Select a micro controller

When selecting a microcontroller for measuring 0 to 100V DC using an ADC, several factors need to be considered such as the number of ADC channels, ADC resolution, operating voltage, availability of UART for communication, and ease of programming.

Considering these factors, the **PIC16F877A** microcontroller from Microchip is a good choice. Here's why:

1. ADC Resolution and Channels:
   - 10-bit ADC with 8 channels.
2. Operating Voltage:
   - Operates at 5V which matches the reference voltage used in our design.
3. UART Communication:
   - Integrated UART module for serial communication.
4. Ease of Programming:
   - Supported by MPLAB X IDE and XC8 compiler, making it easy to develop and debug code.
5. Community and Documentation:
   - Widely used microcontroller with extensive documentation and community support.

PIC16F877A Key Specifications

CPU Speed: Up to 20 MHz

Flash Memory: 14 KB

RAM: 368 bytes

EEPROM: 256 bytes

I/O Pins: 33

Timers: 3 (Timer0, Timer1, Timer2)

Communication Interfaces: USART, SPI, I2C

Algorithm for measurement:

Theoretical Accuracy Calculation for ADC-based Voltage Measurement

Step 1: Determine the ADC Resolution

The ADC resolution for a 10-bit ADC is:

$$2^{10} = 1024$$

Step 2: Reference Voltage

Assume the reference voltage (V_{ref}) is:

$$5V$$

Step 3: Calculate the Least Significant Bit (LSB)

The LSB is calculated as:

$$\text{LSB} = \frac{V_{ref}}{2^{\text{resolution}}} = \frac{5V}{1024} = 0.00488V$$

Step 4: Voltage Divider Ratio

For measuring 0 to 100V, the voltage divider ratio required to scale down to 0 to 5V is:

$$\text{Voltage Divider Ratio} = 20 : 1$$

Step 5: Effective LSB for 0-100V Range

The effective LSB when considering the voltage divider is:

$$\text{Effective LSB} = \text{LSB} \times \text{Voltage Divider Ratio} = 0.00488V \times 20 = 0.0976V$$

Step 6: Quantization Error

The quantization error, considering a $\pm 0.5 \times \text{LSB}$, is:

$$\text{Quantization Error (in voltage)} = 0.5 \times \text{Effective LSB} = 0.5 \times 0.0976V = 0.0488V$$

Step 7: Calculate the Theoretical Accuracy

The theoretical accuracy is calculated as:

$$\text{Accuracy} = \frac{\text{Quantization Error}}{\text{Full Scale Range}} \times 100\%$$

$$\text{Full Scale Range} = 100V$$

$$\text{Accuracy} = \frac{0.0488V}{100V} \times 100\% = 0.0488\%$$

Flow chart:

```
+-------------------------------+
|           Start               |
+-------------------------------+
            |
            v
+-------------------------------+
| Initialize ADC and UART       |
+-------------------------------+
            |
            v
+-------------------------------+
|           Loop                |
+-------------------------------+
            |
            v
+-------------------------------+
|       Read ADC Value          |
+-------------------------------+
            |
            v
+-------------------------------+
|  Convert ADC Value to Voltage |
+-------------------------------+
            |
            v
+-------------------------------+
|  Send Voltage Value Over UART |
+-------------------------------+
            |
```

```
            v
+--------------------------------+
|          Delay 1 Second        |
+--------------------------------+
            |
            v
+------------+-------------------+
|           End Loop             |
+--------------------------------+
```