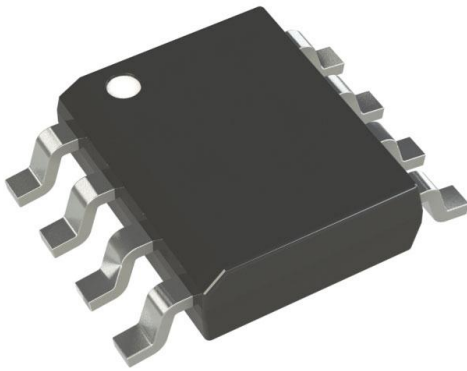


# MCP1404-E/SN Datasheet

[www.digi-electronics.com](http://www.digi-electronics.com)



<https://www.DiGi-Electronics.com>

DiGi Electronics Part Number	MCP1404-E/SN-DG
Manufacturer	<a href="#">Microchip Technology</a>
Manufacturer Product Number	MCP1404-E/SN
Description	IC GATE DRVR LOW-SIDE 8SOIC
Detailed Description	Low-Side Gate Driver IC Non-Inverting 8-SOIC



Tel: +00 852-30501935

RFQ Email: [Info@DiGi-Electronics.com](mailto:Info@DiGi-Electronics.com)

DiGi is a global authorized distributor of electronic components.

## Purchase and inquiry

Manufacturer Product Number:

MCP1404-E/SN

Series:

-

DiGi-Electronics Programmable:

Not Verified

Channel Type:

Independent

Gate Type:

IGBT, N-Channel, P-Channel MOSFET

Logic Voltage - VIL, VIH:

0.8V, 2.4V

Input Type:

Non-Inverting

Operating Temperature:

-40°C ~ 150°C (Tj)

Package / Case:

8-SOIC (0.154", 3.90mm Width)

Base Product Number:

MCP1404

Manufacturer:

Microchip Technology

Product Status:

Active

Driven Configuration:

Low-Side

Number of Drivers:

2

Voltage - Supply:

4.5V ~ 18V

Current - Peak Output (Source, Sink):

4.5A, 4.5A

Rise / Fall Time (Typ):

15ns, 18ns

Mounting Type:

Surface Mount

Supplier Device Package:

8-SOIC

## Environmental & Export classification

RoHS Status:

ROHS3 Compliant

REACH Status:

REACH Unaffected

HTSUS:

8542.39.0001

Moisture Sensitivity Level (MSL):

1 (Unlimited)

ECCN:

EAR99





# MCP1403/4/5

## 4.5A Dual High-Speed Power MOSFET Drivers

### Features

- High Peak Output Current: 4.5A (typ.)
- Low Shoot-Through/Cross-Conduction Current in Output Stage
- Wide Input Supply Voltage Operating Range:
  - 4.5V to 18V
- High Capacitive Load Drive Capability:
  - 2200 pF in 15 ns
  - 5600 pF in 34 ns
- Short Delay Times: 40 ns (typ.)
- Low Supply Current:
  - With Logic '1' Input – 1.0 mA (typ.)
  - With Logic '0' Input – 150  $\mu$ A (typ.)
- Latch-Up Protected: Will Withstand 1.5A Reverse Current
- Logic Input Will Withstand Negative Swing Up To 5V
- Packages: 8-Pin SOIC, PDIP, 8-Pin 6x5 DFN, and 16-Pin SOIC

### Applications

- Switch Mode Power Supplies
- Pulse Transformer Drive
- Line Drivers
- Motor and Solenoid Drive

### General Description

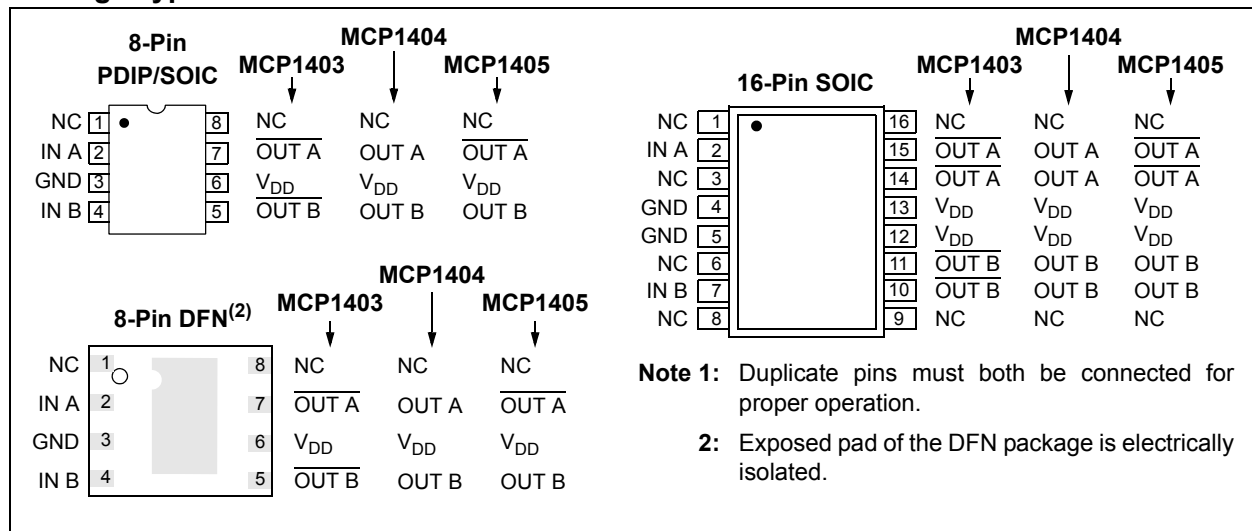
The MCP1403/4/5 are a family of dual-inverting, dual-non-inverting, or complimentary output drivers. They can delivery high peak currents of 4.5A typically into capacitive loads. These devices also feature low shoot-through current, matched rise/fall times and propagation delays.

The MCP1403/4/5 drivers operate from a 4.5V to 18V single power supply and can easily charge and discharge 2200 pF gate capacitance in under 15 ns (typ). They provide low enough impedances in both the on and off states to ensure the MOSFETs intended state will not be affected, even by large transients. The input to the MCP1403/4/5 may be driven directly from either TTL or CMOS (3V to 18V).

The MCP1403/4/5 dual-output 4.5A driver family is offered in both surface-mount and pin-through-hole packages with a -40°C to +125°C temperature rating. The low thermal resistance of the thermally enhanced DFN package allows for greater power dissipation capability for driving heavier capacitive or resistive loads.

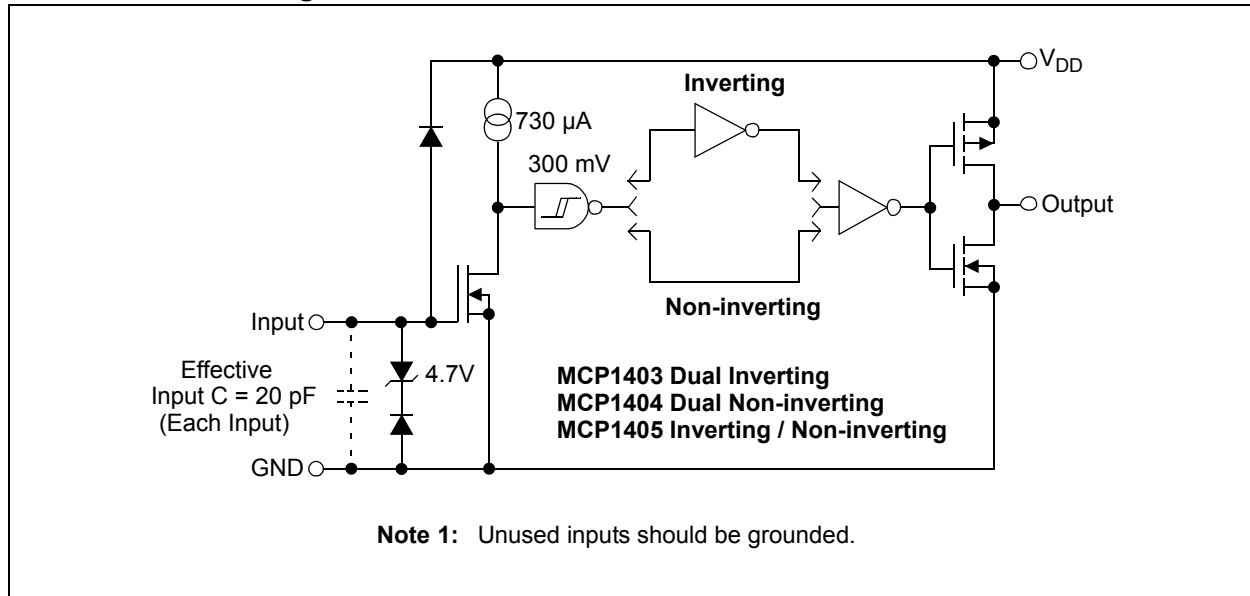
These devices are highly latch-up resistant under any conditions within their power and voltage ratings. They are not subject to damage when up to 5V of noise spiking (of either polarity) occurs on the ground pin. All terminals are fully protect against Electrostatic Discharge (ESD) up to 4 kV.

### Package Types



# MCP1403/4/5

## Functional Block Diagram (1)



## 1.0 ELECTRICAL CHARACTERISTICS

### Absolute Maximum Ratings †

Supply Voltage .....	+20V
Input Voltage .....	( $V_{DD} + 0.3V$ ) to (GND – 5V)
Input Current ( $V_{IN} > V_{DD}$ ).....	50 mA

† **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 sections of this specification is not intended. Exposure to maximum rating conditions for extended periods may affect device reliability.

### DC CHARACTERISTICS (NOTE 2)

Electrical Specifications: Unless otherwise indicated, $T_A = +25^\circ\text{C}$ , with $4.5V \leq V_{DD} \leq 18V$ .						
Parameters	Sym	Min	Typ	Max	Units	Conditions
<b>Input</b>						
Logic '1', High Input Voltage	$V_{IH}$	2.4	1.5	—	V	
Logic '0', Low Input Voltage	$V_{IL}$	—	1.3	0.8	V	
Input Current	$I_{IN}$	-1	—	1	$\mu\text{A}$	$0V \leq V_{IN} \leq V_{DD}$
Input Voltage	$V_{IN}$	-5	—	$V_{DD}+0.3$	V	
<b>Output</b>						
High Output Voltage	$V_{OH}$	$V_{DD} - 0.025$	—	—	V	DC Test
Low Output Voltage	$V_{OL}$	—	—	0.025	V	DC Test
Output Resistance, High	$R_{OH}$	—	2.2	3.0	$\Omega$	$I_{OUT} = 10 \text{ mA}$ , $V_{DD} = 18V$
Output Resistance, Low	$R_{OL}$	—	2.8	3.5	$\Omega$	$I_{OUT} = 10 \text{ mA}$ , $V_{DD} = 18V$
Peak Output Current	$I_{PK}$	—	4.5	—	A	$V_{DD} = 18V$ ( <b>Note 2</b> )
Latch-Up Protection Withstand Reverse Current	$I_{REV}$	—	>1.5	—	A	Duty cycle $\leq 2\%$ , $t \leq 300 \mu\text{sec}$ .
<b>Switching Time (Note 1)</b>						
Rise Time	$t_R$	—	15	28	ns	Figure 4-1, Figure 4-2 $C_L = 2200 \text{ pF}$
Fall Time	$t_F$	—	18	28	ns	Figure 4-1, Figure 4-2 $C_L = 2200 \text{ pF}$
Delay Time	$t_{D1}$	—	40	48	ns	Figure 4-1, Figure 4-2
Delay Time	$t_{D2}$	—	40	48	ns	Figure 4-1, Figure 4-2
<b>Power Supply</b>						
Supply Voltage	$V_{DD}$	4.5	—	18.0	V	
Power Supply Current	$I_S$	—	1.0	2.0	mA	$V_{IN} = 3V$ (Both Inputs)
	$I_S$	—	0.15	0.25	mA	$V_{IN} = 0V$ (Both Inputs)

**Note 1:** Switching times ensured by design.

**2:** Tested during characterization, not production tested.

# MCP1403/4/5

## DC CHARACTERISTICS (OVER OPERATING TEMPERATURE RANGE)

Electrical Specifications: Unless otherwise indicated, operating temperature range with $4.5V \leq V_{DD} \leq 18V$ .						
Parameters	Sym	Min	Typ	Max	Units	Conditions
<b>Input</b>						
Logic '1', High Input Voltage	$V_{IH}$	2.4	—	—	V	
Logic '0', Low Input Voltage	$V_{IL}$	—	—	0.8	V	
Input Current	$I_{IN}$	-10	—	+10	$\mu A$	$0V \leq V_{IN} \leq V_{DD}$
<b>Output</b>						
High Output Voltage	$V_{OH}$	$V_{DD} - 0.025$	—	—	V	DC TEST
Low Output Voltage	$V_{OL}$	—	—	0.025	V	DC TEST
Output Resistance, High	$R_{OH}$	—	3.1	6.0	$\Omega$	$I_{OUT} = 10 \text{ mA}$ , $V_{DD} = 18V$
Output Resistance, Low	$R_{OL}$	—	3.7	7	$\Omega$	$I_{OUT} = 10 \text{ mA}$ , $V_{DD} = 18V$
<b>Switching Time (Note 1)</b>						
Rise Time	$t_R$	—	25	40	ns	Figure 4-1, Figure 4-2 $C_L = 2200 \text{ pF}$
Fall Time	$t_F$	—	25	40	ns	Figure 4-1, Figure 4-2 $C_L = 2200 \text{ pF}$
Delay Time	$t_{D1}$	—	50	65	ns	Figure 4-1, Figure 4-2
Delay Time	$t_{D2}$	—	50	65	ns	Figure 4-1, Figure 4-2
<b>Power Supply</b>						
Power Supply Current	$I_S$	—	2.0	3.0	mA	$V_{IN} = 3V$ (Both Inputs) $V_{IN} = 0V$ (Both Inputs)

**Note 1:** Switching times ensured by design.

**2:** Tested during characterization, not production tested.

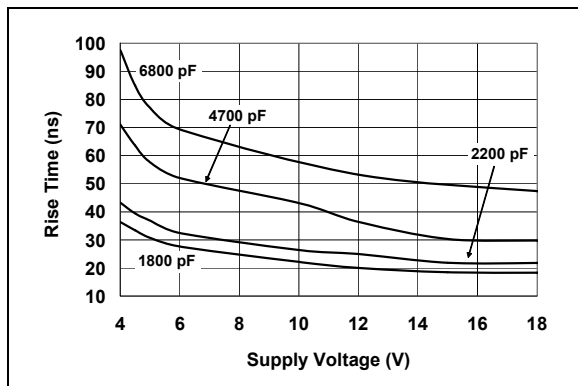
## TEMPERATURE CHARACTERISTICS

Electrical Specifications: Unless otherwise noted, all parameters apply with $4.5V \leq V_{DD} \leq 18V$ .						
Parameters	Sym	Min	Typ	Max	Units	Conditions
<b>Temperature Ranges</b>						
Specified Temperature Range	$T_A$	-40	—	+125	$^{\circ}C$	
Maximum Junction Temperature	$T_J$	—	—	+150	$^{\circ}C$	
Storage Temperature Range	$T_A$	-65	—	+150	$^{\circ}C$	
<b>Package Thermal Resistances</b>						
Thermal Resistance, 8L-6x5 DFN	$\theta_{JA}$	—	33.2	—	$^{\circ}C/W$	Typical four-layer board with vias to ground plane
Thermal Resistance, 8L-PDIP	$\theta_{JA}$	—	125	—	$^{\circ}C/W$	
Thermal Resistance, 8L-SOIC	$\theta_{JA}$	—	155	—	$^{\circ}C/W$	
Thermal Resistance, 16L-SOIC	$\theta_{JA}$	—	155	—	$^{\circ}C/W$	4-Layer JC51-7 Standard Board, Natural Convection

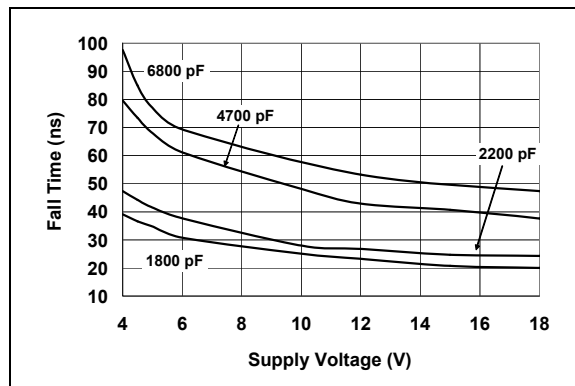
## 2.0 TYPICAL PERFORMANCE CURVES

**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.

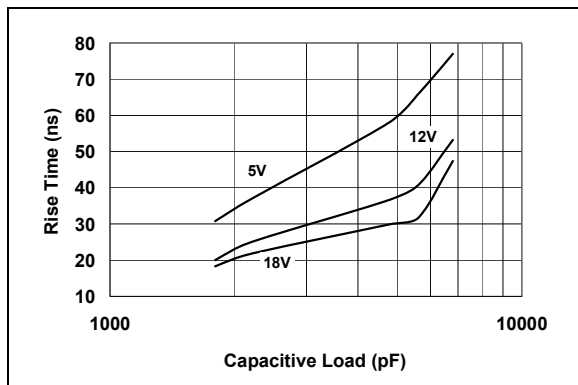
**Note:** Unless otherwise indicated,  $T_A = +25^\circ\text{C}$  with  $4.5\text{V} \leq V_{DD} \leq 18\text{V}$ .



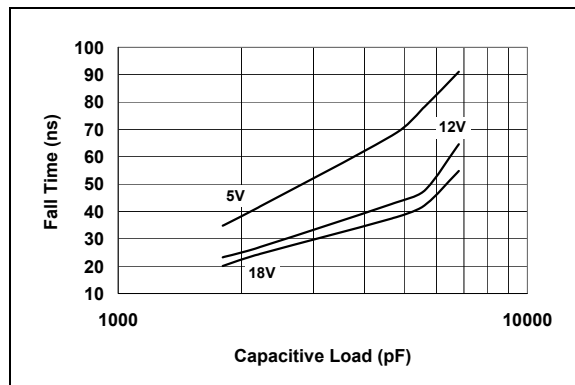
**FIGURE 2-1:** Rise Time vs. Supply Voltage.



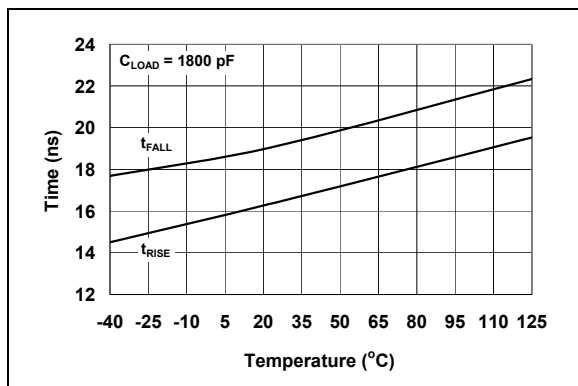
**FIGURE 2-4:** Fall Time vs. Supply Voltage.



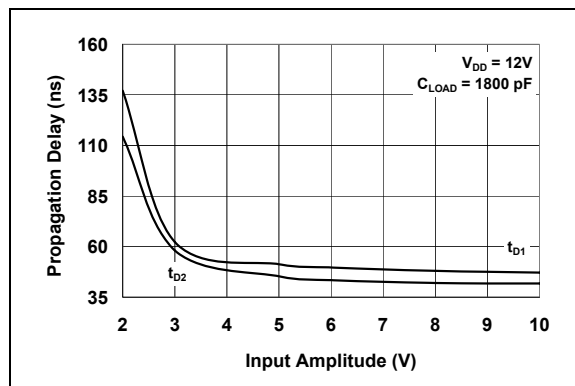
**FIGURE 2-2:** Rise Time vs. Capacitive Load.



**FIGURE 2-5:** Fall Time vs. Capacitive Load.



**FIGURE 2-3:** Rise and Fall Times vs. Temperature.

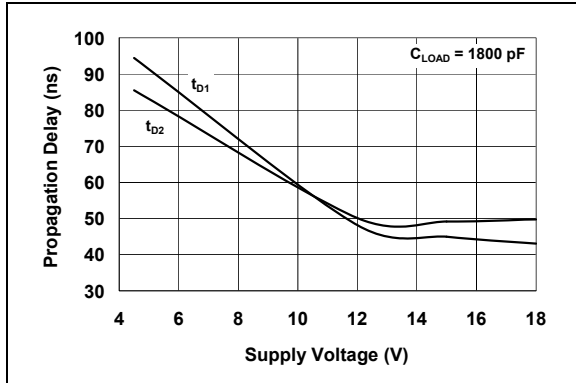


**FIGURE 2-6:** Propagation Delay vs. Input Amplitude.

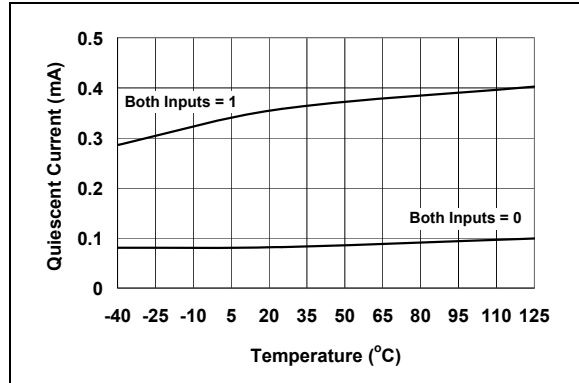
# MCP1403/4/5

## Typical Performance Curves (Continued)

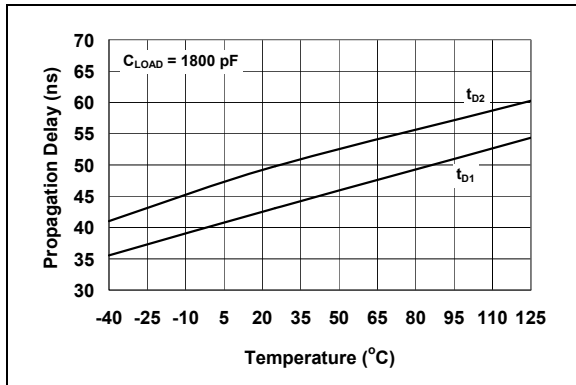
Note: Unless otherwise indicated,  $T_A = +25^\circ\text{C}$  with  $4.5\text{V} \leq V_{DD} \leq 18\text{V}$ .



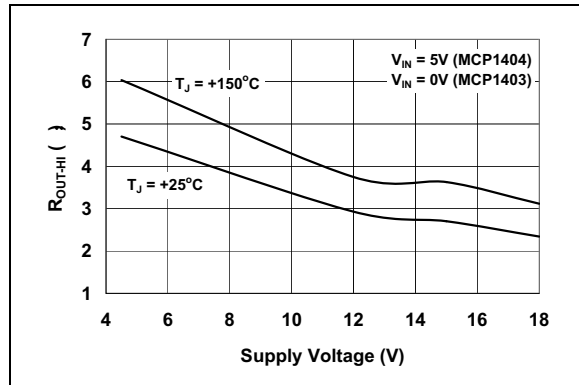
**FIGURE 2-7:** Propagation Delay Time vs. Supply Voltage.



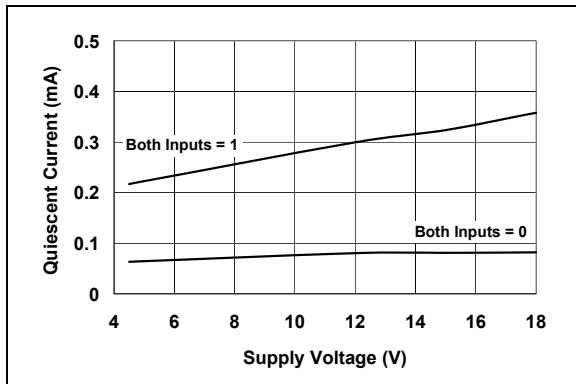
**FIGURE 2-10:** Quiescent Current vs. Temperature.



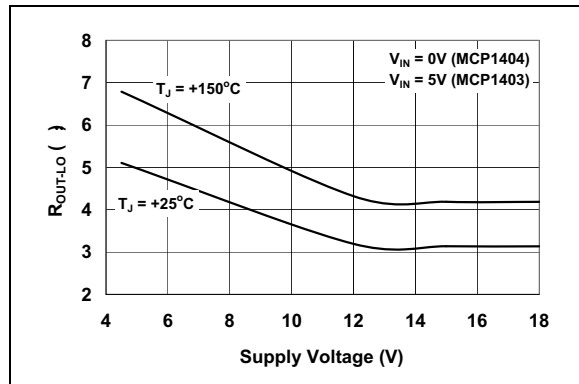
**FIGURE 2-8:** Propagation Delay Time vs. Temperature.



**FIGURE 2-11:** Output Resistance (Output High) vs. Supply Voltage.



**FIGURE 2-9:** Quiescent Current vs. Supply Voltage.

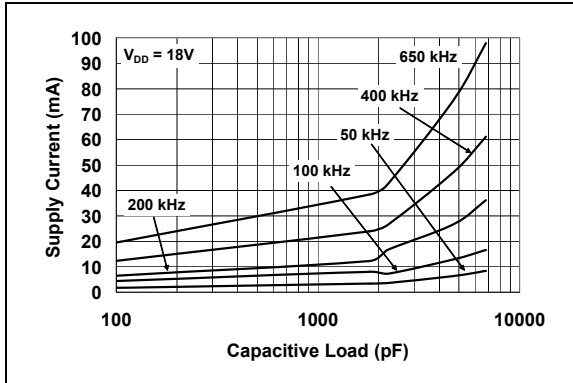


**FIGURE 2-12:** Output Resistance (Output Low) vs. Temperature.

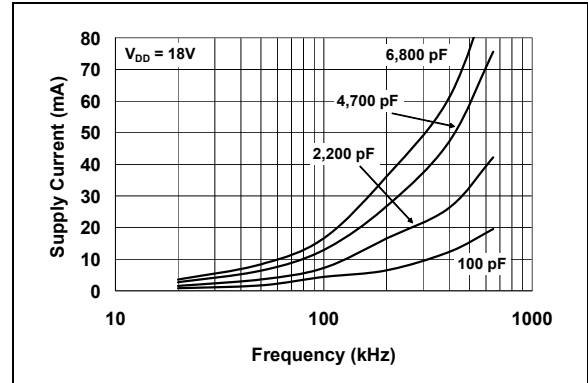


**Typical Performance Curves (Continued)**

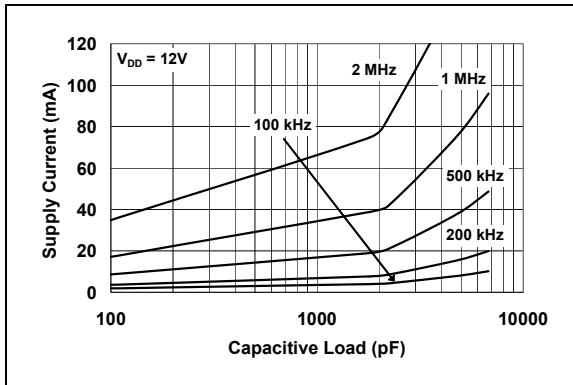
**Note:** Unless otherwise indicated,  $T_A = +25^\circ\text{C}$  with  $4.5\text{V} \leq V_{DD} \leq 18\text{V}$ .



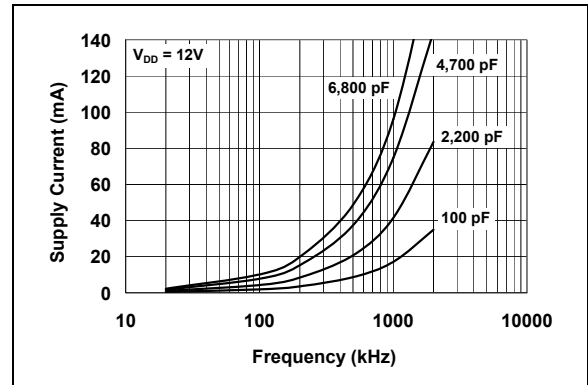
**FIGURE 2-13:** Supply Current vs. Capacitive Load.



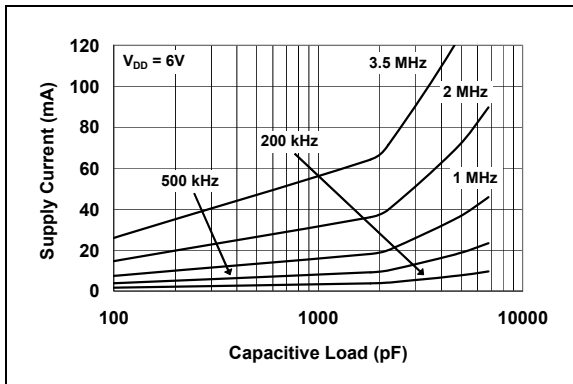
**FIGURE 2-16:** Supply Current vs. Frequency.



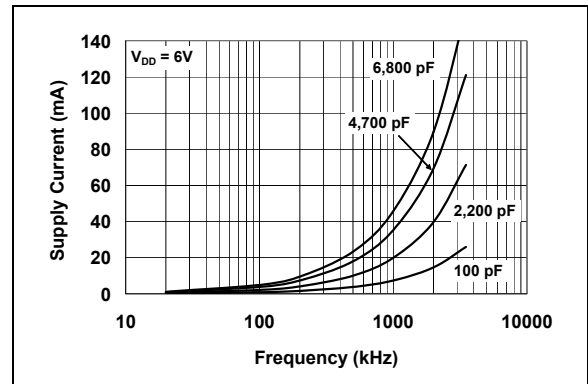
**FIGURE 2-14:** Supply Current vs. Capacitive Load.



**FIGURE 2-17:** Supply Current vs. Frequency.



**FIGURE 2-15:** Supply Current vs. Capacitive Load.

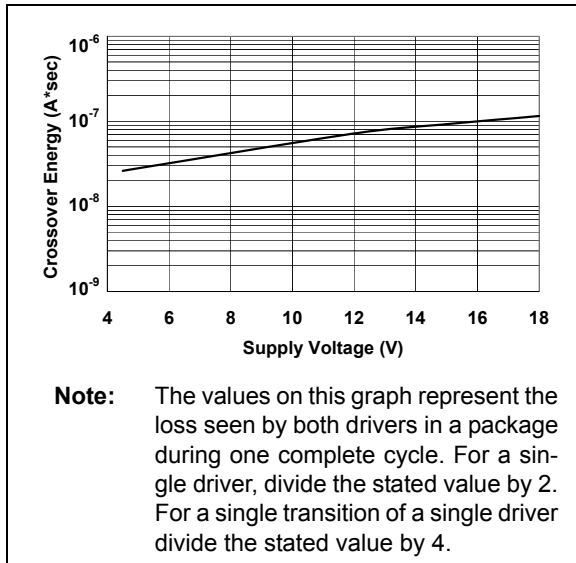


**FIGURE 2-18:** Supply Current vs. Frequency.

# MCP1403/4/5

## Typical Performance Curves (Continued)

**Note:** Unless otherwise indicated,  $T_A = +25^\circ\text{C}$  with  $4.5\text{V} \leq V_{DD} \leq 18\text{V}$ .



**FIGURE 2-19:** Crossover Energy vs. Supply Voltage.

### 3.0 PIN DESCRIPTIONS

The descriptions of the pins are listed in [Table 3-1](#).

**TABLE 3-1: PIN FUNCTION TABLE <sup>(1)</sup>**

8-Pin PDIP SOIC	8-Pin DFN	16-Pin SOIC	Symbol	Description
1	1	1	NC	No Connection
2	2	2	IN A	Control Input for Output A
—	—	3	NC	No Connection
3	3	4	GND	Ground
—	—	5	GND	Ground
—	—	6	NC	No Connection
4	4	7	IN B	Control Input for Output B
—	—	8	NC	No Connection
—	—	9	NC	No Connection
5	5	10	OUT B	Output B
—	—	11	OUT B	Output B
6	6	12	V <sub>DD</sub>	Supply Input
—	—	13	V <sub>DD</sub>	Supply Input
7	7	14	OUT A	Output A
—	—	15	OUT A	Output A
8	8	16	NC	No Connection
—	PAD	—	NC	Exposed Metal Pad

**Note 1:** Duplicate pins must be connected for proper operation.

#### 3.1 Supply Input (V<sub>DD</sub>)

V<sub>DD</sub> is the bias supply input for the MOSFET driver and has a voltage range of 4.5V to 18V. This input must be decoupled to ground with a local capacitor. This bypass capacitor provides a localized low-impedance path for the peak currents that are to be provided to the load.

#### 3.2 Control Inputs A and B

The MOSFET driver input is a high-impedance, TTL/CMOS-compatible input. The input also has hysteresis between the high and low input levels, allowing them to be driven from slow rising and falling signals, and to provide noise immunity.

#### 3.3 Ground (GND)

Ground is the device return pin. The ground pin should have a low impedance connection to the bias supply source return. High peak currents will flow out the ground pin when the capacitive load is being discharged.

#### 3.4 Outputs A and B

Outputs A and B are CMOS push-pull output that is capable of sourcing and sinking 4.5A of peak current (V<sub>DD</sub> = 18V). The low output impedance ensures the gate of the external MOSFET will stay in the intended state even during large transients. These output also has a reverse current latch-up rating of 1.5A.

#### 3.5 Exposed Metal Pad

The exposed metal pad of the DFN package is not internally connected to any potential. Therefore, this pad can be connected to a ground plane or other copper plane on a printed circuit board to aid in heat removal from the package.

# MCP1403/4/5

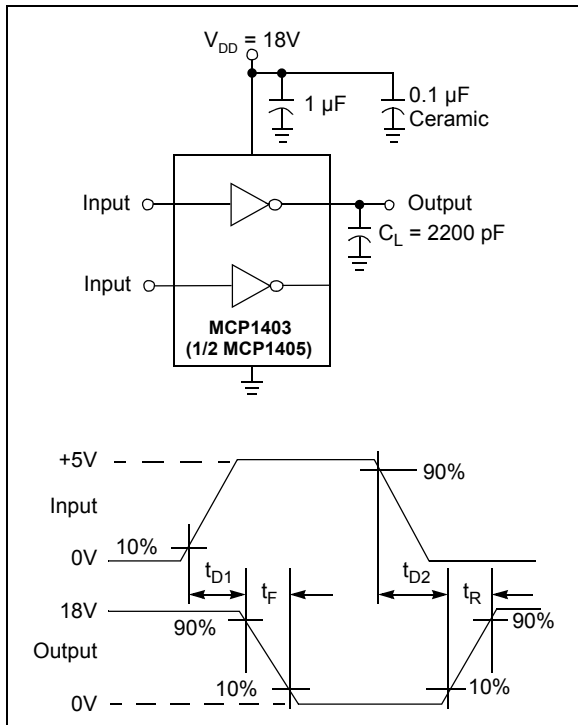
## 4.0 APPLICATION INFORMATION

### 4.1 General Information

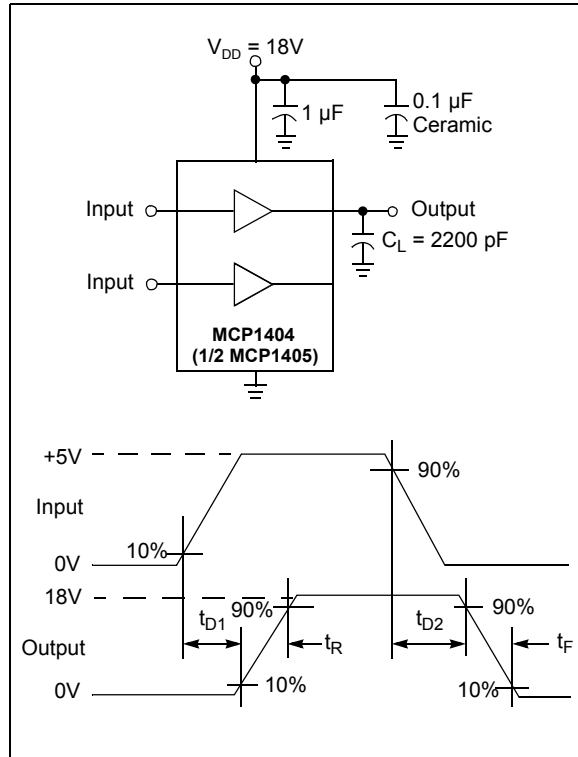
MOSFET drivers are high-speed, high current devices which are intended to source/sink high peak currents to charge/discharge the gate capacitance of external MOSFETs or IGBTs. In high frequency switching power supplies, the PWM controller may not have the drive capability to directly drive the power MOSFET. A MOSFET driver like the MCP1403/4/5 family can be used to provide additional source/sink current capability.

### 4.2 MOSFET Driver Timing

The ability of a MOSFET driver to transition from a fully off state to a fully on state are characterized by the drivers rise time ( $t_R$ ), fall time ( $t_F$ ), and propagation delays ( $t_{D1}$  and  $t_{D2}$ ). The MCP1403/4/5 family of drivers can typically charge and discharge a 2200 pF load capacitance in 15 ns along with a typical matched propagation delay of 40 ns. [Figure 4-1](#) and [Figure 4-2](#) show the test circuit and timing waveform used to verify the MCP1403/4/5 timing.



**FIGURE 4-1:** Inverting Driver Timing Waveform.



**FIGURE 4-2:** Non-Inverting Driver Timing Waveform.

### 4.3 Decoupling Capacitors

Careful layout and decoupling capacitors are highly recommended when using MOSFET drivers. Large currents are required to charge and discharge capacitive loads quickly. For example, 2.5A are needed to charge a 2200 pF load with 18V in 16 ns.

To operate the MOSFET driver over a wide frequency range with low supply impedance a ceramic and low ESR film capacitor are recommended to be placed in parallel between the driver  $V_{DD}$  and GND. A 1.0  $\mu\text{F}$  low ESR film capacitor and a 0.1  $\mu\text{F}$  ceramic capacitor placed between  $V_{DD}$  and GND pins should be used. These capacitors should be placed close to the driver to minimized circuit board parasitics and provide a local source for the required current.

### 4.4 PCB Layout Considerations

Proper PCB layout is important in a high current, fast switching circuit to provide proper device operation and robustness of design. PCB trace loop area and inductance should be minimized by the use of ground planes or trace under MOSFET gate drive signals, separate analog and power grounds, and local driver decoupling.

Placing a ground plane beneath the MCP1403/4/5 will help as a radiated noise shield as well as providing some heat sinking for power dissipated within the device.

#### 4.5 Power Dissipation

The total internal power dissipation in a MOSFET driver is the summation of three separate power dissipation elements.

$$P_T = P_L + P_Q + P_{CC}$$

Where:

$P_T$  = Total power dissipation

$P_L$  = Load power dissipation

$P_Q$  = Quiescent power dissipation

$P_{CC}$  = Operating power dissipation

##### 4.5.1 CAPACITIVE LOAD DISSIPATION

The power dissipation caused by a capacitive load is a direct function of frequency, total capacitive load, and supply voltage. The power lost in the MOSFET driver for a complete charging and discharging cycle of a MOSFET is:

$$P_L = f \times C_T \times V_{DD}^2$$

Where:

f = Switching frequency

$C_T$  = Total load capacitance

$V_{DD}$  = MOSFET driver supply voltage

##### 4.5.2 QUIESCENT POWER DISSIPATION

The power dissipation associated with the quiescent current draw depends upon the state of the input pin. The MCP1403/4/5 devices have a quiescent current draw when both inputs are high of 1.0 mA (typ) and 0.15 mA (typ) when both inputs are low. The quiescent power dissipation is:

$$P_Q = (I_{QH} \times D + I_{QL} \times (1 - D)) \times V_{DD}$$

Where:

$I_{QH}$  = Quiescent current in the high state

D = Duty cycle

$I_{QL}$  = Quiescent current in the low state

$V_{DD}$  = MOSFET driver supply voltage

##### 4.5.3 OPERATING POWER DISSIPATION

The operating power dissipation occurs each time the MOSFET driver output transitions because for a very short period of time both MOSFETs in the output stage are on simultaneously. This cross-conduction current leads to a power dissipation describes as:

$$P_{CC} = CC \times f \times V_{DD}$$

Where:

CC = Cross-conduction constant (A\*sec)

f = Switching frequency

$V_{DD}$  = MOSFET driver supply voltage

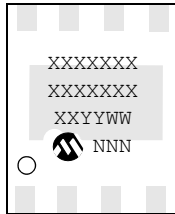


# MCP1403/4/5

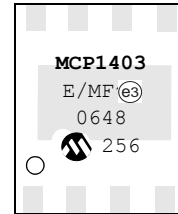
## 5.0 PACKAGING INFORMATION

### 5.1 Package Marking Information (Not to Scale)

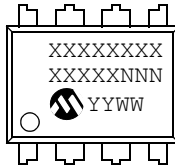
8-Lead DFN



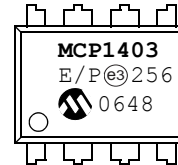
Example:



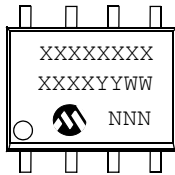
8-Lead PDIP (300 mil)



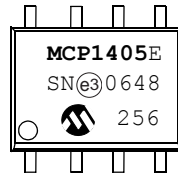
Example:



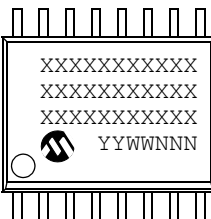
8-Lead SOIC (150 mil)



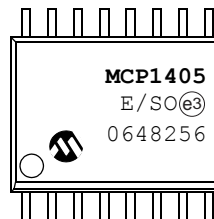
Example:



16-Lead SOIC (300 mil)



Example:

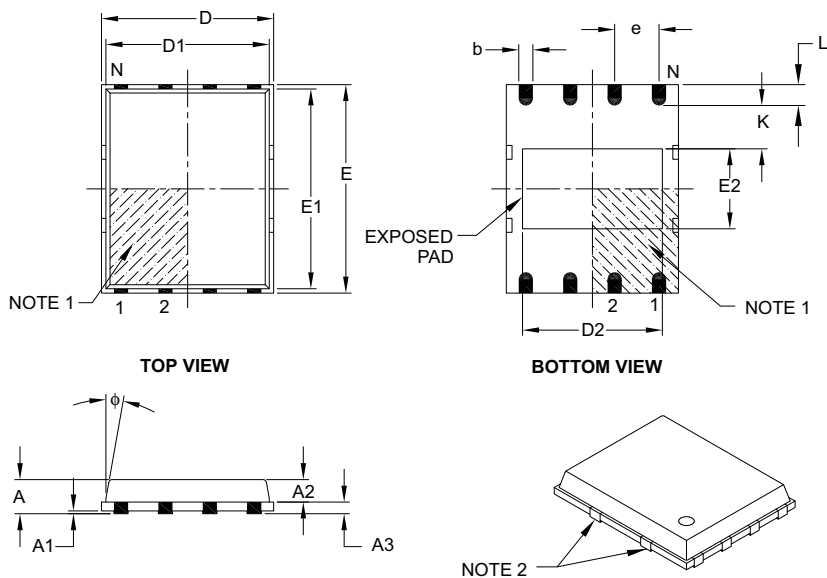


<b>Legend:</b>	XX...X	Customer-specific information
	Y	Year code (last digit of calendar year)
	YY	Year code (last 2 digits of calendar year)
	WW	Week code (week of January 1 is week '01')
	NNN	Alphanumeric traceability code
	(e3)	Pb-free JEDEC designator for Matte Tin (Sn)
	*	This package is Pb-free. The Pb-free JEDEC designator (e3) can be found on the outer packaging for this package.

**Note:** In the event the full Microchip part number cannot be marked on one line, it will be carried over to the next line, thus limiting the number of available characters for customer-specific information.

**8-Lead Plastic Dual Flat, No Lead Package (MF) – 6x5 mm Body [DFN-S]  
PUNCH SINGULATED**

**Note:** For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>



Dimension Limits	Units	MILLIMETERS		
		MIN	NOM	MAX
Number of Pins	N	8		
Pitch	e	1.27 BSC		
Overall Height	A	–	0.85	1.00
Molded Package Thickness	A2	–	0.65	0.80
Standoff	A1	0.00	0.01	0.05
Base Thickness	A3	0.20 REF		
Overall Length	D	4.92 BSC		
Molded Package Length	D1	4.67 BSC		
Exposed Pad Length	D2	3.85	4.00	4.15
Overall Width	E	5.99 BSC		
Molded Package Width	E1	5.74 BSC		
Exposed Pad Width	E2	2.16	2.31	2.46
Contact Width	b	0.35	0.40	0.47
Contact Length	L	0.50	0.60	0.75
Contact-to-Exposed Pad	K	0.20	–	–
Model Draft Angle Top	$\phi$	–	–	12°

**Notes:**

- Pin 1 visual index feature may vary, but must be located within the hatched area.
- Package may have one or more exposed tie bars at ends.
- Dimensioning and tolerancing per ASME Y14.5M.

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

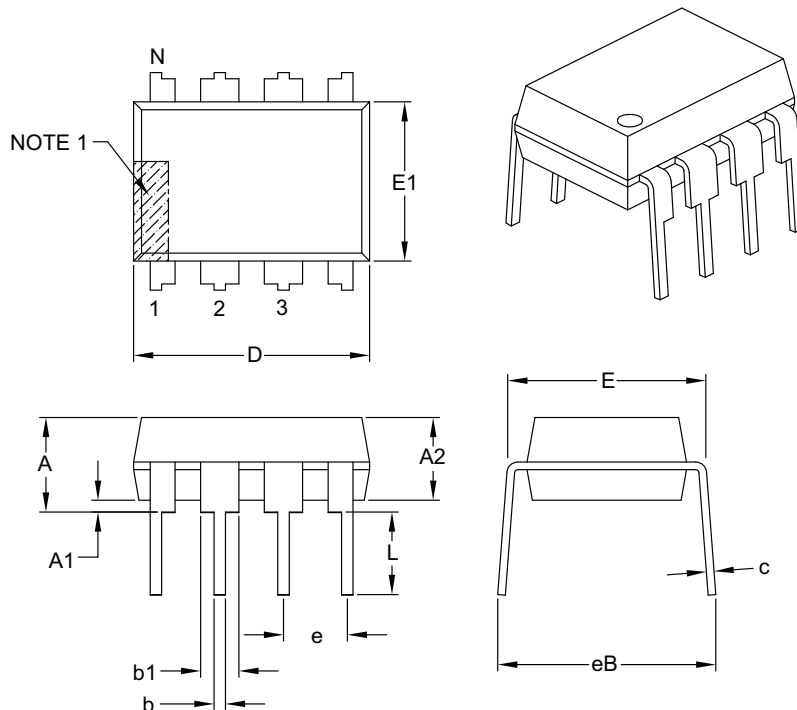
REF: Reference Dimension, usually without tolerance, for information purposes only.

Microchip Technology Drawing C04-113B

# MCP1403/4/5

## 8-Lead Plastic Dual In-Line (P) – 300 mil Body [PDIP]

**Note:** For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>



		Units	INCHES		
Dimension Limits			MIN	NOM	MAX
Number of Pins	N		8		
Pitch	e		.100 BSC		
Top to Seating Plane	A	–	–		.210
Molded Package Thickness	A2	.115	.130		.195
Base to Seating Plane	A1	.015	–		–
Shoulder to Shoulder Width	E	.290	.310		.325
Molded Package Width	E1	.240	.250		.280
Overall Length	D	.348	.365		.400
Tip to Seating Plane	L	.115	.130		.150
Lead Thickness	c	.008	.010		.015
Upper Lead Width	b1	.040	.060		.070
Lower Lead Width	b	.014	.018		.022
Overall Row Spacing §	eB	–	–		.430

### Notes:

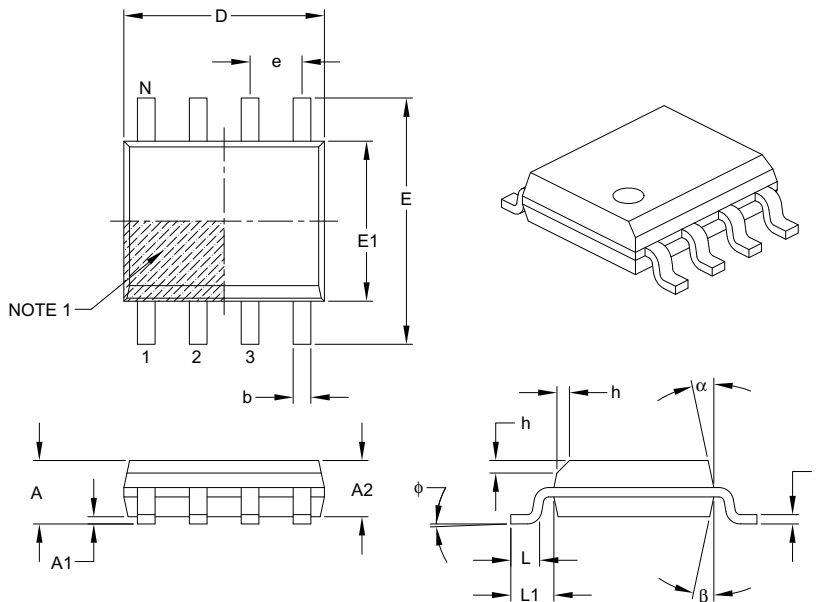
- Pin 1 visual index feature may vary, but must be located with the hatched area.
- § Significant Characteristic.
- Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed .010" per side.
- Dimensioning and tolerancing per ASME Y14.5M.

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

Microchip Technology Drawing C04-018B

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

**Note:** For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>



Dimension Limits	Units	MILLIMETERS		
		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	$\phi$	0°	–	8°
Lead Thickness	c	0.17	–	0.25
Lead Width	b	0.31	–	0.51
Mold Draft Angle Top	$\alpha$	5°	–	15°
Mold Draft Angle Bottom	$\beta$	5°	–	15°

**Notes:**

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

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

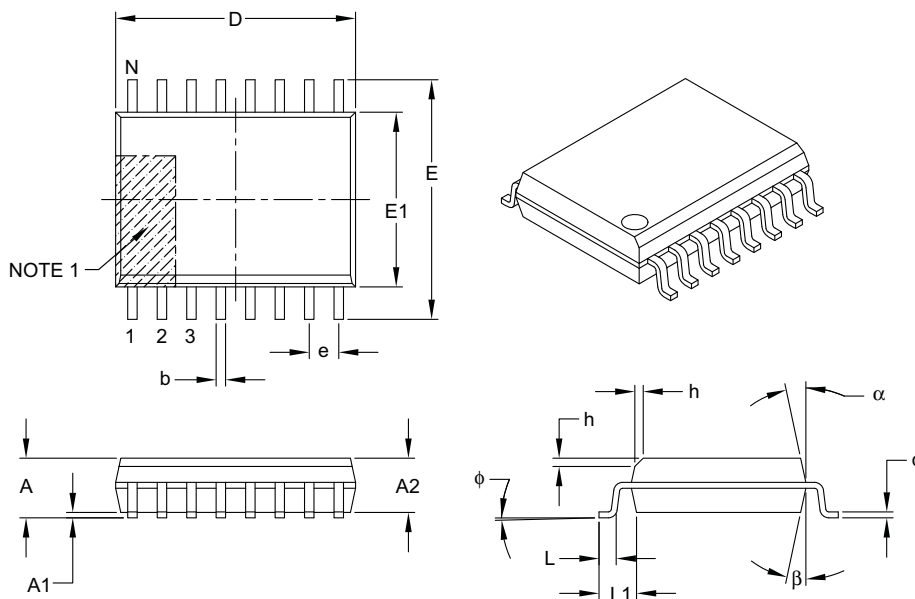
REF: Reference Dimension, usually without tolerance, for information purposes only.

Microchip Technology Drawing C04-057B

# MCP1403/4/5

## 16-Lead Plastic Small Outline (SO) – Wide, 7.50 mm Body [SOIC]

**Note:** For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>



Dimension Limits	Units	MILLIMETERS		
		MIN	NOM	MAX
Number of Pins	N	16		
Pitch	e	1.27 BSC		
Overall Height	A	–	–	2.65
Molded Package Thickness	A2	2.05	–	–
Standoff §	A1	0.10	–	0.30
Overall Width	E	10.30 BSC		
Molded Package Width	E1	7.50 BSC		
Overall Length	D	10.30 BSC		
Chamfer (optional)	h	0.25	–	0.75
Foot Length	L	0.40	–	1.27
Footprint	L1	1.40 REF		
Foot Angle	$\phi$	0°	–	8°
Lead Thickness	c	0.20	–	0.33
Lead Width	b	0.31	–	0.51
Mold Draft Angle Top	$\alpha$	5°	–	15°
Mold Draft Angle Bottom	$\beta$	5°	–	15°

### Notes:

- Pin 1 visual index feature may vary, but must be located within the hatched area.
- § Significant Characteristic.
- Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.15 mm per side.
- 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 C04-102B



## APPENDIX A: REVISION HISTORY

### Revision B (May 2007)

- Page 13: Updated Package Outline Drawing
- Page 14: Updated Package Outline Drawing
- Page 15: Updated Package Outline Drawing
- Page 16: Updated Package Outline Drawing
- Page 17: Updated Revision History
- Page 19: Corrected Package Codes in Product Identification System

### Revision A (December 2006)

- Original Release of this Document.

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NOTES:

**PRODUCT IDENTIFICATION SYSTEM**

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

<u>PART NO.</u>	<u>X</u>	<u>XX</u>	<b>Examples:</b>
Device	Temperature Range	Package	
Device:	MCP1403: 4.5A Dual MOSFET Driver, Inverting		a) MCP1403-E/SN: 4.5A Dual Inverting MOSFET Driver, 8LD SOIC package.
	MCP1403T: 4.5A Dual MOSFET Driver, Inverting (Tape and Reel)		b) MCP1403-E/P: 4.5A Dual Inverting MOSFET Driver, 8LD PDIP package.
	MCP1404: 4.5A Dual MOSFET Driver, Non-Inverting		c) MCP1403-E/MF: 4.5A Dual Inverting MOSFET Driver, 8LD DFN package.
	MCP1404T: 4.5A Dual MOSFET Driver, Non-Inverting (Tape and Reel)		d) MCP1403-E/SO: 4.5A Dual Inverting MOSFET Driver, 16LD SOIC package.
	MCP1405: 4.5A Dual MOSFET Driver, Complementary		a) MCP1404T-E/SN: Tape and Reel, 4.5A Dual Non-Inverting, MOSFET Driver, 8LD SOIC package,
	MCP1405T: 4.5A Dual MOSFET Driver, Complementary (Tape and Reel)		b) MCP1404-E/P: 4.5A Dual Non-Inverting, MOSFET Driver, 8LD PDIP package.
Temperature Range:	E = -40°C to +125°C		a) MCP1405-E/SN: 4.5A Dual Complementary, MOSFET Driver, 8LD SOIC package.
Package: *	MF = Dual, Flat, No-Lead (6x5 mm Body), 8-lead		b) MCP1405-E/P: 4.5A Dual Complementary, MOSFET Driver, 8LD PDIP package.
	P = Plastic DIP, (300 mil body), 8-lead		c) MCP1405T-E/SO: Tape and Reel, 4.5A Dual Complementary MOSFET Driver, 16LD SOIC package.
	SN = Plastic SOIC (150 mil Body), 8-Lead		
	SO = Plastic SOIC (Wide), 16-Lead		
	* All package offerings are Pb Free (Lead Free)		

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NOTES:

**Note the following details of the code protection feature on Microchip devices:**

- Microchip products meet the specification contained in their particular Microchip Data Sheet.
- Microchip believes that its family of products is one of the most secure families of its kind on the market today, when used in the intended manner and under normal conditions.
- There are dishonest and possibly illegal methods used to breach the code protection feature. All of these methods, to our knowledge, require using the Microchip products in a manner outside the operating specifications contained in Microchip's Data Sheets. Most likely, the person doing so is engaged in theft of intellectual property.
- Microchip is willing to work with the customer who is concerned about the integrity of their code.
- Neither Microchip nor any other semiconductor manufacturer can guarantee the security of their code. Code protection does not mean that we are guaranteeing the product as "unbreakable."

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