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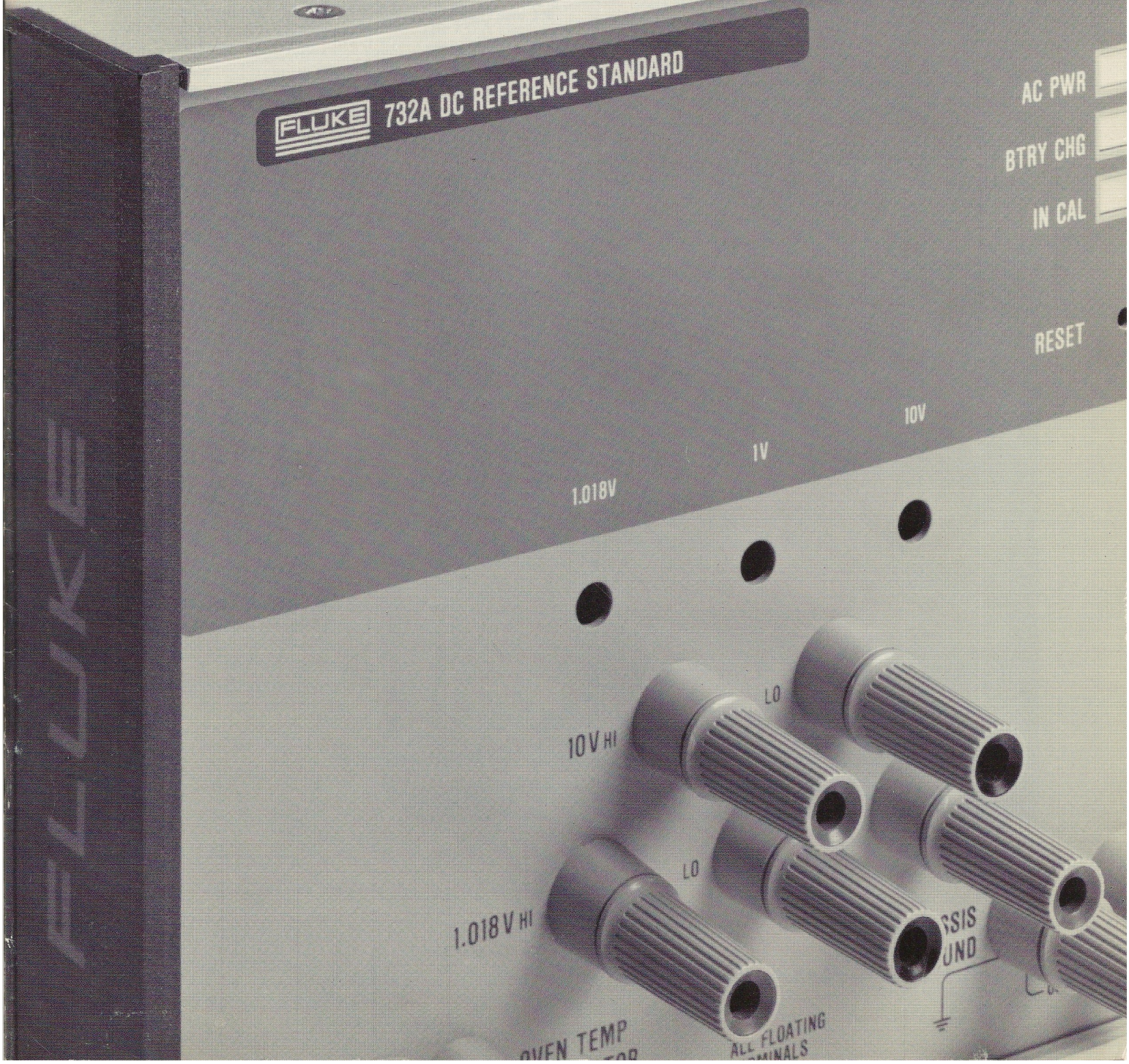
732A & DVMP

732A DC Reference Standard and Direct Voltage Maintenance Program



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732A Features

- 10V, 1.018V, 1.0V outputs
- 3.0 ppm 1-year stability
- 23°C ± 5°C operating range
- Transportable

DVMP Features

- Uncertainty within a few tenths of a part per million
- Complies with MIL-STD-45662
- Calibration on site—in your lab
- Close traceability to NBS

Power indicator

Lights when batteries are charging

Remains lit unless power fails

Reset for IN CAL light

Calibration access

10V output terminals

1.018V and 1V output terminals

Access to oven temperature thermistor

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732A DC Reference Standard

The Fluke 732A is a solid state, direct voltage reference standard that provides significant performance improvements in stability, ruggedness and transportability over standard cells. Its 10V output also offers better resolution, lower noise and simpler operation. The 732A also includes outputs of 1.0 and 1.018 volts.

The accuracy and stability of the 732A allows direct substitution for saturated standard cells in many applications. Its stability of 3.0 ppm for 1 year provides the confidence necessary to calibrate high-performance instrumentation. In addition, the use of the 10V output as a primary reference standard means that the effect of thermal emfs and noise are reduced.

The 732A can be shorted, even for extended periods, without damage, and recovers without loss of stability. The unit may be powered by line voltage or will operate 12 hours on its internal battery and even longer on external batteries. Either line power or the battery may be removed without affecting the output.

Saturated standard cells are fragile and susceptible to change from shock and vibration during shipping. The 732A was designed for air or ground shipment with no special handling. The high thermal gain oven allows full accuracy to be specified over an operating range of 23°C ± 5°C. So it may be used outside of the traditional standards laboratory environment in areas where saturated cells (or traditional, less rugged transfer standards) would not be reliable.

The 732A DC Reference Standard was originally developed by Fluke to transfer "the volt" into its own manufacturing facility. The unprecedented success achieved by this effort led to the development of the 732A for the commercial market. Fluke has developed a worldwide network of regional support centers to provide calibration support for the 732A where local standards are not available. These centers maintain volt transfer programs with the national standards laboratories.

732A DC Reference Standard Specifications

Absolute Uncertainty:

The 732A is normally delivered without absolute uncertainty specifications, because to maintain calibration as a traceable standard, the 732A must continue to receive uninterrupted operating voltage from line power or from the self contained batteries following calibration. The 732A is normally shipped from the factory with the battery switch turned off. Upon receipt, the 732A must be powered up and stabilized for 24 hours before calibration against traceable standards. The absolute uncertainty specifications for the 732A must then relate to the uncertainty specifications of the traceable standards used for this calibration.

For a traceable calibration by the Fluke Standards Laboratory and shipment under power, refer to the 732A-000 and 732A-100 options described under the Direct Voltage Maintenance Program in the following pages.

Stability

Output	Output Stability (23°C ± 5°C) in ppm			
	30 Days	90 Days	6 Months	1 Year
10V	0.5	1.0	1.5	3.0
1.018V	1.5	3.0	6.0	12.0
1.0V	1.5	3.0	6.0	12.0

These specifications assume the unit has been continuously powered up by ac, battery or both.

These specifications include effects of ± 10% line voltage variations.

Temperature Coefficient of Output

These specifications define the degradation of the 732A in ranges outside the 18°C to 28°C range.

Output	Temperature Coefficient (ppm/°C)	
	0°C to 18°C	28°C to 40°C
10V	± 0.05	± 0.05
1.018V	± 1.0	± 1.0
1.0V	± 1.0	± 1.0

Output Adjustment

Output	Adj Range	Adj Resolution
10 Volts	± 50 μV	<0.05 ppm
1.018 Volts	± 50 μV	<0.25 ppm
1.0 Volts	± 5 μV	<0.10 ppm

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Output Impedance

Output Impedance is less than 1 milliohm for 10V output: approximately 1 kΩ for 1.0V and 1.018V outputs.

Load Regulation

For output current from 0 to 12 mA, output voltage changes less than 1.2 ppm at 10V output.

Output Current

12 mA maximum at 10V output. Divider output current limited by 1 kΩ output impedance at 1.0V and 1.018V output.

Output Protection

The output may be shorted indefinitely without damage to the instrument. The instrument is protected against high voltage transients up to 1100V. The net current through the 732A must not exceed 30 mA.

Line Regulation

Less than or equal to 0.05 ppm of output for ±10% nominal power line variation.

Output Noise

Less than or equal to 1 μV rms at 10V output from 0.1 Hz to 10 Hz.

Line Power Requirements

AC volts, 50 to 400 Hz

Nominal Setting	Voltage Limits	Fuse
100V	90 to 110V	0.375A/250V SLO-BLO
120V	108 to 132V	0.375A/250V SLO-BLO
220V	198 to 242V	0.25A/250V SLO-BLO
240V	216 to 264V	0.25A/250V SLO-BLO

Low Voltage Alternative Power Requirements

The 732A DC Reference Standard may be operated through low-power connectors on the rear panel.

24V to 40V dc
24V to 30V ac, 50 to 60 Hz

Internal Batteries

Gelled-electrolyte 24V lead-acid batteries operate the instrument for 24 hours at 23°C when fully charged.

Weight

Net 12.3 kg (27 lbs.) including battery pack.
Shipping 18.2 kg (40 lbs.)

Size

60.3cm L × 22.1cm W × 19.1cm H
(23.75 in L × 8.69 in W × 7.53 in H)

Compliance with Standards

ANSI C39.5, 1980
IEC 348, 2nd edition, 1978

Temperature and Humidity

Condition	Temperature	Relative Humidity (Non-condensing)
Non-operating	−40°C to 0°C	Not controlled
	0°C to 60°C	95 ± 5% max.
Operating	0°C to 30°C	95 ± 5% max.
	30°C to 40°C	75 ± 5% max.

Note: At temperatures above 40°C the 732A battery pack should be switched off to prevent internal overheating.

Altitude

Operating 0 to 3,050m (10,000 feet)

Vibration

Per MIL-T-28800C, Type III, Class 5, Style E.

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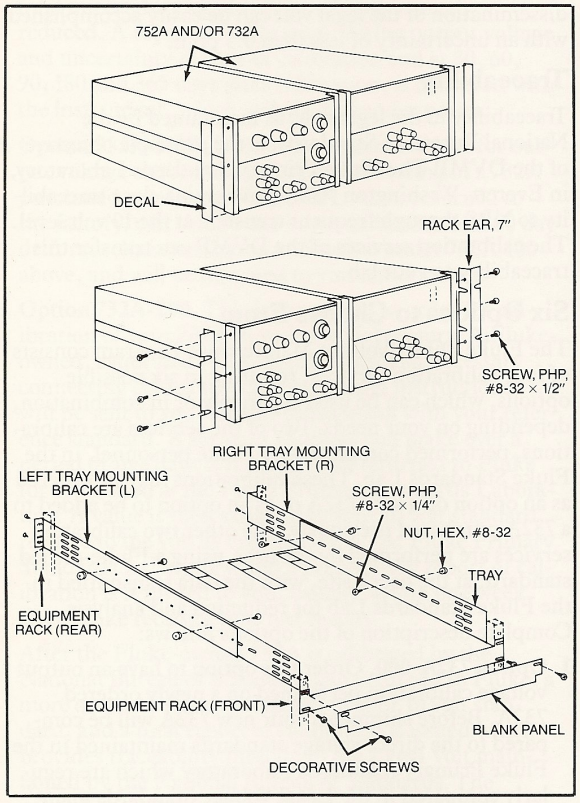
732A Options and Accessories

732A-7004 Rack Tray Kit

The 732A-7004 Rack Tray Kit provides a convenient way to mount two instruments the size of a 732A side by side in a standard 19-inch rack. The instruments accommodated may be a 732A dV Reference Standard, 752A Reference Divider or 732A-7003 Battery Charger. The instruments may be bolted in the rack using rack ears or simply stored loose on the tray for easy removal. For a set of rack ears and special bolts for bolting two instruments together side-by-side, order MO7-200-603, 7-inch Full Width Rack Mount Kit.

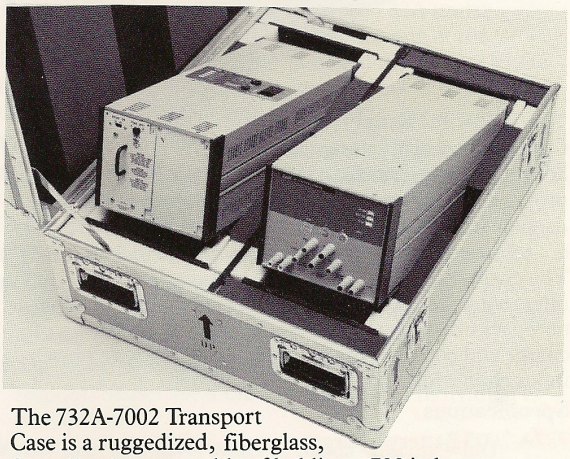


Installing the 732A-7004 rack tray kit.

5440A-7002 Low Thermal EMF Cables

The 5440A-7002 Low Thermal EMF Cables are a set of three shielded, 2-conductor cables terminated with berilium copper, low thermal EMF, banana plug type connectors. One cable is 4-feet long, and two are 2-feet long. The cables are particularly well suited for interconnecting a 732A, 752A Reference Divider and 845A Null Detector for calibration of a 5440 Series Direct Voltage Calibrator. In addition, they will be found useful for general purpose lab work where the low thermal EMF and quick disconnect features are important.

732A-7002 Transport Case



The 732A-7002 Transport Case is a ruggedized, fiberglass, foam-lined case capable of holding a 732A dc Reference Standard and a 732A-7003 Battery Charger, complete with up to four 732A-7005 Battery Packs. This extra battery capacity plus the heat-conserving insulation of the foam-lined case will extend the off-line operating time of the 732A to about 72 hours.

Specifications

732A-7002 Transport Case
Size: 77cm × 61cm × 31cm (30 in × 24 in × 12 in)
Weight: 12 kg (26 lbs.)

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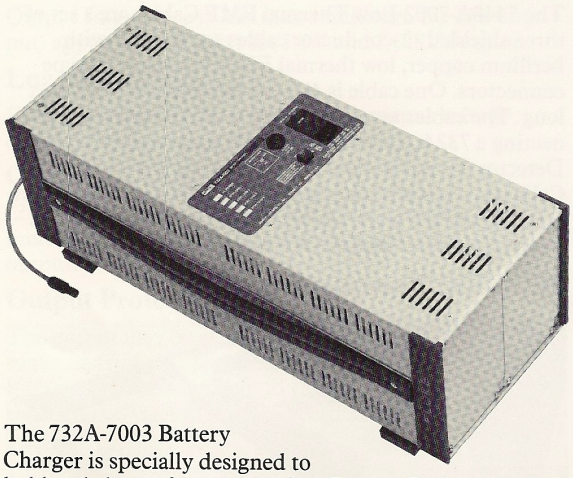
732A-7003 Battery Charger



The 732A-7003 Battery Charger is specially designed to hold and charge from one to four Battery Packs with the proper constant current, constant voltage cycle to avoid damage from over-charging. Fully discharged batteries are returned to approximately 95% charge in 24 hours. The charger provides the necessary isolation diodes and interconnections to provide the optimum charge to battery packs that may have unequal capacities or states of charge and connects the batteries to the 732A dc power input connector.

Specifications

732A-7003 Battery Charger

Input Power: 100V, 110V, 115V, 120V, 200V, 220V, 230V or 240V ac ±10%, 50 to 400 Hz, 100W max.

Size: 61cm × 19cm × 22cm (24 in × 8 in × 9 in)

Weight: 5.9kg (13 lbs.) alone. 23kg (50 lbs.) when equipped with four battery packs (732A-7005)

732A-7005 Battery Pack

The 732A-7005 Battery Pack is a replacement or spare battery pack for the 732A. From one to four battery packs can also be plugged into the 732A-7003 battery charger for recharging and connection to the 732A external power input connector for extended battery operation.

Direct Voltage Maintenance Program

Built around the 732A Direct Voltage Reference Standard, the Fluke Direct Voltage Maintenance Program (DVMP) provides state-of-the-art uncertainty for your own laboratory, traceable to the U.S. National Bureau of Standards (NBS). The 732A is a solid-state direct voltage reference standard which enables voltage transfers with uncertainties of only a few tenths of a ppm, while meeting the requirements for ruggedness and a wide range of operating temperatures. This level of performance is made possible by the low, predictable drift rate of the 732A, allowing accurate extrapolation of the output voltage to be made over long time intervals. With the DVMP, dissemination of the legal volt can be easily accomplished with an uncertainty of less than 0.5 ppm.

Traceability

Traceability to the legal volt, as maintained by the National Bureau of Standards, is the principle objective of the DVMP. The Fluke Primary Standards Laboratory, in Everett, Washington (USA), maintains close traceability to NBS through frequent transfers at the 10 volt level. The calibration services of the DVMP can transfer this traceability to your lab.

Six Options to Choose From

The Fluke Direct Voltage Maintenance Program consists of four calibration services, resulting in six possible options, which can be used separately or in combination, depending on your needs. Two of the services are calibrations, performed completely by Fluke personnel, in the Fluke Standards Lab. These calibrations may be ordered as an option on a new 732A or as an option to be added to a 732A purchased previously. The other two calibration services are performed by the user, using a Fluke-owned standard, at the user's site, with the data transmitted to the Fluke Standards Lab for reduction and analysis. Complete description of the options follows:

1. **Option 732A-000.** Order this option to have an output voltage calibration performed on a newly ordered 732A. Before shipment, your new 732A will be compared to the direct voltage standards maintained in the Fluke Primary Standards Laboratory which are regularly compared to the Legal Voltage Standards maintained by the U.S. National Bureau of Standards. A report of calibration, listing the deviation from the nominal and the uncertainty of calibration is delivered with the instrument. The instrument will be delivered under power from self-contained and auxiliary batteries to insure the calibration.

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2. **Option 732A-000R.** This is the option to order for calibration or re-calibration of a 732A purchased previously. Your 732A, when returned to the factory, will receive the same calibration as detailed under 732A-000 above, and will be returned to you under power.
3. **Option 732A-100.** Order this option to have a new instrument calibrated for output voltage and characterized for drift rate before shipment from the factory. Your new 732A will be tested for both output voltage and drift rate by comparison against traceable standards for a period of 60 days in the Fluke Primary Standards Laboratory. Knowing the drift rate, the total uncertainty as a function of time is much reduced. A report of calibration, listing output voltage and uncertainty at time of calibration and at 30, 60, 90, 180 and 365 days after calibration, is delivered with the instrument, which is delivered under power.
4. **Option 732A-100R.** This is the option to order for output voltage calibration and drift rate testing of a 732A purchased previously. Your 732A, when returned to the factory, will receive the same calibration and 60 day drift rate characterization as detailed under 732A-100 above, and will be returned to you under power.
5. **Option 732A-200.** This is the option to order for calibration of your 732A in your own laboratory. A Fluke-owned, calibrated 732A, together with all necessary connecting cables and clear operating instructions, will be sent to your site for comparison with your reference standard. A series of readings you make over a period of five days is recorded and returned to Fluke for evaluation at the Fluke Primary Standards Laboratory. A value is then assigned to your 10 volt standard, relative to the volt as maintained by the Fluke Primary Standards Laboratory, and a preliminary report of calibration is returned to you, usually within one week after Fluke receives your test results.

   After the Fluke-owned 732A is calibrated by the National Bureau of Standards and returned to Fluke, a more accurate value is assigned to your 10 volt standard, and a final report of calibration is issued which provides traceability directly to the Legal Volt maintained by the National Bureau of Standards. The quoted price for the 732A-200 option includes the shipping costs for the Fluke-owned 732A.
6. **Option 732A-201.** If you have more than one 732A in your lab, this is the option to order for calibration of each additional reference at the same site (must be ordered with Option 732A-200). Data collected by the user will be reduced and evaluated by the Fluke Standards Lab, and a report of calibration issued for the reference standard, just as for Option 732A-200.

Option Specifications

Option Number	Calibration Uncertainty (CU)*	Drift Rate Uncertainty (DU)*			Total Uncertainty
		30 Days	90 Days	1 Year	
732A-000	0.6 ppm	0.5 ppm	1.0 ppm	3.0 ppm	$[(CU)^2 + (DU)^2]^{1/2}$
732A-100	0.5 ppm	0.35 ppm	0.5 ppm	1.0 ppm	
732A-200	0.3 ppm	**	**	**	

**Typical 99% confidence level; actual uncertainties determined at the time of test*

***Drift rate uncertainty will be established with repeated participation in the DVMP*

How to Order

It is important to recognize that proper timing and coordination of the activities between Fluke and your firm are essential to successful delivery of a 732A under power. Following receipt of an order for one of the DVMP services, you will be contacted directly by Fluke factory personnel. For this reason the following information must be included with each order:

- The option number ordered.
- If options 732A-000R or 732A-100R are ordered, include the serial number of the instrument to be returned to Fluke for the service.
- The exact address where the shipment will be received.
- The name and telephone number of the person who will be responsible for receiving the shipment and connecting it to the power line when it arrives.
- The name and telephone number of an alternate responsible person if the first designated individual is unavailable.
- Any restrictions on hours of the day during which receiving can take place.

Fluke guarantees arrival of the instrument under power. If it is delayed, Fluke or the carrier will pay the shipping charges for return of the instrument to Fluke for recalibration.

Note: Due to the uncertainties of international shipping schedules and timely customs clearance, the DVMP services are limited to locations within the continental U.S.A.

732A Ordering and Planning Guide

Instrument and Description

732A DC Reference Standard with battery pack
10V, 1.018V and 1.0V Outputs

732A and DVMP Options

732A-000 Calibrated 732A.
Includes calibration in Fluke Standards Lab, Traceability Test Report and shipment under power

732A-000R Calibration of a 732A.
Same calibration service as for 732A-000, performed on previously purchased 732A

732A-100 Calibrated and Drift Rate Characterized 732A.
Includes calibration and drift rate characterization for a period of 60 days in Fluke Standards Lab, Traceability Test Report and shipment under power

732A-100R Calibration and Drift Rate Characterization.
Same calibration and characterization as for 732A-100, performed on previously purchased 732A

732A-200 On-site Calibration (includes shipping costs).
1-week use of a Fluke-owned, calibrated 732A for on-site calibration of 10 volt reference and Traceability Test Report

732A-201 Additional 10 Volt Reference Calibration at same site (may be ordered with 732A-200 only)

Accessories

MO7-200-603 7-inch Full Width Rack Mount Kit

5440A-7002 Low Thermal EMF Cable Set

732A-7002 Transport Case

732A-7003 Battery Charger

732A-7004 Rack Tray Kit

732A-7005 Battery Pack

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