Route 3000 Controller

Systems Manual

Route 3000 Controller

Systems Manual

Loadcell Systems (Pty) Ltd
t/a Route Industrial Automation

61 Langermann Drive
Kensington South 2094
Johannesburg
South Africa

P.O. Box 1210, Kengray 2100
Tel: +27 (11) 615-7068 9
Fax: +27 (11) 615-7889
E-Mail: technical@route.co.za

Preface

This section contains a discussion of the hardware of the ***Route*** controller. A detailed explanation of the features, functions and uses of the building blocks of the ***Route*** controller are included. Typical wiring diagrams and discussions on each of the I/O interfaces are included to enlighten the interfacing capabilities to these interfaces.

The information contained within this section will enable the user to identify the capabilities and limitations of the ***Route*** series controllers.

The description of the hardware is concentrated around the building blocks of the ***Route*** series controllers. A detailed explanation of the features and functions of each of the building blocks is provided.

Please Note

In correspondence concerning your ***Route*** instrument, please quote the model and serial number as given on the name plate.

If available, also note the software release and revision number printed on the EPROM's label on the inside of the ***Route*** controller

Important

As this instrument is an electrical apparatus, it may be operated only by trained personnel. Maintenance and repairs may also be carried out only by qualified personnel as appointed by Loadcell Systems (Pty) Ltd.

Disclaimer

Route is a registered trademark of Loadcell Systems (Pty) Ltd t/a Route Industrial Automation

The information in this document is subject to change without notice and should not be construed as a commitment by Loadcell Systems (Pty) Ltd. Loadcell Systems (Pty) Ltd assumes no responsibility for any damages or loss of production which may be suffered directly or indirectly as a result of errors within this document.

Table of Contents

1 Introduction

The *Route* 3000 series controller is a microprocessor based process controller designed around the *Intel 80188* microprocessor. The microprocessor-based *Route* controllers form part of the wider range of *Route* series controllers and indicators.

The *Intel 80188* microprocessor is the heart of the *Route* 3000 series controller. The microprocessor is responsible for controlling the complete process which is entrusted to the controller. The program (*which is a list of instructions*) of the microprocessor is contained within an EPROM (*Erasable Programmable Read-Only Memory*). This program informs the microprocessor of all the tasks to be performed, how they should be performed, and what actions to take when certain conditions arise. Therefor it is possible to completely change the function of the controller by merely replacing its program.

To be able to interface to its environment and perform the tasks entrusted to it, the *Route* 3000 series controller features I/O (*input/output*) interfacing facilities which include:

- AIN - Analog I/P (Input) Channels
- AOU - Analog O/P (Output) Channels
- DIN - Digital I/P's (Inputs)
- DOU - Digital O/P's (Outputs)
- SIO - Serial I/O (input/output) Communications Channels
- CON - Console (Keyboard and Display)

The information collected by the input interfaces may include the following:

- Fixed parameters which depend on the characteristics of the environment within which the controller has been installed. These parameters (which are entered into the system by means of the keyboard) may be distances, lengths, circumference, time durations, etc.
- Measurands such as mass, force, tension, pressure, temperature, speed, torque, target, etc.
- Control input signals such as start/stop, halt/run, gate open/close, etc.

The measurands and parameters may be used to calculate additional parameters (*such as belt loads, feed rates, flow rates, etc.*) required by the system to fulfil its task. In addition, these measurands and parameters (*both fixed and calculated*) may be used in conjunction with the control input signals to perform control functions (*such as feed rate control, speed control, bag filling, batching, blending, etc.*) by means of the output interfaces.

2 System Layout

The *Route* 3000 Controller's the main board (also known as the CPU-card or mother board) is mounted horizontally on the base plate of the enclosure. Both the panel mount and the wall mount enclosure utilizes the same mounting arrangement.

The I/O interface cards of the ***Route*** 3000 controller are mounted vertically on the main board. The I/O interface cards, listed in the standard order of mounting (left to right) include;

- RED3020 - Communications Interface (COM)
- RED3010 - Console Interface (CON)
- RED3030 - Load Cell Interface (LCI)
- RED3040 - Digital Input Interface (DIP)
- RED3050 - Digital Output Interface (DOP)
- RED3065 - Analog I/O Interface (AIO)
- RED3090 - 24 Vdc Secondary Power Supply
- RED30A0 - 220/110/24 Vac Primary Power Supply

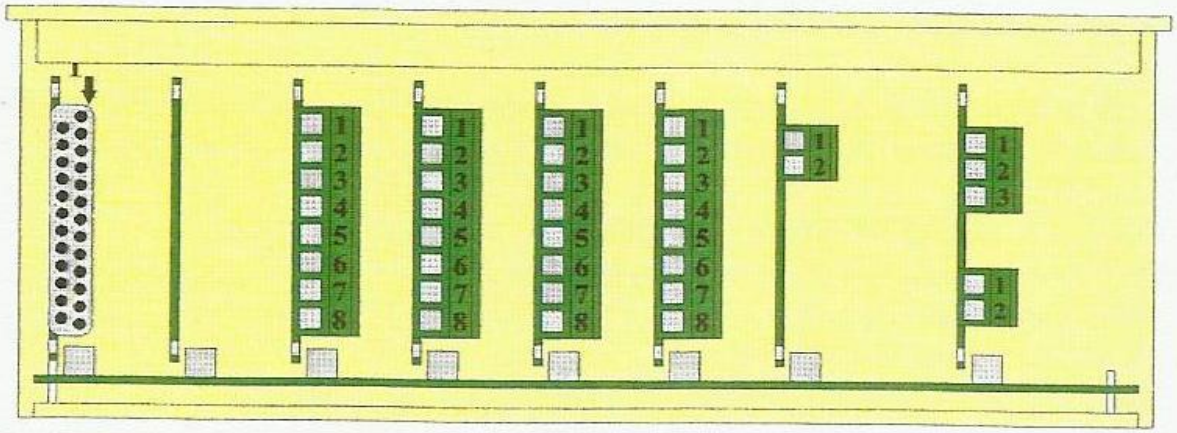

Fig. SYS-1: Route 3000 IP-65 Steel Wall Mount enclosure viewed from the cable entry side indicating the arrangement of the termination terminals.

Since all the I/O interface cards, except the Console Interface and 24 V Power Supply, are optional, and more than one I/O interface card of a specific type may be installed, this arrangement is not guaranteed. The specific arrangement used, is identified on the inside of the lid of the ***Route*** 3000 Controller.

3 Main Board

The main board of the ***Route*** 3000 controller hosts only the Microprocessor system and the I/O expansion bus.

3.1 Microprocessor System

The microprocessor system of the ***Route*** controller includes features such as:

- An Intel 80188 Microprocessor.
- 128 K EPROM.
- 96 K Non Volatile System Memory.
- 32 K Non Volatile Key-switch Protected Calibration Memory.
- 128 K Flash Memory

- 24 Hour, full calendar real time clock.

3.1.1 Intel 80188 Microprocessor

The Intel 80188 microprocessor is the heart of the *Route* controller. It is responsible for controlling the complete process which is entrusted to the controller.

The microprocessor includes the following features:

- Priority interrupt controller
- Dual Channel Timer/Counter
- DMA controller
- 16 MHz crystal providing a bus speed of 8 Mhz.

3.1.2 Program Memory

The program memory (the EPROM) contains a complete list of instructions. This list of instructions carefully defines the tasks which are to be performed by the controller. By changing the instructions or the order of the instructions, the function of the controller can be altered.

3.1.3 System Memory

The system memory contains all the temporarily registers which the microprocessor requires to perform it's assigned tasks. The system memory is typically used for:

- Values that have been measured
- Calculation results
- Results of totalizer functions
- Notepad for things to do

3.1.4 Calibration Memory

As the Calibration Memory is key-switch protected, it is used for storing information such as:

- System Setup
- Setpoint Values
- Calibration Values
- I/O Re-assignment Tables
- Programmed Recipes

The key-switch protection provides this memory with save storage for information. As the write access to this memory is protected by hardware, the processor have to request for access to this memory whenever it needs to alter any of the information contained within this memory area.

3.1.5 Real Time Clock

The Real Time Clock of the ***Route*** controller provides it with:

- A 24 hour clock
- A 100 year calender with leap year correction

The Real Time Clock is used for date and time based functions such as:

- Reporting facilities
- Activating control functions

3.2 Expansion Interface Bus

The expansion interface bus of the ***Route*** 3200 controller contains 8 general purpose I/O slots, all of which are compatible.

Since the expansion slots are not dedicated to specific expansion cards, any I/O card may be placed in any expansion slot, however, for sake of uniformity, the system is always supplied with the I/O cards fitted in a pre-determined order which are:

- RED3020 - Serial Communications Interface (COM)
- RED3010 - Console Interface (*Display & Keypad*) (CON)
- RED3030 - Load Cell Interface (LCI)
- RED3040 - Digital Inputs Interface (DIP)
- RED3050 - Digital Outputs Interface (*Relay*) (DOP)
- RED3065 - Analog I/O (*4-20 mA/0-10 V*) (AIN & AOU)
- RED3090 - 24 Vdc Secondary Power Supply
- RED30A0 - 220/110/24 Vac Primary Power Supply

A minimum system must have at least the console interface (*RED3010*) and secondary power supply (*RED3090*) cards fitted. All other I/O cards are optional and will be fitted only on request.

More than one card of a specific type (*for example, 2 Load Cell Interface Cards*) may be fitted on request. Where more than one card of a specific type is fitted, each will come pre-programmed as Card #1 or Card #2 respectively. The order in which such two or more cards are fitted, does not affect their functional position.

4 Console Interface Card - RED3010

The console interface unit of the ***Route*** 3000 series controller allows communication with the outside world. Instructions are entered into the system via a keypad and values are return by the system via a 16-character display module. Function indicators on the console interface itself also relay information regarding general system health to the outside world.

The faceplate of the *Route* 3000 panel mount and wall mount units are different. The *Route* 3000 panel mount unit has adopted the face and looks of the *Route* 4000-7000 series, whereas the face of the *Route* 3000 wall mount unit has been simplified for easier operation.

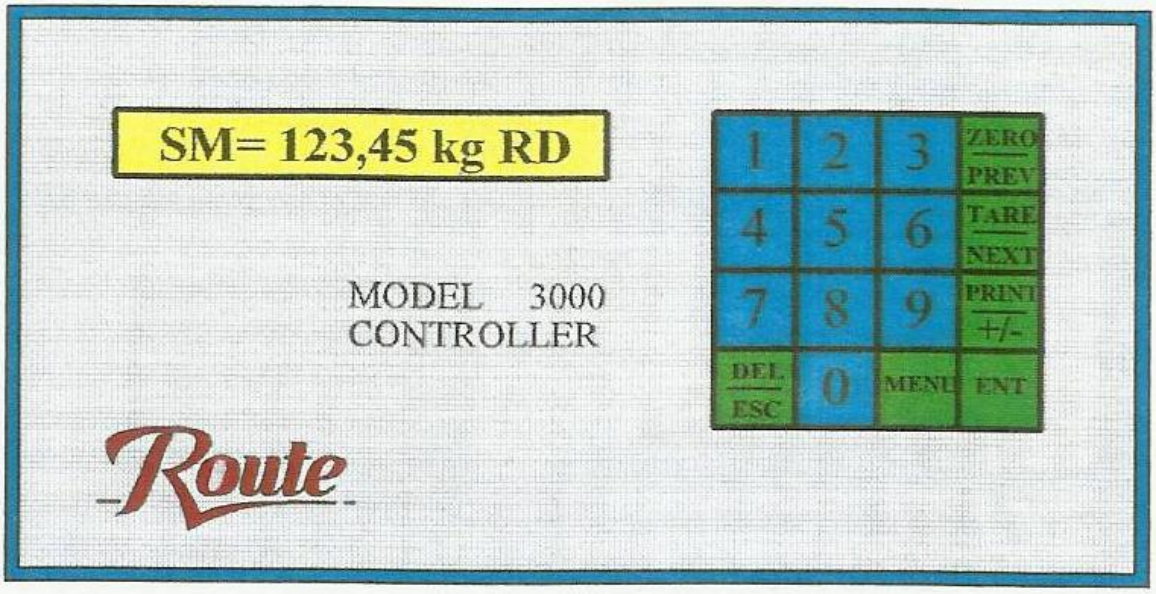

*Fig CON-1: Keyboard and Display of the **Route** 3000 wall mount series controller*

The differences between the *Route* 3000 wall mount and panel mount versions are summarized in Table CON-1 below.

	Wall Mount	Panel Mount
Keypad	16 Key Matrix Switch	30 Key Matrix Membrane
Display	16 Character Single Line	32 Character Dual Line
Function Indicators	8 Internal	4 External
Key-Switch	Automatic Switching	Automatic Switching
Command Entry Method	Menu Driven	Function Keys

Table CON-1: *An overview of the basic differences between the **Route** 3000 Wall Mount and Panel Mount versions.*

4.1 Keyboard

The console interface of the *Route* 3000 series controller is able to interface both with the 30 key matrix keyboards supplied with the panel mount version and the 16 key matrix keyboards supplied with the wall mount versions. The keyboard supplied with the *Route* 3000 panel mount series controller is a 30 key, multi-function, full alpha-numeric membrane keyboard. The keyboard supplied with the *Route* 3000 wall mount series controller is a 16-key multi-function switch matrix keyboard.

By means of the keyboard, the operator may:

- supply the controller with information
- request information from the controller
- request the controller to perform certain functions

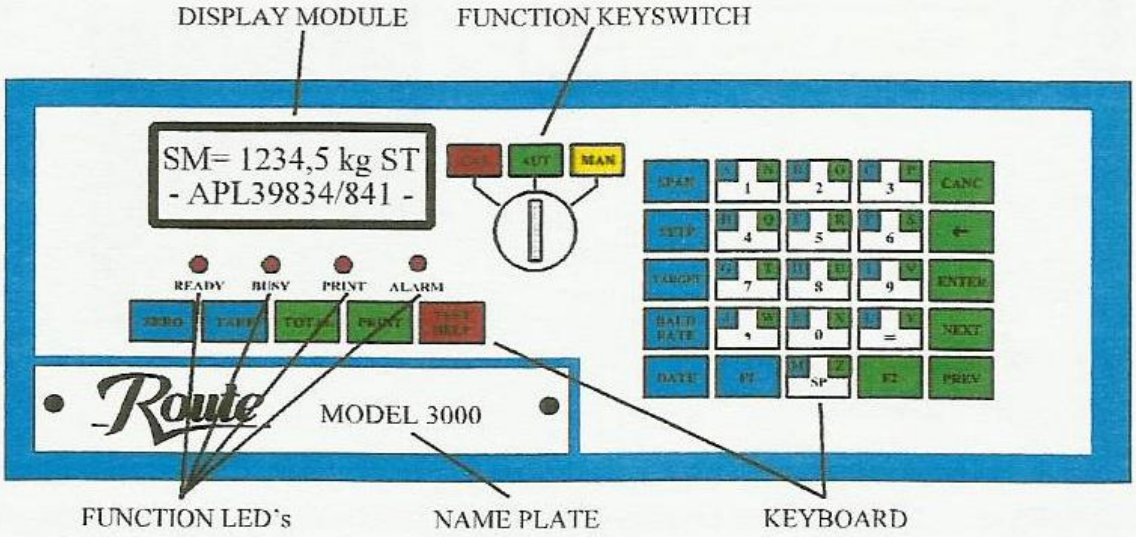

*Fig CON-2: The Display and Keyboard supplied with the **Route** 3000 panel mount series controller.*

Special features of the keyboard supplied with the ***Route*** 3000 panel mount series controllers, include:

- F1 and F2 function keys to access the alpha characters.
- Dedicated function keys to access of all the common calibration and operational functions.
- An on-line TEST/HELP key.

All functions of the ***Route*** 3000 wall mount series controller are fully menu-driven.

4.2 Display

The console interface of the ***Route*** 3000 series controller is designed to interface with an Optrex 32 character, dual line, back lit, alpha-numeric LCD display module. The ***Route*** 3000 panel mount series is supplied with a dual line display module and the wall mount series controller is supplied with a single line display module.

The display allows the controller to present the operator with information which relates to the control function. The information presented on the display is arranged in such a way as to allow for the maximum utilization of the available display area and include:

- All Measurands
- Calculated Parameters
- Control Status

- Key-board Activities
- Alarm/Warning Messages

4.3 Function Key-switch

The *Route* 3000 series controllers are fitted with a automatic key-switch which allows for the selection of functions such as:

- Access to setup and calibration RAM
- Auto selection
- Manual override of I/O's

4.4 Function LED Indicators

The *Route* 3000 series controllers are fitted with function LED indicators which presents visual confirmation of functions such as:

- Ready/Busy Status
- Printer/Communications Activities
- Alarm Presence
- Calibration selection
- Auto/Manual Selection

5 Serial Communications Interface Card - RED3020

The *Route* 3000 series controller can optionally be fitted with the RED3020 Serial Communications Interface card. The RED3020 Serial Communications Interface card comes standard with four serial communications channels.

The serial communications channels may be utilized for communications to printers, PLC's, SCADA systems, etc. This provides you with the facility to implement fully integrated process control and production management.

Unless otherwise stated, the four communication ports are utilized as follows;

- Com #1 - Printing Functions
- Com #2 - Slave Printing
- Com #3 - Standard MODBUS
- Com #4 - RCUBUS (*Remote Console Unit Interface Bus*)

Each of the communications channels can, independently of the other, be programmed for:

- Any of the standard baud rates
- Word lengths of 5, 6, 7 and 8 bits
- 1 or 2 Stop bits

- None, Odd, Even, Mark or Space parity
- Up to 256 slave channels for multi-drop applications

Each of these channels is, independently of the other, hardware and software configurable for:

- RS232 (Standard RS232)
- RS422 (RS422 Non-Multi-Drop).
- RS422A/485 (Internal 422/485 Multi-Drop Hardware)
- RS422R/485R (External 422/485/Modem Multi-Drop Hardware)

NOTE: The software format selected has to conform to the hardware installed, to be able to support the selected format.

5.1 Cable and Wiring Specifications

The standard specifications for proper RS-232 communications require at least 0.5 mm^2 overall screened cable with a maximum length of 50 meters when operating at 9600-baud.

This specification assumes a "clean" environment and guarantees a "clean" signal on both ends with minimal distortion. This is however very much a function of factors such as the environment and cable quality. Within the industrial environment, the environment itself probably has the biggest effect on signal quality.

Since the cable specifications for RS-232 cabling assumes a maximum percentage distortion of the original signal, theoretically, the cable length can be doubled each time the baud rate is halved. This allows for a cable length of 400m at 1200-baud without sacrificing the specifications. To achieve maximum distance, we have to ensure that only high quality signal cable is used and pay proper attention to the grounding and routing of the cable.

The cable route is to be selected to minimize any contact with high inductive load cables. This may require a separation of up to 2m between signal and power cables. When a signal cable needs to cross the path of a power cable, this must be done at right angles to minimize the contact area between the signal and power cables. The same theory would apply to the separation between low level dc signals and high frequency signals.

Special attention should be paid to the grounding of all signal wires. If the same ground plane can be guaranteed, it is always best to ground the screen of all signal cables at both ends. If a common ground plane is not available, the screen at the signal source side should be left un-terminated.

5.2 Communications Connector

The *Route* 3200 series controller utilizes a single 25-pin D-Type connector for the it's communications interface. The pin-functions are assigned as indicated in table **COM-1** below.

RS232	RS422/485	COM-1	COM-2	COM-3	COM-4
TXD	TXA	2	15	9	21
RXD	RXA	3	16	10	22
RTS*	TXB	4	17	11	23
CTS*	RXB	5	18	12	24
GND	GND	1	14	13	25

Table COM-1: The pin-out configuration for the Communications Channels of the Route 3000 controller.

The figures in the discussions that follow provide some examples of how equipment such as printers, PC's and other ***Route*** controllers may be inter-connected via their serial communication channels.

5.3 Switching between RS-232 and RS-485/422

Any of the four communications channels of the ***Route*** 3000 controller may, independently of the other, selected for either RS-232 or RS-485/422 operation. The communications interface card of the ***Route*** 3000 series controller is as standard supplied with all four communication channels selected for RS-232 operation.

	Com #1	Com #2	Com #3	Com #4
RS-232	LK1 (*Closed*) LK3-2 LK4-2 LK5-2 LK6-2 LK7-2	LK8 (*Closed*) LK10-2 LK11-2 LK12-2 LK13-2 LK14-2	LK15 (*Closed*) LK17-2 LK18-2 LK19-2 LK20-2 LK21-2	LK22 (*Closed*) LK24-2 LK25-2 LK26-2 LK27-2 LK28-2
RS-485/422	LK1 (*Open*) LK3-3 LK4-3 LK5-3 LK6-3 LK7-3	LK8 (*Open*) LK10-3 LK11-3 LK12-3 LK13-3 LK14-3	LK15 (*Open*) LK17-3 LK18-3 LK19-3 LK20-3 LK21-3	LK22 (*Open*) LK24-3 LK25-3 LK26-3 LK27-3 LK28-3

*Table COM-2: Link positions of the communications interface card or the **Route** 3000 series controller for RS-232 versus RS-485/422 operation.*

The selection of RS-485/422 operation of a communications channel consists of the hardware configuration of that channel and the selection of the appropriate software driver (*the selection of the software driver is integrated with the baud rate configuration of the channel concerned*).

The hardware configurations of the four communication channels are summarized in Table COM-2 above.

5.4 RS-485/422 Termination Resisters

The Communications Interface Card of the ***Route*** 3000 series controller comes with an on-board termination resister of 500Ω for the receive channel of each communication channel. When active, the input termination ensures a nominal 3 Vdc on the RX-A line and 2 Vdc on the RX-B line when all transmitters on the receive-line are tri-stated.

When operating either a RS-422 or a RS-485 multi-drop communication path, at least the two controllers at the two far ends of the communication path should be terminated. The termination resister links for Com#1..Com#4 are LK2, LK9, LK16 and LK23 respectively, and are installed by default during assembly.

The termination resister is active when both jumpers of the termination link are installed in the horizontal plane along the length of the Communications Interface Card (*Note: When installed in the vertical plane, the terminations will short the receiver lines and no communication will be possible*). When both jumpers of the link are removed, the receiver is un-terminated.

5.5 Printer Connection

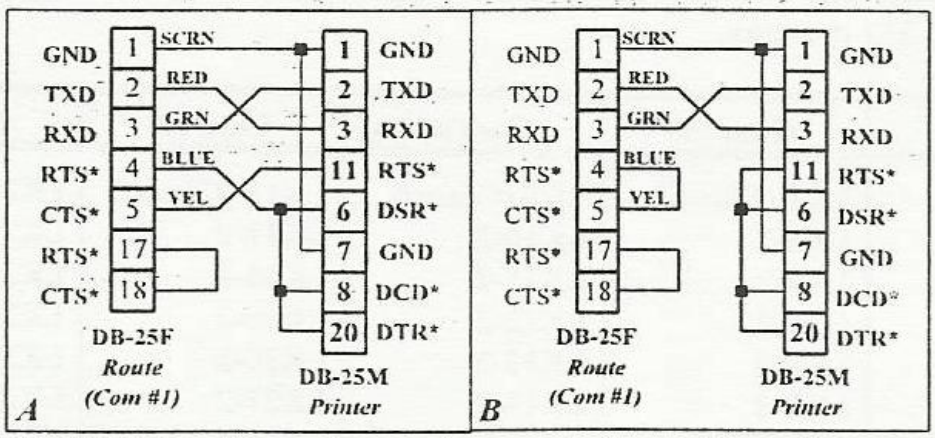

*Fig COM-1: Connecting a printer to the **Route** Controller via its Com#1 RS-232 interface A) utilizing RTS*/CTS* hardware handshaking B) not utilizing RTS*/CTS* hardware handshaking.*

The ***Route*** series controller allows interfacing to serial printers for the purpose of generating management reports. Although other ports may be configured as printer ports upon request, communications port #1 is normally utilized for this purpose. The diagram in Fig COM-1 below indicates a printer connection to the ***Route*** 3200 series controller's communications port #1. When a printer is to be connected to other ports, the correct pin numbers may be found from Table COM-1 above.

It is not vital to connect the two handshake lines, RTS* and CTS*. Such a connection is indicated

in Fig COM-1B. The handshake lines are only necessary when connecting to printers with a limited buffer size.

Any standard ASCII printer with an RS-232 interface may be interfaced to the ***Route*** series controllers. Only the standard 7-bit ASCII set is used to generate the print output.

5.6 Computer and Modem Connections

The ***Route*** 3000 series controller allows interfacing to equipment such as computers and PLC's for the purpose of exchange of information. Most commonly this type of connection will be used to link the ***Route*** 3000 series controller to a SCADA system running on a IBM-PC.

The standard protocol used by ***Route*** controllers to communicate with SCADA packages, is the MODBUS protocol. More information on this protocol is available in a separate document. At this point it suffice to say that MODBUS is protocol widely supported by all field equipment and SCADA packages and is commonly used to exchange various control and data parameters.

For those users whose application does not justify the cost of a full SCADA package, we have developed the R-Link Windows based MODBUS DDE driver. This allows the creation of the most simple to the most complex implementations. The R-Link driver is compatible with standard MODBUS and allows the integration of all MODBUS compatible equipment

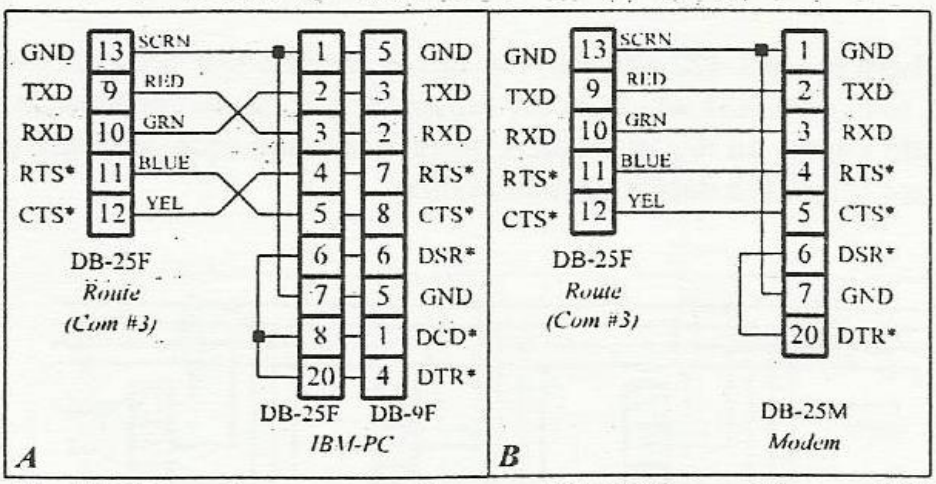

Fig COM-2: *Connecting A) an IBM-PC or B) an IBM compatible modem to the* ***Route*** *3200 series controller via its Com#3 RS-232 port.*

The standard implementation of MODBUS on the ***Route*** 3000 series controllers defines communications port #3 as the MODBUS port, although other communication ports may also be configured for MODBUS communications. Fig COM-2 below assumes this configuration. When other ports are utilized for MODBUS communications, the correct pin numbers may be identified from Table COM-1.

The connection of a computer, such as the IBM-PC, to the ***Route*** 3000 series controller may be

done either as a direct connection using RS-232 (as indicated below in Fig COM-2A), or via telephone modems, RS-485 modems or radio links.

5.7 RS-485/422 Multi-drop Connection

In some instances it might be required to be able to communicate with multiple controllers from a single master device using a single communications line. The ***Route*** 3000 series controller lends itself to this ability by having on-board RS-422/485 drivers, thus no external hardware is required.

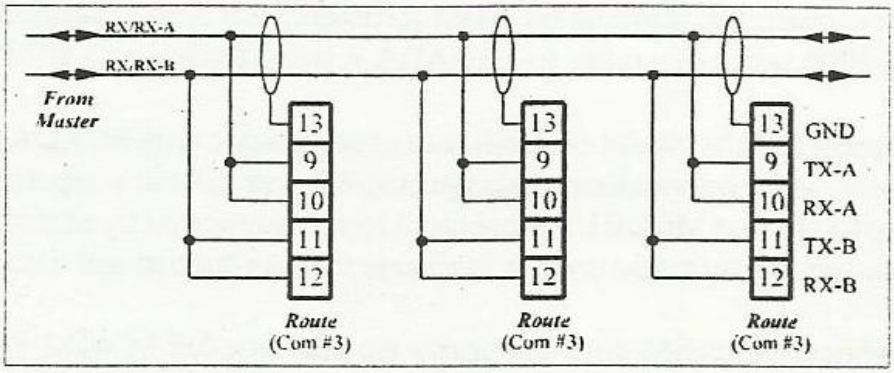

*Fig COM-3: Connecting multiple **Route** controllers to a common Master device in an RS-485 multi-drop configuration.*

The difference between RS-422 and RS-485 lies in the fact that RS-422 allows full duplex communication, unlike RS-485 which is only capable of half duplex communication. In practice this has very little impact on the application, since most multi-drop communication-protocols neither require nor utilize full duplex communication.

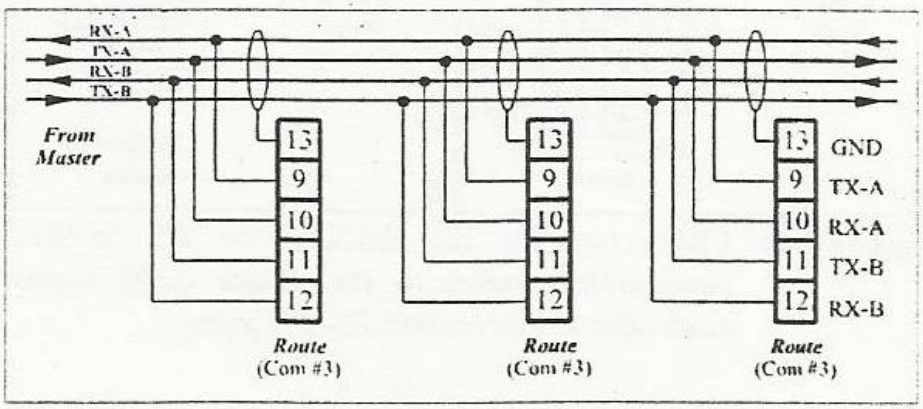

*Fig COM-4: Connecting multiple **Route** controllers to a common Master device in an RS-422 multi-drop configuration.*

The most common use for the RS-422 multi-drop configuration is when interfacing is required to a master device not capable of multi-drop communications, since the RS-422 multi-drop

configuration does not require the master to multi-drop.

Fig COM-3 and Fig COM-4 are sample diagrams of ***Route*** controllers wired for RS-485 and RS-422 multi-drop communications respectively. The major advantage of the RS-485 multi-drop configuration is the reduced cost in cabling requirements.

When connecting a system for RS-485 multi-drop communications, 500 Ω termination resisters is required at both ends of the transmission line. With RS-422 on the other hand, the termination resisters are only required on the receive-line at the master device.

5.8 Large Display Connection

The ***Route*** 3000 series controller may optionally be used to drive RS232-based large display units. A wide variety of RS232-based large display drivers are available. The specific large display brand and model, as well as the information to appear on the large display unit, must be specified at the time of order to allow the correct driver to be loaded into the ***Route*** controller.

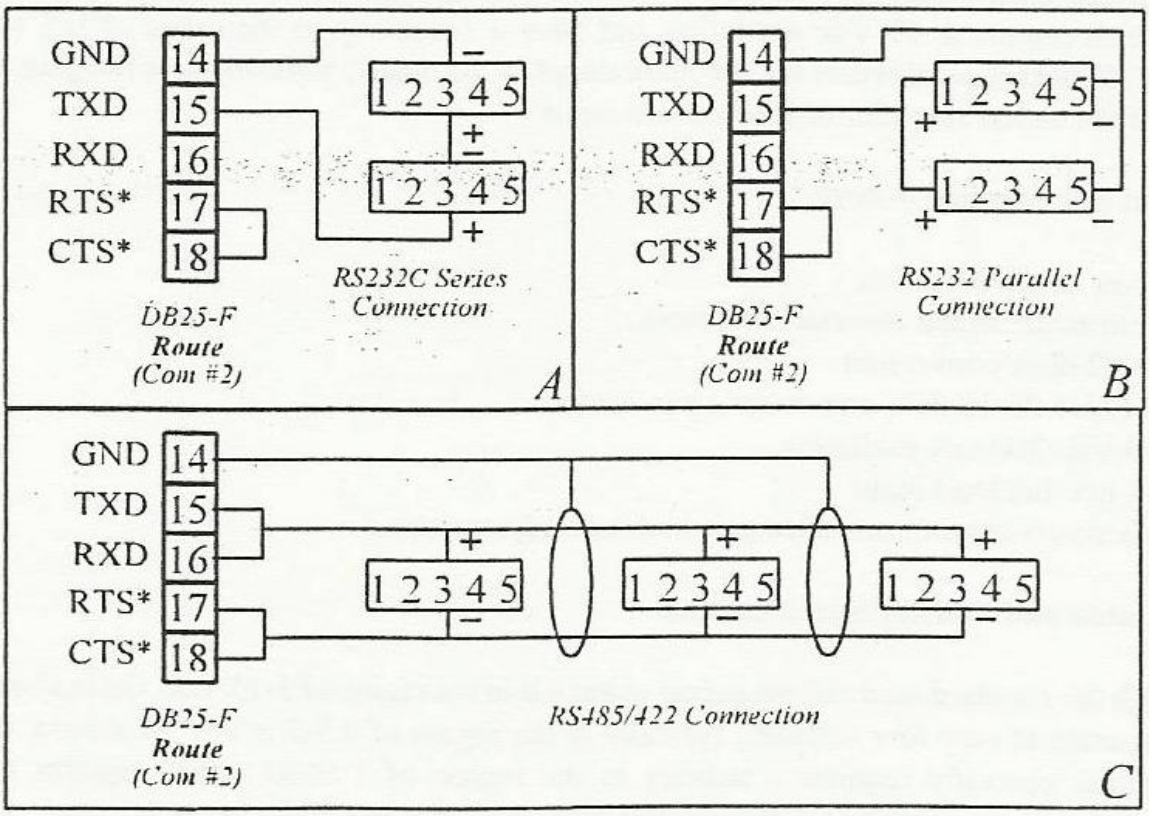

*Fig COM-5: Connecting two large displays to the **Route** 3200 Series Controller. A) using a series connection for RS232C display units, and B) using a parallel connection for standard RS232 display units.*

Although any of the communication-ports of the ***Route*** controller may be configured to communicated information to a large display unit, the Com#2 port is normally configured to drive the large display unit. If required, more than one port may also be configured to communicate

unrelated information two different large display units.

Where large display units support a multidrop-protocol, more that one display unit may be connected to a single RS422/485 port. In this instance, as each display unit is addressed separately, each display unit may display its own characteristic information.

Normally, it would only be required to drive a single large display unit, but in some instances it may be required to drive two or more large display units. In such instances, a maximum of two large display units may be connected to a single RS232 output port on the ***Route*** controller, provided both large display units are either RS232 or RS232C compatible, and the same information need to appear on both large display units. RS232 and RS232C may not be mixed on a single output port of the ***Route*** controller.

6 Load Cell Input Interface Card - RED3030

The ***Route*** 3000 series controller may optionally be fitted with a load cell interface card. The load cell interface is an analog I/P interface which has been designed to specifically interface to load cells which require a 10 Vdc excitation and have a sensitivity in the range of 0.5 mV/V to 2 mV/V. Different sensitivities are accommodated by automatic adjustment of the gain and zero offset of the signal amplifier of the load cell input.

The load cell interface feature;

- Over range detection
- Automatic signal reversal correction
- 4-1/2 digit conversion
- 3.125/6.25/12.5/25 conversions per second
- 10 Vdc/200 mA excitation
- 24 mV full load input
- Micro-processor controlled gain and zero adjustments

6.1 Cable and Wiring Specifications

Although the standard load cell excitation voltage is in the region of 5-15 Vdc, the load cell signal wires operate at very low voltages, typically in the region of 0.5-3 mV/V excitation. Certified installations generally requires a stability in the region of 1:5000, which equates to signal sensitivities of between 0.5 µV in the worst case and 9 µV in the best case.

Since the signal voltages are of very low levels, it is absolutely vital that proper attention is paid to the selection and installation of the load cell cables.

The general specification for load cell cable is summarized as follows;

- Minimum wire thickness for lengths up to 5 meters: 0.5 mm^2
- Minimum wire thickness for lengths up to 20 meters: 1.0 mm^2

- Minimum wire thickness for lengths above 20 meters: 1.5 mm^2
- Cable type: Individual twisted pairs, Overall-screened.
- Two pair wires should only be used for short distances and under controlled temperature conditions. Whenever environment temperature is or cannot be controlled, an additional pair should be used to accommodate the excitation remote sense above the two pairs required for load cell excitation and signals.

When planning the routing of the load cell cables, the same care should be taken as with all other wire routes. As a general rule, the following should be adhered to;

- The load cell cables shall not be routed with cables carrying high voltages, high currents, inductive loads or frequency signals.
- Separation between load cell cables and those pointed out above, should be at least 1-2 meters.
- When crossing the path of any of the cables pointed out above, it should be done at 90" angles only.
- The cables shall be well protected against accidental damage, excessive heat and overexposure to corrosive chemicals.
- All cable entry points into junction boxes and electronic equipment should be sealed properly.
- All terminals of junction boxes should be treated with an anti-corrosive agent.
- All cable lengths between load cells and the junction point should be of equal length.

Although some of the above measures are stringent, they will ensure a problem free and maintainable installation.

6.2 Conversion Rate Selection

The conversion rate selection link, LK1, allows the load cell interface to be selected for conversion rates of 3.125, 6.25, 12.5 and 25 conversions per second. Only one link position within LK1 may be installed at anyone time. Table LCI-1 below indicates the link positions required to select the various conversion rates.

	3.125	6.25	12.5	25
LK1-1	Off	Off	Off	On
LK1-2	Off	Off	On	Off
LK1-3	Off	On	Off	Off
LK1-4	On	Off	Off	Off

Table LCI-1: Conversion Rate Selections of the load cell interface of the Route 3000 series controllers.

6.3 Load Cell Wiring

Fig LCI-1 above indicates the wiring of a load cell to the load cell interface of the ***Route*** 3000 series controller.

Four-core screened cable should only be used for distances not exceeding 20m. Preferable, all distances in excess of 10m should use a 6-core screened cable. If the load cell cable is exposed to temperature changes which might affect the resistance of the cable, it is advisable to use a 6-core screened cable to take advantage of the excitation compensation inherent to the ***Route*** series controllers.

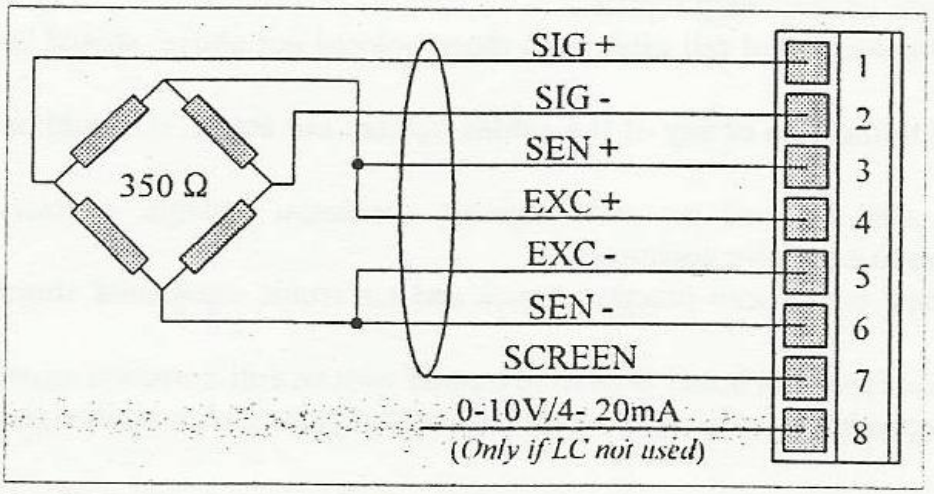

Fig LCI-1: *Diagram indicating the wiring of a single load cell to the Route 3000 series controller*

7 Digital Input Interface Card - RED3040

The ***Route*** 3000 series controller can optionally be fitted with a Digital Input Interface Card, the RED3040. The digital inputs interface card provides the ***Route*** 3000 series controller with eight digital inputs. Each digital inputs features:

- 24 Vdc/6 mA switching
- Input resistance of 3K.
- Polarity protection
- Full input re-assignment via software functions.
- Input status polarity reversal via software functions.

All digital inputs are internally bridged for common 24 Vdc operation and are activated when switched to 0Vdc. A typical wiring diagram is provided in Fig DIN-1. The digital inputs can be activated by:

- Potential free contact switched to ground.
- 24 Vdc/7 mA PNP output (*i.e. from other PLC's*) switching to ground.
- Open Collector output switching to ground (*the pull-up resistor, 3KΩ, and supply voltage, 24 Vdc, are supplied by the* ***Route*** *3000 series controller*)

The digital inputs are normally used for sensing of digital input control signals such as start, stop, select, dump, abort, interlock, etc. functions, as a means of interfacing with other process control equipment.

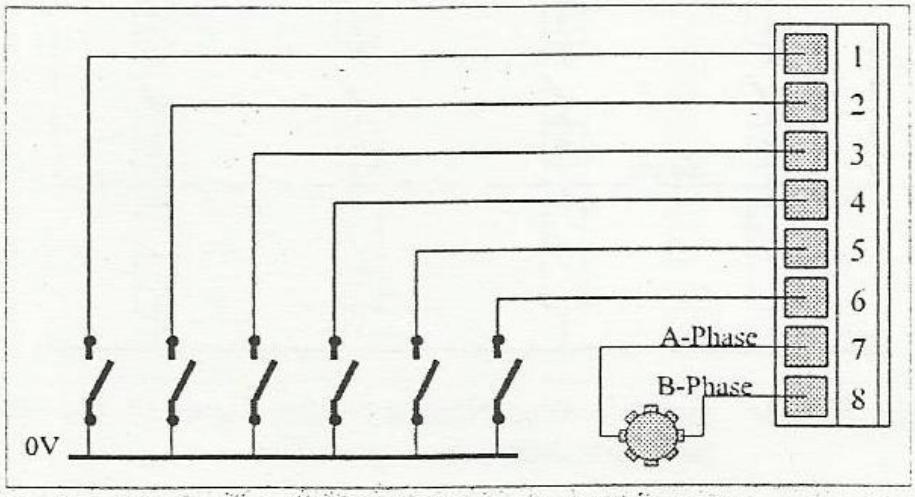

Fig DIN-1: *Typical wiring diagram of the Digital Inputs of the* ***Route*** *3000 controller including a dual phase speed sensor*

Two of the inputs can be used as high speed switching inputs with frequencies of up to ±2 kHz. Both these inputs may be driven by tachometers, digital flow meters, etc. for the measurement of speed, frequency, flow, volumes, etc.

All inputs can be bridged internally to simulate permanently switched contacts. This feature is supported by dip switch SW1 on the Digital Input Card. This eliminates the need to include external wires for bridged contacts.

8 Digital Output Interface Card - RED3050

The ***Route*** 3000 series controller can optionally be fitted with a Digital Output Interface card. The Digital Output Interface Card provides the ***Route*** 3000 series controller with four digital outputs. Each digital-output features:

- Full optical-isolation (*no internal commons*).
- 50 W relay contacts.
- On-board hardware test function.
- Full re-assignment via software function.
- Output state polarity reversal via software function.

- Contact protection via an onboard fuse link.

The digital outputs are normally used for the switching of dual state (on/off or open/close) output control signals such as fast feed, slow feed, discharge, trip, etc., or as status indication outputs such as belt running, alarm conditions, system tripped, ready to discharge, ready to start, etc. The output relays may be used to directly control the gates, motors, valves, etc. or may interface with the plant via PLC's.

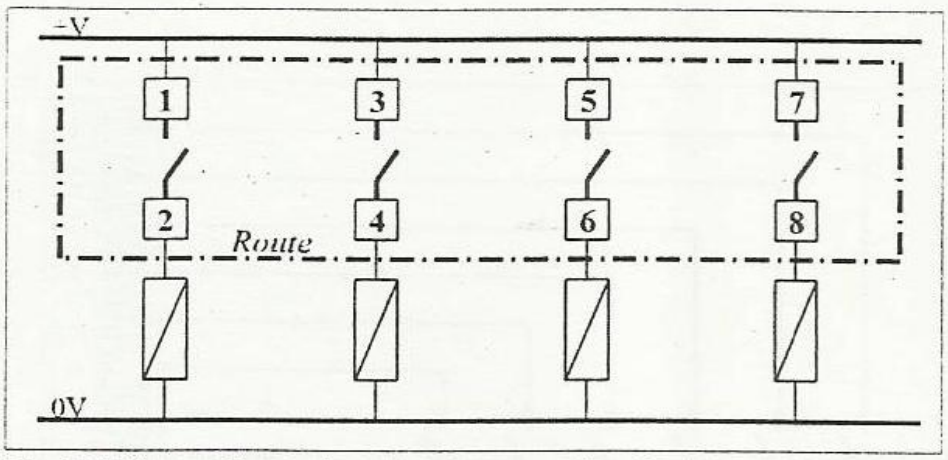

*Fig DOU-1: Typical wiring diagram for the Digital Outputs of the **Route** 3000 series controller*

A typical wiring diagram of the digital outputs of the ***Route*** 3000 series controller is demonstrated in Fig DOU-1.

9 Analog I/O Interface Card - RED3065

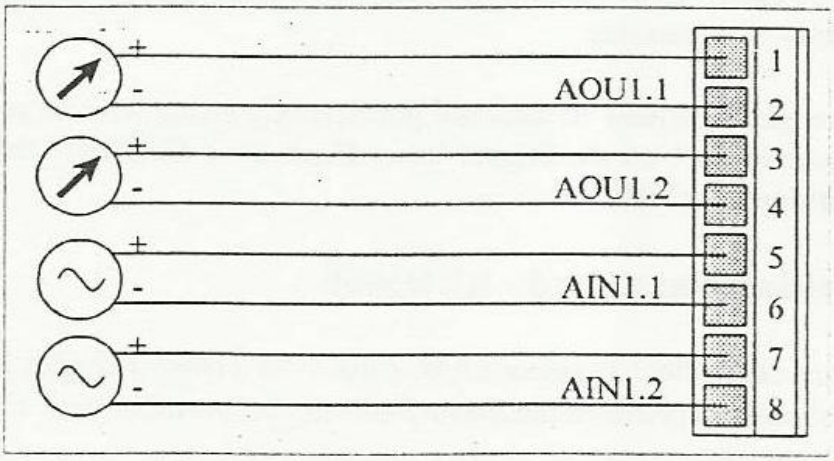

*Fig AIO-1: A Typical wiring diagram for the analog inputs and outputs of the **Route** 3000 controller*

The ***Route*** 3000 series controller can optionally be fitted with an analog I/O interface card, the RED3065. The Analog I/O Interface Card provides the ***Route*** 3000 series controller with 2

analog input channels (*AIN1.1 and AIN1.2*) and 2 analog output channels (*AOU1.1 and AOU1.2*)

A typical wiring diagram of the analog inputs and analog outputs of the ***Route*** 3000 is demonstrated in Fig AIO-1.

9.1 Analog Input Interface (*AIN*)

The analog inputs are normally used for the measurement of parameters such as pressure, temperature, etc. as well as the setting of targets such as required rate, required speed, etc.

Both analog-inputs offer the following features:

- 0-10 Vdc or 4-20 mA drive by link selection.
- 12 bit resolution.
- 6 Conversions per second
- Full calibration including zero, span, damping and digital filtering.
- Full re-assignment via software functions.

A typical wiring diagram of the analog inputs of the ***Route*** 3000 series controller is as indicated in Fig AIO-1.

The analog inputs can be terminated in 500 Ω by links LK1 and LK2 respectively, to allow the inputs to be driven by 4-20 mA.

9.2 Analog Output Interface (*AOU*)

The analog outputs are normally used for remote indication of mass, rates, loads, pressure, or any other measurable parameter. The analog outputs may also be used to control speed, feed rates, flow rates, etc.

Both analog-outputs offer the following features.

- 0-10 Vdc/4-20 mA by link selection
- Calibration for either 4-20 mA or 0-20 mA
- 12 bit resolution.
- Full calibration for both zero and span via keyboard (*ie. no potentiometer adjustments*)
- Full re-assignment via software functions.

A typical wiring diagram of the analog outputs of the ***Route*** 3000 series controller is as indicated in Fig AIO-1.

The analog outputs can be terminated in 500Ω by links LK3 and LK4 respectively to allow the analog outputs to 0-10 V loads.

10 Power Supply - RED7090/70A0

The ***Route*** 3000 series controller operates on a dual power supply system. The primary power supply, Fig PSU-1B, is a 220/110/24 Vac power pack which supplies the secondary power supply with 24 Vdc. The primary power supply is only required if the ***Route*** 3000 series controller needs to be operated from an AC source. The AC power supply features the following input variations:

- 220/240 Vac (*Standard*)
- 115/110 Vac (*Link Selectable*)
- 12-30 Vac (*Optional*)

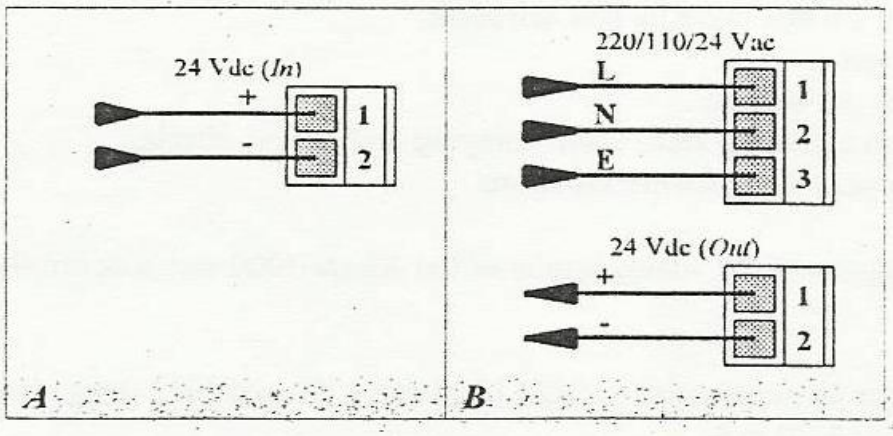

Fig PSU-1: *The power connections to the **Route** 3000 series controller for A) Secondary Power Supply and B) Primary Power Supply*

The secondary power supply of the ***Route*** 3000 series controller, Fig PSU-1A is a versatile switch mode power supply which supplies the controller with all the necessary output voltages. The secondary power supply may only be operated from a DC source within the range 10-35 Vdc.

Fig PSU-1A indicates the power connections of the ***Route*** series controller's AC power supply, and Fig PSU-1B indicates the power connections of the DC power supply.

When the system is operated from 220/110/24 Vac, 24 Vdc may be drawn for the 24 Vdc terminals for powering of external units such as tachometers (*see Fig PSU-1A*). The current drawn from this point may not exceed 100 mA.

When the system is operated from 24 Vdc, the 24 Vdc terminals on the secondary supply may be used for powering the unit (*see Fig PSU-1A*).

Note: *Only one power input may be utilized at any one time. The maximum current that may be drawn from the 24 Vdc line is 100 mA.*

11 Specifications

SPECIFICATIONS	MODEL 3000
Applications	Pre-programmed to requirements
Processor	Intel 80188
Clock Frequency	16 MHz
RAM	128 K non-volatile
EPROM	128 K
EEPROM	128 K
Systems Security	Calibration Lock-out; Password Protected
Power : Supply : Consumption	10-40 V dc/ac; 220/110 V ac ±10 % 10 VA
Load Cell : Channels : Excitation : Sense Voltage : Resolution : Full Scale Input : Sensitivity	4 Max *1 10 V dc / < 171 mA 10 V dc 1:±20000 Counts ±24 mV dc 10-1000 nV dc/Count
Keyboard : Type : Functions	16 Key Matrix Switch Numeric/Function Keys
Real Time Clock	24 Hour 100 year full calendar
Display	16 x 1 Char Back Lit LCD
Calibration	Via Keyboard
Damping	Adjustable
Linearity	0,005 %
Linearization	30 Point Via Keyboard
Automatic Correction	Auto Zero, In-flight
Temperature Range	0 to 35 °C (Ambient)
Analog I/O (4-20 mA/0-10 V)	4 (2 I/P, 2 O/P)
Digital I/O	16 I/O Max *2

SPECIFICATIONS	MODEL 3000
Communication : Ports : Type : Protocols	8 Maximum *3 Serial RS 232/422/485 Standard ASCII, MODBUS RTU
I/O Expansion slots	6
Dimensions : Panel Mount : Wall Mount (IP 65)	W x D x H :293 x 250 x 114 mm :300 x 255 x 145 mm
Weight	± 4 kg

*1,3.4 I/O expansion slots allocated to Load Cell and Communications (combined maximum)

*2 Depending on available free I/O expansions slots.