

## LM106/LM306 Voltage Comparator

### General Description

The LM106 series are high-speed voltage comparators designed to accurately detect low-level analog signals and drive a digital load. They are equivalent to an LM710, combined with a two input NAND gate and an output buffer. The circuits can drive RTL, DTL or TTL integrated circuits directly. Furthermore, their outputs can switch voltages up to 24V at currents as high as 10 mA.

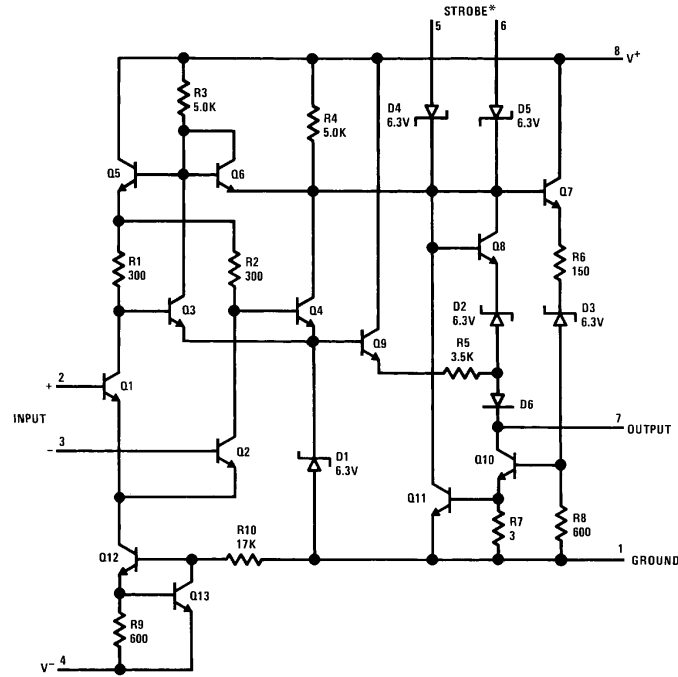
The devices have short-circuit protection which limits the in-rush current when it is used to drive incandescent lamps, in addition to preventing damage from accidental shorts to the positive supply. The speed is equivalent to that of an LM710. However, they are even faster where buffers and additional logic circuitry can be eliminated by the increased flexibility of the LM106 series. They can also be operated from any negative supply voltage between -3V and -12V with little effect on performance.

The LM106 is specified for operation over the -55°C to +125°C military temperature range. The LM306 is specified for operation over 0°C to +70°C temperature range.

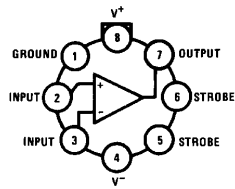
### Features

- Improved accuracy
- Fan-out of 10 with DTL or TTL
- Added logic or strobe capability
- Useful as a relay or lamp driver
- Plug-in replacement for the LM710
- 40 ns maximum response time

## Schematic and Connection Diagrams



### Metal Can



**Note:** Pin 4 connected to case.  
 †Available per SMD# 8003701

**Top View**  
**Order Number LM106H,**  
**LM106H/883† or LM306H**  
**See NS Package Number H08A**

**Absolute Maximum Ratings** (Note \*NO TARGET FOR FNxref NS0058\*)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/ Distributors for availability and specifications.

(Note 6)

Positive Supply Voltage	15V
Negative Supply Voltage	-15V
Output Voltage	24V
Output to Negative Supply Voltage	30V
Differential Input Voltage	±5V

Input Voltage	±7V
Power Dissipation (Note 1)	600 mW
Output Short Circuit Duration	10 seconds
Operating Temperature Range	$T_{MIN}$ $T_{MAX}$
LM106	-55°C to +125°C
LM306	0°C to +70°C
Storage Temperature Range	-65°C to +150°C
Lead Temperature (Soldering, 10 sec.)	300°C
ESD rating to be determined.	

**Electrical Characteristics** (Note 2)

Parameter	Conditions	LM106			LM306			Units
		Min	Typ	Max	Min	Typ	Max	
Input Offset Voltage	(Note 3)		0.5	2.0		1.6	5.0	mV
Input Offset Current	(Note 3)		0.7	3.0		1.8	5.0	µA
Input Bias Current			10	20		16	25	µA
Response Time	$R_L = 390\Omega$ to 5V $C_L = 15$ pF, (Note 4)		28	40		28	40	ns
Saturation Voltage	$V_{IN} \leq -5$ mV, $I_{OUT} = 100$ mA $V_{IN} \leq -7$ mV, $I_{OUT} = 100$ mA		1.0	1.5		0.8	2.0	V
Output Leakage Current	$V_{IN} \geq 5$ mV, $8V \leq V_{OUT} \leq 24V$ $V_{IN} \geq 7$ mV, $8V \leq V_{OUT} \leq 24V$		0.02	1.0		0.02	2.0	µA

**THE FOLLOWING SPECIFICATIONS APPLY FOR  $T_{MIN} \leq T_A \leq T_{MAX}$  (Note 5)**

Input Offset Voltage	(Note 3)			3.0			6.5	mV
Average Temperature Coefficient of Input Offset Voltage			3.0	10		5	20	µV/°C
Input Offset Current	$T_L \leq T_A \leq 25^\circ\text{C}$ , (Note 3) $25^\circ\text{C} \leq T_A \leq T_H$		1.8	7.0		2.4	7.5	µA
Average Temperature Coefficient of Input Offset Current	$25^\circ\text{C} \leq T_A \leq T_H$ $T_L \leq T_A \leq 25^\circ\text{C}$		0.25	3.0		5.0	5.0	µA
Input Bias Current	$25^\circ\text{C} \leq T_A \leq T_H$ $T_L \leq T_A \leq 25^\circ\text{C}$		5.0	25		15	50	nA/°C
Input Bias Current	$25^\circ\text{C} \leq T_A \leq T_H$ $T_L \leq T_A \leq 25^\circ\text{C}$		15	75		24	100	nA/°C
Input Bias Current	$T_L \leq T_A \leq 25^\circ\text{C}$ $25^\circ\text{C} \leq T_A \leq T_H$			45		25	40	µA
Input Bias Current	$T_L \leq T_A \leq 25^\circ\text{C}$ $25^\circ\text{C} \leq T_A \leq T_H$			20			25	µA
Input Voltage Range	$-7V \geq V^- \geq -12V$	±5.0			±5.0			V
Differential Input Voltage Range		±5.0			±5.0			V
Saturation Voltage	$V_{IN} \leq -5$ mV, $I_{OUT} = 50$ mA $V_{IN} \leq -8$ mV For LM306			1.0			1.0	V
Saturation Voltage	$V_{IN} \leq -5$ mV, $I_{OUT} = 16$ mA $V_{IN} \leq -8$ mV For LM306			0.4			0.4	V
Positive Output Level	$V_{IN} \geq 5$ mV, $I_{OUT} = -400\mu\text{A}$ $V_{IN} \geq 8$ mV For LM306	2.5		5.5	2.5		5.5	V
Output Leakage Current	$V_{IN} \geq 5$ mV, $8V \leq V_{OUT} \leq 24V$ $V_{IN} \geq 8$ mV For LM306 $T_L \leq T_A \leq 25^\circ\text{C}$ $25^\circ\text{C} < T_A \leq T_H$			1.0			2.0	µA
Output Leakage Current	$T_L \leq T_A \leq 25^\circ\text{C}$ $25^\circ\text{C} < T_A \leq T_H$			100			100	µA
Strobe Current	$V_{STROBE} = 0.4V$		-1.7	-3.2		-1.7	-3.2	mA
Strobe "ON" Voltage		0.9	1.4		0.9	1.4		V
Strobe "OFF" Voltage	$I_{SINK} \leq 16$ mA		1.4	2.2		1.4	2.2	V
Positive Supply Current	$V_{IN} = -5$ mV $V_{IN} = -8$ mV for LM306		5.5	10		5.5	10	mA
Negative Supply Current			-1.5	-3.6		-1.5	-3.6	mA

## Electrical Characteristics (Note 2) (Continued)

**Note 1:** The maximum junction temperature of LM106 is 150°C, LM306 is 85°C. For operating at elevated temperatures, devices must be derated based on a thermal resistance of 170°C/W, junction to ambient, or 23°C/W, junction to case.

**Note 2:** These specifications apply for  $-3V \geq V^- \geq -12V$ ,  $V^+ = 12V$  and  $T_A = 25^\circ C$  unless otherwise specified. All currents into device pins are considered positive.

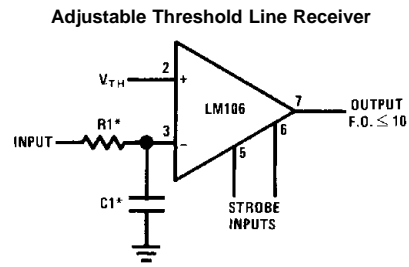
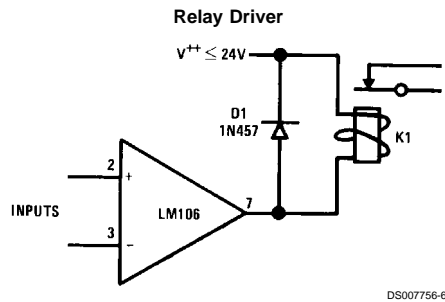
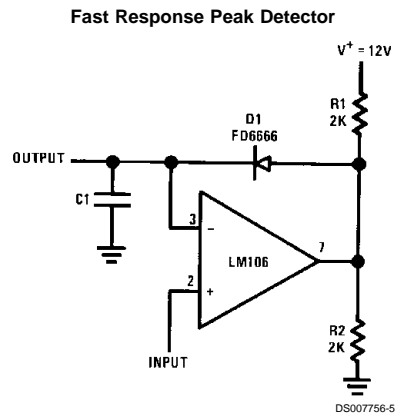
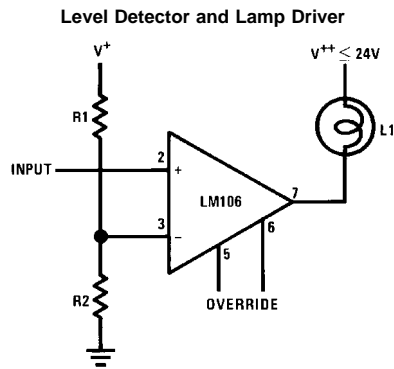
**Note 3:** The offset voltages and offset currents given are the maximum values required to drive the output down to 0.5V or up to 4.4V (0.5V or up to 4.8V for the LM306). Thus, these parameters actually define an error band and take into account the worst-case effects of voltage gain, specified supply voltage variations, and common mode voltage variations.

**Note 4:** The response time specified (see definitions) is for a 100 mV input step with 5 mV overdrive.

**Note 5:** All currents into device pins are considered positive.

**Note 6:** Refer to RETS106X for LM106 military specifications.

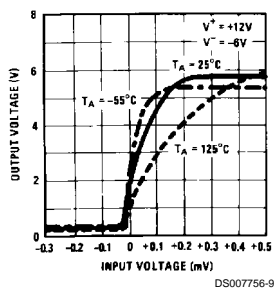
## Typical Applications



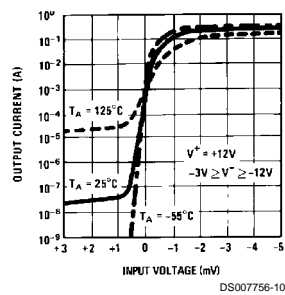
\*Optional for response time control.

## Typical Performance Characteristics

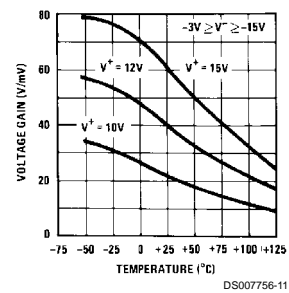
**Transfer Function**



**Transconductance**

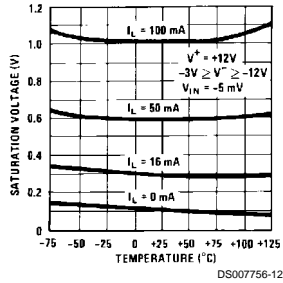


**Voltage Gain**

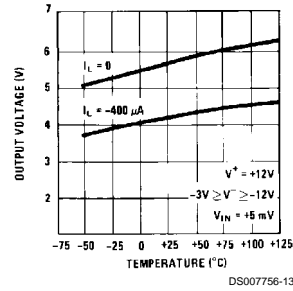


## Typical Performance Characteristics (Continued)

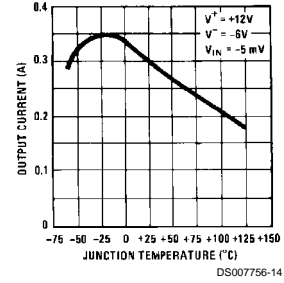
Saturation Voltage



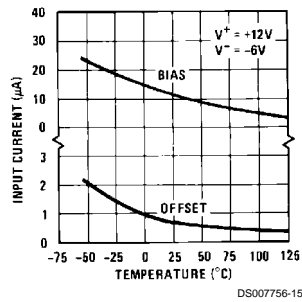
Positive Output Level



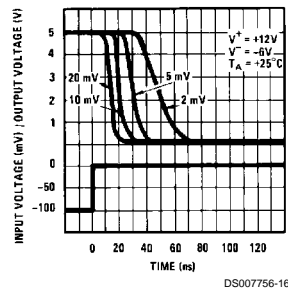
Short Circuit Output Current



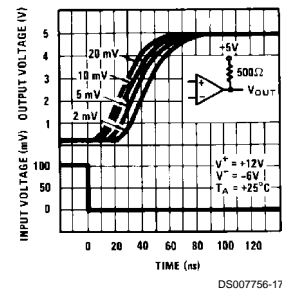
Input Current



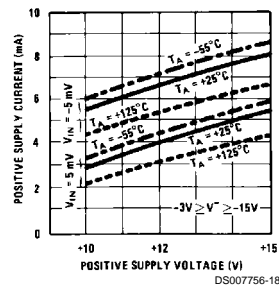
Response Time for Various Input Overdrives



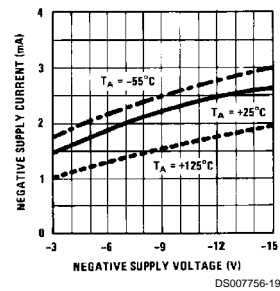
Response Time for Various Input Overdrives



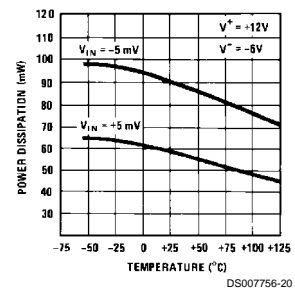
Positive Supply Current



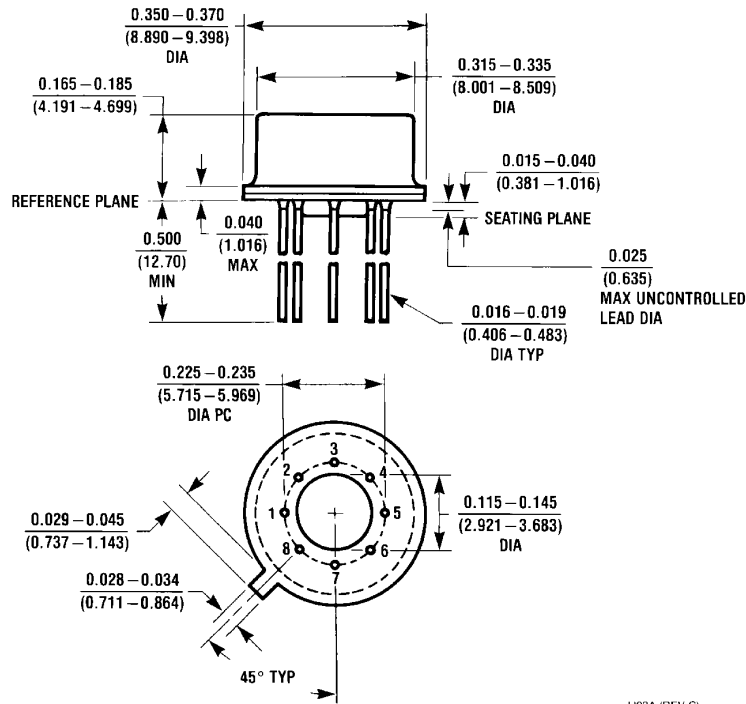
Negative Supply Current



Power Consumption



**Physical Dimensions** inches (millimeters)



H08A (REV C)

**Metal Can Package (H)**  
**Order Number LM106H, LM106H/883 or LM306H**  
**NS Package Number H08A**

**LIFE SUPPORT POLICY**

NATIONAL'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT OF NATIONAL SEMICONDUCTOR CORPORATION. As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
2. A critical component in any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

 <p><b>National Semiconductor Corporation</b>          1111 West Bardin Road          Arlington, TX 76017          Tel: 1(800) 272-9959          Fax: 1(800) 737-7018   <a href="http://www.national.com">www.national.com</a></p>	<p><b>National Semiconductor Europe</b>          Fax: (+49) 0-180-530 85 86          Email: <a href="mailto:cnjwge@tevm2.nsc.com">cnjwge@tevm2.nsc.com</a>          Deutsch Tel: (+49) 0-180-530 85 85          English Tel: (+49) 0-180-532 78 32          Français Tel: (+49) 0-180-532 93 58          Italiano Tel: (+49) 0-180-534 16 80</p>	<p><b>National Semiconductor Hong Kong Ltd.</b>          13th Floor, Straight Block,          Ocean Centre, 5 Canton Rd.          Tsimshatsui, Kowloon          Hong Kong          Tel: (852) 2737-1600          Fax: (852) 2736-9960</p>	<p><b>National Semiconductor Japan Ltd.</b>          Tel: 81-043-299-2308          Fax: 81-043-299-2408</p>
-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------

National does not assume any responsibility for use of any circuitry described, no circuit patent licenses are implied and National reserves the right at any time without notice to change said circuitry and specifications.