

DATA SHEET

TDA4671

Picture Signal Improvement (PSI) circuit

Product specification
Supersedes data of June 1993
File under Integrated Circuits, IC02

1996 Dec 11

Picture Signal Improvement (PSI) circuit

TDA4671

FEATURES

- Luminance signal delay from 20 to 1 100 ns (minimum step 45 ns)
- Luminance signal peaking with symmetrical overshoots selectable
- Selectable 2.6 or 5 MHz peaking centre frequency and degree of peaking (–3, 0, +3 and +6 dB)
- Selectable noise reduction by coring
- Handles negative as well as positive colour-difference signals
- Selectable Colour Transient Improvement (CTI) to decrease the colour-difference signal transient times to those of the high frequency luminance signals
- Selectable 5 or 12 V sandcastle input voltage
- All controls selected via the I²C-bus
- Timing pulse generation for clamping and delay time control synchronized by sandcastle pulse
- Automatic luminance signal delay correction using a control loop
- Luminance and colour-difference input signal clamping with coupling capacitor
- 4.5 to 8.8 V supply voltage range
- Minimum of external components.



GENERAL DESCRIPTION

The TDA4671 delays the luminance signal and improves colour-difference signal transients. The luminance signal can also be improved by peaking and noise reduction (coring).

QUICK REFERENCE DATA

SYMBOL	PARAMETER	MIN.	TYP.	MAX.	UNIT
V _P	supply voltage (pins 1 and 5)	4.5	5	8.8	V
I _{P(tot)}	total supply current	31	41	52	mA
t _{d(Y)}	Y signal delay time	20	–	1 130	ns
V _{i(VBS)(p-p)}	composite Y input signal (peak-to-peak value, pin 16)	–	450	640	mV
V _{i(CD)(p-p)}	colour-difference input signal (peak-to-peak value)				
	±(R – Y) on pin 3	–	1.05	1.48	V
	±(R – Y) on pin 7	–	1.33	1.88	V
G _Y	gain of Y channel	–	–1	–	dB
G _{CD}	gain of colour-difference channel	–	0	–	dB
T _{amb}	operating ambient temperature	0	–	70	°C

ORDERING INFORMATION

TYPE NUMBER	PACKAGE		
	NAME	DESCRIPTION	VERSION
TDA4671	DIP18	plastic dual in-line package; 18 leads (300 mil)	SOT102-1

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BLOCK DIAGRAM

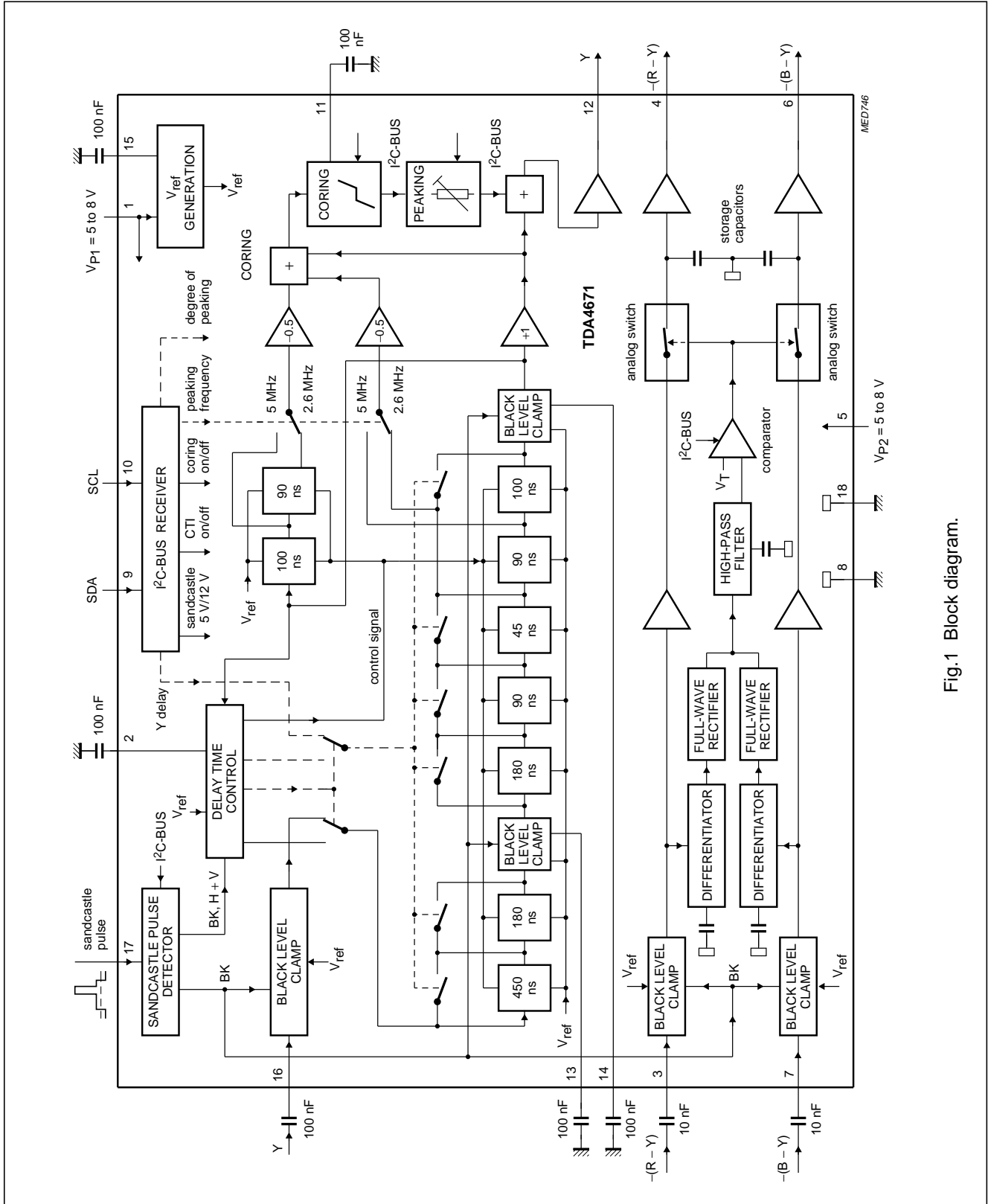


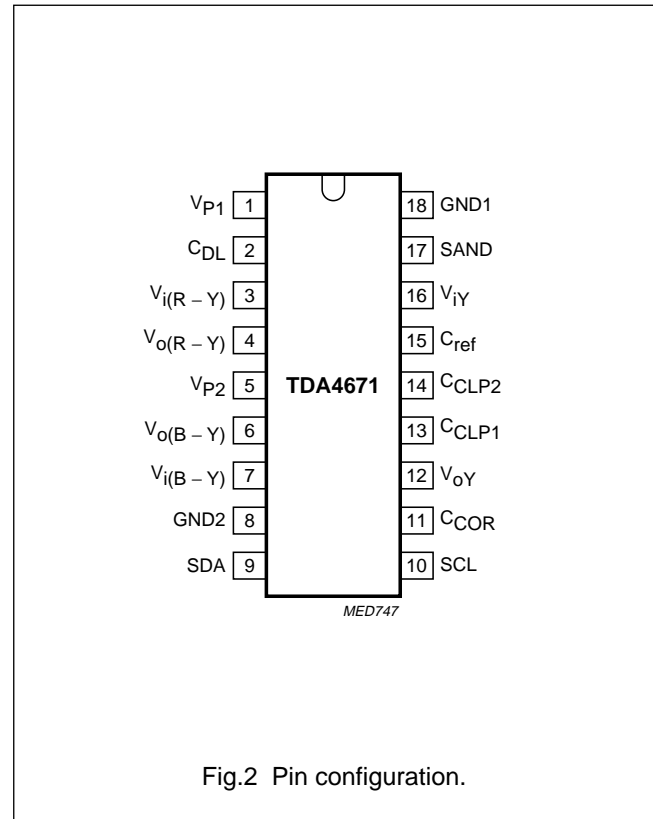
Fig.1 Block diagram.

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PINNING

SYMBOL	PIN	DESCRIPTION
V _{P1}	1	positive supply voltage 1
C _{DL}	2	capacitor of delay time control
V _{i(R-Y)}	3	$\pm(R - Y)$ colour-difference input signal
V _{o(R-Y)}	4	$\pm(R - Y)$ colour-difference output signal
V _{P2}	5	positive supply voltage 2
V _{o(B-Y)}	6	$\pm(B - Y)$ colour-difference output signal
V _{i(B-Y)}	7	$\pm(B - Y)$ colour-difference input signal
GND2	8	ground 2 (0 V)
SDA	9	I ² C-bus serial data input/output
SCL	10	I ² C-bus serial clock input
C _{COR}	11	coring capacitor
V _{oY}	12	delayed luminance output signal
C _{CLP1}	13	black level clamping capacitor 1
C _{CLP2}	14	black level clamping capacitor 2
C _{ref}	15	capacitor of reference voltage
V _{iY}	16	luminance input signal
SAND	17	sandcastle pulse input
GND1	18	ground 1 (0 V)



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FUNCTIONAL DESCRIPTION

The TDA4671 contains luminance signal processing and colour-difference signal processing. The luminance signal section comprises a variable, integrated luminance delay line with luminance signal peaking and a noise reduction by coring.

The colour-difference section consists of a transient improvement circuit to decrease the rise and fall times of the colour-difference signal transients. All functions and parameters are controlled via the I²C-bus.

Y-signal path

The video and blanking signal is AC-coupled to the input pin 16. Its black porch is clamped to a DC reference voltage to ensure the correct operating range of the luminance delay stage.

The luminance delay line consists of all-pass filter sections with delay times of 45, 90, 100, 180 and 450 ns (see Fig.1). The luminance signal delay is controlled via the I²C-bus in steps of 45 ns in the range of 20 to 1100 ns, this ensures that the maximum delay difference between the luminance and colour-difference signals is ± 22.5 ns.

An automatic luminance delay time adjustment in an internal control loop (with the horizontal frequency as a reference) is used to correct changes in the delay time, due to component tolerances. The control loop is automatically enabled between the burst key pulses of lines 16 (330) and 17 (331) during the vertical blanking interval. The control voltage is stored in capacitor C_{DL} connected to pin 2.

The peaking section is using a transversal filter circuit with selectable centre frequencies of 2.6 and 5.0 MHz.

It provides selectable degrees of peaking of -3, 0, +3 and +6 dB and noise reduction by coring, which attenuates the high-frequency noise introduced by peaking.

The output buffer stage ensures a low-ohmic VBS output signal on pin 12 (<160 Ω). The gain of the luminance signal path from pin 16 to pin 12 is unity.

An oscillation signal of the delay time control loop is present on output pin 12 instead of the VBS signal. It is present during the vertical blanking interval of the burst key pulses in lines 16 (330) to 18 (332). This sync should not be applied for synchronization.

Colour-difference signal paths

The colour-difference input signals (on pins 3 and 7) are clamped to a reference voltage.

Each colour-difference signal is fed to a transient detector and to an analog signal switch with an attached voltage storage stage.

The transient detectors consist of differentiators and full-wave rectifiers. The output voltages of both transient detectors are added and then compared. The comparator controls both following analog signal switches simultaneously.

The analog signal switches are in open position at a certain value of transient time; the held value (held by capacitors) is then applied to the outputs. The switches close to rapidly accept the actual signal levels at the end of these transients. The improved transient time is approximately 100 ns long independent of the input transient time.

Colour-difference paths are independent of the input signal polarity and have a nominal unity gain.

The CTI functions are switched on and off via the I²C-bus.

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LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134). V_{P1} and V_{P2} as well as GND1 and GND2 connected together.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{P1}	supply voltage (pin 1)		0	8.8	V
V_{P2}	supply voltage (pin 5)		0	8.8	V
P_{tot}	total power dissipation		0	0.97	W
T_{stg}	storage temperature		-25	+150	°C
T_{amb}	operating ambient temperature		0	70	°C
V_{ESD}	electrostatic handling	note 1			
	for pins 9 and 10		-	+300	V
	for other pins		-	-500	V
			-	±500	V

Note

1. Equivalent to 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	82	K/W

CHARACTERISTICS

$V_{P1} = V_{P2} = 5$ V; nominal video amplitude $V_{VB} = 315$ mV; $t_H = 64$ μ s; $t_{BK} = 4$ μ s (burst key); $T_{amb} = 25$ °C and measurements taken in Fig.4; unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{P1}	supply voltage (pin 1)		4.5	5	8.8	V
V_{P2}	supply voltage (pin 5)		4.5	5	8.8	V
$I_{P(tot)}$	total supply current		31	41	52	mA
Y-signal path						
$V_{i(Y)(p-p)}$	VBS input signal on pin 16 (peak-to-peak value)		-	450	640	mV
V_{16}	black level clamping voltage		-	3.1	-	V
I_{16}	input current	during clamping	±95	-	±190	μ A
		outside clamping	-	-	±0.1	μ A
R_{16}	input resistance	outside clamping	5	-	-	M Ω
C_{16}	input capacitance		-	3	10	pF
$t_{d(Y)(max)}$	maximum Y delay time	set via I ² C-bus	1070	1100	1130	ns
$t_{d(Y)(min)}$	minimum Y delay time	set via I ² C-bus	-	20	-	ns

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SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$\Delta t_{d(Y)}$	minimum delay step	set via I ² C-bus	40	45	50	ns
	group delay time difference	f = 0.5 to 5 MHz; maximum delay	–	0	±25	ns
	delay time difference between Y and colour-difference signals	Y delay; CTI and peaking off	70	100	130	ns
$t_{d(\text{peak})}$	minimum delay time for peaking		185	215	245	ns
G_Y	VBS signal gain measured on output pin 12 (composite signal, peak-to-peak value)	V_o/V_i ; f = 500 kHz; maximum delay	–2	–1	0	dB
I_{12}	output current (emitter-follower with constant current source)	source current	–1	–	–	mA
		sink current	0.4	–	–	mA
R_{12}	output resistance		–	–	160	Ω
f_{res}	frequency response for	maximum delay f = 0.5 to 3 MHz	–2	–1	0	dB
		f = 0.5 to 5 MHz	–4	–3	–1	dB
LIN	signal linearity for video contents of 315 mV (p-p)	$\alpha_{\text{min}}/\alpha_{\text{max}}$; $V_{\text{VBS}} = 450$ mV (p-p)	0.85	–	–	–
	video contents of 450 mV (p-p)	$V_{\text{VBS}} = 640$ mV (p-p)	0.60	–	–	–
Luminance peaking, selected via I²C-bus						
f_{peak}	peaking frequency	f_{C1} ; LCF-bit = 0	4.5	5	5.5	MHz
		f_{C2} ; LCF-bit = 1	2.3	2.6	2.9	MHz
V_{peak}	peaking amplitude for grade of peaking (f_C amplitude over 0.5 MHz amplitude) selectable values		–	–3	–	dB
			–	0	–	dB
			–	+3	–	dB
			–	+6	–	dB
	limitation of peaking (positive amplitude of correction signal referred to 315 mV)		–	20	–	%
$V_{n(\text{rms})}$	noise voltage on pin 12 (RMS value)	without peaking; f = 0 to 5 MHz	–	–	1	mV
COR	coring of peaking (coring part referred to 315 mV)	COR-bit = 1	–	20	–	%

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SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Colour-difference paths measured with transient times $t_r = t_f = 1 \mu\text{s}$; $t_{pH} \geq 1 \mu\text{s}$; $V_i = 1.33 \text{ V}$ (p-p) on pins 3 and 7 and with burst key pulse $t_{BK} = 4 \mu\text{s}$						
$V_{i(CD)(p-p)}$	$\pm(R - Y)$ input signal (peak-to-peak value; pin 3)	75% colour bar	–	1.05	1.48	V
	$\pm(B - Y)$ input signal (peak-to-peak value; pin 7)	75% colour bar	–	1.33	1.88	V
	input transient sensitivity	$V_{3,7}/\delta t$	0.22	–	–	V/ μs
$V_{3,7}$	internal clamping voltage level		–	2.45	–	V
$I_{3,7}$	input current	outside clamping	–	–	± 1	μA
		during clamping	± 100	–	± 190	μA
$C_{3,7}$	input capacitance		–	6	12	pF
$V_{4,6}$	DC output voltage		–	2	–	V
$\Delta V_{4,6}$	output offset voltage	$R_S \leq 300 \Omega$; note 1	–	–	± 5	mV
		during and after storage time	–	–	± 18	mV
V_{spike}	spurious spike signals on pins 4 and 6	$R_S \leq 300 \Omega$; note 1	–	–	± 30	mV
$I_{4,6}$	output current (emitter-follower with constant current source)	source current	–1	–	–	mA
		sink current	0.4	–	–	mA
$R_{4,6}$	output resistance		–	–	100	Ω
G_v	signal gain in each path	V_o/V_i	–1	0	+1	dB
ΔG_v	gain difference $-(R - Y)/(B - Y)$		–	0	± 0.3	dB
LIN	signal linearity for nominal signal	$\alpha_{\text{min}}/\alpha_{\text{max}}$; $V_i = 1.33 \text{ V}$ (p-p)	0.90	–	–	–
	+3 dB signal	$V_i = 1.88 \text{ V}$ (p-p)	0.65	–	–	–
ΔV_o	signal reduction at higher frequency (output signal ratio V_i/V_o)	signal with $t_{pH} = 50 \text{ ns}$; $t_r = t_f = 1 \mu\text{s}$	–1.5	–	–	dB
Sandcastle pulse, input voltage selectable via I²C-bus						
V_{17}	input voltage threshold for H and V sync	SC5-bit = 0 (12 V)	1.1	1.5	1.9	V
	input voltage threshold for burst	SC5-bit = 0 (12 V)	5.5	6.5	7.5	V
	input voltage threshold for H and V sync	SC5-bit = 1 (5 V)	1.1	1.5	1.9	V
	input voltage threshold for burst	SC5-bit = 1 (5 V)	3.0	3.5	4.0	V
R_{17}	input resistance	+12 V input level	30	40	50	k Ω
		+5 V input level	15	20	25	k Ω
C_{17}	input capacitance		–	4	8	pF
t_{BK}	burst key pulse width		3.0	4.0	4.6	μs
t_d	leading edge delay for clamping pulse	referred to t_{BK}	–	1	–	μs
n_p	number of required burst key pulses vertical blanking interval	note 2	4	–	31	–

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SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I²C-bus control, SDA and SCL						
V _{IH}	HIGH level input voltage on pins 9 and 10		3	–	5	V
V _{IL}	LOW level input voltage		0	–	1.5	V
I _{9,10}	input current		–	–	±10	μA
V _{o(ACK)}	output voltage at acknowledge on pin 9	I _{o(ACK)} = 3 mA	–	–	0.4	V
I _{o(ACK)}	output current at acknowledge on pin 9	sink current	3	–	–	mA

Notes

1. Crosstalk on output, measured in the unused channel when the other channel is provided with a nominal input signal (CTI active).
2. A number of more than 31 burst key pulses repeats the counter cycle of delay time control.

I²C-BUS FORMAT

S ⁽¹⁾	SLAVE ADDRESS ⁽²⁾	ACK ⁽³⁾	SUBADDRESS ⁽⁴⁾	ACK ⁽³⁾	DATA ⁽⁵⁾	P ⁽⁶⁾
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Notes

1. S = START condition.
2. SLAVE ADDRESS = 1000 100X.
3. ACK = acknowledge, generated by the slave.
4. SUBADDRESS = subaddress byte, see Table 1.
5. DATA = data byte, see Table 1.
6. P = STOP condition.
7. X = read/write control bit.
X = 0, order to write (the circuit is slave receiver).
X = 1, order to read (the circuit is slave transmitter).

If more than 1 byte of DATA is transmitted, then auto-increment of the subaddress is performed.

Table 1 I²C-bus transmission; see Table 2

FUNCTION	SUBADDRESS	DATA							
		D7	D6	D5	D4	D3	D2	D1	D0
Y delay/CTI/SC	00010000	0	SC5	CTI	DL4	DL3	DL2	DL1	DL0
Peaking and coring	00010001	COR	PEAK	LCF	0	0	0	PCON1	PCON0

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Table 2 Function of the bits

DATA	FUNCTION	LOGIC 1	LOGIC 0
DL0	set delay in luminance channel	45 ns	0 ns
DL1		90 ns	0 ns
DL2		180 ns	0 ns
DL3		180 ns	0 ns
DL4		450 ns	0 ns
CTI	set colour transient improvement	active	inactive
SC5	select sandcastle pulse voltage	+5 V	+12 V
LCF	set peaking frequency response	2.6 MHz	5.0 MHz
PEAK	set peaking delay	active	inactive
COR	set coring control	active	inactive
PCONx	set peaking amplification	see Table 3	

Table 3 Peaking amplification

PCON1	PCON0	GRADE OF PEAKING (dB)
0	0	-3
0	1	0
1	0	+3
1	1	+6

Remarks to the subaddress bytes

Subaddresses 00H to 0FH are reserved for colour decoders and RGB processors.

Subaddresses 10 and 11 only are acknowledged.

General call address is not acknowledged.

Power-on-reset: D7 to D1 bits of data bytes are set to logic 0, D0 bit is set to logic 1.

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INTERNAL CIRCUITRY

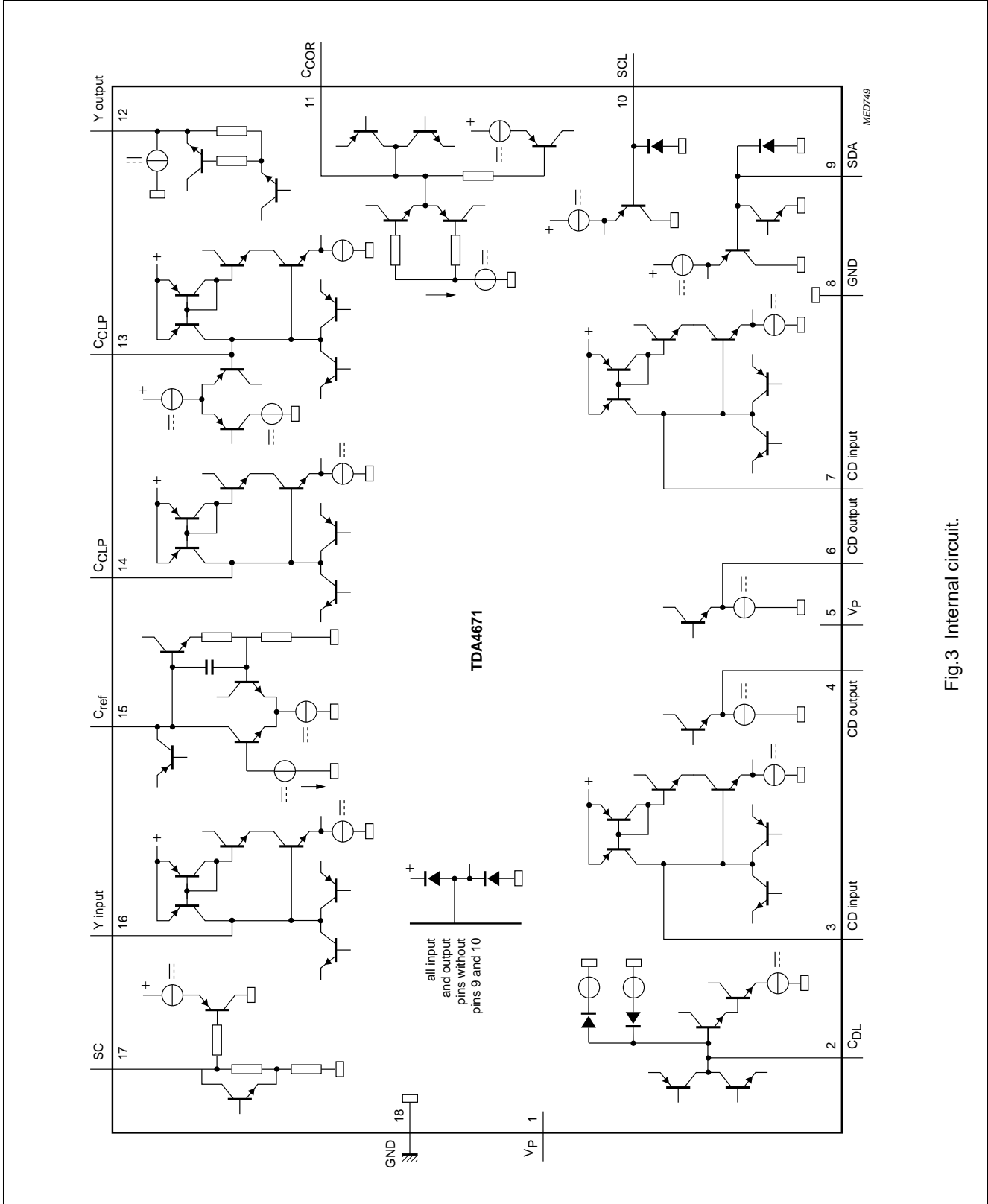


Fig.3 Internal circuit.

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TEST AND APPLICATION INFORMATION

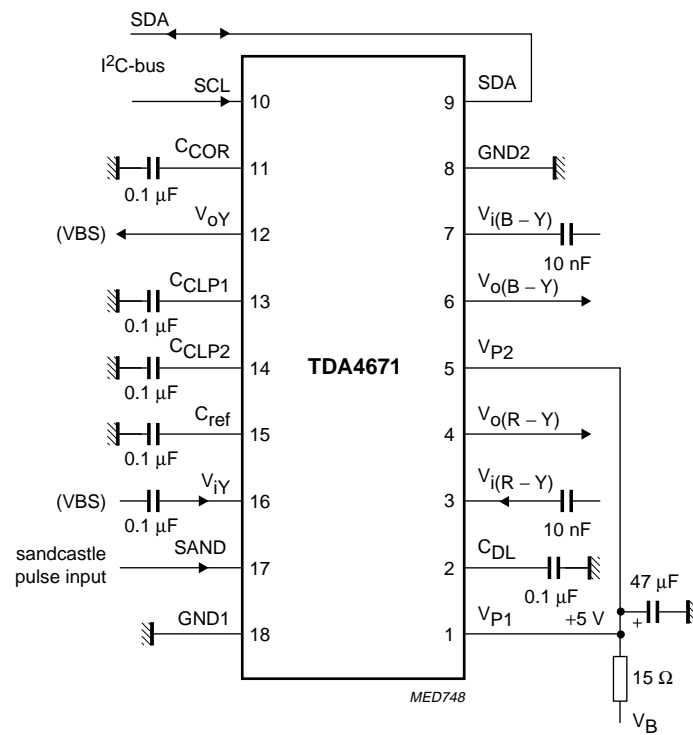


Fig.4 Test and application circuit.

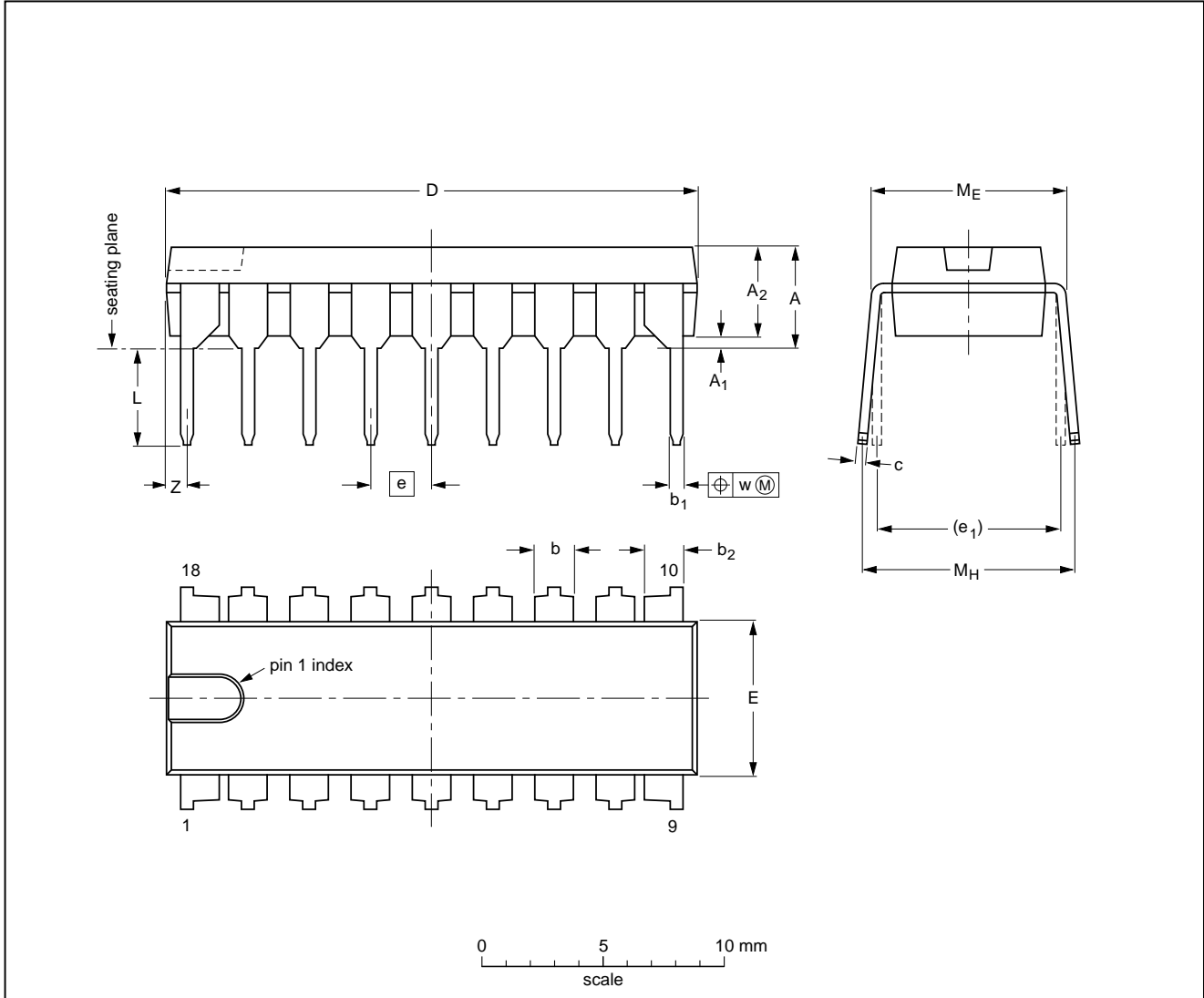
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PACKAGE OUTLINE

DIP18: plastic dual in-line package; 18 leads (300 mil)

SOT102-1



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

UNIT	A max.	A ₁ min.	A ₂ max.	b	b ₁	b ₂	c	D ⁽¹⁾	E ⁽¹⁾	e	e ₁	L	M _E	M _H	w	Z ⁽¹⁾ max.
mm	4.7	0.51	3.7	1.40 1.14	0.53 0.38	1.40 1.14	0.32 0.23	21.8 21.4	6.48 6.20	2.54	7.62	3.9 3.4	8.25 7.80	9.5 8.3	0.254	0.85
inches	0.19	0.020	0.15	0.055 0.044	0.021 0.015	0.055 0.044	0.013 0.009	0.86 0.84	0.26 0.24	0.10	0.30	0.15 0.13	0.32 0.31	0.37 0.33	0.01	0.033

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			
SOT102-1						93-10-14 95-01-23