

**Digital Recorders**  
**WIRELESS DATA TRANSFER**

**Operations and  
Maintenance Manual**

**P/N 597-0002-000**

Release 5/15/01

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Printed in the US

**NOTE:** This equipment 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.



**WARNING:** Changes or modifications not expressly approved by Digital Recorders, Inc. may void the user's authority to operate this equipment.



**WARNING:** To satisfy FCC RF exposure requirements for mobile transmitting devices, a separation distance of 32cm or more should be maintained between the antenna of this device and persons during device operation. To ensure compliance, operations at closer than this distance is not recommended.

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To our valued customer;

Digital Recorders is pleased to provide you with this Operations and Maintenance Manual for your Wireless Data Transfer. We hope you will find the information within both useful and informative.

Every effort has been made to ensure the information found in this manual is accurate. If, however, you discover any errors, omissions or have any suggestions for changes or improvements please contact us.

All of us at Digital Recorders wish to sincerely thank-you for choosing the Talking Bus® family of products. We are continually striving to provide the highest quality products available along with the best customer service possible!

We look forward to working with you. If you have any questions you can visit us on the web at [www.talkingbus.com](http://www.talkingbus.com) or contact us at 1-800-222-9583.

***“The Transit Market’s choice for automated voice announcement systems and related products and services.”™***

Yours Truly,

A handwritten signature in black ink that reads "Tanya L. Johnson". The signature is written in a cursive, flowing style.

Tanya L. Johnson  
General Manager and Vice President



## GENERAL INFORMATION

### **1.1 ABOUT THIS MANUAL**

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This manual describes the theory of operation, system components, connections, and checkout procedure for the Digital Recorders Wireless Data Transfer option, which is an add-on to the DR500C 'Talking Bus' product.

### **1.2 ABOUT THE WIRELESS DATA TRANSFER OPTION**

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#### **1.2.1 INTRODUCTION**

The Wireless Data Transfer option enables data to be wirelessly transmitted within a localized area between one or more base-station PC's and vehicle-mounted DR500C 'Talking Bus' units. Depending upon system configuration, data transfer may be one-way (vehicles to PC or vice-versa) or two-way communication. This wireless communication link eliminates the need to physically transport the associated data to and/or from each vehicle via a PCMCIA card or other media.

Wireless communication is provided using 2.4Ghz, Spread Spectrum Frequency Hopping (SSFH) technology. This technology provides high speed, secure, and reliable communication which is highly immune to outside interference.

#### **1.2.3 THEORY OF OPERATION**

In addition to the standard 'Talking Bus' equipment, each Wireless Data Transfer-enabled vehicle contains a 2.4Ghz SSFH wireless modem, antenna, and associated hardware. A localized area on the transit property where the equipped vehicles congregate (such as the vehicle refueling area or garage) is identified and a centralized computer (with wireless modem, antenna, and associated hardware - collectively known as the wireless base-station), is installed at the location. For operational or coverage purposes, there may be more than one base-station installed at each location, or base-stations may be installed at multiple locations such as separate garages.

In a typical vehicle yard there is a consistent manner in which the vehicles arrive for nighttime storage. Each vehicle arrives, one by one, at a fare collection, refueling, and/or washing station where it is serviced for a number of minutes. Afterwards, each continues to a yard or garage where it is parked along side all of the other vehicles and stored for the night.



These two areas (fare/fuel/wash and yard/garage) are typically co-located and within a few hundred yards of each other.

Depending upon system configuration, the two locations described above may combine to define a single large wireless transmission area, or instead be considered two separate communication points, each with a separate base-station or set of stations.

In the case of data download from the vehicle to the base-station (such as AVM data), the data will typically be downloaded at the fare/fuel/wash station area. Where physically possible, the yard/garage storage area may also be included to enable downloads to continue as the vehicles are parked. As each vehicle enters the download area, a full duplex communication link with the base-station is established. Up to four vehicles may communicate with a single base-station simultaneously and at full speed. If four vehicles are in the process of downloading data when additional vehicles enter the area, the entering vehicles are placed in a queue. Additional base-stations may be added to scale the number of simultaneous downloads. A day's worth of AVM data will typically consist of less than 1MB of data, which should complete in under 5 minutes time per vehicle.

If uploading of data (such as route changes) to the vehicles is also configured, then the yard/garage area is defined as a second communication point. A separate base-station is located in this area and dedicated to the data upload to vehicles. In the case of a card update, a large amount of identical information (20+MB) is typically broadcast to each of the vehicles. This upload is accomplished in a cyclical broadcast mode, where the data is transmitted repeatedly over the entire night as the vehicles arrive and are stored, giving each vehicle several opportunities to acquire the entire message. The onboard vehicle equipment is configured to remain powered until completing its download, after which it shuts itself down automatically.

Figure 1 below illustrates the above two wireless locations and the data transfer that occurs at each.

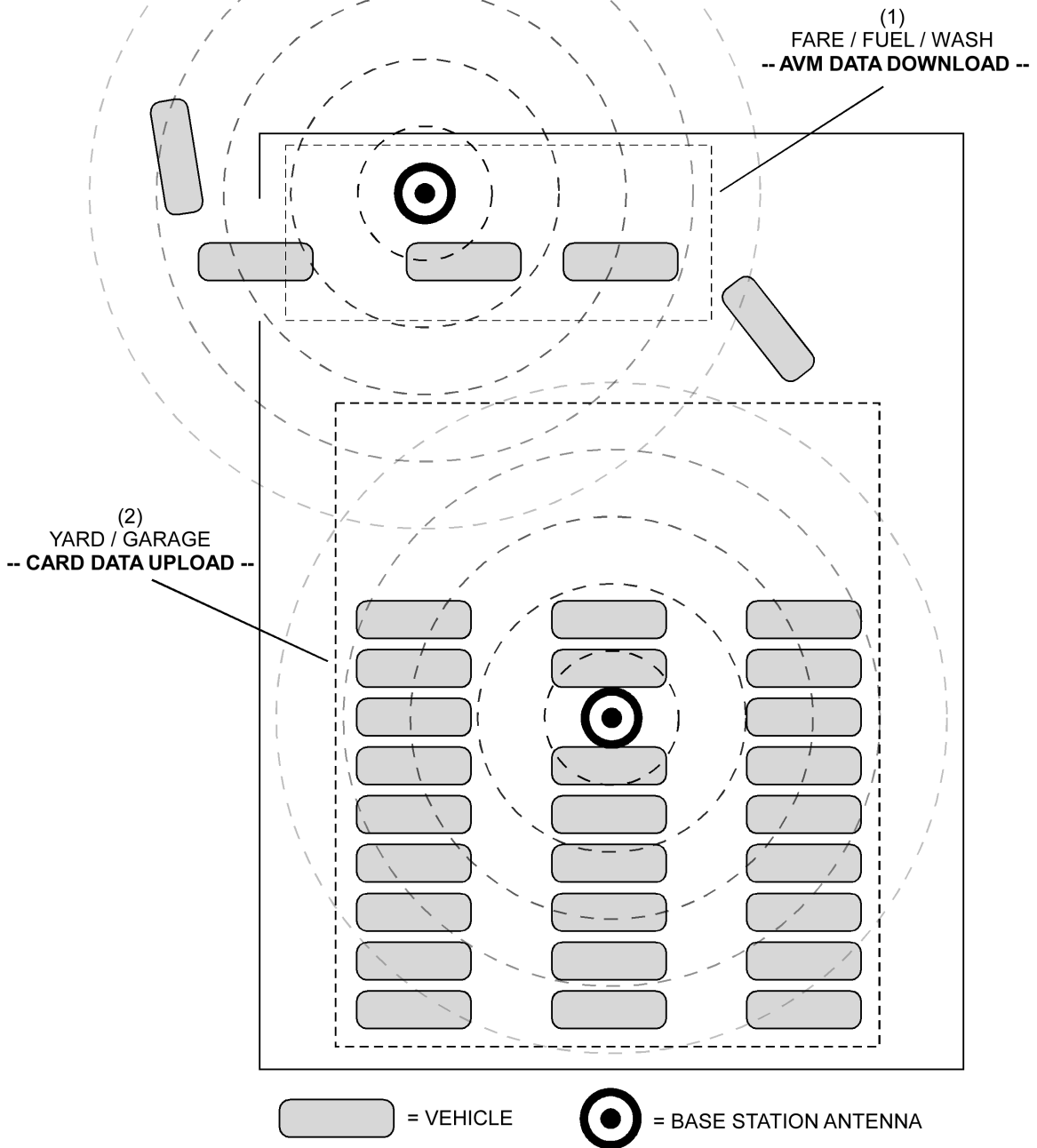


Figure 1: Typical Wireless Base-station configuration.



## COMPONENT LIST & DRAWINGS

### 2.1 INTRODUCTION

This chapter lists the major components of the Wireless Data Transfer Option, and contains drawings for the hardware components. In most cases the equipment will be pre-installed and wired by the vehicle OEM manufacturer, or by a certified Digital Recorders installation technician.

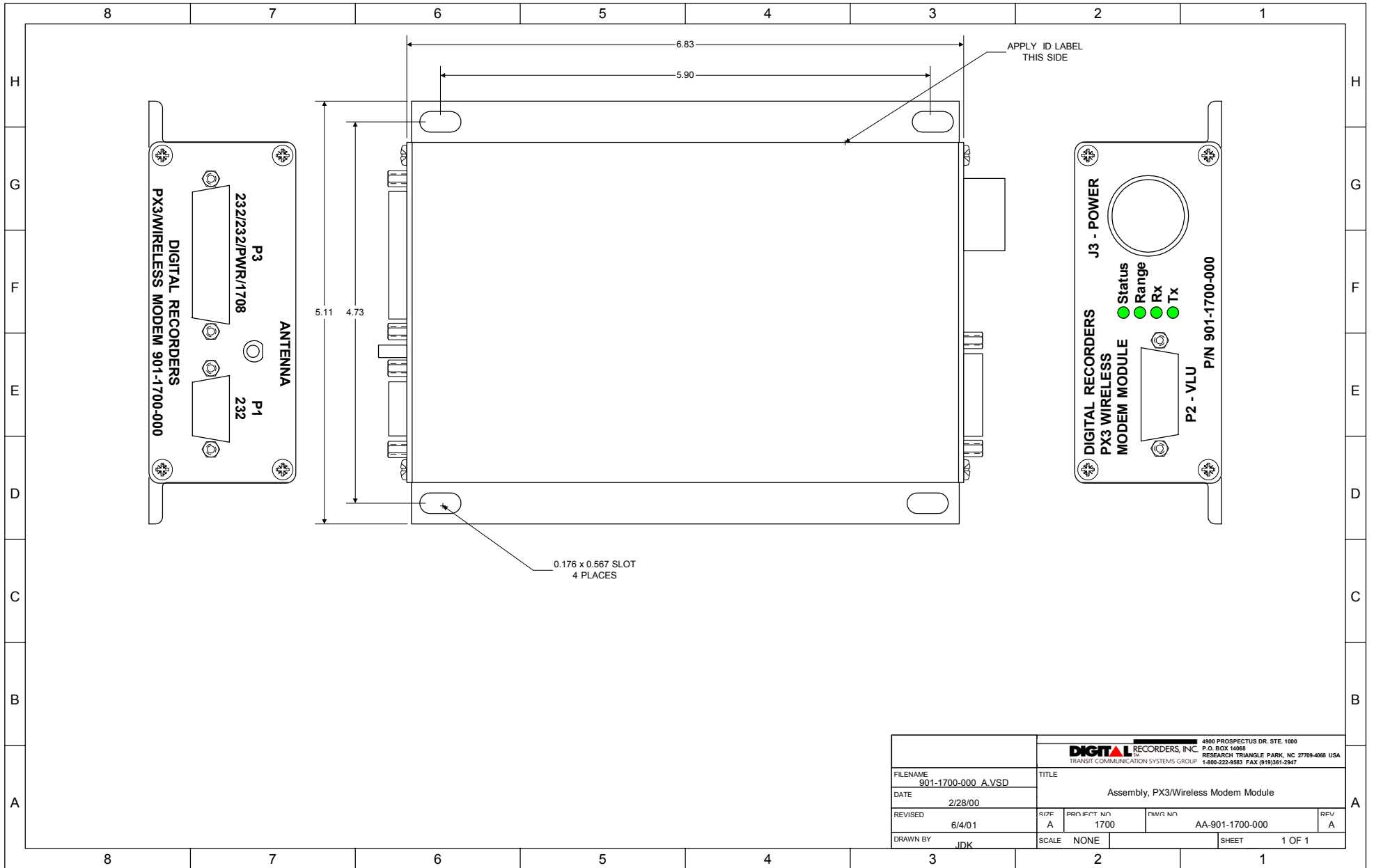
### 2.2 COMPONENT LIST

Following is a list of the major components of the Wireless Data Transfer Option. Complete component list and quantities of each will vary per transit property dependent upon installation, number of vehicles, number of base-stations, etc.

DR PART #	DESCRIPTION
<b>ON VEHICLE</b>	
901-1700-000	Module, PX3 with Wireless
941-5220-000	Cable, PX3 To VLU, Comm
801-5207-000	Antenna Assembly, Vehicle
941-5207-020	Cable, Wireless Modem Antenna
<b>BASE-STATION</b>	
941-5213-000	RS485 Cable, PX3 to Base-station, Comm
801-5210-000	Antenna Assembly, Base-station
290-0003-000	RS485 Adapter, Comm, Async, 1 Port
530-0001-024	Power Block, 24VDC, 10W
530-0002-700	UPS, Triplite 700VA, Omnismart PNP
575-0002-000	Software, Wireless/AVM Bundle
597-0002-000	Manual, Wireless Data Transfer Option

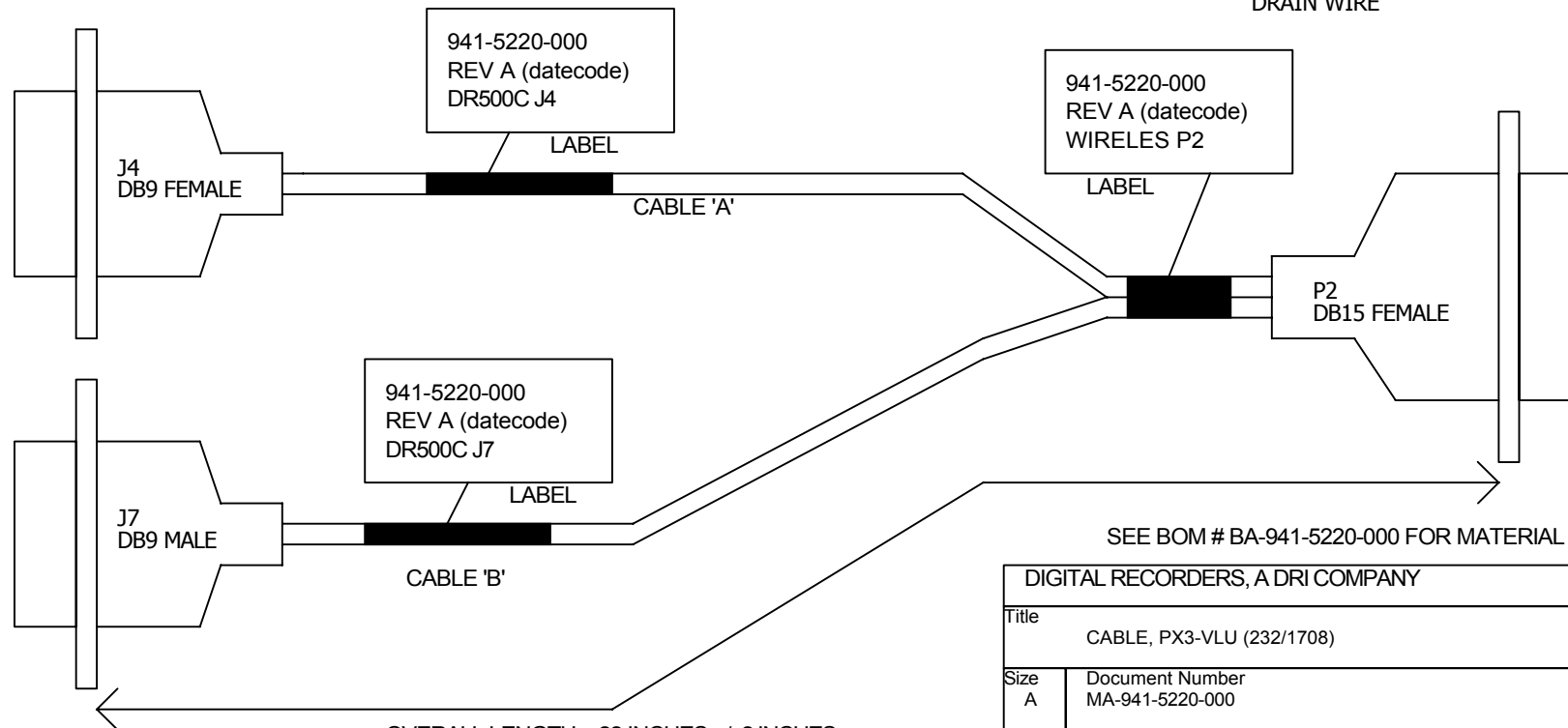
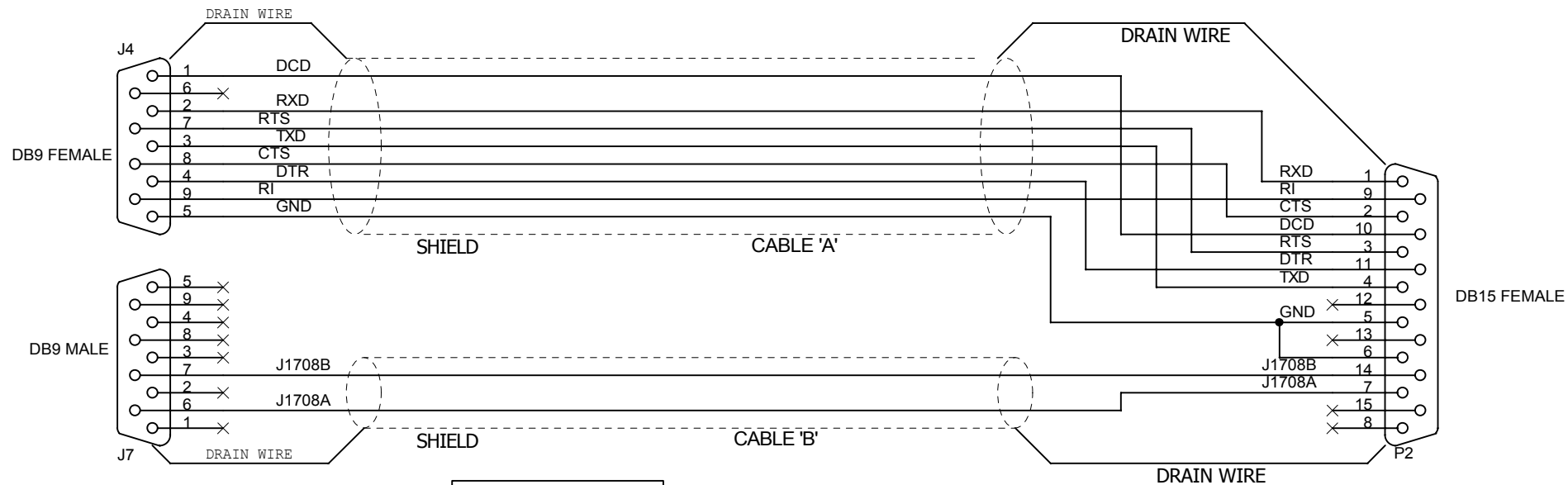
### 2.3 COMPONENT DRAWINGS

Following are sample mechanical drawings for the major hardware components of the Wireless Data Transfer Option. Actual components may vary per transit property dependent upon installation, etc.



		<small>4800 PROSPECTUS DR. STE. 1000 P.O. BOX 14068 RESEARCH TRIANGLE PARK, NC 27709-4068 USA 1-800-222-9583 FAX (919)361-2947</small>	
<b>DIGITAL RECORDERS, INC.</b> <small>TRANSPORT COMMUNICATION SYSTEMS GROUP</small>		<b>TITLE</b> Assembly, PX3/Wireless Modem Module	
<b>FILENAME</b> 901-1700-000 A.VSD	<b>DATE</b> 2/28/00		
<b>REVISED</b> 6/4/01	<b>SIZE</b> A	<b>PROJ. LEAD NO.</b> 1700	<b>FWG. NO.</b> AA-901-1700-000
<b>DRAWN BY</b> JDK	<b>SCALE</b> NONE	<b>SHEET</b> 1 OF 1	

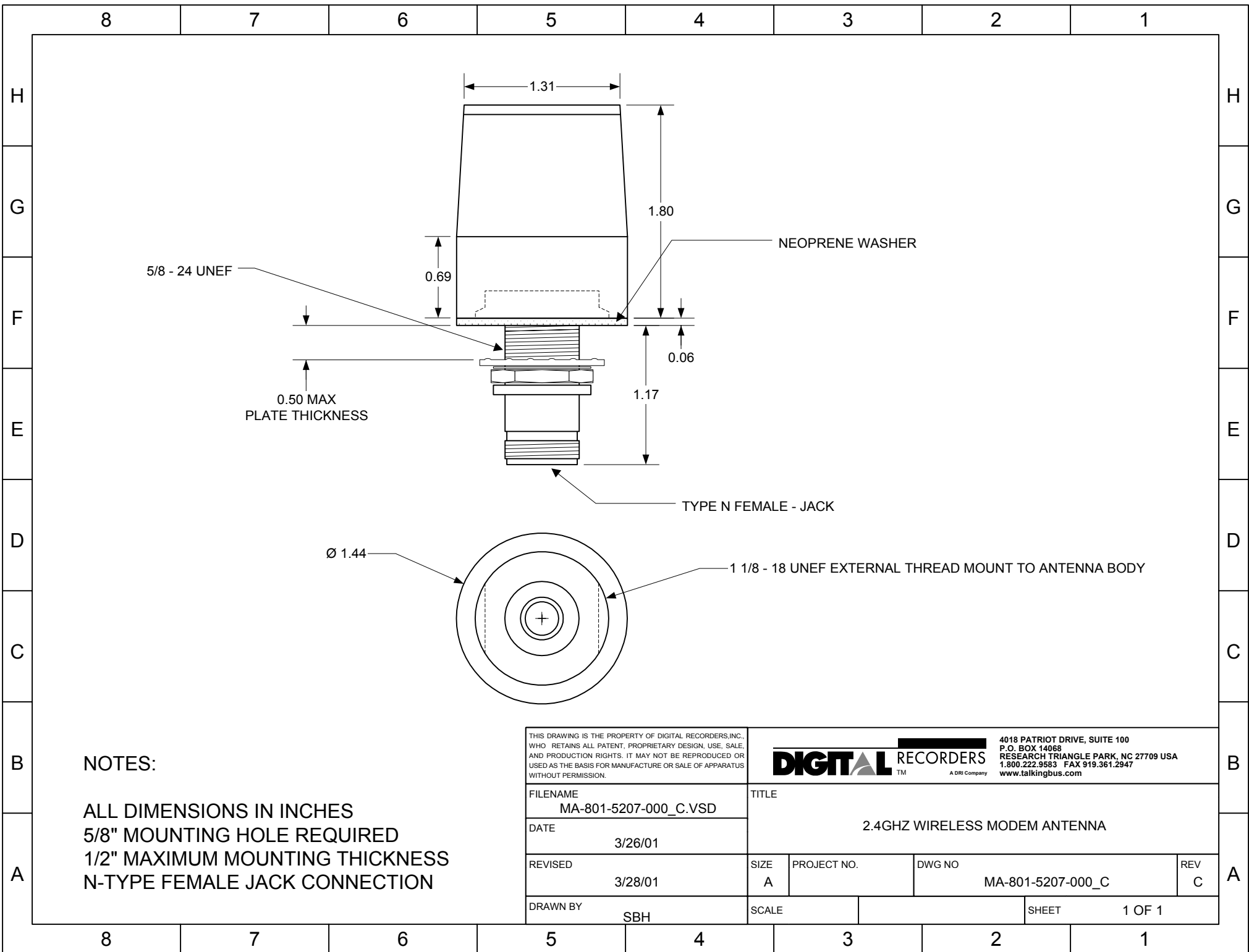




OVERALL LENGTH = 22 INCHES +/- 2 INCHES

SEE BOM # BA-941-5220-000 FOR MATERIAL LIST

DIGITAL RECORDERS, A DRI COMPANY		
Title CABLE, PX3-VLU (232/1708)		
Size A	Document Number MA-941-5220-000	Rev A
Date: Monday, March 26, 2001	Sheet 1	of 1



**NOTES:**

ALL DIMENSIONS IN INCHES  
 5/8" MOUNTING HOLE REQUIRED  
 1/2" MAXIMUM MOUNTING THICKNESS  
 N-TYPE FEMALE JACK CONNECTION

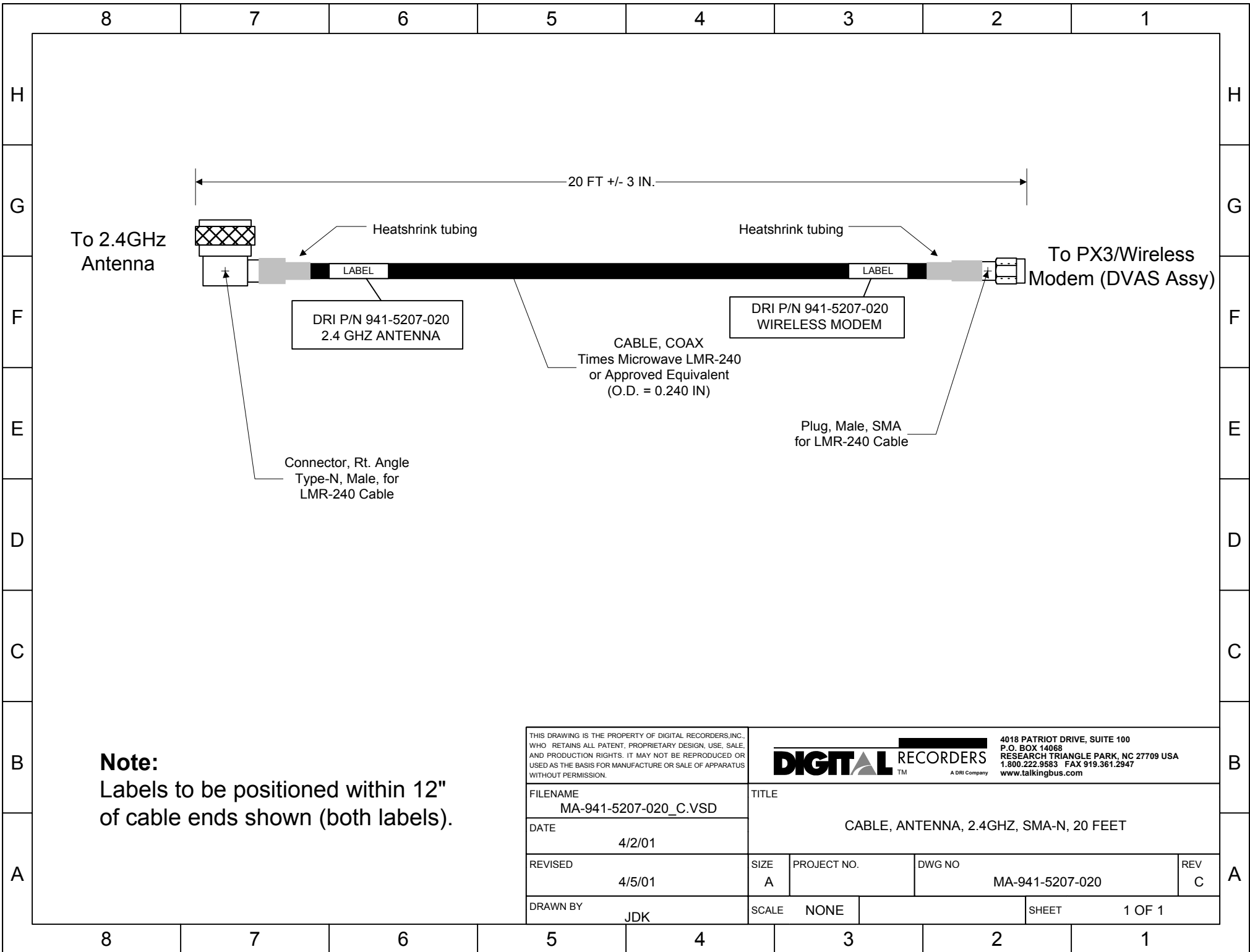
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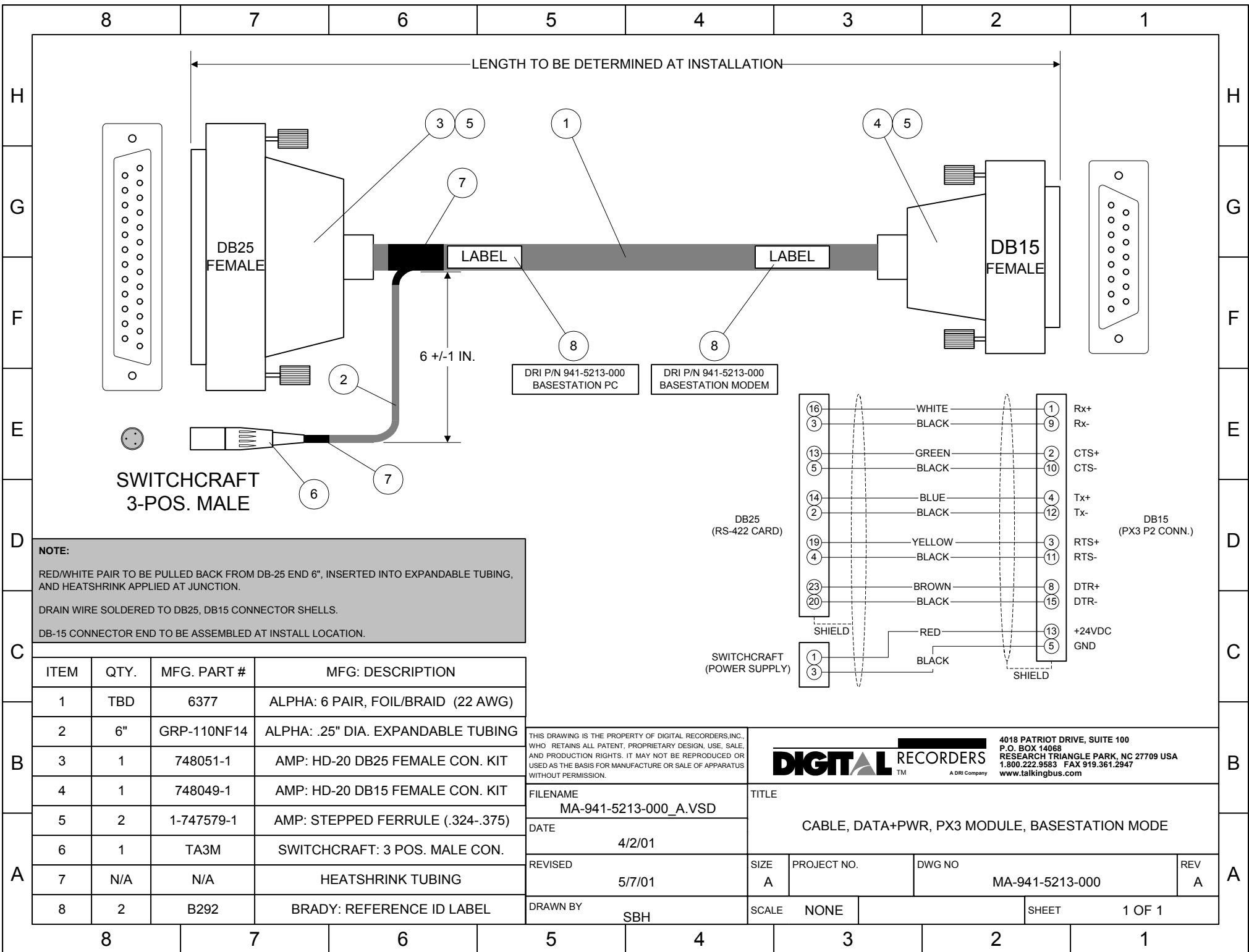
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DATE	3/26/01		
REVISED	3/28/01	SIZE	A
DRAWN BY	SBH	SCALE	

TITLE			
2.4GHZ WIRELESS MODEM ANTENNA			
PROJECT NO.	DWG NO	REV	
	MA-801-5207-000_C	C	
SHEET		1 OF 1	



**Note:**  
Labels to be positioned within 12"  
of cable ends shown (both labels).

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FILENAME MA-941-5207-020_C.VSD		TITLE CABLE, ANTENNA, 2.4GHZ, SMA-N, 20 FEET			
DATE 4/2/01					
REVISED 4/5/01		SIZE A	PROJECT NO.	DWG NO MA-941-5207-020	REV C
DRAWN BY JDK		SCALE NONE	SHEET 1 OF 1		



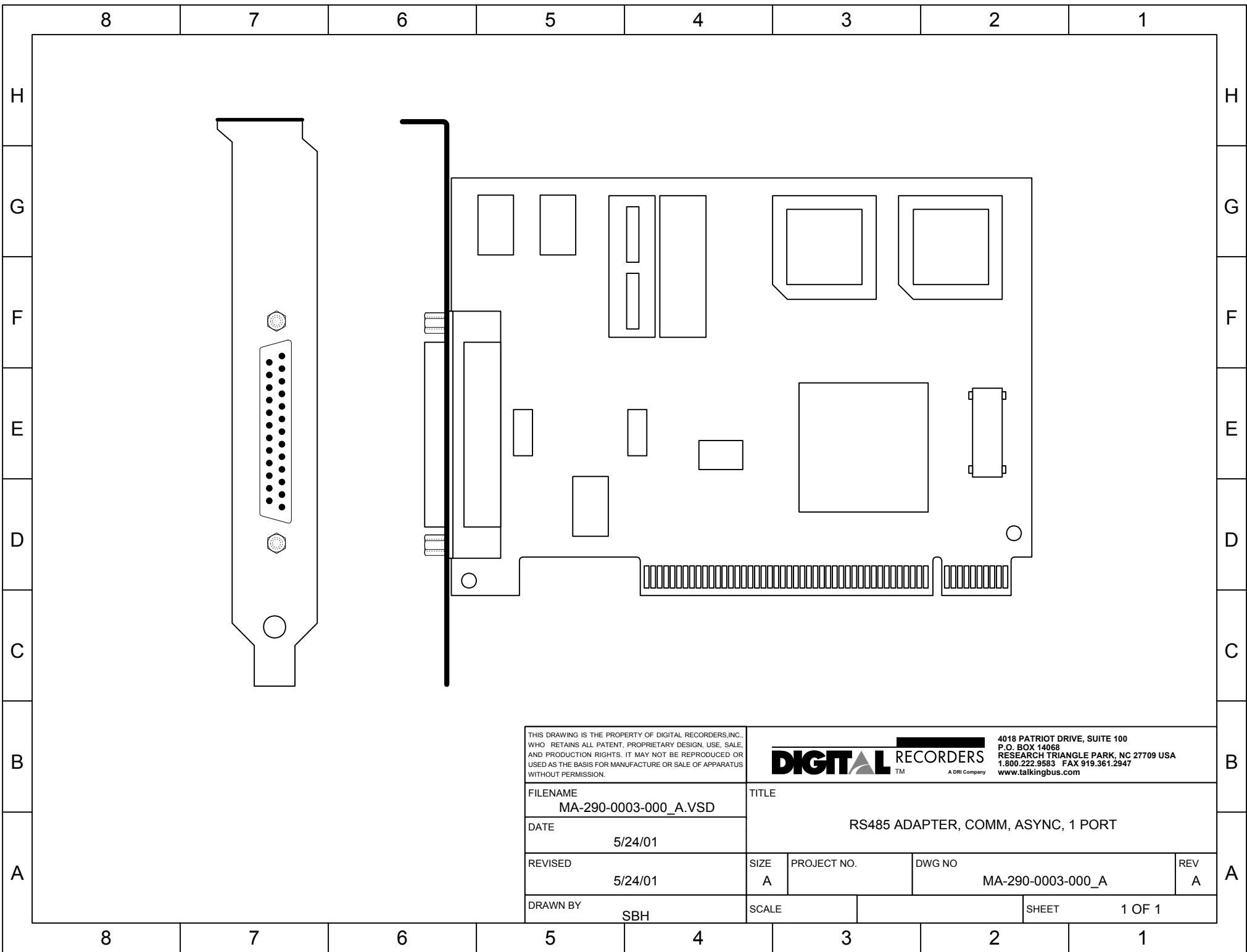
**NOTE:**  
 RED/WHITE PAIR TO BE PULLED BACK FROM DB-25 END 6", INSERTED INTO EXPANDABLE TUBING, AND HEATSHRINK APPLIED AT JUNCTION.  
 DRAIN WIRE SOLDERED TO DB25, DB15 CONNECTOR SHELLS.  
 DB-15 CONNECTOR END TO BE ASSEMBLED AT INSTALL LOCATION.

ITEM	QTY.	MFG. PART #	MFG: DESCRIPTION
1	TBD	6377	ALPHA: 6 PAIR, FOIL/BRAID (22 AWG)
2	6"	GRP-110NF14	ALPHA: .25" DIA. EXPANDABLE TUBING
3	1	748051-1	AMP: HD-20 DB25 FEMALE CON. KIT
4	1	748049-1	AMP: HD-20 DB15 FEMALE CON. KIT
5	2	1-747579-1	AMP: STEPPED FERRULE (.324-.375)
6	1	TA3M	SWITCHCRAFT: 3 POS. MALE CON.
7	N/A	N/A	HEATSHRINK TUBING
8	2	B292	BRADY: REFERENCE ID LABEL

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FILENAME	MA-941-5213-000_A.VSD
DATE	4/2/01
REVISED	5/7/01
DRAWN BY	SBH

		4018 PATRIOT DRIVE, SUITE 100 P.O. BOX 14068 RESEARCH TRIANGLE PARK, NC 27709 USA 1.800.222.9583 FAX 919.361.2947 www.talkingbus.com	
TITLE		CABLE, DATA+PWR, PX3 MODULE, BASESTATION MODE	
SIZE	PROJECT NO.	DWG NO	REV
A		MA-941-5213-000	A
SCALE	NONE	SHEET	1 OF 1



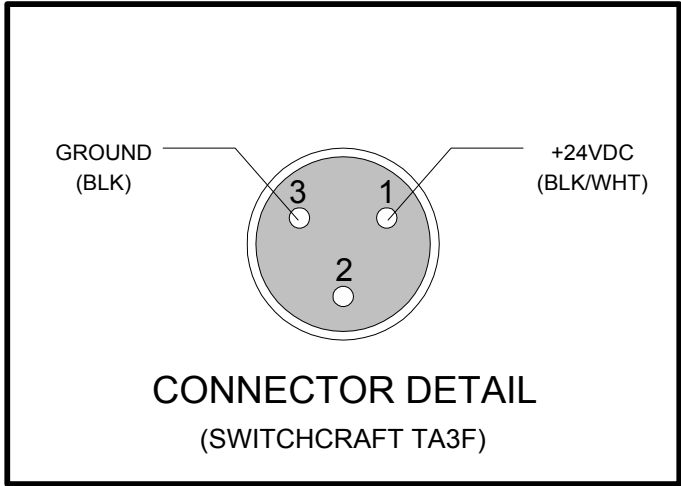
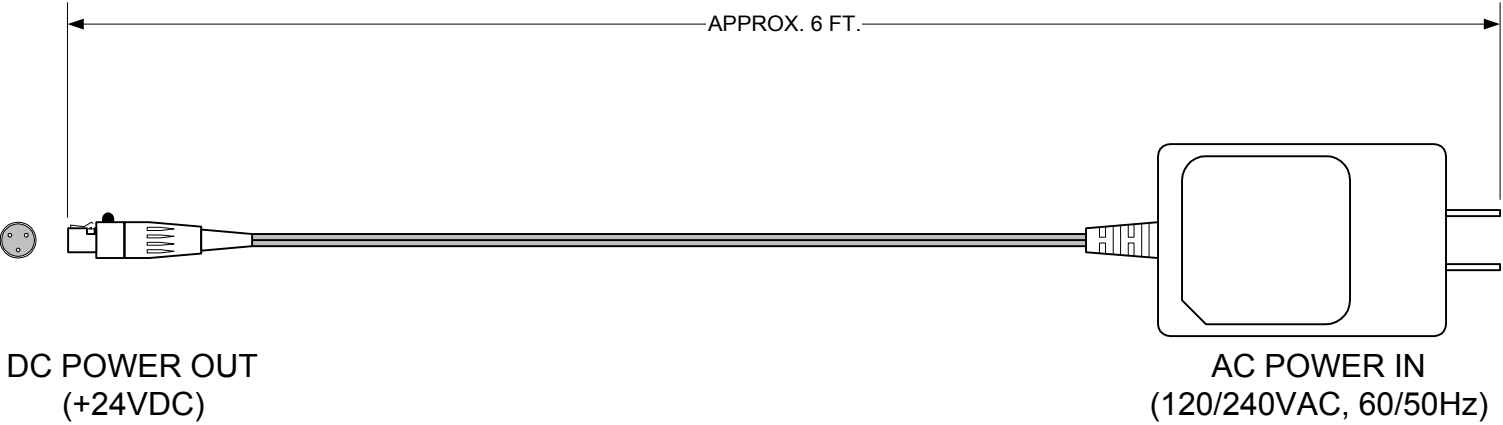
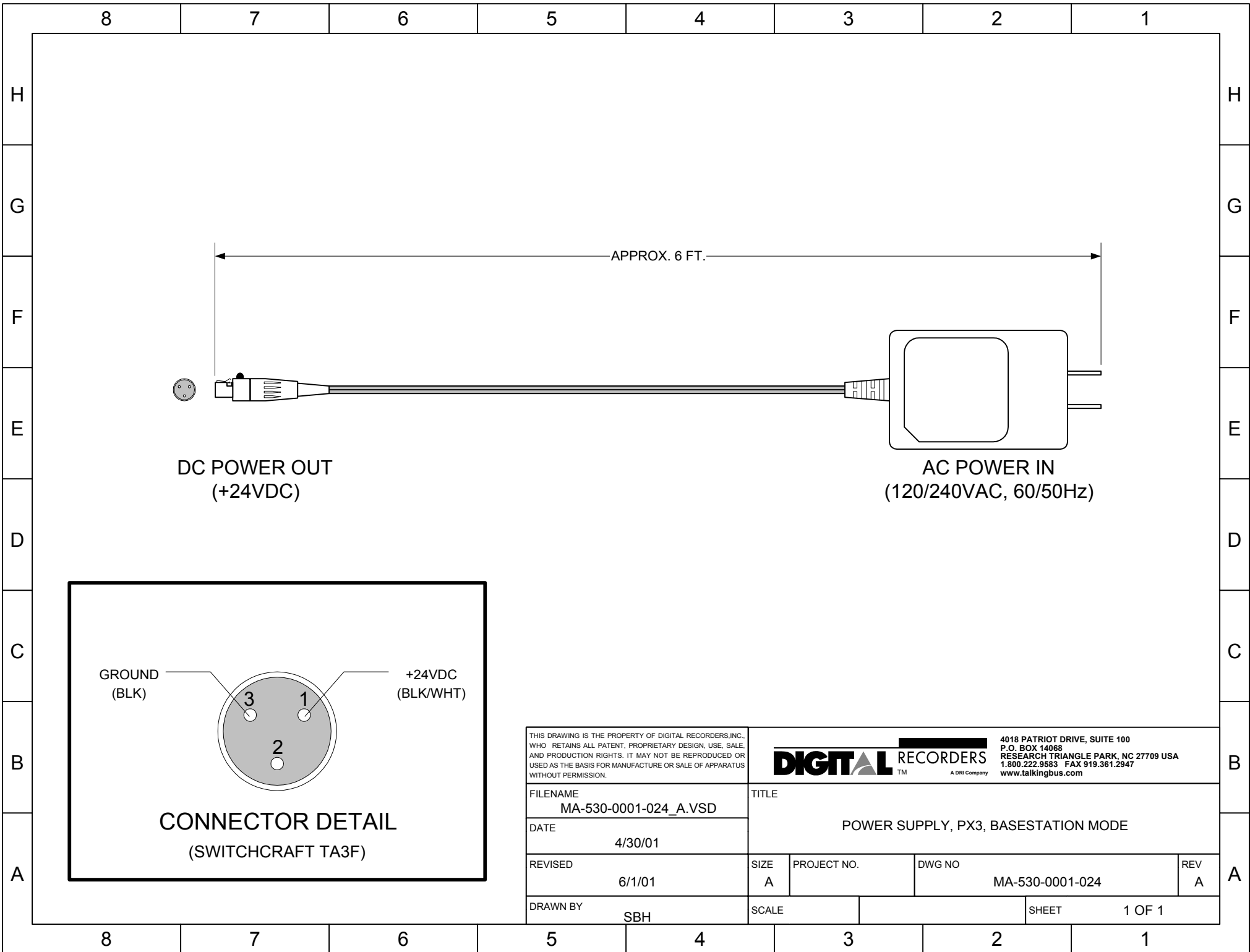
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FILENAME	MA-290-0003-000_A.VSD		
DATE	5/24/01		
REVISED	5/24/01	SIZE	A
DRAWN BY	SBH	SCALE	

TITLE	RS485 ADAPTER, COMM, ASYNC, 1 PORT		
PROJECT NO.	DWG NO	REV	A
	MA-290-0003-000_A		
SHEET	1 OF 1		



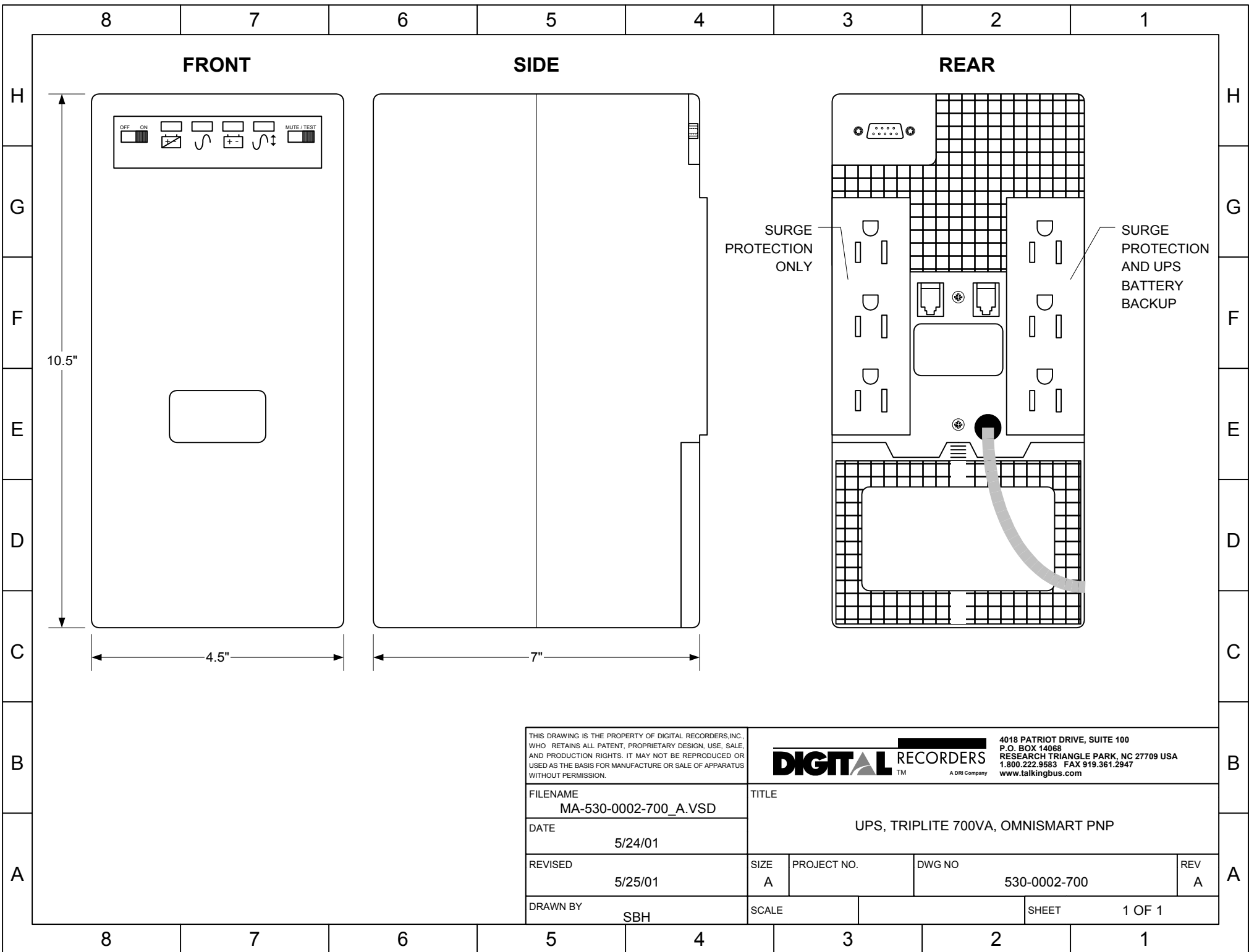
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FILENAME	MA-530-0001-024_A.VSD		
DATE	4/30/01		
REVISED	6/1/01	SIZE	A
DRAWN BY	SBH	SCALE	

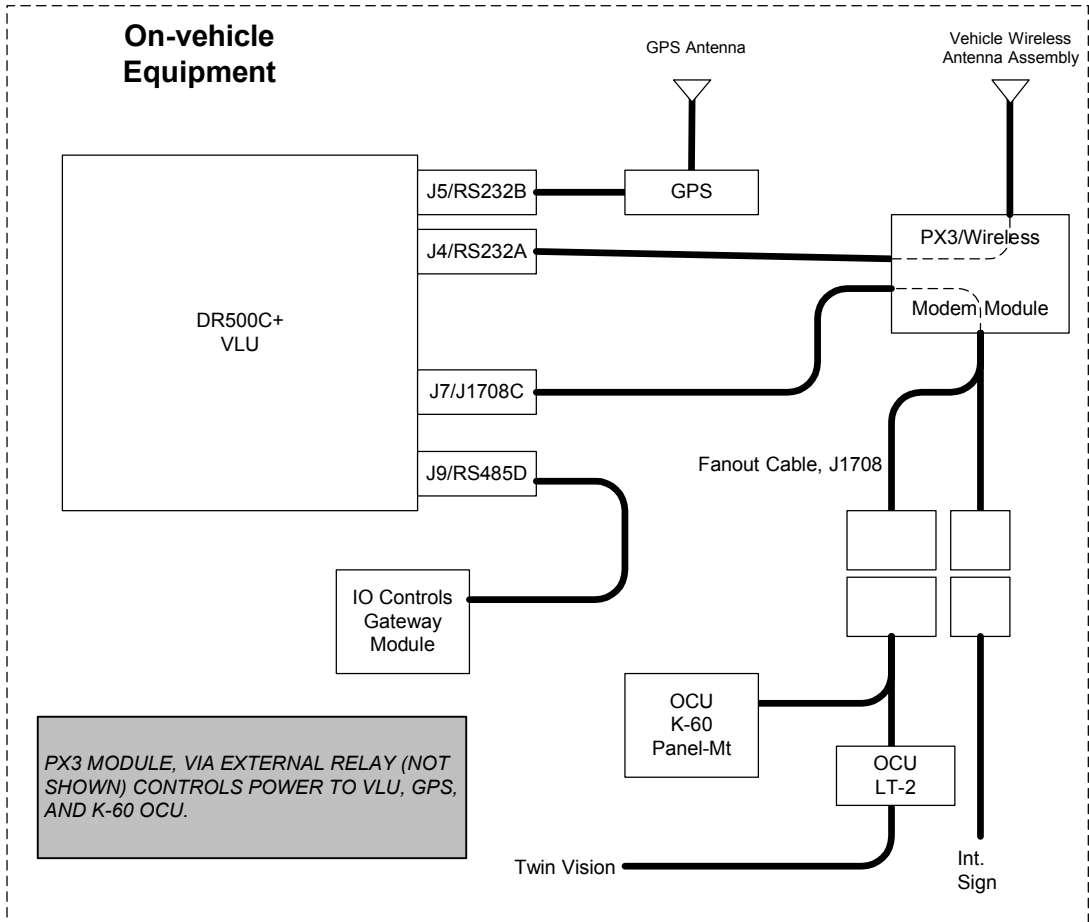
TITLE			
POWER SUPPLY, PX3, BASESTATION MODE			
PROJECT NO.	DWG NO	REV	
	MA-530-0001-024	A	
SHEET		1 OF 1	



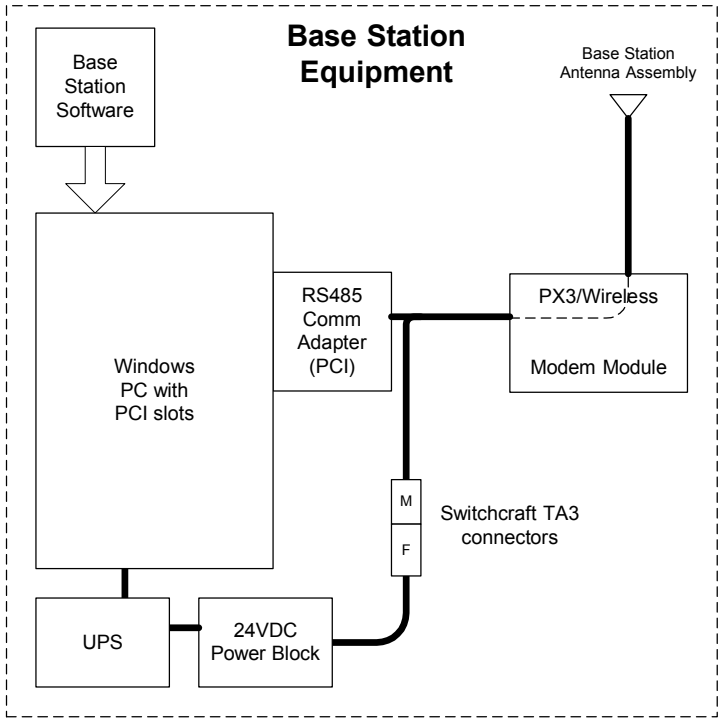
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FILENAME	MA-530-0002-700_A.VSD
DATE	5/24/01
REVISED	5/25/01
DRAWN BY	SBH

 <small>A DRI Company</small>		<small>4018 PATRIOT DRIVE, SUITE 100 P.O. BOX 14068 RESEARCH TRIANGLE PARK, NC 27709 USA 1.800.222.9583 FAX 919.361.2947 www.talkingbus.com</small>	
TITLE		UPS, TRIPLITE 700VA, OMNISMART PNP	
SIZE	PROJECT NO.	DWG NO	REV
A		530-0002-700	A
SCALE	SHEET		1 OF 1

# SAMPLE SYSTEM ARCHITECTURE



PX3 MODULE, VIA EXTERNAL RELAY (NOT SHOWN) CONTROLS POWER TO VLU, GPS, AND K-60 OCU.



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FILENAME	SYSTEM ARCHITECTURE.VSD	TITLE	WIRELESS TRANSFER OPTION SYSTEM ARCHITECTURE		
DATE	4/24/01	SIZE	PROJECT NO.	DWG NO	REV
REVISED	6/4/01	A		None	
DRAWN BY	JDK	SCALE		SHEET	1 OF 1





## COMPONENT CONNECTIONS

### 3.1 INTRODUCTION

---

This chapter describes the major component connections of the Wireless Data Transfer Option.

**NOTE:** The equipment comprising your Wireless Transfer Option should have been pre-installed by the OEM vehicle manufacturer and/or by Digital Recorders certified installation technicians. Installation may vary significantly from one location to another. The following instructions are therefore basic in nature and designed only to assist in understanding the system or for individual component replacement.



**WARNING:** Changes or modifications not expressly approved by Digital Recorders, Inc. may void the user's authority to operate this equipment.

### 3.2 ON-VEHICLE EQUIPMENT

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The Wireless Data Transfer Option on-vehicle equipment includes the following five basic components:

1. Wireless Modem Module
2. Power harness
3. Data communications cable
4. Antenna cable
5. Antenna assembly

Note that item 2, power harness, is potentially different for each installation and is therefore is not described in detail in this manual.

The Wireless Modem Module (DR P/N 901-1700-000) is an enclosure which houses a wireless modem, controlling electronics, and expanded serial ports for the DR500C. It also 'fans out' (duplicates) the DR500C J1708 communication port. Typically the module will be found mounted on a plate along with the DR500C and other supporting electronics.



The modem module is powered by a power harness (unique to each installation) via the 9-pin CPC connection J3. This connection also provides relay control to automatically shutdown power to the DR500C once data transfer has completed.

Serial communication between the modem module and the DR500C is performed via a data cable (DR P/N 941-5220-000). The DB-15 end of this cable connects to the modem module port P2. The other end of the cable has two connections: the DB-9 female is for RS232 communications and connects to the DR500C port A (J4), while the DB-9 Male is for J1708 'fan out' and connects to the DR500C port C (J7). Thumbscrews for each connector should be securely fastened.

The antenna cable (DR P/N 941-5207-020) is connected to the wireless modem module via its SMA connection marked "Antenna". The SMA connector should be screwed on clockwise and firmly hand-tightened

The vehicle antenna assembly (DR P/N 801-5207-000) is typically mounted on the roof above the driver's area of the vehicle via a 5/8" mounting hole. The antenna assembly terminates within the interior of the vehicle with a Type-N connector, to which the right-angle mating end of the antenna cable is connected and firmly hand-tightened in a clockwise fashion.



**WARNING:** To satisfy FCC RF exposure requirements for mobile transmitting devices, a separation distance of 32cm or more should be maintained between the antenna of this device and persons during device operation. To ensure compliance, operations at closer than this distance is not recommended.



### 3.3 BASE-STATION EQUIPMENT

---

The Wireless Data Transfer Option base-station equipment includes the following eight basic components:

1. Wireless Modem Module
2. Antenna cable
3. Base-station antenna assembly
4. RS485 communications / power cable
5. RS485 PCI adapter
6. 24VDC power supply
7. Uninterruptible Power Supply (UPS)
8. PC with software

The wireless modem module and antenna cable are identical to those which are used on the vehicle and described in the previous section. The antenna cable is connected to the module via a SMA connector. The other end of the antenna cable is connected to the Base-station antenna assembly via Type-N connector.

The base-station antenna, antenna cable, and modem module are mounted in a location which provides the best “top-down” line-of-sight view of the vehicles within its intended zone of communication. Base-station antenna type will vary per installation depending upon mounting location and coverage pattern requirements. Typical mounting locations include the roof of a building, a well-positioned wall, a tall pole, or the center ceiling of a covered garage area. The antenna must be securely fastened, and if in an outside location it must be properly grounded for lightning strike protection.



**WARNING:** To satisfy FCC RF exposure requirements for mobile transmitting devices, a separation distance of 32cm or more should be maintained between the antenna of this device and persons during device operation. To ensure compliance, operations at closer than this distance is not recommended.

Communication from the base-station PC and DC power are delivered via the RS485 cable (DR P/N 941-5213). This cable is built to length for each installation, and can be run up to 1000 feet without compromising data integrity. Depending upon installation location, this cable may be routed through conduit, underground, etc. The cable connects to the Wireless Modem Module port P2 via



its male DB-15 connector, and terminates at the base-station PC end in a male DB-25 connector (data) and male Switchcraft "TA3M" connector (power).

The base-station PC contains a 485 PCI communications card (DR P/N 290-0003-000), to which the male DB-25 data connector of the RS485 cable is connected. Both thumbscrews on the connector should be hand tightened.

A small wall "plug-style" 24VDC power block (DR P/N 530-0001-024) supplies DC power to the modem module. It connects to the RS485 cable at the base-station PC end via its female Switchcraft "TA3F" connector. Press down on the top-mounted button to disconnect, and push the two ends together until a "click" is heard to re-connect.

Both the 24VDC power block and the base-station PC should be plugged into the 700VA UPS (DR P/N 530-0002-700), which in turn plugs into a standard 120VAC outlet. The UPS (Uninterruptible Power Supply) provides battery backup during short (<15 minute) AC power outages, spikes, or "brownouts". This ensures that such occurrences will not affect communication with the vehicles. Both the PC and the power block must be plugged into the UPS outlets labeled "BATTERY/SURGE & NOISE PROTECTED OUTLETS" (right side outlets as viewed from the rear) to be protected from full power outages. Digital Recorders suggests plugging the PC monitor and other peripherals into the left side outlets, which are only surge protected, to maximize battery backup time of the PC and modem during complete power failures.



## CHECKOUT PROCEDURE

### 4.1 INTRODUCTION

This chapter contains a basic checkout procedure for the vehicle mounted wireless equipment. For checkout information regarding the base-station equipment, please refer to its separate documentation.

### 4.2 VEHICLE MOUNTED EQUIPMENT CHECKOUT

To confirm operation of the vehicle mounted equipment, perform the following:

1. Turn on vehicle and wait for 'Talking Bus' equipment to boot (OCU will prompt for route login).
2. Observe the front panel of the wireless modem module. A vertical row of four LED's is located on this panel. The LED's are, from top to bottom, "Status", "Range", "Rx", Tx".

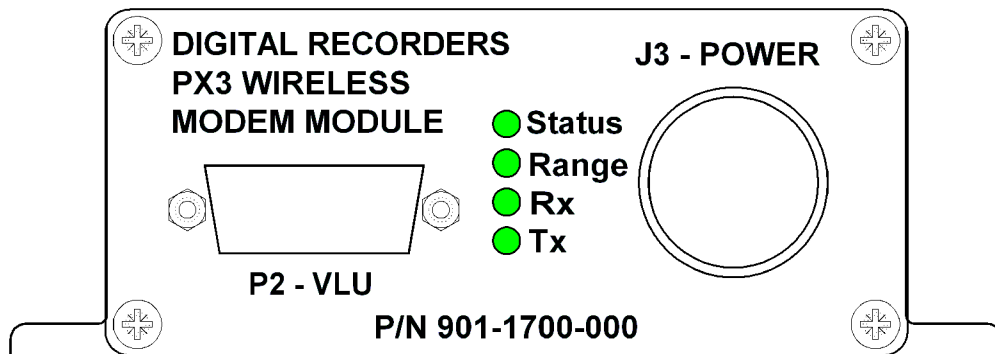


Figure 2: Wireless Modem Module Front Panel

3. The "Status" LED will flash when power is applied to the unit and it is functioning properly. If solidly lit or unlit, disconnect the J3 power connector, wait five seconds, then reconnect. If the LED still does not blink, contact Digital Recorders for further testing instructions.
4. If the vehicle is within communication range of the base-station, the "Range" LED should be lit. If not lit, first check that the vehicle is well within the receiving range of the base-station antenna (typically <1000 feet, without major structures between). Second, check that the antenna cable is firmly attached to the back of the unit. Third, ensure that the



opposite end of the cable is firmly attached to the antenna assembly mounted on the roof of the vehicle. Lastly, verify that the base-station and related software are powered and running correctly.

5. The Rx and Tx LED's will flash to indicate data being received or transmitted, respectively.

For further information or troubleshooting assistance, please contact Digital Recorders technical support at:

**1 – 800 – 222 – 9583**

Mon. – Fri. 8:30am – 5:30pm EST