Video analog input interface TDA8708A

FEATURES

- 8-bit resolution
- Sampling rate up to 32 MHz
- Binary or two's complement 3-state TTL outputs
- TTL-compatible digital inputs and outputs
- Internal reference voltage regulator
- Power dissipation of 365 mW (typical)
- Input selector circuit (one out of three video inputs)
- Clamp and Automatic Gain Control (AGC) functions for CVBS and Y signals
- No sample-and-hold circuit required.
- The TDA8708A has white peak control in modes 1 and 2 whereas the TDA8708B has control in mode 1 only.

APPLICATIONS

- Video signal decoding
- Scrambled TV (encoding and decoding)
- Digital picture processing
- Frame grabbing.

GENERAL DESCRIPTION

The TDA8708A is an analog input interface for video signal processing. It includes a video amplifier with clamp and gain control, an 8-bit analog-to-digital converter (ADC) with a sampling rate of 32 MHz and an input selector.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	MIN.	TYP.	MAX.	UNIT
V_{CCA}	analog supply voltage	4.5	5.0	5.5	V
V_{CCD}	digital supply voltage	4.5	5.0	5.5	V
V_{CCO}	TTL output supply voltage	4.2	5.0	5.5	V
I_{CCA}	analog supply current	–	37	45	mA
I_{CCD}	digital supply current	–	24	30	mA
I_{CCO}	TTL output supply current	–	12	16	mA
ILE	DC integral linearity error	–	–	±1	LSB
DLE	DC differential linearity error	–	–	±0.5	LSB
$f_{clk(max)}$	maximum clock frequency	30	32	–	MHz
B	maximum −3 dB bandwidth (AGC amplifier)	12	18	–	MHz
P_{tot}	total power dissipation	–	365	500	mW

ORDERING INFORMATION

TYPE NUMBER	PACKAGE			
	PINS	PIN POSITION	MATERIAL	CODE
TDA8708A	28	DIP	plastic	SOT117-1
TDA8708AT	28	SO28L	plastic	SOT136-1

BLOCK DIAGRAM

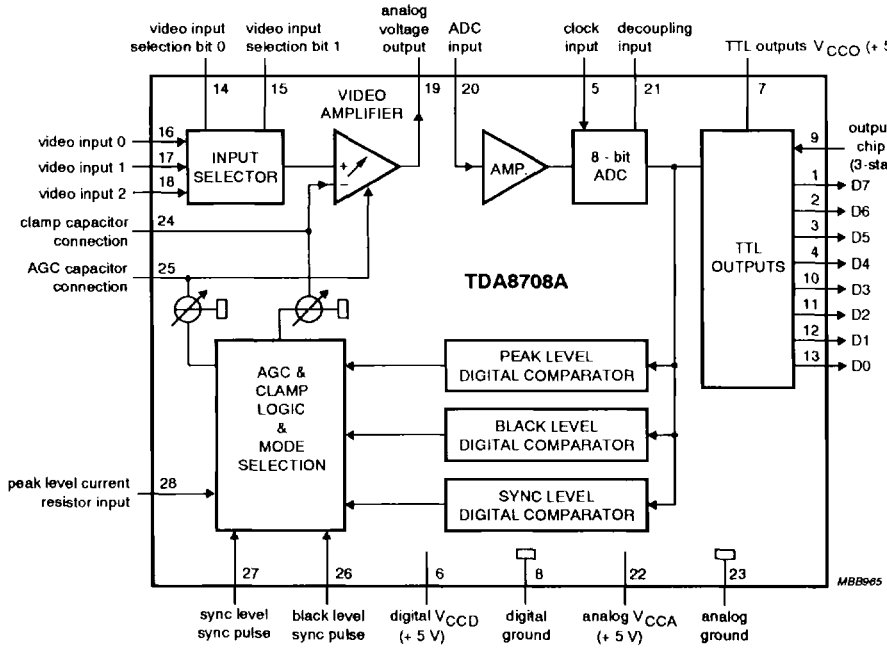

Fig.1 Block diagram.

PINNING

SYMBOL	PIN	DESCRIPTION
D7	1	data output; bit 7 (MSB)
D6	2	data output; bit 6
D5	3	data output; bit 5
D4	4	data output; bit 4
CLK	5	clock input
V_{CCD}	6	digital supply voltage (+5 V)
V_{CCO}	7	TTL outputs supply voltage (+5 V)
DGND	8	digital ground
OF	9	output format/chip enable (3-state input)
D3	10	data output; bit 3
D2	11	data output; bit 2
D1	12	data output; bit 1
D0	13	data output; bit 0 (LSB)
I0	14	video input selection bit 0
I1	15	video input selection bit 1
VIN0	16	video input 0
VIN1	17	video input 1
VIN2	18	video input 2
ANOUT	19	analog voltage output
ADCIN	20	analog-to-digital converter input
DEC	21	decoupling input
V_{CCA}	22	analog supply voltage (+5 V)
AGND	23	analog ground
CLAMP	24	clamp capacitor connection
AGC	25	AGC capacitor connection
GATE B	26	black level synchronization pulse
GATE A	27	sync level synchronization pulse
RPEAK	28	peak level current resistor input

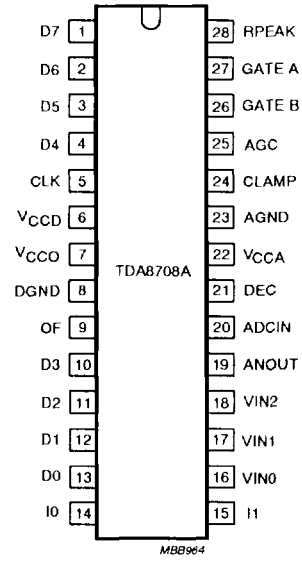

Fig.2 Pin configuration.

FUNCTIONAL DESCRIPTION

The TDA8708A provides a simple interface for decoding video signals.

The TDA8708A operates in configuration mode 1 (see Fig.4) when the video signals are weak (i.e. when the gain of the AGC amplifier has not yet reached its optimum value). This enables a fast recovery of the synchronization pulses in the decoder circuit. When the pulses at the GATE A and GATE B inputs become distinct (GATE A and GATE B pulses are synchronization pulses occurring during the sync period and rear porch respectively) the TDA8708A automatically switches to configuration mode 2 (see Fig.5).

When the TDA8708A is in configuration mode 1, the gain of the AGC amplifier will be roughly adjusted (sync level to a digital output level of 0 and the peak level to a digital output level of 255).

In configuration mode 2 the digital output of the ADC is compared to internal digital reference levels. The resultant outputs control the charge or discharge current of a capacitor connected to the AGC pin. The voltage across this capacitor controls the gain of the video amplifier. This is the gain control loop.

The sync level comparator is active during a positive-going pulse at the GATE A input. This means that the sync pulse of the composite video signal is used as an amplitude reference. The bottom of the sync pulse is adjusted to obtain a digital output of logic 0 at the converter output. As the black level is at digital level 64, the sync pulse will have a digital amplitude of 64 LSBs.

The peak-white control loop is always active. If the video signal tends to exceed the digital code of 248, the gain will be limited to avoid any over-range of the converter.

The use of nominal signals will prevent the output from exceeding a digital code of 213 and the peak-white control loop will be non-active.

The clamp level control is accomplished by using the same techniques as used for the gain control. The black-level digital comparator is active during a positive-going pulse at the GATE B input. The clamp capacitor will be charged or discharged to adjust the digital output to code 64.

LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

SYMBOL	PARAMETER	MIN.	MAX.	UNIT
V_{CCA}	analog supply voltage	−0.3	+7.0	V
V_{CCD}	digital supply voltage	−0.3	+7.0	V
V_{CCO}	output supply voltage	−0.3	+7.0	V
ΔV_{CC}	supply voltage difference between V_{CCA} and V_{CCD}	−1.0	+1.0	V
	supply voltage difference between V_{CCO} and V_{CCD}	−1.0	+1.0	V
	supply voltage difference between V_{CCA} and V_{CCO}	−1.0	+1.0	V
V_I	input voltage	−0.3	V_{CCA}	V
I_O	output current	0	+10	mA
T_{stg}	storage temperature	−55	+150	°C
T_{amb}	operating ambient temperature	0	+70	°C
T_j	junction temperature	0	+125	°C

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient in free air		
	SOT117-1	55	K/W
	SOT136-1	70	K/W

CHARACTERISTICS

$V_{CCA} = V_{22}$ to V_{23} = 4.5 to 5.5 V; $V_{CCD} = V_6$ to V_8 = 4.5 to 5.5 V; $V_{CCO} = V_7$ to V_8 = 4.2 to 5.5 V; AGND and DGND shorted together; V_{CCA} to V_{CCD} = −0.5 to +0.5 V; V_{CCO} to V_{CCD} = −0.5 to +0.5 V; V_{CCA} to V_{CCO} = −0.5 to +0.5 V; T_{amb} = 0 to +70 °C; typical readings taken at $V_{CCA} = V_{CCD} = V_{CCO}$ = 5 V and T_{amb} = 25 °C; unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Supplies						
V_{CCA}	analog supply voltage		4.5	5.0	5.5	V
V_{CCD}	digital supply voltage		4.5	5.0	5.5	V
V_{CCO}	TTL output supply voltage		4.2	5.0	5.5	V
I_{CCA}	analog supply current		–	37	45	mA
I_{CCD}	digital supply current		–	24	30	mA
I_{CCO}	TTL output supply current	TTL load (see Fig.8)	–	12	16	mA
Video amplifier inputs						
VIN(0 TO 2) INPUTS						
$V_{I(p-p)}$	input voltage (peak-to-peak value)	AGC load with external capacitor; note 1	0.6	–	1.5	V
$\|Z_i\|$	input impedance	f_i = 6 MHz	10	20	–	kΩ
C_I	input capacitance	f_i = 6 MHz	–	1	–	pF
I0 AND I1 TTL INPUTS (SEE TABLE 1)						
V_{IL}	LOW level input voltage		0	–	0.8	V
V_{IH}	HIGH level input voltage		2.0	–	V_{CCD}	V
I_{IL}	LOW level input current	V_I = 0.4 V	−400	–	–	μA
I_{IH}	HIGH level input current	V_I = 2.7 V	–	–	20	μA
GATE A AND GATE B TTL INPUTS (SEE FIGS 4 AND 5)						
V_{IL}	LOW level input voltage		0	–	0.8	V
V_{IH}	HIGH level input voltage		2.0	–	V_{CCD}	V
I_{IL}	LOW level input current	V_I = 0.4 V	−400	–	–	μA
I_{IH}	HIGH level input current	V_I = 2.7 V	–	–	20	μA
t_W	pulse width	see Fig.5	2	–	–	μs
RPEAK INPUT (PIN 28)						
$I_{28(min)}$	minimum peak level current	R_{28} = 0 Ω	–	80	150	μA
AGC INPUT (PIN 25)						
$V_{25(min)}$	AGC voltage for minimum gain		–	2.8	–	V
$V_{25(max)}$	AGC voltage for maximum gain		–	4.0	–	V
	AGC output current		see Table 2			
CLAMP INPUT (PIN 24)						
V_{24}	clamp voltage for code 128 output		–	3.5	–	V
I_{24}	clamp output current		see Table 3			

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Video amplifier outputs						
ANOUT OUTPUT (PIN 19)						
$V_{19(p-p)}$	AC output voltage (peak-to-peak value)	V_{VIN} = 1.33 V (p-p); V_{25} = 3.6 V	–	1.33	–	V
I_{19}	internal current source	$R_L = \infty$	2.0	2.5	–	mA
$I_{O(p-p)}$	output current driven by the load	V_{ANOUT} = 1.33 V (p-p); note 2	–	–	1.0	mA
V_{19}	DC output voltage for black level	note 3	–	V_{CCA} – 2.24	–	V
Z_{19}	output impedance		–	20	–	Ω
Video amplifier dynamic characteristics						
α_{ct}	crosstalk between VIN inputs	V_{CCA} = 4.75 to 5.25 V	–	–50	–45	dB
G_{diff}	differential gain	V_{VIN} = 1.33 V (p-p); V_{25} = 3.6 V	–	2	–	%
φ_{diff}	differential phase	V_{VIN} = 1.33 V (p-p); V_{25} = 3.6 V	–	0.8	–	deg
B	–3 dB bandwidth		12	–	–	MHz
S/N	signal-to-noise ratio	note 4	60	–	–	dB
SVRR1	supply voltage ripple rejection	note 5	–	45	–	dB
ΔG	gain range	see Fig.10	–4.5	–	+6.0	dB
G_{stab}	gain stability as a function of supply voltage and temperature	see Fig.10	–	–	5	%
Analog-to-digital converter inputs						
CLK INPUT (PIN 5)						
V_{IL}	LOW level input voltage		0	–	0.8	V
V_{IH}	HIGH level input voltage		2.0	–	V_{CCD}	V
I_{IL}	LOW level input current	V_{clk} = 0.4 V	–400	–	–	μA
I_{IH}	HIGH level input current	V_{clk} = 2.7 V	–	–	100	μA
$\|Z_i\|$	input impedance	f_{clk}= 10 MHz	–	4	–	kΩ
C_i	input capacitance	f_{clk} = 10 MHz	–	4.5	–	pF
OF INPUT (3-STATE; SEE TABLE 4)						
V_{IL}	LOW level input voltage		0	–	0.2	V
V_{IH}	HIGH level input voltage		2.6	–	V_{CCD}	V
V_9	input voltage in high impedance state		–	1.15	–	V
I_{IL}	LOW level input current		–370	–300	–	μA
I_{IH}	HIGH level input current		–	300	450	μA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
ADCIN INPUT (PIN 20; SEE TABLE 5)						
V_{20}	input voltage	digital output = 00	–	V_{CCA} – 2.42	–	V
V_{20}	input voltage	digital output = 255	–	V_{CCA} – 1.41	–	V
$V_{20(p-p)}$	input voltage amplitude (peak-to-peak value)		–	1.0	–	V
I_{20}	input current		–	1.0	10	μA
$\|Z_i\|$	input impedance	f_i = 6 MHz	–	50	–	MΩ
C_I	input capacitance	f_i = 6 MHz	–	1	–	pF
Analog-to-digital converter outputs						
DIGITAL OUTPUTS D0 TO D7						
V_{OL}	LOW level output voltage	I_{OL} = 2 mA	0	–	0.6	V
V_{OH}	HIGH level output voltage	I_{OL} = −0.4 mA	2.4	–	V_{CCD}	V
I_{OZ}	output current in 3-state mode	0.4 V < V_O < V_{CCD}	−20	–	+20	μA
Switching characteristics						
$f_{clk(max)}$	maximum clock input frequency	see Fig.6; note 6	30	32	–	MHz
Analog signal processing (f_{clk} = 32 MHz; see Fig.8)						
G_{diff}	differential gain	V_{20} = 1.0 V (p-p); see Fig.3; note 7	–	2	–	%
φ_{diff}	differential phase	see Fig.3; note 7	–	2	–	deg
f_1	fundamental harmonics (full-scale)	f_i = 4.43 MHz; note 7	–	–	0	dB
f_{all}	harmonics (full-scale); all components	f_i = 4.43 MHz; note 7	–	−55	–	dB
SVRR2	supply voltage ripple rejection	note 8	–	1	5	%/V
Transfer function (see Fig.8)						
ILE	DC integral linearity error		–	–	±1	LSB
DLE	DC differential linearity error		–	–	±0.5	LSB
ILE	AC integral linearity error	note 9	–	–	±2	LSB
Timing (f_{clk} = 32 MHz; see Figs 6, 7 and 8)						
DIGITAL OUTPUTS (C_L = 15 pF; I_{OL} = 2 mA; R_L = 2 kΩ)						
t_{ds}	sampling delay time		–	2	–	ns
t_h	output hold time		6	8	–	ns
t_d	output delay time		–	16	20	ns
t_{dEZ}	3-state delay time; output enable		–	19	25	ns
t_{dDZ}	3-state delay time; output disable		–	14	20	ns

Notes

1. 0 dB is obtained at the AGC amplifier when applying $V_{i(p-p)}$ = 1.33 V.
2. The output current at pin 19 should not exceed 1 mA. The load impedance R_L should be referenced to V_{CCA} and defined as:
   a) AC impedance ≥1 kΩ and the DC impedance >2.7 kΩ.
   b) The load impedance should be coupled directly to the output of the amplifier so that the DC voltage supplied by the clamp is not disturbed.
3. Control mode 2 is selected.
4. Signal-to-noise ratio measured with 5 MHz bandwidth:

   $$\frac{S}{N} = 20 \log \frac{V_{ANOUTC(p-p)}}{V_{ANOUTY\ (RMS\ noise)}}$$ at B = 5 MHz.

5. The voltage ratio is expressed as:

   $$SVRR1 = 20 \log \frac{\Delta V_{CCA}}{V_{CCA}} \times \frac{G}{\Delta G}$$ for V_I = 1 V (p-p), gain at 100 kHz = 1 and 1 V supply variation.

6. It is recommended that the rise and fall times of the clock are ≥2 ns. In addition, a 'good layout' for the digital and analog grounds is recommended.
7. These measurements are realized on analog signals after a digital-to-analog conversion (TDA8702 is used).
8. The supply voltage rejection is the relative variation of the analog signal (full-scale signal at input) for 1 V of supply variation:

   $$SVRR2 = \frac{\Delta (V_{I(00)} - V_{I(FF)}) + (V_{I(00)} - V_{I(FF)})}{\Delta V_{CCA}}$$

9. Full-scale sine wave (f_i = 4.4 MHz; f_{clk} = 27 MHz).

Table 1 Video input selection (CVBS).

I1	I0	SELECTED INPUT
0	0	VIN0
0	1	VIN1
1	0	VIN2
1	1	VIN2

Table 2 AGC output current.

GATE A	GATE B	DIGITAL OUTPUT	I_{AGC}	MODE[2]
1	1	output < 255	−2.5 μA	1
		output > 255	I_{AGCM}	1
0	X[1]	output < 248	0 μA	2
		output > 248	I_{AGCM}	2
1	0	output < 0	+2.5 μA	2
		0 < output < 248	-2.5 μA	2
		output > 248	I_{AGCM}	2

Note

1. X = don't care.
2. Mode 2 can only be initialized with successive pulses on GATE A and GATE B (see Fig.5).

Table 3 CLAMP output current.

GATE A	GATE B	DIGITAL OUTPUT	I_{CLAMP}	MODE
1	1	output < 0	I_{CLAMPM}	1
		output > 0	−2.5 μA	1
X[1]	0	X[1]	0 μA	2
0	1	output < 64	+50 μA	2
		64 < output	−50 μA	2

Note

1. X = don't care.

Table 4 OF input coding.

OF	D0 TO D7
0	active, two's complement
1	high impedance
open circuit[1]	active, binary

Note

1. Use C ≥ 10 pF to DGND.

Table 5 Output coding and input voltage (typical values).

STEP	V_{ADCIN}	BINARY OUTPUTS								TWO'S COMPLEMENT							
		D7	D6	D5	D4	D3	D2	D1	D0	D7	D6	D5	D4	D3	D2	D1	D0
Underflow	–	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
0	V_{CCA} − 2.41 V	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
1	–	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1
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.	–	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
254	–	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	0
255	V_{CCA} − 1.41 V	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1
Overflow	–	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1

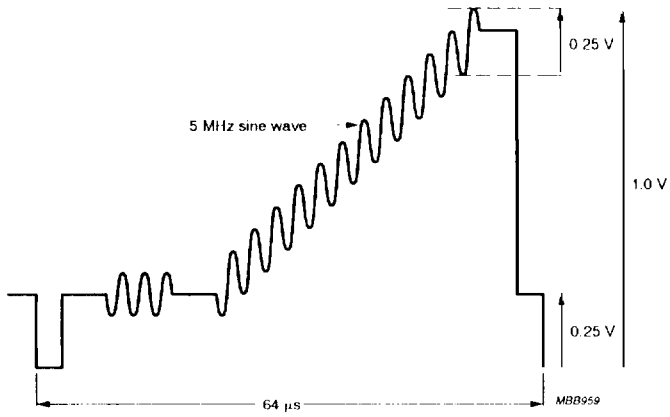


Fig.3 Test signal on the ADCIN pin for differential gain and phase measurements.

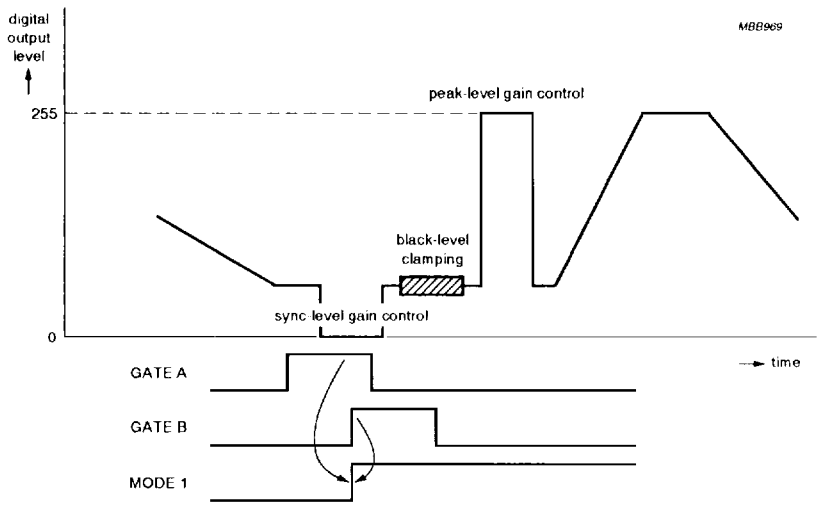


Fig.4 Control mode 1.

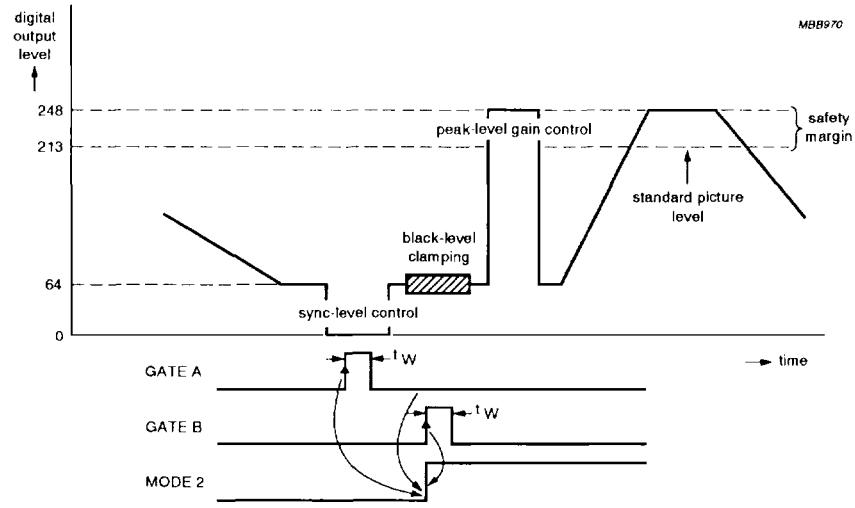


Fig.5 Control mode 2.

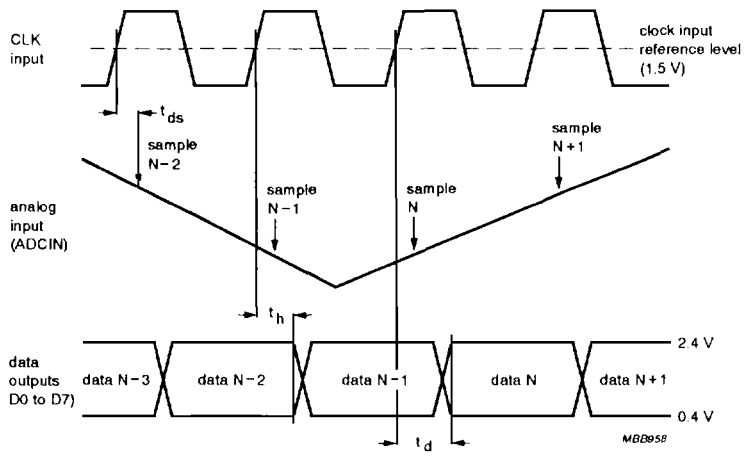


Fig.6 Timing diagram for data output.

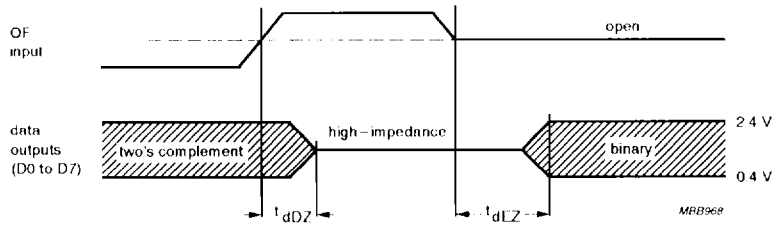


Fig.7 Output format timing diagram.

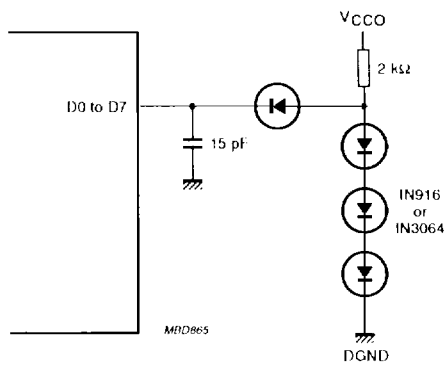


Fig.8 Load circuit for timing measurement; data outputs (OF = LOW or open-circuit).

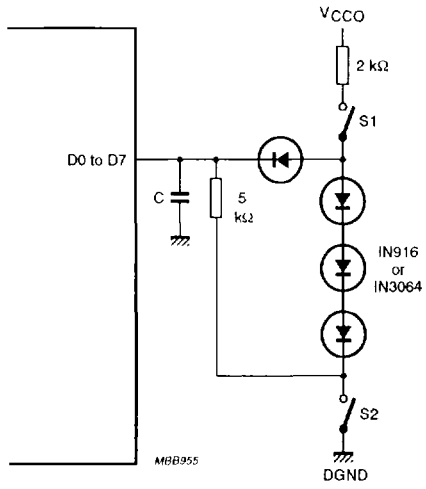
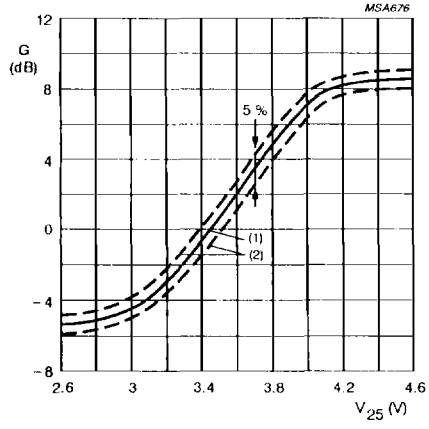


Fig.9 Load circuit for timing measurement; 3-state outputs (OF: f_i = 1 MHz; V_{OF} = 3 V).



(1) Typical value (V_{CCA} = V_{CCD} = 5 V; T_{amb} = 25 °C).
(2) Minimum and maximum values (temperature and supply).

Fig.10 Gain control curve.

INTERNAL PIN CIRCUITRY

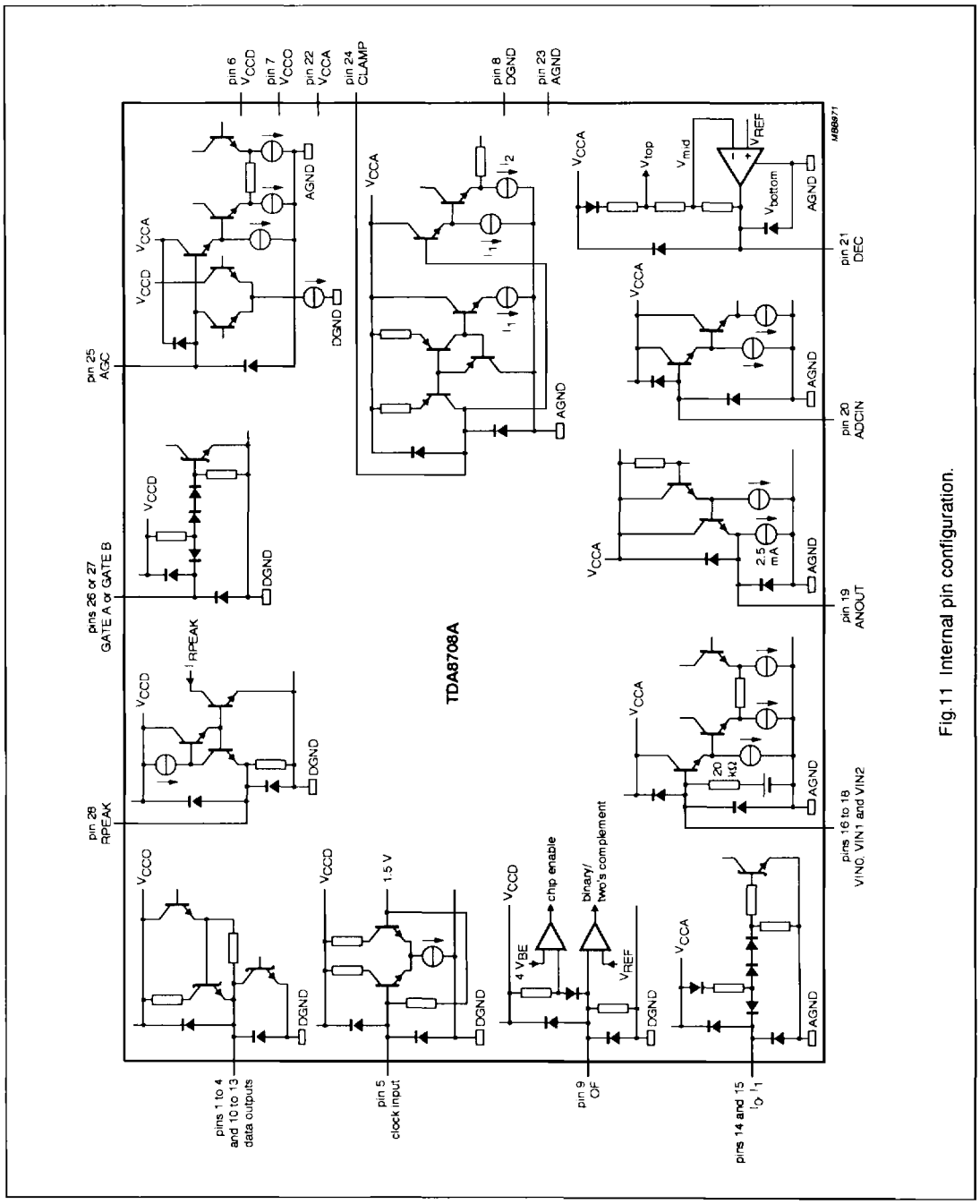
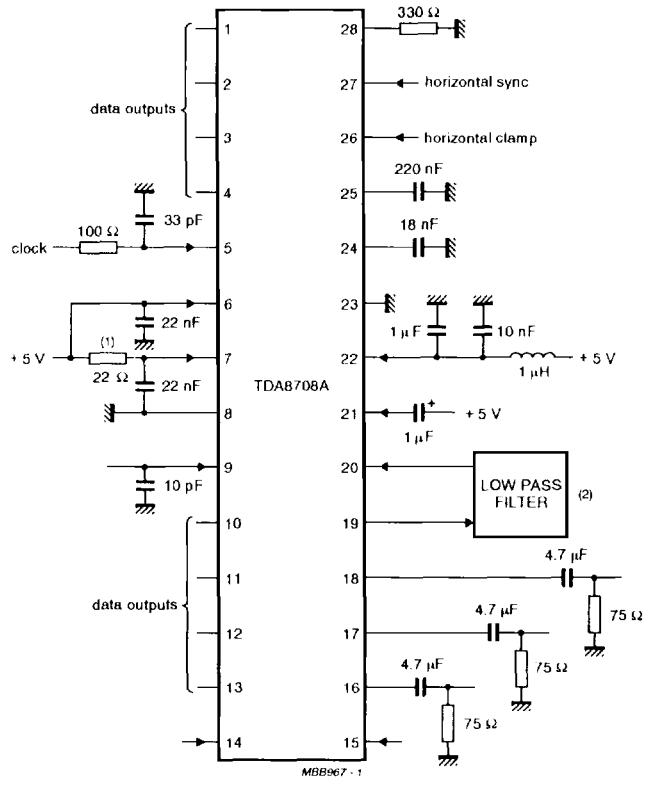


Fig.11 Internal pin configuration.

APPLICATION INFORMATION

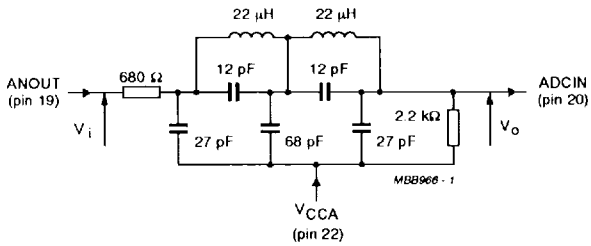
Additional information can be found in the laboratory report *"FBL/AN9308"*.



(1) It is recommended to decouple V_{CCO} through a 22 Ω resistor especially when the output data of TDA8708A interfaces with a capacitive CMOS load device.

(2) See Figs 13 and 15 for examples of the low-pass filters.

Fig.12 Application diagram.



This filter can be adapted to various applications with respect to performance requirements. An input and output impedance of at least 680 Ω and 2.2 kΩ must in any event be applied.

Fig.13 Example of a low-pass filter for CVBS and Y signals.

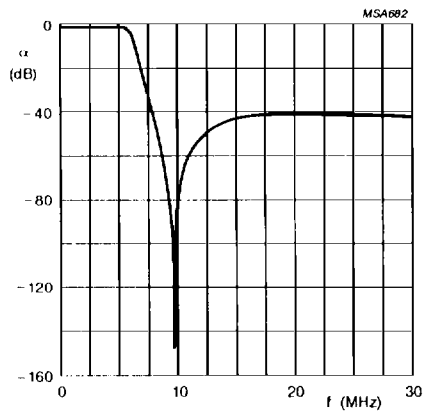
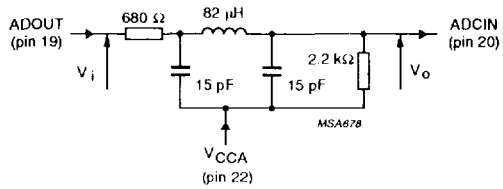


Fig.14 Frequency response for filter shown in Fig.13.

Characteristics of Fig. 13

- Order 5; adapted CHEBYSHEV
- Ripple $\rho \leq 0.4$ dB
- f = 6.5 MHz at −3 dB
- f_{notch} = 9.75 MHz.



This filter can be adapted to various applications with respect to performance requirements. An input and output impedance of at least 680 Ω and 2.2 kΩ must in any event be applied.

Fig.15 Example of an economical low-pass filter for CVBS and Y signals.

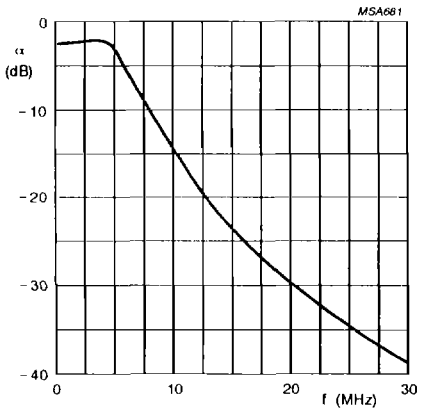


Fig.16 Frequency response for filter shown in Fig.15.

Characteristics of Fig. 15

- Order 5; adapted CHEBYSHEV
- Ripple $\rho \leq 0.4$ dB
- f = 6.5 MHz at –3 dB.

TDA8708A; Video analog input interface

Information as of 2002-09-02

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General description

The TDA8708A is an analog input interface for video signal processing. It includes a video amplifier with clamp and gain control, an 8-bit analog-to-digital converter (ADC) with a sampling rate of 32 MHz and an input selector.

Features

- 8-bit resolution
- Sampling rate up to 32 MHz
- Binary or two's complement 3-state TTL outputs
- TTL-compatible digital inputs and outputs
- Internal reference voltage regulator
- Power dissipation of 365 mW (typical)
- Input selector circuit (one out of three video inputs)
- Clamp and Automatic Gain Control (AGC) functions for CVBS and Y signals
- No sample-and-hold circuit required.
- The TDA8708A has white peak control in modes 1 and 2 whereas the TDA8708B has control in mode 1 only.

Applications

- Video signal decoding
- Scrambled TV (encoding and decoding)
- Digital picture processing
- Frame grabbing.

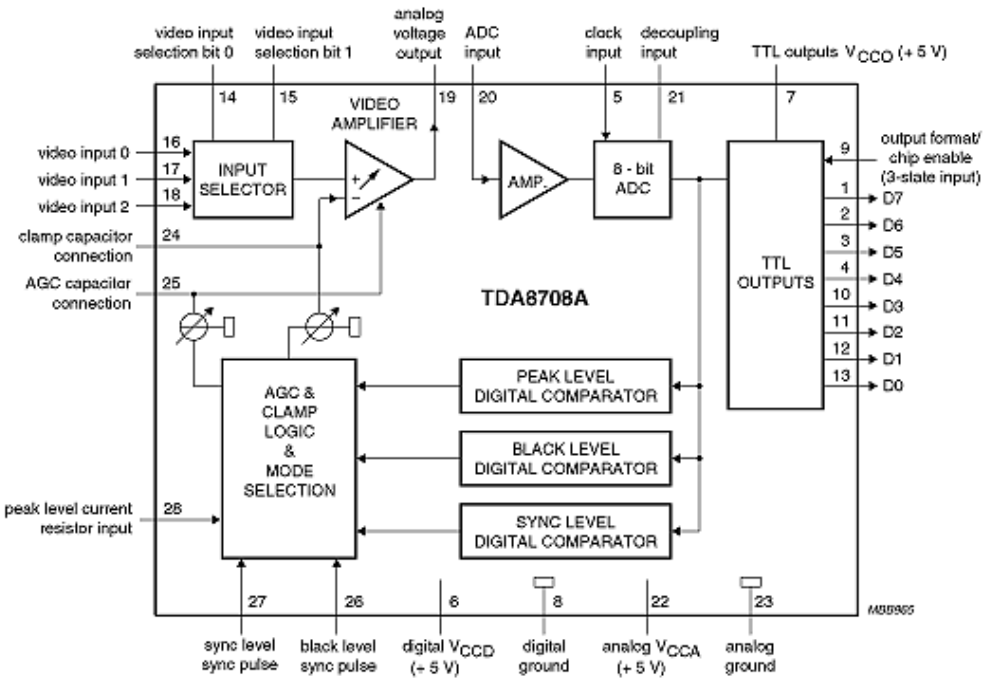
PDF An Overview Of Data Converters (date 01-Dec-91)

PDF A High-Speed Converter For Every Application (date 18-Sep-96)

Datasheet

Type number	Title	Publication release date	Datasheet status	Page count	File size (kB)	Datasheet
TDA8708A	Video analog input interface	01-Jun-94	Product specification	24	124	PDF Download

Blockdiagram(s)



Parametrics

Type number	Package	REMARKS	Power dissipation(mW)	Resolution(bits)	conversion rate max.(MSPS)	Operating temp.(Cel)	I²C-bus controlled	Analog Inputs	Supply voltage, analog part, V_{DDA}(V)	Supply voltage, digital part, V_{DD}(V)	I/O type	Supply Voltage, output stages(V)

TDA8708AT/C1	SOT117-1 (DIP28)	CVBS and Y inputs; AGC, and Clamp, with white peak control in modes 1 & 2	500	8	32	0~70	no	3	5	5	TTL	5

Products, packages, availability and ordering

Type number	North American type number	Ordering code (12NC)	Marking/Packing PDF IC packing info	Package	Device status	Buy online
TDA8708AT/C1	TDA8708ATD	9350 630 30112	Standard Marking * Tube	SOT117-1 (DIP28)	Full production	BUY ONLINE
	TDA8708ATD-T	9350 630 30118	Standard Marking * Reel Pack, SMD, 13"	SOT117-1 (DIP28)	Full production	BUY ONLINE

Products in the above table are all in production. Some variants are discontinued; click here for information on these variants.

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