

RS485 Supplemental Manual

PC100 Series Pressure Controllers

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Introduction

Many applications of Pressure Controllers (PCs) are increasing the use of automation. Automation comes in many forms:

PLC's (Programmable Logic Controllers, DCS's (Distributed Control Systems, and PC-based solutions. Digital communications from these varied automation systems and the devices they control are very efficient means of not only accomplishing more effective and rapid system integration, but also providing greatly improved system diagnostics and maintainability.

The purpose of this document is to outline the generic RS485 multi-drop communication protocol for Brooks Instrument digital Pressure Controller (PC).

This protocol is intended to serve all digital PCs. Only the following messages are supported:

Query for MAC	The master controller will use this message to query the existence of a PC.
Digital mode selection	The master controller will use this message to set a PC to digital mode.
Freeze Follow	The master controller will use this message to configure a PC to act upon a new setpoint when received.
Setpoint	The master controller will use this message to send a new setpoint to a PC.
Ramp Time	The master controller will use this message to send a ramp time to a PC.
Filtered Setpoint	The master controller will use this message to get the current setpoint from a PC.
Indicated Flow	The master controller will use this message to get the current flow reading from a PC.
Valve Drive Current	The master controller will use this message to get the valve drive current.
Calibration Instance (Process Gas Page) Selection	The master controller will use this message to select which calibration instance is to be used for pressure control.
Query for Calibration Instance (Process Gas Page) Selected	The master controller will use this message to query the selected calibration instance, which is currently being used for pressure control.
Query for Available Calibration Instances (Process Gas Pages)	The master controller will use this message to query available number of calibration instances.
Requested Zero Enable	The master controller will use this message to enable requested function.
Query for Requested Zero Status	The master controller will use this message to query if the requested zero function has been completed.
Query for Sensor Current Zero	The master controller will use this message to query the current sensor zero offset.
Query for Sensor Reference Zero	The master controller will use this message to query the sensor reference zero offset.
Set Sensor Reference Zero	The master controller will use this message to set sensor reference zero offset.
Query for Inlet Pressure	The master controller will use this message to query the pressure transducer reading.
Query for Temperature	The master controller will use this message to query the temperature reading.

Topology

The controller acts as a Master device on an RS-485 multi-drop bus. The master device controls all transactions on the bus.

The digital PC (up to 31 devices) acts as a slave device on an RS-485 multi-drop bus. The slave device continually listens for transaction requests from the Master controller, processes requests addressed to it, and sends replies as needed.

Communication Parameters

BAUD rate	9600, 19200, 38400, 57600, 115200
Data Bits	8
✧ Start bit	1
✧ Stop bit	1
✧ Parity	none
Byte Order	LSB first
MAC(Address)	
Master Controller	0
Digital MFC controller 1-31	0x21(33) – 0x3F (63)
Broadcast Packet Address	0xFF (255)
Addresses 0x01 to 0x1F are reserved for bus control characters.	
ACK	0x06
NAK	0x16

Message Format

Messages on the bus are sent as packets with a fixed format, illustrated as the following diagram. Each packet begins with the target digital PC MAC ID (address), an STX character (0x02), a service (command) code (0x80 for read and 0x81 for write), a packet length character, a variable identifier (consisting of Class ID, Instance ID, Attribute ID) and a data count between 0 to 2. Each packet ends with a pad byte of 0, and a 1-byte checksum, which is the sum of all the bytes in the packet, other than the target MAC ID, modulo 256. The checksum calculation discards the carry from the byte summation calculation. This message structure is similar to the one used by DeviceNet protocol.

MAC ID (Targeted PC Address)
STX (0x02)
Command Code (0x80 for read, 0x81 for write)
Packet Length
Class ID
Instance ID
Attribute ID
Data (0 - 2 bytes)
Pad (0x00)
Checksum

All communications on the bus are done by service requests (from Master controller to a specified slave PC), each addressed to a specific MAC ID, Class ID, Instance ID and Attribute ID. Currently this protocol supports only 2 services – Read and Write.

The following table summarizes the specification of Class ID, Instance ID, and Attribute ID for each supported message:

Message	Class ID	Instance ID	Attribute ID
Query for MAC ID	0x03	0x01	0x01
Digital Mode Selection	0x69	0x01	0x03
Query for Present Control Mode	0x69	0x01	0x03
Freeze Follow	0x69	0x01	0x05
New Setpoint	0x69	0x01	0xA4
Ramp Time	0x6A	0x01	0xA4
Filtered Setpoint	0x6A	0x01	0xA6
Indicated Flow	0x6A	0x01	0xA9
Valve Drive Current	0x6A	0x01	0xB6
Calibration Instance	0x66	0x00	0x65
Query for Calibration Instance	0x66	0x00	0x65
Query for Available # of Calibration Instances	0x66	0x00	0xA0
Auto Zero Enable/Disable	0x68	0x01	0xA5
Requested Zero Enable	0x68	0x01	0xBA
Query for Requested Zero Status	0x68	0x01	0xBA
Query for Sensor Current Zero	0x68	0x01	0xA9
Query for Sensor Reference Zero	0x68	0x01	0xAA
Set Sensor Reference Zero	0x68	0x01	0xAA
Set Default Control Mode	0x69	0x01	0x03
Query for Default Control Mode	0x69	0x01	0x03
Query for Inlet Pressure	0x31	0x02	0x06
Query for Temperature	0x31	0x03	0x06
Set MAC ID (Hardware Dependent): See Appendix	0x03	0x01	0x01

The following sub-sections describe in detail the supported messages.

Query for MAC ID

The master controller will use this message to query the existence of a PC.

Query message from master controller to a digital PC

MAC ID (Targeted PC address)
STX (0x02)
Command Code (0x80 for read)
Packet Length (0x03)
Class ID (0x03)
Instance ID (0x01)
Attribute ID (0x01)
Pad (0x00)
Checksum (0x8A)

Response message from a digital PC to master controller

MAC ID (0 – Master controller)
STX (0x02)
Command Code (0x80 for read)
Packet Length (0x04)
Class ID (0x03)
Instance ID (0x01)
Attribute ID (0x01)
PC MAC ID
Pad (0x00)
Checksum

Digital Mode Selection

Master controller will use this message to set a PC to digital or analog mode.

Digital mode selection messages

MAC ID (Targeted PC controller address)
STX (0x02)
Command Code (0x81 for write)
Packet Length (0x04)
Class ID (0x69)
Instance ID (0x01)
Attribute ID (0x03)
Mode (1 – digital, 2 - analog)
Pad (0x00)
Checksum

Query Present Control Mode

Master controller will use this message to query the present control mode.

Query message from master controller to a digital PC

MAC ID (Targeted PC address)
STX (0x02)
Command Code (0x80 for read)
Packet Length (0x03)
Class ID (0x69)
Instance ID (0x01)
Attribute ID (0x03)
Pad (0x00)
Checksum (0xF2)

Response message from a digital PC to master controller

MAC ID (0-Master Controller)
STX (0x02)
Command Code (0x80 for read)
Packet Length (0x04)
Class ID (0x69)
Instance ID (0x01)
Attribute ID (0x03)
Mode (1 – digital, 2 - analog)
Pad (0x00)
Checksum

Freeze Follow

Master controller will use this message to configure a PC to act upon, or ignore, a new setpoint when received.

MAC ID (Targeted PC address)
STX (0x02)
Command Code (0x81 for write)
Packet Length (0x04)
Class ID (0x69)
Instance ID (0x01)
Attribute ID (0x05)
FreezeFollow (1-Act on new setpoint immediately- (default)) (0-Ignore change in setpoint)
Pad (0x00)
Checksum

New Setpoint

Master controller will use this message to send a new setpoint to a PC.

MAC ID (Targeted PC address)
STX (0x02)
Command Code (0x81 for write)
Packet Length (0x05)
Class ID (0x69)
Instance ID (0x01)
Attribute ID (0xA4)
Data Byte#1 (LSB)*
Data Byte#2 (MSB)*
Pad (0x00)
Checksum

*See New Setpoint conversion Table, pg. 51

Ramp Time

The master controller will use this message to send a ramp time to a PC controller. The ramp time is how long the PC controller should take to reach the final setpoint from the current setpoint. The unit is millisecond. A zero ramp time effectively disables the ramping.

Request message from Master controller to a digital PC

MAC ID (Targeted PC address)
STX (0x02)
Command Code (0x81 for write)
Packet Length (0x05)
Class ID (0x6A)
Instance ID (0x01)
Attribute ID (0xA4)
Data Byte#1 (LSB)
Data Byte#2 (MSB)
Pad (0x00)
Checksum

Ramp time (msec)	Ramp Time value (hex)
0	0000
65535	FFFF

Query for Ramp Time Setting

The master controller will use this message to query the ramp time setting.

Request message from Master controller to a digital PC

MAC ID (Targeted PC address)
STX (0x02)
Command Code (0x80 for read)
Packet Length (0x03)
Class ID (0x6A)
Instance ID (0x01)
Attribute ID (0xA4)
Pad (0x00)
Checksum (0x94)

Response message from a digital PC controller to a Master controller

MAC ID (0 - controller address)
STX (0x02)
Command Code (0x80 for read)
Packet Length (0x07)
Class ID (0x6A)
Instance ID (0x01)
Attribute ID (0xA4)
Data Byte #1 (LSB)
Data Byte #2 (MSB)
Reserved Byte #1
Reserved Byte #2
Pad (0x00)
Checksum

Filtered Setpoint

The master controller will use this message to get the current setpoint from a PC. This is the current setpoint after ramping has been applied.

Request message from Master controller to a digital PC

MAC ID (Targeted PC address)
STX (0x02)
Command Code (0x80 for read)
Packet Length (0x03)
Class ID (0x6A)
Instance ID (0x01)
Attribute ID (0xA6)
Pad (0x00)
Checksum (0x96)

Response message from a digital PC controller to a Master controller

MAC ID (0 – Master controller)
STX (0x02)
Command Code (0x80 for read)
Packet Length (0x05)
Class ID (0x6A)
Instance ID (0x01)
Attribute ID (0xA6)
Data Byte #1 (LSB)*
Data Byte #2 (MSB)*
Pad (0x00)
Checksum

*See New Setpoint Conversion Table Pg. 51

Indicated Flow

The master controller will use this message to get the current pressure reading from a PC.

Request message from Master controller to a digital PC

MAC ID (Targeted PC address)
STX (0x02)
Command Code (0x80 for read)
Packet Length (0x03)
Class ID (0x6A)
Instance ID (0x01)
Attribute ID (0xA9)
Pad (0x00)
Checksum (0x99)

Response message from a digital PC controller to a Master controller

MAC ID (0 – Master controller)
STX (0x02)
Command Code (0x80 for read)
Packet Length (0x05)
Class ID (0x6A)
Instance ID (0x01)
Attribute ID (0xA9)
Data Byte #1 (LSB)*
Data Byte #2 (MSB)*
Pad (0x00)
Checksum

*See New Setpoint Conversion Table Pg. 51

Valve Drive Current

The master controller will use this message to get the valve drive current.

Request message from Master controller to a digital PC

MAC ID (Targeted PC address)
STX (0x02)
Command Code (0x80 for read)
Packet Length (0x03)
Class ID (0x6A)
Instance ID (0x01)
Attribute ID (0xB6)
Pad (0x00)
Checksum (0xA6)

Response message from a digital PC controller to a Master controller

MAC ID (0 – Master controller)
STX (0x02)
Command Code (0x80 for read)
Packet Length (0x05)
Class ID (0x6A)
Instance ID (0x01)
Attribute ID (0xB6)
Data Byte #1 (LSB)*
Data Byte #2 (MSB)*
Pad (0x00)
Checksum

% Valve Drive	Valve Drive value (Hex)
0.0	0000
100.0	FFFF

Calibration Instance (Process Gas Page) Selection

Master controller will use this message to select which calibration instance is to be used for pressure metering.

MAC ID (Targeted PC controller address)
STX (0x02)
Command Code (0x81 for write)
Packet Length (0x04)
Class ID (0x66)
Instance ID (0x00)
Attribute ID (0x65)
Calibration Instance ID (#)
Pad (0x00)
Checksum

Query for Calibration Instance (Process Gas Page) Selection

The master controller will use this message to query the selected calibration instance, which is currently being used for pressure metering.

Request message from Master controller to a digital PC

MAC ID (Targeted PC controller address)
STX (0x02)
Command Code (0x80 for read)
Packet Length (0x03)
Class ID (0x66)
Instance ID (0x00)
Attribute ID (0x65)
Pad (0x00)
Checksum (0x50)

Response message from a digital PC controller to a Master controller

MAC ID (0 – Master controller)
STX (0x02)
Command Code (0x80 for read)
Packet Length (0x05)
Class ID (0x66)
Instance ID (0x00)
Attribute ID (0x65)
Calibration Instance ID (#)
Reserved Byte
Pad (0x00)
Checksum

Query for Available Calibration Instances (Process Gas Page)

Master controller will use this message to query available number of calibration instances.

Request message from Master controller to a digital PC

MAC ID (Targeted PC address)
STX (0x02)
Command Code (0x80 for read)
Packet Length (0x03)
Class ID (0x66)
Instance ID (0x00)
Attribute ID (0xA0)
Pad (0x00)
Checksum (0x8B)

Response message from a digital PC controller to a Master controller

MAC ID (0 – Master controller)
STX (0x02)
Command Code (0x80 for read)
Packet Length (0x04)
Class ID (0x66)
Instance ID (0x00)
Attribute ID (0xA0)
Available # Of Calibration Instances
Pad (0x00)
Checksum

Auto Zero Enable/Disable

Master controller will use this message to enable auto zero function.

MAC ID (Targeted PC address)
STX (0x02)
Command Code (0x81 for write)
Packet Length (0x04)
Class ID (0x68)
Instance ID (0x01)
Attribute ID (0xA5)
1 for Enable, 0 for Disable
Pad (0x00)
Checksum

Requested Zero Enable

Master controller will use this message to enable requested function.

MAC ID (Targeted PC address)
STX (0x02)
Command Code (0x81 for write)
Packet Length (0x04)
Class ID (0x68)
Instance ID (0x01)
Attribute ID (0xBA)
1 for enable
Pad (0x00)
Checksum

Query for Requested Zero Status

Master controller will use this message to query if the requested zero function has been completed.

Request message from Master controller to a digital PC

MAC ID (Targeted PC address)
STX (0x02)
Command Code (0x80 for read)
Packet Length (0x03)
Class ID (0x68)
Instance ID (0x01)
Attribute ID (0xBA)
Pad (0x00)
Checksum (0xA8)

Response message from a digital PC controller to a Master controller

MAC ID (0 – Master controller)
STX (0x02)
Command Code (0x80 for read)
Packet Length (0x04)
Class ID (0x68)
Instance ID (0x01)
Attribute ID (0xBA)
0 = Completed, 1 = In progress
Pad (0x00)
Checksum

Query for Sensor Current Zero

Master controller will use this message to query the current sensor zero offset.

Request message from Master controller to a digital PC

MAC ID (Targeted PC address)
STX (0x02)
Command Code (0x80 for read)
Packet Length (0x03)
Class ID (0x68)
Instance ID (0x01)
Attribute ID (0xA9)
Pad (0x00)
Checksum (0x97)

Response message from a digital PC controller to a Master controller

MAC ID (0 – Master controller)
STX (0x02)
Command Code (0x80 for read)
Packet Length (0x07)
Class ID (0x68)
Instance ID (0x01)
Attribute ID (0xA9)
Data Byte #1 (LSB)
Data Byte #2 (MSB)
Reserved Byte #1
Reserved Byte #2
Pad (0x00)
Checksum

Query for Sensor Reference Zero

Master controller will use this message to query the sensor reference zero offset.

Request message from Master controller to a digital PC

MAC ID (Targeted PC address)
STX (0x02)
Command Code (0x80 for read)
Packet Length (0x03)
Class ID (0x68)
Instance ID (0x01)
Attribute ID (0xAA)
Pad (0x00)
Checksum (0x98)

Response message from a digital PC controller to a Master controller

MAC ID (0 – Master controller)
STX (0x02)
Command Code (0x80 for read)
Packet Length (0x05)
Class ID (0x68)
Instance ID (0x01)
Attribute ID (0xAA)
Data Byte #1 (LSB)
Data Byte #2 (MSB)
Pad (0x00)
Checksum

Set Sensor Reference Zero

Master controller will use this message to set sensor reference zero offset.

MAC ID (Targeted PC address)
STX (0x02)
Command Code (0x81 for write)
Packet Length (0x05)
Class ID (0x68)
Instance ID (0x01)
Attribute ID (0xAA)
Data Byte#1 (LSB)
Data Byte#2 (MSB)
Pad (0x00)
Checksum

Query Default Control Mode

Master controller will use this message to query the PC wakeup control mode.

Request message from Master controller to a digital PC

MAC ID (Targeted PC address)
STX (0x02)
Command Code (0x80 for read)
Packet Length (0x03)
Class ID (0x69)
Instance ID (0x01)
Attribute ID (0x04)
Pad (0x00)
Checksum (0xF3)

Response message from a digital PC controller to a Master controller

MAC ID (Targeted PC address)
STX (0x02)
Command Code (0x80 for read)
Packet Length (0x04)
Class ID (0x69)
Instance ID (0x01)
Attribute ID (0x04)
Mode (1 = Digital, 2 = Analog)
Pad (0x00)
Checksum

Query for Inlet Pressure

Master Controller will use this message to query the current pressure transducer reading.

Request message from Master controller to a digital PC

MAC ID (Targeted PC address)
STX (0x02)
Command Code (0x80 for read)
Packet Length (0x03)
Class ID (0x31)
Instance ID (0x02)
Attribute ID (0x06)
Pad (0x00)
Checksum (0xBE)

Response message from a digital PC controller to a Master controller

MAC ID (0 – Master controller)
STX (0x02)
Command Code (0x80 for read)
Packet Length (0x05)
Class ID (0x31)
Instance ID (0x02)
Attribute ID (0x06)
Data Byte #1 (LSB)
Data Byte #2 (MSB)
Pad (0x00)
Checksum

Actual Pressure Reading (psia)	Output Value (hex)	Output Value (decimal)
0	0000	0
100	6000	24576

The actual pressure reading is calculated from the output value:

$$\text{Actual Pressure Reading} = (\text{Output_Value} / \text{Full_scale_output_value}) * 100$$

Where: Full_scale_output_value = 24576 (0x6000)

Query for Temperature

Master controller will use this message to query the current temperature reading.

Request message from Master controller to a digital PC

MAC ID (Targeted PC address)
STX (0x02)
Command Code (0x80 for read)
Packet Length (0x03)
Class ID (0x31)
Instance ID (0x03)
Attribute ID (0x06)
Pad (0x00)
Checksum (0xBF)

Response message from a digital PC controller to a Master controller

MAC ID (0 – Master controller)
STX (0x02)
Command Code (0x80 for read)
Packet Length (0x05)
Class ID (0x31)
Instance ID (0x03)
Attribute ID (0x06)
Data Byte #1 (LSB)
Data Byte #2 (MSB)
Pad (0x00)
Checksum

Actual Temperature Reading (psia)	Output Value (hex)	Output Value (decimal)
0	0000	0
500	6000	24576

The actual temperature reading is calculated from the output value:

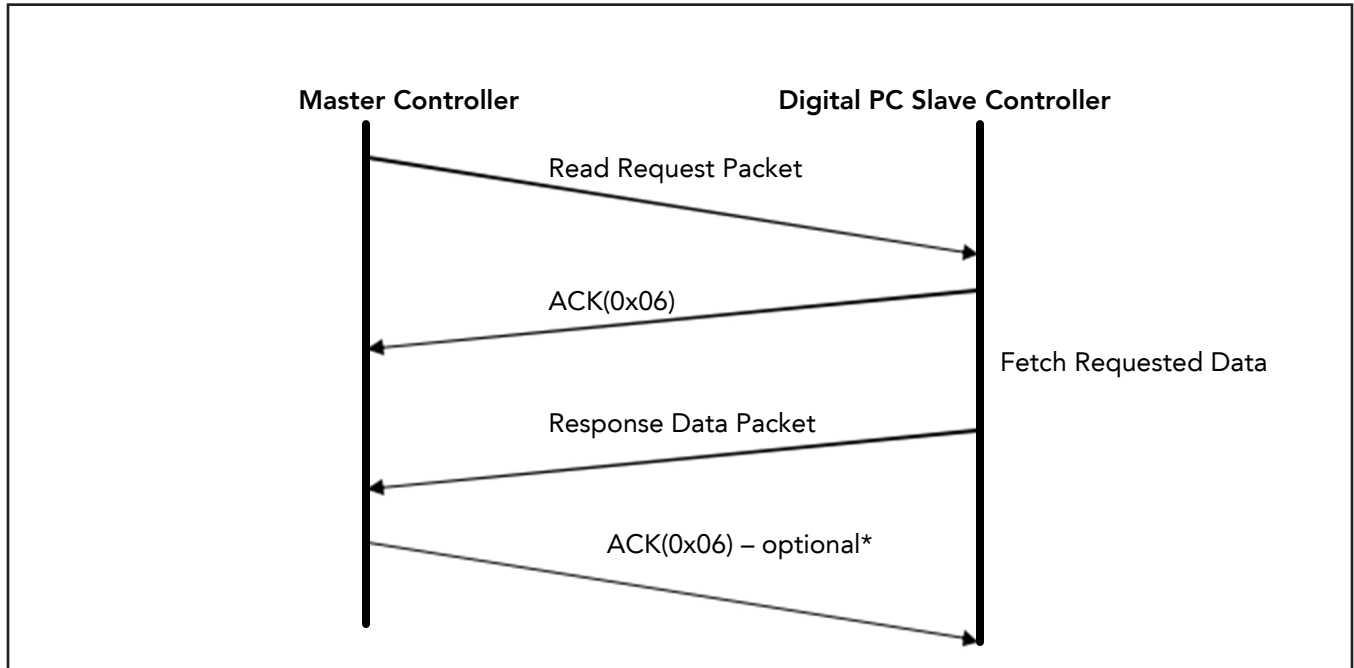
$$\text{Actual Temperature Reading (}^{\circ}\text{K)} = (\text{Output_Value}/\text{Full_scale_output_value}) * 500$$

Where $\text{Full_scale_output_value} = 24576 \text{ (0x6000)}$

$$\text{Actual Temperature Reading (}^{\circ}\text{C)} = ((\text{Output_value}/\text{Full_scale_output_value}) * 500) - 273.15$$

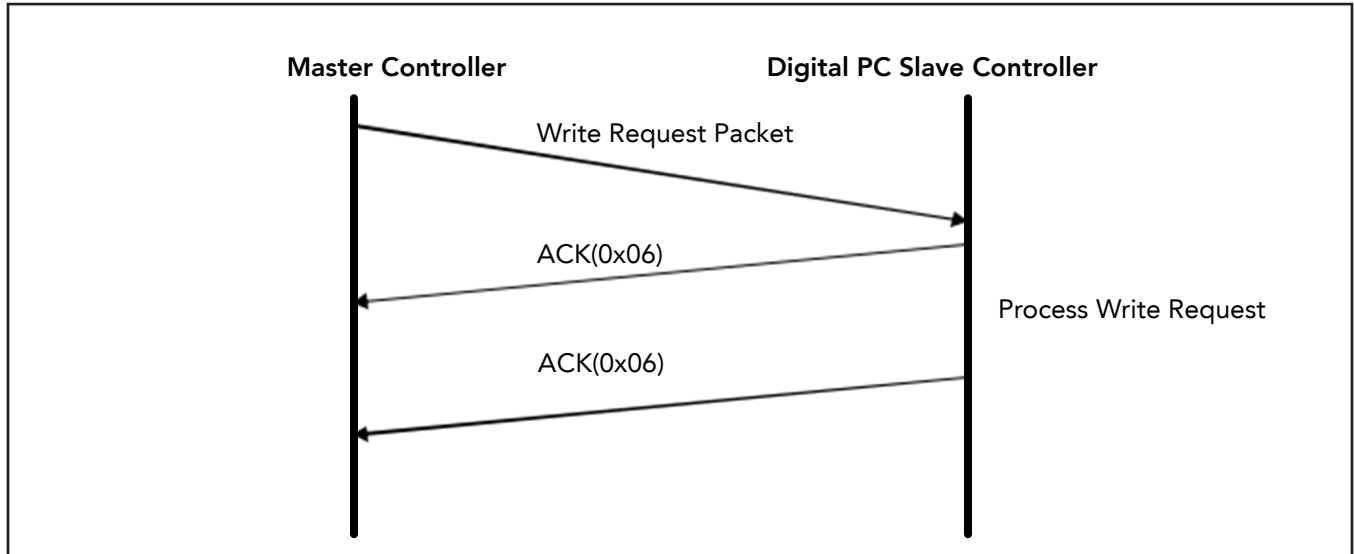
Normal Transaction Scenarios

Read Transaction Scenarios



* If the slave controller does not receive any response within a reasonable time (18-20 character times) after sending a message, it behaves as though it received an ACK. If the slave controller receives an invalid response, it behaves as though it received an ACK, and assumes that the invalid character is the target address for a new message.

Write Transaction Scenarios

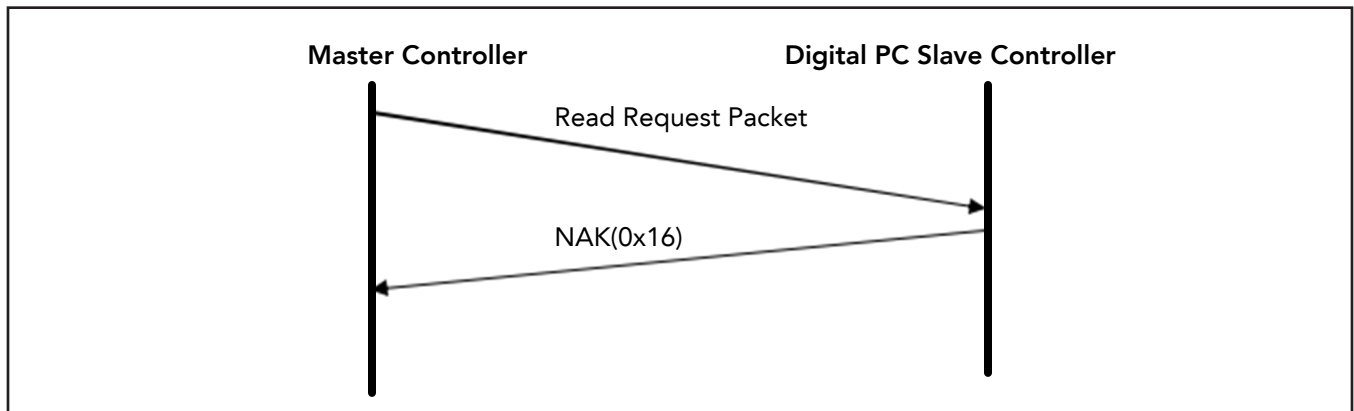


Abnormal Transaction Scenarios

Read Transaction Scenarios

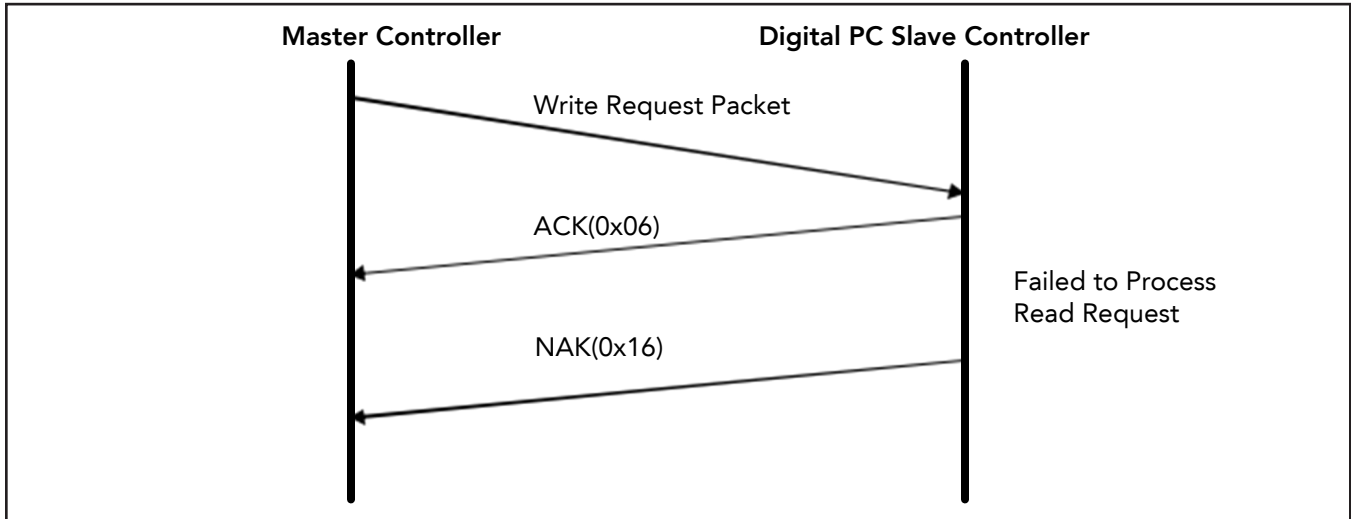
There are two different types of abnormal read transaction scenarios: packet error or read error within the pressure controller.

If the Class, Instance, or Attribute ID is invalid in the Read Request Packet, the digital PC responds with a NAK (0x16) character.



Read Error

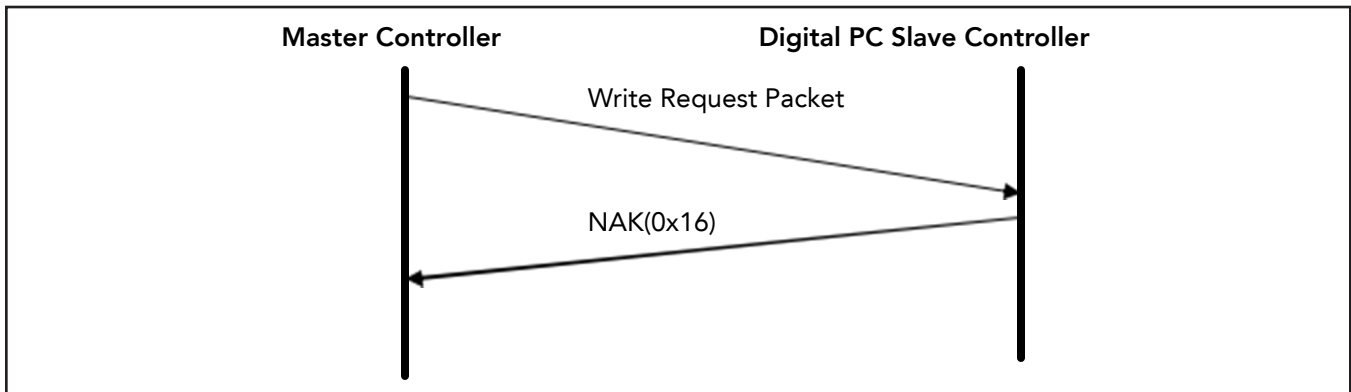
If any errors occur within the PC after the first ACK is sent (no packet errors), a NAK (0x16) will be sent to indicate an execution error.



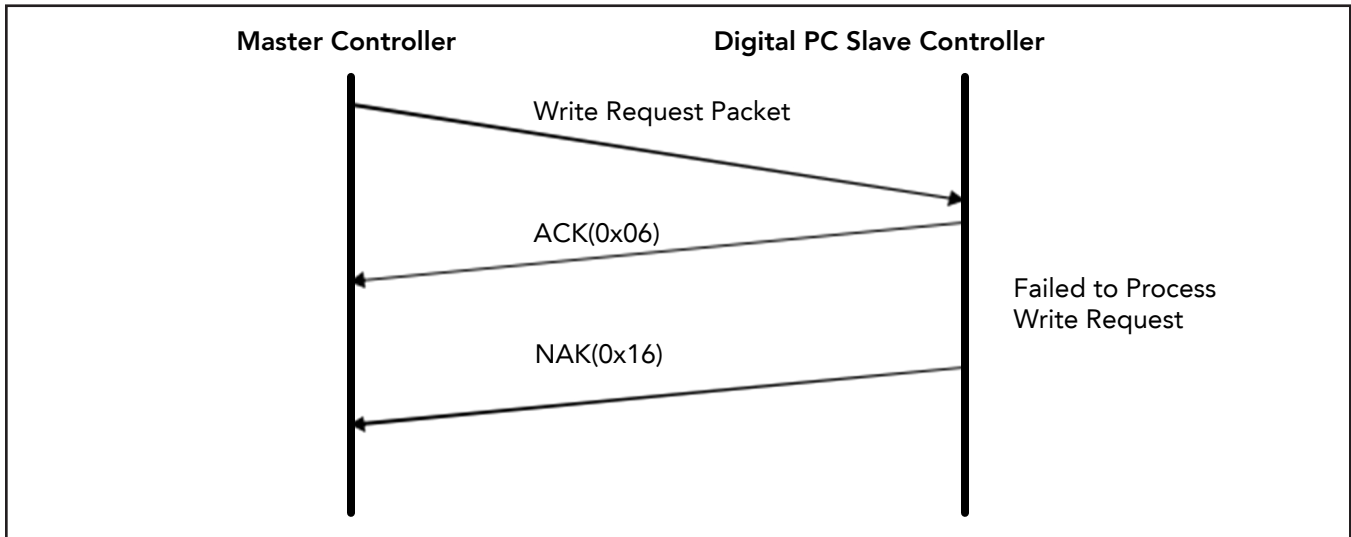
Write Transaction Scenarios

There are two different types of abnormal write transaction scenarios: packet error or write error within the PC controller.

If the Class, Instance, or Attribute ID is invalid in the Write Request Packet, the digital PC controller responds with a NAK (0x16) character.



If any errors occur within the PC after the first ACK is sent (no packet errors), a NAK (0x16) will be sent to indicate an execution error.



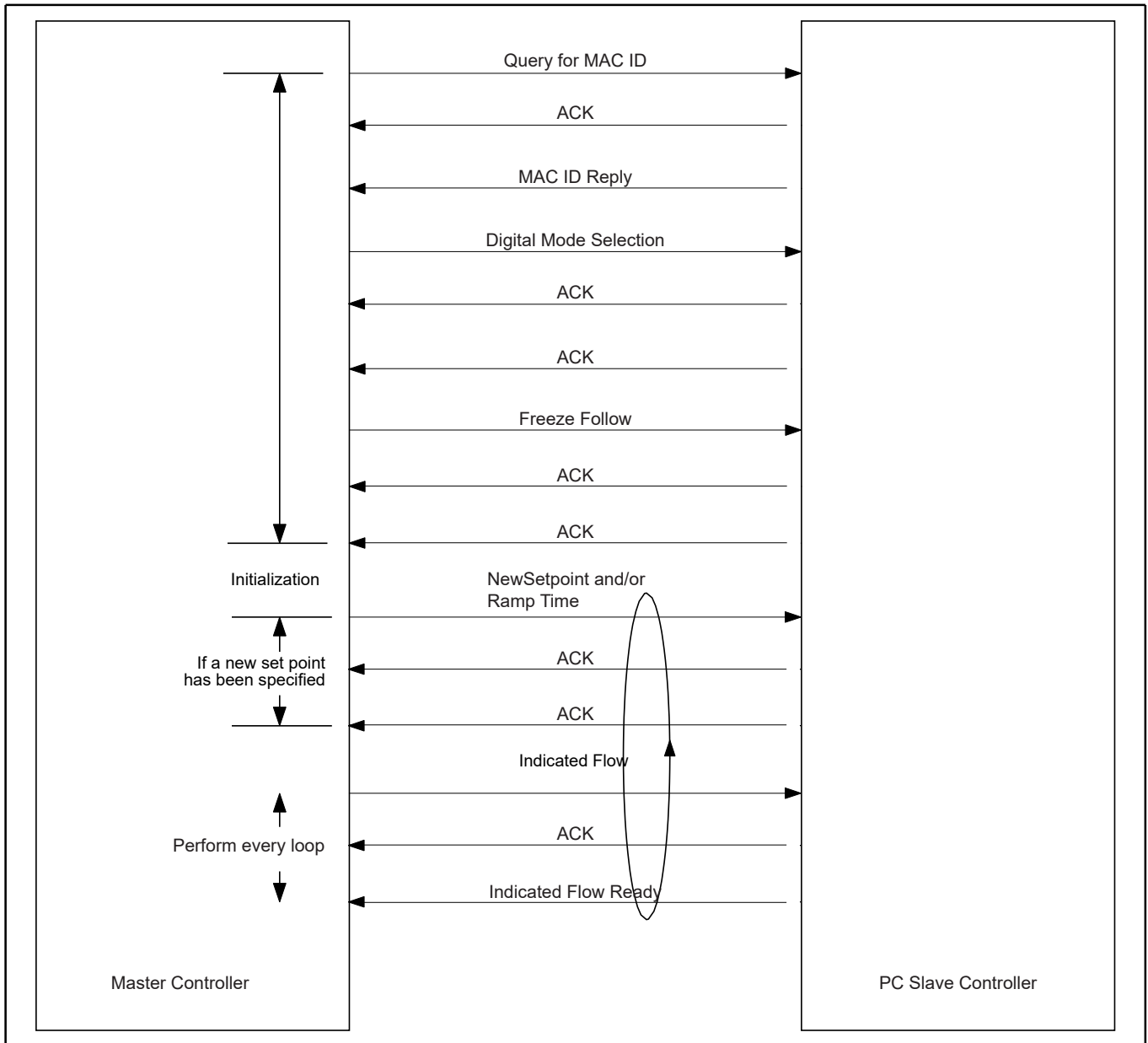
Protocol Timing

Devices on the RS485 bus distinguish address characters from other packet characters by maintaining an idle timer. This timer is started at the end of each received character and expires if the next character does not arrive within two bytes times (20 bit times). If the timer expires, the device assumes that the message has ended, and the next character received will be either a target address, or a response indicating the acceptance of the previous packet (ACK or NAK). Thus, it is vital that devices on the bus does not insert idle gaps of 1 character time or more within a packet. A target device can also assume that an error has occurred if a new character is expected and does not arrive within 2-character times of the preceding character's arrival.

Each transaction on the bus begins when the Master controller transmits a request packet on the bus, following an idle gap of at least 1 character time. The specified slave PC replies quickly with an ACK character (0x06) to indicate that it has received the packet correctly. After the request message is processed, the specified controller responds with a reply message or an ACK.

Since the current supported messages are simple and small, the Master controller expects that the entire response to the request message to be completed by the PC within 5 ms. If the Master controller does not receive all response characters (ACK+ACK (2 bytes) for write request, ACK + response packet (11 or 12 bytes)) within 5ms, it assumes that an error has occurred and up to 3 retries are performed automatically.

Protocol Message Sequence between Mater Controller and PC Slave Controller



PC New Setpoint Conversion

The NewSetpoint request takes values in the range of 0x4000 to 0xC000 which represent setpoints between 0% and 100% full scale. The linear relationship between Full Scale setpoints and NewSetpoint is demonstrated in the following table:

Full Scale % setpoint	NewSetpoint Value (Hex)
0.0	4000
25.0	6000
50.0	8000
75.0	A000
99.0	BEB8
100.0	C000

The “NewSetpoint” value may be calculated from the full scale percent value by:

$$\text{“NewSetpoint”} = (327.68 * \text{full scale \%}) + 16,384 \text{ or } \text{“NewSetpoint”} = ((0xC000-0x4000)/100 * \text{full scale \%}) + 0x4000$$

Note that at the communication level all values are sent in binary format. The decimal and hexadecimal formats shown above are for convenience.

- Other commands that use this scaling are: Filtered Setpoint, Indicated flow, Sensors Zero, and Sensor Reference Zero

Sensor Zero Filter

The digital PC should provide sensor zero filter to support correction for reasonably stable offsets in the gas flow sensor. The actual flow reading (IndicatedFlow) should be derived by subtracting SensorCurrentZero from each sensor measurement. SensorCurrentZero can be updated under two conditions, described in the following sub-sections.

Auto zero process can be started under the following condition:

- Auto Zero Enable has been issued by Master controller
- The digital MFC is in OFF mode

Once the above condition has been true for a specified delay (typically 90 seconds), auto zero process can be started at the specified rate (typically 10 times per second) and the SensorCurrentZero is to be updated through the entire process.

During the auto zero calculations, the digital MFC controller can use SensorReferenceZero to check against the calculated results. If the difference between SensorReferenceZero and the calculated result is beyond a specified limit, exception can be raised within the digital MFC controller.

Calibration Instances

Each calibration instance contains values needed by pressure controller to calculate the actual pressure for a particular process gas and pressure range from pressure transducer readings. This protocol allows Master controller to query for number of available calibration instances supported by the digital PC and select a calibration instance for digital PC operation and calculation. The detailed calibration instance internal setup is not supported through this interface and must be programmed through local pressure controller.

Analog / Digital Mode

The default mode for the PC is set to Analog Mode. PC's can be switch to Digital Mode with the "Digital Mode Selection" command as soon as communication is established.

LIMITED WARRANTY

Visit www.BrooksInstrument.com for the terms and conditions of our limited warranty.

BROOKS SERVICE AND SUPPORT

Brooks is committed to assuring all of our customers receive the ideal flow solution for their application, along with outstanding service and support to back it up. We operate first class repair facilities located around the world to provide rapid response and support. Each location utilizes primary standard calibration equipment to ensure accuracy and reliability for repairs and recalibration and is certified by our local Weights and Measures Authorities and traceable to the relevant International Standards.

Visit www.BrooksInstrument.com to locate the service location nearest to you.

START-UP SERVICE AND IN-SITU CALIBRATION

Brooks Instrument can provide start-up service prior to operation when required.

For some process applications, where ISO-9001 Quality Certification is important, it is mandatory to verify and/or (re)calibrate the products periodically. In many cases this service can be provided under in-situ conditions, and the results will be traceable to the relevant international quality standards.

SEMINARS AND TRAINING

Brooks Instrument can provide seminars and dedicated training to engineers, end users and maintenance persons.

Please contact your nearest sales representative for more details.

Due to Brooks Instrument's commitment to continuous improvement of our products, all specifications are subject to change without notice.

TRADEMARKS

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RS485-Manual-PC100-EN/541B238AAG/2023-05

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