

APPLICATION NOTE IC

VDP 31xxB/Y,
VCT 38xxA/B,
DDP 331xB/C
RGB and SVM
Driver Circuit

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RGB and SVM Driver Circuit

Release Note: Revision bars indicate significant changes to the previous edition.

1. Introduction

This application note describes an RGB driver circuitry connecting the RGB outputs of the Micronas ICs VDP 31xxB/Y, VCT 38xxA/B, and DDP 331xB/C to the RGB amplifiers of a CRT board.

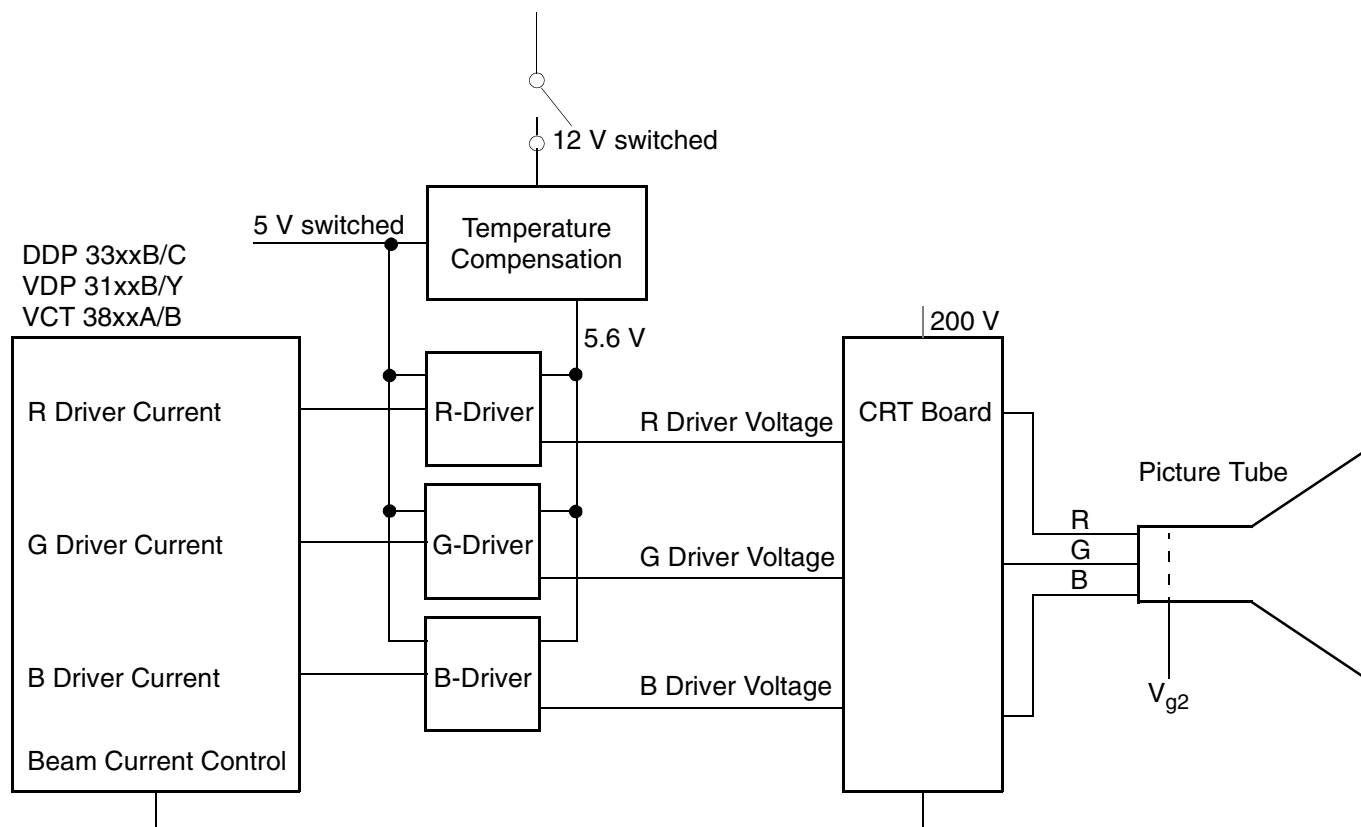


Fig. 1-1: Connecting the VDP 31xxB/Y, VCT 38xxA/B, DDP 331xB/C to a CRT board

2. The RGB Driver Circuit

The RGB outputs of VDP 31xxB/Y, VCT 38xxA/B, and DDP 331xB/C are current outputs with current sink characteristics with maximum current at peak white.

A current-to-voltage conversion is accomplished to drive the video output amplifier.

2.1. Functions of the RGB Driver Circuit

- Current-to-voltage converter
- Inverter
- Amplifier
- Frequency compensation
- Temperature compensation

2.2. Amplifier

The output current of the Micronas IC is converted into a voltage via a 150 Ω pull-up resistor connected to 5 V. A current variation between 0 mA and 6 mA leads to an output voltage between 5 and 4.1 V.

The base of a PNP driver transistor is directly connected to the open-drain output of the IC.

The gain of this stage is defined through 33 Ω emitter resistor R2 and collector resistor R1. The capacitor C1, in parallel to the emitter resistor, compensates frequency loss of this amplifier stage. The inverted output voltage is provided at the collector resistor R1.

For each RGB output, a pull-up resistor R3 and a driver stage with PNP transistor is needed.

The driver stage has a gain of approximately 5 (regarding influences from current source modulation and load from the CRT board and R1). The peak output voltage before clipping is 4.6 V.

Current flow from the CRT board causes a DC offset at the collector resistor R1.

Table 2-1: Frequency response depending on C1

5 MHz	8 MHz	13 MHz	C1	Application
0 dB	-2 dB	-3 dB	220 pF	50-Hz TV solutions
0 dB	0 dB	-1 dB	560 pF	high-end 100-Hz TV solutions and VGA

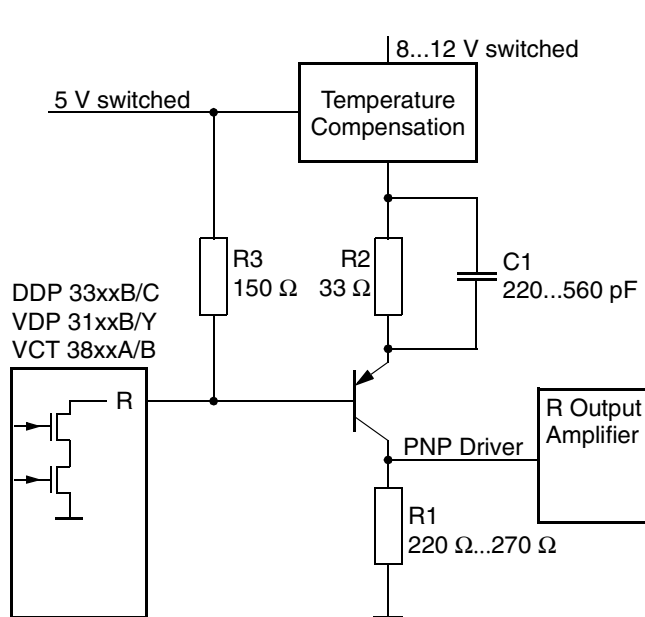


Fig. 2-1: RGB driver (one stage)

2.3. Temperature Compensation

The IC's active output voltage range is 5 V to 4.1 V. Therefore, the emitter voltage of each driver transistor must be 0.6 V higher than 5 V. This bias allows operating from 5 V base voltage onwards.

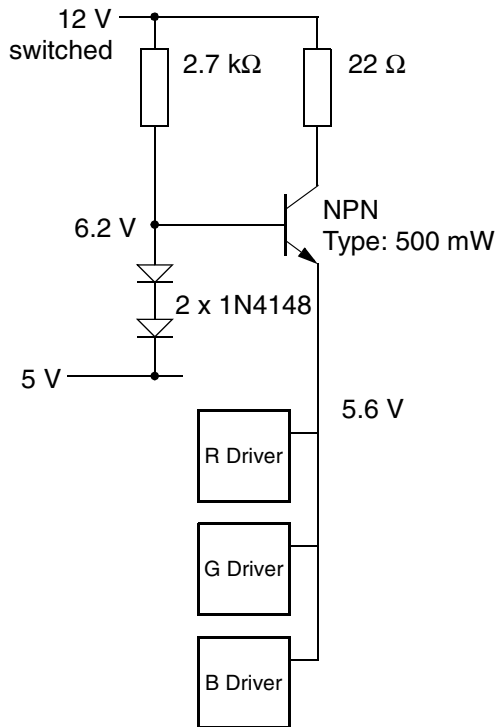
The supply is delivered by an NPN transistor. By means of 2 diodes, the voltage at the base of this NPN transistor is 1.2 V higher than 5 V getting 5.6 V on the emitter.

A second function of the two diodes is temperature compensation of the driver stages.

To reduce material cost and layout area, one transistor is sufficient to supply all three PNP driver stages.

If a 22-Ω resistor is applied, the power dissipation of the transistor is less than 300 mW, having a high current range from 0 mA to 60 mA.

This current range causes a small modulation of the 5.6 V, reducing the luminance signal gain of the RGB driver.



2.4. RGB Driver Output Voltage: Typical Values

Active: 0.6 V...3.6 V = 3 V_{pp}
 Headroom before clipping: 1 V.

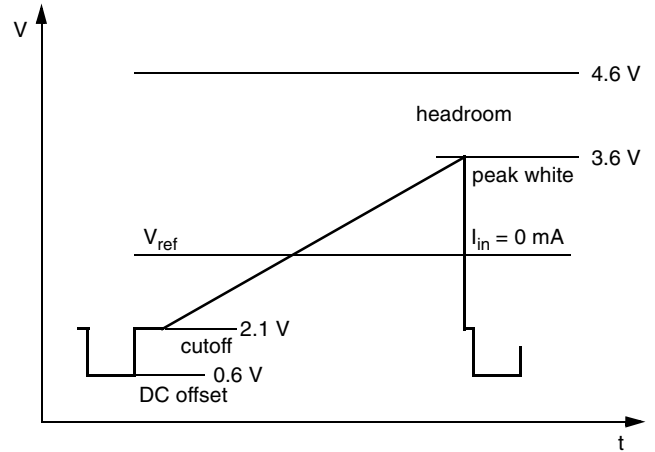


Fig. 2-3: RGB driver voltage: diagram with typical values

Fig. 2-2: Temperature compensation (current source)

3. Calculation of Values for CRT and Output Amplifier

This section describes the calculation of values for a typical video output amplifier with external reference voltage.

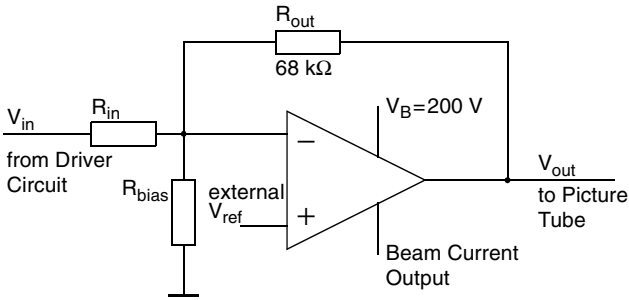


Fig. 3–1: Typical output amplifier (one stage)

3.1. Target

The target is to achieve an acceptable picture without CRT measurement and control.

Therefore, best dimensions for **reference voltage**, **R_{in}**, **R_{bias}** and **R_{out}** with standard parts, in respect to the relevant picture tube values, have to be found.

(Tube measurement and picture measurement disabled: service mode cathode current G2)

3.2. Steps

1. Find out the recommended cutoff voltage (picture tube specification). See Fig. 3–2.
2. Find out the video drive voltage from spot cutoff (picture tube specification). See Fig. 3–3.
3. Calculate necessary gain $A_v = \Delta V_{out} / \Delta V_{in}$.
4. Calculate R_{in} (R_{out} given). See Table 3–2.
 $R_{in} = R_{out} / A_v$
5. Calculate R_{bias} (R_{out} given). See Table 3–3.
 $R_{bias} = R_{out} \times (V_{ref} / (V_{out} - V_{ref}))$

Table 3–1: Driving the CRT: Typical Values

Parameter	Value
Power Supply	200 V
Ultra Black	190 V
Cutoff	160 V
Peak White	70 V
ΔV_{out}	130 V _{pp}
ΔV_{in}	3 V
A_v	44
Reference Voltage ¹⁾	2.7 V
Output Voltage ¹⁾	120 V
R_{out}	68 kΩ
V_{g2}	800 V
¹⁾ input current = 0; input voltage = reference voltage	

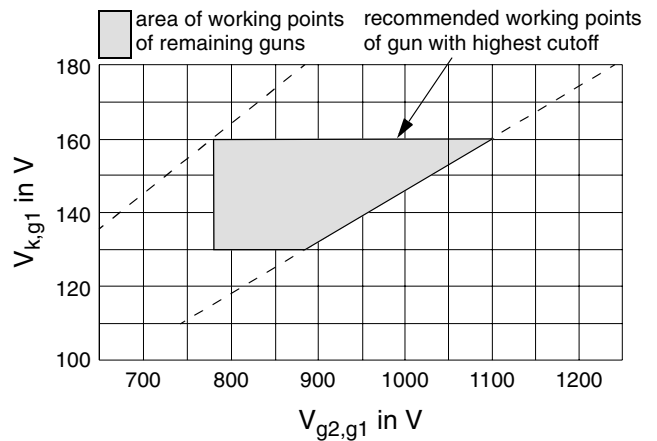


Fig. 3–2: Cutoff voltage of the CRT

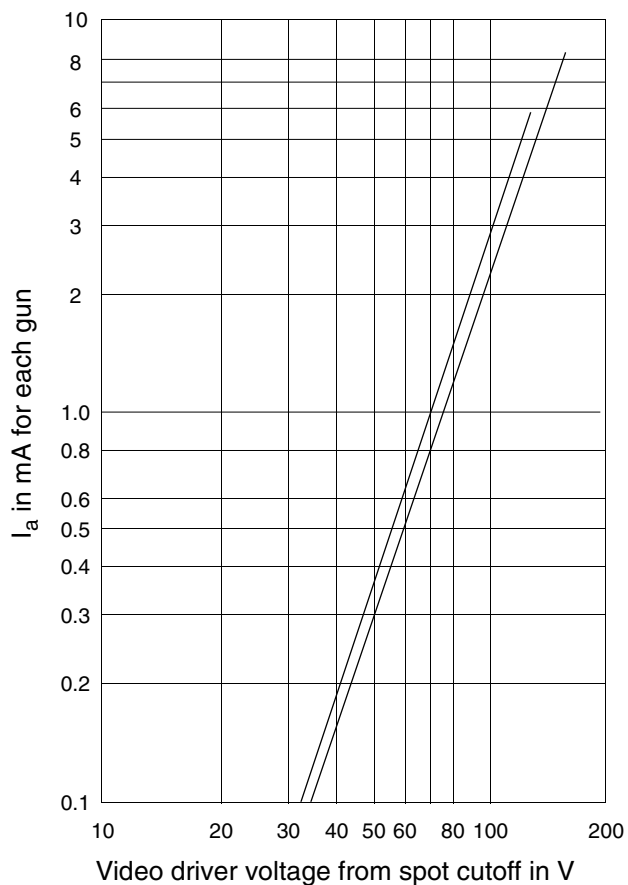


Fig. 3-3: Video driver voltage

Table 3-2: Gain depending on R_{in} ($R_{out} = 68\text{ k}\Omega$)

R_{in} [Ω]	Gain
1300	52
1500	45
1600	43
1800	38

Table 3-3: Nominal Output Voltage depending on V_{ref} and R_{bias} ($I_{in}=0$; $R_{out} = 68\text{ k}\Omega$)

V_{ref} [V]	2.5	2.6	2.7	2.8
R_{bias} [Ω]	Output Voltage [V]			
1300	133	139	144	149
1500	116	120	125	130
1600	109	113	117	122
1800	97	101	105	109

After finding out best dimensions without beam current control; **cutoff**, **brightness**, **white drive**, and **current limiter** can be optimized with closed control loop for the individual picture tube with respect to the recommended G2 voltage.

4. CRT Measurement and Control

During vertical blanking period, RGB cutoff and white-drive measurement pulses are inserted and controlled. For a constant tube current, the SENSE input voltage (measured) is held constant. If the cutoff current of the tube alters, e.g. caused by aging of the picture tube, the controlled value will adapt for a constant sense input.

The different current ranges for the measurement will be switched via RSW1 and RSW2. RSW1 and RSW2 are switched off for cutoff measurement with the lowest current.

Some RGB amplifiers need the additional transistor Q1 to compensate a DC offset of the black current. This maintains a linear current transfer.

4.1. Adjustment Tools

- VISUAL I²C software
- Service connector (EXPERT MODE, CCU off) or SERVICE MODE with IR-remote control

4.2. Adjustment

- Internal brightness (IBRM) center position
- G2 low voltage

For the first white-drive adjustment, the current limiter should be switched off

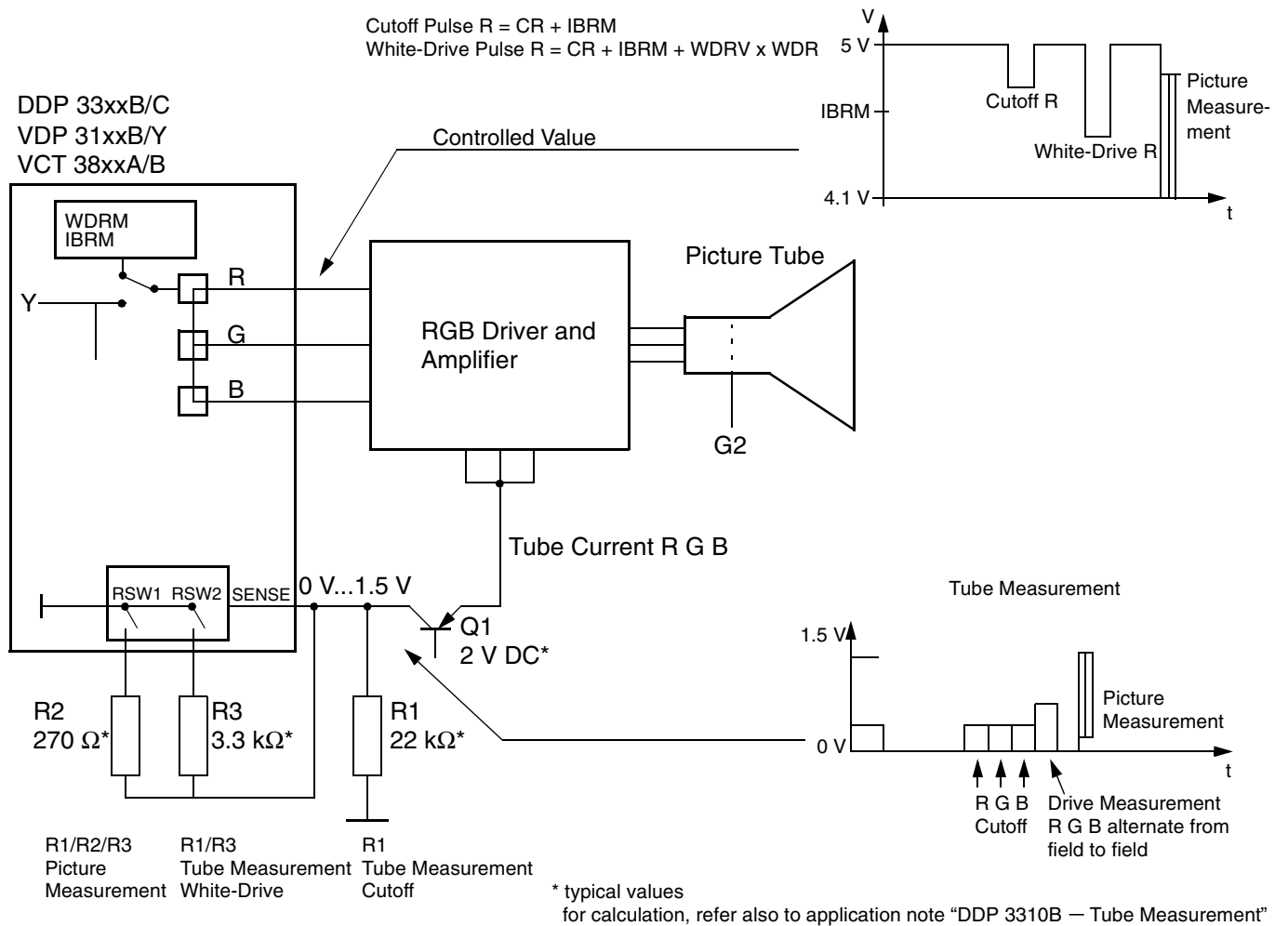


Fig. 4-1: Block diagram of the CRT measurement and control circuit

4.3. Typical Values in Service Mode for the VCT 38xxA/B (Micronas TV Software)

Table 4–1: G2 adjustment

Cathode Current (G2)	R	G	B	Test Conditions
Controlled	128	128	128	open control loop
Measured	12	0	18	adjust G2 so that the lowest cathode current should just reach zero

Table 4–2: Cutoff adjustment (black-balance)

Cutoff	CR+IBRM	CG+IBRM	CB+IBRM	Value	Test Conditions
Cutoff ref.	123	123	123	max. 255	control loop closed
Controlled	271	219	151	0...511	depending on picture tube
Measured	122	123	125	–	is nearly the same as reference value

Note: Align cutoff by changing cutoff ref.

Table 4–3: White-drive adjustment (white-balance)

White-Drive	R	G	B	Value	Test Conditions
Drive ref.	123	123	123	max. 255	control loop closed
Controlled	900	900	900	0...1023	depending on picture tube
Measured	122	123	124	–	is nearly the same as reference value

Note: Align white-drive by changing drive ref.

The values are adjusted by the IR-remote control.

For further information, e.g. timing adjustment, tube and picture measurement, please refer to the VDP 31xxB/Y, VCT 38xxA/B, or DDP 331xB/C data sheet.

5. SVM Driver

The SVM outputs of VDP 31xxB/Y, VCT 38xxA/B, and DDP 331xB/C are current outputs with current sink characteristics.

A current-to-voltage conversion is accomplished to drive the SVM amplifier.

5.1. Functions of the SVM Driving Circuit

- Current-to-voltage converter
- Inverter
- Amplifier
- Frequency compensation

The SVM driver input and output are AC-coupled. Temperature compensation for the driver is not necessary. Therefore, a standard circuit with an NPN transistor is sufficient.

The maximum SVM current from the analog SVM output is 1.88 mA. With the typical amplifier shown in Fig. 5-1, the gain (driver output voltage/ V_{SVM}) is 11. Depending on the SVM amplifier and coil, dimensions have to be adapted.

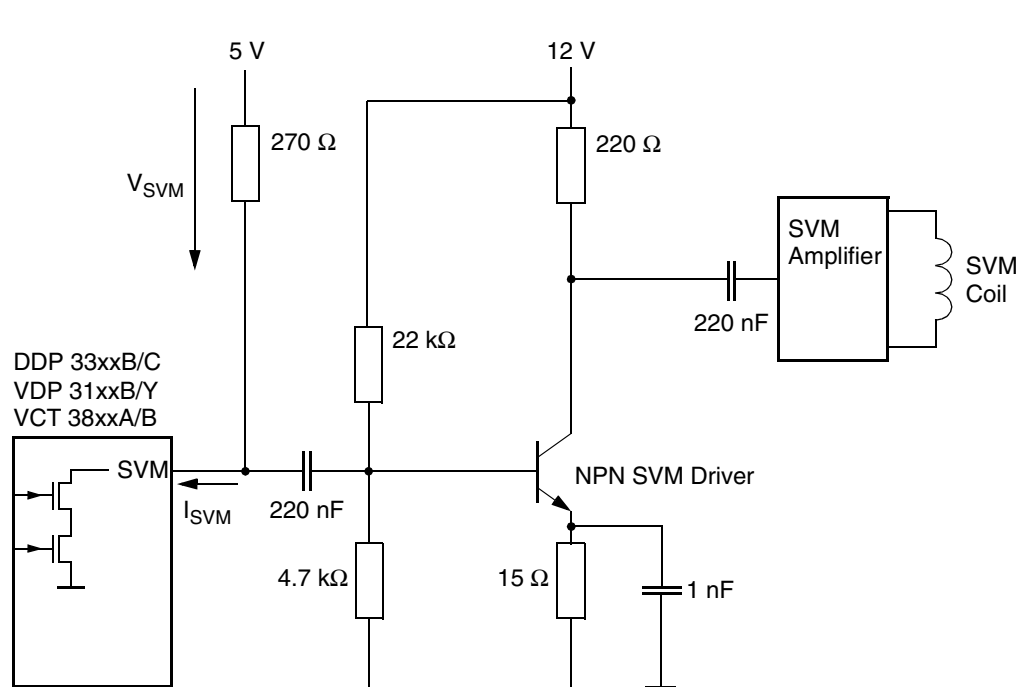


Fig. 5-1: Block diagram of the SVM circuit

5.2. RGB/VGA Output

For RGB or VGA output with 75- Ω impedance, an emitter follower can be added to the RGB driver output.

R1 increases the DC offset. With the RGB tube output stage, the DC value is increased with regard to the current from the reference source. C1 compensates frequency loss of this stage for VGA applications.

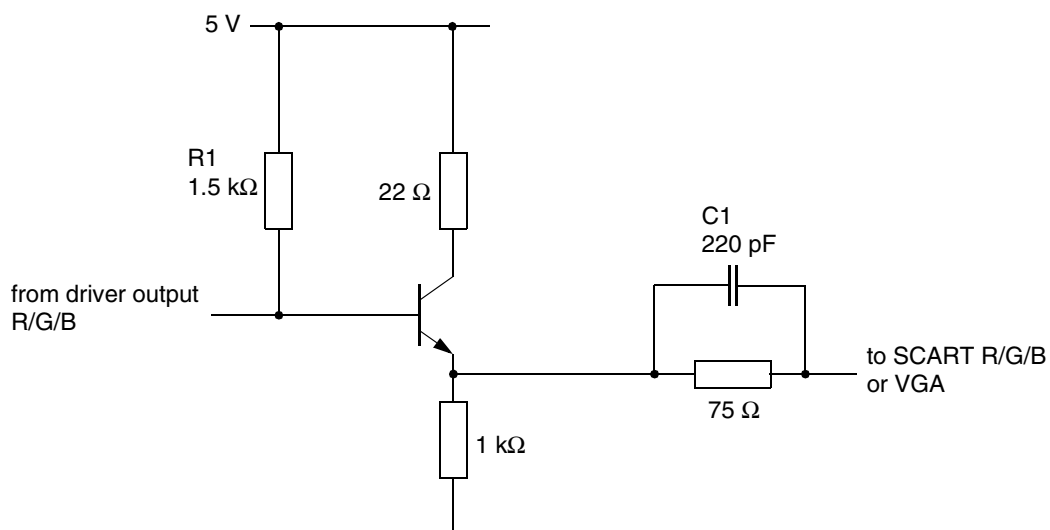


Fig. 5-2: Additional circuitry for RGB/VGA output (one stage)

6. Application Note History

1. Application Note IC: "VDP 31xxB/Y, VCT 38xxA, DDP 331xB RGB and SVM Driver Circuit", Nov. 8, 2000, 6251-539-1AN. First release of the application note.
2. Application Note IC: "VDP 31xxB/Y, VCT 38xxA, DDP 331xB RGB and SVM Driver Circuit", Jan. 24, 2001, 6251-539-2AN. Second release of the application note.
3. Application Note IC: "VDP 31xxB/Y, VCT 38xxA/B, DDP 331xB/C RGB and SVM Driver Circuit", May 23, 2002, 6251-539-3AN. Third release of the application note. Major changes:
 - DDP 3315C mentioned
 - Fig. 2–1: RGB driver circuit changed
 - Table 2–1: Frequency response depending on C1
 - Fig. 5–1: SVM circuit changed
 - New section: RGB/VGA output

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