

The 6042 Control Processor with analog and digital outputs adds real time processing and control operations to the Series 6000 data acquisition systems. It is appropriate for PID control loops including fast decisions such as test shutdown due to limit violations, frequency analysis, waveform generation, derived parameter calculation and a variety of other real-time, facility dependent operations.

Data from all measurement channels in the enclosure are automatically available in real time as inputs to control or processing algorithms. A Texas Instruments TMS320C6711 floating point digital signal processor with 16 or 32 Megabytes program and data memory runs the built-in or user programmed algorithms.

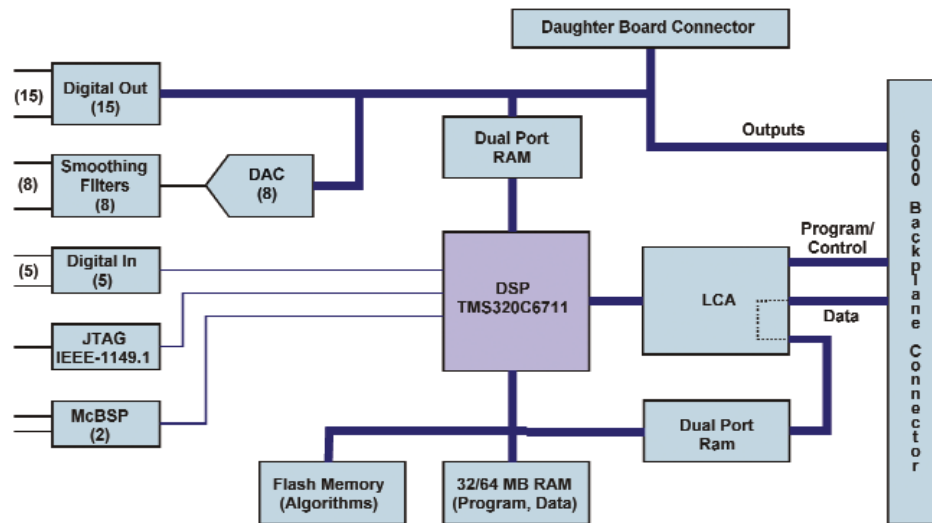
The 6042 provides eight 16-bit DAC outputs, 15 digital outputs and five digital inputs that can be used as interrupts for application control. A daughter board increases the number of analog and digital control outputs.

The 6042 lends itself to custom applications. Programming tools enable the user to design custom algorithms for data acquisition, processing and control. It has a built-in IEEE-1145.1 (JTAG) port for debugging and testing user developed algorithms on the 6042 itself. A Buffered Serial Port (McBSP) is provided for higher-speed application program loading and loading of large waveform files.



FEATURES

- Floating point digital signal processor with 16 or 32 MB program/data memory
- ±10 Volt analog outputs (DAC) with smoothing filter
- 64 Recordable outputs with alarms
- Analog & digital output expansion on daughter board
- Preprogrammed algorithms
- JTAG and IEEE 1145.1 Buffered Serial Ports



DESCRIPTION

The DSP, Texas Instruments TMS320C6711, is based on the high-performance, advanced VelociTI very-long-instruction-word (VLIW) architecture. This makes it an excellent choice for multifunction control applications where several algorithms are running simultaneously. Using a clock rate of 150 MHz it is capable of up to 900 million floating-point-operations per second. The DSP has thirty-two general-purpose registers of 32-bit length, and eight functional units (consisting of four floating/fixed-point Arithmetic Logic Units (ALUs), two fixed-point ALUs and two floating/fixed-point multipliers).

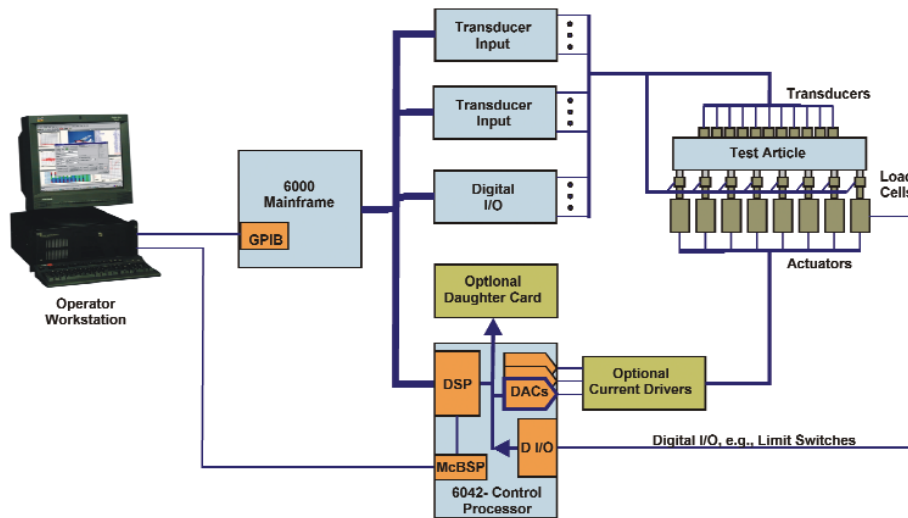
If the built-in algorithms do not satisfy the user's requirement, new ones may be developed and incorporated in the Control Processor. A complete set of development tools that include a C/C++ language compiler, assembly optimizer that simplify programming and scheduling and a Windows debugger interface are available.

A 2-MB Flash memory contains the initialization code and built-in algorithms. It can also store user-developed algorithms. The algorithms have as inputs the measurement channels from the enclosure in which the DSP is located and the Control Processor's inputs and outputs. Application of built-in algorithms is supported by PI660 data acquisition and display software.

The 6000 data acquisition system is frequently used for load and fatigue testing of aircraft and other complex structures. Input modules condition and record strain and load measurements from transducers applied to the test article. The 6042 Control Processor completes the system by processing the measurements and supplying control signals, analog and digital, that drive the actuators loading the specimen.

CONTROL APPLICATION

In the application shown below it is desired to produce a predetermined load distribution on a test article using individual actuators attached to eight different locations. Load cells between the actuator and load point on the test article measure the force output of each actuator. Strain gauges measure the resulting strain on the test article and are continuously monitored to prevent catastrophic failure.



In order to impart the proper load distribution a control algorithm will drive the actuators using the DACs on the 6042 DSP module or daughter board with voltage-to-current drivers. A PID algorithm loaded into the 6042's DSP processor generates the DAC outputs according to the desired loading profile. Load cells provide the feedback to the PID algorithm that determines the level of force applied by the actuators. The PID algorithm ensures that the desired load distribution is achieved over time and checks load and strain from transducers attached to the test article to assure they are within limits programmed by the operator. Should any measurement violate programmed limits automatic shutdown procedures may be initiated.

CONTROL EXECUTION

The 6000 system simultaneously acquires, records and displays data from the measurement transducers while the 6042 is executing the PID algorithm in the DSP processor providing real-time control of the actuators loading the test article. All of the measurement data being acquired in the enclosure in which the 6042 resides is available to it within two sample periods. Data from any channel, analog or digital, along with inputs and outputs of the Control Processor itself is available for use in the control or data processing algorithms.

The 6042 Control Processor has 64 outputs that can be recorded and displayed like any other channel in the 6000 data acquisition system. Each output has settable alarm limits that are continuously monitored. The DAC and digital outputs of the 6042 and its daughter card, if installed, are mapped to output registers. The remaining output registers are available for derived parameters or other user applications.

DSP PROGRAMMING

The 6042 Control Processor is supplied with generic DSP control and data processing algorithms that can get the user application started and serve as prototypes for advanced algorithm development. The supplied algorithms are known to PI660 the operating software for the 6000 system. This enables the user to easily program the input and output parameters for each algorithm, which means

that the 6042 can run control applications immediately upon installation in the 6000 system.

The user can develop application specific control algorithms for the 6042 using the Texas Instrument Code Composer Studio Software Development Kit (SDK). Once the algorithm exists it can be made into executable code using the SDK, debugged on a Windows based PC using an emulator, and downloaded into the 6042 for execution. If the user wishes to debug the algorithm directly on the 6042, a debugging pod may be attached to the JTAG port and stepped through the program execution while the 6000 is operating. User developed algorithms can be saved in the Flash RAM where they are available for future use.

The primary hardware layer for programming the 6042 is the 6000's GPIB, USB or Ethernet interface. Alternatively a McBSP port is available that provides a high speed serial interface for downloading programs (algorithms) and large data sets to the Control Processor's data and program memory.