

# MC92053

## Product Brief

### MC92053

#### Quad FTTC Network Framer

The MC92053 is a peripheral device composed of four parallel bidirectional TC-sublayer functional units with UTOPIA Level 2 compliant ATM-layer ports.

#### MC92053 Features

- Implements the DAVIC short-range baseband asymmetrical physical layer standard
- Interfaces to an ATM-layer device using a multi-PHY UTOPIA Level 2 compliant interface
- Provides an 8-bit system interface as a generic slave device
- IEEE 1149.1 (JTAG) boundary scan test port
- 3.3 V operation with TTL compatibility on I/O pins
- Extended temperature operation: -40 to 85 °C
- Available in 208 Pin Plastic Quad Flat Package

#### Each of the four framers:

- Provides a bit rate of up to 51.84 Mbit/sec downstream
- Controls the Time Division Multiple Access (TDMA) among up to 4 user devices
- Supports a bit rate of up to 6.48 Mbit/s upstream, including DAVIC Bit Rates B, C, and D
- Includes serial data link interfaces for upstream and downstream frames
- Performs convolutional interleaving of the downstream payload blocks for the full range of interleaving depths ( $M = 1-31$ ) using an external 32K x 16 SRAM shared by all four framers
- Performs Reed-Solomon encoding of the downstream frames and decoding of the upstream frames
- Performs ATM cell TC functions, including HEC-based error detection and correction on the upstream data
- Includes serial data interfaces to Physical Media Devices (PMD).

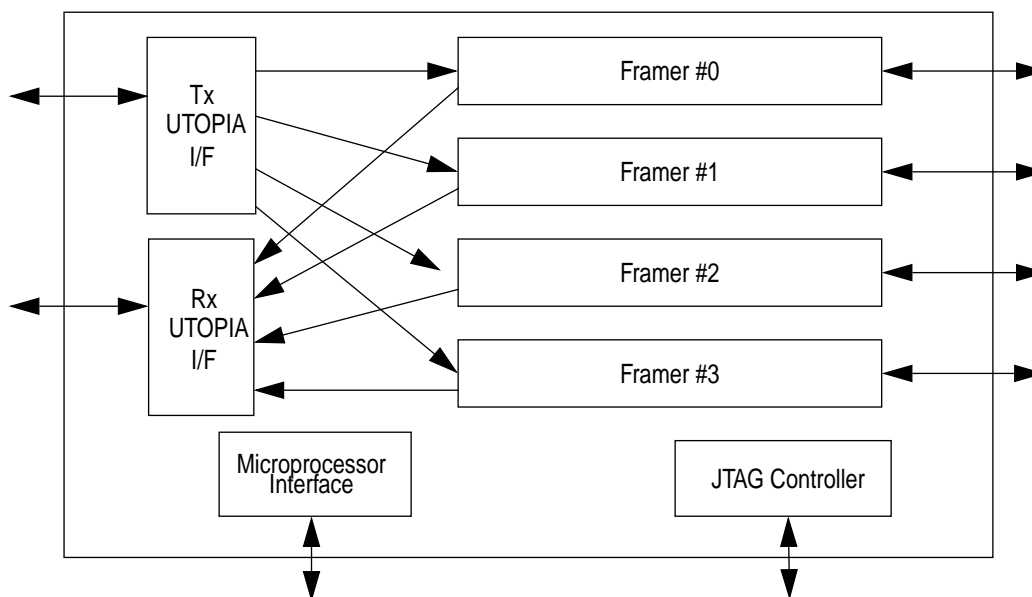


Figure 1. MC92053 Block Diagram

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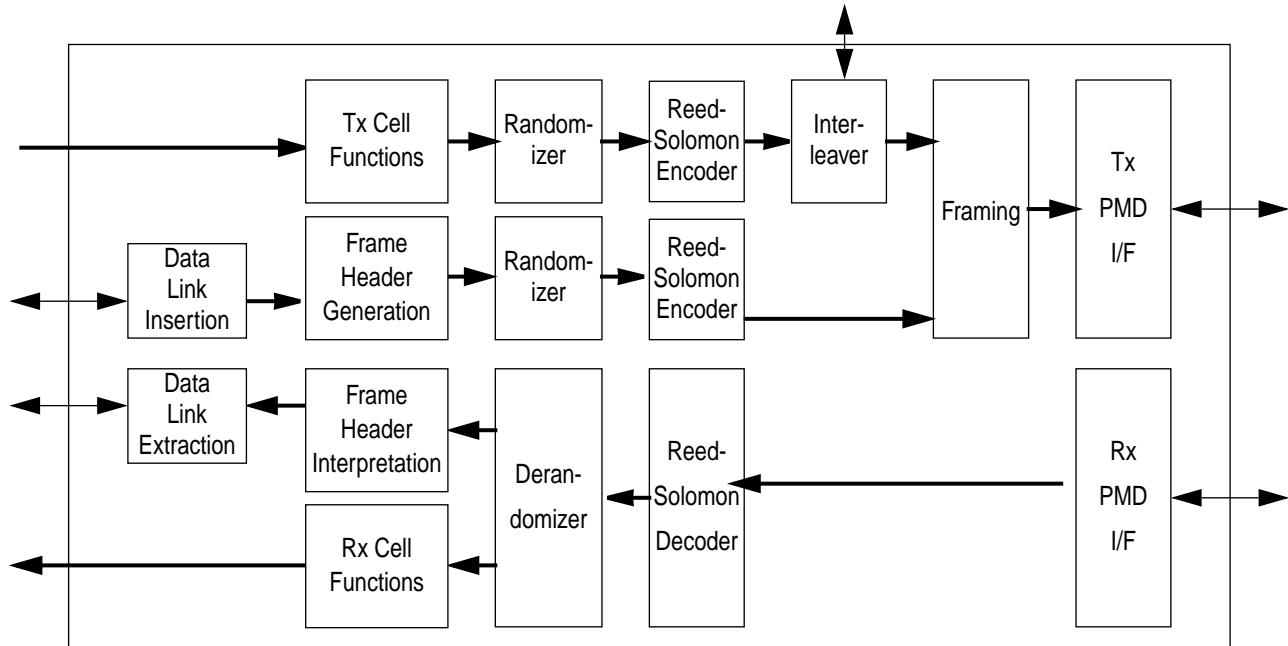


Figure 2. Framer Block Diagram

### General Description

The MC92053 implements four copies of the TC sublayer of the DAVIC asymmetrical FTTC PHY specification for network devices. The MC92053 key functional blocks are described in the paragraphs which follow.

#### Tx UTOPIA Interface

The Transmit UTOPIA interface accepts ATM cells from the ATM layer according to the UTOPIA Level 2 specification. Each cell is stored in one of the four transmit cell FIFO's. This block uses TXCLK provided by the ATM layer. The FIFO's are used for rate adaptation between TXCLK (the UTOPIA interface clock) and the device clock.

#### Rx UTOPIA Interface

The receive UTOPIA interface reads ATM cells from the four receive cell FIFO's and transfers them to the ATM layer according to the ATM Forum UTOPIA Level 2 specification. This block uses RXCLK provided by the ATM layer. The FIFO is used for rate adaptation between RXCLK (the UTOPIA interface clock) and the device clock.

#### Microprocessor Interface

The microprocessor interface is an 8-bit generic slave interface. It is used for initializing the internal registers and reading status registers and counters.

### JTAG

The MC92053 provides JTAG boundary scan.

### Framers

Each of the four framers performs the TC functions for a single user. The blocks contained in a framer are shown in Figure 2 and are described in the paragraphs which follow.

#### Tx Cell Functions

The transmit cell functions block reads ATM cells from a transmit cell FIFO. If there are no cells available when a downstream frame should be transmitted, the cell functions block generates an idle cell. It calculates the HEC value based on the ATM header of each cell and inserts it in the fifth octet of the cell. This block also randomizes the payload of the ATM cells according to ITU-T Recommendation I.432.

A count of the cells transferred from the transmit cell FIFO is maintained.

#### Data Link Insertion Block

The data link insertion block provides direct serial access to the data link bytes of the downstream frame headers. The data link stream for the downstream frames is optionally inserted using an output clock pin and an input data pin. The device ID to which the data link stream is destined is programmable.

### Frame Header Generation Block

The frame header generation block generates the 12 header bytes (excluding the two sync bytes) for each downstream frame. One of the main functions of this block is to allocate grants to the user devices. A programmable grant allocation mechanism is implemented to provide a combination of fixed and on-demand allocations in order to support both CBR and ABR connections.

### Randomizers

The data is randomized for better transmission performance. The two randomizers are identical. One is used for 12 header bytes per frame, and the other is used for the  $(12 * 58)$  payload bytes per frame.

### Reed-Solomon Encoders

There are two Reed-Solomon encoders. One encoder adds four parity bytes to the 12 header bytes to produce a (16,12) RS code. The other encoder adds eight parity bytes to each block of 58 payload bytes to produce (66,58) RS codes.

### Interleaver

The interleaver block spreads the blocks of payload data over a large period of time. Transmitting interleaved data allows for better correction of bursts of errors because the deinterleaver at the receiving end spreads the incorrect data over many blocks so that the Reed-Solomon decoder can correct the small number of errors in each block.

The interleaver separates the data byte stream into 33 branches. Each of the branches is delayed by a different amount, and then they are recombined into a single data stream. The delay of branch  $k$  ( $0 \leq k \leq 32$ ) is  $M * k$ .  $M$  is the programmable Interleaving Depth Parameter which is included in the downstream frame header and ranges from 0 to 31.  $M=0$  effectively disables the interleaver.

The delay of the interleaver/deinterleaver combination is  $1056 * M$  payload byte periods.

The four interleavers are implemented together since the downstream frame alignment is synchronized among the four framers. This requires the same value of  $M$  to be used for all four framers.

An external SRAM must be provided for temporary storage of the data unless interleaving is disabled.

### Tx PMD Interface

The Tx PMD interface block constructs the downstream frames by combining the 2 sync bytes with 1 header

block and 12 payload blocks. It transmits a serial data stream along with a signal that indicates the symbol alignment.

### Rx PMD Interface

The receive PMD interface consists of a clock signal, a data signal, and a start-of-frame signal. The clock signal is only required to be active while valid data is being transferred. The start-of-frame signal indicates the first bit of each frame.

### Reed-Solomon Decoder

The Reed-Solomon decoder operates on the 65-byte RS codeword of the upstream frame. It either corrects up to 4 bytes of the 57 data bytes or declares the frame to be uncorrectable, in which case the frame is discarded.

### Derandomizer

The received data has been randomized on the user side for better transmission performance. The derandomizer performs the inverse function to restore the original data. The derandomizer is initialized at the beginning of each frame.

### Frame Header Interpretation Block

The frame header interpretation block extracts the useful information from the received frame header. It provides status information to both the frame header generation block and to the processor.

### Data Link Extraction Block

The data link extraction block optionally provides the data link bytes of the upstream frame headers to a serial data link controller (e.g., MC68360 QUICC) for further processing. The received upstream data link bytes are filtered on the basis of the device ID in the data link address byte according to a programmable filter. The filtered data link stream is extracted using a clock pin and a data pin.

### Rx Cell Functions

The receive cell functions block checks the received HEC value against the calculated value and corrects single-bit errors in the header. Any cell with non-correctable errors is discarded. Also, all idle cells are discarded.

The cell functions block transfers entire ATM cells to the receive cell FIFO. A count of the cells transferred to the receive cell FIFO is maintained.

## System Functional Description

### Downstream Data Flow

In the downstream direction, the MC92053 receives ATM cells from an ATM-layer device. Each cell is directed to one of the four downstream framers as indicated by the ATM layer. Each framer adds idle cells, as necessary, to produce a continuous cell stream.

The ATM cell stream is randomized and then divided into blocks of 58 bytes. The Reed-Solomon encoder adds eight parity bytes to each block. The block is then sent to the interleaver.

Frame headers are generated internally. The frame headers include the control of the TDMA for the upstream direction. A data link byte may also be included. Each header is randomized, and then the Reed-Solomon encoder adds four parity bytes.

One frame header is combined with twelve payload blocks from the output of the interleaver to produce an 810-byte frame. Such frames are transmitted continuously through the Tx PMD interface.

### Upstream Data Flow

In the upstream direction, the MC92053 receives the frames recovered by the PMD device. Each frame undergoes error correction by a Reed-Solomon decoder.

The corrected frame is derandomized, and then the frame header is separated from the ATM cell.

The frame header is processed in accordance with the definition of the header bytes. The payload is sent to the cell functions block. Any physical layer cells are discarded, and the remaining cells are transferred to the ATM layer using a UTOPIA-compliant interface shared by the four framers.

### Other Functions

A microprocessor interface is provided for configuration control and status monitoring.

A standard IEEE 1149.1 boundary scan test port is provided.

### Applications

The primary application of the MC92053 is to provide TC-sublayer processing functions for a network device, e.g., an optical network unit (ONU), in an FTTC network. Figure 3 shows the location of the network device within an FTTC network. Figure 4 shows a generic ONU architecture using the MC92053.

The MC92053 uses an external memory for convolutional interleaving of the downstream data. If interleaving is not performed, the external memory is not required.

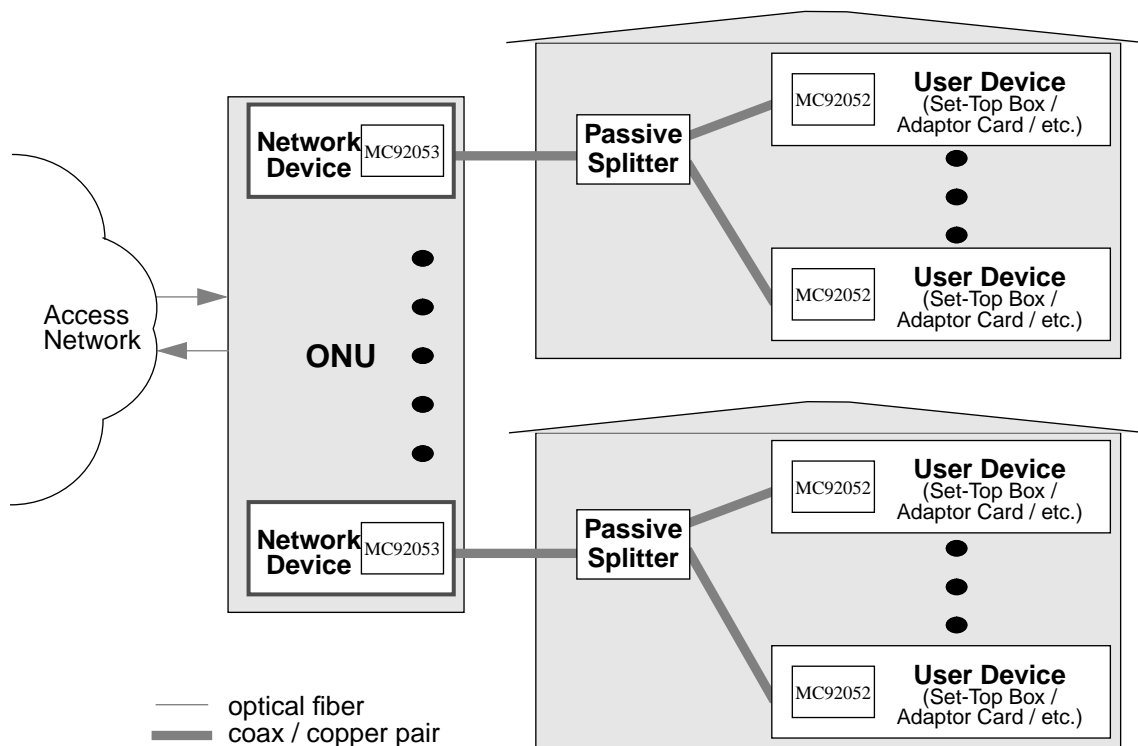


Figure 3. Typical FTTC Network

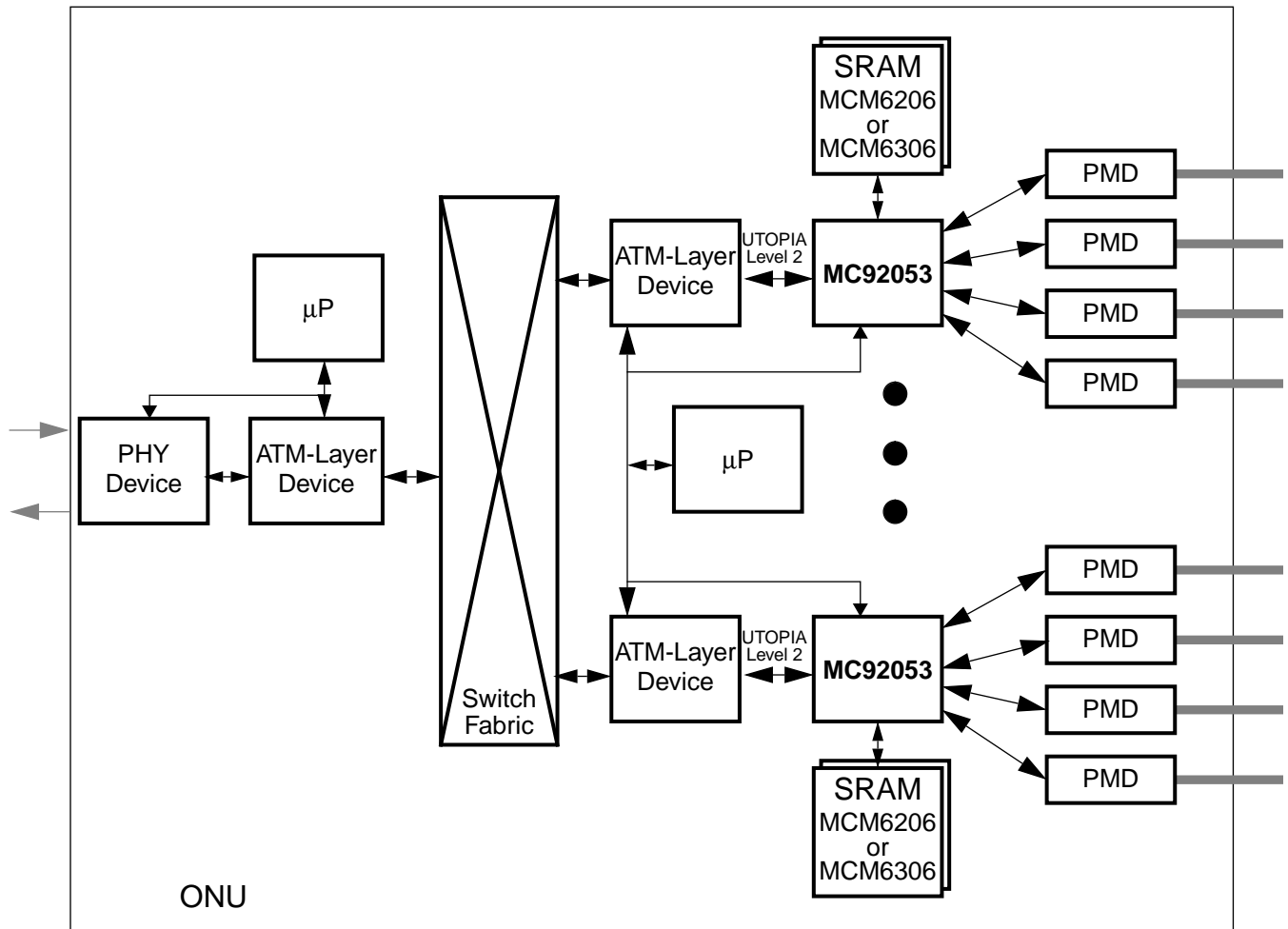



Figure 4. Generic ONU

Table 1. MC92053 Package/Frequency Availability

Package Type	Frequency (MHz)	Temperature	Order Number
208-pin PQFP	0 - 52	-40° to 85° C	MC92053CN

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