National Semiconductor

December 1994

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.

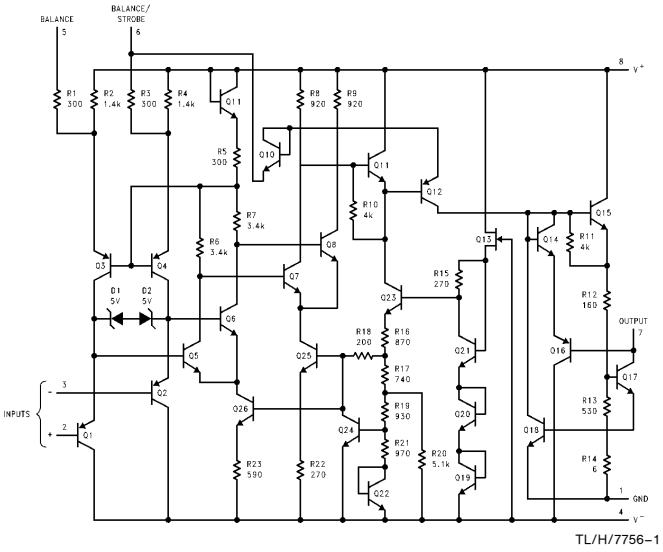
The devices have short-circuit protection which limits the inrush current when it is used to drive incandescent lamps, in addition to preventing damage from accidental shorts to the positive supply. The speed is equivalent to that of an LM710. However, they are even faster where buffers and additional 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



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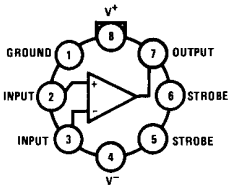
Metal Can



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Top View

Note: Pin 4 connected to case.

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

†Available per SMD # 8003701

Absolute Maximum Ratings

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 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 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	$T_L \leq T_A \leq 25°C$, (Note 3) $25°C \leq T_A \leq T_H$		1.8 0.25	7.0 3.0		2.4	7.5 5.0	μA μA
Average Temperature Coefficient of Input Offset Current	$25°C \leq T_A \leq T_H$ $T_L \leq T_A \leq 25°C$		5.0 15	25 75		15 24	50 100	nA/°C nA/°C
Input Bias Current	$T_L \leq T_A \leq 25°C$ $25°C \leq T_A \leq T_H$			45 20		25	40 25	μA 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, $I_{OUT} = -400\mu A$ $V_{IN} \geq 8$ 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 $T_L \leq T_A \leq 25°C$ $25°C < T_A \leq T_H$			1.0 100			2.0 100	μA μA
Strobe Current	$V_{STROBE} = 0.4V$		−1.7	−3.2		−1.7	−3.2	mA

Electrical Characteristics (Note 2) (Continued)

Parameter	Conditions	LM106			LM306			Units
		Min	Typ	Max	Min	Typ	Max	
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

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 $T_A = 25°C$ 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.

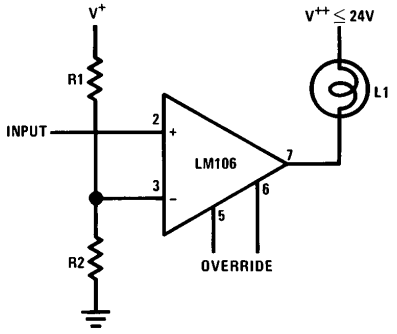
Note 4: The response time specified (see definitions) is for a 100 mV input step with 5 mV overdrive.

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

Note 6: Refer to RETS106X for LM106 military specifications.

Typical Applications

Level Detector and Lamp Driver



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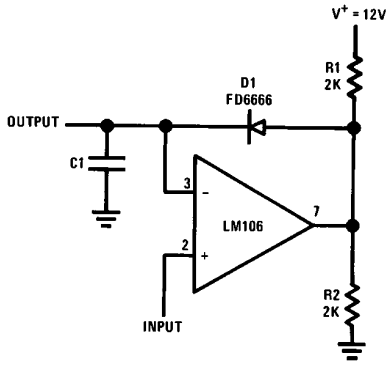
Fast Response Peak Detector



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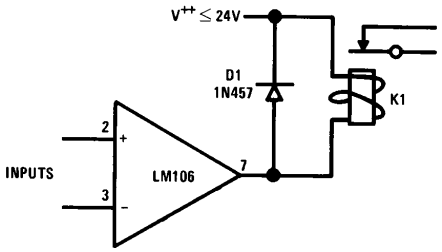
Relay Driver



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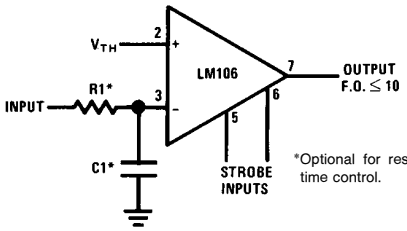
Adjustable Threshold Line Receiver



*Optional for response time control.

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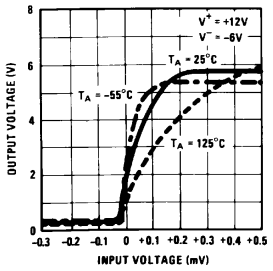
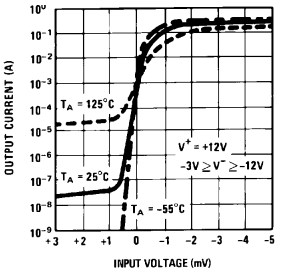
Typical Performance Characteristics

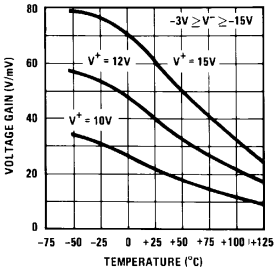
Transfer Function



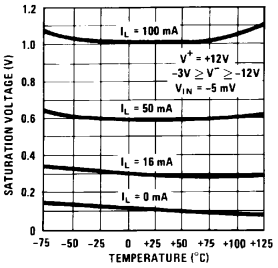
Transconductance



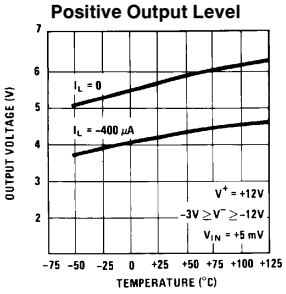
Voltage Gain



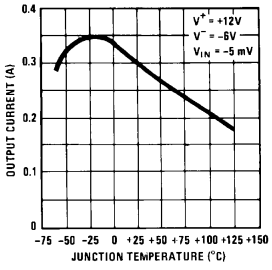
Saturation Voltage



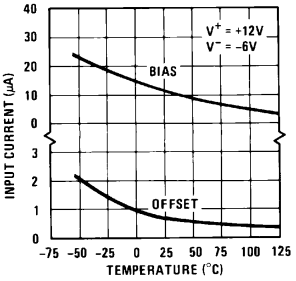
Positive Output Level



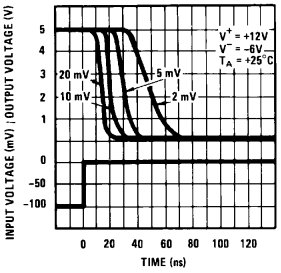
Short Circuit Output Current



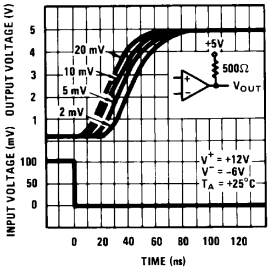
Input Current



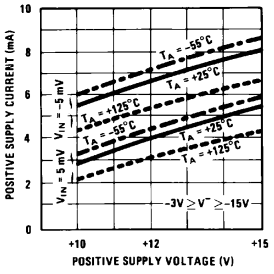
Response Time for Various Input Overdrives



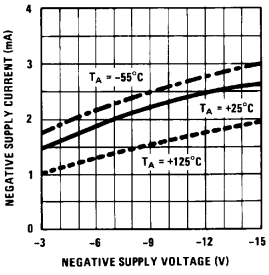
Response Time for Various Input Overdrives



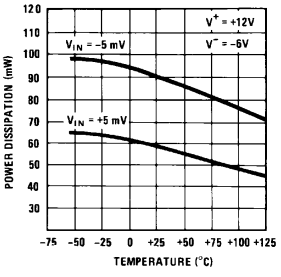
Positive Supply Current



Negative Supply Current



Power Consumption



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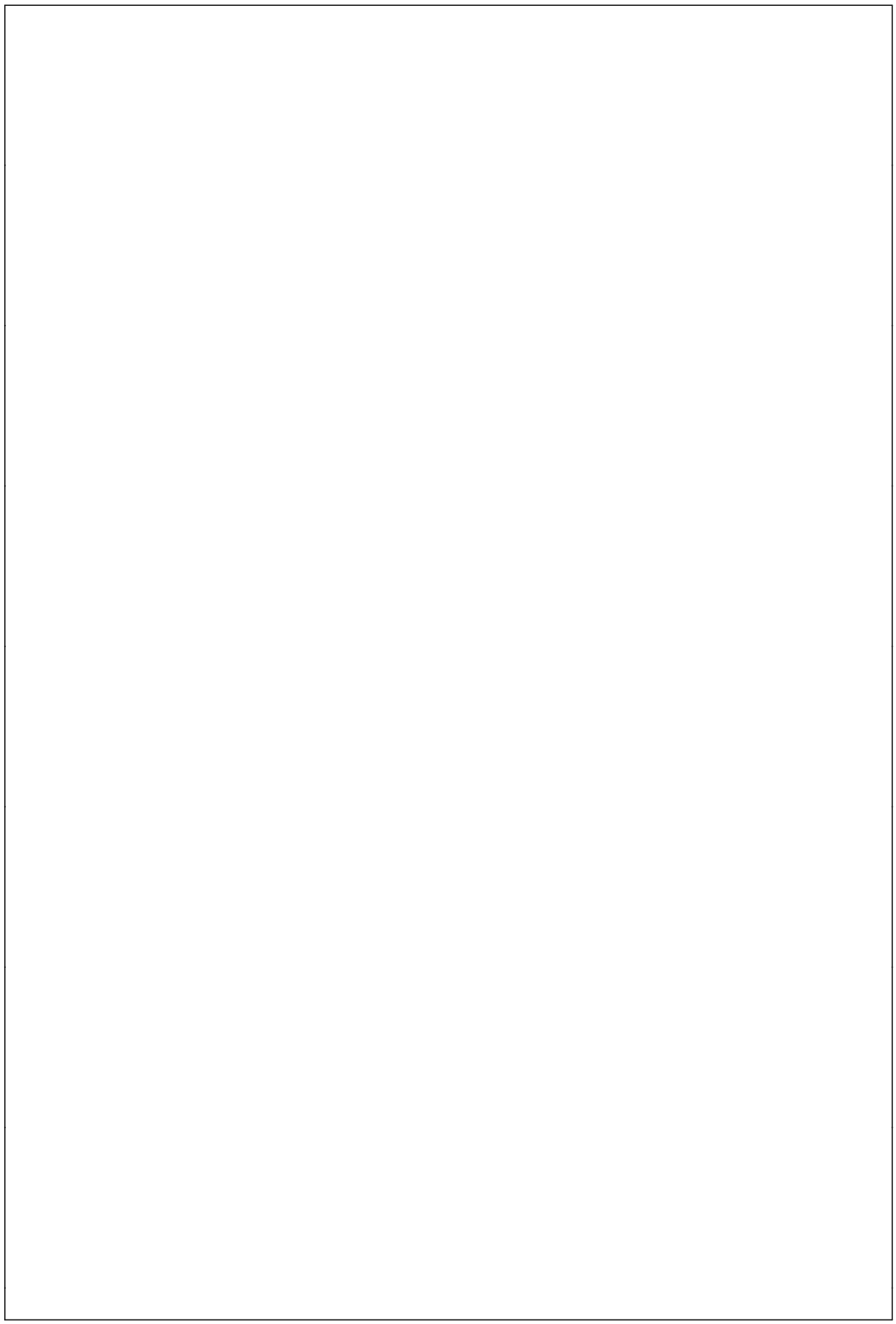
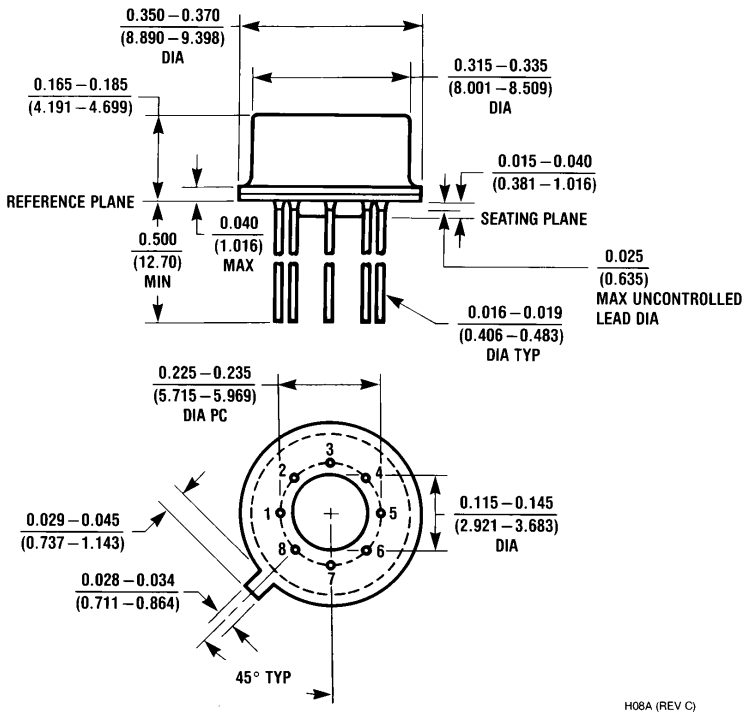


Physical Dimensions inches (millimeters)



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

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