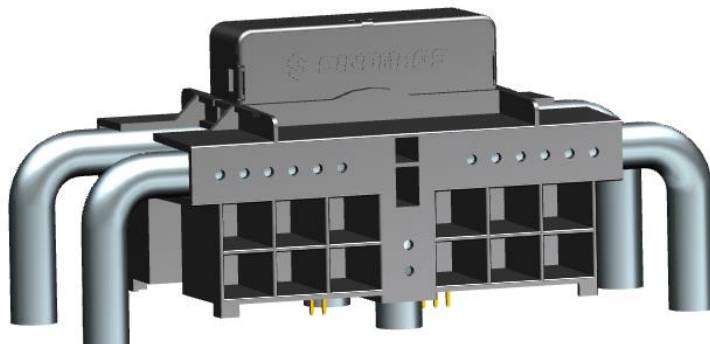


CURRENT SENSOR

PRODUCT SERIES: SFG-X.XP/L5
SFG-0.6P/L5
SFG-1.0P/L5
PRODUCT PART NUMBER: SFG-3.0P/L5
SFG-5.0P/L5
SFG-6.0P/L5

Version: Ver 1.5



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1. Description

Features

- Closed loop (compensated) current transducer
- Voltage output
- Insulation voltage for 5 kVAC
- Single supply voltage
- PCB mounting.

Advantages

- High accuracy
- High overload capability
- High insulation capability
- High separation ability
- Low temperature drift
- Degauss and test functions

Applications

- Residual current measurement
- Leakage current measurement in PV inverters
- First human contact protection of PV arrays
- Failure detection in power sources
- Leakage current detection in stacked DC sources
- Communication power.

1. Absolute parameter: SFG-X.XP/L5

Absolute maximum ratings

Parameter	Symbol	Unit	Value
Maximum Supply voltage	$V_{C\ max}$	V	7
Maximum Primary conductor temperature	$T_{B\ max}$	°C	110
Maximum overload capability (100 μ s, 500 A/ μ s)	$\hat{I}_{P\ max}$	A	3300
Maximum Voltage between test winding and secondary pins	$V_{d\ max}$	V	35
Maximum Current of test winding	$I_{T\ max}$	mA	300

Ratings

Parameter	Symbol	Unit	Value
Primary involved potential		V AC/DC	1000
Primary current @ $T_{Amax}=105^{\circ}C$	I_P	A	305
Primary current @ $T_{Amax}=85^{\circ}C$	I_P	A	340

Isolation parameters

Parameter	Symbol	Unit	Value	Remark
RMS voltage for AC	V_d	kV	5.1	test 50 Hz/1 min
Impulse withstand voltage	V_w	kV	6	1.2/50 μ s
Clearance distance (pri. –pri.)	d_{Cl}	mm	17.3	Shortest distance through air
Creepage distance (pri. – pri.)	d_{Cp}	mm	22	Shortest path along device body
Clearance distance (pri. –sec.)	d_{Cl}	mm	14.1	When mounted on PCB with recommended layout
Creepage distance (pri. –sec.)	d_{Cp}	mm	14.1	When mounted on PCB with recommended layout
Comparative tracking index	CTI	V	600	
Application example		V	600 CAT III, PD2	Reinforced insulation, non uniform field
Application example		V	1500 CAT III, PD2	Basic insulation, non uniform field

Environmental and mechanical characteristics

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Ambient operating temperature	T_A	°C	-40		105	
Ambient storage temperature	T_S	°C	-40		105	
Mass	m	g		300		
standard	EN 50178, IEC 61010, UL 508					

2. Electrical data: SFG-0.6P/L5

At $T_A = 25\text{ }^\circ\text{C}$, $V_C = 5\text{ V}$.

Parameters	Symbol	Unit	Min	Typ	Max	Remark
Primary nominal residual rms current	I_{PN}	A		0.6		
Primary residual current, measuring range	I_{PM}	A	-0.85		0.85	
Supply voltage	V_C	V	4.75	5	5.25	
Current consumption	I_C	mA		17.5	21.6	$I_P(\text{mA}) / N_a$ $N_a = 1000\text{ turns}$ - $40\text{ }^\circ\text{C} \dots 105\text{ }^\circ\text{C}$
Reference voltage @ $I_P = 0$	V_{ref}	V	2.495	2.5	2.505	Internal reference
External reference voltage	V_{REF}	V	2.3		4	Internal reference of V_{ref} input = $499\ \Omega$
Electrical offset current referred to primary	I_{OE}	mA	-24	4.2	24	
Temperature coefficient of VOE @ $I_P = 0$	TCV_{OE}	ppm/K			± 520	ppm/K of 2.5 V - $40 \dots 105\text{ }^\circ\text{C}$
Theoretical sensitivity	G_{th}	V/A		2.476		
Sensitivity error	ϵ_G	%	-1.6	0.5	1.6	$R_L > 500\text{ k}\Omega$
Temperature coefficient of G	TCG	ppm/K			± 100	- $40\text{ }^\circ\text{C} \dots 105\text{ }^\circ\text{C}$
Linearity error	ϵ_L	%		0.4	1.3	
Number of turns (test winding)	N_T			20		$R_L > 500\text{ k}\Omega$, $di/dt > 5\text{ A}/\mu\text{s}$
Reaction time @ 10 % of I_{PRN}	t_{ra}	μs		5		$R_L > 500\text{ k}\Omega$, $di/dt > 5\text{ A}/\mu\text{s}$
Step response time to 90 % of I_{PN}	t_r	μs		40		$R_L > 500\text{ k}\Omega$
Frequency bandwidth (-3dB)	BW	kHz		15		$R_L > 500\text{ k}\Omega$
Noise(1 Hz ~ 10 kHz)	V_{no}	mV rms		10		
Accuracy @ I_{PN} @ $T_A = 25\text{ }^\circ\text{C}$	$X_{25\text{ }^\circ\text{C}}$	% of I_{PN}		± 1.9		
Accuracy @ I_{PN} @ $T_A = 105\text{ }^\circ\text{C}$	$X_{105\text{ }^\circ\text{C}}$	% of I_{PN}		± 3.2		

3. Electrical data: SFG-1.0P/L5

At $T_A = 25\text{ }^\circ\text{C}$, $V_C = 5\text{ V}$.

Parameters	Symbol	Unit	Min	Typ	Max	Remark
Primary nominal residual rms current	I_{PN}	A		1		
Primary residual current, measuring range	I_{PM}	A	-1.7		1.7	
Supply voltage	V_C	V	4.75	5	5.25	
Current consumption	I_C	mA		17.5	21.6	$I_P(\text{mA}) / N_a$ $N_a = 1000\text{ turns}$ - $40\text{ }^\circ\text{C} \dots 105\text{ }^\circ\text{C}$
Output voltage referred to V_{ref} (Test current)	V_{out}	V	0.2	0.35	0.5	
Reference voltage @ $I_P = 0$	V_{ref}	V	2.495	2.5	2.505	Internal reference
External reference voltage	V_{REF}	V	2.3		4	Internal reference of V_{ref} input = $499\ \Omega$
Electrical offset current referred to primary	I_{OE}	mA	-24	7	24	
Temperature coefficient of VOE @ $I_P = 0$	TCV_{OE}	ppm/K		± 50	± 500	ppm/K of 2.5 V - $40 \dots 105\text{ }^\circ\text{C}$
Theoretical sensitivity	G_{th}	V/A		1.2		
Sensitivity error	ϵ_G	%	-1.6	0.5	1.6	$R_L > 500\text{ k}\Omega$
Temperature coefficient of G	TCG	ppm/K			± 400	- $40\text{ }^\circ\text{C} \dots 105\text{ }^\circ\text{C}$
Linearity error	ϵ_L	%		0.5	1	
Number of turns (test winding)	N_T			20		$R_L > 500\text{ k}\Omega$, $di/dt > 5\text{ A}/\mu\text{s}$
Reaction time @ 10 % of I_{PRN}	t_{ra}	μs		7		$R_L > 500\text{ k}\Omega$, $di/dt > 5\text{ A}/\mu\text{s}$
Step response time to 90 % of I_{PN}	t_r	μs		50		$R_L > 500\text{ k}\Omega$, $di/dt > 5\text{ A}/\mu\text{s}$
Frequency bandwidth (-3dB)	BW	kHz		15		$R_L > 500\text{ k}\Omega$
Noise(1 Hz ~ 10 kHz)	V_{no}	mV rms		10		$R_L > 500\text{ k}\Omega$
Accuracy @ I_{PN} @ $T_A = 25\text{ }^\circ\text{C}$	$X_{25\text{ }^\circ\text{C}}$	% of I_{PN}		± 1.9		
Accuracy @ I_{PN} @ $T_A = 105\text{ }^\circ\text{C}$	$X_{105\text{ }^\circ\text{C}}$	% of I_{PN}		± 3.2		

4. Electrical data: SFG-3.0P/L5

At $T_A = 25\text{ }^\circ\text{C}$, $V_C = 5\text{ V}$.

Parameters	Symbol	Unit	Min	Typ	Max	Remark
Primary nominal residual rms current	I_{PN}	A		3		
Primary residual current, measuring range	I_{PM}	A	-5		5	
Supply voltage	V_C	V	4.75	5	5.25	
Current consumption	I_C	mA		17.5	21.6	$I_P(\text{mA}) / N_a$ $N_a = 1000\text{ turns}$ - $40\text{ }^\circ\text{C} \dots 105\text{ }^\circ\text{C}$
Reference voltage @ $I_P = 0$	V_{ref}	V	2.495	2.5	2.505	Internal reference
External reference voltage	V_{REF}	V	2.3		4	Internal reference of V_{ref} input = $499\ \Omega$
Electrical offset current referred to primary	I_{OE}	mA	-24	7	24	
Temperature coefficient of VOE @ $I_P = 0$	TCV_{OE}	ppm/K			570	ppm/K of 2.5 V - $40 \dots 105\text{ }^\circ\text{C}$
Theoretical sensitivity	G_{th}	V/A		0.4		
Sensitivity error	ϵ_G	%	-1.6	0.5	1.6	$R_L > 500\text{ k}\Omega$
Temperature coefficient of G	TCG	ppm/K		± 400		- $40\text{ }^\circ\text{C} \dots 105\text{ }^\circ\text{C}$
Linearity error	ϵ_L	%		0.5	1	
Number of turns (test winding)	N_T			20		$R_L > 500\text{ k}\Omega$, $di/dt > 5\text{ A}/\mu\text{s}$
Reaction time @ 10 % of I_{PRN}	t_{ra}	μs		5		$R_L > 500\text{ k}\Omega$, $di/dt > 5\text{ A}/\mu\text{s}$
Step response time to 90 % of I_{PN}	t_r	μs		40		$R_L > 500\text{ k}\Omega$
Frequency bandwidth (-3dB)	BW	kHz		15		$R_L > 500\text{ k}\Omega$
Noise(1 Hz ~ 10 kHz)	V_{no}	mV rms		10		
Accuracy @ I_{PN} @ $T_A = 25\text{ }^\circ\text{C}$	$X_{25\text{ }^\circ\text{C}}$	% of I_{PN}		± 1.9		
Accuracy @ I_{PN} @ $T_A = 105\text{ }^\circ\text{C}$	$X_{105\text{ }^\circ\text{C}}$	% of I_{PN}		± 3.2		

5. Electrical data: SFG-5.0P/L5

At $T_A = 25\text{ }^\circ\text{C}$, $V_C = 5\text{ V}$.

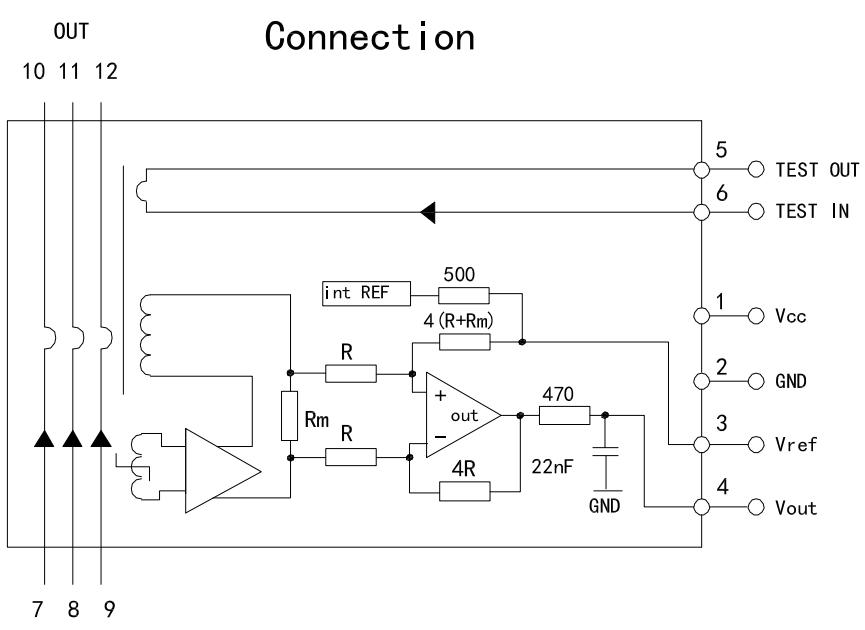
Parameters	Symbol	Unit	Min	Typ	Max	Remark
Primary nominal residual rms current	I_{PN}	A		5		
Primary residual current, measuring range	I_{PM}	A	-10		10	
Supply voltage	V_C	V	4.75	5	5.25	
Current consumption	I_C	mA		17.5	21.6	$I_P(\text{mA}) / N_a$ $N_a = 1000\text{ turns}$ - 40°C ... 105°C
Reference voltage @ $I_P = 0$	V_{ref}	V	2.495	2.5	2.505	Internal reference
External reference voltage	V_{REF}	V	2.3		4	Internal reference of V_{ref} input = 499Ω
Electrical offset current referred to primary	I_{OE}	mA	-75	12	75	
Electrical offset voltage	V_{oe}	mV	-15		15	$(V_{out} - V_{ref})$ @ 0 A
Temperature coefficient of VOE @ $I_P = 0$	TCV_{OE}	ppm/K			570	ppm/K of 2.5 V -40 ... 105 °C
Theoretical sensitivity	G_{th}	V/A		0.2		
Sensitivity error	ϵ_G	%	-1.6	0.5	1.6	$R_L > 500\text{ k}\Omega$
Temperature coefficient of G	TCG	ppm/K		±400		- 40°C ... 105°C
Linearity error	ϵ_L	%		0.5	1	
Number of turns (test winding)	N_T			20		$R_L > 500\text{ k}\Omega$, $di/dt > 5\text{ A}/\mu\text{s}$
Reaction time @ 10 % of I_{PRN}	t_{ra}	μs		5		$R_L > 500\text{ k}\Omega$, $di/dt > 5\text{ A}/\mu\text{s}$
Step response time to 90 % of I_{PN}	t_r	μs			30	$R_L > 500\text{ k}\Omega$
Frequency bandwidth (-3dB)	BW	kHz		15		$R_L > 500\text{ k}\Omega$
Noise(1 Hz ~ 10 kHz)	V_{no}	mV rms		10		
Accuracy@ I_{PN} @TA = 25°C	$X_{25^\circ\text{C}}$	% of I_{PN}		±1.3		
Accuracy@ I_{PN} @TA = 105°C	$X_{105^\circ\text{C}}$	% of I_{PN}		±1.9		

6. Electrical data: SFG-6.0P/L5

At $T_A = 25\text{ }^\circ\text{C}$, $V_C = 5\text{ V}$.

Parameters	Symbol	Unit	Min	Typ	Max	Remark
Primary nominal residual rms current	I_{PN}	A		6		
Primary residual current, measuring range	I_{PM}	A	-10		10	
Supply voltage	V_C	V	4.75	5	5.25	
Current consumption	I_C	mA		17.5	21.6	$I_P(\text{mA}) / N_a$ $N_a = 1000\text{ turns}$ - $40\text{ }^\circ\text{C} \dots 105\text{ }^\circ\text{C}$
Reference voltage @ $I_P = 0$	V_{ref}	V	2.495	2.5	2.505	Internal reference
External reference voltage	V_{REF}	V	2.3		4	Internal reference of V_{ref} input = $499\ \Omega$
Electrical offset current referred to primary	I_{OE}	mA	-75	12	75	
Electrical offset voltage	V_{oe}	mV	-15		15	$(V_{out} - V_{ref})$ @ 0 A
Temperature coefficient of VOE @ $I_P = 0$	TCV_{OE}	ppm/K			570	ppm/K of 2.5 V - $40 \dots 105\text{ }^\circ\text{C}$
Theoretical sensitivity	G_{th}	V/A		0.2		
Sensitivity error	ϵ_G	%	-1.6	0.5	1.6	$R_L > 500\text{ k}\Omega$
Temperature coefficient of G	TCG	ppm/K		± 400		- $40\text{ }^\circ\text{C} \dots 105\text{ }^\circ\text{C}$
Linearity error	ϵ_L	%		0.5	1	
Number of turns (test winding)	N_T			20		$R_L > 500\text{ k}\Omega$, $di/dt > 5\text{ A}/\mu\text{s}$
Reaction time @ 10 % of I_{PRN}	t_{ra}	μs		5		$R_L > 500\text{ k}\Omega$, $di/dt > 5\text{ A}/\mu\text{s}$
Step response time to 90 % of I_{PN}	t_r	μs			30	$R_L > 500\text{ k}\Omega$
Frequency bandwidth (-3dB)	BW	kHz		15		$R_L > 500\text{ k}\Omega$
Noise(1 Hz ~ 10 kHz)	V_{no}	mV rms		10		
Accuracy @ I_{PN} @ $T_A = 25\text{ }^\circ\text{C}$	$X_{25\text{ }^\circ\text{C}}$	% of I_{PN}		± 1.3		
Accuracy @ I_{PN} @ $T_A = 105\text{ }^\circ\text{C}$	$X_{105\text{ }^\circ\text{C}}$	% of I_{PN}		± 1.9		

7. SFG- P/L5 Application information

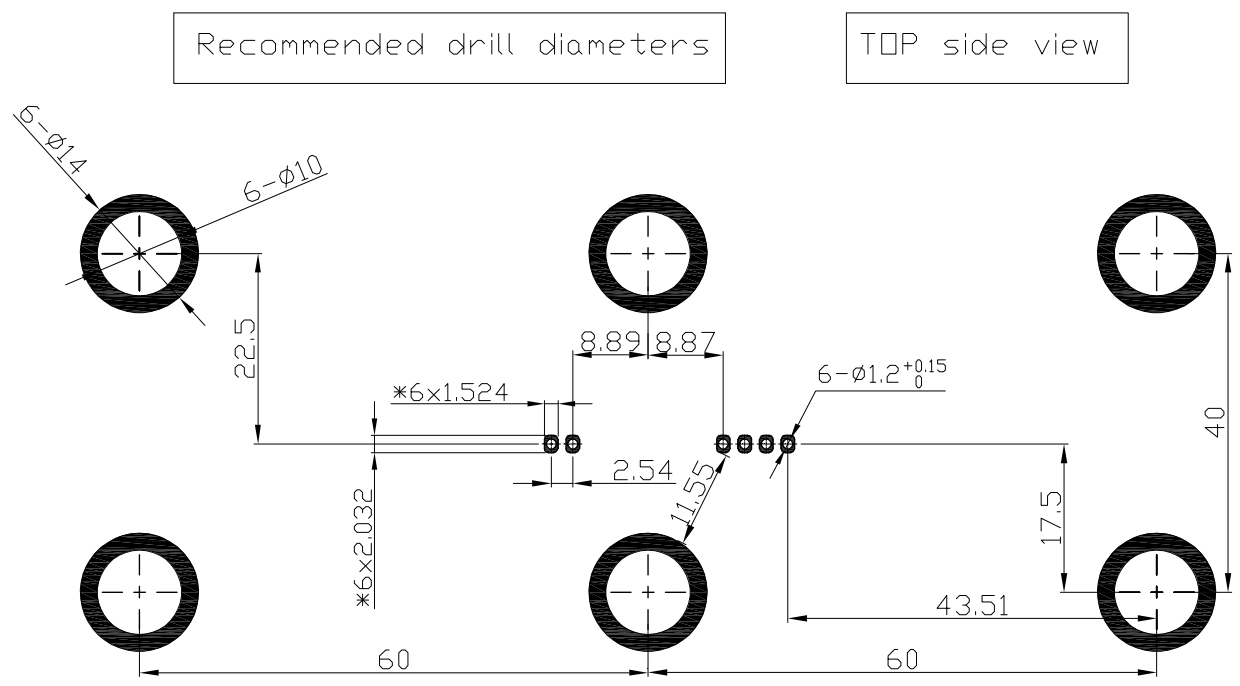


Test winding

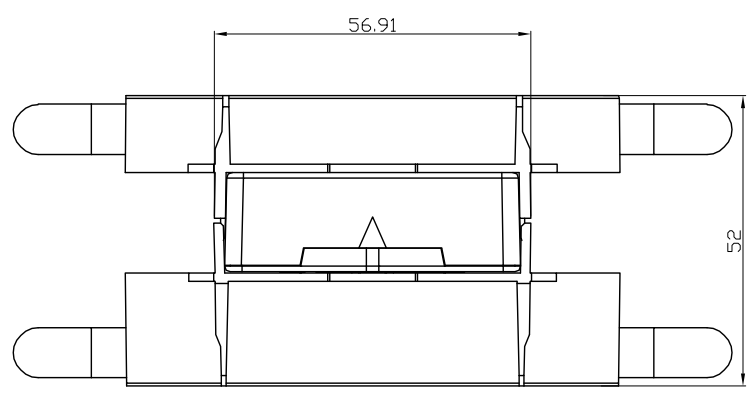
A test winding is wound around the compensation winding. It allows simulating a primary residual current to test the function of the transducer. The output voltage V_{out} referred to V_{ref} for a test current I_T is below.

$$V_{out} - V_{ref} = G_{th} * I_T \text{ (test current)} * 20$$

8. SFG- P/L5 PCB footprint



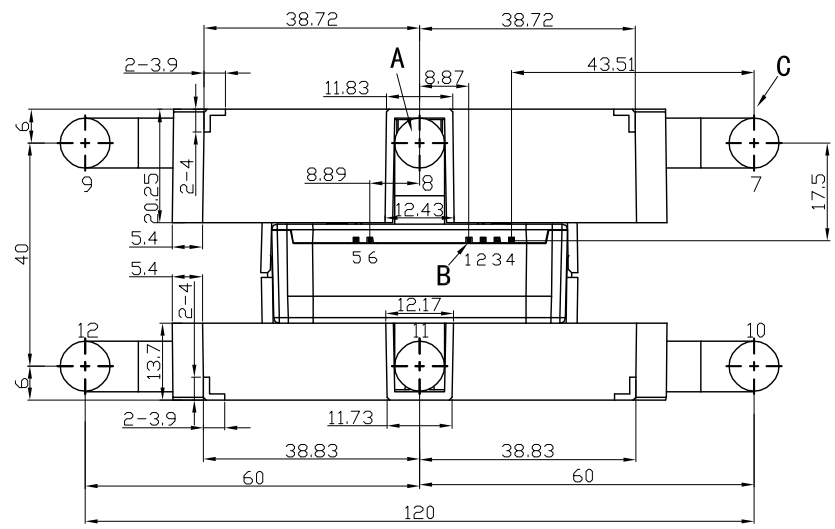
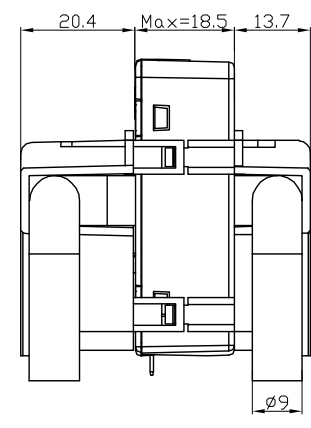
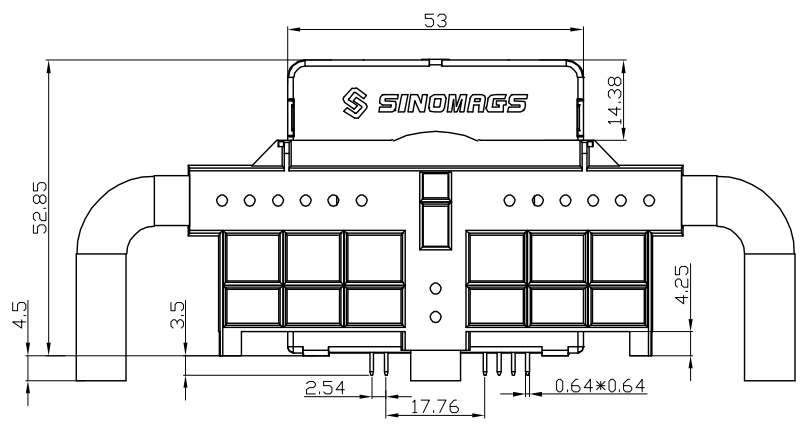
9. SFG- P/L5 Dimensions



	D _{Cl}	D _{CP}
A-B	14.4	—
A-C	15	22
A-D	15	15

D is secondary inside the transducer

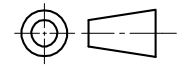
On the customer's PCBA		
	D _{Cl}	D _{CP}
A-B	11.55	11.55
A-C	46	46



Terminals :

1	Vcc	7	I _{p+}
2	GND	8	I _{p+}
3	Vref	9	I _{p+}
4	Vout	10	I _{p-}
5	Test Out	11	I _{p-}
6	Test In	12	I _{p-}

Material : Fit UL94V-0 & RoHS requirements ;
General tolerance : ±0.5
Unit :mm



Assembly on PCB

- Maximum PCB thickness 2.4 mm
- Wave-soldering: 260°C @ 10 s
- Recommended PCB hole diameter 1.2 mm for secondary pin.