MICROCHIP TC4423/TC4424/TC4425

3A Dual High-Speed Power MOSFET Drivers

Features

- High Peak Output Current: 3A
- Wide Input Supply Voltage Operating Range:
  - 4.5V to 18V
- High Capacitive Load Drive Capability:
  - 1800 pF in 25 ns
- Short Delay Times: <40 ns (typ)
- Matched Rise/Fall Times
- Low Supply Current:
  - With Logic '1' Input – 3.5 mA (Max)
  - With Logic '0' Input – 350 µA (Max)
- Low Output Impedance: 3.5Ω (typ)
- Latch-Up Protected: Will Withstand 1.5A Reverse Current
- Logic Input Will Withstand Negative Swing Up To 5V
- ESD Protected: 4 kV
- Pin compatible with the TC1426/TC1427/TC1428, TC4426/TC4427/TC4428 and TC4426A/TC4427A/TC4428A devices.
- Space-saving 8-Pin 6x5 DFN Package

Applications

- Switch Mode Power Supplies
- Pulse Transformer Drive
- Line Drivers

General Description

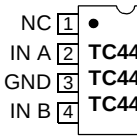
The TC4423/TC4424/TC4425 devices are a family of 3A, dual-output buffers/MOSFET drivers. Pin compatible with the TC1426/27/28, TC4426/27/28 and TC4426A/27A/28A dual 1.5A driver families, the TC4423/24/25 family has an increased latch-up current rating of 1.5A, making them even more robust for operation in harsh electrical environments.

As MOSFET drivers, the TC4423/TC4424/TC4425 can easily charge 1800 pF gate capacitance in under 35 nsec, providing low enough impedances in both the on and off states to ensure the MOSFET's intended state will not be affected, even by large transients.

The TC4423/TC4424/TC4425 inputs may be driven directly from either TTL or CMOS (2.4V to 18V). In addition, the 300 mV of built-in hysteresis provides noise immunity and allows the device to be driven from slowly rising or falling waveforms.

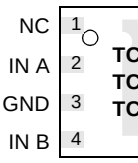
Package Types(1)

8-Pin PDIP



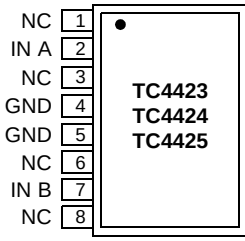
	TC4423	TC4424	TC4425
1	NC	NC	NC
2	$\overline{\text{OUT A}}$	OUT A	$\overline{\text{OUT A}}$
3	V_{DD}	V_{DD}	V_{DD}
4	$\overline{\text{OUT B}}$	OUT B	OUT B

8-Pin DFN(2)



	TC4423	TC4424	TC4425
1	NC	NC	NC
2	$\overline{\text{OUT A}}$	OUT A	$\overline{\text{OUT A}}$
3	V_{DD}	V_{DD}	V_{DD}
4	$\overline{\text{OUT B}}$	OUT B	OUT B

16-Pin SOIC (Wide)

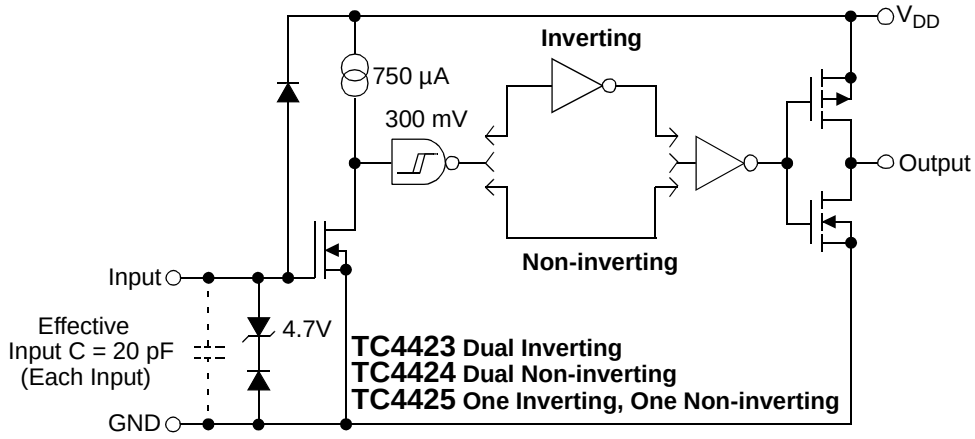


	TC4423	TC4424	TC4425
1	NC	NC	NC
2	$\overline{\text{OUT A}}$	OUT A	$\overline{\text{OUT A}}$
3	$\overline{\text{OUT A}}$	OUT A	$\overline{\text{OUT A}}$
4	V_{DD}	V_{DD}	V_{DD}
5	V_{DD}	V_{DD}	V_{DD}
6	$\overline{\text{OUT B}}$	OUT B	OUT B
7	$\overline{\text{OUT B}}$	OUT B	OUT B
8	NC	NC	NC

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

2: Exposed pad of the DFN package is electrically isolated.

Functional Block Diagram(1)



Note 1: Unused inputs should be grounded.

1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings †

Supply Voltage .....+22V
Input Voltage, IN A or IN B
.....(V_{DD} + 0.3V) to (GND – 5V)
Package Power Dissipation ($T_A \leq 70°C$)
DFN ..... **Note 2**
PDIP .....730 mW
SOIC.....470 mW

† **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

Electrical Specifications: Unless otherwise indicated, T_A = +25°C, with 4.5V $\leq V_{DD} \leq$ 18V.						
Parameters	**Sym**	**Min**	**Typ**	**Max**	**Units**	**Conditions**
Input						
Logic '1', High Input Voltage	V_{IH}	2.4	—	—	V	
Logic '0', Low Input Voltage	V_{IL}	—	—	0.8	V	
Input Current	I_{IN}	–1	—	1	µA	$0V \leq V_{IN} \leq V_{DD}$
Output						
High Output Voltage	V_{OH}	V_{DD} – 0.025	—	—	V	
Low Output Voltage	V_{OL}	—	—	0.025	V	
Output Resistance, High	R_{OH}	—	2.8	5	Ω	I_{OUT} = 10 mA, V_{DD} = 18V
Output Resistance, Low	R_{OL}	—	3.5	5	Ω	I_{OUT} = 10 mA, V_{DD} = 18V
Peak Output Current	I_{PK}	—	3	—	A	
Latch-Up Protection With-stand Reverse Current	I_{REV}	—	>1.5	—	A	Duty cycle ≤ 2%, t ≤ 300 µsec.
Switching Time (Note 1)						
Rise Time	t_R	—	23	35	ns	**Figure 4-1**, **Figure 4-2**, C_L = 1800 pF
Fall Time	t_F	—	25	35	ns	**Figure 4-1**, **Figure 4-2**, C_L = 1800 pF
Delay Time	t_{D1}	—	33	75	ns	**Figure 4-1**, **Figure 4-2**, C_L = 1800 pF
Delay Time	t_{D2}	—	38	75	ns	**Figure 4-1**, **Figure 4-2**, C_L = 1800 pF
Power Supply						
Power Supply Current	I_S	— —	1.5 0.15	2.5 0.25	mA	V_{IN} = 3V (Both inputs) V_{IN} = 0V (Both inputs)

Note 1: Switching times ensured by design.

2: Package power dissipation is dependent on the copper pad area on the PCB.

DC CHARACTERISTICS (OVER OPERATING TEMPERATURE RANGE)

Electrical Specifications: Unless otherwise indicated, operating temperature range with 4.5V ≤ V_{DD} ≤ 18V.

Parameters	Sym	Min	Typ	Max	Units	Conditions
Input						
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	µA	0V ≤ V_{IN} ≤ V_{DD}
Output						
High Output Voltage	V_{OH}	V_{DD} – 0.025	—	—	V	
Low Output Voltage	V_{OL}	—	—	0.025	V	
Output Resistance, High	R_{OH}	—	3.7	8	Ω	I_{OUT} = 10 mA, V_{DD} = 18V
Output Resistance, Low	R_{OL}	—	4.3	8	Ω	I_{OUT} = 10 mA, V_{DD} = 18V
Peak Output Current	I_{PK}	—	3.0	—	A	
Latch-Up Protection Withstand Reverse Current	I_{REV}	—	>1.5	—	A	Duty cycle ≤ 2%, t ≤ 300 µsec
Switching Time (Note 1)						
Rise Time	t_R	—	28	60	ns	**Figure 4-1**, **Figure 4-2**, C_L = 1800 pF
Fall Time	t_F	—	32	60	ns	**Figure 4-1**, **Figure 4-2**, C_L = 1800 pF
Delay Time	t_{D1}	—	32	100	ns	**Figure 4-1**, **Figure 4-2**, C_L = 1800 pF
Delay Time	t_{D2}	—	38	100	ns	**Figure 4-1**, **Figure 4-2**, C_L = 1800 pF
Power Supply						
Power Supply Current	I_S	— —	2.0 0.2	3.5 0.3	mA	V_{IN} = 3V (Both inputs) V_{IN} = 0V (Both inputs)

Note 1: Switching times ensured by design.

TEMPERATURE CHARACTERISTICS

Electrical Specifications: Unless otherwise noted, all parameters apply with 4.5V ≤ V_{DD} ≤ 18V.

Parameters	Sym	Min	Typ	Max	Units	Conditions
Temperature Ranges						
Specified Temperature Range (C)	T_A	0	—	+70	°C	
Specified Temperature Range (E)	T_A	–40	—	+85	°C	
Specified Temperature Range (V)	T_A	–40	—	+125	°C	
Maximum Junction Temperature	T_J	—	—	+150	°C	
Storage Temperature Range	T_A	–65	—	+150	°C	
Package Thermal Resistances						
Thermal Resistance, 8L-6x5 DFN	θ_{JA}	—	33.2	—	°C/W	Typical four-layer board with vias to ground plane
Thermal Resistance, 8L-PDIP	θ_{JA}	—	125	—	°C/W	
Thermal Resistance, 16L-SOIC	θ_{JA}	—	155	—	°C/W	

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.

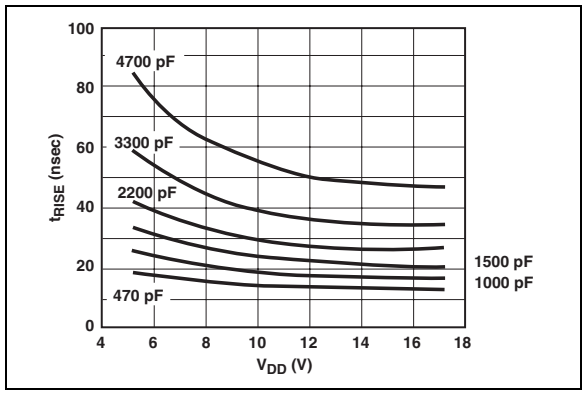


FIGURE 2-1: *Rise Time vs. Supply Voltage.*

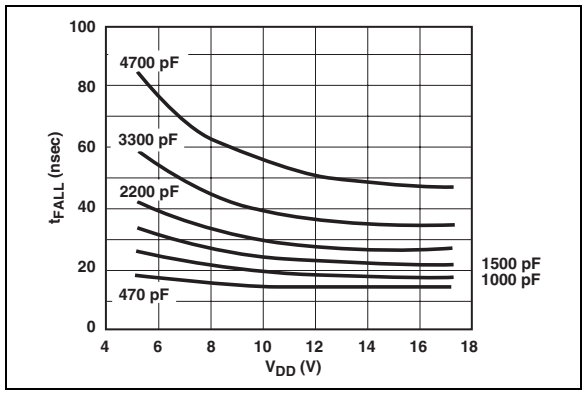


FIGURE 2-4: *Fall Time vs. Supply Voltage.*

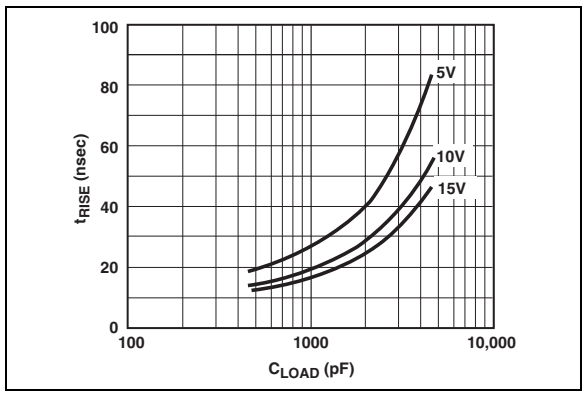


FIGURE 2-2: *Rise Time vs. Capacitive Load.*

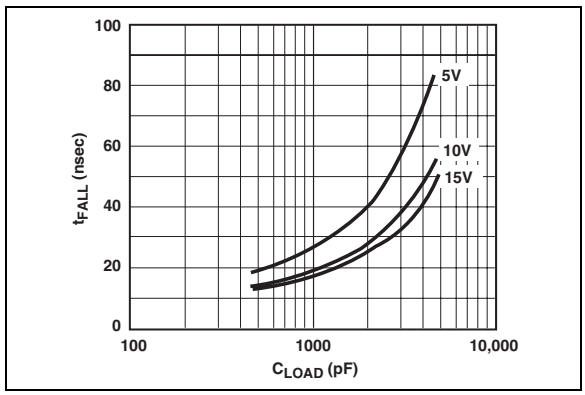


FIGURE 2-5: *Fall Time vs. Capacitive Load.*

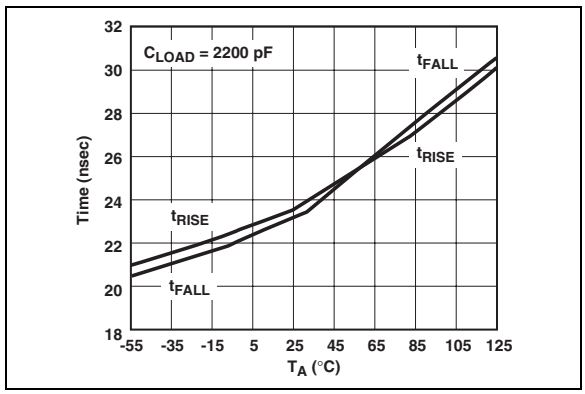


FIGURE 2-3: *Rise and Fall Times vs. Temperature.*

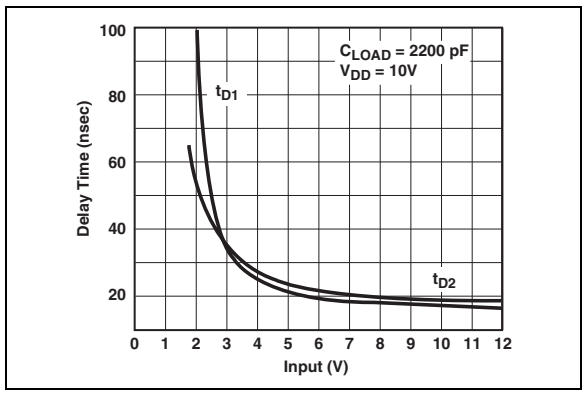


FIGURE 2-6: *Propagation Delay vs. Input Amplitude.*

Typical Performance Curves (Continued)

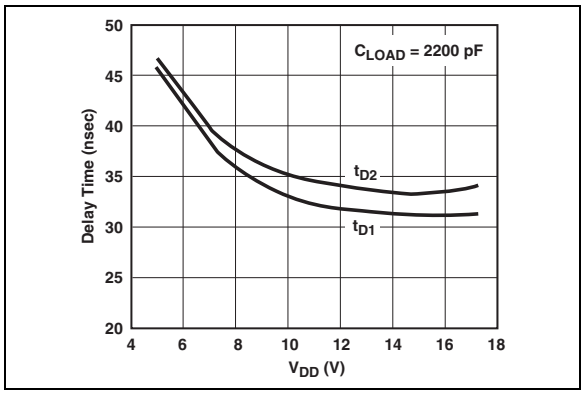


FIGURE 2-7: *Propagation Delay Time vs. Supply Voltage.*

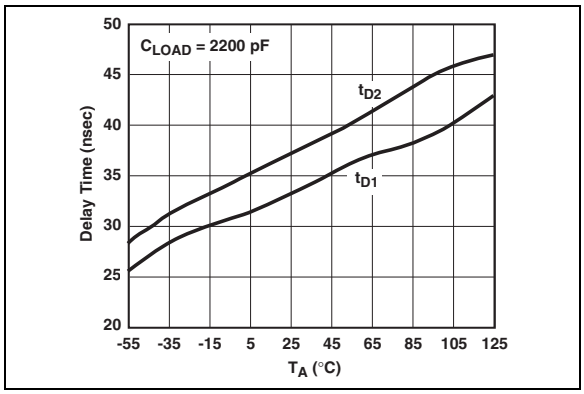


FIGURE 2-10: *Propagation Delay Time vs. Temperature.*

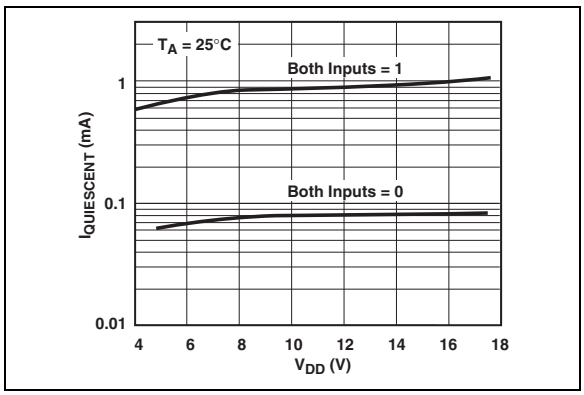


FIGURE 2-8: *Quiescent Current vs. Supply Voltage.*

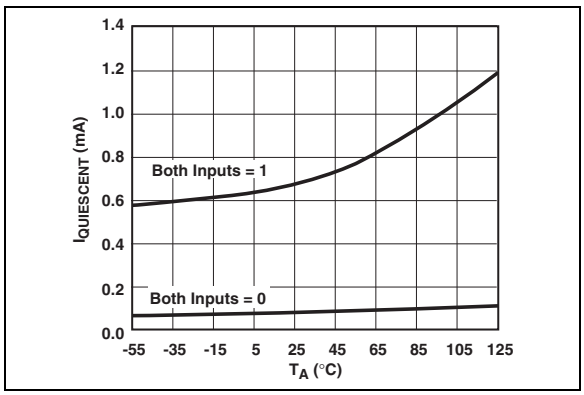


FIGURE 2-11: *Quiescent Current vs. Temperature.*

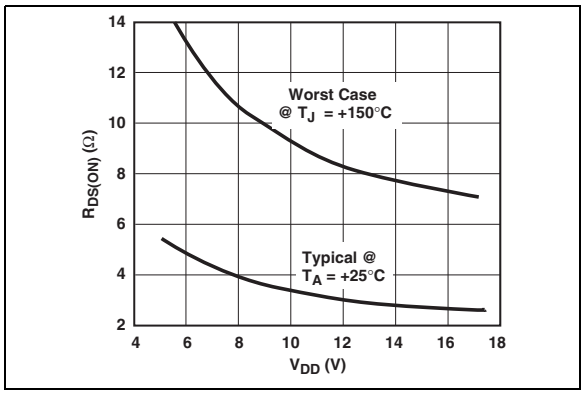


FIGURE 2-9: *Output Resistance (Output High) vs. Supply Voltage.*

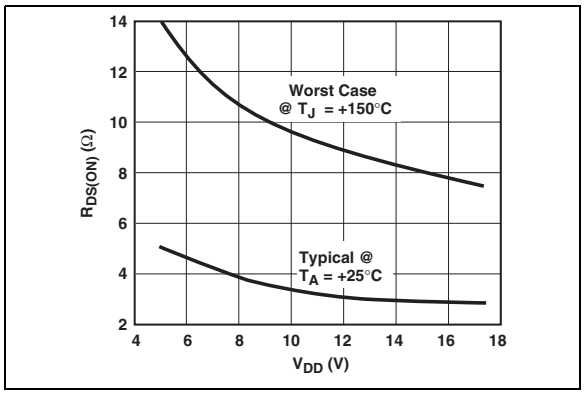


FIGURE 2-12: *Output Resistance (Output Low) vs. Supply Voltage.*

Typical Performance Curves (Continued)

Note: Load on single output only

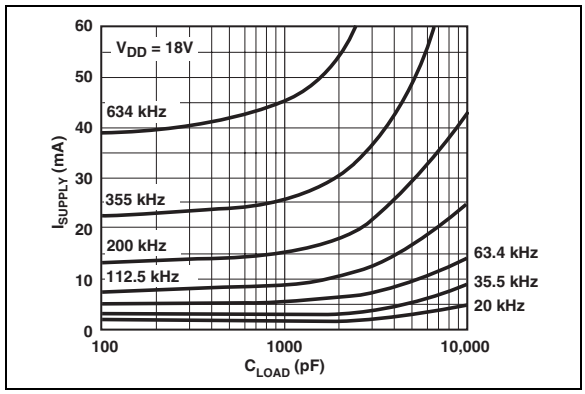


FIGURE 2-13: *Supply Current vs. Capacitive Load.*

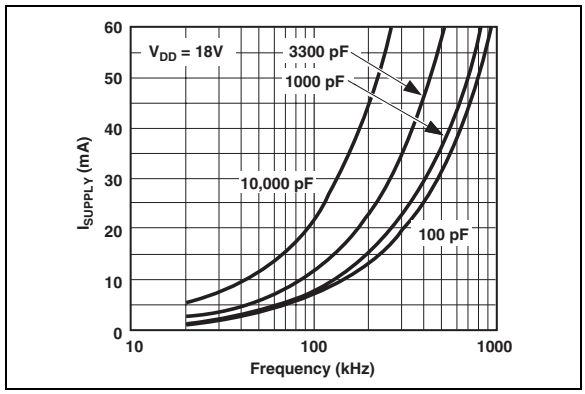


FIGURE 2-16: *Supply Current vs. Frequency.*

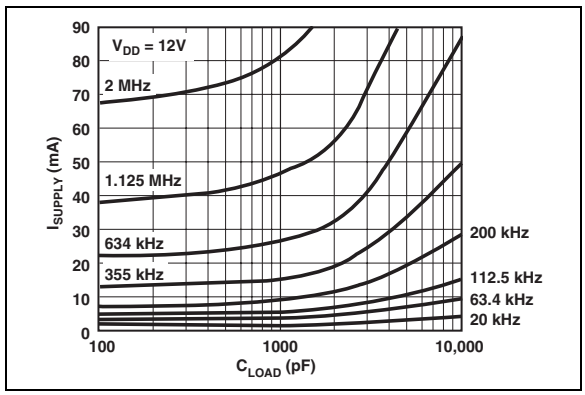


FIGURE 2-14: *Supply Current vs. Capacitive Load.*

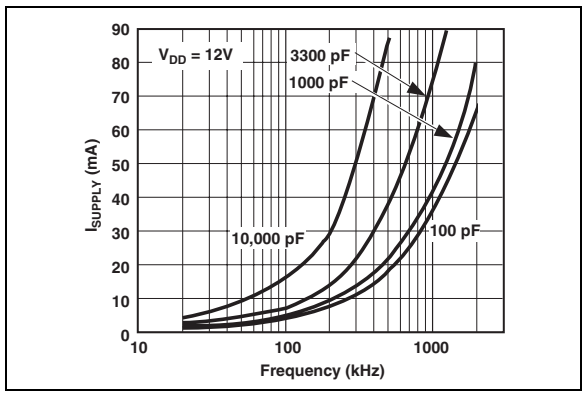


FIGURE 2-17: *Supply Current vs. Frequency.*

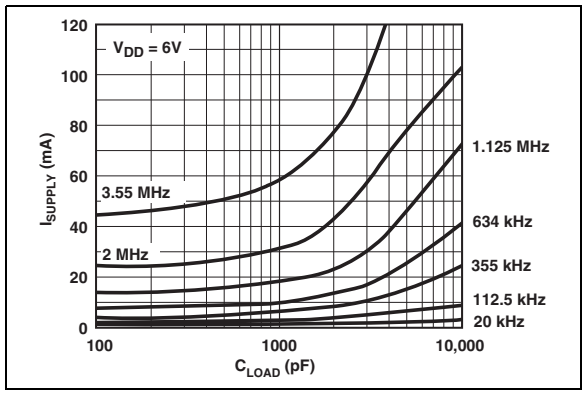


FIGURE 2-15: *Supply Current vs. Capacitive Load.*

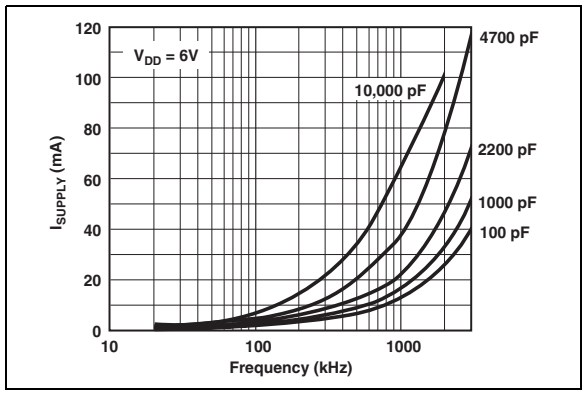
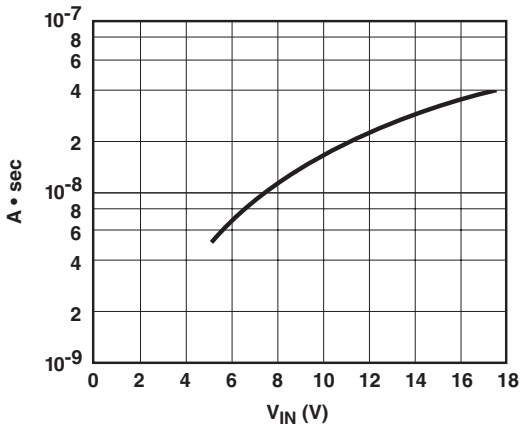


FIGURE 2-18: *Supply Current vs. Frequency.*

Typical Performance Curves (Continued)



Note: The values on this graph represent the loss seen by both drivers in a package during one complete cycle. For a single driver, divide the stated values by 2. For a single transition of a single driver, divide the stated value by 4.

FIGURE 2-19: ***TC4423*** *Crossover Energy.*

3.0 PIN DESCRIPTIONS

The descriptions of the pins are listed in Table 3-1.

TABLE 3-1: PIN FUNCTION TABLE (1)

8-Pin PDIP	8-Pin DFN	16-Pin SOIC (Wide)	Symbol	Description
1	1	1	NC	No connection
2	2	2	IN A	Input A
—	—	3	NC	No connection
3	3	4	GND	Ground
—	—	5	GND	Ground
—	—	6	NC	No connection
4	4	7	IN B	Input 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_{DD}	Supply input
—	—	13	V_{DD}	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 Inputs A and B

Inputs A and B are TTL/CMOS compatible inputs that control outputs A and B, respectively. These inputs have 300 mV of hysteresis between the high and low input levels, allowing them to be driven from slow rising and falling signals, and to provide noise immunity.

3.2 Outputs A and B

Outputs A and B are CMOS push-pull outputs that are capable of sourcing and sinking 3A peaks of current (V_{DD} = 18V). The low output impedance ensures the gate of the external MOSFET will stay in the intended state even during large transients. These outputs also have a reverse current latch-up rating of 1.5A.

3.3 Supply Input (V_{DD})

V_{DD} 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 ceramic capacitor. This bypass capacitor provides a localized low-impedance path for the peak currents that are to be provided to the load.

3.4 Ground (GND)

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

3.5 Exposed Metal Pad

The exposed metal pad of the 6x5 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.

4.0 APPLICATIONS INFORMATION

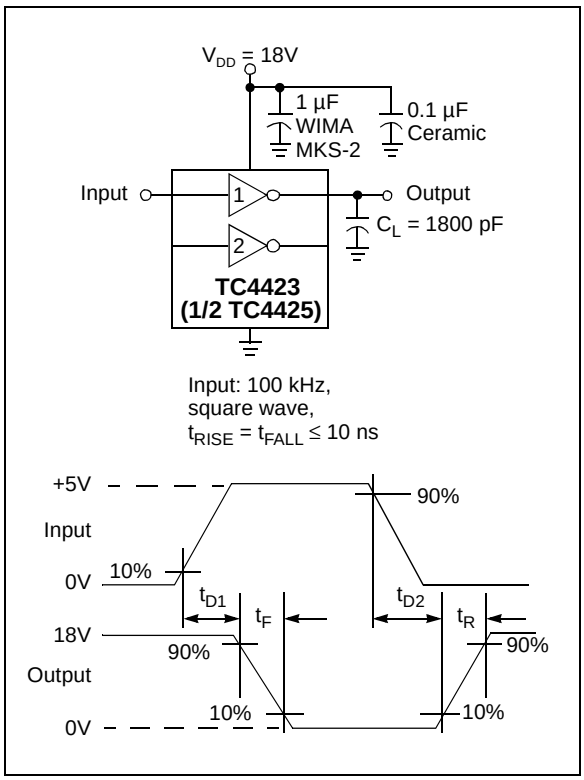


FIGURE 4-1: *Inverting Driver Switching Time.*

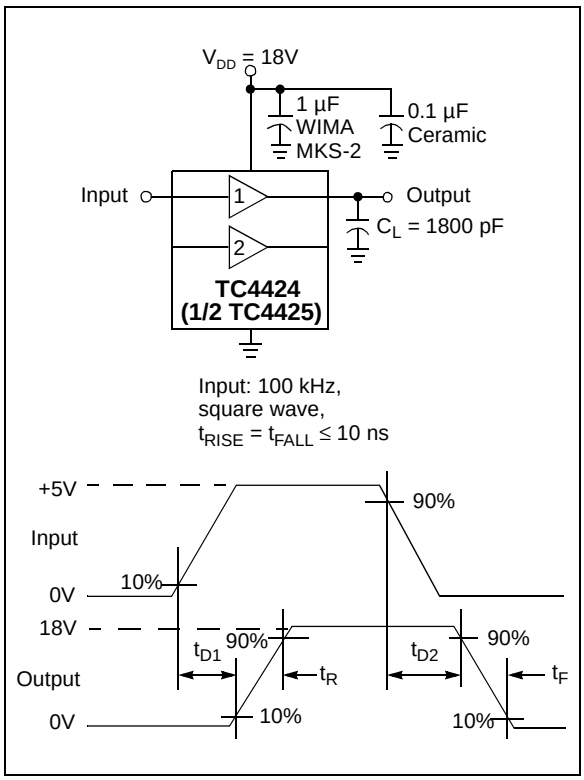
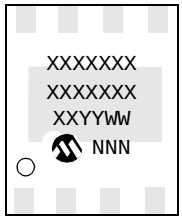


FIGURE 4-2: *Non-inverting Driver Switching Time.*

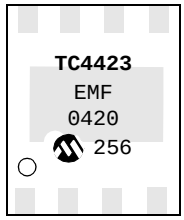
5.0 PACKAGING INFORMATION

5.1 Package Marking Information

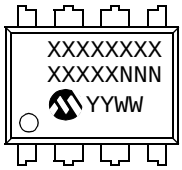
8-Lead DFN



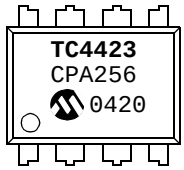
Example:



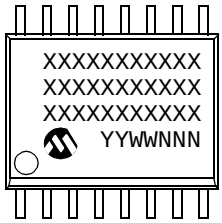
8-Lead PDIP (300 mil)



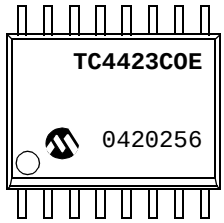
Example:



16-Lead SOIC (300 mil)



Example:

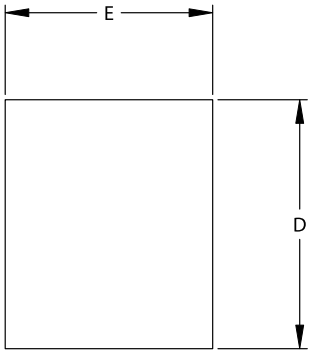


Legend:	XX...X	Customer specific information*
	YY	Year code (last 2 digits of calendar year)
	WW	Week code (week of January 1 is week ‘01’)
	NNN	Alphanumeric traceability code

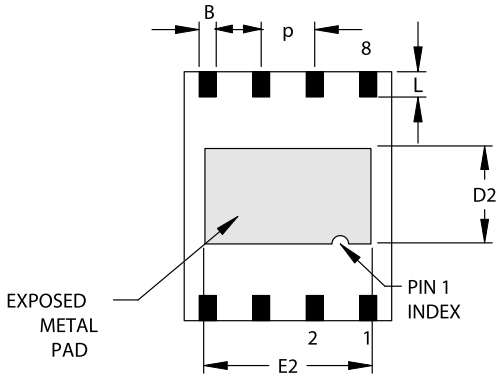
Note: In the event the full Microchip part number cannot be marked on one line, it will be carried over to the next line thus limiting the number of available characters for customer specific information.

***** Standard marking consists of Microchip part number, year code, week code, traceability code (facility code, mask rev#, and assembly code). For marking beyond this, certain price adders apply. Please check with your Microchip Sales Office.

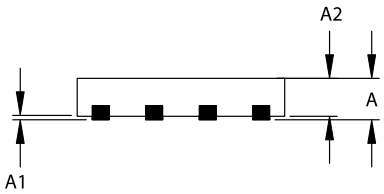
8-Lead Plastic Dual Flat No Lead Package (MF) 6x5 mm Body (DFN-S) – Saw Singulated

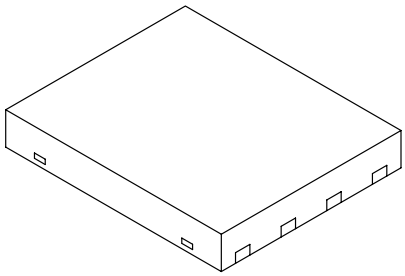


TOP VIEW



BOTTOM VIEW





Units		INCHES			MILLIMETERS*		
Dimension Limits		MIN	NOM	MAX	MIN	NOM	MAX
Number of Pins	n		8			8	
Pitch	p	.050 BSC			1.27 BSC		
Overall Height	A	.033	.035	.037	0.85	0.90	0.95
Package Thickness	A2	.031	.035	.037	0.80	0.89	0.95
Standoff	A1	.000	.0004	.002	0.00	0.01	0.05
Base Thickness	A3	.007	.008	.009	0.17	0.20	0.23
Overall Length	E	.195	.197	.199	4.95	5.00	5.05
Exposed Pad Length	E2	.152	.157	.163	3.85	4.00	4.15
Overall Width	D	.234	.236	.238	5.95	6.00	6.05
Exposed Pad Width	D2	.089	.091	.093	2.25	2.30	2.35
Lead Width	B	.014	.016	.019	0.35	0.40	0.47
Lead Length	L	.024		.026	0.60		0.65

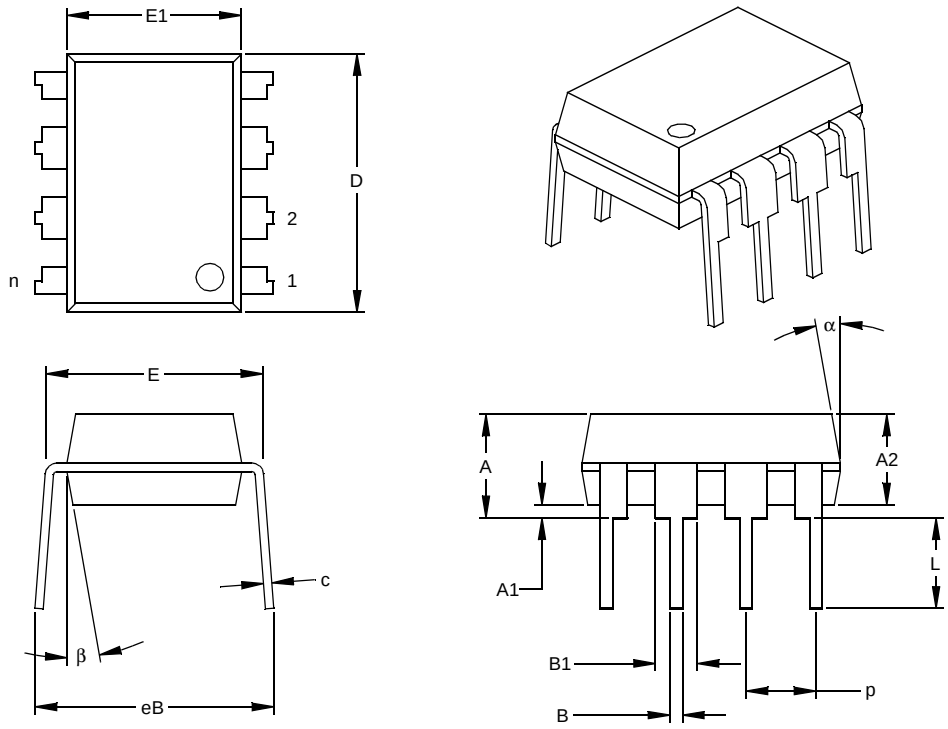
Notes:

JEDEC equivalent: MO-220

Drawing No. C04-122

Revised 11/3/03

8-Lead Plastic Dual In-line (P) – 300 mil (PDIP)

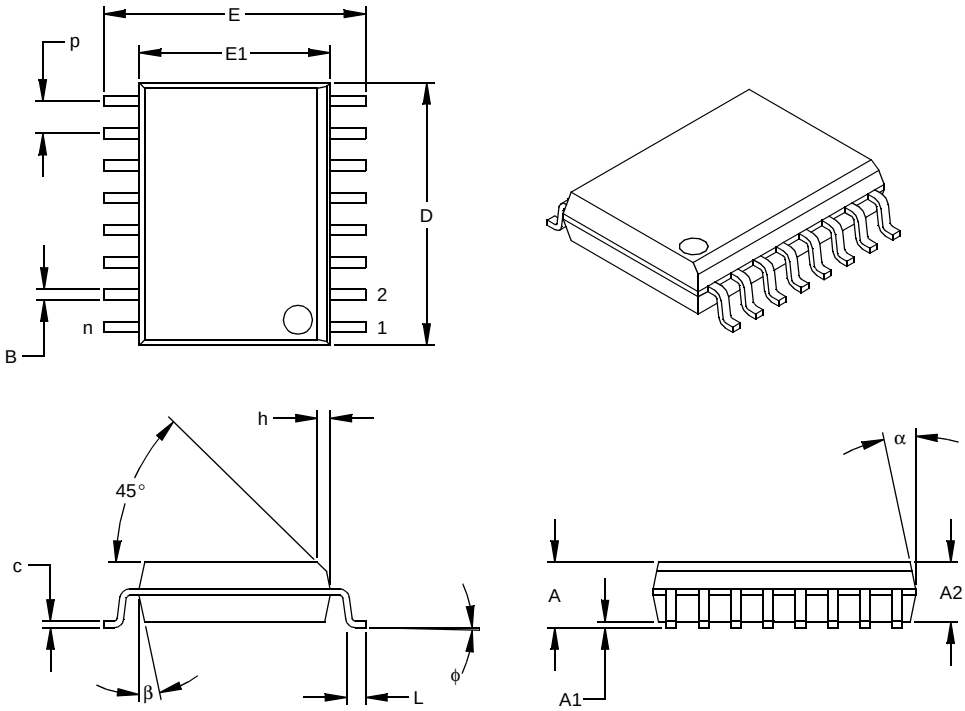


Units		INCHES*			MILLIMETERS		
Dimension Limits		MIN	NOM	MAX	MIN	NOM	MAX
Number of Pins	n		8			8	
Pitch	p		.100			2.54	
Top to Seating Plane	A	.140	.155	.170	3.56	3.94	4.32
Molded Package Thickness	A2	.115	.130	.145	2.92	3.30	3.68
Base to Seating Plane	A1	.015			0.38		
Shoulder to Shoulder Width	E	.300	.313	.325	7.62	7.94	8.26
Molded Package Width	E1	.240	.250	.260	6.10	6.35	6.60
Overall Length	D	.360	.373	.385	9.14	9.46	9.78
Tip to Seating Plane	L	.125	.130	.135	3.18	3.30	3.43
Lead Thickness	c	.008	.012	.015	0.20	0.29	0.38
Upper Lead Width	B1	.045	.058	.070	1.14	1.46	1.78
Lower Lead Width	B	.014	.018	.022	0.36	0.46	0.56
Overall Row Spacing §	eB	.310	.370	.430	7.87	9.40	10.92
Mold Draft Angle Top	α	5	10	15	5	10	15
Mold Draft Angle Bottom	β	5	10	15	5	10	15

* Controlling Parameter
§ Significant Characteristic

Notes:
Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed .010” (0.254mm) per side.
JEDEC Equivalent: MS-001
Drawing No. C04-018

16-Lead Plastic Small Outline (SO) – Wide, 300 mil (SOIC)



Units		INCHES*			MILLIMETERS		
Dimension Limits		MIN	NOM	MAX	MIN	NOM	MAX
Number of Pins	n		16			16	
Pitch	p		.050			1.27	
Overall Height	A	.093	.099	.104	2.36	2.50	2.64
Molded Package Thickness	A2	.088	.091	.094	2.24	2.31	2.39
Standoff §	A1	.004	.008	.012	0.10	0.20	0.30
Overall Width	E	.394	.407	.420	10.01	10.34	10.67
Molded Package Width	E1	.291	.295	.299	7.39	7.49	7.59
Overall Length	D	.398	.406	.413	10.10	10.30	10.49
Chamfer Distance	h	.010	.020	.029	0.25	0.50	0.74
Foot Length	L	.016	.033	.050	0.41	0.84	1.27
Foot Angle	ϕ	0	4	8	0	4	8
Lead Thickness	c	.009	.011	.013	0.23	0.28	0.33
Lead Width	B	.014	.017	.020	0.36	0.42	0.51
Mold Draft Angle Top	α	0	12	15	0	12	15
Mold Draft Angle Bottom	β	0	12	15	0	12	15

* Controlling Parameter
§ Significant Characteristic

Notes:
Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed .010” (0.254mm) per side.
JEDEC Equivalent: MS-013
Drawing No. C04-102

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	XXX	X
Device	Temperature Range	Package	Tape & Reel	PB Free

Device:	TC4423:	3A Dual MOSFET Driver, Inverting
	TC4424:	3A Dual MOSFET Driver, Non-Inverting
	TC4425:	3A Dual MOSFET Driver, Complementary
Temperature Range:	C =	0°C to +70°C (PDIP & SOIC Only)
	E =	-40°C to +85°C
	V =	-40°C to +125°C
Package:	MF =	Dual, Flat, No-Lead (6x5 mm Body), 8-lead
	MF713 =	Dual, Flat, No-Lead (6x5 mm Body), 8-lead (Tape and Reel)
	OE =	SOIC (Wide), 16-pin
	OE713 =	SOIC (Wide), 16-pin (Tape and Reel)
	PA =	Plastic DIP, (300 mil body), 8-lead
PB Free:	G =	Lead-Free device *
	=	Blank

* Available on selected packages. Contact your local sales representative for availability.

Examples:

a) TC4423COE: 3A Dual Inverting MOSFET Driver, 0°C to +70°C, 16LD SOIC package.

b) TC4423CPA: 3A Dual Inverting MOSFET Driver, 0°C to +70°C, 8LD PDIP package.

c) TC4423VMF: 3A Dual Inverting MOSFET Driver, -40°C to +125°C, 8LD DFN package.

a) TC4424COE713: 3A Dual Non-Inverting, MOSFET Driver, 0°C to +70°C, 16LD SOIC package, Tape and Reel.

b) TC4424EPA: 3A Dual Non-Inverting, MOSFET Driver, -40°C to +85°C, 8LD PDIP package.

a) TC4425EOE: 3A Dual Complementary, MOSFET Driver, -40°C to +85°C, 16LD SOIC package.

b) TC4425CPA: 3A Dual Complementary, MOSFET Driver, 0°C to +70°C, PDIP package.

Sales and Support

Data Sheets

Products supported by a preliminary Data Sheet may have an errata sheet describing minor operational differences and recommended workarounds. To determine if an errata sheet exists for a particular device, please contact one of the following:

1. Your local Microchip sales office
2. The Microchip Corporate Literature Center U.S. FAX: (480) 792-7277
3. The Microchip Worldwide Site (www.microchip.com)

Please specify which device, revision of silicon and Data Sheet (include Literature #) you are using.

Customer Notification System

Register on our web site (www.microchip.com/cn) to receive the most current information on our products.

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."

Code protection is constantly evolving. We at Microchip are committed to continuously improving the code protection features of our products. Attempts to break Microchip's code protection feature may be a violation of the Digital Millennium Copyright Act. If such acts allow unauthorized access to your software or other copyrighted work, you may have a right to sue for relief under that Act.

QUALITY MANAGEMENT SYSTEM
CERTIFIED BY DNV
ISO/TS 16949:2002

Microchip received ISO/TS-16949:2002 quality system certification for its worldwide headquarters, design and wafer fabrication facilities in Chandler and Tempe, Arizona and Mountain View, California in October 2003. The Company's quality system processes and procedures are for its PICmicro® 8-bit MCUs, KEELOQ® code hopping devices, Serial EEPROMs, microperipherals, nonvolatile memory and analog products. In addition, Microchip's quality system for the design and manufacture of development systems is ISO 9001:2000 certified.

WORLDWIDE SALES AND SERVICE

AMERICAS

Corporate Office
2355 West Chandler Blvd.
Chandler, AZ 85224-6199
Tel: 480-792-7200
Fax: 480-792-7277
Technical Support:
480-792-7627
Web Address:
www.microchip.com

Atlanta
Alpharetta, GA
Tel: 770-640-0034
Fax: 770-640-0307

Boston
Westford, MA
Tel: 978-692-3848
Fax: 978-692-3821

Chicago
Itasca, IL
Tel: 630-285-0071
Fax: 630-285-0075

Dallas
Addison, TX
Tel: 972-818-7423
Fax: 972-818-2924

Detroit
Farmington Hills, MI
Tel: 248-538-2250
Fax: 248-538-2260

Kokomo
Kokomo, IN
Tel: 765-864-8360
Fax: 765-864-8387

Los Angeles
Mission Viejo, CA
Tel: 949-462-9523
Fax: 949-462-9608

San Jose
Mountain View, CA
Tel: 650-215-1444
Fax: 650-961-0286

Toronto
Mississauga, Ontario,
Canada
Tel: 905-673-0699
Fax: 905-673-6509

ASIA/PACIFIC

Australia - Sydney
Tel: 61-2-9868-6733
Fax: 61-2-9868-6755

China - Beijing
Tel: 86-10-8528-2100
Fax: 86-10-8528-2104

China - Chengdu
Tel: 86-28-8676-6200
Fax: 86-28-8676-6599

China - Fuzhou
Tel: 86-591-750-3506
Fax: 86-591-750-3521

China - Hong Kong SAR
Tel: 852-2401-1200
Fax: 852-2401-3431

China - Shanghai
Tel: 86-21-6275-5700
Fax: 86-21-6275-5060

China - Shenzhen
Tel: 86-755-8290-1380
Fax: 86-755-8295-1393

China - Shunde
Tel: 86-757-2839-5507
Fax: 86-757-2839-5571

China - Qingdao
Tel: 86-532-502-7355
Fax: 86-532-502-7205

ASIA/PACIFIC

India - Bangalore
Tel: 91-80-2229-0061
Fax: 91-80-2229-0062

India - New Delhi
Tel: 91-11-5160-8632
Fax: 91-11-5160-8632

Japan - Kanagawa
Tel: 81-45-471- 6166
Fax: 81-45-471-6122

Korea - Seoul
Tel: 82-2-554-7200
Fax: 82-2-558-5932 or
82-2-558-5934

Singapore
Tel: 65-6334-8870
Fax: 65-6334-8850

Taiwan - Kaohsiung
Tel: 886-7-536-4816
Fax: 886-7-536-4817

Taiwan - Taipei
Tel: 886-2-2500-6610
Fax: 886-2-2508-0102

Taiwan - Hsinchu
Tel: 886-3-572-9526
Fax: 886-3-572-6459

EUROPE

Austria - Weis
Tel: 43-7242-2244-399
Fax: 43-7242-2244-393

Denmark - Ballerup
Tel: 45-4420-9895
Fax: 45-4420-9910

France - Massy
Tel: 33-1-69-53-63-20
Fax: 33-1-69-30-90-79

Germany - Ismaning
Tel: 49-89-627-144-0
Fax: 49-89-627-144-44

Italy - Milan
Tel: 39-0331-742611
Fax: 39-0331-466781

Netherlands - Drunen
Tel: 31-416-690399
Fax: 31-416-690340

England - Berkshire
Tel: 44-118-921-5869
Fax: 44-118-921-5820

08/24/04