

IRS20957S Protected Digital Audio Driver

Features

- Floating PWM input enables easy half bridge implementation
- Programmable bidirectional over-current protection with self-reset function
- Programmable preset dead-time for improved THD performances
- High noise immunity
- $\pm 100V$ ratings deliver up to 500W in output power
- 3.3 V/ 5 V logic compatible input
- Operates up to 800kHz

Typical Applications

- Home theatre systems
- Mini component stereo systems
- Powered speaker systems
- General purpose audio power amplifiers

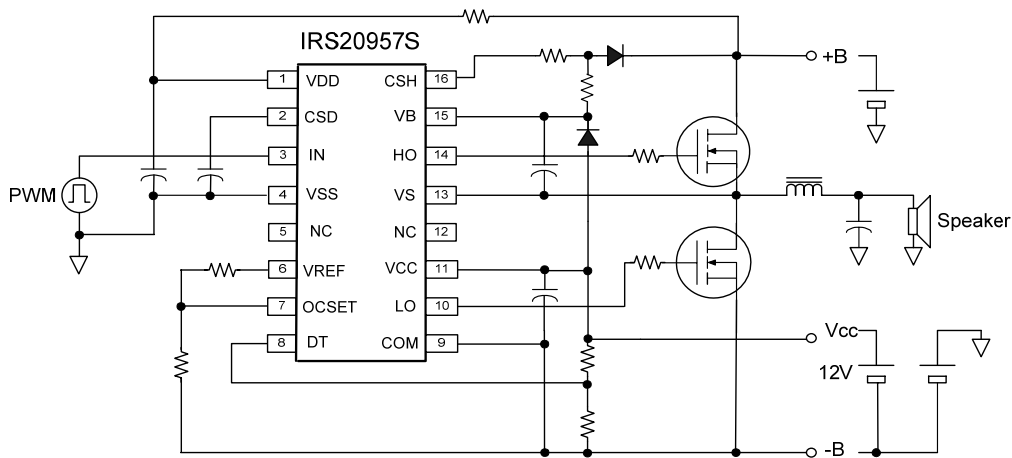
Product Summary

| | |
|-------------------------------|---------------|
| Topology | Half-Bridge |
| $V_{\text{OFFSET (max)}}$ | +/- 100 V |
| I_{O+} & I_{O-} (typical) | 1.0 A & 1.2 A |
| Selectable deadtime | 15/25/35/80ns |
| Ton & toff (typical) | 95ns & 80ns |
| OC protection delay | 500ns (max) |
| Shutdown propagation delay | 250ns (max) |

Package



Typical Connection Diagram



Note: Please refer to Lead Assignments for correct pin configuration. This diagram shows electrical connections only.

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Description

The IRS20957S is a high voltage, high speed MOSFET driver with a floating PWM input designed for Class D audio amplifier applications.

Bi-directional current sensing detects over current conditions during positive and negative load currents without any external shunt resistors. A built-in protection control block provides a secure protection sequence against over-current conditions and a programmable reset timer.

The internal dead-time generation block enables accurate gate switching and optimum dead-time setting for better audio performance, such as lower THD and lower audio noise floor.

Qualification Information[†]

| | | | |
|-----------------------------------|-------------------------|---|--|
| Qualification Level | | Industrial ^{††} | |
| | | Comments: This family of ICs has passed JEDEC's Industrial qualification. IR's Consumer qualification level is granted by extension of the higher Industrial level. | |
| Moisture Sensitivity Level | | SOIC16N | MSL2 ^{†††} 260°C (per IPC/JEDEC J-STD-020) |
| ESD | Machine Model | Class B (per JEDEC standard EIA/JESD22-A115) | |
| | Human Body Model | Class 2 (per EIA/JEDEC standard JESD22-A114) | |
| IC Latch-Up Test | | Class I , Level A (per JESD78) | |
| RoHS Compliant | | Yes | |

† Qualification standards can be found at International Rectifier's web site <http://www.irf.com/>

†† Higher qualification ratings may be available should the user have such requirements. Please contact your International Rectifier sales representative for further information.

††† Higher MSL ratings may be available for the specific package types listed here. Please contact your International Rectifier sales representative for further information.

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_{SS} ; all currents are defined positive into any lead. The Thermal Resistance and Power Dissipation ratings are measured under board mounted and still air conditions.

| Symbol | Definition | Min. | Max. | Units |
|----------------|---|------------------|---------------|-------|
| V_B | High side floating supply voltage | -0.3 | 215 | V |
| V_S | High side floating supply voltage [†] | V_B-15 | $V_B+0.3$ | |
| V_{HO} | High side floating output voltage | $V_S-0.3$ | $V_B+0.3$ | |
| V_{CSH} | CSH pin input voltage | $V_S-0.3$ | $V_B+0.3$ | |
| V_{CC} | Low side fixed supply voltage [†] | -0.3 | 20 | |
| V_{LO} | Low side output voltage | -0.3 | $V_{CC} +0.3$ | |
| V_{DD} | Floating input supply voltage | -0.3 | 210 | |
| V_{SS} | Floating input supply voltage [†] | (See I_{DDZ}) | $V_{DD}+0.3$ | |
| V_{IN} | PWM input voltage | $V_{SS} -0.3$ | $V_{DD}+0.3$ | |
| V_{CSD} | CSD pin input voltage | $V_{SS} -0.3$ | $V_{DD}+0.3$ | |
| V_{DT} | DT pin input voltage | -0.3 | $V_{CC} +0.3$ | |
| V_{OCSET} | OCSET pin input voltage | -0.3 | $V_{CC} +0.3$ | |
| V_{REF} | VREF pin voltage | -0.3 | $V_{CC} +0.3$ | |
| I_{DDZ} | Floating input supply zener clamp current [†] | - | 10 | |
| I_{CCZ} | Low side supply zener clamp current [†] | - | 10 | |
| I_{BSZ} | Floating supply zener clamp current [†] | - | 10 | |
| I_{OREF} | Reference output current | - | 5 | |
| $d V_S /dt$ | Allowable V_S voltage slew rate | - | 50 | V/ns |
| $d V_{SS} /dt$ | Allowable V_{SS} voltage slew rate ^{††} | - | 50 | |
| $d V_{SS} /dt$ | Allowable V_{SS} voltage slew rate upon power-up ^{†††} | - | 50 | V/ms |
| P_d | Maximum power dissipation | - | 1.0 | W |
| R_{thJA} | Thermal resistance, Junction to ambient | - | 115 | °C/W |
| T_J | Junction Temperature | - | 150 | °C |
| T_S | Storage Temperature | -55 | 150 | |
| T_L | Lead temperature (Soldering, 10 seconds) | - | 300 | |

† $V_{DD} - V_{SS}$, $V_{CC} -COM$ and $V_B - V_S$ contain internal shunt zener diodes. Please note that the voltage ratings of these can be limited by the clamping current.

†† For the rising and falling edges of step signal of 10V. $V_{SS}=15V$ to 200V.

††† V_{SS} ramps up from 0V to 200V.

Recommended Operating Conditions

For proper operation, the device should be used within the recommended conditions below. The Vs and COM offset ratings are tested with supplies biased at $I_{DD}=5\text{mA}$, $V_{CC}=12\text{V}$ and $V_B-V_S=12\text{V}$.

| Symbol | Definition | Min. | Max. | Units |
|-------------|--|----------|----------|-------|
| V_B | High side floating supply absolute voltage | V_S+10 | V_S+14 | V |
| V_S | High side floating supply offset voltage | † | 200 | |
| I_{DDZ} | Floating input supply zener clamp current | 1 | 5 | mA |
| V_{SS} | Floating input supply absolute voltage | 0 | 100 | V |
| V_{HO} | High side floating output voltage | V_S | V_B | |
| V_{CC} | Low side fixed supply voltage | 10 | 15 | |
| V_{LO} | Low side output voltage | 0 | V_{CC} | |
| V_{IN} | PWM input voltage | V_{SS} | V_{DD} | |
| V_{CSD} | CSD pin input voltage | V_{SS} | V_{DD} | |
| V_{DT} | DT pin input voltage | 0 | V_{CC} | |
| I_{OREF} | Reference output current to COM [†] | 0.3 | 0.8 | mA |
| V_{OCSET} | OCSET pin input voltage | 0.5 | 5 | V |
| T_A | Ambient Temperature | -40 | 125 | °C |

† Logic operational for Vs equal to -5V to +200V. Logic state held for Vs equal to -5V to -V_{BS}.

†† Nominal voltage for V_{REF} is 5V. I_{OREF} of 0.3 – 0.8mA dictates total external resistor value on VREF to be 6.3k to 16.7k Ω.

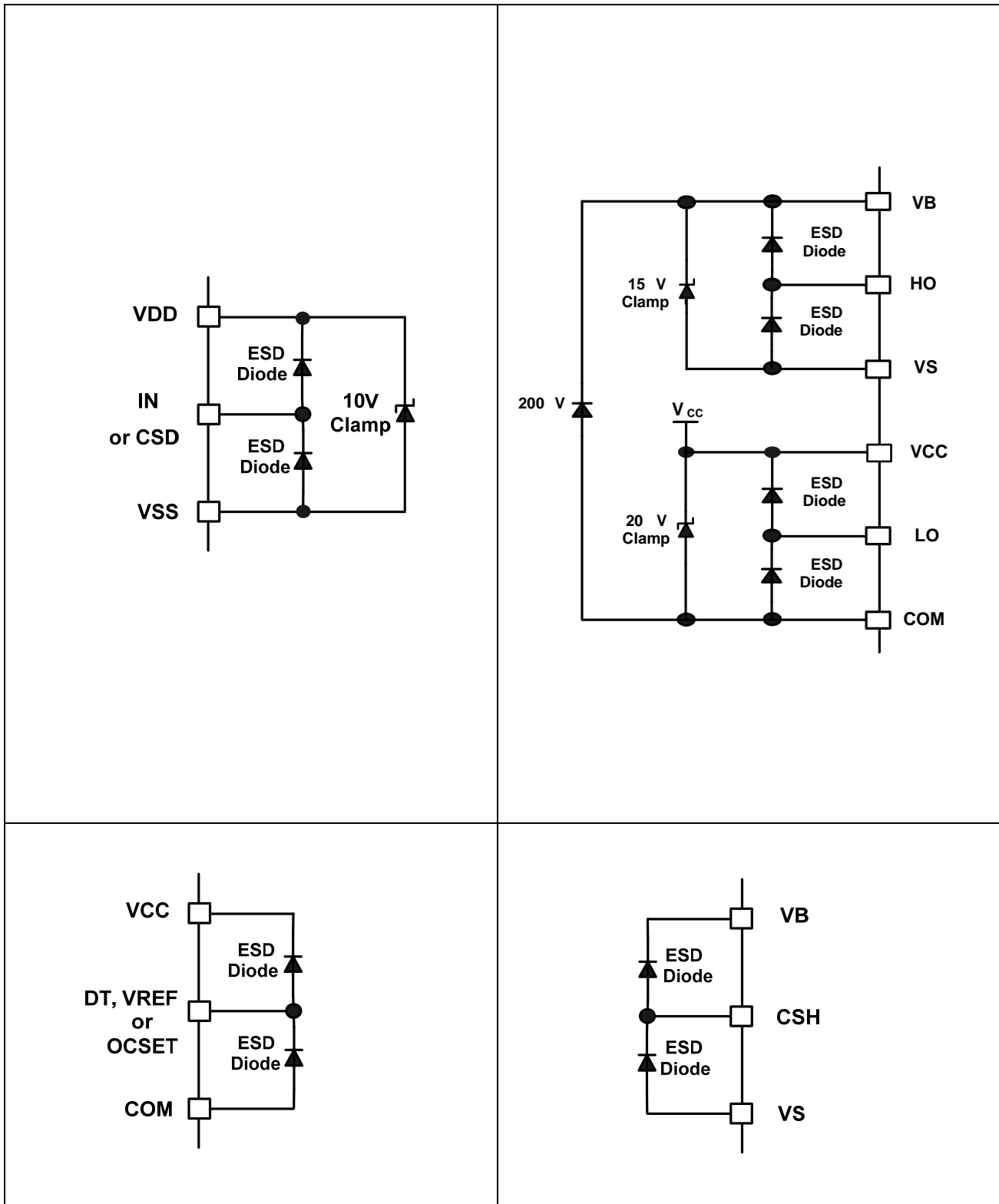
Electrical Characteristics

$V_{CC}, V_{BS} = 12\text{ V}$, $I_{DD} = 5\text{ mA}$, $V_{SS} = 20\text{ V}$, $V_S = 0\text{ V}$, $C_L = 1\text{ nF}$ and $T_A = 25^\circ\text{C}$ unless otherwise specified.

| Symbol | Description | Min | Typ | Max | Units | Test Conditions |
|----------------------------------|--|----------------------|----------------------|----------------------|---------------|------------------------------------|
| Low Side Supply | | | | | | |
| UV_{CC+} | V_{CC} supply UVLO positive threshold | 8.4 | 8.9 | 9.4 | V | |
| UV_{CC-} | V_{CC} supply UVLO negative threshold | 8.2 | 8.7 | 9.2 | | |
| I_{QCC} | Low side quiescent current | - | - | 3 | mA | $V_{DT} = V_{CC}$ |
| V_{CLAMPL} | Low side zener diode clamp voltage | 19.6 | 20.4 | 21.6 | V | $I_{CC} = 5\text{ mA}$ |
| High Side Floating Supply | | | | | | |
| UV_{BS+} | High side well UVLO positive threshold | 8.0 | 8.5 | 9.0 | V | |
| UV_{BS-} | High side well UVLO negative threshold | 7.8 | 8.3 | 8.8 | | |
| I_{QBS} | High side quiescent current | - | - | 1 | mA | |
| I_{LKH} | High to Low side leakage current | - | - | 50 | μA | $V_B = V_S = 200\text{ V}$ |
| V_{CLAMPH} | High side zener diode clamp voltage | 14.7 | 15.3 | 16.2 | V | $I_{BS} = 5\text{ mA}$ |
| Floating Input Supply | | | | | | |
| UV_{DD+} | V_{DD}, V_{SS} floating supply UVLO positive threshold | 8.2 | 8.7 | 9.2 | V | $V_{SS} = 0\text{ V}$ |
| UV_{DD-} | V_{DD}, V_{SS} floating supply UVLO negative threshold | 7.7 | 8.2 | 8.7 | | $V_{SS} = 0\text{ V}$ |
| I_{QDD} | Floating Input quiescent current | - | - | 1 | mA | $V_{DD} = 9.5\text{ V} + V_{SS}$ |
| V_{CLAMPM} | Floating Input zener diode clamp voltage | 9.8 | 10.2 | 10.8 | V | $I_{DD} = 5\text{ mA}$ |
| I_{LKM} | Floating input side to Low side leakage current | - | - | 50 | μA | $V_{DD} = V_{SS} = 200\text{ V}$ |
| Floating PWM Input | | | | | | |
| V_{IH} | Logic high input threshold voltage | 2.3 | 1.9 | - | V | |
| V_{IL} | Logic low input threshold voltage | - | 1.9 | 1.5 | | |
| I_{IN+} | Logic "1" input bias current | - | - | 40 | μA | $V_{IN} = 3.3\text{ V}$ |
| I_{IN-} | Logic "0" input bias current | - | - | 1 | | $V_{IN} = V_{SS}$ |
| Protection | | | | | | |
| V_{REF} | Reference output voltage | 4.8 | 5.1 | 5.4 | V | $I_{OREF} = 0.5\text{ mA}$ |
| V_{thOCL} | Low side OC threshold in V_S | 1.1 | 1.2 | 1.3 | | OCSET=1.2V, Figure 3 |
| V_{thOCH} | High side OC threshold in V_{CSH} | $1.1 + V_S$ | $1.2 + V_S$ | $1.3 + V_S$ | | $V_S = 200\text{ V}$, Figure 4 |
| V_{th1} | CSD pin shutdown release threshold | $0.62 \times V_{DD}$ | $0.70 \times V_{DD}$ | $0.78 \times V_{DD}$ | | $V_{SS} = 0\text{ V}$ |
| V_{th2} | CSD pin self reset threshold | $0.26 \times V_{DD}$ | $0.30 \times V_{DD}$ | $0.34 \times V_{DD}$ | | $V_{SS} = 0\text{ V}$ |
| I_{CSD+} | CSD pin discharge current | 70 | 100 | 130 | μA | $V_{SD} = V_{SS} + 5\text{ V}$ |
| I_{CSD-} | CSD pin charge current | 70 | 100 | 130 | | $V_{SD} = V_{SS} + 5\text{ V}$ |

| Protection (continued) | | | | | | | |
|------------------------|---|----------|----------|----------|-------|--|--|
| Symbol | Description | Min | Typ | Max | Units | Test Conditions | |
| t_{SD} | Shutdown propagation delay from $V_{CSD} > V_{SS} + V_{th_{OCH}}$ to Shutdown | - | - | 250 | ns | Figure 2 | |
| t_{OCH} | Propagation delay time from $V_{CSH} > V_{th_{OCH}}$ to Shutdown | - | - | 500 | | Figure 4 | |
| t_{OCL} | Propagation delay time from $V_S > V_{th_{OCL}}$ to Shutdown | - | - | 500 | | Figure 3 | |
| Gate Driver | | | | | | | |
| I_{o+} | Output high short circuit current (Source) | - | 1.0 | - | A | $V_o=0V$, $PW \leq 10\mu S$ | |
| I_{o-} | Output low short circuit current (Sink) | - | 1.2 | - | | $V_o=12V$, $PW \leq 10\mu S$ | |
| V_{OL} | Low level out put voltage LO – COM, HO – VS | - | - | 0.1 | V | $I_o=0A$ | |
| V_{OH} | High level out put voltage VCC – LO, VB – HO | - | - | 1.4 | | $I_o=0A$ | |
| t_r | Turn-on rise time | - | 15 | - | ns | | |
| t_f | Turn-off fall time | - | 10 | - | | | |
| Ton_1 | High and low side turn-on propagation delay, floating inputs | - | 95 | - | | $V_{DT} = V_{CC}$, $V_S = 100V$, $V_{SS} = 100V$ | |
| Toff_1 | High and low side turn-off propagation delay, floating inputs | - | 80 | - | | $V_{DT} = V_{CC}$, $V_S = 100V$, $V_{SS} = 100V$ | |
| Ton_2 | High and low side turn-on propagation delay, non-floating inputs | - | 95 | - | | $V_{DT} = V_{CC}$, $V_S = 100V$, $V_{SS} = COM$ | |
| Toff_2 | High and low side turn-off propagation delay, non-floating inputs | - | 80 | - | | $V_{DT} = V_{CC}$, $V_S = 100V$, $V_{SS} = COM$ | |
| DT1 | Deadtime: LO turn-off to HO turn-on (DT_{LO-HO}) & HO turn-off to LO turn-on (DT_{HO-LO}) | 8 | 15 | 22 | | $V_{DT} > V_{DT1}$, $V_{SS} = COM$ | |
| DT2 | Deadtime: LO turn-off to HO turn-on (DT_{LO-HO}) & HO turn-off to LO turn-on (DT_{HO-LO}) | 15 | 25 | 35 | | $V_{DT1} > V_{DT} > V_{DT2}$, $V_{SS} = COM$ | |
| DT3 | Deadtime: LO turn-off to HO turn-on (DT_{LO-HO}) & HO turn-off to LO turn-on (DT_{HO-LO}) | 20 | 35 | 50 | | $V_{DT2} > V_{DT} > V_{DT3}$, $V_{SS} = COM$ | |
| DT4 | Deadtime: LO turn-off to HO turn-on (DT_{LO-HO}) & HO turn-off to LO turn-on (DT_{HO-LO}) $V_{DT} = V_{DT4}$ | 50 | 80 | 110 | | $V_{DT3} > V_{DT}$, $V_{SS} = COM$ | |
| V_{DT1} | DT mode select threshold 1 | 0.51xVcc | 0.57xVcc | 0.63xVcc | | V | |
| V_{DT2} | DT mode select threshold 2 | 0.32xVcc | 0.36xVcc | 0.40xVcc | | | |
| V_{DT3} | DT mode select threshold 3 | 0.21xVcc | 0.23xVcc | 0.25xVcc | | | |

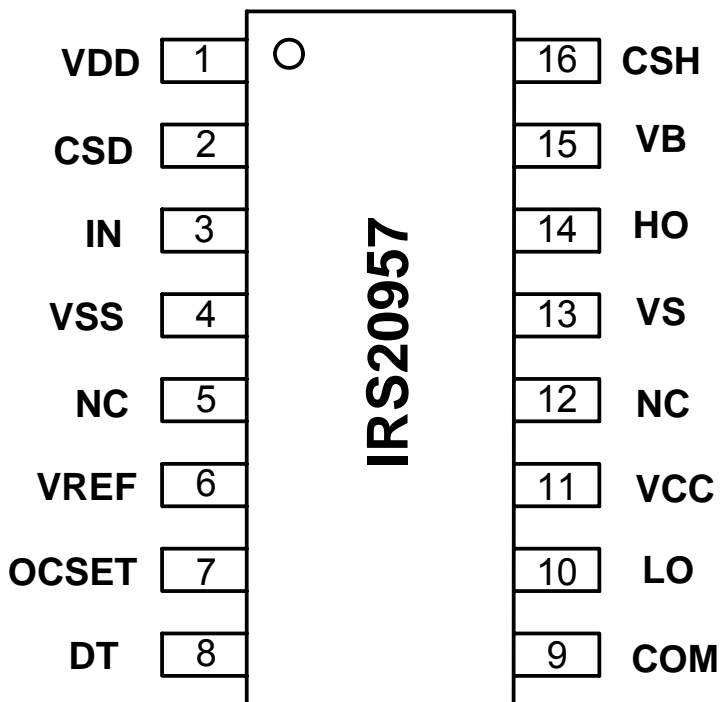
I/O Pin Equivalent Circuit Diagrams



Lead Definitions

| Pin # | Symbol | Description |
|-------|--------|--|
| 1 | VDD | Floating input positive supply |
| 2 | CSD | Shutdown timing capacitor, referenced to VSS |
| 3 | IN | PWM non-inverting input, in phase with HO |
| 4 | VSS | Floating input supply return |
| 5 | NC | |
| 6 | VREF | 5V reference output for setting OCSET |
| 7 | OCSET | Low side over current threshold setting, referenced to COM |
| 8 | DT | Input for programmable dead-time, referenced to COM |
| 9 | COM | Low side supply return |
| 10 | LO | Low side output |
| 11 | VCC | Low side logic supply |
| 12 | NC | |
| 13 | VS | High side floating supply return |
| 14 | HO | High side output |
| 15 | VB | High side floating supply |
| 16 | CSH | High side over current sensing input, referenced to VS |

Lead Assignments



Waveform definitions

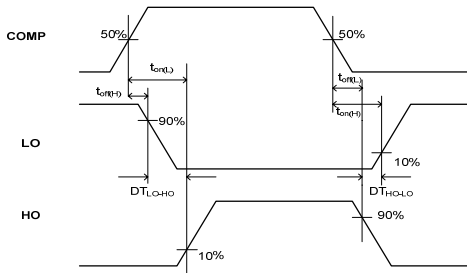


Figure 1: Switching Time Waveform Definitions

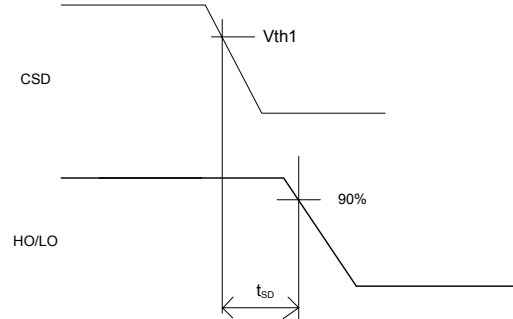


Figure 2: CSD to Shutdown Waveform Definitions

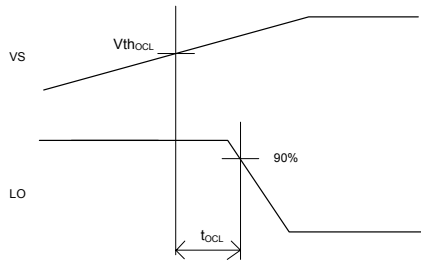


Figure 3: $V_S > V_{thOCL}$ to Shutdown Waveform

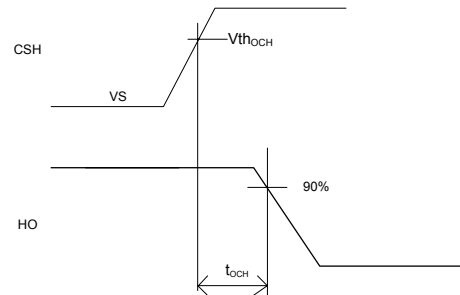
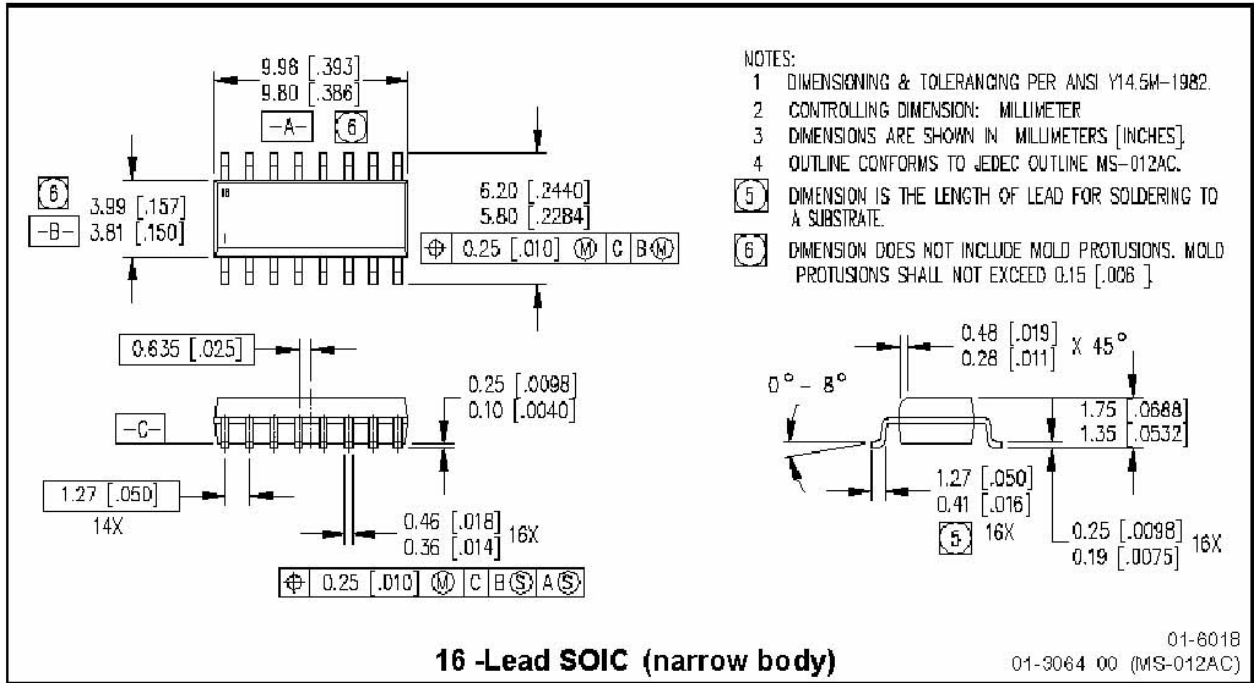


Figure 4: $V_{CSH} > V_{thOCH}$ to Shutdown Waveform

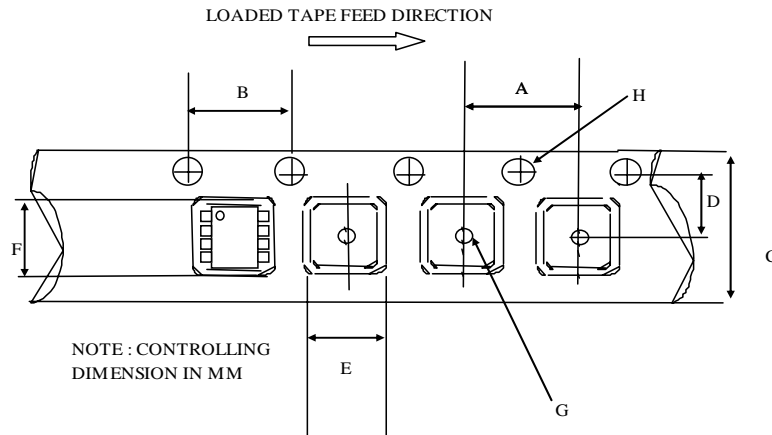
Application information and additional information

Please refer to AN-1144 for IRS20957 functional description.

Package Details: SOIC16N

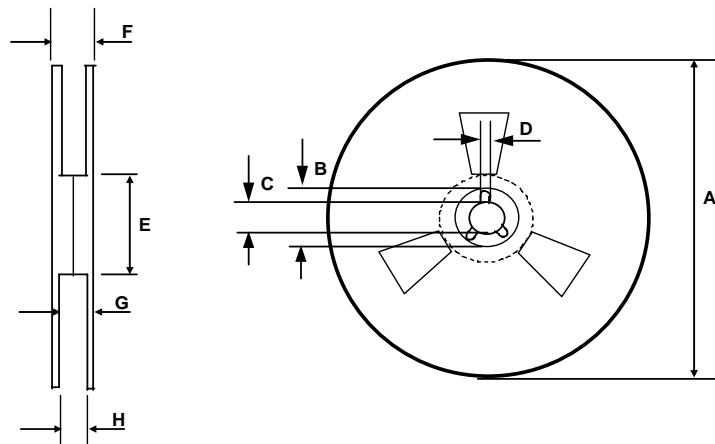


Package Details: SOIC16N, Tape and Reel



CARRIER TAPE DIMENSION FOR 16SOICN

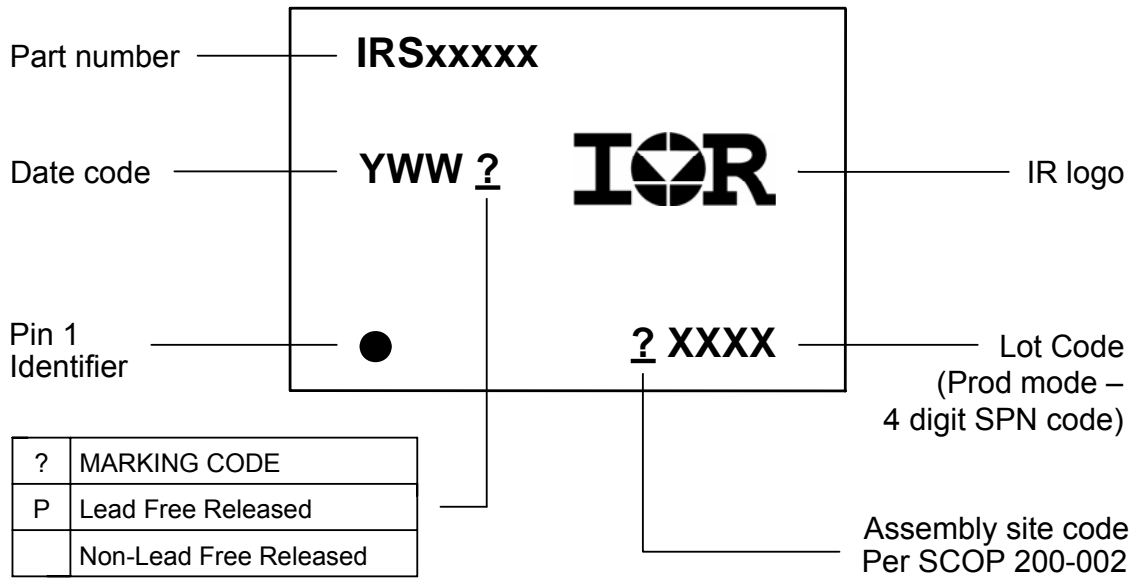
| Code | Metric | | Imperial | |
|------|--------|-------|----------|-------|
| | Min | Max | Min | Max |
| A | 7.90 | 8.10 | 0.311 | 0.318 |
| B | 3.90 | 4.10 | 0.153 | 0.161 |
| C | 15.70 | 16.30 | 0.618 | 0.641 |
| D | 7.40 | 7.60 | 0.291 | 0.299 |
| E | 6.40 | 6.60 | 0.252 | 0.260 |
| F | 10.20 | 10.40 | 0.402 | 0.409 |
| G | 1.50 | n/a | 0.059 | n/a |
| H | 1.50 | 1.60 | 0.059 | 0.062 |



REEL DIMENSIONS FOR 16SOICN

| 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 | 22.40 | n/a | 0.881 |
| G | 18.50 | 21.10 | 0.728 | 0.830 |
| H | 16.40 | 18.40 | 0.645 | 0.724 |

Part Marking Information



Ordering Information

| Base Part Number | Package Type | Standard Pack | | Complete Part Number |
|------------------|--------------|---------------|----------|----------------------|
| | | Form | Quantity | |
| IRS20957S | SOIC16N | Tube/Bulk | 45 | IRS20957SPBF |
| | | Tape and Reel | 2500 | IRS20957STRPBF |

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