Evaluation Form – Technical Background Review

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_____ / 30 Technical Content

- Current state-of-the-art and commercial products
- Underlying technology
- Implementation of the technology
- Overall quality of the technical summary

_____ / 30 Use of Technical Reference Sources

- Appropriate number of sources (at least six)
- Sufficient number of source types (at least four)
- Quality of the sources
- Appropriate citations in body of text
- Reference list in proper format

_____ / 40 Effectiveness of Writing, Organization, and Development of Content

- Introductory paragraph
- Clear flow of information
- Organization
- Grammar, spelling, punctuation
- Style, readability, audience appropriateness, conformance to standards

_____ **/ 100 Total - Technical Review Paper**

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Low-Cost VHF Antenna

Power Supply Reviews for Low-Cost, Low Power Radar System

Introduction

The most important component of any technological system is the power supply. Without it, nothing would run. The only thing limiting the choice of power supply is the level of human interaction wanted for the final product. For example, a low power radar system using VHF antennas with minimal maintenance will need a power supply that can sufficiently power the entire system for extended period. This will limit the size of the power supply chosen for the final product. Where the final product will be used will also determine what type of power supply is used. The low power radar system with VHF antenna will need a portable power supply because of the characteristic of VHF waves. VHF waves are limited to elevated areas or elevated installation due to its inability to pass through hills and large structures [1]. This means the radar system will ideally have either a battery pack or a long, underground power line. This technical review will discuss the commercial applications of VHF antennas, explain the technology of battery packs, and how to implement the chosen battery pack.

Commercial Applications of VHF Antennas

VHF (Very High Frequency) allows for a larger bandwidth and can be found in air control, marine communications, and most television connections [2]. VHF antennas are mostly used for short range, line of sight communications because they are not impaired by random electromagnetic noise of longer wavelengths [1]. An example is the use of VHF antennas on boats for communication by radiating the power that the transmitter in the radio produces [3]. It is also used in weather tracking as well as weather predictions. Many amateur radio operators also transmit through VHF waves because of its short range. VHF signals of the same frequency can be used by transmitters several hundred miles apart [1]. The military uses the VHF antennas for communication as well as detecting enemy vehicles advancing on friendly territory. The VHF range can detect certain “stealth fighters” that cannot be picked up by higher frequency radars. Electromagnetic radiation is known to scatter from bodies smaller than its wavelengths in a phenomenon called Rayleigh scatterings [9]. Using this phenomenon, radar systems utilizing VHD antennas can pick up on stealth fighters, which are usually designed small to avoid visual recognition at high altitudes. Each of these different applications all require different specifications for the power supply.

Technology of Battery Packs

There are a variety of battery packs all varying in size, voltage, and amp hours. The simplest power supply would be straight from a wall socket. For larger applications, such as the military radar systems, large power cables would be laid out to supply the radar with sufficient power. However, for small or isolated systems, a battery pack would be the best choice. For example, a sign measuring the speed of the car passing by could get away with small battery packs depending on the type of transceiver it was using. For example, the K-MC1_LP Radar Transceiver is able to track the speed of an object as well as work off of a battery [5]. The transceiver only requires a supply voltage between 3.15V and 6.0V and a supply current of 7.5mA to 9mA. This means any battery pack that falls within this specification like the BGN800-4EWP-B830EC would work [7]. A battery pack can either be built of multiple cells or a single block that equates to multiple cells. The BGN800-4EWP-B830EC is a battery pack made up of 4 separate cells that are connected in a series.

Implementation of Battery Packs

Depending on the specific requirements of the radar system, the battery pack needed will vary. The low-cost, low power radar system with the VHF antenna will need to have a transmit power between 0.01 – 1.0 Watt. Both the K-MC1_LP and the K-MC4 radar transceivers output about 18 dBm [5, 6]. When converted to Watts, this is 0.063 Watt, which falls within the desired specification. Finding the voltage requirement for the transceivers chosen is the simplest way to decide on a battery pack to implement. The K-MC1_LP needs 3.15V to 6.0V while the K-MC4 needs 4.75V to 5.25V. The BGN800-5FWP-A800EC battery with its 6.0V will work for K-MC1_LP while the BGN800-4EWP-B830EC battery with its 4.8V capacity would work well with K-MC4 [7, 8]. Once chosen, depending on the design of the antenna, just connecting the wires would suffice. However, this is not the only way to decide and implement a battery pack for the specifications given. If possible, implementing a multitone measurement signal, a purely passive RF frontend, and using an ultra-low power microcontroller can significantly bring down the transmit power [4]. Depending on which transmitter is used through this process, the voltage requirement for the overall system could be lower, resulting in smaller battery and an overall smaller size.

[1] "VHF | communications", *Encyclopedia Britannica*, 2017. [Online]. Available: https://www.britannica.com/technology/VHF. [Accessed: 05- Oct- 2021].

[2] "Military Antenna Use", *Kten.com*, 2021 ca. [Online]. Available: https://www.kten.com/story/40648233/military-antenna-use. [Accessed: 05- Oct- 2021].

[3] "Selecting a VHF Antenna | West Marine", *Westmarine.com*, 2021. [Online]. Available: https://www.westmarine.com/WestAdvisor/Selecting-a-VHF-Antenna. [Accessed: 06- Oct- 2021].

[4] F. Lurz and A. Koelpin, "Next Generation Ultra-Low-Power Radar Sensors and Systems", IEEE MTT-S, Erlangen, 2016.

[5] RFbeam Microwave GmbH, “K-MC1_LP RADAR TRANSCEIVER,” K-MC1_LP datasheet, Nov. 2013 [Revised May 2021]

[6] RFbeam Microwave GmbH, “K-MC4 MONOPULSE RADAR TRANSCEIVER,” K-MC4 datasheet, Oct. 2010 [Revised Nov. 2018]

[7] BatteryGuy, “BGN800-4EWP-B830EC,” BGN800-4EWP-B830EC datasheet, n.d.

[8] BatteryGuy, “BGN800-5FWP-A800EC,” BGN800-5FWP-A800EC datasheet, n.d.

[9] The Diplomat, "The F-35 vs. The VHF Threat", 2014.