Datasheet

Key Features
- System used for mapping pipe networks
- Compact PCB size of 1"x1"
- SPI protocol used for subsystem communication
- Probe is powered by 3xAA batteries connected in series

Absolute Maximum Probe Ratings

Rating	Value	Unit
Probe Input Voltage	5.5	V
Maximum Operating Temperature	-40 to 85	℃

Absolute Maximum Movement System Ratings

Rating	Value	Unit
Motor Controller Input Voltage	34	V
Maximum Operating Temperature	-40 to 100	℃

Movement system
- Components
  - Motor Controller
    - 7.5 Amps Continuous Per Channel
    - 15 Amps Peak Per Channel
    - Dual Encoders Supported
    - Position Control
    - Autotuning PID
    - Multimode Control Interface
    - USB, Serial, R/C, Analog Inputs
    - Limit, Home and E-Stops
    - Up to 34VDC Operation
  - Motor with encoder and controller
    - This motor controller is capable of controlling two brushed DC motors as shown in the figure taken from the datasheet above. This system also has a setting for running them in sync with each other as a part of the compatible software (Motion Studio) shown below.
    - This motor controller is designed to control two motors up to 34V 7.5 Amps continuous and 34V 15 Amps peak per channel which is well above the 12V 1.8 Amp stall current of each motor. These values were taken from the datasheets of both the motor and motor controller.
    - This controller can be controlled via USB (from the data sheet shown above) which eliminates the need for an Arduino or Raspberry Pi for easy velocity control, and is

Datasheet

compatible with quadrature encoders as stated in the datasheet which will allow for accurate velocity control regardless of load changes

Fig.1 Motor Velocity Deviation Table

Run Number	Set Velocity(ft/sec)	Maximum Velocity Deviation(ft/sec)
1	1.39	0.016
2	1.36	0.060
3	1.34	0.038
4	1.41	0.019
5	1.27	0.052

Probe Systems

- Memory
  - Memory chip (AT25SL128A-MHE-T)
    - Single 1.7 V - 2.0 V Supply
    - 128 Mbit Flash Memory
    - Serial Peripheral Interface (SPI)
    - Supports SPI Modes 0 and 3
    - Supports Dual Output Read and Quad I/O Program and Read
    - 133 MHz Maximum Operating Frequency
    - Clock-to-Output (tV1) of 6 ns
    - Up to 65 Mbytes/s continuous data transfer rate
    - Full Chip Erase

Fig.2 Memory Testing

Run Time (minutes)	Bytes Stored (bytes)	Bytes Retrieved (bytes)	Remaining Bytes (bytes)
1	32,760	32,760	16,744,456
5	163,800	163,800	16,613,416
10	327,600	327,600	16,449,616
15	491,400	491,400	16,285,816
20	655,200	655,200	16,122,016

Datasheet

- Power
  - Batteries
    - 3xAA batteries in series (4.5V total supply voltage)
  - LDOs
    - 1.8 V LDO
      - Operating Input Voltage Range: 2.2 V to 5.5 V
      - ±2% Accuracy Over Load/Temperature
      - Ultra Low Quiescent Current Typ. 12 A
      - Standby Current: Typ. 0.1 A
      - Very Low Dropout: 80 mV at 250 mA
      - Ultra High PSRR: Typ. 92 dB at 20 mA, f = 1 kHz
      - Ultra Low Noise: 6.5 VRMS
    - 3.3 V LDO
      - Operating Input Voltage Range: 2.7 V to 18 V
      - Output Voltage: 3.3 V
      - Capable of Sourcing 140 mA Peak Output Current
      - Low Shutdown Current: 100 nA typ.
      - Very Low Quiescent Current: 1 A typ.
      - Low Dropout: 215 mV typ. at 100 mA
      - Output Voltage Accuracy ±1%
      - Power Good Output (Version B)
      - Built−in Soft Start Circuit to Suppress Inrush Current
      - Over−Current and Thermal Shutdown Protections

Fig.3 Battery testing

Run Time (minutes)	Initial Voltage (V)	Post-test Voltage (V)	Load Current (mA)
20	5.08	5.03	15-18
20	5.03	4.98	15-18
20	4.98	4.92	15-18

- Microcontroller
  - SPI and I2C capabilities
- IMU (ISM330DHCXTR)
  - 3D accelerometer with selectable full scale: ±2/±4/±8/±16 g
  - 3D gyroscope with extended selectable full scale
  - Embedded compensation for high stability over temperature
  - SPI/I²C serial interface
  - Auxiliary SPI serial interface for data output of gyroscope and accelerometer
  - (OIS and other stabilization applications)
  - Six-channel synchronized output

Datasheet

- ○ Sensor hub feature to efficiently collect data from additional external sensors
  - ○ Embedded smart FIFO up to 9 kbytes
  - ○ Programmable Finite State Machine to process data from accelerometer, gyroscope, and external sensors
  - ○ Smart embedded functions and interrupts: tilt detection, free-fall, wakeup, 6D/4D orientation, click and double-click
  - ○ Analog supply voltage: 1.71 V to 3.6 V
  - ○ Embedded self-test both for gyroscope and accelerometer
- ● Software
  - ○ Probe software
    - ■ Utilizes C
  - ○ Mapping software
    - ■ Utilizes Python

Citations and Datasheets

- ● [NCP163 - LDO Regulator - Ultra-Low Noise, High PSRR, RF and Analog Circuits, 250 mA](#)
- ● https://www.mouser.com/datasheet/2/308/NCP711_D-1879967.pdf
- ● [AT25SL128A-MHE-T Adesto Technologies | Integrated Circuits (ICs) | DigiKey](#)
- ● https://www.basicmicro.com/Roboclaw-2x7A-Motor-Controller_p_55.html
- ● https://www.pololu.com/product/4865