

DATA SHEET

TDA4780

RGB video processor with
automatic cut-off control and
gamma adjust

Preliminary specification
Supersedes data of May 1994
File under Integrated Circuits, IC02

1997 Feb 06

RGB video processor with automatic cut-off control and gamma adjust

TDA4780

FEATURES

- Gamma adjust
- Dynamic black control (adaptive black)
- All input signals clamped on black-levels
- Automatic cut-off control, alternative: output clamping on fixed levels
- Three adjustable reference voltage levels via I²C-bus for automatic cut-off control
- Luminance/colour difference interface
- Two luminance input levels allowed
- Two RGB interfaces controlled by either fast switches or by I²C-bus
- Two peak drive limiters, selection via I²C-bus
- Blue stretch, selection via I²C-bus
- Luminance output for scan velocity modulation (SCAVEM)
- Extra luminance output; same pin can be used as hue control output e.g. for the TDA4650 and TDA4655
- Non standard operations like 50 Hz/32 kHz are also possible
- Either 2 or 3 level sandcastle pulse applicable
- High bandwidth for 32 kHz application
- White point adjusts via I²C-bus
- Average beam current and improved peak drive limiting
- Two switch-on delays to prevent discoloration during start-up
- All functions and features programmable via I²C-bus
- PAL/SECAM or NTSC matrix selection.

GENERAL DESCRIPTION

The TDA4780 is a monolithic integrated circuit with a luminance and a colour difference interface for video processing in TV receivers. Its primary function is to process the luminance and colour difference signals from a colour decoder which is equipped e.g. with the multistandard decoder TDA4655 or TDA9160 plus delay line TDA4661 or TDA4665 and the Picture Signal Improvement (PSI) IC TDA467X or from a feature module.



The required input signals are:

- Luminance and negative colour difference signals
- 2 or 3-level sandcastle pulse for internal timing pulse generation
- I²C-bus data and clock signals.

Two sets of analog RGB colour signals can also be inserted, e.g. one from a peritelevision connector (SCART plug) and the other one from an On-Screen Display (OSD) generator. The TDA4780 has I²C-bus control of all parameters and functions with automatic cut-off control of the picture tube cathode currents. It provides RGB output signals for the video output stages. In clamped output mode it can also be used as an RGB source.

The main differences with the sister type TDA4680 are:

- Additional features, namely gamma adjust, adaptive black, blue stretch and two different peak drive limiters
- The measurement lines are triggered by the trailing edge of the vertical component of the sandcastle pulse
- I²C-bus receiver only. Automatic white level control is not provided; the white levels are determined directly by the I²C-bus data.
- The TDA4780 is pin compatible (except pin 18) with the TDA4680. The I²C-bus slave address can be used for both ICs. When a function of the TDA4780 is not included in the TDA4680, the I²C-bus command is not executed. Special commands (except control bit FSWL) for the TDA4680 will be ignored by the TDA4780.

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QUICK REFERENCE DATA

| SYMBOL | PARAMETER | MIN. | TYP. | MAX. | UNIT |
|--------------|---|------|-----------|------|------|
| V_P | supply voltage (pin 5) | 7.2 | 8.0 | 8.8 | V |
| I_P | supply current (pin 5) | 80 | 100 | 120 | mA |
| $V_{8(p-p)}$ | luminance input (peak-to-peak value) (C)VBS | – | 0.45/1.43 | – | V |
| $V_{6(p-p)}$ | –(B – Y) input (peak-to-peak value) | – | 1.33 | – | V |
| $V_{7(p-p)}$ | –(R – Y) input (peak-to-peak value) | – | 1.05 | – | V |
| V_{14} | three-level sandcastle pulse | | | | |
| | H + V | – | 2.5 | – | V |
| | H | – | 4.5 | – | V |
| | BK | – | 8.0 | – | V |
| | two-level sandcastle pulse | | | | |
| | H + V | – | 2.5 | – | V |
| | BK | – | 4.5 | – | V |
| V_i | RGB input signals at pins 2, 3, 4, 10, 11 and 12 (black-to-white value) | – | 0.7 | – | V |
| $V_{o(p-p)}$ | RGB output at pins 24, 22 and 20 (black-to-white value) | – | 2.0 | – | V |
| T_{amb} | operating ambient temperature | –20 | – | +70 | °C |

ORDERING INFORMATION

| TYPE NUMBER | PACKAGE | | |
|----------------|---------|--|----------|
| | NAME | DESCRIPTION | VERSION |
| TDA4780 | DIP28 | plastic dual in-line package; 28 leads (600 mil) | SOT117-1 |

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BLOCK DIAGRAM

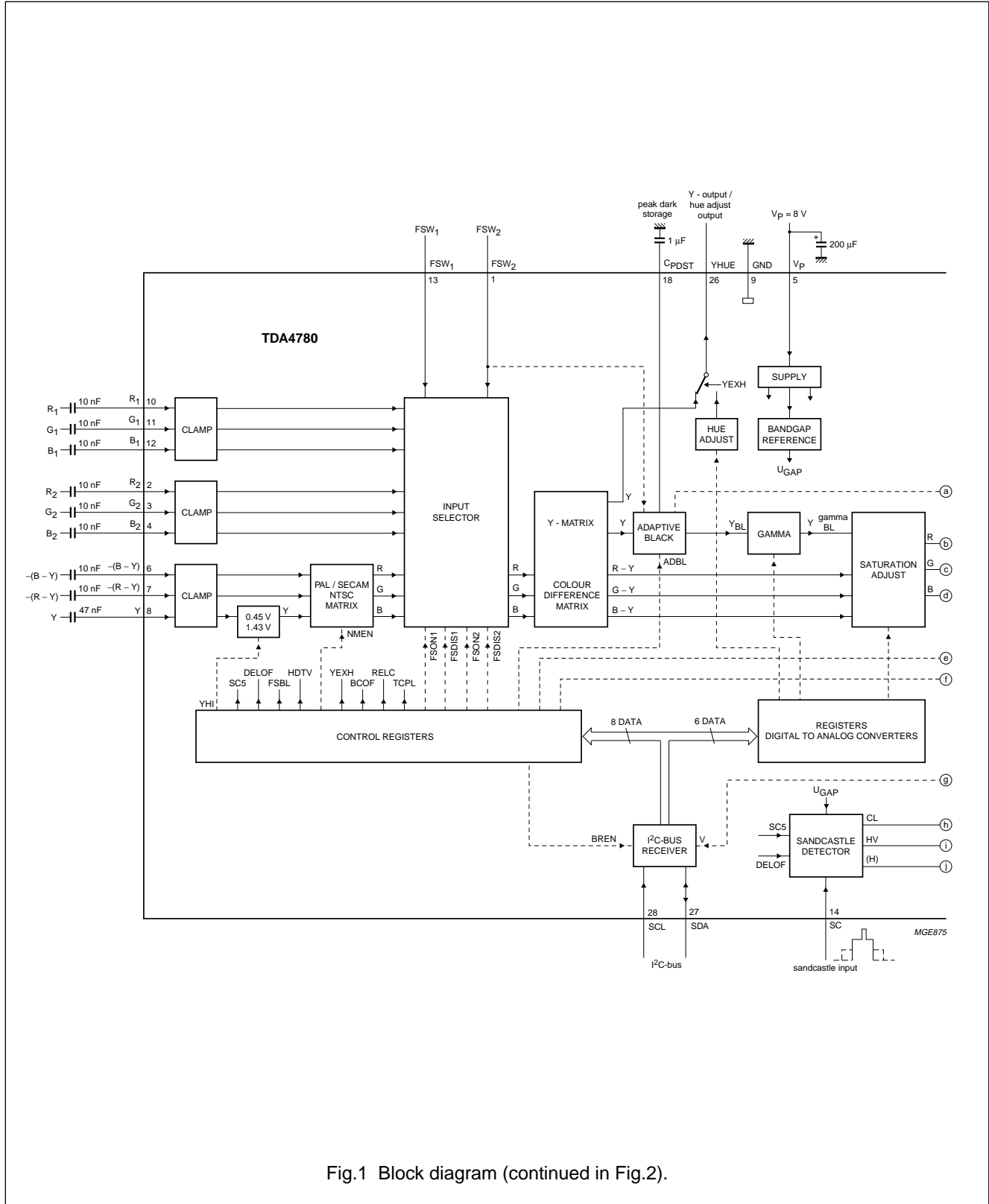


Fig.1 Block diagram (continued in Fig.2).

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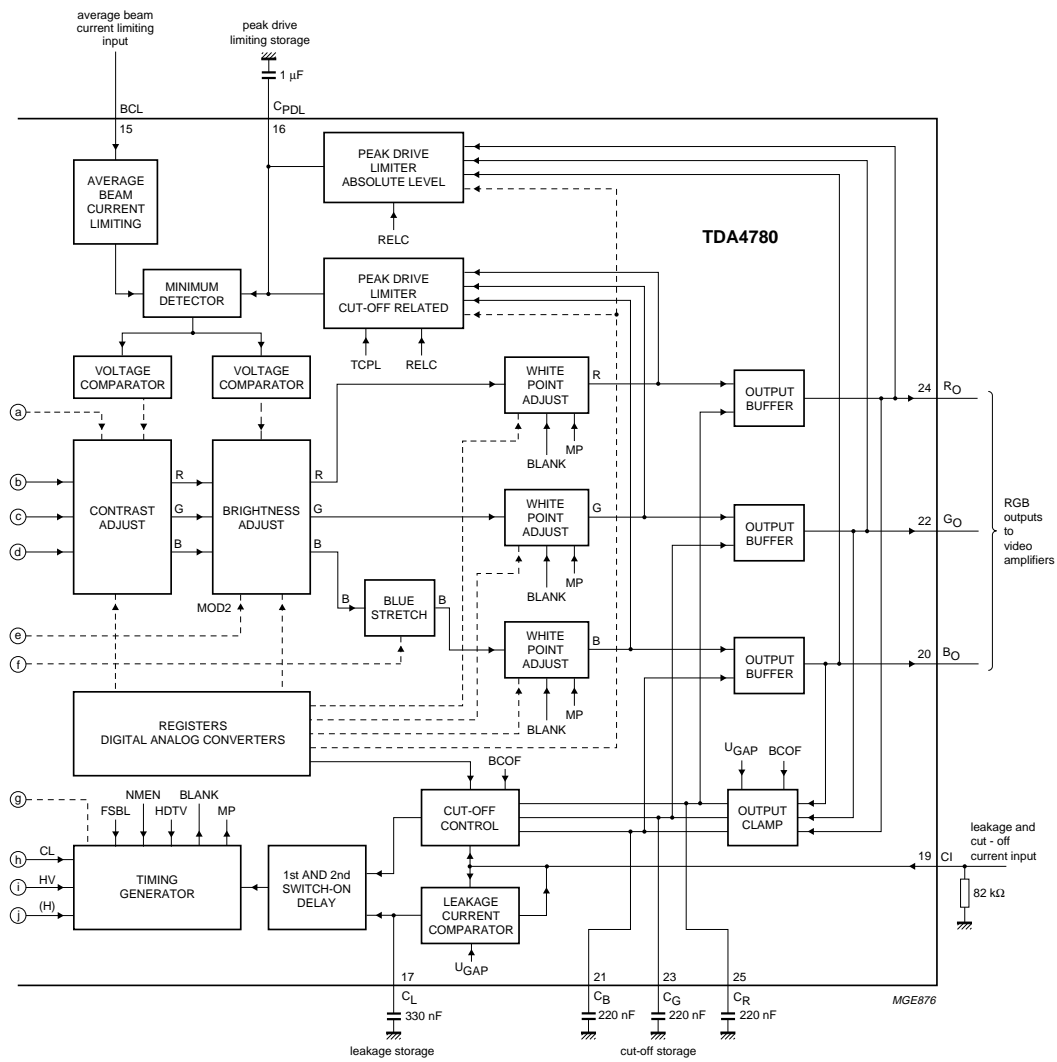


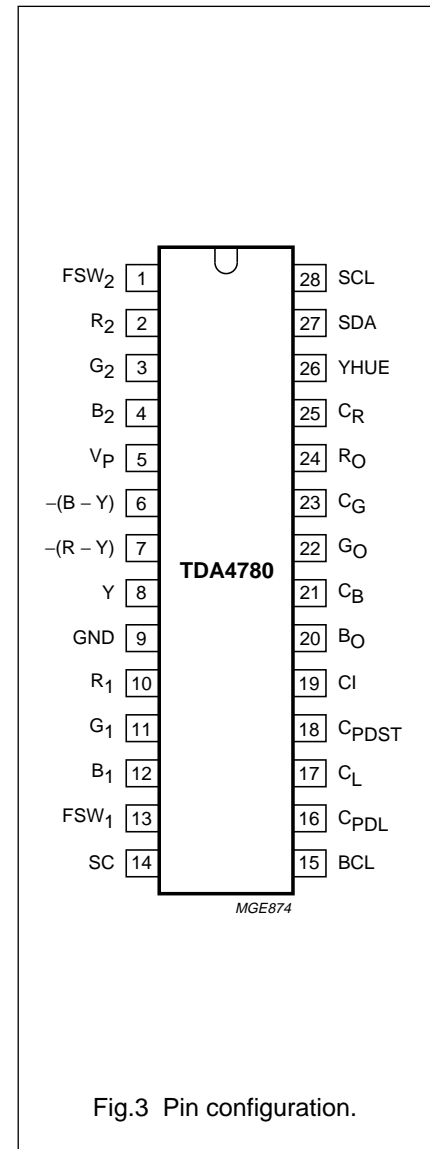
Fig.2 Block diagram (continued from Fig.1).

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PINNING

| SYMBOL | PIN | DESCRIPTION |
|--------------------|-----|---|
| FSW ₂ | 1 | fast switch 2 input |
| R ₂ | 2 | red input 2 |
| G ₂ | 3 | green input 2 |
| B ₂ | 4 | blue input 2 |
| V _P | 5 | supply voltage |
| -(B - Y) | 6 | colour difference input -(B - Y) |
| -(R - Y) | 7 | colour difference input -(R - Y) |
| Y | 8 | luminance input |
| GND | 9 | ground |
| R ₁ | 10 | red input 1 |
| G ₁ | 11 | green input 1 |
| B ₁ | 12 | blue input 1 |
| FSW ₁ | 13 | fast switch 1 input |
| SC | 14 | sandcastle pulse input |
| BCL | 15 | average beam current limiting input |
| C _{PD} L | 16 | storage capacitor for peak limiting |
| C _L | 17 | storage capacitor for leakage current compensation |
| C _{PD} ST | 18 | storage capacitor for peak dark |
| CI | 19 | cut-off measurement input |
| B _O | 20 | blue output |
| C _B | 21 | blue cut-off storage capacitor |
| G _O | 22 | green output |
| C _G | 23 | green cut-off storage capacitor |
| R _O | 24 | red output |
| C _R | 25 | red cut-off storage capacitor |
| YHUE | 26 | Y-output/hue adjust output |
| SDA | 27 | I ² C-bus serial data input/acknowledge output |
| SCL | 28 | I ² C-bus serial clock input |



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FUNCTIONAL DESCRIPTION

Signal input stages

The TDA4780 contains 3 sets of input signal stages for:

1. Luminance/colour-difference signals:
 - a) Y: 0.45 V (p-p) VBS or 1.43 V (p-p) VBS, selectable via I²C-bus.
 - b) $-(R - Y)$: 1.05 V (p-p).
 - c) $-(B - Y)$: 1.33 V (p-p).

The capacitively coupled signals are matrixed to RGB signals by either a PAL/SECAM or NTSC matrix (selected via I²C-bus).
2. (RGB)₁ signals (0.7 V (p-p) VB), capacitively coupled (e.g. from external source).
3. (RGB)₂ signals (0.7 V (p-p) VB), capacitively coupled (e.g. videotext, OSD).

All input signals are clamped in order to have the same black levels at the signal switch input. Displayed signals must be synchronous with the sandcastle pulse.

Signal switches

Both fast signal switches can be operated by switching pins (e.g. SCART facilities) or set via the I²C-bus. With the pin FSW₁ the Y-CD signals or the (RGB)₁ signals can be selected, with pin FSW₂ the above selected signals or the (RGB)₂ signals are enabled. During the vertical and horizontal blanking time an artificial black level equal to the clamped black level is inserted in order to clip off the sync pulse of the luminance signal and to suppress hum during the cut-off measurement time and eliminate noise during these intervals.

Saturation, contrast and brightness adjust

Saturation, contrast and brightness adjusts are controlled via the I²C-bus and act on Y, CD as well as on RGB input signals. Gamma acts on the luminance content of the input signals.

Gamma adjust

The gamma adjust stage has a non-linear transmission characteristic according to the formula $y = x^{\text{gamma}}$, where x represents the input and y the output signal. If gamma is smaller than unity, the lower parts of the signal are amplified with higher gain.

Adaptive black (ADBL)

The adaptive black stage detects the lowest voltage of the luminance component of the internal RGB signals during the scanning time and shifts it to the nominal black level. In order to keep the nominal white level the contrast is increased simultaneously.

Blue stretch (BLST)

The blue stretch channel gets additional amplification if the blue signal is greater than 80% of the nominal signal amplitude. In the event the white point is shifted towards higher colour temperature so that white parts of a picture seem to be brighter.

Measurement pulse and blanking stage

During the vertical and horizontal blanking time and the measurement period the signals are blanked to an ultra black level, so the leakage current of the picture tube can be measured and automatically compensated for.

During the cut-off measurement lines (one line period for each R, G or B) the output signal levels are at cut-off measurement level.

The vertical blanking period is timed by the sandcastle pulse. The measurement pulses (leakage, R, G and B) are triggered by the negative going edge of the vertical pulse of the sandcastle pulse and start after the following horizontal pulse.

The IC is prepared for 2f_H (32 kHz) application.

Output amplifier and white adjust potentiometer

The RGB signals are amplified to nominal 2 V (p-p), the DC-levels are shifted according to cut-off control. The nominal signal amplitude can be varied by $\pm 50\%$ by the white point adjustment via the I²C-bus (individually for RGB respect).

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Automatic cut-off control

During leakage measurement time the leakage current is compensated in order to get a reference voltage at the cut-off measurement info pin. This compensation value is stored in an external capacitor. During cut-off current measurement times for the R, G and B channels, the voltage at this pin is compared with the reference voltage, which is individually adjustable via I²C-bus for each colour channel. The control voltages that are derived in this way are stored in the external feedback capacitors. Shift stages add these voltages to the corresponding output signals. The automatic cut-off control may be disabled via the I²C-bus. In this mode the output voltage is clamped to 2.5 V. Clamping periods are the same as the cut-off measurement periods.

Signal limiting

The TDA4780 provides two kinds of signal limiting. First, an average beam limiting, that reduces signal level if a certain average is exceeded. Second, a peak drive limiting, that is activated if one of the RGB signals even shortly exceeds a via I²C-bus adjusted threshold. The latter can be either referred to the cut-off measurement level of the outputs or to ground.

When signal limiting occurs, contrast is reduced, and at minimum contrast brightness is reduced additionally.

Sandcastle decoder and timer

A 3-level detector separates the sandcastle pulse into combined line and field pulses, line pulses, and clamping pulses. The timer contains a line counter and controls the cut-off control measurement.

Application with a 2-level 5 V sandcastle pulse is possible.

Switch on delay circuit

After switch on all signals are blanked and a warm up test pulse is fed to the outputs during the cut-off measurement lines. If the voltage at the cut-off measurement input exceeds an internal level the cut-off control is enabled but the signal remains still blanked. In the event of output clamping, the cut-off control is disabled and the switch on procedure will be skipped.

Y output and hue adjust

The TDA4780 contains a D/A converter for hue adjust. The analog information can be fed, e.g. to the multistandard decoder TDA4650 or TDA4655. This output pin may be switched to a Y output signal, which can be used for scan velocity modulation (SCAVEM). The Y output is the Y input signal or the matrixed (RGB) input signal according to the switch position of the fast switch.

I²C-bus

The TDA4780 contains an I²C-bus receiver for control function.

ESD protection

The Pins are provided with protection diodes against ground and supply voltage (see Chapter "Internal pin configurations"). I²C-bus input pins do not shunt the I²C-bus signals in the event of missing supply voltage.

EMC

The pins are protected against electromagnetic radiation.

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I²C-BUS RECEIVER

Table 1 Slave address; note 1

| A6 | A5 | A4 | A3 | A2 | A1 | A0 | \bar{W} |
|----|----|----|----|----|----|----|-----------|
| 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |

Note

1. Explanation for the cell contents of the table:
 - a) W means write.

Table 2 Slave receiver format (write mode; BREN = 0); note 1

| S | SLAVE ADDRESS | A | SUBADDRESS ⁽²⁾ | A | DATA BYTE | A | P |
|---|---------------|---|---------------------------|---|--|---|---|
| | | | | | n data bytes with auto-increment of subaddresses | | |

Notes

1. Explanation for the cell contents of the table:
 - a) S means START condition.
 - b) P means STOP condition.
 - c) A means acknowledge.
2. All subaddresses within the range 00H to 0FH are automatically incremented. The subaddress counter wraps around from 0FH to 00H. Only in this event 0FH will be acknowledged. Subaddresses outside the range 00H to 0EH are not acknowledged by the device and neither auto-increment nor any other internal operation takes place. All eight bits of the subaddress have to be decoded by the device.

Table 3 Slave receiver format (write mode; BREN = 1); note 1

| S | SLAVE ADDRESS | A | SUBADDRESS | A | DATA BYTE ⁽²⁾ | A | P |
|---|---------------|---|------------|---|--------------------------|---|---|
| | | | | | | | |

Notes

1. Explanation for the cell contents of the table:
 - a) S means START condition.
 - b) P means STOP condition.
 - c) A means acknowledge.
2. Auto-increment is not possible.

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Table 4 Signal input selection and effect on adaptive black measurements by fast source switches and I²C-bus; note 1

| I ² C-BUS CONTROLLED BITS | | | | ANALOG SWITCH | | SELECTED SIGNALS | | | |
|--------------------------------------|--------|-------|--------|---------------|---------------|------------------------------------|----------|---------------------------------------|----------------------|
| FSON2 | FSDIS2 | FSON1 | FSDIS1 | FSW2 (pin 1) | FSW1 (pin 13) | RGB ₂ (pins 2, 3 and 4) | ADBL | RGB ₁ (pins 10, 11 and 12) | TV (pins 6, 7 and 8) |
| L | L | L | L | L | L | | active | | ON |
| | | | | L | H | | active | ON | |
| | | | | H | X | ON | inactive | | |
| L | L | L | H | L | X | | active | | ON |
| | | | | H | X | ON | inactive | | |
| L | L | H | X | L | X | | active | ON | |
| | | | | H | X | ON | inactive | | |
| L | H | L | L | X | L | | active | | ON |
| | | | | X | H | | active | ON | |
| L | H | L | H | X | X | | active | | ON |
| L | H | H | X | X | X | | active | ON | |
| H | L | X | X | L | X | ON | active | | |
| | | | | H | | ON | inactive | | |
| H | H | X | X | X | X | ON | active | | |

Note

- Explanation for the cell contents of the table:
 - H = set to logic 1 or analog switch (pins 1 and 13) to >0.9 V.
 - L = set to logic 0 or analog switch (pins 1 and 13) to <0.4 V.
 - X = don't care.
 - ON = this signal is selected.

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Table 5 Crosstalk; note 1

| FSW1 | FSW2 | CROSSTALK | AT 4 MHz MAXIMUM VALUE (dB) | AT 8 MHz MAXIMUM VALUE (dB) | AT 13 MHz MAXIMUM VALUE (dB) |
|------|------|-------------------------------------|-----------------------------|-----------------------------|------------------------------|
| L | L | RGB ₁ → Y, CD | -58 | -55 | -50 |
| | | RGB ₂ → Y, CD | -58 | -55 | -50 |
| L | H | Y, CD → RGB ₁ | -51 | -50 | -47 |
| | | RGB ₂ → RGB ₁ | -58 | -55 | -50 |
| L | H | Y, CD → RGB ₂ | -51 | -50 | -47 |
| | | RGB ₁ → RGB ₂ | -58 | -55 | -50 |
| H | H | Y, CD → RGB ₂ | -51 | -50 | -47 |
| | | RGB ₁ → RGB ₂ | -58 | -55 | -50 |

Note

1. Explanation for the cell contents of the table:

- a) H = set to logic 1.
- b) L = set to logic 0.

Table 6 Subaddress byte and data byte format; notes 1 and 2

| FUNCTION | SUBADDRESS | DATA BYTE | | | | | | | |
|-----------------------|------------|-----------|-------|------|------|--------|-------|--------|-------------------|
| | | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 ⁽³⁾ |
| Brightness | 00H | L | L | A05 | A04 | A03 | A02 | A01 | A00 |
| Saturation | 01H | L | L | A15 | A14 | A13 | A12 | A11 | A10 |
| Contrast | 02H | L | L | A25 | A24 | A23 | A22 | A21 | A20 |
| Hue | 03H | L | L | A35 | A34 | A33 | A32 | A31 | A30 |
| Red gain | 04H | L | L | A45 | A44 | A43 | A42 | A41 | A40 |
| Green gain | 05H | L | L | A55 | A54 | A53 | A52 | A51 | A50 |
| Blue gain | 06H | L | L | A65 | A64 | A63 | A62 | A61 | A60 |
| Red level reference | 07H | L | L | A75 | A74 | A73 | A72 | A71 | A70 |
| Green level reference | 08H | L | L | A85 | A84 | A83 | A82 | A81 | A80 |
| Blue level reference | 09H | L | L | A95 | A94 | A93 | A92 | A91 | A90 |
| Peak drive limit | 0AH | L | L | AA5 | AA4 | AA3 | AA2 | AA1 | AA0 |
| Gamma | 0BH | L | L | AB5 | AB4 | AB3 | AB2 | AB1 | AB0 |
| Control register 1 | 0CH | SC5 | DELOF | BREN | X | NMEN | X | X | X |
| Control register 2 | 0DH | X | HDTV | FSBL | BCOF | FSDIS2 | FSON2 | FSDIS1 | FSON1 |
| Control register 3 | 0EH | ADBL | YHI | MOD2 | BLST | YEXH | RELC | TCPL | L |

Notes

1. Explanation for the cell contents of the table:

- a) L = set to logic 0.
 - b) X means don't care but for software compatibility with further video ICs with the same slave address, it is recommended to set all these bits to logic 0.
2. After power on reset all alignment registers are set to 01H.
3. The least significant bit of the analog alignment register.

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Table 7 RGB processor mode bits control register

| SYMBOL | PARAMETER | CONDITIONS |
|---------------------------|---|--|
| Control register 1 | | |
| SC5 | sandcastle 5 V | 0 = 3-level sandcastle pulse 1 = 2-level sandcastle pulse |
| DELOF | delay of leading edge of clamping pulse switched off | 0 = delay 1 = no delay |
| BREN | buffer register enable | 0 = new data are executed just after reception 1 = data is held in a latch (buffer register) and will be transferred to their destination register within the next vertical blanking interval; the device does not acknowledge any new data transfer until the internal transfer to the destination register has been completed |
| NMEN | NTSC matrix enable; note 1 | 0 = PAL matrix 1 = NTSC matrix; hue position set on -2 degrees |
| Control register 2 | | |
| HDTV | HDTV / progressive scan for ADBL line counter | 0 = 272 (PAL), 224 (NTSC) lines 1 = 544 (PAL), 448 (NTSC) lines |
| FSBL | full screen black level, e.g. for optical measurement | 0 = normal mode 1 = cut-off measurement level during full field, brightness inactive |
| BCOF | internal black level control off | 0 = automatic cut-off control active 1 = RGB outputs clamped to fixed DC levels |
| FSON2 | fast switch 2 on | see Table 4 |
| FSDIS1 | fast switch 1 disable | |
| FSDIS2 | fast switch 2 disable | |
| FSON1 | fast switch 1 on | |
| Control register 3 | | |
| ADBL | adaptive black | 0 = off 1 = on |
| YHI | Y high level | 0 = input = 0.315 V (p-p) (black-white) 1 = input = 1.0 V (p-p) (black-white) |
| MOD2 | modus 2 | 0 = inactive; (BCOF = 0) AND (MOD2 = 1) is senseless, no output stabilization 1 = output clamp without brightness adjust, brightness remains active e.g. for blue stretch |
| BLST | blue stretch | 0 = off 1 = on |
| YEXH | Y exclusive hue | 0 = pin 26 is switched to hue adjust output 1 = pin 26 is switched to Y output |
| RELC | relative to cut-off | 0 = peak drive limit to absolute output 1 = peak drive limit relative to cut-off |
| TCPL | time constant peak drive limiter | 0 = $2f_H$ 1 = $1f_H$ |

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Note

- Matrix coefficients should be tested by comparing RGB output signals with a reference RGB colour bar, which is fed in at (RGB)₁ or (RGB)₂ inputs. In the event of NMEN = 1 (NTSC) at minimum saturation the Y output and RGB output signals are not identical to the Y input signal. PAL/SECAM signals are matrixed by the equation:

$$V_{G-Y} = -0.51V_{R-Y} - 0.19V_{B-Y}$$

NTSC signals are matrixed by the equations (hue phase shift of -2 degrees):

$$V_{R-Y^*} = 1.39V_{R-Y} - 0.07V_{B-Y}; \quad V_{G-Y^*} = -0.46V_{R-Y} - 0.15V_{B-Y}; \quad V_{B-Y^*} = V_{B-Y}$$

For demodulation axis see Fig.11.

In the matrix equations: V_{R-Y} and V_{B-Y} are conventional PAL demodulation axes and amplitudes at the output of the demodulator. V_{R-Y^*} , V_{G-Y^*} and V_{B-Y^*} are the NTSC-modified colour-difference signals.

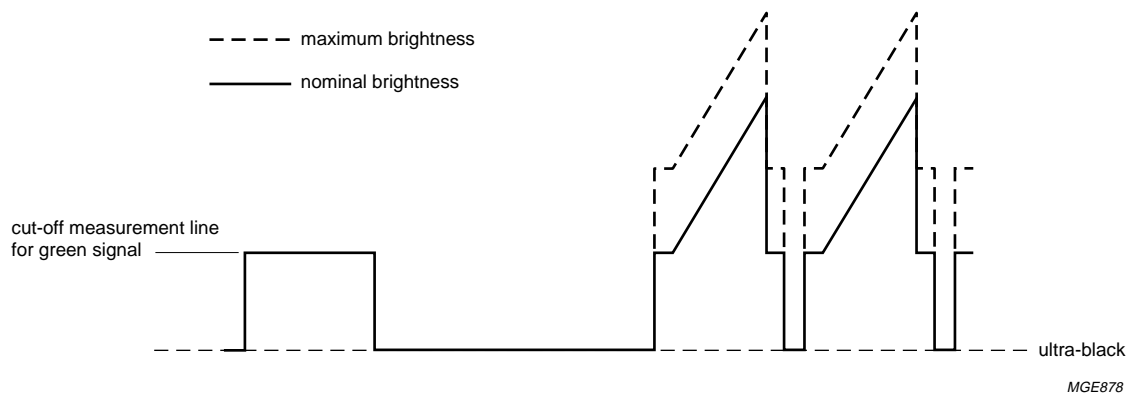


Fig.7 Cut-off measurement pulses.

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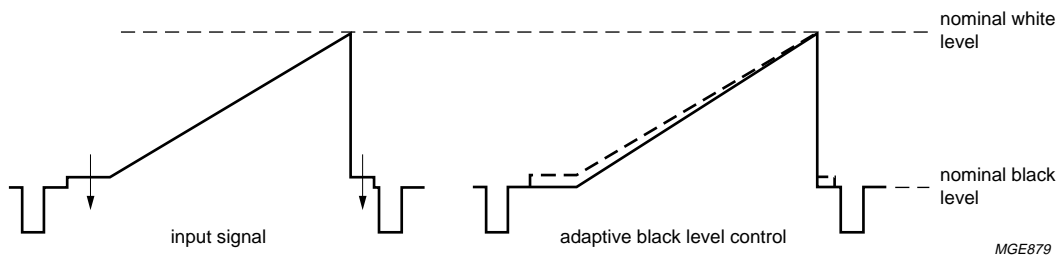


Fig.8 Principle of adaptive black control.

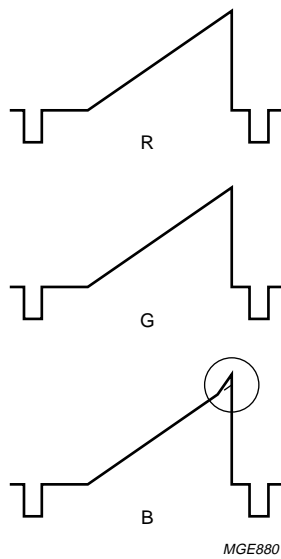
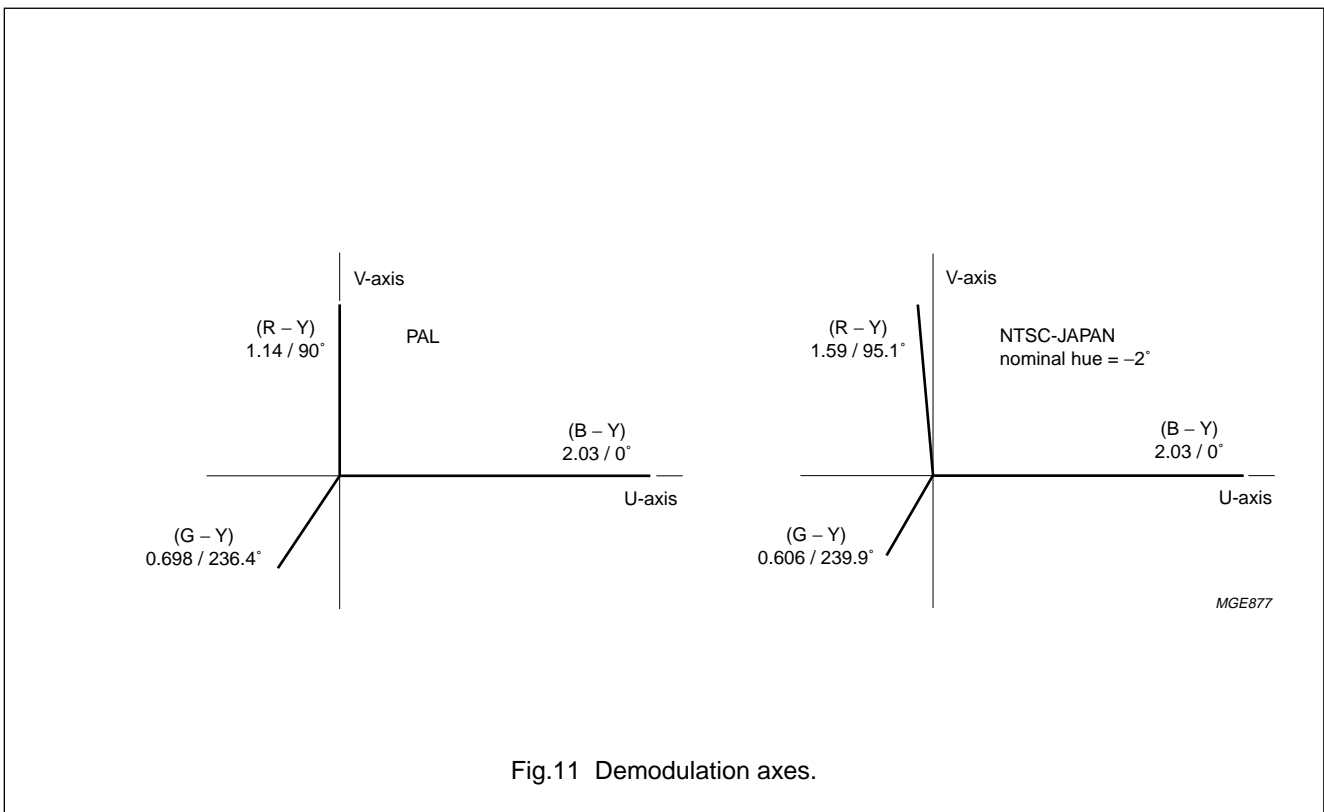
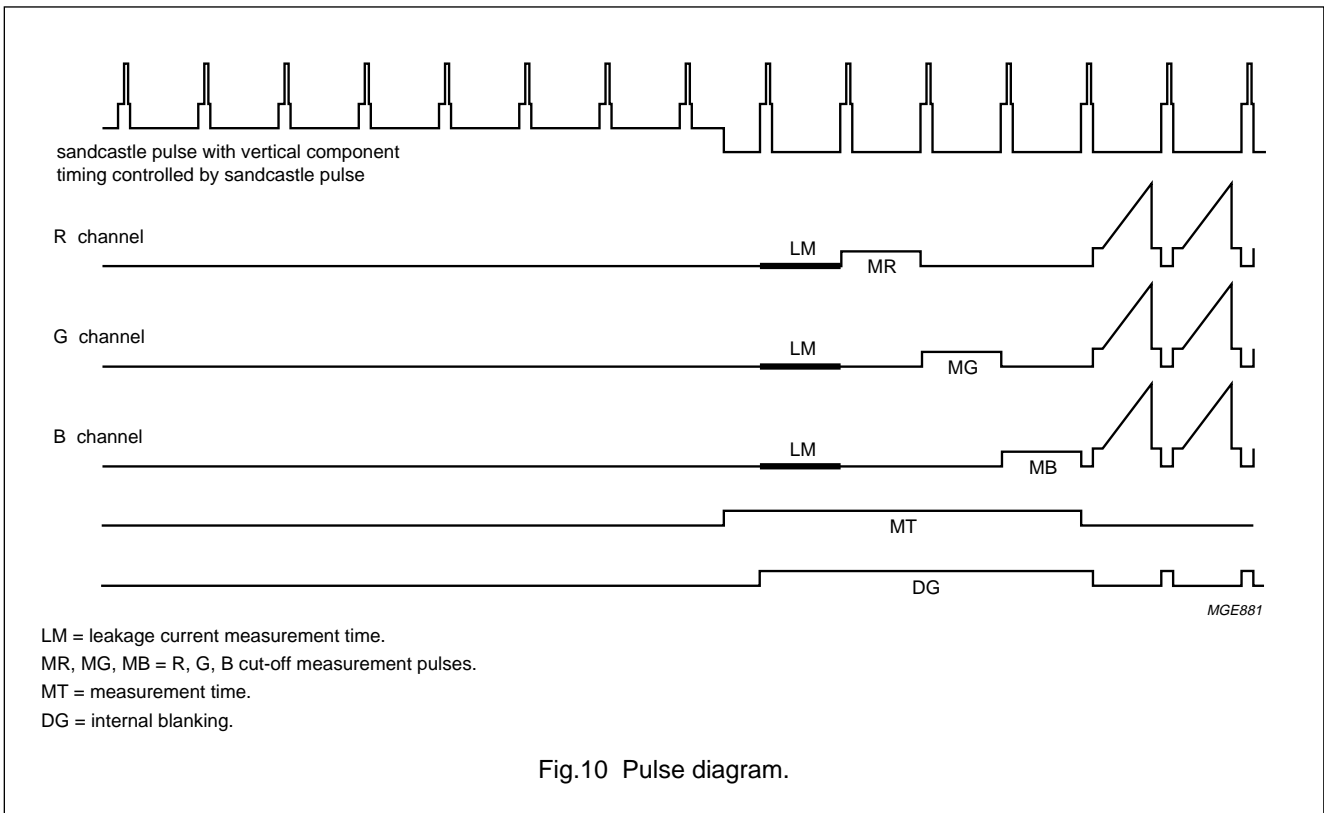


Fig.9 Principle of blue stretch.

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LIMITING VALUES

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

| SYMBOL | PARAMETER | CONDITIONS | MIN. | MAX. | UNIT |
|----------------------|---|---------------------|------|-------------|------|
| V_P | supply voltage | | -0.1 | +9.0 | V |
| $V_{10, 11, 12}$ | (RGB) ₁ inputs | with respect to GND | -0.1 | V_P | V |
| $V_{2, 3, 4}$ | (RGB) ₂ inputs | with respect to GND | -0.1 | V_P | V |
| $V_{8, 7, 6}$ | Y, CD-inputs | with respect to GND | -0.1 | V_P | V |
| $V_{13, 1}$ | switch 1 and switch 2 input voltage | with respect to GND | -0.1 | V_P | V |
| $V_{25, 23, 21, 17}$ | black level, leakage storage | with respect to GND | -0.1 | V_P | V |
| V_{14} | sandcastle | with respect to GND | -0.7 | $V_P + 5.8$ | V |
| V_{15} | average current information | with respect to GND | -0.7 | $V_P + 0.7$ | V |
| V_{16} | peak drive storage | with respect to GND | -0.1 | V_P | V |
| V_{18} | peak dark storage | with respect to GND | -0.1 | V_P | V |
| V_{19} | cut-off control input voltage | with respect to GND | -0.7 | $V_P + 0.7$ | V |
| $V_{27, 28}$ | I ² C-bus: SDA and SCL voltage | with respect to GND | -0.1 | V_P | V |
| $I_{24, 22, 20}$ | output peak current | | -20 | - | mA |
| $I_{24, 22, 20}$ | output average current | | -10 | - | mA |
| I_{26} | Y output/hue adjust current | | -8 | - | mA |
| P_{tot} | total power dissipation | | - | 1200 | mW |
| T_{amb} | operating ambient temperature | | -20 | +70 | °C |
| T_{stg} | storage temperature | | -20 | +150 | °C |
| V_{es} | electrostatic handling; note 1 | | -500 | +500 | V |

Note

- Charge device model class A: discharging a 200 pF capacitor through a 0 Ω series resistor.

THERMAL CHARACTERISTICS

| SYMBOL | PARAMETER | VALUE | UNIT |
|---------------|---|-------|------|
| $R_{th\ j-a}$ | thermal resistance from junction to ambient in free air | 47 | K/W |

QUALITY SPECIFICATION

In accordance with URV-4-2-59/601. The number of the quality specification can be found in the "Quality Reference Handbook". The handbook can be ordered using the code 9397 750 00192.

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CHARACTERISTICS

$V_P = 8\text{ V}$; $T_{amb} = +25\text{ °C}$; V_{nom} : nominal signal amplitude (black-white) 2 000 mV (peak-to-peak value) at output pins; $\gamma = 1$; adaptive black inactive; brightness, contrast, saturation and white balance at nominal settings; no beam current or peak drive limiting; all voltages are related to ground (pin 9) and measured in Figs 1 and 2; unless otherwise specified.

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|--|--|---|--------|--------------|--------|------------------|
| V_P | supply voltage (pin 5) | | 7.2 | 8 | 8.8 | V |
| I_P | supply current (pin 5) | | – | 100 | 120 | mA |
| Colour-difference inputs (–(B – Y): pin 6, –(R – Y): pin 7; capacitively coupled to a low-ohmic source; recommendation: maximum 600 Ω) | | | | | | |
| $V_{6(p-p)}$ | –(B – Y) signal (peak-to-peak value) | 75% colour bar signal | – | 1.33 | – | V |
| $V_{6,7}$ | internal bias during clamping | | – | 4.0 | – | V |
| $I_{6,7}$ | DC input current between clamping pulses | | – | – | 0.1 | μA |
| $I_{6,7}$ | maximum input current during clamping | | 100 | 180 | 260 | μA |
| $V_{7(p-p)}$ | –(R – Y) signal (peak-to-peak value) | 75% colour bar signal | – | 1.05 | – | V |
| $R_{6,7}$ | AC input resistance | | 10.0 | – | – | $\text{M}\Omega$ |
| Y input (pin 8; capacitively coupled to a low-ohmic source; recommendation: maximum 600 Ω) | | | | | | |
| $V_{8(p-p)}$ | input signal (composite signal; VBS; peak-to-peak value) | adaption to two different signal levels via control bit YHI YHI = 0 YHI = 1 | – – | 0.45 1.43 | – – | V V |
| R_8 | AC input resistance | | 10.0 | – | – | $\text{M}\Omega$ |
| V_8 | internal bias during clamping | YHI = 0 YHI = 1 | – – | 3.7 4.6 | – – | V V |
| I_8 | DC input current between clamping pulses | | – | – | 0.1 | μA |
| $I_{8(max)(clamp)}$ | maximum input current during clamping | | 100 | 180 | 260 | μA |
| RGB input 1 (R_1: pin 10, G_1: pin 11, B_1: pin 12; capacitively coupled to a low-ohmic source; recommendation: maximum 600 Ω); note 1 | | | | | | |
| $V_{10,11,12(p-p)}$ | input signal (peak-to-peak value) | | – | 0.7 | – | V |
| $R_{10,11,12}$ | AC input resistance | | 10.0 | – | – | $\text{M}\Omega$ |
| $V_{10,11,12}$ | internal bias during clamping | | – | 5.1 | – | V |
| $I_{10,11,12}$ | DC input current between clamping pulses | | – | – | 0.1 | μA |
| $I_{10,11,12(clamp)}$ | maximum input current during clamping | | 100 | 180 | 260 | μA |

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| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|--|--|-----------------------------------|------|------|------|------|
| RGB input 2 (R₂: pin 2, G₂: pin 3, B₂: pin 4; capacitively coupled to a low-ohmic source; recommendation: maximum 600 Ω); note 1 | | | | | | |
| V _{2, 3, 4(p-p)} | input signal (peak-to-peak value) | | – | 0.7 | – | V |
| R _{2, 3, 4} | AC input resistance | | 10.0 | – | – | MΩ |
| V _{2, 3, 4} | internal bias during clamping | | – | 5.1 | – | V |
| I _{2, 3, 4} | DC input current between clamping pulses | | – | – | 0.1 | μA |
| I _{2, 3, 4(max)(clamp)} | maximum input current during clamping | | 100 | 180 | 260 | μA |
| Fast signal switches and blanking (fast signal switch 1 (pin 13); Y, CD / R₁, G₁, B₁; control bits FSDIS1, FSON1) | | | | | | |
| V ₁₃ | voltage to select Y and CD | | – | 0 | 0.4 | V |
| V ₁₃ | voltage range to select R ₁ , G ₁ and B ₁ | | 0.9 | 1.0 | 5.5 | V |
| R ₁₃ | internal resistor to ground | | 3.3 | 3.8 | 4.8 | kΩ |
| CROSSTALK (SEE TABLE 5) | | | | | | |
| t _s – t _i | difference between transit times for signal switching and signal insertion | | – | – | 10 | ns |
| Fast signal switch 2 (pin 1; Y, CD or R₁, G₁, B₁ / R₂, G₂, B₂; control bits FSDIS2, FSON2) | | | | | | |
| V ₁ | voltage to select Y and CD / R ₁ , G ₁ and B ₁ | | – | 0 | 0.4 | V |
| V ₁ | voltage range to select R ₂ , G ₂ and B ₂ | | 0.9 | 1.0 | 5.5 | V |
| V ₁ | required minimal voltage to switch off the ADBL measurement | | – | 0.87 | 1.0 | V |
| R ₁ | internal resistor to ground | R ₁ > R ₁₃ | 2.8 | 4.2 | 6.0 | kΩ |
| CROSSTALK (SEE TABLE 5) | | | | | | |
| t _s – t _i | difference between transit times for signal switching and signal insertion | | – | – | 10 | ns |
| Adjust stages (adaptive black, gamma, contrast, saturation, brightness and white point adjust, blue stretch) | | | | | | |
| ADAPTIVE BLACK (DETECTORS INACTIVE STATUS DUE TO ACTION OF FAST SWITCH 2 (PIN 1); see Table 4, Fig.9 and note 2) | | | | | | |
| I _{18(dch)} | discharge current of peak dark storage capacitor | outside active measurement window | –1.0 | 0.0 | +1.0 | μA |
| | | inside active measurement window | 1.5 | 2.5 | 3.5 | μA |
| I _{18(ch)} | charge current of peak dark storage capacitor | | –360 | –300 | –250 | μA |
| d _{bl(max)} | maximum level shift: Δ black level in percent of nominal signal amplitude | | 10 | 13 | 16 | % |
| d _{bl(nom)} | difference between nominal black and adaptive black in percent of nominal signal amplitude | | –3 | 0 | +3 | % |
| t _{dibb} | detectors inactive time before blanking | | 2.3 | 3.1 | 4.0 | μs |
| t _{diab} | detectors inactive time after blanking | | 2.3 | 2.5 | 3.4 | μs |

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| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|--|--|--|--------|------------|--------|--------|
| GAMMA ADJUST (ACTS ON INTERNAL Y SIGNAL; Y MATRIX SEE Y OUTPUT; I ² C-BUS CONTROLLED POTENTIOMETER (SUBADDRESS 0BH); RESOLUTION 6 BIT; note 3) | | | | | | |
| d _g | range of gamma minimum (3FH) maximum (00H) | | – – | 0.7 1.0 | – – | – – |
| G _{max} | maximum gain at minimum gamma | near nominal black | 5 | 6 | 7 | dB |
| SATURATION ADJUST (ACTS ON RGB SIGNALS; Y MATRIX SEE Y OUTPUT; I ² C-BUS CONTROLLED POTENTIOMETERS (SUBADDRESS 01H); RESOLUTION 1.5% OF MAXIMUM SATURATION) | | | | | | |
| d _{s(max)} | maximum saturation | I ² C-bus data 3FH; measured at 100 kHz; relative to nominal saturation; note 4 | 4.7 | 5.2 | 5.8 | dB |
| d _{s(min)} | minimum saturation | I ² C-bus data 00H; measured at 100 kHz; relative to typical value of maximum saturation | – | – | –50 | dB |
| CONTRAST ADJUST (ACTS ON RGB SIGNALS; I ² C-BUS CONTROLLED POTENTIOMETERS (SUBADDRESS 02H); RESOLUTION 1.5% OF MAXIMUM CONTRAST) | | | | | | |
| d _{c(max)} | maximum contrast | I ² C-bus data 3FH; limiters inactive; relative to nominal contrast; note 5 | – | 4.5 | 5.5 | dB |
| d _{c(min)} | minimum contrast | I ² C-bus data 00H; relative to maximum contrast | –28 | –22 | –16 | dB |
| BRIGHTNESS ADJUST (ACTS ON RGB SIGNALS; I ² C-BUS CONTROLLED POTENTIOMETERS (SUBADDRESS 00H); RESOLUTION 1.5% OF RANGE; Δ BLACK LEVEL IN PERCENT OF NOMINAL SIGNAL AMPLITUDE REFERRED TO CUT-OFF MEASURING LEVEL) | | | | | | |
| d _{br(max)} | maximum brightness: Δ black level | I ² C-bus data 3FH | 23 | 30 | 37 | % |
| d _{br(nom)} | nominal brightness: Δ black level | I ² C-bus data 29H | –7 | 0 | +7 | % |
| d _{br(min)} | minimum brightness: Δ black level | I ² C-bus data 00H | –58 | –50 | –42 | % |
| d _{br(max)} | maximum brightness: Δ black level | I ² C-bus data 3FH; control bits BCOF = 1 and MOD2 = 0 | 23 | 30 | 37 | % |
| d _{br(min)} | minimum brightness: Δ black level | I ² C-bus data 00H; control bits BCOF = 1 and MOD2 = 0 | –58 | –50 | –42 | % |
| BLUE STRETCH (BLUE STRETCH IS ACTIVATED BY I ² C-BUS CONTROL BIT BLST = 1; see Fig.9) | | | | | | |
| G _{bs} | increase of small signal gain | 100% of nominal signal amplitude and at 1 MHz | 15 | 20 | 25 | % |

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| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|--|--|------|------|------|----------|
| DIFFERENCES OF BLACK LEVEL STEPS (DIFFERENCES FROM CHANNEL TO CHANNEL OF THE RATIO OF THE DIFFERENCE (BLACK LEVEL CUT-OFF MEASUREMENT LEVEL) TO ACTUAL NOMINAL SIGNAL AMPLITUDE (V_{NOM24} , V_{NOM22} , V_{NOM20}) OVER THE WHOLE CONTRAST, BRIGHTNESS AND SATURATION RANGE, SWITCHING MATRIX OR SWITCHING FAST SWITCHES, GAMMA = 1, BLST = 0, ADBL = 0) | | | | | | |
| $\Delta V/V_{nom}$ | static deviation | note 6; ripple on pin 5 during clamping ≤ 1 mV; note 7 | -1.0 | - | +1.0 | % |
| | | at nominal saturation | -0.5 | - | +0.5 | % |
| RGB outputs (output for positive RGB signals (R: pin 24, G: pin 2, B: pin 20); following data without external load) | | | | | | |
| $R_{24, 22, 20}$ | differential output resistance | | - | 25 | 30 | Ω |
| $I_{24, 22, 20(max)}$ | maximum output current | | 4.0 | 5.0 | - | mA |
| $V_{24, 22, 20(min)}$ | minimum output voltage | note 8 | - | - | 0.8 | V |
| $V_{24, 22, 20(max)}$ | maximum output voltage | $R_L \geq 2$ k Ω | 6.3 | 7.0 | - | V |
| $V_{24, 22, 20(max)(p-p)}$ | maximum signal amplitude (black-white) due to internal limits (peak-to-peak value) | | 3.3 | - | - | V |
| $V_{24, 22, 20(max)(p-p)}$ | nominal signal amplitude (black-white; peak-to-peak value) | at nominal white adjust, contrast and saturation setting; gamma = 1; nominal input signals | 1.7 | 2.0 | 2.3 | V |
| $V_{24, 22, 20}$ | cut-off measurement level | note 8 | 1.0 | - | 5.0 | V |
| $V_{24, 22, 20}$ | recommended cut-off measurement level | | - | 3.0 | - | V |
| OUTPUT CLAMPING (RGB) | | | | | | |
| $V_{20, 22, 24}$ | clamp voltage black level | control bit BCOF = 1 | 2.3 | 2.5 | 2.7 | V |
| WHITE POTENTIOMETERS | | | | | | |
| $\Delta G_{V(inc)(max)}$ | maximum increase of AC gain | I ² C-bus data 3FH; relative to nominal setting; note 9 | 40 | 50 | 60 | % |
| $\Delta G_{V(dec)(max)}$ | maximum decrease of AC gain | I ² C-bus data 00H; relative to nominal setting; note 9 | 40 | 50 | 60 | % |

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| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|--|---|--|------|------|-------------|---------|
| OVERALL WHITE POINT DEVIATION | | | | | | |
| $\Delta V/V_{nom}$ | note 10 | input: (RGB) _{1, 2} ; differences from channel to channel of the ratio of the difference (signal white level cut-off measurement level) to actual nominal signal amplitude (V_{nom24} , V_{nom22} , V_{nom20}) over the whole saturation range at nominal contrast, brightness and nominal input signals; ripple on pin 5 during clamping ≤ 1 mV; note 7 | -2.0 | - | +2.0 | % |
| Frequency behaviour | | | | | | |
| BETWEEN THE Y INPUT (PIN 8) AND THE RGB OUTPUTS (PINS 24, 22 AND 20) | | | | | | |
| ΔG | decrease in gain | 1 M Ω and 20 pF load at 13 MHz | - | - | 3 | dB |
| BETWEEN THE COLOUR-DIFFERENCE INPUTS (PINS 7 AND 6) AND THE CORRESPONDING R AND B OUTPUTS (PINS 24 AND 20) | | | | | | |
| ΔG | decrease in gain | at 13 MHz | - | - | 3 | dB |
| BETWEEN THE (RGB) _{1, 2} INPUTS (PINS 10, 11 AND 12 OR 2, 3 AND 4) AND THE RGB OUTPUTS (PINS 24, 22 AND 20) | | | | | | |
| ΔG | decrease in gain | at 22 MHz | - | - | 3 | dB |
| Sandcastle input (pin 14; control bit SC5); note 11 | | | | | | |
| I_{14} | input current | $V_{14} < 0.5$ V | -100 | - | - | μ A |
| C_{14-9} | input capacitance | | - | - | 10 | pF |
| V_{14} | required voltage range | | | | | |
| | for horizontal and vertical blanking pulses | SC5 = 0 or SC5 = 1 | 2.0 | 2.5 | 3.0 | V |
| | for horizontal pulses (line count) | SC5 = 0 | 4.0 | 4.5 | 4.9 | V |
| | for burst key pulses | SC5 = 0 | 6.1 | - | $V_P + 5.8$ | V |
| | for burst key pulses and line count | SC5 = 1 | 4.0 | - | $V_P + 5.8$ | V |

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| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|---|---|----------|-----------------|----------|--------------------------------|
| CLAMP PULSE DELAY | | | | | | |
| $T_{d(\text{clamp})}$ | delay of leading edge of clamping pulse | nominal sandcastle pulse DELOF = 0 DELOF = 1 | 1.2 – | 1.5 0 | 1.8 – | μs μs |
| REQUIRED MINIMAL BURST GATE PULSE WIDTH | | | | | | |
| t_w | DELOF = 0 | line frequency: 16 kHz | 3 | – | – | μs |
| | DELOF = 1 | line frequency: 32 kHz | 1.5 | – | – | μs |
| Generation of measurement lines and blanking; note 12 | | | | | | |
| $\Delta V/V_{\text{nom}}$ | $\Delta V = V_{\text{CL}} - V_{\text{UB}}$ difference between ultra black level (VUB) and measurement level (VCL) in percent of nominal signal amplitude | no clipping; independent of white point adjust | 25 | 35 | 45 | % |
| WARM UP TEST PULSE DURING MT (see pulse diagram Fig.10) | | | | | | |
| V_{WU} | warm up level | $V_{\text{WU}} = V_{\text{PL}} - 1 \text{ V}$; V_{PL} = peak drive level (see also signal limiting); given by I ² C-bus; subaddress 0AH; no warm up test pulse in the event of output clamping (BCOF = 1) | – | – | – | – |
| $V_{\text{WU(max)}}$ | maximum warm up level | I ² C-bus data 3FH; RELC = 0 | 6.3 | 6.6 | 6.9 | V |
| $V_{\text{WU(fixed)}}$ | fixed warm up level | RELC = 1 | 5.0 | 5.2 | 5.4 | V |
| THRESHOLD FOR POWER ON RESET (POR) DURING TIME DG (see pulse diagram Fig.10) | | | | | | |
| $V_{20, 22, 24(\text{POR})}$ | output voltage to cause POR | RELC = 0 | – | V_{PL} | – | V |
| | | RELC = 1 | – | 5.7 | – | V |
| Y output (pin 26; note 13) | | | | | | |
| $V_{26(\text{nom})(\text{p-p})}$ | nominal signal amplitude (black-white; independent of gamma, adaptive black, saturation, contrast and brightness; peak-to-peak value) | control bit YEXH = 1; hue DAC (subaddress 03H) set to >28H | 0.85 | 1.0 | 1.15 | V |
| V_{26} | black level | YEXH = 1; I ² C-bus data 3FH | – | 4.0 | – | V |
| | | YEXH = 1; I ² C-bus data 20H | – | 2.0 | – | V |
| a_r | Y matrix coefficients | $Y = a_r R + a_g G + a_b B$ | 0.27 | 0.30 | 0.33 | |
| a_g | Y matrix coefficients | $Y = a_r R + a_g G + a_b B$ | 0.53 | 0.59 | 0.65 | |
| a_b | Y matrix coefficients | $Y = a_r R + a_g G + a_b B$ | 0.10 | 0.11 | 0.12 | |

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| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|--|---|-------------------------------------|------|------|-------------|------------|
| R_{26} | differential output resistance | | – | 190 | 230 | Ω |
| $\Delta\tau_{26}$ | group delay time | between RGB outputs and Y output | 20 | 25 | 30 | ns |
| f_g | 3 dB bandwidth | | 11 | 15 | – | MHz |
| Automatic cut-off control (pin 19; measurement periods see beam info on pin 19) | | | | | | |
| V_{19} | permissible voltage (also during scanning period) | | – | – | $V_P - 1.4$ | V |
| V_{REF0} | internally controlled voltage on pin 19 | during leakage measurement time LM | 2.4 | 2.7 | 3.0 | V |
| $I_{o19(max)}$ | maximum output current | | –350 | – | –250 | μ A |
| $I_{i19(max)}$ | maximum input current | | 250 | – | 350 | μ A |
| R_{19} | input resistance for measurement input | | 1 | – | – | M Ω |
| I_{19} | additional input current | only during warm up | – | 0.5 | – | mA |
| V_{19} | threshold of warm up detector (active in line MG) | | 4.3 | 4.5 | 4.7 | V |
| V_{MEAS} | difference between input voltage for cut-off and V_{REF0} ; adjustable via I ² C-bus (subaddress for reference: R: 07H, G: 08H and B: 09H) | | – | – | – | – |
| | maximum V_{MEAS} | I ² C-bus data 3FH | 1.45 | 1.6 | 1.75 | V |
| | nominal V_{MEAS} | I ² C-bus data 20H | 0.9 | 1.0 | 1.1 | V |
| | minimum V_{MEAS} | I ² C-bus data 00H | 0.4 | 0.45 | 0.5 | V |
| Storage of cut-off control voltage / output clamping voltage (pins 25, 23 and 21) | | | | | | |
| $I_{25, 23, 21}$ | input currents of storage inputs outside of the measurement time | | – | – | 0.1 | μ A |
| $ I_{25, 23, 21(max)} $ | maximum charge / discharge current during measurement time | | 0.2 | 0.3 | 0.4 | mA |
| G_{stg} | gain from storage pins 25, 23 and 21 to outputs | | – | 1.7 | – | – |
| Storage of leakage information (pin 17) | | | | | | |
| I_{17} | maximum charge / discharge current at time LM | | 300 | 400 | – | μ A |
| I_{17} | discharge current | peak limiting during time MK active | – | 4 | – | mA |
| I_{17} | leakage current | outside time LM | – | – | 0.1 | μ A |
| V_{17} | voltage to reset IC to switch on conditions | V_{17} is below | 2.3 | 2.5 | 3.0 | V |

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| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|---|---|------|------|------|------|
| Signal limiting (the limitation acts on contrast and at low contrast on brightness) | | | | | | |
| AVERAGE BEAM CURRENT LIMITING (PIN 15) | | | | | | |
| V ₁₅ | start of contrast reduction | | – | 4 | – | V |
| ΔV ₁₅ | input range for full contrast reduction | | – | –2 | – | V |
| V ₁₅ | start of brightness reduction | | – | 2.5 | – | V |
| ΔV ₁₅ | input range for full brightness reduction | | – | –1.6 | – | V |
| I ₁₅ | input current | | – | – | –0.5 | μA |
| PEAK SIGNAL LIMITING OF OUTPUT SIGNALS (PIN 16; THE LIMITATION ACTS 1H DELAYED; LIMITING LEVEL ADJUSTABLE BY I ² C-BUS (SUBADDRESS 0AH; CONTROL BIT RELC = 0)) | | | | | | |
| V _{24, 22, 20(max)} | maximum limiting level | extrapolated from 2FH | 6.8 | – | 7.2 | V |
| V _{24, 22, 20(min)} | minimum limiting level | I ² C-bus data 00H | – | 2.3 | 3 | V |
| I _{16(max)} | maximum discharge current at peak drive | RELC = 0 | 4 | – | 6 | mA |
| PEAK SIGNAL LIMITING (PIN 16; CONTROL BIT RELC = 1; LIMITING LEVEL (V _{LIL}) ADJUSTABLE BY I ² C-BUS (SUBADDRESS 0AH)) | | | | | | |
| V _{LIL} | | equal gain in white point adjust; signal only in one output channel; peak drive limiting starts, if the maximum of the RGB signals after white point adjustment exceeds a threshold | | | | |
| | maximum limiting level | I ² C-bus data 3FH | 3.2 | 3.5 | 4.0 | V |
| | minimum limiting level | I ² C-bus data 00H | 1.2 | 1.5 | 1.8 | V |
| DISCHARGE CURRENTS (CUT-OFF MEASUREMENT LEVEL MX = MR OR MB OR MG) | | | | | | |
| I _{16(tot)(dch)} | total discharge current | $I_{16} = I_{16(1)} + I_{16(2)} + I_{16(3)}$ | – | – | – | – |
| <i>Threshold 1 (TH1)</i> | | | | | | |
| I _{16(1)(max)(dch)} | maximum discharge current | TH1 = MX + V _{LIL} ; 1 line delayed and low-pass filtered | 4.5 | 6 | 7.5 | mA |
| S | steepness | | – | 15 | – | mA/V |
| <i>Low-pass filter, control bit TCPL</i> | | | | | | |
| t _{DPDL} | time constant low-pass filter | TCPL = 1 (at 1f _H); RELC = 1 | 0.9 | 1.2 | 1.5 | μs |
| t _{DPDL} | time constant low-pass filter | TCPL = 0 (at 2f _H); RELC = 1 | 0.4 | 0.6 | 0.8 | μs |
| <i>Threshold 2 (TH2)</i> | | | | | | |
| I _{16(2)(max)(dch)} | maximum discharge current | TH2 = MX + V _{LIL} × 1.10; 1 line delayed | 4.5 | 6 | 7.5 | mA |
| S | steepness | | – | 15 | – | mA/V |

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|--|---|--|------|------|------|---------|
| Threshold 3 (TH3) | | | | | | |
| $I_{16(3)(\max)(dch)}$ | maximum discharge current | TH3 = MX + V_{LIL} ; undelayed | 0.45 | 0.6 | 0.75 | mA |
| S | steepness | | – | 1.5 | – | mA/V |
| CHARGE CURRENT | | | | | | |
| I_{16} | charge current | | –2 | –1 | –0.5 | μ A |
| V_{16} | start of contrast reduction | | – | 4 | – | V |
| ΔV_{16} | input range for full contrast reduction | | – | –2 | – | V |
| V_{16} | start of brightness reduction | | – | 2.5 | – | V |
| ΔV_{16} | input range for full brightness reduction | | – | –1.6 | – | V |
| $V_{16(\max)}$ | maximum voltage by internal limitation | | 4.5 | – | – | V |
| Hue adjust output (pin 26); note 14 | | | | | | |
| $V_{o26(\min)}$ | minimum output voltage | YEXH = 0; I ² C-bus data 00H | 0.5 | – | 1.0 | V |
| $V_{o26(\text{nom})}$ | nominal output voltage | YEXH = 0; I ² C-bus data 20H | 3.0 | 3.2 | 3.4 | V |
| $V_{o26(\max)}$ | maximum output voltage | YEXH = 0; I ² C-bus data 3FH | 4.8 | – | 5.6 | V |
| I_{26} | current of internal emitter follower | | 500 | 700 | – | μ A |
| I²C-bus inputs | | | | | | |
| f_{28} | clock frequency range | | 0 | – | 100 | kHz |
| $t_{SU;DAT}$ | data set-up time | | 250 | – | – | ns |
| t_H | clock pulse HIGH | | 4 | – | – | μ s |
| t_L | clock pulse LOW | | 4.7 | – | – | μ s |
| t_r | rise time | | – | – | 1 | μ s |
| t_f | fall time | | – | – | 0.3 | μ s |
| Input levels (pins 27 and 28) | | | | | | |
| V_{IL} | LOW level input voltage | | – | – | 1.5 | V |
| V_{IH} | HIGH level input voltage | | 3.0 | – | 5.5 | V |
| I_I | input current | V_{27} and $V_{28} = 0.4$ V | –10 | – | – | μ A |
| | | V_{27} and $V_{28} = 0.9V_P$ | – | – | 10 | μ A |
| Output level (pin 27) | | | | | | |
| V_{OL} | LOW level output voltage | | – | – | 0.4 | V |
| I_O | output current | $V_{27} = 0.4$ V | 3.0 | – | – | mA |

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Notes to the characteristics

1. RGB signals controlled by saturation, adaptive black, contrast and brightness. Gamma affects the Y component of the internal RGB signals.
2. Adaptive black control acts on Y signal, which is either Y input or Y output from RGB matrix. Negative set-up is not affected. The level shift value is determined by the peak dark detector, operation selected by control bit ADBL. The peak dark detector is inactive during blanking. Peak dark detector activated by internal line counter, which starts after the end of the vertical blank of the sandcastle. Active from line 16 (after end of vertical sandcastle) to line 224 (NTSC mode, NMEN = 1) or line 272 (PAL mode, NMEN = 0). It is recommended to increase the contrast value (subaddress 02H) by 15% if ADBL = 1. The line numbers are doubled if control bit HDTV = 1.
3. At minimum gamma (3FH) any differences in black level steps are amplified by 6 dB.
4. For nominal saturation the range of values is:
 - a) 1FH is the minimum value that can be used
 - b) 20H is the typical value that can be used
 - c) 21H is the maximum value that can be used.
5. For nominal contrast the range of values is:
 - a) 20H is the minimum value that can be used
 - b) 22H is the typical value that can be used
 - c) 24H is the maximum value that can be used.
6.
$$\frac{\Delta V}{V_{\text{nom}}} = \frac{\Delta V_{24}}{V_{\text{nom24}}} - \frac{\Delta V_{22}}{V_{\text{nom22}}} = \frac{\Delta V_{24}}{V_{\text{nom24}}} - \frac{\Delta V_{20}}{V_{\text{nom20}}} = \frac{\Delta V_{22}}{V_{\text{nom22}}} - \frac{\Delta V_{20}}{V_{\text{nom20}}}$$
. For meaning of actual nominal signal see chapter "Characteristics".
7. Series resistor in supply voltage should be less than 0.3 Ω .
8. At 1.0 V cut-off measurement level the function of the cut-off control loop is not guaranteed because the blanking level is limited to the minimum output voltage. For proper working a guide number for the minimum cut-off measurement level is 1.3 V.
9. For nominal AC gain settings the range of values is:
 - a) 21H is the minimum value that can be used
 - b) 22H is the typical value that can be used
 - c) 23H is the maximum value that can be used.
10.
$$\frac{\Delta V}{V_{\text{nom}}} = \frac{\Delta V_{24}}{V_{\text{nom24}}} - \frac{\Delta V_{22}}{V_{\text{nom22}}} = \frac{\Delta V_{24}}{V_{\text{nom24}}} - \frac{\Delta V_{20}}{V_{\text{nom20}}} = \frac{\Delta V_{22}}{V_{\text{nom22}}} - \frac{\Delta V_{20}}{V_{\text{nom20}}}$$
. For meaning of actual nominal signal see chapter "Characteristics".
11. Sandcastle pulse detector (pin 14)
The sandcastle pulse is compared with 3 (control bit SC5 = 0) or 2 (SC5 = 1) internal threshold levels to separate the various pulses; the internal pulses are generated while the input is higher than the thresholds. The thresholds are independent of supply voltage and temperature.

RGB video processor with automatic cut-off control and gamma adjust

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12. Blanking to ultra black level occurs during time DG except MR in R-channel, MG in G-channel, MB in B-channel (see Fig.10).
 - a) Leakage current measuring time:
LM will start after the end of vertical sandcastle (see Fig.10).
 - b) Vertical blanking period and cut-off measurement lines (see Fig.10):
The vertical component will be identified if it contains 2 or more burst key pulses in the event of SC5 = 1 or two or more line pulses (H) in the event of SC5 = 0. The line counter is triggered by the leading edge.
The blanking time is valid for a vertical pulse detected by the sandcastle decoder.
The internal blank pulse is OR gated with the sandcastle vertical pulse and the end of the measurement pulses.
 - c) Insertion time: full line period.
 - d) Measurement time: line period minus horizontal period (50/60 Hz).
 - e) Line sequence of measuring lines (see Fig.10):
First line after end of horizontal pulse which followed the end of vertical pulse: leakage measurement LM
First line after leakage measurement pulse: red measurement MR
Second line after leakage measurement pulse: green measurement MG
Third line after leakage measurement pulse: blue measurement MB.
13. Y output can be switched to hue adjust output via I²C-bus control bit YEXH. Output without sync pulse.
Recommendation: Hue adjust DAC set to 3FH. Black level adjustable via hue adjust DAC.
14. Output can be switched to Y output via I²C-bus control bit YEXH (via I²C-bus, resolution 6-bit, bus subaddress 03H).

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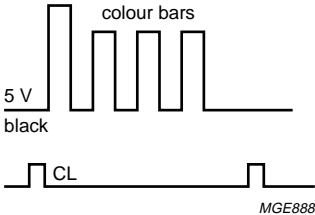
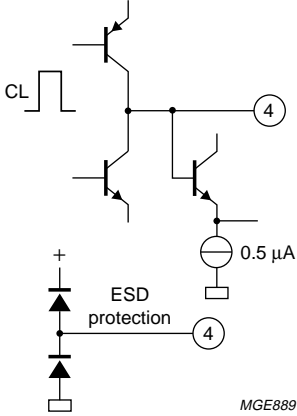
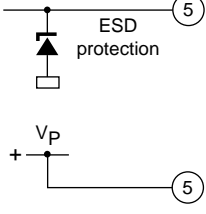
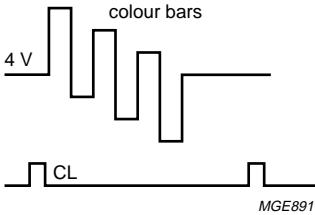
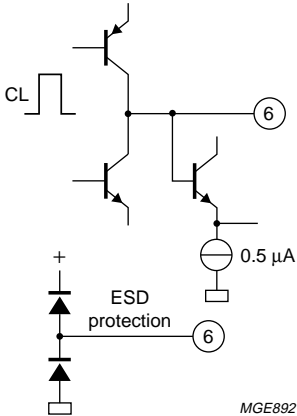
INTERNAL PIN CONFIGURATIONS

Abbreviations: OB: Open Base and CL: Clamp Pulse.

| PIN | PIN NAME (DESCRIPTION) | WAVE FORM | I or Z | INTERNAL CIRCUIT |
|-----|------------------------|---------------|-----------|------------------|
| 1 | fast switch 2 input | | | <p>MGE883</p> |
| 2 | red input 2 | <p>MGE884</p> | 100 μA/OB | <p>MGE885</p> |
| 3 | green input 2 | <p>MGE886</p> | 100 μA/OB | <p>MGE887</p> |

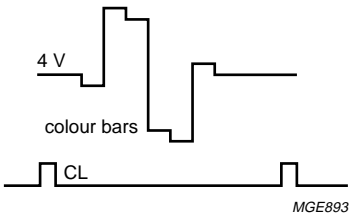
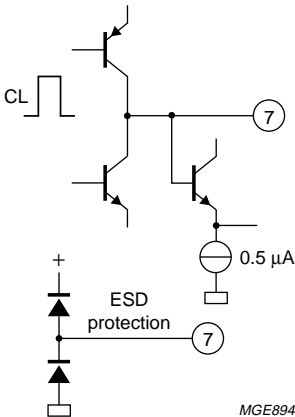
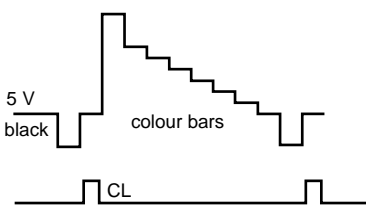
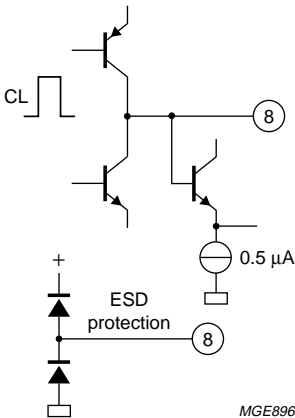
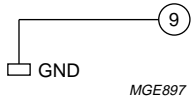
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| PIN | PIN NAME (DESCRIPTION) | WAVE FORM | I or Z | INTERNAL CIRCUIT |
|-----|------------------------------------|---|----------------|---|
| 4 | blue input 2 |  <p style="text-align: right;"><i>MGE888</i></p> | 100 μ A/OB |  <p style="text-align: right;"><i>MGE889</i></p> |
| 5 | supply voltage | | |  <p style="text-align: right;"><i>MGE890</i></p> |
| 6 | colour difference input $-(B - Y)$ |  <p style="text-align: right;"><i>MGE891</i></p> | 100 μ A/OB |  <p style="text-align: right;"><i>MGE892</i></p> |

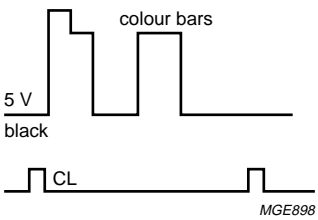
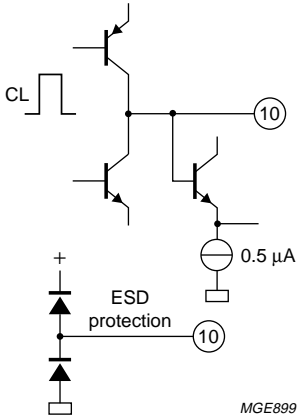
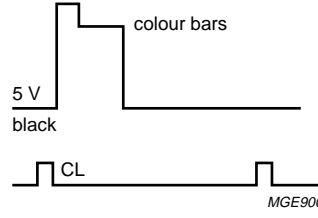
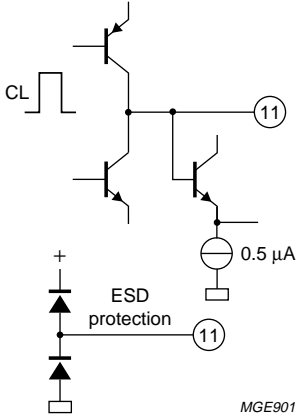
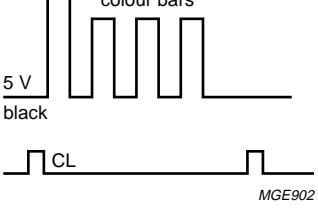
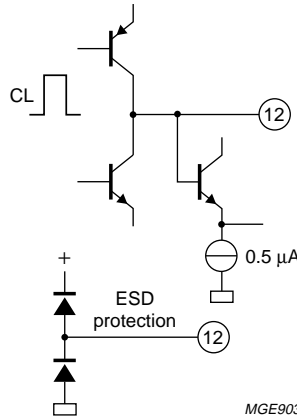
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| PIN | PIN NAME (DESCRIPTION) | WAVE FORM | I or Z | INTERNAL CIRCUIT |
|-----|------------------------------------|--|----------------|---|
| 7 | colour difference input $-(R - Y)$ |  | 100 μ A/OB |  |
| 8 | luminance input |  | 100 μ A/OB |  |
| 9 | ground | | |  <p data-bbox="1027 1621 1347 1682">no ESD protection circuit for ground pin</p> |

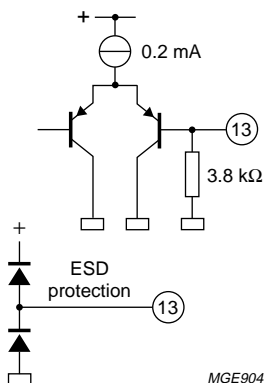
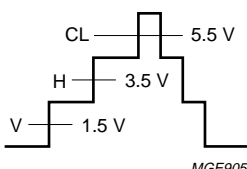
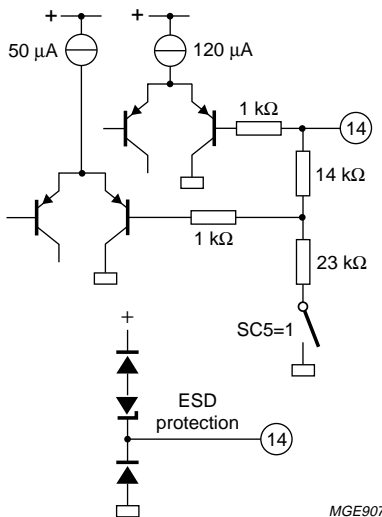
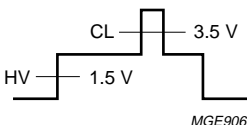
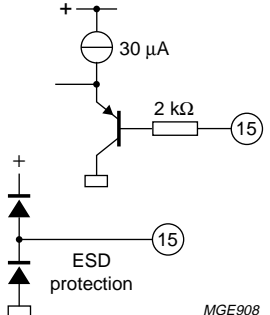
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| PIN | PIN NAME (DESCRIPTION) | WAVE FORM | I or Z | INTERNAL CIRCUIT |
|-----|------------------------|---|----------------|---|
| 10 | red input 1 |  | 100 μ A/OB |  |
| 11 | green input 1 |  | 100 μ A/OB |  |
| 12 | blue input 1 |  | 100 μ A/OB |  |

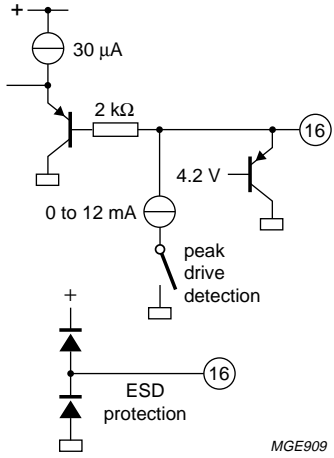
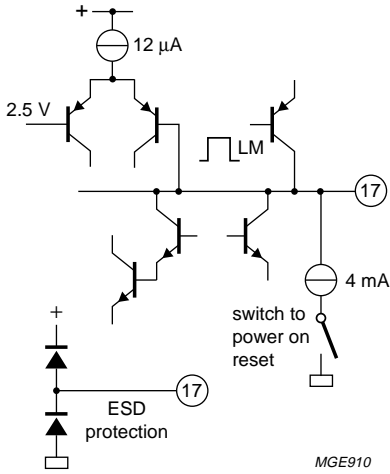
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| PIN | PIN NAME (DESCRIPTION) | WAVE FORM | I or Z | INTERNAL CIRCUIT |
|-----|-------------------------------------|--|--------------------|--|
| 13 | fast switch 1 input | | |  <p style="text-align: right;">MGE904</p> |
| 14 | sandcastle pulse input | <p>3-level sandcastle</p>  <p style="text-align: right;">MGE905</p> | 37 kΩ (SC5 = 0) |  <p style="text-align: right;">MGE907</p> |
| | | <p>2-level sandcastle</p>  <p style="text-align: right;">MGE906</p> | OB (SC5 = 1) | |
| 15 | average beam current limiting input | | OB |  <p style="text-align: right;">MGE908</p> |

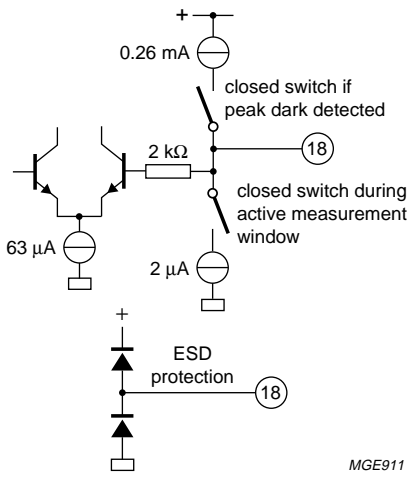
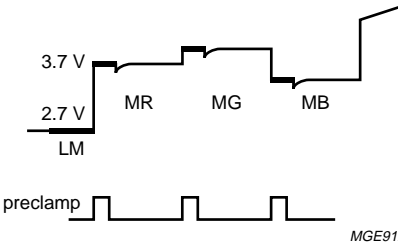
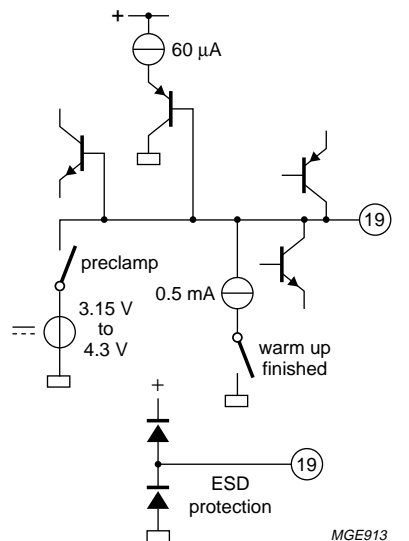
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| PIN | PIN NAME (DESCRIPTION) | WAVE FORM | I or Z | INTERNAL CIRCUIT |
|------------------------------------|--|-------------------------------------|--------|---|
| 16 | storage capacitor for peak limiting | outside peak drive | OB |  |
| during peak drive (RELC = 1) | | 0 to 12 mA | | |
| during peak drive (RELC = 0) | | 5 mA | | |
| 17 | storage capacitor for leakage current compensation | outside leakage current measurement | OB |  |
| during leakage current measurement | | -400 µA to +400 µA | | |
| automatic switch to power on reset | | 4 mA | | |

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| PIN | PIN NAME (DESCRIPTION) | WAVE FORM | I or Z | INTERNAL CIRCUIT |
|-----|---------------------------------|--|--------------------|---|
| 18 | storage capacitor for peak dark | | OB/0.26 mA |  <p>0.26 mA closed switch if peak dark detected 2 kΩ closed switch during active measurement window 63 μA 2 μA ESD protection MGE911</p> |
| 19 | cut-off measurement input |  <p>3.7 V 2.7 V MR MG MB LM preclamp MGE912</p> | -300 μA to +300 μA |  <p>60 μA 0.5 mA 3.15 V to 4.3 V preclamp warm up finished ESD protection MGE913</p> |

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| PIN | PIN NAME (DESCRIPTION) | WAVE FORM | I or Z | INTERNAL CIRCUIT |
|-----|--------------------------------|--|------------------------------------|---|
| 20 | blue output | <p>BCOF = 0 cut-off measurement pulse brightness ultra black 1st line sawtooth signal MGE914</p> | 5 mA | <p>5 mA ESD protection MGE917</p> |
| | | <p>BCOF = 1 MOD2 = 0 brightness 2.5 V MGE915</p> | 5 mA | |
| | | <p>BCOF = 1 MOD2 = 1 2.5 V MGE916</p> | 5 mA | |
| 21 | blue cut-off storage capacitor | during cut-off control or during output clamping | OB -300 μ A to +300 μ A | <p>2.5 V 5 kΩ ESD protection MGE918</p> |

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| PIN | PIN NAME (DESCRIPTION) | WAVE FORM | I or Z | INTERNAL CIRCUIT |
|-----|---------------------------------|--|---------------------------------------|--|
| 22 | green output | <p>BCOF = 0 cut-off measurement pulse brightness 1st line sawtooth signal ultra black MGE919</p> | 5 mA | <p>5 mA ESD protection 22 MGE922</p> |
| | | <p>BCOF = 1 MOD2 = 0 brightness 2.5 V MGE920</p> | 5 mA | |
| | | <p>BCOF = 1 MOD2 = 1 2.5 V MGE921</p> | 5 mA | |
| 23 | green cut-off storage capacitor | during cut-off control or during output clamping | OB -300 μ A to +300 μ A | <p>2.5 V 5 kΩ ESD protection 23 MGE923</p> |

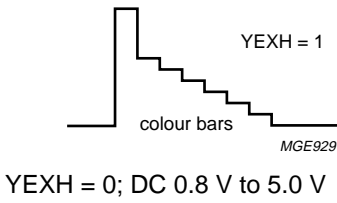
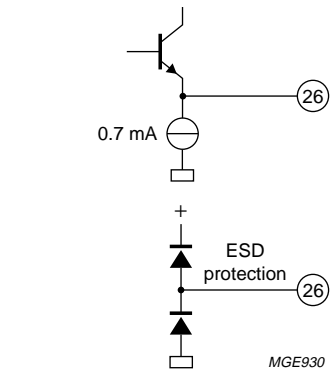
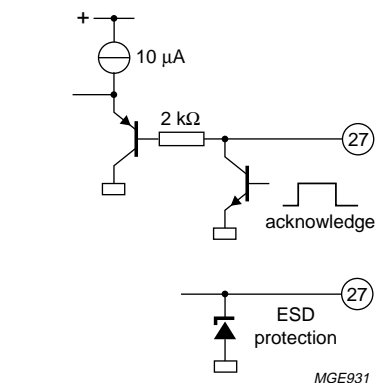
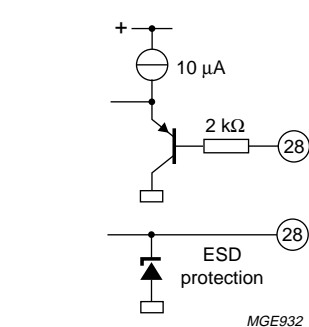
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| PIN | PIN NAME (DESCRIPTION) | WAVE FORM | I or Z | INTERNAL CIRCUIT |
|-----|-------------------------------|--|---------------------------------------|--|
| 24 | red output | <p>BCOF = 0 cut-off measurement pulse brightness ultra black 1st line sawtooth signal MGE924</p> | 5 mA | <p>5 mA ESD protection 24 MGE927</p> |
| | | <p>BCOF = 1 MOD2 = 0 brightness 2.5 V MGE925</p> | 5 mA | |
| | | <p>BCOF = 1 MOD2 = 1 brightness 2.5 V MGE926</p> | 5 mA | |
| 25 | red cut-off storage capacitor | during cut-off control or during output clamping | OB -300 μ A to +300 μ A | <p>2.5 V 5 kΩ ESD protection 25 MGE928</p> |

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| PIN | PIN NAME (DESCRIPTION) | WAVE FORM | I or Z | INTERNAL CIRCUIT |
|-----|---|---|---|---|
| 26 | Y output/hue adjust output |  | 0.7 mA |  |
| 27 | I ² C-bus serial data input/acknowledge output | outside acknowledge during acknowledge | OB less than 0.1 V up to 4 mA due to external pull-up resistor |  |
| 28 | I ² C-bus serial clock input | | OB |  |

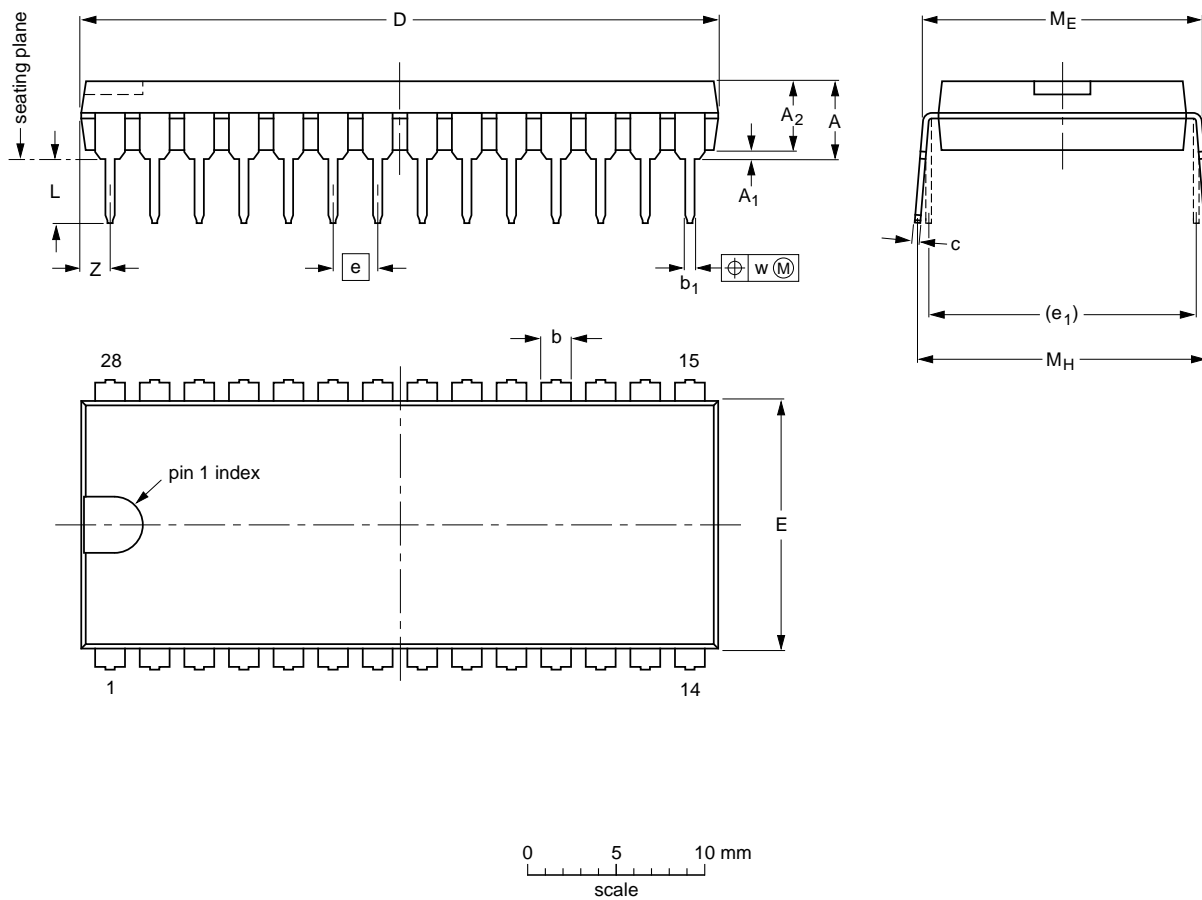
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PACKAGE OUTLINE

DIP28: plastic dual in-line package; 28 leads (600 mil)

SOT117-1



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

| UNIT | A max. | A ₁ min. | A ₂ max. | b | b ₁ | c | D ⁽¹⁾ | E ⁽¹⁾ | e | e ₁ | L | M _E | M _H | w | Z ⁽¹⁾ max. |
|--------|--------|---------------------|---------------------|----------------|----------------|----------------|------------------|------------------|------|----------------|--------------|----------------|----------------|------|-----------------------|
| mm | 5.1 | 0.51 | 4.0 | 1.7 1.3 | 0.53 0.38 | 0.32 0.23 | 36.0 35.0 | 14.1 13.7 | 2.54 | 15.24 | 3.9 3.4 | 15.80 15.24 | 17.15 15.90 | 0.25 | 1.7 |
| inches | 0.20 | 0.020 | 0.16 | 0.066 0.051 | 0.020 0.014 | 0.013 0.009 | 1.41 1.34 | 0.56 0.54 | 0.10 | 0.60 | 0.15 0.13 | 0.62 0.60 | 0.68 0.63 | 0.01 | 0.067 |

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|-----------------|------------|----------|------|--|---------------------|----------------------|
| | IEC | JEDEC | EIAJ | | | |
| SOT117-1 | 051G05 | MO-015AH | | | | 92-11-17 95-01-14 |

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SOLDERING

Introduction

There is no soldering method that is ideal for all IC packages. Wave soldering is often preferred when through-hole and surface mounted components are mixed on one printed-circuit board. However, wave soldering is not always suitable for surface mounted ICs, or for printed-circuits with high population densities. In these situations reflow soldering is often used.

This text gives a very brief insight to a complex technology. A more in-depth account of soldering ICs can be found in our "*IC Package Databook*" (order code 9398 652 90011).

Soldering by dipping or by wave

The maximum permissible temperature of the solder is 260 °C; solder at this temperature must not be in contact with the joint for more than 5 seconds. The total contact time of successive solder waves must not exceed 5 seconds.

The device may be mounted up to the seating plane, but the temperature of the plastic body must not exceed the specified maximum storage temperature ($T_{stg\ max}$). If the printed-circuit board has been pre-heated, forced cooling may be necessary immediately after soldering to keep the temperature within the permissible limit.

Repairing soldered joints

Apply a low voltage soldering iron (less than 24 V) to the lead(s) of the package, below the seating plane or not more than 2 mm above it. If the temperature of the soldering iron bit is less than 300 °C it may remain in contact for up to 10 seconds. If the bit temperature is between 300 and 400 °C, contact may be up to 5 seconds.

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DEFINITIONS

| | |
|---|---|
| Data sheet status | |
| Objective specification | This data sheet contains target or goal specifications for product development. |
| Preliminary specification | This data sheet contains preliminary data; supplementary data may be published later. |
| Product specification | This data sheet contains final product specifications. |
| Limiting values | |
| Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability. | |
| Application information | |
| Where application information is given, it is advisory and does not form part of the specification. | |

LIFE SUPPORT APPLICATIONS

These products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. Philips customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Philips for any damages resulting from such improper use or sale.

PURCHASE OF PHILIPS I²C COMPONENTS



Purchase of Philips I²C components conveys a license under the Philips' I²C patent to use the components in the I²C system provided the system conforms to the I²C specification defined by Philips. This specification can be ordered using the code 9398 393 40011.

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