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INFORMAL DATACON SYSTEM REPORT

R. Frankel

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Accelerator Department
BROOKHAVEN NATIONAL LABORATORY
Associated Universities, Inc.
Upton, New York

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CENTRAL MODULE

Computer Interface

The computer interface is presently designed to work with a PDP-8 class computer. It is a parallel link with a logic repeater for correction of additional central modules without returning each unit back to the computer. If I were to redesign this portion of the system, I would give serious consideration to a semiserial type of interface (two to six cables) and have each central module individually return to the computer. The computer transfers three twelve bit words to the Datacon. The first word contains eight address bits and the sign bit is used to specify whether the datacon should perform a command function or merely reply with requested information. The R/S bit is also used to specify direction of data flow to and from the computer with the objective of reducing the number of computer command codes required. The second word is a twelve bit magnitude command or reading, and the third word consists of eight command or status bits. After the 29 bit composite word is assembled (send), the computer issues a go pulse. Note that transmission may be time synced to the accelerator via this feature. On Read only it is sufficient to specify only the desired address. Two hundred fifty-six was chosen as the largest number of devices which should be trusted to a single communications line. Using hindsight I might be tempted to add several additional address bits to permit manual control via multiple central modules patched on the same line. The reader should note that by limiting each central module to 256 channel and using interrupt programming, it is possible to interleave many datacon central modules in the nominal quarter of a second it takes to read a single set of 256.

Manual Control Panel and Logic

The serial transmission register of the central module has the ability to receive logical instructions from four branches. One is utilized for computer information, the other three for various modes of manual data entry. Although I have employed a single command panel, it is possible to substitute multiple manual control heads. An apparently unique feature of Datacon (compared to work at NAL and LAMPF) is the existence of a manual control head. I elected to employ my three entry branches to permit data entry in binary decimal and to allow an independent hardware scan feature. In this mode the Datacon will cycle consecutively through each address pausing at any address flying a malfunction flag.

Serial Shift Register and Data Format

Signal transmission and reception is accomplished by a pulse width code: A logical zero pulse is one unit wide, a logical one is three units in width, and a frame (clear or sync) pulse is five units long. The received signals are decoded via one shot circuits.

Note that such a system is self clocking, noise resistant and cheap to generate and decode. When the central module (transmitter) receives a synchronized GO command, it outputs a frame pulse and initiates the clocking out of data stored in the serial shift register by the computer or manual control panel. The next pulse transmitted is always a logical one, the key; its purpose is to tell the remote receiving shift register, which was previously cleared by the frame pulse, to check parity and either accept or reject the transmission. The R/S, eight address, 12 magnitude and command and a parity bit are then sent. The same physical shift register is employed in reverse fashion for reply data. Tranmissions are fail-safe to the extent that a transmission error is always assumed if a remote (receiver) fails to respond or garbled data is received at the central (no answer and time out faults). The clock speed is arbitrary and jitter independent; it was selected to permit round trip data flow in less than one millisecond. Speeds several times faster are readily achieved.

Line Driver

Serial data transmission systems like Datacon can be built with a single or several signal lines to each Remote. The Remotes may use repeaters or just appear as high impedance ports on a branch line. The nature of signal distribution systems existing or planned at a given location must be weighed heavily

in selecting a fanned versus distributed system. The use of balanced line is on another option open to the designer of a new system. The Brookhaven Datacon uses a three state line driver: One, zero and high Z. Pulses are generated at 15 volts into 50 Ω with an adjustable noise rejection level in the line receiver section. As all systems thus far installed are of the cluster remote type, extensive tests on the maximum number of line taps have not been made. The major disadvantage of the single wire system is intrinsic difficulty with remote interrupt capability. Our system scans under computer control.

REMOTE MODULE

Logical Structure

Remote modules may vary from an ultra simple single address remote designed for on/off control of some device to a multiaddress cluster for full two directional control of a complex system including digital/analog and analog/digital converters. At the AGS the system built thus far are complex clusters. The logic of the remote is similar to that of the central. After successfully receiving a command or a request, the remote responds to the central with frame pulse, it then puases while it executes or collects the parameter desire. After the data is available it is clocked back to the central.

Buffer Cards

Large systems at a remote point may use buffer cards to funnel parallel data to serial form. This reduces internal system wiring complexity and cost.

Device Cards

Special control cards designed for the device to be controlled are the end point of the system. Existing designs include power supply control, digital delay, analog switching and analog/digital converter cards.

As of today the AGS has over 200 hardware control channels in everyday use on the injection transport and low field orbit correction system. Additional units being installed and under construction include a secondary beam line and the AGS fast and slow external beam.

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