An ISO 9001 Certified Company

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Manual No.: SB-00-132

AG965-07E
AET500 Micron Precision Demonstration

SB-00-132

Overview

The demonstration includes:

- AET500-02E five-mm pole pitch TMR Linear Sensor
- NVE part number 12592, five-mm pitch magnetic tape, and fixturing
- Low-cost dual op-amp and microcontroller interface
- Four-digit LED micron display
- LEDs for pole detected and field strength intensity indicator
- Sensor test points and screw terminals
- 3" (76 mm) x 5" (127 mm) printed circuit board
- Three AAA batteries to power the board

AET500-02E Features:

- 200 mVpp/V typical max output
- 20 mVpp/V max offset
- High Accuracy: 1% max hysteresis / 1% typical linearity
- 350 kHz magnetic bandwidth
- −50 °C to 150 °C
- Compact SOIC8 package

Quick Start

- ➔ Turn on the power
- ➔ Slide the magnetic tape through the mounting fixture
- ➔ Observe the micron position on the display, from zero to 9999.

Magnetic Operation
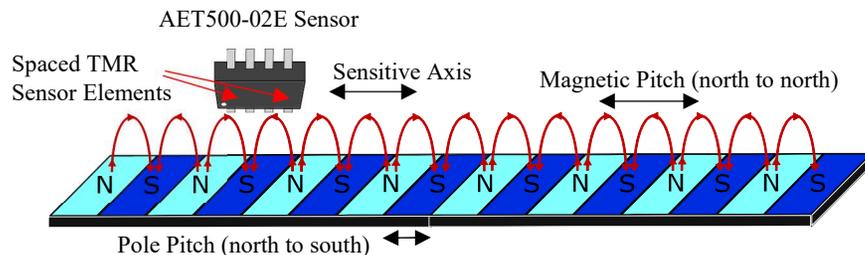
The AET500 is a linear sensor that detects the periodic magnetic fields produced by alternating magnetic poles. The sensor is single-axis sensitive, and its spaced TMR elements are optimized for five-mm pole pitch.

Bill of Materials

Reference	Manufacturer	Part Number	Description
N/A	NVE Corporation	AET500-02E	SENSOR TMR LINEAR 8SOIC
U1	Microchip Technology	ATTiny85	IC MCU 8BIT 8KB FLASH 8SOIC
U2	Microchip Technology	MCP6002	IC OPAMP GP 2 CIRCUIT 8MSOP
R1, R2	N/A	Generic	RES SMD 3K OHM 1% 1/8W 1206
R3, R4, R5, R6, R7, R8	N/A	Generic	RES SMD 100K OHM 1% 1/8W 1206
C1, C2	N/A	Generic	CAP CER 0.1UF 50V X7R 0805
D1, D2	Kingbright	APT3216LSECK/J3-PRV	LED CLEAR CHIP 2SMD
	Keystone Electronics	500x	PC TEST POINT MINI
	TE Connectivity	282834-2	TERM BLK 2P SIDE ENT 2.54M M
	CW Industries	GF-124-0196	SWITCH SLIDE SPDT 500MA 125V
	Keystone Electronics	2466	BATTERY HOLDER AAA PC PIN
	Energizer Battery Company	EN92	BATTERY ALKALINE 1.5V AAA
N/A	NVE Corporation	12592	MAG SCALE 5MM PITCH
NVE 3D-printed fixturing for magnetic tape and bezel mount for display			

Demonstration Board Layout (Actual Size) and Schematic
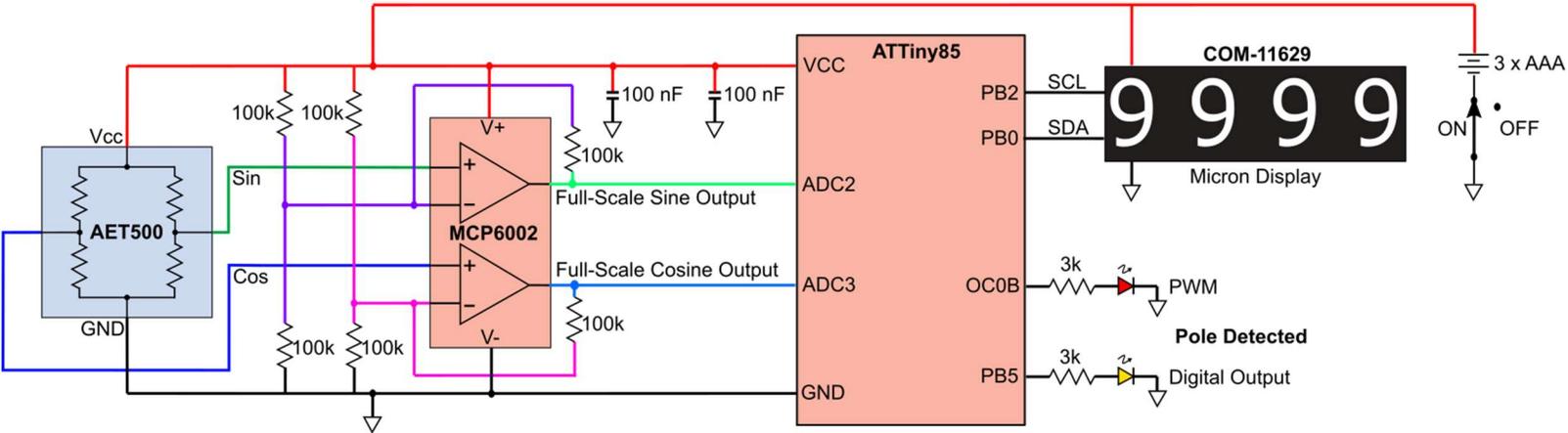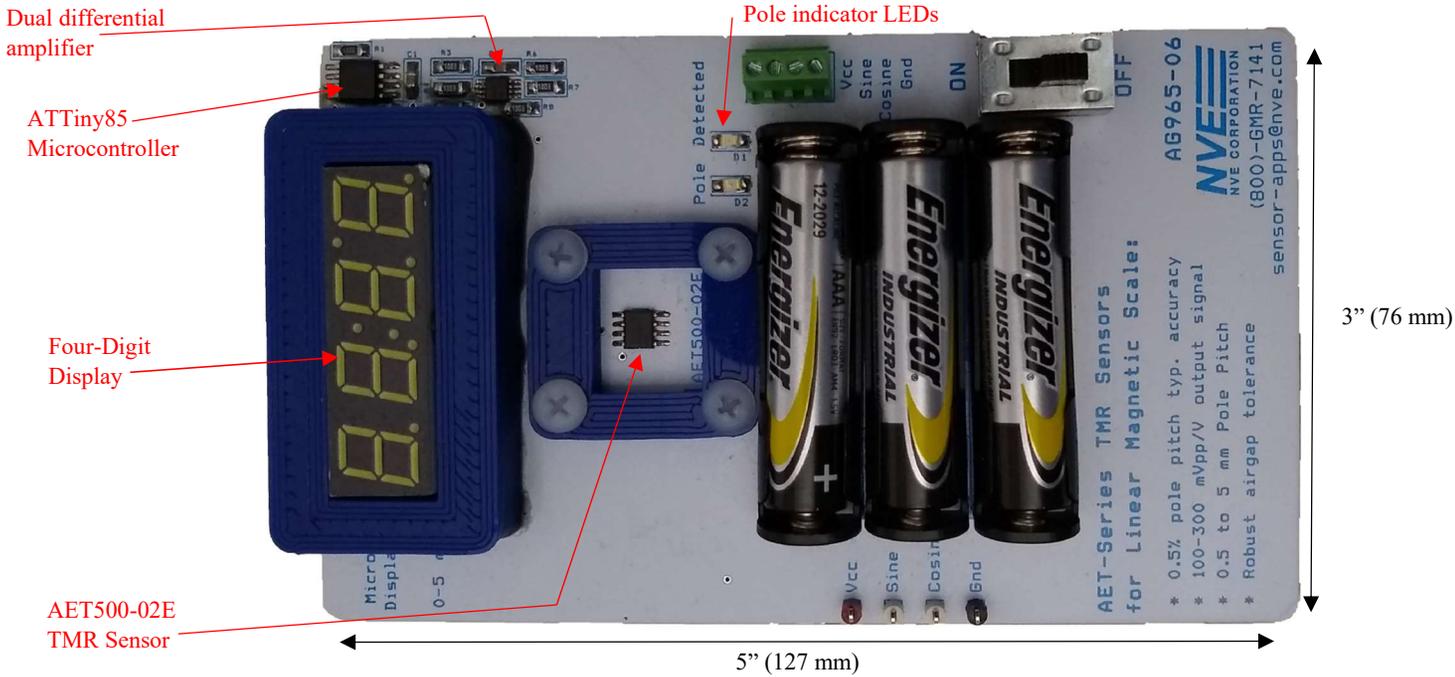
Microcontroller Firmware

The firmware is simple. We read the sine and cosine signals, calculate the angle, scaling 360° to 10,000 microns, and update the I2C display and LEDs. For higher accuracy, offset compensation can be added.

```c
#include <math.h> // needed for atan2
#include <Wire.h> // Arduino library for I2C
const byte s7sAddress = 0x71; //define micron display I2C address (default value)
char tempString[10]; // Will be used with sprintf to create strings
int sine=1; // initialised to 1 to avoid 0/0
int cosine=1;
int angle=1;

void setup()
{
  pinMode(5,OUTPUT);
  Wire.begin(); // Initialise hardware I2C pins
  clearDisplayI2C(); // Clears display, resets cursor
  pinMode(1,OUTPUT);
}

void loop()
{
  sine = analogRead(A2)-512;
  cosine = analogRead(A3)-512;
  angle = atan2(sine,cosine)*180/3.14159*10000/360+5000;   // "angle": 0 to 9999 microns
  angle = (int) angle; //atan2 casts to double, will cause issues with analogWrite if not int
  if(angle>9998) // prevent overflow
    angle=9999;
  if(angle<1)
    angle=0;
  if(angle>9980 || angle <20 || (angle>4480 && angle<5020))   // turn on LED every 5 mm for
    digitalWrite(5,HIGH);                                       // "pole detected"
  else
    digitalWrite(5,LOW);
  sprintf(tempString, "%4d", angle); //create string for display (%4d option creates a 4-digit integer)
  s7sSendStringI2C(tempString); //display the string
  if(angle<5000) // associate angle with pole location for LED indicator   // Linear LED brightness vs.
    angle=abs(angle-2500)*255/2500;                                          // proximity to a pole (every 5
  if(angle>4999)                                                             // mm)
    angle=abs(angle-7500)*255/2500;
  analogWrite(1,angle);
}

void s7sSendStringI2C(String toSend) // sends a string to display by taking first 4 characters
{
  Wire.beginTransmission(s7sAddress);
  for (int i=0; i<4; i++)
    Wire.write(toSend[i]);
  Wire.endTransmission();
}
void clearDisplayI2C() // This will clear the display and reset the cursor
{
  Wire.beginTransmission(s7sAddress);
  Wire.write(0x76); // Clear display command
  Wire.endTransmission();
}
```
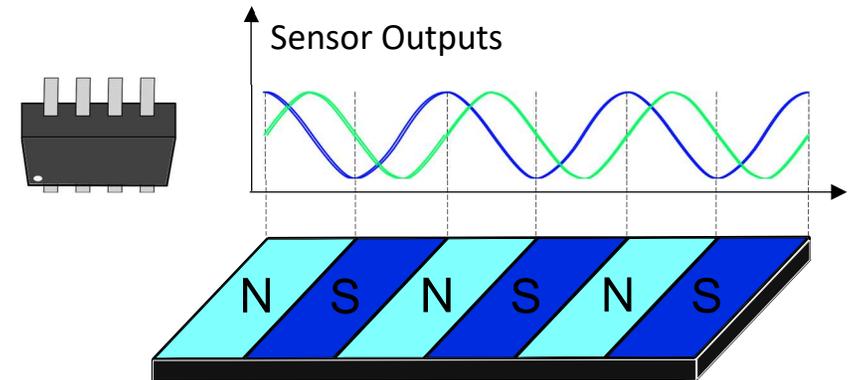
Because the TMR sensor elements are bipolar, the sensor's sine and cosine outputs are periodic with the "magnetic pitch," rather than the manufacturer-specified "pole pitch," as shown below:

Sensor Outputs

In this demonstration, the sensor detects a zero to 9999 micron distance, corresponding to the 10 mm north-to-north "magnetic pitch" of the five-mm "pole pitch" magnetic tape. For more information about AET-Series operation, read the datasheet and visit the sensor applications page:

www.nve.com/Downloads/AET-Series-Datasheet.pdf

www.nve.com/SensorApps.php