MCP6546/6R/6U/7/8/9

Open-Drain Output Sub-Microamp Comparators

Features

- Low Quiescent Current: 600 nA/comparator (typ.)
- Rail-to-Rail Input: V_{SS} - 0.3V to V_{DD} + 0.3V
- Open-Drain Output: $V_{OUT} \leq 10V$
- Propagation Delay: 4 µs (typ., 100 mV Overdrive)
- Wide Supply Voltage Range: 1.6V to 5.5V
- Single available in SOT-23-5, SC-70-5 * packages
- Available in Single, Dual and Quad
- Chip Select ($\overline{CS}$) with MCP6548
- Low Switching Current
- Internal Hysteresis: 3.3 mV (typ.)
- Temperature Range:
  - Industrial: -40°C to +85°C
  - Extended: -40°C to +125°C

Typical Applications

- Laptop Computers
- Mobile Phones
- Metering Systems
- Hand-held Electronics
- RC Timers
- Alarm and Monitoring Circuits
- Windowed Comparators
- Multi-vibrators

Related Devices

- CMOS/TTL-Compatible Output: MCP6541/2/3/4

Description

The Microchip Technology Inc. MCP6546/6R/6U/7/8/9 family of comparators is offered in single (MCP6546, MCP6546R, MCP6546U), single with chip select ($\overline{CS}$) (MCP6548), dual (MCP6547) and quad (MCP6549) configurations. The outputs are open-drain and are capable of driving heavy DC or capacitive loads.

These comparators are optimized for low power, single-supply application with greater than rail-to-rail input operation. The output limits supply current surges and dynamic power consumption while switching. The open-drain output of the MCP6546/6R/6U/7/8/9 family can be used as a level-shifter for up to 10V using a pull-up resistor. It can also be used as a wired-OR logic. The internal Input hysteresis eliminates output switching due to internal noise voltage, reducing current draw. These comparators operate with a single-supply voltage as low as 1.6V and draw a quiescent current of less than 1 µA/comparator.

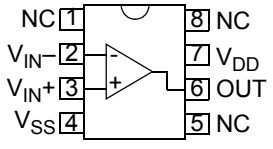
The related MCP6541/2/3/4 family of comparators from Microchip has a push-pull output that supports rail-to-rail output swing and interfaces with CMOS/TTL logic.

* SC-70-5 E-Temp parts not avaliable at this release of the data sheet.

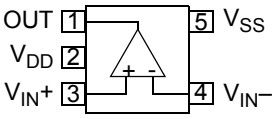
MCP6546U SOT-23-5 is E-Temp only.

Package Types

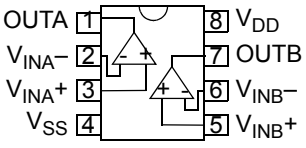
MCP6546
PDIP, SOIC, MSOP



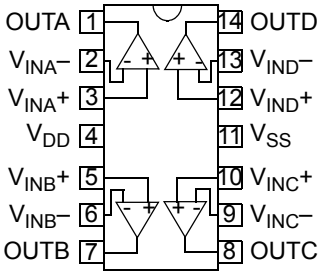
MCP6546R
SOT-23-5



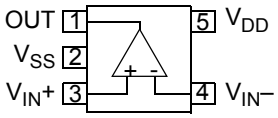
MCP6547
PDIP, SOIC, MSOP



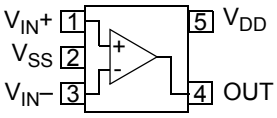
MCP6549
PDIP, SOIC, TSSOP



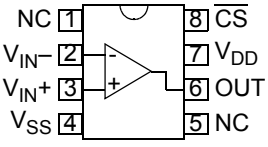
MCP6546
SOT-23-5, SC-70-5



MCP6546U
SOT-23-5



MCP6548
PDIP, SOIC, MSOP



1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings †

V_{DD} - V_{SS} 7.0V
Open-Drain output..... V_{SS} + 10.5V
Analog Input (V_{IN}+, V_{IN}-)†† ..... V_{SS} - 1.0V to V_{DD} + 1.0V
All other inputs and outputs ..... V_{SS} – 0.3V to V_{DD} + 0.3V
Difference Input voltage ..... $|V_{DD} – V_{SS}|$
Output Short-Circuit Current .....continuous
Current at Input Pins .....±2 mA
Current at Output and Supply Pins .....±30 mA
Storage temperature .....-65°C to +150°C
Maximum Junction Temperature (T_J) ..... +150°C
ESD protection on all pins:
(HBM;MM) 2 kV;200V (MCP6546U)
(HBM;MM) ..... 4 kV; 200V (all other parts)

† Notice: Stresses above those listed under “Absolute 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.

†† See **Section 4.1.2 “Input Voltage and Current Limits”**

DC CHARACTERISTICS

Electrical Specifications: Unless otherwise indicated, V_{DD} = +1.6V to +5.5V, V_{SS} = GND, T_A = 25°C, V_{IN}+ = V_{DD}/2, V_{IN}– = V_{SS}, R_{PU} = 2.74 kΩ to V_{PU} = V_{DD} (Refer to Figure 1-3).

Parameters	Sym	Min	Typ	Max	Units	Conditions
Power Supply						
Supply Voltage	V_{DD}	1.6	—	5.5	V	$V_{PU} \geq V_{DD}$
Quiescent Current (per comparator)	I_Q	0.3	0.6	1	µA	I_{OUT} = 0
Input						
Input Voltage Range	V_{CMR}	V_{SS} – 0.3	—	V_{DD} + 0.3	V	
Common Mode Rejection Ratio	CMRR	55	70	—	dB	V_{DD} = 5V, V_{CM} = -0.3V to 5.3V
Common Mode Rejection Ratio	CMRR	50	65	—	dB	V_{DD} = 5V, V_{CM} = 2.5V to 5.3V
Common Mode Rejection Ratio	CMRR	55	70	—	dB	V_{DD} = 5V, V_{CM} = -0.3V to 2.5V
Power Supply Rejection Ratio	PSRR	63	80	—	dB	V_{CM} = V_{SS}
Input Offset Voltage	V_{OS}	-7.0	±1.5	+7.0	mV	V_{CM} = V_{SS} **(Note 1)**
Drift with Temperature	$\Delta V_{OS}/\Delta T_A$	—	±3	—	µV/°C	T_A = -40°C to +125°C, V_{CM} = V_{SS}
Input Hysteresis Voltage	V_{HYST}	1.5	3.3	6.5	mV	V_{CM} = V_{SS} **(Note 1)**
Linear Temp. Co.	TC_1	—	6.7	—	µV/°C	T_A = -40°C to +125°C, V_{CM} = V_{SS} **(Note 2)**
Quadratic Temp. Co.	TC_2	—	-0.035	—	µV/°C^2	T_A = -40°C to +125°C, V_{CM} = V_{SS} **(Note 2)**
Input Bias Current	I_B	—	1	—	pA	V_{CM} = V_{SS}
At Temperature (I-Temp parts)	I_B	—	25	100	pA	T_A = +85°C, V_{CM} = V_{SS} **(Note 3)**
At Temperature (E-Temp parts)	I_B	—	1200	5000	pA	T_A = +125°C, V_{CM} = V_{SS} **(Note 3)**
Input Offset Current	I_{OS}	—	±1	—	pA	V_{CM} = V_{SS}
Common Mode Input Impedance	Z_{CM}	—	10^{13}||4	—	Ω||pF	
Differential Input Impedance	Z_{DIFF}	—	10^{13}||2	—	Ω||pF	

Note 1: The input offset voltage is the center of the input-referred trip points. The input hysteresis is the difference between the input-referred trip points.

2: V_{HYST} at differential temperatures is estimated using: V_{HYST} (T_A) = V_{HYST} + (T_A -25°C) TC_1 + (T_A - 25°C)$^2TC_2$.

3: Input bias current at temperature is not tested for the SC-70-5 package

4: Do not short the output above V_{SS} + 10V. Limit the output current to Absolute Maximum Rating of 30 mA. The minimum V_{PU} test limit was V_{DD} before Dec. 2004 (week code 52).

DC CHARACTERISTICS (CONTINUED)

Electrical Specifications: Unless otherwise indicated, V_{DD} = +1.6V to +5.5V, V_{SS} = GND, T_A = 25°C, $V_{IN}+ = V_{DD}/2$, $V_{IN}– = V_{SS}$, R_{PU} = 2.74 kΩ to $V_{PU} = V_{DD}$ (Refer to Figure 1-3).

Parameters	Sym	Min	Typ	Max	Units	Conditions
Open-Drain Output						
Output Pull-Up Voltage	V_{PU}	1.6	—	10	V	(**Note 4**)
High-Level Output Current	I_{OH}	-100	—	—	nA	V_{DD} = 1.6V to 5.5V, V_{PU} = 10V **(Note 4)**
Low-Level Output Voltage	V_{OL}	V_{SS}	—	V_{SS} + 0.2	V	I_{OUT} = 2 mA, $V_{PU} = V_{DD}$ = 5V
Short-Circuit Current	I_{SC}	—	±1.5	—	mA	$V_{PU} = V_{DD}$ = 1.6V **(Note 4)**
	I_{SC}	–	30	—	mA	$V_{PU} = V_{DD}$ = 5.5V **(Note 4)**
Output Pin Capacitance	C_{OUT}	—	8	—	pF	

Note 1: The input offset voltage is the center of the input-referred trip points. The input hysteresis is the difference between the input-referred trip points.

2: V_{HYST} at differential temperatures is estimated using: V_{HYST} (T_A) = V_{HYST} + (T_A -25°C) TC_1 + (T_A - 25°C)$^2TC_2$.

3: Input bias current at temperature is not tested for the SC-70-5 package

4: Do not short the output above V_{SS} + 10V. Limit the output current to Absolute Maximum Rating of 30 mA. The minimum V_{PU} test limit was V_{DD} before Dec. 2004 (week code 52).

AC CHARACTERISTICS

Electrical Specifications: Unless otherwise indicated, V_{DD} = +1.6V to +5.5V, V_{SS} = GND, T_A = 25°C, $V_{IN}+ = V_{DD}/2$, Step = 200 mV, Overdrive = 100 mV, R_{PU} = 2.74 kΩ to $V_{PU} = V_{DD}$, and C_L = 36 pF (Refer to Figure 1-2 and Figure 1-3).

Parameters	Sym	Min	Typ	Max	Units	Conditions
Fall Time	t_F	—	0.7	—	µs	**(Note 1)**
Propagation Delay (High-to-Low)	t_{PHL}	—	4.0	8.0	µs	
Propagation Delay (Low-to-High)	t_{PLH}	—	3.0	8.0	µs	**(Note 1)**
Propagation Delay Skew	t_{PDS}	—	-1.0	—	µs	**(Notes 1 and 2)**
Maximum Toggle Frequency	f_{MAX}	—	225	—	kHz	V_{DD} = 1.6V
	f_{MAX}	—	165	—	kHz	V_{DD} = 5.5V
Input Noise Voltage	E_{ni}	—	200	—	$µV_{P-P}$	10 Hz to 100 kHz

Note 1: t_R and t_{PLH} depend on the load (R_L and C_L); these specifications are valid for the indicated load only.

2: Propagation Delay Skew is defined as: $t_{PDS} = t_{PLH} - t_{PHL}$.

TEMPERATURE CHARACTERISTICS

Electrical Specifications: Unless otherwise indicated, V_{DD} = +1.6V to +5.5V and V_{SS} = GND.						
Parameters	**Sym**	**Min**	**Typ**	**Max**	**Units**	**Conditions**
Temperature Ranges						
Specified Temperature Range	T_A	-40	—	+85	°C	
Operating Temperature Range	T_A	-40	—	+125	°C	**Note**
Storage Temperature Range	T_A	-65	—	+150	°C	
Thermal Package Resistances						
Thermal Resistance, 5L-SC-70	θ_{JA}	—	331	—	°C/W	
Thermal Resistance, 5L-SOT-23	θ_{JA}	—	256	—	°C/W	
Thermal Resistance, 8L-PDIP	θ_{JA}	—	85	—	°C/W	
Thermal Resistance, 8L-SOIC	θ_{JA}	—	163	—	°C/W	
Thermal Resistance, 8L-MSOP	θ_{JA}	—	206	—	°C/W	
Thermal Resistance, 14L-PDIP	θ_{JA}	—	70	—	°C/W	
Thermal Resistance, 14L-SOIC	θ_{JA}	—	120	—	°C/W	
Thermal Resistance, 14L-TSSOP	θ_{JA}	—	100	—	°C/W	

Note: The MCP6546/6R/6U/7/8/9 I-temp family operates over this extended temperature range, but with reduced performance. In any case, the Junction Temperature (T_J) must not exceed the absolute maximum specification of +150°C.

1.1 Test Circuit Configuration

This test circuit configuration is used to determine the AC and DC specifications.

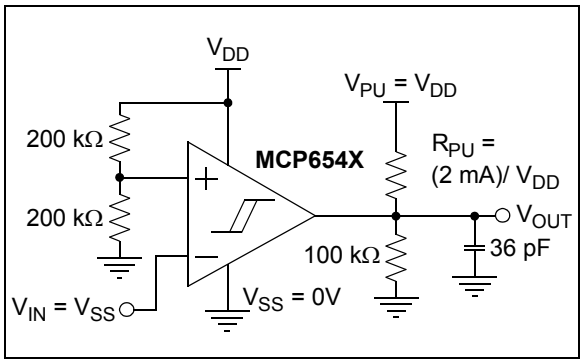
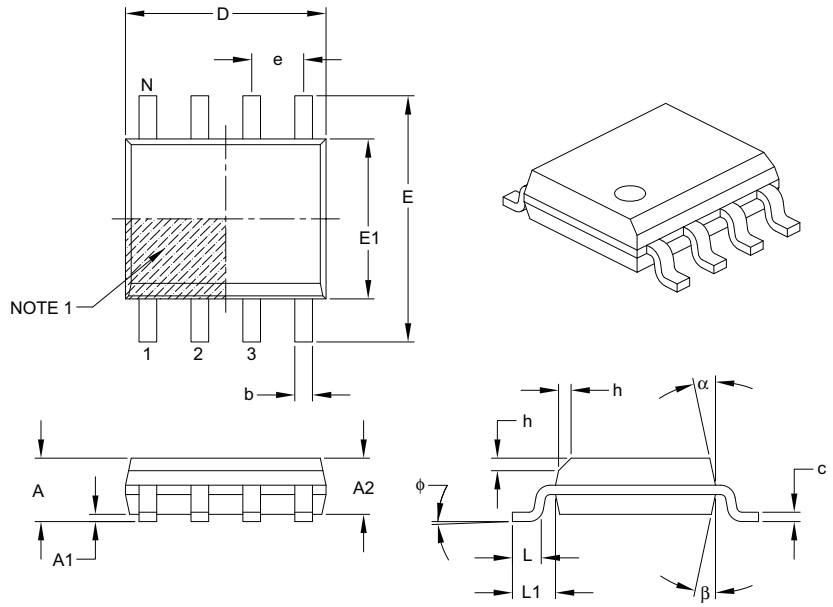


FIGURE 1-3: *AC and DC Test Circuit for the Open-Drain Output Comparators.*

8-Lead Plastic Small Outline (SN) – Narrow, 3.90 mm Body [SOIC]



Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Number of Pins	N		8	
Pitch	e		1.27 BSC	
Overall Height	A	–	–	1.75
Molded Package Thickness	A2	1.25	–	–
Standoff §	A1	0.10	–	0.25
Overall Width	E		6.00 BSC	
Molded Package Width	E1		3.90 BSC	
Overall Length	D		4.90 BSC	
Chamfer (optional)	h	0.25	–	0.50
Foot Length	L	0.40	–	1.27
Footprint	L1		1.04 REF	
Foot Angle	φ	0°	–	8°
Lead Thickness	c	0.17	–	0.25
Lead Width	b	0.31	–	0.51
Mold Draft Angle Top	α	5°	–	15°
Mold Draft Angle Bottom	β	5°	–	15°

Notes:

1. Pin 1 visual index feature may vary, but must be located within the hatched area.
2. § Significant Characteristic.
3. Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.15 mm per side.
4. Dimensioning and tolerancing per ASME Y14.5M.

   BSC: Basic Dimension. Theoretically exact value shown without tolerances.

   REF: Reference Dimension, usually without tolerance, for information purposes only.

Microchip Technology Drawing C04-057B

PRODUCT IDENTIFICATION SYSTEM

To order or obtain information, e.g., on pricing or delivery, refer to the factory or the listed sales office.

PART NO.	–X	/XX
Device	Temperature Range	Package

Device:	MCP6546:	Single Comparator
	MCP6546T:	Single Comparator (Tape and Reel) (SC-70, SOT-23, SOIC, MSOP)
	MCP6546RT:	Single Comparator (Rotated - Tape and Reel) (SOT-23 only)
	MCP6546UT:	Single Comparator (Tape and Reel) **(SOT-23-5 is E-Temp only)**
	MCP6547:	Dual Comparator
	MCP6547T:	Dual Comparator (Tape and Reel for SOIC and MSOP)
	MCP6548:	Single Comparator with $\overline{CS}$
	MCP6548T:	Single Comparator with $\overline{CS}$ (Tape and Reel for SOIC and MSOP)
	MCP6549:	Quad Comparator
	MCP6549T:	Quad Comparator (Tape and Reel for SOIC and TSSOP)
Temperature Range:	I =	-40°C to +85°C
	E * =	-40°C to +125°C
	* SC-70-5 E-Temp parts not available at this release of the data sheet.	
Package:	LT =	Plastic Package (SC-70), 5-lead
	OT =	Plastic Small Outline Transistor (SOT-23), 5-lead
	MS =	Plastic MSOP, 8-lead
	P =	Plastic DIP (300 mil Body), 8-lead, 14-lead
	SN =	Plastic SOIC (150 mil Body), 8-lead
	SL =	Plastic SOIC (150 mil Body), 14-lead (MCP6549)
	ST =	Plastic TSSOP (4.4mm Body), 14-lead (MCP6549)

Examples:

a)	MCP6546T-I/LT:	Tape and Reel, Industrial Temperature, 5LD SC-70.
b)	MCP6546T-I/OT:	Tape and Reel, Industrial Temperature, 5LD SOT-23.
c)	MCP6546-E/P:	Extended Temperature, 8LD PDIP.
d)	MCP6546RT-I/OT:	Tape and Reel, Industrial Temperature, 5LD SOT23.
e)	MCP6546-E/SN:	Extended Temperature, 8LD SOIC.
f)	MCP6546UT-E/OT:	Tape and Reel, Extended Temperature, 5LD SOT23.
a)	MCP6547-I/MS:	Industrial Temperature, 8LD MSOP.
b)	MCP6547T-I/MS:	Tape and Reel, Industrial Temperature, 8LD MSOP.
c)	MCP6547-I/P:	Industrial Temperature, 8LD PDIP.
d)	MCP6547-E/SN:	Extended Temperature, 8LD SOIC.
a)	MCP6548-I/SN:	Industrial Temperature, 8LD SOIC.
b)	MCP6548T-I/SN:	Tape and Reel, Industrial Temperature, 8LD SOIC.
c)	MCP6548-I/P:	Industrial Temperature, 8LD PDIP.
d)	MCP6548-E/SN:	Extended Temperature, 8LD SOIC.
a)	MCP6549T-I/SL:	Tape and Reel, Industrial Temperature, 14LD SOIC.
b)	MCP6549T-E/SL:	Tape and Reel, Extended Temperature, 14LD SOIC.
c)	MCP6549-I/P:	Industrial Temperature, 14LD PDIP.
d)	MCP6549-E/ST:	Extended Temperature, 14LD TSSOP.