

2A 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: 2A
- Wide Input Supply Voltage Operating Range:
 - 4.5V to 16V
- High Capacitive Load Drive Capability:
 - 1000 pF in 18 nsec
- Short Delay Time: 35 nsec Typ.
- Matched Delay Times
- Low Supply Current:
 - With Logic '1' Input: 500 μ A
 - With Logic '0' Input: 100 μ A
- Low Output Impedance: 4 Ω
- Available in Space-Saving 8-pin MSOP Package
- Pinout Same as TC1410/TC1411/TC1413

General Description

The TC1412/TC1412N are 2A 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 TC1412/TC1412N can easily charge a 1000 pF gate capacitance in 18 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.

Applications

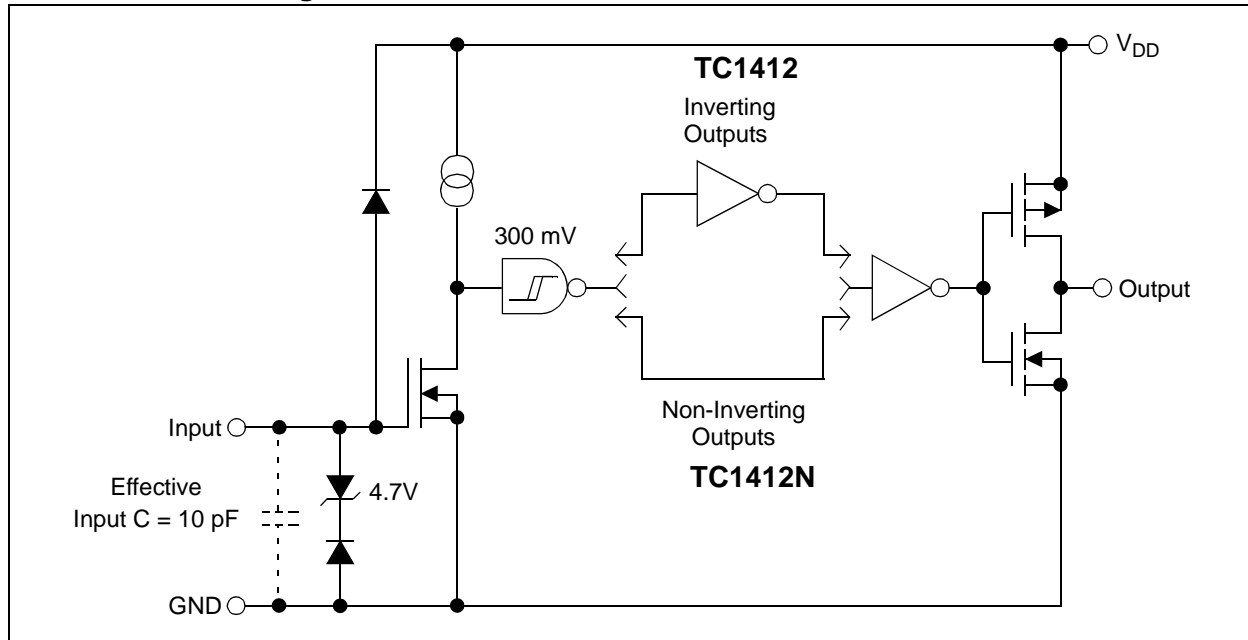
- Switch Mode Power Supplies
- Pulse Transformer Drive
- Line Drivers
- Relay Driver

Package Type



TC1412/TC1412N

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 ($T_A \leq 70^\circ C$)
 MSOP 340 mW
 PDIP 730 mW
 SOIC 470 mW
 Storage Temperature Range $-65^\circ C$ to $+150^\circ C$
 Maximum Junction Temperature $+150^\circ C$

† 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 $T_A = +25^\circ C$, $V_{DD} = 16V$.

Parameters	Sym	Min	Typ	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 -10	— —	1.0 10	μA	$0V \leq V_{IN} \leq V_{DD}$, $T_A = +25^\circ C$ $-40^\circ C \leq T_A \leq +85^\circ C$
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	—	4 5 5	6 7 7	Ω	$V_{DD} = 16V$, $I_O = 10 mA$, $T_A = +25^\circ C$ $0^\circ C \leq T_A \leq +70^\circ C$ $-40^\circ C \leq T_A \leq +85^\circ C$
Peak Output Current	I_{PK}	—	2.0	—	A	$V_{DD} = 16V$
Latch-Up Protection Withstand Reverse Current	I_{REV}	—	0.5	—	A	Duty cycle $\leq 2\%$, $t \leq 300 \mu sec$, $V_{DD} = 16V$
Switching Time (Note 1)						
Rise Time	t_R	—	18 20 22	26 31 31	nsec	$T_A = +25^\circ C$ $0^\circ C \leq T_A \leq +70^\circ C$ $-40^\circ C \leq T_A \leq +85^\circ C$, Figure 4-1
Fall Time	t_F	—	18 20 22	26 31 31	nsec	$T_A = +25^\circ C$ $0^\circ C \leq T_A \leq +70^\circ C$ $-40^\circ C \leq T_A \leq +85^\circ C$, Figure 4-1

Note 1: Switching times ensured by design.

TC1412/TC1412N

DC ELECTRICAL CHARACTERISTICS (CONTINUED)

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

Parameters	Sym	Min	Typ	Max	Units	Conditions
Delay Time	t_{D1}	—	35	45	nsec	$T_A = +25^\circ C$, $0^\circ C \leq T_A \leq +70^\circ C$ $-40^\circ C \leq T_A \leq +85^\circ C$, Figure 4-1
		—	40	50		
		—	40	50		
Delay Time	t_{D2}	—	35	45	nsec	$T_A = +25^\circ C$ $0^\circ C \leq T_A \leq +70^\circ C$ $-40^\circ C \leq T_A \leq +85^\circ C$, Figure 4-1
		—	40	50		
		—	40	50		
Power Supply						
Power Supply Current	I_S	—	0.5	1.0	mA	$V_{IN} = 3V$, $V_{DD} = 16V$ $V_{IN} = 0V$
		—	0.1	0.15		

Note 1: Switching times ensured by design.

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
Temperature Ranges						
Specified Temperature Range (C)	T_A	0	—	+70	$^\circ C$	
Specified Temperature Range (E)	T_A	-40	—	+85	$^\circ C$	
Maximum Junction Temperature	T_J	—	—	+150	$^\circ C$	
Storage Temperature Range	T_A	-65	—	+150	$^\circ C$	
Package Thermal Resistances						
Thermal Resistance, 8L-MSOP	θ_{JA}	—	206	—	$^\circ C/W$	
Thermal Resistance, 8L-PDIP	θ_{JA}	—	125	—	$^\circ C/W$	
Thermal Resistance, 8L-SOIC	θ_{JA}	—	155	—	$^\circ C/W$	

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 $4.5V \leq V_{DD} \leq 16V$.



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



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



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



FIGURE 2-5: Input Threshold vs. Temperature.



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



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

TC1412/TC1412N

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



FIGURE 2-7: Rise Time vs. Supply Voltage.

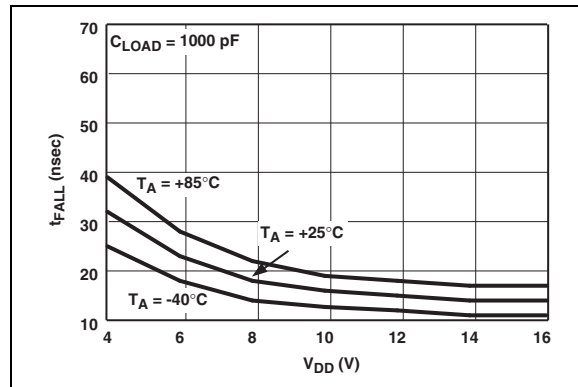


FIGURE 2-10: Fall Time vs. Supply Voltage.



FIGURE 2-8: Propagation Delay vs. Supply Voltage.

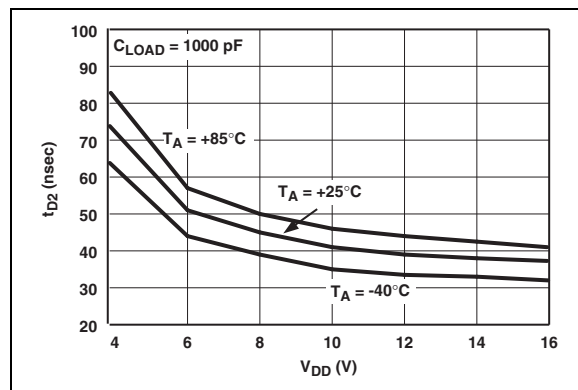


FIGURE 2-11: Propagation Delay vs. Supply Voltage.



FIGURE 2-9: Rise and Fall Times vs. Capacitive Load.

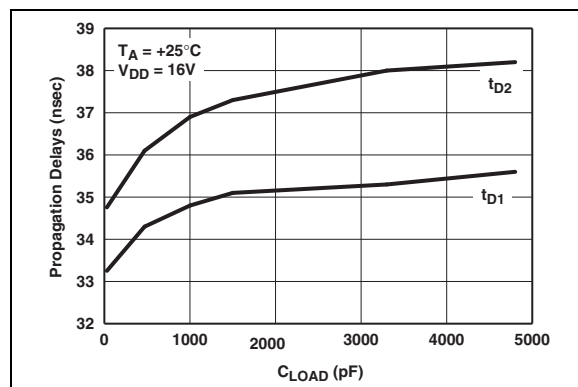


FIGURE 2-12: Propagation Delays vs. Capacitive Load.

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 μ F 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 2A 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.

TC1412/TC1412N

4.0 APPLICATION INFORMATION



FIGURE 4-1: Switching Time Test Circuit.

5.0 PACKAGING INFORMATION

5.1 Package Marking Information

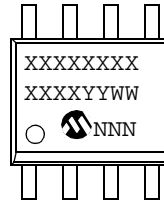
8-Lead PDIP (300 mil)



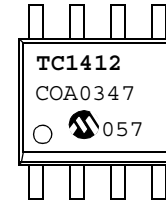
Example:



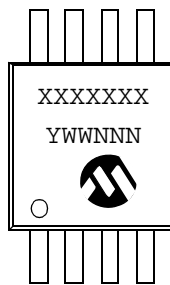
8-Lead SOIC (150 mil)



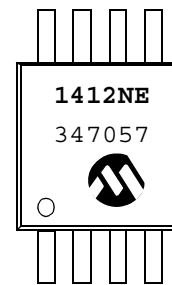
Example:



8-Lead MSOP



Example:



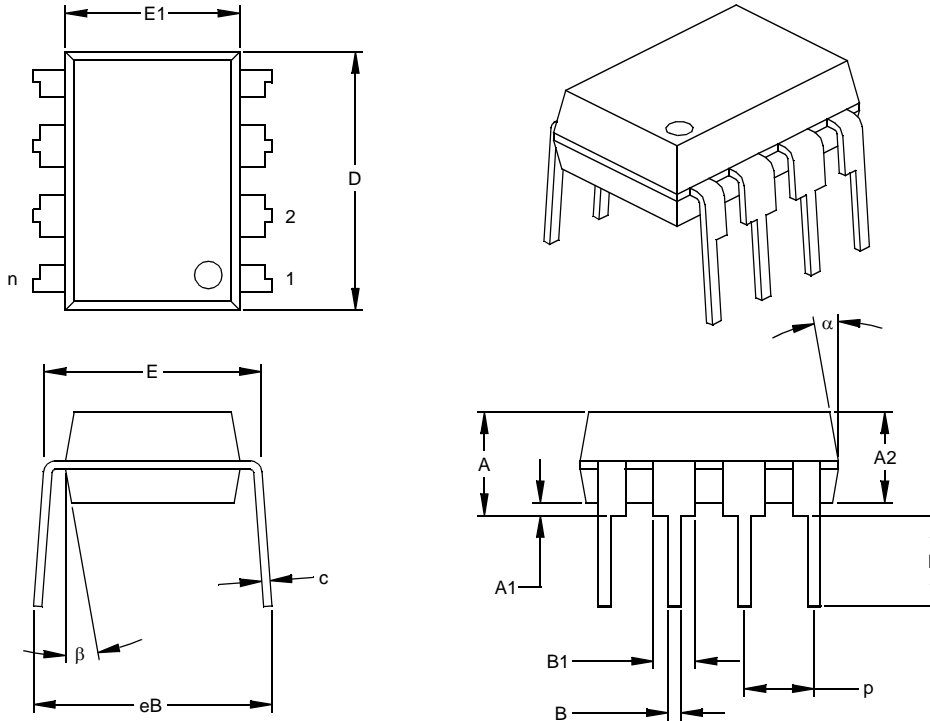
Legend:	XX...X	Customer-specific information
	Y	Year code (last digit of calendar year)
	YY	Year code (last 2 digits of calendar year)
	WW	Week code (week of January 1 is week '01')
	NNN	Alphanumeric traceability code
	(e3)	Pb-free JEDEC designator for Matte Tin (Sn)
	*	This package is Pb-free. The Pb-free 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.

TC1412/TC1412N

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

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



Dimension Limits		INCHES*			MILLIMETERS		
		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.

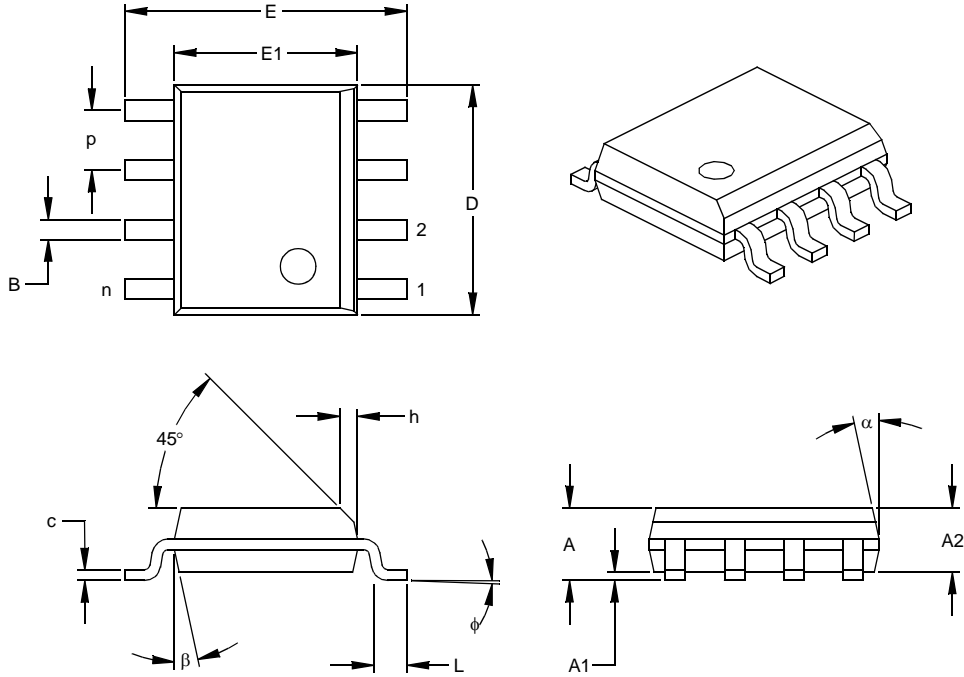
JEDEC Equivalent: MS-001

Drawing No. C04-018

TC1412/TC1412N

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

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



Dimension	Units	INCHES*			MILLIMETERS		
		MIN	NOM	MAX	MIN	NOM	MAX
Number of Pins	n		8			8	
Pitch	p		.050			1.27	
Overall Height	A	.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	E	.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	phi	0	4	8	0	4	8
Lead Thickness	c	.008	.009	.010	0.20	0.23	0.25
Lead Width	B	.013	.017	.020	0.33	0.42	0.51
Mold Draft Angle Top	alpha	0	12	15	0	12	15
Mold Draft Angle Bottom	beta	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-012
 Drawing No. C04-057

TC1412/TC1412N

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

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



Dimension Limits	Units	INCHES			MILLIMETERS*		
		MIN	NOM	MAX	MIN	NOM	MAX
Number of Pins	n		8			8	
Pitch	P	.026 BSC			0.65 BSC		
Overall Height	A	-	-	.043	-	-	1.10
Molded Package Thickness	A2	.030	.033	.037	0.75	0.85	0.95
Standoff	A1	.000	-	.006	0.00	-	0.15
Overall Width	E	.193 BSC			4.90 BSC		
Molded Package Width	E1	.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	c	.003	.006	.009	0.08	-	0.23
Lead Width	B	.009	.012	.016	0.22	-	0.40
Mold Draft Angle Top		5°	-	15°	5°	-	15°
Mold Draft Angle Bottom		5°	-	15°	5°	-	15°

*C 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

6.0 REVISION HISTORY

Revision D (December 2012)

Added a note to each package outline drawing.

TC1412/TC1412N

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>
Device	Temperature Range	Package
Device:	TC1412: 2 A Single MOSFET Driver, Inverting TC1412N: 2 A Single MOSFET Driver, Non-Inverting	
Temperature Range:	C = 0°C to +70°C E = -40°C to +85°C	
Package:	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.	

Examples:

- a) TC1412COA: 2A Single MOSFET driver, SOIC package, 0°C to +70°C.
- b) TC1412CPA: 2A Single MOSFET driver, PDIP package, 0°C to +70°C.
- c) TC1412EUA713: Tape and Reel, 2A Single MOSFET driver, MSOP package, -40°C to +85°C.

- a) TC1412NCPA: 2A Single MOSFET driver, PDIP package, 0°C to +70°C.
- b) TC1412NEPA: 2A Single MOSFET driver, PDIP package, -40°C to +85°C.
- c) TC1412NEUA: 2A Single MOSFET driver, MSOP package, -40°C to +85°C.

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TC1412/TC1412N

NOTES:

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Tel: 86-27-5980-5300
Fax: 86-27-5980-5118

China - Xian
Tel: 86-29-8833-7252
Fax: 86-29-8833-7256

China - Xiamen
Tel: 86-592-2388138
Fax: 86-592-2388130

China - Zhuhai
Tel: 86-756-3210040
Fax: 86-756-3210049

ASIA/PACIFIC

India - Bangalore
Tel: 91-80-3090-4444
Fax: 91-80-3090-4123

India - New Delhi
Tel: 91-11-4160-8631
Fax: 91-11-4160-8632

India - Pune
Tel: 91-20-2566-1512
Fax: 91-20-2566-1513

Japan - Osaka
Tel: 81-66-152-7160
Fax: 81-66-152-9310

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

Korea - Daegu
Tel: 82-53-744-4301
Fax: 82-53-744-4302

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

Malaysia - Kuala Lumpur
Tel: 60-3-6201-9857
Fax: 60-3-6201-9859

Malaysia - Penang
Tel: 60-4-227-8870
Fax: 60-4-227-4068

Philippines - Manila
Tel: 63-2-634-9065
Fax: 63-2-634-9069

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

Taiwan - Hsin Chu
Tel: 886-3-5778-366
Fax: 886-3-5770-955

Taiwan - Kaohsiung
Tel: 886-7-213-7828
Fax: 886-7-330-9305

Taiwan - Taipei
Tel: 886-2-2508-8600
Fax: 886-2-2508-0102

Thailand - Bangkok
Tel: 66-2-694-1351
Fax: 66-2-694-1350

EUROPE

Austria - Wels
Tel: 43-7242-2244-39
Fax: 43-7242-2244-393

Denmark - Copenhagen
Tel: 45-4450-2828
Fax: 45-4485-2829

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

Germany - Munich
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

Spain - Madrid
Tel: 34-91-708-08-90
Fax: 34-91-708-08-91

UK - Wokingham
Tel: 44-118-921-5869
Fax: 44-118-921-5820

11/27/12



Компания «ЭлектроПласт» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов;
- Поставка более 17-ти миллионов наименований электронных компонентов;
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Помимо этого, одним из направлений компании «ЭлектроПласт» является направление «Источники питания». Мы предлагаем Вам помощь Конструкторского отдела:

- Подбор оптимального решения, техническое обоснование при выборе компонента;
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



Как с нами связаться

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