

# DCBA1ME, DCBA2ME, DCBA1MF

## General

The DCBA1ME and the DCBA2ME amplify the voltage differences of full resistor bridges.



Figure 1: DC Bridge Amplifier DCBA1ME.

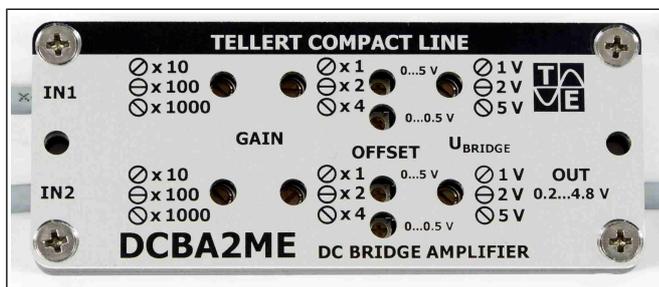
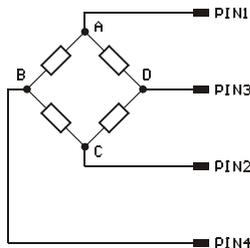


Figure 2: DC Bridge Amplifier DCBA2ME.

The DCBA1ME supports one bridge whereas the DCBA2ME supports two bridges.



Usually, point A of the bridge above is connected with the bridge supply (1 V DC, 2 V DC, or 5 V DC) and point C is connected with ground (0 V). Then, one of the points B and D is connected with the inverting sensor input, and the other point is connected with the noninverting sensor input. Using this configuration, the signal to be amplified is given by the voltage difference between noninverting and inverting sensor input.

## Voltage Amplifier

Another application is to use the DCBA1ME or DCBA2ME without the resistor bridge as a voltage amplifier for positive voltage signals within the range from 0 V to 400 mV. Note that pin 2 of the corresponding input socket must be short-circuited to pin 3.

**IN1/IN2:** This socket is manufactured by Binder (Binder Series 719). The socket IN1 refers to channel CH1, and the socket IN2 refers to channel CH2 and is only available for DCBA2ME.

Pin	Assignment for voltage amplifier [Wire color]
1	Unconnected [white]
2	Ground (short-circuit to pin 3 is required) [brown]
3	Ground (short-circuit to pin 2 is required) [green]
4	Positive voltage signal (0...400 mV) [yellow]

## Output Signal

The output voltage  $U_o$  is defined as

$$U_o(r) = a \cdot U_r \cdot r + U_z$$

$$r = \frac{U_n - U_i}{U_r}$$

where

- $a$  is the amplification,
- $r$  is the auxiliary ratio,
- $U_r$  is the voltage between point A and point C,
- $U_z$  is the amplifier's offset voltage,
- $U_n$  is the noninverting input voltage,
- $U_i$  is the inverting input voltage.

For force sensor applications, the output voltage  $U_o$  is defined as

$$U_o(F) = \frac{a \cdot U_r \cdot r_{\max}}{F_{\max}} \cdot F + U_z$$

where

- $a$  is the amplification,
- $F$  is the force,
- $r_{\max}$  is the auxiliary ratio at  $F_{\max}$  (e.g. 2 mV/V)
- $F_{\max}$  is the force at  $r_{\max}$  (e.g. 500 N)
- $U_r$  is the voltage between point A and point C,
- $U_z$  is the amplifier's offset voltage.

For voltage amplifier applications, the output voltage  $U_o$  is defined as

$$U_o(U) = a \cdot U + U_z$$

where

- $a$  is the amplification,
- $U$  is the positive voltage signal,
- $U_z$  is the amplifier's offset voltage (usually 0.5 V)

The amplifier's output voltage lies within the range from 0.2 V to 4.8 V.

## Setup

The amplification  $a$  is set with the two GAIN switches:

Gain switch 1	Gain switch 2	Amplification $a$
x10	x1	10
x10	x2	20
x10	x4	40
x100	x1	100
x100	x2	200
x100	x4	400
x1000	x1	1000
x1000	x2	2000
x1000	x4	4000

The offset voltage  $U_z$  is set with the two OFFSET potentiometers: One coarse potentiometer (0...5 V) and one fine potentiometer (0...0.5 V).

Unipolar applications usually use  $U_z = 0.5$  V, and bipolar applications usually use  $U_z = 2.5$  V.

The bridge supply is set with the  $U_{BRIDGE}$  switch to 1 V DC, 2 V DC or 5 V DC.

## TEMES Parameters (General)

The parameters which are used by TEMES to define a linear relationship between physical value  $p$  and input signal  $v$  are not (as commonly used) polynomial coefficients. Instead, TEMES uses two distinct points  $P_0 = (v_0, p_0)$  and  $P_1 = (v_1, p_1)$  of a two dimensional space, which is spanned by the input signal and the physical value. The relationship is then given by the line through these two points. The coordinates of the two points are given by the first physical value  $p_0$ , the corresponding input signal  $v_0$ , the second physical value  $p_1$  and the corresponding input signal  $v_1$ . Note that  $p_1$  must not equal  $p_0$  and  $v_1$  must not equal  $v_0$ .

Factor  $m$  and offset  $t$  are used to describe the linear relationship with polynomial coefficients. Thus,  $p(v) = m \cdot v + t$ .

Factor, Offset	Example for two points
$m = \frac{p_1 - p_0}{v_1 - v_0}$ $t = p_0 - m \cdot v_0$	$P_0: v_0 = 0, p_0 = t$ $P_1: v_1 = 1, p_1 = m + t$

## TEMES Parameters (DCBA)

The following TEMES parameters may be used for a force sensor application:

<b>Point <math>P_0</math>:</b>	$p_0 = 0$ N	$v_0 = U_z$
<b>Point <math>P_1</math>:</b>	$p_1 = F_{\max}$	$v_1 = a \cdot r_{\max} \cdot U_r + U_z$

## Pin Assignment

The plugs and sockets of the DCBA1ME/DCBA2ME are compatible with DCBA2/DCBA8.

**IN1/IN2:** This socket is manufactured by Binder (Binder Series 719). The socket IN1 refers to channel CH1, and the socket IN2 refers to channel CH2 and is only available for DCBA2ME.

Pin	Assignment [Wire color]
1	Bridge supply $U_{BRIDGE}$ (1 V DC, 2 V DC, or 5 V DC; max 25 mA) [white]
2	Bridge ground (0 V) [brown]
3	Inverting input [green]
4	Noninverting input [yellow]

Note that the valid CMMR (common-mode input voltage range) is from -0.1 V to 3.4 V (Both, inverting and noninverting input voltages must be within this range).

**OUT:** This plug is manufactured by Binder (Binder Series 719). It supplies the DCBA with voltage and puts out the amplified signals.

Pin	Assignment [Wire color]
1	Supplying voltage (7 V DC to 16 V DC) [white]
2	Ground [brown]
3	Output channel CH1 [green]
4	[DCBA2ME only:] Output channel CH2 [yellow]

## Electrical Specifications

**Input signal frequency range (typical):**

$$f_{-0.1 \text{ dB}} > 1 \text{ kHz}; f_{-3 \text{ dB}} > 4 \text{ kHz};$$

**Gain Error (verified):**  $e_g < 1.5 \%$

**Max Input Offset Drift (typical):**  $2 \mu\text{V}/^\circ\text{C}$

**Noise (typical):**  $35 \frac{\text{nV}}{\sqrt{\text{Hz}}}$  RTI noise at 1 kHz

**Current consumption without bridge (pin 1 of IN1/IN2 is unconnected):** about 2 mA per channel

## Mechanical Specifications

Box Dimensions:	DCBA1ME: 72 mm x 17 mm x 8 mm DCBA2ME: 72 mm x 30 mm x 8 mm
Weight:	DCBA1ME: 27 g DCBA2ME: 41 g
Cable IN1/IN2:	Length: about 5 cm
Cable OUT:	Length: about 46 cm
Box Protection:	Splash-proof
Switches:	Slot width: 1.8 mm

The boxes are stackable with M3 screws.

## DCBA1MF

The DCBA1MF is almost like the DCBA1ME but with a rotatable pot for the fine offset voltage.



**Figure 3:** DC Bridge Amplifier DCBA1MF.

Box Dimensions:	DCBA1MF: 85 mm x 17 mm x 8 mm
Weight:	DCBA1MF: 29 g