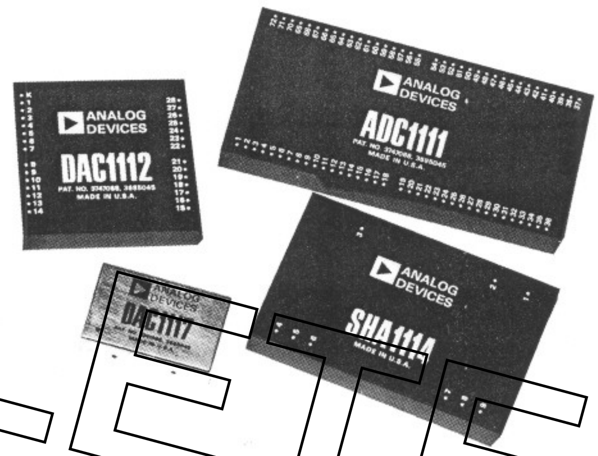
HIGH RELIABILITY CONVERTERS
ADC1111, DAC1112, SHA1114, DAC1117



GENERAL DESCRIPTION
The ADC1111, DAC1112, SHA1114, and DAC1117 are fully documented, high reliability converter products which are guaranteed to operate within specifications over the full military temperature range. Qualification testing has proven that these devices are capable of operating under severe environmental conditions. A specification document is available for each product which lists its characteristics and capabilities in great detail.

ADC1111
The ADC1111 is a high reliability version of the ADC-12QM. It performs 12 bit conversions in 25μs (max) and has excellent stability over temperature. It comes complete with an input buffer and offers the choice of five user-programmable input voltage ranges. Module dimensions are 2″ x 4″ x 0.4″ (51 x 102 x 10mm).

DAC1112
The DAC1112 is a high reliability version of the DAC-12QS. This 2″ x 2″ x 0.4″ (51 x 51 x 10mm) module, which comes complete with a versatile output amplifier, settles to 0.01% accuracy in 5μs. The user can program either of five output voltage ranges by means of jumpers connected to the module's terminal pins.

SHA1114
The SHA1114 is a high reliability version of the SHA-2A. It is a fast sample-and-hold amplifier with a 500ns (max) acquisition time to 0.01% accuracy. Module dimensions are 2″ x 3″ x 0.4″ (51 x 76 x 10mm).

DAC1117
The DAC1117 is a high reliability 12 bit current output D/A converter packaged in a 1.5″ x 1″ x 0.4″ (38 x 25 x 10mm) hermetically sealed metal enclosure. It settles to 0.01% accuracy in 3μs when used with a high speed output amplifier. This device is also available in a non-military grade extended temperature version, the MDA-12QD/ET, and a commercial grade version, the MDA-12QD.

THE HIGH RELIABILITY CONVERTER PROGRAM
Analog Devices has, over the past several years, supplied a great many A/D and D/A converter modules intended for military and critical industrial applications. As a result of this experience, we know what is needed in a high reliability converter and what it takes to build one. This experience is now available to you in the form of the industry's first line of converter products intended expressly for high reliability applications.

ADVANTAGES TO THE USER
The first big advantage is the ease of specification. As part of our development program, we have generated a separate specification drawing for each of the four products. These drawings run an average of 17 pages and specify in exact detail all pertinent characteristics of the module. By copying our drawing over onto his own specification control drawing format, the user can completely specify a high reliability converter module in a very short time with a mimimum of effort.

The second advantage is that the system designer can get quick delivery of units needed for breadboarding and prototyping. Since the high reliability converters are standard products for us, they're available in small quantities in a few weeks or less.

The third advantage is cost. The user is no longer in the position of having to subsidize the development of a special high reliability converter. We have sustained all the development costs and the user pays only for the modules he actually requires

SYM.	DESCRIPTION	DR.	CKD.	APPD.	DATE
A	INITIAL RELEASE PER E.R. NO.				

OBSOLETE

REV STATUS															
OF SHEETS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES:
DECIMALS:
.XX ± FRACTIONS: ±
.XXX ± ANGLES: ±

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DRAWN	
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REVIEW	
ENG MGR	

ANALOG DEVICES INC
NORWOOD • MASSACHUSETTS

SPECIFICATIONS FOR 12 BIT
ANALOG-TO-DIGITAL CONVERTER,
MODEL NUMBER ADC1111

SIZE	CODE IDENT NO	DWG NO	REV
A	24355	03-66510	A

SCALE | MODEL ADC1111 | SH 1 OF 17

DWG. NO.

FOR REVISIONS AND APPROVAL SEE SHEET I

1.0 SCOPE:

1.1 This specification covers the requirements for an encapsulated 12-bit analog-to-digital converter module. This A/D converter module accepts analog input signals within any of several input voltage ranges and converts them into TTL/DTL compatible parallel output digital data.

2.0 GENERAL REQUIREMENTS:

2.1 Modules supplied to this specification shall be manufactured, processed and tested in a careful and workmanlike manner in accordance with good engineering practice. The manufacturer of modules, in compliance with this specification, shall have production and test facilities and a quality and reliability assurance program adequate to assure successful compliance with the requirements of this specification.

3.0 APPLICABLE DOCUMENTS:

3.1 The following documents form a part of this specification to the extent specified herein. Applicable documents referenced in the remainder of this specification are referenced by number only, without reference to amendment or issue. In each case, the amendment or issue referenced below shall apply.

3.2 In the event of any conflict between this specification and any other document, this specification shall take precedence.

3.3 Military Standards

MIL-STD-130D Identification Marking of U.S. Military Property

MIL-STD-202E Test Methods for Electronic and Electrical Component Parts

MIL-STD-454D Standard General Requirements for Electronic Equipment

MIL-STD-883 Test Methods and Procedures for Microelectronics

3.4 Military Handbooks

MIL-HDBK-217A Reliability Stress and Failure Rate Data for Electronic Equipment

3.5 Military Specifications

MIL-R-11-1A	Resistor, Fixed, Composition (Insulated)/Appropriate Device Specification
MIL-M-14G	Molding Plastics and Molded Plastic Parts, Thermosetting
MIL-C-20E	Capacitor, Fixed, Ceramic Dielectric, (Temperature Compensating)/Appropriate Device Specification
MIL-R-10509F	Resistor, Fixed, Film (High Stability)/Appropriate Device Specification
MIL-C-11015D	Capacitor, Fixed, Ceramic Dielectric (General Purpose)/Appropriate Device Specification
MIL-P-13949G	Plastic Sheet, Laminated, Copper Clad (For Printed Wiring)
MIL-I-16923E	Insulating Compound, Electrical, Embedding
MIL-S-19500E	Semiconductor Device/Appropriate Device Specification
MIL-S-23586C	Sealing Compound, Electrical, Silicone Rubber, Accelerator Required
MIL-C-26655B	Capacitor, Fixed, Electrolytic (Solid Electrolyte), Tantalum
MIL-M-38510A	Microcircuits, General Specifications For/Appropriate Device Specification
MIL-G-45204B	Gold Plating, Electrode Deposited
MIL-I-45208A	Inspection System Requirements
MIL-I-46058C	Insulating Compound, Electrical (For Coating Printed Circuit Assembles)

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4.0 ABSOLUTE MAXIMUM RATINGS:

4.1 Absolute maximum ratings shall be as shown in Table 1.

5.0 ELECTRICAL SPECIFICATIONS:

5.1 Recommended operating conditions shall be as shown in Table 2.

5.2 Electrical specifications shall be as shown in Table 3.

5.3 The module's timing characteristics shall be as shown in Figure 1.

6.0 MODULE CONNECTIONS:

6.1 The desired input range, and whether or not the internal input buffer is used, shall be determined according to Table 4.

6.2 When using a bipolar input voltage range, either offset binary or two's complement output coding shall be available. The only difference between the two codes is the state of the most significant bit (MSB). For offset binary coding use pin 72 (MSB) as the MSB output. For two's complement use pin 70 (MSB).

6.3 Gain and zero adjustment potentiometers, if used, shall be connected as shown in Figure 2.

6.4 When the A/D converter is used with its own internal clock, as is normally the case, connection to the clock shall be effected by connecting together pins 35 and 36 of the module.

7.0 MECHANICAL SPECIFICATIONS:

7.1 The module's circuitry shall conform to the block diagram shown in Figure 2.

7.2 The module's pin assignments and pin designations shall be as shown in Table 5.

7.3 The physical outline of the module shall be in accordance with Figure 3.

7.4 The maximum weight of the module shall be 3.5 ounces (99.3 grams).

7.5 The module shall be permanently and legibly marked per MIL-STD-130. The manufacturer's identification, model numbers, and pin numbers shall be marked on top of the module. Any additional markings shall be on one or more sides of the module.

7.6 Modules meeting the requirements of this specification shall have their printed circuit cards coated subsequent to component mounting and soldering, but prior to encapsulation, using a plastic coating material meeting the requirements of MIL-I-46058.

8.0 ENVIRONMENTAL SPECIFICATIONS:

8.1 A/D modules meeting the requirements of this specification shall be capable of passing the environmental tests shown in Table 6.

9.0 QUALITY CONFORMANCE INSPECTION

9.1 All modules meeting the requirements of this specification shall be inspected using an inspection system meeting the requirements of MIL-I-45208.

9.2 All modules meeting the requirements of this specification shall be subjected to the following screening tests, in the order shown, before delivery:

9.3 After assembly, the module, while at ambient room temperature, shall be tested for, and shall pass, the 25°C operating parameters designated by reference numbers 1, 2, and 4 of Table 3.

9.4 After temperature stabilization of the module at +125°C, the module shall be tested for, and shall pass, the high temperature operating parameters designated by reference numbers 1, 2, 3 and 4 of Table 3.

9.5 After temperature stabilization of the module at -55°C, the module shall be tested for, and shall pass, the low temperature operating parameters designated by reference numbers 1, 2, 3 and 4 of Table 3.

9.6 The module shall be temperature cycled in accordance with MIL-STD-883, Method 1010, test condition B.

9.7 The module shall be operated in an ambient temperature of +125°C ±2°C for 168 hours with +5V and ±15V power applied to the unit, and with a 5kHz minimum repetition rate convert command.

9.8 The module, after stabilization at room ambient temperature, shall be retested, and shall pass the 25°C operating parameters designated by reference numbers 1, 2, and 4 of Table 3.

9.9 A pre-encapsulation visual inspection shall be performed to verify that workmanship is in accordance with MIL-STD-454, Requirement 9.

9.10 After encapsulation, the module shall have a final electrical test, which shall consist of being tested for, and passing, the 25°C operating parameters designated by reference numbers 1, 2, and 4 of Table 3.

9.11 If any components, other than trim resistors, are replaced within the module after the quality conformance inspection has commenced, any tests already performed on the module are invalidated, and the module must begin the quality conformance inspection procedure again.

10.0 CALCULATED MEAN TIME BETWEEN FAILURES:

10.1 The module shall have a minimum calculated MTBF of 100,000 hours at normal room ambient temperature with nominal supply voltages applied. The MTBF shall be calculated in accordance with Handbook MIL-HDBK-217A.

11.0 COMPONENTS:

11.1 Except as allowed for in paragraph 11.2 of this specification, all components used in modules meeting this specification shall meet the requirements of the appropriate specification(s) called out below:

11.1.1 CARBON RESISTORS shall meet the requirements of MIL-R-11.

11.1.2 METAL FILM RESISTORS shall meet the requirements of MIL-R-10509.

11.1.3 CERAMIC CAPACITORS shall meet the applicable requirements of MIL-C-11015 and MIL-C-20.

11.1.4 TANTALUM CAPACITORS shall meet the requirements of MIL-C-26655.

11.1.5 MICROCIRCUITS shall be hermetically sealed and shall meet one of the following requirements, shown in order of preference: 1) microcircuits qualified to MIL-M-38510, Class B, 2) microcircuits processed to MIL-M-38510, Class B. 3) microcircuits processed to the applicable requirements of MIL-STD-883, Class B. Microcircuits meeting the requirements of a lower preference are acceptable only when those meeting the requirements of a higher preference are not available.

11.1.6 DISCRETE SEMICONDUCTORS shall be hermetically sealed and meet the requirements of MIL-S-19500.

11.1.7 PRINTED CIRCUIT BOARDS shall use material meeting the requirements of MIL-P-13949.

11.1.8 ENCAPSULATING COMPOUND shall meet the requirements of Thermal Shock MIL-I-16923, and Corrosion Resistance MIL-S-23586.

11.1.9 PLASTIC CASES shall be manufactured of diallyl phthalate meeting the requirements of MIL-M-14, SDG.

11.1.10 TERMINAL PINS shall be made of half-hard brass and shall be gold plated per MIL-G-45204, Class 1, Type II.

11.2 The vendor shall, upon request, furnish a list of all components not meeting the appropriate requirements of paragraph 11.1, and shall indicate the reason(s) for using such components.

12.0 PREPARATION FOR DELIVERY:

12.1 Preservation and Packaging; The module shall be afforded preservation and packaging in a manner that will afford adequate protection against corrosion, deterioration, and physical damage during shipment.

12.2 Packing; The module shall be packed in containers of the type, size, and kind commonly used for the purpose, in a manner that will insure acceptance by common carrier and safe delivery at destination.

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TABLE 1

ABSOLUTE MAXIMUM RATINGS

+15 Volt Supply Voltage	+18 Volts
-15 Volt Supply Voltage	-18 Volts
+5 Volt Supply Voltage	+5.5 Volts
Analog Input Voltage	$\pm$15 Volts
Storage Temperature	-55°C to +125°C
Lead Temp. During Soldering:	
Soldering Iron on one pin	572°F (300°C) for 3 sec.
Wave Solder on all pins	500°F (260°C) for 3 sec.

TABLE 2

RECOMMENDED OPERATING CONDITIONS

+15V Supply Voltage	+15 Volts $\pm$3%
-15V Supply Voltage	-15 Volts $\pm$3%
Tracking Error Between +15V and -15V Supplies	1% Maximum
+5V Supply Voltage	+5 Volts $\pm$5%
Analog Input Voltage Range	-15V to +15V
Convert Command Logic "1" Voltage	$+2.4 < V_{IN} < +5.0V$
Convert Command Logic "0" Voltage	$+0V < V_{IN} < +0.4V$
Convert Command Pulse Width	100ns Minimum
Ambient Operating Temperature Range	-55°C to +125°C

For all tests, supply voltages are set at +15.00 volts, -15.00 volts, and +5.00 volts

TABLE 3
ELECTRICAL SPECIFICATIONS

REF NO.	CHARACTERISTIC	NOTES	AMBIENT TEMP=-55°C MIN	NOM	MAX	AMBIENT TEMP=+25°C MIN	NOM	MAX	AMBIENT TEMP=+125°C MIN	NOM	MAX	UNITS	PINS
	POSITIVE SUPPLY CURRENT	1			25			25			25	mA	27
	NEGATIVE SUPPLY CURRENT	1			-45			-40			-35	mA	25
	POSITIVE SUPPLY CURRENT	2			275			275			275	mA	29
	POWER SUPPLY REJECTION	3					0.002					%/%ΔVs	--
1	RELATIVE ACCURACY ERROR							±0.5				LSB	--
2	DIFFERENTIAL LINEARITY ERROR							±0.5				LSB	--
3	TEMP. COFFICIENTS	4											
	GAIN				±10			±7			±12	ppm/°C	--
	ZERO				±50			±50			±50	µV/°C	--
	OFFSET				±6			±5			±6	ppm/°C	--
	DIFF. LINEARITY				±6			±3			±6	ppm/°C	--
	INPUT IMPEDANCE												
	BUFFERED		10^9			10^9			10^9			OHMS	2
	DIRECT:												
	0V to +10V RANGE			5000			5000			5000		OHMS	6
	-5V to +5V RANGE			5000			5000			5000		OHMS	6
	-10V to +10V RANGE			10000			10000			10000		OHMS	5
	0V to +5V RANGE			2500			2500			2500		OHMS	6
	-2.5V to +2.5V RANGE			2500			2500			2500		OHMS	6
4	CONVERSION TIME	5			25			25			25	µs	33
	REFERENCE OUTPUT VOLTAGE	6	5.87		6.53	5.89		6.51	5.87		6.53	VOLTS	22
	HIGH LEVEL INPUT CURRENT	7,9			40			40			40	µA	34
	LOW LEVEL INPUT CURRENT	8,9			-1.6			-1.6			-1.6	mA	34
	HIGH LEVEL OUTPUT VOLTAGE	10,12	2.4			2.4			2.4			VOLTS	33,43
	LOW LEVEL OUTPUT VOLTAGE	11,12			0.4			0.4			0.4	VOLTS	33,43

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TABLE 3
ELECTRICAL SPECIFICATIONS (CONTD.)

REF NO.	CHARACTERISTIC	NOTES	AMBIENT TEMP=-55°C MIN	NOM	MAX	AMBIENT TEMP=+25°C MIN	NOM	MAX	AMBIENT TEMP=+125°C MIN	NOM	MAX	UNITS	PINS
	HIGH LEVEL OUTPUT VOLTAGE	13,15	2.4			2.4			2.4			VOLTS	48,50, 52,54, 56,58, 61,63, 65,67, 71,72
	LOW LEVEL OUTPUT VOLTAGE	14,15			0.4			0.4			0.4	VOLTS	48,50, 52,54, 56,58, 61,63, 65,67, 71,72
	HIGH LEVEL OUTPUT VOLTAGE	15,16	2.4			2.4			2.4			VOLTS	70
	LOW LEVEL OUTPUT VOLTAGE	15,17			0.4			0.4			0.4	VOLTS	70

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NOTES TO TABLE 3

1. As measured with +15 volt supply set to +15.00 volts and -15 volt supply set to -15.00 volts
2. As measured with +5 volt supply set to +5.00 volts.
3. Applies only to slowly occurring variations in ±15 volt supplies. Also assumes +15 volt and -15 volt supplies track.
4. Gain TC is expressed as ppm/°C of range. For unipolar input range, range = +F.S. voltage. For bipolar input range, range = 2 x +F.S. voltage.
   Zero TC applies when using a unipolar input range.
   Offset TC applies when using a bipolar input range, and is expressed as ppm/°C of range.
5. Conversion time is measured from falling edge ("1" to "0" transition) of convert command pulse to "1" to "0" transition of status output.
6. As measured with a high input impedance voltmeter. Any load connected to the reference output should draw no more than 10μA.
7. As measured with an input voltage of 2.4 volts.
8. As measured with an input voltage of 0.4 volts.
9. Convert command is a positive-going pulse with a minimum width of 100ns.
10. As measured with a load current of 160μA.
11. As measured with a load current of -6.4mA
12. STATUS output (pin 33) is a logic "1" (output >2.4V) during a conversion.
    $\overline{\text{STATUS}}$ output (pin 43) is a logic "0" (output <0.4V) during a conversion.
13. As measured with a load current of 400μA.
14. As measured with a load current of -16mA.
15. For all bit outputs, a logic "1" is defined as a high level voltage (output >2.4V).
16. As measured with a load current of 320μA.
17. As measured with a load current of -12.8mA.

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TABLE 4

INPUT RANGE AND BUFFER SELECTION

Input Range in Volts	Input Impedance	Input To Pin	Jumper Pin 4 To	Jumper Pin 20 To	Jumper Pin 19 To
0 to +10	10^9 OHMS MINIMUM	2	6	--	23
0 to +10	5K OHMS	6	--	--	23
-5 to +5	10^9 OHMS MINIMUM	2	6	--	20
-5 to +5	5K OHMS	6	--	--	20
-10 to +10	10^9 OHMS MINIMUM	2	5	--	20
-10 to +10	10K OHMS	5	--	--	20
0 to +5	10^9 OHMS MINIMUM	2	6	5	23
0 to +5	2.5K OHMS	6	--	5	23
-2.5 to +2.5	10^9 OHMS MINIMUM	2	6	5	20
-2.5 to +2.5	2.5K OHMS	6	--	5	20

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TABLE 5

PIN DESIGNATIONS

PIN NUMBER	DESIGNATION
1	GAIN ADJUST
2	BUFFER INPUT
3	SIGNAL GROUND
4	BUFFER OUTPUT
5	20 VOLT RANGE INPUT
6	10 VOLT RANGE INPUT
19	BIPOLAR OFFSET CURRENT OUTPUT
20	COMPARATOR INPUT
22	REFERENCE OUTPUT
23	SIGNAL GROUND
25	-15VDC INPUT
27	+15VDC INPUT
29	+5VDC INPUT
30	DIGITAL GROUND
32	COMPARATOR OUTPUT
33	STATUS OUTPUT
34	CONVERT COMMAND INPUT
35	CLOCK INPUT
36	CLOCK OUTPUT
37	CLOCK INHIBIT INPUT
43	STATUS OUTPUT
48	BIT 12 (LSB) OUTPUT
50	BIT 11 OUTPUT
52	BIT 10 OUTPUT
54	BIT 9 OUTPUT
56	BIT 8 OUTPUT
58	BIT 7 OUTPUT
61	BIT 6 OUTPUT
63	BIT 5 OUTPUT
65	BIT 4 OUTPUT
67	BIT 3 OUTPUT
70	BIT 1 (MSB) OUTPUT
71	BIT 2 OUTPUT
72	BIT 1 (MSB) OUTPUT

NOTE: Pins are installed only in those pin locations called out in this table.

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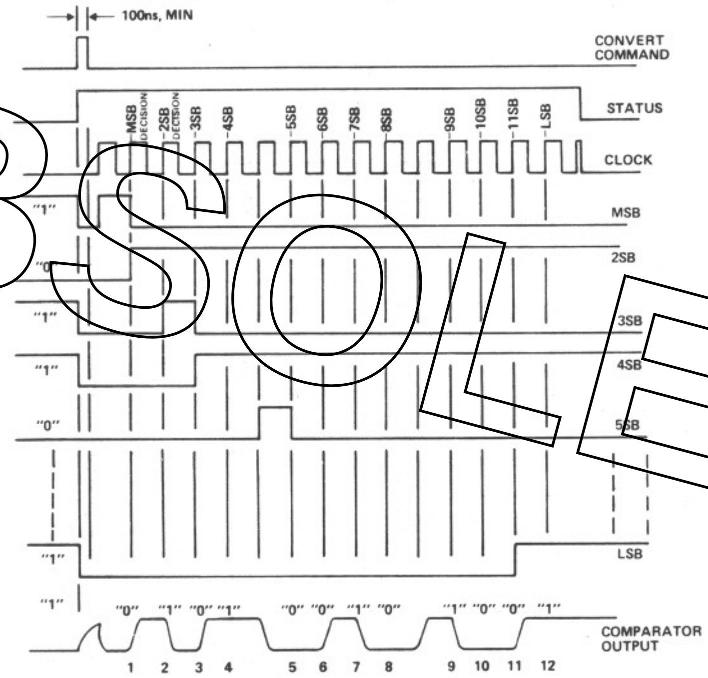
TABLE 6
ENVIRONMENTAL TESTS

TEST	MIL-STD	METHOD	CONDITIONS
VISUAL AND MECHANICAL	883	2008	A,B
BAROMETRIC PRESSURE (REDUCED)	202	105C	B
TEMPERATURE CYCLING	883	1010	B
MOISTURE RESISTANCE	883	1004	delete section 3.1 delete section 3.42, step 7b section 3.5: nominal power supply voltages shall be applied
SHOCK	883	2002	B pulse duration: 0.5ms
TERMINAL STRENGTH	202	211A	A applied force: 4.5 lbs
VIBRATION FATIGUE	883	2005	A
STEADY-STATE LIFE	883	1005	B maximum temperature: 125°C test duration: 1000 hrs.
SOLDERABILITY	883	2003	--
FUNGUS RESISTANCE	MIL-I-46058	--	per ASTM STD G-21
SALT ATMOSPHERE	883	1009	A delete section 3.1
HIGH TEMPERATURE STORAGE	883	1008	B test duration: 1000 hrs.

FIGURE 1

TIMING DIAGRAM



Previous Code = 10110...1
New Code = 01010...1
Note Idle Clock Pulses between 4th and 5th bits, and between 8th and 9th bits.

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FIGURE 2

BLOCK DIAGRAM

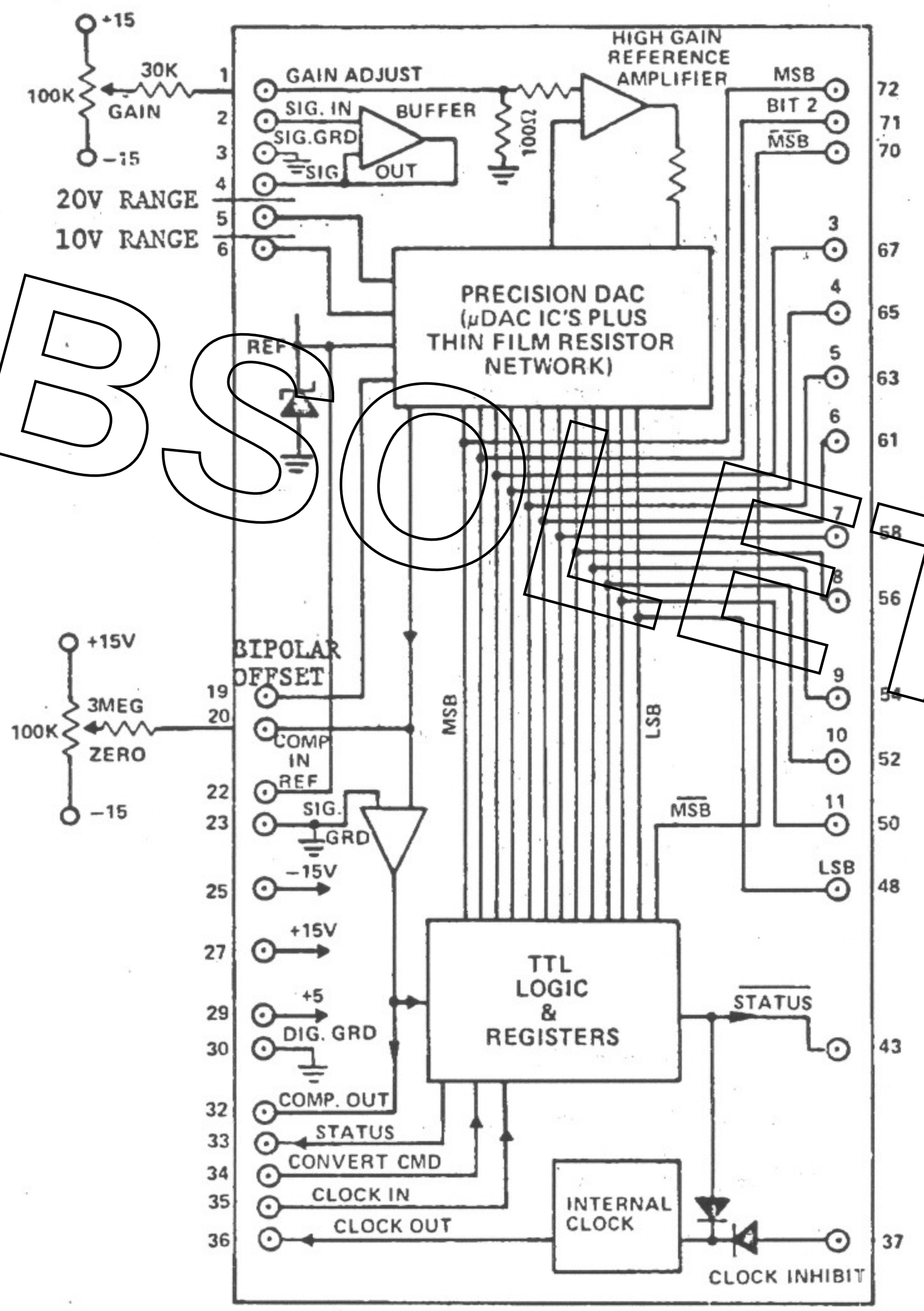

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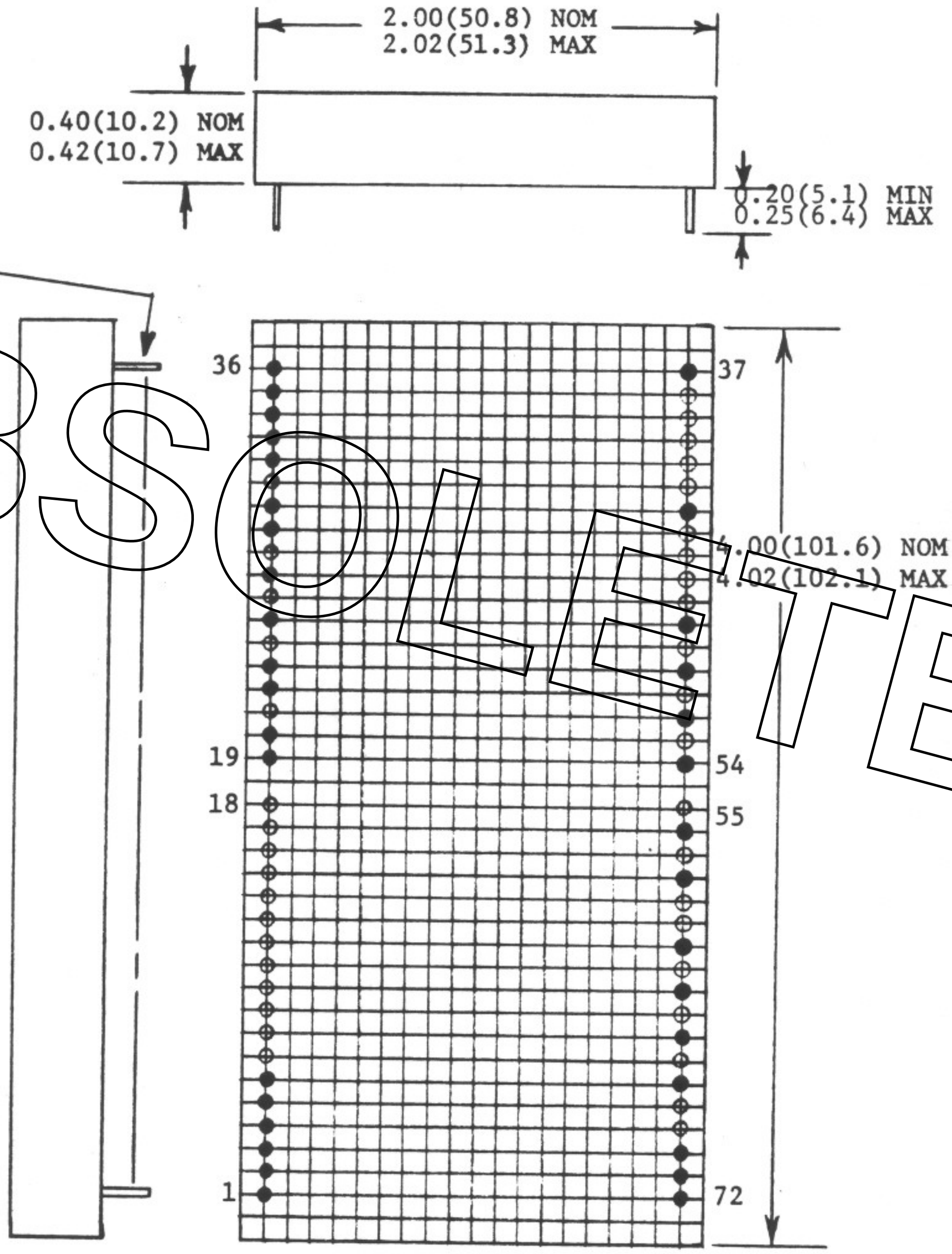
FIGURE 3

PHYSICAL OUTLINE



Note:

Dimensions in inches shown outside parenthesis

Dimensions in mm shown inside parenthesis

Note:

Pins installed only in shaded hole locations

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	SCALE			SHEET 17 OF 17

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