

## DS3/E3/STS-1 Line Interface Unit

# CX28333/28332/28331

### Complete Single-Chip, Multiport Line Interface Units

The CX28333/28332/28331 line interface units (LIUs) from Mindspeed Technologies™ provide data transceiver capability over coaxial cable up to 900 feet in an on-premises environment. The use of programmable pulse filtering in each independent transmit section simplifies system implementation by ensuring full compliance with ANSI T1.102-1993 cross-connect pulse-mask standards. Independent on-chip band-gap references are included to enable precise pulse-shape generation. The large receiver, dynamic range, and minimal requirement for external components reduce the cost and complexity of test and monitoring functions in a typical DS3 or E3 front-end design.

The receiver sections for each port of the CX28332 and CX28333 are completely separate and feature automatic gain control provided by a variable gain amplifier, clock recovery phase-locked loop (PLL), receive equalizer and signal slicer. The sophisticated receive equalizer recovers the signal attenuated by several different cable types (such as types 734 and 728) as well as “flat loss” introduced by many in-service testing and redundant cabling configurations. These line interfaces are intended to meet all applicable requirements for DS3/E3 and STS-1 data rates. Current ANSI, ETSI, ITU-T and Bellcore standards are supported.

### KEY FEATURES

- > Receive equalizer requires no user configuration
- > Programmable pulse filtering to meet cross-connect pulse mask standards (ANSI T1.102-1993)
- > Meets jitter specifications of Bellcore GR-499 and GR-253
- > Large input dynamic range
- > Full-loopback capability

### Integrated Alarms and Maintenance

The CX28333, CX28332 and CX28331 feature alarms for coding violations and loss of signal, a built-in B3ZS/HDB3 encoder/ decoder, and full-loopback capability. On-chip facilities for network management and testing eliminate the need for external circuitry. Many external components have been eliminated, with the exception of coupling transformers, termination resistors and supply bypass capacitors. The devices meet interoperability requirements as defined by the Bellcore GR-499 and GR-253 jitter specifications.

Each channel has an independent equalizer on the receive side, requiring no user configuration. Also, each channel has a programmable transmit pulse shaper that can be set to ensure the cross-connect pulse mask requirement is met for transmit cable lengths of up to 450 feet. Superior input receiver sensitivity allows for a minimum 25 mV receive level.



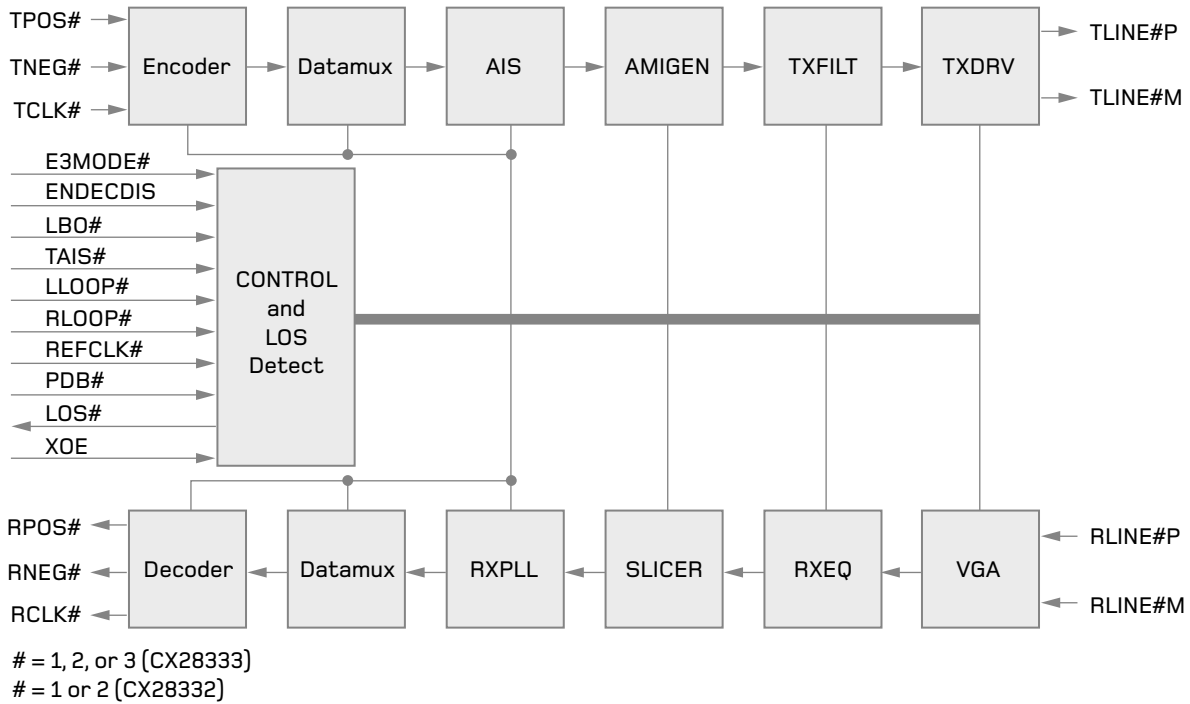
The CX28333 gives the user new economies of scale in concentrator applications where three DS3 or STS-1 channels are mapped into a single STS-3 channel. An optional receive equalizer setting is provided for test applications using "square" DS3 as STS-1 test pulses.

**What is DS3?**

DS3 is a dedicated, private-line digital service designed for point-to-point communications at 43.736 Mbps. It is suited for organizations requiring very high-capacity Internet connections that surpass the capabilities of the more popular DS1 (1.544 Mbps) service. DS3 is also used by network operators to multiplex 28 of the lower-speed DS1 connections.

The term "DS3" stands for Digital Service at Level 3 of the digital network hierarchy (also called plesiochronous digital hierarchy or PDH). The encoded line signal and physical connection for this service are generally referred to as T3.

Although the transport medium outside customer premises is usually fiber-optic cable, the connection between the network elements at the customer premises or in network equipment is generally copper coaxial cable of up to 450 feet in length. However, for wiring using simple patch cables, repeaters are needed unless the network equipment is capable of operation over at least two spans of cable (900 feet).



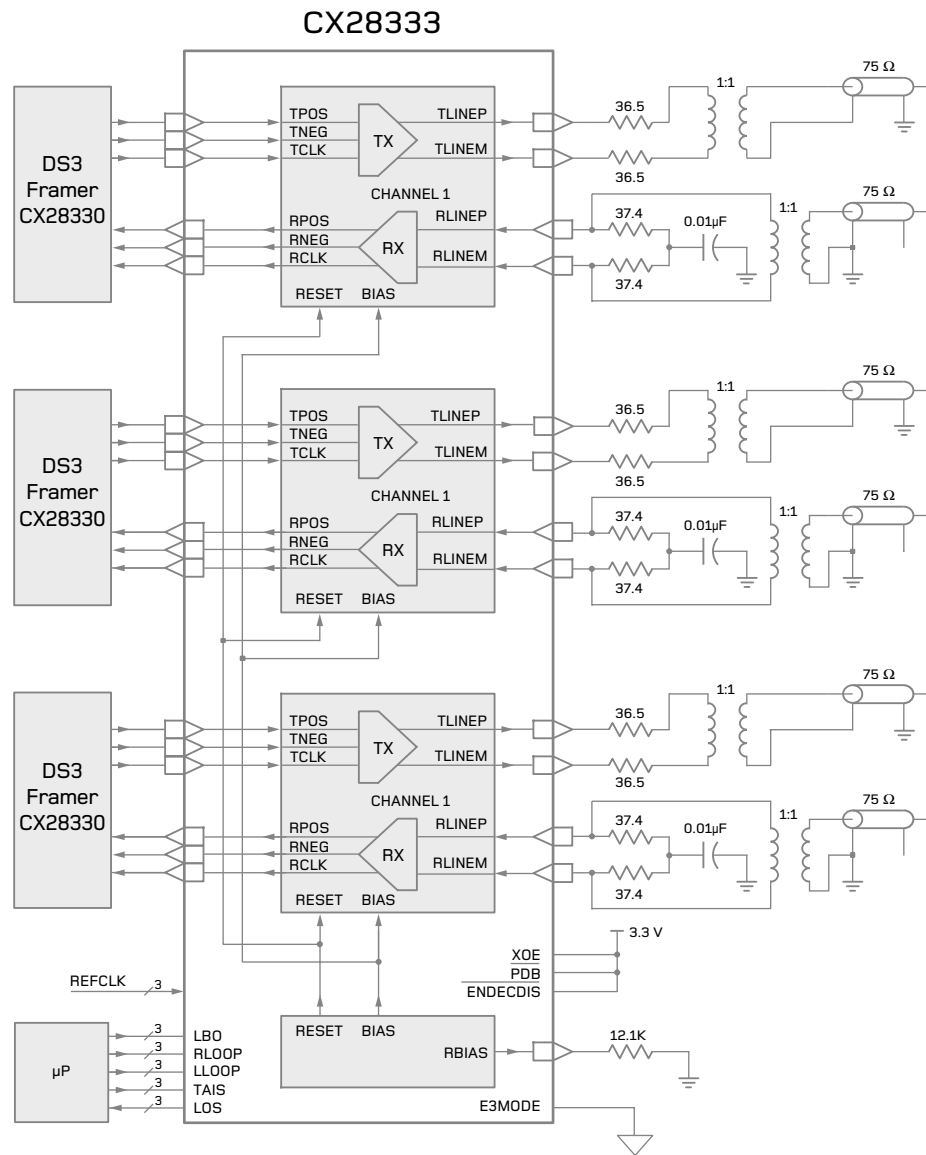
CX28332/CX28333 functional block diagram

### What is E3?

E3 is similar to DS3, but operates at the lower data rate of 34.368 Mbps. Both transport (which is generally provided by fiber-optic cable) and the access service are referred to as E3.

### What is STS-1?

STS-1 is at the first level of the synchronous optical network (SONET). It is a 51.84 Mbps digital transport or access service which usually transports a single DS3 or up to 28 DS1 services.



Typical connection of CX28333



## Product Highlights

- Receive equalization for coaxial cable lengths up to 900 feet
  - Can be used as data transceiver over a maximum of 900 feet of coaxial cable in an on-premises environment
  - Programmable pulse filtering to meet cross-connect pulse masks (ANSI T1.102-1993)
  - Meets jitter specifications of Bellcore GR-499 and GR-253
  - Large input dynamic range
  - Alarms for coding violations and loss of signal
  - Full-loopback capability
  - Uses a minimum of external components
  - Compatible with ITU-T G.703
- Channelized line-aggregation units
  - Test equipment
  - Channel server units
  - Multiplexers

### Data Rates

- DS3: 43.736 Mbps
- E3: 34.368 Mbps
- STS-1: 51.84 Mbps

### Cable Type

- 75  $\Omega$  coaxial cable (type 728, type 734, type 735 or similar)

### External Components

- 12.1 K  $\Omega \pm 1\%$  resistor for internal-voltage reference
- 2x 31.6  $\Omega$  transmit termination resistors (per channel)
- 2x 37.4  $\Omega$  receive termination resistors plus 0.01 $\mu$ F capacitor (per channel)
- 1:1 transmit pulse transformer per channel (Pulse Engineering T3001 or equivalent)
- 1:1 receive pulse transformer per channel (Pulse Engineering T3001 or equivalent)

### Physical Characteristics

- 80-pin ETQFP package
- Single 3.3 V power supply
- 1,100 mW max. power dissipation (CX28333)
- -40°C to + 85°C temperature range
- 5 V-tolerant I/O ring

### Applications

- Digital cross-connect systems
- Routers
- ATM switches

### Receiver Performance Sensitivity

- E3: up to 900 feet of type 728 cable (maximum loss = 12 dB  $\sqrt{f}$ )
- DS3: up to 900 feet of type 728 or 734 cable; up to 450 feet of type 735 cable
- STS-1: up to 1350 feet of type 728 or 734 cable; up to 450 feet of type 735 cable
- Receives signals with minimum amplitude of 25 mV

### Loss of Signal

- 128  $\pm 1$  consecutive zeroes

### Jitter Tolerance

- E3 rate: ITU-T G.823, Section 3, and ETSI prTBR24 contain frequency masks for input jitter tolerance
- DS3 rate: ITU-T G.823, Section 2, and Bellcore GR-499 specify jitter tolerance frequency masks for Category I and Category II interfaces
- STS-1 rate: Bellcore GR-253, Section 5.6.2.2, specifies a jitter tolerance. The STS-1 jitter tolerance differs from DS3 requirements only for Category II interfaces

### Transmitter Performance

#### Intrinsic Jitter

- 0.05 UI maximum, 10 Hz to 100 MHz

#### Transmit Power

##### E3:

- Nominal peak voltage of a mark (pulse) into a test load of 75  $\Omega$  is  $\pm 1.0$  V (at the device output)

##### DS3:

- 22.368 KHz: -1.8 to +5.7 dBm (75  $\Omega \pm 5\%$  termination)
- 44.736 KHz: at least 20 dB below the power at 22.368 KHz (at the first DSX, with 0 to 450 feet of cable between device and DSX)
- GR-499: pulse amplitude between  $\pm 0.36$  V and  $\pm 0.85$  V, wideband (DC to 200 MHz) power between -4.7 to +3.6 dBm (75  $\Omega \pm 5\%$ ) for 225 to 450 feet of cable
- STS-1: DC to 207.36 MHz transmit power between -2.7 and +4.7 dBm (75  $\Omega \pm 5\%$  termination) for 225 to 450 feet of cable

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