

Dual 1.5A-Peak Low-Side MOSFET Drivers

Features

- Bipolar/CMOS/DMOS Construction
- Latch-Up Protected to >500 mA Reverse Current
- 1.5A-Peak Output Current
- 4.5V to 18V Operating Range
- · Low Quiescent Supply Current
 - 4 mA at Logic 1 Input
 - 400 µA at Logic 0 Input
- Switches 1000 pF in 25 ns
- Matched Rise and Fall Times
- 7Ω Output Impedance
- <40 ns Typical Delay
- Logic-Input Threshold Independent of Supply Voltage
- Logic-Input Protection to -5V
- 6 pF Typical Equivalent Input Capacitance
- · 25 mV Max. Output Offset from Supply or Ground
- Replaces MIC426/7/8 and MIC1426/7/8
- Dual inverting, dual non-inverting, and inverting/ non-inverting configurations
- ESD Protection

Applications

- MOSFET Driver
- Clock Line Driver
- Coax Cable Driver
- Piezoelectric Transducer Driver

General Description

The MIC4426/4427/4428 family are highly reliable dual low-side MOSFET drivers fabricated on a BiCMOS/DMOS process for low power consumption and high efficiency. These drivers translate TTL or CMOS input logic levels to output voltage levels that swing within 25 mV of the positive supply or ground. Comparable bipolar devices are capable of swinging only to within 1V of the supply. The MIC4426/7/8 is available in three configurations: dual inverting, dual non-inverting, and one inverting plus one non-inverting output.

The MIC4426/4427/4428 pin-compatible are replacements for the MIC426/427/428 and MIC1426/1427/1428 with improved electrical performance and rugged design. They can withstand up to 500 mA of reverse current (either polarity) without latching and up to 5V noise spikes (either polarity) on ground pins.

Primarily intended for driving power MOSFETs, MIC4426/7/8 drivers are suitable for driving other loads (capacitive, resistive, or inductive) that require low-impedance, high peak current, and fast switching time. Other applications include driving heavily loaded clock lines, coaxial cables, or piezoelectric transducers. The only load limitation is that total driver power dissipation must not exceed the limits of the package.

See MIC4126/4127/4128 for high power and narrow pulse applications.



Functional Block Diagram



1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings †

Supply Voltage (V _S)	+
Input Voltage (V _{IN})	V _S + 0.3V to GND – 5V
ESD Rating	

Operating Ratings ††

Supply Voltage (V_S)+4.5V to +18V

† Notice: Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at those or any other conditions above those indicated in the operational sections of this specification is not intended. Exposure to maximum rating conditions for extended periods may affect device reliability.

†† Notice: The device is not guaranteed to function outside its operating ratings.

Note 1: Devices are ESD sensitive. Handling precautions are recommended.

ELECTRICAL CHARACTERISTICS

Electrical Characteristics: $4.5V \le V_S \le 18V$; $T_A = +25^{\circ}C$, **bold** values valid for full specified temperature range; unless noted. Note 1

Parameter	Sym.	Min.	Тур.	Max.	Units	Conditions		
Input								
	N	2.4	1.4		V			
Logic 1 input voltage	VIH	2.4	1.5	_		—		
			1.1	0.8				
Logic U input voltage	VIL		1.0	0.8		-		
Input Current	I _{IN}	-1	_	1	μA	$0V \le V_{IN} \le V_S$		
Output								
High Output Voltage	V _{OH}	V _S - 0.025		_	V	_		
Low Output Voltage	V _{OL}	_	_	0.025	V	—		
Output Desistance	Р		6	10	0	$= 10 m \Lambda V = 10 V$		
	R ₀		8	12	12	$r_{OUT} = 10 \text{ mA}, v_{S} = 18 \text{ v}$		
Peak Output Current	I _{PK}		1.5	_	А	—		
Latch-Up Protection I		>500 —		— mA		Withstand Reverse Current		
Switching Time			-		-			
Piao Timo	+		18	30		Test Figure 1-1		
Rise Time	L Lr		20	40	ns	—		
			15	20		Test Figure 1-1		
	ι ^τ f		29	40	ns	—		
Deley Time	t _{D1}		17	30	ns	Test Figure 1-1		
		_	19	40		_		
Dolov Time	+	_	23	50		Test Figure 1-1		
	^L D2	_	27	60	ns			

Note 1: Specification for packaged product only.

ELECTRICAL CHARACTERISTICS (CONTINUED)

Electrical Characteristics: $4.5V \le V_S \le 18V$; $T_A = +25^{\circ}C$, **bold** values valid for full specified temperature range; unless noted. Note 1

Parameter	Sym.	Min. Typ. Max. Units		Units	Conditions				
Pulse Width	ulse Width t _{PW}		_	_	ns	Test Figure 1-1			
Power Supply									
Device Cumply Cumpert	۱ _S	0.6	1.4	4.5	mA	$V_{INA} = V_{INB} = 3.0V$			
Power Supply Current			1.5	8					
David Community Community	۱ _S	_	0.18	0.4	mA	$V_{INA} = V_{INB} = 0V$			
Power Supply Current			0.19	0.6					

Note 1: Specification for packaged product only.

TEMPERATURE SPECIFICATIONS

Parameters	Sym.	Min.	Тур.	Max.	Units	Conditions			
Temperature Ranges									
Maximum Junction Temperature	TJ	—	—	+150	°C	—			
Storage Temperature Range	Τ _S	-65	—	+150	°C	—			
Lead Temperature	—	—	—	+300	°C	10 sec.			
Junction Operating Temperature Range	Τ _J	0	—	+70	°C	Z option			
Junction Operating Temperature Range	Τ _J	-40	—	+85	°C	Y option			
Package Thermal Resistances									
Thermal Resistance, PDIP 8-Ld	θ_{JA}	—	130	—	°C/W	—			
Thermal Resistance, PDIP 8-Ld	θ_{JC}	—	42	—	°C/W	—			
Thermal Resistance, SOIC 8-Ld	θ_{JA}	—	120	—	°C/W	—			
Thermal Resistance, SOIC 8-Ld	θ _{JC}	—	75		°C/W	—			
Thermal Resistance, MSOP 8-Ld	θ _{JA}	_	250	_	°C/W	-			

Note 1: The maximum allowable power dissipation is a function of ambient temperature, the maximum allowable junction temperature and the thermal resistance from junction to air (i.e., T_A, T_J, θ_{JA}). Exceeding the maximum allowable power dissipation will cause the device operating junction temperature to exceed the maximum +125°C rating. Sustained junction temperatures above +125°C can impact the device reliability.

Test Circuits



FIGURE 1-1:

Inverting Driver Switching Time.





Non-Inverting Driver Switching Time.

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 2-2: Delay Time vs. Supply Voltage.



Temperature.







FIGURE 2-5: Supply Current vs. Capacitive Load.



FIGURE 2-6: Rise and Fall Time vs. Capacitive Load.



Frequency.





FIGURE 2-9:





FIGURE 2-10: Quiescent Power Supply Current vs. Supply Voltage.



FIGURE 2-11: Quiescent Power Supply Current vs. Supply Voltage.



3.0 PIN DESCRIPTIONS

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

Pin Number	Pin Name	Description				
1, 8	NC	Not internally connected.				
2	INA	Control Input A: TTL/CMOS compatible logic input.				
3	GND	Ground.				
4	INB	Control Input B: TTL/CMOS compatible logic input.				
5	OUTB	Output B: CMOS totem-pole output.				
6	VS	Supply Input: +4.5V to +18V.				
7	OUTA	Output A: CMOS totem-pole output.				

4.0 APPLICATION INFORMATION

4.1 Supply Bypassing

Large currents are required to charge and discharge large capacitive loads quickly. For example, changing a 1000 pF load by 16V in 25 ns requires 0.8A from the supply input.

To guarantee low supply impedance over a wide frequency range, parallel capacitors are recommended for power supply bypassing. Low-inductance ceramic MLC capacitors with short lead lengths (< 0.5") should be used. A 1.0 μ F film capacitor in parallel with one or two 0.1 μ F ceramic MLC capacitors normally provides adequate bypassing.

4.2 Grounding

When using the inverting drivers in the MIC4426 or MIC4428, individual ground returns for the input and output circuits or a ground plane are recommended for optimum switching speed. The voltage drop that occurs between the driver's ground and the input signal ground, during normal high-current switching, will behave as negative feedback and degrade switching speed.

4.3 Control Input

Unused driver inputs must be connected to logic high (which can be VS) or ground. For the lowest quiescent current (<500 μ A), connect unused inputs to ground. A logic high signal will cause the driver to draw up to 9 mA.

The drivers are designed with 100 mV of control input hysteresis. This provides clean transitions and minimizes output stage current spikes when changing states. The control input voltage threshold is approximately 1.5V. The control input recognizes 1.5V up to VS as a logic high and draws less than 1 μ A within this range.

The MIC4426/7/8 drives the TL494, SG1526/7, MIC38C42, TSC170, and similar switch-mode power supply integrated circuits.

4.4 **Power Dissipation**

Power dissipation should be calculated to make sure that the driver is not operated beyond its thermal ratings. Quiescent power dissipation is negligible. A practical value for total power dissipation is the sum of the dissipation caused by the load and the transition power dissipation ($P_{I} + P_{T}$).

4.5 Load Dissipation

Power dissipation caused by continuous load current (when driving a resistive load) through the driver's output resistance is:

$$P_L = I_L^2 \times R_O$$

For capacitive loads, the dissipation in the driver is:

EQUATION 4-2:

$$P_L = f \times C_L \times {V_S}^2$$

4.6 Power Dissipation

In applications switching at a high frequency, transition power dissipation can be significant. This occurs during switching transitions when the P-channel and N-channel output FETs are both conducting for the brief moment when one is turning on and the other is turning off.

EQUATION 4-3:

$$P_T = 2 \times f \times V_S \times Q$$

Charge (Q) is read from the following graph:



FIGURE 4-1: Crossover Energy Loss per Transition.

5.0 PACKAGING INFORMATION

5.1 Package Marking Information



Legend	: XXX Y YY WW NNN (€3) * •, ▲, ▼ mark).	Product code or customer-specific information Year code (last digit of calendar year) Year code (last 2 digits of calendar year) Week code (week of January 1 is week '01') Alphanumeric traceability code 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 even be carried characters the corpor Underbar	nt the full Microchip part number cannot be marked on one line, it will d over to the next line, thus limiting the number of available for customer-specific information. Package may or may not include ate logo. (_) and/or Overbar (⁻) symbol may not be to scale.



8-Lead SOICN Package Outline & Recommended Land Pattern







8-Lead MSOP Package Outline and Recommended Land Pattern

NOTES:

APPENDIX A: REVISION HISTORY

Revision A (May 2019)

- Converted Micrel document MIC4426/7/8 to Microchip data sheet template DS20006202A.
- Minor grammatical text changes throughout.

NOTES:

PRODUCT IDENTIFICATION SYSTEM

To order or obtain information, e.g., on pricing or delivery, contact your local Microchip representative or sales office.

						Example	es:			
Dev	ice	X	<u>XX</u>	- <u>XX</u>						
Part No. Ju Tem		Junction mp. Range	nction Package Media Type). Range		a) MIC4426: Dual Inverting, Dual 1.5A-Peak Low-Side MOSFET Driver, -40°C to +85°C Temp. Range					
						MIC442	6YM	8-Lead SOIC	95/Tube	
	MIC4426: Dual Inverting, Dual 1.5A-Peak Low-Side					MIC442	6YM-TR	8-Lead SOIC	2,500/Reel	
Device:	MIC4427	: Dua	al Non-Inverting,	I-Inverting, Dual 1.5A-Peak Low-	MIC442	6YN	8-Lead PDIP	50/Tube		
Device.	MIC4428	Side	e MOSFET Drive	er averting Dual 1	5A-	MIC442	6YMM	8-Lead MSOP	100/Tube	
	101104420	Pea	ak Low-Side MO	SFET Driver	0/1	MIC442	6YMM-TR	8-Lead MSOP	2,500/Reel	
Junction						 b) MIC4426: Dual Inverting, Dual 1.5A-Peak Low-Side MOSFET Driver, 0°C to +70°C Temp. Range 				
Temperature	Y = Z =	-40°C to - 0°C to +7	+85°C, RoHS-Co 0°C. RoHS-Com	C, RoHS-Compliant			6ZN	8-Lead PDIP	50/Tube	
Range:						MIC442	6ZM	8-Lead SOIC	95/Tube	
	NI –		סור			MIC442	6ZM-TR	8-Lead SOIC	2,500/Reel	
Package:	M = MM =	8-Lead S(8-Lead M	DIC SOP			c) MIC4 Side MC	427: Dual N DSFET Drive	on-Inverting, Dual er, –40°C to +85°C	1.5A-Peak Low- Temp. Range	
						MIC442	7YM	8-Lead SOIC	95/Tube	
	<blank>=</blank>	95/Tube (SOIC only)			MIC442	7YM-TR	8-Lead SOIC	2,500/Reel	
Media Type:	<blank>= 10 <blank>= 50 TR = 2,</blank></blank>	100/Tube (M 50/Tube (PD	100/Tube (MSOP only) 50/Tube (PDIP only) 2,500/Reel (SOIC only)			MIC442	7YN	8-Lead PDIP	50/Tube	
		2,500/Ree				MIC442	7YMM	8-Lead MSOP	100/Tube	
						MIC442	7YMM-TR	8-Lead MSOP	2,500/Reel	
						d) MIC4 Side MC	427: Dual N DSFET Drive	on-Inverting, Dual er, 0°C to +70°C Te	1.5A-Peak Low- mp. Range	
						MIC442	7ZN	8-Lead PDIP	50/Tube	
						MIC442	7ZM	8-Lead SOIC	95/Tube	
						MIC442	7ZM-TR	8-Lead SOIC	2,500/Reel	
							e) MIC4 Low-Sid Range	428: Invertir e MOSFET	ng + Non-Inverting, Driver, –40°C to +	Dual 1.5A-Peak 85°C Temp.
						MIC442	8YM	8-Lead SOIC	95/Tube	
						MIC442	8YM-TR	8-Lead SOIC	2,500/Reel	
				MIC442	8YN	8-Lead PDIP	50/Tube			
				MIC442	8YMM	8-Lead MSOP	100/Tube			
				MIC442	8YMM-TR	8-Lead MSOP	2,500/Reel			
				f) MIC4428: Inverting + Non-Inverting, Dual 1.5A-Peak Low-Side MOSFET Driver, 0°C to +70°C Temp. Range						
						MIC442	8ZN	8-Lead PDIP	50/Tube	
						MIC4428ZM		8-Lead SOIC	95/Tube	
				MIC442	8ZM-TR	8-Lead SOIC	2,500/Reel			
					Note 1:	Tape and F catalog par used for or the device Sales Offic Tape and F	Reel identifier only a t number descriptio dering purposes an package. Check wit e for package availa Reel option.	ppears in the n. This identifier is d is not printed on h your Microchip ability with the		

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