Prior Art

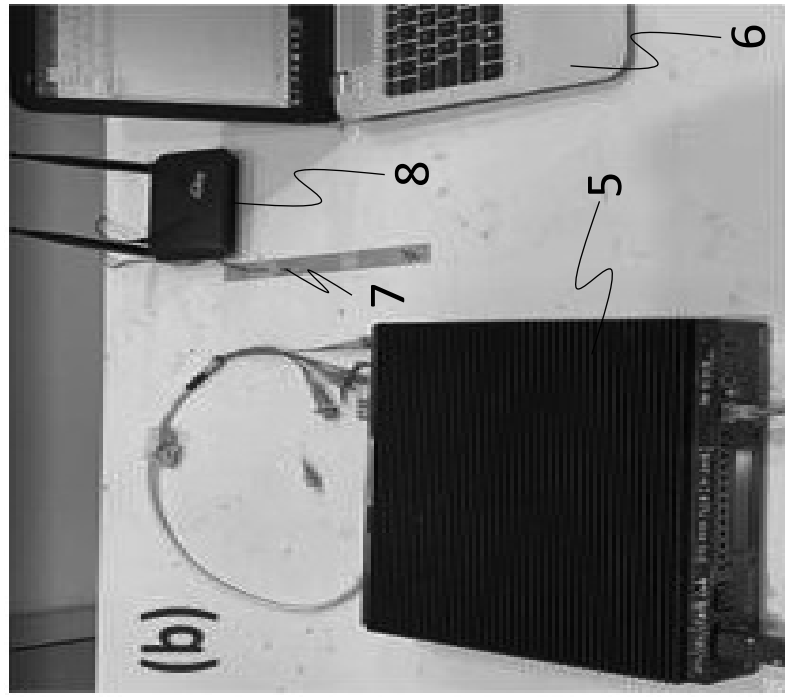


FIG. 1B

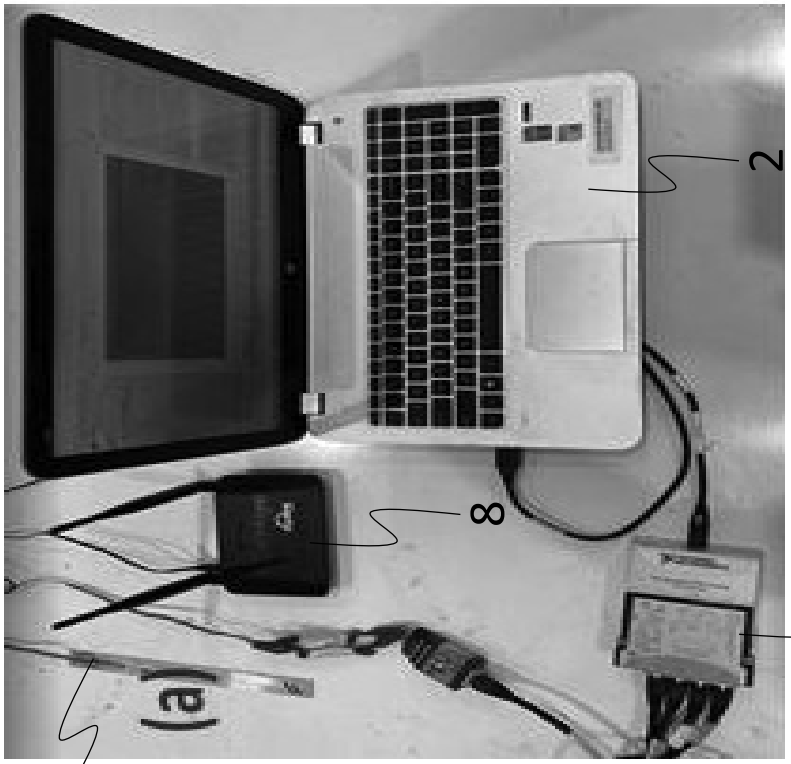


FIG. 1A

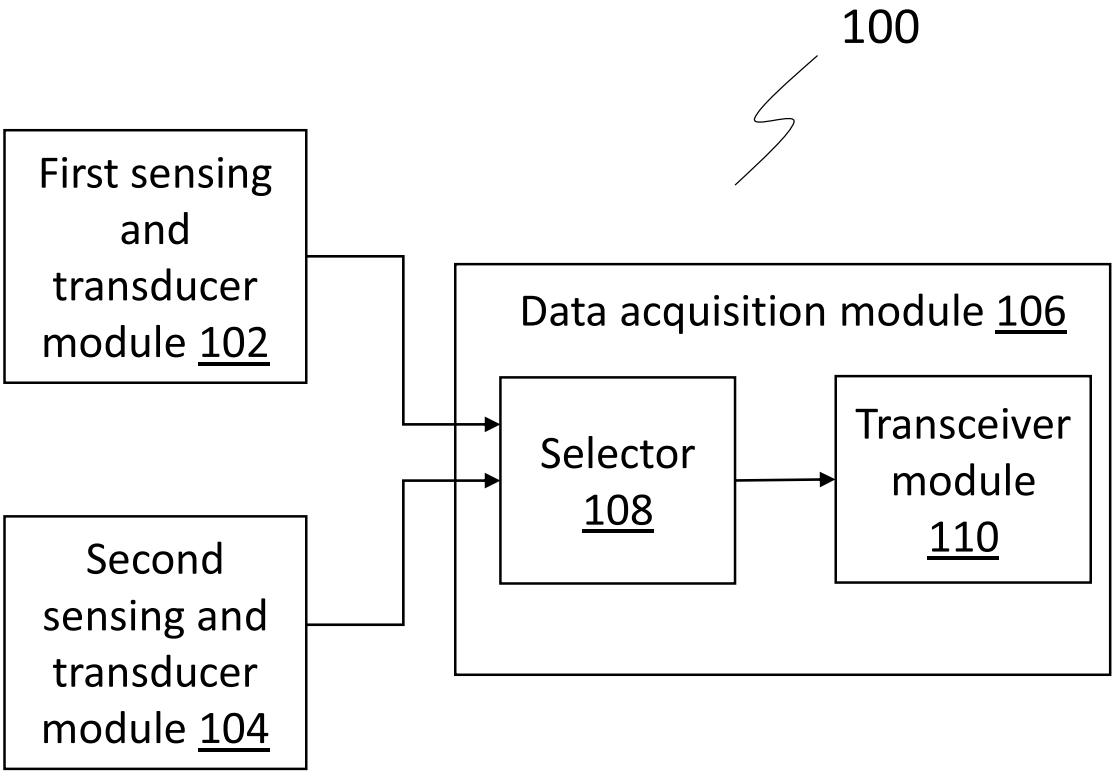

100
First sensing and transducer module 102
Second sensing and transducer module 104
Data acquisition module 106
Selector 108
Transceiver module 110

FIG. 2

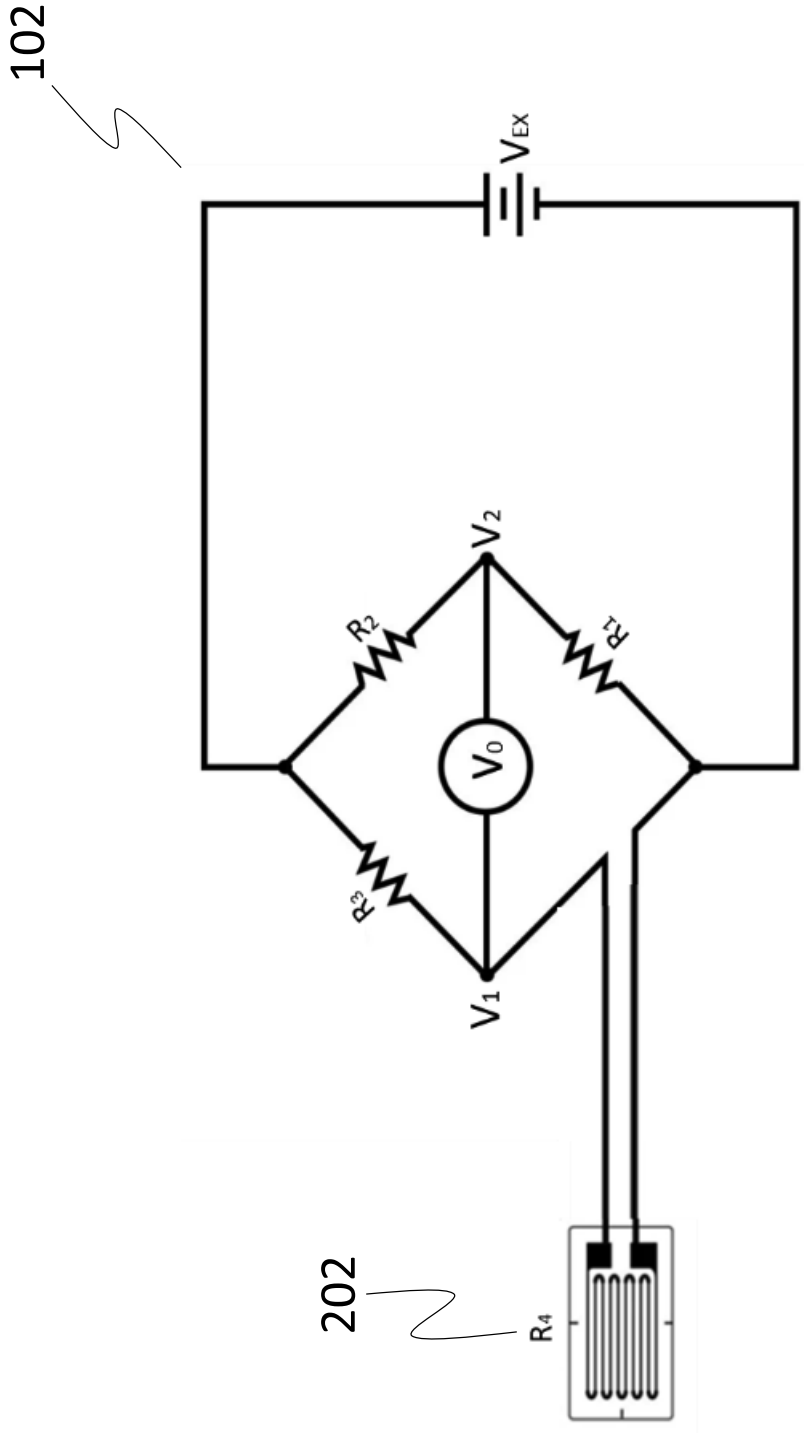


FIG. 3

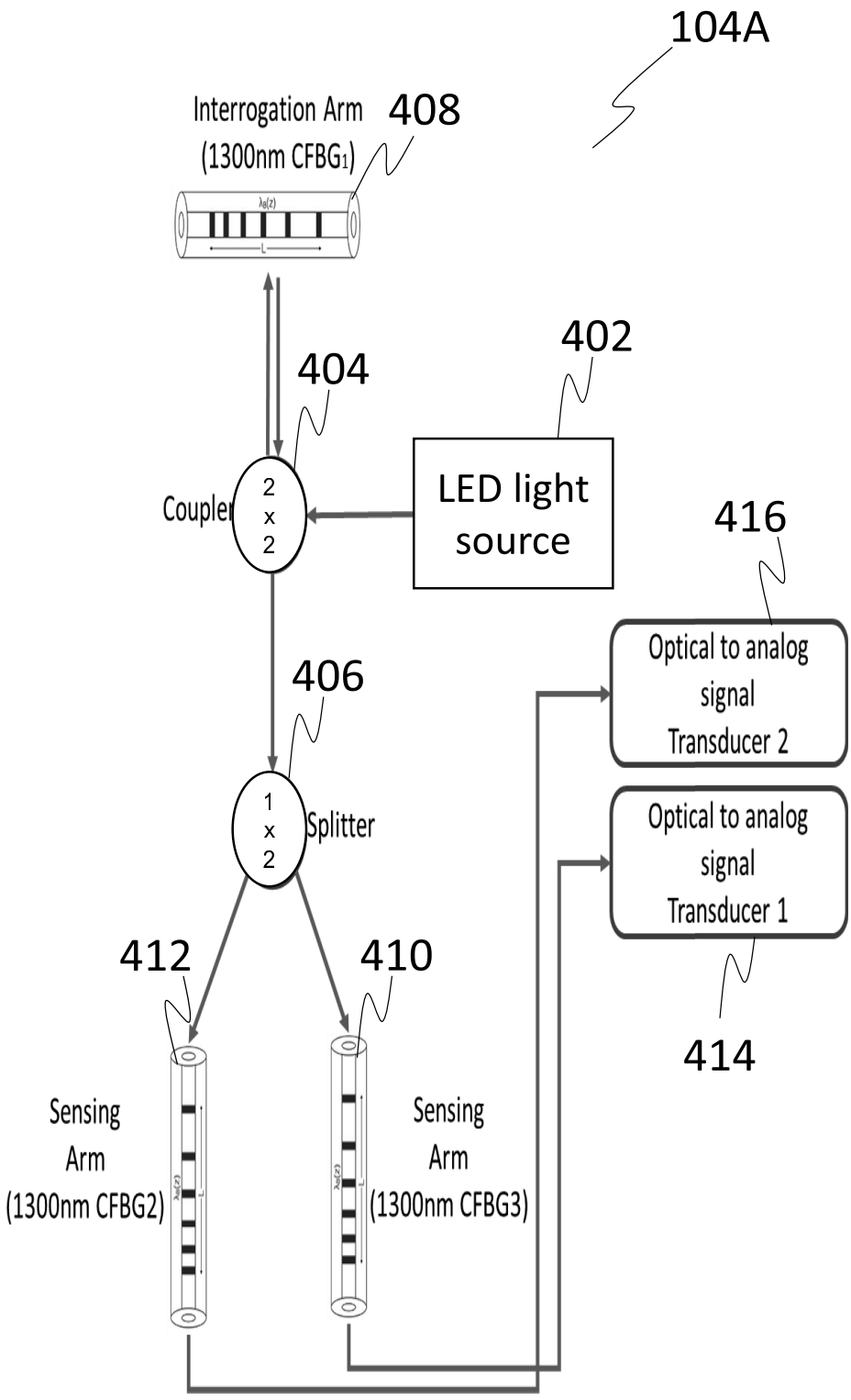

104A
Interrogation Arm
(1300nm CFBG1)
408
404
402
Coupler
2
x
2
LED light
source
416
406
Optical to analog
signal
Transducer 2
1
x
2
Splitter
Optical to analog
signal
Transducer 1
412
410
414
Sensing
Arm
(1300nm CFBG2)
Sensing
Arm
(1300nm CFBG3)

FIG. 4A

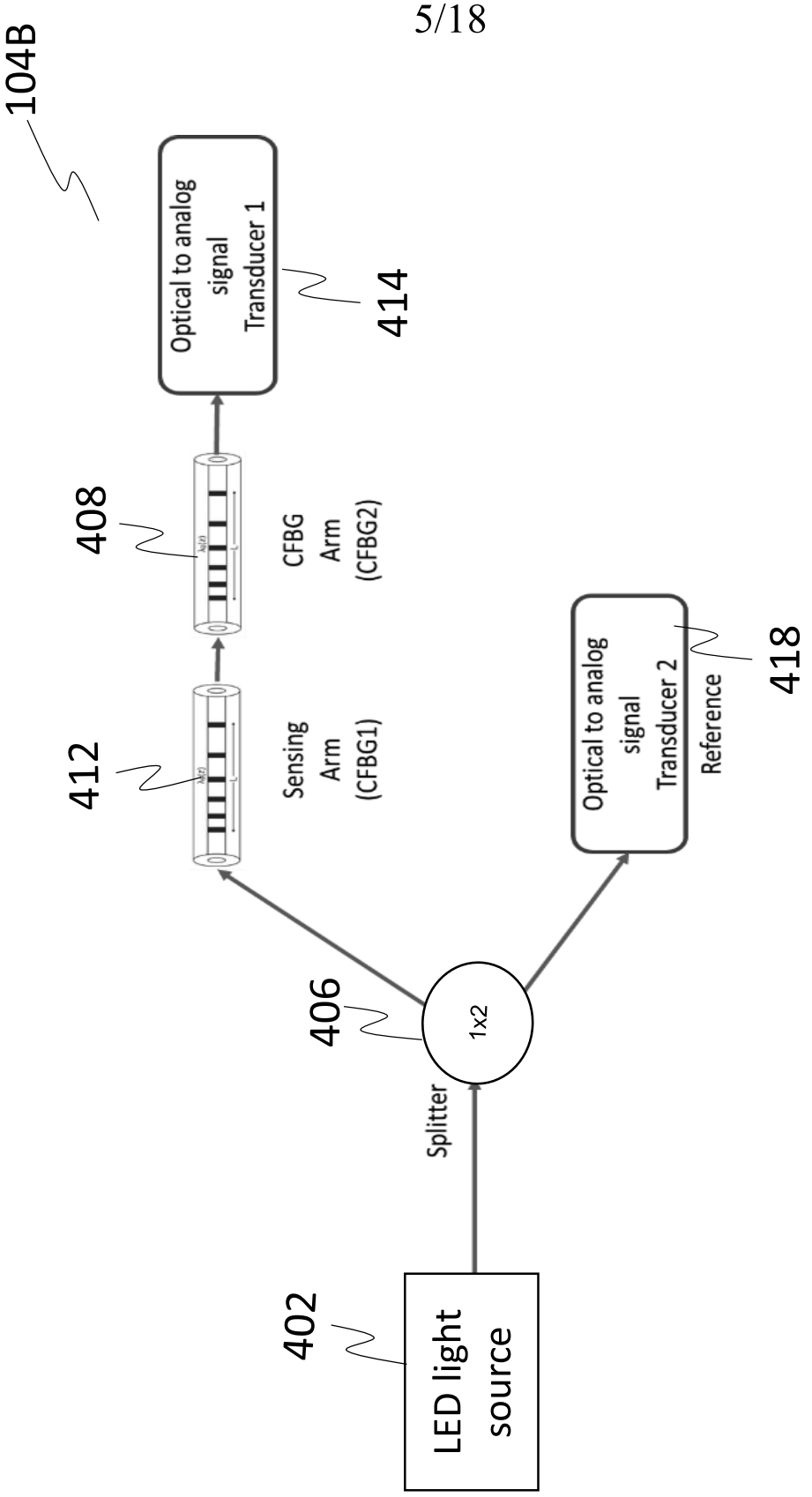

104B
Optical to analog signal Transducer 1
414
408
CFBG Arm (CFBG2)
412
Sensing Arm (CFBG1)
Optical to analog signal Transducer 2
Reference
418
406
1x2
Splitter
402
LED light source

FIG. 4B

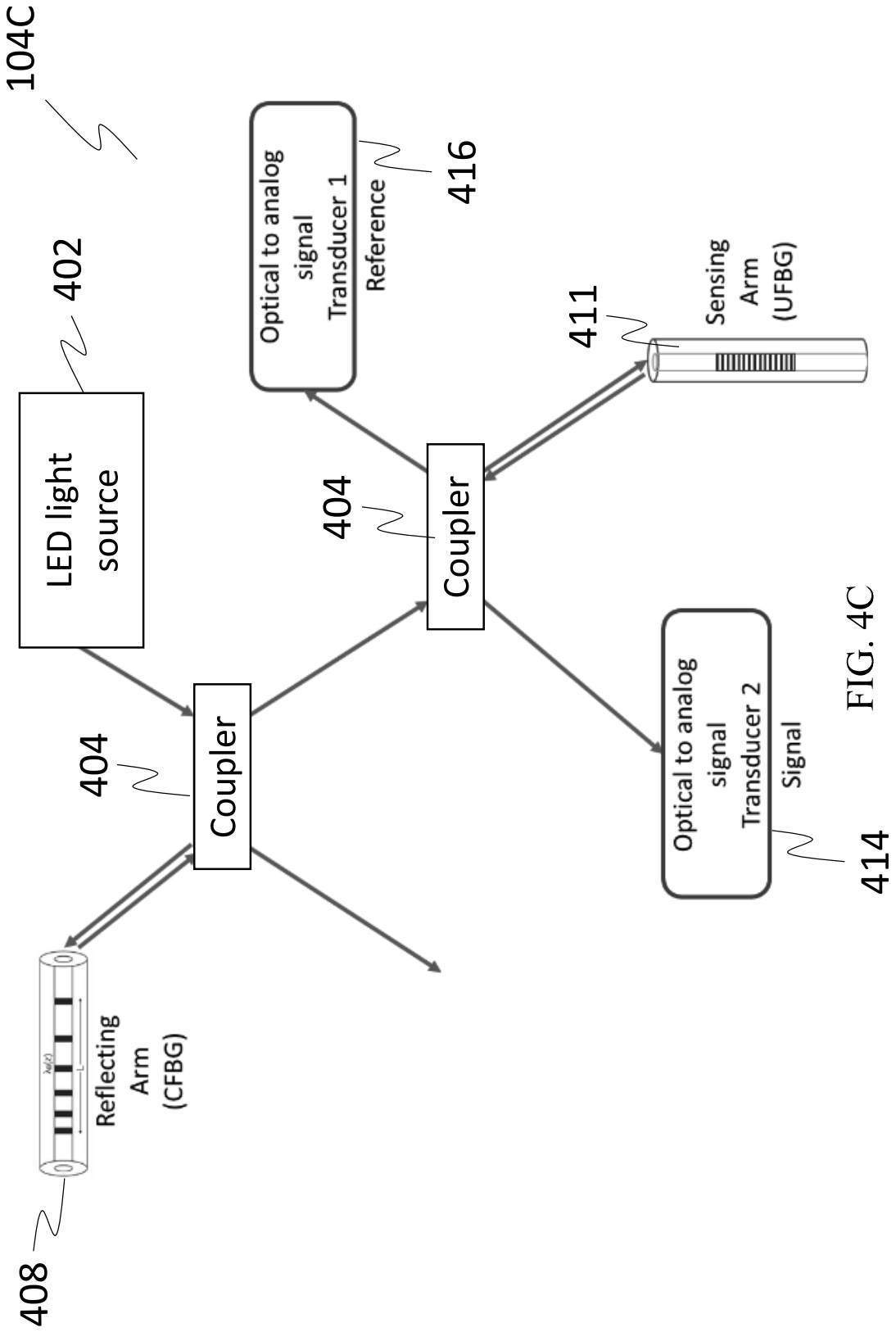

104C
402
LED light source
404
Coupler
404
Coupler
Optical to analog signal Transducer 1
Reference
416
411
Sensing Arm (UFBG)
Optical to analog signal Transducer 2
Signal
414
Reflecting Arm (CFBG)
408

FIG. 4C

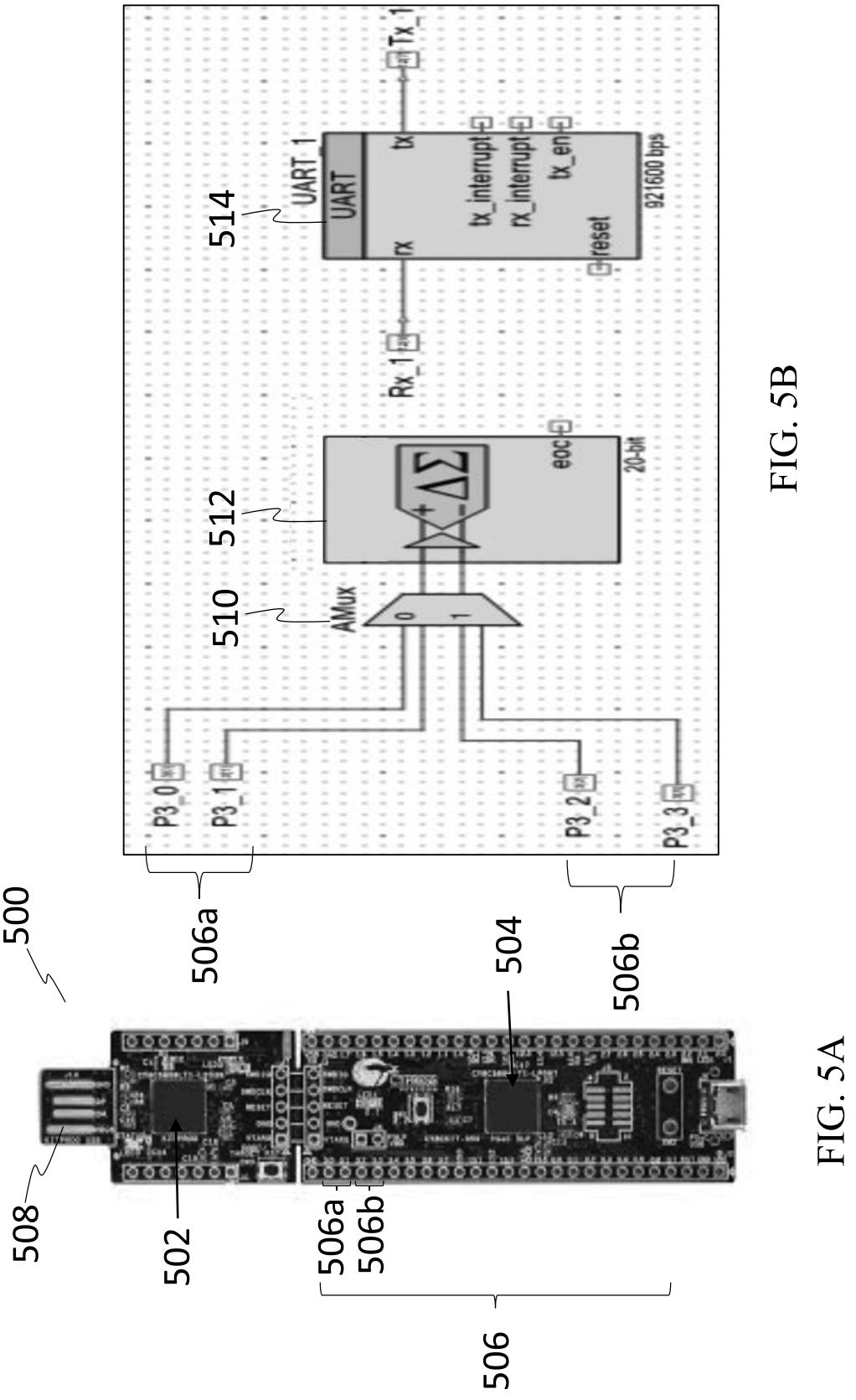

500
506a
504
506b
508
502
506a
506b
506
514
UART 1
UART
tx
rx
tx_interrupt
rx_interrupt
tx_en
reset
921600 bps
Tx_1
Rx_1
512
eoc
20-bit
510
AMux
0
1
P3_0
P3_1
P3_2
P3_3

FIG. 5A

FIG. 5B

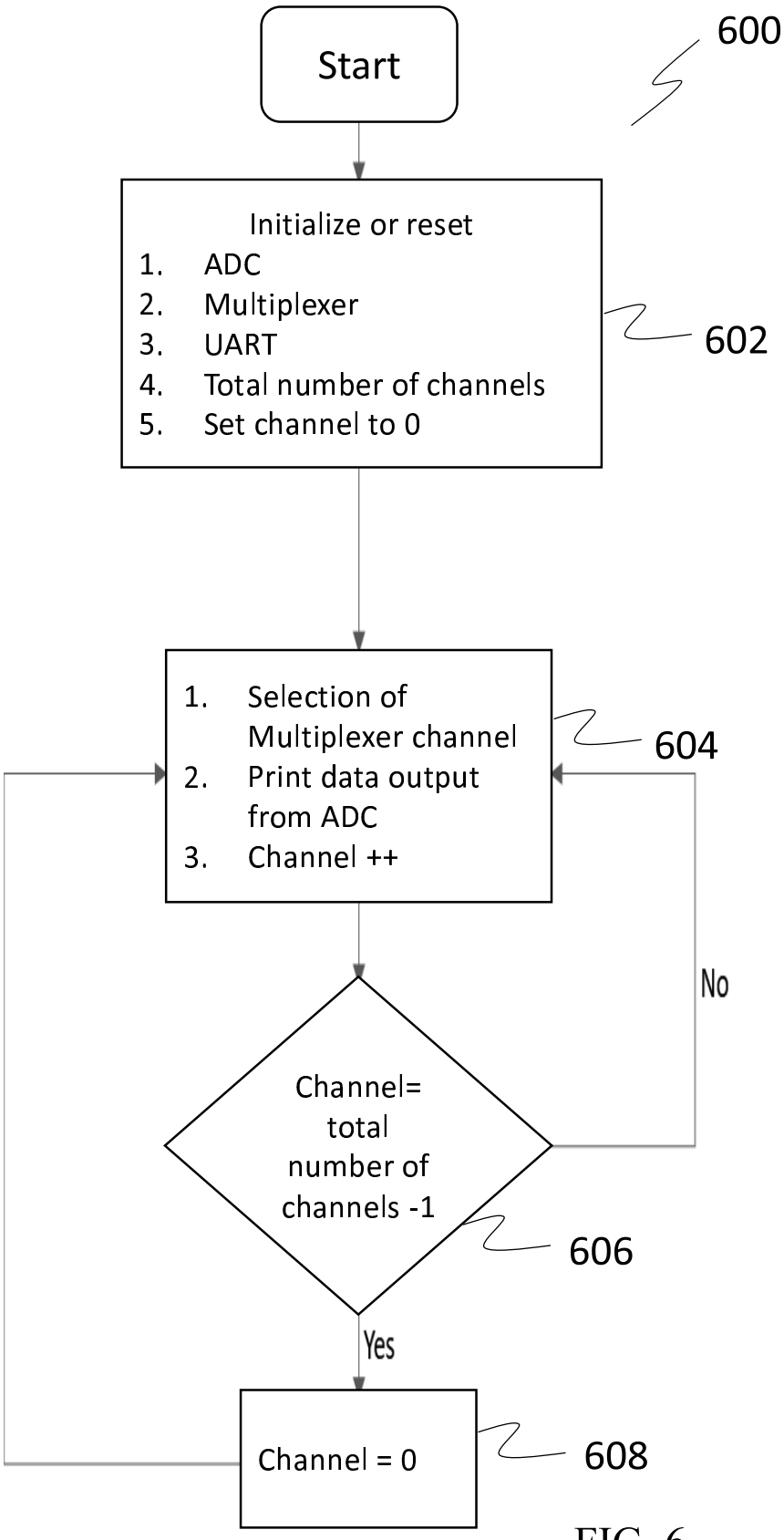

Start
600
Initialize or reset
1. ADC
2. Multiplexer
3. UART
4. Total number of channels
5. Set channel to 0
602
1. Selection of Multiplexer channel
2. Print data output from ADC
3. Channel ++
604
Channel= total number of channels -1
606
No
Yes
Channel = 0
608

FIG. 6

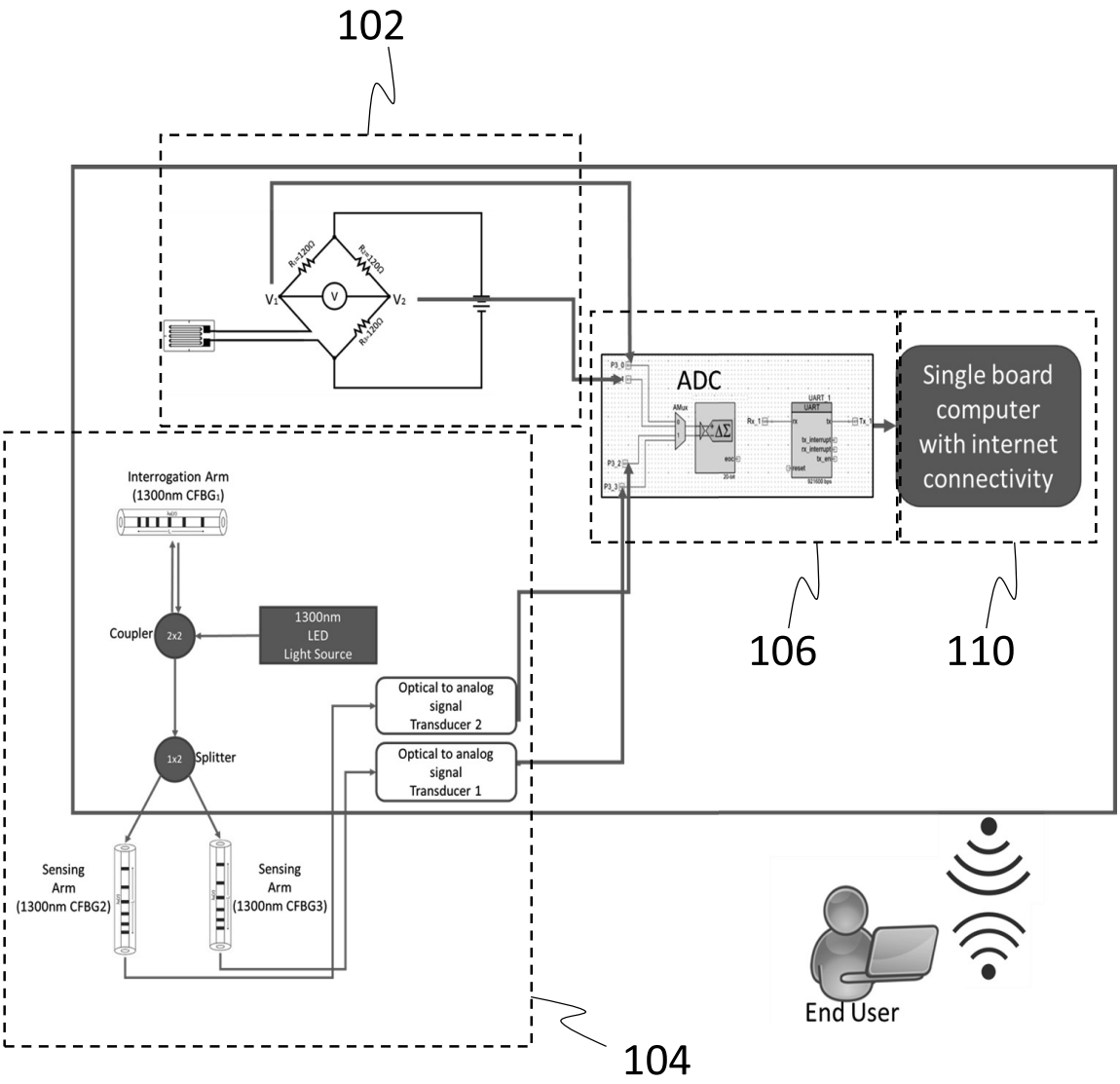

102
ADC
Single board computer with internet connectivity
106
110
Interrogation Arm (1300nm CFBG1)
Coupler
2x2
1300nm LED Light Source
Optical to analog signal Transducer 2
Optical to analog signal Transducer 1
1x2
Splitter
Sensing Arm (1300nm CFBG2)
Sensing Arm (1300nm CFBG3)
End User
104

FIG. 7

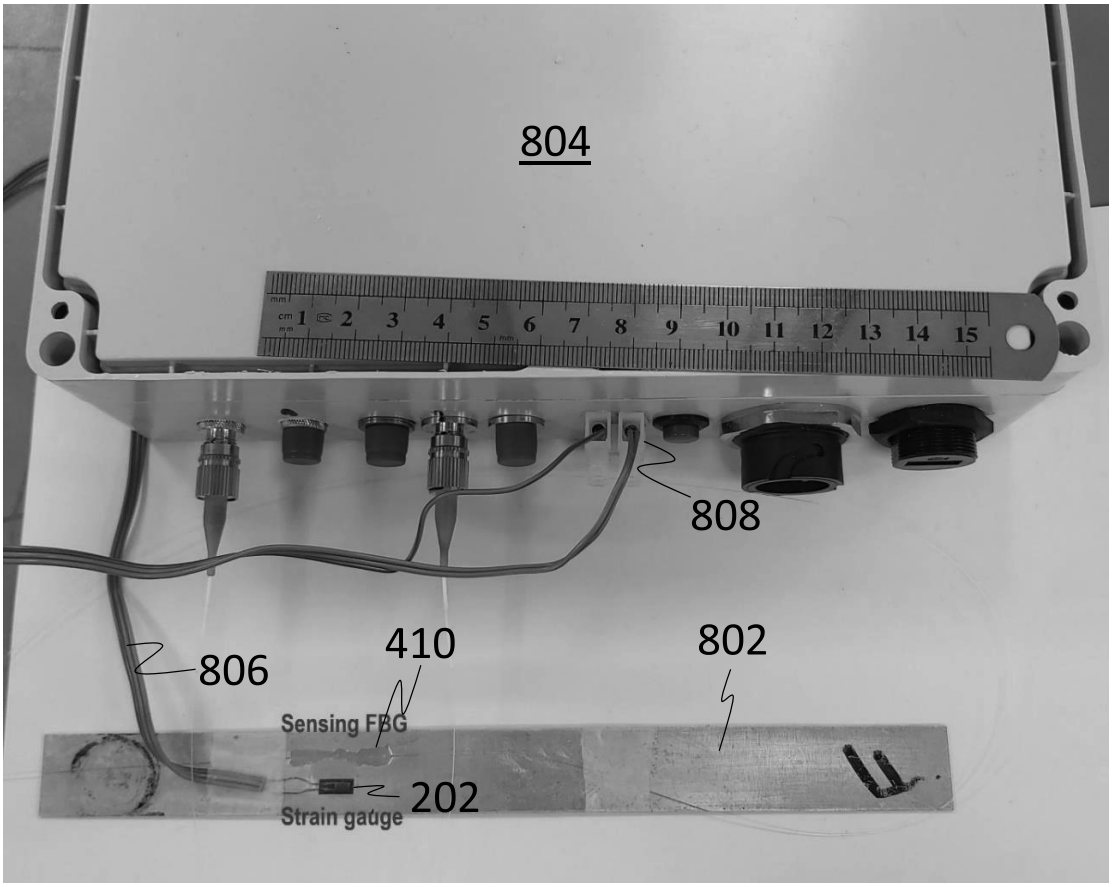

804
808
806
410
802
Sensing FBG
202
Strain gauge

FIG. 8A

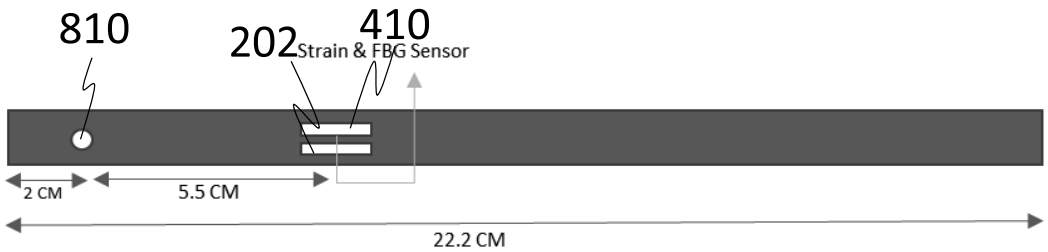

810
202
410
Strain & FBG Sensor
2 CM
5.5 CM
22.2 CM

FIG. 8B

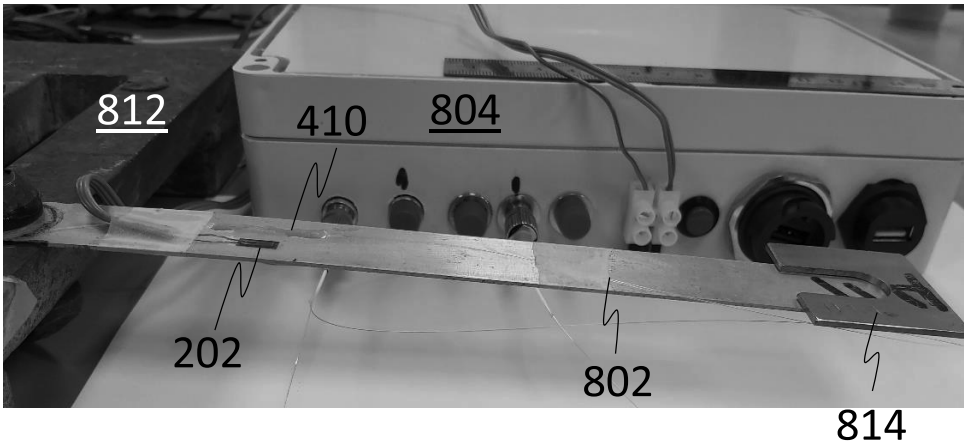


FIG. 8C

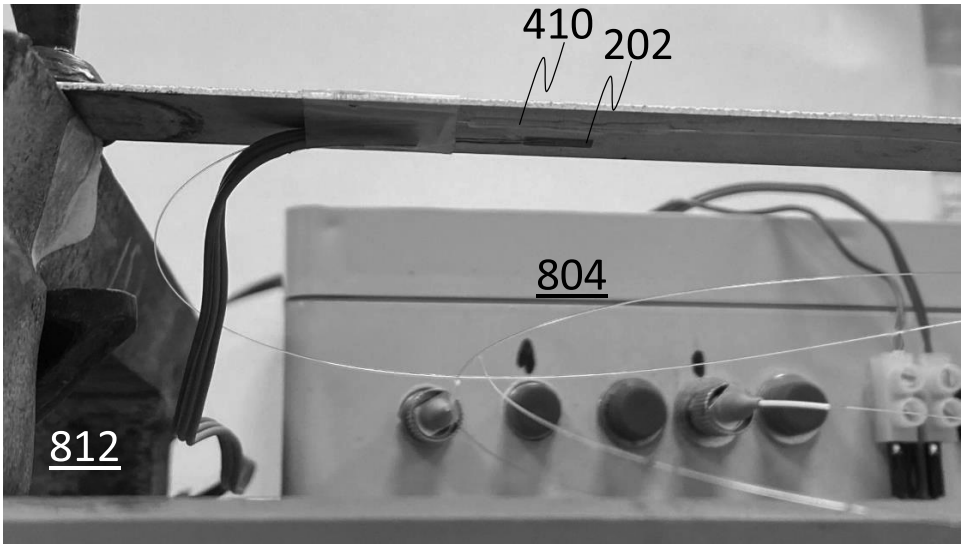


FIG. 8D

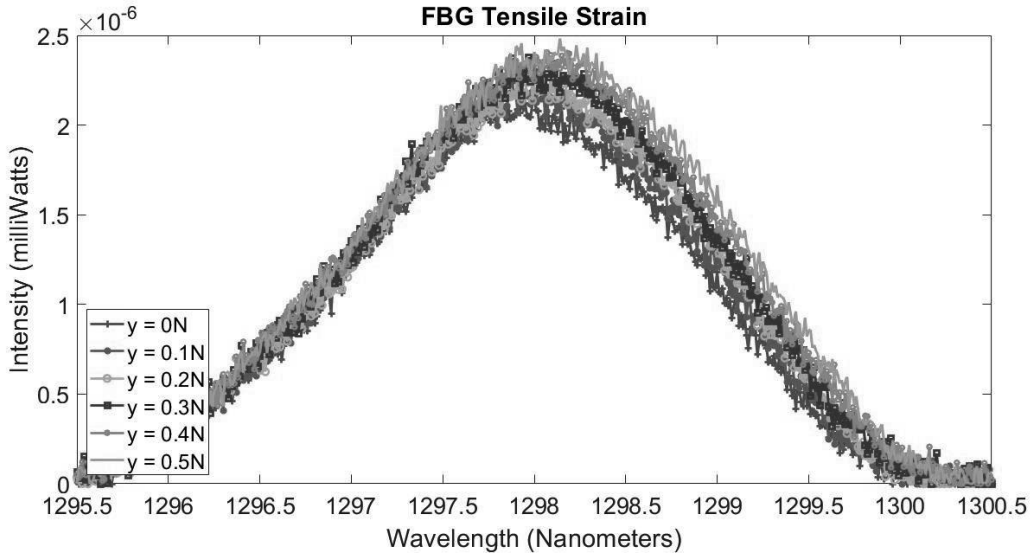

FBG Tensile Strain
×10^-6
2.5
2
1.5
1
0.5
0
Intensity (milliWatts)
y = 0N
y = 0.1N
y = 0.2N
y = 0.3N
y = 0.4N
y = 0.5N
1295.5
1296
1296.5
1297
1297.5
1298
1298.5
1299
1299.5
1300
1300.5
Wavelength (Nanometers)

FIG. 9A

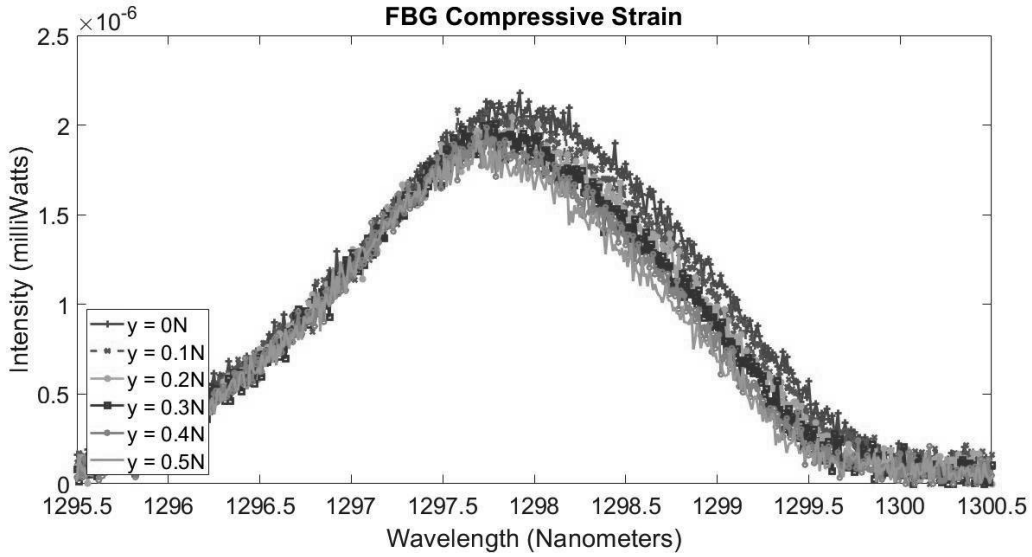

FBG Compressive Strain
×10^-6
2.5
2
1.5
1
0.5
0
Intensity (milliWatts)
y = 0N
y = 0.1N
y = 0.2N
y = 0.3N
y = 0.4N
y = 0.5N
1295.5
1296
1296.5
1297
1297.5
1298
1298.5
1299
1299.5
1300
1300.5
Wavelength (Nanometers)

FIG. 9B

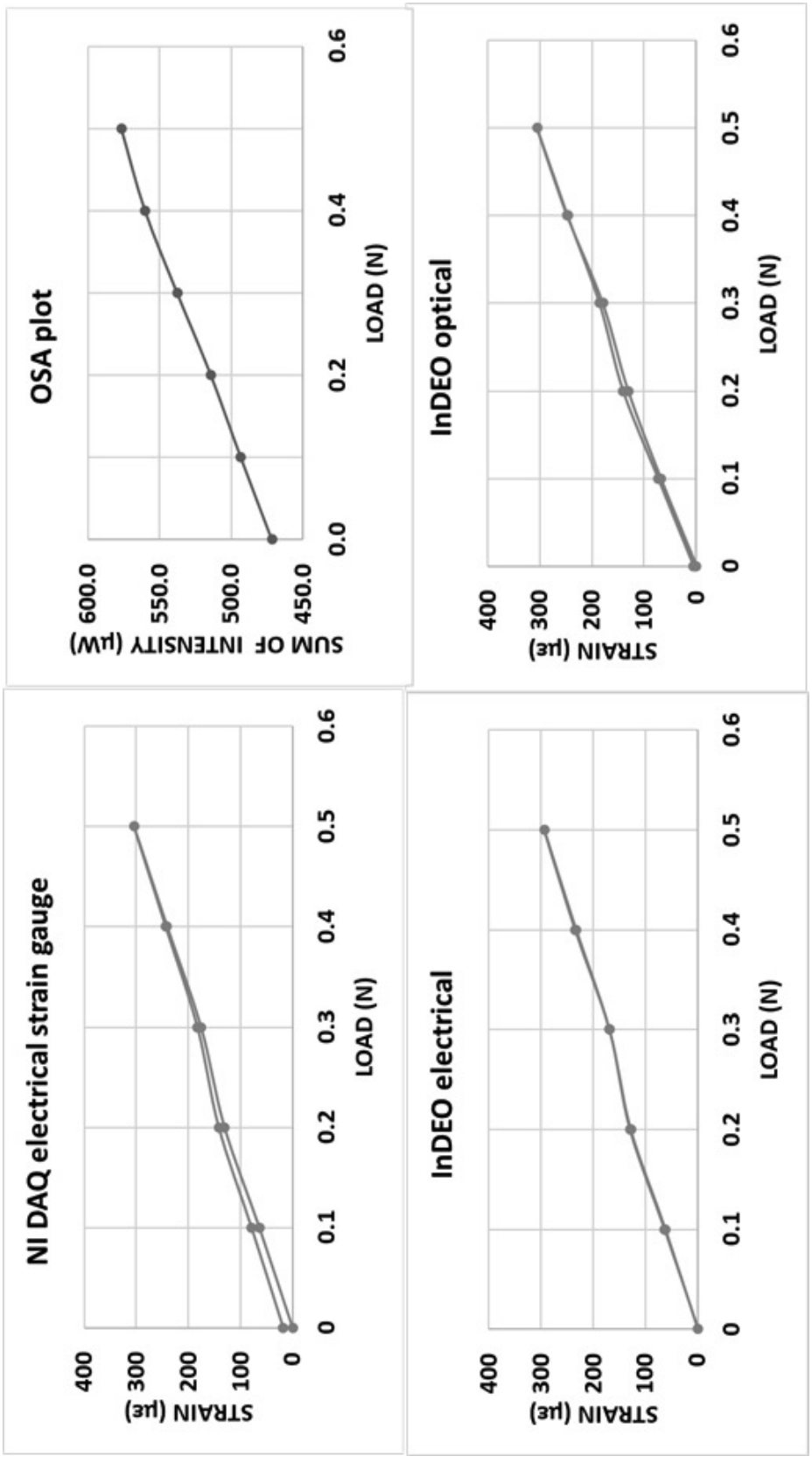


FIG. 10A

FIG. 10B

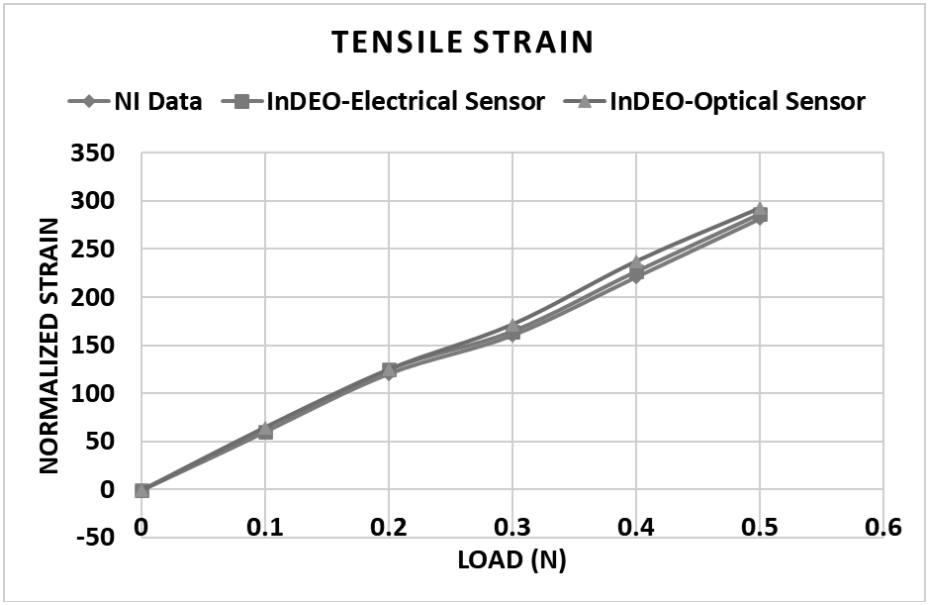


FIG. 11A

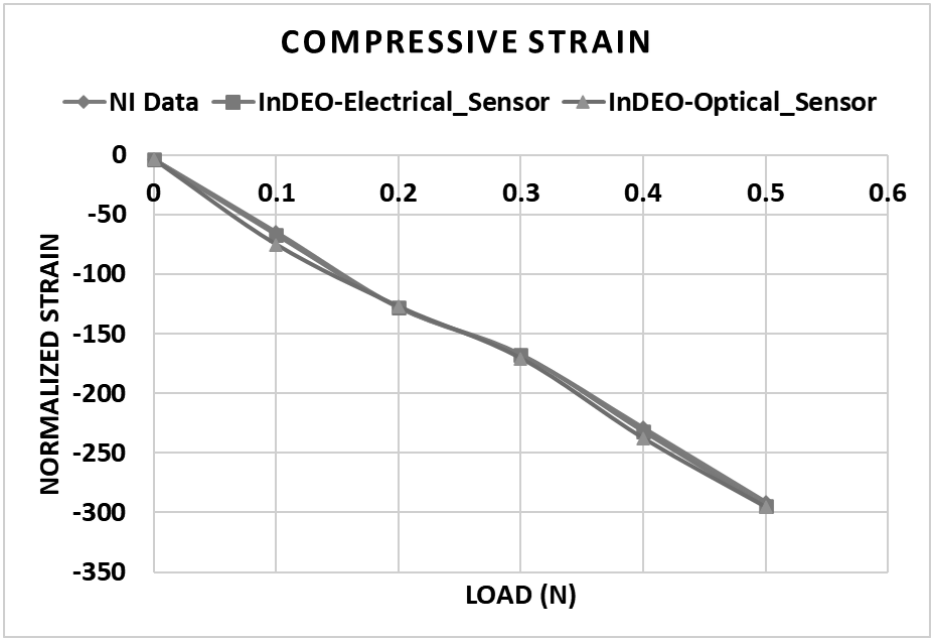


FIG. 11B

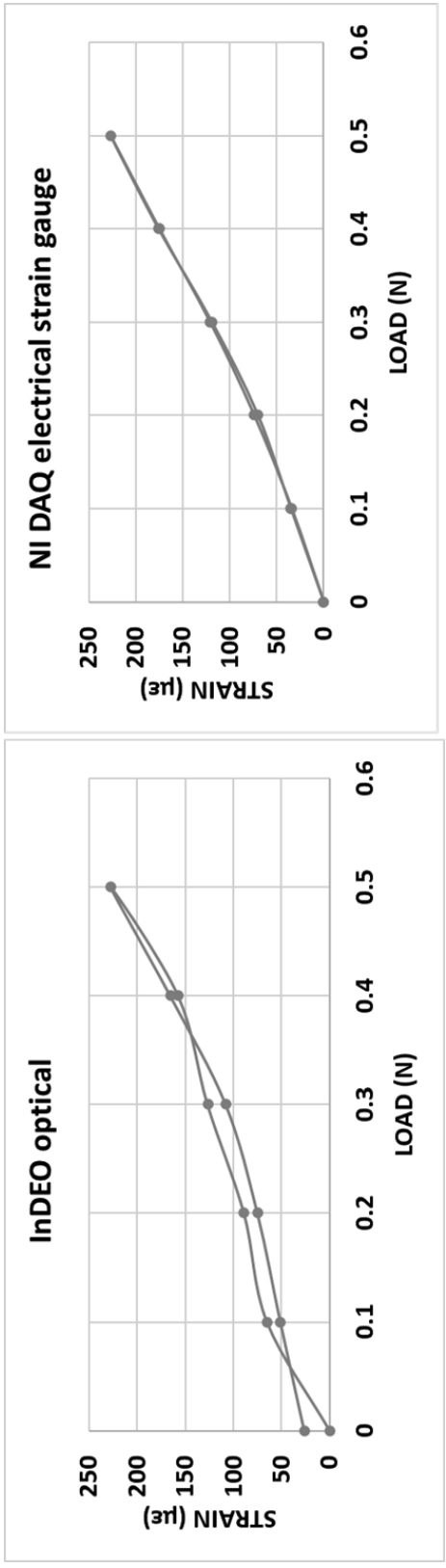

NI DAQ electrical strain gauge
STRAIN (με)
LOAD (N)
0
50
100
150
200
250
0
0.1
0.2
0.3
0.4
0.5
0.6
InDEO optical
STRAIN (με)
LOAD (N)
0
50
100
150
200
250
0
0.1
0.2
0.3
0.4
0.5
0.6

FIG. 12A

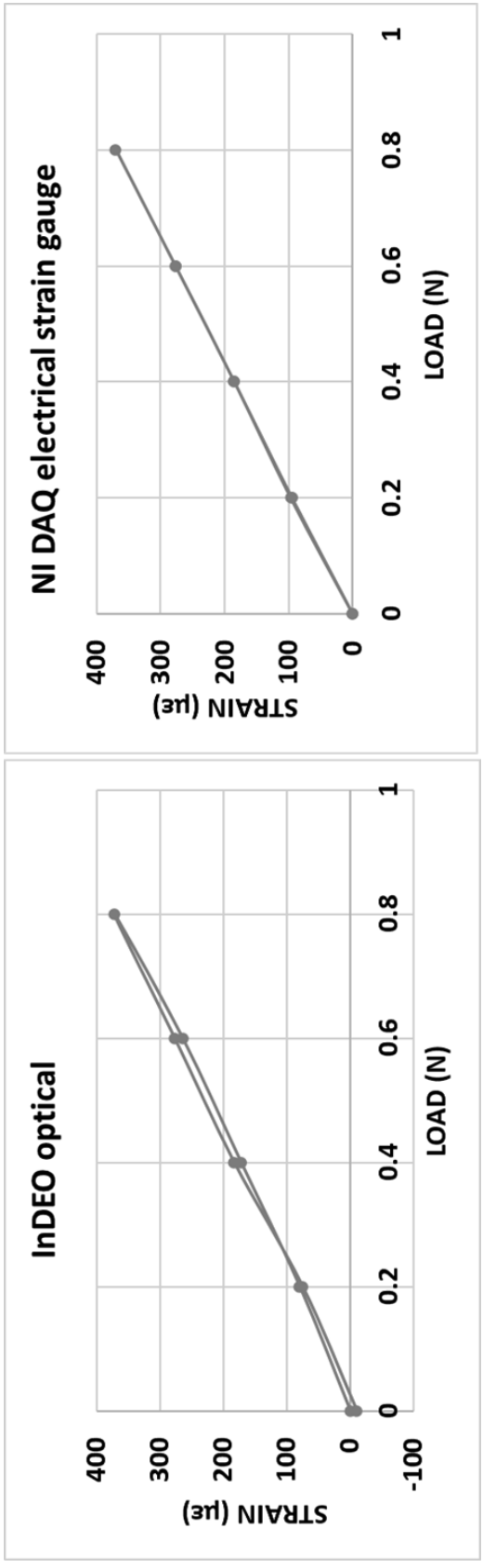

NI DAQ electrical strain gauge
STRAIN (με)
400
300
200
100
0
LOAD (N)
0
0.2
0.4
0.6
0.8
1
InDEO optical
STRAIN (με)
400
300
200
100
0
-100
LOAD (N)
0
0.2
0.4
0.6
0.8
1

FIG. 12B

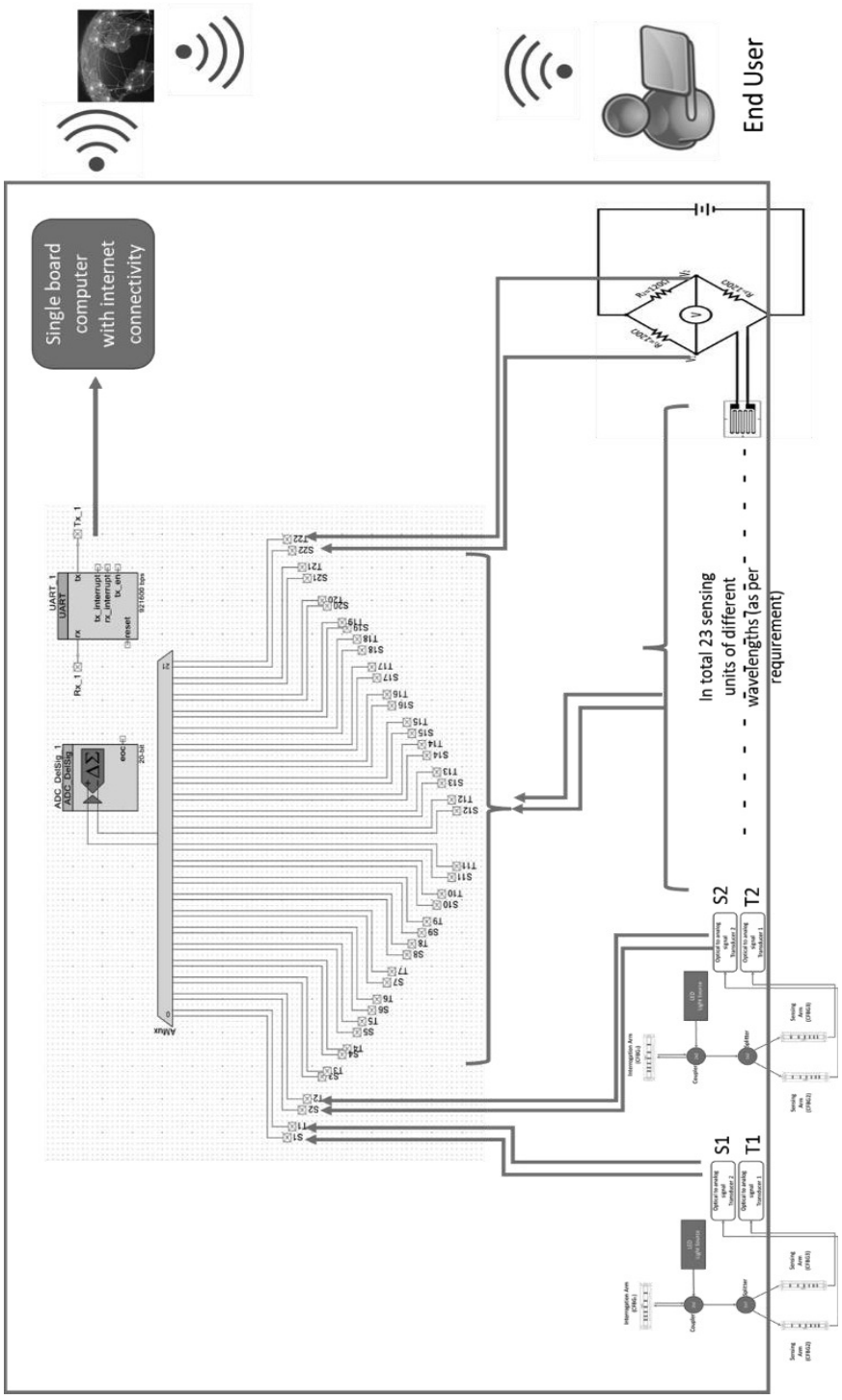

End User
Single board computer with internet connectivity
In total 23 sensing units of different wavelengths (as per requirement)
S1
T1
S2
T2

FIG. 13

	FBG data acquisition	ESG data acquisition	**InDEO**
Equipment required	Interrogator (SGD~40k)	DAQ or logger (SGD~2k)	Items in columns 2 and 3 replaced by InDEO (SGD~ 1k estimated)
Software	Proprietary/package with equipment	Proprietary/package with equipment	
Laptop at site	Needed	Needed	
Wireless router setup	Needed	Needed	

FIG. 14