

Semiconductors for

CRT Displays



PHILIPS

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NOTE

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 specifications defined by Philips. This specification can be downloaded in PDF format at <http://www.semiconductors.philips.com/i2c/facts>



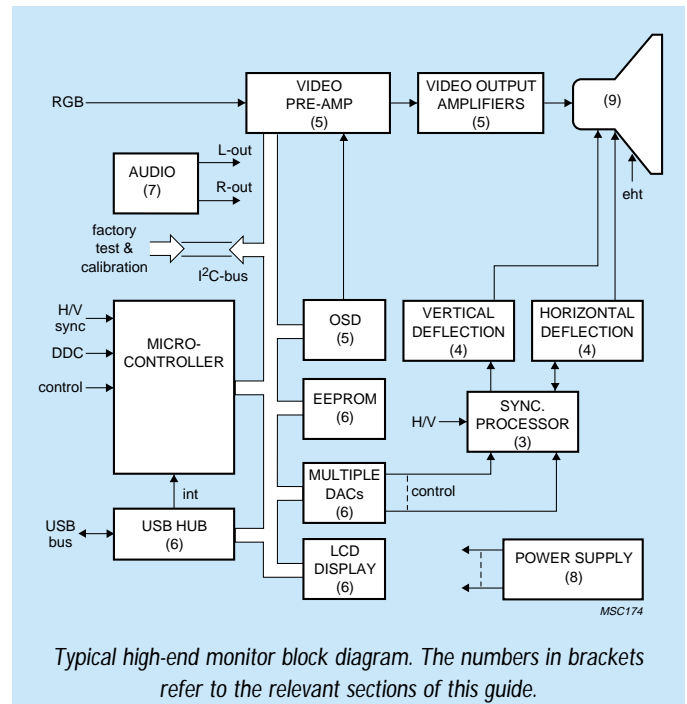
INTRODUCTION

1 CRT MONITOR DESIGNER'S GUIDE – JULY 2001

An obvious, but nonetheless, crucial performance criterion of any monitor system is its ability to display the generated data or images with high resolution and imperceptible phase jitter. For the vast majority of applications, the cathode-ray tube remains unequalled, and still provides the highest levels of such basic image characteristics as resolution, brightness, and color fidelity, and has the advantages of a simple, proven operating system and a low overall price.

As well as providing a high-quality display, CRT monitors are increasingly being required to operate at a variety of horizontal and vertical frequencies. In the personal computer market especially, the large number of semi-compatible or incompatible graphic cards on the market means there is the need for low-cost multifrequency and autosync designs. All this calls for a wealth of dedicated components – ranging from very high-resolution monitor-tubes with deflection units that can operate at high horizontal frequencies to signal-processing ICs able to accommodate the almost infinitely variable requirements for synchronization and scanning frequencies, and wideband video amplifiers and switching components with specs meeting the stringent requirements of today's monitor designs.

Since the available component ranges are wide, and component selection is determined by the desired monitor performance, let's first take a short look at the interrelationship of some basic design parameters before introducing Philips' latest systems and circuit concepts.



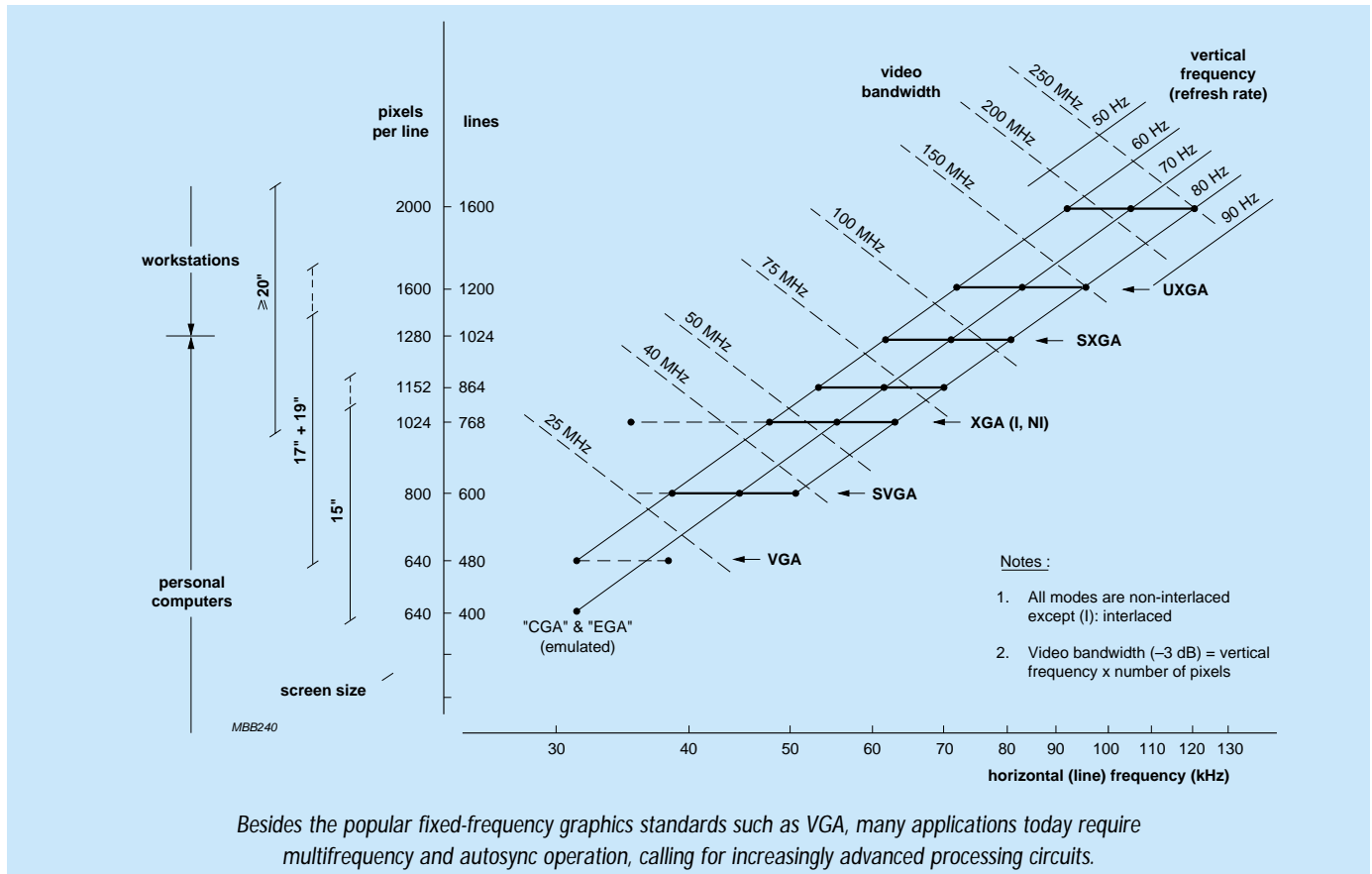
Typical high-end monitor block diagram. The numbers in brackets refer to the relevant sections of this guide.

GRAPHICS STANDARDS

The table below shows the Video Electronics Standards Association (VESA) standards, guidelines, and proposals for the most common display modes in use today. "Guidelines" designations are typically used for lower resolutions or lower refresh-rates which are used in lower-performance systems.

Commonly used display modes

Resolution	Refresh rate (Hz)	Horizontal frequency (kHz)	Pixel frequency (MHz)	Standard type
640 × 400	70	31.5	25.175	DOS setup mode
	85	37.8	31.500	
640 × 480	60	31.5	25.175	Industry standard
	72	37.9	31.500	VESA standard
	75	37.5	31.500	VESA standard
	85	43.3	36.000	
800 × 600	56	35.1	36.000	VESA guidelines
	60	37.9	40.000	VESA guidelines
	72	48.1	50.000	VESA standard
	75	46.9	49.500	VESA standard
	85	53.7	56.300	
1024 × 768	43, interlaced	35.5	44.900	Industry standard
	60	48.4	65.000	VESA guidelines
	70	56.5	75.000	VESA standard
	75	60.0	78.750	VESA standard
	85	68.7	94.500	
1152 × 864	70	63.85	94.500	VESA proposal
	85	77.1	121.500	
1280 × 1024	75	60.0	78.750	VESA standard
	75	80.0	135.000	VESA standard
	85	91.1	157.500	
1600 × 1200	60	75.0	162.000	VESA proposal
	75	93.75	202.500	VESA proposal
	85	106.3	229.500	



“Proposals” are pending the approval procedures for future standardization. For reference, a number of “Industry Standards” are also included, as they are defacto standards and widely used in the computer industry.

The figure above shows a number of basic design parameters for modern color monitors in the main market segments. On the vertical axis are the horizontal and vertical resolutions of the display system. As is well known, the resolutions together with the vertical (refresh) frequency determine the horizontal (line) frequency of the system shown on the horizontal axis. Several PC graphics standards, as well as the overall video bandwidth needed under different conditions, are also indicated.

While most PCs currently offer VGA format signals (640 x 480 pixels, 60 Hz refresh, 31.5 kHz horizontal frequency), their video cards normally emulate the older standards of CGA (320 x 200, 60 Hz, 15.75 kHz) and EGA (640 x 350, 60 Hz, 21.85 kHz). Modern modes display 800 x 600 pixels, non-interlaced, and have refresh frequencies from 60 to 85 Hz and above, and corresponding line frequencies from 38 to 54 kHz. Non-interlaced XGA (1024 x 768) versions have become very popular in high-end PCs and PC workstations commonly using 15" and 17" picture tubes. Depending on the refresh rate, line frequencies for these monitors have gone up to 64 kHz for 15" monitors, 70 kHz for main-stream 17" monitors, and 90 kHz

for high-end 17" monitors. Furthermore, as they can display the higher resolution mode of 1280 x 1024 pixels, they are suitable for high-end CAD/CAM and DTP applications.

MONITOR EVOLUTION

Single-frequency monitors

Single-frequency monitors are simple and straightforward. They do not require a microprocessor, and brightness and/or contrast are controlled with potentiometers. Today, single-frequency monitors are only designed for low-cost surveillance applications and other dedicated systems where the flexibility offered by the multifrequency and autosync concepts is not needed because there is only one video format (often proprietary). This commonly occurs in workstations, where the monitor (although usually separate) is a dedicated part that cannot be replaced by off-the-shelf alternatives, or in personal computers where monitor and computer are in one cabinet. Besides the popular fixed-frequency graphics standards such as VGA, many applications today require multifrequency and autosync operation, calling for increasingly advanced processing circuits. But, the role of single-frequency monitors isn't over! With the forthcoming introduction of consumer Internet PCs, we may see a revival of single-frequency monitors because of their inherently low-cost potential. A concept with horizontal single-frequency and vertical multisync could be one of the options.

I²C bus-controlled Autosync monitors

The monitor market today is dominated by I²C bus-controlled autosync monitors, which work with the vast majority of video cards. Although VESA tries hard to limit and standardize pixel rates and refresh frequencies, many video card manufacturers still offer non-standard modes which must be dealt with by the multisync capability of the monitor.

One example of such a state-of-the-art I²C bus-controlled autosync monitor is Philips' ECO monitor concept (see Section 2). Based around the TDA4856 deflection controller, this advanced IC provides synchronization processing, horizontal and vertical synchronization with full autosync capability, and very short settling times after mode changes. All functions are controllable by the I²C bus. Together with the I²C bus-driven TDA4887 video processor and the TDA4863 vertical deflection booster, a very advanced system solution is offered.

Universal Serial Bus

The Universal Serial Bus (USB) provides a simple, expandable "Hot Plug-and-Play" bus system for low and medium speed PC peripherals. Philips offers a wide range of dedicated USB devices, including interface ICs, audio ICs, and microcontroller – all of which comply with the current USB specification. The ISPxxx and PDIUSBxxx family of USB interface ICs incorporate a number of advanced features, including GoodLink™, which allows a quick visual check to see if peripherals are working properly – and SoftConnect™, for an extra level of peripheral control via the host connection. (GoodLink and SoftConnect are Philips trademarks.) Our second generation UDA1321 and UDA1325 USB digital audio ICs can be configured to support various application topologies and HID class connectivity, with configuration stored in ROM or external EEPROM.

EXTENSIVE SUPPORT

Whatever your market segment, Philips can provide world-wide design-in support through its many worldwide Systems Laboratories with unequalled system and component know-how. Evaluation boards, complete demonstration models, and detailed literature are available to those wanting the best component solutions for their next monitor systems. The monitor concepts described on the following pages are just a few of the many monitor examples available for customers to evaluate the capability of our components.



MONITOR CONCEPT

2.1 ECO monitor

Full I²C bus-controlled autosync monitor

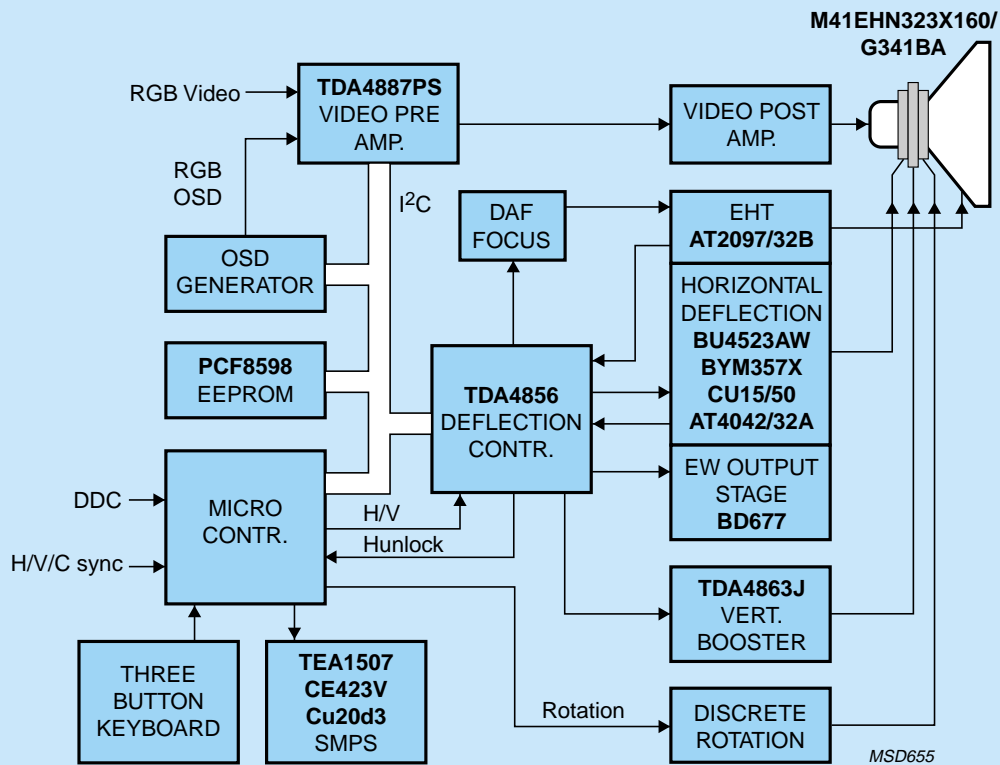
Features

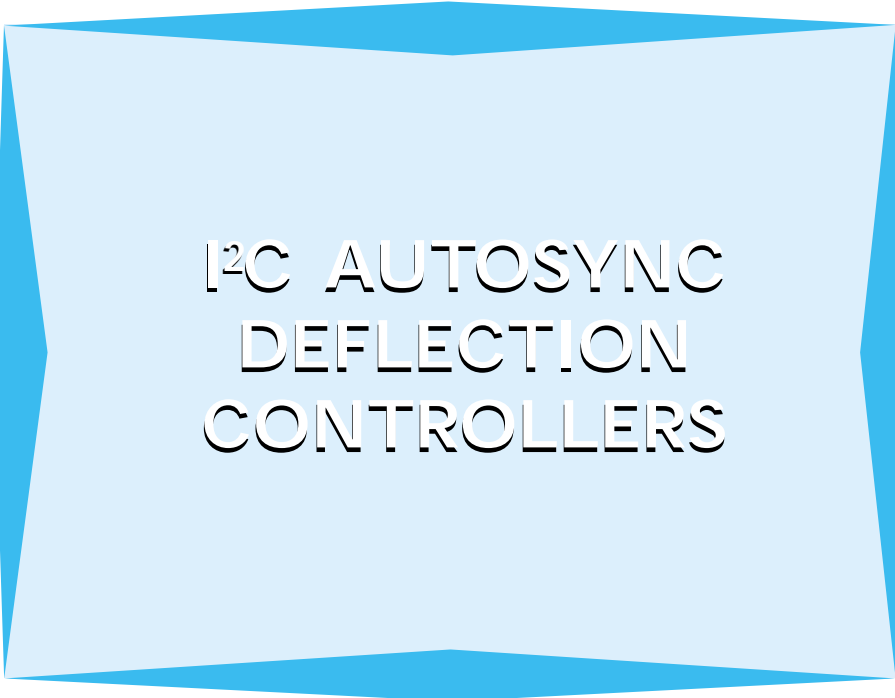
- Autosync
- Extended geometry controls
- Moiré cancellation
- I²C bus-driven controls
- Mains power standby < 1.5 W
- Horizontal frequency 30 to 70 kHz
- Vertical frequency 50 to 150 Hz
- Video maximum dot rate = 120 MHz
- Video rise and fall times < 6 ns
- Graphics mode 640 × 480 to 1280 × 1024 (70 Hz)
- White color Ø_x, Ø_y < 0.01

Specifications

- Mains voltage range 90 to 265 VAC
- Mains power nominal < 75 W

ECO monitor





I²C AUTOSYNC
DEFLECTION
CONTROLLERS

3.1 I²C Autosync deflection controllers

TDA4853, TDA4854

Concept features

- Full horizontal plus vertical autosync capability, TV and VCR mode included
- Extended horizontal frequency range from 15-30 kHz
- Comprehensive set of I²C bus-driven geometry adjustments and functions, including standby mode
- Very good vertical linearity
- Moire cancellation
- Start-up and switch-off sequence for safe operation of all power components
- X-ray protection
- Flexible switched-mode B+ supply function block for feed-back and feed-forward converter
- Internally stabilized voltage reference
- Drive signal for focus amplifiers with combined horizontal and vertical parabola waveforms (TDA4854)
- DC controllable inputs for Extremely High Tension (EHT) compensation
- SDIP32 package

Synchronization

- Handles all sync signals (horizontal, vertical, composite, and sync-on-video)
- Output for video clamping (leading/trailing edge selectable by I²C bus), vertical blanking, and protection blanking
- Output for fast unlock status of horizontal synchronization and blanking on grid 1 of picture tube

Horizontal section

- I²C bus-controllable wide-range linear picture position, pin-unbalance, and parallelogram correction via horizontal phase
- Frequency-locked loop for smooth catching of horizontal frequency
- TV mode at 15.625 or 15.750 kHz selectable by I²C bus
- Simple frequency preset of f_{\min} and f_{\max} by external resistors
- Low jitter
- Soft start for horizontal and B+ control-drive signals

Vertical section

- I²C bus-controllable vertical picture size, picture position, linearity (S-correction), and linearity balance
- Output for I²C bus-controllable vertical sawtooth and parabola (for pin-unbalance and parallelogram)
- Vertical picture size independent of frequency
- Differential current outputs for DC coupling to vertical booster
- 50-160 Hz vertical autosync range

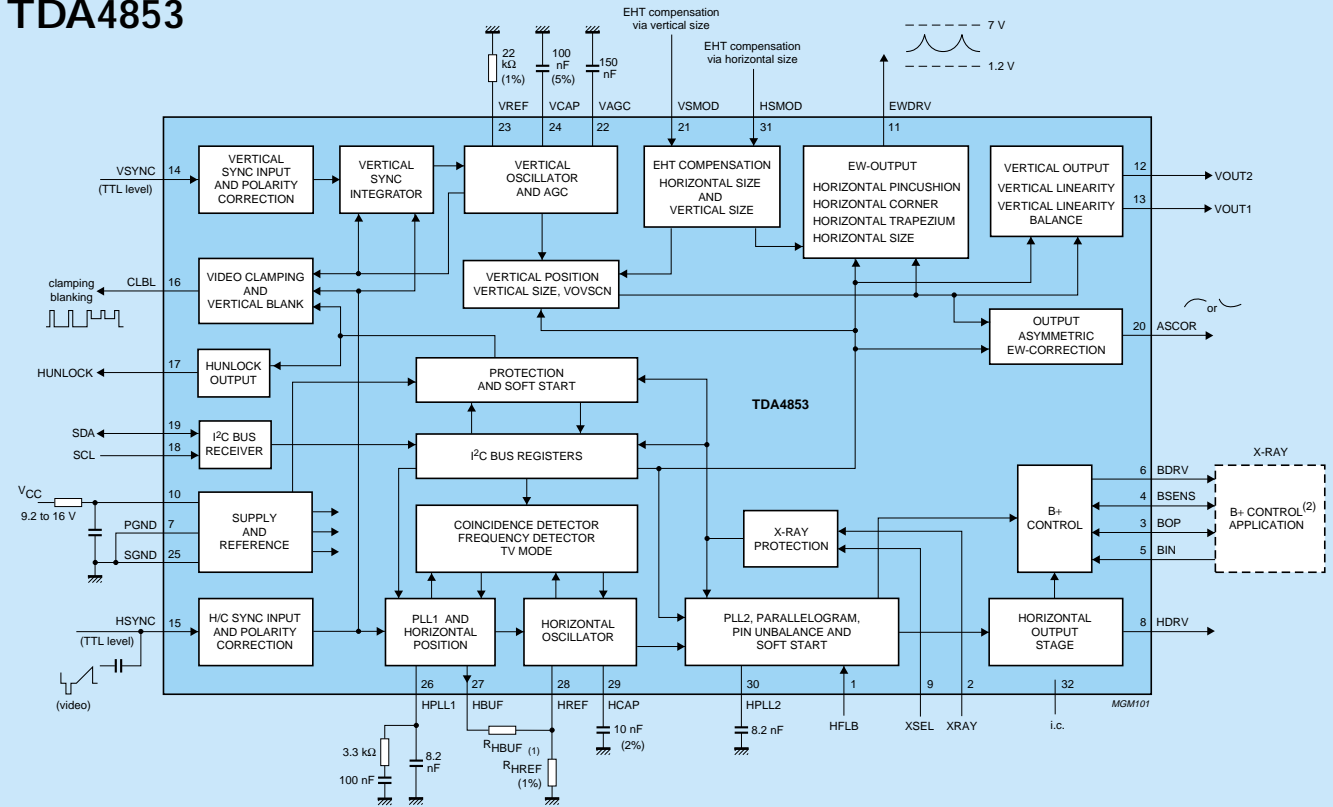
East-West (EW) section

- I²C bus-controllable output for horizontal pincushion, horizontal size, corner and trapezium correction
- Optional tracking of EW drive waveform with line frequency selectable by I²C bus

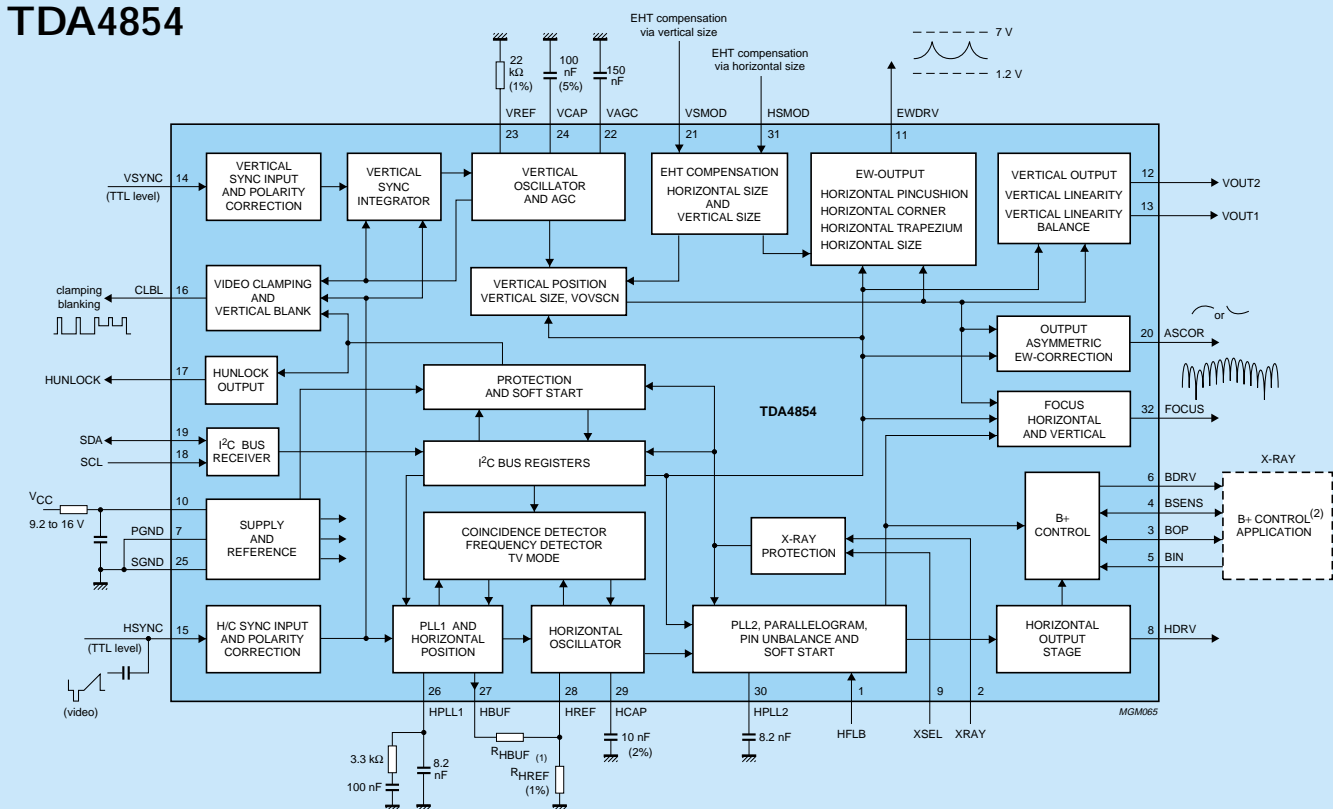
Focus section of TDA4854

- I²C bus-controllable output for horizontal and vertical parabolas
- Vertical parabola independent of frequency and tracks with vertical adjustments
- Horizontal parabola independent of frequency
- Adjustable pre-correction of delay in focus output stage

TDA4853



TDA4854



TDA4856

Concept features

- Full horizontal plus vertical autosync capability
- Extended horizontal frequency range from 15-130 kHz
- Comprehensive set of I²C bus-driven geometry adjustments and functions, including standby mode
- Very good vertical linearity
- Moire cancellation
- Start-up and switch-off sequence for safe operation of all power components
- X-ray protection
- Power dip recognition
- Flexible switched-mode B+ supply function block for feed-back and feed-forward converter
- Internally stabilized voltage reference
- Drive signal for focus amplifiers with combined horizontal and vertical parabola waveforms
- DC controllable inputs for Extremely High Tension (EHT) compensation
- SDIP32 package

Synchronization

- Can handle all sync signals (horizontal, vertical, composite, and sync-on-video)
- Output for video clamping (leading/trailing edge selectable by the I²C bus), vertical blanking, and protection blanking
- Output for fast unlock status of horizontal synchronization and blanking on grid 1 of picture tube

Horizontal section

- I²C bus-controllable wide-range linear picture position, pin-unbalance, and parallelogram correction via horizontal phase
- Frequency-locked loop for smooth catching of horizontal frequency
- Simple frequency preset of f_{\min} and f_{\max} by external resistors
- Low jitter
- Soft start for horizontal and B+ control-drive signals

Vertical section

- I²C bus-controllable vertical picture size, picture position, linearity (S-correction), and linearity balance
- Output for the I²C bus-controllable vertical sawtooth and parabola (for pin-unbalance and parallelogram)
- Vertical picture size independent of frequency
- Differential current outputs for DC coupling to vertical booster
- 50-160 Hz vertical autosync range

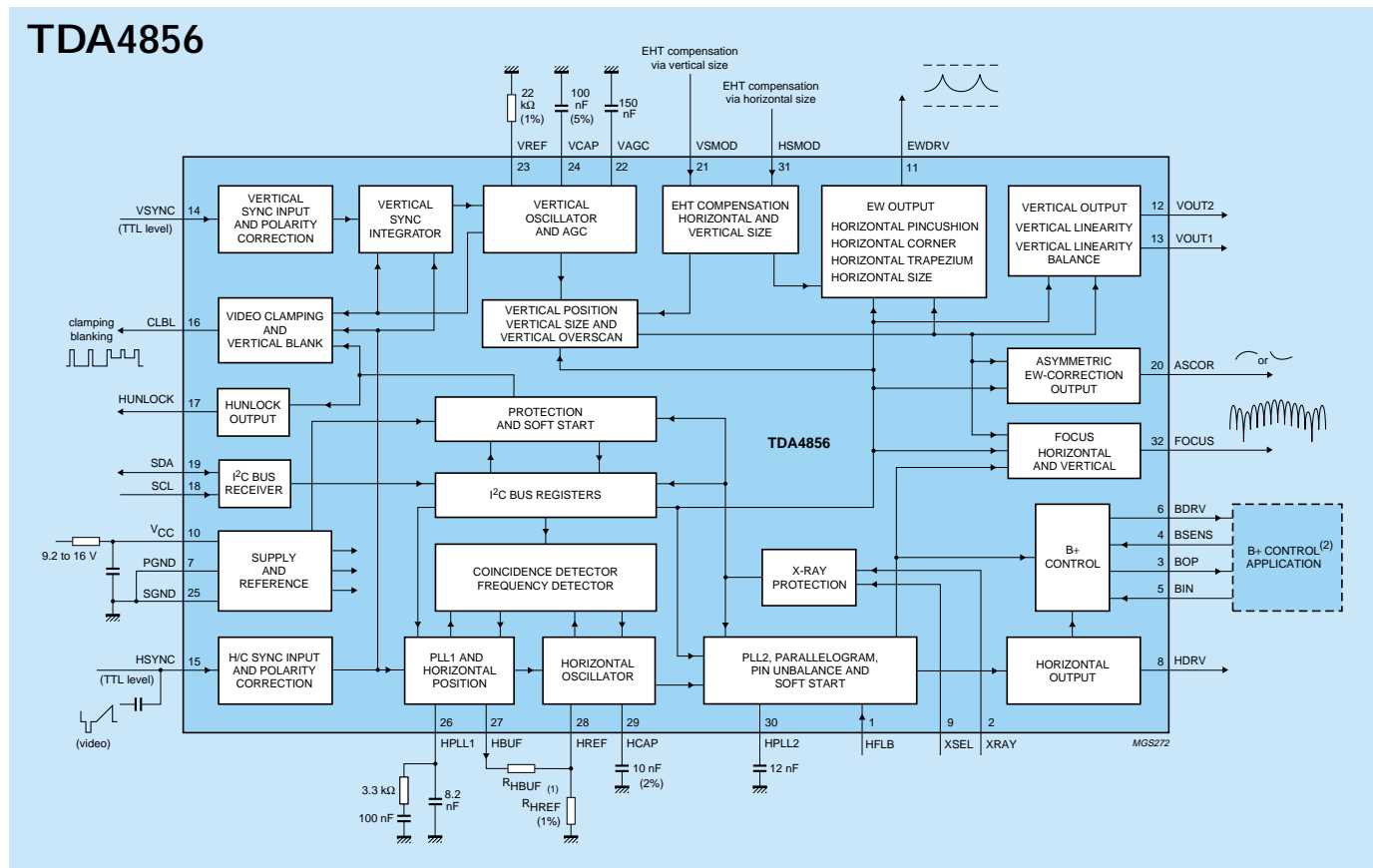
East-West (EW) section

- I²C bus-controllable output for horizontal pincushion, horizontal size, corner and trapezium correction
- Optional tracking of EW drive waveform with line frequency selectable by the I²C bus

Focus section

- I²C bus-controllable output for horizontal and vertical parabolas
- Vertical parabola independent of frequency and tracks with vertical adjustments
- Horizontal parabola independent of frequency
- Adjustable pre-correction of delay in focus output stage

TDA4856



TDA4857PS

Concept features

- Full horizontal plus vertical autosync capability
- Extended horizontal frequency range from 15-130 kHz
- Comprehensive set of I²C bus-driven geometry adjustments and functions, including standby mode
- Very good vertical linearity
- Moire cancellation
- Start-up and switch-off sequence for safe operation of all power components
- X-ray protection
- Flexible switched-mode B+ supply function block for feed-back and feed-forward converter
- Internally stabilized voltage reference
- Drive signal for focus amplifier with vertical parabola waveforms
- DC controllable inputs for Extremely High Tension (EHT) compensation
- SDIP32 package

Synchronization

- Can handle all sync signals (horizontal, vertical, composite, and sync-on-video)
- Output for video clamping (leading/trailing edge selectable by I²C bus), vertical blanking, and protection blanking
- Output for fast unlock status of horizontal synchronization and blanking on grid 1 of picture tube

Horizontal section

- I²C bus-controllable wide-range linear picture position, pin-unbalance, and parallelogram correction via horizontal phase
- Frequency-locked loop for smooth catching of horizontal frequency
- Simple frequency preset of f_{\min} and f_{\max} by external resistors
- Low jitter
- Soft start for horizontal and B+ control drive signals

Vertical section

- I²C bus-controllable vertical picture size, picture position, linearity (S-correction), and linearity balance
- Output for I²C bus-controllable vertical sawtooth and parabola (for pin-unbalance and parallelogram)
- Vertical picture size independent of frequency
- Differential current outputs for DC coupling to vertical booster
- 50-160 Hz vertical autosync range

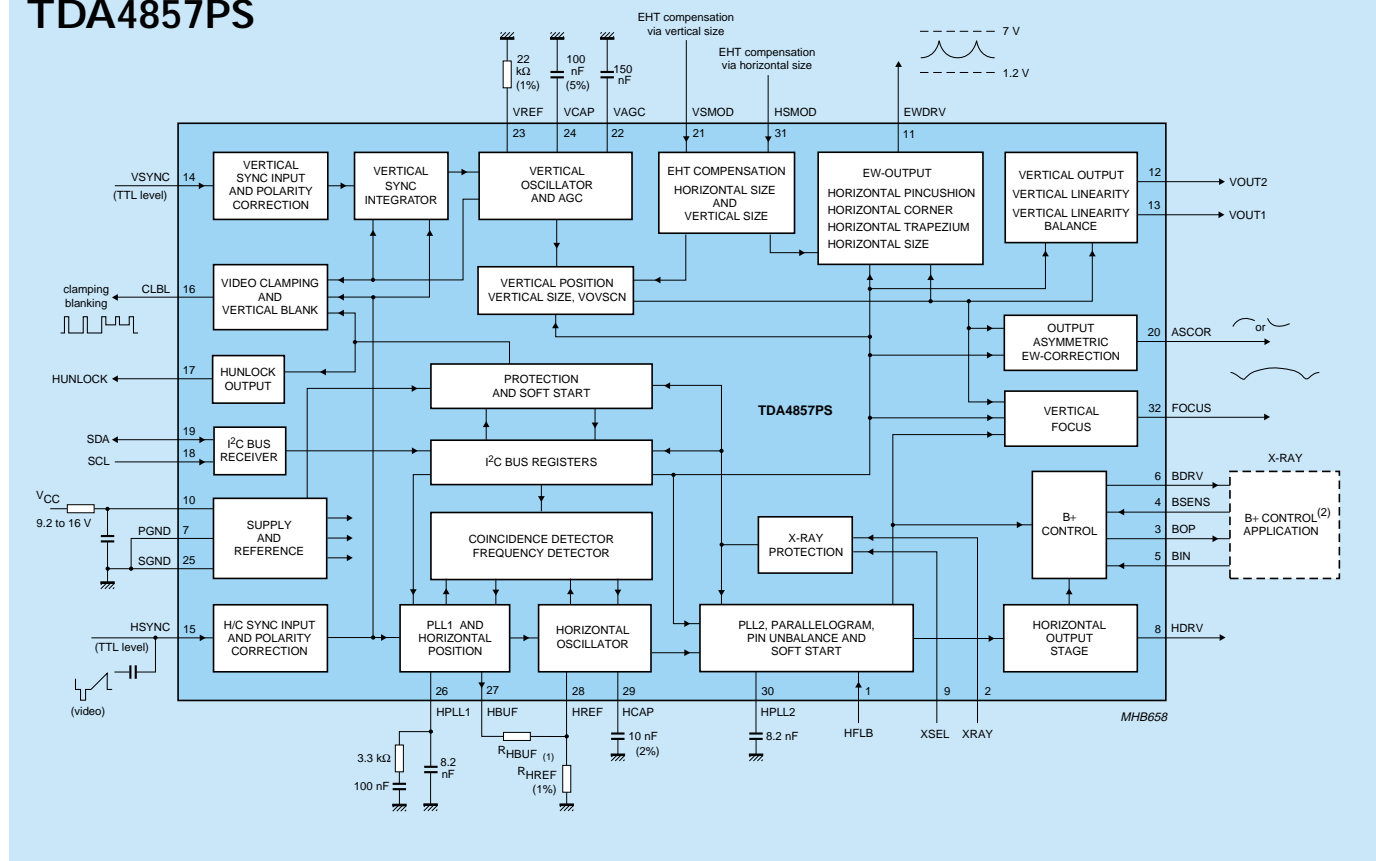
East-West (EW) section

- I²C bus-controllable output for horizontal pincushion, horizontal size, corner and trapezium correction
- Optional tracking of EW drive waveform with line frequency selectable by I²C bus

Focus section

- I²C bus-controllable output for vertical parabola
- Vertical parabola independent of frequency and tracks with vertical adjustments

TDA4857PS



3

TDA4841PS

Concept features

- Full horizontal plus vertical autosync capability
- Extended horizontal frequency range from 15-130 kHz
- Comprehensive set of I²C bus-driven geometry adjustments and functions, including standby mode
- Very good vertical linearity
- Moire cancellation
- Start-up and switch-off sequence for safe operation of all power components
- X-ray protection
- Power-dip recognition
- Flexible switched-mode B+ supply function block for feed-back and feed-forward converter
- Internally stabilized voltage reference
- Drive signal for focus amplifiers with combined horizontal and vertical parabola waveforms
- DC controllable inputs for Extremely High Tension (EHT) compensation
- SDIP32 package

Synchronization

- Can handle all sync signals (horizontal, vertical, composite, and sync-on-video)
- Output for video clamping (leading/trailing edge selectable by I²C bus), vertical blanking, and protection blanking
- Output for fast unlock status of horizontal synchronization and blanking on grid 1 of picture tube

Horizontal section

- I²C bus-controllable wide-range linear picture position, pin-unbalance, and parallelogram correction via horizontal phase
- Frequency-locked loop for smooth catching of horizontal frequency
- Simple frequency preset of f_{\min} and f_{\max} by external resistors
- Low jitter
- Soft start for horizontal and B+ control-drive signals

Vertical section

- I²C bus-controllable vertical picture size, picture position, linearity (S-correction), and linearity balance
- Output for I²C bus-controllable vertical sawtooth and parabola (for pin-unbalance and parallelogram)
- Vertical picture size independent of frequency
- Differential current outputs for DC coupling to vertical booster
- 50-160 Hz vertical autosync range

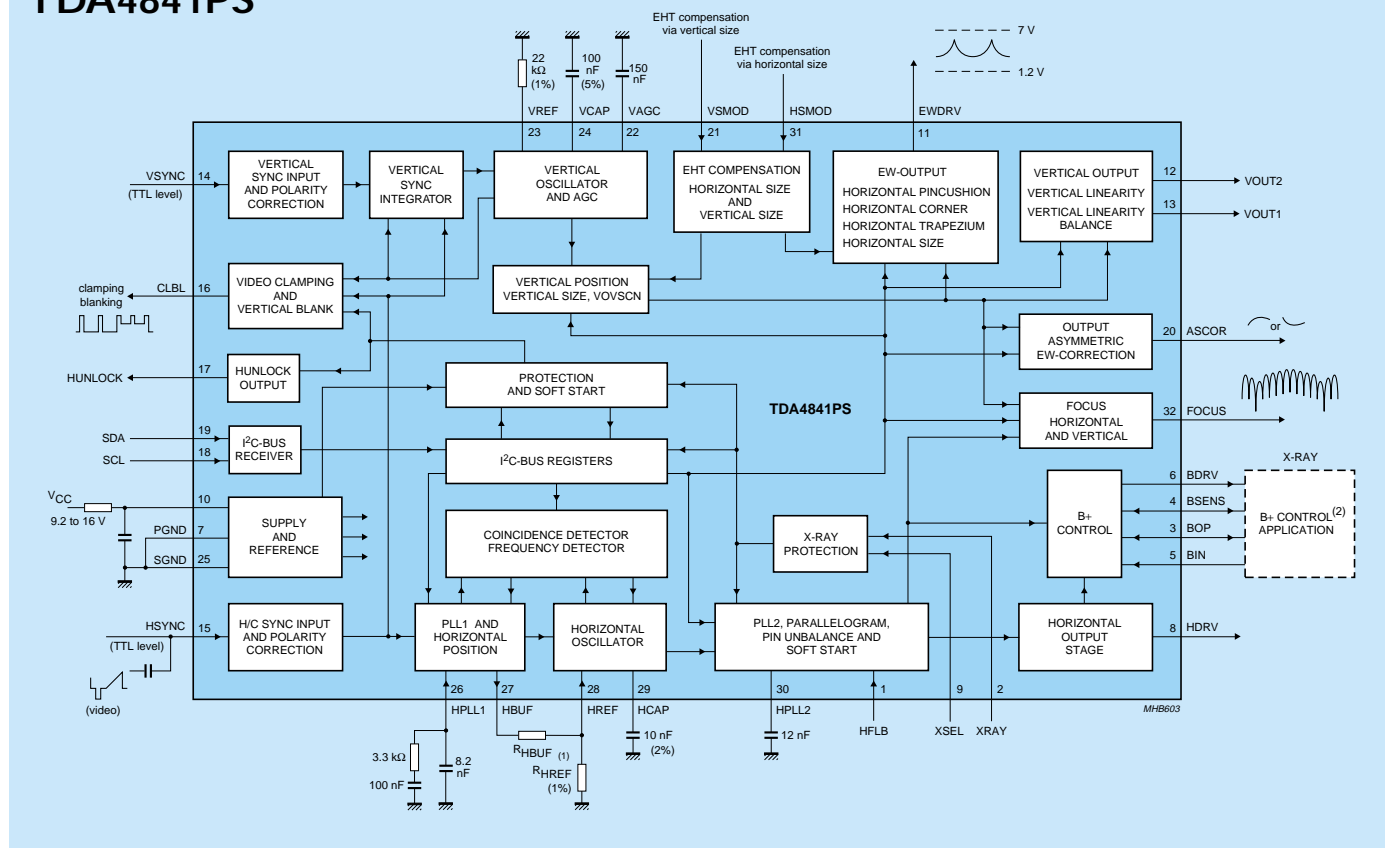
East-West (EW) section

- I²C bus-controllable output for horizontal pincushion, horizontal size, corner and trapezium correction
- Optional tracking of EW drive waveform with line frequency selectable by I²C bus

Focus section

- I²C bus-controllable output for horizontal and vertical parabolas
- Vertical parabola independent of frequency and tracks with vertical adjustments
- Horizontal parabola independent of frequency
- Adjustable pre-correction of delay in focus output stage

TDA4841PS



3.2 Autosize IC for color monitors

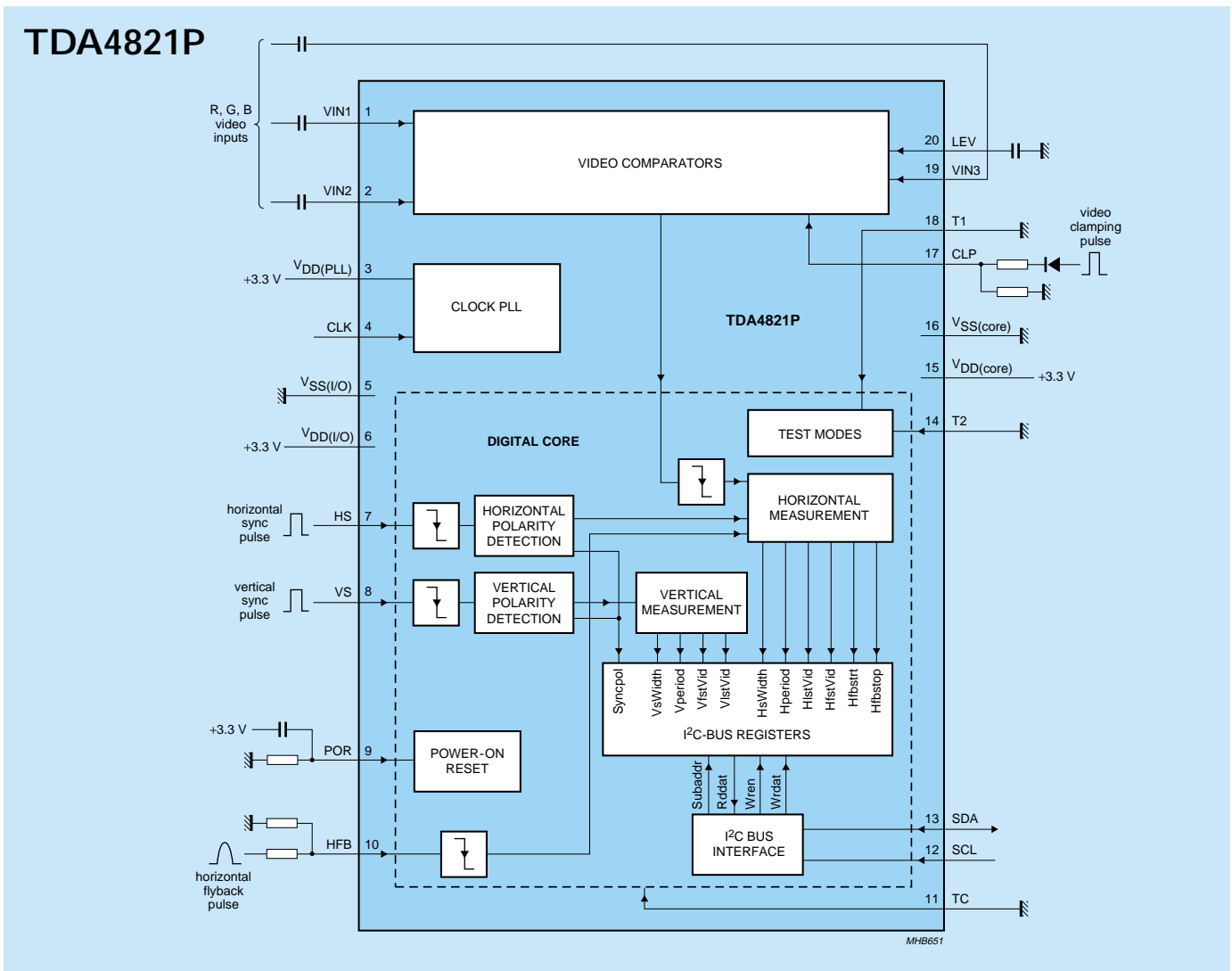
TDA4821P

Concept features

- Measures six horizontal and four vertical timing parameters:
 - Horizontal: sync width, sync period, video start, video end, horizontal flyback pulse start, and end
 - Vertical: sync width, sync period, first line of video active, and last line of video active
- Detection of H-sync and V-sync polarity
- I²C bus-interface (maximum clock frequency 400 kHz) for read-out of data and write data of the internal clock multiplier using double byte (16-bit format)
- Flexible digital-clock input with built-in and (via I²C bus) adjustable clock multiplier; internal clock is 48 MHz (typical value)

- Horizontal measurements are expressed in number of clock pulses; precision is approximately 20 ns at 48 MHz and can be improved if external averaging methods are used
- Vertical measurements are expressed in number of lines
- Internal buffer keep I²C bus-registers stable between the V-sync pulses, allowing for asynchronous read-out
- DIP20 package

The TDA4821P performs the “autosize” feature for color monitors. The IC measures the timing of active H/V video, with respect to the H-sync, V-sync, and horizontal flyback pulses, in order to allow the microcontroller to adjust the display settings automatically, particularly in parameters HSIZE, VSIZE, HPOS, and VPOS.





DEFLECTION AND EHT

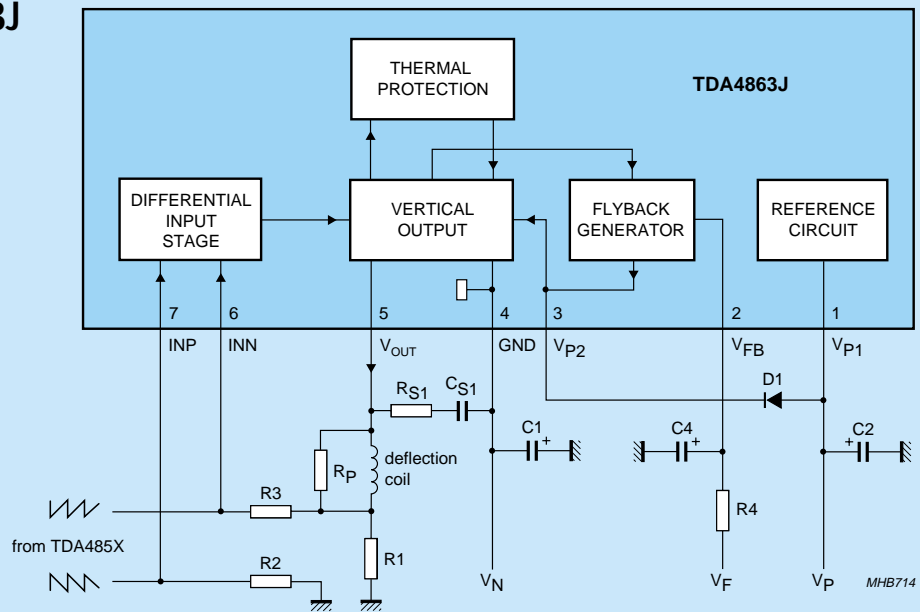
4.1 Vertical deflection boosters

TDA4863J, TDA4863AJ

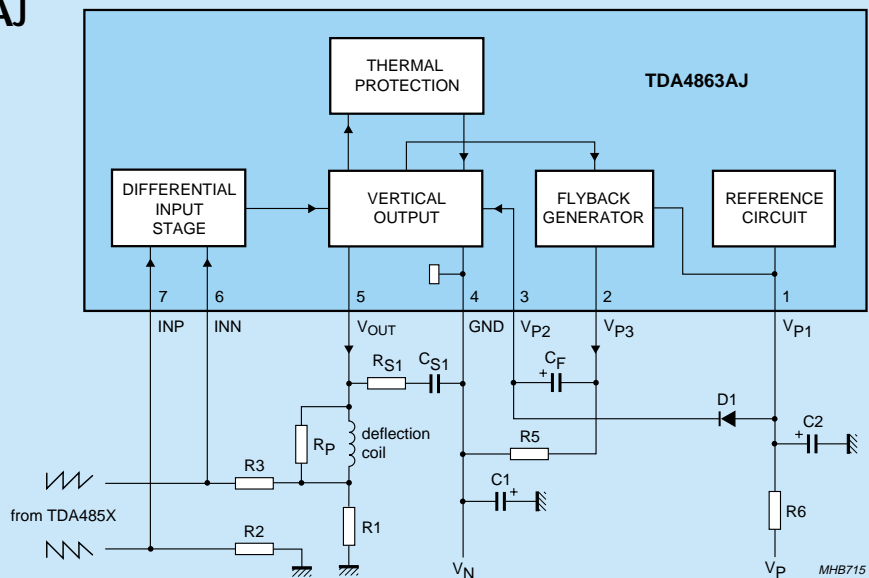
Concept features

- Power amplifier with differential inputs
- Output current up to 3 A (p-p)
- High vertical-deflection frequency up to 200 Hz
- High linear sawtooth signal amplification
- Flyback generator:
 - TDA4863J: separate adjustable flyback supply voltage up to 60 V
 - TDA4863AJ: internally doubled supply voltage (two supply voltages only for DC-coupled outputs)

TDA4863J



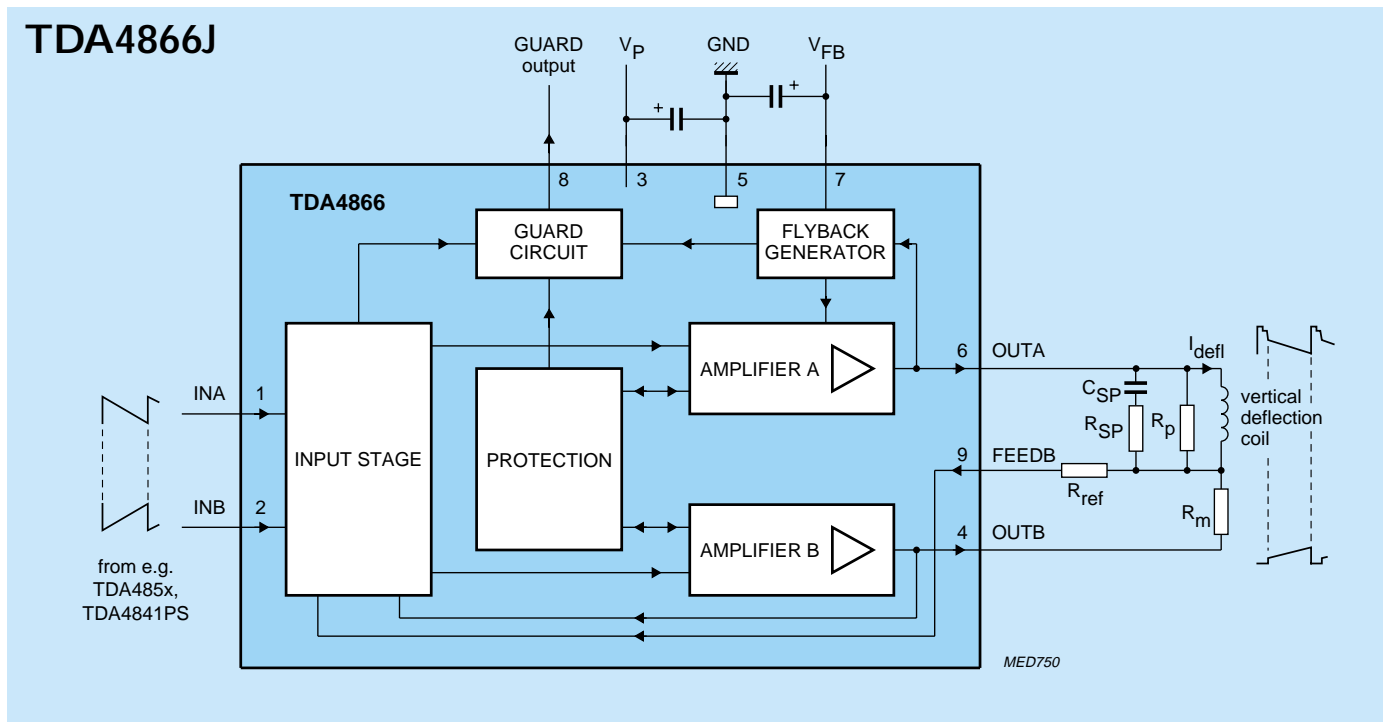
TDA4863AJ



TDA4866J

Concept features

- Fully integrated, few external components
- No additional components in combination with the deflection controller TDA485x, TDA4841PS
- Pre-amplifier with differential high CMRR current-mode inputs
- Low offsets
- High linear sawtooth signal amplification
- High efficient DC-coupled vertical output bridge circuit
- Powerless vertical shift
- High deflection frequency up to 160 Hz
- Power supply and flyback supply voltage independent, adjustable to optimize power consumption and flyback time
- Excellent transition behavior during flyback
- Guard circuit for screen protection



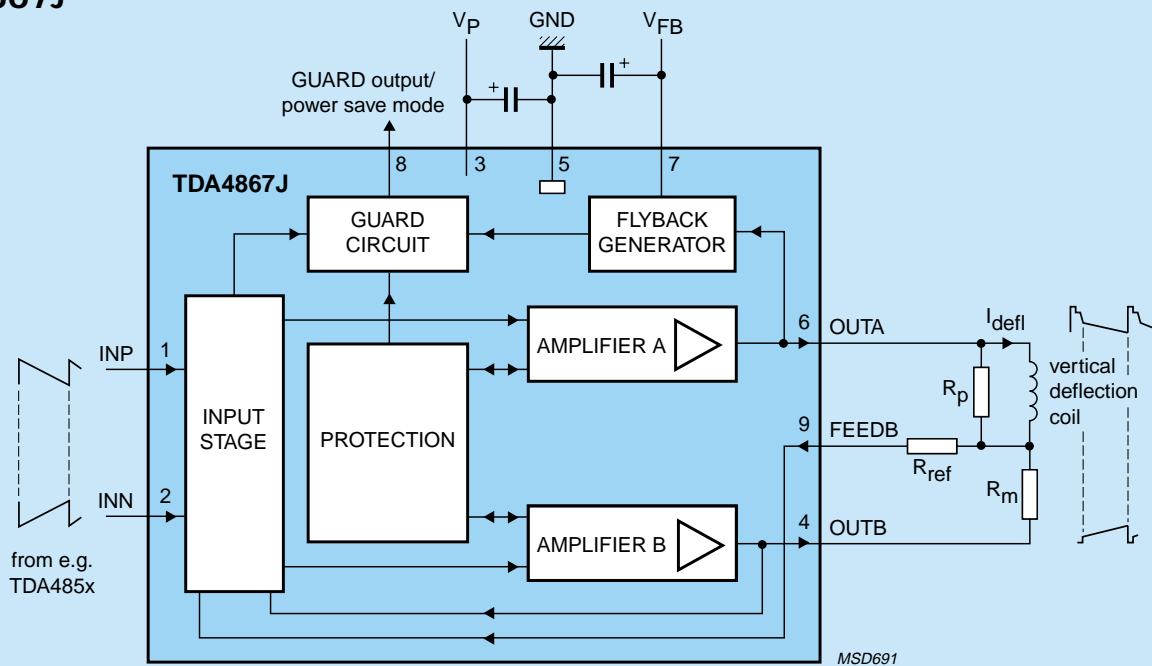
TDA4867J

Concept features

- Fully integrated, few external components
- No additional components in combination with the deflection controller family TDA485x
- Pre-amplifier with differential-high CMRR current- mode inputs
- Low offsets
- High linear sawtooth signal amplification
- High efficient DC-coupled vertical output bridge circuit
- Powerless vertical shift
- High deflection frequency up to 200 Hz
- Power supply and flyback supply voltage independent, adjustable to optimize power consumption and flyback time
- Excellent transition behavior during flyback
- Guard circuit for screen protection
- Power save mode

4

TDA4867J



4.2 Diodes for deflection, rectification, and EHT generation

Type number	V_{RRM} max (V)	$I_{F(AV)}$ max (A)	t_{rr} max (ns)	V_F max (V)	@	I_F (A)	Package (A)
<i>Fast soft-recovery controlled avalanche rectifiers</i>							
BYD33 series	200-1400	1.3	250/300/500	1.3		1	SOD81
BYV95 series	200-600	1.5	250	1.6		3	SOD57
BYV96E	1000	1.5	300	1.6		3	SOD57
BYW95 series	200-600	3	250	1.5		5	SOD64
BYW96 series	800-1000	3	300	1		5.5	SOD64
<i>Ultra fast low-loss controlled avalanche rectifiers</i>							
BYD73 series	50-400	1.7	25/50	0.98/1.05		1	SOD81
BYV27 series	50-600	2.0	25/50	0.98/1.05/1.25		2	SOD57
BYV28 series	50-600	3.5	25/50	1.02/1.05/1.25		3.5	SOD64
<i>High-voltage soft-recovery rectifiers</i>							
BY8000 series	5-19 kV	20-3 mA	100	20-63		0.1	SOD61
BY8100 series	5-19 kV	20-3 mA	60	26-94		0.1	SOD61
BY8200 series	6-12 kV	10-5 mA	<45	19-38		0.1	SOD107
BY8400 series	5-30 kV	20-3 mA	100	20-98		0.1	SOD61
BY8500 series	5-30 kV	20-3 mA	60	23-129		0.1	SOD61
<i>Damper diodes</i>							
		I_{FWM} typ					
BY328	1500	4	500	1.45		5	SOD64
BY329X series	800-1200	6	135	1.85		20	TO220
BY329X-1500(S)	1500	6	135	1.85		20	SOD113
BY359X-1500(S)	1500	8	600	1.5		10	TO220 (SOT186A)
BY428	1500	4	250	1.95		4	SOD64
BY459X-1500(S)	1500	10	350	1.3		6.5	TO220 (SOT186)
<i>Dual diode - Damper/Modulator</i>							
		I_{FSM}	QS ($\mu C/nC$)				
BYM357X/DX	1500/600	60-70	1.2/70				SOT186A/SOT399
BYM358X/DX	1500/600	60-70	0.9/70				SOT186A/SOT399
BYM359X	1500/600	60-70	2/700				SOT186A/SOT399
<i>Modulation diode</i>							
		I_{FWM} typ					
BY229X series	200-800	6	135	1.85		20	TO220(SOT186)

4.3 Power transistors for EHT

Type number	I_C (A)	V_{CESM} (V)	Package
BUT11A(F/X)	5	1000	TO220 (SOT186/SOT186A)
BUT18A(F)	6	1000	TO220 (SOT186)
BUT12A(F)	8	1000	TO220 (SOT186)

4.4 Power transistors for horizontal deflection output stages

Type number	V_{CESM} (V)	$I_{c DC}$ (A)	I_{csat} (A)	$t_{f MAX}$ (μs)	Package
<i>without integrated damper diode</i>					
BU4506AZ/AF/AX	1500	5	3	0.45	SOT186A/SOT199/SOT399
BU4507AX	1500	8	4	0.45	SOT399
BU1508AX	1500	8	4.5	0.6	SOT186A
BU2508AF/AX	1500	8	4.5	0.6	SOT199/SOT399
BU4508AF/AX	1500	8	5	0.48	SOT199/SOT399
BU2515AX	1500	9	4.5	0.4	SOT399
BU4515AF/AX	1500	9	6	0.5	SOT199/SOT399
BU2520AF/AX	1500	10	6	0.5	SOT199/SOT399
BU2522AF/AX	1500	10	6	0.25	SOT199/SOT399
BU4522AF/AX	1500	10	7	0.4	SOT199/SOT399
BU2523AF/AX	1500	11	5.5	0.3	SOT199/SOT399
BU4523AX	1500	11	8	0.4	SOT399
BU2527AF/AX	1500	12	6	0.2	SOT199/SOT399
BU2525AF/AX/AW	1500	12	8	0.35	SOT199/SOT399/SOT429
BU4525AX	1500	12	9	0.55	SOT399
BU2532AW	1500	16	7	0.1	SOT429
BU2530AW	1500	16	9	0.25	SOT429
BU4530AW	1500	16	10	0.4	SOT429
BU2708AF	1700	8	4	0.52	SOT199/SOT399
<i>with integrated damper diode</i>					
BU4506DZ/DF/DX	1500	5	3	0.4	SOT186A/SOT199/SOT399
BU4507DX	1500	8	4	0.4	SOT399
BU1508DX	1500	8	4.5	0.6	SOT186A
BU2508DF/DX	1500	8	4.5	0.6	SOT199/SOT399
BU4508DZ/DF/DX	1500	8	5	0.4	SOT186A/SOT199/SOT399
BU2515DX	1500	9	4.5	0.4	SOT399
BU2520DF/DX/DW	1500	10	6	0.5	SOT199/SOT399/SOT429
BU2527DX	1500	12	6	0.2	SOT399
BU2720DX	1700	10	5.5	0.9	SOT399
BU2725DX	1700	12	7	0.8	SOT399



**VIDEO CONTROL
AND AMPLIFICATION**

VIDEO CONTROL AND AMPLIFICATION

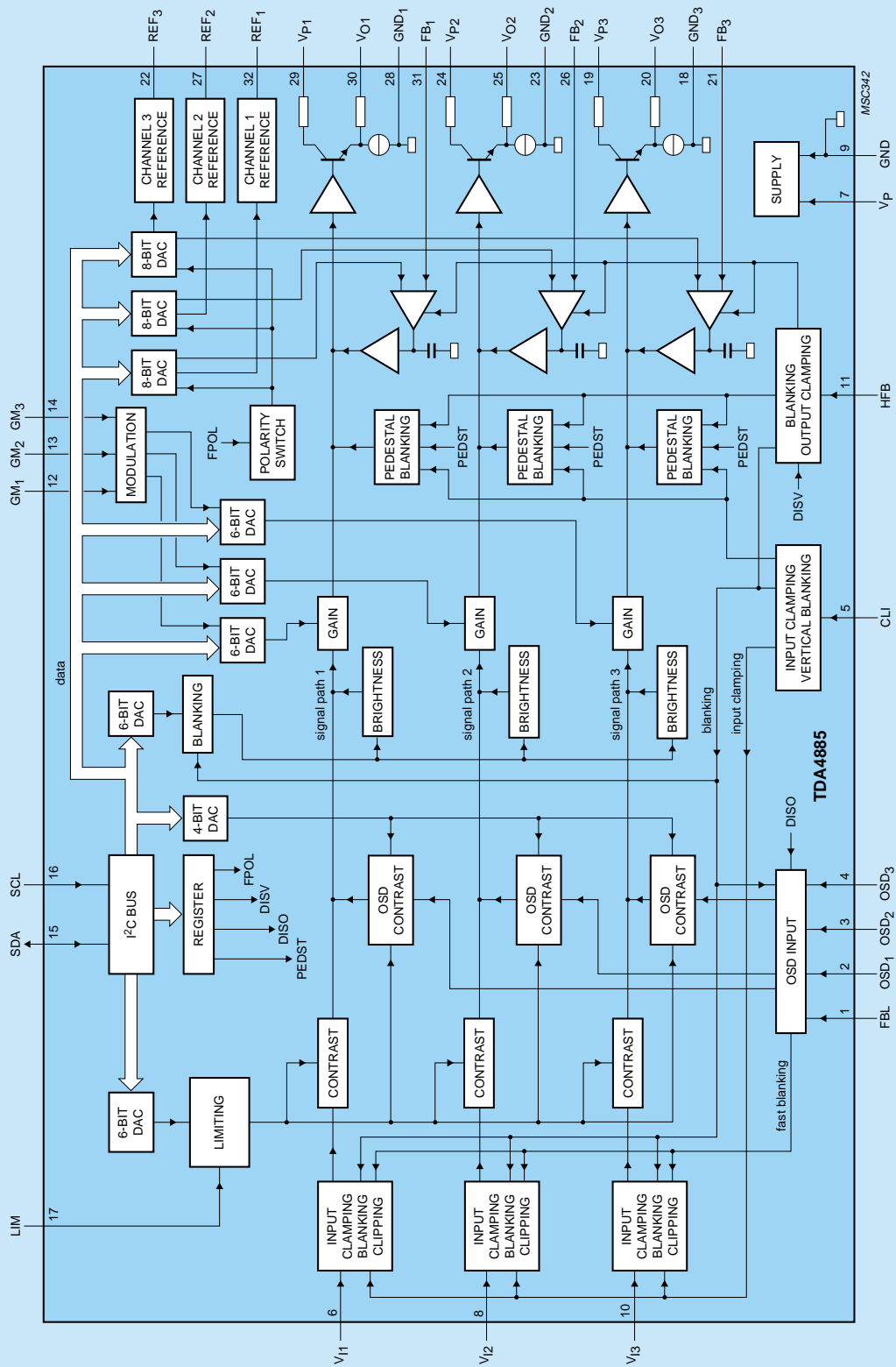
5.1 Sensor to compensate for the earth's magnetic field

Type number	Package	Supply voltage (V)	Sensitivity mV/V kA/m	Field range kA m	Bridge resistance (kOhm)	Operating temperature (°C)
KMZ51	SO8	5-8	12-16	-0.2-0.2	1.0-2.6	-40-125

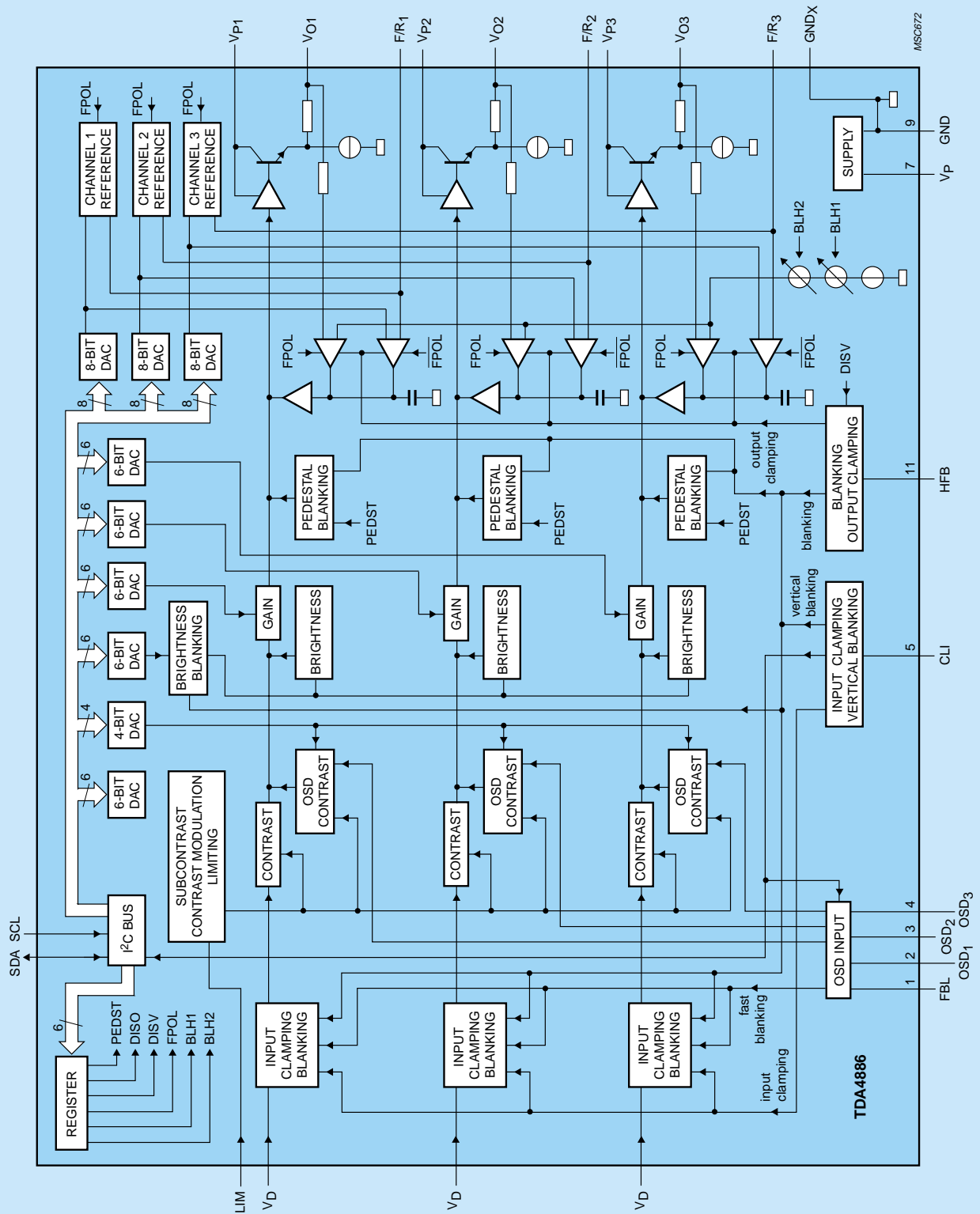
5.2 Video pre-amplifiers

Type number	TDA4885	TDA4886(A)	TDA4887PS	TDA4889PS
Bandwidth (MHz)	150	160 (165)	160	250
Adjustment of:				
gain	3-channel, I ² C bus	3-channel, I ² C bus	3-channel, I ² C bus	3-channel, I ² C bus
contrast	I ² C bus	I ² C bus	I ² C bus	I ² C bus
brightness	I ² C bus	I ² C bus	I ² C bus	I ² C bus
black level	I ² C bus	I ² C bus	I ² C bus	I ² C bus
Grey scale tracking	yes	yes	yes	yes
Gain control range (dB)	-7-0	-7-0	-13.5-0	-19 to 0
Output voltage (V typ.)	2.8	2.8	4.6	4.7
Output current (mA typ.)	20	20	20	30
Blanking and switch-off input	blanking only	blanking only	blanking only	blanking only
Black level clamping input	yes	yes	yes	yes
Gain modulation	yes	yes	yes	yes
Beam-current limitation	yes	yes	yes	yes
Output stages	universal	universal	universal	universal
Package	SDIP32	SDIP24	SDIP24	SDIP32

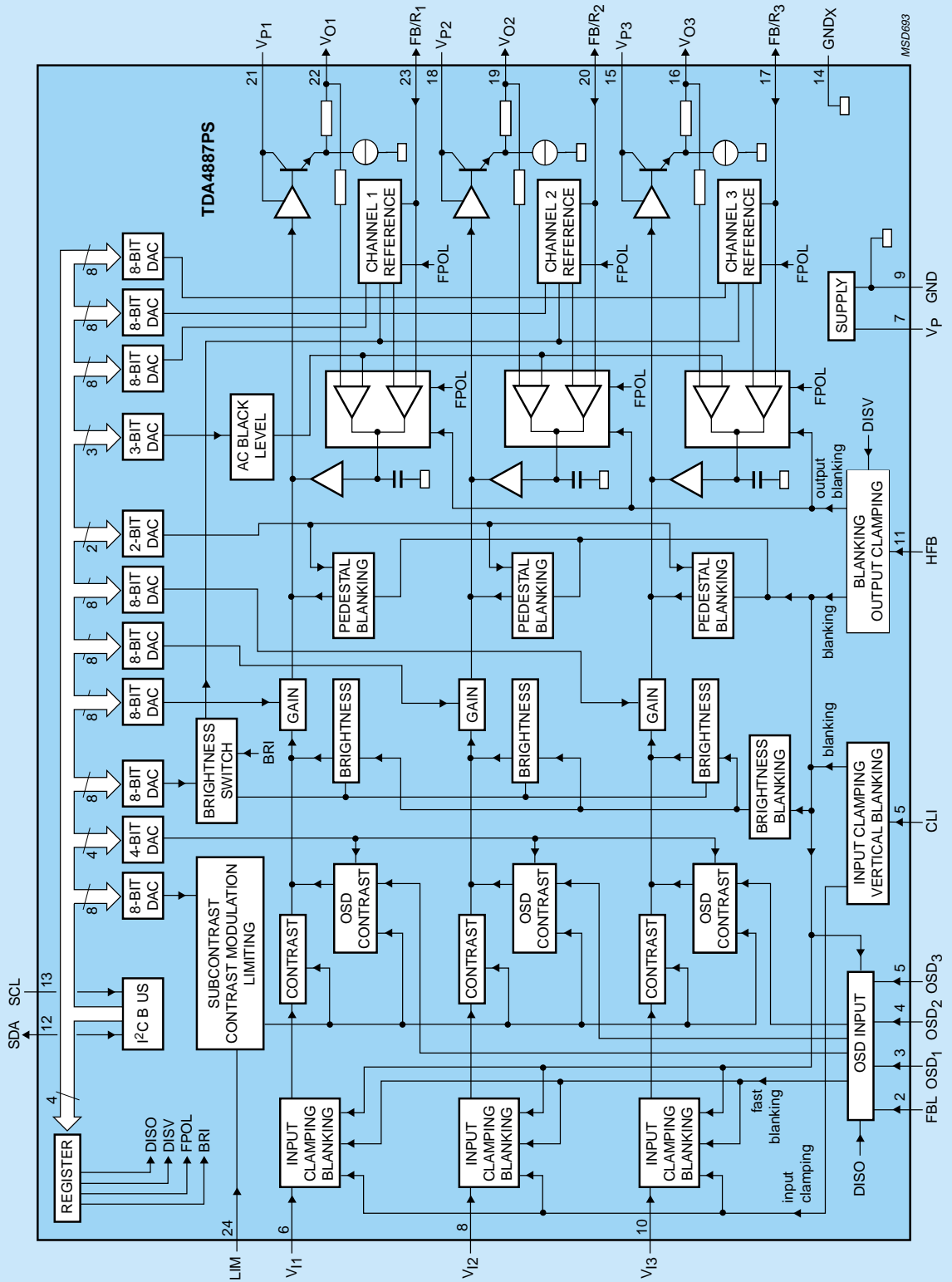
TDA4885



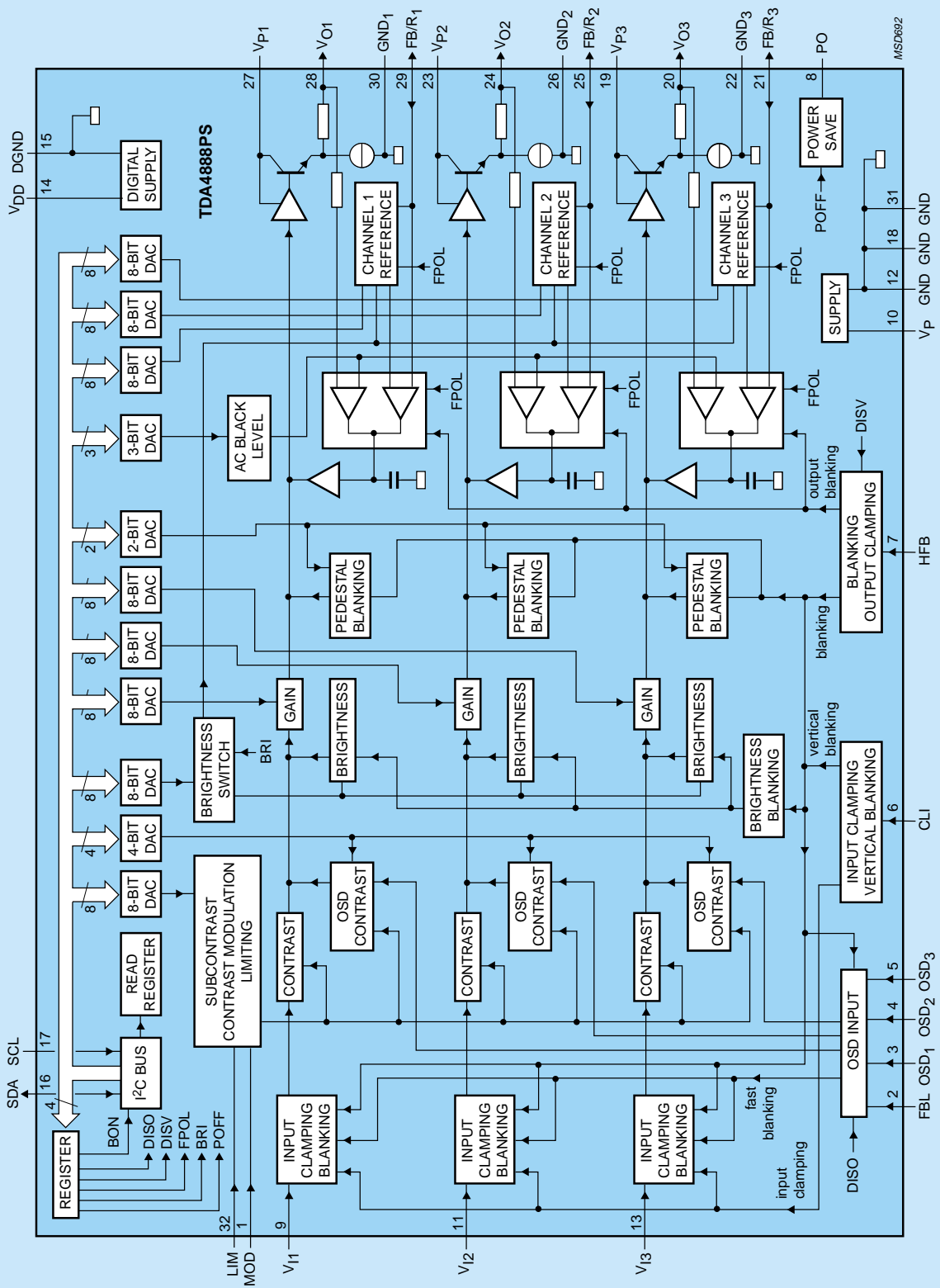
TDA4886



TDA4887PS



TDA4889PS





CONTROL

6

6.1 Non-volatile memories

Type number	PCB2421	PCA8581(C)	PCF8582C-2	PCF8594C-2	PCF8598C-2	PCF85116-3
Organization (bits, serial access)	128×8	128×8	256×8	512×8	1024×8	2048×8
DDC1/DDC2 support	yes	no	no	no	no	no
I ² C bus	yes	yes	yes	yes	yes	yes
Slave address (bits)	–	3	3	2	1	–
Write protection input	yes	no	no	yes	yes	yes
Min. erase/write cycles	10 ⁵	10 ⁵	10 ⁶	10 ⁶	10 ⁶	10 ⁶
Min. data retention (years)	10	10	10	10	10	10
Max. standby current (μA)	10	10	10	10	10	10
Supply voltage (V)	4.5-5.5	4.5-5.5 2.5-6 (C-ver.)	3.0-5.5	3.0-5.5	3.0-5.5	3.0-5.5
Package	DIP8, SO8	DIP8, SO8	DIP8, SO8	DIP8, SO8	DIP8, SO8L	DIP8, SO8

6.2 USB interface

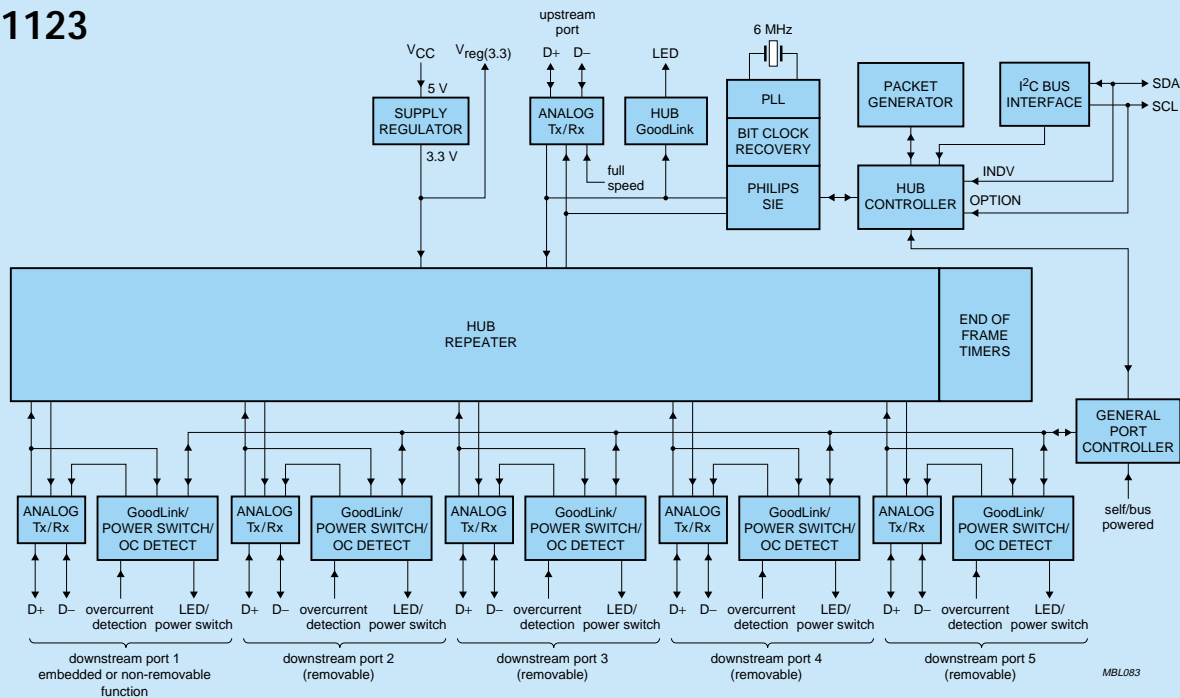
All Philips USB interface ICs conform to their respective USB specifications and are fully compliant with most device specifications. Many also include the GoodLink and SoftConnect features. GoodLink allows a quick visual check of whether peripherals connected to the hub's downstream ports are working properly, delivering significant cost savings in user-support

“hotline” costs, while SoftConnect provides an extra level of peripheral control via the host connection.

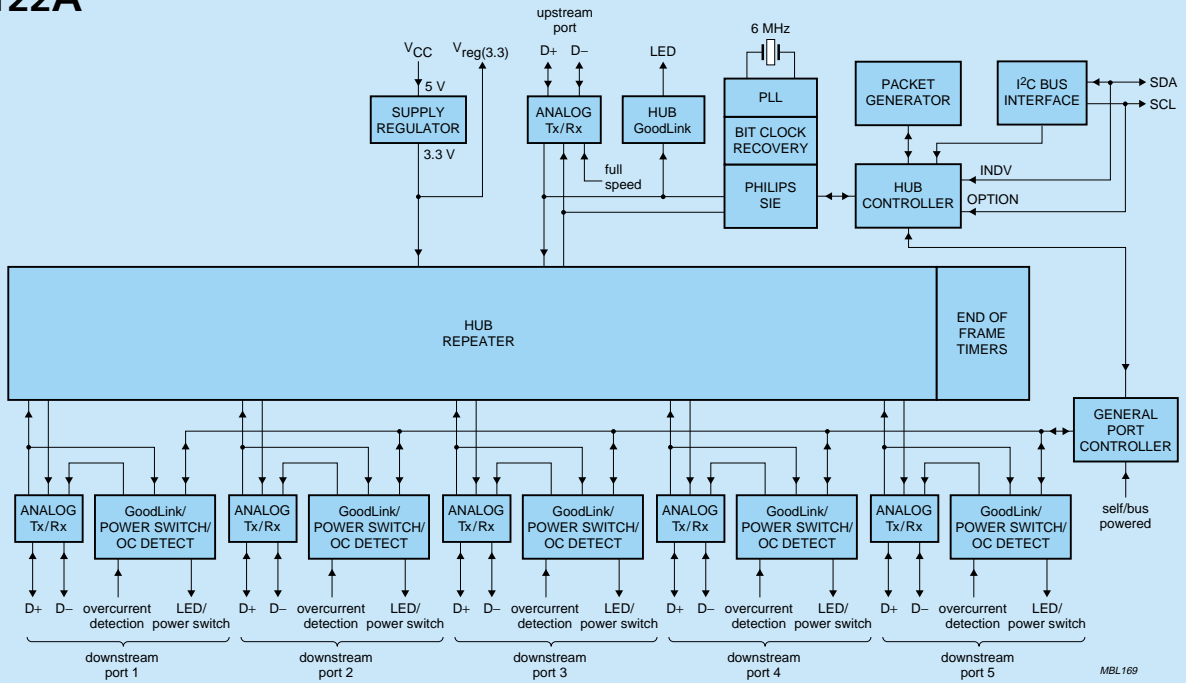
Such feature enhancements make a significant contribution to cost savings in a total system implementation, and at the same time ease the implementation of advanced USB functionality into PC peripherals.

Type number	ISP1123	ISP1122A	PDIUSBH11A	PDIUSB11
Hub	yes	yes	yes	no
USB spec. compliance	1.1	1.1	1.0	1.1
Upstream ports	1	1	1	1
Downstream ports	2-5	2-5	4	0
Embedded function	0	0	3	1
Embedded USB port	Port 1	0	0	0
Integrated FIFOs	yes	yes	yes	yes
Automatic USB protocol handling	yes	yes	yes	yes
SoftConnect	yes	yes	yes	yes
GoodLink	yes	yes	yes	no
I ² C bus	yes	yes	yes	yes
Bundled Monitor Control software	no	no	yes	yes
Clock frequency (MHz)	6	6	12	12
Supply voltage (V)	5.0	5.0	3.0-3.6	3.0 to 3.6
Package	LQFP32	SDIP32, SO32, LQFP32	SDIP32, SO32	DIP16, SO16

ISP1123



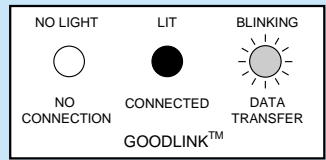
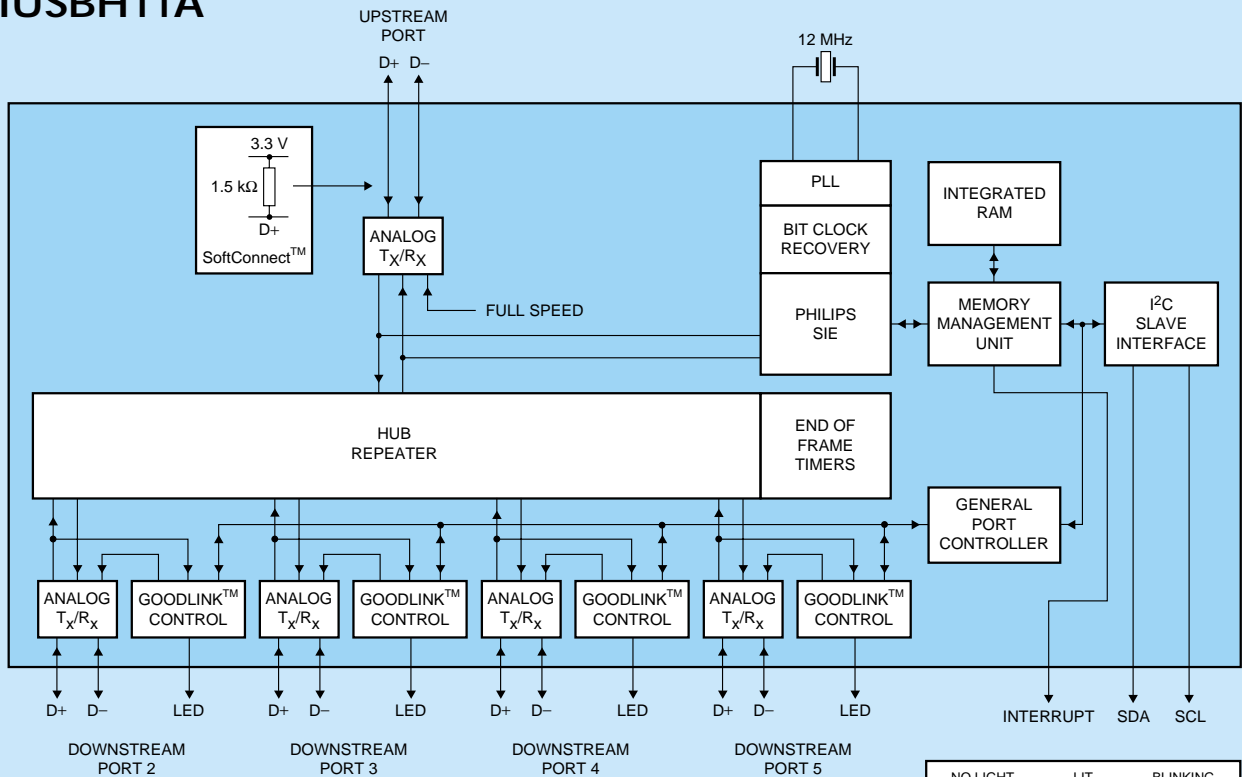
ISP1122A



MBL169

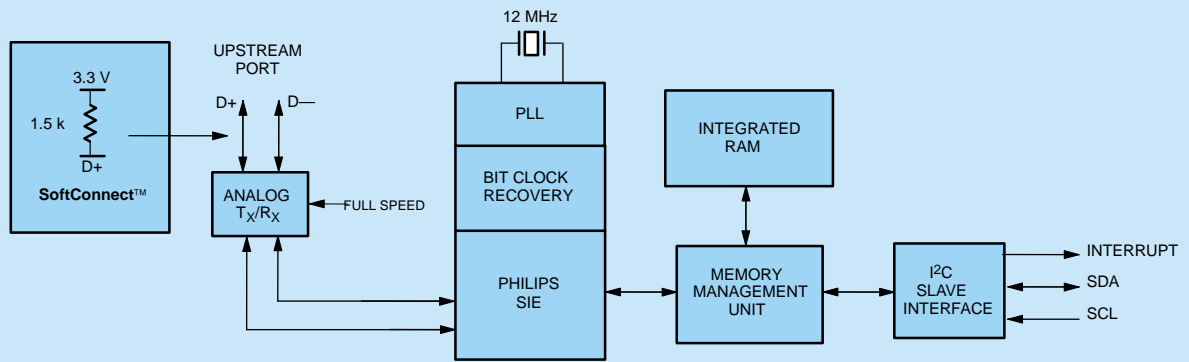
6

PDIUSBH11A



MSC666

PDIUSB11

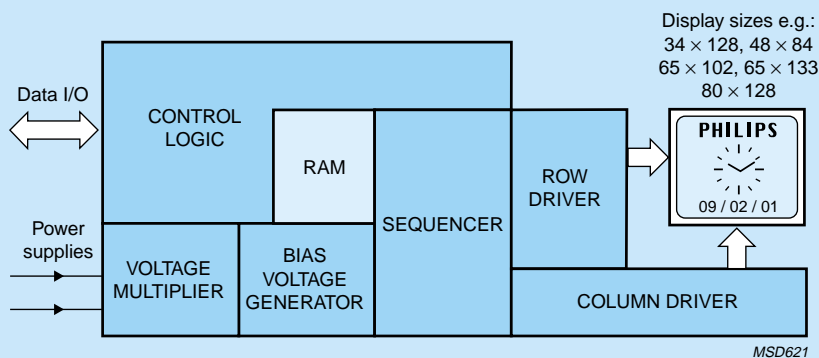


SV00823

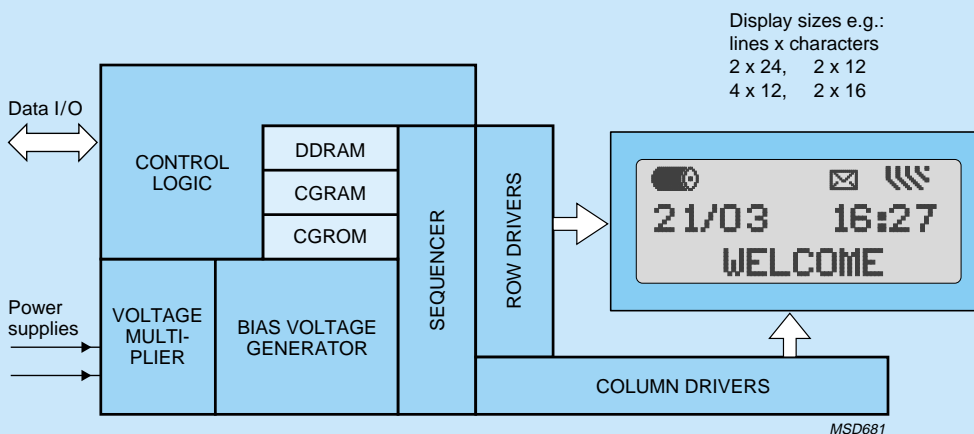
NOTE:
This is a conceptual block diagram and does not include each individual signal.

6.3 LCD display drivers

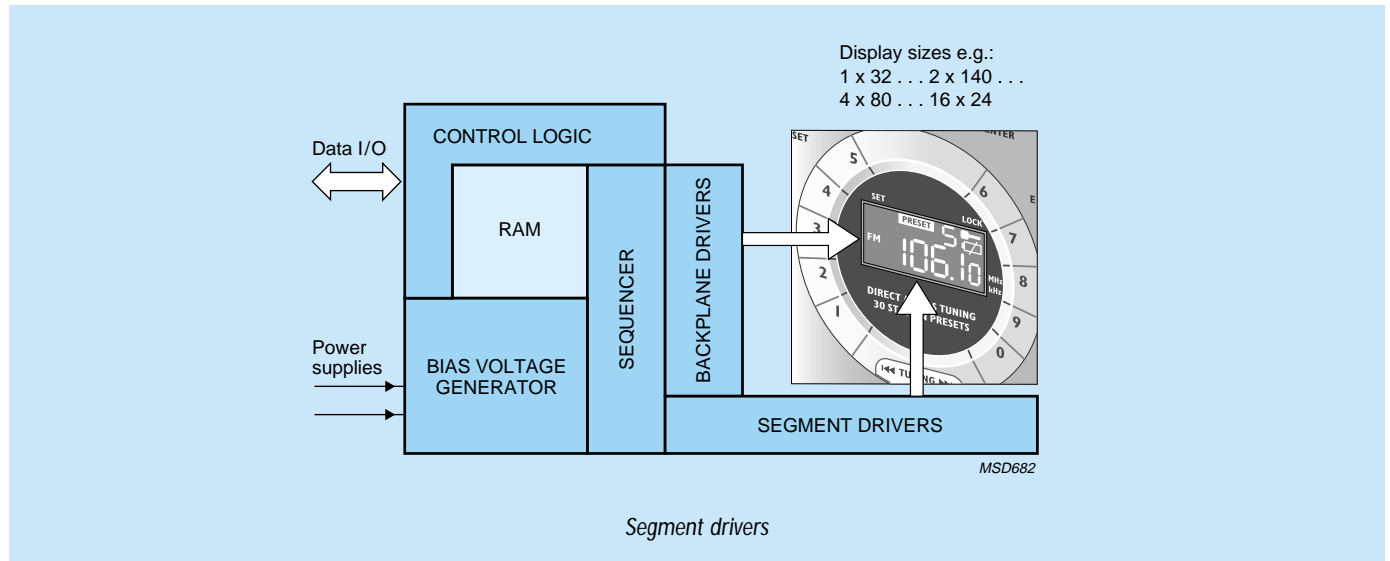
Type number	PCF8566	PCF8576C	PCF8548	PCF2113	PCF2119
Segment/dot-matrix driver	segment	segment	dot-matrix	dot-matrix	dot-matrix
Drive capability: (multiplexed) segments	24-96	40-160	-	-	-
rows/columns	-	-	65/102	18/60	18/80
Format lines/characters/icons	-	-	-/-/102	2/12 /120	2/16/160
Character generator (characters)	-	-	-	16 RAM, 240 ROM	16 RAM, 240 ROM
Display RAM	24x4 bits	40x4 bits	65x102 bits	80 characters	80 characters
I ² C bus	yes	yes	yes	yes	yes
LCD bias voltage generator	yes	yes	yes	yes	yes
LCD voltage multiplier	no	no	yes	yes	yes
Supply voltage V_{logic} , V_{op} (V)	2.5-6	2.5-6	1.5-5.5, 8.5	1.8-5.5, 6.5	1.8-5.5, 6.5
Package	DIP40, VSO40, dice	VSO56, LQFP64, dice	TCP, bumped dice	LQFP100, dice	bumped dice



Graphic drivers



Character drivers



6.4 Other display drivers

Type number	Function
HEF4511B	7-Segment LED driver
HEF4556B	Dual 1-of-4 decoder/demultiplexer with LED drive capability
SAA1064	4-Digit LED driver with I ² C bus interface



STEREO AUDIO

STEREO AUDIO

We have a wide range of audio amplifiers suitable for monitor applications, only a selection of which are given here. From a 35 mW headphone driver to a 25 W multimedia amplifier, the ICs are designed for efficient, easy mounting and effective supply voltage ripple rejection with emphasis on THD, S/N ratio, low DC offsets, crossover distortion, intermodulation and good channel separation.

USB-controlled audio (see Section 7.2) can be implemented with the UDA1321 and the new UDA1325, both of which bring the benefits of USB connectivity to the digital audio module within monitors. The UDA1321 is a USB audio DAC, while the UDA1325 is a combined ADC/DAC with DSP features and has all the necessary analog and digital functions on chip for high-quality audio over the USB.

7.1 Stereo audio output amplifiers

Type number	TDA8559(T)	TDA8542TS	TDA8552T(TS)	TDA8542AT	TDA8942P
Output power (W)	2×0.035	2×0.7	2×1.4	2×1.5	2×1.5
BTL output configuration	no	yes	yes	yes	yes
Voltage gain (dB)	26	6-30	-60 to +30	6-30	32
Volume control	-	-	digital control	-	no
Mute mode	yes	yes	yes	yes	yes
Standby	yes	yes		yes	yes
Thermal protection	yes	yes	yes	yes	yes
Short-circuit protection	yes	yes	yes	yes	yes
Supply voltage (V)	1.9-30	2.2-18	2.7-5.5	2.2-18	6-18
Package	DIP16 (SO16)	SSOP20	SO20 (SSOP20)	SO20	DIP16

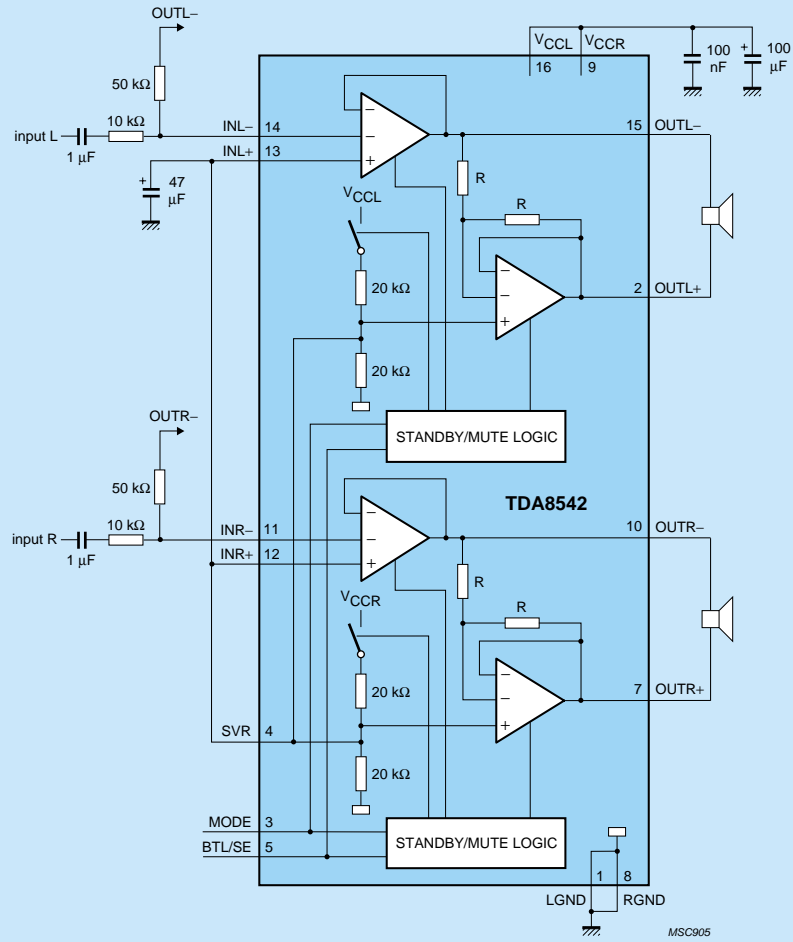
Stereo audio output amplifiers (continued)

Type number	TDA1517(A)	TDA2615	TDA1519B	TDA8944J	TDA1516BQ
Output power (W)	2×6 (2×6)	2×6	2×6	2×6	2×12
BTL output configuration	SE (also BTL)	no	yes	yes	yes
Voltage gain (dB)	20	30	40	32	20
Volume control	no	no	no	no	no
Mute mode	yes	yes	yes	yes	yes
Standby	yes	no	yes	yes	yes
Thermal protection	yes	yes	yes	yes	yes
Short-circuit protection	yes	yes	yes	yes	yes
Supply voltage (V)	6-18	15-42	6-18	6-18	6-18
Package	SIL9MP, HDIP18 (HTSSOP)	SIL9MPF	SIL9MPF	SIL17P	DBS13P

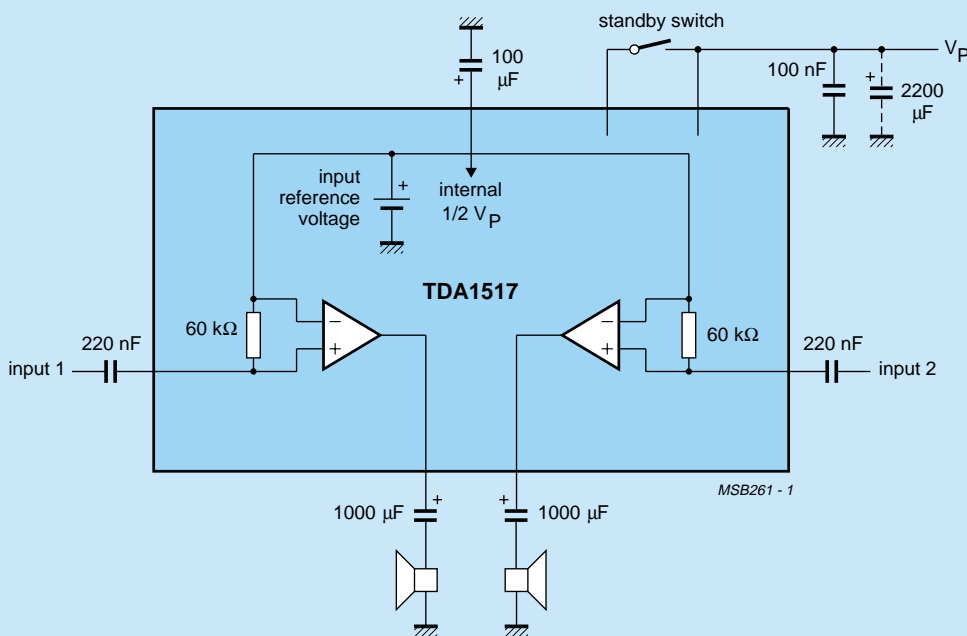
Stereo audio output amplifiers (continued)

Type number	TDA1518BQ	TDA1519CJ	TDA2616	TDA8946	TDA1552Q	TDA1563Q
Output power (W)	2×12	2×12	2×12	2×15	2×22	2×25
BTL output configuration	yes	yes	no	yes	yes	yes
Voltage gain (dB)	40	40	30	32	26	26
Volume control	no	no	no	no	no	no
Mute mode	yes	yes	yes	yes	yes	yes
Standby	yes	yes	no	yes	yes	yes
Thermal protection	yes	yes	yes	yes	yes	yes
Short-circuit protection	yes	yes	yes	yes	yes	yes
Supply voltage (V)	6-18	6-18	15-42	6-18	6-18	6-18
Package	DBS13P	SIL9P,DBS9P	SIL9P	SIL17P	DBS13P	DSP17P

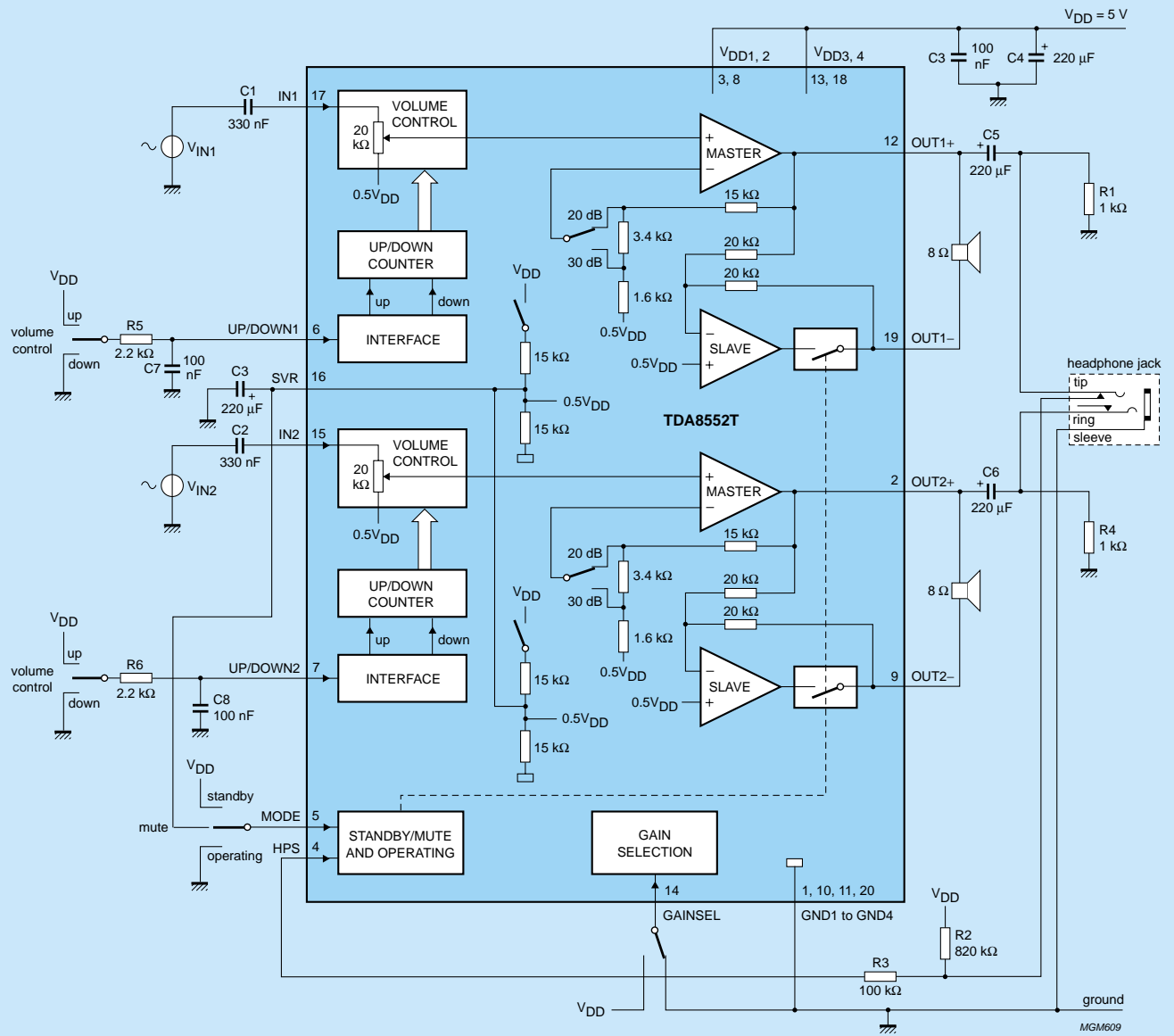
TDA8542TS



TDA1517(P)

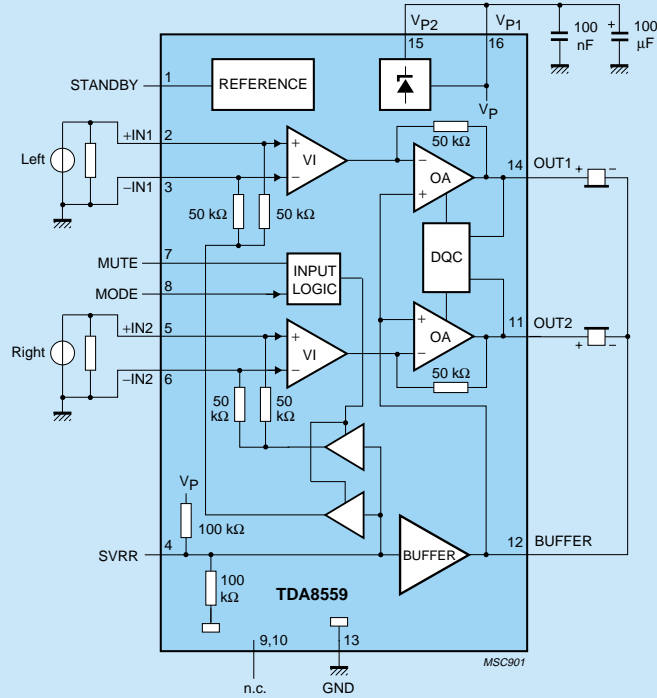


TDA8552(TS)

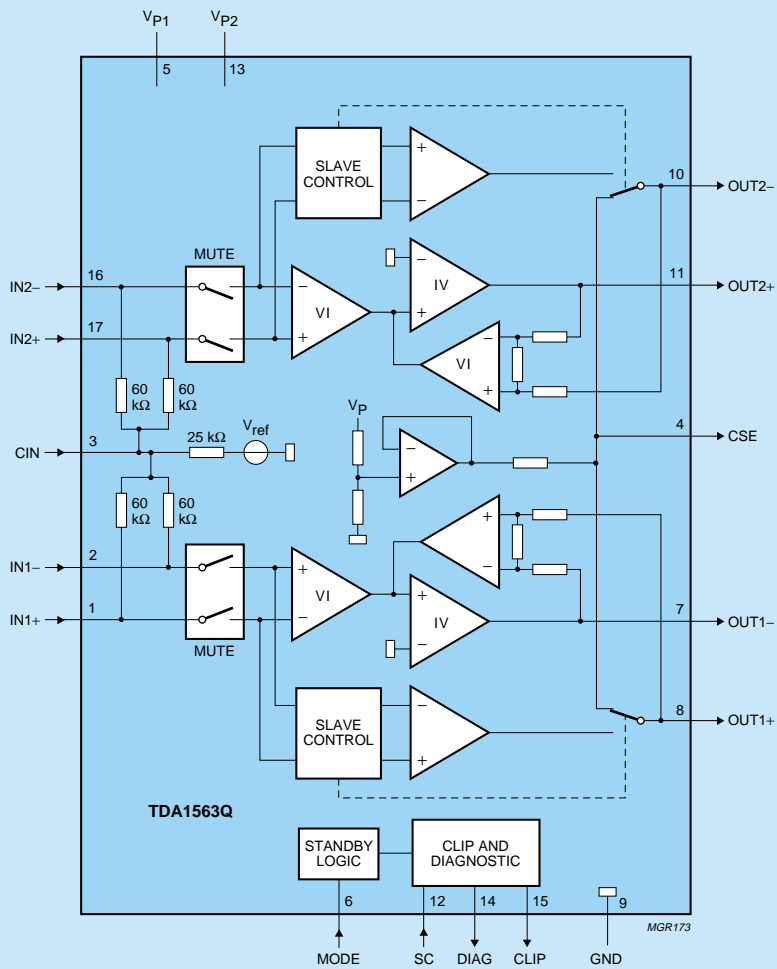


7

TDA8559(T)



TDA1563Q



7.2 USB audio

UDA1321

USB-DAC

- Complete stereo USB-DAC system with integrated filtering and line output drivers
- Supports all USB-compliant audio multimedia devices
- On-board DSP complies with USB audio-device class specification and provides extensive sound processing
- Supports 12 Mb/s “full speed” serial-data transmission
- Fully automatic “Hot Plug-and-Play” operation
- Supports multiple audio data I/O formats
- Asynchronous and isochronous support
- High SNR with low total harmonic distortion
- High linearity and wide dynamic range
- Digital PLL-based asynchronous Master clock
- Low power consumption and power management
- On-chip timing reference recovery system, including oscillator circuitry, using an external crystal for clock regeneration

The UDA1321 is a stereo CMOS DAC and USB interface specifically designed for USB-compliant audio devices and multimedia audio applications such as USB-equipped monitors and telephony devices and digital audio speakers. It incorporates an analog front-end, USB processor, embedded microcontroller, and an Asynchronous DAC (ADAC). The USB processor forms the interface between the USB, ADAC, and microcontroller – and consists of a Serial Interface Engine (SIE), a Memory Management Unit (MMU), and an Audio Sample Redistribution (ASR) module.

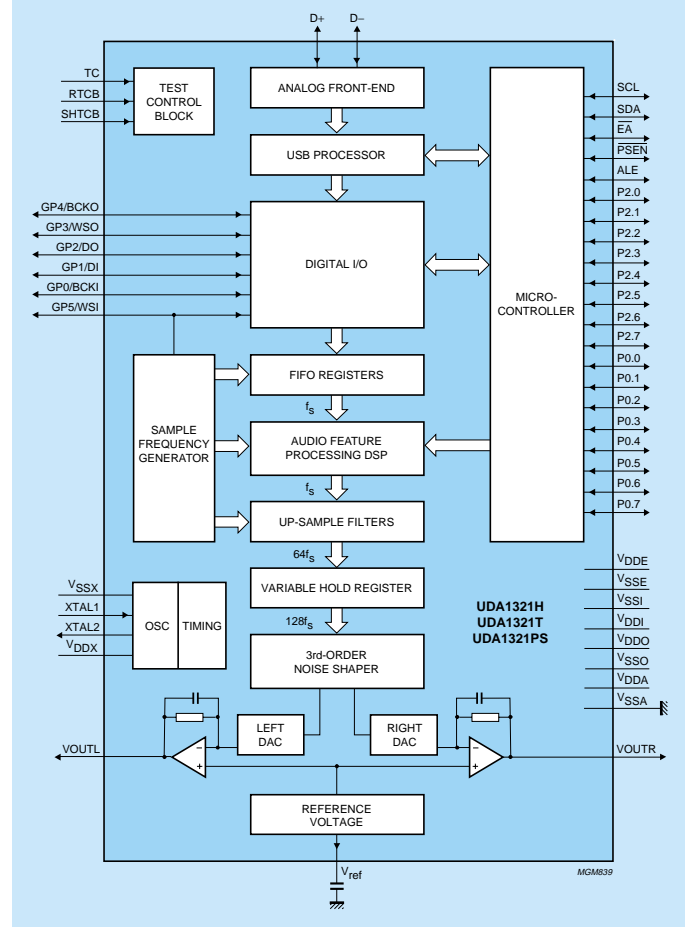
The ADAC includes a Sample Frequency Generator (SFG) which reconstructs the sample clock, digital upsampling filters, a noise shaper, a Filter Stream DAC (FSDAC), and a unique sound processing DSP to handle feature processing. Audio information can be applied to the ADAC via the USB interface, or directly as I²S input data or LSB-justified data with word lengths of 16-, 18- or 20-bits. Two upsample filters, along with a variable sample-and-hold function, increase the oversampling rate from 1 f_s to 128 f_s , after which a third-order noise shaper converts oversampled data to a bitstream for the FSDAC. Finally, on-board amplifiers convert the FSDAC output current to a voltage output signal for driving a line output.

Sound processing features are in line with the USB audio-device class specification and include digital de-emphasis, separate digital volume control for left and right channels via USB or direct control, digital bass and treble tone control, and separate soft mute for left and right channels. Additional features can be included with the use of an external DSP IC, connected via the I²S bus.

QUICK REFERENCE DATA

Power supply	3.3 V
I ² C bus-controlled	Yes
Digital supply current	85 mA
Typical THD + N at 0 dB	-90 dB
SNR	95 dB
Total power dissipation (max.)	330 mW
Package	QFP64, SO28, SDIL32

UDA1321



STEREO AUDIO

UDA1325

Audio CODEC

- Single-chip USB audio CODEC with playback and record functionality
- Integrated microcontroller with on-chip ROM supports a variety of topologies and configurations by editing the USB descriptor set held in EEPROM
- Fully compliant with USB Specification Rev 1.0, USB Audio Device Class 1.0, USB HID Device Class, and HID Usage Table final specifications
- Supports full-speed 12 Mbit/s USB, all USB-compliant audio devices, and HID connectivity with two general I/O pins
- Adaptive Sample Rate Conversion supporting 5 and 55 kHz frequencies for playback
- Input sample rate supports 5.5125, 6, 8, 11.025, 12, 16, 22.05, 24, 32, 44.1, 48 kHz with integrated PLL, and other frequencies with external crystal
- High linearity, dynamic range, and SNR (95 dB)
- Low THD (90 dB output and 85 dB on input)
- Extensive DSP features (separate left/right volume control, soft mute, treble and bass tone control, dynamic bass boost, selectable clipping detection/prevention and de-emphasis)
- Multiple input/output data formats (8-, 16-, 18-, and 24-bit)
- I²S and Japanese digital audio format I/O for external digital audio processing; separate I²S input can be directly connected to an ADC or used as DSP interface for AEC
- Can operate in Bus- and Self-powered modes

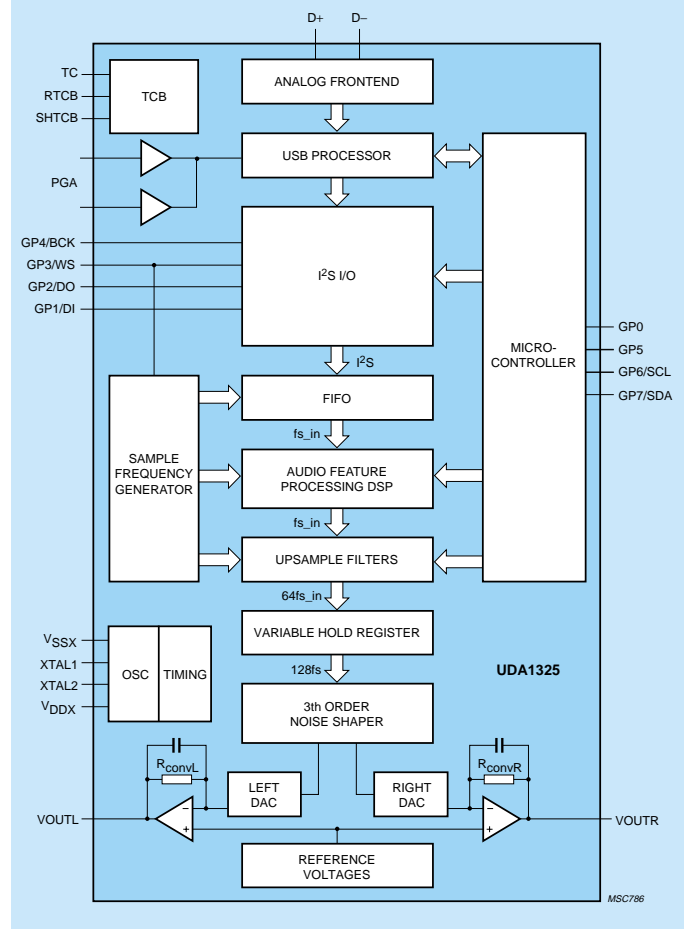
The UDA1325 is a single-chip stereo audio USB playback and record solution. It has an analog audio input, with a Programmable Gain Amplifier (PGA) supporting gain selection in small steps, which can be used to support line and microphone inputs. It also has a digital (I²S) audio input. Host-based and local (directly communicating with UDA1325) DSP-based Acoustic Echo Cancellation (AEC) can be implemented.

All USB control and HID class-support functions are handled by the integrated microcontroller, with the USB-compliant firmware stored in 12 kB on-chip ROM. Offering fully automatic “Hot Plug-and-Play”, the UDA1325H is simple and inexpensive to design in, for a variety of applications. The QFP64 version is pin-compatible with the first generation devices.

QUICK REFERENCE DATA

Power supply	3.3 V
I ² C bus-controlled	Yes
Digital supply current	t.b.f.
Audio input sample frequency range	5 - 55 kHz (continuous)
Typical THD + N at 0 dB input	-85 dB
output	-90 dB
SNR	95 dB
Total power dissipation (max.)	t.b.f.
Package	QFP64

UDA1325





**SWITCHED-MODE
POWER SUPPLY
(SMPS)**

8.1 GreenChip™ & STARplug™ circuits

Low standby power SMPS systems

The Switched-Mode Power Supply (SMPS) is the most compact and efficient electrical power supply for monitors. Although many SMPS systems provide a standby mode, during which they consume just 5 to 10 Watts, this “standby” accounts for up to 10% of domestic and office electricity bills. Philips Semiconductors now offers a new SMPS controller family that drastically reduces the overall cost and power consumption of SMPS designs. In addition to the GreenChip TEA1504 SMPS controller, Philips offers two GreenChip™ ICs and a family of STARplug ICs that save energy in all modes of operation.

GreenChip circuits

GreenChip designs, based around the TEA15xx family, bring typical standby power consumption down to 1-2 W. GreenChip ICs are optimized for both primary and secondary sensing configurations and operate directly from a 90-276 V AC supply. They also contain an on-chip startup current source and integrated on/off circuitry that replaces an expensive mains switch. GreenChips have a built-in standby mode that uses burst-mode operation. In this mode standby power level as low as 1 W can be reached without the need for a dedicated standby SMPS.

The newest additions to the GreenChip family are the TEA1507 and TEA1541 GreenChip SMPS controllers. Besides standby power, these products offer optimal efficiency at all power levels. GreenChip uses valley switching to reduce switch-on losses and EMI radiation. The TEA1507 operates in Quasi-Resonant (QR) mode at high power levels, and fixed-frequency operation at medium power levels. At low power level the switching frequency is reduced to limit switching losses.

STARplug circuits

The TEA152x STARplug family of SMPS controller ICs are designed for compact and efficient power supplies supplying up to 50 W. They operate directly from the rectified mains and all ICs (except the TEA152AJM) incorporate dedicated circuitry for valley switching, resulting in minimal switch-on loss. They also feature frequency reduction at low power output, which brings their standby power down to 100 mW or less. The ICs are available in 8-pin DIP, 14-pin SO, and 9-pin DBS packages.

8.2 GreenChip circuits for monitor SMPS

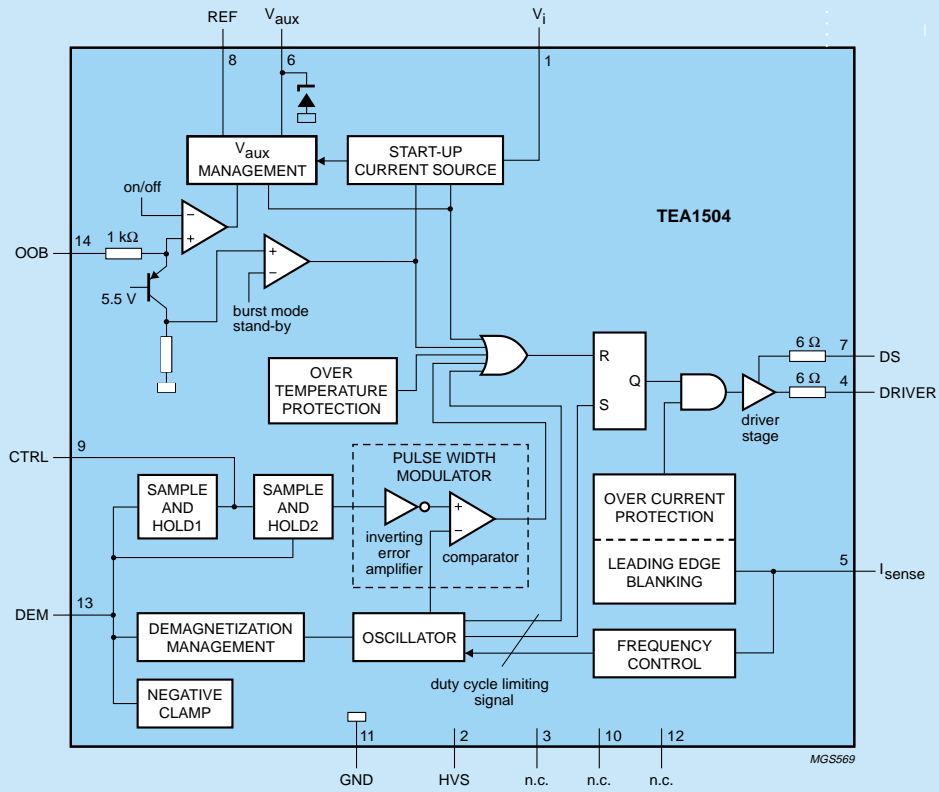
Type package	Power* (W)	Package	Operation
TEA1504	< 2	DIP14	Fixed-frequency flyback
TEA1507	< 3	DIP8	Quasi-resonant flyback SOPS
TEA1541	< 3	DIP8	Synchronised frequency flyback

* Universal mains 70-276 V (AC)

8.3 STARplug circuits for monitor SMPS

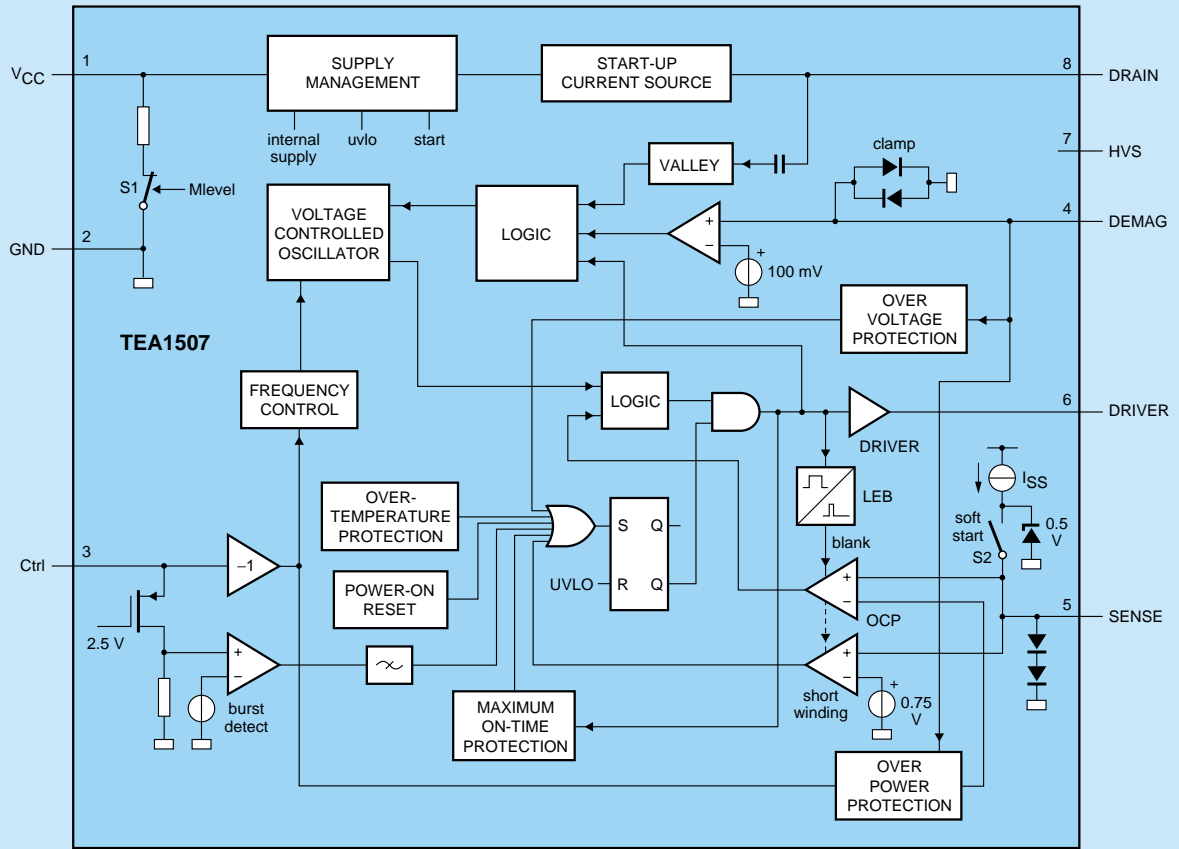
Type package	R _{DS,ON}	Global mains		180 - 276 V		150 V MAX	
		DIP/SO	DBS	DIP/SO	DBS	DIP/SO	DBS
TEA1524	3.5 Ω	15 W	30 W	30 W	50 W	15 W	30 W
TEA1523	7 Ω	10 W	20 W	15 W	35 W	10 W	20 W
TEA1522	12 Ω	7 W	10 W	8 W	20 W	7 W	10 W
TEA1521	24 Ω	3 W	-	4.5 W	-	3 W	-
TEA1520	50 Ω	2 W	-	3 W	-	2 W	-

TEA1504



SWITCHED-MODE POWER SUPPLY (SMPS)

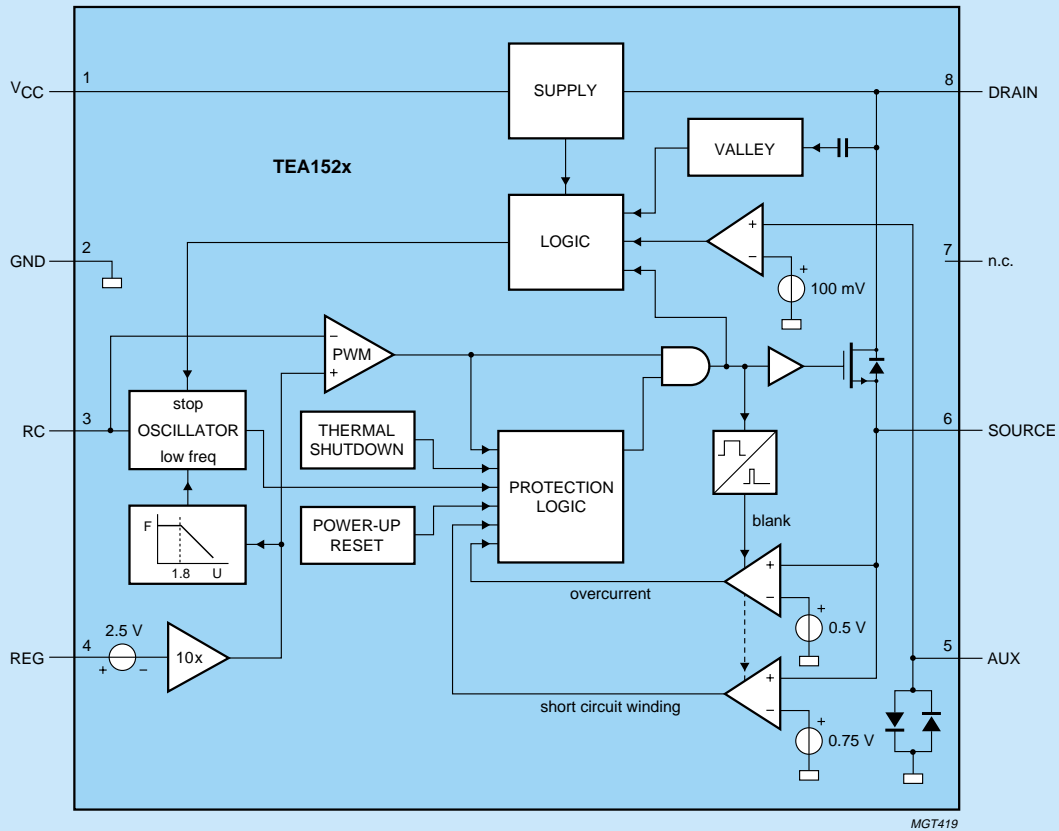
TEA1507



MSD547

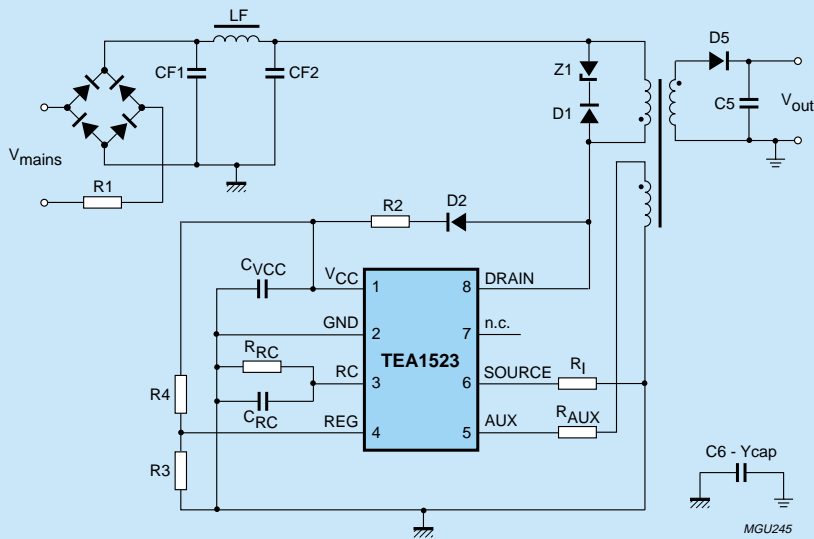
SWITCHED-MODE POWER SUPPLY (SMPS)

TEA152x



MGT419

TEA1523



MGU245

Starplug™ typical application

8.4 Power MOSFETs for S-correction capacitor/mode switching

Type number	V _{DS} max (V)	R _{DS(ON)} (Ω)	Package
PHX23NQ10T	100	70	SOT186A
PHP18NQ10T	100	90	TO220
PHP23NQ10T	100	70	TO220
PHP27NQ10T	100	50	TO220
PHP34NQ10T	100	40	TO220
PHP45NQ10T	100	25	TO220
PHX9NQ20T	200	400	SOT186A
PHX14NQ20T	200	230	SOT186A
PHX18NQ20T	200	180	SOT186A
PHP9NQ20T	200	400	TO220
PHP14NQ20T	200	230	TO220
PHP18NQ20T	200	180	TO220
PHP20NQ20T	200	130	TO220

SWITCHED-MODE POWER SUPPLY (SMPS)

8.5 Rectifier diodes for SMPS

Type number	V _{RRM} max (V)	I _{F(AV)} max (A)	I _{FSM} max (A)	t _{rr} max (ns)	V _F max at I _F (V)	I _F (A)	Package
<i>Fast soft-recovery controlled avalanche rectifier diodes</i>							
BYD33 series	200-1400	1.30/1.26	20	250/300/500	1.3	1	SOD81
BYM26 series	200-1400	2.3/2.4	45	30/75/150	2.65/2.30	2	SOD64
BYM36 series	200-1400	3.0/2.9	65	100/150/250	1.6/1.78/1.57	3	SOD64
BYV26 series	200-1400	1.0/1.05	30	30/75/150	2.5/2.15	1	SOD57
BYV36 series	200-1400	1.6/1.5	30	100/150/250	1.35/1.45	1	SOD57
BYV95 series	200-600	1.5	35	250	1.6	3	SOD57
BYV96E	1000	1.5	35	300	1.6	3	SOD57
BYW95 series	200-600	3.0	70	250	1.5	5	SOD64
BYW96 series	800-1000	3.0	70	300	1.5	5	SOD64
<i>Ultra-fast low-loss controlled avalanche rectifier diodes</i>							
BYD73 series	50-400	1.75/1.70	25	25/50	0.98/1.05	1	SOD81
BYV27 series	50-600	2.0/1.9/1.6	50/40	25/50	0.98/1.05/1.25	2	SOD57
BYV28 series	50-600	3.5/3.0	90	25/50	1.02/1.05/1.25	3.5	SOD64
<i>Ultra-fast rectifier diodes (single)</i>							
BYR29(F) series	600-800	8	60	75	1.95	20	TO220
BYT79 series	300-500	14	130	60	1.4	50	TO220
BYV29(F) series	300-500	9	70	60	1.4	20	TO220
<i>Ultra-fast rectifier diodes (dual)</i>							
BYT28 series	300-500	10	50	60	1.4	15	TO220
BYV34 series	300-500	20	120	60	1.4	30	TO220
BYV44 series	300-500	30	130	60	1.4	50	TO220
BYV72(F) series	100-200	30	150	28	1.2	30	SOT93 (SOT199)
BYV74(F) series	300-500	30	130	60	1.6	30	SOT93 (SOT199)
<i>Ultra-fast rugged rectifier diodes (single)</i>							
BYV79E(X) series	100-200	14	150	30	1.05	14	TO220
BYW29E(X) series	100-200	8	80	25	1.05	8	TO220
<i>Ultra-fast rugged rectifier diodes (dual)</i>							
BYQ28E(X) series	100-200	10	50	25	1.1	5	TO220
BYV32E(X) series	100-200	20	125	25	1.15	20	TO220
BYV40E series	100-200	1.5	6	25	1.0	1.5	SOT223
BYV42E(X) series	100-200	30	150	28	1.2	30	TO220
BYV72E series	100-200	30	150	28	1.2	30	SOT93
<i>General-purpose rectifiers</i>							
BYW54 to 56	600-1000	2	50	3000 typ.	1.0	1	SOD57
1N5059 to 62	200-800	2	50	3000 typ.	1.0	1	SOD57

SWITCHED-MODE POWER SUPPLY (SMPS)

8.6 Schottky rectifier diodes

20/25 V	V_{RRM} max		$I_{F(AV)}$ max (A)	Package
	40/45 V	60/80/100 V		
	PBYR240/45CT		2	SOT223
	PBYR745x		7.5	TO220 (SOD113)
	PBYR1040/45x	PBYR1060/80/100x	10	TO220 (SOD113)
	PBYR1540/45CTx		15	TO220V(SOT186A)
	PBYR1645		16	TO220
	PBYR2045CT	PBYR20100CT	20	TO220
	PBYR2545CT		30	TO220
	PBYR3045WT	PBYR30100WT	30	TO247
PBYR4025WT	PBYR4040/45WT		40	TO247
	PBYR6040/45WT		60	TO247
PBYR7020/25WT			70	TO247



**DISPLAY & PASSIVE
COMPONENTS**

9.1 Display components

Color monitor tubes

Type number	Size (inch)	Screen			Gun	Base	Mechanical dimensions				
		Horiz. pitch	Glass transmission	Phosphor			Length max.	Weight	Z-to-lug	Horiz. ear-to-ear	Vertical ear-to-ear
		(mm)	(%)								
M34EDC	14	0.28	57	P22	Polygon	B10-277	352.0	6.4	34.0	311.4	243.2
M36EDR	15	0.28	56	P22	Polygon	B10-277	352.8	7.5	34.0	331.0	261.0
M41EHN	17	0.27	53.5	P22/EBU	DAF/DBF	B10-301	388.0	10.0	20.0	367.0	291.6

Color monitor tubes (continued)

Type number	Typical operating characteristics								Useful phosphor area		
	V_f	I_f	V_k	V_a	I_a	V_{g3}	V_{g2}	V_{dyn} hor/vert parabola	vert.	hor.	diag.
	(V)	(mA)	(V)	(kV)	(μ A)	(kV)	(V)		(mm)	(mm)	(mm)
M34EDC	6.3	315	100-125	25	200	6-7	360-750		210.6	280.8	335.4
M36EDR	6.3	315	106-125	24	200	6-7	425-700		213.6	283.6	352.6
M41EHN	6.1	315	100-125	26	250	6.6-7.7	425-700	350/150	244.4	324.7	404.0

Color monitor tubes – options

Type number	Size (inch)	Screen surface treatment				Rotation coil	Deflection units Horizontal inductances (mH)	Horizontal frequency range (kHz)	Ergonomic approvals
		High gloss	Anti glare	AGAS	IRIS				
					IRIS-HC ²				
M34EDC	14	•	•	•		0.18-1.44	16 to 64	MPR-II, TCO	
M36EDR	15	•	•	•	•	0.18, 0.34	38 to 64	MPR-II, TCO	
M41EHN	17				•	0.12, 0.18	66 to 84	MPR-II, TCO	

Note: These color monitor tubes, along with the deflection units to support them, are supplied by LG. Philips.

9.2 Flyback transformers

Flyback transformers

Type number	Application
<i>14"-15" color monitors</i>	
MLT-E2	up to 69 kHz
<i>17"-19" color monitors</i>	
MLT-M1	DAF up to 95 kHz
<i>19"-21" color monitors</i>	
MLTB-M1	DAF up to 115 kHz
<i>32" wide-screen color monitors</i>	
CML 17 RCD	DAF up to 32 kHz



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North America

Philips Semiconductors C.R.M Center
2800 Wells Branch Parkway
Mailstop P-411
Austin, Texas 78728
United States

Tel: +1 800 234 7381
Fax: +1 800 943 0087
E-mail: P411webinq.smi@harte-hanks.com

Europe, Africa, Middle East and South America

Philips Semiconductors International
Fulfillment and Sales Support Center
P.O. Box 366
2700 AJ Zoetermeer
The Netherlands

Fax: +31 79 3685126

Asia Pacific

Philips Semiconductors Asia Pacific
Market Response Management Center
P.O. Box 68115
Kowloon East Post Office
Hong Kong

Fax: +852 2756 8271

Japan

Philips Semiconductors
Philips Building 13-37
Kohnan 2-chome
Minato-ku,
Tokyo 108-8507

Tel: +81 3 3740 5130
Fax: +81 3 3740 5057

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