FEED POSITIONING SYSTEM

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Abstract

This report presents a proposal for the feed positioning system. User specifications and features are discussed. Alternative encoders are considered for the application. This is only a preliminary report. More detailed and complete report will be brought out in due course.

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Introduction

The GMRT is designed for multi-frequency operation. Multiple feeds for different operating frequencies are located on a rotating turret at the focus of the dish. Four feeds are spaced 90^{o} apart on the turret. These feeds have to be positioned accurately to an angular accuracy of about 1 arc min. A simple scheme for achieving this is proposed in this report.

User Specifications

Electronics of the proposed scheme is capable of accurate positioning to within 1 arc min. This is limited by the worm gear and feed bull gear backlash (Ref. 1). However, there is enough intelligence in the proposed control system to take care of repeatable errors, and to employ programmable positioning strategies to minimise errors. These may include;

1. Trapezoidal velocity profile for point-point movement.
2. Uni directional approach to the target position.

It will be possible to position the feed at any given angle with an accuracy limited only by the mechanical system. Once the feed is positioned, it can be monitored for any displacement.

Either an absolute or an incremental encoder can be used.

Block diagram

1. Fig.1 is a block diagram of the mechanical arrangement for the feed drive. (From Ref. 1)

2. Fig.2 is the block diagram of the proposed scheme.

It is proposed to couple the encoder to the output drive shaft of the worm gear. The shaft is easily accessible and the encoder can be housed in a weather proof enclosure with the feed drive motor. Encoder cables can also be routed conveniently with

the feed motor cables. At this stage, there is a 5:1 reduction to the feed. A feedback control system is implemented with the microcontroller. Software is stright forward as the velocity and acceleration profiles are not stringent.

Pulse Width Modulated(PWM) output is directly avaliable from the microcontroller. Only a power buffer is required to drive the motor. This can be implemented with power MOSFETS. With this hardware, it will be possible to;

1. Have programmable velocity profiles for point-point movement.
2. Implement dynamic braking and feed motor locking.
3. Step the motor in small increments.

Choice of encoders

It is possible to use either incremental or absolute encoders. Absolute encoders should be of the multiturn type. Incremental encoders normally give an index pulse every revolution. This will be used as a reference. An auxillary marker, either from a photo-interruptor or a limit switch is required to correlate the index pulse with absolute position. Coupling can be adjusted to make the index pulse coincide with the absolute antenna reference position. It is also possible to use the photo-interruptor output as the reference. In the first case, repeatability is dependent only on the encoder coupling to the feed. In the later case, both the encoder coupling and the interruptor accuracy affect repeatability.

With an incremental encoder, whenever power supply to the micro-controller gets interrupted, counting should be restarted from the reference index pulse . It is therefore essential that the microcontroller be battery backed. With an absolute multiturn encoder, it is not necessary to go back to the starting position after every power interruption. Increamental encoders are however cost effective. The options are therefore;

a) Absolute multiturn encoder with 12 or 13 bit resolution and ± 1/2 bit accuracy.

b) Incremental encoder with 2048 - 4096 lines per revolution. With 4096 lines/rev, it is possible to have upto 16384 steps/rev. With the proposed encoder coupling, this is equivalent to 81920 steps/rev of the feed or a step of 0.26 arc min. Listing of possible resolutions using 2048 and 4096 lines/rev encoders follows;

Lines/rev	X 5 (steps)	angular (arc min)	X4 Electronics (arc min)
2048	10,240	2.11	0.53
4096	20,480	1.05	0.26

It is possible to choose the required resolution by software.

Encoders with more than 6400 lines/rev do not give enhanced resolution, as the microcontroller uses only 16 bits for position.

Microcontroller can be connected to the ABC by a serial line. ABC is in turn connected to the servo computer.

Proposed hardware can also be used to monitor and log wind speed. Both the functions can be realised with this hardware, which can be battery backed and located at the dish base. Encoder can be connected to the microcontroller by shielded twisted pairs or a pair of optical fibers.

Ref.1 : Vaidya.V, Kulkarni.G.R "Feed Drive Control System".
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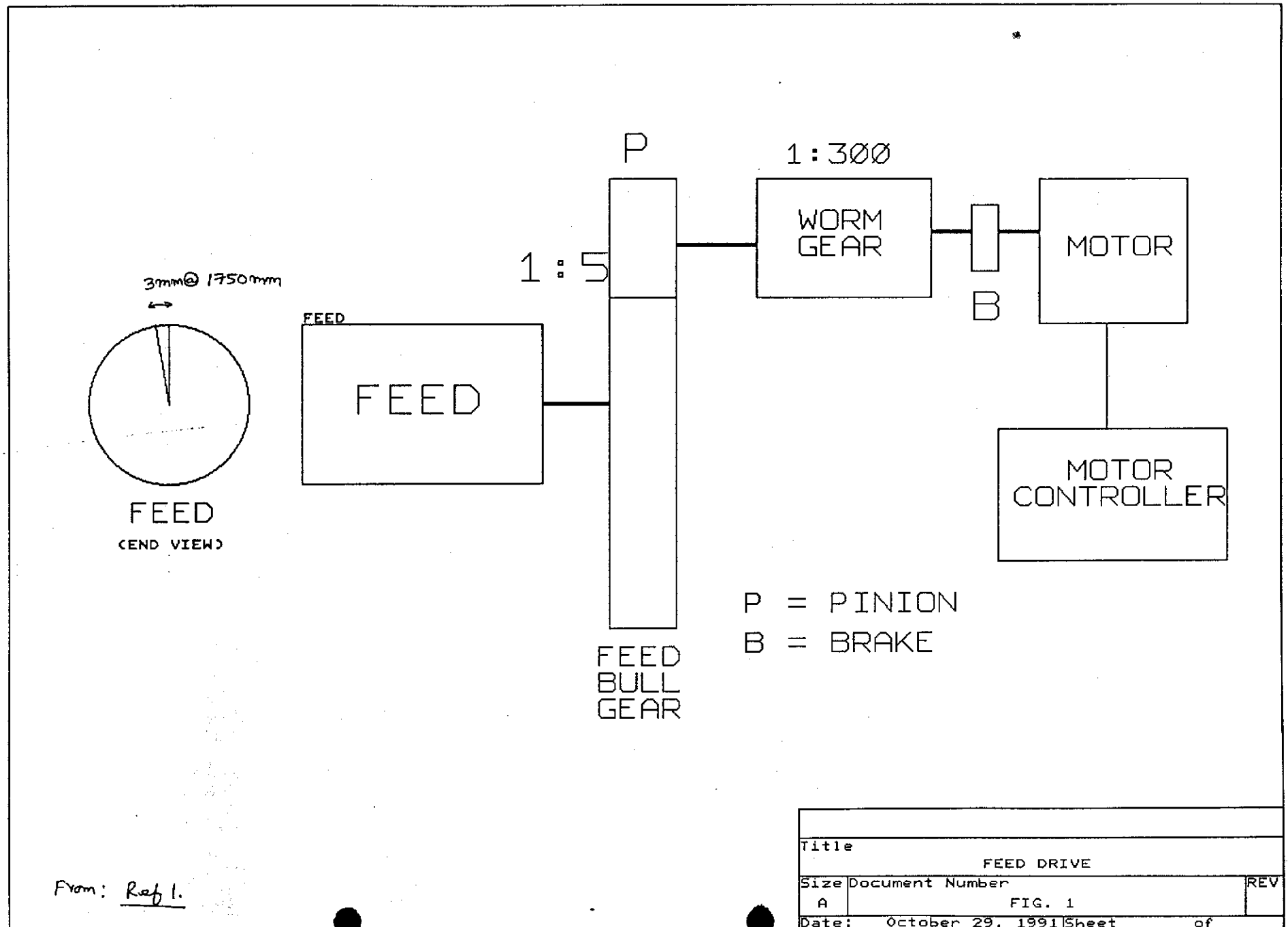

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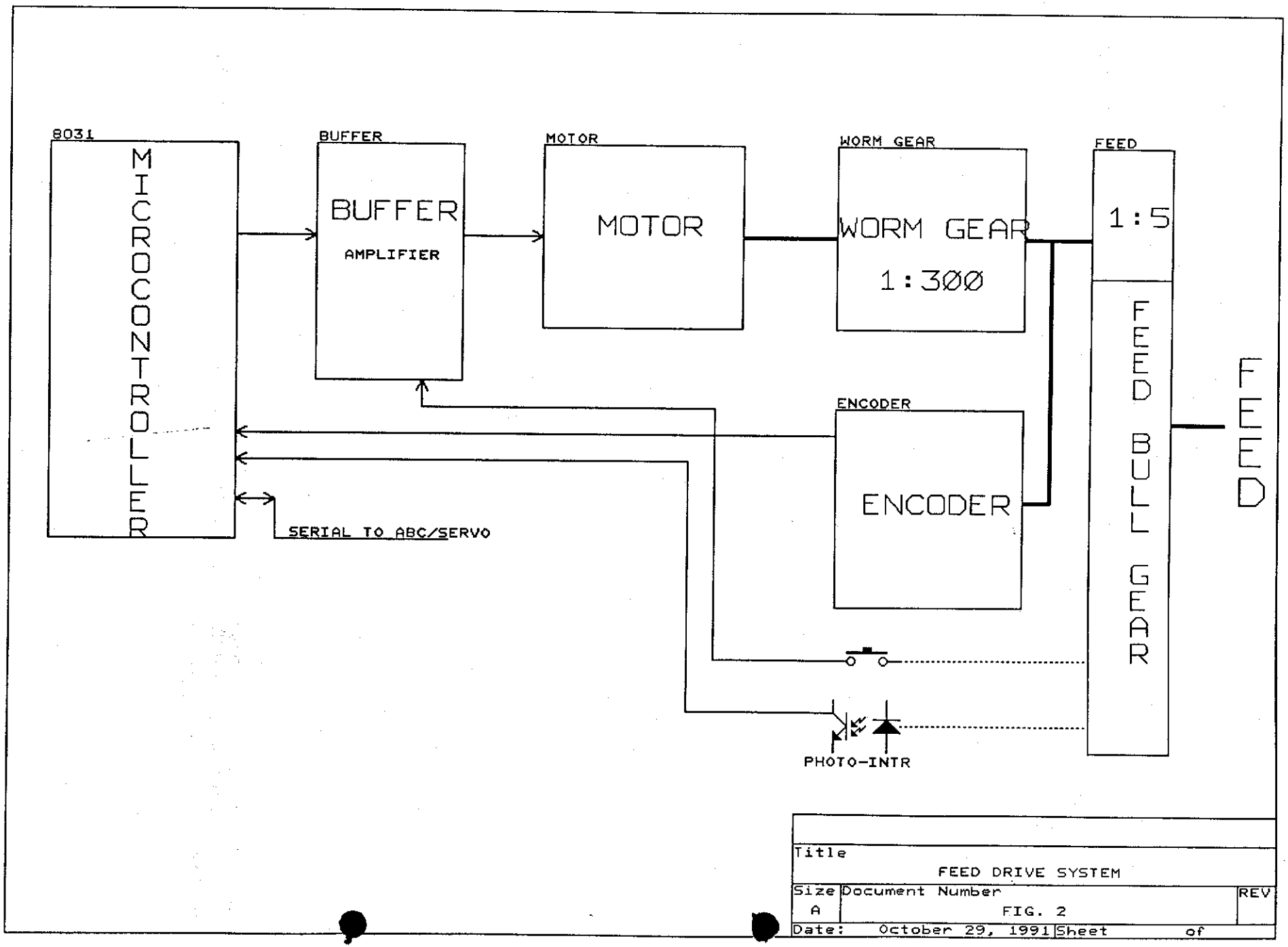
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MICROCONTROLLER
BUFFER
BUFFER
AMPLIFIER
MOTOR
MOTOR
WORM GEAR
WORM GEAR
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FEED
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FEED BULL GEAR
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FEED DRIVE SYSTEM
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FIG. 2
REV
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