Com-pany	Name	ALeader Europe Ltd.	CyberOptics Corporation	GÖPEL electronic GmbH	Koh Young Technology	Mek	Mirtec	Omron Europe Ltd.
Inspection machine	Name and model	ALD8720S	SQ3000 3D AOI System	Vario Line · 3D	Zenith 2 Side Cameras	Mek ISO-Spector M1A (with Artificial Intelligence)	Alpha_SIP	VT-S730-HE
	Size / weight	1085 mm (L) 1275 mm (W) 1570 mm (H) / 920 kg	1100 mm (W) 1270 mm (D) 1390 mm (H) / 965 kg	1200 mm (W) 1450 mm (D) 1650 mm (H) / 950 kg	L Size-1000 mm (W) 1530 mm (D) 1805 mm (H) / 850 kg	1070 mm (W) 1550 mm (D) 1500 mm (H) / 800 kg	1080 mm (W) 1492 mm (D) 1560 mm (H)	1100 mm (W) 1470 mm (D) 1500 mm (H) / 800 kg
	Max. size of board	510 x 500 mm (620 x 550 mm – model ALD8730S)	Standard system 510 x 510 mm Large PCB system 710 x 610 mm	510 mm	(L Size) 330 x 510 mm (XL Size) 510 x 690 mm	510 x 680 mm	510 x 460 mm	510 × 460 mm
	Max. # of inspected components	Unlimited	Unlimited	Unlimited	N/A	Unlimited	Unlimited	Up to 10,000 components per PCB
	Max. height of components	40 mm top 85 mm bottom	Up to 24 mm Measured in full 3D & 30 mm in 2D	40 mm	20 mm	50 mm top clearance, measurable 25 mm	45 mm	25 mm
	Speed: low/high	High speed inspection	44 sq/cm/sec @ 10 um + 15 sq/cm/sec @ 7 um	up to 100 cm^2/s	N/A	High speed inspection (FoV 69 x 69 mm)	4,040 mm^2/sec	High speed full 3D inspection
	PCB clearance	40 mm top, Conveyor height – 870-970 mm	50 mm	40 mm	Top – 40 mm Bottom – 50 mm	50 mm top clearance	Top – 45 mm Bottom – 50 mm	40 mm top/bottom
	Monitor	23.6" touch screen	Touch screen operation	24" multi-touch, non-reflective surface	N/A	24" touchscreen monitor mounted in the frame	24"	Touch panel
	Operating system	Windows 10 64 bit Professional	MS Windows 10	Windows 10 LTSC	Windows 7	Windows 10 Pro	Windows 10	Windows 10
	Aspects of manufacturing line it covers	Designed for after-reflow, but capable to inspect pre-reflow and after wave too	3D SPI, pre-reflow AOI, post reflow AOI, post wave, wire bond, packaging, CMM, metrology	All aspects can be covered	Pre-reflow, post-reflow	Pre-reflow, post-reflow and post-wave (solder)	Pre-reflow, post-reflow, post wave	Post-reflow and wave solder
	(Other)			System as benchtop-version with manual loading available				
Image capture system	Number of cameras in machine	1 camera	1 x multi function 3D MRS sensor	4 cameras with 12 MegaPixel technology (angled view), 1 camera with 28 MegaPixel technology (orthogonal view)	1 (4 side – optional)	5 cameras: 1 main camera, 4 side cameras	5 cameras: 1 main (top-down) camera & 4 side cameras	1x direct view 4x angle view
	Type of camera(s)	12 MegaPixel high speed intelligent camera, telecentric lens	Programmable projector + 4 x oblique cameras + 1 x HR colour 2D camera	4 angled-view cameras with 360 inspection directions and 1 orthogonal camera	12 m highspeed camera (top) (side 2 m)	Main camera 25 MegaPixel with Coaxpress interface, side cameras 2.5 MegaPixel each with Coaxpress interface	Monochrome	• Direct view is the eye of the system, to capture images of a PCB using12MCMOS camera. • Angle view to capture the PCB oblique image using CCD
	Capabilities of camera(s): HD/3D?	N/A	100 % 3D measurement + statistical image analysis	3D / 2D / 360 inspection directions / 360 projection directions	3D inspection	Both HD and 3D	Top camera 12 MP, side cameras 18 MP, lens resolution alternatively available with 10 µm or 15 µm	CMOS Camera. Full 3D capabilities with unique patented technology

Com-pany	Name	Parmi Corporation	Pemtron Europe GmbH	Saki Corporation	TRI Test Research, Inc	Viscom AG	Vi Technology	Yamaha Motor Europe N.V.
Inspection machine	Name and model	Xceed	Eagle 3D 8800	3Di-LS2	TR7500QE	S3088 ultra gold	5K 3D	YSi-V; Type HS2
	Size / weight	850 mm (W) 1205 mm (D) 1525 mm (H)	1190 mm (W) 1370 mm (D) 1600 mm (H)/970 kg	1040 mm (W) 1440 mm (D) 1500 mm (H)	1100 mm (W) 1730 mm (L) 920 kg	800 kg	1110 mm (W) 1351 mm (D) 1892 mm (H)/ 900 kg	1252 mm (W) 1498 mm (D) 1550 mm (H) / 1300 kg
	Max. size of board	Up to 1200 mm length and 610 mm width	510 x 510 mm Possible up to: 650 x 1500 mm	Single lane: 50 × 60 mm (min) to 500 × 510 mm (max) Dual lane: 50 × 60 mm (min) to 320 × 510 mm (max)	519 x 460 mm optional 510 x 590 mm	508 x 508 mm	533 x 609 mm	610 x 560 mm
	Max. # of inspected components	Unlimited	Unlimited	Unlimited	Unlimited	Unlimited	Unlimited	12,800 components
	Max. height of components	up to 50 mm	60 mm	Machine clearance: • Top: 40 mm / Bottom: 50 mm • Max. measurement height: 25 mm	50 mm	up to 50 mm	34 mm (40 mm optional)	45 mm
	Speed: low/high	up to 65 cm^2/s	58.3 cm^2/sec	High speed: 57 sq.cn/s	up to 50 cm^2/sec	High speed	up to 26 cm^2/s in full 3D	32.94 cm^2/sec
	PCB clearance	Top – 40 mm Bottom – 50 mm	3 mm	Machine clearance Top – 40 mm Bottom – 50 mm	Top – 50 mm Bottom – 40 mm	50 mm	Top – 34 mm (40 mm optional) Bottom – 60 mm	3 mm front and rear
	Monitor	24"	24"	• Screen Size: 24" LCD monitor • Screen Resolution: WUXGA (1920 × 1200) 24-bit full color	Touchscreen	Yes	22" LCD	Full HD
	Operating system	Windows 10	Windows10	Windows 10	Windows	MS Windows	Windows10	Windows 7 embedded 64 bit
	Aspects of manufacturing line it covers	All test gates in the manufacturing line (pre-/post-reflow, post-wave with bottom side inspection head, Underfill, Die, IGBT, CCOD, etc.	Pre-/post reflow and post-wave	All: pre-reflow, post-reflow, post-wave and special application	Pre-reflow, post-reflow, post-wave	Pre-reflow, post-reflow, post-wave, solder paste inspection	All: Pre-reflow, post-reflow, post-wave	All: pre-reflow, post-reflow, post-wave
	(Other)							
Image capture system	Number of cameras in machine	Color textured range scan camera, side cameras for 360 ° inspection	up to 5 cameras	5 cameras: 1 for orthogonal 4 for side view	5 high resolution cameras and 4 digital fringe pattern projectors	9 cameras	3 cameras	5 cameras
	Type of camera(s)	UHS image sensor with FPGA real time image processing	Telecentric high resolution / high speed camera	CMOS area camera	Mpix	Viscom	1 orthogonal color camera 8 Megapixel, 12-bit CCD + 2 angled cameras for laser triangulation	1 top looking, 4 angled cameras
	Capabilities of camera(s): HD/3D?	High resolution 3D TRSC sensor head	2D/3D algorithms for full 3D images	3D	3D fringe pattern	HD and 3D	HD and 3D	2D and 3D

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Image capture system	Quality of image: Judged by pixel size	15 micron	10 µm + 7 µm HR option	up to 10.5 µm per pixel	15 µm - 20 µm	15 µ/pixel resolution	4,096 x 3,072 pixel	High quality 3D imagery using CMOS camera	50 MPix/s	HD	XYI Resolution: 7 µm/ 12 µm/ 18 µm Height (Z) resolution: 1 µm	12 MPix top, 6,5 MPix side cameras	up to 10 µm	4.75 µm X,Y resolution + laser triangulation with Z constant resolution 1 µm from -5 to +20 mm	12 micron
	Illumination unit: LED/infra-red/etc…	LED	LED	Multispectral, multidirectional (infrared/visible/ultra violet), can be adjusted in intensity and direction	3D Projectors (8), IR_RGB LED, Dome styled Illumination	Two stage, omnidirectional RGB LED lighting	2D: RGB color LED 3D: white LED source	Omron proprietary color highlight illumination consisting of red, green and blue LEDs	Multi-LED, RGB	LED and UV available	• 2D lighting system: 6 stage lighting ring (Coaxial Toplight: Red LED, Toplight: Red LED, Sidelight: Blue LED, Green LED, Red LED, and Lowlight: Red LED) • 3D lighting system: white high power LED (for profilometry)	Multi-phase true color LED, Coaxial lighting	LED	Axial and peripheral LED with holographic diffuser	White LED + infrared
	Projector unit	4 digital projector units	N/A	Multi fringe projection, 360 projection directions	8	4x multi-frequency Moiré projectors (total 12 projectors) with 80° projection angle	Digital projector	DPL phase shift projector units that project stiped lighting for 3D imagery	Shadow-free, Dual Laser Triangulation	10 projector Moire technology	4 height projection: multi-frequency digital projectors	4 digital fringe pattern	Yes	Red laser with 2 angular cameras	4 projectors
Types of defects – Footprint Inspection	Filet (height/length)	Yes, height, volume and area measurement	Yes measured	Yes	Yes	Yes, also volume	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes: height, length & width	Yes
	Wetting angle	Fillet shape	Yes	Yes	Yes	Yes, full profile meniscus shape analysis	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	End/Side connection (width/length)	Yes	Yes measured	Yes	Yes	Yes, including bridges detection in both 2D and 3D	Yes	Yes	Yes	Yes	Yes	Yes	Yes	• End solder in 3D (wetting angle/concavity) • Side solder in 2D	Yes
	Missing solder	Yes, no solder and insufficient solder	Yes	Yes	Yes	Yes, also lack of solder	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Foreign material	Yes	Yes full FOD capability	Yes	Yes	Yes, full range foreign material in both 2D and 3D	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Footprint error	Yes	Yes	Yes	Yes	Yes, confirmation of width, length and height	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	(Other)			Contamination on pads	All others for body and lead	IPC 610 classes I, II and III tolerance value checks in addition to regular measurements; IC lifted lead measurement, bent leads defects, excess solder defects, hair solder bridges	• Cold solder • Insufficient and excessive solder • Void • Wave solder • Selective solder • Laser solder • Robot solder, etc.		• Contamination inspection • Underfill-fillet • SIP-inspection • Die • Underfill • CCOD • Solder paste • Solder ball	• Excessive solder • Solder bridge	• Soldering volume • Excessive solder • Lifted lead • Bridge • Contamination • Solder balls				None or insufficient wetting
Types of defects – Component body inspection	Component height	Yes	Yes measured	Yes	Yes	up to 25 mm	Yes, up to 34 mm	Yes	Yes, up to 25 mm	Yes	Yes	Up to 20 mm	Yes	Yes	Yes
	Component missing/ wrong	Missing inspect., OCV, OCR, component color inspection	Yes	Yes	Yes	Yes, including OCR/OCV text inspection	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Polarity	Yes	Yes	Yes	Yes	Yes, in both 2D and 3D	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Reverse front/back	Yes	Yes	Yes	Yes	Yes, dedicated front/ back check algorithms	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Component shift, lift, tilt	Yes – automatic tolerance definition according to IPC level	Yes	Yes	Yes	Yes, in steps of 1 µ resolution in X,Y, Z. Tilt in length and width directions of the component (4 corners are measured)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

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Types of defects	Component body inspection	**(Other)**			• Component co-planarity • Component type (OCR) • Component colour		• IPC 610 classes I, II and III tolerance value checks in addition to regular measurements. • Component absence verification (make sure a component is not placed)	• Tombstone • Upside down • OCR • Double chip • Lift • Shift (X, Y offset) • Angle of component • Manhattan • Height • Tilt • Scratch •Crack • Misalignment • Dimension		• Bond-Line-Thickness (BLT) • Die-tilt • Die-misalignement • Die-chipping • Die-crack • Epoxy coverage • Fillet height & run-out • Resin bleed out (RBO)	• Coplanarity • Color • Test • Billboard • Tomb stone	• Tombstone • Broken component • Text (OCV & OCR)	• OCR • OCV • Foreign component	• Component damage • Lifted leads	• Coplanarity • Lifted leads detection • Billboard detection • Tombstone detection • Upside down components	
	Electrode inspection	**Electrode shift**	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	N/A	Yes	Yes, possible	Yes
		Electrode posture	Yes	Yes	Yes	N/A	Yes	Yes	Yes	Yes	Yes	Yes	N/A	Yes	Yes	Yes
		(Other)	All inspection related to TH – missing, insufficient and no solder, short, flag, hole, etc..					• Excessive solder (over electrode) • Component shift according to IPC 610 • Slope (height diff. between electrodes)	• Electrode presents		• Offset inspection • Twist inspection	• Electrode height				
	Peripheral inspection	**Foreign object**	Yes	Yes	Yes	Yes	Yes full range (across the whole PCB) in both 2D and 3D	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
		Solder ball	Yes	Yes	Yes	Yes	Yes, with solder "ball" shape verification in 3D	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
		Solder bridge	Yes	Yes	Yes	Yes	Yes in both 2D and 3D	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
		(Other)					• THT pin height • Solder meniscus measurement	• Shortage of leads • IC-lead fillet • Lead lift • Lead shift • Lead bent		• SPI • Solder paste/ball coplanarity • Copper Clip On Die (CCOD) • IGBT • Wire Loop • Bridge • Stitch	• Text and 1D/2D bar code	• Scratch on the PCB • Contamination • Flux • Residue • Wrong silk print • Wrong drilling/routing		• PCB damage		
	Board inspection	**Foreign object**	Yes	Yes	Yes	Yes	Yes full range (across the whole PCB) in both 2D and 3D	Yes	Yes (Full view window)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
		(Other)			• Distance measurements between components and/or pad	• Critical distance	• Warpage compensation up to 10 mm	• PCB warpage compensation		• Contamination inspection	• Board warpage • Board shrink	• Stretch • Scratch on the PCB • Contamination • Flux • Residue • Wrong silk print • Wrong drilling / routing	• Bending • Warpage		• ID code • Metrology: specific distance between components, or to any reference point	
Software		**Ease of use**	Very easy, auto programming	Easy simple intuitive GUI	Very easy	Medium difficulty depending on algorithms used	Easy: Semi-automatic components programming, 100 % automatic solder measurement strategy programming using Artificial Intelligence. Programmer level independent results	Easy to use	Easy	Very easy	Clear structured GUI – easy and fast to use	Easy and simple but flexible: Saki Self Programming	5 step programming	Easy	Medium, very high flexibility to inspect exotic components	Easy
		Program creation	Fast and easy, intuitive interface, auto programming	On line / Off line from CAD, Gerber, ODB++	Automatic test program generation and optimization	Easy	By importing Gerber and CAD (centroid) data files	Automatic programming function based on deep learning provided	QupAuto Process Software using AI control function	ePM (Gerber, BOM, CAD)	Offline or by using the system	Automatic program creation complied with IPC standards: Saki Self Programming	Menu controlled	Easy	Fast and intuitive GUI	Yes

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Software	**Off-line mode for programming/ teaching/repair**	Yes	Yes	Yes	Yes- Medium difficulty	Yes, offline programming, offline debugging during production, 100 % automatic debugging of solder joints	Yes		Yes, off-line teaching and repair station for program creation and optimization, In-line verification software	Yes	Yes	• Full offline programming capability • Auto tuning function in offline teaching system • Judgementstation (repair/verification)	Yes	Yes	Yes	Yes
	Analysis software	Real time and history SPC	Full traceability + SPC solution for machine & factory	Yes	Yes- Medium difficulty	Analyzer software for extensive SPC reports and feedback	Yes		Yes, SPC and process improvement software, QupNavi SPI analysis software	Yes	SPC and customized solutions	• SPC Software available • Reporting software available	SPC	Yes		Yes
	Predictive capability	Process analysis	No	Yes	Yes	Yes, Artificial Intelligence: the systems learns process variables based on measurements and gets better over time for excellent detection of solder joint defects	Yes		VT-S730-H machine with AI based predictive maintenance function	Yes	Yes	• Self-diagnostic function: system status health check including data base, preventive and predictive maintenance check • Inspection result and process warning system	Yes	Yes	Cycle time simulator	Yes
	Software for CAD conversion	Included into the system SW	Yes	Yes, completely integrated in system software	Easy- EPM, 3rd party software	Not included	Yes		ePM software for CAD conversion	Yes	Yes	• Full support: ODB++, OPM and custom formats • Optional ePM	Yes	Yes	Fast and intuitive GUI	Yes
	(Other)			• Direct import of Mentor/Valor files • Multi-line verification • Central failure verification • Central failure verification without inline verification equipment • Presentation of corresponding SPI-, AOI- and AXI-failures at verification station • Presentation of corresponding SPI-, AOI- and AXI-failures at verification station, as well as from third-party-suppliers		Software for Artificial Intelligence management and monitoring				• Veriworks (Real Time Defect Analysis, Cross-Section Profile Analysis, Defect History) • SPC • xNET (correlation to SPI, multiple machine management & remote control, web browser based (PC & mobile), library management)	• Close loop software between SPI and AOI	• Library validation • Golden/Silver sample board verification • Shop floor/ traceability connection system • History management system (a program version control) • Multi-Language support • GPU calculation • New production introduction support (Programming without PCB in-hand) • Advanced user privilege / access rights control	• Gerber input	• Statistical Process Control • Viscom Quality Uplink • Closed Loop		• Analyses data combined with mounter and SPI data
Use of Golden board	**Demo board**	Regular board is enough to create the program	Yes	Yes, but not mandatory	Yes	Available	For optimization, Golden board is helpful but not necessary		N/A	No	Not necessary	Not required for programming or tuning however, those are used for library validation feature for inspection capability check.	Not necessary	Yes	Not needed	N/A
	Test board	Regular board is enough to create the program	Yes	Yes, but not mandatory	Yes	Available	For optimization, Golden board is helpful but not necessary		N/A	No	Not necessary	Not required for programming or tuning however, those are used for library validation feature for inspection capability check.	Useful, but not necessary	Yes	Not needed	Yes
	Other													Golden board		Bare board