

# AWC



## **GPMPU40 MPU Development Board Data Sheet**

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## Overview

The GPMPU40 kit is a universal MPU prototyping and development platform for nearly any microcontroller in a DIP package with 40 or fewer pins. The board has many features, including:

- MAX232/MAX232A RS232 converter with DB-9 connector.
- 7805-compatible regulator circuit.
- In circuit programming connector.
- Ceramic resonator or crystal.
- An edge connector that can plug into a solderless breadboard or connect to other circuitry.
- A unique system that allow you to customize the board's personality quickly and easily.

## If You Need Help

If you require assistance, please feel free to contact us. The best way to get support is via e-mail ([stamp@al-williams.com](mailto:stamp@al-williams.com)). However, you may also call between 9AM - 4PM Central Time at (281) 334-4341. You can also fax to (281) 754-4462. Be sure to check out our Web page for updates at [www.al-williams.com/awce](http://www.al-williams.com/awce).

## Planning

If your GPMPU board is part of another kit, refer to that kit's instructions to determine what options you must build and any modifications you may need to make to the board. If you are building the GPMPU for your own circuit, consider these options you can exercise when building:

- CPU and clock choice. The board can accommodate many different microcontrollers including PICs, AVRs, Uvicom, Stamp, and more.
- You can power the board from a 5V regulated supply, or build the onboard 5V supply using a 7805 (or other pin compatible regulator such as a TI PT78ST105 switching regulator or an LM2940-CT5.0 low drop out regulator).
- For RS232 connections you can install a MAX232 or MAX232A IC and a right-angle female DB9.
- For TTL serial, you may jumper across the MAX232 to connect the microprocessor directly to the DB9.
- The board is designed to accept standard resonators with capacitors built-in. There are also holes for external capacitors for use with a crystal.
- If you are using fewer than 40 pins, you can use the remaining pins for other circuits (for example, a serial EEPROM or I2C A/D chip).

## **Understanding the Board's Subsystems**

The heart of the GPMPU40 is the hole patterns surrounding IC1. This is the socket for a standard 40 pin processor. It also fits modules and ICs that have .6 inch spacing (for example, a Basic Stamp). Inside this socket is the IC2 socket (labeled IC2A and IC2B). This socket also has 40 pins, but is on .3" spacing. You can use IC2 to fit ICs that have a .3 inch spacing.

Each of the 40 pins of IC1 and IC2 connect together. They also connect to JP3 and JP4 which provide access to each pin with a wire jumper. Finally, each pin also connects to the JP1 and JP2 connector at the edge of the board. Typically, JP1 and JP2 are used

to plug into a solderless breadboard, although you can also use it to connect to another circuit board or external circuitry.

None of the pins on the IC sockets are committed. You customize the board for a particular processor by connecting the board's subsystems (see below) to the appropriate pins on JP3 and JP4.

The board has several supporting subsystems that make it easy to connect virtually any microprocessor. Depending on your goals, you may or may not need all of the subsystems. The subsystems are:

- Power – A 7805 or compatible regulator provides a 5V power supply on the Vcc and Ground headers
- Clock – A hole pattern suitable for a ceramic resonator or crystal is present on the CLK header
- Reset – A reset jumper or switch with pull up resistor and a pattern for an optional 3-terminal reset controller are present on the RST header
- RS232 – A MAX232 provides an RS232 port on the RS header (JP5 and JP6 allow you to customize the RS-232 port).
- Auxiliary Connector (JP7) – This connector is not committed, but is usually used for programming or in circuit debugging connections.

For example, consider using the board with a Microchip PIC16F877. You'd make the following connections:

- RST – JP3-1
- Ground – JP3-12
- CLK-1 – JP3-13

- CLK-2 – JP3-14
- Ground – JP4-11
- Vcc – JP4-12
- Connections to JP7 to match your in circuit programmer (optional)

Once you've decided which components to install, start with the shortest components first. Try not to install the tall components (IC sockets, pins, LEDs, connectors) until all of the smaller components are in place. Installing tall components first will make it more difficult to fit the smaller parts in the board for soldering, although this is not strictly necessary – you can install the components in any order you wish.

If you are building the board to use with a solderless breadboard, you should install the headers at JP1 and JP2 on the bottom of the board and solder them at the top of the board. This allows you to plug the GPMPU40 directly into a solderless breadboard.

**Selecting C1-C4:** If you are installing a MAX232, you need 1uF capacitors for C1-C4. If you are installing a MAX232A, then you need .1uF capacitors instead. If you are not installing IC3, there is no need to install C1-C4.

**Special note about electrolytic capacitors:** If you use electrolytic capacitors for C1-C4, you must insert them correctly as indicated on the PCB silk screen.

### ***Testing***

It is possible to build the board in sections, testing as you go (although this will certainly cause you to violate the tall components last rule). The suggested order of construction is:



- Power supply – install IC4, C5 and C6. Assemble the heat sink (if any) on IC4. Connect a DC supply (unregulated) that supplies 8 to 12 volts between the Vin and Ground pins (or the optional coaxial connector at J2). You should be able to measure 5V between the Vcc and Ground headers with a volt meter. If this does not work, check your connections and make sure IC4 is not backwards.
- RS232 section – Install J1, IC3, and C1-C4. You can test this section using a PC with Hyperterminal and an appropriate cable. First start Hyperterminal and create a connection to the port you are using. Set the serial parameters to 19200 baud, 8 bits, no parity, and one stop bit. Set handshaking to none (very important). You'll also want to disable local echo (in the ASCII setup options).

The next step is to make sure you have Hyperterminal working properly. Connect the cable to your PC but **not** the GPMPU. Using a test jumper, short pin 2 and 3 of the cable together. When you type into Hyperterminal, you should see what you are typing when the jumper is present and not see anything when you remove the jumper. If you see each character twice, you have local echo enabled (turn it off, or remember that you have it on, it doesn't really matter). If you don't see any characters then you have the wrong port, or a port conflict with another serial port. You must fix this before you can test the board (or use it with the serial port, for that matter).

Now remove the test jumper from the serial cable. Using a test lead, short pins 11 and 12 of IC3. Plug the serial cable into the GPMPU and apply power to the board (either via the power supply or, if you don't have the power supply, with a 5V regulated supply). When you type in Hyperterminal, you should see what you are typing if everything is functioning (unless you have local echo on, in which case you should see each character *twice*). If this

does not work, check for proper insertion of IC3. You should read about +/- 8V on IC3 pins 2 and 6, respectively. If using electrolytic capacitors for C1-C4, check the polarity carefully.

- Processor, clock and reset sections – There isn't much you can do to test the processor-related section other than use them for something. It is a good idea to program a very simple test program to blink an LED, for example, until you are certain the board is assembled properly. Common errors include setting the wrong oscillator fuse bits, or using an unprogrammed processor.

### ***Customization***

As explained previously, you must customize the connections between the processor and the various subsystems. Many common processors configurations are described on our Web site. You may find it convenient to wire the customizing jumpers under the board so they do not obstruct the socket and silk screening of the board.

Another method for customizing the board involves replacing components with other components. For example, suppose you don't want to install a MAX232, and you need to do TTL-level serial output. You can fit a wire between IC3 pins 12 and 13 along with another wire between pins 11 and 14.

You can also fit different components in the resonator or crystal holes. For example, a two pin resonator or crystal will fit in the pattern provided.

There are also many substitutions you can make for IC4. For example, you may wish to use a low dropout regulator (a LM2940-CT5.0) or a 78L05 in these holes. I43 faces the inside of the board so that you may fit a heat sink or heat sink the chip to a metal case, if desired.

Normally, the reset jumper is simply two pins and a jumper cap. However, it is possible to insert a small switch (for example, Radio Shack 275-1571) in these holes to create a reset button.

## Powering the GPMPU40

If you have the power supply installed, you simply feed DC voltage into the Vin (+) and Ground (-) terminals. Alternately, you can use a 2mm coaxial connector (center positive). In either case, you must not use an AC voltage. With a standard 7805, you should feed at least 8V to produce a stable 5V supply. A 12 to 15V supply is ideal. Do not exceed the voltage rating of C6 (it is OK to replace C6 with a higher voltage capacitor if you are using a regulator that can handle more voltage).

Be aware that common wall transformers often put out much more than their rated voltage at low loads. A 12V 1A transformer may put out 18V or more at 100mA. Conversely, you may be able to use a transformer rated at a lower voltage (say, 6V) if you are drawing less current than the transformer expects to supply.

With a 12V input and a standard 7805, you should be able to draw at least 1A (although you will probably need to add a heat sink if you draw too much current). The basic GPMPU card draws only a fraction of this (depending on the processor you are using). The more input voltage you provide, the less current the regulator will provide.

If you don't build the power supply, you can also feed **regulated** 5V directly to the board's power buss. In particular, you can feed +5V into the Vcc and Ground headers. You can also feed +5V into the hole for IC4 pin 3 and the ground connection to IC4 pin 2.

Even if you aren't using the onboard power supply, you should install C5. This filters noise from the power supply. You can also install a jumper from IC4 pin 1 to IC4 pin 3 and use C6 as a larger filter capacitor if you aren't using IC4.

## About the RS232 Interface

The DB9 connector has two levels of customization available. First, the T R t and r terminals on the RS header allow you connect to the MAX232 level converter. The T and R terminals are the main transmit and receive lines, respectively. The t and r terminals connect to the auxiliary transmitter and receiver.

JP5 allows you to route the main transmit and receive signals to pins 2 and 3 of the DB9. Near the edges of JP5 you'll see T R 3 and 2 marked. If you place jumpers from 3 to T and 2 to R, the DB9 will be suitable for connecting to a PC (that is, it will be wired DCE). On the other hand, you can jumper between 3 and R and T and 2 to get a DTE connection suitable for a modem, for example. If you wish, you can install pins in these locations and switch on the fly with jumper caps.

Pin 5 of the DB9 is always connected to ground. The remaining pins appear on JP6 as follows:

JP6-1 J1-1

JP6-3 J1-4

JP6-5 J1-6

JP6-7 J1-7

JP6-9 J1-8

JP6-11 J1-9

In addition, JP6-2, JP6-4, and JP6-6 connect to the MAX232's auxiliary receiver (which eventually winds up at the r terminal of the RS header). J65-8, JP6-10, and JP6-12 connect to the MAX232's auxiliary transmitter (which winds up at the t terminal of the RS header). By using short jumper wires, you can connect one input and one output to the MAX232. For example, you could

connect RTS and CTS. You would also connect r and t to the pins of JP3 and JP4 that match the I/O port on your processor that you wish to use for these signals.

## **Using JP7**

JP7 simply connects to JP8. You can wire jumpers from the rest of the board to JP8 to make an external connection on JP7. For example, you might place pins here to connect to a programmer, a debugger, or a serial LCD.

Of course, since all 40 pins appear on JP1 and JP2, you can also connect a programmer to these jumpers or to a solderless breadboard or other PCB attached to these jumpers. This is useful if your programmer requires an odd hole pattern.

## **Other Customizations**

It is possible to connect many different types of components to the GPMPU's flexible structure. For example, for a Basic Stamp, you may wish to connect a header to female DB9 (with straight pins). Connect the pins on the DB9's pins 2, 3, 4, and 5. In addition, short pins 6 and 7 on the connector. Now you can solder the header into JP7 and use JP8 to connect the pins to the Basic Stamp's programming port. This allows you to program the Stamp via the DB9 at JP7 and still leaves the J1 serial port free for your own applications.

In addition, for a Basic Stamp (and some other processors) you don't need the clock section. You can place a 5V LEDs in the C7 and C8 holes. Then the CLK header would allow you to connect the LEDs to the CPU. Alternately, you could use regular LEDs and use a series resistor to jumper between the CPU and the CLK header.

If you are using a CPU shorter than 40 pins, you will have room to place other devices in the remaining pins. For example, a 24 pin Basic Stamp can coexist with two 8 pin EEPROMs (or other devices).

However, if you do use a processor with fewer than 40 pins, keep in mind that the JP2 header numbers will not match up as you would expect. For example, an 18 pin processor at IC2 will have 9 pins on JP1-1 to JP1-9. However, pin 18 will appear on JP2-20 (pin 40), pin 17 will appear on JP2-19 (pin 39), and so forth.

## JP1/2 Mapping

JP1's pin numbers always map to the first row of pins on IC1 (or IC2A). So, for example, a 24 pin IC in IC1 will have pin 1 on JP1-1, pin 2 on JP1-2, and pin 12 on JP1-12. However, the JP2 pins don't directly correspond to the IC pins (unless you are using a 40 pin IC, of course). Use this table to help you decide the correct pin numbers

JP2 Pin	32 pin	28 pin	20 pin	18 pin	16 pin	8 pin
20	32	28	20	18	16	8
19	31	27	19	17	15	7
18	30	26	18	16	14	6
17	29	25	17	15	13	5
16	28	24	16	14	12	
15	27	23	15	13	11	
14	26	22	14	12	10	
13	25	21	13	11	9	
12	24	20	12	10		
11	23	19	11			
10	22	18				
9	21	17				
8	20	16				
7	19	15				
6	18					
7	17					

## Bill of Materials

Note: Not all parts may be in your kit (see the specific GP kit manual for details). Many parts are optional depending on the kit you've purchased:

C1, C2, C3, C4 – If IC3 is a MAX232, then 1uF; if IC3 is a MAX232A, then .1uF, 16V minimum

C5 – .1uF capacitor, 16V minimum

C6 – 220uF (or larger) capacitor, 35V minimum

IC1/IC2 – 40/28-pin CPU

IC3 – Maxim MAX232 or MAX232A

IC4 – 7805 regulator (or equivalent, see text)

J1 – Right angle female DB9 (short reach style)

R1 – 10K to 22K resistor

X1 – Ceramic resonator with capacitors or Crystal

### Optional:

Header pins or connectors for interface holes

Heat sink and hardware for IC4

Socket for IC1 or IC2

T1 – 3 terminal reset controller

C7, C8 – Loading capacitors for resonator/crystal

# Figure 1. Circuit Diagram

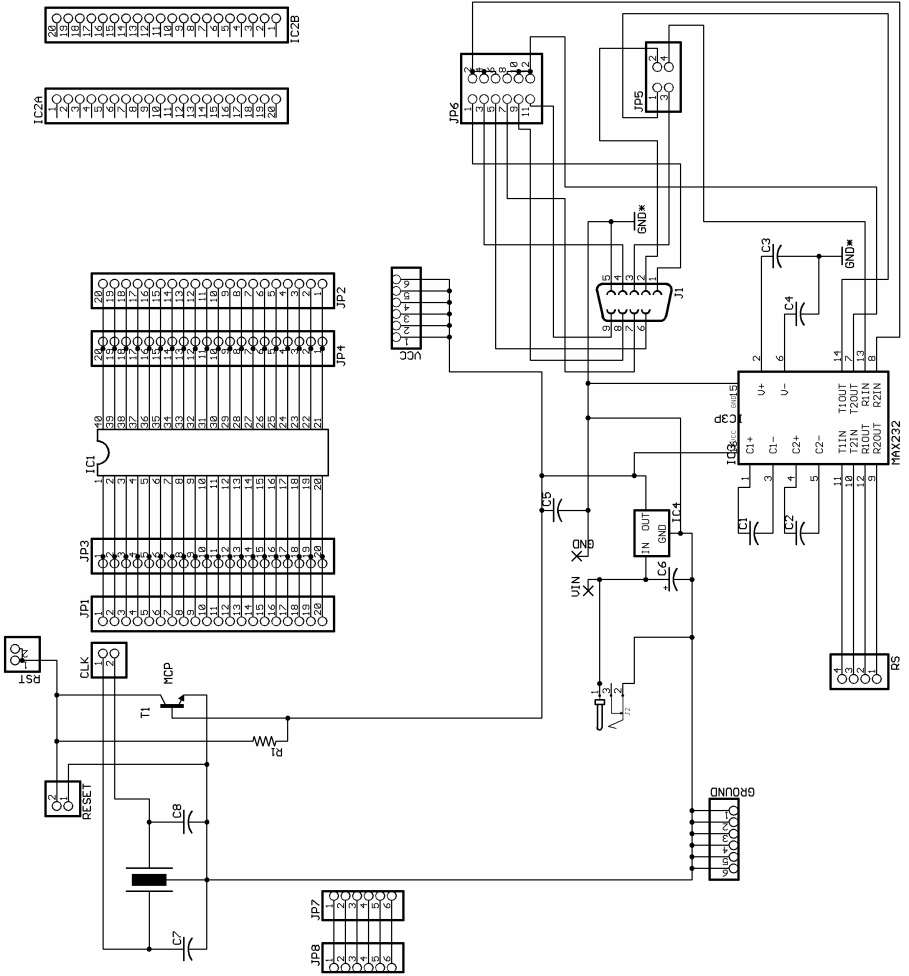
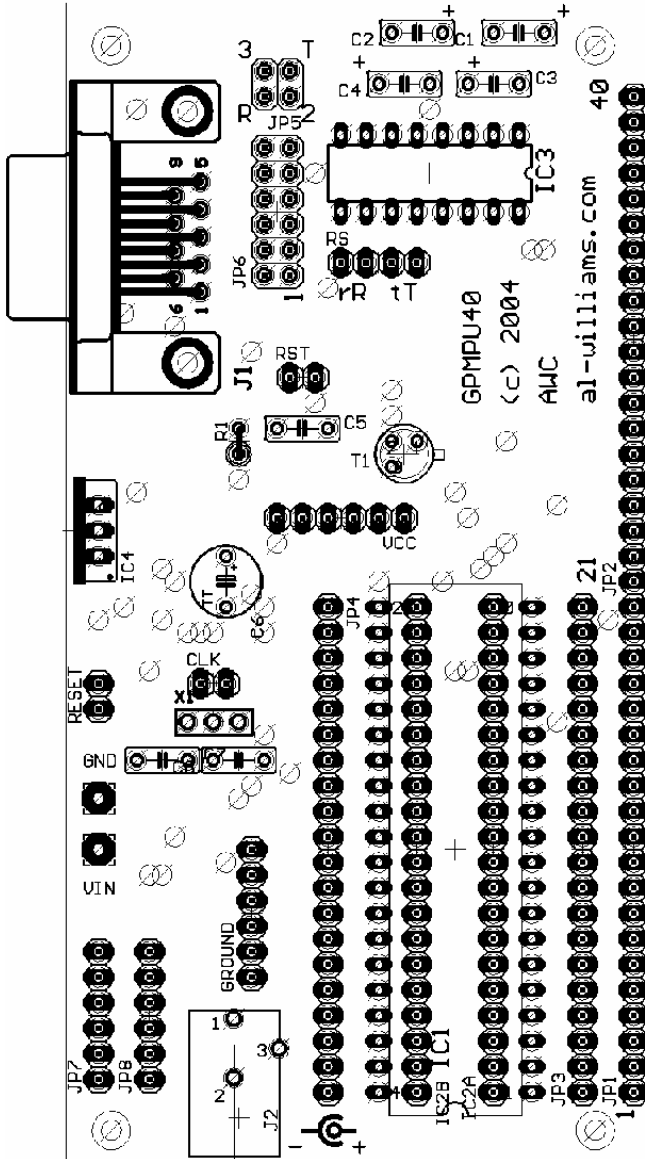




Figure 2. Board Layout



# Example Configurations

## ATMEGA32 (LPT Programming Connector)

First Connection	Second Connection	Notes
JP3-9	RST-1	Reset
JP3-10	Vcc	+5V
JP3-11	Ground	Ground
JP3-12	CLK-1	Oscillator
JP3-13	CLK-2	Oscillator
JP3-14	RS-R	RS232 Receive
JP3-15	RS-T	RS232 Transmit
JP4-10	Vcc	AVcc
JP4-11	Ground	Ground
JP4-12	Vcc	Aref
JP8-1	Vcc	+5V
JP8-2	Ground	Ground
JP8-3	JP3-8	SCK
JP8-4	JP3-7	MISO
JP8-5	JP3-6	MOSI
JP8-6	RST-2	Reset

## **ATMEGA32 (JTAG Programming Connector)**

<b>First Connection</b>	<b>Second Connection</b>	<b>Notes</b>
JP3-9	RST-1	Reset
JP3-10	Vcc	+5V
JP3-11	Ground	Ground
JP3-12	CLK-1	Oscillator
JP3-13	CLK-2	Oscillator
JP3-14	RS-R	RS232 Receive
JP3-15	RS-T	RS232 Transmit
JP4-10	Vcc	AVcc
JP4-11	Ground	Ground
JP4-12	Vcc	Aref
JP8-1	Vcc	+5V
JP8-2	Ground	Ground
JP8-3	JP4-4	TCK
JP8-4	JP4-6	TDO
JP8-5	JP4-7	TDI
JP8-6	JP4-5	TMS

## **PIC16F873 (ICD Programming Connector)**

<b>First Connection</b>	<b>Second Connection</b>	<b>Notes</b>
JP3-1	RST-1	Reset
JP3-8	Ground	Ground
JP3-9	CLK-1	Oscillator
JP3-10	CLK-2	Oscillator
JP4-9	RS-T	RS232 Transmit
JP4-10	RS-R	RS232 Receive
JP4-11	Ground	Ground
JP4-12	Vcc	+5V
JP8-1	JP4-16	RB3
JP8-2	JP4-19	RB6
JP8-3	JP4-20	RB7
JP8-4	Ground	Ground
JP8-5	Vcc	+5V
JP8-6	RST-2	Reset

Note: This configuration is usable for most 28 pin PICs including PIC18F252

## ***PIC16F877 (ICD Programming Connector)***

<b>First Connection</b>	<b>Second Connection</b>	<b>Notes</b>
JP3-1	RST-1	Reset
JP3-11	Vcc	+5V
JP3-12	Ground	Ground
JP3-13	CLK-1	Oscillator
JP3-14	CLK-2	Oscillator
JP4-5	RS-T	RS232 Transmit
JP4-6	RS-R	RS232 Receive
JP4-11	Ground	Ground
JP4-12	Vcc	+5V
JP8-1	JP4-16	RB3
JP8-2	JP4-19	RB6
JP8-3	JP4-20	RB7
JP8-4	Ground	Ground
JP8-5	Vcc	+5V
JP8-6	RST-2	Reset

Note: This configuration is usable for most 40 pin PICs

## **PIC16F628 (ICD Programming Connector)**

<b>First Connection</b>	<b>Second Connection</b>	<b>Notes</b>
JP3-4	RST-1	Reset
JP3-5	Ground	Ground
JP3-7	RS-R	RS232 Receive
JP3-8	RS-T	RS232 Transmit
JP4-16	Vcc	+5V
JP3-17	CLK-1	Oscillator
JP3-18	CLK-2	Oscillator
JP8-1	JP4-12	RB4
JP8-2	JP4-14	RB6
JP8-3	JP4-15	RB7
JP8-4	Ground	Ground
JP8-5	Vcc	+5V
JP8-6	RST-2	Reset

## Basic Stamp (24 or 40 pin)

First Connection	Second Connection	Notes
JP4-17	Vcc	+5V
JP4-18	RST-1	Reset
JP4-19	Ground	Ground
JP8-1	JP3-1	TX
JP8-2	JP3-2	RX
JP8-3	JP3-3	DSR
JP8-4	Ground	Ground

Note: A female DB-9 connector can be soldered to a 4 pin header. Solder pin 1 of the header to the DB-9's pin 2 (and, therefore, pin 4 of the header to the DB9's pin 5). In addition, jumper DB9 pin 6 and 7. Then solder the header to JP8 (lining up pins 1-4). You can then use this DB9 connector as a programming connector. You can also connect a DB9 with a right angle header to JP3, or connect from JP5 and JP6 to JP3 (omitting IC3 and C1-C4).

If you omit IC3 (and C1-C4) you can also wire from JP5-2 to JP3-1, JP5-3 to JP3-2, and JP6-3 to JP3-3 to use J1 as a programming connector.

## **Ubicom SX (28 Pin)**

<b>First Connection</b>	<b>Second Connection</b>	<b>Notes</b>
JP3-2	Vcc	+5V
JP3-4	Ground	Ground
JP4-20	RST-1	Reset
JP4-19	CLK-1	Clock
JP4-18	CLK-2	Clock
JP4-19 (use IC1 pin 39)	JP8-1	SXKey connection
JP4-18 (use IC1 pin 38)	JP8-2	SXKey connection
Vcc	JP8-3	SXKey connection
Ground	JP8-4	SXKey connection

Note: The SX does not have a dedicated serial port. However, it is possible to connect the RS232 port to any general purpose I/O pins with the appropriate software (e.g., a virtual peripheral UART) driving those pins.