DESIGN OF SMART BOOST CONVERTER FOR AUTOMOTIVE ECALL

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ABSTRACT

This design is a Smart OR-ing boost converter for automotive emergency services. In recent years we come across many accidents in our day to day life which enhances the death rate. Though we are aware of road safety rules and regulations there is no reduction in road accidents. The Government has also stepped into diminishing human deaths by improving the road infrastructures and other facilities. So, to overcome these accidents and to save human lives we have designed a layout of Automotive Emergency call. This Emergency call system will allow the passengers to alert emergency services when they crash manually or through automatic instantiation. This system will automatically contact the emergency responders when a passenger gets into severe accidents. The passenger may not able to inform the location as he/she will be in trouble So, GPS will be coordinated to the nearby emergency services. Automotive emergency call system will not delay to response there will be faster responses which will reduce the severity of injuries and we can save many lives. Here we use two boost power stages in our design which is driven by a single controller operation. The main battery input has a bypass function that reduces losses and the backup battery input is enabled with separate disconnect switches and automatic crossover for flaw-free performance. This allows a seamless crossover from the main battery to the backup battery. PMP21152 is designed into pre-eminent and the circuits are also implemented in Printed Circuit Boards(PCB) by using mentor graphics Xpedition tool.

Keywords: boost converter, GPS, PCB, Xpedition tool

I. INTRODUCTION

The PMP21152 board is designed by using the PCB design flow procedures. PCB is considered as a base for most electronics like motherboards, computers, Digital cameras etc. There are two fundamental stages in PCB which includes Prototyping and Product development. Prototyping is considered an initial stage for the designing process. The foremost goal of the prototyping stage is to have an efficient, accurate, and effective product. It also involves the individual engineers to research how to define certain system or applications. After validating the design it moves to the next stage that is Product development. In this stage, we should concern about the product yields and decreasing manufacturing re-spins. It also makes the product to get ready for the final application. Printed Circuit Boards are designed using many layers like Single-layer PCBs which is used for designing simple electronics. It has a single layer of base material or substrate. One side of the base material is coated with metal most commonly copper is used as it is a good electrical conductor. After this process solder mask is applied followed by this silk screen to mark out all the elements on the board. In the case of Double-layer PCB base material is coated on both sides of the board. Holes are drilled through the board so that circuits on one side of the board can be allowed to connect with another side of the board. Either by utilizing a through-hole or surface mount the circuits and components of the Double-layer PCB board is connected. Double-layered PCBs are usually used in applications that require an intermediate level of circuit complexity like industrial controls, automotive dashboards, vending machines etc. Throughout the years, PCBs have evolved from the simple single-layer PCBs used in electronics such as calculators to more complex systems, such as a high-frequency Teflon design. PCBs have found their way into almost every industry on the planet, from simple electronics like lighting solutions up to more complex industries. The evolution of PCBs has also pushed development in PCB building materials: no longer are PCBs built solely out of fiberglass-backed copper foil. New construction materials include aluminum, Teflon and even bendable plastics. Plastics and aluminum, in particular, have spurred the creation of
products like rigid-flex and aluminum-backed PCBs to address the common problems associated with many industries.

**Mentor graphics expedition**

PMP21152 Board is designed using a tool Mentor Graphics Xpedition. It is the industry's most creative PCB design flow, offering convergence from design description to output. Its proprietary innovations can cut design cycles in half or more while also greatly enhancing the overall quality and resource performance. Xpedition Enterprise provides a broad range of best-in-class engineering, architecture, research, production, and data processing solutions. The workflow and methods for laying out printed circuit boards using the new version of Mentor Graphics Xpedition PCB Layout are presented in Xpedition PCB Layout Introduction. The xDM Library Tools course will teach you how to create, protect, add to, and alter the various data types in your Central Library. XpeditionxDX Creator, formerly known as DxDesigner, is a full schematic design solution that enables you to build, describe, and reuse your designs. In a concurrent team-based design environment, it provides everything required for circuit design and simulation, component selection, library management, and signal integrity planning.

**II. EXISTING SYSTEM**

If a serious road accident occurs, an e-call may be made either manually by vehicle passengers or automatically by triggering the in-vehicle e-call system. When the in-vehicle e-call system is switched on, it creates a direct 112-voice connection with the required Public Safety Answering Point (PSAP). Even if passengers are unable to communicate because of injuries, a minimum collection of data is sent to PSAP, including the precise location of the crash site, the vehicle identification number, a timestamp, and current and previous positions. As a result, the responders are forced to reach them as quickly as possible to save their lives. E-call is a ground-breaking European emergency call system for vehicles that aims to provide urgent assistance in the event of a traffic accident. Its goal is to improve European protection and safety while also reducing deaths and injuries caused by traffic accidents. Many governments have sought to enforce protective measures to minimize accidents. The majority of these programmers are directed toward improving the road infrastructure, but many countries around the world have recognized the potential of technology to enhance road safety. With e-call, an emergency call solution developed by the European Union, this approach has been pioneered, and this project will likely become common practice around the world.

2.1 **Off battery power and current voltage sense**

Off Battery power is the key circuitry used to transform power from a car battery into different power domains used by the display is shown in the block diagram. It includes an EMI filter, as well as transient, reverse polarity, and several DC/DC converters. Current sense amplifiers, also known as current shunt controls, are advanced differential amplifiers with a precisely matched resistive gain network. In a telemetry device, some devices require the monitoring of dark current or voltage. This can be located at the system's input, backup battery, or other places.

2.2 **Telemetric power system and modem connectivity**

Multiple DC/DCs, including buck, boost, LDOs, and buck-boost, are used to power telemetries. Depending on the number of wireless modules, processors, and audio specifications, the power application can take several different forms. Since the main car battery is no longer connected to the telemetry device, a backup battery is required to keep the system running. Monitoring, gauging, and safety of the device can vary depending on the battery chemistries used and the needs of the customer. The way you connect to a modem differs from one modem to the next. USB, RS232, RS485, and even Ethernet are common interfaces. RS232 is a serial communication protocol that is used to link a computer and its peripheral devices so that serial data can be shared between them. It obtains the voltage for the data transmission path between the devices.

2.3 **RF power and hands free**

A radio frequency power amplifier (RF power amplifier) transforms a low-power radio-frequency signal into a higher-power signal. RF power amplifiers are usually used to drive a transmitter's antenna. A low noise power supply is needed to support an antenna in order to provide a signal to the wireless communication modules. Audio CODEC, ADCs/DACs, amplifiers, and other support circuitry help allow the cellular system's voice transmit and receive functionality in systems with integrated E-Calling. A Class-D amplifier, also known as a switching amplifier, is an electronic amplifier in which the amplifying devices (usually MOSFETs) serve as electronic
switches rather than linear gain devices. The sudden flow of electricity between electrically charged objects caused by contact, electric shot, or dielectric breakdown is known as ESD (Electrostatic Discharge). An ESD safety system protects a circuit from electrostatic discharge (ESD) in order to prevent an electronic device from malfunctioning or breaking down. The DAC (Digital to Analog Converter) is a system that transforms digital data streams into analogue signals and is typically used in music players, televisions, and other electronic devices. The ADC (Analog to Digital Converter) converts analogue signals to digital signals.

2.4 Ambient backlight indicator and system boot monitoring

LED drivers are electrical devices that protect LEDs from damage by controlling the forward voltage (VF) of the LED, which varies with temperature, preventing thermal runaway and providing a steady current to the LED. An LED driver is required if an LED is used for activation indication or ambient lighting. Typical interfaces such as LIN and CAN help support the device's boot and monitoring scheme by interfacing with the telemetry system or directly to the central processor or MCU. CAN Controller Area Network is a protocol for sending and receiving messages in a network of electronic devices. It specifies the method for transferring data from one system to another. Comparators, voltage supervisors, translation, and other logic are included in the device to enable normal digital processing. When two voltages are compared, a comparator circuit outputs a 1 (the voltage on the plus side; VDD in the illustration) or a 0 (the voltage on the negative side) to show that is greater. Comparators are commonly used to verify if an input has reached a predetermined value.

III. PROPOSED SYSTEM

Road traffic accidents are the 9th leading cause of death worldwide, accounting for 2.2 percent of all deaths. Every year, almost 1.25 million people die in traffic collisions, with an additional 20-50 million injured or disabled. According to reports, traffic accidents cost countries between 1% and 3% of their gross domestic product per year, owing to the cost of victim care and lost productivity. As a result, Europe agreed that, as of March 31, 2018, any new form of car sold in Europe must include the 112 e-call system. Finally, the European Union began enforcing the compulsory implementation of e-call for new cars and light trucks on March 31, 2018. If the car is involved in a serious collision, E-call is automatically triggered. It establishes a phone connection with the relevant emergency call centre and transmits information about the accident, including the location. In urban areas, e-call can reduce emergency response time by 40%, and in rural areas, it can reduce response time by 50%. It has the ability to reduce the number of deaths by at least 4% and the number of serious injuries by 6%. As a result, E-call is becoming increasingly useful in saving human lives. The E-call system has the potential to save about 2500 lives each year by allowing trained and prepared paramedics to arrive at the scene within the vital first hour of an incident. It also has the potential to reduce the severity of injuries by 10% to 15%. Emergency call (eCall) systems allow passengers to warn emergency services of a crash through a manual trigger or automatic crash instantiation; they are becoming more popular for automotive manufacturers to meet regulatory requirements as well as boost customers’ peace of mind. Our integrated circuits, reference designs, and products help you build eCall systems that are not only consistent with the law, but also cost-effective, increasingly integrated, and highly dependable.

3.1 PMP21152

PMP21152 is the design board of Automotive Emergency call which is designed using Xpedition tool. Global innovation teams use this method to build the world's most complex electronics systems in a multi-discipline business environment, giving their businesses a competitive edge and bringing advanced products to market.

3.2 Working

The input front end and output of an audio signal are often merged into a single codec, which consists of one analog-to-digital converter (ADC) and one digital-to-analog converter (DAC) (DAC). It's made up of two ADCs or two DACs in just a few instances. Most systems only need one channel since the audio signal path would verbally link the driver to emergency services via phone (one microphone, one ADC,
one DAC, one Class-D amplifier and one speaker). The codec can include an embedded mini DSP for digital audio processing; a codec with a mini DSP frees the processor from performing computations. Certain circumstances, such as when a digital microphone is linked directly to the microprocessor, do not necessitate the use of a codec. Through the use of a digital input Class-D amplifier, the audio signal path will remain digital all the way to the amplifier, despite being more costly to implement with optimum noise immunity. The ADC (inside the codec) transforms the audio line-level data from an external source into digital samples, which are then fed to the system's processor. DACs (in the codec) transform the digital audio signal from the processor to analogue on the output side. Since the signal from the DAC has low voltage and current capabilities, an audio amplifier improves the signal to provide the higher voltage and current needed to drive the speaker system's drivers. The E-call device is operated by a backup battery system that allows it to operate even if the car battery is disconnected due to an accident. The processor receives the results of the amplifier's continuous diagnostics.

3.3 Efficiency graph

The below figures show the VBATT efficiency which was taken by enabling bypass and converter efficiency with 3-V, 6-V, 9-V, 16-V, and 30-V inputs.

3.4 Backup battery and efficiency consideration
The backup battery for the E-call device presents a fascinating design challenge: how to keep costs low when adopting a required (and potentially expensive) battery backup, which could be made up of one or more individual cells with different battery chemistries. The charge from the backup battery will mostly waste as heat in an E-call device. Since many e-call systems require between 10 and 20 minutes of communication between emergency responders and the driver, the low productivity comes at a high cost. To satisfy this requirement, a device that uses a Class-AB amplifier would need additional battery cells. The high efficiency of Class-D amplifiers makes them suitable for e-call systems; their high efficiency means that an E-call device can be operated by a very low-cell-count cell battery (even a single battery cell if the right chemistry is used). This greatly decreases the overall cost of the machine, as well as its weight and size. The results of these diagnostics are transmitted to the processor through a Class-D amplifier with integrated diagnostics. The diagnostics help ensure that the speaker is still linked for verbal contact between the driver and emergency personnel in the event of an accident. It also assists in advising emergency services that the driver's health condition cannot be checked verbally if the link to the speaker is broken during an accident.

3.5 Waveforms

i) VBATT Switching

The switch node voltage and output voltage ripple of the converter when operated from the battery input are shown in the diagrams. With 500 MHz probes and a 350 MHz oscilloscope, switching was tested at maximum bandwidth.

![Figure 3. VBATT switching and output voltage ripple](image1)

ii) VBUB Switching

The switch node voltage and output voltage ripple of the converter when driven from the backup input are shown in the diagrams. With 500 MHz probes and a 350 MHz oscilloscope, switching was tested at maximum bandwidth.

![Figure 4. VBUB switching and output voltage ripple](image2)

iii) Load transients

The duration before the output voltage returns to a preset value after falling or rising, as well as the waveform of the output voltage, are the characteristics of load transient response to a sudden load fluctuation.
iv) Startup and holdup from VBATT

The below Figures show the battery input startup and holdup efficiency using a constant current electronic load.

v) Holdup using VBUB_EN

The backup activate controls the holdup output using a constant current electronic load, as shown in the figures.

vi) Assembly drawing

The below figure is the assembly drawing for Smart Boost Converter for Automotive E-call
IV. FINAL DESIGN

After all the assembly and routing process we can stimulate the design to check whether the connections are correct or not by passing the input through the thermostat.
V. CONCLUSION

We believe that this e-call technology is extremely effective and will play a major role in the future emergency response system. However, in fact, the government must bear the burden of introducing this technology and taking all appropriate steps to make the best use of this e-call so that we can resolve one of the most serious issues of today's increase in the number of accidental deaths. The day is not far off when every car or truck is fitted with e-call devices, enabling passengers and drivers to enjoy a comfortable and enjoyable ride.

REFERENCES