OCR601 – Operational Description

OCR601 is an USB connected passport reader which has a Camera Imager and a RFID contactless reader. The camera imager is used as an OCR decoder by the host application, which decodes the passport MRZ data. The MRZ data is then sent to the RFID reader to authenticate with the RFID chip in the passport to read the data. The following figure shows the hardware architecture of OCR601.

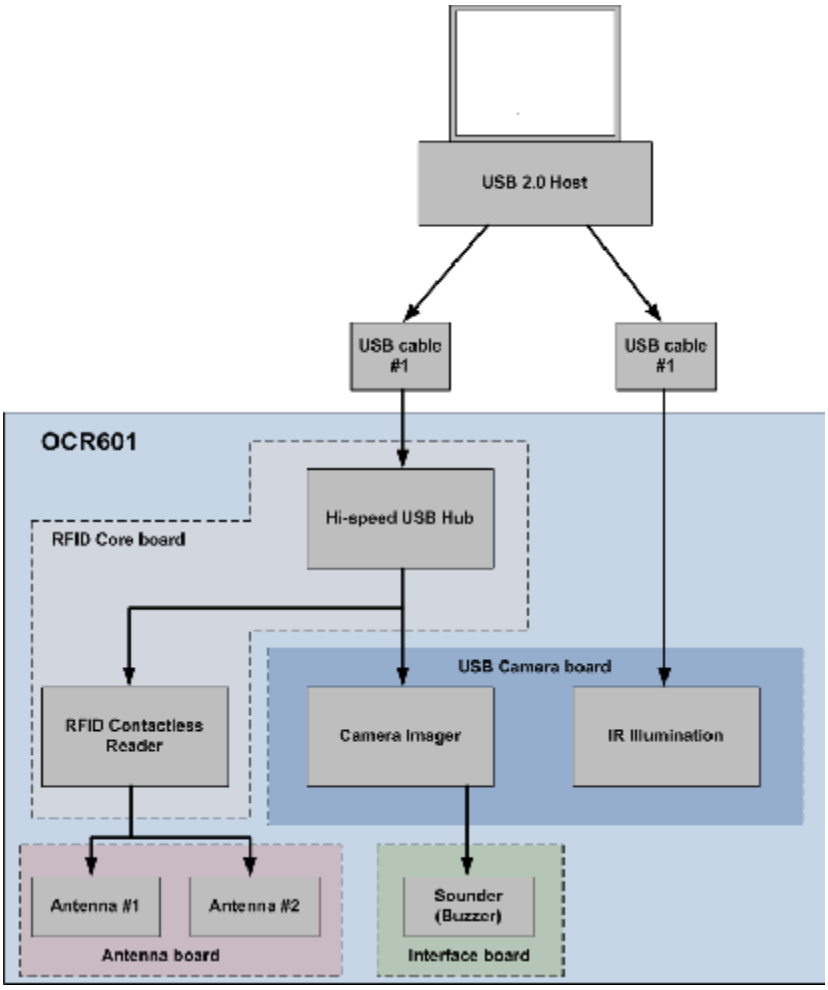

Fig 1: OCR601 Hardware Architecture

The IR illumination circuitry is independent from rest of the device. It provides IR illumination for the the camera imager. It should be noted that a separate USB cable is used to power the IR illumination circuit.

The RFID contactless reader drives two independent antennas. There is one antenna around the glass prism window. This antenna will be referred as antenna #1 in this document. The other antenna is near the power LED indicator. This antenna will be referred as antenna #2 in this document. Typically, both these antennas will be scanning for RFID passports – one at a time.

High Speed USB Hub:

Device classification	2 port USB High speed hub
Operating Voltage / Current	3.3V / 150mA
Digital/Analog	Digital circuitry
Crystal Frequency	24 MHz
PLL Multiplier	x20 (480 MHz internal frequency)
Data transfer rate	480Mbps
Intentional Radiation	No
Software requirements	USB host should have generic USB hub driver. All windows machine supports this USB hub class and it should start up right away. There are not application software requirements.

Operational Description:

The High speed USB hub provides USB connectivity to the RFID and the camera. It provides two USB downstream ports. One of the downstream ports is connected to a RFID full speed device and the other is connected to a 1.3 Mega pixel imager.

Camera Imager:

Device classification	USB 2.0 High speed camera
Operating Voltage / Current	5V / 150mA
Digital/Analog	Digital circuitry
Crystal Frequency	24 MHz
PLL Multiplier	x20 (480 MHz internal frequency)
Data transfer rate	480Mbps
Intentional Radiation	No
Image resolution	1280 x 800 (1.3 Mega pixel)
Software requirements	USB host should have Access IS camera drivers installed. The camera starts-up only if camera application software (like Amcap or IScap) is running. The camera shuts down when then application software is closed.

Operational Description:

The camera imager is a USB 2.0 high speed camera capable of streaming images at 1.3 Mega pixel resolutions. The data from the camera reaches the USB host through the USB high speed hub. It should be noted that the camera is in shutdown state when there is no application software running. For normal operation camera application software like Amcap or IScap should be running.

It should be noted that the IR illumination circuit is also embedded in the imager PCB. The illumination could be turned ON or OFF by the camera digital circuit. This kind of arrangement helps the USB host software to control the illumination. The power supply for the illumination circuit is drawn from USB cable #2. In fact, USB cable #2 is used only for the illumination power supply and the USB data lines are NOT used.

The following diagram shows the internal blocks of the camera imager along with the IR illumination circuit.

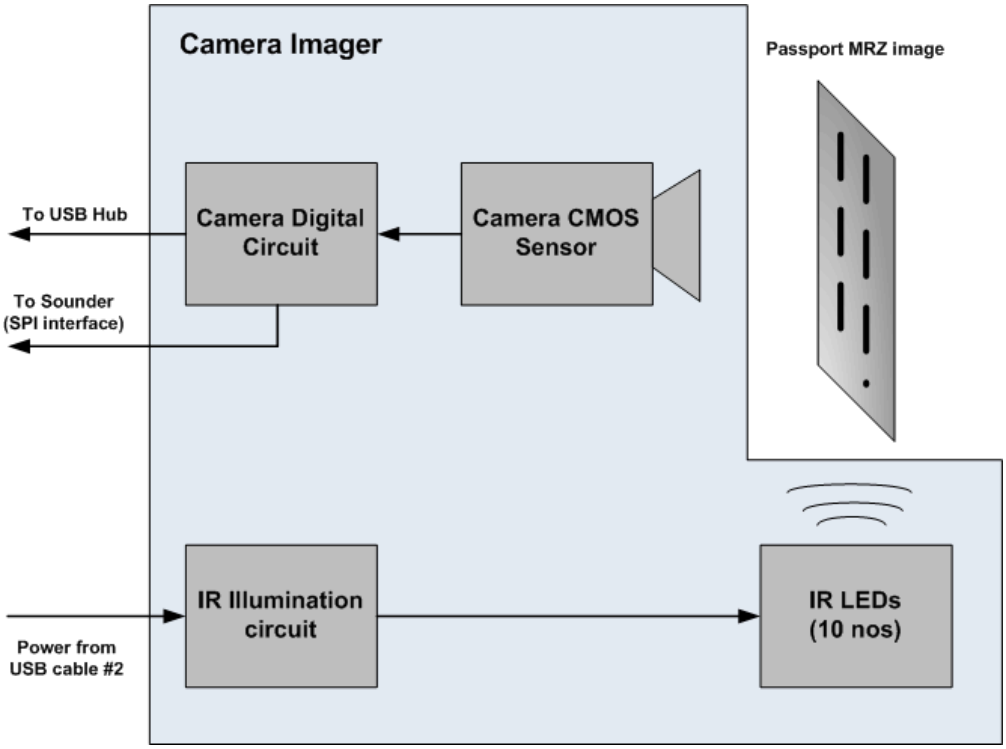

Fig 2: Camera imager internal block diagram

IR Illumination:

Device classification	Boost regulator for lighting application
Operating Voltage / Current	5V / 250mA
Digital/Analog	Analog circuitry
Switching Frequency	1.2MHz
LED drive Voltage / Current	~25V / 20mA (Drives a string of 10 IR LEDs)
Intentional Radiation	No
Software requirements	None. Starts up as soon as power is applied

Operational Description:

IR illumination circuit drives 10 IR LEDs to provide a uniform illumination to the camera imager. Please refer operational description of camera Imager.

Sounder:

Device classification	Audible tone generator
Operating Voltage / Current	3.3V / 20mA
Digital/Analog	Digital circuitry
Operating Frequency	8 MHz
Intentional Radiation	No
Software requirements	None. Camera imager digital circuit controls the tone generator. The communication is through SPI interface operating at 100KHz.

Operational Description:

Sounder block is basically a small microcontroller that generates tones. The sounder controller receives commands from the camera digital circuit on which tone it has to play. With this kind of arrangement, the USB host software can access the sounder through the camera digital circuit.

RFID Contactless Reader

RFID contactless reader contains both digital and analog section. Information on these two sections are provided below.

RFID Contactless Reader – Digital Section

Device classification	USB full speed device
Operating Voltage / Current	5V / 50mA
Digital/Analog	Digital circuitry
Crystal Frequency	8 MHz
PLL Multiplier	x6 (48 Mhz internal frequency)
Data transfer rate	12Mbps
Intentional Radiation	No
Software requirements	Microsoft CCID smartcard driver is required. Only if the driver is loaded in the host machine the digital section will enable the RFID analog section. There are no application software requirements to get the RFID active. However, to reader RFID passport application software (like Golden reader tool) is required.

RFID Contactless Reader – Analog Section

Device classification	RFID transceiver
Operating Voltage / Current	5V / 150mA
RFID protocol	ISO14443 Type A and Type B
Digital/Analog	Analog circuitry
Crystal Frequency	13.56 MHz
PLL Multiplier	None
RF Data transfer rate	424 Kbps
Intentional Radiation	Yes
Carrier frequency	13.56 Mhz +/- 7 KHz
Sub Carrier frequency	847 KHz (max)
Number of Antenna	2
Output power	< 250 mW
RF field strength	6 A/m (RMS)
Software requirements	Refer the RFID contactless reader - digital section software requirements

Operational Description:

The RFID contactless reader is a proximity reader that operates on 13.56 Mhz carrier frequency. It communicates to RFID passports using ISO14443 A/B protocols. The reader has two inbuilt antennas and it keeps switching the carrier between the two antennas, polling for RFID passports. The following diagram shows the internal blocks of the RFID reader.

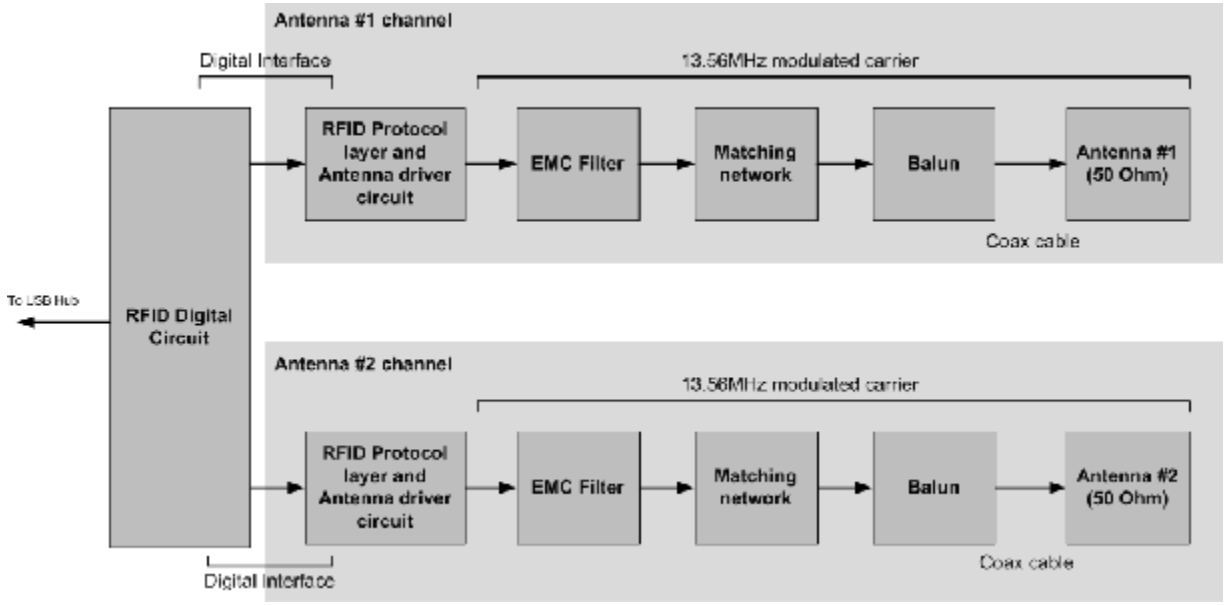

Fig 3: RFID reader internal block diagram

Note that there are two identical channels for driving antenna #1 and antenna #2. The RFID digital circuit controls both the antenna channels. The EMC filter provides the necessary attenuation to block higher frequency harmonics from reaching the antenna. The matching network along with the balun provides the required matching to a 50 Ohm antenna.

The RFID reader uses loop antenna to radiate RF energy. The antennas are tuned to 50 Ohm impedance with a phase angle of +/- 10 degrees. The following diagram shows a simplified circuitry of the antenna.

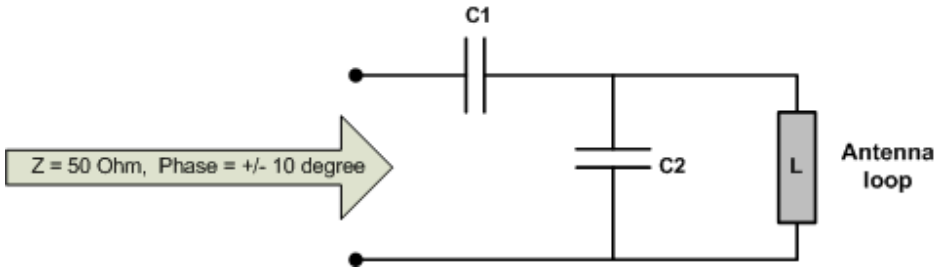

Fig 4: RFID loop antenna circuit

The antenna board has two loop antennas tuned to operate at 13.56 MHz. Antenna #1 is around the glass prism window and antenna #2 is near the power LED indicator. Variable capacitors are used in place of C1 and C2 so that the antenna could be tuned accurately during production. The following plots show a typical antenna impedance plots for both antenna #1 and #2.

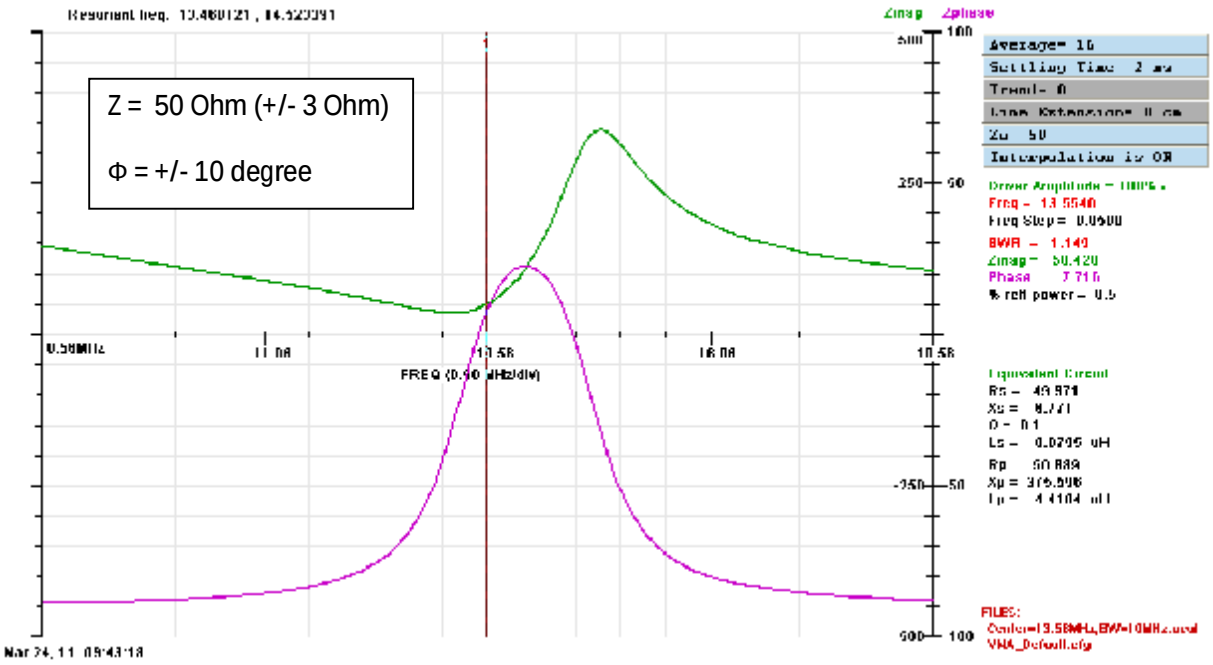

Fig 5: OCR601 Antenna #1 – Typical Impedance and Phase plot

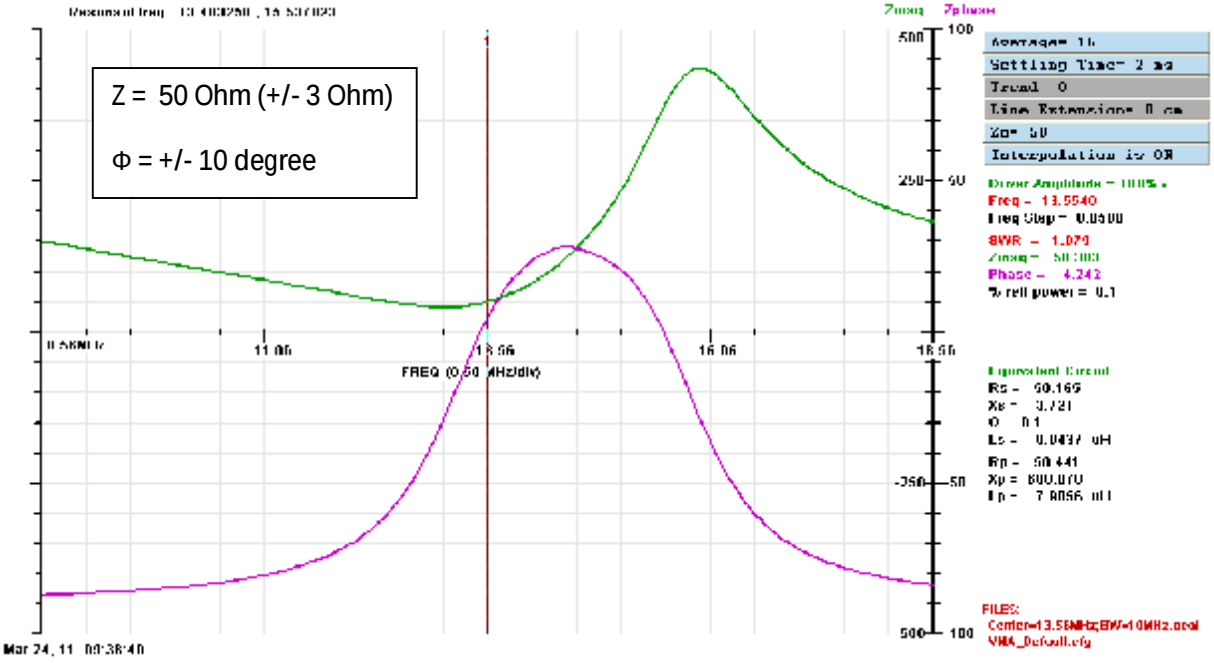

Fig 6: OCR601 Antenna #2 – Typical Impedance and Phase plot

As said earlier, the RF energy is switched between the antennas one at a time, scanning for RFID passports. The antenna switching and the polling sequence timing are shown in the following diagram.

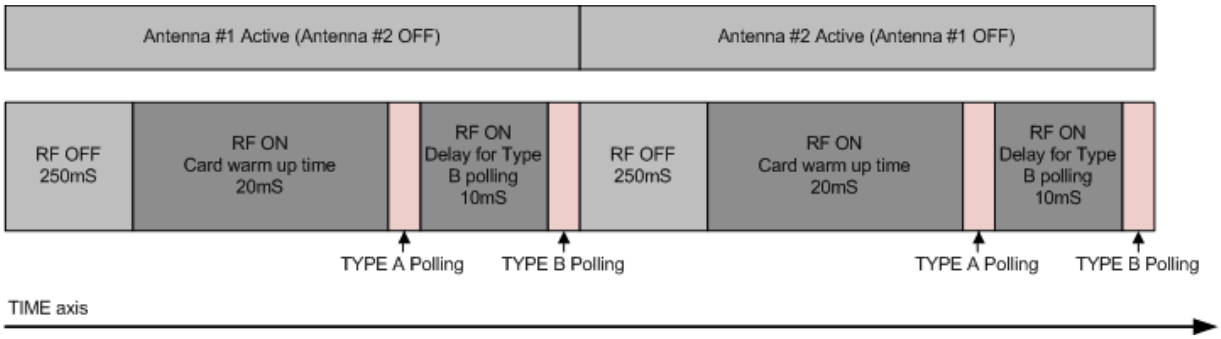

Fig 7: RFID antenna switching and polling sequence

Once a passport is detected the RFID reader exchanges data with it and stays locked on to the RFID passport. As long as the passport stays in the communicable range, the antenna switching/polling does not happen.

It should be noted that the reader always does transceive operation. (i.e. Transmits command and receives or expects reception of data from the RFID passport). Hence, it is NOT possible to have the reader in transmit only or receive only mode.