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PA900 PERFORMANCE SPECIFICATIONS

DIMENSIONAL, ENVIRONMENTAL AND POWER SUPPLY SPECIFICATIONS

DIMENSIONAL

Nominal Dimensions	137mmH x 248mmW x 284mmD (5.4" x 9.75" x 11.2") with feet not extended
Nominal Weight	3.2kg (7lb) net, 5kg (11lb) shipping

ENVIRONMENTAL

Storage Environment	-20 to 75C (-4 to 167F) (non-condensing)
Operating Environment	0 to 40C (32 to 104F), <85% RH (non-condensing), Pollution Degree 2
Operating Altitude	0 to 2000m (6560ft) ASL

POWER SUPPLY

Line Power	Installation Category II; 85-264Vrms, 45 to 65Hz, 40VA max. Internally fused with a non-user serviceable fuse

ELECTRICAL CHANNEL INPUT AND ACCURACY SPECIFICATIONS

Specifications are valid under the following conditions-

- All specifications are valid following a 20 minute warm-up period after turning power ON in the PA900, when operated from the specified source of power and within the specified environmental conditions.

- All specifications in the tables of this section other than those labelled Base Scaling Error are valid for the lifetime of the PA900; Base Scaling Error specifications are valid for up to 2 years after calibration in normal use, or 6 months when continuously used above 75% of the maximum specified voltage or current signal range.

- All specifications are valid at the PA900 terminals.

- DC floor specifications assume that AUTOZERO is ON. If AUTOZERO is OFF add the DC Floor specification per C from the temperature of the last performed INT DC ZERO or when AUTOZERO was last ON (whichever occurred last).

- MAINS specifications are valid for signals with 45Hz to 65Hz fundamental with 20 to 100 harmonics configured and when using AUTO-TRACK bandwidth limiting; otherwise use the AVIONICS or AC specifications as applicable.

- AVIONICS specifications are valid for signals with 300Hz to 900Hz fundamental with 20 to 62 harmonics configured or for signals with 45Hz to 65Hz fundamental with >100 harmonics configured, and when using AUTO-TRACK bandwidth limiting; otherwise use the AC or MAINS specifications.

- Accuracy specifications are valid for Crest Factors <100 (within peak measurable input signal range and bandwidth limitations).

- Harmonics specifications are valid for <(10%/configured number of harmonics) cycle-to-cycle jitter in fundamental frequency and with each harmonic <(100%/harmonic number) of the total signal.

Note:

The specifications listed in this document are superseded by the specifications listed in the PA900 Operating Manual. The Operating Manual additionally contains charts and examples for various specifications.

The No Damage input signal range is that which will not cause immediate damage. Continued use of these levels may reduce reliability and/or future accuracy.

The Measurable input signal range is that which can be measured (the No Damage limits may limit the time for which they may be applied). The maximum measurable level shown is a typical value; the actual measurable maximum level is within ±2% of that shown.

The Specified input signal range is that of continuously applied signal levels for which measurements are guaranteed to be within the specified accuracies. The RMS level is also the maximum rated working signal level for safety purposes.

Accuracy specifications are guaranteed maximum errors. You should round the total maximum error upwards to the next integer count of resolution (e.g. if the total error is 18.3mV and the data is read with 1mV resolution then use 19mV as the maximum error).

All percentages are % of reading unless otherwise described.

When a signal has multiple significant frequency components (e.g. significant DC and AC components), add the relevant specifications for each such component.

V_{DC}, A_{DC}, V_{AC}, A_{AC}, V_{AC+DC}, A_{AC+DC}, V_{RDG}, A_{RDG} etc. indicate the relevant voltage, current etc. reading.

H is the harmonic or spectrum point number.

N is the configured number of harmonics or spectrum points.

F or F_{FUND} is the frequency of the signal in kHz.

F_{BW} is the frequency of the user bandwidth setting in kHz.

INPUT ISOLATION SPECIFICATIONS

Valid for any V terminal to PA900 chassis ground; any A terminal to PA900 chassis ground; and between any V and any A terminal.

Impedance	>1GΩ || <30pF
Max. Voltage	$4500V_{PK}$ max without damage
	$2500V_{RMS}$ max for <1s without damage
	$1000V_{RMS}$ max continuous rated working voltage (CAT I/II)
	$600V_{RMS}$ max continuous rated working voltage (CAT III)
	$300V_{RMS}$ max continuous rated working voltage (CAT IV)

VOLTAGE MEASUREMENT SPECIFICATIONS

The specifications for voltage are independent of the current input option installed in the respective channel.

VOLTAGE INPUT CAPABILITY AND CHARACTERISTICS

Specification		S Channel Type	A Channel Type	L Channel Type	W Channel Type
No Damage Voltage Range	<1ms	<3000V_{RMS} and V_{PK}		<500V_{RMS} and 3000V_{PK}	<3000V_{RMS} and V_{PK}
	<100ms	<2000V_{RMS}		<300V_{RMS}	<1500V_{RMS}
	<5s	<1500V_{RMS}		<250V_{RMS}	<1000V_{RMS}
	Continuous	<1000V_{RMS}		<160V_{RMS}	<650V_{RMS}
	PA900 Unpowered	As above			
Measurable Voltage Range		<1803V_{RMS} and V_{PK}		<182.3V_{RMS} and V_{PK}	<1803V_{RMS} and V_{PK}
Specified Voltage Range		<1000V_{RMS} and <1750V_{PK}		<160V_{RMS} and <175V_{PK}	<650V_{RMS} and <1750V_{PK}
Impedance Burden		1.201MΩ ± 0.25%		121kΩ ± 0.25%	399.5kΩ ± 0.25%
3dB Bandwidth (typical)		900kHz			3MHz

PRIMARY VOLTAGE MEASUREMENT ACCURACY TABLE

Add relevant errors from the table below for the maximum error in primary voltage measurements (e.g. DC, AC, AC+DC, Rectified, Peak, Valley, Peak-Valley).

MAXIMUM SCALING ERRORS					
Apply to all results as shown below as a percentage of the reading					
If signal contains significant levels at multiple frequencies, apply to each level & frequency					
Specification		S Channel Type	A Channel Type	L Channel Type	W Channel Type
Base Scaling Error Apply to all results		0.1%	0.03%		0.1% (0.2% if 2ms LF/PERIOD)
Frequency Dependent Scaling Error Apply to all results other than DC or MAINS	AVIONICS	None	0.005%		None
	LF or VLF	0.01%			0.05%
	<10kHz	F*0.005%			F*0.002%
	10k-40kHz	0.05%+(F-10)*0.012%			
	40k-100kHz	0.41%+(F-40)*0.025%			0.08%+(F-40)*0.004%
	100k-1MHz	Typically (F/1000)^2*100%			0.32%+(F-100)*0.013%
	>1MHz	Not specified			Typically (F/3500)^2*100%
Self-Heating Scaling Error Apply to all results (only significant at higher voltages) 1 minute nominal time constant		0.05%*(V_{AC+DC}/1000)^2		0.5%*(V_{AC+DC}/1000)^2	0.15%*(V_{AC+DC}/1000)^2
Temperature Scaling Error Apply to all results if outside of ±5C from calibration temperature		0.005% per C outside of ±5C from calibration temperature			
Bandwidth Limit Scaling Error Apply if using USER bandwidth setting		10%*(F/F_{BW})^2, unspecified for F > 0.3*F_{BW}			
MAXIMUM FLOOR ERRORS					
Apply to all results as shown below in Volts (generally only significant at low input levels)					
Specification		S Channel Type	A Channel Type	L Channel Type	W Channel Type
Base Floor Error Apply to all results		1.8mV	450µV	45µV	1.8mV
DC Floor Error Apply to DC and RECTIFIED results Apply to AC+DC results after multiplying by V_{DC}/V_{AC+DC}		3mV	1mV	100µV	5mV
AC Floor Error Apply to AC, AC+DC, and RECTIFIED results	MAINS, LF, VLF & F_{BW}≤10kHz	100µV/V_{RDG}	100µV/V_{RDG}	4µV/V_{RDG}	200µV/V_{RDG}
	AVIONICS & F_{BW}≤50kHz	300µV/V_{RDG}	300µV/V_{RDG}	8µV/V_{RDG}	650µV/V_{RDG}
	Otherwise	1.1mV/V_{RDG}	1.1mV/V_{RDG}	11µV/V_{RDG}	1.5mV/V_{RDG}
Peak Floor Error Apply to PK, VLY and PK-VLY results	MAINS, LF, VLF & F_{BW}≤10kHz	40mV	40mV	8mV	60mV
	AVIONICS & F_{BW}≤50kHz	75mV	75mV	11mV	125mV
	Otherwise	125mV	125mV	17mV	175mV

Common Mode Error Apply to AC, AC+DC, and RECTIFIED results Apply using voltage on V LO terminal relative to chassis ground. Error has 90° phase shift to common-mode voltage	1µV per V.Hz (11.5mV@230V/50Hz)	100nV per V.Hz (1.15mV@230V/50Hz)	700nV per V.Hz (8.05mV@230V/50Hz)
Adjacent Channel Error Apply to AC, AC+DC, and RECTIFIED results Apply using adjacent channel A LO or V LO terminal voltage relative to chassis ground. Error has 90° phase shift to adjacent channel voltage	300nV per V.Hz (3.45mV@230V/50Hz)	30nV per V.Hz (345µV@230V/50Hz)	210nV per V.Hz (2.415mV@230V/50Hz)

SECONDARY VOLTAGE MEASUREMENT ACCURACY TABLE

Specification		S Channel Type	A Channel Type	L Channel Type	W Channel Type
Crest Factor Error		(Total Floor Error from preceding table for PK results) / V_{AC}			
Form Factor Error		(Total Floor Error from preceding table for AC+DC results) / $V_{RECTIFIED}$			
Inter-Channel Error For 120° between equal amplitudes		(Relevant Voltage Errors from preceding table at the inter-channel voltage) + 0.0015%*F			
Harmonic or Spectrum Error		AC Voltage Errors from preceding table at V and F of the harmonic or spectrum point + $(H/N)^2$*0.3% of reading + (if not fundamental) from below using the frequency of the harmonic or spectrum point			
	<10kHz	0.01% of V_{AC+DC}	0.006% of V_{AC+DC}		0.015% of V_{AC+DC}
	10k-115kHz	0.05% of V_{AC+DC}			0.03% of V_{AC+DC}
	115k-435kHz	Not Available			0.08% of V_{AC+DC}
Inter-Channel Fundamental Phase Error		0.02°+0.15°*F			0.01°+0.07°*F
Harmonic-Fundamental Phase Error (typical, BANDWIDTH configured as UNFILTERED)		0.02°+0.1°*F+0.001°*H			0.02°+0.03°*F+0.001°*H
%THD Error Errors shown are all expressed in %THD units		$(0.005+0.000025*N)$*%THD+0.00005*N*$\sqrt{N}$ + from below using the frequency of highest included harmonic			
	<10kHz	0.025+1.25/V_{AC}	0.015+1/V_{AC}	0.015+0.2/V_{AC}	0.03+1.5/V_{AC}
	10k-115kHz	0.15+3.5/V_{AC}		0.15+0.35/V_{AC}	0.06+4/V_{AC}
	115k-435kHz	Not Available			0.15+4/V_{AC}

CURRENT MEASUREMENT SPECIFICATIONS

CURRENT INPUT CAPABILITY AND CHARACTERISTICS

Specification		Channel Type	Option H	Option D HI Range or Auto-Range when on HI Range	Option D LO Range or Auto-Range when on LO Range	Option X HI Range	Option X LO Range
No Damage Current Range	<8ms	All	<200A_{RMS} and <300A_{PK}	<150A_{RMS} and <250A_{PK}	<60A_{RMS} and <150A_{PK}	<200V_{RMS} and <300V_{PK}	<20V_{RMS} and <30V_{PK}
	<40ms	All	<75A_{RMS}	<50A_{RMS}	<40A_{RMS}	<50V_{RMS}	<10V_{RMS}
	<1s	All	<50A_{RMS}	<30A_{RMS}	<5A_{RMS}	<30V_{RMS}	<5V_{RMS}
	Continuous	All	<30A_{RMS}	<20A_{RMS}	<2A_{RMS}	<25V_{RMS} and V_{PK}	<5V_{RMS} and V_{PK}
	PA900 Unpowered	All	As Above	<2A_{RMS} and <150A_{PK}		<25V_{RMS} and <300V_{PK}	
Measurable Current Range		All	<225A_{RMS} and A_{PK}	<150A_{RMS} and A_{PK}	<1.02A_{RMS} and A_{PK}	<23.1V_{RMS} and V_{PK}	<0.576V_{RMS} and V_{PK}
Specified Current Range		All	<30A_{RMS} and <200A_{PK}	<20A_{RMS} and <140A_{PK}	<1A_{RMS} and A_{PK}	<15V_{RMS} and <20V_{PK}	<0.55V_{RMS} and V_{PK}
Impedance Burden		All	2.5mΩ to 7mΩ	4mΩ to 12mΩ	0.562Ω ± 0.75%	20.5kΩ ± 0.25%	10.25kΩ ± 0.25%
3dB Bandwidth (typical)		S, A or L	1.25MHz				
		W	5MHz			3MHz	

PRIMARY CURRENT MEASUREMENT ACCURACY TABLE

Add relevant errors from the table below for the maximum error in primary current measurements (e.g. DC, AC, AC+DC, Rectified, Peak, Valley, Peak-Valley).

MAXIMUM SCALING ERRORS Apply to all results as shown below as a percentage of the reading If signal contains significant levels at multiple frequencies, apply to each level & frequency							
Specification		Channel Type	Option H	Option D HI Range	Option D LO Range	Option X HI Range	Option X LO Range
Base Scaling Error Apply to all results		A or L	0.03%				
		S or W	0.1% (0.2% if 2ms LF/PERIOD)				
Frequency Dependent Scaling Error Apply to all results other than DC or MAINS	LF or VLF	S, A or L	0.01%				
		W	0.05%				
	AVIONICS	A or L	0.002%				
		S or W	None				
	<10kHz	S, A or L	F*0.003%				
		W	F*0.0015%				
	10k-40kHz	S, A or L	0.03%+(F-10)*0.007%				
		W	F*0.0015%				
	40k-100kHz	S, A or L	0.24%+(F-40)*0.02%				
		W	0.06%+(F-40)*0.003%			0.06%+(F-40)*0.004%	
	100k-1MHz	S, A or L	Typically $(F/1250)^2$*100%				
		W	0.24%+(F-100)*0.012%			0.3%+(F-100)*0.015%	
	>1MHz	W	Typically $(F/5000)^2$*100%			Typically $(F/3000)^2$*100%	
Self-Heating Scaling Error Apply to all results (only significant at higher currents)		All	0.00015%*A_{AC+DC}^2	0.0002%*A_{AC+DC}^2	None		

Specification	Channel Type					
3 minute nominal time constant						
Temperature Scaling Error Apply to all results if outside of ±5C from calibration temperature	All	0.005% per C outside of ±5C from calibration temperature				
Bandwidth Limit Scaling Error Apply if using USER bandwidth setting	All	$10\% * (F/F_{BW})^2$, unspecified above $0.3 * F_{BW}$				

MAXIMUM FLOOR ERRORS
Apply to all results as shown below in Amps (generally only significant at low input levels)

Specification	Channel Type	Option H	Option D HI Range	Option D LO Range	Option X HI Range	Option X LO Range
Base Floor Error Apply to all results	A or L	56µA	38µA	250nA	6µV	150nV
	S or W	225µA	150µA	1µA	23µV	600nV
DC Floor Error Apply to DC and RECTIFIED results	A or L	0.23mA	0.15mA	1µA	40µV	5µV
	S	0.45mA	0.3mA	2µA	80µV	6µV
Apply to AC+DC results after multiplying by A_{DC}/A_{AC+DC}	W	0.68mA	0.45mA	3µA	120µV	8µV
AC Floor Error Apply to AC, AC+DC, and RECTIFIED results — MAINS, LF, VLF & $F_{BW} \le 10kHz$	S, A or L	$3.3µA/A_{RDG}$	$1.5µA/A_{RDG}$	$90pA/A_{RDG}$	$35nV/A_{RDG}$	$20pV/A_{RDG}$
	W	$5µA/A_{RDG}$	$2.5µA/A_{RDG}$	$125pA/A_{RDG}$	$50nV/A_{RDG}$	$50pV/A_{RDG}$
AVIONICS & $F_{BW} \le 50kHz$	S, A or L	$33µA/A_{RDG}$	$15µA/A_{RDG}$	$0.9nA/A_{RDG}$	$350nV/A_{RDG}$	$200pV/A_{RDG}$
	W	$50µA/A_{RDG}$	$25µA/A_{RDG}$	$1.25nA/A_{RDG}$	$500nV/A_{RDG}$	$500pV/A_{RDG}$
Otherwise	S, A or L	$330µA/A_{RDG}$	$150µA/A_{RDG}$	$9nA/A_{RDG}$	$3.5µV/A_{RDG}$	$2nV/A_{RDG}$
	W	$500µA/A_{RDG}$	$250µA/A_{RDG}$	$12.5nA/A_{RDG}$	$5µV/A_{RDG}$	$5nV/A_{RDG}$
Peak Floor Error Apply to PK, VLY and PK-VLY results — MAINS, LF, VLF & $F_{BW} \le 10kHz$	S, A or L	8mA	5mA	40µA	0.75mV	25µV
	W	10mA	6.5mA	50µA	0.9mV	30µV
AVIONICS & $F_{BW} \le 50kHz$	S, A or L	25mA	17mA	125µA	2.5mV	65µV
	W	30mA	20mA	150µA	3mV	80µV
Otherwise	S, A or L	75mA	50mA	400µA	7.5mV	200µV
	W	90mA	60mA	500µA	10mV	250µV
Common Mode Error Apply to all results Apply using voltage on A LO terminal relative to chassis ground. Error has 90° phase shift to common-mode voltage	All	500pA per V.Hz (5.75µA@230V/50Hz)	400pA per V.Hz (4.6µA@230V/50Hz)	20pA per V.Hz (0.23µA@230V/50Hz)	15nV per V.Hz (0.172mV@230V/50Hz)	0.5nV per V.Hz (5.75µV@230V/50Hz)
Adjacent Channel Error Apply to all results Apply using adjacent channel A LO or V LO terminal voltage relative to chassis ground. Error has 90° phase shift to adjacent channel voltage	All	150pA per V.Hz (1.725µA@230V/50Hz)	120pA per V.Hz (1.38µA@230V/50Hz)	7pA per V.Hz (80.5nA@230V/50Hz)	7nV per V.Hz (80.5µV@230V/50Hz)	0.2nV per V.Hz (2.3µV@230V/50Hz)

SECONDARY CURRENT MEASUREMENT ACCURACY TABLE

Specification	Channel Type	Option H	Option D HI Range	Option D LO Range	Option X HI Range	Option X LO Range
Crest Factor Error	All	(Total Current Floor Error from preceding table for PK results) / A_{AC}				
Form Factor Error	All	(Total Current Floor Error from preceding table for AC+DC results) / $A_{RECTIFIED}$				
Multi-Channel Error For similar current level and phase in each phase.	A_N (2ø3w)	All — Relevant Current Errors from preceding table for $A_{øA}$ + Relevant Current Errors from preceding table for $A_{øB}$ + 0.0005% of $(A_{øA} + A_{øB})*F$				
	$A_{øC}$ (3ø3w 2ch)	All — Relevant Current Errors from preceding table for $A_{øA}$ + Relevant Current Errors from preceding table for $A_{øB}$ + 0.0015% of $(A_{øA} + A_{øB})*F$				
	A_N (3ø4w)	All — Relevant Current Errors from preceding table for $A_{øA}$ + Relevant Current Errors from preceding table for $A_{øB}$ + Relevant Current Errors from preceding table for $A_{øC}$ + 0.0015% of $(A_{øA} + A_{øB} + A_{øC})*F$				
Harmonic or Spectrum Error		All — AC Current Errors from preceding table at A and F of the harmonic or spectrum point + $(H/N)^2*0.3\%$ of reading + (if not fundamental) from below using the frequency of the harmonic or spectrum point				
	<10kHz	A or L — 0.006% of A_{AC+DC}				
	10k-115kHz	— 0.05% of A_{AC+DC}				
	<10kHz	S — 0.01% of A_{AC+DC}				
	10k-115kHz	— 0.05% of A_{AC+DC}				
	<10kHz	W — 0.015% of A_{AC+DC}				
	10k-115kHz	— 0.03% of A_{AC+DC}				
	115k-435kHz	— 0.08% of A_{AC+DC}				
Current-Voltage Fundamental Phase Error	S, A or L	0.005° + 0.015°*F				
	W	0.005° + 0.007°*F				
Harmonic-Fundamental Phase Error (typical, BANDWIDTH configured as UNFILTERED)	S, A or L	0.02°+0.1°*F+0.001°*H				
	W	0.02°+0.03°*F+0.001°*H				
%THD Error Errors shown are all expressed in %THD units.		All — $(0.005+0.000025*N)*\%THD+0.00005*N*\sqrt{N}$ + from below using the frequency of highest included harmonic				
	<10kHz	A or L	0.015+0.2/A_{AC}	0.015+0.15/A_{AC}	0.015+0.001/A_{AC}	0.015+0.025/A_{AC}	0.015+0.0006/A_{AC}
	10k-115kHz		0.15+2/A_{AC}	0.15+1.5/A_{AC}	0.15+0.01/A_{AC}	0.15+0.25/A_{AC}	0.15+0.006/A_{AC}
	<10kHz	S	0.025+0.2/A_{AC}	0.025+0.15/A_{AC}	0.025+0.001/A_{AC}	0.025+0.025/A_{AC}	0.025+0.0006/A_{AC}
	10k-115kHz		0.15+2/A_{AC}	0.15+1.5/A_{AC}	0.15+0.01/A_{AC}	0.15+0.25/A_{AC}	0.15+0.006/A_{AC}
	<10kHz	W	0.03+0.25/A_{AC}	0.03+0.18/A_{AC}	0.03+0.0012/A_{AC}	0.03+0.03/A_{AC}	0.03+0.001/A_{AC}

	10k-115kHz	$0.06+2.5/A_{AC}$	$0.06+1.8/A_{AC}$	$0.06+0.012/A_{AC}$	$0.06+0.3/A_{AC}$	$0.06+0.01/A_{AC}$
	115k-435kHz	$0.15+2.5/A_{AC}$	$0.15+1.8/A_{AC}$	$0.15+0.012/A_{AC}$	$0.15+0.3/A_{AC}$	$0.15+0.01/A_{AC}$

WATTS, VAR AND VA MEASUREMENT SPECIFICATIONS

PRIMARY WATTS, VAR AND VA MEASUREMENT ACCURACY TABLE

Add relevant errors from the table below for the maximum error in all Watts, VA and VAR measurements except harmonic Watts. Note that by definition DC Watts and DC VA are identical, and DC VAR is zero.

MAXIMUM SCALING ERRORS						
Apply to all results as shown below as a percentage of the reading If signal contains significant levels at multiple frequencies, apply to each level & frequency						
Specification	Channel Type	Option H	Option D HI Range	Option D LO Range	Option X HI Range	Option X LO Range
Base Scaling Error Apply to all results	A or L	0.045%				
	S or W	0.15% (0.3% if 2ms LF/PERIOD)				
Frequency Dependent Scaling Error Apply to AC component of all results other than DC or MAINS	LF or VLF — S, A or L	0.01%				
	LF or VLF — W	0.05%				
	AVIONICS — A or L	0.005%				
	AVIONICS — S or W	None				
	<10kHz — S, A or L	F*0.006%				
	<10kHz — W	F*0.0025%				
	10k-40kHz — S, A or L	0.06%+(F-10)*0.014%				
	10k-40kHz — W	F*0.0025%				
	40k-100kHz — S, A or L	0.48%+(F-40)*0.032%				
	40k-100kHz — W	0.1%+(F-40)*0.005%			0.1%+(F-40)*0.0055%	
	100k-1MHz — S, A or L	Typically $(F/1100)^2$*150%				
	100k-1MHz — W	0.4%+(F-100)*0.018%			0.43%+(F-100)*0.02%	
	>1MHz — W	Typically $(F/5000)^2$*150%			Typically $(F/3000)^2$*150%	
Self-Heating Scaling Error Apply as % of Power reading to all results using voltage and current Self-Heating Errors from previous tables	All	Add Voltage and Current Self-Heating Errors				
Temperature Scaling Error Apply to all results if outside of ±5C from calibration temperature	All	0.005% per C outside of ±5C from calibration temperature				
Bandwidth Limit Scaling Error Apply to AC component of all results if using USER bandwidth setting	All	20%*$(F/F_{BW})^2$, unspecified above 0.3*F_{BW}				
MAXIMUM FLOOR ERRORS						
Apply to all results as shown below in Watts, VA or VAR as applicable (generally only significant at low input levels)						
Specification	Channel Type	Option H	Option D HI Range	Option D LO Range	Option X HI Range	Option X LO Range
Base Floor Error Apply to all results	L	$(V_{AC+DC}*56\mu A)$ + $(A_{AC+DC}*45\mu V)$	$(V_{AC+DC}*38\mu A)$ + $(A_{AC+DC}*45\mu V)$	$(V_{AC+DC}*250nA)$ + $(A_{AC+DC}*45\mu V)$	$(V_{AC+DC}*6\mu A)$ + $(A_{AC+DC}*45\mu V)$	$(V_{AC+DC}*0.15\mu A)$ + $(A_{AC+DC}*45\mu V)$
	A	$(V_{AC+DC}*56\mu A)$ + $(A_{AC+DC}*450\mu V)$	$(V_{AC+DC}*38\mu A)$ + $(A_{AC+DC}*450\mu V)$	$(V_{AC+DC}*250nA)$ + $(A_{AC+DC}*450\mu V)$	$(V_{AC+DC}*6\mu A)$ + $(A_{AC+DC}*450\mu V)$	$(V_{AC+DC}*0.15\mu A)$ + $(A_{AC+DC}*450\mu V)$
	S or W	$(V_{AC+DC}*225\mu A)$ + $(A_{AC+DC}*1.8mV)$	$(V_{AC+DC}*150\mu A)$ + $(A_{AC+DC}*1.8mV)$	$(V_{AC+DC}*1\mu A)$ + $(A_{AC+DC}*1.8mV)$	$(V_{AC+DC}*23\mu A)$ + $(A_{AC+DC}*1.8mV)$	$(V_{AC+DC}*0.6\mu A)$ + $(A_{AC+DC}*1.8mV)$
DC Floor Error Apply to DC and AC+DC results using the Voltage and Current DC Floor Errors from previous tables	All	$(V_{DC}*Current\ DC\ Floor\ Error)$ + $(A_{DC}*Voltage\ DC\ Floor\ Error)$ + $(Current\ DC\ Floor\ Error*Voltage\ DC\ Floor\ Error)$				
AC Floor Error (VA and VAR only) Apply to AC and AC+DC VA & VAR results using voltage and current AC Floor Errors from previous tables	All	$(V_{AC}*Current\ AC\ Floor\ Error)$ + $(A_{AC}*Voltage\ AC\ Floor\ Error)$				
Common Mode Error (VA and VAR only) Apply to AC component of VA and VAR results using the Voltage and Current Common Mode Errors from previous tables.	All	$(V_{AC}*Current\ Common\ Mode\ Error)$ + $(A_{AC}*Voltage\ Common\ Mode\ Error)$				
Common Mode Error (Watts only) Apply to AC component of Watts results using the Voltage Common Mode Error from previous table	All	$(A_{AC}*Voltage\ Common\ Mode\ Error)$				
Adjacent Channel Error Apply to AC component of all results using the Voltage and Current Adjacent Channel Errors from previous tables	All	$(V_{AC}*Current\ Adjacent\ Channel\ Error)$ + $(A_{AC}*Voltage\ Adjacent\ Channel\ Error)$				
Phase Floor Error (Watts only) Apply to AC and AC+DC Watts results	S, A or L	$VA_{FUND}*(PF_{FUND} - \cos(\cos^{-1}(PF_{FUND}) + 0.015°*F))$ Alternately, as a worst case (at PF=0) this can expressed as F*0.028% of VA				
	W	$VA_{FUND}*(PF_{FUND} - \cos(\cos^{-1}(PF_{FUND}) + 0.007°*F))$ Alternately, as a worst case (at PF=0) this can expressed as F*0.013% of VA				
Phase Floor Error (VAR only) Apply to all VAR results	S, A or L	$VA_{FUND}*(1 - PF_{FUND} - \cos(\cos^{-1}(1-PF_{FUND}) + 0.015°*F))$ Alternately, as a worst case (at PF=1) this can expressed as F*0.028% of VA				
	W	$VA_{FUND}*(1 - PF_{FUND} - \cos(\cos^{-1}(1-PF_{FUND}) + 0.007°*F))$ Alternately, as a worst case (at PF=1) this can expressed as F*0.013% of VA				

HARMONIC WATTS MEASUREMENT ACCURACY TABLE

Specification	Channel Type	Option H	Option D HI Range	Option D LO Range	Option X HI Range	Option X LO Range
Harmonic or Spectrum Watts Error	All	AC Watts Errors other than Phase Floor Error from preceding table at levels and F of the harmonic or spectrum point $+ (H/N)^2*0.5\%$ of reading $+$ from below using the frequency of the harmonic or spectrum point				
	A or L	<10kHz	$0.006\% + (0.004\%+0.028\%*F)/PF$			
		10k-115kHz	$0.05\% + (0.004\%+0.028\%*F)/PF$			
	S	<10kHz	$0.01\% + (0.004\%+0.028\%*F)/PF$			
		10k-115kHz	$0.05\% + (0.004\%+0.028\%*F)/PF$			
	W	<10kHz	$0.015\% + (0.004\%+0.013\%*F)/PF$			
		10k-115kHz	$0.03\% + (0.004\%+0.013\%*F)/PF$			
		115k-435kHz	$0.08\% + (0.004\%+0.013\%*F)/PF$			

POWER FACTOR MEASUREMENT SPECIFICATIONS

PF MEASUREMENT ACCURACY TABLE

Add relevant errors from the table below for the maximum error in PF measurements. For PF_{FUND} apply only the Base Floor and Phase Errors.

Note:

DC PF is 1.0 by definition and has no error; the table below applies to AC, AC+DC and FUND PF results.

Specification	Channel Type	Option H	Option D HI Range	Option D LO Range	Option X HI Range	Option X LO Range
Base Floor Error Apply to all PF results	L	$(56\mu A/A_{AC+DC}) + (45\mu V/V_{AC+DC})$	$(38\mu A/A_{AC+DC}) + (45\mu V/V_{AC+DC})$	$(250nA/A_{AC+DC}) + (45\mu V/V_{AC+DC})$	$(6\mu A/A_{AC+DC}) + (45\mu V/V_{AC+DC})$	$(0.15\mu A/A_{AC+DC}) + (45\mu V/V_{AC+DC})$
	A	$(56\mu A/A_{AC+DC}) + (450\mu V/V_{AC+DC})$	$(38\mu A/A_{AC+DC}) + (450\mu V/V_{AC+DC})$	$(250nA/A_{AC+DC}) + (450\mu V/V_{AC+DC})$	$(6\mu A/A_{AC+DC}) + (450\mu V/V_{AC+DC})$	$(0.15\mu A/A_{AC+DC}) + (450\mu V/V_{AC+DC})$
	S or W	$(225\mu A/A_{AC+DC}) + (1.8mV/V_{AC+DC})$	$(150\mu A/A_{AC+DC}) + (1.8mV/V_{AC+DC})$	$(1\mu A/A_{AC+DC}) + (1.8mV/V_{AC+DC})$	$(23\mu A/A_{AC+DC}) + (1.8mV/V_{AC+DC})$	$(0.6\mu A/A_{AC+DC}) + (1.8mV/V_{AC+DC})$
AC Floor Error Apply to all PF results using voltage and current AC Floor Error from previous tables, this error always causes a reduced PF reading	All	$-PF_{RDG}*((Current\ AC\ Floor\ Error/A_{RDG}) + (Voltage\ AC\ Floor\ Error/V_{RDG}))$				
DC Floor Error Apply to AC+DC PF result after multiplying by (1-PF)	L	$(0.23mA/A_{AC+DC}) + (0.1mV/V_{AC+DC})$	$(0.15mA/A_{AC+DC}) + (0.1mV/V_{AC+DC})$	$(1\mu A/A_{AC+DC}) + (0.1mV/V_{AC+DC})$	$(40\mu A/A_{AC+DC}) + (0.1mV/V_{AC+DC})$	$(5\mu A/A_{AC+DC}) + (0.1mV/V_{AC+DC})$
	A	$(0.23mA/A_{AC+DC}) + (1mV/V_{AC+DC})$	$(0.15mA/A_{AC+DC}) + (1mV/V_{AC+DC})$	$(1\mu A/A_{AC+DC}) + (1mV/V_{AC+DC})$	$(40\mu A/A_{AC+DC}) + (1mV/V_{AC+DC})$	$(5\mu A/A_{AC+DC}) + (1mV/V_{AC+DC})$
	S	$(0.45mA/A_{AC+DC}) + (3mV/V_{AC+DC})$	$(0.3mA/A_{AC+DC}) + (3mV/V_{AC+DC})$	$(2\mu A/A_{AC+DC}) + (3mV/V_{AC+DC})$	$(80\mu A/A_{AC+DC}) + (3mV/V_{AC+DC})$	$(6\mu A/A_{AC+DC}) + (3mV/V_{AC+DC})$
	W	$(0.68mA/A_{AC+DC}) + (5mV/V_{AC+DC})$	$(0.45mA/A_{AC+DC}) + (5mV/V_{AC+DC})$	$(3\mu A/A_{AC+DC}) + (5mV/V_{AC+DC})$	$(120\mu A/A_{AC+DC}) + (5mV/V_{AC+DC})$	$(8\mu A/A_{AC+DC}) + (5mV/V_{AC+DC})$
Phase Error Apply to all PF results	S, A or L	$(PF_{FUND} - \cos(\cos^{-1}(PF_{FUND}) \pm 0.015°*F))$ Alternately, as a worst case (at PF=0) this can expressed as $F*0.00028$				
	W	$(PF_{FUND} - \cos(\cos^{-1}(PF_{FUND}) \pm 0.007°*F))$ Alternately, as a worst case (at PF=0) this can expressed as $F*0.00013$				

FREQUENCY MEASUREMENT SPECIFICATIONS

Frequency Range	FUND setting of MAINS: 45Hz to 65Hz
	FUND setting of AVIONICS: 300Hz to 900Hz
	Otherwise-
	LF/PERIOD setting of VLF: 0.0099Hz to 65Hz
	LF/PERIOD setting of LF: 0.19Hz to 1kHz
	LF/PERIOD setting of 300ms period: 9Hz to 305kHz (W channel type) or 80kHz (other channel types)
	LF/PERIOD setting of 100ms period: 19Hz to 305kHz (W channel type) or 80kHz (other channel types)
	LF/PERIOD setting of 20ms period: 44Hz to 305kHz (W channel type) or 80kHz (other channel types)
	LF/PERIOD setting of 10ms period: 145Hz to 305kHz (W channel type) or 80kHz (other channel types)
	LF/PERIOD setting of 2ms period: 495Hz to 305kHz (W channel type) or 80kHz (other channel types)
	If BANDWIDTH set to USER setting then upper limit is 0.5*setting
DC Level	DC offset is automatically eliminated
Min. Input (typical)	Voltage: 0.5Vrms (W, S or A channel type) or 75mVrms (L channel type) at fundamental
	Current, H option: 0.05Arms at fundamental
	Current, D option: 0.04Arms (HI range) or 0.3mArms (LO range) at fundamental
	Current, X option: 5mVrms (HI range) or 150µVrms (LO range) at fundamental
Min. Pulse Width (typical)	Greater of -
	1.25µs (W channel type) or 5µs (other channel types)

	0.001% of measurement period
	10% of signal period
Update Period (nominal)	As shown below for FREQ SPEED settings of FAST/NORMAL/SLOW respectively -
	LF/PERIOD setting of VLF: greater of 1/2/15s or 1 cycle
	LF/PERIOD setting of LF: greater of 1/1/5s or 1 cycle
	LF/PERIOD setting of 300ms period: 0.25s/0.75s/2s
	LF/PERIOD setting of 100ms period: 55ms/250ms/1s
	LF/PERIOD setting of 20ms period: 25ms/200ms/700ms
	LF/PERIOD setting of 10ms period: 10ms/100ms/300ms
	LF/PERIOD setting of 2ms period: 2ms/50ms/150ms
Resolution (nominal)	W Channel Type: 0.000125%/Update Period in seconds
	Otherwise: 0.0005%/Update Period in seconds
Maximum Error	0.01% + Resolution
Settling Time (nominal)	Greater of (x2 if significant DC content) -
	a) 2 amplitude periods
	b) 2 frequency measurement periods
	c) 4 cycles of the signal

MECHANICAL CHANNEL INPUT AND ACCURACY SPECIFICATIONS (MT TYPE)

Specifications are valid under the following conditions-

- All specifications are valid following a 20 minute warm-up period after turning power ON in the PA900, when operated from the specified source of power and within the specified environmental conditions.

- All specifications other than Analog Input Measurement Specifications are valid for the lifetime of the PA900; Analog Input Measurement Specifications are valid for 2 years after calibration.

- All specifications are valid at the PA900 terminals.

Note:

The No Damage input signal range is that which will not cause immediate damage. Continued use of these levels may reduce reliability and/or future accuracy.

The Specified input signal range is that of continuously applied signal levels for which measurements are guaranteed to be within the specified accuracies.

Accuracy specifications are guaranteed maximum errors. You should round the total maximum error upwards to the next integer count of resolution (e.g. if the total error is 18.3mV and the data is read with 1mV resolution then use 19mV as the maximum error).

All percentages are % of reading unless otherwise described.

INPUT CAPABILITIES AND CHARACTERISTICS

Input Terminals	SPD (Speed) : BNC (isolated from PA900 chassis), configurable as analog or digital input
	TRQ (Torque) : BNC (isolated from PA900 chassis), configurable as analog or digital input
	DIR (Direction) : BNC (isolated from PA900 chassis), digital input
Input Common-Mode	Up to -15Vpk to +15Vpk specified
	Up to -30Vpk to +30Vpk with no damage
Analog Input Range	Up to -12Vdc to +12Vdc specified
	Up to -15Vpk to +15Vpk specified
	Up to -30Vpk to +30Vpk with no damage
Digital Input Range	LO: <0.8V (nominal)
	HI: >2V (nominal)
	Up to -30Vpk to +30Vpk with no damage
Input Impedance	Each input nominally 150kΩ to PA900 chassis ground

DIGITAL INPUT MEASUREMENT SPECIFICATIONS

Digital Frequency Timing	Signal must be LO for >500ns
	Signal must be HI for >500ns
	Frequency measurement up to 500kHz (typically 900kHz)
	Minimum measurable frequency limited by user set measurement period
DIR Setup/Hold Timing	DIR must be stable for >550ns prior to and after active edge of SPD input

| Maximum Frequency Error | Measurement Period >10ms: 0.01% |
| | Measurement Period ≤10ms: 0.015% |

ANALOG INPUT MEASUREMENT SPECIFICATIONS

| Maximum Input Error | 0.05% + 1mV |
| | Add (0.005% + 50μV) per C outside of ±5C from calibration temperature |

ANALYSIS SPECIFICATIONS

Specifications are valid under the following conditions-

- All specifications are valid following a 20 minute warm-up period after turning power ON in the PA900, when operated from the specified source of power and within the specified environmental conditions.
- All specifications are valid for the lifetime of the PA900.

Note:

All percentages are % of reading unless otherwise described.

INTEGRATION SPECIFICATIONS

Start Delay Time	Zero to 99 days, 99 hours, 99 minutes, 99 seconds (1 second resolution)
	0.01% + 8ms maximum error
Integration Time	Manual (unrestricted period of time), or 1 second to 99 days, 99 hours, 99 minutes, 99 seconds
	0.01% + 1ms maximum error
Maximum Data Error	(0.01% + 1ms) (not for integrated average data) + (0.03/measurement period in seconds)% per year

HARMONIC ANALYSIS SPECIFICATIONS

Method	DFT performed at each frequency on same set of sampled signals (there is no discontinuity throughout the analysed frequency range)
Window	F > (2/measurement period): Hann (also called Hanning)
	Otherwise: Rectangular
Maximum Harmonic	The smaller of -
	a) A frequency of 435kHz (W type channels) or 115kHz (otherwise)
	b) 500th (harmonics over the 100th requires option H500)
	c) HARMONICS setting
	d) If BANDWIDTH set to USER: 0.5*setting/fundamental frequency
Harmonic Bandwidth	Nominally the greater of-
	a) The smaller of fundamental frequency or 2/(LF/PERIOD measurement period)
	b) If FUND set to AVIONICS: 20Hz
	c) (Fundamental Frequency*Maximum Harmonic/2250)
Measurement Period	Nominally (1/Harmonic Bandwidth)
Update Interval	Nominally the greater of -
	a) LF/PERIOD measurement period
	b) Harmonic Measurement Period (from above)
	c) 0.25ms x Σ(Maximum Harmonic for each channel configured for harmonics)
Data Available	Volts, Amps and Watts amplitudes for each configured harmonic
	Volts and Amps as a percentage of the fundamental of the same signal
	Volts and Amps THD as a percentage of the fundamental of the same signal
	Volts and Amps THD as a percentage of the AC+DC amplitude of the same signal
	V and A Phase of fundamental relative to the voltage fundamental of the lowest numbered channel in the VPA
	V and A Phase of each non-fundamental harmonic relative to the fundamental of the same signal
Accuracy	See relevant Voltage, Current and Watts accuracy specifications

SPECTRUM ANALYSIS SPECIFICATIONS

Method	DFT performed at each frequency on same set of sampled signals (there is no discontinuity throughout the analysed frequency range)
Window	Hann (also called Hanning)
Frequency Resolution	0.01Hz to 1kHz
Measurement Period	Nominally (1/ Frequency Resolution)

Maximum Frequency	Minimum is 100 x Frequency Resolution
	Maximum is the lowest of nominally -
	a) 16384 x Frequency Resolution (under some circumstances as low as 8192 x Frequency Resolution)
	b) 435kHz (W type channels) or 115kHz (otherwise)
Data Available	Volts, Amps and Watts amplitudes for each configured spectrum frequency
Accuracy	See relevant Voltage, Current and Watts accuracy specifications

CYCLE VIEW SPECIFICATIONS

Signal Range	As specifications for Voltage and Current
Cycle Period	From 2.3us (W type channels), 8.7us (otherwise) up to 100 seconds
Time Resolution	$1/512^{th}$ of a cycle
Method	Mean cycle formed by asynchronously sampling all cycles within measurement period
Maximum Error	As Voltage and Current Specifications for PK data (Watts = multiplication of V and A waveforms)

SCOPE SPECIFICATIONS

Signal Range	As specifications for Voltage and Current
Timebase	1/2/5 settings from 5us/div to 20s/div
Capture Depth	Up to 32k points per signal
Capture Resolution	<0.00005% of specified maximum measurable peak Voltage or Current
Sampling Period (nominal)	Greater of -
	$1.1\mu s$ (W type channels) or $4.1\mu s$ (otherwise)
	0.03% of timebase setting
Maximum Error	As Voltage and Current Specifications for PK data (Watts = multiplication of V and A waveforms)

HISTORICAL DATA COLLECTION SPECIFICATIONS

Collection Time	Automatically continuously variable between 1 measurement period and 584.5 million years (collection is automatically stopped after this time has elapsed but this is untested at the time of writing)
Time Resolution	Note: this is the resolution by which you can determine when an event occurred, not that of the PA900 detecting events. All events are captured.
	The greater of-
	a) 1 pixel of displayed data (front panel) or 1 increment of the requested time interval (interface)
	b) 1 measurement period of the data being recorded
	c) A maximum of $1/4096^{th}$ of the elapsed historical data collection time (typically $1/8192^{th}$).
Data Capture	Every measurement is included in the maximum, average and minimum data for each increment of the time resolution interval regardless of the time resolution.

DATA LOGGING SPECIFICATIONS

Logged Measurements	Up to 16 measurement data per record (each of which can be 1 measurement or up to 500 harmonic measurements)
Data per Record	Up to 8003 data per record
Internal FIFO Buffer	32Mbyte (always in binary format, 4 bytes per data)
Internal Memory	≥2Gbyte (always in binary format, 4 bytes per data) non-volatile
	Typically 5Mbytes/sec maximum sustained mean write rate
External Data File Format	ASCII (CSV, scientific format) or Binary
Timestamp	Record number + optional date and time (1 second resolution)
Maximum File Size	4Gbyte
Maximum Records	Only limited by maximum file size
Start Delay Time	Zero to 99 days, 99 hours, 99 minutes, 99 seconds (1 second resolution)
	0.01% + 8ms maximum error
Run Time	Manual (unrestricted period of time), or 1 second to 99 days, 99 hours, 99 minutes, 99 seconds (1 second resolution)
	0.01% + 8ms maximum error
Log Interval	0.002 second, or 0.01 second to 99 hours, 99 minutes, 99.99 seconds (0.01 second resolution)
	0.01% maximum error ± 2ms non-accumulating error