



Ethernet Packet Generator  
**Header Definitions**  
Version 1.2



**APG4 APG8 APG208**

## Hardware Versions

This document applies to the following hardware versions:

<b>Version 1 (APGV1)</b>	<p><b>Launched: 2016 with API 161016</b></p> <p><b>Products: APG4, APG8, APG200, APG208</b></p> <p><b>Port Speeds: 1Gbps, 10Gbps, 40Gbps</b></p> <p><b>Processing Cores: 6.X (10Gbps) 7.X (1Gbps)</b> Note: Cannot mix 10Gbps and 1Gbps ports</p> <p><b>Capture Buffer: 64MB/port (10G) 256MB/port (40G)</b></p> <p><b>Timestamp Resolution: 8ns</b></p>
<b>Version 2 (APGV2)</b>	<p><b>Launched: 2023 with API 161016</b></p> <p><b>Products: APG4V2-10, APG8V2-10</b></p> <p><b>Port Speeds: 1Gbps, 10Gbps 2.5Gbps, 5Gbps (optional)</b></p> <p><b>Processing Core: 10.X (10Gbps/1Gbps)</b></p> <p><b>Capture Buffer: 128MB/port</b></p> <p><b>Timestamp Resolution: 2.5ns</b></p>

## Software Versions

This document applies to the following software versions:

	Version 1	Version 2
<b>APG API</b>	<b>161016</b>	<b>161016</b>
<b>APG Unit Firmware</b>	<b>Version 2.3</b>	<b>Version 1.2-2</b>
<b>APG Processing Core</b>	<p><b>Version 6.010E (10Gbps)</b> <b>Version 7.0103 (1Gbps)</b> Datecode: 01 March 2019</p>	<p><b>Version 10.2</b> Datecode: 1 December 2023</p>
<b>APG Control Interface</b>	<b>Version 3.3</b>	<b>Version 3.3</b>
<b>APG TCL API</b>	<b>Version 1.4.1</b>	<b>Version 1.4.1</b>
<b>APG Header Definition</b>	<b>Version 1.1</b>	<b>Version 1.1</b>

## Revision History

Date	Version	Changes
10 August 2016	1.0	<ul style="list-style-type: none"> <li>• First customer release</li> </ul>
8 February 2018	1.1	<ul style="list-style-type: none"> <li>• Merged Layer 2+ and Type layers (Section 3)</li> <li>• Corrected VLAN Protocol ID field label to TPID and set to editable (Section 3.1)</li> <li>• Added Layer 3 IPV4 Header (Section 4.1)</li> <li>• Added Layer 3 IPV6 Header (Section 4.2)</li> <li>• Added Layer 4 ESP Header (Section 5.1)</li> <li>• Added Layer 4 GRE Header (Section 5.2)</li> <li>• Moved User Defined Header descriptions (Section 6)</li> </ul>
4 September 2019	1.1.1	<ul style="list-style-type: none"> <li>• Corrected ETHERNET_II (underscore not hyphen)</li> </ul>
21 February 2023	1.1.2	<ul style="list-style-type: none"> <li>• Added APGV2</li> </ul>
16 February 2024	1.2	<ul style="list-style-type: none"> <li>• IPV4_HEADER IDENTIFICATION is now editable</li> <li>• Added UDP header (See Section 5.3)</li> <li>• DEC (decrementing) and RND (random) variable field options removed from MACHEADER DA,SA (Section 2.1), VLAN VID (Sections 3.1,3.2) and ARP fields (Section 4.3)</li> <li>• DEC and RND added to IPV4 DSCP, IDENTIFICATION, SOURCE &amp; DESTINATION (Section 4.1)</li> </ul>

## Related Documentation

- [1] APG-UG            Axtrinet User Guide (including APG Control Interface)
- [2] APG-TCL-UG     Axtrinet TCL API User Guide
- [3] APG-SW-TC      Axtrinet APG Software License Terms And Conditions

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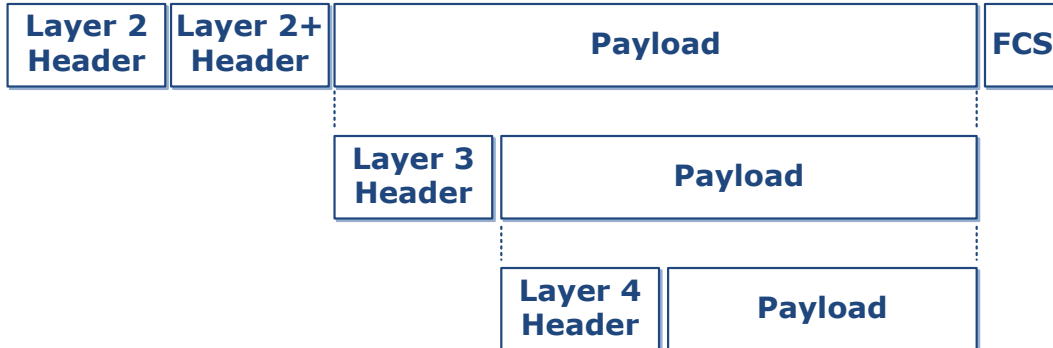
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# 1. INTRODUCTION

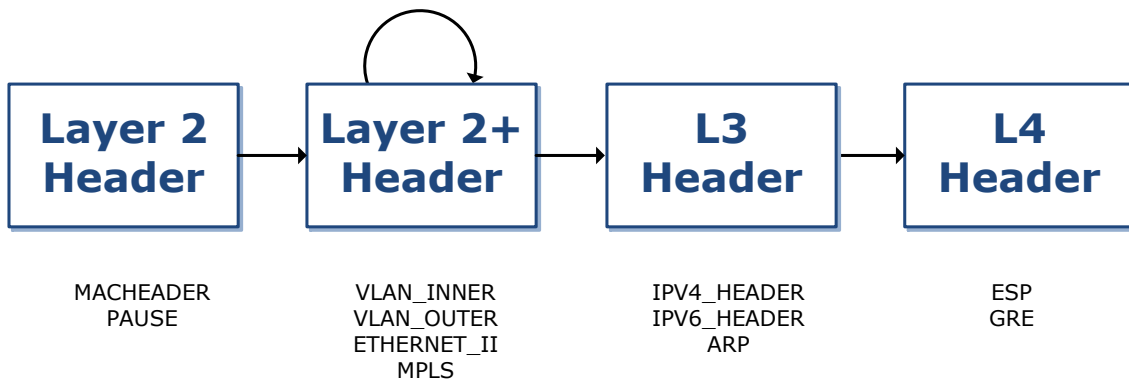
The Axtrinet Packet Generators use a header definition to determine the header types, fields and expected structure within the Ethernet packet.

In a valid Ethernet packet, the headers identify the Network Layers in the OSI Model.



## 1.1 SUPPORTED HEADERS

The following headers are supported by the APG Control Interface and APG TCL API:



## 1.2 HEADER STYLES

Each header variable has a STYLE that defines the format, minimum and maximum values.

The following styles are used:

[STYLE]	Length	Min	Max
<b>MAC-ADDRESS</b>	17 chars	0:0:0:0:0:0	FF:FF:FF:FF:FF:FF
<b>INT</b>	Variable	0	
<b>HEX2</b>	1 byte	0x0	0xFF
<b>HEX4</b>	2 bytes	0x0	0xFFFF
<b>HEX8</b>	4 bytes	0x0	0xFFFFFFFF
<b>HEX2ARRAY</b>	Variable	0x0	0xFF
<b>IPV4-ADDRESS</b>	4 bytes	0.0.0.0	255.255.255.255
<b>IPV6-ADDRESS</b>	16 bytes	0:0:0:0:0:0:0:0	FFF:FFF:FFF:FFF:FFF:FFF:FFF:FFF

## 2. LAYER 2 HEADERS

### 2.1 MACHEADER

Editable→

LABEL	DESCRIPTION	SIZE	STYLE	ED	DEFAULT	MODES	Default
<b>DA</b>	MAC Destination Address	6 bytes	mac-address	1	0:0:0:0:0:0	FIX INC	FIX
<b>SA</b>	MAC Source Address	6 bytes	mac-address	1	0:0:0:0:0:0	FIX INC	FIX

Where:  
 FIX = Fixed  
 INC = Incrementing  
 DEC = Decrementing  
 RND = Random

### 2.2 PAUSE

LABEL	DESCRIPTION	SIZE	STYLE	ED	DEFAULT	MODES	Default
<b>DA</b>	MAC Destination Address	6 bytes	mac-address	0	1:80:C2:0:0:1	-	-
<b>SA</b>	MAC Source Address	6 bytes	mac-address	1	0:0:0:0:0:0	-	-
<b>TYPE</b>	Ethertype	2 bytes	hex4	0	0x8808	-	-
<b>OPCODE</b>	Control Opcode	2 bytes	hex4	0	0x0001	-	-
<b>QUANTA</b>	Pause Quanta	2 bytes	int	1	0x0001	-	-

### 2.3 USERDEFINED

See Section 6

### 2.4 USERDEFINED16

See Section 6

## 3. LAYER 2+ HEADERS

### 3.1 VLAN\_INNER

LABEL	DESCRIPTION	SIZE	STYLE	ED	DEFAULT	MODES	Default
<b>TPID</b>	Protocol ID	2 bytes	HEX4	1	0x8100	-	-
<b>PRIORITY</b>	User Priority	3 bits	INT	1	0	-	-
<b>CFI</b>	Canonical Format Indicator	1 bit	INT	1	0	-	-
<b>VID</b>	VLAN Identifier	12 bits	INT	1	1	FIX INC	FIX

### 3.2 VLAN\_OUTER

LABEL	DESCRIPTION	SIZE	STYLE	ED	DEFAULT	MODES	Default
<b>TPID</b>	Protocol ID	2 bytes	HEX4	1	0x9100	-	-
<b>PRIORITY</b>	User Priority	3 bits	INT	1	0	-	-
<b>CFI</b>	Canonical Format Indicator	1 bit	INT	1	0	-	-
<b>VID</b>	VLAN Identifier	12 bits	INT	1	1	FIX INC	FIX

Note:

- VLAN\_INNER and VLAN\_OUTER have different default TPID values only.
- For a Service Tag (S-Tag), set TPID to 0x88A8

### 3.3 ETHERNET\_II

LABEL	DESCRIPTION	SIZE	STYLE	ED	DEFAULT	MODES	Default
<b>ETHERTYPE</b>	Encapsulated protocol ID	2 bytes	hex4	1	0x800	-	-

Note:

- When using the Control Interface, the ETHERTYPE field may be configured automatically depending on the next header type, eg an MPLS header will set the ETHERTYPE to 0x8847
- When using the TCL API, the ETHERTYPE field is never configured automatically

### 3.4 MPLS

LABEL	DESCRIPTION	SIZE	STYLE	ED	DEFAULT	MODES	Default
<b>LABEL</b>	Label value	20 bits	int	1	16	-	-
<b>TC</b>	Traffic Class	3 bits	int	1	0	-	-
<b>S</b>	Bottom of Stack	1 bit	int	1	1	-	-
<b>TTL</b>	Time to Live	1 byte	int	1	64	-	-

### 3.5 USERDEFINED

See Section 6

### 3.6 USERDEFINED16

See Section 6



## 4. LAYER 3 HEADERS

### 4.1 IPV4\_HEADER

LABEL	DESCRIPTION	SIZE	STYLE	ED	DEFAULT	MODES	Default
<b>VERSION</b>	Version Field	4 bits	int	0	4	-	-
<b>IHL</b>	Internet Header Length	4 bits	int	0	5	-	-
<b>DSCP</b>	Differentiated Services Code Point	6 bits	int	1	0	FIX INC	FIX
<b>ECN</b>	Explicit Congestion Notification	2 bits	int	1	0	-	-
<b>TOTAL_LENGTH</b>	Total IP Packet Length	2 bytes	int	1	0	-	-
<b>IDENTIFICATION</b>	Identification Field	2 bytes	int	1	0	FIX INC	FIX
<b>FLAGS</b>	Fragment Flags	3 bits	int	1	0	-	-
<b>FRAGMENT_OFFSET</b>	Fragment Offset	13 bits	int	1	0	-	-
<b>TTL</b>	Time to Live	1 byte	int	1	0	-	-
<b>PROTOCOL</b>	IP Protocol Number	1 byte	hex2	1	0x00	-	-
<b>CHECKSUM</b>	Header Checksum	2 bytes	hex4	1	0x0000	-	-
<b>SOURCE</b>	Source IP Address	4 bytes	ipv4-address	1	0.0.0.0	FIX INC	FIX
<b>DESTINATION</b>	Destination IP Address	4 bytes	ipv4-address	1	0.0.0.0	FIX INC	FIX

Note:

- When using the Control Interface, the TOTAL\_LENGTH and CHECKSUM can be calculated automatically by checking the corresponding Length and Checksum checkboxes. The values are calculated **once** for a **fixed length** packet. Calculated TOTAL\_LENGTHs and CHECKSUMs will be incorrect for variable length (random, incrementing, decrementing) packet lengths. If the checkboxes are unchecked, the TOTAL\_LENGTH and CHECKSUM values can be entered manually.
- When using the TCL API, the automatic TOTAL\_LENGTH and CHECKSUM calculation is not available. Values must be entered manually.

### 4.2 IPV6\_HEADER

LABEL	DESCRIPTION	SIZE	STYLE	ED	DEFAULT	MODES	Default
<b>VERSION</b>	Version Field	4 bits	int	0	6	-	-
<b>DS</b>	Differentiated Services	6 bits	hex2	1	0	-	-
<b>ECN</b>	Explicit Congestion Notification	2 bits	int	1	0	-	-
<b>FLOW_LABEL</b>		20 bits	int	1	0	-	-
<b>PAYLOAD_LENGTH</b>		2 bytes	int	1	0	-	-
<b>NEXT_HEADER</b>	Next header type	1 byte	hex2	1	0	-	-
<b>HOP_LIMIT</b>		1 byte	int	1	0	-	-
<b>SOURCE</b>	Source IP Address	16 bytes	ipv6-address	1	0:0:0:0:0:0:0:0	-	-
<b>DESTINATION</b>	Destination IP Address	16 bytes	ipv6-address	1	0:0:0:0:0:0:0:0	-	-

Note:

- When using the Control Interface, the PAYLOAD\_LENGTH can be calculated automatically by checking the Length checkbox. The value is calculated **once** for a **fixed length** packet. Calculated PAYLOAD\_LENGTH will be incorrect for variable length (random, incrementing, decrementing) packet lengths. If the checkboxes are unchecked, the PAYLOAD\_LENGTH value can be entered manually.
- When using the TCL API, the automatic PAYLOAD\_LENGTH calculation is not available. The value must be entered manually.

### 4.3 ARP\_HEADER

LABEL	DESCRIPTION	SIZE	STYLE	ED	DEFAULT	MODES	Default
<b>HTYPE</b>	Header Type	2 bytes	hex4	0	0x1	-	-
<b>PTYPE</b>	Protocol Type	2 bytes	hex4	0	0x0800	-	-
<b>HLEN</b>	Header Length	1 byte	hex2	0	0x6	-	-
<b>PLEN</b>	Protocol Length	1 byte	hex2	0	0x4	-	-
<b>OPERATION</b>	Operation	2 bytes	int	1	1	-	-
<b>SHA</b>	Sender Header Address	6 bytes	mac-address	1	0	FIX INC	FIX
<b>SPA</b>	Sender Protocol Address	4 bytes	ipv4-address	1	0 0 0 0	FIX INC	FIX
<b>THA</b>	Target Protocol Header	6 bytes	mac-address	1	0	FIX INC	FIX
<b>TPA</b>	Target Protocol Address	4 bytes	ipv4-address	1	0 0 0 0	FIX INC	FIX

### 4.4 USERDEFINED

See Section 6

### 4.5 USERDEFINED16

See Section 6

## 5. LAYER 4 HEADERS

### 5.1 ESP

LABEL	DESCRIPTION	SIZE	STYLE	ED	DEFAULT	MODES	Default
<b>SPI</b>	Security Parameters Index	4 bytes	int	1	0	-	-
<b>SEQUENCE_NUMBER</b>		4 bytes	int	1	0	-	-

### 5.2 GRE

LABEL	DESCRIPTION	SIZE	STYLE	ED	DEFAULT	MODES	Default
<b>CHECKSUM_PRESENT</b>	-	1 bit	int	1	0	-	-
<b>RESERVED</b>	-	1 bit	int	0	0	-	-
<b>KEY_PRESENT</b>	-	1 bit	int	1	0	-	-
<b>SEQUENCE_PRESENT</b>	-	1 bit	int	1	0	-	-
<b>RESERVED1</b>	-	9 bits	int	0	0	-	-
<b>VERSION</b>	-	3 bits	int	0	0	-	-
<b>PROTOCOL</b>	-	2 bytes	hex4	1	0	-	-
<b>CHECKSUM</b>	-	2 bytes	hex4	0	0	-	-
<b>RESERVED2</b>	-	2 bytes	hex4	0	0	-	-
<b>KEY</b>	-	4 bytes	hex8	1	0	-	-
<b>SEQUENCE_NUMBER</b>	-	4 bytes	int	1	0	-	-

### 5.3 UDP

LABEL	DESCRIPTION	SIZE	STYLE	ED	DEFAULT	MODES	Default
<b>SOURCEPORT</b>	-	2 bytes	int	1	0	FIX INC	FIX
<b>DESTPORT</b>	-	2 bytes	int	1	0	FIX INC	FIX
<b>LENGTH</b>	-	2 bytes	int	1	0	-	-
<b>CHECKSUM</b>	-	2 bytes	hex4	1	0	-	-

### 5.4 USERDEFINED

See Section 6

### 5.5 USERDEFINED16

See Section 6

## 6. USER DEFINED HEADERS

User-defined field can be used anywhere within the header structure to allow undefined headers to be incorporated into the packet header.

USERDEFINED headers are fixed length, fixed payload headers.

USERDEFINED16 headers are 16-bit variable content headers.

### 6.1 USERDEFINED

LABEL	DESCRIPTION	SIZE	STYLE	ED	DEFAULT	MODES	Default
<b>LENGTH</b>	Byte Length of User Defined Data	2 bytes	int	1	16	-	-
<b>DATA</b>	Byte Data	LENGTH	hex2array	1	-	-	-

Note:

- When using the Control Interface, the LENGTH field defined the number of bytes that can be entered in the DATA box. DATA is truncated if the number of DATA bytes is greater LENGTH.
- When using the TCL API, the LENGTH field is calculated automatically from the configured DATA.

### 6.2 USERDEFINED16

LABEL	DESCRIPTION	SIZE	STYLE	ED	DEFAULT	MODES	Default
<b>DATA</b>	Byte Data	2 bytes	hex4	1	-	FIX INC	FIX



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