

SCOPE: Complete, 8-Channel, 12-Bit Data Acquisition Systems

<u>Device Type</u>	<u>Generic Number</u>	<u>Circuit Function</u>
01	MAX186AM(x)/883B	Low Power, 8-Channel, 12-Bit Serial ADC Track/Hold and Reference
02	MAX186BM(x)/883B	
03	MAX186CM(x)/883B	
04	MAX186DM(x)/883B	
05	MAX188AM(x)/883B	Low Power, 8-Channel, 12-Bit Serial ADC with Track/Hold
06	MAX188BM(x)/883B	
07	MAX188CM(x)/883B	
08	MAX188DM(x)/883B	

Case Outline(s). The case outlines shall be designated in Mil-Std-1835 and as follows:

<u>Outline Letter</u>	<u>Mil-Std-1835</u>	<u>Case Outline</u>	<u>Package Code</u>
JP	GDIP1-T20 or CDIP2-T20	20 LEAD Cerdip	J20
LP	CQCC1-N20	20-Pin LCC	L20

Absolute Maximum Ratings

V_{DD} to AGND	-0.3V to +6V
V_{SS} to AGND	+0.3V to -6V
V_{DD} to V_{SS}	-0.3V to +12V
AGND to DGND	-0.3V to +0.3V
CH0-CH7 to AGND, DGND	(V_{SS} -0.3V) to (V_{DD} +0.3V)
VREF to AGND	-0.3V to (V_{DD} +0.3V)
REFADJ to AGND	-0.3V to (V_{DD} +0.3V)
Digital Inputs to DGND.....	-0.3V to (V_{DD} +0.3V)
Digital Outputs to DGND	-0.3V to (V_{DD} +0.3V)

Lead Temperature (soldering, 10 seconds) +300°C

Storage Temperature -65°C to +150°C

Continuous Power Dissipation $T_A = +70^\circ\text{C}$

20 pin Cerdip(derate 11.1mW/°C above +70°C) 889mW

20 pin LCC(derate 9.1mW/°C above +70°C) 727mW

Junction Temperature T_J +150°C

Thermal Resistance, Junction to Case, θ_{JC} :

20 pin Cerdip..... 40°C/W

20 pin LCC 20°C/W

Thermal Resistance, Junction to Ambient, θ_{JA} :

20 pin Cerdip..... 90°C/W

20 pin LCC 110°C/W

Recommended Operating Conditions

Ambient Operating Range (T_A)	-55°C to +125°C
Positive Supply Voltage (V_{DD})	+4.75V to +5.25V
Negative Supply Voltage (V_{SS}).....	-4.75V to -5.25V

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.

TABLE 1. ELECTRICAL TESTS:

TEST	Symbol	CONDITIONS -55 °C ≤ T _A ≤ +125°C V _{DD} =+5V±5%, f _{CLK} =2.0MHz V _{SS} =0V or -5V, external clock (50% duty cycle). <u>1/</u> Unless otherwise specified	Group A Subgroup	Device type	Limits Min	Limits Max	Units
ACCURACY <u>2/</u>							
Resolution	N			All	12		Bits
Relative Accuracy <u>3/</u>			1,2,3	01,02 05,06 03,04,08 07		±0.5 ±1.0 ±.75	LSB
Differential Nonlinearity	DNL	No missing codes over temperature	1,2,3	All		±1.0	LSB
Offset Error	V _{OS}		1,2,3	01,05 02,03 04,06 07,08		±2.0 ±3.0	LSB
Gain Error NOTE 4			1,2,3	01,02 03,04 05 06,07 08		±3.0 ±1.5 ±2.0 ±3.0	LSB
DYNAMIC TESTS Bipolar Input Mode		10kHz sine wave input, 4.096V _p - p, 133ksps, 2.0MHz external clock					
Signal-to-Noise Plus Distortion	SINAD		1,2,3	All	70		dB
Total Harmonic Distortion	THD	Up to the 5th Harmonic	1,2,3	All		-80	dB
Spurious Free Dynamic Range	SFDR		1,2,3	All	80		dB
CONVERSION RATE							
Track-and-Hold Acquisition Time	t _{ACQ}		9,10,11	All		1.5	μs
Conversion Time NOTE 5	t _{CONV}	Internal clock External clock, 2mhz, 12 clocks/ conversion	9,10,11	All	5.5 6.0	10	μs
External Clock Frequency Range		Exteral compensation, 4.7μF Internal compensation, NOTE 6	4,5,6	All	0.1 0.1	2.0 0.4	MHz
ANALOG INPUT							
Input Voltage Range Single Ended and Differential NOTE 8		Unipolar, V _{SS} =0V Bipolar, V _{SS} =-5V	1,2,3	All		0 to V _{REF} ±V _{REF} /2	V
Multiplexer Leakage Current		On/Off Leakage Current, VIN=±5V	1,2,3	All	0	±1.0	μA

TEST	Symbol	CONDITIONS -55 °C <=T _A <= +125°C V _{DD} =+5V±5%, f _{CLK} =2.0MHz V _{SS} =0V or -5V, external clock (50% duty cycle). 1/ Unless otherwise specified	Group A Subgroup	Device type	Limits Min	Limits Max	Units
REFERENCE INPUT		Reference Buffer Enabled					
V _{REF} Output Voltage			1	01-04	4.076	4.116	V
V _{REF} Short Circuit Current			1,2,3	01-04		30	mA
V _{REF} Tempco			1,2,3	01-03		±80	ppm/°C
Capacitive Bypass at V _{REF}		Interenal Compensation	test condition only	01-04	.0.0		μF
		External Compensation			4.7		
Capacitive Bypass at REF _{ADJ}		Interenal Compensation	test condition only	01-04	.01		μF
		External Compensation			.01		
EXTERNAL REFERENCE AT V _{REF}		Buffer disabled, V _{REF} =4.096V					
Input Voltage Range			1,2,3	All	2.50	V _{DD} + 50mV	V
Input Current			1,2,3	All		350	μA
Input Resistance			1,2,3	All	12		kΩ
Shutdown V _{REF} Input Current			1,2,3	All		10	μA
Buffer Disable Threshold REF _{ADJ}			1,2,3	All	V _{DD} - 50mV		V
EXTERNAL REFERENCE AT REF _{ADJ}							
Capacitive Bypass at V _{REF}		Internal Compensation	1,2,3	All	0.0		μF
		External Compensation			4.7		
REF _{ADJ} Input Current			1,2,3	01-04 05-08		±50 ±5	μA
DIGITAL INPUTS		DIN, SCLK, CS, SHDN					
___ DIN, SCLK, CS Input Voltage High	V _{INH}		1,2,3	All	2.4		V
___ DIN, SCLK, CS Input Voltage Low	V _{INL}		1,2,3	All		0.8	V
___ DIN, SCLK, CS Input Leakage	I _{IN}	V _{IN} =0V or V _{DD}	1,2,3	All		±1.0	μA
___ DIN, SCLK, CS Input Capacitance	C _{IN}	NOTE 6		All		15	pF
SHDN Input High Voltage	V _{INH}		1,2,3	All	V _{DD} - 0.5		V
SHDN Input Low Voltage	V _{INL}		1,2,3	All		0.5	V
SHDN Input High Current	I _{INH}	SHDN=V _{DD}	1,2,3	All		4.0	μA

TEST	Symbol	CONDITIONS -55 °C ≤ T _A ≤ +125°C V _{DD} =+5V±5%, f _{CLK} =2.0MHz V _{SS} =0V or -5V, external clock (50% duty cycle). <u>1</u> / Unless otherwise specified	Group A Subgroup	Device type	Limits Min	Limits Max	Units
SHDN Input Low Current	I _{INL}	SHDN=0V	1,2,3	All	-4.0		μA
SHDN Input Mid Voltage	V _{IM}		1,2,3	All	1.5	V _{DD} - 1.5	V
SHDN Max Allowed Leakage, Mid Input		SHDN=open	1,2,3	All	-100	100	nA
DIGITAL OUTPUTS		DOUT, SSTRB					
Output High Voltage	V _{OH}	I _{SOURCE} =1mA	1,2,3	All	4.0		V
Output Low Voltage	V _{OL}	I _{SINK} =5mA	1,2,3	All		0.4	V
Three-State Leakage Current	I _{LKG}	CS=5V	1,2,3	All		±10	μA
Three-State Output Capacitance NOTE 5	C _{OUT}	NOTE 6		All		15	pF
POWER REQUIREMENTS							
Positive Supply Current	I _{DD}	Operating Mode	1,2,3	All		2.5	mA
		Fast power-down				70.0	μA
		Full power-down				10.0	
Negative Supply Current	I _{SS}	Operating mode and fast power-down	1,2,3	All		50.0	μA
						10.0	
		Full power-down					
Positive Supply Rejection NOTE 7	PSR	V _{DD} =+5V ±5%, external reference, 4.096V; full-scale input	1,2,3	All		±0.5	mV
Negative Supply Rejection NOTE 7	PSR	V _{DD} =-5V ±5%, external reference, 4.096V; full-scale input	1,2,3	All		±0.5	mV
TIMING		V _{DD} =+5V ±5%, V _{SS} =0V or -5V Unless otherwise specified					
Acquisition Time	t _{AZ}		9,10,11	All	1.5		μs
DIN to SCLK Setup	t _{DS}		9,10,11	All	100		ns
DIN to SCLK Hold	t _{DH}		9,10,11	All		0	ns
SCLK Fall to Output Data Valid	t _{DO}	C _{LOAD} =100pF	9,10,11	All	20	200	ns
CS Fall to Output Enable	t _{DV}	C _{LOAD} =100pF	9,10,11	All		100	ns
CS Rise to Output Disable	t _{TR}	C _{LOAD} =100pF	9,10,11	All		100	ns
CS to SCLK Rise Setup	t _{CSS}		9,10,11	All	100		ns
CS to SCLK Rise Hold	t _{CSH}		9,10,11	All	0		ns
SCLK Pulse Width High	t _{CH}		9,10,11	All	200		ns
SCLK Pulse Width Low	t _{CL}		9,10,11	All	200		ns
SCLK Fall to SSTRB	t _{SSTRB}	C _{LOAD} =100pF	9,10,11	All		200	ns

TEST	Symbol	CONDITIONS	Group A Subgroup	Device type	Limits Min	Limits Max	Units
		-55 °C ≤ T _A ≤ +125°C V _{DD} =+5V±5%, V _{SS} =0V or -5V Unless otherwise specified					
CS Fall to SSTRB Output Enable NOTE 6	t _{SDV}	External clock mode only, C _{LOAD} =100pF	9,10,11	All		200	ns
CS Rise to SSTRB Output Disable NOTE 6	t _{STR}	External clock mode only, C _{LOAD} =100pF	9,10,11	All		200	ns
SSTRB Rise to SCLK Rise NOTE 6	t _{SCK}	Internal clock mode only	9,10,11	All	0		ns

NOTE 1: 15 clocks/conversion cycle (133kps); MAX186 - 4.7μF capacitor at V_{REF} pin;

MAX188 - external reference, V_{REF}=4.096V applied to V_{REF} pin.

NOTE 2: Tested at V_{DD}=+5V, V_{SS}=0V, unipolar input mode.

NOTE 3: Relative accuracy is the deviation of the analog value at any code from its theoretical value after the full-scale range has been calibrated.

NOTE 4: MAX186-internal reference, offset nulled; MAX188-external reference (V_{REF} = +4.096V), offset nulled.

NOTE 5: Conversion time defined as the number of clock cycles times the clock period; clock has 50% duty cycle

NOTE 6: Guaranteed by design. Not production tested.

NOTE 7: Measured at V_{SUPPLY} +5% and V_{SUPPLY} -5% only..

NOTE 8: The common-mode range for the analog inputs is from V_{SS} to V_{DD}.

Package	ORDERING	INFORMATION:		
20 pin CERDIP	MAX186AMJP/883B	MAX186BMJP/883B	MAX186CMJP/883B	MAX186DMJP/883B
20 pin CERDIP	MAX188AMJP/883B	MAX188BMJP/883B	MAX188CMJP/883B	MAX188DMJP/883B
20 pin LCC	MAX186AMLJP/883B	MAX186BMLJP/883B	MAX186CMLJP/883B	MAX186DMLJP/883B
20 pin LCC	MAX188AMLJP/883B	MAX188BMLJP/883B	MAX188CMLJP/883B	MAX188DMLJP/883B

TERMINAL CONNECTIONS:

MODE SELECTION TABLE:

MAX186	& MAX188	Channel Selection in Single-Ended Mode _____ (SGL/DIFF=1)											
1	CH0	SEL2	SEL1	SEL0	CH0	CH1	CH2	CH3	CH4	CH5	CH6	CH7	AGND
2	CH1	0	0	0	+								-
3	CH2	1	0	0		+							-
4	CH3	0	0	1			+						-
5	CH4	1	0	1				+					-
6	CH5	0	1	0					+				-
7	CH6	1	1	0						+			-
8	CH7	0	1	1							+		-
9	V _{SS}	1	1	1								+	-
10	_____ SHDN		Channel Selection in Differential Mode _____ (SGL/DIFF=0)										
11	V _{REF}	SEL2	SEL1	SEL0	CH0	CH1	CH2	CH3	CH4	CH5	CH6	CH7	AGND
12	REF _{ADJ}	0	0	0	+	-							
13	AGND	0	0	1			+	-					
14	DGND	0	1	0					+	-			
15	DOUT	0	1	1							+	-	
16	SSTRB	1	0	0	-	+							
17	DIN	1	0	1			-	+					
18	_____ CS	1	1	0					-	+			
19	SCLK	1	1	1							-	+	
20	V _{DD}												

QUALITY ASSURANCE

Sampling and inspection procedures shall be in accordance with MIL-Prf-38535, Appendix A as specified in Mil-Std-883.

Screening shall be in accordance with Method 5004 of Mil-Std-883. Burn-in test Method 1015:

1. Test Condition, A, B, C, or D.
2. TA = +125°C minimum.
3. Interim and final electrical test requirements shall be specified in Table 2.

Quality conformance inspection shall be in accordance with Method 5005 of Mil-Std-883, including Groups A, B, C, and D inspection.

Group A inspection:

1. Tests as specified in Table 2.
2. Selected subgroups in Table 1, Method 5005 of Mil-Std-883 shall be omitted.

Group C and D inspections:

- a. End-point electrical parameters shall be specified in Table 1.
- b. Steady-state life test, Method 1005 of Mil-Std-883:
 1. Test condition A, B, C, D.
 2. TA = +125°C, minimum.
 3. Test duration, 1000 hours, except as permitted by Method 1005 of Mil-Std-883.

TABLE 2. ELECTRICAL TEST REQUIREMENTS

Mil-Std-883 Test Requirements	Subgroups per Method 5005, Table 1
Interim Electric Parameters Method 5004	1
Final Electrical Parameters Method 5005	1*, 2, 3, 4, 5, 6, 7, 9, 10, 11
Group A Test Requirements Method 5005	1, 2, 3, 4, 5, 6, 7, 9, 10, 11
Group C and D End-Point Electrical Parameters Method 5005	1

* PDA applies to Subgroup 1 only.