Reader RF Board

Overview

Revision History

Date	Revision	Description	Signature / Date	
07/14/10	1.0a	Initial Draft	Prepared	D Stagg
			Verified	
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1 Introduction

The Transponder system provides a mean to transfer data between a moving vehicle (typically a locomotive) relative to a fixed wayside point, it provides indications to a reader as the vehicle passes successive points of known separation. Data transfer between the vehicle and the wayside occurs at fixed-point locations defined by the position of the Tags. The unit describe here shall be the part of object location/ identification system that consist of the transponder (Passive RFID), vehicle antenna, reader and communication system.

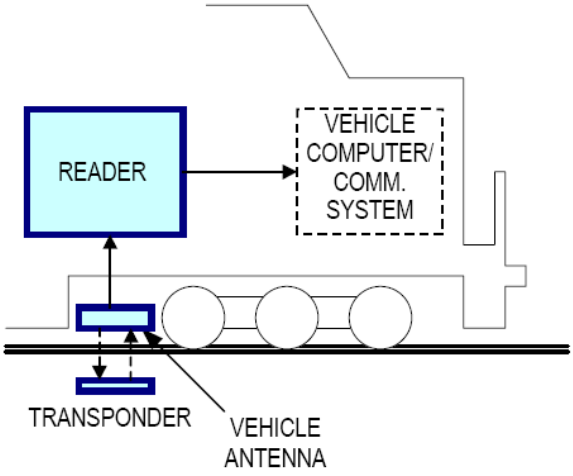

Figure 1-1 Transponder System

1.1 Purpose of this document

The purpose of this document is to list major aspects of the electronic design

1.2 Scope

This document contains major electronic design aspects of the Reader RF Board

References

Sr.	Reference	Detail
1		
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Table 1-1 References

Abbreviation, Definitions and Acronyms

Items	Detail
TCRC	Tapped Capacitor Resonance Circuit
DPSK	Differential Phase Shift Keying
AM	Amplitude Modulation
RF	Radio Frequency

Table 1-2 Abbreviation, Definitions and Acronyms

2 Mechanical Design

The Mechanical Design deals with all the mechanical details and calculations involved.

2.1 Design Overview

2.1.1 Board Size

Board Size is 4’’x 2’’.

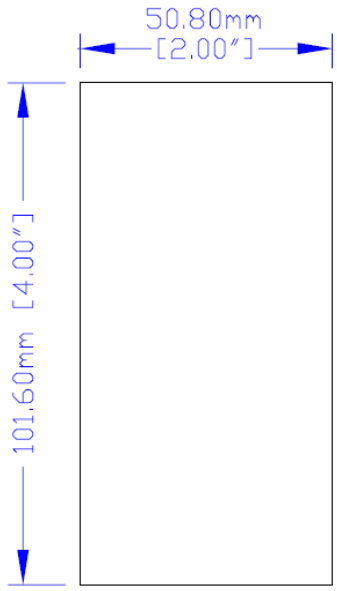

Figure 2-1-Board Outline

2.1.2 Mounting Holes

Board has four plated, 0.128” diameter mounting holes as per drawing shown in Figure 2-2

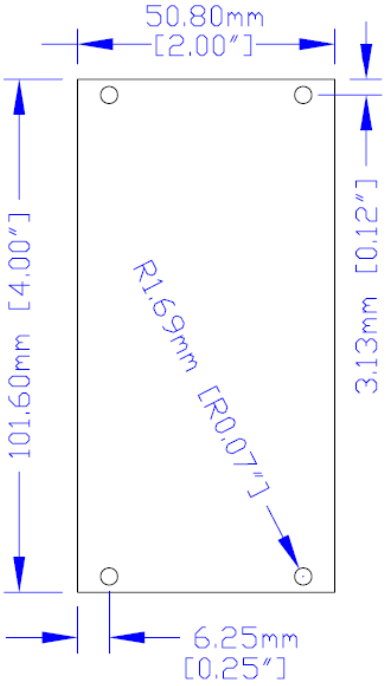

Figure 2-2-RF Board Mounting Hole Locations

2.1.3 Floor Plan

The board features Backplane interface connectors as per following drawing.

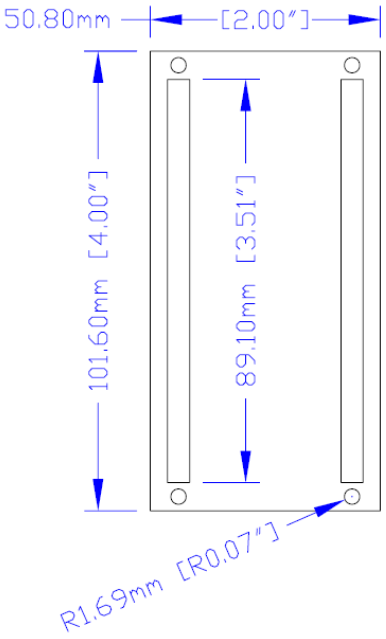

Figure 2-3-Floor plan

2.1.4 Component Height Restriction

There are no components which have height higher than 850 mils.

3 Electrical Design

The Electrical Design deals with major circuit details, calculations and theory of operations involved.

3.1 Design Overview

The RF Board is an important part of the Reader that contains RF amplifier, AGC system, AM Demodulator and peak detector circuit. It receives AM modulated RF signal transmitted from the transponder and manipulates it accordingly to output successive positive and negative peak voltages (square wave) required for DPSK demodulation.

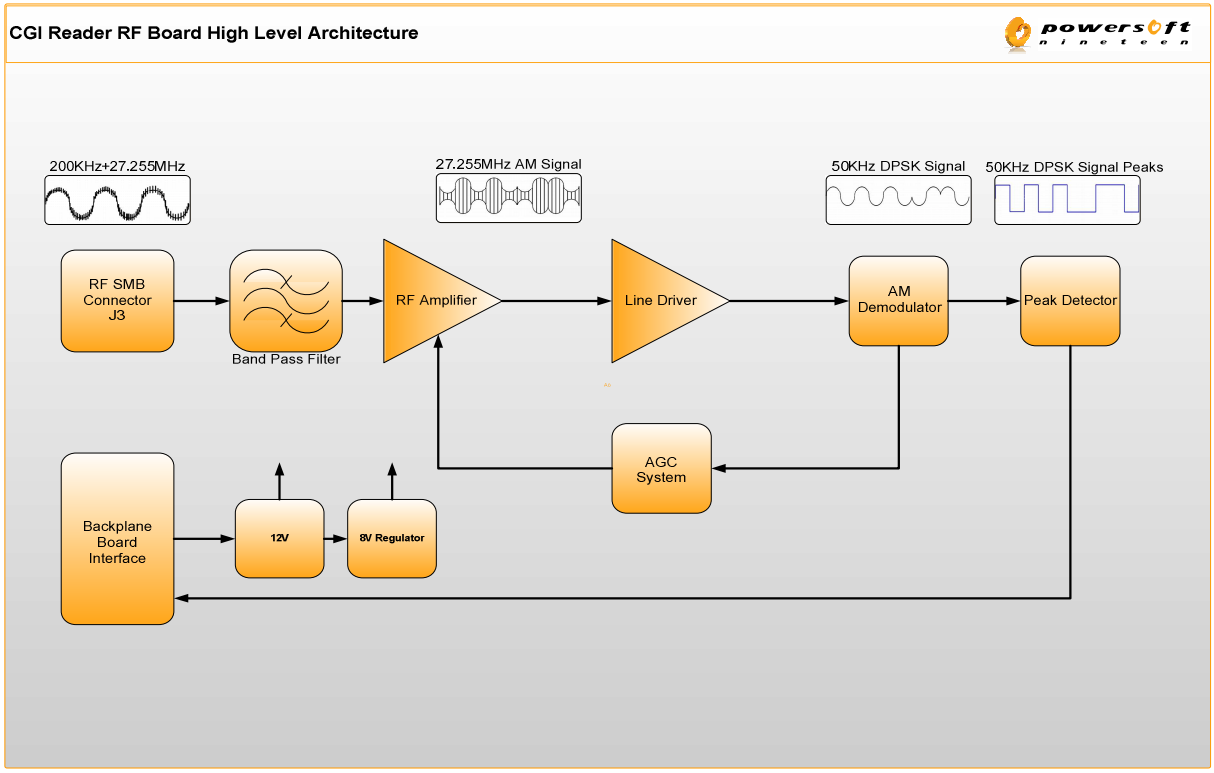

Figure 3-1-Reader RF Board High Level Architecture

The Reader-RF Board takes power supply from Reader-Backplane Board. The RF signal enters the band pass filter which allows only a particular band of frequency to pass through it which goes in to the RF amplifier. The RF amplifier enhances that signal and forwards it to the line driver which further increases its amplitude. The AM demodulator extracts DPSK signal from carrier frequency and delivers it to the peak detector circuit.

3.2 Interfaces

The CGI Reader RF Board design has two interfaces to interact with the external environment.

3.2.1 Backplane Board Interface

The Backplane Board interface is used to connect the RF Board with backplane board.

3.2.2 RF Signal Interface

The RF signal interface is used to connect RF board to 27.255MHz loop receive antenna

3.3 Theory of Operation

The operation of the circuit is described in following sections.

3.3.1 Power Supply

The power supply section consists of input filter low dropout voltage regulator

3.3.2 Band Pass Filter

The band pass filter is formed from two separate TCRC circuits in cascade configuration. Both TCRC circuits have been tuned at frequency of 27.255MHz.

3.3.3 RF Amplifier

The RF amplifier is used to amplify weak RF signal received by 27.255MHz loop antenna. RF amplifier consists of two cascaded stages. It has 50dB of power gain and AGC range of 60dB.

3.3.4 Line Driver

The amplified RF signal is fed to line driver circuit. The line driver circuit has been configured as a high pass filter with gain therefore it further amplifies and improves the load driving capability of RF signal so as to drive the AM demodulator circuit. Meanwhile it also attenuates low frequency components such as 200 KHz.

3.3.5 AM Demodulator

The envelope detector uses a fast recovery diode to perform the function of an AM demodulator. The AM modulated RF signal is fed to the input of envelope detector which allows only positive half cycle of RF carrier wave and blocks its negative half cycle.

3.3.6 Peak Detector

This circuit works in three cases. First, when no phase change occurs in DPSK voltage, it gives equal positive and negative width in its output. Second, when phase change occurs at the negative side in DPSK voltage, it gives only negative width in its output. And third, when phase change occurs at positive side in DPSK voltage it gives only positive width in its output.

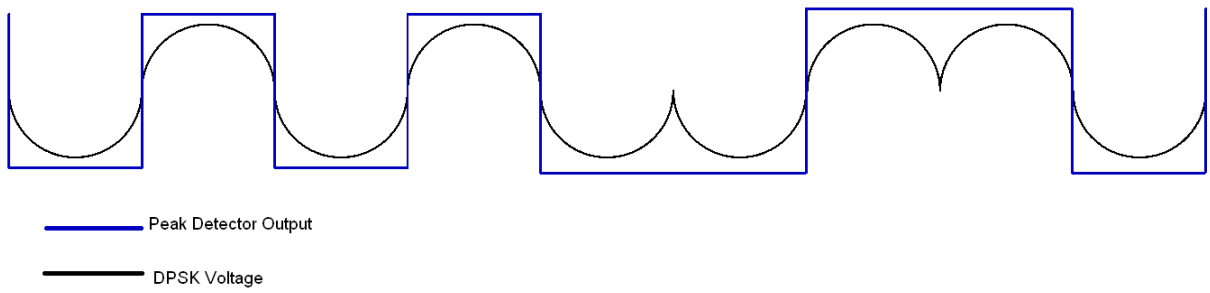

Figure 3-2-Peak Detection of DPSK Signal

3.3.6.1 Second Order High Pass Filter

The main function of this circuit is to create phase difference in DPSK signal.

3.3.6.2 Second Order Low Pass Filter

. The main function of this circuit is to introduce more phase difference in DPSK signal arriving from the previous stage.

3.3.6.3 Voltage Comparator

The circuit compares a reference voltage of value 5.1V containing some fraction of input DPSK voltage to a phase shifted DPSK voltage. The output of the voltage comparator transitions from low to high or high to low after comparing both original DPSK and phase shifted DPSK.