

# HM-APL-PCB User Manual

## Introduction

The HM-APL-PCB (PCB) converts existing HART field devices to the new Ethernet Advanced Physical Layer (APL) interface. The PCB offers an easy migration path for HART to APL. The PCB can be modified to incorporate custom features or size requirements. Contact ProComSol if interested in PCB customization.

## System Diagram

The complete HART to APL system consists of a HART field device, the HM-APL-PCB, a power supply, an APL switch, an Ethernet switch/router, and a host device running a HART-IP compliant App.



Figure 1. HART-APL System Diagram



## **PCB Block Diagram**

The PCB contains the APL interface and the HART interface. Customizable firmware runs on a ST microelectronics MCU. Peripheral interfaces are available for adding additional memory and analog measurement circuits, for example.



Figure 2. HM-APL-PCB Block Diagram

## **HART Connections**

A two terminal wire connector is used to make the connection to the existing HART field device. A HART power supply is NOT needed. A loop resistor is also NOT needed. The PCB supplies loop power to the HART field device. Note that polarity it important. The HART (+) connects to the HART field device (+) terminal of the HART device and the HART (-) connects to the HART field device (-) terminal.



Figure 3. HART Connections



# HART Polling Address

Using a HART Communicator, set the HART field device to Polling Address 1. This puts the field device in a fixed current modem (4mA). This only needs to occur one time. The PCB uses Polling Address 1 to communicate HART as the default setting. Note that the HART Polling Address can be changed from Polling Address 1 in the Web Browser (browser) interface. If changed in the browser, a HART Communicator is then required to make the same HART Polling Address change in the HART field device.

## **APL Connections**

APL is a two wire Ethernet physical layer. APL also provides power to the APL field devices on the network. Each APL field device is connected via a twisted pair cable to an APL switch. The switch supplies power to the individual APL field devices. Polarity is not important.

## **APL Switch**

An APL switch is used to connect APL field devices to the Ethernet network. When deployed in the field, an APL Switch that is intrinsically safe and rugged for industrial use should be used. These devices are starting to become available. However, for APL field device development and testing, a lower cost option is available, the APL-SW-3.

## APL-SW-3, Development APL Switch Option

A low cost APL switch option for APL development work is the ProComSol APL-SW-3, Ethernet-APL Switch, 3 Channels. It requires one standard 24Vdc power supply. It provides APL connections for up to 3 APL field devices. It has an Ethernet port to connect to the Ethernet network. It supplies power to native APL field devices and to HART devices through the PCB.







# **PCB** Component Locations



Figure 5. Component Locations



#### Switches

The PCB has two push-button switches. SW1 is located near the board edge. It was used for initial PCB development testing. It is no longer used. SW2 is located near the Bournes transformer. It can be used to reset the PCB.

## **LED Indications**

There are three LEDs that indicate PCB status. D4 is located near SW2. When Green, it means the PCB is undergoing a power-up or reset operation. D5 is located near J4. When blinking Orange, it means there is APL network activity. When it is solid Green, no APL link is detected. D6 is also near J4. When Green, it means power is applied to the PCB.

## **Connectors and Headers**

Connectors are for the HART and APL interfaces. The headers are available for developing APL field devices.

## J2 APL Connector

Pin 1	Loop +
Pin 2	Loop -
Pin 3	Shield GND

## J4 HART Connector

Pin 1	HART +
Pin 2	HART -

## P1 Debug UART Debug Header

Pin 1	USART3_RX
Pin 2	USART3_TX
Pin 3	GND

## P2 STM32 SWD Debug Header

Pin 1	PWR
Pin 2	SWDIO
Pin 3	GND
Pin 4	SWCLK
Pin 5	GND
Pin 6	JTDI
Pin 7	NC
Pin 8	JTDO



HM-APL-PCB	User Manual
------------	-------------

Pin 9	GND
Pin 10	NJTRST

#### P3 I/O Header

DIO PD14
DIO PD15
DIO PD12
DIO PD13
GND
GND
GND
ADC12 IN4
GND
ADC12 IN5

## P4 I/O Header

Pin 1	I2C3_SCLK
Pin 2	I2C3_SDA
Pin 3	UART1_RX
Pin 4	UART1_TX
Pin 5	3.3V PWR
Pin 6	GND
Pin 7	SPI1_MOSI
Pin 8	SPI1_CS
Pin 9	SPI_CLK
Pin 10	SPI_MISO

## **PCB Schematic**

The schematic for the PCB is available upon request.

#### PCB Configuration Management via Browser

Connect a PC to the APL switch via an Ethernet cable and launch a web browser on the PC. Determine the URL for the connected PCB to configure. Launch another web browser and enter this URL. The login screen appears:



~	0	192.168	8.2.1/settingsPage	html X	192.168.2.26/index	x.html X	192.168.2.27	/index.html	×   🕲 19	2.168.2.28/index.html	×   +				-	0	×
~	• →	C	A Not secure	192.168.2	.26/index.html									☆	Ð	J	•
														PR	200	DMS	iol
				Log I adm Pa:	n in ssword							Gateway Informa Description: Serial Number: Device Tag: Device LongTag: Firmware	tion HART IP GATEWAY 255 HMAPLPCB : HART-IP APL Gateway				
						Login						Version:	2.7-1093024-0-2HS				

The default login credentials are: User Name: admin Password: root

The password can be changed.

After login, the Device List screen is shown. Navigate to other screens using the tabs. Each screen is explained next:

## **Device List**

<ul> <li>O 192.168.2.1/settingsPage.html</li> <li>X</li> <li>I 192.168.2.26/settingsPage.html</li> <li>X</li> <li>I 192.168.2.27/index.html</li> <li>X</li> <li>I 192.168.2.28/index.html</li> <li>X</li> <li>I 192.168.2.28/index.html</li> <li>X</li> <li>I 192.168.2.27/index.html</li> <li>X</li> <li>I 192.168.2.28/index.html</li> <li>X</li> <li>I 192.168.2.168.2.88/index.html</li> <li>X</li> <li>I 192.168.2.88/index.html</li> <li>X</li> <li>X</li> <li>X</li></ul>	- 0 ×
← → C ▲ Not secure 192.168.2.26/settingsPage.html	∞ ☆ Ď Ø :
Serial Number: 255 Reboot Device Logout Device Tag: HMAPLPCB Firmware Version: 2.7-P093024-0-2HS	
Device List General Settings LAN Settings Protocol Settings Firmware Updater Diagnostics	
Detected Devices	
Port Status Address Manufacturer HighSpeed Device Tag	
0.1 OK 0x6de60023c7 0x006d No T-1234: PR 5437	

The Device List shows the connected HART field device.

Detail from above:



D	Detected Devices							
P	ort	Status	Address	Manufacturer	HighSpeed	Device Tag		
0	:1	OK	0x6de60023c7	0x006d	No	T-1234: PR 5437		

#### Port Will always show 0:1

<u>Status</u> Set to OK when a HART field device is connected

## Address

Is made up of these components: 0x: Indicates displayed as hexadecimal values DeviceType: next 4 characters, 6de6 in the example above DeviceID: next 6 characters, 0023c7 in the example above

<u>Manufacturer</u>

0x: Indicates displayed as hexadecimal value ManufacturerID: Value assigned to the manufacturer of the HART field device by the FieldComm Group

#### HighSpeed

Yes: PSK interface to the HART field device, communication speed is 9600 baud. No: FSK interface to the HART field device, communication speed is 1200 baud.

<u>Device Tag</u> The short HART tag for the HART Field device



# **General Settings**

O 192168221/settingsPage.html × O 192168226/settingsPage.html × O 192168227/index.html × O 192168228/index.html ×	+	- 0 ×
← → C △ Not secure 192.168.2.26/settingsPage.html		∞ ☆ ♪ 0 :
Serial Number: 255 Device Tag: HMAPLPCB Firmware Version: 2.7-P093024-0-2HS	Reboot Device Logout	
Device List Central Settings LAN Settings Protocol Settings Firmware Updater	Diagnostics	
Gateway Identification:		_
Gateway Tag     HMAPLPCB       Gateway Long Tag     HART-IP APL Gateway		
System Time And Date		
New Date (dd-mm-yyyy):         31         12         1969           New Time (hh:mm):         23         0           Image: Inset Clock         1         1         1		
O Use NTP Server		
Time Zone: California ~		
Time Server 1         216 239 35 0           Time Server 2         216 239 35 4		
	Αρρ	v v
Change Password		
Current Password		
New Password		
Re-Type Password		
	Change Pa	ssword

The General Settings screen is used to set various parameters for the PCB.

#### **Gateway Identification**

<u>Gateway Tag</u>: The short HART tag used to identify this device on a network. <u>Gateway Long Tag</u>: The long HART tag used to identify this device on a network.

#### System Time and Date

Time is used to timestamp Diagnostic log events

Note: The PCB can maintain the time/date information for 12 hours when not powered. <u>Manual:</u> The user enters the current date and time and the PCB clock is used for time stamping the log data. Not highly accurate, but there is no dependency on Internet access or other network devices.

<u>Use PC Clock</u>: Uses the time data as seen by the browser from the PC clock. Simple, but dependent on the accuracy of the PC clock settings.

<u>Use NTP Time</u>: Very accurate, but it requires access to an NTP server via its IP address. Once this setting is selected and saved, the NTP daemon queries the NTP server to get the exact time.

<u>Time Zone</u>: Used for the NTP time option only. Ensures the time stamp for a diagnostics event is in local time.



Once a setting has been changed, click the "Apply" button to send the changes to the PCB.

## Change Password

Allows the user to change the password for browser access to the PCB. Default password is "root". It is recommended to change the password after first connection to the PCB via a browser.

Once the password data has been entered, click the "Change Password" button to make the password change.

## LAN Settings

▼         Ø         192.168.2.1/settingsPage.html         ×         Ø         192.168.2.22//ndex.html         ×         Ø         192.168.2.22//ndex.html         ×         Image: Non-State State Sta	+	- 0 ×
← → C ▲ Not secure 192.168.2.26/settingsPage.html		∞☆ ⊉ 0 :
Serial Number: 255 Device Tag: HMAPLPCB Firmware Version: 2.7-P093024-0-2HS	Reboot Device Logout	
Device List General Settings LAN Settings Protocol Settings Firmware Updater	Diagnostics	
Hardware Address		
MAC Address: 00:80:e1:00:00:ff		
LAN IP address		
Automatic address assignment(DHCP)		
O Manual Address Assignment		
IP Address 192.168.18.20		
Subnet Mask 255 255 255 0		
Default Gateway 192.168.18.1		
Apply		

#### Hardware Address

<u>MAC Address</u>: Unique identifier for the PCB. It is set at the factory and cannot be changed.

#### LAN IP Address

<u>Automatic address assignment (DHCP)</u>: When enabled, the IP address for the PCB is assigned by the APL switch.

<u>Manual Address Assignment</u>: When enabled, the user assigns the IP address and other network parameters to the PCB. Caution! Be careful with this setting and make sure the IP address is documented.

Once a setting has been changed, click the "Apply" button to send the changes to the PCB.



# **Protocol Settings**

▼         Ø 192.168.2.1/settingsPage.html         ×         Ø 192.168.226/settingsPage.html         ×         Ø 192.168.227/index.html         ×         Ø	192.168.2.28/index.html ×   +	- 0 X
← → C ▲ Not secure 192.168.2.26/settingsPage.html	60	x 10 0 :
Serial Number: 255 Device Tag: HMAPLPCB Firmware Version: 2.7-P093024-0-2HS	Reboot Device   Logout	
Device List General Settings LAN Settings Protocol Settings	Firmware Updater Diagnostics	
Additional TCP Port		
© Frimmay O Secondary Acply		

# **Additional TCP Port**

Alternative port to access the PCB. The HART-IP port is defined as 5094.

## Search by Poll Address

The user selects the polling method to find the connected HART field device. The default is Polling Address 1.

<u>Use Poll address 0 only</u>: Select if the connected HART field device is set to Polling Address 0. Caution! If the HART field device is requires more than the maximum PCB power, the HART field device will shut down. Setting the HART field device to an address between 1 and 15 fixes the loop output to 4ma, ensuring the HART field device requires minimal power to turn on.

<u>Use Poll address from 0 to 15</u>: The PCB tries each Polling Address starting at 0. If a HART field device is detected, that Polling Address is used.

<u>Use Poll Address</u>: User sets the HART Polling Address to use. Default is 1.

#### **Master Mode Selection**

This setting allows the PCB to be used in systems that may have multiple HART communication channels, for example a HART Communicator.

Primary: PCB is the Primary HART Master. Default setting.

<u>Secondary</u>: PCB is the Secondary HART Master. Caution! If there are two Primary or two Secondary masters attempting communication with the HART field device, communications will fail for both hosts.

Once a setting has been changed, click the "Apply" button to send the changes to the PCB.



# Firmware Updater

👻 🗞 192.168.2.1/settingsPage.html 🗴 🔇 192.168.2.26/settingsPage.html 🗴 🔇 192.168.2.27/index.html 🛛 🗴 🚫 192.168.2.28/index.html	x   +	- 0 ×
← → C △ Not secure 192.168.2.26/settingsPage.html		@ ☆ ① ⑧ :
Serial Number: 255 Device Tag: HMAPLPCB Firmware Version: 2.7-P093024-0-2HS	Reboot Device Logout	
Device List General Settings LAN Settings Protocol Settings Firmware Updater Choose File No file chosen Lpliced	Diagnostics	

The Firmware Updater screen allows the user to update the firmware for the PCB. If a firmware update is required, save the update file (.bin) to the hard drive on the PC. Click Choose File and select the downloaded file. Then click Update to send the file to the PCB. After the "Success" message, please wait at least 5 minutes before logging back on to the PCB with a browser.

#### Diagnostics



The Diagnostics screen shows time stamped PCB events that can be useful for troubleshooting any connection issues.



## Step by Step Connection Procedure Using APL-SW-3

1. Power up the HART field device and set the HART Polling Address to 1 using a HART Communicator.

2. Verify loop current is 4mA.

3. Remove connections from Step 1 and connect the HART field device (+) to the HART

(+) terminal on the PCB. Also connect HART field device (-) to the HART (-) terminal on the PCB.

4. Connect the APL terminals to the APL terminals on the APL-SW-3 Switch. Note there are 3 different channels.

5. Connect a 24Vdc power supply to the APL-SW-3. This will turn the whole APL system on.

6. Verify D4 LED is green on the PCB.

7. Verify D6 LED is blinking Orange on the PCB.

8. The APL-SW-3 has default setting of a DHCP server enabled. It will appear on the network as 192.168.2.1. This setting can be changed using the Web Browser discussed in the user manual for the APL-SW-3. If you connect the APL-SW-3 directly to your PC's Ethernet port, the PC should get an IP address assigned to 192.168.2.26. As APL devices are added, they appear as 192.168.2.27 (Channel 1), 192.168.2.28 (Channel 2), and 192.168.2.29 (Channel 3).

9. Launch DevCom or some other HART-IP enabled host on a device connected to the same Ethernet network as the APL Switch.

10. Configure DevCom to use TCP/IP (HART-IP).

11. Enter the IP address of the APL channel you wish to communicate on.

12. Poll the network.

13. You should see the PCB with the HART field device listed as a sub device.

14. Tap the HART field device.

15. You can now view the HART field device parameters using the APL connection. You can edit parameters, run methods, etc.



#### Warranty

The HM-APL-PCB is warranted for 1 year for materials and workmanship. Contact Support at ProComSol, Ltd if having any problems. An RMA (Return Material Authorization) number obtained from ProComSol, Ltd is required on all returned items.

## **Contact Information**

**ProComSol, Ltd** Process Communications Solutions 13001 Athens Ave Suite 220 Lakewood, OH 44107 USA

Phone: 216.221.1550 Email: <u>sales@procomsol.com</u> <u>support@procomsol.com</u> Web: www.procomsol.com