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MCP433X/435X

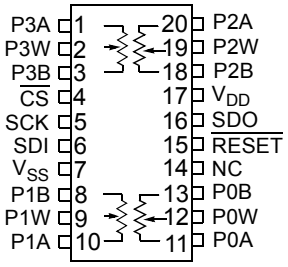
7/8-Bit Quad SPI Digital POT with Volatile Memory

Features

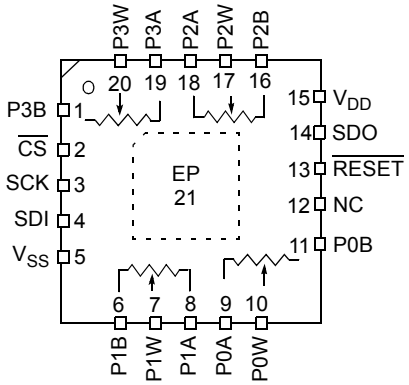
- Quad Resistor Network
- Potentiometer or Rheostat Configuration Options
- Resistor Network Resolution:
  - 7-bit: 128 Resistors (129 Taps)
  - 8-bit: 256 Resistors (257 Taps)
- R_{AB} Resistances Options of:
  - 5 kΩ
  - 10 kΩ
  - 50 kΩ
  - 100 kΩ
- Zero Scale to Full Scale Wiper Operation
- Low Wiper Resistance: 75 Ω (typical)
- Low Tempco:
  - Absolute (Rheostat): 50 ppm typical (0°C to 70°C)
  - Ratiometric (Potentiometer): 15 ppm typical
- SPI Serial Interface (10 MHz, Modes 0,0 and 1,1):
  - High-Speed Read/Writes to wiper registers
- Resistor Network Terminal Disconnect Feature via Terminal Control (TCON) Register
- Reset Input Pin
- Brown-out Reset Protection (1.5V typical)
- Serial Interface Inactive Current (2.5 µA typical)
- High-Voltage Tolerant Digital Inputs: Up to 12.5V
- Supports Split Rail Applications
- Internal Weak Pull-up on all Digital Inputs
- Wide Operating Voltage:
  - 2.7V to 5.5V – Device Characteristics Specified
  - 1.8V to 5.5V – Device Operation
- Wide Bandwidth (-3 dB) Operation:
  - 2 MHz (typical) for 5.0 kΩ device
- Extended Temperature Range (-40°C to +125°C)

Package Types (Top View)

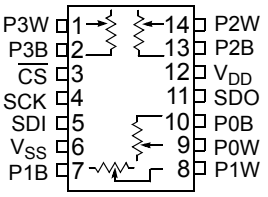
MCP43X1 Quad Potentiometers
TSSOP



MCP43X1 Quad Potentiometers
4x4 QFN*

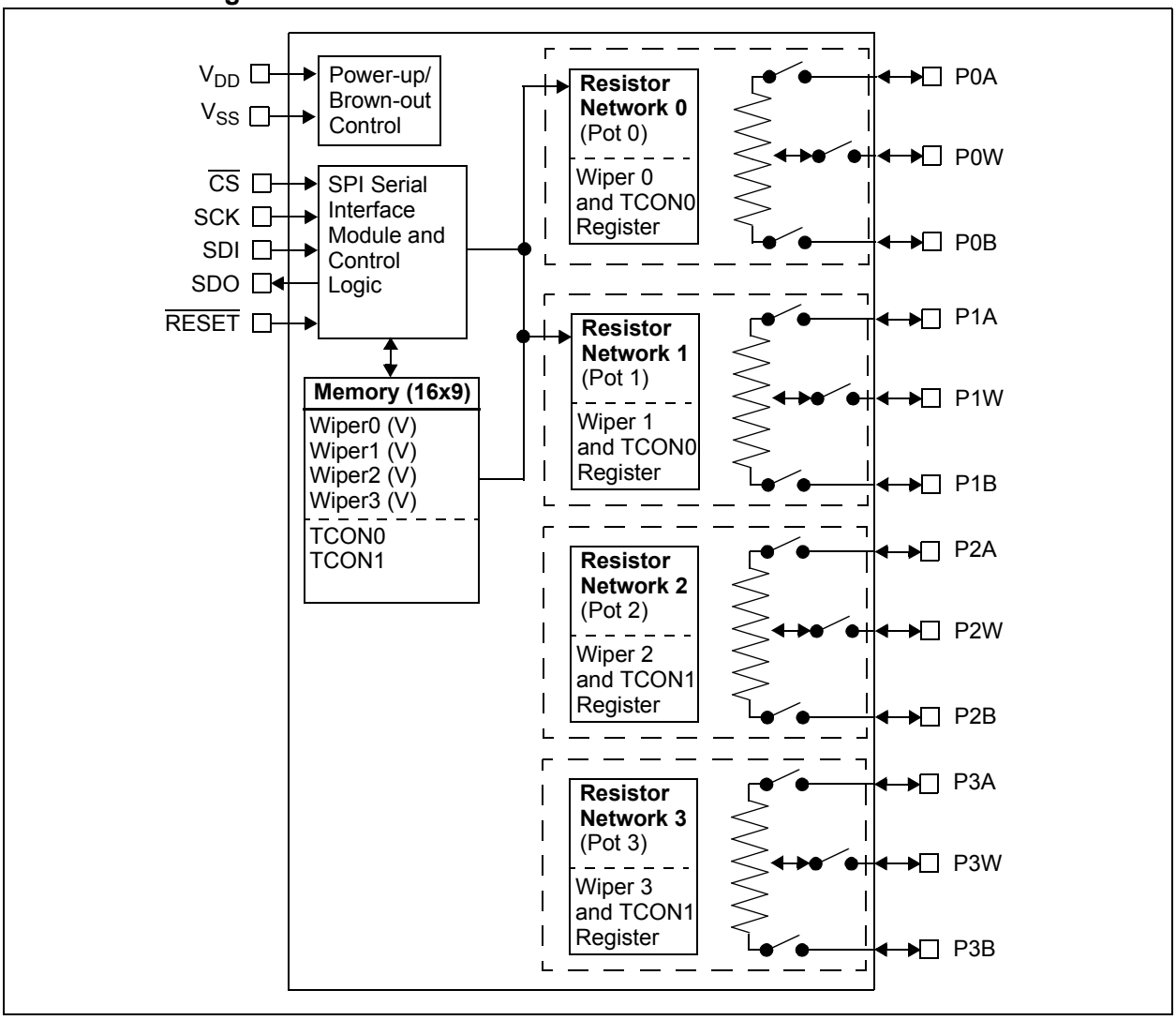


MCP43X2 Quad Rheostat
TSSOP



* Includes Exposed Thermal Pad (EP); see Table 3-1.

Device Block Diagram



Device Features

Device	# of POTs	Wiper Configuration	Control Interface	Memory Type	WiperLock Technology	POR Wiper Setting	Resistance (typical)		# of Taps	V_{DD} Operating Range (2)
							R_{AB} Options (kΩ)	Wiper - R_W (Ω)		
MCP4331	4	Potentiometer (1)	SPI	RAM	No	Mid-Scale	5.0, 10.0, 50.0, 100.0	75	129	1.8V to 5.5V
MCP4332	4	Rheostat	SPI	RAM	No	Mid-Scale	5.0, 10.0, 50.0, 100.0	75	129	1.8V to 5.5V
MCP4341	4	Potentiometer (1)	SPI	EE	Yes	NV Wiper	5.0, 10.0, 50.0, 100.0	75	129	2.7V to 5.5V
MCP4342	4	Rheostat	SPI	EE	Yes	NV Wiper	5.0, 10.0, 50.0, 100.0	75	129	2.7V to 5.5V
MCP4351	4	Potentiometer (1)	SPI	RAM	No	Mid-Scale	5.0, 10.0, 50.0, 100.0	75	257	1.8V to 5.5V
MCP4352	4	Rheostat	SPI	RAM	No	Mid-Scale	5.0, 10.0, 50.0, 100.0	75	257	1.8V to 5.5V
MCP4361	4	Potentiometer (1)	SPI	EE	Yes	NV Wiper	5.0, 10.0, 50.0, 100.0	75	257	2.7V to 5.5V
MCP4362	4	Rheostat	SPI	EE	Yes	NV Wiper	5.0, 10.0, 50.0, 100.0	75	257	2.7V to 5.5V

Note 1: Floating either terminal (A or B) allows the device to be used as a Rheostat (variable resistor).

2: Analog characteristics only tested from 2.7V to 5.5V unless otherwise noted.

1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings †

Voltage on V_{DD} with respect to V_{SS} ..... -0.6V to +7.0V
Voltage on $\overline{CS}$, SCK, SDI, SDI/SDO, and $\overline{RESET}$ with respect to V_{SS} ..... -0.6V to 12.5V
Voltage on all other pins (PxA, PxW, PxB and SDO) with respect to V_{SS} ..... -0.3V to V_{DD} + 0.3V
Input clamp current, I_{IK} (V_I < 0, V_I > V_{DD}, V_I > V_{PP} ON HV pins) ..... ±20 mA
Output clamp current, I_{OK} (V_O < 0 or V_O > V_{DD}) ..... ±20 mA
Maximum output current sunk by any Output pin ..... 25 mA
Maximum output current sourced by any Output pin ..... 25 mA
Maximum current out of V_{SS} pin ..... 100 mA
Maximum current into V_{DD} pin ..... 100 mA
Maximum current into PxA, PxW and PxB pins ±2.5 mA Storage temperature ..... -65°C to +150°C
Ambient temperature with power applied ..... -40°C to +125°C
Package power dissipation (T_A = +50°C, T_J = +150°C) TSSOP-14 ..... 1000 mW
TSSOP-20 ..... 1110 mW
QFN-20 (4x4) ..... 2320 mW
Soldering temperature of leads (10 seconds) ..... +300°C
ESD protection on all pins ..... ≥ 4 kV (HBM), ... ≥ 300V (MM)
Maximum Junction Temperature (T_J) ..... +150°C

† Notice: Stresses above those listed under "Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at those or any other conditions above those indicated in the operational listings of this specification is not implied. Exposure to maximum rating conditions for extended periods may affect device reliability.

AC/DC CHARACTERISTICS

DC Characteristics		**Standard Operating Conditions (unless otherwise specified)** Operating Temperature –40°C ≤ T_A ≤ +125°C (extended) All parameters apply across the specified operating ranges unless noted. V_{DD} = +2.7V to 5.5V, 5 kΩ, 10 kΩ, 50 kΩ, 100 kΩ devices. Typical specifications represent values for V_{DD} = 5.5V, T_A = +25°C.					
Parameters	**Sym**	**Min**	**Typ**	**Max**	**Units**	**Conditions**	
Supply Voltage	V_{DD}	2.7	—	5.5	V		
		1.8	—	2.7	V	Serial Interface only.	
$\overline{CS}$, SDI, SDO, SCK, $\overline{RESET}$ pin Voltage Range	V_{HV}	V_{SS}	—	12.5V	V	$V_{DD} \geq$ 4.5V	The $\overline{CS}$ pin will be at one of three input levels (V_{IL}, V_{IH} or V_{IHH}). (**Note 6**)
		V_{SS}	—	V_{DD} + 8.0V	V	V_{DD} < 4.5V	
V_{DD} Start Voltage to ensure Wiper Reset	V_{BOR}	—	—	1.65	V	RAM retention voltage (V_{RAM}) < V_{BOR}	
V_{DD} Rise Rate to ensure Power-on Reset	V_{DDRR}	(**Note 9**)			V/ms		
Delay after device exits the Reset state (V_{DD} > V_{BOR})	T_{BORD}	—	10	20	µs		
Supply Current **(Note 10)**	I_{DD}	—	—	450	µA	Serial Interface Active, V_{DD} = 5.5V, $\overline{CS}$ = V_{IL}, SCK @ 5 MHz, write all 0's to volatile Wiper 0 (address 0h)	
		—	2.5	5	µA	Serial Interface Inactive, $\overline{CS}$ = V_{IH}, V_{DD} = 5.5V	
		—	0.55	1	mA	Serial Interface Active, V_{DD} = 5.5V, $\overline{CS}$ = V_{IHH}, SCK @ 5 MHz, decrement volatile Wiper 0 (address 0h)	

Note 1: Resistance is defined as the resistance between terminal A to terminal B.

2: INL and DNL are measured at V_W with V_A = V_{DD} and V_B = V_{SS}.

3: **MCP43X1** only.

4: **MCP43X2** only, includes V_{WZSE} and V_{WFSE}.

5: Resistor terminals A, W and B's polarity with respect to each other is not restricted.

6: This specification by design.

7: Non-linearity is affected by wiper resistance (R_W), which changes significantly over voltage and temperature.

8: The **MCP43X1** is externally connected to match the configurations of the **MCP43X2**, and then tested.

9: POR/BOR is not rate dependent.

10: Supply current is independent of current through the resistor network.

AC/DC CHARACTERISTICS (CONTINUED)

DC Characteristics		**Standard Operating Conditions (unless otherwise specified)** Operating Temperature –40°C ≤ T_A ≤ +125°C (extended) All parameters apply across the specified operating ranges unless noted. V_{DD} = +2.7V to 5.5V, 5 kΩ, 10 kΩ, 50 kΩ, 100 kΩ devices. Typical specifications represent values for V_{DD} = 5.5V, T_A = +25°C.					
Parameters	**Sym**	**Min**	**Typ**	**Max**	**Units**	**Conditions**	
Resistance (± 20%)	R_{AB}	4.0	5	6.0	kΩ	-502 devices **(Note 1)**	
		8.0	10	12.0	kΩ	-103 devices **(Note 1)**	
		40.0	50	60.0	kΩ	-503 devices **(Note 1)**	
		80.0	100	120.0	kΩ	-104 devices **(Note 1)**	
Resolution	N	257			Taps	8-bit	No Missing Codes
		129			Taps	7-bit	No Missing Codes
Step Resistance	R_S	—	R_{AB}/(256)	—	Ω	8-bit	**Note 6**
		—	R_{AB}/(128)	—	Ω	7-bit	**Note 6**
Nominal Resistance Match	(| R_{ABWC} - R_{ABMEAN} |)/ R_{ABMEAN}	—	0.2	1.50	%	5 kΩ	**MCP43X1** devices only
		—	0.2	1.25	%	10 kΩ	
		—	0.2	1.0	%	50 kΩ	
		—	0.2	1.0	%	100 kΩ	
	(| R_{BWWC} - R_{BWMEAN} |)/ R_{BWMEAN}	—	0.25	1.75	%	5 kΩ	Code = Full Scale
		—	0.25	1.50	%	10 kΩ	
		—	0.25	1.25	%	50 kΩ	
		—	0.25	1.25	%	100 kΩ	
Wiper Resistance (**Note 3, Note 4**)	R_W	—	75	160	Ω	V_{DD} = 5.5 V, I_W = 2.0 mA, code = 00h	
		—	75	300	Ω	V_{DD} = 2.7 V, I_W = 2.0 mA, code = 00h	
Nominal Resistance Tempco	$\Delta R_{AB}/\Delta T$	—	50	—	ppm/°C	T_A = -20°C to +70°C	
		—	100	—	ppm/°C	T_A = -40°C to +85°C	
		—	150	—	ppm/°C	T_A = -40°C to +125°C	
Ratiometeric Tempco	$\Delta V_{WB}/\Delta T$	—	15	—	ppm/°C	Code = Mid-scale (80h or 40h)	
Resistance Tracking	ΔR_{TRACK}	**Section 2.0**			ppm/°C	See **Section 2.0 "Typical Performance Curves"**	

Note 1: Resistance is defined as the resistance between terminal A to terminal B.

2: INL and DNL are measured at V_W with V_A = V_{DD} and V_B = V_{SS}.

3: **MCP43X1** only.

4: **MCP43X2** only, includes V_{WZSE} and V_{WFSE}.

5: Resistor terminals A, W and B's polarity with respect to each other is not restricted.

6: This specification by design.

7: Non-linearity is affected by wiper resistance (R_W), which changes significantly over voltage and temperature.

8: The **MCP43X1** is externally connected to match the configurations of the **MCP43X2**, and then tested.

9: POR/BOR is not rate dependent.

10: Supply current is independent of current through the resistor network.

AC/DC CHARACTERISTICS (CONTINUED)

DC Characteristics		Standard Operating Conditions (unless otherwise specified) Operating Temperature –40°C ≤ T_A ≤ +125°C (extended) All parameters apply across the specified operating ranges unless noted. V_{DD} = +2.7V to 5.5V, 5 kΩ, 10 kΩ, 50 kΩ, 100 kΩ devices. Typical specifications represent values for V_{DD} = 5.5V, T_A = +25°C.				
Parameters	**Sym**	**Min**	**Typ**	**Max**	**Units**	**Conditions**
Resistor Terminal Input Voltage Range (Terminals A, B and W)	V_A, V_W, V_B	Vss	—	V_{DD}	V	**Note 5, Note 6**
Maximum current through A, W or B	I_W	—	—	2.5	mA	Worst case current through wiper when wiper is either Full Scale or Zero Scale. **(Note 6)**
Leakage current into A, W or B	I_{WL}	—	100	—	nA	**MCP43X1** PxA = PxW = PxB = V_{SS}
		—	100	—	nA	**MCP43X2** PxB = PxW = V_{SS}

Note 1: Resistance is defined as the resistance between terminal A to terminal B.

2: INL and DNL are measured at V_W with V_A = V_{DD} and V_B = V_{SS}.

3: **MCP43X1** only.

4: **MCP43X2** only, includes V_{WZSE} and V_{WFSE}.

5: Resistor terminals A, W and B's polarity with respect to each other is not restricted.

6: This specification by design.

7: Non-linearity is affected by wiper resistance (R_W), which changes significantly over voltage and temperature.

8: The **MCP43X1** is externally connected to match the configurations of the **MCP43X2**, and then tested.

9: POR/BOR is not rate dependent.

10: Supply current is independent of current through the resistor network.

AC/DC CHARACTERISTICS (CONTINUED)

DC Characteristics		Standard Operating Conditions (unless otherwise specified) Operating Temperature –40°C ≤ T_A ≤ +125°C (extended) All parameters apply across the specified operating ranges unless noted. V_{DD} = +2.7V to 5.5V, 5 kΩ, 10 kΩ, 50 kΩ, 100 kΩ devices. Typical specifications represent values for V_{DD} = 5.5V, T_A = +25°C.						
Parameters	**Sym**	**Min**	**Typ**	**Max**	**Units**	**Conditions**		
Full Scale Error (**MCP43X1** only) (8-bit code = 100h, 7-bit code = 80h)	V_{WFSE}	-6.0	-0.1	—	LSb	5 kΩ	8-bit	3.0V ≤ V_{DD} ≤ 5.5V
		-4.0	-0.1	—	LSb		7-bit	3.0V ≤ V_{DD} ≤ 5.5V
		-3.5	-0.1	—	LSb	10 kΩ	8-bit	3.0V ≤ V_{DD} ≤ 5.5V
		-2.0	-0.1	—	LSb		7-bit	3.0V ≤ V_{DD} ≤ 5.5V
		-0.8	-0.1	—	LSb	50 kΩ	8-bit	3.0V ≤ V_{DD} ≤ 5.5V
		-0.5	-0.1	—	LSb		7-bit	3.0V ≤ V_{DD} ≤ 5.5V
		-0.5	-0.1	—	LSb	100 kΩ	8-bit	3.0V ≤ V_{DD} ≤ 5.5V
		-0.5	-0.1	—	LSb		7-bit	3.0V ≤ V_{DD} ≤ 5.5V
Zero Scale Error (**MCP43X1** only) (8-bit code = 00h, 7-bit code = 00h)	V_{WZSE}	—	+0.1	+6.0	LSb	5 kΩ	8-bit	3.0V ≤ V_{DD} ≤ 5.5V
		—	+0.1	+3.0	LSb		7-bit	3.0V ≤ V_{DD} ≤ 5.5V
		—	+0.1	+3.5	LSb	10 kΩ	8-bit	3.0V ≤ V_{DD} ≤ 5.5V
		—	+0.1	+2.0	LSb		7-bit	3.0V ≤ V_{DD} ≤ 5.5V
		—	+0.1	+0.8	LSb	50 kΩ	8-bit	3.0V ≤ V_{DD} ≤ 5.5V
		—	+0.1	+0.5	LSb		7-bit	3.0V ≤ V_{DD} ≤ 5.5V
		—	+0.1	+0.5	LSb	100 kΩ	8-bit	3.0V ≤ V_{DD} ≤ 5.5V
		—	+0.1	+0.5	LSb		7-bit	3.0V ≤ V_{DD} ≤ 5.5V
Potentiometer Integral Non-linearity	INL	-1	±0.5	+1	LSb	8-bit	3.0V ≤ V_{DD} ≤ 5.5V **MCP43X1** devices only **(Note 2)**	
		-0.5	±0.25	+0.5	LSb	7-bit		
Potentiometer Differential Non-linearity	DNL	-0.5	±0.25	+0.5	LSb	8-bit	3.0V ≤ V_{DD} ≤ 5.5V **MCP43X1** devices only **(Note 2)**	
		-0.25	±0.125	+0.25	LSb	7-bit		
Bandwidth -3 dB (See Figure 2-92, load = 30 pF)	BW	—	2	—	MHz	5 kΩ	8-bit	Code = 80h
		—	2	—	MHz		7-bit	Code = 40h
		—	1	—	MHz	10 kΩ	8-bit	Code = 80h
		—	1	—	MHz		7-bit	Code = 40h
		—	200	—	kHz	50 kΩ	8-bit	Code = 80h
		—	200	—	kHz		7-bit	Code = 40h
		—	100	—	kHz	100 kΩ	8-bit	Code = 80h
		—	100	—	kHz		7-bit	Code = 40h

Note 1: Resistance is defined as the resistance between terminal A to terminal B.

2: INL and DNL are measured at V_W with V_A = V_{DD} and V_B = V_{SS}.

3: **MCP43X1** only.

4: **MCP43X2** only, includes V_{WZSE} and V_{WFSE}.

5: Resistor terminals A, W and B's polarity with respect to each other is not restricted.

6: This specification by design.

7: Non-linearity is affected by wiper resistance (R_W), which changes significantly over voltage and temperature.

8: The **MCP43X1** is externally connected to match the configurations of the **MCP43X2**, and then tested.

9: POR/BOR is not rate dependent.

10: Supply current is independent of current through the resistor network.

AC/DC CHARACTERISTICS (CONTINUED)

DC Characteristics		**Standard Operating Conditions (unless otherwise specified)** Operating Temperature –40°C ≤ T_A ≤ +125°C (extended) All parameters apply across the specified operating ranges unless noted. V_{DD} = +2.7V to 5.5V, 5 kΩ, 10 kΩ, 50 kΩ, 100 kΩ devices. Typical specifications represent values for V_{DD} = 5.5V, T_A = +25°C.						
Parameters	**Sym**	**Min**	**Typ**	**Max**	**Units**	**Conditions**		
Rheostat Integral Non-linearity **MCP43X1** (**Note 4, Note 8**) **MCP43X2** devices only **(Note 4)**	R-INL	-1.5	±0.5	+1.5	LSb	5 kΩ	8-bit	5.5V, I_W = 900 µA
		-8.25	+4.5	+8.25	LSb			3.0V, I_W = 480 µA (**Note 7**)
		Section 2.0						1.8V, I_W = 190 µA
		-1.125	±0.5	+1.125	LSb		7-bit	5.5V, I_W = 900 µA
		-6.0	+4.5	+6.0	LSb			3.0V, I_W = 480 µA (**Note 7**)
		Section 2.0						1.8V, I_W = 190 µA
		-1.5	±0.5	+1.5	LSb	10 kΩ	8-bit	5.5V, I_W = 450 µA
		-5.5	+2.5	+5.5	LSb			3.0V, I_W = 240 µA (**Note 7**)
		Section 2.0						1.8V, I_W = 150 µA
		-1.125	±0.5	+1.125	LSb		7-bit	5.5V, I_W = 450 µA
		-4.0	+2.5	+4.0	LSb			3.0V, I_W = 240 µA (**Note 7**)
		Section 2.0						1.8V, I_W = 150 µA
		-1.5	±0.5	+1.5	LSb	50 kΩ	8-bit	5.5V, I_W = 90 µA
		-2.0	+1	+2.0	LSb			3.0V, I_W = 48 µA (**Note 7**)
		Section 2.0						1.8V, I_W = 30 µA
		-1.125	±0.5	+1.125	LSb		7-bit	5.5V, I_W = 90 µA
		-1.5	+1	+1.5	LSb			3.0V, I_W = 48 µA (**Note 7**)
		Section 2.0						1.8V, I_W = 30 µA
		-1.0	±0.5	+1.0	LSb	100 kΩ	8-bit	5.5V, I_W = 45 µA
		-1.5	+0.25	+1.5	LSb			3.0V, I_W = 24 µA (**Note 7**)
		Section 2.0						1.8V, I_W = 15 µA
		-0.8	±0.5	+0.8	LSb		7-bit	5.5V, I_W = 45 µA
		-1.125	+0.25	+1.125	LSb			3.0V, I_W = 24 µA (**Note 7**)
		Section 2.0						1.8V, I_W = 15 µA

Note 1: Resistance is defined as the resistance between terminal A to terminal B.

2: INL and DNL are measured at V_W with V_A = V_{DD} and V_B = V_{SS}.

3: **MCP43X1** only.

4: **MCP43X2** only, includes V_{WZSE} and V_{WFSE}.

5: Resistor terminals A, W and B's polarity with respect to each other is not restricted.

6: This specification by design.

7: Non-linearity is affected by wiper resistance (R_W), which changes significantly over voltage and temperature.

8: The **MCP43X1** is externally connected to match the configurations of the **MCP43X2**, and then tested.

9: POR/BOR is not rate dependent.

10: Supply current is independent of current through the resistor network.

AC/DC CHARACTERISTICS (CONTINUED)

DC Characteristics		**Standard Operating Conditions (unless otherwise specified)** Operating Temperature –40°C ≤ T_A ≤ +125°C (extended) All parameters apply across the specified operating ranges unless noted. V_{DD} = +2.7V to 5.5V, 5 kΩ, 10 kΩ, 50 kΩ, 100 kΩ devices. Typical specifications represent values for V_{DD} = 5.5V, T_A = +25°C.						
Parameters	**Sym**	**Min**	**Typ**	**Max**	**Units**	**Conditions**		
Rheostat Differential Non-linearity **MCP43X1** (**Note 4, Note 8**) **MCP43X2** devices only **(Note 4)**	R-DNL	-0.5	±0.25	+0.5	LSb	5 kΩ	8-bit	5.5V, I_W = 900 µA
		-1.0	+0.5	+1.0	LSb			3.0V, I_W = 480 µA (**Note 7**)
		Section 2.0						1.8V, I_W = 190 µA
		-0.375	±0.25	+0.375	LSb		7-bit	5.5V, I_W = 900 µA
		-0.75	+0.5	+0.75	LSb			3.0V, I_W = 480 µA (**Note 7**)
		Section 2.0						1.8V, I_W = 190 µA
		-0.5	±0.25	+0.5	LSb	10 kΩ	8-bit	5.5V, I_W = 450 µA
		-1.0	+0.25	+1.0	LSb			3.0V, I_W = 240 µA (**Note 7**)
		Section 2.0						1.8V, I_W = 150 µA
		-0.375	±0.25	+0.375	LSb		7-bit	5.5V, I_W = 450 µA
		-0.75	+0.5	+0.75	LSb			3.0V, I_W = 240 µA (**Note 7**)
		Section 2.0						1.8V, I_W = 150 µA
		-0.5	±0.25	+0.5	LSb	50 kΩ	8-bit	5.5V, I_W = 90 µA
		-0.5	±0.25	+0.5	LSb			3.0V, I_W = 48 µA (**Note 7**)
		Section 2.0						1.8V, I_W = 30 µA
		-0.375	±0.25	+0.375	LSb		7-bit	5.5V, I_W = 90 µA
		-0.375	±0.25	+0.375	LSb			3.0V, I_W = 48 µA (**Note 7**)
		Section 2.0						1.8V, I_W = 30 µA
		-0.5	±0.25	+0.5	LSb	100 kΩ	8-bit	5.5V, I_W = 45 µA
		-0.5	±0.25	+0.5	LSb			3.0V, I_W = 24 µA (**Note 7**)
		Section 2.0						1.8V, I_W = 15 µA
		-0.375	±0.25	+0.375	LSb		7-bit	5.5V, I_W = 45 µA
		-0.375	±0.25	+0.375	LSb			3.0V, I_W = 24 µA (**Note 7**)
		Section 2.0						1.8V, I_W = 30 µA

Note 1: Resistance is defined as the resistance between terminal A to terminal B.

2: INL and DNL are measured at V_W with $V_A = V_{DD}$ and $V_B = V_{SS}$.

3: **MCP43X1** only.

4: **MCP43X2** only, includes V_{WZSE} and V_{WFSE}.

5: Resistor terminals A, W and B's polarity with respect to each other is not restricted.

6: This specification by design.

7: Non-linearity is affected by wiper resistance (R_W), which changes significantly over voltage and temperature.

8: The **MCP43X1** is externally connected to match the configurations of the **MCP43X2**, and then tested.

9: POR/BOR is not rate dependent.

10: Supply current is independent of current through the resistor network.

AC/DC CHARACTERISTICS (CONTINUED)

DC Characteristics		**Standard Operating Conditions (unless otherwise specified)** Operating Temperature –40°C ≤ T_A ≤ +125°C (extended) All parameters apply across the specified operating ranges unless noted. V_{DD} = +2.7V to 5.5V, 5 kΩ, 10 kΩ, 50 kΩ, 100 kΩ devices. Typical specifications represent values for V_{DD} = 5.5V, T_A = +25°C.				
Parameters	**Sym**	**Min**	**Typ**	**Max**	**Units**	**Conditions**
Capacitance (P_A)	C_{AW}	—	75	—	pF	f =1 MHz, Code = Full Scale
Capacitance (P_w)	C_W	—	120	—	pF	f =1 MHz, Code = Full Scale
Capacitance (P_B)	C_{BW}	—	75	—	pF	f =1 MHz, Code = Full Scale
Digital Inputs/Outputs ($\overline{CS}$, SDI, SDO, SCK, $\overline{WP}$, $\overline{RESET}$)						
Schmitt Trigger High Input Threshold	V_{IH}	0.45 V_{DD}	—	—	V	2.7V ≤ V_{DD} ≤ 5.5V (Allows 2.7V Digital V_{DD} with 5V Analog V_{DD})
		0.5 V_{DD}	—	—	V	1.8V ≤ V_{DD} ≤ 2.7V
Schmitt Trigger Low Input Threshold	V_{IL}	—	—	0.2V_{DD}	V	
Hysteresis of Schmitt Trigger Inputs	V_{HYS}	—	0.1V_{DD}	—	V	
High Voltage Input Entry Voltage	V_{IHH}	8.5	—	12.5 **(6)**	V	
High Voltage Input Exit Voltage	V_{IHH}	—	—	V_{DD} + 0.8V	V	
High Voltage Limit	V_{MAX}	—	—	12.5 **(6)**	V	Pin can tolerate V_{MAX} or less.
Output Low Voltage (SDO)	V_{OL}	V_{SS}	—	0.3V_{DD}	V	I_{OL} = 5 mA, V_{DD} = 5.5V
		V_{SS}	—	0.3V_{DD}	V	I_{OL} = 1 mA, V_{DD} = 1.8V
Output High Voltage (SDO)	V_{OH}	0.7V_{DD}	—	V_{DD}	V	I_{OH} = -2.5 mA, V_{DD} = 5.5V
		0.7V_{DD}	—	V_{DD}	V	I_{OL} = -1 mA, V_{DD} = 1.8V

Note 1: Resistance is defined as the resistance between terminal A to terminal B.

2: INL and DNL are measured at V_W with V_A = V_{DD} and V_B = V_{SS}.

3: **MCP43X1** only.

4: **MCP43X2** only, includes V_{WZSE} and V_{WFSE}.

5: Resistor terminals A, W and B's polarity with respect to each other is not restricted.

6: This specification by design.

7: Non-linearity is affected by wiper resistance (R_W), which changes significantly over voltage and temperature.

8: The **MCP43X1** is externally connected to match the configurations of the **MCP43X2**, and then tested.

9: POR/BOR is not rate dependent.

10: Supply current is independent of current through the resistor network.

AC/DC CHARACTERISTICS (CONTINUED)

DC Characteristics		Standard Operating Conditions (unless otherwise specified) Operating Temperature –40°C ≤ T_A ≤ +125°C (extended) All parameters apply across the specified operating ranges unless noted. V_{DD} = +2.7V to 5.5V, 5 kΩ, 10 kΩ, 50 kΩ, 100 kΩ devices. Typical specifications represent values for V_{DD} = 5.5V, T_A = +25°C.					
Parameters	**Sym**	**Min**	**Typ**	**Max**	**Units**	**Conditions**	
Weak Pull-up Current	I_{PU}	—	—	1.75	mA	Internal V_{DD} pull-up, V_{IHH} pull-down, V_{DD} = 5.5V, $V_{\overline{CS}}$ = 12.5V	
		—	170	—	µA	$\overline{CS}$ pin, V_{DD} = 5.5V, $V_{\overline{CS}}$ = 3V	
$\overline{CS}$ Pull-up/ Pull-down Resistance	R_{CS}	—	16	—	kΩ	V_{DD} = 5.5V, $V_{\overline{CS}}$ = 3V	
$\overline{RESET}$ Pull-up Resistance	R_{RESET}	—	16	—	kΩ	V_{DD} = 5.5V, $V_{\overline{RESET}}$ = 0V	
Input Leakage Current	I_{IL}	-1	—	1	µA	V_{IN} = V_{DD} (all pins) and V_{IN} = V_{SS} (all pins except $\overline{RESET}$)	
Pin Capacitance	C_{IN}, C_{OUT}	—	10	—	pF	f_C = 20 MHz	
RAM (Wiper, TCON) Value							
Value Range	N	0h	—	1FFh	hex	8-bit device	
		0h	—	1FFh	hex	7-bit device	
TCON POR/BOR Setting		1FF			hex	All terminals connected	
Wiper POR/BOR Setting	N	080h			hex	8-bit	
		040h			hex	7-bit	
Power Requirements							
Power Supply Sensitivity (**MCP43X1**)	PSS	—	0.0015	0.0035	%/%	8-bit	V_{DD} = 2.7V to 5.5V, V_A = 2.7V, Code = 80h
		—	0.0015	0.0035	%/%	7-bit	V_{DD} = 2.7V to 5.5V, V_A = 2.7V, Code = 40h

Note 1: Resistance is defined as the resistance between terminal A to terminal B.

2: INL and DNL are measured at V_W with V_A = V_{DD} and V_B = V_{SS}.

3: **MCP43X1** only.

4: **MCP43X2** only, includes V_{WZSE} and V_{WFSE}.

5: Resistor terminals A, W and B's polarity with respect to each other is not restricted.

6: This specification by design.

7: Non-linearity is affected by wiper resistance (R_W), which changes significantly over voltage and temperature.

8: The **MCP43X1** is externally connected to match the configurations of the **MCP43X2**, and then tested.

9: POR/BOR is not rate dependent.

10: Supply current is independent of current through the resistor network.

1.1 SPI Mode Timing Waveforms and Requirements

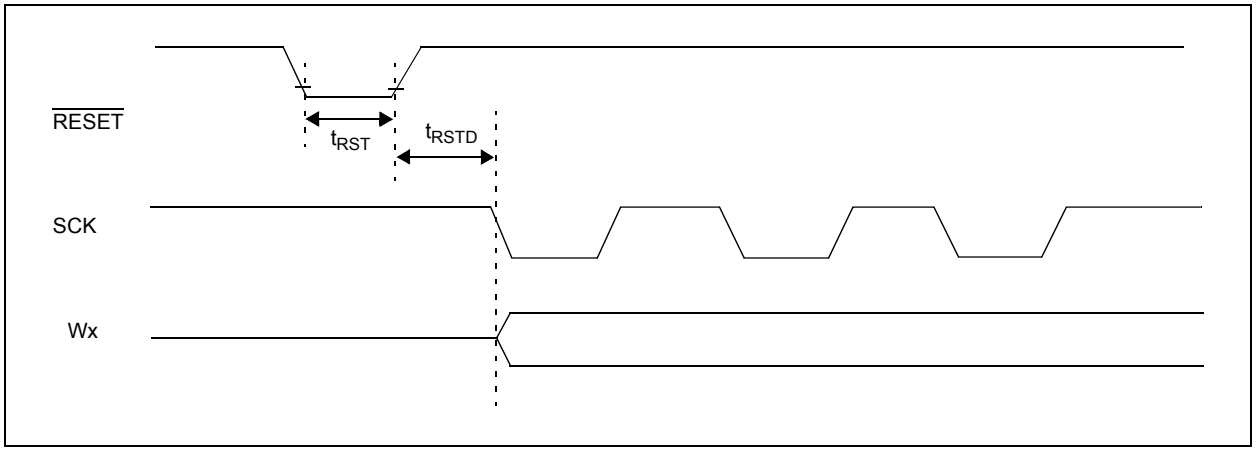


FIGURE 1-1: *Reset Waveforms.*

TABLE 1-1: RESET TIMING

Timing Characteristics		**Standard Operating Conditions (unless otherwise specified)** Operating Temperature –40°C ≤ T_A ≤ +125°C (extended) All parameters apply across the specified operating ranges unless noted. V_{DD} = +2.7V to 5.5V, 5 kΩ, 10 kΩ, 50 kΩ, 100 kΩ devices. Typical specifications represent values for V_{DD} = 5.5V, T_A = +25°C.				
Parameters	**Sym**	**Min**	**Typ**	**Max**	**Units**	**Conditions**
$\overline{\text{RESET}}$ pulse width	t_{RST}	50	—	—	ns	
$\overline{\text{RESET}}$ rising edge normal mode (Wiper driving and SPI interface operational)	t_{RSTD}	—	—	20	ns	

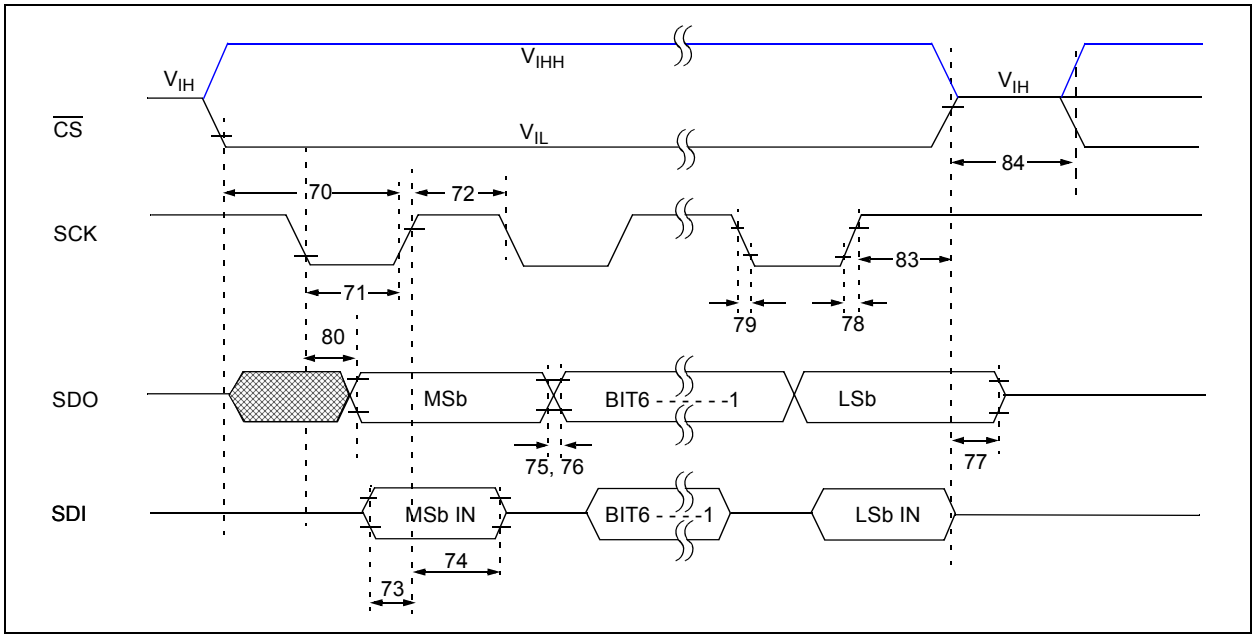


FIGURE 1-2: *SPI Timing Waveform (Mode = 11).*

TABLE 1-2: SPI REQUIREMENTS (MODE = 11)

#	Characteristic	Symbol	Min	Max	Units	Conditions
	SCK Input Frequency	F_{SCK}	—	10	MHz	V_{DD} = 2.7V to 5.5V
			—	1	MHz	V_{DD} = 1.8V to 2.7V
70	$\overline{CS}$ Active (V_{IL} or V_{IHH}) to SCK↑ input	TcsA2scH	60	—	ns	
71	SCK input high time	TscH	45	—	ns	V_{DD} = 2.7V to 5.5V
			500	—	ns	V_{DD} = 1.8V to 2.7V
72	SCK input low time	TscL	45	—	ns	V_{DD} = 2.7V to 5.5V
			500	—	ns	V_{DD} = 1.8V to 2.7V
73	Setup time of SDI input to SCK↑ edge	TDIV2scH	10	—	ns	V_{DD} = 2.7V to 5.5V
			20	—	ns	V_{DD} = 1.8V to 2.7V
74	Hold time of SDI input from SCK↑ edge	TscH2DIL	20	—	ns	
77	$\overline{CS}$ Inactive (V_{IH}) to SDO output high-impedance	TcsH2DOZ	—	50	ns	**Note 1**
80	SDO data output valid after SCK↓ edge	TscL2DOV	—	70	ns	V_{DD} = 2.7V to 5.5V
				170	ns	V_{DD} = 1.8V to 2.7V
83	$\overline{CS}$ Inactive (V_{IH}) after SCK↑ edge	TscH2csI	100	—	ns	V_{DD} = 2.7V to 5.5V
			1		ms	V_{DD} = 1.8V to 2.7V
84	Hold time of $\overline{CS}$ Inactive (V_{IH}) to $\overline{CS}$ Active (V_{IL} or V_{IHH})	TcsA2csI	50	—	ns	

Note 1: This specification by design.

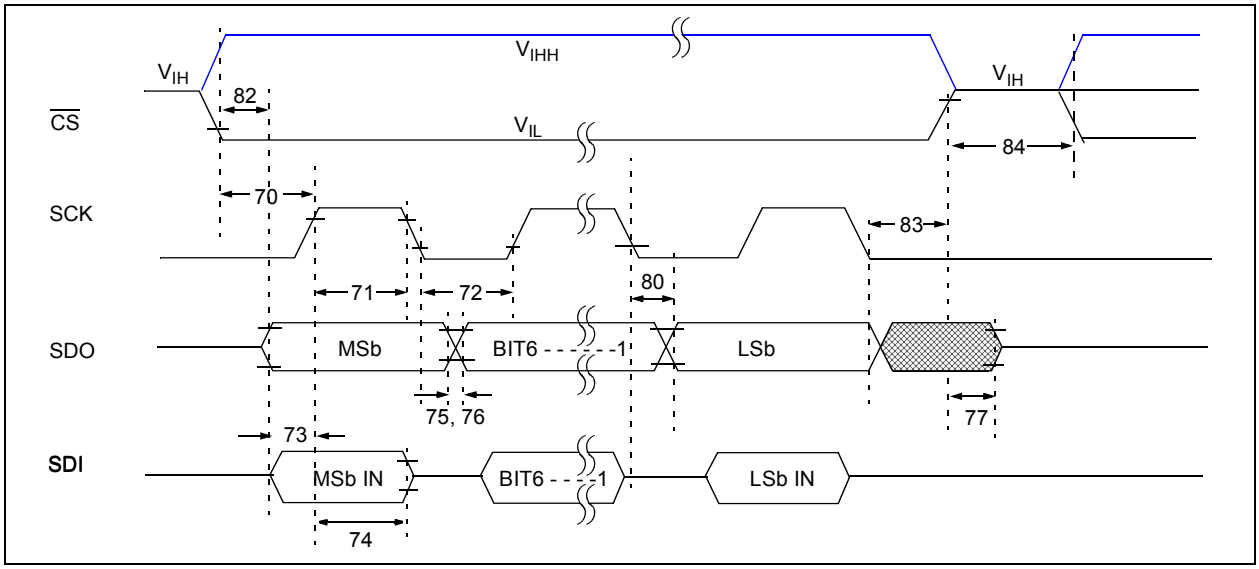


FIGURE 1-3: *SPI Timing Waveform (Mode =* 00*).*

TABLE 1-3: SPI REQUIREMENTS (MODE = 00**)**

#	Characteristic	Symbol	Min	Max	Units	Conditions
	SCK Input Frequency	F_{SCK}	—	10	MHz	V_{DD} = 2.7V to 5.5V
			—	1	MHz	V_{DD} = 1.8V to 2.7V
70	$\overline{CS}$ Active (V_{IL} or V_{IHH}) to SCK↑ input	TcsA2scH	60	—	ns	
71	SCK input high time	TscH	45	—	ns	V_{DD} = 2.7V to 5.5V
			500	—	ns	V_{DD} = 1.8V to 2.7V
72	SCK input low time	TscL	45	—	ns	V_{DD} = 2.7V to 5.5V
			500	—	ns	V_{DD} = 1.8V to 2.7V
73	Setup time of SDI input to SCK↑ edge	TDIV2scH	10	—	ns	V_{DD} = 2.7V to 5.5V
			20	—	ns	V_{DD} = 1.8V to 2.7V
74	Hold time of SDI input from SCK↑ edge	TscH2DIL	20	—	ns	
77	$\overline{CS}$ Inactive (V_{IH}) to SDO output high-impedance	TcsH2DOZ	—	50	ns	**Note 1**
80	SDO data output valid after SCK↓ edge	TscL2DOV	—	70	ns	V_{DD} = 2.7V to 5.5V
				170	ns	V_{DD} = 1.8V to 2.7V
82	SDO data output valid after $\overline{CS}$ Active (V_{IL} or V_{IHH})	TssL2doV	—	85	ns	
83	$\overline{CS}$ Inactive (V_{IH}) after SCK↓ edge	TscH2csI	100	—	ns	V_{DD} = 2.7V to 5.5V
			1		ms	V_{DD} = 1.8V to 2.7V
84	Hold time of $\overline{CS}$ Inactive (V_{IH}) to $\overline{CS}$ Active (V_{IL} or V_{IHH})	TcsA2csI	50	—	ns	

Note 1: This specification by design.

TEMPERATURE CHARACTERISTICS

Electrical Specifications: Unless otherwise indicated, V_{DD} = +2.7V to +5.5V, V_{SS} = GND.						
Parameters	**Sym**	**Min**	**Typ**	**Max**	**Units**	**Conditions**
Temperature Ranges						
Specified Temperature Range	T_A	-40	—	+125	°C	
Operating Temperature Range	T_A	-40	—	+125	°C	
Storage Temperature Range	T_A	-65	—	+150	°C	
Thermal Package Resistances						
Thermal Resistance, 14L-TSSOP	θ_{JA}	—	100	—	°C/W	
Thermal Resistance, 20L-QFN	θ_{JA}	—	43	—	°C/W	
Thermal Resistance, 20L-TSSOP	θ_{JA}	—	90	—	°C/W	

NOTES:

2.0 TYPICAL PERFORMANCE CURVES

Note: The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only. The performance characteristics listed herein are not tested or guaranteed. In some graphs or tables, the data presented may be outside the specified operating range (e.g., outside specified power supply range) and therefore outside the warranted range.

Note: Unless otherwise indicated, T_A = +25°C, V_{DD} = 5V, V_{SS} = 0V.

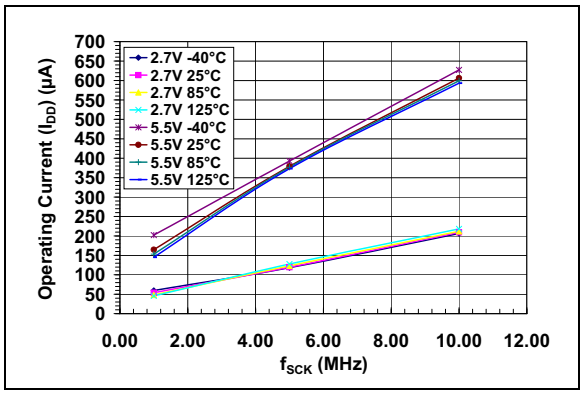


FIGURE 2-1: *Device Current (I_{DD}) vs. SPI Frequency (f_{SCK}) and Ambient Temperature (V_{DD} = 2.7V and 5.5V).*

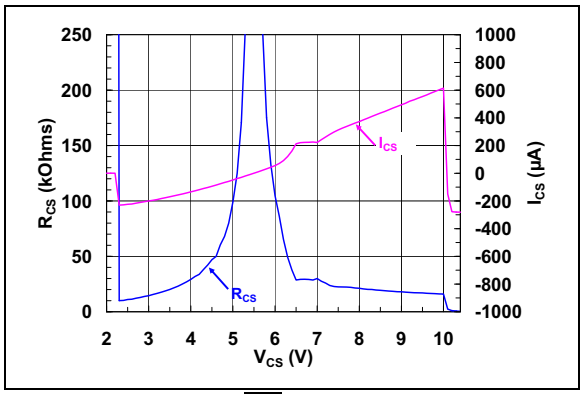


FIGURE 2-3: *$\overline{CS}$ Pull-up/Pull-down Resistance ($R_{\overline{CS}}$) and Current ($I_{\overline{CS}}$) vs. $\overline{CS}$ Input Voltage ($V_{\overline{CS}}$) (V_{DD} = 5.5V).*

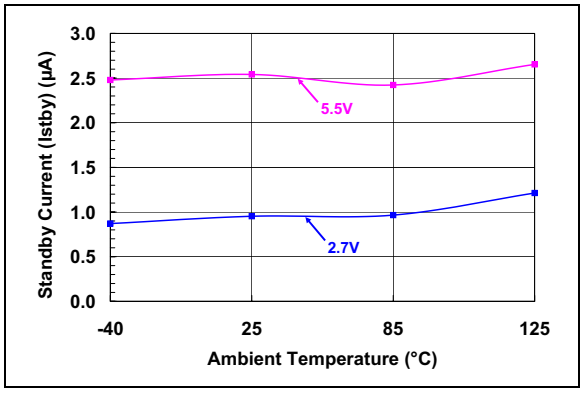


FIGURE 2-2: *Device Current (I_{SHDN}) and V_{DD}. ($\overline{CS}$ = V_{DD}) vs. Ambient Temperature.*

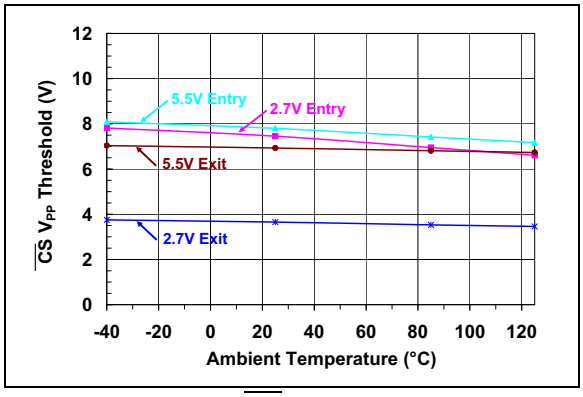


FIGURE 2-4: *$\overline{CS}$ High Input Entry/Exit Threshold vs. Ambient Temperature and V_{DD}.*

Note: Unless otherwise indicated, T_A = +25°C, V_{DD} = 5V, V_{SS} = 0V.

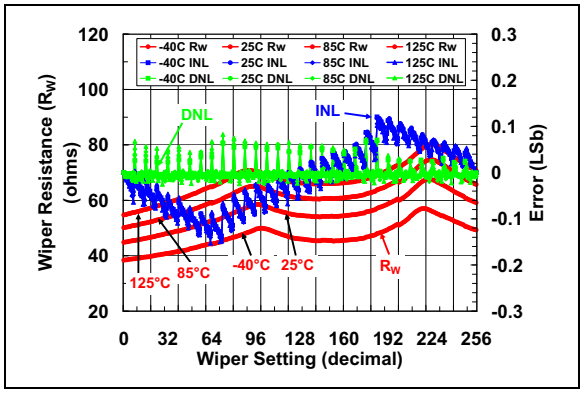


FIGURE 2-5: *5 kΩ Pot Mode – R_W (Ω), INL (LSb), DNL (LSb) vs. Wiper Setting and Ambient Temperature (V_{DD} = 5.5V).*

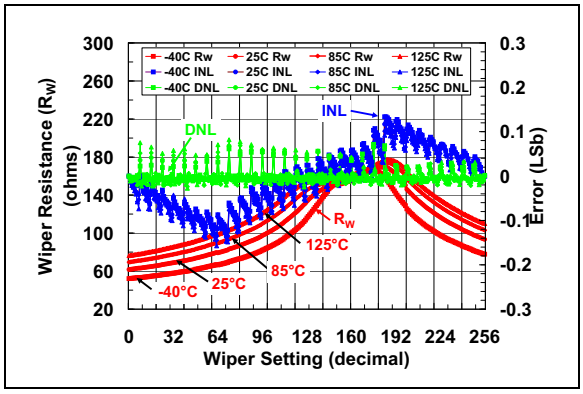
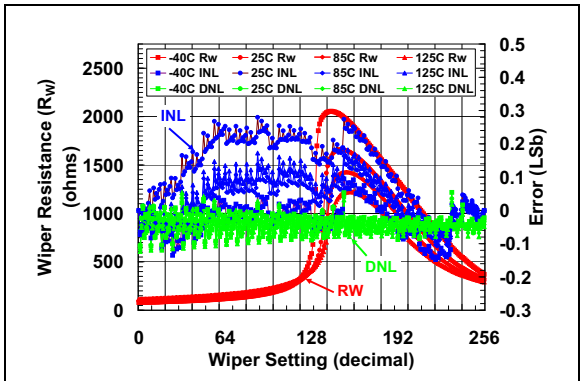


FIGURE 2-6: *5 kΩ Pot Mode – R_W (Ω), INL (LSb), DNL (LSb) vs. Wiper Setting and Ambient Temperature (V_{DD} = 3.0V).*



Note: See **Appendix B:** for additional information of R_W resistance variation characteristics for V_{DD} > 2.7V.

FIGURE 2-7: *5 kΩ Pot Mode – R_W (Ω), INL (LSb), DNL (LSb) vs. Wiper Setting and Ambient Temperature (V_{DD} = 1.8V).*

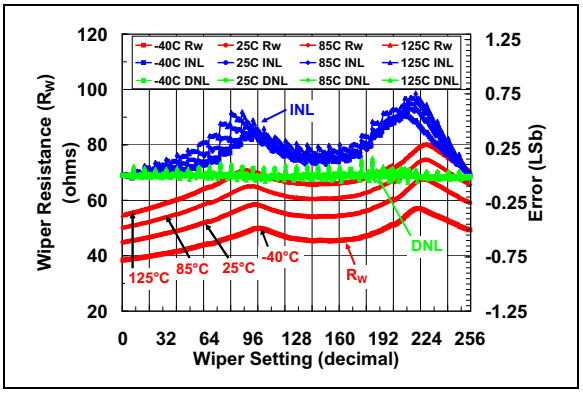


FIGURE 2-8: *5 kΩ Rheo Mode – R_W (Ω), INL (LSb), DNL (LSb) vs. Wiper Setting and Ambient Temperature (V_{DD} = 5.5V, I_W = 900 µA).*

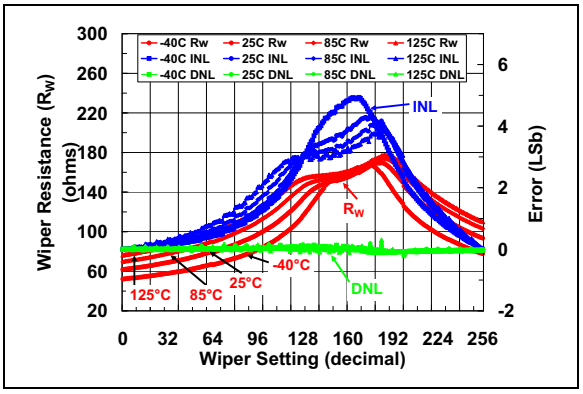
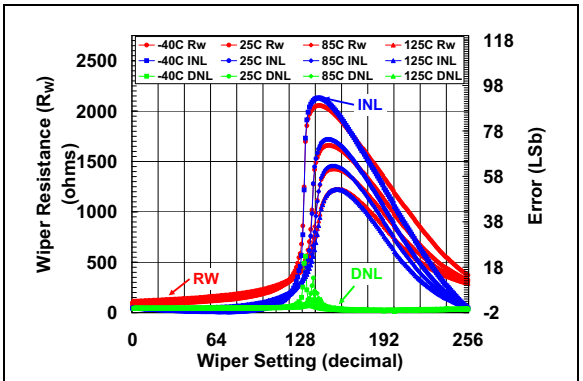


FIGURE 2-9: *5 kΩ Rheo Mode – R_W (Ω), INL (LSb), DNL (LSb) vs. Wiper Setting and Ambient Temperature (V_{DD} = 3.0V, I_W = 480 µA).*



Note: See **Appendix B:** for additional information of R_W resistance variation characteristics for V_{DD} > 2.7V.

FIGURE 2-10: *5 kΩ Rheo Mode – R_W (Ω), INL (LSb), DNL (LSb) vs. Wiper Setting and Ambient Temperature (V_{DD} = 1.8V, I_W = 260 µA).*

Note: Unless otherwise indicated, T_A = +25°C, V_{DD} = 5V, V_{SS} = 0V.

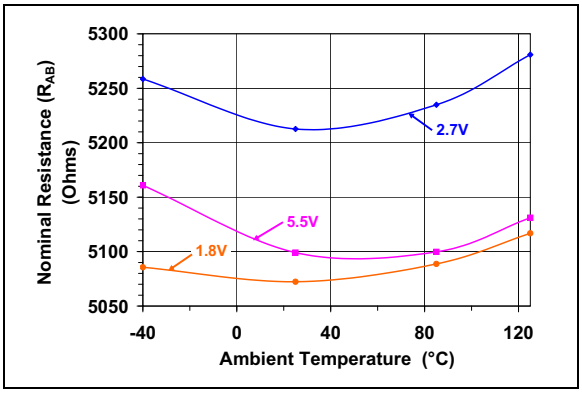


FIGURE 2-11: *5 kΩ – Nominal Resistance (R_{AB}) (Ω) vs. Ambient Temperature and V_{DD}.*

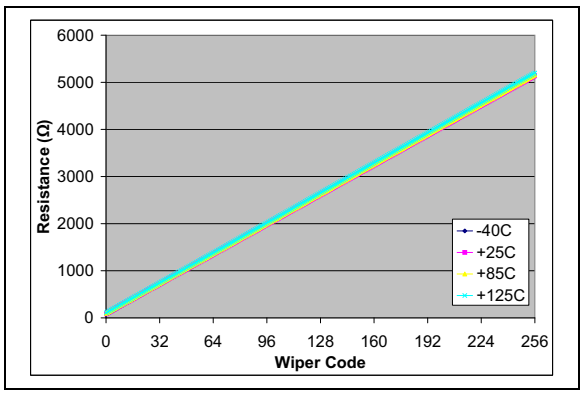


FIGURE 2-12: *5 kΩ – R_{WB} (Ω) vs. Wiper Setting and Ambient Temperature (V_{DD} = 5.5V, I_W = 190 µA).*

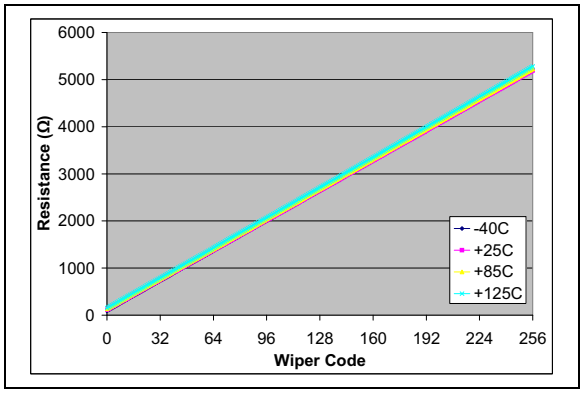
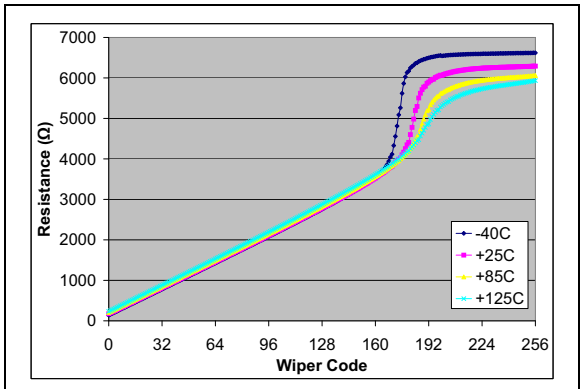


FIGURE 2-13: *5 kΩ – R_{WB} (Ω) vs. Wiper Setting and Ambient Temperature (V_{DD} = 3.0V, I_W = 190 µA).*



Note: See **Appendix B:** for additional information of R_W resistance variation characteristics for V_{DD} > 2.7V.

FIGURE 2-14: *5 kΩ – R_{WB} (Ω) vs. Wiper Setting and Ambient Temperature (V_{DD} = 1.8V, I_W = 190 µA).*

Note: Unless otherwise indicated, T_A = +25°C, V_{DD} = 5V, V_{SS} = 0V.

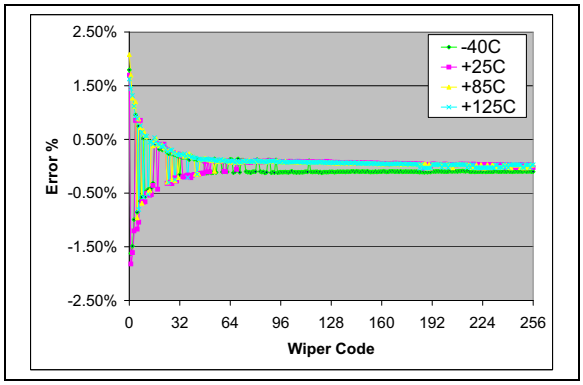


FIGURE 2-15: *5 kΩ – Worst Case R_{BW} from Average R_{BW} (R_{BW0}-R_{BW3}) Error (%) vs. Wiper Setting and Temperature (V_{DD} = 5.5V, I_W = 190 µA).*

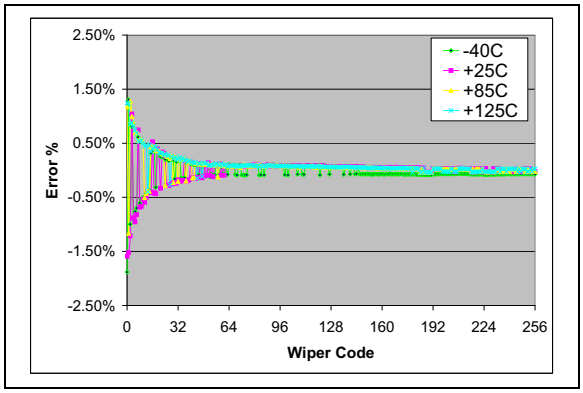
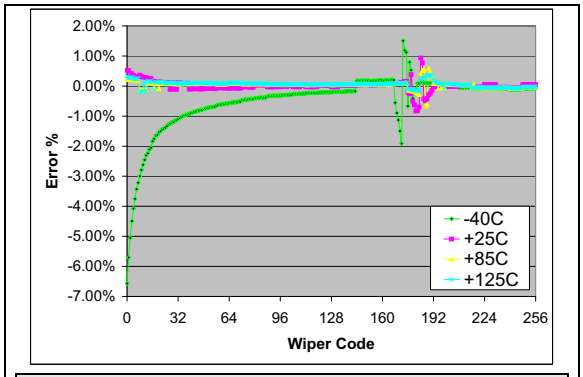


FIGURE 2-16: *5 kΩ – Worst Case R_{BW} from Average R_{BW} (R_{BW0}-R_{BW3}) Error (%) vs. Wiper Setting and Temperature (V_{DD} = 3.0V, I_W = 190 µA).*



Note: See **Appendix B:** for additional information of R_W resistance variation characteristics for V_{DD} > 2.7V.

FIGURE 2-17: *5 kΩ – Worst Case R_{BW} from Average R_{BW} (R_{BW0}-R_{BW3}) Error (%) vs. Wiper Setting and Temperature (V_{DD} = 1.8V, I_W = 190 µA).*

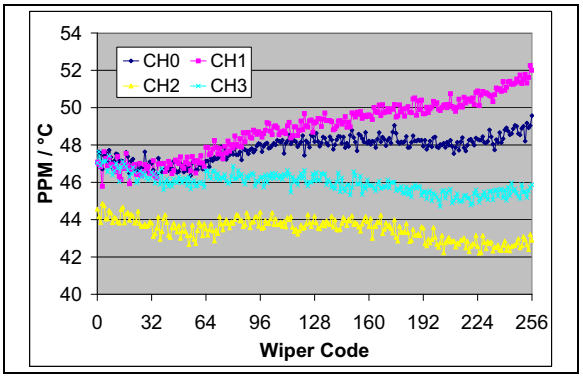


FIGURE 2-18: *5 kΩ – R_{WB} PPM/°C vs. Wiper Setting. ($R_{BW(code=n,\ 125°C)}$-$R_{BW(code=n,\ -40°C)}$)/$R_{BW(code\ =\ 256,\ 25°C)}$/165°C * 1,000,000) ($V_{DD}$ = 5.5V, I_W = 190 µA).*

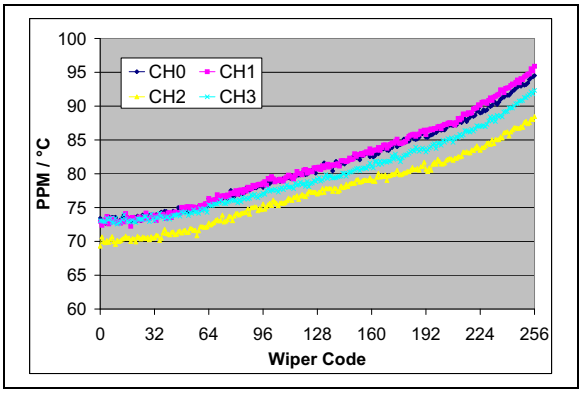
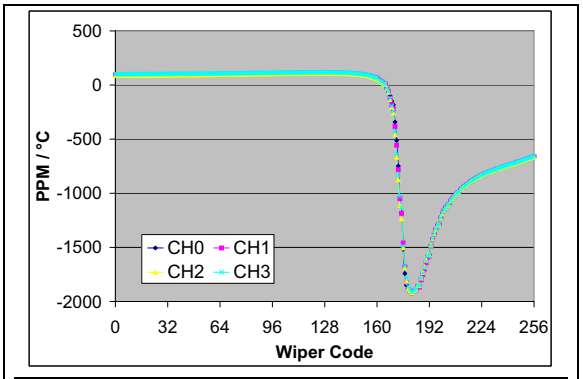


FIGURE 2-19: *5 kΩ – R_{WB} PPM/°C vs. Wiper Setting. ($R_{BW(code=n,\ 125°C)}$-$R_{BW(code=n,\ -40°C)}$)/$R_{BW(code\ =\ 256,\ 25°C)}$/165°C * 1,000,000) ($V_{DD}$ = 3.0V, I_W = 190 µA).*



Note: See **Appendix B:** for additional information of R_W resistance variation characteristics for V_{DD} > 2.7V.

FIGURE 2-20: *5 kΩ – R_{WB} PPM/°C vs. Wiper Setting. ($R_{BW(code=n,\ 125°C)}$-$R_{BW(code=n,\ -40°C)}$)/$R_{BW(code\ =\ 256,\ 25°C)}$/165°C * 1,000,000) ($V_{DD}$ = 1.8V, I_W = 190 µA).*

Note: Unless otherwise indicated, T_A = +25°C, V_{DD} = 5V, V_{SS} = 0V.

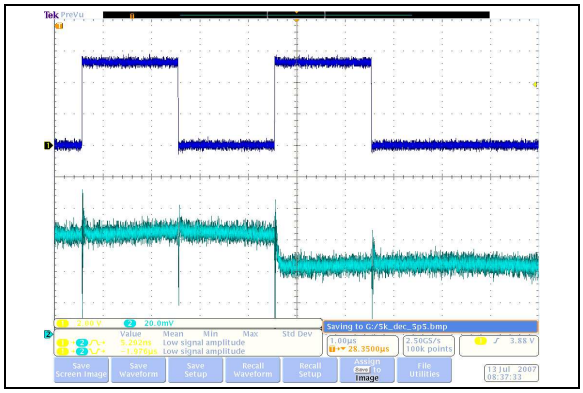


FIGURE 2-21: *5 kΩ – Low-Voltage Decrement Wiper Settling Time (V_{DD} = 5.5V) (1 µs/Div).*

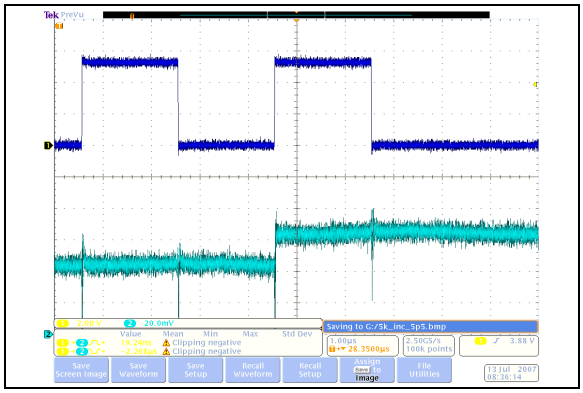


FIGURE 2-24: *5 kΩ – Low-Voltage Increment Wiper Settling Time (V_{DD} = 5.5V) (1 µs/Div).*

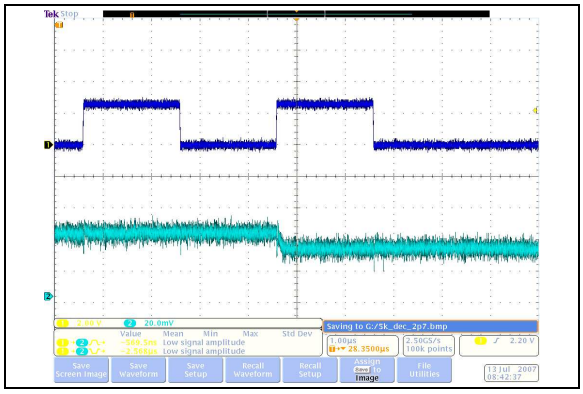


FIGURE 2-22: *5 kΩ – Low-Voltage Decrement Wiper Settling Time (V_{DD} = 2.7V) (1 µs/Div).*

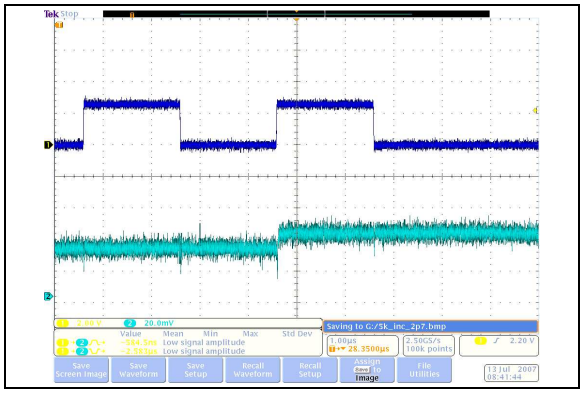


FIGURE 2-25: *5 kΩ – Low-Voltage Increment Wiper Settling Time (V_{DD} = 2.7V) (1 µs/Div).*

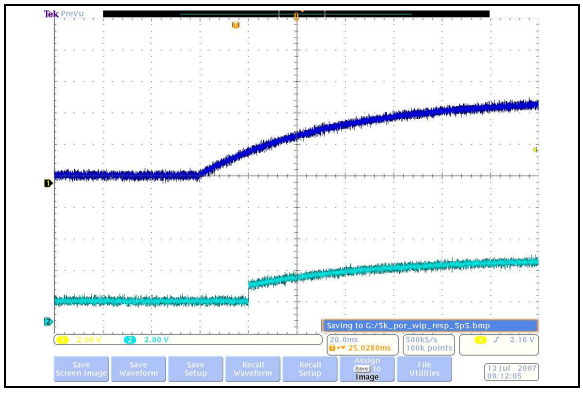


FIGURE 2-23: *5 kΩ – Power-Up Wiper Response Time (20 ms/Div).*

Note: Unless otherwise indicated, T_A = +25°C, V_{DD} = 5V, V_{SS} = 0V.

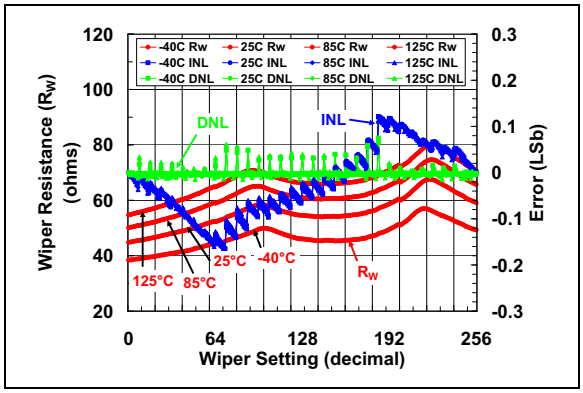


FIGURE 2-26: *10 kΩ Pot Mode – R_W (Ω), INL (LSb), DNL (LSb) vs. Wiper Setting and Ambient Temperature (V_{DD} = 5.5V).*

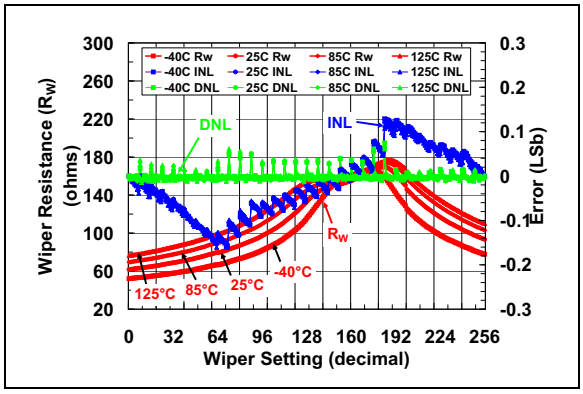
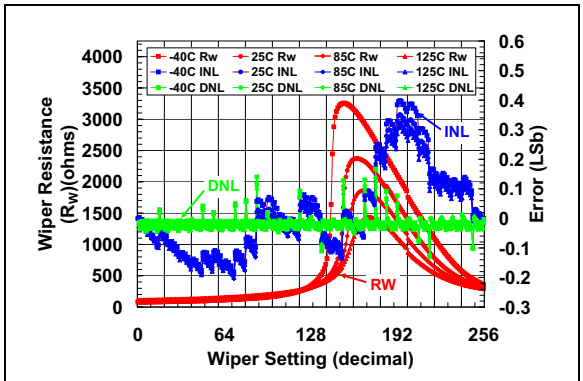


FIGURE 2-27: *10 kΩ Pot Mode – R_W (Ω), INL (LSb), DNL (LSb) vs. Wiper Setting and Ambient Temperature (V_{DD} = 3.0V).*



Note: See **Appendix B:** for additional information of R_W resistance variation characteristics for V_{DD} > 2.7V.

FIGURE 2-28: *10 kΩ Pot Mode – R_W (Ω), INL (LSb), DNL (LSb) vs. Wiper Setting and Ambient Temperature (V_{DD} = 1.8V).*

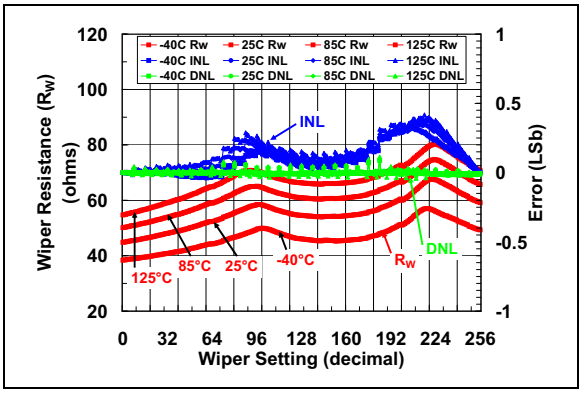


FIGURE 2-29: *10 kΩ Rheo Mode – R_W (Ω), INL (LSb), DNL (LSb) vs. Wiper Setting and Ambient Temperature (V_{DD} = 5.5V, I_W = 450 µA).*

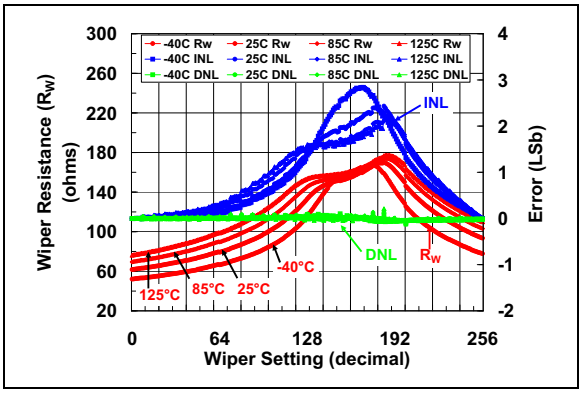
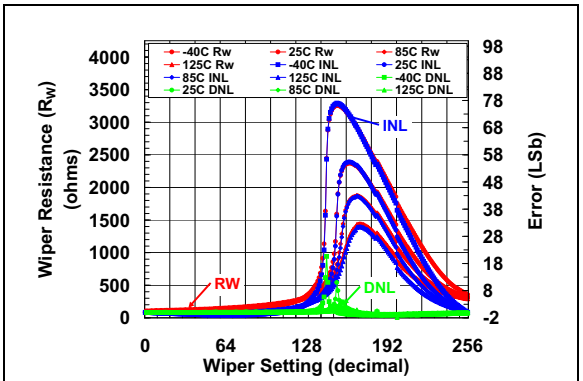


FIGURE 2-30: *10 kΩ Rheo Mode – R_W (Ω), INL (LSb), DNL (LSb) vs. Wiper Setting and Ambient Temperature (V_{DD} = 3.0V, I_W = 240 µA).*



Note: See **Appendix B:** for additional information of R_W resistance variation characteristics for V_{DD} > 2.7V.

FIGURE 2-31: *10 kΩ Rheo Mode – R_W (Ω), INL (LSb), DNL (LSb) vs. Wiper Setting and Ambient Temperature (V_{DD} = 1.8V, I_W = 125 µA).*

Note: Unless otherwise indicated, T_A = +25°C, V_{DD} = 5V, V_{SS} = 0V.

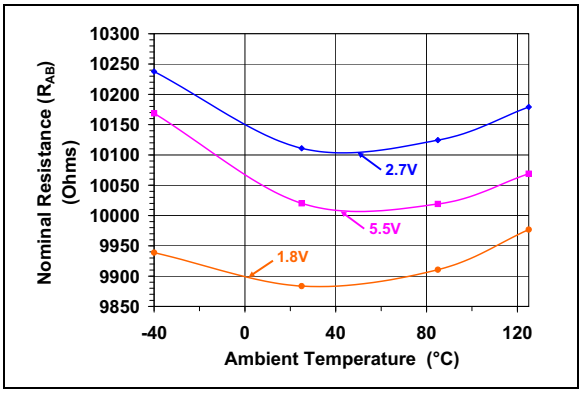


FIGURE 2-32: *10 kΩ – Nominal Resistance (R_{AB}) (Ω) vs. Ambient Temperature and V_{DD}.*

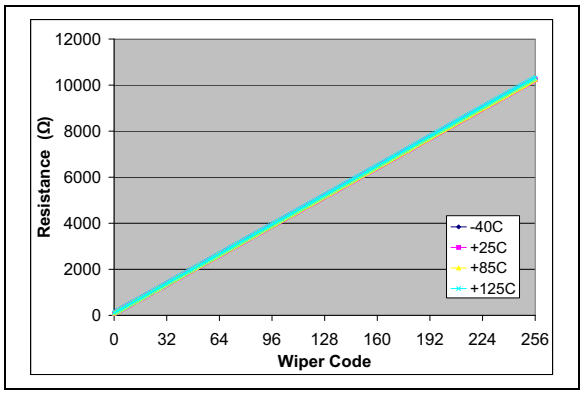


FIGURE 2-33: *10 kΩ – R_{WB} (Ω) vs. Wiper Setting and Ambient Temperature (V_{DD} = 5.5V, I_W = 150 µA).*

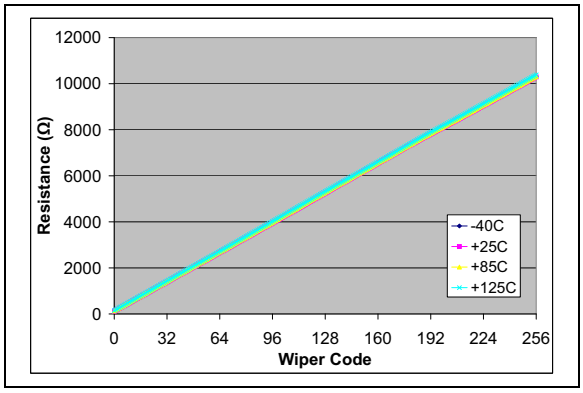
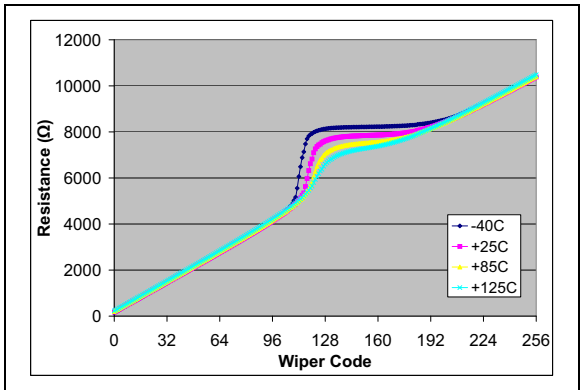


FIGURE 2-34: *10 kΩ – R_{WB} (Ω) vs. Wiper Setting and Ambient Temperature (V_{DD} = 3.0V, I_W = 150 µA).*



Note: See **Appendix B:** for additional information of R_W resistance variation characteristics for V_{DD} > 2.7V.

FIGURE 2-35: *10 kΩ – R_{WB} (Ω) vs. Wiper Setting and Ambient Temperature (V_{DD} = 1.8V, I_W = 150 µA).*

Note: Unless otherwise indicated, T_A = +25°C, V_{DD} = 5V, V_{SS} = 0V.

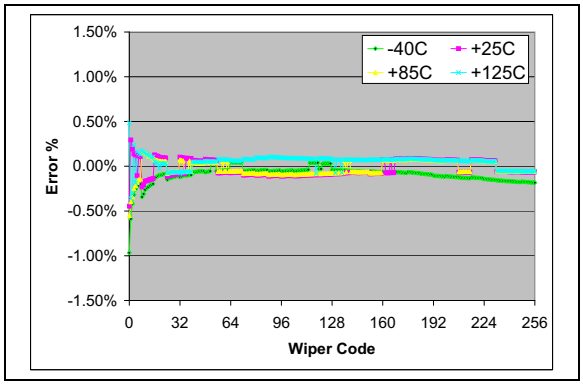


FIGURE 2-36: *10 kΩ – Worst Case R_{BW} from Average R_{BW} (R_{BW0}-R_{BW3}) Error (%) vs. Wiper Setting and Temperature (V_{DD} = 5.5V, I_W = 150 µA).*

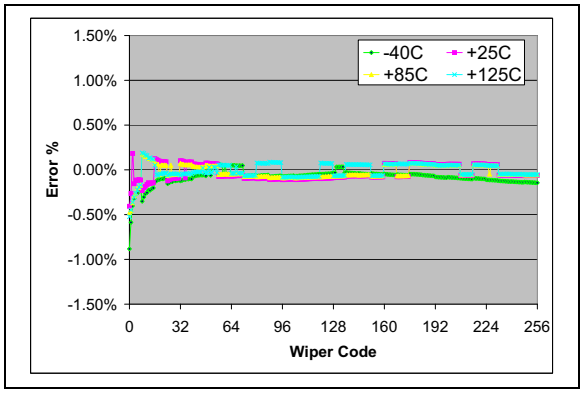
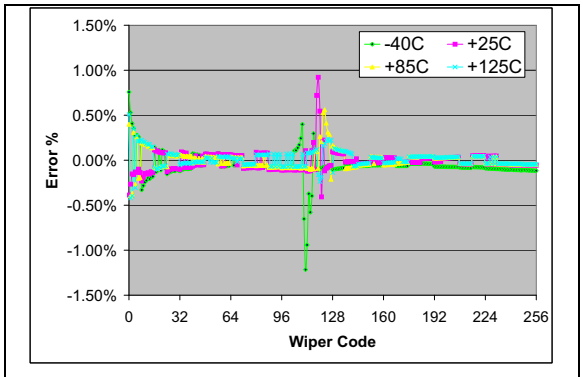


FIGURE 2-37: *10 kΩ – Worst Case R_{BW} from Average R_{BW} (R_{BW0}-R_{BW3}) Error (%) vs. Wiper Setting and Temperature (V_{DD} = 3.0V, I_W = 150 µA).*



Note:	See **Appendix B:** for additional information of R_W resistance variation characteristics for V_{DD} > 2.7V.

FIGURE 2-38: *10 kΩ – Worst Case R_{BW} from Average R_{BW} (R_{BW0}-R_{BW3}) Error (%) vs. Wiper Setting and Temperature (V_{DD} = 1.8V, I_W = 150 µA).*

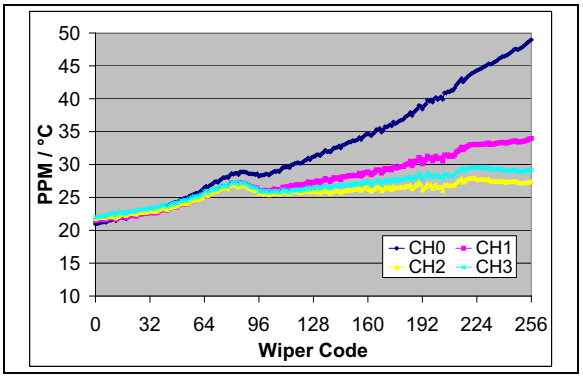


FIGURE 2-39: *10 kΩ – R_{WB} PPM/°C vs. Wiper Setting. ($R_{BW(code=n,\ 125°C)}$-$R_{BW(code=n,\ -40°C)}$)/$R_{BW(code\ =\ 256,\ 25°C)}$/165°C * 1,000,000) ($V_{DD}$ = 5.5V, I_W = 150 µA).*

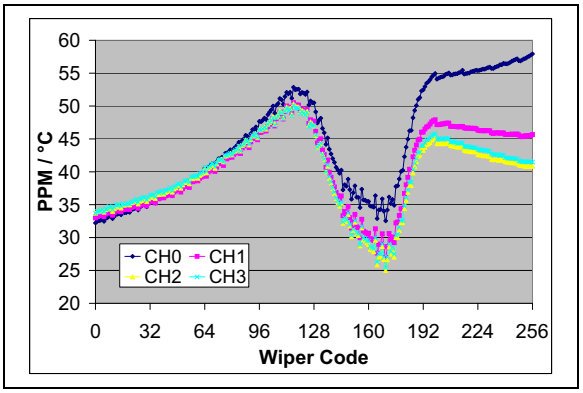
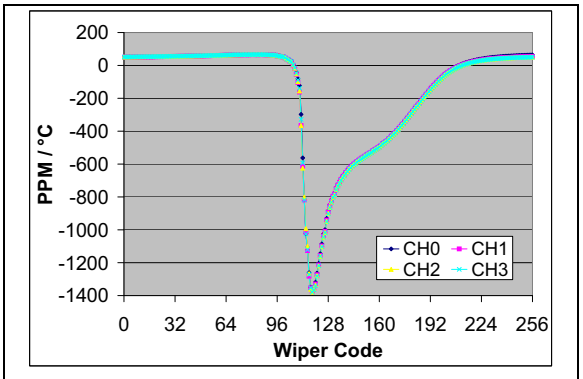


FIGURE 2-40: *10 kΩ – R_{WB} PPM/°C vs. Wiper Setting. ($R_{BW(code=n,\ 125°C)}$-$R_{BW(code=n,\ -40°C)}$)/$R_{BW(code\ =\ 256,\ 25°C)}$/165°C * 1,000,000) ($V_{DD}$ = 3.0V, I_W = 150 µA).*



Note:	See **Appendix B:** for additional information of R_W resistance variation characteristics for V_{DD} > 2.7V.

FIGURE 2-41: *10 kΩ – R_{WB} PPM/°C vs. Wiper Setting. ($R_{BW(code=n,\ 125°C)}$-$R_{BW(code=n,\ -40°C)}$)/$R_{BW(code\ =\ 256,\ 25°C)}$/165°C * 1,000,000) ($V_{DD}$ = 1.8V, I_W = 150 µA).*

Note: Unless otherwise indicated, T_A = +25°C, V_{DD} = 5V, V_{SS} = 0V.

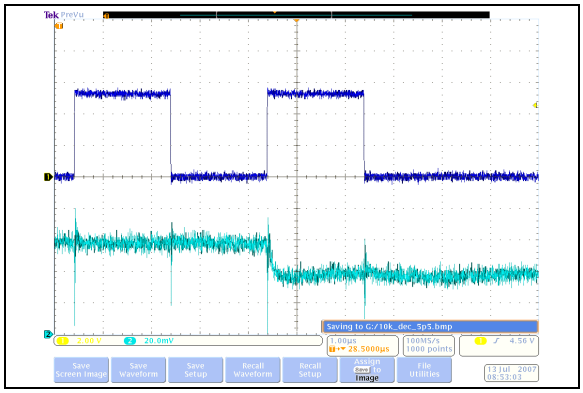


FIGURE 2-42: *10 kΩ – Low-Voltage Decrement Wiper Settling Time (V_{DD} = 5.5V) (1 µs/Div).*

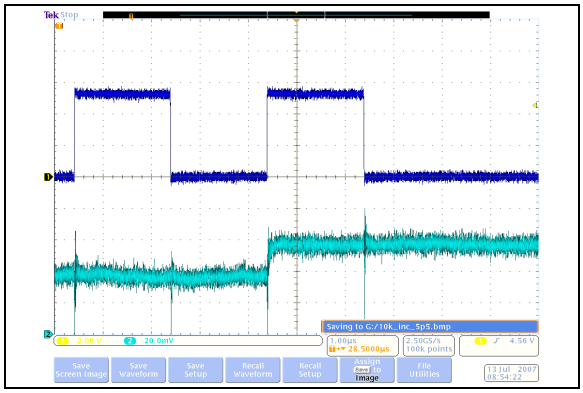


FIGURE 2-44: *10 kΩ – Low-Voltage Increment Wiper Settling Time (V_{DD} = 5.5V) (1 µs/Div).*

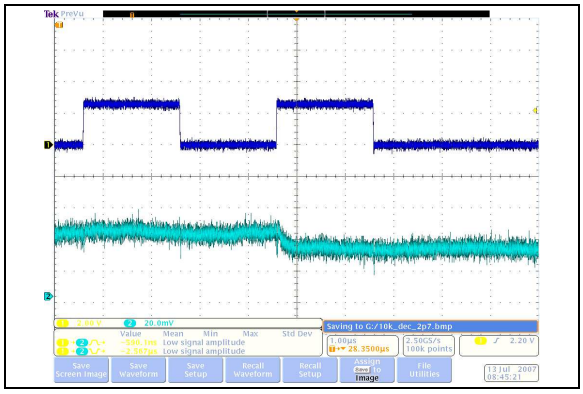


FIGURE 2-43: *10 kΩ – Low-Voltage Decrement Wiper Settling Time (V_{DD} = 2.7V) (1 µs/Div).*

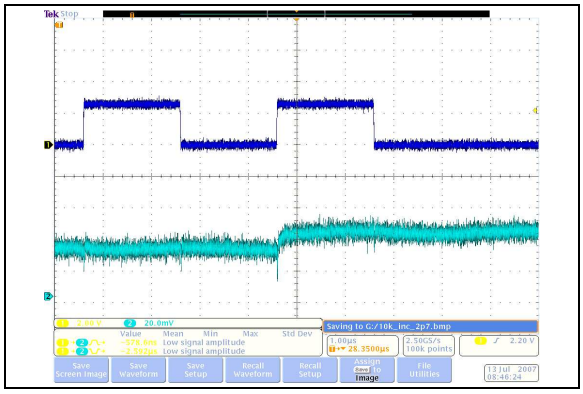


FIGURE 2-45: *10 kΩ – Low-Voltage Increment Wiper Settling Time (V_{DD} = 2.7V) (1 µs/Div).*