PC-COM4

Introduction

The PC-COM4 is an 8 or 16-bit ISABUS module providing up to four 16c550 type serial asynchronous communications channels: two of non-isolated RS232 and two channels that can be configured as either non-isolated RS232 or optically isolated RS422 or RS485. A depopulated version of the PC- COM4 (PC-COM4-RS232) is available, which does not contain the RS422/485 circuitry.

Features

- 4 off 16C550 compatible UART channels. (Referred to as channels A, B, C & D)
- 2 off opto-isolated RS422/485 ports, or full feature RS232 ports. (channels A & B)
- 2 off full feature RS232 ports. (channels C & D)
- Baud rates up to 115.2kbaud supported.
- +5V only operation.
- Configurable as standard PC AT COM1-4 or anywhere in I/O address range 000-3FFh
- Each channel is link selectable IRQ of 3, 4, 5, 7, 9, 10, 11, 12 or 15.
- Combined interrupt option for any channel combination to IRQ 3, 4, 5, 7, 9, 10, 11, 12, or 15.
- ISABUS 16 bit interface (but can be used in 8-bit slot if IRQ10,11, 12 and 15 are not required).
- Board access LED.
- Isolation:

Channel A to Channel B	>100V DC
Channels A or B to Channels C or D	> 100V DC
Channels A or B to ISABUS Ground	> 100V DC
Channels A or B to Chassis Ground	> 100V DC

- Power Requirements:
  120mA (typ) at +5V DC
- Temperature Range:
  0 ºC to +70 ºC operating.
  - 40 ºC to +125 ºC storage.
- MTBF 181, 152 hours (PC-COM4)
  232, 837 hours (PC-COM4-RS232)

(Calculated using MIL-HDBK-217F generic failure rates at Ground Benign)

Note:

In order to prevent confusion between standard PC AT nomenclature of COM1-4, this manual will refer to the four communications channels on the PC-COM4 as Channel A-D. Where the manual refers to COM1-4, this will mean the standard PC AT communications ports.

Product Components

As shipped, the PC-COM4 is supplied with the following items:

- The PC-COM4 board.
- This Manual
- A disk containing a ‘C’ example program and the UART data-sheet in Adobe Acrobat (Portable Document) Format.

Adobe Acrobat Reader can be downloaded free of charge from Arcom’s Internet Site at http://www.arcomcontrols.com

Description

The PC-COM4 uses a quad 16C550 type UART device to provide the four communications channels. The 16C550 device is the standard type of UART used on PC AT type machines and is supported by a wide range of third party software.

Two channels on the PC-COM4 (channels A and B) can either be configured as RS323 or RS422/485. When configured as RS422/485 these are independently electrically isolated from the ISABUS bus and can be configured for either RS422 type communications or RS485 type communications. When configured for RS232 these channels offer all the signals found on a PC AT type 9-pin RS232 port.

Similarly, the other two channels (CandD) are configured as RS232, supporting all the signals found on a PC AT type 9-pin RS232 port.

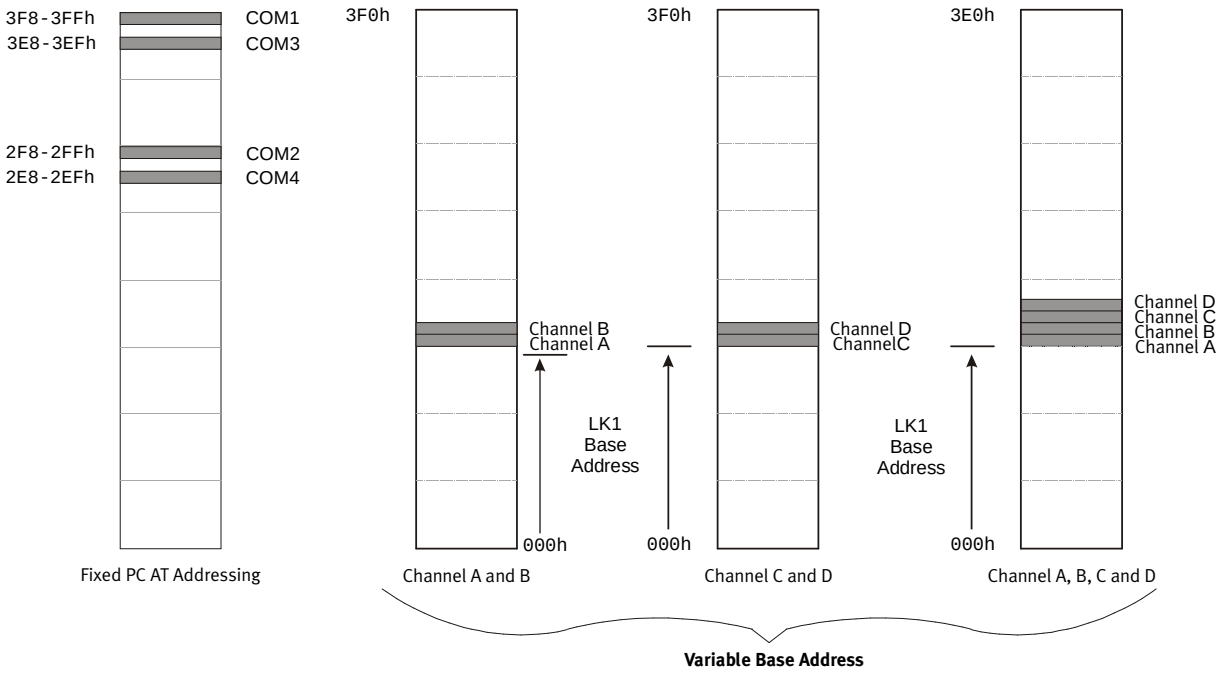
A flexible addressing system allows the four channels to be mapped into the standard PC AT communications channel addresses for COM1-4. Alternatively, pairs of channels can be mapped into any I/O location from 000-3FFh. See later for more details of address mapping.

Each channel has its own interrupt line that can be linked to any of the following ISABUS Interrupts IRQ3-5, 7, 9-12, 15. Additionally, interrupts from any combination of channels may be ORed together to produce a single interrupt to any of the above signals.

The PC - COM4 has a 16 bit ISABUS connector but utilises only interrupt lines IRQ10, 11, 12 and 15 on the 16-bit part of the ISABUS connector. This means that the board can also be used in an 8 bit ISABUS slot providing that these interrupt lines are not required.

I/O Map

The PC-COM4 has a flexible addressing system that allows the channels A, B, C and D to be addressed at the fixed PC locations for COM1, COM2, COM3 and COM4, or allows them to be addressed using the user base address link LK36:



The option link LK34 defines the addressing mode for channels A and B, and channels C & D as follows:

LK34 – Option Link				Channel Address Mapping			
CD1	**CD0**	**AB1**	**AB0**	**Chan A**	**Chan B**	**Chan C**	**Chan D**
X	X	Omit	Omit	COM1	COM2	X	X
X	X	Omit	Fit	COM 2	COM 3	X	X
X	X	Fit	Omit	COM 3	COM 4	X	X
X	X	Fit +	Fit +	Variable Base Address		X	X
Omit	Omit	X	X	X	X	COM 1	COM 2
Omit	Fit	X	X	X	X	COM 2	COM 3
Fit +	Omit +	X	X	X	X	COM 3	COM 4
Fit	Fit	X	X	X	X	Variable Base Address	

Additionally, LK31 can be used to disable any channel from being addressed by removing the appropriate link A, B, C or D.

Each channel occupies 8 bytes of I/O space with the following registers defined:

Register Offset	Mnemonic	Read Register	Write Register
General Register Set (DLAB[ICR:7]clear)			
0	RHT/THR	Receive holding register	Transmit Holding Register
1	IER	Interrupt Enable Register	
2	ISR/FCR	Interrupt Status Register	FIFO Control Register
3	LCR	Line Control Register	
4	MCR	Modem Control Register	
5	LSR	Line Status Register	
6	MSR	Modem Status Register	
7	SCR	Scratchpad Register	
Baud Rate Register Set (DLAB[ICR:7]set)			
0	DLL	LSB of Divisor Latch	
1	DLM	MSB of Divisor Latch	

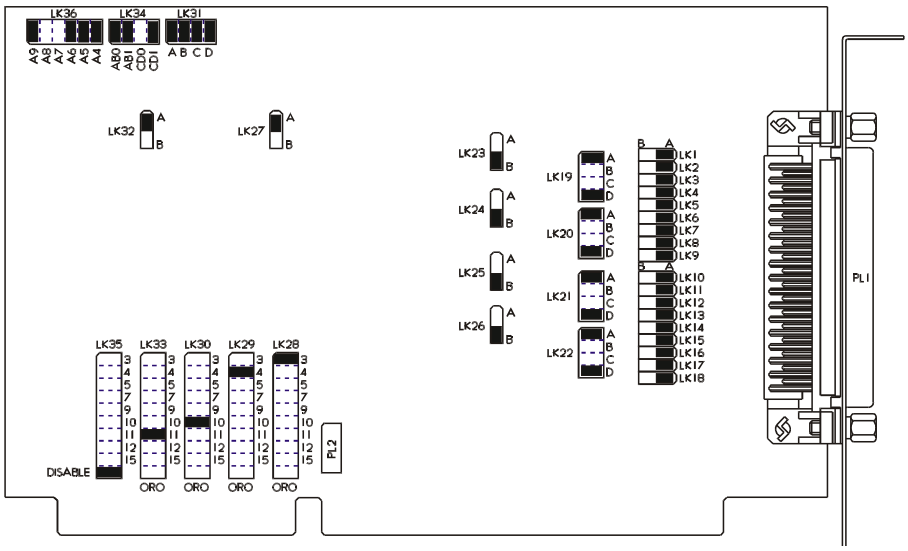
Interrupts

Four links, LK28-30,33 define the interrupt mapping for each of channels A to D respectively. Each channel can be connected to any of IRQ3, 4, 5, 7, 9, 10, 11, 12 or 15. Note that IRQ10, 11, 12 and 15 are only available when the PC-COM4 is used in a 16 bit ISABUS slot.

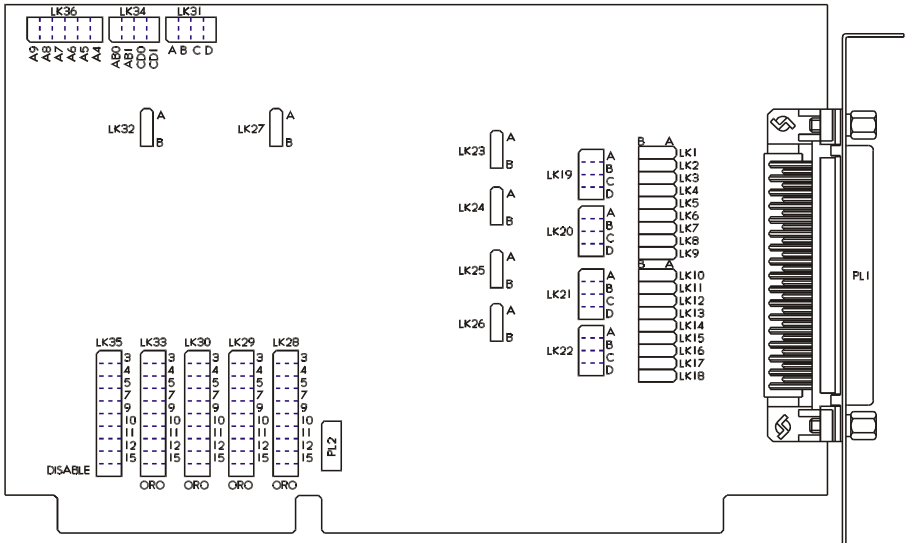
If any of links LK28-30,33 is fitted in the OR position, then this channels interrupt is ORed to link LK35 which can then be connected to any of the above IRQ lines. This permits all of the UARTs on the PC-COM4 to share a single interrupt line to conserve IRQ resources.

Links

Link Position Diagram



User Configuration Diagram



Default Shipment Configuration

Channel	PC/AT COM	I/O Address	IRQ Number	Comms Type	Terminator
A	n/a	180h	11	RS485	Pulled inactive
B	n/a	188h	10	RS485	Pulled inactive
C	COM3	3E8h	4	RS232	n/a
D	COM4	2E8h	3	RS232	n/a

LK1-9, 32 Channel B Configuration Links

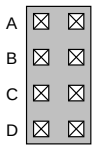
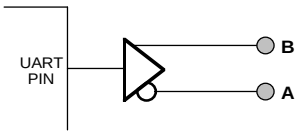
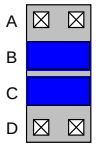
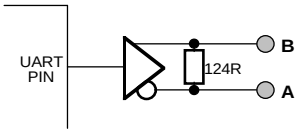
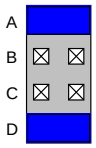
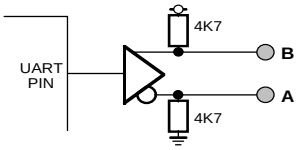
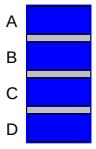
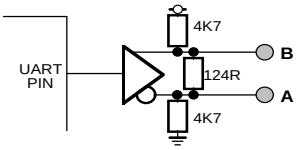
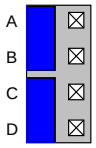
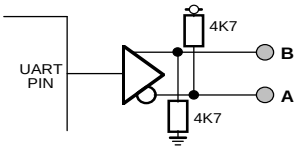
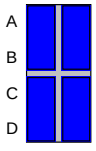
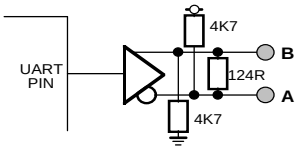
These links are used to configure channel B for either RS232 operation (all links in position A) or RS422/485 operation (all links in position B). The default configuration is for RS422/485 (all B).

LK10-18, 27 Channel A Configuration Links

These links are used to configure channel A for either RS232 operation (all links in position A) or RS422/485 operation (all links in position B). The default configuration is for RS422/485 (all A)

LK19-22 Differential Pair Termination Links

Each differential Pair on Channels A and B can be terminated in six ways according to the following table:

Link Configuration	Circuit Configuration	Description
		***Unterminated*** Line Driver connects directly to the differential pair.
		***Terminated*** Differential pair is terminated with 124R resistance between signal lines.
		***Pulled Inactive*** + Differential pair is pulled apart to mimic no character being transmitted from the UART.
		***Pulled Inactive and Terminated*** Differential pair is terminated with 124R and is pulled apart to mimic to character being transmitted.
		***Pulled Active*** Differential pair is pulled apart to mimic a UART sending a break condition.
		***Pulled Active and Terminated*** Differential pair is terminated with 124R and is pulled apart to mimic a break condition.

Note: Optical Isolation has been omitted from the above diagrams to aid clarity..

(Default link positions are marked +.)

The following links relate to the following differential pairs:

Link	Channel	RS422 Pair	RS485 Pair	Signal Names
LK19	B	Transmit	BI-directional	B-TXBA, B-TXBB
LK20	B	Receive	n/a	B-RXA, B-RXB
LK21	A	Transmit	Bi-directional	A-TXBA, A-TXBB
LK22	A	Receive	n/a	A-RXA, A-RXB

LK23, 24 Channel B Mode Links

LK23	LK24	Mode	Comment
A	A	RS422 Point-point	Transmit on B-TXB, Receive on B-RX
B	A	RS422 Multi-drop	Transmit on B-TXB, Receive on B-RX
B+	B+	RS485	Transmit and Receive on B-TXB

(Default positions marked with +).

LK25, 26 Channel A Mode Links

LK25	LK26	Mode	Comment
A	A	RS422 Point-point	Transmit on B-TXB, Receive on B-RX
B	A	RS422 Multi-drop	Transmit on B-TXB, Receive on B-RX
B+	B+	RS485	Transmit and Receive on B-TXB

(Default positions marked with +).

LK28-30,33 Channel Interrupt Links

LK28-30,33 are the interrupt select links for channels D to A respectively. The possible IRQ lines available are IRQ3, 4, 5, 7, 9, 10, 11, 12 and 15. Note that it is only possible to use IRQ lines 10, 11, 12 and 15 when the PC-COM4 is inserted in a 16 bit ISABUS slot. (Default links are: LK29 position 4, LK28 position 3, LK33 position 11, LK30 position 10.)

See section on Interrupts above.

If any link is in position OR, then that channels IRQ is ORed with all the other channels with links in the same position and passed to the shared interrupt link LK35. (See later for description.)

LK31 Channel Enable Link

LK31 is used to enable each of the channels. Fit a link to enable the addressing of a channel, omit it to disable. (Default is all enabled.)

LK34 OPtion Link

LK34 – Option Link				Channel Address Mapping			
CD1	**CD0**	**AB1**	**AB0**	**Chan A**	**Chan B**	**Chan C**	**Chan D**
X	X	Omit	Omit	COM1	COM2	X	X
X	X	Omit	Fit	COM 2	COM 3	X	X
X	X	Fit	Omit	COM 3	COM 4	X	X
X	X	Fit +	Fit +	Variable Base Address		X	X
Omit	Omit	X	X	X	X	COM 1	COM 2
Omit	Fit	X	X	X	X	COM 2	COM 3
Fit +	Omit +	X	X	X	X	COM 3	COM 4
Fit	Fit	X	X	X	X	Variable Base Address	

For more information see the I/O Map section above. (Default positions marked with +).

LK35 Shared Interrupt Link

LK35 is the shared interrupt link. Any channel whose IRQ link is selected at position O OR R will be ored together and passed to this link. This link can then be set for any of the positions 3, 4, 5, 7, 9, 10, 11, 12 or 15 or **Disabled**. The default position is **Disabled**.

LK36 Address Link

L LK K3 36 6 is the address decode link. The desired user base address is set on this link. Note that if two channels are configured to use the user address then this defines the base address of a 16 byte access window in the I/O space and can be set on any 16 byte boundary from 000h to 3F0h; if four channels are configured to use the user address link A4 is ignored: LK36 defines a 32 byte window on any 32 byte boundary from 000h to 3E0h. (Default LK36 setting is for base address of 180h.)

See I/O Map section above.

Using the Differential Communications Channels - A and B

In order to use channels A and B on the PC-COM4 they must be configured appropriately:

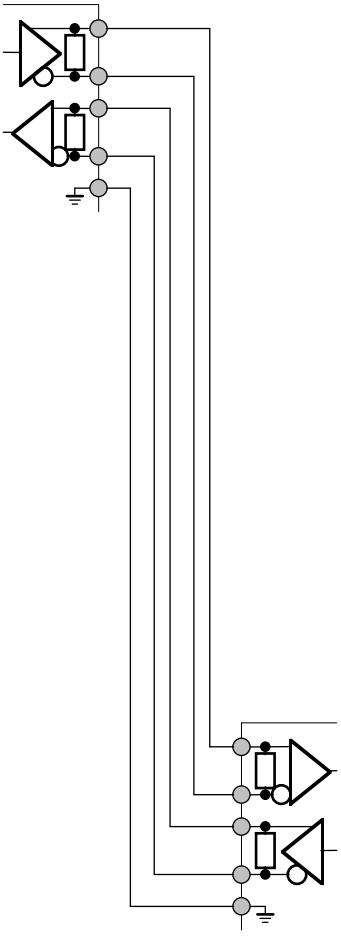
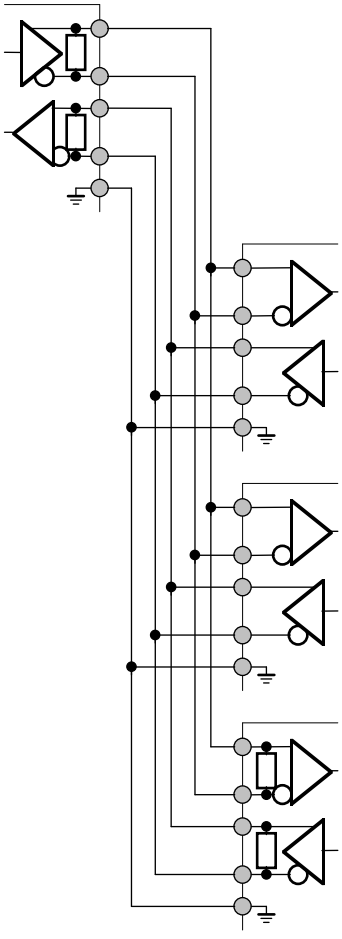
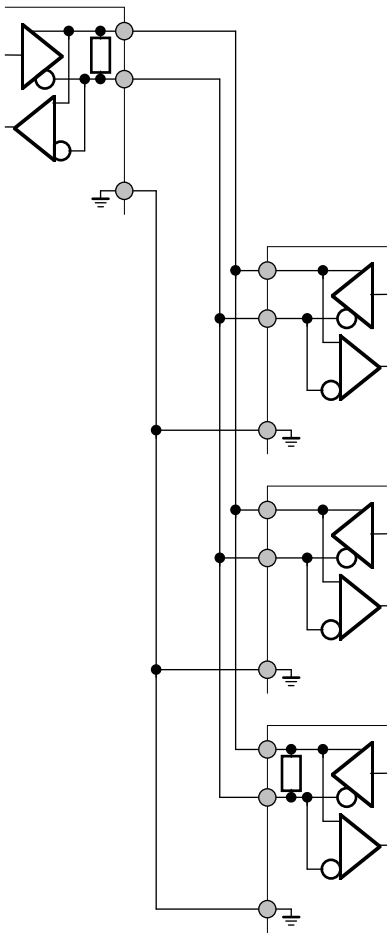
Address and Interrupt Selection

The I/O address of channels A and B must first be configured, together with the interrupt line for each channel. You will need to refer to the documentation on your CPU card to establish spare I/O and interrupt channels to use.

Then refer to the I/O Map, Interrupts and Links section of this manual to configure the appropriate links.

Communications Mode

The PC-COM4 supports both RS422 and RS485 type differential communications modes. In the RS422 mode of operation, this can function as either point to point or multidrop. The differences between each of the configurations is illustrated below:

RS422 Point-point	RS422 Multi-drop	RS485
		
Number of Wires 5 **Transmitters Enabled** always **Receivers Enabled** always **Duplex Mode** full **LK23 (LK24)** position A **LK25 (LK26)** position A **LK1-9, 27 (LK10-18, 28)** position B	**Number of Wires** 5 **Transmitters Enabled** active RTS **Receivers Enabled** always **Duplex Mode** full **LK23 (LK24)** position B **LK25 (LK26)** position A **LK1-9, 27 (LK10-18, 28)** position B	**Number of Wires** 3 **Transmitters Enabled** active RTS **Receivers Enabled** inactive RTS **Duplex Mode** half **LK23 (LK24)** position B **LK25 (LK26)** position B **LK1-9, 27 (LK10-18, 28)** position B

Note: LK25 and 26 are the mode links for channel A, LK23 and 24 (in brackets) are for channel B.

If you are designing your own systems implementation from scratch, you will be able to select the appropriate type of communications standard for your system:

RS422 point-point is a good way of connecting two pieces of equipment together as the differential communications system gives good noise immunity and the full duplex gives high speed.

RS422 Multi-drop is suitable for systems where one piece of equipment is controlling a number of other pieces of equipment in a master/slave type relationship. The full duplex nature of the system provides for high speed communication. Be aware that the software must ensure that no two transmitters are driving on to the bus at once. The line drivers have protection circuitry in them to prevent damage occurring, but communications data will be lost.

RS485 is also a multi-drop configuration and is ideal for peer-peer networking or for systems where cabling cost is large so there is advantages to be gained with a three wire system. Not again that the software must ensure that only one transmitter is driving the communications pair at once.

Configure links LK23-26 for the appropriate differential communications mode for channels A and B.

Line Terminations

Differential communications pairs should be terminated to prevent reflections from either end of the communications cables. Each pair should be terminated at each end of the wire run with a resistance that matches the impedance of the cable.

The PC-COM4 is capable of terminating each of the differential pairs on channels A and B using links LK19-22. Two types of termination network can be configured: line matching terminators and pull apart resistors.

Line Matching Terminators

124 ohm resistors can be linked across each communications pair (see Links section). This will be a fair match with twisted pair wiring. These should be configured on boards at either end of the wiring run only.

Pull Apart Resistors

The PC-COM4 is also able to pull each line of a communications pair to either +5V or 0V through a 4K7 resistor. This facility is primarily intended for use in RS422 multi-drop or RS485 systems to ensure that the communications pair floats to a known state when no transmitters are active.

Normally, a communications pair would be pulled apart in the inactive state. This mimics the condition where no character is being transmitted from the UART. It is however possible for the PC- COM4 to pull the communications pair in either direction.

Care should be taken when using the pull-apart resistors in systems with multiple pieces of equipment on the same pair as each fitted pull apart network will load the line driver devices. Reduce the number of fitted resistor networks to prevent this causing problems.

If there are no pull-apart resistor networks fitted anywhere on a multi-drop communications pair, it will be necessary for software to wait in excess of one character transmission time after asserting the RTS signal before loading the first character into the UART transmit buffer. This gives the receiving equipment time to clear any error character caused by a rogue start bit when the line driver was enabled at the transmitter.

Software Considerations

RS422 point-point does not require any special consideration within the software other than that hardware handshaking is obviously not possible. If flow control is required, it must be implemented by software such as the use of the XON/XOFF protocol.

RS422 multi-drop and RS485 configurations need careful control of the RTS signal from the UART which is used to enable the transmitter on the differential pair.

RTS needs to be asserted prior to the beginning of the first start bit of the first transmitted character transmitted from the UART and needs to be disabled after the last stop bit of the last character has actually been transmitted from the UART.

The opto-isolation on the PC-COM4 has a fixed delay from RTS becoming active on the UART to the line driver switching ON of approximately 2 microseconds. A delay must be added before loading the first character into the UART transmit buffer to ensure that the driver is ON.

After a character has been transmitted on the UART, it is possible to monitor the TEMT (Transmitter Empty) bit of the Line Status register. Only after this has become asserted is it valid to negate the RTS signal. ***Reception of a Transmit Buffer Empty interrupt is not a valid condition for negating RTS. The output shift register of the UART is still active until the TEMT bit is set.***

Using Channels A and B in RS232 mode

Channels A and B can be used as normal RS232 ports by appropriately configuring links LK1-9,32 for channel B and LK10-18,27 for channel A.

Using the RS232 Channels - C & D

The RS232 channels on the PC-COM4 are of a standard implementation providing for all of the standard signals available on a nine way RS232 interface.

Address and Interrupt Selection

The I/O address of channels C and D must first be configured, together with the interrupt line for each channel. You will need to refer to the documentation on your CPU card to establish spare I/O and interrupt channels to use.

Then refer to the I/O Map, Interrupts and Links section of this manual to configure the appropriate links.

Connector

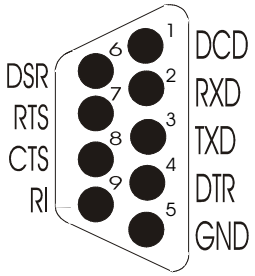
PL1 Pin Assignments

Channel	Description	Pin	Pin	Description
D	Data Carrier Detect (D-DCD)	1	34	(D-DSR) Data Set Ready
	Received Data (D-RXD)	18	2	(D-RTS) Ready to Send
	Transmitted Data (D-TXD)	35	19	(D-CTS) Clear to Send
	Data Terminal Ready (D-DTR)	3	36	(D-RI) Ring Indicator
	RS232 Signal Ground (GND)	20	4	(CHASSIS) Screen or Shield
C	Data Carrier Detect (C-DCD)	37	21	(C-DSR) Data Set Ready
	Received Data (C-RXD)	5	38	(C-RTS) Ready to Send
	Transmitted Data (C-TXD)	22	6	(C-CTS) Clear to Send
	Data Terminal Ready (C-DTR)	39	23	(C-RI) Ring Indicator
	RS232 Signal Ground (GND)	7	40	(CHASSIS) Screen or Shield
	reserved	24	8	reserved
	reserved	41	25	reserved
	reserved	9	42	reserved
	reserved	26	10	reserved
	reserved	43	27	reserved
B	B-DCD Isolated Channel B +5V	11	44	no connect B-DSR
	B-RXD Isolated Chan B Ground (GND)	28	12	Isolated Chan B Ground (GND) B-RTS
	B-TXD RS422 Tx / RS485 B (B-TXBB)	45	29	RS422 Tx / RS485 A (B-TXBA) B-CTS
	B-DTR RS422 Rx Line B (B-RXB)	13	46	RS422 Rx Line A (B-RXA) B-RI
	B-RI Isol Chan B Res Gnd (RGND)	30	14	(CHASSIS) Screen or Shield
A	A-DCD Isolated Channel A +5V	47	31	no connect A-DSR
	A-RXD Isolated Chan A Ground (GND)	15	48	Isolated Cha A Ground (GND) A-RTS
	A-TXD RS422 Tx / RS485 B (A-TXBB)	32	16	RS422 Tx / RS485 A (A-TXBA) A-CTS
	A-DTR RS422 Rx Line B (A-RXB)	49	33	RS422 Rx Line A (A-RXA) A-RI
	A-RI Isol Chan A Res Gnd (RGND)	17	50	(CHASSIS) Screen or Shield

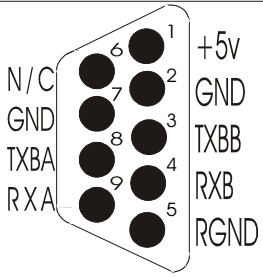
CAB PC-COM4

PL3 has been wired so that it can easily split into standard 9 way male D-sub connectors with standard pin-outs for communications channels. Supplied with the PC-COM4 is a suitable example cable. Tha CAB PC-COM4 is wired as follows

PC/AT RS232 Port Pinout



Arcom SERT-485 Pinout



Cable connectors A and B can be of either pinout depending on links LK1-18. Cable connectors C and D are always RS232 pinout.

Installation for CE Compliance

To maintain compliance with the requirements of the EMC directive (89/336/EEC), this product must be correctly installed. The PC system in which the board is housed must be CE compliant as declared by the manufacturer. The external I/O cable should be the Arcom CAB PC-COM4, or a fully screened cable to the same pattern.

1. Remove the cover of the PC observing any additional instructions of the PC manufacturer.
2. Locate the board in a spare PCI local bus slot and press gently but firmly into place.
3. Ensure that the metal bracket attached to the board is fully seated.
4. Fit the bracket clamping screw and firmly tighten this on the bracket.
   Note:- Good contact of the bracket to the chassis is essential.
5. Replace the cover of the PC observing any additional instructions of the PC manufacturer.

Cable

Cable length 1 Metre or less	:	Ribbon cable satisfactory.
Cable 1 Metre to 3 Meters	:	Commercial screened cable.
> 3 Meters of noisy environment	:	Use fully screened cable with metal backshells e.g. Arcom CAB50CE

The following standards have been applied to this product:

BS EN50081-1 : 1992 Generic Emissions Standard, Residential, Commercial, Light Industry
BS EN50082-1 : 1992 Generic Immunity Standard, Residential, Commercial, Light Industry
BSEN55022 : 1995 ITE Emissions, Class B, Limits and Methods.

Appendix A. Notes on Using the 16C550 UART

Enabling the Interrupt Outputs

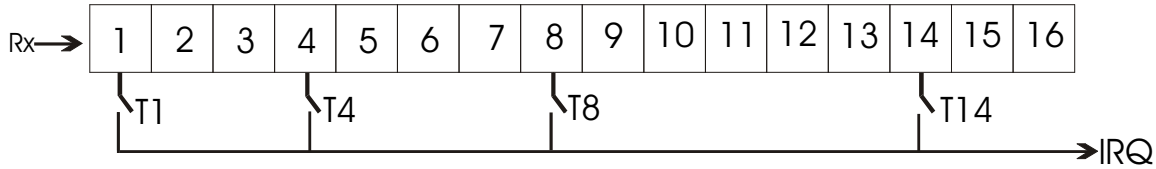
If you intend to write your own low level UART handler, it is necessary to remember that in order for the UART channel on the PC-COM4 to generate interrupts to the host CPU, you must enable the IRQ output from the UART by setting bit 3 in the Modem Control Register (MRC).

Standard driver software (including that supplied on the library disk with the PC-COM4) will do this as part of the port initialisation, so no action will be necessary if you are using Arcom's software or that of a 3rd. party vendor.

The Receiver FIFO Trigger Point and Timeout

The 16C550 has sixteen byte FIFO's for both it's transmit buffer and receive buffer. This can enhance the performance of the serial ports and reduce the interrupt rate main processor. However, it is necessary to set up the receive trigger point optically for your application.

With the FIFO enabled, any receive character is added to the 16 byte receive FIFO. This has four programmable trigger points as shown in the following diagram:



Once the FIFO has received sufficient characters to reach the FIFO trigger point, an interrupt is generated that is serviced in order to remove all the characters from the FIFO.

If the stream stops adding characters to the FIFO before the trigger point is reached. For example the trigger may set at eight when only six characters has been received. In this situation the UART will generate an IRQ after specific timeout period from the end of the last character received.

The timeout period, expressed in the number of characters can be calculated using the following equation:

$$T = \frac{(4 \times n_{Char}) + 12}{(n_{Parity} + n_{Char} + n_{Stop} + 1)}$$

Where: n_{Char} is the number of programmed bits per character (5, 6, 7 or 8)

n_{Parity} is the number of programmed parity bits (1 unless no parity)

n_{Stop} is the number of stop bits (1 ,1 or 2)

The actual time for timeout is simply defined as :

$$t = \frac{(4 \times n_{Char}) + 12}{F_{Braud}}$$

Where F_{Braud} is the baud rate.

For example, communications at 9600 baud, 8 data bits, no parity and 1 stop bit would have the following timeout period:

$$T = \frac{(4 \times 8) + 12}{0 + 8 + 1 + 1} \quad \frac{44}{10} = 4.4 \text{ chars} \qquad t = \frac{(4 \times 8) + 12}{9600} = 4.58 \text{ ms}$$

This timeout can significantly impact on the performance of the serial communications within an application. If your serial communications is single character orientated, it is better to set the FIFO trigger point lower and handle more frequent receive interrupts. If your application transfers large blocks of data it is probably better to set the FIFO trigger point higher.

Remember that the FIFO trigger point does not define the size of the FIFO; characters are still received after the trigger has been activated until all sixteen positions in the FIFO have been

Appendix B. Utility Disk

The utility disk supplied contains the excutable `com4util`. This program is intended to help you check that the PC-COM4 board is functioning correctly following installation; instructions are given in `readme.txt`. The data sheet for the UART is in the subdirectory data, in `st16554.pdf`.

The source `code com4util.c` and project files are also supplied in this directory. It is intended that some of the functions in the code will be of use in writing your own programs for the PC-COM4. If you have Borland C++V4.52, create a directory on your hard drive called `pc_com4` and copy the entire contents of the disk into it. You will be able to run the `com4util.ide` Intergrated Development Environment straight away. If you have another C compiler, the source code may require translation by that compiler prior to recompilation, in particular when using Microsoft C.

The header files `stddefs.h` and pcints.h are in the subdirectory `inc. pcints` contains the interrupt definitions and will be particularly useful.

Function Descriptions

The following functions are defined in `com4util. c:`

```
Void Init_Channel (int port, int rate)
```

- Initialises a channel given its base address and baud rate. The baud rate argument must be in the format given on page 5-42 of the UART data sheet. Use the first column (1.8432 Mhz). The function sets the serial format to 8 data bits, two stop bits and no parity. To set your own format refer to page 5-49 of the UART data sheet.

```
void AssertRTS (int port)
```

- For use with channels A or B when set to RS422/485 mode. Call this function prior to tranamitting on this channel.

```
Void DeAssertRTS (int port)
```

- For use with channels A or B when set to RS422/485 mode. Call this function when finished transmitting on this channel.

```
Word serout (int port, char character)
```

- Transmits the byte argument down the port. The port must have been initialised first using Init_Channel (). The most significant byte of the returned word contains the status bits indicating any errors that occurred.

```
WORD serin (int port)
```

- Reads a charater in from the given port. The read-in character is returned in the LSB of the word and status bits are returned in the MS. You may choose to call serin in a loop, e.g if polling, but it will usually be better to call it when a receive interrupt has been generated, as in this example program.

```
void interrupt ISR_SERRQ (void)
```

- The interrupt service routine. This one checks the interrupt flag register of each port, clears the interrupt and sets the global interrupt flag. In this simple program, where only port is receiving at a time (and where the default settings provide a different interrupt for each port) it is sufficient only to know that an interrupt has occurred. In situations where it is unclear which port generated the interrupt, this IRS will need to be modified.

Page 5-46 of the UART data sheet shows how to use the Interrupt Enable Register to set the conditions for interrupt : for example, setting the board to generate an interrupt whenever a character has been received, or when the receive FIFO has filled to a certain level, or a character has been successfully transmitted.

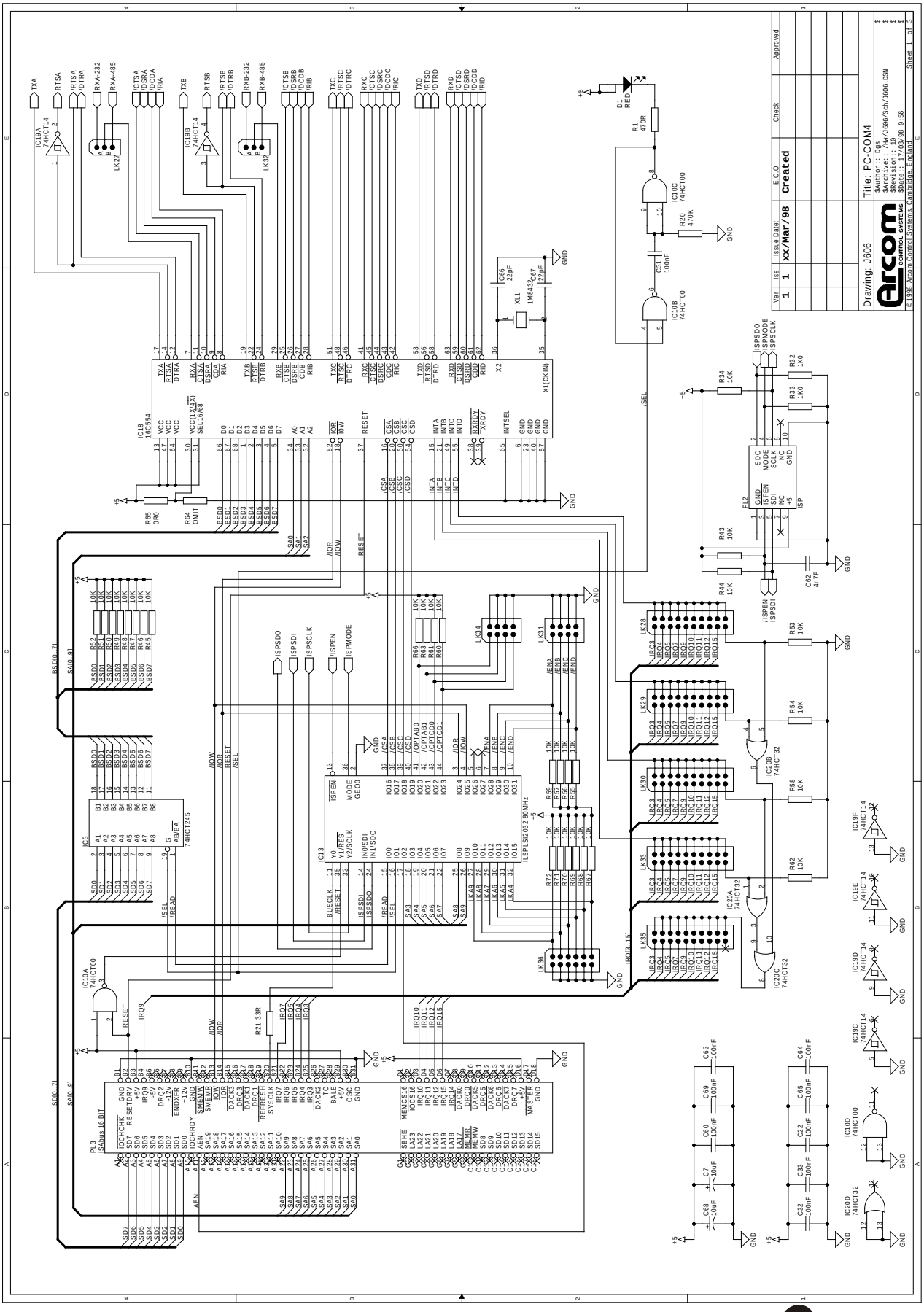
```
Void far *Install (void interrupt (*faddr) ( ), int vect_num )
```

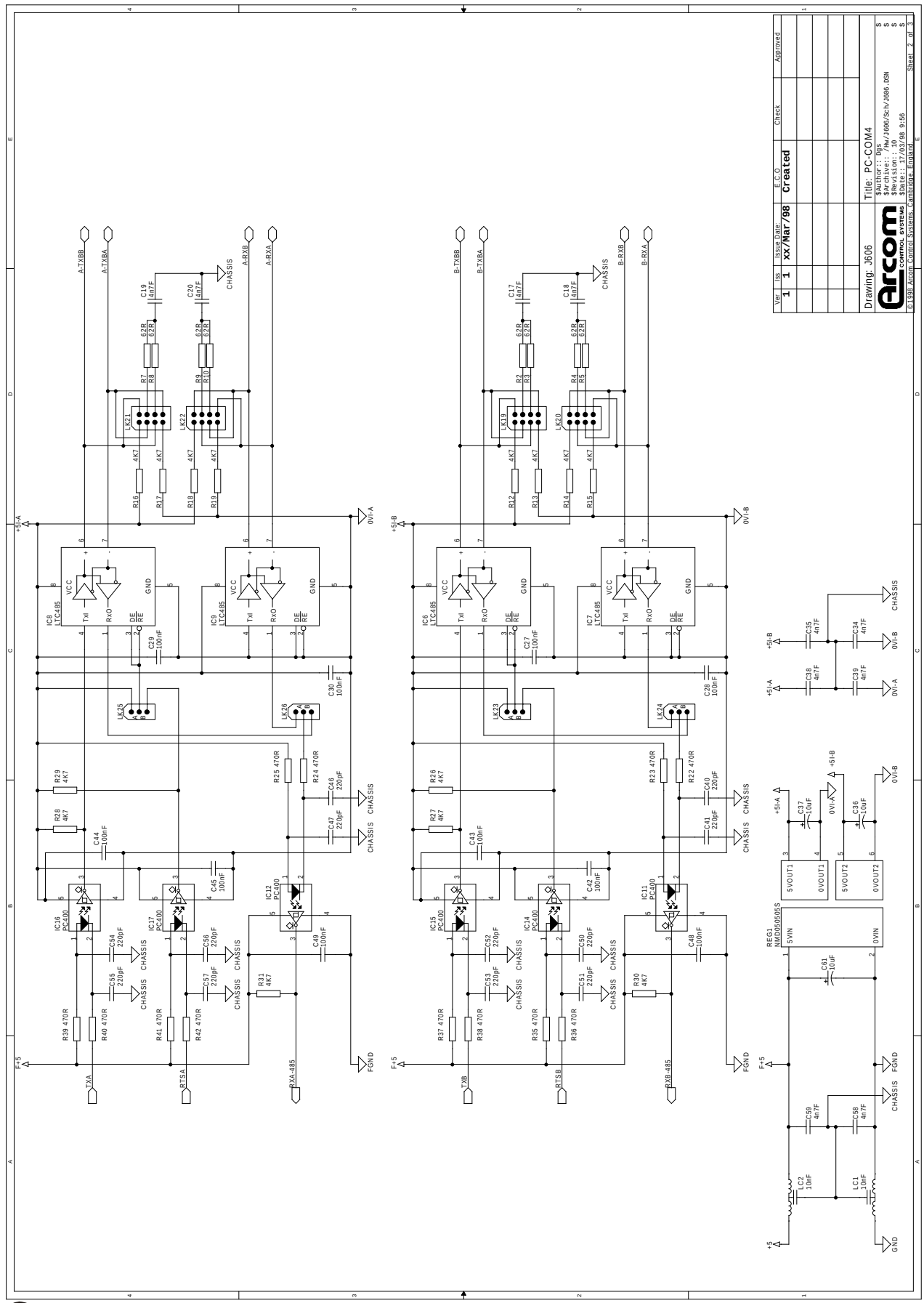
- Installs the given ISR onto the given interrupt vector

```
void DeInstall (void interrupt (*oldISR) ( ), int vect_num)
```

- Re-installs the old ISR.

Appendix C. Circuit Diagrams

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Ver. 1
Iss 1
Issue Date: xx/Mar/98
E.C.O Created
Check
Approved
Arcom CONTROL SYSTEMS
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Sheet 2 of 3
IC8 LTC485
IC9 LTC485
IC6 LTC485
IC7 LTC485
IC16 PC400
IC17 PC400
IC12 PC400
IC15 PC400
IC14 PC400
IC11 PC400
REG1 NMD0505DS
A-TXB
A-TXA
A-RXB
A-RXA
B-TXB
B-TXA
B-RXB
B-RXA
+5I-A
0VI-A
+5I-B
0VI-B
F+5
FGND
CHASSIS
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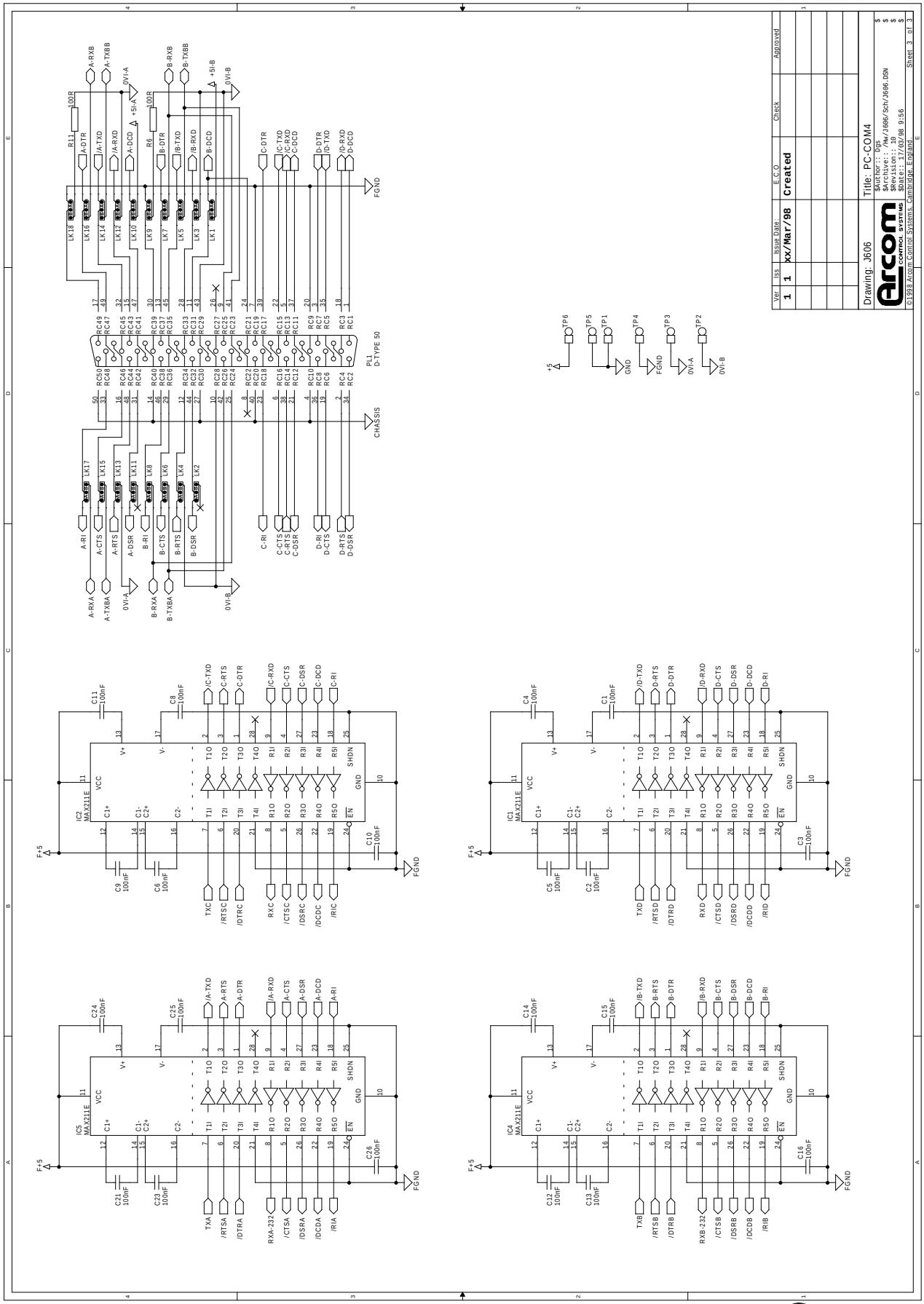
TXB
RTSB
RXB-485
+5
GND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Title: PC-COM4
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Sheet 3 of 3
A-RXB
A-TXBB
B-RXB
B-TXBB
A-DTR
A-TXD
A-RXD
A-DCD
B-DTR
B-TXD
B-RXD
B-DCD
C-DTR
C-TXD
C-RXD
C-DCD
D-DTR
D-TXD
D-RXD
D-DCD
FGND
CHASSIS
A-RI
A-CTS
A-RTS
A-DSR
B-RI
B-CTS
B-RTS
B-DSR
C-RI
C-CTS
C-RTS
C-DSR
D-RI
D-CTS
D-RTS
D-DSR
A-RXA
A-TXBA
B-RXA
B-TXBA
0VI-A
0VI-B
+5I-A
+5I-B
PL1 D-TYPE 50
IC2 MAX211E
IC5 MAX211E
IC1 MAX211E
IC4 MAX211E
TXC
/RTSC
/DTRC
RXC
/CTSC
/DSRC
/DCDC
/RIC
TXA
/RTSA
/DTRA
RXA-232
/CTSA
/DSRA
/DCDA
/RIA
TXD
/RTSD
/DTRD
RXD
/CTSD
/DSRD
/DCDD
/RID
TXB
/RTSB
/DTRB
RXB-232
/CTSB
/DSRB
/DCDB
/RIB
TP1
TP2
TP3
TP4
TP5
TP6
GND
FGND
0VI-A
0VI-B
+5

Manual	PCB	Comments
Issue A	V1 Iss 1	981110 Manual first released in this format

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