SYNERGISTIC INSTRUMENT DESIGN

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I. The Synergistic Approach

A. Do a functional design

1. Block-out all system functions.
2. Identify all areas that are exclusively analog.
3. Identify all areas that are exclusively digital.
4. Identify any analog/digital hybrid areas.

B. Design hardware to promote efficient software.

1. Supply task-efficient timing.
2. Supply task efficient I/O structures.
3. Design a task/code efficient system architecture.

C. Design software to promote efficient hardware.

1. Structure software to minimize hardware.
2. Customize coding to be task efficient.
3. Directly replace hardware functions wherever possible.
4. Use time and memory space wisely.

D. Completed design yields bonuses.

1. Additional features can be included with nominal hardware increases.
2. Design changes can be made easily.
3. Less hardware means less power, less mass and fewer failures.

II. The Galileo Television Camera

A. Taking pictures.

1. Filter selection and shuttering with software timed pulses directly to mechanism drive amplifiers.
2. CCD readout H1 rate timing executed in hardware.
3. CCD readout L0 rate timing and video/data system time syncronization executed in software.
4. Software timing is precision synchronized with system clock to assure exposure accuracy.

B. Telemetry acquisition.

1. Software controlled ADC and Mux.
2. Precision sample times.
3. Software can position sample times anywhere within the camera cycle to monitor specific activities.

C. Communications

1. Non-immediate bus adapter does most work in software.
2. Software sequencing sync's up with time broadcast.
3. Software rate buffers telemetry for transmission.

D. In-flight problem solving.

1. Programmable telemetry can profile electrical activity.
2. Multi-mode memory switching and mixing.
3. In-flight re-programming capability.
4. Diagnostic software reports and time tags errors.

SSI Timing

SSI image parameter control and timing signal generation is based on application of microcomputer technology. In addition to controlling serial pixel shifting and pixel analog-to-digital conversion, all timing, sequencing, mechanism control, engineering and status data acquisition, and buffering shall be performed under programmed microcomputer control. SSI data rates and formats shall be as specified in GLL-3-280, Telemetry Measurements and Data Formats. Additional SSI rates and timing intervals are presented in Table 1. Figures 2A, 2B and 2C present the relationship between the various SSI timing parameters for SSI imaging modes of 8 2/3, 30 1/3 and 60 2/3 seconds respectively.

TABLE 1. SSI TIMING PARAMETERS

	8 2/3 Second Mode	30 1/3 Second Mode	60 2/3 Second Mode
a. Pixel bit rate	806.4 KBPS	806.4 KBPS	806.4 KBPS
b. Pixel rate	100.8K Pixels/s	100.8K Pixels/s	100.8K Pixels/s
c. Line time	8 1/3 m sec	33 1/3 m sec	66 2/3 m sec
d. Read frame time	6 2/3 sec	26 2/3 sec	53 1/3 sec
e. Frame repetition time	8 2/3 sec	30 1/3 sec	60 2/3 sec
f. Prepare time	2.0 sec	3 2/3 sec	7 1/3 sec
g. Filter steps allowed	2	3	7
h. Maximum normal exposure	800 m sec	800 m sec	800 m sec
i. Maximum extended exposure	6400 m sec	25600 m sec	51200 m sec
j. SSI reply data rate	403.2 KBPS	403.2 KBPS	403.2 KBPS
k. CDS sync	806.4 KBPS	806.4 KBPS	806.4 KBPS
l. Real-time interrupt	15 Hz	15 Hz	15 Hz

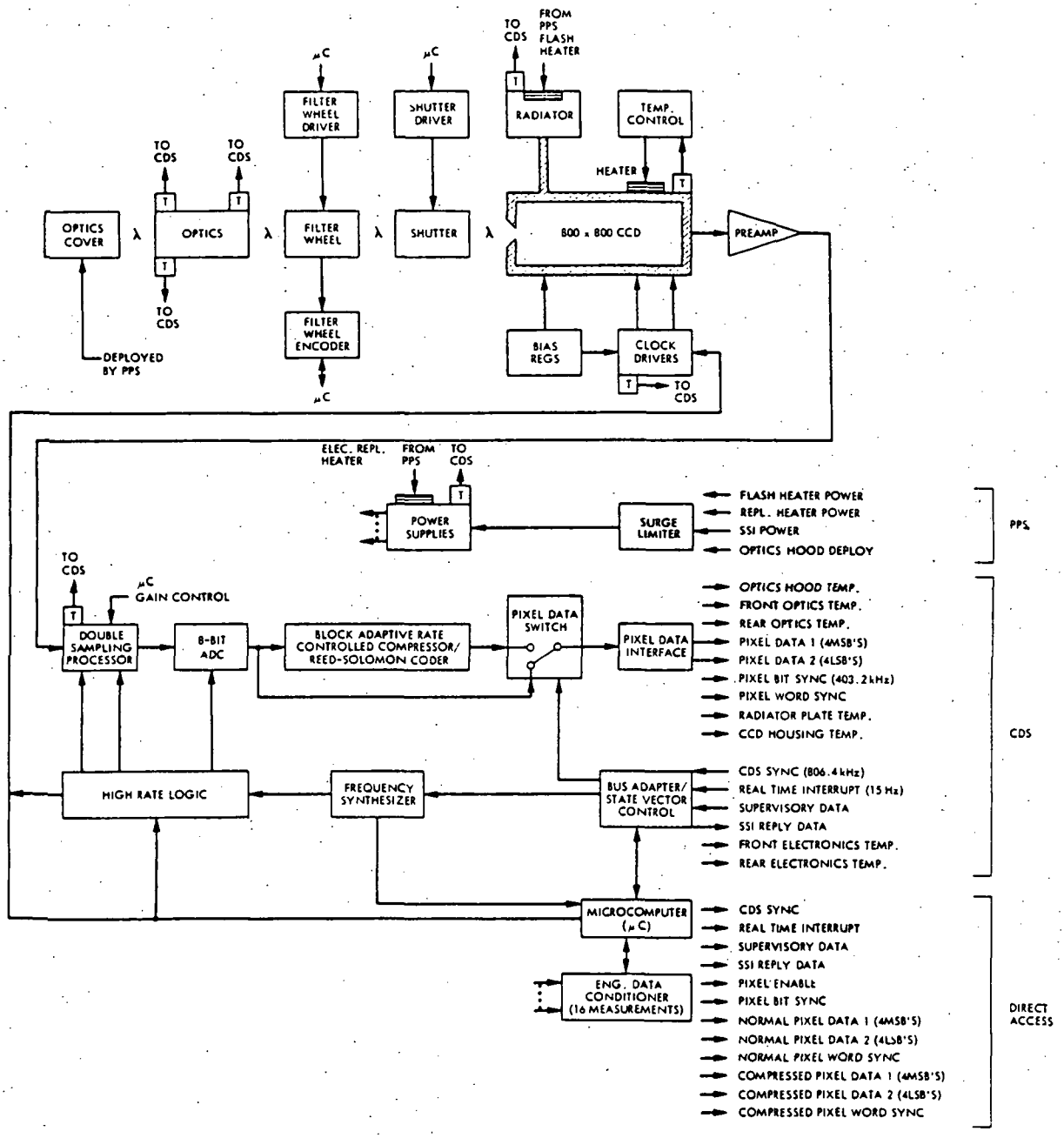

FIGURE 1. SSI FUNCTIONAL BLOCK DIAGRAM

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REQUIREMENTS

- COMMUNICATE VIA CDS BUS PROTOCOL
- MEET CAMERA FUNCTIONAL OBJECTIVES
- PREVENT HAZARDOUS CONDITIONS
- PROVIDE CAMERA HEALTH DATA
- PROVIDE FOR BACK-UP MODES
- PROVIDE FOR POST LAUNCH REPROGRAMMING
- PROVIDE DIAGNOSTIC TOOLS

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DESIGN CRITERIA

- FUNCTIONAL REQUIREMENTS
- CIRCUIT STIMULATION REQUIREMENTS
- COMMUNICATIONS REQUIREMENTS
- TIMING CONSIDERATIONS
- HARDWARE/SOFTWARE TRADEOFFS
- DIAGNOSTICS
- FAULT DETERMINATION
- REPROGRAMMING TECHNIQUES

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DESIGN APPROACH

- EFFICIENT PROGRAM ARCHITECTURE
  - OPTIMAL MEMORY USAGE AND EXECUTION TIMES
- ERRONEOUS COMMAND PROTECTION
  - PARITY ERRORS/ILLEGAL COMMANDS
- CONTINUOUS DIAGNOSTICS
  - CHECKSUMS/SCRATCH-PAD WRITE-READ
- FAULT DATA IN TELEMETRY
  - PARITY ERROR, COMMAND TRAFFIC, ILLEGAL COMMAND COUNTS
  - DIAGNOSTIC RESULTS/FAULT TIME TAG
- SPECIAL FAULT ANALYSIS TOOLS
  - PROGRAMMABLE ENGINEERING READOUTS
  - PROGRAMMABLE MEMORY MONITOR
- BACK-UP MEMORY CONFIGURATIONS
  - EXECUTE CODE FROM RAM, ROM + RAM, ROM/RAM + SCRATCH-PAD

    USE SPARE SCRATCH-PAD FOR CODE OR DATA

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DATA SYSTEM ARCHITECTURE

- OUTPUT PORTS SUPPLY LOW AND MEDIUM RATE PULSES AND SIGNALS TO CAMERA ELECTRONICS
- SOFTWARE DISPATCHES AND TIMES OUTPUTS IN ACCORDANCE WITH COMMAND, FUNCTIONAL AND ELECTRICAL REQUIREMENTS
- INPUT PORTS SUPPLY ENGINEERING, FILTER POSITION AND STATUS DATA TO THE SOFTWARE
- FLAGS SUPPLY RTI, PROGRAM LINK MODE, SRTI PHASE AND CDS BUS PARITY ERROR DATA TO THE SOFTWARE
- SOME OUTPUTS ARE RE-CLOCKED WITH SRTI OR SRTI PHASE TO ASSURE SYSTEM SYNCHRONISM

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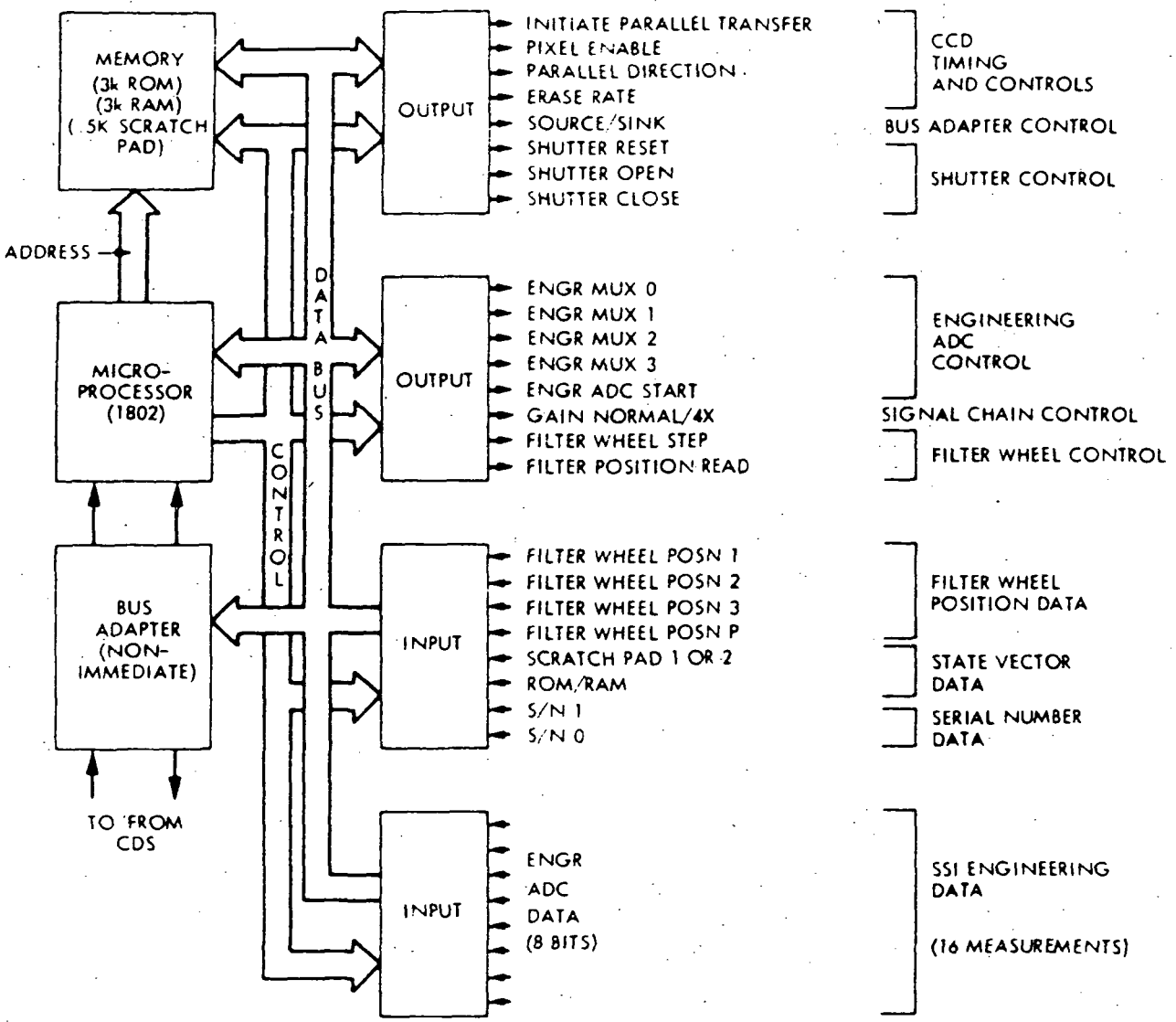
SSI MICROCOMPUTER



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SOFTWARE STRUCTURE

- REAL TIME INTERRUPT DRIVEN
- FOREGROUND/BACKGROUND OPERATION
- INTERNAL SPACECRAFT TIME CLOCK
- TIME DISPATCHED EVENTS
- SYNCHRONOUS OUTPUTS

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BASIC PROGRAM FLOW