ECO – MONITOR CONCEPT USED IN MEDICAL APPLICATIONS

Laurentiu GAVRA (*), Radu ARSINTE (**), Dorin Petreus(**)

(*) Tedelco SRL – Calea Turzii 42, Cluj Napoca, phone: 195613, fax :192257, e-mail:laurentiu.gavra@tedelco.ro
(**)Technical University Cluj-Napoca, Baritiu 26-28 str, Cluj Napoca

Abstract: The ECO monitor concept has introduced by Philips in 2001, and this concept had to meet the European standard EN55022. The paper presents a medical monitor developed by Tedelco research team for medical applications. This monitor has built using Philips chip set and Myson micro controller with 80C51 core.
Keywords: green chip, ECO concept, EMC radiations, DDC control.

1.INTRODUCTION

Inside modern computer monitors, many electro-magnetic noise sources are present. Due to the increase of the operating frequency of the electronics, the electromagnetic radiation increases easily to a level, which exceeds existing emission standards.

General solutions like screening of the complete monitor and applying (expensive) filtering on mains and VGA cables are unfavourable due to both manufacturing and costs.

By tackling noise sources at their origin (e.g. at component or PCB level), the RF emission can be efficiently reduced. As such measures at product level will be less necessary, if not completely superfluous.

The emission of a monitor (or basically: any product) mainly takes place via the attached wires like mains, VGA and for instance USB. The monitor can be seen as a small source, existing for example two wires. As such, geometry similar to a dipole antenna appears. As a rule of thumb, the source voltage between the two elements shall be below 500uV (measured with a bandwidth of 120KHz), in order to meet the European emission standard.

The European emission requirements for PC monitors are covered by standard EN55022. A monitor has to meet the conducted as well as the radiated limits. A distinction is made in the application area of the monitor. Two classes exist; their definition is as follows:

1. Class A equipment doesn't meet the class B limit. Its use is restricted to certain environments like industry or laboratories.
2. Class B equipment is not restricted in its use. It is generally used in public environments. Class B is more stringent then class A.

This paper includes a functional description of the circuit of ECO monitor concept used in medical applications for electrocardiograph device. The monitor has follow features.

- Universal auto sync design capable of driving 17" picture tubes with dynamic focus.
- Global mains supply 90…264V without external jumper.
- Horizontal deflection 15.6…70KHz.
- Vertical deflection 50…150Hz.
- 17" high resolution, high contrast picture tube with 0.27mm dot pitch.
- Combined EHT and horizontal deflection.
- DDC controlled.

The block diagram for ECO monitor is show in fig 1. As can see the monitor is built on Myson micro controller and Philips chip set TDA 4887; TDA4856; TDA4863; TEA 1507; OSD MTV 018 as well. The CRT tube is M41EHN323X160/G341BA with Dynamic focus facility. Philips makes the tube and it has 17" size.

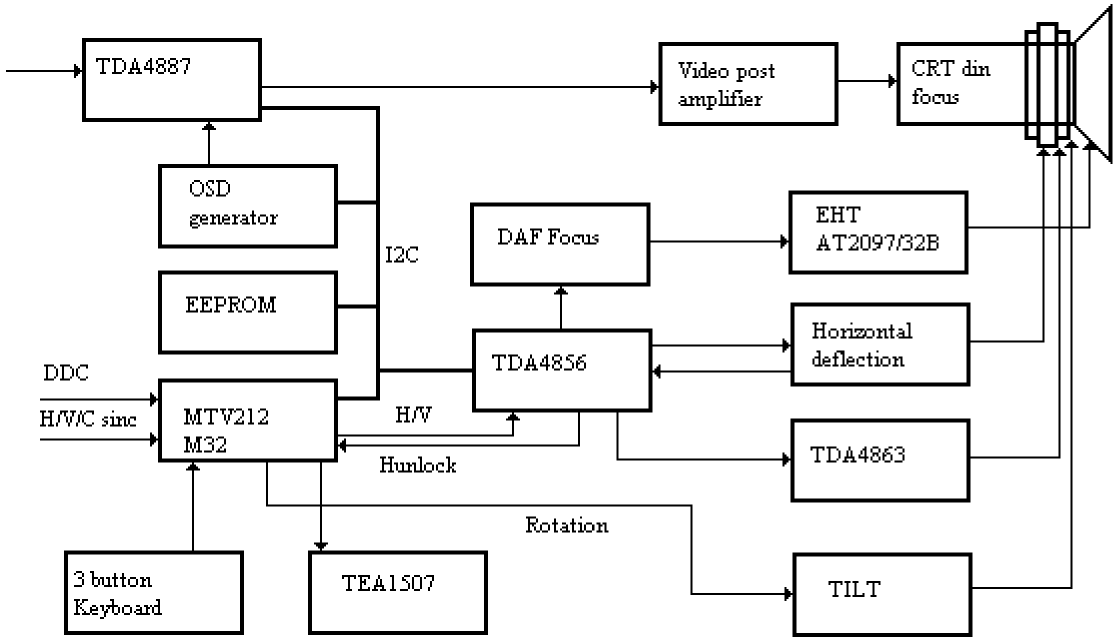

Fig1. Block Diagram for ECO monitor

2. FUNCTIONAL CIRCUIT DESCRIPTION

2.1 Switch mode power supply

The Green Chip TEA1507 is a variable frequency SMPS controller for a Quasi-Resonant Flyback converter operating directly from the rectified universal mains. The topology is particularly suitable for TV and monitors supplies. During nominal load it operates in a critical conduction mode including zero/low voltage switching (ZVS/LVS). The ZVS/LVS is achieved by the Quasi-Resonant behaviour of the voltage across the switch. This also called the Quasi-Resonant mode. On account of the discontinuous character, the converter starts each period with zero inductor current. The control method applied in the TEA1507 is known by the name Current-mode control. Control takes place by varying the on time of the switch. The frequency is determined by the actual magnetisation time of the transformer. The input voltage and/or the output load influence the frequency. Feedback is achieved by means of an opto-coupler, which makes it possible to detect the output voltage at secondary side, which means a good stabilisation and good ripple suppression can be obtained.

The controller provides two different types of stand-by possibilities. The first is Frequency Reduction to minimise the power losses at minimum output load. This feature enables stand-by power consumption down to 3W and needs no additional circuitry. Especially the Frequency Reduction Mode is a very important benefit of this controller. The second stand-by mode for power dissipation down to 1W is called Burst Mode, which requires some additional circuitry. This burst-mode is activated by setting the DPMS signal high, which is done by the micro controller. In this monitor the Burst Mode is used.

The distinctive features of the TEA1507 are:

- Operates from universal mains input 85Vac~276Vac.
- High level of integration leads to a very low external component count.
- Leading Edge Blanking for current noise immunity.
- Valley switching for minimal switching losses.
- Efficient Quasi-Resonant mode at high power levels.
- Frequency Reduction Mode at low power stand-by for improved system efficiency, power consumption down 3W.
- On chip start up current source.
- Burst mode operating for very low stand-by levels (power consumption down to 1W.

2.2 Micro controller

The block diagram for micro controller is shown in fig2. For this application is used MTV212M32 a flash micro controller with ISP facility. This micro controller has an 80C51 core and is made by Myson Company.

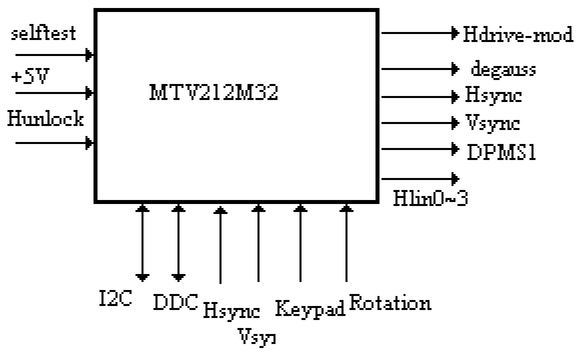

Fig 2. Micro controller block diagram

The micro controller takes care of the monitor control functions. These include hardware mode detection, linearity capacitor switching, DPMS mode, degaussing, I2C command and some DAC controls.

2.3 Deflection controller and +B circuit

The TDA 4856 is a high performance and efficient solution for auto sync monitors. All functions are controllable by I2C bus. The TDA4856 provides synchronisation processing, horizontal and vertical synchronisation with full auto sync capability and very short settling times after mode changes. External power components are a great deal of protection. The IC generates the drive waveforms for DC coupled vertical booster such as TDA486x and TDA835x.

The TDA4856 provides extended functions e.g. as flexible B+ control, and extensive set of geometry control facilities and a combined output for horizontal and vertical focus signals. The block diagram is shown in fig 3.

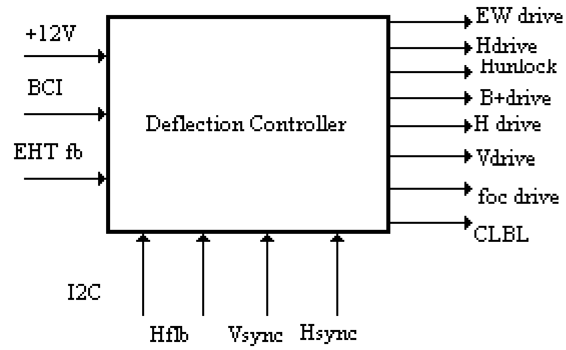

Fig3. Deflection controller block diagram

The horizontal oscillator is synchronised in frequency range 15.6~70KHz (determined by two resistors and one capacitor.

These components are calculated with the following formulas:

$$R_{BUF} = 78/f_{min}+0.0012*f_{min}^2 \text{ [Kohm]}$$

$$R_{PAR} = 78/f_{max}+0.0012*f_{max}^2 \text{ [Kohm]}$$

The capacitor must be 10nF for optimum jitter performance. The value for this capacitor should not be changed.

The B+ section of the deflection controller is applied in feedback configuration. The divided EHT voltage is fed back to the deflection controller, which adjusts the B+ drive pulse according to the EHT voltage. Without this feedback loop the EHT and as a result Vg2 vary too much, resulting in a background colour variation on the screen. The bandwidth of the loop is made that slow that the EHT is varied in one frame; the time constant is a couple of frames. This means that vertical size is not affected in the steady state when going EHT breathing. This adjustment of the horizontal size is done by applying beam current information to HSMOD, which modulates the size via the EW Modulator. The current source needed for the saw tooth generator at pin 5 must be active until the deflection controller is switched off. C_{sense} of B+ section must have a low temperature coefficient for stable horizontal size.

C_{BOP} must be positioned close to pin3 and pin7 of deflection part. This capacitor is necessary for stability of the internal OTA (opamp with current output).

The B+ circuit is a Buck converter (step down converter) in feedback mode. The EHT voltage is divided and back to pin 5 of the deflection controller.

The east-west amplifier amplifies the east-west output voltage from the deflection controller. This east-west output stage contains also the horizontal size information. The east-west modulator is combined with the flyback diode in one package.

The high voltage transformer is combined with the horizontal deflection. The EHT voltage is stabilised via the B+ control stage. Also the beam current is measured and fed back to pin HSMOD of the deflection controller to stabilise the horizontal size via the EW modulator. This beam current measurement is also used for beam current limiting, in this way protecting the high voltage transformer and picture tube against too high beam currents. When the deflection controller is out of lock or the vertical deflection is not working properly the grid 1 is switched to –150V. This means that the spot is suppressed, so no picture tube burn-in occurs.

The TDA4863 is a half bridge vertical booster for use in vertical deflection systems for frame frequencies up to 200Hz. The TDA4863 needs a separate flyback supply voltage. This gives the designer the advantage that all supply voltage can be independently chosen for minimum power consumption and optimum flyback time. The circuit provides differential voltage input stage and fits well with the TDA485x and TDA484x monitor deflection controller family.

2.4 Video processor

The TDA4887 is a monolithic integrated RGB pre-amplifier for colour monitor systems with I2C bus control and OSD. In addition to bus control, beam current liming and contrast modulation are possible. The IC offers brightness control with grey scale tracking and without grey tracking for easy alignment. The signal is amplified in order to drive commonly used video modules or discrete solutions. Individual black level control with negative feedback from the cathode or black level control with positive feedback and 3DAC outputs for external cut off control is possible.

In this monitor the AC coupling mode with positive feedback is used and brightness is done in the signal path with grey scale tracking.

The block diagram is shown in fig 4.

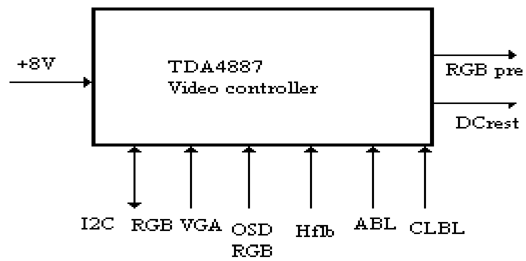

Fig 4. Video proccesing block diagram

The OSD generator is MTV018 made by Myson.

3. CONCLUSIONS

The monitor is built to pass the EN5022 for ECO requirements. For this, the ECO monitor has a few specific thinks:

- The heat sinks are mounted on the PCB with specific mounting studs. Some of these studs are connected to the ground plane of the circuit. This grounding provides also EMI shielding.
- The ferrite core provides HF decoupling in the video cable.
- The aquadag is directly connected to ground plane of the video board by means of a thick wire. In this way the HF video currents are kept local.
- An extra-grounded wire from the LOT to the video board ground plane provides a low ohmic path to the EHT source, which is also crucial for flashes.

The monitor is realised like a prototype and it works well in frequency range 15.6~70KHz.

We have some problem with electrical field around the monitor and we have to pay an extra effort to meet the TCO99 requirements.

4. REFERENCES

[1] Application note from Philips AN00042
[2] Application note from Philips AN00040
[3] Application note from Philips AN00032
[4] Application note from Philips AN00047
[5] Application note from Philips AN97072
[6] Application note from Philips ETV/AN97002
[7] Application note from Philips ETV/AN97001
[8] Application note from Philips AN00038
[9] Tetraco marketing study, internal note.
[10] B&K medical company requirements.