Model Electronic Railway Group
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RPI Remote Panel Interface PIC — November 2001

Introduction

The Remote Panel Interface PIC Module provides the vital link between the Personal Computer (PC) and the layout. This design replaces the original 8051 based version which required external EPROM and associated bus latching devices.

The new design uses a single Arizona Microchip 'PIC' device (hence RPIC) which removes the need for most of the external components. Whilst the RPIC was conceived for layout control, clearly the PCB could be used as the basis for any design using this type of PIC microcontroller. Four versions of the RPIC are currently planned. It is intended that two of the new designs will be virtually direct replacements for the original 8051 versions, avoiding the need for any major changes to any software already in existence. At worst, this would be limited to renumbering the bytes using a much simpler and easier to understand structure, similar to the PTP System numbering method (see G16/23), for which this new numbering scheme was originally developed. All bytes now number from zero.

The first of the new types (RPIC232) uses the commonly available RS232 Interface Standard which allows a single RPIC Module to be connected directly to a standard PC COM port. Up to 32 Bytes of I/O capability is provided, (32 out, 32 in) which can be made up from any combination of RPC System Modules. This is equivalent to, and replaces, the original RPI Issue 6.

The second (RPIC485) uses the RS485 Interface Standard which allows multiple RPIC modules to be connected together via a single screened twisted pair cable giving distributed control centres around the layout. This is equivalent to, and replaces, the original RPI Issue 7, though it will also include support for the fourth version (see below).

The third (RPICUSB) uses the USB 1.1 Interface Standard acting as a single panel interface, much like the RS232 version in principle. This is intended for modern PCs, many of which lack RS232 COM ports, but have USB 1.1 capability.

The fourth (RPICUSB+) uses the USB 1.1 Interface Standard, but also acts as a 'bridge' to further RS485 RPICs distributed around the layout, i.e. multiple extra 'second' versions.

The RPIC Module interprets and acts on the messages sent from the PC using the protocols specified in Technical Bulletin G16/4 Issue 2. The new functionality expands on the original capabilities listed in Issue 1.

Interface Specifications

- **Power Requirements** — +5V to +18V DC Regulated Supply, 1A Max, depending on attached Modules. (See text regarding USB power options)
- **Module Control Output** — RPC Shift Register Compatible.
- **Connectors** — 10 way Molex for RPC Module Stack (J1).
  3 way Molex for Serial Interface (J4).
  Type B USB Socket (J5).
  2 pin Unpluggable Screw Terminal for Power Input (J2).
  14 pin dual row boxed header for LCD using ribbon cable (J3).
- **Indicators** — "TX" Activity LED, "RX" Activity LED.

Circuit Description

The main component of the RPIC Module is the Microcontroller IC1. This is one of many variants of the popular 'PIC' family from Arizona Microchip. The 40 pin DIL package was chosen for ease of use, and interchangeability with other similar devices in the Microchip range. The 'conventional' serial versions of RPIC use the PIC16F874, while the USB versions currently use the PIC16C765, pending the release of Flash programmable devices with USB facilities. Kits are supplied with the software pre-programmed into the device.

The PCB layout for the RPIC has been designed to be universal across all versions - you simply fit the components needed for your chosen type. All versions include an on-board voltage regulator with heatsink, though an option is provided on USB versions to power the module direct from the USB +5V supply.

An LCD display can be connected to the Module via J3. The LCD Contrast Bias is set at around 0.6V by R3 and D1. These components may be replaced if an LCD is connected which needs a different bias level.

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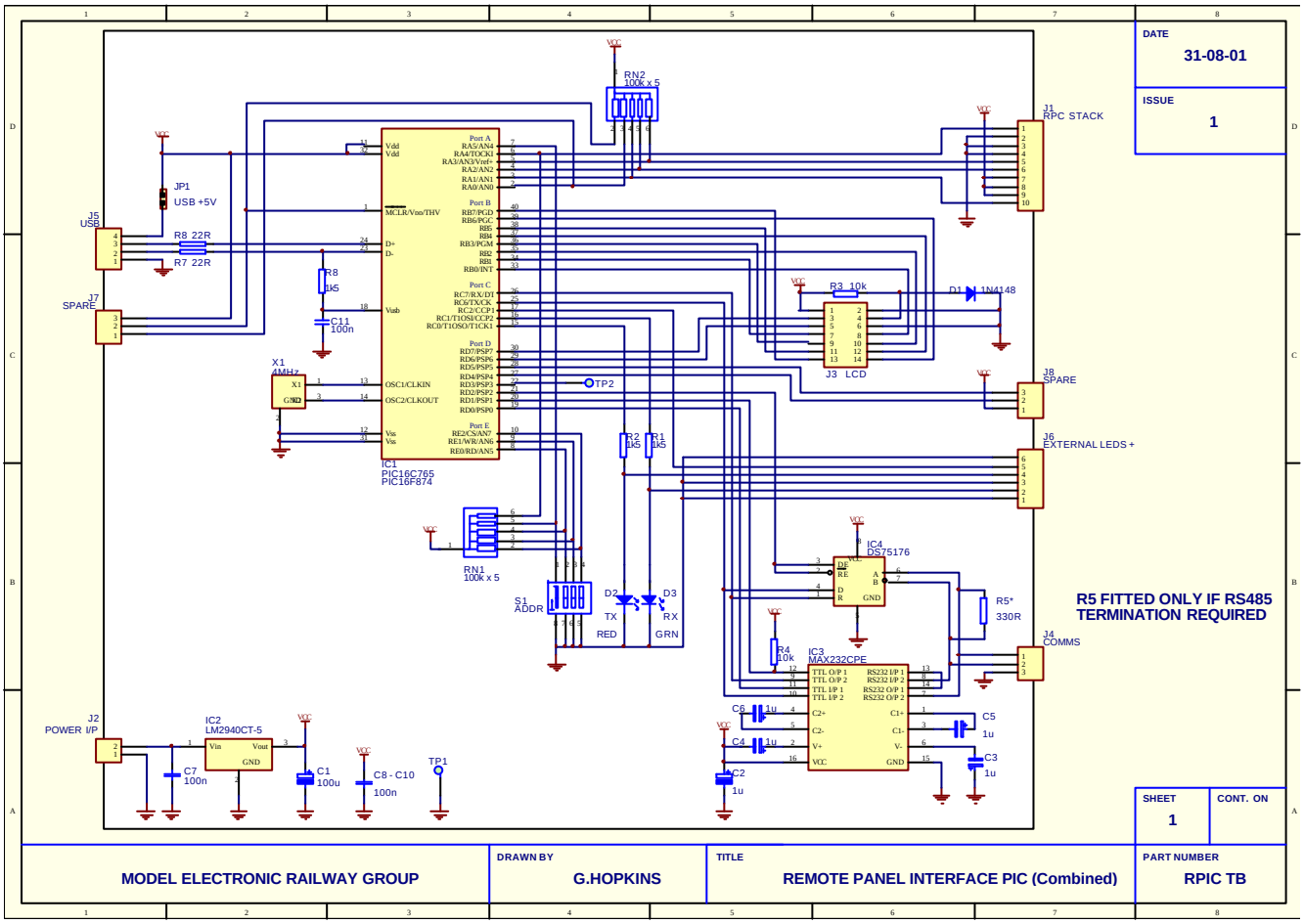
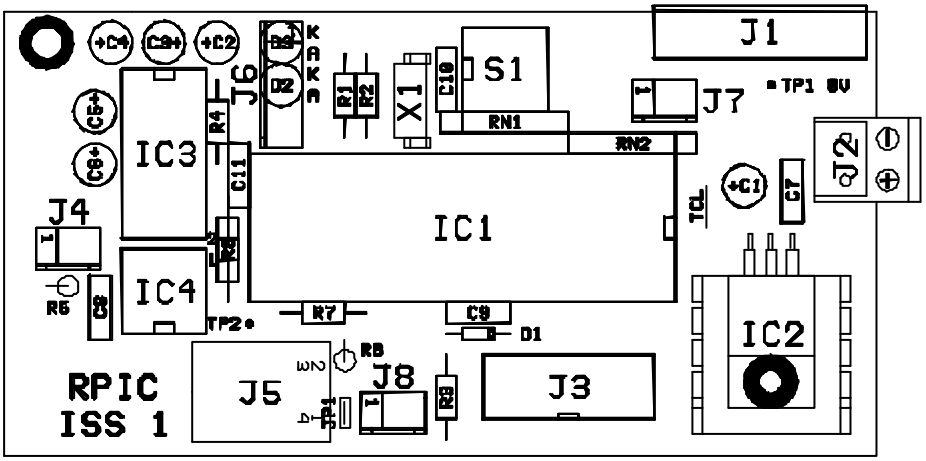
The pinout of J3 has been designed to allow a ribbon cable with IDC connectors to be used between it and the rear of the LCD. In doing so, the connector rows may appear to be reversed, so if planning to connect an LCD by any means other than ribbon cable, the pinout must be carefully checked between the two.

Serial Communication activity is indicated by LEDs D2 and D3. X1 is the PIC Oscillator, which runs at 4MHz on the '232' and '485' versions to provide a reasonably accurate 9600 Baud Rate for the communication interface (9615 actual). The USB versions require a 6MHz Oscillator to achieve the USB timing constraints. The capacitors provide supply line decoupling, C1 being the only one which is polarised. IC2 is a low drop-out (LDO) regulator which provides +5V output for any input between +5V and +18V. Space is provided for a small TO-220 heatsink on board, whose fasteners also serve as a PCB mount. Higher input voltages can be used, but it is likely that additional heatsinking would be required in that case.



Circuit Diagram and PCB Overlay (includes components for all versions)



The circuit diagram and component overlay show the complete set of components which the PCB can accommodate. Each version uses a different subset of these components. The Serial Interface devices are the main area where the designs differ. The PIC software automatically detects which version has been constructed by attempting to exercise some of the features of the interface devices.

The RS232 version uses the 'Industry Standard' MAX232CPE (or compatible alternative) as the interface device IC3. This has on-chip circuitry which uses external capacitors to generate the voltage levels required by this standard.

The RS485 version uses S1 to define the board address, and IC4 as the RS485 transceiver. The transceiver direction is controlled by a separate PIC port pin. If Line Termination is required, R5 should be fitted to the last RPIC on the cable (furthest from the PC or RPICUSB+).

The USB version requires no separate interface device, as USB is a built-in function of the chip. However, a few passive components are required to satisfy and/or protect the internal USB circuitry.

The USB+ version includes an RS485 interface device in addition to the built-in USB, allowing an extension bus to be constructed, occupied by standard RS485 versions acting as slaves to the main unit.

For each specific version, many of the components can be omitted. Kits are supplied with only the parts relevant to that particular variant. For example:

RPIC232 Omit IC4, S1, J5 and associated components, and use a 4MHz resonator.
RPIC485 Omit IC3 and its capacitors, J5 and associated components, and use a 4MHz resonator.
RPICUSB Omit IC4, IC3 and its capacitors, S1, and use a 6MHz resonator.
RPICUSB+ Omit IC3 and its capacitors, S1, and use a 6MHz resonator.

On the USB versions, R8 is used to set the operating mode, either USB 1.1 high speed or low speed, depending on the position of the resistor. Two mutually exclusive positions are provided on the PCB to allow the selection of one or other mode, although at present only low speed is available as this is a limitation of the PIC16C765. To set low speed mode, R8 is fitted in the location nearest to the USB connector, J5.

Also on the USB versions, JP1 provides the option to power the RPIC and any attached RPC module logic devices from the USB +5V supply rather than via J2 / IC2. Care must be taken if this option is chosen as the current available from the USB supply is limited, detected and controlled by the PC.

The PIC oscillator X1 is normally formed by a 3 pin ceramic resonator with built-in loading capacitors. If a two pin resonator or crystal is used instead, it will be necessary to fit external capacitors to form the conventional oscillator layout. Pads are provided for 0805 surface mount capacitors, required value approximately 22pF.
An option is provided to allow the indicator LEDs to be mounted off board. To do this, a connector (J6) can be fitted in the same pads that the LEDs themselves normally occupy. Spare PIC pins are made available for future expansion via connectors J6, J7 and J8 (if fitted).

LCD Connector J3

PL3 pin	LCD Function
1	V_{cc}
2	0V
3	RS
4	Bias
5	E
6	0V
7	D1
8	D0
9	D3
10	D2
11	D5
12	D4
13	D7
14	D6

Shift Register 'Stack' Interface J1

Pin	Function
1	Data in
2	0V
3	0V
4	0V
5	Clock
6	Strobe
7	+5V
8	+5V
9	+5V
10	Data out

USB Interface J5 (Type B)

Pin	Function
1	0V
2	D-
3	D+
4	+5V

LED Interface J6

Pin	Function
1	D3 Cathode (0V)
2	D3 Anode
3	D2 Cathode (0V)
4	D2 Anode
5	Spare (PIC RC2)
6	0V

Serial Connector J4

	RS232			RS485	
J1 Pin	Function	9 Way COM	25 Way COM	Function	RSB 9 Way
1	RX from PC	2	3	A	2 or 3
2	TX to PC	3	2	B	6 or 7
3	GND	5	7	GND	1 or 5

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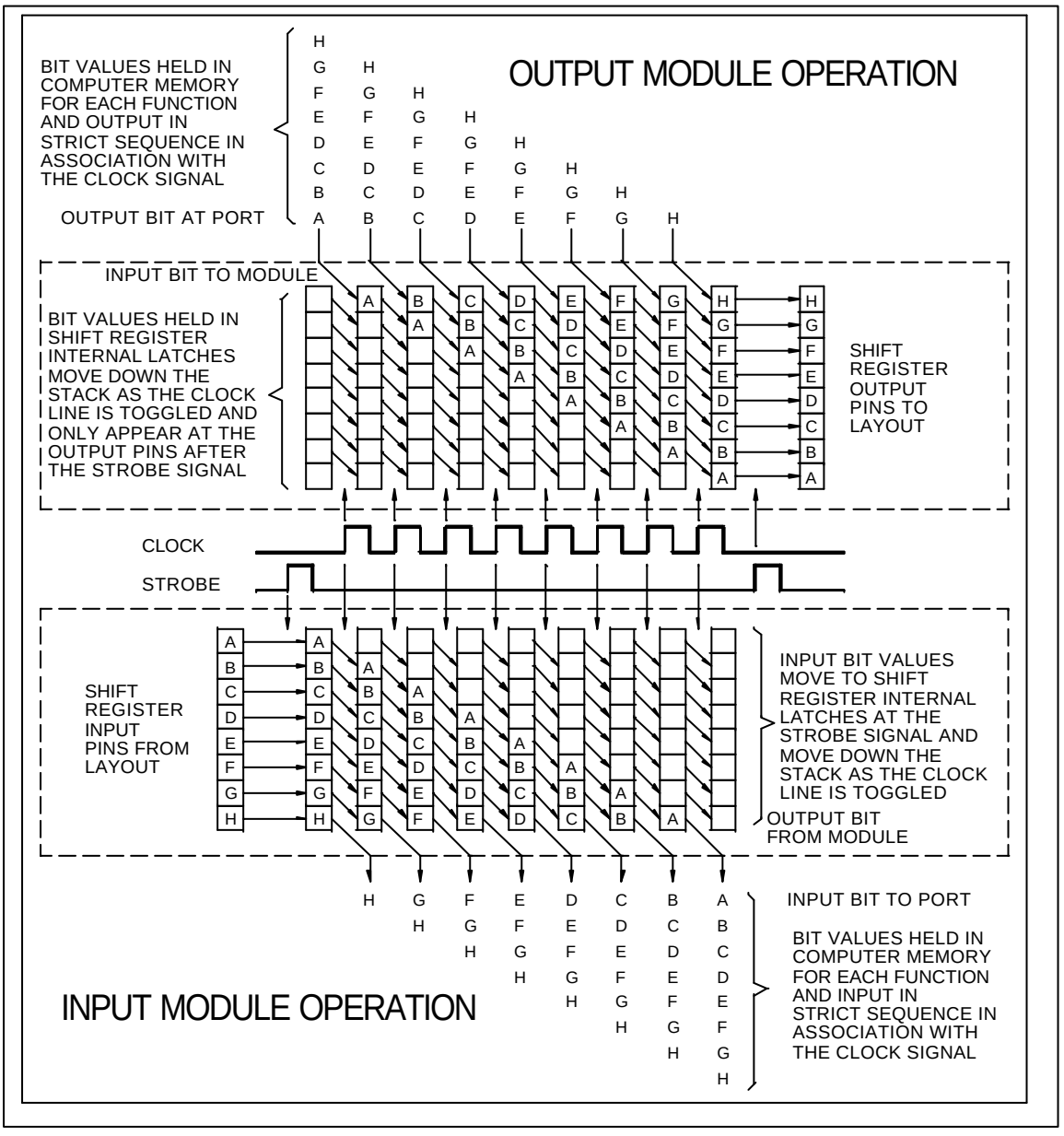
The table for J4 may be used to design PC Interface cables. Users of PCs other than IBM Compatibles should refer to their manufacturer's documentation for interface connection details. The RSB 9 Way pinout is designed to be compatible with the KK Systems™ range of RS232-485 adaptors. An RPICUSB+ extension bus would consist of parallel connections between the equivalent pins on each module's J1 using Screened Twisted Pair cable, pin 3 being the screen.

The Shift Register Interface J1 is used to pass data to and from the RPC Module Stack attached to the RPIC. The Interface uses a 10 Way connector, with Clock, Strobe, Data In, Data Out and Logic Power available (See Table above for connection details). The +5V and 0V outputs are normally derived from IC2, and three pins are assigned to each to minimise contact resistance. When a valid data type message has been received from the PC, the PIC goes through a routine of updating all the output bits and reading all the input bits of the attached modules. The PIC holds the values of all current output bit states in its RAM, to allow subsequent individual bit and byte updates. Input data is also stored internally, to allow input state changes to be detected and reported quickly via one of the new commands available on the RPIC. This also allows the PIC to search through the new data if an individual bit or byte value is requested after a change is detected. Details of message operations such as these are covered in RPC Interface Specification TB G16/4.

The logic lines operate in a manner suitable for 4094BE Serial In/Parallel Out and 4021BE Parallel In/Serial Out Shift Registers. These are used extensively on RPC System Modules as the I/O devices. The 4094BE is used on all 'Output' type modules such as the DPR, SRO4 and QPR boards, and the 4021BE is used on all 'Input' type modules such as the FTC and SRI4 boards. The diagram below attempts to show the internal sequence for the 4094BE SIPO and 4021BE PISO devices when they are used with the same Clock and Strobe lines. For further information on these devices, refer to the manufacturers data sheets.



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