

PSG6110 for Harris AN/PRC-117G Wideband Tactical Radio

Energy Savings with On-Demand Power®

Executive Summary

Packet Digital's PowerSage® Power Management Integrated Circuits (PMIC) have been shown to substantially reduce power consumption in portable radios compared to their standard configuration. This application note introduces the PSG6110 PMIC for Harris portable radio designs, specifically targeted for functionally replacing the EL7531 in the Harris AN/PRC-117G Wideband Tactical Radio. This document serves as a guide to finalize design requirements to meet Harris' power saving design needs.



1 Introduction

The PSG6110 is a highly integrated, high-efficiency, synchronous radio controller which integrates Packet Digital's On-Demand Power® for real-time, autonomous voltage scaling based on system activity. This application note discusses the integration of the PSG6110 into new and existing radio and communications designs.

2 Reference Documents

PSG6110 datasheet

PSG5220 datasheet

Setting ODP Registers

3 Power Delivery for Mobile Radios

A modern mobile radio will require a number of voltage rails for both analog and digital domains. The number of voltage rails and the output voltage varies for each application, however, the analog components generally require higher voltage whereas the digital components require lower voltages, within the range of 1.2V – 5V. A generalized power map is presented in Figure 1.

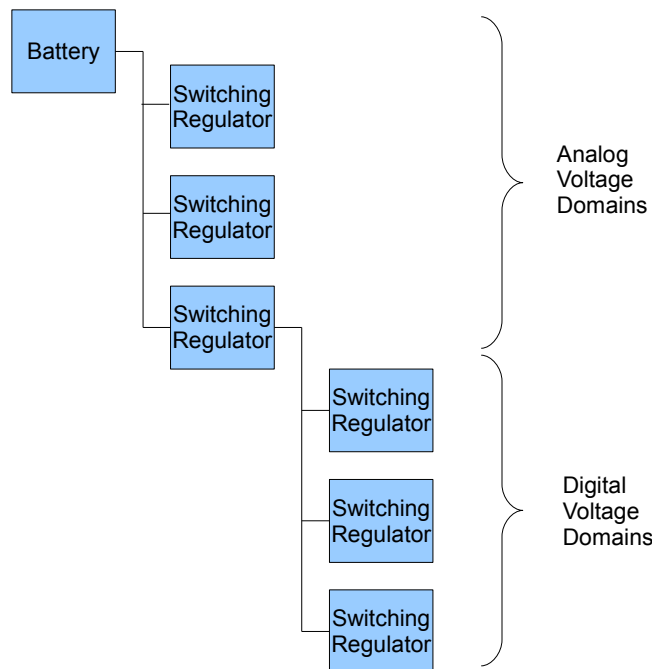


Figure 1: Generalized Power Map of a Mobile Radio

With its low output voltage capability and high efficiency, fixed frequency architecture, the PSG6110 is ideal for powering the digital voltage domains for mobile radios. Furthermore, the integration of Packet Digital's On-Demand Power to the PSG6110 allows the power consumed by the loads to be lower, benefiting from real-time, autonomous voltage scaling. A properly configured digital sub-section with On-Demand Power can significantly reduce power consumption and increase battery life.

3.1 Input/Output Voltage

The wide input voltage range of the PSG6110, from 2.5V to 5.5V, allows for direct powering from many different batteries and power supplies. The PSG6110 integrates a 5.0V linear regulator and a 1.8V linear regulator to power internal analog and digital logic. No other input supplies are required for operation other than the main input voltage, simplifying the design.

The PSG6110 output voltage is programmable between the range of 1.2V to 5V. Each digital supply rail voltage will use a single PSG6110.

3.2 Connections to I/O

Communication to the register map is provided through the SMBUS interface through the SMBDAT and SMBCLK pins. System designers can choose to connect this directly to an embedded controller or through an SMBUS hub. The SMBUS pull-up resistors should be connected to 3.3V. SMBUS is required for in-system configuration of On-Demand Power.

The PSG6110 autonomously scales the voltage supplied to the loads based on information gathered from sensing current and activity. The activity inputs, ACT0 and ACT1, provide activity information from the system to PowerSage. The activity inputs support a wide range of input voltages and configurable polarity. Refer to the PSG6110 datasheet for in-circuit programming of the input conditions through SMBUS registers.

4 On-Demand Power Operation

Packet Digital developed its innovative, patented On-Demand Power technology to virtually eliminate idle-state power consumption and reduce active-state power consumed. On-Demand Power does this by autonomously monitoring systems using voltage scaling, distributing only the amount of power needed as demand for energy changes.

On-Demand Power technology unobtrusively senses within the system and correlates to the radio demand for energy. Once the energy demand is determined, then the PSG6110 power management will provide dynamic voltage scaling at the power supply to provide load management.

To enable On-Demand Power, the power saving features of the PSG6110, register writes through SMBUS are required. On-Demand Power is completely configurable and can be applied to any digital system within a radio.

4.1 Configuring Activity Inputs

ACT0 and ACT1 are system control inputs to the On-Demand Power voltage scaling algorithm. Logic levels on these pins indicate a momentary idle or active state within the system. ACT0

indicates to the state machine the highest level of system activity. ACT1 can be used for an intermediate, lower power state. For many systems, only a single activity signal is available, so then only ACT0 would be used.

The ACT inputs can be independently selected as either standard or low voltage digital inputs and can also be inverted globally and independently through the ACTCON register. V_{IH} and V_{IL} levels for standard and low voltage inputs are defined in the electrical characteristics section of the PSG6110 datasheet. Also refer to the PSG6110 datasheet for the methodology of configuring the activity inputs.

4.2 Configuring On-Demand Power State Machine

Figure 2 provides a visual representation of the ODP state machine. The three states are selected by the ODP algorithm by the signals on the ACT inputs and internal timeouts. Signals on ACT0 indicate the highest power state, causing an immediate shift to activity state 0. Signals on ACT1 direct the state machine to the adjacent state.

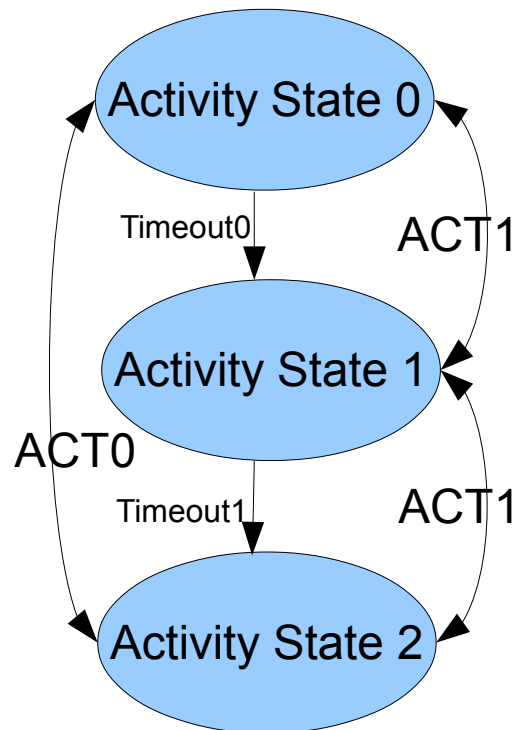


Figure 2: ODP State Machine

5 Application Circuit

A block diagram of the PSG6110 is shown in Figure 3.

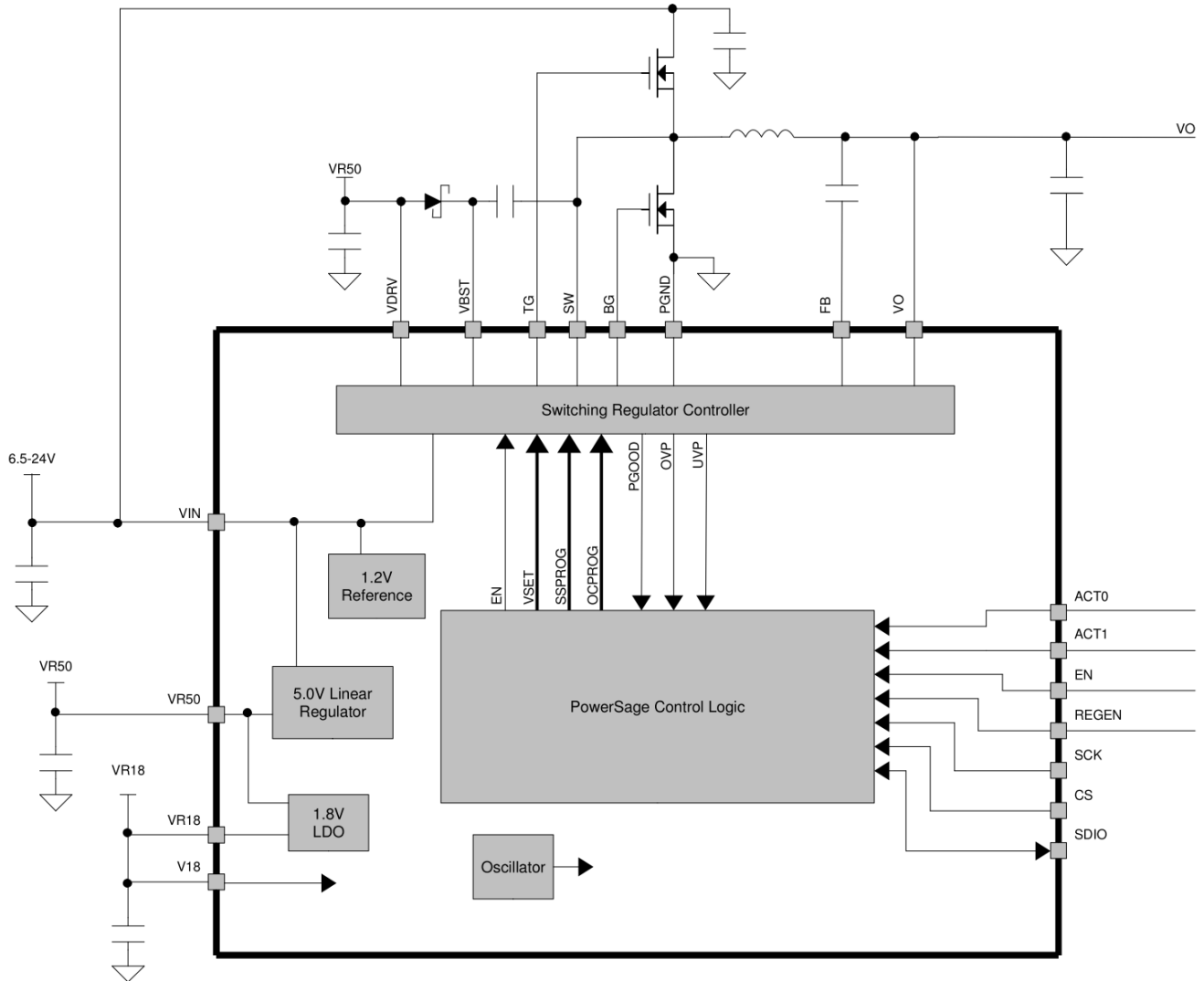


Figure 3: PSG6110 Functional Block Diagram

6 Initial Test Results from PowerSage Integration into a Portable Radio

Packet Digital implemented PowerSage technology into a Motorola-XPR 4500 UHF Mobile Radio as part of research with the Office of Naval Research and the Marine Corps Systems Command. This research included:

- Developing architecture for just in time/just enough power management for military radios
- Creating a development board and demonstrator for PowerSage technology. Figure 4 shows the demonstrator part of this research.
 - System was tested
 - Data collected and analyzed



Figure 4: Mobile Radio demonstration

Figure 5 shows the vast difference in power consumption between the original radio configuration as compared to the PowerSage improved version in our lab.

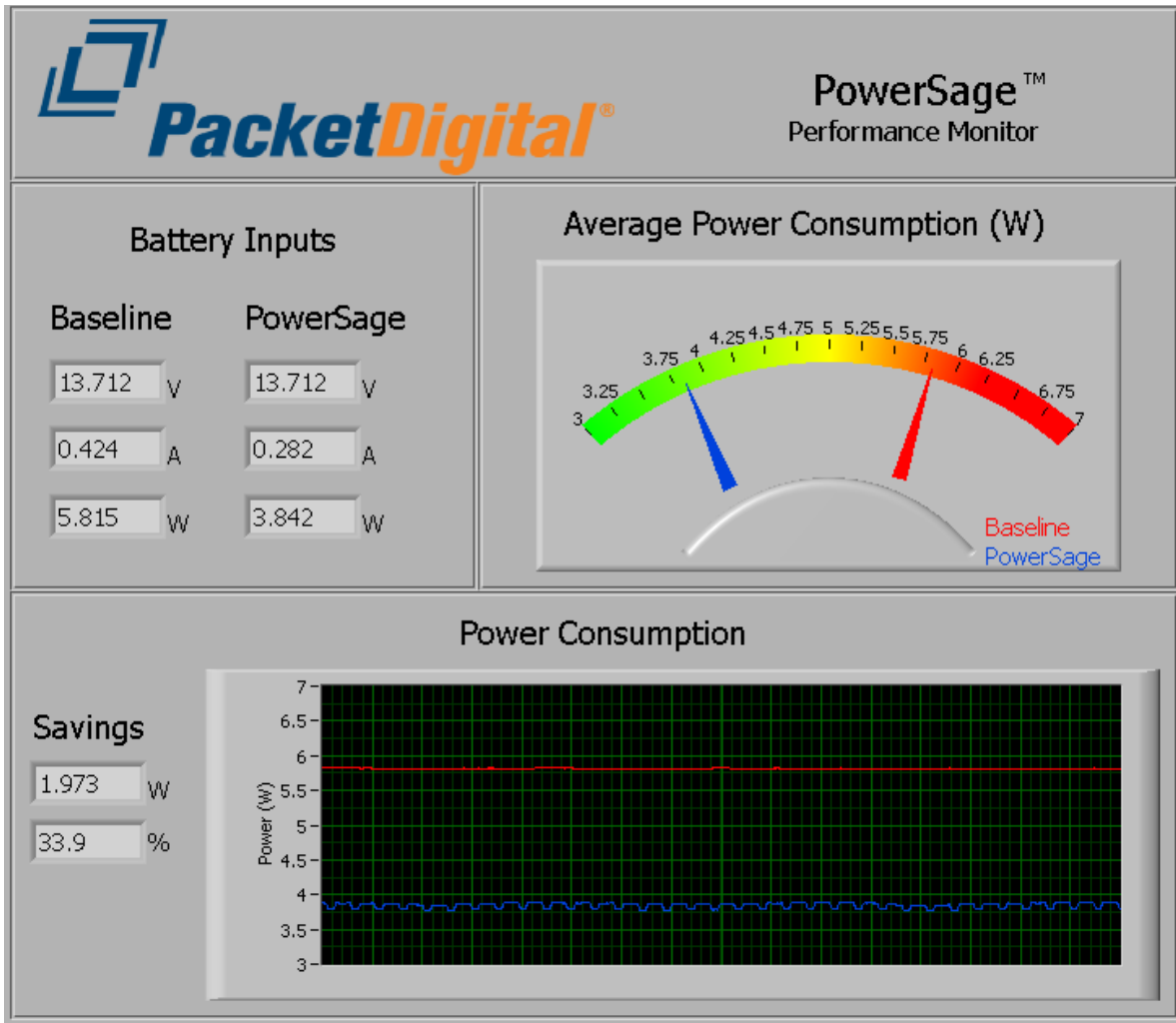


Figure 5: Radio Power Consumption Comparison

Table 1 displays the power savings achieved and demonstrated on a Motorola-XPR 4500 UHF Mobile Radio. The PSG6110 will power the digital portion of the radio and will achieve over 400mW of power savings. Please note, another future Packet Digital offering, the PSG7110 will power the analog portion of the radio and can save over 1.5 Watts!

Table 1: PowerSage Radio Power Savings Test Results

Type of Power	Measured Power Savings (mW)
Analog	1557
Digital	409
Total	1966

7 Wrap-up

Designing PSG6110 into a portable radio not only will help yield up to a 34.5% energy savings and give up to a 53% battery life extension, but will also reduce the temperature by up to 16 degrees Fahrenheit and reduce the signal to noise ratio, improving the quality of the overall system. On military radios this energy savings results in less payload (batteries) and a significant reduction in cost while increasing quality.

8 Next Steps with Harris

As mentioned, Packet Digital will work in cooperation with Harris to have final say on all PSG6110 design requirements. Packet Digital is currently finalizing PSG6110 design architecture and is also designing a PSG6110 evaluation board (Note: a PSG5220 evaluation kit is available now with similar features) and a daughter card. A plan to retrofit older models of the AN/PRC-117 portable radio is also in progress to make this design retroactive.

9 Contact info

Please contact Packet Digital's worldwide engineering support team with any questions on designing portable radios with PSG6110.

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