

This is a short form datasheet and is intended to provide an overview only. Additional details are available from IDT. Contact information may be found on the last page.

## HIGHLIGHTS

- Synchronization Management Unit (SMU) provides tools to manage physical layer and packet based synchronous clocks for IEEE 1588 / PTP Telecom Profile applications
- Supports independent IEEE 1588 and Synchronous Ethernet (SyncE) timing paths
- Combo mode provides SyncE physical layer frequency support for IEEE 1588 Telecom Boundary Clocks (T-BC) and Telecom Time Slave Clocks (T-TSC) per G.8273.2
- Digital PLL 1 (DPLL1) and DPLL 2 can be configured as Digitally Controlled Oscillators (DCOs) for PTP clock synthesis
- DCO frequency resolution is  $[(77760 / 1638400) * 2^{48}]$  or  $\sim 1.686305041e-10$  ppm
- DPLL1 and DPLL2 generate G.8262 compliant SyncE clocks
- Two independent Time of Day (ToD) counters/time accumulators, one associated with each of DPLL1 and DPLL2, can be used to track differences between the two time domains and to time-stamp external events
- DPLL3 performs rate conversions to frequency synchronization interfaces or for other general purpose timing applications
- APLL3 is Voltage Controlled Crystal Oscillator (VCXO) based and generates clocks with jitter  $< 0.3$  ps RMS (10 kHz to 20 MHz) for: 10GBASE-R, 10GBASE-W, 40GBASE-R and 100GBASE-R
- APLL1 and APLL2 generate clocks with jitter  $< 1$  ps RMS (12 kHz to 20 MHz) for: 1000BASE-T and 1000BASE-X
- Fractional-N input dividers support a wide range of reference frequencies
- Locks to 1 Pulse Per Second (PPS) references
- DPLLs, APLL1 and APLL2 can be configured from an external EEPROM after reset
- FRSYNC\_8K\_1PPS and MFRSYNC\_2K\_1PPS output sync pulses that are aligned with the selected external input sync pulse input and frequency locked to the associated reference clock input
- DPLL1 and DPLL2 can be configured with bandwidths between 0.09 mHz and 567 Hz
- DPLL1 and DPLL2 lock to input references with frequencies between 1 PPS and 650 MHz
- DPLL3 locks to input references with frequencies between 8 kHz and 650 MHz
- DPLL1 and DPLL2 comply with ITU-T G.8262 for Synchronous Ethernet Equipment Clock (EEC), and G.813 for Synchronous Equipment Clock (SEC); and Telcordia GR-253-CORE for Stratum 3 and SONET Minimum Clock (SMC)
- DPLL1 and DPLL2 generate clocks with PDH, TDM, GSM, CPRI/OBSAI, 10/100/1000 Ethernet and GNSS frequencies; these clocks are directly available on OUT1
- DPLL1 and DPLL2 can be configured as DCOs to synthesize IEEE 1588 clocks
- DPLL3 generates  $N \times 8$  kHz clocks up to 100 MHz that are output on OUT9 and OUT10
- APLL1, APLL2 and APLL3 can be connected to DPLL1 or DPLL2
- APLL1 and APLL2 generate 10/100/1000 Ethernet, 10G Ethernet, or SONET/SDH frequencies
- APLL3 generates 10G/40G/100G Ethernet, WAN-PHY and LAN-PHY frequencies
- Any of eight common TCXO/OCXO frequencies can be used for the System Clock: 10 MHz, 12.8 MHz, 13 MHz, 19.44 MHz, 20 MHz, 24.576 MHz, 25 MHz or 30.72 MHz
- The I2C slave interface can be used by a host processor to access the control and status registers
- The I2C master interface can automatically load a device configuration from an external EEPROM after reset; APLL3 must be configured via the I2C slave interface

## FEATURES

- Composite clock inputs (IN1 and IN2) accept 64 kHz synchronization interface signals per ITU-T G.703
- Differential reference inputs (IN3 to IN8) accept clock frequencies between 1 PPS and 650 MHz
- Single ended inputs (IN9 to IN14) accept reference clock frequencies between 1 PPS and 162.5 MHz
- Loss of Signal (LOS) pins (LOS0 to LOS3) can be assigned to any clock reference input
- Reference monitors qualify/disqualify references depending on activity, frequency and LOS pins
- Automatic reference selection state machines select the active reference for each DPLL based on the reference monitors, priority tables, revertive and non-revertive settings and other programmable settings
- Fractional-N input dividers enable the DPLLs to lock to a wide range of reference clock frequencies including: 10/100/1000 Ethernet, 10G/40G/100G Ethernet, OTN, SONET/SDH, PDH, TDM, GSM, CPRI and GNSS frequencies
- Any reference input (IN3 to IN14) can be designated as external sync pulse inputs (1 PPS, 2 kHz, 4 kHz or 8 kHz) associated with a selectable reference clock input
- DPLL1 or DPLL3 can be connected to an internal composite clock generator that outputs its 64 kHz synchronization signal on OUT8
- Differential outputs OUT3 to OUT6 output clocks with frequencies between 1 PPS and 650 MHz
- Differential outputs OUT11 and OUT12 output clocks with frequencies up to 650 MHz
- Single ended outputs OUT1, OUT2 and OUT7 output clocks with frequencies between 1 PPS and 125 MHz
- Single ended outputs OUT9 and OUT10 output clocks  $N \times 8$  kHz multiples up to 100 MHz
- DPLL1 and DPLL2 support independent programmable delays for each of IN3 to IN14; the delay for each input is programmable in steps of 0.61 ns with a range of  $\sim \pm 78$  ns
- The input to output phase delay of DPLL1 and DPLL2 is programmable in steps of 0.0745 ps with a total range of  $\pm 20$   $\mu$ s
- The clock phase of each of the output dividers for OUT1 (from APLL1) to OUT7 is individually programmable in steps of  $\sim 200$  ps with a total range of  $\pm 180^\circ$
- 1149.1 JTAG Boundary Scan
- 144-pin CABGA green package

## APPLICATIONS

- Access routers, edge routers, core routers
- Carrier Ethernet switches
- Multiservice access platforms
- PON OLT
- LTE eNodeB
- IEEE 1588 / PTP Telecom Profile clock synthesizer
- ITU-T G.8273.2 Telecom Boundary Clock (T-BC) and Telecom Time Slave Clock (T-TSC)
- ITU-T G.8264 Synchronous Equipment Timing Source (SETS)
- ITU-T G.8263 Packet-based Equipment Clock (PEC)
- ITU-T G.8262 Synchronous Ethernet Equipment Clock (EEC)
- ITU-T G.813 Synchronous Equipment Clock (SEC)
- Telcordia GR-253-CORE Stratum 3 Clock (S3) and SONET Minimum Clock (SMC)

## DESCRIPTION

The 82P33831 Synchronization Management Unit (SMU) provides tools to manage timing references, clock sources and timing paths for IEEE 1588 / Precision Time Protocol (PTP) and Synchronous Ethernet (SyncE) based clocks. The device supports up to three independent timing paths that control: PTP clock synthesis; SyncE clock generation; and general purpose frequency translation. The device supports physical layer timing with Digital PLLs (DPLLs) and it supports packet based timing with Digitally Controlled Oscillators (DCOs). Input-to- input, input-to-output and output-to-output phase skew can all be precisely managed. The device outputs low-jitter clocks that can directly synchronize 100GBASE-R, 40GBASE-R, 10GBASE-R and 10GBASE-W and lower-rate Ethernet interfaces; as well as CPRI/OBSAI, SONET/SDH and PDH interfaces and IEEE 1588 Time Stamp Units (TSUs).

The 82P33831 accepts six differential reference inputs and six single ended reference inputs that can operate at common GNSS, Ethernet, SONET/SDH and PDH frequencies that range in frequency from 1 Pulse Per Second (PPS) to 650 MHz. The device also provides two Alternate Mark Inversion (AMI) inputs for Composite Clock (CC) signals bearing 64 kHz, 8 kHz and 0.4 kHz synchronization information. The references are continually monitored for loss of signal and for frequency offset per user programmed thresholds. All of the references are available to all three DPLLs. The active reference for each DPLL is determined by forced selection or by automatic selection based on user programmed priorities and locking allowances and based on the reference monitors and LOS inputs.

The 82P33831 can accept a clock reference and an associated phase locked sync signal as a pair. DPLL1 or DPLL2 can lock to the clock reference and align the frame sync and multi-frame sync outputs with the paired sync input. The device allows any of the differential or single ended reference inputs to be configured as sync inputs that can be associated with any of the other differential or single ended reference inputs. The input sync signals can have a frequency of 1 PPS, 2 kHz, 4 kHz or 8 kHz. This feature enables DPLL1 or DPLL2 to phase align its frame sync and multi-frame sync outputs with a sync input without the need use a low bandwidth setting to lock directly to the sync input.

DPLL1 and DPLL2 support four primary operating modes: Free-Run, Locked, Holdover and DCO. In Free-Run mode the DPLLs synthesize clocks based on the system clock alone. In Locked mode the DPLLs filter reference clock jitter with the selected bandwidth. In Locked mode, the long-term output frequency accuracy is the same as the long term frequency accuracy of the selected input reference. In Holdover mode, the DPLL uses frequency data acquired while in Locked mode to generate accurate frequencies when input references are not available. In DCO mode the DPLL control loop is opened and the DCO can be controlled by a PTP clock recovery servo running on an external processor to synthesize PTP clocks.

The 82P33831 requires a system clock for its reference monitors and other digital circuitry. The frequency accuracy of the system clock determines the frequency accuracy of the DPLLs in Free-Run mode. The frequency stability of the system clock determines the frequency stability of the DPLLs in Free-Run mode and in Holdover mode; and it affects the wander generation of the DPLLs in Locked and DCO modes.

When used with a suitable system clock, DPLL1 and DPLL2 meet the frequency accuracy, pull-in, hold-in, pull-out, noise generation, noise tolerance, transient response, and holdover performance requirements of the following applications: ITU-T G.8262/G.813 EEC/SEC options 1 and 2, ITU-T G.8263, ITU-T G.8273.2, Telcordia GR-1244 Stratum 3 (S3), Telcordia GR-253-CORE Stratum 3 (S3) and SONET Minimum Clock (SMC).

DPLL1 and DPLL2 can be configured with a range of selectable filtering bandwidths from 0.09 mHz to 567 Hz. The 17 mHz bandwidth can be used to lock the DPLL directly to a 1 PPS reference. The 69 mHz and the 92 mHz bandwidths can be used for G.8273.2. The 92 mHz bandwidth can be used for G.8262/G.813 Option 2 or Telcordia GR-253-CORE S3 or SMC applications. The bandwidths in the range 1.1 Hz to 8.9 Hz can be used for G.8262/G.813 Option 1 applications. Bandwidths above 10 Hz can be used in jitter attenuation and rate conversion applications.

DPLL1 and DPLL2 are each connected to Time of Day (ToD) counters or time accumulators; these ToD counters/time accumulators can be used to track differences between the two time domains and to time-stamp external events by using reference inputs as triggers.

DPLL3 supports three primary operation modes: Free-Run, Locked and Holdover. DPLL3 is a wideband (BW > 25Hz) frequency translator that can be used, for example, to convert a recovered line clock to a 1.544 MHz or 2.048 MHz synchronization interface clock.

In Telecom Boundary Clock (T-BC) and Telecom Time Slave Clock (T-TSC) applications per ITU-T G.8275.2, DPLL1 and DPLL2 are both used; one DPLL is configured as a DCO to synthesize PTP clocks and the other DPLL is configured as an EEC/SEC to generate physical layer clocks. Combo mode provides physical layer frequency support from the EEC/SEC to the PTP clock.

In Synchronous Equipment Timing Source (SETS) applications per ITU-T G.8264, DPLL1 or DPLL2 can be configured as an EEC/SEC to output clocks for the T0 reference point and DPLL3 can be used to output clocks for the T4 reference point.

Clocks generated by DPLL1 or DPLL2 can be passed through APLL1 or APLL2 which are LC based jitter attenuating Analog PLLs (APLLs). The output clocks generated by APLL1 and APLL2 are suitable for serial GbE and lower rate interfaces.

Clocks generated by DPLL1 or DPLL2 can be passed through APLL3 which is a voltage controlled crystal oscillator (VCXO) based jitter attenuating APLL. APLL3 can be provisioned with one or two selectable crystal resonators to support up to two base frequencies. The output clocks generated by APLL3 are suitable for multi-lane 100GBASE-R, 40GBASE-R and lower rate interfaces.

The device provides an AMI output for a CC signal bearing 64 kHz, 8 kHz and 0.4 kHz synchronization information. The CC output can be connected to either DPLL1 or DPLL3.

All 82P33831 control and status registers are accessed through an I2C slave microprocessor interface. For configuring the DPLLs, APLL1 and APLL2, the I2C master interface can automatically load a configuration from an external EEPROM after reset. APLL3 must be configured via the I2C slave interface.

FUNCTIONAL BLOCK DIAGRAM

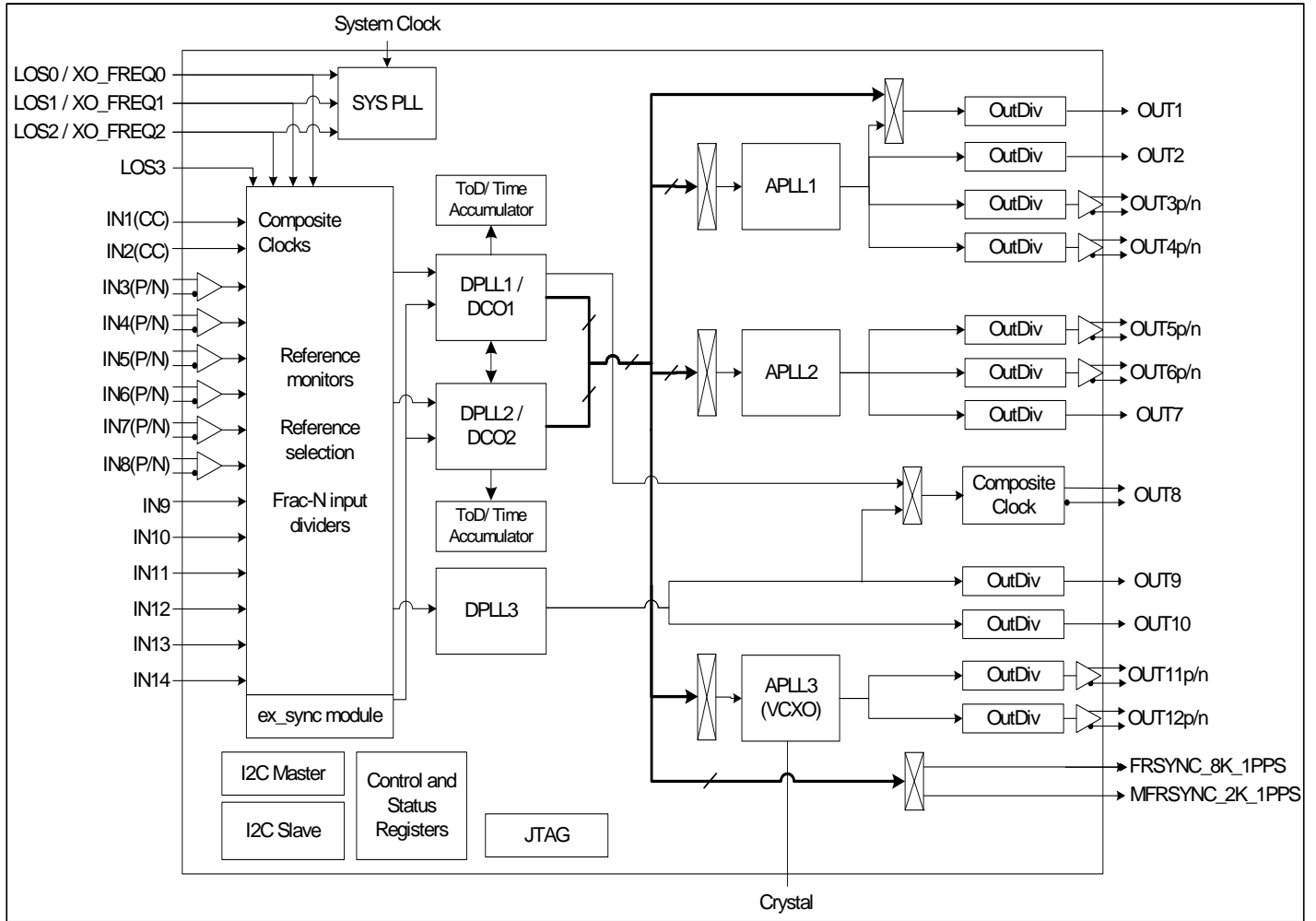


Figure 1. Functional Block Diagram

# 1 PIN ASSIGNMENT

|   | 1             | 2             | 3        | 4        | 5        | 6         | 7     | 8         | 9           | 10        | 11                 | 12              |   |
|---|---------------|---------------|----------|----------|----------|-----------|-------|-----------|-------------|-----------|--------------------|-----------------|---|
| A | OUT5_POS      | OUT5_NEG      | OUT6_POS | OUT6_NEG | VDDAO    | OUT12_POS | VDDAO | OUT11_POS | CAP2        | XTAL2_IN  | SONET/SDH/LOS3     | XTAL1_IN        | A |
| B | VSSAO         | VDDAO         | VDDAO    | VSSAO    | VSSAO    | OUT12_NEG | VSSAO | OUT11_NEG | VSSA        | XTAL2_OUT | MPU_MODE1/I2CM_SCL | XTAL1_OUT       | B |
| C | VDDA          | VSSA          | VSS      | OUT7     | I2C_SDA  | VDDA      | VDDA  | IC        | CAP1        | IC        | MPU_MODE0/I2CM_SDA | MFRSYNC_2K_1PPS | C |
| D | VSSA          | VDDA          | VSSCOM   | VSSD     | VDDD     | VSSA      | VSSA  | CAP3      | I2C_AD2     | I2C_SCL   | OUT10              | OUT9            | D |
| E | OSCI          | VSSA          | IC       | VDDDO    | I2C_AD1  | VDDDO     | VSSDO | VSSA      | DPPLL3_LOCK | IN14      | IN13               | FRSYNC_8K_1PPS  | E |
| F | TMS           | VDDA          | VSSA     | VSSDO    | VSS      | VSSD      | VDDD  | VSSA      | VDDA        | IN12      | IN8_NEG            | IN8_POS         | F |
| G | TCK           | VDDA          | IC       | VSS      | VSS      | VSS       | IC    | VSS       | DPPLL2_LOCK | IN11      | IN7_NEG            | IN7_POS         | G |
| H | XO_FREQ0/LOS0 | VDDA          | VSSA     | VSS      | VSS      | VSS       | VSS   | VSS       | DPPLL1_LOCK | IN10      | VSSD               | VDDD_1_8        | H |
| J | XO_FREQ1/LOS1 | XO_FREQ2/LOS2 | VSS      | VSS      | VSS      | VSS       | VSS   | VSS       | INT_REQ     | IN9       | IN6_NEG            | IN6_POS         | J |
| K | VDDA          | VDDA          | TRSTB    | VSSAO    | OUT2     | RSTB      | VSSDO | MS_SL     | IN2         | IN1       | IN5_NEG            | IN5_POS         | K |
| L | VSSA          | VSSA          | TDI      | VDDAO    | TDO      | IC        | VDDDO | OUT1      | VSSD        | VDDD_1_8  | IN4_NEG            | IN4_POS         | L |
| M | OUT4_POS      | OUT4_NEG      | VSSAO    | VDDAO    | OUT3_POS | OUT3_NEG  | VSSDO | VDDDO     | OUT8_POS    | OUT8_NEG  | IN3_NEG            | IN3_POS         | M |
|   | 1             | 2             | 3        | 4        | 5        | 6         | 7     | 8         | 9           | 10        | 11                 | 12              |   |

**Figure 2. Pin Assignment (Top View)**

## 2 PIN DESCRIPTION

**Table 1: Pin Description**

| Pin No.   | Name  | I/O            | Type      | Description   |     |        |     |        |     |        |     |        |     |        |     |        |     |        |     |        |
|---|---|----------------|-----------|---|-----|--------|-----|--------|-----|--------|-----|--------|-----|--------|-----|--------|-----|--------|-----|--------|
| <b>Global Control Signal</b>                              |   |                |           |   |     |        |     |        |     |        |     |        |     |        |     |        |     |        |     |        |
| E1  | OSCI  | I              | CMOS      | <b>OSCI: Crystal Oscillator System Clock</b><br>A clock provided by a crystal oscillator is input on this pin. It is the system clock for the device. The oscillator frequency is selected via pins XO_FREQ0 ~ XO_FREQ2.  |     |        |     |        |     |        |     |        |     |        |     |        |     |        |     |        |
| K8  | MS/SL   | I<br>pull-up   | CMOS      | <b>MS/SL: Master / Slave Selection</b><br>This pin, together with the MS_SL_CTRL bit, controls whether the device is configured as the Master or as the Slave. The signal level on this pin is reflected by the MASTER_SLAVE bit.   |     |        |     |        |     |        |     |        |     |        |     |        |     |        |     |        |
| A11   | SONET/SDH/<br>LOS3  | I<br>pull-down | CMOS      | <b>SONET/SDH: SONET / SDH Frequency Selection</b><br>During reset, this pin determines the default value of the IN_SONET_SDH bit (b2, 09H):<br>High: The default value of the IN_SONET_SDH bit is '1' (SONET);<br>Low: The default value of the IN_SONET_SDH bit is '0' (SDH).<br>After reset, this pin takes on the operation of LOS3.<br><b>LOS3</b> - This pin is used to disqualify input clocks. See input clocks section for more details.  |     |        |     |        |     |        |     |        |     |        |     |        |     |        |     |        |
| K6  | RSTB  | I<br>pull-up   | CMOS      | <b>RSTB: Reset</b><br>Refer to section 2.2 reset operation for detail.  |     |        |     |        |     |        |     |        |     |        |     |        |     |        |     |        |
| H1<br>J1<br>J2  | XO_FREQ0/<br>LOS0<br>XO_FREQ1/<br>LOS1<br>XO_FREQ2/<br>LOS2 | I<br>pull-down | CMOS      | <b>XO_FREQ0 ~ XO_FREQ2: These pins set the oscillator frequency.</b><br><b>XO_FREQ[2:0] Oscillator Frequency (MHz)</b><br><table style="margin-left: 20px;"> <tr><td>000</td><td>10.000</td></tr> <tr><td>001</td><td>12.800</td></tr> <tr><td>010</td><td>13.000</td></tr> <tr><td>011</td><td>19.440</td></tr> <tr><td>100</td><td>20.000</td></tr> <tr><td>101</td><td>24.576</td></tr> <tr><td>110</td><td>25.000</td></tr> <tr><td>111</td><td>30.720</td></tr> </table><br><b>LOS0 ~ LOS2</b> - These pins are used to disqualify input clocks. See input clocks section for more details. After reset, these pins take on the operation of LOS0-2. | 000 | 10.000 | 001 | 12.800 | 010 | 13.000 | 011 | 19.440 | 100 | 20.000 | 101 | 24.576 | 110 | 25.000 | 111 | 30.720 |
| 000   | 10.000  |                |           |   |     |        |     |        |     |        |     |        |     |        |     |        |     |        |     |        |
| 001   | 12.800  |                |           |   |     |        |     |        |     |        |     |        |     |        |     |        |     |        |     |        |
| 010   | 13.000  |                |           |   |     |        |     |        |     |        |     |        |     |        |     |        |     |        |     |        |
| 011   | 19.440  |                |           |   |     |        |     |        |     |        |     |        |     |        |     |        |     |        |     |        |
| 100   | 20.000  |                |           |   |     |        |     |        |     |        |     |        |     |        |     |        |     |        |     |        |
| 101   | 24.576  |                |           |   |     |        |     |        |     |        |     |        |     |        |     |        |     |        |     |        |
| 110   | 25.000  |                |           |   |     |        |     |        |     |        |     |        |     |        |     |        |     |        |     |        |
| 111   | 30.720  |                |           |   |     |        |     |        |     |        |     |        |     |        |     |        |     |        |     |        |
| <b>Input Clock and Frame Synchronization Input Signal</b> |   |                |           |   |     |        |     |        |     |        |     |        |     |        |     |        |     |        |     |        |
| K10   | IN1   | I              | AMI       | <b>IN1: Input Clock 1</b><br>A 64 kHz + 8 kHz or 64 kHz + 8 kHz + 0.4 kHz composite clock is input on this pin. AMI input has internal 1k ohm to 1.5V termination.  |     |        |     |        |     |        |     |        |     |        |     |        |     |        |     |        |
| K9  | IN2   | I              | AMI       | <b>IN2: Input Clock 2</b><br>A 64 kHz + 8 kHz or 64 kHz + 8 kHz + 0.4 kHz composite clock is input on this pin. AMI input has internal 1k ohm to 1.5V termination.  |     |        |     |        |     |        |     |        |     |        |     |        |     |        |     |        |
| M12<br>M11  | IN3_POS<br>IN3_NEG  | I              | PECL/LVDS | <b>IN3_POS / IN3_NEG: Positive / Negative Input Clock 3</b><br>A reference clock is input on this pin. This pin can also be used as a sync input, and in this case a 2 kHz, 4 kHz, 8 kHz, or 1PPS signal can be input on this pin.  |     |        |     |        |     |        |     |        |     |        |     |        |     |        |     |        |
| L12<br>L11  | IN4_POS<br>IN4_NEG  | I              | PECL/LVDS | <b>IN4_POS / IN4_NEG: Positive / Negative Input Clock 4</b><br>A reference clock is input on this pin. This pin can also be used as a sync input, and in this case a 2 kHz, 4 kHz, 8 kHz, or 1PPS signal can be input on this pin.  |     |        |     |        |     |        |     |        |     |        |     |        |     |        |     |        |
| K12<br>K11  | IN5_POS<br>IN5_NEG  | I              | PECL/LVDS | <b>IN5_POS / IN5_NEG: Positive / Negative Input Clock 5</b><br>A reference clock is input on this pin. This pin can also be used as a sync input, and in this case a 2 kHz, 4 kHz, 8 kHz, or 1PPS signal can be input on this pin.  |     |        |     |        |     |        |     |        |     |        |     |        |     |        |     |        |
| J12<br>J11  | IN6_POS<br>IN6_NEG  | I              | PECL/LVDS | <b>IN6_POS / IN6_NEG: Positive / Negative Input Clock 6</b><br>A reference clock is input on this pin. This pin can also be used as a sync input, and in this case a 2 kHz, 4 kHz, 8 kHz, or 1PPS signal can be input on this pin.  |     |        |     |        |     |        |     |        |     |        |     |        |     |        |     |        |
| G12<br>G11  | IN7_POS<br>IN7_NEG  | I              | PECL/LVDS | <b>IN7_POS / IN7_NEG: Positive / Negative Input Clock 7</b><br>A reference clock is input on this pin. This pin can also be used as a sync input, and in this case a 2 kHz, 4 kHz, 8 kHz, or 1PPS signal can be input on this pin.  |     |        |     |        |     |        |     |        |     |        |     |        |     |        |     |        |
| F12<br>F11  | IN8_POS<br>IN8_NEG  | I              | PECL/LVDS | <b>IN8_POS / IN8_NEG: Positive / Negative Input Clock 8</b><br>A reference clock is input on this pin. This pin can also be used as a sync input, and in this case a 2 kHz, 4 kHz, 8 kHz, or 1PPS signal can be input on this pin.  |     |        |     |        |     |        |     |        |     |        |     |        |     |        |     |        |

Table 1: Pin Description (Continued)

| Pin No.                                    | Name                   | I/O            | Type      | Description  |
|--|------------------------|----------------|-----------|--|
| J10  | IN9                    | I<br>pull-down | CMOS      | <b>IN9: Input Clock 9</b><br>A reference clock is input on this pin. This pin can also be used as a sync input, and in this case a 2 kHz, 4 kHz, 8 kHz, or 1PPS signal can be input on this pin.   |
| H10  | IN10                   | I<br>pull-down | CMOS      | <b>IN10: Input Clock 10</b><br>A reference clock is input on this pin. This pin can also be used as a sync input, and in this case a 2 kHz, 4 kHz, 8 kHz, or 1PPS signal can be input on this pin. |
| G10  | IN11                   | I<br>pull-down | CMOS      | <b>IN11: Input Clock 11</b><br>A reference clock is input on this pin. This pin can also be used as a sync input, and in this case a 2 kHz, 4 kHz, 8 kHz, or 1PPS signal can be input on this pin. |
| F10  | IN12                   | I<br>pull-down | CMOS      | <b>IN12: Input Clock 12</b><br>A reference clock is input on this pin. This pin can also be used as a sync input, and in this case a 2 kHz, 4 kHz, 8 kHz, or 1PPS signal can be input on this pin. |
| E11  | IN13                   | I<br>pull-down | CMOS      | <b>IN13: Input Clock 13</b><br>A reference clock is input on this pin. This pin can also be used as a sync input, and in this case a 2 kHz, 4 kHz, 8 kHz, or 1PPS signal can be input on this pin. |
| E10  | IN14                   | I<br>pull-down | CMOS      | <b>IN14: Input Clock 14</b><br>A reference clock is input on this pin. This pin can also be used as a sync input, and in this case a 2 kHz, 4 kHz, 8 kHz, or 1PPS signal can be input on this pin. |
| <b>Output Frame Synchronization Signal</b> |                        |                |           |  |
| E12  | FRSYNC_8K_1PPS         | O              | CMOS      | <b>FRSYNC_8K_1PPS: 8 kHz Frame Sync Output</b><br>An 8 kHz signal or a 1PPS sync signal is output on this pin.   |
| C12  | MFRSYNC_2K_1PPS        | O              | CMOS      | <b>MFRSYNC_2K_1PPS: 2 kHz Multiframe Sync Output</b><br>A 2 kHz signal or a 1PPS sync signal is output on this pin.  |
| <b>Output Clock</b>                        |                        |                |           |  |
| L8<br>K5                                   | OUT1<br>OUT2           | O              | CMOS      | <b>OUT1 ~ OUT2: Output Clock 1 ~ 2</b>   |
| M5<br>M6                                   | OUT3_POS<br>OUT3_NEG   | O              | PECL/LVDS | <b>OUT3_POS / OUT3_NEG: Positive / Negative Output Clock 3</b><br>This output is set to LVDS by default. The LVDS output has internal 100 ohm termination.   |
| M1<br>M2                                   | OUT4_POS<br>OUT4_NEG   | O              | PECL/LVDS | <b>OUT4_POS / OUT4_NEG: Positive / Negative Output Clock 4</b><br>This output is set to LVDS by default. The LVDS output has internal 100 ohm termination.   |
| A1<br>A2                                   | OUT5_POS<br>OUT5_NEG   | O              | PECL/LVDS | <b>OUT5_POS / OUT5_NEG: Positive / Negative Output Clock 5</b><br>This output is set to LVDS by default. The LVDS output has internal 100 ohm termination.   |
| A3<br>A4                                   | OUT6_POS<br>OUT6_NEG   | O              | PECL/LVDS | <b>OUT6_POS / OUT6_NEG: Positive / Negative Output Clock 6</b><br>This output is set to LVDS by default. The LVDS output has internal 100 ohm termination.   |
| C4   | OUT7                   | O              | CMOS      | <b>OUT7: Output Clock 7</b>  |
| M9<br>M10                                  | OUT8_POS<br>OUT8_NEG   | O              | AMI       | <b>OUT8_POS / OUT8_NEG: Positive / Negative Output Composite Clock</b><br>A 64 kHz + 8 kHz or 64 kHz + 8 kHz + 0.4 kHz composite clock is differentially output on this pair of pins.              |
| D12  | OUT9                   | O              | CMOS      | <b>OUT9: Output Clock 9</b>  |
| D11  | OUT10                  | O              | CMOS      | <b>OUT10: Output Clock 10</b>  |
| A8<br>B8                                   | OUT11_POS<br>OUT11_NEG | O              | PECL/LVDS | <b>OUT11_POS / OUT11_NEG: Positive / Negative Output Clock 11</b>  |
| A6<br>B6                                   | OUT12_POS<br>OUT12_NEG | O              | PECL/LVDS | <b>OUT12_POS / OUT12_NEG: Positive / Negative Output Clock 12</b>  |
| <b>Miscellaneous</b>                       |                        |                |           |  |
| C9, A9, D8                                 | CAP1, CAP2,<br>CAP3    |                |           | <b>CAP1, CAP2 and CAP3: Analog Power Filter Capacitor connection 1 to 3.</b> These capacitors are be part of the power filtering.  |
| A12  | XTAL1_IN               | I              | Analog    | <b>Crystal oscillator 1 input.</b><br>Determines first of two frequency families (Sonet/SDH, Ethernet or Ethernet*66/64) available for APLL3. Connect to ground if XTAL1 is not used.              |



Table 1: Pin Description (Continued)

| Pin No.                         | Name   | I/O            | Type                | Description  |
|---------------------------------|--|----------------|---------------------|--|
| B12                             | XTAL1_OUT  | O              | Analog              | Crystal oscillator 1 output.<br>Leave open if XTAL1 is not used.   |
| A10                             | XTAL2_IN   | I              | Analog              | Crystal oscillator 2 input.<br>Determines first of two frequency families (chosen from Sonet/SDH, Ethernet or Ethernet*66/64) available for APLL3. Connect to ground if XTAL2 is not used  |
| B10                             | XTAL2_OUT  | O              | Analog              | Crystal oscillator 2 output.<br>Leave open if XTAL2 is not used.   |
| <b>Lock Signal</b>              |  |                |                     |  |
| E9                              | DPLL3_LOCK   | O              | CMOS                | DPLL3_LOCK<br>This pin goes high when DPLL3 is locked  |
| G9                              | DPLL2_LOCK   | O              | CMOS                | DPLL2_LOCK<br>This pin goes high when DPLL2 is locked  |
| H9                              | DPLL1_LOCK   | O              | CMOS                | DPLL1_LOCK<br>This pin goes high when DPLL1 is locked  |
| <b>Microprocessor Interface</b> |  |                |                     |  |
| J9                              | INT_REQ  | O<br>Tri-state | CMOS                | INT_REQ: Interrupt Request<br>This pin is used as an interrupt request.  |
| B11<br>C11                      | MPU_MODE1/<br>I2CM_SCL<br><br>MPU_MODE0/<br>I2CM_SDA | I/O<br>pull-up | CMOS/<br>Open Drain | MPU_MODE[1:0]: Microprocessor Interface Mode Selection<br>During reset, these pins determine the default value of the MPU_SEL_CNFG[1:0] bits as follows:<br>00: I2C mode<br>01 ~ 10: Reserved<br>11: I2C master (EEPROM) mode<br>I2CM_SCL: Serial Clock Line<br>In I2C master mode, the serial clock is output on this pin.<br>I2CM_SDA: Serial Data Input for I2C Master Mode<br>In I2C master mode, this pin is used as the for the serial data. |
| D9                              | I2C_AD2  | I<br>pull-down | CMOS                | I2C_AD2: Device Address Bit 2<br>I2C_AD[2:1] pins are the address bus of the microprocessor interface.   |
| E5                              | I2C_AD1  | I<br>pull-down | CMOS                | I2C_AD1: Device Address Bit 1<br>I2C_AD[2:1] pins are the address bus of the microprocessor interface.   |
| D10                             | I2C_SCL  | I              | CMOS                | I2C_SCL: Serial Clock Line<br>The serial clock is input on this pin.   |
| C5                              | I2C_SDA  | I/O            | Open Drain          | I2C_SDA: Serial Data Input/Output<br>This pin is used as the input/output for the serial data.   |
| <b>JTAG (per IEEE 1149.1)</b>   |  |                |                     |  |
| F1                              | TMS  | I<br>pull-up   | CMOS                | TMS: JTAG Test Mode Select<br>The signal on this pin controls the JTAG test performance and is sampled on the rising edge of TCK.  |
| K3                              | TRSTB  | I<br>pull-up   | CMOS                | TRSTB: JTAG Test Reset (Active Low)<br>A low signal on this pin resets the JTAG test port.<br>This pin should be connected to ground when JTAG is not used.  |
| G1                              | TCK  | I<br>pull-down | CMOS                | TCK: JTAG Test Clock<br>The clock for the JTAG test is input on this pin. TDI and TMS are sampled on the rising edge of TCK and TDO is updated on the falling edge of TCK.<br>If TCK is idle at a low level, all stored-state devices contained in the test logic will indefinitely retain their state.  |
| L3                              | TDI  | I<br>pull-up   | CMOS                | TDI: JTAG Test Data Input<br>The test data are input on this pin. They are clocked into the device on the rising edge of TCK.  |



Table 1: Pin Description (Continued)

| Pin No.  | Name     | I/O            | Type | Description  |
|--|----------|----------------|------|--|
| L5   | TDO      | O<br>tri-state | CMOS | <b>TDO: JTAG Test Data Output</b><br>The test data are output on this pin. They are clocked out of the device on the falling edge of TCK.<br>TDO pin outputs a high impedance signal except during the process of data scanning. |
| <b>Power &amp; Ground</b>  |          |                |      |  |
| C1, C6, C7, D2, F2, F9, G2, H2, K1, K2                             | VDDA     | Power          | -    | VDDA: Analog Core Power - +3.3V DC nominal   |
| A5, A7, B2, B3, L4, M4   | VDDAO    | Power          |      | VDDAO: Analog Output Power - +3.3V DC nominal  |
| E4, E6, L7, M8   | VDDDO    | Power          |      | VDDDO: Digital Output Power - +3.3V DC nominal   |
| D5, F7   | VDDD     | Power          |      | VDDD: Digital Core Power - +3.3V DC nominal  |
| L10, H12   | VDDD_1_8 | Power          |      | VDDD_1_8: Digital Core Power - +1.8V DC nominal  |
| B9, C2, D1, D6, D7, E2, E8, F3, F8, H3, L1, L2                     | VSSA     | Ground         | -    | VSSA: Ground   |
| B1, B4, B5, B7, K4, M3   | VSSAO    | Ground         |      | VSSAO: Ground  |
| E7, F4, K7, M7   | VSSDO    | Ground         |      | VSSDO: Ground  |
| D4, F6, H11, L9  | VSSD     | Ground         |      | VSSD: Ground   |
| D3   | VSSCOM   | Ground         | -    | VSSCOM: Ground   |
| C3, F5, G4, G5, G6, G8, H4, H5, H6, H7, H8, J3, J4, J5, J6, J7, J8 | VSS      | Ground         | -    | VSS: Ground  |
| <b>Other</b>   |          |                |      |  |
| C8, C10, E3, G3, G7, L6  | IC       | -              | -    | IC: Internal Connection<br>Internal Use. This pin must be left open for normal operation.  |

## 2.1 RECOMMENDATIONS FOR UNUSED INPUT AND OUTPUT PINS

### 2.1.1 INPUTS

#### Control Pins

All control pins have internal pull-ups or pull-downs; additional resistance is not required but can be added for additional protection. A 1k $\Omega$  resistor can be used.

#### Single-Ended Clock Inputs

For protection, unused single-ended clock inputs should be tied to ground.

#### Differential Clock Inputs

For applications not requiring the use of a differential input, both \*\_POS and \*\_NEG can be left floating. Though not required, but for additional protection, a 1k $\Omega$  resistor can be tied from \_POS to ground.

#### XTAL Inputs

For applications not requiring the use of a crystal oscillator input, both \_IN and \_OUT can be left floating. Though not required, but for additional protection, a 1k $\Omega$  resistor can be tied from \_IN to ground.

### 2.1.2 OUTPUTS

#### Status Pins

For applications not requiring the use of a status pin, we recommend bringing out to a test point for debugging purposes.

#### Single-Ended Clock Outputs

All unused single-ended clock outputs can be left floating, or can be brought out to a test point for debugging purposes.

#### Differential Clock Outputs

All unused differential outputs can be left floating. We recommend that there is no trace attached. Both sides of the differential output pair should either be left floating or terminated.

### 3 PACKAGE DIMENSIONS

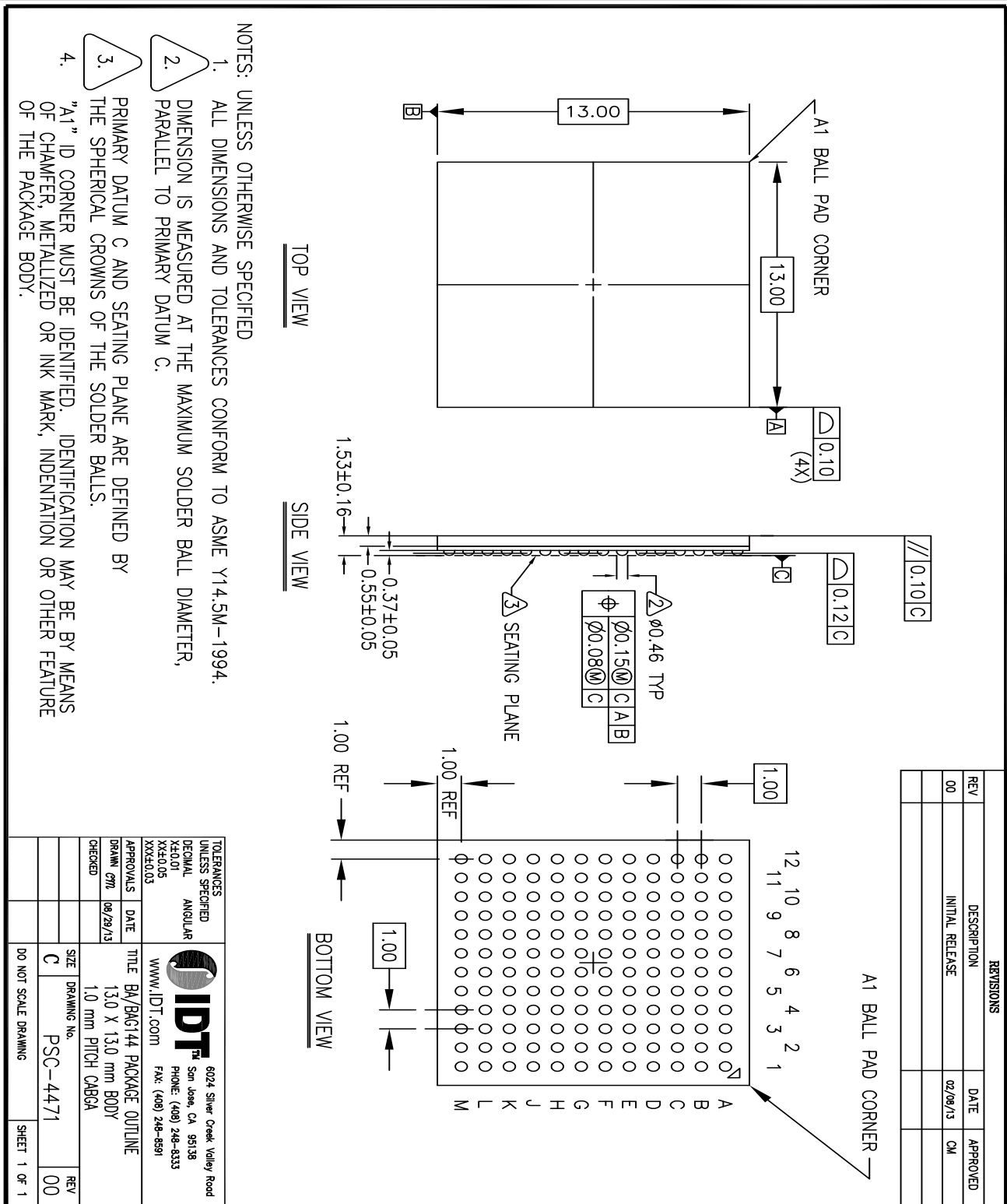
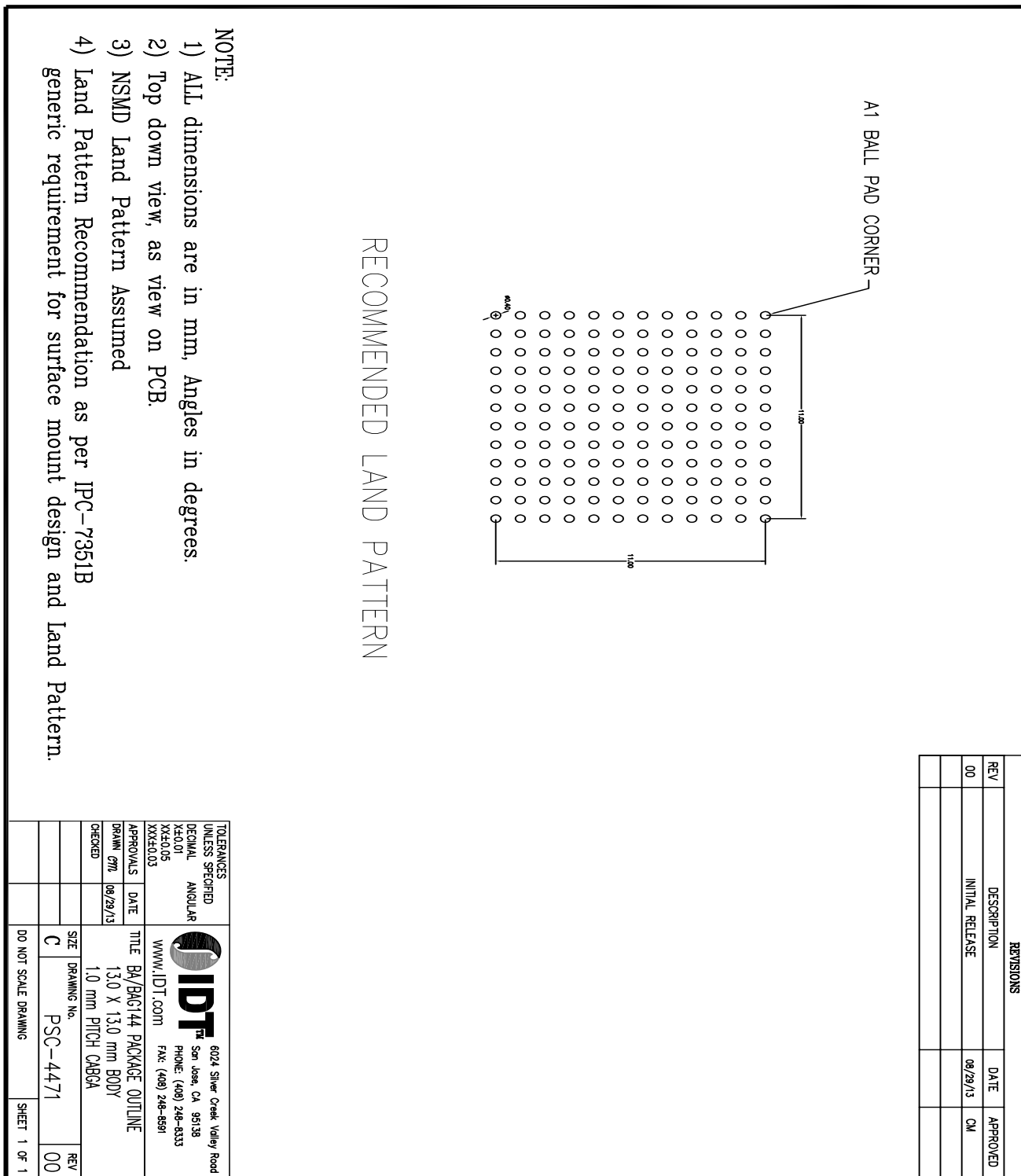


Figure 3. 144-Pin BAG Package Dimensions



**Figure 4. 144-Pin BAG Package Recommended Land Pattern**

## ORDERING INFORMATION

Table 2: Ordering Information

| Part/Order Number | Package                     | Shipping Packaging | Temperature   |
|-------------------|-----------------------------|--------------------|---------------|
| 82P33831ABAG      | 144-pin CABGA green package | Tray               | -40° to +85°C |
| 82P33831ABAG8     | 144-pin CABGA green package | Tape & Reel        | -40° to +85°C |

"G" after the two-letter package code denotes Pb-Free configuration, RoHS compliant.



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