

## Self-Oscillating Half-Bridge Driver

### Features

- Floating channel designed for bootstrap operation
- Integrated 600 V half-bridge gate driver
- 15.6 V zener clamp on Vcc
- True micropower start up
- Tighter initial dead time control
- Low temperature coefficient dead time
- Shutdown feature (1/6th Vcc) on CT pin
- Increased undervoltage lockout Hysteresis (1 V)
- Lower power level-shifting circuit
- Constant LO, HO pulse widths at startup
- Lower di/dt gate driver for better noise immunity
- Low side output in phase with RT
- Excellent latch immunity on all inputs and outputs
- ESD protection on all leads

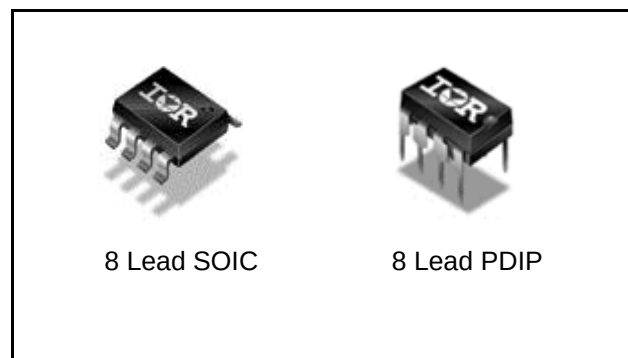
### Product Summary

|                        |                 |
|------------------------|-----------------|
| $V_{\text{OFFSET}}$    | 600 V max.      |
| Duty Cycle             | 50%             |
| $T_r / T_f$            | 80 ns / 40 ns   |
| $V_{\text{CLAMP}}$     | 15.6 V          |
| Dead time (typ.)       | 1.2 $\mu$ s     |
| $I_{O+}/I_{O-}$ (typ.) | 180 mA / 260 mA |

### Description

The IR25603(S) incorporates a high voltage half-bridge gate driver with a front end oscillator similar to the industry standard CMOS 555 timer. A shutdown feature has been designed into the CT pin, so that both gate driver outputs can be disabled using a low voltage control signal. In addition, the gate driver output pulse widths are the same once the rising undervoltage lockout threshold on Vcc has been reached, resulting in a more stable profile of frequency vs time at startup. Special attention has been paid to maximizing the latch immunity of the device and providing comprehensive ESD protection on all pins.

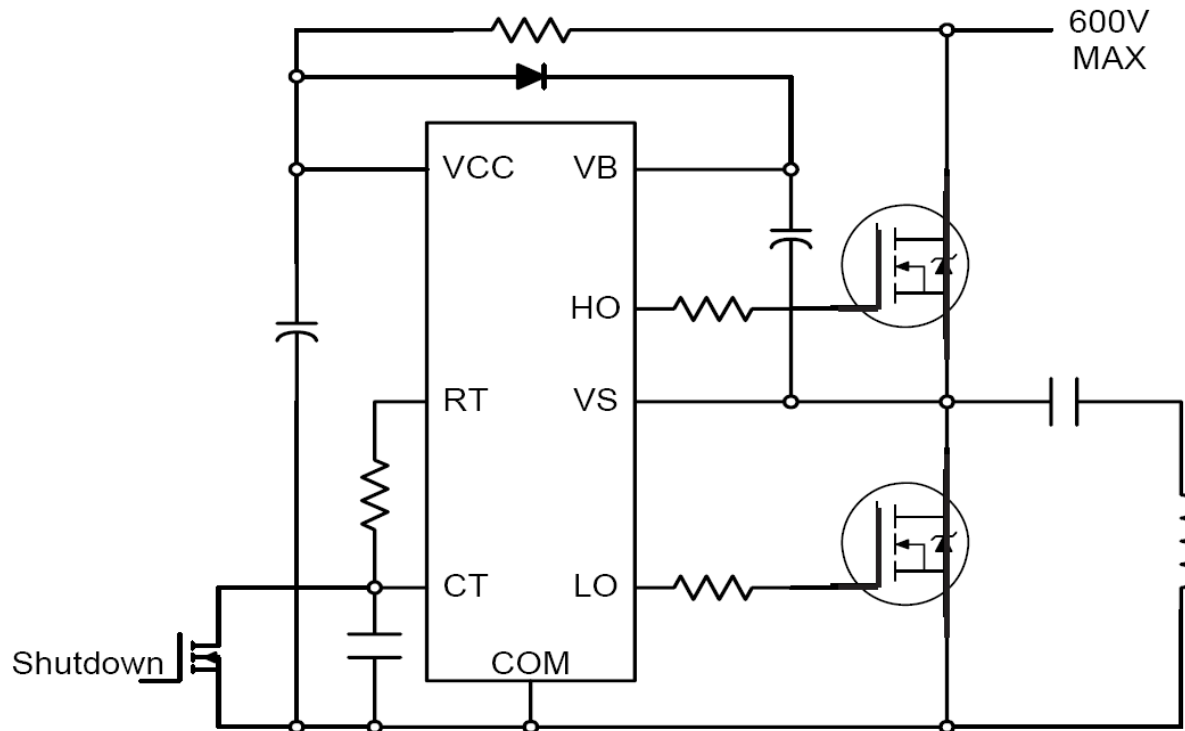
### Package Options



### Ordering Information

| Base Part Number | Package Type | Standard Pack |          | Orderable Part Number |
|------------------|--------------|---------------|----------|-----------------------|
|                  |              | Form          | Quantity |                       |
| IR25603SPBF      | SO8N         | Tube          | 95       | IR25603SPBF           |
| IR25603SPBF      | SO8N         | Tape and Reel | 2500     | IR25603STRPBF         |
| IR25603PBF       | PDIP8        | Tube          | 50       | IR25603PBF            |

# Typical Connection Diagram



## 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 COM, 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 absolute voltage                      | -0.3        | 625            | V                         |
| $V_S$      | High side floating supply offset voltage                 | $V_B - 25$  | $V_B + 0.3$    |                           |
| $V_{HO}$   | High side floating output voltage                        | $V_S - 0.3$ | $V_B + 0.3$    |                           |
| $V_{LO}$   | Low side output voltage                                  | -0.3        | $V_{CC} + 0.3$ |                           |
| $V_{RT}$   | $R_T$ pin voltage                                        | -0.3        | $V_{CC} + 0.3$ |                           |
| $V_{CT}$   | $C_T$ pin voltage                                        | -0.3        | $V_{CC} + 0.3$ |                           |
| $I_{CC}$   | Supply current†                                          | —           | 25             | mA                        |
| $I_{RT}$   | $R_T$ pin current                                        | -5          | 5              |                           |
| $dV_S/dt$  | Allowable offset supply voltage transient                | —           | 50             | V/ns                      |
| $P_D$      | Package power dissipation @ $T_A \leq +25^\circ\text{C}$ | 8 lead PDIP | 1              | W                         |
|            |                                                          | 8 lead SOIC | 0.625          |                           |
| $R_{thJA}$ | Thermal resistance, junction to ambient                  | 8 lead PDIP | 125            | $^\circ\text{C}/\text{W}$ |
|            |                                                          | 8 lead SOIC | 200            |                           |
| $T_J$      | Junction temperature                                     | —           | 150            | $^\circ\text{C}$          |
| $T_S$      | Storage temperature                                      | -55         | 150            |                           |
| $T_L$      | Lead temperature (soldering, 10 seconds)                 | —           | 300            |                           |

## Recommended Operating Conditions

For proper operation the device should be used within the recommended conditions. The  $V_S$  offset rating is tested with all supplies biased at 15V differential.

| Symbol   | Definition                                            | Min.           | Max.        | Units            |
|----------|-------------------------------------------------------|----------------|-------------|------------------|
| $V_B$    | High side floating supply absolute voltage            | $V_{CC} - 0.7$ | $V_{CLAMP}$ | V                |
| $V_S$    | Steady state high side floating supply offset voltage | ††             | 600         |                  |
| $V_{CC}$ | Supply voltage                                        | 10             | $V_{CLAMP}$ |                  |
| $I_{CC}$ | Supply current                                        | †††            | 5           | mA               |
| $T_A$    | Ambient temperature                                   | -40            | 125         | $^\circ\text{C}$ |

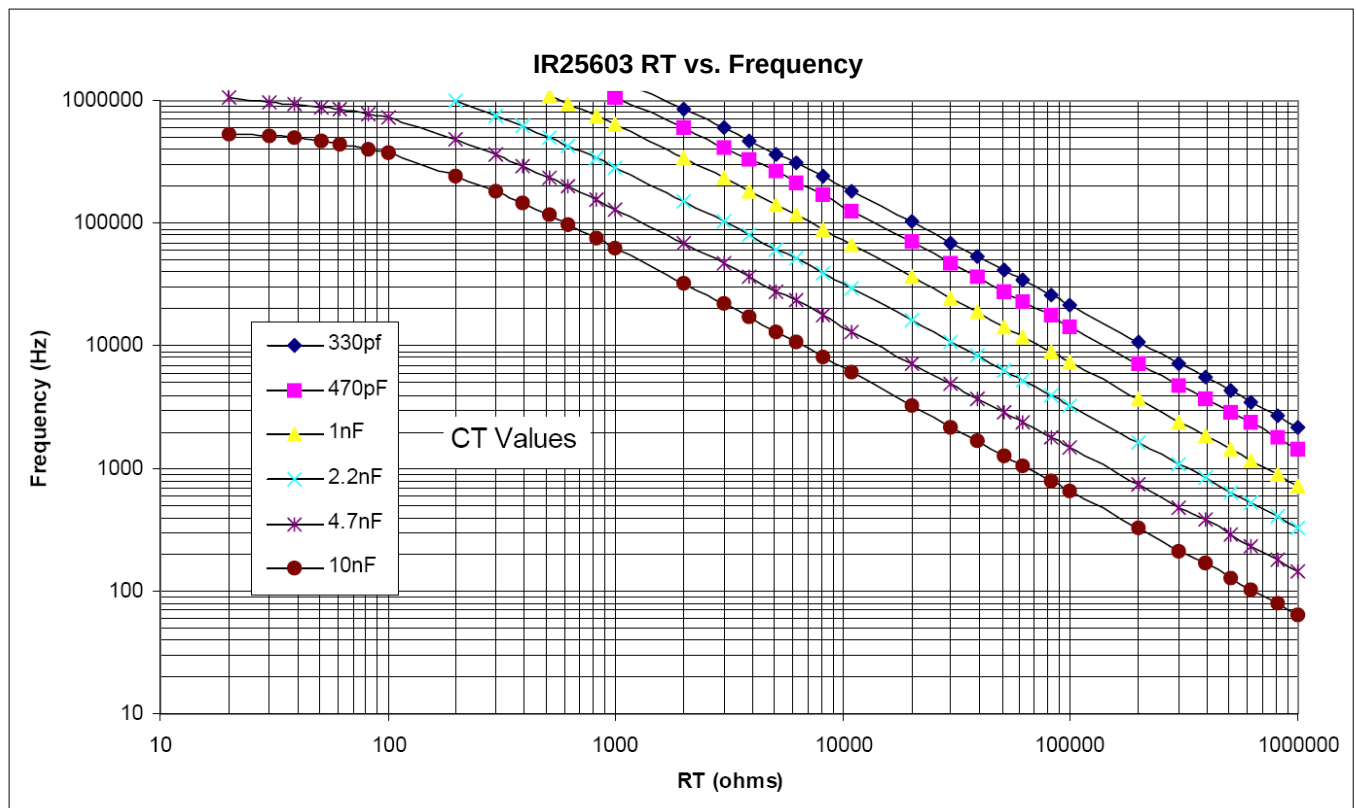
† This IC contains a zener clamp structure between the chip  $V_{CC}$  and COM which has a nominal breakdown voltage of 15.6V. Please note that this supply pin should not be driven by a DC, low impedance power source greater than the  $V_{CLAMP}$  specified in the Electrical Characteristics section.

†† Care should be taken to avoid output switching conditions where the  $V_S$  node flies inductively below ground by more than 5V.

††† Enough current should be supplied to the  $V_{CC}$  pin of the IC to keep the internal 15.6V zener diode clamping the voltage at this pin.

## Recommended Component Values

| Symbol | Component                 | Min. | Max. | Units     |
|--------|---------------------------|------|------|-----------|
| $R_T$  | Timing resistor value     | 10   | —    | $k\Omega$ |
| $C_T$  | $C_T$ pin capacitor value | 330  | —    | pF        |



## Electrical Characteristics

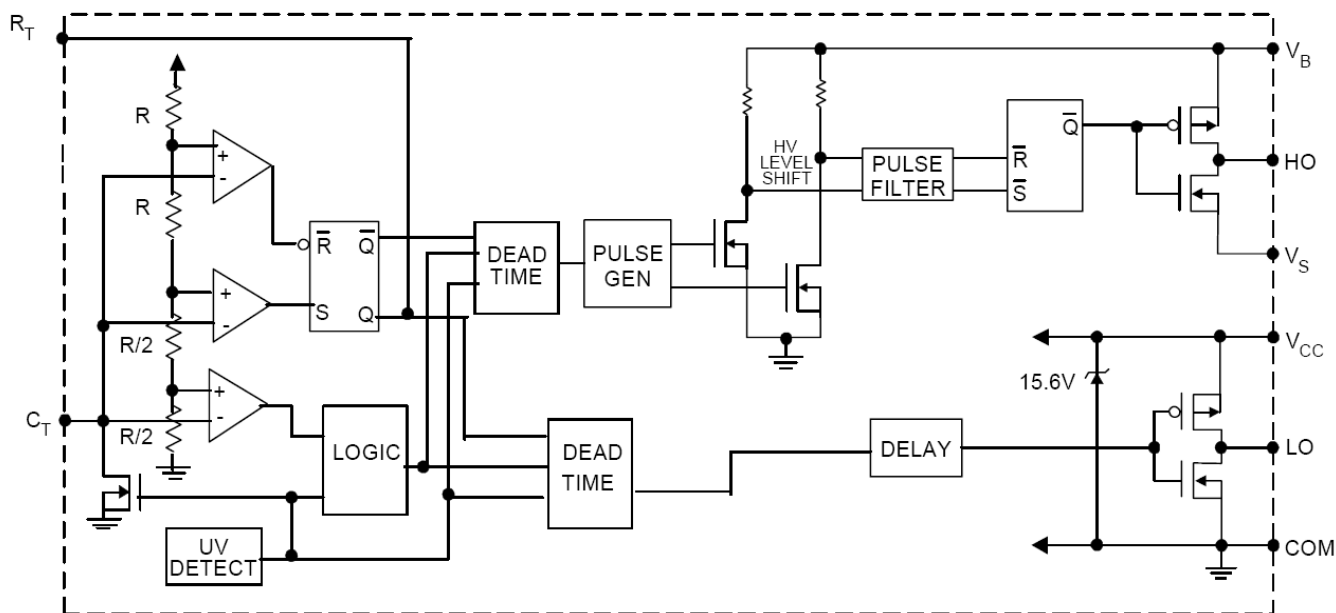
$V_{BIAS}$  ( $V_{CC}$ ,  $V_{BS}$ ) = 12V,  $C_L$  = 1000 pF,  $C_T$  = 1nF and  $T_A$  = 25°C unless otherwise specified.

| Low Voltage Supply Characteristics |                                                                             |      |       |      |         |                                         |
|------------------------------------|-----------------------------------------------------------------------------|------|-------|------|---------|-----------------------------------------|
| Symbol                             | Definition                                                                  | Min. | Typ.  | Max. | Units   | Test Conditions                         |
| $V_{CCUV+}$                        | $V_{CC}$ supply undervoltage positive going threshold                       | 8.1  | 9.0   | 9.9  | V       |                                         |
| $V_{CCUV-}$                        | $V_{CC}$ supply undervoltage negative going threshold                       | 7.2  | 8.0   | 8.8  |         |                                         |
| $V_{CCUVH}$                        | $V_{CC}$ undervoltage hysteresis                                            | 0.5  | 1.0   | 1.5  |         |                                         |
| $I_{QCCUV}$                        | Micropower startup $V_{CC}$ supply current                                  | —    | 75    | 150  | $\mu A$ | $V_{CC} \leq V_{CCUV-}$                 |
| $I_{QCC}$                          | Quiescent $V_{CC}$ supply current                                           | —    | 500   | 950  |         |                                         |
| $V_{CLAMP}$                        | $V_{CC}$ zener clamp voltage                                                | 14.4 | 15.6  | 16.8 | V       | $I_{CC} = 5mA$                          |
| Floating Supply Characteristics    |                                                                             |      |       |      |         |                                         |
| Symbol                             | Definition                                                                  | Min. | Typ.  | Max. | Units   | Test Conditions                         |
| $I_{QBSUV}$                        | Micropower startup $V_{BS}$ supply current                                  | —    | 0     | 10   | $\mu A$ | $V_{CC} \leq V_{CCUV-}$                 |
| $I_{QBS}$                          | Quiescent $V_{BS}$ supply current                                           | —    | 30    | 50   |         |                                         |
| $V_{BSMIN}$                        | Minimum required $V_{BS}$ voltage for proper functionality from $R_T$ to HO | —    | 4.0   | 5.0  | V       | $V_{CC} = V_{CCUV+} + 0.1V$             |
| $I_{LK}$                           | Offset supply leakage current                                               | —    | —     | 50   | $\mu A$ | $V_B = V_S = 600V$                      |
| Oscillator I/O Characteristics     |                                                                             |      |       |      |         |                                         |
| Symbol                             | Definition                                                                  | Min. | Typ.  | Max. | Units   | Test Conditions                         |
| $f_{OSC}$                          | Oscillator frequency                                                        | 19.4 | 20    | 20.6 | kHz     | $R_T = 36.9k\Omega$                     |
|                                    |                                                                             | 94   | 100   | 106  |         | $R_T = 7.43k\Omega$                     |
| $d$                                | $R_T$ pin duty cycle                                                        | 48   | 50    | 52   | %       | $f_O < 100kHz$                          |
| $I_{CT}$                           | $C_T$ pin current                                                           | —    | 0.001 | 1.0  | $\mu A$ |                                         |
| $I_{CTUV}$                         | UV-mode $C_T$ pin pull down current                                         | 0.3  | 0.7   | 1.2  | mA      | $V_{CC} = 7V$                           |
| $V_{CT+}$                          | Upper $C_T$ ramp voltage threshold                                          | —    | 8     | —    | V       |                                         |
| $V_{CT-}$                          | Lower $C_T$ ramp voltage threshold                                          | —    | 4     | —    |         |                                         |
| $V_{CTSD}$                         | $C_T$ voltage shutdown threshold                                            | 1.8  | 2.1   | 2.4  |         |                                         |
| $V_{RT+}$                          | High-level $R_T$ output voltage, $V_{CC} - V_{RT}$                          | —    | 10    | 50   | mV      | $I_{RT} = 100 \mu A$                    |
|                                    |                                                                             | —    | 100   | 300  |         | $I_{RT} = 1mA$                          |
| $V_{RT-}$                          | Low-level $R_T$ output voltage                                              | —    | 10    | 50   |         | $I_{RT} = 100 \mu A$                    |
|                                    |                                                                             | —    | 100   | 300  |         | $I_{RT} = 1mA$                          |
| $V_{RTUV}$                         | UV-mode $R_T$ output voltage                                                |      | 0     | 100  |         | $V_{CC} \leq V_{CCUV-}$                 |
| $V_{RTSD}$                         | SD-Mode $R_T$ output voltage, $V_{CC} - V_{RT}$                             | —    | 10    | 50   |         | $I_{RT} = 100 \mu A$ ,<br>$V_{CT} = 0V$ |
|                                    |                                                                             | —    | 10    | 300  |         | $I_{RT} = 1mA$ ,<br>$V_{CT} = 0V$       |

## Electrical Characteristics (cont.)

| Gate Driver Output Characteristics |                                             |      |      |      |         |                                       |
|------------------------------------|---------------------------------------------|------|------|------|---------|---------------------------------------|
| Symbol                             | Definition                                  | Min. | Typ. | Max. | Units   | Test Conditions                       |
| VOH                                | High level output voltage, $V_{BIAS} - V_O$ | —    | 0    | 100  | mV      | $I_O = 0A$                            |
| VOL                                | Low-level output voltage, $V_O$             | —    | 0    | 100  |         | $I_O = 0A$                            |
| VOL_UV                             | UV-mode output voltage, $V_O$               | —    | 0    | 100  |         | $I_O = 0A$<br>$V_{CC} \leq V_{CCUV-}$ |
| $t_r$                              | Output rise time                            | —    | 80   | 150  | ns      |                                       |
| $t_f$                              | Output fall time                            | —    | 45   | 100  |         |                                       |
| $t_{sd}$                           | Shutdown propagation delay                  | —    | 660  | —    |         |                                       |
| $t_d$                              | Output dead time (HO or LO)                 | 0.75 | 1.20 | 1.65 | $\mu s$ |                                       |
| $I_{O+}$                           | Output source current                       | —    | 180  | —    | mA      |                                       |
| $I_{O-}$                           | Output sink current                         | —    | 260  | —    |         |                                       |

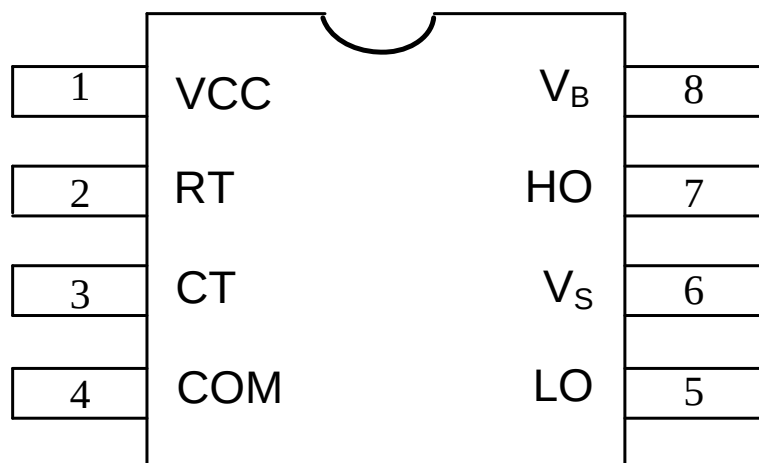
## Functional Block Diagram



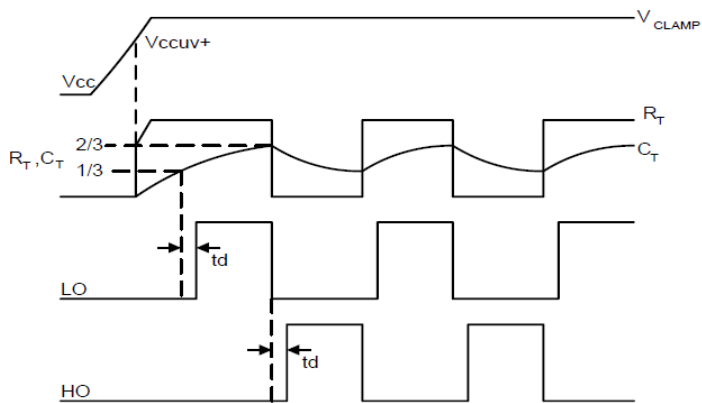
## Lead Definitions

| Symbol          | Description                                  |
|-----------------|----------------------------------------------|
| V <sub>CC</sub> | Logic and internal gate drive supply voltage |
| R <sub>T</sub>  | Oscillator timing resistor input             |
| C <sub>T</sub>  | Oscillator timing capacitor input            |
| COM             | IC power and signal ground                   |
| LO              | Low side gate driver output                  |
| V <sub>S</sub>  | High voltage floating supply return          |
| HO              | High side gate driver output                 |
| V <sub>B</sub>  | High side gate driver floating supply        |

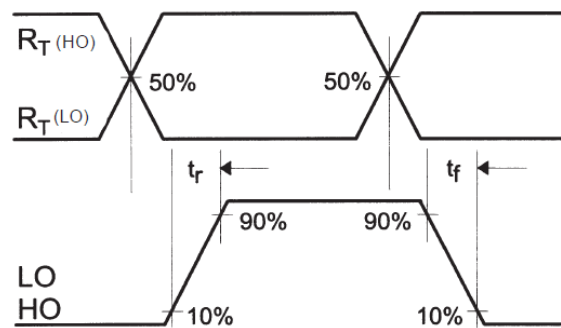
## Lead Assignments



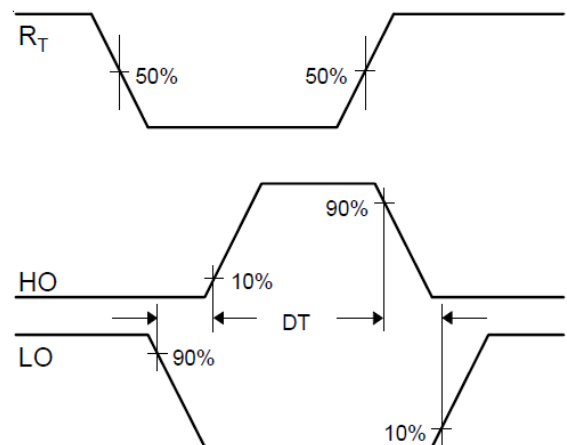
## Application Information and Additional Details



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



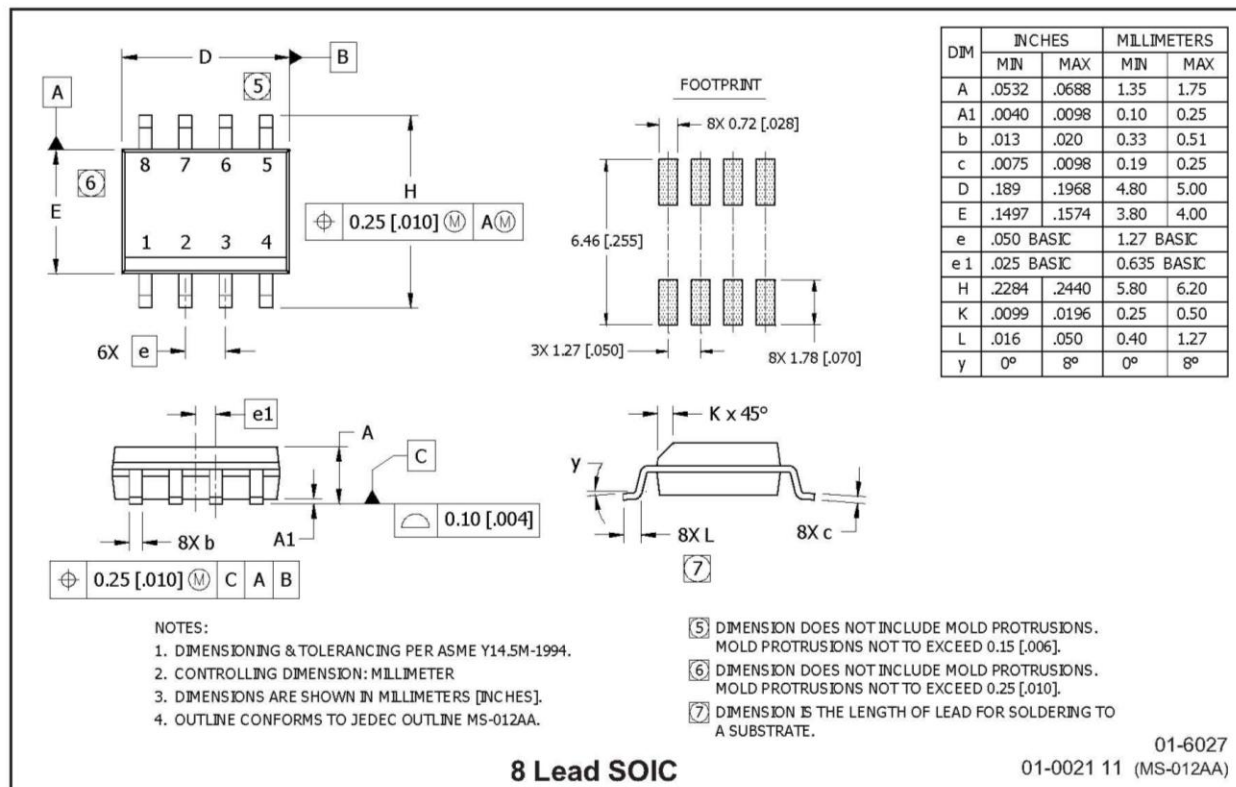
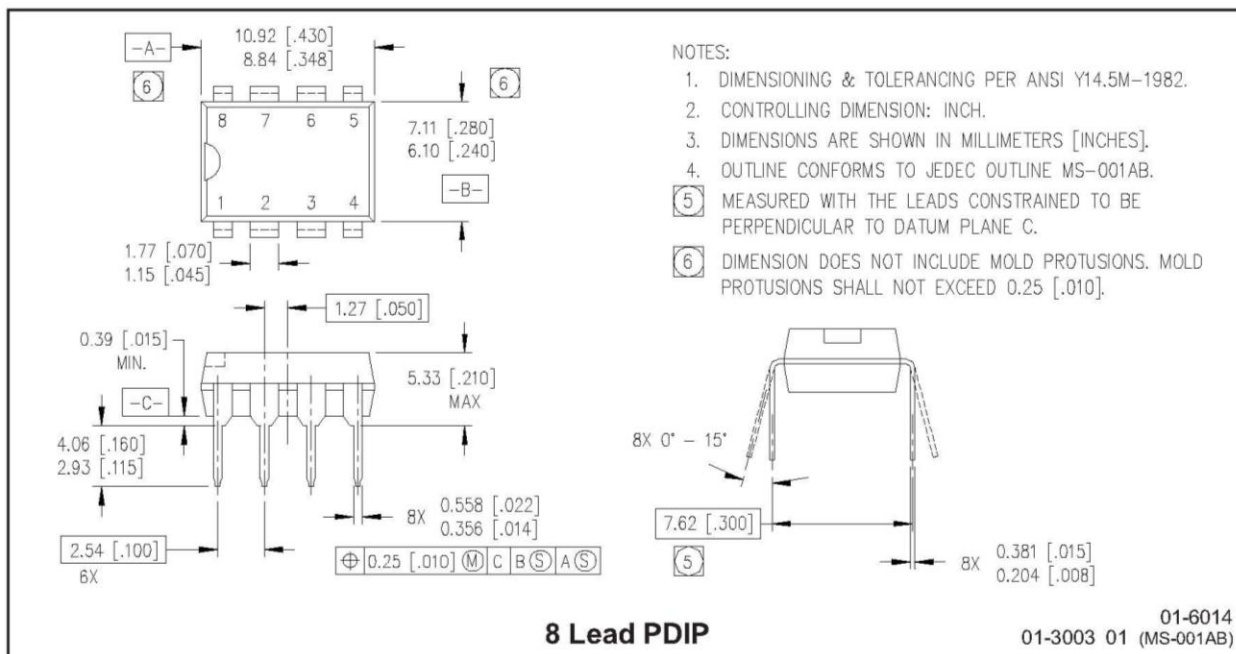
**Figure 2. Switching Time Waveform Definitions**



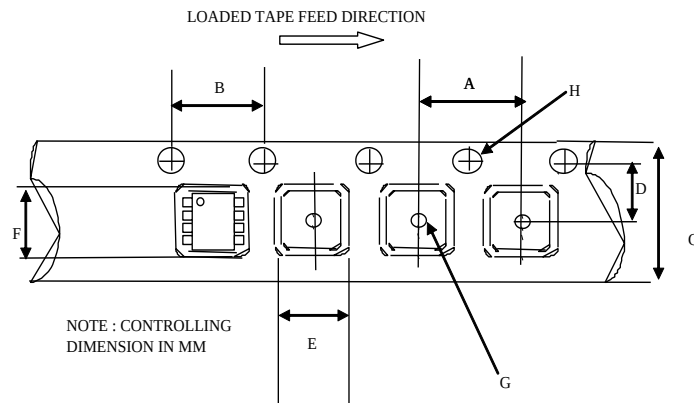
**Figure 3. Deadtime Waveform Definitions**



## Package Details

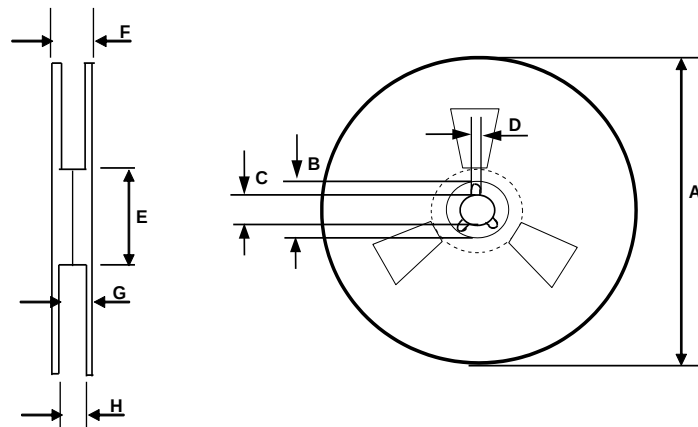


## Tape and Reel Details, SO8N



CARRIER TAPE DIMENSION FOR 8SOICN

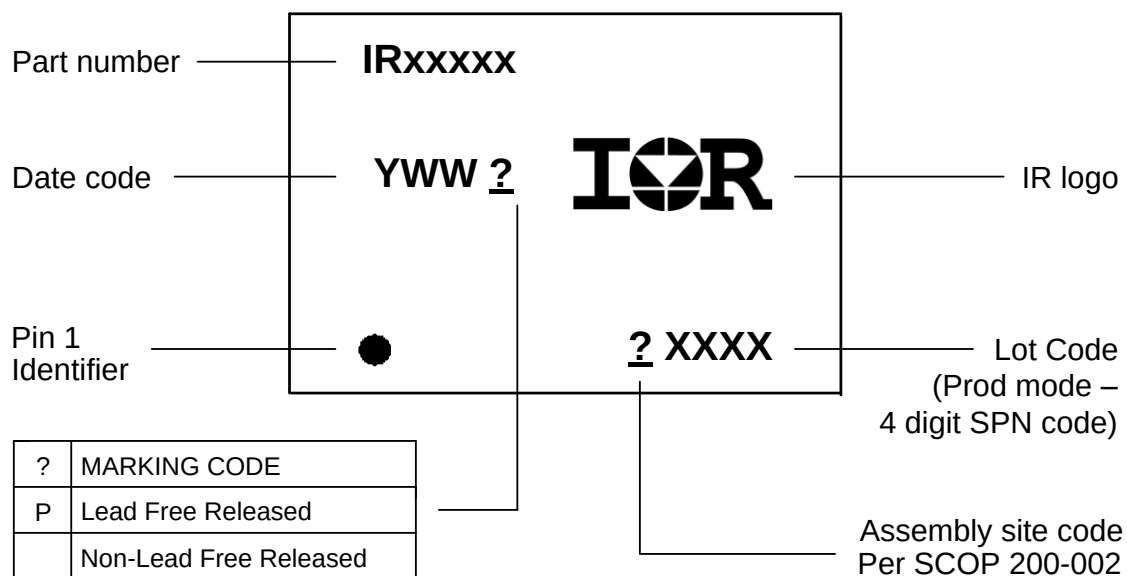
| Code | Metric |       | Imperial |       |
|------|--------|-------|----------|-------|
|      | Min    | Max   | Min      | Max   |
| A    | 7.90   | 8.10  | 0.311    | 0.318 |
| B    | 3.90   | 4.10  | 0.153    | 0.161 |
| C    | 11.70  | 12.30 | 0.46     | 0.484 |
| D    | 5.45   | 5.55  | 0.214    | 0.218 |
| E    | 6.30   | 6.50  | 0.248    | 0.255 |
| F    | 5.10   | 5.30  | 0.200    | 0.208 |
| G    | 1.50   | n/a   | 0.059    | n/a   |
| H    | 1.50   | 1.60  | 0.059    | 0.062 |



REEL DIMENSIONS FOR 8SOICN

| 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    | 18.40  | n/a      | 0.724  |
| G    | 14.50  | 17.10  | 0.570    | 0.673  |
| H    | 12.40  | 14.40  | 0.488    | 0.566  |

## Part Marking Information



## Qualification Information<sup>†</sup>

|                                   |                                                                                                                                                                     |                                                     |
|-----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|
| <b>Qualification Level</b>        | Industrial <sup>††</sup><br>(per JEDEC JESD 47)                                                                                                                     |                                                     |
|                                   | 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. |                                                     |
| <b>Moisture Sensitivity Level</b> | SOIC8N                                                                                                                                                              | MSL2 <sup>†††</sup><br>(per IPC/JEDEC J-STD 020)    |
|                                   | PDIP8                                                                                                                                                               | Not applicable<br>(non-surface mount package style) |
| <b>RoHS Compliant</b>             | 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.

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