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Current Transformers

for Electronic Watt-hour Meters and Electronic Earth Leakage Circuit Breakers

The Solution for High Accuracy on Electronic Watt-hour Meter and Earth Leakage Breaker

AMOSENSE

AMOSENSE Co., Ltd.

Recent advances in the field of power and energy measurements have placed increasingly stringent accuracy requirements on current transformers. Moreover for demanding more moderate size and capacity, applying telemetering system and international meter standard, pre-existing mechanical meters need replacing with electronic method.

AST, ASD series cores meet the requirements of phase and amplitude-error and linearity according the international meter standards (IEC 620xx) with and without DC tolerance in a very easy and economic way.

The properties of the toroidal core current transformers such as maximum transmissible primary current, amplitude and phase error as well as linearity are basically determined by the material used for the magnetic core. The three areas of application mentioned place different demands on the respective materials.

AST series

- Minimal Phase Angle error
- Excellent coupling of primary and secondary currents
- Very low losses
- High Permeability

ASD series

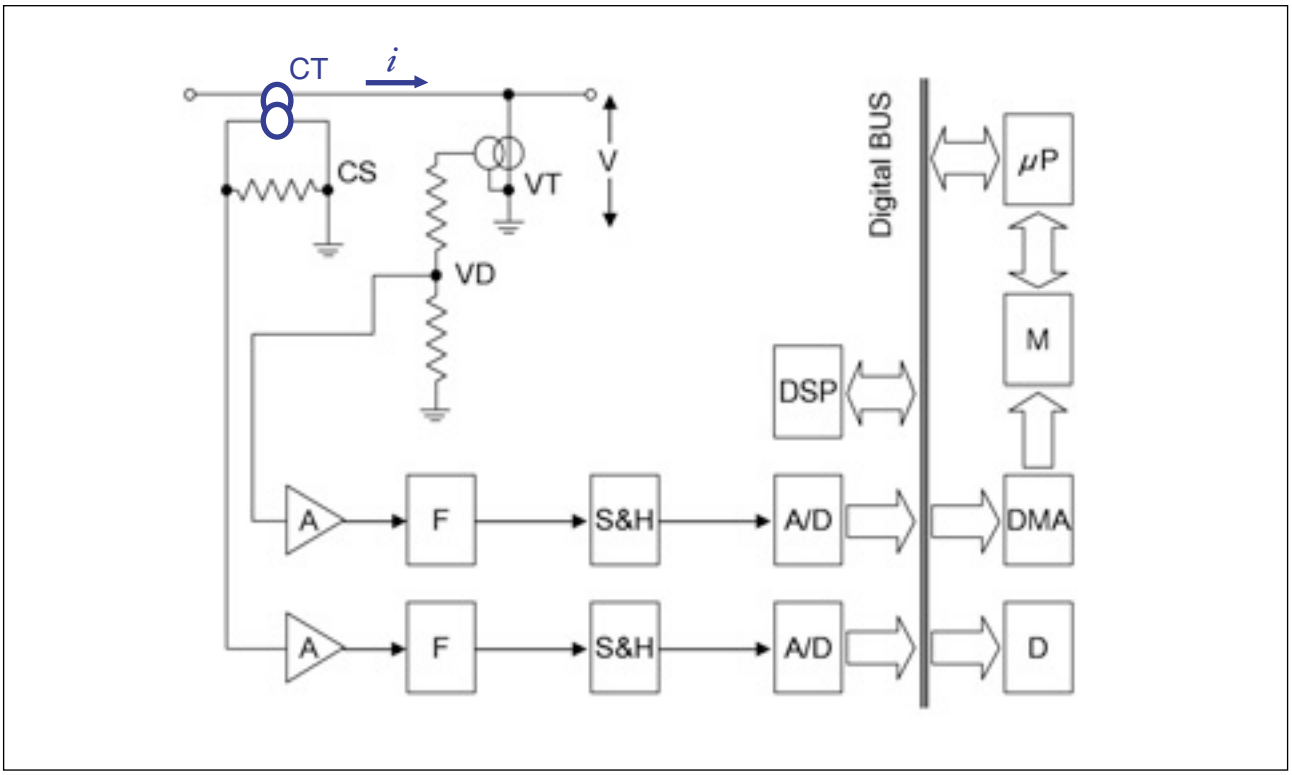
- With DC-tolerance
- High linearity of hysteresis loop and DC-bias properties
- Very low losses

Benefits of Current Transformer

Common features of toroidal shape of core	- No required additional magnetic shielding - Less sensitive to low interference fields - Having long-term stability due to the controlled magnetic function - Needs only small additive circuit elements - Easier assembly than electromechanical ac induction meter
Nanocrystalline Material (Suitable for IEC 62053-22[1] & ANSI C12.xx)	- Very small amplitude error - Very small phase error - Low temperature dependence
Co-based Material (Suitable for IEC 62053-21[2])	- Complaint 'DC tolerance' without air gap - Low temperature dependence - Negligibly small amplitude error

[1] Former standard is for IEC 687 and [2] for IEC 61036

Block diagram of Electronic Watt-hour Meter



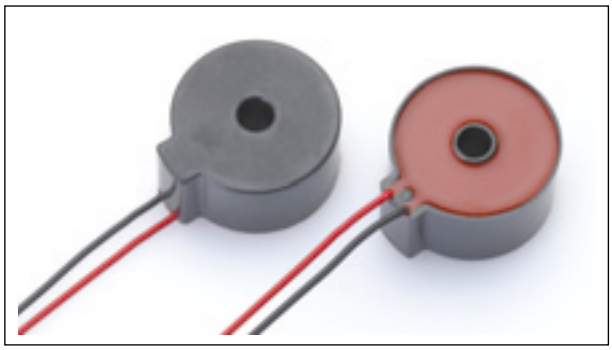
Electronic Watt-hour Meter

CT	: current transformer
CS	: current shunt
VT	: voltage transformer
VD	: voltage divider
A	: analog signal processing block
F	: analog electronic filter
S&H	: sample and hold
A/D	: analog-to-digital converter
DSP	: digital signal processor
D	: display
DMA	: direct memory access circuit
M	: memory
μ P	: microprocessor, CPU

Table 1. Current Transformer Specifications *with DC-tolerance* (according to IEC 62053-21, -23)

P/N	Primary Current Range		Errors		Characteristical Values		
	I_N [A_{rms}]	$I_{DC,max}$ [A_{OP}]	Phase $\varphi(I)$ [°]	Amplitude IF(I)I [%]	L [H]	R_{Cu} [Ω]	R_B [Ω]
ASD-020LB	20	20	6.37	< 0.02	2.6	99	18.75
ASD-040L	40	40	3.42	< 0.03	3.5	60	18.75
ASD-060L	60	60	3.6	< 0.03	2.76	53	12.5
ASD-100L	100	100	4.24	< 0.02	1.86	45	7.5
ASD-120L	120	120	4.01	< 0.04	1.6	36	6.25

Operating frequency 60Hz, transformation ratio 1 : 2500



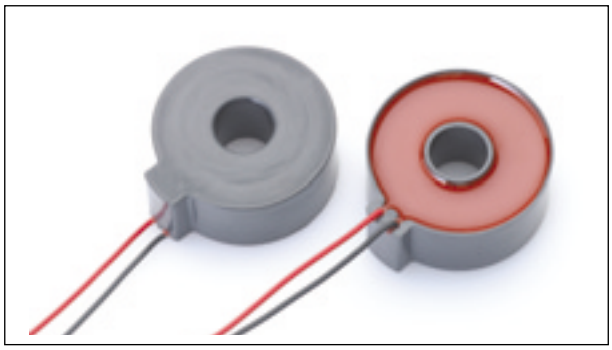
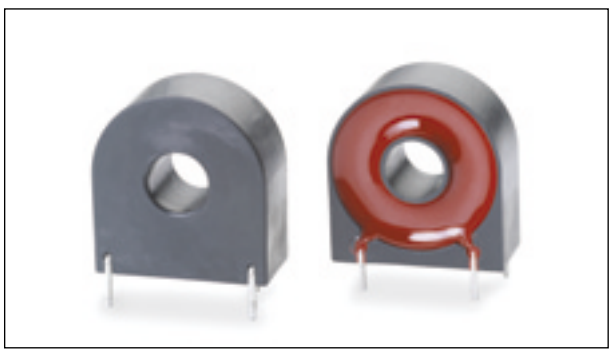


Table 2. Current Transformer Specifications *without DC-tolerance* (according to IEC 62053-22)

P/N	Primary Current Range		Errors		Characteristical Values		
	I_N [A_{rms}]	$I_{DC,max}$ [A_{OP}]	Phase $\varphi(I)$ [°]	Amplitude IF(I)I [%]	L [H]	R_{Cu} [Ω]	R_B [Ω]
AST-005PA/LA	5	-	0.32	< 0.02	183.1	236	150
AST-005P/L	5	-	0.25	< 0.02	183.1	152	150
AST-040PA/LA	40	-	0.21	< 0.01	183.1	236	18.75
AST-040P/L	40	-	0.14	< 0.01	183.1	152	18.75
AST-080P/L	80	-	0.11	< 0.03	225.8	160	9.375
AST-120L	120	-	0.14	< 0.04	180.1	160	6.25

Operating frequency 60Hz, transformation ratio 1 : 2500



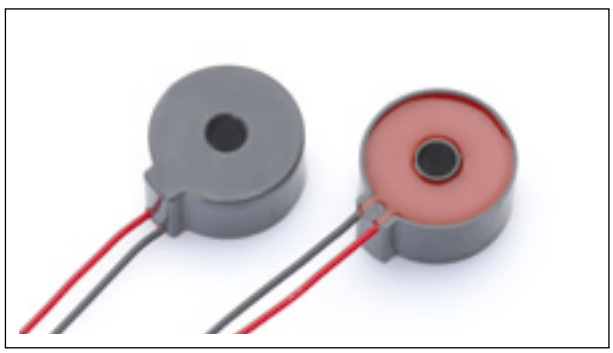


Table 3. Current Transformer Specifications *with DC-tolerance* (according to IEC 62053-21, -23)

P/N	Primary Current Range		Errors		Characteristical Values		
	I_N [A_{rms}]	$I_{DC,max}$ [A_{OP}]	Phase $\varphi(I)$ [°]	Amplitude IF(I)I [%]	L [H]	R_{Cu} [Ω]	R_B [Ω]
ASM-060L	60	60	0.22	< 0.02	117.5	160	12.5
ASM-120LS	120	120	0.11	< 0.01	133	90	6.25

Operating frequency 60Hz, transformation ratio 1 : 2500

Current Transformers standard types

Explanation of Table 1, 2, 3 :

I_N = AC primary current range with defined errors

$I_{DC,max}$ = maximum half wave rectified DC amplitude without saturation

Phase = maximum phase error for $I < I_N$

Amplitude = maximum amplitude error for $I < I_N$

L = maximum inductance in a condition of frequency = 60 Hz and level = 100 mV

R_{Cu} = winding resistance

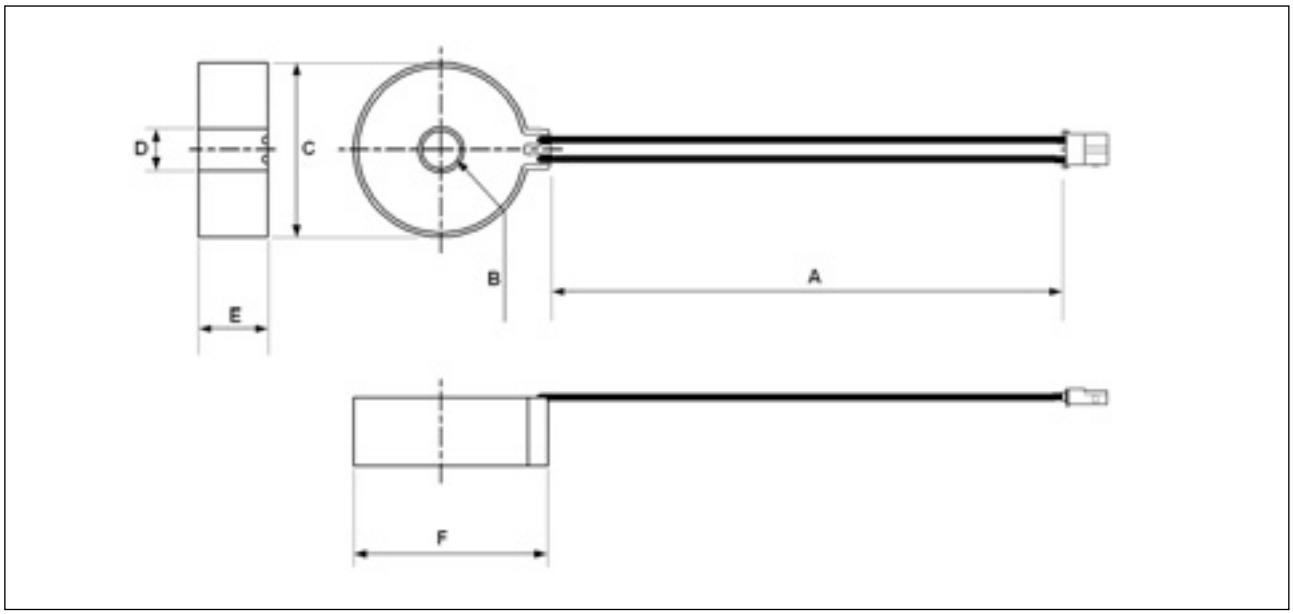
R_B = burden resistor

Explanation of Model name

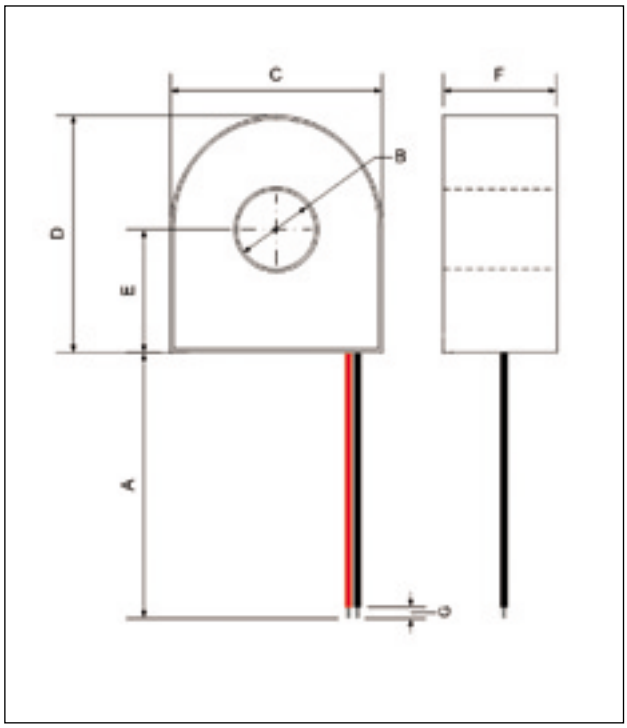
AS□-□□□□□□...

- Extra words (changed spec. etc)
- Terminal structure: L = Lead type; P = Pin type
- Rated current in ampere (rms). The '040' means it measures up to 40 Amperes in rms current (typical).
- Type of DC-tolerance: D = with DC-tolerance; T = without DC-tolerance; M = combind...

Wire Lead Type - Toroidal



Wire Lead Type - Standing



PCB Mount Type

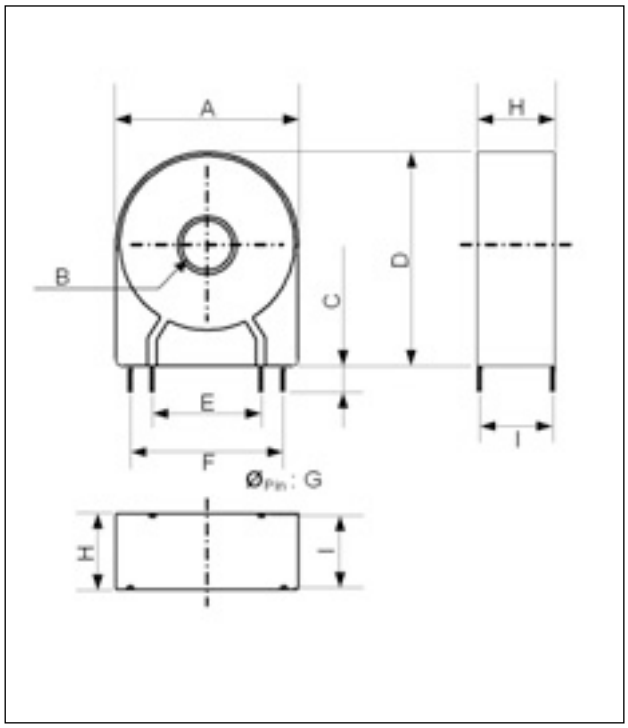


Table 4. Dimensions of Wire Lead Type - Toroidal

Series	P/N	A (±5)	B (min)	C (max)	D (max)	E (max)	F (max)
ASD	ASD-020LB	100	7.25	23.5	7.3	10.97	28.3
	ASD-040L	130	7.1	28	8.7	16.5	31.5
	ASD-060L	130	7.8	31.3	9	15.5	34.3
	ASD-100L	130	9.8	35.4	10.5	15.6	39.65
	ASD-120L	100	14	39	10.4	14.5	44
AST	AST-005L	130	5.7	24.9	8	13.5	27.5
	AST-005LA	130	7.25	23.5	7.3	10.97	28.3
	AST-080L	130	8.5	26.5	8.4	17.5	29.1
	AST-120L	130	11.8	39.5	10.4	18	43.3
ASM	ASM-060L	130	8.5	26.5	8.4	17.5	29.1

The dimensions of AST-005L(A) and AST-040L(A) are the same.

All size shown in 'mm'

Table 4-1. Dimensions of Wire Lead Type - Standing

Series	P/N	A (±5)	B (min)	C (max)	D (max)	E (max)	F (max)	G (max)
ASD	ASD-060L(300mm)	300	7.5	30.3	32	16	14.7	5
AST	AST-080L(300mm)	300	7.5	30.3	32	16	14.7	5
ASM	ASM-120LS	245	12.5	37.7	39	19.85	16	5

All size shown in 'mm'

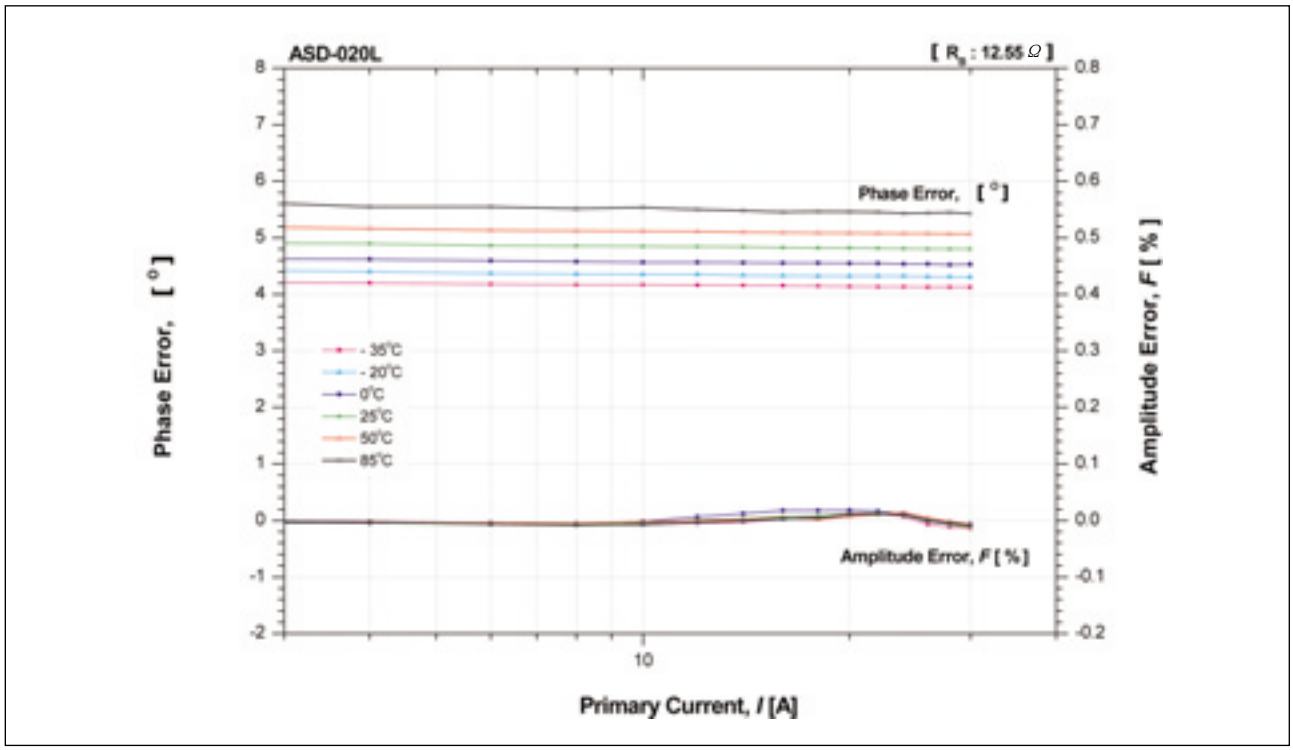
Table 5. Dimensions of PCB Mount Type

Series	P/N	A (max)	B (min)	C (±1)	D (max)	E (±0.3)	F (±0.3)	G (max)	H (max)
AST	AST-005P	24.85	5.65	3	27.4	15	19	1	13.7
	AST-005PA	23.5	7.2	3.5	25.1	15	19	1	11.1
	AST-080P	25.7	8.5	3	27.9	15.1	19.1	1	17.15

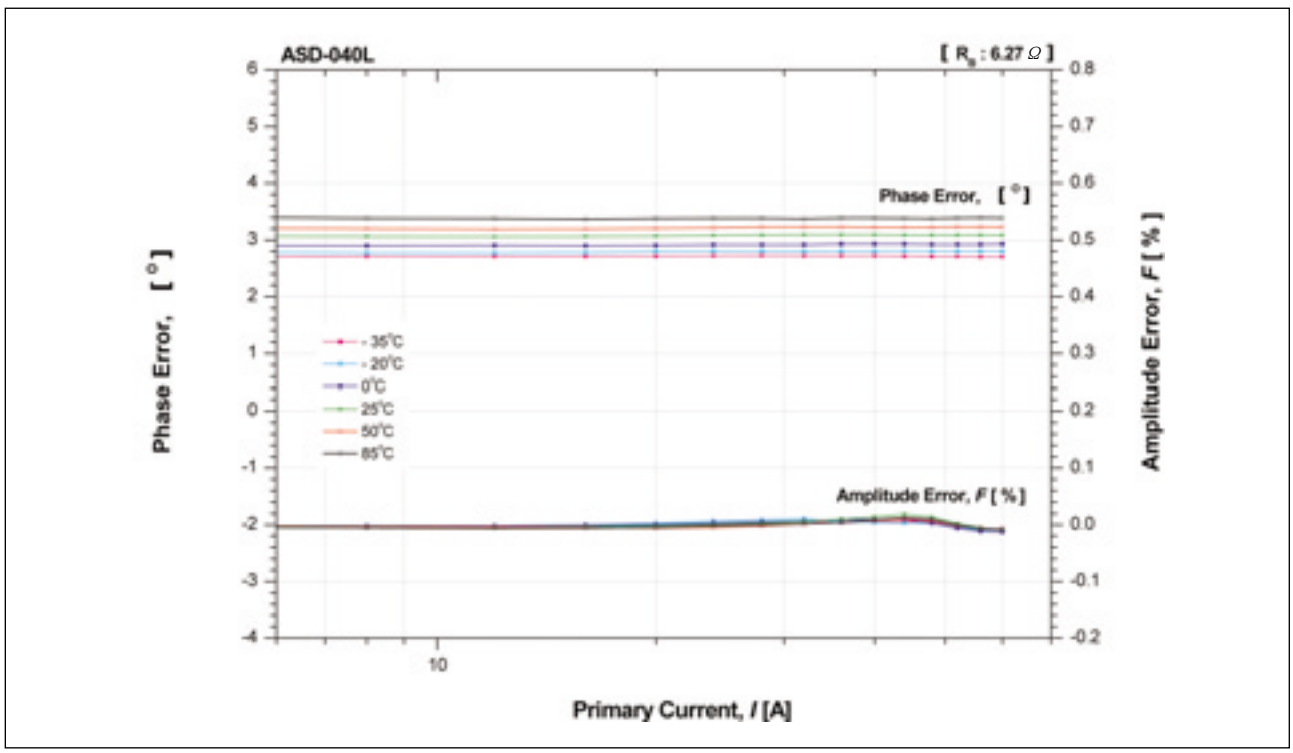
The dimensions of AST-005P(A) and AST-040P(A) are the same.

All size shown in 'mm'

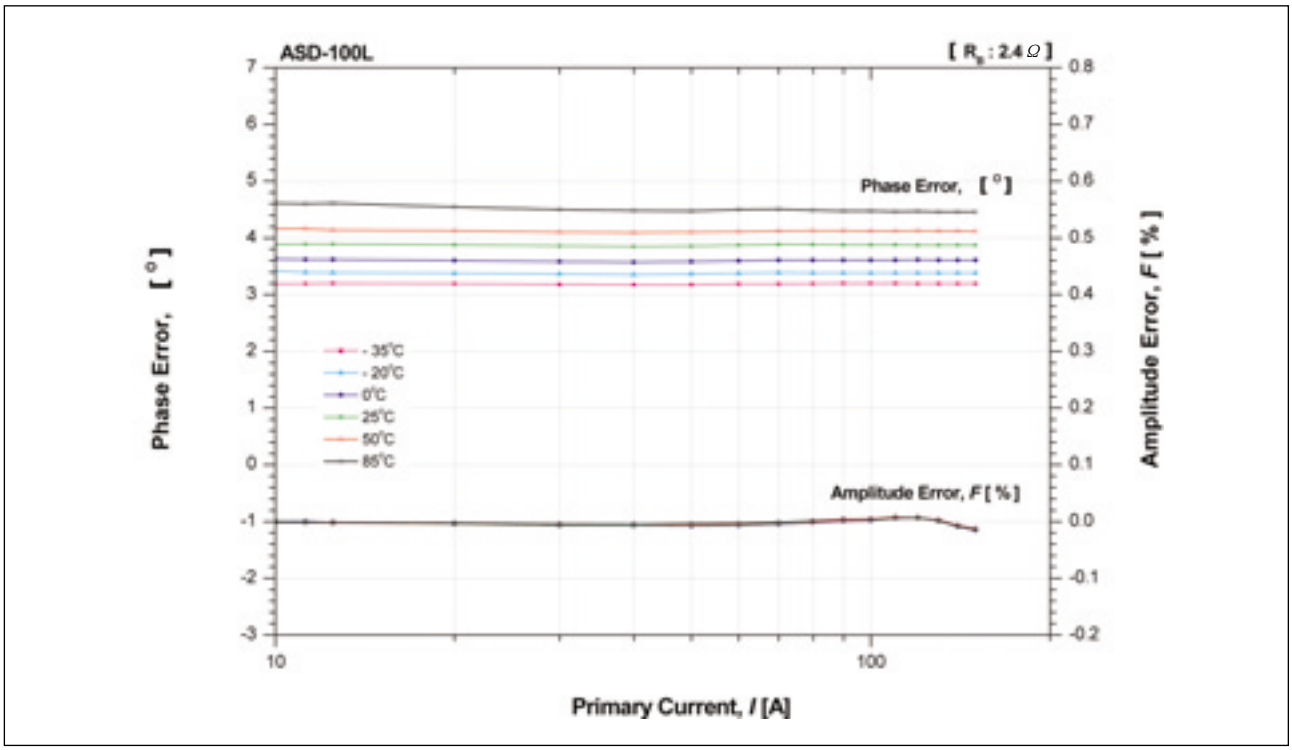
ASD-020L : 20 Ampere Current Transformer Core with DC-tolerance



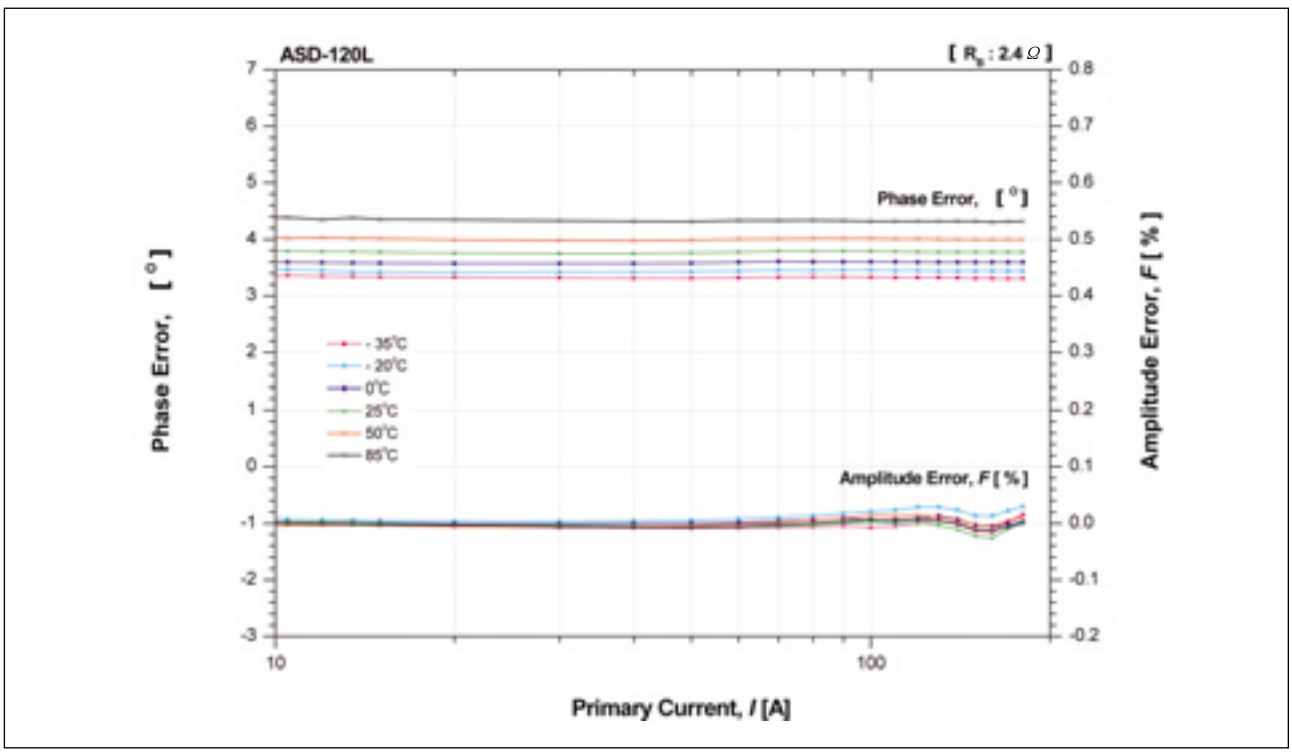
ASD-040L : 40 Ampere Current Transformer Core with DC-tolerance



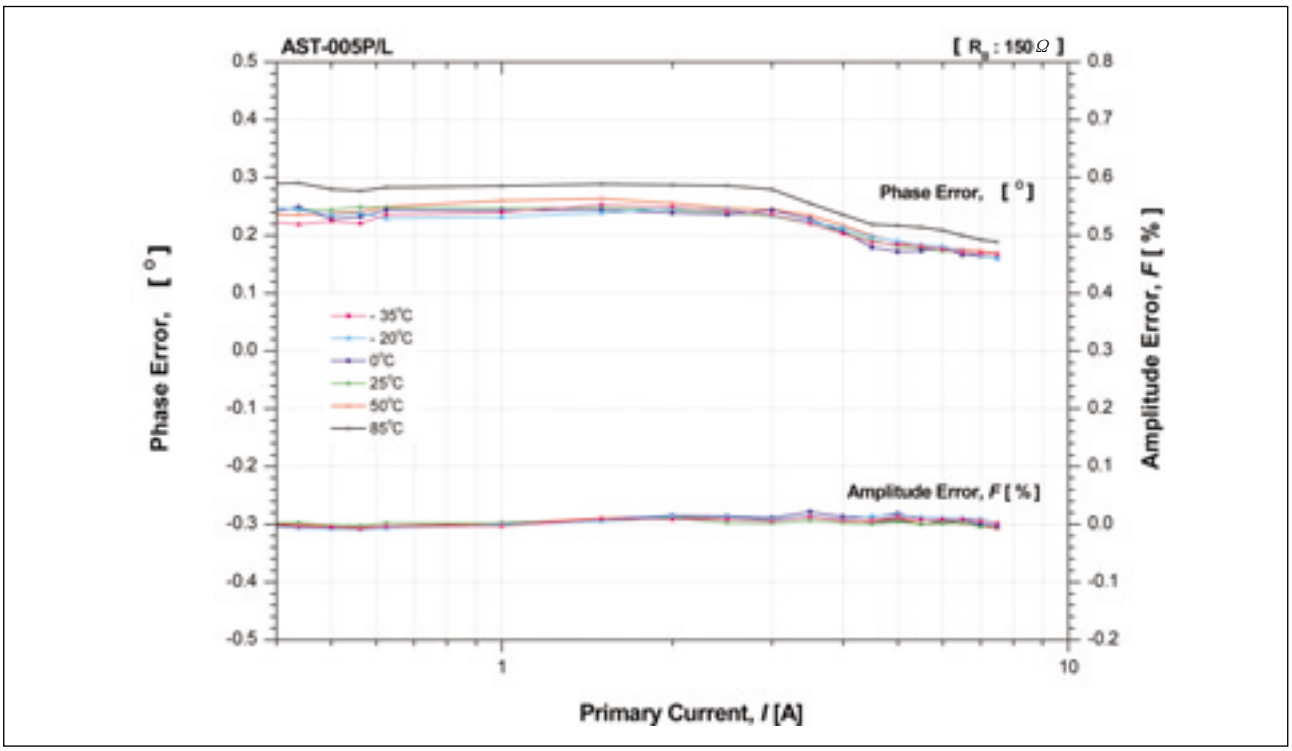
ASD-100L : 100 Ampere Current Transformer Core with DC-tolerance



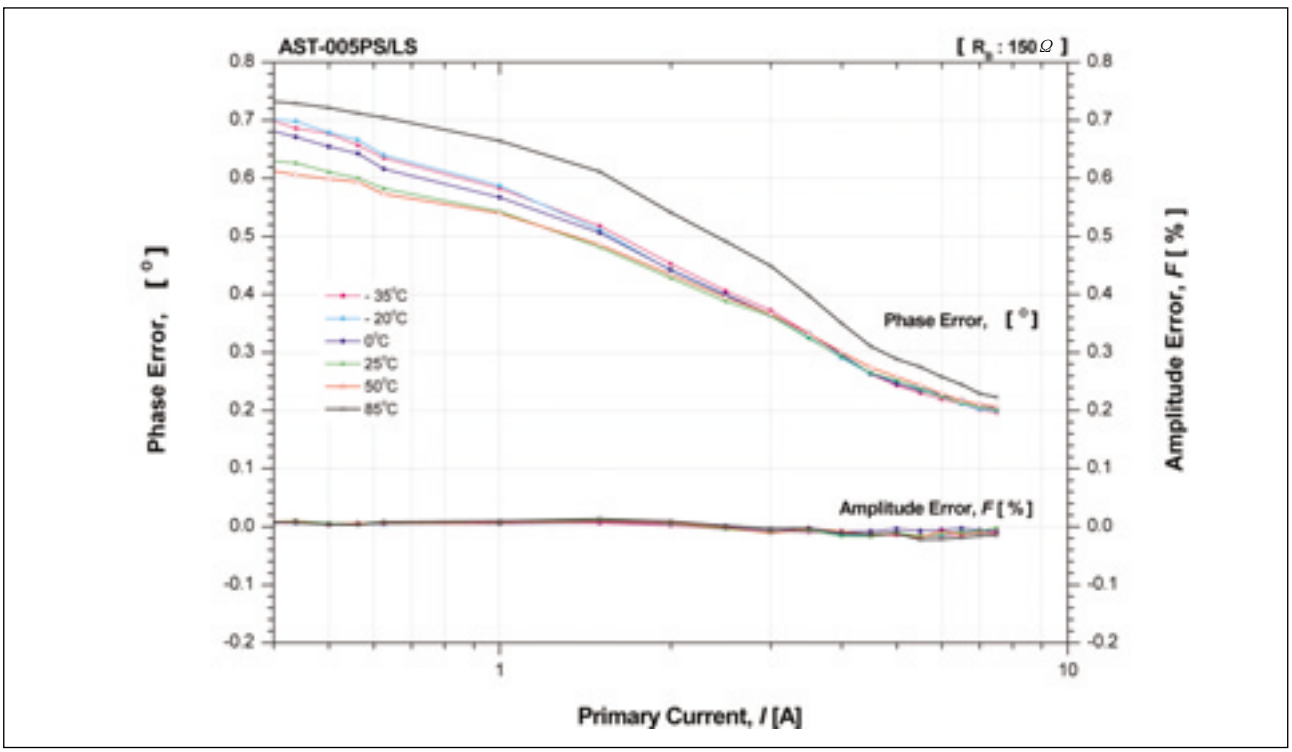
ASD-120L : 120 Ampere Current Transformer Core with DC-tolerance



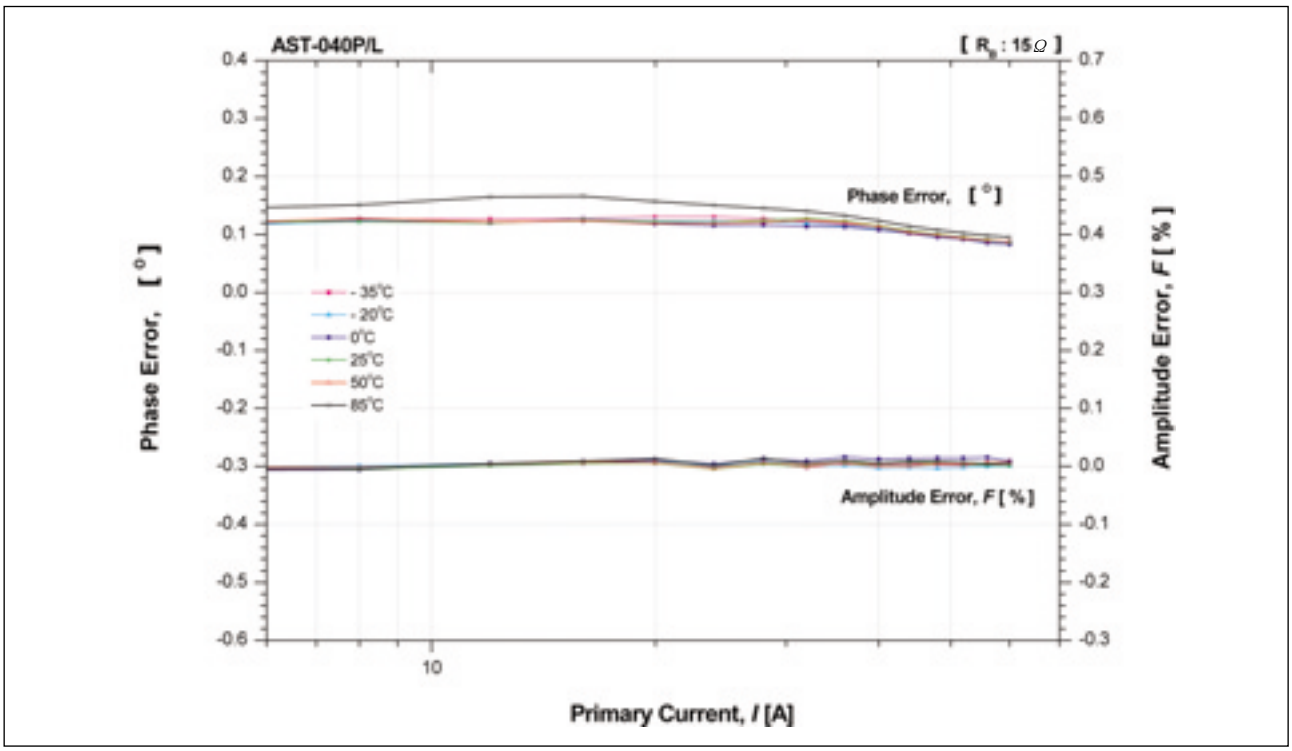
AST-005P/L : 5 Ampere Current Transformer Core without DC-tolerance



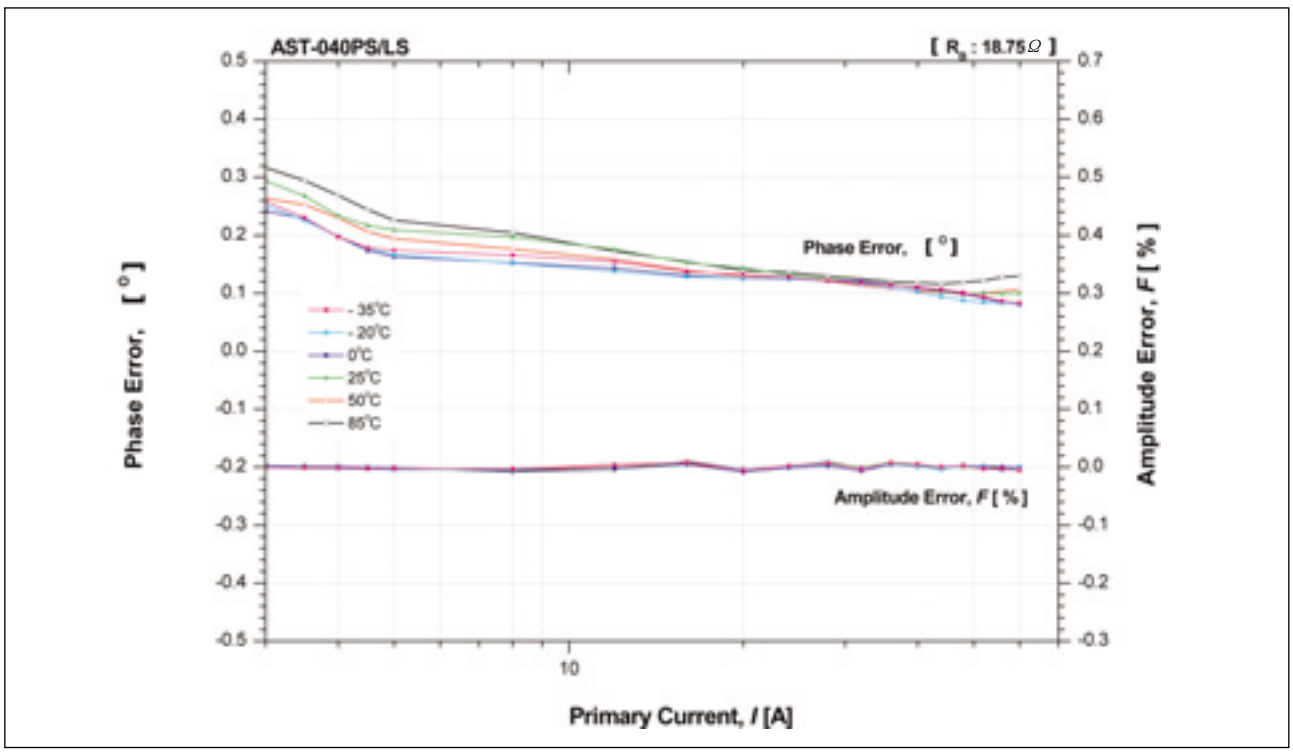
AST-005PS/LS : 5 Ampere Current Transformer Core without DC-tolerance



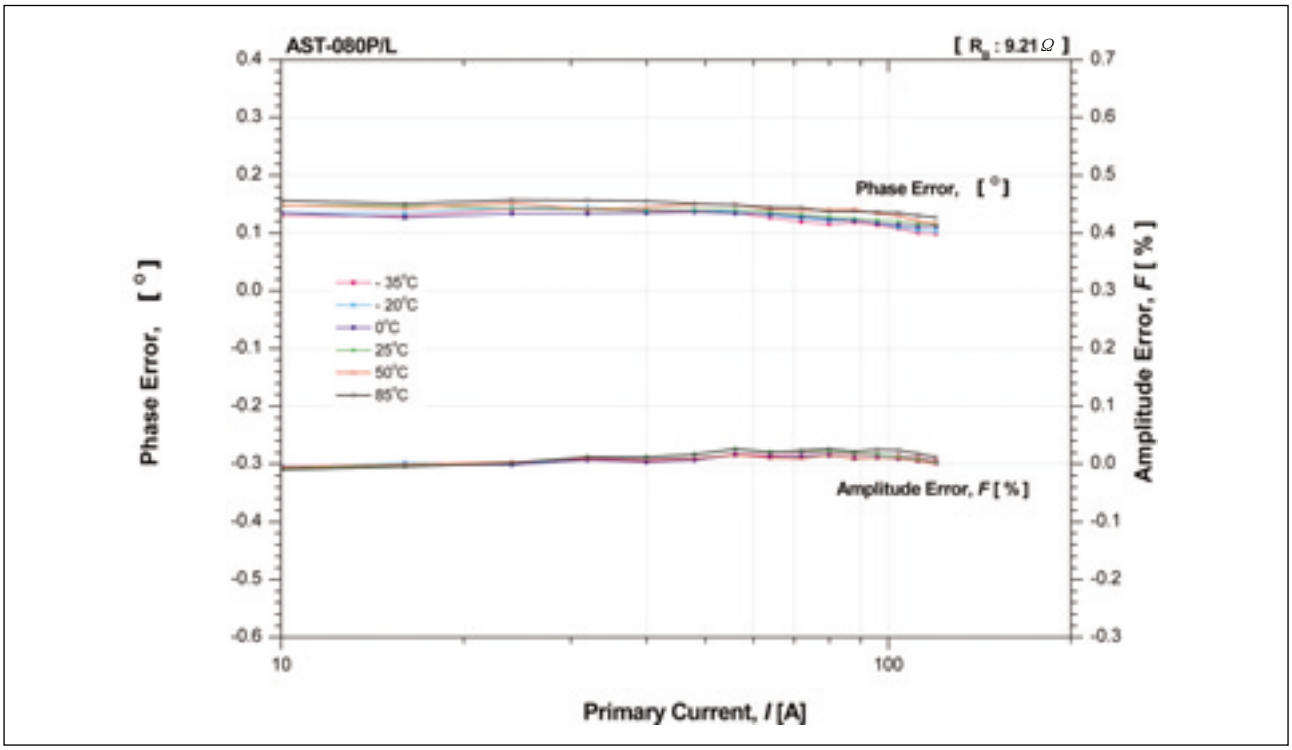
AST-040P/L : 40 Ampere Current Transformer Core without DC-tolerance



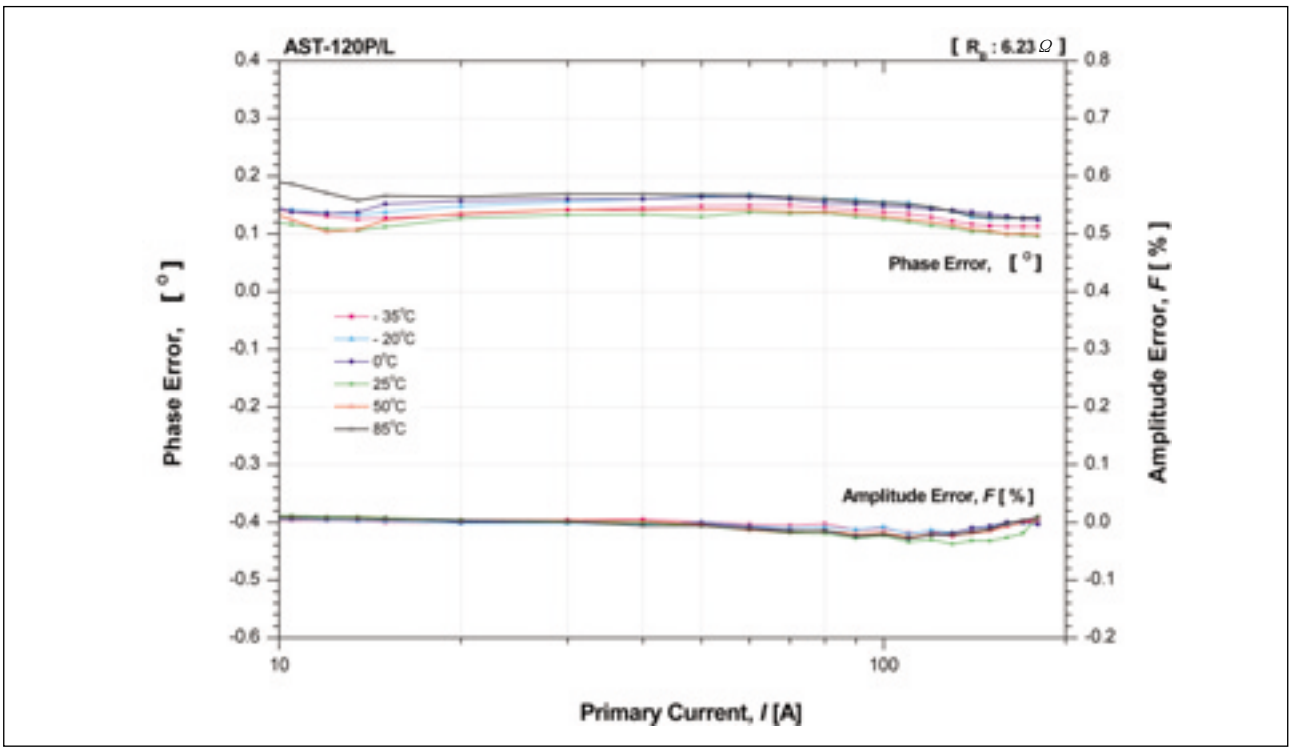
AST-040PS/LS : 40 Ampere Current Transformer Core without DC-tolerance



AST-080P/L : 80 Ampere Current Transformer Core without DC-tolerance



AST-120P/L : 120 Ampere Current Transformer Core without DC-tolerance



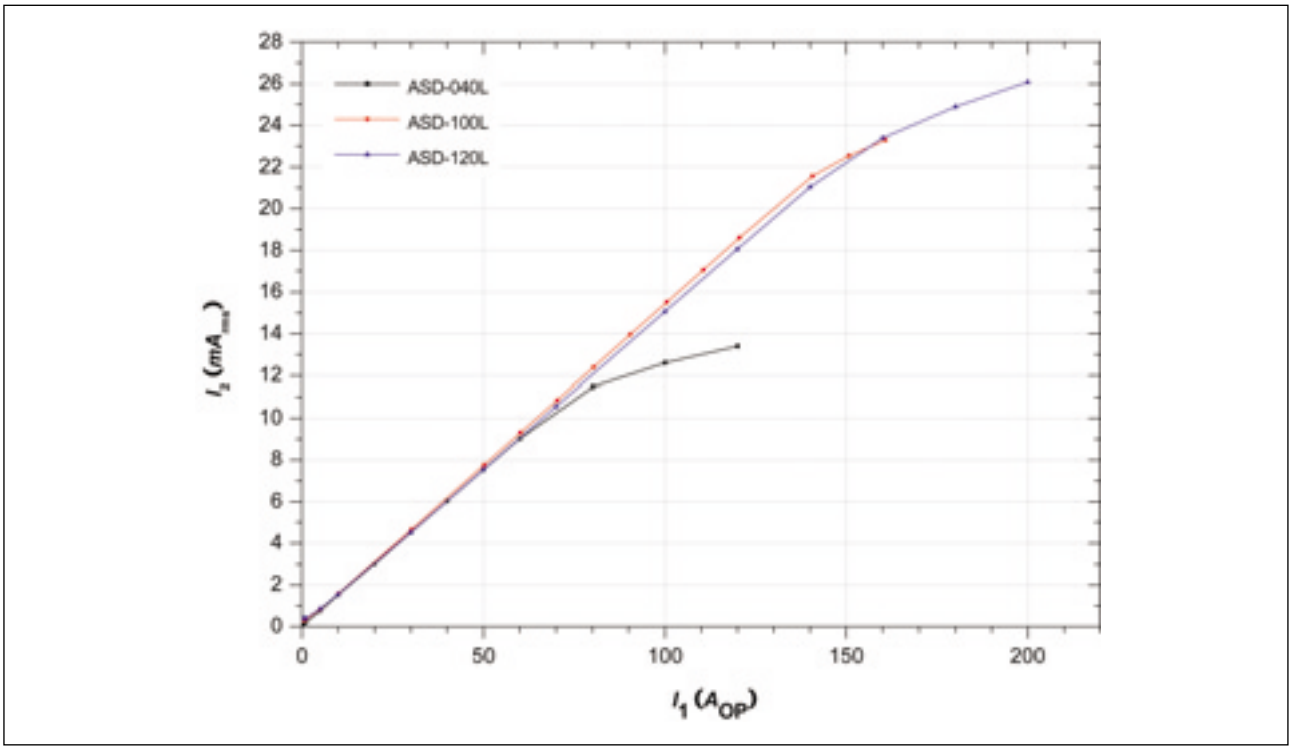
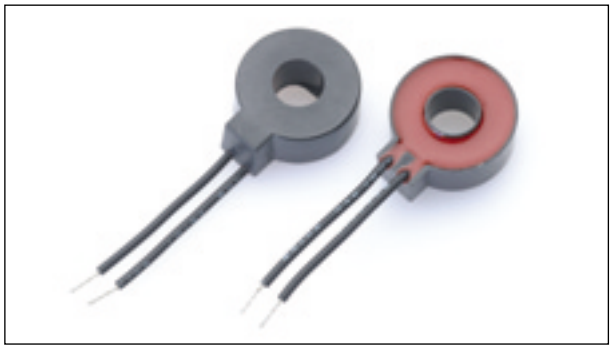
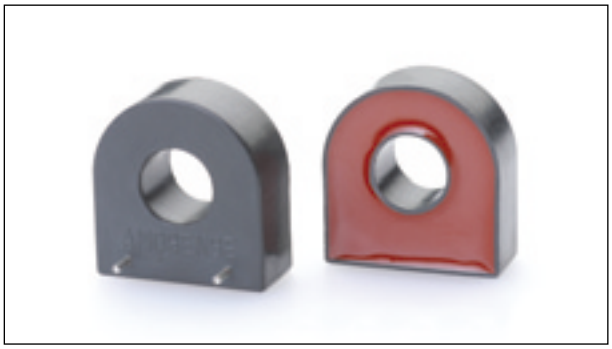

ASD-040L
ASD-100L
ASD-120L
I_2 (mA_{rms})
I_1 (A_{OP})
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
0
50
100
150
200

Table 6. Zero-Phase Current Transformer Specifications

P/N	Primary Current Range	Characteristical Values		
	I_A [mA]	R_{Cu} [Ω]	R_B [Ω]	V_O [mV]
ASZ-030P/L	20	42±4	560	11.2±0.6
ASZ-050L	20	-	-	11.2±0.6

Operating frequency 60Hz, transformation ratio 1 : 1000





Benefits of ASZ-series

ASZ series

- High temperature stability
- Excellent dynamic properties
- Suitable for AC and pulsating DC currents
- High output signal

ASZ-series have extremely stable characteristics across the entire application temperature range. Stably it have a large output signal voltage for all current types and also it is available for detection of very small current (〈 100mA).
We show you the graphs about characteristics ASZ-series secondary voltage on burden resistance and typical temperature dependence of secondary voltage on right side.

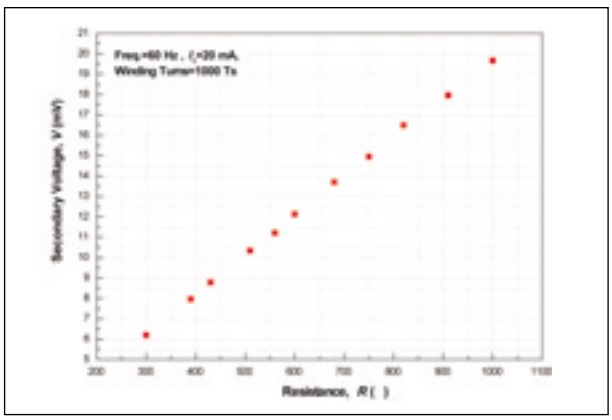
Application notes :

-AFCI (Arc Fault Circuit Interrupter)

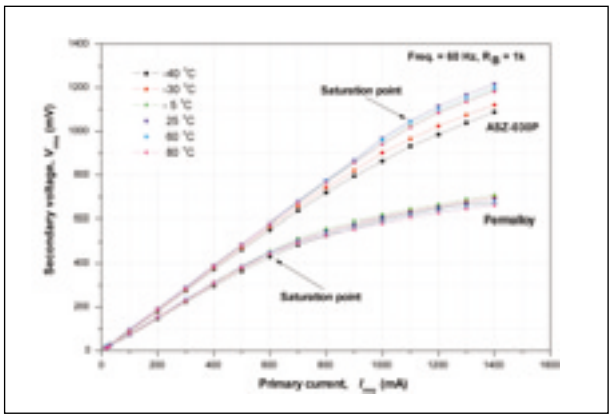
-GFCI (Ground Fault Circuit Interrupter)

-LCDI (Leakage Current Detector Interrupter)

ASZ series Secondary Voltage on Burden Resistance

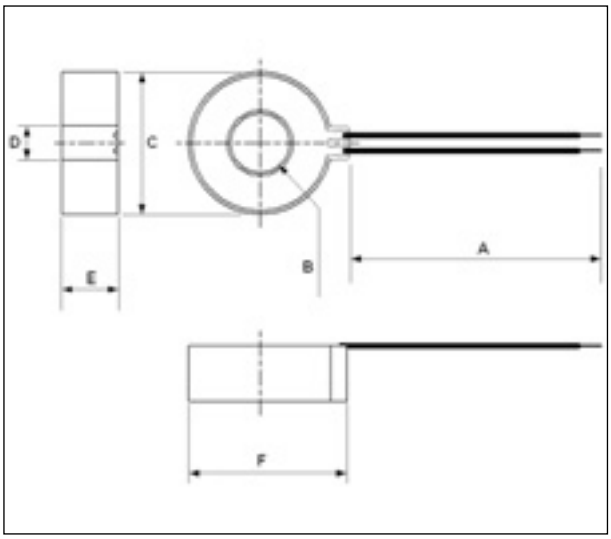


Typical Temperature Dependence of Secondary Voltage

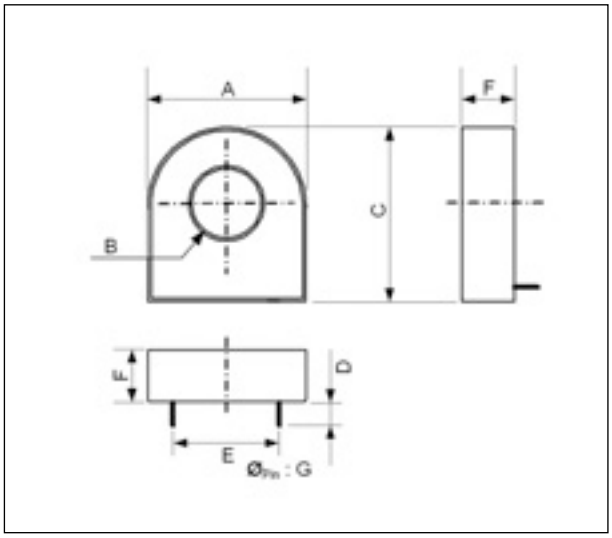


Drawings :

Wire Lead Type



PCB Mount Type



Dimensions :

Table 7. Dimensions of Wire Lead Type

Series	P/N	A (±1)	B (min)	C (max)	D (max)	E (max)	F (max)
ASZ	ASZ-030L	28	6.6	17	6.6	7.3	20.1
	ASZ-050L	120	8.8	22	6.7	8.3	25.1

All size shown in 'mm'

Table 8. Dimensions of PCB Mount Type

Series	P/N	A (max)	B (min)	C (max)	D (±0.25)	E (±0.3)	F (±0.3)	G
ASZ	ASZ-030P	17.7	6.6	18.2	2.75	10	19	0.8

All size shown in 'mm'

Explanation of Table 6 :

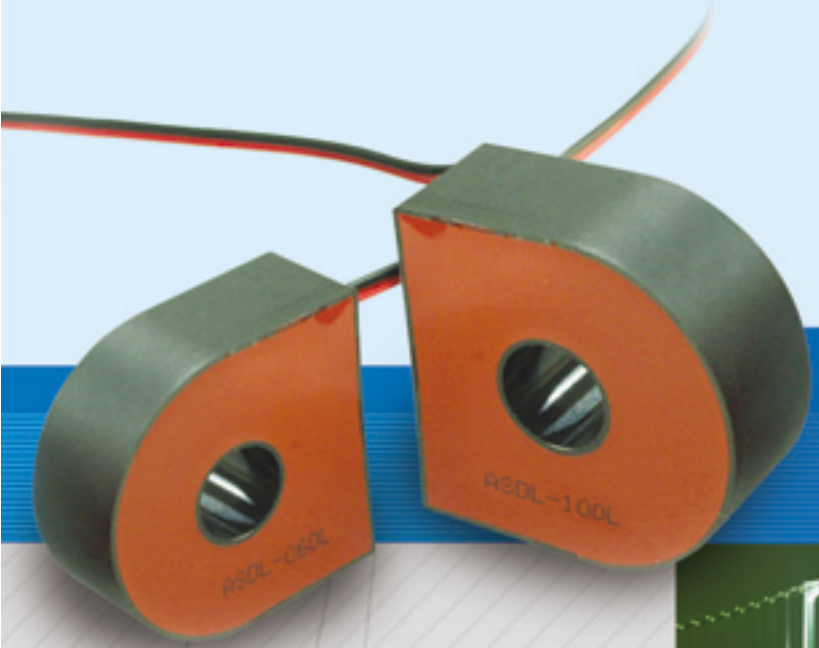
I_A = applied primary current

R_{Cu} = winding resistance

R_B = burden resistor

V_o = output voltage in a condition of I_A = 20 mA and R_B=560 Ω

Current Transformers
for Electronic Watt-hour Meters



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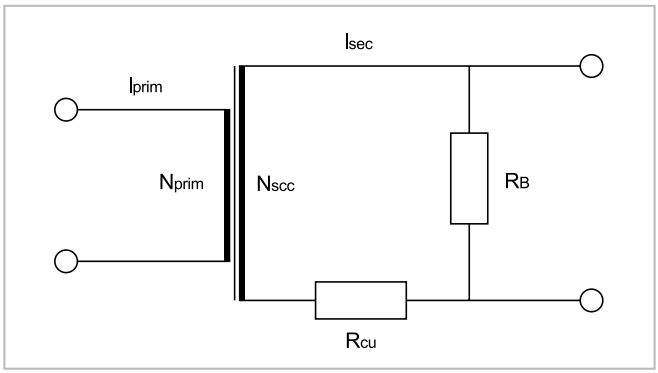
ASDL-Series

FOR DIRECT CONNECTION WITH DC-TOLERANCE

The function of current transformers(sensor) is control and monitoring in electrical equipments and devices, in heavy current and power electronics.
For this task, current transformer with high turns ratios are used.
The current will be converted into smaller values of some mA.



Current transformer circuit

What's new?

Current transformer for direct connection with DC-Tolerance according to IEC 62053-21, -23 have been made from Cobalt-based materials until now.
But now, there is new product to immune from DC that made from Fe-based amorphous materials.
It has good linearity to use current transformer and low price compared with cobalt-based product.

Features

- Low price and good linearity and precision
- Steady phase shift and No saturation in DC factor
- Stability from the external magnetic field
- Negligible small amplitude error and very low losses
- Possible to adopt the permanent magnetic immunity and RoHS compliant

Applications

- Very Good accuracy power sensor and instruments
- 0.2~1.0 class power meters (in MVCT & LVCT for industrial complex and commercial watt hour meters)

Specifications

50 Hz

Part number (P/N)	Primary current range		Turns ratio	Errors		Characteristics			Dimensions	
	I_N (A_{rms})	$I_{DC,MAX}$ (A_{op})	1 : [ ]	Phase Φ (°)	Amplitude IFI (%)	L (H)	R_{cu} (Ω)	R_B (Ω)	Φ (mm)	Width x height (mm x mm)
ASDL-060L	60	60	2,500	4.55	0.02	3.02	63	12.5	≥ 8.0	30.5 x 15.0
ASDL-100L	100	100	2,500	4.42	0.02	2.53	54	7.5	≥ 9.5	35.0 x 15.0
ASDL-120L	120	120	2,500	4.21	0.02	2.00	40	6.25	≥14.0	39.0 x 17.5

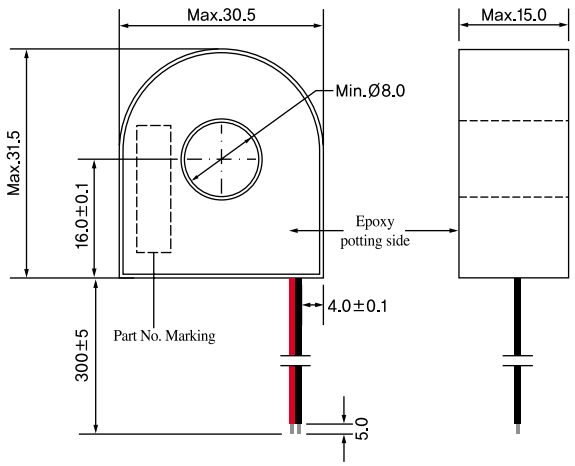
1) These current transformers with DC-Tolerance according to IEC 62053-21, 23
2) Operating frequency 50 / 60 Hz , transformation ratio 1 : 2500

ASDL-Series

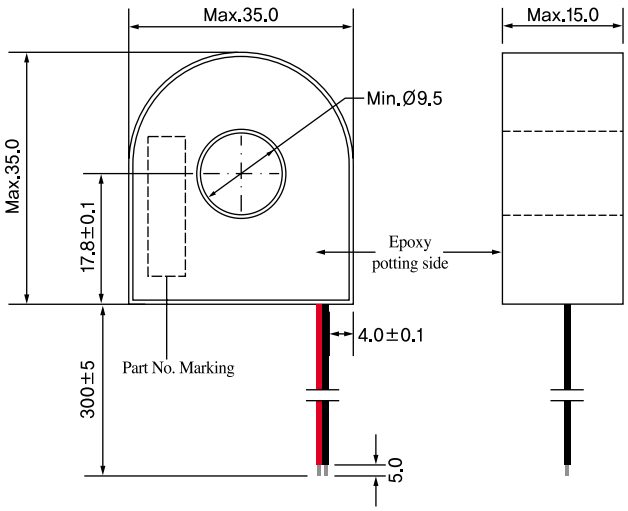
FOR DIRECT CONNECTION WITH DC-TOLERANCE

Drawings & dimensions

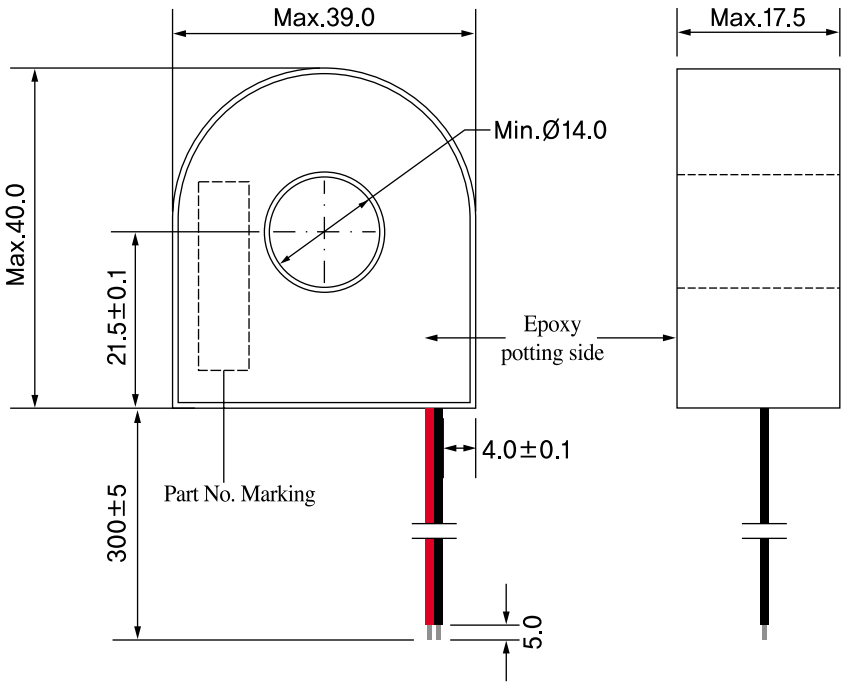
▶ASDL-060L



▶ASDL-100L



▶ASDL-120L

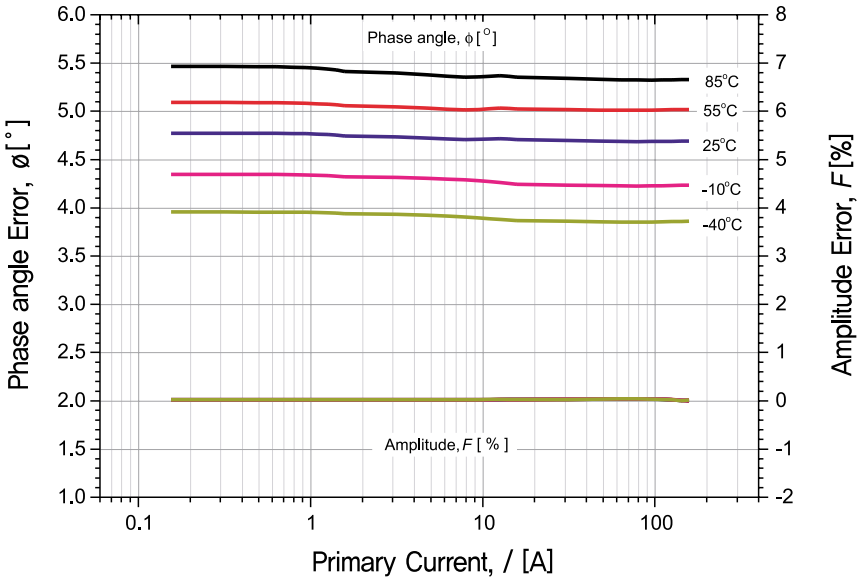


ASDL-Series

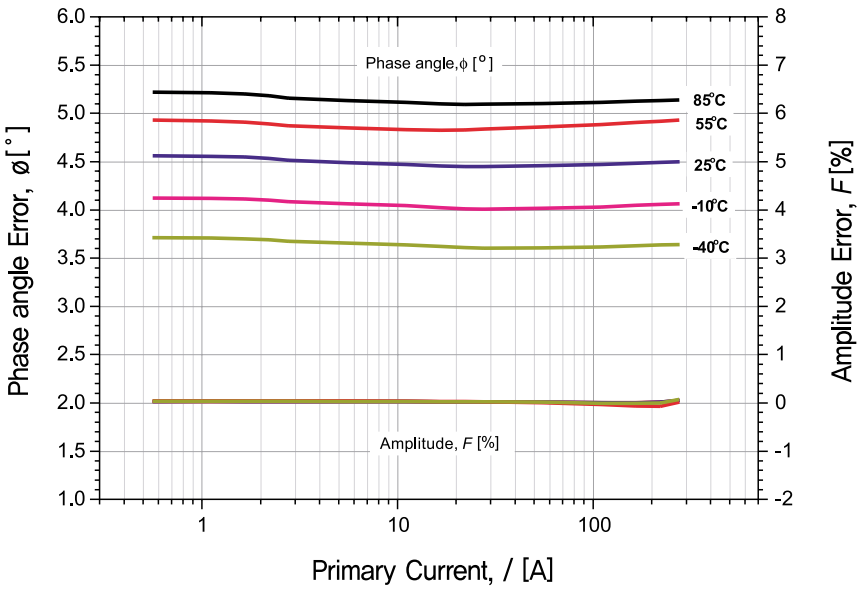
FOR DIRECT CONNECTION WITH DC-TOLERANCE

Typical temperature dependence of Phase angle error and amplitude error

▶ASDL-060L, 60A with DC-Tolerance



▶ASDL-100L, 100A with DC-Tolerance



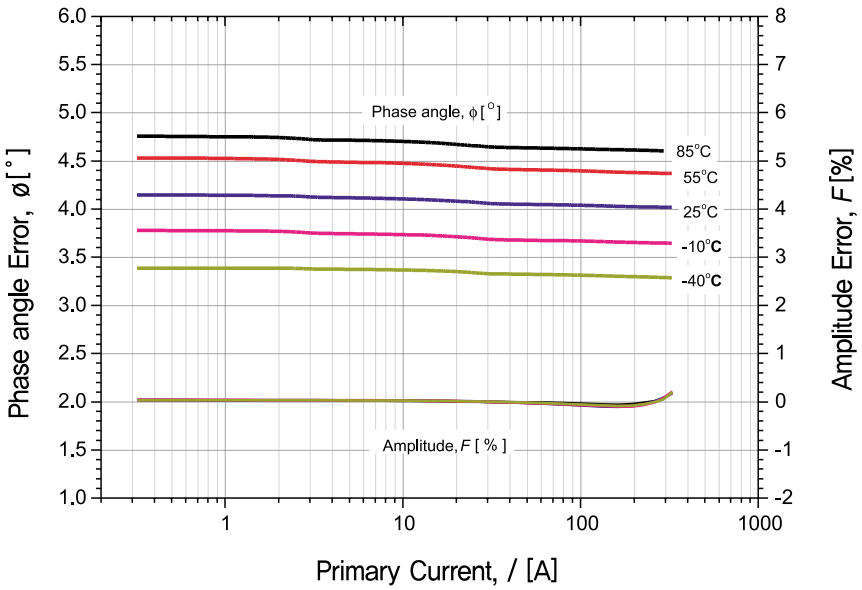
AMO Advanced Material Organization

ASDL-Series

FOR DIRECT CONNECTION WITH DC-TOLERANCE

Typical temperature dependence of Phase angle error and amplitude error

▶ASDL-120L, 120A with DC-Tolerance



AST-Series

FOR INDIRECT CONNECTED EQUIPMENTS

What's new?

These product have very small and very good linear property (phase and amplitude error) according to IEC 62053-22 and the phase angle error of them show approximately from 0.1 to 1.0.
So it is easy to compensate phase angle error and low temperature dependence.

Specifications

50 Hz

Part number (P/N)	Primary current range		Turns ratio	Errors		Characteristics			Dimensions	
	I_N (A_{rms})	$I_{DC,MAX}$ (A_{op})	1 : [ ]	Phase Φ (°)	Amplitude IFI (%)	L (H)	R_{cu} (Ω)	R_B (Ω)	Φ (mm)	Width x height (mm x mm)
AST-006PS	6	-	1,500	0.63	0.02	35	46	75	≥ 5.0	16.8 x 9.0
AST-006P	6	-	2,000	0.25	0.02	156	114	30	≥ 6.3	24.5 x 11.5

1) TThese current transformers with DC-Tolerance according to IEC 62053-22
2) Operating frequency 50 / 60 Hz
3) These product are under development (Spec. can be changed).

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