Application Note, V 1.0, September 2001
AP SUP 01

TLE 6361
Application Board 1.1

by Gunther Krall

Automotive Power

Never stop thinking.

1. Introduction

This Application Note is intended to provide information about how to operate the multi-voltage power supply TLE 6361 Application Board 1.1 (see marking) and how to use the SPI software to control some of the functions of the TLE 6361.

2. Board Components

In the following figures the top and bottom side of the three layers application board are shown with a description of the components mounted on it. The middle layer is a GND plain for best EMI behaviour.

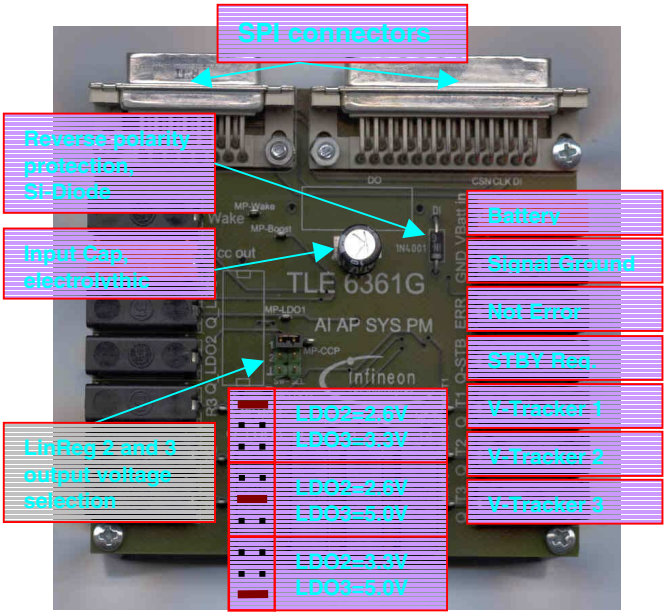

Figure 1: Top side

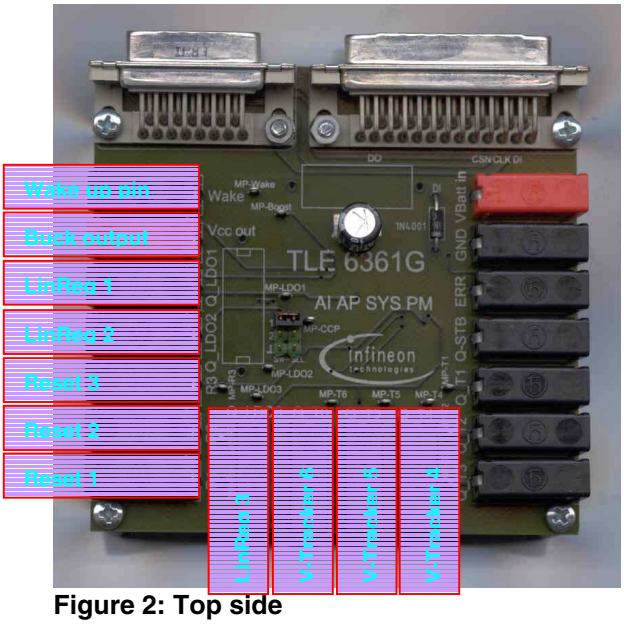

Figure 2: Top side

On the top side of Figure 1 you find the SPI connectors which make the communication between the board and the e.g. parallel port of a PC possible. There are two kinds of connectors available, just one has to be used according to the application's needs.

For reverse polarity protection a silicon diode is foreseen, when having problems with minimum input voltage requirements the diode can be shorted or replaced by e.g. a PMOS-constructed protection.

As one of the input caps a 100µF electrolythic capacitor is put onto the board, lower values are also sufficient for proper operation but the ripple seen at the battery line will increase.

To determine the output voltages of the two linear regulators LDO2 and LDO3 the selection jumper has to be set accordingly. In jumper position 1 the linear regulator two will have an output voltage of 2.6V where linear regulator three sets its output voltage to 3.3V. At position 2 we get 2.6V at LDO2 and 5.0V at LDO3 and at jumper position ⊥ the output voltages settle to 3.3V LDO2 and 5.0V LDO3. LDO1 will always have an output voltage of 5V.

Considering the remaining connectors on Figure 1 and Figure 2 you will find as inputs the battery connection, the wake up and the GND near the outputs Not Error, STBY-Regulator, Trackers 1 to 6, Linear Regulators 1 to 3, Resets 1 to 3 and the pre-regulated output voltage of the Buck converter.

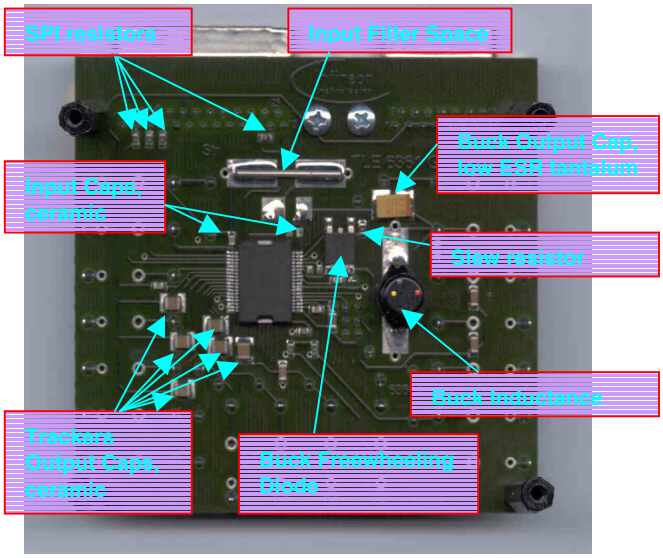

Figure 3: Bottom side

The passive components needed for proper operation of the buck converter you find at the bottom side. For the freewheeling diode a schottky diode is recommended to keep the

losses as low as possible. The output capacitor of the buck converter is a low ESR tantalum cap for lowest output voltage ripple where a minimum of 4.7µF is sufficient for stability. Higher values can be always chosen if desired.

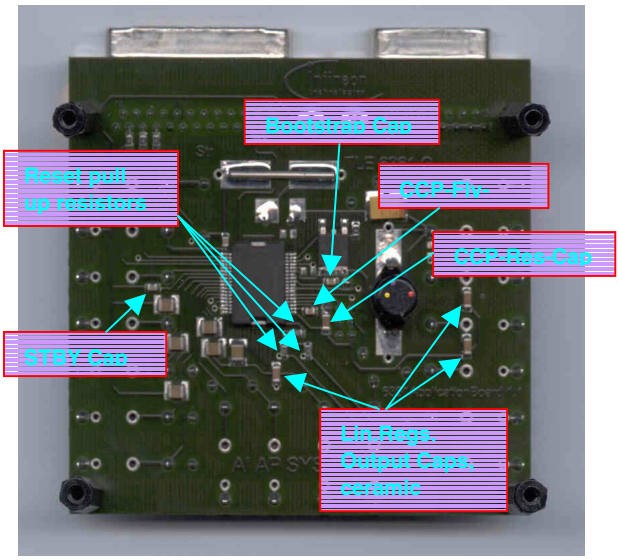

Figure 4: Bottom side

The storage element of the buck circuit, the buck inductance, is chosen with 47µH, below a value of 22µH a stable operation can not be guaranteed. To filter the high frequency components of the buck converter at the input two places for ceramic caps are foreseen, values between 10nF and 100nF are recommended. If additional filtering is required, a filter inductance can be set to the input line, the value can be in the same range as the inductance of the buck circuit. For low EME in the high frequency range (>10MHz) the slew rate of the current pulses flowing through the internal buck DMOS can be adjusted with the slew resistor. Values between 0Ω for highest slew rate and 20kΩ for lowest EME can be adjusted. Be aware that lowest EME means also higher switching losses in the buck DMOS. For driving the gate of the buck switch the bootstrap principle is used which needs the bootstrap cap to work. The value of the bootstrap and the output cap are depending on each other where the bootstrap cap is roughly 1/50 of the output cap. To supply the gate of the DMOS transistor in 100% duty cycle operation the bootstrap concept does not apply, in that case the charge pump is needed, 220nF for the reservoir cap and 100nF for the flying cap are taken. If one observes some voltage dips at the linear regulators in low input voltage conditions the reservoir cap can be increased to e.g. 1µF.

Considering the output caps of the linear regulators 3.3µF ceramic caps are put on the board. For stability of the regulators 100nF would be sufficient but in case of load steps higher values are recommended.
At the outputs of the voltage trackers ceramic caps with values of 1µF are taken for stability and the STBY regulator requires a ceramic cap of 100nF.
The open drain reset outputs are connected with 10kΩ resistors to the output of linear regulator 1 and for the SPI signal lines three 10kΩ (CLK, DI, not CS) and one 1kΩ (DO) resistor are put to the signal lines.

Minimising the switching loss:
In the TLE 6361 a unique concept for minimising the switching loss is implemented.

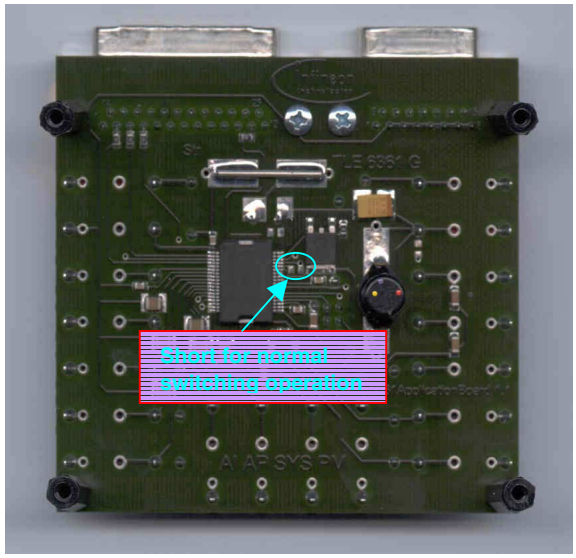

Figure 5: Operation of 12V and 24V systems

The idea behind this concept is to use the output voltage level to turn on the buck switch during switching operation. In that way the dynamic losses of the switch can be decreased drastically which is very important in 42V systems. Of course the concept works also in 12V or 24V systems but generally the requirements in terms of low switching losses are not very tough here. If there are no needs for minimising the switching losses just set a short between the Boost pin (pin 33) and the IN pin (pin 32) as indicated in Figure 5.
When using the feature to get down the switching losses, three additional components, one resistor of 22Ω, one silicon diode and one cap of 100nF have to be put onto the application board as shown in Figure 6.

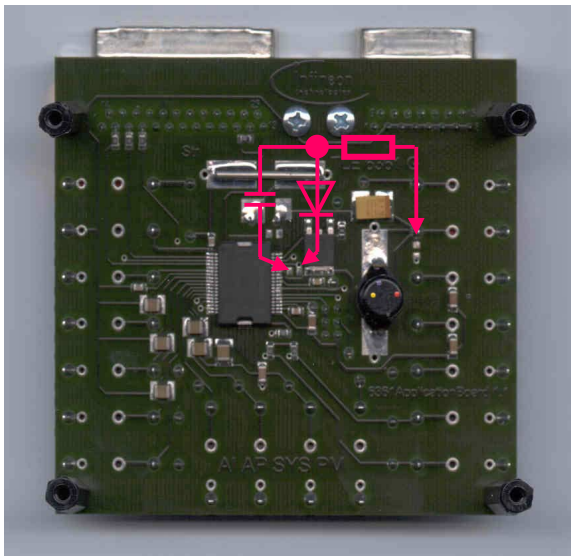

Figure 6: Minimising the switching loss

3. SPI Software

The Infineon SPI software is used for communication between the PC and the 16 bit SPI of the TLE 6361. The software is available for the operating systems WIN95, WIN98 and WIN NT. With this software one is able to create and name his own commands and/or group the commands to create a program. When running the program one single command is executed every 50ms. The created commands and programs will be saved automatically and can be recalled at any time desired.

Installing the SPI on your PC:
In the software package SPI_6361_Package.zip you will find an installation_engl.txt file which will guide you through the software installation. When having executed one of the set-up programs you have to copy the TLE6361 files (.dsp, .spi) still to the created Spiwin directory (Programs->Spiwin) before being able to run the program. Regarding the BIOS set-up of your PC make sure that the mode for your parallel port is set appropriate, e.g. parallel mode [EPP], parallel address [378h, IRQ7] but NOT parallel mode [bidirectional], in that way you do not get signals out of the parallel port.

Running the SPI Interface program:
When you start the SPI interface 2.2 software the window according to Figure 7 will appear. The tool bar offers selections for File, Definition, Windows and Help. The File menu is for exiting the program, in the Definition menu you will be able to define single commands and whole programs which should be run by the SPI, the

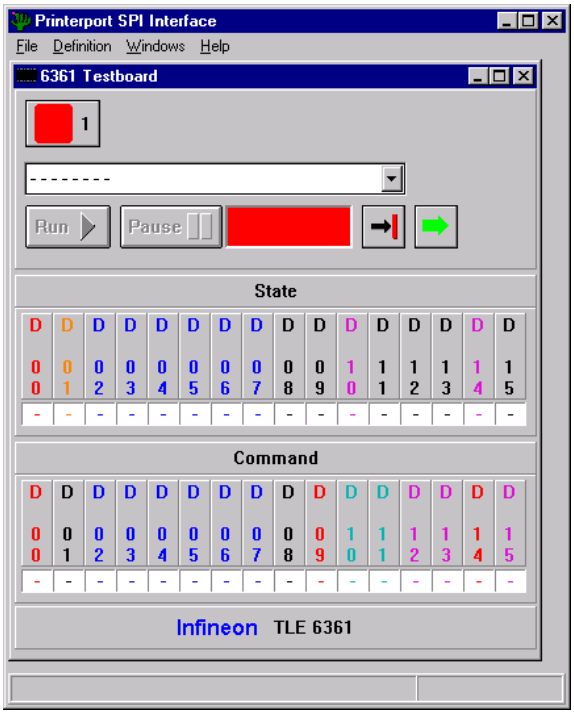

Figure 7: SPI Interface main window

Windows choice offers arranging your working windows and the Help menu consists a description of the printer port SPI Interface.

Command definition:
Like said before you can define your own commands which you would like to send to the TLE6361. If you select in the SPI window, Figure 7, the menu Definition and there Command Defintion... a window according to Figure 8 will open.

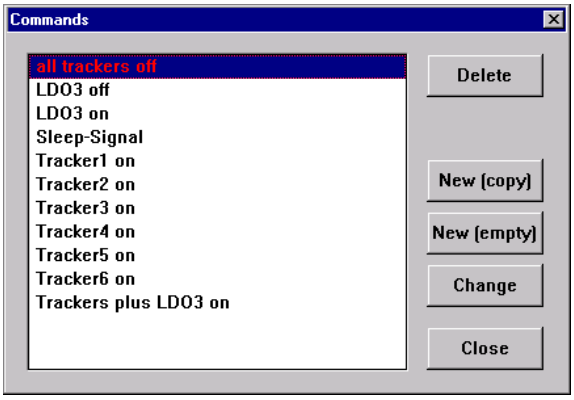

Figure 8: Commands window

Here you find an overview of all the commands being already available. If you want to create a new command based on an existing one you have to select the base-command and then

press the New (copy) button. E.g. you have chosen the last command “Tracker plus LDO3 on” and pressed the New (copy) button, the following window, Figure 9 , will show up. Here you can define each single bit of one 16 bit command which should be sent to the 6361 by clicking the appropriate bit in the “zeros line” with your mouse. To insert a new bit stream just click to Insert Word for changing the existing bit stream shown at 1. in Figure 9 just click at Change Word. If desired you can place a pause between single commands in multiples of 50ms or set a stop command to terminate the command by clicking the buttons.

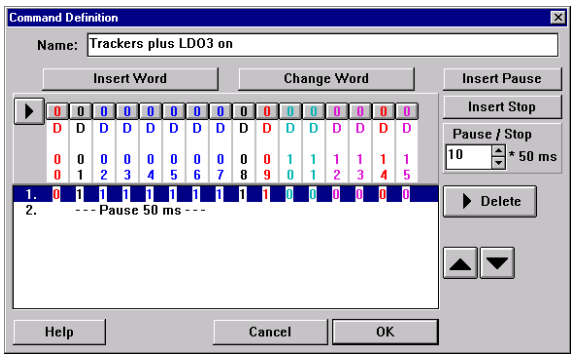

Figure 9: Command definition

To change the order of single commands use the up and down arrows and for deleting commands just click the button. Before pressing OK make sure you have defined also a name for the command.
If you have selected New (empty) or Change in the window Figure 8, the same procedure applies for the command definition.

Program defintion:
All the commands defined before can be linked together to define a program. With the selection of Program Definition in the menu Definition you reach the window, Figure 10.

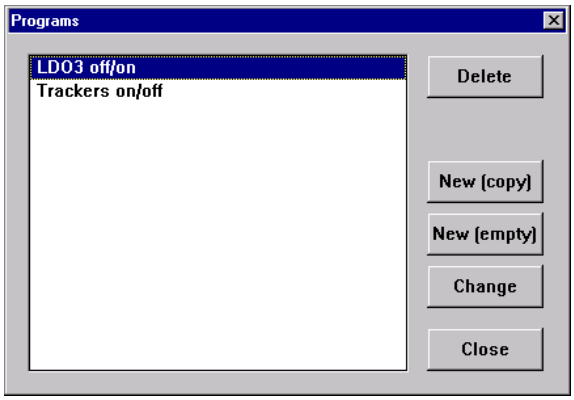

Figure 10: Programs window

Applying a similar procedure to the command definition by pressing the New (empty) button you get to Figure 11.

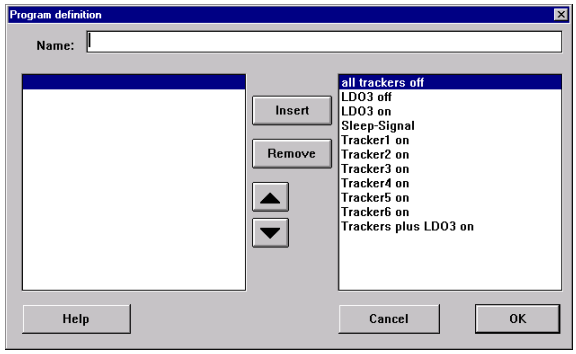

Figure 11: Program definition

On top you can name the Program which you want to define. At the right side you will find all the commands you have defined before of which you can make up now your program just by clicking Insert, Remove or the up and down arrows. With the OK button the new program will be saved and appears automatically next time you start or run the SPI.

Running programs on the SPI:
For running a self defined program on the SPI load the desired one in the main SPI window with the arrow.

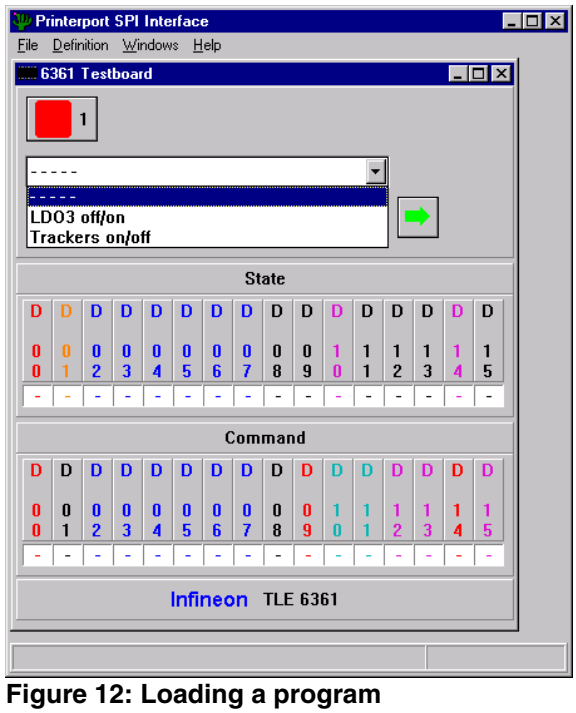

Figure 12: Loading a program

With the buttons below the program selection field you can determine how the program should be executed. By pressing the Run button you start the whole program. You have also the

choice to run it continuously (black arrow with red bar) or as single shot (green arrow) or go through each single command per mouse click (both buttons pressed).

4. Operating the Board

Before connecting the battery voltage connector and the WAKE connector to 12V, 24V or 42V the SPI should be connected to the PC or Laptop. If you want to send the device to sleep by an SPI command do not forget to disconnect the WAKE signal. After start up, without having sent an SPI command (or run a SPI program), the Reset1 will toggle Hi-Low because of the missing watchdog trigger. In the predefined SPI programs the watchdog is turned off with the first command.

Device	Supplier	Type	Remarks
Buck and input-filter inductor	Coilcraft	DO3340P-473 -333 -223 DO3316P-473 -333 -223 DS3316P-223	47µH, 110mΩ 33µH, 80mΩ 22µH, 66mΩ 47µH, 140mΩ 33µH, 100mΩ 22µH, 85mΩ 22µH, 207mΩ
	EPCOS	B82464-A4473-K -A4333-K -A4223-K	47µH, 145mΩ 33µH, 110mΩ 22µH, 85mΩ
Free-wheeling diode	Motorola	MBRD360	60V, 3A
Buck output cap	EPCOS	B45192-E/-R B45195-E/-R B45196-E/-H/-P	Low ESR Tantalum 4.7µF minimum
Boots-trap, input filter and CCP caps	EPCOS	B37872-... B37941-...	Ceramic, variable, X7R
	TDK	C3216X7R... CKCL44X7R...	Ceramic, variable, X7R
Input cap	EPCOS	B41/B43821 B41866	Aluminium electrolythic caps, variable

Table 1: Component recommendation

Disclaimer

Edition 2000-07-14

**Published by Infineon Technologies AG,
St.-Martin-Strasse 53,
D-81541 München, Germany**

Attention please!

The information herein is given to describe certain components and shall not be considered as warranted characteristics.

Terms of delivery and rights to technical change reserved.

We hereby disclaim any and all warranties, including but not limited to warranties of non-infringement, regarding circuits, descriptions and charts stated herein.

Infineon Technologies is an approved CECC manufacturer.

Information

For further information on technology, delivery terms and conditions and prices please contact your nearest Infineon Technologies Office in Germany or our Infineon Technologies Representatives worldwide (see address list).

Warnings

Due to technical requirements components may contain dangerous substances. For information on the types in question please contact your nearest Infineon Technologies Office.

Infineon Technologies Components may only be used in life-support devices or systems with the express written approval of Infineon Technologies, if a failure of such components can reasonably be expected to cause the failure of that life-support device or system, or to affect the safety or effectiveness of that device or system. Life support devices or systems are intended to be implanted in the human body, or to support and/or maintain and sustain and/or protect human life. If they fail, it is reasonable to assume that the health of the user or other persons may be endangered.

Infineon goes business Excellence

“Business excellence means intelligent approaches and clearly defined processes, which are both constantly under review and ultimately lead to good operating results.
Better operating results and business excellence mean less idleness and wastefulness for all of us, more professional success, more accurate information, a better overview and, thereby, less frustration and more satisfaction.”

Dr. Ulrich Schuhmacher

http://www.infineon.com

Published by Infineon Technologies AG