NIBP OEM Module

(Model : M_NIBP)

Contents

Rev V1.00

1. Concept

Oscillometry : The oscillometric method of blood pressure measurement is a non-invasive method that monitors the amplitude of cuff pressure changes during cuff deflation to determine arterial blood pressure. The cuff pressure is first elevated above the patient systolic blood pressure level and the cuff begins to deflate at a certain rate. The initial rise in amplitude of these pressure fluctuations during cuff deflation corresponds closely to the systolic blood pressure. As the cuff is further deflated, these pressure fluctuations increase in amplitude until a peak is reached which is usually referred to as the mean arterial pressure(MAP). As cuff deflation continues, the diastolic pressure can be determined based upon the rapidly diminishing amplitude of the pressure fluctuations. Thus systolic, MAP and diastolic blood pressures can be accurately obtained by supervising the pressure fluctuations while controlling the cuff deflation rate.

2. Composition

2-1. Module Selection Model : M_NIBP

2-2. Components

Discription	Accessory		Fig. No.	Order No.
M_NIBP Components	NIBP Board		Fig 1	M_NIBP_PCB
	RS232C & Power Harness	Harness to Connect RS-232C Communication & Supply Power	Fig 2	M_NIBP_C1
	UART TTL & Power Harness	Harness to Connect UART TTL Communication & Supply Power	Fig 3	M_NIBP_C2
	Cuff	Adult Set(A:Large, B:Medium, C:Small)	Fig 4	Cuff_Adt_*
		Neonate Set(A:Large, B:Medium, C:Small)	Fig 5	Cuff_Neo_*
	Hose	Silicon Tube 1meter	Fig 6	D3_1000
	PC Program CD	WindowsXP(only for evaluation test module)	Fig 7	M_NIBP_SW

2-3. Evaluation Kit

Discription	Accessory			Fig. No.	Order No.
M_NIBP Evaluation Kit	NIBP Board			Fig 1	M_NIBP_EV
	RS232C & Power Harness	Harness to Connect RS-232C Communication & Supply Power		Fig 2	
	Cuff	Adult	Cuff_Adt_B	Fig 4	
		Neonate	Cuff_Neo_B	Fig 5	
	Hose	Silicon Tube 1meter		Fig 6	
	PC Program CD	WindowsXP(only for evaluation test module)		Fig 7	

2-4. Figures

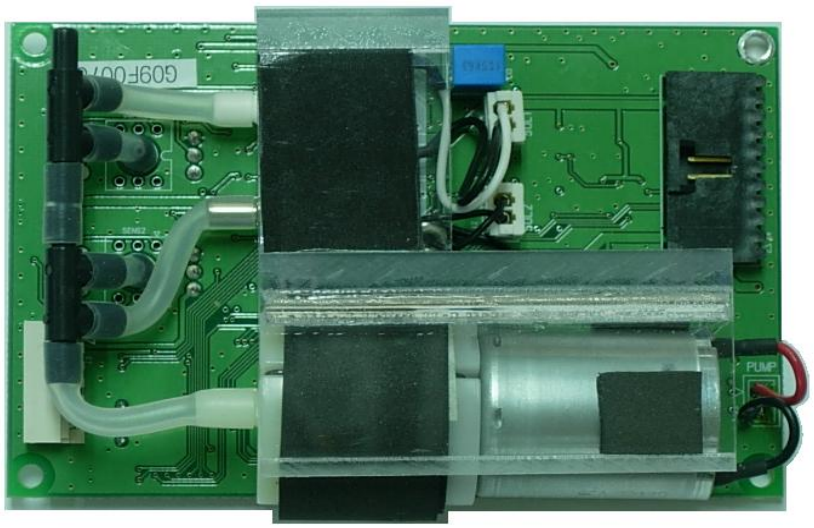


Fig 1 NIBP Board(M_NIBP_PCB)

J4 is an Amp part number 103635-9(90° connector).

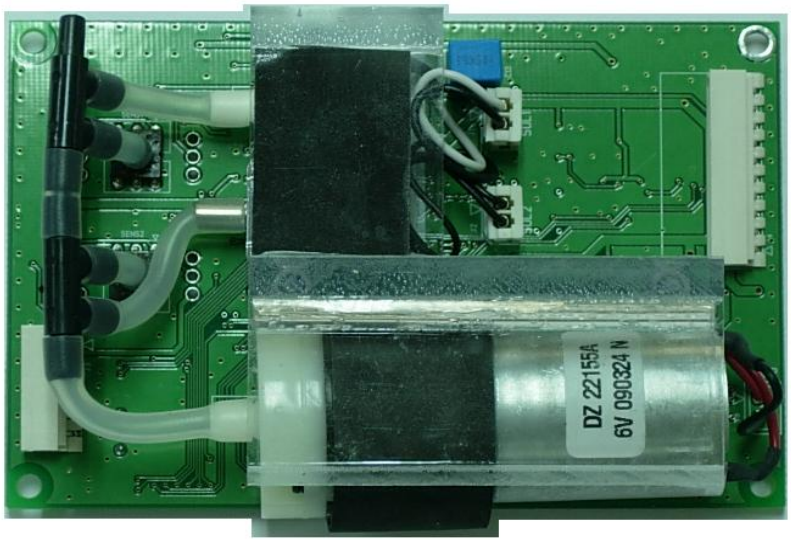


Fig 1 NIBP Board(M_NIBP_PCB)

J4 is an Molex part number 5268-10(90° connector).

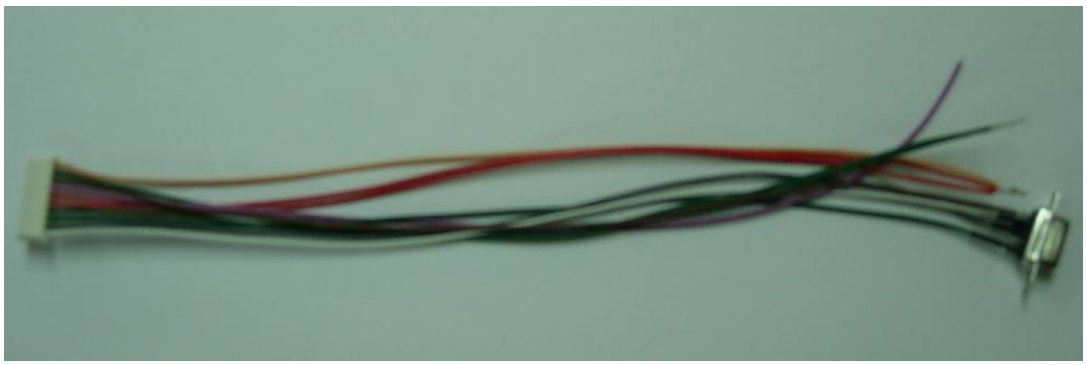


Fig 2 RS232C & Power Harness(M_NIBP_C1)

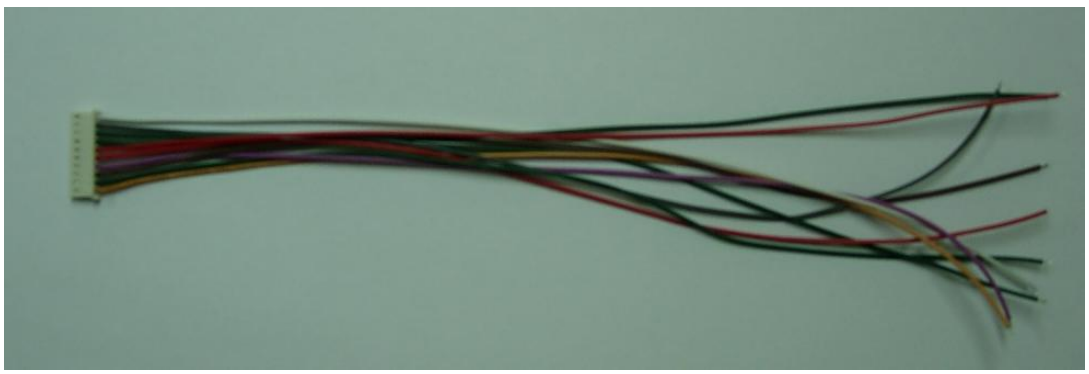


Fig 3 UART TTL & Power Harness(M_NIBP_C2)

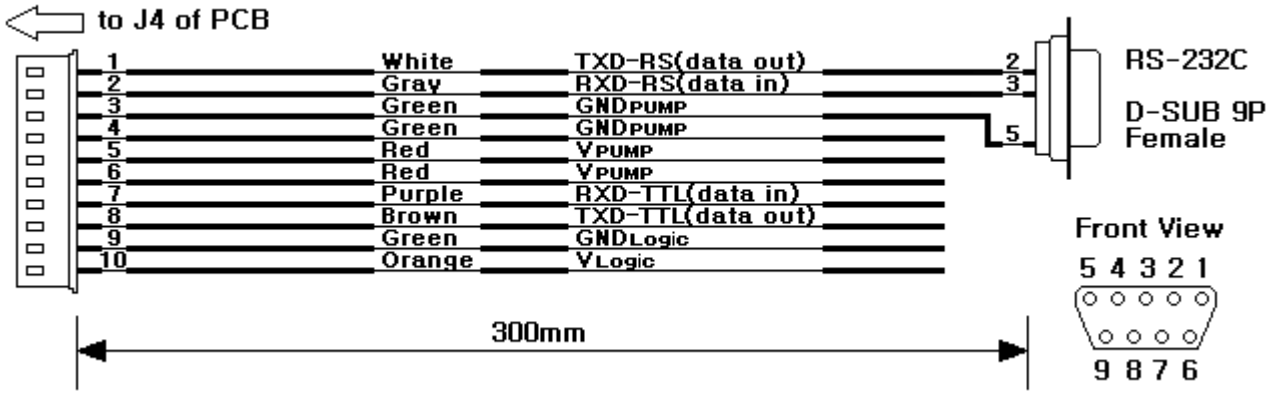


Fig 2 RS232C & Power Harness(M_NIBP_C1)

Fig 4 Adult Cuff(Cuff_Adt_*)

Fig 5 Neonate Cuff(Cuff_neo_*)

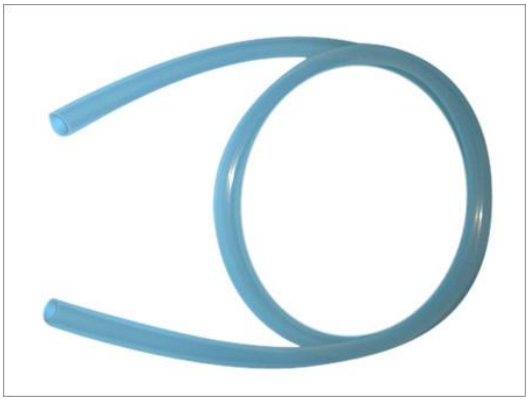
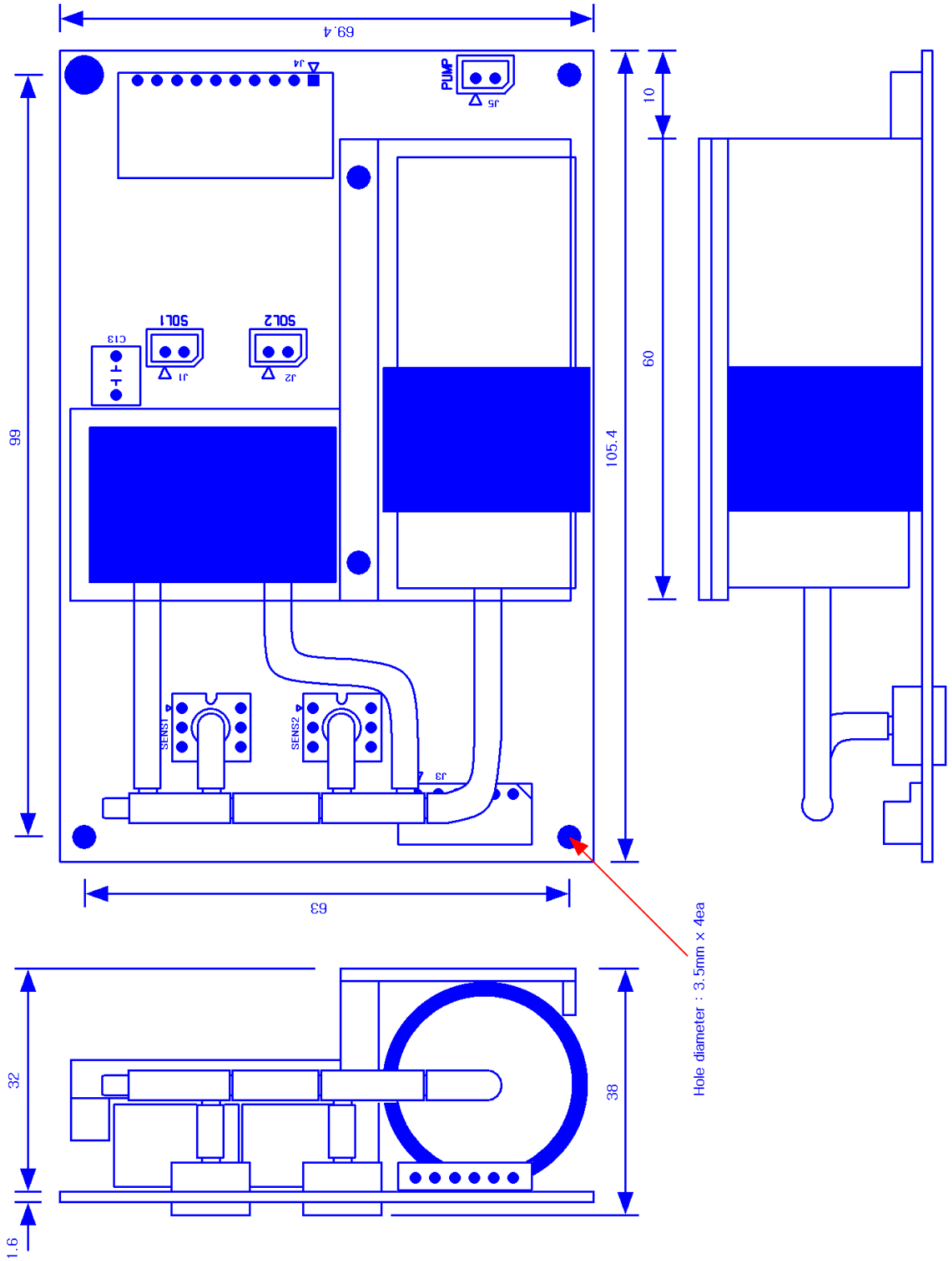


Fig 6 Silicon Hose

3. PCB Dimension



Dimension	105.4 × 69.4 × 38mm(Width ×Length ×Height)		
Weight	Appro. 150g		
Power Source	DC from 6.0 to 15Volt ± 5%		
Power consumption	Maximum12Watt, Typical 6Watt		
Measuring Method	Oscillomeric		
Measuring range	SYSTOLIC of Blood Pressure	Adult	40 – 270mmHg
		Pediatric	40 – 150mmHg
		Neonate	40 – 130mmHg
	MAP of Blood Pressure	Adult	30 – 260mmHg
		Pediatric	30 – 140mmHg
		Neonate	30 – 120mmHg
	DIASTOLIC of Blood Pressure	Adult	20 – 250mmHg
		Pediatric	20 – 130mmHg
		Neonate	20 – 110mmHg
	Pulse Rate	Measuring range	30 - 300bpm
Measuring Accuracy	Blood Pressure	±3mmHg between 0 mmHg and 300 mmHg for operating conditions between 0°C and 50°C.	
	Pulse Rate	± 2% or ± 3 BPM, whichever is greater	
Initial Inflation Pressure	Adult	180mmHg(Defualt), Variable 120-280mmHg	
	Pediatric	130mmHg(Defualt), Variable 100-160mmHg	
	Neonate	120mmHg(Defualt), Variable 80-140mmHg	
Startup Initialization Period		5 seconds	

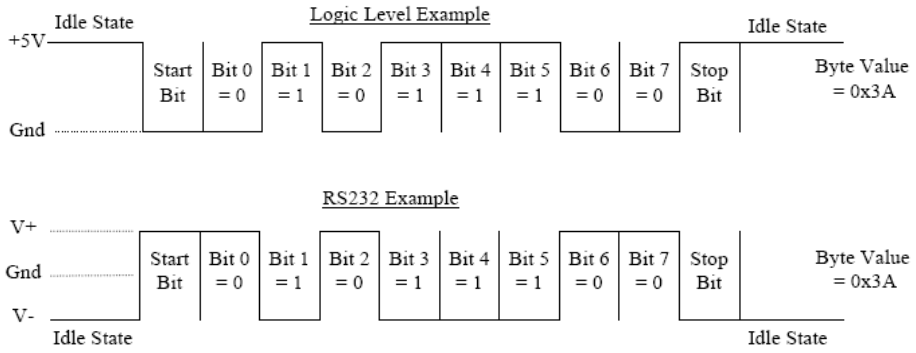
4. Specification

Patient Safety	Maximum cuff inflation time is limited to 35 seconds	
	cuff pressure exceeds 300 mmHg (Adult & Pediatric modes) or 150mmHg (Neonate mode) at any time	
	the cuff has been inflated for 180 seconds (Adult & Pediatric modes) or 90 seconds (Neonate mode)	
Operation Condition	0°C to 50°C, 15% to 95% non-condensing humidity	
Storage Condition	–20°C to 65°C, 15% to 95% non-condensing humidity	
Altitude	Measurement accuracy is not affected by altitude	
Interfacing	UART TTL	Asynchronous Operation Baud rate 9600bps, 8 Data bit, 1 Stop bit, no parity bit
	UART RS-232C	
The Module meets all relevant parts of the following Safety Standards: • IEC60601-1:1997 • IEC/EN60601-2-30:1999/2000 • AAMI SP10:1992/2002 • EN1060-1:1996 • EN1060-3:1997		

5. Protocol

5.1 Protocol

- UART [TTL Level (0~5[V])] / [RS-232C Level]
- Asynchronous Operation
- Baud rate : 9600bps
- 8 Data bit
- 1 Stop bit
- no parity bit



5.2 Host Command Packet Structure(Host ⇨ Module)

HOST START BYTE	COMMAND BYTE	DATA BYTE(S)	CHECKSUM BYTE
":" character (0x3A) 1Byte	1Byte	Supplemental command data. The number of data bytes varies according to the command.	LSB 1Byte [0x100 - BYTE(Startbyte + Command bytes + Data bytes)]

COMMAND DATA DESCRIPTION

COMMAND	DATA	DESCRIPTION
0x17	Pressure Data(2Bytes)	Sets initial pressure for next BP Data
0x20	None	Starts Adult Mode BP
0x87	None	Starts Pediatric Mode BP
0x28	None	Starts Neonate Mode BP
0x79	0x01, 0x00	Aborts current BP reading
0x79	0x05, 0x00	Returns current cuff pressure
0x79	0x03, 0x00	Returns data from last BP measurement
0x0C	B_0, B_1, B_2	External control of pump & valves **This command should never be used when the cuff is attached to a patient.** B0 = Pump (0x00 = Off, 0x01 = On) B1 = Control Valve (0x00 = Open, 0x01 = Closed) B2 = Dump Valve (0x00 = Open, 0x01 = Closed)

Sending the Starts BP command will automatically place the module in the Adult monitoring mode, causing excessive cuff pressures on a neonate.

It is the responsibility of the Host system to always determine Adult, Pediatric or Neonate mode when initiating a BP measurement.

5.3 Module Packet Structure(Module ⇨ Host)

MODULE START BYTE	PACKET BYTE	DATA BYTE(S)	CHECKSUM BYTE
">" character (0x3E)	total number of bytes in the packet.	the Module data response to the COMMAND issued by the Host.	LSB 1Byte [0x100 - BYTE(Startbyte + Command bytes + Data bytes)]

5.4 Example to set initial inflate to 180mmHg pressure(Decimal 180 ⇨ Hex 0xB4)

Host ⇨ Module

START	COMMAND	DATA	CHECKSUM
0x3A	0x17	0xB4, 0x00	0xFB

Module ⇨ Host(“OK” packets)

START	PACKET	DATA	CHECKSUM
0x3E	0x04	0x4F	0x6F
0x3E	0x04	0x4B	0x73

5.5 Example to start adult mode BP

Host ⇨ Module

START	COMMAND	DATA	CHECKSUM
0x3A	0x20	(None)	0xA6

Module ⇨ Host (acknowledges ”O” about the start command)

START	PACKET	DATA	CHECKSUM
0x3E	0x04	0x4F	0x6F

Module ⇨ Host (“K” after BP measurement is completed)

START	PACKET	DATA	CHECKSUM
0x3E	0x04	0x4B	0x73

When the Module is taking a BP measurement, the only commands that are "valid" are the abort BP and the returns current cuff pressure commands. The Module will respond to all other commands with a "Busy" data packet (data byte = "B") as shown below.

Module ⇨ Host (“B” module is busy)

START	PACKET	DATA	CHECKSUM
0x3E	0x04	0x42	0x7C

5.6 Example to start Pediatric mode BP

Host ⇨ Module

START	COMMAND	DATA	CHECKSUM
0x3A	0x87	(None)	0x3F

Module ⇨ Host (acknowledges ”O” about the start command)

START	PACKET	DATA	CHECKSUM
0x3E	0x04	0x4F	0x6F

Module ⇨ Host (“K” after BP measurement is completed)

START	PACKET	DATA	CHECKSUM
0x3E	0x04	0x4B	0x73

When the Module is taking a BP measurement, the only commands that are "valid" are the abort BP and the returns current cuff pressure commands. The Module will respond to all other commands with a "Busy" data packet (data byte = "B") as shown below.

Module ⇨ Host (“B” module is busy)

START	PACKET	DATA	CHECKSUM
0x3E	0x04	0x42	0x7C

5.7 Example to start Neonate mode BP

Host ⇨ Module

START	COMMAND	DATA	CHECKSUM
0x3A	0x28	(None)	0x9E

Module ⇨ Host (acknowledges ”O” about the start command)

START	PACKET	DATA	CHECKSUM
0x3E	0x04	0x4F	0x6F

Module ⇨ Host (“K” after BP measurement is completed)

START	PACKET	DATA	CHECKSUM
0x3E	0x04	0x4B	0x73

When the Module is taking a BP measurement, the only commands that are "valid" are the abort BP and the returns current cuff pressure commands. The Module will respond to all other commands with a "Busy" data packet (data byte = "B") as shown below.

Module ⇨ Host (“B” module is busy)

START	PACKET	DATA	CHECKSUM
0x3E	0x04	0x42	0x7C

5.8 Example to abort BP

Host ⇨ Module

START	COMMAND	DATA	CHECKSUM
0x3A	0x79	0x01, 0x00	0x4C

Module ⇨ Host("AK" packets : Module Response when BP measurement in progress)

START	PACKET	DATA	CHECKSUM
0x3E	0x04	0x41	0x7D
0x3E	0x04	0x4B	0x73

Module ⇨ Host("A" packets : Module Response when BP measurement not in progress)

START	PACKET	DATA	CHECKSUM
0x3E	0x04	0x41	0x7D

5.9 Example to return current cuff pressure

Host ⇨ Module

START	COMMAND	DATA	CHECKSUM
0x3A	0x79	0x05, 0x00	0x48

Module ⇨ Host(current pressure of 258mmHg)

START	PACKET	DATA	CHECKSUM
0x3E	0x05	0x02, 0x01	0xBA

Module ⇨ Host(current pressure of 142mmHg)

START	PACKET	DATA	CHECKSUM
0x3E	0x05	0x8E, 0x00	0x2F

5.10 Example to return data from last BP measurement

Host ⇨ Module

START	COMMAND	DATA	CHECKSUM
0x3A	0x79	0x03, 0x00	0x4A

Module ⇨ Host

START	PACKET	DATA	CHECKSUM
0x3E	0x18	SYS, DIA, N1, N2, N3, HR, MAP, EC, N4, N5	0x100 – Modulo 256 sum of all bytes

DATA PACKET

Data	Description	Number of Bytes
SYS	Systolic value in mmHg (unsigned integer, LSB first)	2
DIA	DDD Diastolic value in mmHg (unsigned integer, LSB first)	2
N1	Not used	1
N2	Not used	1
N3	Not used	8
HR	Heart Rate in beats per minute (unsigned integer, LSB first)	2
MAP	Mean Arterial Pressure (MAP) in mmHg (unsigned integer, LSB first)	2
EC	Error Code (unsigned byte)	1
N4	Not used	1
N5	Not used	1

Error Code List & Definitions

Error Code	Description	Corrective Action:
0 = 0x00	Good BP Reading	None
1 = 0x01	Weak or no oscillometric signal	Check that the cuff is in the correct position. Check the patient. Check that the cuff is properly tightened. Check that there is no excessive clothing between the arm and the cuff. Check that the correct size cuff is being applied.
2 = 0x02	Artifact / erratic oscillometric signal	The patient may have been moving too much. Check that the cuff is in the correct position. Check that the correct size cuff is being applied.
4 = 0x04	Exceeded measurement time limit	The patient may have been moving too much. Check that the cuff is properly tightened. Check that the cuff is in the correct position. Check that the correct size cuff is being applied. Check that there is no excessive clothing between the arm and the cuff.
85 = 0x55	Pneumatic Blockage	Check that the hose has no sharp bends or is pinched. Check that the patient is not lying on the cuff. Check that the cuff is in the correct position.
86=0x56	BP reading terminated by user	Check the patient. Take another BP reading.
87 = 0x57	Inflate Timeout, Air Leak or Loose Cuff	Check that the hose is connected to the system and the cuff. Check that the cuff is properly tightened. Check that the cuff is in the correct position. Check that the correct size cuff is being applied. Check that the cuff is not leaking air. Check that the hose connections are not damaged or loose.

89 = 0x59	Cuff Overpressure	Check that the correct size cuff is being applied. Check that the hose has no sharp bends or is pinched. Check that the cuff is in the correct position. Check that the patient is not lying on the cuff.
90 = 0x5A	Power supply out of range or other hardware problem	Check that V_{PUMP} and V_{LOGIC} are within the voltage specifications. Check the data/power input connection. Service may be required. Call a manufacturer representative.
97 = 0x61	Transducer out of range	It is not correct calibration, need to recalibrate. Service may be required. Call a manufacturer representative.
98 = 0x62	ADC out of range	Service may be required. Call a manufacturer representative.
99 = 0x63	EEPROM calibration data failure	It is not correct calibration, need to recalibrate. Service may be required. Call a manufacturer representative.

5.11 CONTROL_PNEUMATICS

Caution : This command should never be used when the cuff is attached to a patient.

Host ⇨ Module

START	COMMAND	DATA	CHECKSUM
0x3A	0x0C	B0, B1, B2	0x100 – Modulo 256 sum of all bytes

Data definitions:

B0 = Pump (0x00 = Off, 0x01 = On)

B1 = Control Valve (0x00 = Open, 0x01 = Closed)

B2 = Dump Valve (0x00 = Open, 0x01 = Closed)

Example to close the Control Valve and the Dump Valve:

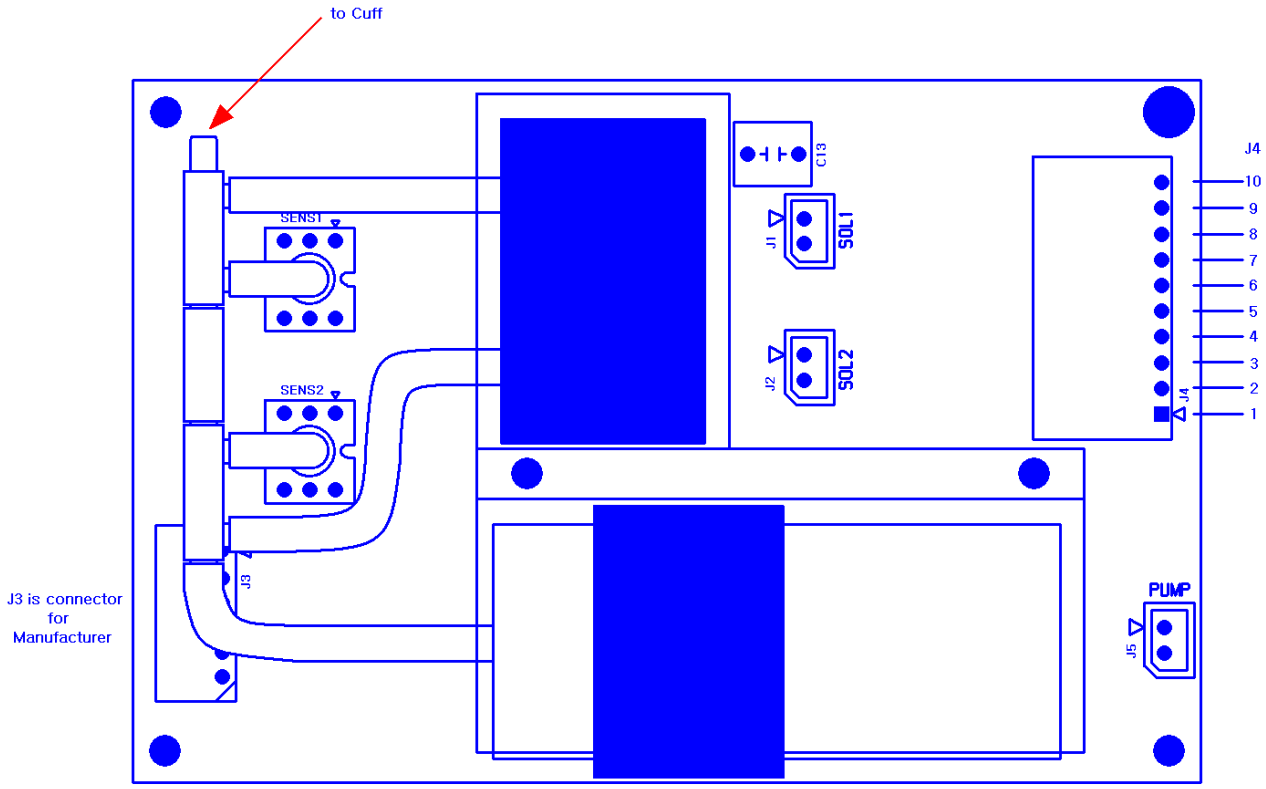
Host ⇨ Module

START	COMMAND	DATA	CHECKSUM
0x3A	0x0C	0x00, 0x01, 0x01	0xB8

Module ⇨ Host(“OK” packets)

START	PACKET	DATA	CHECKSUM
0x3E	0x04	0x4F	0x6F
0x3E	0x04	0x4B	0x73

6. Cuff & Electrical Connection



6.1 Power and communication connector (PCB J4)

Pin NO.(PCB J4)	Description	Name
1	No Connect or Optional RS-232 TxD (data out)	TXD-RS
2	No Connect or Optional RS-232 RxD (data in)	RXD-RS
3	Ground of Pump	GND_{PUMP}
4	Ground of Pump	GND_{PUMP}
5	+VCC of Pump	V_{PUMP}
6	+VCC of Pump	V_{PUMP}
7	Logic Level RxD (data in) or No Connect	RXD-TTL
8	Logic Level TxD (data out) or No Connect	TXD-TTL
9	Ground of Logic	GND_{Logic}
10	+VCC of Logic	V_{Logic}

6.2 J4 is an Amp part number 103670-9(straight connector) or 103635-9(90° connector). The mating connector is Amp part number 104257-9. Pins for the mating connector are Amp part number 104480-7.

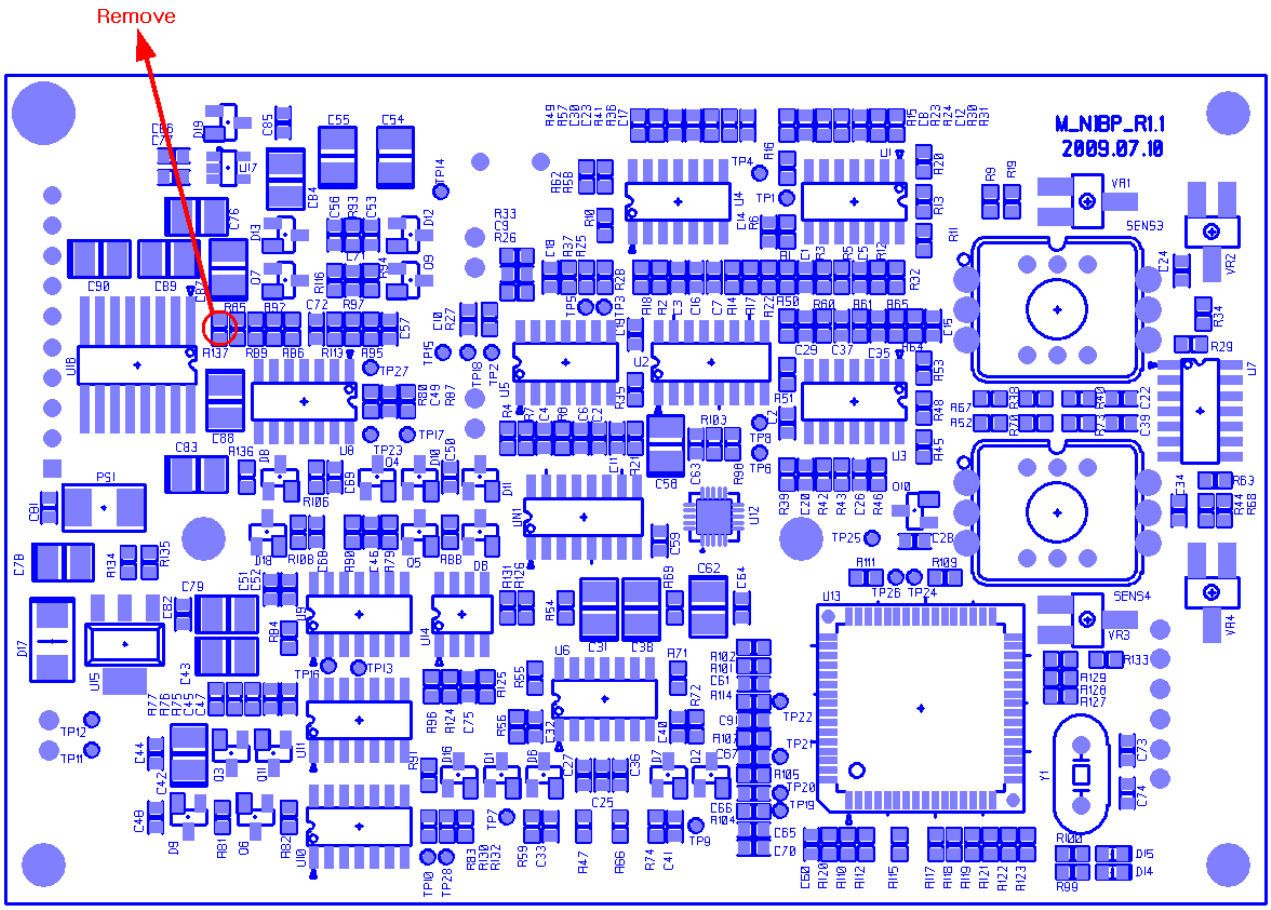
OR

J4 is an Molex part number 5267-10(straight connector) or 5268-10(90° connector). The mating connector is Molex part number 5264-10. Pins for the mating connector are Molex part number 5263PBT9.

6.3 Caution to communication connection

Do not attempt to connect to both Logic Level and RS232 simultaneously.

If use to connect to Logic Level, have to remove R137 on PCB.



Rear View of PCB