Construction and Calibration of a 2-Wire V to I Converter

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October 20, 2024

1 Introduction

This document outlines the features, construction, and calibration of a 2-wire V to I (Voltage-to-Current) converter, specifically using the LM10 integrated circuit (IC). The LM10 IC is a monolithic linear IC comprising a precision reference and an adjustable buffer, with an operational amplifier.

2 LM10: Features

The LM10 IC has the following features:

- Input Offset Voltage: 2 mV (Maximum)
- Input Offset Current: 0.7 nA (Maximum)
- Input Bias Current: 20 nA (Maximum)
- Offset Voltage Drift: 2 μV/°C
- Reference Regulation: 0.1% (Maximum)
- Reference Drift: 0.002%/°C

The LM10 operates with a supply voltage ranging from 1.1 V to 40 V, drawing only 270 μA. It provides a complementary output stage, swinging within 15 mV of the supply terminals or delivering ±20-mA output current.

3 Construction of the V/I Converter

The circuit for the 2-wire V/I converter is based on the LM10 IC. The key components include:

- A 10kΩ potentiometer for Zero Adjustment

- A 100Ω potentiometer for Span Adjustment
- A DC power supply set to 24V
- A 7V DC supply for generating the input voltage V_{in}

The circuit diagram is designed for portability and operates with a single power supply. The IC is capable of functioning in floating mode, which makes it suitable for remote sensing and signal conditioning applications.

4 Calibration Procedure

The following steps outline the calibration of the 2-wire V/I converter:

1. Set up the circuit with a 24V power supply and a milli-ammeter for current measurement.
2. Set V_{in} to 0 mV by shorting the input to ground. Adjust the zero and span using the 10kΩ and 100Ω potentiometers.
3. Vary V_{in} from 0 mV to 800 mV using the "Vi Set" potentiometer and record the output current using a digital multimeter.
4. Calibrate the converter by observing the zero-span interaction and ensure a linear relationship between V_{in} and output current I.

5 Calibration Data

Sl. No	V_{in} **(mV)**	**True Value** I_t **(mA)**	**Actual Value** I_1 **(mA)**
1	0	4.0	3.92
2	100	6.0	5.96
3	200	8.0	7.98
4	300	10.0	9.94
5	400	12.0	12.0
6	500	14.0	13.95
7	600	16.0	15.91
8	700	18.0	17.99
9	800	20.0	20.0

Table 1: Calibration Data for V/I Converter

6 Functional Evaluation

The functional evaluation of the 2-wire V/I converter includes:

- Setting the output current to 20 mA by applying a suitable V_{in}.
- Observing the effect of varying supply voltage on the output current.
- Analyzing the maximum load resistance for which the output current remains independent of load resistance.
- Verifying the circuit's compliance with Ohm's law.

7 Zero-Span Interaction

Adjustments of zero and span can affect the calibration range of the converter. When applying an input of 300 mV and adjusting the zero for an output of 4 mA, the new calibration range must be checked for consistency.

8 Conclusion

The LM10-based 2-wire V/I converter provides reliable performance with precise zero and span adjustments, enabling accurate signal conditioning in a variety of applications.

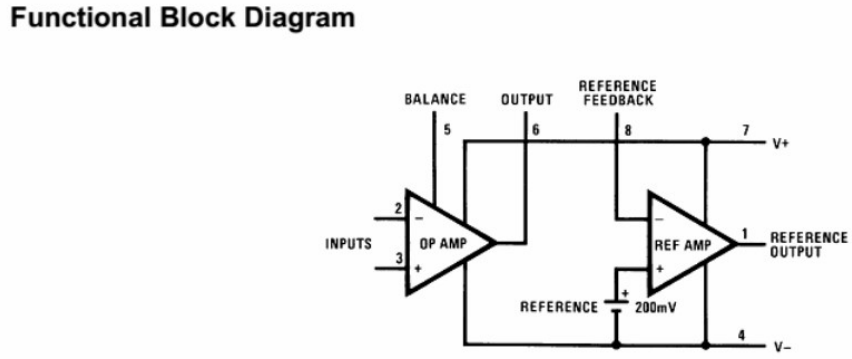

Figure 1: Functional Block Diagram of LM10 IC

Pin Functions — 8-Pin SDIP or PDIP

PIN		I/O	DESCRIPTION
NAME	NO.		
Balance	5	I	Used for offset nulling
Op Amp Input (+)	3	I	Noninverting input of operational amplifier
Op Amp Input (–)	2	I	Inverting input of operational amplifier
Op Amp Output	6	O	Output terminal of operational amplifier
Reference Feedback	8	I	Feedback terminal of reference
Reference Output	1	O	Output terminal of reference
V+	7	I	Positive supply voltage
V–	4	I	Negative supply voltage

Figure 2: Pin Diagram of LM10 IC

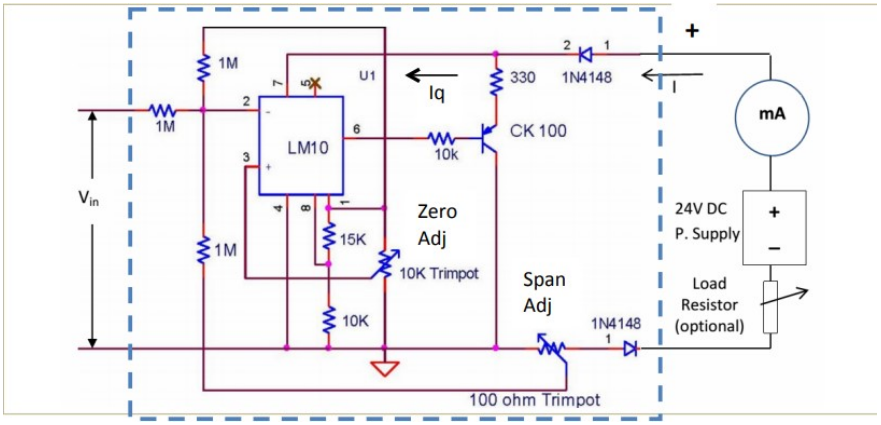

Figure 3: Schematic of the Circuit

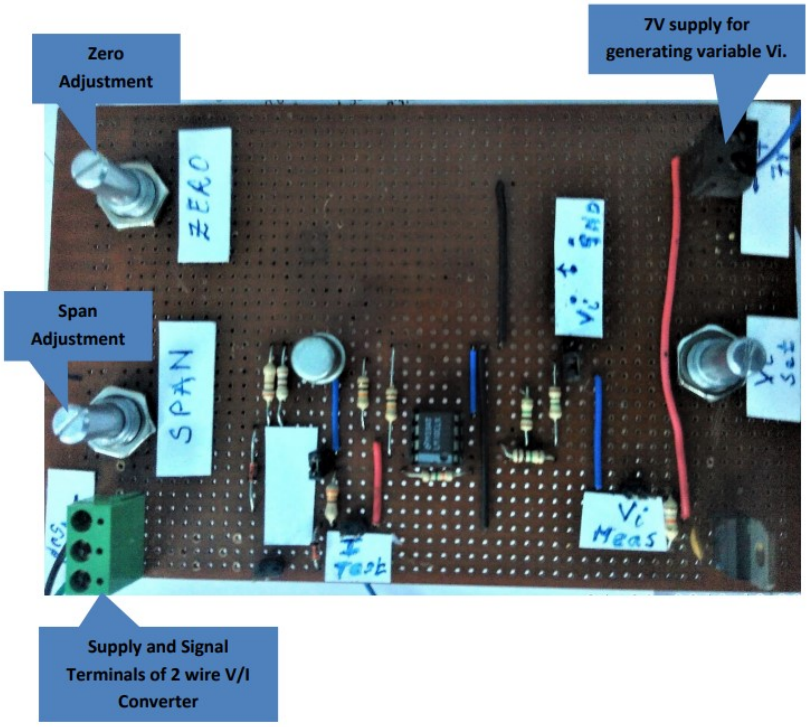

Figure 4: An image of the functional Hardware