JED MICROPROCESSORS PTY LTD

173 Boronia Rd, Boronia, (PO Box 30), Victoria, 3155, Australia.
Phone: +61 3 9762 3588, Fax: +61 3 9762 5499.
Internet web site: http://www.jedmicro.com.au/ (email via web site links)

T520, AVR mega103 or Tiger modular micro-controller for flexible embedded applications.

PRELIMINARY CONCEPT RELEASE

This family of base boards and plug-in modules is designed as an extendable and flexible way of implementing embedded systems with standard plug-in modules inserted into sockets in a base board.

Even the CPU is selectable....there are two possibilities to cover a range of applications:

- An AVR RISC microcontroller type ATmega103 with 128 kBytes of FLASH, 4kByte of RAM, one UART, timers, powerful interrupts, programmable in C, BASIC or assembly code; or
- A 28-pin Tiny Tiger "E" device, a CPU module from Wilke Technology (Germany) with FLASH, RAM, 20 Mhz CPU, 2 UARTs, programmed in Multi-tasking BASIC. This device has several 10-bit analog inputs.

The Base-boards.

The flexibility of this system is the various sizes of base boards in the family. These range from a three-slot unit for simple data gathering and interfacing through a 5-slot and an extendable 8-slot. Each module has a "system connector" at one end and an "I/O connector" at the other. Each of the system connectors is driven with a number of lines, either from the CPU (in a small system) or from a low power gate array (in larger systems).

These lines can be used for direct I/O (in the case of simple I/O buffering/protection modules) or can be used as SPI communication lines with more complex modules. The AVR has 8 external interrupts with their own vectors, and one of these comes from each module, allowing the AVR to process interrupts very efficiently. (A Tiger based system takes these lines into the gate array for processing under the multi-tasker.)

All base boards in the series will have some standard features (loaded as users desire) e.g.:

- A real-time-clock, a SPI Dallas DS1305, with two time-of-day alarms, battery charge control;
- RS232 serial, with hand-shake, to go to PC or to a GSM phone or modem. Jumpers could connect an optional RS485 transceiver. (With Tiger, a second serial port for down load can be used as an additional user port);
- An interface to SPI-written removable FLASH modules for carrying data logged data back to a PC;
- A 10 bit ADC in the AVR or Tiger cpu, or a 12-bit ADC, and an 4.096 volt accurate reference. Four channels are available from each module;
- A watchdog timer/reset generator/eeprom chip to support the Tiger. (The AVR has EE PROM inside, as well as a watchdog.) The EEPROM can hold calibration constants for on-module or off-module systems;
- Power regulator using a low-drop-out linear regulator, allowing the board to run from a 6 to 12 volt DC supply;

The Modules

The plug-in modules are 50mm by 20mm and have a 14-pin system connector at one end supplying power and system signals to the electronics on the module.

On the other end are 5 higher-current connectors which connect (via baseboard links) to a 5-pin Phoenix screw terminal. Clearance around these pins allows isolated inputs to go to the module and opto-isolators there can protect this board from outside voltage transients.

An initial list of modules planned are:

- Four N-channel FET outputs to a common ground (or for higher density, an extra row of terminals can be added on the module, for 8 outputs per module);
- Four P-channel FET outputs using the 5th pin as a positive rail input;
- Four triac AC switches using the 5th pin as a common for controlling four 24 volt AC solenoid watering system valves;
- Four inputs with pull-up resistors (switch input) or pull-down resistors (voltage input). Series resistors feed Vcc/Gnd referenced clamps so input to the gate array or microprocessor are protected. Inputs can be used as logic inputs or signals to pulse counters, frequency inputs, or quadrature inputs (For higher density, an extra row of terminals can be added, allowing for 8 inputs per module);
- Four inputs using the 5th pin as a return with optoisolators. The values of the series resistors set input voltage. Opto-isolators could be DC or AC, eg for air conditioning signals;

Designed and manufactured in Australia

- Additional RS232 interfaces using a SPI interfaced Maxim UART and RS232 in ter face. With an AVR micro, an in ter rupt is avail able for each mod ule for se rial I/O un der in ter rupt. With the Ti ger, the CPU must poll the UART un der the multi- tasker. The UART has an 8-byte buffer;
- As for RS232, but RS485;
- In ter faces to Dal las "1- Wire" sys tem, to, for ex am ple, DS1820 temperature sen sors, etc.;
- Interface to CAN bus, using Microchip's SPI-interfaces CAN bus con trol ler. Be ware...the CAN soft-ware can be scary, but sam ple soft ware in C is avail able from Mi cro chip's www site;
- Gate array interfaces using Xilinx (ex Philips) "Cool-run ner" FPGA, pro vid ing cu stomised com plex I/O to a sys tem....us ers can load gate ar ray with low cost Xil inx schematic capture development system and design their own special purpose logic.

Analog input and output

Ana log in puts can be fed via any of the Phoe nix screw terminals. On the modules, analog sig nal proc ess ing, fil-tering, etc can preceed amplification and multiplexing onto a 1- wire ana log bus which can feed sev eral dif fer ent analog to digital converters:

- The AVR and the Ti ger both have 10 bit ADCs;
- An SPI in ter faced 12 bit Maxim ADC;
- A mod ule could have a LTC2400 24-bit Delta- Sigma converter for high accuracy fil tered con versions.
- Analog in puts 0-4 volts with just a mul ti plexer, se ries resistor and diode clamps on the module. Inputs can have 200 ohm re sis tors to ter mi nate 4-20 mA loops;
- Amplified analog inputs with a chopper amplifier per chan nel, gain set by re sis tors, for thermocouples;
- Trans ducer in ter faces for bridges;
- Analog voltage or current outputs, using SPI mode drive to a se rial quad DAC, with 8 or 12 bit reso lu tion.

Intelligent modules

AVR processor based modules are in design, using a surface mounted 20 pin AVR2313 CPU. Distributed in-telligence on the module can offload simple but timing critical tasks to the module.

The AVR2313 has an SPI port, and these pins, as well as the RE SET* pin come to the 14- pin mod ule port con-nector. This allows the surface mounted CPU to be pro-grammed in situ by a pro gram ming util ity run ning on the main CPU, using serial programming mode via the SPI port, holding RE SET* LOW on the microprocessor.

Possible intelligent modules are:

- Multiple 32 bit counters, accumulating pulses from me ter lo gi cal al, ocean o graphic or in dus trial sources (eg wind run, rain gauges, water flow in rivers, beer or chemical flow in pipes monitored by anemometers, water wheels, flow me ters, etc;
- Quadrature de coder/coun ters;
- Serial communication channels with larger buffers, new pro to col in ter faces (X10, MIDI, SDI-12 etc);
- Stepper motor driver, given count, direction and rate, producing pulses on the output connector ready for a bridge drive;
- PC key board/mouse/touchscreen de vices.

Double (and larger) width modules

This mod u lar sys tem also al lows for spe cial wide mod-ules to be built, eg:

- Adual communications interface using an Exar XR16C2852 dual UART with 128 byte buff ers on both TX and RX chan nels;
- A GPS re ceiver com mu nicating via a UART at CMOS levels. The GPS power can be controlled via Vcc switch ing on the car rier board.

Module Mix and Match

Modules can be mixed and matched to suit applica-tions, so it is pos si ble to build imagi na tive sys tems, e.g.;

- A system with nine(!) RS232/RS485 serial interfaces all op er at ing un der their in ter rupts on an AVR;
- A sys tem with CAN bus and 28 ana log I/O;
- An RS485 sys tem with 28 sprin kler valves;
- A re mote I/O sys tem with 64 in puts, 64 out puts (or any-thing in-between);
- A data log ger sav ing data to re mov able FLASH mod-ules, pow er ing up and down un der con trol of the RTC interrupt outputs.

The CPUs

Data sheets on the AVR micros are available on At-mel's site at *www.atmel.com* The ATmega103 part has 128 kByte of FLASH, one se rial port, 4 kb ee prom and 4 kB of RAM.

Data sheets on the Ti ger are on JED's site at *www.jed-micro.com.au*. (The 28- pin "E" ver sion of the Tiny Ti ger is similar to the 44 pin Tiny Tiger, but does not have a RTC or battery backed RAM). FLASH memory on this part is 128kB or 512 kByte, and RAM is 32kB, 128 kB or 512 kByte. A data sheet is avail able from JED.

In Conclusion

It does not have to end there, though....with a se ries of stan dard CPU hook- ups (Ti ger and AVR) and a li brary of mod ules, base boards of any de sired size and I/O ca pa bil-ity can be put together on a custom basis easily and cheaply to suit a variety of mechanical and case or I/O connector requirements. Or single boards for mass con-struc tion can be tested with a base board and sev eral mod-ules, and when the sys tem has been proved, a cus tom ver-sion com bin ing just the needed bits con structed.

We are keen to discuss this concept...please call or email Ed Schoell with comments.