# NCS5652, NCV5652

# Dual Power Operational Amplifier

### Description

The NCx5652 is a dual power operational amplifier with a versatile output stage configuration that allows conventional op−amp biasing or user tuning of efficiency, isolation, or current monitoring. Integrated flyback diodes protect the amplifiers during inductive load transients. Operating at supply voltages as low as 3.3 V, the NCx5652 is capable of delivering 500 mA of current while maintaining an excellent output swing. The integrated thermal shutdown circuit protects the NCx5652 from excessive power dissipation. A thermal warning flag is provided for external monitoring of the device, providing a flexible interface to a system's microcontroller. This open−collector thermal flag output doubles as a $\overline{\text{DISABLE}}$ input that can be used to tri−state both amplifier outputs under user control. The 12−pin UDFN 3x3 mm package provides thermal robustness while achieving space savings on high density PCBs.

### Features

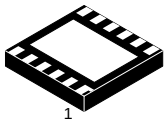
- Operating Supply Voltage Range: 3.3 V to 13.2 V
- Output Supply Voltage Range: 3.3 V to 13.2 V
- High Current Drive: 500 mA Operating
- Thermal Flag: Open−collector for Flexible Interface
- Thermal Shutdown/ Disable Function
- Output Short Circuit Tolerable (1 A to Source or Ground)
- No Power Sequencing Required ($V_{CC}$, VC1, VC2)
- UDFN12 Package Features Wettable Flank for Improved Solderability
- NCV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC−Q100 Qualified and PPAP Capable
- These Devices are Pb−Free, Halogen Free/BFR Free and are RoHS Compliant

### Typical Applications

- Telecom
- Vcom Driver
- Small DC Brush Motors
- LED String Driver
- Electrochromic Driver

ON Semiconductor®

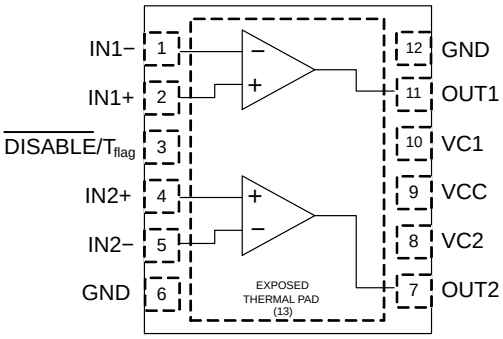
www.onsemi.com




**UDFN12**
**MU SUFFIX**
**CASE 517AM**

### MARKING DIAGRAM

N5652 = Specific Device Code
A = Assembly Location
L = Wafer Lot
Y = Year
W = Work Week
▪ = Pb−Free Package
(Note: Microdot may be in either location)




### ORDERING INFORMATION

See detailed ordering and shipping information on page 12 of this data sheet.

© Semiconductor Components Industries, LLC, 2015

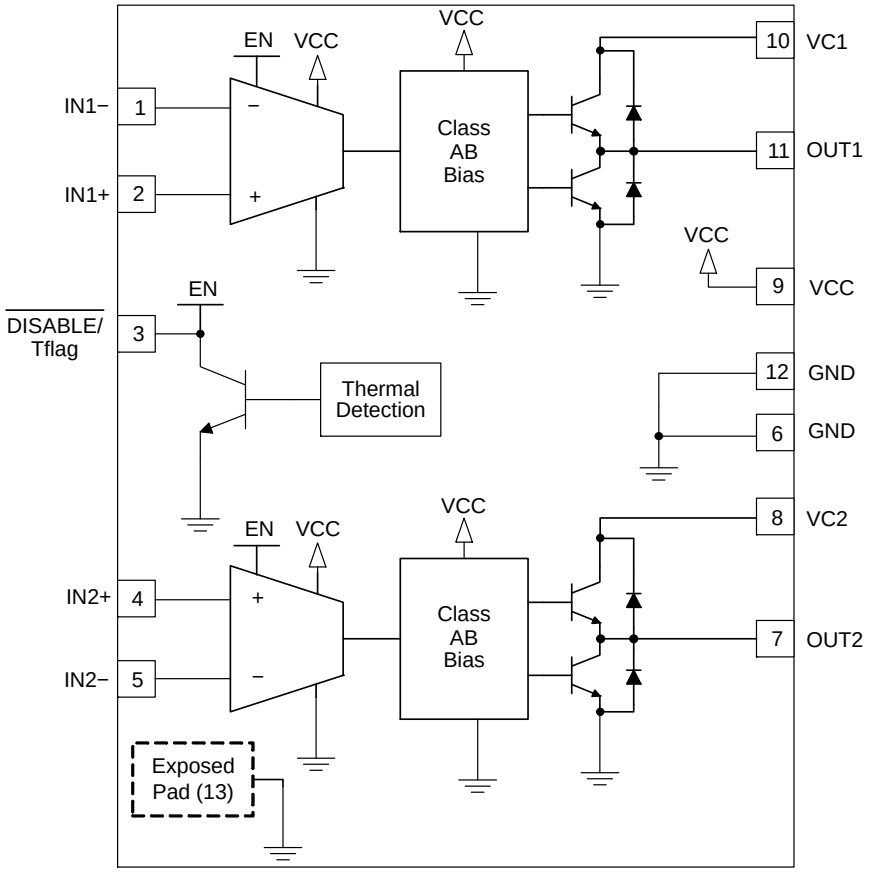



**Figure 1. Block Diagram**

**Table 1. PIN DESCRIPTION**

| Pin | Name | Type | Description |
|---|---|---|---|
| 1 | IN1− | Input | Negative input of amplifier 1. |
| 2 | IN1+ | Input | Positive input of amplifier 1. |
| 3 | $\overline{\text{DISABLE}}$/Tflag | Input/Output | Dual use pin −Thermal flag− an open collector output requiring an external pull−up resistor. The output is pulled low when the thermal limit is reached. It is high−impedance in normal operation.<br>Disable − Must use an open collector/drain for input with pull−up resistor to Vcc. Pulling pin low disables the amplifiers. If pin is not used, a pull−up resistor to Vcc is still required (10 KΩ recommended) |
| 4 | IN2+ | Input | Positive input of amplifier 2. |
| 5 | IN2− | Input | Negative input of amplifier 2. |
| 6 | GND | Power | Power ground. |
| 7 | OUT2 | Output | Output of amplifier 2. |
| 8 | VC2 | Power | Positive supply of output stage 2. |
| 9 | VCC | Power | Positive supply of core circuitry. |
| 10 | VC1 | Power | Positive supply of output stage 1. |
| 11 | OUT1 | Output | Output of amplifier 1. |
| 12 | GND | Power | Power ground. |
| 13 | EXPOSED PAD | Power | The Exposed Pad must be attached to a heat−sinking conduit and **connected to GND**. |

**Table 2. ABSOLUTE MAXIMUM RATINGS** Over operating free−air temperature, unless otherwise stated

| Parameter | Symbol | Limit | Unit |
|---|---|---|---|
| Supply Voltage ($V_{CC}$ − GND) | $V_{CC}$ | 16 | V |
| Output Supply Voltage | VC1, VC2 | 16 | V |
| **INPUT AND OUTPUT PINS** | | | |
| Differential Input Voltage | $V_{id}$ | $\pm V_{CC}$ | V |
| Input Common Mode Voltage Range | $V_{ICR}$ | −0.3 to $V_{CC}$ +0.3 | V |
| Output Current (Note 1) | $I_{OUT}$ | ±1000 | mA |
| DISABLE/Tflag Pin Voltage (Note 2) | $V_{DISABLE/Tflag}$ | 7 | V |
| **TEMPERATURE** | | | |
| Storage Temperature | $T_{STG}$ | −65 to 165 | °C |
| Junction Temperature | $T_{J(MAX)}$ | 150 | °C |
| **ESD RATINGS (Note 3)** | | | |
| Human Body Model | HBM | ±1500 (IN−, Tflag pins).<br>±2000 (All other pins) | V |
| Machine Model | MM | ±150( IN−, Tflag pins).<br>±200 (All other pins) | V |
| Charge Device Model | CDM | ±2500 | V |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. Continuous short−to−ground or source; power dissipation must be taken into consideration.
2. Connected to voltage source via a pull−up resistor.
3. This device series incorporates ESD protection and is tested by the following methods:
   ESD Human Body Model tested per AEC−Q100−002 (JEDEC standard: JESD22−A114)
   ESD Machine Model tested per AEC−Q100−003 (JEDEC standard: JESD22−A115)
   ESD Charged Device Model tested per ANSI/ESD S5.3.1−2009 (AEC−Q100−011)

**Table 3. THERMAL INFORMATION** (Note 4)

| Thermal Metric | Symbol | Limit | Unit |
|---|---|---|---|
| Junction to Ambient – UDFN12<br>(Exposed pad connected to 50 $mm^2$ one ounce copper.) | $\theta_{JA}$ | 147 | °C/W |
| Junction to Ambient – UDFN12<br>(Exposed pad connected to 1200 $mm^2$ one ounce copper.) | $\theta_{JA}$ | 52 | °C/W |

4. Based on JEDEC.

**Table 4. RECOMMENDED OPERATING CONDITIONS**

| Parameter | Symbol | Limit | Unit |
|---|---|---|---|
| Operating Supply Voltage | $V_{CC}$ | 3.3 to 13.2 | V |
| Output Supply Voltage | VC1, VC2 | 3.3 to 13.2 | V |
| Output Current (Note 5) | IC1, IC2 | ±500 | mA |
| Operating Temperature Range | $T_A$ | −40 to +125 | °C |

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

5. Power dissipation must be taken into consideration to avoid thermal shutdown.

**Table 5. ELECTRICAL CHARACTERISTICS: $V_{CC}$ = VC1 = VC2 = 5 V**
**Boldface** limits apply over the specified temperature range, $T_A$ = –40°C to +125°C.
At $T_A$ = +25°C, $R_L$ = 1 kΩ connected to midsupply, $V_{OUT}$ = midsupply, unless otherwise noted.

| Parameter | Symbol | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **INPUT CHARACTERISTICS** | | | | | | |
| Offset Voltage | $V_{OS}$ | | | 1 | **15** | mV |
| Offset Voltage Drift | δV/δT | | | 2 | | μV/°C |
| Input Bias Current | $I_{IB}$ | | | 550 | **1000** | nA |
| Input Offset Current | $I_{OS}$ | | | 10 | **100** | nA |
| Input Common Mode Range (Note 6) | $V_{CM}$ | | 0 | | **3.8** | V |
| Common Mode Rejection Ratio | CMRR | | 90 | 100 | | dB |
| **OUTPUT CHARACTERISTICS (OUT1, OUT2)** | | | | | | |
| Output Voltage High (Note 7) | $V_{OH}$ | $V_{id}$ = 1 V, $I_O$ = +250 mA | 4.0 | 4.15 | | V |
| Output Voltage Low | $V_{OL}$ | $V_{id}$ = −1 V, $I_O$ = −250 mA | | 200 | 350 | mV |
| **DYNAMIC PERFORMANCE** | | | | | | |
| Open Loop Voltage Gain | $A_{VOL}$ | | 90 | 105 | | dB |
| Gain Bandwidth Product | GBWP | $R_L$ = 47 Ω, $C_L$ = 100 nF | | 350 | | kHz |
| Gain Margin | $A_M$ | $R_L$ = 47 Ω, $C_L$ = 100 nF | | 6 | | dB |
| Phase Margin | ψM | $R_L$ = 47 Ω, $C_L$ = 100 nF | | 45 | | ° |
| Slew Rate | SR | | | 1.5 | | V/μs |
| **POWER SUPPLY** | | | | | | |
| Power Supply Rejection Ratio | PSRR | $V_{CC}$ = VC1 = VC2 = 3.3 V to 13.2 V | 65 | 75 | | dB |
| Quiescent Current (Operating) | $I_{CC}$ | No $R_L$, $C_L$ = 100 nF | | 3 | **4** | mA |
| Quiescent Current (Output) | $I_{C1}$, $I_{C2}$ | (Per op amp) No $R_L$, $C_L$ = 100 nF | | 4 | **6** | mA |
| **THERMAL CHARACTERISTICS** | | | | | | |
| Thermal Shutdown (Note 8) | $T_{SHUTDOWN}$ | | | 160 | | °C |
| **LOGIC CHARACTERISTICS ($\overline{\text{DISABLE}}$/Tflag)** | | | | | | |
| Output Voltage Low (Note 6) | $V_{OL}$ | $I_{OL}$ = 1 mA | | | 0.7 | V |
| Input Voltage High (Note 9) | $V_{IH}$ | | 1.5 | | | V |
| Input Voltage Low (Note 10) | $V_{IL}$ | | | | 1.1 | V |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.
6. $V_{CM}$ is a function of $V_{CC}$ ($V_{CC}$ – 1.2 V).
7. $V_{OH}$ is a function of $V_{CC}$ ($V_{CC}$ − 0.8 V).
8. Guaranteed by design/characterization.
9. $\overline{\text{DISABLE}}$/Tflag pin with a pull−up resistor for sourcing.
10. $\overline{\text{DISABLE}}$/Tflag pin with an open collector/drain for sinking.

## TYPICAL CHARACTERISTICS

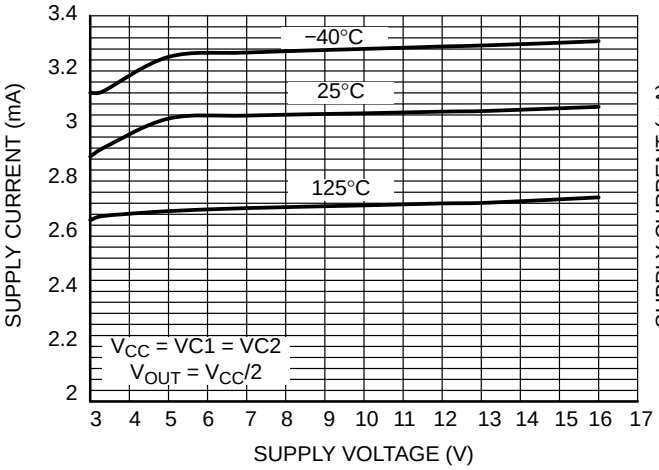



**Figure 2. $I_{CC}$ Quiescent Current vs. Supply Voltage over Temperature**

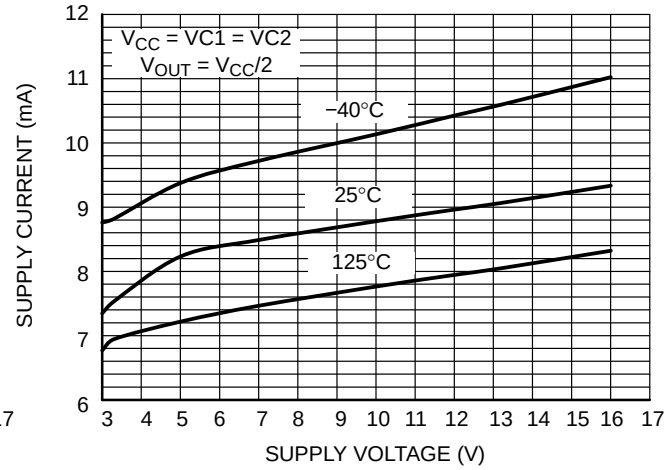



**Figure 3. Ic Quiescent Current vs. Supply Voltage over Temperature (Ic1, Ic2 combined)**

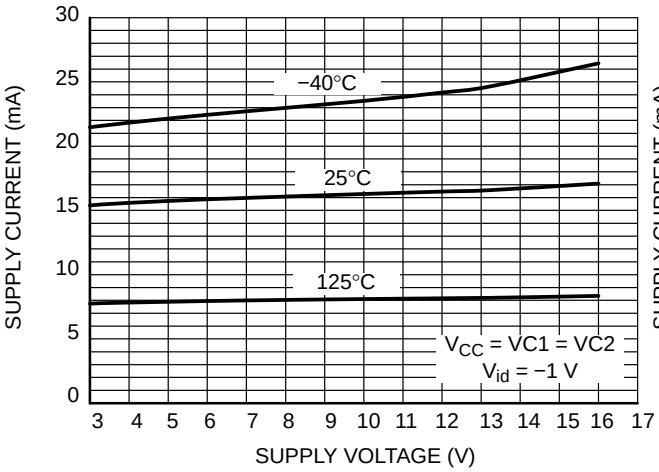



**Figure 4. Comparator Mode (Negative), $I_{CC}$ Quiescent Current vs Supply Voltage**

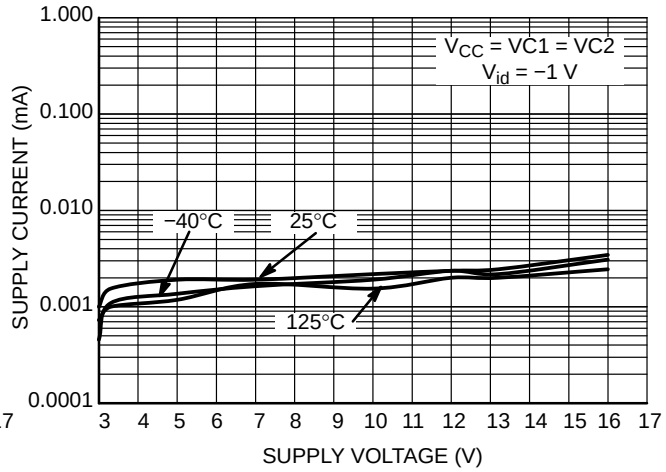



**Figure 5. Comparator Mode (Negative), Ic Quiescent Current vs Supply Voltage (Ic1,Ic2 Combined)**

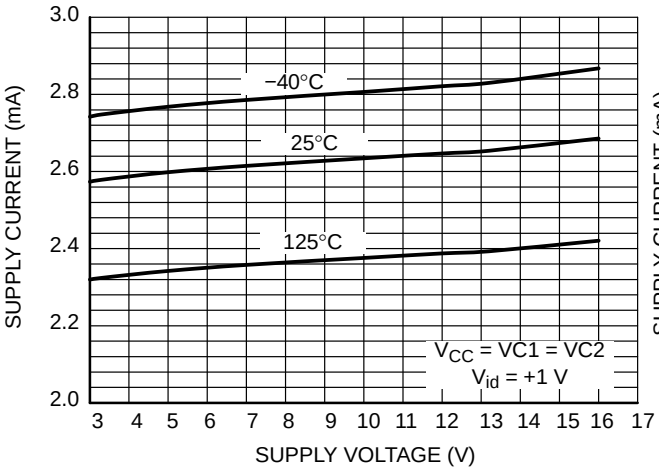



**Figure 6. Comparator Mode (Positive), $I_{CC}$ Quiescent Current vs Supply Voltage**

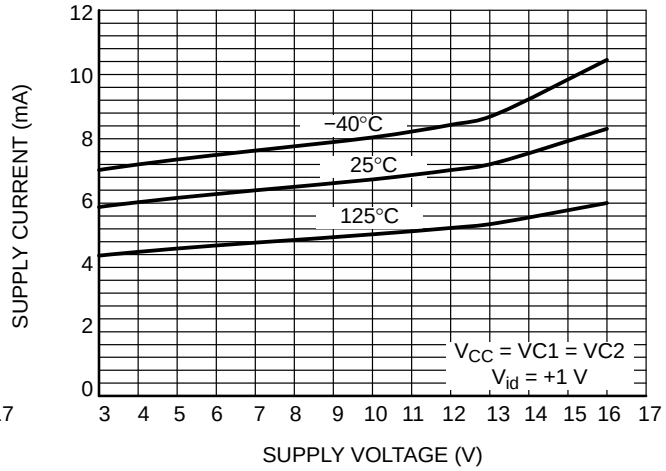



**Figure 7. Comparator Mode (Positive), Ic Quiescent Current vs Supply Voltage (Ic1,Ic2 Combined)**

## TYPICAL CHARACTERISTICS

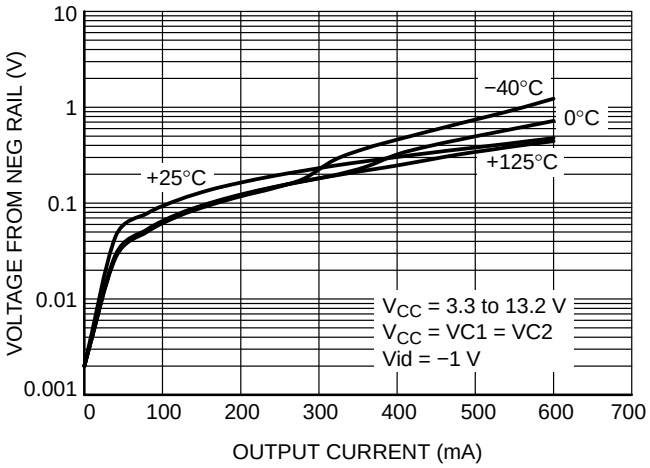



**Figure 8. Low Level Output Voltage vs. Output Current Over Temperature**

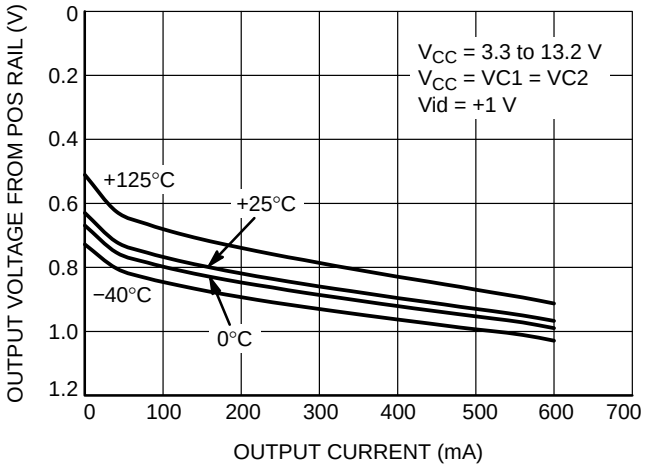



**Figure 9. High Level Output Voltage vs. Output Current Over Temperature**

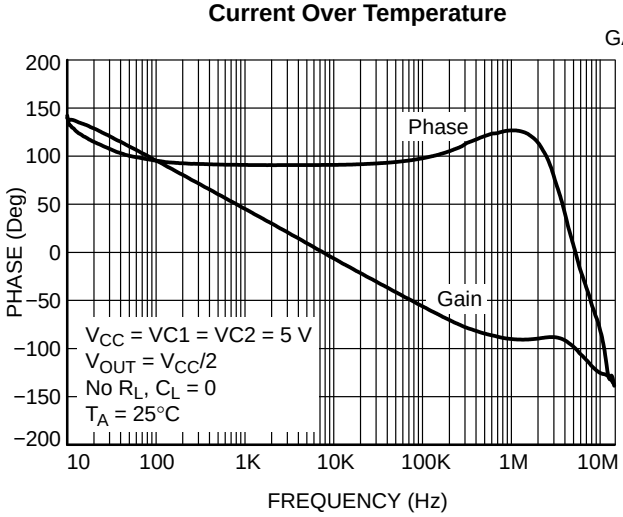



**Figure 10. Open Loop Gain/Phase (No $R_L$, $C_L$ = 0)**

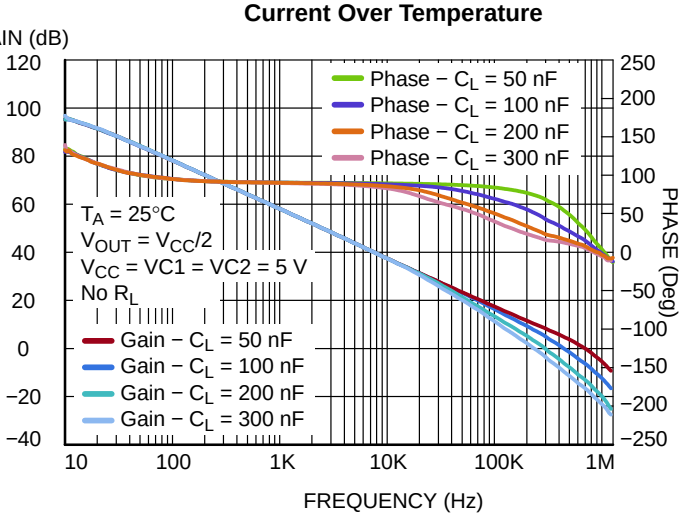



**Figure 11. Open Loop Gain/Phase (No $R_L$, $C_L$ = Varied)**

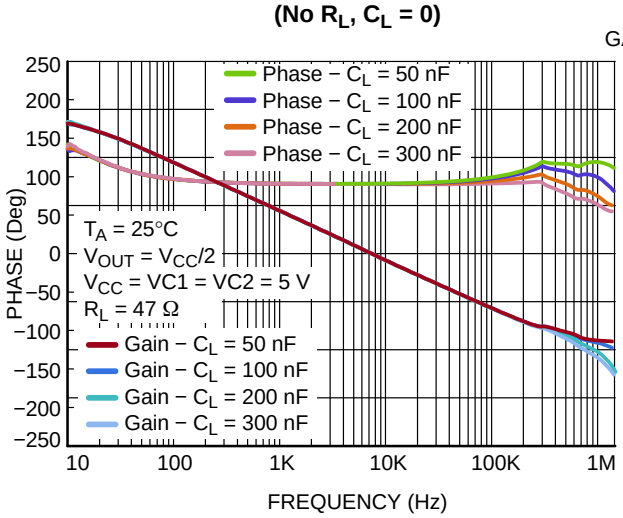



**Figure 12. Open Loop Gain/Phase ($R_L$ = 47 Ω, $C_L$ = Varied)**

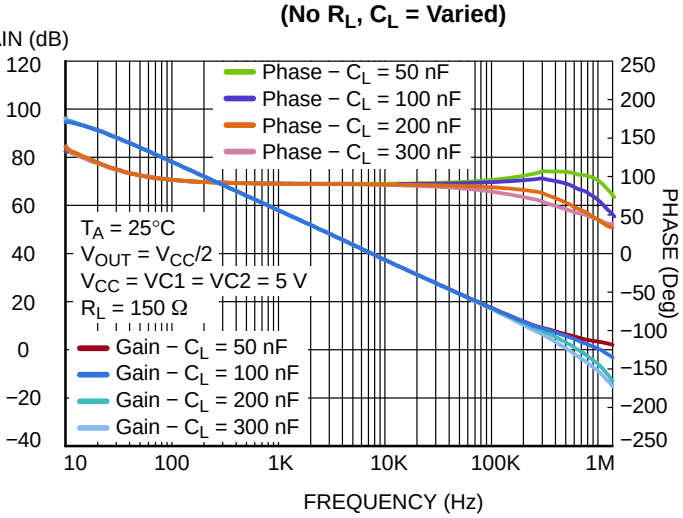



**Figure 13. Open Loop Gain/Phase ($R_L$ = 150 Ω, $C_L$ = Varied)**

## TYPICAL CHARACTERISTICS

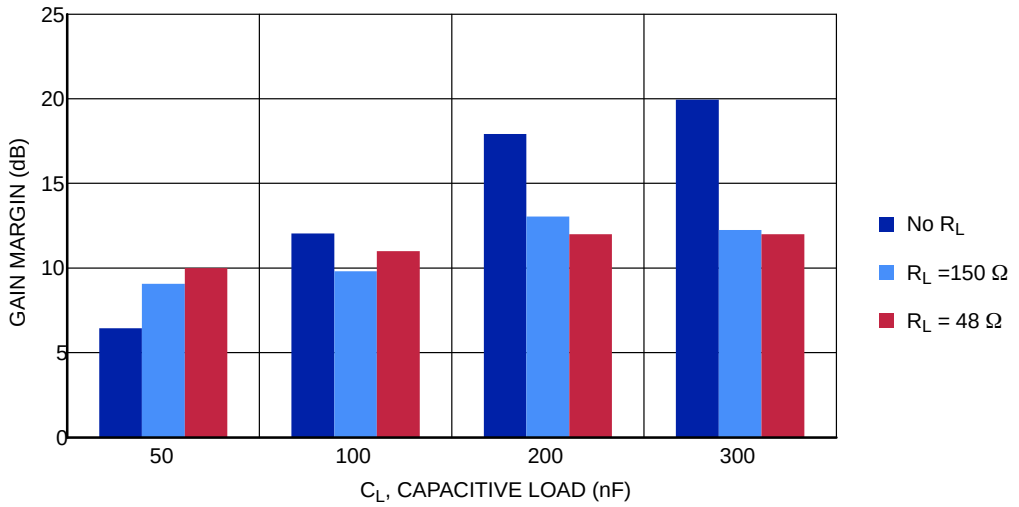



**Figure 14. Gain Margin vs. Load**

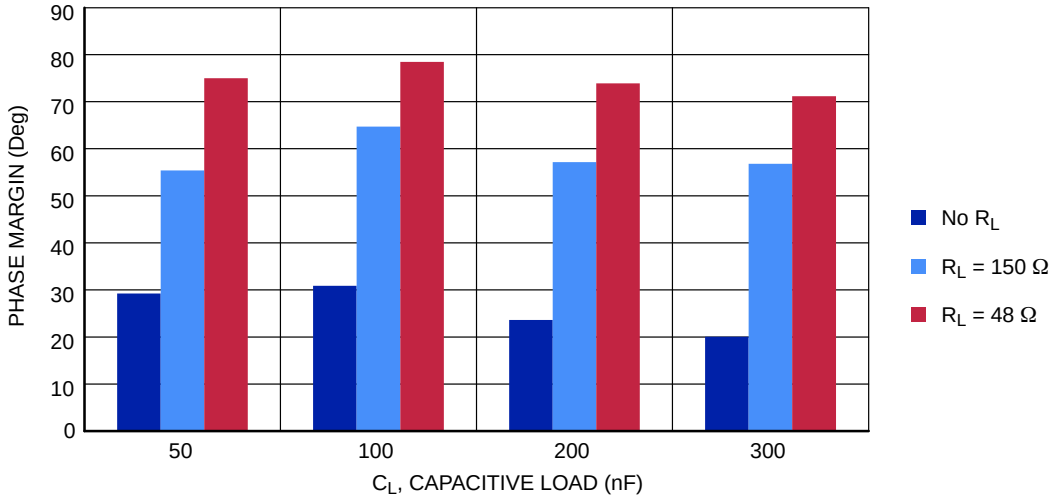



**Figure 15. Phase Margin vs. Load**

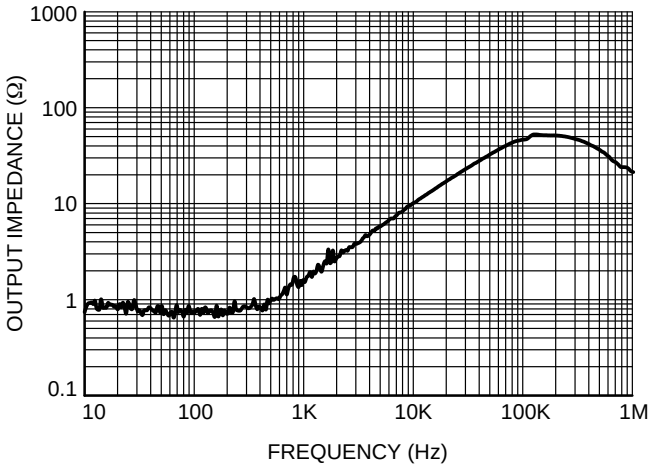



**Figure 16. Open Loop Output Impedance vs. Frequency**

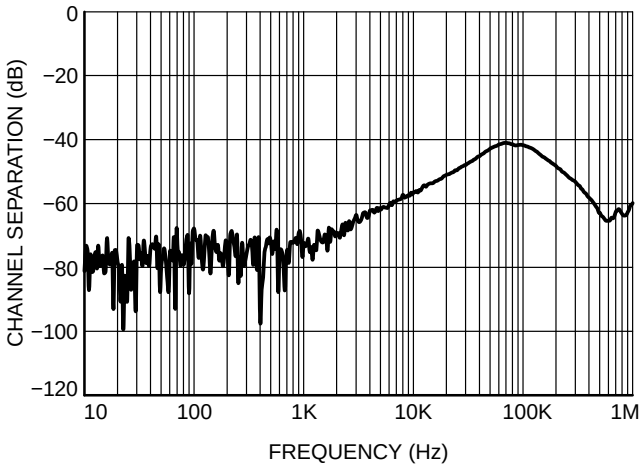



**Figure 17. Channel Separation vs. Frequency**

## TYPICAL CHARACTERISTICS

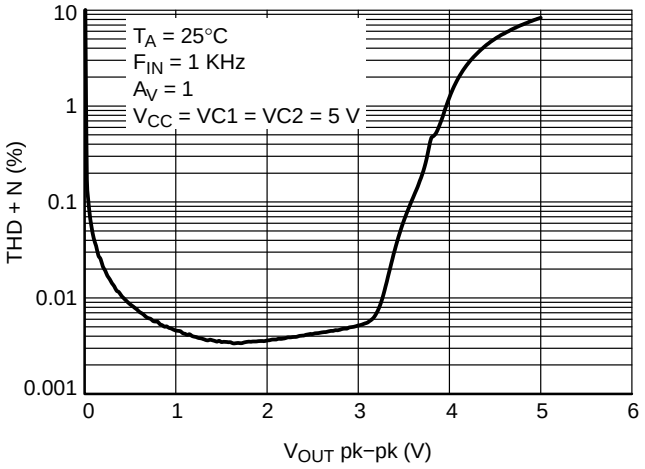



**Figure 18. Total Harmonic Distortion + Noise vs. Vout**

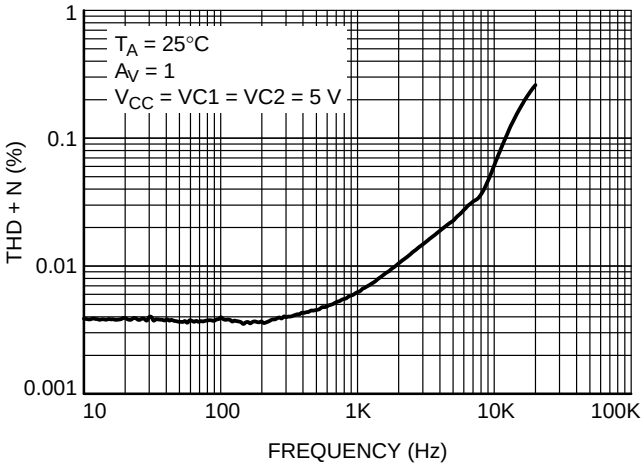



**Figure 19. Total Harmonic Distortion + Noise vs. Frequency**

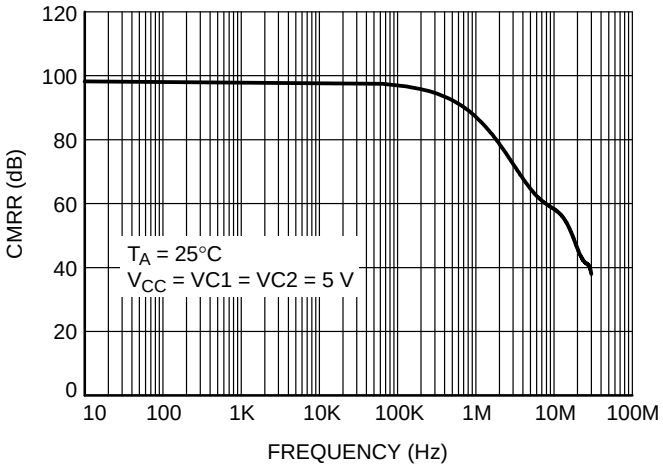



**Figure 20. CMRR vs. Frequency**

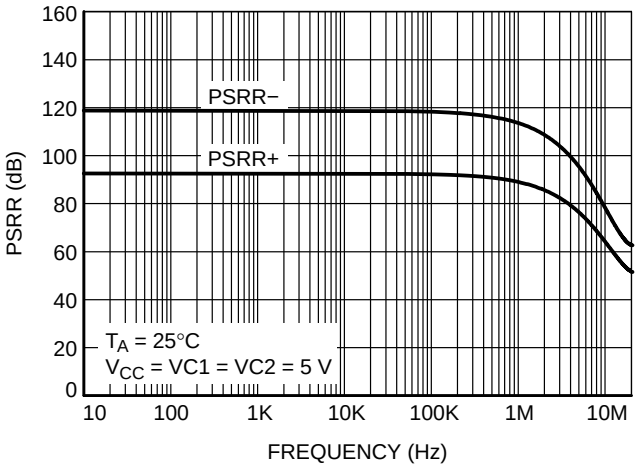



**Figure 21. PSRR vs. Frequency**

## APPLICATIONS INFORMATION

Figure 22 shows a typical application on how to connect the NCx5652 pins where the $V_{CC}$ is supplied by 5 V and the output stages are supplied with 12 V. In this configuration the inputs can be driven up to 3.8 V. The outputs can be as high as 4 V and able to go near ground due to the excellent $V_{OL}$ parameters. The loads can be up to 500 mA continuous.

### Power Supply

The supply pins should be properly bypassed with ceramic 0.1 μF to 1 μF capacitors. The different supply pins for the input stage ($V_{CC}$) and the output stage (VC1,VC2) provide a flexible power option. In many applications there is often a digital supply and different supply for driving motors or elements. The output stage can be optimized for the voltage requirements of the load. There are no requirements on the voltage levels (as long as they are within specification) and sequencing of the $V_{CC}$, VC1, and VC2 pins. It should be noted that the input and output swings are a function of $V_{CC}$. The common mode voltage range and output swings are specified in the electrical section according to the $V_{CC}$ voltage.

### Shutdown Feature

The NCx5652 provides a thermal shutdown feature to protect the device during fault conditions (See Output Short Circuit Protection section). Pin 3 is an open collector output that can be connected to a microcontroller to alert the system that a thermal shutdown has occurred. The thermal shutdown circuit has approximately 20°C hysteresis. When the device is in a thermal shutdown condition, the outputs are tri−stated. The same pin can be used for an input as well. It can be open collector OR'd so that the microcontroller can disable the device by driving this pin low. This pin must always be pulled high via a 10 kΩ resistor (recommended value). It should always be driven with an open collector/drain device. Some microcontrollers have open drain configurable outputs.

### Stability

The NCx5652 is designed to drive large capacitive loads and not oscillate even at unity gain. It is recommended that a minimum of 0.1 μF capacitor be placed on the outputs to ensure stability. This is mainly required for no load or light load conditions. If configuring the device as a follower, it is also recommended to use a 10 kΩ feedback resistor as shown in **Figure 22**.

### Thermal Considerations

As power in the NCx5652 increases, it might become necessary to provide some thermal relief. The maximum power dissipation supported by the device is dependent upon board design and layout. Mounting pad configuration on the PCB, the board material, and the ambient temperature affect the rate of junction temperature rise for the part. When the NCS5652 has good thermal conductivity through the PCB, the junction temperature will be relatively low with high power applications. The maximum dissipation the NCx5652 can handle is given by:

$$P_{D(MAX)} = \frac{\left[T_{J(MAX)} - T_A\right]}{R_{\theta JA}} \qquad \text{(eq. 1)}$$

Since $T_J$ is not recommended to exceed 150°C, then the NCx5652 soldered on 1200 $mm^2$, 1 oz copper area, FR4 can dissipate up to 2.5 W when the ambient temperature ($T_A$) is 25°C.

### Output Short Circuit Protection

The NCx5652 is designed to withstand short circuits on the outputs. With proper application design, the outputs can be shorted to ground or to a source up to 16 V without damage. Depending on the ambient temperature and thermal conductivity of the PCB, the device may enter thermal shutdown during a short circuit event. Even though the thermal shutdown disables the outputs, the application should not allow the outputs to be enabled continuously during a short circuit event when a thermal shutdown occurs. The $\overline{\text{DISABLE}}$/Tflag pin (pin 3) should be monitored to recognize when a thermal shutdown event happens. And then respond within 5ms to disable the outputs for a minimum of 5 seconds (DIS and $DIS_{HOLD}$ parameters in Figure 23). This low duty cycle keeps the device average junction temperature in a safe zone.

- Output Short to Source

When it is possible that the NCx5652 can be shorted to a source higher than VC1, VC2, a diode (D1) should be used to prevent current flow going back to the VC1,VC2 source as shown in Figure 22. The worst case for this event is when $V_{OUT}$ is low ($V_{OL}$). Figure 23 shows a diagram short from low to high ($V_{OUT}$ = $V_{OL}$ shorted to 12 V−16 V). Note that when the short circuit current ($I_{SC}$) is low, the device is either operating normal or the outputs are disabled (tri−stated). Table 6 shows typical values for $I_{SC-PK}$ and $I_{SC-CLAMP}$. The parameter $I_{SC-HOLD}$ is the time it takes the device to enter thermal shutdown. This parameter varies depending on the ambient temperature and the thermal conductivity of the PCB. If the device thermal limit is not reached, the output current will stay clamped to the $I_{SC-CLAMP}$ value.

As stated earlier, the device should be disabled as soon as thermal shutdown occurs (noted by $T_{SHDN}$ in figure 23). After $T_{SHDN}$ occurs the device thermal shutdown circuit will disable the outputs for approximately 20ms before enabling them again (a characteristic from the thermal shutdown hysteresis). To allow variations of conditions, it is recommended that the microcontroller responds within 5ms (DIS parameter in Table 6) to keep pin 3 low. After a minimum of 5 seconds the microcontroller can then enable the outputs (indicated by the EN in Figure 23). This cycle will repeat until the short is removed from the outputs. Figures 24 thru 26 show some typical values for an example

application using a 1200 mm$^2$ one ounce copper PCB. The microcontroller disables the outputs 1ms after detecting the thermal shutdown. Note that at −40°C thermal shutdown does not happen. Again the $I_{SC-HOLD}$ parameter will vary with temperature and PCB characteristics.

It is possible that a short from low to high can disable the outputs and not cause a thermal shutdown. When the short is pulled significantly higher than VCC (8−9 V), the high−side NPN protection circuit will be activated. This protection circuitry will turn off the current source providing the drive current to the output stage. This results in a very short $I_{SC-PK}$ pulse and then disables the output. The output is disabled until the short is removed.

- Output short to ground

When possible, it is recommended that the application use current limiting resistors to limit the output current to 1 A maximum when shorted to ground. This method helps distribute the heat between the NCx5652 and the current limiting resistors during normal operation and for a short to ground condition. Say that Figure 22 application example will have a 3 V maximum output with a full load of 300 mA. The $R_{ILIM}$ resistors of 27 Ω are chosen so the voltage drop across them will be greater than 3 V at a full load of 300 mA. (VC1 = VC2 = 12 V – $V_{D1}$− ($R_{ILIM}$ * 300 mA) = 3.2 V).

Worst case is the voltage across $R_{ILIM}$ will be ~ 11.3 V. So maximum current = 11.3 V / 27 Ω ~ 420 mA.

If the power dissipation exceeds the thermal shutdown limit, the thermal shutdown circuit will disable the outputs. As discussed with the low to high short above, the microcontroller should disable the outputs within 5 ms and not enable them again for 5 seconds.

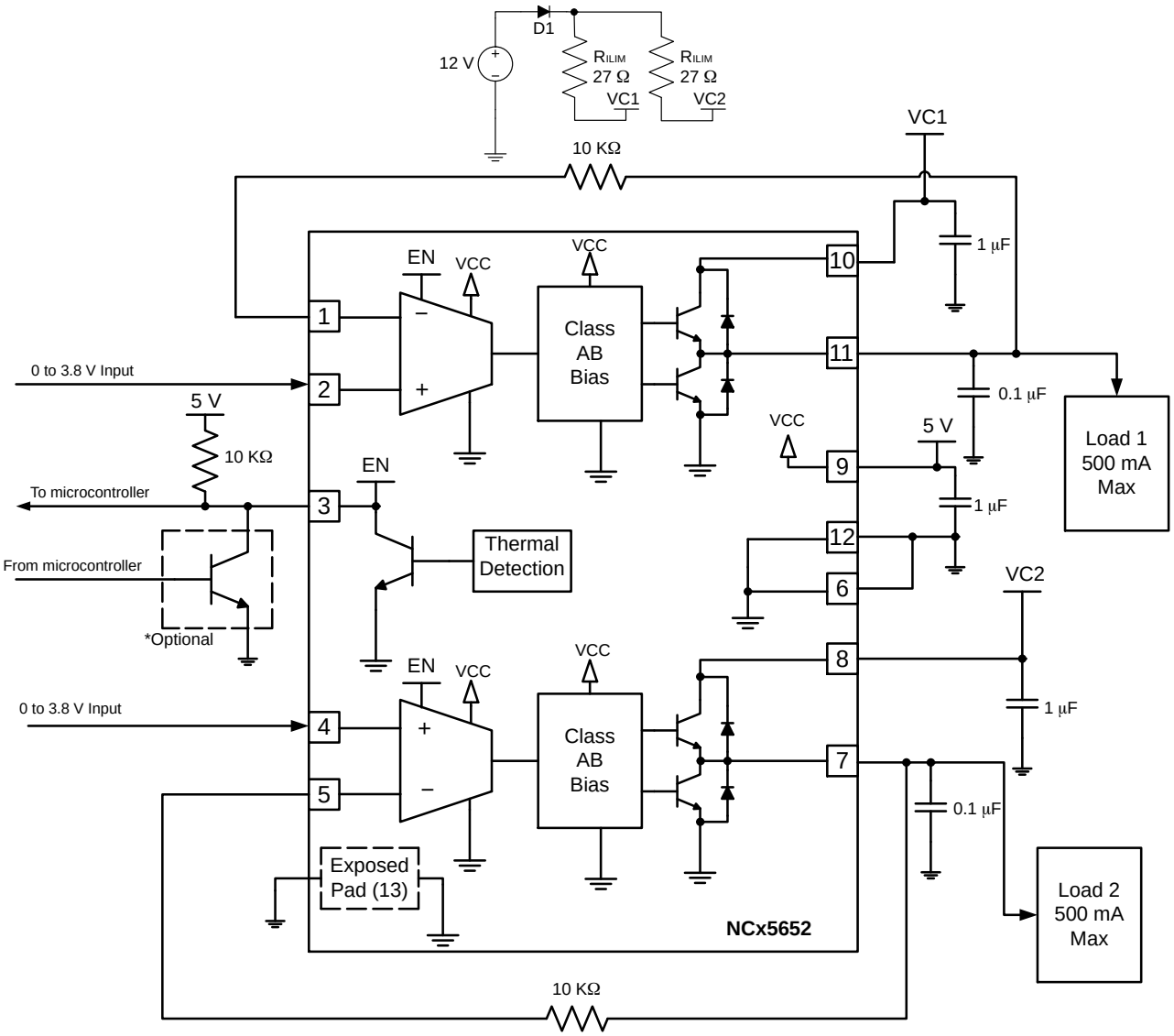



**Figure 22. NCx5652 Application Diagram**

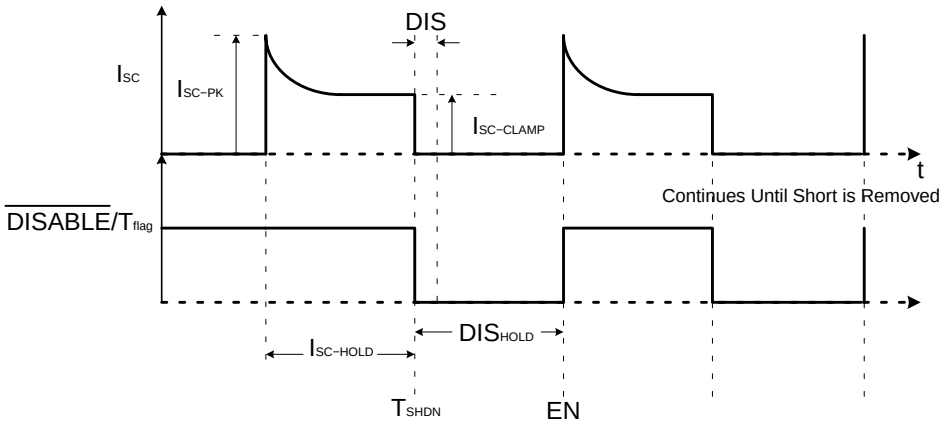



**Figure 23. Output Short to Source. Output = $V_{OL}$ Shorted to 12−16 V**

**Table 6. SHORT CIRCUIT PARAMETERS**

| Parameter | Symbol | Min | Typ | Max | Units |
|---|---|---|---|---|---|
| Peak Instantaneous Short Current | $I_{SC-PK}$ | | 1000 | | mA |
| Short−Circuit Clamping Current | $I_{SC-CLAMP}$ | | 600 | | mA |
| Disable Response Time after Thermal Shutdown | DIS | 5 | | | ms |
| Disable Hold Time | $DIS_{HOLD}$ | 5 | | | seconds |
| Short Circuit Hold Time* | $I_{SC-HOLD}$ | | Varies | | |

*Short circuit hold time is dependent on ambient temperature and printed circuit board characteristics.

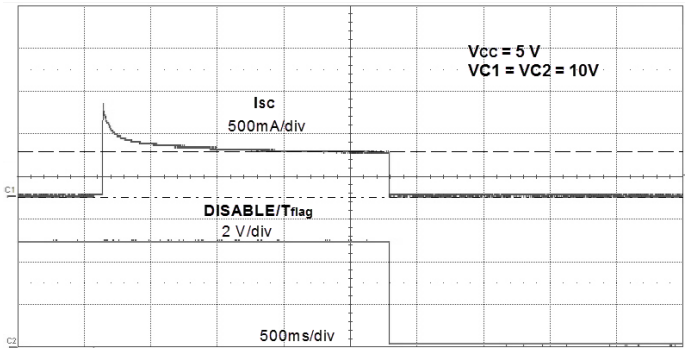



**Figure 24. Output Short to Source. Output = $V_{OL}$ Shorted to 12 V, $T_A$ = 25°C**

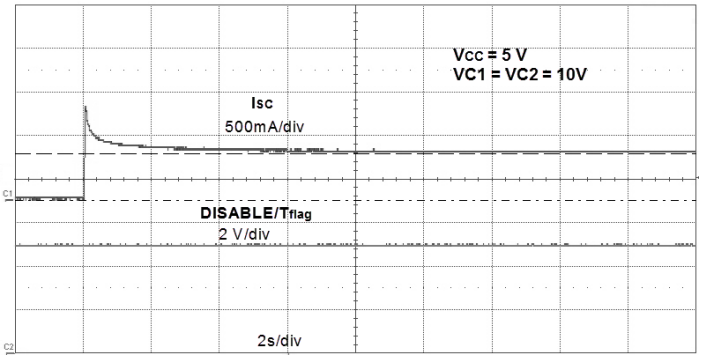



**Figure 25. Output Short to Source. Output = $V_{OL}$ Shorted to 12 V, $T_A$ = −40°C**

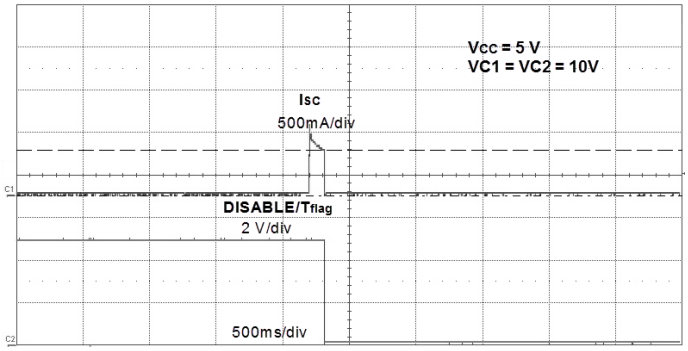



**Figure 26. Output Short to Source. Output = $V_{OL}$ Shorted to 12 V, $T_A$ = 125°C**

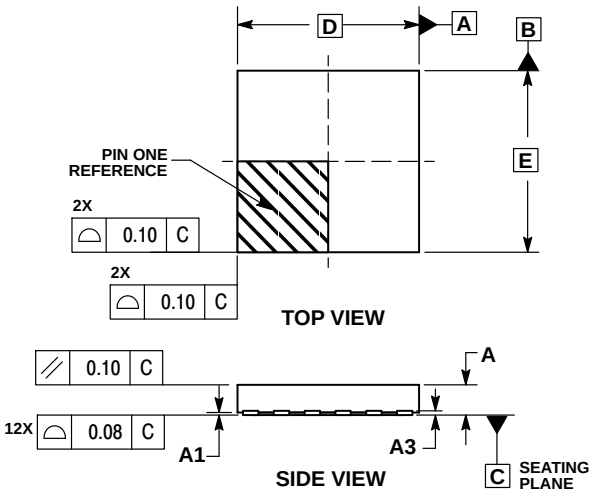
## ORDERING INFORMATION

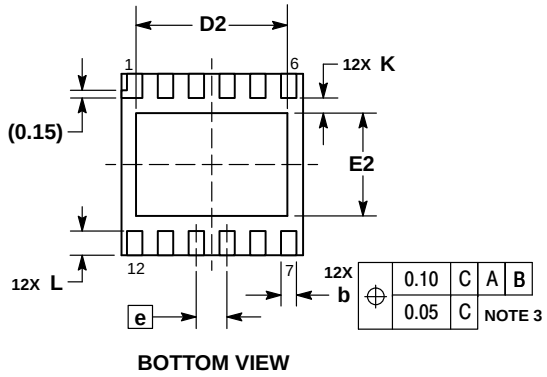
| Device | Automotive | Marking | Package | Shipping † |
|---|---|---|---|---|
| NCS5652MUTWG | No | N5652 | UDFN12, 3x3 mm<br>Pb−Free | 3000 / Tape & Reel |
| NCV5652MUTWG | Yes | N5652 | UDFN12, 3x3 mm<br>Pb−Free | |

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

## PACKAGE DIMENSIONS

**UDFN12 3x3, 0.5P**
CASE 517AM
ISSUE O

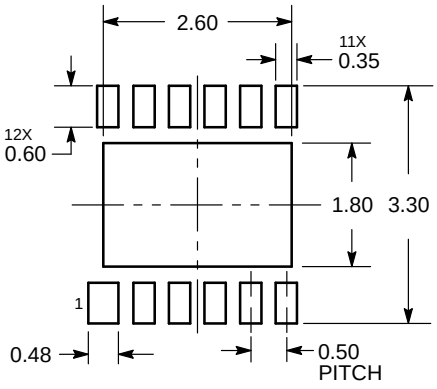



NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.15 AND 0.30 MM FROM TERMINAL TIP.
4. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.

| | MILLIMETERS | |
|---|---|---|
| DIM | MIN | MAX |
| A | 0.45 | 0.55 |
| A1 | 0.00 | 0.05 |
| A3 | 0.07 REF | |
| b | 0.20 | 0.30 |
| D | 3.00 BSC | |
| D2 | 2.40 | 2.60 |
| E | 3.00 BSC | |
| E2 | 1.60 | 1.80 |
| e | 0.50 BSC | |
| K | 0.20 | −−− |
| L | 0.30 | 0.50 |

**SOLDERING FOOTPRINT***




DIMENSIONS: MILLIMETERS

*For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

ON Semiconductor and the ON 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/pdf/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 products for any such unintended or unauthorized application, Buyer shall indemnify and hold SCILLC and its officers, employees, subsidiaries, affiliates, 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 design or manufacture of the part. SCILLC is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

**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

**NCS5652/D**

# OCEAN CHIPS
## Океан Электроники
## Поставка электронных компонентов

Компания «Океан Электроники» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Поставка оригинальных импортных электронных компонентов напрямую с производств Америки, Европы и Азии, а так же с крупнейших складов мира;
- Широкая линейка поставок активных и пассивных импортных электронных компонентов (более 30 млн. наименований);
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Помощь Конструкторского Отдела и консультации квалифицированных инженеров;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Поставка электронных компонентов под контролем ВП;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- При необходимости вся продукция военного и аэрокосмического назначения проходит испытания и сертификацию в лаборатории (по согласованию с заказчиком);
- Поставка специализированных компонентов военного и аэрокосмического уровня качества (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Actel, Aeroflex, Peregrine, VPT, Syfer, Eurofarad, Texas Instruments, MS Kennedy, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Компания «Океан Электроники» является официальным дистрибьютором и эксклюзивным представителем в России одного из крупнейших производителей разъемов военного и аэрокосмического назначения «**JONHON**», а так же официальным дистрибьютором и эксклюзивным представителем в России производителя высокотехнологичных и надежных решений для передачи СВЧ сигналов «**FORSTAR**».

AVIC JONHON

**«JONHON»** (основан в 1970 г.)

Разъемы специального, военного и аэрокосмического назначения:

(Применяются в военной, авиационной, аэрокосмической, морской, железнодорожной, горно- и нефтедобывающей отраслях промышленности)

**«FORSTAR»** (основан в 1998 г.)

ВЧ соединители, коаксиальные кабели, кабельные сборки и микроволновые компоненты:

(Применяются в телекоммуникациях гражданского и специального назначения, в средствах связи, РЛС, а так же военной, авиационной и аэрокосмической отраслях промышленности).

FORSTAR®

Телефон: 8 (812) 309-75-97 (многоканальный)
Факс: 8 (812) 320-03-32
Электронная почта: ocean@oceanchips.ru
Web: http://oceanchips.ru/
Адрес: 198099, г. Санкт-Петербург, ул. Калинина, д. 2, корп. 4, лит. А