UNION SWITCH & SIGNAL

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ASES
FRA EVENT RECORDER
SERVICE MANUAL

Installation
Operation
Maintenance

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Revision History

Rev.	Date	Nature of Revision
Original	September 2002	Initial issue of the Manual
1	January 2003	Revised manual to incorporate Release 11 of MRU Executive
2	January 2005	Manual was revised to incorporate changes in the event recorder software.

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1 Introduction

1.1 Purpose

The purpose of this manual is to provide technical guidance for the installation, operation, and maintenance of the Federal Railway Administration (FRA) Event Recorder system including overview, setup, and data retrieval. The Event Recorder is part of the complete ASES non-vital system.

The documentation and software listed below are recommended for setup, maintenance, and operation of the Event Recorder.

1.2 Reference Documents

SM 8845C - US&S ASES FRA Event Recorder Playback Tool User's Guide

SM 8845D - US&S ASES FRA Event Recorder Maintenance Tool User's Guide

1.3 System Requirements

The system requirements for the Event Recorder are as follows:

- PC compatible computer running Windows 95/98 (Windows 98 preferred)
- A minimum of 32 MB of RAM (minimum of 64 MB preferred)
- A video display adapter and monitor capable of displaying at least 256 colors at a minimum resolution of 800 x 600 (resolution of 1024 x 768 is preferred)
- A null-modem (crossover) cable that has a male DB-9 on one end and a female connector to plug into a PC on the other

1.4 Software Required

1.4.1 Installation

The following software is required for installation:

US&S p/n N451232-2277, Event Recorder Maintenance Tool

US&S p/n N451232-2281, Event Recorder Executive

1.4.2 Data Retrieval and Manipulation

The following software is required for data retrieval and manipulation but not for installation:

US&S p/n N451232-2264, Event Recorder Playback Software, Version 8.00 or later

US&S p/n N451232-2542, ASES SES PTU Tool

1.5 Glossary

AREMA	American Railway Engineering and Maintenance-of-Way Association
ASES	Advanced Speed Enforcement System (Integrated CSS, SES, and FRA Recorder)
ATSS	Ansaldo Transporti Signal System AB
CPU	Central Processing Unit
CSS	Continuous Signaling System
DAU	Data Acquisition Unit
FIS	Fault Information System
FRA	Federal Railway Administration
LON	LONWORKS® Network
MRU	Main Recorder Unit
PCB	Printed Circuit Board
REU	Recorder Expansion Unit
RTC	Real Time Clock
SES	Speed Enforcement System
TMC	Traction Motor Current

2 System Description

The Event Recorder consists of two major sub-assemblies, the Main Recorder Unit (MRU) and the Data Acquisition Unit (DAU) as shown in Figure 2-1.

The Main Recorder Unit is based on Union Switch & Signal's 332 Central Processing Unit (CPU) operating with a stand-alone Event Recorder Executive. The CPU communicates via RS-422 serial links to the Continuous Signal System (CSS), the Speed Enforcement System (SES), and the DAU's LON Network Manager.

The Data Acquisition Unit is an Echelon LONWORKS-based I/O system which provides discrete and analog inputs. An Echelon serial gateway provides the interface between the MRU and the Echelon twisted pair network.

2.1 Main Recorder Unit (MRU)

The MRU is based on US&S's standard 332 CPU and consists of the 322 CPU Assembly (p/n N17061306), the Power Supply/LONWORKS Input Board Assembly (p/n N26561102) and the

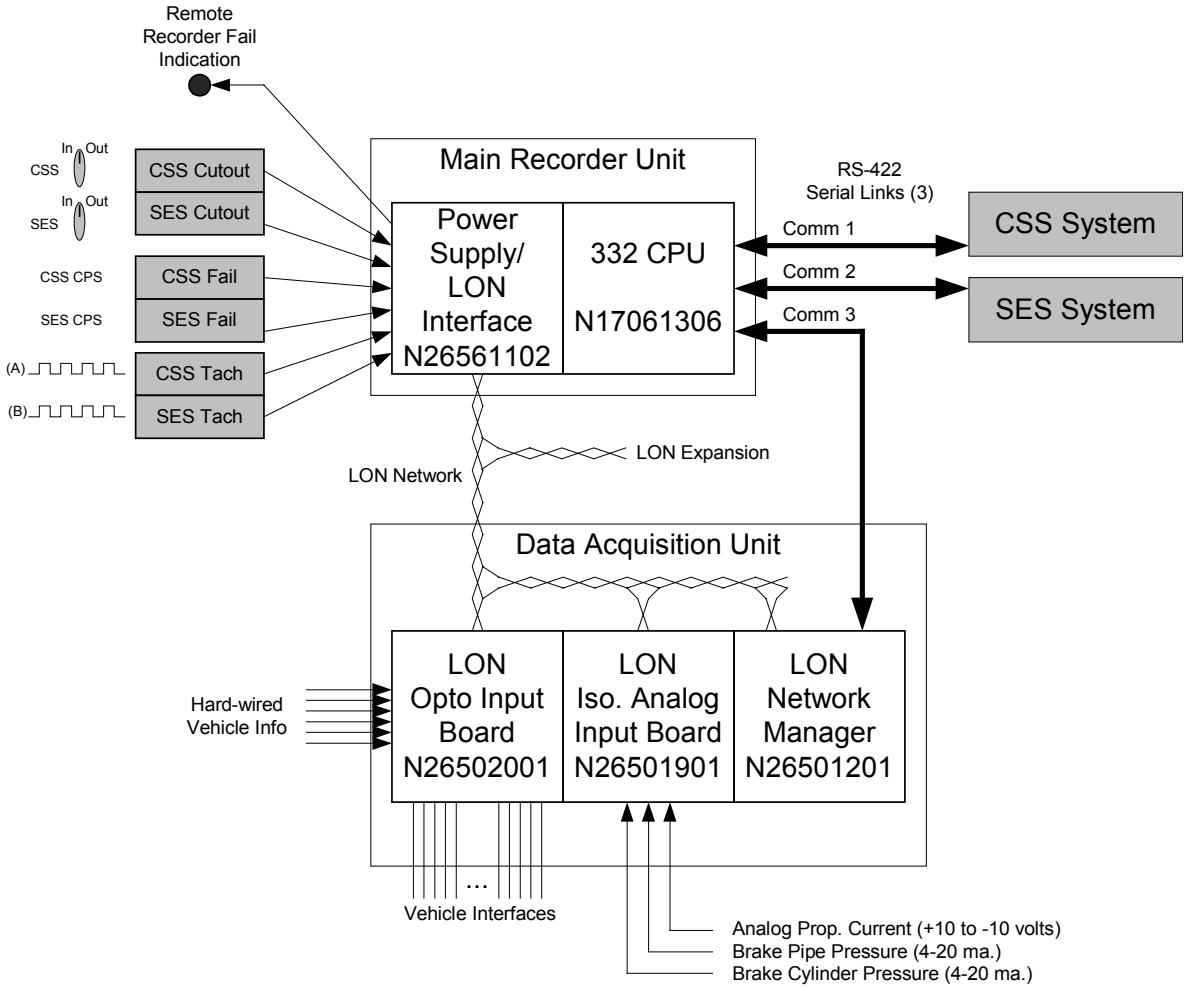

Figure 2-1 - Event Recorder System Block Diagram

Motherboard (p/n N26500502). These boards all mount in an ASES enclosure. The MRU communicates with the DAU Network Manager, the CSS, and the SES through three isolated RS-422/485 asynchronous serial ports included on the 332 CPU Daughter Board (see Figure 2-2).

A diagnostic serial port is also provided and is accessible either through the front of the 322 CPU or through the external connector located on the ASES enclosure.

2.2 Data Acquisition Unit (DAU)

The DAU chassis will mount to standard 19" equipment rails. The approximate dimensions for the chassis are 19" wide x 10" deep x 5 ¼" high.

In addition to the DAU Motherboard (p/n N26501801), the chassis contains (see Figure 2-3 and Figure 2-4):

- Network Manager Board (p/n N26501201)
- Discrete Input Assembly (p/n N26502001)
- DAU Analog Input Board (p/n N26501901)
- DAU Interface Board (p/n N26501501)
- DAU Power Supply Board (p/n N26501701)

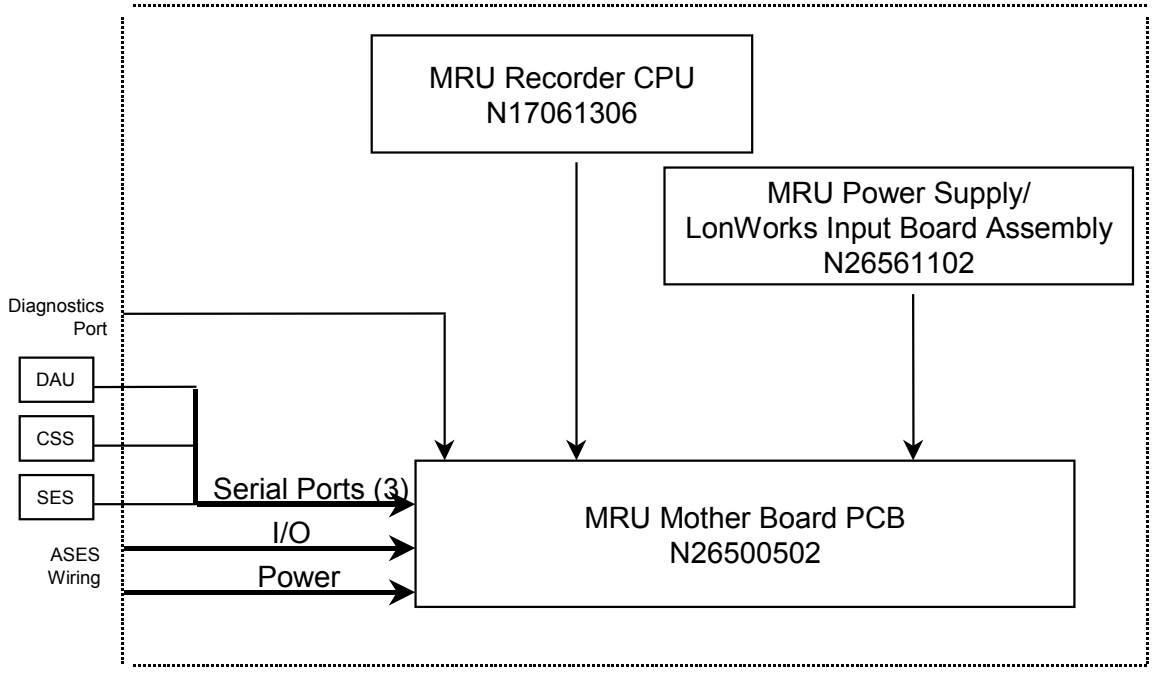

Figure 2-2 - MRU Block Diagram

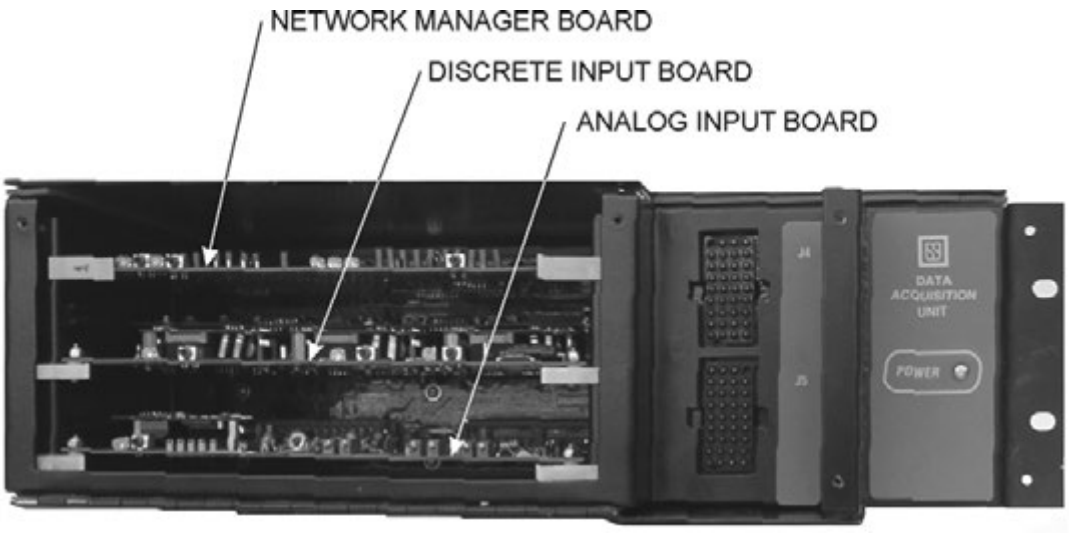

Figure 2-3 - DAU Chassis Configuration

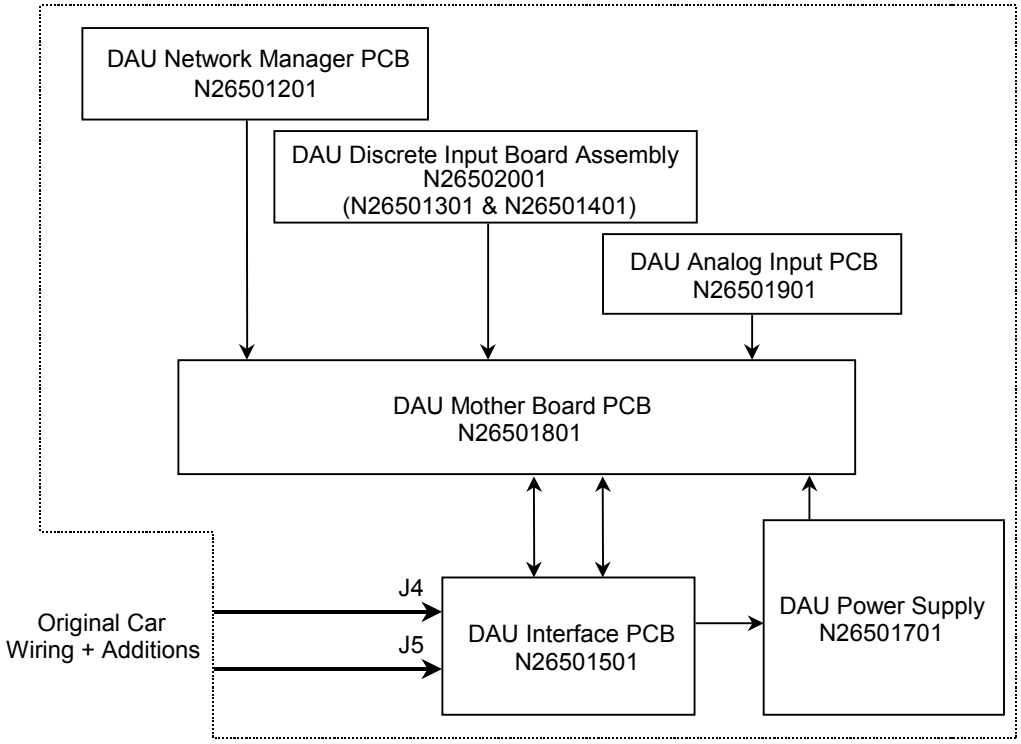

Figure 2-4 - DAU Block Diagram (US&S p/n N26404302)

2.3 Event Recorder General Specifications

2.3.1 Size

The DAU Chassis is approximately 19” wide x 10 ¼” deep x 5 ¼” high, suitable for mounting in a standard 19” enclosure.

2.3.2 Environmental

The Event Recorder system has been designed to operate under the following environmental conditions:

- Operating temperature: -40° to +70°C
- Storage temperature: -55° to +85°C
- Humidity: 0 to 95%, non-condensing
- The system meets Class I of AREMA 11.5.1

2.3.3 Electrical

The Event Recorder system has been designed to operate with the following electric conditions:

- Operating voltage: 20 to 90 VDC
- Power: 15 watts DAU, 15 watts MRU
- Dielectric strength: 1500 VDC for enclosure wiring (Input Power to Chassis)
- Transient surge: IEC 1000-4-5 Level 2, 1000V differential mode
- Fast Transient Burst Susceptibility IEC 1000-4-4 Level 2, 1000V on power, 500V on I/O lines
- RF Immunity, 5-watt walkie-talkie and standard cell phone at 18 inches, doors closed, horizontal and vertical orientations

3 Functional Description

3.1 Data Acquisition Unit (DAU)

3.1.1 DAU Network Manager, US&S p/n N26501201

The Network Manager performs several functions relating to the support of the LONWORKS network. The Network Manager board includes the Echelon PSG-10 Serial Gateway. The Network Manager PCB can accommodate an optional DM-20 Network Configuration Manager module that can be used for dynamic network configuration of any newly installed or unconfigured nodes on the LONWORKS network. Dynamic configuration of the network nodes is not used for the Event Recorder and does not require the DM-20 module. In the event that dynamic configuration of the network is needed in the future, the DM-20 may be simply plugged into the Network Manager board. Nodes are used for all I/O functions on the network and may include sub- or pre-processing of data prior to being placed on the network. The Serial Gateway is responsible for maintaining an image of all the LONWORKS Network Variables and passing them to the MRU's CPU when requested. The Network Manager also provides the RS-422/485 serial interface for communications with the MRU CPU.

An alternate version of the DAU Network Manager is available to support Expanded LON Functions. The N26501202 Network Manager Board utilizes the Echelon PSG-20 in place of the PSG-10 to support Recorder Expansion Unit functions. DAUs equipped with the PSG-20 are available under US&S p/n N26404303.

3.1.1.1 DAU Communications

The DAU uses the following communications links:

For MRU communications - RS-422/485, asynchronous, non-isolated

For externally networked modules - LONWORKS twisted pair link, isolated

3.1.1.2 DAU LONWORKS Network Configuration Option

> **NOTE**
>
> This feature is only applicable to the DAU Network Manager Board N26501202 with PSG-20 firmware revision level 4.00 or higher.

LON configuration is to be selected by setting the configuration jumper AUX7 located on the Network Manager Board. For FRA Event Recorder installations that only utilize the MRU and DAU, the configuration jumper AUX7 is to be set to the "D" position. For FRA Event Recorder installations that also utilize the Recorder-Expansion-Unit (REU), the configuration jumper AUX7 is to be set to the "E" position (See Table 3-1).

Table 3-1 - LON Configuration for AUX 7

AUX7	LON Configuration
"D"	MRU and DAU Only (Figure 3-1)
"E"	MRU, DAU, and REU Installed (Figure 3-1)

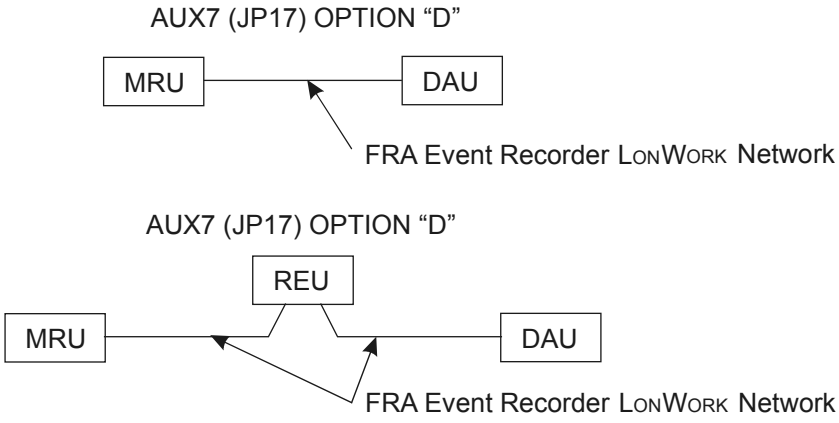

Figure 3-1 - Event Recorder Jumper Settings

CAUTION

If the AUX7 jumper is incorrectly set to the "E" position and no REU is installed, LON system performance will be greatly degraded. Be sure that the AUX7 jumper is set correctly for the specific Event Recorder System**.**

In addition, the Network Fault indications located on the DAU Network Manager Board, the MRU CPU Board, and the Remote Fail indication (if installed), will be lit, reporting the absence of the REU LON components from the FRA Event Recorder LONWORKS network.

3.1.1.3 DAU Indications

There are three indicators on the front of the DAU Network Manager (Figure 3-2): Watch Dog, Fault, and Valid Data. The indicators and their meaning are delineated in Section 8.3.

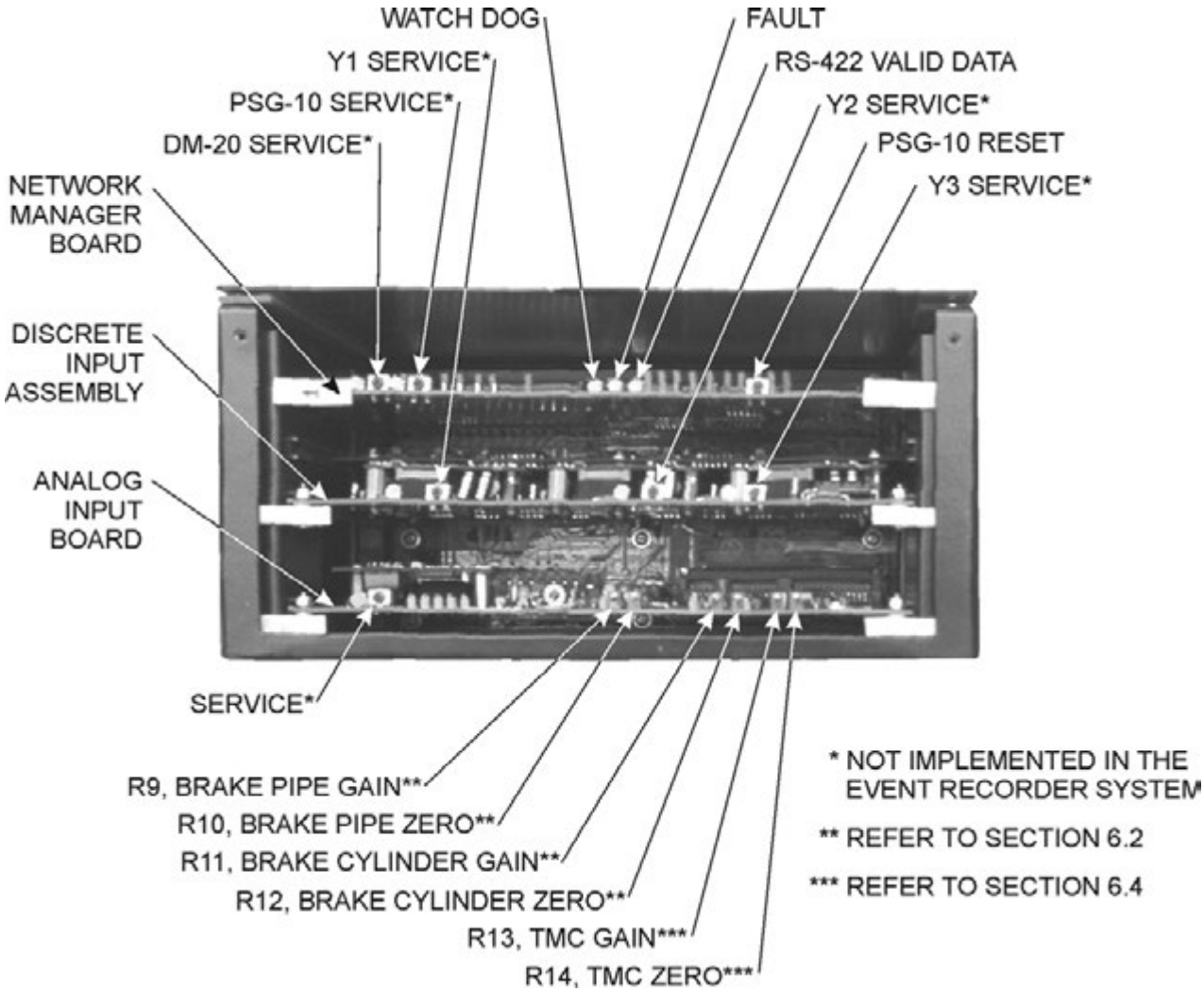

Figure 3-2 - DAU Indicators

3.1.2 DAU Input Board Assembly, US&S p/n N26502001

The Input Board Assembly is a one and one-half board combination assembly that provides optically isolated inputs to three Echelon network nodes. The network nodes perform sub- or pre-processing of the inputs that include high-speed sampling of all non-multiplexed inputs as well as de-bounce of these inputs. Generally, the sampling rate of the inputs is performed at a much higher rate than the polling rate of the MRU.

3.1.2.1 DAU Discrete Inputs

All inputs are optically isolated from the system electronics and chassis and will accept 20 to 90 volts DC. The inputs are described in Table 3-2.

Table 3-2 - Input Description

Qty	Reference	Type	Monitor Rate
14	Battery Return	Single Ended	Continuous
3	30V Return	Single Ended	Continuous
4	Jumper Configurable	Single Ended	Continuous
11	Configurable by Wiring	Fully Independent	Continuous
3	30V Return	Single Ended	Multiplexed (5 sec.)
3	Configurable by Wiring	Fully Independent	Multiplexed (5 sec.)

NOTE

32 inputs are provided for continuous status monitoring and six multiplexed inputs are provided for determining vehicle configuration.

3.1.3 DAU Analog Input Board, US&S p/n N26501901

The Analog Input Board assembly provides an isolated analog input barrier which maintains separation between the externally supplied inputs and the DAU system circuitry. An Echelon network node controls a serial A-to-D converter and performs sub- or pre-processing of the analog input values including high-speed sampling and averaging. Generally, the sampling rate of the inputs is performed at a much higher rate than the polling rate of the DAU.

3.1.3.1 DAU Analog Board Inputs

The DAU Analog Board has three inputs:

- Two 4 to 20 ma current loops for brake pipe and brake cylinder pressure transducers. These are electrically isolated from both the electronics system ground and the chassis. The resolution of the inputs is 1 psi with 150 psi = 20 mA.

- One +10 to –10 volt input for measuring Traction Motor Current (TMC). The input is electrically isolated from both the electronics system ground and the chassis. The logging resolution is in 100-amp increments.

In the event a Current-to-Frequency TMC interface/isolation module is not provided, DC traction motor current can be monitored using an isolated Hall Effect current transducer, [F.W. Bell p/n IA-2000 (US&S p/n J705057058)]. This transducer can provide the analog signal needed for the Event Recorder with a scale factor of 1 volt per 200 amperes.

NOTE

For AC Traction Motor Systems, the TMC signal is to be provided by others. Scaling is to be 3.4 KN (Kilo-Newton's) per volt.

3.1.4 DAU Power Supply, US&S p/n N26501701

The Power Supply assembly contains the DC to DC converter and the LED status indicator. An isolated 5 volts is generated to operate all DAU circuitry.

3.1.4.1 DAU TMC Transducer Power (Optional)

The DAU Power Supply can accommodate an isolated +15 and –15 volts @ 200 ma DC to DC converter to operate an external TMC current transducer where applications require it. For the ASES application, the TMC power supply is not included; however, it can be retrofitted if required by ordering US&S p/n J7257090326.

3.1.5 DAU Interface Board, US&S p/n N26501501

The Interface Board also provides battery line filtering, transient protection, and an input fuse.

Table 3-3 lists the electrical mating connector parts required.

Table 3-4 lists the pin definition and those connections that can be used in retrofit installations. All other connections need to be removed from the existing connectors since new functionality has been assigned to these pins.

Table 3-3 - DAU Mating Connector Parts

Qty.	Description	FCI Burndy	US&S p/n
2	Receptacle	Burndy SMS-36P-1	J7091460397
0.4 (2pcs)	Key	Burndy SMSPKB1-5PK	J7091461347
70	Socket	Burndy SC20M-1S6	J7091460396

NOTE

Use FCI Burndy Y8ND Hand Crimp Tool and N20RT-29 Die Set.

Table 3-4 - DAU Electrical Connector Pinouts

Pin	J4 (See Figure 2-3)	Reference
1	Polarizing Key	
2	EIE Brake (DSP 6) +	
3	13T Loco Batt +	
4	DSP 4-	
5	13T Loco Batt -	
6	EIE Brake (DSP6) -	
7	RS422 RX + (B)	
8	RS422 RX – (A)	
9	Traction Motor Type (AC)	30V_Ret
10	RS422 Comm Gnd	
11	DSP 4+	
12	RS422 TX + (B)	
13	RS422 TX – (A)	
14	TMC_+15V	
15	TMC_GND	
16	TMC_-15V	
17	Lon Net A	
18	Lon Net B	
19	Headlight Rear -	
20	Wheel SP2 + (Gen A)	
21	Headlight Rear +	
22	Cab B	Batt_Ret
23	DB	Batt_Ret
24	DV	Batt_Ret
25	Alerter Acknowledge	Batt_Ret
26	Brake Pipe + (4-20ma)	
27	Brake Pipe Ret (4-20ma)	
28	Cab A	Batt_Ret
29	Wheel SP3 (Gen B)	
30	Wheel SP2 – (Gen A)	
31	Wheel SP3 – (Gen B)	
32	Reverse	Batt_Ret
33	CV	Batt_Ret
34	GF	Batt_Ret
35	+ 30V	
36	Pwr Batt +	

Pin	J5 (See Figure 2-3)	Reference
1	Alerter Penalty +	
2	Alerter Alarm -	
3	DSP 2+	
4	DSP 3-	
5	Warning Bell	30V_Ret
6	Brake Cyl + (4-20ma)	
7	Wheel Dia B	30V_Ret
8	Wheel Dia A	30V_Ret
9	Warning Horn	30V_Ret
10	Brake Cyl Ret (4-20ma)	
11	Alerter Penalty -	
12	Alerter +G9 Alarm +	
13	ItoF TMC mod. (DSP 1+)	Batt_Ret
14	ItoF TMC mod. (DSP 1-)	To Batt_Ret
15	DSP 2-	
16	DSP 3+	
17	TMC_+VO	
18	Loco/Car	30V _Ret
19	TMC_-VO	
20	32V Ret	
21	AV	Batt_Ret
22	Forward	Batt_Ret
23	SP1	Configurable
24	SP4	Configurable
25	Headlight Front -	
26	Wheel Slip	Batt_Ret
27	I BRK-	
28	Polarizing key	
29	Pwr Batt Ret	
30	BV	Batt_Ret
31	End Door Closure (SP6)	Batt_Ret
32	Center Door Closure (SP5)	Batt_Ret
33	Headlight Front +	
34	Hand Brake	Batt_Ret
35	PCS	Batt_Ret
36	I BRK+	

DSPx = Dual Input Spare
SSPx = Single Sided Spare
= Existing Wiring

3.1.6 DAU Connection to the ASES

Table 3-5 lists the connections to be made between the DAU and the ASES system to link the DAU to the MRU.

Table 3-5 - Electrical Connections from DAU to ASES

Description	DAU	ASES
LONWORKS A	J4-17	C1-u
LONWORKS B	J4-18	C1-v
Recorder RS-422 TX-	J4-13	C1-s
Recorder RS-422 TX+	J4-12	C1-r
Recorder RS-422 RX-	J4-8	C1-q
Recorder RS-422 RX+	J4-7	C1-p
Recorder RS-422 Comm	J4-10	C1-t

3.2 Main Recorder Unit (MRU)

3.2.1 MRU CPU, US&S p/n N17061306

The MRU CPU is based on US&S's standard 332 CPU.

A 4-MB PCMCIA Flash memory card is provided for a minimum storage of two days of data; 8-MB memory cards are also supported. If memory capacities of more than 8 MB are needed, consult US&S for products that have been approved for use in the Event Recorder.

CAUTION

Use only US&S p/n J7031050107 PCMCIA FLASH Memory Cards for data storage. This memory card has been carefully qualified for operation with the Event Recorder.

The use of unqualified PC Memory Cards is not recommended and can result in system malfunction and/or loss of data.

3.2.1.1 MRU CPU Communications

There are four serial ports used for communication with the MRU CPU:

- Three isolated RS-422/485 asynchronous serial ports are provided for the CSS, SES, and DAU serial links. Isolation is provided through a daughter board connected to the 332 CPU.
- One non-isolated RS-232 serial port for diagnostics is provided. The diagnostics port is accessible in two locations, the CPU front panel DB-9F and at the outside of the ASES enclosure. Only one of the two connections is to be used at any one time to avoid device contention.

3.2.1.2 MRU CPU Indications

There are seven indicators on the front of the MRU CPU (Figure 3-3): CSS Link, SES Link, and DAU Link, PC Card, Network Fault, On-Line, and Vpp On. The indicators and their meaning are delineated in Section 8.2.

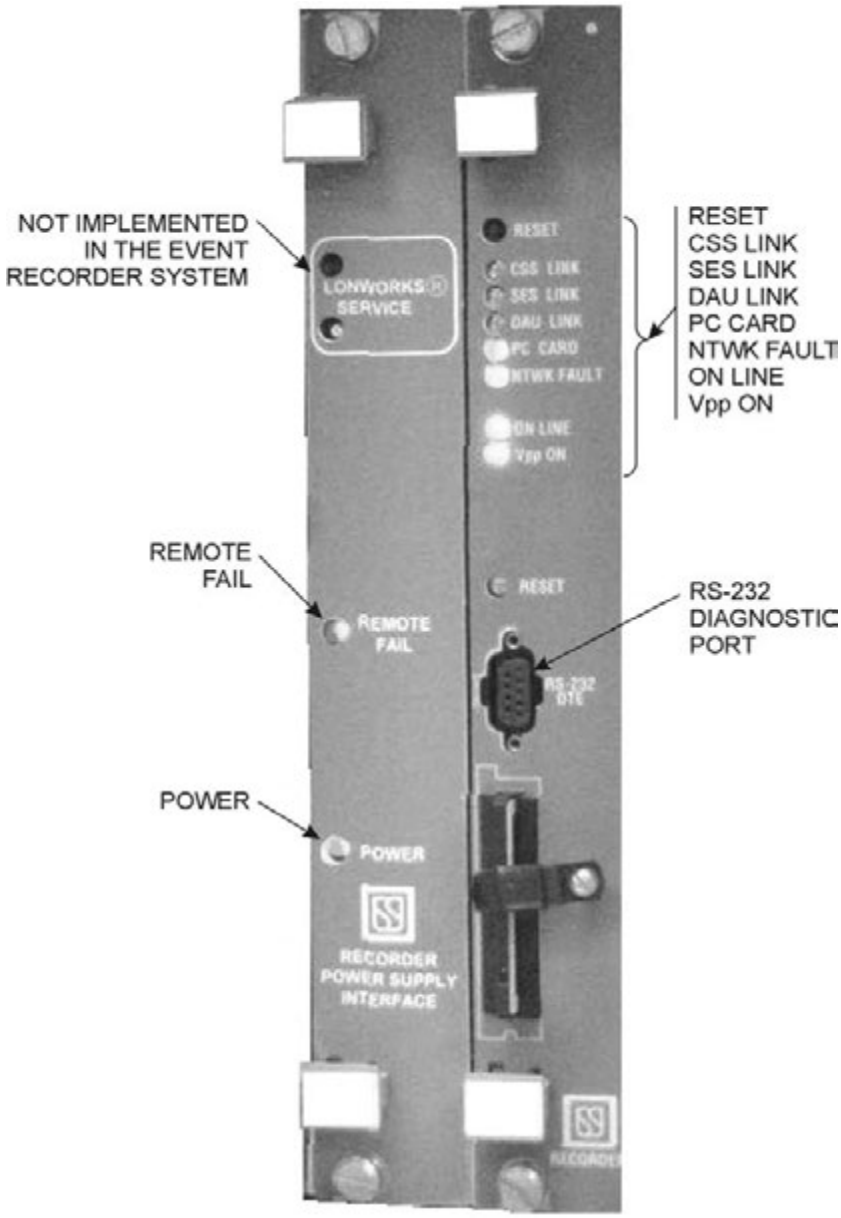

Figure 3-3 - Indicators on the MRU

3.2.2 MRU Power Supply/Interface, US&S p/n N26561102

The MRU Power Supply has two functions. The first is to provide power to the MRU CPU and the recorder unit in the ASES. The second function is to provide a LONWORKS network node for various I/O functions such as tachometer pulse counting and various input indications. Supporting circuitry provides an isolation barrier between the tachometer inputs and the MRU/network circuitry.

3.2.2.1 Discrete Inputs

Four non-isolated inputs with transient protection are provided. They are for contact closure interface to the US&S ASES system only. The inputs are: CSS Cutout, SES Cutout, CSS Fail, and SES Fail.

3.2.2.2 Discrete Output

One non-isolated output for a "Remote Recorder Fail" indication is provided. The output is an open collector and "Recorder +5 Volts" is also provided for the indication power source.

3.2.2.3 Tachometer Inputs

Two isolated tachometer inputs are provided to accept the ASES 0 to 12-volt digital tachometer signals. They are the CSS Tach and SES Tach signals.

3.2.3 Remote Recorder Fail Indication

The Remote Recorder Fail Indicator has three states: on, flashing, and off**.** The indicators and their meaning are delineated in Section 8.1.

> **NOTE**
>
> In the event that a remote fail indication occurs (continuously on), refer to Section 3.2.1.2 for additional information regarding CPU fault indications. The Maintenance Tool (SM8845D) also provides a system status field to provide the user with fault information.

3.2.4 MRU Mother Board, US&S p/n N26500501

3.2.4.1 Connection (internal to the ASES enclosure)

Connection is made to the MRU motherboard via two connectors: J602 and J603. The pinouts for these connectors are listed in Table 3-6.

- J602 is a 40-position connector with 0.1" centers. It is used for serial communications and power.
- J603 is a 26-position connector with 0.1" centers. It is used for I/O functions.

3.2.5 MRU Recorded Items

The Main Recording Unit (MRU) can record a maximum of 256 discrete indications and analog values. The MRU typically only records items that have changed state from a previous value. Items such as brake pipe pressure, brake cylinder pressure, main line pressure, and propulsion current which change state frequently are filtered by the MRU before they are recorded. Filter parameters for these inputs can be entered via the MRU Maintenance Tool (SM 8845D).

The MRU records items from three separate subsystems - the CSS, SES, and the DAU. Indications are sent to the MRU over three separate RS-422 serial links. The recorded parameters for each subsystem are listed in the tables as follows: Table 3-7 lists the CSS Recorded Items; Table 3-8 lists the CSS Departure Test Values; Table 3-9 lists the SES Recorded Items; Table 3-10 lists the SES key code functions; Table 3-11 lists the DAU Recorded Items; and Table 3-12 lists the MRU recorded items.

Table 3-6 - MRU Mother Board Electrical Connector Pinouts

J602 Serial	Description	ATC Nomenclature
1	Battery Ret	REC_COND_BATT-
2	Battery Ret	REC_COND_BATT-
3		
4		
5	Battery +	REC_COND_BATT+
6	Battery +	REC_COND_BATT+
7		
8		
9		
10		
11		
12	GND	REC_GND
13	+5V	REC_5V
14	TX4	REC_REAR_TX
15	GND	REC_GND
16	RX4	REC_REAR_RX
17		
18		
19		
20	COMM 3 GND	LON_GND
21	TX3-	REC_LON_TX-
22	TX3+	REC_LON_TX+
23	RX3-	REC_LON_RX-
24	RX3+	REC_LON_RX+
25		
26		
27		
28	COMM 2 GND	ICSS_GND
29	TX2-	ICSS_REC_RX-
30	TX2+	ICSS_REC_RX+
31	RX2-	ICSS_REC_TX-
32	RX2+	ICSS_REC_TX+
33		
34		
35		
36	COMM 1 GND	CCSS_REC_GND
37	TX1-	CCSS_REC_RX-
38	TX1+	CCSS_REC_RX+
39	RX1-	CCSS_REC_TX-
40	RX1+	CCSS_REC_TX+

J603 I/O	Description	ATC Nomenclature
1	LONWORKS A	LONWORKS A
2	LONWORKS B	LONWORKS B
3		
4		
5	+5V	REC_5V
6	GND	REC_GND
7	TACH A+	TACH2_BUFF
8	TACH A-	TACH2_GND
9	TACH B+	TACH1_CH1_BUFF
10	TACH B-	TACH1_GND
11	REC FAIL	REC_FAIL
12	LWO1	
13	LWO2	
14	LWO3	
15	LWO4	
16	LWO5	
17	LWO6	
18	LWO7	
19	LWI0	CCSS_FAIL
20	LWI1	ICSS_FAIL
21	LWI2	CCSS_CO
22	LWI3	ICSS_CO
23	LWI4	
24	LWI5	
25	LWI6	
26	LWI7	

= Isolation barrier, no wires to be installed

Table 3-7 - CSS Recorded Items

Item		Meaning
1	NoCode	1 indicates 0000 0000 is being received
2	75Code	1 indicates 0000 0001 is being received
3	120Code	1 indicates 0000 0010 is being received
4	180Code	1 indicates 0000 0100 is being received
5	220Code	1 indicates 0000 1000 is being received
6	270Code	1 indicates 0001 0000 is being received
7	Dual75Code	1 indicates 1000 0001 is being received
8	Dual120Code	1 indicates 1000 0010 is being received
9	Dual180Code	1 indicates 1000 0100 is being received
10	Dual270Code	1 indicates 1001 0000 is being received
11	InvalidCabCode	1 indicates no recognizable code is being received
12	Passenger	1 indicates Passenger Vehicle
13	CSS_PSI	1 indicates INIT Permanent Suppression
14	CSS_PS	1 indicates Permanent Suppression
15	BCTP_Input	1 indicates Brake Cylinder Input
16	PSI_Input	1 indicates INIT Permanent Suppression Input
17	PS_Input	1 indicates Permanent Suppression Input
18	CSS_Idle	1 indicates Idle
19	LogCSSVZero	1 indicates 000 0001 is being received and CSS train speed is less than 3 mph
20	250_HZ_Bad_Duty_Cycle	1 indicates 250 HZ input has bad duty cycle
21	100_HZ_Bad_Duty_Cycle	1 indicates 100 HZ input has bad duty cycle
22	250_HZ_Bad_Period	1 indicates 250HZ input period is bad
23	100_HZ_Bad_Period	1 indicates 100HZ input period is bad
24	250_HZ_Low_Level	1 indicates 250 HZ Level is Low
25	100_HZ_Low_Level	1 indicates 100 HZ Level is Low
26	LogCSSOverSpeed	1 indicates 0000 0001 is being received and CSS train speed > CSS allowable speed
27	LogCSSPenalty	1 indicates 0000 0001 is being received and CSS penalty brake is applied
28	LogCSSAlarmAck	1 indicates 0000 0001 is being received and operator acknowledged alarm
29	LogCSSAlarm	1 indicates 0000 0001 is being received and alarm is on
30	LogCSSTerritory	0 indicates Non CSS Territory 1 indicates CSS Territory (switch in coded) 2 indicates CSS Territory (switch in Non Coded)
31	CSSDecel	Decelerometer Data (0-255)
32	CSSSPeed_Limit	CSS Enforced Speed Limit (0-255)
33	CSSEvent	Last Logged CSS Event Code (0-65535)
34	CSSDepartureTest	Indicates the status of the CSS Departure Test. See Table 3-8 for details
35	CSS_Link_Status	1 indicates Event Recorder is communicating regularly with CSS link

Table 3-8 - CSS Departure Test Values

CSS Departure Test Value	Departure Test Status
0	No Updated Departure Test Data to Record
1	Passed
2	Cancelled
3	Failed – Cab Not Keyed
4	Failed - Brake Pressure
5	Failed – Not In Forward
6	Failed – Not In Idle
7	Failed – Not Normal Mode
8	Failed – No Vzero
9	Failed – Perm Supp Detect
10	Failed – Code Rate Detect
11	Failed – Terr Switch
12	Failed –1st No Code
13	Failed – VZero Off
14	Failed – Dual 270 Code
15	OS On Alarm ON
16	OS Off Alarm OFF
17	SING 75 Code
18	SING 75 Code Ack
19	2nd No Code
20	2nd No Code Ack
21	Cab Territory Not Set
22	Penalty Brake Applied
23	Cab Territory Set
24	3rd No Code
25	3rd No Code Ack
26	Invalid State
255	Departure Test Running

Table 3-9 - SES Recorded Items

Item		Meaning
1	UnknownTerritory	1 indicates 0000 0000 is being received
2	CombinedTerritory	1 indicates 0000 0001 is being received
3	SESOnlyTerritory	1 indicates 0000 0010 is being received
4	CSSOnlyTerritory	1 indicates 0000 0100 is being received
5	DarkTerritory	1 indicates 0000 1000 is being received
6	MandETerritory	1 indicates 0001 0000 is being received
7	SES_MandETerritory	1 indicates 0010 0000 is being received
8	CabControlledTerritory	1 indicates 0100 0000 is being received
9	InvalidSESTerritory	1 indicates no recognizable code is being received
10	SESOverSpeed	1 indicates SES train speed > SES allowable speed
11	SESTrainStopPen	1 indicates SES Train Stop Penalty is applied
12	KeyCodeFunc1—16 bits	See Table 3-10 - SES Key Code Functions
13	SESDTestExec	1 indicates the Departure Test executed
14	SESDTestRun	1 indicates the Departure Test is running
15	SESDTestPass	1 indicates the Departure Test passed
16	SESDTestFail	1 indicates the Departure Test failed or was cancelled
17	SES_Link_Status	1 indicates the Event Recorder is communicating regularly with SES link
18	SDUAlarmValue	SDU Alarm converted to decimal
19	MaxSpeedinMPH	Maximum train speed authorized by SES in mph
20	SupervisedSpeedinMPH	Maximum vehicle speed includes profiling (MPH)
21	SESSpeedinMPH	SES vehicle speed in MPH
22	TargetSpeedinMPH	SES target train speed in mph
23	TargetDistanceinYARDS	SES target distance in yards
24	PositioninYARDS	Train position in yards
25	LogSESBPipePresinPSI	Brake pipe pressure according to SES in psi
26	tlgnum16	1 of 16 chunks of numeric representation of telegram message
27	tlgnum15	1 of 16 chunks of numeric representation of telegram message
28	tlgnum14	1 of 16 chunks of numeric representation of telegram message
29	tlgnum13	1 of 16 chunks of numeric representation of telegram message
30	tlgnum12	1 of 16 chunks of numeric representation of telegram message
31	tlgnum11	1 of 16 chunks of numeric representation of telegram message

Item		Meaning
32	tlgnum10	1 of 16 chunks of numeric representation of telegram message
33	tlgnum9	1 of 16 chunks of numeric representation of telegram message
34	tlgnum8	1 of 16 chunks of numeric representation of telegram message
35	tlgnum7	1 of 16 chunks of numeric representation of telegram message
36	tlgnum6	1 of 16 chunks of numeric representation of telegram message
37	tlgnum5	1 of 16 chunks of numeric representation of telegram message
38	tlgnum4	1 of 16 chunks of numeric representation of telegram message
39	tlgnum3	1 of 16 chunks of numeric representation of telegram message
40	tlgnum2	1 of 16 chunks of numeric representation of telegram message
41	tlgnum1	1 of 16 chunks of numeric representation of telegram message
42	tlgtimestamp	Timestamp of telegram received
43	KeyCodeValue	Key Code
44	LogVehicleID	When a valid SES Vehicle ID is received by the MRU, the MRU records the Vehicle ID and stores the value in EE prom. If the SES does not send a valid vehicle ID the MRU uses the Vehicle ID entered via the MRU maintenance tool. This Value is also stored in EE Prom
	Note There are two types of SES Events • Pulsed • SET/RESET Pulsed events are momentary events. SET/RESET events are events that are first set by the SES and then later reset. When an event is reset by the SES, the SES logically **OR**'s a hexadecimal value of 0x20000 to the events number. Therefore a recorded event of 2XXXX, where XXXX is the event number, indicates that the event was reset by the SES system.	
45	SESEvent1	SES Event number 1
46	SESEvent2	SES Event number 2
47	SESEvent3	SES Event number 3
48	SESEvent4	SES Event number 4
49	SESEvent5	SES Event number 5

Table 3-10 - SES Key Code Functions

The Key Code Function bits describe the type and status of the key code. The Key Code is a 32 bit integer (from 0 to 999,999).

The individual bit disposition within the Key Code Function sub-package:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
S	S	S	S	S	S	S	S	D	D	D	D	P	P	P	P

S – spare (8 bits)
D – Dark Territory Code bits (4 bits)
P – Pass Stop Code bits (4 bits)

Pass Stop Code bits (12..15)
Bit 15: Pass Code entered successfully
Bit 14: Pass Code rejected
Bit 13: Pass Code entered but not validated (i.e. before any transponders have been received
Bit 12: Unused

Dark Territory Code bits (8..11)
Bit 11: Dark Territory entered successfully
Bit 10: Dark Code rejected
Bit 9: Unused
Bit 8: Unused

Note: The Key Code Function bits are set for only one message duration after the operator presses the # key with a code entry prompt displayed on the SDU. The normal state of these bits is all zeroes.

Table 3-11 - DAU Recorded Items

Item		Meaning
1	ThrottlePos	0-8 indicates Locomotive throttle
2	SW	1 indicates Car motor current relay SW is on
3	A1	1 indicates Car motor current relay A1 is on
4	A2	1 indicates Car motor current relay A2 is on
5	A3	1 indicates Car motor current relay A3 is on
6	InvalidThrottle	1 indicates no recognizable throttle position or motor current relay status was computed
7	CSSfail	1 indicates CSS has failed
8	CSSCO	1 indicates CSSS is in cut out mode
9	SESfail	1 indicates SES has failed
10	SESCO	1 indicates SES is in cut out mode
11	AlertAck	1 indicates train operator has acknowledged the alerter
12	PCS (Power Control Switch)	1 indicates PCS is on
13	CabA	1 indicates Cab A is active
14	CabB	1 indicates Cab B is active
15	Forward	1 indicates train movement will be forward direction
16	Reverse	1 indicates train movement will be reverse direction
17	WheelSlip	1 indicates wheels are slipping
18	HandBrake	1 indicates hand brake is applied
19	DynBrake	1 indicates dynamic brake is applied
20	WarnBell	1 indicates warning bell is on
21	WarnHorn	1 indicates warning horn is on

Item		Meaning
22	30/32V	Power supply voltage
23	HeadlightF	1 indicates the front headlight is on
24	HeadlightR	1 indicates the rear headlight is on
25	Ibrake	1 indicates independent brake is applied
26	AlertPnlty	1 indicates penalty brake alert is on
27	AlertAlarm	1 indicates alarm alert is on
28	Y3ModHealth	1 indicates Module Y3's health is good
29	Y1ModHealth	1 indicates Module Y1's health is good
30	Y2ModHealth	1 indicates Module Y2's health is good
31	AnalogModHealth	1 indicates Analog Module's health is good
32	MRUModHealth	1 indicates MRU Module's health is good
33	ADCHealth	1 indicates ADC Health is good
34	Invalid LONWORKS Spare	1 indicates one or more LONWORKS spare bits is non-zero
35	DAU_Link_Status	1 indicates Event Recorder is communicating regularly with LONWORKS link
36	LogBPipePresinPSI	Brake pipe pressure according to LONWORKS inputs
37	LogCylPresinPSI	Brake cylinder pressure according to LONWORKS inputs
38	TMC_Type	1 indicates traction motor current from A/D converter is valid. 0 indicates traction motor current from ItoF Converter unit is valid
39	LocoCar	1 indicates the system is DC, 0 indicates the system is AC
40	EIEBrake	1 indicates the EIEBrake is set
41	LogPropCurrinAMPSorKN	Motor propulsion current according to LONWORKS inputs
42	UsedWhlDiameter	This value represents the value used for Wheel Diameter in speed and distance calculations
43	NumGearTeeth	Number of Gear Teeth on tachometer (Table 4-1)
44	InvalidWhlDiam	1 indicates WhlDiamA and WhlDiamB both = 1
45	LogSpeedAinMPH	Current train speed based on LONWORKS tachAinst input in mph
46	LogSpeedBinMPH	Current train speed based on LONWORKS tachBinst input in mph
47	DistanceTraveledAinFEET	Vehicle distance traveled in feet based on LONWORKS tachAinst input (See Note)
48	DistanceTraveledBinFEET	Vehicle distance traveled in feet based on LONWORKS tachBinst input (See Note)
49	MainReservoirPresinPSI	Main Reservoir pressure according to LONWORKS inputs
50	Analog_Spare_B	Analog Spare data according to LONWORKS inputs
51	Analog_Spare_Health	1 indicates the LONWORKS Analog Spare Health module is healthy
52	REU_Gateway_Health	1 indicates the LONWORKS REU Gateway is healthy
53	ADC_Health_Spare	1 indicates the LONWORKS ADC Spare module is healthy
54	13TlocoBattery	1 indicates the 13T Loco Battery is present
55	EndDoorClosure	1 indicates the vehicle End door is closed
56	CenterDoorClosure	1 indicates the vehicle Center Door is closed

NOTE

When the train is travelling forward, distance traveled is calculated upward with a given maximum distance of 10 miles. When the train reaches the maximum distance traveled, the value for distance traveled, is reset to 0. When the train is travelling in reverse, distance traveled is set to the maximum distance of 10 miles, and then proceeds to towards the minimum distance of 0. When the minimum distance is reached, distance traveled is set back to the maximum distance value of 10 miles.

Table 3-12 - MRU Recorded Items

Item		Meaning
1	Recorder Event	Numeric value representing a Recorder Event (See Table 3-13)
2	MRU SoftwareversionNum	MRU Software version number (displayed as a hexadecimal number)

Table 3-13 - Recorder Event Types

Recorder Event Number	Type of Event	Meaning
1	SYSTEM_INIT_EXTERNAL	External Reset
2	POWER_UP_RESET	Power Up Reset
3	WATCH_DOG_RESET	Software Watch Dog Reset
4	HALT_MONITOR_RESET	Halt Monitor Reset
5	LOSS_CLOCK_RESET	Reset caused by Loss of clock frequency
6	SYSTEM_RESET_INSTRUCTION	System Reset caused by reset Instruction
7	RECORDER_RESET	Recorder Reset (default)
8	RTC_BATTERY	RTC Battery Low
23	CARD_INVALID	Invalid PCMCIA card
27	CARD_NO_CARD	NO PCMCIA card Detected
46	CONFIGRATION_DATA_EEPROM	Error writing to EEPROM
48	STATE_MACHINE_ERROR	State Machine Error managing the PCMCIA card
64	SRAM_MARKER_ERROR	SRAM Marker Error

Recorder Event Number	Type of Event	Meaning
65	SRAM_FORMAT	Error formating SRAM
67	SRAM_INIT_FAIL	SRAM Initialization failure
68	FLASH_INIT_ERROR	Error Initializing flash
69	STATE_CARD_WRITE_ERROR	State Machine Error writing to flash
70	STATE_WRITE_COMPLETE_ERROR	State Machine Error completing the last write to flash
71	STATE_ERASE_COMPLETE_ERROR	State Machine Error completing the last erase of flash
72	STATE_BLOCK_ERASE_ERROR	State Machine Error erasing flash
73	STATE_WRITE_UNSUCCESSFULL	State Machine Error last write to flash was not successful
74	STATE_DEFAULT_ERROR	State Machine input error
75	STATE_READ_BACK_ERROR	State Machine error reading back last data written to flash
76	FLASH_STORE_BOUNDARY_ERROR	Flash partition boundary exceeded
77	FLASH_STORE_EQUAL_ERROR	Flash write buffer error
78	FLASH_FORMAT_ERROR	Error Formatting the PCMCIA card

4 Vehicle Specific Event Recorder Installation

4.1 Wiring for Vehicle Type

Selection of vehicle type is accomplished with wiring of the Loco/Car, Wheel SP2, and Wheel SP3 DAU inputs per Table 4-1.

Table 4-1 - Vehicle Specific Configuration

TMC Type	Loco/Car	Wheel SP2 (Gen A)	Wheel SP3 (Gen B)	Vehicle Traction Type	Axle Generator Teeth	Default Wheel Diameter
0	0	0	0	AC	60	30” (30-32”)
0	0	0	1	AC	88	30” (30-32”)
0	0	1	0	AC	100	30” (30-32”)
0	0	1	1	AC	40	34” (34-36”)
1	0	0	0	AC	40	42” (42-44”)
1	0	0	1	AC	40	49” (49-51”)
0	1	1	0	DC	40	38” (38-40”)
0	1	1	1	DC	100	30” (30-32”)

NOTE

Loco/Car input (J5-18) must be wired with CSS +30V to activate.

Wheel SP2 (J4-20) and Wheel SP3 (J4-29) may also be connected to CSS +30V when the two return lines for SP2 (J4-30) and SP3 (J4-31) are connected to CSS 30V_Return.

4.2 Wiring for Default Wheel Wear

Selection for default wheel wear may be configured per Table 4-2. This parameter is used in the event that a wheel diameter is not entered into the User Configurable Variables using the Maintenance Tool (SM8845D) and that no wheel diameter information has been received via the CSS serial link.

Table 4-2 - Default Wheel Wear

Wheel Dia. A	Wheel Dia. B	Size Over Default
1	0	+2”
0	1	+1”
0	0	+0”

NOTE

The TMC_Type (J4-9) input must be wired with CSS +30V to activate.

Wheel Dia. A (J5-8) and Wheel Dia. B (J5-7) must also be connected to CSS 30V_Return.

4.2.1 Wheel Size Order-of-Precedence

The Event Recorder Executive uses the following order of precedence for determining the wheel diameter used to calculate speed and distance.

1. **Hard Wire**

   "Hard wire wheel size and wear" is the low-level default setting and is used when the configuration wheel size is not set (zero).

2. **User Configurable**

   If a value is entered in the User Configurable Variables for wheel size, it will take precedence over the Hard Wire default configuration. The User Configurable Variables are stored in EEPROM located on the Event Recorder motherboard mounted in the ASES enclosure. This ensures that car specific information remains with the vehicle in the event the MRU's CPU is replaced.

3. **CSS-Supplied**

   If a wheel size is received from the CSS system by way of the serial link, that value will take precedence over both hard wire and user configurable wheel size values. In the event that the CSS serial link is lost, the Event Recorder continues to use that CSS-provided wheel size since it is considered the most accurate.

To ensure data integrity and to allow for possible corrections, the wheel diameter used is recorded in the event log.

4.3 Wiring for DC Traction Motor Current Input Type

Selection between "TMC to Frequency" or Analog input is determined by the wiring of the TMC_Type input as shown in Table 4-3.

Table 4-3 - DC TMC Input Selection

Option	TMC_Type	Configuration
A	0	DC Drive, Frequency Input (ItoF_TMC+ and ItoF_TMC- inputs)
B	1	DC Drive, Analog Input (TMC_+VO and TMC_-VO inputs)

NOTE

The TMC_Type (J4-9) input must be wired with CSS +30V to activate.

In the event that an analog input signal is desired to measure DC traction motor current, a DC TMC Transducer (p/n J705057058) can be installed.

4.4 Wiring For DC "Current to Frequency" TMC Transducers

When a "Current to Frequency" transducer is to be used, ItoF_TMC Return (J5-14) must be connected to Batt_Return and the TMC input signal is to be connected to ItoF_TMC+ (J5-13).

For "Current to Frequency" systems, 0 Hz equals 0 amperes and 10 Hz equals 1500 amperes.

NOTE

Option A in Table 4-3 must be wired for correct operation of the "Current to Frequency" input.

4.5 Wiring For AC or DC Analog TMC System Inputs

When analog traction motor signals are provided (+10V to -10V scaling), the TMC_+VO (J5-17) and TMC_-VO (J5-19) inputs are to be used.

4.5.1 Scaling

For AC traction systems, 1 volt equals 3.4 Kilo-Newton, +/-34 Kilo-Newton range.

For DC traction systems, 1 volt equals 200 amperes, +/-2000 ampere range.

NOTE

Option B in Table 4-3 must be wired for correct operation of the Analog input.

4.6 PC and Maintenance Tool Installation

A laptop PC is required for field maintenance, setup, and data download of the Event Recorder. Reference US&S Event Recorder Maintenance Tool Users Guide (SM8845D).

Install US&S software N451232-2277, Event Recorder Maintenance Tool, by inserting disk 1 (N451232-2278) into the A drive and running :setup.exe.

4.7 Event Recorder General Configuration

Using a null modem cable, connect a PC with the Event Recorder Maintenance Tool installed to the MRU CPU. Turn on the PC and invoke the Maintenance Tool by double clicking on the tool's icon located on the Windows desktop on the PC.

4.7.1 Setting the Real Time Clock

1. Select the **Configuration** tab in the Maintenance Tool.

2. Select the **Set Time** button and either use the default PC time or modify the time displayed; then select **OK**.

3. If the time has been accepted, it is displayed at the bottom of the Maintenance Tool screen; otherwise, an error message is displayed.

NOTE

The Real Time Clock (RTC) automatically adjusts for daylight savings time. The Windows operating system will set the time back on the last Sunday in October and set the time forward on the first Sunday in April. In both cases Windows will alert the user of the time change the first time the PC is turned on after the time is adjusted.

4.7.2 Entering the Default Wheel Diameter and Vehicle ID

The Wheel Diameter and Vehicle ID are stored in EEPROM located on the Event Recorder motherboard within the ASES enclosure.

CAUTION

The wheel diameter and vehicle ID must be set only when the MRU CPU is installed in the ASES enclosure for which it is intended. Failure to do so will result in the loss of the custom User Configuration Variables. (This is because the configuration parameters are stored on the EEPROM located on the ASES motherboard.)

In the event of a software upgrade of the Executive per 7, the custom User Configuration Variables should be verified.

1. Select the **Configuration** tab in the Maintenance Tool (SM8845D).

2. Enter the required vehicle ID number.

3. Enter the wheel diameter in inches, accurate to the first decimal place (for example: "51.3").

4. Once complete, click the "**Update Settings**" button.

5. Enter the configuration password. (The default password as the system is supplied is "**frarecorder.**")

> **NOTE**
>
> The default password for the Event Recorder Maintenance Tool can be changed. To do so, select the **System** tab in the Maintenance Tool, click the **Change** button and follow the instructions on the screen.

6. Click the **OK** button to save the configuration. The User Configuration Variables are now written to EEPROM located on the Event Recorder motherboard within the ASES enclosure.

7. Upon successful update of the configuration, a prompt will appear. Select the **OK** button to return to the Maintenance Tool.

5 Operating Procedures

The Event Recorder is completely automatic and, once set up, requires no operator intervention under normal circumstances. For Calibration, Verification, and Maintenance procedures please refer to 6.

6 Calibration, Verification, and Maintenance

Upon installation of the Event Recorder system, the Event Recorder Maintenance Tool is to be used to verify each of the discrete and analog inputs.

The analog inputs for brake pipe pressure, brake cylinder pressure, and analog traction motor current (TMC) should be periodically checked and, when needed, recalibration must be performed.

NOTE

The battery that maintains the RTC when system power is removed is located on the Recorder Board in the ASES enclosure and should be replaced during routine service every **5 years** with US&S p/n J7051850052 (Section 6.7). Upon replacement, record the replacement date for tracking purposes.

6.1 Monitoring Real Time or Logged Data

To view the real time values (or logged values) for both discrete input indications and analog signals for calibration, perform the following:

1. Invoke the Maintenance Tool and select the **Real-Time Data** (or **Logged Data**) tab. All data variable names in the Event Recorder and their respective unfiltered values can be viewed in the Real-Time Data (or Logged Data) window.

6.2 Brake Pipe and Brake Cylinder Pressure Transducer Calibration

NOTE

Calibration of the brake pipe and brake cylinder pressure transducers is required upon initial installation and also after transducer replacement. It is also recommended that the calibration of the system be checked during the regularly scheduled maintenance of the vehicle. Replacement pressure transducers are available under US&S p/n J7248250019.

Calibration should be performed by first zeroing the corresponding scaling amplifier located on the DAU Analog PCB. Once both channels are “zeroed” with no air pressure applied, apply a known pressure to the brake system. Using a reference pressure gauge that has been certified, “span” the corresponding scaling amplifier so that the value displayed with the Maintenance Tool matches the reference pressure gauge reading. A label located on the inside cover of the DAU identifies the corresponding adjustment pots to be adjusted on the DAU Analog PCB for routine calibration.

The **Brake Pipe** pressure transducer is identified by the reference variable "**logBPipePresinPSI**" displayed by the Maintenance Tool (SM8845D).

The **Brake Cylinder** pressure transducer is identified by the reference variable "**logCylPresinPSI**" displayed by the Maintenance Tool (SM8845D).

6.3 Main Reservoir Pressure Transducer Calibration

NOTE

Not all vehicles are equipped with a Main Reservoir Pressure Transducer.

For those that do, calibration of the Main Reservoir pressure transducers is required upon initial installation and also after transducer replacement. It is also recommended that the calibration of the system be checked during the regularly scheduled maintenance of the vehicle. Replacement pressure transducers are available under US&S p/n J7248250019.

Calibration should be performed by first zeroing the corresponding scaling amplifier (Zero A) located on the REU Analog PCB. Once the channel is "zeroed" with no air pressure applied, apply a known pressure to the brake system. Using a reference pressure gauge that has been certified, "span" the corresponding scaling amplifier (Span A) so that the value displayed with the Maintenance Tool matches the standard gauge reading.

For calibrating the **Main Reservoir Pressure** pressure transducer, reference variable "**MainReservoirPresinPSI**" displayed by the maintenance tool.

6.4 Traction Motor Current Calibration (if required)

Similar to the calibration of the pressure transducers described in Section 6.2, the analog traction motor current amplifier must also be calibrated **but only when an analog TMC interface signal is used**. For most DC traction motor systems a "TMC to Frequency" converter is provided (by others) and no calibration is necessary for the Event Recorder; only verification of the measured values is required. Refer to Section 4.3 to determine the TMC input type. If AC Traction Motor Type is selected, the TMC values recorded will be in Kilo-Newtons; otherwise, the values will be in amps.

The TMC input is identified by the reference variable "logPropCurrinAMPSorKN" displayed by the Maintenance Tool (SM8845D).

6.5 Discrete and Serial Link Indication Verification

To verify the remaining discrete inputs and indications provided by the CSS, SES, and DAU serial links, refer to the US&S application-specific programming specification.

6.6 Data Retrieval

Data retrieval from the Event Recorder may be accomplished several different ways. For data archival and manipulation purposes, it is recommended that the MRU be powered down, the PC Card removed from the MRU CPU, and the PC Card be read directly via a PCMCIA socket installed in a personal computer and the Union Switch & Signal Playback Tool (SM8845C).

6.6.1 Using the Playback Tool for Data Retrieval

Refer to the detailed instructions on the Playback Tool's operation and features in the US&S Event Recorder Playback Tool User's Guide (SM8845C) for more information.

1. Remove power from the Event Recorder's MRU CPU.
2. Place the PMCIA Card's Write Protect switch in the Write Protect position and remove the card.
3. Install the PCMCIA Card in a PC that has the Playback Tool installed.
4. Invoke the Event Recorder Playback Tool (an icon should be present on the desktop of the PC).
5. Under File, select Import from PC Card.
6. Select the desired time frame for the data study.
7. Select the variable names to display and the format for the display. It is suggested that the Telegram data be displayed as hex.
8. If desired, reorder the variable names so that the variables are in logical order and groupings. The variable order affects the display of tabular data, graphing, and comma delimited files.
9. Once the date variables have been selected and sorted, the configuration can be saved for future use. To do so, select Setup and then Save As. Enter an appropriate file name to the prompt and select OK. All Playback Tool Setup Files are given a ".pbs" extension (SM 8845C).

6.7 RTC Battery Replacement

The RTC battery maintains the RTC when power is disconnected from the recorder. It should be replaced every five years during normal maintenance procedures on the ASES system

The battery is located on the back of the front panel of the Recorder board in the ASES enclosure. The board is removed from the enclosure and the daughter board is removed to gain access to the battery. The battery is replaced as follows:

1. Remove the Recorder board from the ASES enclosure.
2. Remove the five screws that secure the daughter board to the motherboard on the Recorder and carefully lift the daughter board from the motherboard (Figure 6-1). This will allow access to the battery holder.

3. Remove the two screws, along with the two nuts that secure the battery holder to the back of the recorder board front panel (Figure 6-2).

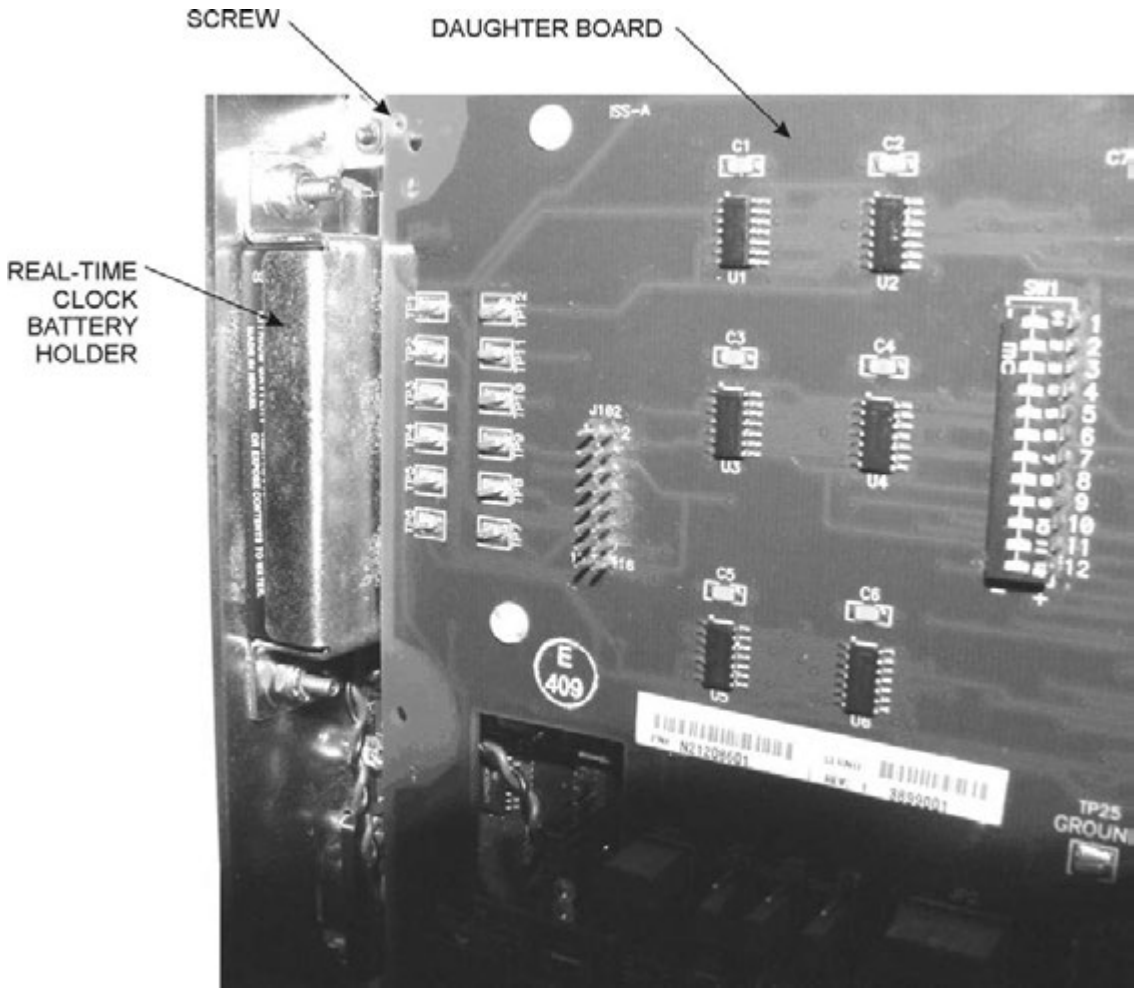

Figure 6-1 - Daughter Board on the Recorder Board

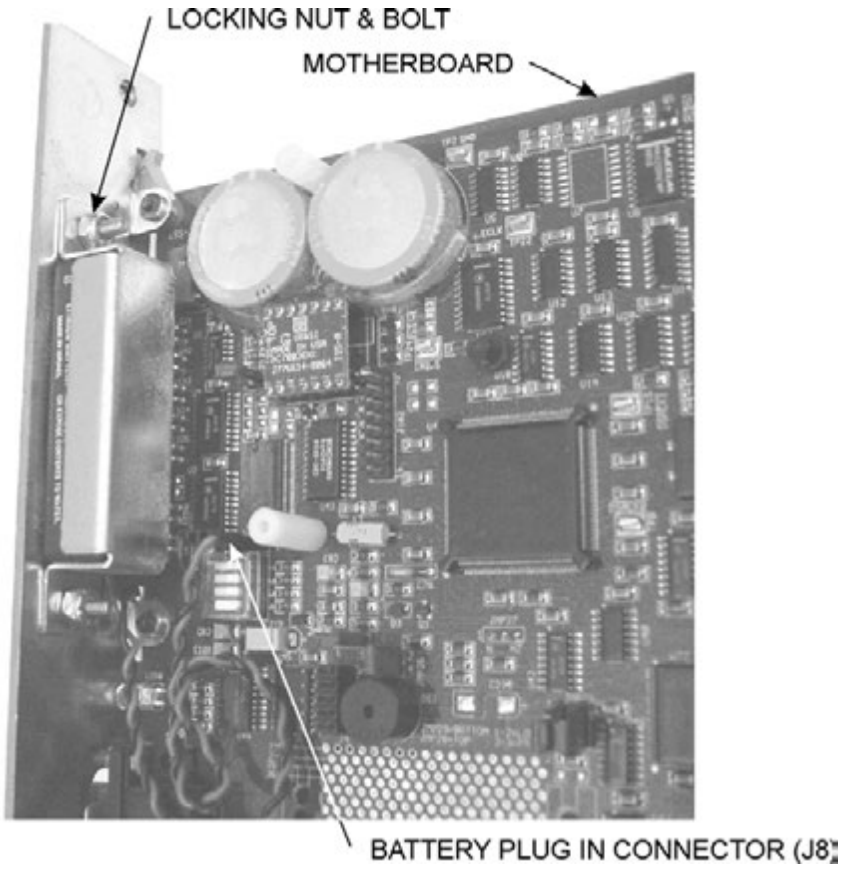

Figure 6-2 - Recorder with Daughter Board Removed

4. Lift the battery holder from the Recorder board and disconnect the battery lead from the board (Figure 6-3).

5. Remove the battery from the battery holder and insert a new battery into the holder.

6. Connect the battery lead to connector J8 on the Recorder motherboard.

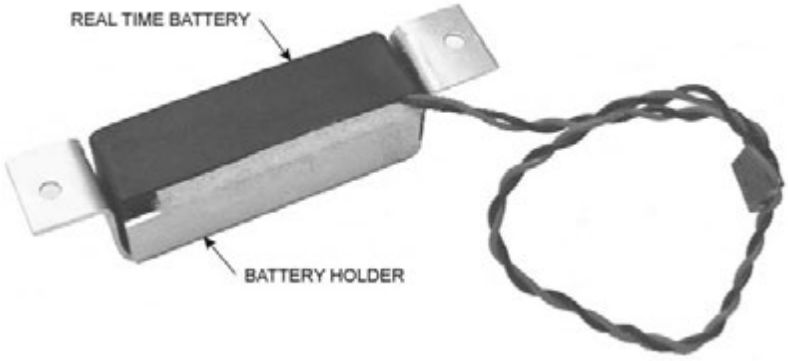

Figure 6-3 - Battery and Battery Holder

7. Position the battery holder in place on the back of the Recorder front panel.
8. Using the two screws and nuts removed in Step 3, secure the battery holder to the panel.
9. Position the daughter board on the motherboard and firmly seat the connectors.
10. With the daughter board firmly attached to the motherboard, secure the daughter board with the five screws removed in Step 2.
11. Replace the Recorder board in the ASES enclosure.

7 MRU CPU Software Upgrades

Software upgrades are performed using the Event Recorder Maintenance Tool (SM8845D).

The MRU Executive software is provided on a 3 ½“ floppy disk. The file contained on the disk is given an “.abs” file extension so that the maintenance tool can recognize the file. Event Recorder Executive software upgrades, if required, are obtained by ordering US&S p/n N451232-2281.

NOTE

Any time a software upgrade is performed on the Event Recorder’s MRU CPU, the user configurable variables, which are stored in EEPROM on the recorder motherboard, should be verified for correctness. To do so, select the **Configuration** tab in the Maintenance Tool and check the User Configurable Variable values displayed. If any changes are required, refer to Section 4.7.

7.1 MRU Software Upgrade Process

Software upgrades are installed on the PC using the Maintenance Tool (SM8845D) as follows:

1. Using the Event Recorder Maintenance Tool, select the **System** tab.
2. Click on the “Load” button.
3. When prompted, select the file to be loaded. Typically software upgrades are performed from a 3-½” floppy disk inserted in the computers floppy disk drive (a:). Select the Executive software file “asesrcdr.abs”.
4. Reset the MRU CPU when instructed. The erase and loading process should start. The software loading process may take a minute or two to complete.
5. When completed, select “OK” to restart the MRU CPU with the newly loaded executive.
6. Exit the Event Recorder Maintenance Tool, and then re-enter the Maintenance Tool.
7. To verify the new executive version, select the **Configuration** tab in the Maintenance Tool. The software version is displayed below the User Configurable Variables.

NOTE

Always exit the Event Recorder Maintenance Tool and then re-enter the Maintenance Tool after installing the new MRU Executive software.

8 System Indications

8.1 Remote Mounted Fail Indication

Indication	Status
Remote Fail	**Off – Okay** Flashing – No FRA data has changed in 24 hours On – Failure

In the event of a remote fail indication, proceed to the tables in Sections 8.2 and 8.3 for further diagnostics.

8.2 MRU CPU Indications

Indication	Status
CSS Link	**Flashing – Link Okay** Off – Link Fault On- Link Fault
SES Link	**Flashing – Link Okay** Off – Link Fault On- Link Fault
DAU Link	**Flashing – Link Okay** Off – Link Fault On- Link Fault
PC Card	**On – Okay** Off – No Card Detected Slow Flashing – Write Protect Fast Flashing – Card Being Formatted/Erased (See Note at end of this section)
Network Fault	**Off – Okay** On – LONWORKS Fault Flashing – RTC Battery Failure
On-Line	**On – Okay** Off- System off-line
Vpp	**On – Okay** Off - PCMCIA programming voltage is not available

NOTE

If the PCMCIA card is missing, write protected, or if there is an error writing to the card, the MRU CPU board will beep (about once a second).

In this case, ensure that the PCMCIA card is properly installed in the MRU PCMCIA card slot. If the problem persists, replace the PCMCIA card.

8.3 DAU Indications

Indication	Status
Watch Dog (Left)	**Flashing – LONWORKS Serial Gateway Okay** Off – Fault On – Fault
Fault (Center)	**Off – Okay** On – Fault of LONWORKS Module or MRU link
Valid Data (Right)	**Flicker – Okay - MRU link up, confirmation received** Off – Fault MRU link down

9 Parts List

Description	US&S Part Number
Data Acquisition Unit top Assembly	
with PSG-10	N26404302
with PSG-20	N26404303
DAU Motherboard	N26501801
DAU Interface	N26501501
DAU Power Supply (20V – 90V)	N26501701
DAU Network Manager Board	
with PSG-10	N26501201
with PSG-20	N26501202
DAU Analog Input Board	N26501901
DAU Discrete Input Board Assembly	N26502001
Main Recorder / CPU Assembly	N17061306
MRU Power Supply/Interface Assembly	N26561102
MRU Motherboard	N26500502
4-Mb PCMCIA FLASH Memory Card	J7031050107
Real Time Clock Battery	J7051850052
Pressure Transducer (150 psi)	J7248250019
Software	
Event Recorder Maintenance Tool	N451232-2277
Event Recorder Executive	N451232-2281
Event Recorder Playback Tool	N451232-2264
ASES SES PTU Tool	N451232-2542
DAU MRU Power Supply	N451575-2901
DAU Y1 Input	N451575-2902
DAU Y2 Input	N451575-2903
DAU Y3 Input	N451575-2904
DAU Analog Input	N451575-2905
DAU NM PSG10	N451575-3201

10 Drawings

This section contains the engineering drawing for the Event Recorder and Data Acquisition Unit.

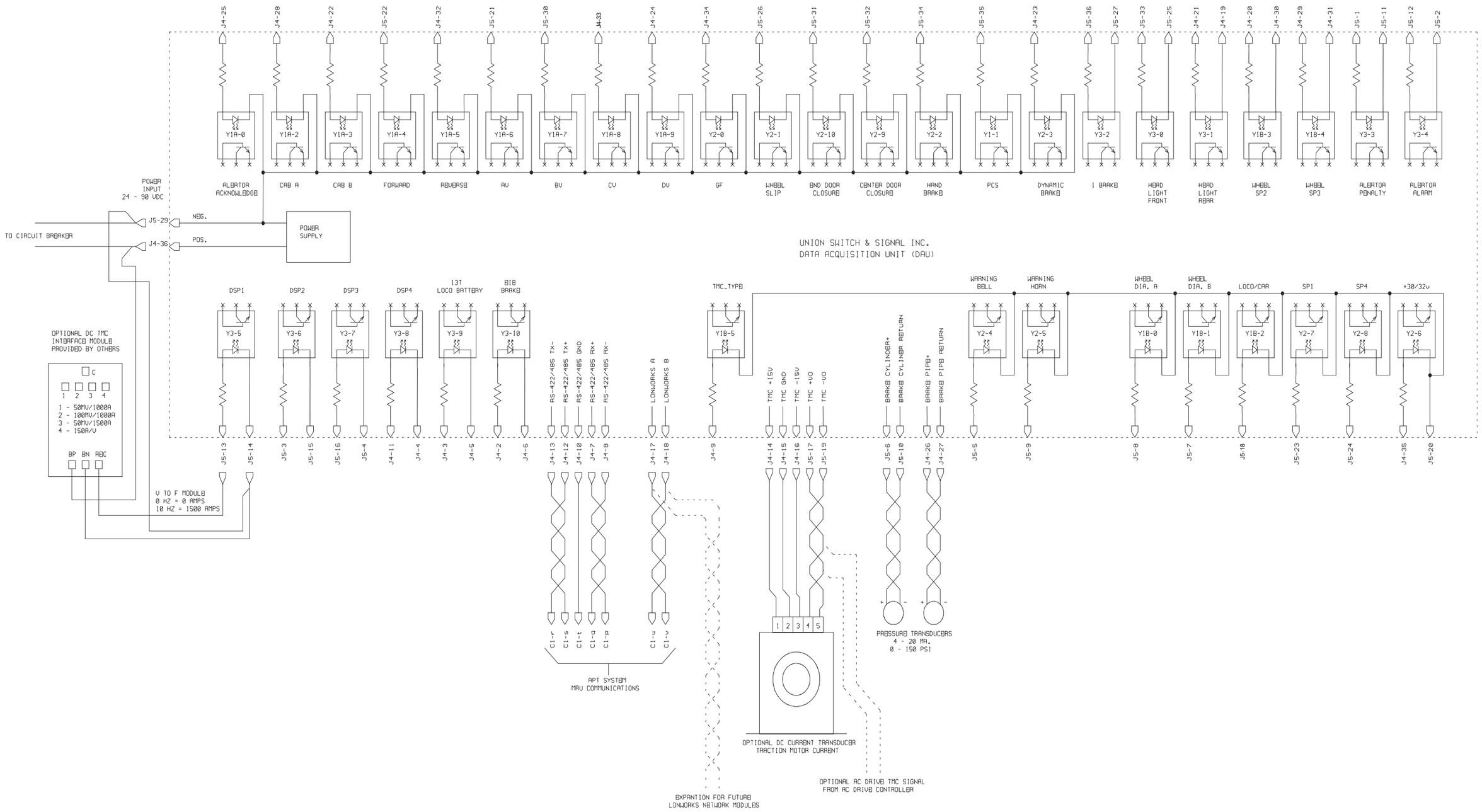

Figure 10-1 - Event Recorder – Data Acquisition Unit