MTL HART CONNECTION SYSTEM

FLEXIBLE SOLUTIONS

Cooper Industries Japan K.K. MTL-JP@eaton.com http://www.cooperindustries.jp/

WELCOME TO MTL

MTL, the world leader in intrinsic safety, has built an outstanding reputation over 25 years for supplying quality products into the harshest environments.

Where explosive gases are present, MTL's 'intrinsic safety' technique prevents ignition by restricting the energy available in high-risk areas. MTL's solution is simply the most cost effective and reliable method of preventing explosions.

When it comes to **HART Connections** MTL offers the most cost effective, reliable and flexible solutions for every application and industry. From Siberian oil fields to Mexican power plants, MTL HART Connections provide the optimum solution.

The world's leading companies rely on MTL to protect their business and their personnel because MTL's quality and reliability are beyond question. Whatever the client's needs, MTL's holistic, flexible approach delivers a safe, reliable, total solution that integrates easily with existing components and systems.

The simplicity, quality and robustness of MTL's components and processes contribute to significant cost savings when MTL solutions are compared with less well-engineered or incomplete approaches.

HART® FIELD COMMUNICATIONS PROTOCOL

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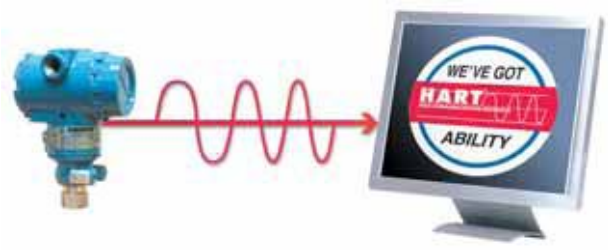
WHAT IS HART?

HART is an open protocol that enables two way digital communication with Smart field devices. It has become the de facto standard for communicating with SMART devices in the process industry as it allows the user to realise the full potential of Smart field devices whilst preserving the traditional 4-20mA signal.



The HART protocol allows additional information to be carried on the same pair of wires with the 4-20mA analogue signal.

Simultaneously and Transparently

WHAT DOES HART GIVE YOU

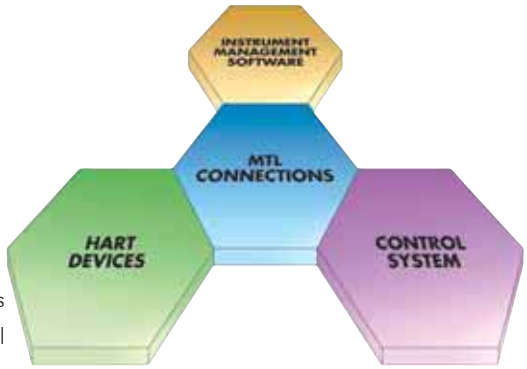
There are millions of HART devices installed in process plants worldwide and each contains valuable data which can enable better management of plant assets, helping to help to reduce commissioning, maintenance and documentation costs.

To communicate with HART devices and extract this data a wide range of powerful Instrument Management Software packages have been developed by a number of different manufacturers i.e AMS, Cornerstone , FieldCare etc. these software packages offer online, continuous communication with your HART devices simplifying configuration, calibration, diagnostics, predictive maintenance and automating documentation etc.

To access this information and maximise the benefits of online HART communication you need HART CONNECTIONS.

HART CONNECTIONS

MTL provide the HART CONNECTION between your field devices, your control system and our instrument management software package.



Our HART CONNECTIONS strip the HART digital signal from the 4-20mA signal (which passes to the control system unscathed) and sends it directly to your maintenance PC. Thus giving you access to the benefits offered by the latest powerful configuration and predictive maintenance software.

For process control systems using traditional I/O installations, the MTL4840 HART Connection System is the ideal HART solution for new installations or upgrades, either intrinsically safe or general purpose applications.

For process I/O installations, MTL8000 Remote I/O is fully HART compatible, allowing read-and-write configuration and calibration parameters as well as online monitoring of key variables and status.

MTL4840 HART CONNECTIONS

FOR TRADITIONAL POINT TO POINT INSTALLATIONS

A Typical MTL4840 HART Connection System will consist of the following three components.

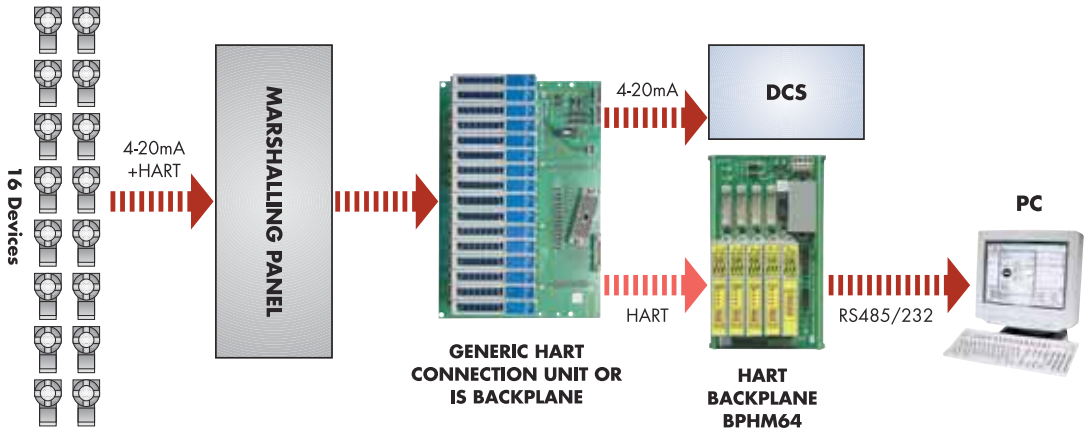
- 1. A **HART Communication Board** to provide a physical connection - HART Communication Unit for safe area applications or intrinsically safe backplane for hazardous area applications.
- 2. **HART multiplexer** to route the communication between the maintenance PC and the HART devices.
- 3. **HART backplane** BPHM64 to hold the HART multiplexer modules.

The HART communication board is the link between the HART field devices and the HART backplane. Normally a 16 channel board, it accepts either AI or AO inputs maintaining channel to channel isolation between each.

The HART backplane is the backbone of the MTL4840 system. This small but vitally important board holds the MTL4840 HART modules which handle the HART multiplexing. Each board can communicate with up to 64 HART devices.

The HART multiplexer is the brains of the system. Its is a combination of two modules, the MTL4841 - HART communications module and MTL4842 - HART interface module. They provide the HART data interface between smart devices in the field and HART instrument management software running on a PC. The modules which mount on the BPHM64 HART backplane connect to the field devices via either HART connection units or IS backplanes depending on the application.

A simple system layout for a 16 channel system is illustrated below:



The MTL4840 system is however completely modular and scalable allowing you to grow the system to the size you require. i.e each 16 channel HART connection board is connected to one MTL interface module and up to 16 of these modules can be connected to one HART communications module. This enables one multiplexer to communicate with up to 256 different HART devices in the network. Additionally up to 31 HART Comms modules can be daisy linked giving 7936 HART devices on one network.

See illustration on centre spread.

The flexibility of the MTL4840 and its ability to communicate with any of the instrument management software packages on the market today allows MTL the ability to offer the optimum solution for any application. Whether for general purpose or IS applications, retrofit or new installations, the versatile MTL4840 system with its wide range of standard or customised backplanes and Hart connection units offers the best connection solution.

SAFE AREA APPLICATIONS

For safe area applications HART field devices are connected to the HART multiplexer via a range of HART Connection Units, the choice of HCU being dependent on the type and number of the HART field devices. The generic HART communication boards are generally mounted in series to the existing Field Termination Panel, see diagram 1, but in certain retrofit applications they can be mounted in parallel, see diagram 2 - Discuss with your MTL representative which is the most appropriate installation for your application.

Dependent on the application see diagrams below:

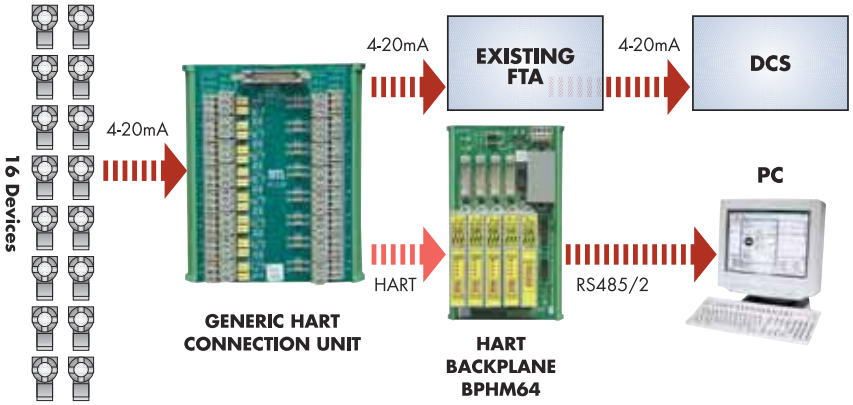
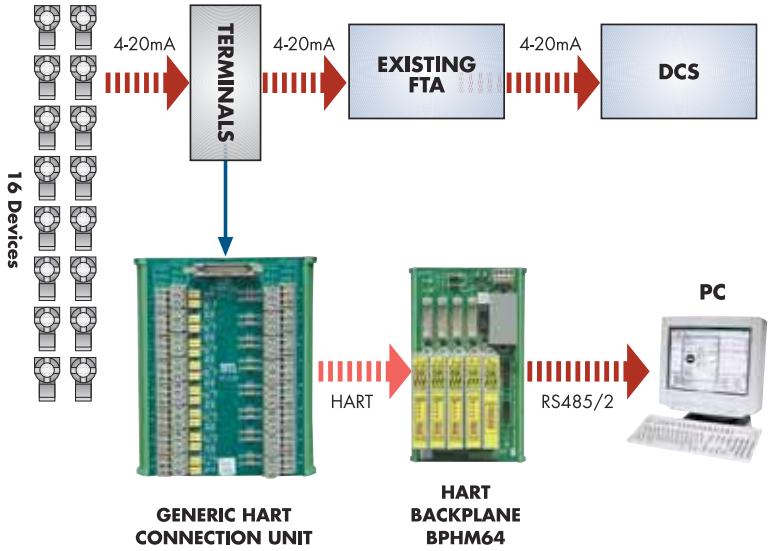


Diagram 1
HCU installed in series

Diagram 2
HCU installed in parallel



Alternatively, customised HCUs can be utilised to replace the exiting the Field Termination Panel thereby reducing the number of connections and simplyfying the installation (see Integrated Solutions - page 10)

INTRINSICALLY SAFE APPLICATIONS

When HART field devices are mounted in the hazardous area the HART signal will have to pass through the IS interface that is protecting the loop.

MTL offer a range of HART compatible zener barriers and galvanic isolators including:

- **MTL4000** - Galvanic Isolators - backplane mounting
- **MTL5000** - Galvanic Isolators for DIN rail mounting
- **MTL700 & MTL7700** - Zener barriers

The MTL4840 is designed specifically for use with the MTL4000 range of backplane mounted galvanic isolators. Connections and integration with this system is as simple as safe area applications.

Every IS backplane is fitted with the HART connector to give simple connection to the HART backplane.

MTL4000 Series backplanes provide both mechanical and electrical connections through the backplane. The advantages they offer include:

Integrated Solutions incorporate	Benefits seen
Power distribution Dual Supply connection Power fail relay	Saves on wiring and installation time Less chance of wiring error Higher reliability Peace of mind
Optional system connector	Saves money, no marshalling panel needed Easy integration gives less chance of wiring errors
Removable connectors	Easier maintenance
16mm module width to give high packing density	Saves money and panel space
Mechanical and electrical connection	Saves installation time Less wiring Less chance of wiring errors

The following range of HART compatible MTL4000 Series isolators are available:

MTL4041A	Single channel input	4-20mA passive HART input
MTL4041B	Single channel input	4-20mA smart transmitter
MTL4041P	Single channel input	4-20mA smart transmitter
MTL4043	Single channel input	4-20mA smart transmitter
MTL4044	Dual channel input	4-20mA smart transmitter
MTL4046	Single channel output	4-20mA smart positioners + LFD
MTL4046C	Single channel output	4-20mA smart positioners
MTL4046P	Single channel output	4-20mA smart positioners + LFD

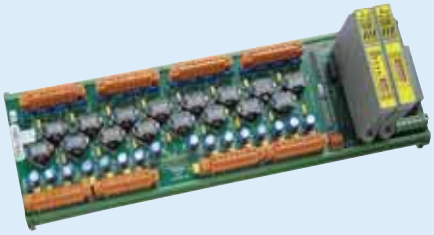
For information on HART compatible interfaces from our other ranges please contact you local MTL representative.

GENERIC HART CONNECTION BOARDS

I/O Card Type	GP Applications	IS Applications
16ch Analogue inputs	HCU16	BPM16U - Multi way connector BPSH16 - fitted with screw connectors
16ch Analogue outputs	HCU16AO	As above
Mix of Analogue inputs/outputs	HCU16AIO	As above
8ch Analogue inputs	HCU08	As above
32 ch Analogue inputs/outputs		BPSH16/32

SPECIAL APPLICATIONS

Some applications only require the use of a few HART field devices in a single location i.e pipe line monitoring. For these applications MTL can mount the HART multiplexer directly onto the HCU or IS Backplane.



HMU16/32 ...

... for General Purpose applications of up to 32 analogue in or analogue out loops.

BPMH16U/BPSH16 ...

... for IS applications. The interface modules can be mounted directly on the backplane alongside the IS isolators.

SIL RATED MULTIPLEXERS

Certified by BASEEFA to IEC61508, the MTL HART multiplexers are approved for use as a safety related sub system in SIL 3 loops.

THE MTL4840 comes with fully certified reliability data from BASEEFA, thus the safety system designer no longer has the uncertainty of having to use uncertified devices.

MTL HART SOLUTIONS

The MTL4840 HART connection system provides the link between HART field instruments, the control system and the instrument management software package.

The MTL systems strips the HART digital signal from the 4-20mA signal (which passes to the control room unscathed) and sends it directly to a maintenance PC, thus giving access to the benefits offered by the latest powerful configuration and predictive maintenance software.

The illustration right shows the architecture of the system and how it can be built to monitor either a few devices or up to 7936 devices on one network.

The connection boards detailed are our generic solution, however we offer a wide variety of connection units to allow full integration of the system whatever DCS, ESD or PLC is used on site.

See page 12 for further details.

BPM16U

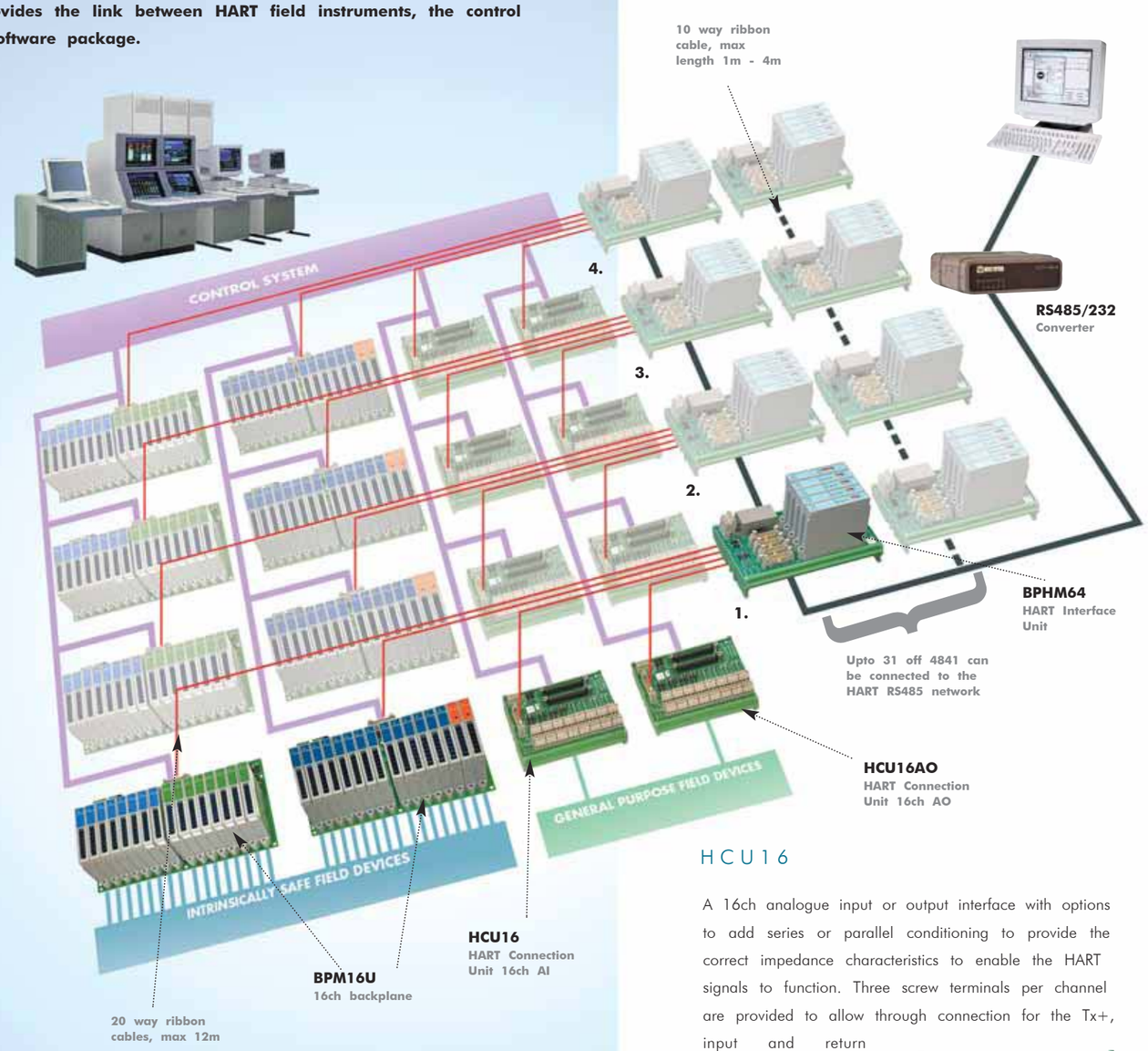
The BPM16U backplane provides the user with a common backplane for all input and output types. All signal conditioning and routing is designed onto a plug-in interface board thus providing a simple and cost effective way to customise the backplane for different applications.

The interface board is held in place with six mounting posts, giving a solid support for the I/O connectors and cables.

Each backplane has connections for dual power feeds and power supply monitoring. Relay contacts provide an alarm if either power feed fails.

HART data is routed from each isolator via a 20-way ribbon cable to the MTL4842 HART multiplexer mounted on the backplane.

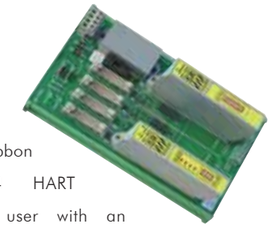
HART SYSTEM OVERVIEW



INSTRUMENT MANAGEMENT SOFTWARE

See page 12 for a full listing of compatible software.

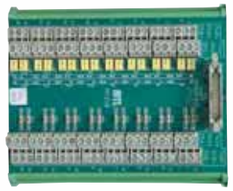
BPHM64



Designed to be connected to remote connection units via ribbon cables, the BPHM64 HART interface provides the user with an interface easily configurable and expandable to meet the system requirements. Each BPHM64 accommodates one MTL4841 communications module and up to four MTL4842 HART interface modules. Since it is possible to connect a total of 16 MTL4842 modules to each comms module, up to 3 BPHM64 backplanes, each with four MTL4842 modules fitted, may be linked via expansion cables.

HCU16

A 16ch analogue input or output interface with options to add series or parallel conditioning to provide the correct impedance characteristics to enable the HART signals to function. Three screw terminals per channel are provided to allow through connection for the Tx+, input and return signals.



Connection to the BPHM64 is made via a 20 way ribbon cable. Channel to channel isolation is provided.

HCU16AO

A 16 channel analogue output interface with HART filters for use in systems where the analogue output signal interferes with the HART data or may become unstable with the presence of the HART data signal. Each filter presents a low impedance d.c. thus maintaining good current drive capability.

Removable screw terminal strips are provided for field and system connections in groups of 4 channels.

Connection to the BPHM64 is made via a 20 way ribbon cable and channel to channel isolation is provided.

INSTRUMENT MANAGEMENT SOFTWARE

Powerful instrument management software is being widely adopted by the process industry to provide detailed process and maintenance information for a broad range of HART field devices.

The online access to the information contained within HART devices allows users to diagnose field device troubles before they lead to costly problems. Software such as AMS, PRM and Cornerstone can capture and use diagnostic data from HART field instruments via the MTL HART connection hardware. This allows users to realise the full potential of their field devices to optimise plant assets, which results in significant operations improvement and direct maintenance savings.

IMS products provide essential configuration, calibration, monitoring and maintenance history functions for conventional analog (4-20 mA) and HART protocol compatible smart process instruments and field devices. They deliver powerful tools to meet the need for standardised instrument maintenance procedures and record keeping mandated by some quality standards and regulatory bodies.

The benefits of utilising these powerful software packages online include:

- **Reduced commissioning time and costs**
- **Reduced maintenance costs**
- **Reduced documentation**
- **Reduced process downtime**

The MTL HART Connection System offers connectivity to a comprehensive range of both...

- **general instrument management software packages and**
- **dedicated software packages for optimising Valve positioner performance and maintenance including...**

Software	Manufacturer	4841 Version
AMS Device Manager v7	Emerson Process Management	MTL4841-AMSv7
Cornerstone	Applied System Technologies	MTL4841
FDM	Honeywell	MTL4841
FieldCare	Endress & Hauser/Metso Automation	MTL4841-AMS with Comms DTM
HART OPC Server	HART Communication Foundation	MTL4841
PACTware	PACTware Consortium	MTL4841-AMS with Comms DTM
PDM	Siemens	MTL4841
PRM	Yokogawa	MTL4841-PRM
SmartVision	ABB	MTL4841-AMS with Comms DTM
SoftTools	Flowserve	MTL4841
ValveLink	Emerson Process Management	MTL4841
Valvue	Masoneilan	MTL4841

For software packages that are based on an FDT frame i.e FieldCare, PACTware etc. communication with the MTL HART multiplexer system requires the MTL Generic Communications DTM. This can be downloaded free of charge from www.mtl-inst.com.

HART CONNECTIONS FOR PROCESS I/O

So you've 'future-proofed' your process plant with field-mounted I/O and smart field devices... but are you making the most of your HART?

The high accuracy offered by HART transmitters is used to its maximum potential when the process variables are transmitted in digital form from the field instrument through the I/O to the controlling host. The controller can access the status of each smart field devices, providing greater diagnostic information on the health and operation of the associated sensor.

For HART valve positioners, the travel of the control valve dictated by the 4-20mA drive signal can be monitored by the controller as one of the HART process variables, allowing the valve position to be displayed on the HMI face plate.

MTL8000 Process I/O ™ system has been designed to be transparent to HART signals, thus allowing the host control software and any field instruments to communicate directly with each other. In addition MTL8000 systems provide on line access from a PC to the HART field devices for monitoring device performance. HART devices may be selected for regular status monitoring and alerts can be issued if the status changes.

The benefits of this approach are:

- **Reduced commissioning time and costs**
- **Reduced process downtime through status monitoring**
- **Lower loop maintenance costs by using field device diagnostics**

For Zone 2 applications the **MTL8000 2/x Series** modular I/O system provides direct communication with the controller via an open bus to an I/O 'node' located close to field instruments often in harsh and hazardous environments. Process I/O uses MTL8000 Series AI and AO with HART modules to regularly scan up to four HART process and device status variables. These are accessible to the controller via the Modbus or Profibus link and the control system can be configured to use this important data to improve overall process control.

MTL8000 1/1 Series is an innovative remote I/O system targeted at applications which require installation in Zone 1 hazardous areas and connection to Profibus-DP hosts while maintaining a low installed cost. Analog modules 'with HART' can obtain information from HART instruments of revision 5.0 or later. Each channel can communicate with a single HART instrument. The 'with HART' modules regularly scan up to four HART process and device status variables which are communicated over Profibus-DP for easy integration in the controller.

HART over Profibus functionality enables the HART information to be passed through the system direct to Asset Management Packages such as AMS Device Manager.

MTL HART INTEGRATED SOLUTIONS

One of the simplest and most cost effective methods of integrating HART CONNECTIONS into a traditional point to point Process I/O solution is to install a customised HART connection board in place of the normal DCS Field Termination Panel.

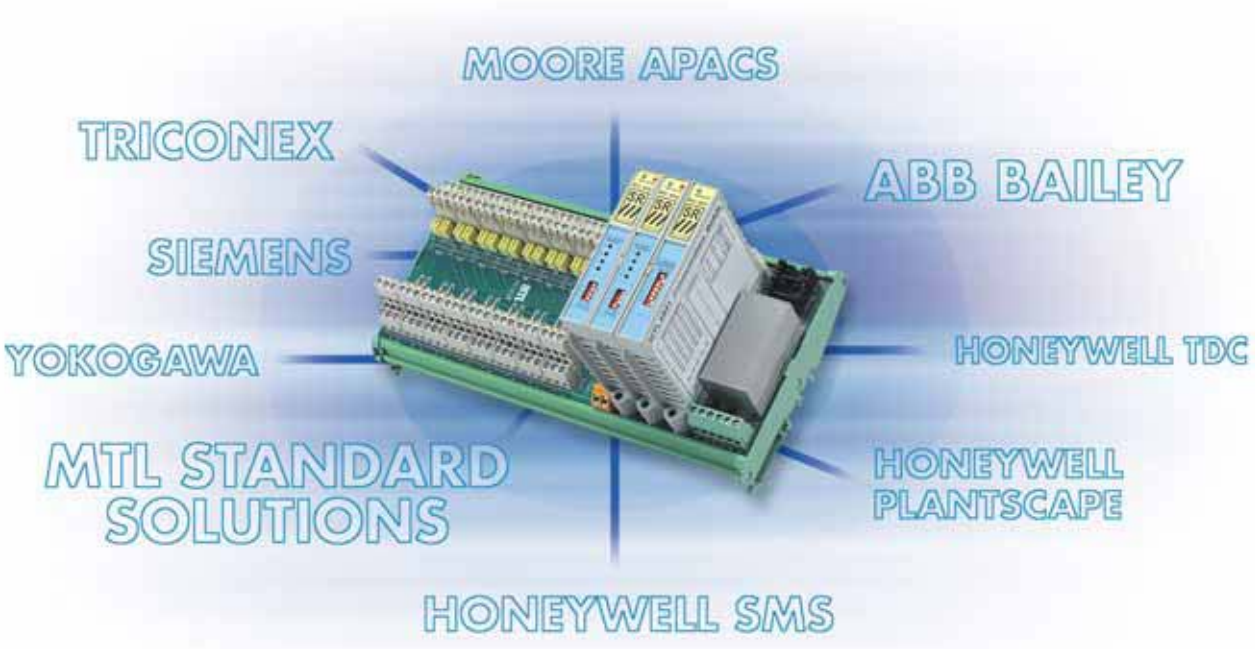
MTL manufacture a wide range of customised backplanes and HART connection units to replace the standard DCS termination boards and provide direct pickup of the HART signal.

The MTL HART connection units have all the features of the standard DCS termination board with the addition of the HART multiway connector which links the board to the HART backplane. Additional features can be added as required.

- **Channel to channel isolation**
- **Customised field and system connectors**
- **HART signal conditioning**
- **HART filters for use in systems where the analogue output signal either interferes with HART data or may become unstable with the presence of the HART signal**
- **Variable number of channels**
- **Channel labelling**

Whatever the application, MTL have, or can design, an integrated solution to allow simple, flexible and space effective connection to your control system. Installations worldwide show that users everywhere recognise the quality and reliability of MTL Integrated Solutions

The range of integrated options is too extensive to list. Please contact your local MTL representative for full details.



CONNECTING HART

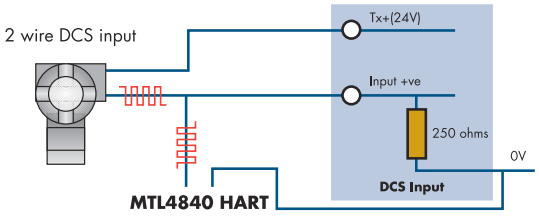
When connecting any HART device, be it an instrument, hand held configurator or HART connection system there are a few rules to follow concerning the impedance of the loop. Customised backplanes and HCUs are designed with these rules in mind making HART connections simple and reliable.

ANALOGUE INPUTS

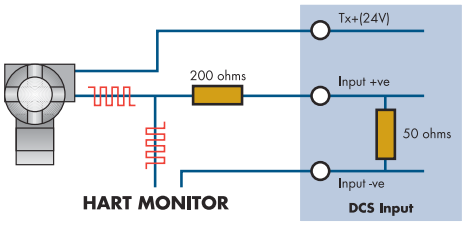
As HART devices monitor the HART signal in a voltage form, the impedance at the monitoring point must be >240 ohms or the amplitude of the signal will be insufficient for the input circuits in the monitoring device to detect the data. Where the HART signal is monitored within the loop is not important, as long as there is sufficient impedance. This can be at the transmitter or across the DCS input if it has a 250 ohm input resistor.

Where HART is to be detected on inputs of <240 ohms, either in IS or safe area applications, a series resistor must be added to the loop to raise the impedance to >240 ohms. Various versions of the HCU16 are available to add the necessary resistance to the loop. Custom backplanes for IS applications are already fitted with components to raise the impedance where necessary.

Impedance in the loop >240ohms



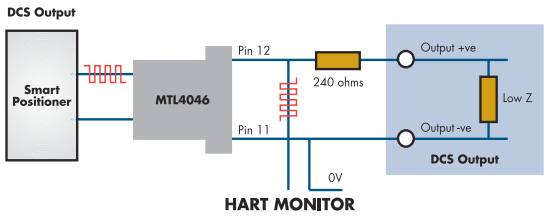
If the DCS inputs are less than 240 ohms



ANALOGUE OUTPUTS

With analogue outputs there is more to consider. As with inputs, the impedance in the loop for HART to operate must be >240 ohms. Very few DCS analogue outputs present a high impedance to the loop. Most analogue outputs monitor the current in the loop and control a voltage source to obtain the correct current. Voltage sources are generally low impedance so connecting a HART signal will limit the amplitude of that signal to a point where it can no longer work.

IS ANALOGUE OUTPUTS

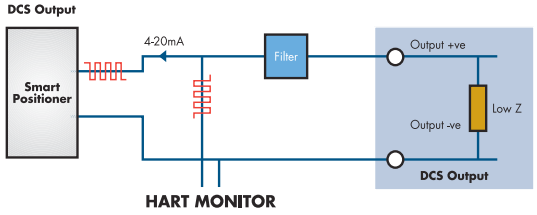


In IS applications, fitting a simple resistor between the output +ve and the input to the isolator will raise the impedance up to the required level. In some cases it may be necessary to add additional filtering between the output and the isolator if:

1. the HART signal affects the stability of the current signal or:
2. the noise generated by the analogue output interferes with the HART data.

Talk to MTL for full installation details and advice.

NON-IS ANALOGUE OUTPUTS



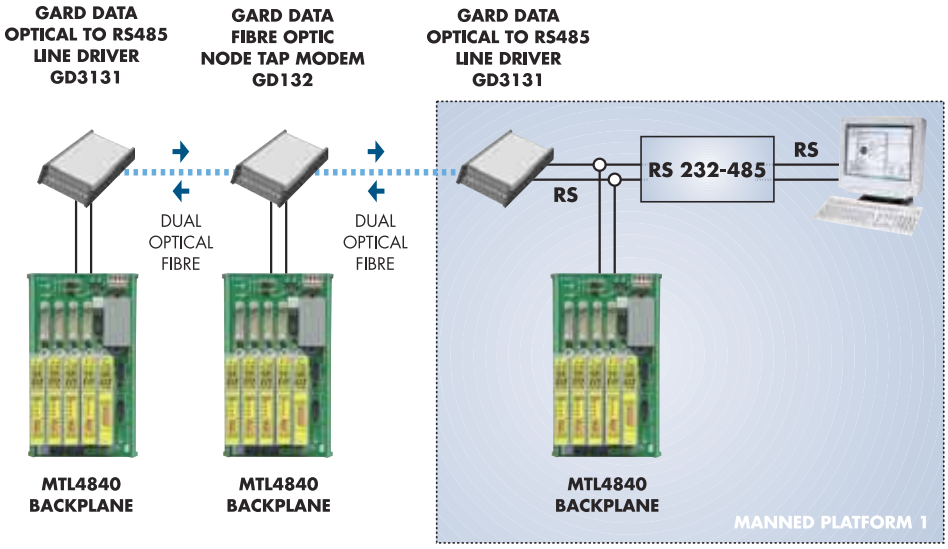
In safe area applications it's important not to significantly increase the resistance to the loop. A simple resistive filter will reduce the available voltage to the loop by up to 5V. This in many applications will cause the loop to 'run out of volts' towards 20mA. The filter circuit used on the HCU16AO presents a very low series resistance to dc but a high impedance to the HART signal. This filter circuit should be used in these applications and will maintain the full output drive specification of the control system.

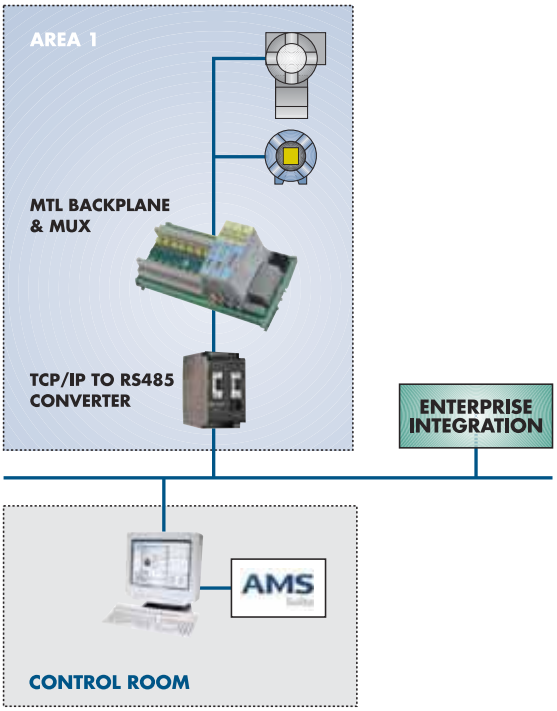
HART APPLICATIONS

MTL HART maintenance systems are utilised in a wide variety of applications around the world. The system is extremely flexible allowing communication between the host and HART device to be carried by copper, optical fibre, wireless or ethernet.

One application in the North Sea required HART devices situated on a number of unmanned platforms to be connected to the Instrument Management Software system running on a nearby manned platform.

An underground fibre optic network had been installed to connect the various platforms and this was utilised to carry the HART signals. On each of the unmanned platforms the HART devices were connected to a standard MTL HART Maintenance System. The RS485 connection from each of the HART backplanes was then connected to a Guard Data Fibre Optic Node Tap Modem.





HART devices on the manned platform were connected via the HART backplanes to the copper RS485 network. All HART devices on manned and unmanned platforms were now connected to the serial port on one PC running Cornerstone software. This enabled all devices to be monitored and configured without the need for an engineer to visit the unmanned platform.

Similarly on large plants where HART devices may be scattered over a very large area, the use of a copper RS485 network is impractical. At a recent installation in Kazakhstan there was a requirement to connect up to 20,000 HART devices to a Predictive Maintenance software package.

The site had been designed to include a full Ethernet network, and the brief from the contractor was to offer a HART maintenance system which would run over the Ethernet LAN.

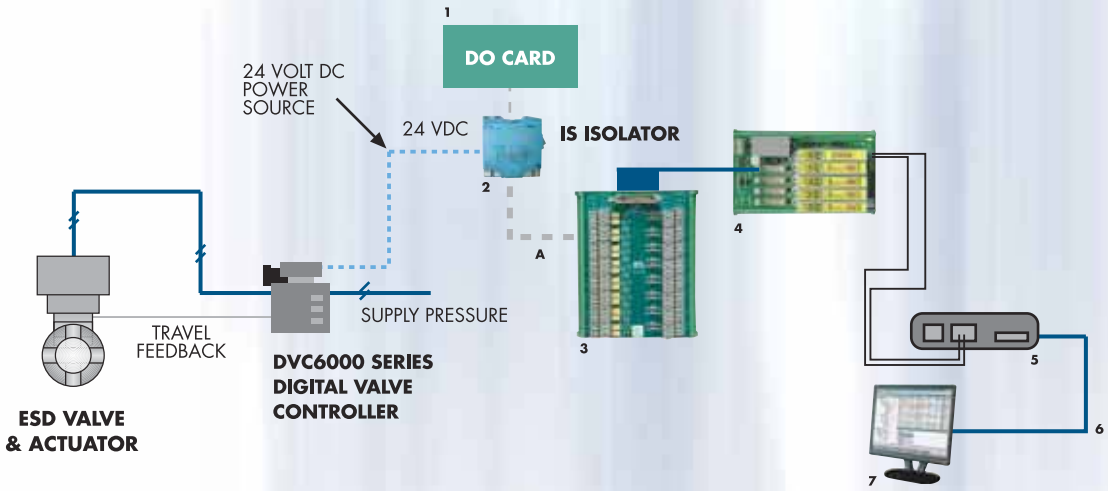
AMS Device Manager from Emerson has the ability to run on an Ethernet network allowing secure access from a number of client stations.

The site will eventually have 20 operating areas and cover approx 400 square kilometers. The MTL HART Maintenance System will link all the HART devices from each of these areas into a single database running on the AMS server, giving the ability to check a device status, configure, re-range and perform diagnostics from the PC without going into the field.

PARTIAL STROKE VALVE TESTING WITH HART

An increasingly popular application for HART is for the partial stroke testing of Emergency Shut Down (ESD) valves. Unlike normal process valves which are continuously moving, ESD valves can stay in one position for a long time. Therefore they can become stuck and may not operate when needed.

Connecting a SMART positioner such as the DVC6000 to the MTL HART Maintenance System allows the software to perform a Partial Stroke test on the ESD valve without the need for a disruptive process shutdown.



NOMENCLATURE:

ITEM 1 - Safety system DO card

ITEM 2 - Repeater power supply barrier - MTL5042

ITEM 3 - MTL HCU16-P250 HART Connection Unit (with 250 ohm parallel resistor)

ITEM 4 - MTL BPHM64 HART backplane with MTL4842 HART interface module and MTL4841 HART communication module

ITEM 5 - RS485/232 converter - Westermo MA45

ITEM 6 - Max 10m signal cable

ITEM 7 - Instrument Management Software workstation

ITEM A - Cable connection from MTL isolator to MTL HART Connection Unit

The system can be used for intrinsically safe, Exd or safe area applications. The diagram above shows an IS application with a MTL5042 IS isolator connected between the Safety System DO card, the SMART positioner and the HART maintenance system. For Exd or safe area applications the Isolator can be removed from the circuit.

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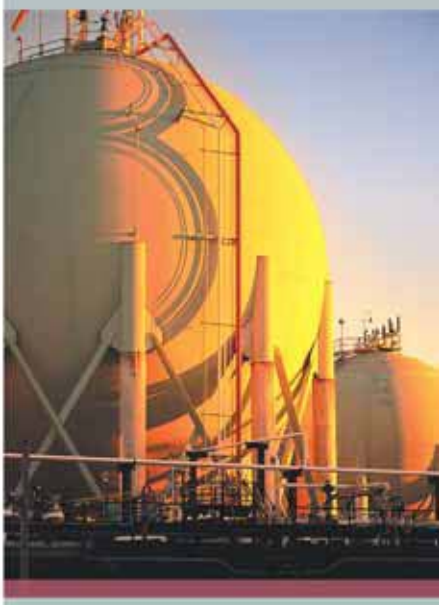

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