Manual

STARLOG

Starlogger Hardware

Model 6004C

Revision History

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Previous version BX	2004	RS/ JH
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1. INTRODUCTION

The STARLOGGER (Model 6004) is a battery powered data gathering unit manufactured by UNIDATA. It is ideally suited for automatic data collection at remote, unmanned locations. The STARLOGGER incorporates the latest advanced CMOS technology and intelligent auto calibration techniques to provide a very accurate, low cost, programmable data collection system.

The STARLOGGER is an upward compatible development of the STARLOG Portable Data Logger (Model 6003) - it offers all the features of the Portable Data Logger plus the extensions provided by 10-bit resolution and universal memory storage. Like all STARLOG products it is battery-powered, has a simple robust construction, is available at a low cost, and has a universal application.

The STARLOGGER is designed to be operated with either Version 2 or Version 3 STARLOG Software Support Package (Models 6300 and 6301).

1.1. How to Use this Supplement

This supplement provides technical details for users of the STARLOGGER. It is divided into several chapters. Each chapter describes a different part of the STARLOGGER. In addition, a set of Appendices provide information for very advanced users. Brief introductions to these chapters appear below.

> **STARLOGGER** – introduces the STARLOGGER and gives a brief summary of its features and operation.

> **Specifications** – lists physical and performance specifications and explains battery and memory capacity options.

> **Power Supply** – describes how to change battery packs, use an external power supply and how to test and monitor power supply.

> **Installation & Connection** – describes how to connect instruments to the Logger and initialising the Logger.

> **Internal Channels** – a listing and explanation of two special channels.

Computer Communication – lists the specifications for communication with a computer and explains in detail the most common method of interface.

STARLOGGER Programming – describes STARLOGGER programming techniques if you intend to program your own Logger.

Configuration Table – describes how a STARLOGGER is configured - it identifies and explains that particular part of memory and how it is used.

Test Diagnostics – explains how to use inbuilt diagnostic firmware to test and calibrate the STARLOGGER.

2. STARLOGGER OVERVIEW

This chapter provides an overview of the STARLOGGER's features, including its programming and operation.

As a major design development in the STARLOG range, the STARLOGGER has an expanded signal capacity and range, and easier programmability. It offers 12 input channels, two high speed serial input/output busses and two outputs. It also provides two power sources for external instruments. The range of scan rates extends from 125 milliseconds to 5 minutes. (See Chapter 3 for a list of exact operational specifications.)

The STARLOGGER communicates using standard asynchronous RS-232 serial communication standards which allow it to communicate with an IBM PC or compatible computer using a standard cable. (See Chapter 7, Computer Communication.)
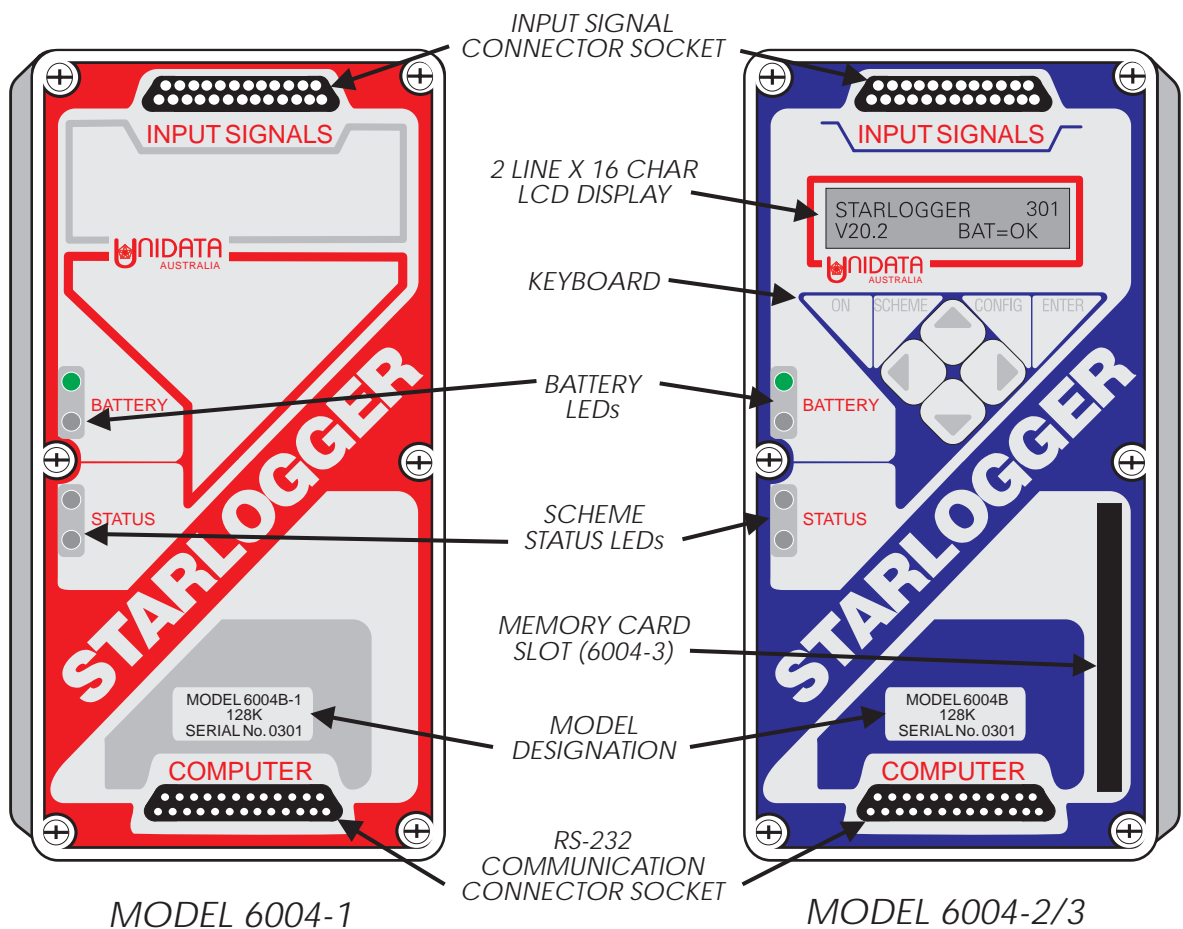
Figure 2.1 – Front Panel Layout

All setting up and adjustments associated with range changing and calibration are performed by firmware. Full programmability is provided by STARLOG Software Version 2.1. (See Chapter 8, STARLOGGER Programming, for more details.)

The STARLOGGER was designed for very low power consumption. Power is provided by an internal battery with a typical life of one year. Data is stored in a 128K low power CMOS RAM memory. An internal crystal clock provides accurate time referencing of all recorded data and also controls the adjustable scan rate. The Logger's only external connections are: a connector (labeled **INPUT SIGNALS**) for instrument inputs, user power supplies, and controls; and a connector (labeled **COMPUTER**) used for communication with a computer.

The STARLOGGER and its battery are housed in a small, robust, dustproof enclosure. Exact hardware specifications are listed in Chapter 3.

2.1. Model Variants

The STARLOGGER is available as a basic unit (Model 6004-1), with a display (Model 6004-2), and with a Memory Card (Model 6004-3). The correct product identification, memory size and serial number are shown in the Model Description window in the front panel (figure 2.1).

Model Description:

Model <u>6004C</u>

Model Number

Revision
A Released 1 Jan '93
B Released 1 Apr '94
C Released 1 Mar '97
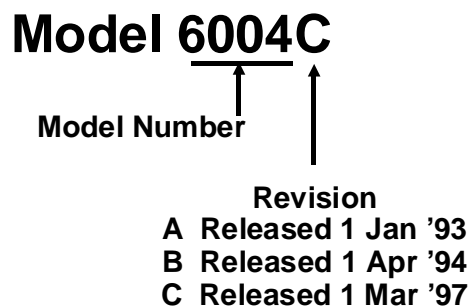
2.2. Programming Overview

The STARLOGGER is a microprocessor based device designed to be programmed using Unidata's STARLOG Software Package (Version 2). This package - designed to run on IBM PC-compatible computers - creates and implements instructions that control the Logger.

Through a series of windows and menus, the STARLOG Software Package allows you to define how and when the STARLOGGER records, what channels to record and what signal types to measure. These definitions are complied by the package into a list of instructions to be interpreted by the STARLOGGER.

» Note: The STARLOGGER must be programmed before it will record/log or display readings.

STARLOG Software generates a set of instructions to program the STARLOGGER. These instructions are explained in the STARLOG Programmer's Supplement (6201). If you do not use STARLOG Software, then you require these instructions in order to program the STARLOGGER.

2.3. Operation Overview

The STARLOGGER must be "initialised" before it can be used. This is done automatically when you load a scheme.Alternatively, you can manually initialise the Logger (see Chapter 5). Note that when delivered, the STARLOGGER is in a "shutdown" state to conserve batteries and must be initialised before use.

The STARLOGGER switches on once a scan. The scan rate is specified by the user. It performs three operations each time it is switched on: scanning, inter-log analysis, and RS-232 "comms" check. It performs a fourth operation, logging, at a user-specified interval. These operations are described below:

❶ Scan rates, which may be from 125 milliseconds to 5 minutes, determine how frequently the Logger switches on. When it switches on the logger scans its input signals. These signals, called the "hardware values", are recorded in the STARLOGGER memory. The hardware values are updated in the logger memory every scan.

❷ Then the logger program runs and performs an "inter-log" analysis of the hardware values, storing the analysed values in a different part of the logger's memory (referred to as the Register). The operations done at program run time in the "inter-log analysis" include: averaging and storing maximum, minimum and raw values. For instance, if a certain channel is programmed to store maximum values of its input, the logger will check to see if the hardware value is higher than the value already stored in the Register. If so, then it updates the Register. If not, then it changes nothing and goes to the next instruction. The Register is used to store data between log intervals.

❸ Next, if the STARLOGGER is operating in SCAN SYNCHRONISED communications mode (default) the logger checks to see whether it is connected to a computer. If so, it sends a prompt (*C/R) to the computer and awaits a command response.

❸ Next, if the STARLOGGER is operating in SCAN SYN-
CHRONISED communications mode (default) the logger
checks to see whether it is connected to a computer. If so, it
sends a prompt (*C/R) to the computer and awaits a command
response.

❹ When the scan occurs at a log interval, the logger program re-
cords data found in the Register into another part of its mem-
ory. Here, the data remains until the logger is unloaded (or until
the entire memory storage space is filled, then earlier stored
data may be overwritten when recent data is logged).

❺ Finally, it switches off.

This sequence repeats every scan interval.

2.3.1. Compatibility Modes

The STARLOGGER operates in either Standard (6004) or Compatibility (6003)
Mode. The operating Mode is selectable via the STARLOGGER keyboard or by
loading a Scheme.

Standard (6004) Mode – Default setting. This allows you to use all of the new
features of the STARLOGGER, including:

- *Analog Channels available as (8 bit, a0 – a7, and 10 bit, h0 –
  h7) 10 bit resolution*
- *16 bit resolution Counter Channels*
- *Asynchronous RS-232 computer communication
  (selectable)*
- *Internal channels (Temperature and Battery)*

In this mode, Schemes created for the *Model 7000 Macro Data Logger* may also
be loaded into the STARLOGGER.

Version 2.1 (or later) STARLOG Software supports 6004 Mode.

Compatiblity (6003) Mode – This mode enables the STARLOGGER to be used
in place of a *Model 6003 Portable Data Logger* and be programmed using earlier
versions of the STARLOG Software Package. It reconfigures the
STARLOGGER to use only 8 bit analog channels, 4/8 bit counters, no internal
channels, and the Portable Data Logger computer communication standard
(see section 9.8).

6003 Mode is selectable from the keyboard on the Model 6004-2 and Model
6004-3 STARLOGGERs after a Scheme is loaded. However, if you are using a
Model 6004-1 STARLOGGER, you can use Version 2 Software to enable

Compatibility Mode by defining a Scheme which includes a special code in the Scheme Title (see section 9.8).

Users of Version 3 Software cannot select 6003 Mode: use the **CONFIG** key on the STARLOGGER keyboard.

2.4. Input Signals

The STARLOGGER offers 12 channels for input signals. These are:

- *8 Analog channels (any combination of up to 8 single-ended voltage inputs, 10-bit resolution) These channels accept signals from +255 millivolts fullscale to +2.55 Volts fullscale.*
- *2 High Speed Serial Ports (bi-directional synchronous, eight 16 bit channels on each) Note: Version 2 Software supports only 7 channels (s0 to s6).*
- *4 Counter input channels (16-bit resolution)*
- *2 Sense input channels (used for LOG START and SDI-12 signals)*

The STARLOGGER has a number of operating modes for its analog inputs. Analog inputs are available as low resolution (8 bit, a0 – a7) or high resolution (16 bit, h0 – h7) which a user can change, and calibration factors. (See Chapter 9, Configuration Table.)

For more about inputs see Chapter 5, Installation and Connection.

2.4.1. Instruments

To complement the Data Logger, a range of low power instruments and sensors is available. They can be powered either by the Data Logger's battery or their own battery and are designed for direct connection to the Data Logger.

2.5. Outputs

The STARLOGGER offers two outputs and two power sources for external instruments.

The outputs have a wide range of uses, for instance; to set off an alarm, or switch on another device.

The two "user power sources" (UPS) – described fully in Chapter 9, Configuration Table – are:

- *+5 Volts regulated, scan synchronised*
- *+6 Volts unregulated, continuous*

2.6. Memory Capacity

Two memory sizes are available in the STARLOGGER: 128K or 128K plus a user selected Memory Card from 256K up to 16,384K (16M).

The logging duration of the logger depends on the scheme. It is calculated by the Software once the scheme is created (see Scheme Information menu).

The calculation includes the following:

$$\text{Number of Days} = \{(K-8)*1024\} * \frac{LI}{1440} * \frac{1}{LS}$$

```
K       =    Memory size (in k)
LI      =    Logging Interval (in minutes)
LS      =    Log Size
1024    =    the number of bytes in a K
1440    =    the number of minutes in a day
```

Log Size   The Log Size is the sum of bytes used per channel. The bytes used per channel varies depending on the Log Action (raw reading, totalise to 1 or 2 bytes, etc.) and the capacity of the channel {a counter channel may use from 1 to 4 bytes, while a serial channel is usually 2 bytes, an analog channel may use 2 bytes (hi-resolution) or 1 byte (lo-resolution)}.

Eg.: A typical weather station logging raw readings for wind speed (1 byte), temperature (1 byte), solar radiation (1 byte) and relative humidity (1 byte) every half hour in a 128K STARLOGGER would record for:

$$\text{Number of Days} = (128-8)*1024\} * \frac{30}{1440} * \frac{1}{4} = 672 \text{ Days}$$

2.7. Status Indicators

The STARLOGGER has four LED indicators which flash briefly each scan (5 seconds) to show status of the battery and logging Scheme.

2.7.1. Battery Status LEDs

The top two indicators (labelled **BATTERY**) show the internal battery status (see section 4.3).

2.7.2. Scheme Status LEDs

When the STARLOGGER has been programmed with a Scheme (using Version 2 Software) the lower two indicators show the status of the Scheme operation.

LED On	Description	State
none	Waiting to be unloaded	Stopped
	Waiting for input signals to be connected.	Primed
Green	Waiting to begin logging.	Primed
Green & Red	Actively recording.	Logging
Red	(No Scheme loaded.)	(Invalid)

2.8. Display and Keyboard

STARLOGGER Models 6004–2/3 have a 32 character Liquid Crystal Display (LCD) and an eight key operator keyboard.

LCD
DISPLAY

STARLOGGER   301
V20.2   BAT=OK

LINE 1
LINE 2

KEYBOARD

ON   SCHEME   CONFIG   ENTER
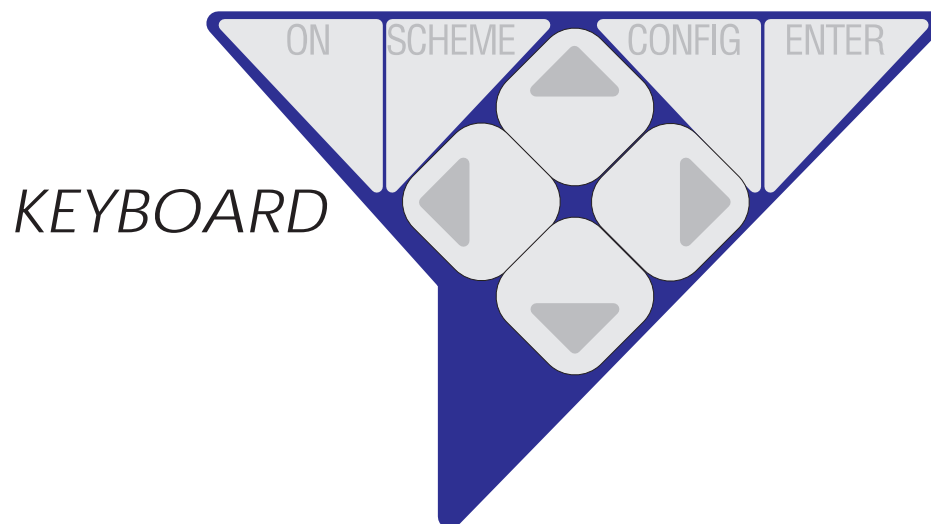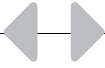
Figure 2.2 – Model 6004-2/3 Display and Keyboard

The Display may be activated by pressing the ON key. The Display will turn OFF automatically after a delay of 20 seconds (when no further keys have been pressed).

» NOTE: Whilst the Display is active, the STARLOGGER is in high power mode and uses about 100 times more battery power than in normal scanning mode.

2.8.1. Keys Definition

ON	Actives Display and displays the first entry of the **STATUS LIST**.
SCHEME	Displays the first entry of the **SCHEME LIST**.
CONFIG	Displays the first entry of the **CONFIG LIST.**
ENTER	Used only in the **CONFIG LIST** to save the current SETUP entry or perform the current SETUP action.
	Scroll UP ▲ or DOWN ▼ the current list entries.
	Adjust the current CONFIG entry UP in value ▶ or DOWN in value ◀ . Used only in **CONFIG LIST**.

2.9. Using the Keyboard and Display

The Display shows you three lists of useful information.

STATUS LIST – Lists information about the logger, battery and channel readings (unscaled).

SCHEME LIST – Lists details of the current Scheme compose by STARLOG Software V2.1. This is normally blank unless a Scheme has been loaded.

CONFIG LIST – Lets you adjust some logger configuration parameters (change the scan rate) and execute some useful commands (such as, setting the logger to the "sleep mode").

> **IMPORTANT !**
> **Saving altered Setup Entries using the Enter key will cause data stored in memory above 64K to be lost.**

2.9.1. Selecting a Display List and List Entry

Whenever the **ON**, **SCHEME** or **CONFIG** keys are pressed the first entry in the Status, Scheme or Config list is displayed. Note: The **ON** key will also turn the Display **ON** if not already on.

By pressing the scroll keys, you display the next Entry in the list (▼ DOWN key) or the previous Entry (▲ UP key).

» NOTE: Entries may be one or two lines, therefore the scroll keys will move the Display UP or DOWN one or two lines, depending on whether the Entry is two lines or not.

2.9.2. Auto Key Repeat

When a key is held down, it automatically repeats. This is a quick way to scan up or down a list of display entries. (Releasing the key stops the repeat mode).

2.9.3. Adjusting a Config Entry

To alter a Logger Config Entry, scroll to the desired Entry in the Config List and

use the Adjust keys ◄ ► to adjust the Config Entry to the required settings, then press **ENTER** to save the new setting PERMANENTLY. If you do not want to save the Config Entry, press any other key (or no keys at all).

> **IMPORTANT !**
> **Pressing the Enter key whilst displaying a Config Entry with the message "...use ◄ ► & ENTER" on Line 2 will cause data stored in memory above 64K to be lost.**

2.9.4. Commands in the Config List

Some entries in the Config List are simple commands, they do not use the

Adjust keys ◀▶ and they do not cause loss of memory when executed (**ENTER** pressed). A useful command "TURN DISPLAY OFF" is the first entry in the Setup List. Therefore, whenever you have finished viewing the Display, press **CONFIG**, then **ENTER** keys.

» Note: The Display will automatically turn OFF anyway after 20 seconds if no keys are pressed.

2.9.5. Using a PIN# (Password)

The Model 6004-2 and 6004-3 STARLOGGERs are fitted with a keyboard and display. This enables you to configure various functions of the logger without a computer. To ensure that only authorised users alter the operation of the logger, an optional 4-digit PIN# (personal identification number) may be entered. The factory default for the PIN# is 0.

To change this PIN#, turn the display **ON** and then press **CONFIG**. Press the down arrow until CHANGE PIN# appears in the display. Press the left arrow key to select the digit and then the up or down arrow to alter the digit. Once you have selected a suitable 4 digit number, press the **ENTER** key. It is now impossible to change important configuration settings until the PIN# is re-entered.

Once a STARLOGGER has been protected by a non-zero PIN#, you must re-enter the correct PIN# before altering a configuration via the keyboard.

1. Turn the display **ON** and then press **CONFIG**.

2. Press the down arrow until ENTER PIN# appears.

3. Select the correct 4-digit code (using the arrow keys) and press **ENTER**.

   You may now alter the logger's configuration.

To change the PIN#, you must enter the old PIN# first. A PIN# of 0 means that all settings may be changed without PIN# validation. (DEFAULT)

WARNING:
As with all PIN#s, if you forget the PIN#, you are in trouble. The STARLOGGER will operate normally but you will not be able to use the keyboard configuration facility until the STARLOGGER is returned to UNIDATA for service.

2.9.6. Displaying the Scheme List

The Model 6004-2 Display STARLOGGER and Model 6004-3 Memory Card STARLOGGER have a two-line liquid crystal display (LCD) and eight key keyboard.

The display can be set-up by Version 2.1 Software to enable you to examine the actual values being recorded by the various transducers connected to the logger. This Scheme Display List contains information similar to the Scheme Test Mode screen (in Version 2). A one-line display entry is provided for each Scheme Test Mode entry. You view two entries (lines) on the display at a time.

When the up/down scroll keys are pressed the display moves up/down this list one line at a time.

To view the readings of each transducer:-

1. Press the **ON** key firmly, the following is displayed:-

    ```
    STARLOGGER  900
    V022.01 BAT=OK
    ```

2. Press the **SCHEME** key firmly

    ```
    09:14:50 30APR93
    Scheme: RMTEMP
    ```

3. Press the ▼ down key firmly

    ```
    Scheme: RMTEMP
    Status: Primed
    ```

4. Press the ▼ (down) key firmly.

    ```
    Status: Primed
    Memory: 121K Free
    ```

5. Press the ▼ (down) key firmly.

    ```
    Memory: 121K Free
    Log Inter  10 mins
    ```

6. Press the ▼ key again.

```
┌─────────────────────────────┐
│ Log Inter  10 mins          │
│ Temp  22.7deg C             │
└─────────────────────────────┘
```

7. Continue pressing the ▼ until the end of the display list (the screen is blank).

8. Press **CONFIG** then **ENTER** keys to turn the display OFF.

»   The display turns OFF after 20 seconds, if no keys are pressed.

»   If the instrument being displayed uses a non-linear correction formula (such as a thermistor or wind direction) then the uncorrected (raw) mV reading will be displayed without units.

2.10. Differences with Model 6003 Portable Data Logger

2.10.1. Input Signals

The following inputs are different from the Portable Data Logger:

Pin	Model 6004	Model 6003
14	Analog Ground	Analog and Digital Ground
15	Digital Ground/HSIO Sync	Digital Ground
16	External Power IN	External Power/Battery Voltage
18	Battery Voltage	Unused
20	Sense 1/SDI	Sense 1

For improved signal measurement accuracy, use the Grounds as specified under Model 6004 above. Pin 14 should only be used for Analog Ground, not Digital Ground. Pin 15 should not be used as a power or signal ground, instead use Pin 23 for the Digital Ground.

Pin 16 cannot be used to measure battery voltage. However, it can be used to connect External Power. Battery voltage is monitored and displayed via the BATTERY indicator light or can be logged (see section 4.4).

Pin 18 provides power to external instruments (as does Model 6003 Pin 16).

Pin 20 now defaults to a low state (0) whereas in Model 6003 it defaulted to a high state (1). In 6003, to change the sense input to 0, it was pulled down, but now to change the input, it must be pulled high to 1.

2.10.2. Computer Communication

A simple one-to-one cable connects the STARLOGGER to a standard COM1: computer port. This is possible because the STARLOGGER supports RS-232 signal levels and the computer connector is a socket. This is different from the Portable Data Logger computer connection which supports TTL levels and requires a Model 6800B RS Interface. See Chapter 7 for details.

2.10.3. Battery Packs

The STARLOGGER battery pack is not interchangeable with previous versions. It has two wires (red and green) and is not fitted to a metal plate. Instead, it sits in a metal retainer in the logger enclosure. See Chapter 4 for details. Battery type (Alkaline or NiCad) is detected by STARLOGGER for low battery warnings. The Model 6405 Tester does not indicate a low battery condition.

3. SPECIFICATIONS

This chapter lists the physical and performance specifications of the STARLOGGER. (See also, Chapter 5, Installation and Connection.)

Material:	Grey, high impact rigid P.V.C.
Size:	211 x 108 x 81mm (H x W x D)
Weight:	2 kg incl. battery
Operating Temp:	-20°C to 60°C, not effected by humidity
Scan Rate:	0.125 second to 5 minutes programmable
Log Interval:	0.125 second to 1 week programmable
Memory:	Low power CMOS RAM 128K standard 68 pin JEIDA/PCMCIA Memory Card (256K to 16M) (Model 6004C–3)
Time Clock:	Crystal regulated, ±10 seconds per month
Analog Inputs:	8 channels, 10-bit resolution Unipolar, single ended
Counters:	4 channels, 16-bit resolution
STARBUS:	2 High Speed Serial lines with 8 channels on each, 16 bits, bi-directional, synchronous data & clock
SDI-12:	optional 1200 Baud instrument channel
Controls:	2 channels, 1 CMOS output 1 uncommitted open collector output
Computer I/O:	Full duplex, Serial, RS-232C, Baud rates: 300/1200/2400/4800/9600/19200/38400/76800
Processor:	8 bit, 80C31 microcontroller, 14.7456 MHz
Battery Life:	Alkaline 1 year (typical), or rechargeable NiCad
Flat Battery Shutdown:	5.6 Volts
Instrument Power:	+5 V DC regulated 250ma (user programmable Model 6004C only) +6.5 V DC unregulated 1 mA continuous

Signal Specifications

Counter Channels:	DC to 20 kHz potential free contact or 0–5 V DC digital input	
Analog Channels:	Voltage input in two ranges, programmable 0 to 2.550 Volts, 2.5 mV resolution 0 to 255 mV, 250 μV resolution	
Input Impedance:	>1 MΩ	
Load Impedance:	for signals <500 mV:	>1 MΩ
	for signals >500 mV:	10 kΩ

Recommended Source
     Drive Impedance: <10 kΩ

Model 6910A	
Scan Rate	**Life**
0.25	16 days
1	66 days
5	330 days
10	660 days

4. POWER SUPPLY

This chapter describes the uses of internal and external power supplies for the STARLOGGER, including a "low battery shutdown" feature. All STARLOG Data Loggers are powered by internal battery power. External power sources can be used either as an alternate supply or to recharge batteries (NiCad and Sealed Lead Acid only).

A battery must remain connected at all times to protect memory storage. Provision is made for fitting a Lithium back-up battery to protect memory storage if the main battey is removed or fails.

4.1. Internal Battery Pack

The Data Logger is powered by its own internal power supply in the form of a battery pack (usually supplied with each Logger). The battery pack – which is available in Alkaline (Model 6910A) and NiCad (Model 6910B) types – is located in the base of the logger housing and connected via a three-way socket to the logger.

The STARLOGGER requires a single battery voltage of 6.5 to 10 V DC.

Battery life varies anywhere from a few weeks up to 2 years depending on the logging project (see below).

This section discusses:

- Battery life
- Battery connections
- Battery replacement
- Recharging a NiCad battery pack

4.1.1. Battery Life

The Data Logger battery life is influenced by five factors:

- logger scan rate
- logger program run time
- external instrument power requirement
- display usage
- computer communication (RS-232)

➢ Formula for Determining Battery Life

The following calculation will determine the battery life for UNIDATA battery packs (Model 6910A):

```
Life (days) = [ST/(RT+35)] * 3300

ST = Scan Time (seconds)
RT = Run Time (milliseconds)

where external instrument load is not exceeding 20mA
```

The run time is determined by examining Address 1 of the Data Logger (Block 0, locations 1 and 2), where the program run time is saved.

Note: 6910A battery packs have a maximum life of 3 years.

➢ Battery Life Estimation Tables

The following tables details the estimated battery life from data loggers with various scan rates and battery types. This table assumes a program run time of 12 milliseconds (approximately 40 instructions).

Model 6910C	
Scan Rate	**Life**
0.25	12 days
1	30 days
5	40 days
10	40 days

Model 6910A – 10 Ah Alkaline Battery Pack
Model 6910C – 4 Ah Nickel Cadmium Battery Pack

4.1.2. Battery Pack Connections

The Model 6910 battery packs are manufactured with a 3-way socket connector which plugs into the Model 6004C STARLOGGER.

Users who manufacture their own replacement battery packs may purchase connectors from a Molex dealer or simply re-use the wire & connector from the old battery pack. The connector type is Molex brand 050-57-9403 70066-0177 shell with type 016-02-1125 71851-0224 crimp terminals.

4.1.3. Replacing A Battery Pack

> ***IMPORTANT!***
> ***All recorded data will be lost when the battery pack is disconnected (unless the optional Back-up Battery is installed (see section 4.3). Ensure the STARLOGGER has been unloaded before replacing the battery.***

1. Remove STARLOGGER lid by unscrewing the six lid screws.

2. Depress the small retaining clip securing the battery plug and disconnect the battery cable.

3. Lift out the black metal battery retaining plate and remove the used battery pack.

4. Insert a new battery pack and replace the metal retaining plate making certain not to crush the battery wires.

5. Reconnect the new battery (The STARLOGGER automatically begins operating).

6. Replace lid into Data Logger base. Tighten six lid screws.

RECYCLE. UNIDATA uses only Mercury-free Alkaline cells in battery packs. UNIDATA or your battery manufacturer will accept battery packs returned for recycling.

> ***IMPORTANT – Reverse Polarity Protected***
> ***The STARLOGGER is NOT damaged if battery wires are accidently reversed.***

4.1.4. Recharging NiCad Battery Pack

The NiCad Battery Pack can be recharged by a mains power pack or a solar powered recharge system. You can also recharge a battery pack on site using an external power source. (See the next section.)

4.2. External Power Supply

An external power source can be connected to the Data Logger. The external power may be used with an Alkaline or NiCad battery pack as a backup power source or simply on its own.

A mains power pack and a solar power pack are available from UNIDATA.

IMPORTANT
The supply voltage to the Data Logger must be maintained at all times to ensure correct logger operation and data integrity. (See optional Back-up Battery.)

The voltage to the logger must be in the range of 9 V to 20 V and able to supply a load of 100 mA peak (increasing to 500 mA when recharging a battery.)

4.2.1. Connecting an External Power Supply

To install an external power supply:

1. Connect +ve to pin 16 of the **INPUT SIGNALS** socket (terminal 1 of the Field Termination Strip).

2. Connect -ve (common) to pin 23 of the **INPUT SIGNALS** socket (terminal 2 of the Field Termination Strip).

4.2.2. Recharging Batteries

The Data Logger with a NiCad battery pack can be recharged from a solar recharge panel or a mains power pack or other DC power source. The input voltage should be between 11 V and 20 V.

» NOTE: NiCad Battery Packs require several charge/discharge cycles before their full charge is retained. Therefore ensure the Data Logger has been fully charged (connected to solar recharge or mains power pack) then left to discharge at fast scan rate.

4.3. Battery Status Indicators

The STARLOGGER measures its internal battery voltage every scan. If the battery voltage falls below preset levels this is displayed on the Battery Status LED on the front panel.

GREEN	RED	BATTERY STATUS	ALKN	NiCAD	LCD DISPLAY
ON	OFF	Battery OK	>7.2V	>7.2V	OK
ON	ON	Battery Low (Replace soon)	<7.2V	<7.2V	Low
OFF	ON	Battery Flat (Replace immediately)	<6.6V	<7.1V	Chg
OFF	OFF	Not Operating ("Sleep" or "Shutdown" Mode)	<6.2V	<7.0V	Bad

» NOTE: Whenever an external power source greater than 11V DC is connected to the logger, the internal battery is bypassed (and/or recharged). The logger operates from the external power, but will automatically use the internal battery if external power falls below 11V DC or fails altogether.

4.4. Monitoring Battery Voltage

The most recent battery voltage measurement is stored in the logger memory and can be displayed or logged.

The STARLOGGER saves the voltage measurement at Address 236 (Internal Channel I2, also called, "Batt", see Chapter 6). Use the **MDL Information** screen in **Test Mode** to display the internal channels.

When operating in Compatibility (6003) Mode, the monitored battery voltage is optionally available in channels a0... a7 (selectable, scaled 0 to 14.14 volts).

4.5. Flat Battery Shutdown

As a further protection, the logger continues to monitor the battery voltage whilst in "Sleep mode" and if the voltage falls to a level that may cause faulty operations, the logger enters "Shutdown" state and will not scan, communicate with a computer or activate the Display. In addition, all equipment power loads are disconnected (counter channels and pin 18 continuous power) to preserve memory.

The Flat Battery Shutdown voltage limit is 5.6V.

4.5.1. Saving Memory

A logger in "Shutdown" or "Sleep" mode will preserve its memory for many weeks. To recover information stored in the logger:

1. Connect a computer to the logger and attempt to "Unload" it.

2. If the logger was in:

    a. "Sleep" mode it will "wake-up" and unload normally.

    b. "Shutdown", connect an external power source to the logger (such as a new battery pack, see section 4.3). The logger will then "wake-up" and unload normally.

»   Note: The external power must be connected without disconnecting the internal "Flat" battery (unless the optional memory back-up battery is installed). Follow the procedure in "Connecting an External Power Supply" above.

4.5.2. Auxillary Memory Back-up Battery

An optional Lithium battery (Model 6909A) may be installed to provide memory back-up power when the main battery pack is removed or fails completely. The battery type is a 3.4V $\frac{1}{2}$AA Lithium cell with wire leads (SAFT LS14250 or similar).

The status of the auxillary battery is monitored by the logger. If the battery requires replacement (or is not installed) an asterisk (*) is displayed adjacent to the main battery status (Models 6004-21/31 only).

To check auxillary memory back-up battery:

1. Press the ON key firmly. The following is displayed:

    > **STARLOGGER 900**
    > **V022.01 BAT=OK ***

    This indicates the auxillary battery is either not installed or needs replacing.

In all loggers the auxillary memory back-up battery status is indicated in Bit 6 of Register 33 (see section 8.2.1).

a0	①		
a1	②	⑭	ANALOG GROUND
a2	③	⑮	OUT 1/GROUND/ HSIO SYNC
a3	④	⑯	EXTERNAL POWER INPUT
a4	⑤	⑰	OUT 0
a5	⑥	⑱	MICROPOWER +6V continuous
a6	⑦	⑲	SENSE 0/LOG START
a7	⑧	⑳	SENSE 1/SDI

Analog single ended unipolar

High Speed Synchronous Serial I/O Port

| CLOCK 0 | ⑨ | ㉑ | DATA 0 |
| DATA 1 | ⑩ | ㉒ | CLOCK 1 |

Counters

| C0 | ⑪ | ㉓ | Digital Ground |
| C2 | ⑫ | ㉔ | C1 |

+5V scan sychronised User Power Source

| | ⑬ | ㉕ | C3 |
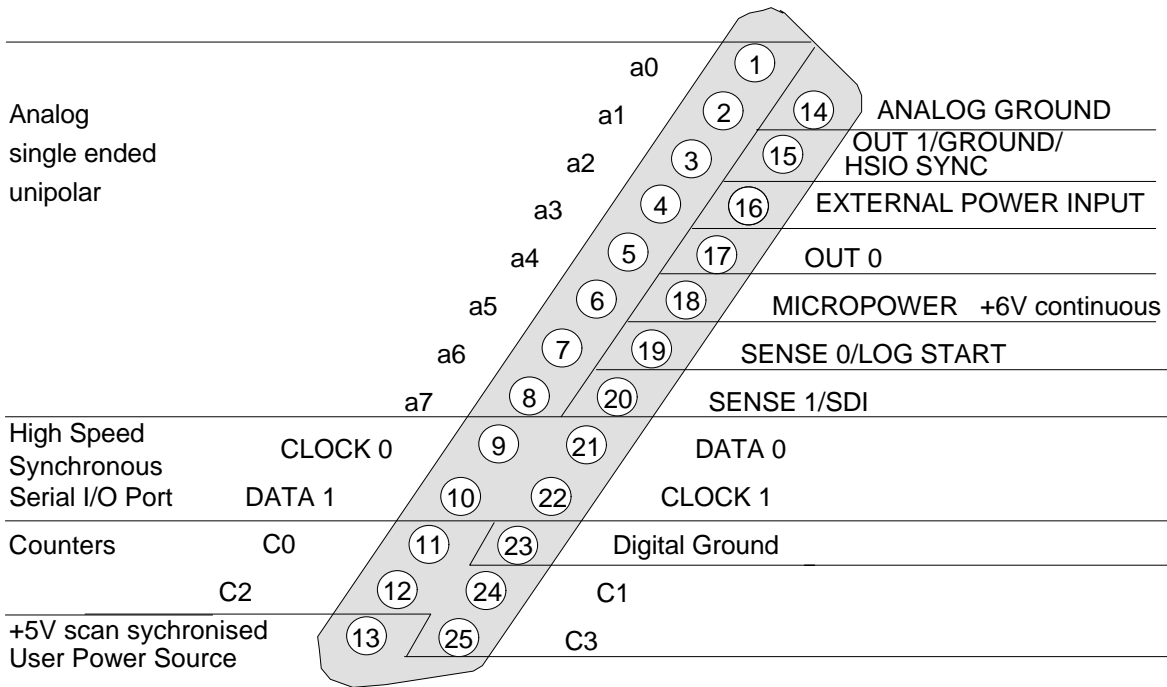
Figure 5.1 Input Signal Connector Pins (Single-Ended Analog)

4.6. Internal Battery Charger

The STARLOGGER has an inbuilt battery charging circuit designed for continuous recharging of NiCad and Sealed Lead Acid batteries as well as providing regulated power to the logger when operating from external power.

4.7. Automatic Battery Type Detection

The Model 6004C STARLOGGER automatically detects which type of battery is installed and sets the voltage thresholds accordingly. The logger also enables the battery charging circuit when a NiCad battery is installed.

The Model 6004-21/31 displays ALKLN or NiCad on its LCD to indicate which battery type is installed. (Note: If external power is used and no battery pack is installed, the LCD will indicate ALKLN.)

Table continued on the next page

5. INSTALLATION & CONNECTION

This chapter provides information necessary to install a STARLOGGER. This includes:

– a list of the connections of the **INPUT SIGNALS** connector
– signal specifications for each connection
– how to initialise a STARLOGGER

For information about the connecting the Logger to a computer, see Chapter 7, Computer Communication.

5.1. Locating the Logger

The STARLOGGER may be installed in nearly any environment. The Data Logger should not be exposed directly to the weather and if it is to be used externally, it should be housed in a weatherproof enclosure. The Data Logger should be mounted away from electrical noise sources (such as electrical contactors and radio transmitters) and in all cases signal leads should be shielded and kept as short as possible.

Wherever possible, install the Data Logger in a protected location exposed to the least temperature extremes. This will increase the battery life, and improve clock and signal measurement accuracy.

5.2. Instrument Connection

You connect instruments to the STARLOGGER via the 25-pin socket located on the Logger's front panel and labelled **INPUT SIGNALS**. For ease of use you can plug a Field Termination Strip into this connector (see below). Each input is referred to as a channel in the STARLOG Software Package.

Field Termination Strip - This extends the **INPUT SIGNALS** connector to a row of numbered screw terminals. The Field Termination Strip (Model 6103B) and its manual (supplement 6208) are available from UNIDATA. You can use the previous Model 6103B Field Termination Strip, however some STARLOGGER features are different or not available on this strip.

This section contains a table and an illustration identifying each pin in the **INPUT SIGNALS** connector followed by input descriptions.

The following table lists each pin in the INPUT SIGNALS connector by number. Next to the pin number is a description of the signal for which this connection is designed. The last column lists the high resolution channel mneumonic used by STARLOG Software to refer to this connection.

Pin	Signal Description	Channel
1	Analog input (see section 5.2.2)	a0
2	Analog input (see section 5.2.2)	a1
3	Analog input (see section 5.2.2)	a2
4	Analog input (see section 5.2.2)	a3
5	Analog input (see section 5.2.2)	a4
6	Analog input (see section 5.2.2)	a5
7	Analog input (see section 5.2.2)	a6
8	Analog input (see section 5.2.2)	a7
9	High Speed Synchronous Serial Port 0 CMOS OUTPUT CLOCK 0	HSIO CLOCK 0
10	High Speed Synchronous Serial Port 1 CMOS BI-DIRECTIONAL DATA 1	HSIO DATA 1
11	16 bit counter input (20kHz)	C0 (or c0 or c0l)*
12	16 bit counter input (20kHz)	C2 (or c1 or c1l)*
13	+5V scan synchronised User Power Source	UPS
14	Analog Signal Ground	analog ground
15	CMOS Output, HSIO Sync/Ground (not to be used in new installations)	OUT 1/HSIO sync
16	Power input for recharging battery and/or operating logger	power input
17	Control, Open Collector Output, 30V maximum, 100mA drive	OUT 0
18	+6V continuous power for external instruments (1mA maximum)	MICROPOWER
19	Sense input BIT 3 (Log Start, MASK 8)	SENSE 0
20	Sense input BIT 1 (MASK 2)	SENSE 1/SDI-12

standby ≈ 4.5V

100k

10k

0.001μF (C0/C2)
0.01μF (C1/C3)

Counter Input
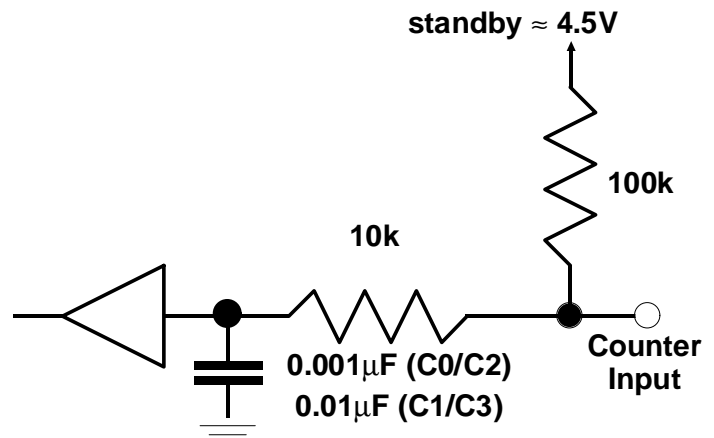
Pin	Signal Description	Channel
	Figure 5.2 – Digital Input Circuit	
21	High Speed Synchronous Serial Port 0 CMOS BI-DIRECTIONAL DATA 0	HSIO DATA 0
22	High Speed Synchronous Serial Port 1 CMOS OUTPUT CLOCK 1	HSIO CLOCK 1
23	Data Logger power and logic ground	Digital Ground
24	16 bit counter input (3kHz)	C1 (or c0u)*
25	16 bit counter input (3kHz)	C3 (or c1u)*

* Compatibility (6003) Mode Channel Assignment

5.2.1. Log Start Sense

Normally, the Data Logger only begins to record when an instrument is connected to the **INPUT SIGNALS**. To sense this condition, Pin 19 (Log Start Sense 0) of the **INPUT SIGNALS** socket is grounded (connected to Pin 23). The Data Logger program may then sense this condition by the 'BJMPN   32,#8,Branch Label' instruction which branches when the **INPUT SIGNALS** are not connected. (See the description of the startup.INCLUDE file in the Programmer's Supplement (#6201) for further information).

WARNING
The STARLOGGER will not begin recording UNLESS the LOG START
Sense is connected to ground (Pin 23).

» Note: LOG START is automatically connected to ground when the Model 6103 Field Termination Strip is used.

5.2.2. Analog Inputs

Analog inputs can be used as low resolution (8 bit) or high resolution channels (16 bit). Their usage depends how you refer to the input using STARLOG software. The software interprets analog inputs as low resolution channels when
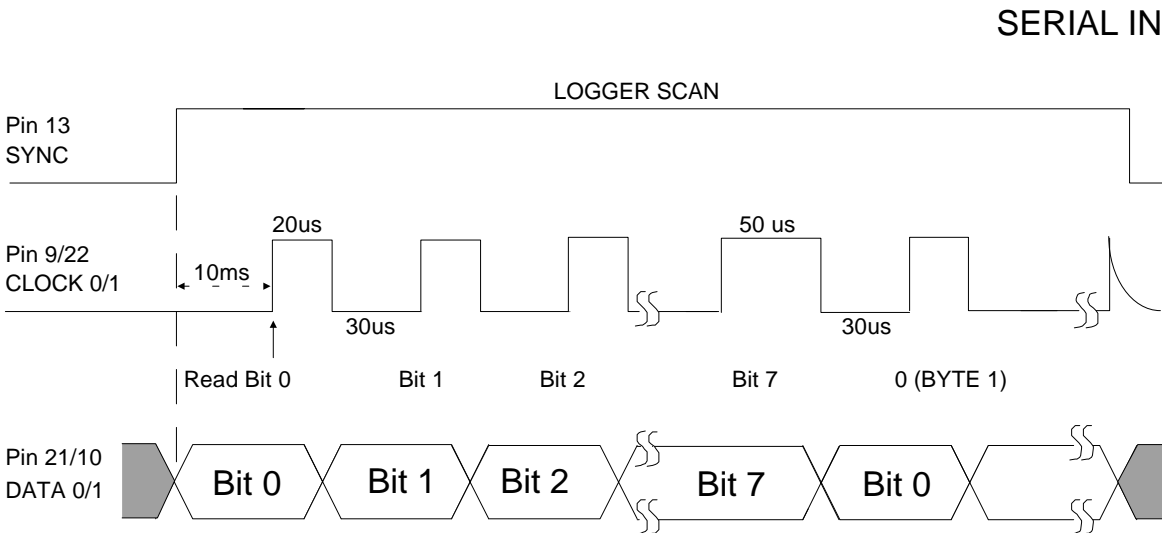
SERIAL IN

Figure 5.3 - Serial In Timing Diagram

you refer to them as a0 – a7 and high resolution channels when you refer to them as h0 – h7.
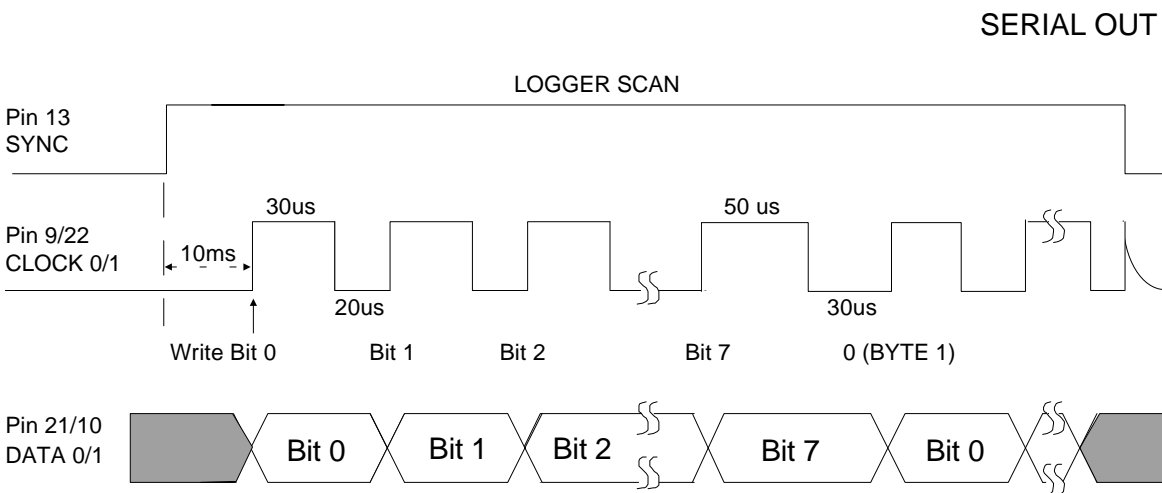
SERIAL OUT

Figure 5.4 - Serial Out Timing Diagram

All Analog channels are programmable to carry a signal in one of two ranges: 0 to 2.550 V (2.5 mV per bit) and 0 to 255 mV (250 µV per bit). Input impedance (when the logger is active) is greater than 1 MΩ. Load impedance (when the Logger is inactive) for signals less than 500 mV is greater than 1 MΩ, while for signals greater than 500 mV, it is 10 kΩ. The recommended source drive impedance is <10 kΩ.

Analog channels calibration coefficients are stored in the Configuration Table (see Chapter 9.)

5.2.3. Counters and Digital Inputs

Counters and Digital inputs are DC inputs, suitable for 20 kHz potential free contacts or 0–5V to 0–12V DC digital input.

Maximum pulse rate to the counters is 20 kHz. Pulse rates must also be related to scan rate, to ensure counters do not overflow before being scanned by the Data Logger.

5.2.4. User Power Sources (UPS)

The User Power Source (Pin 13) is intended to power instruments associated with the Data Logger. The full load output capability is 250mA in pulsed mode.

The UPS switches on and off (synchronised with the logger scan). Any loads connected to these outputs will contribute to the drain on the Data Logger battery (and reduce battery life).

The UPS may be programmed to switch on prior to the logger scan by setting the Prescan in the STARLOGGER Configuration Table. (See Chapter 9 and the User's Manual.)

5.2.5. High Speed Serial Ports

There are two serial ports:	Port 0	Pin 9 (Clock 0)
		Pin 21 (Data 0)
	Port 1	Pin 22 (Clock 1)
		Pin 10 (Data 1)
		Pin 13 +5V sync signal

Each logger scan, the High Speed Serial Ports are read. The Sync signal (Pin 13) is used to indicate to the remote equipment that a logger read scan is about to begin. This signal is usually used to load the serial shift register(s) in the remote equipment in preparation of being read.

» NOTE: the first data bit LSB must be present on the Data (0/1) signal within 7ms after the Sync signal.

Serial transfer rate is 50 microseconds per bit with a 30 microsecond gap between each byte. (See timing diagrams for Serial In and Serial Out below.)

» NOTE: every 1 millisecond a logger interrupt sequence adds a 50 micro-second delay to the serial transfer sequence. Transfer starts with the least significant bit of the least significant byte and each clock reads the next most significant bit.

5.3. SDI-12 Serial Digital Interface (optional)

The STARLOGGERs support the U.S. SDI-12 standard for serial data inter-change between the logger and intelligent instruments.

SDI-12 is implemented as an alternate use of Sense 1 (Pin 20). Up to ten SDI-12 compatible instruments may be connected onto this bus. Programming the SDI-12 interface is supported in the STARLOG Version 3 Software.

See Appendix E for details on how to use the SDI-12 Interface.

5.4. STARLOGGER Initialisation

The STARLOGGER is normally stored and delivered to you in a "sleep" state to conserve batteries. You MUST LOAD A SCHEME into the logger before it can be used.

In normal use, the STARLOGGER will not require initialisation. If however, the logger does not appear to scan at a correct rate, then the logger may need re-initialization.

Any of the following actions will (re)initialise the logger:

    a)   Load a Scheme into the logger.

    b)   Execute the "RESET LOGGER" command in the Config List.

    c)   Use the ALT-I command in Diagnostics. (See STARLOG Software Package.)

    d)   Disconnect, then re-connect the battery after a ten second delay. WARNING: Memory storage will be lost.

    e)   Adjust and save any of the Config Entries. (Model 6004-2/3)

During initialization, the logger's firmware and Configuration Table is check-summed to confirm its integrity. The Scan Counter is set to the Logger Scan Rate and other housekeeping functions performed.

See the Users Manual for more information.

Table continued on next page...

6. INTERNAL CHANNELS

The STARLOGGER has two internal channels. These are presented as high resolution values (signed 16 bit) in Register Addresses 232 to 239 as detailed below:

Name	Description	Register Address
I0 (Temp)	Logger Temperature (0.1221 °C per bit)	232
I2 (Batt)	Logger battery (or supply) voltage (1.221 mv per bit)	236

The values of these internal channels are available for recording (logging) or use in computations in the User Log Program.

6.1. Battery Voltage Monitor (I2, "Batt")

Battery voltage is automatically monitored by the logger and recording will cease (the logger goes into a dormant "sleep" mode) if the battery falls below a defined threshold. The threshold is defined in the Configuration Table (see Chapter 9). The battery state is also displayed on the Battery Status LED's while the logger is operating (see section 4.3).

Baud Rate	COMPUTER Pins		
	17	16	15
300	√		À
1200		√	
2400		√	À
4800	√	À	
9600			
19200			√
38400	√		
76800	√	À	√

7. COMPUTER COMMUNICATION

The STARLOGGER communicates using standard asynchronous, RS-232 serial communication standards which allow it to communicate with an IBM PC or compatible computer using a direct 25 pin to 25 pin cable at 9600 baud. (Model 6602A "25-to-25 pin" and Model 6602I "25-to-9 pin" cables are available from UNIDATA.)

The communication format is:

- RS-232C compatible
- 300 to 76800 baud (see section 7.2 below)
- 8 data bits
- 1 stop/start bit
- no parity

You connect a computer to the STARLOGGER via the 25-pin socket (labelled **COMPUTER**) located on the Logger's front panel. This allows you to load and unload schemes and data. About half of the pins in this plug are allocated a function. The rest are reserved for future use. This chapter:

- explains how to set the baud rate,
- describes the communications protocol for 128K Loggers,
- provides a sample communication program, and
- includes a table listing pin allocations.

7.1. Computer Connector Pin Designations

The following table lists each pin in the COMPUTER connector by number. Next to the pin number is a description of the signal for which this connection is designed. The last column explains how the pin is being used.

Pin	Signal Description	Usage
1	Data Logger signal & logic ground	Ground
2	Serial data signal to Data Logger	RxD*
3	Serial data signal from Data Logger	TxD*
4	RTS from computer (See Note 1.)	RTS*
6	DSR from Logger	DSR* to CPU
7	Signal Ground	GND

Pin	Signal Description	Usage
10	Mode	
15	Baud Rate Select (See section 7.2.)	
16	Baud Rate Select (See section 7.2.)	
17	Baud Rate Select (See section 7.2.)	
20	from computer (not used)	DTR
25	Remote Telemetry Control from Logger	OUT 0

All other pins are not connected and reserved for future use.

* These are RS-232 signals.

Notes:

1. RTS signal from the computer will activate the Logger even between scans. The Logger may respond with a prompt (*C/R) immediately the RTS becomes true or wait until the next scan (depending on communication mode settings). See section 7.1.

2. CTS signal is not used to synchronise communications between Logger and computer, this is acheived by the Logger prompt (*C/R). The DSR is true whenever the Logger scan is active.

7.2. Baud Rates

The communication baud rate is selected on the **COMPUTER** connector on the face of the Logger. Note that PC/XT and slow PC/AT computers can only communicate up to 9600 baud. Fast PC/AT and 386 machines can communicate at 19200. 38400 and higher is not normally available on PC type systems.

To select the desired RS-232 communication baud rate (other than the default 9600 baud) you must link one (or more) of the **COMPUTER** connector pins 15, 16 and 17 to ground (pin 7) according to this table.

Note that pin 14 is reserved.

7.3. Communications (STARLOG) Protocol

This section describes communications protocol. See Appendix C for a complete list of STARLOG Protocol commands.

7.3.1. Scan Synchronised RS-232 Communication (default)

At the end of every Data Logger scan (5 seconds usually) the logger will check to see if the Computer Interface is connected. If the interface is connected, the logger sends a prompt to the interface (host computer). This prompt is an ASCII asterisk followed by a carriage return (* c/r).

The Data Logger then waits 0.5 second for a request from the host computer. If no request is received by the logger, then the logger powers down (switches off) until the next scan (5 seconds usually).

Whilst the logger is communicating with the computer, it will remain active (in high power mode) however any logger Scans that are due will be processed "simultaneously" with ongoing communications.

7.3.2. Non-Synchronised RS-232 Communication

If the STARLOGGER is set to operate in non-synchronised mode the RS-232 communication protocol timing is slightly different.

The logger will immediately enter communications state (and send a prompt) whenever the Request To Send (RTS) line becomes true (ON/HIGH), it does not wait until the end of the next Logger Scan.

If a logger Scan occurs during RS-232 communications then the scan will be processed.

7.3.3. Data Logger Requests

The following are valid Data Logger requests (or Commands). If the logger receives an invalid command it will be ignored. Other commands are used to maintain and initialise the Configuration Table (see Chapter 8).

A STARLOGGER has three basic commands - GET, PUT & KILL. The (G)ET and (P)UT commands will access the first 64K of memory only. For memory sizes greater than 64K, a lowercase equivalent of the basic commands serves as an Extended Protocol Command (i.e., "g" command performs an extended "G" GET command). All Extended Protocol Commands require a checksum following the message.

See Appendix C for a complete list of STARLOG Protocol commands.

GET {and (g)et} Commands

GAAAASS   where G is the GET command, AAAA is the 16 bit address (MSB/LSB) and SS is the number of bytes required. (Zero in the SS command

corresponds to 256 bytes.) (AAAAis the command for a 16 bit address in the first 64K memory storage of the Logger.)

gaaaaaaaasssscccc   where g is the get command, aaaaaaaa is the 32 bit start memory address (MSB...LSB), ssss is the 16 bit number of bytes to transfer, and cccc is the 16 bit checksum.

> To read 256 bytes from address 768 into the host computer the command is:

> ```
> G030000
> ```

PUT {and (p)ut} Commands

PAAAASS
paaaaaaaassss...put data...cccc   similar to the GET command except that data is sent to the logger immediately following the command string.

cccc the 16 bit checksum for the (p)ut command includes the address, size and data fields (i.e., everything excpet the "p" command and the checksum itself) and is sent MSB/LSB.

> To reset the logger timer to zero, you will want to put zero into addresses 4,5,6 & 7. The command is:

> ```
> P00040400000000
> ```

> | | |
> |---|---|
> | P | is the put command |
> | 0004 | is the offset address (in the registers) |
> | 04 | is the put data count |
> | 00000000 | is the data to put |

The data format for the GET or PUT is a continuous string of hex characters. The 1st two characters correspond to the 1st byte requested or to be sent, the next two characters is the second byte, etc. The data string is terminated by a carriage return.

> a command to retrieve 16 bytes may appear as:

> ```
> G000010
> ```

> the returned data may appear as:

> ```
> 00112233445566778899AABBCCDDEEFFmmllc/r
> ```

Where mmll = Get Data checksum consisting of a 16 bit binary addition of all binary data (not HEX representation) within the retrieved information (excluding the checksum and c/r). The checksum is sent as four HEX characters; mm = Most Significant Byte and ll = Least Significant Byte.

Note: Two hex characters are always received or transmitted (most significant digit then least significant digit) even though the number is smaller then 16. E.g., 10 decimal is sent or received as 0A.

Note: GET or PUT may address any continuous segment of the memory.

(K)ILL command

K is the KILL command which directs the Data Logger to switch OFF until the next scan cycle (usually 5 seconds).

a command to load location 2 with 0 then exit, would be:

```
P00020100K
```

Note: After a GET command, the computer must wait until the Data Logger has sent the GET data before a KILL is issued.

7.4. Sample Program

The following program written in Microsoft QBASIC communicates between the Data Logger and an IBM PC or compatible computer.

Address

0 ┌──────────────────────────┐
  │   │
  │   Hardware Registers   │
  │   │
256 ├──────────────────────────┤
  │   Buffer Control Table   │
384 ├────── Start Log Program ──────┤
  │   │
  │   Log Program   │
  │   │
1536 ├──────────────────────────┤
  │   │
  │   Log Buffer   │
  │   │
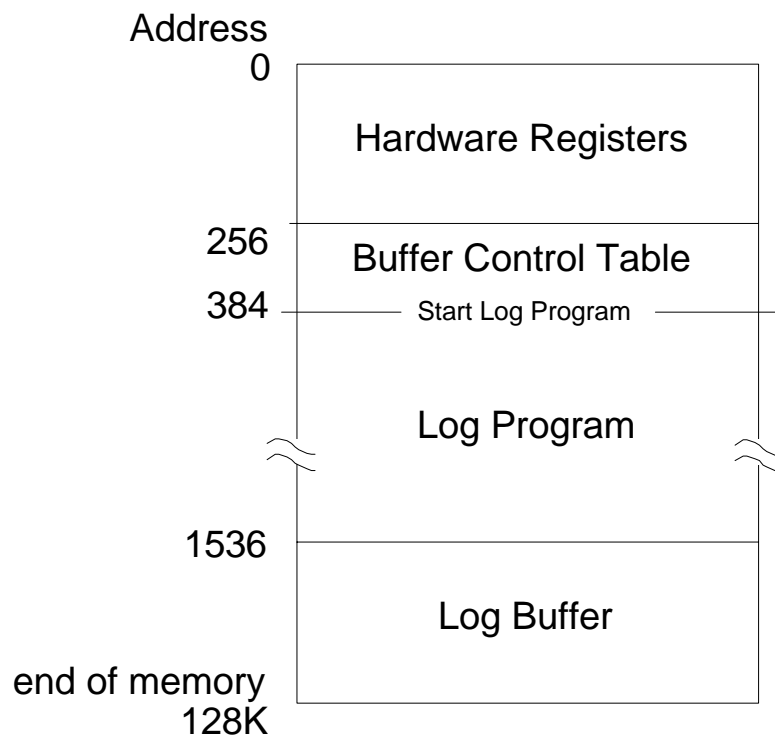end of memory └──────────────────────────┘
128K

Figure 8.1 – Memory Map

7.4.1. Simple Interrogation Example

This sample program will issue a command to the Data Logger and display the response from the logger. The commands must be valid commands (see above).

The "ON ERROR GOTO 140" statement is needed to trap (and ignore via RESUME statement) any I/O errors that may occur as the Data Logger powers up and the RS-232 signals lines change states.

The statement 70, sends the command to the logger. Notice that a "K" command (kill) is appended to the operator request. This shuts the Data Logger down, immediately after the request has been completed (to save logger battery power).

Try entering these commands:

G000008	(get 8 bytes from location 0)
G000502	(get 2 bytes from location 5)
G010010	(get 16 bytes (10 hex) from location 256 (Block 1, Location 0)
P00020188G000201	(put 88 into location 2 and immediately gets the data)

Note: the maximum G (get) size is 127 (7F hex). This is limited by BASIC string length maximum of 255 characters.

```
10        REM  STARLOGGER - data transfer example
20        INPUT "Enter data logger command-",A$
                                      'Get Command from operator
30        IF A$="" THEN END           'Finish on c/r
40        OPEN "COM1:9600,N,8,1,CS0,DS0,CD0" FOR RANDOM AS #1
                                      'Open RS-232 to logger
50        ON ERROR GOTO 140           'Trap I/O errors
60        INPUT #1,L$:IF INSTR(L$"*")=0 THEN 60
                                      'Wait for logger prompt
70        PRINT #1,A$;                'Send command to logger
80        INPUT #1,L$                 'Get response from logger
90        PRINT #1,"K";               'Send KILL to save battery
100       ON ERROR GOTO 0             'Reset error trapping
110       CLOSE #1                    'Close RS-232 file (channel)
120       PRINT "Data Logger Response =";L$   'Print result on terminal
130       GOTO 20                     'Go back to beginning
140       RESUME                                      'Ignore I/O error
```

Table continued on next page...

8. STARLOGGER PROGRAMMING

This chapter describes programming techniques for the STARLOGGER including memory layout. The information included here is especially useful to those who program and test the Logger with the **Test Mode** screens provided with a STARLOG Software Package. For those who use this Software Package, this chapter provides important details on Data Logger instructions used by the assembler. For complete programming information, a programmer should consult the Programmer's Supplement (Model 6201) included with a STARLOG Software Package (Model 6300).

8.1. Memory Layout

The STARLOGGER uses its data CMOS memory for:

»   Hardware Registers - Storage of housekeeping registers

»   Logger Program - Storage of user scheme definition

»   Buffer Control Table - Storage of pointers controlling Log Buffer

»   Log Buffer - 1536 to end of memory for recording measured data

8.2. Hardware Register Information

The information contained in the header may be viewed in **Test Mode** or used by programmers wishing to write their own unload and analysis programs. The table below gives a description of each register numbered 0 to 255. For multiple byte registers the convention used is – least significant byte to most significant byte. A byte may contain a number from 0 to 255 (8 bits) and for calculating multiple byte numbers the first byte is added to the second byte times 256 plus the third byte times 256 times 256, etc.

```
eg. The four byte number 1,2,3 and 4 would give
1+(2*256)+(3*256*256)+(4*256*256*256) = 67305985
```

Arithmetic instructions using 32-bit unsigned integers can represent values from 0 to 4294967295.

8.2.1. Model 6004, V2.00 Memory Assignments

The Model 6004 STARLOGGER, operating the standard instruction set, has the following fixed memory assignments in the Hardware Register:

(Pin xx) refers to a pin of the **INPUT SIGNALS** connector.

  *   Active in Standard (6004) Mode (See Chapter 9)

  †   Active in Compatibility (6003) Mode

Address	Size	Description
0	1	Software Revision Number (20 onwards)
1	2	Logger runtime in milliseconds (16 bit integer)
3	1	Error flags (see Appendix A)
4	4	Logger scan counter (32 bit integer)
8	1	Reserved
†9	1	HSIO MASK (128=Serial 0, 16=Serial 1)
10	1	Reserved
11	2	msb of address (bits 8-23) used in LDBLK and MVBLK instructions
13	2	Reserved
14	1	Binary states of analog channels
16	8	Eight analog channels (a0 to a7) unsigned low resolution representation (8 bit) of the 16 bit channel (h0 to h7) measurement
24	8	Counter channels (see section 8.2.2)

*32	1	Digital input values (normally high)
		Bit 0...2 Baud Rate: 000=9600; 101=300; 010=1200
		                             011=2400; 110=4800; 001=19200;
		                             100=38400; 111=76800
		Bit 3=0 Log Start (SENSE 0) connected to GND
		Bit 4=0 Memory Card inserted
		Bit 5=0 SDI-12 (SENSE 1) not active
		Bit 6 High speed serial DATA 1
		Bit 7 High speed serial DATA 0

†32	1	Digital input values (normally high) Bit 0 = 0 "Pin 7, C=GND" 9600 baud select Bit 1 = 0 "Pin 20, S=GND" SENSE 1 Bit 2 = 0 "Pin 20, C=GND" 300 baud select Bit 3 = 0 "Pin 19, S+GND" Log Start Detect Bits 4...7 Not available

Address	Size	Description
*33	1	User Power Supply status register Bit 0 = 1 UPS will be ON next scan Bit 1 = 1 UPS was ON this scan Bit 2 = 1 UPS is currently ON Bit 3 unused Bit 4 = 1 RTS is not active Bit 5 unused Bit 6 = 1 Memory Backup Battery OK Bit 7 = 1 unused
34	1	Arithmetic status register set by ADD, SUB, MUL,DIV instructions. Bit 2 = Arithmetic overflow Bit 7 = Arithmetic carry Logic status register set by CMP (compare) instruct. Bit 4 set Operand 1 =Operand 2 Bit 5 set Operand 1 < Operand 2 (unsigned) Bit 6 set Operand 1 < Operand 2 (signed)
35	1	Reserved
80	6	Version 2 Software stores Scheme Name here.
*200	16	8 x analog channel h0 (Pin 1) signed 16 bit channel
*232	2	STARLOGGER internal temperature signal $\pm500°C$ range (0.1221°C resolution/bit)
*236	2	Supply (Battery) voltage scaled 1.221 millivolt/bit
*238	7	Reserved

8.2.2. Counter Register Assignments

In Standard (6004) Mode the use of a prescale setting enables a 1 byte counter result to be recorded. The mnemonic in brackets indicates how this channel is referred to in Software.

» Note: The Counter channels' mnemonic changes in Compatibility (6003) Mode to maintain compatibility with PDL documentation. Prescale is available for all four counters. (See Appendix D.)

Address	Standard (6004) Mode		Pin Assignment
	Prescale = 1...15	Prescale = 0	

24	Counter 0 remainder	Counter 0 [C0]	Pin 11
25	8 bit difference [c0]	16 bit difference LSB/MSB	
26	Counter 1 remainder	Counter 1 [C1]	Pin 24
27	8 bit difference [c0u]	16 bit difference LSB/MSB	
28	Counter 2 remainder	Counter 2 [C2]	Pin 12
29	8 bit difference [c1]	16 bit difference LSB/MSB	
30	Counter 3 remainder	Counter 3 [C3]	Pin 25
31	8 bit difference [c1u]	16 bit difference LSB/MSB	

8.2.3. Logger Scan Counter

This is incremented every scan and when loaded with a scheme represents the number of scan intervals past 1/1/1980 at 00:00:00.
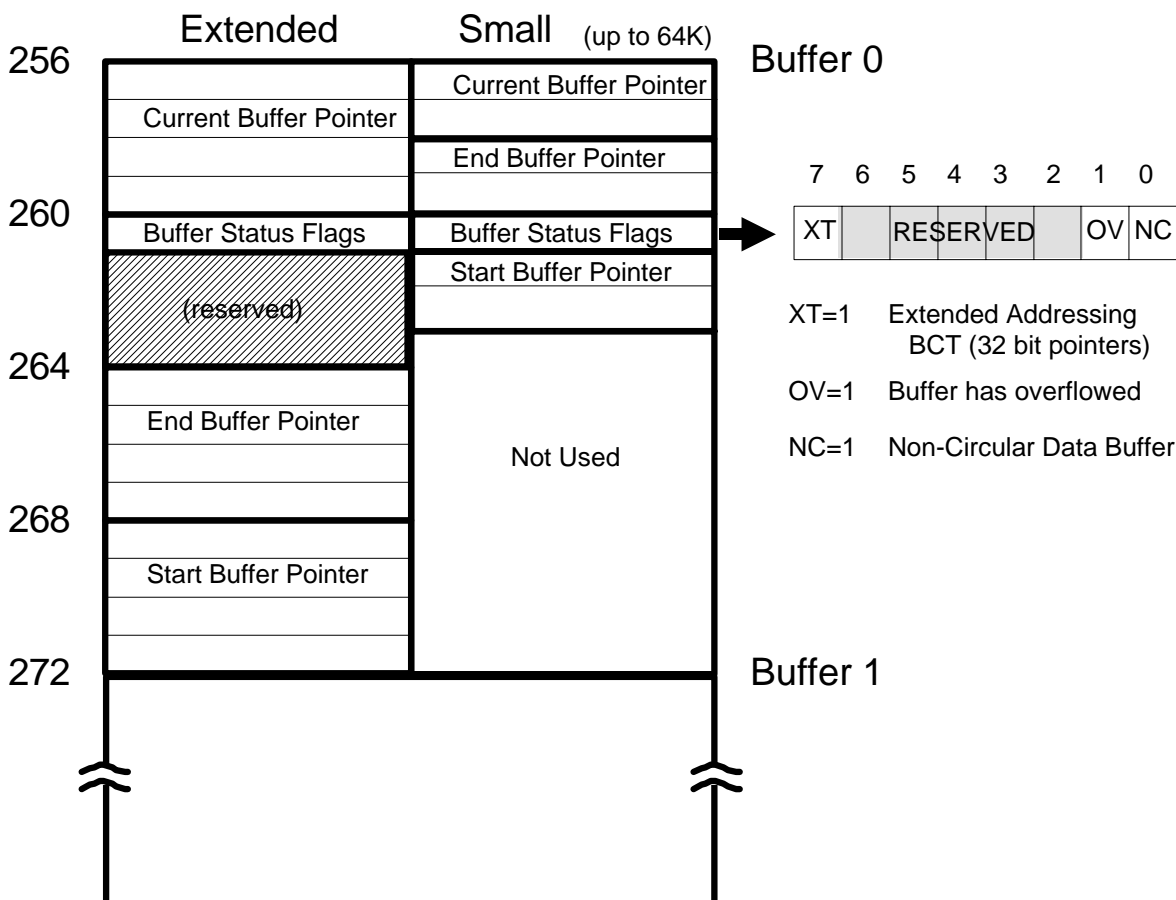
Figure 8.2 – Buffer Control Table

8.3. STARLOGGER - Program

The STARLOGGER is a programmable data recording unit programmed using a computer. Its program resides in the first part of the logger's main memory (after the Hardware Registers and Buffer Control Table). It is defined by a user and loaded into logger memory from the host computer.

The logger program is executed every logger scan (from .125 of a second to 5 minutes). The first instruction in the logger program is at Address 384. The Data Logger executes this program until an EXIT instruction is encountered (opcode = 0), then the Logger proceeds to service the Computer RS-232 port.

8.3.1. Data Logger - Operation Sequence

Every logger scan cycle, the logger hardware performs the following sequence:

1. Read all channels and store their values in the Hardware Register area (Address 0 to 255).

2. Execute the logger program (until EXIT detected).

3. If an RS-232 connection is sensed, send * c/r prompt to Computer Port and wait 0.5 second for a response.

4. Shut down Data Logger and await next scan time.

8.3.2. Data Logger - Program Instructions

A logger program starts at Address 384 and consists of one or more instructions. Each instruction is four bytes long (even though some instruction do not use all four bytes). An instruction takes about 0.5 millisecond to interpret and execute.

Typical instructions include:

TIMED GOTO	Timer controlled logging sequences
CONDITIONAL GOTO	Event controlled logging sequences
LOG DATA	Flexible data storage command
(BLOCK) MOVE	Block, Word and Byte move
ACCUMULATE	Block summation for averaging
OUTPUT	Control output sequences
BLOCK CLEAR	Storage initialization
ADDITION	2 & 4 byte operands, 4 byte result
SUBTRACTION	2 & 4 byte operands, 4 byte result

Table continued on next page...

MULTIPLICATION	2 & 4 byte operands, 4 byte result
DIVISION	2 & 4 byte operands, 4 byte result or 2 byte result & remainder
SERIAL INPUT/OUTPUT	Bi-directional Data Bus read/write

8.4. Buffer Control Table

Information to be recorded by the Data Logger is stored in one of eight memory areas. Normally only one memory area is used and this occupies all free external memory, starting at Address 1536 and ending at the limit of the Data Logger's CMOS memory (64K to 128K).

NOTE: For some log programs requiring lookup tables the storage starting address may be different.

The storage of channel data in these memory areas (buffers) is controlled by pointer registers held in the Buffer Control Table. Both standard (16 bit pointers) and extended (32 bit pointers) are supported by Revision #32 firmware. There is one table entry for each buffer (memory area) used by the Data Logger program "LOG" instructions.

An extended (32 bit, 4 byte pointers) Buffer Control Table is indicated by setting bit 7 of the "flag" byte (BFLO) in the Buffer Control Table entry for the appropriate buffer(s). (See Figure 7.2) Standard and extended buffers can be intermixed, but only extended buffers can log data past the 64K memory limit.

The small Buffer Control Table entry format is:

Address	Size	Label	Description
256	1	BCL0	Buffer 0 LSB of current log pointer
257	1	BCH0	Buffer 0 MSB of current log pointer
258	1	BEL0	Buffer 0 LSB of buffer end (last used +1)
259	1	BEH0	Buffer 0 MSB of buffer end

Address	Size	Label	Description
260	1	BFL0	Buffer 0 Status Flags Bit 0 = 1 non-circular, stop when full Bit 1 = 1 buffer has overflowed once Bit 5 = 1 MC first time through Bit 6 = 1 Log to memory card (6004-3 only) Bit 7 = 0 Extended Address (32 bit pointers)
261	1	BSL0	Buffer 0 LSB of buffer start address
262	1	BSH0	Buffer 0 MSB of buffer start address
263	1	BPL0	Buffer 0 LSB of current printer pointer

Real Address

Real Address is the actual hardware memory address.

Virtual Address

Virtual Address is the address used by the LOG program and other user communications.
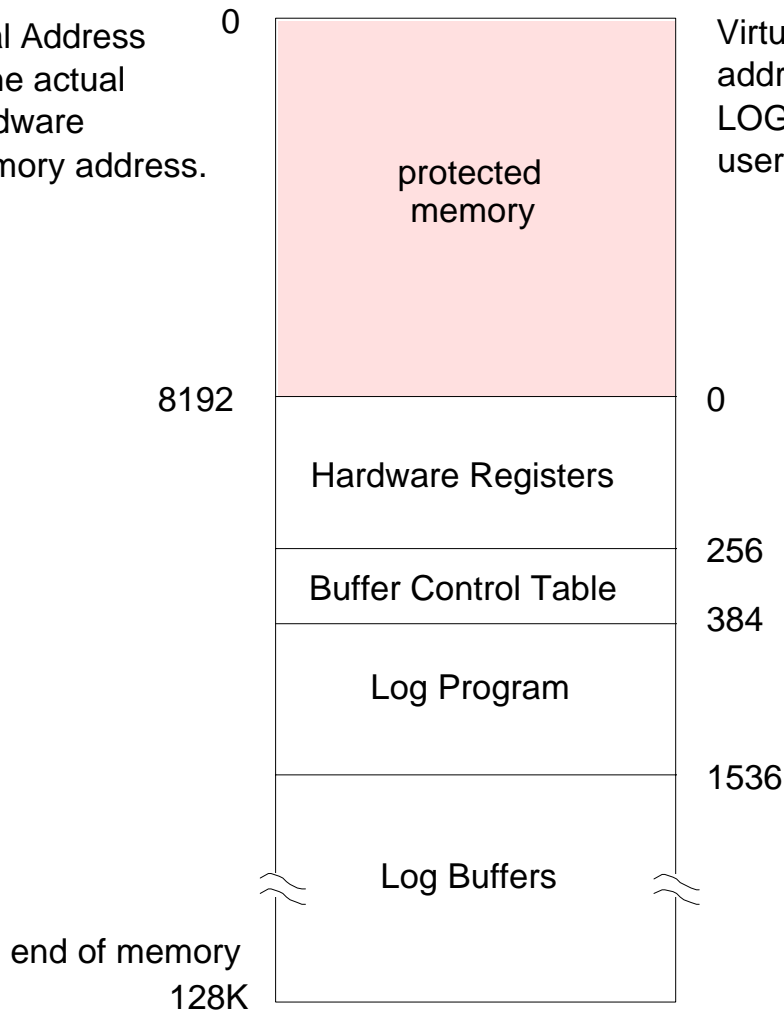
Figure 9.1 – Memory Map of Real and Virtual Addresses

Address	Size	Label	Description
264	1	BPH0	Buffer 0 MSB of current printer pointer
265	1	BTL0	Buffer 0 LSB of current telemetry pointer
266	1	BTH0	Buffer 0 MSB of current telemetry pointer
267	5		Reserved
272 383			Buffer 1 to Buffer 7 pointers (as above)

The extended Buffer Control Table entry format is:

Address	Size	Label	Description
256	4	EBC0	Current log pointer (LSB...MSB)
260	1	EBF0	Buffer 0 Status Flags Bit 0 = 1 non-circular, stop when full Bit 1 = 1 Buffer has overflowed once Bit 7 = 1 Extended Buffer pointers
261	3		Reserved
264	4	EBE0	Buffer End Pointer (LSB...MSB)
268	4	EBE0	Buffer Start Pointer (LSB...MSB)
272			Buffer #1 Definition, etc...

8.4.1. Buffer Format Convention

Information is stored in the data buffers as a sequence of one or more data bytes. Each sequence is called a 'log entry'. There may be many log entries in each buffer.

There are two log entry types:

- Fixed TIME & SIZE
- Variable TIME & Fixed SIZE

➢ Fixed TIME & SIZE

This is the most common form of log entry. Each entry is a fixed number of bytes long and is stored at a fixed interval. For example, recording the wind speed and ambient temperature every hour would produce fixed TIME & SIZE log entries.

➢ Variable TIME & Fixed SIZE

This form is used with event-initiated log entries. The first 4 bytes of the entry is the time that the event occurred {the time bytes come from Register Address 4 to 7 followed by the log entry (if any)}. For example, if an event initiated log entry stored the instantaneous value channel 1, the entry would be:

```
time (4 bytes), channel 1 (1 byte)
```

9. STARLOGGER CONFIGURATION TABLE

The STARLOGGER has a number of operating modes for its analog inputs. During factory calibration and testing a standard setup and some calibration factors are permanently written into the Logger's firmware (in ROM). This part of the firmware is referred to as the Configuration Table and a copy of it is also located in protected memory. If a different configuration is required, you may alter parts of the table.

This chapter describes the Configuration Table and its operation.

9.1. Default Configuration Table

The STARLOGGER has a permanent (default) copy of the Configuration Table in a ROM (Read Only Memory) chip. This default version instructs the logger to operate with commonly used settings. A user may alter some (or all) of these default settings to instruct the logger in another manner.

9.2. Memory Layout and Protected Memory

A small portion of the STARLOGGER memory is set aside for housekeeping functions such as I/O buffers and the LCD Scheme Display List. This portion of memory is protected (hidden) from normal logger operations and cannot be read or written by the Log Program or normal GET/PUT commands.

9.3. Configuration Table Layout

The Configuration Table is stored in ROM and may be read by the computer using the "S/s" commands. The CDT contains an array of 16 bit (LSB/MSB) variables which control many aspects of the STARLOGGER's operation (such as Scan Rate). The (i)nt command is used to permanently alter settings in the CDT. Some settings may be viewed and adjusted from the Display/Keyboard (Model 6004–2/3).

A copy of the Configuration Table is also stored at Real Address 0 and may be read using the protected (R)ead command (see section 9.7) This copy is not used for STARLOGGER control, it is available for reference only. (See Appendix F.)

9.4. STARLOGGER Linear Calibration Correction

The STARLOGGER uses the following linear correction formula:-

$$y = gx + o$$

where   y = corrected value

```
┌──────────────────── General Details ──────────────────────┐
│                                                            │
│   Scheme Name       RMTEMP                                 │
│   Scheme Title      <6004A MODE PDL> Average Room Temperature│
│   Scheme Directory  RMTEMP                                 │
│   Unload Comment    Yes                                    │
│                                                            │
│                                                            │
└────────────────────────────────────────────────────────────┘
```

```
x = raw value (from A/D converter)
g = gain coefficient
o = offset coefficient
```

The gain coefficient (g) is made up of the gain coefficients from the appropriate Gain Drive Table gain stage entry.

The same applies to the offset coefficient (o).

These coefficients represent decimal numbers (e.g. 0.15) which are stored in the STARLOGGER in a normalised 16 bit form as follows:

GAIN — the decimal gain coefficient is multiplied by 8192 to form the STARLOGGER gain coefficient entry.
ie. each bit is 1/8192 or 1.2207E-4.

```
E.g.,   g   = 0.00610
            = 0.00610 * 8192 = 50. (or 32 HEX)
```

NOTE: Gain coefficients must be POSITIVE.

OFFSET — Decimal offset coefficient is multiplied by 8 to form the STARLOGGER offset coefficient entry IN BITS. This offset must take into account the 10 bit A/D conversion as each offset bit has a magnitude of 1/4096 of the input signal range.

For example:

```
Gain stage  = 1, input range 0 – 2550 mV (2.55V)
each bit    = 5000/4096 = 1.221mV

Gain stage  = 100, input range 0 – 255 mV
each bit    = 50000/4096 = 122.1uV
```

```
        therefore,  if O = 12.21mV on a gain stage of 1
                   = 12.21/1.221 = 10. (A HEX)
```

NOTE: Offset coeffiecients may be POSITIVE or NEGATIVE.

9.5. Initialising via the RS-232

Before the STARLOGGER can be used it must be initialised. In some cases, the Logger may have stopped scanning to conserve its battery. Normally this initialisation occurs automatically when the logger is loaded with a Scheme.

The command to initialise (or re-initialise) the logger is:

Issss   (where ssss is a 4 HEX ASCII number equal to the logger serial number)

The response from the logger following the initialisation is:

CC c/r   (where CC is the checksum error in the Configuration Table)

if CC = 00   then the resident Configuration Table is valid and the logger has been initialised to use its configuration.

if CC = 01   then the resident Configuration Table is corrupted and the logger must be returned to UNIDATA for service.

9.6. Read/Write Protected Memory

There are five new RS-232 commands used with the STARLOGGER. They relate to the maintenance and initialization of the Configuration Table. For a complete list of STARLOG Protocol commands see Appendix C.

Command	Description
S	Read the Default copy of the Configuration Table from ROM
N	Read the Logger's serial number.
Issss	Initialize the logger with the Configuration Table.
RssssBBLLCC	Read from or write to real memory Wssss BBLLCCddddcccc {same construct as GET/PUT but with checksum of configuration table (cccc = MSB/LSB)}
Tssss	Activiate diagnostic firmware (see Chapter 9)

» ssss in these instructions relates to the 16 bit serial number of the STARLOGGER and acts as a password for protected commands.

» cccc checksum for the (W)rite command includes serial# (password), address, size and data fields (i.e., everything except the "W" command and the checksum itself).

» The 'S' command does not require the serial number password as it only reads the Configuration Table.

9.7. Compatibility (6003) Mode

The STARLOGGER may be operated in a mode that is very similar to a Model 6003 Portable Data Logger. Compatibility Mode is selectable in two ways:

- *Use the **CONFIG** key on 6004-2 and -3 STARLOGGERS to select Mode: 6003 after a Scheme is loaded.*
- *Version 3 Software users – 6003 Mode is not selectable using this version. Use the **CONFIG** key where available.*
- *Version 2 Software users – Enter special settings in the Scheme Title, then load this Scheme (see section 9.8.5).*

Once set in Compatibility Mode the following functions occur:

- A/D high resolution values are not stored
- Internal channels are not stored
- Battery voltage is monitored on Channel A6 (optional in Version 2 Software)
- Counters C0...3 become C0...1 upper/lower 4/8 bit
- A/D binary state is disabled
- Status settings are compatible (see section 8.2.1)

9.7.1. Computer Communication

RS-232 Communication with a computer only occurs at the end of the scan (if RTS is present). If RTS is presented between scans, the STARLOGGER switches ON but immediately switches OFF again until the next scan time.

9.7.2. Analog Channels

Register addresses 16 to 23 contain the 8 bit (low resolution) equivalent of the input signals present on Analog channels h0 to h7 scaled as a 0 to 2.55V value. (Note: If a gain of 10 is configured these 8 bit values represent 0 – 255 mV.) High resolution values h0 to h7 and internal channels are not stored.

9.7.3. Counter Channels

16 Bit counters are configured similar to the Model 6003 Portable Data Logger. (See Appendix D and the STARLOGGER Programming supplement 6201, Chapter 8.)

9.7.4. Setting Compatibility Mode using Version 2 Software

To configure a STARLOGGER in 6003 Mode using Version 2 Software, you define a Scheme with the following code preceding the Scheme Title.

For example,

This code can also include

- The option to monitor Battery Voltage on A6:

```
(6004A MODE A6 BAT)
```

- Prescale setting for Counter Channels, eg., c1 prescale of 1:

```
(6004A MODE A6 BAT c1 1)
```

- Configuring the battery type, eg., NiCad:

```
(6004A MODE PDL BATT NICAD)
```

Other custom configurations can be set in the title line by using the setting below. The format is:

Scheme Title   (6004A name1 setting1 name2 setting2 etc) title

Possible names and settings are:

Name	Setting	Description
c0	0...15	8 bit count c0 prescale
c1	0...15	8 bit count c1 prescale
BATT	NICAD/ALKLN	Configure Battery Type
MODE	PDL/A6BAT	Configure 6003 Mode or 6003 Mode with channel A6 = battery voltage

10. TEST DIAGNOSTICS

The STARLOGGER has inbuilt diagnostic firmware activated by the protected command:

```
Tssss        ssss        = serial number*
```

WARNING
Once the diagnostic mode has been selected, information stored in the logger may be lost. Always unload the logger before performing test diagnostic requests and also reload the logger after diagnostics.

10.1. Diagnostic

This diagnostic offers several tasks used to test and calibrate the STARLOGGER during manufacture. Each task corresponds to a single character sent to the logger via the RS-232 Computer Interface. After receiving the Protected Command... Tssss, the logger enters Diagnostic Mode and sends the message:

```
"STARLOGGER Diagnostics 6004B V22.1"

...followed by a menu of diagnostic commands
```

The diagnostic then awaits the entry of a Task Command from the host computer. When a Task Command is received, the logger executes the Task then awaits another Task Command (unless the previous task exited the logger from the Diagnostic Mode).

» The serial number must be in hex format and entered Least Significant Byte to Most Significant Byte; ie., the serial number 4001 is hex number 0FA7, or, (as it should be entered in the Tssss command), TA70F.

WARNING
Diagnostic Mode is intended for technical maintenance and certain protection features are disabled. TAKE CARE.

10.1.1. Task Command List

ANALOG

E	Continuously convert and display channela a0...a7
H	Select High level signals GAIN = 1 (0–2.55V)
I	Continuously convert and display temperature and battery readings
L	Select Low level signals GAIN = 10 (0–255mV)

CONTROL

K	Kill (exit from) Diagnostic Mode. Resets logger
S	Sleep. Shut down logger to conserve batteries when the logger is left unused for long periods.
	WARNING: Logger will be left in an uninitialized state and will not scan. The User must reset the logger using the Issss command (or reload the logger with a valid Scheme).

COUNTER

Y	Continuously read and display four Counter channels in hertz (frequency mode.)
T	Continuously read and display four Counter channels in binary. (Type any character to stop continuous conversion mode.)

INPUT/OUTPUTS

J	Display Binary inputs UIN0/UIN1
C	Set Binary output UOT0/(CNTL)
O	Set Binary output UOT1/(LEDs)
V	Test HSIO Ports and UPS (User Power Source)

KEYBOARD/DISPLAY

B	Test beeper and Vlc
D	Test LCD display
M	Play tune on beeper
P	Test keyboard

MEMORY

X	Test memory circuit
Z	Write/Read cycle through 256 date values on RAM address 0
R	Test RAM/ROM shadow

MEMORY CARD

A	Read/Write memory card
W	Display Memory Card status and test Memory Card memory

MISCELLANEOUS

C/R	Pressing the Enter key will end the current command (if any) and display the Command Menu.
Esc	End the current command

This page intentionally left blank.

11. MEMORY CARD STARLOGGER

The Memory Card STARLOGGER is designed to be used with industry standard PCMCIA 200ns SRAM (CMOS Static RAM) memory cards.

The Model 6004-23 STARLOGGER contains a single Type I PCMCIA Card Slot which complies with the Release 2.0 PC Card Standard. Memory cards up to 16Mbyte are supported.

WARNING: Use only 68-pin PCMCIA V2.0 Type I SRAM (200ns or faster) memory cards in your STARLOGGER.

Most Notebook computers support PCMCIA memory cards and all PC compatible computers can be supplied with a memory card adaptor. (Model 6806B available from UNIDATA.)

Using a memory card allows you to transfer data (including Unload Files and the Scheme) between the STARLOGGER and your computer without a connection between the two. The following functions are performed:

- *Program the STARLOGGER from a Memory Card*
- *Unload the STARLOGGER to a Memory Card*
- *Log onto a Memory Card*

There are two ways of using the memory card.

Memory Extension – allows you to extend the STARLOGGER memory size with a memory card up to 16M bytes. In this mode of operation the memory card is left in the STARLOGGER during data logging. The internal STARLOGGER memory is not used for logging (see section 11.9 ❸**Log onto Memory Card**).

Data Transfer – allows you to use a memory card to unload one or more STARLOGGERs. The internal memory is used for logging (see 11.9 ❷**Unload to Memory Card**).

» Note: The STARLOGGER supports MS-DOS file structures on the memory card. Before a memory card can be used with a STARLOGGER it must be formatted using a PC Card Format utility provided with your PC system (see Memory Card Maintenance in Version 3 Software).

» Note: Schemes should be defined with a Circular Data Buffer

---

The following description assumes that a suitably prepared memory card is available.

11.1. Version 3 STARLOG Software

The Version 3 STARLOG Software Package (Model 6303) supports memory card operation. This PC software enables you to:

- Prepare (format) a memory card for use with a STARLOGGER (or any other PCMCIA system)
- Transfer a Scheme onto a memory card (to Program the STARLOGGER)
- Transfer recorded data from the memory card into the Scheme's unload file database.

For details see the STARLOG Version 3 Software Users Manual (6245).

11.2. Using the Memory Card in the STARLOGGER

The operation of the STARLOGGER changes when a memory card is inserted. Without the memory card, the STARLOGGER operates normally, preforming all standard functions.

When a memory card is inserted (and switched ON) new memory card functions are available (see below).

11.3. Card Clock (Master Clock)

Before detailing Memory Card functions, it is necessary to describe the Card Clock. This is an internal time clock, based on real time, in all Memory Card STARLOGGERs which is used to:

- Set the Scheme Date and Time (Scheme Clock) when a STARLOGGER is loaded (programmed) with a Scheme from a Memory Card.
- Time/Date stamp the DOS unload files of recorded data transferred to the Memory Card.

» Note: The Card Clock is not the same as the Scheme Clock (which is used to time stamp logged data). The Scheme Clock is based on the number of scans since 1980 and is supported in all Unidata Loggers.

11.3.1. Viewing the Card Clock

Press the **ON** key (twice if a memory card is inserted) to display the first entry of the STATUS LIST, then press the ▼ (down) key twice to view the Card Clock current reading.

```
07:22:40      16 NOV 94
Card Clock Time
```

11.3.2. Setting the Card Clock

There are two ways to set the Card Clock:

a)   Whenever the STARLOGGER is programmed with a Scheme directly from a PC, the computer date/time is transferred to the Card Clock (as well as to the scan based Scheme Clock).

b)   Using the CONFIG LIST on the STARLOGGER keyboard to adjust the Card Clock as follows:

1.   Press **ON** then **CONFIG** k**eys.**

2.   Press the ▼ (down) key seven times until

```
Set Year     94

..use  ◀ , ▶   & ENTER
```

use the ◀ and ▶ keys to move to the digit to be adjusted and press the ▼ (down) key to decrement digit or the ▲ (up) key to increment digit. When YEAR is correct, press the **ENTER** key to store it.

3.   Press ▼ (down) keys to adjust MONTH, DAY, HOUR, and MINUTE in a similar manner.

11.4. Inserting the Memory Card

> WARNING: A memory card may be inserted into the STARLOGGER anytime but MAY ONLY BE REMOVED when Card Logging is OFF.

Insert the memory card into the Card Slot with the top of the card facing right. Push the memory card in firmly until the card is flush with the eject button.

> WARNING: Do not force the memory card, you may have inserted it backwards or upside down.

11.5. Card Validation

When a memory card is inserted and the ON key pressed, the STARLOGGER performs several card validation checks.

– Card Ready
– Card Battery OK
– DOS Format

If these checks fail, the card is not used and the **STATUS LIST** is displayed. If the card is valid, the first entry (Card Status) in the Card List is displayed:

```
Card Status 020
Card Free        500k
```

11.6. Card List

When the ON key is pressed and a memory card is inserted, the Card List is displayed instead of the usual **STATUS LIST**.

» Note: To view the **STATUS LIST**, press the ON key twice.

The Card List contains:

```
Card Status 020      Always displayed
Card free        500k
```

```
Card Logging Off          Displayed if card is

...use      & ENTER        Write enabled.
```

| Unload to Card
...press ENTER | Displayed if card is
Write enabled. |

| Load Schemename
...press ENTER | Displayed if valid
Schemes exist. |

11.7. Card Status Display

When a memory card is inserted, the Card Status is displayed as the first Card List entry.

| Card Status020
Card Free   118k |

Status Codes are:

Code	Meaning
000	Card Logging ON and Card Not Busy
001 ... 009	DOS File Errors
020	Card Logging OFF
021	Card Not Ready
022	Card Battery Low or Flat
023	Card is Write Protected
024	Card Busy transferring data
025	Card Full

» Note: The memory card should only be removed when a Card Status is 020, Card Logging OFF.

The Card Free entry shows how much free memory there is left on the memory card (in units of 1,000 bytes)

11.8. Card File Names

The STARLOGGER creates the following DOS files on the memory card:

■ During Card Logging

serial#.BHD	Header File
serial#.B00	Data Buffer #0 File
...	
serial#.B07	Data Buffer #7 File

» Note: In standard Schemes only .BDH and .B00 files are created.

» Where: serial# is the STARLOGGER's Serial Number shown on the front of the unit.

■ During Load Memory Card to Scheme (Version 3 Software)

schemename.LDR	Scheme Log Program File
schemename.KBD	Scheme LCD Display File
schemename.CDT	Scheme Configuration File

» Note: Each of these files MUST be present if you want to load a Scheme from the memory card into the STARLOGGER.

■ During Transfer STARLOGGER Memory to Card

serial#.B	STARLOGGER memory image

» Note: This is a maintenance function only. DO NOT USE this function for unloading logged data.

11.9. Memory Card Functions

Follow these sequences to perform the various card functions:

❶ **Program a STARLOGGER with a Scheme from the memory card.**

1. Transfer Scheme from computer to memory card.
   (See Version 3 Software **Load Memory Card with Scheme**.)

2. Check that Card Clock Time is correct.

3. Insert card into STARLOGGER.

4. Press **ON** key and then ▼ (down) key until the display shows the Scheme Name(s) available to load from the card.

5. Press **ENTER** to program the Logger with that Scheme.

❷ **Unload recorded data from STARLOGGER to card.**

1. Insert card into STARLOGGER.

2. Press **ON** key.

```
Card Logging OFF

...use   ◀▶   & ENTER
```

3. Press ▶ (adjust right) key and then **ENTER** key to turn Card Logging ON.

4. Press ▲ (up) key to view Card Status and progress of data transfer.

```
Card Status024
Card free        100k
```

5. When Card Status changes to 000 press ▼ (down) key, the ▶ (adjust right) key and **ENTER** key to turn Card Logging OFF.

6. Press the Card Eject button to remove the memory card from STARLOGGER.

7. Transfer data from memory card to computer (see Version 3 Software **Unload data from Memory Card**).

❸ **Log Onto Memory Card**

This function is the same as Steps 1 to 3 above. the memory card is simply left in the logger permanently. When recording is completed, follow Steps 4 to 7 above to remove the memory card.

❹ **Transfer STARLOGGER memory to card.**

This function transfers the complete STARLOGGER memory image to the card. The card file created is 131072 bytes long (128K) and has a filename

serial#.B   (e.g., 1280.B)

This function works whether or not a scheme has already been loaded into the STARLOGGER. The complete memory is always unloaded regardless of how much data has been recorded.

DO NOT USE THIS FUNCTION for normal unloading procedures. Use only for error diagnosis purposes.

1. Insert memory card.

2. Press the **ON** key and ▼ (down) key twice.

> **Unload to Card**
> **...press ENTER**

3. Press **ENTER** to transfer all of memory to card.

4. Wait approximately 15 seconds until the keyboard beeper stops, then press Eject Button to remove card.

» Note: The Card Logging Status must be OFF during this function.

» Note: The serial#.B file cannot be processed directly by the Version 3. Software.

11.10. Questions About the Memory Card

☞ ***Can I insert the memory card at any time?*** Yes.

☞ ***Can I remove the memory card at any time?*** Provided that the Memory Card Status is Card Logging OFF, you may remove the card, otherwise, DO NOT REMOVE THE CARD.

☞ ***What happens if I remove the card when Card Logging Status is ON?*** The files on the Card may be corrupted and the card may be damaged. (NOTE: These are remote possibilities, but a potential source of errors.)

☞ ***What happens if the card fills up with data?*** The Card Status will indicate 025 (Card Full) and the Card Free shows 0k. The STARLOGGER will swap to internal memory. If the full card is removed and an empty card inserted (using Card Logging OFF/ON sequence) the "overflowed" recording will then automatically transfer from STARLOGGER internal memory to memory card.

☞ ***What happens if the memory card is Write Protected?*** No data will be logged onto the memory card and its Card Status shows 023 (Write Protected). The STARLOGGER will automatically use internal memory until the memory card is Write Enabled.

☞ ***I have inserted a memory card back into the STARLOGGER without deleting the old unload file(s) (serial#.B00) What happens?*** New recordings (logged data) will be stored at the end of the old unload file. No data is lost, the unload now includes old and new data.

☞ ***What happens if I turn Card Logging OFF then turn it back ON some time later?*** The STARLOGGER reverts to recording to internal memory then swaps back to card memory and appends to the original unload file (serial#.B00) automatically transferring internal data to card in the correct time sequence. NO DATA IS LOST.

☞ ***What happens when the Card Battery goes flat?*** The Card Status indicates 022 (Card Battery Flat) and the STARLOGGER reverts to logging into internal memory.

☞ ***Can I plug a Flash Card or DRAM (Dynamic RAM) Card into the STARLOGGER?*** No. Only SRAM (CMOS Battery backed Static RAM) Cards are used in the STARLOGGER.

☞ ***Can I use one card to unload several loggers?*** YES. You may use one card and insert it into several loggers (until it is full) then return to your computer and unload the data into each appropriate Scheme.

☞ ***Can I transfer DOS files to/from the card whilst it is inserted into the STARLOGGER (via the RS-232 computer connector)?*** No. You must use a computer with a PCMCIA Card Slot or a Card Adaptor (available from UNIDATA).

APPENDIX A
ERROR CONDITIONS
DURING LOGGER OPERATION

The STARLOGGER may detect certain error conditions and an indication of these errors is presented in Register Address 3.

Register Address 3

(ERROR FLAGS)

7	6	5	4	3	2	1	0	BITS
SC	RT	B1	B0	MB	OS	BT	CS	
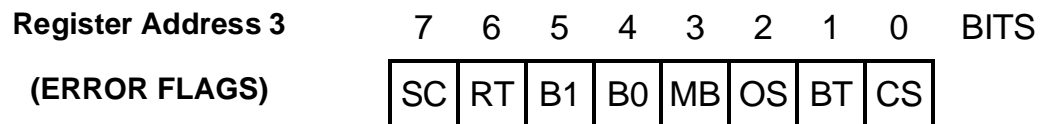
Flag	Meaning	Result
CS	Checksum error or other inconsistency found in the STARLOGGER's Configuration Table or firmware	fatal
BT	Battery is too low for safe operation.	fatal
OS	Operator Stop. Logger entered "Sleep" mode by command (not due to detected error.)	fatal
MB	Lithium memory backup battery needs replacement or is not installed (default).	warning
B1 B0	00 – Battery OK, 01 – Battery Low, 10 – Battery Flat, 11 – Battery Dead	warning
RT	User Log Program exceeded maximum runtime and was prematurely terminated (no EXIT instruction or corrupted/incorrect Log Program.	warning
SC	Scan counter fault detected.	warning

Error flags are divided into WARNING and FATAL errors. FATAL errors cause the STARLOGGER to stop operation and become dormant ("sleep mode"). WARNING errors are informative only.

» NOTE 1: To "wake" a logger from "sleep mode" the logger must be connected to a computer and the RTS signal presented. This powers on the logger but does not allow signal scanning or Log programs to run, however normal RS-232 communications can occur after the prompt (* C/R).

» NOTE 2: A logger RESET will also set the logger from "sleep" to operating state.

The ERROR FLAGS are READ ONLY and cannot be reset by the Log Program or a (P)ut command. These flags are only cleared when the logger is RESET (using the I command or Keyboard RESET).

APPENDIX B
STARLOGGER REVISIONS

This is a list of STARLOGGERS. Beside each model is a list of serial numbers and firmware included in each Logger when it was released from the factory. Features of each revision are listed. You can use this list to determine your upgrade options.

It is possible to upgrade STARLOGGER firmware *within* a particular model (contact your UNIDATA office for information).

It is not possible to upgrade firmware across different models.

Model	Firmware	Feature
6004C	Revision 23.10 Serial #3374 (after 1 Mar 97)	Improved internal temperature measurement New keyboard beeper New steel shell signal connectors Remote wake-up via RTU/Modem User programmable 5V power supply
6004B	Revision 22.10 Serial #3374 (after 1 Mar 97)	Correct p (put) command for 64K boundaries Introduced Model C
	Revision 22.9 Serial #3219 (after 22 Jul 96)	Add 'q' command Half duplex mode
	Revision 22.8 Serial #2769 (after 8 Feb 96)	Fix UART initialise in Hayes mode.
	Revision 22.7 Serial #2769 (after 29 Jan 96)	Keyboard repeat fixed. Hayes revised. Log and global timeout added. Error will not halt program. Unload to Memory Card disabled.
	Revision 22.6 Serial #2349 (after 30 Aug 95)	Timing improvement in SDI-12 sensor mode, fixes erratic communications with Campbell CR10 Recorder.
	Revision 22.5 Serial #2349 (after 22 Aug 95)	DDIVS error fixed. Hayes Code added.

Table continued on next page...

Model	Firmware	Feature
6004B	Revision 22.4 Serial #1749 (after 10 Nov 94)	Memory Card tested and SDI-12 usage enabled.
	Revision 22.3 Serial #1216 (after 21 June 94)	Memory Card code added. Sense 1 input now stored correctly. SDI-12 data communication changed.
	Revision 22.2 Serial #1216 (after 25 Apr 94)	Improved HSIO compatibility in 6003 Mode using HSIO Clock. Scan I/O held during Diagnostics.
	Revision 22.1 Serial #867 (after 15 Mar 94)	Original release.
6004A	Revision 21.12 (after 7 Aug 94)	Ensure A/D conversion on EVEN PC boundary.
	Revision 21.11 Serial #751 (after 11 Apr 94)	Fixes problem of losing first count after reloading Scheme. Improved compatibility in 6003 Mode using HSIO Clock.
	Revision 21.10 Serial #751 (after 7 Dec 93)	Sounder pitch adjustment no longer causes the Display to go blank. Any low-res channel A0 to A7 may be assigned to monitor the internal battery voltage.
	Revision 21.9 Serial #751 (to 7 Dec 93)	Corrects problem of STARLOGGER shutting down if you connect a computer cable to the Input Signals socket.
	Revision 21.8 Serial #551 (after 31 Aug 93)	Fixes inverted polarity of DSR signal. UPS power on time extended to 16ms. Corrects fatal error in R=PROM Diagnostic test
	Revision 21.7 Serial #552 (after 1 Aug 93)	Sense #1 input is now detected in 6004 Mode.
	Revision 21.6 Serial #552 (to 1 Aug 93)	Corrects configuration error when using asynchronous communications. Corrects lock-up in Diagnostic Mode.
	Revision 21.5 Serial #551 (after 19 June 93)	Fixes problem with resetting after installing new battery.

Model	Firmware	Feature
6004A	Revision 21.4 Serial #451 (after 17 June 93)	Fixes problem of losing first count after loading Scheme.
	Revision 21.3 Serial #451 (after 2 June 93)	Counter channels C1 and C3 now set to 16 bit mode. Modification to eliminate communica- tion errors (***Timeout on input***). Modified for RTU.
	Revision 21.3 (after 29 May 93)	Fixed SEROUT instruction.
	Revision 20.0 Serial #300	Original release.

APPENDIX C
STARLOG PROTOCOL – COMMAND LIST

There is no response if a GET or READ request has a bad checksum.

Command		Format	Response
G	G/get data block from PDL	GAAAASS	dd--ddcccc(c/r)
g		gaaaaaaaassssscccc	
P	P/put data block to PDL	PAAAASSdd--dd	eeccccc(c/r)
p		paaaaaaaassssdd--ddcccc	
W	W/write protected mode	WnnnnAAAASSdd--dd	eeccccc(c/r)
w		wnnnnaaaaaaaassssdd--ddcccc	
R	R/read protected mode	RnnnnAAAASS/r	dd--ddcccc(c/r)
r		rnnnnaaaaaaaassssscccc	
T	T/test mode (Diagnostics)	Tnnnnzz	
t		tnnnnzz	
I	Initialise CDT/Firmware	Innnnzz	ee(c/r)
S	Unload CDT from PROM	S	dd--ddcccc(c/r)
s	Partial Unload of CDT from PROM*	sss	dd--ddcccc(c/r)
N	N/number (serial#) of Logger	N	nnnncccc(c/r)
n		n	
K	K/kill (power down logger)	K	
k		k	

* where the last ss is the size of unload.

C.1. Standard/Extended Command Differences

Standard (UPPER CASE) supports 64K (16 bit) address and 256 byte (8 bit) data transfers.

Extended (lower case) supports 4G (32 bit) address and 16K (16 bit) data transfers except the (p)ut/(w)rite commands which are limited to 1024 byte (10 bit) data transfers.

C.2. Definitions

AAAA	=	4 Hex memory address (16 bit) MSB/LSB
aaaaaaaa	=	8 Hex memory address (32 bit) MSB...LSB
SS	=	2 Hex size in bytes of transfer (8 bit 00=256)
ssss	=	4 Hex size in bytes of transfer (16 bit 0000=65536) MSB/LSB
zz	=	2 Hex parameter (8 bit)
dd	=	2 Hex data per byte transferred (if applicable)
cccc	=	4 Hex data binary addition checksum (16 bit) MSB/LSB excluding the C/c and the cccc fields.
nnnn	=	4 Hex Logger serial # (16 bit) password LSB/MSB
ee	=	2 Hex error code (00=OK)

C.3. (i)nit Parameters

0	=	Init USER CDT
1	=	Load Firmware from RAM
2	=	Load USER CDT from RAM (then init00)
3	=	Load FACTORY CDT from RAM (then init02)
4	=	Copy FACTORY CDT to USER CDT (then init02)

Error Code

00 = OK, 01 = Bad checksum in ROM, 02 = PROM/Verify Fail,
03 = Mirror Fail, 04 = Bad checksum in RAM firmware.

APPENDIX D
MODEL 6004A STARLOGGER

The Model 6004A STARLOGGER has the following differences.

- Battery Charger Settings Switch
- Replacing a Battery
- Compatibility (6003) Mode Counter Settings

D.1. Battery Charger Settings Switch

Inside the Model 6004A STARLOGGER there is a two pole DIL switch which is used to set the battery charging circuit to the type of battery installed (this is automatic in the Model 6004B).

IMPORTANT!
You must set this switch correctly if you install a different type of battery (i.e. change from Alkaline to NiCad, etc).

SW1	SW2	Battery Type	Battery Charger Setting
OFF	OFF	Alkaline	Non rechargeable setting. External power with battery back-up.
ON	ON	NiCad	Constant current 255mA regulated Continuous (24 hour) recharge rate
ON	OFF	Sealed Lead Acid	Constant voltage 9.5V regulated Continuous (float) recharge rate for 4 cell pack.
OFF	ON	DO NOT USE	

D.2. Replacing a Battery Pack

An internal battery pack is connected to the Model 6004A STARLOGGER's circuit board using screw-type, colour-coded termination blocks.

Battery packs (Model 6910A and Model 6910B) now have a 3-way socket which is not used for Model 6004A STARLOGGERS. To connect a new battery pack, simply remove this socket first. Then,

1. Remove STARLOGGER lid by unscrewing the six lid screws.

2. Unscrew the terminations holding the red and green wires.

3. Lift out the black metal battery retaining plate and remove the used battery pack.

4. Insert a new battery pack and replace the metal retaining plate making certain not to crush the battery wires.

5. Connect the new pack by inserting first the green, then the red wires.

6. Replace lid into STARLOGGER base. Tighten six lid screws.

GREEN RED

GND +ve
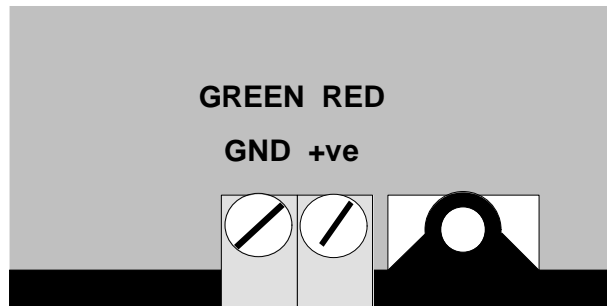
Model 6004A Battery Connections

RECYCLE. UNIDATA uses only Mercury free Alkaline cells in battery packs. UNIDATA or your battery manufacturer will accept battery packs returned for recycling.

IMPORTANT – Reverse Polarity Protected
The STARLOGGER is NOT damaged if battery wires are accidently reversed.

D.3. Compatibility (6003) Mode Counter Settings

In 6003 Mode the pin number and its associated channel mnemonic for counters are shown below. This maintains compatibility with documentation for the Model 6003 Portable Data Logger.

6003 Mode			
Address	**Channel Mnemonic**	**Description**	**Pin Assignment**
24		Counter 0 remainder	Pin 11
25	c0	8 bit difference	
26	c0l	8 bit difference	
27	c0u	8 bit difference	Pin 24
28		Counter 1 remainder	Pin 12
29	c1	8 bit difference	
30	c1l	8 bit difference	
31	c1u	8 bit difference	Pin 25

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APPENDIX E
USING THE STARLOGGER SDI-12 INTERFACE

E.1. INTRODUCTION

SDI-12 is an industry-originated, serial digital interface bus designed to allow an operator to connect a wide variety of transducers (such as, meteorological, hydrological, water quality, etc.) to a single SDI-12 Data Recorder, such as a STARLOGGER, with a single cable bus. This means that you could, for instance, connect several SDI-12 sensors to a STARLOGGER and not have to worry about combinations of RS-232, parallel analog, BCD, serial analog, RS-422, etc., signal types.

A unique feature of the STARLOGGER is its ability to operate as an SDI-12 Data Recorder or an SDI-12 Sensor.

This appendix assumes that the reader is familiar with the operation of the SDI-12 Sensor (the *Sensor*) and the STARLOGGER (the *Recorder*). For more information see the STARLOGGER Programmer's Manual, #6201.

E.2. THEORY OF OPERATION

When the STARLOGGER sends a "break signal", the Sensor wakens and captures the SDI-12 command following the break signal. If the command is valid, the Sensor reads its address setting to see whether or not its address is in fact being called, or if the address of some other device (at another location) is being sought. If the STARLOGGER is looking for a different address, the Sensor will go back to sleep until another break signal is received.

If the address being sent belongs to the Sensor, it will scan the instructions coming from the STARLOGGER to see what action is required. The two most important commands at this time are:

Measure: If the Sensor receives the START MEASUREMENT command, it will report back to the STARLOGGER the number of parameters enabled for measurement, and that these parameters are available to be sent to the STARLOGGER immediately.

Data: If the Sensor receives the SEND DATA command,
                it will send the last parameter readings measured to
                the STARLOGGER for storage.

E.3. MASTER MODE (SDI-12 DATA RECORDER)

Using the STARLOGGER as an SDI-12 Data Recorder allows several STAR-LOGGERs to be connected together.

E.3.1. SDI-12 Data Recorder Commands

Two Scheme Program instructions are used to control the SDI-12 Master operation:

SDIGET   which collects measurements from the nominated SDI-12
                sensor, and

SDICONV   which converts the collected data for use by the Log
                Program.

Measurements may be converted into fixed point Short Integers (for manipulation by the Scheme), Floating Point Numbers (for logging by the Scheme) or an ASCII string.

- Integers are two bytes.
- Floating Point numbers are 4 bytes.
- An ASCII string is zero byte terminated.

E.3.2. Data Recorder Coordination

Once an SDI-12 communication has commenced (SDIGET instruction executed) the SDI-12 Bus is busy and will ignore any subsequent SDIGET commands until the active measurement transfer is complete. The measurements are stored in memory, to be converted by a SDICONV instruction. Converted measurements (stored on STARLOGGER channels) may be further processed by the Scheme program and Logged.

Because most SDI-12 sensors require considerable time to make their measurements (typically 60 seconds), the STARLOGGER remains powered up awaiting a response from the sensor. This mode of operation usually requires the Scheme Program to initiate SDI-12 Measurements (SDIGETs) prior to the desired Log Interval.

The sequencing of the SDI-12 measurements is under the control of the Scheme Program (which is defined during Scheme Editing.) (See Chapter 7 in the STARLOG Version 3 Software Manual #6245.)

E.3.3. Measurement Errors

If during a data collection sequence (SDIGET) an error occurs, the sequence is retried a total of 10 times (configurable). A non-recoverable error causes the SDIGET instruction to report a "null" result and a subsequent SDICONV will not return any data (the channel readings remain unchanged from their last good reading).

E.3.4. Transparent Mode (Extended Commands)

STARLOGGER supports a transparent mode of operation that allows "ad-hoc" commands from an external computer (or modem) to be sent to SDI-12 Sensors connected to the SDI-12 bus.

This mode is entered using the STARLOG protected command:

```
tssss01
```

Extended commands may be issued whilst the Scheme Program is operating, but remember that the extended commands may disrupt the Scheme Program data collection timing. Type Alt - T from within the **Communications** window to enter this mode.

E.3.5. SDI-12 Test

To check the operation of the SDI-12 system the following sequence can be tested:

1. Configure the STARLOGGER as SDI-12 Data Recorder to en-
    able SDI-12 operation.

2. At address 384 (Log Program) insert these instructions:

```
128 0 255 4          SDIGET       BUSY
129 1 100 0          SDICONV      INTEGER,100
128 0 0   0          SDIGET       ADDR0
0              BUSY: EXIT
```

This sequence will branch to "BUSY" whilst SDI-12 bus is busy – then convert the previous measurement to 16 bit integers stored into addr 100 – then issue an SDI-12 measurement sequence to the Sensor at SDI-12 address 0.

Commands not used:

aM1…9!	start additional Measurement	×	À
aD1…9!	send additional Data	×	ö
extended commands		×	À

E.6.1. DEFAULT SETTINGS

address	=	0	
retry	=	10	
# of channels	=	2	
SDI0 channel 1 address	=	200	A0
SDI1 channel 2 address	=	202	A1
SDI2 channel 3 address	=	204	A2
SDI3 channel 4 address	=	206	A3
SDI4 channel 5 address	=	208	A4
ID string	=	011UNIDATA 6004B 2200000<C/R><L/F>	
VERIFY string	=	00000<C/R><L/F>	
START string	=	00002<C/R><L/F>	

E.6.2. ALTERING SDI-12 SETTINGS

Change the STARLOGGER Configuration Setting (see Appendix D of the STARLOG Version 3 Software Manual #6245) to adjust SDI-12 settings in the STARLOGGER's Configuration Table. Adjustments are:

address	=	0…9
retry count	=	1…25
# of channels	=	0…5
channel 0…4addr	=	n (location of 16 bit channel in the STARLOGGER Register Block)

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APPENDIX F
STARLOGGER CONFIGURATION TABLE

WARNING: This section is for the expert user only. The STARLOGGER may be configured into an inoperable state and then must be returned to the factory for service. PLEASE TAKE CARE.

WARNING:
Once a STARLOGGER has been re-configured it remains set to that configuration until explicitly changed again. For example, once a STARLOGGER has been loaded with a scheme configured for a 1 minute scan rate, it will remain as such, until re-configured to another scan rate. In Scheme Test Mode, use the .FTU Test Screen to carefully examine settings that need altering.

STARLOGGER configuration is adjusted during Scheme loading to conform to Scheme requirements. There are three ways of altering the configuration during loading.

a.   **Globally** – by editing the file "PDL6004.CDT" which effects all future schemes or schemes that are altered.

b.   **Locally** – by editing the file "scheme.CDT" which only effects the scheme "schemename". (In this case, a future edit of this scheme will regenerate the file "scheme.CDT" and your special configuration requirements will be lost. Consider using the "ATTRIB +R scheme.CDT" DOS command to set this file as *Read Only* so it cannot be overwritten.

c.   **New Product Type** – Define a new STARLOGGER product type that has its own "PDLxxxxx.CDT" definition file. This will allow you to select the standard Model 6004 setting or your own modified Model xxxxx settings whenever you create a new scheme.

F.1. CONFIGURATION FILE FORMAT (.CDT)

These files are ASCII Text files with a single configuration entry per line. Each entry contains three fields separated by a space and may be specified as decimal or hexidecimal numbers:

```
Address   Mask        Value
```

» The "Address" field contains the address of the configuration parameter to be altered (headed ADDR in Table A).

» The "Mask" field indicates whether one or two bytes (or part of a byte) need to be altered [logical AND].

» The "Value" field contains the new configuration setting.

Example: To set the RS-232 communications timeout to 1.5 seconds, the .CDT entry would be:

```
164     0xFFFF       384
```

Example: To set the STARLOGGER to Compatibility Mode, the .CDT entries would be:

```
10      255          0
11      255          61
```

» Note: 0x prefixes a hexadecimal number.

» Note: The STARLOGGER only changes those configuration settings that are different to its existing configuration. If no changes are required, the configuration is not performed (although the STARLOGGER is re-initialized.

F.2. CONFIGURATION TABLE

STARLOGGER DEFAULT ROM CONTROL & DEFINITION TABLE

;   Firmware File Naming convention:-

;   pppMvR_V.opt   (eg. stl2v2_9.red, mlg6v1_1.ata)

;   ppp=Product Prefix   (stl/udi/mlg/fec/obs)

;   M=(M)odel #

;   R=Hardware (R)evision

;   V=Software (V)ersion

;   opt=Option/Variant   (red/blu/yel/ata/sdi)

;   REV=2 PCB 6078DF   Model B. Yellow, SDI & EEPROM Prot.

;   REV=3 PCB 6078G..   Model C. UPS Control, Sonalert, LM34

;   ; STARLOGGER Type 1=RED, ATA

;   ; STARLOGGER Type 2=BLUE, SDI+ATA

;   ; STARLOGGER Type 3=YELLOW, SDI+ATA

;   Timebases = *7.8125ms (1/128th sec), **3.90625ms (1/256th sec)

;***1.628us (614/ms), **** 0.125sec, ***** 1sec

0000DCDT:

0000DSIZ:WORDDEND-DSIZ; Size of CDT LDB/MSB

0002DSER:WORD1d; Data Logger Serial

0004DVER:DBREV,VER; Data Logger Microcode Rev #.sub

0006DTYP:DB2d,OPT; CDT Type 2=1/256th sec. Firmware Options

0008DSCN:WORD128d; 128 * 1/128ths (1 sec) PDL Scan Rate

0010DMCF:WORDH,0000H; STL Configuration FLAGS (32 bits)

; 0 = Sync RS-232 Comms to Scan 8 = No A/D Hi-Res stored

; 1 = Extnded Protocl ONLY 9 = A6 LORES = Battery 0 to 14.14V

; 2 = NO HALT on FATAL errors10 = No Internal Channels stored

STARLOGGER CONFIGURATION TABLE (part 1 of 3)

; 3 = 1/UPS is Programmable11 = PDL status combatibility

; 4 = 1/Enable SDI-12 System12 = PDL Cntr C0..3 - C0..1 U/L 4/8 Bit

; 5 = 1/Enable SDI-12 as MASTER13 = No A/D Binary state

; 6 =14 =

; 7 =15 =

;**COUNTER Channel Settings (Prescale 0..15)**

0014DCTR:DB0; CTR0 = 16 Bit

0015DB0; CTR1 = 16 Bit

0016DB0; CTR2 = 16 Bit

0017DB0; CTR3 = 16 Bit

;**ANALOG Channel Type Table**

; 0 = ADHG 0=2.55V, 1=255mV range   8 =

; 1 = ADAU 1=AUTO-ranging ON 9 =

; 2 =10 =

0018DADT:WORD0000H; Chan 0 (Type)

WORD0000H; Chan 1 (Type)

WORD0000H; Chan 2 (Type)

WORD0000H; Chan 3 (Type)

WORD0000H; Chan 4 (Type)

WORD0000H; Chan 5 (Type)

WORD0000H; Chan 6 (Type)

WORD0000H; Chan 7 (Type)

;A**NALOG GAIN Drive table. Offset Gain and Temp Coefficient for each gain**

0034DGNT:WORD,8581d,0; 2.55V ... O=0, G=2.0475, T=0

0040DB8d,3+6; Averaging & Divide (incl. 6 bit shift)

WORD,8581d,0; 255mV ... O=0, G=2.0475, T=0

0048DB32d,5+6; Averaging & Divide

STARLOGGER CONFIGURATION TABLE (part 2 of 3)

```
$if(rev=3)

0050DATM:WORD1164d,1530d          ; TEMP. ... O=-17.8, G=1.187 T=0
(##.# degC)

0054DB0,0;       ... TO=0, TG=0

0056DB32d,5+6

$else

0050DATM:WORD17897d,18441d,0      ; Temp (deg C) gain=10, O=-2733,
G=3.251, T=0

DB32d,5+6; Averaging & Divide

$endif

0058DABT:WORD,39657d,0; Batt (V) gain = 1 ... O=0, G=5.841, T=0

0064DB8d,1+6; Averaging & Divide (NOTE: Effective *4)

WORD,0,0,0; **RESERVED**

;A/D Settings

0074DACT:WORD0; AC volts max period

0077DMUX:WORD200d; 800usec (4us)

WORD,0,0,0; **RESERVED**

;VM register address assignments

0086DCAD:WORD24d; VM addr of Counter registers

0088DALR:WORD16d; VM addr Lo-res registers

0090DAST:WORD14d; VM addr for Binary status registers

0092DAHR:WORD200d; VM addr Hi-res registers

0094DAIN:WORD232d; VM addr Internal chans, Temp & Batt
```

STARLOGGER CONFIGURATION TABLE (part 3 of 3)

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