Application Note

# Vertical dynamic focus circuit

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DAF
Wide-screen
Cineline

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**Summary:This application note describes a simple electronic vertical parabola generator. The parabola amplitude is optimized for DAF (Dynamic Astigmatism Focusing) cineline (wide-screen) tubes operated at a fixed vertical frequency. Adapting the circuit for other parabola amplitudes is relative simple.**

**Table of Contents:**

# 1. Introduction

At present there are two types of CRT's (**C**athode **R**ay **T**ubes) that use dynamic focusing, the wide-screen or "Cineline" tubes and high resolution CMT (**Colour M**onitor **T**ubes). These tubes have a so called DAF gun (**D**ynamic **A**stigmatism **Focusing**). These guns have two focus electrodes, one static electrode which acts on the horizontal and vertical focus performance (Focus-X), and one electrode which acts mainly on the vertical spot performance (Focus-Y). The focus Y-electrode is driven by a static (DC) voltage and an added dynamic signal. For optimum performance, the dynamic signal consists of a horizontal and a vertical (parabola shaped) waveform. In the tube data sheets the optimum amplitudes of the parabolas can be found. The wide-screen tubes need only 120V vertical parabola, and for most applications, this parabola can be left out. This report describes a vertical dynamic focus circuit, for those applications that require the maximum possible performance.

The circuit is developed for the focus requirements for wide-screen tubes. It can be optimised for other tubes as well. The circuit is small and relative simple, but the amplitude of the output parabola is frequency dependent. The circuit is optimized for wide-screen monitor applications operating at 60 or 70Hz, and a parabola peak to peak amplitude of approximately 140V (60Hz) and 120V (70Hz). By changing the value of R9, the amplitude can be adapted easily to other frequencies and/or different amplitudes. For 50Hz wide-screen R9=180kΩ will result in approximately 140V output amplitude (see also chapter 3). The circuit cannot be used for wide range autoscan (autosync) applications.

# 2. Circuit description

**Principle.**
The circuit is built with a sawtooth generator followed by an integrator and a class A output stage. The bottom level of the output parabola is clamped at approximately 20V. The circuit is self biasing. See page 6 for the circuit diagram.

**Supply.**
The circuit is supplied from a 30V scan winding of the line output transformer. By means of D6 and C6 a 30V supply is made. The output stage (T5) is supplied out of a 230V rail which is made via a peak peak rectifier (C5, D5, D7 and C7). This part of the circuit can be omitted if these supplies are already available in the set or monitor.

**Controlled sawtooth generator and buffer.**
Adjustable current source R4,R5 and T2 will charge C2. C2 is discharged by a filtered (R18,C4) vertical blanking pulse via T1 and R2. The current source will give a DC level shift of the sawtooth signal across R6 to keep the emitter follower T3 linear operating. R7 is the pull down resistor for the emitter follower. Across R7 the buffered vertical sawtooth signal is available. The amplitude of the sawtooth depends on the adjustable current source. Via this source and the feedback section, the circuit is automatically biased (see text below).

**Integrator.**
The sawtooth voltage is converted into current by means of R8. This current is integrated to a parabola by T4 and C3. The integrator is biased by R9, R10, R12 and D1. The DC level of the output parabola (negative) at the collector of T4 is determined by the feedback section (see relevant chapter for explanation).

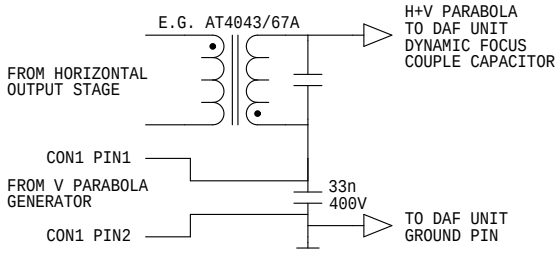
**Class A output stage.**
The parabola voltage at the collector of T4 is inverted and amplified with approximately a factor 21 (R14/R11) by means of T5, R14 and T5. R13 is used for biasing. R15 and R16 are the collector pull-up resistors.
The output is protected against CRT flash over by means of D2, D3 and R17.
The output parabola is available at pin 1 of the connector (Con1).

**Feedback and auto biasing.**
The bottom value of the output parabola is stored on C1 via D4 and R3. The voltage on C1 determines the DC biasing and the amplitude of the signals. If the bottom of the output signal has a too high DC level, the voltage at C1 is too high, resulting in a too small current through C3. This leads to a small sawtooth with a too low average voltage, resulting in a too small parabola and a too high DC level at the collector of T4. This will result in a lower collector voltage on T5, resulting in a higher bias current and a larger amplitude. In this way the loop is closed.
This loop will stabilize not only the DC biasing, but also the amplitude, for a fixed frequency. Since the integrator current is not clamped or disturbed in any other way, the distortion of the parabola is very low. The bandwidth of the loop is very low, which means that the settling time after startup is rather long (approximately 10 seconds).

For applications where an **adjustable parabola** voltage is desired, see the circuit diagram on the next page.

# 3. Application hints

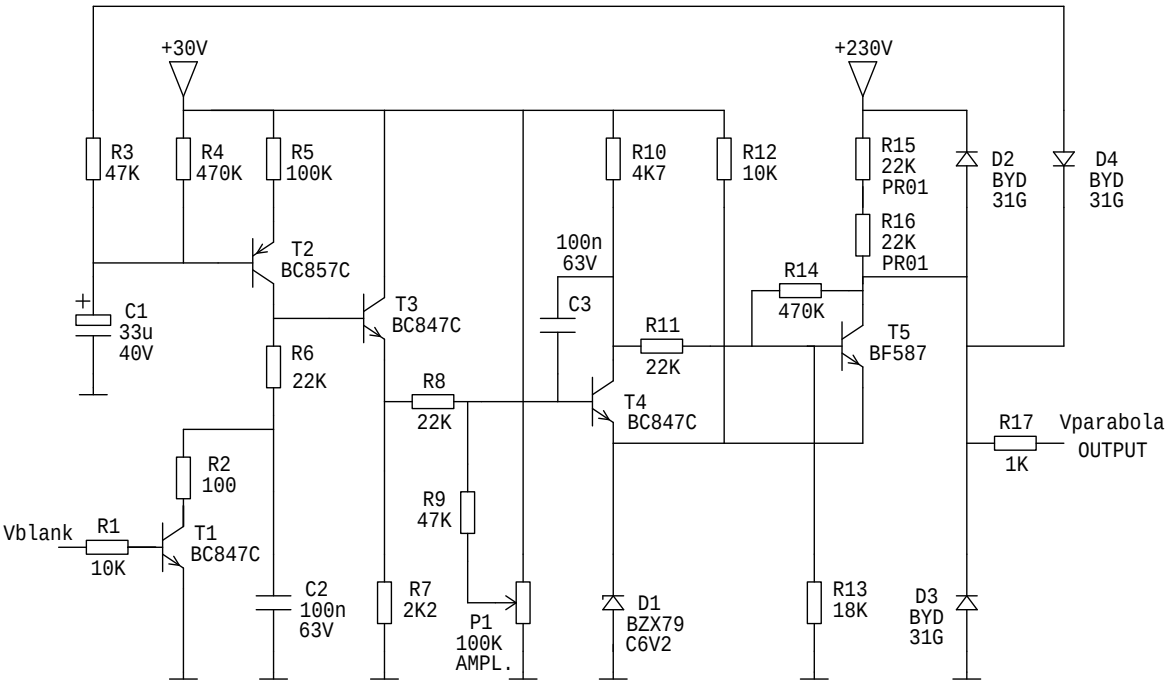
**How to connect the vertical parabola.**




To prevent semiconductor destruction during a flash, it is of great importance that the 33nF capacitor is placed close to the horizontal parabola generator, and connected directly to the DAF unit. The two traces (wires) of the vertical output parabola with the ground (connector 1 pins 1 and 2) must be kept close together and connected directly across the 33nF capacitor.

**Making the parabola amplitude adjustable.**

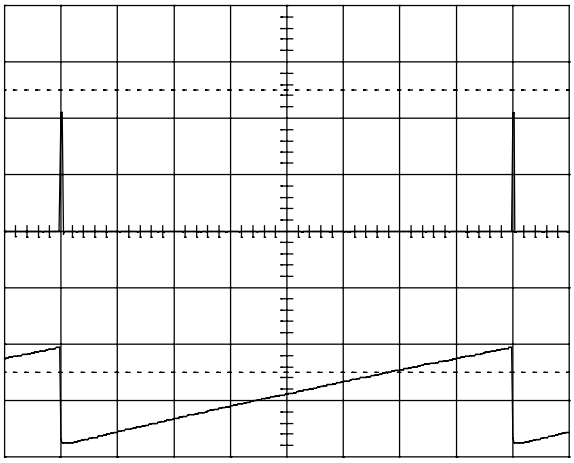
With potentiometer P1 a DC parabola amplitude control can be achieved. A DAC output could also be used instead of a potentiometer.




**Special requirements for the coupling impedance to the focus electrodes.**

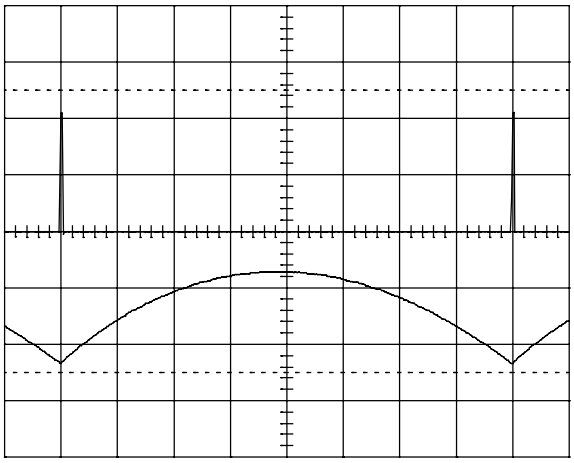
Many DAF units have a coupling capacitor of 220pF with a series resistance of 22kΩ to the focus grids. This will lead to an unacceptable vertical parabola distortion. Recommended values are at least 1nF with 2k2 series resistance. For wide-screen tubes with a 7 layer high voltage transformer like the AT2091/32S the codenumber for the recommended DAF unit is :8222 412 96681. Contact your local Philips organisation for information on the complete DAF potentiometer unit program.

# 4. Oscillograms



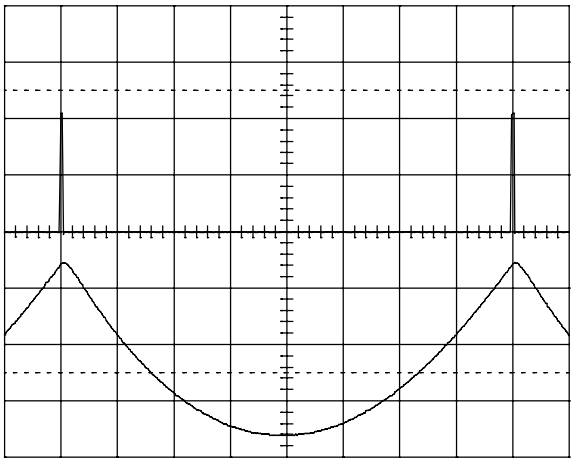
Top trace: Vblank at connector 1 pin 5.
2V/div. and 2ms/div.

Bottom trace: Vbuffered-saw across R7
5V/div. and 2ms/div.



Top trace: Vblank at connector 1 pin 5.
2V/div. and 2ms/div.

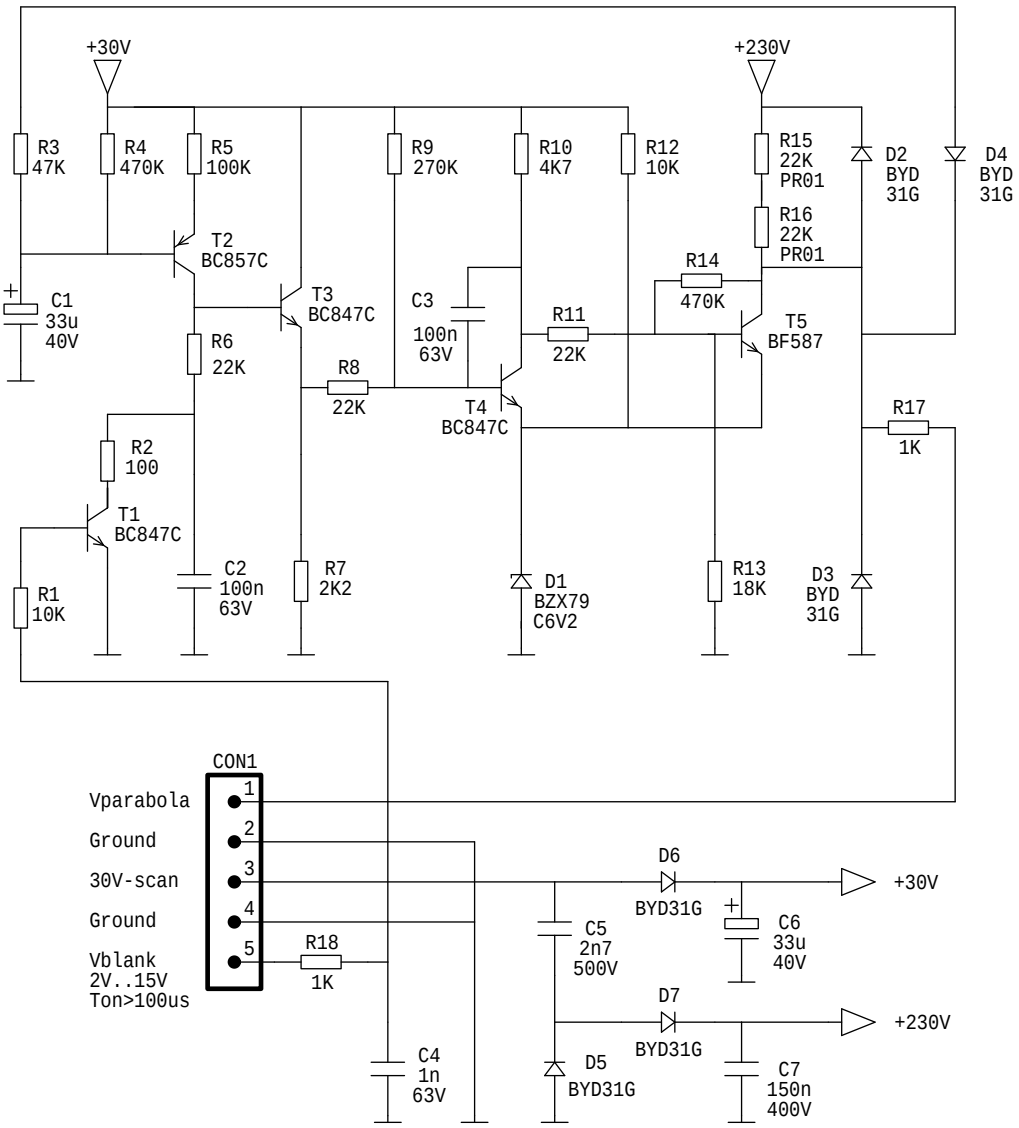
Bottom trace: Integrator output at coll. of T4
5V/div. and 2ms/div.



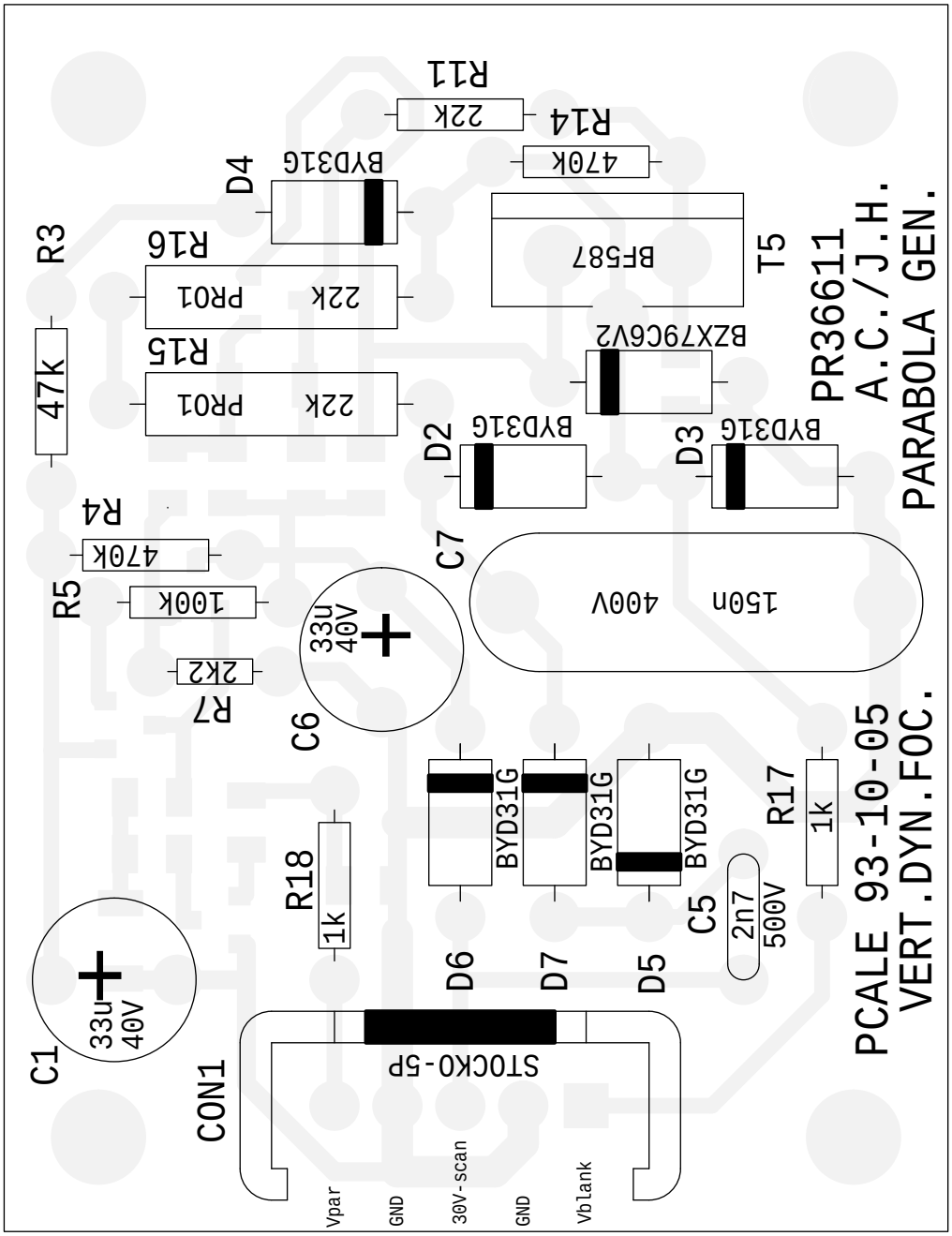
Top trace: Vblank at connector 1 pin 5.
2V/div. and 2ms/div.

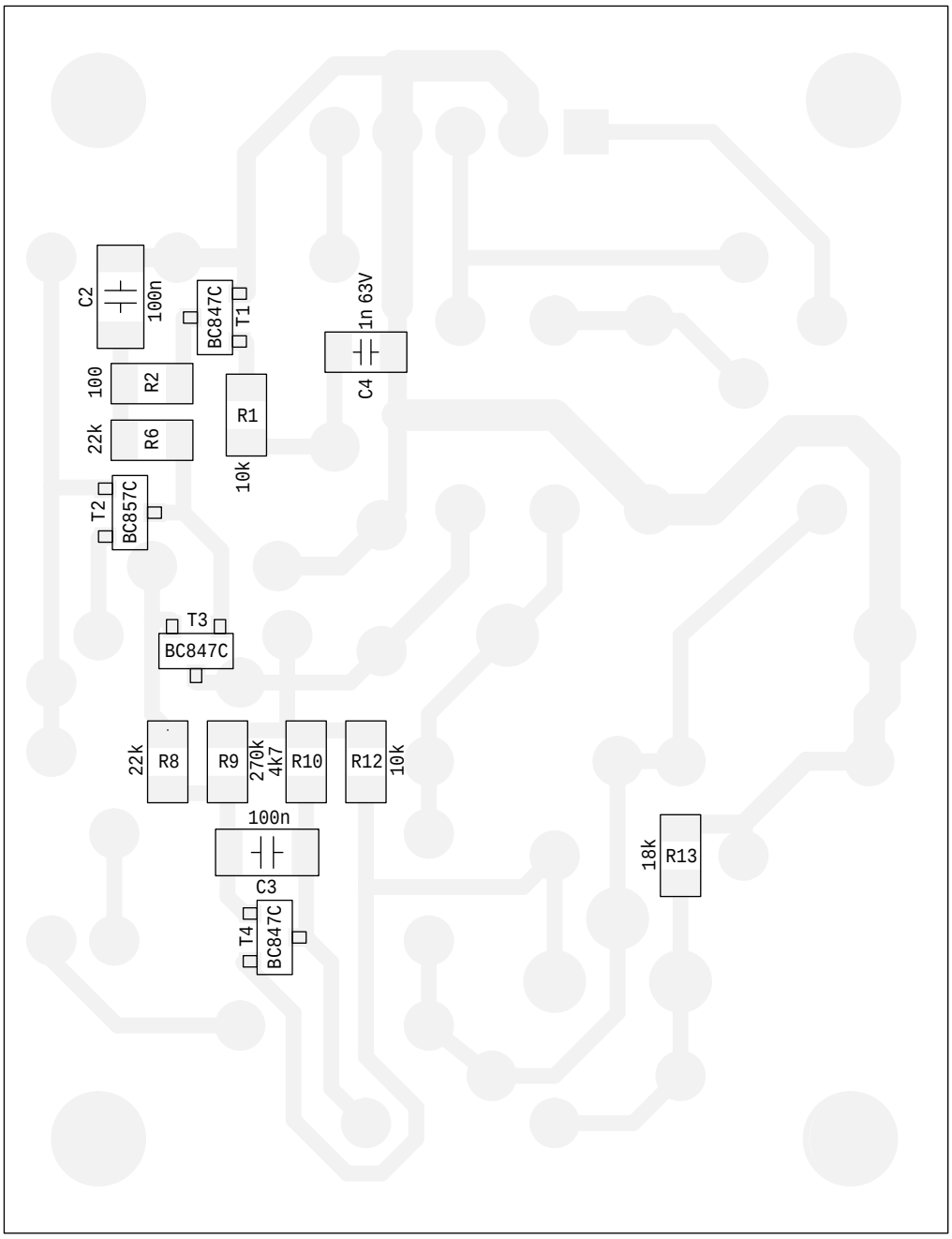
Bottom trace: Voutput at connector1 pin 1.
50V/div. and 2ms/div.

# 5. Circuit diagram



# 6. PC board description




C2
100n
BC847C
T1
1n 63V
C4
100
R2
R1
22k
R6
10k
T2
BC857C
T3
BC847C
22k
R8
R9
270k
4k7
R10
R12
10k
100n
C3
T4
BC847C
18k
R13

# 7. Parts list

| Comp. numbers | Value | Type | 12 n.c. |
|---|---|---|---|
| **Resistors** | | | |
| R1,12 | 10K | SMD R0805 | 2322 730 **103 |
| R2 | 100 | SMD R0805 | 2322 730 **101 |
| R3 | 47K | SFR16 | 2322 180 **473 |
| R4,14 | 470K | SFR16 | 2322 180 **474 |
| R5 | 100K | SFR16 | 2322 180 **104 |
| R6,8 | 22K | SMD R0805 | 2322 730 **223 |
| R7 | 2K2 | SFR16 | 2322 180 **222 |
| R9 | 270K | SMD R0805 | 2322 730 **274 |
| R10 | 4K7 | SMD R0805 | 2322 730 **472 |
| R11 | 22K | SFR16 | 2322 180 **223 |
| R13 | 18K | SMD R0805 | 2322 730 **183 |
| R15,16 | 22K | PR01 | 2322 193 **223 |
| R17,18 | 1K | SFR16 | 2322 180 **102 |
| **Capacitors** | | | |
| C1,6 | 33u/40V | ELCO 035 | 2222 035 67339 |
| C2,3 | 100n/63V | SMD C1206 | 2222 581 16641 |
| C4 | 1n/63V | SMD C0805 | 2222 861 12102 |
| C5 | 2n7/500V | CER 655 | 2222 655 03272 |
| C7 | 150n/400V | FILM 368 | 2222 368 55154 |
| **Semiconductors** | | | |
| D1 | BZX79C6V2 | | 9331 177 40153 |
| D2,3,4,5,6,7 | BYD31G | | 9339 235 50143 |
| T1,3,4 | BC847C | SOT23 | 9335 896 00212 |
| T2 | BC857C | SOT23 | 9337 699 00212 |
| T5 | BF587 | TO220 | 9337 626 40127 |
| **Miscellaneous** | | | |
| CON1 | 5 pins | Stocko | MKS3735 1 0 505 |
| PC board | PR36152 | | |