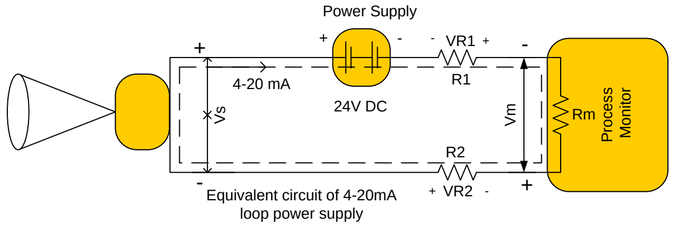
DESIGN & IMPLEMENTATION OF A NON-CONTACT LEVEL SENSOR

By Jonathan Ward

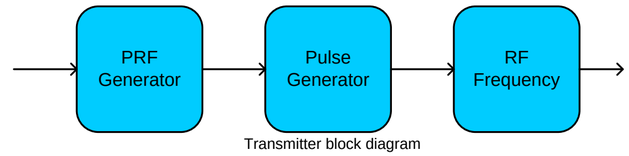


INTRODUCTION

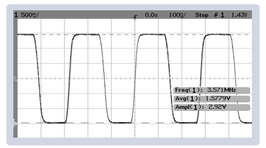
The instrument will be used for determining the level of a substance inside a vessel of known size.
The industry partner for this project is KAB Instruments whos primary product is the manufacturing of ultrasonic level sensors.

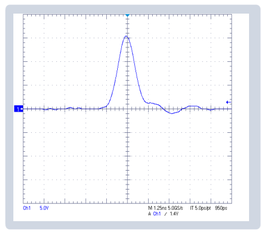
Since radar based level sensors are gaining market share and becoming more affordable, it is our goal to design low cost and low power technology which can be incorporated into their product line.

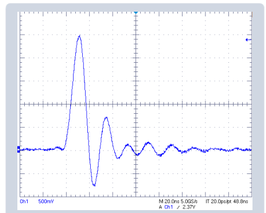
Advantages of radar based level measurement systems include better accuracy, operation is unaffected by process temperature and pressure, low power and operating costs



Transmitter block diagram







PRF Generator

The reference clock generator sets the PRF for the system. The output is a square-wave at the required frequency. A silicon oscillator is used and the frequency is set by a resistor.

Pulse Driver

The pulse driver is responsible for outputting short 1ns pulses. It is triggered by the PRF generator. The pulses are generated by a bipolar transistor in an avalanche mode.

RF Carrier

The pulse generated by the pulse driver travels down a transmission line where it couples magnetically to a dielectric resonator. The resonator, which acts like a bandpass filter, resonates at the frequency selected and the signal is magnetically coupled back onto the transmission line or onto a second transmission line. The RF pulse is then fed through to the antenna and transmitted towards the target surface.

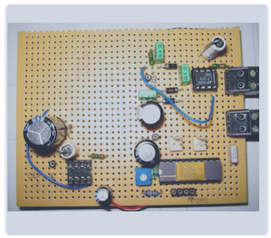
POWER SUPPLY

Loop power supplies are also referred to as 4-20 mA current loop supplies and are a standard method of transmitting sensor information in industrial process-monitoring applications.

The operation of the current loop is very straight forward. In the case of a level measurement instrument, the detected level is converted to a proportional current, with 4 mA representing the zero or lowest-level output and 20 mA representing the full-scale output or vice versa.

This current is then maintained in the loop where a receiver at a remote end can convert the 4-20 mA current into a voltage, which can then be processed and displayed by a computer.

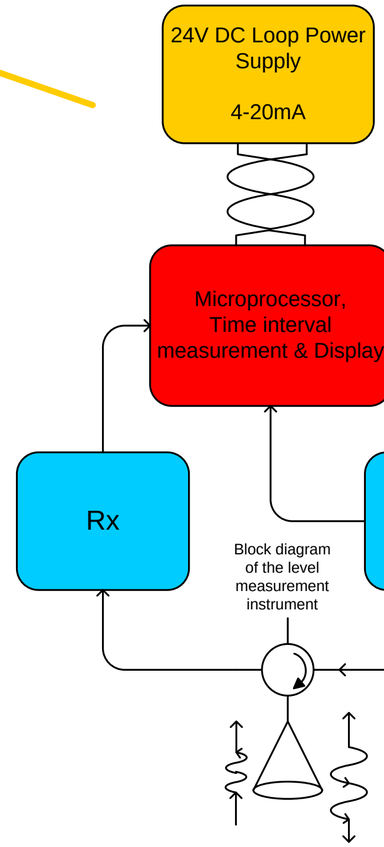
Sending a current over long distances produces voltage losses proportional to the wiring's length. However, these voltage losses do not reduce the 4-20mA current as long as the transmitter and loop supply can compensate for these drops.

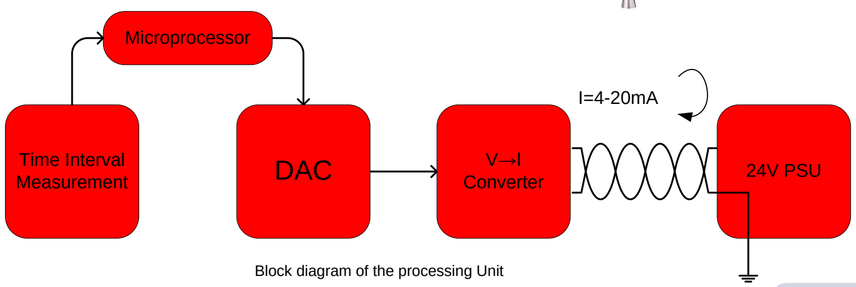


A prototype 4-20mA loop power supply

Commercial products

Mining





Block diagram of the processing Unit

The microprocessor is responsible for controlling the intrument. It is responsible for taking in and co-ordinating time interval measurement. It uses this information to calculate the level which it displays and converts to a digital value. It then passes this value to a digital to analogue converter. The digital to analogue converter then sends a voltage to a voltage to current converter which is responsible for modifying the current on the loop of the supply.

Applications

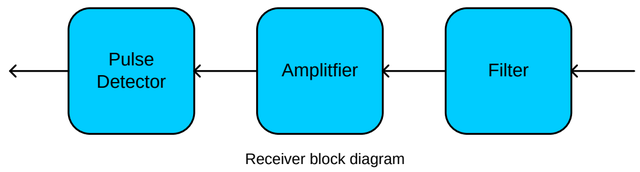
Many applications in industry require the use of large tanks for storage, which can include the chemical, food, oil, mining, water supply and beverage industries.

Accurate level data of the contents of every tank is vital where inventories, batching and process efficiency are critical measurements. Due to the large surface areas of these industrial storage tanks, a small change in level corresponds to a large change in volume. Therefore, if the volume of the tank has to be strictly controlled, a very accurate measurement of level is required.

Ocean Observation

Waste water industry

Chemical Industry



Receiver block diagram

RECEIVER

The receiver is responsible for receiving the echoes, which have reflected of the target surface. A filter is used to select only the frequency of the pulses. A low noise amplifier is used to boost the signal strength as the echoes which return are only a fraction of the power of the transmitted signal. A detector then determines whether a pulse is a legitimate echo or noise depending on a certain threshold. The leading edge of the echo is then detected and sent along with the timing information from the transmitted pulse to the time interval measurement stage.

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