ANALOG DEVICES

Four Channel RTD/Strain Gage Conditioner

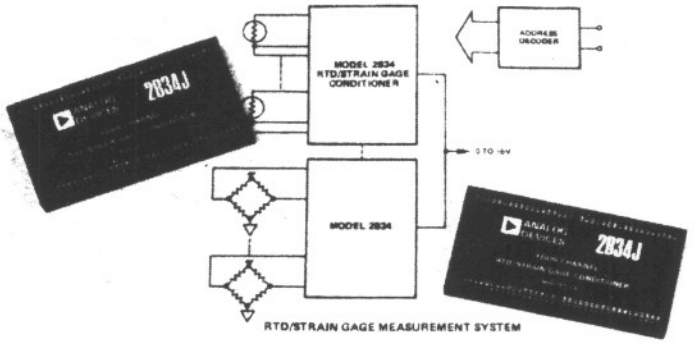
MODEL 2B34

FEATURES

- Low Input Offset Drift: ±1.0μV/°C
- Low Gain Drift: ±25ppm/°C
- Low Nonlinearity: ±0.01% max (±0.005% typ)
- Differential Input Protection: ±130V rms
- Channel Multiplexing: 3000 chan/sec Scanning Speed
- Solid State Reliability
- Internal RTD Excitation/Lead Wire Compensation

APPLICATIONS

- Multichannel Signal Conditioning
- Data Acquisition
- Industrial Process Monitoring



RTD/STRAIN GAGE MEASUREMENT SYSTEM

GENERAL DESCRIPTION

The model 2B34 is a four channel signal conditioner providing input protection, multiplexing, and amplification in a single, low cost package. A multi-purpose device, the 2B34 is designed to effectively condition low level signals (±30mV to ±100mV) such as those produced by RTD and strain gage sensors. The superior design of the 2B34 provides low input drift (±1.0μV/°C), high common mode rejection (94dB @ 60Hz), and extremely stable gain (±25ppm/°C). Other features include low nonlinearity (±0.01% max), excitation and lead wire compensation for RTD inputs, and a wide operating temperature range (–25°C to +85°C).

APPLICATIONS

The 2B34 is a superior alternative to the relay multiplexing technique used in multichannel data acquisition systems, computer interface systems, and measurement and control instrumentation. Advantages over relay circuits include functional versatility, superior signal conditioning, and solid state speed and reliability.

DESIGN FEATURES AND USER BENEFITS

Solid State Design: Complete solid state construction offers both high performance and reliability.

Ease of Use: The multichannel, functionally complete design in a compact (2″ × 4″ × 0.4″) module, conserves board space and eliminates the need for a number of discrete components that would otherwise be required.

Low Cost: The 2B34 offers the lowest cost per channel for solid state, low level sensor signal conditioning.

Wide Operating Temperature Range: The 2B34 has been designed to operate over –25°C to +85°C ambient temperature range.

FUNCTIONAL DESCRIPTION

The internal structure of the 2B34 is shown in Figure 1. Four individual input channels are multiplexed into a single, low

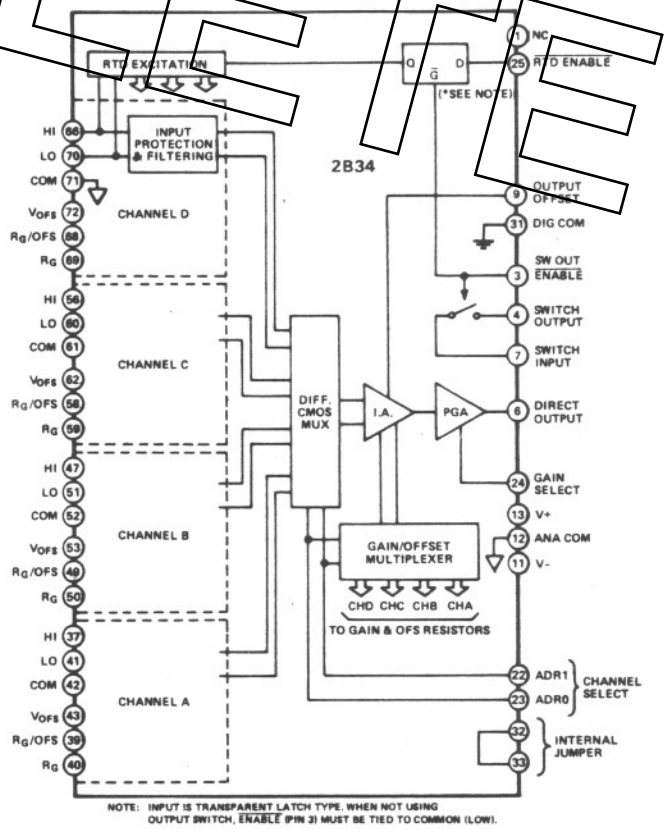


Figure 1. 2B34 Functional Diagram

SPECIFICATIONS (typical @ +25°C, V_S = ±15V, unless otherwise noted)

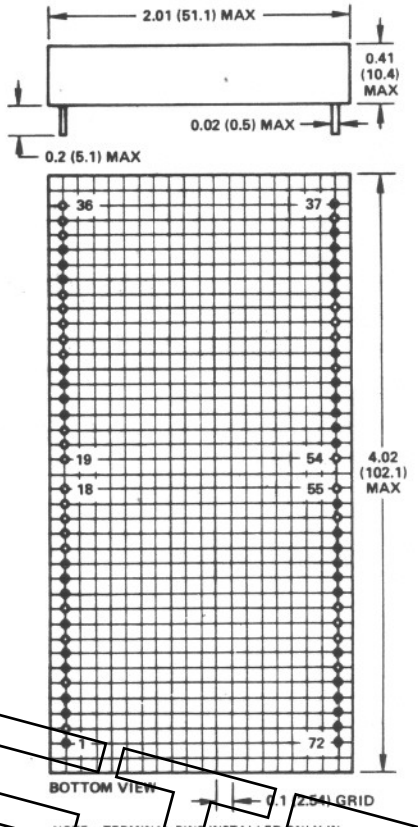
Model	2B34J Strain Gage Mode	RTD Mode
ANALOG INPUT		
Number of Channels	4	*
Input Range	±30mV & ±100mV	25–175Ω & 0–350Ω
Gain Range (R_G =945Ω)	166.6V/V & 50V/V	*
Expanded[1]	50V/V to 1000V/V	*
Transfer Function	N/A	$V_{OUT} = [0.4 \times 10^{-3} \times (R_{RTD}) - 0.04]\ G$
Gain Error	±0.6% max (G = 50)	*
	±0.8% max (G = 166.6)	*
Gain Temperature Coefficient[2]	±25ppm/°C	*
Gain Nonlinearity	±0.01% of Span, max	*
Offset Voltage		
Input Offset, Initial[3] (Adj. to Zero)	±150µV	*
vs. Temperature	±1µV/°C	±0.015 deg/deg
Channel to Channel Offset	±25µV	*
Total Offset Drift (RTI)	±1µV/°C	*
Input Noise Voltage		
0.01Hz–100Hz, R_S = 1kΩ	1.5µV p-p	*
Common Mode Voltage	±6V	N/A
Common Mode Rejection		
R_S = 100Ω, f = 60Hz	94dB (@ G = 166.6)	N/A
R_S = 1kΩ, f = 60Hz	86dB (@ G = 166.6)	
Maximum Safe Differential Input (10 min)	130V rms	*
Normal Mode Rejection @ 60Hz	24dB	*
Input Resistance	20MΩ	*
Input Bias Current	10nA max	*
Lead Resistance Effect	N/A	±0.03 deg/Ω
ANALOG OUTPUT		
Output Voltage Swing	±5V @ 1mA	*
Output Resistance		
Direct Output	0.1Ω	*
Switched Output	35Ω, ±0.5%/°C	*
Maximum Switched Voltage	±9V, no load	*
SENSOR EXCITATION		
Excitation Level (per channel)	NA	0.4mA ±1% (±1.7% max)
vs. Temperature	NA	±10ppm/°C
CHANNEL SELECTION		
Channel Selection Time to ±0.01% F.S.	300µs	*
Channel Scanning Speed	>3000 chan/sec	*
DYNAMIC RESPONSE		
Input Settling Time to ±0.01% F.S.	0.4 sec	*
Bandwidth	4Hz	*
POWER SUPPLY		
Voltage, ±V_S, Rated Performance	±15V dc ±5%	*
Current	+35mA, –15mA, max	*
Supply Effect on Offset	±0.003%/%	±0.02%/%
ENVIRONMENTAL		
Temperature		
Rated Performance	0 to +70°C	*
Operating	–25°C to +85°C	*
Storage	–55°C to +85°C	*
CASE SIZE	2″ × 4″ × 0.4″	

NOTES
[1] Gain range may be expanded by use of external amplifier as shown in Figure 3.
[2] Does not include effects of sensor excitation drift.
[3] With no induced offset, using circuit shown in Figure 2 (pots centered).
*Specifications same as Strain Gage Mode.

Specifications subject to change without notice.

OUTLINE DIMENSIONS

Dimensions shown in inches and (mm).



NOTE: TERMINAL PINS INSTALLED ONLY IN SHADED HOLE LOCATIONS

2B34 PIN DESIGNATIONS

PIN	FUNCTION	PIN	FUNCTION
1	NC	37	HI
2		38	
3	SW'D OUTPUT ENABLE	39	R_G/OFS
4	SW'D OUTPUT	40	R_G (CHANNEL A)
5		41	LO
6	DIRECT OUTPUT	42	COM
7	SW'D INPUT	43	V_{OFS} (+10V)
8		44	
9	OUTPUT OFFSET	45	
10		46	
11	-15V	47	HI
12	ANA COM	48	
13	+15V	49	R_G/OFS
14		50	R_G (CHANNEL B)
15		51	LO
16		52	COM
17		53	V_{OFS} (+10V)
18		54	
19		55	
20		56	HI
21		57	
22	ADR1 (CHANNEL SELECT)	58	R_G/OFS
23	ADR0 (CHANNEL SELECT)	59	R_G (CHANNEL C)
24	GAIN SELECT	60	LO
25	RTD ENABLE	61	COM
26		62	V_{OFS} (+10V)
27		63	
28		64	
29		65	
30		66	HI
31	DIG COM	67	
32	SYNC IN *	68	R_G/OFS
33	SYNC OUT *	69	R_G (CHANNEL D)
34		70	LO
35		71	COM
36		72	V_{OFS} (+10V)

*SHORTED INTERNALLY FOR FEEDTHROUGH FOR USE WITH 2B54/55 MODELS.

drift differential instrumentation amplifier, with the desired channel specified by the two digital channel select inputs. This signal is then fed to a digitally controlled programmable gain amplifier (PGA). The appropriate gain for a particular sensor type is selected by the gain select input.

User selectable direct or switched output permits direct output connection of several modules, should more than four channels be required.

An internally selectable constant current excitation source provides direct connection of 2 or 3 wire RTDs, thus eliminating the need for external excitation sources. Each channel contains an input protection and filtering network to preserve signal integrity in the presence of series mode 50/60Hz noise.

OPERATING INSTRUCTIONS

Connection of the 2B34 with three wire RTD inputs is shown in Figure 2 and will be all that is needed in most cases. The following sections describe the basic application, as well as detail some optional connections that enhance the module's performance in more complex applications. All unused inputs should be shorted to common.

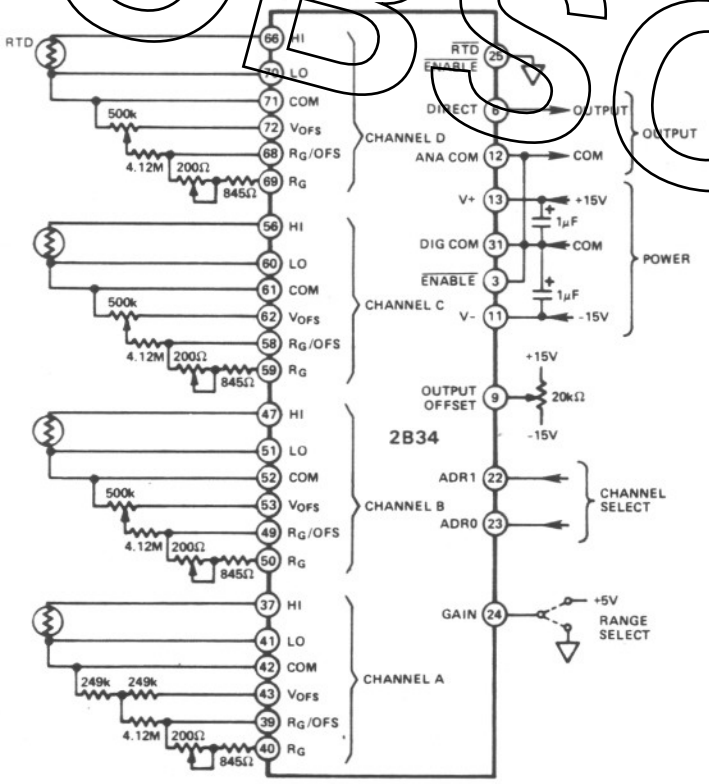


Figure 2. Basic RTD Application

Channel Selection: Each channnel of the 2B34 is turned on and off by applying the proper binary code to channel select inputs (ADR0, ADR1). Channels may be selected in any order and there are no restrictions on rate other than the 300µs settling time for access to a channel (Table I, channel select truth table).

Gain Selection: The 2B34 is designed to provide signal conditioning of both RTD and strain gage sensor inputs. To accommodate both of these sensor types, the 2B34 is precalibrated to provide gains of 50 and 166.6, with gain components shown in Figure 2. This provides proper amplification of input signals over the span of ±30mV to ±100mV. Selection of the desired gain and sensor input mode is achieved by applying the appropriate binary codes shown in Table II. A 200Ω pot provides ±3% full scale span adjustment.

AD1	AD0	Channel
0	0	A
0	1	B
1	0	C
1	1	D

Table I. Channel Selection

(Pin 24) Gain Select Input	Selected Gain
0	166.6
1	50

(Pin 25) RTD ENABLE	Selected Mode
0	RTD
1	Strain Gage

Table II. Gain and Mode Selection

Zero Suppression & Gain: In most instances, the gain capability of the 2B34 will be sufficient. However, in the case of input signals that may require gains greater than 166, the

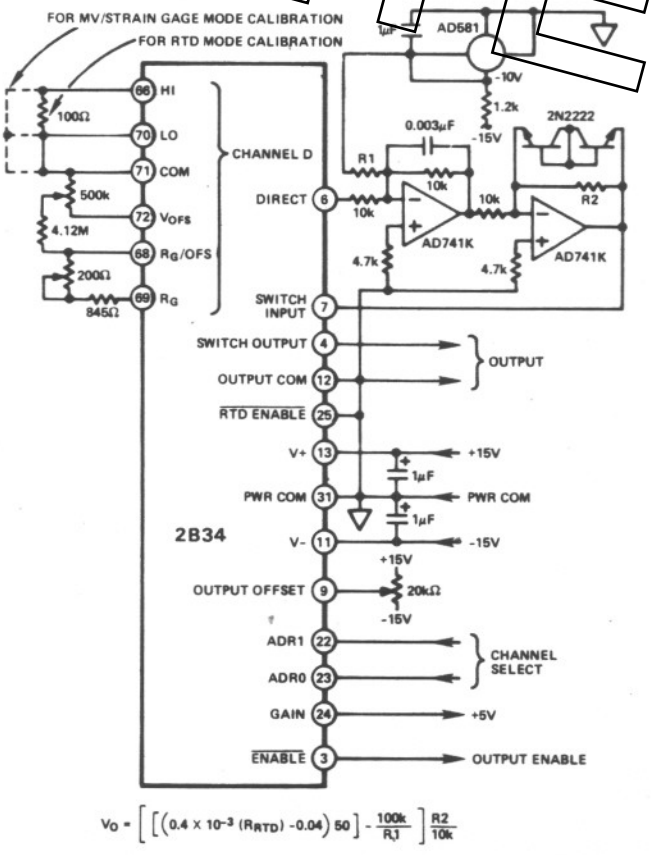


Figure 3. Zero Suppressed Switched Output RTD Application

gain range of the 2B34 may be supplemented by use of an external amplifier (Figure 3). A low drift, operational amplifier (such as the AD741K) should be used to maintain signal integrity.

Optional Offset Adjustment: All channels of the 2B34 are typically within ±150μV (RTI) offset. For use in more demanding applications, the module has provisions for fine adjustment of the input offset (RTI) of each input as well as the output offset (RTO) of the entire module. None of the offset adjustments will affect drift performance.

In some applications, where ±25μV channel-to-channel offset voltage can be tolerated, adjustment of only the output offset will be sufficient. The offset circuit shown in Figure 2 (for channel "A") is required when a potentiometer is not used to adjust input offset. The output offset adjustment may then be used to null the 150μV (RTI) offset, leaving an offset difference between channels of ±25μV. If input offset adjustment is desired, the input offset circuitry shown in Figure 3 should be used. This provides approximately ±140mV (RTO) of adjustment, and should be adequate, in most cases, for elimination of sensor offset errors.

To calibrate in the mV (strain gage) mode, (Figure 3), short the signal inputs (for example, pins 66, 70 for channel "D") to common and center the input offset adjustment potentiometer. Adjust the output offset potentiometer until the output is nulled for that channel at the appropriate gain. The input offset pots on each channel may then be used to eliminate any errors on subsequent channels that are selected.

To calibrate in the RTD mode, follow the same procedure, but replace the short with a 100Ω resistance standard.

Channel Expansion: The 2B34 has provisions for directly interconnecting several modules when more than four channels are required. The series switched outputs of the modules are connected together, the channel select inputs are driven in parallel, and the switched output of the desired module is selected using the $\overline{\text{ENABLE}}$ pin. This technique is shown in Figure 4. Channel address and $\overline{\text{ENABLE}}$ (active low) inputs are CMOS/TTL compatible with an input current of 100μA each.

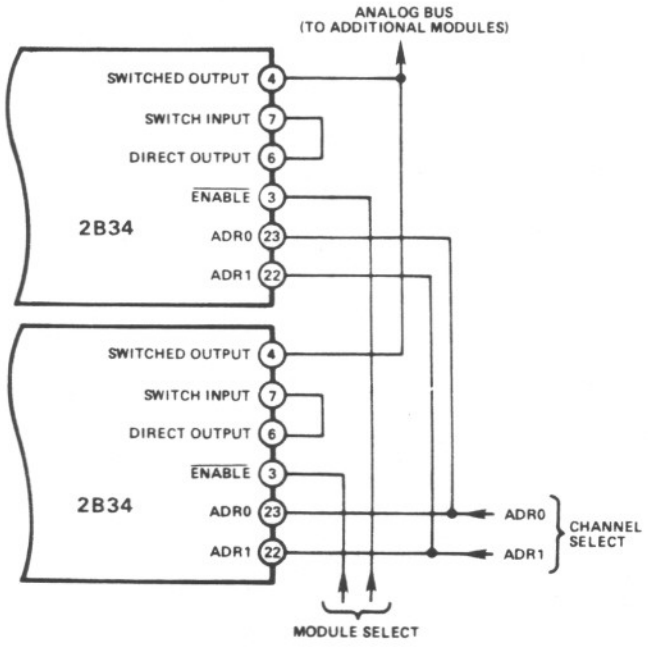


Figure 4. Channel Expansion

2B34 Strain Gage Application: Figure 5 shows a four channel strain gage input system utilizing the multiplexing feature of the 2B34. Input offset and gain adjustments are used to eliminate inherent sensor errors. The model 2B35 triple output supply may be used to provide power for the 2B34 as well as excitation for the strain gage sensors.

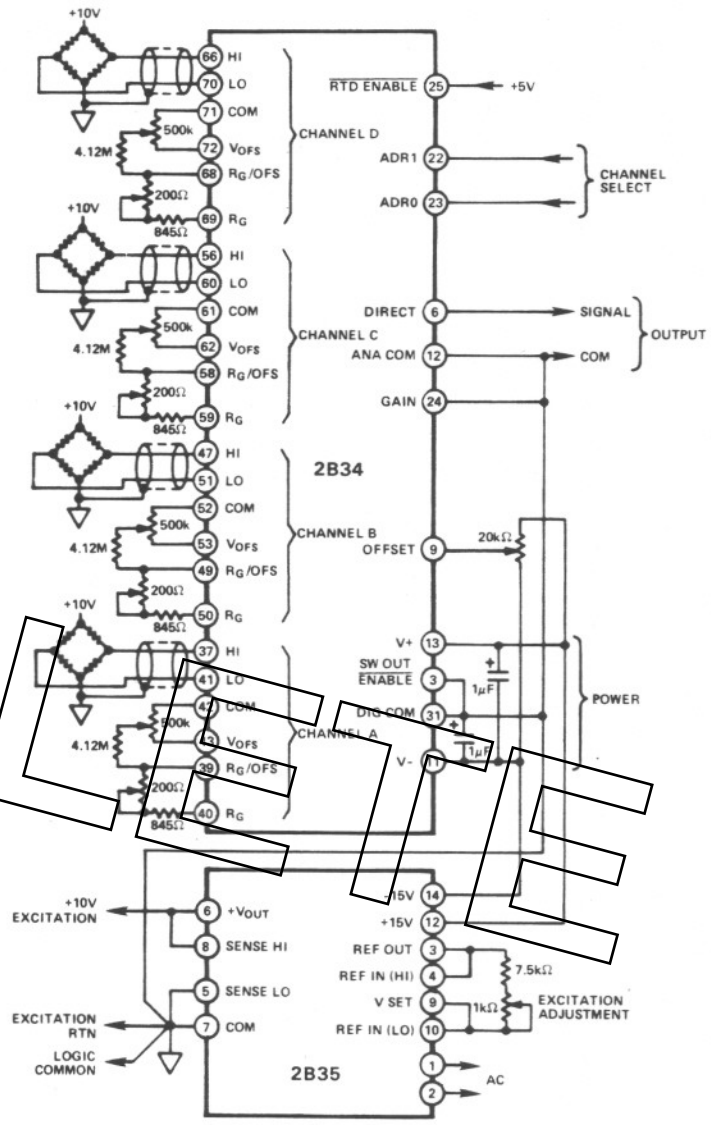


Figure 5. 2B34 Strain Gage Application