Exhibit 3

Circuit Description A2832-1014-01 Reader

FCCID:	ILPWARFIDHF
Part No.	A2832-1014-01
Drawing No.	IDS134020A
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Document Description:

This document is a brief overview and technical description of the circuit operation for the RFID reader module, A2832-1014-01. This document should be read in conjunction with the other documentation concerning the technical construction of this module. In particular, the schematic and layout information for DM021_B1 and DM022_B1 boards (RFID reader module), and the DM023_B1 integral antenna board.

1. Overview

The A2832-1014-01 Radio Frequency Identification (RFID) reader module is designed to read and write to high frequency tags with a carrier frequency of 13.56MHz. The RFID tag behaves like a transponder, with the tag electronics being powered by the presence of a RF field coupling into the tag antenna, at the carrier frequency. The tag types supported by this module are the Philips Semiconductors I.CODE and Texas Instruments Tag-It. In use, the relevant tag type is automatically interrogated and selected by the module, when the tag is placed within the range of the module antenna.

The reader is designed as an OEM module, which can be easily integrated with the Psion Workabout. Control and powering of the module is achieved by linking the module to a Psion Workabout via a serial communications interface.

2. The Microcontroller

The microcontroller (U4) supervises operation of the circuit and interfaces with external circuitry. Ports A and C are not used. A summary of pin operations is given in Table 1 below. An In circuit Serial Programming (ISP) port is provided for downloading firmware.

Pin Name	Description
SCK	Serial clock for data transfer in ISP mode.
MISO	Data output to ISP programmer
MOSI	Data input from ISP programmer
SIG_INJ	Not Implemented
C_MOD1	Used to modulate RF amplitude by 15%

C_MOD2	Used to modulate RF amplitude by 100%
RXD	Data received from External Source
TXD	Data transmitted to External Source
WAKE_UP	Interrupt to wake up processor (not implemented)
ASK/FSK	Select line between ASK and FSK demodulation
GP_DATA	Data received from demodulator
RF_ON	Output controls RF supply voltage enable
AN_ON	Output controls analog supply voltage enable
XTAL1	Processor Clock input
/RST	Reset active low

Table 1: Microcontroller Pin Operations

The microcontroller is reset by a dedicated reset control IC (U3), which operates by sensing the supply voltage and automatically resetting when the supply drops below a certain threshold.

3. Power Supplies

Digital power (+5V) is derived directly from an external +5V supply. Analogue power is also derived from the +5V supply but is boosted to 8.3 volts D.C using a switching converter U10. This is linearly regulated by U2 to produce a RF supply (+8VRF), U5 to produce a low noise analogue supply (+5VAN) and by U25 to produce a low noise oscillator supply (+5VOSC). The +5V, 8.3V and +5VOSC supplies are switched on when the PWR_ON line from the external interface is asserted high via Q3 and Q1. The +5VAN and +5VRF supplies are controlled by the microcontroller to enable low power modes.

4. RF Generator, Transmitter and Antenna

A 13.56MHz sinusoidal signal is generated by the crystal oscillator U1. A high degree of noise immunity is achieved on this signal by using a separate, low noise, regulated +5V supply, derived from U25. This signal is amplified by U6 to produce a 5V pk-pk sine wave with a very low harmonic content, and a high drive current potential. This is fed into an integral antenna soldered directly to the DM023_B1 PCB via pads J1 and J2.

The antenna circuit comprises a parallel tuned circuit formed by C2, C4, C7 and the Antenna Coil inductance, where substantial antenna coil currents are produced due to resonance.

Q-factor of the tuned circuit is set by series resistor R19 to be approximately 12. This allows adequate field strength to be generated, yet still gives permissible bandwidth for the highest tag data rate.

When writing data, the processor either disables the carrier output to cause the RF field to be modulated to 100% depth (via Q5), or attenuates the oscillator drive signal (via Q4) causing only 15% modulation depth. This is dependent on the tag type being written to.

5. Data Receiver and Demodulator

When a tag is placed into the RF field it must first receive a valid command from the reader before producing any response. The response is demodulated using U27, which is a dedicated radio receiver device. It contains a mixer, IF stage, RSSI output, and quadrature detector.

Depending upon tag type, the received and demodulated signal can be in the form of ASK or FSK data. An analogue switch, U29, is therefore used to select the required data signal from the receiver device.

The circuitry for the Data Receiver and Demodulator is located under a tin plated, copper shielding can to improve noise immunity.

The appropriate demodulated data signal, is then buffered and filtered using U7B. This attenuates any IF components, while still allowing the 26.4KHz square wave data to pass through to TP2. This filtered data is then passed though the data shaping circuit of U7A, which produces the reconstructed 5V amplitude data stream at TP3. This signal is fed into the microcontroller where it is subsequently decoded using proprietary software algorithms.

6. External Interface

It is important to ensure that any high level TTL signals, generated by powered external components to which the module may be connected, are not imposed on to the inputs of the powered down A2832-1014-01. Consequently, the RXD and TXD lines are isolated by the solid state switch U8 when the A2832-1014-01 is switched off, to ensure that no current flows along these lines. The switch is powered from the external supply, so that it will continue to operate when the A2832-1014-01 is in powered down mode.

7. External Connector J2 Signals

Pin Number	Pin Name	Description
1	+5VIN	+5V Supply
2	n/c	Not used
3	PWR_ON	Board power on from external source (TTL active L)
4	RXD	Serial data input from external source (TTL)
5	TXD	Serial data output to external source (TTL)
6	n/c	Not Used
7	GND	Ground
8	GND	Ground

Table 2: User Control Signals