ANALOGIC®

AH50008

8-Bit 90 MHz Video D/A Converter

Performance Features

The AH50008 is a complete 8-bit composite video D/A converter subsystem with 90 MHz update rate and military operating temperature range of −55°C to +125°C. The AH50008 is designed for monochromatic and color video applications, such as radar systems or engineering workstations. With an hermetically sealed ceramic package and a wide temperature range, the AH50008 is the converter of choice for display systems designed for harsh environments.

The AH50008 is easy to use, with TTL compatible inputs and RS170A/RS343A compatible output. The AH50008 accepts 8-bit digital video data plus sync, blanking, and 10% overbright control inputs and produces a composite video output capable of directly driving a 75Ω coaxial cable with a 1.064V peak-to-peak signal at a 90 MHz update rate. No additional amplifiers are required. The AH50008 offers high speed settling time of 7.5 ns, a glitch settling time of 3 ns, and a maximum rise and fall time of 4 ns. This video D/A converter exhibits sufficiently low glitch impulse at code transitions so that no further processing of the output is required.

Packaged as a 24-pin dual-in-line hybrid, the AH50008 consumes only 1.15W, improving reliability over the life of the device. With its high reliability, low power, and "glitch-free" performance, the AH50008 is ideally suited for military applications. In addition, Analogic individually tests each unit to ensure that every AH50008 that is shipped meets or exceeds its stringent design specifications.

Custom versions are available; for example, to drive two 75Ω cables or to drive a long cable with an extended output voltage range. Please consult the factory.

Features

- **Military Temperature Range**
- **Hermetically Sealed Ceramic Package**
- **256 Gray Scale Levels**
- **Low Power (1.15W)**
- **Complete TTL Compatible Video D/A Subsystem**
- **Up to 90 MHz Update Rate**
- **"Glitch-free" Performance**
- **Fast Full Step Settling Time (7.5 ns)**
- **Excellent Differential Linearity (± 0.5 LSB)**
- **RS170A/RS343A Compatible Output**
- **Direct Drive to 75Ω Coaxial Cable/Monitor**
- **Monotonicity Guaranteed**
- **Standard Size 24-Pin DIP**

Applications

- **Display Systems Designed for Harsh Environments**
- **CAD/CAM Display Systems**
- **Monochrome or Color Display Systems**
- **Radar Systems**
- **Image Processing Systems**
- **Workstations**
- **"Quick Look" Display Systems**

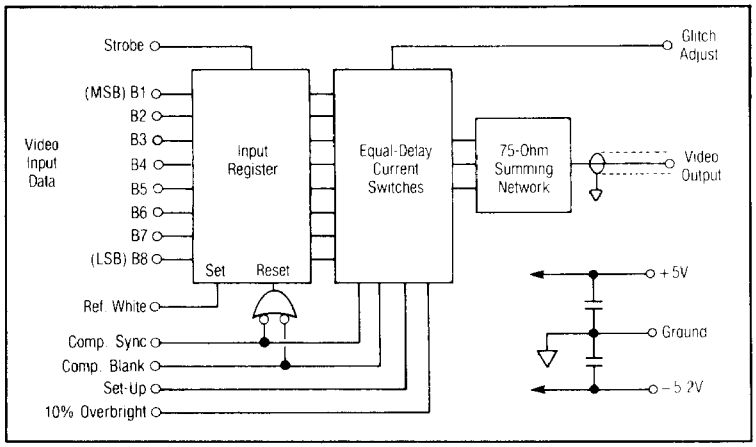


Figure 1. AH50008 Functional Block Diagram.

Specifications[1]

ANALOG OUTPUT

Composite Video
0V to − 1.064V; ± 3% into 75Ω termination

Gray Scale
− 0.064V to − 0.707V; ± 3% into 75Ω termination

Recommended Load Impedance
75Ω, dc to 50 MHz

Source (Thevenin) Impedance
75Ω, dc to 50 MHz

LSB Size
2.51 mV, nominal

Rise and Fall Time
3 ns, typ.; 4 ns Max. (10% to 90%)

Full Step Settling Time
7.5 ns, Typ., to 1 LSB (0.4% FSR)

Glitch Settling Time
3 ns to < 1 LSB for worst MSB transition

Glitch Area
35 pV·s, Typ.; 75 pV·s Max.

Glitch Adjust
Input Impedance
7.5 kΩ

Control Sensitivity
50 pV·s/V

Compliance Voltage
− 1.1V to + 1.1V

Cable Drive Capacity
75Ω characteristic impedance

Composite Sync Level
− 1.064V with standard setup
− 0.286V (− 40 IRE units)[2] with respect to blanking level (back porch)

Composite Blanking Level
− 0.778V with standard setup

10% Overbright Level
Logic "0" at 10% Overbright
+ 0.064V (referenced to output)

Logic "0" at 10% Overbright and Reference White
0V

DIGITAL INPUTS

Logic Levels
Logic "0"
+ 0.8V Max.

Logic "1"
+ 2.0V Min.

Rise and Fall Time
10 ns Max. (10% to 90%)

Data
8 TTL Compatible Inputs

Loading
2 TTL Loads

Validity
Data must be valid 2.0 ns Min. prior to strobe and remain valid for 1.5 ns after data is strobed

Update Rate
90 MHz

Strobe Input
Data entered on positive-going edge

Strobe Pulse Width
5 ns Min.

Setup (Reference Black To Blanking)
Input Open
Standard 71 mV (10 IRE units)

Input to − 5.2V
142 mV (20 IRE units)

Input to Ground
0 mV (0 IRE units)

Loading
Input to Ground
26 mA

Input to − 5.2V
− 15 mA

Composite Sync Level
Logic "0" on Sync and Blanking inputs simultaneously resets the input register to 0000 0000 and drives the output to − 1.064V

Composite Blanking Level
Logic "0" on this input simultaneously resets the input register to 0000 0000 and drives the output to − 0.778V

Reference White Level
Logic "0" on this input simultaneously sets the input register to 1111 1111 and drives the output to − 0.064V

10% Overbright Level
Logic "0" on this input shifts output level by + 0.064V. Logic "0" on this input and on Ref. White input drives output to 0V

TRANSFER CHARACTERISTICS

Resolution
8 bits, 256 Gray Scale Levels

Coding
Binary

Reference White Level
1111 1111 produces − 0.064V absolute; + 0.714V (100 IRE units) relative to blanking level with standard setup; + 0.643V relative to reference black

Reference Black Level
0000 0000 produces − 0.707V absolute; + 0.071V (10 IRE units) relative to blanking level with standard setup

Differential Linearity
± 0.5 LSB Max.

Monotonicity
Guaranteed

Offset (dc Output with 10% Overbright Actuated)
± 0.5 LSB

Offset Tempco
– 55°C to 25°C
10 μV/°C
25°C to 80°C
100 μV/°C
80°C to 125°C
1 mV/°C

Transfer Gain (Slope) Tempco
± 0.15% FSR/°C

Propagation Delay
7 ns, Strobe to Output, 50% points

Control Input Speed (Sync, Blanking, Reference White, and 10% Overbright)
10 ns to settle to 10% of final value

POWER REQUIREMENTS

Supply Range
+ 5V Supply
4.75V Min., + 5.25V Max. (50 mV p-p ripple Max.)
– 5.20V Supply
– 4.75V Min., – 5.5V Max. (5 mV p-p ripple Max.)
+ 5V Current Drain
22 mA Typ.
– 5.20V Current Drain
200 mA Typ.
Power Consumption
1.15W Typ.

ENVIRONMENTAL & MECHANICAL

Temperature Range
Rated Performance
– 55°C to + 100°C
Operating
– 55°C to + 125°C
Storage
– 55°C to + 150°C
Dimensions
0.785" x 1.32" x 0.20"
(19.94 mm x 33.53 mm x 5.08 mm)

Notes
1. Unless otherwise noted, all specifications apply at 25°C. Supplies are + 5V, – 5.20V.
2. 1 IRE unit is 7.14 mV.

Principles of Operation

As shown in the Timing Diagram in Figure 2, eight bit TTL digital data presented to the AH50008 on the data inputs are latched into the input register at the rising edge of the STROBE pulse applied to the STROBE control input. The outputs of the register drive high speed switches that steer current into a summing network with an output impedance of 75Ω, developing a 1 Vp-p signal directly. Due to the extremely small differential delay among the eight data channels, the code switching output glitches are invisible even on the best video monitor.

Digital control inputs for REFERENCE WHITE, SYNC, BLANKING and 10% OVERBRIGHT are provided. A logic 0 on the REF.

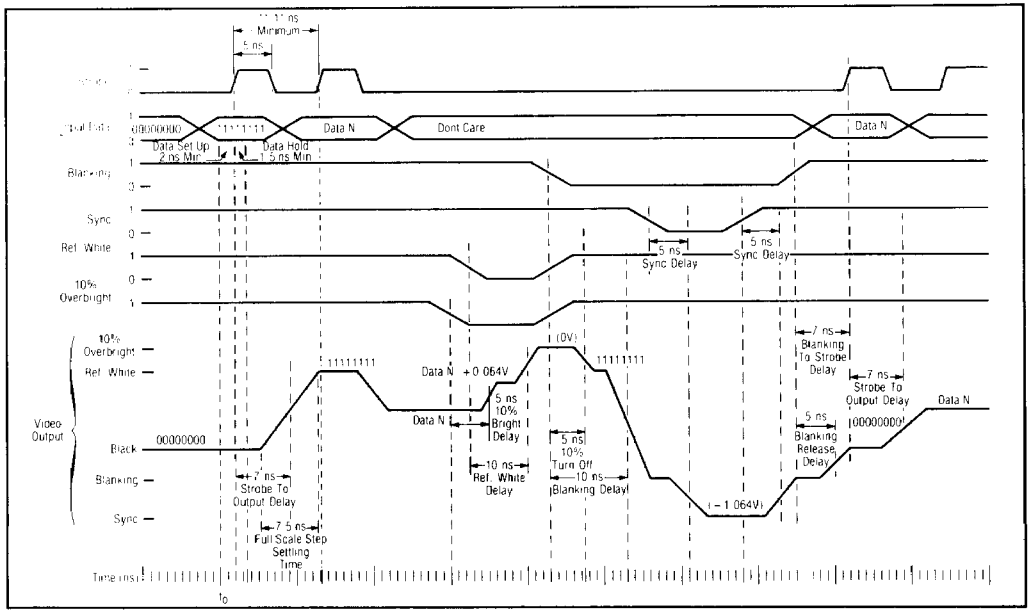


Figure 2. AH50008 Typical Timing Diagram.

WHITE input sets the registers and drives the output to −0.064V. Logic 0 on 10% OVERBRIGHT increases the output by 0.064V. Used in conjunction with REF. WHITE, all registers are set and the output is driven to 0V. Logic 0 on the BLANKING and SYNC (plus BLANKING) inputs resets the registers and drives the output to −0.778V and −1.064V, respectively. Combinations of BLANKING/SYNC and REF. WHITE should be avoided. While no damage will result, active levels on both control lines may cause an indeterminate output.

The condition of the SETUP line determines the relative levels between Reference Black and the Blanking level — left open, the standard 71 mV (10 IRE units) is produced; tied to −5.2V, 142 mV (20 IRE units) is produced; tied to ground, 0 mV (0 IRE units) is produced. (See Figure 4).

Power Supply Requirements

The AH50008 requires both +5V ±5% and −5.20V (−4.75V to −5.5V operating range) power supplies. The output amplitudes specified are nominal values based on a −5.20V supply and will change in proportion to the −5.20V supply voltage.

Glitch Adjust

The glitch area will also vary as a function of the −5.20V supply voltage. The factory trim is normally carried out at −5.20V and may be done at another voltage if specified when ordering.

If other than −5.20V is used with a unit trimmed for −5.20V operation, provisions should be made on the PC board for a 10 kΩ potentiometer connected to the GLITCH ADJUST terminal as shown in Figure 3). The pot should be adjusted to reduce the glitch area to a minimum.

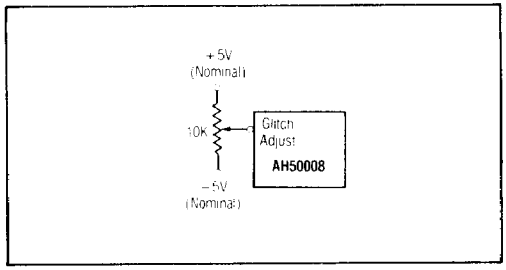


Figure 3. Glitch Adjust.

Signal	Active Logic Level	Resultant Output
Data Bit 1 – Bit 8	000 000 00 111 111 11	−0.707V (Ref. Blk) −0.064V (Ref. Wht)
Strobe	↑	Data Loaded
Ref. White	0	−0.064V
Comp. Blank	0	−0.778V
10% Overbright	0	Vout +0.064V
10% + Ref. White	0	0V
Comp. Sync + Blanking	0	−1.064V
Setup	Open	71 mV (10 IRE)
	−5.2V	142 mV (20 IRE)
	Gnd	0 mV (0 IRE)

Figure 4. AH50008 Control Signals.

Current Output

The AH50008 can be used as a current output device by connecting the inverting input of an op-amp to the AH50008 output and then selecting the appropriate op-amp feedback resistor for the voltage output required by the application.

Cursor

To produce a cursor on a display, both 10% OVERBRIGHT and REF. WHITE should brought to a logic "0" which will drive the output to 0V. If 10% OVERBRIGHT only is brought to logic "0", the output of the AH50008 will increase +0.064V above its prior output.

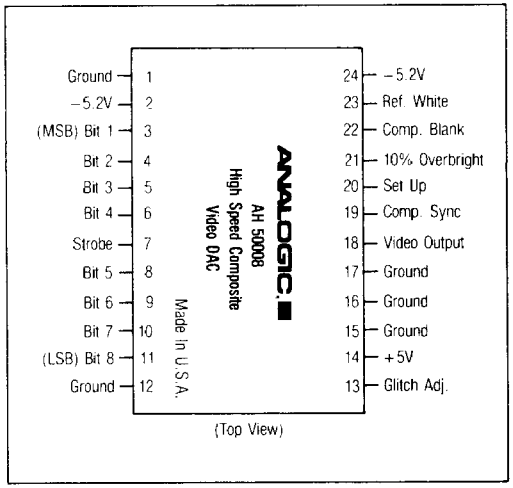


Figure 5. AH50008 Pinout.

Color Graphic Systems

The AH50008 is ideally suited for both monochrome composite video and RGB color applications. Normally only one channel (the green) carries the BLANKING and SYNC signals. For use in the other channels of such systems, the BLANKING and SYNC lines of the AH50008 can be disabled by tying them to logic "1".

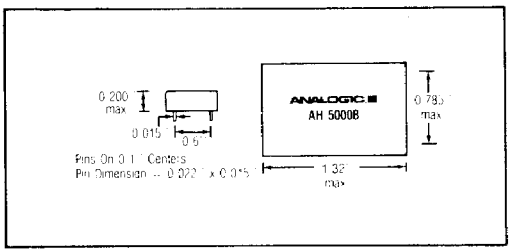


Figure 6. AH50008 Mechanical.

The Video Signal

The EIA Standards RS170 and RS343 define the video signal in detail and refer to the IRE units for measuring the various components of the signal. The total peak amplitude of the standard video signal, from the maximum white level to the sync level, is 140 IRE units. The standards further define the video signal as 1 Vp-p; therefore, 1 IRE unit is 7.14 mV. The maximum white level is the most positive amplitude of the video signal, and sync the most negative; this is referred to as a black-negative (as opposed to a black-positive) video signal. The illustration in Figure 7 depicts the composite video signal produced by the AH50008.

The AH50008 provides a 10% Overbright feature which causes a negative shift in all of the various levels (i.e. Reference White, Reference Black, Blanking and Sync) by approximately 9 IRE units. The relative number of IRE units between each of these levels is compatible with the EIA Standards. As the definitions are given for the various levels in the AH50008 composite signal, it should be remembered that they differ from the standard RS170/RS343 absolute levels by 9 IRE units (0.064V).

The most positive amplitude level is the 10% Overbright. As its name implies, this level is higher than the whitest level of the picture information by 10% of the signal or 0.064V (10% of 0.643V). This level is most often used to define a cursor on a display screen. By making the cursor 10% brighter than the remainder of the picture, it can be located easily. REFERENCE WHITE is the most positive amplitude of the normal picture information, while REFERENCE BLACK is the most negative. The span of signal from

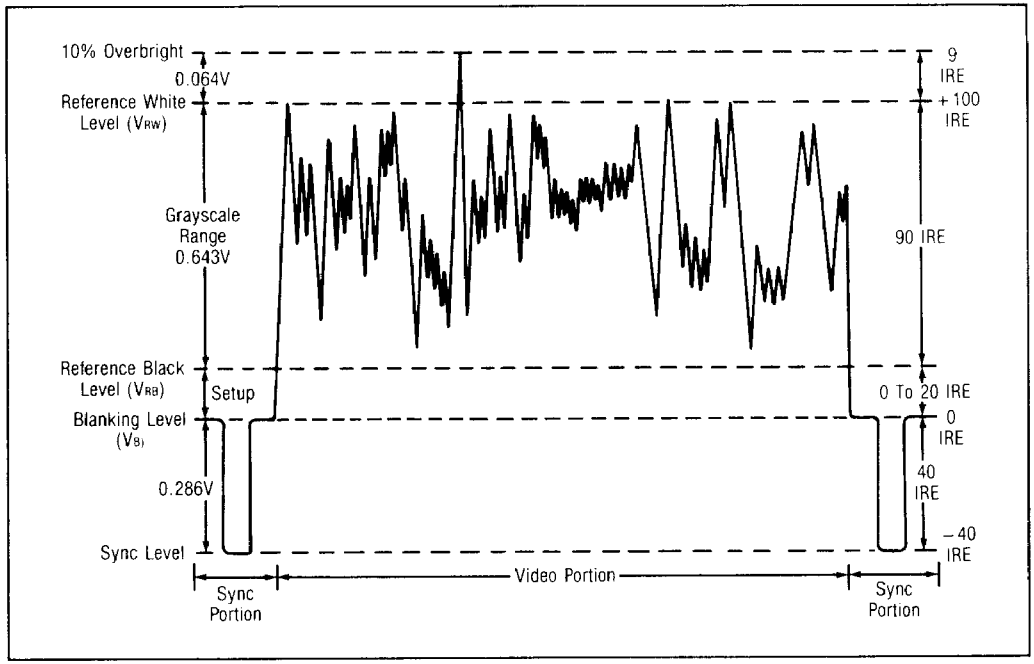


Figure 7. The Composite Video Signal (Not to Scale).

REFERENCE WHITE to REFERENCE BLACK is 90 IRE units or 0.643V. This span is divided into 256 discrete levels (gray scale) because of the 8-bit resolution of the AH50008.

The BLANKING LEVEL is 10 IRE units below REFERENCE BLACK in a standard video signal and is the voltage level that will completely cut off the display screen. The AH50008 provides a means of varying the relative distance between the REFERENCE BLACK and BLANKING LEVEL, referred to as the setup. The SETUP pin on the AH50008 can be programmed to provide a set-up of 0 mV, 71 mV or 142 mV (0 IRE, 10 IRE or 20 IRE units). Left open, the standard setup of 71 mV (10 IRE units) is produced. Tied to −5V, 142 mV (20 IRE units) is produced; tied to ground, 0 mV (0 IRE units) is produced. The BLANKING LEVEL is also referred to as the PEDESTAL, BACK PORCH or FRONT PORCH.

The most negative amplitude of the video signal is the SYNC LEVEL at −40 IRE (−0.286V) below the BLANKING LEVEL. Relative to 10% OVERBRIGHT, this level is −1.064V. The SYNC level is used to synchronize the scanning circuits in the display system. It is this sync level (along with BLANKING) produced directly by the AH50008 that provides the composite video signal.

All of the above definitions apply to both monochrome and color (RED/BLUE/GREEN) display systems. In color systems, the composite signal is produced on only one channel (usually the green). The other two DACs producing the Red and Blue video have the Sync and Blanking levels disabled by tying them to logic 1.

Typical Application

An example of a video display subsystem using the AH50008 is shown in Figure 8. The memory and monitor circuits are not discussed in any detail, since system requirements vary. It is assumed that eight bits of digital data are available from some TTL source for use by the AH50008 and that a monitor or sinx/x filter is being driven by the AH50008. If fewer than eight bits are used, tie the unused LSBs to logic 0. Any AH50008 control signals not required in a particular system application should be tied to logic 1 to prevent erroneous operation.

Timing for the overall display subsystem is derived from the system Master Clock. Through a suitable divider chain, a frequency of 2.04 MHz is generated and applied to the clock input of the 3262A Sync Generator IC or equivalent. From this clock signal, the 3262A generates the Sync and Blanking signals. The Composite Sync and Blanking Signals are applied to the corresponding control inputs on the AH50008. The Sync and Blanking signals are also sent to the Memory System for use by the Memory Address logic if required. The 3262A produces a timing signal which is valid during the Vertical Interval at the start of the odd Field for interlaced systems. This signal may be used to control Memory addressing.

In most systems the "setup" level is left at one particular value such as the Standard 71 mV. In rare cases where application requires it, the setup level can be controlled digitally by means of a DAC with either current or voltage output. If the SETUP pin is driven as a voltage point, values from −1 to −5V will produce 0 to 10 IRE units, respectively. If a current is injected into the SETUP pin, approximately 11 mA is needed to produce 0 IRE units.

When connecting the AH50008's composite video output to the (75Ω-terminated) video input of the monitor, the length of coax cable should be limited to prevent the dc resistance of the cable run from exceeding 7.5Ω. The signal will then be attenuated by 10% or less. A longer length cable can be used, but the output will be attenuated. If an amplifier is used between the AH50008 output and the monitor, a longer length of cable can be used without attenuation.

The AH50008 is normally used in Digital Display applications. It can, however, be used for broadcast applications in which case additional circuitry is required in order to comply fully with EIA Industrial Tentative Standard No. 1 (part of RS170A). This standard details the exact waveform and timing characteristics of the broadcast composite video signal. The additional circuitry would, at a minimum, provide sin x/x correction and bandwidth filtering. In addition, the SETUP on the AH50008 should be changed to 7.5 IRE units by placing a nominal 560Ω resistor between the SETUP terminal and ground.

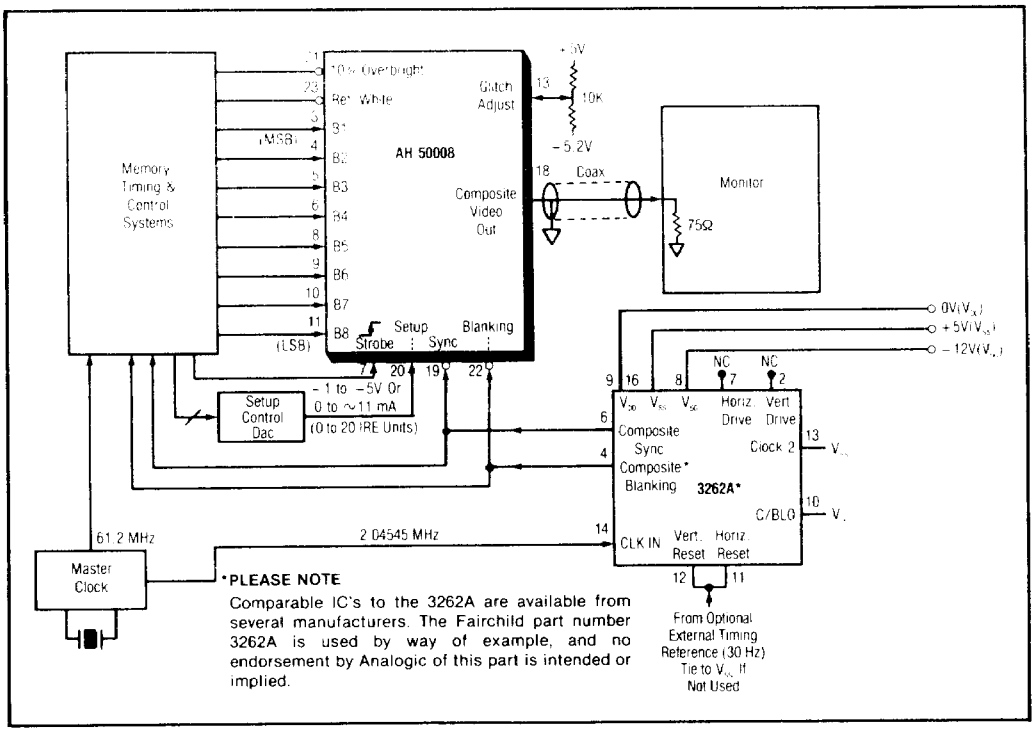


Figure 8. Typical AH50008 Application.

ORDERING GUIDE

90 MHz 8-Bit Hermetically Sealed Video DAC
– 55°C to + 125°C Operating Temperature Range
Specify **AH50008**

For different voltage levels or other custom variations, consult factory.

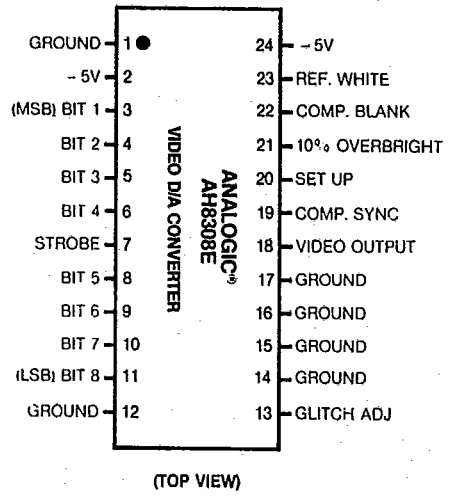
T-51-09-08

The Video Signal (cont.)

The most negative amplitude of video signal is the SYNC LEVEL at −40 IRE (0.286V) below the BLANKING LEVEL. Relative to 10% OVERBRIGHT, this level is −1.064V. The SYNC level is used to synchronize the scanning circuits in the display system. It is this sync level (along with BLANKING) produced directly by the AH8308E that provides the composite video signal.

All of the above definitions apply to both monochrome and color (RED/BLUE/GREEN) display systems. In color systems, the composite signal is produced on only one channel (usually the green). The other two DACs producing the Red and Blue video have the Sync and Blanking levels disabled by tying them to logic 1.

PINOUT

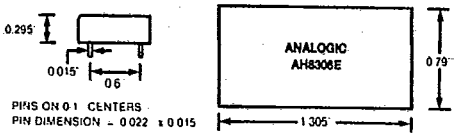


(TOP VIEW)

Available Options

The AH8308E is normally supplied with eight DATA INPUTS, STROBE, REFERENCE WHITE, 10% OVERBRIGHT, BLANKING and SYNC control inputs, capable of driving a 75 ohm terminated monitor. We invite inquiries on modifications such as dual monitor capability, REFERENCE BLACK CONTROL and other custom requirements.

MECHANICAL



CONTROL SIGNALS

SIGNAL	ACTIVE LOGIC LEVEL	RESULTANT OUTPUT
DATA. BIT 1—BIT 8	000 000 00	−0.707V (REF. BLK)
	111 111 11	−0.064V (REF. WHT)
STROBE	⌐¯_	DATA LOADED
REF. WHITE	0	−0.064V
COMP. BLANK	0	−0.778V
10% OVERBRIGHT	0	0V
COMP. SYNC	0	−1.064V
SETUP	OPEN	71 mV (10 IRE)
	−5.0V	−142 mV (20 IRE)
	GND	0 mV (0 IRE)

ORDERING GUIDE

150 MHz 8-Bit ECL Video DAC...

Specify **AH8308E**