# Using the Integrating Sphere in the Multiple Application Platform (MAP)

## Introduction

This application note details the specifications, properties and potential applications of the integrating sphere. It also provides information on how the integrating sphere can be ordered from JDSU.

The Multiple Application Platform (MAP) is a flexible instrumentation platform used for optical or electro-optical test and measurement applications in a production or lab environment.

MAP can be configured as a benchtop instrument or as a rack-mount system and is controllable locally via the local interface module or remotely by a GPIB or RS232 remote interface. It is supplied with comprehensive PC-based instrument drivers and MAP console for added functionality.

MAP can be configured in a wide variety of ways to varied applications. To facilitate this, MAP comes with a number of accessories, one of which is the integrating sphere.

The Integrating Sphere (JDSU Part Number AC330) is an accessory used for high power measurements using the MAP Power Meter Cassette MAPM+2PS...

The AC330 is a specially designed integrating sphere to ensure accurate power measurement regardless of the fiber type and fiber cleave conditions. Each sphere has been individually tested and characterized during manufacturing. The calibration data sheet is provided with the unit.

Table 1: Integrating Sphere Specifications

| | **Specifications** | **Comments** |
|---|---|---|
| Attenuation at reference | 30.7 ± 0.8 dB | Measured with wavelength of 1550 nm at 23 ± 5 °C and RH = 50 % with flat connector |
| Spectral range | 800 - 1650 nm | |
| Wavelength flatness | < ± 1.5 dB | From 850 - 1650 nm, with respect to the attenuation at a wavelength of 1310 nm |
| Return loss | > 65 dB (Typical) | Measured at 1310 nm and 1550 nm with single mode fiber and FC/APC connector |
| Relative uncertainty | < ± 0.05 dB | At reference condition, with 8 degree angled connector, due to the residual PDL and interference |
| Residual PDL | < 0.005 dB | Measured at 1550 nm |
| Maximum power | +33 dBm (2W) | CW laser |
| Warm-up time | 30 minutes | |
| Operation conditions | 10 - 40 °C | RH 15 % - 70 % |
| Storage conditions | -40 to + 70 °C | RH 15 % to 95 % non-condensing |

## Potential Applications

The major application of the integrating sphere is in high power measurements. It provides a constant high loss at any wavelength, thus converting the input into a power range that can be measured accurately. The loss at any wavelength can be calibrated, and measurement uncertainties from variations in this loss with humidity and temperature are small, as shown in Table 1. Prior to shipping, each integrating sphere is calibrated at seven wavelengths. The calibration sheet is supplied with the unit. When power is measured at any wavelength, the measured power can be corrected for wavelength using the calibration sheet data. The user can also do a calibration at any desired wavelength, if desired, using the procedure supplied in this application note.

The integrating sphere has the ability to collect all the light falling on it irrespective of the incident angle. Thus, it is extremely useful in applications that require good repeatability in measurements. The integrating sphere provides a means of making highly repeatable measurements, even using bare-fiber adapters.

Another important property of the integrating sphere is the complete loss of polarization when light passes through the integrating sphere. Thus, there is very little PDL in power measurements using integrating spheres. The integrating sphere can therefore be used to reduce the effects of detector PDL to increase the accuracy and repeatability of PDL and IL measurements. The residual PDL in power measurements is shown in Table 1.

## Unpacking and Inspection

The AC330 accessory package includes the following items:

- Integrating sphere
- Adapters for bare fiber connectors
- Dust caps for connector adapters
- Calibration data sheet

Please make sure that all items are present and in good condition.

## Using the Integrating Sphere

### Connecting to the Power Meter

The AC330 accessory can be directly screwed on to the front panel of the MAP Power Meter Cassette, as shown in Figure 1.


Figure 1: Installing the Integrating Sphere

### Fiber Preparation

As stated earlier, the integrating sphere can be used for making high power measurements using a bare fiber adapter. Care should always be used when working with high power sources. In particular, when working with bare fiber, ensure that cleaves are straight. Also, clean the ends of the fiber thoroughly to ensure that light is not scattered by dirt.

**Caution:** Clean the connector thoroughly before connecting to the high power source.

## Calibration

### Need for Calibration

The AC330 comes with its own calibration data. Each AC330 is calibrated with a CW laser diode at or near the following wavelengths: 980 nm, 1310 nm, 1480 nm, 1550 nm, and 1625 nm at the ambient temperature of 25°C at 50% relative humidity. Refer to the testing sheet for further details. If the measurement is within ±20 nm of the calibrated wavelength, customer calibration is not required. The measurement accuracy is guaranteed.

However, if the measurement is performed significantly away from a calibrated wavelength (> 20 nm), an on-site customer calibration is recommended.

### Calibration Procedure

Make sure the cable connector and adapters are clean. Refer to the MAP Power Meter Cassette User Manual for proper connector cleaning. Set up the equipment as shown in Figure 2. Set the laser power to - 10 dBm. If the power can be set only at a higher value, use a proper attenuator, e.g., a MAP IA3, to achieve the desired power level.

From the MAP controller front panel, set the power meter wavelength to the wavelength at which the AC330 is to be calibrated.

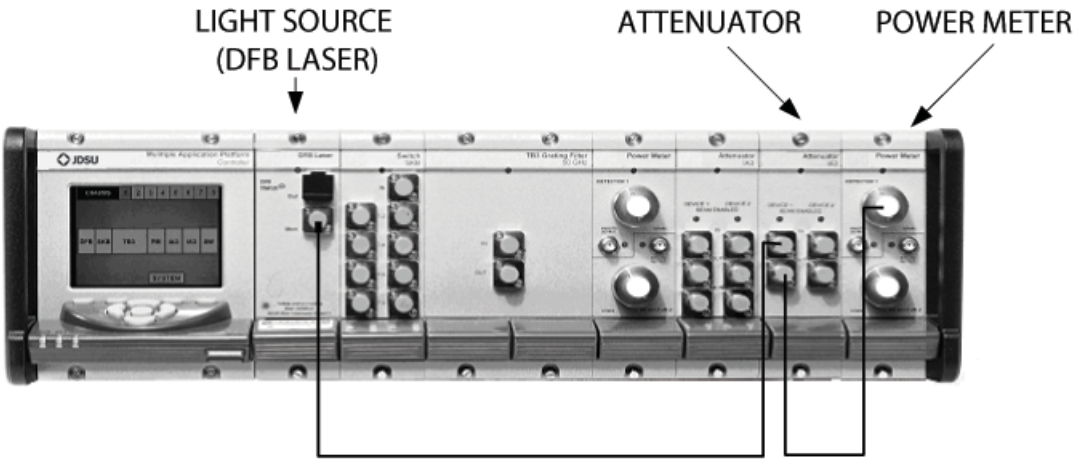


Figure 2: Setup for calibrating the Integrating Sphere

Connect the laser directly to the power meter without the integrating sphere, select appropriate channel and take the power reading $P_1$.

*Note: Please include three digits after the decimal point when recording the power reading, e.g., -9.885 dBm.*

Screw the integrating sphere on the power meter head adapter.

*Note: Make sure the integrating sphere is properly tightened.*

Connect the fiber to the integrating sphere fiber adapter and take the power reading, $P_2$.

*Note: Please include three digits after the decimal point when recording the power reading, e.g., -39.674 dBm.*

Subtract power $P_2$ from $P_1$ to obtain the integrating sphere attenuation at the measured wavelength and environmental condition, $\Delta P = P_1 - P_2$, *i.e.* in above example, $\Delta P$= -9.885 - (-39.674) = 29.79 dB.

From the front panel of the MAP controller, set the power offset on the power meter to the value of $\Delta P$, 29.79 dB in the example. If the power is now measured, the power displayed on the MAP controller is the absolute power of the input light. Refer to the OPM manual for further details on using the power meter.

## Calibration Data

Table 2: Example Calibration Sheet

| **Serial Number** AC330-123-456 | **Measured Value** | | **Comments** |
|---|---|---|---|
| Attenuation | Wavelength | Attenuation | |
| | 850 nm | 28.26 dB | |
| | 975 nm | 28.51 dB | |
| | 1311 nm | 29.43 dB | |
| | 1483 nm | 30.31 dB | |
| | 1548 nm | 30.33 dB | |
| | 1624 nm | 30.41 dB | |
| Uncertainty | ±1% | | |
| Return loss | > 65 dB | | Measured at 1310 and 1550 nm with FC/APC connector |
| Maximum power | +33 dBm (2 W) | | CW laser |
| Operation condition | 10 - 40°C, RH 15% - 60% | | No condensation |
| Storage temperature | -40 - 70 °C, RH 15% - 95% | | No condensation |



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