

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

- Synchronous Equipment Timing Source (SETS) for Synchronous Ethernet (SyncE) per ITU-T G.8264
- DPLL1 generates ITU-T G.8262 compliant SyncE clocks, Telcordia GR-1244-CORE/GR-253-CORE, and ITU-T G.813 compliant SONET/SDH clocks
- DPLL2 performs rate conversions for 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 and 40GBASE-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

## 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 Ethernet, OTN, SONET/SDH, PDH, TDM, GSM, CPRI, and GNSS frequencies
- Any reference inputs (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
- 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 can be configured with bandwidths between 0.09 mHz and 567 Hz
- DPLL1 locks to input references with frequencies between 1 PPS and 650 MHz
- DPLL2 locks to input references with frequencies between 8 kHz and 650 MHz
- DPLL1 complies with ITU-T G.8262 for Synchronous Ethernet Equipment Clock (EEC), and G.813 for Synchronous Equipment Clock

- (SEC); and Telcordia GR-253-CORE/ GR-1244-CORE for Stratum 3 and SONET Minimum Clock (SMC)
- DPLL1 generates clocks with PDH, TDM, GSM, CPRI/OBSAI, 10/100/1000 Ethernet and GNSS frequencies; these clocks are directly available on OUT1
- DPLL2 generates N x 8 kHz clocks up to 100 MHz that are output on OUT9 and OUT10
- APLL1, APLL2 and APLL3 are connected to DPLL1
- APLL1 and APLL2 generate 10/100/1000 Ethernet, 10G Ethernet, or SONET/SDH frequencies
- APLL3 generates 10G 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
- DPLLs 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\*8 kHz multiplies up to 100 MHz
- DPLL1 supports 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  $\pm 78$  ns
- The input to output phase delay of DPLL1 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
- ITU-T G.8264 Synchronous Equipment Timing Source (SETS)
- ITU-T G.8262 Synchronous Ethernet Equipment Clock (EEC)
- ITU-T G.813 Synchronous Equipment Clock (SEC)
- Telcordia GR-253-CORE/GR1244-CORE Stratum 3 Clock (S3) and SONET Minimum Clock (SMC)

## DESCRIPTION

The 82P33731 Synchronous Equipment Timing Source (SETS) for 10G Synchronous Ethernet (SyncE) provides tools to manage timing references, clock generation and timing paths for SyncE based clocks, per ITU-T G.8264 and ITU-T G.8262. 82P33731 meets the requirements of ITU-T G.8262 for synchronous Ethernet Equipment Clocks (EECs) and ITU-T G.813 for Synchronous Equipment Clocks (SEC). The device outputs low-jitter clocks that can directly synchronize 40GBASE-R, 10GBASE-R and 10GBASE-W and lower-rate Ethernet interfaces; as well as CPRI/OBSAI, SONET/SDH and PDH interfaces.

The 82P33731 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 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 both Digital PLLs (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 82P33731 can accept a clock reference and an associated phase locked sync signal as a pair. DPLL1 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 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.

The DPLLs support three primary operating modes: Free-Run, Locked and Holdover. 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.

The 82P33731 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 mode.

When used with a suitable system clock, DPLL1 meets the frequency accuracy, pull-in, hold-in, pullout, 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, Telcordia GR-1244 Stratum 3 (S3), Telcordia GR-253-CORE S3 and SONET Minimum Clock (SMC).

DPLL1 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 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. The bandwidth of 1.1 Hz or 2.2 Hz can be used for Telcordia GR-1244-CORE S3 applications. Bandwidths above 10 Hz can be used in jitter attenuation and rate conversion applications.

DPLL2 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.

For SETS applications per ITU-T G.8264, DPLL1 is configured as an EEC/SEC to output clocks for the T0 reference point and DPLL2 is used to output clocks for the T4 reference point.

Clocks generated by DPLL1 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 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 serial 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 82P33731 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

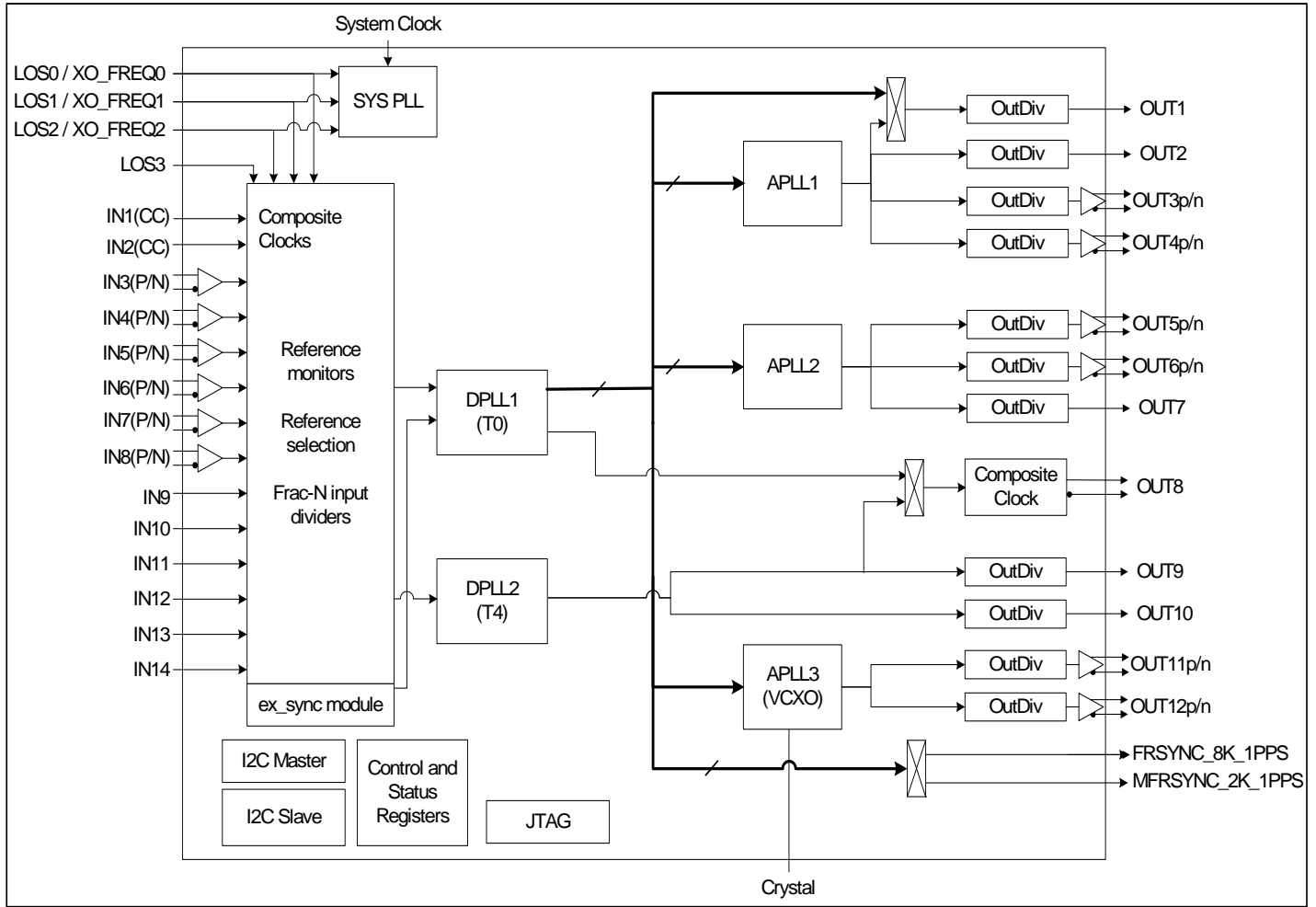


Figure 1. Functional Block Diagram

# 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	DPLL2_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	IC	IN11	IN7_NEG	IN7_POS	G
H	XO_FREQ0/LOS0	VDDA	VSSA	VSS	VSS	VSS	VSS	VSS	DPLL1_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> 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 pull-up	CMOS	<b>MS/SL: Master / Slave Selection</b> 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/ LOS3	I pull-down	CMOS	<b>SONET/SDH: SONET / SDH Frequency Selection</b> During reset, this pin determines the default value of the IN_SONET_SDH bit (b2, 09H): High: The default value of the IN_SONET_SDH bit is '1' (SONET); Low: The default value of the IN_SONET_SDH bit is '0' (SDH). After reset, this pin takes on the operation of LOS3 <b>LOS3</b> - This pin is used to disqualify input clocks. See input clocks section for more details.
K6	RSTB	I pull-up	CMOS	<b>RSTB: Reset</b> Refer to section 2.2 reset operation for detail.
H1 J1 J2	XO_FREQ0/ LOS0 XO_FREQ1/ LOS1 XO_FREQ2/ LOS2	I pull-down	CMOS	<b>XO_FREQ0 ~ XO_FREQ2:</b> These pins set the oscillator frequency. XO_FREQ[2:0] Oscillator Frequency (MHz) 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>LOS0 ~ LOS2</b> - These pins are used to disqualify input clocks. See input clocks section for more details. After reset, this pin takes on the operation of LOS0-LOS2
<b>Input Clock and Frame Synchronization Input Signal</b>				
K10	IN1	I	AMI	<b>IN1: Input Clock 1</b> 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. This pin can also be used as a frame pulse input, and in this case a 8 kHz signal can be input on this pin.
K9	IN2	I	AMI	<b>IN2: Input Clock 2</b> 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. This pin can also be used as a frame pulse input, and in this case a 8 kHz signal can be input on this pin.
M12 M11	IN3_POS IN3_NEG	I	PECL/LVDS	<b>IN3_POS / IN3_NEG: Positive / Negative Input Clock 3</b> 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 L11	IN4_POS IN4_NEG	I	PECL/LVDS	<b>IN4_POS / IN4_NEG: Positive / Negative Input Clock 4</b> 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 K11	IN5_POS IN5_NEG	I	PECL/LVDS	<b>IN5_POS / IN5_NEG: Positive / Negative Input Clock 5</b> 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 J11	IN6_POS IN6_NEG	I	PECL/LVDS	<b>IN6_POS / IN6_NEG: Positive / Negative Input Clock 6</b> 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 G11	IN7_POS IN7_NEG	I	PECL/LVDS	<b>IN7_POS / IN7_NEG: Positive / Negative Input Clock 7</b> 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
F12 F11	IN8_POS IN8_NEG	I	PECL/LVDS	<b>IN8_POS / IN8_NEG: Positive / Negative Input Clock 8</b> 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.
J10	IN9	I pull-down	CMOS	<b>IN9: Input Clock 9</b> 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 pull-down	CMOS	<b>IN10: Input Clock 10</b> 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 pull-down	CMOS	<b>IN11: Input Clock 11</b> 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 pull-down	CMOS	<b>IN12: Input Clock 12</b> 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 pull-down	CMOS	<b>IN13: Input Clock 13</b> 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 pull-down	CMOS	<b>IN14: Input Clock 14</b> 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> 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> A 2 kHz signal or a 1PPS sync signal is output on this pin.
<b>Output Clock</b>				
L8 K5	OUT1 OUT2	O	CMOS	<b>OUT1 ~ OUT2: Output Clock 1 ~ 2</b>
M5 M6	OUT3_POS OUT3_NEG	O	PECL/LVDS	<b>OUT3_POS / OUT3_NEG: Positive / Negative Output Clock 3</b> This output is set to LVDS by default.
M1 M2	OUT4_POS OUT4_NEG	O	PECL/LVDS	<b>OUT4_POS / OUT4_NEG: Positive / Negative Output Clock 4</b> This output is set to LVDS by default.
A1 A2	OUT5_POS OUT5_NEG	O	PECL/LVDS	<b>OUT5_POS / OUT5_NEG: Positive / Negative Output Clock 5</b> This output is set to LVDS by default.
A3 A4	OUT6_POS OUT6_NEG	O	PECL/LVDS	<b>OUT6_POS / OUT6_NEG: Positive / Negative Output Clock 6</b> This output is set to LVDS by default.
C4	OUT7	O	CMOS	<b>OUT7: Output Clock 7</b>
M9 M10	OUT8_POS OUT8_NEG	O	AMI	<b>OUT8_POS / OUT8_NEG: Positive / Negative Output Composite Clock</b> 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 B8	OUT11_POS OUT11_NEG	O	PECL	<b>OUT11_POS / OUT11_NEG: Positive / Negative Output Clock 11</b>
A6 B6	OUT12_POS OUT12_NEG	O	PECL	<b>OUT12_POS / OUT12_NEG: Positive / Negative Output Clock 12</b>
<b>Miscellaneous</b>				
C9, A9, D8	CAP1, CAP2, CAP3			<b>CAP1, CAP2 and CAP3: Analog Power Filter Capacitor connection 1 to 3.</b> These capacitors are part of the power filtering.

Table 1: Pin Description (Continued)

Pin No.	Name	I/O	Type	Description
A12	XTAL1_IN	I	Analog	<b>Crystal oscillator 1 input.</b> Determines first of two frequency families (Sonet/SDH, Ethernet or Ethernet*66/64) available for APLL3. Connect to ground if XTAL1 is not used.
B12	XTAL1_OUT	O	Analog	<b>Crystal oscillator 1 output.</b> Leave open if XTAL1 is not used.
A10	XTAL2_IN	I	Analog	<b>Crystal oscillator 2 input.</b> 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	<b>Crystal oscillator 2 output.</b> Leave open if XTAL2 is not used.
<b>Lock Signal</b>				
E9	DPLL2_LOCK	O	CMOS	DPLL2_LOCK This pin goes high when DPLL2 is locked
H9	DPLL1_LOCK	O	CMOS	DPLL1_LOCK This pin goes high when DPLL1 is locked
<b>Microprocessor Interface</b>				
J9	INT_REQ	O Tri-state	CMOS	<b>INT_REQ: Interrupt Request</b> This pin is used as an interrupt request.
B11 C11	MPU_MODE1/ I2CM_SCL  MPU_MODE0/ I2CM_SDA	I/O pull-down	CMOS/ Open Drain	<b>MPU_MODE[1:0]: Microprocessor Interface Mode Selection</b> During reset, these pins determine the default value of the MPU_SEL_CNFG[1:0] bits as follows: 00: I2C mode 01 ~ 10: Reserved 11: I2C master (EEPROM) mode <b>I2CM_SCL: Serial Clock Line</b> In I2C master mode, the serial clock is output on this pin. <b>I2CM_SDA: Serial Data Input for I2C Master Mode</b> In I2C master mode, this pin is used as the for the serial data.
D9	I2C_AD2	I pull-down	CMOS	<b>I2C_AD2: Device Address Bit 2</b> I2C_AD[2:1] pins are the address bus of the microprocessor interface.
E5	I2C_AD1	I pull-down	CMOS	<b>I2C_AD1: Device Address Bit 1</b> I2C_AD[2:1] pins are the address bus of the microprocessor interface.
D10	I2C_SCL	I	CMOS	<b>I2C_SCL: Serial Clock Line</b> The serial clock is input on this pin.
C5	I2C_SDA	I/O	Open Drain	<b>I2C_SDA: Serial Data Input/Output</b> This pin is used as the input/output for the serial data.
<b>JTAG (per IEEE 1149.1)</b>				
F1	TMS	I pull-up	CMOS	<b>TMS: JTAG Test Mode Select</b> The signal on this pin controls the JTAG test performance and is sampled on the rising edge of TCK.
K3	TRSTB	I pull-up	CMOS	<b>TRSTB: JTAG Test Reset (Active Low)</b> A low signal on this pin resets the JTAG test port. This pin should be connected to ground when JTAG is not used.
G1	TCK	I pull-down	CMOS	<b>TCK: JTAG Test Clock</b> 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. 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 pull-up	CMOS	<b>TDI: JTAG Test Data Input</b> 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 tri-state	CMOS	<b>TDO: JTAG Test Data Output</b> The test data are output on this pin. They are clocked out of the device on the falling edge of TCK. 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, G9, L6	IC	-	-	IC: Internal Connection 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

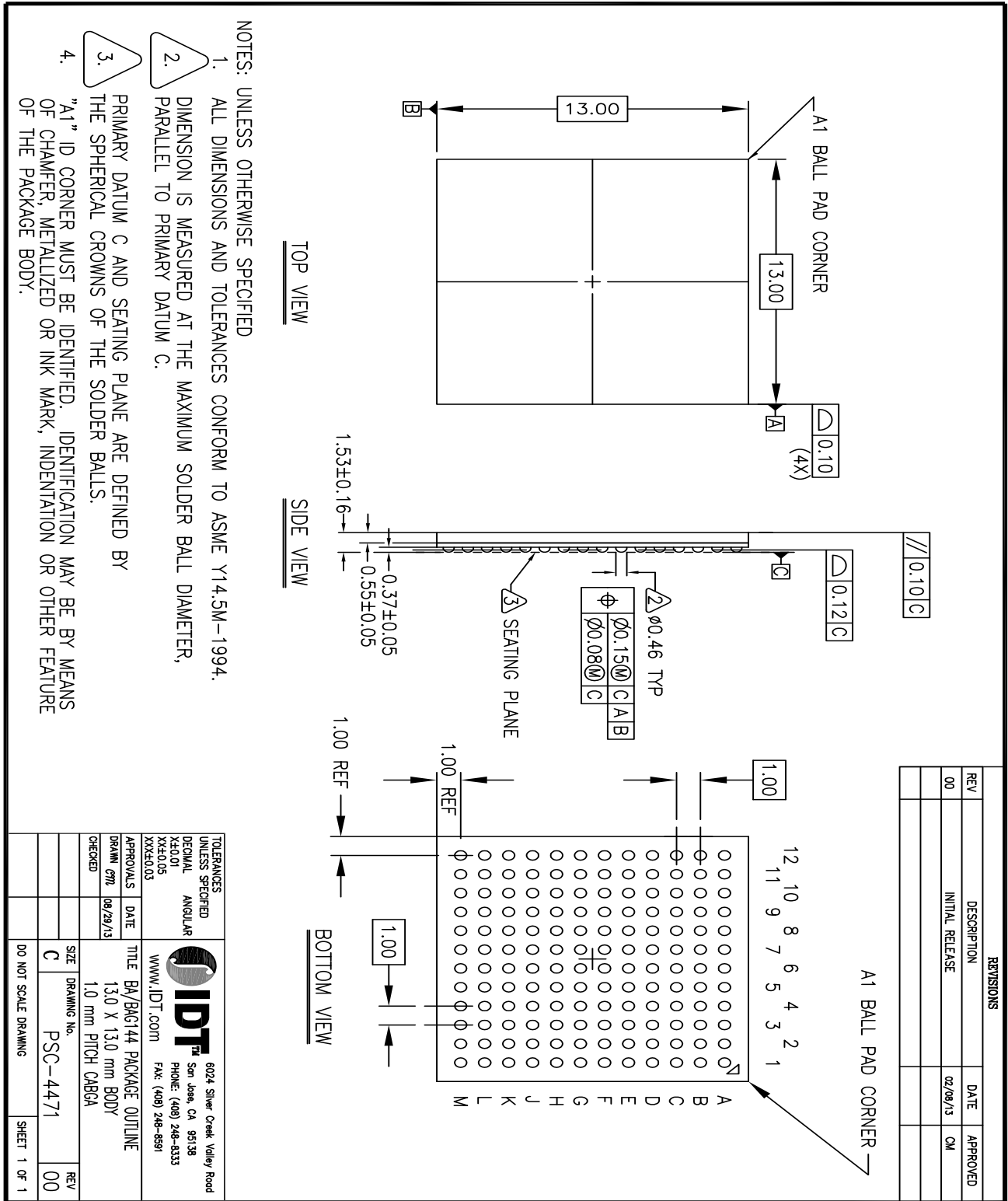
All unused single-ended clock outputs can be left floating, or can be brought out to a test point for debugging purposes.

#### 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.



## PACKAGE DIMENSIONS



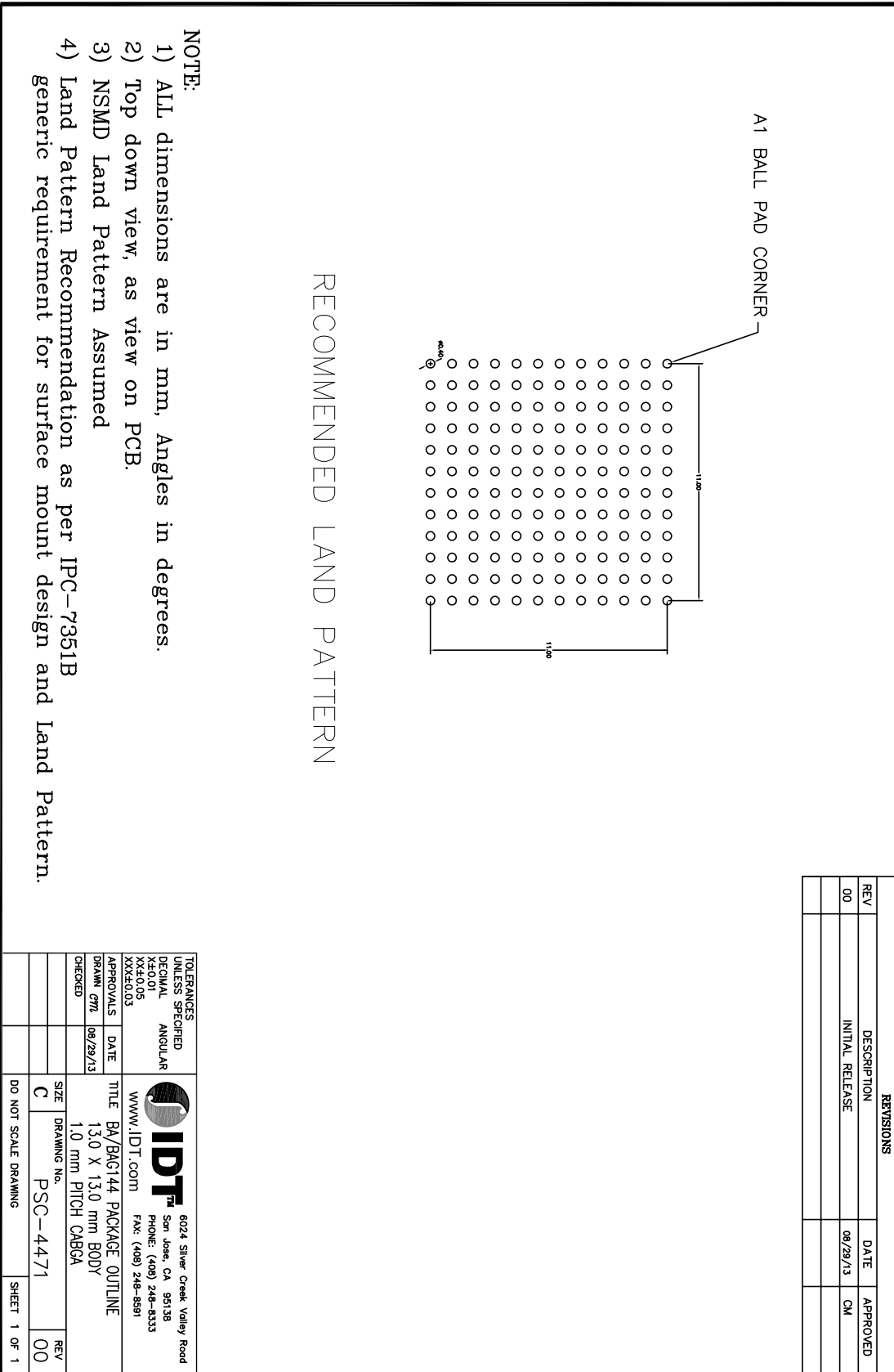


Figure 4. 144-Pin BAG Package Recommended Land Pattern

## ORDERING INFORMATION

Table 2: Ordering Information

Part/Order Number	Package	Temperature
82P33731ABAG	144-pin CABGA green package	-40° to +85°C

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

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