

3A High-Speed MOSFET Drivers

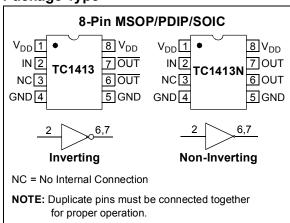
Features

- Latch-Up Protected: Will Withstand 500 mA Reverse Current
- · Input Will Withstand Negative Inputs Up to 5V
- · ESD Protected: 4 kV
- · High Peak Output Current: 3A
- · Wide Input Supply Voltage Operating Range:
 - 4.5V to 16V
- High Capacitive Load Drive Capability:
 - 1800 pF in 20 nsec
- · Short Delay Time: 35 nsec Typ
- · Matched Delay Times
- · Low Supply Current
 - With Logic '1' Input: 500 μA
 With Logic '0' Input: 100 μA
- Low Output Impedance: 2.7Ω
- · Available in Space-Saving 8-pin MSOP Package
- Pinout Same as TC1410/TC1411/TC1412

Applications

- · Switch Mode Power Supplies
- · Line Drivers
- · Pulse Transformer Drive
- · Relay Driver

Package Type

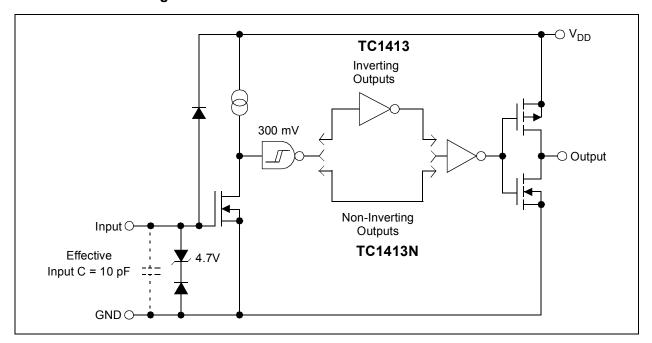


General Description

The TC1413/TC1413N are 3A CMOS buffers/drivers. They will not latch-up 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. They can accept, without damage or logic upset, up to 500 mA of current of either polarity being forced back into their output. All terminals are fully protected against up to 4 kV of electrostatic discharge.

As MOSFET drivers, the TC1413/TC1413N can easily charge an 1800 pF gate capacitance in 20 nsec with matched rise and fall times, and provide low enough impedance in both the ON and the OFF states to ensure the MOSFET's intended state will not be affected, even by large transients. The leading and trailing edge propagation delay times are also matched to allow driving short-duration inputs with greater accuracy.

Functional Block Diagram



1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings†

Supply Voltage+20V
Input Voltage V_{DD} + 0.3V to GND – 5.0V
Power Dissipation (T _A ≤ 70°C)
MSOP340 mW
PDIP730 mW
SOIC470 mW
Storage Temperature Range65°C to +150°C
Maximum Junction Temperature +150°C

[†] Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions above those indicated in the operation sections of the specifications is not implied. Exposure to Absolute Maximum Rating conditions for extended periods may affect device reliability.

PIN FUNCTION TABLE

Symbol	Description					
V _{DD}	Supply input, 4.5V to 16V					
INPUT	Control input					
NC	No connection					
GND	Ground					
GND	Ground					
OUTPUT	CMOS push-pull output, common to pin 7					
OUTPUT	CMOS push-pull output, common to pin 6					
V _{DD}	Supply input, 4.5V to 16V					

DC ELECTRICAL CHARACTERISTICS

Electrical Specifications: Unless otherwise noted, over operating temperature range with 4.5V \leq V_{DD} \leq 16V. Typical values are measured at T_A = +25°C, V_{DD} = 16V.

Typical values are measured at T _A = +25°C, V _{DD} = 16V.							
Parameters	Sym	Min	Тур	Max	Units	Conditions	
Input							
Logic '1', High Input Voltage	V_{IH}	2.0	_	_	V		
Logic '0', Low Input Voltage	V_{IL}	_	_	0.8	V		
Input Current	I _{IN}	-1.0	_	1.0	μA	$0V \le V_{IN} \le V_{DD}, T_A = +25^{\circ}C$	
		-10	_	10		-40°C ≤ T _A ≤ +85°C	
Output							
High Output Voltage	V _{OH}	V _{DD} – 0.025	_	_	V	DC Test	
Low Output Voltage	V_{OL}	_	_	0.025	V	DC Test	
Output Resistance	R _O	_	2.7	4.0	Ω	$V_{DD} = 16V, I_{O} = 10 \text{ mA}, T_{A} = +25^{\circ}\text{C}$	
		_	3.3	5.0		$0^{\circ}C \leq T_{A} \leq +70^{\circ}C$	
		_	3.3	5.0		$-40^{\circ}\text{C} \leq \text{T}_{\text{A}} \leq +85^{\circ}\text{C}$	
Peak Output Current	I _{PK}	_	3.0	_	Α	V _{DD} = 16V	
Latch-Up Protection	I _{REV}	_	0.5	_	Α	Duty cycle $\leq 2\%$, t $\leq 300 \mu sec$,	
Withstand Reverse Current						V _{DD} = 16V	
Switching Time (Note 1)							
Rise Time	t_R	_	20	28	nsec	T _A = +25°C	
		_	22	33		$0^{\circ}C \leq T_{A} \leq +70^{\circ}C$	
		_	24	33		$-40^{\circ}\text{C} \le \text{T}_{\text{A}} \le +85^{\circ}\text{C}$, Figure 4-1	
Fall Time	t _F	_	20	28	nsec	T _A = +25°C	
		_	22	33		$0^{\circ}C \leq T_{A} \leq +70^{\circ}C$	
			24	33		$-40^{\circ}\text{C} \le \text{T}_{A} \le +85^{\circ}\text{C}$, Figure 4-1	

Note 1: Switching times ensured by design.

DC ELECTRICAL CHARACTERISTICS (CONTINUED)

Electrical Specifications: Unless otherwise noted, over operating temperature range with $4.5V \le V_{DD} \le 16V$. Typical values are measured at $T_A = +25$ °C, $V_{DD} = 16V$.

Parameters	Sym	Min	Тур	Max	Units	Conditions		
Delay Time	t _{D1}	_	35	45	nsec	T _A = +25°C,		
		_	40	50		0°C ≤ T _A ≤ +70°C		
			40	50		$-40^{\circ}\text{C} \le \text{T}_{A} \le +85^{\circ}\text{C}$, Figure 4-1		
Delay Time	t _{D2}		35	45	nsec	T _A = +25°C		
		_	40	50		0°C ≤ T _A ≤ +70°C		
		_	40	50		-40° C \leq T _A \leq +85 $^{\circ}$ C, Figure 4-1		
Power Supply								
Power Supply Current	I _S	_	0.5	1.0	mA	V _{IN} = 3V, V _{DD} = 16V		
			0.1	0.15		V _{IN} = 0V		

Note 1: Switching times ensured by design.

TEMPERATURE CHARACTERISTICS

Parameters	Sym	Min	Тур	Max	Units	Conditions
Temperature Ranges					<u> </u>	
Specified Temperature Range (C)	T _A	0	_	+70	°C	
Specified Temperature Range (E)	T _A	-40	_	+85	°C	
Maximum Junction Temperature	TJ	_	_	+150	°C	
Storage Temperature Range	T _A	-65	_	+150	°C	
Package Thermal Resistances	•					
Thermal Resistance, 8L-MSOP	θ_{JA}	_	206	_	°C/W	
Thermal Resistance, 8L-PDIP	θ_{JA}	_	125	_	°C/W	
Thermal Resistance, 8L-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.

Note: Unless otherwise indicated, over operating temperature range with $4.5V \le V_{DD} \le 16V$.

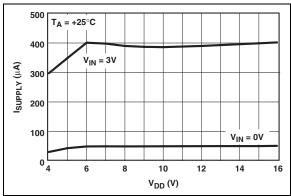


FIGURE 2-1: Quiescent Supply Current vs. Supply Voltage.

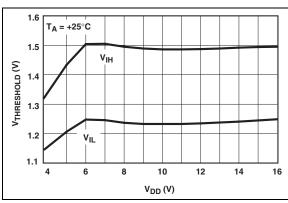


FIGURE 2-2: Input Threshold vs. Supply Voltage.

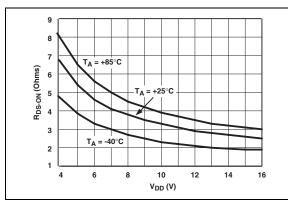


FIGURE 2-3: High-State Output Resistance vs. Supply Voltage

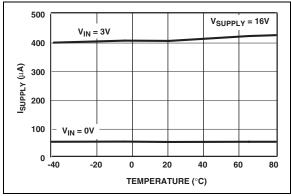


FIGURE 2-4: Quiescent Supply Current vs. Temperature.

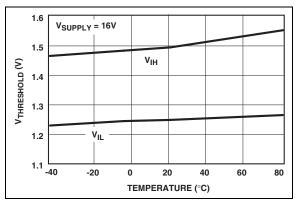


FIGURE 2-5: Input Threshold vs. Temperature.

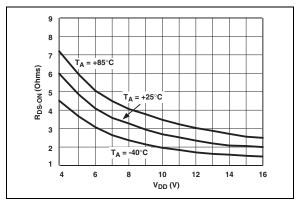


FIGURE 2-6: Low-State Output Resistance vs. Supply Voltage.

Note: Unless otherwise indicated, over operating temperature range with 4.5V \leq V_{DD} \leq 16V.

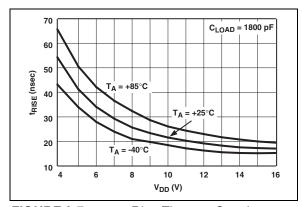


FIGURE 2-7: Voltage.

Rise Time vs. Supply

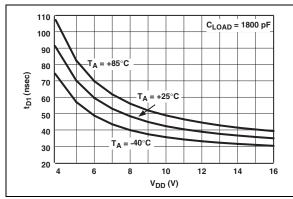


FIGURE 2-8: Supply Voltage.

Propagation Delay vs.

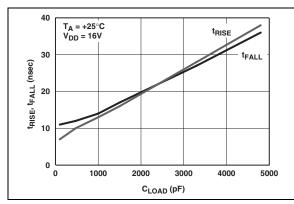


FIGURE 2-9: Capacitive Load.

Rise and Fall Times vs.

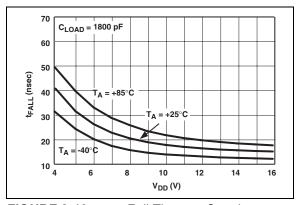


FIGURE 2-10: Voltage.

Fall Time vs. Supply

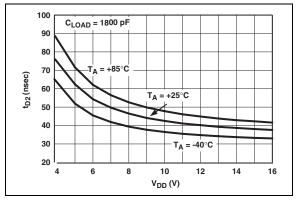


FIGURE 2-11: Supply Voltage.

Propagation Delay vs.

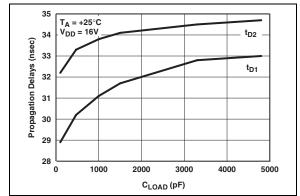


FIGURE 2-12: Capacitive Load.

Propagation Delays vs.

3.0 PIN DESCRIPTIONS

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

TABLE 3-1: PIN FUNCTION TABLE

Pin No.	Symbol	Description
1	V_{DD}	Supply input, 4.5V to 16V
2	INPUT	Control input
3	NC	No connection
4	GND	Ground
5	GND	Ground
6	OUTPUT	CMOS push-pull output, common to pin 7
7	OUTPUT	CMOS push-pull output, common to pin 6
8	V_{DD}	Supply input, 4.5V to 16V

3.1 Supply Input (V_{DD})

The V_{DD} input is the bias supply for the MOSFET driver and is rated for 4.5V to 16V with respect to the ground pin. The V_{DD} input should be bypassed to ground with a local ceramic capacitor. The value of the capacitor should be chosen based on the capacitive load that is being driven. A value of 1.0 μF is suggested.

3.2 Control Input (INPUT)

The MOSFET driver input is a high-impedance, TTL/CMOS-compatible input. The input has 300 mV of hysteresis between the high and low thresholds which prevents output glitching even when the rise and fall time of the input signal is very slow.

3.3 CMOS Push-Pull Output (OUTPUT)

The MOSFET driver output is a low-impedance, CMOS push-pull style output, capable of driving a capacitive load with 3A peak currents.

3.4 Ground (GND)

The ground pins are the return path for the bias current and for the high peak currents that discharge the load capacitor. The ground pins should be tied into a ground plane or have very short traces to the bias supply source return.

3.5 No Connect (NC)

No internal connection.

4.0 APPLICATION INFORMATION

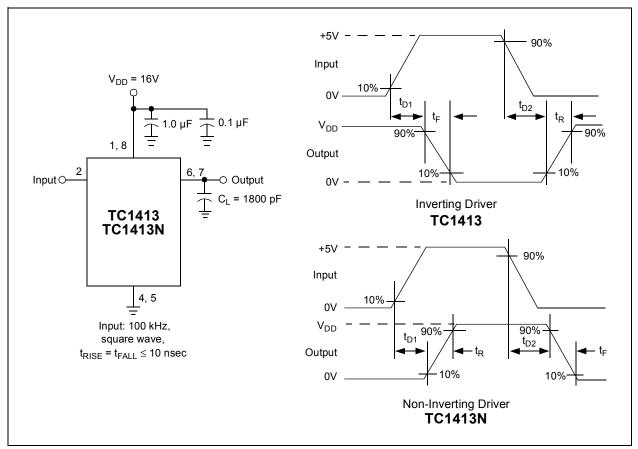
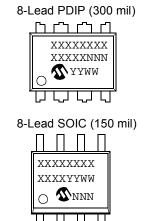
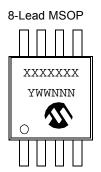


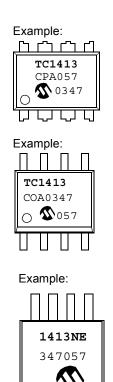
FIGURE 4-1: Switching Time Test Circuit.

5.0 PACKAGING INFORMATION

5.1 Package Marking Information







Legend: XX...X Customer specific information*
YY Year code (last 2 digits of caler

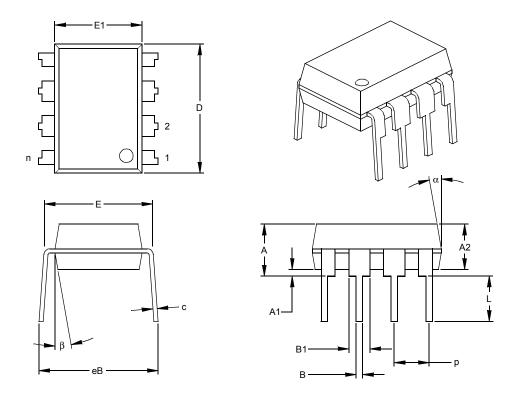
YY Year code (last 2 digits of calendar year)
WW Week code (week of January 1 is week '01')

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 In-line (PA) - 300 mil (PDIP)



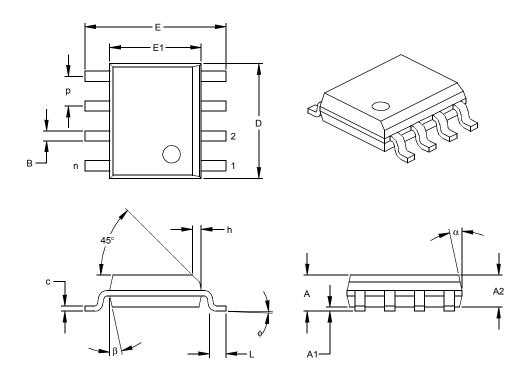
	Units		INCHES*		N	IILLIMETERS	3
Dimensio	n Limits	MIN	NOM	MAX	MIN	NOM	MAX
Number of Pins	n		8			8	
Pitch	р		.100			2.54	
Top to Seating Plane	Α	.140	.155	.170	3.56	3.94	4.32
Molded Package Thickness	A2	.115	.130	.145	2.92	3.30	3.68
Base to Seating Plane	A1	.015			0.38		
Shoulder to Shoulder Width	Е	.300	.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	С	.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	В	.014	.018	.022	0.36	0.46	0.56
Overall Row Spacing §	eВ	.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

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

^{*} Controlling Parameter § Significant Characteristic

8-Lead Plastic Small Outline (OA) - Narrow, 150 mil (SOIC)



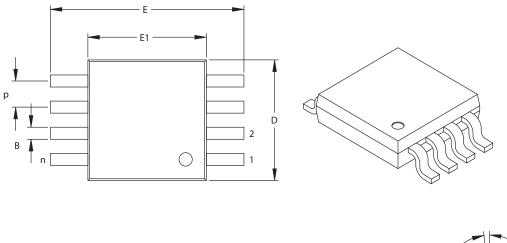
	Units		INCHES*		N	IILLIMETERS	3
Dimension	Limits	MIN	NOM	MAX	MIN	NOM	MAX
Number of Pins	n		8			8	
Pitch	р		.050			1.27	
Overall Height	Α	.053	.061	.069	1.35	1.55	1.75
Molded Package Thickness	A2	.052	.056	.061	1.32	1.42	1.55
Standoff §	A1	.004	.007	.010	0.10	0.18	0.25
Overall Width	Е	.228	.237	.244	5.79	6.02	6.20
Molded Package Width	E1	.146	.154	.157	3.71	3.91	3.99
Overall Length	D	.189	.193	.197	4.80	4.90	5.00
Chamfer Distance	h	.010	.015	.020	0.25	0.38	0.51
Foot Length	L	.019	.025	.030	0.48	0.62	0.76
Foot Angle	ф	0	4	8	0	4	8
Lead Thickness	С	.008	.009	.010	0.20	0.23	0.25
Lead Width	В	.013	.017	.020	0.33	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

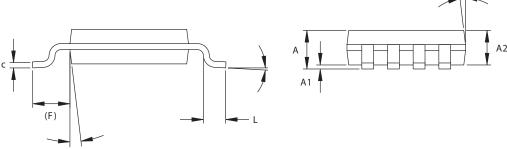
Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed

.010" (0.254mm) per side. JEDEC Equivalent: MS-012 Drawing No. C04-057

^{*} Controlling Parameter § Significant Characteristic

8-Lead Plastic Micro Small Outline Package (UA) (MSOP)





	INCHES			М	ILLIMETERS	*		
Dimension Lim	nits	MIN	NOM	MAX	MIN	NOM	MAX	
Number of Pins	n		8			8		
Pitch	р		.026 BSC		0.65 BSC			
Overall Height	Α	-	-	.043	-	-	1.10	
Molded Package Thickness	A2	.030	.033	.037	0.75	0.85	0.95	
S tandoff	A1	.000	-	.006	0.00	-	0.15	
Overall Width	E		.193 BSC			4.90 BSC		
Molded Package Width	E 1	.118 BSC			3.00 BSC			
Overall Length	D		.118 BSC		3.00 BSC			
Foot Length	L	.016	.024	.031	0.40	0.60	0.80	
Footprint (Reference)	F		.037 REF			0.95 REF		
Foot Angle		0°	-	8°	0°	-	8°	
Lead Thickness	С	.003	.006	.009	0.08	-	0.23	
Lead Width	В	.009	.012	.016	0.22	-	0.40	
Mold Draft Angle Top		5°	-	15°	5°	-	15°	
Mold Draft Angle Bottom		5°	-	15°	5°	-	15°	

^{*}Controlling Parameter

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: MO-187

Drawing No. C04-111

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. Device	X /XX 	Examples: a) TC1413COA: 3A Single MOSFET driver, SOIC package, 0°C to +70°C. b) TC1413CPA: 3A Single MOSFET driver,
Device:	TC1413: 3 A Single MOSFET Driver, Inverting TC1413N: 3 A Single MOSFET Driver, Non-Inverting	PDIP package, 0°C to +70°C. c) TC1413EUA713: Tape and Reel, 3A Single MOSFET driver, MSOP package, -40°C to +85°C.
Temperature Range: Package:	C = 0°C to +70°C E = -40°C to +85°C OA = Plastic SOIC, (150 mil Body), 8-lead OA713 = Plastic SOIC, (150 mil Body), 8-lead (Tape and Reel) UA = Plastic Micro Small Outline (MSOP), 8-lead * UA713 = Plastic Micro Small Outline (MSOP), 8-lead * (Tape and Reel) PA = Plastic DIP (300 mil Body), 8-lead * MSOP package is only available in E-Temp.	 a) TC1413NCPA: 3A Single MOSFET driver, PDIP package, 0°C to +70°C. b) TC1413NEPA: 3A Single MOSFET driver, PDIP package, -40°C to +85°C. c) TC1413NEUA: 3A Single MOSFET driver, MSOP package, -40°C to +85°C.

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:

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