Saturn Reader
User Manual

Version 1.00

On Track Innovations Ltd.
(O T I)

P/N 1100054F

FCC Compliance

This device (Reader Saturn 3000) complies with Part 15, of the FCC Rules.

Operation is subject to the following two conditions:

1. **This device may not cause harmful interference,**

   and

2. **This device must accept any interference received, including interference that may cause undesired operation**

   • **NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15, subpart C of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications.**

Changes or modifications in this equipment, not expressly approved by the party responsible for compliance (On Track Innovations Ltd,) could void the user's authority to operate the equipment.

FCC ID: JNX-OTI-SATURN

Responsible Party:

OTI America Inc.
1601 South DeAnza Blvd.
Cupertino, CA95014
USA
Phone: 408-252-0333

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1. Product Overview

1.1 Product Description
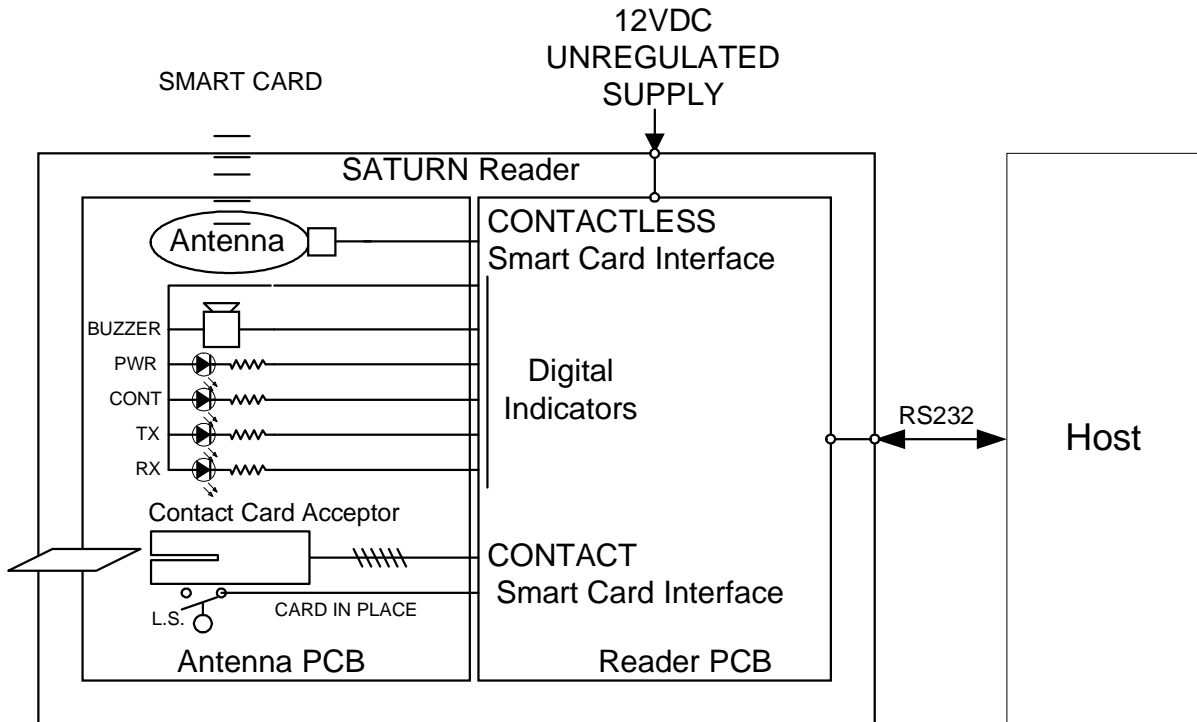
Figure 1-1: SATURN Reader
System Block Diagram

The SATURN Reader is an inexpensive, compact radio frequency communications electronic interface unit. With bi-directional contact & contactless communication to smart cards and RS232 communication to local controllers, the SATURN reader is the key stone in contactless smart card systems.

The SATURN Reader can be integrated into existing systems. Using RS232 serial communication interface between reader and Host, the Saturn allows **bi-directional, full duplex** communication between the Host and passive, contactless smart card.

The SATURN OEM Reader Board serves as a smart interface unit between the application controller and:
1. ISO14443 Type B Contactless smart cards.
2. SAM Secured Applications Module
3. Contact smart cards.

Contact cards
The SATURN provides interface (T=0 and T=1) between the contact card and the Application Controller. Communication with the contact card acceptor is TTL NRZ.

Contactless Cards
At the Host's command, the SATURN generates and modulates a 13.56 MHz carrier signal for the transmission of power, commands and data to an in-range smart card. Read and write operations have equal data rates and range.

Secured Transactions
Secured Purse to Purse transactions can be achieved either between a Contact card and a Contactless card or between cards (contact or contactless) and an "on board" SAM Secured Applications Module
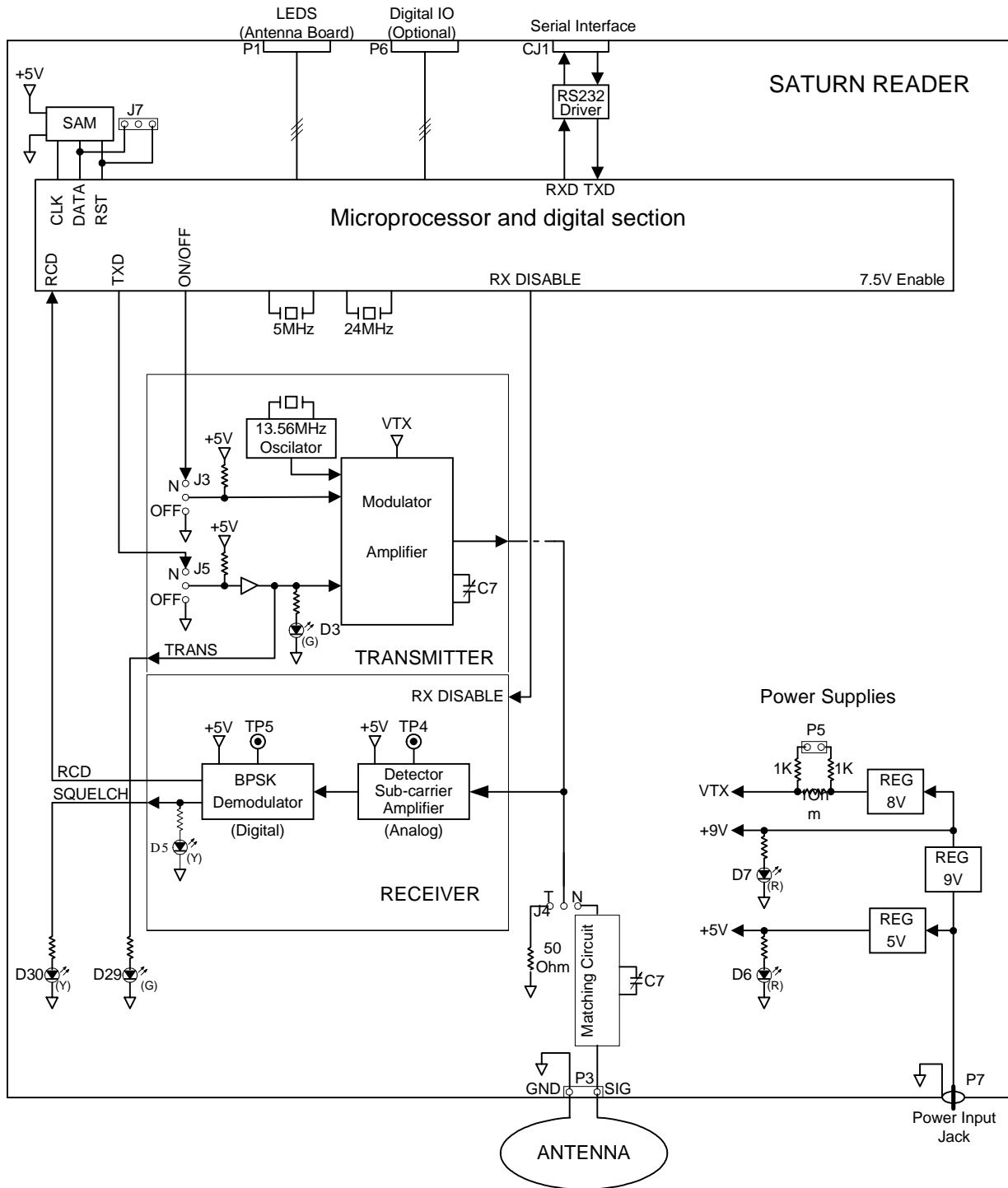
Indicator LEDs
Nine on board indicator LEDs are provided. (see 1.4.2)

Digital IO
The Saturn provides interface to an external contact card acceptor as well as external indication LEDS and user configurable sink type digital IO.

Figure 1-2: SATURN Reader Schematic Diagram

1.2 Product Features

- Bi-directional radio frequency interface between Host and Contactless Smart Cards
- Bi-directional interface to Contact Smart Cards
- Flexible, software configurable microcomputer-based design.
- Integrated, sophisticated Smart Card Operating System on board.
- High security encryption system (DES/RSA) in the board's Operating System (with SAM option on-board).
- 13.56 MHz transmission frequency conforming to ISO 14443 standard.
- ISO 14443 Type B transmission of commands and data to/from the card.
- Equidistant read/write transaction operation.
- Proximity range - up to 6 cm.
- Signal penetrates virtually any non-conductive material - no contact or line-of-sight required.
- Bi-directional data transmission from/to the EYECON at 50/106 kbps.
- RS232 Communications interface to Host controller.
- SAM "on-board" option.
- Simultaneous transmission of power and bi-directional read write messages, through its antenna, to the passive smart card.
- Indicator LEDs for Power, Card Detected, RF Transmit/ Receive.
- Flash programmable digital IO.
- Operating temperature range 0°C to 70°C (32°F to 158°F).
- Single 12V 500mA non-regulated power supply.
- Firmware stored in on-line programmable Flash memory.

1.3 Product Specifications

Table 1-1: Performance/Electrical Specifications

■ Contactless Read/Write Range:	Up to 6 centimeters with Contactless Smart Card (depending on card type and orientation).
■ **RF Interface**:	
RF Carrier Frequency	13.56 MHz
RF Output	200mW
Output Short Protection	Built-in (continuous)
RF Data Operations	Half duplex
RF Data Transmission Rate	50/106 kbps
Data Error Checking	Message Length, Parity, Frame , Bits , CRC.
■ **Contact Card Interface**	TTL level
Data line	Bi-directional, Half duplex
Reset line	
Clock	5MHz
Data Error Checking	Message Length, Parity, Frame , Bits , CRC.
■ Host Data Communications Interface	
■ TTL NRZ/ RS232	
■ **Signals**	Transmit, receive
Bit/Byte Protocol	Async (start/stop), bit serial, full duplex, 9600/38400 baud; data byte=8 data bits, no parity, 2 stop bits, full 8-bit binary data
Data Error Checking	Message Length , Parity , Frame , Bits , CRC.
Connector/Cable	Standard connectors on board
■ **Indicators:**	
+5V Power	Red LED
+9V Power	Red LED
Transmit	Green LED (x2)
Receive B	Yellow LED

Performance/Electrical Specifications (continued)

■ **Digital I/O:**	Serial TTL Level
■ **Microprocessor Circuit**	
Microprocessor	80C32 - PLCC - 24MHz
XTAL	24 MHz
FLASH MEMORY	128Kbyte
RAM	8Kbyte
LOCK-UP PROTECTION	Watch Dog Timer
■ **Electronic Board Power Requirements:**	
	12VDC @ 500mA (non-regulated)
Maximum Current Draw	300 mA
■ **Mechanical:**	
Dimensions	125x102x20mm
Weight	100 gr.
Vibrations	10 ÷ 200 Hz @ 2.0G
Environmental	
■ **Temperature:**	
Operating	0° to 70°C (32° to 158°F)
Storage	-25° to 85°C (-13° to 185°F)
■ **Humidity:**	5 to 95% non-condensing
■ **Tuning**	RF output filter SQUELCH
■ **Secured Applications**	Secured applications with SAM option

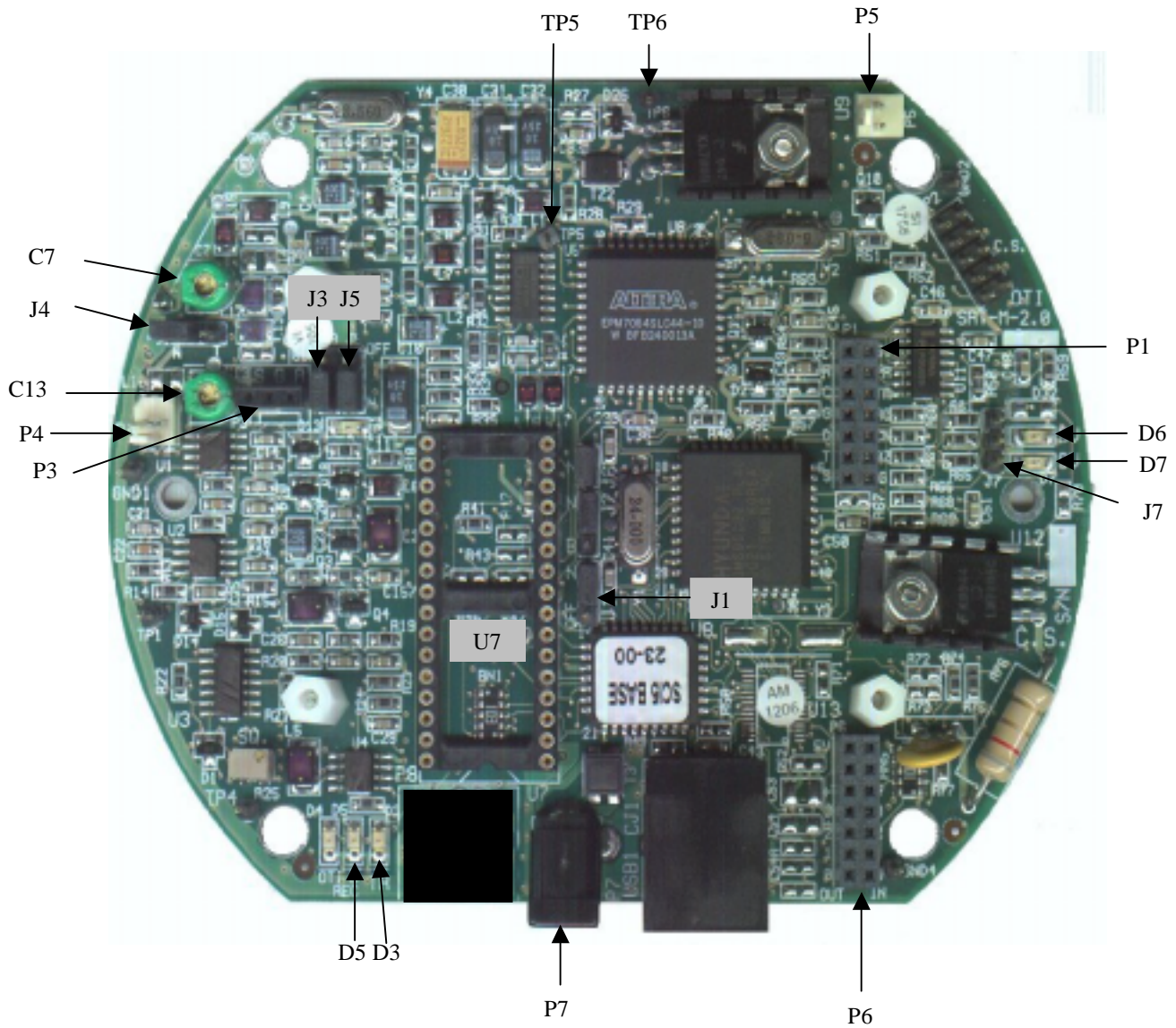## 1.4 SATURN Reader PCB
Interface Summary by Reference Designation

Figure 1-3: SATURN Reader PCB Layout
Front
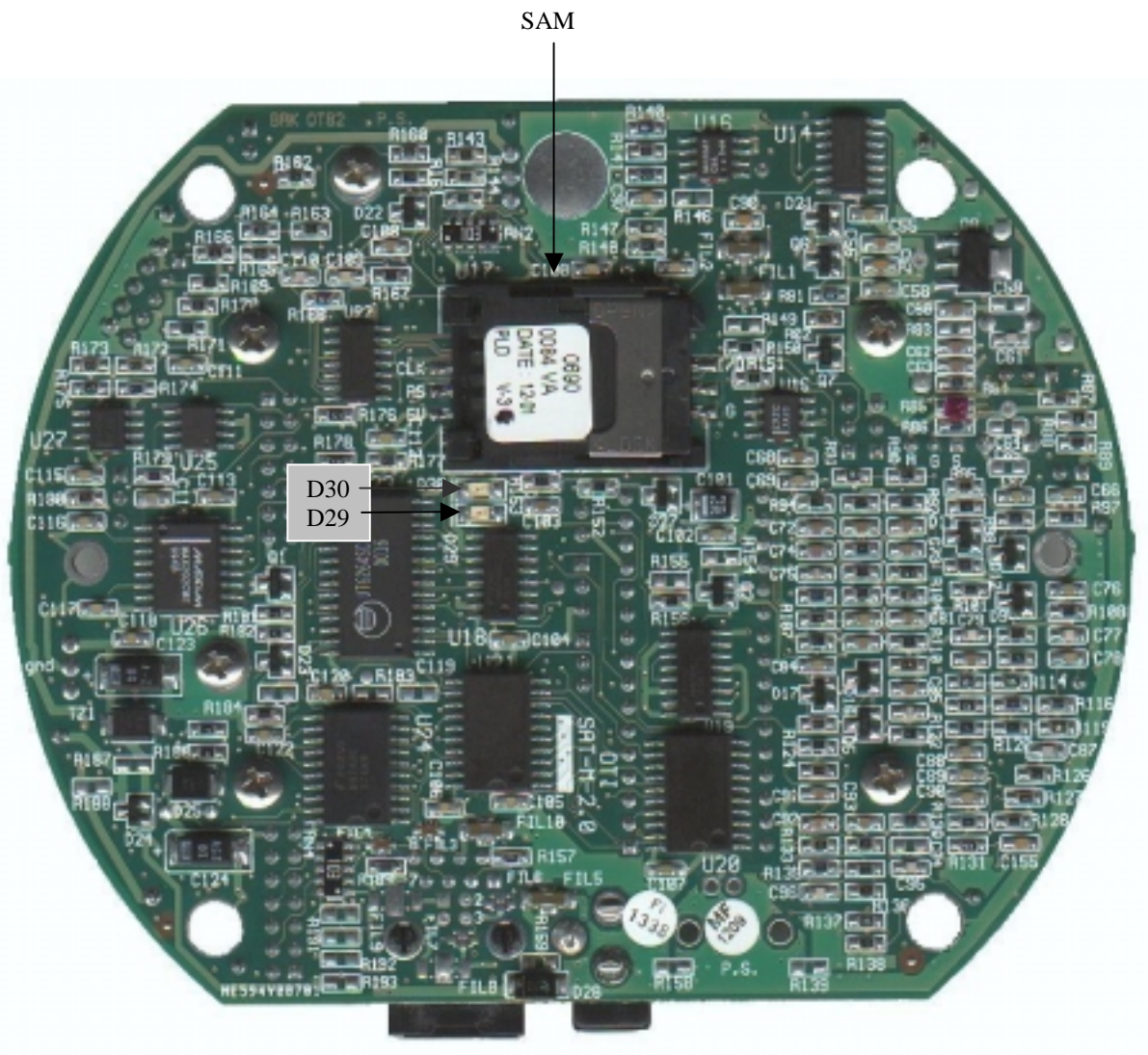
SAM

D30
D29

**Figure 1-4: SATURN Reader PCB Layout
Back**

1.4.1 Connectors

P1 14 pin digital I/O connector to Antenna PCB.

P3 3 pin Antenna connector to Antenna PCB.

P4 2 pin connector for measurement of transmitter voltage.

P5 2 pin connector for measurement of transmitter current.

P6 Optional 14 pin digital I/O connector.

P7 12VDC power input jack connector. (+=Center)

CJ1 RJ45 connector for RS232 serial communication to host.

1.4.2 LEDs

D3 Transmit indicator (green).

D5 Receive indicator (yellow).

D6 +5V (red).

D7 +9V (red)

D29 Transmit indicator (green).

D30 Squelch indicator (yellow).

1.4.3 Jumpers

J1 Transmit selector: (MT/CONT/OFF)

J3 Transmitter modulation selector: (MT/CONT/OFF)

J4 Antenna selector:
Normal Transmission to antenna/50Ω load at transmitter output (maintenance only).

J5 Transmitter carrier selector: (MT/CONT/OFF)

J7 Optional connection to external SAM.

1.4.4 Tuning Capacitors

C7 Transmitter tuning.

C13 Antenna matching variable capacitor VCp

1.4.5 Test Points

TP5 Squelch measuring point.
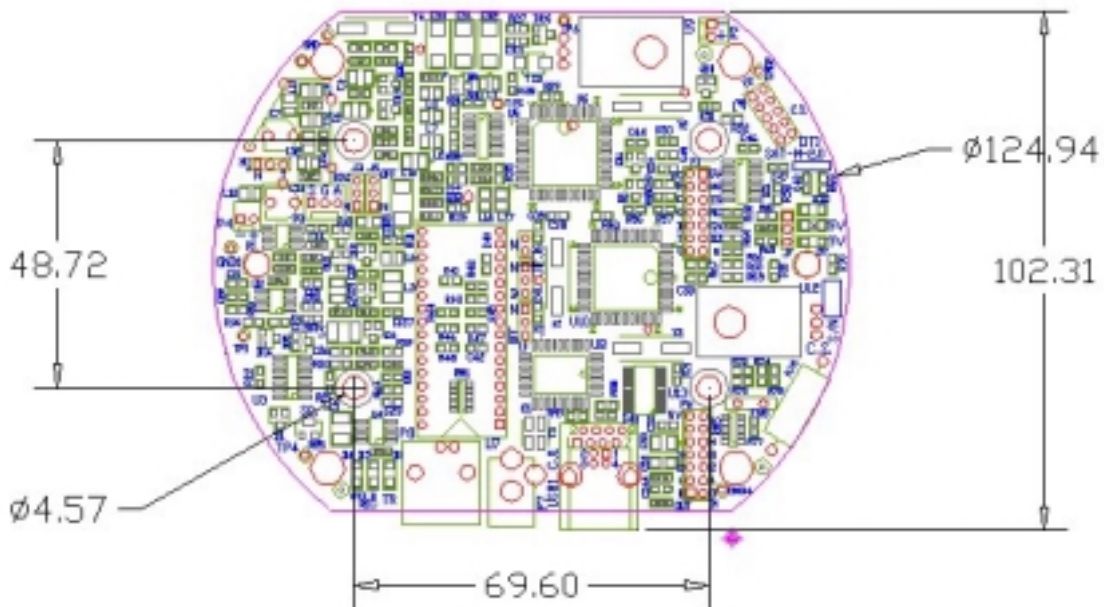
TP6 Received data input to µP measuring point.

1.4.6 SAM

SAM Secured Applications Module.

2. PCB Mechanical Installation

2.1 PCB Mounting Dimensions

All dimensions are in millimeters

Figure 2-1: PCB Mounting Drawing

2.2 PCB Mounting Instructions

2.2.1 Enclosure

The SATURN OEM Reader should be mounted in a protective enclosure. The Reader Board has 4x4.57 mm diameter mounting holes. If mounted on a metallic surface, spacers are required to prevent contact between the Reader Board and the metallic surface.
The reader can be mounted directly on to the main controller motherboard. For this option, the pins of connectors P1and P6 can be connected to the bottom of the board to enable piggyback mounting of the reader PCB.
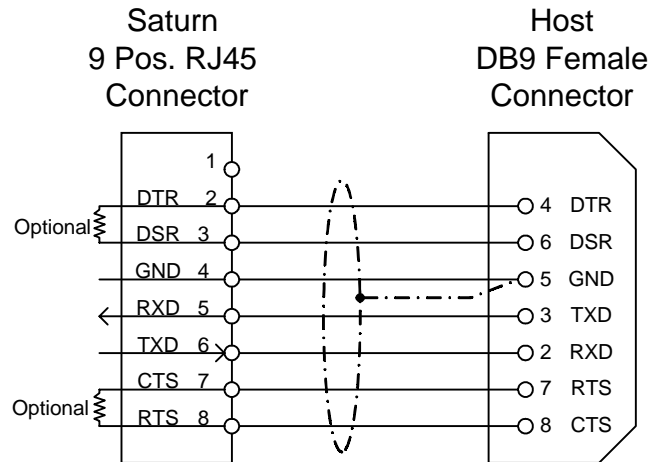
2.2.2 Ventilation

The SATURN OEM Reader Board does not require ventilation for component cooling purposes.

3. Interface Connections

3.1 Communication Connectors

3.1.1 RS232 Serial Interface connector CJ1

Figure 3-1: RS232 Serial Interface connector CJ1

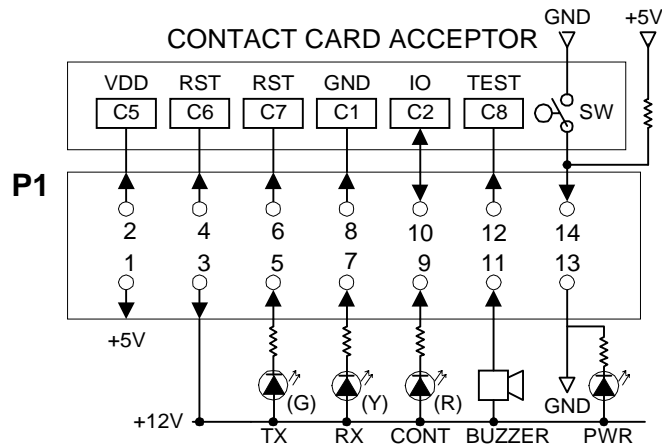**CJ1** RJ45 type connector for RS232/TTL serial communication to Host.

Note: CTS is shorted to RTS and DTR is shorted to CD on the SATURN PCB.

3.2 Digital IO Connectors

3.2.1 Antenna Board Connector P1

Figure 3-2: Antenna Board Connector P1

Pin 1 - +5Vdc out.
Pin 3 - +12Vdc out. Output common
Pin 5 – Transmit LED output. (Sink)
Pin 7 – Receive LED output. (Sink)
Pin 9 – Contact card in place indicator. (Sink)
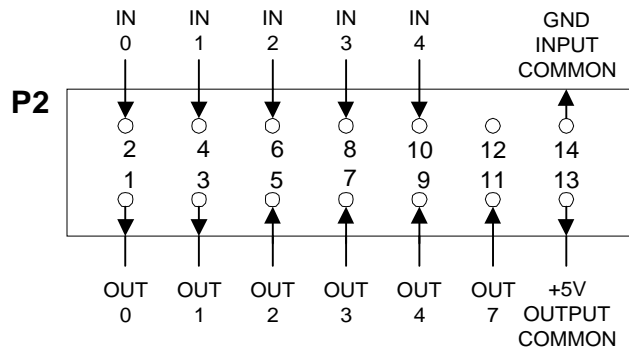*Pin 11* – Buzzer output. (Sink)
Pin 14 - GND.
Pins 2,4,6,8,10,12, – Connections to contact card acceptor.
Pin 14 – Input from "contact card in place" indicator switch.

3.2.2 Optional I/O Connector P2

Figure 3-3: I/O Connector P1

Pins 1,3,5,7,9, - Programmable digital outputs 0 to 4. (Sink)
Pin 11 - Programmable digital output 7. (Sink)
Pin 13 – +5V (output common).
Pins 2,4,6,8,10 – Programmable digital inputs 0 to 4. (Sink)
Pin 12 – Not connected.
Pin 14 – GND (input common).

3.3 Power Connection

3.3.1 Power input Jack P7
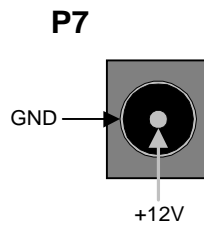
Figure 3-4: SATURN Power Input Jack

Power supply to the SATURN OEM reader is made via 2.5mm input jack P7.
(+V connected to center pin)

4. Jumper & Mode Settings

4.1 Transmission Jumper J1

1) N position - normal microprocessor controlled data transmission.
2) Off position - no RF signal.
3) No jumper - constant RF signal.

4.2 Transmission Modulation Jumper J3

1) Normal position (N) - normal microprocessor controlled data modulation.
2) 80% position (OFF) – Carrier level at 80%.
3) No jumper – Carrier level at 100%.

4.3 Antenna Jumper J4

1) Normal position (N) - transceiver connected to antenna.
2) Resistor position - transceiver connected to 50Ω load.
3) No jumper - Transceiver disconnected.

4.4 Transmitter Carrier Jumper J5

1) Normal position (N) - normal microprocessor controlled carrier transmission.
2) Off position - no carrier transmission.
3) No jumper - constant carrier transmission.

4.5 Normal Operation Jumper Settings

1) Jumpers J1, J3, J4 and J5 should be placed in N position

4.6 Selection of Operating Mode and Baud Rate

The operating system mode and baud rate settings may be changed during operation by transmitting the following ASCII strings:

1) MODE0 - switches from Host Mode to OEM Mode.
    MODE0 $\rightarrow$ Response M0

2) MODE1 - switches from OEM Mode to Host Mode.
    MODE1 $\rightarrow$ Response M1

3) BAUD0 - switches to 9600-baud rate.
    BAUD0 $\rightarrow$ Response B0

4) BAUD1 - switches to 19200-baud rate.
    BAUD1 $\rightarrow$ Response B1

5. Flash Memory Programming

5.1 Introduction

The SATURN OEM reader's program is stored in it's non volatile Flash Memory. Application versions and updates to the SATURN OEM reader's program, may be written only at OTI.

The application versions and updates can be programmed into the SATURN OEM reader's Flash memory by the customer through use of the Flash Memory Programmer software, described in the following paragraphs.

5.2 PC requirements

■ Flash Memory Programmer software runs on Windows 95 or Windows NT 32bit operating systems.

■ PC should be at least a 486 DX2.
Program loading time depends on the speed of PC.

5.3 Programmer Software Installation

1. Run the setup.exe file from diskette No. 1.

2. Follow the instructions on the PC screen.

5.4 Hardware Setup

1. Connect RS232 cable between PC and SCI interface.
Note: DTR and DSR as well as CTS and RTS in the PC connector should be shorted. For 25 pin D type connector, short between 4 & 5 and between 6 & 20. For 9 pin D type connector, short between 4 & 6 and between 7 & 8.

2. Apply power to the reader

5.5 Programming

5.5.1 Flash Memory Files

The flash memory files, written at OTI can be loaded into the PC from diskettes or through the Internet.

The prefix of the flash memory files is SCI5, followed by a four-character application code, followed by the date.

5.5.2 Programming Procedure

1. Run the Flash Programmer software

2. Choose the communication port

3. Press the "Load" button.
   A dialogue window opens,

4. Select the file to be programmed into the SATURN OEM reader.
   The selected file is validated as an SCI5flash memory file.

5. Press the "Program" button.
   The programmer will start programming the selected file into the flash memory.
   If the SATURN OEM reader is already programmed, the programmer will issue a warning and wait for an approval to continue by pressing the "yes" button
   The system automatically finds and switches to the fastest Baud rate possible.

6. After programming the file into the flash memory, the programmed file is verified, and a " valid version" flag in the SATURN OEM reader's memory is set.

7. The SATURN OEM reader is ready to operate with the new program file.

5.6 Help

A comprehensive Help section provides the user with detailed explanations regarding the operation of the Flash Memory Programmer software.