Field Interface Bus

A simple distributed low speed SCADA solution

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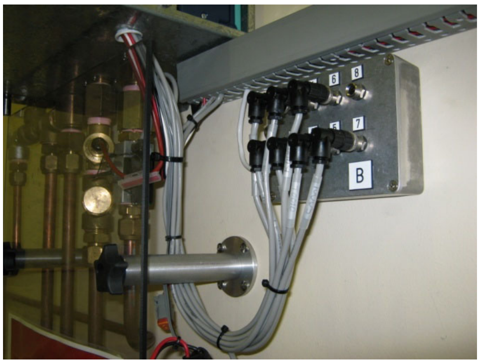
It is often necessary to implement a SCADA system for a small to medium complexity process with minimal development effort and cost. The advantages inherent in distributed control networks of having sensor and actuator interfaces in close proximity to their position are well documented. This minimizes interference and keeps the layout simple. With appropriate tools, it also allows localized testing and commissioning making the set to work task much easier.

Typical SCADA systems have solved the decentralization process by distributing intelligence and I/O around a network. For smaller systems in a limited space with low speed timing requirements, this can represent significant “over kill” however. A lot of systems need data acquisition and control with timing in the 100s of milliseconds or seconds range (think of pumps, fans, temperature sensors, flow meters and the like).

Applidyne, faced with a similar quandary, has developed an appropriate solution. This solution places Applidyne in a position to build systems with similar requirements and complexity for customers on a turnkey basis, drawing on existing hardware and software components to facilitate rapid development. Presented here are the constituent parts.

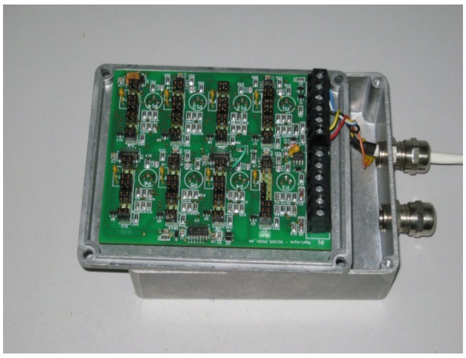
Sensor/Actuator Module (SAM)



SAM at a subsystem location

The essential part of the FIB system. It is the access point where local sensors and actuators connect to the system. In the upper picture all the signals for control of a water heater come together. The module is sealed to stop ingress of fluids and has excellent shielding from electromagnetic interference.

Industry standard M8 sockets provide robust locked and sealed removable connections to make maintenance and configuration changes a breeze. Break out test connectors allow access for test equipment without opening the box when required.



SAM configuration links

In the picture to the right, the configuration links accessible when the module is opened are shown. All 8 I/O points can be configured to suit individual sensors and actuators. Power can be provided to the individual connectors at either 24V at up to 50mA or 5.00V at 5mA. The bus connection between modules is shielded and has separate measurement and power grounds.

A wide variety of sensors and actuators can be accommodated, a selection (by no means exhaustive) is:

- Semi conductor, platinum and resistive temperature sensors, thermocouples with conditioner
- Pressure sensors, with or without internal amplifiers
- Voltage and current sources, 4-20mA, 0-10V to 0-500mV, differential or single ended
- Pulse sources such as flow meters and RPM counters
- Switches and potentiometers
- Indicators, panel meters
- Output relays
- Analog voltage outputs

Inline (circuit heat shrink protected in the cable assembly) conditioners are used where there are special interface requirements. So far there are circuits for user indicator/operating switch, isolated input/output (relay), pulse input and gas flow meter applications. These circuits are designed to operate from the interface power available. The picture below illustrates a pulse interface used to condition an RPM proximity switch.

Driving the bus

Motor RPM in line conditioner

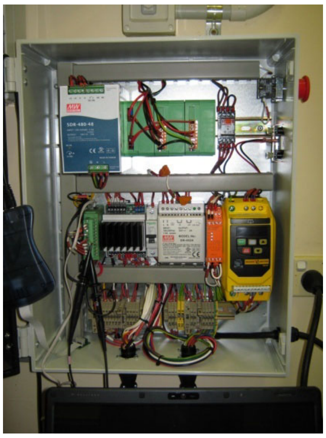
Interfacing to the bus from a controller is easily accomplished.

Only a general purpose digital output and an analog input are required. The timing sequence to control the scanning of inputs and the operation of outputs is not complex and within the capability of most micro controllers. A library of C functions is available to make integration easy.

Alternatively, a DIN rail mounted control module can be provided with custom programming for projects in association with Applidyne.

In the illustration to the right, a typical control cabinet is shown containing one of the Applidyne controllers and various power supplies and motor drives.

The oscilloscope probes show where the FIB is monitored at the termination to the control module. Up to 8 SAM modules can be accommodated to provide up to 64 I/O points in the system. It is possible to connect more than one FIB too if more I/O needs to be accommodated.



Typical control cabinet

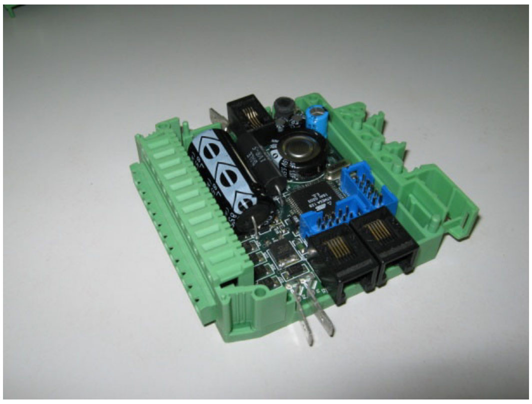
Universal Control Module

The control module (UCM) internally used by Applidyne for project development is housed in a DIN rail mounted enclosure and has dimensions of 80x80x25mm. It has 12 configurable input/output terminals connected via a detachable screw terminal socket so the module can be removed without disturbing the connections.

Universal Control Module

Power is connected via spade terminals and can be from 10V to 35V, power consumption is less than 1W. The module has two RS485 interfaces as standard, one of which can float within ±50V from the local ground. Data rates are up to 250kb/s. An expansion circuit will be available shortly for connection of 10Mb/s Ethernet, a µSD storage card and 4 separate FIB chains which will fit inside the module.

Each terminal has a fully programmable bi-color indicator beside it; a separate indicator next to the non-isolated RS485 connector is available for communications related status. Internal power storage will maintain a Real Time Clock and keep volatile status information for up to two days in the absence of power. Of the 12 terminals, 6 can be used for driving DC loads of up to 48V/3A.



UCM with lid removed

The other six can drive Pulse Width Modulated outputs with or without filtering; they can be set up for 4-20mA and 0-10V as well as general purpose switched output. Maximum power dissipation is 250mW, maximum current 125mA at 48V for these six, but software can ensure that the limit is not exceeded.

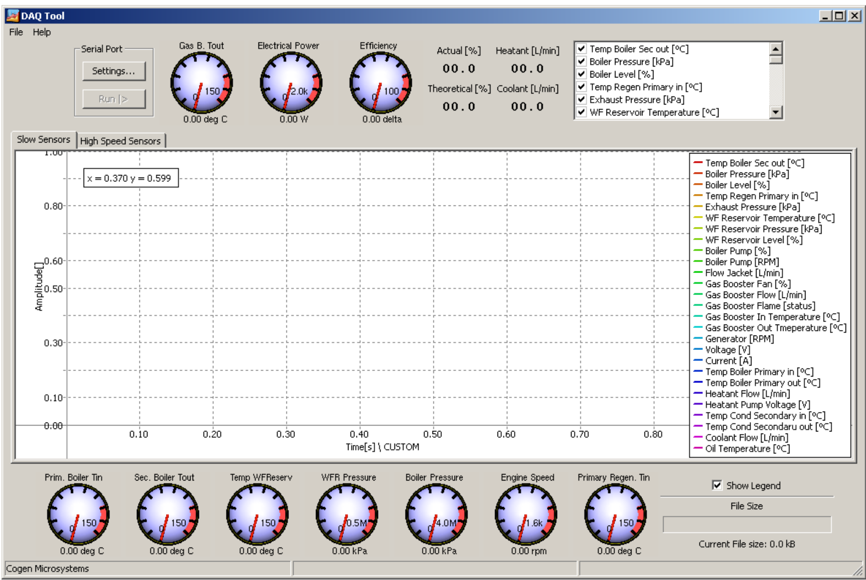
Output currents can be measured internally to allow soft limits. All terminals are protected against over voltage with transzorbs. When used as inputs, terminals can accept analog or digital inputs.

Analog inputs have a resolution of 10 bits and are configurable in scale between 1.1V and 48V. Several inputs can be used in differential mode.

At present, applications are programmed individually, but a ladder logic based user programming system is planned for 4th quarter 2011. This will have facilities for TCP/IP and MODBUS protocols and allow internet connected operation.

Facilities for HTTP, FTP, SNTP and SMTP will be implemented to allow flexible integration in a web centric environment. In a current implementation in use at Applidyne, we have a data logging interface capable of running on a multi-platform computers (Windows, Linux etcetera).

Fixed control programs in the UCM run the machine, whilst an RS485 interface sends measurement data at 250kb/s to a GUI user interface and logger running on a PC.



Data Logger Interface

How does this compare with other systems?

There are a wide variety of SCADA systems available on the market today, why did we at Applidyne decide to “roll our own”? The short answer is ease of use and configurability. It was simply impossible to find a good match for our requirements that was both flexible and inexpensive. We considered using a LabView solution and an “off the shelf” PLC approach. Below is a decision chart that helped us make up our mind:

	CONSIDERATION	LABVIEW	LG K ser. PLC	Our system
1.	**Cost of parts and software for our initial project**	10K	6K	4K
2.	**Time to implement our initial project**	4 months	4 months	6 months
3.	**Can we change sensors/actuators easily?**	Most need interfaces	Most need interfaces	Flexible interface built in
4.	**Does it have a suitable user interface?**	Yes	No	Custom interface developed for each application
5.	**Can we verify sensors and operate actuators at the source?**	No, centralized	No, centralized	Yes (At the SAM)
6.	**Do we have access to all internals?**	No, black box	No, black box	Yes (we built it!)
7.	**How easy is it to make changes to the control application?**	Easy for standard things, impossible when functions are not provided	Easy for standard things, impossible when functions are not provided	Usually very easy, sometimes we need to create additional hardware/software
8.	**Can we control data logging to suit our needs exactly?**	No	No	We make sure of that
9.	**How much work does it take to build a new application?**	Every system is a new one	Every system is a new one	New systems will take a fraction of the initial development time
10.	**Is it rugged?**	No, uses a PC and office style interface	If used in suitable cabinets	The SAM is very rugged, the controller needs a cabinet
11.	**Is it reliable?**	No, the PC can crash sometimes	Yes, has its own microcontroller	Yes, internal microcontroller

The decision was easy. The alternative solutions could not adequately cover our needs. Now that we have this solution, you might consider letting us solve your problem too.