

January 1998

12-Bit, High-Speed, CMOS μ P-Compatible A/D Converter

Features

- 12-Bit Resolution and Accuracy
- No Missing Codes
- Microprocessor Compatible Byte-Organized Buffered Outputs
- Auto-Zeroed Comparator for Low Offset Voltage
- Low Linearity and Gain Errors
- Low Power Consumption (60mW)
- No Gain or Offset Adjustment Necessary
- Provides 3% Usable Overrange
- Fast Conversion (40 μ s)

Description

The ICL7112 is a monolithic 12-bit resolution, fast successive approximation A/D converter. It uses thin film resistors and CMOS circuitry combined with an on-chip PROM calibration table to achieve 12-bit linearity without laser trimming. Special design techniques used in the DAC and comparator result in high speed operation, while the fully static silicon-gate CMOS circuitry keeps the power dissipation very low.

Microprocessor bus interfacing is eased by the use of standard memory WRite and ReaD cycle timing and control signals, combined with Chip Select and Address pins. The digital output pins are byte-organized and three-state gated for bus interface to 8-bit and 16-bit systems.

The ICL7112 provides separate Analog and Digital grounds for increased system accuracy. Operating with $\pm 5V$ supplies, the ICL7112 accepts 0V to +10V input with a -10V reference or 0V to -10V input with a +10V reference.

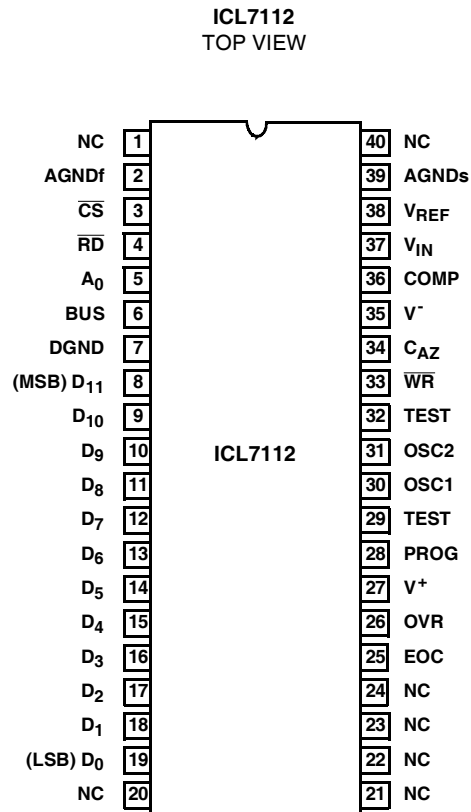
Ordering Information

| PART NO. | TEMP. RANGE ($^{\circ}C$) | PACKAGE | RESOLUTION WITH NO MISSION CODES |
|-------------|-----------------------------|--------------|----------------------------------|
| ICL7112JCDL | 0 to 70 | 40 Ld Cerdip | 11-Bit |
| ICL7112KCDL | 0 to 70 | 40 Ld Cerdip | 12-Bit |
| ICL7112LCDL | 0 to 70 | 40 Ld Cerdip | 12-Bit (Note) \pm |
| ICL7112JIDL | -25 to 85 | 40 Ld Cerdip | 11-Bit |
| ICL7112KIDL | -25 to 85 | 40 Ld Cerdip | 12-Bit |
| ICL7112LIDL | -25 to 85 | 40 Ld Cerdip | 12-Bit (Note) \pm |
| ICL7112JMDL | -55 to 125 | 40 Ld Cerdip | 11-Bit |
| ICL7112KMDL | -55 to 125 | 40 Ld Cerdip | 12-Bit |
| ICL7112LMDL | -55 to 125 | 40 Ld Cerdip | 12-Bit (Note) \pm |

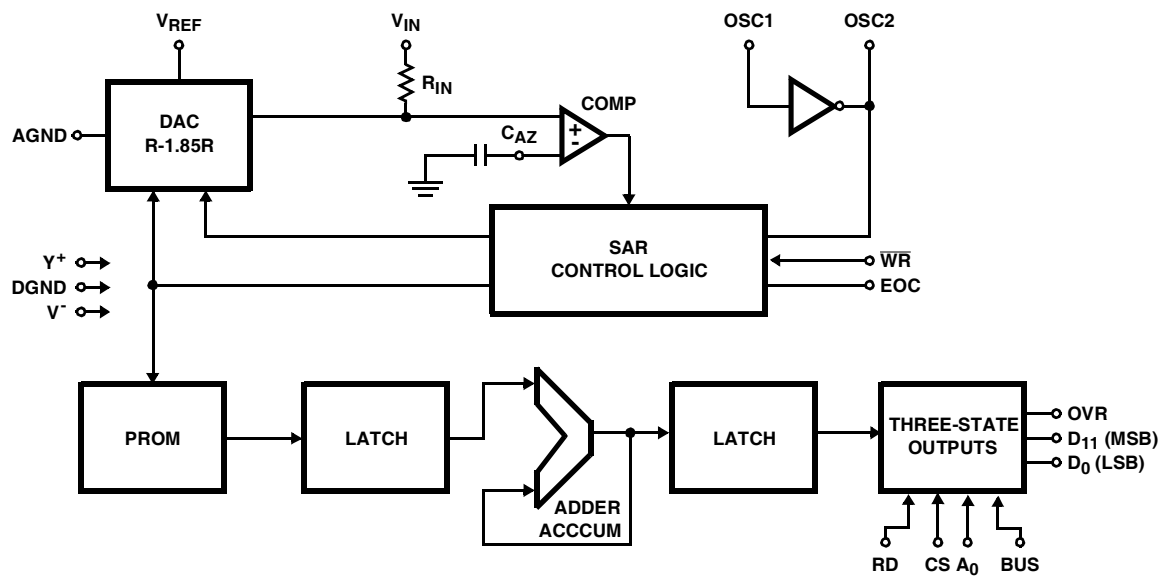
NOTE: Over operating temperature range.

ICL7112

Pinout



Functional Block Diagram



ICL7112

Absolute Maximum Ratings $T_A = 25^\circ\text{C}$

Supply Voltage (V^+ to DGND) -0.3V to +6.5V
 Supply Voltage (V^- to DGND) +0.3V to -6.5V
 V_{REF} , V_{IN} to DGND $\pm 25\text{V}$
 AGND to DGND +1V to -1V
 V_{REF} , V_{IN} , AGND Current 25mA
 Digital I/O Pin Voltages -0.3V to V^+ +0.3V
 PROG to DGND Voltage V^- to (V^+ +0.3V)

Thermal Information

Thermal Resistance (Typical, Note 1) θ_{JA} ($^\circ\text{C/W}$) θ_{JC} ($^\circ\text{C/W}$)
 CERDIP Package
 Maximum Power Dissipation (Note 2) 500mW
 Derate above 70°C at $10\text{mW}/^\circ\text{C}$
 Maximum Junction Temperature (Ceramic Package) 175°C
 Maximum Storage Temperature Range -65°C to 150°C
 Maximum Lead Temperature (Soldering 10s) 300°C

Operating Conditions

ICL7112XCXX 0 to 70
 ICL7112XIXX -25 to 70
 ICL7112XMXX -55 to 125

CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

NOTES:

1. θ_{JA} is measured with the component mounted on an evaluation PC board in free air.
2. All voltages with respect to DGND, unless otherwise noted.
3. Assumes all leads soldered or welded to printed circuit board.

Electrical Specifications Test Conditions: $V^+ = +5\text{V}$, $V^- = -5\text{V}$, $V_{REF} = -10\text{V}$, $T_A = 25^\circ\text{C}$, $f_{CLK} = 500\text{kHz}$, Unless Otherwise Noted

| PARAMETER | SYMBOL | TEST CONDITIONS | | J | | | K | | | L | | | UNITS |
|-------------------------------------|----------------|-------------------------|-----------------------------------|----------|-----------|----------------------------|----------|-----------|----------------------------|----------|-----------|----------------------------|-------------------|
| | | | | MIN | TYP | MAX | MIN | TYP | MAX | MIN | TYP | MAX | |
| ACCURACY | | | | | | | | | | | | | |
| Resolution | RES | 12 | | | | | | | | | | | Bits |
| Resolution with No Missing Codes | RES (NMC) | Notes 4, 5, 6 | R_M $T_{MIN} - T_{MAX}$ | 11 10 | - | - | 12 11 | - | - | 12 12 | - | - | Bits |
| Integral Linearity Error | I_{LE} | Notes 4, 5 | R_M $T_{MIN} - T_{MAX}$ | - | - | ± 0.024 ± 0.030 | - | - | ± 0.012 ± 0.020 | - | - | ± 0.012 ± 0.020 | %FSR |
| Unadjusted Full Scale Error | FSE | Adjust-able to Zero | C R_M $T_{MIN} - T_{MAX}$ | - | - | ± 0.10 ± 0.12 | - | - | ± 0.08 ± 0.10 | - | - | ± 0.08 ± 0.10 | %FSR |
| | | | I R_M $T_{MIN} - T_{MAX}$ | - | - | ± 0.10 ± 0.13 | - | - | ± 0.08 ± 0.11 | - | - | ± 0.08 ± 0.11 | |
| | | | M R_M $T_{MIN} - T_{MAX}$ | - | - | ± 0.10 ± 0.14 | - | - | ± 0.08 ± 0.12 | - | - | ± 0.08 ± 0.12 | |
| Zero Error | ZE | Notes 4, 5 | R_M $T_{MIN} - T_{MAX}$ | - | - | ± 1 ± 1.5 | - | - | ± 1 ± 1.5 | - | - | ± 1 ± 1.5 | |
| ANALOG INPUT | | | | | | | | | | | | | |
| Analog Input Range | V_{IN} | | | 0 | - | 10.3 | 0 | - | 10.3 | 0 | - | 10.3 | V |
| Input Resistance | R_{IN} | Notes 5, 8 | | 4 | - | 9 | 4 | - | 9 | 4 | - | 9 | k Ω |
| Temperature Coefficient of R_{IN} | $T_C (R_{IN})$ | $T_{MIN} - T_{MAX}$ | | - | -300 | - | - | -300 | - | - | -300 | - | ppm/ $^{\circ}$ C |
| REFERENCE INPUT | | | | | | | | | | | | | |
| Analog Reference | V_{REF} | | | - | -10.0 | - | - | -10.0 | - | - | -10.0 | - | V |
| Reference Resistance | R_{REF} | | | - | 5 | - | - | 5 | - | - | 5 | - | k Ω |
| POWER SUPPLY SENSITIVITY | | | | | | | | | | | | | |
| Power Supply Rejection Ration | PSRR | $V^+, V^- = 4.5 - 5.5V$ | R_M $T_{MIN} - T_{MAX}$ | - | ± 0.5 | ± 1 ± 2 | - | ± 0.5 | ± 1 ± 2 | - | ± 0.5 | ± 1 ± 2 | LSB |
| LOGIC INPUT | | | | | | | | | | | | | |
| Low State Input Voltage | V_{IL} | $T_{MIN} - T_{MAX}$ | | - | - | 0.8 | - | - | 0.8 | - | - | 0.8 | V |

ICL7112

Electrical Specifications Test Conditions: $V^+ = +5V$, $V^- = -5V$, $V_{REF} = -10V$, $T_A = 25^\circ C$, $f_{CLK} = 500kHz$, Unless Otherwise Noted

| PARAMETER | SYMBOL | TEST CONDITIONS | J | | | K | | | L | | | UNITS |
|-------------------------------|--------------|--|-----------|-----|-----------|-----------|-----|-----------|-----------|-----|-----------|---------|
| | | | MIN | TYP | MAX | MIN | TYP | MAX | MIN | TYP | MAX | |
| High State Input Voltage | V_{IH} | $T_{MIN} - T_{MAX}$ | 2.4 | - | - | 2.4 | - | - | 2.4 | - | - | V |
| Logic Input Current | I_{LIH} | $0 < V_{IN} < V^+$ | - | 1 | 10 | - | 1 | 10 | - | 1 | 10 | μA |
| Logic Input Capacitance | C_{IN} | | - | 15 | - | - | 15 | - | - | 15 | - | pF |
| LOGIC OUTPUT | | | | | | | | | | | | |
| Low State Output Voltage | V_{OL} | $I_{OUT} = 1.6mA$ $T_{MIN} - T_{MAX}$ | - | - | 0.4 | - | - | 0.4 | - | - | 0.4 | V |
| High State Output Voltage | V_{OH} | $I_{OUT} = -200\mu A$ $T_{MIN} - T_{MAX}$ | 2.8 | - | - | 2.8 | - | - | 2.8 | - | - | V |
| Three-State Output Current | I_{OX} | $0 < V_{OUT} < V^+$ | - | 1 | - | - | 1 | - | - | 1 | - | μA |
| Logic Output Capacitance | C_{OUT} | Three-State | - | 15 | - | - | 15 | - | - | 15 | - | pF |
| POWER REQUIREMENTS | | | | | | | | | | | | |
| Supply Voltage Range | V_{SUPPLY} | Functional Operation Only | ± 4.5 | - | ± 6.0 | ± 4.5 | - | ± 6.0 | ± 4.5 | - | ± 6.0 | V |
| Supply Current, I_+ , I_- | I_{SUPPLY} | R_M $T_{MIN} - T_{MAX}$ | - | 2 | 4 6 | - | 2 | 4 6 | - | 2 | 4 6 | mA |

NOTES:

- Full scale range (FSR) is 10V (reference adjusted).
- Assume all leads are soldered or welded to printed circuit board.
- "J" and "K" versions not production tested. Guaranteed by Integral Linearity Test.
- Typical values are not tested, for reference only.
- Not production tested. Guaranteed by design.

AC Electrical Specifications Test Conditions $V^+ = +5V$, $V^- = -5V$, $T_A = 25^\circ C$, $f_{CLK} = 500kHz$, unless otherwise noted. Data derived from extensive characterization testing. Parameters are not production tested

| PARAMETER | SYMBOL | TEST CONDITIONS | MIN | TYP | MAX | UNITS |
|--|------------------|--|-----|-----|-----|--------------------|
| READ CYCLE TIMING | | | | | | |
| Propagation Delay \overline{CS} to Data | t_{cd} | \overline{RD} Low, A_0 Valid | - | - | 200 | ns |
| Propagation Delay A_0 to Data | t_{ad} | \overline{CS} Low, \overline{RD} Low | - | - | 200 | |
| Propagation Delay \overline{RD} to Data | t_{rd} | \overline{CS} Low, A_0 Valid | - | - | 200 | |
| Propagation Delay Data to Three-State | t_{rx} | | - | - | 150 | |
| Propagation Delay EOC High to Data | t_{ed} | | - | - | 200 | |
| WRITE CYCLE TIMING | | | | | | |
| \overline{WR} Low Time | t_{wr} | | 150 | - | - | ns |
| Propagation Delay \overline{WR} Low to EOC Low | t_{we} | Wait Mode | 1 | - | 2 | 1/f _{CLK} |
| EOC High Time | t_{eo} | Free Run Mode | 0.5 | - | 1.5 | |
| Conversion Time | t_{conv} | | - | - | 20 | |
| Clock Frequency Range | f _{CLK} | Functional Operation Only | - | 500 | - | kHz |

NOTE:

- All typical values have been characterized, but are not tested.

Pin Descriptions

| PIN NO. | NAME | DESCRIPTION | |
|---------|-------------------|---|-----------|
| 1 | | No connection. | |
| 2 | AGND _f | FORCE input for analog ground. | |
| 3 | \overline{CS} | Chip Select enables reading and writing (active low). | |
| 4 | \overline{RD} | \overline{ReaD} (active low). | |
| 5 | A ₀ | Byte select (low = D ₀ -D ₇ , high = D ₈ -D ₁₁ , OVR). | |
| 6 | BUS | Bus select (low = outputs enabled by A ₀ , high = all outputs enabled together). | |
| 7 | DGND | Digital GrouND return. | |
| 8 | D ₁₁ | Output Data Bits (High =True) | High Byte |
| 9 | D ₁₀ | | |
| 10 | D ₉ | | |
| 11 | D ₈ | | |
| 12 | D ₇ | | |
| 13 | D ₆ | | |
| 14 | D ₅ | | Low Byte |
| 15 | D ₄ | | |
| 16 | D ₃ | | |
| 17 | D ₂ | | |
| 18 | D ₁ | | |
| 19 | D ₀ | | |
| 20 | | No connection. | |
| 21 | | No connection. | |
| 22 | | No connection. | |
| 23 | | No connection. | |
| 24 | | No connection. | |
| 25 | EOC | End of conversion flag (low = busy, high = conversion complete). | |
| 26 | OVR | OVerRange flag (valid at end of conversion when output code exceeds full-scale; three-state output enabled with high byte). | |
| 27 | V ⁺ | Positive power supply input. | |
| 28 | PROG | Used for programming only. Must tie to V ⁺ for normal operation. | |
| 29 | TEST | Used for programming only. Must tie to V ⁺ for normal operation. | |
| 30 | OSC1 | Oscillator inverter input. | |
| 31 | OSC2 | Oscillator inverter output. | |
| 32 | TEST | Must tie to V ⁺ for normal operation. | |
| 33 | \overline{WR} | \overline{WR} ite pulse input (low starts new conversion). | |
| 34 | C _{AZ} | Auto-zero capacitor connection (Note). | |
| 35 | V ⁻ | Negative power supply input. | |
| 36 | COMP | Used in test, tie to V ⁻ . | |
| 37 | V _{IN} | SENSE line for input voltage. | |
| 38 | V _{REF} | SENSE line for reference input. | |
| 39 | AGND _s | SENSE line for analog ground. | |
| 40 | | No connection | |

NOTE: The voltage of CAZ is driven; NEVER connect directly to ground.

Timing Diagrams

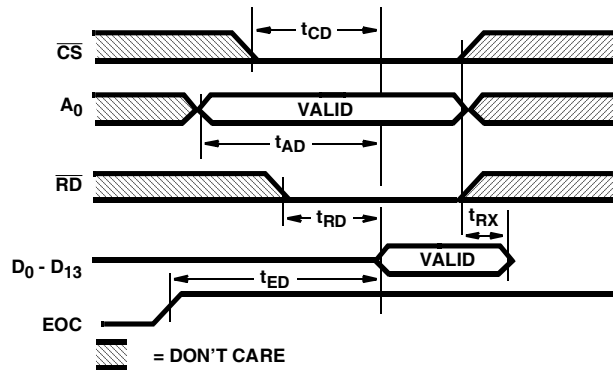


FIGURE 1. READ CYCLE TIMING

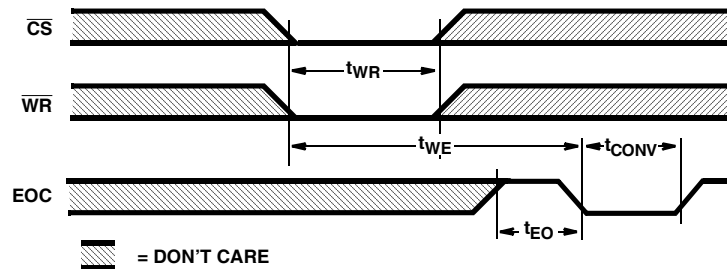


FIGURE 2. WRITE CYCLE TIMING

TABLE 2: I/O CONTROL

| CS | WR | RD | A ₀ | BUS | FUNCTION |
|----|----|----|----------------|-----|--------------------------------------|
| 0 | 0 | x | x | x | Initiates a conversion. |
| 1 | x | x | x | x | Disables all chip commands. |
| 0 | x | 0 | 0 | 0 | Low byte is enabled. |
| 0 | x | 0 | 1 | 0 | High byte is enabled. |
| 0 | x | 0 | x | 1 | Low and High bytes enabled together. |
| x | x | 1 | x | x | Disables outputs (high-impedance). |

TABLE 3: TRANSFER FUNCTION

| INPUT VOLTAGE | EXPECTED OUTPUT CODE | | | |
|---------------------------|----------------------|-----|------------|-----|
| V _{REF} = -10.0V | OVR | MSB | | LSB |
| 0 | 0 | 0 | 0000000000 | 0 |
| +0.00244 | 0 | 0 | 0000000000 | 1 |
| +0.30029 | 0 | 0 | 0000111101 | 1 |
| +4.99756 | 0 | 0 | 1111111111 | 1 |
| +5.00000 | 0 | 1 | 0000000000 | 0 |
| +9.99512 | 0 | 1 | 1111111111 | 0 |
| +9.99756 | 0 | 1 | 1111111111 | 1 |
| +10.00000 | 1 | 0 | 0000000000 | 0 |
| +10.00244 | 1 | 0 | 0000000000 | 1 |
| +10.29000 | 1 | 0 | 0000111101 | 1 |

Detailed Description

The ICL7112 is basically a successive approximation A/D converter with an internal structure much more complex than

a standard SAR-type converter. The Functional Block Diagram shows the functional diagram of the ICL7112 12-bit A/D converter. The additional circuitry incorporated into the ICL7112 is used to perform error correction and to maintain the operating speed in the 40μs range.

The internal DAC of the ICL7112 is designed around a radix of 1.85, rather than the traditional 2.00. This radix gives each bit of the DAC a weight of approximately 54% of the previous bit. The result is a usable range that extends to 3% beyond the full-scale input of the A/D. The actual value of each bit is measured and stored in the on-chip PROM. The absolute value of each bit weight then becomes relatively unimportant because of the error correction action of the ICL7112.

The output of the high-speed auto-zeroed comparator is fed to the data input of a successive approximation register (SAR). This register is uniquely designed for the ICL7112 in that it tests bit pairs instead of individual bits in the manner of a standard SAR. At the beginning of the conversion cycle, the SAR turns on the MSB (D₁₁) and the MSB 4-bit (D₇). The sequence continues for each bit pair, B_x and B_{x-4}, until only the four LSBs remain. The sequence concludes by testing the four LSBs individually.

The SAR output is fed to the DAC register and to the preprogrammed PROM where it acts as PROM address. PROM data is fed to a full-adder/accumulator where the decoded results from each successive phase of the conversion are summed with the previous results. After 20 clock cycles, the accumulator contains the final binary data which is latched and sent to the three-state output buffers. The accuracy of the A/D converter depends primarily upon the accuracy of the data that has been programmed into the PROM during

the final test portion of the manufacturing process.

The error correcting algorithm built into the ICL7112 reduces the initial accuracy requirements of the DAC. The overlap in the testing of bit pairs reduces the accuracy requirements on the comparator which has been optimized for speed. Since the comparator is auto-zeroed, no external adjustment is required to get ZERO code for ZERO input voltage.

Twenty clock cycles are required for the complete 12-bit conversion. The auto-zero circuitry associated with the comparator is employed during the last three clock cycles of the conversion to cancel the effect of offset voltage. Also during this time, the SAR and accumulator are reset in preparation for the start of the next conversion.

The overflow output of the full-adder is also the OVER Range (OVR) output of the ICL7112. Unlike standard SAR type A/D converters, the ICL7112 has the capability of providing valid usable data for inputs that exceed the fullscale range by as much as 3%.

Optimizing System Performance

When using A/D converters with 12 or more bits of resolution, special attention must be paid to grounding and the elimination of potential ground loops. A ground loop can be formed by allowing the return current from the ICL7112's DAC to flow through traces that are common to other analog circuitry. If care is not taken, this current can generate small unwanted voltages that add to or detract from the reference or input voltages of the A/D converter.

Figure 3 and Figure 4 show two different grounding techniques. Although the difference between the two circuits may not be readily apparent, the circuit of Figure 3 is very likely to have significant ground loop errors which the circuit of Figure 4 avoids. In Figure 3, the supply currents for analog ground, digital ground, and the reference voltage all flow through a lead, common to the input. This will generate a DC offset voltage due to the currents flowing in the resistance of the common lead. This offset voltage will vary with the input

voltage and with the digital output. Even the auto-zero loop of the ICL7112 cannot remove this error.

Figure 4 shows a much better arrangement. The ground and reference currents do not flow through the input common lead, eliminating any error voltages. Note that the supply currents and any other analog system currents must also be returned carefully to analog ground. The clamp diodes will protect the ICL7112 against signals which could result from separate analog and digital grounds. The absolute maximum voltage rating between AGND and DGND is $\pm 1.0V$. The two inverse-parallel diodes clamp this voltage to less than $\pm 0.7V$.

Input Warning

As with any CMOS integrated circuit, no input voltages should be applied to the ICL7112 until the $\pm 5V$ power supplies have stabilized.

Interfacing To Digital Systems

The ICL7112 provides three-state data output buffers, \overline{CS} , \overline{RD} , \overline{WR} , and bus select inputs (A_0 and BUS) for interfacing to a wide variety of microcomputers and digital systems. The I/O Control Truth Table shows the functions of the digital control lines. The BUS select and A_0 lines are provided to enable the output data onto either 8-bit or 16-bit data buses. A conversion is initiated by a \overline{WR} pulse (pin 33) when \overline{CS} (pin 3) is low. Data is enabled on the bus when the chip is selected and \overline{RD} (pin 4) is low.

Figure 5 illustrates a typical interface to an 8-bit microcomputer. The "Start and Wait" operation requires the fewest external components and is initiated by a low level on the \overline{WR} input to the ICL7112 after the I/O or memory mapped address decoder has brought the \overline{CS} input low. After executing a delay or utility routine for a period of time greater than the conversion time of the ICL7112, the processor issues two consecutive bus addresses to read output data into two bytes of memory. A low level on A_0 enables the LSBs, and a high level enables the MSBs.

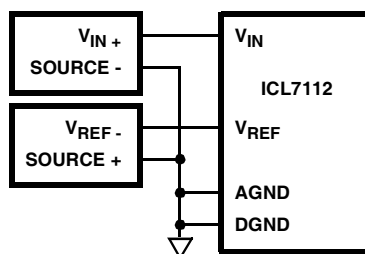


FIGURE 3. IMPROPER GROUNDING TECHNIQUE WILL CAUSE GROUND LOOP ERRORS

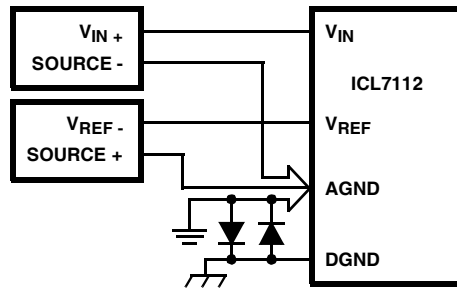


FIGURE 4. RECOMMENDED GROUNDING TECHNIQUE TO ELIMINATE GROUND LOOP ERRORS

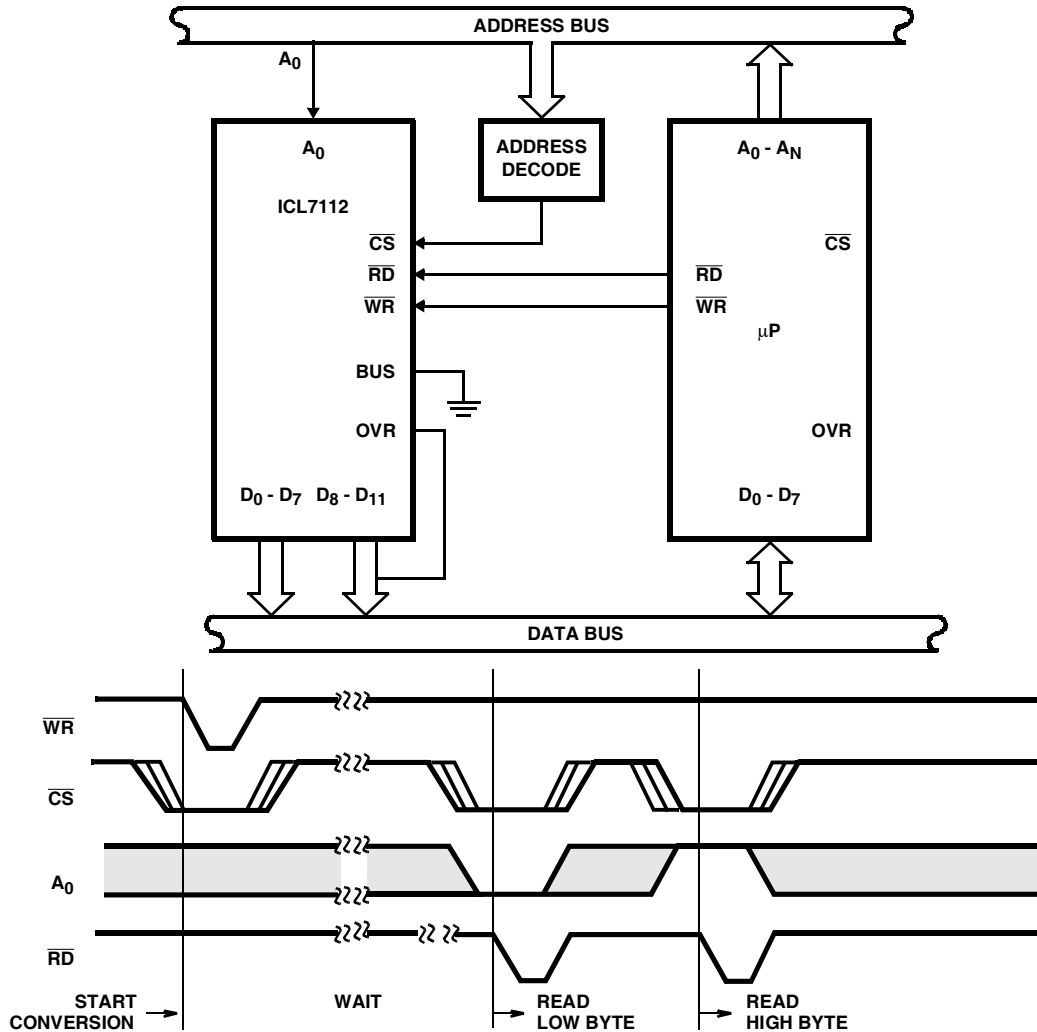


FIGURE 5. "START AND WAIT" OPERATION

By adding a three-state buffer and two control gates, the End-of-Conversion (EOC) output can be used to control a "Start and Poll" interface (Figure 6). In this mode, the A_0 and \overline{CS} lines connect the EOC output to the data bus along with the most significant byte of data. After pulsing the \overline{WR} line to initiate a conversion, the microprocessor continually reads the most significant byte until it detects a high level on the EOC bit. The "Start and Poll" interface increases data throughput compared with the "Start and Wait" method by eliminating delays between the conversion termination and

the microprocessor read operation.

Other interface configurations can be used to increase data throughput without monopolizing the microprocessor during waiting or polling operations by using the EOC line as an interrupt generator as shown in Figure 7. After the conversion cycle is initiated, the microprocessor can continue to execute routines that are independent of the A/D converter until the converter's output register actually holds valid data. For fastest data throughput, the ICL7112 can be connected directly to the data bus but controlled by way of a Direct

Memory Access (DMA) controller as shown in Figure 8.

Applications

Figure 9 shows a typical application of the ICL7112 12-bit A/D converter. A bipolar input voltage range of +10V to -10V is the result of using the current through R_2 to force a 1/2 scale offset on the input amplifier (A_1). The output of A_1 swings from 0V to -1 0V. The overall gain of the A/D is varied by adjusting the 100 Ω trim resistor, R_5 . Since the ICL7112 is automatically zeroed every conversion, the system gain and offset stability will be superb as long as a reference with a tempco of 1ppm/ $^{\circ}$ C and stable external resistors are used.

It is important to note that since the 7112's DAC current flows in A_1 , the amplifier should be a wideband (GBW > 20MHz) type to minimize errors.

The clock for the ICL7112 is taken from whatever system clock is available and divided down to the level for a conversion time of 40 μ s. Output data is controlled by the BUS and A_0 inputs. Here they are set for 8-bit bus operation with BUS grounded and A_0 under the control of the address decode section of the external system.

Because the ICL7112's internal accumulator generates accurate output data for input signals as much as 3% greater than full-scale, and because the converter's OVR output flags overrange inputs, a simple microprocessor routine can be employed to precisely measure and correct for system gain and offset errors. Figure 10 shows a typical data acquisition system that uses a 10V reference, input signal multiplexer, and input signal Track/Hold amplifier. Two of the multiplexer's input channels are dedicated to sampling the system analog ground and reference voltage. Here, as in Figure 9, bipolar operation is accommodated by an offset resistor between the reference voltage and the summing junction of A_1 . A flip-flop in IC_3 sets $1C_2$'s Track/Hold input after the microprocessor has initiated a WR command, and resets when EOC goes high at the end of the conversion.

The first step in the system calibration routine is to select the multiplexer channel that is connected to system analog ground and initiate a conversion cycle for the ICL7112. The results represent the system offset error which comes from the sum of the offsets from IC_1 , IC_2 , and A_1 . Next the channel connected to the reference voltage is selected and measured. These results, minus the system offset error, represent the system full-scale range. A gain error correction factor can be derived from this data. Since the ICL7112 provides valid data for inputs that exceed full-scale by as much as 3%, the OVR output can be thought of as a valid 13th data bit. Whenever the OVR bit is high, however, the total 12-bit result should be checked to ensure that it falls within 100% and 103% of full-scale. Data beyond 103% of full-scale should be discarded.

Clock Considerations

The ICL7112 provides an internal inverter which is brought out to pins OSC1 and OSC2, for crystal or ceramic resonator oscillator operation. The clock frequency is calculated from:

$$f_{CLK} = \frac{20}{t_{CONV}}$$

ICL7112

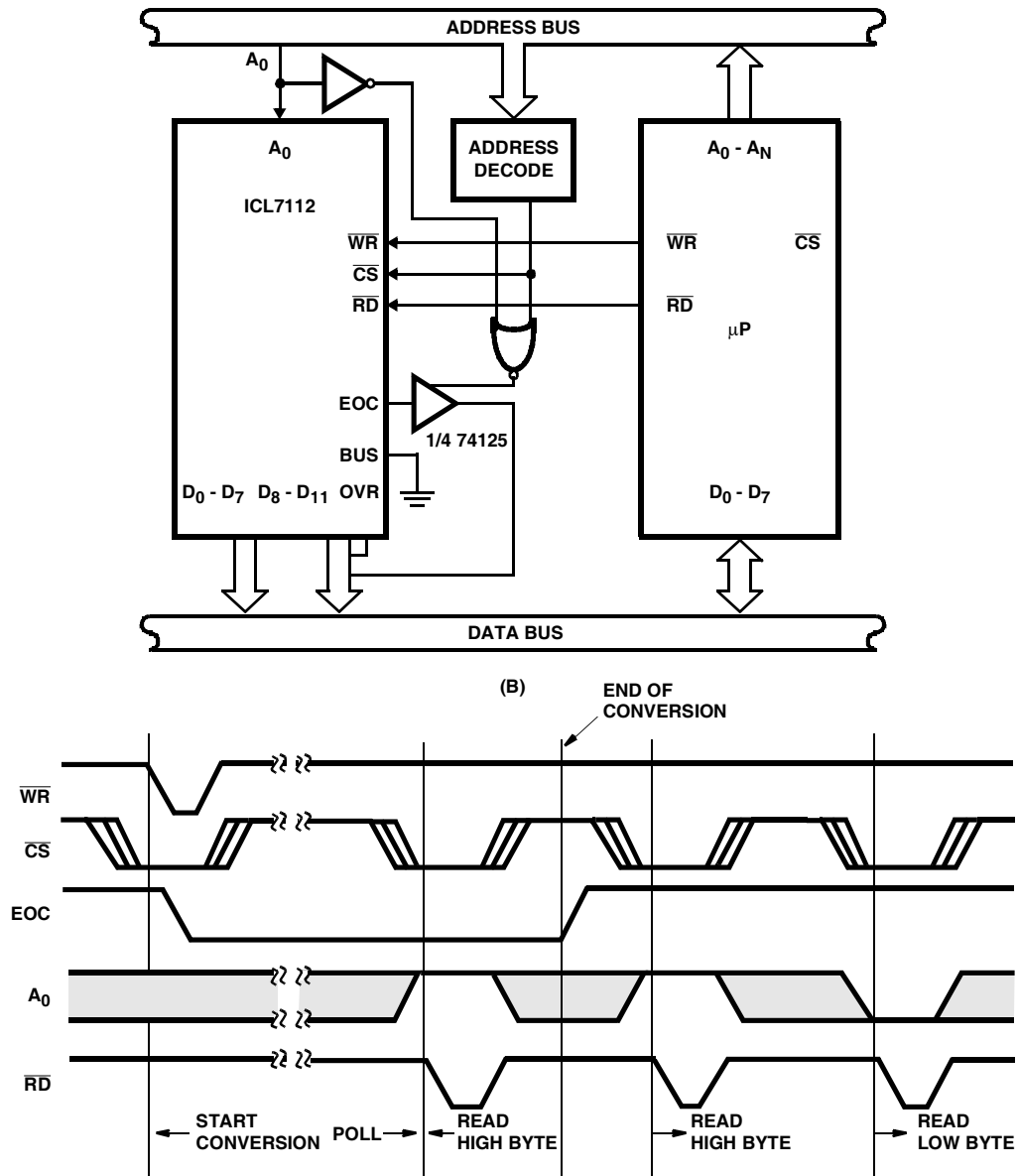


FIGURE 6. START AND POLL" OPERATION

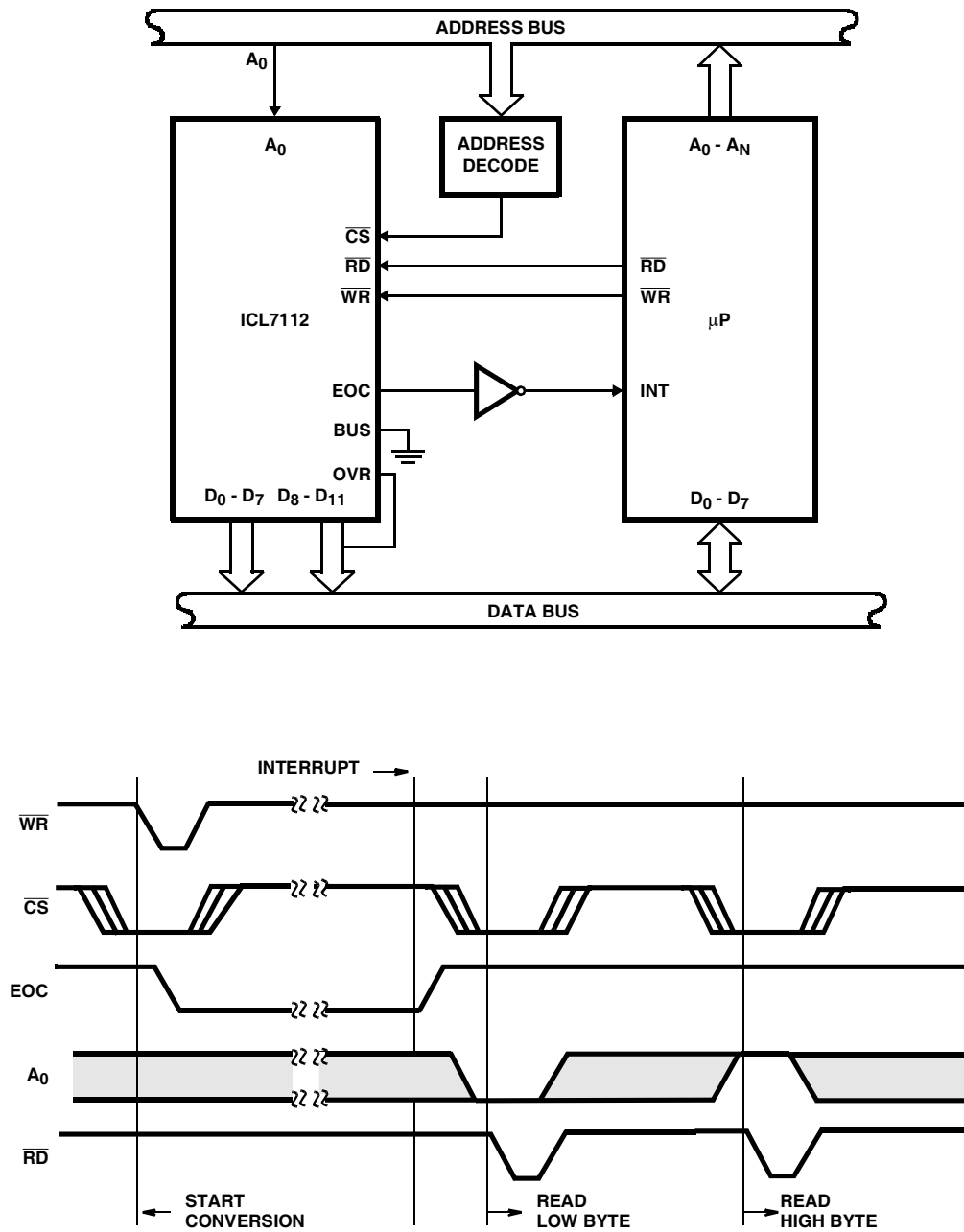


FIGURE 7. USING EOC AS AN INTERRUPT

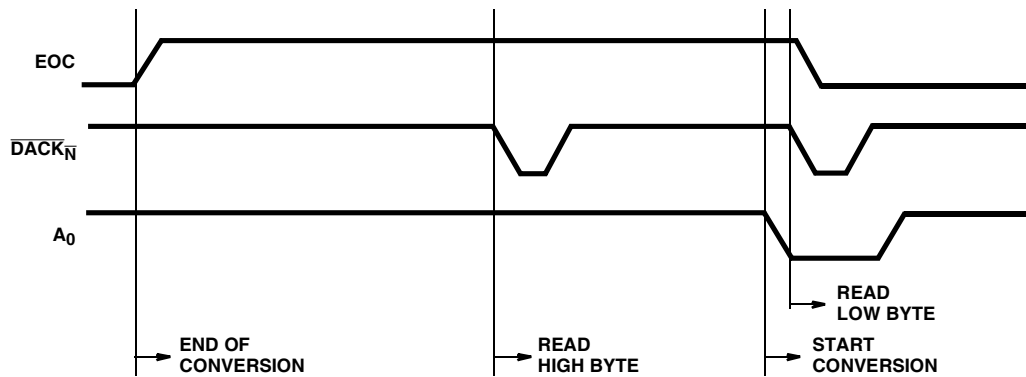
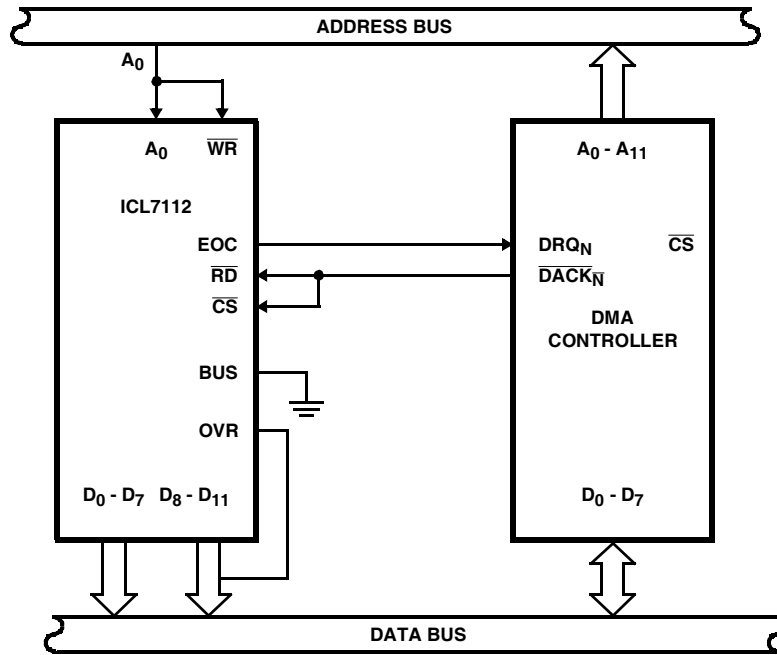


FIGURE 8. DATA TO MEMORY VIA DMA CONTROLLER

ICL7112

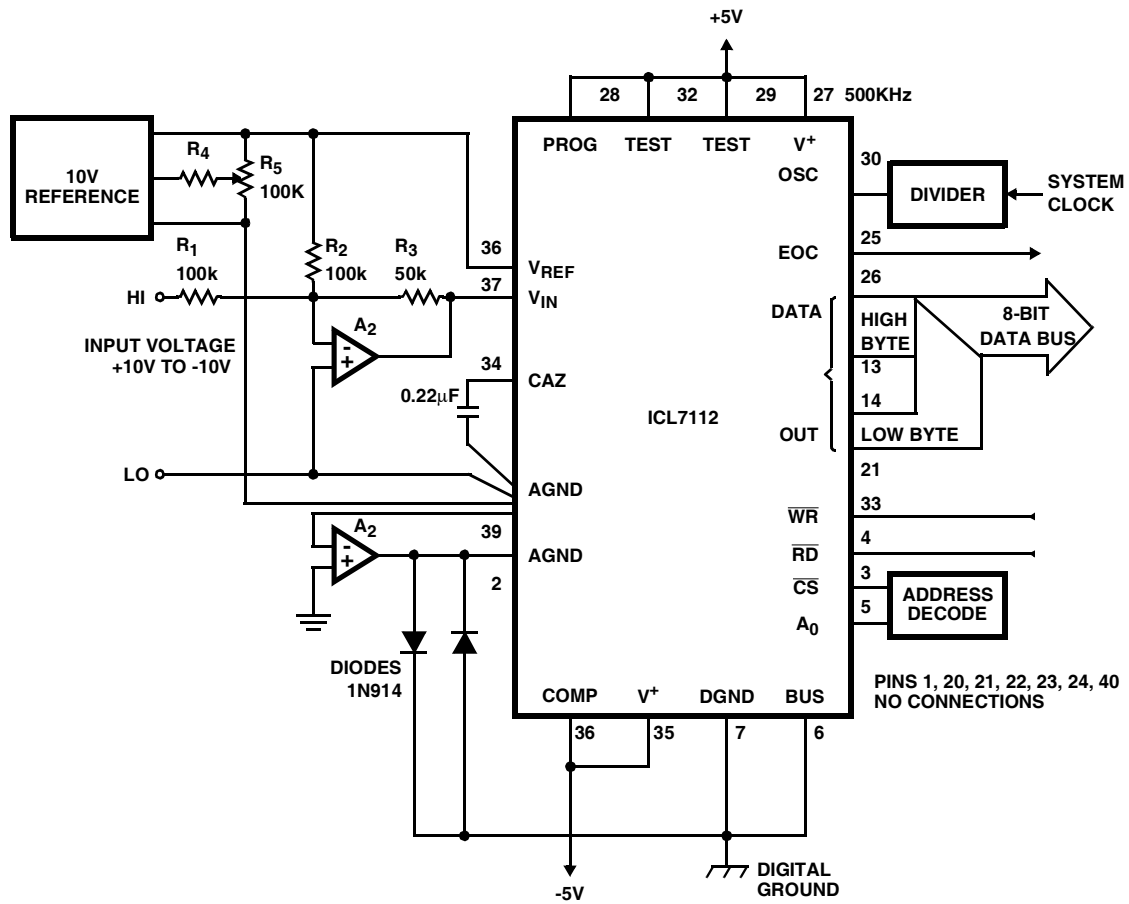


FIGURE 9. TYPICAL APPLICATION WITH BIPOLAR INPUT RANGE, FORCED GROUND, AND 10V ULTRA STABLE REFERENCE

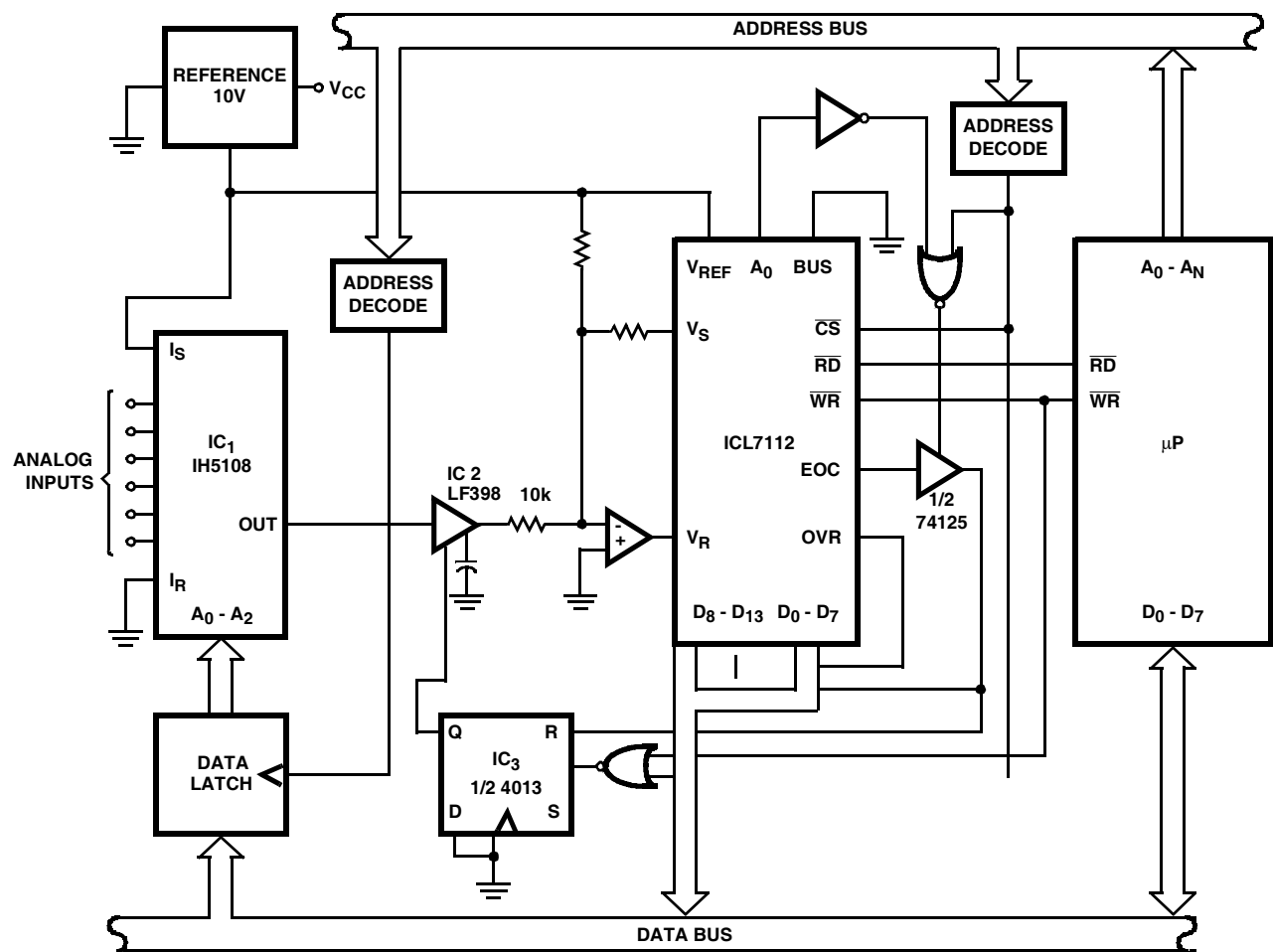


FIGURE 10. MULTI-CHANNEL DATA ACQUISITION SYSTEM WITH ZERO AND REFERENCE LINES BROUGHT TO MULTIPLEXER FOR SYSTEM GAIN AND OFFSET ERROR CORRECTION