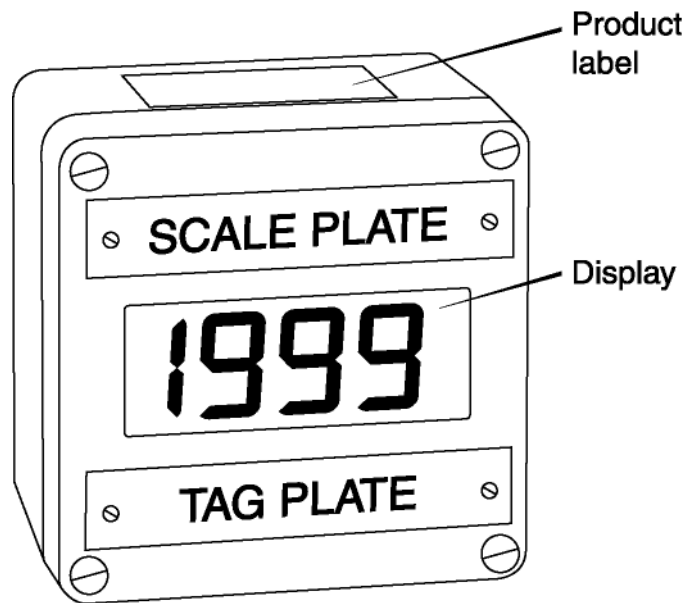


BA504C
loop-powered
3½ digit field
mounting indicator



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1. Description

The BA504C is a loop powered digital indicator which displays the current flowing in a 4/20mA loop in engineering units. The indicator introduces less than a 1.1V drop which allows it to be installed into almost any 4/20mA current loop. No additional power supply or battery is required.

The BA504C is a second generation instrument which, although having additional functions, remains compatible with the original BA504.

The main application of the BA504C is to display a measured variable or control signal in a process area. The zero and span of the display are independently adjustable so that the indicator may be calibrated to display any variable represented by the 4/20mA current, e.g. temperature, flow, pressure or level.

The indicator is available in a glass reinforced polyester (GRP), or an epoxy painted aluminium enclosure. Both provide IP66 protection.

2. Operation

Fig 1 shows a simplified block diagram of a BA504C. The 4/20mA input current flows through resistor R1 and forward biased diode D1. The voltage developed across D1, which is relatively constant, is multiplied by a switch mode power supply and used to power the analogue to digital converter and liquid crystal display. The voltage developed across R1, which is proportional to the 4/20mA input current, provides the input signal for the analogue to digital converter.

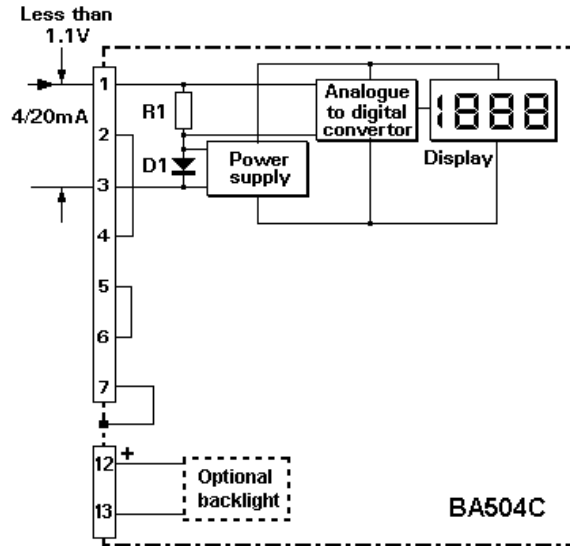


Fig 1 Simplified block diagram of BA504C

3. Applications

3.1 Transmitter loops

The BA504C indicator may be connected in series with any 4/20mA current loop providing the loop can tolerate the additional 1.1V required to operate the indicator. Fig 2 illustrates a typical application in which a BA504C indicator is connected in series with a 2-wire transmitter.

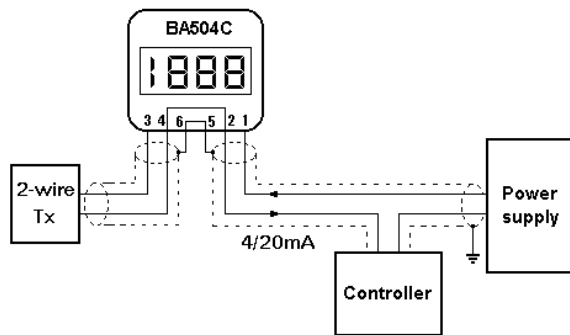


Fig 2 BA504C in a transmitter loop

The sum of the maximum voltage drop of all the components must be less than the minimum power supply voltage.

Minimum operating voltage of 2-wire Tx	10.0
Maximum voltage drop caused by controller	5.0
Maximum voltage drop caused by BA504C	1.1
Maximum voltage drop caused by cables	0.4

16.5V

Therefore at 20mA the power supply in this example must have an output greater than 16.5V

3.2 Remote indication

The BA504C indicator may be driven from any 4/20mA signal to provide remote indication. Fig 3 shows a typical application in which the output from a gas analyser drives a BA504C. Again it is necessary to ensure that the voltage capability of the 4/20mA output is greater than the sum of the voltage drops caused by the BA504C and cable resistance.

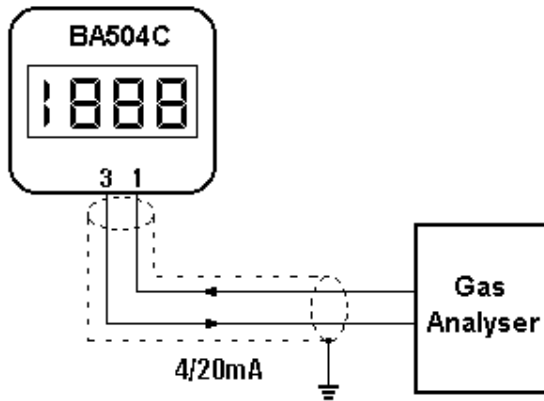


Fig 3 Remote indication

4. Installation

4.1 Location

The BA504C indicator can be supplied in either a glass reinforced polyester (GRP), or an epoxy painted aluminium enclosure. Both provide IP66 protection and have a toughened glass window and stainless steel fittings. The GRP enclosure is suitable for most industrial installations including off-shore and waste water treatment applications. For installations where solvents may be present, the aluminium enclosure provides maximum protection.

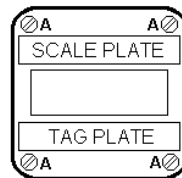
Both enclosures are surface mounting, but may be pipe or panel mounted using the accessory kits described in section 7 of this manual.

To simplify installation, the enclosure can be installed and the field wiring terminated prior to the indicator assembly being fitted. The enclosure contains diodes to maintain continuity of the 4/20mA loop when the indicator assembly is not present. Terminals 2 and 4 are internally joined and may be used for linking the return 4/20mA wire - see Fig 2. Similarly, terminals 5 and 6 are internally joined and may be used for linking the cable screens. Terminal 7 is internally connected to an insulated radio frequency screen in the GRP enclosure, and to the case in the aluminium enclosure.

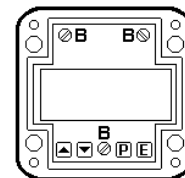
4.2 Installation Procedure

Fig 4 illustrates the instrument installation procedure.

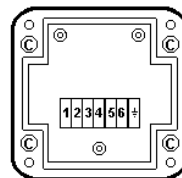
- Remove the enclosure cover by unscrewing the four captive 'A' screws.
- Remove the indicator assembly from the enclosure by unscrewing the three captive 'B' screws.
- Mount the enclosure on a flat surface and secure with screws or bolts through the four corner 'C' holes. Alternatively use one of the pipe or panel mounting kits described in sections 7.5 and 7.6
- Remove the temporary dust seals from the cable entries and install the required glands, conduit fittings or blanking plugs.
- Connect the field wiring to the terminals as shown in Fig 5.
- Replace the indicator assembly and evenly tighten the three 'B' screws.
- Replace the enclosure cover and evenly tighten the four 'A' screws.



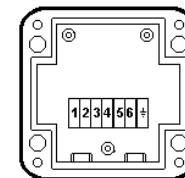
Step 1
Remove the enclosure cover by unscrewing the four 'A' screws



Step 2
Remove the indicator assembly from the enclosure by unscrewing the three captive 'B' screws



Step 3
Mount the enclosure on a flat surface and secure with screws through the four corner 'C' holes.
Alternatively, use a pipe or panel mounting kit which is supplied with separate instructions.



Step 4
Install cable gland, conduit fittings or blanking plug and connect field wiring.

Fig 4 BA504C installation procedure

4.3 EMC

The BA504C complies with the requirements of the European EMC Directive 89/336/EEC. For specified immunity all 4/20mA wiring should be in screened twisted pairs.

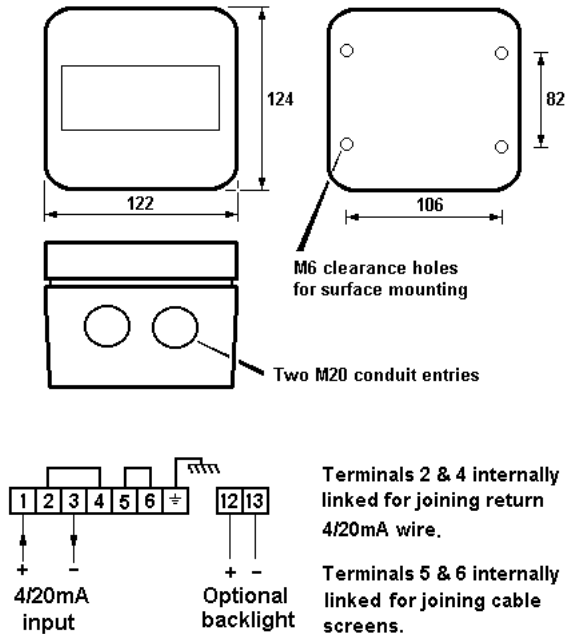


Fig 5 Dimensions and terminal connections

5. Calibration

The BA504C will be supplied calibrated as requested at time of ordering. If calibration is not requested, the indicator will be set to display 00.0 with 4.000mA input, and 100.0 with 20.000mA input.

The BA504C is conditioned and calibrated by plug-in links and two multi-turn potentiometers. For maximum accuracy, the instrument should be calibrated using an external traceable current source with a resolution of at least 4µA. However, when verification is not required, the instrument may be fitted with an internal calibrator which allows rapid calibration without the need for external instruments or disconnection from the 4/20mA input current. See section 7.2 for details.

5.1 Zero adjustment

Zero is defined as the number displayed by the indicator with a 4.000mA input current, and may be adjusted between -1000 and 1000. The zero potentiometer has two ranges, 0 to 500 and 500 to 1000. Zero polarity is defined by the position of the suppression / elevation links which are shown in Fig 6.

Suppression / elevation links

Position	Display with 4mA input adjustable between
Elevation	0 and 1000
Suppression	0 and -1000

Zero link

Position	Display with 4mA input adjustable between
0 to 500	0 and 500
500 to 1000	500 to 1000

5.2 Span adjustment

Span is defined as the difference between the number displayed with 4.000mA input, and the number displayed with 20.000mA input. It is adjustable between 0 and 1999 in four ranges. Fig 6 shows the position of the span links and the span potentiometer.

Span links

Position	Difference in display with 4 & 20mA input adjustable between
000 to 500	000 and 500
or 500 to 1000	500 and 1000
or 1000 to 1500	1000 and 1500
or 1500 to 1999	1500 and 1999

5.3 Decimal point

A decimal point may be displayed between any of the four digits. The position or absence of this dummy decimal point is determined by the position of the decimal point link shown in Fig 6. When calculating the required span and zero settings the decimal point should be ignored.

5.4 Reverse action

Normally the BA504C display increases as the input current increases, but this can be reversed. Please contact BEKA associates for details.

5.5 Calibration example

The BA504C is required to display:
 25.0 with 4.000mA input
 115.0 with 20.000mA input

- i.e. A zero of positive 250 (Ignoring decimal point)
 A span of 900 (Ignoring decimal point)
 A decimal point in position 00.0

The following adjustments are required:

- Step 1 The BA504C is required to display a positive zero therefore the suppression / elevation links should be put in the elevation position.
- Step 2 The required zero is 250, therefore the zero link should be put in the 0 to 500 position.
- Step 3 The required span is 900, therefore the span links should be placed in the 500 to 1000 position.
- Step 4 The decimal point is required between the least two significant digits, therefore the decimal point link should be placed in the 00.0 position.
- Step 5 With 4.000mA input adjust the zero potentiometer until the indicator displays 25.0
- Step 6 With 20.000mA input adjust the span potentiometer until the indicator displays 115.0
- Step 7 Repeat steps 5 and 6 until both calibration points are correct. The span and zero controls are almost independent so it should only be necessary to repeat each adjustment twice.

5.6 Over and under-range

If the indicator display range is exceeded, the three least significant digits will be blanked. Under-range is indicated by -1 and over-range by 1. If the display range is not exceeded, the BA504C will produce accurate readings outside the 4/20mA current range. Although not guaranteed, most BA504C indicators will operate between 3 and 25mA.

6. Maintenance

6.1 Fault finding during commissioning

If the BA504C fails to function during commissioning the following procedure should be followed:

Symptom	Cause	Solution
No display	Incorrect wiring	There should be 1V between terminals 1 & 3 with terminal 1 positive.
No display and 0V between terminals 1 and 3.	Incorrect wiring or no power supply.	Check that a current is flowing in the loop.
	Insufficient loop voltage to operate BA504C.	Check supply voltage and voltage drops caused by all components in the loop.
No display and 4V between terminals 1 and 3	Indicator assembly not correctly installed in enclosure.	Check that the three screws securing the indicator assembly are tightened.
BA504C Positive displays 1	Positive over-range	The BA504C has been incorrectly calibrated & is trying to display a number greater than 1999.
BA504C displays -1	Negative over-range	The BA504C has been incorrectly calibrated & is trying to display a number less than -1999.
Unstable display	4/20mA input has a large ripple	Check loop supply voltage.

6.2 Fault finding after commissioning

ENSURE PLANT SAFETY BEFORE STARTING MAINTENANCE

If a BA504C fails after it has been functioning correctly, the following procedure should be followed:

Symptom	Cause	Solution
No display and 0V between terminals 1 and 3	No power supply	Check that a current is flowing in the loop.
No display and 4V between terminals 1 and 3	Indicator assembly not correctly installed in enclosure.	Check that the three screws securing the indicator assembly are tightened.
Unstable display	4/20mA input has a large ripple	Check loop supply voltage.

If this procedure does not reveal the cause of the fault, it is recommended that the indicator assembly is removed from the enclosure and replaced. This can be done without disconnecting power. If the replacement assembly functions, the fault is within the original indicator assembly, if the indicator is still faulty, it is likely that the fault is within the enclosure assembly or field wiring.

6.3 Servicing

The BA504C is difficult to service to component level on-site, it has therefore been designed so that the indicator assembly can be quickly changed without disturbing the field wiring. All BA504C indicators without accessories are interchangeable, and a single spare assembly can be used to replace any instrument which fails.

We recommend that, except under exceptional circumstances, suspect instruments are returned to BEKA associates or our local agent for repair.

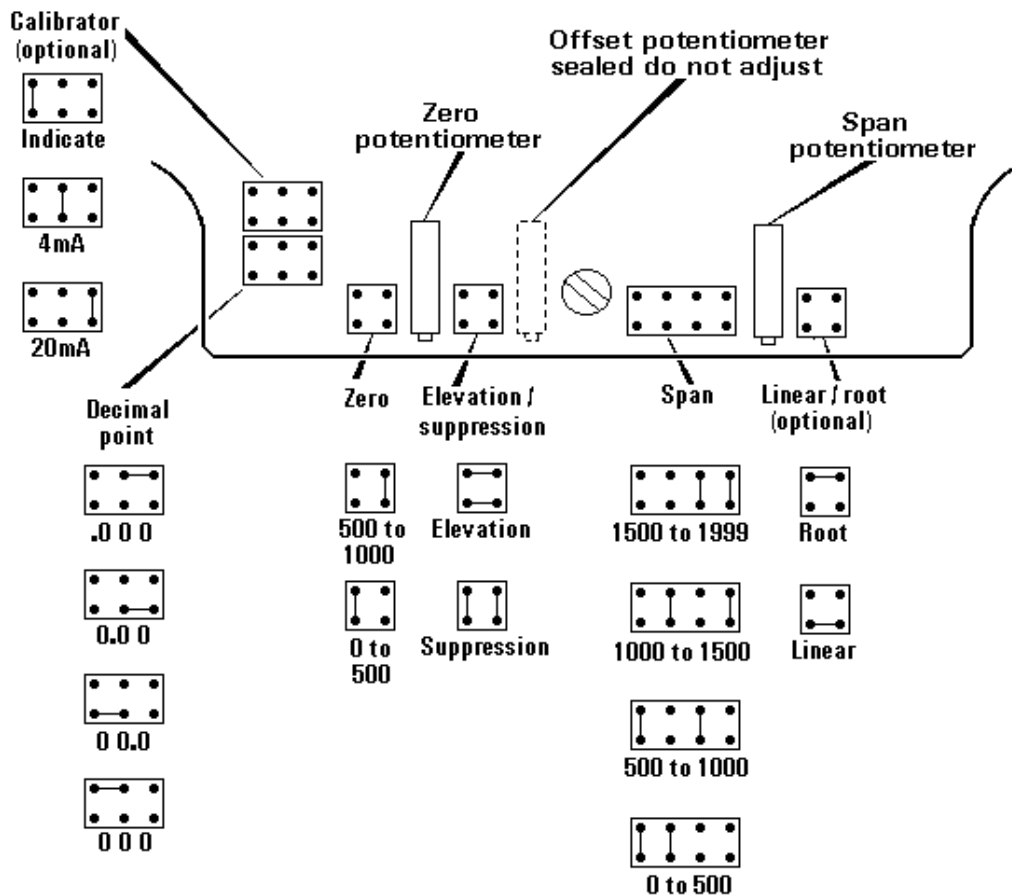


Fig 6 Position of plug-in links and potentiometers

6.4 Guarantee

Indicators which fail within the guarantee period should be returned to BEKA associates or our local agent. It is helpful if a brief description of the fault symptoms is provided.

6.5 Customer comments

BEKA associates is always pleased to receive comments from customers about our products and services. All communications are acknowledged and whenever possible, suggestions are implemented.

7. Accessories

7.1 Engraved scale and tag plates

All BA504C indicators are fitted with blank stainless steel scale and tag plates above and below the display. These can easily be removed for engraving, or if requested they can be supplied engraved with any units of measurement and tag information. Each plate can accommodate:

1 row of 9 alphanumeric characters 10mm high

or 1 row of 11 alphanumeric characters 7mm high

or 2 rows of 18 alphanumeric characters 5mm high

7.2 Internal Calibrator

The BA504C can be supplied with an optional internal calibrator which simulates 4 and 20mA input currents. This allows rapid calibration without the need for external instruments or disconnection from the 4/20mA input current, but it is not a substitute for calibration with a traceable external current source. Fig 6 shows the position of the calibrator link.

An internal calibrator can not be fitted to an instrument with a root extractor.

When using an internal calibrator, the following procedure should be followed. Any input current between 4 and 20mA may be used.

- Step 1 Put the suppression / elevation, zero, span and decimal point links in the required position.
- Step 2 Put the calibrator link in the 4mA position and adjust the indicator zero potentiometer to give the required display at 4mA.
- Step 3 Put the calibrator link in the 20mA position and adjust the indicator span potentiometer to give the required display at 20mA.
- Step 4 Repeat steps 2 and 3 until both calibration points are correct. The span and zero controls are almost independent so it should only be necessary to repeat each adjustment twice.
- Step 5 Return the calibrator link to the 'indicate' position. The indicator will now respond to the 4/20mA input current with the revised calibration.

7.3 Root extractor

The BA504C can be supplied with a square root extractor which enables the indicator to accurately display the output from a differential flow meter in linear engineering units between 10 and 100% of full flow (4.16 to 20mA). The lineariser continues to operate with reduced accuracy down to 2.5% of maximum flow, or clip-off can be selected which will force the display to zero at flows below 5% (4.04mA). The location of the clip-off link is shown in Fig 7.

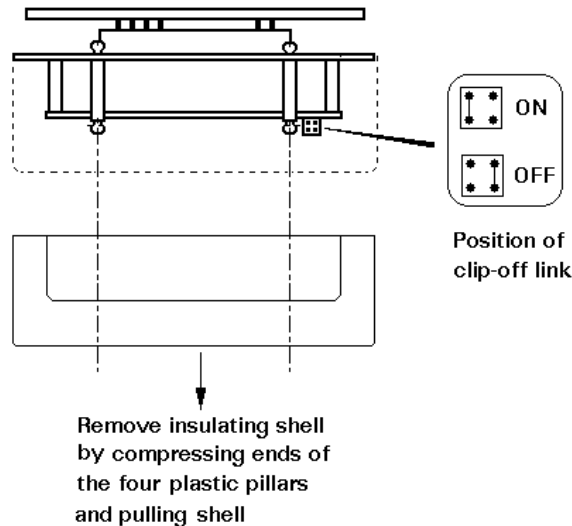


Fig 7 Location root extractor clip-off link

When calibrating a root extracting BA504C the indicator zero potentiometer should be adjusted to give the required display at 10% of flow (4.16mA). The indicator zero potentiometer should not be used to set the display to zero with a 4mA input. Zero suppression or elevation may not be used, i.e. 4mA must correspond to zero flow.

For reference, the following table shows the output current from a non-linearised differential flowmeter.

% of full flow	Current output mA
2.5	4.01
10.0	4.16
25.0	5.00
50.0	8.00
75.0	13.00
100.0	20.00

A root extractor can not be fitted to an instrument with an internal calibrator.

7.3.1 Calibration example with root extractor

The BA504C is required to display rate of flow in gallons per minute, with a resolution of 0.1 gallons. The differential flowmeter has an output of 20mA at a flow rate of 140.0 gallons per minute.

i.e. A span of 1400 ignoring the decimal point
A decimal point in position 00.0

The following adjustments are required:

- Step 1 Put the root / linear link in the root position.
- Step 2 Put the suppression / elevation links in the elevation position.
- Step 3 Put the zero link in the 0 to 500 position.
- Step 4 The required span is 1400, therefore the span links should be placed in the 1000 to 1500 position.
- Step 5 The decimal point is required between the least two significant digits, therefore the decimal point link should be placed in the 00.0 position.
- Step 6 With 4.160mA input current adjust the zero potentiometer until the indicator displays 14.0 (10% of flow). If there is insufficient adjustment to achieve this, put the elevation/suppression links in the suppression position and continue with the calibration procedure.
- Step 7 With 20.000mA input current adjust the span potentiometer until the indicator displays 140.0
- Step 8 Repeat steps 6 and 7 until both calibration points are correct.

7.4 Display backlight

The BA504C can be supplied with LED backlighting to improve display contrast in poorly illuminated areas. The backlight is electrically isolated from the measuring circuit and may be powered from any 18 to 30V dc supply. The backlight brilliance may be reduced by reducing the supply voltage below 18V, or by fitting a current limiting resistor in series with the supply,

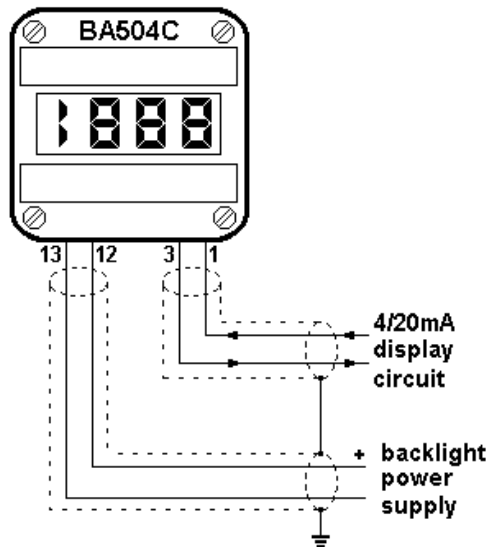


Fig 8 Backlight power supply

7.5 Pipe mounting kits

Three pipe mounting kits are available for securing the BA504C to a horizontal or vertical pipe.

- BA391 Zinc plated steel bracket secured by two worm drive hose clips. Versions available for 40 to 60mm and 60 to 80mm outside diameter pipes.
- BA392 As BA391 but in stainless steel.
- BA393 Heavy duty stainless steel bracket secured by a single 'V' bolt. Will clamp to any pipe with an outside diameter between 40 and 80mm.

7.6 Panel mounting kit

The BA394 stainless steel panel mounting kit will secure a BA504C indicator into a panel aperture, but it does not seal the joint between the indicator enclosure and the instrument panel.