

LM1391 Phase-Locked Loop

General Description

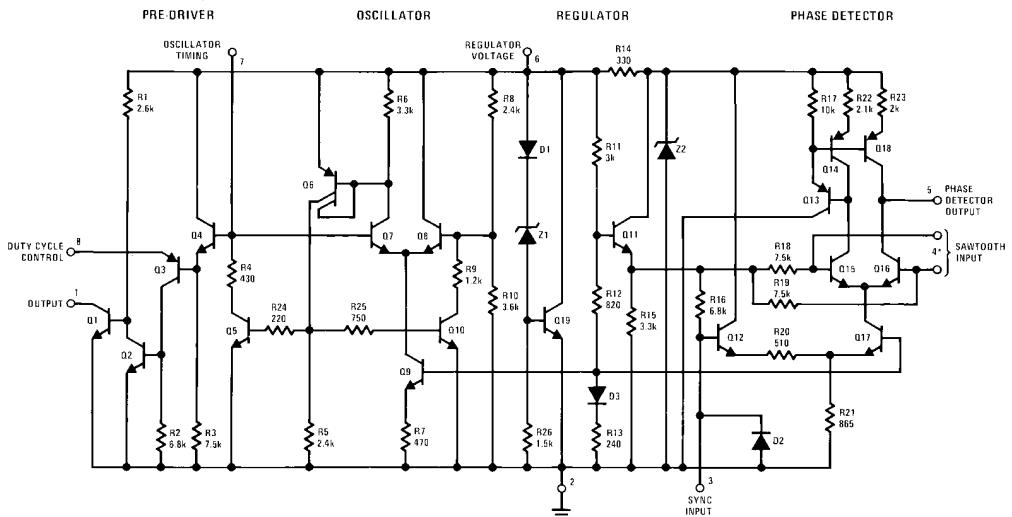
The LM1391 integrated circuit has been designed primarily for use in the horizontal section of TV receivers, but may find use in other low frequency signal processing applications. It includes a stable VCO, linear pulse phase detector, and variable duty cycle output driver.

Features

- Internal active regulator for improved supply rejection
- Uncommitted collector of output transistor

- Output transistor with low saturation and high voltage swing
- APC of the oscillator with a synchronizing signal
- DC controlled output duty cycle
- ± 300 Hz typical pull-in
- Linear balanced phase detector
- Low thermal frequency drift
- Small static phase error
- Adjustable DC loop gain

Schematic Diagram



TL/H/7889-1

(*) Pin 4 Base of Q16 (LM1391) for use with (+) flyback pulse

Absolute Maximum Ratings

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

Supply Current	40 mA _{DC}	Flyback Input Voltage (Pin 4)	5.0 Vp-p
Output Voltage	40 V _{DC}	Power Dissipation (Package Limitation)	
Output Current	30 mA _{DC}	Plastic Package (Note 1)	1000 mW
Sync Input Voltage (Pin 3)	5.0 Vp-p	Operating Temperature Range (Ambient)	0°C to +70°C

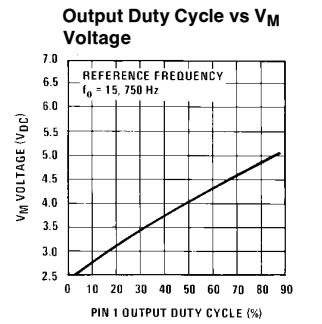
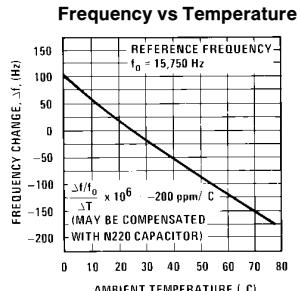
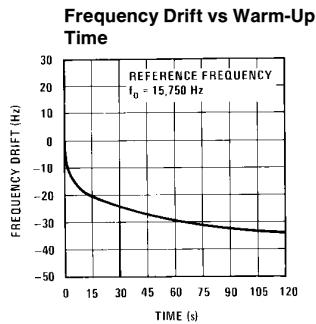
Storage Temperature Range	-65°C to +150°C
Lead Temperature (Soldering, 10 sec.)	260°C

Electrical Characteristics $T_A = 25^\circ\text{C}$ (see test circuit, all switches in position 1)

Parameter	Conditions	Min	Typ	Max	Units
Regulated Voltage (Pin 6)	$I_6 = 22 \text{ mA}_{\text{DC}}$	8.0	8.6	9.2	V _{DC}
Supply Current (Pin 6)			20		mA _{DC}
Collector-Emitter Saturation Voltage of Output Transistor (Pin 1)	$I_{C1} = 20 \text{ mA}$		0.30	0.40	V _{DC}
Pin 4 Voltage			2.0		V _{DC}
Oscillator Pull-in Range	Adjust R_H		±300		Hz
Oscillator Hold-in Range	Adjust R_H		±900		Hz
Static Phase Error	$\Delta f = 300 \text{ Hz}$		0.5		μs
Free-running Frequency Supply Dependance	S1 in position 2		±3.0		Hz/V _{DC}
Phase Detector Leakage (Pin 5)	All switches in position 2			±1.0	μA
Sync Input Voltage (Pin 3)		2.0		5.0	Vp-p
Sawtooth Input Voltage (Pin 4)		1.0		3.0	Vp-p
Maximum Oscillator Frequency			500		kHz

Note 1: For operation in ambient temperatures above 25°C, the device must be derated based on a 150°C maximum junction temperature and a thermal resistance of 120°C/W junction to ambient.

Typical Performance Characteristics



TL/H/7889-3

Application Information

The following equations may be considered when using the LM1391 in a particular application.

$$R_{201} = R_{301} = \frac{V_{CC} - 8.6}{0.02} \Omega$$

$$f_O \cong \frac{1}{0.6 R_O C_O} \text{ Hz} \quad 1.5k \leq R_O < 51k$$

$$R_{204} \approx 10 R_0$$

$$C203 = C204 \cong \frac{1}{600 f_O(\text{Hz})} F$$

$$\text{DC Loop Gain } \mu\beta \cong 3.2 \times 10^{-5} R_0 f_0 \text{ Hz/rad}$$

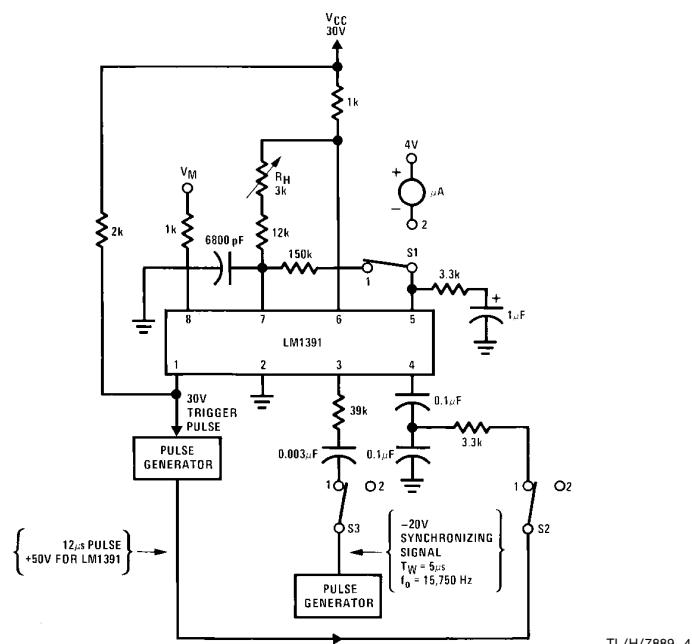
Noise Bandwidth

$$f_{nn} \cong \frac{1 + 2\pi \frac{R_X^2}{R_Y} C_C \mu \beta}{4R_X C_C} \text{ Hz}$$

Damping Factor

$$K \cong \frac{\pi}{2} \frac{R_X^2}{R_Y} C_C \mu \beta$$

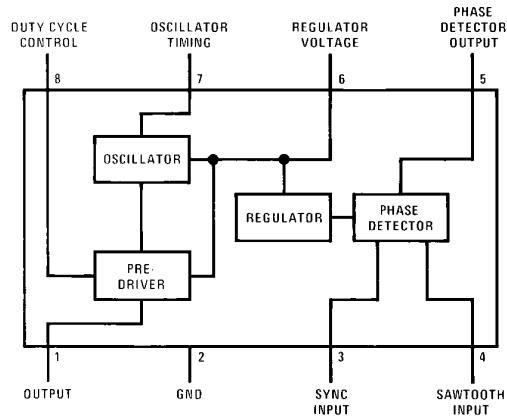
Test Circuit



TL/H/7889-4

Connection Diagram

Dual-In-Line Package



TL/H/7889-2

Top View
Order Number LM1391N
See NS Package Number N08E

Typical Applications

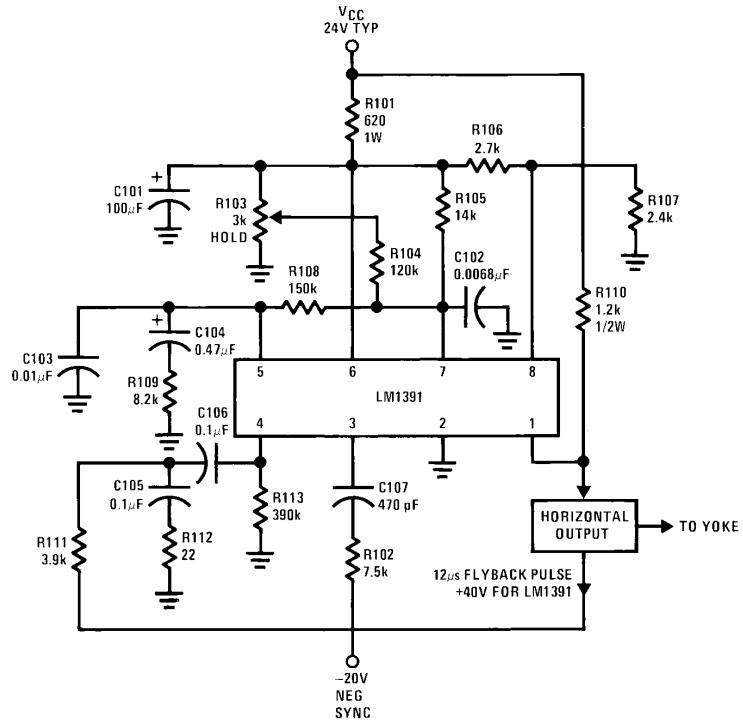


FIGURE 1. TV Horizontal Processor

TL/H/7889-5

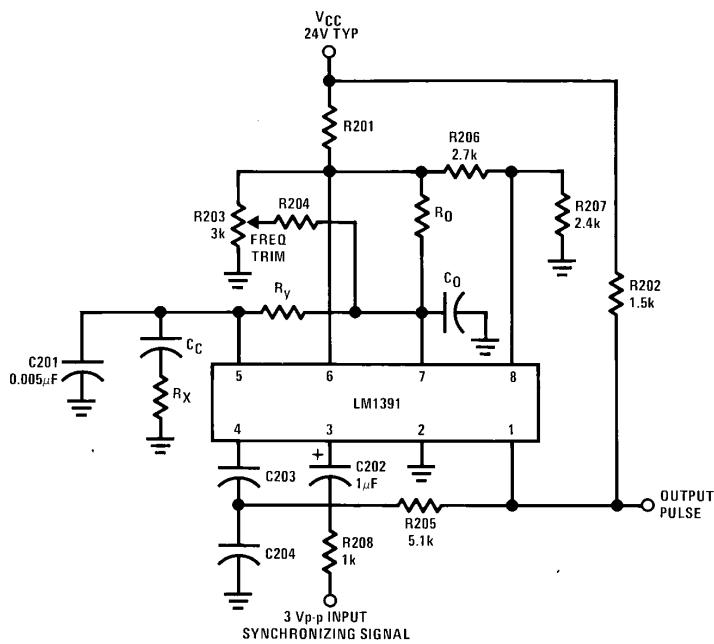
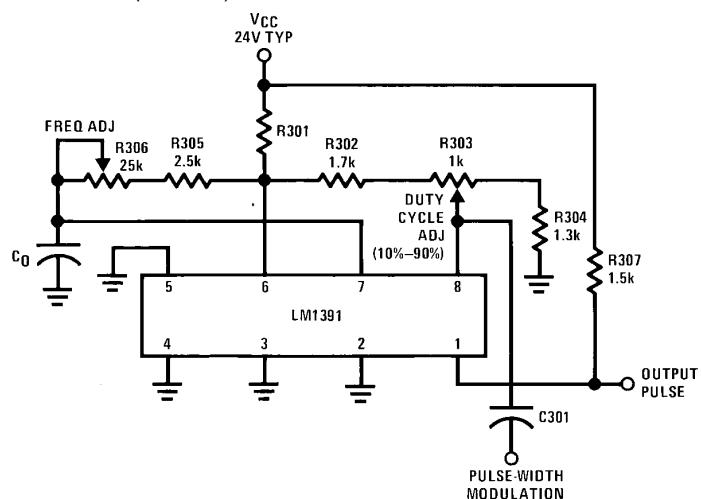


FIGURE 2. General Purpose Phase-Lock Loop
(See Applications Information)

TL/H/7889-6

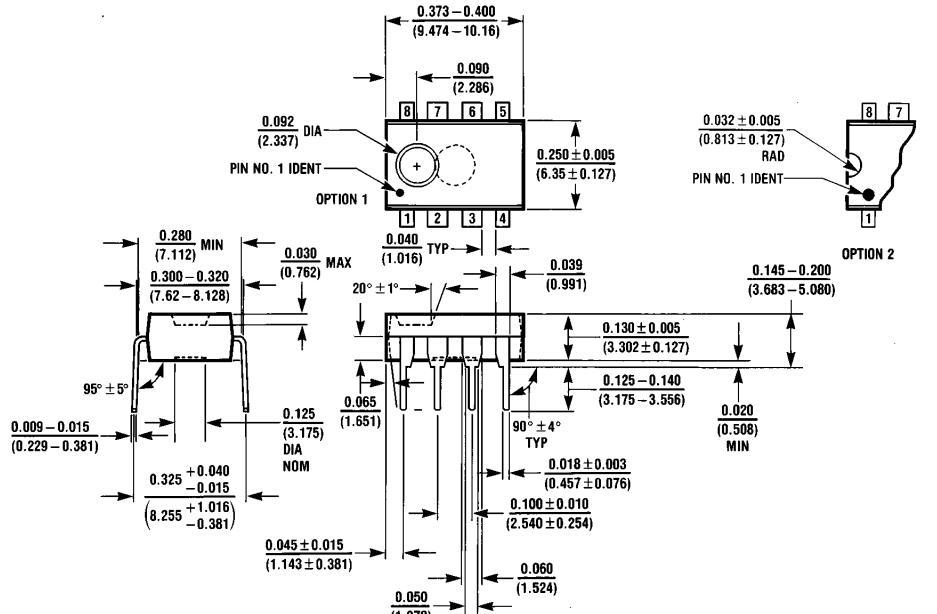
Typical Applications (Continued)



TL/H/7889-7

FIGURE 3. Variable Duty Cycle Oscillator
(See Applications Information)

Physical Dimensions



Molded Dual-In-Line Package (N)
Order Number LM1391N
NS Package Number N08E

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 is 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.

National Semiconductor Corporation 1111 West Bardin Road Arlington, TX 76017 Tel: (800) 272-9959 Fax: (800) 737-7018	National Semiconductor Europe Fax: (+49) 0-180-530 85 86 Email: cniwe@fevm2.nsc.com	National Semiconductor Hong Kong Ltd. 13th Floor, Straight Block, Ocean Centre, 5 Canton Rd. Tsimshatsui, Kowloon Hong Kong Tel: (852) 2737-1600 Fax: (852) 2736-9960	National Semiconductor Japan Ltd. Tel: 81-043-299-2309 Fax: 81-043-299-2408
---	---	--	--