ACS

ACS Atlas Copco Open Protocol

Version 2.10

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Overview of the ACS Atlas Copco Open Protocol

The ACS Atlas Copco Open Protocol implementation is based upon the Open Protocol specification release 1.6, revision 0.

The protocol is based upon TCP/IP. The default port used for the communication is 4545.

The controller acts as TCP server, ACS as TCP client.

ACS initiates the connection to tool controllers, and the controllers need to accept the connection. ACS then sends messages according to the specification release mentioned above, while the controller must respond to messages in the way described in that specification.

There are two protocol versions implemented in ACS, which differ in the telegrams (MID) sent for tool activation and deactivation. The ACS protocol versions are named ‘1.0.0’ and ‘1.1.0’.

Atlas Copco Open Protocol Version 1.0.0

Connection

When the TCP connection is established, ACS sends '**MID 0001 Communication start**' as a first message.

Example: '`00200001003 <NUL>`'

Keep alive

ACS sends '**MID 9999 Keep alive**' messages every 12 seconds, if no other messages are sent in the meantime. The timeout is reset each time a message is sent.

The controller must have a communication timeout equal to 15 s. This means that if no message has been exchanged between ACS and the controller for the last 15 s, then the controller considers the connection lost and closes it.

Example: '`00209999000 <NUL>`'

Disconnection

Before ACS disconnects, it sends '**MID 0003 Communication stop**'.

Example: '`00200003000 <NUL>`'

Tools moving into and out of product spaces and static spaces

When devices (tools) move into and out of spaces, ACS sends messages to the controller depending on the rules configuration for the device. There are:

- *Product spaces*: spaces defined on products, which move together with the product when the product moves (dynamic spaces)
- *Static spaces*: spaces with a static extent on the shop floor. In ACS there are two types of static space relevant to devices: *workspaces* have freely defined extents, whereas *stations* usually have extents of equal size along assembly lines. With regard to device activation and deactivation they behave in exactly the same way.

There are three different configurations possible for a device (tool):

1. *Product space rules enabled*: ACS will send messages when a tool enters or leaves configured product spaces. It is possible to select one space per product type. On space

entry the product ID (VIN) is transmitted. Sending messages when a product leaves a space can be omitted by configuration.

2. *Static space rules enabled*: ACS will send messages when a tool enters or leaves configured static spaces.
3. *Both product space and static space rules enabled*: This is a combination of 1. and 2. Only if a tool has entered both a configured product space and a configured static space is the tool considered to be 'in zone' ('enabled').

'Additional Parameters' of the ACS External System also affect whether telegrams are set or not:

- Abort job when entering product space?: Controls whether or not an 'Abort Job' message is sent when a *tool* enters a product space
- Abort job when leaving static space?: Controls whether or not an 'Abort Job' message is sent when a *tool or product* leaves a static space
- Disable tool when leaving product space?: Controls whether or not a 'Disable tool' message is sent when a *tool* leaves a product space
- Disable tool when leaving static space?: Controls whether or not a 'Disable Tool' message is sent when a *product* leaves a static space. It has no effect if a tool leaves a static space
- Send Enable/Disable only: Controls whether or not 'Abort Job (MID 127)' or 'Identifier Download Request (MID 150)' messages are sent when a tool is enabled. If the option is chosen, only 'Enable tool (MID 43)' is sent when a tool is enabled, and only 'Disable tool (MID 42)' is sent when a tool is disabled. This option overrides the 'Abort job...' options, since no 'Abort job' telegram will be sent. This option only applies to devices with product space rules configured.

Space entry

ACS will send the following messages on zone entry:

'MID 0127 Abort Job'

This message is only sent if product space rules are enabled. The message is not sent if only static space rules are enabled. The Abort Job message is sent to cancel any jobs which have been started but are not yet finished.
The message is not sent after a tool has exited a product space and directly entered the product space of the same product again.

Example: '`00200127000 <NUL>`'

'MID 0150 Identifier download request'

This message is only sent if product space rules are enabled. The message is not sent if only static space rules are enabled. The product ID (VIN) is sent with its full length as stored in ACS, but without any additional characters.

Example: '00280150000 47610383<NUL>'

'MID 0043 Enable tool'

This message is sent if product space or static space rules are enabled.

Example: '00200043000 <NUL>'

Space exit

ACS will send the following messages on zone exit:

'MID 0127 Abort Job'

The Abort Job message is sent to cancel any jobs which have been started but are not yet finished.

This message is only sent if product and workspace rules are enabled and if the additional protocol parameter 'Abort job when leaving static space?' is set to '1' (=yes).

The message is not sent if only static space rules are enabled or if the additional protocol parameter 'Abort job when leaving static space?' is set to '0' (=no).

Example: '00200127000 <NUL>'

'MID 0042 Disable tool'

This message is generally sent if product space or static space rules are enabled. However, if product spaces rules are enabled but the additional protocol parameter 'Disable tool when leaving product space' is set to '0' (= false), the message is not sent when the tool leaves a product space.

The message is not sent if a tool moves directly from within one zone into another zone, staying enabled (e.g. from one product zone directly into another product zone).

Note: The additional parameter 'Disable tool when leaving static space' has no effect on sending messages after tool movements.

Example: '00200042000 <NUL>'

Product moving into or out of static spaces

Static spaces in this respect are the ACS objects Workspace, Station and Ident Zone. The behavior regarding Open Protocol is the same for all three types of objects.

ACS can send enable and disable messages to a controller running the OpenProtocol when products enter or leave static spaces. As a prerequisite the static space event has to be configured such that products can be detected inside. Among others this means that at least one product type has to be activated for the static space event and that the static space event is associated to an ExternalSystem configured with AC OpenProtocol.

There are 'Additional Parameters' of the ACS External System, which also have an effect on sending or not sending telegrams:

- Abort job when entering product space?: This has no effect on sending messages after a product entry into or exit out of a static space
- Abort job when leaving static space?: Controls whether or not an 'Abort Job' message is sent when a *tool or product* leaves a static space
- Disable tool when leaving product space?: This has no effect on sending messages after a product entry into or exit out of a static space
- Disable tool when leaving static space?: Controls whether or not a 'Disable Tool' message is sent when a *product* leaves a static space. It has no effect if a tool leaves a static space

Static space entry

ACS will send the following messages on static space entry:

'MID 0127 Abort Job'

The Abort Job message is sent to cancel any jobs which have been started but are not finished yet.
The message is not sent if after a zone exit the same product enters the static space again.

Example: '`00200127000 <NUL>`'

'MID 0150 Identifier download request'

The product ID (VIN) is sent with its full length as stored in ACS, but without any additional characters.

Example: '`00280150000 47610383<NUL>`'

'MID 0043 Enable tool'

Example: '`00200043000 <NUL>`'

Static space exit

If the additional protocol parameter of the external system "Abort job when leaving static space?" is set to '1' (=yes), Abort Job messages are sent, if the parameter is set to '0' (=no, the default), Abort Job messages are not sent. However sending Abort Job messages also depends on the additional protocol parameter "Disable tool when leaving static space?".

If the additional protocol parameter of the external system "Disable tool when leaving static space?" is set to '1' (=yes), Disable Tool messages are sent, if the parameter is set to '0' (=no, the default), neither Disable Tool messages nor Abort Job messages are sent.

If configured the following messages are sent:

'MID 0127 Abort Job'

Example: '00200127000 <NUL>'

'MID 0042 Disable tool

'Example: '00200042000 <NUL>'

Atlas Copco Open Protocol Version 1.1.0

Connection

When the TCP connection is established ACS sends 'MID 0001 Communication start' as a first message.

Example: '00200001003 <NUL>'

The controller must answer with 'MID 0002 Communication start acknowledge'.

The ACS Atlas Copco Open Protocol Version 1.1.0 will be used only if all of the following conditions are met:

- MID 0002 rev 3 is used
- The Open Protocol Version field contains data which can be evaluated as <Major>.<Minor>.<Build>, with a value >= 1.1.0

Otherwise Version 1.0.0 will be used.

Example:

'01250002003 010000020003 Integrator Software0400005
1.1.006 0.0.007 0.0.0<NUL>'

Tool Tag ID

Directly after the connection being accepted by the controller ACS sends 'MID 0260 Tool tag ID request'

Example: '00200260000 <NUL>'

The controller can answer with 'MID 0262 Tool tag ID'.

Example: '00300262000 0164010203<NUL>'

If the controller cannot derive a tool tag ID, it answers with 'MID 0004 Command error', with an error code '54 Tool Tag ID unknown'.

Example: '00260004000 026054<NUL>'

ACS subscribes for tool tag ID changes with 'MID 0261 Tool tag ID subscribe'

Example: '00200261000 <NUL>'

Keep alive

ACS sends 'MID 9999 Keep alive' messages every 12 seconds, if no other messages are sent in the meantime. The timeout is reset each time a message is sent.

The controller must have a communication timeout equal to 15s. This means that if no message has been exchanged between ACS and the controller for the last 15s, then the controller considers the connection lost and closes it.

Example: '00209999000 <NUL>'

Disconnection

Before ACS disconnects the connection it sends 'MID 0003 Communication stop'.

Example: '00200003000 <NUL>'

Tools moving into and out of product spaces and static spaces

When devices (tools) move into and out of spaces, ACS sends messages to the controller depending on the rules configuration for the device. There are

- Product spaces: spaces defined on products, which move together with the product when the product moves (dynamic spaces)
- Static spaces: spaces with a static extent on the shop floor. In ACS there are two types of static spaces relevant for devices: workspaces have freely defined extents, whereas stations have usually extents of equal size along assembly lines. Regarding device activation and deactivation they behave exactly the same.

There are three different configurations possible for a device (tool):

1. Product space rules enabled: ACS will send messages when a tool enters or leaves configured product spaces. It is possible to select one space per product type. On space entry the product ID (VIN) is transmitted. Sending messages when a product space is left can be omitted by configuration.
2. Static space rules enabled: ACS will send message when a tool enters or leaves configured static spaces.
3. Both product space and static space rules enabled: This is a combination of 1. and 2. Only if a tool has entered both a configured product space and a configured static space the tool is considered as being 'in zone' ('enabled').

There are 'Additional Parameters' of the ACS External System, which also have an effect on sending or not sending telegrams:

- Disable tool when leaving product space?: Controls whether or not a 'MID 0225 Reset digital input function', Tool in product space' message is sent when a *tool* leaves a product space
- Disable tool when leaving static space?: Controls whether or not a 'MID 0225 Reset digital input function', Tool in product space' message is sent when a *product* leaves a static space. It has no effect if a tool leaves a static space

Space entry

ACS will send the following messages on zone entry:

'MID 0150 Identifier download request', VIN identifier

This message is only sent if product space rules are enabled. The message is not sent if only static space rules are enabled. The product ID (VIN) is sent with its full length as stored in ACS, but without any additional characters. The Identifier Data field is filled with blank characters up to its full length of 80 characters

Example: '`01000150000 GH-OEM-06 <NUL>`'

'MID 0150 Identifier download request', Spaces identifier

This message is always sent. The Identifier Data field has a total length of 75 characters. The 75 characters are subdivided into three parts:

- Workarea name: 25 characters, always blank (for later use)
- Static space name: 25 characters, left aligned, blank, if static space rules are *not* enabled
- Product space name: 25 characters, left aligned, blank, if product space rules are *not* enabled

Example: '`0100950150000 GH-Station-1 GH-OEM-Zone <NUL>`'

'MID 0224 Set digital input function', Tool in workspace

This message is sent if static space rules are enabled.

Example: '`00230224000 132<NUL>`'

'MID 0224 Set digital input function', Tool in productspace

This message is sent if product space rules are enabled.

Example: '00230224000 133<NUL>'

Space exit

ACS will send the following messages on zone exit:

'MID 0150 Identifier download request', Spaces identifier

This message is always sent. The Identifier Data field has a total length of 75 characters. The 75 characters are subdivided into three parts:

- Workarea name: 25 characters, always blank (for later use)
- Static space name: 25 characters, left aligned, blank, if static space rules are *not* enabled
- Product space name: 25 characters, left aligned, blank, if product space rules are *not* enabled

If no spaces can be derived by ACS, the complete Identifier Data field is blank

Example: ' 00950150000
<NUL>'

'MID 0225 Reset digital input function', Tool in workspace

This message is sent if static space rules are enabled.

Example: '00230225000 132<NUL>'

'MID 0225 Reset digital input function', Tool in product space

This message is sent if product space rules are enabled, and if the additional protocol parameter 'Disable tool when leaving product space?' is set to a value of '1' (=true). If it is set to a value of '0', this message is omitted.

Example: '00230225000 133<NUL>'

Products moving into or out of static spaces

Static spaces in this respect are the ACS objects Workspace, Station and Ident Zone. The behavior regarding Open Protocol is the same for all three types of objects.

ACS can send enable and disable messages to a controller running the OpenProtocol when products enter or leave static spaces. As a prerequisite the static space event has to be configured such that products can be detected inside. Among others this means that at least one product type has to be activated for the static space event and that the static space event is associated to an External System configured with AC OpenProtocol.

There are 'Additional Parameters' of the ACS External System, which also have an effect on sending or not sending telegrams:

- Disable tool when leaving product space?: This has no effect on sending messages after a product entry into or exit out of a static space
- Disable tool when leaving static space?: Controls whether or not a 'Disable Tool' message is sent when a *product* leaves a static space. It has no effect if a tool leaves a static space

Static space entry

ACS will send the following messages on Static space entry:

'MID 0150 Identifier download request', VIN identifier

This message is always sent. The product ID (VIN) is sent with its full length as stored in ACS, but without any additional characters. The Identifier Data field is filled with blank characters up to its full length of 80 characters

Example: '`01000150000 GH-OEM-06 <NUL>`'

'MID 0150 Identifier download request', Spaces identifier

This message is always sent. The Identifier Data field has a total length of 75 characters. The 75 characters are subdivided into three parts:

- Work area name: 25 characters, always blank (for later use)
- Static space name: 25 characters, left aligned
- Product space name: 25 characters, blank

Example: '`0100950150000 IZone_01 <NUL>`'

'MID 0224 Set digital input function', Tool in workspace

This message is always sent.

Example: '`00230224000 132<NUL>`'

Static space exit

'MID 0225 Reset digital input function', Tool in workspace

If the additional protocol parameter "Disable tool when leaving ident zone?" is set to 1 (=yes), the Reset digital input function message is sent. If the parameter is set to 0 (=no, the default), no messages are sent.

Example: '00230225000 132<NUL>'

Protocol Implementation Details

Reaction to an ‘event’

An *event* in ACS is the fact that a tool enters or leaves a product space or static space, or that a product enters or leaves a static space. The reaction to such an event is usually that a group of messages will be sent to the controller.

If ACS sends an OpenProtocol message, ACS usually expects a response. ACS waits for 3 seconds for a response, and re-sends the message twice (the message is sent a total of 3 times).

If ACS does not get a response, or if the response is NACK (=response was a Command Error), ACS won’t even try to send remaining messages, i.e. if an Abort message cannot be sent, ACS won’t send the IdentifierDownloadRequest or the Enable.

Depending on the ErrorCode, ACS will either discard the event or reschedule the event. Events are discarded, if the received error code is

- 1 = Invalid Data
- 42 = Identifier input source not granted
- 92 = Open protocol commands disabled

If the event is rescheduled, a new attempt to send the messages is started after 1 second. However, the event is discarded if a new event happens for the same tool, e.g. if the tool moved out of the product space and the last event was a ‘move into’.

The connection is never closed because of unsuccessful attempts to send standard telegrams. Only if KeepAlive messages cannot be sent is the connection is closed.

That basically means the communication partner must accept the commands ACS is sending.