

**IRS21856S**  
**High(Dual Mode) and Low Side Driver**

**Features**

- High side Programmable ramp gate drive
- High side generic gate driver integrated using the same high side output pin
- Low side generic gate driver
- Under voltage lockout for VCC & VBS
- 5V input logic compatible
- Tolerant to negative transient voltage on VS
- Shoot through prevention
- RoHS compliant

**Product Summary**

Topology	PDP
V <sub>OFFSET</sub>	≤ 600 V
HO1 SR+	4.5V/us
I <sub>o+</sub> & I <sub>o-</sub> (typical)	0.5A & 0.5A
t <sub>ON</sub> & t <sub>OFF</sub> (typical)	160ns & 160ns

**Package Options**



<b>Table of Contents</b>	<b>Page</b>
Description	3
Simplified Block Diagram	4
Typical Application Diagram	5
Qualification Information	7
Absolute Maximum Ratings	8
Recommended Operating Conditions	8
Static Electrical Characteristics	9
DV / Linear (Stepwise) Mode	10
Dynamic Electrical Characteristics	10
Timing Diagram and logic truth table	11
Input/Output Pin Equivalent Circuit Diagram	16
Lead Definitions	17
Lead Assignments	17
Package Details	18
Tape and Reel Details	19
Part Marking Information	20
Ordering information	21

Not recommended for new designs. No replacement is available

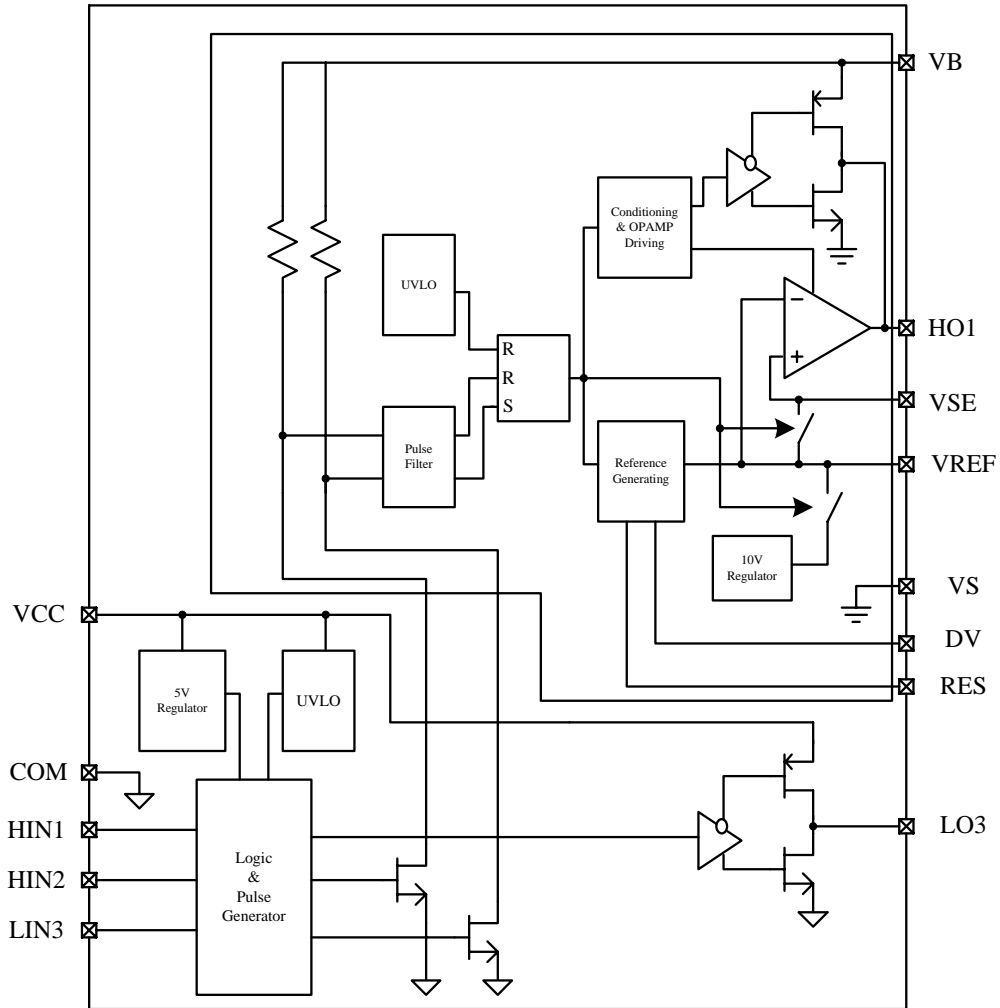
International  
**IR** Rectifier

**IRS21856S**

### **Description**

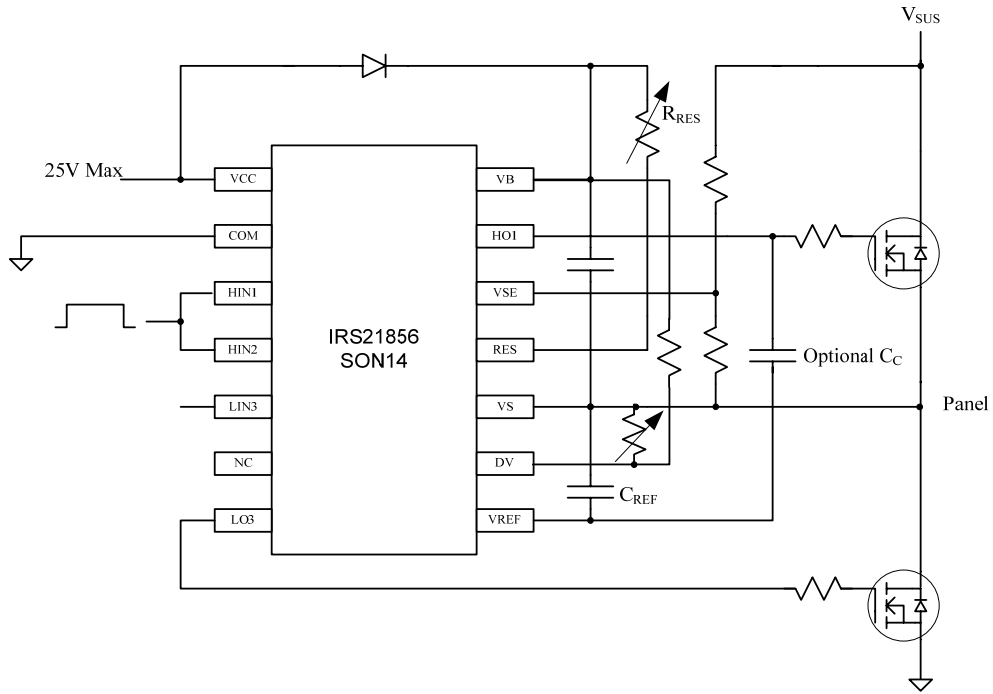
The IRS21856 is high voltage and programmable ramp slope control gate driver for MOSFET and IGBT with single high side dual mode driver and low side driver. Proprietary HVIC and latch immune CMOS technologies enable ruggedized monolithic construction. The logic input is compatible with 5V standard CMOS or LSTTL output. The output driver features a programmable slope control by external R/C and input signal. The floating channels can be used to drive an N-channel power MOSFET or IGBT in the high side configuration, which operates up to 600 volts above the COM ground.

**Simplified Block Diagram**

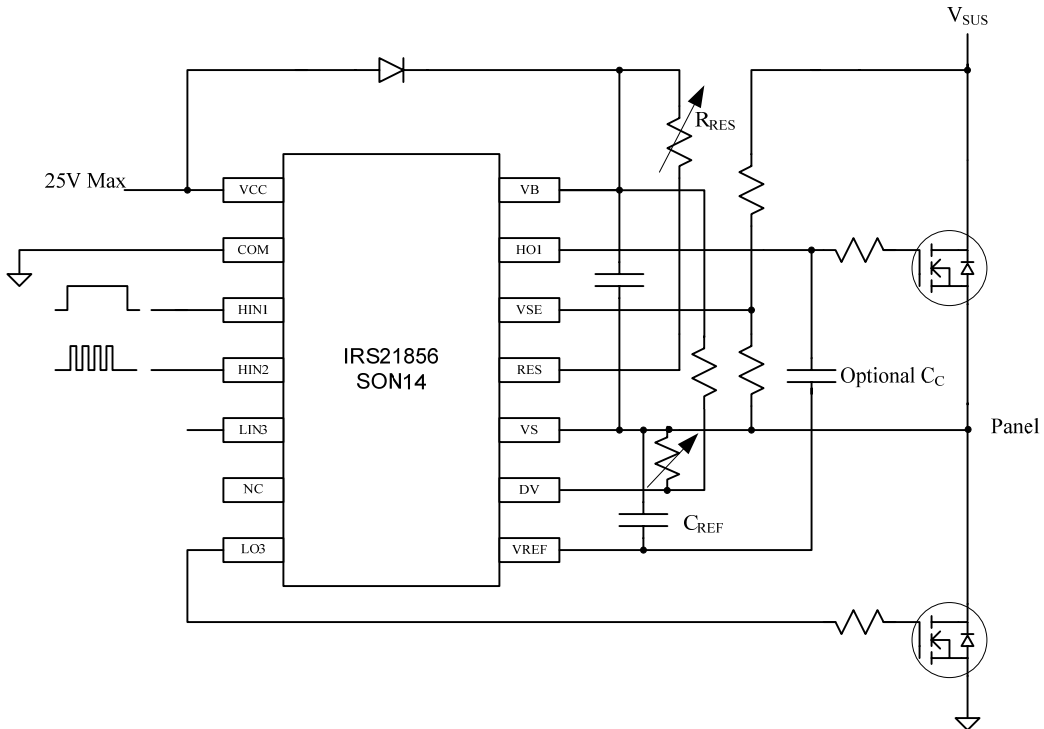


**Typical Connection Diagrams**

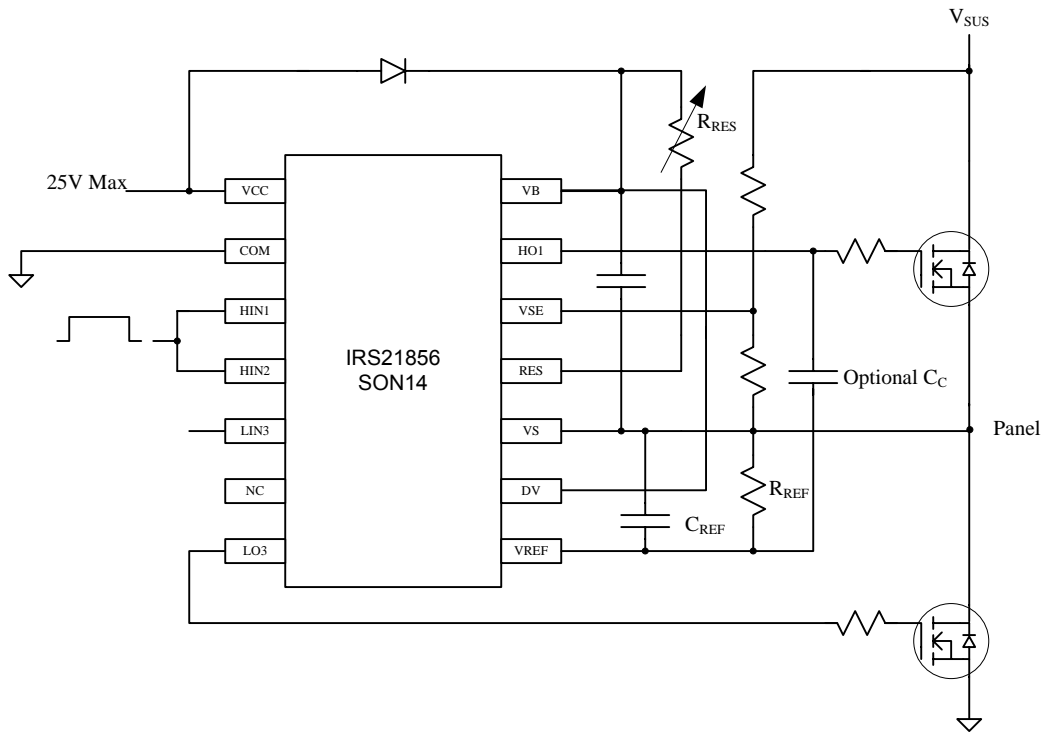
**A) Linear Ramp driver's connection diagram**



**B) Stepwise Linear Ramp driver's connection diagram**



**C) Exponential Ramp driver's connection diagram**



**Qualification Information<sup>†</sup>**

<b>Qualification Level</b>		Industrial <sup>††</sup>	
		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>		SOIC14N	MSL2 <sup>†††</sup> 260°C (per IPC/JEDEC J-STD-020)
<b>ESD</b>	Machine Model	Class A (per JEDEC standard JESD22-A115)	
	Human Body Model	Class 2 (per EIA/JEDEC standard EIA/JESD22-A114)	
<b>IC Latch-Up Test</b>		Class I , Level A (per JESD78)	
<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.

††† 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 COM.

Symbol	Definition	Min	Max	Units
V <sub>CC</sub>	Low side supply voltage	-0.3	25	V
V <sub>IN</sub>	Logic input voltage (HIN1, HIN2, LIN3)	COM-0.3	V <sub>CC</sub> +0.3	V
V <sub>LO</sub>	Low side gate drive output voltage	COM-0.3	V <sub>CC</sub> +0.3	V
V <sub>DV</sub> , V <sub>VREF</sub>	High side inputs voltage	VS-0.3	VB+0.3	V
V <sub>VSE</sub> , V <sub>RES</sub>	High side inputs voltage	VS-0.3	VB+0.3	V
V <sub>B</sub>	High side floating well supply voltage	-0.3	625	V
V <sub>S</sub>	High side floating well supply return voltage	VB-25	VB+0.3	V
V <sub>HO1</sub>	Floating gate drive output voltage	VS-0.3	VB+0.3	V
dV <sub>S</sub> /dt	Allowable VS offset supply transient relative to COM	-	50	V/ns
P <sub>D</sub>	Package Power Dissipation @ TA<=+25°C	-	1.0	W
R <sub>θJA</sub>	Thermal Resistance, Junction to Ambient	-	120	°C/W
T <sub>J</sub>	Junction Temperature	-55	150	°C
T <sub>S</sub>	Storage Temperature	-55	150	°C
T <sub>L</sub>	Lead temperature (Soldering, 10 seconds)	-	300	°C

**Recommended Operating Conditions**

For proper operation, the device should be used within the recommended conditions. All voltage parameters are absolute voltages referenced to COM. The offset rating are tested with supplies of (V<sub>CC</sub>-COM) = (V<sub>B</sub>-V<sub>S</sub>)=15V.

Symbol	Definition	Min	Max	Units
V <sub>CC</sub>	Low side supply voltage	10	20	V
V <sub>IN</sub>	HIN1, HIN2, LIN3 input voltage	COM	V <sub>CC</sub>	V
V <sub>LO3</sub>	Low side gate drive output voltage	COM	V <sub>CC</sub>	V
V <sub>B</sub>	High side floating well supply voltage	V <sub>S</sub> +10	V <sub>S</sub> +20	V
V <sub>RES</sub>	RES input voltage	V <sub>S</sub>	V <sub>B</sub>	V
V <sub>DV</sub>	DV input voltage	V <sub>S</sub>	V <sub>B</sub>	V
V <sub>VREF, VSE</sub>	VREF and VSE input voltage	V <sub>S</sub>	V <sub>B</sub> -3	V
V <sub>S</sub>	High side floating well supply offset voltage	Note2††	600	V
V <sub>HO1</sub>	Floating gate drive output voltage	V <sub>S</sub>	V <sub>B</sub>	V
T <sub>A</sub>	Ambient Temperature	-40	125	°C

† V<sub>S</sub> and V<sub>B</sub> voltages will be tolerant to short negative transient spikes. These will be defined and specified in the future.

†† Logic operation for Vs of -5 to 600V. Logic state held for Vs of -5V to -V<sub>BS</sub>. (Please refer to Design Tip DT97-3 for more details).



**Static Electrical Characteristics**

(VCC-COM) = (VB-VS)=15V. TA = 25°C. The VIN, VIN TH and IIN parameters are referenced to COM. The Vo and Io parameters are referenced to respective VS, COM and are applicable to the respective output leads HO1, LO3. The VCCUV parameters are referenced to COM. The VBSUV parameters are referenced to VS.

Symbol	Definition	Min	Typ	Max	Units	Test Conditions
VCCUV+	VCC supply undervoltage positive going threshold	8.1	9.0	9.9	V	
VCCUV-	VCC supply undervoltage negative going threshold	7.5	8.3	9.1		
VBSUV+	VBS supply undervoltage positive going threshold	8.1	9.0	9.9		
VBSUV-	VBS supply undervoltage negative going threshold	7.5	8.3	9.1		
ILK	High side floating well offset supply leakage current	---	---	50	µA	VB = VS = 600V
IQBS	Quiescent VBS supply current	---	4.7	8.5	mA	IN1, 2 = 5V, RES=130kohm
		---	800	1400	µA	IN1, 2 = 0V, RES=130kohm
IQCC	Quiescent VCC supply current	---	120	250	µA	IN1,2,3 = 0V or 5V
VIH	Logic "1" input voltage	3.5	---	---	V	
VIL	Logic "0" input voltage	---	---	0.8		
IIN+	Logic "1" input bias current	---	5	---	µA	VIN =5V
IIN -	Logic "0" input bias current	---	0	---		VIN =0V
Io+ HO1,LO3	Output high short circuit pulsed current	---	0.5	---	A	Vo=15V, VIN=5V, PW<=10us
Io- HO1,LO3	Output low short circuit pulsed current	---	0.5	---		Vo=0V, VIN=0V, PW<=10us
VOL HO1, LO3	Low level output voltage	---	35	150	mV	Io=2mA
VOH HO1, LO3	High level output voltage, Vbias-Vo	---	15	80	mV	Io=2mA
DV exp+	Positive DV input threshold for exponential ramp	---	9.5	---	V	CREF =1nF, VSE open RRES =130K

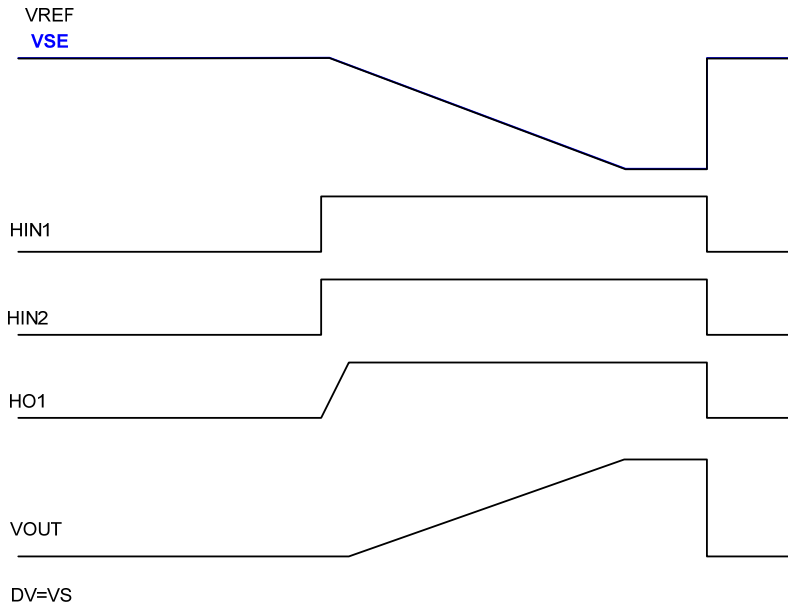
**DV / Linear (Stepwise) Mode**

Symbol	Definition	Min	Typ	Max	Units	Test Conditions
V <sub>REF, hold</sub>	DV reference voltage	0.4	0.5	0.6	V	DV=500mV, C <sub>REF</sub> =1nF, V <sub>SE</sub> open R <sub>RES</sub> =130K,
		2.82	3	3.18		DV=3V, C <sub>REF</sub> =1nF, V <sub>SE</sub> open R <sub>RES</sub> =130K,

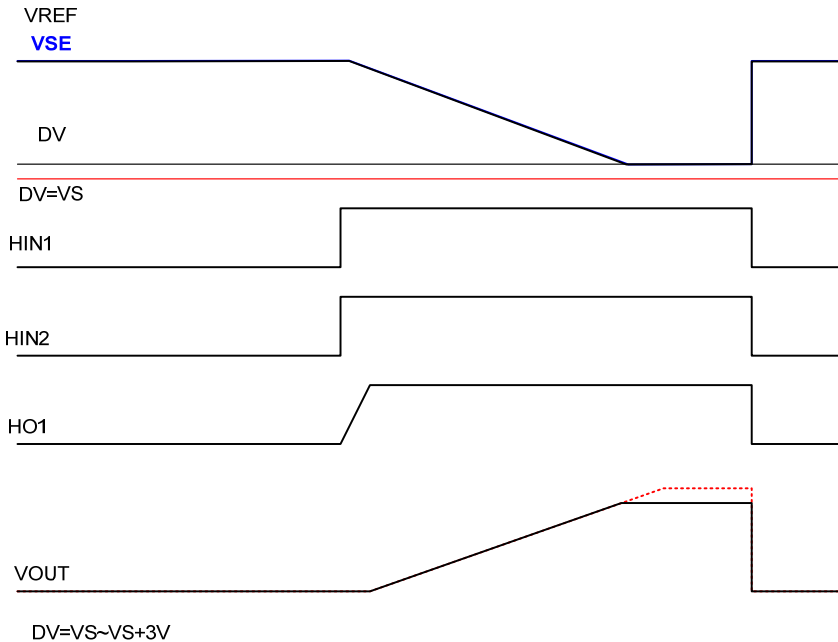
**Dynamic Electrical Characteristics**

(V<sub>CC-COM</sub>)= (V<sub>B</sub>-V<sub>S</sub>)=15V. T<sub>A</sub> = 25°C. C<sub>L</sub> = 1000pF unless otherwise specified. All parameters are reference to COM.

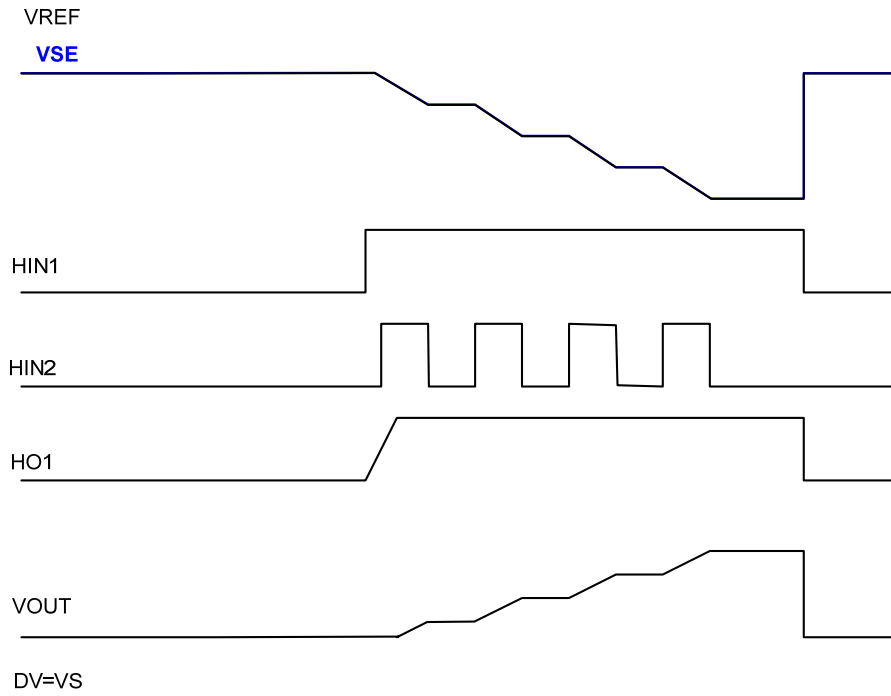
Symbol	Definition	Min	Typ	Max	Units	Test Conditions
<b>Internal Operational Amplifier Characteristics</b>						
t <sub>ref_in_ramp</sub>	Linear ramp reference 10% to 90%	110	170	230	μs	C <sub>REF</sub> =1nF, V <sub>SE</sub> open, R <sub>RES</sub> =130K, V <sub>DV</sub> =V <sub>S</sub> =COM
G <sub>m</sub>	OTA transconductance	---	12	---	mS	C <sub>L_LO</sub> =1nF, V <sub>DV</sub> =V <sub>B</sub> , R <sub>RES</sub> =130K, dc bias 5V
G <sub>open loop</sub>	Open loop gain	45	60	---	dB	C <sub>c</sub> =1nF, V <sub>DV</sub> =V <sub>B</sub> , R <sub>RES</sub> =130K
BW <sub>SS</sub>	Small signal bandwidth	---	3.5	---	MHz	C <sub>c</sub> =1nF V <sub>DV</sub> =V <sub>B</sub> , R <sub>RES</sub> =130K
V <sub>OS</sub>	Input offset voltage	---	10	---	mV	V <sub>DV</sub> =V <sub>B</sub> , R <sub>RES</sub> =130K
HO1 <sub>SR+</sub>	Output positive slew rate	---	4.5	---	V/μs	C <sub>L_HO1</sub> =1nF, V <sub>DV</sub> =V <sub>B</sub> , R <sub>RES</sub> =130K
CMRR	Common mode rejection ratio	55	65	---	dB	V <sub>DV</sub> =V <sub>B</sub> , R <sub>RES</sub> =130K
PSRR	Power supply rejection ratio	55	65	---	dB	V <sub>DV</sub> =V <sub>B</sub> , R <sub>RES</sub> =130K
<b>Propagation Delay Characteristics</b>						
t <sub>on</sub>	Turn-on delay (HO1, LO3)	---	150	250	ns	Gate Drive Mode C <sub>L</sub> =1nF
t <sub>off</sub>	Turn-off delay (HO1, LO3)	---	160	260		
t <sub>r</sub>	Turn-on rise from 10% to 90%	---	30	70		
t <sub>f</sub>	Turn-off fall from 90% to 10%	---	20	70		
MT	Delay matching, HO1 & LO3 turn-on/off			50		



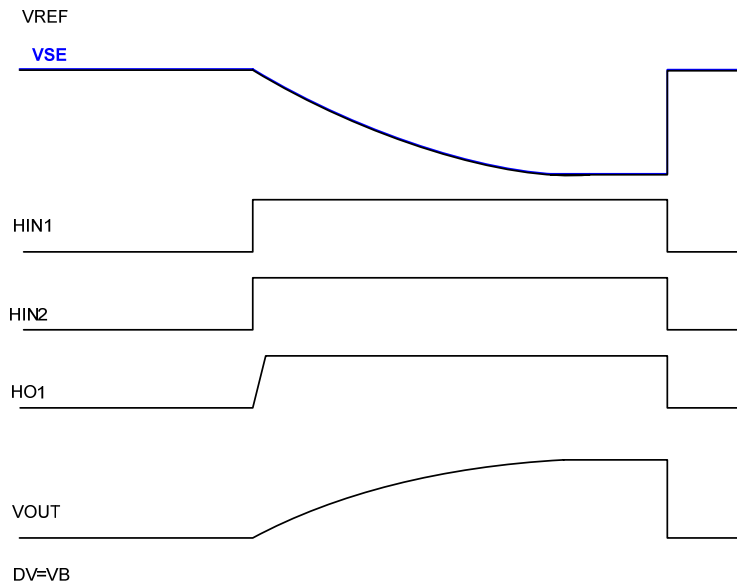
**Figure 1A1 Input/Output Timing Diagram: Linear Ramp**



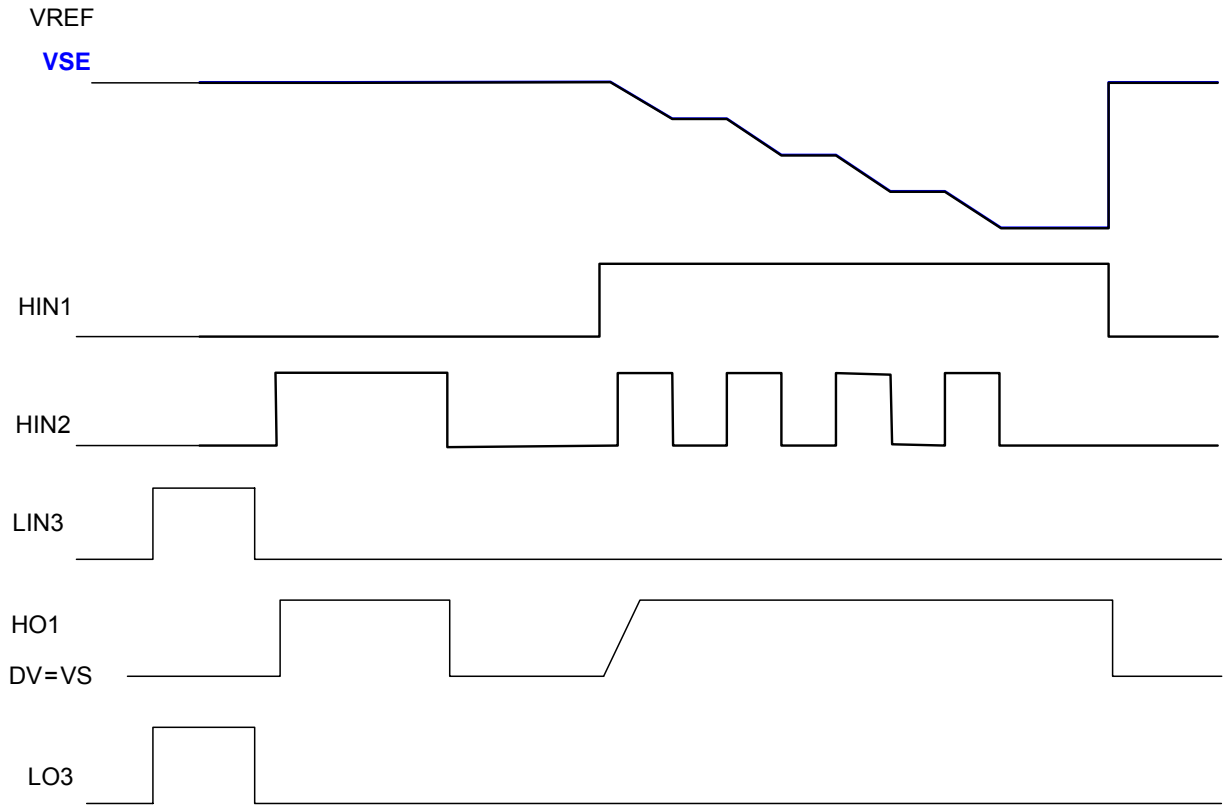
**Figure 1A2 Input/Output Timing Diagram: Linear Ramp with voltage difference**



**Figure 1B** Input/Output Timing Diagram: Stepwise linear Ramp



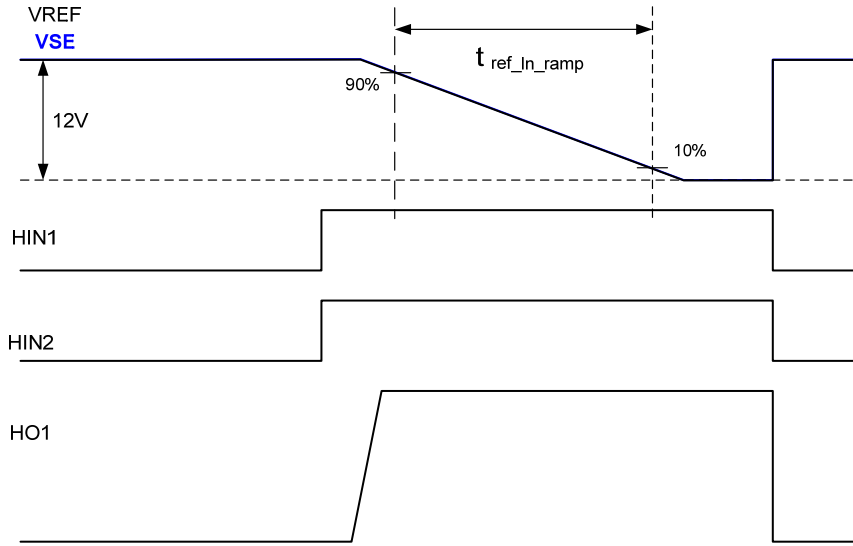
**Figure 1C** Input/Output Timing Diagram: Exponential Ramp



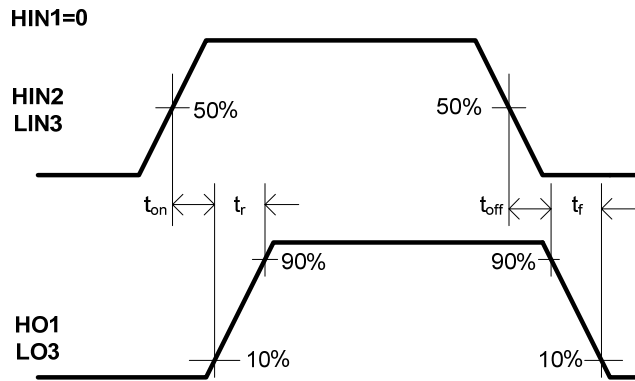
**Figure 1D Input/Output Timing Diagram : HO1/LO3 outputs**

**Logic Truth Table**

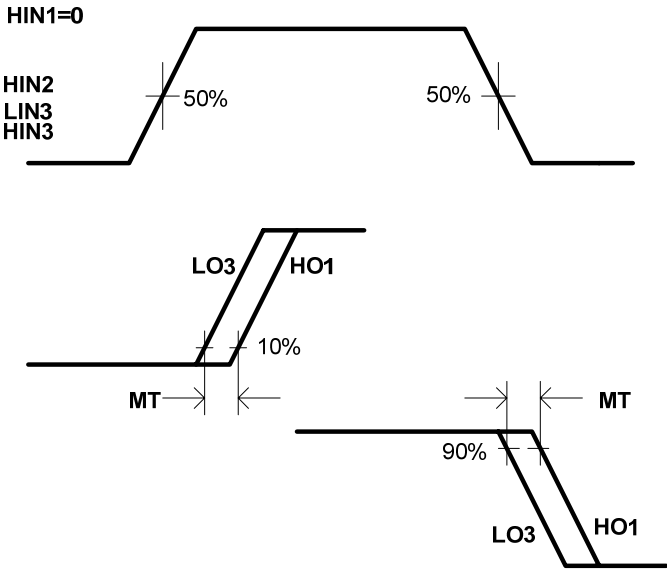
HIN1	HIN2	LIN3	LO3	OTA of HO1	Gate driver of HO1
0	0	0	0	High impedance (HIZ)	0
0	0	1	1	High impedance (HIZ)	0
0	1	0	0	High impedance (HIZ)	1
0	1	1	0	High impedance (HIZ)	0
1	1	0	0	Linear/Exp ramp depend on DV pin	High impedance (HIZ)
1	1	1	0	High impedance (HIZ)	0
1	Step(0/1)	0	0	Stepwise linear if DV pin is Vs	High impedance (HIZ)
1	Step(0/1)	1	0	High impedance (HIZ)	0



**Figure 2 Timing Definitions of  $V_{REF}$**

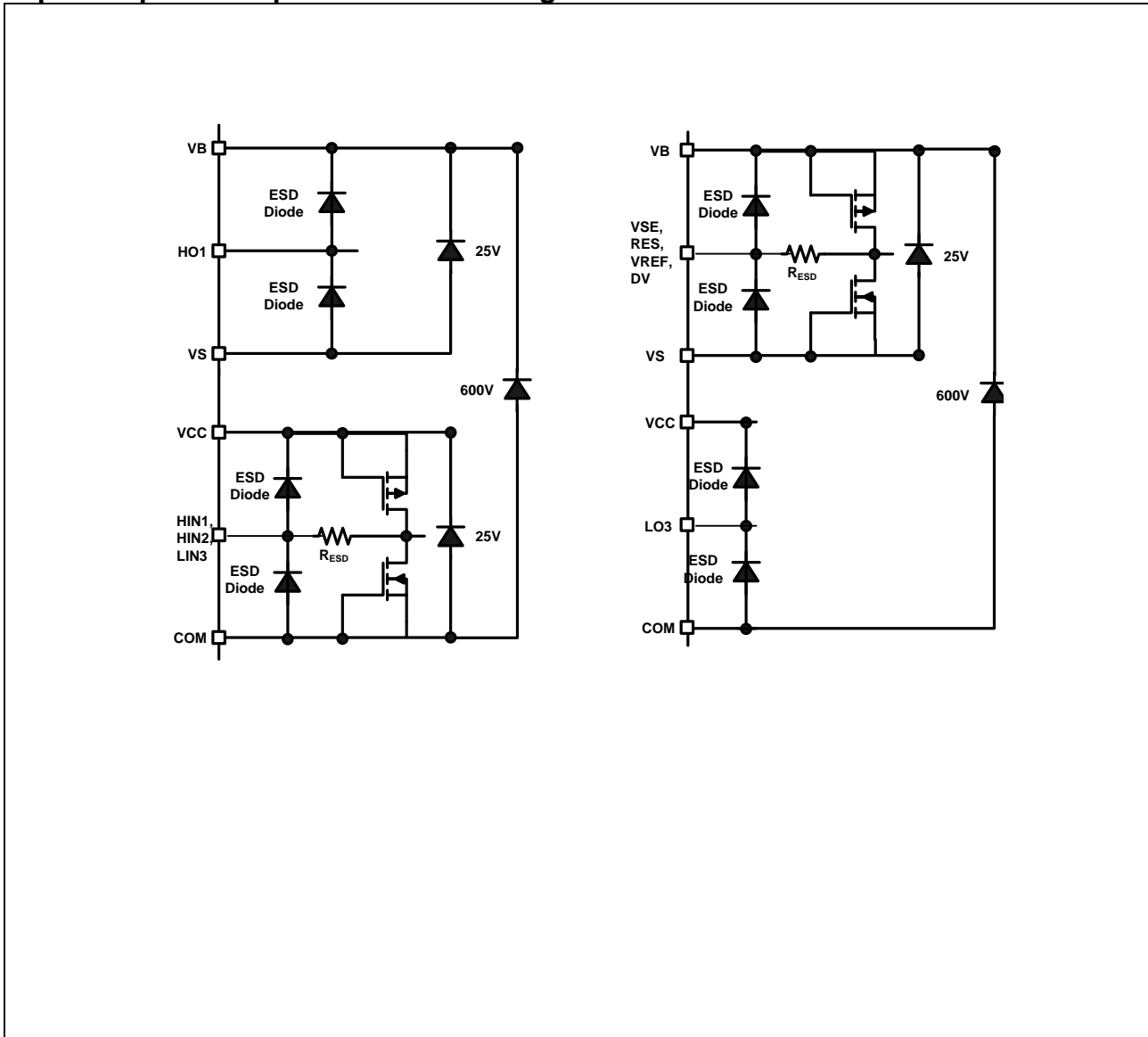


**Figure 3 Switching Time Waveform Definitions of  $HO1$  and  $LO3$**



**Figure 4 Delay Matching Waveform Definitions**

**Input/Output Pin Equivalent Circuit Diagrams**

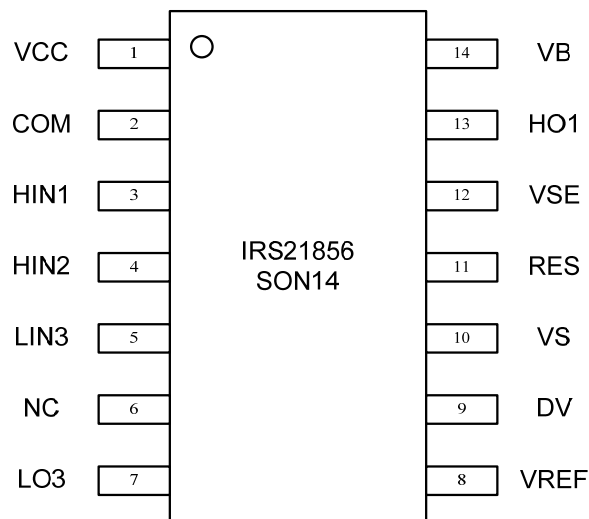




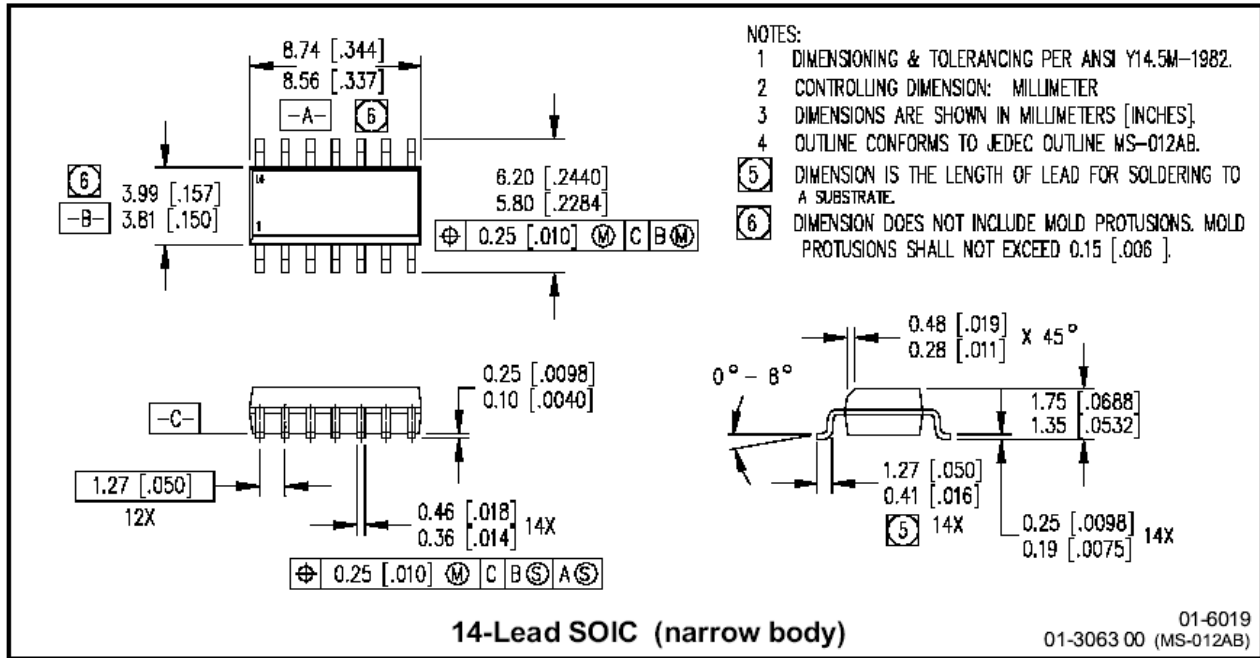
**Lead Definitions**

<b>PIN#</b>	<b>Symbol</b>	<b>Description</b>
1	VCC	Low side supply voltage
2	COM	Low side supply return
3	HIN1	Logic input for HO1 ramp reference control
4	HIN2	Logic input for high side gate driver outputs, in phase
5	LIN3	Logic input for low side gate driver output
6	NC	No Connection
7	LO3	Low side gate driver output
8	VREF	External programmable R/C input for ramp generation
9	DV	Ramp selection and programmable difference voltage (DV) input
10	VS	High side gate drive floating supply return
11	RES	Adjustable current source resistor input
12	VSE	Voltage sense input
13	HO1	High side gate driver output
14	VB	High side gate drive floating supply

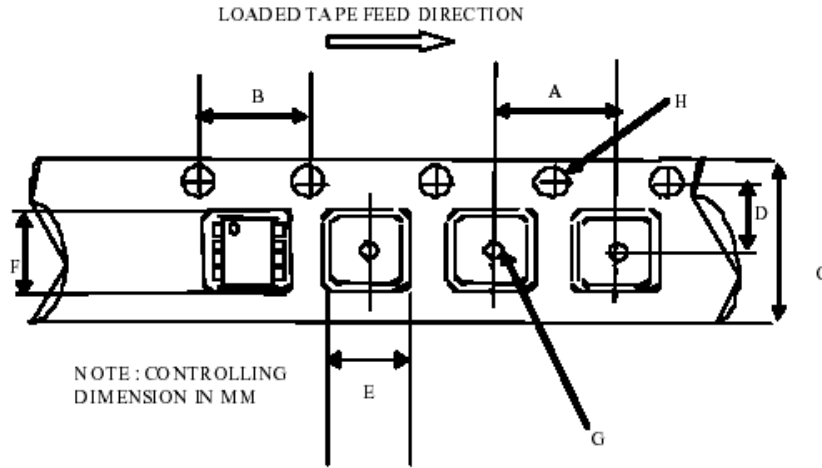
**Lead Assignments**



**Package Details: SOIC14**

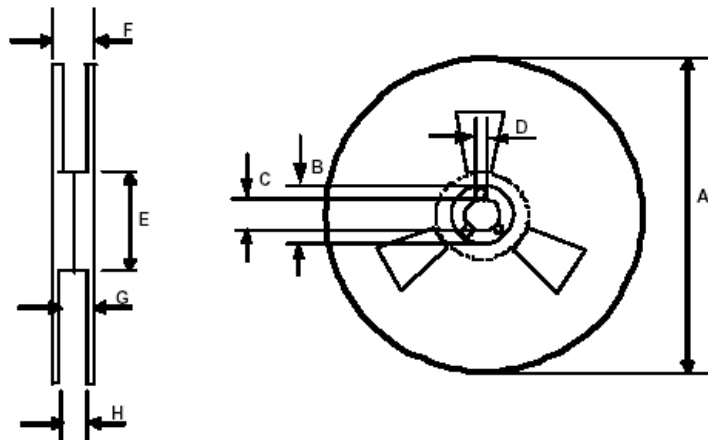


**Tape and Reel Details: SOIC14**



CARRIER TAPE DIMENSION FOR 14SOICN

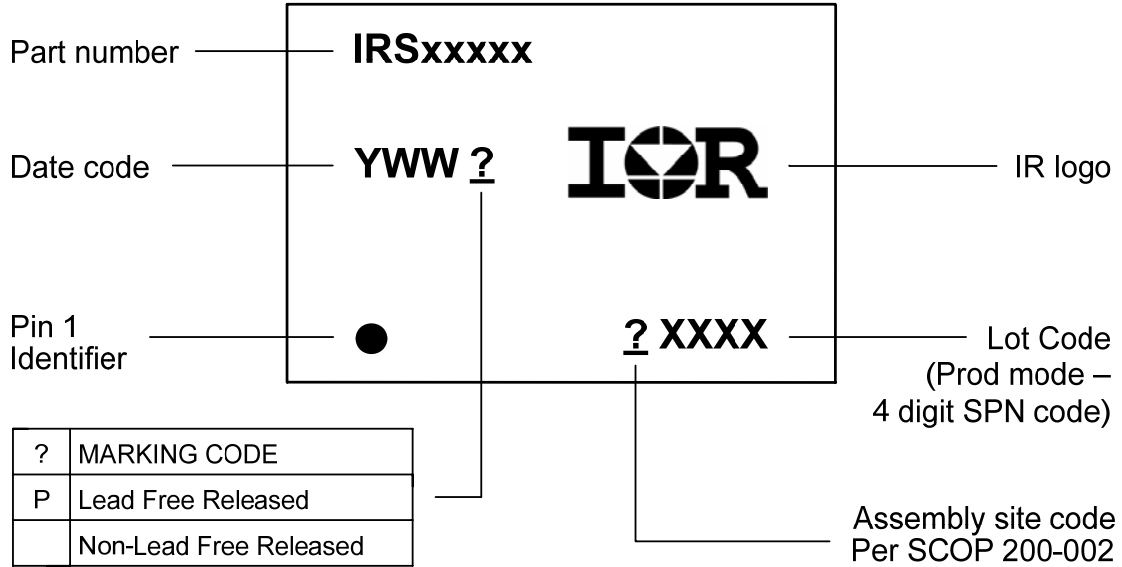
Code	Metric		Imperial	
	Min	Max	Min	Max
A	7.90	8.10	0.311	0.318
B	3.90	4.10	0.153	0.161
C	15.70	16.30	0.618	0.641
D	7.40	7.60	0.291	0.299
E	6.40	6.60	0.252	0.260
F	9.40	9.60	0.370	0.378
G	1.50	n/a	0.059	n/a
H	1.50	1.60	0.059	0.062



REEL DIMENSIONS FOR 14SOICN

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	
IRS21856S	SOIC14	Tube/Bulk	55	IRS21856SPBF
		Tape and Reel	2500	IRS21856STRPBF

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