



# **64-bit TRIMAC CORE**

**10/100/1000 Mbps Ethernet MAC core with FIFO interface**

**DATASHEET**



## 1. INTRODUCTION

This document serves as product info for the trimode Ethernet MAC. The core is configurable for 10/100/1000 Mbps MAC with full and half duplex modes of operation as specified in the IEEE 802.3. The main features of the core include low power consumption by designing the MAC core with 64-bit RX and TX data paths. The core, on the application side, implements a simple and flexible FIFO interface.

## 2. 10/100/1000 ETHERNET MAC CORE FEATURES

- Implements the full 802.3 specification with preamble / SFD generation, frame padding generation, CRC generation and checking on transmit and receive respectively.
- Dynamically configurable to support 10Mbps, 100Mbps or 1000Mbps operation.
- Supports, for 10/100Mbps full duplex or half duplex operation and 1000Mbps full duplex mode selectable via a Core configuration option.
- Seamless interface to commercial Gigabit Ethernet PHY device via a 8-Bit Gigabit Medium Independent Interface (GMII) operating at 125MHz.
- Seamless interface to commercial Fast Ethernet PHY device via a 4-Bit Medium Independent Interface (MII) operating at 25/2.5MHz.
- When operating in Full Duplex mode, implements fully automated XON and XOFF Pause Frame (802.3 Annex 31A) generation and termination providing flow control without user application intervention.
- Pause frame generation additionally controllable by user application offering flexible traffic flow control.
- Implements standard flow-control mechanism in full-duplex operation mode.
- In half-duplex mode, provides full collision support, including jamming, back-off, and automatic retransmission.
- Support for VLAN tagged frames according to IEEE 802.1Q.
- Support any type of Ethernet Frames such as SNAP / LLC, Ethernet II/DIX or IP traffic.
- Programmable MAC addresses; discards frames with mismatching destination address on receive



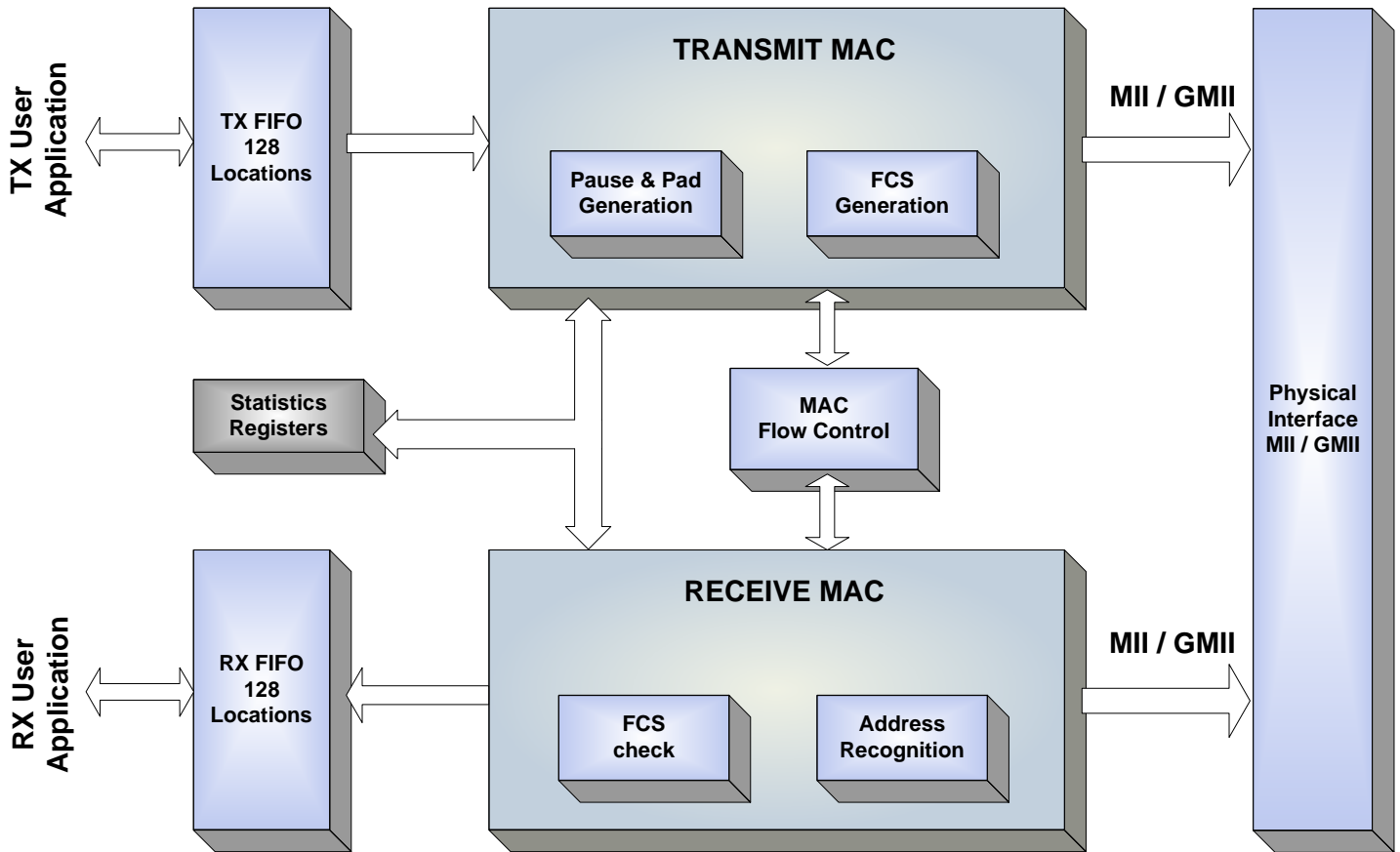
(Except Broadcast and frames).

- Programmable Promiscuous mode support to omit MAC destination address checking on receive
- Multicast address filtering on receive based on 64 entries hash table reducing higher layer processing load.
- Optional multi-cast address filtering with 64-bit HASH Filtering table providing imperfect filtering to reduce load on higher layers.
- Programmable frame maximum length providing support for any standard or proprietary frame length (e.g. 9K-Bytes Jumbo Frames).
- Status word available with each Frame on the user interface providing information such as frame length, VLAN frame type indication and error information.
- Optional padding termination on RX path for NIC applications or forwarding of unmodified data to the user interface.
- Optional internal GMII / MII Loop-back.
- Statistics indicators for frame traffic as well as errors (alignment, CRC, length) and pause frames.
- Simple handshake user application FIFO interface with programmable threshold levels ensuring data rates of 1Gbps with full back-to-back frame transfer support.
- Implements statistics and event signals providing support for 802.3 basic and mandatory managed objects as well as IETF Management Information Database (MIB) package (RFC 2665) and Remote Network Monitoring (RMON) required in SNMP environments.



### 3. MAC CORE BLOCK DIAGRAM

Figure 1: MAC Core Block Diagram





## **4. ETHERNET MAC OPERATION OVERVIEW**

### **1. TX Ethernet MAC performs the following functions**

- Accepts data including DA, SA and length field from the MAC client.
- Inserts PAD field for frames whose data length is less than a minimum value (64 bytes).
- Calculates and Appends proper FCS (CRC-32) value to outgoing frames and verifies full octet boundary alignment.
- Delays transmission of frame data for specified inter-frame gap period.
- Generates preamble and SFD field before frame transmission.
- In half duplex mode, defers transmission of the frame whenever the physical medium is busy.
- In half duplex mode, halts transmission using a “Binary truncated exponential Back-off” when collision is detected.
- In half duplex mode, schedules retransmission after a collision until a specified retry limit is reached.
- In half duplex mode, enforces collision to ensure propagation throughout network by sending jam messages.
- In full duplex mode manages flow control with the help of PAUSE control frames.
- Transmits the frame data to the PHY interface via MII/GMII interface.

### **2. RX Ethernet MAC performs the following functions:**

- Receives a frame from the Physical Layer via MII/GMII interface.
- Presents to the MAC client sublayer frames that are either frames with group address or directly addressed to the local station (Address recognition).
- Filters Multi-cast frames using hash filtering algorithm.
- Discards all frames not addressed to the receiving station when promiscuous mode is disabled.
- Accepts all frames destined to the EMAC if promiscuous mode is enabled.



- Checks incoming frames for transmission errors by way of FCS and verifies octet boundary alignment.
- Discards received transmissions that are less than a minimum length (64 bytes).
- Truncates frames with length greater than maximum frame length.
- Optionally forwards pause frames to user application configured through the host interface.

### **3. MAC Flow Control performs the following functions:**

- Prevents the Receive EMAC congestion by sending pause frames in full duplex mode of operation.
- Prevents the remote device congestion by responding to pause frames and going into idle state for specified number of slot times.



## 5. IMPLEMENTATION SUMMARY

An estimate of the logic resources and memory utilization for the 10/100/1000 Mbps Ethernet MAC for different devices of Altera is shown in the following table

<i>Device</i>	<i>Speed Grade</i>	<i>Logic cells (LE)</i>	<i>Registers</i>	<i>Memory M4K, Block-RAM</i>	<i>Performance MHz</i>
STRATIX	7	4787 LEs	2610	8 M4K	140 MHz
CYCLONE II	7	4561 LEs	2333	8 M4K	140 MHz
STRATIX II	5	2812 ALUTs	2344	8 M4K	155 MHz

*Table 1: EMAC Implementation summary*

## 6. REFERENCES

1. IEEE 802.3 CSMA/CD specification 2002
2. RFC2665, definition of Managed Objects for Ethernet Like Interface Type, [www.ietf.org](http://www.ietf.org)
3. RFC2863, The Interface Group MIB, [www.ietf.org](http://www.ietf.org)
4. RFC2819, Remote Network Monitoring (RMON) MIB, [www.ietf.org](http://www.ietf.org)