

# HIGH VOLTAGE MEDIUM CURRENT DRIVER ARRAYS

## Description

The SG2000 series integrates seven NPN Darlington pairs with internal suppression diodes to drive lamps, relays, and solenoids in many military, aerospace, and industrial applications that require severe environments. All units feature open collector outputs with greater than 50V breakdown voltages combined with 500mA current carrying capabilities.

Five different input configurations provide optimized designs for interfacing with DTL, TTL, PMOS, or CMOS drive signals. These devices are designed to operate from -55°C to 125°C ambient temperature in a 16 pin dual in line ceramic (J) package and 20 pin Leadless Chip Carrier (LCC). The plastic SOIC (DW) is designed to operate over the commercial temperature range of 0°C to 70°C.

## Features

- Seven NPN Darlington Pairs
- -55°C to 125°C Ambient Operating Temperature Range
- Collector Currents to 600mA
- Output Voltages from 50V to 95V
- Internal Clamping Diodes for Inductive Loads
- DTL, TTL, PMOS, or CMOS Compatible Inputs
- Hermetic Ceramic Package

## High Reliability Features

Following are the high reliability features of SG2000 series:

- Available To MIL-STD-883 – 883, ¶ 1.2.1
- Available to DSCC
  - Standard Microcircuit Drawing (SMD)
- MIL-M38510/14101BEA - SG2001J-JAN
- MIL-M38510/14102BEA - SG2002J-JAN
- MIL-M38510/14103BEA - SG2003J-JAN
- MIL-M38510/14104BEA - SG2004J-JAN
  - MSC-AMS Level "S" Processing Available

## Partial Schematics

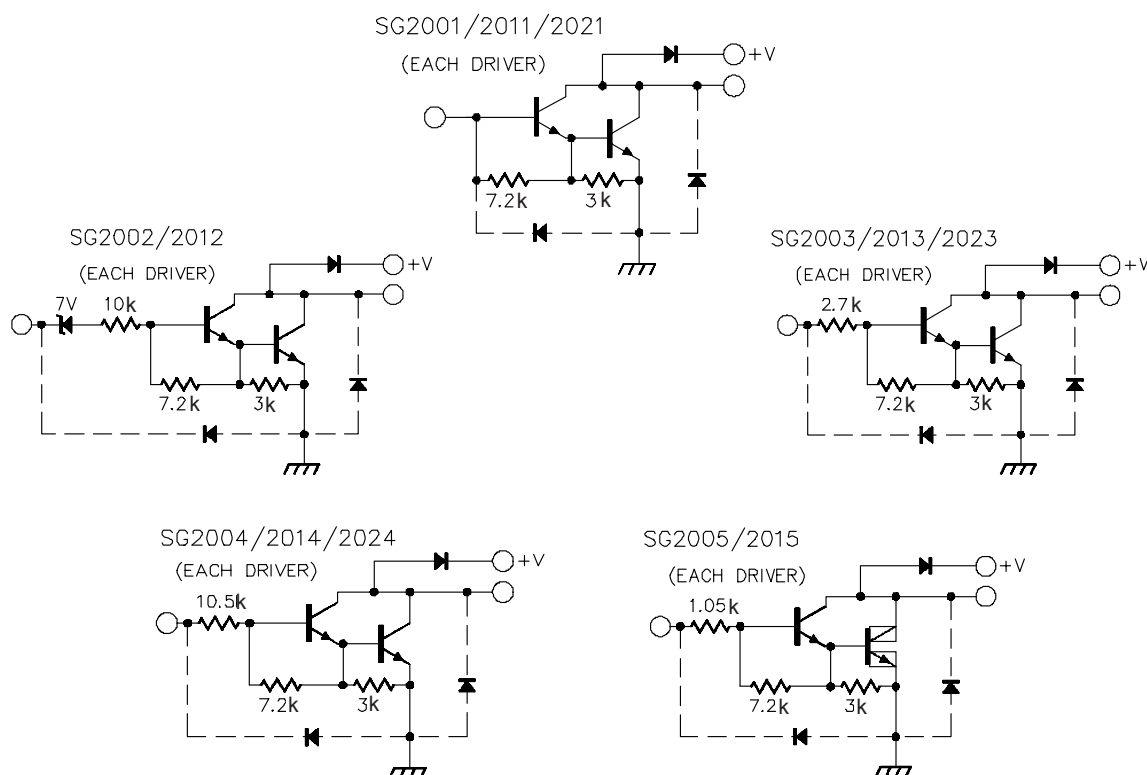


Figure 1 · Partial Schematics

## Absolute Maximum Ratings (Note 1)

|                                    |      |
|------------------------------------|------|
| Output Voltage, $V_{CE}$           |      |
| (SG2000, 2010 series)              | 50V  |
| (SG2020 series)                    | 95V  |
| Input Voltage, $V_{IN}$            |      |
| (SG2002,3,4)                       | 30V  |
| Continuous Input Current, $I_{IN}$ | 25mA |

Note 1. Values beyond which damage may occur.

|                                                           |                |
|-----------------------------------------------------------|----------------|
| Peak Collector Current, $I_C$                             |                |
| (SG2000, 2020)                                            | 500mA          |
| (SG2010)                                                  | 600mA          |
| Operating Junction Temperature                            |                |
| Hermetic (J, L Packages)                                  | 150°C          |
| Plastic (DW Package)                                      | 25°C           |
| Storage Temperature Range                                 | -65°C to 150°C |
| Lead Temperature (Soldering 10 sec.)                      | 300°C          |
| RoHS Peak Package Solder Reflow Temp. (40 sec. max. exp.) | 260°C (+0, -5) |

## Thermal Data

J Package:

|                                                       |        |
|-------------------------------------------------------|--------|
| Thermal Resistance-Junction to Case, $\theta_{JC}$    | 30°C/W |
| Thermal Resistance-Junction to Ambient, $\theta_{JA}$ | 80°C/W |

DW Package:

|                                                       |        |
|-------------------------------------------------------|--------|
| Thermal Resistance-Junction to Case, $\theta_{JC}$    | 35°C/W |
| Thermal Resistance-Junction to Ambient, $\theta_{JA}$ | 90°C/W |

L Package:

|                                                       |         |
|-------------------------------------------------------|---------|
| Thermal Resistance-Junction to Case, $\theta_{JC}$    | 35°C/W  |
| Thermal Resistance-Junction to Ambient, $\theta_{JA}$ | 120°C/W |

Note A. Junction Temperature Calculation:  $T_J = T_A + (P_D \times \theta_{JA})$ .

Note B. The above numbers for  $\theta_{JC}$  are maximums for the limiting thermal resistance of the package in a standard mounting configuration. The  $\theta_{JA}$  numbers are meant to be guidelines for the thermal performance of the device/pc-board system. All of the above assume no ambient airflow.

## Recommended Operating Conditions (Note 2)

|                          |     |
|--------------------------|-----|
| Output Voltage, $V_{CE}$ |     |
| SG2000, SG2010 series    | 50V |
| SG2020 series            | 95V |

Note 2. Range over which the device is functional.

|                                     |                |
|-------------------------------------|----------------|
| Peak Collector Current, $I_C$       |                |
| SG2000, SG2020 series               | 50mA           |
| SG2010 series                       | 500mA          |
| Operating Ambient Temperature Range |                |
| SG2000 Series - Hermetic            | -55°C to 125°C |
| SG2000 Series - Plastic             | 0°C to 70°C    |

## Selection Guide

| Device | $V_{CE}$ Max | $I_C$ Max | Logic Inputs               |
|--------|--------------|-----------|----------------------------|
| SG2001 | 50V          | 500mA     | General Purpose PMOS, CMOS |
| SG2002 | 50V          | 500mA     | 14V-25V PMOS               |
| SG2003 | 50V          | 500mA     | 5V TTL, CMOS               |
| SG2004 | 50V          | 500mA     | 6V-15V CMOS, PMOS          |
| SG2011 | 50V          | 600mA     | General Purpose PMOS, CMOS |
| SG2012 | 50V          | 600mA     | 14V-25V PMOS               |

| Device | $V_{CE}$ Max | $I_C$ Max | Logic Inputs               |
|--------|--------------|-----------|----------------------------|
| SG2013 | 50V          | 600mA     | 5V TTL, CMOS               |
| SG2014 | 50V          | 600mA     | 6V-15V CMOS, PMOS          |
| SG2015 | 50V          | 600mA     | High Output TTL            |
| SG2021 | 95V          | 500mA     | General Purpose PMOS, CMOS |
| SG2023 | 95V          | 500mA     | 5V TTL, CMOS               |
| SG2024 | 95V          | 500mA     | 6V-15V CMOS, PMOS          |
|        |              |           |                            |

# Electrical Characteristics

(Unless otherwise specified, these specifications apply over the operating ambient temperatures for SG2000 series - Hermetic - with  $-55^{\circ}\text{C} \leq T_A \leq 125^{\circ}\text{C}$  and SG2000 series - Plastic - with  $0^{\circ}\text{C} \leq T_A \leq 70^{\circ}\text{C}$ . Low duty cycle pulse testing techniques are used which maintains junction and case temperatures equal to the ambient temperature.)

SG2001 thru SG2004

| Parameter                                      | Applicable Devices | Temp.                      | Test Conditions                                         | Limits |      |      | Units         |
|------------------------------------------------|--------------------|----------------------------|---------------------------------------------------------|--------|------|------|---------------|
|                                                |                    |                            |                                                         | Min    | Typ  | Max  |               |
| Output Leakage Current ( $I_{\text{CEX}}$ )    | All                |                            | $V_{\text{CE}} = 50\text{V}$                            |        |      | 100  | $\mu\text{A}$ |
|                                                | SG2002             |                            | $V_{\text{CE}} = 50\text{V}, V_{\text{IN}} = 6\text{V}$ |        |      | 500  | $\mu\text{A}$ |
|                                                | SG2004             |                            | $V_{\text{CE}} = 50\text{V}, V_{\text{IN}} = 1\text{V}$ |        |      | 500  | $\mu\text{A}$ |
| Collector - Emitter ( $V_{\text{CE(SAT)}}$ )   | All                | $T_A = T_{\text{MIN}}$     | $I_C = 350\text{mA}, I_B = 850\mu\text{A}$              |        | 1.6  | 1.8  | V             |
|                                                |                    | $T_A = T_{\text{MIN}}$     | $I_C = 200\text{mA}, I_B = 550\mu\text{A}$              |        | 1.3  | 1.5  | V             |
|                                                |                    | $T_A = T_{\text{MIN}}$     | $I_C = 100\text{mA}, I_B = 350\mu\text{A}$              |        | 1.1  | 1.3  | V             |
|                                                |                    | $T_A = 25^{\circ}\text{C}$ | $I_C = 350\text{mA}, I_B = 500\mu\text{A}$              |        | 1.25 | 1.6  | V             |
|                                                |                    | $T_A = 25^{\circ}\text{C}$ | $I_C = 200\text{mA}, I_B = 350\mu\text{A}$              |        | 1.1  | 1.3  | V             |
|                                                |                    | $T_A = 25^{\circ}\text{C}$ | $I_C = 100\text{mA}, I_B = 250\mu\text{A}$              |        | 0.9  | 1.1  | V             |
|                                                |                    | $T_A = T_{\text{MAX}}$     | $I_C = 350\text{mA}, I_B = 500\mu\text{A}$              |        | 1.6  | 1.8  | V             |
|                                                |                    | $T_A = T_{\text{MAX}}$     | $I_C = 200\text{mA}, I_B = 350\mu\text{A}$              |        | 1.3  | 1.5  | V             |
|                                                |                    | $T_A = T_{\text{MAX}}$     | $I_C = 100\text{mA}, I_B = 250\mu\text{A}$              |        | 1.1  | 1.3  | V             |
| Input Current ( $I_{\text{IN(ON)}}$ )          | SG2002             |                            | $V_{\text{IN}} = 17\text{V}$                            | 480    | 850  | 1300 | $\mu\text{A}$ |
|                                                | SG2003             |                            | $V_{\text{IN}} = 3.85\text{V}$                          | 650    | 930  | 1350 | $\mu\text{A}$ |
|                                                | SG2004             |                            | $V_{\text{IN}} = 5\text{V}$                             | 240    | 350  | 500  | $\mu\text{A}$ |
|                                                |                    |                            | $V_{\text{IN}} = 12\text{V}$                            | 650    | 1000 | 1450 | $\mu\text{A}$ |
| Input Current ( $I_{\text{IN(OFF)}}$ )         | All                | $T_A = T_{\text{MAX}}$     | $I_C = 500\mu\text{A}$                                  | 25     | 50   |      | $\mu\text{A}$ |
| Input Voltage ( $V_{\text{IN(ON)}}$ )          | SG2002             | $T_A = T_{\text{MIN}}$     | $V_{\text{CE}} = 2\text{V}, I_C = 300\text{mA}$         |        |      | 18   | V             |
|                                                |                    | $T_A = T_{\text{MAX}}$     | $V_{\text{CE}} = 2\text{V}, I_C = 300\text{mA}$         |        |      | 13   | V             |
|                                                | SG2003             | $T_A = T_{\text{MIN}}$     | $V_{\text{CE}} = 2\text{V}, I_C = 200\text{mA}$         |        |      | 3.3  | V             |
|                                                |                    | $T_A = T_{\text{MIN}}$     | $V_{\text{CE}} = 2\text{V}, I_C = 250\text{mA}$         |        |      | 3.6  | V             |
|                                                |                    | $T_A = T_{\text{MIN}}$     | $V_{\text{CE}} = 2\text{V}, I_C = 300\text{mA}$         |        |      | 3.9  | V             |
|                                                |                    | $T_A = T_{\text{MIN}}$     | $V_{\text{CE}} = 2\text{V}, I_C = 200\text{mA}$         |        |      | 2.4  | V             |
|                                                |                    | $T_A = T_{\text{MAX}}$     | $V_{\text{CE}} = 2\text{V}, I_C = 250\text{mA}$         |        |      | 2.7  | V             |
|                                                |                    | $T_A = T_{\text{MAX}}$     | $V_{\text{CE}} = 2\text{V}, I_C = 300\text{mA}$         |        |      | 3.0  | V             |
|                                                | SG2004             | $T_A = T_{\text{MIN}}$     | $V_{\text{CE}} = 2\text{V}, I_C = 125\text{mA}$         |        |      | 6.0  | V             |
|                                                |                    | $T_A = T_{\text{MIN}}$     | $V_{\text{CE}} = 2\text{V}, I_C = 200\text{mA}$         |        |      | 8.0  | V             |
|                                                |                    | $T_A = T_{\text{MIN}}$     | $V_{\text{CE}} = 2\text{V}, I_C = 275\text{mA}$         |        |      | 10   | V             |
|                                                |                    | $T_A = T_{\text{MIN}}$     | $V_{\text{CE}} = 2\text{V}, I_C = 350\text{mA}$         |        |      | 12   | V             |
|                                                |                    | $T_A = T_{\text{MAX}}$     | $V_{\text{CE}} = 2\text{V}, I_C = 125\text{mA}$         |        |      | 5.0  | V             |
|                                                |                    | $T_A = T_{\text{MAX}}$     | $V_{\text{CE}} = 2\text{V}, I_C = 200\text{mA}$         |        |      | 6.0  | V             |
|                                                |                    | $T_A = T_{\text{MAX}}$     | $V_{\text{CE}} = 2\text{V}, I_C = 275\text{mA}$         |        |      | 7.0  | V             |
|                                                |                    | $T_A = T_{\text{MAX}}$     | $V_{\text{CE}} = 2\text{V}, I_C = 350\text{mA}$         |        |      | 8.0  | V             |
| DC Forward Current                             | SG2001             | $T_A = T_{\text{MIN}}$     | $V_{\text{CE}} = 2\text{V}, I_C = 350\text{mA}$         | 500    |      |      | mA            |
| Transfer Ratio ( $h_{\text{FE}}$ )             |                    | $T_A = 25^{\circ}\text{C}$ | $V_{\text{CE}} = 2\text{V}, I_C = 350\text{mA}$         | 1000   |      |      |               |
| Input Capacitance ( $C_{\text{IN}}$ ) (Note 3) | All                | $T_A = 25^{\circ}\text{C}$ |                                                         |        | 15   | 25   | pF            |
| Turn-On Delay (TPLH)                           | All                | $T_A = 25^{\circ}\text{C}$ | $0.5 E_{\text{IN}}$ to $0.5 E_{\text{OUT}}$             |        | 250  | 1000 | ns            |
| Turn-Off Delay (TPHL)                          | All                | $T_A = 25^{\circ}\text{C}$ | $0.5 E_{\text{IN}}$ to $0.5 E_{\text{OUT}}$             |        | 250  | 1000 | ns            |
| Clamp Diode Leakage Current ( $I_{\text{R}}$ ) | All                |                            | $V_{\text{R}} = 50\text{V}$                             |        |      | 50   | $\mu\text{A}$ |
| Clamp Diode Forward Voltage ( $V_{\text{F}}$ ) | All                |                            | $I_{\text{F}} = 350\text{mA}$                           |        | 1.7  | 2.0  | V             |

Note 3. These parameters, although guaranteed, are not tested in production.

## Electrical Characteristics (continued)

SG2011 thru SG2015

| Parameter                               | Applicable Devices | Temp.              | Test Conditions                | Limits |      |      | Units   |
|-----------------------------------------|--------------------|--------------------|--------------------------------|--------|------|------|---------|
|                                         |                    |                    |                                | Min    | Typ  | Max  |         |
| Output Leakage Current ( $I_{CEX}$ )    | All                |                    | $V_{CE} = 50V$                 |        |      | 100  | $\mu A$ |
|                                         | SG2012             |                    | $V_{CE} = 50V, V_{IN} = 6V$    |        |      | 500  | $\mu A$ |
|                                         | SG2014             |                    | $V_{CE} = 50V, V_{IN} = 1V$    |        |      | 500  | $\mu A$ |
| Collector - Emitter ( $V_{CE(SAT)}$ )   | All                | $T_A = T_{MIN}$    | $I_C = 500mA, I_B = 1100\mu A$ |        | 1.8  | 2.1  | V       |
|                                         |                    | $T_A = T_{MIN}$    | $I_C = 350mA, I_B = 850\mu A$  |        | 1.6  | 1.8  | V       |
|                                         |                    | $T_A = T_{MIN}$    | $I_C = 200mA, I_B = 550\mu A$  |        | 1.3  | 1.5  | V       |
|                                         |                    | $T_A = 25^\circ C$ | $I_C = 500mA, I_B = 600\mu A$  |        | 1.7  | 1.9  | V       |
|                                         |                    | $T_A = 25^\circ C$ | $I_C = 350mA, I_B = 500\mu A$  |        | 1.25 | 1.6  | V       |
|                                         |                    | $T_A = 25^\circ C$ | $I_C = 200mA, I_B = 350\mu A$  |        | 1.1  | 1.3  | V       |
|                                         |                    | $T_A = T_{MAX}$    | $I_C = 500mA, I_B = 600\mu A$  |        | 1.8  | 2.1  | V       |
|                                         |                    | $T_A = T_{MAX}$    | $I_C = 350mA, I_B = 500\mu A$  |        | 1.6  | 1.8  | V       |
|                                         |                    | $T_A = T_{MAX}$    | $I_C = 200mA, I_B = 350\mu A$  |        | 1.3  | 1.5  | V       |
| Input Current ( $I_{IN(ON)}$ )          | SG2012             |                    | $V_{IN} = 17V$                 | 480    | 850  | 1300 | $\mu A$ |
|                                         | SG2013             |                    | $V_{IN} = 3.85V$               | 650    | 930  | 1350 | $\mu A$ |
|                                         | SG2014             |                    | $V_{IN} = 5V$                  | 240    | 350  | 500  | $\mu A$ |
|                                         |                    |                    | $V_{IN} = 12V$                 | 650    | 1000 | 1450 | $\mu A$ |
|                                         | SG2015             |                    | $V_{IN} = 3V$                  | 1180   | 1500 | 2400 | $\mu A$ |
| Input Current ( $I_{IN(OFF)}$ )         | All                | $T_A = T_{MAX}$    | $I_C = 500\mu A$               | 25     | 50   |      | $\mu A$ |
| Input Voltage ( $V_{IN(ON)}$ )          | SG2012             | $T_A = T_{MIN}$    | $V_{CE} = 2V, I_C = 500mA$     |        |      | 23.5 | V       |
|                                         |                    | $T_A = T_{MAX}$    | $V_{CE} = 2V, I_C = 500mA$     |        |      | 17   | V       |
|                                         | SG2013             | $T_A = T_{MIN}$    | $V_{CE} = 2V, I_C = 250mA$     |        |      | 3.6  | V       |
|                                         |                    | $T_A = T_{MIN}$    | $V_{CE} = 2V, I_C = 300mA$     |        |      | 3.9  | V       |
|                                         |                    | $T_A = T_{MIN}$    | $V_{CE} = 2V, I_C = 500mA$     |        |      | 6.0  | V       |
|                                         |                    | $T_A = T_{MAX}$    | $V_{CE} = 2V, I_C = 250mA$     |        |      | 2.7  | V       |
|                                         |                    | $T_A = T_{MAX}$    | $V_{CE} = 2V, I_C = 300mA$     |        |      | 3.0  | V       |
|                                         |                    | $T_A = T_{MAX}$    | $V_{CE} = 2V, I_C = 500mA$     |        |      | 3.5  | V       |
|                                         | SG2014             | $T_A = T_{MIN}$    | $V_{CE} = 2V, I_C = 275mA$     |        |      | 10   | V       |
|                                         |                    | $T_A = T_{MIN}$    | $V_{CE} = 2V, I_C = 350mA$     |        |      | 12   | V       |
|                                         |                    | $T_A = T_{MIN}$    | $V_{CE} = 2V, I_C = 500mA$     |        |      | 17   | V       |
|                                         |                    | $T_A = T_{MAX}$    | $V_{CE} = 2V, I_C = 275mA$     |        |      | 7.0  | V       |
|                                         |                    | $T_A = T_{MAX}$    | $V_{CE} = 2V, I_C = 350mA$     |        |      | 8.0  | V       |
|                                         |                    | $T_A = T_{MAX}$    | $V_{CE} = 2V, I_C = 500mA$     |        |      | 9.5  | V       |
|                                         | SG2015             | $T_A = T_{MAX}$    | $V_{CE} = 2V, I_C = 350mA$     |        |      | 3.0  | V       |
|                                         |                    | $T_A = T_{MIN}$    | $V_{CE} = 2V, I_C = 500mA$     |        |      | 3.5  | V       |
|                                         |                    | $T_A = T_{MAX}$    | $V_{CE} = 2V, I_C = 350mA$     |        |      | 2.4  | V       |
|                                         |                    | $T_A = T_{MAX}$    | $V_{CE} = 2V, I_C = 500mA$     |        |      | 2.6  | V       |
| DC Forward Current                      | SG2011             | $T_A = T_{MIN}$    | $V_{CE} = 2V, I_C = 500mA$     | 450    |      |      | mA      |
| Transfer Ratio ( $h_{FE}$ )             |                    | $T_A = 25^\circ C$ | $V_{CE} = 2V, I_C = 500mA$     | 900    |      |      |         |
| Input Capacitance ( $C_{IN}$ ) (Note 3) | All                | $T_A = 25^\circ C$ |                                |        | 15   | 25   | pF      |
| Turn-On Delay (TPLH)                    | All                | $T_A = 25^\circ C$ | $0.5 E_{IN}$ to $0.5 E_{OUT}$  |        | 250  | 1000 | ns      |
| Turn-Off Delay (TPHL)                   | All                | $T_A = 25^\circ C$ | $0.5 E_{IN}$ to $0.5 E_{OUT}$  |        | 250  | 1000 | ns      |
| Clamp Diode Leakage Current ( $I_R$ )   | All                |                    | $V_R = 50V$                    |        |      | 50   | $\mu A$ |
| Clamp Diode Forward Voltage ( $V_F$ )   | All                |                    | $I_F = 350mA$                  |        | 1.7  | 2.0  | V       |
|                                         |                    |                    | $I_F = 500mA$                  |        |      | 2.5  | V       |

Note 3. These parameters, although guaranteed, are not tested in production.

## Electrical Characteristics (continued)

SG2021 thru SG2024

| Parameter                               | Applicable Devices | Temp.              | Test Conditions               | Limits |      |      | Units   |
|-----------------------------------------|--------------------|--------------------|-------------------------------|--------|------|------|---------|
|                                         |                    |                    |                               | Min    | Typ  | Max  |         |
| Output Leakage Current ( $I_{CEX}$ )    | All                |                    | $V_{CE} = 95V$                |        |      | 100  | $\mu A$ |
|                                         | SG2024             |                    | $V_{CE} = 95V, V_{IN} = 1V$   |        |      | 500  | $\mu A$ |
| Collector - Emitter ( $V_{CE(SAT)}$ )   | All                | $T_A = T_{MIN}$    | $I_C = 350mA, I_B = 850\mu A$ |        | 1.6  | 1.8  | V       |
|                                         |                    | $T_A = T_{MIN}$    | $I_C = 200mA, I_B = 550\mu A$ |        | 1.3  | 1.5  | V       |
|                                         |                    | $T_A = T_{MIN}$    | $I_C = 100mA, I_B = 350\mu A$ |        | 1.1  | 1.3  | V       |
|                                         |                    | $T_A = 25^\circ C$ | $I_C = 350mA, I_B = 500\mu A$ |        | 1.25 | 1.6  | V       |
|                                         |                    | $T_A = 25^\circ C$ | $I_C = 200mA, I_B = 350\mu A$ |        | 1.1  | 1.3  | V       |
|                                         |                    | $T_A = 25^\circ C$ | $I_C = 100mA, I_B = 250\mu A$ |        | 0.9  | 1.1  | V       |
|                                         |                    | $T_A = T_{MAX}$    | $I_C = 350mA, I_B = 500\mu A$ |        | 1.6  | 1.8  | V       |
|                                         |                    | $T_A = T_{MAX}$    | $I_C = 200mA, I_B = 350\mu A$ |        | 1.3  | 1.5  | V       |
|                                         |                    | $T_A = T_{MAX}$    | $I_C = 100mA, I_B = 250\mu A$ |        | 1.1  | 1.3  | V       |
| Input Current ( $I_{IN(ON)}$ )          | SG2023             |                    | $V_{IN} = 3.85V$              | 650    | 930  | 1350 | $\mu A$ |
|                                         | SG2024             |                    | $V_{IN} = 5V$                 | 240    | 350  | 500  | $\mu A$ |
|                                         |                    |                    | $V_{IN} = 12V$                | 650    | 1000 | 1450 | $\mu A$ |
| Input Current ( $I_{IN(OFF)}$ )         | All                | $T_A = T_{MAX}$    | $I_C = 500\mu A$              | 25     | 50   |      | $\mu A$ |
| Input Voltage ( $V_{IN(ON)}$ )          |                    | $T_A = T_{MAX}$    | $V_{CE} = 2V, I_C = 300mA$    |        |      | 13   | V       |
|                                         | SG2023             | $T_A = T_{MIN}$    | $V_{CE} = 2V, I_C = 200mA$    |        |      | 3.3  | V       |
|                                         |                    | $T_A = T_{MIN}$    | $V_{CE} = 2V, I_C = 250mA$    |        |      | 3.6  | V       |
|                                         |                    | $T_A = T_{MIN}$    | $V_{CE} = 2V, I_C = 300mA$    |        |      | 3.9  | V       |
|                                         |                    | $T_A = T_{MAX}$    | $V_{CE} = 2V, I_C = 200mA$    |        |      | 2.4  | V       |
|                                         |                    | $T_A = T_{MAX}$    | $V_{CE} = 2V, I_C = 250mA$    |        |      | 2.7  | V       |
|                                         |                    | $T_A = T_{MAX}$    | $V_{CE} = 2V, I_C = 300mA$    |        |      | 3.0  | V       |
|                                         | SG2024             | $T_A = T_{MIN}$    | $V_{CE} = 2V, I_C = 125mA$    |        |      | 6.0  | V       |
|                                         |                    | $T_A = T_{MIN}$    | $V_{CE} = 2V, I_C = 200mA$    |        |      | 8.0  | V       |
|                                         |                    | $T_A = T_{MIN}$    | $V_{CE} = 2V, I_C = 275mA$    |        |      | 10   | V       |
|                                         |                    | $T_A = T_{MIN}$    | $V_{CE} = 2V, I_C = 350mA$    |        |      | 12   | V       |
|                                         |                    | $T_A = T_{MAX}$    | $V_{CE} = 2V, I_C = 125mA$    |        |      | 5.0  | V       |
|                                         |                    | $T_A = T_{MAX}$    | $V_{CE} = 2V, I_C = 200mA$    |        |      | 6.0  | V       |
|                                         |                    | $T_A = T_{MAX}$    | $V_{CE} = 2V, I_C = 275mA$    |        |      | 7.0  | V       |
|                                         |                    | $T_A = T_{MAX}$    | $V_{CE} = 2V, I_C = 350mA$    |        |      | 8.0  | V       |
| DC Forward Current                      | SG2021             | $T_A = T_{MIN}$    | $V_{CE} = 2V, I_C = 350mA$    | 500    |      |      | mA      |
| Transfer Ratio ( $h_{FE}$ )             |                    | $T_A = 25^\circ C$ | $V_{CE} = 2V, I_C = 350mA$    | 1000   |      |      |         |
| Input Capacitance ( $C_{IN}$ ) (Note 3) | All                | $T_A = 25^\circ C$ |                               |        | 15   | 25   | pF      |
| Turn-On Delay (TPLH)                    | All                | $T_A = 25^\circ C$ | $0.5 E_{IN}$ to $0.5 E_{OUT}$ |        | 250  | 1000 | ns      |
| Turn-Off Delay (TPHL)                   | All                | $T_A = 25^\circ C$ | $0.5 E_{IN}$ to $0.5 E_{OUT}$ |        | 250  | 1000 | ns      |
| Clamp Diode Leakage Current ( $I_R$ )   | All                |                    | $V_R = 95V$                   |        |      | 50   | $\mu A$ |
| Clamp Diode Forward Voltage ( $V_F$ )   | All                |                    | $I_F = 350mA$                 |        | 1.7  | 2.0  | V       |

Note 3. These parameters, although guaranteed, are not tested in production.

## Characteristic Curves

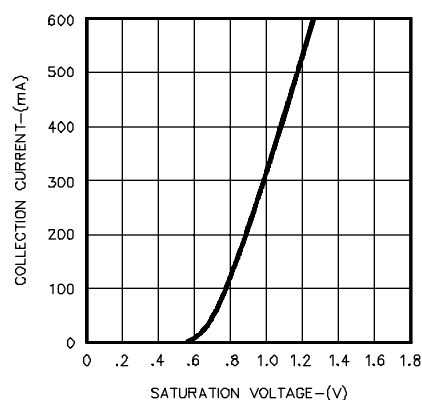


FIGURE 2. OUTPUT CHARACTERISTICS

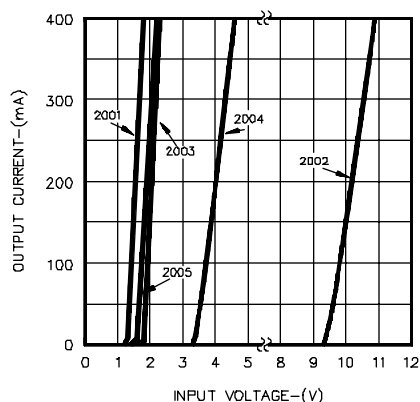


FIGURE 3. OUTPUT CURRENT VS. INPUT VOLTAGE

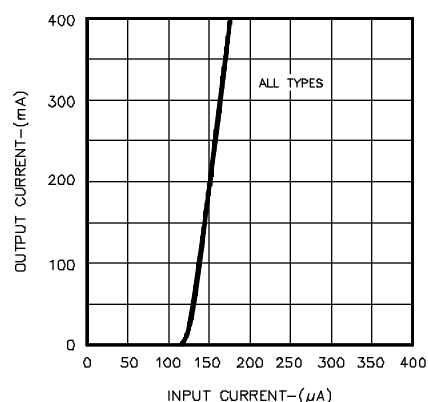


FIGURE 4. OUTPUT CURRENT VS. INPUT CURRENT

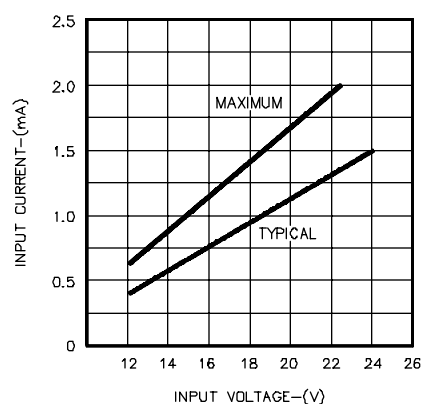


FIGURE 5. INPUT CHARACTERISTICS - SG2002

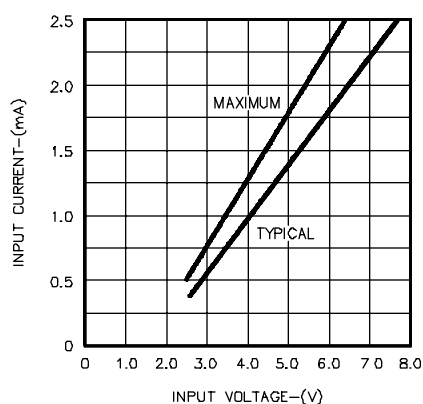


FIGURE 6. INPUT CHARACTERISTICS - SG2003

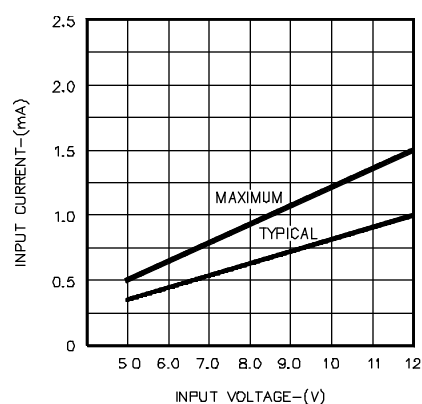


FIGURE 7. INPUT CHARACTERISTICS - SG2004

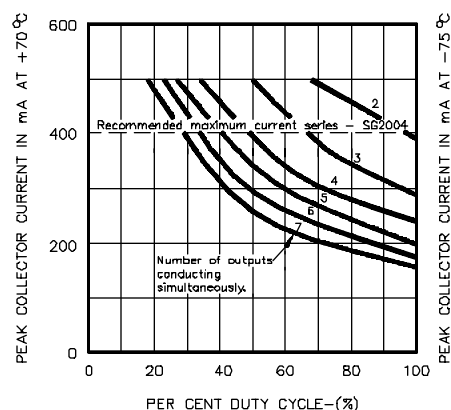
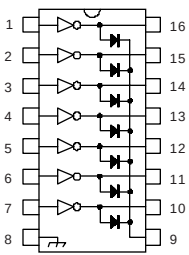
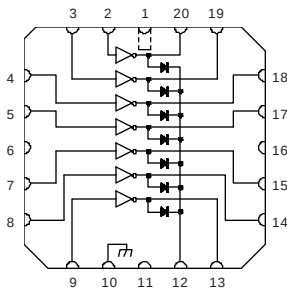


FIGURE 8. PEAK COLLECTOR CURRENT VS. DUTY CYCLE

## Connection Diagrams and Ordering Information (See Notes Below)

| Package                                                | Part No. (Note 3)                                                                                   | Ambient Temperature Range                                                                                                  | Connection Diagram                                                                                                        |
|--------------------------------------------------------|-----------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|
| 16-PIN CERAMIC DIP<br>J - PACKAGE                      | SG2XXXJ-883B<br>SG2023J-DESC<br>SG2001J-JAN<br>SG2002J-JAN<br>SG2003J-JAN<br>SG2004J-JAN<br>SG2XXXJ | -55°C to 125°C<br>-55°C to 125°C<br>-55°C to 125°C<br>-55°C to 125°C<br>-55°C to 125°C<br>-55°C to 125°C<br>-55°C to 125°C |                                        |
| 16-PIN PLASTIC SOIC<br>DW - PACKAGE                    | SG2003DW<br>SG2023DW                                                                                | 0°C to 70°C<br>0°C to 70°C                                                                                                 | <p>DW Package: RoHS Compliant / Pb-free Transition DC: 0516<br/>DW Package: RoHS / Pb-free 100% Matte Tin Lead Finish</p> |
| 20-PIN CERAMIC<br>LEADLESS CHIP CARRIER<br>L - PACKAGE | SG2XXXL-883B<br>SG2XXXL                                                                             | -55°C to 125°C<br>-55°C to 125°C                                                                                           |                                        |

Note 1. Contact factory for JAN and DESC product availability.

2. All parts are viewed from the top.

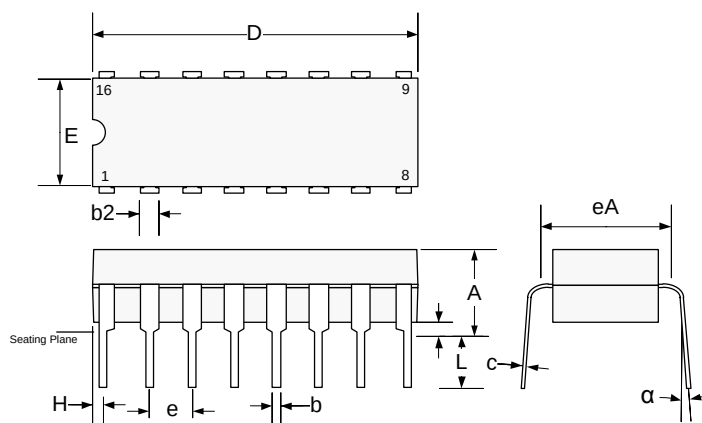
3. See selection guide for specific device types.

4. DW Package (Not Pictured) is 16-Pin Wide Body SOIC, same pinout as J package pictured above.

5. Hermetic Packages J and L use Pb37/Sn63 hot solder lead finish, contact factory for availability of RoHS versions.

## Package Outline Dimensions

Controlling dimensions are in inches, metric equivalents are shown for general information.



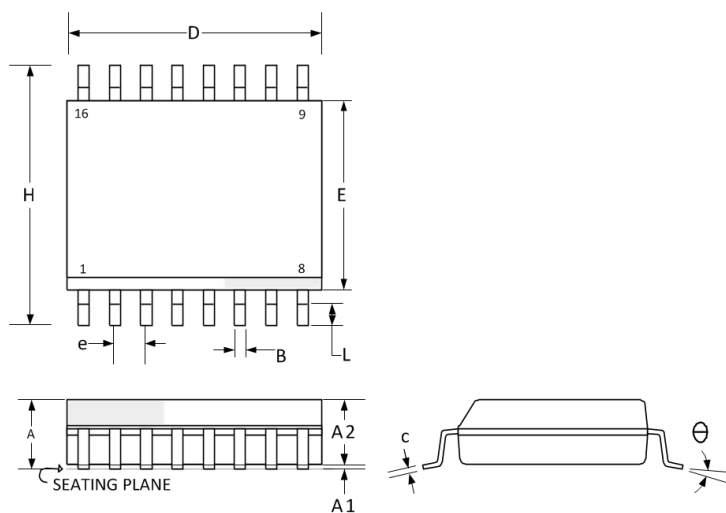
| DIM      | MILLIMETERS |       | INCHES    |       |
|----------|-------------|-------|-----------|-------|
|          | MIN         | MAX   | MIN       | MAX   |
| A        |             | 5.08  |           | 0.200 |
| b        | 0.38        | 0.51  | 0.015     | 0.020 |
| b2       | 1.04        | 1.65  | 0.045     | 0.065 |
| c        | 0.20        | 0.38  | 0.008     | 0.015 |
| D        | 19.30       | 19.94 | 0.760     | 0.785 |
| E        | 5.59        | 7.11  | 0.220     | 0.280 |
| e        | 2.54 BSC*   |       | 0.100 BSC |       |
| eA       | 7.37        | 7.87  | 0.290     | 0.310 |
| H        | 0.63        | 1.78  | 0.025     | 0.070 |
| L        | 3.18        | 5.08  | 0.125     | 0.200 |
| $\alpha$ | -           | 15°   | -         | 15°   |
| Q        | 0.51        | 1.02  | 0.020     | 0.040 |

\*BSC: Basic Spacing Between Centers

**Note:**

Dimensions do not include protrusions; these shall not exceed 0.155mm (.006") on any side. Lead dimension shall not include solder coverage.

**Figure 9 • J 16-Pin Cerdip Package Dimensions**



| Dim      | MILLIMETERS |       | INCHES   |       |
|----------|-------------|-------|----------|-------|
|          | MIN         | MAX   | MIN      | MAX   |
| A        | 2.06        | 2.65  | 0.081    | 0.104 |
| A1       | 0.10        | 0.30  | 0.004    | 0.012 |
| A2       | 2.03        | 2.55  | 0.080    | 0.100 |
| B        | 0.33        | 0.51  | 0.013    | 0.020 |
| c        | 0.23        | 0.32  | 0.009    | 0.013 |
| D        | 10.08       | 10.50 | 0.397    | 0.413 |
| E        | 7.40        | 7.60  | 0.291    | 0.299 |
| e        | 1.27 BSC    |       | 0.05 BSC |       |
| H        | 10.00       | 10.65 | 0.394    | 0.419 |
| L        | 0.40        | 1.27  | 0.016    | 0.050 |
| $\theta$ | 0°          | 8°    | 0°       | 8°    |
| *LC      | -           | 0.10  | -        | 0.004 |

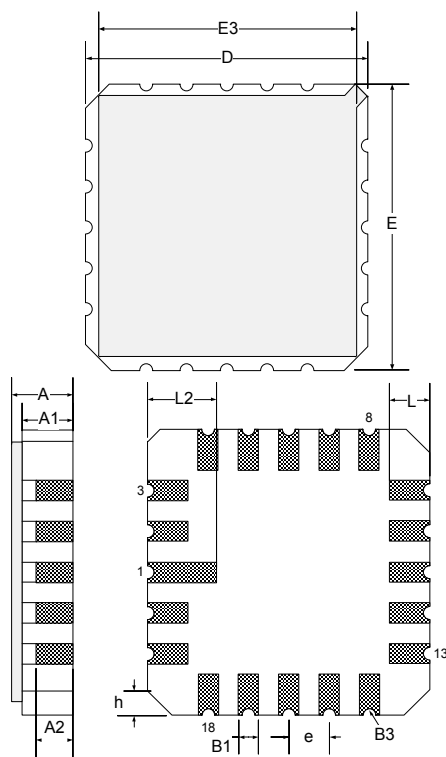
\*Lead co planarity

**Note:**

Dimensions do not include protrusions; these shall not exceed 0.155mm (.006") on any side. Lead dimension shall not include solder coverage. Dimensions are in mm, inches are for reference only.

**Figure 10 • DW 16-Pin SOWB Package Dimensions**

## Package Outline Dimensions (continued)



| Dim | MILLIMETERS |       | INCHES    |       |
|-----|-------------|-------|-----------|-------|
|     | MIN         | MAX   | MIN       | MAX   |
| D/E | 8.64        | 9.14  | 0.340     | 0.360 |
| E3  | -           | 8.128 | -         | 0.320 |
| e   | 1.270 BSC   |       | 0.050 BSC |       |
| B1  | 0.635 TYP   |       | 0.025 TYP |       |
| L   | 1.02        | 1.52  | 0.040     | 0.060 |
| A   | 1.626       | 2.286 | 0.064     | 0.090 |
| h   | 1.016 TYP   |       | 0.040 TYP |       |
| A1  | 1.372       | 1.68  | 0.054     | 0.066 |
| A2  | -           | 1.168 | -         | 0.046 |
| L2  | 1.91        | 2.41  | 0.075     | 0.95  |
| B3  | 0.203R      |       | 0.008R    |       |

### Note:

All exposed metalized area shall be gold plated 60 micro-inch minimum thickness over nickel plated unless otherwise specified in purchase order.

**Figure 11 • L 20-Pin Ceramic LCC Package Outline Dimensions**



**Microsemi Corporate Headquarters**  
One Enterprise, Aliso Viejo,  
CA 92656 USA

**Within the USA:** +1 (800) 713-4113  
**Outside the USA:** +1 (949) 380-6100  
**Sales:** +1 (949) 380-6136  
**Fax:** +1 (949) 215-4996

**E-mail:** [sales.support@microsemi.com](mailto:sales.support@microsemi.com)

© 2014 Microsemi Corporation. All rights reserved. Microsemi and the Microsemi logo are trademarks of Microsemi Corporation. All other trademarks and service marks are the property of their respective owners.

Microsemi Corporation (Nasdaq: MSCC) offers a comprehensive portfolio of semiconductor and system solutions for communications, defense & security, aerospace and industrial markets. Products include high-performance and radiation-hardened analog mixed-signal integrated circuits, FPGAs, SoCs and ASICs; power management products; timing and synchronization devices and precise time solutions, setting the world's standard for time; voice processing devices; RF solutions; discrete components; security technologies and scalable anti-tamper products; Power-over-Ethernet ICs and midspans; as well as custom design capabilities and services. Microsemi is headquartered in Aliso Viejo, Calif., and has approximately 3,400 employees globally. Learn more at [www.microsemi.com](http://www.microsemi.com).

Microsemi makes no warranty, representation, or guarantee regarding the information contained herein or the suitability of its products and services for any particular purpose, nor does Microsemi assume any liability whatsoever arising out of the application or use of any product or circuit. The products sold hereunder and any other products sold by Microsemi have been subject to limited testing and should not be used in conjunction with mission-critical equipment or applications. Any performance specifications are believed to be reliable but are not verified, and Buyer must conduct and complete all performance and other testing of the products, alone and together with, or installed in, any end-products. Buyer shall not rely on any data and performance specifications or parameters provided by Microsemi. It is the Buyer's responsibility to independently determine suitability of any products and to test and verify the same. The information provided by Microsemi hereunder is provided "as is, where is" and with all faults, and the entire risk associated with such information is entirely with the Buyer. Microsemi does not grant, explicitly or implicitly, to any party any patent rights, licenses, or any other IP rights, whether with regard to such information itself or anything described by such information. Information provided in this document is proprietary to Microsemi, and Microsemi reserves the right to make any changes to the information in this document or to any products and services at any time without notice.