | 1/4W | W-E | | Operational Amplifiers |
| ❑ | U5 | TVL2462CD dual opamp | TVL2462CD | SOIC-8 | | | Operational Amplifiers |

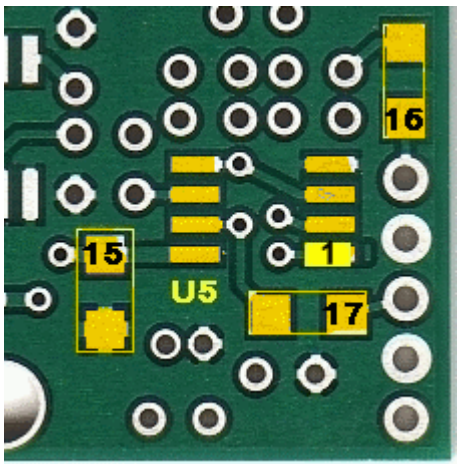
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | |  | | | | |

# Operational Amplifiers Summary Build Notes

- Install U5, Dual OpAmp
- Install SMT Caps
- Install Topside SMT Cap
- Install Ceramic Caps
- Install Electrolytic Cap
- Install Resistors
- Test the Stage

# Operational Amplifiers Detailed Build Notes

## Bottom of the Board




### Install U5, Dual OpAmp

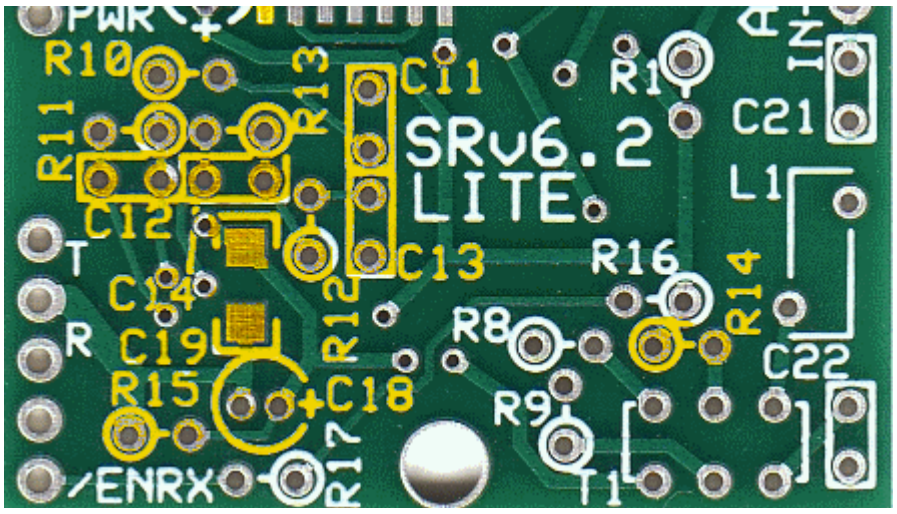
**Orient U5 on its pads so that the pin 1 corner of the IC matches the small “1" (it also looks like a “0”) mark in the copper on the bottom side of the board. In general, pin 1 of an SOIC packaged IC is in the lower left corner of the package when the printing on the package top reads upright, from left to right. Tack-solder one corner pin of U5 and reheat the tacked pin as necessary to line up U5 on its pads properly. Double-check the orientation of U5 and the line up of the IC on its pads with magnification and good lighting. You do NOT want to install U5 oriented incorrectly. If all is well, carefully solder the rest of the leads to their pads.**

| Check | Designation | Component | Marking | Category | Orientation | Notes |
|---|---|---|---|---|---|---|
| ❑ | U5 | TVL2462CD dual opamp | TVL2462CD  | SOIC-8 | | Take ESD precautions |

## Install SMT Caps

| Check | Designation | Component | Marking | Category | Orientation | Notes |
|---|---|---|---|---|---|---|
| ❑ | C15 | 0.1 uF | black stripe  | SMT 1206 | | |
| ❑ | C16 | 0.1 uF | black stripe  | SMT 1206 | | |
| ❑ | C17 | 0.1 uF | black stripe  | SMT 1206 | | |

## Top of the Board




## Install Topside SMT Cap

| Check | Designation | Component | Marking | Category | Orientation | Notes |
|---|---|---|---|---|---|---|
| ❑ | C19 | 0.1 uF | black stripe  | SMT 1206 | | |

## Install Ceramic Caps

| Check | Designation | Component | Marking | Category | Orientation | Notes |
|---|---|---|---|---|---|---|
| ❑ | Cxx | 4.7 uF 10% | 475 | Ceramic | | for audio test |
| ❑ | C11 | 0.047 uF 5% | 473 | Ceramic | | |
| ❑ | C12 | 1500 pF 10% | 152 | Ceramic | | |
| ❑ | C13 | 0.047 uF 5% | 473 | Ceramic | | |
| ❑ | C14 | 1500 pF 10% | 152 | Ceramic | | |

## Install Electrolytic Cap

**C18 is installed with attention paid to ensuring the positive lead (the longest lead) goes to the positive (“+”) hole.**

| Check | Designation | Component | Marking | Category | Orientation | Notes |
|---|---|---|---|---|---|---|
| ❑ | C18 | 10uF/16 VDC | | Electrolytic | | |

## Install Resistors

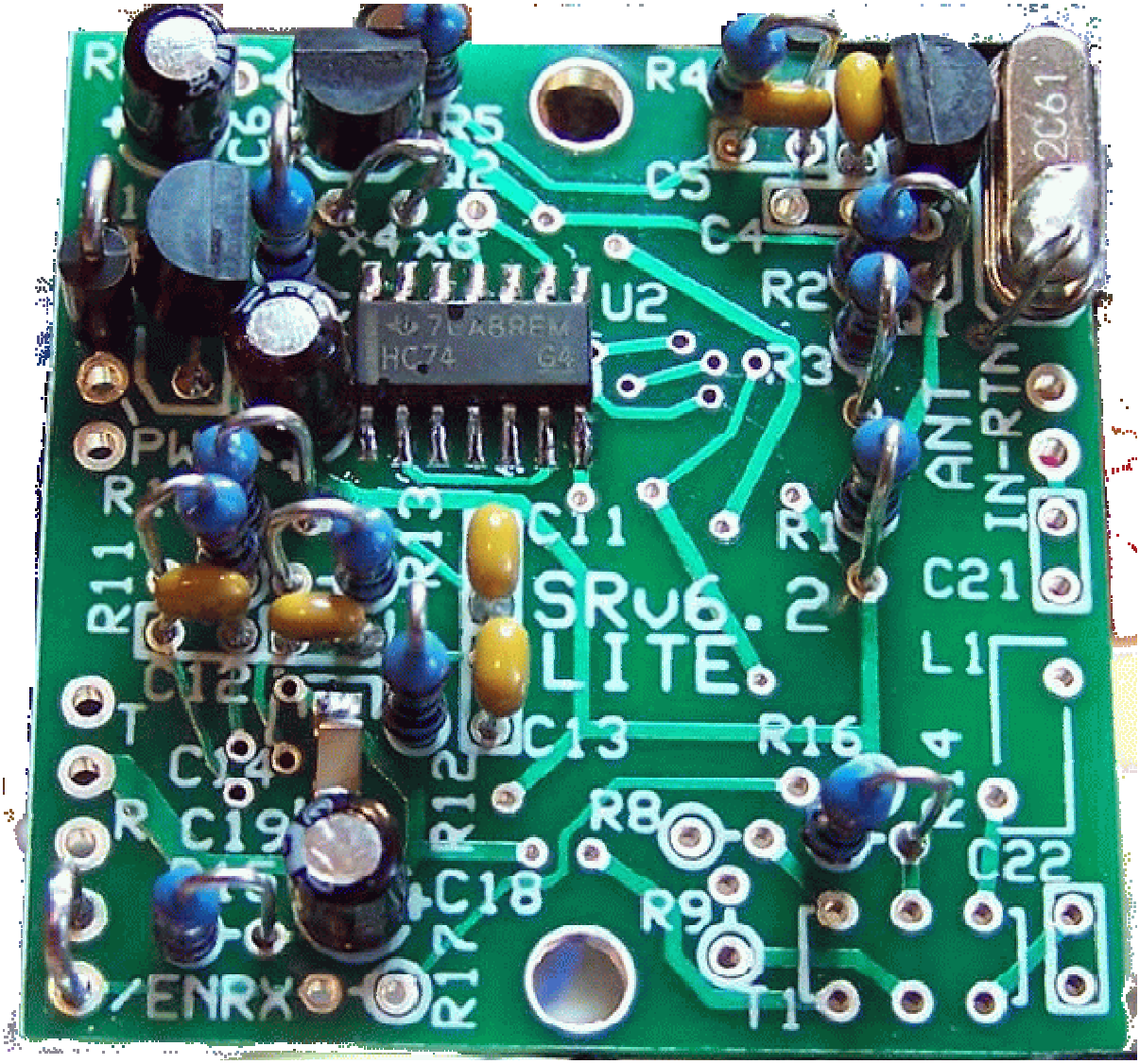
**Finally, install the five resistors (R10-R14) on the top side of the board. Note that R14 and R16 could be confused: R14 lies below R16:**

| Check | Designation | Component | Marking | Category | Orientation | Notes |
|---|---|---|---|---|---|---|
| ❑ | R10 | 10 ohm 1/4W 1% | br-blk-blk-gl-br  | 1/4W | W-E | |
| ❑ | R11 | 1 k 1/4W 1% | br-blk-blk-br-br  | 1/4W | E-W | |
| ❑ | R12 | 10 ohm 1/4W 1% | br-blk-blk-gl-br  | 1/4W | S-N | |
| ❑ | R13 | 1 k 1/4W 1% | br-blk-blk-br-br  | 1/4W | E-W | |
| ❑ | R14 | 1 k 1/4W 1% | br-blk-blk-br-br | 1/4W | W-E | |

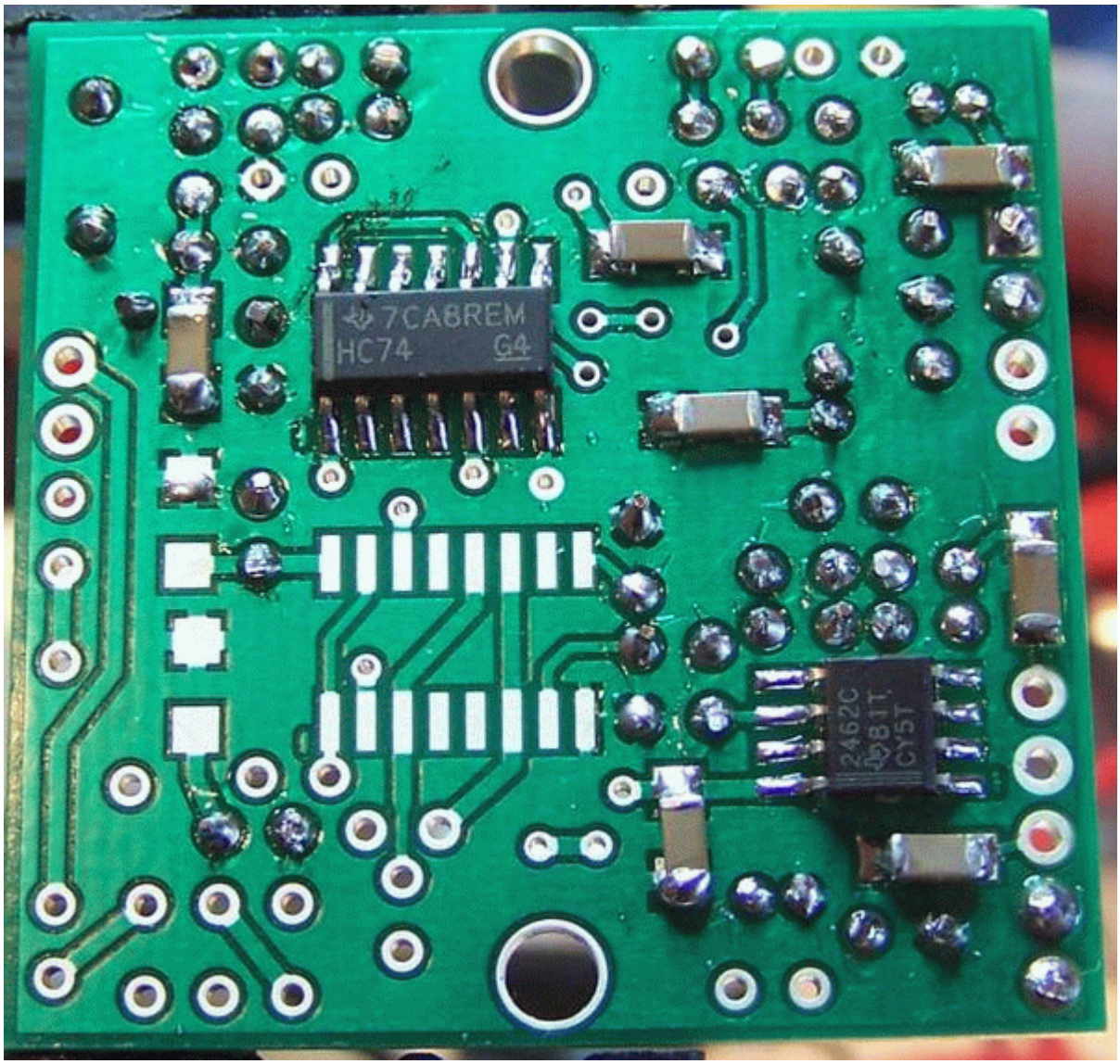
| | | | | | | |
|---|---|---|---|---|---|---|
| ❑ | R15 | 1 k 1/4W 1% | br-blk-blk-br-br | 1/4W | W-E | |

## Operational Amplifiers Completed Stage

### Top of the Board




### Bottom of the Board




# Operational Amplifiers Testing

## Warning

### Test Setup

Take appropriate ESD precautions in these tests, since you will be working around the sensitive OpAmp IC

## Visual Inspection

### Test Setup

Using very good lighting and magnification, carefully inspect the solder joints to identify bridges, cold joints, or poor contacts.

Pay especial attention to the joints on the OpAmp IC pins. If necessary, touch up the joints with your iron and/or some flux. Wick up any excess.

## Current Draw

### Test Setup

- **connect a 1k ohm resistor in series with the positive power lead**
- **apply 9 Vdc and measure the current draw with the limiting resistor in place**
- **remove the current limiting resistor**
- **apply 9 Vdc and measure the current draw without the limiting resistor**

### Test Measurements

| Testpoint | Units | Nominal Value | Author's | Yours |
|---|---|---|---|---|
| Current draw WITH 1k ohm current limiting resistor | mA | < 9 | 6.1 | _____ |
| Current draw without the limiting resistor | mA | 25-35 | 28.1 | _____ |

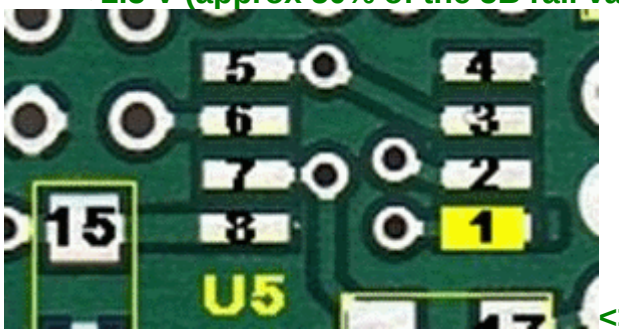
## IC Pin Voltages

### Test Setup

**In addition to using the convenient test points indicated in the table below, you should also double check by measuring the voltages on the actual IC pins (to detect the case of a poor or missing solder joint between the pin and the pad.**

**expected voltages are indicated in the table below:**

- **5 V (range of 4.5 - 5.4)**
- **2.5 V (approx 50% of the 5B rail value)**



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### Test Measurements

| Testpoint | Units | Nominal Value | Author's | Yours |
|---|---|---|---|---|
| pin 1 | Vdc | 2.5 | 2.48 | _____ |
| pin 2 | Vdc | 2.5 | 2.48 | _____ |
| pin 3 | Vdc | 2.5 | 2.48 | _____ |
| pin 4 | Vdc | 0 | 0 | _____ |
| pin 5 | Vdc | 2.5 | 2.48 | _____ |
| pin 6 | Vdc | 2.5 | 2.48 | _____ |
| pin 7 | Vdc | 2.5 | 2.48 | _____ |
| pin 8 | Vdc | 5 | 4.94 | _____ |

## Op Amp Function Test

### Test Setup

**You can test the functioning of both of the op-amps by comparing the pin-out voltages under different input resistance measurements. The test requires you to have a 1.5 k Ohm to 3.3 k Ohm resistor (of any wattage or precision) that you can temporarily connect to the circuit. The author used an available 2.2 k Ohm resistor.**

- **Power up the circuit and measure the voltage at pin 1 of the op-amp (hairpin of R11). It should be ~2.5 Vdc**
- **Power off and use clip leads to connect a 2.2 k Ohm resistor (Rt ) between the hairpin of R10 and circuit ground. (This provides an input resistance Ri) of 2210 ohms to the op-amp. <>li> Power up and measure the voltage at the hairpin of R11. You should get ~3..74 Vdc1.**
- **Remove Rt and the output voltage should go back to ~2.5 Vdc.**
- **Perform the same test for op-amp 2, substituting R12 for R10 and R13 for R11**

**An Excel spreadsheet with a calculator for this test is available for you to plug in your bridginh resistor ohms (Rt) and your pin 1 or pin 7 normal voltages (Ebias) and predict the expected voltage when brodged (Eout).**

### Test Measurements

| Testpoint | Units | Nominal Value | Author's | Yours |
|---|---|---|---|---|
| Normal pin 1 (R1 not connected) | Vdc | 2.4 - 2.5 | 2.5 | _____ |
| pin 1 bridged with 2.2k resistor | Vdc | 3.6 - 3.75 | 3.63 | _____ |
| normal pin 7 | Vdc | 2.4 - 2.5 | 2.5 | _____ |
| pin 7 bridged with 2.2k resistor | Vdc | 3.6 - 3.75 | 3.63 | _____ |