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Advan Tag Reader Application Note

OVERVIEW

The Advan Tag Reader ATR 9000 (Figure 1) is part of Asyst's radio-frequency auto ID system, *Advan Tag,* which conforms to SEMI standard E99. It is a device that reads and writes to Asyst MicroTags (Figure 2) which are embedded in wafer cassettes, pods, FOUPs, reticle boxes, etc. The main component of this unit is a transmitter that generates radio waves through an antenna. This low-frequency (134.2 kHz), low-power RF energy is used to read from or write to a transponder near the antenna. The RFID Reader/Writer also provides serial communication with a host through an RS-232 port, using either SECS or ASCII protocols. Power is supplied by an external source.

This unit is designed for versatile installation in many different situations; it can be installed within OEM tools, or within loadports, or inside stockers, or on tabletops, etc. Simply connect a power source, an external antenna and a communication cable. Then set the reader's address (TargetID and DeviceID as described below in COMMUNICATIONS) and start sending Stream 18 SECS messages or ASCII messages (depending on the protocol being used).

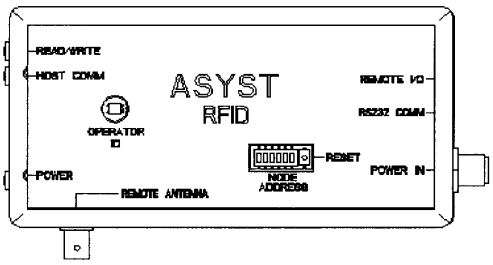

Figure 1.

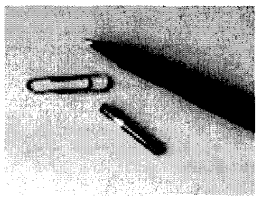

Figure 2.

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DESCRIPTION

The Reader unit is approximately 6.7" (170 mm) x 3.35" (85 mm) x 1.38" (35 mm). There are four external ports.

- The port labeled POWER IN is for a power supply of 12VDC-24VDC. Asyst can supply a 120V adapter (see Table 1) or the OEM can supply this power.
- The port labeled RS232 COMM is for RS232 communication. A cable which connects the Reader to a PC is available from Asyst (see Table 1).
- The port labeled REMOTE ANTENNA is for an external antenna. See Table 1 for available antennas.
- The port labeled REMOTE I/O is for an external presence sensor.

There are three LEDs to signify activity, an operator ID sensor, a RESET button, and a switch panel for specifying the unit's address (TargetID). See below for more details. On the back, there are four M3-.5 x 25mm holes that can be used for mounting. An installation kit for mounting the unit to an Asyst 300mm Frontload is available and listed in Table 1.

DETAILS

POWER IN: 5-pin circular style receptacle, 12-24VDC (+/- 10%), 140mA typical, 750mA maximum.

Pin	1	2	3	4	5
Signal	Drain (N/C)	V+	V-	CAN-H	CAN-L

RS232 COMM: Shielded RJ45 socket.

Pin	4	5	6
Signal	Ground	Tx Data	Rx Data

REMOTE ANTENNA: BNC socket; please use only Asyst antennas (see Table 1).

REMOTE I/O: Shielded RJ45 socket; for external presence sensor.

Pin	1	2	4
Signal	12-24 VDC+	Presence	Ground

POWER LED:

OFF	GREEN
no power	power on

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READ/WRITE LED:

OFF	GREEN	RED	AMBER
radio off	successful read/write	read/write failure[1]	communication error[2]

[1]Due to MicroTag not present or out-of-range.
[2]Due to:

- the MicroTag page being locked, or
- attempted to read multiple pages of a single-page MicroTag, or
- multiple MicroTags are in range, or
- attempted a write operation on a read-only MicroTag.

HOST COMM LED: Green/Red/Amber, controllable by host command (on/off/blinking).

OPERATOR ID: Optical presence sensor for detecting an operator and initiating an antenna read; the antenna read may be disabled through an attribute setting.

RESET: Press this button to reset the unit. This will set the baud rate to 9600 and the SECS DeviceID to match the TargetID.

NODE ADDRESS: Used to specify the unit's address or TargetID. The switches represent powers of binary digits: switch 6 = 1, switch 5 = 2, switch 4 = 4, switch 3 = 8, switch 2 = 16, switch 1 = 32. The ON setting represents 0 and the OFF setting represents 1. For example, to set the address to '3', set switches 5 and 6 OFF and the rest ON.

COMMUNICATIONS

Please refer to the specific protocol documentation concerning either Stream 18 SECS messages or Asyst ASCII messages for details. The basic functions available are to read and write attributes, read and write material IDs (MIDs), read and write data, and various subsystem commands such as turning an LED on or off. Note that the single-page transponders hold an 8 byte MID only and the multi-page transponders hold a 16-byte MID and 120 bytes of data.

The TargetID (as described in the SEMI E99 and E5 standards) can be set with the NODE ADDRESS switches; default value is 3. The SECS I DeviceID can be set through an attribute or the Reset button. When Reset, the DeviceID is automatically changed to match the TargetID; the baud rate will be changed to the default 9600 as well. The baud rate can also be set through an attribute setting. Byte format is 8 data bits, 1 stop bit and no parity. The SECS I timeouts and retries can be set through attribute settings; defaults are T1 = 0.5 secs, T2 = 10 secs, T3 = 45 secs, T4 = 45 secs, Retries = 3.

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COMPONENTS AVAILABLE

Table 1 lists the Advan Tag components that are currently available from Asyst and their part numbers.

Table 1

Component	Part No.
Advan Tag Reader (SECS protocol)	9700-6584-01
120V Power adapter	9700-6697-01
RS232 Cables to PC (DB9F)	9700-4859-01/05/10/20/30 (length in feet)
RS232 Cables to SMART-Comm	9700-7008-05/10/15/20/30 (length in feet)
RS232 Cable to SMART-Comm w/ power	9700-7009-05/10/15/20/30 (length in feet)
Coil Antenna, metallic environment (Asyst Frontload) w/ 6' cable	9700-6225-01
Tubular Antenna, non-metallic environments w/ 6' cable	9700-6224-01
Tubular Antenna, metallic environments w/ 6' cable	9700-6224-02
Single-page glass MicroTag	1420-214
Multi-page glass MicroTag	1420-210
Single-page card MicroTag	1420-211
Mounting Kit for 300mm Frontload (includes a Reader)	9700-6699-01

ADDITIONAL INFORMATION

If you require additional information or have questions regarding STS compatibility, please contact the SMART-Traveler System Product Marketing group at (800) 345-7643.

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RFID
Product Design Specification

10/25/99
Rev. XX

PRELIMINARY

1. SYSTEM ARCHITECTURE

A modular architecture is used so that the system is adaptable to each application, yet uses only a few standard components. In contrast to the previous generation RFID system (FlouroTrac), this system is not confined to fixed numbers of readpoints. Instead the system uses the modular concept to provide expandability from one to 64 readpoints.

The primary components are the Radio Frequency Node (RFN), the Multiple Readpoint controller (MRP), the antenna, and the presence sensor. These components provide all the functionality for single or multiple readpoint configurations. Additional functionality may be added later by designing new components that utilize the system's Controller Area Network (CAN) bus. The CAN bus also allows the RFID system to easily integrate with new Asyst products which will incorporate a CAN bus.

Figure 1.1 shows a typical single readpoint configuration. The RFN along with an antenna and presence sensor create a stand-alone single readpoint with SECS, FTRP, or DeviceNet protocols available for communications to the host. If the HSMS protocol is required, a MRP module would be added to the system.

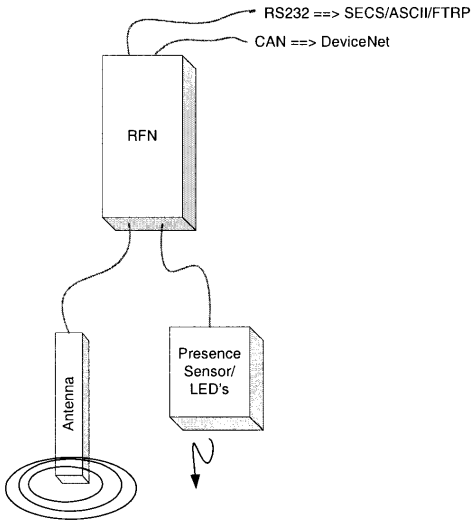

Figure 1.1: A typical single readpoint configuration

Figure 1.2 show a typical multi-readpoint configuration. The MRP is added and the CAN bus is used to network all the RFN's together. When a CAN equipped Asyst I/O product

is available in the future, multiple readpoints can be connected directly to the equipment's CAN bus and the MRP would not be need for that configuration.

For backward compatibility and certain applications, it is desirable for one antenna to read two different sources (i.e. a pod and an operator ID card). This capability will be achieved by providing two presence sensor inputs on the RFN.

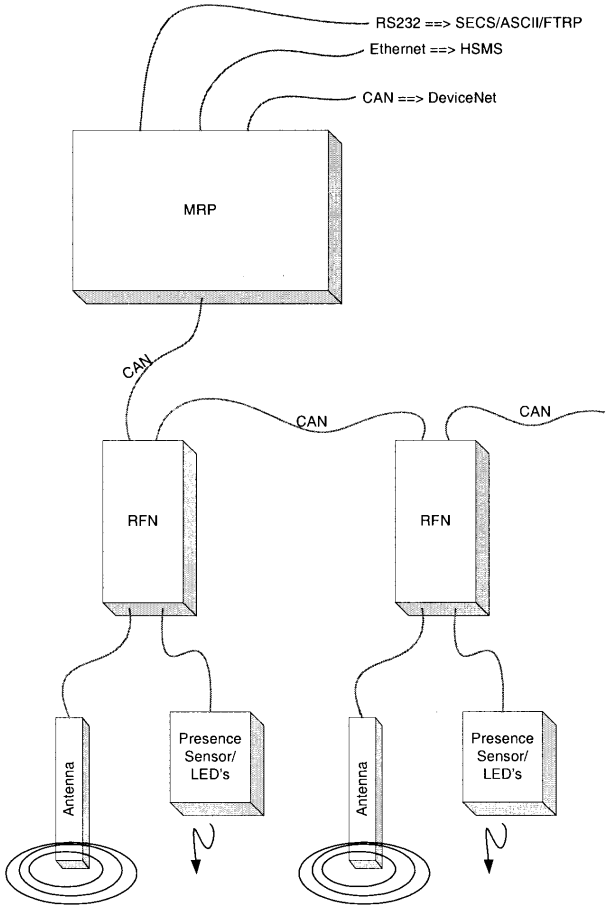

Figure 1.2: A typical multi-readpoint configuration

2. ELECTRICAL SPECIFICATIONS

RFN

The Radio Frequency Node (RFN) is the basic RFID readpoint for both single and multiple readpoint systems. In single readpoint applications, the RFN is a standalone readpoint that reads and writes the tags, detects the presence of pods or operator ID cards, and communicates with the host. When the RFN is used in multiple readpoint applications, all RFN's are networked to an MRP using the CAN bus. The functional blocks of the RFN are the microcontroller, RFID radio and the presence sensor/LED interface.

Table 2.1: RFN Specifications

Tag Compatibility	TIRIS R/O and R/W
Power	24V
Size	5"x1.5"x1" (estimate)
Processor	8051 type microcontroller
Communication Physical Layers	RS232 and CAN
Sensors/LEDs	Connector for external (2 sensors and 3 LED's)

Microcontroller

The RFN will be based on an 8051-type microcontroller using external program and data memory. The DS80C323 has been chosen because of Asyst's previous experience with this device. The microcontroller will operate from 5V and will run at 16MHz, which is 89% of its maximum clock rate. The 8051's two on-chip UART's will be used for RS232 host communications and for communication to the RFID radio module. An 82527 CAN controller will connect via to the 8051's multiplexed bus to provide the CAN communication.

Memory

Program memory will consist of 1Mb of SRAM to provide 128KB of data space. The 8051 architecture only allows access of up to 64KB of program space, so a paged memory scheme will be used to access the entire 128KB. Page selection will be implemented using one I/O pin from the 8051. In order to allow for code upgrades via CAN or RS232 downloads, the program and data memory will need to be swapped via software control. Programmable logic driven by an I/O pin from the 8051 will perform the memory swap. This technique has been used successfully on the ST-8400 tag.

Configuration Data

The RFN will contain a 1Kb serial EEPROM which will be to store configuration data. The will access the EEPROM for reading and writing by using three I/O pins.

Table 2.2: RFN Microcontroller specifications

MCU	DS80C323
Program memory	64KB FLASH
Data memory	128KB SRAM
Config. memory	128Bytes EEPROM
Radio interface	on-chip UART
RS232 host interface	on-chip UART
CAN host intake	82527
Clock speed	16MHz

Interface Logic

Several IC interfacing functions are required to complete the control electronics. These functions are:

1) Demultiplex the 8051 bus to interface with the non-multiplexed SRAM and Flash buses.
2) Create I/O space to map the CAN registers to so that memory space is not used.
3) Create additional general purpuse I/O's in the I/O space.
4) Create a paging mechanism to access all 128KB of SRAM from the 8051's 64KB memory space.

All of the this functionality will be implemented with a Flash CPLD. The Flash technology allows in-circuit programmability which facilitates development, production, and field upgrades of the CPLD code.

MAC ID and Network Termination

An eight position DIP switch will be used to set the DeviceNet MAC ID and select 120Ohm network termination resistor. Positions one through six will represent the binary digits of the MAC ID, giving 64 possible ID's. The eighth position will select the network termination resistance. If the RFN is the node of a CAN network than switch eight should be turn on, otherwise it should be off.

Radio

The RFID radio will initially read and write TIRIS tags since this is currently the most popular tag in the industry. The radio portion of the RFN will be on a detachable module to facilitate radio changes as the industry evolves. The TIRIS Microreader is a popular TIRIS radio with an appropriate form-factor, however the Microreader probably cannot achieve the desired read range with an acceptable antenna size. If this is the case, a custom radio will be built. It will maintain the Microreader form-factor and pinout so

that the Microreader could be used if desired. The radio will interface to the 8051 using asynchronous serial communications and protocol compatible with the Microreader.

The custom radio module would be based on the TIRIS radio ASIC, RI45538NS. This ASIC handles the transmit logic, the receiver amplification and the receiver demodulation. The remaining components to complete the radio module are the tuning circuitry, the transmit amplifier, and a small microcontroller to provide the serial interface to the 8051. A Microchip PIC16C621 is a good choice for the microcontroller since it is low-cost and contains on-chip RAM, ROM, and UART. This is the same microcontroller used by the Mircoreader.

Table 2.3: Radio Module Specifications

Tag Compatibility	TIRIS R/O and R/W
Size	1.2"x1.5"x0.25" (Microreader Compatible)
Power	5V, ??A
Frequency	134.2KHz
Host interface	Asynchronous serial
Protocol	MicroReader Compatible

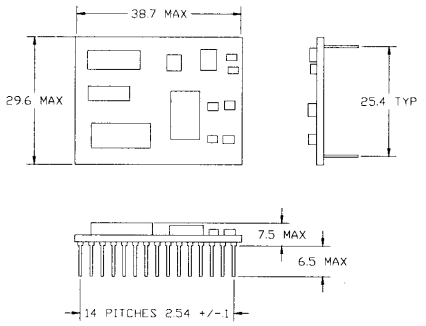

Figure 2.1: Radio module dimensions

Presence Sensor and LED Interface

The RFN will read up to two presence sensors to initiate a read and/or notify the host. Three status LED's will provide visual feedback of the RFN's operation. The presence sensors and LED's will be built as separate module that connects to the RFN with a single cable. The RFN's presence sensor input will be TTL compatible with weak pull-ups so it can be used with a variety of presence sensors technologies. The status light

output circuitry will have transistor switches and current limiting resistors so that LED's can be driven directly from the output signal.

ANTENNA

If possible, the radio will be compatible with the current FlouroTrac antennas.

Table 2.4: Antenna Specifications

Inductance	~~1.6uH~~ 4.7μH
Q	~~15-20~~ 10 - 20.

MRP

The MRP connects up to 64 RFN's on a CAN bus, allowing a to access all readpoints with only one communications connection. The MRP will have at least one RS232 port, two CAN ports, and ethernet. This allows the MRP to provide SECS, FTRP, ASCII, DeviceNet, and HSMS protocols for the host communications.

DeviceNet

The MRP will contain three LED's to indicate the status of the CAN bus as specified by the DeviceNet protocol.

Table 2.5: MRP Specifications

CPU	486, 133MHz
Size	2"x6.5"x8"
RAM	16MB
ROM	Minimum 8MB disk-on-chip
Serial ports	2 UARTs
CAN	2 CAN controllers
LAN	Ethernet, 10BaseT
Power	24VDC (optional external P/S for 110VAC operation)

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ASYST TECHNOLOGIES, INC.

Specifications for RFID Antennas
(For Use With Asyst ATR 9000 Readers)

Part Number: 9700-6224-01
Part Description: ASSY,ANT,T2.5,6FT CABLE,RFN
Specifications:
- **Cable length:** 72.0 inches ± 1.0 inches
- **Connector:** BNC
- **Case OD:** 12.7mm ±0.25mm
- **Case Length:** 62mm ±3mm (must be able to fit in a 70mm space including cable bend)

Summary Description: Tubular antenna designed to be attached to the external antenna connector of the ATR 9000 and optimized for use in non-metallic environments (air/plastic). Estimated read range is 4.25". Write range is approximately 50% of read range. Read and write ranges are dependent upon actual installed environment. See figure 2 for picture.

Part Number: 9700-6224-02
Part Description: ASSY,ANT,T2.5,RFN-FL,6' CABLE
Specifications:
- **Cable length:** 72.0 inches ± 1.0 inches
- **Connector:** BNC
- **Case OD:** 12.7mm ±0.25mm
- **Case Length:** 62mm ±3mm (must be able to fit in a 70mm space including cable bend)

Summary Description: Tubular antenna designed to be attached to the external antenna connector of the ATR 9000 and optimized for use in a metallic environment such as a 300mm Front Load. Estimated read range in air is 3.5". Write range is approximately 50% of read range. Read and write ranges are dependent upon actual installed environment. See figure 2 for picture.

Part Number: 9700-6225-01
Part Description: ASSY,ANT,COIL 1.3, 4.5FT CABLE,RFN
Specifications:
- **Cable length:** 54.0 inches ± 1.0 inches
- **Connector:** BNC
- **Coil ID:** 0.525 inches + 0.010 inches, -0.015 inches
- **Coil OD:** 1.30 inches + 0.02 inches, -0.01 inches
- **Coil Height:** 0.220 inches + 0.025 inches, -0.010 inches
- **Cable Jnctn:** 0.375 inches ± 0.125 inches

Summary Description: Coil antenna designed to be attached to the external antenna connector of the ATR 9000 and optimized for use in metallic environments such as a 300mm Front Load. Estimated read range is 3.0". Write range is approximately 50% of read range. Read and write ranges are dependent upon actual installed environment. See figure 1 for picture.

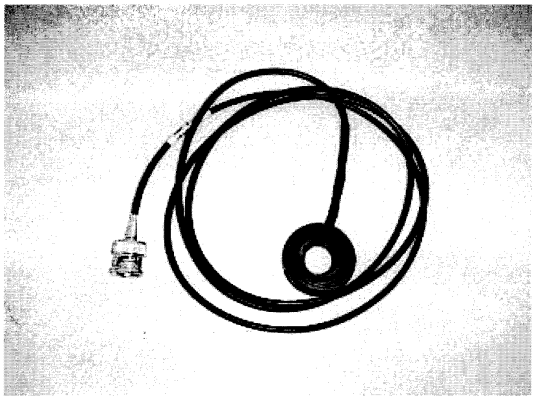

Figure 1 Coil Antenna

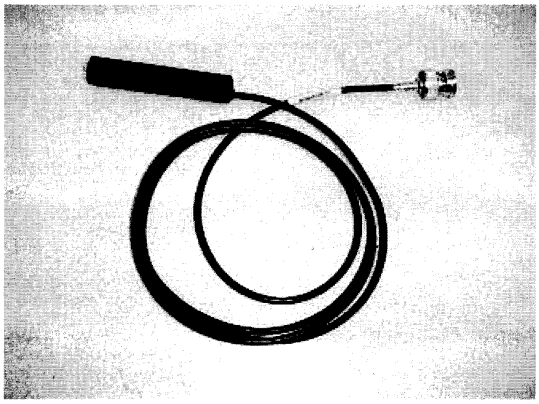

Figure 2 Tubular Antenna