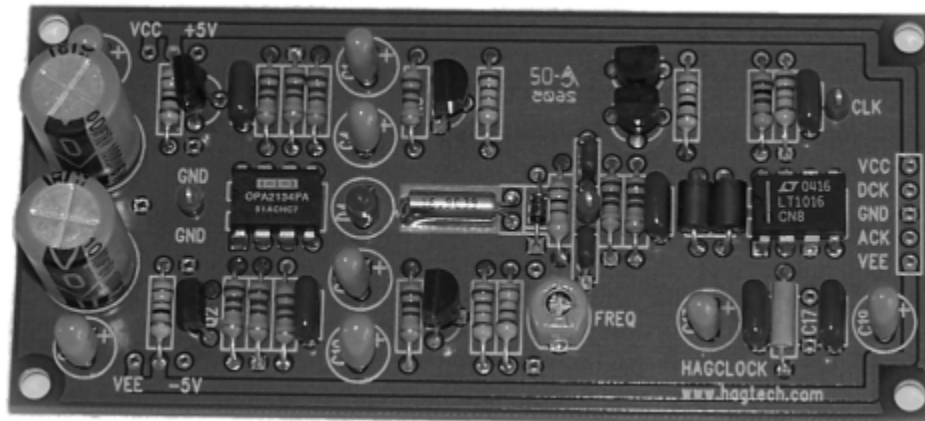
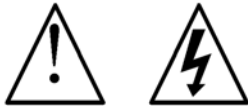




# HagClock

Reference Oscillator





## Warnings

This product uses no lethal or dangerous voltages. However, installation into a CD player or transport can be hazardous. The instructions in this manual are a suggested guide only and Hagerman Technology LLC assumes no liability.

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# 1 Before You Begin

## Description

Congratulations! You have just purchased one of the highest performance-per-dollar audiophile products available. The HagClock is a super-low jitter reference oscillator replacement for CD players and transports. It uses special low noise regulators to drive a pure sinewave oscillator (tuned high-Q) and squaring comparator. Careful attention has been paid to power supply filtering, decoupling, and ground planes to insure the cleanest possible output. Impedance matching and use of a twisted pair transmission line delivers a high fidelity and ripple-free clock waveform right where it is needed.

The HagClock is designed to be exceptionally easy to construct and install by the average DIYer. There are only four wires to attach. The half-kit consists of a blank circuit board and these plans, remaining components must be purchased from DigiKey.

## Features

- Ultra-low jitter output
- Built-in super-regulators
- Easy installation
- Crystal selectable frequency

## Tools

This is a kit product and only skilled electronic technicians should attempt construction and installation. You will need an array of shop tools and a good soldering iron.

## Your CD Transport

Make sure you have located the oscillator section within your CD transport. You will need to identify the integrated circuit (download data sheet from Internet), the crystal, and loading capacitors. Note operating frequency stamped on crystal. You will also need to locate analog power supply taps within the transport, i.e. +12V and -12V (usually found on the opamp in output stage).

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# 2 Parts to Buy

## Kit

If you purchased a factory assembled HagClock, skip to Chapter 4. It is recommended you read this entire manual before starting.

## Modifications

HagClock can be built for 11.2896MHz, 16.9344MHz, or 27.0000MHz. Buy only the crystal you need. The circuit can also operate at other frequencies, contact factory for additional information. If you have no frequency meter, replace the adjustable capacitor with a fixed 39pF.

## Parts List

Parts should be ordered directly from [www.digikey.com](http://www.digikey.com). If you want #4 standoffs for mounting to a chassis, buy #2202K.

Component	Qty	DigiKey	References
1000uF 16V	2	P10253	C2, C6
10uF 16V tant	8	478-1839	C1, C4, C5, C8, C9, C10, C13, C19
10pF	1	399-4198	C17 <sup>2</sup>
39pF	1	399-4238	C15 <sup>3</sup>
47pF	2	399-4239	C11, C16
50pF var	1	490-1974	C15 <sup>3</sup>
100nF	10 <sup>1</sup>	P4525	C3, C7, C12, C14, C18, C20
10uH	1	DN2544	L2 <sup>4</sup>
Bead	10 <sup>1</sup>	P9820BK	L1, L3
Crystal 11.2896M	1	300-5020	Y1 <sup>4</sup>
1N4148	1	1N4148FS	D3
LED	1	160-1142	D4
LM385	2	296-9559-5	D1, D2
OPA2134	1	OPA2134PA	U1
LT1016	1	MAX913CPA	U2
ZTX449	1	ZTX449	Q1
ZTX549	1	ZTX549	Q2
2N5486	2	2N5486GOS	Q3, Q4
22	5 <sup>1</sup>	22QBK	R1, R12, R13
100	5 <sup>1</sup>	100QBK	Rin
150	5 <sup>1</sup>	150QBK	R16
330	5 <sup>1</sup>	330QBK	R19, R20
750	10	750QBK	R3, R4, R5, R6, R7, R8, R9, R11, R14, R15
22k	5 <sup>1</sup>	22KQBK	R2, R10
10M	5 <sup>1</sup>	10MQBK	R17

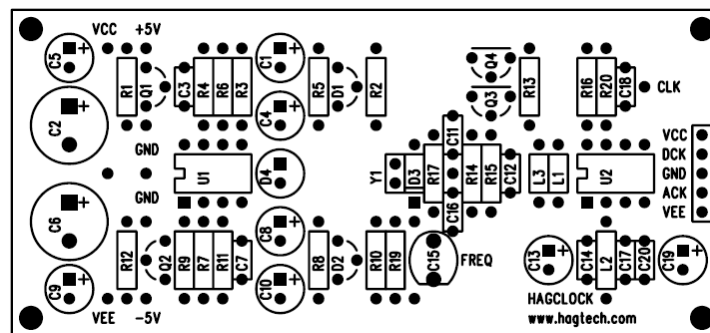
1. Minimum purchased quantity.
2. Used for 11.2896MHz only.
3. If no frequency meter, use 39pF for C15.
4. For 16.9344MHz use #300-5035, for 27.000MHz use #300-8452 (also change L2 to 3.9uH, #DN2534).

# 3 Assembly & Test

## Circuit Board

Assemble in the following order, solder and clip leads before continuing.

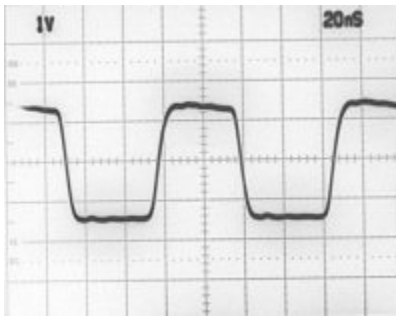
- ❑ Install all resistors.
- ❑ Install inductor and beads.
- ❑ Install crystal. Bend leads over and solder case to ground plane.
- ❑ Install diode.
- ❑ Install sockets.
- ❑ Install small capacitors (non-electrolytic).
- ❑ Install transistors and LM385s.
- ❑ Install large capacitors.
- ❑ Attach wires. Use CAT5 type solid-strand twisted pair wires for the clock output (ACK and GND). Use untwisted wires for VCC and VEE. Wire length should be long enough for proper installation into the transport (cut short later).
- ❑ Optional: soak and brush assembly in 99% isopropyl alcohol to remove solder flux residue (1/2 hour). Rinse with fresh alcohol. Blow dry.
- ❑ Install ICs.



*HagClock circuit board.*

## Testing & Calibration

Double-check all of your work before applying power. Connect VCC, VEE, and GND to a +/-12V power supply source (can be anywhere from +/-8V to +/-15V). LED should turn on. Measure +/-5V outputs using a DVM. If you have a high-speed oscilloscope or frequency counter, measure the ACK (ac-coupled clock) output. It should appear as below.



*Output waveform.*

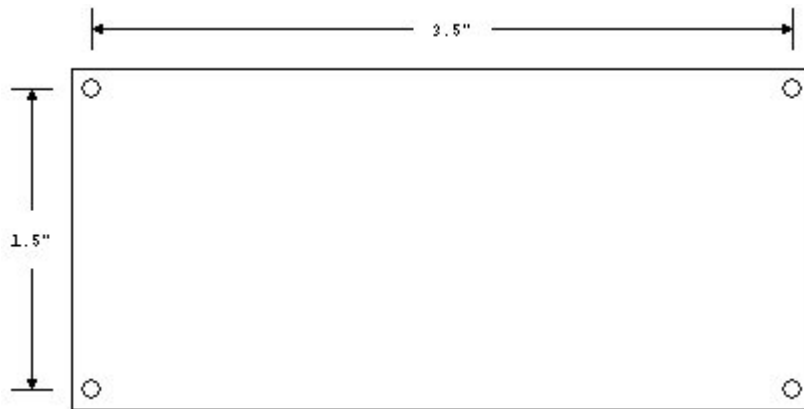
- Adjust C15 for nominal frequency.

If you only have a DVM, the voltage across R13 should be in the range of 50mV to 60mV. If much higher, then the oscillator may not have started. You can also measure the CLK test point; it will read mid-range if the output is oscillating (2V).

# 4 Installation

## Mounting

Find a location within the chassis where the HagClock can be mounted. It should be as close to the original oscillator as possible. The shorter the twisted pair transmission line, the better.



*Mounting hole drill guide.*

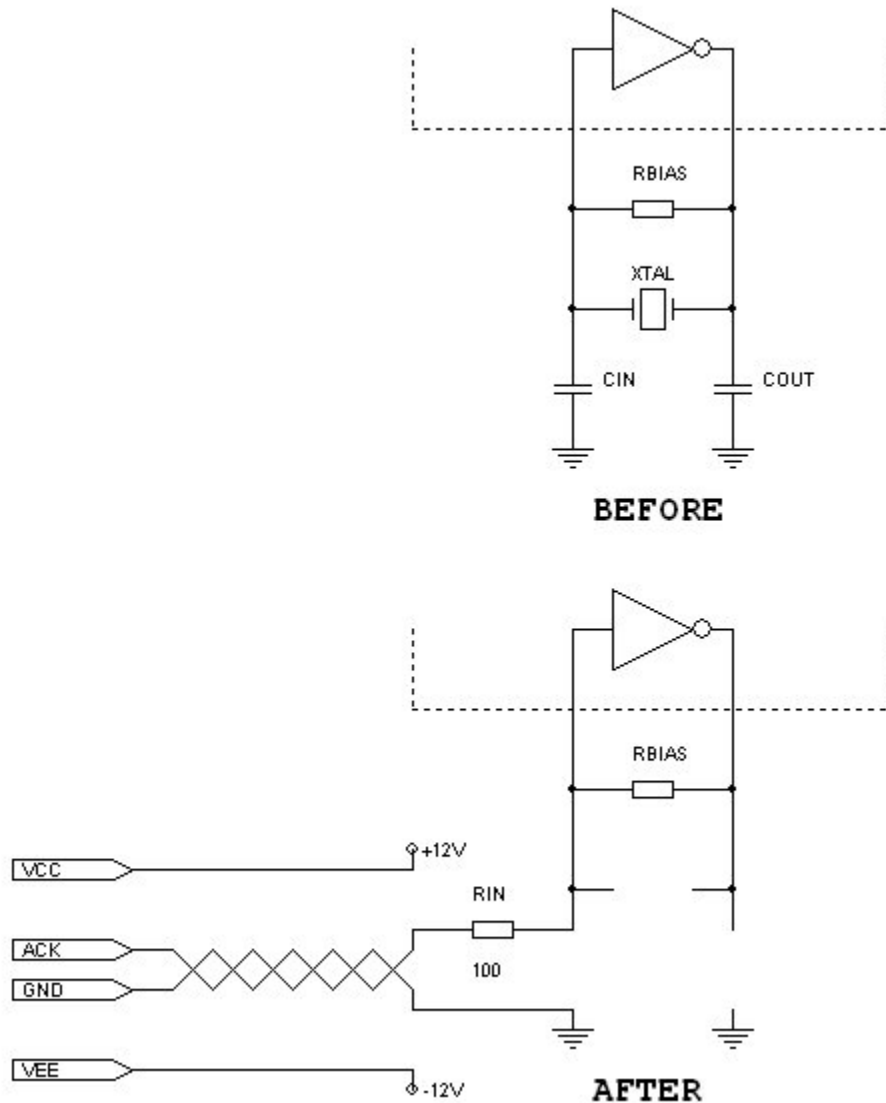
## Wiring

Identify the original crystal oscillator components in the CD transport. Some of them will have to be removed to install the HagClock. Download the data sheet for the audio processor IC from the Internet. Use it to determine oscillator input and output pins. This should help you recognize the oscillator components RBIAS, XTAL, CIN, and COUT (sometimes RBIAS is internal to the IC).

Many modern transports will use surface mount components. It is easier to remove these with two soldering irons, one on each side of the component as you lift it off. Save any removed parts in case you want to restore the original configuration.

Find the +/-12V (or similar) analog supplies within the CD transport. If a player, then the opamp in the output stage will be a good pickoff spot.





*CD transport oscillator modifications, wiring.*

- ❑ Remove XTAL, CIN, and COUT. Save them!
- ❑ Solder one lead of a 100 ohm resistor to the input of inverter (top of CIN).
- ❑ Trim twisted pair wires to proper length. Solder the GND lead to the bottom of CIN, the ACLK lead to the 100 ohm resistor. Keep lead length to a minimum.
- ❑ Solder VCC and VEE wires to their respective locations.

## Operation

The transport is now ready for action. Check to see if it operates correctly. Re-check the HagClock supply voltages and output with a DVM. Make sure the +/-12V supplies have not been affected by the additional loading.

The turn-on delay of HagClock is a relatively long 100ms. Clock must be stable before the RESET line of the processor is released. If this is a problem, you can either modify the reset circuit (not likely) or replace C4 and C8 with the leftover 100nF capacitors.

# 5 Specifications

The following specifications are subject to change without notice.

Item	Specification
Frequency	+/-10ppm (adjustable)
Rise/Fall Time	<5ns (20% to 80%)
Jitter	<5ps rms?
Startup Delay	<100ms
Size (PCB)	3.7" x 1.7"
Input Voltage	+/-8V to +/-15V
Input Current	+45mA, -20mA

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# 6 Warranty & Service

## Warranty

Hagerman Technology LLC warrants this product free of defects in materials and workmanship for 10 years. If you discover a defect, Hagerman Technology LLC will, at its option, repair or replace the product at no charge to you provided you return it during the warranty period, transportation charges prepaid to Hagerman Technology LLC. This warranty does not apply if the product has been damaged by negligence, accident, abuse or misuse or misapplication, has been damaged because it has been improperly connected to other equipment or has been modified without the express written permission of Hagerman Technology LLC. This warranty is limited to the replacement or repair of this product and not to damage to equipment of other manufacturers.

Any applicable implied warranties, including warranty of merchantability, are limited in duration to a period of the express warranty as provided herein beginning with the original date of purchase and no warranties, whether express or implied shall apply to the product thereafter.

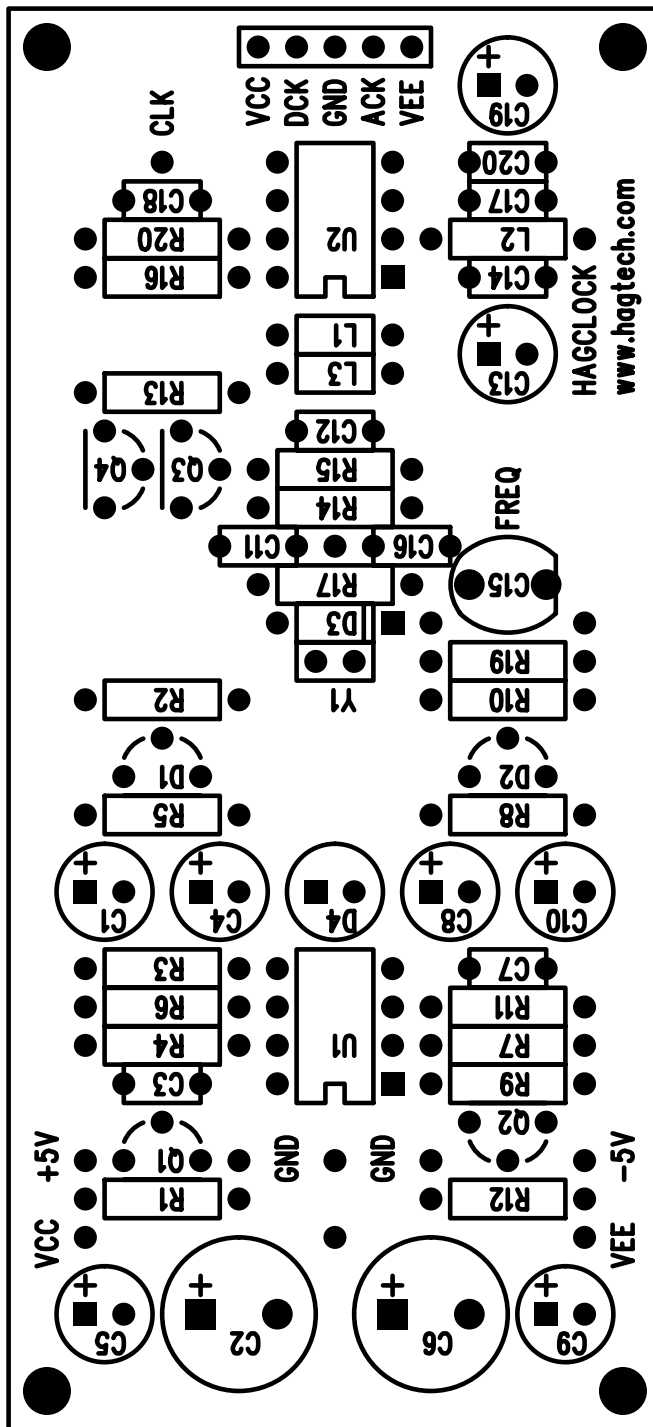
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## Service

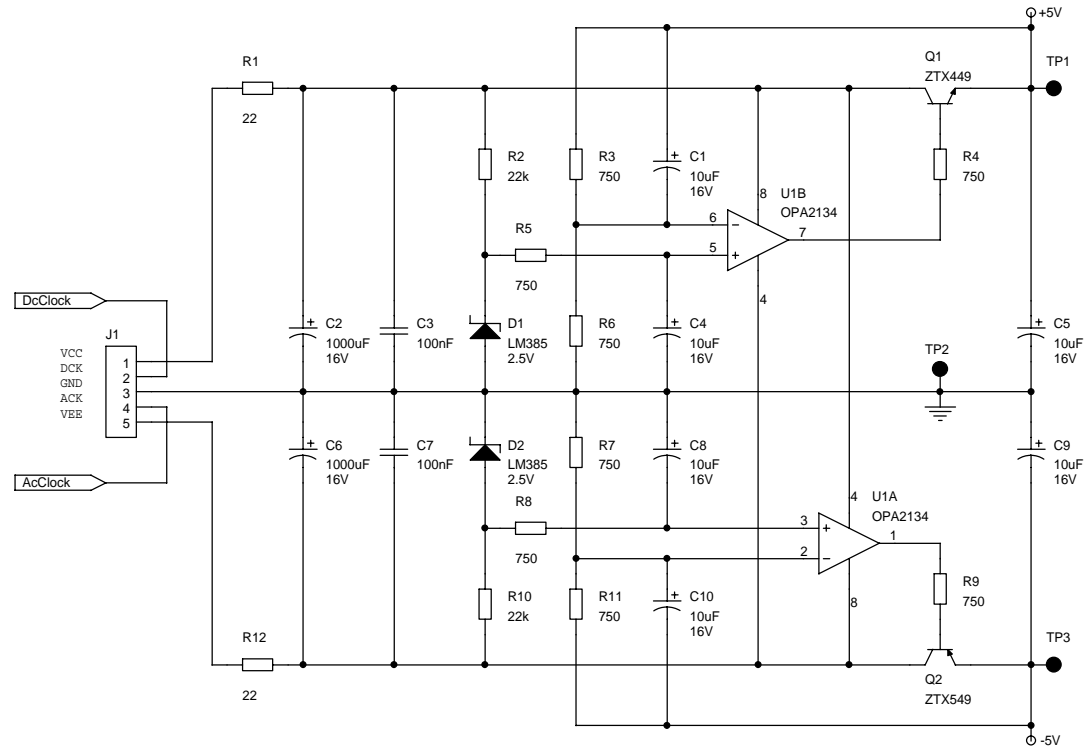
Refer to Chapter 4 for troubleshooting information. If the problem persists, contact Hagerman Technology for service at **[www.hagtech.com](http://www.hagtech.com)**.

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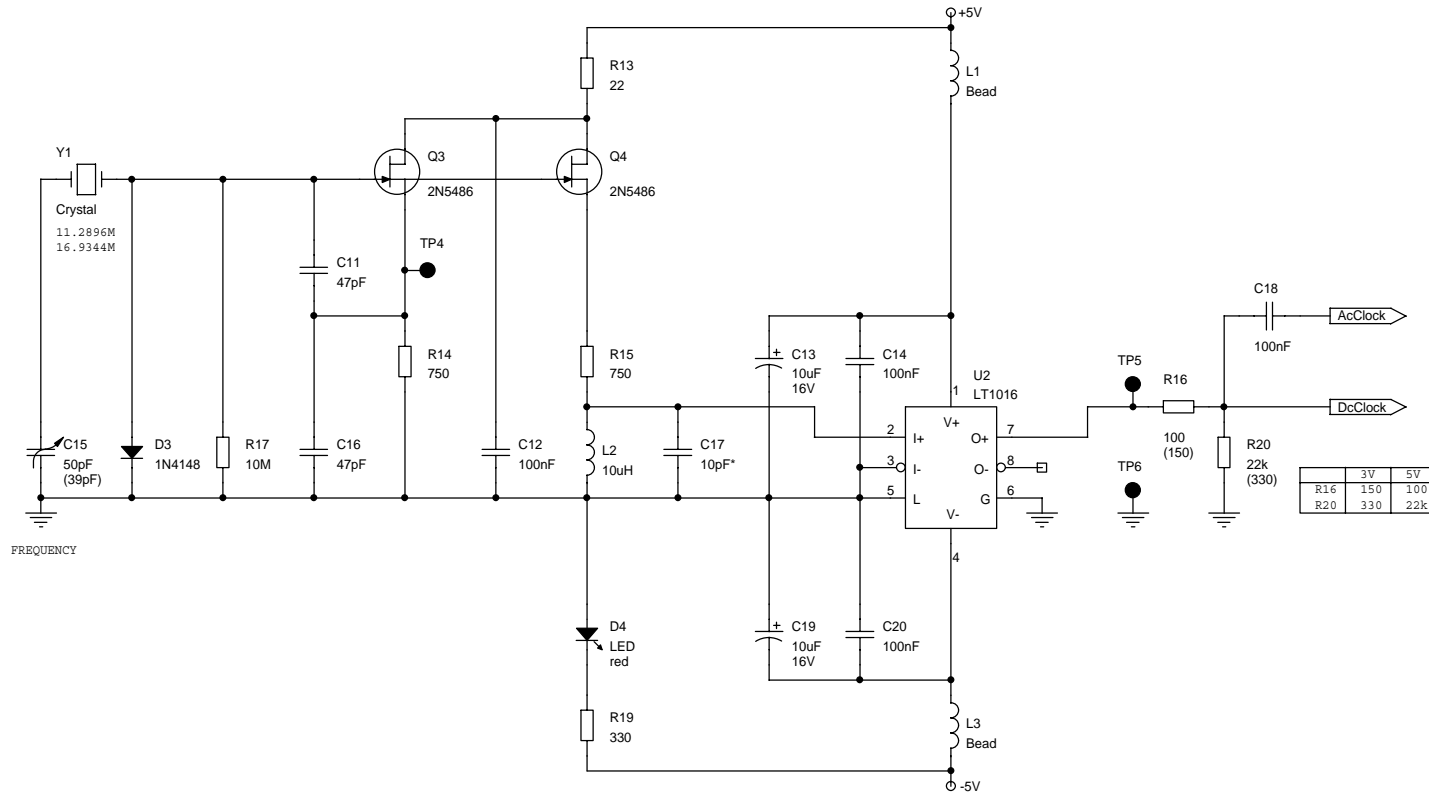


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P.O. Box 26437 Honolulu, HI 96825		
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<b>Constructor: HagClock Regulators</b>		
Size	Document Number	Rev
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Date:	Friday, June 24, 2005	Sheet 1 of 2

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