WESTRONIC S2

Maintenance Manual

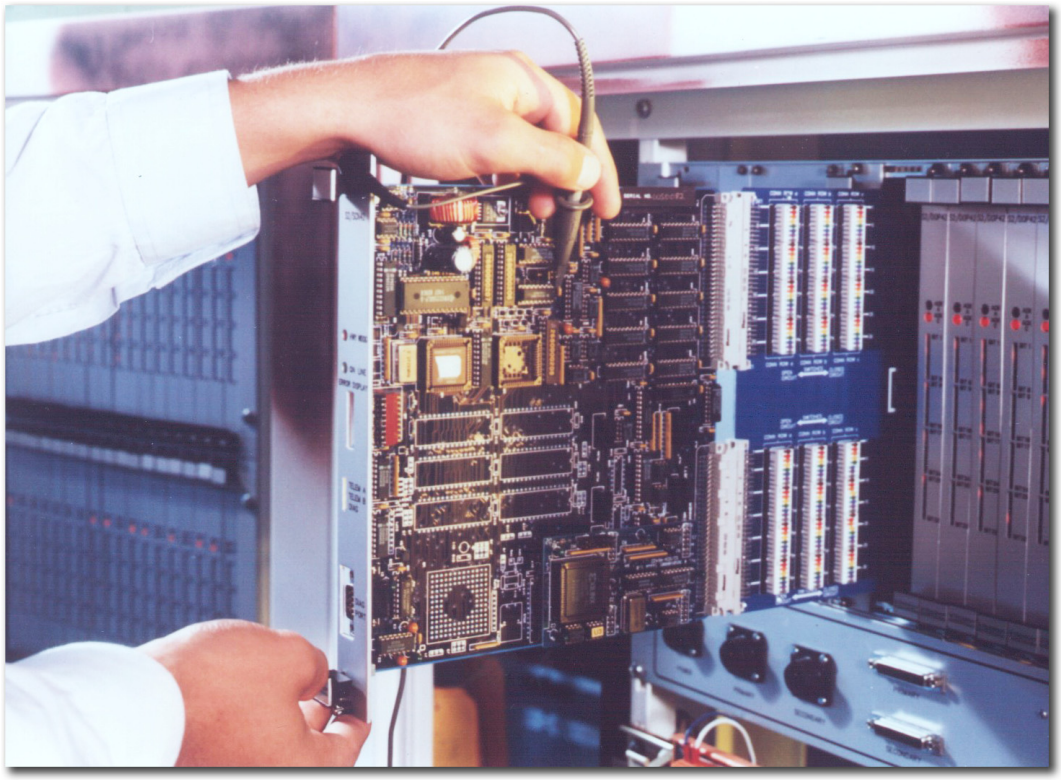

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TABLE OF CONTENTS

1. INTRODUCTION

This manual is a maintenance manual for WESTRONIC S2 telecommunications equipment.

1.1 Purpose

This manual will guide users with electronic and telemetry experience in the maintenance of the range of S2 telemetry products. This release of the manual is generally limited to first line maintenance: further levels will be added in subsequent releases.

1.2 Scope

This manual provides a level of detail sufficient for fault-finding and maintaining WESTRONIC S2 telecommunications equipment.

Specific maintenance tasks such as equipment repair are beyond the scope of this manual.

1.3 Audience

This manual is for railway signalling & telecommunications engineers, technicians and maintainers who maintain WESTRONIC S2 telecommunications equipment.

1.4 User Pre-Requisites

Users who undertake first line maintenance should have a general understanding of telemetry systems and railway operations. They should understand the sensitivities of electronic equipment and the appropriate handling procedures. They should be competent in the use of multimeters and similar instruments.

1.5 Abbreviations

Refer to the Glossary for abbreviations and specialised terms used in this manual.

1.6 Conventions

S2 equipment may contain sub-versions, identified by the last numeral in the name (see section 2.1 for naming conventions).

The letter ‘x’ is used to signify the generic case. For example, S2/SCNx refers to all variations of the equipment (both S2/SCN41 and S2/SCN42).

Symbols in this manual are used in the following manner.

Note: ***Notes are presented in bold italics and are set between ruled lines.***

Notes may be emphasised with the following graphic symbols:

Caution: 'Caution'—cautions are given to highlight the possibility of damage to equipment, but not necessarily a danger to personnel when handling, operating, or maintaining equipment.

'Warning'—warnings are given to highlight the danger to personnel of serious injury or death when handling, operating, or maintaining equipment.

1.7 References

Refer to the installation-specific schematic diagrams and other documents (as applicable) when maintaining or fault-finding WESTRONIC S2 telecommunications equipment.

Other manuals are referred to in this manual, and are indicated by the following abbreviations:

[wa] WESTRACE Application Manual, WRTOAPPM, Latest version.

[sd] WESTRACE System Overview Manual, WRTOOVER, Latest version.

[flm] WESTRACE Generic First Line Maintenance Manual, WRTFGEN, Latest version.

1.8 How to Use This Manual

1.8.1 Document Overview

The WESTRONIC S2 Maintenance Manual is a reference for maintainers of WESTRONIC S2 telecommunications equipment.

It contains the following sections.

Chapter 1	introduces and describes this manual.
Chapter 2	is an overview of the WESTRONIC S2 telecommunications system and equipment.
Chapter 3	describes first-line maintenance philosophies and procedures for WESTRONIC S2 equipment.
Chapter 4	describes the WESTRONIC S2 Testlink 43 unit.
Appendix A	describes basic servicing and functional details of many commonly used WESTRONIC S2 modules.
Glossary	explains specialised term used in this manual.

1.9 Safety Precautions

1.9.1 Electrical Equipment

S2 equipment typically operates from 12 V supplied by the S2/PSU4x power supply module. Note that the S2/PSU4x power supply module may be supplied by a voltage high enough to endanger life.

Functional testing, maintenance or repair is to be undertaken by personnel aware of the danger involved and who have undertaken adequate precautions.

1.9.2 Handling

Do not use a multimeter or a similar instrument on the ohms range while supply voltages are present.

Take care not to bend the connector pins when connecting cables to units. Push the connectors fully home, then progressively and simultaneously tighten each jack screw (finger tightness only).

Ensure that the area in and around the equipment is kept clean and free from litter at all times.

1.9.3 Anti-Static Protection

Caution: ***The modules used throughout the system contain static sensitive devices.***

Always take the following precautions when handling modules:

- Spare modules and components must be kept in conductive packaging.
- Work bench tops must be conducting (antistatic wrist straps connected to the local ground is preferred).
- Soldering irons and other equipment must be earthed.
- Conductive wrist straps connected to the local ground should be worn at all times when handling modules and components.
- Avoid wearing nylon clothing when handling modules and components. A cotton overall is preferred.

1.9.4 Module Removal and Insertion

S2 modules may be removed or inserted whilst the equipment is powered.

1.9.5 EMC Compliance

The S2 system equipment have been tested against the information equipment EMC standard, AS/NZ3548:1995 and found to comply with the limits for Class A equipment.

In a domestic environment this equipment may cause radio interference in which case the user may be required to take adequate measures.

2. OVERVIEW OF WESTRONIC S2

This chapter describes the concepts behind WESTRONIC S2 telemetry systems. It contains sections on:

- What is S2?
- Basic Functions
- Typical S2 Applications
- How S2 Works
- S2 System Components

2.1 What is S2?

WESTRONIC S2 is an intelligent, point to point or multi-point, digital telemetry system. It is designed and manufactured by WRSA (Westinghouse Rail Systems Australia) and marketed world wide for railway signalling applications.

The WESTRONIC S2 systems can be used as the communications core of larger, more intelligent systems, such as:

- office (CTC), see section 2.3.1 for details;
- remote field stations (RFS), see section 2.3.2 for details;
- WESTRACE interfaces, see section 2.3.5 for details.
- panel processor (multiplexer), see section 2.3.3 for details;
- protocol converters, see section 2.3.4 for details.

WESTRONIC S2 telemetry systems are integrated from a set of modules to provide the functionality desired.

S2 telemetry installations (interconnected by a motherboard) may use either:

- S2/SOF42 (single office/field) modules;
- S2/SCN4x (scanner) modules controlling multiple S2/DIP4x (input) and S2/DOP4x (output) modules.

Both systems have identical interfaces and can be intermixed on a single telemetry system.

Figure 2.1 shows an RFS using a combination of input and output modules.

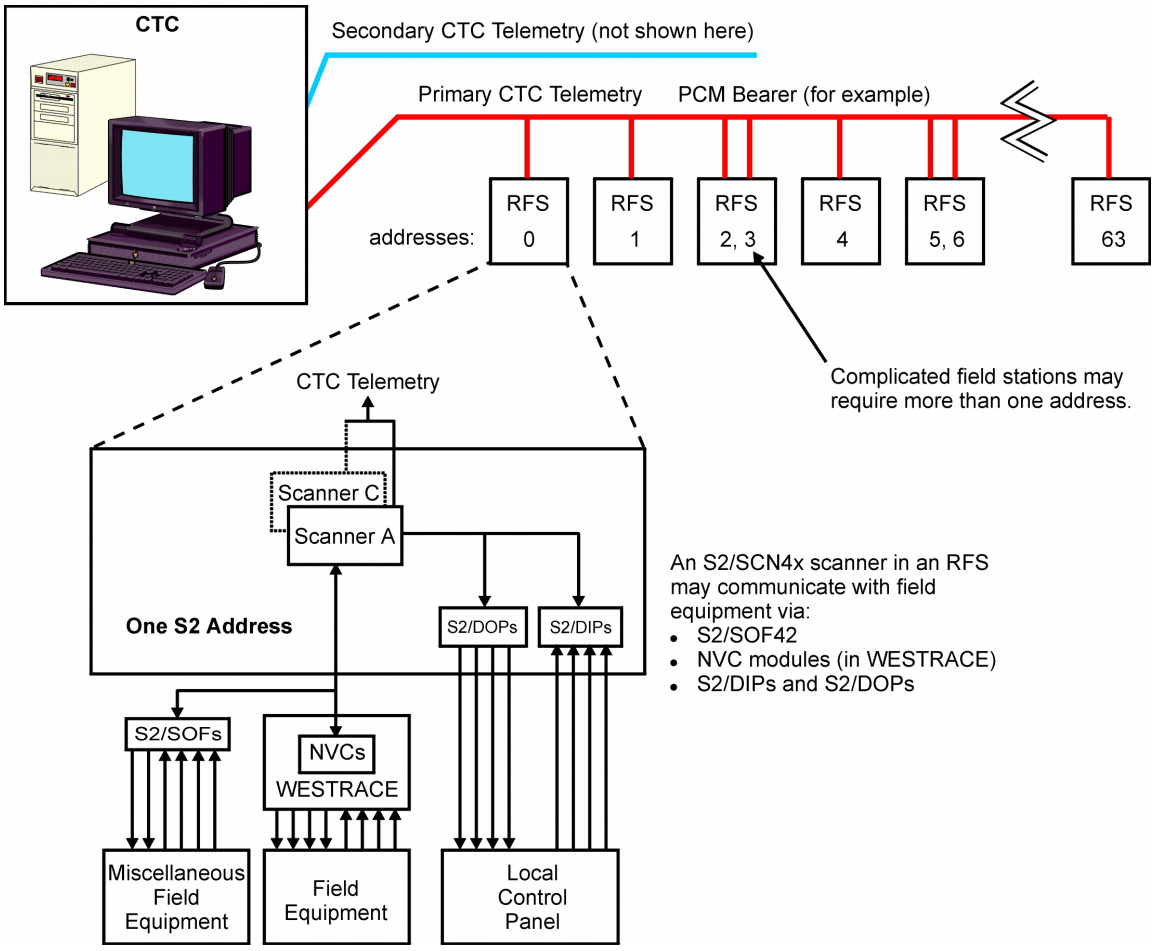


Figure 2.1 Point to Multi-point Remote Control

2.1.1 Naming Convention

Each module as an identifier of the form **S2/AAAnm**, where:

- **S2** is the product family;
- **AAA** is a three letter acronym or abreviation of the function;
- **m** is the BTR Rail company identifier of the place of manufacture (4 and 5 are WRSA);
- **n** is the sub-version number (replaced by 'x' in cases where more than one version is being discussed).

2.1.2 Main Types of Modules

The major components of typical S2 systems are:

S2/SCN4x	Scanner— used to manage communications with input and output modules, external communications and local processing. Scanners are typically used in pairs (designated scanner A and scanner C) to provide parallel highway operation.
S2/MBD4x, S2/MBD5x	Motherboard—supports and interconnects S2 telemetry modules.

S2/DIP4x	Digital Input Module—senses voltage free inputs.
S2/DOP4x	Digital Output Module—drives relays, LEDs and similar.
S2/VFC4x	Voice Frequency Carrier or modem.
S2/ATT4x	Attenuator—connects to the rear of S2 motherboards to allow the modem bearer connection levels to be set.
S2/PSU4x	Power Supply—converts a nominal input voltage to a 12 Vdc output.
S2/SOF42	Single Office Field—single card telemetry module designed to allow remote control and indication of digital 32 inputs and 16 outputs.

S2 modules are listed in section 2.5 and described in detail in Appendix A.

2.2 Basic Functions

WESTRONIC S2 can be used in most railway signalling remote control applications. It is ideal for operation in the remote and harsh signalling environment, with extremes of temperature fluctuations and where high reliability and integrity of operation of (not always ideal) communication channels is of paramount importance. Inputs and outputs are directly suited to interfacing with typical signalling equipment.

Typically, S2 is used to communicate from a single location termed the ‘office’ to multiple field locations on a single or duplicated telemetry link (see Figure 2.1).

Originally, S2 office systems used banks of input and output modules. Today, most offices are part of an overall control computer system with telemetry ports that use the S2 protocol directly.

Whatever form the office system takes, it has the ability to send messages containing the desired output states (controls) that are individually addressed to the fields. Further, it can request and manage input states (indications) from each of the fields.

S2, with the appropriate interface, will operate over a wide variety of communication systems from voice grade analogue lines to digital fibre optic or microwave communication systems.

Figure 2.1 shows a typical CTC application. The one control centre can communicate with up to 64 separate field locations on a single or duplicated telemetry link.

Each location can optionally be enhanced with:

- multiple communication ports for uses such as interfacing with other systems and protocol conversion;
- non-vital logic processing using Interlogic, a ladder logic based integral design, test and processing system (S2/SCN41 only);
- local and remote diagnostic systems including MoviolaW for S2/SCN41 systems.

2.3 Typical S2 Applications

2.3.1 Office (CTC)

From a functional point of view, an 'office' is an S2 address acting as master to a 'slave' of at least one other S2 address.

An S2 office can be a:

- S2/SCN4x scanner; or
- dedicated computer system that communicates using S2/ protocols; or
- S2/SOF42 module (for small input and output requirements).

Figure 2.1 shows a typical S2 telemetry system comprised of a computer-based CTC office and a field with an optional local control panel.

WESTRONIC S2 can be used as a panel processor, integrated with a computer (for example VME, Sun or PC) to provide real time panel processing. Computer-based S2 offices are beyond the scope of this manual.

Hard wired offices may use many input and output modules—up to 64 addresses. The only hardware difference is the use of extension housings and highway buffer modules. Otherwise, they will be like fields.

2.3.2 Remote Field Station (RFS)

Remote field stations typically comprise:

- voltage free contact inputs;
- signalling and control relay outputs.

An RFS is the S2 slave to the office's S2 master. It functions as a mailbox (with an address), collecting data (logic states) from the field equipment to which it is connected. The office transmits an addressed control message to the RFS, and the RFS does two things:

- The RFS transmits the stored data onto the communications bearer.
- The RFS communicates any control commands to the field equipment.

A typical RFS would include:

- modem and possibly stand-by modem, unless fed via a PCM (pulse code modulation) system;
- power supply;
- single or duplicated scanner;
- many S2/DIP4x modules;
- many S2/DOP4x modules;
- housing(s) and motherboard(s), as required;
- input and output cables and terminations.

Alternatively, a WESTRONIC S2 RFS could be a small housing containing one or more S2/SOF4x module(s).

The office may also include a local panel interface that requires:

- local processing or mapping;
- local panel switch inputs;
- local panel LED outputs.

Figure 2.1 shows a typical telemetry system comprised of a CTC office and a field with an optional local control panel. The RFS communicates with the field equipment via the WESTRACE using a serial connection instead of parallel connections. CBIs (Computer-Based Interlockings) other than WESTRACE can be used, as well.

In Figure 2.2, the RFS uses DIPs and DOPs to communicate with the field equipment via multiple parallel connections.

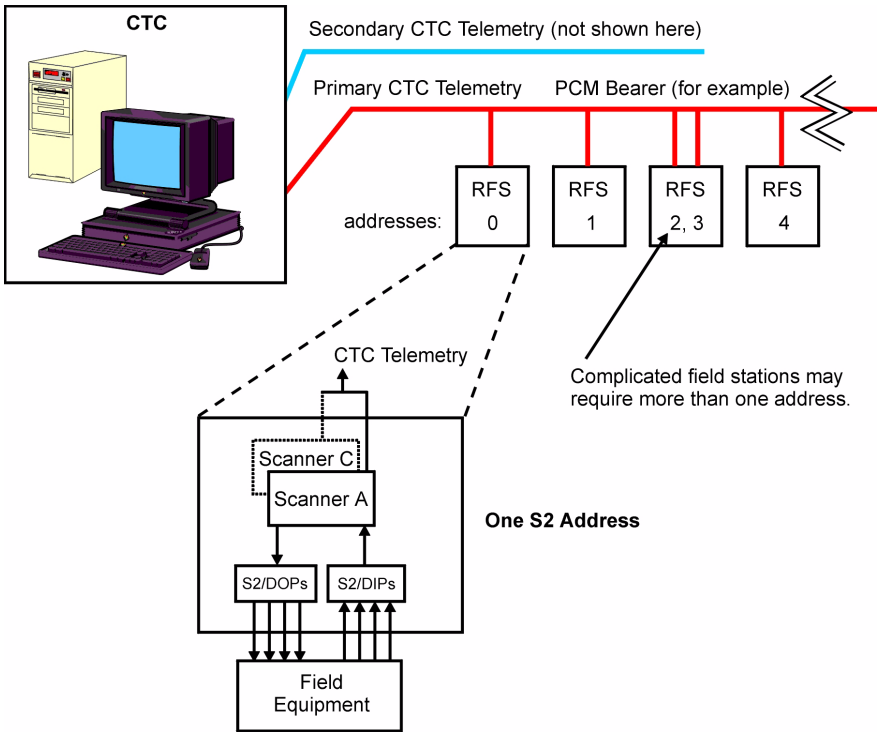


Figure 2.2 : RFS Communicating via DIPs and DOPs

2.3.3 Panel Processor (or Multiplexer)

A panel processor or multiplexer (PMUX) is an application where data displayed on a mimic panel is a processed result of indications or controls. The scanner typically converts the communication protocol from S2 to the protocol used by the SSI panel processors.

A typical S2 panel processor provides for operator interface to an interlocking via an entrance/exit control panel. This interface provides parallel connections from input switches and buttons and LED or lamp outputs.

The WESTRONIC S2 Panel Processor may be comprised of the following equipment modules:

- S2/SCN4x scanner module acting as a communications protocol converter and an alarm processor.
- S2/DIP4x input modules collecting the status of the control panel push buttons and switches.
- S2/DOP4x output modules outputting the status of the indications to the control desk and indication diagram.
- S2/PSU4x power supply units providing power to the Panel Processor modules.

These modules are integrated into a master housing which is fitted with an S2/MBD45 motherboard. If needed, a second housing is fitted with an S2/MBD50 expansion motherboard.

2.3.4 Protocol Converters

A communications protocol is like a language. Other communications protocols use different structures or timings than WDLC (see section 2.4.1).

An S2 Protocol Converter is like a translator to allow S2 equipment to communicate with non-S2 equipment.

For example, an S2/SNC4x scanner may be used in a PMUX to interface with an SSI using the BR1921A or BR1631 protocols.

The S2/SNC4x scanner:

- receives a message transmitted in one protocol;
- processes the message into the other protocol;
- transmits the converted message.

2.3.5 WESTRACE Interface

WESTRACE and conventional S2/ equipment can be freely intermixed on a system. WESTRACE NVC modules have serial ports that communicate directly in S2 protocol (a modem may be required to interface to a voice grade circuit).

Configuring the WESTRACE modules is described in the WESTRACE System Design Manual [sd] and the WESTRACE First Line Maintenance Manual [flm].

2.4 How S2 Works

S2 equipment is typically used to exchange information between an office and (typically) multiple field stations. This is termed ‘point to multi-point’ communications.

The office issues controls to field stations and receives indications from field stations. S2 offices are described in section 2.3.1.

An S2 office can be a:

- S2/SCN4x scanner; or
- dedicated computer system that communicates using S2/ protocols; or
- S2/SOF42 module.

Regardless whether a computer is controlling a large S2 system, or a S2/SOF42 is controlling a simple S2 system, the operating principles of S2 are similar to that of S2/SCN4x scanners. The following description is based on using S2/SCN4x scanners as the office.

This data transfer is controlled by S2/SCN4x scanners using a time division multiplexing (TDM) mode of operation to send and receive data over a serial link. The basis of TDM is to allocate a unique slot of time to each address location. Groups of data (frames), each identified by a destination address, are serially transmitted via a communications bearer.

The communications protocol used by S2 equipment is called Westinghouse Data Link Control (WDLC): a modified form of Synchronous Data Link Control (SDLC).

WESTRONIC S2 is a digital remote control system where the office system is the master and the field system is the slave. The office (master) initiates all communication and usually sends a message containing a complete data set to each connected field in sequential address order. Each field will respond with a message containing its complete data set once it receives a message addressed to it.

Intelligent office systems can insert an address out of the normal clockwork scanning sequence to poll a field when a change is required. This is termed a ‘clock interrupt’.

Here’s how S2 works (using field inputs as an example):

- The WESTRONIC S2 system is driven by S2/SCN4x scanner modules. These modules interrogate (scan) all the S2/DIP4x digital input modules and S2/DOP4x digital output modules in a cyclic (clockwork) manner.
- Digital data (in the form external contact closures) arrive from the field on many parallel connections to an input module. The input module sources a current to the external circuit and reads the resultant voltage across the terminals as either a logical “1” (high voltage) or logical “0” low voltage.
- The scanner collects the parallel data from each input module on every cycle.

- The scanner monitors each message sent from the office, decodes the address and compares this with its own address. All messages for other addresses are discarded.
- The scanner receives and stores valid messages.
- The scanner forms a response message that is transmitted back to the office and contains the state of each local input.
- The output modules convert the serial data contained in the message to outputs on many parallel connections. Each output is a single cut circuit (typically open collector transistor) that can switch an external supply to an external load. These parallel outputs are typically connected to a relays or LEDs on a display panel.

S2/SOF based systems operate in a similar manner with the exception that all the telemetry functions are integrated onto a single printed circuit board.

Office systems are generally computer-based, although hardware systems are available. These control the addressed field locations but ...

2.4.1 WDLC Protocol

The WDLC protocol is based on groups of data called frames. Figure 2.3 shows the parts of a frame.

Start Flag	Address Byte	Control Byte	Data Field	CRC Code	End Flag
8 bits	8 bits	8 bits	64 bits	16 bits	8 bits

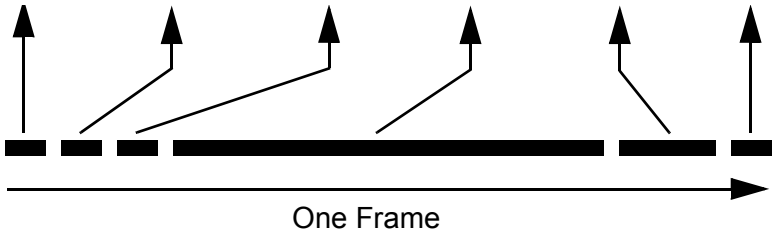


Figure 2.3 : Contents of a WDLC Frame

WDLC frames transmitted by the office are called ‘control frames’, and the frames transmitted by RFSs are called ‘indication frames’. When the office transmits a control frame, only the RFS with the correct address responds.

Details of the WDLC frame protocol are described in the following sections.

2.4.1.1 Address Byte

The Address Byte contains the address, direction bit and system bit.

Address — The six least significant bits of the Address Byte contain the address identifier of the WDLC frame. This provides an address range of 0 to 63.

Direction Bit — The Most Significant Bit (MSB) is the direction bit used to define the origin of the WDLC frame.

Logic 1 indicates that the WDLC frame originated at the office. Logic 0 indicates that the WDLC frame originated at the field.

System Bit — The second MSB is the system bit. This is always clear, logic 0.

2.4.1.2 Control Byte

The Control Byte contains information pertaining to system status.

Main Bit — The MSB (bit 7) is the Main bit used to define which S2/SCN4x module is on-line in a dual S2 Scanner System.

Logic 1 indicates that the scanner for highway A is on-line. Logic 0 indicates that the scanner for highway C is on-line.

When received at an RFS, logic 1 initiates a changeover of the S2 Scanner system on-line/off-line status.

Port Bit — The second MSB (bit 6) is the Port bit. This is used to define which telemetry port the on-line S2/SCN41 module is using for communications. The S2/SCN41 modules do not use dual telemetry ports for communication to the CTC Centre, therefore this bit is ignored.

Flashing Control Bit — The third MSB (bit 5) is the Flashing Control bit. This function is not used in this system.

OOK Bit — The fourth MSB (bit 4) is the OOK (Other OK) bit. This is used to define the health of the off-line S2/SCN41 module in a dual S2 Scanner System. If the bit is set, logic '1', then the off-line S2/SCN41 module has failed. If the bit is clear, logic '0', then the off-line S2/SCN41 module is healthy.

Reset Bit — The fifth MSB (bit 3) is the reset bit. The CTC Centre requests a S2/SCN41 module reset by setting this bit of the control byte. An immediate reset is performed without acknowledgement to the CTC.

Local or Remote Operation Bit — The eighth MSB (bit 0) is the Local/Remote Operation bit. This is used to return the local or remote mode of operation to the CTC Centre. This bit is clear when in remote mode, else set when in local mode

2.4.1.3 Data Bytes

The eight data bytes (64 bits) contain the control or indication information.

2.4.1.4 CRC Bytes

The WDLC protocol incorporates a 16 bit cyclic redundancy check (CRC) code to assist in error detection. The CRC code provides protection against corruption of the WDLC frame (bit errors) caused by transmission line disturbances or signal distortion. The CRC code is generated automatically based on the bit pattern of the address byte, control byte and data field.

2.4.2 Clockwork Scanning

Scanners in the office transmit control frames to the field scanners in repeating numeric sequence called a 'clockwork' scanning pattern. Figure 2.4 shows a typical clockwork scanning cycle for 12 field addresses (the number may vary).

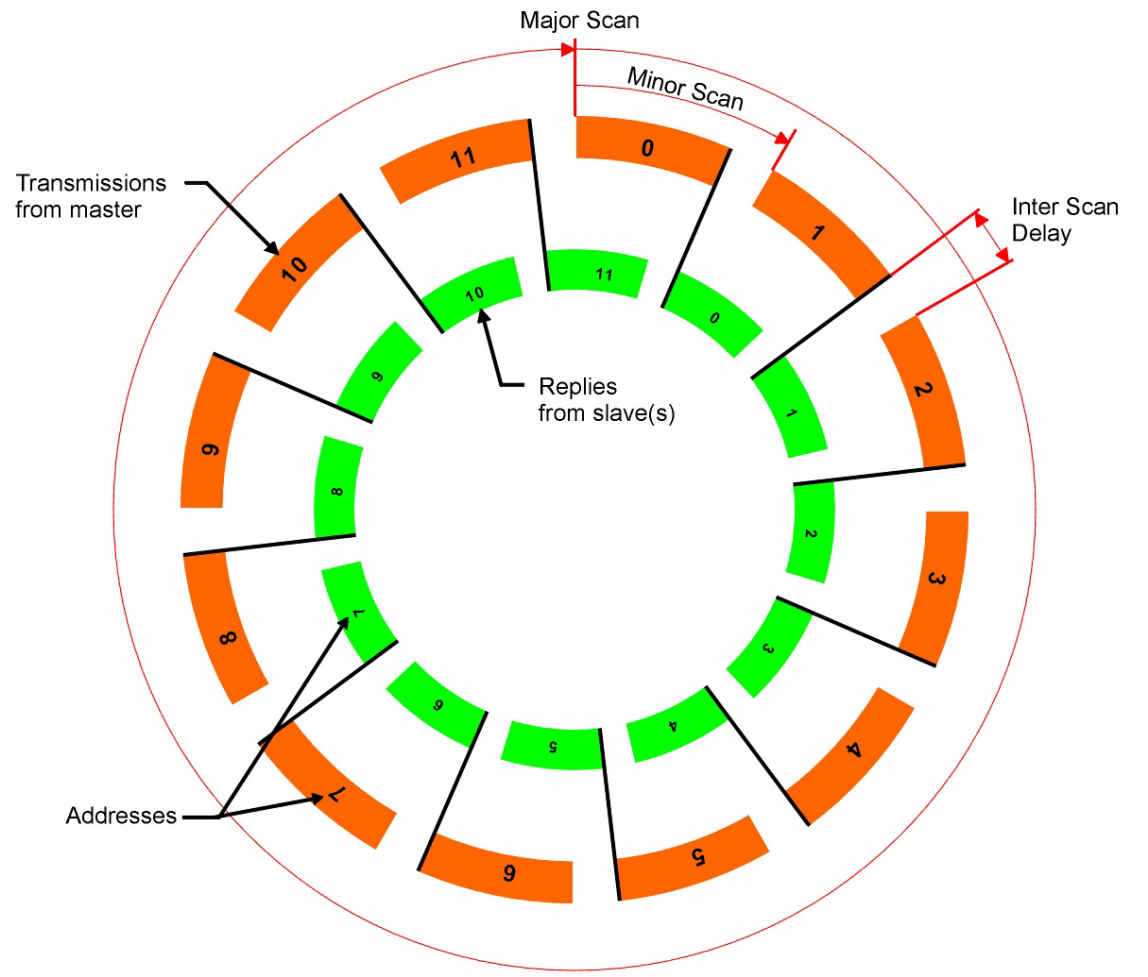


Figure 2.4 : Clockwork Scanning Cycle

WDLC control frames are transmitted from the office (master) in address order and then repeated. Field stations are slaves to the office clockwork pattern: they respond with WDLC indication frames in the same address order as generated by the office. The clockwork scanning system is full duplex, so transmissions and receptions are independent and simultaneous.

This scanning pattern provides a highly reliable method of information transfer, because any WDLC frame missed (due to line disturbances, for example) is transmitted on the next (and every succeeding) clockwork scan.

The NVC-S2/SOF42 equipment is similarly polled by the on-line S2/SCN41 module in a clockwork scanning pattern, with immediate access when new controls are generated by ladder logic processing.

2.4.3 Dual Systems

Parts of the S2 equipment may be duplicated and run in parallel (hot stand-by) mode in order to provide maximum system availability. This enables the system to function if one set of the duplicated equipment fails. The fault can be rectified by module replacement, and the system restored to full dual operation, without losing the remote control facilities.

Either, or both, of the external and internal data transmission paths within a remote control system may be duplicated:

- The external transmission path is the bearer circuit used to carry transmission between the office and field, including any isolating or impedance changing circuits which may be used to interface the bearer circuit to the S2 equipment.
- The internal data transmission path comprises the carrier module (modem), S2/SCN4x, and the parallel highway interface between the S2/SCN4x and the S2/DIPs and S2/DOPs. The internal data transmission is referred to as the highway (A or C).

Figure 2.5 shows three types of dual systems typically found in S2 equipment. Other configurations are possible.

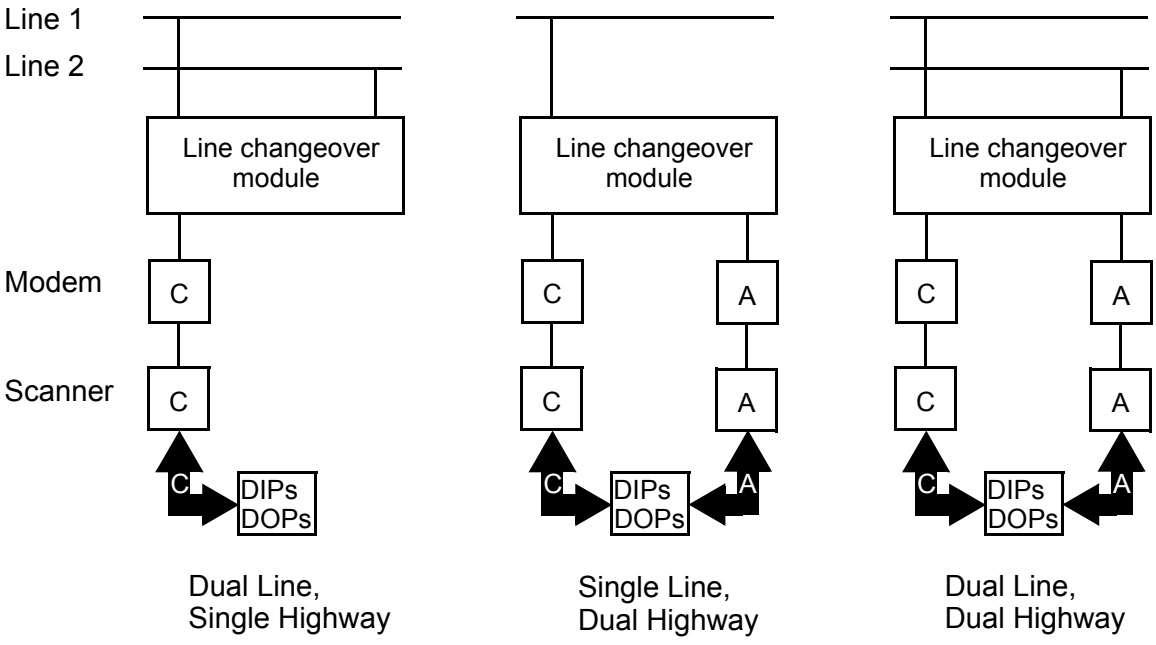


Figure 2.5 : Dual System Configurations

2.4.3.1 Dual Lines

The S2 dual line configuration provides primary and secondary bearers. For example, the primary bearer might be a fibre-optic cable and the secondary bearer might be a microwave link serving as a backup in case of interruption of the primary bearer.

A system having dual lines operates on one line, switching only to the second line under fault conditions. The Alarm and Line Changeover (S2/ALC41) module may be used to perform this switching in response to an alarm condition.

Carrier modules require transmitter and receiver attenuators to set the correct levels for transmitted signals to line and receiver sensitivity.

Alternative lines in a dual line system typically have different characteristics; therefore, it is necessary to switch attenuators and carrier module connections at the same time as switching line and carrier module connections. This is done automatically by the S2/ALC4x.

2.4.3.2 Parallel Highways (A & C)

The parallel highway configuration provides protection against a failure in the highway data transmission path (as opposed to a failure in a line circuit).

The pair of scanners used in the parallel highway are named scanner A and scanner C, depending on which row of motherboard connector pins they occupy (row A or row C).

2.4.3.3 Dual Lines and Parallel Highways

The dual line and parallel highway configuration provides simultaneous protection against failure of:

- one line circuit;
- one highway

If any good path exists from the office to the field, this dual system will automatically find it.

2.5 S2 System Components

S2 is comprised of modules that can be selected, installed and configured to suit different system functions. Table 2.1 lists the modules currently used in S2 applications.

Chapter 5 contains further details of S2 modules.

Name	Function	Typical Application	See also
S2/ALC41	Alarm & Line Changeover Module	Provides alarm monitoring and controlling functions.	section 5.6.7
S2/ATT44	Attenuator Board	Connects to the rear of S2 motherboards to allow the modem bearer connection levels to be set.	section 5.6.1
S2/CAC42	Computer Auto Changeover	Performs control and monitoring of a dual computer S2 system.	
S2/CDC41	Carrier Detect Card	Connects to the rear of the S2 motherboards to provide a transmit timeout alarm and transmission disconnect facility.	section 5.6.2
S2/CXP41	Communications Expander	General purpose module to expand the intelligence and communications abilities of host processors.	
S2/DIP42	Digital Input	Enables a common negative, voltage free closed contact to be detected.	section 5.3.1
S2/DIP43	Digital Input	Enables a 24 volt input to be detected.	section 5.3.2
S2/DOP42	Digital Output	Enables an output device to be driven via a common negative open collector output.	section 5.3.3
S2/DOP43	Digital Output	Enables an output device to be driven via a common positive open collector output.	section 5.3.4
S2/HSG41	Housing Complete	6RU/19 inch rack mountable housing. See S2/MBD45 motherboard for a sample application.	
S2/MBD45	Motherboard	Supports S2/SCN4x scanner modules and provides the interconnection of S2 telemetry modules for large office or field station applications. Capacity to handle up to 320 digital I/Os. Dual or single scanner, dual or single modem, dual or single power supplies. Use one per housing. Accommodates: S2/PSU4x (two); S2/ALC41; S2/VFC4x (two); S2/SCN4x (two); S2/DIP4x or S2/DOP4x (ten); S2/ATT44 (two)	section 5.1.1

Table 2.1 : WESTRONIC S2 Modules and Related Items

Name	Function	Typical Application	See also
S2/MBD46	Motherboard	Supports a single S2 telemetry station comprising one S2/SOF42 module and one S2/VFC42 module for smaller office or field station applications. Compact motherboard for when only up to 32 digital I/Os are required with a single VF connection via modem. Use up to four per housing. Accommodates: S2/SOF42; S2/VFC4x; S2/ATT44.	section 5.1.2
S2/MBD47	Motherboard	Supports six S2/SOF42 modules and three modems for larger office or field station applications. Two of the modem slots are for stand-alone modems to transmit data from peripheral devices (for example, axle-counters). Accommodates: S2/SOF42 (seven); S2/VFC4x (three); S2/ATT44 (three); S2/ALC41; S2/PSU4x (two).	
S2/MBD48	Motherboard	Accommodates: S2/TIC41 (eight); S2/TOC44.	
S2/MBD50	Extended System Motherboard	S2/SCN4x motherboard extension for use with S2/MBD45. Extends an S2 system with up to 18 S2/DIP4x and/or S2/DOP4x modules. Accommodates: S2/BHB11 (two); S2/DIP4x or S2/DOP4x (eighteen).	section 5.1.3
S2/MBD51	Single Modem Motherboard	Stand alone S2/VFC4x modem motherboard to interface between S2/VFC4x modems and any installation requiring communications at RS422 or RS232 levels. Accommodates: S2/VFC42 or S2/VFC45; S2/ATT44.	section 5.1.4
S2/MBD53	Motherboard	Single S2/SOF42 motherboard with an S2/PSU4x slot. Interface between an S2/SOF42 module, parallel input/output connections, and communications at RS422 or RS232 levels. Compact motherboard for when only up to 32 digital I/Os are required. Accommodates: S2/SOF42; S2/PSU4x.	section 5.1.5
S2/MBD54	Motherboard	Standalone operation of two S2/SCN4x modules. Provides manual and automatic selection of the on-line S2/SCN4x module.	section 5.1.6
S2/PSU41	Power Supply Module	Converts 24 Vdc input to 12 Vdc output.	section 5.4.1
S2/PSU42	Power Supply Module	Converts 48 Vdc input to 12 Vdc output.	section 5.4.1
S2/PSU43	Power Supply Module	Converts 110 Vac input to 12 Vdc output.	section 5.4.1

Table 2.1 : WESTRONIC S2 Modules and Related Items (Continued)

Name	Function	Typical Application	See also
S2/PSU44	Power Supply Module	Converts 240 Vac input to 12 Vdc output.	section 5.4.1
S2/PSU45	Power Supply Module	Converts 72 Vdc input to 12 Vdc output.	section 5.4.1
S2/RIC42	Relay Interface Card	Contains 16 miniature relays and status LEDs.	
S2/SCN41	Scanner	Provides the controlling function at each location. Accommodates Interlogic processing and provides two additional high performance serial channels (ports 1 & 2). S2/SDB4x daughter board modules provide RS422 or RS232 interfaces.	section 5.2.1
S2/SCN42	Scanner	Provides the controlling function at each location. S2/SDB4x daughter board modules provide RS422 or RS232 interfaces.	section 5.2.1
S2/SCP42	Serial Conversion Panel	Provides the interface between the Motorola MVME333-2 Intelligent Communications Controller module and external equipment.	
S2/SDB41	Scanner Daughter Board	Enables an S2/SCN4x to communicate using RS422 signal levels with the use of a modem.	section 5.6.3
S2/SDB42	Scanner Daughter Board	Enables an S2/SCN4x to communicate RS232 signal levels with the use of a modem.	section 5.6.4
S2/SDB44	Scanner Daughter Board	Enables an S2/SCN4x to communicate using RS232 signal levels without the use of a modem (provides clock re-construction).	section 5.6.5
S2/SDB45	Scanner Daughter Board	Enables an S2/SCN4x to communicate using RS422 signal levels without the use of a modem (provides clock re-construction).	section 5.6.6
S2/SLC41	Serial Line Convertor	Provides 16 channels of RS422 to RS232 conversion and 16 channels of RS232 to RS422 conversion.	
S2/SOF42	Single card telemetry (control, input output, comms)	Single office or field telemetry module provides remote control and indication of digital 32 inputs and 16 outputs. May be configured for office or field operation.	section 5.3.6
S2/TIC41	Telephone Interface Card	Interface between most types of telephone lines and switching systems or bearer connections.	
S2/TLU43	Test Link Unit	Portable multipurpose test and monitoring unit	Chapter 4
S2/TOC44	Operator Interface Card	Provides two identical interfaces between two or four wire lines and operator handsets.	

Table 2.1 : WESTRONIC S2 Modules and Related Items (Continued)

Name	Function	Typical Application	See also
S2/VCC42	VME Changeover Module	Provides control and indication of VMEbus Computer System status in a dual VMEbus Computer System.	
S2/VFC42	V22 Voice Frequency Modem	Allow S2 systems to communicate over a voice frequency channel, at up to 1200 bps, in a 2 wire operation.	section 5.5.1
S2/VFC45	FSK Voice Frequency Modem	Allow S2 systems to communicate over a voice frequency channel, at up to 1200 bps, in a 4 wire operation.	section 5.5.2
S2/VFC46	V32 Regenerative Modem	Allow S2 systems to communicate over a voice frequency channel, at up to 2400 bps, in a 2 wire operation.	section 5.5.3

Table 2.1 : WESTRONIC S2 Modules and Related Items (Continued)

3. First Line Maintenance

This chapter contains information required for fault-finding and first line maintenance of S2 telemetry systems. It contains sections on:

- Fault Finding
- S2/SCN4x Fault Finding
- S2/SOF42 Fault Finding (to be added)

Chapter 4 describes how to use the S2/TLU43 (S2 Testlink 43)—a portable multipurpose test and monitoring unit supporting many S2 modules.

3.1 Fault Finding

Some maintenance procedures that you should consider are:

- Have you been given the correct fault symptoms?
- Look at the system as a whole—office, bearers, line protection, field and connected equipment. The fault may not be in the S2/ housing itself.
- Use half split principle to narrow down location of the fault.
- Use the S2/TLU43, or if not available, substitution to isolate parts of the system.
- Label any modules removed. Confirm whether they are faulty and ensure faulty modules are repaired quickly.

3.1.1 To Start

You may be faced with a rack of equipment that you haven't seen before and you're expected to make sense of all the flashing (and not flashing) LEDs on the various modules.

You need to identify:

- the S2 modules and their functions in the system;
- the meaning of the LEDs and other indications offered by the modules.

3.1.2 Identifying Modules

S2 modules have their name on the front panel. Table 2.1 lists many of the S2 modules and provides a brief description of their function.

Chapter 5 contains detailed descriptions of modules, and explains the diagnostic indications (if applicable).

3.1.3 Indications

Refer to the following diagrams for module front panel indications:

- Figure 5.47S2/SCN41 Front Panel
- Figure 5.49S2/DIP42 Front Panel
- Figure 5.51S2/DIP43 Front Panel
- Figure 5.53S2/DOP42 Front Panel
- Figure 5.54S2/DOP43 Front Panel
- Figure 5.57S2/VFC45 Front Panel
- Figure 5.62S2/ALC41 Front Panel
- S2/SOF42 (to be added)

Make good use of the LEDs on the module but don't expect that these will tell you everything. You may have to use other test equipment such as:

- multimeters
- line level meter
- S2/TLU43 Test Link

Preliminary checks

a) Observe all front panel indications. Refer to for details on individual modules. Generally, you should see:
   - input power
   - Watchdog LEDs on scanner should be flashing
   - On Line LED on Scanner should be illuminated
   - Telemetry operation on scanner (alpha-numeric LED display bars should be rotating)
   - Correct LED indications on DIPs and DOPS. Both the ACK A and ACK C LEDs should be flashing. A steady indication means the A or C scanner is offline.

b) Measure power supply voltage(s) and confirm that they are within specification.

c) Ensure that each module is properly located in its edge connector socket.

d) Check the card and module configuration against the system drawings, ensuring that EPROMs, links and DIP switches are correctly installed, positioned or set.

Single bit faults can occur due to failure of a specific input or output. These faults are not detected by the scanner and cannot generate alarms. They will only be detected by mal-operation of the system and may be reported by the Signaller.

See section 3.2.1 for a listing of the messages that may appear on the four character alpha numeric display on the front panel of the S2/SCN4x.

See section 3.2.2 for the diagnostic commands supported on the S2/SCN4x and accessible using PC connected to the scanner's serial diagnostics port.

3.2 S2/SCN4x Fault Finding

Typically, the faulty scanner is off-line. Use the following process to investigate the problem.

a) Look at the scanner's diagnostic display (see section 3.2.1). The source of the error might be adequately identified to save you a lot of further investigation.

b) Obtain the schematic diagrams or other documents for the installation that will tell you the correct configuration settings (such as links and jumpers).

c) Remove the scanner and check that links or jumpers have not come off and the daughterboard is securely in place. If you change anything, reinstall the scanner and re-check operation.

d) If the fault persists, replace the faulty scanner's daughterboard with one from a scanner that is known to be good and check operation.

e) If the fault persists, replace the faulty scanner and daughterboard with a correctly strapped scanner and daughterboard (known to be good) and check operation.

3.2.1 S2/SCN4x Error Messages

Scanners have an alpha numeric display on the front panel consisting of LED segments that either:

- rotate to indicate transmission and reception of data frames at ports 4 and 5; or
- spell out error messages of up to four characters.

On power up, the alpha numeric display normally displays the following messages:

- WAIT (initiating)
- TEST (self test)
- PASS (no faults detected at self test)
- AUX (initiating the auxiliary inputs)

Following power up and the start up messages, the alpha numeric display should consist of rotating LED segments.

Table 3.1 is an alphabetic listing of the error messages that may appear on the S2/SCN4x (not all messages will appear on the S2/SCN42 because some functions do not apply to that scanner).

Message	Test	Description	Action
AB 1	COMMS on port 1	Abort error	Investigate problem with communications link.
ADDR	COMMS on ports 4 and 5	Invalid Address Received	Software error: replace module and return to WRSA
ADDR	IMP	Illegal S2 Address On Imp Control Address Queue	Software error: replace module and return to WRSA

Table 3.1 S2/SCN4x Alpha-numeric Messages

Message	Test	Description	Action
ALM0	AUX Input	General Purpose Input (!IN0) Is Active	Investigate problem with DIP or DOP card
AUX	AUX Input	Change Of State On Aux Input	None required: information only
BR 1	COMMS on port 1	Break sequence received	Investigate problem with communications link.
BRAM	MEMORY	BIPORT RAM (U9) read/write test fail	Faulty memory chip or faulty scanner: replace module and return to WRSA
BSY1	COMMS on port 1	Channel is busy	Investigate problem with communications link.
CT 1	COMMS on port 1	CTS lost during transmission	Investigate problem with communications link.
CD 1	COMMS on port 1	Lost carrier detect	Investigate problem with communications link.
COPS	HC11 Int (Unexpected Interrupts)	Internal Watchdog Timeout Error	Software error: replace module and return to WRSA
CRC1	COMMS on port 1	CRC error (IMPB port 1)	Investigate problem with communications link.
CRCA	COMMS on ports 4 and 5	CRC Error (Channel A - port5)	Investigate problem with communications link.
CRCB	COMMS on ports 4 and 5	CRC Error (Channel B - port4)	Investigate problem with communications link.
CTS	COMMS on ports 4 and 5	Modem Not Returning CTS	Investigate problem with modem or scanner configuration.
DIP0	HWY Devices	DIP Scanning: DIP not responding to address	None required: information only (during startup)
DIP2	HWY Devices	Two or more DIPs responding to address	Investigate incorrectly addressed DIP
DOP0	HWY Devices	DOP Scanning: DOP not responding to address	None required: information only (during startup)
DOP2	HWY Devices	Two or more DOPs responding to address	Investigate incorrectly addressed DOP
DPLL	HWY Devices	Digital Phased-locked Loop Activated	None required: information only

Table 3.1 S2/SCN4x Alpha-numeric Messages (Continued)

Message	Test	Description	Action
EROM	MEMORY	EPROM Memory Test Error (reported in background test mode only)	Faulty memory chip or faulty scanner: replace module and return to WRSA
FLN1	COMMS on port 1	Frame length error (IMPB port 1)	Investigate problem with communications link.
FLNA	COMMS on ports 4 and 5	Frame Length Error (Channel A - port 5)	Investigate problem with communications link.
FLNB	COMMS on ports 4 and 5	Frame Length Error (Channel B - port 4)	Investigate problem with communications link.
FR 1	COMMS on port 1	Frame error: no stop bit received	Investigate problem with communications link.
FRM	COMMS on ports 4 and 5	Framing Error	Investigate problem with communications link.
HAB	HWY Devices	Hwy Bus Error On Loop Back Test: HAB Devices	Error on S2 parallel highway: replace module and return to WRSA
HCB	HWY Devices	Hwy Bus Error On Loop Back Test: HCB Devices	Error on S2 parallel highway: replace module and return to WRSA
HCHK	Startup	68HC11 EPROM Checksum Fail On Bootup Error	Faulty 68HC11 chip: replace module and return to WRSA
HDB	HWY Devices	Hwy Bus Error On Loop Back Test: HDB Devices	Error on S2 parallel highway: replace module and return to WRSA
ILLG	HC11 Int (Unexpected Interrupts)	Illegal Interrupt Generated Error	Software error: replace module and return to WRSA
ICHK	Startup	IMP EPROM Checksum Fail On Bootup Error	Incorrect checksum: replace module and return to WRSA
IMPQ	IMP	IMP Queue Overflow	Software error: replace module and return to WRSA
IPW!	IMP	Inter Processor Watchdog Timeout	Software error: replace module and return to WRSA
IRAM	MEMORY	INTERNAL 68HC11 RAM (U21) read/write test fail	Faulty memory chip or faulty scanner: replace module and return to WRSA
LG 1	COMMS on port 1	Frame length violation error	Investigate problem with communications link.

Table 3.1 S2/SCN4x Alpha-numeric Messages (Continued)

Message	Test	Description	Action
NO 1	COMMS on port 1	Non-octet error	Investigate problem with communications link.
NOIS	COMMS on port 1	Noise error	Investigate problem with communications link.
NVCx	COMMS on port 1	The NVC number x has failed	Investigate problem with communications link.
ORN1	COMMS on port 1	Overrun error	Investigate problem with communications link.
ORUN	COMMS on ports 4 and 5	Overun Error	Investigate problem with communications link.
OV 1	COMMS on port 1	Overrun error	Investigate problem with communications link.
PASS	Startup	Test Pass	None required: normal startup messages
PR 1	COMMS on port 1	Parity error	Investigate problem with communications link.
PRTY	COMMS on ports 4 and 5	Parity Error	Investigate problem with communications link.
REQ!	IMP	Message For Illegal IMP Request	Software error: replace module and return to WRSA
RSET	DIAGNOS TIC	Reset Command Initiated	None required: normal reset message
RTI	HC11 Int (Unexpected Interrupts)	Real-time Interrupt Error	Software error: replace module and return to WRSA
RXB1	COMMS on port 1	Incomplete frame received	Investigate problem with communications link.
SCC	COMMS on ports 4 and 5	Serial Comms Chip Test Fail (In Background Test)	Faulty SCC chip: replace module and return to WRSA
SNTX	DIAGNOS TIC	Command Syntax Error	Enter correct command
SWI	HC11 Int (Unexpected Interrupts)	Software Interrupt Error	Software error: replace module and return to WRSA
TEST	Startup	68HC11 Testing Of Hardware In Progress	None required: normal startup messages
TLM1	COMMS on port 1	Rx Data Timeout On Telemetry Port(1)	Investigate problem with communications link.

Table 3.1 S2/SCN4x Alpha-numeric Messages (Continued)

Message	Test	Description	Action
TLMA	COMMS on ports 4 and 5	Rx Data Timeout On Telemetry Port(5)	Investigate problem with port.
TLMB	COMMS on ports 4 and 5	Rx Data Timeout On Telemetry Port(4)	Investigate problem with port.
TRAP	HC11 Int (Unexpected Interrupts)	Illegal Opcode Detected Error	Software error: replace module and return to WRSA
UN 1	COMMS on port 1	Under-run error	Investigate problem with communications link.
WADL	HWY Devices	Hwy Bus Error On Loop Back Test: WAD Low Devices	Error on S2 parallel highway: replace module and return to WRSA
WADU	HWY Devices	Hwy Bus Error On Loop Back Test: WAD High Devices	Error on S2 parallel highway: replace module and return to WRSA
WAIT	Startup	68HC11 is waiting for IMP startup	None required: normal startup messages
XRAM	MEMORY	EXTERNAL RAM (U13) read/write test fail (u13)	Faulty memory chip or faulty scanner: replace module and return to WRSA
XROM	MEMORY	68HC11 EPROM Checksum Fail Error (reported in background mode)	Faulty memory chip or faulty scanner: replace module and return to WRSA
XSCC	COMMS on ports 4 and 5	XIRQ Occurred During an SCC Int. (for diagnostics)	Scanner error: replace module and return to WRSA

Table 3.1 S2/SCN4x Alpha-numeric Messages (Continued)

3.2.2 S2/SCN4x Diagnostic Commands

The S2/SCN4x scanners provide a diagnostic interface by which technicians can investigate or verify details of the telemetry system performance, including:

- telemetry statistics and performance
- module configuration details

Diagnostic commands and resulting messages are viewed on a PC running a Hazeltine terminal emulation such as CCHelp or ProComm.

Connect the PC to the S2/SCN4x using the serial diagnostics port on the front of the S2/SCN4x. Figure 3.1 shows the pin connections for the locally manufactured cable required to connect the PC to the S2/SCN4x.

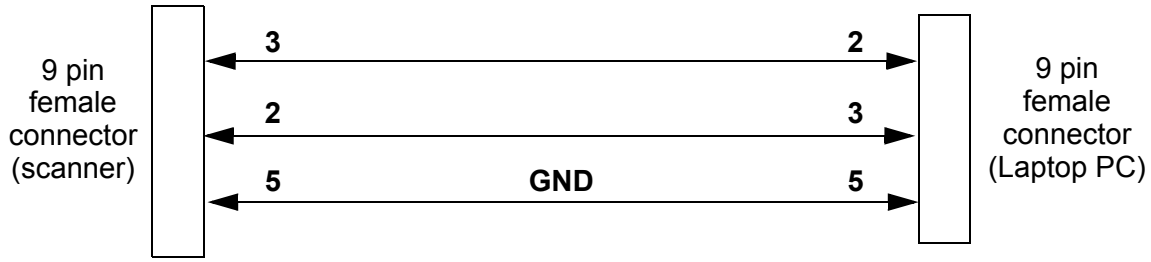


Figure 3.1 Cable Configuration (S2/SCN4x to PC)

The use of CCHelp is described in section 3.2.2.1. Other terminal emulation applications may differ from the description provided.

Generic use of terminal emulation applications to interrogate the SCN4x is described in section 3.2.2.2 through section 3.2.2.11.

Regardless of the terminal emulation application used, the configuration settings shown in Figure 3.6 apply.

3.2.2.1 Using CCHelp

Carbon Copy CCHelp is a typical terminal emulation application and is described here as an example. You can run CCHelp in either a window (as in these examples) or full-screen DOS session.

Start CCHelp. Figure 3.2 shows the CCHelp main screen.

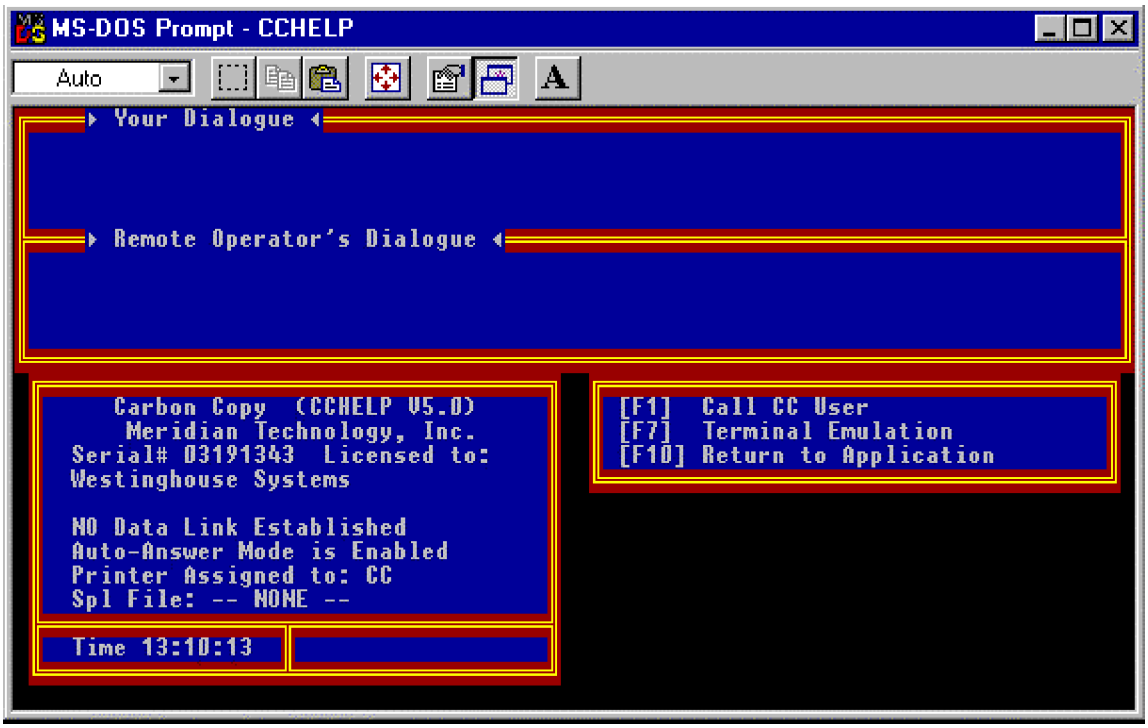


Figure 3.2 CCHelp Main Screen

Press <F7> to display the Terminal Emulation screen shown in Figure 3.3.

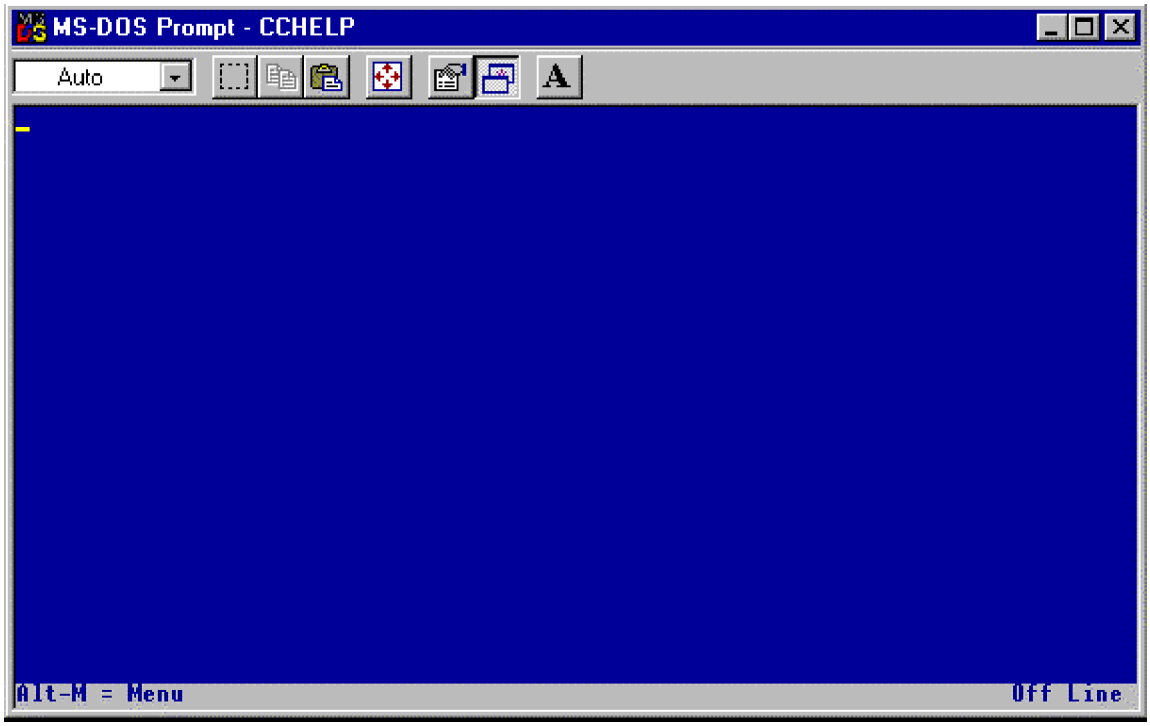


Figure 3.3 Terminal Emulation Screen

Press Alt+M to display the Terminal Emulation command menu shown in Figure 3.4.

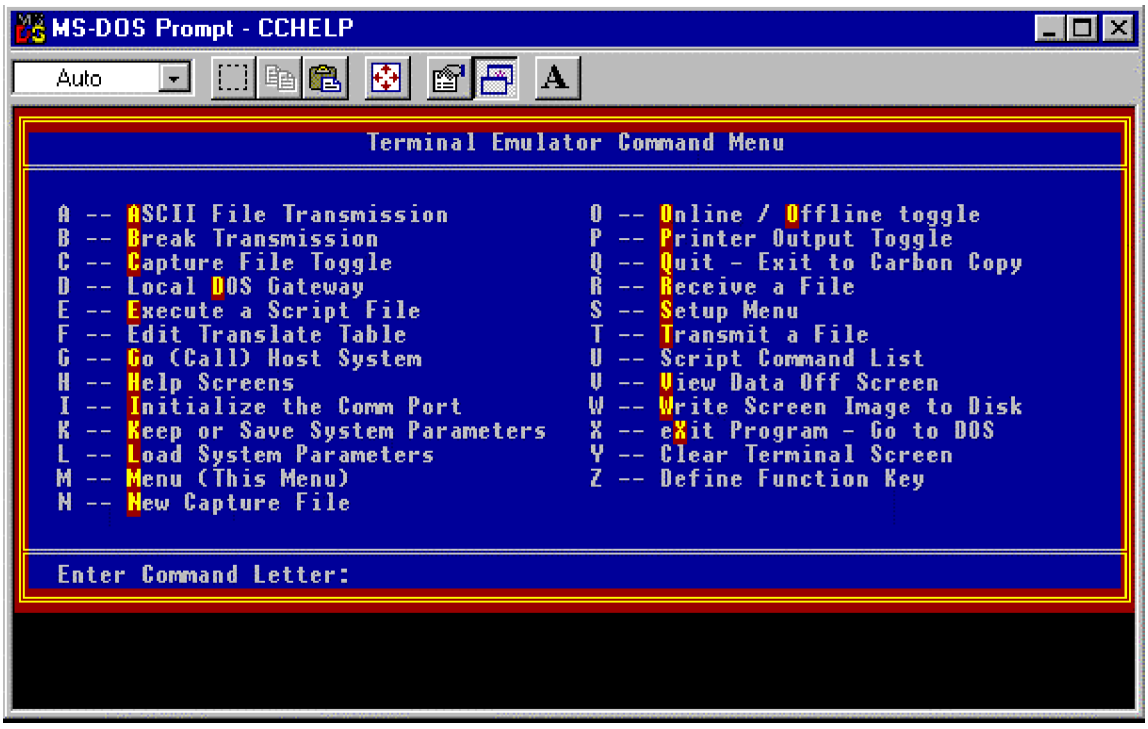


Figure 3.4 Terminal Emulation Command Menu

Press S to select the Setup menu shown in Figure 3.5.

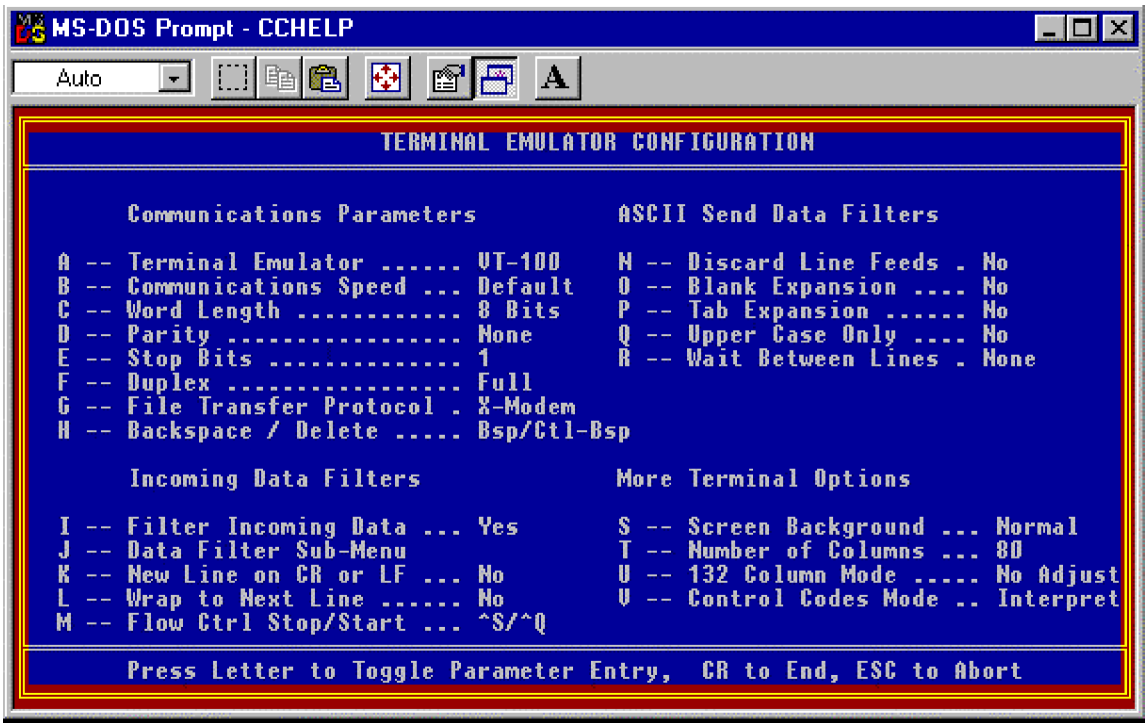


Figure 3.5 Terminal Emulation Setup Menu—initial

Press A repeatedly until the terminal emulator **TVI-920** is selected; press B repeatedly until the communications speed **9600** is selected.

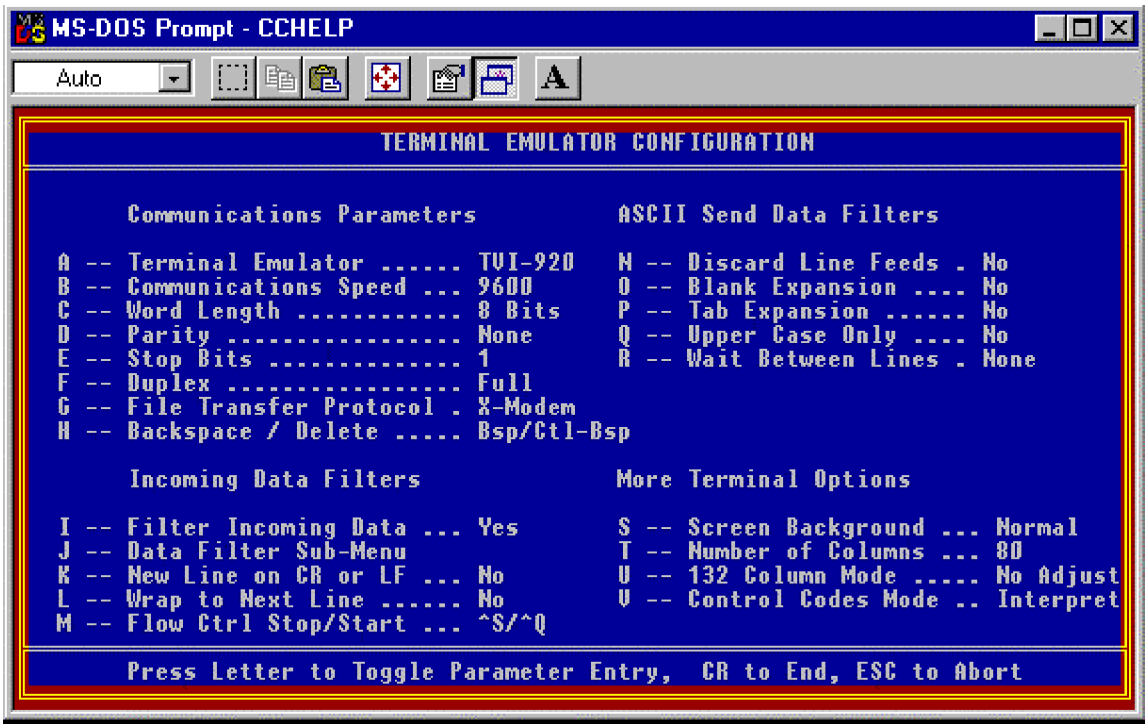


Figure 3.6 Terminal Emulation Setup Menu—done

Check the screen against the configuration settings shown in Figure 3.6. Change if necessary.

Press <Enter> to accept the configuration settings.

Press <Enter> to connect to the S2/SCN4x.

3.2.2.2 Verification of Connection

A successful connection between the terminal emulation application and the S2/SCN4x is indicated by the message ‘WESTRONIC I/O SYSTEM MONITOR’ at the top of the screen (as shown in Figure 3.7, for example).

If the message does not appear, connection has not been made. Check the configuration settings and the cabling.

3.2.2.3 S2/SCN4x Diagnostic Command Inputs

The format for inputting commands is:

< Command > [param#1] [param#2] .. [param#n] <Enter>

where:

- **Command**—up to 8 character mnemonic.
- **Param #1..n**—parameters are command dependent & optional.
- **<Enter>**—each command is terminated by pressing <Enter>.

Note: ***The command characters listed after the ‘*’ are optional.***

3.2.2.4 S2/SCN4x Diagnostic Command Outputs

The CCHelp screen typically displays both the input and the output in the same window. See Figure 3.7 for an example of a CCHelp screen.

3.2.2.5 Getting Ready (S2/SCN 41 only)

Enter the IL command (see section 3.2.2.11) to disable Interlogic on-line monitoring. Enter the IL command a second time if the screen displays the message 'Interlogic now enabled'.

The screen displays the message 'Interlogic now disabled', as shown in Figure 3.7.

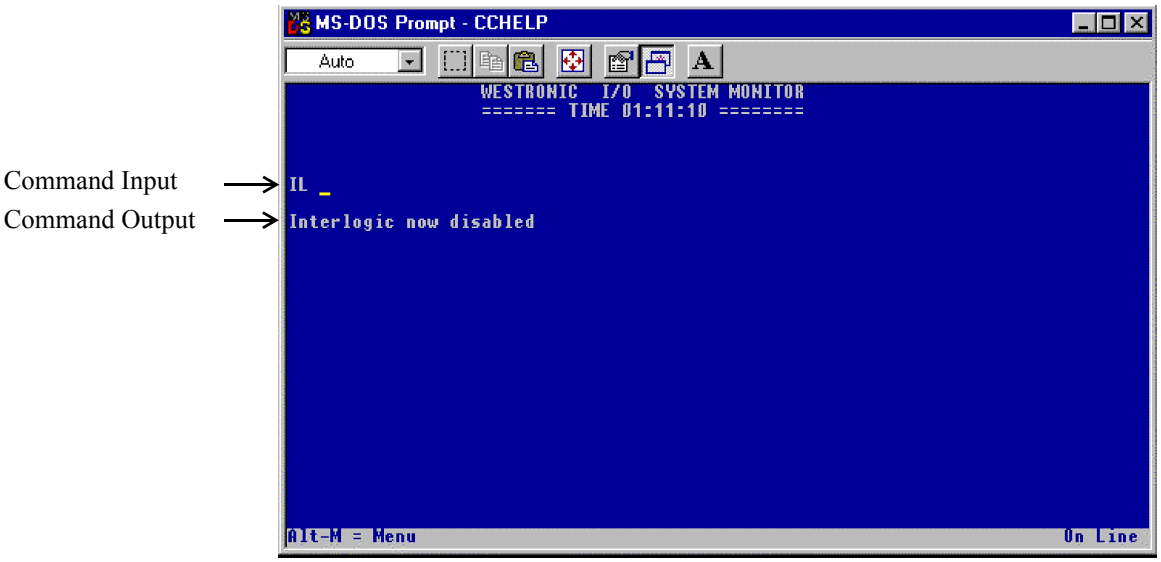


Figure 3.7 Interlogic Disable Command (S2/SCN41 only)

3.2.2.6 Help Command

Use Help to obtain information about a command.

Command	?*HELP ?[command mnemonic]
Description	Displays available commands or help information for any implemented command.
Examples	? ?TSTAT

Figure 3.8 shows the results of a Help command.

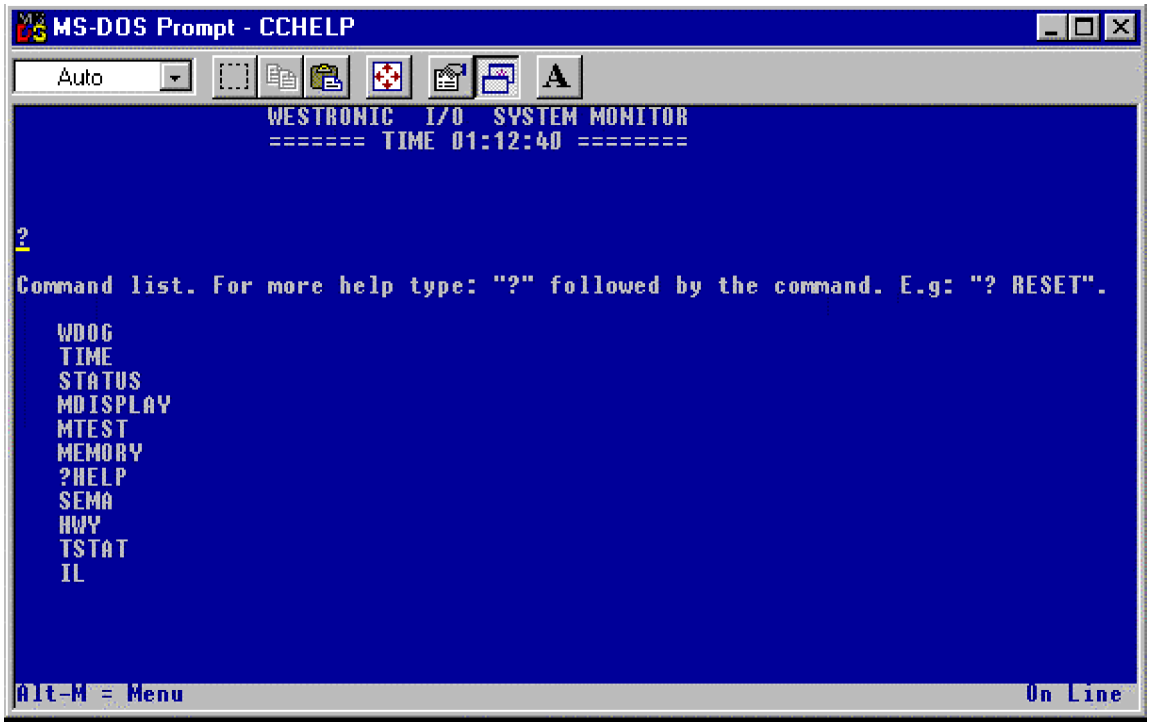


Figure 3.8 Example of Help Command Output

Note:

This section lists only the S2/SCN4x diagnostic commands that may be useful in fault finding. Other commands (listed in the Help screen) are not relevant for the purpose of first line maintenance.

Caution:

Using diagnostic commands not described in this section may alter the configuration of the system to which you are connected. Contact WRSA for further instructions about using commands not described in this section.

3.2.2.7 Memory Display Command

Use the Memory Display command to list the contents of memory locations (in HEX), starting at a specified memory location.

This command is typically used to verify the scanner's configuration details (where the memory location of the detail is known).

For example, the address B637 identifies the S2/SCN4x installation address number. Figure 3.9 shows the value of B637 as 00.

Command	MD*ISPLAY *address* where *address*is a hexadecimal value between 0000 and FFFF
Precede the command with H<space> for S2/SNC41	
Description	Displays contents of 256 memory locations, starting at *address*.
Examples	MD 5000 H MD B600

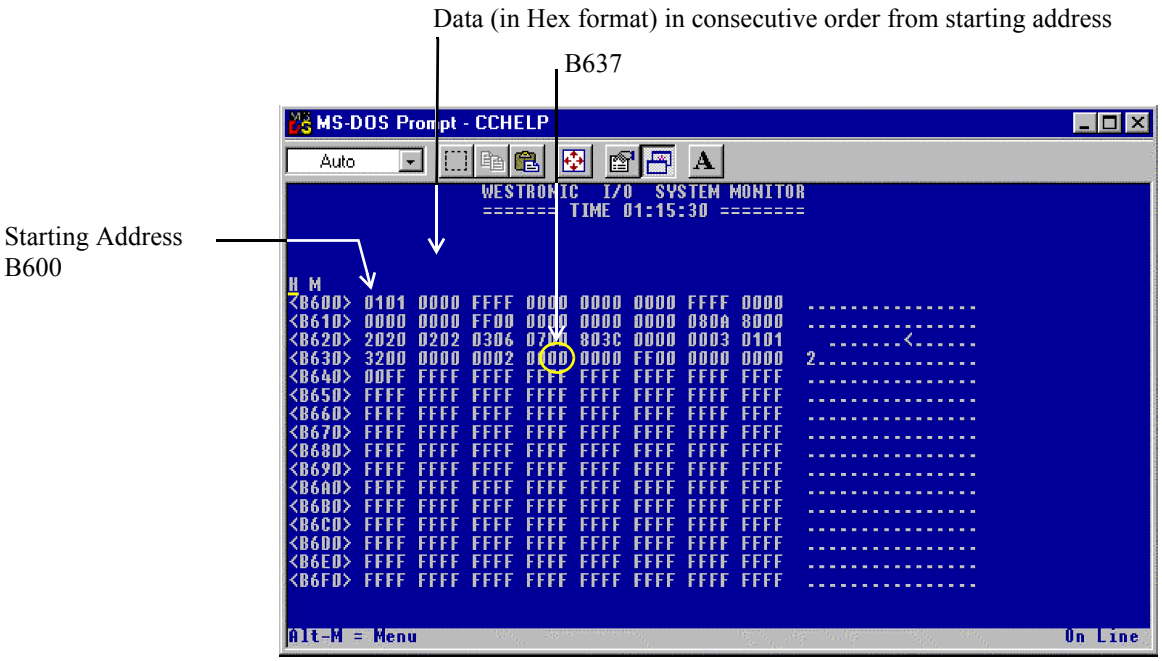


Figure 3.9 Example of Memory Display Command Output

3.2.2.8 Reset Command

Use the Reset command to restart the scanner.

Command	R*ESET
Description	Resets the S2/SCN4x by causing the HWY processor to stop servicing the external Watchdog resulting in a hardware reset within 1.6 seconds.
Precede the command with H<space> for S2/SNC41	
Examples	R H R

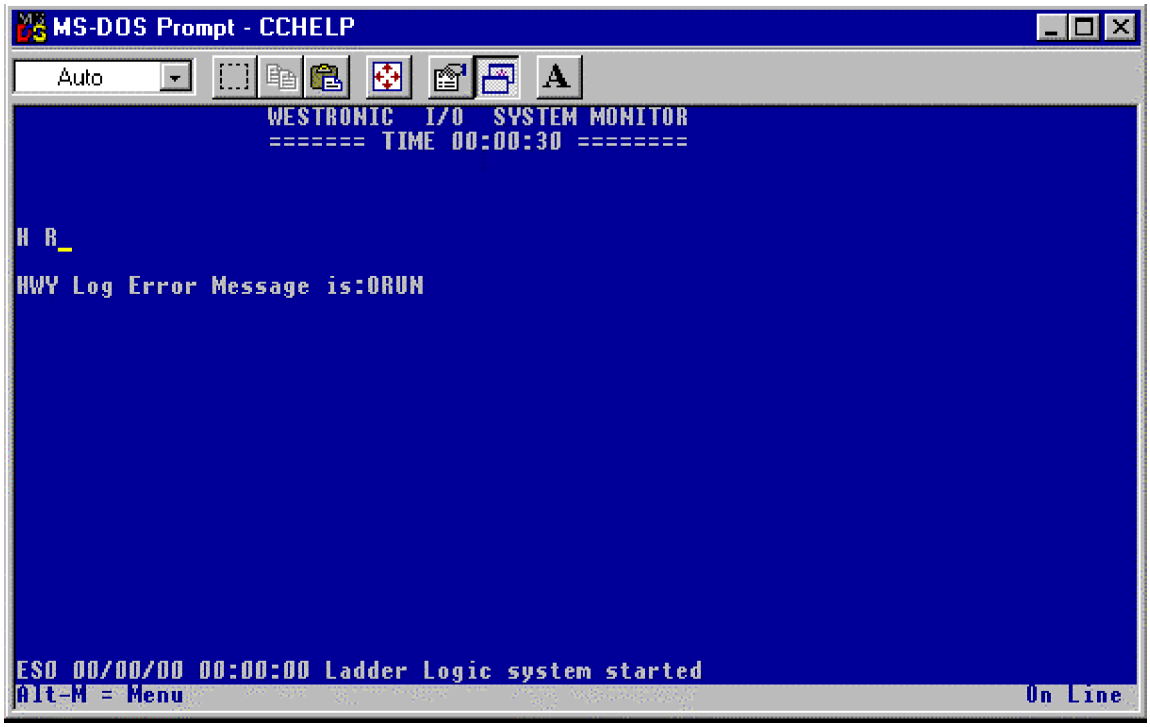


Figure 3.10 Example of Reset Command Output

3.2.2.9 Tstat Command

Use the Tstat command to

- display the telemetry statistics for each port and field address
- display the telemetry statistics for each port (for extended field addresses)
- reset the count and begin building statistics from 0.

Command	T*STAT [R*ESET] | [E*XTENDED] where • R*ESETresets the telemetry statistics, and • E*XTENDED displays telemetry statistics for addresses 32 to 63
Precede the command with H<space> for S2/SNC41	
Description	Displays the S2/SCN4X telemetry statistics in decimal values.
Examples	T T R H T H T E

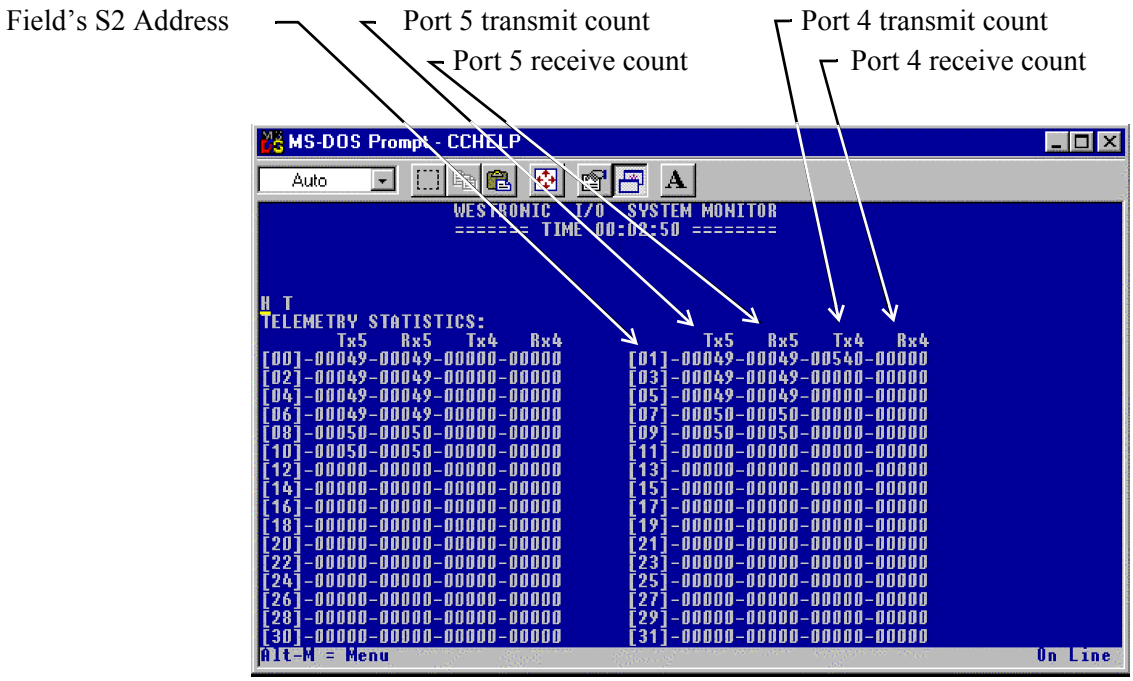


Figure 3.11 Example of H T Command Output (reset option not used)

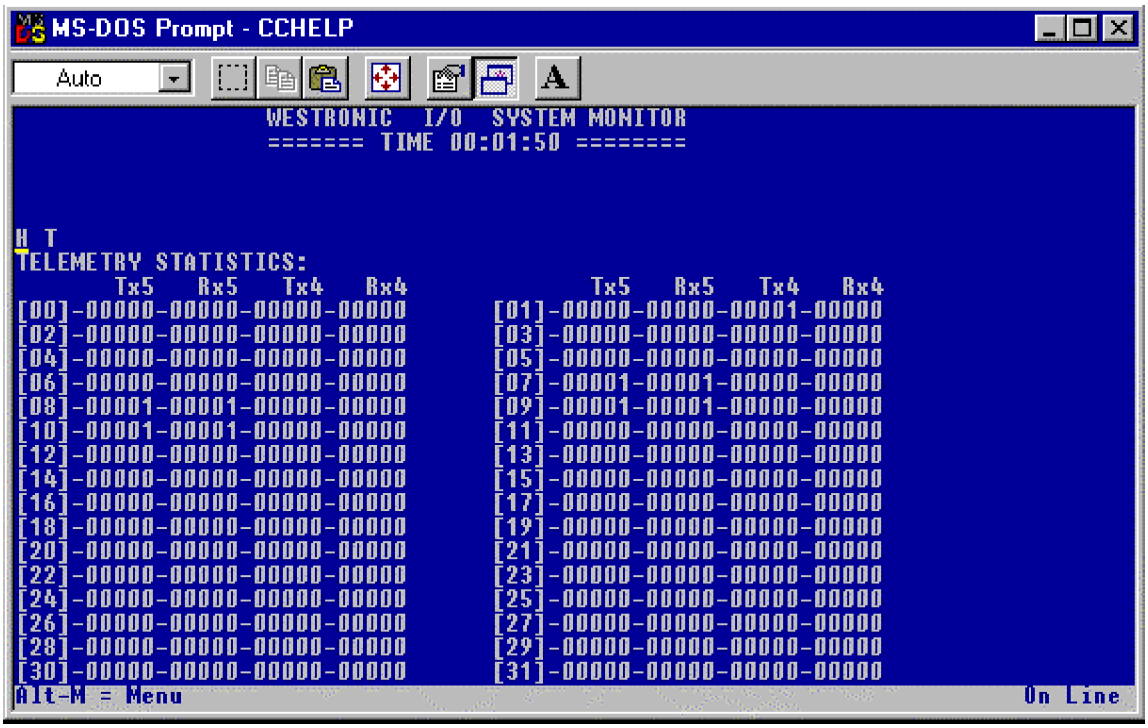


Figure 3.12 Example of H T R Command Output (reset option used)

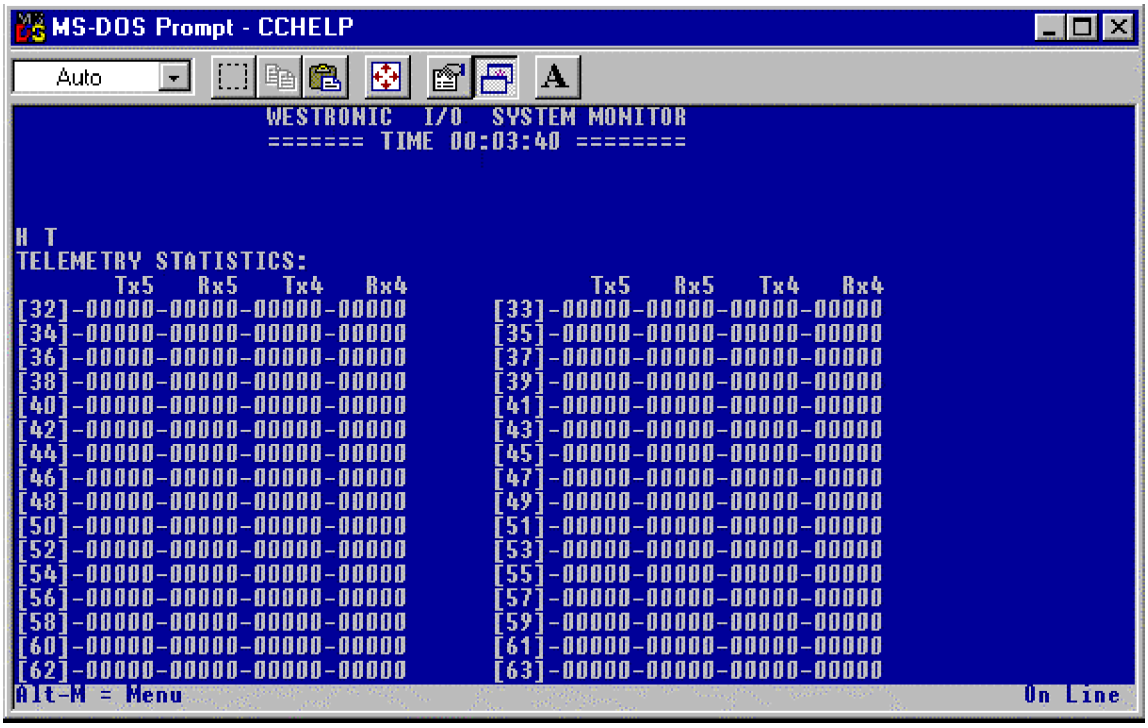


Figure 3.13 Example of H T E Command Output (extended option used)

In the case of S2/SCN41 modules using ports 1 and 2, use the following commands:

- Precede the command with H<space> to display the telemetry statistics for ports 4 and 5.
- Omit the H<space> to display the telemetry statistics for ports 1 and 2.

3.2.2.10 System Status (S2/SCN41 module only)

Use the System Status command to display the state of the scanner's software subsystems. Each system should have a status of 'Grn'.

Command	ST*ATUS
Description	Displays the status of all software subsystems.
Example	ST

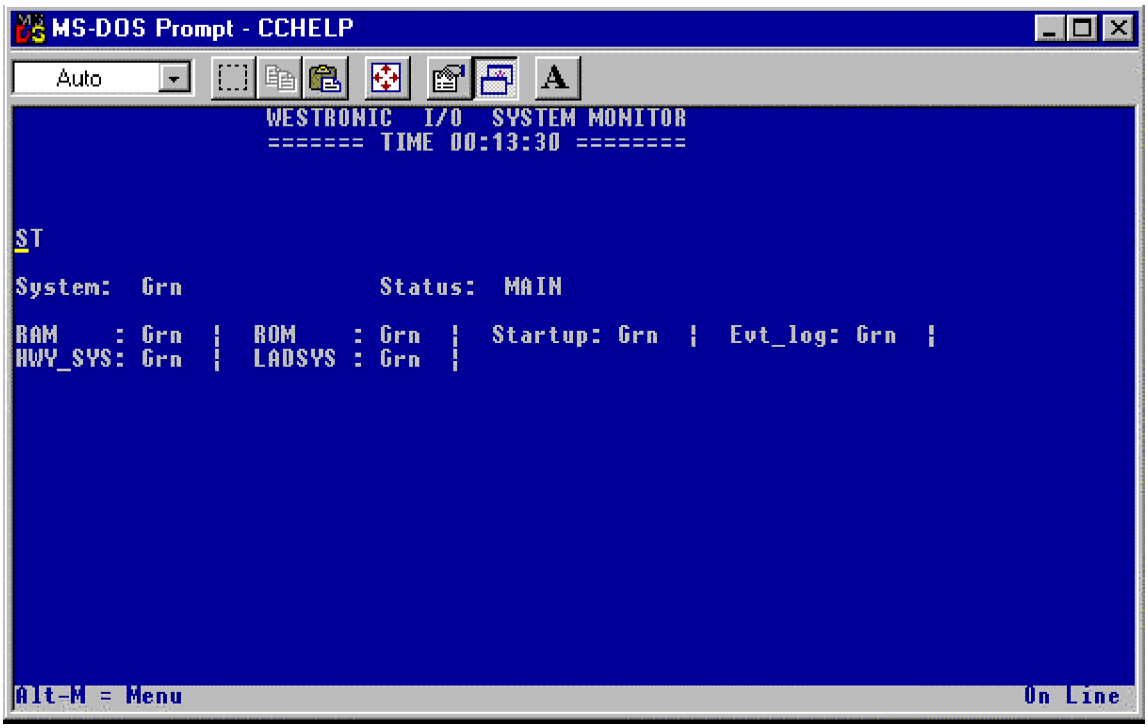


Figure 3.14 Example of System Status Command Output

3.2.2.11 Interlogic On-line Monitoring (S2/SCN41 module only)

Use the IL command (see section 3.2.2.11) to toggle the Interlogic on-line monitoring between the disabled and enabled states. Use

- the disabled state for CCHelp (or equivalent) interface;
- the enabled state for normal operation of the S2/SCN41.

Command	IL
Description	Toggles interlogic information (On or Off) being passed through the diagnostic port.
Example	IL

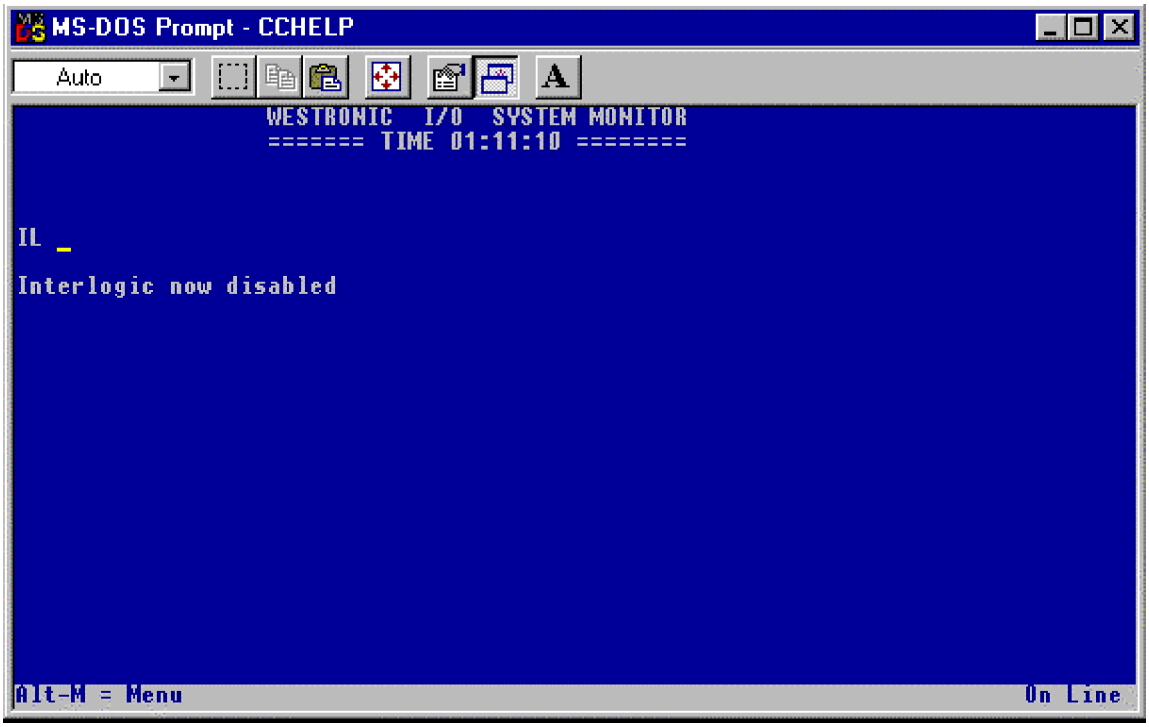


Figure 3.15 Example of Interlogic Command Output

4. S2 TESTLINK TLU43

This chapter describes how to use the S2/TLU43 (WESTRONIC S2 Testlink 43). It contains sections on:

- Overview of Testlink
- Operation
- Equipment Description
- Configuring the S2/TLU43
- Auxiliary Connection Panel

4.1 Overview of Testlink

The S2/TLU43 Testlink is a 'telemetry system in a box'. Figure 4.1 shows a typical configuration of the Testlink unit.

It can:

- simulate the operation of an office or a field side of a telemetry system.
- monitor the transmission or reception of data for the simulated office or field.
- be used as a workshop test instrument for setting up and testing of S2 modules.

The S2/TLU43 is capable of interfacing either to 4 wire or 2 wire S2 carrier systems, or to RS422 or RS232 levels.

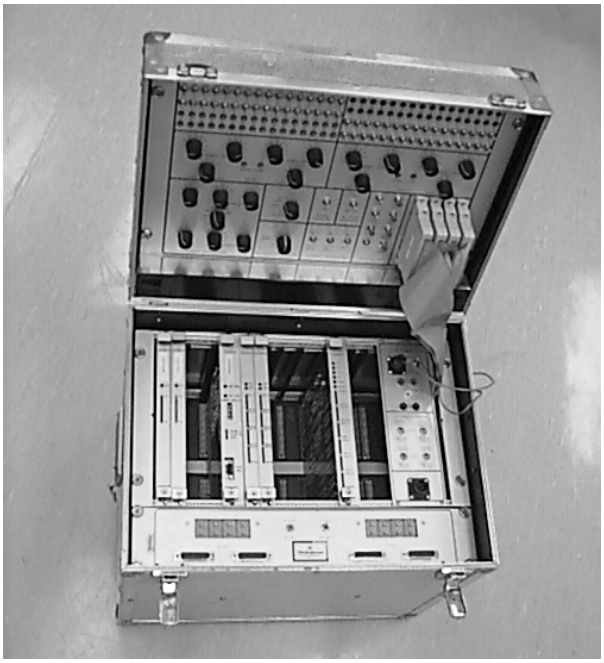


Figure 4.1 S2/TLU43 Testlink Unit

The S2/TLU43 Testlink can test or configure the following S2 modules:

- S2 Carrier Modules (modems) - S2/VFC4x;
- S2 Scanner Modules - S2/SCN4x;
- S2 Input Modules - S2/DIP4x;
- S2 Output Modules - S2/DOP4x;
- S2 Alarm/Change over Modules - S2/ALC4x;
- S2 Single Office/Field Modules - S2/SOF4x;
- S2 Relay Module - S2/RIC42;
- S2 Serial Line Convertor Modules - S2/SLC4x.

4.2 Operation

4.2.1 Office Mode

In office mode, Testlink performs the following functions:

- The toggle switches on the left side of the front panel simulate controls to be sent to the field.
- The LEDs on the left hand side of the front panel are used to display the indications received from the field.

The Testlink office may be configured with either:

- an S2 Scanner System (S2/SCN4x, S2/DIP4x and S2/DOP4x modules), or
- an S2/SOF4x module.

4.2.2 Field Mode

In field mode, Testlink performs the following functions:

- The toggle switches on the right side of the front panel simulate indications to be sent to the office.
- The LEDs on the right side of the front panel are used to display the controls received from the office.

4.2.3 Card Test Mode

In card test mode, Testlink operates as a fully self-contained telemetry unit.

The office and field sections may independently be configured with either an S2 scanner system or an S2/SOF4x module.

Use the configuration switch (see section 4.4.3) to select card test mode.

4.3 Equipment Description

The Testlink unit consists of a 19 inch S2 module housing, a front panel, an auxiliary panel and a miscellaneous panel.

The front panel provides:

- Configuration switches;
- Control and indication status LEDs;
- Control and indication switches.

The auxiliary connection panel provides:

- Interface connectors for the telemetry line and the 12 Vdc Power source;
- Facility to configure the input and output for positive or negative logic.

The miscellaneous connection panel provides:

- Interface connectors for the S2/SCN41 ports 1 and 2;
- Office and Field S2 modem attenuators and the transmit inhibit switches.

The S2/TLU43 is contained within an aluminium case. The front panel is situated in the lid of the case while the housing and miscellaneous panel are in the base. The front panel is shown in Figure 4.2.

The 19" housing accommodates the S2 Telemetry modules, as well as the auxiliary connection panel.

All items of equipment (the S2 module housing, miscellaneous connection panel and front panel) have the capability of being mounted in a 19" rack, if so desired.

4.3.1 S2 Module Housing

The module housing accommodates the S2 modules . The housing is split into an office section and a field section. Depending on the mode of operation, S2 modules may reside in either or both sections.

Table 4.1 lists the required modules and their positions for each mode of operation (blank spaces indicate no requirement).

The modes are described in section 4.4.3.

Note: ***Two (2) S2/RIC42 modules must be installed for the operation of the S2/TLU43, as they control all configuration information supplied from the front panel.***

In addition to the S2 modules in Table 4.1, the following two modules are optional, except as noted:

- S2/SLC4x - Serial Line Convertor function;
- S2/ALC4x - Alarm/Change over functions.

Mode	Using	S2/ VFC4x	S2/ SOF4x	S2/ SCN4x	S2/ DIP4x	S2/ DOP4x	S2/ VFC4x	S2/ SOF4x	S2/ SCN4x	S2/ DIP4x	S2/ DOP4x
Modem Office	scanner	Yes		Yes	Yes	Yes					
	SOF	Yes	Yes								
Digital Office	scanner			Yes	Yes	Yes					
	SOF		Yes								
Modem Field	scanner						Yes		Yes	Yes	Yes
	SOF						Yes				
Digital Field	scanner								Yes	Yes	Yes
	SOF							Yes			
Modem Card Test	scanner	Yes		Yes	Yes	Yes	Yes		Yes	Yes	
	SOF	Yes	Yes				Yes	Yes			
Digital Card Test	scanner			Yes	Yes	Yes			Yes	Yes	Yes
	SOF		Yes					Yes			

Table 4.1 Module requirements for each mode of operation

4.3.2 Front Panel

The front panel (see Figure 4.2) contains switches for setting up the operating parameters of the Testlink and LEDs for displaying system status.

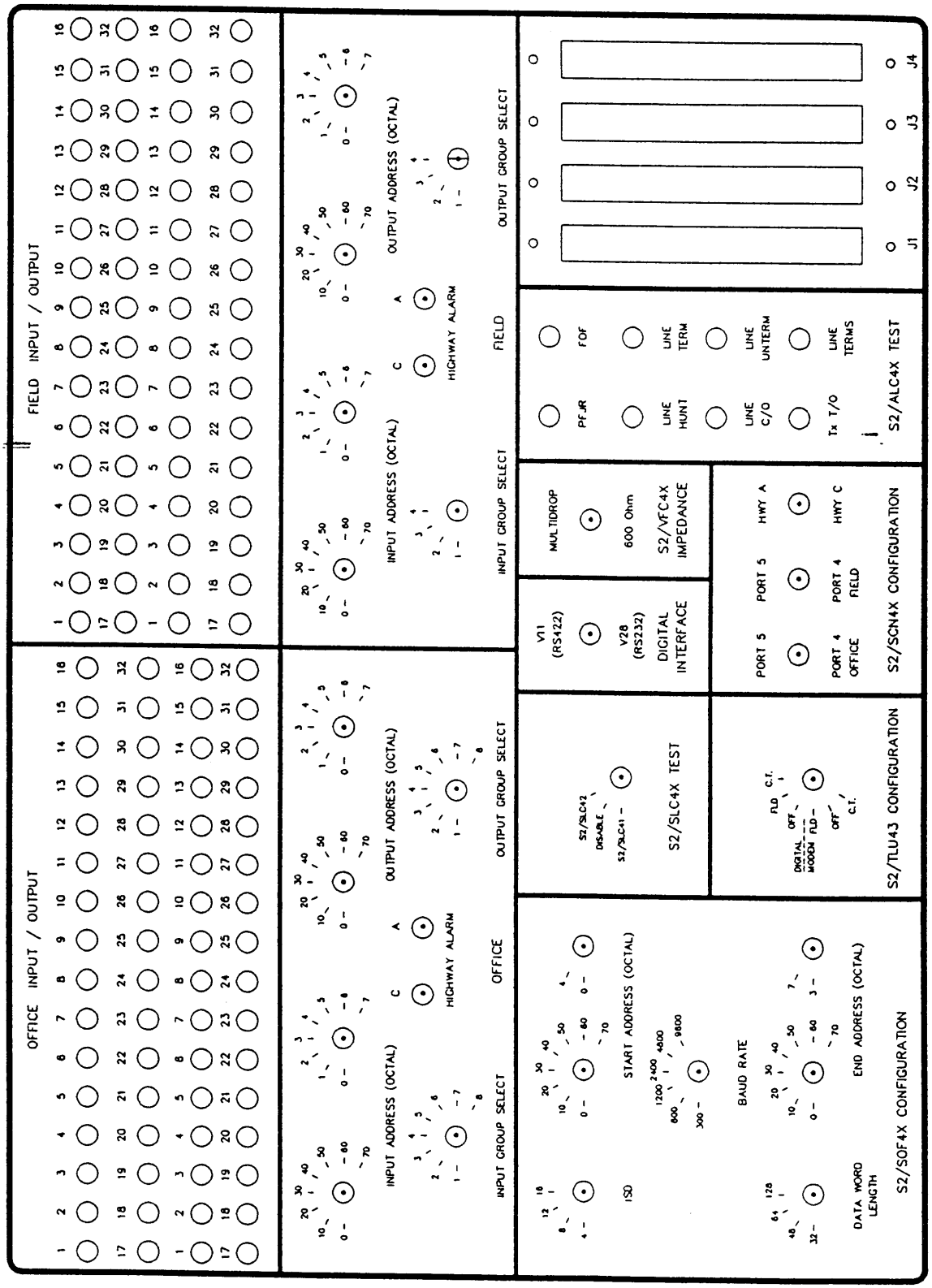


Figure 4.2 S2/TLU43 Front Panel

4.4 Configuring the S2/TLU43

The front panel of the S2/TLU43 contains switches for setting configuration parameters. The switches are arranged in groups for:

- S2/SOF4x Configuration (see section 4.4.1)
- S2/SLC4x Test (see section 4.4.2)
- S2/TLU43 Configuration (see section 4.4.3)
- Digital Interface (see section 4.4.4)
- S2/VFC4x Impedance (see section 4.4.5)
- S2/SCN4x Configuration (see section 4.4.6)
- S2/ALC4x Test (see section 4.4.7)
- Office (and Field) Switches (see section 4.4.8)
- Office Input / Output (see section 4.4.9)
- Field Input / Output (see section 4.4.10)

The following sections describe the each group on the front panel of the S2/TLU43.

4.4.1 S2/SOF4x Configuration

Use the front panel rotary switches to set, as required:

- ISD
- Baud Rate
- Data Word Length
- Start Address
- End Address
- I/P Address (selected to match the address of the Field under test)
- O/P Address (selected to match the address of the Field under test)

The switches are described in the following sections.

4.4.1.1 ISD

Use the ISD (interscan delay) switch to select the required delay between scans. This switch is only applicable to the Office mode. Use it to select:

- 4 ms
- 8 ms
- 12 ms
- 16 ms

4.4.1.2 Baud Rate

Sets the Baud rate (BPS) of the system, using the following constraints based on configuration modes (described in section 4.4.3):

- The switch may be set to any position for DIGITAL configuration mode.
- The switch must correspond with the baud rate of the modem for MDM configuration mode.

Use it to select:

- 300
- 600
- 1200
- 2400
- 4800
- 9600

4.4.1.3 Data Word Length

The switch sets the number of data bits within an SDLC/W frame. Use it to select:

- 32
- 48
- 64
- 128

4.4.1.4 Start Address

The switch sets the Start Address of the Office clockwork scan. This switch is only applicable to Office mode.

The Start Address is set via two rotary switches:

- The eight position switch sets the high address.
- The two position switch sets the low address.

Each switch forms an octal number. Table 4.2 lists the Start Address switch settings.

4.4.1.5 End Address

The switch sets the End Address of the clockwork scan. This switch is only applicable to Office mode.

The End Address is set via two rotary switches:

- The eight position switch sets the high address.
- The two position switch sets the low address.

Each switch forms an octal number. Table 4.2 lists the End Address switch settings.

Start Address Switch Setting		Address	End Address Switch Setting		Address
High	Low	(Octal)	High	Low	(Octal)
0	0	00	0	3	03
0	4	04	0	7	07
10	0	10	10	3	13

Start Address Switch Setting		Address	End Address Switch Setting		Address
High	Low	(Octal)	High	Low	(Octal)
10	4	14	10	7	17
20	0	20	20	3	23
20	4	24	20	7	27
30	0	30	30	3	33
30	4	34	30	7	37
40	0	40	40	3	43
40	4	44	40	7	47
50	0	50	50	3	53
50	4	54	50	7	57
60	0	60	60	3	63
60	4	64	60	7	67
70	0	70	70	3	73
70	4	74	70	7	77

Table 4.2 : Start and End Address Switch Settings

4.4.2 S2/SLC4x Test

This switch is used to test the operation of an S2/SLC4x module (when the S2/TLU43 is in C.T. Mode). Use it to select:

- S2/SLC41
- S2/SLC42
- DISABLE

4.4.3 S2/TLU43 Configuration

The switch selects the S2/TLU43 configuration mode. Each mode may be controlled using either a scanner system or a SOF. See Table 4.1 for details.

Use the S2/TLU43 configuration switch to select:

- DIGITAL CTCard Test using RS422
- DIGITAL FLDField using RS422
- DIGITAL OFF Office using RS422
- MODEM FLD Field using modems
- MODEM OFF Office using modems
- MODEM CTCard Test using modems

Note: ***S2 modules must be located in the relevant positions as described in section 4.3.1.***

4.4.4 Digital Interface

Use the Digital Interface switch to select between:

- V11 (RS422A)
- V28 (RS232C)

4.4.5 S2/VFC4x Impedance

Use the S2/VFC4x Impedance switch to match the impedance of the line to the telemetry modules. Use it to select:

- 600 Ohms (point to point)
- M.D. (multi-drop via LCU's)

4.4.6 S2/SCN4x Configuration

Use the front panel rotary switches to select for S2/SCN4x modules:

- Office Port 5 or Port 4
- Field Port 5 or Port 4
- Hwy A or Hwy C

The switches are described in the following sections.

Note: ***Some configuration details of S2/SCN4x modules are set independently of the S2/TLU43. See section 3.2.2 for details.***

4.4.6.1 Office Port 5 or Port 4

This switch allows selection for the use of either Telemetry Port 5 or Telemetry Port 4 from the Office S2/SCN4x Module.

4.4.6.2 Field Port 5 or Port 4

This switch allows selection for the use of either Telemetry Port 5 or Telemetry Port 4 from the Field S2/SCN4x Module.

4.4.6.3 Hwy A or Hwy C

Selects which scanner (A or C) is used to communicate with the I/O modules. This switch is applicable to dual highway I/O modules only (S2/DIP42, S2/DIP43, S2/DOP42 and S2/DIOP43).

Use it to select:

- HWY A (to select scanner A)
- HWY C (to select scanner C)

4.4.7 S2/ALC4x Test

This section contains 8 switches which are used to test the operation of an S2/ALC4x (when the S2/TLU43 is in C.T. mode):

- PFJR
- FOF
- Line Hunt
- Line Term
- Line C/O
- Line Unterm
- Tx T/O
- Line Terms

The switches are described in the following sections.

4.4.7.1 PFJR

Use the PFJR switch to test the power fail function of the S2/ALC4x. The S2/ALC4x's PFJR LED extinguishes when activated.

4.4.7.2 FOF

Use the FOF switch to force off all outputs on the S2/DOP4x or S2/SOF4x modules.

4.4.7.3 Line Hunt

Use the Line Hunt switch to test the line hunt function of the S2/ALC4x. The S2/ALC4x's LCO LED extinguishes after 30 s and illuminates again after 30 s when activated.

4.4.7.4 Line Term

Use the Line Term switch to test the line terminate function of the S2/ALC4x. The S2/ALC4x's TERM LED extinguishes when this is pressed.

4.4.7.5 Line C/O

Use the Line C/O switch to test the line change over function of the S2/ALC4x. The S2/ALC4x's LCO LED extinguishes when activated.

4.4.7.6 Line Unterm

Use the Line Unterm switch to test the line unterminate function of the S2/ALC4x. The S2/ALC4x's TERM LED illuminates when activated.

4.4.7.7 Tx T/O

Use the Tx T/O switch to test the Transmit Timeout function of the S2/ALC4x. The S2/ALC4x's TTA (or TTC) LED extinguishes when activated.

4.4.7.8 Line Terms

Use the Line Terms switch to test the line terms function of the S2/ALC4x. The S2/ALC4x's TERM LED extinguishes when this is pressed.

4.4.8 Office (and Field) Switches

The following sections describe the groups of switches in the Office section and the Field section of the front panel.

4.4.8.1 Input Address (Octal)

Selects the address of the S2/DIP4x under test. Two switches are used for this purpose, one for high order address (00 to 70) and one for low order (0 to 7).

Use them to select:

- 00 -> 77 (OCTAL)

4.4.8.2 Output Address (Octal)

Selects the address of the S2/DOP4x or S2/SOF4x module under test. Two switches are used for this purpose, one for high order address (00 to 70) and one for low order (0 to 7).

Use it to select:

- 00 -> 77 (OCTAL)

4.4.8.3 Input Group Select

Selects the position of the data inputs set via the Office and Field 32 toggle switches in the construction of the S2 telemetry frame.

Note: ***For S2/SOF4x module, the position determines which set of 16 data bits are read from the first 16 of 32 toggle switches on the Office section of the unit. The switch is not applicable to a S2/SOF4x module installed in the Field section.***

Table 4.3 lists the results of the switch positions.

Switch Position	S2/SOF4x Data Bits	S2/DIP4x Data Bits
1	1 to 16	1 to 32
2	17 to 32	1 to 32
3	33 to 48	33 to 64
4	49 to 64	33 to 64
5	65 to 80	65 to 96
6	81 to 96	65 to 96
7	97 to 112	97 to 128
8	113 to 128	97 to 128

Table 4.3 Input Group Selection Switch Settings

4.4.8.4 Output Group Select

Selects which 32 data outputs are extracted from the S2 telemetry frame and displayed on the Office and Field LEDs.

Note: ***For S2/SOF4x module, the position determines which set of 16 data bits received from the Field, is output to the first 16 of 32 Office LED's. The switch is not applicable to a S2/SOF4x module installed in the Field section.***

Table 4.4 lists the results of the switch positions.

Switch Position	S2/SOF4x Data Bits	S2/DOP4x Data Bits
1	1 to 16	1 to 32
2	17 to 32	1 to 32
3	33 to 48	33 to 64
4	49 to 64	33 to 64
5	65 to 80	65 to 96
6	81 to 96	65 to 96
7	97 to 112	97 to 128
8	113 to 128	97 to 128

Table 4.4 Output Group Selection Switch Settings

4.4.8.5 Highway Alarm

Alarm LEDs illuminate when one or more modules in the unit are in an alarm state. LEDs indicate both the C and A highways. This alarm only applies to the S2/SCN4x modes.

4.4.9 Office Input / Output

The top left of the S2/TLU43 front panel contains 32 each of input switches and output LEDs:

- The toggle switches set the control bits sent within the S2 telemetry frame to the Field.
- The LEDs below the switches represent the indications received from the field.

4.4.10 Field Input / Output

The top right of the S2/TLU43 front panel contains 32 each of input switches and output LEDs:

- The toggle switches set the indication bits sent within the S2 telemetry frame to the Office.
- The LEDs below the switches represent the control received from the Office.

4.5 Auxiliary Connection Panel

The auxiliary connection panel (see Figure 4.3) contains sockets for the connection to external telemetry and power sources. In addition, it contains switches for selection of the I/O configuration and power.

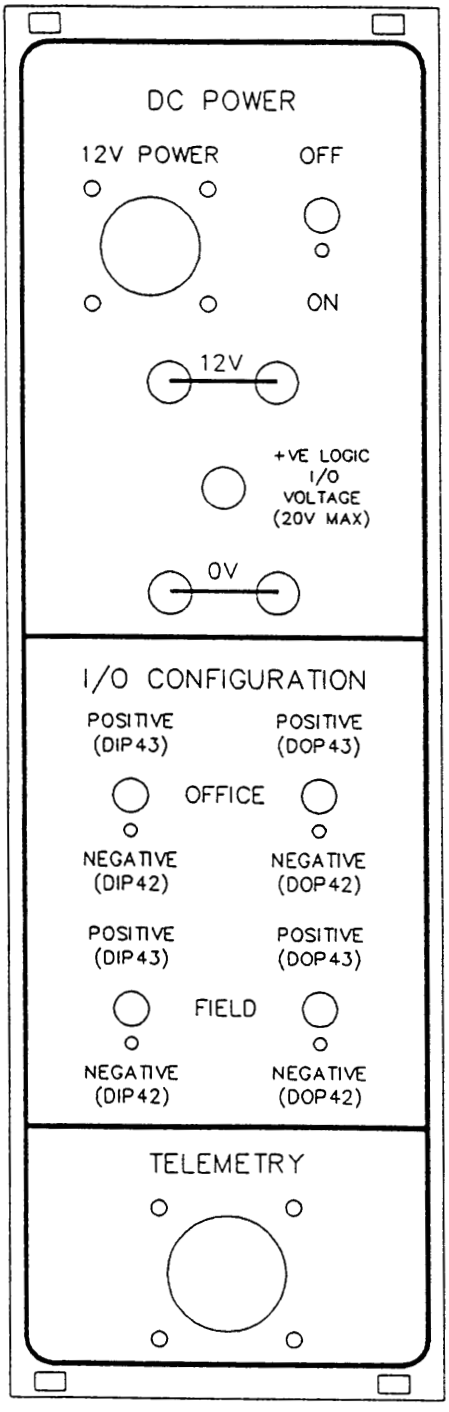


Figure 4.3 Auxiliary Connection Panel

4.5.1 DC Power

The DC Power section contains all miscellaneous power inputs to the S2/TLU43, as well as the power switch for the unit.

4.5.1.1 Power Switch

Use the power switch select:

- ON
- OFF

4.5.1.2 12 V Power

The Testlink runs off a 12 Vdc source. This source is available at all S2 Telemetry locations.

Connection of the power is via an AMP 4 pin plug:

- Pin 1 is +12V
- Pin 4 is 0V (common).

4.5.1.3 12 V (and 0 V)

In additional to the incoming 12 V power, two 12 V sockets and two 0 V sockets are provided for referencing points. These sockets are wired in series with the Testlink power switch such that power will only be present at these terminals when the Testlink is powered on.

4.5.1.4 +VE Logic I/O Voltage (20 V Maximum)

When using positive logic input and output modules (S2/DIP43 and S2/DOP43), an external DC voltage source must be provided. This source must be in the range 13 V to 20 Vdc for reliable operation.

Exceeding 20 V will overload the LED circuits. If an external source is not available, use can be made of the 12 Vdc Power source via looping between one of the 12V sockets to the +VE logic I/O socket. If this 12V option is used, intermittent operation of the S2/DIP43 may occur. This intermittent operation can be eliminated by ensuring the voltage is not less than 13 Vdc.

In positive logic mode, LED indicators on the Front Panel are green while in negative logic mode, the LEDs are red.

4.5.2 I/O Configuration

The S2 product range supports both negative logic and positive logic Input and Output modules.

The S2 Testlink supports these I/O configurations via switches located on the Auxiliary Connection Panel. All I/O slots are independent and may be selected for positive logic or negative logic.

Definition of the logic state for each of the I/O modules is as follows:

- S2/DIP41, 42: Negative
- S2/DIP43: Positive
- S2/SOF41, 42: Negative
- S2/DOP43: Positive
- S2/DOP41, 42: Negative

4.5.2.1 Telemetry

Connection to the Telemetry bearer is via an AMP plug. The Telemetry bearer is brought out of the Testlink as a 4 wire circuit. The direction of circuit is dependent on the configuration as per Table 4.5.

Note: ***Tx = OUTPUT from Testlink; Rx = INPUT to Testlink***

Configuration	Pin	Function
Office	1	Rx+
	2	Rx-
	3	Tx+
	4	Tx-
Field	1	Tx+
	2	Tx-
	3	Rx+
	4	Rx-

Table 4.5 Telemetry Line Pin Allocation

4.5.3 Miscellaneous Connection Panel

The Miscellaneous connection panel (see Figure 4.4) contains S2 modem attenuators and transmit inhibit switches. In addition, the panel provides the interface connectors for ports 1 and 2 of the S2/SCN41.

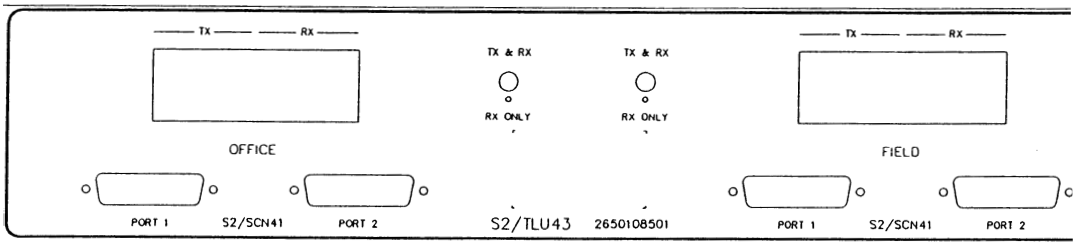


Figure 4.4 S2/TLU43 Miscellaneous Panel

4.5.3.1 Tx + Rx Switches

A pair of Tx & Rx switches are provided: one for the Office and one for the Field. The Tx & Rx switches determine whether a Office or Field is enabled for transmitting and receiving, or receiving (monitoring) only.

Use it to select:

- Tx + Rx
- Rx Only

SAFETY
WARNING

When connecting into a commissioned system the unit should always be in the Rx Only mode. Use the Tx + Rx position only when the address selected on the Testlink is not allocated to any commissioned site.

4.5.3.2 Transmit and Receive Attenuators

The Office and the Field modem modules can have their transmit and receive levels to/from line adjusted independently to suit all line conditions.

4.5.3.3 S2/SCN41: Port 1 and Port 2 Connection

Connectors are available for the external use of Ports 1 and 2 of the SCN41 for either or both of Office and Field.

4.6 Test Procedures

4.6.1 Testing S2 Modules

Use the S2/TLU43 in Card Test Mode (CT Mode) to test S2 modules.

Operation in the Card Test mode requires modules to be fitted into both the Office and Field sections. These may consist of S2/ALC4x, S2/SCN4x, S2/DIP4x, S2/DOP4x or S2/SOF4x modules.

While in Card Test mode, the configuration switch connects the carrier or digital link directly between the Office and Field sections. No line connection to the telemetry system is required. This mode supports either Modem, V11 or V28 communications.

The Office transmits its data from the 32 control switches to the Field section. The data is displayed on the 32 Field LEDs.

The Field then transmits its data from the 32 toggle switches to the Office section. This data is then displayed on the 32 Office LEDs.

4.6.1.1 CT Mode Set Up Procedures

Use the procedures listed in Table 4.6 to set up the S2/TLU43 for CT Mode testing.

Step	Description
1	Insert relevant Office and Field modules.
2 (S2/SCN4x)	For S2/SCN4x tests, set the configuration switches as detailed in section 4.4.6.
2 (S2/SOF4x)	For S2/SOF4x tests, set the configuration switches as detailed in section 4.4.1, subject to the following: • Start Address—as desired (must be less than end address, typically 00). • End Address—as desired (must be greater than start address, typically 03). • Baud Rate—if using modem, determined by baud rate of modem; if using DIGITAL—as desired. • Data Word Length—as desired. • Interscan Delay—as desired.
2 (S2/ALC4x)	For S2/ALC4x tests, set the configuration switches as detailed in section 4.4.7.
3	Select the common switches as follows: • Impedance—as desired. • Configuration—CT (MODEM or DIGITAL) • Output Address—as desired (within range of start and end addresses). • Input Address—as desired (within range of start and end addresses). • Input Group Select—as desired. • Output Group Select—as desired.
4	Connect power cable to 12 V input socket on the auxiliary connection panel.
5	Select power switch to ON.

Table 4.6 S2/TLU43 Card Test Mode Set Up

4.6.1.2 Testing Inputs and Outputs

Observe operation of the unit:

- Toggle switches selected on the Office half should be reflected by the Field LEDs in conjunction with the Input Group Select & Output Group Select rotary switches.
- Toggle switches on the Field half should be reflected by the Office LEDs in conjunction with the Input Group Select & Output Group Select rotary switches.

4.6.1.3 Testing S2/ALC4x Modules

Observe operation of the unit for:

- LINE TERMINATE—confirm that TERM LED on the S2/ALC4x extinguishes.
- LINE UNTERMINATE—confirm that TERM LED on the S2/ALC4x illuminates.
- LINE TERMS—confirm that TERM LED on the S2/ALC4x extinguishes.
- LINE CHANGEOVER—confirm that LCO LED on the S2/ALC4x extinguishes.
- PFJR—confirm that PFJR LED and ALARM LED on the S2/ALC4x extinguish.
- Tx T/O—confirm that TTA LED on the S2/ALC4x extinguishes.
- LINE HUNT—confirm that LCO LED on the S2/ALC4x extinguishes after 30 s and illuminates after a further 30 s.
- Force Off (force off function of S2/SOF4x and S2/DOP4x modules)—confirm that the output LEDs extinguish.

4.6.2 Testing Field Stations

Use the Office Mode to test a Field station or to monitor frames being received from a Field station.

Operation in the Office mode requires either:

- one S2/SOF4x and a modem, or
- one S2/SCN4x, one S2/DIP4x, one S2/DOP42 and a modem (modem is not required for DIGITAL Office mode).

4.6.2.1 Office Mode Set Up Procedures

Use the procedures listed in Table 4.7 to set up the S2/TLU43 for Office Mode testing.

Caution: ***If the S2/TLU43 is to be used for monitoring only, select the Office Tx + Rx switch (see section 4.5.3.1) to Rx Only before using, otherwise corruption of system data may occur.***

Step	Description
1	Install the required modules into the Office half of the Test Link.
2 (S2/SCN4x)	For S2/SCN4x tests, set the configuration switches as detailed in section 4.4.6.
2 (S2/SOF4x)	For S2/SOF4x tests, set the configuration switches as detailed in section 4.4.1, subject to the following: • Start Address—as desired (must be less than end address, typically 00). • End Address—as desired (must be greater than start address, typically 03). • Baud Rate—determined by baud rate of field under test. • Data Word Length—Determined by Data Word Length of Field under test. • Interscan Delay—select 16.
3	Select the common switches as follows: • Impedance—as desired. • Configuration—OFF (MODEM or DIGITAL) • Output Address—Select the required Field address. • Input Address—Select the required Field address. • Input Group Select—as desired. • Output Group Select—as desired.
4	Connect the 12 V supply to the Testlink unit 12 V socket.
5	Connect line input cable to the Testlink Unit Telemetry socket.
6	Select power switch to ON.
7	Ensure that Testlink is functioning correctly via inspection of the S2 module LEDs.

Table 4.7 S2/TLU43 Office Mode Set Up

4.6.2.2 Testing Inputs and Outputs

Observe operation of the unit:

- The S2/TLU43's 32 LEDs reflect the state of the indications received from the Field.
- The S2/TLU43's 32 toggle switches are transmitted as controls if the Tx + Rx switch is in the Tx + Rx position.

4.6.2.3 Testing S2/SOF4x Modules

Set the Output Group Select switch in the Office section of the front panel (see section 4.4.8) to:

- 1 to inspect the first word of data being received from the Field
- 2 to inspect the second word of data being received from the Field
- and so on, if more than 32 data bits are contained within the data frame.

4.6.3 Testing Offices

Use the Field Mode to test an Office or to monitor frames being received from an Office.

Operation in the Office mode requires either:

- one S2/SOF4x and one modem, or
- one S2/SCN4x, S2/DIP4x and S2/DOP4x and a modem (not required if DIGITAL Field mode is being used).

4.6.3.1 Field Mode Set Up Procedures

Use the procedures listed in Table 4.8 to set up the S2/TLU43 for Field Mode testing.

Caution: ***If the S2/TLU43 is to be used for monitoring only, select the Field Tx + Rx switch (see section 4.5.3.1) to Rx Only before using, otherwise corruption of system data may occur.***

Step	Description
1	Install the required modules into the Field half of the Test Link.
2 (S2/SCN4x)	For S2/SCN4x tests, set the configuration switches as detailed in section 4.4.6.
2 (S2/SOF4x)	For S2/SOF4x tests, set the configuration switches as detailed in section 4.4.1, subject to the following: • Start Address—Not applicable. • End Address—Not applicable. • Baud Rate—Determined by baud rate of Telemetry System. • Data Word Length—Determined by Data Word Length of Telemetry System. • Interscan Delay—Not applicable.

Table 4.8 S2/TLU43 Field Mode Set Up

Step	Description
3	Select the common switches as follows: • Impedance—as desired. • Configuration—FIELD (MODEM or DIGITAL) • Output Address—Select the required Field address. • Input Address—Select the required Field address. • Input Group Select—as desired. Applicable only to S2/DIP4x and S2/DOP4x in Field Mode. • Output Group Select—as desired.
4	Connect the 12 V supply to the Testlink unit 12 V socket.
5	Connect line cable to the S2 equipment.
6	Select power switch to ON.
7	Ensure that Testlink is functioning correctly via inspection of the telemetry board LEDs.

Table 4.8 S2/TLU43 Field Mode Set Up (Continued)

4.6.3.2 Testing Inputs and Outputs

Observe operation of the unit:

- The S2/TLU43's 32 LEDs display the information being received from the Office. (These LEDs are pulsed on if the system has pulsed controls).
- The 32 toggle switches represent the Field indications (if the S2/TLU43 is transmitting information to the Office.

4.6.4 Testing a Complete Field Station

Use the Office Mode to:

- test a complete Field station
- confirm that the Field station receives all controls sent to it
- confirm that all indications to the Field from the interlocking are correctly transmitted to the Office.

Use the procedures listed in Table 4.9 to set up the S2/TLU43 for testing a complete Field station.

Do not disconnect the Field from the telemetry bearer without the permission of Train Control.

Step	Description
1	Disconnect the Field from the telemetry bearer. See the safety warning (above).
2	Prevent outputs to the interlocking by disconnecting the S2/SOF4x (S2/DOP4x) O/P cable from the RI20 (RI40).
3	Set up Office mode as described in section 4.6.2. Select the I/P and O/P Address of the Test Link to correspond with the address of the S2/SOF4x module or S2 Scanner System unit under test.
4	Systematically transmit controls to the Field from the Test Link and observe the appropriate S2/SOF4x or S2/DOP4x outputs status LED.
5	In order to test the indications from the Field unit the S2/SOF4x or S2/DIP4x I/P cables must be disconnected from the Interlocking system. Reconnect these cables to a switchbox.
6	Systematically drop each indication and check that it appears on the Test Link Office LEDs.
7	After completion of tests disconnect the Test Link and reconnect the I/P and O/P cables to the interlocking system.
8	Reconnect the Field to the telemetry bearer and notify Train Control.

Table 4.9 S2/TLU43 Set Up for Testing a Field Station

5. S2 Module Descriptions

This chapter contains descriptions and servicing information (as applicable) for WESTRONIC S2 modules.

Module configuration details may contain depictions of jumper connections. Linked pins are shown as being connected with a line.

For example, Figure 5.1 shows the following jumpers as being linked:

- MPE
- OC
- ANS
- TXC EXT

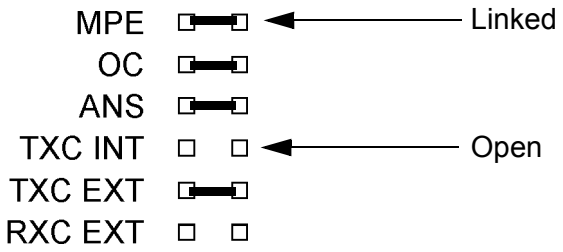


Figure 5.1 Example of Linked Jumpers

5.1 Motherboards

The WESTRONIC S2 motherboards are passive devices designed to provide the interconnection of the wide range of S2 telemetry modules. The motherboards and S2 telemetry products provide the hardware for remote control systems.

Provisions within the different motherboards for integrated power supplies, modems, I/O modules and alarm modules results in stand-alone systems requiring minimal external wiring and connections.

5.1.1 S2/MBD45 Motherboard

The S2/MBD45

- supports office or field applications
- supports dual or single scanner
- supports dual or single modem, 2 wire or 4 wire
- supports dual or single power supplies
- supports up to 320 digital I/Os
- fits directly onto S2/HSG41 card housing

5.1.1.1 Description

The S2/MBD45 motherboard supports the S2/SCN4x scanner modules and provide the interconnection of S2 telemetry modules.

The S2/MBD45 motherboard has dedicated slots for the following modules:

- S2/PSU4x (power supply, 1 or 2 modules)
- S2/ALC4x (alarm and change-over, 0 or 1 module)
- S2/VFC4x (modem, 1 or 2 modules)
- S2/SCN4x (scanner, 1 or 2 modules)
- S2/DIP4x (digital input) or S2/DOP4x (digital output, 1 to 10 modules, any combination)

Figure 5.3 shows the allocation of modules, viewed from the rear of the card housing.

5.1.1.2 Configuration

The S2/MBD45 motherboard is configured through the addition of plug-on shunt links and wire-wrap connections.

Figure 5.2 shows the relative locations of modules and configuration settings. The following sections describe each item in detail.

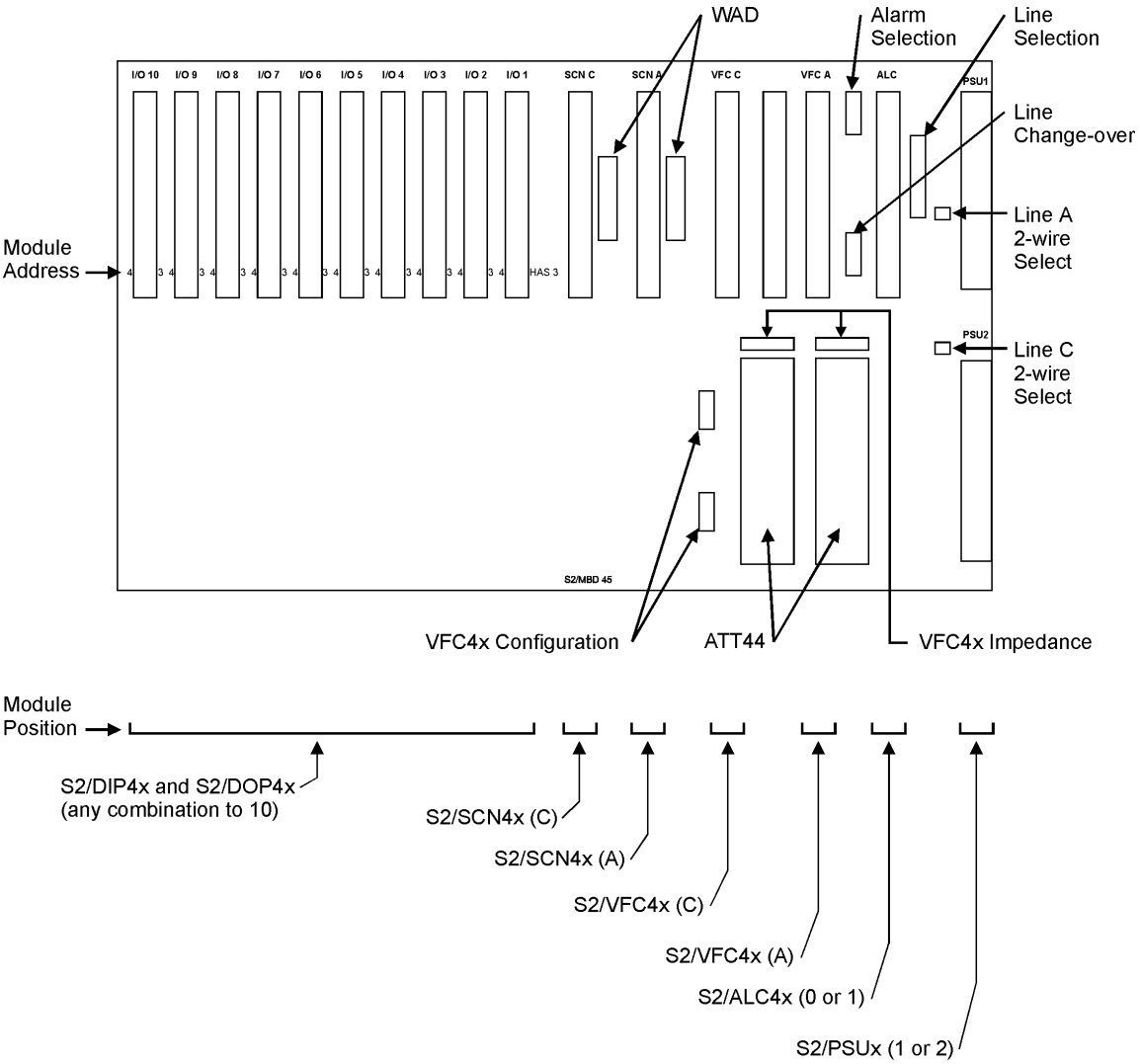


Figure 5.2 Locations of Configuration Jumpers and Modules

The left side of the motherboard is shown in detail in section 5.1.1.3, which contains details about input/output power connections.

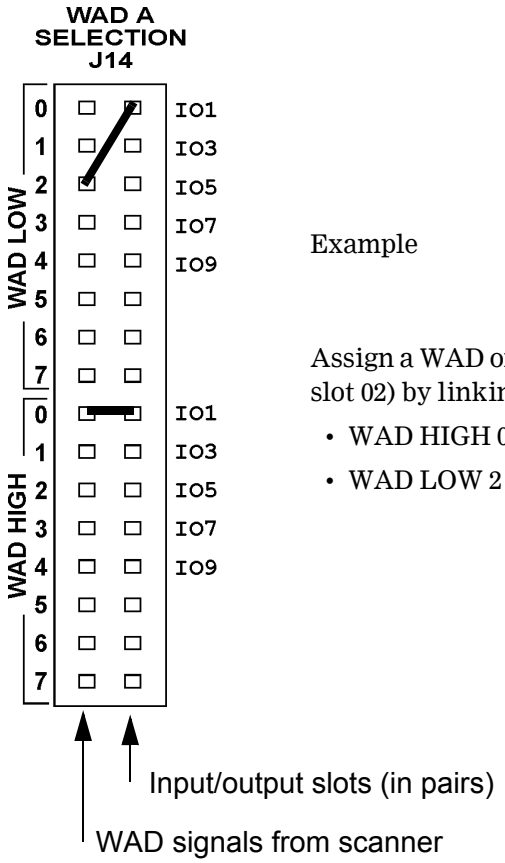
5.1.1.2.1 WAD (Word Address) Selection

Figure 5.2 shows the location of the WAD jumpers.

A WAD (Word Address) selection strapping area is provided for each scanner to select the WAD. The strapping areas are labelled:

- 'WAD A SELECTION J14' for SCN A
- 'WAD C SELECTION J16' for SCN C.

Figure 5.3 shows the WAD A strapping area (WAD C is similar).



Example

Assign a WAD of octal 02 to I/O slot 01 (and I/O slot 02) by linking:

- WAD HIGH 0 and IO1
- WAD LOW 2 and IO1

Figure 5.3 WAD A Strapping Details (example)

This strapping area allows the I/O modules to be allocated to the required address as determined by the application. The WAD signals are outputs from the scanner. The addition of wire wraps in this strapping area enables the I/O pairs.

Thus, to enable I/O slot 1 (and hence 2) to respond to a word address of octal 02, a wire-wrap connection is added between the WAD LOW 2 pin on the left to the pin on the opposite row labelled IO1. Another wire-wrap connection is added between the WAD HIGH 0 pin on the left to the pin on the opposite row labelled IO1.

5.1.1.2.2 Module Address

Figure 5.2 shows the location of the module address jumpers.

Each I/O slot requires a module address. The module address defines where an I/O module's 32 bits are positioned in the data word field for the configured word address.

Two inputs, HAS3 (pin 1a30) and HAS4 (pin 1c30), are used by each I/O module to determine the data position. In each case, the inputs are configured by the following links:

- between pin 1a30 and 1a29 for HAS3
- between pin 1c30 and 1c29 for HAS4

Figure 5.4 shows HAS3 linked and HAS4 open.

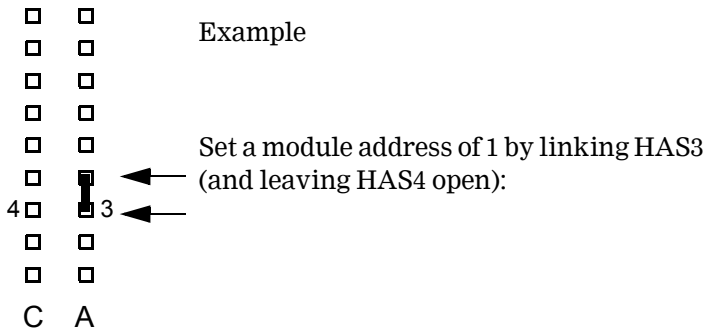


Figure 5.4 : Module Address Pins (rear of I/O slot)

Table 5.1 lists the range of module address links.

HAS4	HAS3	Module Number	Bits
open	open	0	1 through 32
open	linked	1	33 through 64
linked	open	2	65 through 96
linked	linked	3	97 through 128

Table 5.1 : Module Address Links

5.1.1.2.3 VFC4x Configuration

Figure 5.2 shows the location of the VFC4x configuration jumpers (J43 and J44).

Link the VFC4x configuration jumpers as shown in Figure 5.5.

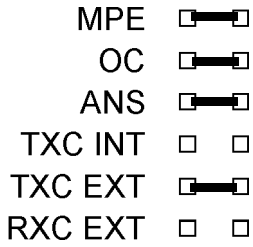


Figure 5.5 VFC4x Configuration Links

Note: ***The ANS link is to be used only for S2/VFC41 and 42 systems, installed at the office end.***

5.1.1.2.4 VFC4x Impedance

Figure 5.2 shows the location of the VFC4x impedance jumpers (J35 and J39). Select the required VFC4x impedance settings as shown in Figure 5.6, Figure 5.7 and Figure 5.8.

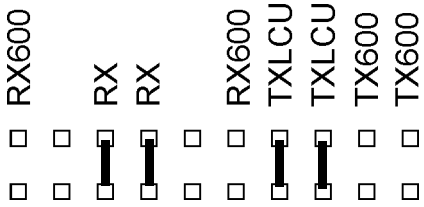


Figure 5.6 Jumper Settings for LCU Line

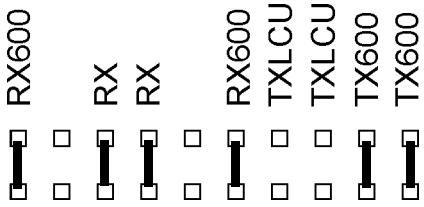


Figure 5.7 Jumper Settings for 600 Ohm Line

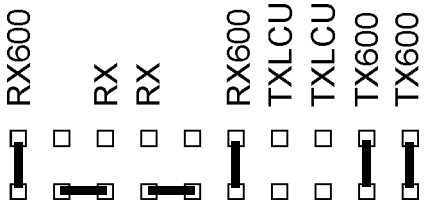


Figure 5.8 Jumper Settings for 600 Ohm Line with 10 dB rx attenuation

5.1.1.2.5 Line Selection

Figure 5.2 shows the location of the line selection jumpers (J6).

The following line arrangements may be selected by adding plug-on shunt links:

- VFC A to line A
- VFC C to line C
- VFC A switchable to either line A or line C
- VFC C switchable to either line A or line C

Note: ***The Line Changeover selection must be correctly set in order for a VFC to be switchable.***

Select the required line arrangement as shown in Figure 5.9.

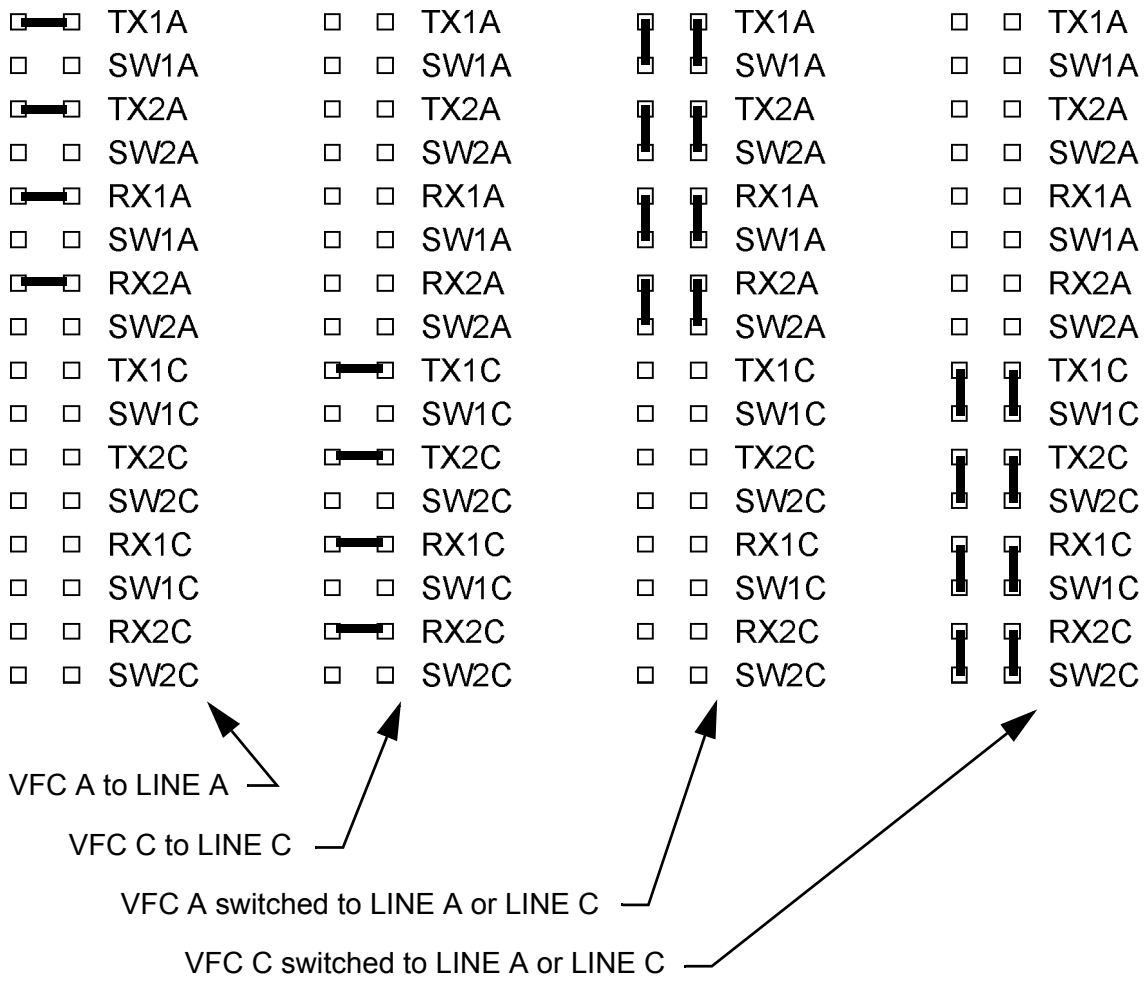


Figure 5.9 Jumper Settings for Line Selection

5.1.1.2.6 2-Wire Line Selection

Figure 5.2 shows the location of the Line A and Line C 2-wire selection jumpers (J3B and J33B).

The 4-wire VFC4x modem connection can be configured for 2 wire operation by adding two shunt links to connect the Tx and Rx pairs together.

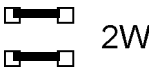


Figure 5.10 Jumper Settings for 2-Wire Selection

5.1.1.2.7 Line Changeover

Figure 5.2 shows the location of the line changeover jumper (J8).

The Line Changeover (LCO) function allows one VFC to communicate to the two bearer lines, line A and line C, as determined by the S2/ALC4x module.

The LCO function is set-up via shunt links to the LCO SELN connector.

Figure 5.11 shows the disable and enable jumper settings.

Figure 5.11 Jumper Settings for Line Changeover

5.1.1.2.8 Alarm Selection

Figure 5.2 shows the location of the alarm selection jumpers (J9A).

The S2/ALC4x module provides alarm monitoring and control facilities which are configured on the ALM SELN connector.

Figure 5.12 shows the alarm monitoring and control jumper settings.

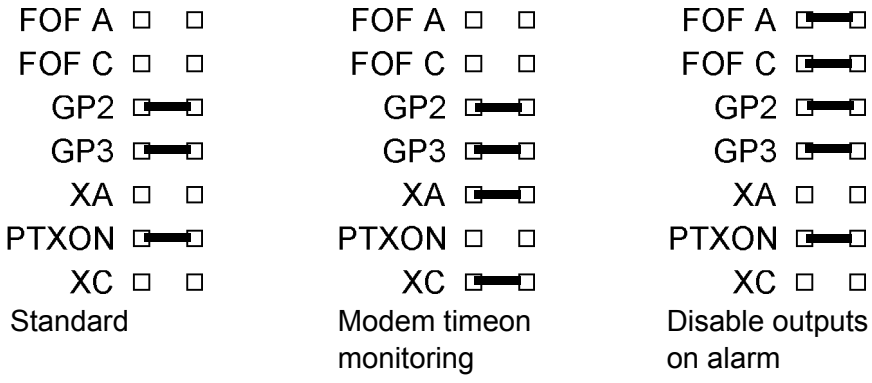


Figure 5.12 Jumper Settings for S2/ALC4x Alarm Selection

5.1.1.3 Input/Output Power Reference Connections

Input and output modules require power reference connections to be made on the S2/MBD45 motherboard. Figure 5.13 shows the left rear of the motherboard with power reference jumpers identified.

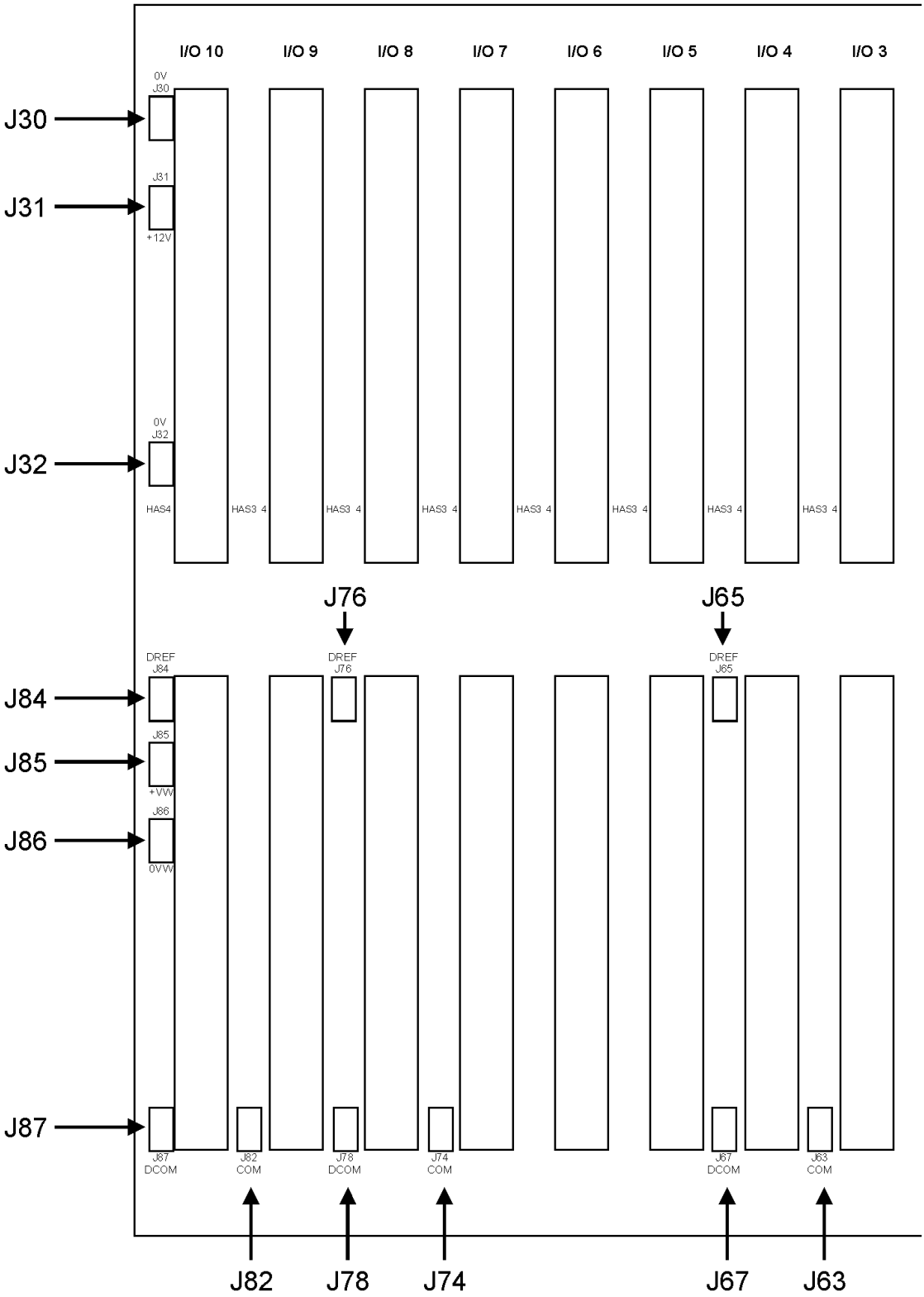


Figure 5.13 : Connection Details—Left Rear of S2/MBD45

The following sections list the power reference connections typically required for each applicable module.

5.1.1.3.1 S2/DIP41 and S2/DIP42

Connect:

- J31 (+12 V) to J85 (+VW)
- J32 (0 V) to J86 (0VW) to J82 (COM) to J74 (COM) to J63 (COM)

5.1.1.3.2 S2/DIP43

Connect:

- Signalling B24 Supply to J85 (+VW)
- J30 (0 V) to J86 (0 VW) to J82 (COM) to J74 (COM) to J63 (COM) to Signalling N24 Supply

5.1.1.3.3 S2/DOP41 and S2/DOP42

Connect:

- J31 (+12 V) to J84 (DREF) to J76 (DREF) to J65 (DREF)
- J32 (0 V) to J87 DCOM to J82 (COM) to J78 (DCOM) to J74 (COM) to J67(DCOM) to J63 (COM) to Signalling Negative Common

5.1.1.3.4 S2/DOP43

Connect:

- J84 (DREF) to J82 (COM) to J76 (DREF) to J74 (COM) to J65 (DREF) to J63 (COM) to Signalling N24 Supply
- J87 DCOM to J78 (DCOM) to J67(DCOM) to Signalling B24 Supply

5.1.2 S2/MBD46 Motherboard

The S2/MBD46

- supports office or field applications
- supports single S2/SOF42
- supports single modem, 2 wire or 4 wire
- supports up to 32 digital I/Os
- fits directly onto S2/HSG41 card housing

5.1.2.1 Description

The WESTRONIC S2/MBD46 motherboard is a passive device designed to support a single S2 Telemetry Station. The S2/MBD46 provides the capability to configure a single S2 Telemetry station comprising one S2/SOF42 module and one S2/VFC42 module.

5.1.2.2 Configuration

The S2/MBD46 has shunt connectors for configuring the S2/SOF42 and S2/VFC4x. These connectors are identified in Figure 5.14 and described in the following sections.

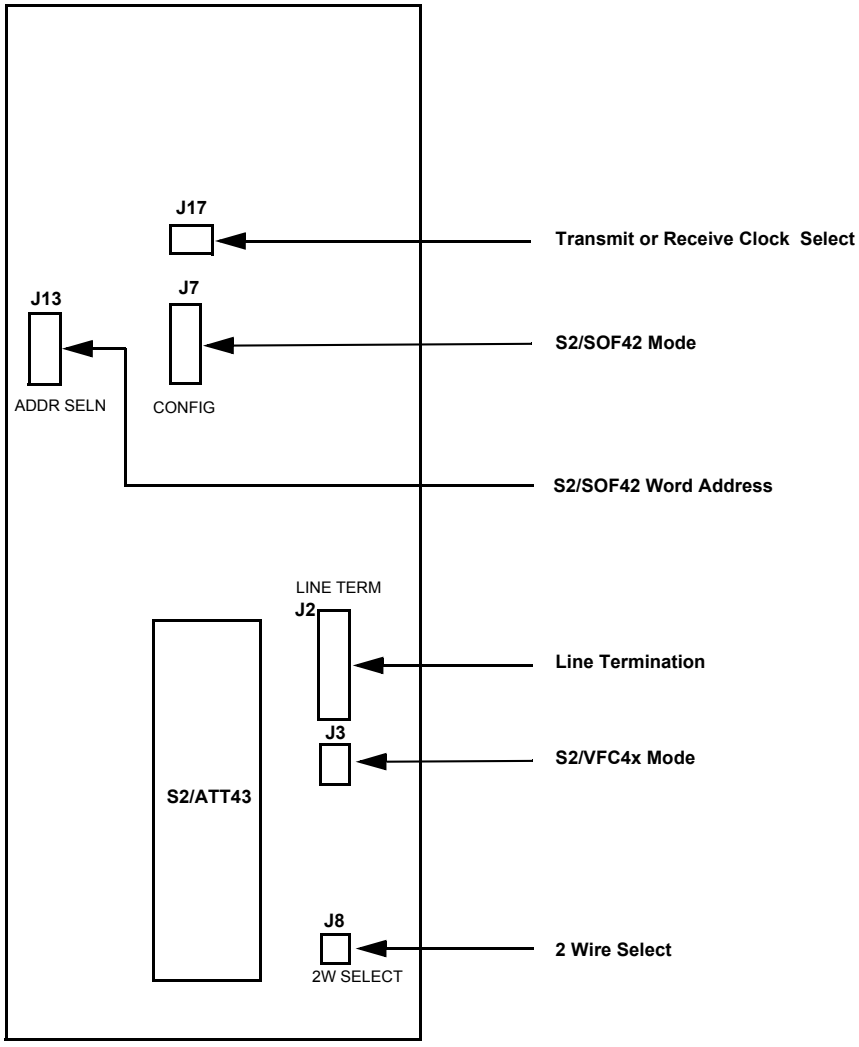


Figure 5.14 S2/MBD46 Jumper Locations

5.1.2.2.1 Line Termination

Set the S2/VFC4x source and termination impedances on connector J2.

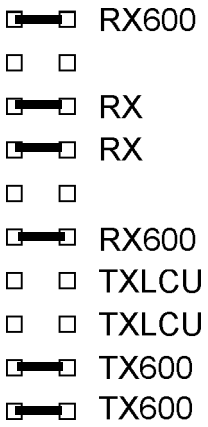


Figure 5.15 Strapping for 600 Ω Impedance

5.1.2.2.2 S2/VFC4x Mode

Set the S2/VFC4x mode of operation on connector J3. Table 5.2 details the options.

Pins	Function	Shunt
ANS	determines transmit and receive frequencies on the S2/VFC42.	Yes = answer mode (field) No = originate mode (office)
RTS	places the S2/VFC42 in constant carrier mode	Yes = constant carrier mode No = S2/SOF42 control of RTS
EN232	places the S2/VFC45 in RS232 mode (not available on the S2/VFC42)	Yes = RS232 mode No = RS422 mode

Table 5.2 S2/VFC4x Configuration

5.1.2.2.3 S2/SOF42 Mode

Set the S2/SOF42 mode of operation on connector J7. Table 5.3 details the options.

Pins	Function	Shunt
CTRL BYTE	determines whether or not a control byte is expected in the receive frame and inserted into the transmit frame	Yes = control byte enabled No = control byte disabled
LATCHED	determines if outputs are latched or pulsed	Yes = sets the outputs as latched No = broadcast mode
CLOCKWORK	determines if mode of operation is broadcast or clockwork	Yes = clockwork mode No = broadcast mode
MODE1	determines the S2/SOF42 mode of operation (Office or Field)	Yes = Office mode No = Field mode
MODE0		Do not shunt MODE0 pins
DWL1 DWL0	determines the data word length of the WDLC frame	See Figure 5.16.

Table 5.3 S2/SOF42 Configuration

Set the data word length in S2/SOF42 WDLC messages using jumpers DWL1 and DWL0. The jumper options are shown in Figure 5.16.

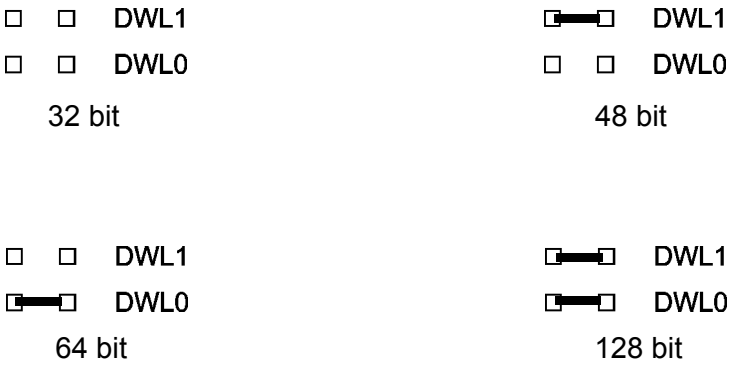


Figure 5.16 S2/SOF42 Data Word Length Selection Jumpers

5.1.2.2.4 S2/SOF42 Word Address

Set the S2/SOF42 word address using jumpers on connector J13.

A linked pair of WAD pins sets the binary value to 0. Refer to Table 5.4 for WAD high order values and Table 5.5 for WAD low order values.

Figure 5.17 shows an example of jumper settings for a word address of octal 17.

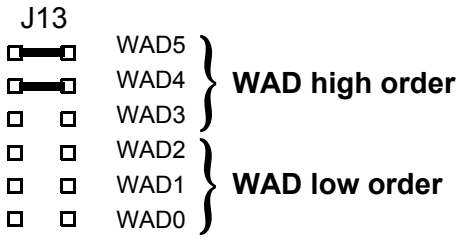


Figure 5.17 Jumper Settings for S2/SOF42 Word Address (Example)

Note: ***0 = shunt installed; 1 = no shunt.***

Address (Octal)	WAD5	WAD4	WAD3
00	0	0	0
10	0	0	1
20	0	1	0
30	0	1	1
40	1	0	0
50	1	0	1
60	1	1	0
70	1	1	1

Table 5.4 WAD High Order

Address (Octal)	WAD2	WAD1	WAD0
00	0	0	0
01	0	0	1
02	0	1	0
03	0	1	1
04	1	0	0
05	1	0	1
06	1	1	0
07	1	1	1

Table 5.5 WAD Low Order

5.1.2.2.5 Internal/External Clock Selection

Select either internal or external clocking of the S2/SOF42 on connector J17:

- Internal clocking uses the S2/SOF42's internal clock regeneration circuit for data synchronisation.
- External clocking uses the S2/VFC42's clock circuit for data synchronisation.

To obtain best results when using a Differential Phase Shift Key (DPSK) type modem (such as the S2/VFC42), use:

- external clocking for receive;
- internal clocking for transmit.

The two options are described in Figure 5.18.

Figure 5.18 Internal and External Clock Jumper Settings

5.1.2.2.6 2W Select

Select 2-wire mode of the S2/VFC42 using jumpers on connector J18. Using no jumpers selects 4-wire mode.

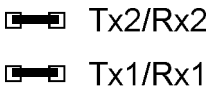


Figure 5.19 2-Wire Mode Selection Jumpers

5.1.3 S2/MBD50 Motherboard

The S2/MBD50 motherboard is an S2 parallel highway extension for use with S2/MBD45. The S2/MBD50:

- supports 18 S2/DIP4x or S2/DOP4x modules;
- fits directly onto S2/HSG41 card housing.

5.1.3.1 Description

The S2/MBD50 enables the S2 scanner system to be extended with up to eighteen S2/DIP42 and/or S2/DOP42 modules.

The S2/MBD50 (in an expansion housing) is used in addition to the S2/MBD45 for stations that require more than 10 I/O modules. Connection to the master housing is made via 64 way ribbon cable.

5.1.3.2 Function

The S2/MBD50 provides:

- backplane interconnection of S2 parallel highway A and the I/O modules;
- backplane interconnection of S2 parallel highway C and the I/O modules;
- address strapping connectors for S2/DIP42 and S2/DOP42 modules on highway A and highway C;
- external power supply connection, via 6.3 mm spade connectors;
- external I/O connections via 40 way ribbon header connectors.

5.1.3.3 Configuration

The S2/MBD50 has shunt connectors for configuring the S2/DIPs and S2/DIPs. These connectors are identified in Figure 5.20 and described in the following sections.

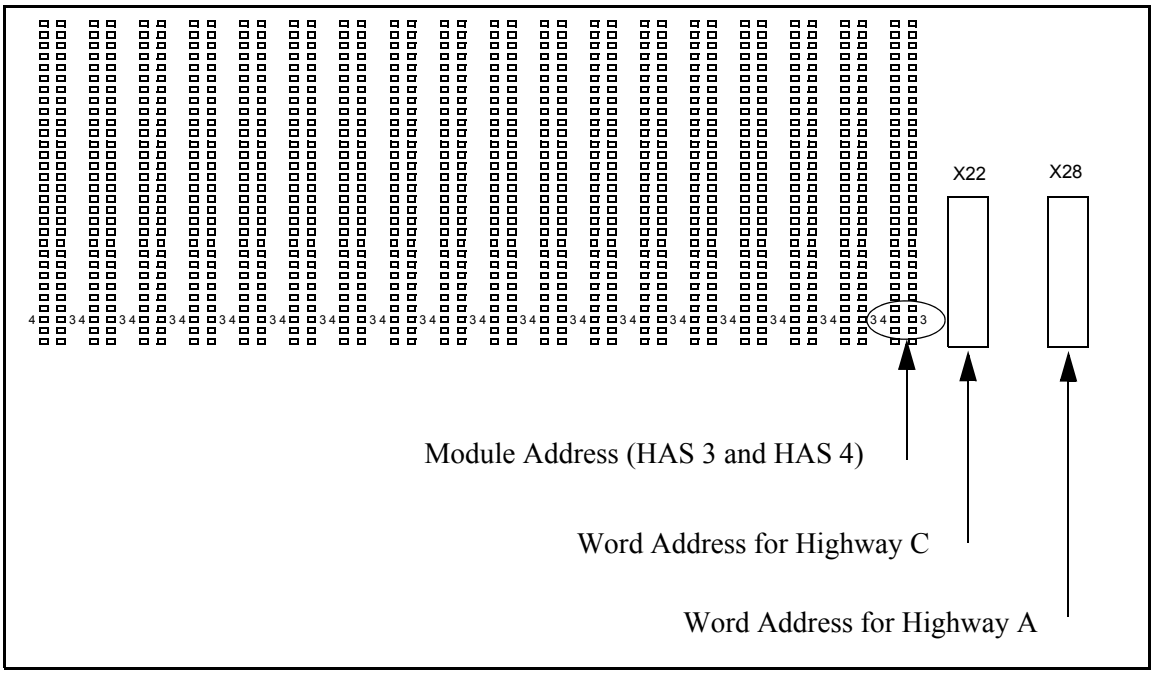


Figure 5.20 Location of Configuration Jumpers

5.1.3.3.1 Word Address Selection

Select the WAD for each S2/DIP and S2/DIP using:

- connector X28 for highway A
- connector X22 for highway C

High order and low order WAD address pins are provided to set up the addresses for each I/O slot. The I/O slots are numbered 1 through 17 and are listed in Table 5.6.

I/O Reference	I/O Modules
1	1 and 2
3	3 and 4
5	5 and 6
7	7 and 8
9	9 and 10
11	11 and 12
13	13 and 14
15	15 and 16
17	17 and 18

Table 5.6 I/O Slot Numbering

For each I/O pair, add jumpers on the appropriate pins for both high and low orders. Figure 5.17 shows an example of WAD jumper settings for I/O slots 3 and 7 for highway A (highway C is similar).

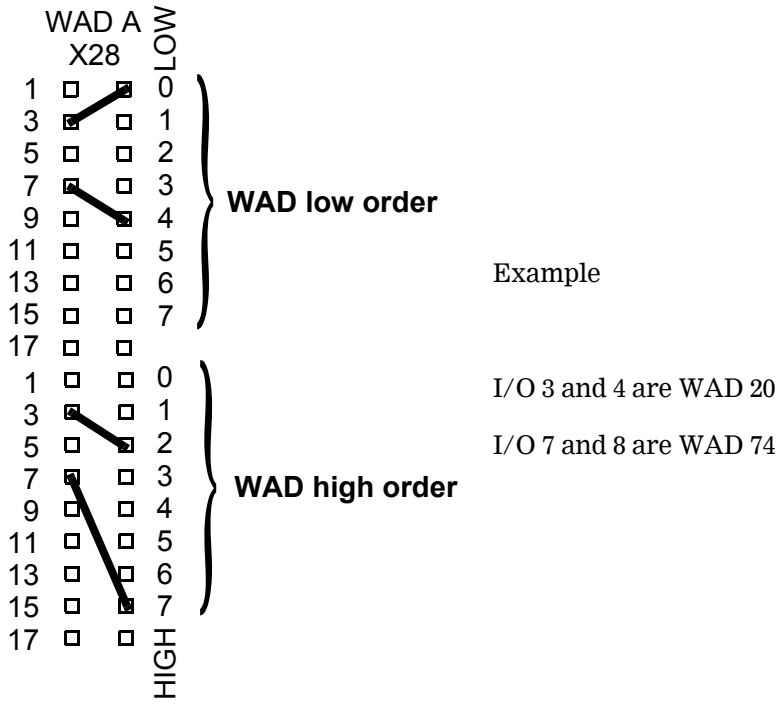


Figure 5.21 Jumper Settings for Word Address (Example)

Table 5.7 lists the high order WAD values and Table 5.8 lists the low order WAD values.

Address (Octal)	WAD High
00	0
10	1
20	2
30	3
40	4
50	5
60	6
70	7

Table 5.7 WAD High Order

Address (Octal)	WAD High
00	0
01	1
02	2
03	3
04	4
05	5
06	6
07	7

Table 5.8 WAD Low Order

5.1.3.3.2 Module Address

Figure 5.20 shows the location of the module address jumpers.

Each I/O slot requires a module address. The module address defines where an I/O module's 32 bits are positioned in the data word field for the configured word address.

Two inputs, HAS3 (pin 1a30) and HAS4 (pin 1c30), are used by each I/O module to determine the data position. In each case, the inputs are configured by the following links:

- between pin 1a30 and 1a29 for HAS3
- between pin 1c30 and 1c29 for HAS4

Figure 5.22 shows HAS3 linked and HAS4 open.

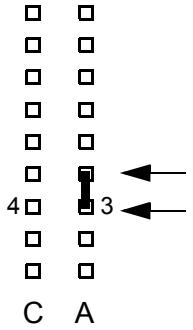


Figure 5.22 : Module Address Pins (rear of I/O slot)

Table 5.1 lists the range of module address links.

HAS4	HAS3	Module Number	Bits
open	open	0	1 through 32
open	linked	1	33 through 64
linked	open	2	65 through 96
linked	linked	3	97 through 128

Table 5.9 : Module Address Links

5.1.4 S2/MBD51 Motherboard

The S2/MBD51 is a stand-alone motherboard to interface between S2/VFC4x modems and any installation requiring communications at RS422 or RS232 levels.

The S2/MBD51 single modem motherboard supports:

- S2/VFC42, S2/VFC45, S2/VFC46 or S2/ATT44;
- transmission media such as PCM, cable, or open wire at voice frequencies.

5.1.4.1 Particulars

Connectors on the board allow:

- either a S2/VFC42, S2/VFC45 or S2/VFC46 to be installed
- interface communications at RS422 or RS232 levels
- the connection of a protocol analyser at RS422 or RS232 levels
- the connection to a line with 4 wires or 2 wires, depending upon the type of modem installed
- the transmit and receive attenuation to be adjusted (by means of a plug on the attenuator board)
- the connection and daisy chaining of the 12V and 0V supply for multiple S2/MBD51 motherboards.

5.1.4.2 Configuration

The S2/MBD51 has shunt connectors for configuring the modem and other settings. These connectors are identified in Figure 5.23 and described in the following sections.

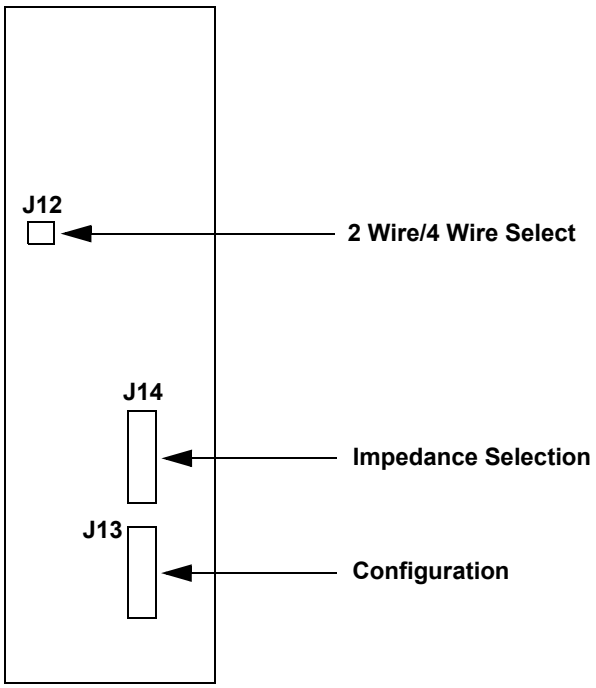


Figure 5.23 Location of Configuration Jumpers

5.1.4.2.1 Modem Configuration

Use links on the J13 connector to select the configuration appropriate to the modem used. Figure 5.24 shows the configuration connector and Table 5.10 lists the parameters.

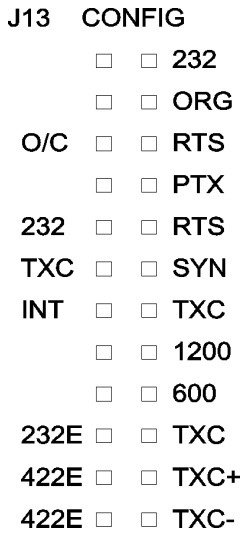


Figure 5.24 S2/VFC4x Modem Configuration

Link	Description	Link In	Used with
232	Selects between RS232 or RS422 for modem interface	Selects RS232	S2/VFC45 only
ORG	Selects the modulation frequency for the modem	Selects ANS	S2/VFC42 only
O/C RTS	Enables modem constant carrier, used for RS422 interface only	Enable Carrier	S2/VFC45/42 only
PTX	Enables modem power transmitter output circuit	Enable Power output	S2/VFC45/42 only
232 RTS	Enable modem constant carrier, used for RS232 interface only	Enable Carrier	S2/VFC45 only
TXC SYN	Selects modem transmit clock synchronised to data	Selects clock not sync to data	S2/VFC42 only
INT TXC	Connects transmit clock output loop back to transmit clock 'IN'	Loop transmit clocks	S2/VFC42 only
1200	Selects modem clock rate at 1200 baud	Selects 1200 baud	S2/VFC45 only
600	Selects modem clock rate at 600 baud	Selects 600 baud	S2/VFC45 only
232E TXC	Connects external transmit clock to modem. Used for RS232 interface only.	Selects External RS232 Transmit Clock	S2/VFC46 only
422E TXC+	Connects external transmit clock to modem. Used for RS422 interface only.	Selects External RS422 Transmit Clock	S2/VFC46 only
422E TXC-	Connects external transmit clock to modem. Used for RS422 interface only.	Selects External RS422 Transmit Clock	S2/VFC46 only

Table 5.10 Modem Configuration Details

5.1.4.2.2 Line Impedance Configuration

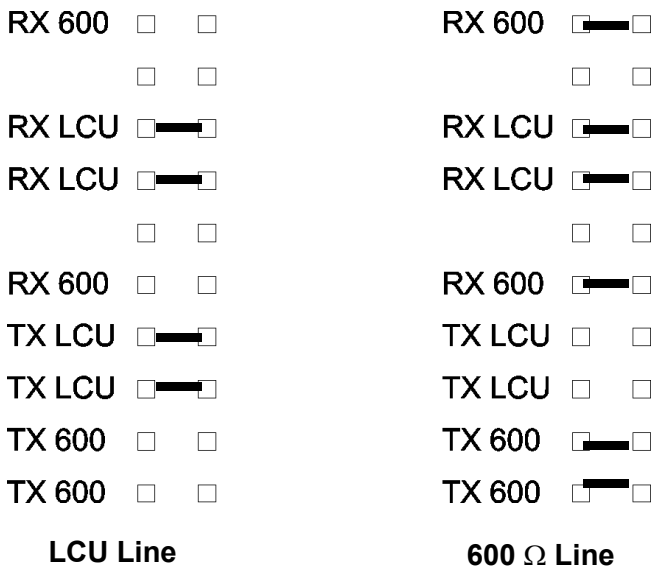


Figure 5.25 S2/VFC42/45 Line Impedance Configuration (for a four-wire line)

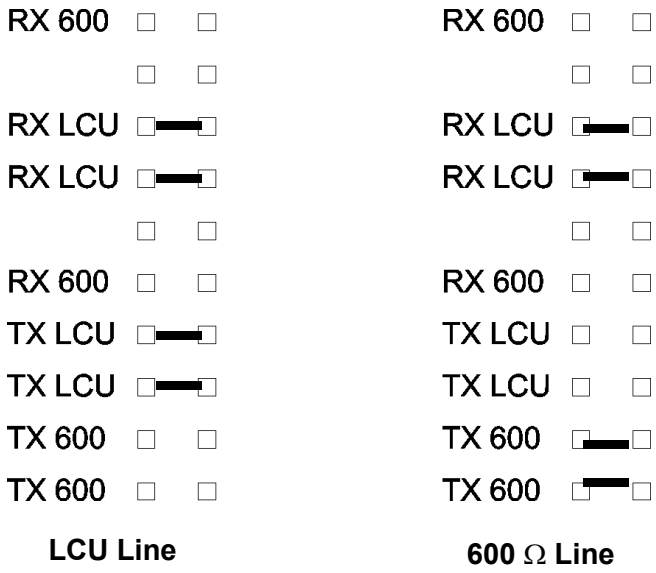


Figure 5.26 S2/VFC42 Line Impedance Configuration (for a two-wire line)

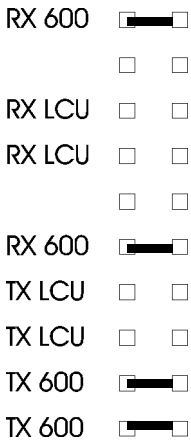


Figure 5.27 : S2/VFC46 Line Impedance Configuration (all line impedances)

5.1.4.2.3 2-Wire Line Selection

The 4-wire S2/VFC4x modem connection can be configured for 2 wire operation by adding two shunt links to connect the Tx and Rx pairs together.

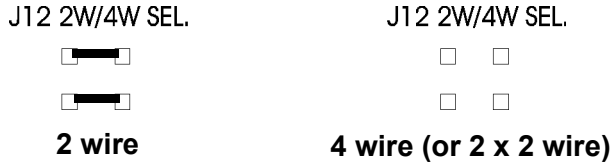


Figure 5.28 Jumper Settings for 2-Wire Selection

5.1.5 S2/MBD53 Motherboard

The S2/MBD53 is a stand-alone motherboard which will enable an interface between an S2/SOF42 module and installation parallel input/output connections, and communications at RS422 or RS232 levels. The S2/MBD53 also supports one S2/PSU4x power supply unit.

5.1.5.1 Particulars

The S2/MBD53 is comprised of a single printed circuit board and various connectors. There are configuration jumpers to select S2/SOF42 mode, pulsed/latched outputs, broadcast/clockwork scanning mode, data word length, system bit, configuration byte, RTS-CTS link (channel A only), Tx enable (both channels), baud rate (both channels), source of S2/SOF42 Forced Off signal, and WAD address of the S2/SOF42.

The connectors on the component side of the S2/MBD53 are used to provide the external links between the installation and the S2/MBD53.

An S2/MBD53 motherboard, fitted with an S2/PSU4x power supply unit, allows daisy-chaining of up to four other S2/MBD53s without power supply units.

5.1.5.2 Configuration

The S2/MBD53 has shunt connectors for configuring the modem and other settings. These connectors are identified in Figure 5.29 and described in the following sections.

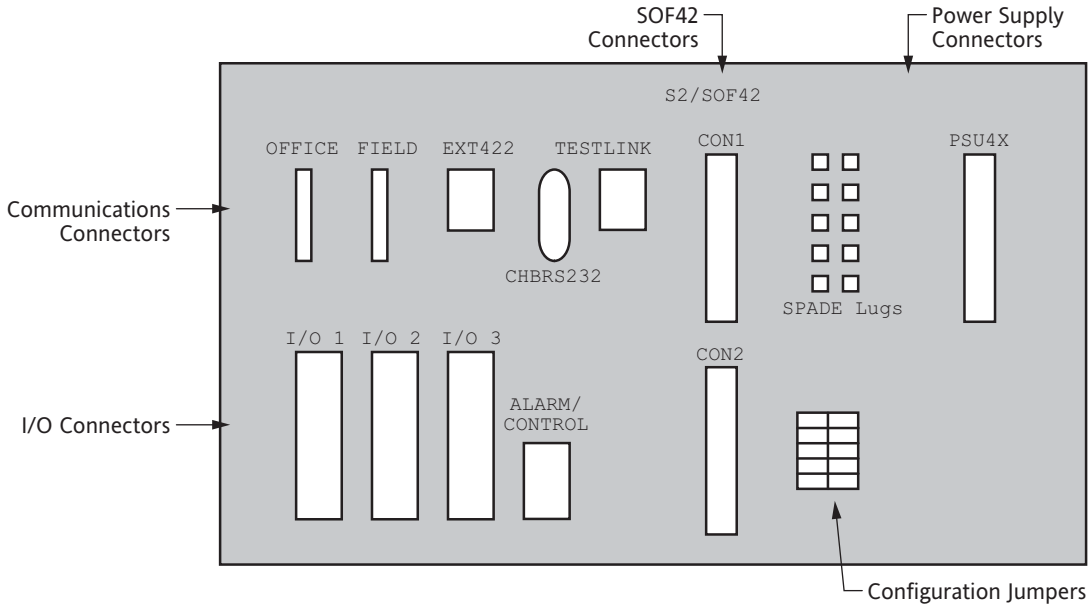


Figure 5.29 Location of Configuration Jumpers

The S2/MBD53 motherboard has two banks of jumpers.

- Jumper fields X9 and X11 are used for S2/SOF42 general configuration.
- Jumper field X21 is used for S2/SOF42 WAD address selection.

S2/SOF42 Configuration jumper fields X9 and X11 are shown in Figure 5.30.

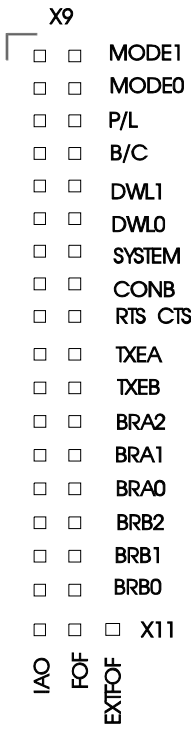


Figure 5.30 S2/SOF42 Configuration Jumper Fields X9 and X11

S2/SOF42 WAD address jumper field X21 is shown in Figure 5.31.

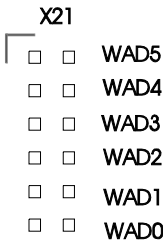


Figure 5.31 S2/SOF42 WAD Address Jumper Field X21

5.1.5.2.1 Mode

Jumpers Mode1 and Mode0 select the S2/SOF42 mode of operation. The jumper options are shown in Figure 5.32.

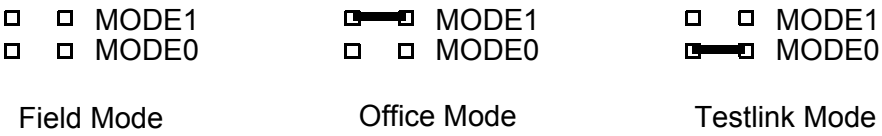


Figure 5.32 S2/SOF42 Field, Office or Testlink Mode Selection Jumpers

5.1.5.2.2 Pulsed/Latched

Jumper P/L selects either the pulsed or latched mode for S2/SOF42 outputs. The jumper options are shown in Figure 5.33.

Figure 5.33 S2/SOF42 Pulsed or Latched Output Mode Selection Jumpers

5.1.5.2.3 Broadcast or Clockwork

Jumper B/C selects either the broadcast or clockwork S2/SOF42 scanning mode. The jumper options are shown in Figure 5.34.

Figure 5.34 S2/SOF42 Broadcast or Clockwork Scanning Mode Selection Jumpers

5.1.5.2.4 Data Word Length

Jumpers DWL1 and DWL0 select the data word length in S2/SOF42 WDLC messages. The jumper options are shown in Figure 5.16.

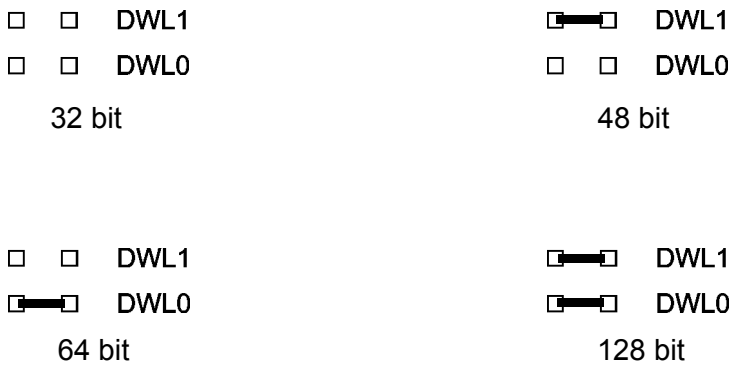


Figure 5.35 S2/SOF42 Data Word Length Selection Jumpers

5.1.5.2.5 System

Jumper SYSTEM selects the value of the system bit in S2/SOF42 WDLC messages. The jumper options are shown in Figure 5.36.

Figure 5.36 S2/SOF42 System Bit Value Selection Jumpers

5.1.5.2.6 Control Byte

Jumper CONB selects the control byte in S2/SOF42 SDLC messages. The jumper options are shown in Figure 5.37.

Figure 5.37 S2/SOF42 Control Byte Selection Jumpers

5.1.5.2.7 RTS CTS

Jumper RTS CTS selects the method of looping back the S2/SOF42 Channel A signal RTS to CTS.

When looped (jumper in), RTS is looped back to CTS via the motherboard. When not looped, external wiring is used to loop RTS back to CTS.

The jumper options are shown in Figure 5.38.

Figure 5.38 S2/SOF42 RTS to CTS Looping Back Selection Jumpers

5.1.5.2.8 TXEA

Jumper TXEA enables data transmission on S2/SOF42 Channel A. The jumper options are shown in Figure 5.39.

Figure 5.39 S2/SOF42 Channel A Enable Selection Jumpers

5.1.5.2.9 TXEB

Jumper TXEB enables data transmission on S2/SOF42 Channel B. The jumper options are shown in Figure 5.40.

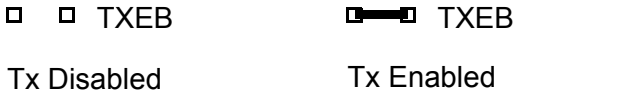


Figure 5.40 S2/SOF42 Channel B Enable Selection Jumpers

5.1.5.2.10 Baud Rate

Jumpers BRA2 to BRA0 and BRB2 to BRB0 select the baud rate for S2/SOF42 channel A or B respectively. The jumper options are shown in Figure 5.41.

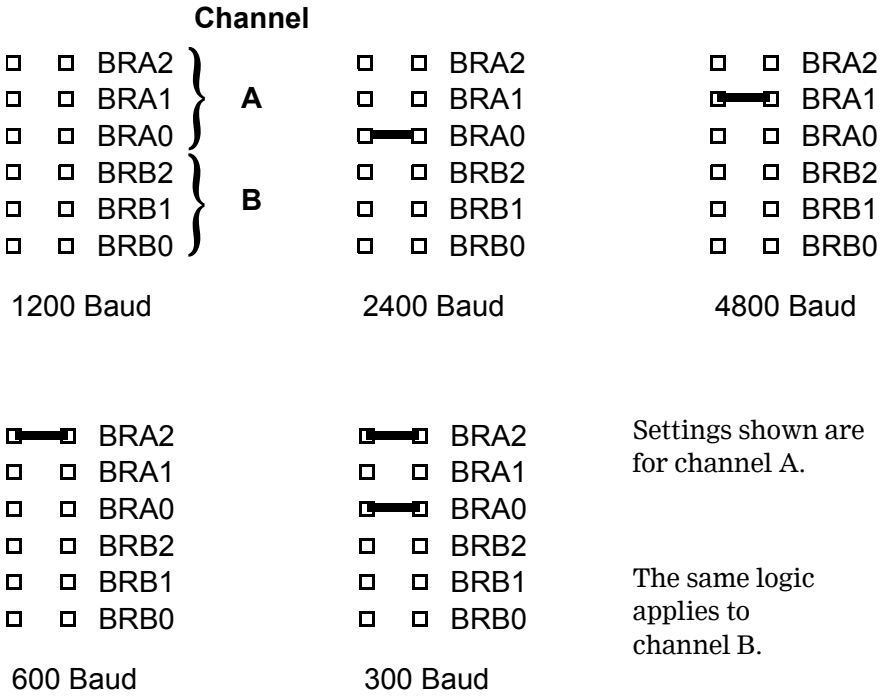


Figure 5.41 S2/SOF42 Channel A and B Baud Rate Selection Jumpers

5.1.5.2.11 Force Off

Jumper FOF (X11) selects the method of driving the S2/SOF42 Force Off, FOF signal (FOF controls the S2/SOF42 hybrid outputs).

The three states are:

- FOF not driven—the S2/SOF42 outputs are always enabled.
- FOF driven by !AO—the S2/SOF42 alarm output !AO drives the FOF signal.
- FOF driven by EXTFOF—the EXTFOF signal from the ALARM/CONTROL connector drives the FOF signal

The jumper options are shown in Figure 5.42.

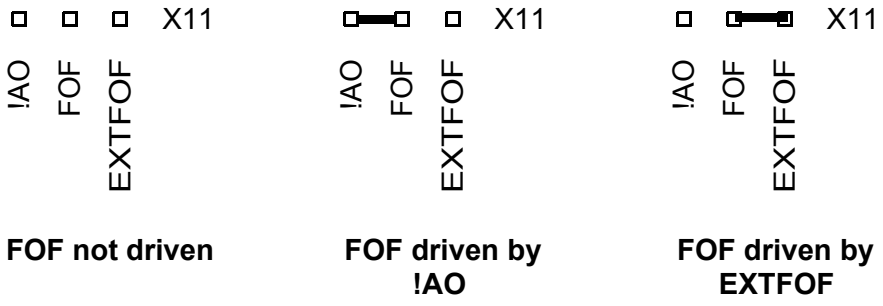
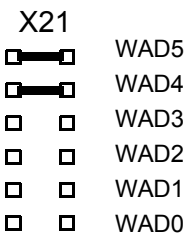


Figure 5.42 S2/SOF42 Force Off Signal Selection Jumpers

5.1.5.2.12 Address

Use jumpers WAD5 to WAD0 in the X21 connector to set the address of the S2/MBD53 motherboard and its S2/SOF42 module:

- The addresses are binary, with WAD5 the most significant bit.
- Jumper in = Logic 0
- Jumper out = logic 1.



Example

Assign an address of 15 (binary 001111) by linking: WAD5, WAD4.

Figure 5.43 S2/SOF42 Address Selection Jumpers

5.1.5.3 External Connectors

The connectors listed in Table 5.11 provide external links between the S2/MBD53 and the particular installation.

Connector	Function
CHBRS232	S2/SOF42 channel B, RS232 communication link, DTE
OFFICE	S2/SOF42 channel A RS422 communication link in the office (master) mode
FIELD	S2/SOF42 channel A RS422 communication link in the field (slave) mode
EXT422	S2/SOF42 channel A RS422 auxiliary link with KRONE connector (both modes)
TESTLINK	S2/SOF42 channel A RS422 connection to Test Link (both modes)
+12V (X6)	Spade lugs, used for the connection and daisy chaining of the 12V power supply from the S2/PSU4x connector X5 (PINS 2,5), for multiple S2/MBD53 motherboards.
0V (X7)	Spade lugs, used for the connection and daisy chaining of the 0V power return to the S2/PSU4x connector X5 (PINS 8,11), for multiple S2/MBD53 motherboards.
+12V (X12)	Used for connection to +VW (X16), providing the wetting voltage to voltage free contacts, connected to the S2/SOF42 inputs.
0V (X13)	Used for connection to 0VW (X17), providing the voltage return to devices driven by the S2/SOF42 outputs.
S2/PSU4x	Connector PINS 2 and 5, used to provide 12V power supply, PINS 8 and 11 provide 0V return signal. PIN 26 (ACIN/DC+), used to provide external power to the S2/PSU4x module used. PIN 32 (ACIN/DC-), used to provide external power return to the S2/PSU4x module used.
I/O1 to I/O3	Keyed KLIPPON I/O connectors, used to provide S2/SOF42 with external input/output connections.
ALARM/CONTROL	KLIPPON connector, used to provide various external control and alarm connections with the S2/SOF42 module.

Table 5.11 S2/MBD53 External Connectors

Table 5.12 lists the pin assignments for the ALARM/CONTROL connector.

Pin Number	Signal Name	Function
1	0V	Signal ground
2	!AS	**Alarm Sense** - This function is not used.
3	!EXT	**External alarm input** - This signal is processed by S2/SOF42, which in turn generates Alarm Output, !AO. When connected through the jumper field X11, it directly drives the S2/SOF42 FOF input. This signal is active when connected to Signal Ground.
4	EXTFOF	**External Force Off input** - This signal, when connected through the jumper field X11, directly drives the S2/SOF42 FOF input. This signal is active when connected to Signal Ground.
5	!AO	**Alarm Output** - This signal is generated by the S2/SOF42 when either the signal !EXT is active or there is an internal alarm generated by the S2/SOF42 software. It is connected to Signal Ground by S2/SOF42 when an alarm has occurred.
6	TXP	**Transmit Proceed** - This function is not used.
7	ASD	**Address Service Demand** - This function is not used.
8	0V	Signal ground.

Table 5.12 ALARM/CONTROL Connector Pin Assignment

5.1.6 S2/MBD54 Motherboard

The S2/MBD54 is a stand-alone motherboard which provides a back plane for connecting and powering two S2/SCN4x scanners.

The S2/MBD54 motherboard allows daisy-chaining of up to seven other S2/MBD54s without power supply units.

The S2/MBD54 supports:

- two S2/SCN4x scanners;
- manual selection of the on-line S2/SCN4X module.

A three-position switch on the rear of the S2/MBD54 is used to manually or automatically select the active S2/SCN4x. Table 5.13 describes the three switch positions.

Switch Selection	System Behaviour
A	Manual selection of S2/SCN4X A
C	Manual selection of S2/SCN4X C
Auto	Automatic selection of functional S2/SCN4X based on the operating condition of either device

Table 5.13 S2/MBD54 Changeover Switch Operation

Figure 5.44 shows the use of an S2/MBD54 as a stand-alone RFS address communicating without the use of a modem. It might be powered by an S2/PSU4x power supply mounted in a different S2 motherboard (an additional RFS address at the same field station).

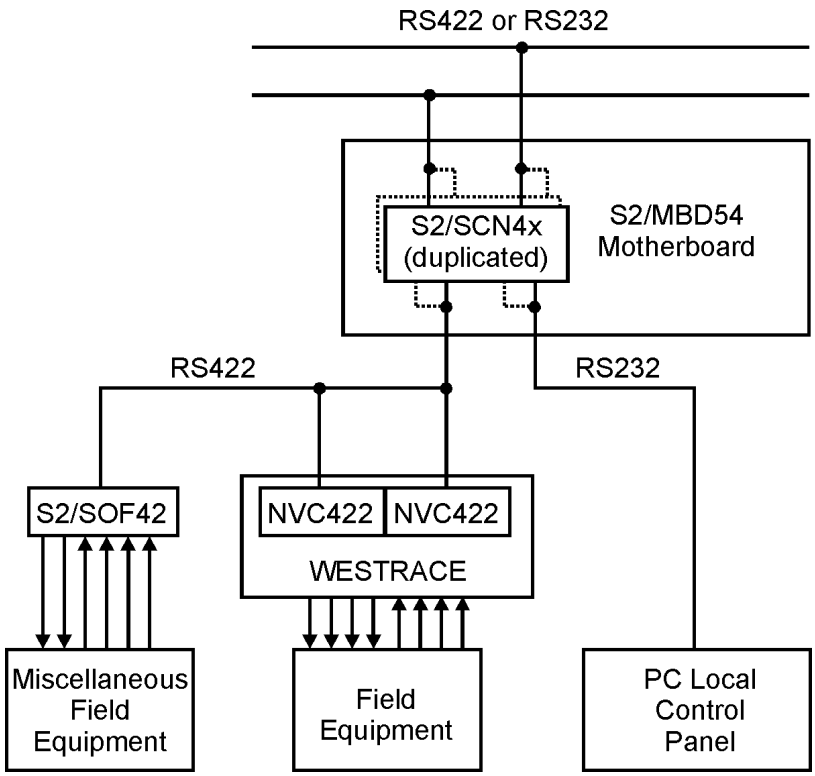


Figure 5.44 Typical Application of S2/MBD54

External Connectors

Connectors on the component side of the S2/MBD54 provide external links between the installation and the S2/MBD54.

The following connectors are used for providing external links between the S2/MBD54 and the particular installation:

Port	Function
PORT 1A	S2/SCN4X A port 1A, communications link
PORT 2A	S2/SCN4X A port 2A, communications link
PORT 4A	S2/SCN4X A port 4A, communications link
PORT 5A	S2/SCN4X A port 5A, communications link
PORT 1C	S2/SCN4X C port 1C, communications link
PORT 2C	S2/SCN4X C port 2C, communications link
PORT 4C	S2/SCN4X C port 4C, communications link
PORT 5C	S2/SCN4X C port 5C, communications link
+12 V (X14)	Spade lugs, used for the connection and daisy chaining of the 12 V power supply for multiple S2/MBD54 motherboards.
0 V (X13)	Spade lugs, used for the connection and daisy chaining of the 0 V power supply return for multiple S2/MBD54 motherboards.

Table 5.14 S2/MBD54 External Connections

5.2 Scanners

5.2.1 S2/SCN4x Scanners

The S2/SCN4x scanners are the controlling modules of the WESTRONIC S2 telemetry system.

The S2/SCN4x scanners controls input and output devices such as:

- S2/DIP4x input modules;
- S2/DOP4x output modules;
- S2/SOF42 single office-field modules;
- WESTRACE NVC modules.

The S2/SCN4x scanner:

- schedules the communication between input and output modules;
- communicates between stations;
- monitors ongoing performance;
- incorporates a watchdog circuit to initiate an orderly restart in the event of a system failure.

The two variations are:

- S2/SCN42—standard;
- S2/SCN41—enhanced with additional processing and serial communication.

5.2.1.1 S2/SCN42

The S2/SCN42 scanner can be used as a control module at office and field (master and slave) locations within an S2 telemetry system.

The standard S2/SCN42 module provides the following functions:

- standard telemetry operation;
- main and standby telemetry channels;
- multidrop communications via appropriate modems;
- ability to handle multiprotocol communications;
- DTE interface for S2/VFC and S2/HFC series modems, and some commercial modems;
- single or dual S2 parallel highway support (main and standby scanner systems);
- onboard diagnostic display;
- serial diagnostics channel;
- interlocking interface via serial channels or parallel highway using S2/DIP and S2/DOP modules.

5.2.1.2 S2/SCN41

In addition to the functions of the S2/SCN42, the SC/SCN41 offers:

- additional serial communication ports.
- additional processing using Interlogic non-vital ladder logic.

Typical applications for the enhanced S2/SCN41 module include the following:

- panel processor (route setting panel interface);
- unit-lever non-vital logic control;
- train describer;
- other applications requiring non-vital processing or serial communications.

5.2.1.3 Communications

Table 5.15 describes the serial communications ports of the S2/SCN4x scanners.

Port	Scanner	Used for
1	S2/SCN41	Ports 1 and 2 can be configured for either RS-232C or RS-422 levels by the use of daughter boards.
2	S2/SCN41	
3	all	Port 3 is dedicated to diagnostics and supports asynchronous protocol using RS232 levels.
4	all	Ports 4 and 5 can be configured for either RS-232C or RS-422 levels by the use of daughter boards.
5	all	

Table 5.15 S2/SCN4x Serial Ports

All serial channels are available on the backplane, with the diagnostic port also available on the front panel. Handshaking is provided on all channels.

The ports are fully compatible with the S2/VFC4x modems and are also generally compatible with commercial modems.

5.2.1.4 Fault Detection

The S2/SCN4x module detects faults that consist of:

- S2/DOP42 module failures;
- S2/DIP42 module failures;
- NVC failures;
- health status of other S2/SCN4x modules used in the system.

Alarms detected by the S2/SCN4x module are reported in two ways:

- The control byte sent back to the VMEbus computer system at the appropriate CTC Centre, will define which S2/SCN4x module is on-line and the health status of the off-line S2/SCN41x module.
- Alarms are displayed locally by the S2/SCN4x on the error display.

5.2.1.5 Power Supply

Item	Module	Value
Supply Voltage	all	12 Vdc (nominal) 9.0 Vdc (minimum) 15.2 Vdc (maximum)
Supply Current	S2/SCN41	350 mA (maximum)
Supply Current	S2/SCN42	280 mA (maximum)

5.2.1.6 Serial Channels (Ports 1, 2, 4 and 5)

Depending on the daughter boards used, each pair of serial channels (channel pair 1 and 2, or channel pair 4 and 5) can be level-converted to RS422 or RS232C.

The following signals are provided for each of the two channels:

TXD output	TXCK output
RXD input	RXCK input
DTR output	DSR input
RTS output	CTS input
Protocol	HDLC modified, asynchronous (other protocols available to order).
Baud Rate	300, 600, 1200, 2400, 4800, 9600, 19200
Indications	Red LEDs indicate state of TX/RX lines.

5.2.1.7 RS-422 Channels

With the RS422 daughter board, the signal types are as follows:

TXD RS422	TXCK RS422
RXD RS422	RXCK RS422
DTR Open-collector	DSR Open-collector
RTS Open-collector	CTS Open-collector

Open-collector lines:

Outputs:	30 V maximum
	300 mA sink maximum
	0.7 V ON maximum
Inputs:	4k7 Ohms Pull up to 5 V,
	< 1.5 V Low,
	> 3.0 V High

5.2.1.8 RS-232C Channels

With the RS232C daughter board, all signals are at RS232C levels.

The input and output voltage characteristics are as follow:

Input	-3 V to -12 V & +3 V to +12 V
Output	-9 V & +9 V (typical) -5 V & +5 V (minimum)

5.2.1.9 Diagnostic Serial Channel Port 3

For serial channel port 3, the following signals are implemented at RS232C levels:

TXD, output

RTS, output

RXD, input

CTS, input

The baud rate is software configurable. The default is 9600 bps.

5.2.1.10 Configuration

Figure 5.45 shows the position of the configuration jumpers for the S2/SCN41.

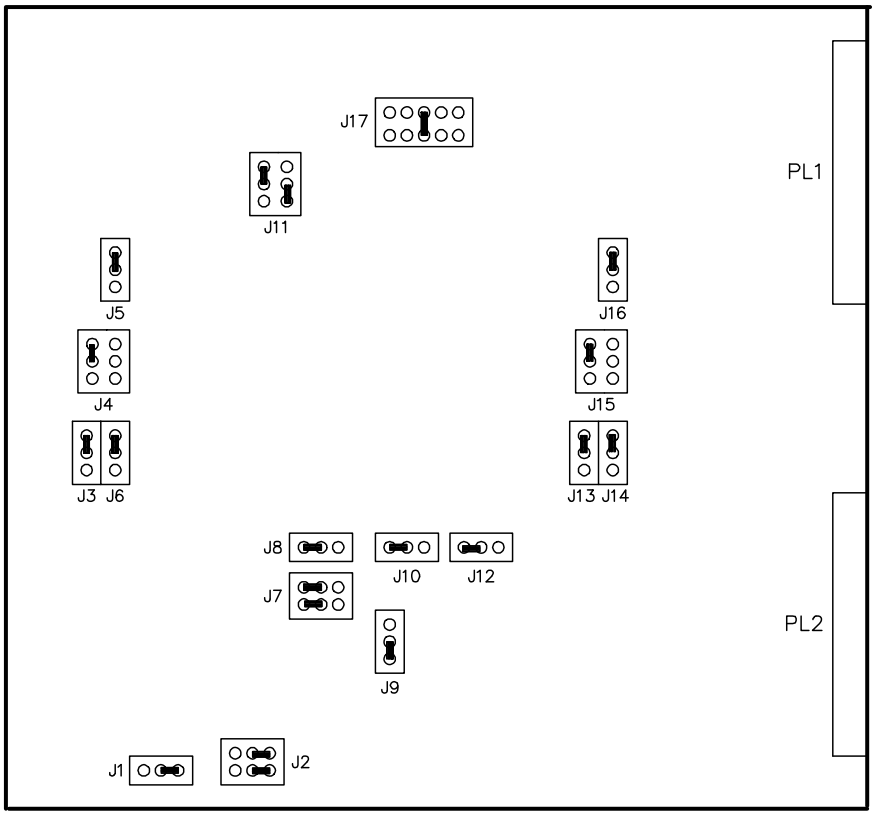


Figure 5.45 S2/SCN41Configuration Jumpers

Figure 5.46 shows the position of the configuration jumpers for the S2/SCN42.

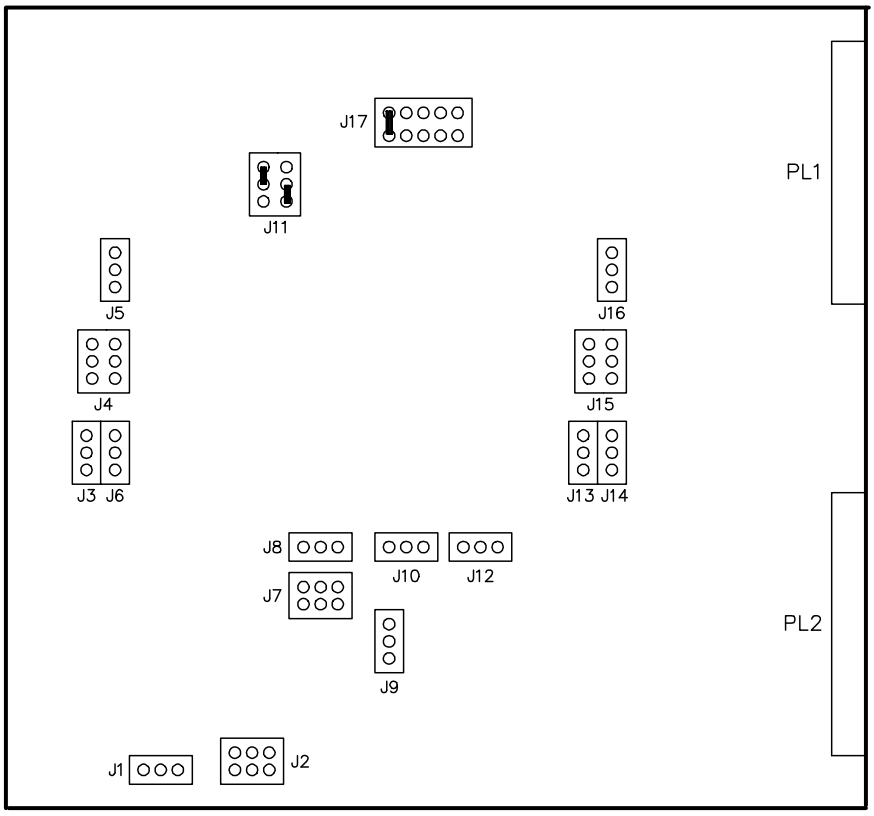


Figure 5.46 S2/SCN42 Configuration Jumpers

In a standard S2/SCN42 scanner, where no integrated multiprotocol processor is used, only J11 and J17 need to be considered.

5.2.1.11 Indications

Normal operation of the S2/SCN4x modules is indicated by the LEDs on the front panel.

Figure 5.49 shows the S2/SCN4x front panel.

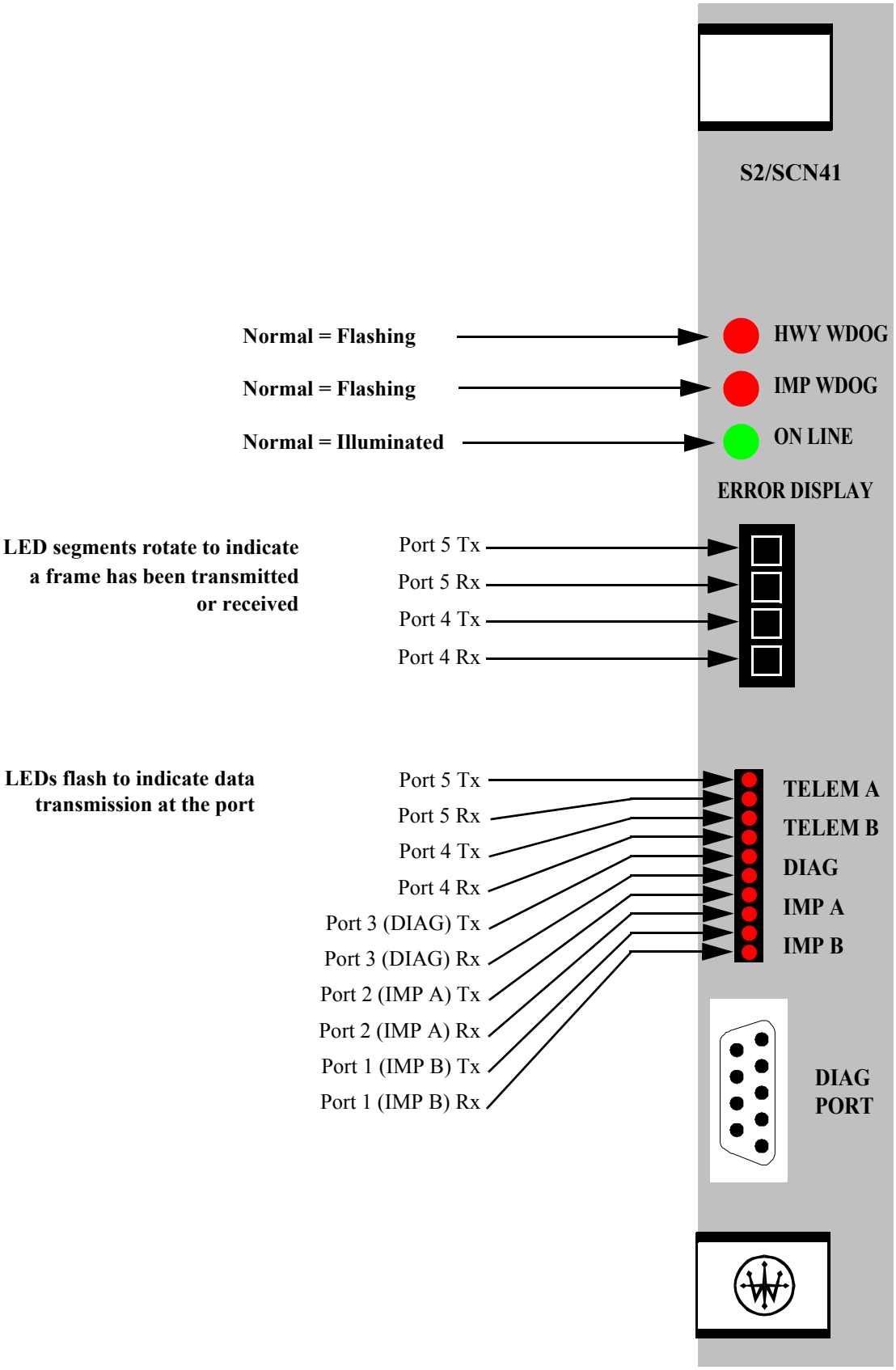


Figure 5.47 S2/SCN41 Front Panel

Table 5.16 lists the meanings of the LED display. The location of the LEDs is shown in Figure 5.47.

LED	Normal State	Comments
HWY WDOG	flashing	Extinguished or illuminated means the processor has stopped.
IMP WDOG	flashing	Extinguished or illuminated means the IMP (integrated multiprotocol processor) has stopped.
ON LINE	illuminated	Extinguished means the S2/SCN41 is off-line
ERROR DISPLAY (1)	rotating Segments rotate when the scanner transmits a frame on port 5.	Reports errors by displaying an error message character
ERROR DISPLAY (2)	rotating Segments rotate when the scanner receives a valid frame on port 5.	Reports errors by displaying an error message character
ERROR DISPLAY (3)	rotating Segments rotate when the scanner transmits a frame on port 4.	Reports errors by displaying an error message character
ERROR DISPLAY (4)	rotating Segments rotate when the scanner receives a valid frame on port 4.	Reports errors by displaying an error message character
TELEM A (Tx)	LED flashes when Port 5 transmits.	Extinguished or illuminated means no data is being transmitted (or received).
TELE A (Rx)	LED flashes when Port 5 receives.	
TELE B (Tx)	LED flashes when Port 4 transmits.	
TELE B (Rx)	LED flashes when Port 4 receives.	
DIAG (Tx)	LED flashes when Port 3 transmits.	
DIAG (Rx)	LED flashes when Port 3 receives.	
IMP A (Tx)	LED flashes when Port 2 transmits.	
IMP A (Rx)	LED flashes when Port 2 receives.	
IMP B (Tx)	LED flashes when Port 1 transmits.	
IMP B (Rx)	LED flashes when Port 1 receives.	

Table 5.16 S2/SCN41 LED Display Status

5.3 Input-Output

5.3.1 S2/DIP42 Digital Input

5.3.1.1 Description

The S2/DIP42 is a module which is part of the WESTRONIC S2 product range. It is used in conjunction with a S2/SCN4x and a motherboard. The digital input module enables a common negative voltage free closed contact to be detected.

5.3.1.2 Particulars

The S2/DIP42 is comprised of a single printed circuit board.

The S2/DIP42 has 32 inputs. Each input can be used independently of all other inputs.

The S2/DIP42 is a dual WESTRONIC highway module for use in a duplicated S2/SCN4x system. The module may be used in single highway systems with no adverse effects.

Connection to the inputs is made according to the diagram below.

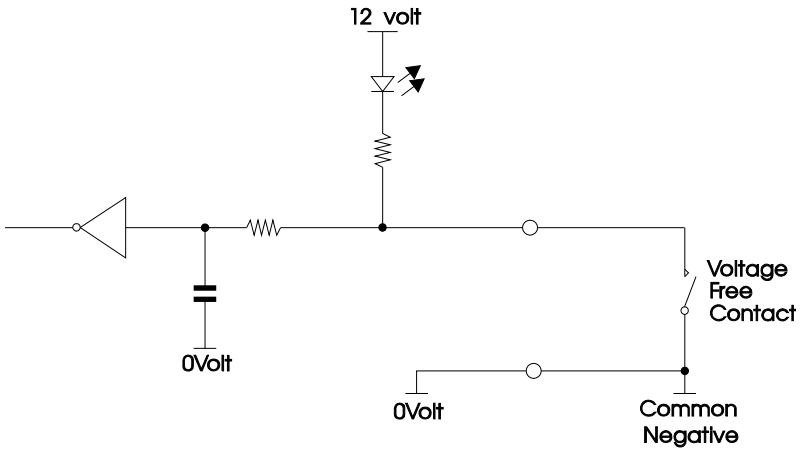


Figure 5.48 : Connection Diagram

5.3.1.3 Function

The S2/DIP42 detects a common negative voltage free closed contact and this is processed via a S2/SCN4x as a logical 1, an open contact is processed as a logical 0.

5.3.1.4 Configuration

None.

5.3.1.5 Indications

Each of the 32 inputs has an LED to indicate the status of the input. The LEDs are labelled from 1 to 32. When the LED is illuminated the input has detected a closed contact and when the LED is extinguished the has detected an open contact.

There are two large LEDs which indicate WESTRONIC highway activity. The top LED is for the 'A' highway and the lower LED is for the 'C' highway. If the module is used in a single highway system, the LED associated with the unused highway will be steady on.

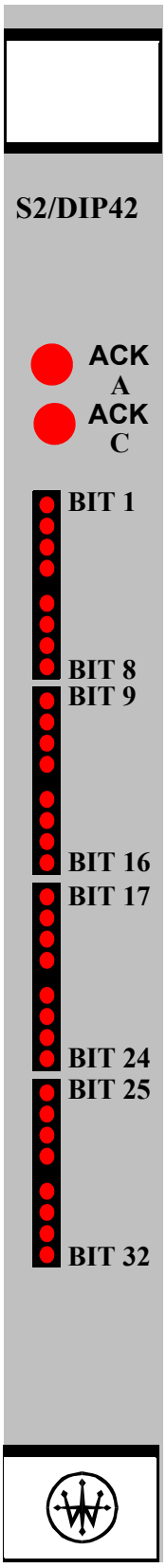


Figure 5.49 S2/DIP42 Front Panel

5.3.2 S2/DIP43 Digital Input

The S2/DIP43 is a module which is part of the WESTRONIC S2 product range. It is used in conjunction with a S2/SCN4x and a motherboard. The digital input module enables a 24 volt input to be detected.

5.3.2.1 Particulars

The S2/DIP43 is comprised of a single printed circuit board.

The S2/DIP43 has 32 inputs. Each input can be used independently of all other inputs.

The S2/DIP43 is a dual WESTRONIC highway module for use in a duplicated S2/SCN4x system. The module may be used in single highway systems with no adverse effects.

Connection to the inputs is made according to the diagram below.

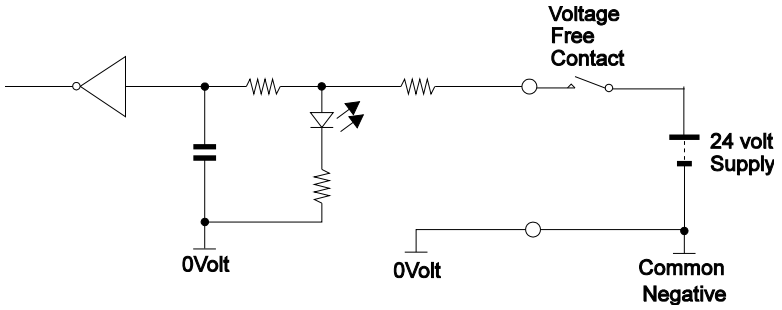


Figure 5.50 : Connection Diagram

5.3.2.2 Function

The S2/DIP43 detects a common negative 24 volt input and this is processed via a S2/SCN4x as a logical 1, a 0 volt input is processed as a logical 0.

5.3.2.3 Configuration

None.

5.3.2.4 Indications

Each of the 32 inputs has an LED to indicate the status of the voltage input. The LEDs are labelled from 1 to 32. When the LED is illuminated the input has detected a 24 volt input and when the LED is extinguished the has detected 0 volt input.

There are two large LEDs which indicate WESTRONIC highway activity. The top LED is for the 'A' highway and the lower LED is for the 'C' highway. If the module is used in a single highway system, the LED associated with the unused highway will be steady on.

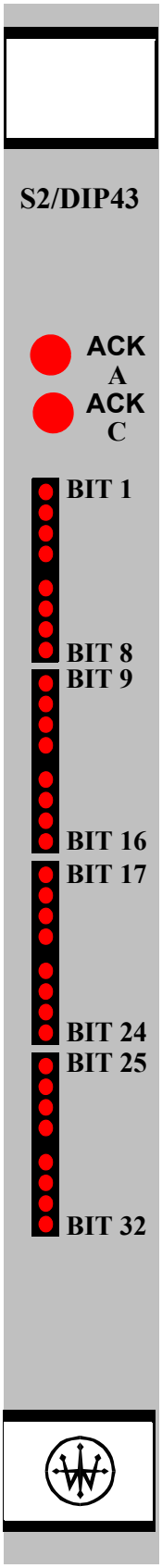


Figure 5.51 S2/DIP43 Front Panel

5.3.3 S2/DOP42 Digital Output

The S2/DOP42 is a module which is part of the WESTRONIC S2 product range. It is used in conjunction with a S2/SCN4x and a motherboard. The digital output module enables an output device to be driven via a common negative open collector output.

5.3.3.1 Particulars

The S2/DOP42 is comprised of a single printed circuit board.

The S2/DOP42 has 32 outputs. Each output can be used independently of all other outputs. The output supply may rated at up to 50 volt dc unsmoothed.

The S2/DOP42 is a dual WESTRONIC highway module for use in a duplicated S2/SCN4x system. The module may be used in single highway systems with no adverse effects.

Connection to the outputs is made according to the diagram below.

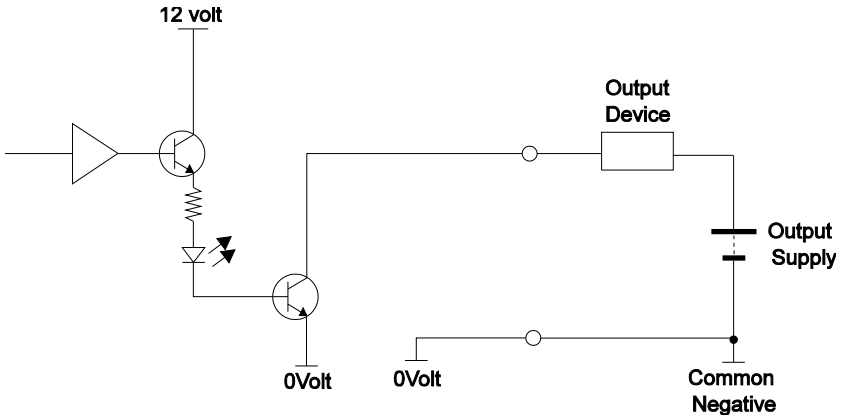


Figure 5.52 : Connection Diagram

5.3.3.2 Function

The S2/DOP42 drives a common negative device. A logical 1 processed via a S2/SCN4x results in the outputs being driven on and the output device is energised. A logical 0 results in the output being driven off and the output device being de-energised.

5.3.3.3 Configuration

None.

5.3.3.4 Indications

Each of the 32 outputs has an LED to indicate the status of the output. The LEDs are labelled from 1 to 32. When the LED is illuminated the output is driven on and when the LED is extinguished the output is driven off.

There are two large LEDs which indicate WESTRONIC highway activity. The top LED is for the 'A' highway and the lower LED is for the 'C' highway. If the module is used in a single highway system, the LED associated with the unused highway will be steady on.

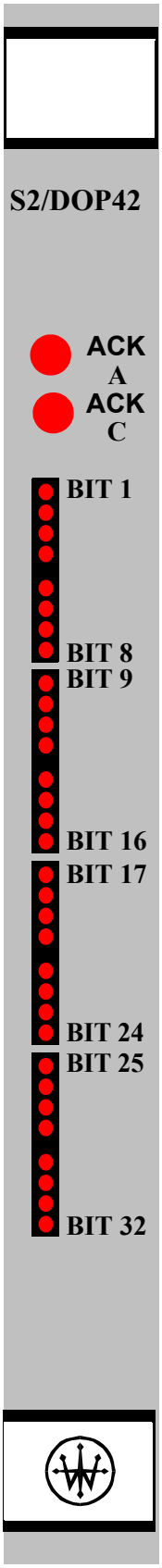


Figure 5.53 S2/DOP42 Front Panel

5.3.4 S2/DOP43 Digital Output

The S2/DOP43 is a module which is part of the WESTRONIC S2 product range. It is used in conjunction with a S2/SCN4X and a motherboard. The digital output module enables an output device to be driven via a common positive open collector output.

5.3.4.1 Particulars

The S2/DOP43 is comprised of a single printed circuit board.

The S2/DOP43 has 32 outputs. Each output can be used independently of all other outputs. The output supply may rated at up to 24 volt dc unsmoothed.

The S2/DOP43 is a dual WESTRONIC highway module for use in a duplicated S2/SCN4X system. The module may be used in single highway systems with no adverse effects.

Connection to the outputs is made according to the diagram below.

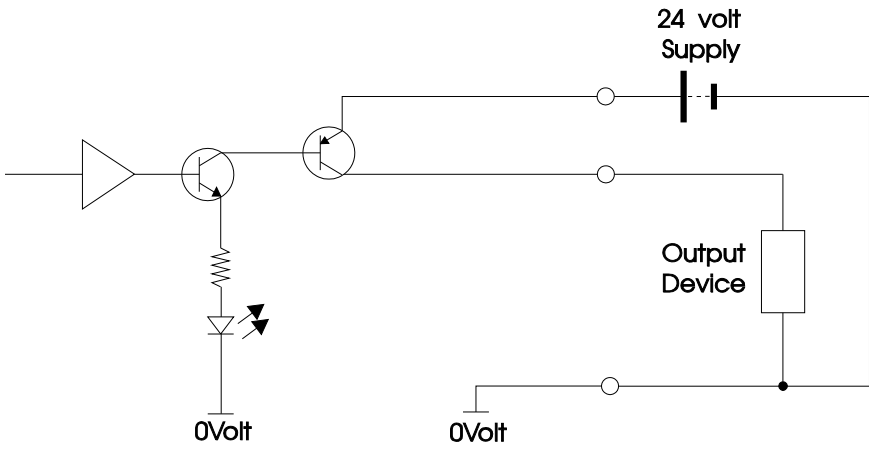


Figure H.1 S2/DOP43 Connection Diagram

5.3.4.2 Function

The S2/DOP43 drives a common negative device. A logical 1 processed via a S2/SCN4X results in the outputs being driven on and the output device is energised. A logical 0 results in the output being driven off and the output device being de-energised.

5.3.4.3 Configuration

None.

5.3.4.4 Indications

Each of the 32 outputs has an LED to indicate the status of the output. The LEDs are labelled from 1 to 32. When the LED is illuminated the output is driven on and when the LED is extinguished the output is driven off.

There are two large LEDs which indicate WESTRONIC highway activity. The top LED is for the 'A' highway and the lower LED is for the 'C' highway. If the module is used in a single highway system, the LED associated with the unused highway will be steady on.

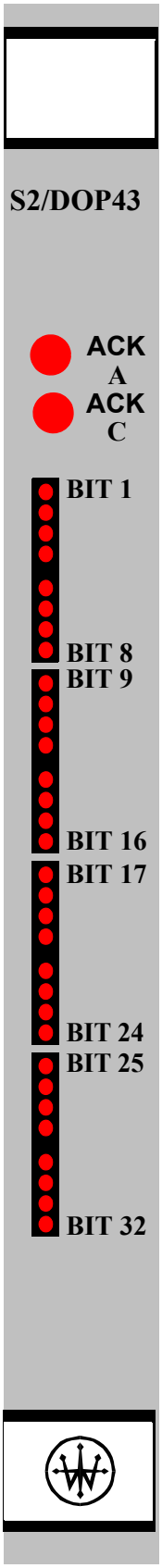


Figure 5.54 S2/DOP43 Front Panel

5.3.5 S2/DOP44

50 V: to be added

5.3.6 S2/SOF42 Single Office Field

The S2/SOF42 is a single card telemetry module designed to allow remote control and indication of digital 32 inputs and 16 outputs. The module is usually used in conjunction with an S2 modem for connection to a communications system.

Data to and from the module is transferred at RS422 levels. The associated control lines may be all RS422 or open collector levels.

5.3.6.1 Particulars

The S2/SOF42 is comprised of a single PCB, normally connected to a housing motherboard. A number of configuration options are made by shunting the required terminals, via the motherboard.

The S2/SOF42 is powered from an external unregulated 12 Vdc power supply and provides a two serial interfaces, one for the RS232 and one for the RS422 level communications.

The S2/SOF42 has 48 input/outputs. These input/outputs can be configured in groups of 16 inputs and outputs. Each input can be used independently of all other inputs. Each output can be used independently of all other outputs. Both inputs and outputs are common negative arrangements.

The LED is illuminated when the output is active and the output device, shown below, is powered. Connection to the outputs is made according to the diagram below.

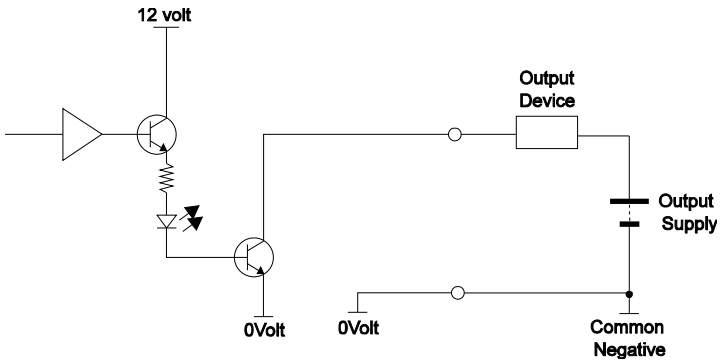


Figure 5.55 Connection Diagram—Outputs

The LED is illuminated when the voltage free contact, shown below, is closed. Connection to the inputs is made according to the diagram below.

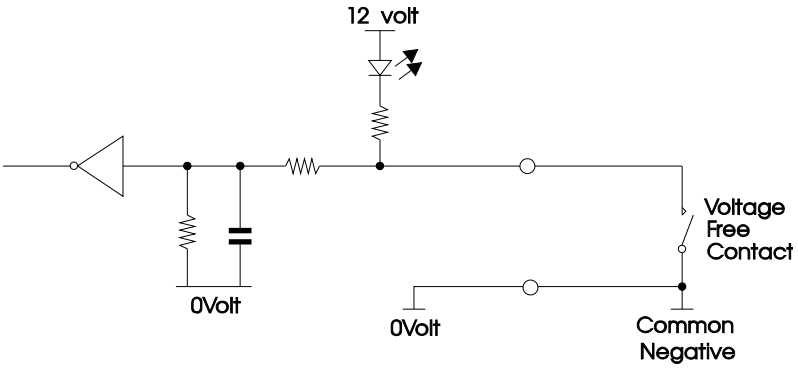


Figure 5.56 Connection Diagram—Inputs

5.3.6.2 Function

The module acts as a intelligent input/output module for S2 telemetry equipment.

5.3.6.3 Configuration

The module is usually configured by means of a number of configuration straps fitted to a motherboard. The following tables show the strapping details to enable various configuration options when a motherboard is not used.

The strapping details in the tables are denoted as follows:

1 = This pin has no strap fitted

0 = This pin is strapped to 0 volt

Note: ***The method of strapping particular modes is dependent on the motherboard type to which the S2/SOF42 is attached. Strapping details are directly strapped on the module's rear connectors.***

5.3.6.4 Serial I/O Channel A Baud Rate

Baud Rate	1a27	1c28	1a28
1200 (Default)	1	1	1
2400	1	1	0
4800	1	0	1
600	0	1	1
300	0	1	0

5.3.6.5 Serial I/O Channel A Data Word Length

Data Word Length	2c1	2a1
32 Bits (Default)	1	1
48 Bits	0	1
64 Bits	1	0
128 Bits	0	0

5.3.6.6 Serial I/O Channel A SDLC Control Byte Present

Control Byte	1c22
Not Present (Default)	1
Present	0

5.3.6.7 Serial I/O Channel A Address Byte System Bit

System Bit	1c26
0 (Default)	1
1	0

5.3.6.8 Serial I/O Channel A Control Handshake Levels

The handshake lines RTS, CTS and DCD are available at either RS422 or S2 levels.

Handshake Level	1a14
RS422 (Default)	1
S2	0

5.3.6.9 Serial I/O Channel A Transmit Enable

Transmit Enable	1a25
Disabled (Default)	1
Enabled	0

5.3.6.10 Serial I/O Channel A Internal Clocking

The clocking of serial data may be either internal or external the table below shows the configuration for internal clocking.

Internal Clocking	**Link**
Transmit Clock	1c17 - 1c20
Received Clock	1a17 - 1a20

5.3.6.11 Addressing Mode

The addressing mode can be configured in two different ways. Broadcast is a feature used for fast response times in systems where change-of-state (COS) indications are required quickly. The broadcast option precludes the use of address 63. Clockwork is used when fast response time are not required.

Address Mode	**1c27**
Broadcast (Default)	1
Clockwork	0

5.3.6.12 Module Outputs

The outputs on a module may be configured as either pulsed or latched. The type of output selected is valid for all the outputs on a particular module. Individual outputs cannot be configured.

Latched outputs are generated from the received data word. Groups of 16 received data bits of the data word are output to the hybrids for each available output hybrid group. Other received data bits are ignored— these outputs remain active from one scan to the next. For example, in a configuration with data word length of 64 bits, group 1 output, groups 2 & 3 input— only the 1st 16 bits received will be output.

Pulsed outputs are generated by outputting received outputs as per latched above, however these are only active for one (1) second. Following this, the next groups of 16 received data bits are output. The second groups of 16 data bits remain active until the next scan.

Module Outputs	**1a26**
Pulsed (Default)	1
Latched	0

5.3.6.13 Parallel Input and Output

Parallel I/O takes the form of digital inputs and digital outputs. Selection of either input or output is made by selecting appropriate input or output hybrid devices. There are up to six (6) hybrid devices per card, these are grouped into 3 groups of pairs of hybrids. Each pair of hybrids must be of the same type (input or output).

There is a correlation between the allowed data word lengths, the type of outputs (pulsed/latched) and the parallel I/O configuration. This correlation is described in the following sections.

Note: ***Configurations using data word lengths other than those specified will result in configuration error and card reset.***

5.3.6.14 Latched Parallel Outputs

Group 1	Group 2	Group 3	Allowable Data Word Lengths
Output	Input	Input	32, 48, 64, 128 bits
Input	Input	Input	48, 64, 128 bits
Output	Output	Input	32, 48, 64, 128 bits
Output	Output	Output	48, 64, 128 bits

5.3.6.15 Pulsed Parallel Outputs

Group 1	Group 2	Group 3	Allowable Data Word Lengths
Output	Input	Input	32, 48, 64, 128 bits
Input	Input	Input	48, 64, 128 bits
Output	Output	Input	64, 128 bits
Output	Output	Output	128 bits

5.3.6.16 Module Addressing

There are six straps used for card addressing which allows up to 64 addresses. The card address is selected by strapping these as a binary code as follows:

Address Decimal	Address Octal	Address Hex	2a2	2c2	2a3	2c3	2a4	2c4
63 (Default)	77 (Default)	3F (Default)	1	1	1	1	1	1
62	76	3E	1	1	1	1	1	0
61	75	3D	1	1	1	1	0	1
60	74	3C	1	1	1	1	0	0
/\/\/\/\	/\/\/\/\	/\/\/\/\	/\/\/\	/\/\/\	/\/\/\	/\/\/\	/\/\/\	/\/\/\
04	04	04	0	0	0	1	0	0
03	03	03	0	0	0	0	1	1
02	02	02	0	0	0	0	1	0
01	01	01	0	0	0	0	0	1
00	00	00	0	0	0	0	0	0

5.3.6.17 Module Mode

The Field mode is used for any Master/Slave field application where the card is operating a slave.

The Office mode is used for any point to point Master/Slave application where the card is operating as a master. The master and slave cards must have the same address in this case. The interscan delay is fixed at 12 ms.

The Test Link mode is only used for a card inserted in a Test Link.

Address Mode	1c32	1a32
Field (Default)	1	1
Test Link	1	0
Office	0	1
Unused	0	0

5.3.6.18 Indications

The module has six visible LEDs which indicate transmit and receive as well as correct operation of the module.

During normal operation, the S2/SOF42 module will show the following LED indications:

- TxDA (red)Transmit Data Channel A
- RxDA (red)Receive Data Channel A
- TxDB (red)Transmit Data Channel B
- RxDB (red)Receive Data Channel B
- WADOG (red)Watchdog and Alarm
- OnLine (green)Outputs active

5.3.6.19 Operation

Transmit Channel A

When working correctly, the S2/SOF42 will flash the TxDA LED when transmitting an SDLC message to a host. The module will only transmit a message when the module is enabled to do so, the control hand shaking is complete and the module has received a message. If no messages are transmitted for 30 seconds the RxDA LED will be illuminated steady. Prior to transmitting the input circuits are read and the state of the circuits is coded into the transmit message.

Receive Channel A

When receiving, the S2/SOF42 will flash the RxDA LED, indicating that the SDLC message received from a host is a valid message and the address information contained in the message matches the address strapped on the module. If no valid and correctly addressed messages are received for 30 seconds the RxDA LED will be illuminated steady. When a valid message is received the data contained in the message is output to the output circuits.

Transmit Channel B

This function is not used in the generic version of the module.

Receive Channel B

This function is not used in the generic version of the module.

WADOG

When working correctly, the S2/SOF42 will flash the WADOG LED at a rate of 1 Hz. If an alarm is detected by the S2/SOF42 then the WADOG LED will be steady.

On-line

When working correctly, the S2/SOF42 will illuminate the On-line LED steady to indicate that the outputs can be activated if required.

5.4 Power Supplies

5.4.1 S2/PSU4x Power Supply Module

The S2/PSU4x is a module which is part of the WESTRONIC S2 product range. It used for converting a nominal input voltage to a 12 Vdc output suitable for use by WESTRONIC S2 modules.

A number of variants are available:

Variant	Nominal Input Voltage	Output
S2/PSU41	24 Vdc	12 Vdc
S2/PSU42	48 Vdc	12 Vdc
S2/PSU43	110 Vac	12 Vdc
S2/PSU44	240 Vac	12 Vdc
S2/PSU45	72 Vdc	12 Vdc

All of these variants are able to deliver 100 W of power at 12 Vdc and have internally fuse protected inputs. Modules are protected against input voltage polarity reversal and have diode isolated outputs for duplicated redundant applications.

All modules will automatically shutdown should load current become excessive.

5.4.1.1 Particulars

The S2/PSU4x is comprised of a single PCB and is normally mounted in a Eurocard housing.

5.4.1.2 Function

The S2/PSU4x is a switch mode power supply, converting voltage from an available power source to a regulated 12 Vdc supply suitable for use by WESTRONIC S2 Telemetry Modules.

5.4.1.3 Configuration

None

5.4.1.4 Indications

The S2/PSU4x module LEDs on the front panel indicate the presence of output voltages. Figure 5.49 shows the front panel.

A switch is used to turn the power supply on and off.

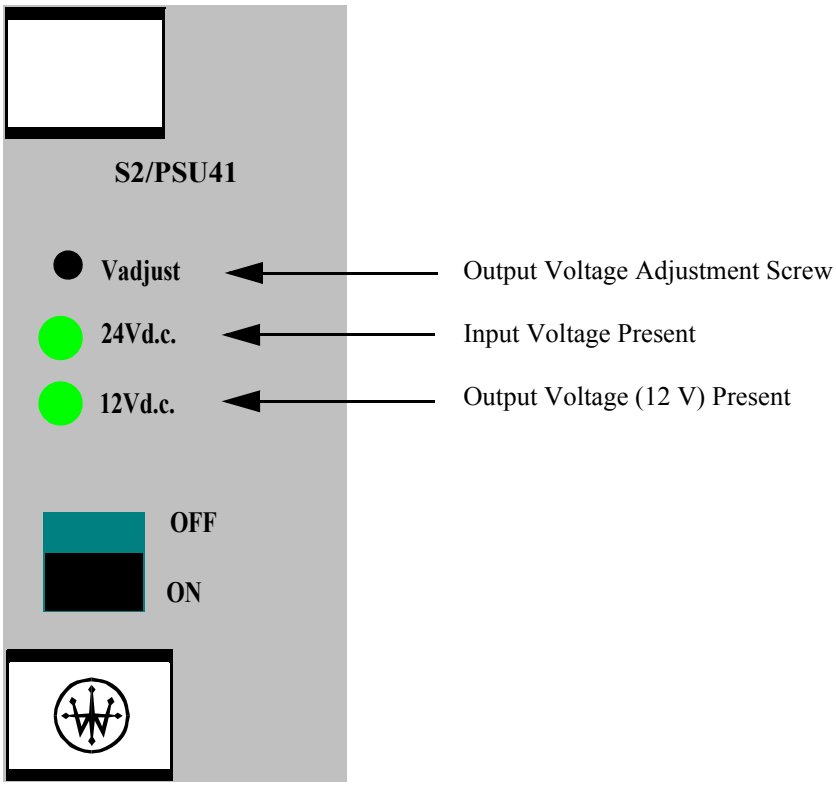


Figure H.2 S2/PSU41 Front Panel

5.4.1.5 Operation

When the input supply voltage is detected at the S2/PSU4x inputs, the "Input Voltage Present" LED will illuminate.

When the power switch is moved to the "ON" position, the "Output Voltage Present" will illuminate, (provided that the power requirements of the load do not exceed the 100 W rating of the supply).

Should the output current exceed the limit threshold, the module will isolate its output and shutdown.

The module will restart normally, (if the overload condition is removed). If the power switch is turned "OFF" and then "ON" again.

5.5 Modems

5.5.1 S2/VFC42 Voice Frequency Modem

The S2/VFC42 is a DPSK type modem designed to allow S2 and associated telemetry systems to communicate over a voice frequency (VF) channel, at up to 1200 bps, in a 2 wire operation. The modem operates in full duplex mode.

Data to and from the modem is transferred in RS422 levels. The associated control lines are a combination of RS422 and open collector levels.

The module can be used, with signal level conversion, to interconnect WESTRACE Vital Telemetry Modules (for example, VTC to VTC). The module can also be used to connect non-vital telemetry, either S2, or WESTRACE to a non-vital control system.

5.5.1.1 Particulars

The S2/VFC42 is comprised of a single PCB., normally connected to a housing motherboard. A number of configuration options are made by shunting the required terminals, via the motherboard.

The S2/VFC42 is powered from an external regulated 12V dc power supply and provides a single serial interface for the RS422 level communications.

5.5.1.2 Function

The module acts as a modem for both S2 and WESTRACE telemetry equipment.

5.5.1.3 Configuration

The S2/VFC42 is configurable for the following parameters.

Note: ***The method of strapping particular modes is dependent on the motherboard type to which the S2/VFC42 is attached. Strapping details are directly strapped on the module's rear connectors.***

Receive Impedance Setting	Input Pin	Link
LCU (High Impedance)	2c3, 2c4	2c3-2c5
600 ohm Line	2c3, 2c4	2c3-2c5
		2c4-2c6
150 ohm Radio Link	2c5, 2c6	2c2-2c3
		2c1-2c4

Transmit Impedance Setting	Output Pins
600 ohm Line	2a5-2a6
LCU (High Impedance)	2a3-2a4

Open Collector/RS422 Interface	Link
RS422	1c25-1c27
Open Collector	2c15-2c14

Answer/Originate Frequency	Link
Answer	1c14-1c16
Originate	No Link

Transmission Enable Selection	
MPE	Low
TXE	High
RTS	Low

5.5.1.4 Indications

The module has four (4) visible LEDs which indicate transmit and receive activity for the modem.

During normal operation, the S2/VFC42 modems will show the following LED indications:

- RTS (red)Request To Send
- DCD (red)Carrier Detect
- TxD (yellow)Transmit Data
- RxD (green)Receive Data

5.5.1.5 Operation

Transmit

When working correctly, the S2/VFC42 will illuminate the RTS LED when transmitting data to the line and the TXD LED will flash as data is transmitted .

Receive

When receiving, the S2/VFC42 will illuminate the DCD LED, indicating that the carrier signal is detected and the RXD LED will flash as data is received.

5.5.2 S2/VFC45 Voice Frequency Modem

The S2/VFC45 is a Frequency Shift Key (FSK) modem designed to allow S2 and associated telemetry systems to communicate over a voice frequency (VF) channel, at up to 1200 bps, in a 4 wire operation. The modem operates in full duplex mode.

Data to and from the modem is transferred in RS422, or RS232 levels. The associated control lines may be all RS232, RS422, or open collector levels.

The module can be used to interconnect WESTRACE Vital Telemetry Modules (for example, VTC to VTC). The module can also be used to connect non-vital telemetry, either S2, or WESTRACE to a non-vital control system.

5.5.2.1 Particulars

The S2/VFC45 comprises a single PCB that is normally connected to a housing motherboard. A number of configuration options are made by shunting the required terminals, via the motherboard.

The S2/VFC45 is powered from an external regulated 12V dc power supply and provides a two serial interfaces, one for the RS232 and one for the RS422 level communications.

5.5.2.2 Function

The module acts as a modem for both S2 and WESTRACE telemetry equipment.

5.5.2.3 Configuration

The S2/VFC45 is configurable for the following parameters.

Note: ***The method of strapping particular modes is dependent on the motherboard type to which the S2/VFC45 is attached. Strapping details are directly strapped on the modules rear connectors.***

An external attenuator is required on the motherboard for the S2/VFC45 to pass input/output signals to the modem line interface and enable control of the transmit and receive signal level to the line.

5.5.2.4 Mode Selection

a) RTS-CTS handshaking, no strap

b) Continuous transmission, strap 1c15 to 1a15

Receive Impedance Setting	Input Pin	Link
LCU (High Impedance)	2c3, 2c4	non
600 ohm Line	2c3, 2c4	2c3-2c5
		2c4-2c6
150 ohm Radio Link	2c5, 2c6	2c2-2c3
		2c1-2c4

When radio link option is used, input signal is attenuated by 10 dB to move the noise level down.

Transmit Impedance Setting	Output Pins
600 ohm Line	2a5-2a6
LCU (High Impedance)	2a3-2a4

LCU output when not loaded with low impedance (12 Ohm) can produce very high levels which can damage other types of equipment if connected to these pins.

RTS-CTS Delay Configuration	Link
15ms	non
10ms	1c11-1c12
5ms	1c11-1c13; 1c11-1c13
Continuous (Constant Carrier)	1c15-1a15

Radio Link/Normal Operation	Soldered In
Normal	J10
Radio link	J11

Additionally, relay S1 has to be installed for radio link operation.

Open Collector/RS422/RS232 Interface	Link
RS422	non
RS232	2a9-2a11
Open Collector	2c15-2c14

TXC & RXC 1200 bps or 600 bps Clock Selection	**Link**
1200 bps	1c25-1c27
600 bps	1c26-1c27

Transmission Enable Selection	
MPE	Low
TXE	High
RTS	Low

5.5.2.5 Indications

The module has 4 LEDs which indicate transmit and receive activity for the modem.

During normal operation, the S2/VFC45 modems will show the following LED indications:

- RTS (red)Request To Send
- DCD (red)Carrier Detect
- TxD (yellow)Transmit Data
- RxD (green)Receive Data

Figure 5.49 shows the front panel of the S2/VFC45 modem.

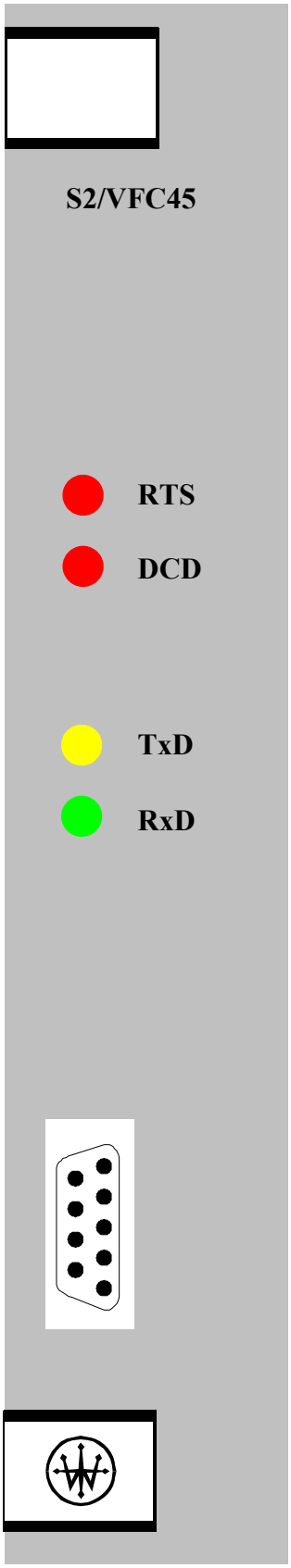


Figure 5.57 S2/VFC45 Front Panel

5.5.2.6 Operation

Transmit

When working correctly, the S2/VFC45 will illuminate the RTS LED when transmitting data to the line and the TXD LED will flash as data is transmitted .

Receive

When receiving, the S2/VFC45 will illuminate the DCD LED, indicating that the carrier signal is detected and the RXD LED will flash as data is received.

5.5.3 S2/VFC46 V32 Regenerative Modem

The S2/VFC46 is V32 compatible modem primarily designed to allow S2 and associated telemetry systems to communicate over a voice frequency (VF) channel, at up to 2400 bps, in a 2 wire operation. The modem operates in full duplex mode.

Data to and from the modem is transferred in RS422, or RS232 levels. The associated control lines may be all RS232, RS422, or open collector levels.

The module can be used in the following modes of operation:

- regenerative S2 mode;
- point to point S2 mode;
- point to point asynchronous mode;
- point to point synchronous mode;
- auto dial S2 mode;
- auto answer S2 mode.

5.5.3.1 Particulars

The S2/VFC46 comprises a single PCB normally connected to a housing motherboard. A number of configuration options are made by using a PC based software package connected to the front RS232 serial port on the modem.

The modem has two line connections, known as Line A and Line B, for connection to other modems in the control system. The module has one serial digital controller connection which is used to connect to WESTRACE, S2 or other serial devices (The S2 interface is a combination of RS422, open collector outputs and buffered inputs).

The S2/VFC46 is powered from an external regulated 12V dc power supply and provides a two serial interfaces, one for the RS232 and one for the RS422 level communications.

5.5.3.2 Function

The functions of the module depend on the mode of operation selected. The functions are detailed below in the configuration section that follows.

5.5.3.3 Configuration

The S2/VFC46 is configurable for the following parameters. Configuration can only take place when the Configuration Link is fitted and the module is powered. Normal operation will only occur with the Configuration Link removed.

Note: ***The method of configuring particular modes is not dependent on the motherboard type to which the S2/VFC46 is attached. Configuration is made using the GMC PC software package and the VFC46.TXT script file.***

The GMC configuration screen is shown in Figure 5.58.

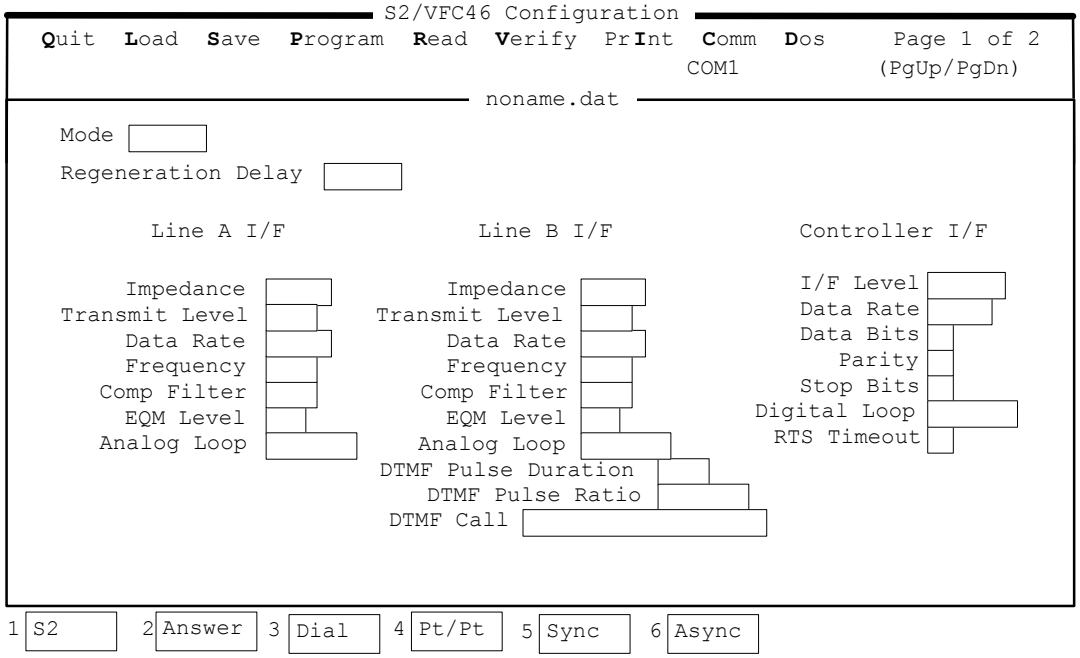


Figure 5.58 GMC Configuration Screen

5.5.3.4 Mode Configuration

Option	Function	Allowable Modes
S2	S2 Regenerative	-
Answer	S2 Auto Answer	-
Dial	S2 Auto Dial	-
Pt/Pt	S2 Point to Point	-
Sync	Synchronous Point to Point	-
Async	Asynchronous Point To Point	-

5.5.3.5 Regeneration Delay

Option	Function	Allowable Modes
4 Char	4 character delay. Both line data rates and the controller data rate must be the same.	S2
Frame	Full frame delay. Line data rates and controller data rates may be different.	S2
None	Used in all modes except S2	All except S2

5.5.3.6 Line A Impedance

Option	Function	Allowable Modes
150	Lease Line 150 ohm impedance	S2,Pt/Pt,Sync,Asyns
600	Lease Line 600 ohm impedance	S2,Pt/Pt,Sync,Asyns
1200	Lease Line 1200 ohm impedance	S2,Pt/Pt,Sync,Asyns

5.5.3.7 Line A Transmit Level

Option	Function	Allowable Modes
0 dBm	Transmit Level is 0 dBm	All
-1 dBm	Transmit Level is -1 dBm	All
-2 dBm	Transmit Level is -2 dBm	All
.	.	.
-14 dBm	Transmit Level is -14 dBm	All
-15 dBm	Transmit Level is -15 dBm	All

5.5.3.8 Line A Data Rate

Option	Function	Allowable Modes
300	Data rate 300 baud	All
600	Data rate 600 baud	All
1200	Data rate 1200 baud	All
2400	Data rate 2400 baud	All
4800	Data rate 4800 baud	All
9600	Data rate 9600 baud	All

5.5.3.9 Line A Frequency

Option	Function	Allowable Modes
Org	Line A is Originate Frequency	Pt/Pt, Sync, Asyns
Ans	Line A is Answer Frequency	Pt/Pt, Sync, Asyns

5.5.3.10 Line A Comp Filter

Option	Function	Allowable Modes
0	Line A Filter Level 0	All
1	Line A Filter Level 1	All
2	Line A Filter Level 2	All
3	Line A Filter Level 3	All
4	Line A Filter Level 4	All
5	Line A Filter Level 5	All

5.5.3.11 Line A EQM Level

Option	Function	Allowable Modes
0	Line A EQM Level 0	All
5	Line A EQM Level 5	All
10	Line A EQM Level 10	All
15	Line A EQM Level 15	All
20	Line A EQM Level 20	All
25	Line A EQM Level 25	All
30	Line A EQM Level 30	All
35	Line A EQM Level 35	All
40	Line A EQM Level 40	All
45	Line A EQM Level 45	All
50	Line A EQM Level 50	All
55	Line A EQM Level 55	All
60	Line A EQM Level 60	All
65	Line A EQM Level 65	All

5.5.3.12 Line A Analog Loopback

Option	Function	Allowable Modes
Loop	Loopback Line A Analog Connection	All
NoLoop	No Loopback Line A Analog Connection	All

5.5.3.13 Line B Impedance

Option	Function	Allowable Modes
150	Lease Line 150 ohm impedance	S2, Pt/Pt, Sync, Asyns
600	Lease Line 600 ohm impedance	S2, Pt/Pt, Sync, Asyns
1200	Lease Line 1200 ohm impedance	S2, Pt/Pt, Sync, Asyns
PSTN	PSTN Compatible impedance	Answer, Dial

5.5.3.14 Line B Transmit Level

Option	Function	Allowable Modes
0 dBm	Transmit Level is 0 dBm	All
-1 dBm	Transmit Level is -1 dBm	All
-2 dBm	Transmit Level is -2 dBm	All
.	.	.
-14 dBm	Transmit Level is -14 dBm	All
-15 dBm	Transmit Level is -15 dBm	All

5.5.3.15 Line B Data Rate

Option	Function	Allowable Modes
300	Data rate 300 baud	All
600	Data rate 600 baud	All
1200	Data rate 1200 baud	All
2400	Data rate 2400 baud	All
4800	Data rate 4800 baud	All
9600	Data rate 9600 baud	All

5.5.3.16 Line B Frequency

Option	Function	Allowable Modes
Org	Line B is Originate Frequency	Pt/Pt, Sync, Asyns
Ans	Line B is Answer Frequency	Pt/Pt, Sync, Asyns

5.5.3.17 Line B Comp Filter

Option	Function	Allowable Modes
0	Line B Filter Level 0	All
1	Line B Filter Level 1	All
2	Line B Filter Level 2	All
3	Line B Filter Level 3	All
4	Line B Filter Level 4	All
5	Line B Filter Level 5	All

5.5.3.18 Line B EQM Level

Option	Function	Allowable Modes
0	Line B EQM Level 0	All
5	Line B EQM Level 5	All
10	Line B EQM Level 10	All
15	Line B EQM Level 15	All
20	Line B EQM Level 20	All
25	Line B EQM Level 25	All
30	Line B EQM Level 30	All
35	Line B EQM Level 35	All
40	Line B EQM Level 40	All
45	Line B EQM Level 45	All
50	Line B EQM Level 50	All
55	Line B EQM Level 55	All
60	Line B EQM Level 60	All
65	Line B EQM Level 65	All

5.5.3.19 Line B Analog Loopback

Option	Function	Allowable Modes
Loop	Loopback Line B Analog Connection	All
NoLoop	No Loopback Line B Analog Connection	All

5.5.3.20 Line B DTMF Pulse Duration (ms)

Option	Function	Allowable Modes
50	DTMF Pulse Duration 50ms	Dial
75	DTMF Pulse Duration 75ms	Dial
100	DTMF Pulse Duration 100ms	Dial
110	DTMF Pulse Duration 110ms	Dial
125	DTMF Pulse Duration 125ms	Dial
150	DTMF Pulse Duration 150ms	Dial
175	DTMF Pulse Duration 175ms	Dial
200	DTMF Pulse Duration 200ms	Dial
225	DTMF Pulse Duration 225ms	Dial
250	DTMF Pulse Duration 250ms	Dial

5.5.3.21 Line B DTMF Pulse Ratio

Option	Function	Allowable Modes
103961	DTMF Pulses 10/s Ratio 39:61	Dial
103367	DTMF Pulses 10/s Ratio 33:67	Dial
203961	DTMF Pulses 20/s Ratio 39:61	Dial
203367	DTMF Pulses 20/s Ratio 33:67	Dial

5.5.3.22 Line B Dial Call Numbers

Option	Function	Allowable Modes
0	Dial Digit Tone 0	Dial
1	Dial Digit Tone 1	Dial
.		
8	Dial Digit Tone 8	Dial
9	Dial Digit Tone 9	Dial
*	Dial Digit Tone *	Dial
#	Dial Digit Tone #	Dial
T	Following Digits are Tone Dialled	Dial
P	Following Digits are Pulse Dialled	Dial
N	Following Digits are reversed pulse dialled	Dial
W	Wait 30 secs for Dial Tone	Dial
,	Delay before dialling next digit	Dial
" "	Space inserted for clarity	Dial

5.5.3.23 Controller Interface Level

Option	Function	Allowable Modes
RS232	Controller Connection is RS232	All
RS422	Controller Connection is RS422	All
S2	Controller Connection is S2	All

5.5.3.24 Controller Connection Data Rate

Option	Function	Allowable Modes
300	Data rate 300 baud	All
600	Data rate 600 baud	All
1200	Data rate 1200 baud	All
2400	Data rate 2400 baud	All
4800	Data rate 4800 baud	All
9600	Data rate 9600 baud	All

5.5.3.25 Controller Interface Data Bits

Option	Function	Allowable Modes
7	Seven Data Bits per Byte	Sync, Async
8	Eight Data Bits per Byte	Sync, Async

5.5.3.26 Controller Interface Parity

Option	Function	Allowable Modes
Odd	Odd Parity	Async
Even	Even Parity	Async
None	No Parity	Async

5.5.3.27 Controller Interface Stop Bit

Option	Function	Allowable Modes
1	One Stop Bit	Async
1.5	One and one half Stop Bits	Async
2	Two Stop Bits	Async

5.5.3.28 Controller Interface Digital Loopback

Option	Function	Allowable Modes
Loop	Loopback of Digital Connection	
NoLoop	No Loopback of Digital Connection	

5.5.3.29 Controller Interface RTS Timeout

Option	Function	Allowable Modes
0	No RTS Assertion Limit	All
1	RTS Maximum Assertion Time 1 sec	All
2	RTS Maximum Assertion Time 2 sec	All
.		
9	RTS Maximum Assertion Time 9 sec	All
10	RTS Maximum Assertion Time 10 sec	All

5.5.3.30 Indications

The module has four large visible LEDs which indicate line connection, transmit and receive activity for the modem.

During normal operation, the S2/VFC46 modems will show the following LED indications:

- DCDA (red)Line A Carrier Detected and Synchronised
- DCDB (red)Line B Carrier Detected and Synchronised
- TxD (yellow)Controller Transmit Data
- RxD (green)Controller Receive Data

The module has three small visible LEDs which indicate line status for the modem.

During normal operation, the S2/VFC46 modems will show the following LED indications:

- TxIA (red)Line A Transmission Inhibited
- TxIB (red)Line B Transmission Inhibited
- Office Direction (red)S2 Office Direction

5.5.3.31 Operation

Line A Carrier Detect and Synchronised

When working correctly, the S2/VFC46 will illuminate the DCDA LED when data synchronisation has been achieved on Line A.

Line B Carrier Detect and Synchronised

When working correctly, the S2/VFC46 will illuminate the DCDB LED when data synchronisation has been achieved on Line B.

Transmit

When working correctly, the TxD LED will flash as data is transmitted from the controller.

Receive

When working correctly, the RxD LED will flash as data is sent to the controller.

Transmit Inhibit Line A

When working correctly, the S2/VFC46 will illuminate the TxIA LED when the external Line A inhibit signal is active.

Transmit Inhibit Line B

When working correctly, the S2/VFC46 will illuminate the TxIB LED when the external Line B inhibit signal is active.

Office Direction

When working correctly, the S2/VFC46 will illuminate the Line A/B LED when the S2 office is detected as being connection to Line A. The module will extinguish the Line A/B LED when the S2 office is detected as being connected to Line B.

Modem Bypass

When the S2/VFC46 detects an internal fault or the external Modem Bypass facility is invoked, the module will initiate a Modem Bypass. When the module is configured in a regenerative mode the Modem Bypass facility will energise the bypass output. The bypass output would normally be connected to a bypass relay. The contacts of the bypass relay will connect Line A to Line B directly thereby bypassing the modem completely.

EQM Level

The EQM Level is a measure of the line quality. The EQM Level should be measured using the Generic Module Diagnostic package (GMD). The higher the level the poorer the line quality. Once the EQM Level has been measured the EQM Level should then be set, using GMC, to a value 30 points higher than the measured value.

Comp Filter

The Comp Filter is used to place different types of filters on the line input to the modem. The setting of this filter should be determined by measuring the EQM Level. Choose the value that provides the lowest EQM Level measurement.

5.6 Peripheral Devices

5.6.1 S2/ATT44 Attenuator Board

Use the S2/ATT44 to set the modem bearer connection levels for an S2/VFC4x modem.

The S2/ATT44 is a a single printed circuit board that connects to the rear of S2 motherboards. See Figure 5.2 for a depiction of the placement of S2/ATT44 cards on an S2/MBD45 motherboard.

Two sets of jumpers set the attenuation from 0 dB to 31 dB:

- the top jumpers set the receive level;
- the bottom jumpers set the transmit level.

Jumpers placed in the 'IN' position set the attenuation level. Jumpers must be placed in either the IN or OUT positions.

Typical attenuation levels are:

- 0 dB for receive
- 6 dB for transmit.

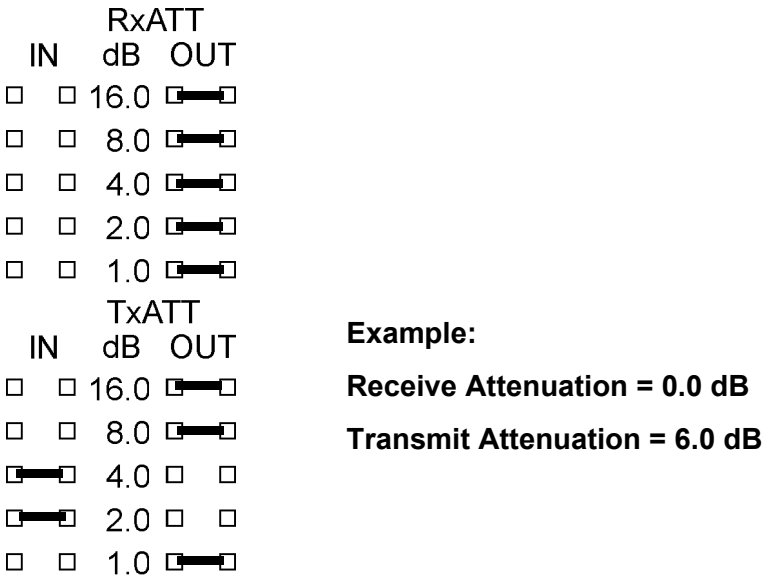


Figure 5.59 S2/ATT44 Configuration Jumper Setting Example

5.6.2 S2/CDC41 Carrier Detect Card

The S2/CDC41 Carrier Detect Card will connect to the rear of the WESTRONIC S2 motherboards. The card is used to provide a transmit timeout alarm and transmission disconnect facility to be used for monitoring of telemetry communications.

The S2/CDC41 Carrier Detect Card is comprised of a single printed circuit board and 64 way connector arrangement that is housed within a connector back shell.

The S2/CDC41 Carrier Detect Card will perform one function only which is to monitor the duration of transmissions by a S2/VFC44 / 45 modem. Should a transmission exceed the maximum set time limit of 10 seconds, the S2/CDC41 will remove power from the transmission circuit of the modem to prevent any further transmissions being broadcast.

5.6.2.1 Configuration

The S2/CDC41 Carrier Detect Card requires two wire links to be installed on the host motherboard. These links are placed at the rear of the upper and lower connectors that the S2/VFC44 / 45 modem are attached to according to the following:

Upper Connector Pin		Lower Connector Pin:
1C30	to	2A7
1C24	to	2A12

5.6.2.2 Indications

The S2/CDC41 has a single indicator used to specify modem status. Under normal conditions where modem transmissions last 10 seconds or less the indicator remains illuminated but, should a fault occur causing the modem to transmit for a duration of greater than 10 seconds the indicator will extinguish until the fault is rectified.

5.6.3 S2/SDB41 Scanner Daughter Board

The S2/SDB41 is a module which is used in conjunction with a WESTRACE NVC or S2/SCN4x. The daughter board enables the modules to communicate using RS422 signal levels with the use of a modem. The daughter board contains complete circuitry for two serial communications channels.

5.6.3.1 Particulars

The S2/SDB41 is comprised of a single printed circuit board.

The S2/SDB41 is a level converter between RS422 and TTL levels.

5.6.3.2 Function

When the S2/SDB41 is used in conjunction with a WESTRACE NVC or S2/SCN4x, the daughter board will provide RS422 signal levels for use with a modem.

5.6.4 S2/SDB42 Scanner Daughter Board

The S2/SDB42 is a module which is used in conjunction with a WESTRACE NVC or S2/SCN4x. The daughter board enables the modules to communicate using RS232 signal levels with the use of a modem. The daughter board contains complete circuitry for two serial communications channels.

5.6.4.1 Particulars

The S2/SDB42 is comprised of a single printed circuit board.

The S2/SDB42 is a level converter between RS232 and TTL levels.

5.6.4.2 Function

When the S2/SDB42 is used in conjunction with a WESTRACE NVC or S2/SCN4x, the daughter board will provide RS232 signal levels for use with a modem. The RS232 outputs are not put into tri-state at any time during operation.

5.6.5 S2/SDB44 Scanner Daughter Board

The S2/SDB44 is a module which is used in conjunction with a WESTRACE NVC or S2/SCN4x. The daughter board enables the modules to communicate using RS232 signal levels without the use of a modem. The daughter board contains complete circuitry for two serial communications channels.

5.6.5.1 Particulars

The S2/SDB44 is comprised of a single printed circuit board.

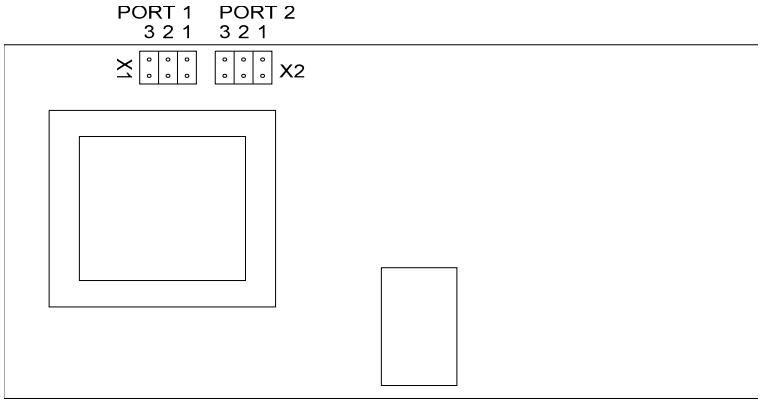
The S2/SDB44 has two sets of links. Each set of links allows the serial communications baud rate to be set. The range of adjustment for each set of links is 600 baud to 38.4kbaud.

5.6.5.2 Function

When the S2/SDB44 is used in conjunction with a WESTRACE NVC or S2/SCN4x, the daughter board will provide RS232 signal levels and clock re-construction for use without a modem. The RS232 outputs will be put into tri-state when the module is not transmitting.

5.6.5.3 Configuration

The daughter board links are positioned as shown below. The baud rate selection is made according to the table.



3 2 1		3 2 1	
	600 baud		9600 baud
	1200 baud		19k2 baud
	2400 baud		38k4 baud
	4800 baud		Illegal

5.6.6 S2/SDB45 Scanner Daughter Board

The S2/SDB45 is a module which is used in conjunction with a WESTRACE NVC or S2/SCN4x. The daughter board enables the modules to communicate using RS422 signal levels without the use of a modem. The daughter board contains complete circuitry for two serial communications channels.

5.6.6.1 Particulars

The S2/SDB45 is comprised of a single printed circuit board.

The S2/SDB45 has two sets of links. Each set of links allows the serial communications baud rate to be set. The range of adjustment for each set of links is 600 baud to 38.4k baud.

5.6.6.2 Function

When the S2/SDB45 is used in conjunction with a WESTRACE NVC or S2/SCN4x, the daughter board will provide RS422 signal levels and clock re-construction for use without a modem. The RS422 outputs will be put into tri-state when the module is not transmitting.

5.6.6.3 Configuration

The daughter board links are positioned as shown below. The baud rate selection is made according to the table.

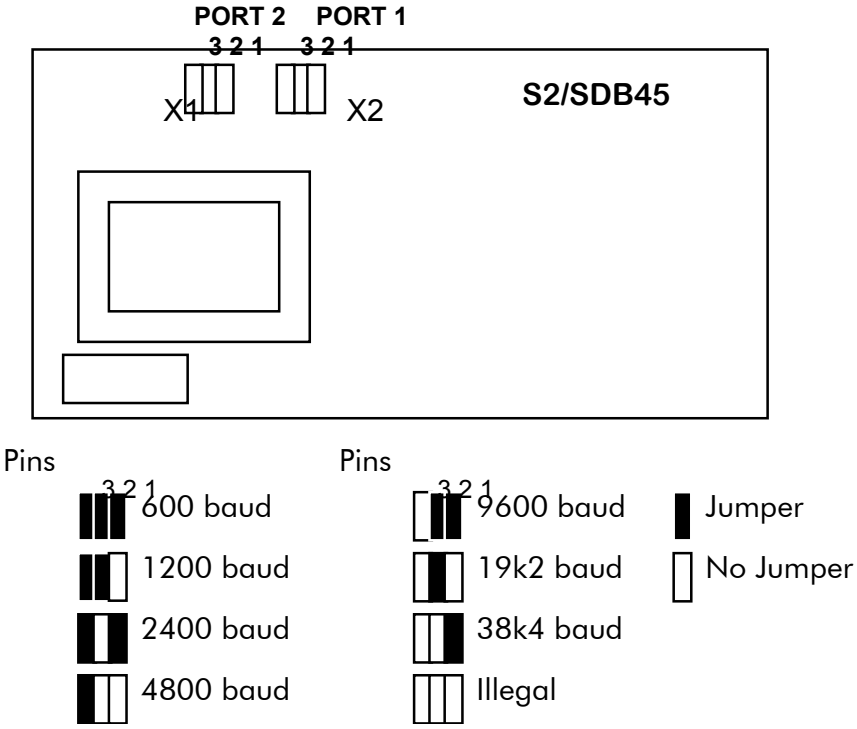


Figure 5.60 Baud Rate Configuration Links

5.6.7 S2/ALC41 Alarm & Line Changeover Module

The S2/ALC41 module provides alarm monitoring and controlling functions in the WESTRONIC S2 telemetry system.

The S2/ALC41 module monitors and combines the following alarms:

- general purpose alarms
- power fail alarm
- transmit timeout alarm

It controls and selects the bearer for the following functions:

- monitoring telemetry alarms to detect bearer failure
- switching bearers or hardware
- switching attenuators with bearers
- operating with bearers of equal or unequal priority
- termination

5.6.7.1 Particulars

The physical characteristics of the S2/ALC41 module are as follows:

- external dimensions are 100 x 220 x 27 mm (including components)
- 96 way DIN 41612 (rows a, b & c) connector at top of board
- Card ejectors fitted at top & bottom of module
- The front is engraved 'S2/ALC41'

The S2/ALC41 module operates from an external regulated 12 Vdc power supply.

5.6.7.2 Function

Some of the functions are controlled by the circuitry of the S2/ALC41 module as determined by the system designer. Such functions are not maintenance items and are outside the scope of this document.

The following sections describe the functions that may be required for fault finding in the S2/ALC41 module or in the WESTRONIC S2 system.

5.6.7.3 Alarms

The S2/ALC41 module displays the following alarms:

- General purpose alarms are based on externally generated signals (contact closure to 0 Volt).
- Transmit timeout alarm is determined from the transmit signal from the carrier card before attenuation.
- Power fail alarm is set to alarm on failure of the external signalling supply.

Section 5.6.7.6 describes the alarm indications.

5.6.7.4 Telemetry Bearer Selection

Selecting and switching of telemetry bearers A and C is controlled, in part, by the circuitry of the S2/ALC41 module as determined by the system designer. This is not a maintenance item and is outside the scope of this document.

Alternatively, the module is fitted with a push-button marked LCO, located above the LEDs on the front panel (see Figure 5.62).

Press the LCO push-button to toggle between telemetry bearers A and C.

5.6.7.5 Configuration

The module's parameters and operating modes are selected by connecting and linking at the card connector. Many of these are not maintenance items and are outside the scope of this document.

Hunt Time Select

The only site adjustment is selection of the hunt time. This is performed by strapping either or both TIMSEL0 and TIMSEL1 low.

TIMSEL0 (connector pin 1)	TIMSEL1 (connector pin 2)	HUNT TIME
H	H	8
H	L	16
L	H	32
L	L	64

Figure 5.61 Hunt Time Strapping

5.6.7.6 Indications

Figure 5.62 shows the indications on the front panel of a typical S2/ ALC41 Alarm & Line Changeover Module.

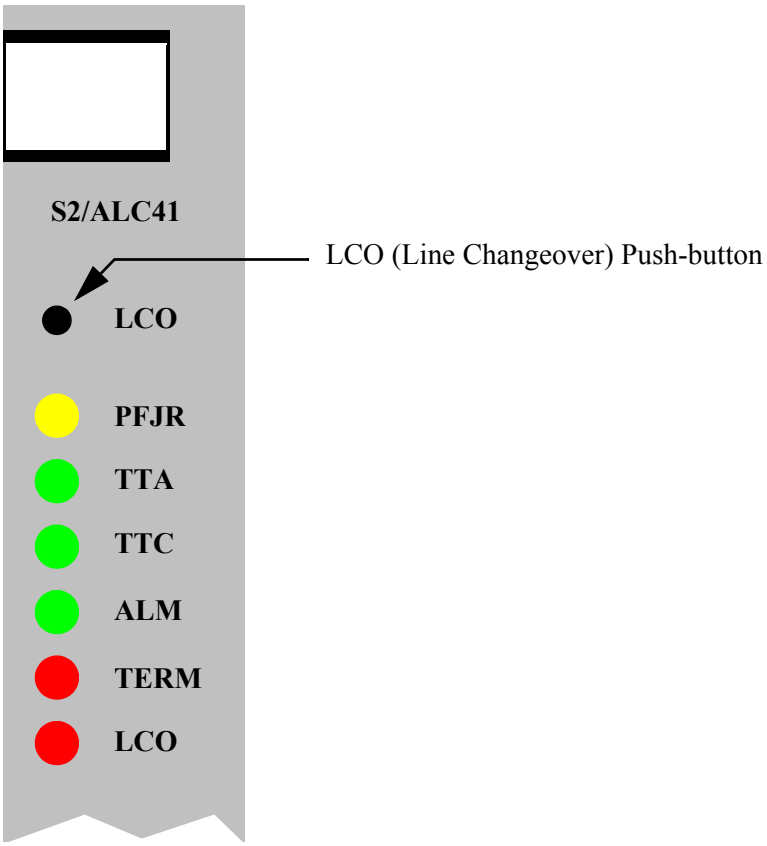


Figure 5.62 S2/ALC41 Front Panel

Table 5.63 lists the meanings of the illuminated LEDs.

LED Colour	Name	Function
Yellow	PFJR	Illuminated except for Power Fail
Green	TTA	Illuminated except for Transmit timeout on A bearer
Green	TTC	Illuminated except for Transmit timeout on C bearer
Green	ALM	Illuminated when no alarms present
Red	TERM	Illuminated for Unterminated
Red	LCO	Illuminated when A bearer is selected

Figure 5.63 : LED Indications

GLOSSARY

AAC	Address Acknowledge. Control signal on the S2 Parallel High
Address	An address is used to identify a group of data. It appears as in encoded and decoded binary form in various parts of the system. The full address code is formed of three parts: Byte Address - that part of the Address code which identifies a byte (8 bits) of data. Module Address - that part of the Address code which identifies the Input or Output module which is handling the data. Word Address - that part of the Address code which identifies a group of data which is to be transmitted or received as one word.
Address Rescanning	Scanning method used when issuing controls to provide the minimum time period to the Operator between a Control and the resultant Indication.
AHB	Address Inhibit. Control signal on the S2 Parallel Highway which is used as part of the change-of-state detection servicing.
ALM	Alarm Control signal on the S2 Parallel Highway which is used as part of the Highway alarm functions.
AMP	All Modules Present. Control signal on the S2 Parallel Highway which is used as part of the Highway alarm functions.
ASD	Address Service Demand. Control signal on the S2 Parallel Highway which is used as part of the change-of-state detection facility.
Bearer	The line circuit over which the WESTRONIC S2 data is transmitted. Bearer Circuit types include telecommunication cables, open wire lines, carrier channels, radio channels and digital PCM channels.
Bearer Circuit	See Bearer.
Bit	One unit of information. Within a transmitted word there are data bits, address bits, function bits, etc.
Byte	A group of eight bits, either data, address, function, etc.
Byte Address	See Address.
CBI	Computer-Based Interlocking
CCITT	The International Telegraph and Telephone Consultative Committee.
CID	Card Identification Code. A code which identifies a particular type or group of types of Input or Output modules which ensures that the module is serviced in the correct manner.

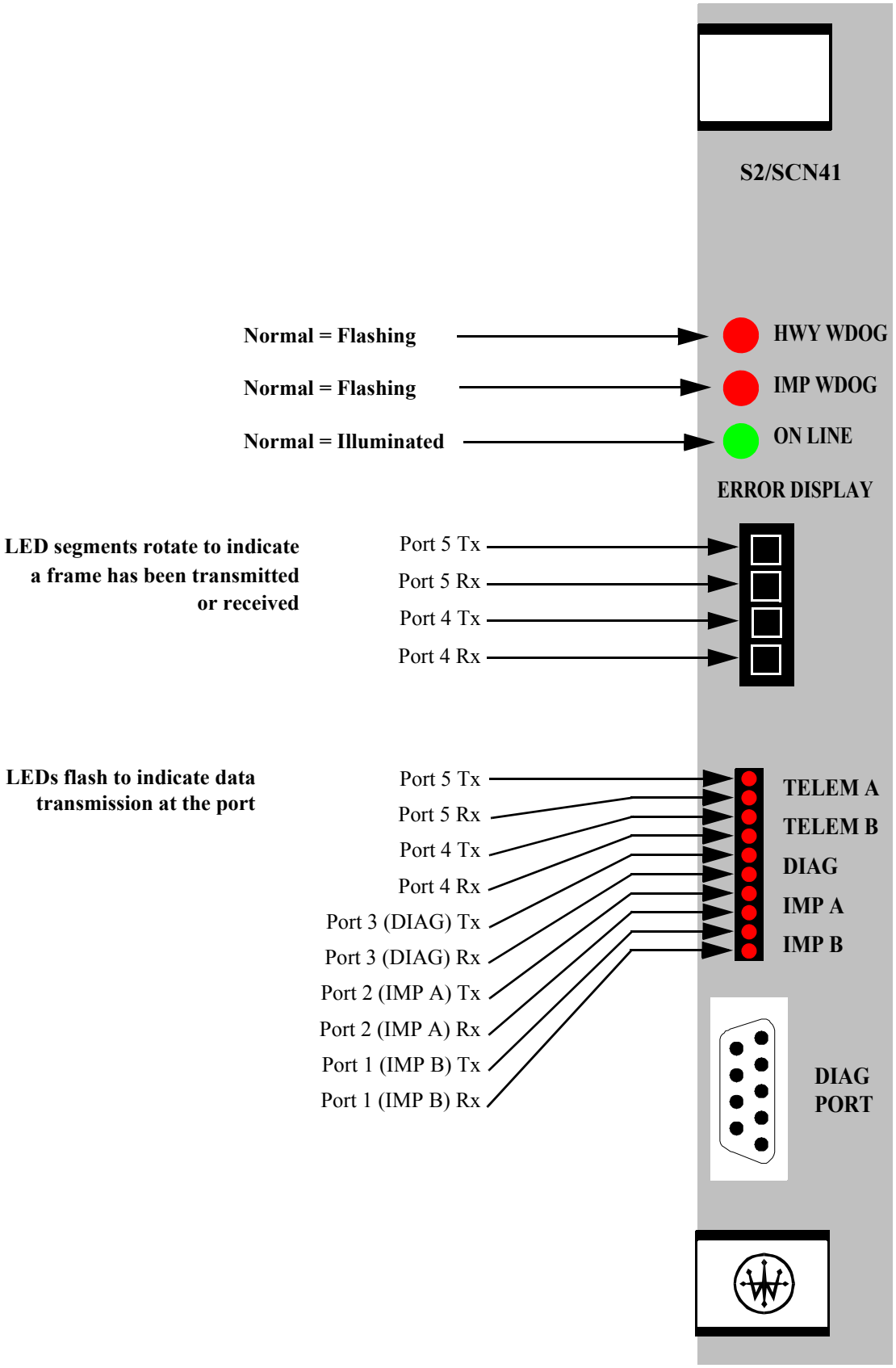
CIE	Classification Identity Enable. Control signal on the S2 Parallel Highway which is used as part of the data transfer procedure.
CKA	Clock Alarm. Control signal on the S2 Parallel Highway which is used as part of the Highway alarm functions.
CLR	Clear. Control signal on the S2 Parallel Highway which is used as part of the data output functions.
Clockwork Scanning	The scanning pattern in which each word is consecutively transmitted in address order from the lowest number to the highest number and repeated continually. The only interruption to this pattern is by Immediate Access (q.v.).
Communications Bearer	See Bearer.
Control Centre	See Office.
CRC	The CRC (Cyclic Redundancy Check) is a two byte code which forms part of the transmitted word, and which is used to detect errors in the received word.
Direct Addressing	The Addressing system where addresses are encoded and decoded using hardware. See also Indirect Addressing.
DPSK	Differential Phase Shift Key
Duplex	The mode of bi-directional transmission on the bearer circuit. There are two basic types of Duplex: Full Duplex - when both controls and indications are transmitted on the same bearer at the same time. (This is the normal mode of WESTRONIC S2). Half Duplex - when control and indication transmissions alternate on the same bearer circuit.
Field Station	The remotely controlled location. Also known as Field, Outstation, Remote Field Station.
Frame	See Word.
FSK	Frequency Shift Keying
HAB	Highway Address Bus. Address bus on the S2 Parallel Highway.
HAS	Highway Address Strap. Address strapping signals on the S2 Parallel Highway.
HDB	Highway Data Bus. Data bus on the S2 Parallel Highway.
HOC	Highway Out Control. Control signal on the S2 Parallel Highway which defines the direction of data transfer.

HWY (Highway) Processor	The HWY (Highway) processor is the 68HC11 microprocessor installed on the S2/SCN4X which provides all the functions for a basic Telemetry system.
Immediate Access	An interruption to the normal Clockwork Scanning pattern which enables controls to be sent from the Office almost immediately. The scanning pattern jumps to the required control address and returns scanning from the previous address.
IMP Processor	The IMP (Integrated Multiprotocol) processor is the 68302 microprocessor installed on the Enhanced Scanner S2/SCN41 module which provides additional operational facilities above those required in basic Telemetry systems.
Indirect Addressing	The Addressing system where addresses are translated in software so that the transmitted word address and the module address are not necessarily the same. See also Direct Addressing.
ISD (Inter-Scan Delay)	The delay between successive carrier envelopes of control words transmitted from the Office, which prevents overlapping of transmissions from Field Stations due to bearer circuit line delays.
LED	Light Emitting Diode.
Line (Circuit)	See Bearer.
Major Scan Time	The time taken to transmit all Words for which addresses are allocated on a Remote Control System.
MCC	Master Communications Controller.
Message (Frame)	See Word.
Minor Scan Time	The time taken to transmit one Word.
Module Address	See Address.
Office	The location from which the WESTRONIC S2 system is controlled. Also known as Control Office, Control Centre Master Station.
Panel Processor	An application where data displayed on a Mimic Panel is a processed result of Indications and/or Controls.
Panel Multiplexer	
Parallel Highway	The parallel communication path between the S2/SCN4Xs and the S2/DIP4X or S2/DOP4Xs, over which data is passed one byte at a time. The Parallel Highway signals consist of address, data and control lines. PCB Printed Circuit Board.
Remote Control System	The Remote Control System refers to the collection of data (Indications) from a number of remote locations (Fields) and outputting at a Central location (Office) and the collection of data (Controls) at the Office and distribution of this data to the remote Fields. RFS (Remote Field Station). See Field Station.

RS232C (Electrical Interface)	An EIA standard (cross reference standards CCITT V.24, V. 28 and ISO 2110). A serial binary interface standard with unbalanced data circuits in common use for communicating with computer peripherals and Modems.
RS422 (Electrical Interface)	An EIA standard (cross reference standards (CCITT) V.11, X.27). A serial binary interface standard with balanced data circuits used for communicating between various parts of the WESTRONIC S2 system and certain peripheral equipment. It permits use up to 1000m and multi-dropping is part of the standard. This interface has better noise immunity than the RS232C interface.
S2	WESTRONIC System 2 (S2) version of Telemetry products.
Scanner module	Use of the term Scanner module refers to the S2/SCN4X module itself.
Scanner system	Use of this term refers to the system, either singular or duplicated, that consists of S2/SCN4X, S2/DIP4X, S2/DOP4X, S2/VFC4X and/or S2/ALC4X modules.
SDLC (Synchronous Data Link Control)	A serial data protocol based on an IBM standard. WESTRONIC S2 Remote Control uses a modified form of this protocol which is better suited for the asynchronous word transmission used in the system and for greater word efficiency.
Telemetry System	See Remote Control System.
VME	Versa Module European (IEEE 1014) is an International standard Bus for the 68000 family of processors.
WAD	Word Address. Address coding signals for S2/SCN4X modules.
WBSA	Westinghouse Brake & Signal Company (Australia) Ltd
WRSA	Westinghouse Rail Systems Australia
WESTRONIC	Product name adopted by WBA covering its range of Telemetry products.
Word	The group of information transmitted to line to convey one block of data allocated to a particular word address. The word contains bytes for synchronism, address, function, data and cyclic redundancy check. Also known as Minor Scan, Frame, Telegram, Message.
Word Address	See Address.

S2 Incident Report

Reference:				Reported by:		
Date:				Time:		
Incident description:						
Operator action:						
Recovery description:						
Faulty module type and serial number: Replacement module serial number:						
S2/PSU4x (power supply) LED Status	(Circle the observed LED condition)					
Input Supply LED	On	Off		On	Off	
Output 12 Vdc LED	On	Off		On	Off	
S2/SCN4x (scanner) LED Status	**Scanner A (left)**			**Scanner C (right)**		
HWY WDOG	Flash	On	Off	Flash	On	Off
IMP WDOG	Flash	On	Off	Flash	On	Off
ON LINE		On	Off		On	Off
Error Display R = Rotating, S = Steady						
Top Segment (Port 5 Tx)		R	S		R	S
2nd Segment (Port 5 Rx)		R	S		R	S
3rd Segment (Port 4 Tx)		R	S		R	S
4th Segment (Port 4 Rx)		R	S		R	S
Error Display Message Text (if applicable):						
Telemetry LEDs						
Port 5 Tx (TELEM A)	Flash	On	Off	Flash	On	Off
Port 5 Rx (TELEM A)	Flash	On	Off	Flash	On	Off
Port 4 Tx (TELEM B)	Flash	On	Off	Flash	On	Off
Port 4 Rx (TELEM B)	Flash	On	Off	Flash	On	Off
Port 3 (DIAG) Tx	Flash	On	Off	Flash	On	Off
Port 3 (DIAG) Rx	Flash	On	Off	Flash	On	Off
Port 2 (IMP A) Tx	Flash	On	Off	Flash	On	Off
Port 2 (IMP A) Rx	Flash	On	Off	Flash	On	Off
Port 1 (IMP B) Tx	Flash	On	Off	Flash	On	Off
Port 1 (IMP B) Rx	Flash	On	Off	Flash	On	Off
I/O module faults (indicate the address, module number, bit numbers, as applicable—refer to system drawings for details) S2/DIP4x Highway Alarm S2/DIP4x Bit Failures S2/DOP4x Highway Alarm S2/DOP4x Bit Failures						
Mother board change over switch position (if applicable)	A	AUTO	C			


S2/SCN41
Normal = Flashing
HWY WDOG
Normal = Flashing
IMP WDOG
Normal = Illuminated
ON LINE
ERROR DISPLAY
LED segments rotate to indicate a frame has been transmitted or received
Port 5 Tx
Port 5 Rx
Port 4 Tx
Port 4 Rx
LEDs flash to indicate data transmission at the port
Port 5 Tx
Port 5 Rx
Port 4 Tx
Port 4 Rx
Port 3 (DIAG) Tx
Port 3 (DIAG) Rx
Port 2 (IMP A) Tx
Port 2 (IMP A) Rx
Port 1 (IMP B) Tx
Port 1 (IMP B) Rx
TELEM A
TELEM B
DIAG
IMP A
IMP B
DIAG PORT

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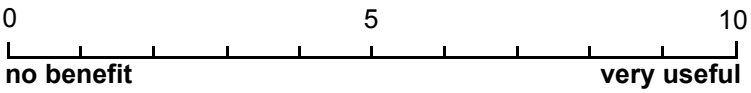

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