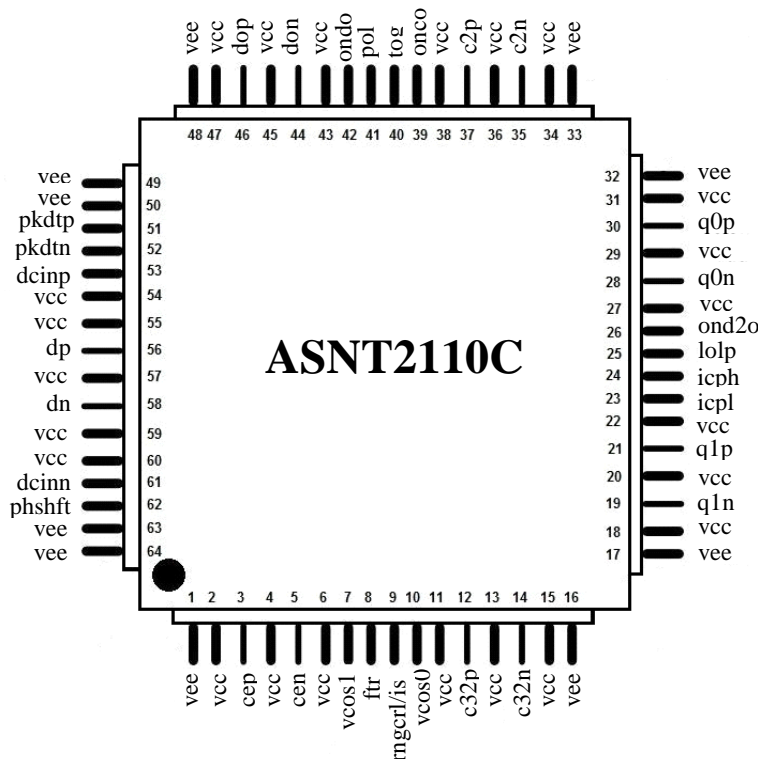




ASNT2110C-KMF Programmable CDR DMUX 1-to-2

- 1:2 demultiplexer (DMUX) with integrated selectable full-rate CDR
- Input data range from DC to 34.0Gb/s
- Digital operational mode with DC to 34GHz external clock
- CDR locking range from 25.2Gb/s to 32.5Gb/s
- RZ and NRZ input data formats
- Adjustable time of data sampling point for optimum BER performance
- CML compliant differential input and output high-speed data and clock interfaces
- LVDS compliant input reference clock interface
- Full rate clock and retimed data output for 1:1 CDR operation
- Half rate data outputs with toggle synchronization functionality
- Signal inversion and muting capabilities in all output buffers
- Single +3.3V or -3.3V power supply
- Low power consumption of 1.6W at the maximum operational speed
- Industrial temperature range
- Custom CQFP 64-pin package





DESCRIPTION

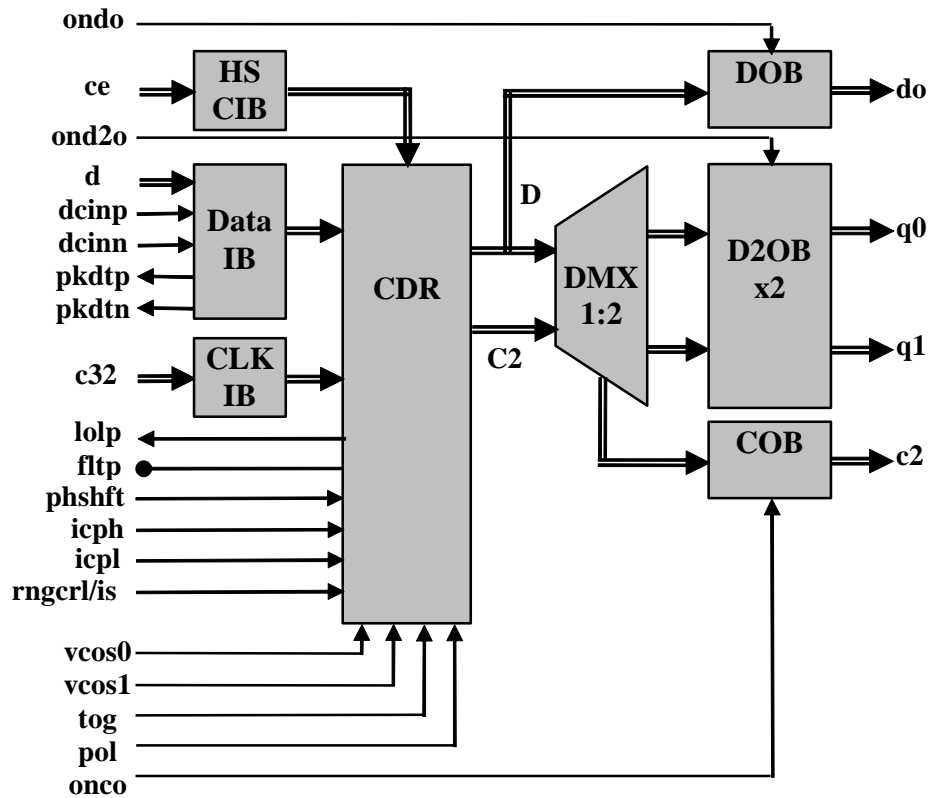


Fig. 1. Functional Block Diagram

ASNT2110C-KMF is a 1:2 demultiplexer (DMUX) with full-rate integrated clock and data recovery (CDR). The IC shown in Fig. 1 can function in either CDR mode covering a wide range of input data rates (f_{bit}) by utilizing its three on-chip VCOs (voltage-controlled oscillators), or in a broadband digital mode. Selection of the desired working data rate and mode is accomplished through pins $vcos0$ and $vcos1$ (see Table 1). An external low speed system clock $c32p/c32n$ running at 1/32 the frequency of the active VCO must be applied to the low-speed LVDS clock input buffer (CLK IB) in CDR mode. An external full-rate clock cep/cen must be applied to the high speed CML clock input buffer (HS CIB) for digital operation.

The main function of the chip is to convert a RZ or NRZ input data signal dp/dn with a bit rate of f_{bit} accepted by CML buffer (Data IB) into 2 parallel NRZ data signals $q0p/q0n$ and $q1p/q1n$ running at bit rates of $f_{bit}/2$ and delivered to the outputs by CML data output buffers (D2OBx2). The clock and data are recovered from the input data stream by the CDR. The phase of the clock recovered by the CDR can be adjusted externally through pin $phshft$ to locate the optimum data sampling point and achieve the lowest system bit error rate (BER).

A full rate retimed NRZ data output signal dop/don is also available through the CML data output buffer (DOB) allowing the part to be used as a 1:1 CDR. Half rate clock $c2p/c2n$ delivered through the CML clock output buffer (COB) has a tight phase alignment to the demultiplexed data output signals $q0p/q0n$ and $q1p/q1n$.



Data IB can operate with either differential or single-ended input signals. It includes tuning pins **dcinp/dcinn** for DC offset of the input signals in case of AC termination. When the buffer is operating with a DC-terminated single ended input signal, a correct threshold voltage should be applied to the unused input pin. A peak detector is also included to provide means of demodulating AM components carried by the input data with frequency ranges of up to a few hundred *KHz*. The peak detector's output signal is delivered to the differential port **pkdtp/pkdtm**.

All CML I/Os provide on chip *50Ohm* termination to **vcc** and may be used differentially, AC/DC coupled, single-ended, or in any combination (see also POWER SUPPLY CONFIGURATION). Output buffers **DOB**, **COB**, and **D2OBx2** can be individually disabled through pins **ondo**, **onco**, and **ond2o** to save power.

Utilizing pin **pol**, the deserializer can invert the polarity of the three output data signals. Pin **tog** flips the order of **q0p/q0n** and **q1p/q1n** signals thus simplifying the interface between the DMUX and a following ASIC. It also allows for synchronization of the bit order of two or more DMUXes working in parallel.

A loss of lock CMOS alarm signal **lolp** is generated by the CDR to indicate its locking state. An off chip passive filter is required by the CDR, and should be connected to pin **fr** (see CDR).

The deserializer is characterized for operation from 0°C to 125°C of junction temperature. The package temperature resistance is 15°C/W.

Data IB

The Data Input Buffer (Data IB) can process an input CML data signal **dp/dn** in either RZ or NRZ format due to its high analog bandwidth. It provides on-chip single-ended termination of *50Ohm* to **vcc** for each input line. The buffer can also accept a single-ended signal to one of its input ports **dp** or **dn** with a threshold voltage applied to the unused pin in case of DC termination. In case of AC termination, tuning pins **dcinp/dcinn** allow for data common mode adjustment. The tuning pins have *1KOhm* terminations to **vcc** and allow the user to change the slicing level before the data is sampled by the recovered clock. Tuning voltages from **vcc** to **vee** deliver *150mV* of DC voltage shift.

Also included in Data IB is an input signal peak detector that delivers its response through the output differential signal **pkdtp/pkdtm**. The detector can demodulate AM component(s) carried by the input data with frequency ranges of up to a few hundred *KHz*. The detector's output impedance is *4KOhm* single ended to **vcc**.

HS CIB

The High-Speed Clock Input Buffer (HS CIB) can process either differential or single-ended external CML clock signals **cep/cen**. In single-ended mode, the clock is applied to one of the pins together with a threshold voltage applied to the unused pin. The buffer utilizes on-chip single-ended termination of *50Ohm* to **vcc** for each input line.

CLK IB

The Clock Input Buffer (CLK IB) consists of a proprietary universal input buffer (UIB) that exceeds LVDS standards IEEE Std. 1596.3-1996 and ANSI/TIA/EIA-644-1995. UIB is designed to accept differential signals with a speed up to *1Gb/s*, DC common mode voltage variation between **vcc** and **vee**,



AC common mode noise with a frequency up to 5MHz, and voltage levels ranging from 0 to 2.4V. It can also receive a DC-terminated single-ended signal with a threshold voltage between vcc and vee applied to the unused pin. The input termination impedance is set to 100Ohm differential.

CDR

The Clock and Data Recovery Block (CDR) contains both a phase and frequency acquisition loop. The frequency loop works in concert with low-speed clock c32p/c32n while the phase loop utilizes data signal dp/dn. The CDR requires a single off-chip filter shown in Fig. 2 to be connected to pin ftr.

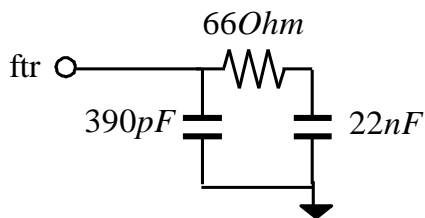


Fig. 2. External Loop Filter

The main function of the CDR is to frequency-lock the selected on-chip VCO to the input data signal (clock recovery) while phase-aligning it to latch in the incoming data with minimal error (data recovery). By default, the CDR aligns the recovered clock's working edge in the middle of the incoming data bits. A DC voltage from vee to vcc applied to pin phshft can be utilized to shift this position from one edge of the data bit to the other in order to locate the optimum sampling point which provides the lowest system BER. The recovered clock is divided down in frequency by two (C2) and utilized by DMX 1:2 for demultiplexation of the recovered data.

By utilizing the 2.5V CMOS control pins vc0s0 and vc0s1, the desired working frequency of the CDR can be selected in accordance with Table 1 below.

Table 1. CDR Mode Selection (Case Temperature from 0 to 90°C)

| vc0s0 | vc0s1 | VCO Operation Frequency (GHz) |
|------------|------------|--|
| "0" (0V) | "0" (0V) | $f_{min} \leq 25.2, f_{max} \geq 27.4$ |
| "0" (0V) | "1" (2.5V) | $f_{min} \leq 26.3, f_{max} \geq 30.0$ |
| "1" (2.5V) | "0" (0V) | $f_{min} \leq 29.9, f_{max} \geq 32.5$ |
| "1" (2.5V) | "1" (2.5V) | Digital Mode, default state |

The loop gain can be adjusted by two 2.5V CMOS control pins icph and icpl that control the charge pump current as shown in Table 2.

Table 2. Charge Pump Current Control

| icph | icpl | Charge Pump current, mA |
|------------|------------|-------------------------|
| "0" (0V) | "0" (0V) | I_{max} |
| "0" (0V) | "1" (2.5V) | $I_{max}-0.04$ |
| "1" (2.5V) | "0" (0V) | $I_{max}-0.27$ |
| "1" (2.5V) | "1" (2.5V) | $I_{max}-0.31$ |

By utilizing the analog control pin rngcrl/is, locking frequency ranges of the three VCOs can be adjusted. Fig. 3, Fig. 4, and Fig. 5 present locking ranges of low-frequency, middle-frequency, and high-frequency



VCOs respectively. Each plot shows the dependence of minimum and maximum locking frequencies (in GHz) on the voltage (in V above vee) of the control pin rangecl/is.

The lock detect circuitry signals an alarm through the 2.5V CMOS signal lolp when a frequency difference exists between an applied system reference clock c32p/c32n and a recovered full rate clock divided-by-32 that is greater than $\pm 1000ppm$.

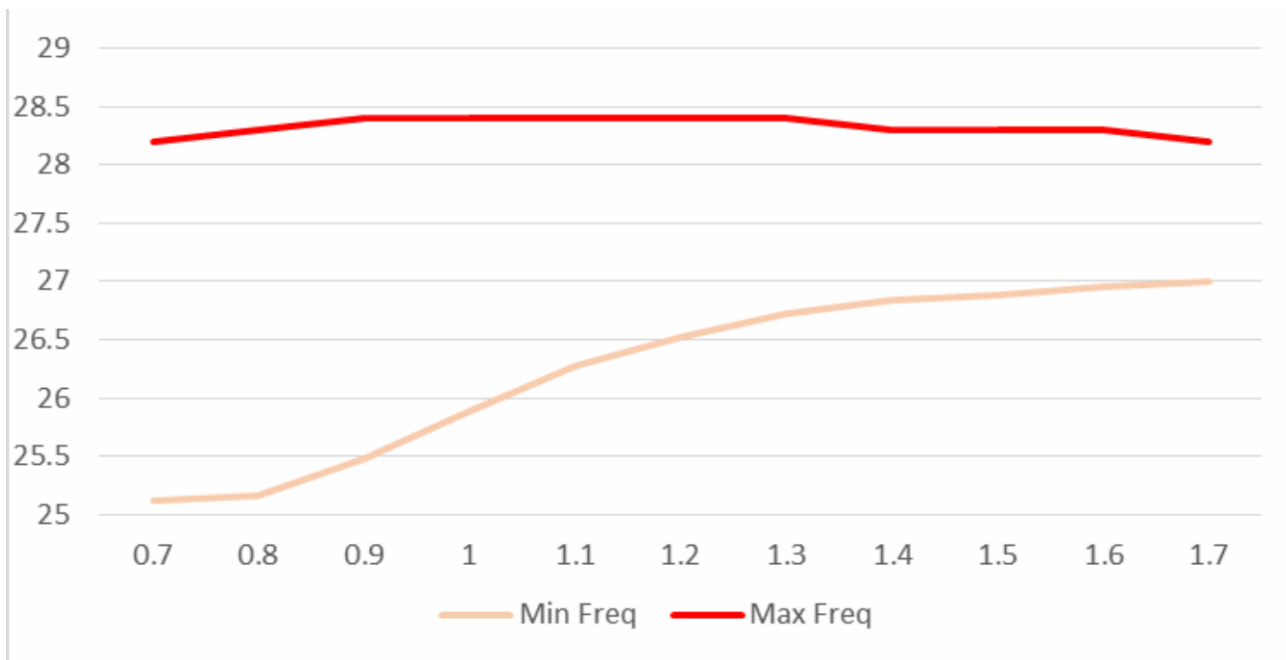


Fig. 3. Locking Range of Low-Frequency VCO vs. Control Voltage

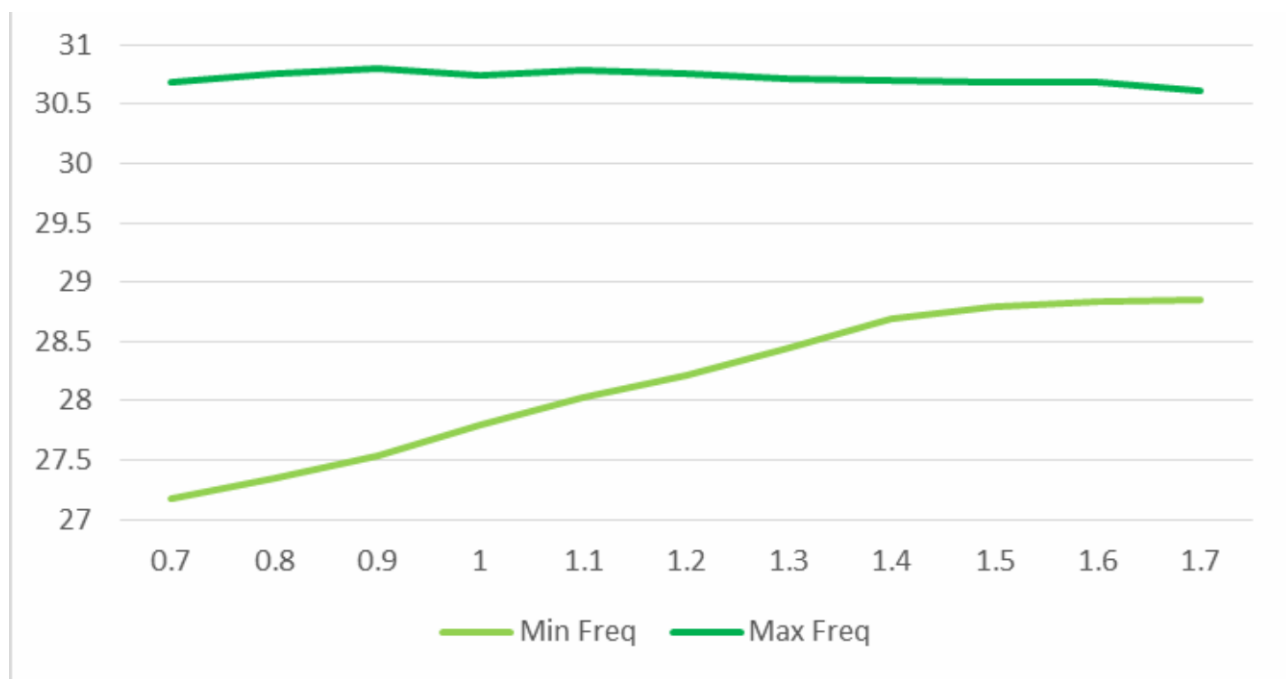


Fig. 4. Locking Range of Middle-Frequency VCO vs. Control Voltage

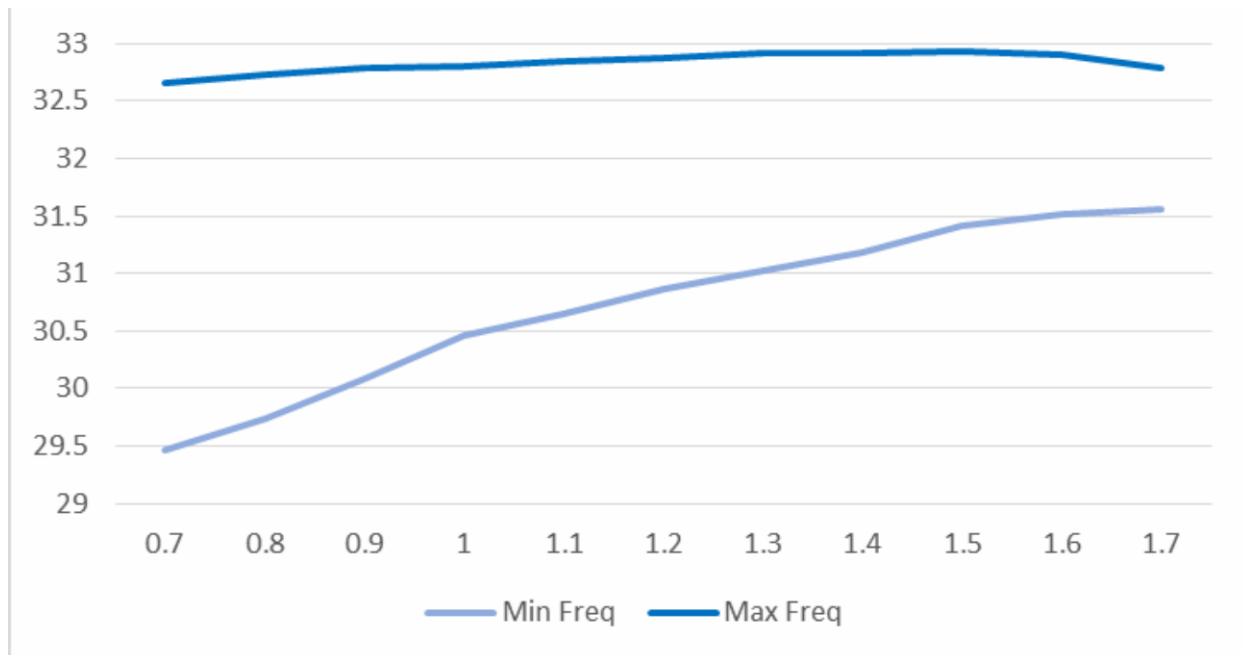


Fig. 5. Locking Range of High-Frequency VCO vs. Control rmgcr/is

Another feature included in the CDR is the ability to simultaneously invert the polarity of all three data outputs through the 2.5V CMOS input pin *pol* (*pol* = “1” (default): direct; *pol* = “0”: inverted). The order of the half-rate output data streams can be inverted by using the 2.5V CMOS input pin *tog*, which provides means to synchronize two adjacent DMUXes operating in parallel. The synchronization process may be accomplished by the “blind” toggling in one of the chips and leaving the task of recognizing the “right” position to downstream components (e.g. FEC chip).

DMX1:2

The 1 to 2 Demultiplexer (DMX1:2) latches in the retimed data stream *D* from the CDR on both edges of the half rate clock signal *C2*. The high speed data signal is subsequently demultiplexed into two half rate NRZ data signals and delivered to *D2OBx2* in parallel fashion as a 2-bit wide word with the order defined by the *tog* signal.

DOB

The Data Output Buffer (DOB) receives a full rate retimed serial data stream *D* from the CDR and converts it into a CML output signal *dop/don*. This CML buffer requires 50 Ω external termination resistors connected between *vcc* and each output. The buffer can be enabled or disabled by the external 2.5V CMOS control signal *ondo* (*ondo* = “1” (default): enabled; *ondo* = “0”: disabled).

D2OBx2

The Half Rate Data Output Buffer (D2OBx2) receives two half rate data signals from DMX1:2 and converts them into CML output signals *q0p/q0n* and *q1p/q1n*. The buffer requires 50 Ω external termination resistors connected between *vcc* and each output. The buffer can be enabled or disabled by the external 2.5V CMOS control signal *ond2o* (*ond2o* = “1” (default): enabled; *ond2o* = “0”: disabled).



COB

The Clock Output Buffer (COB) receives a half rate clock signal from DMX1:2 and converts it into CML output signal $c2p/c2n$. The buffer requires 50Ω external termination resistors connected between vcc and each output. The buffer can be enabled or disabled by the external 2.5V CMOS control signal $onco$ ($onco = "1"$ (default): enabled; $onco = "0"$: disabled). The negative edge of the $c2$ signal is aligned to the half rate output data crossing points.

POWER SUPPLY CONFIGURATION

The ASNT2110C-KMF can operate with either a negative supply ($vcc = 0.0V = \text{ground}$ and $vee = -3.3V$), or a positive supply ($vcc = +3.3V$ and $vee = 0.0V = \text{ground}$). In case of a positive supply, all I/Os need AC termination when connected to any devices with 50Ω termination to ground. Different PCB layouts will be needed for each different power supply combination.

All the characteristics detailed below assume $vcc = 3.3V$ and $vee = 0V$ (external ground)

ABSOLUTE MAXIMUM RATINGS

Caution: Exceeding the absolute maximum ratings shown in Table 3 may cause damage to this product and/or lead to reduced reliability. Functional performance is specified over the recommended operating conditions for power supply and temperature only that are specified in ELECTRICAL CHARACTERISTICS. AC and DC device characteristics at or beyond the absolute maximum ratings are not assumed or implied. All min and max voltage limits are referenced to ground (assumed vee).

Table 3. Absolute Maximum Ratings

| Parameter | Min | Max | Units |
|--------------------------------|-----|------|-------|
| Supply Voltage (vcc) | | +3.8 | V |
| Power Consumption | | 1.6 | W |
| Input Voltage Swing (SE) | | 1.0 | V |
| Case Temperature ^{*)} | | +90 | °C |
| Storage Temperature | -40 | +100 | °C |
| Operational Humidity | 10 | 98 | % |
| Storage Humidity | 10 | 98 | % |

*) - Operating the part at temperatures over this value could/will damage the part. Operating at this temperature or any temperatures above the recommended maximum value specified in ELECTRICAL CHARACTERISTICS does not guarantee correct functionality as is stated above.

TERMINAL FUNCTIONS

| Supply and Termination Voltages | | |
|---------------------------------|-----------------------------------|---|
| Name | Description | Pin Number |
| vcc | Positive power supply (+3.3V) | 2, 4, 6, 11, 13, 15, 18, 20, 22, 27, 29, 31, 34, 36, 38, 43, 45, 47, 54, 55, 57, 59, 60 |
| vee | Negative power supply (GND or 0V) | 1, 16, 17, 32, 33, 48, 49, 50, 63, 64 |



| TERMINAL | | | DESCRIPTION | | |
|------------------------|-----|----------------------|--|--|---|
| Name | No. | Type | | | |
| High-Speed I/Os | | | | | |
| cep | 3 | Input | CML differential full rate clock inputs with internal SE 50Ohm termination to VCC | | |
| cen | 5 | | | | |
| q1p | 21 | Output | CML differential half rate data outputs. Require external SE 50Ohm termination to VCC | | |
| q1n | 19 | | | | |
| q0p | 30 | | | | |
| q0n | 28 | | | | |
| c2p | 37 | Output | CML differential half rate clock outputs. Require external SE 50Ohm termination to VCC | | |
| c2n | 35 | | | | |
| dop | 46 | Output | CML differential full rate data outputs. Require external SE 50Ohm termination to VCC | | |
| don | 44 | | | | |
| dp | 56 | Input | CML differential data inputs with internal SE 50Ohm termination to VCC | | |
| dn | 58 | | | | |
| Low-Speed I/Os | | | | | |
| c32p | 12 | Input | LVDS clock input with internal differential 100Ohm termination | | |
| c32n | 14 | | | | |
| pkdtp | 51 | Output | Peak detector outputs | | |
| pkdtn | 52 | | | | |
| Controls | | | | | |
| vcos1 | 7 | LS In., 2.5V CMOS | CDR operational mode selection, see Table 1 | | |
| vcos0 | 10 | | | | |
| icpl | 23 | | | Charge pump current control, see Table 2 | |
| icph | 24 | | | | |
| ond2o | 26 | | | | D2OBx2 control (high, default: buffer is on; low: buffer is disabled) |
| onco | 39 | | | | COB control (high, default: buffer is on; low: buffer is disabled) |
| tog | 40 | | | | Order inversion of output data signals (default: high) |
| pol | 41 | | | | Data output signal polarity (high, default: inverted data outputs) |
| ondo | 42 | | | | DOB control (high, default: buffer is on; low: buffer is disabled) |
| lolp | 25 | | | | LS out, 2.5V CMOS |
| dcinp | 53 | LS IN | Input data common mode voltage adjustment | | |
| dcinn | 61 | | | | |
| phshft | 62 | LS IN | CDR sampling point adjustment | | |
| rngcr1/is | 9 | LS IN | VCO frequency range adjustment control with internal 107kOhm termination to VCC and 213kOhm termination to VEE | | |
| ftr | 8 | I/O | External CDR filter connection | | |



ELECTRICAL CHARACTERISTICS

| PARAMETER | MIN | TYP | MAX | UNIT | COMMENTS |
|---|----------|----------|-----------|------|-----------------------|
| General Parameters | | | | | |
| vcc | +3.0 | +3.3 | +3.6 | V | ±9% |
| vee | | 0.0 | | V | |
| I _{vcc} | | 490 | | mA | All functions active |
| Power Consumption | | 1.6 | | W | |
| Junction Temperature | -25 | 50 | 125 | °C | |
| Case temperature | | | 75 | °C | Recommended value |
| HS Input Data (dp/dn) | | | | | |
| Data Rate | DC | | 34 | Gbps | Digital mode |
| | | | 32.5 | Gbps | CDR mode |
| Swing p-p (Diff or SE) | 0.05 | | 0.6 | V | at 34Gbps |
| CM Voltage Level | vcc-0.8 | | vcc | V | |
| LS Input Reference Clock (c32p/c32n) | | | | | |
| Frequency | 787.5 | | 1015.625 | MHz | |
| Swing p-p (Diff or SE) | 0.06 | | 0.8 | V | |
| CM Voltage Level | vee | | vcc | V | |
| Duty Cycle | 40 | 50 | 60 | % | |
| HS Output Full Rate Data (dop/don) | | | | | |
| Data Rate | DC | | 34 | Gbps | Digital mode |
| | | | 32.5 | Gbps | CDR mode |
| Logic "1" level | | vcc | | V | |
| Logic "0" level | | vcc -0.4 | vcc -0.3 | V | |
| Jitter | | 7 | 8 | ps | |
| HS Output Half Rate Data (q0p/q0n, q1p/q1n) | | | | | |
| Data Rate | DC | | 17 | Gbps | NRZ, Digital mode |
| | | | 16.25 | Gbps | NRZ, CDR mode |
| Logic "1" level | | vcc | | V | |
| Logic "0" level | | vcc -0.4 | | V | |
| Jitter | | 7 | | ps | |
| HS Output Half Rate Clock (c2p/c2n) | | | | | |
| Clock Rate | DC | | 17.0 | GHz | Digital mode |
| | | | 16.25 | GHz | CDR mode |
| Logic "1" level | | vcc | | V | |
| Logic "0" level | vcc -0.4 | | vcc -0.15 | V | |
| Jitter | | 5 | 8 | ps | |
| Input Data Common Mode Control (dcinp/dcinn) | | | | | |
| Input DC Voltage | vee | | vcc | V | |
| Input Data Voltage Shift | 0 | | -150 | mV | Referenced to vcc |
| Output of Peak Detector (pkdtp/pkdtm) | | | | | |
| Swing p-p (Diff) | -1 | | 1 | V | Over full input range |
| CM Voltage Level | | vcc -1.0 | | V | |
| Data Sampling Point Adjustment (phsft) | | | | | |



| PARAMETER | MIN | TYP | MAX | UNIT | COMMENTS |
|--|-----------|-----|-----------|------|---------------------------------|
| Input DC Voltage | vcc -1.0 | NC | vcc | V | NC=Not Connected |
| Phase Shift | -15 | 0 | +15 | ps | |
| Shift Stability | -2 | | 2 | ps | From 0°C to 125°C |
| Bandwidth | 0.0 | | 100 | MHz | |
| Locking Range Control (rangecl/is) | | | | | |
| Control voltage level | vee + 0.7 | | vee + 1.7 | V | Do not exceed vee+2.5V |
| CMOS Control Inputs/Outputs | | | | | |
| Logic "1" level | 2.1 | | 2.5 | V | |
| Logic "0" level | | | vee +0.4 | V | |
| Timing Parameters | | | | | |
| c2p/c2n to q0p/q0n & q1p/q1n delay variation | | 2 | | ps | Over the full temperature range |

PACKAGE INFORMATION

The chip die is housed in a custom 64-pin CQFP package. The dimensioned drawings are shown in Fig. 6. The package's leads will be trimmed to a length of 1.0mm. After trimming, the package's leads will be further processed as follows:

1. The lead's gold plating will be removed per the following sections of J-STD-001D:
 - 3.9.1 Solderability
 - 3.2.2 Solder Purity Maintenance
 - 3.9.2 Solderability Maintenance
 - 3.9.3 Gold Removal
2. The leads will be tinned with Sn63Pb37 solder

The package provides a center heat slug located on its back side to be used for heat dissipation. ADSANTEC recommends for this section to be soldered to the vcc plain, which is ground for a negative supply, or power for a positive supply.

The part's identification label is ASNT2110C-KMF. The first 9 characters of the name before the dash identify the bare die including general circuit family, fabrication technology, specific circuit type, and part version while the 3 characters after the dash represent the package's manufacturer, type, and pin out count.

This device complies with Commission Delegated Directive (EU) 2015/863 of 4 June 2015 amending Annex II to Directive 2011/65/EU of the European Parliament and of the Council as regards the list of restricted substances (Text with EEA relevance) on the restriction of the use of certain hazardous substances in electrical and electronics equipment (RoHS Directive) in accordance with the definitions set forth in the directives for all ten substances.

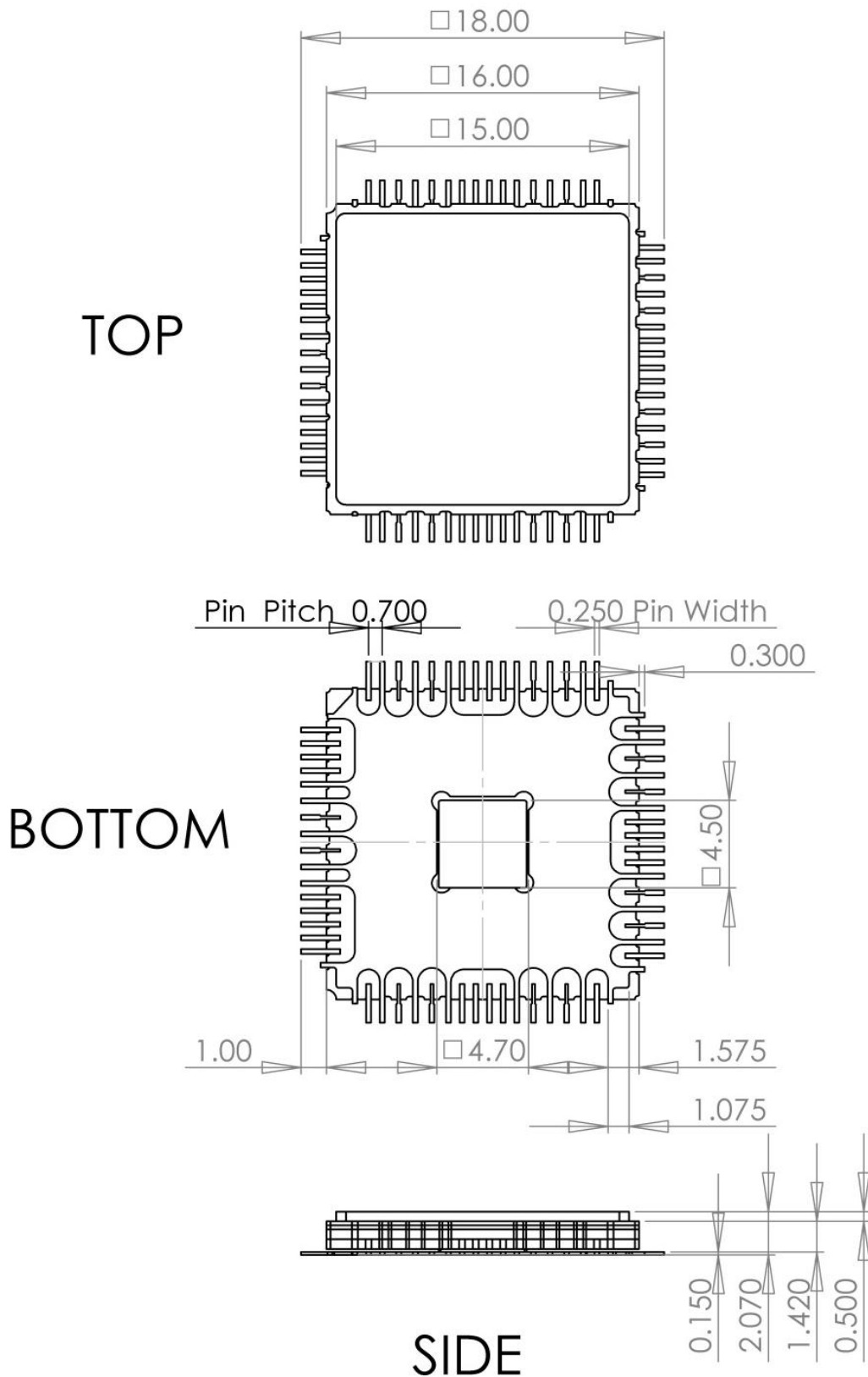


Fig. 6. CQFP 64-Pin Package Drawing (All Dimensions in mm)



REVISION HISTORY

| Revision | Date | Changes |
|----------|---------|--|
| 1.1.2 | 02-2021 | Corrected the description of the control rangectrl/is in the CDR section Corrected Terminal Functions table Corrected Electrical Characteristics table Corrected Power Supply Configuration section |
| 1.0.2 | 10-2020 | Corrected frequency range Corrected short description (bullets) Corrected filter schematic Corrected Electrical Characteristics table |
| 0.2.2 | 04-2020 | Corrected main features Corrected VCO upper frequency limit Corrected Electrical Characteristics |
| 0.1.2 | 04-2020 | Corrected data rate and clock frequency |
| 0.0.2 | 04-2020 | Preliminary release |