HIGH-VOLTAGE VIDEO DRIVER FOR CRT MONITORS

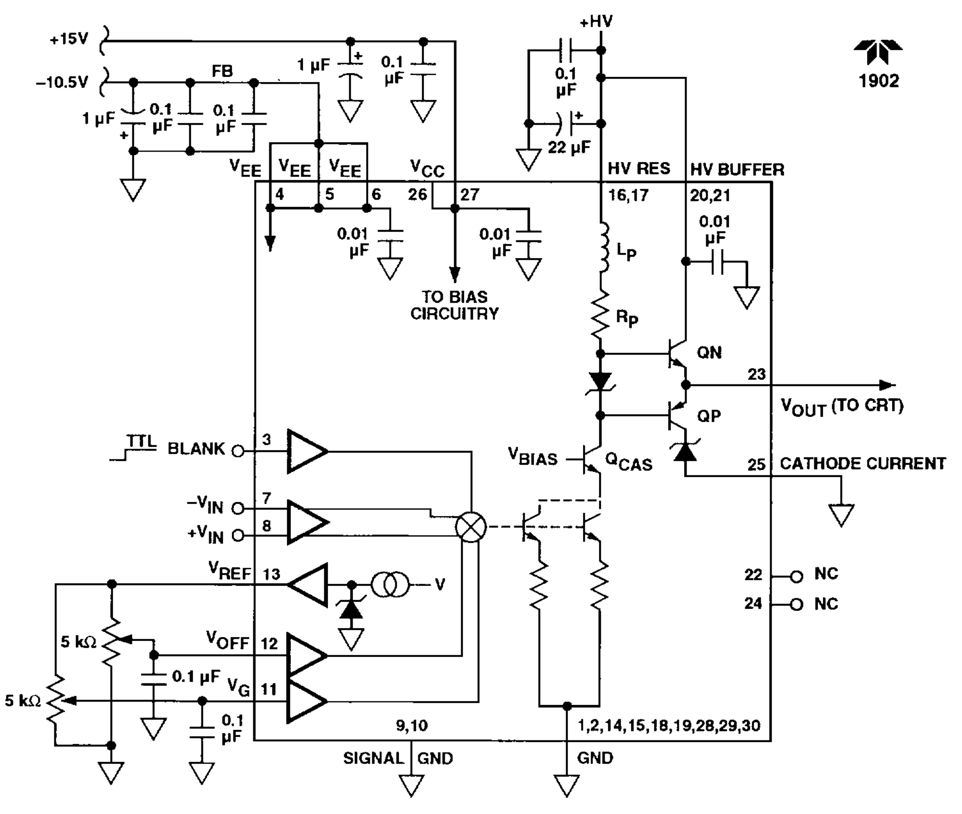
FEATURES

- Output Signals Into 10 pF ....90 $V_{P\text{-}P}$
- Rise and Fall Times @ 50 $V_{P\text{-}P}$ ....2.5 ns
- Linear Gain Adjustment for Matching
- Versions Available to Match Specific CRT Requirements

APPLICATIONS

- CRT Monitors
  - — Projection
  - — High-Resolution Monochrome
  - — High-Resolution RGB

STANDARD CONFIGURATION DIAGRAM



1902

GENERAL DESCRIPTION

The 1902 is a high-performance, high-voltage amplifier designed to drive the cathode in high-resolution, high-brightness CRT monitors and projection displays.

The 1902 is replete with differential inputs, blanking control, linearly-adjustable gain stage, adjustable offset, and a differential emitter-follower output stage. The 1902 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 1902 has three variants for different applications. The internal high-voltage resistor and output transistors are varied to strike the optimum balance between output voltage from 40V to 90V, and rise/fall times from 2.2 ns to 4.5 ns. The 1902-0 has no internal high-voltage resistor, thereby allowing the designer to select a high-voltage resistor to suit the specific application.

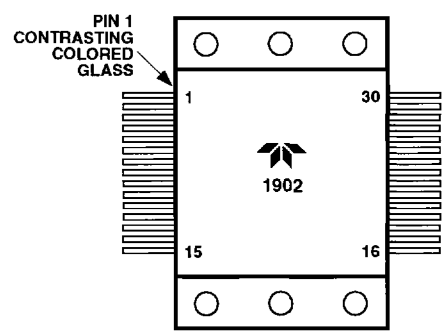
The 1902 is housed in a hermetically-sealed, 30-pin flat pack with 50-mil center pins on two sides. It has mounting flanges suitable for 4-40 screws. The 1902-X is specified for -25°C to +85°C operation. The 1902-X-HR is specified for –55°C to +125°C operation.

PIN CONFIGURATION

PIN NO.	DESIGNATION	PIN NO.	DESIGNATION
1	GND	30	GND
2	GND	29	GND
3	BLANK	28	GND
4	V_{EE}	27	V_{CC}
5	V_{EE}	26	V_{CC}
6	V_{EE}	25	GND
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



ABSOLUTE MAXIMUM RATINGS

V_{HV}	Pull-Up Resistor Supply	(V_{HV} Max +5V)
V_{CC}	Positive IC Supply	+17V
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_{IOS}	Offset Adjust 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	
	1902-X	-25°C to +85°C
	1902-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} = +15V, V_{HV} = Max, that is: 120V for 1902-0, 2 and 70V for 1902-4, V_{BLANK} = TTL Lo, V_{IG} = V_{OF} = ±V_{IN} = 0V, C_L = 10 pF(2), unless otherwise noted.

Symbol	Parameter		Test Conditions	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
CMRR	Common-Mode Rejection Ratio		V_{CM} = ±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	1902-0, -2	V_{HV} = Max (Note 3)	—	—	90	V_{P-P}
	Range, Peak-to-Peak	1902-4	V_{HV} = Max	—	—	50	V_{P-P}
R_P	Internal Pull-Up	1902-0	R_P is External, User-Selected	0	Note 3	0	Ω
	Resistor	1902-2		380	—	420	Ω
		1902-4		190	—	210	Ω
$V_{\Delta B}$	VΔ in BLANK Mode	(Note 4)	V_{BLANK} = 2.4V, V_{OF} = 1V, V_{IG} = 5V	**−R_P**	—	**2xR_P**	mV
	($V\Delta = V_{HV} - V_O$)	1902-0, -2	V_{BLANK} = 2.4V, V_{OF} = 1V, V_{IG} = 5V	**−0.4**	—	**0.8**	V
			V_{BLANK} = 2.4V, V_{OF} = 1V, V_{IG} = 5V	**−0.4**	—	**1**	V
		1902-4	V_{BLANK} = 2.4V, V_{OF} = 1V, V_{IG} = 5V	**−0.2**	—	**0.4**	V
			V_{BLANK} = 2.4V, V_{OF} = 1V, V_{IG} = 5V	**−0.4**	—	**1**	V
$V_{\Delta BIR}$	VΔ BLANK Mode	(Note 4)	V_{BLANK} = 2.4V, ΔV_{IN} = 0.3V, V_{IG} = 5V	—	—	±2xR_P	mV
	Input Rejection	1902-0, -2	V_{BLANK} = 2.4V, ΔV_{IN} = 0.3V, V_{IG} = 5V	—	—	±0.8	V
	($V\Delta = V_{HV} - V_O$)	1902-4	V_{BLANK} = 2.4V, ΔV_{IN} = 0.3V, V_{IG} = 5V	—	—	±0.4	V
$V\Delta/V_{OS}$	VΔ vs Offset Adjust	1902-0, -2	V_{OF} = 0V, V_{IG} = 3V	**0.2**	—	**10**	V
	Min	1902-4	V_{OF} = 0V, V_{IG} = 3.5V	**0.1**	—	**6**	V
	Max	1902-0, -2	V_{OF} = 5V	**32**	—	**52**	V
		1902-4	V_{OF} = 5V	**16**	—	**26**	V
$V\Delta/V_{IG}$	VΔ vs Gain Adjust	(Note 4)	ΔV_{IG} = 5V	—	—	**±10xR_P**	**mV**
	(Gain Adjust	1902-0, -2	ΔV_{IG} = 5V	—	—	**±4**	**V**
	Rejection)	1902-4	ΔV_{IG} = 5V	—	—	**±2**	**V**
VΔ T_C	VΔ Over	(Note 4)	T_C = +25°C to +75°C	—	—	±2xR_P	mV
	Temperature	1902-0, -2	T_C = +25°C to +75°C	—	—	±0.8	V
		1902-4	T_C = +25°C to +75°C	—	—	±0.4	V
V_{REF}	Reference Voltage		V_{CC} and V_{EE} = Nominal ±10%	**5.25**	—	**5.75**	**V**
I_{REF}	Reference Current			—	—	4	mA

1902

ELECTRICAL CHARACTERISTICS (Cont.)

Symbol	Parameter		Test Conditions	Min	Typ	Max	Unit
Transfer							
A	Voltage Gain	1902-0, 2	V_{IG} = 3V, ΔV_{IN} = 0.6V	**71.5**	—	**133.8**	V/V
	(Note 3)	1902-4	V_{IG} = 3.0V, ΔV_{IN} = 0.6V	**36**	—	**67**	V/V
LE_A	Linearity Error Amplifier		V_{IG} = 4V, V_{OF} = 1V, $V_{CM} \leq \pm 0.5V$	—	—	±2	%GS (Note 5)
LE_{GA}	Linearity Error Gain Adjust		V_{IN} = 0.2V, V_{OF} = 1V, $V_{CM} \leq \pm 0.5V$	—	—	±2	%
Dynamic							
t_R/t_F	Output Rise and Fall	1902-0 (25°C)	ΔV_{IN} = 0.6V, V_{OUT} from 20V to 110V	—	—	**5.0**	ns
	(10% to 90%)	(-55,125°C)	ΔV_{IN} = 0.6V, V_{OUT} from 20V to 110V	—	—	**7.0**	ns
		1902-2 (25°C)	ΔV_{IN} = 0.6V, V_{OUT} from 20V to 110V	—	—	**4.0**	ns
		(-55,125°C)	ΔV_{IN} = 0.6V, V_{OUT} from 20V to 110V	—	—	**5.0**	ns
	C_L = 15 pF (Note 2)	1902-4 (25°C)	ΔV_{IN} = 0.6V, V_{OUT} from 15V to 65V	—	—	**2.5**	ns
		(-55,125°C)	ΔV_{IN} = 0.6V, V_{OUT} from 15V to 65V	—	—	**3.0**	ns
t_{BPW}	Blanking Input Pulse Width			—	—	30	ns
THD	Thermal Distortion			—	—	±2	%GS (Note 5)
Power Supplies							
V_{CC}	Positive IC Voltage		Acceptable Range	14.5	15	15.5	V
V_{EE}	Negative IC Voltage		Acceptable Range	−10	−10.5	−11	V
V_{HVMAX}	High-Voltage Supply	1902-0, -2		—	—	120	V
		1902-4		—	—	70	V
I_{CC}	Positive Supply Current			**80**	—	**100**	mA
I_{EE}	Negative Supply Current			**−70**	—	**−100**	mA
PSRR	Power Supply Rejection Ratio		V_{EE} and V_{CC} = Nominal ±5%	25	30	—	dB
PD	Power Dissipation			—	(Note 8)	—	W

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

NOTES:
1. This limit only applies when V_{HV} is greater than 90V.
2. Total load capacitance on the output mode of the IC includes load capacitance and parasitic.
3. All characterization measurements are made using a 400Ω resistor: internal (-2) or external (-0).
4. This specification applies to the 1902-0 when a custom pull-up resistor is selected by the user.
5. "%GS" means percent of grey scale, referring to RS343 standard video levels.
6. Rise and fall times depend on the value of R_P and L_P, peaking inductor (user-selected) and output load.
7. To meet the maximum speed, input rise times of less than 1 ns are needed. These limits are tested to guarantee device functionality.
8. See Table I, page 6, for power dissipation specifications.

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ORDERING INFORMATION

Part Number	R_P (Ω)	High Voltage (V)	t_R At V_{PP} Max	Case Operating Temperature
1902-0	(Note 1)	120	(Note 2)	–25°C to +85°C
1902-0-HR	(Note 1)	120	(Note 2)	–55°C to +125°C
1902-2	400	120	90V/4.0 ns	–25°C to +85°C
1902-2-HR	400	120	90V/4.0 ns	–55°C to +125°C
1902-4	200	70	50V/2.5 ns	–25°C to +85°C
1902-4-HR	200	70	50V/2.5 ns	–55°C to +125°C

NOTES: 1. R_P is user-defined and supplied. The internal $R_P = 0\Omega$.
2. t_R is dependent upon user-defined R_P and V_{HV}.

EVALUATION BOARDS

Board Number	Driver Number	Description
6149-0	1902-0	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.
6149-2	1902-2	
6149-4	1902-4	
6149-98		Heat sink kit used with the evaluation board.
6149-99		Fully assembled evaluation board with no hybrid inserted.

APPLICATIONS INFORMATION

Initial Setup

The initial setup of the 1902 requires proper setting of the V_{OF} and V_{IG} inputs to obtain balanced rise/fall times. If the quiescent current level (V_{OF}) is set too low, it slows the output rise time and limits the bandwidth of the 1902. If it is set too high, it will limit the fall time. Similar effects 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 $V_{P\text{-}P}$. 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 $V_{P\text{-}P}$ = 250 mA x R_P. The dash-numbered versions of the 1902 differ in the values of R_P, L_P, and the breakdown voltages of the output transistors.

Rise and fall time specifications are based on very conservatively-peaked devices (<5% overshoot); i.e., L_P is low. The pull-up 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.

Care should be taken to limit the amount of the gain and offset adjustment so the total current through R_P does not cause excessive power dissipation. The gain adjust can set the AC current swing to greater than 250 mA (250 $mA_{P\text{-}P}$ = 100 $V_{P\text{-}P}$ on 400Ω). Higher currents and lower R_P values result in faster rise and fall times. For V_{HV} > 90V, do not exceed a total of 290 mA through R_P.

Access to the internal R_P also means the 1902 can be very easily configured for low power (but slower speed) applications by adding external resistance. Note that the device is characterized with a 400Ω resistor. Higher R_P values will degrade other specifications in addition to rise/fall times.

If large arc protection resistors are used (>50Ω), series inductance 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 80 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 1902 is:

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

* R_P is inside the hybrid. Standard values are 200Ω ±5% and 400Ω ±5%. Other values can be added externally.

The overall gain of the 1902 may vary by ±20% due to process variations of internal components. Temperature variations also effect gain by as much as 150 ppm/°C. If more than one 1902 is used in a system, steps should be taken to make them track thermally (i.e., a common heat sink). This will reduce any mismatches due to varying ambient conditions.

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 V_{HV} 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 kΩ potentiometer between V_{REF} and GND (see standard configuration diagram).

Blank

The blank input, when asserted (i.e., TTL HIGH), disables the video input of the 1902 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 to adjust offset and gain.

Power Supplies

Power supplies of 15V (±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 1902 version selected. The maximum value is 120V, allowing up to 90 $V_{P\text{-}P}$ output signals. Assume that the absolute maximum value is V_{HV} (listed in the specification table) plus 5V; i.e., the 1902-2 absolute maximum equals 125V. It is recommended the 1902 not be operated above V_{HV}. Because the output from this type of circuit is referenced to the V_{HV} rail, it is important that V_{HV} is very stable. In other words, there is no PSRR for V_{HV}. Your system supply will determine your DC stability.

To achieve maximum high-frequency performance, good high-frequency grounding practices and PC board layout are mandatory.

Supply Sequencing

It is essential that the V_{HV} supply be brought up before V_{EE} and V_{CC} when using the higher voltage versions of the 1902. Supply sequencing is of less importance when V_{HV} is less than 90V. The recommended sequence is V_{HV}, V_{CC}, then V_{EE}. If sequencing cannot be done, the supplies should be brought up within a few milliseconds of each other.

Power Dissipation

The 1902 power dissipation will vary in accordance to load requirements and pixel size. The 1902 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 potential.

Table I. Typical Power Dissipations

					% of Time Signal is at			Average Power	Average Power
Device	V_{HV} (V)	Black Level (V)	White Level (V)	Max Signal (V_O-V_{BLACK}) (V)	Blank Level (%)	Black Level (%)	White Level (%)	Output Stage (Notes 1, 2) (W)	Total (Notes 1, 2) (W)
1902-2	120	110	20	0	100	0	0	0	2.5
1902-2	120	110	20	90	20	40	40	13.2	15.7
1902-4	70	65	15	0	100	0	0	0	2.5
1902-4	70	65	15	50	20	40	40	8.4	10.59

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