T-74-23-01

TELEDYNE COMPONENTS

HIGH NEGATIVE-VOLTAGE VIDEO DRIVER FOR CRT MONITORS

FEATURES

- Output Signals Into 10 pF Loads .... 80 V_{P-P}
- Rise and Fall Times @ 80 V_{P-P} .... <4 ns
- User-Defined Pull-Down Resistor
- Linear Gain Adjustment for Matching
- Versions Available to Match Specific CRT Requirements

APPLICATIONS

- CRT Monitors
  - — Projection
  - — High-Resolution
  - — Beam Index

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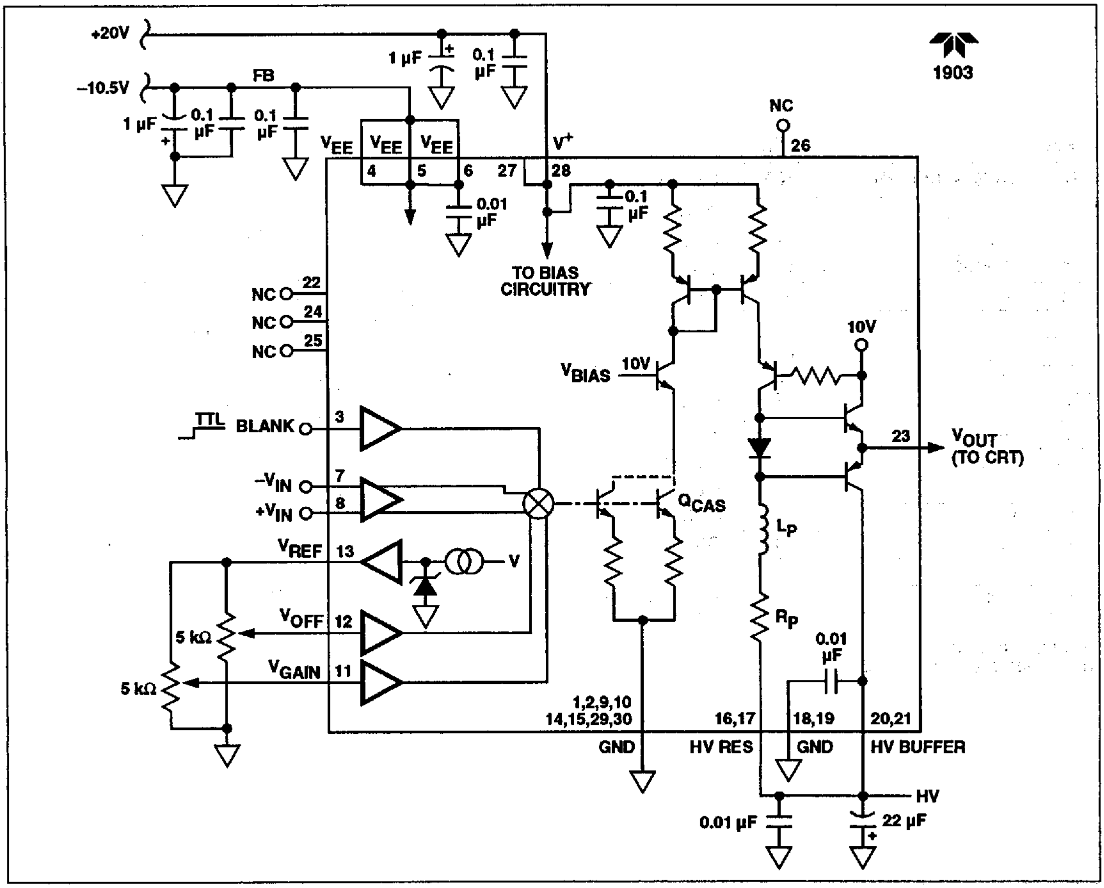
STANDARD CONFIGURATION



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2318 E-03

HIGH NEGATIVE-VOLTAGE VIDEO DRIVER FOR CRT MONITORS

T-74-23-01

1903

GENERAL DESCRIPTION

The 1903 is a high-performance, high-voltage amplifier designed to drive the grid in high-resolution, high-brightness CRT monitors and projection displays.

The 1903 is replete with differential inputs, blanking control, linearly-adjustable gain stage, adjustable offset and a differential emitter-follower output stage. It is capable of driving 10 pF to 20 pF loads, can be driven directly from a standard video DAC, and is RS170 and RS343 compatible.

The 1903 has four variants to suit different applications. There are basically two types: Those with internal pull-down resistors and those that allow the user to choose and apply their own pull-down resistor. The parts within these two types differ in peak-to-peak output signal swing. The 1903-0 and 1903-2 are 90 V_{P-P} versions specified at less than 4 ns rise and fall times. The 1903-0 and 1903-2 operate from a –95V rail.

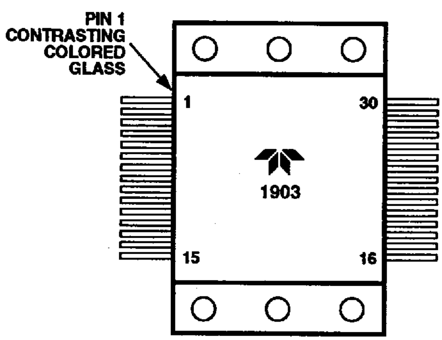
The 1903's are housed in hermetically-sealed, 30-pin flat packs with mounting flanges suitable for 4-40 screws. The standard 1903-X is specified for –25°C to +85°C operation. The 1903-X-HR is specified for –55°C to +125°C operation.

PIN CONFIGURATION

PIN NO.	DESIGNATION	PIN NO.	DESIGNATION
1	GND	30	GND
2	GND	29	GND
3	BLANK	28	V_{CC}
4	V_{EE}	27	V_{CC}
5	V_{EE}	26	NC
6	V_{EE}	25	NC
7	$-V_{IN}$	24	NC
8	$+V_{IN}$	23	V_{OUT}
9	GND	22	NC
10	GND	21	HV BUFFER
11	V_{GAIN}	20	HV BUFFER
12	V_{OFF}	19	GND
13	V_{REF}	18	GND
14	GND	17	HV RESISTOR
15	GND	16	HV RESISTOR

HV = HIGH VOLTAGE
NC = NO INTERNAL CONNECTION

30-Pin Flat Package



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HIGH NEGATIVE-VOLTAGE VIDEO DRIVER FOR CRT MONITORS

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1903

ORDERING INFORMATION

Part Number	R_P	V_{HV}	Output Range	Rise Time	Fall Time	Case Operating Temperature
1903-0	0Ω*	–95V	-5V to -85V	**	**	–25°C to +85°C
1903-0-HR	0Ω*	–95V	-5V to -85V	**	**	–55°C to +125°C
1903-2	400Ω	–95V	-5V to -85V	3 ns	4.5 ns	–25°C to +85°C
1903-2-HR	400Ω	–95V	-5V to -85V	3 ns	4.5 ns	–55°C to +125°C

*User must provide an external R_P.
**Rise and fall times for devices with external R_P will approach the times specified here for corresponding values of external R_P versus internal R_P and output voltage swing.

EVALUATION BOARDS

Board Number	Driver Number	Description
6150-0 6150-2	1903 1903-2	These are demonstration boards which allow a user to quickly and easily evaluate the operating characteristics of the video display drivers in conjunction with the user's display. These cards contain the chosen driver, all necessary connectors (power supply, input/output, control signal) as well as gain and offset adjustment circuits. These boards are compact (4.5" x 4.5" max) and are supplied with an attached heat sink for thermal management. An application note is included with evaluation board to simplify the evaluation of driver performance.
6150-98		Heat sink used with the evaluation board.
6150-99		Fully assembled evaluation board with no hybrid inserted.

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ABSOLUTE MAXIMUM RATINGS

V_{HV} Load Resistor Supply ....(V_{HV} Max +5V)
V_{CC} Positive IC Supply ....+22V
V_{EE} Negative IC Supply ....–12V
V_{IDF} Differential Input Voltage ....+2V
V_{ICM} Common-Mode Input Voltage ....±2V
V_{IG} Gain Adjustment Input Voltage ....+6V
V_{OF} Offset Adjustment Input Voltage ....+6V
V_{BLANK} Blank Input Voltage ....+6V
I_{RP} Total Current Through R_P (Note 1) ....290 mA
I_{REF} Reference Output Current ....–5 mA
T_C Operating Case Temperature Range
1903 ....–25°C to +85°C
1903-X-HR ....–55°C to +125°C
T_J Operating Junction Temperature Range
....–55°C to +150°C
θ_{JC} Junction-to-Case Thermal Resistance
....................10°C/W (For Q_{CAS} and control IC)
..............................1.25°C/W (For R_p internal)
T_{STG} Storage Temperature Range.....–55°C to +150°C
T_S Lead Temperature (Soldering, <10 sec)...+260°C

ELECTRICAL CHARACTERISTICS: T_C = +25°C, V_{EE} = –10.5V, V_{CC} = 20V, V_{HV} = Max, that is, -95V, V_{BLANK} = TTL Low, V_{IG} = V_{OF} = ±V_{IN} = 0V, C_L = 10 pF(2), and external R_P = 400Ω (1903-0), unless otherwise noted.

Symbol	Parameter	Test Conditions	Sbgrp*	Min	Typ	Max	Unit
Input							
V_{IN}	Input Voltage Range	Referenced to Ground, Excluding V_{CM}	—	—	—	±0.714	V
I_B	Input Bias Current		—	–50	—	50	µA
V_{CM}	Input Common-Mode Range		—	–0.5	—	0.5	V

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ELECTRICAL CHARACTERISTICS (Cont.)

Symbol	Parameter		Test Conditions	Min	Typ	Max	Unit
Input (cont.)							
CMRR	Common-Mode Rejection Ratio		$V_{CM} = \pm 0.5V$	—	40	—	dB
R_{IN}	Signal Input Impedance			10	20	—	kΩ
C_{IN}	Signal Input Capacitance			—	2	—	pF
V_{OF}	Offset Adjust Input Voltage			0	—	5.5	V
I_{OF}	Offset Adjust Input Current		$V_{OF} = 1V$	0.5	—	10	μA
V_{IG}	Gain Adjust Input Voltage			0	—	5	V
I_{IG}	Gain Adjust Input Current		$V_{IG} = 5V$	0.5	—	10	μA
Digital Inputs							
I_{IL}	Input Logic "0" Current		$V_{BLANK} = 0.4V$	–600	—	–400	μA
I_{IH}	Input Logic "1" Current		$V_{BLANK} = 2.4V$	–400	—	–200	μA
Output							
V_O	Output Voltage Range	1903-0, -2	V_{HV} = Max	—	—	80	V_{P-P}
R_P	Internal Pull-Down	1903-0	R_P is External and is User-Supplied	—	0	—	Ω
	Resistor	1903-2		380	—	420	Ω
$V_{\Delta B}$	V_Δ in BLANK Mode (Note 4)	1903-0	$V_{BLANK} = 2.4V$, $V_{OF} = 1V$, $V_{IG} = 5V$	$-2xR_P$	—	R_P	mV
	$(V_\Delta = V_{HV} - V_O)$	1903-2	$V_{BLANK} = 2.4V$, $V_{OF} = 1V$, $V_{IG} = 5V$	$-2.5xR_P$	—	0.4	V
				–1	—	0.4	V
$V_{\Delta BIR}$	BLANK Mode Input (Note 4)		$V_{BLANK} = 2.4V$, $\Delta V_{IN} = 0.3V$, $V_{IG} = 5V$	$-2xR_P$	—	$2xR_P$	mV
	Rejection	1903-0, -3	$V_{BLANK} = 2.4V$, $\Delta V_{IN} = 0.3V$, $V_{IG} = 5V$	–0.8	—	0.8	V
V_Δ / V_{OS}	V_Δ Offset Voltage (Note that 1903-0 uses 400Ω load resistor)						
	Min	1903-2	$V_{IG} = 4V$	–0.2	—	–10	V
	Max	1903-2	$V_{OF} = 5V$	–52	—	–32	V
V_O / V_{IG}	V_Δ vs Gain Adjust	1903-0	$\Delta V_{IG} = 5V$	—	—	$\pm 10xR_P$	mV
		1903-2	$\Delta V_{IG} = 5V$	—	—	±4	V
V_Δ T_C	V_Δ Over Temperature	1903-0	T_C = +25°C to +75°C	—	—	$\pm 2xR_P$	mV
		1903-2	T_C = +25°C to +75°C	—	—	±0.84	V
V_{REF}	Reference Voltage		V_{CC} and V_{EE} = Nominal ±10%	5.25	—	5.75	V
I_{REF}	Reference Current			—	—	4	mA
Transfer							
A	Voltage Gain (Note 4)	1903-0, -2	$V_{IG} = 3V$, $\Delta V_{IN} = 0.6V$	71.5	—	133.8	V/V
LE_A	Linearity Error Amplifier		$V_{IG} = 4V$, $V_{OF} = 1V$, $V_{CM} \le \pm 0.5V$	—	—	±2	%GS (Note 3)
LE_{GA}	Linearity Error Gain Adjust		$V_{IN} = 0.2V$, $V_{OF} = 1V$, $V_{CM} \le \pm 0.5V$	—	—	±2	%GS (Note 3)
Dynamic							
t_R	Output Rise Time From $\pm V_{IN}$ (Note 5)	1903-0, -2 25°C, -55°C	$\Delta V_{IN} = 0.6V$, $t_R (V_{IN}) = 1$ ns, $C_L = 15$ pF $V_O = -5V$ to $-85V$ (Note 2)	—	3	4	ns
t_F	Output Fall Time From $\pm V_{IN}$ (Note 5)	1903-0, -2 25°C, -55°C	$\Delta V_{IN} = 0.6V$, $t_R (V_{IN}) = 1$ ns, $C_L = 15$ pF $V_O = -5V$ to $-85V$ (Note 2)	—	4	6	ns
t_R, t_F	Output Rise and Fall Time From $\pm V_{IN}$ (Note 5)	1903-0, -2	HR only, 125°C	—	6	9	ns
t_{BPW}	Blanking Input Pulse Width			30	—	—	ns
THD	Thermal Distortion			—	—	±2	% GS (Note 3)

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ELECTRICAL CHARACTERISTICS (Cont.)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
Power Supplies						
V_{CC}	Positive IC Voltage		19.5	20	20.5	V
V_{EE}	Negative IC Voltage		−10	−10.5	−11	V
V_{HV}	High Voltage Supply	1903-0, -2	0	—	−105	V
		1903-1, -3	0	—	−85	V
I_{CC}	Positive Supply Current		—	—	**100**	mA
I_{EE}	Negative Supply Current		—	—	**−90**	mA
PSRR	Power Supply Rejection Ratio	V_{EE} and V_{CC} = Nominal ±5%	25	—	—	dB
PD	Power Dissipation		—	(Note 6)	—	W

Limits printed in **boldface** type are guaranteed and 100% production tested. Limits in normal font are guaranteed but not 100% production tested. Standard part tested at room temperature. HR parts tested at +125°C, -55°C & +25°C.

NOTES:
1. This limit only applies when V_{HV} is greater than −60V.
2. Total load capacitance on the output mode of the IC includes load capacitance and parasitic.
3. "%GS" means percent of grey scale, referring to RS343 standard video levels.
4. All characterization measurements are made using a 400Ω resistor.
5. Rise and fall times for devices with external R_P will approach the times specified here for corresponding values of external R_P versus internal R_P and output voltage swing, depending on PC board layout parasitics.
6. Refer to Table I, page 6, for power dissipation specifications.

APPLICATIONS INFORMATION

Initial Setup

The initial setup of the 1903 requires proper setting of the V_{OF} and V_{IG} inputs to obtain balanced rise and fall times. If the black level (V_{OF}) is set too low, it will slow the output fall time and limit the bandwidth of the 1903. If it is set too high, it will limit the rise time. Similar effects will result if the gain control (V_{IG}) is set too high.

Signal Inputs

The analog inputs are $+V_{IN}$ and $-V_{IN}$. They are designed to accept RS343 signals, ±0.714 V_{P-P}. It is recommended that the input signal be limited to ±1.3V, referenced to ground (0.714V signal + 0.5V common mode). Offsets of ±2V (referenced to ground, signal included) can be tolerated without damage to the device, but are not recommended.

Output Voltage

The output voltage is controlled by the breakdown voltages of transistors Q_{CAS}, Q_N, and Q_P (see standard configuration diagram), and the value of R_P. The maximum output voltage swing is determined by V_{PP} = 250 mA x R_P.

The rise and fall time specifications are based on conservatively-peaked devices (<5% at the max V_{P-P}). The internal pull-down resistor (R_P) is connected directly to pins 16 and 17. External peaking can be added; use inductors with a high self-resonant frequency and try to minimize capacitive coupling to ground. If no external resistors or inductors are added, use good, high-frequency bypassing on pins 16 and 17.

If large arc-protection resistors are used; i.e., >50Ω, use of a series inductor may improve the rise time of the output signal.

DC Gain (Contrast) Control

V_{IG} is the DC gain (contrast) control input. It can vary the device gain linearly from 0 to 100 by inputting a voltage from 0V to 5V. The internal reference (V_{REF}, pin 13) is designed to drive this input as well as the offset control input. Normally, a 5 kΩ potentiometer between V_{REF} and GND (see standard configuration diagram) is used to vary the gain. However, any external 0V to 5V DC source can be used, but some temperature performance degradation will result.

The gain equation for the 1903 is:

$$[V_{HV} - V_O] = (V_{IN} \times V_{IG} \times 0.1\ (\pm 20\%) \times R_P\ (\pm 5\%) \times 0.9$$

*R_P can be the internal 400Ω resistor or an external user-defined/supplied resistor.

The overall gain of the 1903 may vary by ±20% due to process variations of the internal components. Temperature variations also affect gain by as much as 150 ppm/°C. If more than one 1903 is used in a system, steps should be taken to have them track thermally; i.e., a common heat sink. This will reduce any mismatches due to varying ambient conditions.

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Offset (Brightness) Control

V_{OF} is the output offset (brightness) control input. It sets the quiescent output current, in R_P, thereby setting the output quiescent voltage level. Output quiescent voltage can be adjusted from several µA x R_P to 100 mA x R_P, nominal, from the V_{HV} rail. This is accomplished by inputting a DC voltage in the 0V to 5.5V range at V_{OF}. Normally, this input is from a 5 kW potentiometer bertween V_{REF} and GND (see standard configuration diagram).

Blank

The blank input, when asserted (i.e., TTL HIGH), disables the video input of the 1903 and sets the output to approximately V_{HV}. This input is independent of the input signal and operates with TTL levels.

Reference Voltage

V_{REF} is a zener reference with a nominal output voltage of 5.5V ±5%, and can source up to 4 mA. It is used in adjusting offset and gain.

Power Supply

Power supplies of 20V (±5%) and –10.5V (±5%) are required for proper operation. The negative supply can be set to –12V, but will increase the internal power dissipation and case temperature. V_{HV} is a function of the 1903 version selected. The maximum voltage is –95V, allowing up to 80 V_{P-P} output signals. The absolute maximum voltage, to preclude damage, is equal to the V_{HV} listed in the specification table, plus 5V. For example, the 1903-0 absolute maximum is –100V. It is recommended that the high voltage supply not exceed the listed V_{HV}.

Due to the fact the output from this type of circuit is referenced to the V_{HV} rail, there is no PSRR for V_{HV}. Therefore, it is important that the V_{HV} rail is very stable. Your system power supply will determine your DC stability.

To achieve maximum high-frequency performance, good high-frequency grounding practices and PC board layout are mandatory. For best performance, the case must be held at AC ground. That is, if the case cannot be grounded directly (such as through a grounded heat sink), it should be capacitively grounded.

Supply Sequencing

It is essential that the V_{HV} supply be brought up before V_{EE} and V_{CC} when using the higher voltage version of the 1903. Supply sequencing is less important when V_{HV} is less than –70V. The recommended sequence is V_{HV}, V_{CC} then V_{EE}. If sequencing is not possible, the supplies should be brought up within a few milliseconds of each other.

Power Dissipation

The 1903 power dissipation will vary in accordance to load requirements and pixel size. The 1903 flat pack is designed to provide a low thermal resistance path from the hybrid circuit to an external heat sink. Mounting flanges provide solid mechanical and thermal attachment of the package to the heat sink. In addition, the package is electrically isolated so no mounting insulators are needed and the heat sink can be at any convenient voltage potential. (See Table I.)

Table I. Typical Power Dissipations

					% of Time Signal is at				
Device	V_{HV} (V)	Black Level (V)	White Level (V)	Max. Signal (V_O-V_{BLACK}) (V)	Blank Level (%)	Black Level (%)	White Level (%)	Average Power Output Stage (Notes 1, 2) (W)	Average Power Total (Notes 1, 2) (W)
1903-2	–95	–85	–5	0	100	0	0	0	2.5
1903-2	–95	–85	–5	80	20	40	40	13.5	16

NOTES: 1. Input stage quiescent power is approximately 2.5W.
2. Power dissipations listed do not include power dissipation due to switching.