

Description

The Intersil ICL7116 are high performance, low power, 3 1/2 digit, A/D converters. Included are seven segment decoders, display drivers, a reference, and a clock. The ICL7116 is designed to interface with a liquid crystal display (LCD) and includes a multiplexed backplane drive. The ICL7116 have all of the features of the ICL7106 with the addition of a HOLD Reading input. With this input, it is possible to make a measurement and retain the value on the display indefinitely. To make room for this feature the reference low input has been connected to Common internally rather than being fully differential.

These circuits retain the accuracy, versatility, and true economy of the ICL7106. They feature auto-zero to less than 10 μ V, zero drift of less than 1 μ V/°C, input bias current of 10pA maximum, and roll over error of less than one count. The versatility of true differential input is of particular advantage when measuring load cells, strain gauges and other bridge-type transducers. And finally, the true economy of single power supply operation (ICL7116) enables a high performance panel meter to be built with the addition of only eleven passive components and a display.

Features

- HOLD Reading Input Allows Indefinite Display Hold
- Guaranteed Zero Reading for 0V Input
- True Polarity at Zero for Precise Null Detection
- 1pA Typical Input Current
- Direct Display Drive
 - LCD ICL7116
- Low Noise - Less Than 15 μ V_{P-P} (Typ)
- On Chip Clock and Reference
- Low Power Dissipation - Typically Less Than 10mW
- No Additional Active Circuits Required
- Surface Mount Package Available

Operating Conditions

Temperature Range 0°C to 70°C

Electrical Characteristics

 $T_A = 25^{\circ}\text{C}$, $f_{\text{CLOCK}} = 48\text{kHz}$, $V_{\text{REF}} = 100\text{mV}$

PARAMETER	TEST CONDITIONS	UNITS	MIN.	TYP.	MAX.
SYSTEM PERFORMANCE					
Zero Input Reading	$V_{\text{IN}} = 0\text{V}$, Full Scale = 200mV	-000.0	±000.0	+000.0	Digital Reading
Ratiometric Reading	$V_{\text{IN}} = V_{\text{REF}}$, $V_{\text{REF}} = 100\text{mV}$	999	999/1000	1000	Digital
Rollover Error	$-V_{\text{IN}} = +V_{\text{IN}} \approx 195\text{mV}$ Difference in Reading for Equal Positive and Negative Inputs Near Full Scale	-	±0.2	±1	Counts
Linearity	Full Scale = 200mV or Full Scale = 2V Maximum Deviation from Best Straight Line Fit (Note 5)	-	±0.2	±1	Counts
Common Mode Rejection Ratio	$V_{\text{CM}} = \pm 1\text{V}$, $V_{\text{IN}} = 0\text{V}$, Full Scale = 200mV (Note 5)	-		50 -	μV/V
Noise	$V_{\text{IN}} = 0\text{V}$, Full Scale = 200 mV (Peak-To-Peak Value Not Exceeded 95% of Time) (Note 5)	-		15 -	μV
Leakage Current Input	$V_{\text{IN}} = 0$ (Note 5)	-	1	10	pA
Zero Reading Drift	$V_{\text{IN}} = 0$, 0°C To 70°C (Note 5)	-	0.2	1	μV/°C
Scale Factor Temperature Coefficient	$V_{\text{IN}} = 199\text{mV}$, 0°C To 70°C (Note 5)	-	1	5	ppm/°C
V + Supply Current	$V_{\text{IN}} = 0$	-	1.0	1.8	mA
COMMON Pin Analog Common Voltage	25kΩ Between Common and Positive Supply (With Respect to + Supply)	2.4		3.0 3.2	V
Temperature Coefficient of Analog Common	25kΩ Between Common and Positive Supply (With Respect to + Supply) (Note 5)	-		80 -	ppm/°C
DISPLAY DRIVER (ICL7116 ONLY)					
Peak-To-Peak Segment Drive Voltage	$V_{+} = \text{to } V_{-} = 9\text{V}$, (Note 4)	4	5.5	6	V
Peak-To-Peak Backplane					

NOTES:

1. Input voltages may exceed the supply voltages provided the input current is limited to ±100μA.
2. θ_{JA} is measured with the component mounted on an evaluation PC board in free air.
3. Unless otherwise noted, specifications apply to both the ICL7116. ICL7116 is tested in the circuit of Figure 1.
4. Back plane drive is in phase with segment drive for 'off' segment, 180 degrees out of phase for 'on' segment. Frequency is 20 times conversion rate. Average DC component is less than 50mV.
5. Not tested, guaranteed by design.

Absolute Maximum Ratings

ICL7116, V+ to V-	15V
Analog Input Voltage (Either Input) (Note 1)	
V+ to V- Reference Input Voltage (Either Input)	
V+ to V-	
Clock Input	

Thermal Information

Maximum Junction Temperature.	150 °C
Maximum Storage Temperature Range	-65°C to 150°C
C Maximum Lead Temperature (Soldering 10s).	300 °C

Typical Applications Circuit

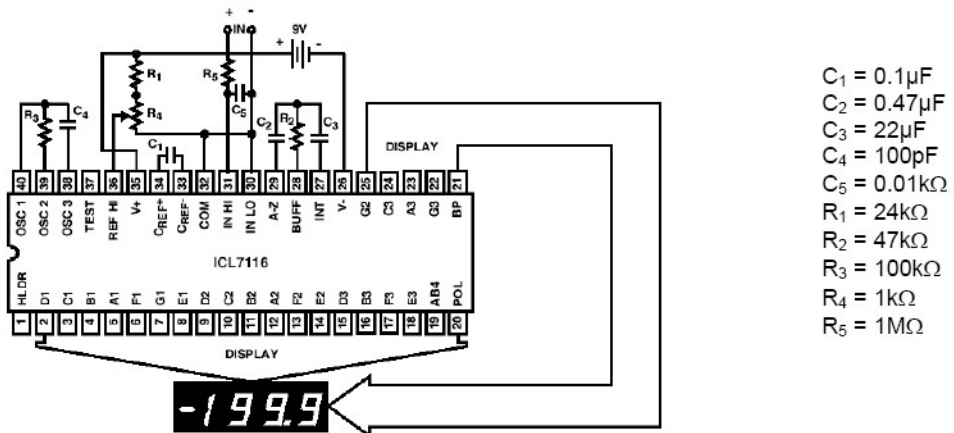


FIGURE 1. ICL7116 TEST CIRCUIT AND TYPICAL APPLICATION WITH LCD DISPLAY COMPONENTS SELECTED FOR 200mV FULL SCALE

DESIGN INFORMATION SUMMARY SHEET

- **OSCILLATOR FREQUENCY**
 $f_{OSC} = 0.45/RC$
 $C_{OSC} > 50pF; R_{OSC} > 50k\Omega$
 $f_{OSC} (Typ) = 48kHz$
- **OSCILLATOR PERIOD**
 $t_{OSC} = RC/0.45$
- **INTEGRATION CLOCK FREQUENCY**
 $f_{CLOCK} = f_{OSC}/4$
- **INTEGRATION PERIOD**
 $t_{INT} = 1000 \times (4/f_{OSC})$
- **60/50Hz REJECTION CRITERION**
 t_{INT}/t_{60Hz} or $t_{INT}/t_{50Hz} = \text{Integer}$
- **OPTIMUM INTEGRATION CURRENT**
 $I_{INT} = 4\mu A$
- **FULL SCALE ANALOG INPUT VOLTAGE**
 $V_{INFS} (Typ) = 200mV$ or $2V$
- **INTEGRATE RESISTOR**

$$R_{INT} = \frac{V_{INFS}}{I_{INT}}$$

- **INTEGRATE CAPACITOR**

$$C_{INT} = \frac{(t_{INT})(I_{INT})}{V_{INT}}$$

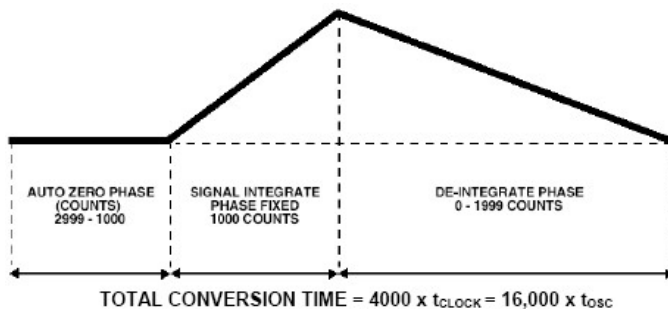
- **INTEGRATOR OUTPUT VOLTAGE SWING**

$$V_{INT} = \frac{(t_{INT})(I_{INT})}{C_{INT}}$$

- **V_{INT} MAXIMUM SWING:**
 $(V- + 1.0V) < V_{INT} < (V+ - 0.5V), V_{INT} (Typ) = 2V$
- **DISPLAY COUNT**

$$COUNT = 1000 \times \frac{V_{IN}}{V_{REF}}$$

- **CONVERSION CYCLE**
 $t_{CYC} = t_{CLOCK} \times 4000$
 $t_{CYC} = t_{OSC} \times 16,000$
 when $f_{OSC} = 48kHz; t_{CYC} = 333ms$
- **COMMON MODE INPUT VOLTAGE**
 $(V- + 1V) < V_{IN} < (V+ - 0.5V)$
- **AUTO-ZERO CAPACITOR**
 $0.01\mu F < C_{AZ} < 1\mu F$
- **REFERENCE CAPACITOR**
 $0.1\mu F < C_{REF} < 1\mu F$
- **V_{COM}**
 Biased between V+ and V-.
- **V_{COM} \approx V+ - 2.8V**
 Regulation lost when V+ to V- $< \approx 6.8V$.
 If V_{COM} is externally pulled down to (V+ to V-)/2,
 the V_{COM} circuit will turn off.
- **ICL7116 POWER SUPPLY: SINGLE 9V**
 $V+ - V- = 9V$
 Digital supply is generated internally
 $V_{TEST} \approx V+ - 4.5V$
- **ICL7116 DISPLAY: LCD**
 Type: Direct drive with digital logic supply amplitude.

TYPICAL INTEGRATOR AMPLIFIER OUTPUT WAVEFORM (INT PIN)


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