# JED MICROPROCESSORS PTY LTD

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## JED AVR200 Assembly Notes

(Ed Schoell 30th March 2005)

Assembly of a kit AVR200 board is quite straight-forward, as the board is a plated-through double-sided board with full solder resist screening on both sides and all components are through-hole, so no wire links and no surface-mounting techniques are needed.

Most resistors are in arrays, reducing the amount of components used for the functionality provided. Very few discrete components are needed.

Before starting, map out the options that are to be loaded, and so decide which ports are to be a standard build, and which are normally inputs to be converted to outputs, and which are normally outputs to be converted to inputs.

The **standard build** has 8 analog/digital inputs, 13 digital ins, and 9 FET outputs, RTC, $I^2C$ and RS232 serial:

- Port A is all inputs, (analog or digital) (The accurate voltage reference is an optional extra);
- Port B is all inputs. This gives counter-timer inputs on PB0 and PB1, INT2 on PB2, and the SPI interface on PB5 … PB7. PB1 … PB4 can give 4 user chip-select lines to the SPI interface. (If SPI is not used, these port pins all become user inputs;
- Port C has the $I^2C$ on PC0 and PC1, but all the other lines (PC2 … PC7) are FET outputs;
- Port D has PD0 and PD1 are predefined for the serial port, with PD2 and PD3 as IN0 and INT1 interrupt inputs and PD6 as Counter/Timer 1 Input capture. Ports PD4, PD5 and PD7 are normally outputs and can be used for PWM outputs from Counter/Timer 1 and 2 Output Compare functions. Without wiring changes (just using plug-in links), users co-opt port pins for RS232 CTS/RTS, RS232/RS485 switching and RS485 TX-On functions. (The RS485 interface is an optional extra.)

With the kit are provided all components needed to make all 28 ports, other than the $I^2C$ and serial port, inputs.

If more ports are needed to be outputs than the nine standard ones, extra FETs are available from JED to load up to 21 FET outputs (still giving 7 user inputs).

### Preliminaries

The voltage regulator U3 goes onto the board first, with its heatsink screwed down horizontally, and connector J1 as the power input (voltage range 6 to 20 volts, with automotive protection against 60-volt surges against, etc. Then put other power-related parts, such as R7 and the LED and the bypass capacitors around the board.

**Ensure correct polarity of the Tantalum bypass capacitors.**

**WRONG POLARITY OF THESE CAPACITORS WIRING WILL PROBABLY CAUSE AN EXPLOSION.**

Check correct operation of the power supply at this point with a multimeter, measuring 4.75 to 5.25 volts on the output pin of the regulator. Note that the LED lights.

### CPU and RTC assembly

The CPU is mounted in two, twenty-pin, socket strips cut from the longer strips provided. Cut squarely with a Stanley knife or a pair of side-cutters.

Mount the CPU crystal on the clear insulator provided.

The small 32khz crystal for the RTC mounts on its side with the other RTC components, between the socket strips for the CPU.

## Take particular notice of the following items relating to options when loading the board:

### Port A (normally analog in)

This is normally loaded with eight socket strips, seven pins long. Cut these from the supplied longer lengths. (Only if FETs are to be installed in all eight port pins is the socket strip omitted for that port. Even if Port A is used as digital inputs or logic-level outputs, the socket strips are still used.)

With the kit are eight 10K series resistors for protection of the analog input pins (in combination with the TL7726 protection devices). User's should configure the ports with pull-up, pull-down or voltage divider resistors as needed by plugging resistors into other holes in the socket strips for each channel (after folding them over and neatly trimming both leads to the same level with 3mm of the leads left.)

If the Vcc rail is to be used as a voltage reference, L3 must be "blobbed" with solder

**Analog precision reference: I**nstall U4 (MAX874) and associated components R1, R2, VR1 and C14. Trim the voltage reference to 4.096 by adjusting VR1 and using a digital multimeter from U4 pin 6 to ground.

(If FETs are installed to use port A as eight power FET outputs, don't forget to load the supplied discrete 10K gate pull-down resistors in the first two holes nearest the CPU. These are soldered directly into the PCB after being folded for vertical mounting and trimmed.)

### Port B (normally 8 inputs, including SPI port)

This is normally loaded as all inputs, and to do this, install the series protection pack, (four separate 4K7 resistors in an eight-pin SIP), into location RP15.

A six-pin section of cut-off socket strip goes into location RP5, which holds a plug-in array (four commoned 4K7 resistors in a five-pin SIP). The "common" pin is at the grounded end (pin 1) if voltage input, or at the Vcc end (pin 6) if contact input is needed. (Pin 1 is marked on the drawing.)

J13, the programming and "upstairs" expansion connector is cut as a 14-pin section from the two-row pin strip provided. With a pair of side-cutters, cut out pins 7 to 10 flush with the plastic strip, or pull them out with a pair of pliers. This is to allow clearance to the sides of the 6-pin programming cable from the AVR-ISP programmer.

RP1 is unused for the standard, "inputs" option. Leave blank.

(For optional Port B outputs on PB0 … PB4: Install FETs F1 … F4, PR1 gate pull-down array (four commoned 4K7 resistors in a five-pin SIP), and omit RP15 and the RP5/5A socket and pull-up/pull-down array.)

### Port C (normally $I^2C$ and 6 FET outputs)

The normal loading for the $I^2C$ on PC0 and PC1 is "buffered", so DO NOT SHORT LINKS L24 AND L25. Install the 82B715 buffer, R3 and R4 pullup resistors (1K5), R9 and R10 (330R) buffered pullups and R11 and R12 (10R) protection resistors. Also load Zener diodes Z1 and Z2, 4V7.

(If "non-buffered" mode is desired, omit U11, R9 and R10 and use 100R resistors in R11 and R12. Link L24 and L25 as solder pads on the PCB.)

J14 is a ten-pin section cut from the 2-row pinstrip provided. This is for "upstairs" expansion purposes.

The normal load for PC2 … PC7 is as FET outputs, so only load the gate pull-down resistor arrays (three separate 4K7 resistors in an six-pin SIP), PR8 and RP9 directly into the board (no sockets.) Also, load FETs F5 … F10

Omit PR13 and RP14, and socket strips and arrays RP2/2a and RP3/3a.

The alternate load for Port C as "inputs" is to place six Zener diodes (Z10 … Z15) soldered vertically into RP8 and RP9 positions. Place two series arrays (three separate 4K7 resistors in a six-pin SIP) in positions RP13 and RP14.

A five-pin section of cut-off socket strip goes into locations RP2 and RP3, which holds a plug-in array (three commoned 4K7 resistors in a four-pin SIP). The "common" pin is at the grounded end (pin 1) if voltage input, or at the Vcc end (pin 5) if contact input is needed. (Pin 1 is marked on the drawing.)

### Port D (RS232, 3 inputs and 3 FET outputs)

The lower two bits of port D are RX and TX for the serial port, and these are fixed functions. The default is an RS232 only configuration, and this loads the RS232 interface chip (U8, MAX202, with voltage multiply capacitors C4 … C8) and the RS232 jumpers L13 and L14 and the D9 female RS232 connector J8. Links L13 and L14 are cut from the two-row pin-strip provided as port configuration and handshake links. (Link L13 can change pins on L13, configuring the ports for DTE or DCE modes. If talking to a PC serial port, link as a DCE, i.e. 1 ... 2 and 3 … 4.

In this configuration, links L20, L21 and L22 need to be jumpered with solder blobs.

Port D bits PD2, PD3 and PD6 are always inputs, and provide two interrupt inputs, INT0 and INT1 and ICP (input compare). Jumpers L15, L16 and L17 are cut from a 1-row wide pin strip provided and provide alternate routing for the INT pins (from the I2C interface) and PD6 (as an RS232 interface, CTS input.) L18 allows pull-up or pull-down on PD6 input.

Port D, bits PD4, PD5 and PD7 are FET outputs in the standard load, but pins can be diverted to provide additional control pins to communications interfaces or can be loaded as inputs as an option. The standard load has FETs F11, F12 and F13 and resistor array RP10, (three separate 4K7 resistors in a six-pin SIP) installed. Omit RP16.

**Port pins diverted to communications use:**

If an RTS output signal is needed, port pin PD7 is connected to an RS232 transmitter and can be linked on L14 to drive either J8 pin 7 (DTE mode) of J8 pin 8 (DCE mode). Also, if the RS485 option is installed (see below), PD7 is used as the TX-ON control from the CPU. This signal is also used as a TX control bit in the "radio" interface J7B (These options lose PD7 as an output bit.)

If CPU-controlled switching between RS232 and RS485 is desired, port PD4 can be co-opted via L19 linked 1 … 2. (This loses PD4 as an output bit.)

If a CTS input signal needs to be monitored, port pin PD6 is connected to an RS232 receiver output at L17 by linking 2 … 3. The RS232 CTS input pin on J8 ( 7 or 8) is selected by links on L14. (This loses PD6 as an input bit.)

(If no handshake is needed, linking L14 pins 5 … 6 just folds back RTS to CTS.)

If Port D bits PD4, PD5 and PD7 are to be loaded as inputs, solder Z16 … Z18 into location RP10, and solder in RP16 (three separate 4K7 resistors in a six-pin SIP).

A five-pin section of cut-off socket strip goes into location RP4, which holds a plug-in array (three commoned 4K7 resistors in a four-pin SIP). The "common" pin is at the grounded end (pin 1) if voltage input, or at the Vcc end (pin 5) if contact input is needed. (Pin 1 is marked on the drawing.)

## Port D (RS485 option)

To install this option, load U9 in place of the link "blobs" L20 … L22. This is a 232/485 signal multiplexer. Also load RS485 transceiver U10, a MAX3082. Load R5 and R6 pullups, L19 (RS232/485 switching control) and the line filters and connector, (LC2, 3 and J7.)

With no links in L19, the board still defaults to RS232 mode. A link between pins 2 ... 3 fixes the board in RS485 mode. A link 1 … 2 in L19 allows CPU port PD4 to control communications mode (low for RS232, high for RS485). (This loses PD4 as an output bit.)

CPU port PD7 becomes the RS485 TX-ON functions (Low is RX, High is TX). (This loses PD7 as an output bit.)

If a TTL/CMOS communications interface is needed for e.g. radio communications, a 4-pin connector can be installed at J7B. TX, RX and a control line from CPU port PD7 can switch the transmitter on and off. U10 must be omitted if J7B is used for radio applications.

**Extra I/O connector options.**

There are additional rows of pins under each of the Phoenix 0.15" spaces I/O connectors. These are alternate connectors if the AVR200 board is used in an embedded system where machine or crimped-on plug-in connectors are wanted rather than screw terminals.

The alternate power connector is J1a.

Alternate port connectors are: J2a, J3a, J11a, J12a, J4a, J5a, J9a and J10a.

The RS232 connector has J8a as an option, and the RS485 connector has J7a as an option.