Vertical Driver for CCD Cameras

Data Sheet

ADDI9023

FEATURES

12-channel vertical driver
8 three-level drivers
4 two-level drivers
Substrate clock driver
Input logic supports a 1.6 V to 3.6 V range
Output drivers support a −9.5 V to +15.5 V range
6 mm × 6 mm CSP_BGA package with 0.65 mm pitch

APPLICATIONS

Digital still cameras
Industrial cameras
Surveillance cameras
Medical imaging

GENERAL DESCRIPTION

The ADDI9023 is a 12-channel vertical driver for charge-coupled device (CCD) imaging applications. It includes eight three-level drivers and four two-level drivers. The input configuration can support up to nine individual vertical timing phases and eight shift gate signals. A separate substrate clock channel (SUBCK) is also included. Typical load drive capability for each channel is 3 nF.

The ADDI9023 is specified over an operating temperature range of −25°C to +85°C.

FUNCTIONAL BLOCK DIAGRAM

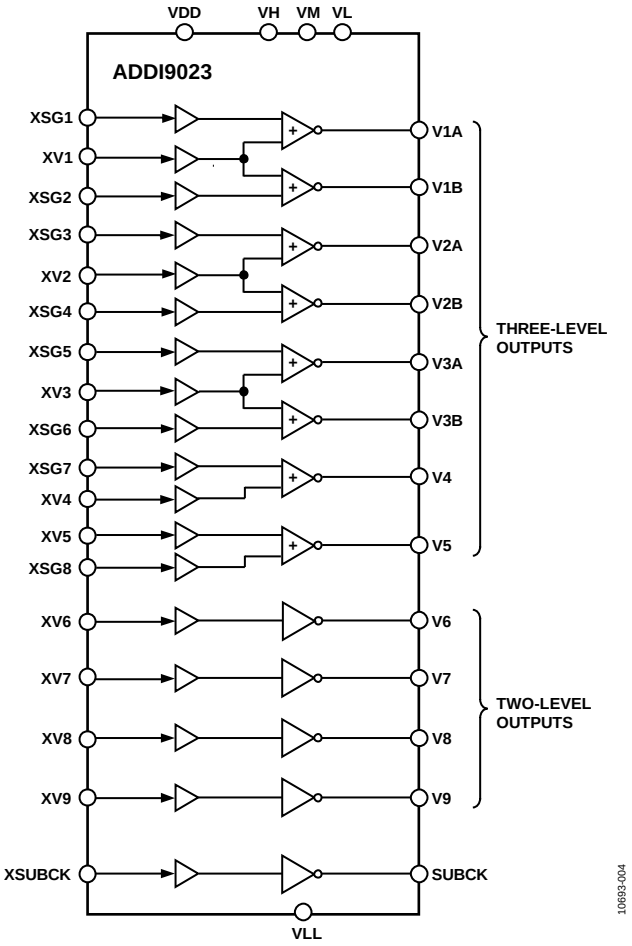

Figure 1.

Rev. 0
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REVISION HISTORY

4/12—Revision 0: Initial Version

SPECIFICATIONS

Table 1.

Parameter	Test Conditions/Comments	Min	Typ	Max	Unit
TEMPERATURE RANGE					
Operating		−25		+85	°C
Storage		−65		+150	°C
V-DRIVER POWER SUPPLY VOLTAGES					
VDD	Input logic supply	1.6	3.0	3.6	V
VH	V-driver high supply	11.0	15.0	15.5	V
VL	V-driver low supply	−9.5	−7.5	−5.5	V
VM	V-driver midsupply	−1.5	0.0	+1.5	V
VLL	SUBCK V-driver low supply	−9.5	−7.5	−5.5	V
VH to VL, VLL	Maximum voltage from VH to VL, VLL			24	V
DC POWER SUPPLY CURRENTS	VH = +15 V, VM = 0 V, VL = VLL = −7.5 V				
I_{VDD}	XVx = XSGx = 0 V			0.5	mA
	XVx = XSGx = VDD			0.5	mA
I_{VH}	XVx = XSGx = 0 V			0.4	mA
	XVx = XSGx = VDD			3.3	mA
I_{VL}	XVx = XSGx = 0 V			2.1	mA
	XVx = XSGx = VDD			0.1	mA
I_{VM}	XVx = XSGx = 0 V			0.3	mA
	XVx = XSGx = VDD			0.2	mA
I_{VLL}	XSUBCK = 0 V			0.3	mA
	XSUBCK = VDD			0.1	mA
DIGITAL INPUTS	VDD = 1.6 V to 3.6 V				
High Level Input Voltage		VDD − 0.6			V
Low Level Input Voltage				0.6	V
High Level Input Current			10	50	µA
Low Level Input Current			10	50	µA
Input Capacitance			10		pF

OUTPUT DRIVER SPECIFICATIONS

VH = 15 V, VM = 0 V, VL, VLL = −7.5 V, T_A = 25°C.

Table 2.

Parameter	Symbol	Test Conditions/Comments	Min	Typ	Max	Unit
V1A TO V5						
Delay Time, VL to VM and VM to VL	t_{PLM}, t_{PML}			37		ns
Delay Time, VM to VH and VH to VM	t_{PMH}, t_{PHM}			43		ns
Rise Time, VL to VM	t_{RLM}	Load circuit: 20 Ω + 3 nF to GND		110		ns
Rise Time, VM to VH	t_{RMH}	Load circuit: 20 Ω + 3 nF to GND		240		ns
Fall Time, VM to VL	t_{FML}	Load circuit: 20 Ω + 3 nF to GND		180		ns
Fall Time, VH to VM	t_{FHM}	Load circuit: 20 Ω + 3 nF to GND		130		ns
Output Currents						
		V1A to V5 = −7.25 V		14		mA
		V1A to V5 = −0.25 V		−23		mA
		V1A to V5 = +0.25 V		23		mA
		V1A to V5 = +14.75 V		−10		mA
On Resistance	R_{ON}					
VH				23	35	Ω
VM				11	20	Ω
VL				17	25	Ω
V6 TO V9						
Delay Time, VL to VM and VM to VL	t_{PLM}, t_{PML}			37		ns
Rise Time, VL to VM	t_{RLM}	Load circuit: 20 Ω + 3 nF to GND		110		ns
Fall Time, VM to VL	t_{FML}	Load circuit: 20 Ω + 3 nF to GND		180		ns
Output Currents						
		V6 to V9 = −7.25 V		14		mA
		V6 to V9 = −0.25 V		−23		mA
On Resistance	R_{ON}					
VM				11	20	Ω
VL				17	25	Ω
SUBCK OUTPUT						
Delay Time, VLL to VH	t_{PLH}			47		ns
Delay Time, VH to VLL	t_{PHL}			47		ns
Rise Time, VLL to VH	t_{RLH}	Load circuit: 1 nF to GND		45		ns
Fall Time, VH to VLL	t_{FHL}	Load circuit: 1 nF to GND		45		ns
Output Currents						
		SUBCK = −7.25 V		23		mA
		SUBCK = +14.75 V		−22		mA
VLL On Resistance	R_{ON}			10	17	Ω

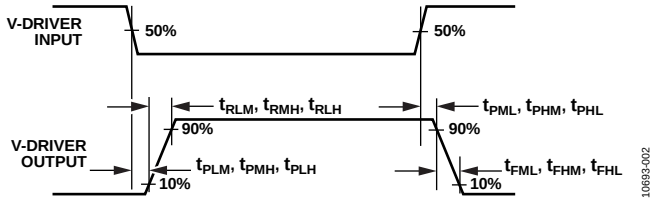

Figure 2. Definition of V-Driver Timing Specifications

ABSOLUTE MAXIMUM RATINGS

Table 3.

Parameter	Rating
VDD to VSS	−0.3 V to +3.9 V
VH to VL, VLL	−0.3 V to +25.0 V
VH to VSS	−0.3 V to +17.0 V
VL to VSS	−17.0 V to +0.3 V
VM to VSS	−6.0 V to +3.0 V
VMM to VSS	−6.0 V to +3.0 V
VLL to VSS	−17.0 V to +0.3 V
V1A to V9 to VSS	VL − 0.3 V to VH + 0.3 V
VDREN to VSS	−0.3 V to VDD + 0.3 V
Junction Temperature	150°C
Lead Temperature (Soldering, 10 sec)	350°C

Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only; functional operation of the device at these or any other conditions above those indicated in the operational section of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

THERMAL RESISTANCE

θ_{JA} is specified for the worst-case conditions, that is, a device soldered in a circuit board for surface-mount packages.

Table 4. Thermal Resistance

Package Type	θ_{JA}	Unit
40-Lead CSP_BGA	46	°C/W

ESD CAUTION

ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

PIN CONFIGURATION AND FUNCTION DESCRIPTIONS

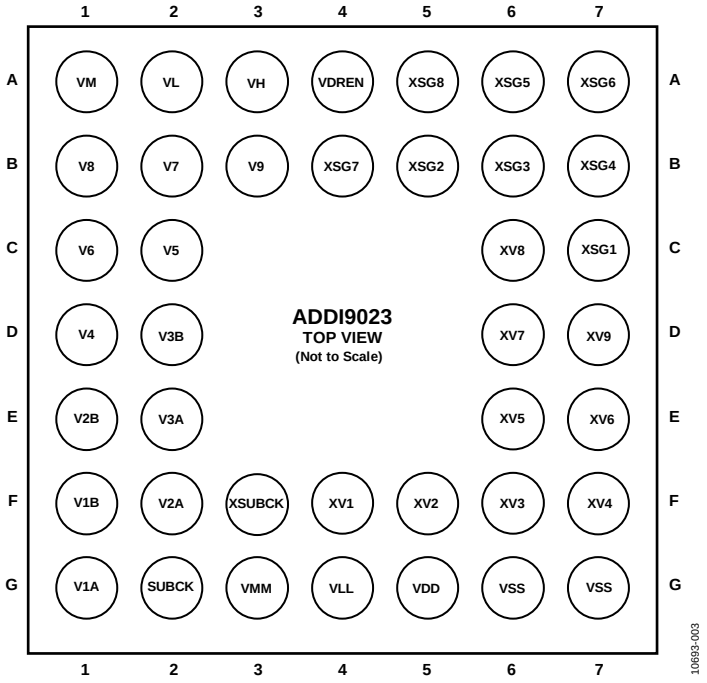

Figure 3. Pin Configuration

Table 5. Pin Function Descriptions

Pin No.	Mnemonic	Type[1]	Description
A1	VM	P	V-Driver Midsupply.
A2	VL	P	V-Driver Low Supply.
A3	VH	P	V-Driver High Supply.
A4	VDREN	DI	V-Driver Enable. Active high.
A5	XSG8	DI	Vertical Input.
A6	XSG5	DI	Vertical Input.
A7	XSG6	DI	Vertical Input.
B1	V8	VO2	CCD Vertical Transfer Clock.
B2	V7	VO2	CCD Vertical Transfer Clock.
B3	V9	VO2	CCD Vertical Transfer Clock.
B4	XSG7	DI	Vertical Input.
B5	XSG2	DI	Vertical Input.
B6	XSG3	DI	Vertical Input.
B7	XSG4	DI	Vertical Input.
C1	V6	VO2	CCD Vertical Transfer Clock.
C2	V5	VO3	CCD Vertical Transfer Clock (XV5 + XSG8).
C6	XV8	DI	Vertical Input.
C7	XSG1	DI	Vertical Input.
D1	V4	VO3	CCD Vertical Transfer Clock (XV4 + XSG7).
D2	V3B	VO3	CCD Vertical Transfer Clock (XV3 + XSG6).
D6	XV7	DI	Vertical Input.
D7	XV9	DI	Vertical Input.
E1	V2B	VO3	CCD Vertical Transfer Clock (XV2 + XSG4).
E2	V3A	VO3	CCD Vertical Transfer Clock (XV3 + XSG5).
E6	XV5	DI	Vertical Input.
E7	XV6	DI	Vertical Input.

Pin No.	Mnemonic	Type[1]	Description
F1	V1B	VO3	CCD Vertical Transfer Clock (XV1 + XSG2).
F2	V2A	VO3	CCD Vertical Transfer Clock (XV2 + XSG3).
F3	XSUBCK	DI	XSUBCK Input to SUBCK Buffer.
F4	XV1	DI	Vertical Input.
F5	XV2	DI	Vertical Input.
F6	XV3	DI	Vertical Input.
F7	XV4	DI	Vertical Input.
G1	V1A	VO3	CCD Vertical Transfer Clock (XV1 + XSG1).
G2	SUBCK	VO2	CCD Substrate Clock Output.
G3	VMM	P	SUBCK Output Driver Ground.
G4	VLL	P	V-Driver Low Supply for SUBCK Output.
G5	VDD	P	Digital Logic Supply.
G6	VSS	P	Digital Logic Ground.
G7	VSS	P	Digital Logic Ground.

[1] DI = digital input; P = power; VO2 = vertical driver output, two-level; VO3 = vertical driver output, three-level.

INPUT/OUTPUT LOGIC STATES

Table 6. V1A Output Polarity

Vertical Driver Input		
XV1	XSG1	V1A Output
L	L	VH
L	H	VM
H	L	VL
H	H	VL

Table 7. V1B Output Polarity

Vertical Driver Input		
XV1	XSG2	V1B Output
L	L	VH
L	H	VM
H	L	VL
H	H	VL

Table 8. V2A Output Polarity

Vertical Driver Input		
XV2	XSG3	V2A Output
L	L	VH
L	H	VM
H	L	VL
H	H	VL

Table 9. V2B Output Polarity

Vertical Driver Input		
XV2	XSG4	V2B Output
L	L	VH
L	H	VM
H	L	VL
H	H	VL

Table 10. V3A Output Polarity

Vertical Driver Input		
XV3	XSG5	V3A Output
L	L	VH
L	H	VM
H	L	VL
H	H	VL

Table 11. V3B Output Polarity

Vertical Driver Input		
XV3	XSG6	V3B Output
L	L	VH
L	H	VM
H	L	VL
H	H	VL

Table 12. V4 Output Polarity

Vertical Driver Input		
XV4	XSG7	V4 Output
L	L	VH
L	H	VM
H	L	VL
H	H	VL

Table 13. V5 Output Polarity

Vertical Driver Input		
XV5	XSG8	V5 Output
L	L	VH
L	H	VM
H	L	VL
H	H	VL

Table 14. V6 to V9 Output Polarity

Vertical Driver Input	
XV6, XV7, XV8, or XV9	V6, V7, V8, or V9 Output
L	VM
H	VL

Table 15. SUBCK Output Polarity

Vertical Driver Input	
XSUBCK	SUBCK Output
L	VH
H	VLL

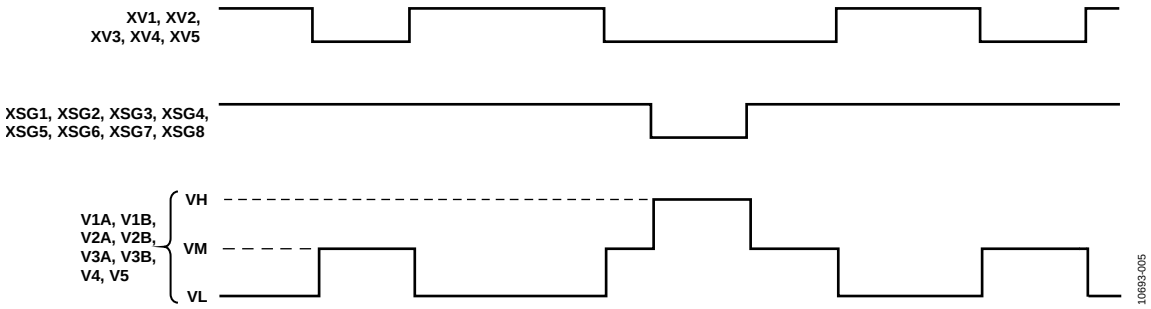

Figure 4. Three-Level V-Driver Output Polarities

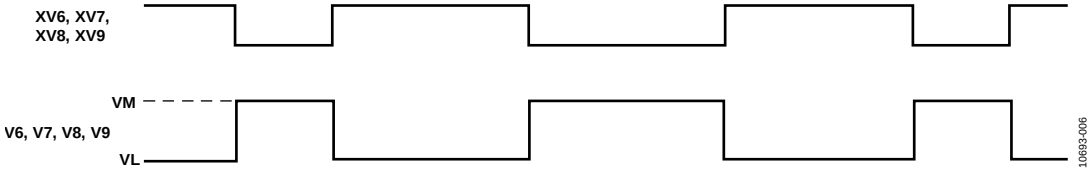

Figure 5. Two-Level V-Driver Output Polarities

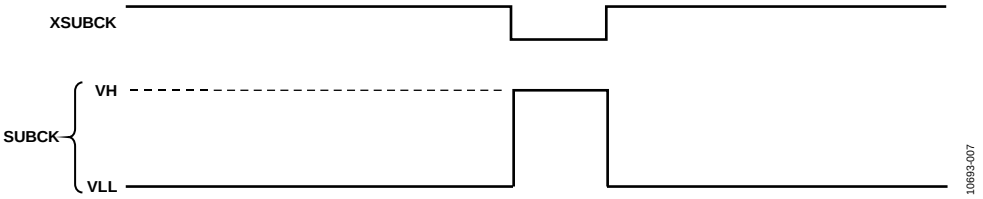

Figure 6. SUBCK Output Polarity

APPLICATIONS INFORMATION

POWER-UP SEQUENCE

When the ADDI9023 is powered up, the following sequence is recommended (refer to Figure 7 for each step). Note that VH is powered on before VL but, depending on CCD restrictions, VH and VL can also be powered on simultaneously.

1. Turn on the VDD power supply, either 1.8 V or 3.3 V. After VDD settles, the logic inputs from the timing generator (XV, XSG, XSUBCK) can become active. Keep VDREN low during this time.
2. Turn on the VH power supply, typically +12 V to +15 V.
3. Turn on the VL/VLL power supply, typically −6 V to −9 V.
4. Take the VDREN pin high to enable the V-driver outputs. VDREN must remain high throughout normal vertical timing operation.

POWER-DOWN SEQUENCE

When the ADDI9023 is powered down, reverse the procedure shown in Figure 7.

1. Take the VDREN pin low to disable the V-driver outputs.
2. Turn off the VL/VLL and VH power supplies.
3. Turn off the VDD power supply.

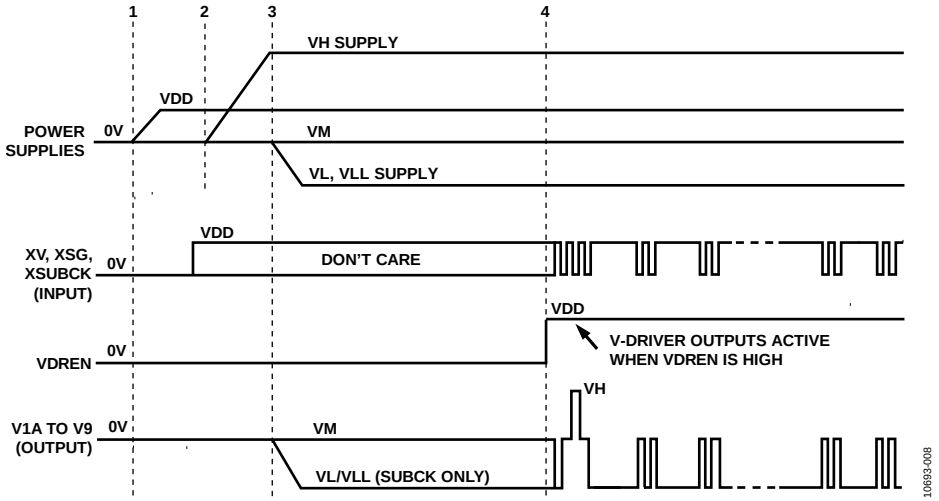

Figure 7. Recommended Power-Up Sequence

CIRCUIT LAYOUT INFORMATION

The recommended circuit configuration is shown in Figure 8. Each supply pin should have a high quality 0.1 µF capacitor connected to ground. The VH and VL supplies should have an additional bypass capacitor, such as a 1.0 µF to 22 µF capacitor, depending on CCD and performance requirements. Connect the ground pins (VSS, VM, and VMM) to a common ground plane.

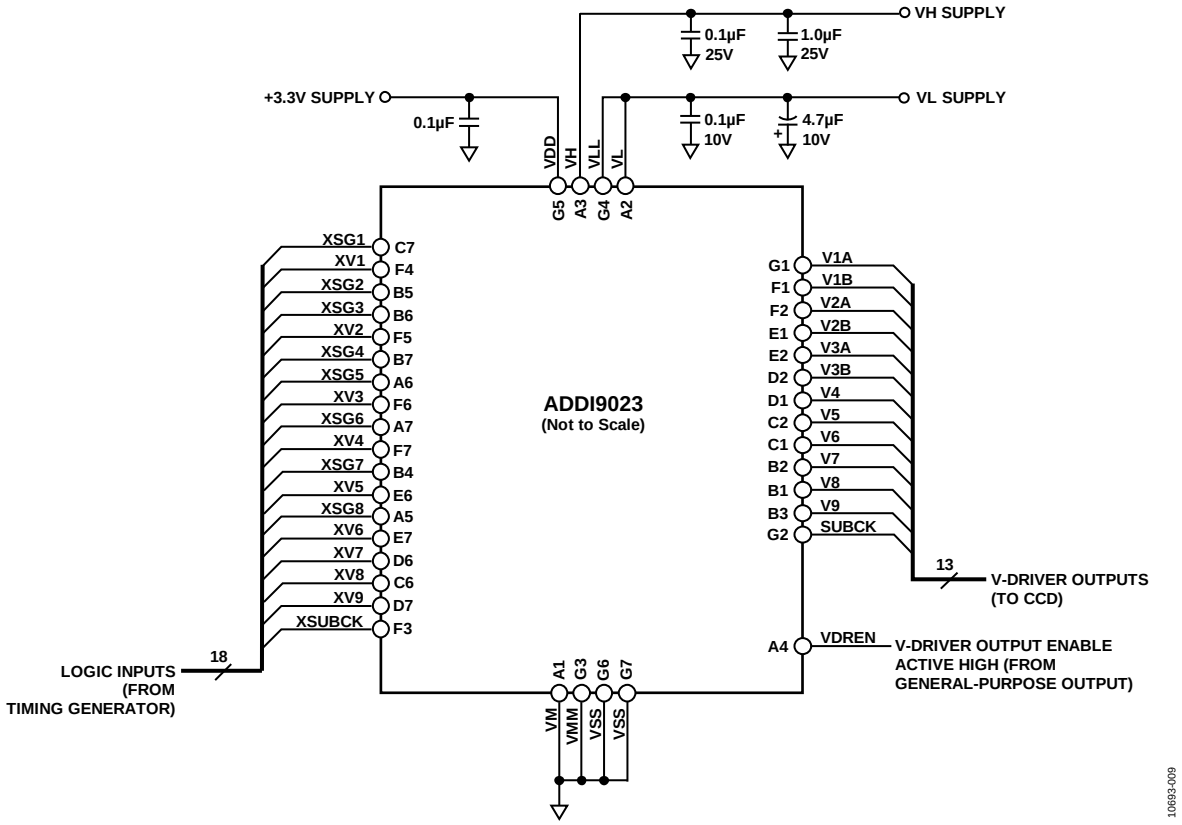

Figure 8. Typical Circuit Configuration

OUTLINE DIMENSIONS

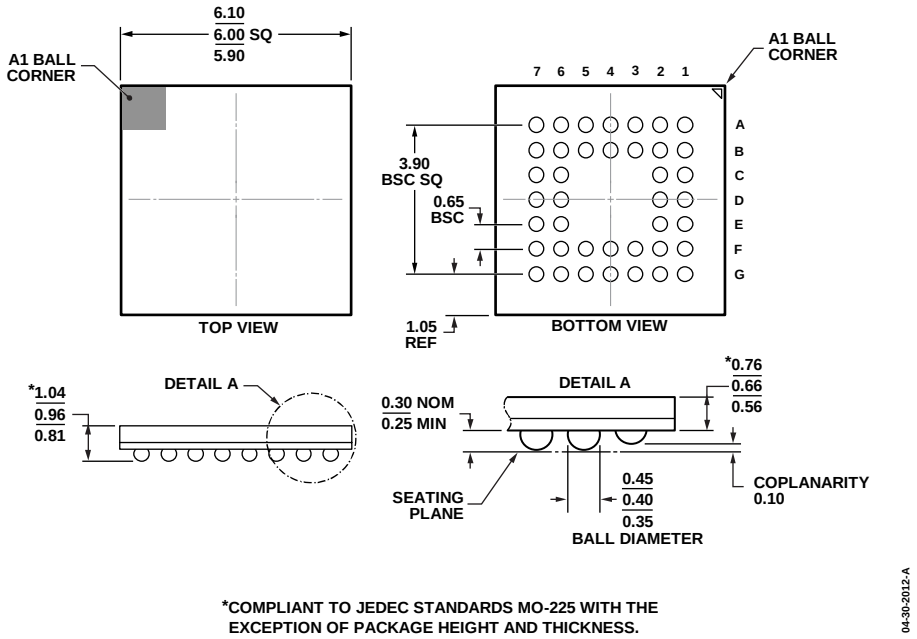

Figure 9. 40-Ball Chip Scale Package Ball Grid Array [CSP_BGA]
BC-40-1
Dimensions shown in millimeters

ORDERING GUIDE

Model[1]	Temperature Range	Package Description	Package Option
ADDI9023BBCZ	−25°C to +85°C	40-Lead CSP_BGA	BC-40-1
ADDI9023BBCZRL	−25°C to +85°C	40-Lead CSP_BGA	BC-40-1

[1] Z = RoHS Compliant Part.

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