

高精度、低電圧アナログスイッチ

概要

MAX381/MAX383/MAX385は、高精度低電圧アナログスイッチです。単極単投(SPST)のMAX381及び双極単投(DPST)のMAX385のデュアルスイッチはノーマリオープンです。単極双投(SPDT)のMAX383はノーマリオープンを2極、ノーマリクローズを2極備えています。いずれの製品もオン抵抗が低く(35以下)、2以下のチャネル間マッチング、全アナログ信号範囲での平坦性(4 max)が保証されています。またリーク電流も低く(+25で250pA以下、+85で2.5nA以下)、スイッチングも高速です(ターンオン時間は175ns以下、ターンオフ時間は100ns以下)。

システムの精度を高めるために、MAX381/MAX383/MAX385はマキシム社の低電圧シリコンゲートプロセスで製造されています。設計改良によって超低チャージインジェクション(5pC以下)及び低消費電力(10 μ W以下)が保証されています。

これらのモノリシックスイッチはプラスの単一電源(+3V~+15V)またはデュアル電源($\pm 3V \sim \pm 8V$)で動作し、CMOSロジック入力とのコンパチビリティ及び高速スイッチング特性を維持します。CMOS入力によって入力負荷を低減しています。

アプリケーション

サンプル&ホールド回路	誘導制御システム
ヘッドアップディスプレイ	試験装置
オーディオ信号配線	軍用無線機
バッテリー駆動機器	通信機器
PBX、PABX	

特長

- ◆ 単一電源動作: +3V~+15V
デュアル電源動作: $\pm 3V \sim \pm 8V$
- ◆ DG401/DG403/DG405とピンコンパチブル
- ◆ 低オン抵抗: 20 typ (35 max)
- ◆ チャネル間のオン抵抗マッチング: 2以下を保証
- ◆ 全規定アナログ信号範囲でのオン抵抗の平坦性: 4以下を保証
- ◆ チャージインジェクション: 5pC以下を保証
- ◆ オフチャネルリーク電流: 2.5nA以下(+85)を保証
- ◆ 3V、5V、 $\pm 3V$ 及び $\pm 5V$ 電源動作時にTTL/CMOSロジックコンパチブル
- ◆ アナログ信号範囲: 電源電圧範囲

型番

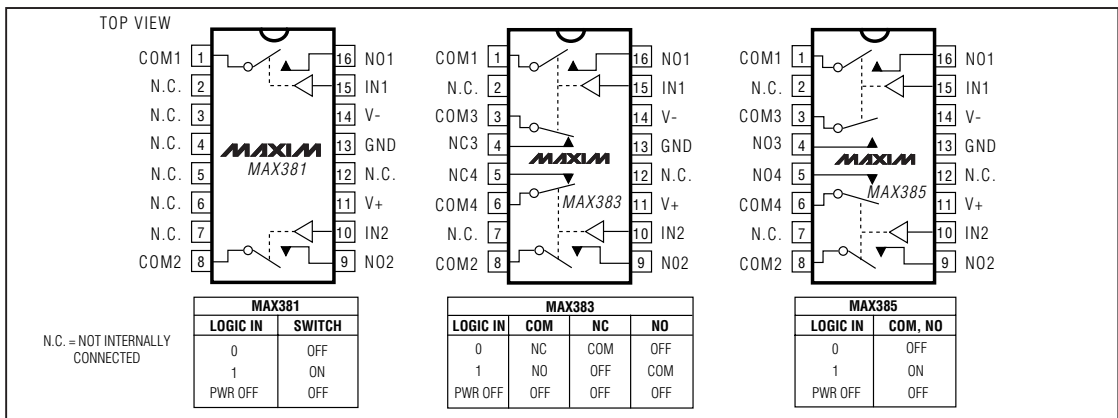
PART	TEMP. RANGE	PIN-PACKAGE
MAX381CPE	0°C to +70°C	16 Plastic DIP
MAX381CSE	0°C to +70°C	16 Narrow SO
MAX381C/D	0°C to +70°C	Dice*
MAX381EPE	-40°C to +85°C	16 Plastic DIP
MAX381ESE	-40°C to +85°C	16 Narrow SO
MAX381EJE	-40°C to +85°C	16 CERDIP**
MAX381MJE	-55°C to +125°C	16 CERDIP**

Ordering Information continued on last page.

* Dice are tested at $T_A = +25^\circ\text{C}$ only.

** Contact factory for package availability.

ピン配置/ブロック図/真理値表



高精度、低電圧アナログスイッチ

MAX381/MAX383/MAX385

ABSOLUTE MAXIMUM RATINGS

Voltage Referenced to GND

V+	-0.3V to +17V
V-	+0.3V to -17V
V+ to V-	-0.3V to +17V
COM-, NO-, NC-, IN-	(V- - 2V) to (V+ + 2V) or 30mA, whichever occurs first
Continuous Current, any pin	30mA
Peak Current, any pin (pulsed at 1ms, 10% duty cycle max)	100mA

Continuous Power Dissipation (T_A = +70°C)

Plastic DIP (derate 10.53mW/°C above +70°C)	842mW
Narrow SO (derate 8.70mW/°C above +70°C)	696mW
CERDIP (derate 10.00mW/°C above +70°C)	800mW
Operating Temperature Ranges	
MAX38_C_E	0°C to +70°C
MAX38_E_E	-40°C to +85°C
MAX38_MJE	-55°C to +125°C
Storage Temperature Range	-65°C to +150°C
Lead Temperature (soldering, 10sec)	+300°C

Note 1: Signals on NC, NO, COM, or IN exceeding V+ or V- are clamped by internal diodes. Limit forward diode current to maximum current rating.

Stresses beyond 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 beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

ELECTRICAL CHARACTERISTICS—Dual Supplies

(V+ = +5V ±10%, V- = -5V ±10%, GND = 0V, V_{INH} = 2.4V, V_{INL} = 0.8V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	TEMP. RANGE	MIN	TYP (Note 2)	MAX	UNITS	
SWITCH								
Analog Signal Range	V _{COM} , V _{NO} , V _{NC}	(Note 3)		V-		V+	V	
On-Resistance	R _{ON}	V+ = 4.5V, V- = -4.5V, V _{NC} or V _{NO} = ±3.5V, I _{COM} = -10mA, V _{INH} = 2.4V, V _{INL} = 0.8V	T _A = +25°C	C, E	20	35	Ω	
			M	20	30			
On-Resistance Match Between Channels (Note 4)	ΔR _{ON}	V _{NC} or V _{NO} = ±3V, I _{COM} = -10mA, V+ = 5V, V- = -5V	T _A = +25°C	C, E, M	0.5	2	Ω	
			T _A = T _{MIN} to T _{MAX}	C, E, M		4		
On-Resistance Flatness (Note 4)	R _{FLAT(ON)}	V _{NC} or V _{NO} = 3V, 0V, -3V; I _{COM} = -10mA, V+ = 5V; V- = -5V	T _A = +25°C	C, E, M		4	Ω	
			T _A = T _{MIN} to T _{MAX}	C, E, M		6		
NC or NO Off Leakage Current (Note 5)	I _{NC(OFF)} or I _{NO(OFF)}	V _{COM} = ±4.5V, V _{NC} or V _{NO} = ±4.5V, V+ = 5.5V, V- = -5.5V	T _A = +25°C	C, E	-0.2	-0.01	0.2	nA
			M	-0.1	-0.01	0.1		
			T _A = T _{MIN} to T _{MAX}	C, E	-2.5		2.5	
			M	-5.0		5.0		
COM Off Leakage Current (Note 5)	I _{COM(OFF)}	V _{COM} = ±4.5V, V _{NC} or V _{NO} = ±4.5V, V+ = 5.5V, V- = -5.5V	T _A = +25°C	C, E	-0.2	-0.01	0.2	nA
			M	-0.1	-0.01	0.1		
			T _A = T _{MIN} to T _{MAX}	C, E	-2.5		2.5	
			M	-5.0		5.0		
COM On Leakage Current (Note 5)	I _{COM(ON)}	V _{COM} = ±4.5V, V _{NC} or V _{NO} = ±4.5V, V+ = 5.5V, V- = -5.5V	T _A = +25°C	C, E	-0.4	-0.04	0.4	nA
			M	-0.2	-0.04	0.2		
			T _A = T _{MIN} to T _{MAX}	C, E	-5.0		5.0	
			M	-20.0		20.0		

ELECTRICAL CHARACTERISTICS—Dual Supplies (continued)

(V+ = +5V ±10%, V- = -5V ±10%, GND = 0V, VINH = 2.4V, VINL = 0.8V, TA = TMIN to TMAX, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP (Note 2)	MAX	UNITS	
DIGITAL LOGIC INPUT							
Input Current with Input Voltage High	IINH	VIN = 2.4V, all others = 0.8V	-1.0	0.005	1.0	μA	
Input Current with Input Voltage Low	IINL	VIN = 0.8V, all others = 2.4V	-1.0	0.005	1.0	μA	
Logic High Input Voltage	VAH	TA = TMIN to TMAX	2.4			V	
Logic Low Input Voltage	VAL	TA = TMIN to TMAX			0.8	V	
DYNAMIC							
Turn-On Time	ton	VCOM = 3V, Figure 2	TA = +25°C		100	175	ns
			TA = TMIN to TMAX		225		
Turn-Off Time	toff	VCOM = 3V, Figure 2	TA = +25°C		60	100	ns
			TA = TMIN to TMAX		150		
Break-Before-Make Time Delay (Note 3)	td	MAX383 only, Figure 3	10	20		ns	
Charge Injection (Note 3)	VCTE	CL = 1.0nF, VGEN = 0V, RGEN = 0Ω, Figure 4	TA = +25°C		2	5	pC
Off Isolation (Note 6)	VISO	RL = 100Ω, CL = 5pF, f = 1MHz, Figure 5	TA = +25°C		72		dB
Crosstalk (Note 7)	VCT	RL = 50Ω, CL = 5pF, f = 1MHz, Figure 6	TA = +25°C		90		dB
Off Capacitance	COFF	f = 1MHz, Figure 7	TA = +25°C		12		pF
COM Off Capacitance	CCOM(OFF)	f = 1MHz, Figure 7	TA = +25°C		12		pF
Channel On Capacitance	CCOM(ON)	f = 1MHz, Figure 8	TA = +25°C		39		pF
SUPPLY							
Power-Supply Range			±3		±8	V	
Positive Supply Current	I+	All channels on or off, V+ = 5.5V, V- = -5.5V, VIN = 0V or V+	-1.0	0.06	1.0	μA	
Negative Supply Current	I-	All channels on or off, V+ = 5.5V, V- = -5.5V, VIN = 0V or V+	-1.0	-0.01	1.0	μA	

Note 2: The algebraic convention, where the most negative value is a minimum and the most positive value a maximum, is used in this data sheet.

Note 3: Guaranteed by design.

Note 4: $\Delta R_{ON} = \Delta R_{ON(max)} - \Delta R_{ON(min)}$. On-resistance match between channels and flatness are guaranteed only with specified voltages. Flatness is defined as the difference between the maximum and minimum value of on-resistance as measured over the specified analog signal range.

Note 5: Leakage parameters are 100% tested at maximum rated hot temperature and guaranteed by correlation at room temperature.

Note 6: See Figure 4. Off isolation = $20 \log_{10} V_{COM}/V_{NC}$ or V_{NO} . VCOM = output, VNC or NO = input to off switch.

Note 7: Between any two switches. See Figure 5.

Note 8: Leakage testing at single supply is guaranteed by testing with dual supplies.

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MAX381/MAX383/MAX385

ELECTRICAL CHARACTERISTICS—Single +5V Supply

(V+ = +5V ±10%, V- = 0V, GND = 0V, VINH = 2.4V, VINL = 0.8V, TA = TMIN to TMAX, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	TEMP. RANGE	MIN	TYP (Note 2)	MAX	UNITS	
SWITCH								
Analog Signal Range	VCOM, VNO, VNC	(Note 3)		0V		V+	V	
On-Resistance	RON	V+ = 5.0V, V- = 0V, VNC or VNO = 3.5V, ICOM = 1.0mA, VINH = 2.4V, VINL = 0.8V	TA = +25°C	C, E	25	65	Ω	
			TA = TMIN to TMAX	C, E, M		75		
On-Resistance Match Between Channels (Note 4)	ΔRON	VNC or VNO = 3V, ICOM = 1.0mA, V+ = 5V	TA = +25°C	C, E, M	0.5	2	Ω	
			TA = TMIN to TMAX	C, E, M		4		
On-Resistance Flatness (Note 4)	RFLAT(ON)	VNC or VNO = 3V, 2V, 1V; ICOM = 1.0mA; V+ = 5V; V- = 0V	TA = +25°C	C, E, M		6	Ω	
			TA = TMIN to TMAX	C, E, M		8		
NC or NO Off Leakage Current (Note 8)	INC(OFF) or INO(OFF)	VCOM = 0V, VNC or VNO = 4.5V, V+ = 5.5V, V- = 0V	TA = +25°C	C, E	-0.2	-0.01	0.2	nA
				M	-0.1	-0.01	0.1	
			TA = TMIN to TMAX	C, E	-2.5		2.5	
COM Off Leakage Current (Note 8)	ICOM(OFF)	VCOM = 4.5V, VNC or VNO = 0V, V+ = 5.5V, V- = 0V	TA = +25°C	C, E	-0.2	-0.01	0.2	nA
				M	-0.1	-0.01	0.1	
			TA = TMIN to TMAX	C, E	-2.5		2.5	
COM On Leakage Current (Note 8)	ICOM(ON)	VCOM = 4.5V, VNC or VNO = 4.5V, V+ = 5.5V, V- = 0V	TA = +25°C	C, E	-0.4	-0.04	0.4	nA
				M	-0.2	-0.04	0.2	
			TA = TMIN to TMAX	C, E	-5.0		5.0	
			M	-20.0		20.0		
DIGITAL LOGIC INPUT								
Input Current with Input Voltage High	IINH	VIN = 2.4V, all others = 0.8V		-1.0	0.005	1.0	μA	
Input Current with Input Voltage Low	IINL	VIN = 0.8V, all others = 2.4V		-1.0	0.005	1.0	μA	

ELECTRICAL CHARACTERISTICS—Single +5V Supply (continued)

(V+ = +5V ±10%, V- = 0V, GND = 0V, VINH = 2.4V, VINL = 0.8V, TA = TMIN to TMAX, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP (Note 2)	MAX	UNITS
DYNAMIC						
Turn-On Time	tON	VCOM = 3V, Figure 2	TA = +25°C	160	250	ns
			TA = TMIN to TMAX		300	
Turn-Off Time	tOFF	VCOM = 3V, Figure 2	TA = +25°C	60	125	ns
			TA = TMIN to TMAX		175	
Break-Before-Make Time Delay (Note 3)	tD	MAX383 only	TA = +25°C	10	20	ns
Charge Injection (Note 3)	VCTE	CL = 1.0nF, VGEN = 0V, RGEN = 0Ω	TA = +25°C	2	5	pC
SUPPLY						
Power-Supply Range	V+		2.7		16	V
Positive Supply Current	I+	All channels on or off, VIN = 0V or V+, V+ = 5.5V, V- = 0V	-1.0	0.01	1.0	μA
Negative Supply Current	I-	All channels on or off, VIN = 0V or V+, V+ = 5.5V, V- = 0V	-1.0	-0.01	1.0	μA

ELECTRICAL CHARACTERISTICS—Single +3.3V Supply

(V+ = 3.0V to 3.6V, GND = 0V, VINH = 2.4V, VINL = 0.8V, TA = TMIN to TMAX, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	TEMP. RANGE	MIN	TYP (Note 2)	MAX	UNITS	
SWITCH								
Analog Signal Range	VCOM, VNO, VNC	(Note 3)		0V		V+	V	
On-Resistance	RON	V+ = 3V, V- = 0V, VNC or VNO = 1.5V, ICOM = 1.0mA, VINH = 2.4V, VINL = 0.8V	TA = +25°C	C, E	75	185	Ω	
				M		175		
NC or NO Off Leakage Current (Note 8)	INC(OFF) or INO(OFF)	VCOM = 0V, VNC or VNO = 3V, V+ = 3.6V, V- = 0V	TA = +25°C	C, E	-0.2	-0.01	0.2	nA
				M	-0.1	-0.01	0.1	
COM Off Leakage Current (Note 8)	ICOM(OFF)	VCOM = 3V, VNC or VNO = 0V, V+ = 3.6V, V- = 0V	TA = TMIN to TMAX	C, E	-2.5		2.5	nA
				M	-5.0		5.0	
COM On Leakage Current (Note 8)	ICOM(ON)	VCOM = 3V, VNC or VNO = 3V, V+ = 3.6V, V- = 0V	TA = +25°C	C, E	-0.4	-0.04	0.4	nA
				M	-0.2	-0.04	0.2	
			TA = TMIN to TMAX	C, E	-5.0		5.0	
				M	-20.0		20.0	

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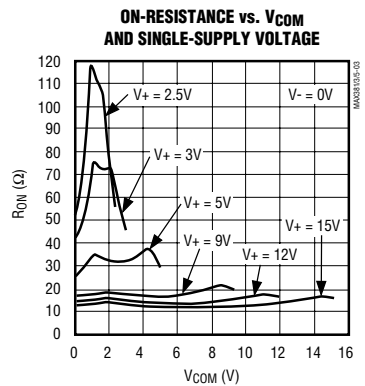
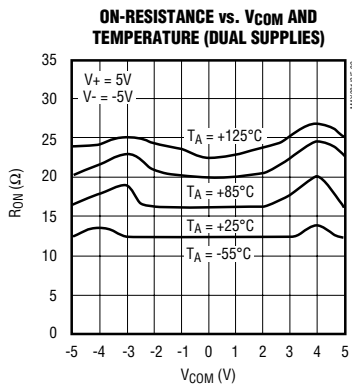
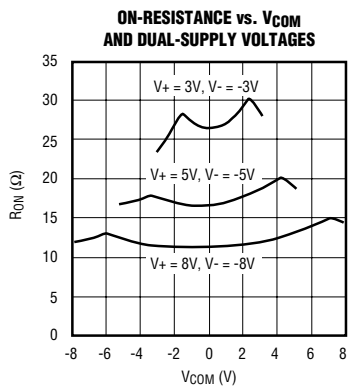
ELECTRICAL CHARACTERISTICS—Single +3.3V Supply (continued)

($V_+ = 3.0\text{V}$ to 3.6V , $\text{GND} = 0\text{V}$, $V_{\text{INH}} = 2.4\text{V}$, $V_{\text{INL}} = 0.8\text{V}$, $T_A = T_{\text{MIN}}$ to T_{MAX} , unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP (Note 2)	MAX	UNITS
DIGITAL LOGIC INPUT							
Input Current with Input Voltage High	I_{INH}	$V_{\text{IN}} = 2.4\text{V}$, all others = 0.8V		-1.0	0.005	1.0	μA
Input Current with Input Voltage Low	I_{INL}	$V_{\text{IN}} = 0.8\text{V}$, all others = 2.4V		-1.0	0.005	1.0	μA
DYNAMIC							
Turn-On Time (Note 3)	t_{ON}	$V_{\text{COM}} = 1.5\text{V}$, Figure 2	$T_A = +25^\circ\text{C}$			400	ns
Turn-Off Time (Note 3)	t_{OFF}	$V_{\text{COM}} = 1.5\text{V}$, Figure 2	$T_A = +25^\circ\text{C}$			150	ns
Break-Before-Make Time Delay (Note 3)	t_{D}	MAX383 only	$T_A = +25^\circ\text{C}$	10	20		ns
Charge Injection (Note 3)	V_{CTE}	$C_L = 1.0\text{nF}$, $V_{\text{GEN}} = 0\text{V}$, $R_{\text{GEN}} = 0\Omega$	$T_A = +25^\circ\text{C}$		1	5	pC
SUPPLY							
Power-Supply Range	V_+			2.7		16	V
Positive Supply Current	I_+	All channels on or off, $V_{\text{IN}} = 0\text{V}$ or V_+ , $V_+ = 3.6\text{V}$, $V_- = 0\text{V}$		-1.0	0.01	1.0	μA
Negative Supply Current	I_-	All channels on or off, $V_{\text{IN}} = 0\text{V}$ or V_+ , $V_+ = 3.6\text{V}$, $V_- = 0\text{V}$		-1.0	-0.01	1.0	μA

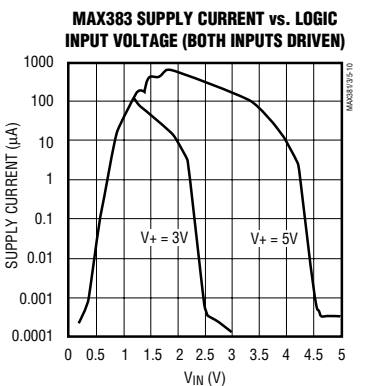
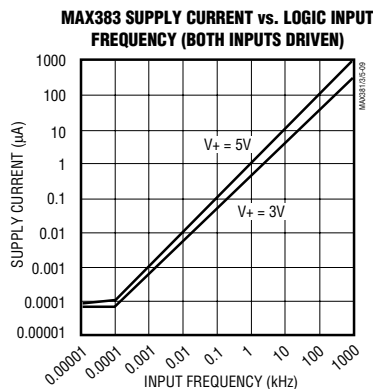
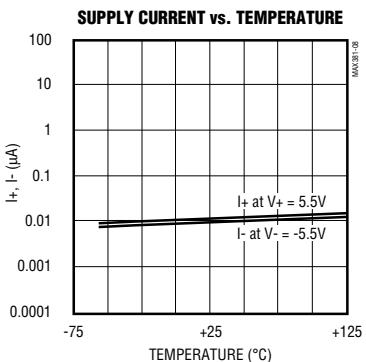
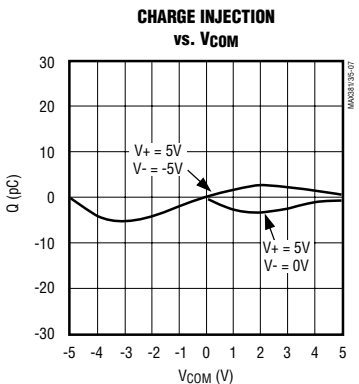
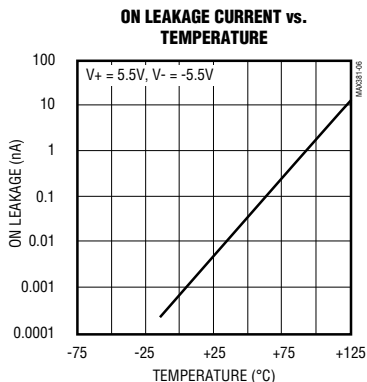
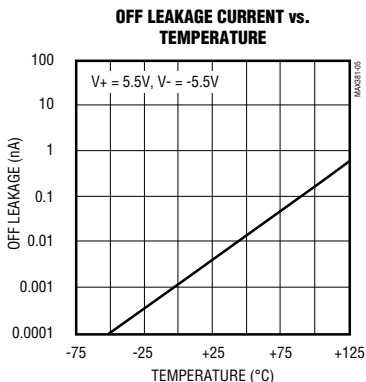
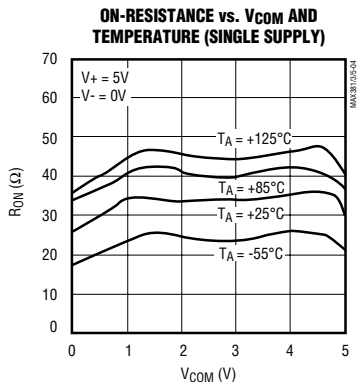
標準動作特性

($T_A = +25^\circ\text{C}$, unless otherwise noted.)



標準動作特性(続き)

($T_A = +25^\circ\text{C}$, unless otherwise noted.)



高精度、低電圧アナログスイッチ

端子説明

端子			名称	機能
MAX381	MAX383	MAX385		
1, 8	1, 3, 6, 8	1, 3, 6, 8	COM _L	アナログスイッチの共通端子
2-7, 12	2, 7, 12	2, 7, 12	N.C.	内部接続されていません。
9, 16	9, 16	4, 5, 9, 16	NO _L	アナログスイッチのノーマリオープン端子
—	4, 5	—	NC _L	アナログスイッチのノーマリクローズ端子
10, 15	10, 15	10, 15	IN _L *	ロジックレベル入力(ノーマリロー)
11	11	11	V ₊	アナログ信号及びロジックの正電源入力
13	13	13	GND	ロジックの負電源入力(グランド)
14	14	14	V ₋	アナログ信号の負電源入力

* IN1はCOM1及びCOM3を制御、IN2はCOM2及びCOM4を制御します。

アプリケーション情報

±5V以外の電源電圧での動作

MAX381/MAX383/MAX385スイッチは、±3.0V ~ ±8Vのデュアル電源及び+3V ~ +15Vの単一電源で動作します。いずれの場合もV₊ ~ V₋の範囲のアナログ信号のスイッチングが可能です。アナログ信号及び電源電圧に対するオン抵抗の変動(typ)は「標準動作特性」のグラフに示されています。オン抵抗の標準的な温度係数は0.5%/ (typ)です。

過電圧保護

CMOSデバイスでは、常に適正な電源シーケンスが必要とされます。絶対最大定格を超えないようにしてください。定格を超えるストレスにさらされた場合、デバイスに恒久的な損傷を与える恐れがあります。常にV₊を最初にオンにし、次にV₋、その次にロジック入力、NO又はCOMというシーケンスを常に守ってください。電源シーケンスの順番が守れない場合、過電圧保護用に電源端に直列に2個の小信号ダイオード(D1、D2)を接続してください(図1)。ダイオードを加えることによって、アナログ信号範囲が(V₊より1ダイオードドロップ分だけ下) ~ (V₋より1ダイオードドロップ分だけ上)の範囲に低減しますが、低スイッチ抵抗、低リーク電流特性には影響はありません。デバイスの動作は変わらないため、V₊とV₋の電圧差は17Vを超えないようにしてください。3V単一電源動作の場合は保護ダイオードの使用は推奨されません。

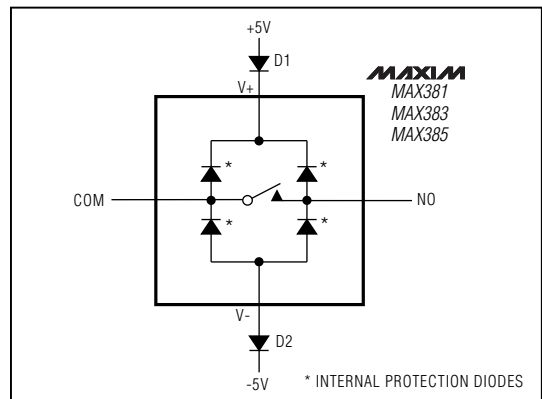


図1. 2つの外付ブロッキングダイオードを用いた過電圧保護

テスト回路/タイミング図

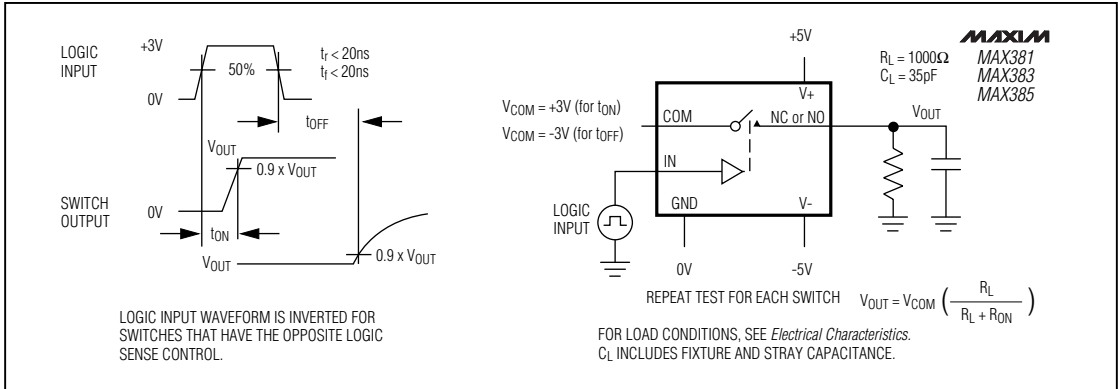


図2. スイッチング時間のテスト回路

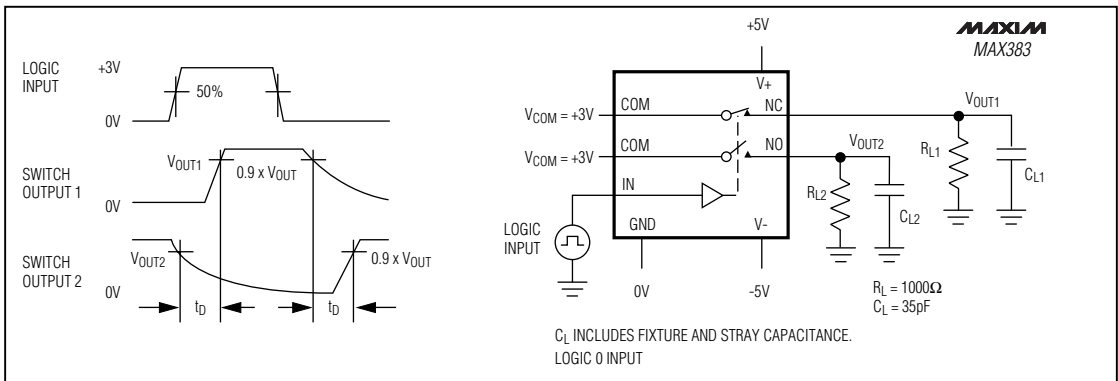


図3. ブレーク・ビフォ・メイクのテスト回路(MAX383のみ)

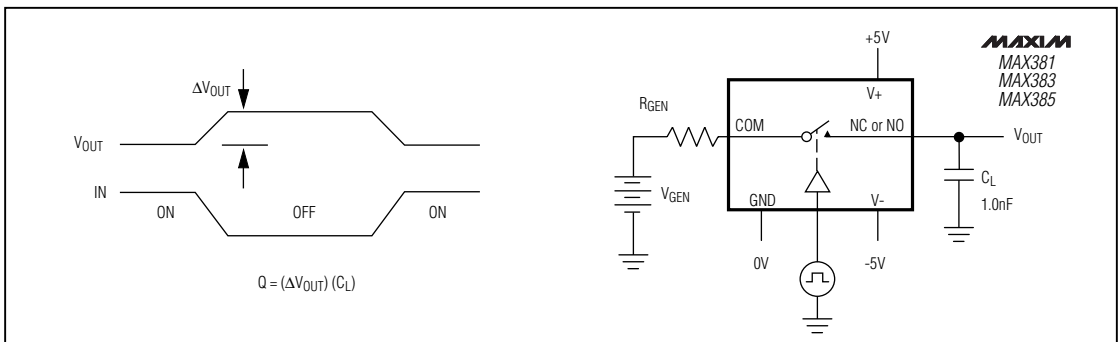


図4. チャージインジェクションのテスト回路

高精度、低電圧アナログスイッチ

MAX381/MAX383/MAX385

テスト回路/タイミング図(続き)

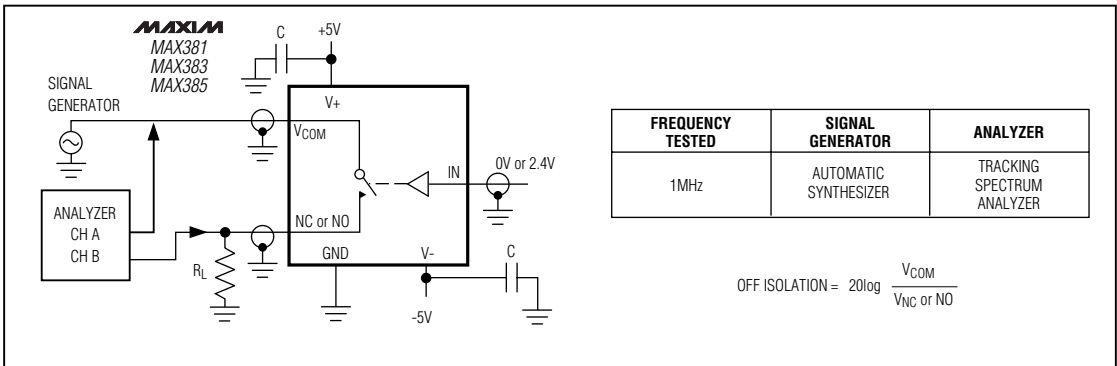


図5. オフアイソレーション

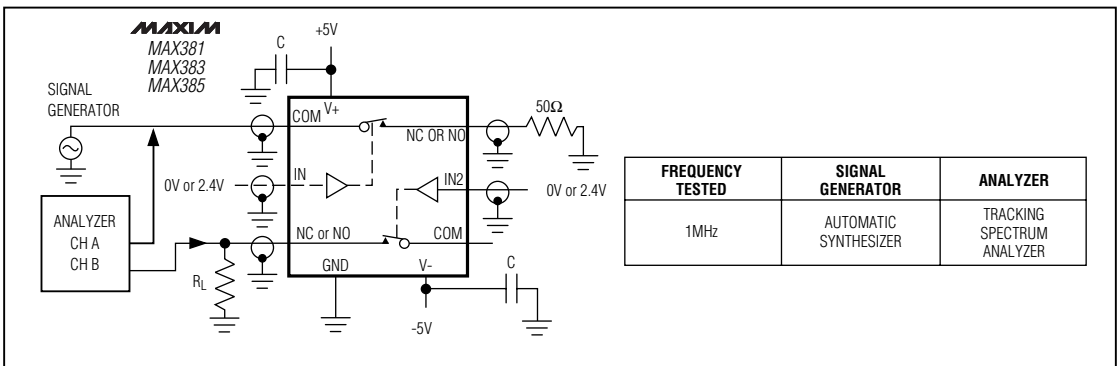


図6. クロストークのテスト回路

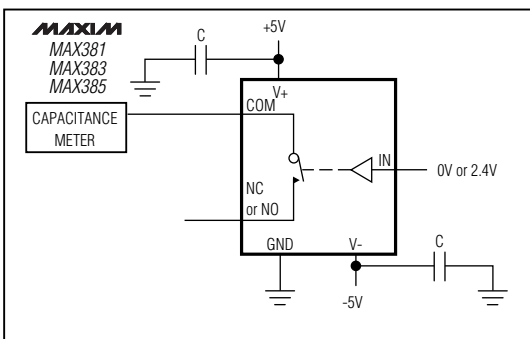


図7. チャンネルオフ容量

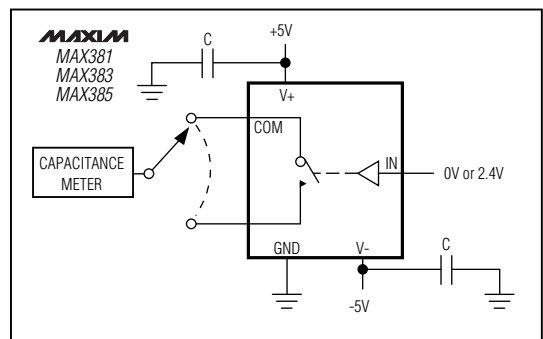


図8. チャンネルオン容量

高精度、低電圧アナログスイッチ

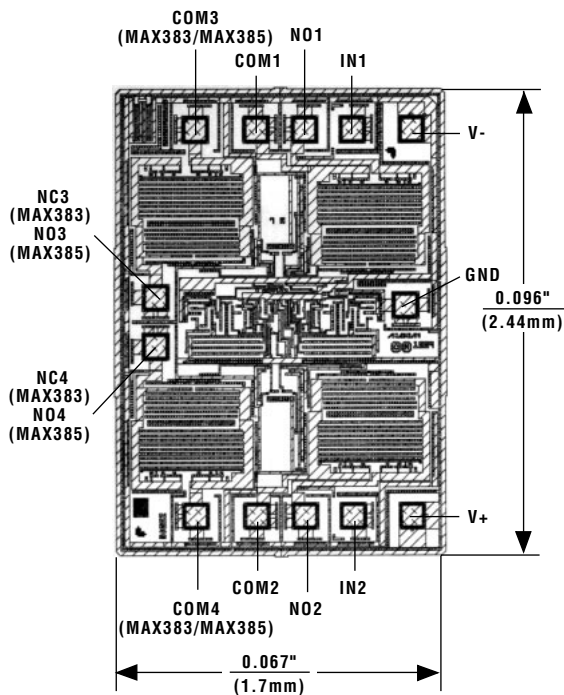
型番(続き)

PART	TEMP. RANGE	PIN-PACKAGE
MAX383CPE	0°C to +70°C	16 Plastic DIP
MAX383CSE	0°C to +70°C	16 Narrow SO
MAX383C/D	0°C to +70°C	Dice*
MAX383EPE	-40°C to +85°C	16 Plastic DIP
MAX383ESE	-40°C to +85°C	16 Narrow SO
MAX383EJE	-40°C to +85°C	16 CERDIP**
MAX383MJE	-55°C to +125°C	16 CERDIP**
MAX385CPE	0°C to +70°C	16 Plastic DIP
MAX385CSE	0°C to +70°C	16 Narrow SO
MAX385C/D	0°C to +70°C	Dice*
MAX385EPE	-40°C to +85°C	16 Plastic DIP
MAX385ESE	-40°C to +85°C	16 Narrow SO
MAX385EJE	-40°C to +85°C	16 CERDIP**
MAX385MJE	-55°C to +125°C	16 CERDIP**

* Dice are tested at $T_A = +25^\circ\text{C}$ only.

** Contact factory for package availability.

チップ構造図



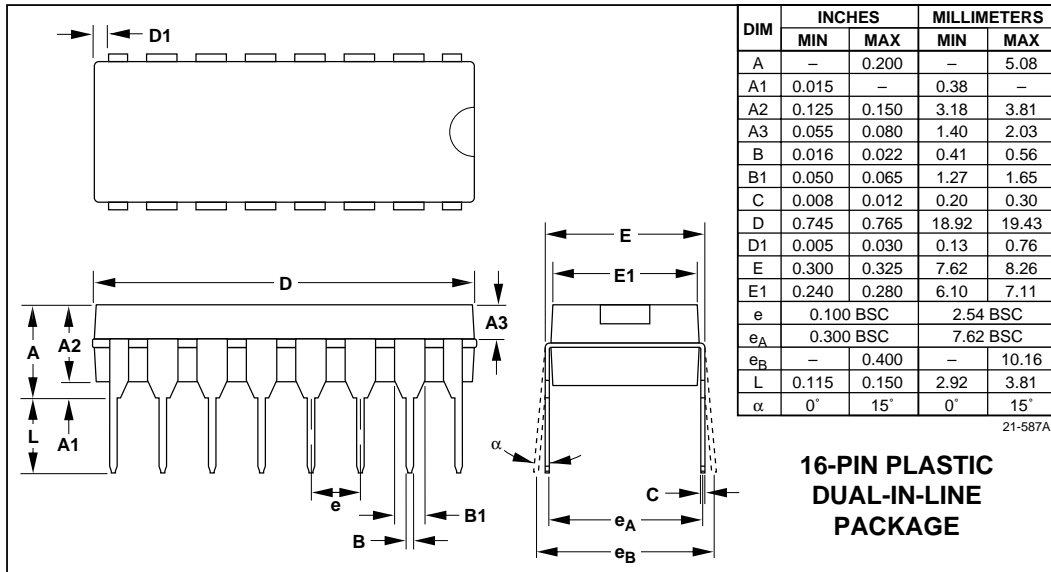
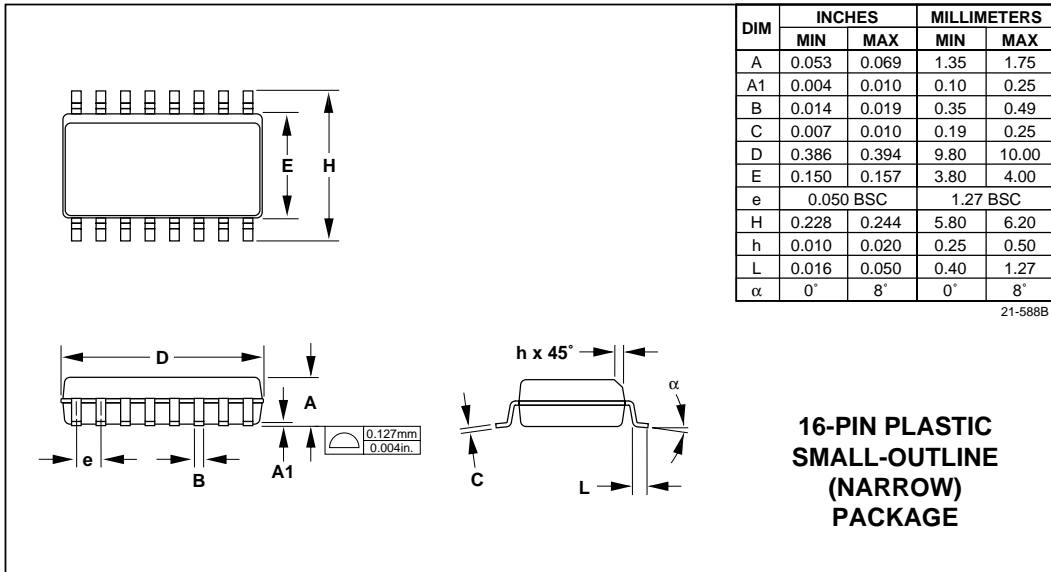
MAX381/MAX383/MAX385

TRANSISTOR COUNT: 57
SUBSTRATE CONNECTED TO V_+

高精度、低電圧アナログスイッチ

MAX381/MAX383/MAX385

パッケージ



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