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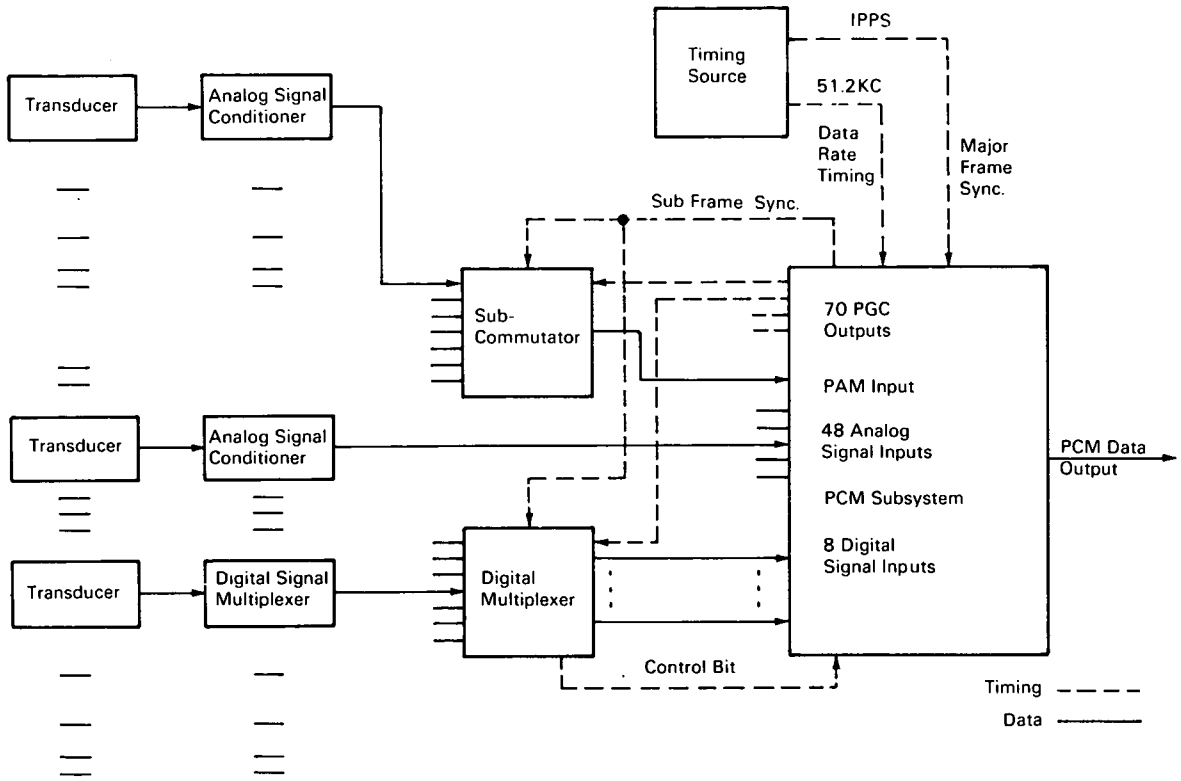
NASA TECH BRIEF

Portable Pulse Code Modulation (PCM) Subsystem



Three problems existed in earlier PCM subsystems, minimal data handling capability, fixed format, and system size, which could not always be tolerated. A PCM subsystem which is programmable, high speed, and small is required to support the variety of signals inherent to a sophisticated spacecraft, for example.

This PCM subsystem, hereinafter known as the subsystem, is capable of meeting the above requirements. The subsystem is used in the manner shown in the figure. A signal, event (on-off) or analog, generated by a transducer is first conditioned to the proper signal range acceptable to the subsystem. The signal is then sampled by an external multiplexer or by the subsystem directly. The sampled signal is then converted by the subsystem and transmitted in a PCM format to a receiving station for data handling and display.

All timing used for sampling signals is generated (and thus synchronized) by the subsystem. This timing is derived from an external timing source supplying both 51,200 Hz data rate timing, and 1 pulse per

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second Major Frame Synchronization (MFS) signs. The MFS controls overall systems' synchronization. A conditioned MFS is generated by the subsystem for synchronization of all multiplexers.

The subsystem contains a timer or programmer with patchboard, high rate analog gates, an analog-to-digital converter, digital gates, and a parallel-to-serial converter.

Three types of data can be handled by the subsystem; Pulse Amplitude Modulation, direct analog, and digital. Each is converted in programmed sequence which is controlled by the timer and prepatching. The timer outputs, Primary Gate Controls (PGC), are patched to output drivers for control of external multiplexer sampling, and also to the internal high rate sampling analog gates.

The sampled analog data is converted into 8-bit digital code by the analog-to-digital converter and transferred to the parallel-to-serial converter where it is "interleaved" with the sampled digital data. The control of data conversion, analog or digital, into the PCM format is directed by the control bit, an externally supplied synchronization signal. Sampling rate and position of data in the PCM format is completely flexible with use of the PGC patchboard and control bit.

The subsystem is a vast improvement over past fixed format systems, mainly due to its format patching capability. Also, its capability of handling the three popular forms of sampled data simultaneously would normally require at least two earlier systems. Finally, its size, less than 0.75 cubic foot, and high speed, 51,200 bits per second, makes the subsystem very useful for a variety of telemetry systems' requirements.

Notes:

1. This subsystem has been reduced to practice and is being used in the sophisticated and complex Apollo spacecraft.
2. The subsystem is capable of handling 128 channels of analog and digital information and would be useful for the accumulation of data from many points for computer processing or real time display.
3. Inquiries concerning this innovation may be directed to:

   Technology Utilization Officer
   Manned Spacecraft Center
   Houston, Texas 77058
   Reference: B68-10106

Patent status:

No patent action is contemplated by NASA.

Source: P. A. Bradanini and J. T. Kluth
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