

# IRS2130/IRS21303/IRS2132 (J&S)PbF

## 3-PHASE BRIDGE DRIVER

### Features

- Floating channel designed for bootstrap operation
- Fully operational to +600 V
- Tolerant to negative transient voltage, dV/dt immune
- Gate drive supply range from 10 V to 20 V
- Undervoltage lockout for all channels
- Over-current shutdown turns off all six drivers
- Three Independent half-bridge drivers
- Matched propagation delay for all channels
- 2.5 V logic compatible
- Outputs out of phase with inputs
- Cross-conduction prevention logic
- All parts are LEAD-FREE

### Product Summary

|                            |                                                                 |
|----------------------------|-----------------------------------------------------------------|
| $V_{\text{OFFSET}}$        | 600 V max.                                                      |
| $I_{\text{O+/- (min.)}}$   | 200 mA / 420 mA                                                 |
| $V_{\text{OUT}}$           | 10 V – 20 V (IRS213(0,2))<br>13 V – 20 V (IRS21303)             |
| $t_{\text{on/off (typ.)}}$ | 500 ns                                                          |
| Deadtime (typ.)            | 2.0 $\mu\text{s}$ (IRS2130)<br>0.7 $\mu\text{s}$ (IRS213(2,03)) |

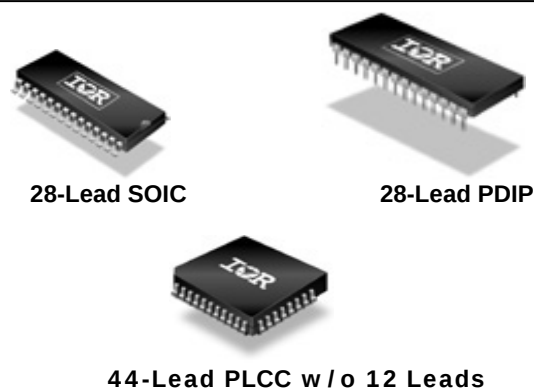
### Applications:

- \*Motor Control
- \*Air Conditioners/ Washing Machines
- \*General Purpose Inverters
- \*Micro/Mini Inverter Drives

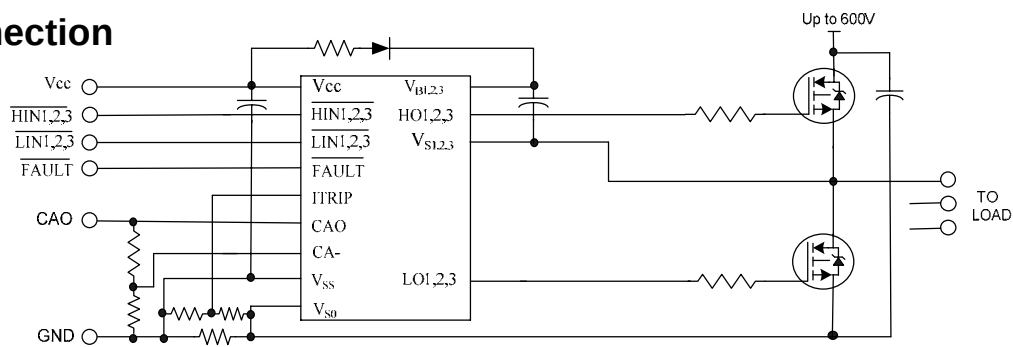
### Description

The IRS213(0, 03, 2) are high voltage, high speed power MOSFET and IGBT drivers with three independent high and low side referenced output channels. Proprietary HVIC technology enables ruggedized monolithic construction. Logic inputs are compatible with CMOS or LSTTL outputs, down to 2.5 V logic. A ground-referenced operational amplifier provides analog feedback of bridge current via an external current sense resistor. A current trip function which terminates all six outputs is also derived from this resistor. An open drain FAULT signal indicates if an over-current or undervoltage shutdown has occurred. The output drivers feature a high pulse current buffer stage designed for minimum driver cross-conduction. Propagation delays are matched to simplify use at high frequencies. The floating channels can be used to drive N-channel power MOSFETs or IGBTs in the high side configuration which operates up to 600 V.

### Packages



### Typical Connection



(Refer to Lead Assignments for correct pin configuration). This diagram shows electrical connections only. Please refer to our Application Notes and Design Tips for proper circuit board layout.

## Absolute Maximum Ratings

Absolute Maximum Ratings indicate sustained limits beyond which damage to the device may occur. All voltage parameters are absolute voltages referenced to  $V_{SO}$ . The thermal resistance and power dissipation ratings are measured under board mounted and still air conditions. Zener clamps are included between  $V_{CC}$  &  $V_{SO}$  (25 V),  $V_{CC}$  &  $V_{SS}$  (20V), and  $V_{Bx}$  &  $V_{Sx}$  (20 V).

| Symbol               | Definition                                                                   |                | Min.                      | Max.                                                                  | Units |
|----------------------|------------------------------------------------------------------------------|----------------|---------------------------|-----------------------------------------------------------------------|-------|
| V <sub>B1,2,3</sub>  | High side floating supply voltage                                            |                | -0.3                      | 625                                                                   | V     |
| V <sub>S1,2,3</sub>  | High side floating offset voltage                                            |                | V <sub>B1,2,3</sub> - 20  | V <sub>B1,2,3</sub> + 0.3                                             |       |
| V <sub>HO1,2,3</sub> | High side floating output voltage                                            |                | V <sub>S1,2,3</sub> - 0.3 | V <sub>B1,2,3</sub> + 0.3                                             |       |
| V <sub>CC</sub>      | Low side and logic fixed supply voltage                                      |                | -0.3                      | 25                                                                    |       |
| V <sub>SS</sub>      | Logic ground                                                                 |                | V <sub>CC</sub> - 20      | V <sub>CC</sub> + 0.3                                                 |       |
| V <sub>LO1,2,3</sub> | Low side output voltage                                                      |                | -0.3                      | V <sub>CC</sub> + 0.3                                                 |       |
| V <sub>IN</sub>      | Logic input voltage ( $\overline{HIN1,2,3}$ , $\overline{LIN1,2,3}$ & ITRIP) |                | V <sub>SS</sub> -0.3      | (V <sub>SS</sub> + 15) or (V <sub>CC</sub> + 0.3), whichever is lower |       |
| V <sub>FLT</sub>     | $\overline{FAULT}$ output voltage                                            |                | V <sub>SS</sub> -0.3      | V <sub>CC</sub> +0.3                                                  |       |
| V <sub>CAO</sub>     | Operational amplifier output voltage                                         |                | V <sub>SS</sub> -0.3      | V <sub>CC</sub> +0.3                                                  |       |
| V <sub>CA-</sub>     | Operational amplifier inverting input voltage                                |                | V <sub>SS</sub> -0.3      | V <sub>CC</sub> +0.3                                                  |       |
| dV <sub>S</sub> /dt  | Allowable offset supply voltage transient                                    |                | —                         | 50                                                                    | V/ns  |
| P <sub>D</sub>       | Package power dissipation @ T <sub>A</sub> ≤ +25 °C                          | (28 lead PDIP) | —                         | 1.5                                                                   | W     |
|                      |                                                                              | (28 lead SOIC) | —                         | 1.6                                                                   |       |
|                      |                                                                              | (44 lead PLCC) | —                         | 2.0                                                                   |       |
| R <sub>th,JA</sub>   | Thermal resistance, junction to ambient                                      | (28 lead PDIP) | —                         | 83                                                                    | °C/W  |
|                      |                                                                              | (28 lead SOIC) | —                         | 78                                                                    |       |
|                      |                                                                              | (44 lead PLCC) | —                         | 63                                                                    |       |
| T <sub>J</sub>       | Junction temperature                                                         |                | —                         | 150                                                                   | °C    |
| T <sub>S</sub>       | Storage temperature                                                          |                | -55                       | 150                                                                   |       |
| T <sub>L</sub>       | Lead temperature (soldering, 10 seconds)                                     |                | —                         | 300                                                                   |       |

## Recommended Operating Conditions

The input/output logic timing diagram is shown in Fig. 1. For proper operation, the device should be used within the recommended conditions. All voltage parameters are absolute voltage referenced to  $V_{SO}$ . The  $V_S$  offset rating is tested with all supplies biased at a 15 V differential.

| Symbol               | Definition                                                                   |             | Min.                    | Max.                    | Units |
|----------------------|------------------------------------------------------------------------------|-------------|-------------------------|-------------------------|-------|
| V <sub>B1,2,3</sub>  | High side floating supply voltage                                            | IRS213(0,2) | V <sub>S1,2,3</sub> +10 | V <sub>S1,2,3</sub> +20 | V     |
|                      |                                                                              | IRS21303    | V <sub>S1,2,3</sub> +13 |                         |       |
| V <sub>S1,2,3</sub>  | High side floating offset voltage                                            |             | Note 1                  | 600                     |       |
| V <sub>HO1,2,3</sub> | High side floating output voltage                                            |             | V <sub>S1,2,3</sub>     | V <sub>B1,2,3</sub>     |       |
| V <sub>CC</sub>      | Low side and logic fixed supply voltage                                      | IRS213(0,2) | 10                      | 20                      |       |
|                      |                                                                              | IRS21303    | 13                      |                         |       |
| V <sub>SS</sub>      | Logic ground                                                                 |             | -5                      | 5                       |       |
| V <sub>LO1,2,3</sub> | Low side output voltage                                                      |             | 0                       | V <sub>CC</sub>         |       |
| V <sub>IN</sub>      | Logic input voltage ( $\overline{HIN1,2,3}$ , $\overline{LIN1,2,3}$ & ITRIP) |             | V <sub>SS</sub>         | V <sub>SS</sub> + 5     |       |
| V <sub>FLT</sub>     | FAULT output voltage                                                         |             | V <sub>SS</sub>         | V <sub>CC</sub>         |       |
| V <sub>CAO</sub>     | Operational amplifier output voltage                                         |             | V <sub>SS</sub>         | V <sub>SS</sub> + 5     |       |
| V <sub>CA-</sub>     | Operational amplifier inverting input voltage                                |             | V <sub>SS</sub>         | V <sub>SS</sub> + 5     |       |
| T <sub>A</sub>       | Ambient temperature                                                          |             | -40                     | 125                     | °C    |

**Note 1:** Logic operational for  $V_S$  of ( $V_{SO} - 8$  V) to ( $V_{SO} + 600$  V). Logic state held for  $V_S$  of ( $V_{SO} - 8$  V) to ( $V_{SO} - V_{BS}$ ).  
(Please refer to the Design Tip DT97-3 for more details).

**Note 2:** The CAO pin and all input pins (except CA-) are internally clamped with a 5.2 V zener diode.

# Static Electrical Characteristics

$V_{BIAS}$  ( $V_{CC}$ ,  $V_{BS1,2,3}$ ) = 15 V,  $V_{SO1,2,3}$  =  $V_{SS}$  and  $T_A$  = 25 °C unless otherwise specified. The  $V_{IN}$ ,  $V_{TH}$ , and  $I_{IN}$  parameters are referenced to  $V_{SS}$  and are applicable to all six logic input leads:  $\overline{HIN1,2,3}$  &  $\overline{LIN1,2,3}$ . The  $V_O$  and  $I_O$  parameters are referenced to  $V_{SO1,2,3}$  and are applicable to the respective output leads:  $HO1,2,3$  or  $LO1,2,3$ .

| Symbol               | Definition                                                    |             | Min. | Typ. | Max. | Units | Test Conditions                                                             |
|----------------------|---------------------------------------------------------------|-------------|------|------|------|-------|-----------------------------------------------------------------------------|
| V <sub>IH</sub>      | Logic “0” input voltage (OUT = LO)                            |             | 2.2  | —    | —    | V     |                                                                             |
| V <sub>IL</sub>      | Logic “1” input voltage (OUT = HI)                            |             | —    | —    | 0.8  |       |                                                                             |
| V <sub>IT,TH+</sub>  | ITRIP input positive going threshold                          |             | 400  | 490  | 580  | mV    |                                                                             |
| V <sub>OH</sub>      | High level output voltage, V <sub>BIAS</sub> - V <sub>O</sub> |             | —    | —    | 1    | V     | V <sub>IN</sub> = 0 V, I <sub>o</sub> = 20 mA                               |
| V <sub>OL</sub>      | Low level output voltage, V <sub>O</sub>                      |             | —    | —    | 400  | mV    | V <sub>IN</sub> = 5 V, I <sub>o</sub> = 20 mA                               |
| I <sub>LK</sub>      | Offset supply leakage current                                 |             | —    | —    | 50   | μA    | V <sub>B</sub> = V <sub>S</sub> = 600 V                                     |
| I <sub>QBS</sub>     | Quiescent V <sub>BS</sub> supply current                      |             | —    | 30   | 70   |       | V <sub>IN</sub> = 0 V                                                       |
| I <sub>QCC</sub>     | Quiescent V <sub>CC</sub> supply current                      |             | —    | 3    | 5    | mA    |                                                                             |
| I <sub>IN+</sub>     | Logic “1” input bias current (OUT = HI)                       |             | —    | 300  | 400  | μA    |                                                                             |
| I <sub>IN-</sub>     | Logic “0” input bias current (OUT = LO)                       |             | —    | 220  | 300  |       | ITRIP = 5 V                                                                 |
| I <sub>ITRIP+</sub>  | “High” ITRIP bias current                                     |             | —    | 5    | 10   |       | ITRIP = 0 V                                                                 |
| I <sub>ITRIP-</sub>  | “Low” ITRIP bias current                                      |             | —    | —    | 100  | nA    |                                                                             |
| V <sub>BSUV+</sub>   | V <sub>BS</sub> supply undervoltage positive going threshold  | IRS213(0,2) | 7.5  | 8.35 | 9.2  | V     |                                                                             |
|                      |                                                               | IRS21303    | 11   | —    | 13   |       |                                                                             |
| V <sub>BSUV-</sub>   | V <sub>BS</sub> supply undervoltage negative going threshold  | IRS213(0,2) | 7.1  | 7.95 | 8.8  |       |                                                                             |
|                      |                                                               | IRS21303    | 9    | —    | 11   |       |                                                                             |
| V <sub>CCUV+</sub>   | V <sub>CC</sub> supply undervoltage positive going threshold  | IRS213(0,2) | 8.3  | 9    | 9.7  |       |                                                                             |
|                      |                                                               | IRS21303    | 11   | —    | 13   |       |                                                                             |
| V <sub>CCUV-</sub>   | V <sub>CC</sub> supply undervoltage negative going threshold  | IRS213(0,2) | 8    | 8.7  | 9.4  |       |                                                                             |
|                      |                                                               | IRS21303    | 9    | —    | 11   |       |                                                                             |
| V <sub>CCUVH</sub>   | Hysteresis                                                    | IRS213(0,2) | —    | 0.3  | —    |       |                                                                             |
|                      |                                                               | IRS21303    | —    | 2    | —    |       |                                                                             |
| V <sub>BSUVH</sub>   | Hysteresis                                                    | IRS213(0,2) | —    | 0.4  | —    |       |                                                                             |
|                      |                                                               | IRS21303    |      | 2    |      |       |                                                                             |
| R <sub>on, FLT</sub> | FAULT low on-resistance                                       |             | —    | 55   | 75   | Ω     |                                                                             |
| I <sub>O+</sub>      | Output high short circuit pulsed current                      |             | 200  | 250  | —    | mA    | V <sub>O</sub> = 0 V, V <sub>IN</sub> = 0 V<br>PW ≤ 10 μs                   |
| I <sub>O-</sub>      | Output low short circuit pulsed current                       |             | 420  | 500  | —    |       | V <sub>O</sub> = 15 V, V <sub>IN</sub> = 5 V<br>PW ≤ 10 μs                  |
| V <sub>OS</sub>      | Operational amplifier input offset voltage                    |             | —    | —    | 10   | mV    | V <sub>SO</sub> = V <sub>CA-</sub> = 0.2 V                                  |
| I <sub>CA-</sub>     | CA- input bias current                                        |             | —    | —    | 50   | nA    | V <sub>CA-</sub> = 2.5 V                                                    |
| CMRR                 | Operational amplifier common mode rejection ratio             |             | TBD  | 80   | —    | dB    | V <sub>SO</sub> = V <sub>CA-</sub> = 0.1 V & 1.1 V                          |
| PSRR                 | Operational amplifier power supply rejection ratio            |             | TBD  | 75   | —    |       | V <sub>SO</sub> = V <sub>CA-</sub> = 0.2 V<br>V <sub>CC</sub> = 10 V & 20 V |
| V <sub>OH,AMP</sub>  | Operational amplifier high level output voltage               |             | 4.9  | 5.2  | 5.4  | V     | V <sub>CA-</sub> = 0 V, V <sub>SO</sub> = 1 V                               |
| V <sub>OL,AMP</sub>  | Operational amplifier low level output voltage                |             | —    | —    | 30   | mV    | V <sub>CA-</sub> = 1 V, V <sub>SO</sub> = 0 V                               |

### Static Electrical Characteristics - (Continued)

$V_{BIAS}$  ( $V_{CC}$ ,  $V_{BS1,2,3}$ ) = 15 V,  $V_{SO1,2,3}$  =  $V_{SS}$  and  $T_A$  = 25 °C unless otherwise specified. The  $V_{IN}$ ,  $V_{TH}$ , and  $I_{IN}$  parameters are referenced to  $V_{SS}$  and are applicable to all six logic input leads:  $\overline{HIN1,2,3}$  &  $LIN1,2,3$ . The  $V_O$  and  $I_O$  parameters are referenced to  $V_{SO1,2,3}$  and are applicable to the respective output leads:  $HO1,2,3$  or  $LO1,2,3$ .

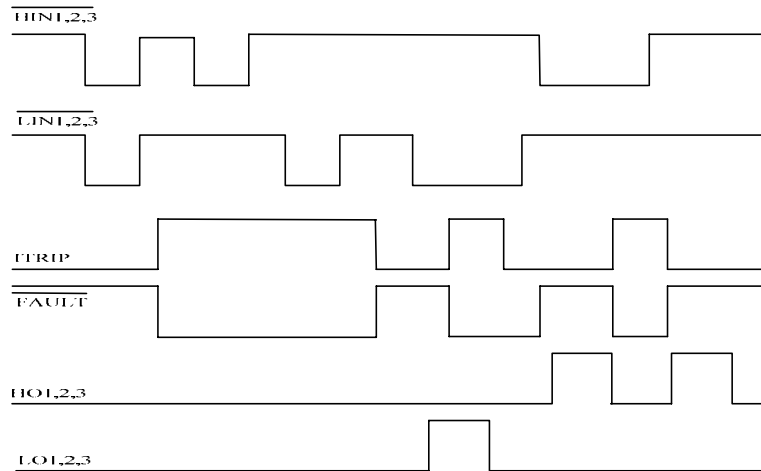
| Symbol        | Definition                                              | Min. | Typ. | Max. | Units | Test Conditions                                                          |
|---------------|---------------------------------------------------------|------|------|------|-------|--------------------------------------------------------------------------|
| $I_{SRC,AMP}$ | Operational amplifier output source current             | 4    | 7    | —    | mA    | $V_{CA-} = 0\text{ V}$ , $V_{SO} = 1\text{ V}$<br>$V_{CAO} = 4\text{ V}$ |
| $I_{SNK,AMP}$ | Operational amplifier output sink current               | 1    | 2.1  | —    |       | $V_{CA-} = 1\text{ V}$ , $V_{SO} = 0\text{ V}$<br>$V_{CAO} = 2\text{ V}$ |
| $I_{O+,AMP}$  | Operational amplifier output high short circuit current | —    | 10   | —    |       | $V_{CA-} = 0\text{ V}$ , $V_{SO} = 5\text{ V}$<br>$V_{CAO} = 0\text{ V}$ |
| $I_{O-,AMP}$  | Operational amplifier output low short circuit current  | —    | 4    | —    |       | $V_{CA-} = 5\text{ V}$ , $V_{SO} = 0\text{ V}$<br>$V_{CAO} = 5\text{ V}$ |

### Dynamic Electrical Characteristics

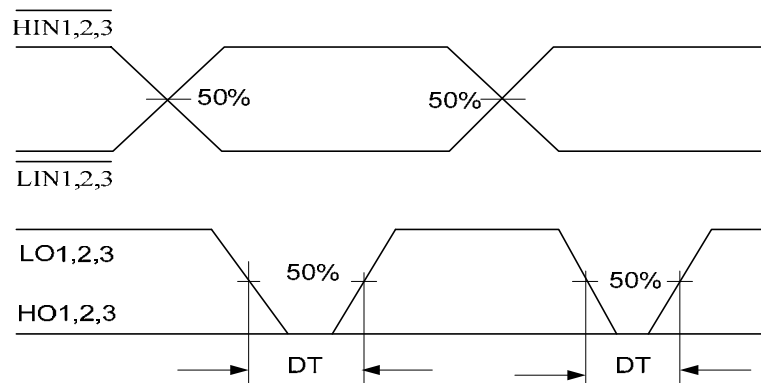
$V_{BIAS}$  ( $V_{CC}$ ,  $V_{BS1,2,3}$ ) = 15 V,  $V_{SO1,2,3}$  =  $V_{SS}$ ,  $C_L$  = 1000 pF,  $T_A$  = 25 °C unless otherwise specified.

| Symbol        | Definition                                                                                         | Min.         | Typ. | Max.  | Units      | Test Conditions                           |
|---------------|----------------------------------------------------------------------------------------------------|--------------|------|-------|------------|-------------------------------------------|
| $t_{on}$      | Turn-on propagation delay                                                                          | 400          | 500  | 700   | ns         | $V_{S1,2,3} = 0\text{ V to }600\text{ V}$ |
| $t_{off}$     | Turn-off propagation delay                                                                         | 400          | 500  | 700   |            |                                           |
| $t_r$         | Turn-on rise time                                                                                  | —            | 80   | 125   |            |                                           |
| $t_f$         | Turn-off fall time                                                                                 | —            | 35   | 55    |            |                                           |
| $t_{itrip}$   | ITRIP to output shutdown propagation delay                                                         | 400          | 660  | 920   |            |                                           |
| $t_{bl}$      | ITRIP blanking time                                                                                | —            | 400  | —     |            |                                           |
| $t_{flt}$     | ITRIP to FAULT indication delay                                                                    | 350          | 550  | 870   |            |                                           |
| $t_{flt, in}$ | Input filter time (all six inputs)                                                                 | —            | 325  | —     |            |                                           |
| $t_{fltclr}$  | $LIN1,2,3$ to FAULT clear time IRS213(0,2)<br>$LIN1,2,3$ & $HIN1,2,3$ to FAULT clear time IRS21303 | 5300         | 8500 | 13700 |            |                                           |
| DT            | Deadtime                                                                                           | IRS2130      | 1300 | 2000  | 3100       |                                           |
|               |                                                                                                    | IRS213(2,03) | 500  | 700   | 1100       |                                           |
| SR+           | Operational amplifier slew rate (+)                                                                | 5            | 10   | —     | V/ $\mu$ s | 1 V input step                            |
| SR-           | Operational amplifier slew rate (-)                                                                | 2.4          | 3.2  | —     |            |                                           |

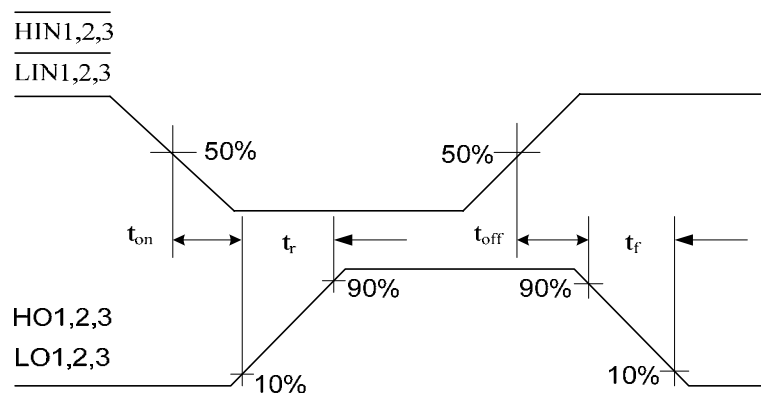
**NOTE:** For high side PWM,  $HIN$  pulse width must be  $\geq 1.5\text{ }\mu$ s.



**Fig. 1. Input/Output Timing Diagram**



**Fig. 2. Deadtime Waveform Definitions**



**Fig. 3. Input/Output Switching Time Waveform Definitions**

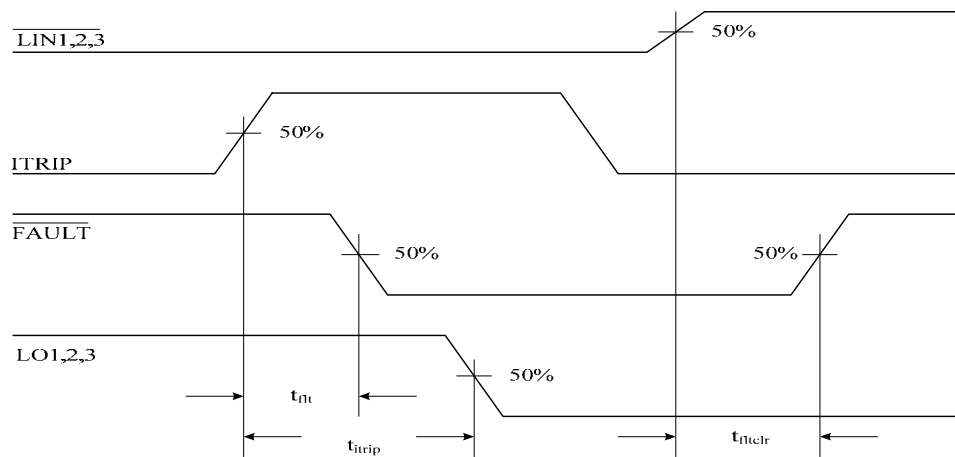


Fig. 4. Overcurrent Shutdown Switching Time Waveform Definitions

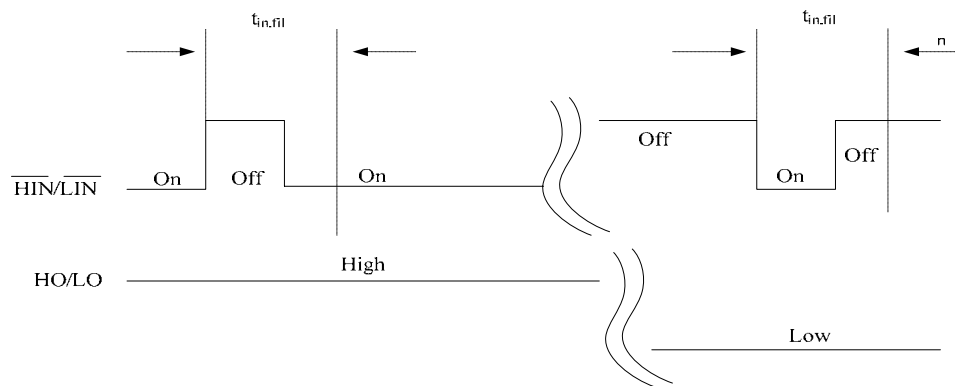


Fig. 5. Input Filter Function

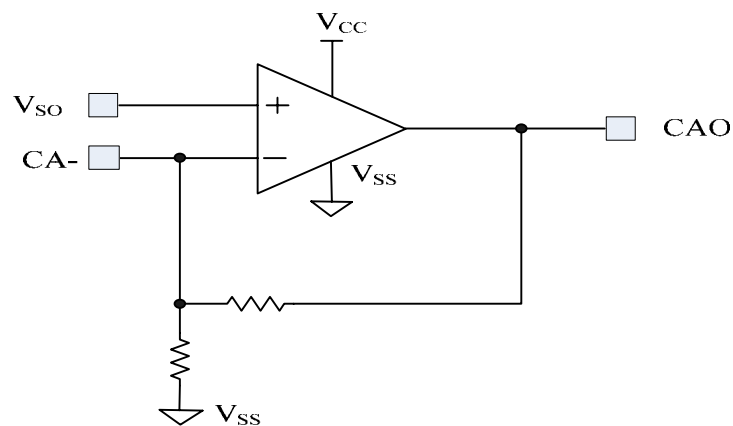


Fig. 6. Diagnostic Feedback Operational Amplifier Circuit

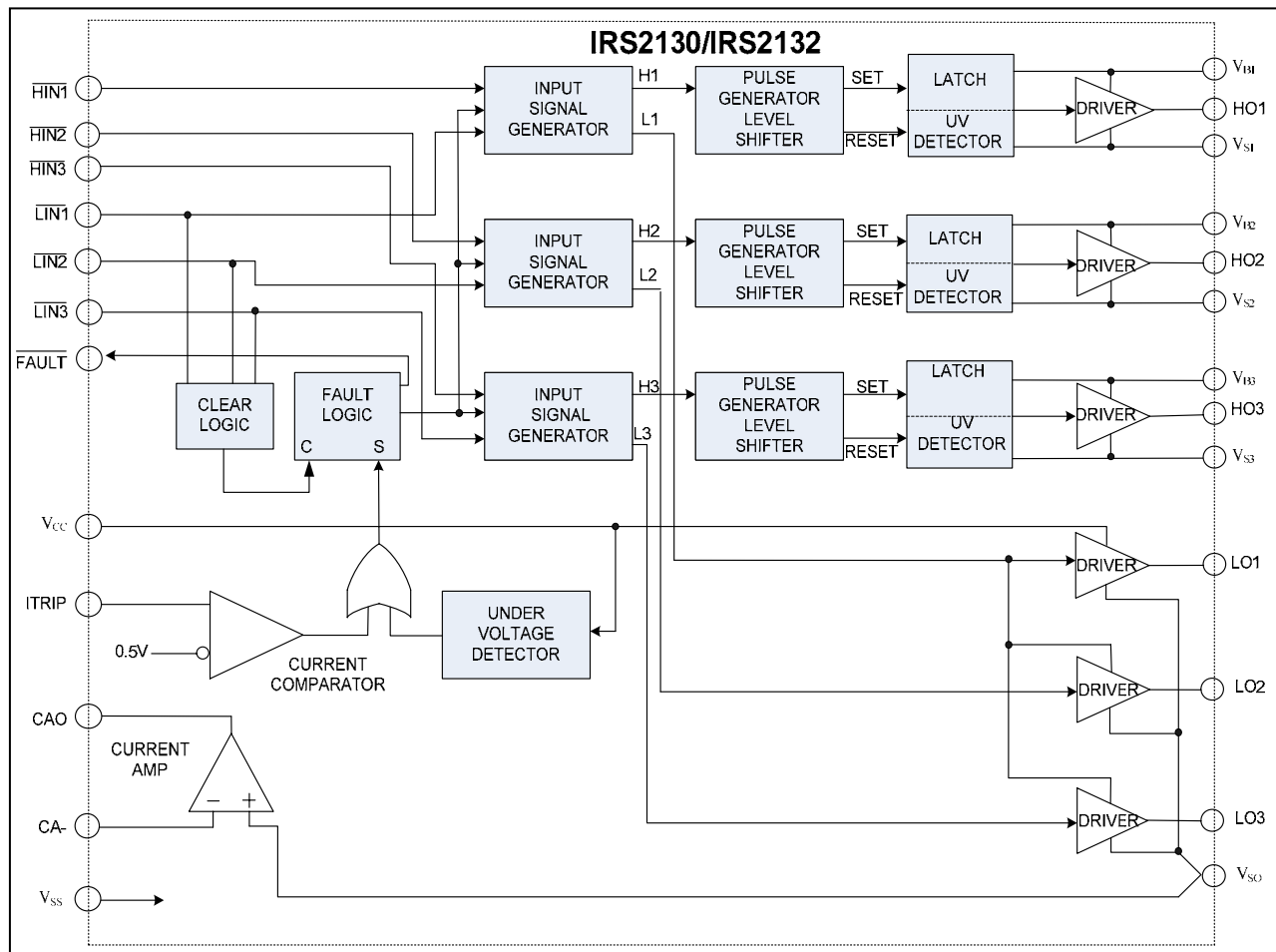
## Lead Definitions

| Symbol              | Description                                                                            |
|---------------------|----------------------------------------------------------------------------------------|
| HIN1,2,3            | Logic input for high side gate driver outputs (HO1,2,3), out of phase                  |
| LIN1,2,3            | Logic input for low side gate driver output (LO1,2,3), out of phase                    |
| FAULT               | Indicates over-current or undervoltage lockout (low side) has occurred, negative logic |
| V <sub>CC</sub>     | Low side and logic fixed supply                                                        |
| ITRIP               | Input for over-current shutdown                                                        |
| CAO                 | Output of current amplifier                                                            |
| CA-                 | Negative input of current amplifier                                                    |
| V <sub>SS</sub>     | Logic ground                                                                           |
| V <sub>B1,2,3</sub> | High side floating supply                                                              |
| HO1,2,3             | High side gate drive output                                                            |
| V <sub>S1,2,3</sub> | High side floating supply return                                                       |
| LO1,2,3             | Low side gate drive output                                                             |
| V <sub>SO</sub>     | Low side return and positive input of current amplifier                                |

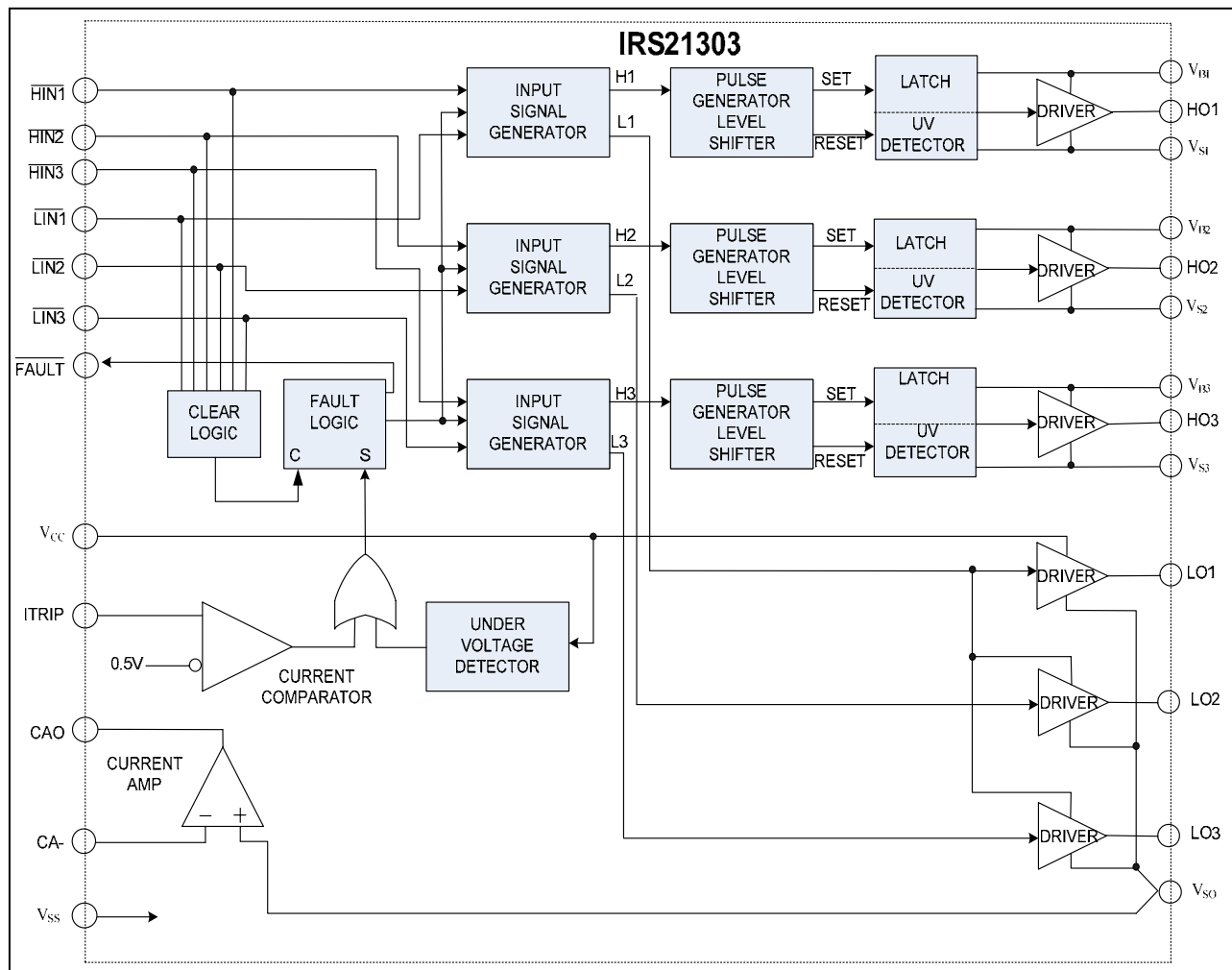
## Lead Assignments

|                     |                                  |                                 |
|---------------------|----------------------------------|---------------------------------|
| <p>28 Lead PDIP</p> | <p>44 Lead PLCC w/o 12 Leads</p> | <p>28 Lead SOIC (Wide Body)</p> |
| IRS213(0,03,2)      | IRS213(0,03,2)J                  | IRS213(0,03,2)S                 |
| Part Number         |                                  |                                 |

## Functional Block Diagram



### Functional Block Diagram



## 1 PCB Layout Tips

### 1.1 Distance from H to L Voltage

The IRS213(0,03,2)J package lacks some pins (see page 8) in order to maximizing the distance between the high voltage and low voltage pins. It's strongly recommended to place the components tied to the floating voltage in the respective high voltage portions of the device ( $V_{B1,2,3}$ ,  $V_{S1,2,3}$ ) side.

### 1.2 Ground Plane

To minimize noise coupling the ground plane must not be placed under or near the high voltage floating side.

### 1.3 Gate Drive Loops

Current loops behave like an antenna able to receive and transmit EM noise (see Fig. 7). In order to reduce EM coupling and improve the power switch turn on/off performances, gate drive loops must be reduced as much as possible. Moreover, current can be injected inside the gate drive loop via the IGBT collector-to-gate parasitic capacitance. The parasitic auto-inductance of the gate loop contributes to develop a voltage across the gate-emitter increasing the possibility of self turn-on effect.

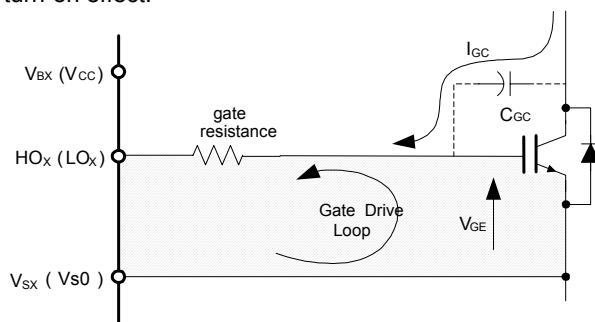


Fig. 7. Antenna Loops

### 1.4 Supply Capacitors

Supply capacitors must be placed as close as possible to the device pins ( $V_{CC}$  and  $V_{SS}$  for the ground tied supply,  $V_B$  and  $V_S$  for the floating supply) in order to minimize parasitic inductance/resistance.

### 1.5 Routing and Placement

Power stage PCB parasitic may generate dangerous voltage transients for the gate driver and the control logic. In particular it's recommended to limit phase voltage negative transients.

In order to avoid such undervoltage it is highly recommended to minimize high side emitter to low side collector distance and low side emitter to negative bus rail stray inductance. See DT04-4 at [www.irf.com](http://www.irf.com) for more detailed information.

Figures 8-38 provide information on the experimental performance of the IRS2130S HVIC. The line plotted in each figure is generated from actual lab data. A large number of individual samples were tested at three temperatures (-40 °C, 25 °C, and 125 °C) in order to generate the experimental (Exp.) curve. The line labeled Exp. consist of three data points (one data point at each of the tested temperatures) that have been connected together to illustrate the understood trend. The individual data points on the curve were determined by calculating the averaged experimental value of the parameter (for a given temperature).

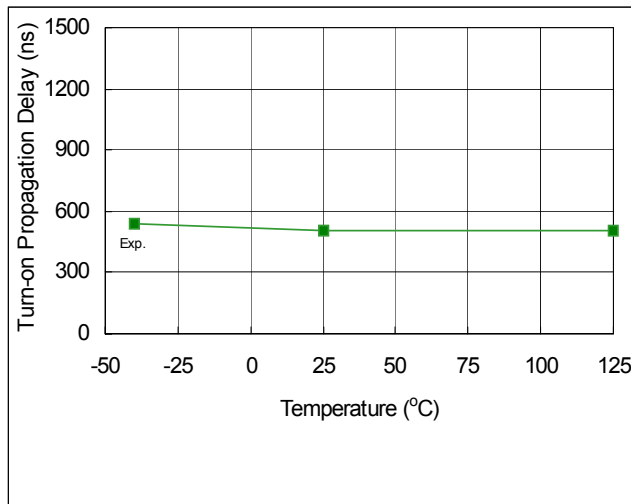


Fig. 8. Turn-On Propagation Delay vs. Temperature

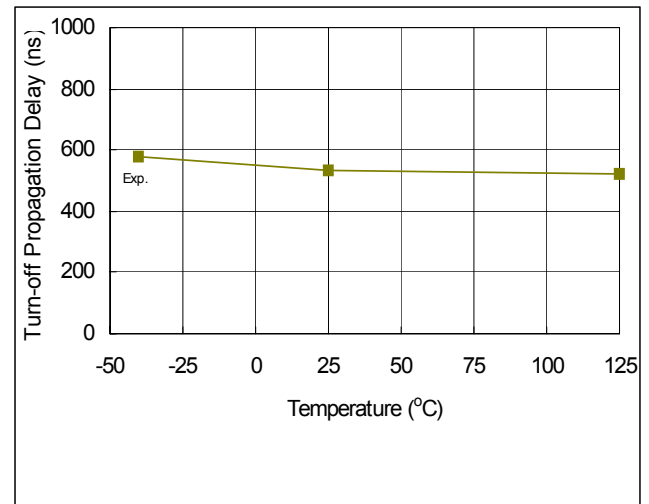


Fig. 9. Turn-Off Propagation Delay vs. Temperature

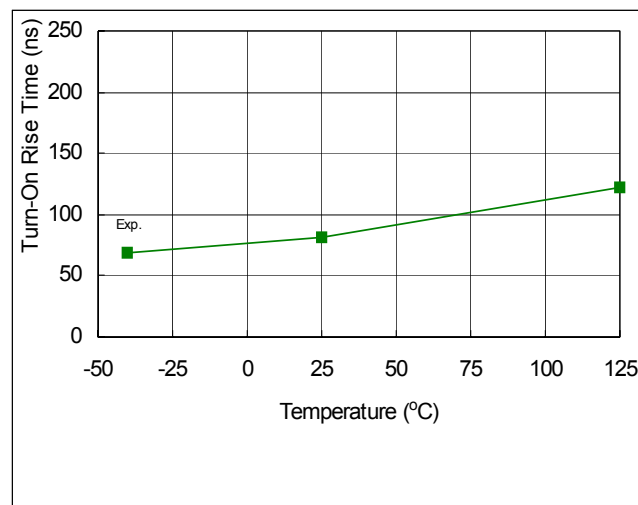


Fig. 10. Turn-On Rise Time vs. Temperature

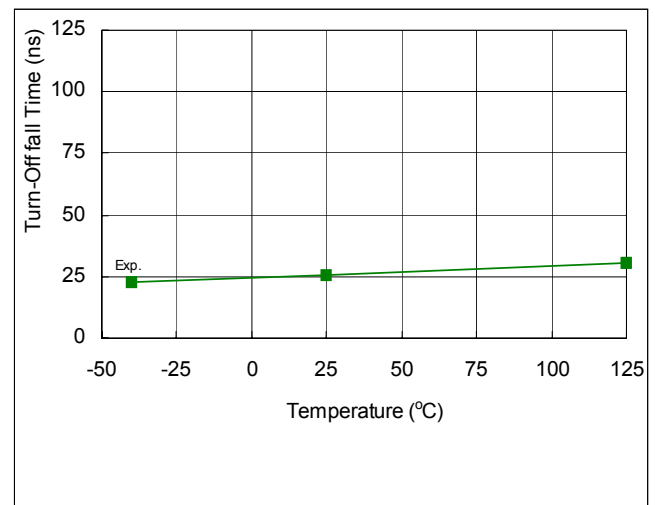


Fig. 11. Turn-Off Fall Time vs. Temperature

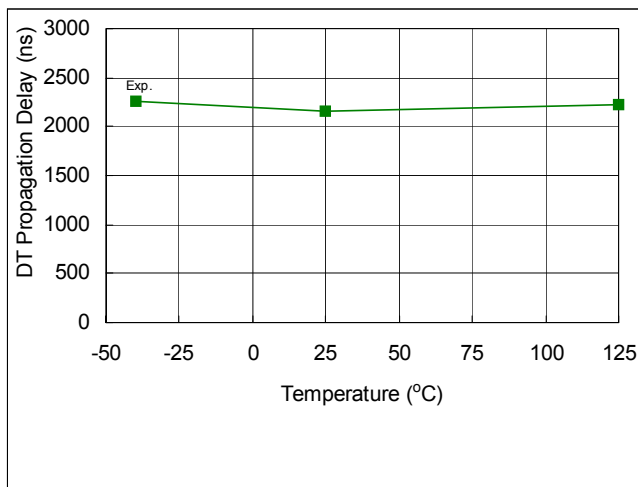


Fig. 12. DT Propagation Delay vs. Temperature

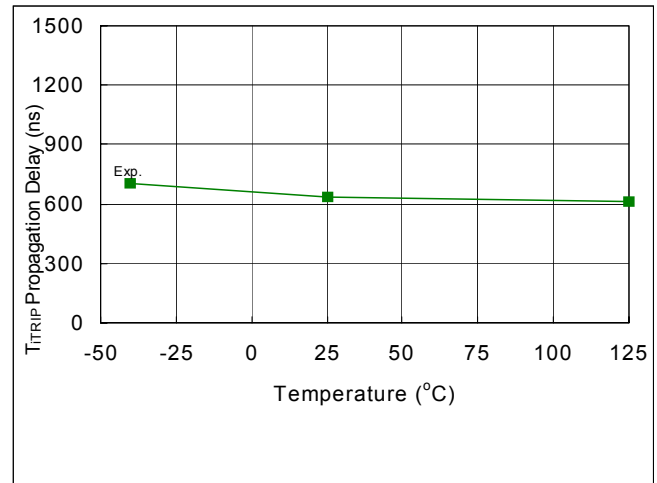


Fig. 13. TITRIP Propagation Delay vs. Temperature

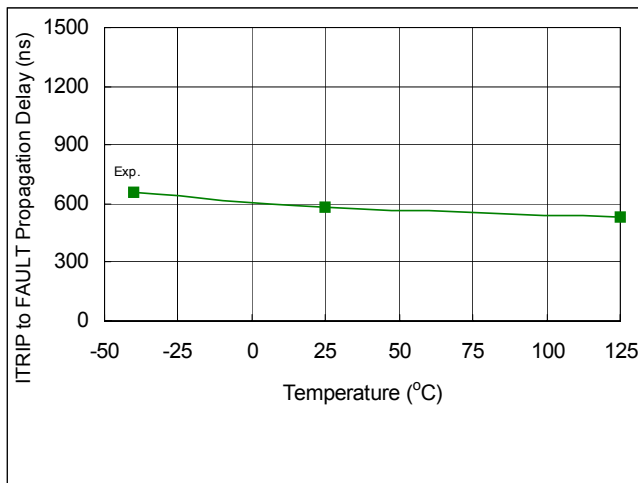


Fig. 14. ITRIP to FAULT Propagation Delay vs. Temperature

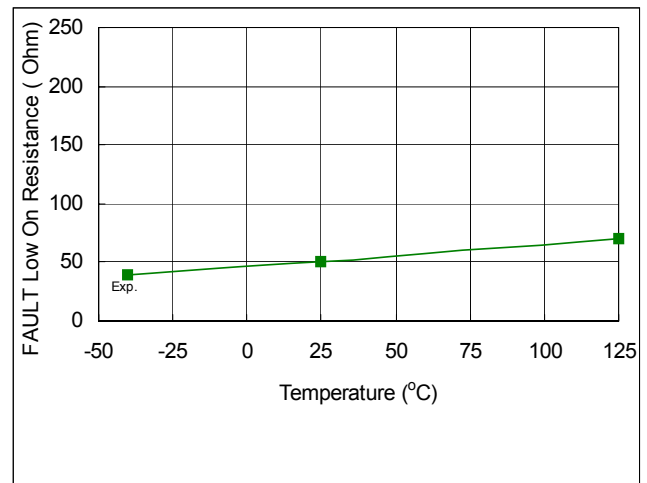


Fig. 15. FAULT Low On Resistance vs. Temperature

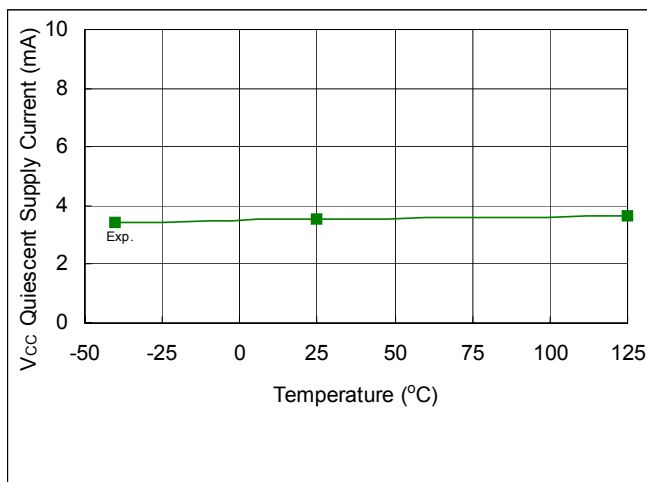


Fig. 16. VCC Quiescent Current vs. Temperature

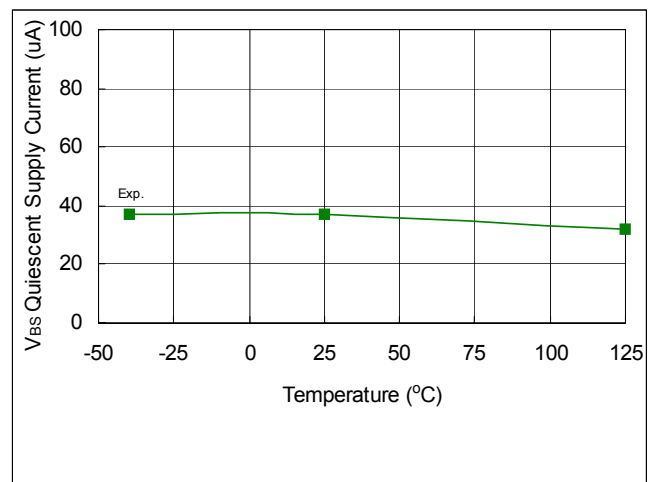


Fig. 17. VBS Quiescent Current vs. Temperature

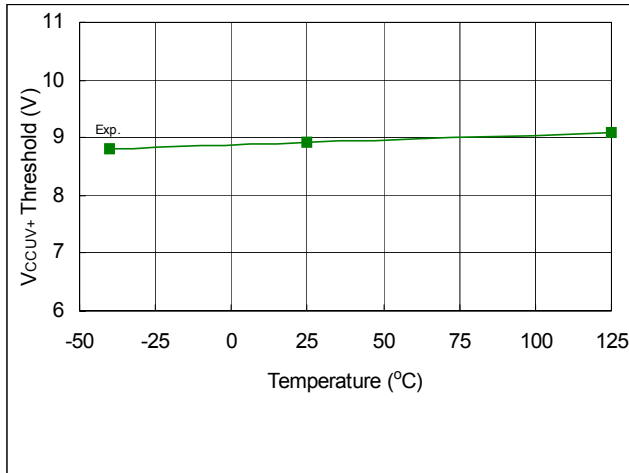


Fig. 18. V<sub>CCUV+</sub> Threshold vs. Temperature

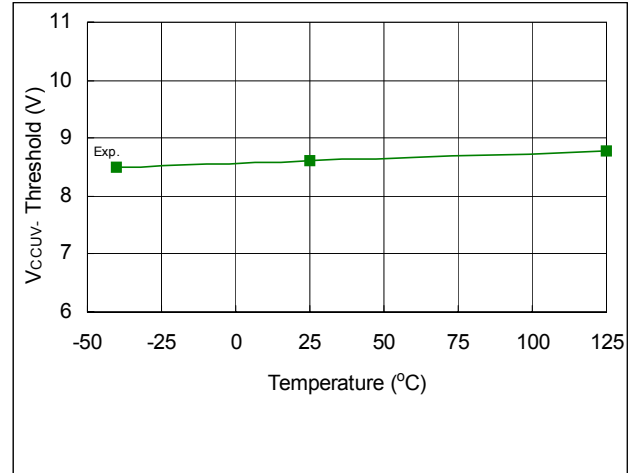


Fig. 19. V<sub>CCUV-</sub> Threshold vs. Temperature

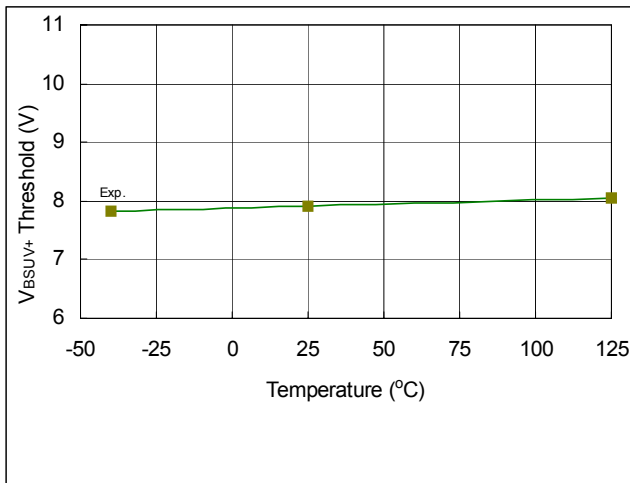


Fig. 20. V<sub>BSUV+</sub> Threshold vs. Temperature

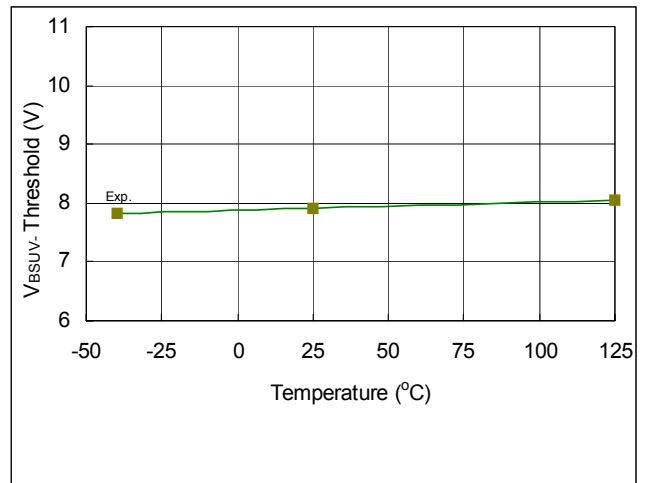


Fig. 21. V<sub>BSUV-</sub> Threshold vs. Temperature

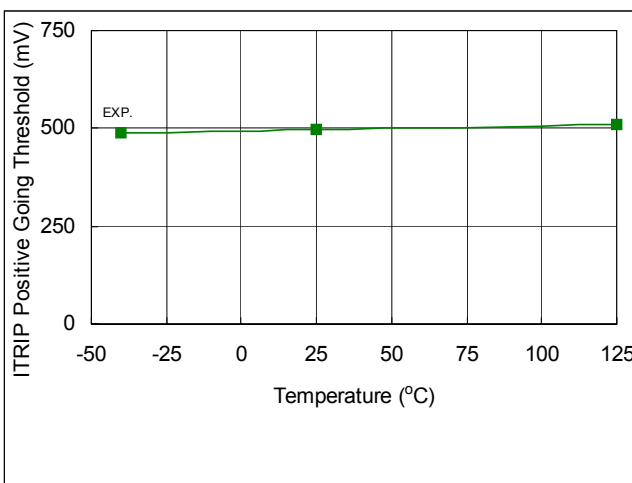


Fig. 22. ITRIP Positive Going Threshold vs. Temperature

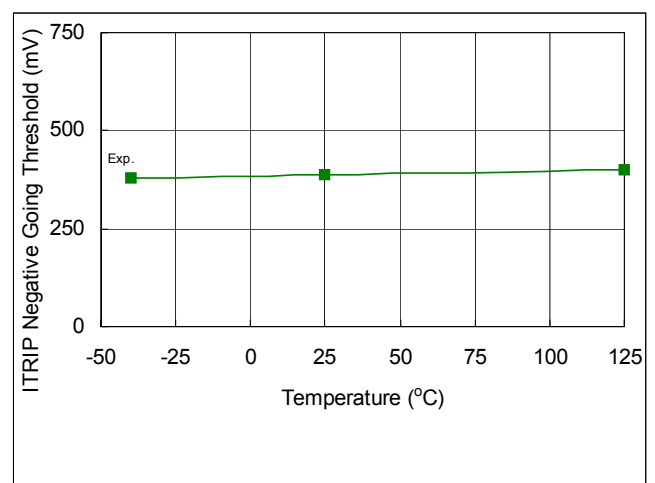


Fig. 23. ITRIP Negative Going Threshold vs. Temperature

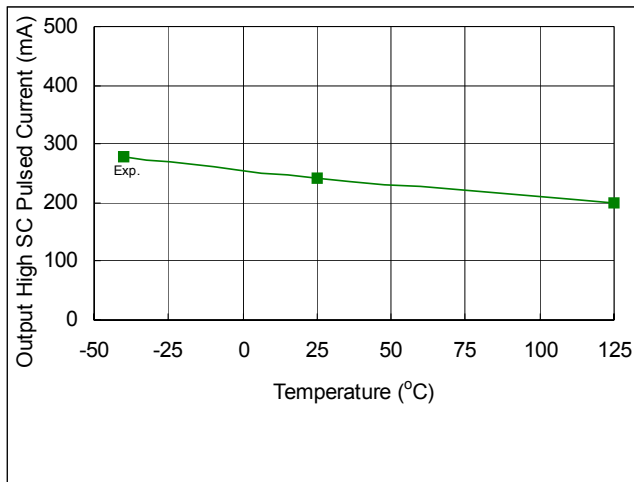


Fig. 24. Output High Short Circuit Pulsed Current vs. Temperature

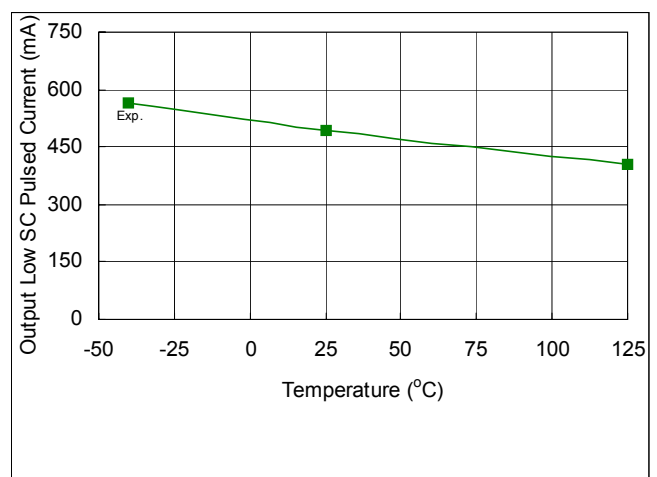


Fig. 25. Output Low Short Circuit Current vs. Temperature

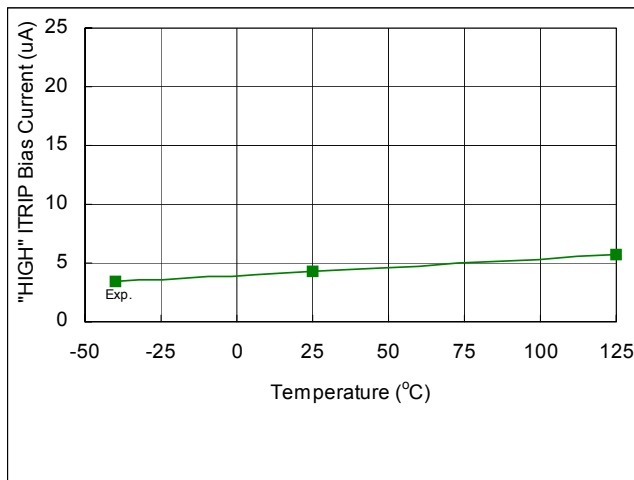


Fig. 26. "High" ITRIP Bias Current vs. Temperature

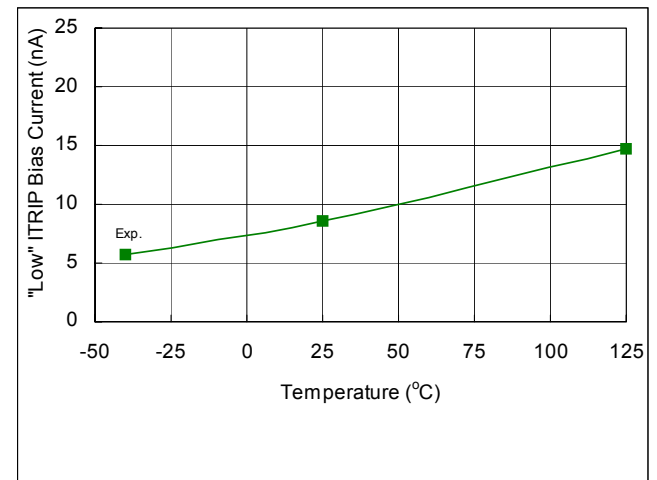


Fig. 27. "Low" ITRIP Bias Current vs. Temperature

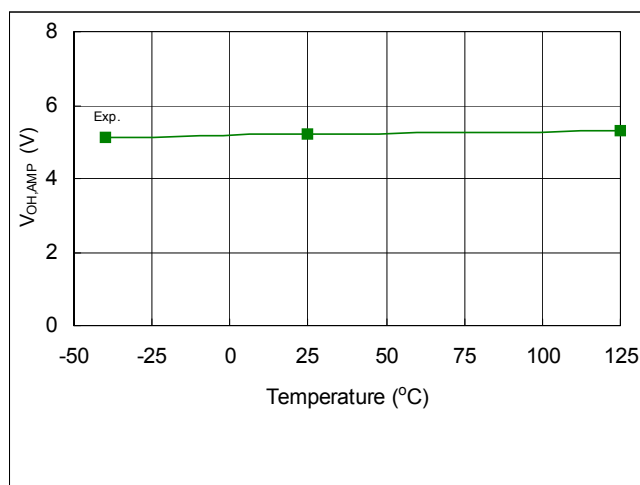


Fig. 28. V<sub>OH,AMP</sub> vs. Temperature

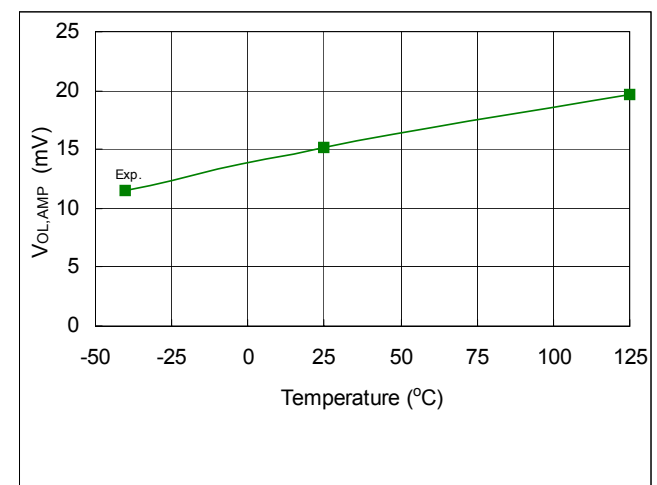


Fig. 29. V<sub>OL,AMP</sub> vs. Temperature

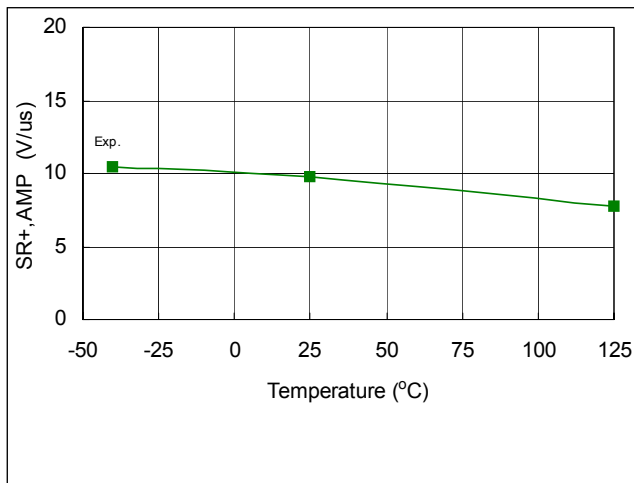


Fig. 30. SR+,AMP vs. Temperature

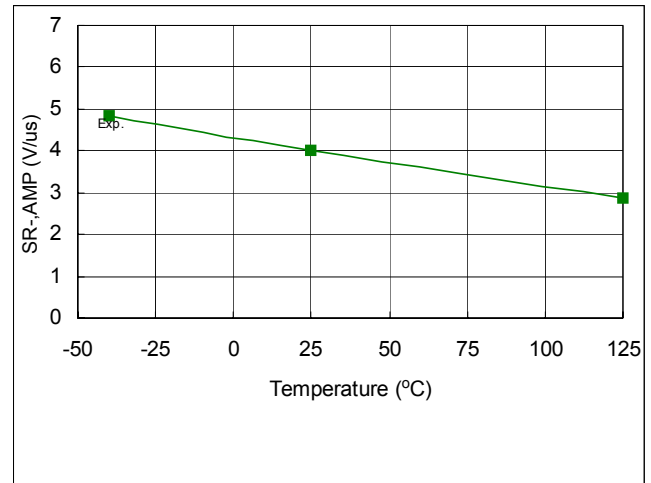


Fig. 31. SR-,AMP vs. Temperature

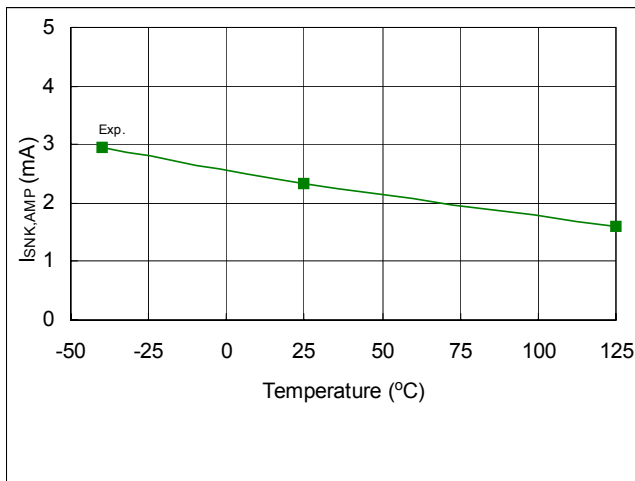


Fig. 32. ISNK,AMP vs. Temperature

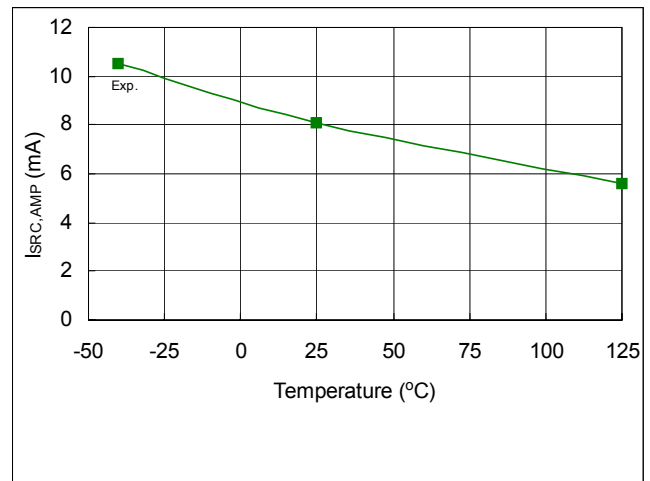


Fig. 33. ISRC,AMP vs. Temperature

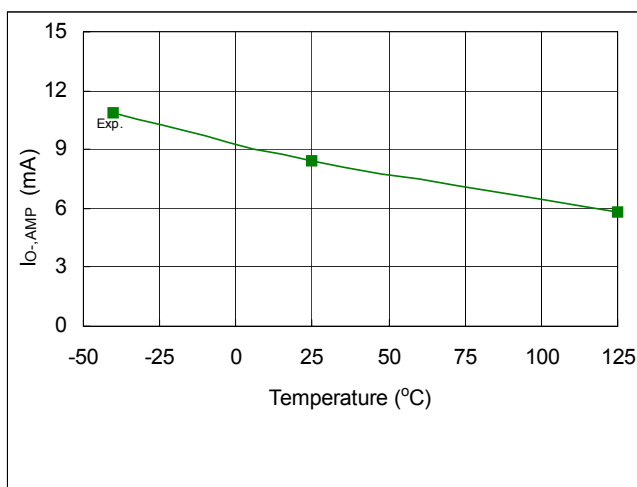


Fig. 34. IO-,AMP vs. Temperature

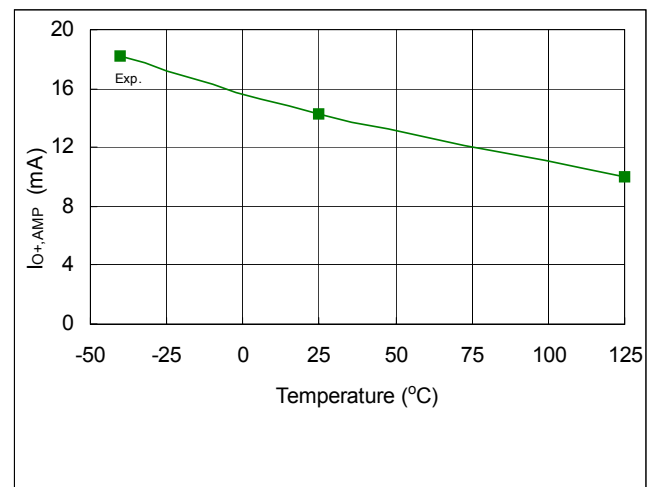


Fig. 35. IO+,AMP vs. Temperature

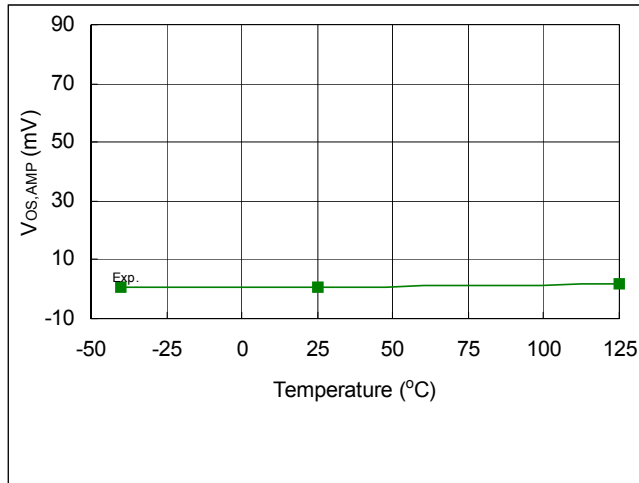


Fig. 36.  $V_{OS,AMP}$  vs. Temperature

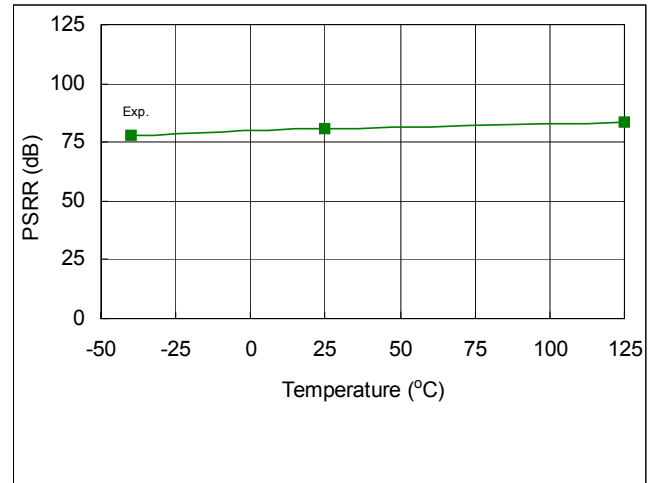


Fig. 37. PSRR vs. Temperature

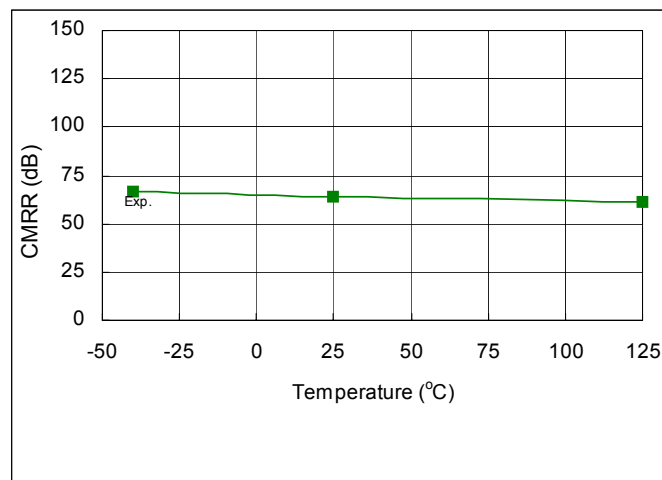
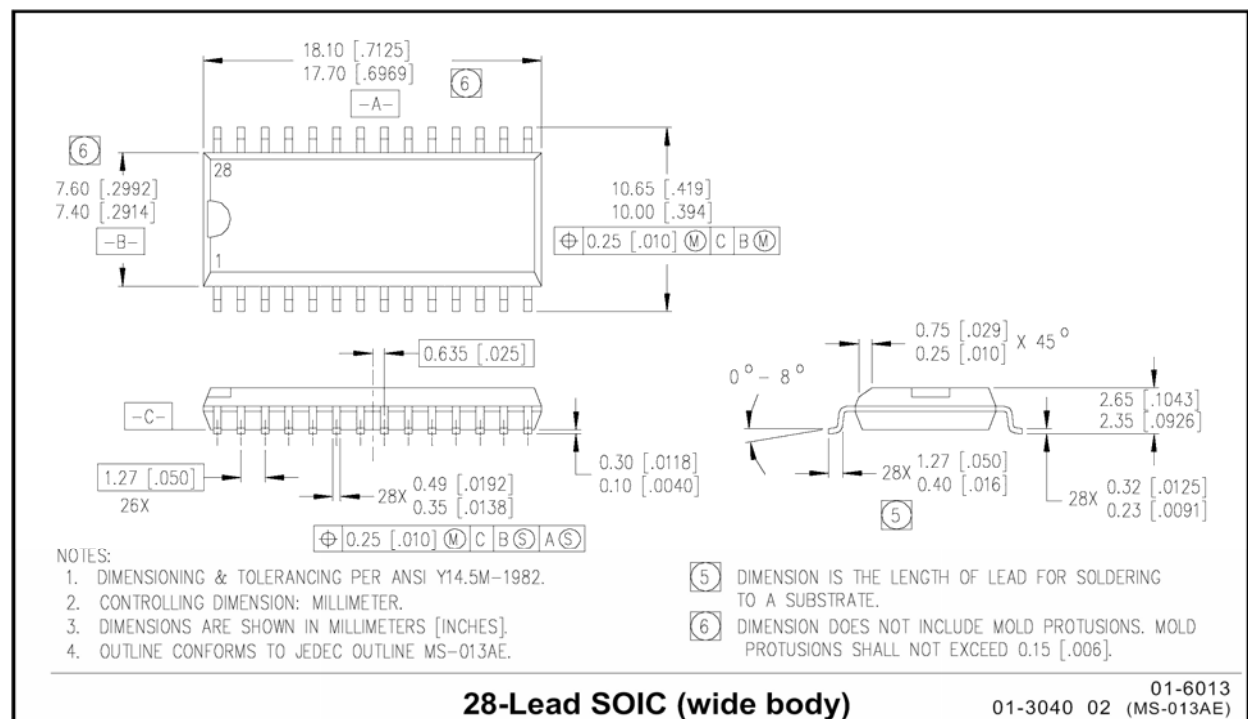
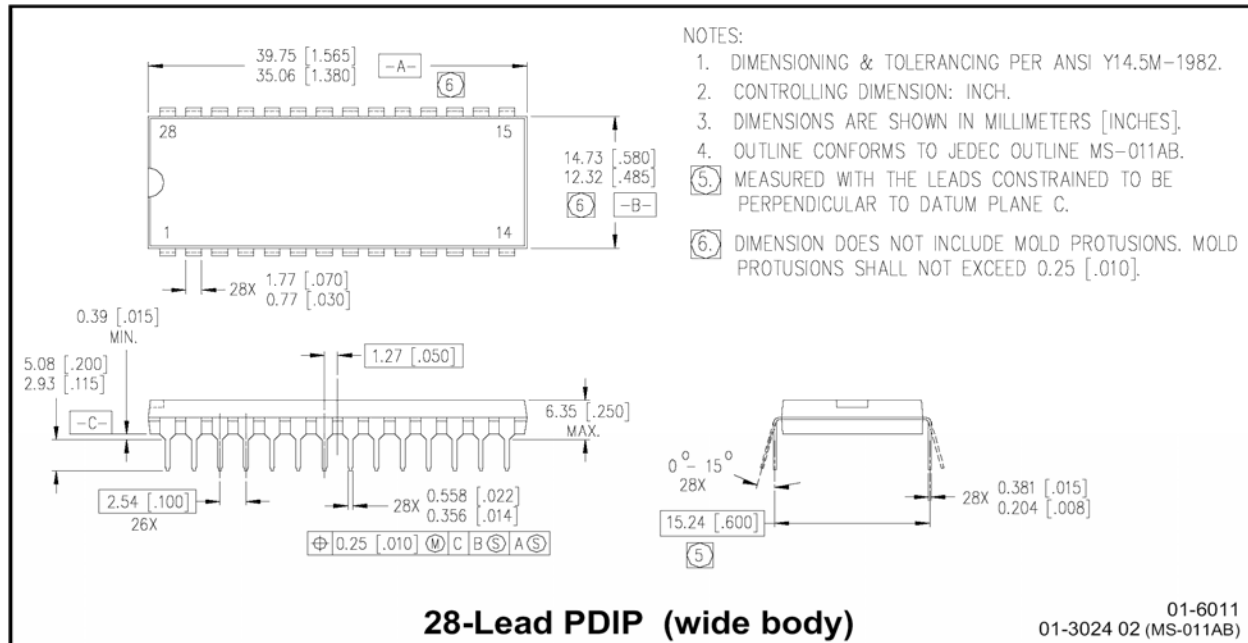
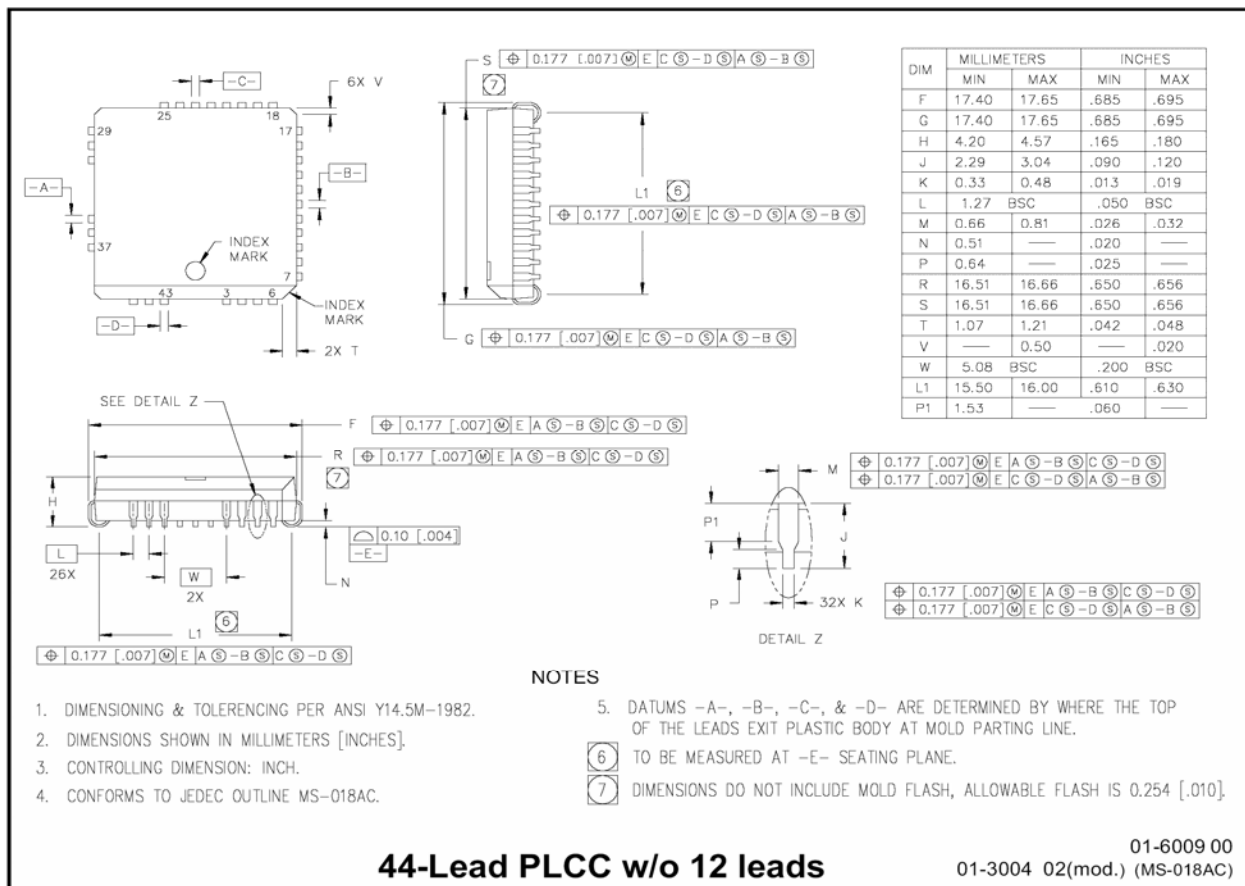


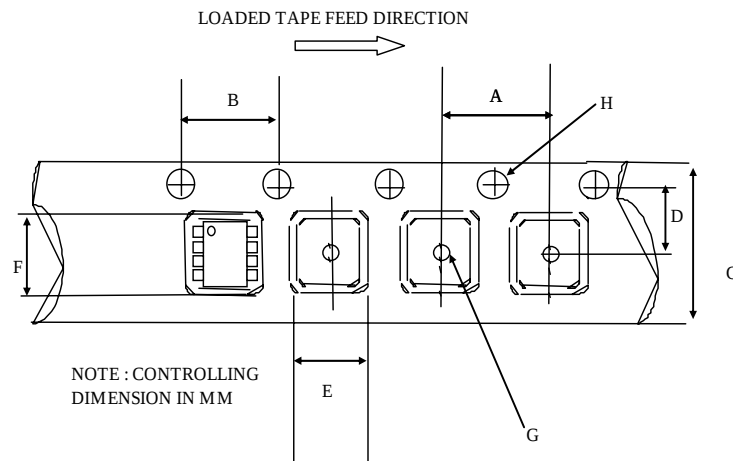
Fig. 38. CMRR vs. Temperature

## Case Outlines



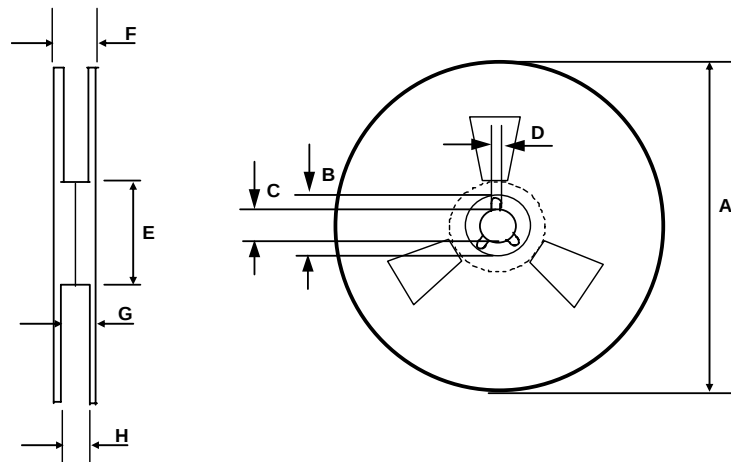
## Case Outlines





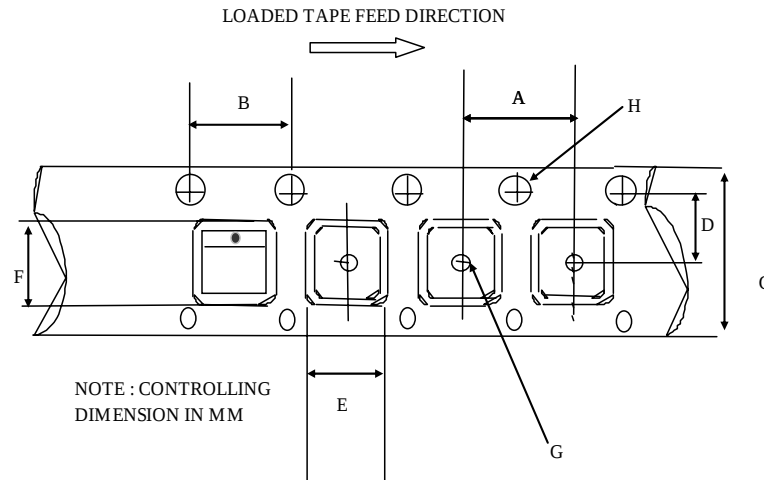
CARRIER TAPE DIMENSION FOR 28SOICW

| Code | Metric |       | Imperial |       |
|------|--------|-------|----------|-------|
|      | Min    | Max   | Min      | Max   |
| A    | 11.90  | 12.10 | 0.468    | 0.476 |
| B    | 3.90   | 4.10  | 0.153    | 0.161 |
| C    | 23.70  | 24.30 | 0.933    | 0.956 |
| D    | 11.40  | 11.60 | 0.448    | 0.456 |
| E    | 10.80  | 11.00 | 0.425    | 0.433 |
| F    | 18.20  | 18.40 | 0.716    | 0.724 |
| G    | 1.50   | n/a   | 0.059    | n/a   |
| H    | 1.50   | 1.60  | 0.059    | 0.062 |



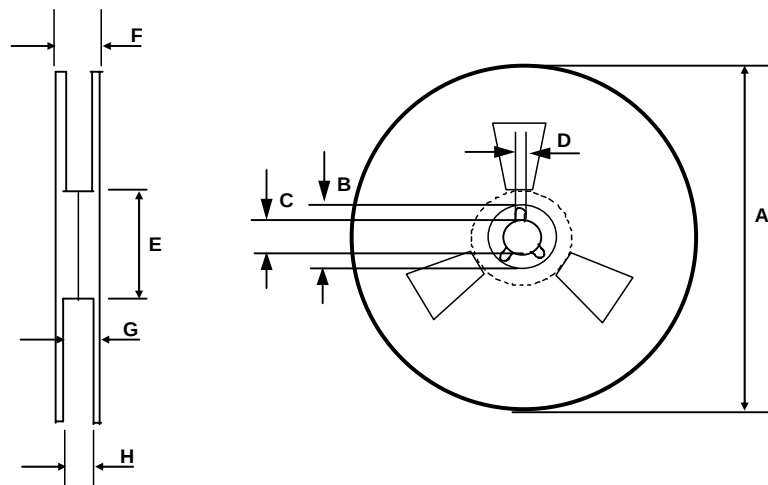
REEL DIMENSIONS FOR 28SOICW

| Code | Metric |        | Imperial |        |
|------|--------|--------|----------|--------|
|      | Min    | Max    | Min      | Max    |
| A    | 329.60 | 330.25 | 12.976   | 13.001 |
| B    | 20.95  | 21.45  | 0.824    | 0.844  |
| C    | 12.80  | 13.20  | 0.503    | 0.519  |
| D    | 1.95   | 2.45   | 0.767    | 0.096  |
| E    | 98.00  | 102.00 | 3.858    | 4.015  |
| F    | n/a    | 30.40  | n/a      | 1.196  |
| G    | 26.50  | 29.10  | 1.04     | 1.145  |
| H    | 24.40  | 26.40  | 0.96     | 1.039  |



CARRIER TAPE DIMENSION FOR 44PLCC

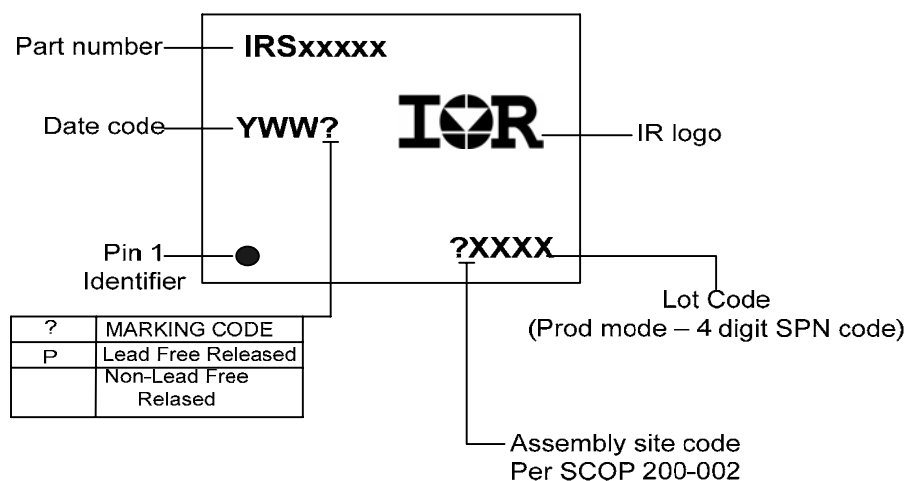
| Code | Metric |       | Imperial |       |
|------|--------|-------|----------|-------|
|      | Min    | Max   | Min      | Max   |
| A    | 23.90  | 24.10 | 0.94     | 0.948 |
| B    | 3.90   | 4.10  | 0.153    | 0.161 |
| C    | 31.70  | 32.30 | 1.248    | 1.271 |
| D    | 14.10  | 14.30 | 0.555    | 0.562 |
| E    | 17.90  | 18.10 | 0.704    | 0.712 |
| F    | 17.90  | 18.10 | 0.704    | 0.712 |
| G    | 2.00   | n/a   | 0.078    | n/a   |
| H    | 1.50   | 1.60  | 0.059    | 0.062 |



REEL DIMENSIONS FOR 44PLCC

| Code | Metric |        | Imperial |        |
|------|--------|--------|----------|--------|
|      | Min    | Max    | Min      | Max    |
| A    | 329.60 | 330.25 | 12.976   | 13.001 |
| B    | 20.95  | 21.45  | 0.824    | 0.844  |
| C    | 12.80  | 13.20  | 0.503    | 0.519  |
| D    | 1.95   | 2.45   | 0.767    | 0.096  |
| E    | 98.00  | 102.00 | 3.858    | 4.015  |
| F    | n/a    | 38.4   | n/a      | 1.511  |
| G    | 34.7   | 35.8   | 1.366    | 1.409  |
| H    | 32.6   | 33.1   | 1.283    | 1.303  |

**LEAD-FREE PART MARKING INFORMATION**



**ORDER INFORMATION**

28-Lead PDIP IRS2130PbF  
 28-Lead PDIP IRS21303PbF  
 28-Lead PDIP IRS2132PbF  
 28-Lead SOIC IRS2130SPbF  
 28-Lead SOIC IRS21303SPbF  
 28-Lead SOIC IRS2132SPbF  
 44-Lead PLCC IRS2132JPbF  
 44-Lead PLCC IRS21303JPbF  
 44-Lead PLCC IRS2132JPbF

28-Lead SOIC Tape & Reel IRS2130STRPbF  
 28-Lead SOIC Tape & Reel IRS21303STRPbF  
 28-Lead SOIC Tape & Reel IRS2132STRPbF  
 44-Lead PLCC Tape & Reel IRS2130JTRPbF  
 44-Lead PLCC Tape & Reel IRS21303JTRPbF  
 44-Lead PLCC Tape & Reel IRS2132JTRPbF