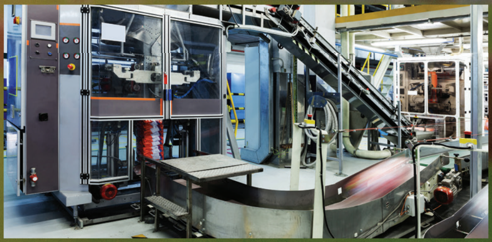
Analog and Interface Products

Microchip

Digital Potentiometers Design Guide



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Digital Potentiometer Solutions

Microchip's Family of Digital Potentiometers

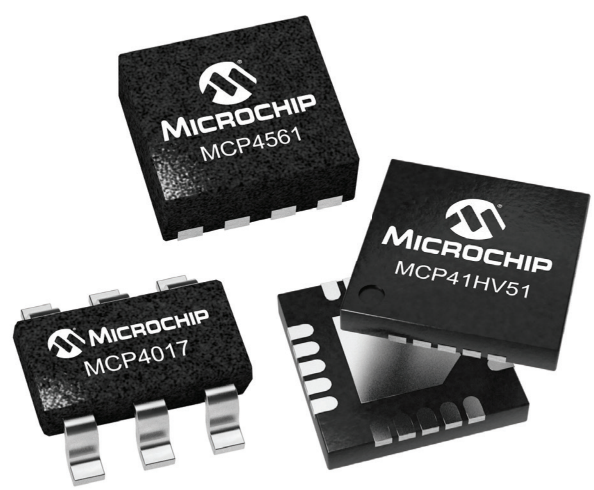
Microchip offers a wide range of devices that allow you to select the best fit for your application needs. Some of the selection options include:

- End-to-end resistance (R_{AB}) values
  - 2.1 kΩ to 100 kΩ (typical)
- Resolution
  - 6-bit (64 steps)
  - 7-bit (128/129 steps)
  - 8-bit (256/257 steps)
- Serial interfaces
  - Up/down
  - SPI
  - I^2C
- Memory types
  - Volatile
  - Non-volatile (EEPROM)
- Resistor network configurations
  - Potentiometer (voltage divider)
  - Rheostat (variable resistor)
- Single, dual and quad potentiometer options
- Different package options
- Special features
  - Shutdown mode
  - WiperLock™ technology
- Low-power options
- Low-voltage options (1.8V)
- High-voltage options (36V or ±18V)

Microchip offers digital potentiometer devices with typical end-to-end resistances of 2.1 kΩ, 5 kΩ, 10 kΩ, 50 kΩ and 100 kΩ. These devices are available in 6, 7 or 8 bits of resolution.

The serial interface options allow you to easily integrate the device into your application. For some applications, the simple up/down interface will be adequate. Higher-resolution devices (7-bit, 8-bit) often require direct read/write to the wiper register. This is supported with SPI or I^2C interfaces. SPI is simpler to implement, but I^2C uses only two signals (pins) and can support multiple devices on the serial bus without additional pins.

Microchip offers both volatile and non-volatile (EEPROM) devices, allowing you the flexibility to optimize your system design. The integrated EEPROM option allows you to save digital potentiometer settings at power-down and restore to its original value and power-up.



Resistor network configurations allow the package size/cost to be minimized for the desired functionality. For example, in the MCP4017/18/19 family, if a variable resistor (rheostat) is desired, the MCP4019 can be selected in a low-cost 5-pin SC70 package to achieve the functionality.

In some applications, matched components are critical to ensure system performance. Dual- and quad-digital potentiometer resistor networks are manufactured on the same silicon and closely matched, creating a good fit for these types of applications.

Packaging options allow you to address your system requirement trade-offs including device cost, board area and manufacturing sites (Surface mount vs. through-hole). Small form factors, such as tiny SC70 packages, are available.

Low-Power Applications

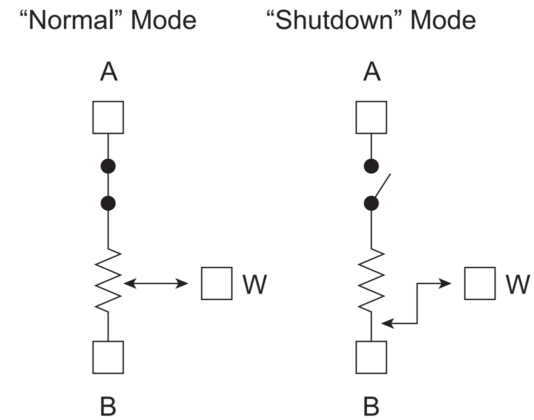
Low-Power Applications

Low power consumption has become more important in recent years, especially in battery-powered applications. Microchip's digital potentiometer families are low power, with the maximum I_{DD} as low as 1 µA in some devices. This low current is possible when the serial interface is inactive and a non-volatile memory write cycle is not active. This low current does not include any current through the resistor network (the A, B and W pins). The 1 µA maximum I_{DD} devices are listed in the table below. Currently, all other devices have a max I_{DD} of 5 µA.

Many other devices are capable of shutting down the resistor network, or disconnect the resistor network from the circuit, in order to substantially reduce the current through the digital potentiometer resistor network(s). This shutdown mode may be achieved by a hardware pin (SHDN) or via software through the Terminal Control (TCON) register(s).

The hardware shutdown forces the resistor network into a defined condition where the resistor network is disconnected from the Terminal A pin and the Wiper value is forced to 00h (Wiper connected to Terminal B). The Wiper register retains its value so that when shutdown is exited the wiper returns to its pervious position.

Normal vs. Shutdown Mode



The software shutdown allows control to each of the resistor network terminal pins. Each resistor network has 4-bit in a TCON register. One bit for each terminal pin (A, B and W) and one bit that mimics the hardware shutdown state (the resistor network is disconnected from the Terminal A pin and the Wiper value is forced to 00h).

The software shutdown is more flexible than the hardware shutdown pin, as it allows devices to retain this capability while being packaged in the smallest package where a hardware shutdown pin (SHDN) was not implemented.

Low-Power Devices

Device	Serial Interface	Memory Type	Resolution (# of steps)	R_{AB} Resistance kΩ (typ.)	Zero-Scale/ Full-Scale[2]	# of Channels	WiperLock™ Technology	Shutdown Mode	Configuration	Voltage Range	Packages	I_{DD} Max. (µA)[4]
MCP4011[1]	U/D	Volatile	64	2.1/5/10/50	Y/Y	1	N	N	Pot	1.8V to 5.5V[5]	8-pin SOIC, 8-pin MSOP, 8-pin DFN	1
MCP4012[1]	U/D	Volatile	64	2.1/5/10/50	Y/Y	1	N	N	Rheo	1.8V to 5.5V[5]	6-pin SOT-23	1
MCP4013[1]	U/D	Volatile	64	2.1/5/10/50	Y/Y	1	N	N	Pot[6]	1.8V to 5.5V[5]	6-pin SOT-23	1
MCP4014[1]	U/D	Volatile	64	2.1/5/10/50	Y/Y	1	N	N	Rheo[6]	1.8V to 5.5V[5]	5-pin SOT-23	1
MCP4021[1]	U/D	EEPROM	64	2.1/5/10/50	Y/Y	1	Y	N	Pot	2.7V to 5.5V	8-pin SOIC, 8-pin MSOP, 8-pin DFN	1
MCP4022[1]	U/D	EEPROM	64	2.1/5/10/50	Y/Y	1	Y	N	Rheo	2.7V to 5.5V	6-pin SOT-23	1
MCP4023[1]	U/D	EEPROM	64	2.1/5/10/50	Y/Y	1	Y	N	Pot[6]	2.7V to 5.5V	6-pin SOT-23	1
MCP4024[1]	U/D	EEPROM	64	2.1/5/10/50	Y/Y	1	Y	N	Rheo[6]	2.7V to 5.5V	5-pin SOT-23	1
MCP41010	SPI	Volatile	256	10	Y/N[3]	1	N	N	Pot	2.7V to 5.5V	8-pin PDIP, 8-pin SOIC	1
MCP41050	SPI	Volatile	256	50	Y/N[3]	1	N	N	Pot	2.7V to 5.5V	8-pin PDIP, 8-pin SOIC	1
MCP41100	SPI	Volatile	256	100	Y/N[3]	1	N	N	Pot	2.7V to 5.5V	8-pin PDIP, 8-pin SOIC	1
MCP42010	SPI	Volatile	256	10	Y/N[3]	2	N	Y	Pot	2.7V to 5.5V	14-pin PDIP, 14-pin SOIC, 14-pin TSSOP	1
MCP42050	SPI	Volatile	256	50	Y/N[3]	2	N	Y	Pot	2.7V to 5.5V	14-pin PDIP, 14-pin SOIC, 14-pin TSSOP	1
MCP42100	SPI	Volatile	256	100	Y/N[3]	2	N	Y	Pot	2.7V to 5.5V	14-pin PDIP, 14-pin SOIC, 14-pin TSSOP	1

1. Resistor options are: –202 (2.1 kΩ), –502 (5.0 kΩ), –103 (10.0 kΩ) and –503 (50.0 kΩ).
2. Zero-scale allows the wiper to "directly" connect to Terminal B, while full-scale allows the wiper to "directly" connect to Terminal A.
3. There is one Rs resistor between the maximum wiper value and Terminal A.
4. This current is with the serial interface inactive, and not during an EEPROM write cycle (for non-volatile devices).
5. The serial interface has been tested to 1.8V, the device's analog characteristics (resistor) have been tested from 2.7V to 5.5V. Review the device's characterization graphs for information on analog performance between 1.8V and 2.7V.
6. One of the terminal pins (A or B) is internally connected to ground, due to the limitation of the number of pins on the package.

Low-Voltage Applications

Low-Voltage Applications

Some applications require a low operating voltage. Microchip offers most of the volatile memory devices and some of the non-volatile devices specified down to 1.8V for their digital operation. The analog performance between 1.8V and 2.7V is not specified, but is characterized and can be found in the device's characterization graphs for more information.

Low-Voltage Devices (1.8V)

Device	Serial Interface	Memory Type	Resolution (# of steps)	R_{AB} Resistance kΩ (typ.)	Zero-Scale/ Full-Scale(2)	# of Channels	WiperLock™ Technology	Shutdown Mode	Configuration	Voltage Range	Packages	I_{DD} Max. (µA)(4)
MCP4011(1)	U/D	Volatile	64	2.1/5/10/50	Y/Y	1	N	N	Pot	1.8V to 5.5V(5)	8-pin SOIC, 8-pin MSOP, 8-pin DFN	1
MCP4012(1)	U/D	Volatile	64	2.1/5/10/50	Y/Y	1	N	N	Rheo	1.8V to 5.5V(5)	6-pin SOT-23	1
MCP4013(1)	U/D	Volatile	64	2.1/5/10/50	Y/Y	1	N	N	Pot(6)	1.8V to 5.5V(5)	6-pin SOT-23	1
MCP4014(1)	U/D	Volatile	64	2.1/5/10/50	Y/Y	1	N	N	Rheo(6)	1.8V to 5.5V(5)	5-pin SOT-23	1
MCP4017(2)	I²C	Volatile	128	5/10/50/100	Y/Y	1	N	N	Rheo	1.8V to 5.5V(5)	6-pin SC70	5
MCP4018(2)	I²C	Volatile	128	5/10/50/100	Y/Y	1	N	N	Pot(6)	1.8V to 5.5V(5)	6-pin SC70	5
MCP4019(2)	I²C	Volatile	128	5/10/50/100	Y/Y	1	N	N	Rheo(6)	1.8V to 5.5V(5)	5-pin SC70	5
MCP40D17(2)	I²C	Volatile	128	5/10/50/100	Y/Y	1	N	N	Rheo	1.8V to 5.5V(5)	6-pin SC70	5
MCP40D18(2)	I²C	Volatile	128	5/10/50/100	Y/Y	1	N	N	Pot(6)	1.8V to 5.5V(5)	6-pin SC70	5
MCP40D19(2)	I²C	Volatile	128	5/10/50/100	Y/Y	1	N	N	Rheo(6)	1.8V to 5.5V(5)	5-pin SC70	5
MCP4131(2)	SPI	Volatile	129	5/10/50/100	Y/Y	1	N	Y(7)	Pot	1.8V to 5.5V(5)	8-pin PDIP, 8-pin SOIC, 8-pin MSOP, 8-pin DFN	5
MCP4132(2)	SPI	Volatile	129	5/10/50/100	Y/Y	1	N	Y(7)	Rheo	1.8V to 5.5V(5)	8-pin PDIP, 8-pin SOIC, 8-pin MSOP, 8-pin DFN	5
MCP4141(2)	SPI	EEPROM	129	5/10/50/100	Y/Y	1	N	Y(7)	Pot	1.8V to 5.5V(5)	8-pin PDIP, 8-pin SOIC, 8-pin MSOP, 8-pin DFN	5
MCP4142(2)	SPI	EEPROM	129	5/10/50/100	Y/Y	1	N	Y(7)	Rheo	1.8V to 5.5V(5)	8-pin PDIP, 8-pin SOIC, 8-pin MSOP, 8-pin DFN	5
MCP4151(2)	SPI	Volatile	257	5/10/50/100	Y/Y	1	N	Y(7)	Pot	1.8V to 5.5V(5)	8-pin PDIP, 8-pin SOIC, 8-pin MSOP, 8-pin DFN	5
MCP4152(2)	SPI	Volatile	257	5/10/50/100	Y/Y	1	N	Y(7)	Rheo	1.8V to 5.5V(5)	8-pin PDIP, 8-pin SOIC, 8-pin MSOP, 8-pin DFN	5
MCP4161(2)	SPI	EEPROM	257	5/10/50/100	Y/Y	1	Y	Y(7)	Pot	1.8V to 5.5V(5)	8-pin PDIP, 8-pin SOIC, 8-pin MSOP, 8-pin DFN	5
MCP4162(2)	SPI	EEPROM	257	5/10/50/100	Y/Y	1	Y	Y(7)	Rheo	1.8V to 5.5V(5)	8-pin PDIP, 8-pin SOIC, 8-pin MSOP, 8-pin DFN	5
MCP4231(2)	SPI	Volatile	129	5/10/50/100	Y/Y	2	N	Y(7)	Pot	1.8V to 5.5V(5)	14-pin PDIP, 14-pin SOIC, 14-pin TSSOP, 16-pin QFN	5
MCP4232(2)	SPI	Volatile	129	5/10/50/100	Y/Y	2	N	Y(7)	Rheo	1.8V to 5.5V(5)	10-pin MSOP, 10-pin DFN	5
MCP4241(2)	SPI	EEPROM	129	5/10/50/100	Y/Y	2	Y	Y(7)	Pot	1.8V to 5.5V(5)	14-pin PDIP, 14-pin SOIC, 14-pin TSSOP, 16-pin QFN	5
MCP4242(2)	SPI	EEPROM	129	5/10/50/100	Y/Y	2	Y	Y(7)	Rheo	1.8V to 5.5V(5)	10-pin MSOP, 10-pin DFN	5
MCP4251(2)	SPI	Volatile	257	5/10/50/100	Y/Y	2	N	Y(7)	Pot	1.8V to 5.5V(5)	14-pin PDIP, 14-pin SOIC, 14-pin TSSOP, 16-pin QFN	5
MCP4252(2)	SPI	Volatile	257	5/10/50/100	Y/Y	2	N	Y(7)	Rheo	1.8V to 5.5V(5)	10-pin MSOP, 10-pin DFN	5
MCP4261(2)	SPI	EEPROM	257	5/10/50/100	Y/Y	2	Y	Y(7)	Pot	1.8V to 5.5V(5)	14-pin PDIP, 14-pin SOIC, 14-pin TSSOP, 16-pin QFN	5

1. Resistor options are: –202 (2.1 kΩ), –502 (5.0 kΩ), –103 (10.0 kΩ) and –503 (50.0 kΩ).
2. Resistor options are: –502 (5.0 kΩ), –103 (10.0 kΩ), 503 (50.0 kΩ), and –104 (100.0 kΩ).
3. Zero-scale allows the wiper to "directly" connect to Terminal B, while full-scale allows the wiper to "directly" connect to Terminal A.
4. This current is with the serial interface inactive, and not during an EEPROM write cycle (for non-volatile devices).
5. The digital serial interface has been tested to 1.8V but the device's analog characteristics have only been specified from 2.7V to 5.5V. Review the device's characterization graphs for information on analog performance between 1.8V and 2.7V.
6. One of the terminal pins (A or B) is internally connected to ground, due to the limitation of the number of pins on the package.
7. Shutdown support via software (TCON register(s)). If device has $\overline{SHDN}$ pin, software shutdown also functions.

Low-Voltage Applications

Low-Voltage Devices (1.8V) (Continued)

Device	Serial Interface	Memory Type	Resolution (# of steps)	R_{AB} Resistance kΩ (typ.)	Zero-Scale/ Full-Scale[2]	# of Channels	WiperLock™ Technology	Shutdown Mode	Configuration	Voltage Range	Packages	I_{DD} Max. (µA)[4]
MCP4262[2]	SPI	EEPROM	257	5/10/50/100	Y/Y	2	Y	Y[7]	Rheo	1.8V to 5.5V[5]	10-pin MSOP, 10-pin DFN	5
MCP4331[2]	SPI	Volatile	129	5/10/50/100	Y/Y	4	N	Y[7]	Pot	1.8V to 5.5V[5]	20-pin TSSOP, 20-pin QFN	5
MCP4332[2]	SPI	Volatile	129	5/10/50/100	Y/Y	4	N	Y[7]	Rheo	1.8V to 5.5V[5]	14-pin TSSOP	5
MCP4341[2]	SPI	EEPROM	129	5/10/50/100	Y/Y	4	Y	Y[7]	Pot	1.8V to 5.5V[5]	20-pin TSSOP, 20-pin QFN	5
MCP4342[2]	SPI	EEPROM	129	5/10/50/100	Y/Y	4	Y	Y[7]	Rheo	1.8V to 5.5V[5]	14-pin TSSOP	5
MCP4351[2]	SPI	Volatile	257	5/10/50/100	Y/Y	4	N	Y[7]	Pot	1.8V to 5.5V[5]	20-pin TSSOP, 20-pin QFN	5
MCP4352[2]	SPI	Volatile	257	5/10/50/100	Y/Y	4	N	Y[7]	Rheo	1.8V to 5.5V[5]	14-pin TSSOP	5
MCP4361[2]	SPI	EEPROM	257	5/10/50/100	Y/Y	4	Y	Y[7]	Pot	1.8V to 5.5V[5]	20-pin TSSOP, 20-pin QFN	5
MCP4362[2]	SPI	EEPROM	257	5/10/50/100	Y/Y	4	Y	Y[7]	Rheo	1.8V to 5.5V[5]	14-pin TSSOP	5
MCP4431[2]	I^2C	Volatile	129	5/10/50/100	Y/Y	4	N	Y[7]	Pot	1.8V to 5.5V[5]	20-pin TSSOP, 20-pin QFN	5
MCP4432[2]	I^2C	Volatile	129	5/10/50/100	Y/Y	4	N	Y[7]	Rheo	1.8V to 5.5V[5]	14-pin TSSOP	5
MCP4441[2]	I^2C	EEPROM	129	5/10/50/100	Y/Y	4	Y	Y[7]	Pot	1.8V to 5.5V[5]	20-pin TSSOP, 20-pin QFN	5
MCP4442[2]	I^2C	EEPROM	129	5/10/50/100	Y/Y	4	Y	Y[7]	Rheo	1.8V to 5.5V[5]	14-pin TSSOP	5
MCP4451[2]	I^2C	Volatile	257	5/10/50/100	Y/Y	4	N	Y[7]	Pot	1.8V to 5.5V[5]	20-pin TSSOP, 20-pin QFN	5
MCP4452[2]	I^2C	Volatile	257	5/10/50/100	Y/Y	4	N	Y[7]	Rheo	1.8V to 5.5V[5]	14-pin TSSOP	5
MCP4461[2]	I^2C	EEPROM	257	5/10/50/100	Y/Y	4	Y	Y[7]	Pot	1.8V to 5.5V[5]	20-pin TSSOP, 20-pin QFN	5
MCP4462[2]	I^2C	EEPROM	257	5/10/50/100	Y/Y	4	Y	Y[7]	Rheo	1.8V to 5.5V[5]	14-pin TSSOP	5
MCP4531[2]	I^2C	Volatile	129	5/10/50/100	Y/Y	1	N	Y[7]	Pot	1.8V to 5.5V[5]	8-pin MSOP, 8-pin DFN	5
MCP4532[2]	I^2C	Volatile	129	5/10/50/100	Y/Y	1	N	Y[7]	Rheo	1.8V to 5.5V[5]	8-pin MSOP, 8-pin DFN	5
MCP4541[2]	I^2C	EEPROM	129	5/10/50/100	Y/Y	1	Y	Y[7]	Pot	1.8V to 5.5V[5]	8-pin MSOP, 8-pin DFN	5
MCP4542[2]	I^2C	EEPROM	129	5/10/50/100	Y/Y	1	Y	Y[7]	Rheo	1.8V to 5.5V[5]	8-pin MSOP, 8-pin DFN	5
MCP4551[2]	I^2C	Volatile	257	5/10/50/100	Y/Y	1	N	Y[7]	Pot	1.8V to 5.5V[5]	8-pin MSOP, 8-pin DFN	5
MCP4552[2]	I^2C	Volatile	257	5/10/50/100	Y/Y	1	N	Y[7]	Rheo	1.8V to 5.5V[5]	8-pin MSOP, 8-pin DFN	5
MCP4561[2]	I^2C	EEPROM	257	5/10/50/100	Y/Y	1	Y	Y[7]	Pot	1.8V to 5.5V[5]	8-pin MSOP, 8-pin DFN	5
MCP4562[2]	I^2C	EEPROM	257	5/10/50/100	Y/Y	1	Y	Y[7]	Rheo	1.8V to 5.5V[5]	8-pin MSOP, 8-pin DFN	5
MCP4631[2]	I^2C	Volatile	129	5/10/50/100	Y/Y	2	N	Y[7]	Pot	1.8V to 5.5V[5]	14-pin TSSOP, 16-pin QFN	5
MCP4632[2]	I^2C	Volatile	129	5/10/50/100	Y/Y	2	N	Y[7]	Rheo	1.8V to 5.5V[5]	10-pin MSOP, 10-pin DFN	5
MCP4641[2]	I^2C	EEPROM	129	5/10/50/100	Y/Y	2	Y	Y[7]	Pot	1.8V to 5.5V[5]	14-pin PDIP, 14-pin SOIC, 14-pin TSSOP, 16-pin QFN	5
MCP4642[2]	I^2C	EEPROM	129	5/10/50/100	Y/Y	2	Y	Y[7]	Rheo	1.8V to 5.5V[5]	10-pin MSOP, 10-pin DFN	5
MCP4651[2]	I^2C	Volatile	257	5/10/50/100	Y/Y	2	N	Y[7]	Pot	1.8V to 5.5V[5]	14-pin TSSOP, 16-pin QFN	5
MCP4652[2]	I^2C	Volatile	257	5/10/50/100	Y/Y	2	N	Y[7]	Rheo	1.8V to 5.5V[5]	10-pin MSOP, 10-pin DFN	5
MCP4661[2]	I^2C	EEPROM	257	5/10/50/100	Y/Y	2	Y	Y[7]	Pot	1.8V to 5.5V[5]	14-pin PDIP, 14-pin SOIC, 14-pin TSSOP, 16-pin QFN	5
MCP4662[2]	I^2C	EEPROM	257	5/10/50/100	Y/Y	2	Y	Y[7]	Rheo	1.8V to 5.5V[5]	10-pin MSOP, 10-pin DFN	5

1. Resistor options are: –202 (2.1 kΩ), –502 (5.0 kΩ), –103 (10.0 kΩ) and –503 (50.0 kΩ).
2. Resistor options are: –502 (5.0 kΩ), –103 (10.0 kΩ), 503 (50.0 kΩ), and –104 (100.0 kΩ).
3. Zero-scale allows the wiper to "directly" connect to Terminal B, while full-scale allows the wiper to "directly" connect to Terminal A.
4. This current is with the serial interface inactive, and not during an EEPROM write cycle (for non-volatile devices).
5. The digital serial interface has been tested to 1.8V but the device's analog characteristics have only been specified from 2.7V to 5.5V. Review the device's characterization graphs for information on analog performance between 1.8V and 2.7V.
6. One of the terminal pins (A or B) is internally connected to ground, due to the limitation of the number of pins on the package.
7. Shutdown support via software (TCON register(s)). If device has SHDN pin, software shutdown also functions.

High-Voltage Applications

High-Voltage Applications

In some applications, such as industrial and audio, 5.5C operation is not enough. Microchip's MCP41HVX1 and MCP45HVX1 family of digital potentiometers can solve the problem by supporting up to 36V operation. These devices have dual power rails. The analog voltage range is determined by the voltage applied to the V+ and V– pin and allows up to 36V, while the digital power rail (VL and DGND) supports operation from 1.8V to 5.5V to ensure proper communication with the microcontrollers.

The system can also be implemented as dual rail, symmetric (such as ±1.8V) or asymmetric (such as +6/−30V), relative to the digital logic ground (DGND).

High-Voltage Devices

Device	Serial Interface	Memory Type	Resolution (# of steps)	R_{AB} Resistance kΩ (typ.)	Zero-Scale/ Full-Scale(2)	# of Channels	WiperLock™ Technology	Shutdown Mode	Configuration	Voltage Range	Packages	I_{DD} Max. (µA)(3)
MCP41HV31(1)	SPI	Volatile	128	5/10/50/100	Y/Y	1	N	Y(5)	Pot	1.8V to 5.5V(4), 10V (±5V) to 36V (±18V)	14-pin TSSOP, 20-pin VQFN	5
MCP41HV51(1)	SPI	Volatile	256	5/10/50/100	Y/Y	1	N	Y(5)	Pot	1.8V to 5.5V(4), 10V (±5V) to 36V (±18V)	14-pin TSSOP, 20-pin VQFN	5
MCP45HV31(1)	I^2C	Volatile	128	5/10/50/100	Y/Y	1	N	Y(5)	Pot	1.8V to 5.5V(4), 10V (±5V) to 36V (±18V)	14-pin TSSOP, 20-pin VQFN	5
MCP45HV51(1)	I^2C	Volatile	256	5/10/50/100	Y/Y	1	N	Y(5)	Pot	1.8V to 5.5V(4), 10V (±5V) to 36V (±18V)	14-pin TSSOP, 20-pin VQFN	5

1. Resistor options are: −502 (5.0 kΩ), −103 (10.0 kΩ), 503 (50.0 kΩ) and −104 (100.0 kΩ).
2. Zero-scale allows the wiper to "directly" connect to Terminal B, while full-scale allows the wiper to "directly" connect to Terminal A.
3. This current is with the serial interface inactive, and not during an EEPROM write cycle (for non-volatile devices).
4. The digital serial interface has been tested to 1.8V but the device's analog characteristics have only been specified from 2.7V to 5.5V. Review the device's characterization graphs for information on analog performance between 1.8V and 2.7V.
5. Shutdown support via software (TCON register(s)). If device has $\overline{SHDN}$ pin, software shutdown also functions.

Non-Volatile Applications

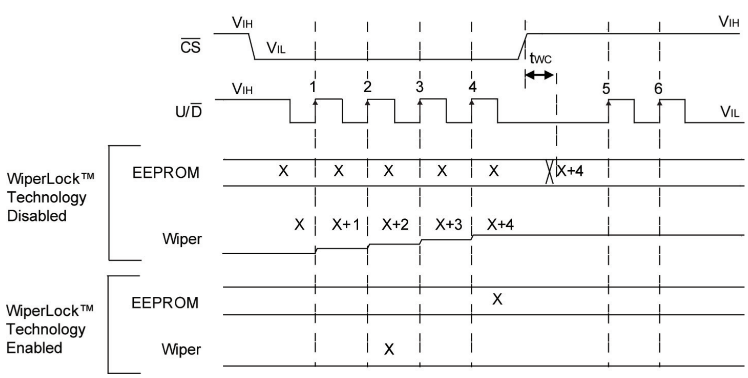
Non-Volatile Applications

Non-volatile digital potentiometers allow the desired wiper position to be saved during device power-down or brown-out condition. When the device power is restored, the wiper value is loaded from the non-volatile register, allowing the device to power-on to the desired wiper settings.

This is most useful for both applications where the wiper value is programmed once and never changed (system calibration) as well as applications where the last user setting is saved on system power-down (such as a volume setting).

Mechanical trim pots have been used for device calibration to optimize the system performance. Digital potentiometer with non-volatile memory can now be a better solutions due to its small size and high reliability.

WiperLock™ Technology Example (Up/Down Interface)



Microchip's non-volatile digital potentiometers adopt a methodology called WiperLock technology to ensure that once the non-volatile wiper is "locked" the wiper setting cannot be modified except with "high-voltage" commands. This inhibits accidental modification of the wiper setting during normal operation.

Many of the non-volatile devices also have some bytes of general purpose EEPROM memory available. This could be used to store system information, such as calibration codes, manufacture date, serial number or user information.

Non-Volatile Applications

Non-Volatile Memory Devices

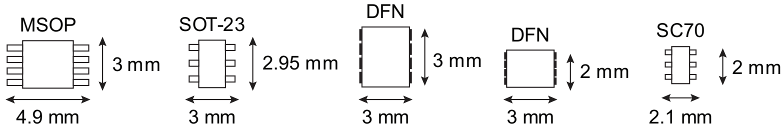
Device	Serial Interface	Memory Type	Resolution (# of steps)	R_{AB} Resistance kΩ (typ.)	Zero-Scale/ Full-Scale[3]	# of Channels	WiperLock™ Technology	Shutdown Mode	Configuration	Voltage Range	Packages	I_{DD} Max. (µA)[4]	General Purpose EEPROM (bytes)
MCP4021[1]	U/D	EEPROM	64	2.1/5/10/50	Y/Y	1	Y	N	Pot	2.7V to 5.5V	8-pin SOIC, 8-pin MSOP, 8-pin DFN	1	–
MCP4022[1]	U/D	EEPROM	64	2.1/5/10/50	Y/Y	1	Y	N	Rheo	2.7V to 5.5V	6-pin SOT-23	1	–
MCP4023[1]	U/D	EEPROM	64	2.1/5/10/50	Y/Y	1	Y	N	Pot[5]	2.7V to 5.5V	6-pin SOT-23	1	–
MCP4024[1]	U/D	EEPROM	64	2.1/5/10/50	Y/Y	1	Y	N	Rheo[5]	2.7V to 5.5V	5-pin SOT-23	1	–
MCP4141[2]	SPI	EEPROM	129	5/10/50/100	Y/Y	1	N	Y[6]	Pot	2.7V to 5.5V	8-pin PDIP, 8-pin SOIC, 8-pin MSOP, 8-pin DFN	5	10
MCP4142[2]	SPI	EEPROM	129	5/10/50/100	Y/Y	1	N	Y[6]	Rheo	2.7V to 5.5V	8-pin PDIP, 8-pin SOIC, 8-pin MSOP, 8-pin DFN	5	10
MCP4161[2]	SPI	EEPROM	257	5/10/50/100	Y/Y	1	Y	Y[6]	Pot	2.7V to 5.5V	8-pin PDIP, 8-pin SOIC, 8-pin MSOP, 8-pin DFN	5	10
MCP4162[2]	SPI	EEPROM	257	5/10/50/100	Y/Y	1	Y	Y[6]	Rheo	2.7V to 5.5V	8-pin PDIP, 8-pin SOIC, 8-pin MSOP, 8-pin DFN	5	10
MCP4241[2]	SPI	EEPROM	129	5/10/50/100	Y/Y	2	Y	Y[6]	Pot	2.7V to 5.5V	14-pin PDIP, 14-pin SOIC, 14-pin TSSOP, 16-pin QFN	5	10
MCP4242[2]	SPI	EEPROM	129	5/10/50/100	Y/Y	2	Y	Y[6]	Rheo	2.7V to 5.5V	10-pin MSOP, 10-pin DFN	5	10
MCP4261[2]	SPI	EEPROM	257	5/10/50/100	Y/Y	2	Y	Y[6]	Pot	2.7V to 5.5V	14-pin PDIP, 14-pin SOIC, 14-pin TSSOP, 16-pin QFN	5	10
MCP4262[2]	SPI	EEPROM	257	5/10/50/100	Y/Y	2	Y	Y[6]	Rheo	2.7V to 5.5V	10-pin MSOP, 10-pin DFN	5	10
MCP4341[2]	SPI	EEPROM	129	5/10/50/100	Y/Y	4	Y	Y[6]	Pot	2.7V to 5.5V	20-pin TSSOP, 20-pin QFN	5	5
MCP4342[2]	SPI	EEPROM	129	5/10/50/100	Y/Y	4	Y	Y[6]	Rheo	2.7V to 5.5V	14-pin TSSOP	5	5
MCP4361[2]	SPI	EEPROM	257	5/10/50/100	Y/Y	4	Y	Y[6]	Pot	2.7V to 5.5V	20-pin TSSOP, 20-pin QFN	5	5
MCP4362[2]	SPI	EEPROM	257	5/10/50/100	Y/Y	4	Y	Y[6]	Rheo	2.7V to 5.5V	14-pin TSSOP	5	5
MCP4441[2]	I²C	EEPROM	129	5/10/50/100	Y/Y	4	Y	Y[6]	Pot	2.7V to 5.5V	20-pin TSSOP, 20-pin QFN	5	5
MCP4442[2]	I²C	EEPROM	129	5/10/50/100	Y/Y	4	Y	Y[6]	Rheo	2.7V to 5.5V	14-pin TSSOP	5	5
MCP4461[2]	I²C	EEPROM	257	5/10/50/100	Y/Y	4	Y	Y[6]	Pot	2.7V to 5.5V	20-pin TSSOP, 20-pin QFN	5	5
MCP4462[2]	I²C	EEPROM	257	5/10/50/100	Y/Y	4	Y	Y[6]	Rheo	2.7V to 5.5V	14-pin TSSOP	5	5
MCP4541[2]	I²C	EEPROM	129	5/10/50/100	Y/Y	1	Y	Y[6]	Pot	2.7V to 5.5V	8-pin MSOP, 8-pin DFN	5	10
MCP4542[2]	I²C	EEPROM	129	5/10/50/100	Y/Y	1	Y	Y[6]	Rheo	2.7V to 5.5V	8-pin MSOP, 8-pin DFN	5	10
MCP4561[2]	I²C	EEPROM	257	5/10/50/100	Y/Y	1	Y	Y[6]	Pot	2.7V to 5.5V	8-pin MSOP, 8-pin DFN	5	10
MCP4562[2]	I²C	EEPROM	257	5/10/50/100	Y/Y	1	Y	Y[6]	Rheo	2.7V to 5.5V	8-pin MSOP, 8-pin DFN	5	10
MCP4641[2]	I²C	EEPROM	129	5/10/50/100	Y/Y	2	Y	Y[6]	Pot	2.7V to 5.5V	14-pin PDIP, 14-pin SOIC, 14-pin TSSOP, 16-pin QFN	5	10
MCP4642[2]	I²C	EEPROM	129	5/10/50/100	Y/Y	2	Y	Y[6]	Rheo	2.7V to 5.5V	10-pin MSOP, 10-pin DFN	5	10
MCP4661[2]	I²C	EEPROM	257	5/10/50/100	Y/Y	2	Y	Y[6]	Pot	2.7V to 5.5V	14-pin PDIP, 14-pin SOIC, 14-pin TSSOP, 16-pin QFN	5	10
MCP4662[2]	I²C	EEPROM	257	5/10/50/100	Y/Y	2	Y	Y[6]	Rheo	2.7V to 5.5V	10-pin MSOP, 10-pin DFN	5	10

1. Resistor options are: –202 (2.1 kΩ), –502 (5.0 kΩ), –103 (10.0 kΩ) and –503 (50.0 kΩ).
2. Resistor options are: –502 (5.0 kΩ), –103 (10.0 kΩ), 503 (50.0 kΩ), and –104 (100.0 kΩ).
3. Zero-scale allows the wiper to "directly" connect to Terminal B, while full-scale allows the wiper to "directly" connect to Terminal A.
4. This current is with the serial interface inactive, and not during an EEPROM write cycle (for non-volatile devices).
5. One of the terminal pins (A or B) is internally connected to ground, due to the limitation of the number of pins on the package.
6. Shutdown support via software (TCON register(s)). If device has $\overline{SHDN}$ pin, software shutdown also functions.

Small-Footprint Applications

Small-Footprint Applications

Some applications have package-size and board-space limitations, and require devices with the smallest footprint possible. Microchip offers several devices in small footprint packages, such as DFN (3 × 3 mm and 2 × 3 mm), SOT-23 and SC70 packages.



Package	Area (mm^2)	Comment
MSOP	~14.7	
DFN (3 x 3)	~9	39% Smaller than MSOP
SOT-23	~8.3	44% Smaller than MSOP
DFN (2 x 3)	~6	59% Smaller than MSOP 33% Smaller than DFN 3 x 3
SC70	~4.2	71% Smaller than MSOP 55% Smaller than DFN 3 x 3 30% Smaller than DFN 2 x 3

Small-Footprint Devices

Device	Serial Interface	Memory Type	Resolution (# of steps)	R_{AB} Resistance kΩ (typ.)	Zero-Scale/ Full-Scale[3]	# of Channels	WiperLock™ Technology	Shutdown Mode	Configuration	Voltage Range	Packages	I_{DD} Max. (µA)[4]
MCP4011[1]	U/D	Volatile	64	2.1/5/10/50	Y/Y	1	N	N	Pot	1.8V to 5.5V[5]	8-pin 2 × 3 DFN	1
MCP4012[1]	U/D	Volatile	64	2.1/5/10/50	Y/Y	1	N	N	Rheo	1.8V to 5.5V[5]	6-pin SOT-23	1
MCP4013[1]	U/D	Volatile	64	2.1/5/10/50	Y/Y	1	N	N	Pot[6]	1.8V to 5.5V[5]	6-pin SOT-23	1
MCP4014[1]	U/D	Volatile	64	2.1/5/10/50	Y/Y	1	N	N	Rheo[6]	1.8V to 5.5V[5]	5-pin SOT-23	1
MCP4021[1]	U/D	EEPROM	64	2.1/5/10/50	Y/Y	1	Y	N	Pot	2.7V to 5.5V	8-pin 2 × 3 DFN	1
MCP4022[1]	U/D	EEPROM	64	2.1/5/10/50	Y/Y	1	Y	N	Rheo	2.7V to 5.5V	6-pin SOT-23	1
MCP4023[1]	U/D	EEPROM	64	2.1/5/10/50	Y/Y	1	Y	N	Pot[6]	2.7V to 5.5V	6-pin SOT-23	1
MCP4024[1]	U/D	EEPROM	64	2.1/5/10/50	Y/Y	1	Y	N	Rheo[6]	2.7V to 5.5V	5-pin SOT-23	1
MCP4017[2]	I^2C	Volatile	128	5/10/50/100	Y/Y	1	N	N	Rheo	1.8V to 5.5V[5]	6-pin SC70	5
MCP4018[2]	I^2C	Volatile	128	5/10/50/100	Y/Y	1	N	N	Pot[6]	1.8V to 5.5V[5]	6-pin SC70	5
MCP4019[2]	I^2C	Volatile	128	5/10/50/100	Y/Y	1	N	N	Rheo[6]	1.8V to 5.5V[5]	5-pin SC70	5
MCP40D17[2]	I^2C	Volatile	128	5/10/50/100	Y/Y	1	N	N	Rheo	1.8V to 5.5V[5]	6-pin SC70	5
MCP40D18[2]	I^2C	Volatile	128	5/10/50/100	Y/Y	1	N	N	Pot[6]	1.8V to 5.5V[5]	6-pin SC70	5
MCP40D19[2]	I^2C	Volatile	128	5/10/50/100	Y/Y	1	N	N	Rheo[6]	1.8V to 5.5V[5]	5-pin SC70	5
MCP4131[2]	SPI	Volatile	129	5/10/50/100	Y/Y	1	N	Y[7]	Pot	1.8V to 5.5V[5]	8-pin 3 × 3 DFN	5
MCP4132[2]	SPI	Volatile	129	5/10/50/100	Y/Y	1	N	Y[7]	Rheo	1.8V to 5.5V[5]	8-pin 3 × 3 DFN	5
MCP4141[2]	SPI	EEPROM	129	5/10/50/100	Y/Y	1	N	Y[7]	Pot	2.7V to 5.5V	8-pin 3 × 3 DFN	5
MCP4142[2]	SPI	EEPROM	129	5/10/50/100	Y/Y	1	N	Y[7]	Rheo	2.7V to 5.5V	8-pin 3 × 3 DFN	5
MCP4151[2]	SPI	Volatile	257	5/10/50/100	Y/Y	1	N	Y[7]	Pot	1.8V to 5.5V[5]	8-pin 3 × 3 DFN	5
MCP4152[2]	SPI	Volatile	257	5/10/50/100	Y/Y	1	N	Y[7]	Rheo	1.8V to 5.5V[5]	8-pin 3 × 3 DFN	5
MCP4161[2]	SPI	EEPROM	257	5/10/50/100	Y/Y	1	Y	Y[7]	Pot	2.7V to 5.5V	8-pin 3 × 3 DFN	5
MCP4162[2]	SPI	EEPROM	257	5/10/50/100	Y/Y	1	Y	Y[7]	Rheo	2.7V to 5.5V	8-pin 3 × 3 DFN	5
MCP4531[2]	I^2C	Volatile	129	5/10/50/100	Y/Y	1	N	Y[7]	Pot	1.8V to 5.5V[5]	8-pin 3 × 3 DFN	5
MCP4532[2]	I^2C	Volatile	129	5/10/50/100	Y/Y	1	N	Y[7]	Rheo	1.8V to 5.5V[5]	8-pin 3 × 3 DFN	5
MCP4541[2]	I^2C	EEPROM	129	5/10/50/100	Y/Y	1	Y	Y[7]	Pot	2.7V to 5.5V	8-pin 3 × 3 DFN	5
MCP4542[2]	I^2C	EEPROM	129	5/10/50/100	Y/Y	1	Y	Y[7]	Rheo	2.7V to 5.5V	8-pin 3 × 3 DFN	5
MCP4551[2]	I^2C	Volatile	257	5/10/50/100	Y/Y	1	N	Y[7]	Pot	1.8V to 5.5V[5]	8-pin 3 × 3 DFN	5
MCP4552[2]	I^2C	Volatile	257	5/10/50/100	Y/Y	1	N	Y[7]	Rheo	1.8V to 5.5V[5]	8-pin 3 × 3 DFN	5
MCP4561[2]	I^2C	EEPROM	257	5/10/50/100	Y/Y	1	Y	Y[7]	Pot	2.7V to 5.5V	8-pin 3 × 3 DFN	5
MCP4562[2]	I^2C	EEPROM	257	5/10/50/100	Y/Y	1	Y	Y[7]	Rheo	2.7V to 5.5V	8-pin 3 × 3 DFN	5

1. Resistor options are: –202 (2.1 kΩ), –502 (5.0 kΩ), –103 (10.0 kΩ) and –503 (50.0 kΩ).
2. Resistor options are: –502 (5.0 kΩ), –103 (10.0 kΩ), 503 (50.0 kΩ), and –104 (100.0 kΩ).
3. Zero-scale allows the wiper to “directly” connect to Terminal B, while full-scale allows the wiper to “directly” connect to Terminal A.
4. This current is with the serial interface inactive, and not during an EEPROM write cycle (for non-volatile devices).
5. The digital serial interface has been tested to 1.8V but the device’s analog characteristics have only been specified from 2.7V to 5.5V. Review the device’s characterization graphs for information on analog performance between 1.8V and 2.7V.
6. One of the terminal pins (A or B) is internally connected to ground, due to the limitation of the number of pins on the package.
7. Shutdown support via software (TCON register(s)). If device has $\overline{SHDN}$ pin, software shutdown also functions.

Serial Interfaces

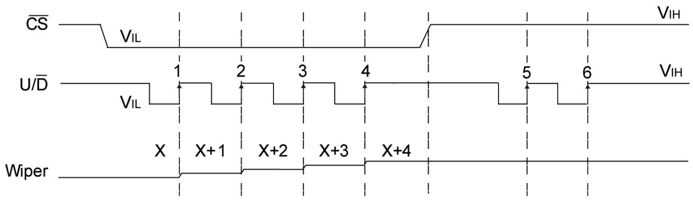
Microchip currently offers digital potentiometers with one of the following three interfaces:

- An up/down interface
- An SPI interface
- An I²C interface

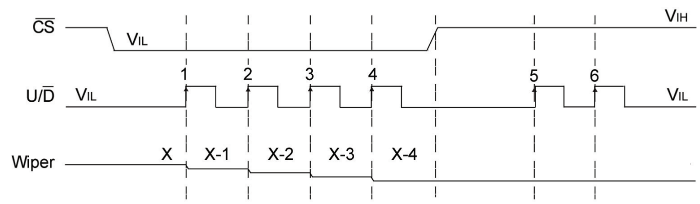
Up/Down Interface

Up/down interface is an easy way to implement interface that requires two pins and can be implemented with minimal software overhead. This interface is also easy for test systems where non-volatile devices are used as replacements for mechanical potentiometers. WiperLock technology can be enabled and disabled when CS pin is forced to the V_{IHH} voltage instead of the V_{IL} voltage.

Increment



Decrement



Devices with an Up/Down Interface

Device	Serial Interface	Memory Type	Resolution (# of steps)	R_{AB} Resistance kΩ (typ.)	Zero-Scale/ Full-Scale[2]	# of Channels	WiperLock™ Technology	Shutdown Mode	Configuration	Voltage Range	Packages	I_{DD} Max. (µA)[3]
MCP4011[1]	U/D	Volatile	64	2.1/5/10/50	Y/Y	1	N	N	Pot	1.8V to 5.5V[4]	8-pin SOIC, 8-pin MSOP, 8-pin DFN	1
MCP4012[1]	U/D	Volatile	64	2.1/5/10/50	Y/Y	1	N	N	Rheo	1.8V to 5.5V[4]	6-pin SOT-23	1
MCP4013[1]	U/D	Volatile	64	2.1/5/10/50	Y/Y	1	N	N	Pot[5]	1.8V to 5.5V[4]	6-pin SOT-23	1
MCP4014[1]	U/D	Volatile	64	2.1/5/10/50	Y/Y	1	N	N	Rheo[5]	1.8V to 5.5V[4]	5-pin SOT-23	1
MCP4021[1]	U/D	EEPROM	64	2.1/5/10/50	Y/Y	1	Y	N	Pot	2.7V to 5.5V	8-pin SOIC, 8-pin MSOP, 8-pin DFN	1
MCP4022[1]	U/D	EEPROM	64	2.1/5/10/50	Y/Y	1	Y	N	Rheo	2.7V to 5.5V	6-pin SOT-23	1
MCP4023[1]	U/D	EEPROM	64	2.1/5/10/50	Y/Y	1	Y	N	Pot[5]	2.7V to 5.5V	6-pin SOT-23	1
MCP4024[1]	U/D	EEPROM	64	2.1/5/10/50	Y/Y	1	Y	N	Rheo[5]	2.7V to 5.5V	5-pin SOT-23	1

1. Resistor options are: –202 (2.1 kΩ), –502 (5.0 kΩ), –103 (10.0 kΩ) and –503 (50.0 kΩ).
2. Zero-scale allows the wiper to “directly” connect to Terminal B, while full-scale allows the wiper to “directly” connect to Terminal A.
3. This current is with the serial interface inactive, and not during an EEPROM write cycle (for non-volatile devices).
4. The digital serial interface has been tested to 1.8V but the device’s analog characteristics have only been specified from 2.7V to 5.5V. Review the device’s characterization graphs for information on analog performance between 1.8V and 2.7V.
5. One of the terminal pins (A or B) is internally connected to ground, due to the limitation of the number of pins on the package.

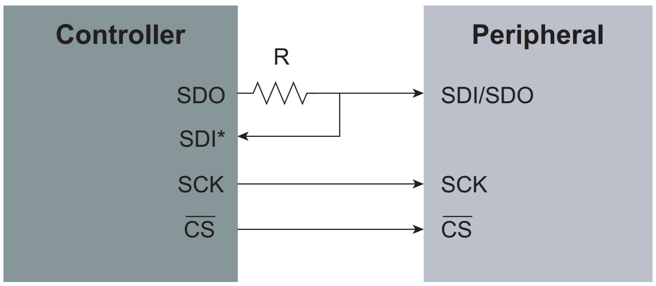
Serial Interfaces

SPI Interface

SPI requires three or four I/O pins. The additional pins can either be used to read data back from the device or for device daisy chaining. Daisy chaining allows the SPI interface to update all devices in that chain at the same time.

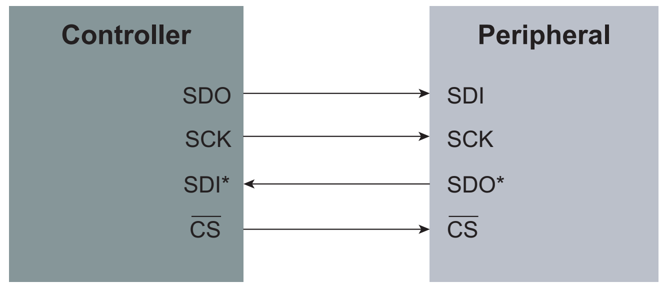
Many microcontrollers offer this interface as a hardware module, further simplifying the code development. WiperLock technology can be enabled and disabled when CS pin is forced to the V_{IHH} voltage instead of the V_{IL} voltage.

Controller to Single Peripheral with Multiplexed SDI and SDO Pins



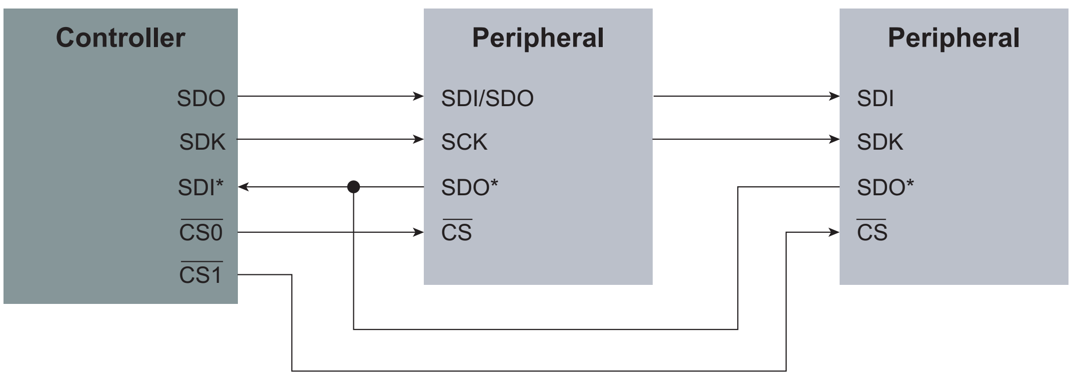
*This connection is optional and only required for read operations.

Controller to Single Peripheral



*This connection is optional and only required for read operations.

Controller to Multiple Peripherals (Multiple Chip Selects)



*This connection is optional and only required for read operations. Additional circuitry may be required for ORing of the peripheral SDO signals based on the device selected.

Serial Interfaces

Devices with an SPI Interface

Device	Serial Interface	Memory Type	Resolution (# of steps)	R_{AB} Resistance kΩ (typ.)	Zero-Scale/ Full-Scale[2]	# of Channels	WiperLock™ Technology	Shutdown Mode	Configuration	Voltage Range	Packages	I_{DD} Max. (µA)[4]
MCP4131[1]	SPI	Volatile	129	5/10/50/100	Y/Y	1	N	Y[6]	Pot	1.8V to 5.5V[5]	8-pin PDIP, 8-pin SOIC, 8-pin MSOP, 8-pin DFN	5
MCP4132[1]	SPI	Volatile	129	5/10/50/100	Y/Y	1	N	Y[6]	Rheo	1.8V to 5.5V[5]	8-pin PDIP, 8-pin SOIC, 8-pin MSOP, 8-pin DFN	5
MCP4141[1]	SPI	EEPROM	129	5/10/50/100	Y/Y	1	N	Y[6]	Pot	2.7V to 5.5V	8-pin PDIP, 8-pin SOIC, 8-pin MSOP, 8-pin DFN	5
MCP4142[1]	SPI	EEPROM	129	5/10/50/100	Y/Y	1	N	Y[6]	Rheo	2.7V to 5.5V	8-pin PDIP, 8-pin SOIC, 8-pin MSOP, 8-pin DFN	5
MCP4151[1]	SPI	Volatile	257	5/10/50/100	Y/Y	1	N	Y[6]	Pot	1.8V to 5.5V[5]	8-pin PDIP, 8-pin SOIC, 8-pin MSOP, 8-pin DFN	5
MCP4152[1]	SPI	Volatile	257	5/10/50/100	Y/Y	1	N	Y[6]	Rheo	1.8V to 5.5V[5]	8-pin PDIP, 8-pin SOIC, 8-pin MSOP, 8-pin DFN	5
MCP4161[1]	SPI	EEPROM	257	5/10/50/100	Y/Y	1	Y	Y[6]	Pot	2.7V to 5.5V	8-pin PDIP, 8-pin SOIC, 8-pin MSOP, 8-pin DFN	5
MCP4162[1]	SPI	EEPROM	257	5/10/50/100	Y/Y	1	Y	Y[6]	Rheo	2.7V to 5.5V	8-pin PDIP, 8-pin SOIC, 8-pin MSOP, 8-pin DFN	5
MCP4231[1]	SPI	Volatile	129	5/10/50/100	Y/Y	2	N	Y[6]	Pot	1.8V to 5.5V[5]	14-pin PDIP, 14-pin SOIC, 14-pin TSSOP, 16-pin QFN	5
MCP4232[1]	SPI	Volatile	129	5/10/50/100	Y/Y	2	N	Y[6]	Rheo	1.8V to 5.5V[5]	10-pin MSOP, 10-pin DFN-10	5
MCP4241[1]	SPI	EEPROM	129	5/10/50/100	Y/Y	2	Y	Y[6]	Pot	2.7V to 5.5V	14-pin PDIP, 14-pin SOIC, 14-pin TSSOP, 16-pin QFN	5
MCP4242[1]	SPI	EEPROM	129	5/10/50/100	Y/Y	2	Y	Y[6]	Rheo	2.7V to 5.5V	10-pin MSOP, 10-pin DFN-10	5
MCP4251[1]	SPI	Volatile	257	5/10/50/100	Y/Y	2	N	Y[6]	Pot	1.8V to 5.5V[5]	14-pin PDIP, 14-pin SOIC, 14-pin TSSOP, 16-pin QFN	5
MCP4252[1]	SPI	Volatile	257	5/10/50/100	Y/Y	2	N	Y[6]	Rheo	1.8V to 5.5V[5]	10-pin MSOP, 10-pin DFN-10	5
MCP4261[1]	SPI	EEPROM	257	5/10/50/100	Y/Y	2	Y	Y[6]	Pot	2.7V to 5.5V	14-pin PDIP, 14-pin SOIC, 14-pin TSSOP, 16-pin QFN	5
MCP4262[1]	SPI	EEPROM	257	5/10/50/100	Y/Y	2	Y	Y[6]	Rheo	2.7V to 5.5V	10-pin MSOP, 10-pin DFN-10	5
MCP4331[1]	SPI	Volatile	129	5/10/50/100	Y/Y	4	N	Y[6]	Pot	1.8V to 5.5V[5]	20-pin TSSOP, 20-pin QFN	5
MCP4332[1]	SPI	Volatile	129	5/10/50/100	Y/Y	4	N	Y[6]	Rheo	1.8V to 5.5V[5]	14-pin TSSOP	5
MCP4341[1]	SPI	EEPROM	129	5/10/50/100	Y/Y	4	Y	Y[6]	Pot	2.7V to 5.5V	20-pin TSSOP, 20-pin QFN	5
MCP4342[1]	SPI	EEPROM	129	5/10/50/100	Y/Y	4	Y	Y[6]	Rheo	2.7V to 5.5V	14-pin TSSOP	5
MCP4351[1]	SPI	Volatile	257	5/10/50/100	Y/Y	4	N	Y[6]	Pot	1.8V to 5.5V[5]	20-pin TSSOP, 20-pin QFN	5
MCP4352[1]	SPI	Volatile	257	5/10/50/100	Y/Y	4	N	Y[6]	Rheo	1.8V to 5.5V[5]	14-pin TSSOP	5
MCP4361[1]	SPI	EEPROM	257	5/10/50/100	Y/Y	4	Y	Y[6]	Pot	2.7V to 5.5V	20-pin TSSOP, 20-pin QFN	5
MCP4362[1]	SPI	EEPROM	257	5/10/50/100	Y/Y	4	Y	Y[6]	Rheo	2.7V to 5.5V	14-pin TSSOP	5
MCP41010[7]	SPI	Volatile	256	10	Y/N[3]	1	N	N	Pot	2.7V to 5.5V	8-pin PDIP, 8-pin SOIC	1
MCP41050[7]	SPI	Volatile	256	50	Y/N[3]	1	N	N	Pot	2.7V to 5.5V	8-pin PDIP, 8-pin SOIC	1
MCP41100[7]	SPI	Volatile	256	100	Y/N[3]	1	N	N	Pot	2.7V to 5.5V	8-pin PDIP, 8-pin SOIC	1
MCP42010[7]	SPI	Volatile	256	10	Y/N[3]	2	N	Y	Pot	2.7V to 5.5V	14-pin PDIP, 14-pin SOIC, 14-pin TSSOP	1
MCP42050[7]	SPI	Volatile	256	50	Y/N[3]	2	N	Y	Pot	2.7V to 5.5V	14-pin PDIP, 14-pin SOIC, 14-pin TSSOP	1
MCP42100[7]	SPI	Volatile	256	100	Y/N[3]	2	N	Y	Pot	2.7V to 5.5V	14-pin PDIP, 14-pin SOIC, 14-pin TSSOP	1
MCP41HV31[1]	SPI	Volatile	128	5/10/50/100	Y/Y	1	N	Y[6]	Pot	1.8V to 5.5V[5], 10V (±5V) to 36V (±18V)	14-pin TSSOP, 20-pin VQFN	5
MCP41HV51[1]	SPI	Volatile	256	5/10/50/100	Y/Y	1	N	Y[6]	Pot	1.8V to 5.5V[5], 10V (±5V) to 36V (±18V)	14-pin TSSOP, 20-pin VQFN	5

1. Resistor options are: –502 (5.0 kΩ), –103 (10.0 kΩ), 503 (50.0 kΩ), and –104 (100.0 kΩ).
2. Zero-scale allows the wiper to “directly” connect to Terminal B, while full-scale allows the wiper to “directly” connect to Terminal A.
3. There is one R_S resistor between the maximum wiper value and Terminal A.
4. This current is with the serial interface inactive, and not during an EEPROM write cycle (for non-volatile devices).
5. The digital serial interface has been tested to 1.8V but the device’s analog characteristics have only been specified from 2.7V to 5.5V. Review the device’s characterization graphs for information on analog performance between 1.8V and 2.7V.
6. Shutdown support via software (TCON register(s)). If device has $\overline{\text{SHDN}}$ pin, software shutdown also functions.
7. SPI interface for these devices supports daisy chain configuration.

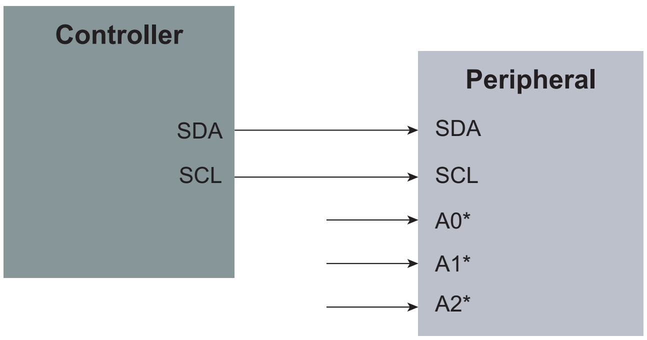
Serial Interfaces

I²C Interface

The I²C interface is a two-wire interface. This protocol supports read and writes using only the interface's two writes. Multiple devices can be connected on the I²C bus, where each device has a unique device address. The I²C protocol requires more host controller firmware overheard than the SPI protocol, but requires less hardware resources (Two pins vs. three or four pins).

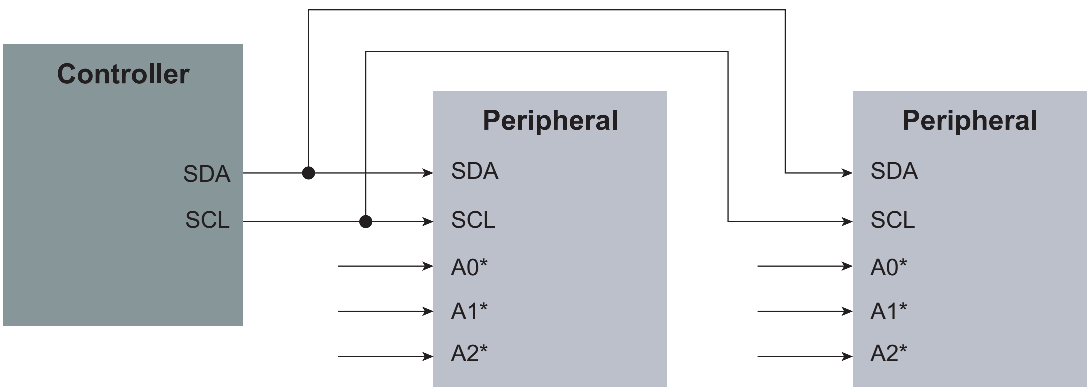
Many microcontrollers offer this interface as a dedicated hardware module, which eases the software requirement of the protocol. WiperLock technology can be enabled and disabled when CS pin is forced to the V_{IHH} voltage instead of the V_{IL} voltage.

Controller to Single Peripheral



*This connection is optional and only required for read operations.

Controller to Multiple Peripherals (Multiple Chip Selects)



* This signal is device dependent, number of devices depends on number of address signals.

Serial Interfaces

Devices with an I²C Interface

Device	Serial Interface	Memory Type	Resolution (# of steps)	R_{AB} Resistance kΩ (typ.)	Zero-Scale/ Full-Scale[2]	# of Channels	WiperLock™ Technology	Shutdown Mode	Configuration	Voltage Range	Packages	I_{DD} Max. (µA)[3]
MCP4017[1]	I²C	Volatile	128	5/10/50/100	Y/Y	1	N	N	Rheo	1.8V to 5.5V[4]	6-pin SC70	5
MCP4018[1]	I²C	Volatile	128	5/10/50/100	Y/Y	1	N	N	Pot[5]	1.8V to 5.5V[4]	6-pin SC70	5
MCP4019[1]	I²C	Volatile	128	5/10/50/100	Y/Y	1	N	N	Rheo[5]	1.8V to 5.5V[4]	5-pin SC70	5
MCP40D17[1]	I²C	Volatile	128	5/10/50/100	Y/Y	1	N	N	Rheo	1.8V to 5.5V[4]	6-pin SC70	5
MCP40D18[1]	I²C	Volatile	128	5/10/50/100	Y/Y	1	N	N	Pot[5]	1.8V to 5.5V[4]	6-pin SC70	5
MCP40D19[1]	I²C	Volatile	128	5/10/50/100	Y/Y	1	N	N	Rheo[5]	1.8V to 5.5V[4]	5-pin SC70	5
MCP4531[1]	I²C	Volatile	129	5/10/50/100	Y/Y	1	N	Y[6]	Pot	1.8V to 5.5V[4]	8-pin MSOP, 8-pin DFN	5
MCP4532[1]	I²C	Volatile	129	5/10/50/100	Y/Y	1	N	Y[6]	Rheo	1.8V to 5.5V[4]	8-pin MSOP, 8-pin DFN	5
MCP4541[1]	I²C	EEPROM	129	5/10/50/100	Y/Y	1	Y	Y[6]	Pot	2.7V to 5.5V	8-pin MSOP, 8-pin DFN	5
MCP4542[1]	I²C	EEPROM	129	5/10/50/100	Y/Y	1	Y	Y[6]	Rheo	2.7V to 5.5V	8-pin MSOP, 8-pin DFN	5
MCP4551[1]	I²C	Volatile	257	5/10/50/100	Y/Y	1	N	Y[6]	Pot	1.8V to 5.5V[4]	8-pin MSOP, 8-pin DFN	5
MCP4552[1]	I²C	Volatile	257	5/10/50/100	Y/Y	1	N	Y[6]	Rheo	1.8V to 5.5V[4]	8-pin MSOP, 8-pin DFN	5
MCP4561[1]	I²C	EEPROM	257	5/10/50/100	Y/Y	1	Y	Y[6]	Pot	2.7V to 5.5V	8-pin MSOP, 8-pin DFN	5
MCP4562[1]	I²C	EEPROM	257	5/10/50/100	Y/Y	1	Y	Y[6]	Rheo	2.7V to 5.5V	8-pin MSOP, 8-pin DFN	5
MCP4631[1]	I²C	Volatile	129	5/10/50/100	Y/Y	2	N	Y[6]	Pot	1.8V to 5.5V[4]	14-pin TSSOP, 16-pin QFN	5
MCP4632[1]	I²C	Volatile	129	5/10/50/100	Y/Y	2	N	Y[6]	Rheo	1.8V to 5.5V[4]	10-pin MSOP, 10-pin DFN	5
MCP4641[1]	I²C	EEPROM	129	5/10/50/100	Y/Y	2	Y	Y[6]	Pot	2.7V to 5.5V	14-pin PDIP, 14-pin SOIC, 14-pin TSSOP, 16-pin QFN	5
MCP4642[1]	I²C	EEPROM	129	5/10/50/100	Y/Y	2	Y	Y[6]	Rheo	2.7V to 5.5V	10-pin MSOP, 10-pin DFN	5
MCP4651[1]	I²C	Volatile	257	5/10/50/100	Y/Y	2	N	Y[6]	Pot	1.8V to 5.5V[4]	14-pin TSSOP, 16-pin QFN	5
MCP4652[1]	I²C	Volatile	257	5/10/50/100	Y/Y	2	N	Y[6]	Rheo	1.8V to 5.5V[4]	10-pin MSOP, 10-pin DFN	5
MCP4661[1]	I²C	EEPROM	257	5/10/50/100	Y/Y	2	Y	Y[6]	Pot	2.7V to 5.5V	14-pin PDIP, 14-pin SOIC, 14-pin TSSOP, 16-pin QFN	5
MCP4662[1]	I²C	EEPROM	257	5/10/50/100	Y/Y	2	Y	Y[6]	Rheo	2.7V to 5.5V	10-pin MSOP, 10-pin DFN	5
MCP4431[1]	I²C	Volatile	129	5/10/50/100	Y/Y	4	N	Y[6]	Pot	1.8V to 5.5V[4]	20-pin TSSOP, 20-pin QFN	5
MCP4432[1]	I²C	Volatile	129	5/10/50/100	Y/Y	4	N	Y[6]	Rheo	1.8V to 5.5V[4]	14-pin TSSOP	5
MCP4441[1]	I²C	EEPROM	129	5/10/50/100	Y/Y	4	Y	Y[6]	Pot	2.7V to 5.5V	20-pin TSSOP, 20-pin QFN	5
MCP4442[1]	I²C	EEPROM	129	5/10/50/100	Y/Y	4	Y	Y[6]	Rheo	2.7V to 5.5V	14-pin TSSOP	5
MCP4451[1]	I²C	Volatile	257	5/10/50/100	Y/Y	4	N	Y[6]	Pot	1.8V to 5.5V[4]	20-pin TSSOP, 20-pin QFN	5
MCP4452[1]	I²C	Volatile	257	5/10/50/100	Y/Y	4	N	Y[6]	Rheo	1.8V to 5.5V[4]	14-pin TSSOP	5
MCP4461[1]	I²C	EEPROM	257	5/10/50/100	Y/Y	4	Y	Y[6]	Pot	2.7V to 5.5V	20-pin TSSOP, 20-pin QFN	5
MCP4462[1]	I²C	EEPROM	257	5/10/50/100	Y/Y	4	Y	Y[6]	Rheo	2.7V to 5.5V	14-pin TSSOP	5
MCP45HV31[1]	I²C	Volatile	128	5/10/50/100	Y/Y	1	N	Y[6]	Pot	1.8V to 5.5V[4], 10V (±5V) to 36V (±18V)	14-pin TSSOP, 20-pin VQFN	5
MCP45HV51[1]	I²C	Volatile	256	5/10/50/100	Y/Y	1	N	Y[6]	Pot	1.8V to 5.5V[4], 10V (±5V) to 36V (±18V)	14-pin TSSOP, 20-pin VQFN	5

1. Resistor options are: –502 (5.0 kΩ), –103 (10.0 kΩ), 503 (50.0 kΩ), and –104 (100.0 kΩ).
2. Zero-scale allows the wiper to "directly" connect to Terminal B, while full-scale allows the wiper to "directly" connect to Terminal A.
3. This current is with the serial interface inactive, and not during an EEPROM write cycle (for non-volatile devices).
4. The digital serial interface has been tested to 1.8V but the device's analog characteristics have only been specified from 2.7V to 5.5V. Review the device's characterization graphs for information on analog performance between 1.8V and 2.7V.
5. One of the terminal pins (A or B) is internally connected to ground, due to the limitation of the number of pins on the package.
6. Shutdown support via software (TCON register(s)). If device has $\overline{SHDN}$ pin, software shutdown also functions.

Single, Dual and Quad Digital Potentiometers

Single, Dual and Quad Digital Potentiometer Options

Microchip currently offers up to four resistor networks on a single device. These networks are referred to as Pot0 (Potentiometer 0), Pot1, Pot2 and Pot3. Having multiple digital potentiometers on the same device has several advantages, including:

- Lower cost per potentiometer
- Smaller PCB layout area per potentiometer
- Good R_{AB} matching between potentiometers

In some applications, the R_{AB} resistance matching between potentiometers is important to ensure system performance. For multi-channel digital potentiometers, since all the devices are manufactured on the same silicon, R_{AB} resistance variation is in general smaller compared to that on different devices. R_{AB} matching specifications as well as additional information can be found in the data sheet.

Single Digital Potentiometer Devices

Device	Serial Interface	Memory Type	Resolution (# of steps)	R_{AB} Resistance kΩ (typ.)	Zero-Scale/ Full-Scale(3)	# of Channels	WiperLock™ Technology	Shutdown Mode	Configuration	Voltage Range	Packages	I_{DD} Max. (µA)(5)
MCP4011(1)	U/D	Volatile	64	2.1/5/10/50	Y/Y	1	N	N	Pot	1.8V to 5.5V(6)	8-pin SOIC, 8-pin MSOP, 8-pin DFN	1
MCP4012(1)	U/D	Volatile	64	2.1/5/10/50	Y/Y	1	N	N	Rheo	1.8V to 5.5V(6)	6-pin SOT-23	1
MCP4013(1)	U/D	Volatile	64	2.1/5/10/50	Y/Y	1	N	N	Pot(7)	1.8V to 5.5V(6)	6-pin SOT-23	1
MCP4014(1)	U/D	Volatile	64	2.1/5/10/50	Y/Y	1	N	N	Rheo(7)	1.8V to 5.5V(6)	5-pin SOT-23	1
MCP4021(1)	U/D	EEPROM	64	2.1/5/10/50	Y/Y	1	Y	N	Pot	2.7V to 5.5V	8-pin SOIC, 8-pin MSOP, 8-pin DFN	1
MCP4022(1)	U/D	EEPROM	64	2.1/5/10/50	Y/Y	1	Y	N	Rheo	2.7V to 5.5V	6-pin SOT-23	1
MCP4023(1)	U/D	EEPROM	64	2.1/5/10/50	Y/Y	1	Y	N	Pot(7)	2.7V to 5.5V	6-pin SOT-23	1
MCP4024(1)	U/D	EEPROM	64	2.1/5/10/50	Y/Y	1	Y	N	Rheo(7)	2.7V to 5.5V	5-pin SOT-23	1
MCP4017(2)	I²C	Volatile	128	5/10/50/100	Y/Y	1	N	N	Rheo	1.8V to 5.5V(6)	6-pin SC70	5
MCP4018(2)	I²C	Volatile	128	5/10/50/100	Y/Y	1	N	N	Pot(7)	1.8V to 5.5V(6)	6-pin SC70	5
MCP4019(2)	I²C	Volatile	128	5/10/50/100	Y/Y	1	N	N	Rheo(7)	1.8V to 5.5V(6)	5-pin SC70	5
MCP40D17(2)	I²C	Volatile	128	5/10/50/100	Y/Y	1	N	N	Rheo	1.8V to 5.5V(6)	6-pin SC70	5
MCP40D18(2)	I²C	Volatile	128	5/10/50/100	Y/Y	1	N	N	Pot(7)	1.8V to 5.5V(6)	6-pin SC70	5
MCP40D19(2)	I²C	Volatile	128	5/10/50/100	Y/Y	1	N	N	Rheo(7)	1.8V to 5.5V(6)	5-pin SC70	5
MCP4131(2)	SPI	Volatile	129	5/10/50/100	Y/Y	1	N	Y(8)	Pot	1.8V to 5.5V(6)	8-pin PDIP, 8-pin SOIC, 8-pin MSOP, 8-pin DFN	5
MCP4132(2)	SPI	Volatile	129	5/10/50/100	Y/Y	1	N	Y(8)	Rheo	1.8V to 5.5V(6)	8-pin PDIP, 8-pin SOIC, 8-pin MSOP, 8-pin DFN	5
MCP4141(2)	SPI	EEPROM	129	5/10/50/100	Y/Y	1	N	Y(8)	Pot	2.7V to 5.5V	8-pin PDIP, 8-pin SOIC, 8-pin MSOP, 8-pin DFN	5
MCP4142(2)	SPI	EEPROM	129	5/10/50/100	Y/Y	1	N	Y(8)	Rheo	2.7V to 5.5V	8-pin PDIP, 8-pin SOIC, 8-pin MSOP, 8-pin DFN	5
MCP4151(2)	SPI	Volatile	257	5/10/50/100	Y/Y	1	N	Y(8)	Pot	1.8V to 5.5V(6)	8-pin PDIP, 8-pin SOIC, 8-pin MSOP, 8-pin DFN	5
MCP4152(2)	SPI	Volatile	257	5/10/50/100	Y/Y	1	N	Y(8)	Rheo	1.8V to 5.5V(6)	8-pin PDIP, 8-pin SOIC, 8-pin MSOP, 8-pin DFN	5
MCP4161(2)	SPI	EEPROM	257	5/10/50/100	Y/Y	1	Y	Y(8)	Pot	2.7V to 5.5V	8-pin PDIP, 8-pin SOIC, 8-pin MSOP, 8-pin DFN	5
MCP4162(2)	SPI	EEPROM	257	5/10/50/100	Y/Y	1	Y	Y(8)	Rheo	2.7V to 5.5V	8-pin PDIP, 8-pin SOIC, 8-pin MSOP, 8-pin DFN	5
MCP4531(2)	I²C	Volatile	129	5/10/50/100	Y/Y	1	N	Y(8)	Pot	1.8V to 5.5V(6)	8-pin MSOP, 8-pin DFN	5
MCP4532(2)	I²C	Volatile	129	5/10/50/100	Y/Y	1	N	Y(8)	Rheo	1.8V to 5.5V(6)	8-pin MSOP, 8-pin DFN	5
MCP4541(2)	I²C	EEPROM	129	5/10/50/100	Y/Y	1	Y	Y(8)	Pot	2.7V to 5.5V	8-pin MSOP, 8-pin DFN	5
MCP4542(2)	I²C	EEPROM	129	5/10/50/100	Y/Y	1	Y	Y(8)	Rheo	2.7V to 5.5V	8-pin MSOP, 8-pin DFN	5
MCP4551(2)	I²C	Volatile	257	5/10/50/100	Y/Y	1	N	Y(8)	Pot	1.8V to 5.5V(6)	8-pin MSOP, 8-pin DFN	5
MCP4552(2)	I²C	Volatile	257	5/10/50/100	Y/Y	1	N	Y(8)	Rheo	1.8V to 5.5V(6)	8-pin MSOP, 8-pin DFN	5

1. Resistor options are: –202 (2.1 kΩ), –502 (5.0 kΩ), –103 (10.0 kΩ) and –503 (50.0 kΩ).
2. Resistor options are: –502 (5.0 kΩ), –103 (10.0 kΩ), 503 (50.0 kΩ), and –104 (100.0 kΩ).
3. Zero-scale allows the wiper to "directly" connect to Terminal B, while full-scale allows the wiper to "directly" connect to Terminal A.
4. There is one Rs resistor between the maximum wiper value and Terminal A.
5. This current is with the serial interface inactive, and not during an EEPROM write cycle (for non-volatile devices).
6. The digital serial interface has been tested to 1.8V but the device's analog characteristics have only been specified from 2.7V to 5.5V. Review the device's characterization graphs for information on analog performance between 1.8V and 2.7V.
7. One of the terminal pins (A or B) is internally connected to ground, due to the limitation of the number of pins on the package.
8. Shutdown support via software (TCON register(s)). If device has $\overline{SHDN}$ pin, software shutdown also functions.

Single, Dual and Quad Digital Potentiometers

Single Digital Potentiometer Devices (Continued)

Device	Serial Interface	Memory Type	Resolution (# of steps)	RAB Resistance kΩ (typ.)	Zero-Scale/ Full-Scale[3]	# of Channels	WiperLock™ Technology	Shutdown Mode	Configuration	Voltage Range	Packages	IDD Max. (µA)[5]
MCP4561[2]	I²C	EEPROM	257	5/10/50/100	Y/Y	1	Y	Y[8]	Pot	2.7V to 5.5V	8-pin MSOP, 8-pin DFN	5
MCP4562[2]	I²C	EEPROM	257	5/10/50/100	Y/Y	1	Y	Y[8]	Rheo	2.7V to 5.5V	8-pin MSOP, 8-pin DFN	5
MCP41010	SPI	Volatile	256	10	Y/N[4]	1	N	N	Pot	2.7V to 5.5V	8-pin PDIP, 8-pin SOIC	1
MCP41050	SPI	Volatile	256	50	Y/N[4]	1	N	N	Pot	2.7V to 5.5V	8-pin PDIP, 8-pin SOIC	1
MCP41100	SPI	Volatile	256	100	Y/N[4]	1	N	N	Pot	2.7V to 5.5V	8-pin PDIP, 8-pin SOIC	1
MCP41HV31[2]	SPI	Vol	128	5/10/50/100	Y/Y	1	N	Y[8]	Pot	1.8V to 5.5V[6], 10V (±5V) to 36V (±18V)	14-pin TSSOP, 20-pin VQFN	5
MCP41HV51[2]	SPI	Vol	256	5/10/50/100	Y/Y	1	N	Y[8]	Pot	1.8V to 5.5V[6], 10V (±5V) to 36V (±18V)	14-pin TSSOP, 20-pin VQFN	5
MCP45HV31[2]	I²C	Vol	128	5/10/50/100	Y/Y	1	N	Y[8]	Pot	1.8V to 5.5V[6], 10V (±5V) to 36V (±18V)	14-pin TSSOP, 20-pin VQFN	5
MCP45HV51[2]	I²C	Vol	256	5/10/50/100	Y/Y	1	N	Y[8]	Pot	1.8V to 5.5V[6], 10V (±5V) to 36V (±18V)	14-pin TSSOP, 20-pin VQFN	5

1. Resistor options are: –202 (2.1 kΩ), –502 (5.0 kΩ), –103 (10.0 kΩ) and –503 (50.0 kΩ).
2. Resistor options are: –502 (5.0 kΩ), –103 (10.0 kΩ), 503 (50.0 kΩ), and –104 (100.0 kΩ).
3. Zero-scale allows the wiper to "directly" connect to Terminal B, while full-scale allows the wiper to "directly" connect to Terminal A.
4. There is one Rs resistor between the maximum wiper value and Terminal A.
5. This current is with the serial interface inactive, and not during an EEPROM write cycle (for non-volatile devices).
6. The digital serial interface has been tested to 1.8V but the device's analog characteristics have only been specified from 2.7V to 5.5V. Review the device's characterization graphs for information on analog performance between 1.8V and 2.7V.
7. One of the terminal pins (A or B) is internally connected to ground, due to the limitation of the number of pins on the package.
8. Shutdown support via software (TCON register(s)). If device has SHDN pin, software shutdown also functions.

Dual Digital Potentiometer Devices

Device	Serial Interface	Memory Type	Resolution (# of steps)	RAB Resistance kΩ (typ.)	Zero-Scale/ Full-Scale[2]	# of Channels	WiperLock™ Technology	Shutdown Mode	Configuration	Voltage Range	Packages	IDD Max. (µA)[4]
MCP4231[1]	SPI	Volatile	129	5/10/50/100	Y/Y	2	N	Y[6]	Pot	1.8V to 5.5V[5]	14-pin PDIP, 14-pin SOIC, 14-pin TSSOP, 16-pin QFN	5
MCP4232[1]	SPI	Volatile	129	5/10/50/100	Y/Y	2	N	Y[6]	Rheo	1.8V to 5.5V[5]	10-pin MSOP, 10-pin DFN	5
MCP4241[1]	SPI	EEPROM	129	5/10/50/100	Y/Y	2	Y	Y[6]	Pot	2.7V to 5.5V	14-pin PDIP, 14-pin SOIC, 14-pin TSSOP, 16-pin QFN	5
MCP4242[1]	SPI	EEPROM	129	5/10/50/100	Y/Y	2	Y	Y[6]	Rheo	2.7V to 5.5V	10-pin MSOP, 10-pin DFN	5
MCP4251[1]	SPI	Volatile	257	5/10/50/100	Y/Y	2	N	Y[6]	Pot	1.8V to 5.5V[5]	14-pin PDIP, 14-pin SOIC, 14-pin TSSOP, 16-pin QFN	5
MCP4252[1]	SPI	Volatile	257	5/10/50/100	Y/Y	2	N	Y[6]	Rheo	1.8V to 5.5V[5]	10-pin MSOP, 10-pin DFN	5
MCP4261[1]	SPI	EEPROM	257	5/10/50/100	Y/Y	2	Y	Y[6]	Pot	2.7V to 5.5V	14-pin PDIP, 14-pin SOIC, 14-pin TSSOP, 16-pin QFN	5
MCP4262[1]	SPI	EEPROM	257	5/10/50/100	Y/Y	2	Y	Y[6]	Rheo	2.7V to 5.5V	10-pin MSOP, 10-pin DFN	5
MCP4631[1]	I²C	Volatile	129	5/10/50/100	Y/Y	2	N	Y[6]	Pot	1.8V to 5.5V[5]	14-pin TSSOP, 16-pin QFN	5
MCP4632[1]	I²C	Volatile	129	5/10/50/100	Y/Y	2	N	Y[6]	Rheo	1.8V to 5.5V[5]	10-pin MSOP, 10-pin DFN	5
MCP4641[1]	I²C	EEPROM	129	5/10/50/100	Y/Y	2	Y	Y[6]	Pot	2.7V to 5.5V	14-pin PDIP, 14-pin SOIC, 14-pin TSSOP, 16-pin QFN	5
MCP4642[1]	I²C	EEPROM	129	5/10/50/100	Y/Y	2	Y	Y[6]	Rheo	2.7V to 5.5V	10-pin MSOP, 10-pin DFN	5
MCP4651[1]	I²C	Volatile	257	5/10/50/100	Y/Y	2	N	Y[6]	Pot	1.8V to 5.5V[5]	14-pin TSSOP, 16-pin QFN	5
MCP4652[1]	I²C	Volatile	257	5/10/50/100	Y/Y	2	N	Y[6]	Rheo	1.8V to 5.5V[5]	10-pin MSOP, 10-pin DFN	5
MCP4661[1]	I²C	EEPROM	257	5/10/50/100	Y/Y	2	Y	Y[6]	Pot	2.7V to 5.5V	14-pin PDIP, 14-pin SOIC, 14-pin TSSOP, 16-pin QFN	5
MCP4662[1]	I²C	EEPROM	257	5/10/50/100	Y/Y	2	Y	Y[6]	Rheo	2.7V to 5.5V	10-pin MSOP, 10-pin DFN	5
MCP42010	SPI	Volatile	256	10	Y/N[3]	2	N	Y	Pot	2.7V to 5.5V	14-pin PDIP, 14-pin SOIC, 14-pin TSSOP	1
MCP42050	SPI	Volatile	256	50	Y/N[3]	2	N	Y	Pot	2.7V to 5.5V	14-pin PDIP, 14-pin SOIC, 14-pin TSSOP	1
MCP42100	SPI	Volatile	256	100	Y/N[3]	2	N	Y	Pot	2.7V to 5.5V	14-pin PDIP, 14-pin SOIC, 14-pin TSSOP	1

1. Resistor options are: –502 (5.0 kΩ), –103 (10.0 kΩ), 503 (50.0 kΩ), and –104 (100.0 kΩ).
2. Zero-scale allows the wiper to "directly" connect to Terminal B, while full-scale allows the wiper to "directly" connect to Terminal A.
3. There is one Rs resistor between the maximum wiper value and Terminal A.
4. This current is with the serial interface inactive, and not during an EEPROM write cycle (for non-volatile devices).
5. The digital serial interface has been tested to 1.8V but the device's analog characteristics have only been specified from 2.7V to 5.5V. Review the device's characterization graphs for information on analog performance between 1.8V and 2.7V.
6. Shutdown support via software (TCON register(s)). If device has SHDN pin, software shutdown also functions.

Single, Dual and Quad Digital Potentiometers

Quad Digital Potentiometer Devices

Device	Serial Interface	Memory Type	Resolution (# of steps)	R_{AB} Resistance kΩ (typ.)	Zero-Scale/ Full-Scale[2]	# of Channels	WiperLock™ Technology	Shutdown Mode	Configuration	Voltage Range	Packages	I_{DD} Max. (µA)[3]
MCP4331[1]	SPI	Volatile	129	5/10/50/100	Y/Y	4	N	Y[5]	Pot	1.8V to 5.5V[4]	20-pin TSSOP, 20-pin QFN	5
MCP4332[1]	SPI	Volatile	129	5/10/50/100	Y/Y	4	N	Y[5]	Rheo	1.8V to 5.5V[4]	14-pin TSSOP	5
MCP4341[1]	SPI	EEPROM	129	5/10/50/100	Y/Y	4	Y	Y[5]	Pot	2.7V to 5.5V	20-pin TSSOP, 20-pin QFN	5
MCP4342[1]	SPI	EEPROM	129	5/10/50/100	Y/Y	4	Y	Y[5]	Rheo	2.7V to 5.5V	14-pin TSSOP	5
MCP4351[1]	SPI	Volatile	257	5/10/50/100	Y/Y	4	N	Y[5]	Pot	1.8V to 5.5V[4]	20-pin TSSOP, 20-pin QFN	5
MCP4352[1]	SPI	Volatile	257	5/10/50/100	Y/Y	4	N	Y[5]	Rheo	1.8V to 5.5V[4]	14-pin TSSOP	5
MCP4361[1]	SPI	EEPROM	257	5/10/50/100	Y/Y	4	Y	Y[5]	Pot	2.7V to 5.5V	20-pin TSSOP, 20-pin QFN	5
MCP4362[1]	SPI	EEPROM	257	5/10/50/100	Y/Y	4	Y	Y[5]	Rheo	2.7V to 5.5V	14-pin TSSOP	5
MCP4431[1]	I^2C	Volatile	129	5/10/50/100	Y/Y	4	N	Y[5]	Pot	1.8V to 5.5V[4]	20-pin TSSOP, 20-pin QFN	5
MCP4432[1]	I^2C	Volatile	129	5/10/50/100	Y/Y	4	N	Y[5]	Rheo	1.8V to 5.5V[4]	14-pin TSSOP	5
MCP4441[1]	I^2C	EEPROM	129	5/10/50/100	Y/Y	4	Y	Y[5]	Pot	2.7V to 5.5V	20-pin TSSOP, 20-pin QFN	5
MCP4442[1]	I^2C	EEPROM	129	5/10/50/100	Y/Y	4	Y	Y[5]	Rheo	2.7V to 5.5V	14-pin TSSOP	5
MCP4451[1]	I^2C	Volatile	257	5/10/50/100	Y/Y	4	N	Y[5]	Pot	1.8V to 5.5V[4]	20-pin TSSOP, 20-pin QFN	5
MCP4452[1]	I^2C	Volatile	257	5/10/50/100	Y/Y	4	N	Y[5]	Rheo	1.8V to 5.5V[4]	14-pin TSSOP	5
MCP4461[1]	I^2C	EEPROM	257	5/10/50/100	Y/Y	4	Y	Y[5]	Pot	2.7V to 5.5V	20-pin TSSOP, 20-pin QFN	5
MCP4462[1]	I^2C	EEPROM	257	5/10/50/100	Y/Y	4	Y	Y[5]	Rheo	2.7V to 5.5V	14-pin TSSOP	5

1. Resistor options are: –502 (5.0 kΩ), –103 (10.0 kΩ), 503 (50.0 kΩ), and –104 (100.0 kΩ).
2. Zero-scale allows the wiper to "directly" connect to Terminal B, while full-scale allows the wiper to "directly" connect to Terminal A.
3. This current is with the serial interface inactive, and not during an EEPROM write cycle (for non-volatile devices).
4. The digital serial interface has been tested to 1.8V but the device's analog characteristics have only been specified from 2.7V to 5.5V. Review the device's characterization graphs for information on analog performance between 1.8V and 2.7V.
5. Shutdown support via software (TCON register(s)). If device has $\overline{\text{SHDN}}$ pin, software shutdown also functions.

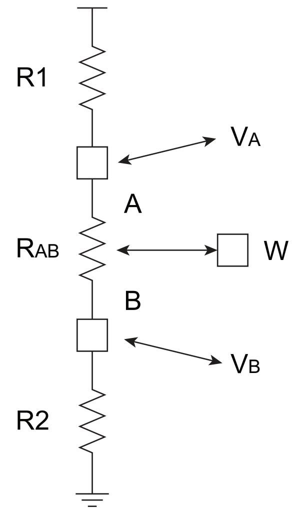
Step Resistance and Voltage Windowing

The Step Resistance (Rs)

The R_{AB} resistor ladder is really a string of resistors (R_S). The step resistance (Rs) value can be calculated by dividing end-to-end resistances (R_{AB}) with the number of Rs elements. The number of Rs element equals to the number of wiper steps minus one. Depending on the architecture, a 7-bit digital potentiometer could have 127 or 128 R_S and an 8-bit device could have 255 or 256 R_S.

The step resistance is important to understand when you are using the device in rheostat mode, or the potentiometer is being windowed by resistors on the Terminal A and/or on the Terminal B.

Voltage Windowing



Voltage Windowing

Terminal A and Terminal B may be any voltage within the device specification limits. Let's call the voltages at these nodes V_A and V_B. So the voltage across the resistor Rav (V_{AB}) is $|V_A - V_B|$. The V_{AB} voltage is determined by the values of the R1 and R2 and R_{AB} resistors. As the V_{AB} voltage becomes smaller relative to the voltage range, the effective resolution of the device increases.

This allows a less precise device to be used for more precise circuit tuning over a narrower range. When replacing a mechanical potentiometer, this configuration can be used and R1 and R2 may be any resistance (including 0).

Step Resistance (Rs)

R_{AB}	6-bit (63)	7-bit (127)	7-bit (128)	8-bit (255)	8-bit (256)
2100	33.33	–	–	–	–
5000	79.365	39.370	39.0625	19.608	19.53125
10000	158.730	78.740	78.125	39.216	39.0625
50000	793.651	393.701	390.625	196.078	195.3125
100000	–	787.402	781.25	392.157	390.625

How the V_{AB} Voltage Effects the Effective Resolution

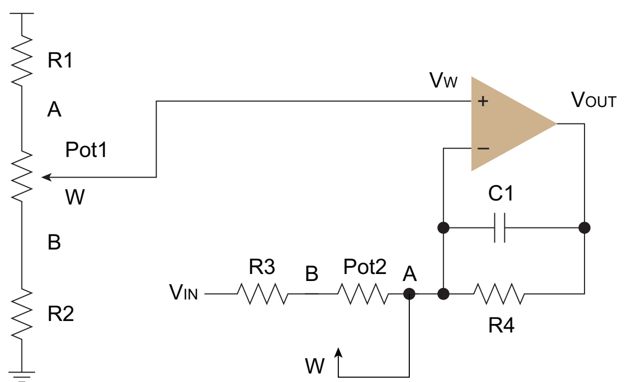
V_{AB}	mV per Step				Effective V_{AB} Resolution vs. Fixed V_{DD}				Comment
	6-bit (63)	7-bit (127)	7-bit (128)	8-bit (256)	6-bit (63)	7-bit (127)	7-bit (128)	8-bit (256)	
5.00	79.4E	39.4E	39.1E	19.5E	6-bit	7-bit	7-bit	8-bit	$V_{AB} = V_{DD} = 5.0V$
2.50	39.7E	19.7E	19.5E	9.8E	7-bit	8-bit	8-bit	9-bit	$V_{DD} = 5.0V$
1.25	19.8E	9.8E	9.8E	4.9E	8-bit	9-bit	9-bit	10-bit	$V_{DD} = 5.0V$

Inverting Amplifier with Offset and Gain Trimming

Digital potentiometers are a good fit for application to trim offset and gain in amplifier circuits.

In the following circuit, a resistor ladder is used to create a voltage window where Pot1 is used to trim the desired offset for the inverting amplifier. A second digital potentiometer (Pot2) is used in rheostat mode along with resistor R3 to control the gain of the amplifier. The step resistance of Pot2 relative to resistor R3 determines if the gain trimming is a fine adjustment or a coarse adjustment. Capacitor C1 is for compensation of the op amp and to inhibit the output from oscillating.

In this circuit, there is no interaction between the offset trimming and the gain trimming, but the input signal (V_{IN}) is loaded by the resistance of R2 plus Pot2's R_{BW} value.

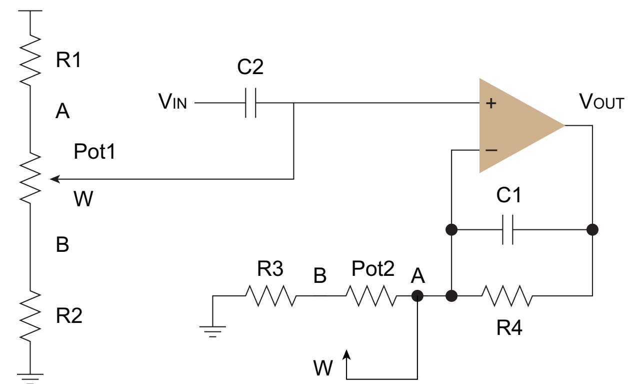


Band Pass Filter with Offset and Gain Trimming

In the following circuit, a resistor ladder is used to create a voltage window where Pot1 is used to trim the desired offset for the band pass filter. This resistor ladder setting also works with capacitor C2 to set the high pass filter frequency.

A second potentiometer (Pot2) is used in rheostat mode along with R3 and R4 to control the gain of the amplifier. The step resistance of Pot2 relative to resistors R3 and R4 determines if the gain trimming is a fine adjustment or a coarse adjustment. Capacitor C1 along with Pot2, R3 and R4 is used to set the low pass filter.

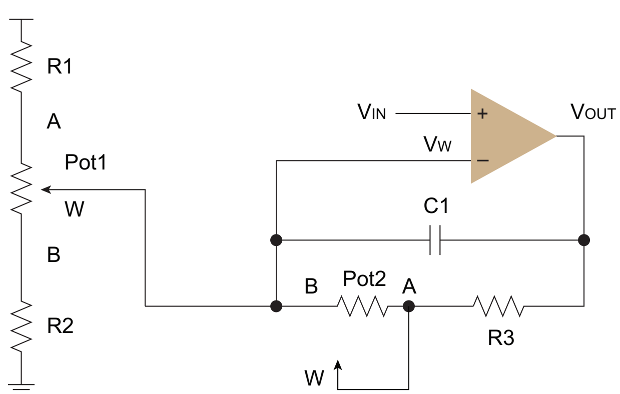
Capacitor C1 is also used for compensation of the op amp and to inhibit the output from oscillating. If capacitor C1 is not present, then the circuit is a high-pass filter, while if capacitor C2 is not present then the circuit is a low-pass filter.



Non-Inverting Amplifier with Offset and Gain Trimming

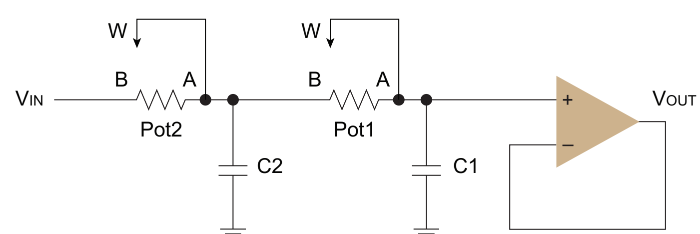
In the following circuit, a resistor ladder is used to create a voltage window where Pot1 is used to trim the desired offset for the non-inverting amplifier. A second potentiometer is used in a rheostat mode to control the gain of the amplifier. The step resistance of Pot2 relative to resistor R3 determines if the gain trimming is a fine adjustment or a coarse adjustment. Capacitor C1 is for compensation of the op amp and to inhibit the output from oscillating.

In this circuit, there is an interaction between the offset trimming and the gain trimming. To minimize this interaction, Pot2 should be small compared to resistor R3 and Pot1 should be small relative to the sum of R1 and R2. But the input signal (V_{IN}) is not loaded.



Programmable Filter

The following circuit uses an RC filter created by digital potentiometers (PotX) and capacitors (CX). This will filter at the selected frequency. That frequency is determined by the resistance value (R_{BW}) of the digital potentiometer (PotX) and the capacitor value (CX). Each additional stage of the RC filter is used to enhance the roll-off characteristics for the filter. The capacitors CX should be the same, while the wiper values of the Pots should be similar. The differences would be to compensate for the slight variations of the R_{AB} values of each Pot and the variations of the capacitors.



Additional information can be found in application note AN1316.

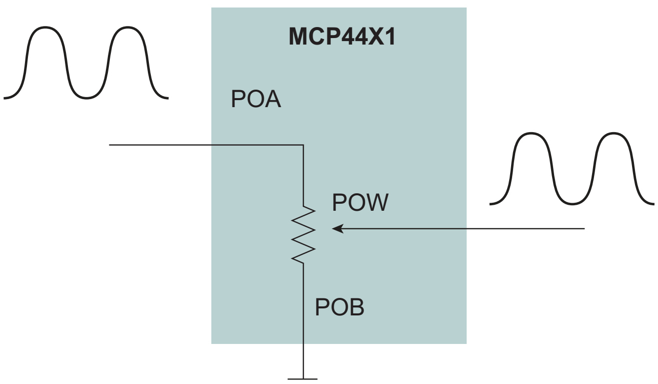
Application Circuits and Techniques

Logarithmic Steps

Logarithmic steps are desirable since the human ear hears in a logarithmic manner. The use of a linear potentiometer can approximate a log potentiometer, but with fewer steps. An 8-bit potentiometer can achieve fourteen 3 dB log steps plus a 100% (0 dB) and a mute setting.

The figure below shows a block diagram of one of the MCP44X1 resistor networks being used to attenuate an input signal. In this case, the attenuation will be ground referenced. Terminal B can be connected to a common mode voltage, but the voltages on the A, B and Wiper terminals must not exceed the MCP44X1 device's V_{DD}/V_{SS} voltage limits.

Signal Attenuation Block Diagram: Ground Referenced



The following equation shows how to calculate voltage dB gain ratios for the digital potentiometer.

dB Calculations (Voltage)

$$L = 20 \times \log_{10}(V_{OUT}/V_{IN})$$

$$L = 20 \times \log_{10}(R_{BW}/R_{AB})$$

dB	V_{OUT}/V_{IN} Ratio
–3	0.70795
–2	0.79433
–1	0.89125

More detail on this can be found in Section 8.5 of the MCP444X/446X Data Sheet (DS22265).

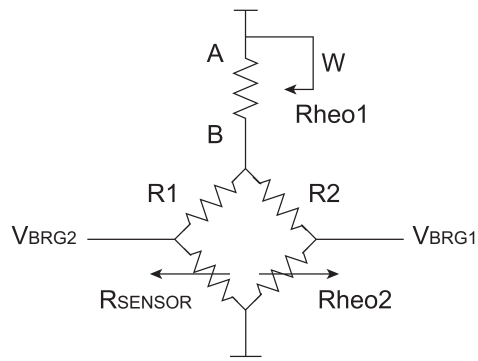
Wheatstone Bridge Trimming

The following circuit shows a Wheatstone Bridge with current limiting. In a Wheatstone Bridge, there are four resistive elements. In this example, two are fixed value (R1 and R2), there is a resistive sensor (R_{SENSOR}) and then there is the digital potentiometer in rheostat configuration to calibrate the circuit due to variations of the resistive sensor. This sensor could be used for temperature or weight measurement.

At a default condition the sensor should be a given value, but this value will change from device to device. To compensate for the resistive changes in the R1 plus R_{SENSOR} leg of the bridge, the Rheo2 would be modified for the R2 plus Rheo2 leg of the bridge. This would be done so that the voltages of V_{BRG1} and V_{BRG2} are at their desired levels. Many times this is $V_{BRG1} = V_{BRG2}$.

Now as the conditions on the sensor change, the resistance of the sensor will change, causing the V_{BRG2} voltage to change. The delta voltage between V_{BRG1} and V_{BRG2} can then be used to determine the state of the system (temperature, weight, etc.).

Rheo 1 is used in a rheostat mode to limit the current or trim the current through the Wheatstone Bridge.



Implementing a More Precise Rheostat

The RAB value of a typical digital potentiometer can vary as much as ±20%, so a device with a 10 kΩ R_{AB} value could have an R_{AB} value as small as 8 kΩ, as large as 12 kΩ. In a system, this variation for the rheostat value may not be desirable. This variation can be calibrated out to make a precise rheostat, at a cost of the resolution of the device.

If we design the application circuit where this rheostat only operates from 0Ω to 8 kΩ, all digital potentiometer devices (over process) will meet this requirement. Now with calibration, we will need to ensure that the wiper value is limited to a value where the rheostat value is the closest resistance value to the desired rheostat target value of 8 kΩ. The worst case (lowest) wiper value occurs when the R_{AB} value is 12 kΩ. In this case, a wiper value of 171 results in a resistance of 8016Ω. This results in a resolution of approximately 7.4 bits, or 0.58%.

In potentiometer mode, the process variation of the R_{AB} value may not be an application issue since the device is operating as a voltage divider.

Development Tools and Resources

Demonstration/Evaluation Board Support

Microchip Technology offers several boards that support the demonstration and evaluation of the digital potentiometer devices. These boards fall into two categories:

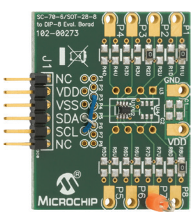
- Populated boards to demonstrate/evaluate the specific device(s)
- Blank printed circuit boards (PCBs)

The blank PCBs allow customers to populate the device and supporting circuit to best evaluate the performance and characteristics of the desired device configuration.

The following boards are available on the Microchip web site at: www.microchip.com/analog.

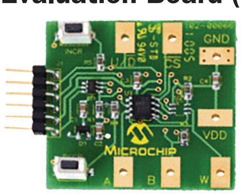
Name	Part Number	Package Supported	
		# Pins	Device/ Package Type
MCP401X Evaluation Board	MCP401XEV	–	MCP401X
MCP402X Non-Volatile Digital Potentiometer Evaluation Board	MCP402XEV	–	MCP40X1 (SOT-23)
MCP42X1 Evaluation Board	MCP42X1EV	–	MCP42X1
MCP43X1 Evaluation Board	MCP43X1EV	–	MCP43X1
MCP46X1 Evaluation Board	MCP46X1EV	–	MCP46X1
MCP4XXX Digital Potentiometer Daughter Board	MCP4XXXDM-DB	–	MCP42XXX (DIP) and MCP40X1 (SOIC)
MCP42XX PICtail™ Plus Daughter Board	MCP42XXDM-PTPLS	–	MCP42XX
MCP46XX PICtail Plus Daughter Board	MCP46XXDM-PTPLS	–	MCP46XX
5/6-pin SOT-23 Voltage Supervisor Evaluation Board	VSUPEV2	5, 6	SOT-23
8-pin SOIC/MSOP/DIP Evaluation Board	SOIC8EV	8	DIP, MSOP, SOIC and TSSOP
14-pin SOIC/TSSOP/DIP Evaluation Board	SOIC14EV	14	DIP, SOIC and TSSOP
20-pin TSSOP/SSOP Evaluation Board	TSSOP20EV	20	TSSOP and SSOP

MCP401X Evaluation Board (MCP401XEV)



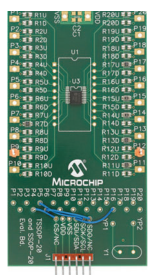
The MCP401XEV Evaluation Board allows you to quickly evaluate the operation of Microchip's MCP40D18 digital potentiometer device. The board uses the SC70EV Generic PCB and has been populated for the MCP40D18. The 6-pin header (PICkit™ Serial) has been jumpered to the appropriate pins on the MCP40D18 device, allowing the PICkit Serial to communicate with the device. The User's Guide includes demonstrations of the PICkit Serial controlling the MCP40D18 device.

MCP402X Non-Volatile Digital Potentiometer Evaluation Board (MCP402XEV)



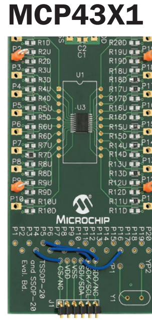
This low-cost board enables you to exercise all of the features of the MCP401X and MCP402X devices. The kit includes one populated and one unpopulated PCB. The populated board has an MCP4021-103E/SN digital potentiometer configured as a "windowed" potentiometer using a 2.5 kΩ pull-up and a 2.5 kΩ pull-down resistor. The PCB supports the 8-pin SOIC, SOT-23-6 and SOT-23-5 package variations. The unpopulated PCB allows you to build the exact combination of components your application requires.

MCP42X1 Evaluation Board (MCP42X1EV)



The MCP42XXEV Evaluation Board allows you to quickly evaluate the operation of Microchip's MCP4261 digital potentiometer device. The board uses the TSSOP20EV generic PCB and has been populated for the MCP4261. The 6-pin header (PICkit Serial) has been jumpered to the appropriate pins on the MCP4261 device, allowing the PICkit Serial to communicate with the device.

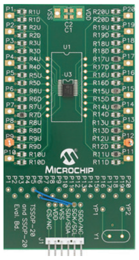
MCP43X1 Evaluation Board (MCP43X1EV)



The MCP43XXEV Evaluation Board allows you to quickly evaluate the operation of Microchip's MCP4361 digital potentiometer device. The board uses the TSSOP20EV generic PCB and has been populated for the MCP4361. The 6-pin header (PICkit Serial) has been jumpered to the appropriate pins on the MCP4361 device, allowing the PICkit Serial to communicate with the device.

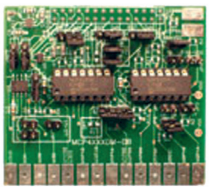
Development Tools and Resources

MCP46X1 Evaluation Board (MCP46X1EV)



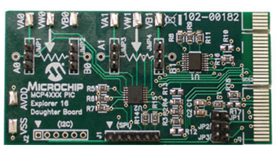
The MCP46XXEV Evaluation Board allows you to quickly evaluate Microchip's MCP4661 digital potentiometer device. The board uses the TSSOP20EV generic PCB and has been populated for the MCP4661. The 6-pin header (PICkit Serial) has been jumpered to the appropriate pins on the MCP4661 device, allowing the PICkit Serial to communicate with the device.

MCP4XXX Digital Potentiometer Daughter Board (MCP4XXXDM-DB)



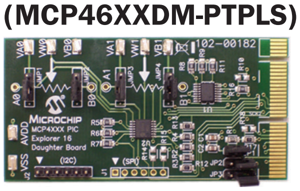
This board allows evaluation of the MCP42XXX and MCP402X digital potentiometers. The MCP42XXX are dual digital potentiometer devices that have the same characteristics as the single digital potentiometer devices (MCP41XXX). The MCP402X devices are non-volatile and have similar characteristics to their volatile memory versions (MCP401X). The board supports two MCP42XXX devices to allow the resistor networks to be "stacked" and form a programmable windowed digital potentiometer. The board also has a voltage doubler device (TC1240A), which can be used to show the WiperLock technology feature of the MCP4021.

MCP42XX PICtail Plus Daughter Board (MCP42XXDM-PTPLS)



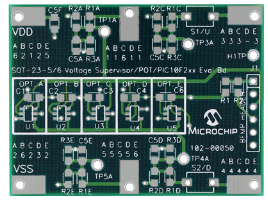
This daughter board is used to demonstrate the operation of Microchip's MCP42XX or MCP41XX digital potentiometers. This board is designed to be used in conjunction with either the PIC24 Explorer 16 Demonstration Board or the PICkit Serial Analyzer.

MCP46XX PICtail Plus Daughter Board (MCP46XXDM-PTPLS)



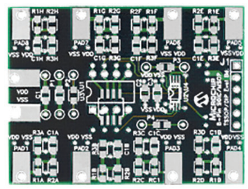
This daughter board demonstrates the features and abilities of Microchip's MCP45XX and MCP46XX digital potentiometers. This board is designed to exclusively use the MCP46X1 devices. The MCP4661 uses an I^{2}C interface and can be controlled via the PICkit Serial Analyzer interface or via the PICtail Plus interface.

5/6-pin SOT-23 Voltage Supervisor Evaluation Board (VSUPEV2)



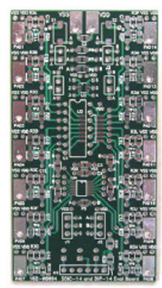
This blank PCB allows quick evaluation of voltage supervisors and voltage detectors in the 5-pin SOT-23-5 and SOT-23-6 packages. This PCB supports many Microchip devices, including the non-volatile Digital Potentiometer and PIC10F2XX devices.

8-lead SOIC Evaluation Board (SOIC8EV)



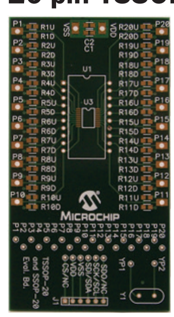
This board is a blank PCB to easily evaluate Microchip's 8-pin devices (in SOIC, DIP, MSOP and TSSOP packages). Each device pin is connected to a pull-up resistor, a pull-down resistor, an in-line resistor and a loading capacitor. The PCB pads allow through hole or surface-mount connectors to be installed to ease connection to the board. Additional passive component footprints are on the board to allow simple circuits to be implemented.

14-pin SOIC/TSSOP/DIP Evaluation Board (SOIC14EV)



This 14-lead SOIC/TSSOP/DIP evaluation board allows you to quickly evaluate the operation of Microchip devices in either SOIC, DIP or TSSOP packages.

20-pin TSSOP/SSOP Evaluation Board (TSSOP20EV)



This 20-pin TSSOP and SSOP evaluation board allows you to quickly evaluate the operation of Microchip devices in any of the following 20-pin packages: TSSOP-20/16/14/8 or SSOP-20. The board has a 6-pin header (PICkit Serial, ICSP™ programming capability, etc.) that can be easily jumpered to the device's desired pins to communicate with the device (using PICkit Serial) or in the case of PIC® microcontrollers or EEPROM, programmed (using ICSP programming capability).

Development Tools and Resources

Application Notes

The following literature is available on the Microchip web site: www.microchip.com/appnotes. There are additional application notes that may be useful.

AN219: Comparing Digital Potentiometers to Mechanical Potentiometers

This application note compares two types of potentiometers, the mechanical potentiometer (also called a trimmer potentiometer) and the digital potentiometer. Resistor potentiometers can be found in electronic circuits across a wide spectrum of applications. Most typically, they function in a voltage divider configuration in order to execute various types of tasks, such as offset or gain adjust.

AN691: Optimizing Digital Potentiometer Circuits to Reduce Absolute Temperature Variations

Circuit ideas are presented that use the necessary design techniques to mitigate errors, consequently optimizing the performance of the digital potentiometer.

AN692: Using Digital Potentiometers to Optimize a Precision Single-Supply Photo Detect Circuit

This application note shows how the adjustability of the digital potentiometer can be used to an advantage in photosensing circuits.

AN737: Using Digital Potentiometers to Design Low-Pass Adjustable Filters

A programmable, second-order, low-pass filter is presented in four different scenarios. The first three scenarios will illustrate how a dual digital potentiometer and a single amplifier can be configured for low-pass second-order Butterworth, Bessel and Chebyshev responses with a programmable corner frequency range of 1:100. An example of the digital potentiometer setting for these designs is summarized. The fourth scenario will show the same circuit design, where all three approximation methods (Butterworth, Bessel and Chebyshev) can coexist with a programmable corner frequency range of 1:10.

AN746: Interfacing Microchip's MCP41XXX/ MCP4XXX Digital Potentiometer to a PIC® Microcontroller Communications between the MCP41XXX and MCP42XXX

family of digital potentiometers and a PIC16F876 microcontroller is discussed. These devices communicate using a standard 3-wire SPI compatible interface. The code supplied with this application note will include both absolute and relocatable assembly code, written for both hardware SPI and firmware SPI implementations.

AN747: Communicating with Daisy Chained MCP42XXX Digital Potentiometers

The MCP41XXX and MCP42XXX family of digital potentiometers allow for daisy chaining of multiple devices on a single SPI bus. It is possible to communicate to multiple devices using one 3-wire data bus (CS, CLK and DATA), by connecting the SO pin on one device to the SI pin of the next device in the chain. This application note details one example of source code that is used to communicate with eight daisy chained devices.

AN757: Interfacing Microchip's MCP41XXX/ MCP4XXX Digital Potentiometer to the Motorola 68HC12 Microcontroller

Communication between the MCP41XXX and MCP42XXX family of digital potentiometers and the Motorola 68HC12 family of microcontrollers is discussed. These devices communicate using a standard 3-wire SPI compatible interface. Specifically, the MC68HC912B32 evaluation board was used.

AN1080: Understanding Digital Potentiometer Resistance Variations

This application note discusses how process, voltage and temperature effect the resistor network's characteristics, specifications and techniques to improve system performance.

AN1316: Using Digital Potentiometers for Programmable Amplifier Gain

This application note will discuss implementations of programmable gain circuits using an op amp and a digital potentiometer. This discussion will include implementation details for the digital potentiometer's resistor network. It is important to understand these details to understand the effects on the application.

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Microchip's Stand-Alone Analog and Interface Portfolio

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