## NCS5651MNSG Evaluation Board User's Manual

#### Introduction

The NCS5651MNSGEVB is an evaluation board for the NCS5651 operational amplifier.

The NCS5651 is a high efficiency, class B, low distortion power line driver. It incorporates two operational amplifiers (opamps). The output opamp is designed to drive up to 2 A peak. At an output current of 1.5 A, the output voltage is guaranteed to swing within 1 V or less of either rail, giving the user improved SNR. In addition to the output amplifier, a small-signal opamp is provided which can be configured as a unity gain follower buffer or can provide a stage of a 4-pole low pass filter.

Although the NCS5651 is designed for power line communication (PLC) applications, it is equally suitable to drive actuators or motors, or for any application where a robust power amplifier is required.

For more information refer to [1, 2, 3].



### **ON Semiconductor®**

www.onsemi.com

## **EVAL BOARD USER'S MANUAL**

#### Description

The evaluation boards are small  $(26 \times 23.5 \text{ mm}^2)$  printed circuit boards (Figure 1) carrying the NCS5651 line driver. The schematic is appended at the end of this document.

An NCP4640H033 linear regulator is provided to derive the 3.3 V  $V_{uc}$  voltage. The latter determines the output voltage of the warning output pins of the line driver. These three pins (viz. the thermal warning flag, the thermal shutdown flag, and the current limitation flag) are connected to LEDs.

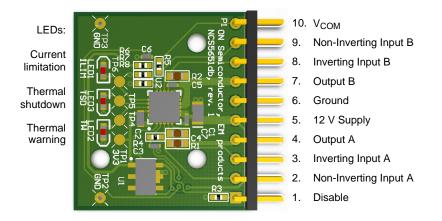


Figure 1. NCS5651MNSGEVB Outline

A 2.54 mm-pitch header with ten pins brings the most important signals outside.

Besides the ground and 12 V supply pin, these include the line driver disable and 6 V  $V_{com}$  bias voltage generated by the line driver. Both signals can be left open if unused.

All pins of the two operational amplifiers are available on the header. As a result, any opamp topology can be realized by fitting the appropriate external feedback and biasing network. To ensure stability, 10 pF ceramic capacitors are fitted on the board between the inverting input and the output of each opamp. This must be taken into account if an external capacitance is added, as is the case with a multi-feedback (MFB) topology.

For convenience, a 3 k $\Omega$  resistor is also fitted between the non-inverting input and V<sub>com</sub>. If this biasing is not required, for instance to realize a Sallen and Key filter topology, the resistor should be removed.

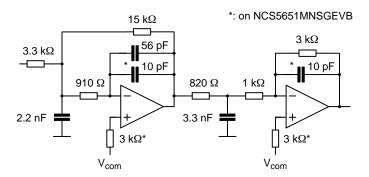


Figure 2. Recommended Transmission Filter for PLC with PL110 Carrier Frequencies

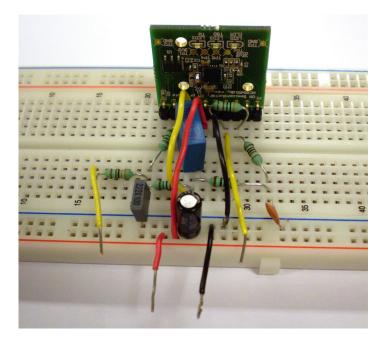


Figure 3. The Schematic of Figure 2 Built on Breadboard with an NCS5651MNSGEVB

#### **Application Ideas**

The size and header of the evaluation board make it perfectly suited for breadboarding. For instance, Figure 2 shows the recommended transmission filter for PLC S–FSK\* with the PL110 carrier frequencies (105 and 115 kHz). This schematic is easily realized on breadboard (Figure 3).

Some applications require a lower copper-to-ambient thermal resistance ( $R_{CuA}$ ) to improve line driver cooling. The board design makes it possible to fit a heat sink on the bottom side: solder mask openings and mounting holes are foreseen.

The heat sink can be mounted with thermally conducting adhesive tape (Figure 4). For more information on cooling, refer to [1, 4].

Fischer Elektronik ICK SMD B 19 SA is recommended. It may be obtained through Farnell (ref. 4302266) or Newark (ref. 34M6437).

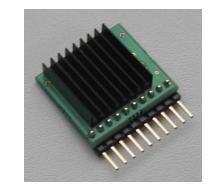
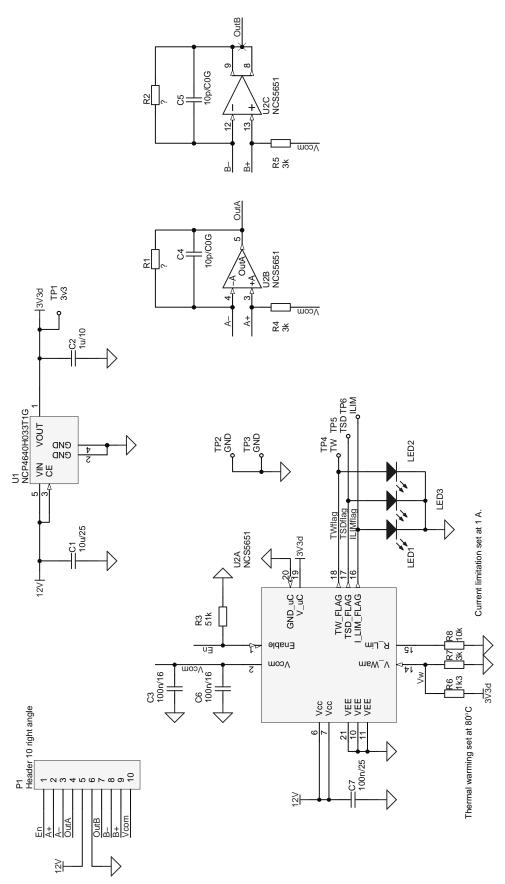


Figure 4. Adding a Heat Sink to Improve Cooling

\*Spread-frequency shift keying (S–FSK) is a modulation scheme widely used in power line communication (PLC). It combines simplicity (and thus allows a low cost implementation) with good resilience.





#### References

- [1] ON Semiconductor. Evaluation kit for power-line communication user manual, December 2014.
- [2] ON Semiconductor. Getting started with power line communication (application note AND9165/D), June 2014. Online at <u>www.onsemi.com/pub\_link/</u> <u>Collateral/AND9165–D.PDF.</u>
- [3] ON Semiconductor. NCS5651 2 Amp PLC line driver datasheet, December 2014.
  Online at <u>www.onsemi.com/pub\_link/</u> <u>Collateral/NCS5651–D.PDF.</u>
- [4] ON Semiconductor, Roger Stout. Thermal considerations for the NCS5651 (application note AND8402/D), August 2014. Online at <u>www.onsemi.com/pub\_link/</u> <u>Collateral/AND8402–D.PDF.</u>

ON Semiconductor and the 🛄 are registered trademarks of Semiconductor Components Industries, LLC (SCILLC) or its subsidiaries in the United States and/or other countries. SCILLC owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of SCILLC's product/patent coverage may be accessed at www.onsemi.com/site/pdt/Patent-Marking.pdf. SCILLC reserves the right to make changes without further notice to any products herein. SCILLC makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does SCILLC assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. "Typical" parameters which may be provided in SCILLC data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. SCILLC does not convey any license under its patent rights nor the rights of others. SCILLC products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the SCILLC product could create a situation where personal injury or death may occur. Should Buyer purchase or use SCILLC for any such unintended or unauthorized application, Buyer shall indemnify and hold SCILLC and its officers, employees, subsidiaries, affliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that SCILLC was negligent regarding the des

#### PUBLICATION ORDERING INFORMATION

#### LITERATURE FULFILLMENT:

Literature Distribution Center for ON Semiconductor P.O. Box 5163, Denver, Colorado 80217 USA Phone: 303–675–2175 or 800–344–3860 Toll Free USA/Canada Fax: 303–675–2176 or 800–344–3867 Toll Free USA/Canada Email: orderlit@onsemi.com N. American Technical Support: 800–282–9855 Toll Free USA/Canada Europe, Middle East and Africa Technical Support:

Phone: 421 33 790 2910 Japan Customer Focus Center Phone: 81–3–5817–1050 ON Semiconductor Website: www.onsemi.com

Order Literature: http://www.onsemi.com/orderlit

For additional information, please contact your local Sales Representative