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Inertial Reference Unit

The Mariner '71 inertial reference unit is included as part of the attitude control subsystem to maintain a 3-axis inertial reference for the spacecraft during times when it is not locked onto celestial references. It provides rate damping information to the attitude control subsystem and angular position information to the attitude control subsystem during turns and motor burns. The linear change of velocity of the spacecraft during motor burns can also be obtained from this unit.

The primary sensors of the inertial reference unit are three floated rate-integrating gyroscopes with internal gains of 250 deg/deg, and one miniature, pulse captured, linear, single-axis nongyroscopic accelerometer. The gyroscopes are always held in the rate mode; analog feedback is provided to their DC permanent magnet torquers. The rate output from the reference unit is derived by sensing torquer current as a voltage with respect to ground across a precision resistor. The rate scale factors of the gyro loops are 1.0 mV/(deg/hr) in the roll channel and 0.5 mV/(deg/hr) in the pitch and yaw channels. Maximum linear slew rates of the loops before electrical saturation are 1.6°/sec in roll and 3.2°/sec in pitch and yaw. Absolute maximum inaccuracy of the rate output is 0.5°/hr. Position information for the spacecraft reference is derived as the first integral of spacecraft angular rate, and this is accomplished by use of an analog electronic integrator. The position scale factor is approximately 3 volts/degree and gyro plus integrator drift is of the order of 0.05 equivalent degrees in an hour. Spacecraft turns are accomplished by offsetting the integrator at its input; this forces the spacecraft to rotate in the proper direction at the desired rate (approximately 650°/hr) to offset this signal with the rate output of the gyro loop. The net angle traversed by the spacecraft is derived by timing the turn at this preset turn rate.

Linear velocity is derived as the first integral of linear acceleration from a digital feedback loop in a pulse-on-demand configuration around the accelerometer. Each pulse is kept at a precise width and amplitude and is gated to the accelerometer torquer by its pickoff output when needed to keep the pendulum at null. Each pulse is equivalent to approximately 0.03 meter/second. The pulses are counted for derivation of the velocity change of the spacecraft due to motor burn.

A tight analog loop has been provided for use during launch so as to reduce the probability of accelerometer damage. Since inertial control about the roll axis may be required during mission phases when power is at a premium, a low-power roll-channel mode is included during which only the roll gyro spinmotor is operated along with its loop and integrator. The pitch and yaw channel loops are operated as well for reasons of increased safety. This reduces the probability of damage to these gyros during ground testing in the event that their spinmotors are inadvertently powered by a system failure. The pitch and yaw integrators and accelerometer electronics, however, are not powered.

The unit also is able to rotate the spacecraft in ±2° steps, as commanded, about the roll axis by applying the precision command voltage signal of proper polarity to the roll integrator for a preset amount of time. This function also is available in the roll-channel-only mode.

(continued overleaf)

Note:

Requests for further information may be directed to:

Technology Utilization Officer
NASA Pasadena Office
4800 Oak Grove Drive
Pasadena, California 91103
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No patent action is contemplated by NASA.

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