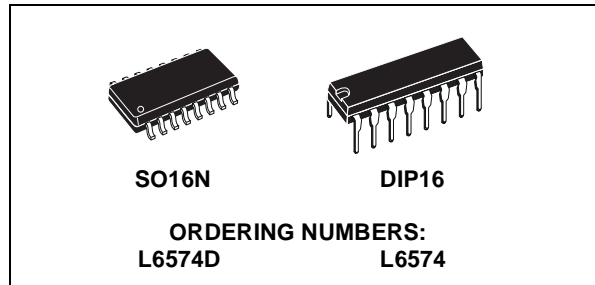




## CFL/TL BALLAST DRIVER PREHEAT AND DIMMING

- HIGH VOLTAGE RAIL UP TO 600V
- $dV/dt$  IMMUNITY  $\pm 50$  V/ns IN FULL TEMPERATURE RANGE
- DRIVER CURRENT CAPABILITY:  
250mA SOURCE  
450mA SINK
- SWITCHING TIMES 80/40ns RISE/FALL  
WITH 1nF LOAD
- CMOS SHUT DOWN INPUT
- UNDER VOLTAGE LOCK OUT
- PREHEAT AND FREQUENCY SHIFTING TIMING
- SENSE OP AMP FOR CLOSED LOOP CONTROL OR PROTECTION FEATURES
- HIGH ACCURACY CURRENT CONTROLLED OSCILLATOR
- INTEGRATED BOOTSTRAP DIODE
- CLAMPING ON  $V_S$ .
- SO16, DIP 16 PACKAGES



The device is intended to drive two power MOSFETS, in the classical half bridge topology, ensuring all the features needed to drive and properly control a fluorescent bulb.

A dedicated timing section in the L6574 allows the user set the necessary parameters for proper pre-heat and ignition of the lamp.

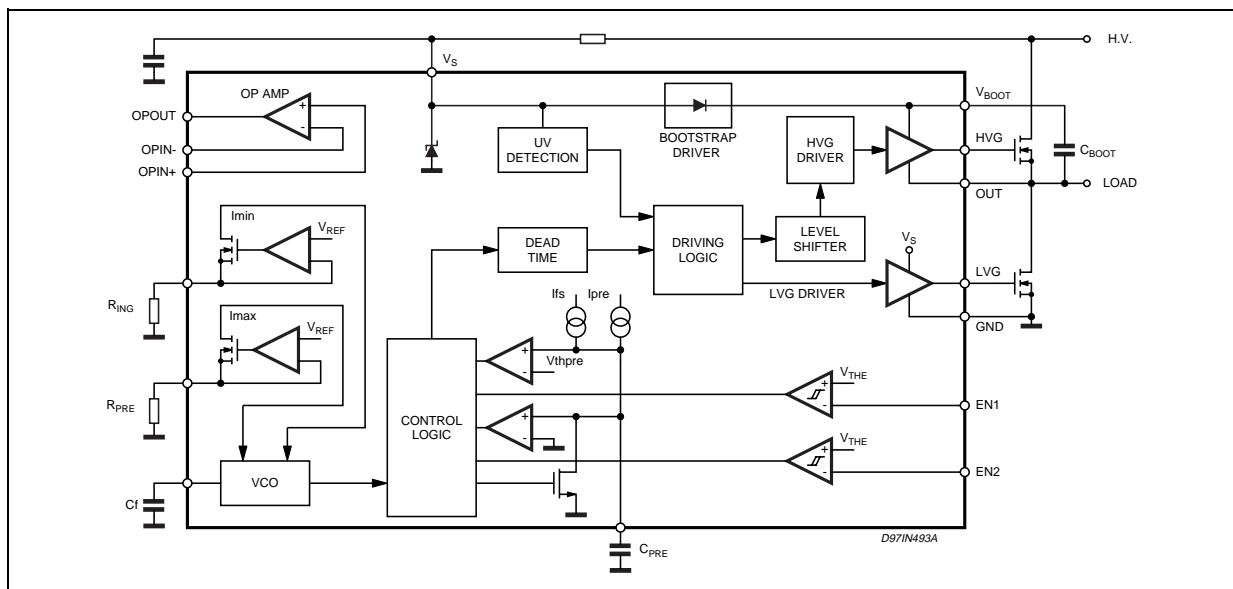
Also, an OP AMP is available to implement closed loop control of the lamp current during normal lamp burning.

An integrated bootstrap section, eliminating the normally required bootstrap diode and the zener clamping on  $V_S$ , makes the L6574 well suited for low cost applications where few additional components are needed to build a high performance ballast.

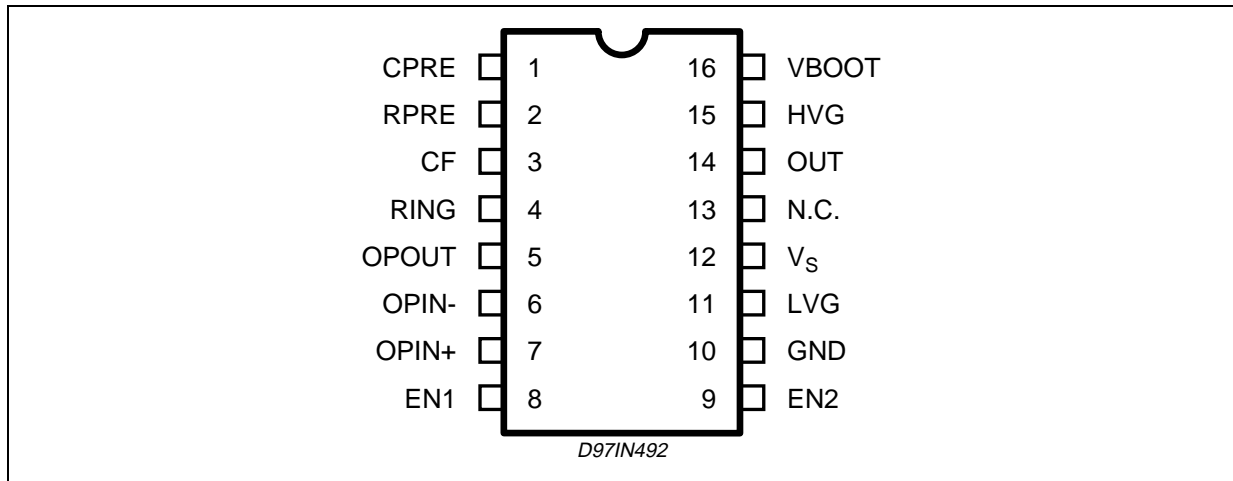
### DESCRIPTION

In order to ensure voltage ratings in excess of 600V, the L6574 is manufactured with BCD OFF LINE technology, which makes it well suited for lamp ballast applications.

### BLOCK DIAGRAM



**PIN CONNECTION** (top view)



**THERMAL DATA**

Symbol	Parameter		DIP16	SO16N	Unit
R <sub>th j-amb</sub>	Thermal Resistance Junction to ambient	Max.	80	120	°C/W

**PIN DESCRIPTION**

N°	Pin	Function
1	CPRE	Preheat Timing Capacitor. The capacitor C <sub>PRE</sub> sets the preheating and the frequency shift time, according to the relations: t <sub>PRE</sub> = K <sub>PRE</sub> · C <sub>PRE</sub> and t <sub>SH</sub> = K <sub>FS</sub> · C <sub>PRE</sub> (typ. K <sub>PRE</sub> = 1.5s/μF, K <sub>FS</sub> = 0.15s/μF). This feature is obtained by charging C <sub>PRE</sub> with two different currents. During t <sub>PRE</sub> this current is independent of the external components, so C <sub>PRE</sub> is charged up to 3.5V (preheat timing comparator threshold). During t <sub>SH</sub> the current depends on R <sub>PRE</sub> value (i.e. on the difference between f <sub>PRE</sub> and f <sub>IGN</sub> ). In this way t <sub>SH</sub> is always set at 0.1t <sub>PRE</sub> . In steady state the voltage at pin 1 is 5V.
2	RPRE	Maximum Oscillation Frequency Setting. The resistance connected between this pin and ground sets the f <sub>PRE</sub> value, fixing the difference between f <sub>PRE</sub> and f <sub>IGN</sub> (f <sub>PRE</sub> > f <sub>IGN</sub> ). At the end of the Start-up procedure, the effect current drawn from R <sub>PRE</sub> is over. The voltage at this pin is fixed at V <sub>REF</sub> = 2V.
3	CF	Oscillator Frequency Setting. The capacitor C <sub>F</sub> , along with R <sub>PRE</sub> and R <sub>IGN</sub> , sets f <sub>PRE</sub> and f <sub>IGN</sub> . In normal operation this pin shows a triangular wave.
4	RIGN	Minimum Oscillation Frequency Setting. The resistance connected between this pin and ground sets the f <sub>IGN</sub> value. The voltage at this pin is fixed at V <sub>REF</sub> = 2V.
5	OPOut	Out of the operational amplifier. To implement a feedback control loop this pin can be connected to the RIGN pin by means an appropriate circuitry.
6	OPin-	Inverting Input of the operational amplifier.
7	OPin+	Non Inverting Input of the operational amplifier.
8	EN1	Enable 1. This pin (active high), forces the device in a latched shutdown state (like in the under voltage conditions). There are two ways to resume normal operation: – the first is to reduce the supply voltage below the undervoltage threshold and then increase it again until the valid supply is recognised. – the second is activating EN2 input. The enable 1 is especially designed for strong fault (e.g. in case of lamp disconnection).

**PIN DESCRIPTION** (continued)

N°	Pin	Function
9	EN2	Enable 2. EN2 input (active high) restarts the start-up procedure (preheating and ignition sequence). This features is useful if the lamp does not turn-on after the first ignition sequence .
10	GND	Ground.
11	LVG	Low Side Driver Output. This pin must be connected to the low side power MOSFET gate of the half bridge. A resistor connected between this pin and the power MOS gate can be used to reduce the peak current.
12	VS	Supply Voltage. This pin, connected to the supply filter capacitor, is internally clamped (15.6V typical).
13	N.C.	Non Connected. This pin set a distance between the pins related to the HV and those related to the LV side.
14	OUT	High Side Driver Floating Reference. This pin must be connected close to the source of the high side power MOS or IGBT.
15	HVG	High Side Driver Output. This pin must be connected to the high side power MOSFET gate of the half bridge. A resistor connected between this pin and the power MOS gate can be used to reduce the peak current.
16	VBOOT	Bootstrapped Supply Voltage. Between this pin and VS must be connected the bootstrap capacitor. A patented integrated circuitry replaces the external bootstrap diode, by means of a high voltage DMOS, synchronously driven with the low side power MOSFET.

**ABSOLUTE MAXIMUM RATINGS**

Symbol	Parameter	Value	Unit
$I_S$	Supply Current (*)	25	mA
$V_{LVG}$	Low Side Output	-0.3 to $V_S$ +0.3	V
$V_{OUT}$	High Side Reference	-1 to VBOOT -18	V
$V_{HVG}$	High Side Output	-1 to VBOOT	V
$V_{BOOT}$	Floating Supply Voltage	-1 to 618	V
$dV_{BOOT}/dt$	VBOOT pin Slew rate (repetitive)	$\pm 50$	V/ns
$dV_{OUT}/dt$	OUT pin Slew Rate (repetitive)	$\pm 50$	V/ns
$V_{ir}$	Forced Input Voltage (pins Ring, Rpre)	-0.3 to 5	V
$V_{ic}$	Forced Input Voltage (pins Cpre, Cf)	-0.3 to 5	V
$V_{EN1}, V_{EN2}$	Enable Input Voltage	-0.3 to 5	V
$I_{EN1}, I_{EN2}$	Enable Input Current	$\pm 3$	mA
$V_{opc}$	Sense Op Amp Common Mode Range	-0.3 to 5	V
$V_{opd}$	Sense Op Amp Differential Mode Range	$\pm 5$	V
$V_{opo}$	Sense Op Amp Output Voltage (forced)	4.6	V
$T_{stg}, T_j$	Storage Temperature	-40 to +150	°C
$T_{amb}$	Ambient Temperature	-40 to +125	°C

(\*) The device has an internal Clamping Zener between GND and the  $V_{CC}$  pin, it must not be supplied by a Low Impedance Voltage Source.

Note: ESD immunity for pins 14, 15 and 16 is guaranteed up to 900V (Human Body Model)

## RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Value	Unit
V <sub>S</sub>	Supply Voltage	10 to V <sub>CL</sub>	V
V <sub>OUT</sub> (*)	High Side Reference	-1 to V <sub>BOOT</sub> -V <sub>CL</sub>	V
V <sub>BOOT</sub> (*)	Floating Supply Voltage	500	V

(\*) If the condition V<sub>boot</sub> - V<sub>out</sub> < 18 is guaranteed, V<sub>out</sub> can range from -3 to 580V.

## ELECTRICAL CHARACTERISTICS

(V<sub>S</sub> = 12V; V<sub>BOOT</sub>-V<sub>OUT</sub> = 12V; T<sub>amb</sub> = 25°C)

Symbol	Pin	Parameter	Test Condition	Min.	Typ.	Max.	Unit
<b>Supply Voltage</b>							
V <sub>supv</sub>	12	V <sub>S</sub> Turn On Threshold		9.5	10.2	10.9	V
V <sub>suvn</sub>		V <sub>S</sub> Turn Off Threshold		7.3	8	8.7	V
V <sub>suvh</sub>		Supply Voltage Under Voltage Hysteresys			2.2		V
V <sub>cl</sub>		Supply Voltage Clamping		14.6	15.6	16.6	V
I <sub>su</sub>		Start Up Current	V <sub>S</sub> < V <sub>suvn</sub>			250	μA
I <sub>q</sub>		Quiescent Current, f <sub>out</sub> = 60kHz, no load.	V <sub>S</sub> > V <sub>supv</sub>		2		mA
<b>High voltage Section</b>							
I <sub>bootleak</sub>	16	BOOT pin leakage current	V <sub>BOOT</sub> = 580V			5	μA
I <sub>outleak</sub>	14	OUT pin Leakage Current	V <sub>OUT</sub> = 562V			5	μA
<b>High/Low Side Drivers</b>							
I <sub>hvgso</sub>	15	High Side Driver Source Current	V <sub>HVG</sub> -V <sub>OUT</sub> = 0	170	250		mA
I <sub>hvgsi</sub>	15	High Side Driver Sink Current	V <sub>HVG</sub> -V <sub>BOOT</sub> = 0	300	450		mA
I <sub>lvgsso</sub>	11	Low Side Drive Source Current	V <sub>LVG</sub> -GND = 0	170	250		mA
I <sub>lvgsi</sub>	11	Low Side Drive Source Current	V <sub>LVG</sub> -V <sub>S</sub> = 0	300	450		mA
t <sub>rise</sub>	15, 11	Low/High Side Output Rise Time	C <sub>load</sub> = 1nF		80	120	ns
t <sub>fall</sub>		Low/High Side Output Fall Time	C <sub>load</sub> = 1nF		50	80	ns
<b>Oscillator</b>							
DC	14	Output Duty Cycle		48	50	52	%
f <sub>ing</sub>	14	Minimum Output Oscillation Frequency	C <sub>F</sub> = 470pF; R <sub>ing</sub> = 50kΩ	58.2	60	61.8	kHz
f <sub>pre</sub>	14	Maximum Output Oscillation Frequency	C <sub>F</sub> = 470pF; R <sub>ing</sub> = 50kΩ; R <sub>pre</sub> = 47kΩ	114	120	126	kHz
V <sub>ref</sub>	2,4	Voltage to current converters threshold		1.9	2	2.1	V
I <sub>vref</sub>	2,4	Reference Current		0		120	μA
t <sub>d</sub>	14	Dead Time between Low and High Side Conduction		0.8	1.25	1.7	μs

**ELECTRICAL CHARACTERISTICS** (continued)(V<sub>S</sub> = 12V; V<sub>BOOT</sub>-V<sub>OUT</sub> = 12V; T<sub>amb</sub> = 25°C)

Symbol	Pin	Parameter	Test Condition	Min.	Typ.	Max.	Unit
<b>Timing Section</b>							
k <sub>pre</sub>	1	Pre Heat Timing constant	C <sub>pre</sub> = 330nF	1.15	1.5	1.85	s/μF
k <sub>fs</sub>		Frequency Shift Timing Constant	C <sub>pre</sub> = 330nF	0.115	0.15	0.185	s/μF
V <sub>thpre</sub>		Pre Heat Timing Comparator Threshold		3.3	3.5	3.7	V
<b>Sense OP AMP</b>							
I <sub>lib</sub>	6,7	Input Bias current				0.1	μA
V <sub>io</sub>		Input Offset Voltage		-10		10	mV
R <sub>out</sub>	5	Output Resistance		200		300	Ω
I <sub>out+</sub>		Sink Output Current	V <sub>out</sub> = 0.2V	0.5			mA
I <sub>out-</sub>		Source Output Current	V <sub>out</sub> = 4.5V	0.5			mA
V <sub>ic</sub>	6,7	Common Mode Input Range		-0.2		3	V
GBW		Sense Op Amp Gain Band Width Product			1		MHz
G <sub>dc</sub>		DC Open Loop Gain			80		dB
<b>Comparators</b>							
V <sub>the</sub>	8,9	Enabling Comparators Threshold		0.56	0.6	0.64	V
V <sub>hye</sub>		Enabling Comparators Hysteresis		20		100	mV
t <sub>pulse</sub>		Minimum Pulse length			200		ns

**High/Low Side Driving Section:**

High and low side driving sections provide the proper drive to the external power MOSFET. A high sink/source driving current (450/250 mA typical) ensures fast switching times when a size 4 external power MOSFET needs to be driven.

**Bootstrap Section:**

A patented integrated bootstrap section replaces an external bootstrap diode. This section together with a bootstrap capacitor provides the bootstrap voltage to drive the high side power MOSFET. This function is achieved using a high voltage DMOS driver which is driven synchronously with the low side external power MOSFET.

For a safe operation, current flow into the Vboot pin is inhibited, even though ZVS operation may not be ensured.

**Timing Section:**

To set the proper preheat time (t<sub>pre</sub>=k<sub>pre</sub>\*C<sub>pre</sub>) for the bulb, a capacitor is connected to the C<sub>pre</sub> pin which is charged with a fixed current. During t<sub>pre</sub>, the output is switching at f<sub>pre</sub> (see Oscillator Section). When the t<sub>pre</sub> expires, the C<sub>pre</sub> capacitor is discharged and then recharged with a different current. This sets a second time interval t<sub>sh</sub> (0.1 times the selected preheat time t<sub>pre</sub>) during which frequency shifting from f<sub>pre</sub> to f<sub>ing</sub> is performed to ensure lamp ignition.

**Oscillator Section:**

A voltage controlled oscillator, with the selected frequencies  $f_{pre}$  and  $f_{ing}$ , drives the output half bridge. Independently selected,  $f_{pre}$  is effective during  $t_{pre}$  and  $f_{ing}$  is effective during normal lamp burning. When working open loop,  $f_{pre}$  and  $f_{ing}$  are the highest and lowest allowed oscillation frequencies.

Closed loop control of the lamp current under normal operation can be achieved with the L6574. This is accomplished by automatic adjustment of the oscillator frequency. The OP AMP output is fed through a resistor diode network to the Ring pin. See AN 993.

**OP AMP Section:**

The integrated OP AMP offers low output impedance, wide bandwidth, high input impedance and wide common mode range. It can be readily used to implement closed loop control (see Oscillator Section) of the lamp current.

**EN1, EN2 Comparators:**

Two CMOS comparators, with thresholds set at 0.6 V (typical) are available to implement protection methods (such as overvoltage, lamp removal, etc.). Short pulses (>200nsec) at the comparator inputs are recognized.

The EN1 input (active high) forces the L6574 in the shut down state (e.g. LVG low, HVG low, oscillator stopped) in the event of an undervoltage condition. Normal operating condition is resumed after a power-off power-on sequence or when EN2 input is high.

The EN2 input (active high) also restarts a preheat sequence (see timing diagrams).

**TIMING DIAGRAMS**

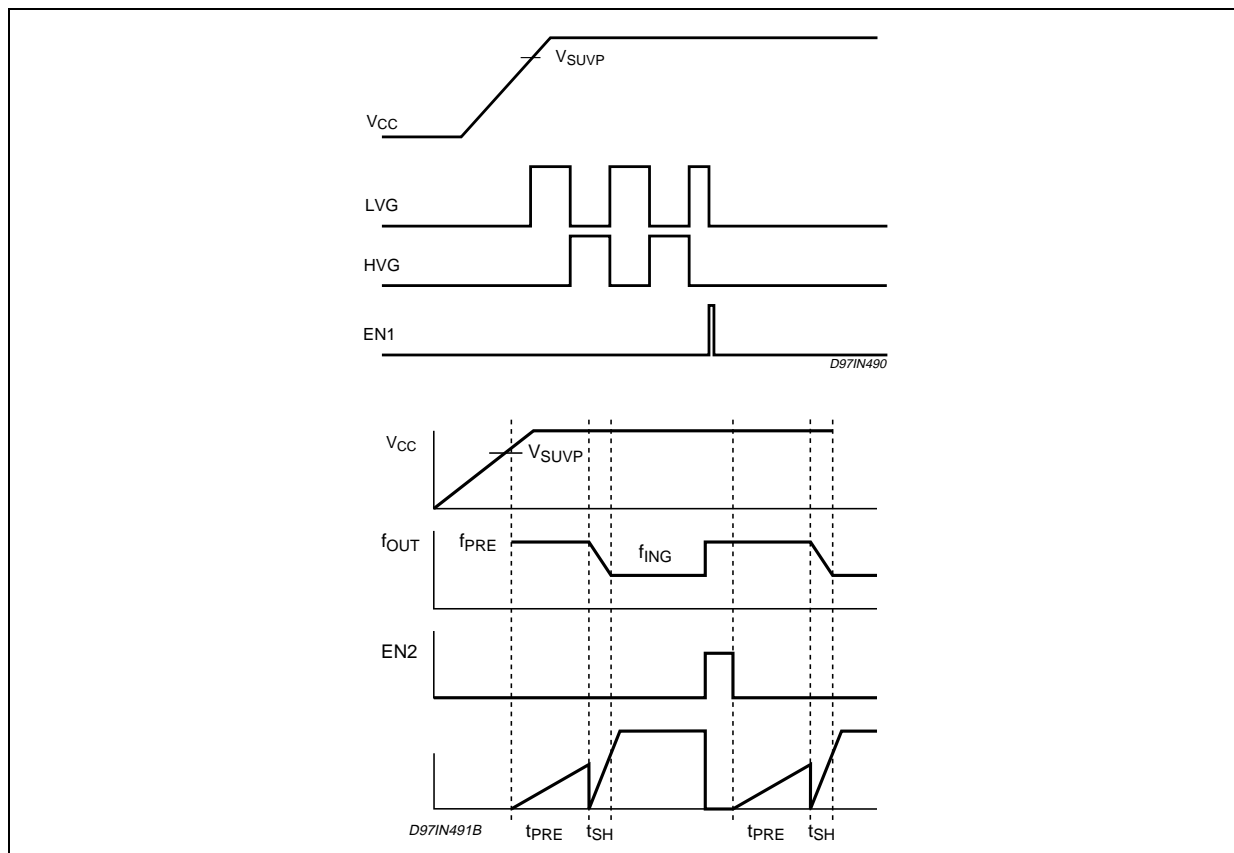


Figure 1.  $f_{ING}$  vs.  $R_{ING}$ .

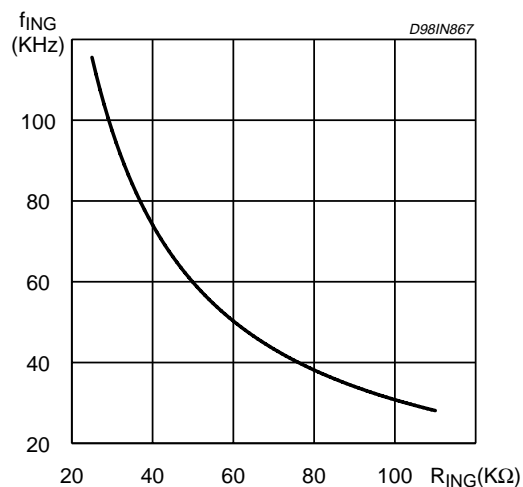


Figure 4.  $\Delta f$  vs.  $R_{PRE}$ , with  $R_{ING} = 100k\Omega$

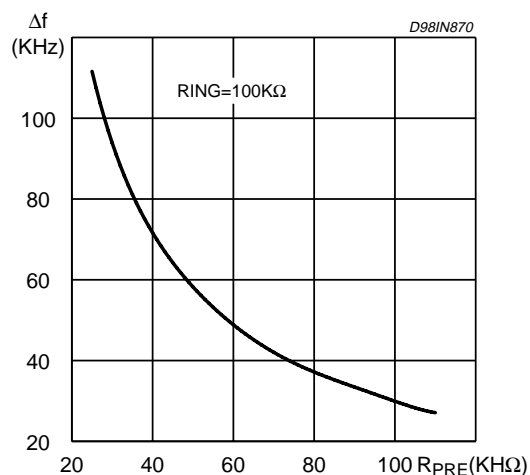


Figure 2.  $\Delta f$  vs.  $R_{PRE}$ , with  $R_{ING} = 33k\Omega$

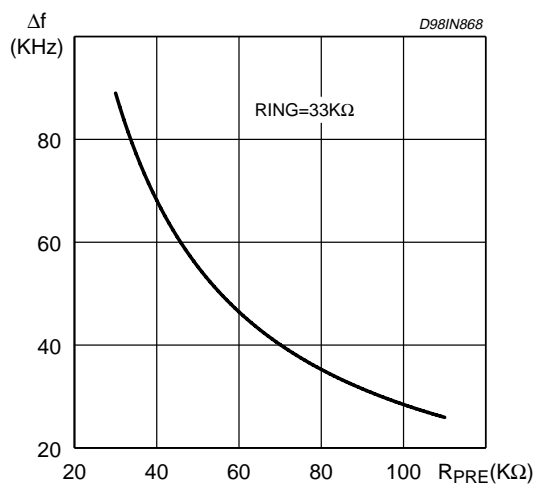


Figure 5.  $f_{ING}$  vs. temperature.

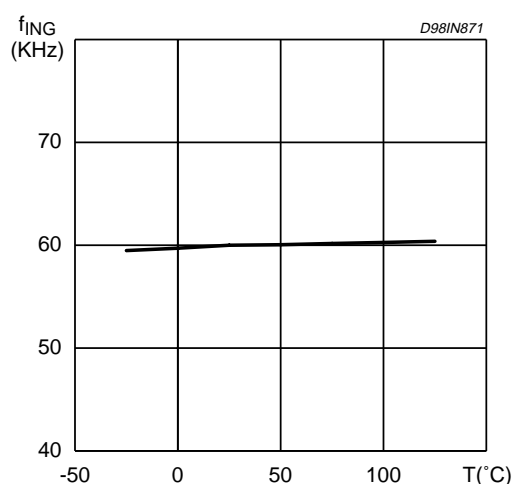


Figure 3.  $\Delta f$  vs.  $R_{PRE}$ , with  $R_{ING} = 50k\Omega$

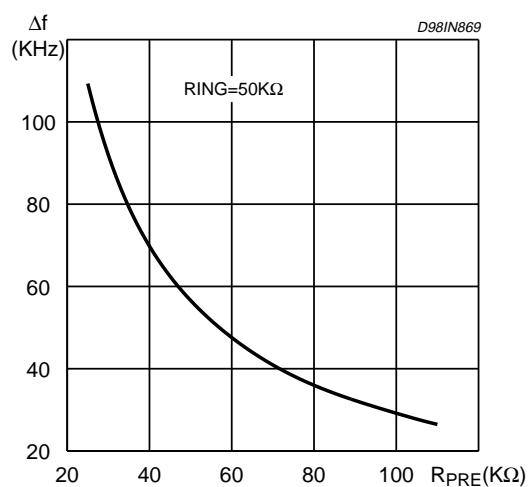
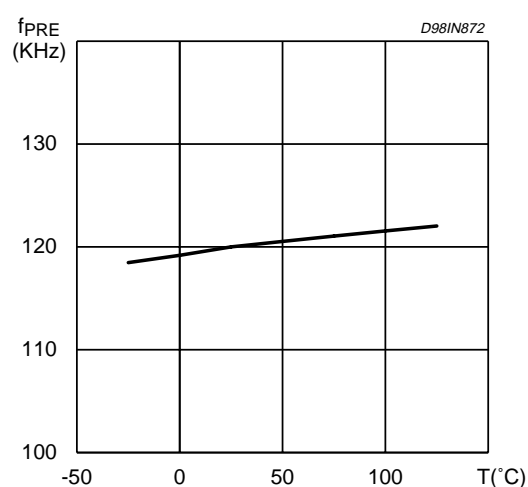


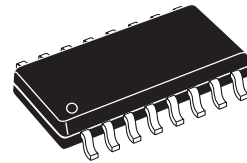
Figure 6.  $f_{PRE}$  vs. temperature.



DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			1.75			0.069
a1	0.1		0.25	0.004		0.009
a2			1.6			0.063
b	0.35		0.46	0.014		0.018
b1	0.19		0.25	0.007		0.010
C		0.5			0.020	
c1	45° (typ.)					
D (1)	9.8		10	0.386		0.394
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		8.89			0.350	
F (1)	3.8		4	0.150		0.157
G	4.6		5.3	0.181		0.209
L	0.4		1.27	0.016		0.050
M			0.62			0.024
S	8° (max.)					

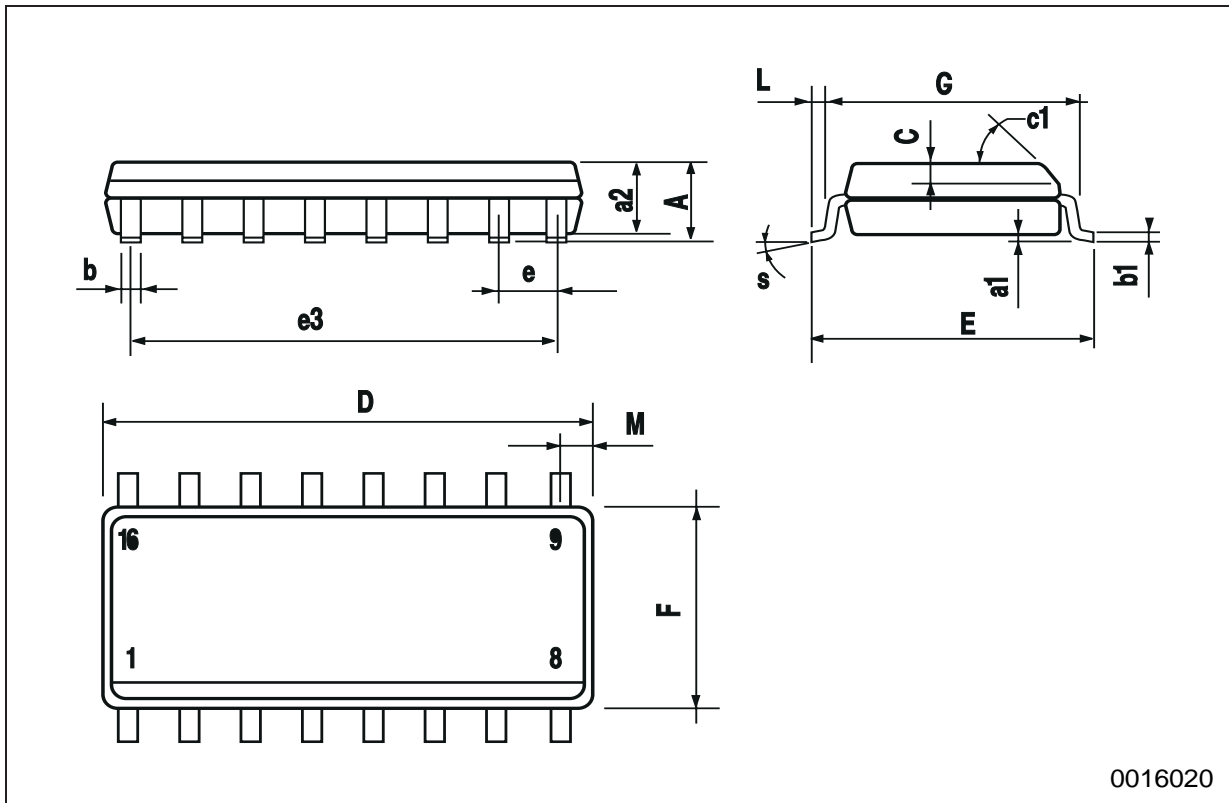
**OUTLINE AND MECHANICAL DATA**

Weight: 0.20gr



**SO16 Narrow**

(1) D and F do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.15mm (.006inch).

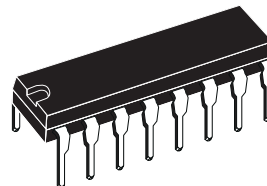


0016020

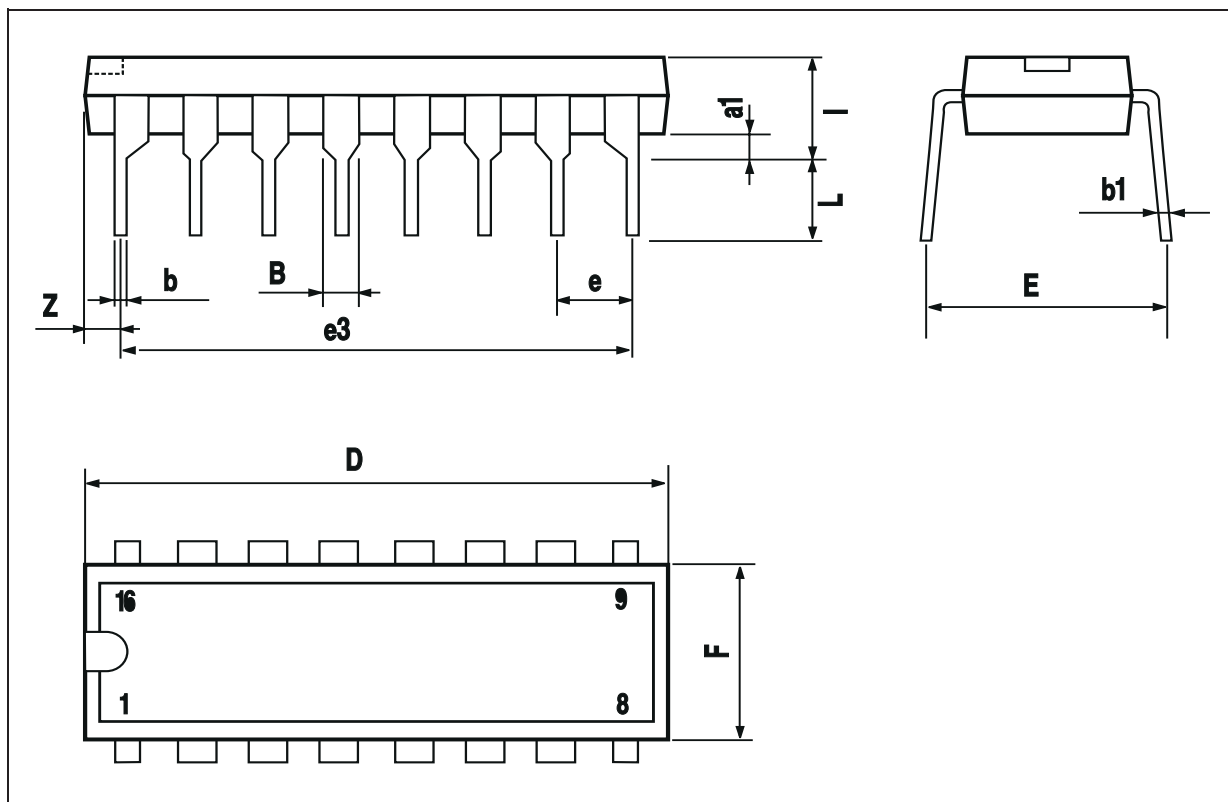


DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
a1	0.51			0.020		
B	0.77		1.65	0.030		0.065
b		0.5			0.020	
b1		0.25			0.010	
D			20			0.787
E		8.5			0.335	
e		2.54			0.100	
e3		17.78			0.700	
F			7.1			0.280
I			5.1			0.201
L		3.3			0.130	
Z			1.27			0.050

## OUTLINE AND MECHANICAL DATA



**DIP16**



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