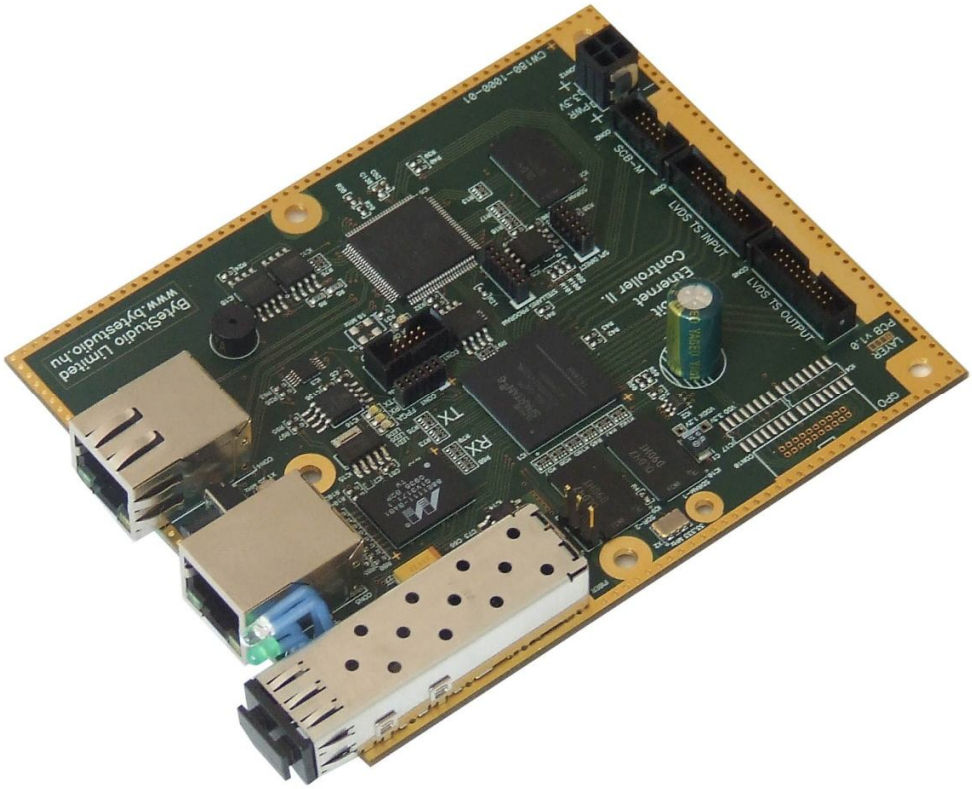
Gigabit Ethernet Controller II.



Version 1.12

Instruction Manual

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Using this Document

This document is intended for the software and hardware engineer's reference and provides detailed information about the Gigabit Ethernet Controller II. Though every effort has been made to ensure that this document is current and accurate, more information may have become available subsequent to the production of this guide. In that event, please contact ByteStudio (bytestudio@bytestudio.hu) for additional information that may help in the development process.

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1 Introduction

The Gigabit Ethernet Controller II. is a universal data transmission and device controller module for IP based digital television systems. The controller can receive and transmit 64 IP streams and supports several data formats. For the device control over the IP network, the module provides a serial communication bus and an output port for driving LEDs.

2 Features

- Single 3.3 V power supply
- Integrated 10Base-T, 100Base-TX and 1000Base-T Ethernet transceiver for Transport Stream input and output (RJ45 and SFP)
- Separated 10Base-T and 100Base-TX management Ethernet interface with RJ45 connector
- 64 IP Transport Stream inputs
  IPTV or RTP format, 1..7 TS packets, 188/204 bytes. Supports unicast, broadcast and multicast reception using IGMPv2 protocol, VLAN Tagging (IEEE 802.1Q).
- 64 IP Transport Stream outputs
  IPTV or RTP format, 1..7 TS packets, 188/204 bytes, VLAN Tagging (IEEE 802.1Q).
- On–board 768-Mbit SDRAM.
- Automatic PSI packet analyzer and stream statistics
- PID Filtering
- PSI Inserter with automatic Continuity Counter Generator
- SPTS generation from MPTS
- Internal stream loopback
- Real-time TS analyzer
- Easy to program via UDP/IP or HTTP
- Integrated WEB server
- Firmware upgrade via Ethernet
- 8-bit instruction set (Digital Data Transmission over IP v3 – DDToIPv3)
- Protocols: ICMP ping, ARP, IGMPv2, DHCP, UDP, TCP, HTTP
- Programmable ARP and IGMP Membership Report advertisement
- Status and overflow LED port
- Serial Communication Bus (SCB)
- 16-bit general purpose output port
- Low power consumption, high reliability, long life time

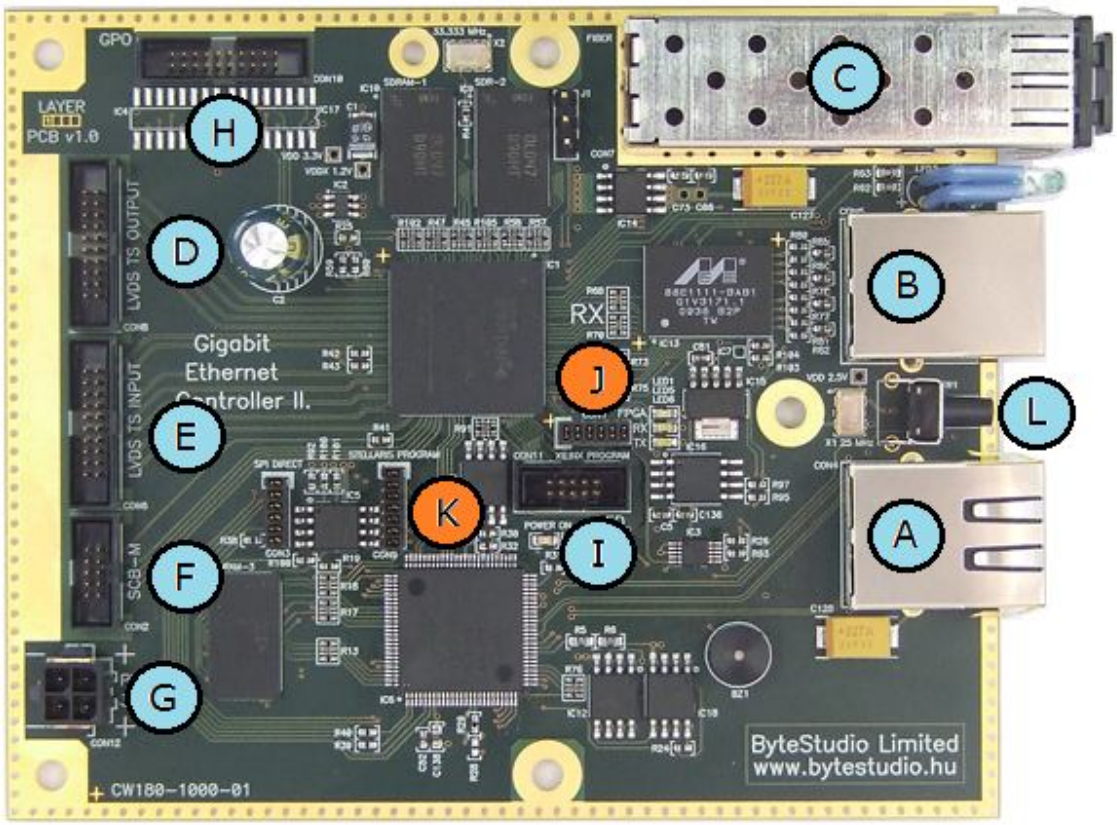
3 Model List and Block Diagram

Gigabit Ethernet Controller Model List:

Model	Features
GEC II.	Gigabit Ethernet Controller II. Firmware group reference number: BSF11-0001 PCB reference number: BSP11-0000

Figure 1. Gigabit Ethernet Controller II. Block Diagram
(GEC II.)

4 General Description

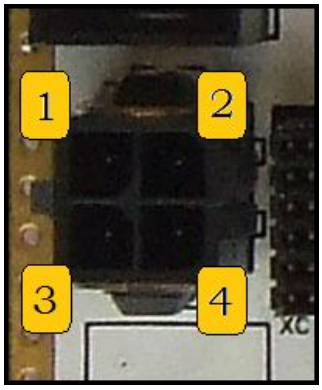


Char	Connector
A	RJ45 ETHERNET INTERFACE (MANAGEMENT)
B	RJ45 ETHERNET INTERFACE (TRANSPORT STREAM)
C	SFP INTERFACE (TRANSPORT STREAM)
D	LVDS TS OUTPUT
E	LVDS TS INPUT
F	SERIAL COMMUNICATION BUS
G	POWER
H	GPO (optional)
I	LED
J	XILINX JTAG (Don’t connect!)
K	STELLARIS JTAG (Don’t connect!)
L	RESET DEFAULTS SWITCH

4.1 Power Supply

The Gigabit Ethernet Controller II. needs single 3.3 V power supply. The board contains one power connector (Connector G).

Pin	Description	Direction
1	GND	
2	Power 3.3 V	Input
3	GND	
4	Power 3.3 V	Input



Connector G type:
Tyco Micro MATE-N-LOK 3
(dual row, vertical, through hole mount)

Maximum current consumption: 1500 mA.

4.2 Device Management

Building the network and connecting the devices is made using the standard elements used in computer networks, no special elements or cables are required. For connecting a device UTP (Unshielded Twisted Pair) cables of at least category 5 have to be used. The connections are made with RJ45 8-pin telephony connectors (Connector A and B) or SFP modules (Connector C).

The management port complies with the 10Base-T and 100Base-TX IEEE 802.3 standards (UTP cable only). The Transport Stream port contains a Marvell 88E1111 integrated Ethernet transceivers that complies with the 10Base-T, 100Base-TX and 1000Base-T IEEE 802.3 standards. The Marvell PHY provides all the necessary physical layer functions to over UTP cable or optical cable. The Gigabit Ethernet Controller II. operates in full-duplex mode. Although half-duplex mode is also advertised, working in full-duplex mode is supported only.

Using the management port the controller can easily be programmed via UDP/IP or HTTP (TCP/IP). The device supports Digital Data Transmission over IP version 3 (DDToIPv3) protocol.

The Gigabit Ethernet Controller II. supports several protocols that do not belong closely to the device management:

- ARP query and request (see RFC 826.).
- ICMP PING (see RFC 792).
- IGMPv2 (see RFC 2236).
- DHCP

DDToIPv1 compatibility: The device answers to SENDACK instruction.
DDToIPv2 compatibility: The device answers to SENDACK (General ACK Type) instruction.

4.2.1 IPv4 and MAC Addresses

The GEC II. has programmable MAC addresses and programmable IPv4 addresses.

The MAC addresses can be set using the SETMAC instruction. The device supports three modes of setting the MAC address:

- In Factory Default mode the MAC Address is the factory default.
- In Static mode the user can freely set the MAC address.
- In CW Auto mode the device automatically computes the MAC address from its IP address (Figure 2). The first two bytes of the MAC address are constant 42:57 hexadecimal. The lower 4 bytes refer to the IPv4 address.

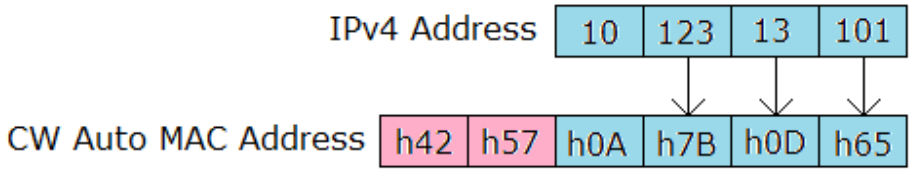


Figure 2. CW Auto MAC Mode

The IP addresses can be configured with the SETIPV4 instruction. Both Static IP and DHCP mode is supported. Note that the Internet Assigned Numbers Authority (IANA) has reserved the following three blocks of the IP address space for private networks (see RFC 1918):

Network Address Range	CIDR Notation
10.0.0.0 - 10.255.255.255	/8
172.16.0.0 - 172.31.255.255	/12
192.168.0.0 - 192.168.255.255	/16

Factory default settings (MAC addresses are given in hexadecimal format, IPv4 addresses in decimal format):

- Management port MAC address: B4:00:9C:xx:xx:xx
- Management port IPv4 address: 10.123.13.101
- TS port MAC address: B4:00:9C:xx:xx:xx
- TS port IPv4 address: 10.123.13.102
- Static IP and Factory Default MAC mode

4.2.2 Network Mask and Default Gateway

The network address space is usually organized into several subnets. Routers (default gateways) constitute borders between subnets. In IPv4, the subnet is identified by its base address and network mask.

The network mask can be programmed using the SETIPV4NETMASK instruction. The factory default value is 255.255.255.0. If the IP Mode is set to DHCP the controller automatically gets the network mask from the DHCP server.

A default gateway is a node (a router) on a network that serves as an access point to another network. The Default gateway can be programmed using the SETIPV4GATEWAY instruction. The device supports three gateway modes:

- None: There is no default gateway in the network.
- Static: The user sets the gateway IP's. The gateway MAC address will be found by the device using ARP sequence.
- DHCP: The controller finds the default gateway with DHCP protocol.

References:

- RFC 950 Internet Standard Subnetting Procedure
- RFC 1812 New Internet Subnetting Procedure
- RFC 950 Utility of Subnets of Internet Networks
- RFC 1101 DNS Encodings of Network Names and Other Types

4.2.3 DDToIPv3 Protocol

Digital Data Transmission over IP Version 3 (DDToIPv3) is a flexible device management protocol specially developed for the GEC II. board. The instructions can be encapsulated in UDP/IP packets as shown in Figure 3. or in HTTP POST messages.

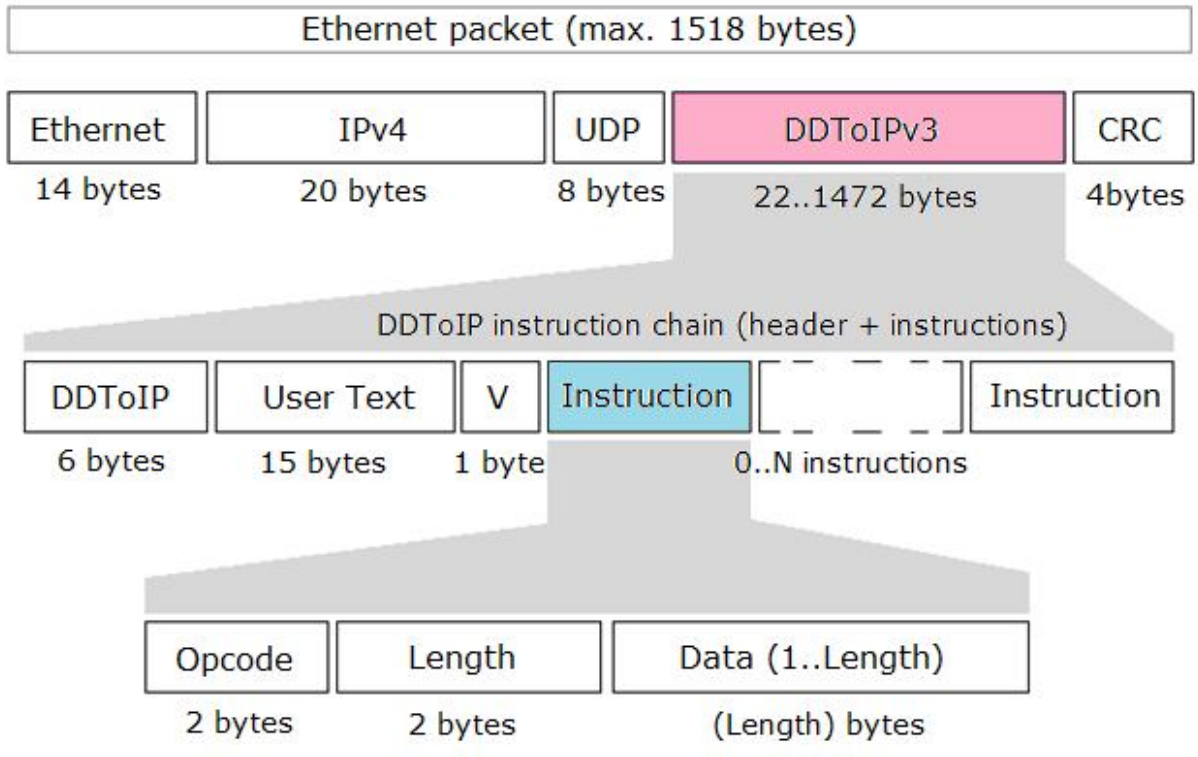


Figure 3. DDToIPv3 Protocol

The DDToIP instruction chain (contained by the UDP payload or the HTTP POST body) must start with "DDToIP" characters (44-44-54-6F-49-50 hexadecimal). It is followed by a 15-character user-defined string (User Text). User can use this field to place his company name into the packet. V (version number) must be 0x03.

The DDToIP packet can contain one or more instructions. The instructions are performed sequentially.

4.2.4 Device Management via HTTP

The Gigabit Ethernet Controller II. can be programmed via TCP/IP using the HTTP GET and POST messages.

Using HTTP GET method the user can read data from the controller. The read instruction is coded in the URI string of the request line. Requests using GET only retrieve data and have no other effect.

URI	Instruction
SENDACKxxx	Send ACK type xxx (xxx must be between 0 and 999)
READSDRAMppppp	Read a 1024-byte page from the SDRAM of the microcontroller or the FPGA (ppppp must be between 0 and 65535)
SDRFpppppTrrrrr	Read several pages from the SDRAM. The first page is ppppp, the last page is rrrrr (ppppp and rrrrr must be between 0 and 65535).
FLREADpppp	Read a 1024-byte page from the Storage Flash (pppp must be between 0 and 8191)
FLRFpppppTrrrrr	Read several pages from the Storage Flash.
SCBREADCAaaaannnn	Read data from the communication area via the SCB. aaaa is the SCB Address in hexadecimal format (e.g. 01B0). nnnn is the number of bytes to read in decimal format.
PSIxx	Read the PSI data (4 kBytes) of the output stream #xx.
RTAxx	Read the RTA counters of a given stream.
STARTFUP	Calculate checksum, send FUP CHECKSUM answer and start firmware upgrade.

Request line examples:

- GET /SENDACK8 HTTP/1.1
- GET /READSDRAM0 HTTP/1.1
- GET /READSDRAM32456 HTTP/1.1
- GET /SDRF16T20 HTTP/1.1
- GET /FLREAD29 HTTP/1.1
- GET /SCBREADCA0050256 HTTP/1.1
- GET /PSI5 HTTP/1.1
- GET /RTA2 HTTP/1.1

To program the controller the user must send a HTTP POST message to the controller with the "POST /DDToIP HTTP…" request line. The body of the message contains the DDToIPv3 instruction chain (DDToIP header with the user text and the instructions, max. 256 kbyte). If the instruction chain contains read instructions (e.g. SENDACK, READSDRAM, FLREAD) the answer can read out sending a HTTP GET message with the "DDToIP" URI.

Request lines:

- POST /DDToIP HTTP/1.1
- GET /DDToIP HTTP/1.1

4.2.5 Integrated WEB Server

Limitations of the website:

- Maximum size of the firmware image (*.fim): 4 MB
- Maximum filesize: 1 MB
- Maximum filename length: 28 chars
- The firmware image (*.fim) can contain 65535 files as a maximum.

4.3 Transport Stream Receiver

The input of the Transport Stream Receiver of the Gigabit Ethernet Controller II. is an universal gigabit port (connector B) separated from the management port, and it can be connected beyond with conventional UTP cable also with optical cable, through an optional converter module.

The Transport Stream Receiver receives IPTV or RTP (Real-time Transfer Protocol) format streams from the network and converts them into time multiplexed LVDS TS format. The Receiver can process 64 IP streams as a maximum. The Receiver consists of the RX Filter, the Input Stream Table, the TS FIFO, the Stream Analyzer and the Stream Statistics.

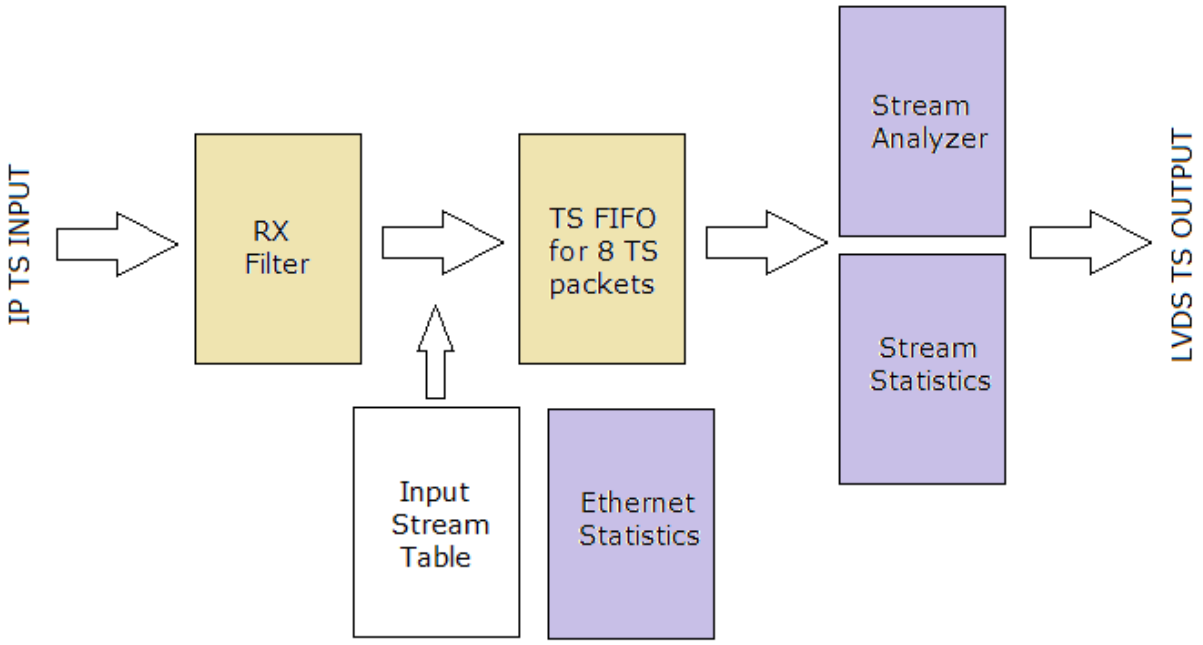


Figure 4. Transport Stream Receiver

4.3.1 RX Filter

The RX Filter processes the headers (Ethernet, IP and UDP header) of the Ethernet packets and selects the transport stream and the management packets. The RX Filter contains five filter units.

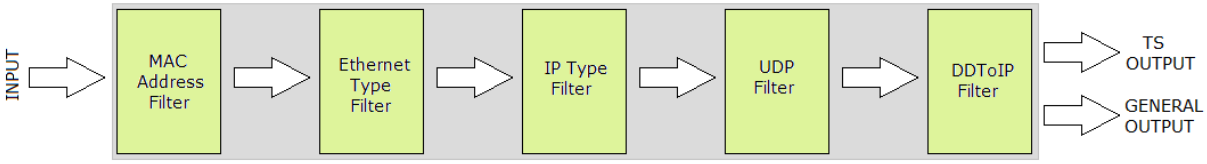


Figure 5. RX Filter

The MAC Address Filter examines the destination MAC address of the packet. The own address of the device, broadcast and multicast addresses are passed, others are filtered.

The Ethernet Type Filter examines the type field of the Ethernet header. ARP and IPv4 types are passed, others are filtered. The device filters and removes IEEE 802.1Q VLAN Tags

The IP Type Filter examines the type and the header length of the IPv4 header. IGMP, ICMP (except Destination Unreachable) and UDP types are passed, others are filtered. The length of the IP header must be 20 bytes in case of UDP packets.

The UDP Filter examines the destination port and the payload length of the UDP header. The port must be greater than 255 (except DHCP messages at port 68). If the payload length is n*188, n*204 or 12+n*188 (RTP) (n=1..7), the packet is marked as transport stream packet.

The DDToIP Filter examines the first 6 bytes of the UDP payload. If the first 6 bytes are "DDToIP", the packet is marked as DDToIP instruction packet.

For proper reception TS packets must have the following properties:

- Unfiltered destination MAC Address
- IPv4 with 20 bytes long IP header
- UDP port greater than 255
- UDP length is n*188, n*204 or 12+n*188 (where n=1..7)

Management (or general) packets are processed by the microcontroller and must have the following properties:

- Unfiltered destination MAC Address
- ARP or IPv4 (ICMP, IGMP, DHCP or DDToIP)
- In case of DDToIP message UDP port must be greater than 255

4.3.2 Input Stream Table

The Input Stream Table (IST) contains the properties of the input Transport Streams (16 bytes per stream): Control byte, Filter byte, Destination IP Address (4 bytes), Destination UDP Port (2 bytes), VLAN Tag (2 bytes), Source IP Address (4 bytes) and Source UDP Port (2 bytes).

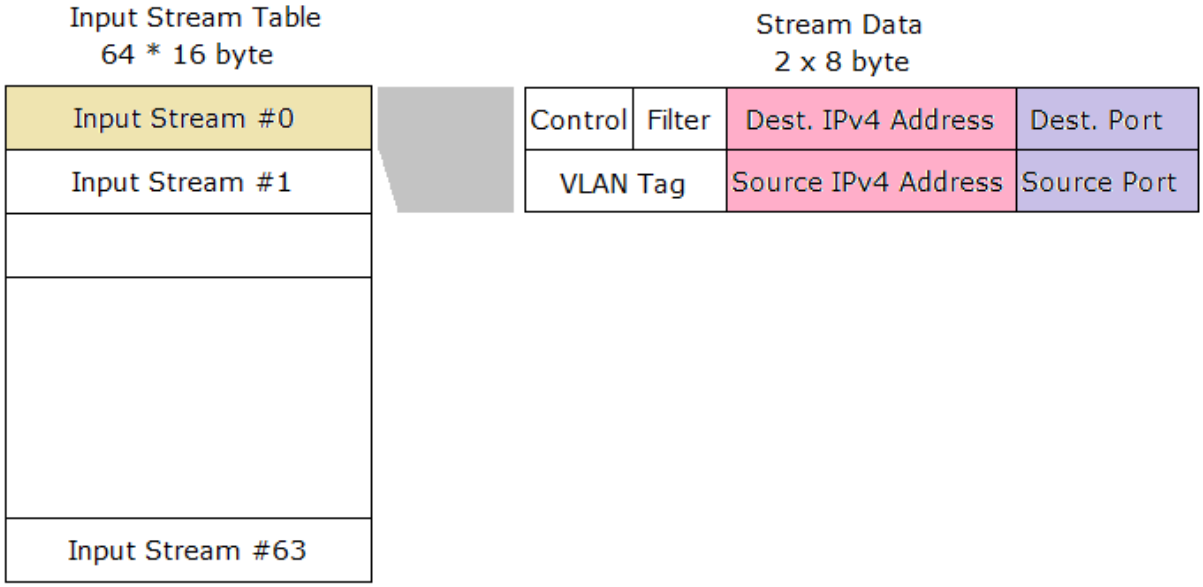


Figure 6. Input Stream Table

The Control byte has the following bits:

- E (bit 7): Stream enabled (1) / disabled (0)
- I (bit 6): Generate IGMP messages (1)
- V (bit 5): VLAN stream (1)
- (bit 4): Reserved (0)
- S (bit 3): Remove scrambled packets (1) (Future release)
- T (bit 2): Remove packets with Transport Error (1)
- N (bit 1): Remove nullpackets (1)
- A (bit 0): TS Analyzer on (1) / off (0)

It is important to fill in the table out correctly. The GEC II. is continuously monitoring the table and sends out IGMPv2 messages in order to be able to receive multicast IP streams. The destination multicast IP address must be properly set if bit I is set in the control byte.

If the V bit is set the controller sends VLAN Tagged IGMP messages. The Ethernet header of the received packets must contain a 4-byte IEEE 802.1Q

VLAN Tag. The controller checks the VLAN ID (the last 12 bits of the TCI field) and compares it with the VLAN Tag field of the Input Stream Table.

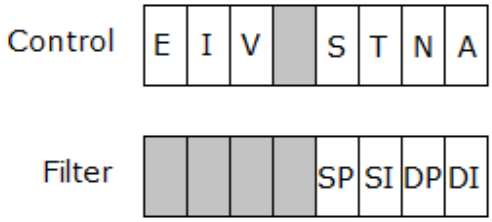


Figure 7. IST Control and Filter bytes

The Filter byte has the following bits:

- SP (bit 3): Filter source UDP port (1)
- SI (bit 2): Filter source IP address (1)
- DP (bit 1): Filter destination UDP port (1)
- DI (bit 0): Filter destination IP address (1)

To clear the table use the CLEARINPUTSREAMTABLE instruction. To set an input stream use the SETINPUTSREAM or the SETINPUTSREAMF instruction. The complete instruction set can be found in section 5.4.

4.3.3 Stream Analyzer

The Gigabit Ethernet Controller II. has an integrated Stream Analyzer module in both the TS Receiver and the TS Transmitter. The device has a 16-Mbyte internal SDRAM area which can be read using the READSDRAM instruction. The lower half of this memory is for the Input Stream Analyzer (TS Receiver), the upper half is for the Output Stream Analyzer (TS Transmitter). Every stream has a 128-kbyte memory area. The Stream Analyzer automatically collects and stores the PSI sections of the transport stream (PAT, CAT, SDT, NIT and PMT sections). The timing limits of the collection are the followings:

- Each section (PAT, CAT, SDT, NIT and PMT) has an own Collection Time Max parameter. The maximum collection times (the maximum time interval while the Analyzer waits for the section to be received) can be set between 1 and 65565 ms using the SETCOLLECTIONTIMEMAX instruction.
- The analyzer automatically recollects the sections if the recollection period expired. This period can be set between 1 and 65565 seconds using the SETRECOLLECTIONTIME instruction. This function is off if the period is set to zero.

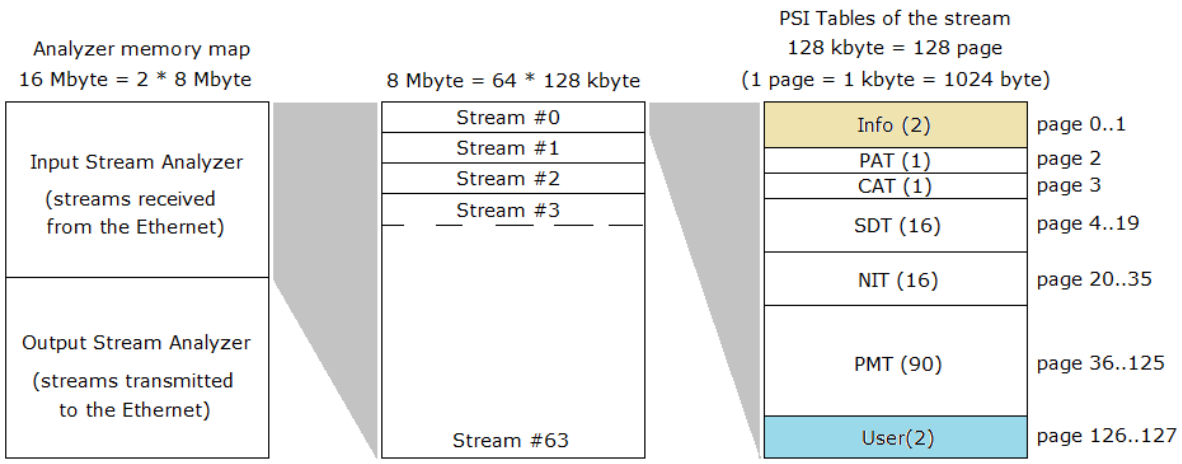


Figure 8. Stream Analyzer memory map

One TS section takes 1024 bytes (1 page) as a maximum. The Analyzer collects the PAT section first. The PAT is fully processed to determine the PMT tables to be collected. Maximum 90 PMTs can be stored. The first page of the SDT area contains the first SDT section (section number is zero). Maximum 16 SDT sections can be stored. The NIT area is similar to the SDT.

The state of the collection and the basic section information are stored on the info pages. The info field stores the latest information about the section:

- State: the lower four bits are the state of the collection
  0x0 : State after reset
  0x1 : No stream (bitrate is zero)
  0x2 : Need collection
  0x3 : Collection in process
  0x4 : Section collected (OK)
  0x5 : Section not found
  0x6 : Collection error
  The upper four bits are the type of the collection:
  0x1 : First collection
  0x2 : Updated (repeated) collection
- PID value
- TID: Table ID
- ID: Transport Stream ID or Program Number
- Ver: Version
- Sect: Section Number
- LSect: Last Section Number
- TimeStamp: copy of the System Up Time (see the VARIABLES ACK) when the field was last modified (in ms).

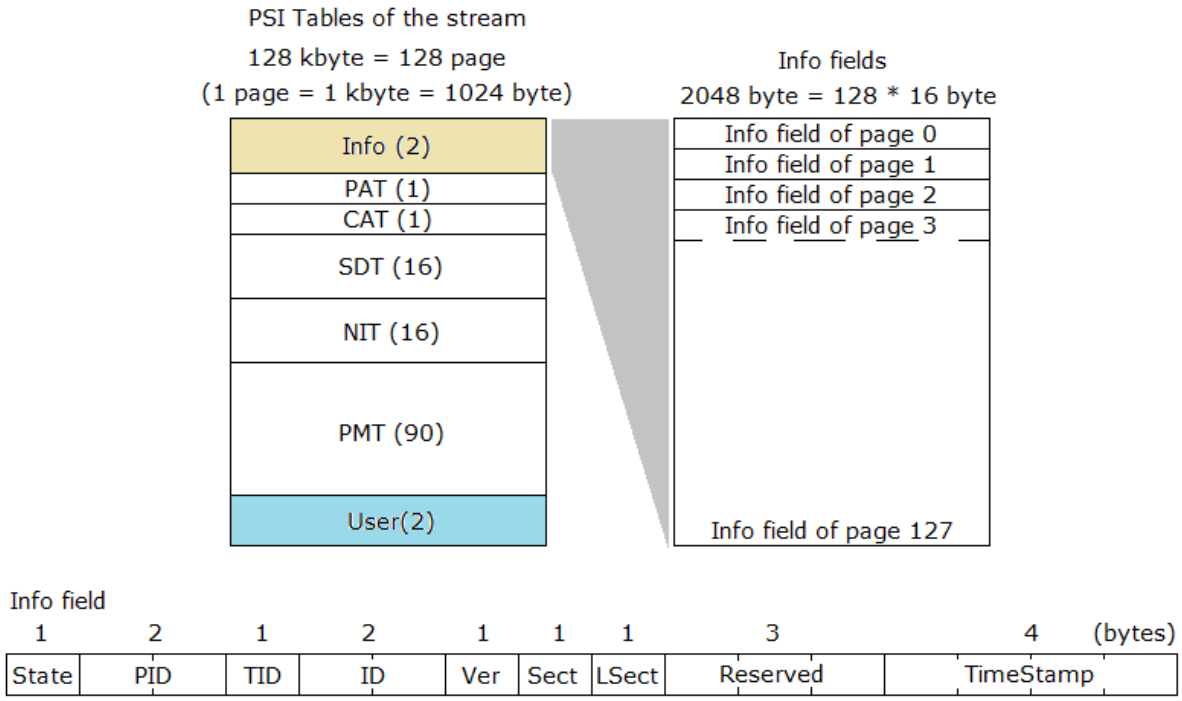


Figure 9. Stream Analyzer info page

4.3.4 Stream Statistics

The Gigabit Ethernet Controller II. has an integrated Stream Statistics module in both the TS Receiver and the TS Transmitter. The Stream Statistics module counts the selected TS packets received under an approximately 1000 ms time period. Every stream has a 16 bytes long memory area which contains the packet counters and the length of the actual period. The table is refreshed in every second.

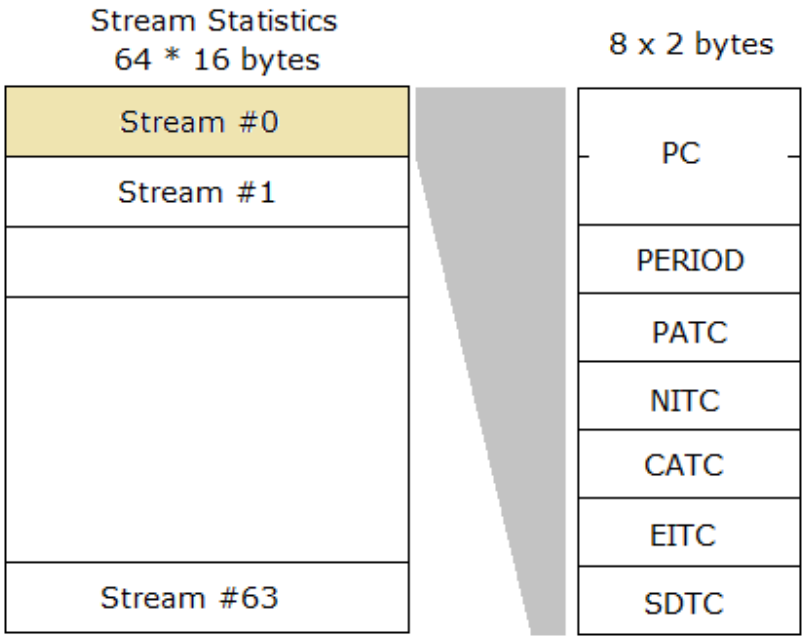


Figure 10. Stream Statistics

The fields are the followings:

- PC: 32-bit Packet Counter, the number of TS packets received under the time period.
- PERIOD: 16-bit period length in ms.
- PATC: 16-bit PAT Counter, the number of TS packets with PID value 0x0000 received under the time period.
- NITC: 16-bit NIT Counter, the number of TS packets with PID value 0x0010 received under the time period.
- CATC: 16-bit CAT Counter, the number of TS packets with PID value 0x0001 received under the time period.
- EITC: 16-bit EIT Counter, the number of TS packets with PID value 0x0012 received under the time period.

- SDTC: 16-bit SDT and BAT Counter, the number of TS packets with PID value 0x0011 received under the time period.

The Stream Statistic memory can be read out using the SENDACK instruction.

4.3.5 Ethernet Statistics

The Gigabit Ethernet Controller II. has an integrated Ethernet Statistics module in the TS Receiver. The Ethernet Statistics module counts the UDP packets received in 1 s time period, it measures the maximum and the minimum delay between two packets and counts the RTP Sequence Number errors. Every input stream has a 16 bytes long memory area which contains the counters. The table is refreshed in every second.

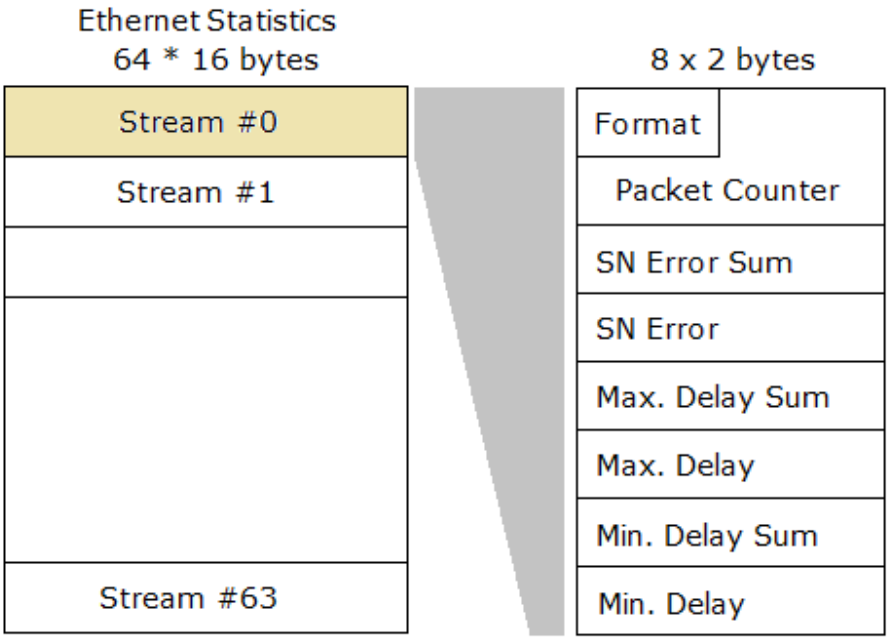


Figure 11. Ethernet Statistics

The fields are the followings:

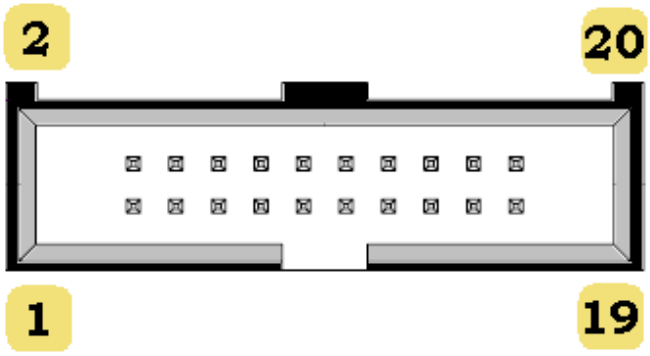
- Format: 8-bit field. Bit 7 is set if the stream format is RTP. Bit 6..4 contain the number of TS packets per UDP.
- Packet Counter: 24-bit Packet Counter, the number of UDP packets received under 1 second.
- SN Error Sum: 16-bit RTP Sequence Number error counter. This field can be erased using the CLEARETHERNETSTAT instruction. If the counter reaches the 0xFFFF value it doesn't incremented.
- SN Error: 16-bit counter. RTP Sequence Number errors in the last 1 second.

- Max. Delay Sum: 16-bit field. The maximum delay between two UDP packets in ms. This field can be erased using the CLEARETHERNETSTAT instruction.
- Max. Delay: 16-bit field. The maximum delay between two UDP packets in ms measured in the last 1 second.
- Min. Delay Sum: 16-bit field. The minimum delay between two UDP packets in ms. This field can be erased using the CLEARETHERNETSTAT instruction.
- Min. Delay: 16-bit field. The minimum delay between two UDP packets in ms measured in the last 1 second.

The counters of the Ethernet Statistic can be erased using the CLEARETHERNETSTAT instruction.

4.3.6 LVDS Transport Stream Output

The Parallel LVDS TS Output port (Connector D) is a 20-pin LVDS output port on the board.



Connector F type: Samtec SHF-110-01-L-D-TH
(Cable strip: Samtec FFSD-10-01-N)

Pin	Description	Direction	IO Standard
1	TS Clock P	Output	3.3 V LVDS
2	TS Clock N	Output	3.3 V LVDS
3	TS Sync P	Output	3.3 V LVDS
4	TS Sync N	Output	3.3 V LVDS
5	TS Data0 P	Output	3.3 V LVDS
6	TS Data0 N	Output	3.3 V LVDS
7	TS Data1 P	Output	3.3 V LVDS
8	TS Data1 N	Output	3.3 V LVDS
9	TS Data2 P	Output	3.3 V LVDS
10	TS Data2 N	Output	3.3 V LVDS
11	TS Data3 P	Output	3.3 V LVDS
12	TS Data3 N	Output	3.3 V LVDS
13	TS Data4 P	Output	3.3 V LVDS
14	TS Data4 N	Output	3.3 V LVDS
15	TS Data5 P	Output	3.3 V LVDS
16	TS Data5 N	Output	3.3 V LVDS
17	TS Data6 P	Output	3.3 V LVDS
18	TS Data6 N	Output	3.3 V LVDS
19	TS Data7 P	Output	3.3 V LVDS
20	TS Data7 N	Output	3.3 V LVDS

The LVDS TS Output can be used to source external boards or can be feed back with a ribbon cable to the LVDS TS Input. The TS Sync output must be high during the sync byte.

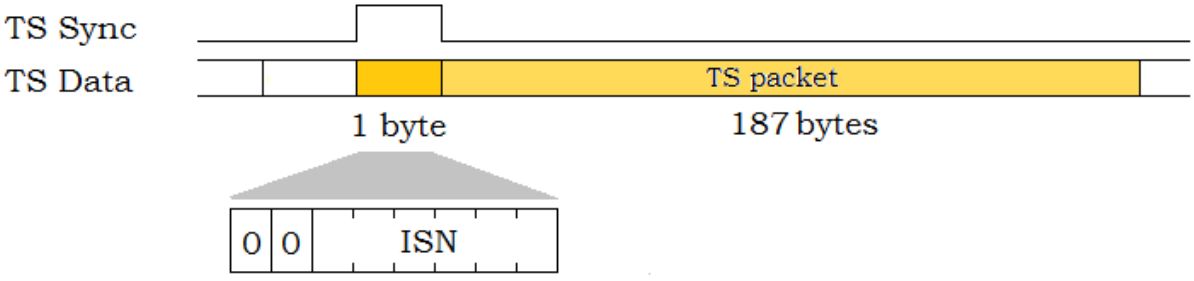


Figure 12. LVDS TS Output

The original sync byte (0x47) of the TS packet is replaced by two zero value bits (bit7 and bit6) and the 6-bit Stream Number (bit5..bit0). TS Clock runs at the rate at which bytes are offered by the controller. Data must be sampled (it must be stable) on the rising edge of the clock signal. The TS Clock frequency is 125 MHz.

4.4 Transport Stream Transmitter

The input of the Transport Stream Transmitter of the Gigabit Ethernet Controller II. is the parallel LVDS TS input port (connector E). The data format is the same as the LVDS TS Output. The Transport Stream Transmitter receives LVDS format streams and converts them into UDP or RTP format. The Transmitter can process 64 Transport Streams as a maximum. The Transmitter consists of the Loopback Unit, the Stream Analyzer, the Stream Statistics, the PID Filter, the Output Filter and MPX Table (OFMT), the PSI Inserter and the Output Stream Table.

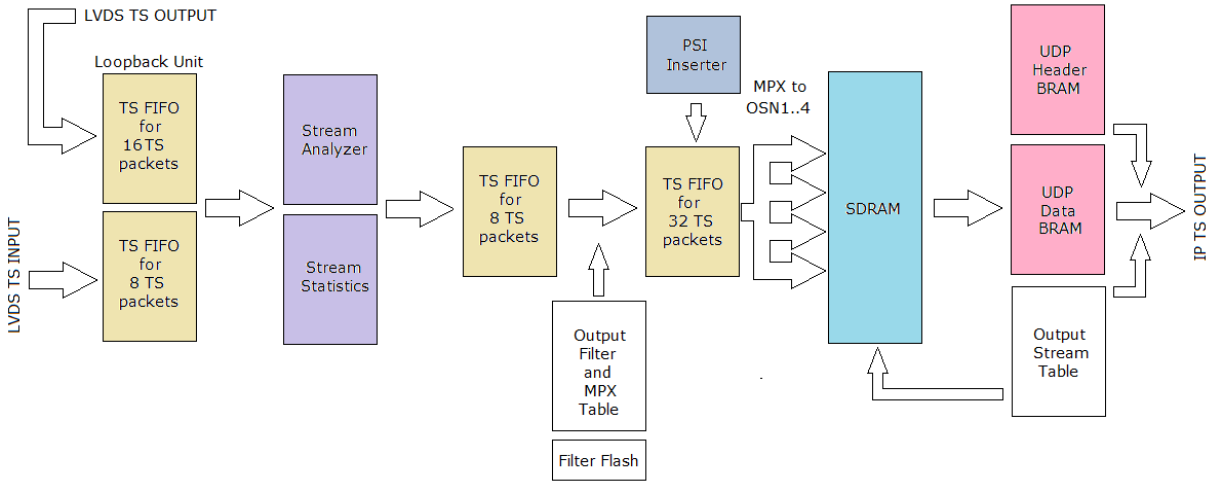


Figure 13. Transport Stream Transmitter

4.4.1 Loopback Unit

Using the Loopback Unit transport streams from the LVDS Output can be looped back to the Transmitter. The Loopback Unit can be enabled or disabled using the SETCONFIGURATION instruction (Configuration register, bit 11). If the unit is enabled and the stream number of the LVDS output stream is equal or greater than the TS Loopback Stream Number the stream will be looped back. The TS Loopback Stream Number can be set using the SETTSLOOPBACKSN instruction.

4.4.2 Stream Analyzer

The Stream Analyzer of the Transport Stream Transmitter is the same as the analyzer of the TS Receiver described in section 4.3.3.

4.4.3 Stream Statistics

The Stream Statistics of the Transport Stream Transmitter is the same as the Stream Statistics of the TS Receiver described in section 4.3.4.

4.4.4 PID Filter

The Gigabit Ethernet Controller II. has an integrated PID Filter unit. It can be enabled or disabled using the SETCONFIGURATION instruction (Configuration register, bit 8). Using the PID Filter TS packets with different PID values can be individually filtered or moved to a given output stream.

The PID Filter has an 8-Mbyte on-chip serial flash memory, but only the first 512 Kbytes are used. Each stream has an 8-Kbyte area which can be erased using the CLEARPIDFILTER instruction. The instruction sets all memory (8 Kbytes) to the erased state of all 1s (hFF). In erased state the behavioral depends on the PID Filter mode (Configuration register, bit 10). In case of Normal mode the TS packets will be filtered. In case of Pass through mode the TS packets will be passed through with the original OSN.

The PID Filter can be programmed using the SETPIDFILTER instruction. The instruction consists of 4-byte blocks (move a given PID of an output stream to another output stream). 256 PIDs can be enabled in an output stream as a maximum. Before programming the filter memory of the output stream must be cleared.

The PID Filter can be read using the SENDACK instruction with Type 0x00C0 to 0x00FF (Stream #0 to Stream #63). The ACK answer has a compressed format (only the enabled PIDs are transferred).

4.4.5 Output Filter and MPX Table

The Output Filter and MPX Table (OFMT) contains 64 control bytes corresponding to the 64 input LVDS streams. An input TS packet can be filtered (nullpackets, scrambled packets and packets with TSP error can be removed) and multiplexed (copied) to four different output IP channels. The table can be set using the SETOUTPUTFILTERANDMPX instruction. The table can be read using the SENDACK instruction.

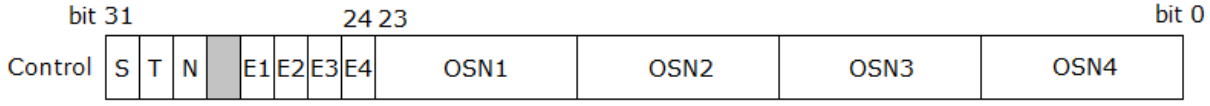


Figure 14. Output Filter and MPX Table control word

The Control byte has the following bits:

- S (bit 31): Remove scrambled packets (1)
- T (bit 30): Remove packets with Transport Error (1)
- N (bit 29): Remove nullpackets (1)
- E1 (bit 27): Enable packet multiplexing to OSN1 (1)
- E2 (bit 26): Enable packet multiplexing to OSN2 (1)
- E3 (bit 25): Enable packet multiplexing to OSN3 (1)
- E4 (bit 24): Enable packet multiplexing to OSN4 (1)
- OSN1 (bit 23..18)
- OSN2 (bit 17..12)
- OSN3 (bit 11..6)
- OSN4 (bit 5..0)

4.4.6 PSI Inserter

The Gigabit Ethernet Controller II. has a PSI table inserter unit used to generate PAT, PMT, SDT and other tables for the SPTSs. The PSI Inserter can be enabled or disabled using the SETCONFIGURATION instruction (Configuration register, bit 9).

The PSI Inserter uses the upper 256 Kbytes of the storage flash memory. Each output stream has a 4-Kbyte memory area to store TS packets. 16 different TS packets can be inserted into a selected output stream as a maximum.

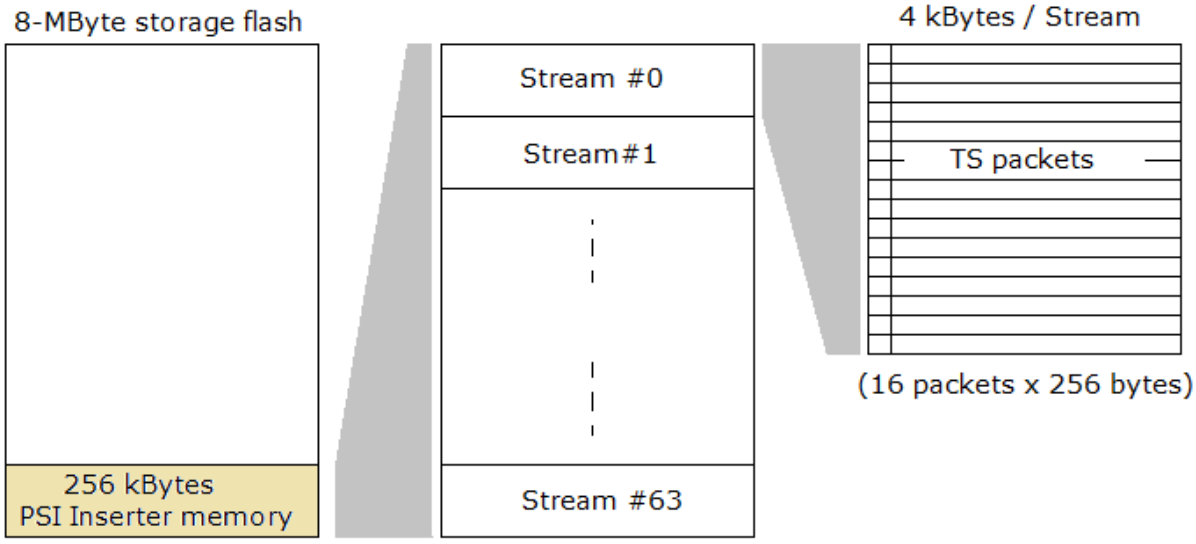


Figure 15. PSI Inserter memory structure

The inserter memory content of a given output stream can be erased using the PSIINSERASE instruction. The instruction sets all memory (4-Kbytes) to the erased state of all 1s (hFF). In erased state no TS packets will be inserted to the stream.

To program the PSI Inserter use the PSIINSWRITE instruction. This instruction writes one TS packet into a given location. One TS packet occupies 256 bytes in the memory. The first 3 bytes (CCG and Delay) are control information. It is followed by the packet (188 bytes, start with 0x47). The last 65 bytes cannot be programmed, these are unused bytes (0xFF).

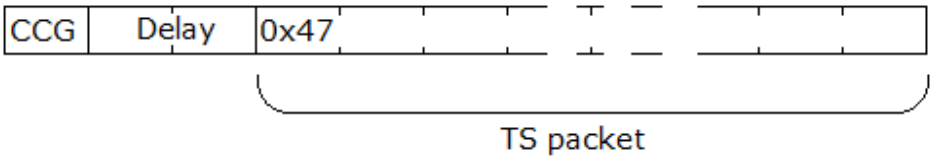


Figure 16. PSI Inserter Transport Stream packet format

The first byte is the CCG. It is the packet indicator (CCG <> 0xFF) and it determines the continuity counter group. If CCG is set to zero the automatic continuity counter generator is switched off for this packet. Each output stream has 8 continuity counter generators. To enable the automatic continuity counter generator the CCG field must be set to a number between 1 and 8. The Delay filed determines the delay (in 1 ms units) after the packet insertion. The packet insertion starts with the first packet in the sector (4-Kbyte area). After the last packet the insertion is started afresh.

4.4.7 Output Stream Table

The Gigabit Ethernet Controller II. can generate 64 independent output IP streams. The parameters of the streams are stored in a memory called Output Stream Table (OST).

The Output Stream Table is an 1-Kbyte BRAM. Every stream has a 16 bytes long memory area. The first 4 bytes are for stream control. The Control field is followed by the 4-byte IPv4 Address, the 6-byte MAC Address and the 2-byte UDP Port number.

Notes:

- The source and the destination UDP port of the output IP stream are the same.
- The source IP address of the output IP stream is the address of the Transport Stream port.

- The source MAC address of the output IP stream is the address of the Transport Stream port.

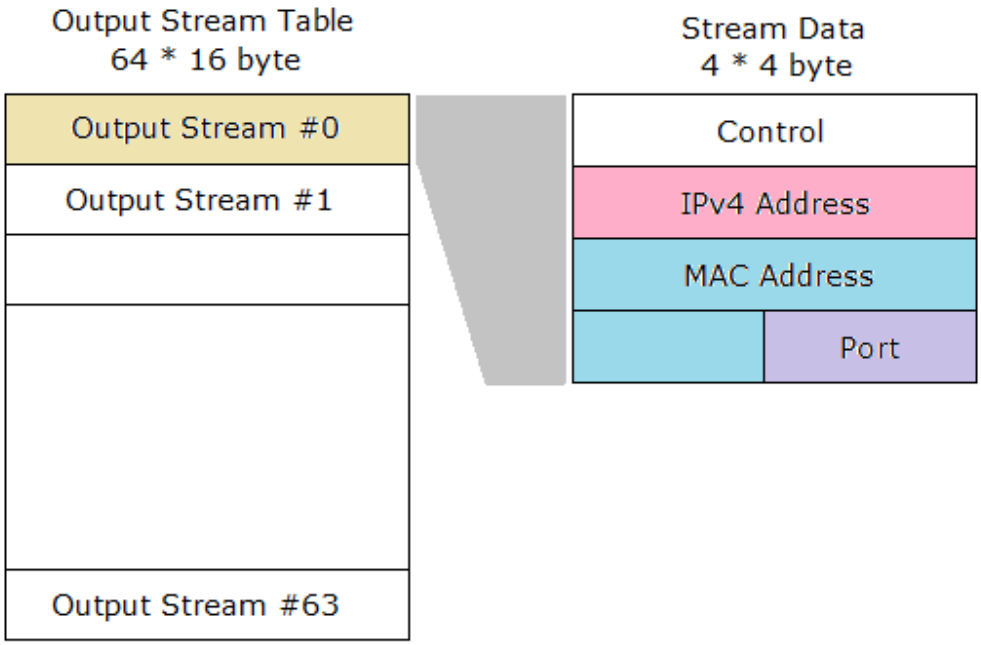


Figure 17. Output Stream Table structure

The OST can be programmed with the following instructions: SETIPV4OUTPUTSTREAM, DISABLEOUTPUTSTREAM, CLEAROUTPUTSTREAMTABLE and SAVEOUTPUTSTREAMTABLE. The content of the OST can be read out using the SENDACK instruction. The fields in the OST memory are stored with MSB first. The Control word has the following fields:

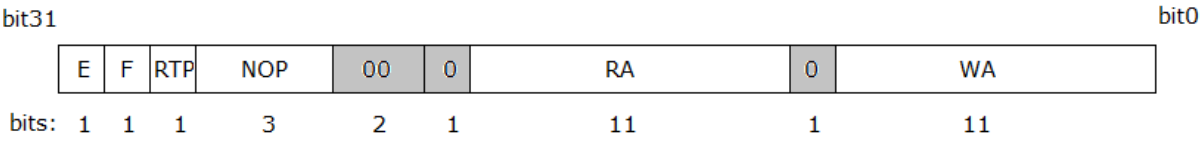


Figure 18. 32-bit Control word

- E (bit 31): Output stream enabled (1) / disabled (0)
- F (bit 30): Format is 188-byte (1) / 204-byte (0)
- RTP (bit 29): Real-Time Protocol format (1) / IPTV format (0)
- NOP (bit 28..26): Number of TS packets per UDP (1..7)

- RA (bit 22..12): SDRAM read address
- WA (bit 10..0): SDRAM write address

Before the IP transmission the TS packets are stored in an SDRAM. Every output stream has a 512-Kbyte memory area (FIFO) which can store 2048 TS packets. The usage (number of the stored TS packets) of the SDRAM FIFO can be calculated by WA-RA, where WA is the current write address of the FIFO and RA is the current read address.

4.5 Real-Time Analyzer

With the embedded Real-Time Analyzer (RTA) the Gigabit Ethernet Controller II. offers the users a measuring device, which is capable of the simultaneous and continuous monitoring of 64 transport streams. The device monitors and gathers numerous data described in Recommendation TR 290.

The RTA collects PID specific information about the Transport Streams using 32-bit and 16-bit counters and stores them in the SDRAM. The RAM content can be read out using the READSDRAM instruction from page 0x8000 to page 0x9FFF. The RAM content can be erased using the CLEARRTA instruction. Each Transport Stream has a 16*8192 = 131072 bytes long memory area.

The RTA can be enabled or disabled using the SETCONFIGURATION instruction. The RTA has three different stream configurations which can be set with the Real-Time Analyzer mode bits (bit 13 and 12 in the Configuration register):

- 00 – RTA is Disabled
- 01 – IP input mode (RTA measures the 64 IP input streams)
- 10 – LVDS input mode (RTA measures the 64 LVDS input streams)
- 11 – Mixed mode (RTA measures IP input streams from 0 to 31 and LVDS input streams from 32 to 63)

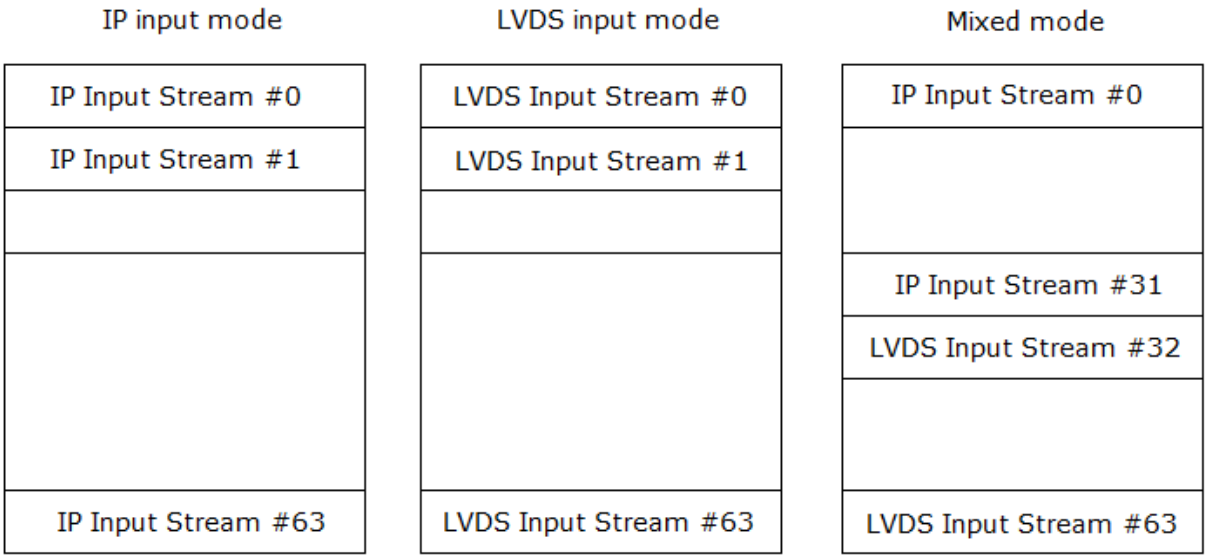


Figure 19. RTA modes

Using the CLEARRTA instruction user can clear all the counters in the RTA memory area (including the Time Stamp). The measurement starts automatically after performing the clear instruction or enabling the unit.

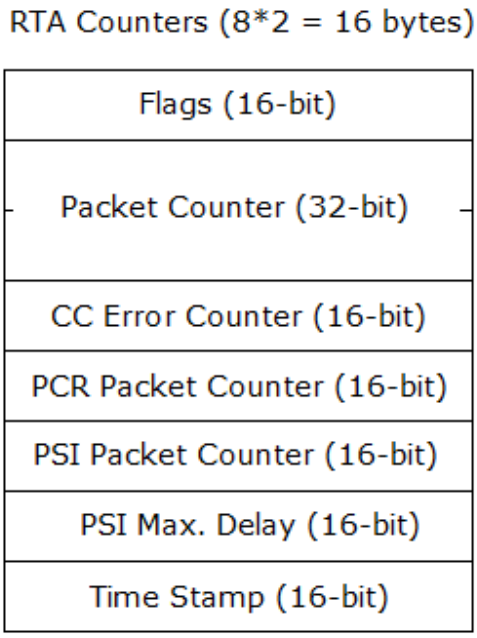


Figure 20. RTA counters

The 16-byte RTA area of a given PID has the following counters:

- Flags
- 32-bit packet counter
- 16-bit CC (continuity counter) error counter
- 16-bit PCR packet counter. It counts packets with PCR timestamp.
- 16-bit PSI packet counter. It counts packets with the following condition: (Payload Unit Start indicator is set) and (Section Number is zero) and ((PID = 0x10 and Table ID = 0x40) or (PID = 0x11 and Table ID = 0x42) or (PID = other))
- 16-bit PSI Max. Delay. The maximum gap between two PSI packet counter incrementation in milliseconds. The value is zero if less than two packets received. The value is 0xFFFF if there was a time overflow.
- 16-bit time stamp. The timestamp (in ms) of the last packet. It is for internal use.

The Flags field has the following structure:

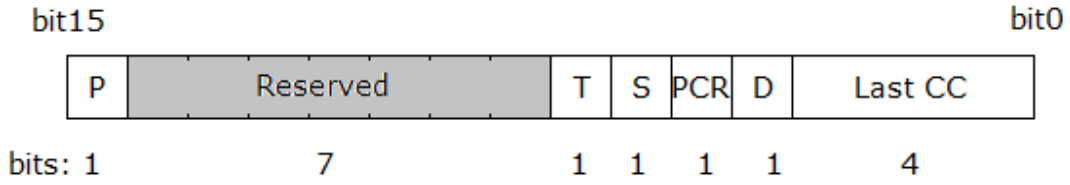


Figure 21. Flags

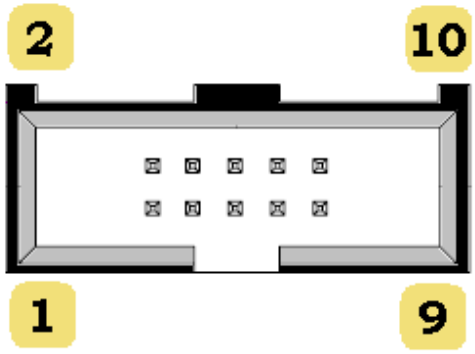
- P – Packet indicator (there was at least one TS packet)
- T – Transport error flag (there was at least one TS packet with transport error)
- S – Scrambled packet flag (there was at least one scrambled TS packet)
- PCR – PCR packet flag
- D – There was at least one continuity counter discount. event
- CC – Continuity counter value of the last packet. It is for internal use.

Flags can be cleared by the CLEARRTA instruction.

Programming the GEC II. via HTTP the counters of a given stream (4+16*8192 bytes) can be read out within a single cycle using the RTAxx URI. In this case the first four bytes of the answer is a 32-bit timestamp (MSB first, in ms). The 32-bit timestamp will be cleared automatically after performing a clear instruction or enabling the unit.

4.6 Serial Communication Bus

The Serial Communication Bus (SCB-M) port (Connector F) is a 10-pin IO port on the board.



Connector type: Samtec SHF-105-01-L-D-TH
(Cable strip: Samtec FFSD-05-01-N)

Pin	Description	Direction	IO Standard	Impedance
1	GND	-	-	-
2	CLK	Output	3.3 V CMOS	27 Ω serial
3	GND	-	-	-
4	IRQ	Input	3.3 V CMOS	4.7 kΩ pulldown
5	GND	-	-	-
6	DI	Input	3.3 V CMOS	4.7 kΩ pulldown
7	GND	-	-	-
8	DO	Output	3.3 V CMOS	-
9	GND	-	-	-
10	RESET#	Output	3.3 V CMOS	4.7 kΩ pulldown

For more information about the SCB visit www.bytestudio.hu and download the latest user manual (Serial Communication Bus Vx.x) in pdf format.

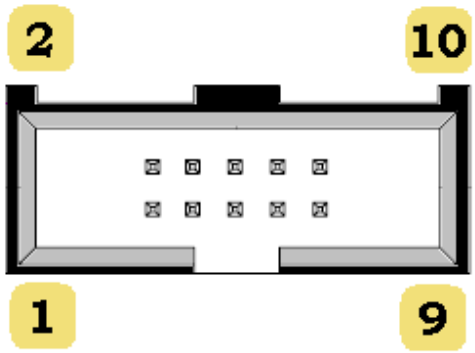
4.7 LED Port

The status LEDs port (connector I) is a 10-pin output port on the board and it can be used to directly drive the LEDs on the front panel of the device (serial resistors required). The GIGABIT port is high at 1000Base-T connection. OVERFLOW is high (for 1 second) if an overflow event occurs. POWERON is high after power up. The LINK, ACT and SFP (SFP module is plugged) ports refer to the LAN connector's LEDs. The overflow sources are the followings:

- TS Transmitter SDRAM overflow
- TS Transmitter FIFO overflow

Pin	Description	Direction
1	LINK (MANAGEMENT INTERFACE)	Output
2	LINK (TS INTERFACE)	Output
3	ACT (MANAGEMENT INTERFACE)	Output
4	ACT (TS INTERFACE)	Output
5	Not used	Output
6	SFP (TS INTERFACE)	Output
7	Not used	Output
8	GIGABIT (TS INTERFACE)	Output
9	OVERFLOW	Output
10	POWERON	Output

The port values are refreshed in every 1000 ms. So, an overflow event causes a high pulse of 1000 ms width on the respective pin.

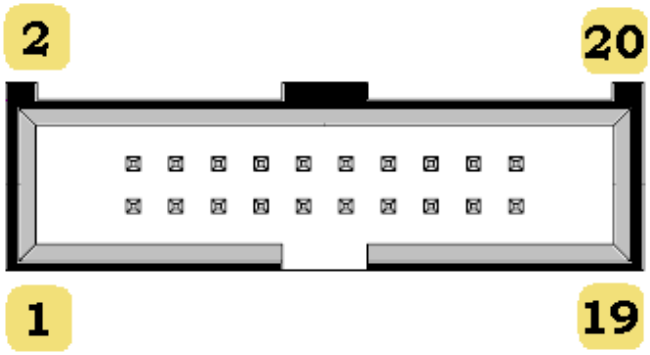


Connector type: Samtec SHF-105-01-L-D-TH
(Cable strip: Samtec FFSD-05-01-N)

4.8 GPO Port

The GPO port (connector H) is a 16-bit general purpose output port on the board. The GPO can be set using the SETGPO instruction.

Pin	Description	Direction
1	GND	-
2	GPO 0	Output
3	GPO 1	Output
4	GPO 2	Output
5	GPO 3	Output
6	GPO 4	Output
7	GPO 5	Output
8	GPO 6	Output
9	GPO 7	Output
10	GND	-
11	GND	-
12	GPO 8	Output
13	GPO 9	Output
14	GPO 10	Output
15	GPO 11	Output
16	GPO 12	Output
17	GPO 13	Output
18	GPO 14	Output
19	GPO 15	Output
20	GND	-



Connector type: Samtec SHF-110-01-L-D-TH
(Cable strip: Samtec FFSD-10-01-N)

4.9 Storage Flash

The Gigabit Ethernet Controller II. has an on-chip 8-Mbyte SPI flash memory to store user data. The flash can be erased using the FLCHIPERASE, FLBLOCKERASE, FLBLOCKERASEW and FLSECTORERASEW instructions. The flash can be programmed and read in 1024-byte pages using the FLPROGRAM and FLREAD instructions.

After performing an erase instruction (except FLBLOCKERASE) the user must check the busy flag in the State register (see the Variables type ACK) to recognize the end of the erase process. While erase is being processed no other instructions can be performed by the flash memory.

Note that the PSI Inserter uses the upper 256 kBytes of the storage flash memory. If the PSI Inserter is disabled, the entire 8 Mbytes can be used to store user data. The FLCHIPERASE instruction erases the PSI Inserter memory too.

4.10 Network Device Management

The Network Device Management unit can be used to manage other devices on the network.

The received ARP request and ARP reply packets are processed and the MAC Address – IP Address pairs are stored in the ARP table. ARP Tables can be read out using the SENDACK instruction. User can generate ARP Request messages using the SENDARPREQUEST and SENDARPREQUESTQUEUE instructions.

The controller can send/receive DDToIP or CW-Net UDP messages to/from another device. To manage a device the user must set the parameters of the managed device using the SETMANAGEDDEVICE instruction. These parameters can be read back from the VARIABLES ACK. To send a DDToIP or CW-Net UDP message to the managed device use the SENDDNDMMESSAGE instruction. To read out the answer of the managed device use the NDM ACK answer. The first byte of the NDM ACK (Answer Counter) is set to zero if a SENDNDMMESSAGE instruction is performed. The first byte is incremented if an answer received from the managed device. The NDM ACK stores the last answer only.

4.11 Reset Defaults Button

The user can reset the default settings by pressing the Reset Defaults button (connector L). It is useful when the device is locked and user forgot the key, or the IP address of the device is unknown. To reset the default settings follow these steps:

- Switch on the device.
- Press the Reset Defaults button for a second.
- The controller sounds a blast, the device resets and starts working.

Settings changed to:

- Host Name: CW-4906-0000
- User Text: _CableWorld Net
- Configuration word: 0x0000
- Management Port MAC Mode: Factory Default
- Management Port IPv4 Address: 192.168.10.10
- Management Port Network Mask: 255.255.255.0
- Management Port IP Mode: Static
- Management Port Gateway Mode: Static
- Management Port Gateway IPv4 Address: 192.168.10.1
- Management Port ARP Report Period: 15 sec
- Management Port IPv4 Time To Live: 128
- TS Port MAC Mode: Factory Default
- TS Port IPv4 Address: 10.123.13.102
- TS Port Network Mask: 255.0.0.0
- TS Port IP Mode: Static
- TS Port Gateway Mode: Static
- TS Port Gateway IPv4 Address: 10.123.13.1
- TS Port ARP Report Period: 15 sec
- TS Port IPv4 Time To Live: 128
- TS Port IGMP Report Period: 60 sec
- HTTP Port: 80
- SMTP Server Port: 25
- PAT Collection Time Max: 800 ms
- CAT Collection Time Max: 100 ms
- SDT Collection Time Max: 4 s
- NIT Collection Time Max: 100 ms
- PMT Collection Time Max: 800 ms
- Recollection Time: 300 sec.

- All input streams are disabled
- All output streams are disabled
- Device is unlocked

4.12 Self Test and Error Codes

After power on the controller perform a test sequence. If a critical error occurs the GEC cannot start up. In this case tree status LEDs (the power on LED, the management port LINK LED and the ACT LED) are blinking. In case of non critical errors the corresponding flag in the Hardware Error register is set. The power on test sequence is the following:

1. Microcontroller SDRAM, EEPROM, External Flash1 and Flash2 test. SDRAM and EEPROM errors are critical. (In case of Flash1 error the WEB interface is not working, only the UDP based communication is active.)
2. Loading the settings from the EEPROM. An error is critical.
3. Waiting for FPGA program loading (boot). The controller waits 2 seconds as a maximum. (In case of FPGA program error the management port of the controller is active, the user can read the Hardware Error register.)

In case of critical error the three status LEDs blink N times depends on the error type.

N	Error type	What to do?
2	SDRAM Error	Contact the vendor.
3	EEPROM Error	Power off and power on the device again or try to reset the default settings by pressing the Reset Defaults button.
4	LOADSETTINGS error	Power off and power on the device again or try to reset the default settings by pressing the Reset Defaults button.

5 Instruction Set

General instructions:

NOP	Opcode = 0x0000
LASTINSTRUCTION	Opcode = 0x0001
WAIT	Opcode = 0x0002
RESET	Opcode = 0x0003
LOCK	Opcode = 0x0004
UNLOCK	Opcode = 0x0005
SENDACK	Opcode = 0x0006
READSDRAM	Opcode = 0x0007

Configuration instructions:

SETSERIAL	Opcode = 0x0010
SETTYPE	Opcode = 0x0011
SETNAME	Opcode = 0x0012
SETUSERTEXT	Opcode = 0x0013
SETCOMPANY	Opcode = 0x0014
SETHOSTNAME	Opcode = 0x0015
SETCONFIGURATION	Opcode = 0x0016
SETGPO	Opcode = 0x0017
SAVESETTINGS	Opcode = 0x001F

Network instructions:

SETMAC	Opcode = 0x0020
SETIPV4	Opcode = 0x0021
SETIPV4NETMASK	Opcode = 0x0022
SETIPV4GATEWAY	Opcode = 0x0023
SETARPREPORTPERIOD	Opcode = 0x0024
SETMACMODE	Opcode = 0x0025

Transport Stream Input instructions:

CLEARINPUTSTREAMTABLE	Opcode = 0x0030
SAVEINPUTSTREAMTABLE	Opcode = 0x0031
DISABLEINPUTSTREAM	Opcode = 0x0032
SETIPV4INPUTSTREAM	Opcode = 0x0033
SETIPV4INPUTSTREAMF	Opcode = 0x0034
SETIGMPREPORTPERIOD	Opcode = 0x0035
ENABLEINPUTSTREAM	Opcode = 0x0036
DISABLEALLINPUTSTREAMS	Opcode = 0x0037

Transport Stream Output instructions:

CLEAROUTPUTSTREAMTABLE	Opcode = 0x0040
SAVEOUTPUTSTREAMTABLE	Opcode = 0x0041
DISABLEOUTPUTSTREAM	Opcode = 0x0042
SETIPV4OUTPUTSTREAM	Opcode = 0x0043
CLEAROUTPUTFILTERANDMPXTABLE	Opcode = 0x0045
SAVEOUTPUTFILTERANDMPXTABLE	Opcode = 0x0046
SETOUTPUTFILTERANDMPX	Opcode = 0x0047
CLEARVLANTAGTABLE	Opcode = 0x0048
SAVEVLANTAGTABLE	Opcode = 0x0049
SETVLANTAG	Opcode = 0x004A
CLEARPIDFILTER	Opcode = 0x004B
SETPIDFILTER	Opcode = 0x004C
SETTSLOOPBACKSN	Opcode = 0x004D

Analyzer instructions:

RECOLLECT	Opcode = 0x0050
COLLECT	Opcode = 0x0051
SETCOLLECTIONTIMEMAX	Opcode = 0x0052
SETCOLLECTIONTIME	Opcode = 0x0053
CLEARETHERNETSTAT	Opcode = 0x0054
CLEARRTA	Opcode = 0x0055

SCB instructions:

SCBWRITECA	Opcode = 0x0060
SCBWRITERA	Opcode = 0x0061
SCBREADCA	Opcode = 0x0062
SCBREADRA	Opcode = 0x0063
SCBWRITECWNET	Opcode = 0x0064
SCBREADCWNET	Opcode = 0x0065

Storage Flash & PSI Inserter instructions:

FLCHIPERASE	Opcode = 0x0070
FLBLOCKERASE	Opcode = 0x0071
FLBLOCKERASEW	Opcode = 0x0072
FLPROGRAM	Opcode = 0x0073
FLREAD	Opcode = 0x0074
FLSECTORERASEW	Opcode = 0x0075
PSIINSERASE	Opcode = 0x0078
PSIINSWRITE	Opcode = 0x0079

Network Device Management instructions:

CLEARARPTABLE	Opcode = 0x0080

SENDARPREQUEST	Opcode = 0x0081
SENDARPREQUESTQUEUE	Opcode = 0x0082
SETMANAGEDDEVICE	Opcode = 0x0083
SENDNDMMESSAGE	Opcode = 0x0084

Firmware Upgrade and Test instructions

LOADFUP	Opcode = 0x0800
STARTFUP	Opcode = 0x0801
SHORTBEEP	Opcode = 0x0810

Answers:

ACKANSWER	Opcode = 0xFF00
SDRAMPAGE	Opcode = 0xFF01
SCBDATA	Opcode = 0xFF02
FLASHPAGE	Opcode = 0xFF03

5.1 General Instructions

NOP instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0x0000					
3-4	Length							
5-	Data (optional)							

Description:
Do nothing.

LASTINSTRUCTION instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0x0001					
3-4	Length							
5-6	Data (optional)							

Description:
This is the last instruction in the chain. This instruction can be followed by any user data byte in the UDP packet.

WAIT instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0x0002					
3-4	Length		0x0002					
5-6	Wait							

Description:
Wait before processing the next instruction: $t_{Wait\ Time}$ = Wait [ms]

RESET instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0x0003					
3-4	Length		0x0003					
5	ResetType		0 – System Reset 1 - Serial Communication Bus Reset					
6-7	ResetTime							

Description:

The System Reset resets the whole controller. The reset time is about 2000 ms.

The ResetTime determines the width of the reset pulse during Serial Communication Bus Reset:

$$t_{Reset\ Width} = \text{ResetTime [ms]}$$

LOCK instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0x0004					
3-4	Length		0x0010					
5-20	LockKey (MSB..LSB)							

Description:

The LOCK instruction locks the device with the LockKey. The locked device performs SENDACK, READSDRAM, FLREAD, SCBREADCA, SCBREADRA and UNLOCK instructions only. Don't forget the LockKey! Without it you cannot unlock the device via Ethernet. If you forget the LockKey use the Reset Defaults Switch to unlock the device (section 4.8).

UNLOCK instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0x0005					
3-4	Length		0x0010					
5-20	LockKey (MSB..LSB)							

Description:

Use the UNLOCK instruction to unlock a locked device. You must use the same LockKey, which was used to lock the device.

SENDACK instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0x0006					
3-4	Length		0x0002					
5-6	ACKType		0x0000 – DIT 0x0001 – Settings 0x0002 – DIT & Settings 0x0003 – Variables 0x0004 – Reserved 0x0005 – Input Stream Table 0x0006 – Reserved 0x0007 – Output Stream Table 0x0008 – VLAN Tag Table 0x0009 – Output Filter and MPX Table 0x000A – Input Stream Statistics 0x000B – Output Stream Statistics 0x000C – Ethernet Statistics 0x000D – ARP Tables 0x000E – NDM 0x00C0 .. 0x00FF – PID Filter 0x0080 – HTTP Instruction Queue (for test only) 0x0801 – FUP Checksum					

Description:

Send an ACKANSWER message to the host computer (see section 5.8).

READSDRAM instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0x0007					
3-4	Length		0x0002					
5-6	Page Address							

Description:

Read the SDRAM memory of the microcontroller in 1024-byte pages. Page Address must be between 0 and 32767. Data read from the SDRAM is sent to the host computer encapsulated in a SDRAMPAGE answer message.

5.2 Configuration Instructions

SETSERIAL instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0x0010					
3-4	Length		0x0004					
5-8	Serial Number (MSB..LSB)							

Description:

Set the Serial Number. Serial Number is a user-defined 4-byte unsigned integer. (Use the SAVESETTINGS instruction to save changes to the EEPROM.)

SETTYPE instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0x0011					
3-4	Length		0x0002					
5-6	Type (MSB..LSB)							

Description:

Set the Type. Type is a user-defined 2-byte unsigned integer. (Use the SAVESETTINGS instruction to save changes to the EEPROM.)

SETNAME instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0x0012					
3-4	Length		0x0030					
5-52	Name (MSB..LSB)							

Description:

Set the Name. Name is a user-defined 48-byte (character) long string. (Use the SAVESETTINGS instruction to save changes to the EEPROM.)

SETUSERTEXT instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0x0013					
3-4	Length		0x000F					
5-19	User Text (MSB..LSB)							

Description:

Set the User Text. User Text is a user-defined 15-byte (character) long string in the DDToIP header (in device answers). (Use the SAVESETTINGS instruction to save changes to the EEPROM.)

SETCOMPANY instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0x0014					
3-4	Length		0x0012					
5-22	Company (MSB..LSB)							

Description:

Set the Company. Company is a user-defined 18-byte (character) long string. (Use the SAVESETTINGS instruction to save changes to the EEPROM.)

SETHOSTNAME instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0x0015					
3-4	Length		0x000C					
5-16	Host Name (MSB..LSB)							

Description:

Set the Host Name. Host Name is a user-defined 12-byte (character) long string used in the DHCP messages. (Use the SAVESETTINGS instruction to save changes to the EEPROM.)

SETCONFIGURATION instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0x0016					
3-4	Length		0x0002					
5-6	Configuration (MSB..LSB)							

Description:

Set the Configuration. Configuration is a 2-byte unsigned integer. (Use the SAVESETTINGS instruction to save changes to the EEPROM.)

Bit 15..14 – Reserved (0)
Bit 13..12 – Real-Time Analyzer mode (00 – Disabled, 01-IP input mode, 10 – LVDS input mode, 11 – Mixed mode)
Bit 11 – TS Loopback enabled (1) / disabled (0)
Bit 10 – PID Filter Pass Through mode (1) / Normal mode (0)
Bit 9 – PSI Inserter enabled (1) / disabled (0)
Bit 8 – PID Filter enabled (1) / disabled (0)
Bit 7..1 – Reserved (0)
Bit 0 – Device is locked (1) / unlocked (0) (read-only bit)

SETGPO instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0x0017					
3-4	Length		0x0002					
5-6	GPO (MSB..LSB)							

Description:

Set the GPO. (Use the SAVESETTINGS instruction to save changes to the EEPROM.)

SAVESETTINGS instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0x001F					
3-4	Length		0x0000					

Description:

Save the settings to the EEPROM.

5.3 Network Instructions

SETMAC instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0x0020					
3-4	Length		0x0007					
5	P	0	0	0	0	0	MM	
6-11	MAC (MSB..LSB)							

Description:

Set and store the MAC address and mode. For details see section 4.2.1. (Use the SAVESETTINGS instruction to save changes to the EEPROM.)

P: 0 – Management port
1 – Transport Stream port

MM: 0 – MAC mode is Factory Default
1 – MAC mode is CW-Auto
2 – MAC mode is Static

SETIPV4 instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0x0021					
3-4	Length		0x0005					
5	P	0	0	0	0	0	0	IM
6-9	IP (MSB..LSB)							

Description:

Set and store the IPv4 address and mode. For details see section 4.2.1. (Use the SAVESETTINGS instruction to save changes to the EEPROM.)

P: 0 – Management port
1 – Transport Stream port

IM: 0 – IP mode is DHCP
1 – IP mode is Static

SETIPV4NETMASK instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0x0022					
3-4	Length		0x0005					
5	P	0	0	0	0	0	0	0
6-9	NetMask (MSB..LSB)							

Description:

Set and store the network mask. For details see section 4.2.2. (Use the SAVESETTINGS instruction to save changes to the EEPROM.)

P: 0 – Management port
1 – Transport Stream port

Note: If the IP Mode is set to DHCP the controller automatically gets the network mask from the DHCP server.

SETIPV4GATEWAY instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0x0023					
3-4	Length		0x0005					
5	P	0	0	0	0	0	GM	
6-9	IP (MSB..LSB)							

Description:

Set and store the gateway parameters. For details see section 4.2.2. (Use the SAVESETTINGS instruction to save changes to the EEPROM.)

P: 0 – Management port
1 – Transport Stream port

GM: 00 – Gateway mode is None
01 – Gateway mode is Static
10 – Gateway mode is DHCP

SETARPREPORTPERIOD instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0x0024					
3-4	Length		0x0002					
5	P	0	0	0	0	0	0	0
6	Report Period							

Description:

Set the ARP Auto-Report function. If the ARP Auto-Report function is on, the device periodically sends broadcast ARP reply messages ("the device is at its IP address"). If Report Period is set to zero (0x00) this function is switched off. Otherwise:

$$T_{ARP\ Report\ Period} = \text{Report Period [s]}$$

(Use the SAVESETTINGS instruction to save changes to the EEPROM.)

P: 0 – Management port
1 – Transport Stream port

SETMACMODE instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0x0025					
3-4	Length		0x0001					
5	P	0	0	0	0	0	MM	

Description:

Set and store the MAC mode. For details see section 4.2.1. (Use the SAVESETTINGS instruction to save changes to the EEPROM.)

P: 0 – Management port
1 – Transport Stream port

MM: 0 – MAC mode is Factory Default
1 – MAC mode is CW-Auto
2 – MAC mode is Static

5.4 Transport Stream Input Instructions

CLEARINPUTSTREAMTABLE instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0x0030					
3-4	Length		0x0000					

Description:
Clear the Input Stream Table.

SAVEINPUTSTREAMTABLE instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0x0031					
3-4	Length		0x0000					

Description:
Save the whole Input Stream Table to the EEPROM.

DISABLEINPUTSTREAM instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0x0032					
3-4	Length		0x0001					
5	Input Stream Number (ISN)							

Description:
Disable an IP Stream in the Input Stream Table.

SETIPV4INPUTSTREAM instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode 0x0033							
3-4	Length 0x0009							
5	Input Stream Number (ISN)							
6	0	I	0	0	S	T	N	A
7	Reserved (0x00)							
8-11	Destination IPv4 Address (MSB..LSB)							
12-13	Destination UDP Port (MSB..LSB)							

Description:

Set an IPv4 Input Stream in the Input Stream Table. The Input Stream Table contains 64 IP streams (ISN = 0..63).

I: 0 – Unicast or broadcast stream
1 – Multicast stream with IGMP

S: 0 – Scrambled packet Remover disabled
1 – Remove scrambled TS packets

T: 0 – TSP Error Remover disabled
1 – Remove TS packets if TSP Error flag is set

N: 0 – Nullpacket Remover disabled
1 – Remove TS Nullpackets (PID = 0x1FFF)

A: 0 – TS Analyzer Disabled
1 – TS Analyzer Enabled

SETIPV4INPUTSTREAMF instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode 0x0034							
3-4	Length 0x0011							
5	Input Stream Number (ISN)							
6	0	I	V	0	S	T	N	A
7	0	0	0	0	SP	SI	DP	DI
8-11	Destination IPv4 Address (MSB..LSB)							
12-13	Destination UDP Port (MSB..LSB)							
14-15	VLAN Tag (IEEE 802.1Q TCI) (MSB..LSB)							
16-19	Source IPv4 Address (MSB..LSB)							
20-21	Source UDP Port (MSB..LSB)							

Description:

Set an IPv4 Input Stream with advanced filter parameters (destination and source IP and Port filtering). The Input Stream Table contains 64 IP streams (ISN = 0..63).

I: 0 – Unicast or broadcast stream
1 – Multicast stream with IGMP

V: 0 – Simple Ethernet stream
1 – VLAN stream (IEEE 802.1Q)

S: 0 – Scrambled packet Remover disabled
1 – Remove scrambled TS packets

T: 0 – TSP Error Remover disabled
1 – Remove TS packets if TSP Error flag is set

N: 0 – Nullpacket Remover disabled
1 – Remove TS Nullpackets (PID = 0x1FFF)

A: 0 – TS Analyzer Disabled
1 – TS Analyzer Enabled

SP: 0 – Source port filter off
1 – Source port filter on

SI: 0 – Source IP address filter off
1 – Source IP Address filter on

DP: 0 – Destination port filter off
1 – Destination port filter on

DI: 0 – Destination IP address filter off
1 – Destination IP Address filter on

SETIGMPREPORTPERIOD instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0x0035					
3-4	Length		0x0001					
5	IGMP Report Period							

Description:

Set the IGMP Auto-Report function. If the IGMP Auto-Report function is on, the device periodically sends IGMP Membership Report messages (in order to receive multicast input streams). If IGMP Report Period is set to zero (0x00) this function is switched off. Otherwise:

$$T_{\text{IGMP Report Period}} = \text{IGMP Report Period [s]}$$

(Use the SAVESETTINGS instruction to save changes to the EEPROM.)

ENABLEINPUTSTREAM instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0x0036					
3-4	Length		0x0001					
5	Input Stream Number (ISN)							

Description:

Enable an IP Stream in the Input Stream Table.

DISABLEALLINPUTSTREAMS instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0x0037					
3-4	Length		0x0000					

Description:

Disable all IP Streams in the Input Stream Table.

5.5 Transport Stream Output Instructions

CLEAROUTPUTSTREAMTABLE instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0x0040					
3-4	Length		0x0000					

Description:
Clear the Output Stream Table.

SAVEOUTPUTSTREAMTABLE instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0x0041					
3-4	Length		0x0000					

Description:
Save the whole Output Stream Table to the EEPROM.

DISABLEOUTPUTSTREAM instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0x0042					
3-4	Length		0x0001					
5	Output Stream Number (OSN)							

Description:
Disable an IP Stream in the Output Stream Table.

SETIPV4OUTPUTSTREAM instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode 0x0043							
3-4	Length 0x000E							
5	Output Stream Number (OSN)							
6	0	F	RTP	NOP			VLAN	0
7-10	IPv4 Address (MSB..LSB)							
11-16	MAC Address (MSB..LSB)							
17-18	UDP Port (MSB..LSB)							

Description:

Set an IPv4 Output Stream in the Output Stream Table. The Output Stream Table contains 64 IP streams (OSN = 0..63).

F: 0 – 204-byte TS format
1 – 188-byte TS format

RTP: 0 – IPTV format
1 – Real-Time Protocol format

NOP: Number of TS packets per UDP packet (1..7)

VLAN: 0 – Normal Ethernet frame
1 – Ethernet frame with VLAN Tag (IEEE 802.1Q)

CLEAROUTPUTFILTERANDMPXTABLE instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0x0045					
3-4	Length		0x0000					

Description:

Clear the Output Filter Table.

SAVEOUTPUTFILTERANDMPXTABLE instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0x0046					
3-4	Length		0x0000					

Description:

Save the Output Filter Table to the EEPROM.

SETOUTPUTFILTERANDMPX instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0x0047					
3-4	Length		0x0006					
5	Output Stream Number (OSN)							
6	S	T	N	0	E1	E2	E3	E4
7	0	0	OSN1					
8	0	0	OSN2					
9	0	0	OSN3					
10	0	0	OSN4					

Description:

Set the Output Filter and MPX Table. OSN is the stream number of the input LVDS stream. OSN1..OSN4 are the stream numbers of the output IP streams. TS packet multiplexing to OSN1..OSN4 can be enabled or disabled with the E1..E4 bits. Filter bits:

S: 0 – Scrambled packet Remover disabled
1 – Remove scrambled TS packets
T: 0 – TSP Error Remover disabled
1 – Remove TS packets if TSP Error flag is set
N: 0 – Nullpacket Remover disabled
1 – Remove TS Nullpackets (PID = 0x1FFF)

CLEARVLANTAGTABLE instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0x0048					
3-4	Length		0x0000					

Description:
Clear the VLAN Tag Table.

SAVEVLANTAGTABLE instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0x0049					
3-4	Length		0x0000					

Description:
Save the VLAN Tag Table to the EEPROM.

SETVLANTAG instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0x004A					
3-4	Length		0x0005					
5	Output Stream Number (OSN)							
6-7	TPID (MSB..LSB)							
8-9	TCI (MSB..LSB)							

Description:
Set the VLAN Tag of an Output Stream. For details see IEEE802.1Q.

CLEARPIDFILTER instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode 0x004B							
3-4	Length 0x0001							
5	Stream Number (0..63 or 255)							

Description:

If Stream Number is between 0 and 63 the instruction sets the PID Filter memory of the specified stream to the erased state of all 1s (hFF). The controller waits while the busy flag becomes 0. The erase time is about 100 ms.

If Stream Number is 255 the instruction erases the whole PID Filter memory area. The busy flag (bit 0 in the PID Filter Flash State register of the Variables) is 1 during the erase and becomes 0 when finished and the device is ready to accept other PID Filter instructions again. User must check this flag by receiving Variables type ACKs. The maximum of the chip erase time is 30 seconds (typ. 15 sec.).

SETPIDFILTER instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode 0x004C							
3-4	Length							
5	Output Stream Number #1 (0..63)							
6-7	PID (MSB..LSB) #1							
8	New Output Stream Number #1 (0..63)							
…								
	Output Stream Number #N (0..63)							
	PID (MSB..LSB) #N							
	New Output Stream Number #N (0..63)							

Description:

Program the PID Filter. 256 PIDs can be enabled in a given output stream as a maximum. The filter memory of the stream(s) must be previously cleared (hFF).

SETTSLOOPBACKSN instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0x004D					
3-4	Length		0x0001					
5	TS Loopback Stream Number (0..63 or 255)							

Description:

Set the TS Loopback Stream Number.

(Use the SAVESETTINGS instruction to save changes to the EEPROM.)

5.6 Analyzer Instructions

RECOLLECT instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0x0050					
3-4	Length		0x0003					
5	Source		0 or 1					
6	Stream Number		0..63					
7	Page Number		2..127					

Description:

Recollect a PSI Table or the user-defined packets (Page Number = 126). Source selects the source analyzer, 0 is the Input Stream Analyzer, 1 is the Output Stream Analyzer. Page Number identifies the page to be recollected, for example:

PAT : Page Number = 2
CAT : Page Number = 3
SDT Section #0 : Page Number = 4
NIT Section #0 : Page Number = 20
User : Page Number = 126

A State of the Info Field of the selected page must be COLLECTED, NOTFOUND or ERROR.

COLLECT instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0x0051					
3-4	Length		0x000A					
5	Source		0 or 1					
6	Stream Number		0..63					
7	P	I	S	PID(11..8)				
8	PID(7..0)							
9	Table ID							
10-11	ID (MSB..LSB)							
12	Section Number							
13-14	Maximum Collection Time (in ms, MSB..LSB)							

Description:

Collect a PSI Table or 8 user-defined packets to the User pages of the Analyzer (page 126..127). Source selects the source analyzer, 0 is the Input Stream Analyzer, 1 is the Output Stream Analyzer. Configuration bit P, S and I control the collector:

- If P = 0 the collector collects 8 TS packets with the selected PID. Packets are stored on page 126 and 127 (2048 byte, 256 byte/packet). The analyzer has to finish the collection in Maximum Collection Time milliseconds. If less than 8 packets are collected, the remainder memory space is filled with zeros.
- If P = 1 the collector collects one section of the selected table and PID. Bits I and S offer other filter options. If I = 1 the collector collects TS section with the selected ID (TS ID, Program Number or Service ID). If S = 1 the collector collects TS section with the selected section number. The analyzer has to finish the collection in Maximum Collection Time milliseconds. TS section is stored on page 126.

SETCOLLECTIONTIMEMAX instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0x0052					
3-4	Length		0x0003					
5	Section		0..4					
6-7	Max Time		(in ms, MSB..LSB)					

Description:

Set the maximum of the collection time. Sections:
0 = PAT
1 = CAT
2 = SDT
3 = NIT
4 = PMT

(Use the SAVESETTINGS instruction to save changes to the EEPROM.)

SETRECOLLECTIONTIME instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0x0053					
3-4	Length		0x0002					
5-6	Time		(in sec., MSB..LSB)					

Description:

Set the recollection time. Time is in seconds. If Time is zero this function is off.

(Use the SAVESETTINGS instruction to save changes to the EEPROM.)

CLEARETHERNETSTAT instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0x0054					
3-4	Length		0x0000					

Description:

Clear the Ethernet statistics.

CLEARRTA instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0x0055					
3-4	Length		0x0000					

Description:

Clear the SDRAM content of the Real-Time Analyzer.

5.7 SCB Instructions

SCBWRITECA instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode 0x0060							
3-4	Length							
5-6	SCB Address (MSB..LSB)							
7-	Data							

Description:

Write to the SCB Communication Area. SCB Address can be a unique or a broadcast (0xnnnF) address.

SCBWRITERA instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode 0x0061							
3-4	Length							
5-6	SCB Address (MSB..LSB)							
7-8	Register Address (MSB..LSB)							
9-	Data							

Description:

Write to the SCB Register Area. SCB Address can be a unique or a broadcast (0xnnnF) address. Register Address must be between 0 and 511.

SCBREADCA instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0x0062					
3-4	Length		0x0004					
5-6	SCB Address (MSB..LSB)							
7-8	Number Of Bytes (MSB..LSB)							

Description:

Read from to the SCB Communication Area. SCB Address must be a unique address. Data is sent to the host computer encapsulated in a SCBDATA answer message.

SCBREADRA instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0x0063					
3-4	Length		0x0006					
5-6	SCB Address (MSB..LSB)							
7-8	Register Address (MSB..LSB)							
9-10	Number Of Bytes (MSB..LSB)							

Description:

Read from the SCB Register Area. SCB Address must be a unique address. Register Address must be between 0 and 511. Data is sent to the host computer encapsulated in a SCBDATA answer message.

SCBWRITECWNET instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode 0x0064							
3-4	Length							
5	CW-Net Address (MSB..LSB)							
6-	Data							

Description:

Write to the CW-Net port of the SCB controller. CW-Net Address must be between 1 and 15.

SCBREADCWNET instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode 0x0065							
3-4	Length 0x0001							
5	CW-Net Address (MSB..LSB)							

Description:

Read 1024 bytes from the CW-Net port of the SCB controller. CW-Net Address must be between 1 and 15. Data is sent to the host computer encapsulated in a SCBDATA answer message.

5.8 Storage Flash & PSI Inserter Instructions

FLCHIPERASE instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0x0070					
3-4	Length		0x0000					

Description:

Full chip erase of the 8-Mbyte storage flash. The instruction sets all memory to the erased state of all 1s (hFF). The busy flag (bit 1 in the State register of the Variables) is 1 during the erase and becomes 0 when finished and the device is ready to accept other instructions again. User must check this flag by receiving Variables type ACKs. The maximum of the chip erase time is 30 seconds (typ. 15 sec.).

FLBLOCKERASE instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0x0071					
3-4	Length		0x0001					
5	Block							

Description:

The instruction sets all memory within the specified block (64-Kbytes) to the erased state of all 1s (hFF). The busy flag (bit 1 in the State register of the Variables) is 1 during the erase and becomes 0 when finished and the device is ready to accept other instructions again. User must check this flag by receiving Variables type ACKs. The maximum of the block erase time is 1 second (typ. 150 ms).

FLBLOCKERASEW instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0x0072					
3-4	Length		0x0001					
5	Block							

Description:

The instruction sets all memory within the specified block (64-Kbytes) to the erased state of all 1s (hFF). The controller waits while the busy flag (bit 1 in the State register of the Variables) becomes 0. The maximum of the block erase time is 1 second (typ. 150 ms).

FLPROGRAM instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0x0073					
3-4	Length							
5-7	Address (MSB..LSB)							
8-	Data							

Description:

The instruction allows 1 to 1024 bytes of data to be programmed at previously erased (hFF) memory locations. Address must be between 0 and 8388607 (0x7FFFFF). Typical program time of 1024 bytes is 700 us.

FLREAD instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0x0074					
3-4	Length		0x0002					
5-6	Page Address (MSB..LSB)							

Description:

Read the flash memory in 1024-byte pages. Page Address must be between 0 and 8191. Data read from the flash memory is sent to the host computer encapsulated in a FLASHPAGE answer message.

FLSECTORERASEW instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0x0075					
3-4	Length		0x0002					
5-6	Sector (MSB..LSB)							

Description:

The instruction sets all memory within the specified sector (4-Kbytes) to the erased state of all 1s (hFF). The controller waits while the busy flag (bit 1 in the State register of the Variables) becomes 0. The maximum of the sector erase time is 200 ms (typ. 30 ms).

PSIINSERASE instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode 0x0078							
3-4	Length 0x0001							
5	Stream Number (0..63 or 255)							

Description:

If Stream Number is between 0 and 63 the instruction sets the PSI Inserter memory of the specified stream to the erased state of all 1s (hFF). The controller waits while the busy flag (bit 1 in the State register of the Variables) becomes 0. The maximum of the block erase time is 1 second (typ. 150 ms).

If Stream Number is 255 the instruction erases the whole PSI Inserter memory area. (It performs 4 block erases: block #124, #125, #126 and #127.) The typical erase time is 600 ms.

PSIINSWRITE instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode 0x0079							
3-4	Length 0x00C1							
5	Stream Number (0..63)							
6	Packet Number (0..15)							
7	CC Group (0..8)							
8-9	Delay (MSB..LSB)							
10 - 197	Transport Stream packet							

Description:

Program the PSI Inserter. It writes one TS packet to the flash memory with the control information. The memory location must be previously erased (hFF).

5.9 Network Device Management Instructions

CLEARARPTABLE instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0x0080					
3-4	Length		0x0001					
5	Port							

Description:

Clear the ARP Table of the selected port.

Port: 0 – Management port
1 – Transport Stream port
255 - Both

SENDARPREQUEST instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0x0081					
3-4	Length		0x0005					
5	Port							
6-9	Destination IPv4 Address (MSB..LSB)							

Description:

Send an ARP Request packet to the Destination IP.

Port: 0 – Management port
1 – Transport Stream port

SENDARPREQUESTQUEUE instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0x0082					
3-4	Length		0x0005					
5	Port							
6-9	Destination IPv4 Address (MSB..LSB)							

Description:

Send 255 ARP Request packets to the Destination subnet. The last byte of the Destination IP is masked and it runs from 0 to 254 in the ARP packets.

Port: 0 – Management port
1 – Transport Stream port

SETMANAGEDDEVICE instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0x0083					
3-4	Length		0x000D					
5	Port							
6-11	MAC Address (MSB..LSB)							
12-15	IPv4 Address (MSB..LSB)							
16-17	UDP Port (MSB..LSB)							

Description:

Set the network parameters (Port, MAC Address, IPv4 Address and UDP Port) of the managed device.

Port: 0 – Management port
1 – Transport Stream port

SENDNDMMESSAGE instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode 0x0084							
3-4	Length							
5	Message Type							
6-	Instruction Queue							

Description:

Send a DDToIP or CW-Net instruction UDP message to the managed device.

Message Type: 0 – CW-Net
1 – DDToIP v1
2 – DDToIP v2
3 – DDToIP v3

5.10 Firmware Upgrade and Test Instructions

LOADFUP instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0x0800					
3-4	Length		L					
5-8	Address		0x00000000 – 0x00800000					
9-	Data							

Description:

Not public.

STARTFUP instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0x0801					
3-4	Length		0x0004					
5-8	Upgrade Date (4 bytes long date field, the format is Y[2]M[1]D[1].)							

Description:

Not public.

SHORTBEEP instruction

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0x0810					
3-4	Length		L					
5-	Optional stuffing bytes							

Description:

The controller sounds a blast. This instruction is used for test.

5.11 Answers

ACKANSWER message

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0xFF00					
3-4	Length		L					
5-6	Type							
7-	ACK Data							

Description:

This is the answer for the SENDACK instruction. The ACK Data can be the following depending on the Type field:

- 0x0000 – DIT
- 0x0001 – Settings
- 0x0002 – DIT & Settings
- 0x0003 – Variables
- 0x0004 – Reserved
- 0x0005 – Input Stream Table
- 0x0006 – Reserved
- 0x0007 – Output Stream Table
- 0x0008 – VLAN Tag Table
- 0x0009 – Output Filter and MPX Table
- 0x000A – Input Stream Statistics
- 0x000B – Output Stream Statistics
- 0x000C – Ethernet Statistics
- 0x000D – ARP Tables
- 0x000E – NDM
- 0x0801 – FUP Checksum

DIT

Every device developed by ByteStudio Limited has a Device Identity Table (DIT, 64 bytes) which stores the main read-only manufacturing properties. All fields are MSB first.

Byte	7	6	5	4	3	2	1	0
7-16	Board Type (10 bytes long string = "BSP11-0000".)							
17-30	Firmware Group (14 bytes long string = "BSF11-0001-xxx", where xxx is the version number (e.g. 101 = version 1.01).)							
31-32	Firmware Group Version (2 bytes long version, the format is VH[1].VL[1] (the first is the version high, the second is the version low).)							
33-36	Upgrade Date (4 bytes long date field, the format is Y[2]M[1]D[1].)							
37-50	Manufacturer Firmware Group (14 bytes long firmware group programmed originally by the manufacturer.)							
51-54	Manufacturer Program Date (4 bytes long date of the manufacturer programming.)							
55-58	Manufacturer Serial (4 bytes long unique serial number.)							
59-62	Manufacturer Test Result (4 bytes long test result.)							
63-70	Reserved (8 bytes long reserved field.)							

SETTINGS

Settings are the writable registers of the device. The settings can be set using the configuration and network instructions.

Byte	7	6	5	4	3	2	1	0
7	Settings Version (version number of the data structure, for internal use)							
8-55	Device Name (48 bytes long string, e.g. "64-Channel IPTV Streamer".)							
56-57	Device Type (2 bytes long integer, MSB first.)							
58-61	Device Serial (4 bytes long integer, MSB first.)							
62-79	Company Name (18 bytes long string, e.g. "ByteStudio Limited".)							
80-91	Host Name (12 bytes long string, used in the DHCP messages.)							
92-93	Configuration (2 bytes long configuration word, MSB first.) Bit 0 – Device is locked (1) / unlocked (0) Bit 1..7 – Reserved (0) Bit 8 – PID Filter enabled (1) / disabled (0) Bit 9 – PSI Inserter enabled (1) / disabled (0) Bit 10 – PID Filter Pass Through mode (1) / Normal mode (0) Bit 11 – TS Loopback enabled (1) / disabled (0) Bit 12..13 – Real-Time Analyzer mode Bit 14..15 – Reserved (0)							
94-108	User Text (15 bytes long string, used in the DDToIP header.)							
109-110	PAT Collection Time Maximum (in ms) (LSB first!)							
111-112	CAT Collection Time Maximum (in ms) (LSB first!)							
113-114	SDT Collection Time Maximum (in ms) (LSB first!)							
115-116	NIT Collection Time Maximum (in ms) (LSB first!)							
117-118	PMT Collection Time Maximum (in ms) (LSB first!)							
119-120	Recollection Time (in sec.) (LSB first!)							

121-122	GPO (MSB First)
123	Ethernet Statistics Interval (in ms)
124	TS Loopback Stream Number
125-134	Reserved (0x00)
135-140	Management Port Static MAC Address (MSB first)
141-144	Management Port IPv4 Address (MSB first)
145-148	Management Port IPv4 Network Mask (MSB first)
149	Management Port MAC Mode (0 – Factory Default, 1 – CW-Auto, 2 – Static)
150	Management Port IP Mode (1 – Static , 2 - DHCP)
151	Management Port Gateway Mode (0 – None, 1 – Static , 2 - DHCP)
152-155	Management Port Gateway IPv4 Address (MSB first)
156	Management Port ARP Advertisement Report Period (in second, 0 = this function is off)
157	Management Port IGMP Report Period (in second, 0 = this function is off)
158	Management Port IPv4 Time To Live (TTL value in the IPv4 header)
159-164	Management Port Factory Default MAC Address (MSB first)
165-182	Reserved (0x00)
183-188	Transport Stream Port Static MAC Address (MSB first)
189-192	Transport Stream Port IPv4 Address (MSB first)
193-196	Transport Stream Port IPv4 Network Mask (MSB first)
197	Transport Stream Port MAC Mode (0 – Factory Default, 1 – CW-Auto, 2 – Static)
198	Transport Stream Port IP Mode (1 – Static , 2 - DHCP)
199	Transport Stream Port Gateway Mode (0 – None, 1 – Static , 2 - DHCP)
200-203	Transport Stream Port Gateway IPv4 Address (MSB first)
204	Transport Stream Port ARP Advertisement Report Period (in second,

	0 = this function is off)
205	Transport Stream Port IGMP Report Period (in second, 0 = this function is off)
206	Transport Stream Port IPv4 Time To Live (TTL value in the IPv4 header)
207-212	Transport Stream Port Factory Default MAC Address (MSB first)
213-230	Reserved (0x00)
231-232	HTTP Port (LSB first!)
233-234	SMTP Server Port (LSB first!)
235-262	Reserved (0x00)

DIT & SETTINGS

Byte	7	6	5	4	3	2	1	0
7-70	DIT							
71-	Settings							

VARIABLES

Variables are the read-only registers of the device. The variables cannot be set.

Byte	7	6	5	4	3	2	1	0
7-12	Management Port MAC Address (MSB first)							
13-16	Management Port IPv4 Address (MSB first)							
17-20	Management Port IPv4 Network Mask (MSB first)							
21	Management Port Link On (0 = Link is off, 1 = Link is on)							
22	Management Port Gateway State (0 = None, 1 = OK, 2 = Searching MAC, 3 = Searching IP with DHCP)							
23	Management Port IP State (1 = OK, 3 = Searching IP with DHCP)							
24	Management Port DHCP State (0 = Idle, 1 = Request, 2 = Discover)							
25-30	Management Port Gateway MAC Address (MSB first)							
31-34	Management Port Gateway IPv4 Address (MSB first)							
35-40	Management Port DHCP Server MAC Address (MSB first)							
41-44	Management Port DHCP Server IPv4 Address (MSB first)							
45-50	Management Port IGMP Switch MAC Address (MSB first)							
51-54	Management Port IGMP Switch IPv4 Address (MSB first)							
55-58	Management Port DHCP Lease Time (LSB first!)							
59-62	Management Port Ethernet RX Frames (LSB first!)							
63-66	Management Port Ethernet TX Frames (LSB first!)							
67-70	Reserved (0x00)							
71-	Transport Stream Port MAC Address (MSB first)							

76	
77-80	Transport Stream Port IPv4 Address (MSB first)
81-84	Transport Stream Port IPv4 Network Mask (MSB first)
85	Transport Stream Port Link On (0 = Link is off, 1 = Link is on)
86	Transport Stream Port Gateway State (0 = None, 1 = OK, 2 = Searching MAC, 3 = Searching IP with DHCP)
87	Transport Stream Port IP State (1 = OK, 3 = Searching IP with DHCP)
88	Transport Stream Port DHCP State (0 = Idle, 1 = Request, 2 = Discover)
89-94	Transport Stream Port Gateway MAC Address (MSB first)
95-98	Transport Stream Port Gateway IPv4 Address (MSB first)
99-104	Transport Stream Port DHCP Server MAC Address (MSB first)
105-108	Transport Stream Port DHCP Server IPv4 Address (MSB first)
109-114	Transport Stream Port IGMP Switch MAC Address (MSB first)
115-118	Transport Stream Port IGMP Switch IPv4 Address (MSB first)
119-122	Transport Stream Port DHCP Lease Time (LSB first!)
123-126	Transport Stream Port Ethernet RX Frames (LSB first!)
127-130	Transport Stream Port Ethernet TX Frames (LSB first!)
131-134	Reserved (0x00)
135	Management Port Ethernet Buffers Used
136	Management Port Ethernet Buffers Used Max.
137-138	Reserved (0x00)
139-142	Management Port Ethernet Dropped Frames (LSB first!)
143-	Management Port TCP RX Packets (LSB first!)

146	
147-150	Management Port TCP TX Packets (LSB first!)
151-154	Management Port TCP Established Connections (LSB first!)
155-158	Management Port TCP Rejected Connections (LSB first!)
159-162	Management Port TCP Closed Connections (LSB first!)
163-166	Management Port TCP Active Connections (LSB first!)
167-170	Management Port TCP Keep Alive Timeout (LSB first!)
171-174	Management Port TCP Retransmit Timeout (LSB first!)
175-178	Management Port TCP Retransmissions (LSB first!)
179-182	Reserved (0x00)
183-186	System Up Time (LSB first!) (in miliseconds)
187-188	Hardware Error (LSB first!) Bit 0 : SDRAM Error Bit 1 : EEPROM Error Bit 2 : FPGA Error Bit 3 : Internal Flash Error Bit 4 : Flash 1 Error (Web Server Flash) Bit 5 : Flash 2 Error Bit 7..15 : Reserved (0)
189-190	IIC Error (LSB first!) Bit 0 : No ACK received Bit 1 : Address overflow Bit 2 : Polling Error Bit 3..15 : Reserved (0)
191	Test code read from the FPGA (0x5C)
192	FPGA Program Version High
193	FPGA Program Version Low
194	Transport Stream Port Ethernet Status Bit1..0 : Speed (0 – Link off, 1 – 10 MB, 2 – 100 MB, 3 – 1G) Bit 2 : SFP (SFP module connected) Bit 3..6 : Reserved (0)

	Bit 7 : TX buffer is free (for internal use)
195-196	Transport Stream Port Input CRC Errors (MSB first)
197-198	Transport Stream Port Input Management (general)Packets (MSB first)
199-200	Transport Stream Port RX Buffer Usage in bytes (MSB first)
201	FPGA Status Bit 0 : PLL Locked (PLL generates 133 MHz clock from 33 MHz) Bit 1 : SDRAM DCM Locked Bit 2 : Internal 133 MHz DCM Locked Bit 3 : TS Output BRAM Overflow Bit 4 : TS Output SDRAM Overflow Bit 5 : TS Loopback BRAM Overflow Bit 6..7 : Reserved (0)
202	Ethernet Statistics Measurement Counter
203	PID Filter Flash Status Bit 0 : Flash is busy (1) or free (0)
204-214	Reserved (0x00)
215-218	Status (LSB first!) bit 31..2 – Reserved (0) bit 1 – Storage Flash is busy (1) or free (0) bit 0 – WEB Flash is busy (1) or free (0)
219-222	DDToIP Version 1 Instruction Counter (LSB first!)
223-226	DDToIP Version 2 Instruction Counter (LSB first!)
227-230	DDToIP Version 3 Instruction Counter (LSB first!)
231	Reserved (0x00)
232-234	SCB Status Register of the SCB-S1 port
235	Reserved (0x00)
236-238	SCB Status Register of the SCB-S2 port
239	Reserved (0x00)
240-242	SCB Status Register of the SCB-S3 port
243	Reserved (0x00)
244-	SCB Status Register of the SCB-S4 port

246	
247	Reserved (0x00)
248-250	SCB Status Register of the SCB-S5 port
251	Reserved (0x00)
252-254	SCB Status Register of the SCB-S6 port
255	Reserved (0x00)
256-258	SCB Status Register of the SCB-S7 port
259	Reserved (0x00)
260-262	SCB Status Register of the SCB-S8 port
263	Reserved (0x00)
264-266	SCB Status Register of the SCB-S9 port
267	Reserved (0x00)
268-270	SCB Status Register of the SCB-S10 port
271-274	FUP Checksum
275	FUP In Process
276	Board Temperature (in Celsius)
277	Number of enabled input streams
278	Number of enabled input IGMP streams
279-280	VDD 3.3V voltage in mV (LSB first!) (Main power supply.)
281-282	VDD 2.5V voltage in mV (LSB first!)
283-284	VDD 1.2V XC voltage in mV (LSB first!) (Core voltage of the Xilinx FPGA.)
285-286	VDD 1.2V ST voltage in mV (LSB first!) (Core voltage of the Stellaris Microcontroller.)
287-288	SCB Controller Version
289-290	Max. VDD 3.3 V (LSB first!)
291	Max. Temperature
292	WEB Boot Completed
293-294	Debug State (LSB first!) (For internal use only!)

295	Ethernet Statistics Measurement Counter Old (For internal use only!)
296	NDM Status (For internal use only!)
297	NDM Port (For internal use only!)
298-301	NDM IPv4 Address (For internal use only!)
302	NDM Managed Device Port
303-308	NDM Managed Device MAC Address (MSB first)
309-312	NDM Managed Device IPv4 Address (MSB first)
313-314	NDM Managed Device UDP Port (MSB first)

INPUT STREAM TABLE

Byte	7	6	5	4	3	2	1	0
7	Stream #0 Control							
8	Stream #0 Filter							
9-12	Stream #0 Destination IPv4 Address (MSB First)							
13-14	Stream #0 Destination UDP Port (MSB First)							
15-16	Stream #0 VLAN Tag (MSB First)							
17-20	Stream #0 Source IPv4 Address (MSB First)							
21-22	Stream #0 Source UDP Port (MSB First)							
23	Stream #1 Control							
...	…							
1029-1030	Stream #63 Source UDP Port (MSB First)							

OUTPUT STREAM TABLE

Byte	7	6	5	4	3	2	1	0
7-10	Stream #0 Control (MSB First)							
11-14	Stream #0 Destination IPv4 Address (MSB First)							
15-20	Stream #0 Destination MAC Address (MSB First)							
21-22	Stream #0 Destination UDP Port (MSB First)							
23-26	Stream #1 Control							
...	…							
1029-1030	Stream #63 Destination UDP Port (MSB First)							

OUTPUT FILTER TABLE

Byte	7	6	5	4	3	2	1	0
7-10	Stream #0 Control (MSB..LSB)							
11-14	Stream #1 Control (MSB..LSB)							
15-18	Stream #2 Control (MSB..LSB)							
19-258	…							
259-262	Stream #63 Control (MSB..LSB)							
263-1030	Reserved (0x00)							

INPUT and OUTPUT STREAM STATISTICS

Byte	7	6	5	4	3	2	1	0
7-10	Stream #0 PC (LSB first!)							
11-12	Stream #0 PERIOD (LSB first!)							
13-14	Stream #0 PATC (LSB first!)							
15-16	Stream #0 NITC (LSB first!)							
17-18	Stream #0 CATC (LSB first!)							
19-20	Stream #0 EITC (LSB first!)							
21-22	Stream #0 SDTC (LSB first!)							
23-26	Stream #1 PC (LSB first!)							
27-28	Stream #1 PERIOD (LSB first!)							
...	…							
1029-1030	Stream #63 SDTC (LSB first!)							

ETHERNET STATISTICS

Byte	7	6	5	4	3	2	1	0
7-9	Stream #0 Packet Counter (LSB first!)							
10	Stream #0 Format							
11-12	Stream #0 SN Error Sum (LSB first!)							
13-14	Stream #0 SN Error (LSB first!)							
15-16	Stream #0 Max. Delay Sum (LSB first!)							
17-18	Stream #0 Max. Delay (LSB first!)							
19-20	Stream #0 Min. Delay Sum (LSB first!)							
21-22	Stream #0 Min. Delay (LSB first!)							
23-25	Stream #1 Packet Counter (LSB first!)							
...	…							
1029-1030	Stream #63 Min. Delay (LSB first!)							

ARP TABLES

Byte	7	6	5	4	3	2	1	0
7-12	Management Port Item #1 MAC Address (MSB..LSB)							
13-16	Management Port Item #1 IPv4 Address (MSB..LSB)							
…	…							
497-502	Management Port Item #50 MAC Address (MSB..LSB)							
503-506	Management Port Item #50 IPv4 Address (MSB..LSB)							
507-518	Reserved (0x00)							
519-524	Stream Port Item #1 MAC Address (MSB..LSB)							
525-528	Stream Port Item #1 IPv4 Address (MSB..LSB)							
…	…							
1009-1014	Stream Port Item #50 MAC Address (MSB..LSB)							
1015-1018	Stream Port Item #50 IPv4 Address (MSB..LSB)							
1019-1030	Reserved (0x00)							

NDM

Byte	7	6	5	4	3	2	1	0
7	Answer Counter							
8	Answer Type 0 – CW-Net 1 – DDToIP v1 2 – DDToIP v2 3 – DDToIP v3							
9-10	Answer Length (MSB..LSB)							
11-	Answer Data							

PID FILTER

Byte	7	6	5	4	3	2	1	0
7-8	PID Value #1 (MSB..LSB)							
9	OSN #1							
10-11	PID Value #2 (MSB..LSB)							
12	OSN #2							
…								
	PID Value #N (MSB..LSB)							
	OSN #N							
…	…							
-1030	0xFF							

FUP CHECKSUM

Byte	7	6	5	4	3	2	1	0
7-10	Checksum							

SDRAMPAGE message

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0xFF01					
3-4	Length		0x0402					
5-6	Page Address							
7-1030	Page Data							

SCBDATA message (reply for SCBREADCA)

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0xFF02					
3-4	Length							
5-	SCB Data							

SCBDATA message (reply for SCBREADRA)

Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0xFF02					
3-4	Length							
5-6	Register Address							
7-	SCB Data							

FLASHPAGE message

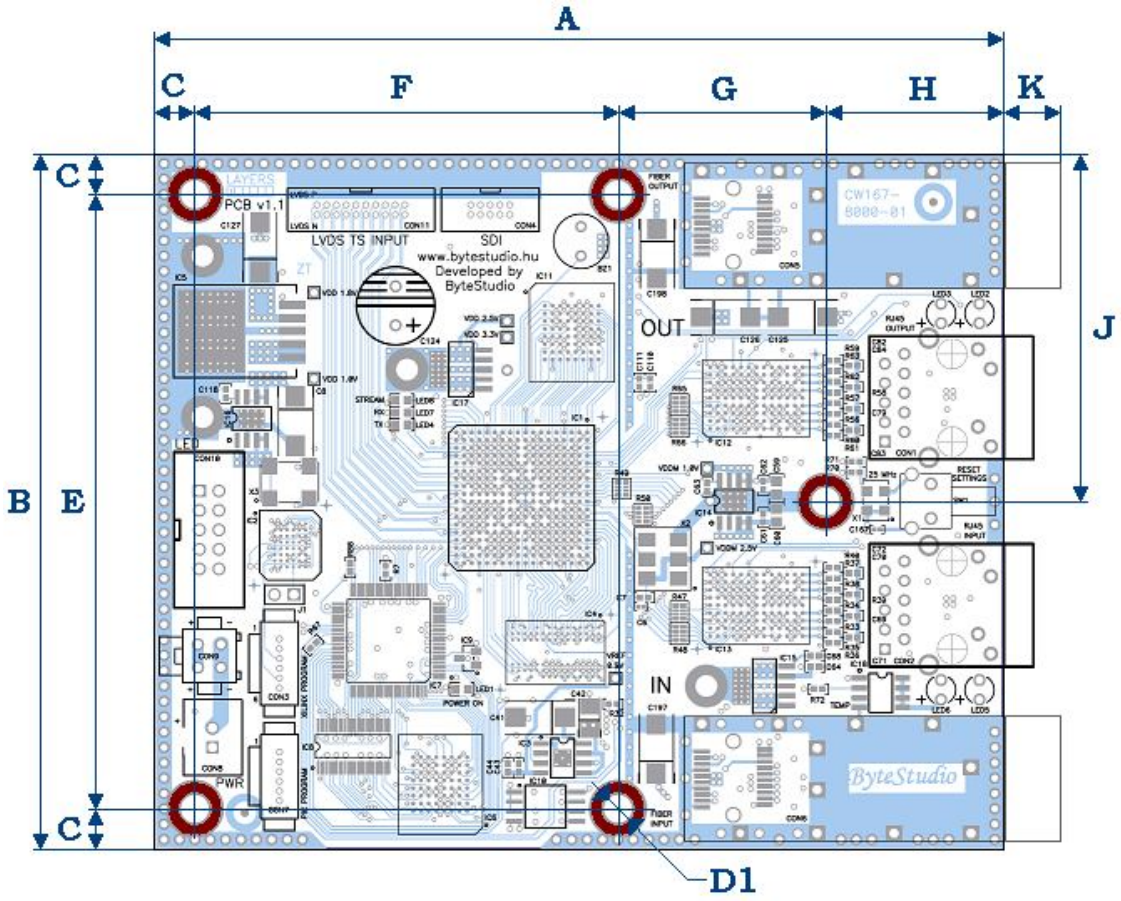
Byte	7	6	5	4	3	2	1	0
1-2	Opcode		0xFF03					
3-4	Length		0x0402					
5-6	Page Address							
7-1030	Page Data							

6 Electrical Characteristics

Recommended operating conditions:

Parameter	Min	Typ	Max	Units
VCC (power supply)	3.26	3.3	3.41	V
Input current	500	1000	1500	mA
Operating temperature	+5		+70	°C

7 Mechanical Dimensions



Units: mm
Tolerance: ±2 %

A	110
B	90
C	5
D1	3.5
E	80
F	55
G	27
H	23
J	45
K	8

Max. height: 20 mm

8 Version Information

Version	Date	Modifications
0.xx	10.05.2012	Test versions for development
1.00	03.10.2012	First official version of the controller
1.01	12.11.2012	[e] TS Analyzer Table Collection error corrected
1.02	13.02.2013	[p] CW-Net SCB instructions added [p] CW-Net bus DDToIP instructions added
1.03	20.02.2013	[e] TCP stack bug fixed [m] Default Table Collection Times modified
1.04	24.02.2013	[e] Eth. interrupt synchronization error corrected
1.05	01.03.2013	[m] CW-Net bus timing modified
1.06	05.28.2013	[p] SCBRefreshStatus auto repeater
1.07	16.12.2013	[p] GPO port [e] Gateway MAC search
1.08	28.01.2014	[p] Firmware Upgrade via UDP [p] Max. Temperature and VDD 3.3V storage
1.09	24.04.2014	[p] Ethernet Statistics
1.10	21.06.2014	[p] TCP receive buffers [e] ARP and IGMP report time setup
1.11	01.10.2015	[p] PID Filter [p] PSI Inserter
1.12	17.08.2015	[p] TS Loopback Unit [p] Network Device Management [p] Real-time stream analyzer [p] VLAN Tagged input streams

Keys:
[m] – modification
[e] – error correction
[p] - new feature