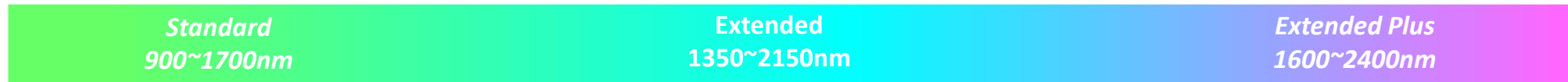




# *Fiber Input Module & Measurement*

*Nov. 14, 2022*

# Fiber Input Modules



**NIR-M-F1**



**NIR-S-F2**



**NIR-M-F11**



**NIR-S-F12**



**NIR-M-F13**



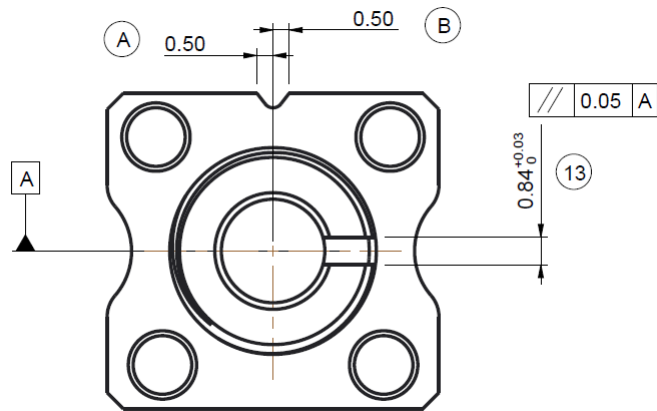
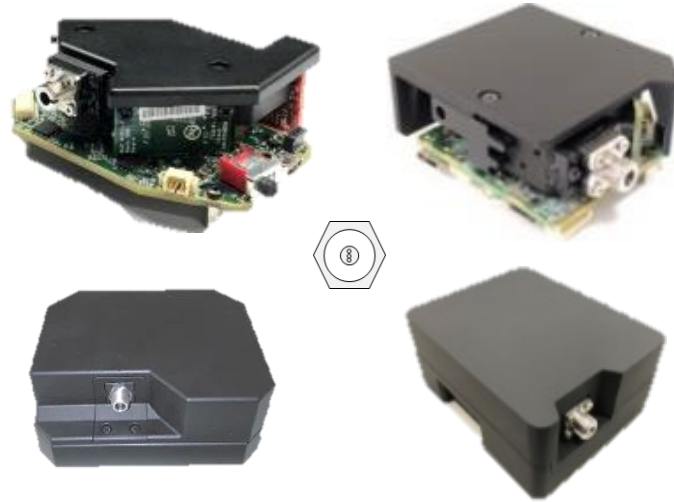
**NIR-S-F14**



NIR-M-F1 / NIR-S-F2	NIR-M-F11 / NIR-S-F12	NIR-M-F13 / NIR-S-F14
Wavelength Range: 900 to 1700nm	Wavelength range: 1350~2150nm	Wavelength range: 1600~2400nm
Optical Resolution: Typ. 10nm	Optical Resolution: Typ. 12nm	Optical Resolution: Typ. 12nm
Wavelength Accuracy: Typ. $\pm 1$ nm (verified with RM-NIR)		
Detector: 1mm standard InGaAs (Uncooled)	Detector: 1mm extended InGaAs (Uncooled)	
Slit Size: 1.8mm * 0.025mm		
Scan Capability: Linear (Column) / Hadamard / Slew Scan		
Fiber Optic Connector: SMA905 with key slot		
Communication Interface: Micro USB / UART / Bluetooth Low Energy (optional)		
Sensors: Humidity and temperature sensor		
Power: Micro USB / UART / Li-ion battery (optional)		
Operating Temperature: 0 ~ 40 °C, RH Max. 85%		

# Fiber Optic Connector

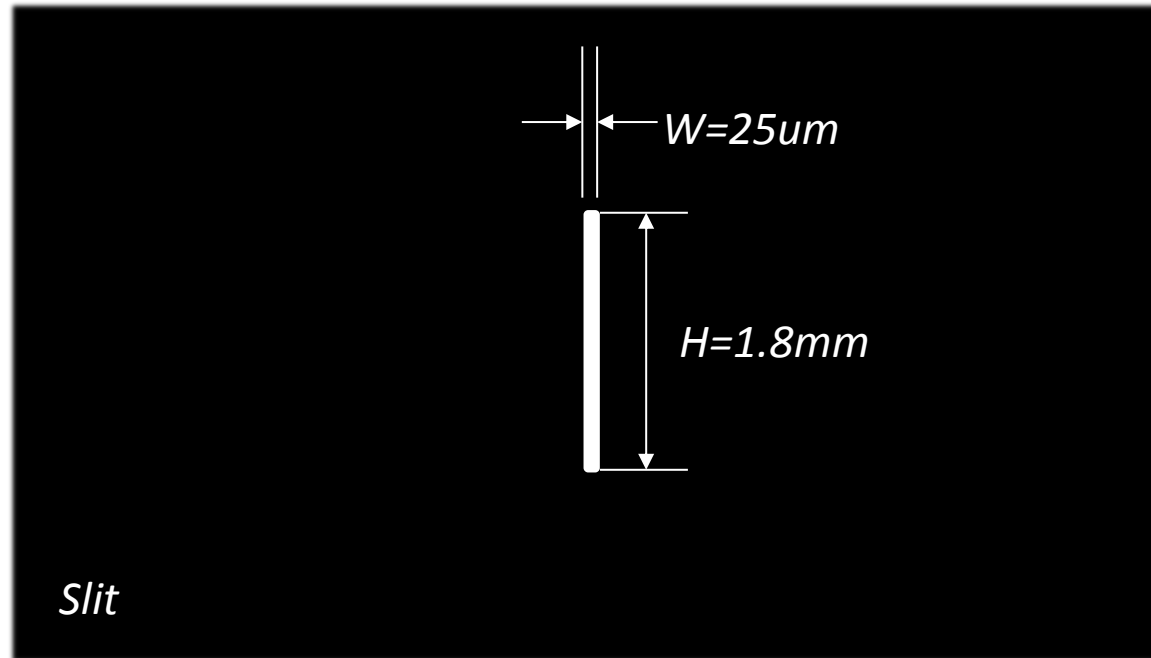
We provide SMA905 fiber optic connector for our customer to connect fiber cable into the fiber input module.



# Slit Dimensions

*We suggest our customer using linear fiber bundle to couple incident light into the slit.*

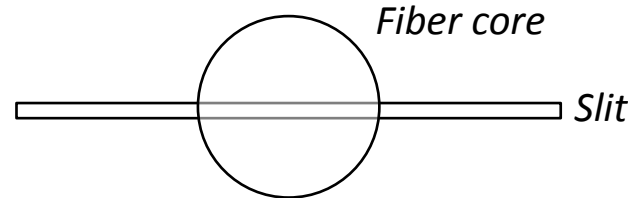
*Please check the following page to learn the reason why a linear fiber bundle is recommended.*



# Fiber Coupled Illumination

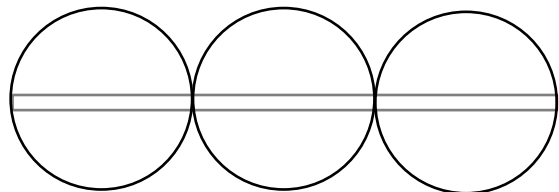
Optical fibers are often used to couple different illumination modules with the main spectrometer system. DLP spectrometers will typically have taller entrance slits than array detector systems because the DMD is taller than the array detector. This allows for increased signal throughput, but can make fiber coupling more complex.

*Standard optical fibers can be utilized, but will only illuminate a small section of the entrance slit.*



*(Not recommended)*

In order to take advantage of the DLP spectrometer's large etendue, a round-to-linear fiber bundle should be used. These optical fibers have multiple cores arranged in a circular pattern at one end, and a linear configuration at the opposite end. *The round end can be utilized at the sample as in typical spectroscopy illumination modules, while the linear end can be more effectively coupled to the slit.*



*Option #1: 600umx3*

or

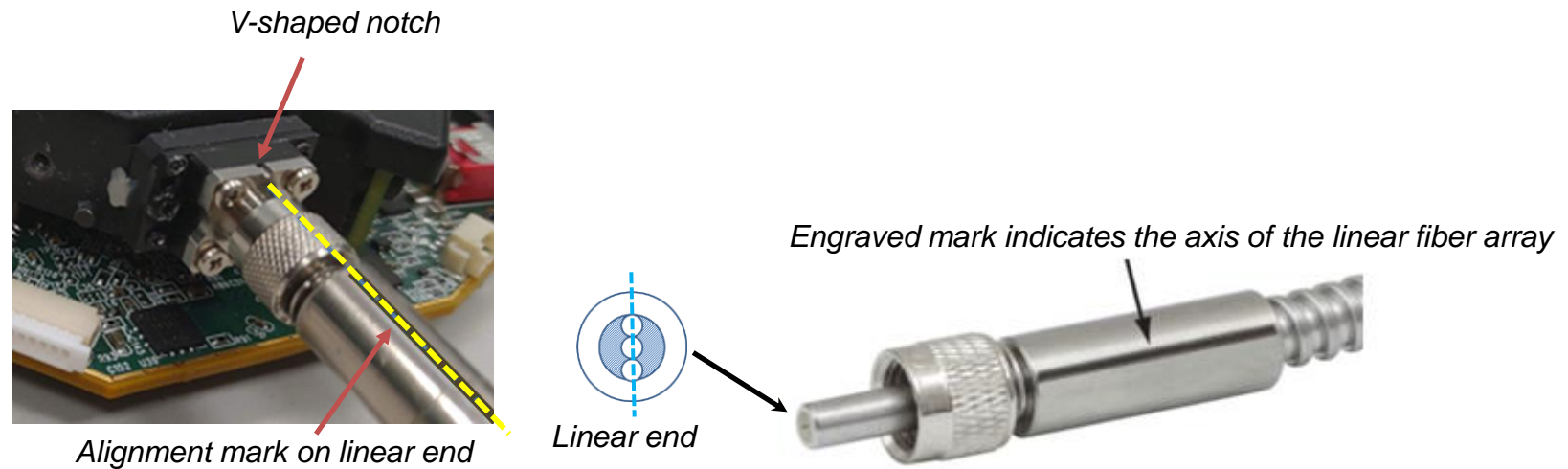


*Option #2: 200umx7*

*(Recommended)*

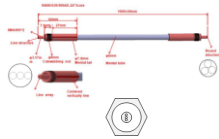
# Fiber Cable Attachment

*The engraved mark of linear fiber bundle should be aligned with the V-shaped notch of fiber input module.*



## NIR-A-R2L1

Round to Linear Fiber Bundle (1m)



### NIR-A-R2L1

Round-to-Linear Fiber Optic Bundle

Number of Fibers: 3

Fiber Core Size:  $\varnothing 600\mu\text{m}$

Fiber NA: 0.22

Hydroxyl Ion Content: Low OH

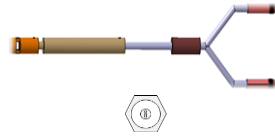
Wavelength Range: 400 - 2,500nm

Length: 1m

Connectors: SMA905

## NIR-A-DIP1

Bifurcated Reflection Probe/  
Transmission Dip Probe



### NIR-A-DIP1

Bifurcated Reflection Probe / Transmission Dip Probe

Number of Fibers: 6

Fiber Core Size:  $\varnothing 600\mu\text{m}$

Fiber NA: 0.22

Hydroxyl Ion Content: Low OH

Wavelength Range: 400 - 2,500nm

Length: 1m

Connectors: SMA905

Transmission Dip Probe Tip: pathlength=5mm and adjustable

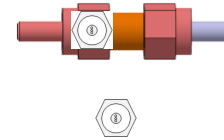
Sample Leg: 50cm,  $\varnothing 600\mu\text{m}$  \* 6 (round end)

Light Source Leg: 50cm,  $\varnothing 600\mu\text{m}$  \* 3 (round end)

Spectrometer Leg: 50cm,  $\varnothing 600\mu\text{m}$  \* 3 (round end)

## NIR-A-R2LS

Round to Linear Fiber Bundle (Short)



### NIR-A-R2LS

Round-to-Linear Short Fiber

Number of Fibers: 3

Fiber Core Size:  $\varnothing 600\mu\text{m}$

Fiber NA: 0.22

Hydroxyl Ion Content: Low OH

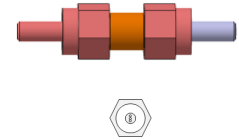
Wavelength Range: 400 - 2,500nm

Length: 35mm

Connectors: SMA905

## NIR-A-R2RS

Round to Round Fiber Bundle (Short)



### NIR-A-R2RS

Round-to-Round Short Fiber

Number of Fibers: 1

Fiber Core Size:  $\varnothing 1,000\mu\text{m}$

Fiber NA: 0.22

Hydroxyl Ion Content: Low OH

Wavelength Range: 400 - 2,500nm

Length: 35mm

Connectors: SMA905

## NIR-A-COL1

Collimator (SMA)



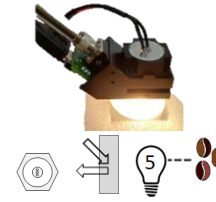
## NIR-A-COL2

Collimator



## NIR-A-DRP1

Diffuse Reflective Probe



NIR-A-COL1
Collimator
Lens Material: S-LAM66
Type: Double Lenses
Wavelength Range: 900 - 2,500nm
Connector Threads: 3/8-24 external thread
Fiber Optic Connector: SMA905
Lens Diameter: $\varnothing$ 6.6mm
Focal Length: 3.687mm
FOV: 17.56°
Operating Temperature: 0 ~ 40 °C, RH Max. 85%

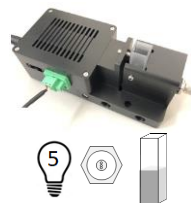
NIR-A-COL2
Collimator
Lens Material: S-LAM66
Type: Double Lenses
Wavelength Range: 900 - 2,500nm
Connector Threads: 3/8-24 external thread
Lens Diameter: $\varnothing$ 6.6mm
Focal Length: 3.687mm
FOV: 17.56°
Operating Temperature: 0 ~ 40 °C, RH Max. 85%

NIR-A-DRP1
Diffuse Reflective Probe
Illumination Module: one 5W tungsten filament lamp with reflector and constant current (CC) driver board with lamp on-off control interface.
Lamp Life Hours: 10,000
Sampling Module: Diffuse reflective sampling module
Collection Region: Typ. 16mm in diameter
Working Distance: Typ. 8mm from the sample surface to the sampling module
Fiber Optic Connector: SMA905
Time to Stable: ~ 20 minutes
Power Supply: DC 5V/2A
Dimensions: 49 mm * 27 mm * 27 mm
Weight: 34 g (without spacer), 39g (with spacer and screws)
Operating Temperature: 0 ~ 40 °C, RH Max. 85%
Accessory : Spacer (for contact measurement)



## NIR-A-LS1

Light Source with Cuvette Holder



### NIR-A-LS1

Light Source with Cuvette Holder

Lamp Type: miniature xenon, user replaceable

Lamp CCT: 2600K

Lamp Power: 5W

Lamp Life Hours: 10,000

Fiber Optic Connector: SMA905

Cuvette Holder: Path length=10mm, Z-dimension=15mm (adjustable)

Lamp Control: Always on or via external trigger

Lamp External Trigger Input: 5V TTL input

Cooling Fan: integrated

Water Input Fittings: 1/8" NPT for connecting a temperature stabilizing water source

Time to Stable: ~ 20 minutes

Power Supply: DC 5V/2A

Dimensions: 149mm \* 64mm \* 54mm

Weight: 520g

Operating Temperature: 0 ~ 40 °C, RH Max. 85%

## NIR-A-LS2

Light Source with SMA Interface



### NIR-A-LS2

Light Source with SMA Interface

Lamp Type: miniature xenon, user replaceable

Lamp CCT: 2600K

Lamp Power: 5W

Lamp Life Hours: 10,000

Fiber Optic Connector: SMA905

Time to Stable: ~ 20 minutes

Power Supply: DC 5V/2A

Dimensions: 90mm \* 60mm \* 45mm

Weight: 400g

Operating Temperature: 0 ~ 40 °C, RH Max. 85%

## NIR-A-LS3

Light Source with reflector



### NIR-A-LS3

Light Source with Reflector

Lamp Type: miniature xenon, user replaceable

Lamp CCT: 2600K

Lamp Power: 5W

Lamp Life Hours: 10,000

Spot Size: Typ. Ø16mm at 8mm working distance

Time to Stable: ~ 20 minutes

Power Supply: DC 5V/2A

Dimensions: 49 mm \* 22 mm \* 21 mm

Weight: 34 g (without spacer), 39g (with spacer and screws)

Operating Temperature: 0 ~ 40 °C, RH Max. 85%

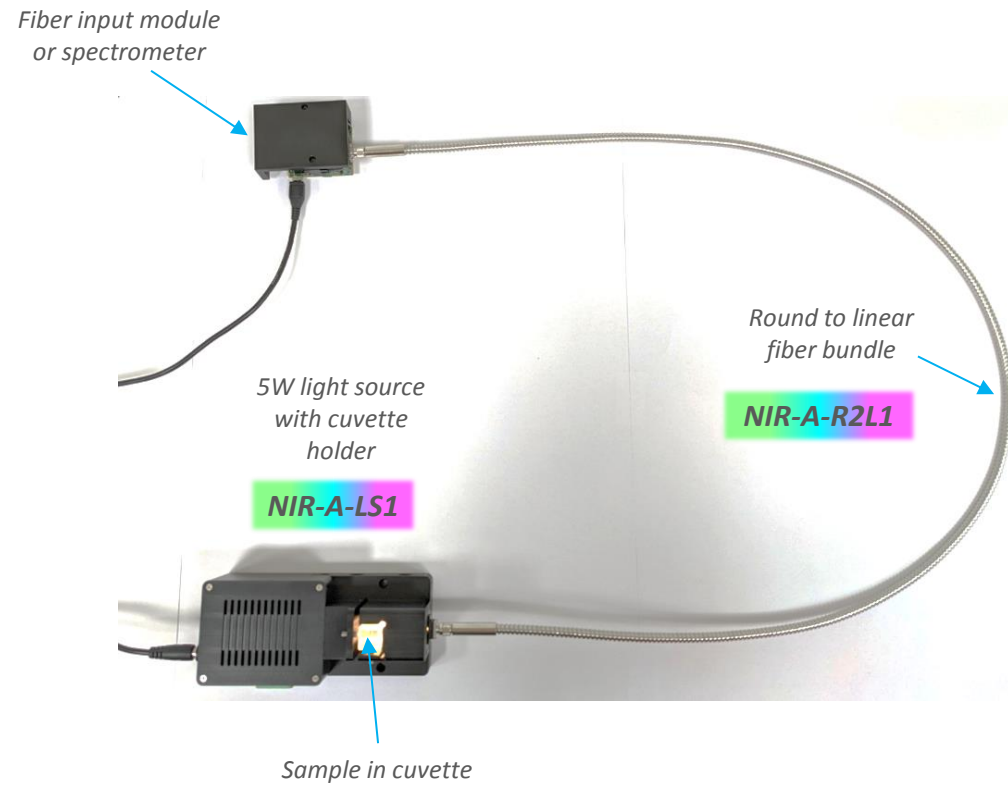
Accessory : Spacer (for contact measurement)

# Transmission Measurement (1)

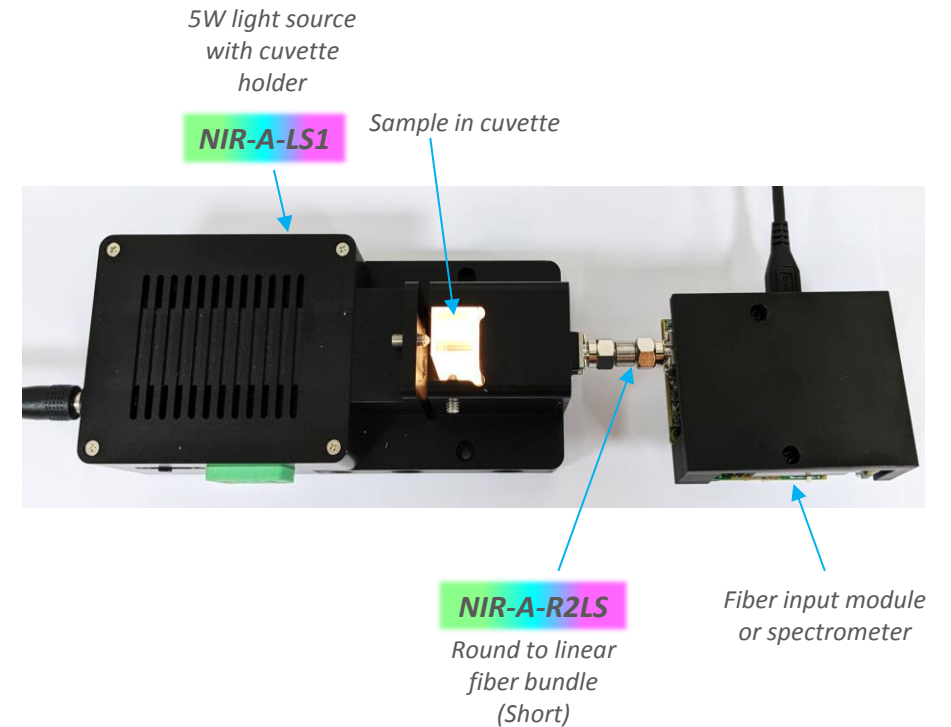
Fiber input module + round-to-linear fiber bundle (R2L1 or R2LS) + external light source with cuvette holder (LS1)

- F1 / F2 : 900~1700nm
- F11 / F12 : 1350~2150nm
- F13 / F14 : 1600~2400nm

- Transmission measurement of liquids, transparent solids, etc.
- Light source with cuvette holder and external trigger interface
- Cuvette path length up to 10mm
- Lamp power = 5W



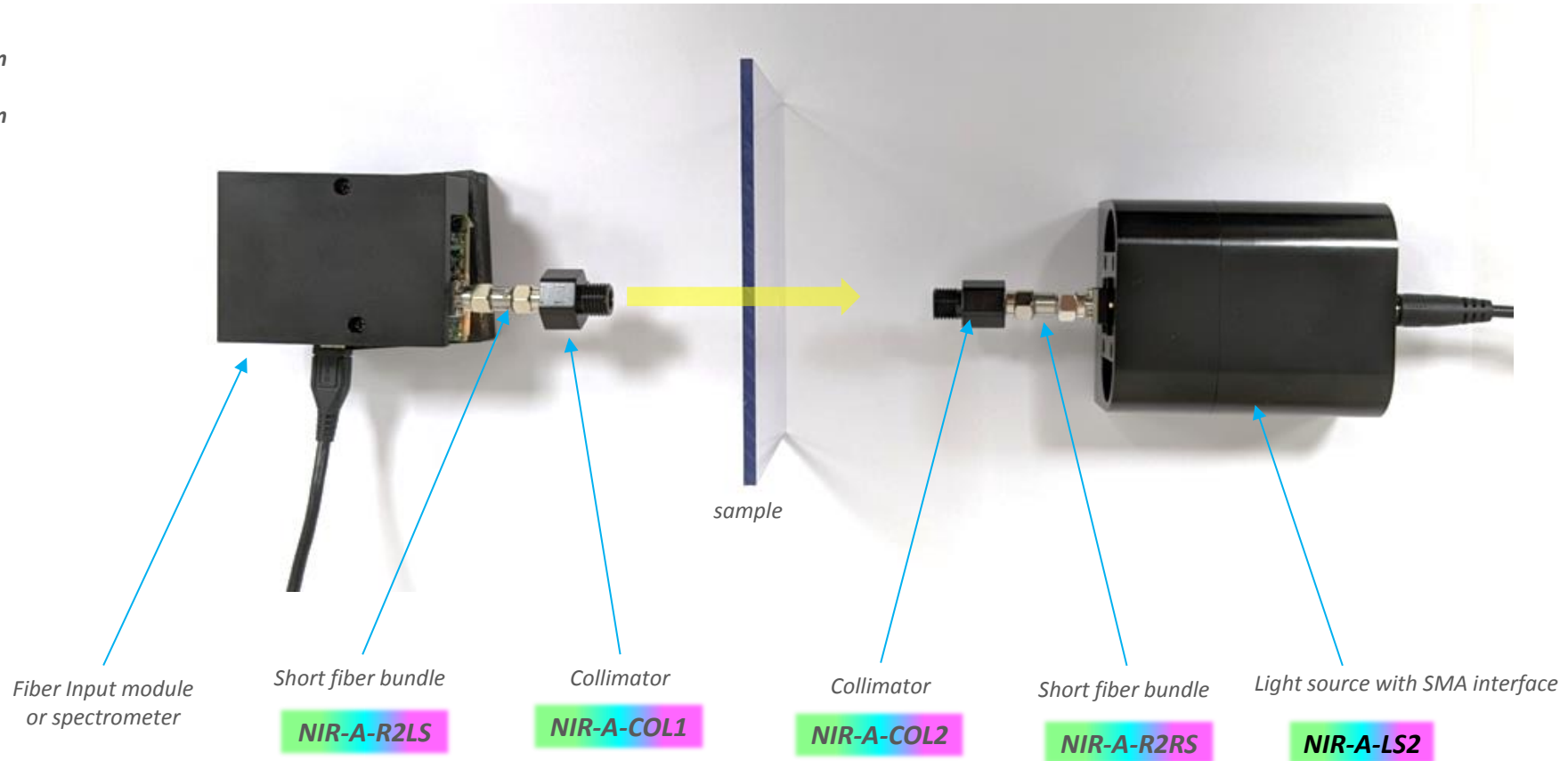
or



# Transmission Measurement (2)

*Fiber input module + short fiber bundle (R2LS) + collimator (COL1) + collimator (COL2) + short fiber bundle (R2RS) + external light source (LS2)*

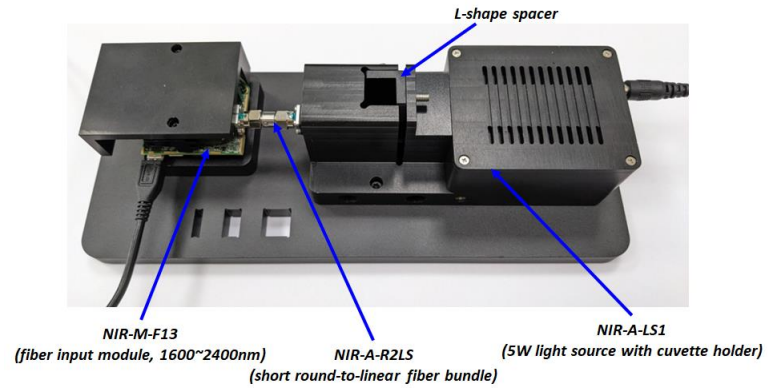
- F1 / F2: 900~1700nm
- F11 / F12 : 1350~2150nm
- F13 / F14 : 1600~2400nm



- *Transmission measurement of liquids, transparent solids, etc.*
- *Lamp power = 5W*

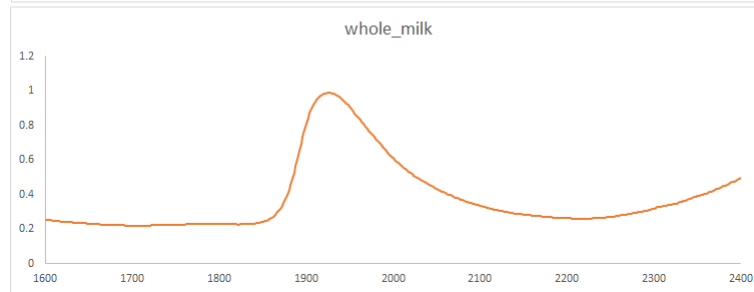
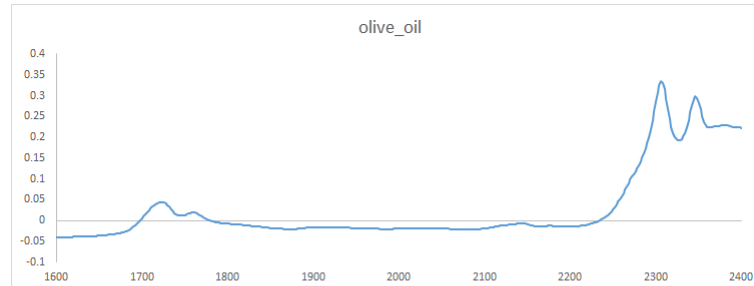
# Transmission Measurement (3)

- **Sample:**
  - whole milk, fat 3.7g/dL, protein 3.2g/dL.
  - olive oil
- **Cuvette path length: 200um**
- **Scan Configuration:**

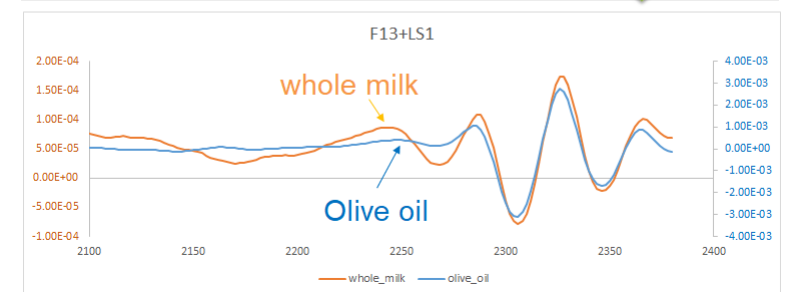
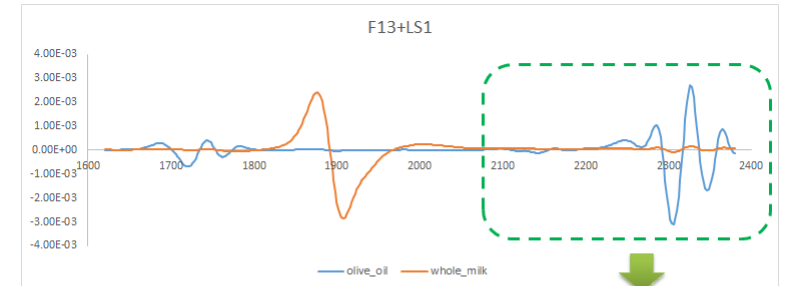


***Scan Config Information***	M-F13 + A-R2LS + A-LS1
Scan Config Name:	milk30
Scan Config Type:	Slew
Section Config Type:	Column
Start Wavelength (nm):	1600
End Wavelength (nm):	2400
Pattern Width (nm):	9
Exposure (ms):	0.635
Digital Resolution:	228
Num Repeats:	30
PGA Gain:	8

- **Scan results: 2nm cubic-spline resampling**



- **Savitzky\_Golay Derivative : 2 Polynomial Order : 2 Window Size : 21**

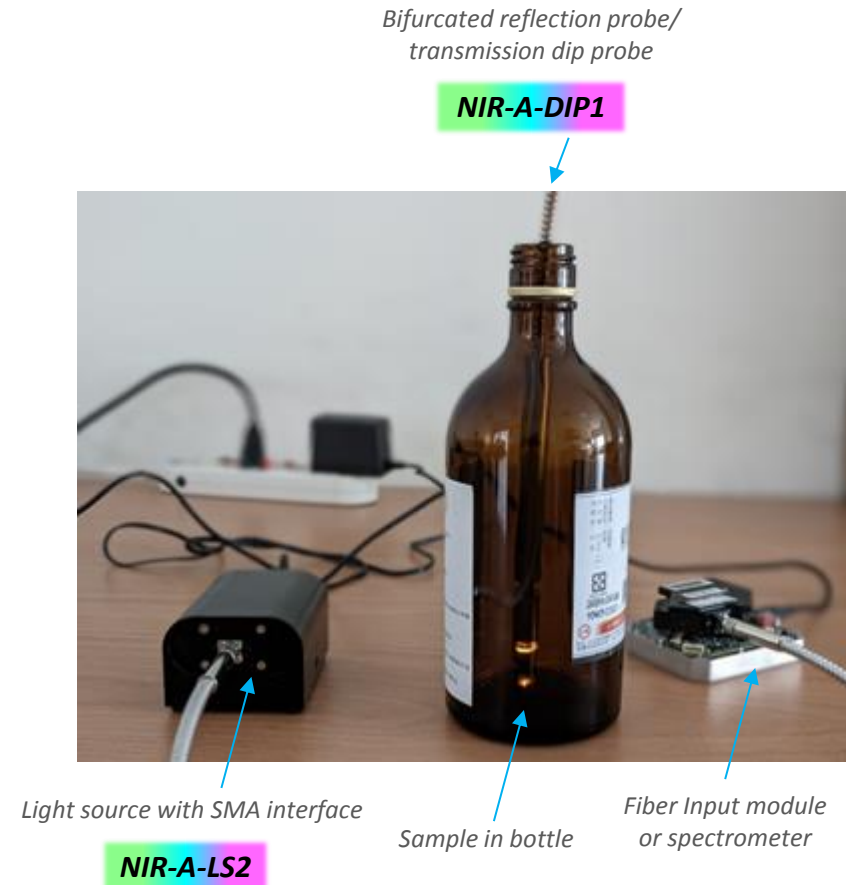
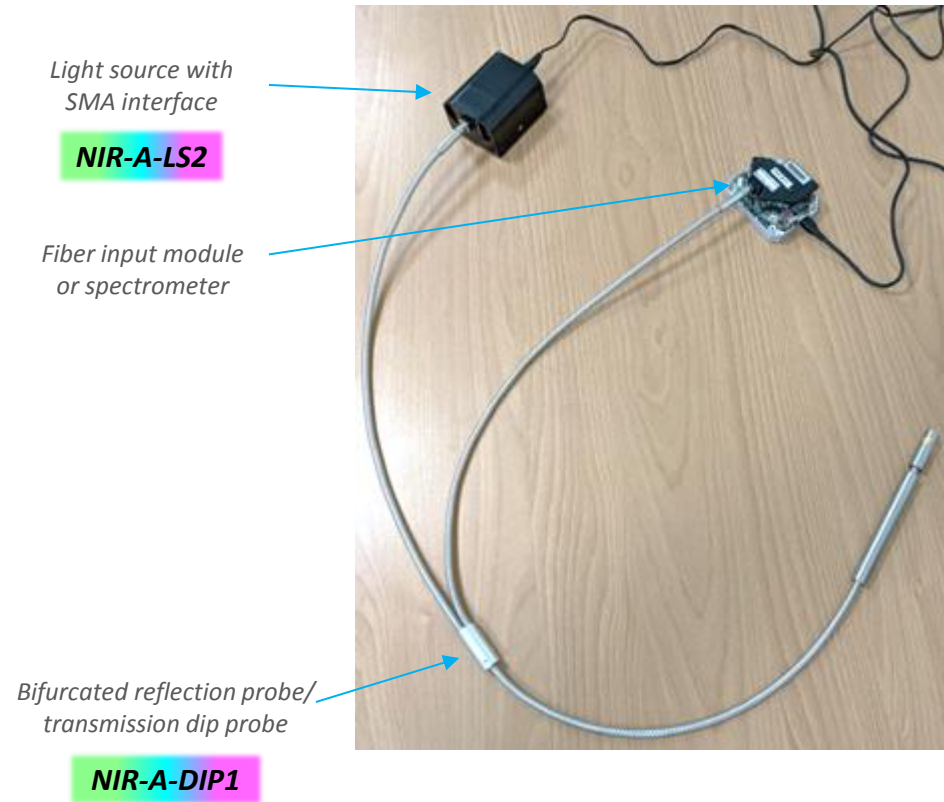


- **Scan procedure: LS1 warm-up > 10min F13+LS1 reference scan sample scan**

# Transflectance Measurement (1)

Fiber input module or spectrometer + external light source (LS2) + dip probe (DIP1)

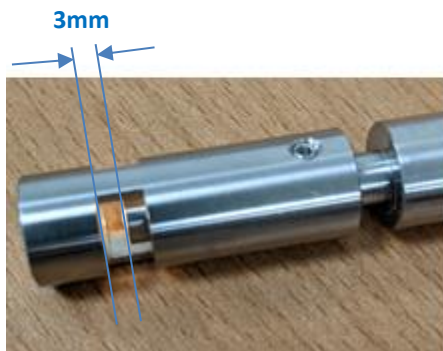
- F1 / F2 : 900~1700nm
- F11 / F12 : 1350~2150nm
- F13 / F14 : 1600~2400nm





# Transflectance Measurement (2)

- Spectrometer: NIR-M-F1
- Light source: NIR-A-LS2
- Dip probe: NIR-A-DIP1, path length=3mm
- Sample: alcohol & soy bean oil



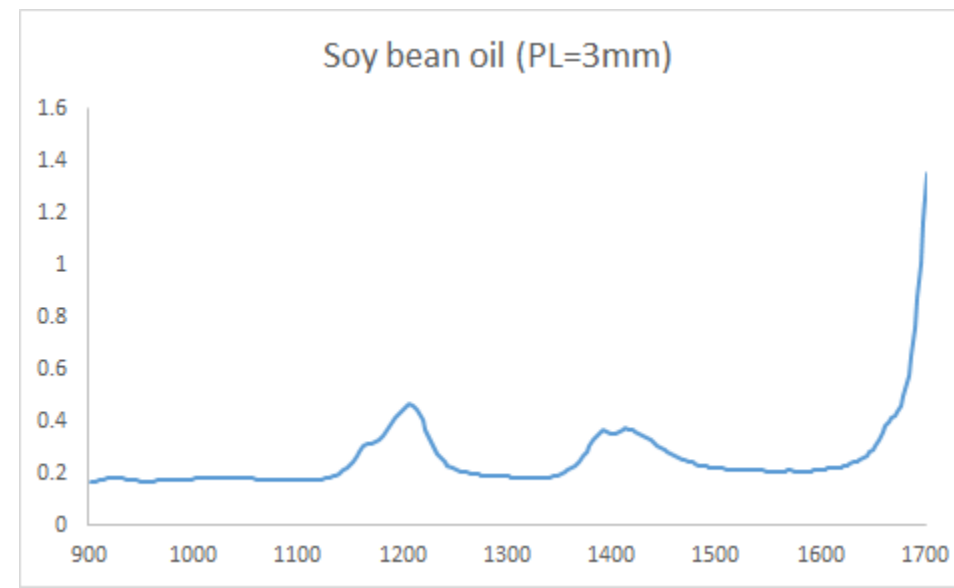
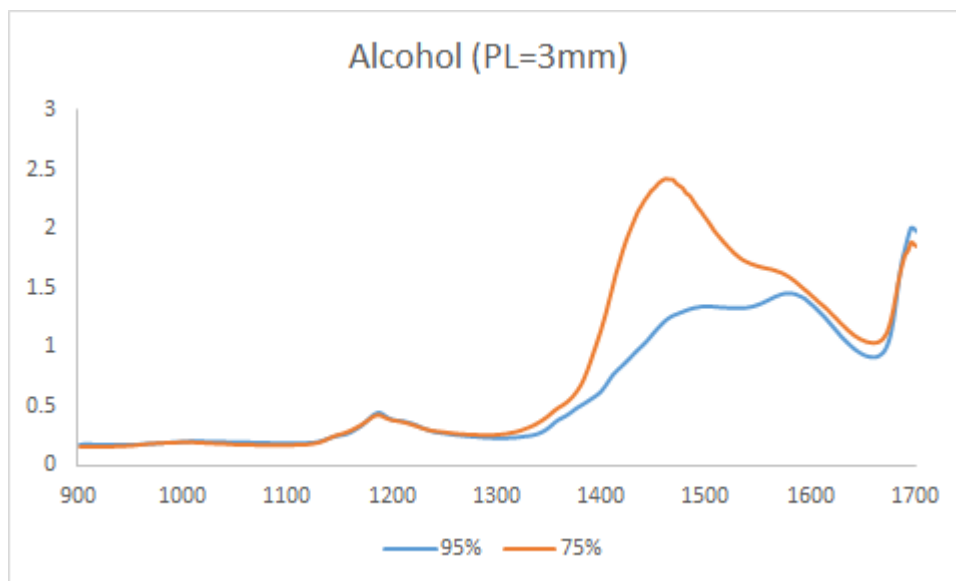
95% alcohol



75% alcohol



Soy bean oil



# Diffuse Reflectance Measurement (1)

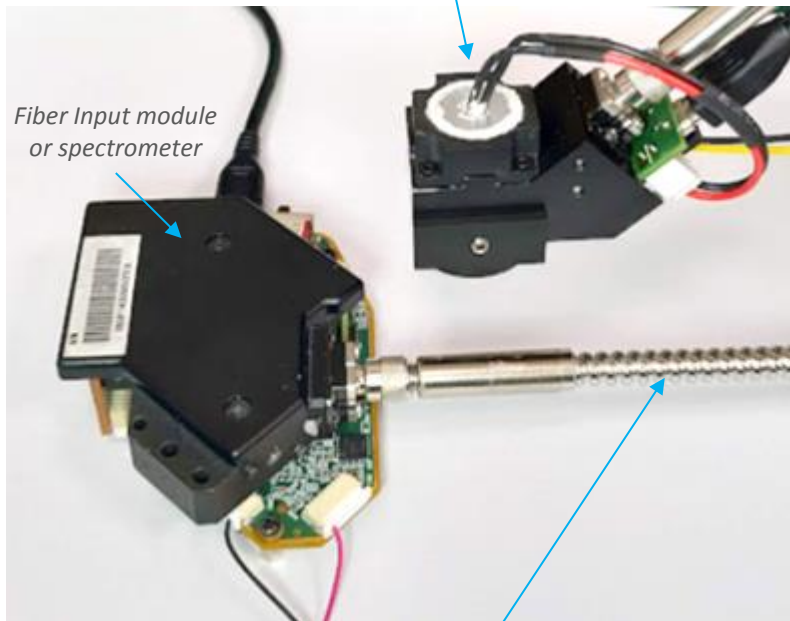
Fiber input module + round-to-linear fiber bundle (R2L1 or R2LS) + diffuse reflective probe (DRP1)

- F1 / F2 : 900~1700nm
- F11 / F12 : 1350~2150nm
- F13 / F14 : 1600~2400nm

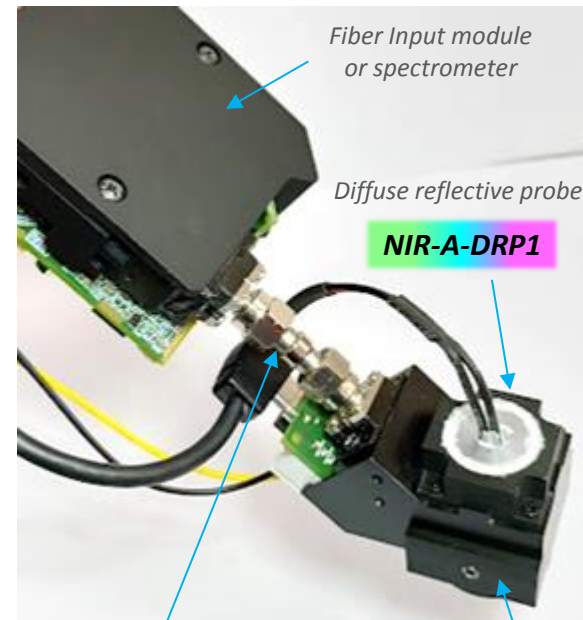
- Diffuse reflectance measurement of solids, slurry or opaque liquids, etc.
- Non-contact measurement (Distance = 8mm)
- Contact measurement with 8mm spacer
- Large sampling area (Diameter = 16mm)
- Lamp power = 5W

Diffuse reflective probe

**NIR-A-DRP1**



**NIR-A-R2L1**



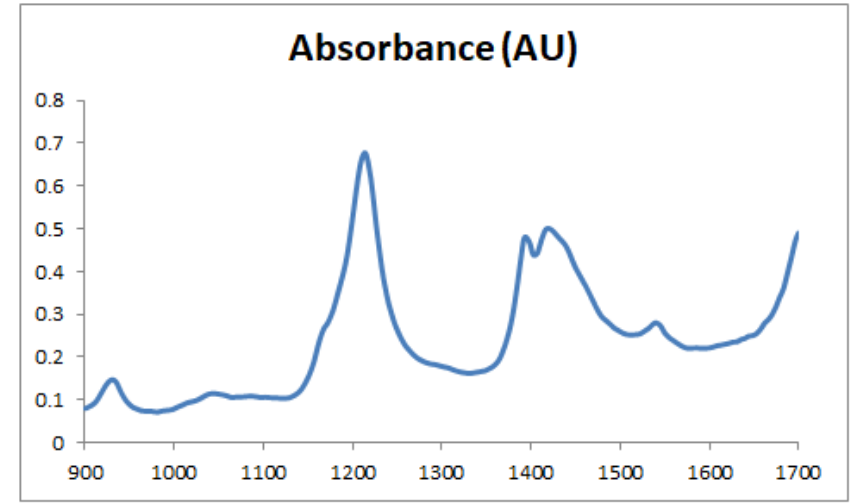
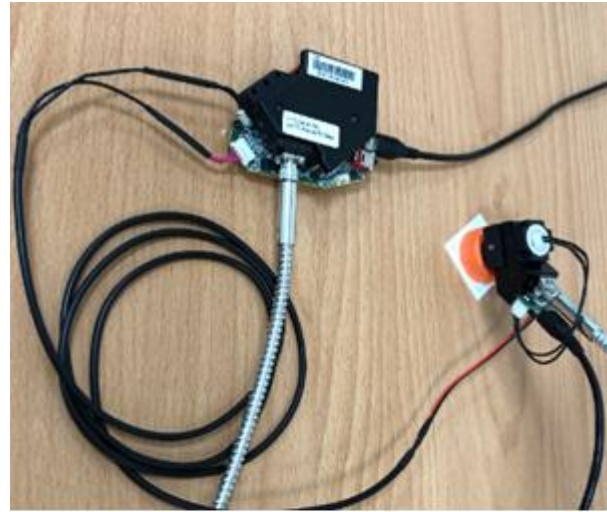
**NIR-A-R2LS**



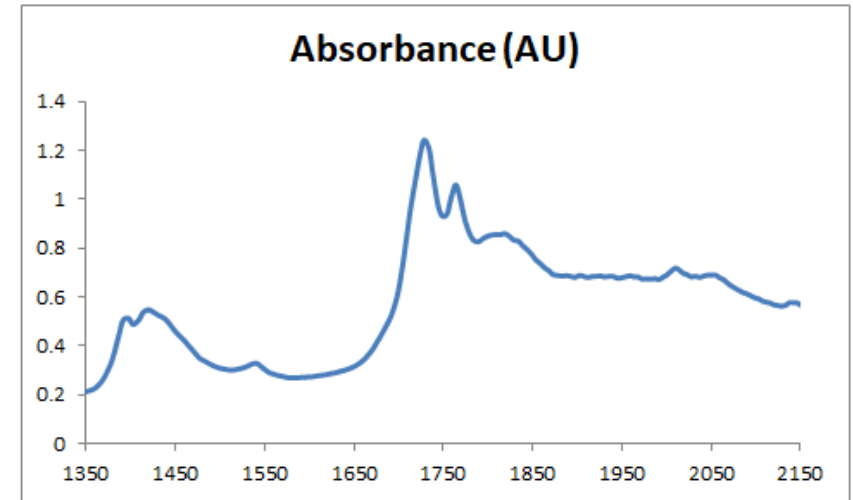
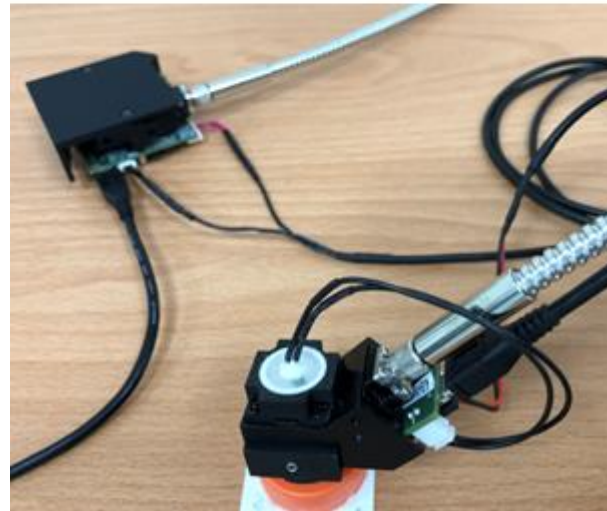
# Diffuse Reflectance Measurement (2)

- Spectrometer: NIR-M-F1 & NIR-M-F2
- Round to linear fiber bundle: NIR-A-R2L1
- Diffuse reflective probe: NIR-A-DRP1
- Sample: HDPE cap

Section Config Type:	Hadamard
Start Wavelength (nm):	900
End Wavelength (nm):	1700
Pattern Width (nm):	10.54
Exposure (ms):	1.27
Digital Resolution:	160
Num Repeats:	6
PGA Gain:	32



Section Config Type:	Hadamard
Start Wavelength (nm):	1350
End Wavelength (nm):	2150
Pattern Width (nm):	10.54
Exposure (ms):	1.27
Digital Resolution:	160
Num Repeats:	12
PGA Gain:	32





# Interactance Measurement (1)

Fiber input module or spectrometer + bifurcated reflection probe (DIP1) + external light source (LS2)

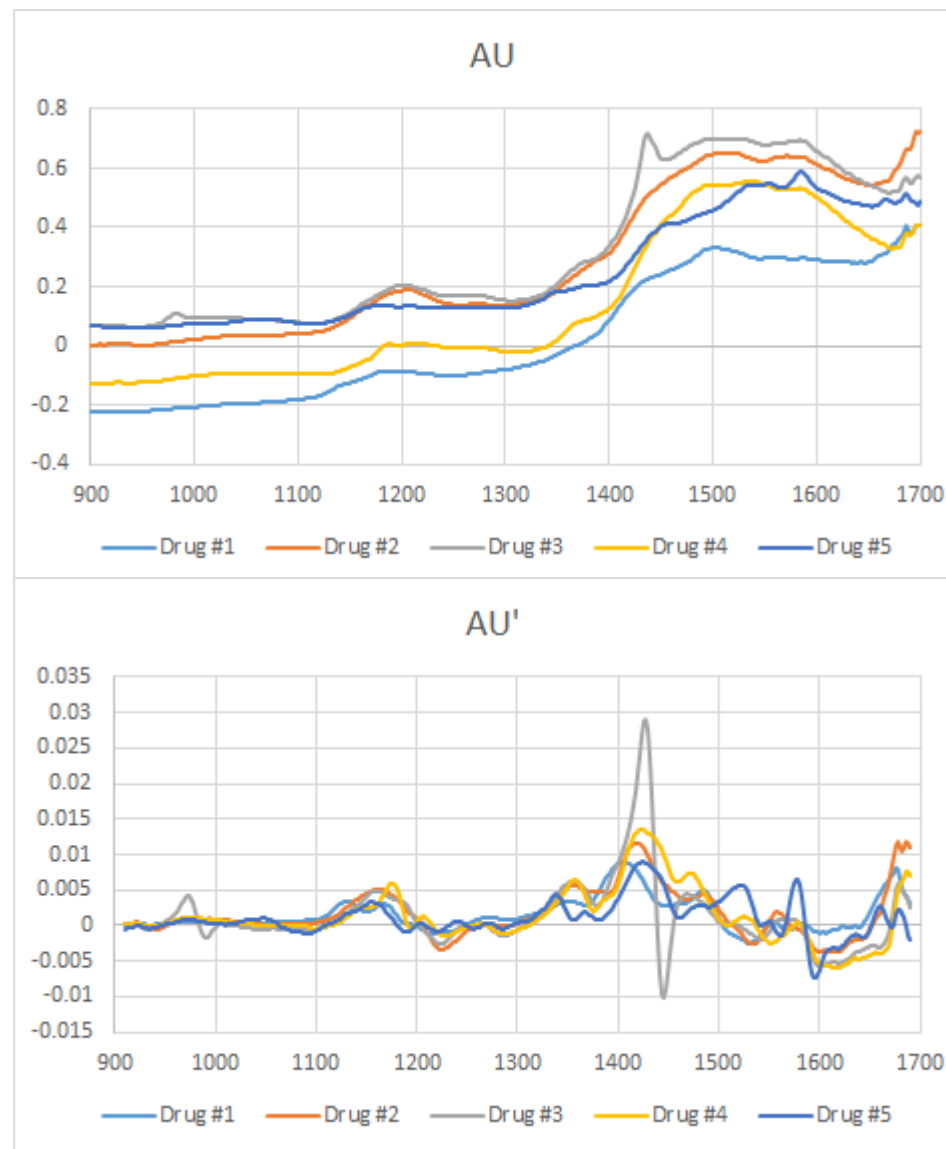
- F1 / F2 : 900~1700nm
- F11 / F12 : 1350~2150nm
- F13 / F14 : 1600~2400nm



# Interactance Measurement (2)

- **Spectrometer:** NIR-M-F1
- **Bifurcated Reflection Probe:** NIR-A-DIP1
- **Light source:** NIR-A-LS2
- **Sample:** Drugs

Section Config Type:	Hadamard
Start Wavelength (nm):	900
End Wavelength (nm):	1700
Pattern Width (nm):	7.03
Exposure (ms):	0.635
Digital Resolution:	228
Num Repeats:	6
PGA Gain:	32





**Thank You!**