TRANSMILLE
SOLUTIONS IN CALIBRATION

TRANSMILLE 4610A ADVANCED MULTIPRODUCT CALIBRATOR

EXTENDED SPECIFICATIONS

V1.0

Warm Up Time	Double the time since last used, up to 20 minutes maximum	
Standard Interfaces	USB, GPIB (IEEE-488)	
Optional Interfaces	RS232	
Temperature Performance	Storage : -5°C to +60°C	
	Operation : 0°C to +50°C	
Relative Humidity	Operation : <80% to 30°C, <70% to 40°C, <40% to 50°C	
	Storage : <95%, non-condensing	
Altitude	Operation : 3000m (10,000ft) Maximum	
	Transit : 12000m (40,000ft) Maximum	
EMC & Safety	The calibrator line input plug must be earthed	
	See D.O.C for full details	
Line Power	Line Voltage Selectable : 100V/120V/230V/240V	
	Line Frequency : 50Hz to 60Hz	
	Line Voltage Variation : -6% +10%	
Power Consumption	28 Watts (Standby)	450 Watts (Maximum)
Low Analogue Isolation	100V	
Front Panel Connections	Voltage / 2 Wire Resistance / Capacitance	1x Black : 1x Red 4mm Binding Posts
	Low Current (<=2A) / Resistance Compensation	1x Black : 1x Red 4mm Binding Posts
	High current (>2A)	1x Blue : 1x Yellow 4mm Binding Posts
	Earth Connection	1x Green 4mm Binding Posts
	Adapter Interface	1 x Female 'D' Type Socket
	USB Interface	1 x Female 'B' Type Socket
	Oscilloscope Output	1 x Female BNC Socket
	Thermocouple Output	1 x Female 'Mini TC' Cu-Cu Socket
Display Information	Type	Touchscreen LCD
	Viewing Area	7"
	Resolution	800 * 480
	Backlight Type	LED
Indicators	Voltage / Current / High Current / TC	Red LED (left of terminals)
	Negative to ground	Green LED (left of Earth terminal)
	Standby Indicator	Red LED (left of Standby Key)
	Output Indicator	Green LED (left of Operate Key)
	Adapter Interface	Green LED (above Adapter Interface)
	Oscilloscope Output	Green LED (below Osciloscope Output)
Keyboard	Rubber key	
Fuses	Mains Inlet	3.15A A/S (230/240 Volt) (E006)
Transmille P/N's Exxx		5A A/S (100/120 Volt operation) (E007)
	Internal	2A FF, 250V x 2 (E035)
		25A, 32V x 2 Blade Fuse (E044)
		630mA A/S, 250V x 2 (E002)
Isolation	Outputs are opto-isolated from mains earth and remote interfaces	
	Maximum common mode voltage between earth and the low terminals - 50 Volts ac/dc.	
Dimensions & Weights	Calibrator Only	46cm x 43cm x 19cm : 20.5 kg
(Length x Width x Height)	Calibrator in Shipping Box	60cm x 65cm x 45cm : 28 kg
	Calibrator in Hard Transit case	70cm x 44cm x 74cm : 42 kg
Warranty Period	3 Years (Parts & Labour)	
Recommended Service Interval	1 Year	
Supplied Connections	1x Mains Lead	1 x Adapter connection Lead
	1 x Fuse Kit	
	1 x Red 4mm Lead	
	1 x Black 4mm Lead	
Optional Lead Set Kit	1x Voltage connection lead set	
	1x Low Current connection lead set	
	1x High current connection lead set	
	1x AC connection lead set	
Mounting Kit (optional)	4U rack mount kit	
Case Colour	Grey	

Due to continuous development specifications may be subject to change.

Interpreting Specifications

Transmille have taken great care over presenting the extended specifications in a manner that is easy to read while including high levels of details

Transmille specify specifications as both Total Accuracy and Relative Specifciation, with varying calibration intervals, from 24 Hours to 2 Years

By 'Total Accuracy', this means that all internal components of the calibrator have been compensated for. This includes stability, line voltage variations, temperature, humidity as well as the uncertainty of calibration as performed by Transmille Ltd.

This does NOT include external sources of uncertainty, such as the leads that are used to connect to the calibrator, and resolution of the UUT

Relative Accuracy' refers to the stablity of the instrment itself, without any external factors except temperature variation.

During re-calibration, the 'Total Accuracy' should be used for verification of the instrument. If the calibration laboratory offers better uncertainties than those offered by Transmille, new uncertainties can be calculated by combining the relative specification and the new imported uncertainties.

All of Transmilles Total Accuracies are presented to 95% confidence, k=2.

This is for ease of use in a 17025 accredited laboratory, where other contributions will likely also be calculated for k=2, minimising the need for re-calibration of uncertainties.

1 year Total Accuracy Specifications at Tcal ±5°C

Range	Resolution	Max. Burden Current	Typical Output Resistance[1]	Overload Protection	1 Year Total ppm set		uV
0-202mV	0.01uV	1mA[2]	50 Ohms	20 V	12.5	+	0.8
0.2-2.02V	0.1uV	50mA	0.2 Ohms	150V	9	+	2
2-20.2V	1uV	50mA	0.2 Ohms	150V	7.5	+	20
20-202V	10uV	20mA[3]	0.5 Ohms	1200V	10.5	+	200
200-1025V	100uV	20mA[3]	0.7 Ohms	1200V	11.5	+	2000

Stability (Accuracy relative to calibration Standards)

Range	24 Hour Stability			Noise[4]	90 day Rel			180 Day Rel			1 year Rel			2 year Rel		
	ppm Set		uV	uV	ppm Set		uV	ppm Set		uV	ppm Set		uV	ppm Set		uV
0-202mV	2	+	1	0.3	8.8	+	0.8	9.9	+	0.8	11	+	0.8	15.4	+	1.12
0.2-2.02V	2	+	1.2	0.4	5.6	+	2	6.3	+	2	7	+	2	9.8	+	2.8
2-20.2V	2	+	9	3	4.8	+	20	5.4	+	20	6	+	20	8.4	+	28
20-202V	3.5	+	120	40	7.6	+	200	8.55	+	200	9.5	+	200	13.3	+	280
200-1020V	5	+	1100	363	8	+	2000	9	+	2000	10	+	2000	14	+	2800

Notes

Note 1 : Allowance must be made for output resistance when driving into a load.

Note 2 : Limited by 50 Ohm output impedance.

Note 3 : Internally adjustable from 2mA to 30mA - Factory set to 20mA as standard.
For safety the trip is controlled by a fail-safe circuit independant of the processor which shuts the high voltage output off in the event of an overload.

Note 4 : Typical RMS noise figures at 50% of full scale, bandwidth 1Hz to 10Hz.

High Voltage Safety

High voltage output is ramped to allow instrument under test to auto range.
Standby is automatically activated when setting voltages greater than 20V or 200V from a lower voltage
Standby is automatically selected for high voltage (>20V) after 20 minutes on the same setting. This function can be disabled
High voltage (> 20V) output is indicated to user through an audible warning beep.
An external high voltage output/standby control switch is available as an option.

2 Wire output / Remote sensing not available.
Isolation : Floating or grounded selection available as standard.
Maximum floating voltage : 100V
Specifications apply at TCal ± 5°C
Outside this range an allowance of 0.18 x 1 Year Spec. per °C should be added.

1 year Total Accuracy Specifications at TCal ±5°C

Range	Resolution	Max. Inductive Load	Compliance Voltage	Overload Protection	1 Year Total ppm set		uA
0-202uA	10pA	10mH	4.2 Volts	150V	100	+	0.01
0.2-2.02mA	100pA	10mH	4.2 Volts	150V	50	+	0.03
2-20.2mA	1nA	10mH	4.2 Volts	150V	50	+	0.2
20-202mA	10nA	10mH	4.2 Volts	150V	50	+	2
0.2-2.02A	100nA	10mH	4.2 Volts	150V	130	+	30
2-20.2A	1uA	10mH	3.9 Volts	150V	300	+	300
20.2-30A	1uA	10mH	3.9 Volts	150V	500	+	450

Stability (Accuracy relative to calibration Standards)

Range	Noise[1] 0.1-1Hz	90 Day Rel %Set		uA	180 Day Rel %Set		uA	1 Year Rel %Set		uA	2 Year Rel %Set		uA
0-202uA	180pA	0.006	+	0.01	0.007	+	0.01	0.008	+	0.01	0.0112	+	0.014
0.2-2.02mA	500pA	0.0032	+	0.03	0.0036	+	0.03	0.004	+	0.03	0.0056	+	0.042
2-20.2mA	4nA	0.0032	+	0.2	0.0036	+	0.2	0.004	+	0.2	0.0056	+	0.28
20-202mA	40nA	0.0032	+	2	0.0036	+	2	0.004	+	2	0.0056	+	2.8
0.2-2.02A	1uA	0.0056	+	30	0.006	+	30	0.007	+	30	0.0098	+	42
2-20.2A[2]	20uA	0.016	+	300	0.018	+	300	0.02	+	300	0.028	+	420
20.2-30A[2]	20uA	0.024	+	450	0.027	+	450	0.03	+	450	0.042	+	630

Notes

Note 1 : Typical RMS noise figures at 50% of full scale.

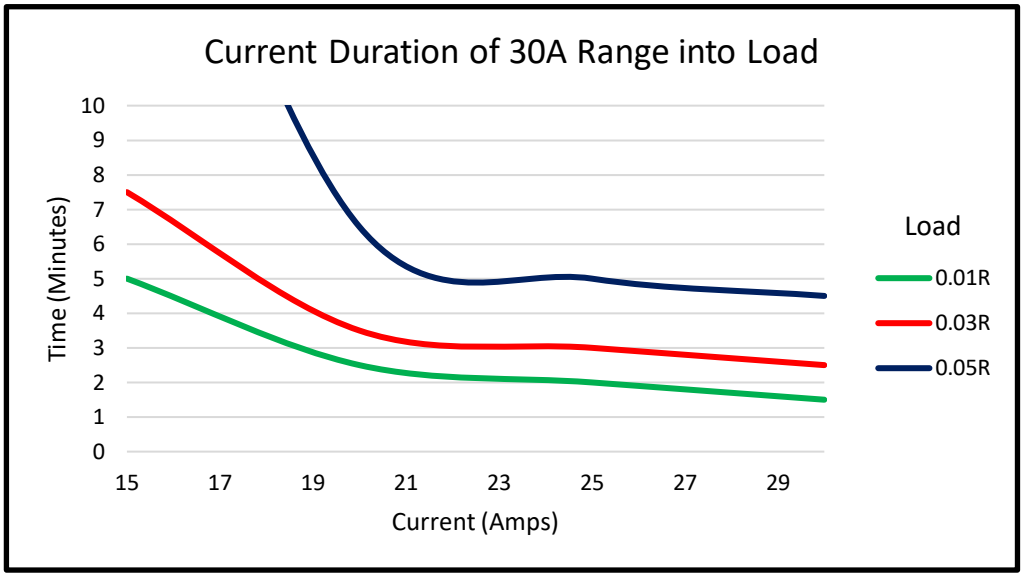
Note 2 : Power & temperature sensor on 30A range - microprocessor monitors & protects from overheating. Higher resistance loads allow a longer ON period. See graphs 1 and 2 for details.

Note 3 : Specifications apply to loads of less than 10% of the maximum burden voltage.

Note 4: Zero or floor allowance.

Specifications apply at TCal ± 5°C

Outside this range an allowance of 0.18 x 1 Year Spec. per °C should be added.



Measurement Conditions : Ambient Temperature 20'C, Mains Voltage 230V, Mains Frequency 50Hz
Allow at least 7 minutes 'off' period between current output

Shorter periods will reduce the output time availiable.

A higher ohmic value load (for example, a 0.1R Shunt) allows greater output time as more heat is dissapated within the shunt / load. With lower loads more heat is dissapated within the instrument, reducing output time

Into a 0.1R Load outputs of up to 20A are available for periods of greater than 30 minutes continously, considerations of self heating of the external load/Uut should be considered due to the power being dissapated

1 year Total Accuracy Specifications at TCal ±5°C

Range	Frequency	Resolution	Max. Burden Current	Typical Output Resistance	Overload Protection	1 Year Accuracy ppm set		uV
1-20.2mV	10 to 45Hz	1uV	1mA [1]	50 Ohms	20 V	800	+	10
	45Hz to 1kHz	1uV	1mA [1]	50 Ohms	20 V	220	+	10
	1 to 20kHz	1uV	1mA [1]	50 Ohms	20 V	180	+	10
	20 to 50kHz	1uV	1mA [1]	50 Ohms	20 V	1200	+	10
	50 to 100kHz	1uV	1mA [1]	50 Ohms	20 V	3500	+	12
	100 to 500kHz	1uV	1mA [1]	50 Ohms	20 V	8000	+	50
20-202mV	10 to 45Hz	1uV	1mA [1]	50 Ohms	20 V	280	+	12
	45Hz to 1kHz	1uV	1mA [1]	50 Ohms	20 V	160	+	10
	1 to 20kHz	1uV	1mA [1]	50 Ohms	20 V	200	+	15
	20 to 50kHz	1uV	1mA [1]	50 Ohms	20 V	800	+	20
	50 to 100kHz	1uV	1mA [1]	50 Ohms	20 V	1000	+	40
	100 to 500kHz	1uV	1mA [1]	50 Ohms	20 V	3000	+	50
0.2-2.02V [6]	10 to 45Hz	10uV	50mA	0.2 Ohms	1200V	320	+	12
	45Hz to 1kHz	10uV	50mA	0.2 Ohms	1200V	200	+	20
	1 to 20kHz	10uV	50mA	0.2 Ohms	1200V	200	+	50
	20 to 50kHz	10uV	50mA	0.2 Ohms	1200V	650	+	50
	50 to 100kHz	10uV	50mA	0.2 Ohms	1200V	650	+	170
	100kHz to 500kHz	10uV	50mA	0.2 Ohms	1200V	2500	+	300
	500kHz to 1MHz	10uV	50mA	0.2 Ohms	1200V	3000	+	450
2-20.2V	10 to 45Hz	100uV	50mA	0.2 Ohms	1200V	400	+	250
	45Hz to 1kHz	100uV	50mA	0.2 Ohms	1200V	180	+	200
	1 to 20kHz	100uV	50mA	0.2 Ohms	1200V	220	+	320
	20 to 50kHz	100uV	50mA	0.2 Ohms	1200V	350	+	500
	50 to 100kHz	100uV	50mA	0.2 Ohms	1200V	750	+	300
20V - 202V	10Hz to 45Hz	1mV	20mA [2]	0.5 Ohms	1200V	400	+	5000
	45Hz to 1kHz	1mV	15mA [2]	0.5 Ohms	1200V	190	+	1800
	1 to 20kHz	1mV	15mA [2]	0.5 Ohms	1200V	250	+	2500
	20 to 50kHz	1mV	15mA [3]	0.5 Ohms	1200V	350	+	1000
	50 to 100kHz	1mV	2mA [2]	0.5 Ohms	1200V	800	+	5000
200-1020V [3,9]	30 to 45Hz	10mV	20mA [2]	0.7 Ohms	1200V	600	+	15000
	45Hz to 1kHz	10mV	15mA [2]	0.7 Ohms	1200V	240	+	8000
	1kHz to 10kHz	10mV	2mA [2]	0.7 Ohms	1200V	300	+	12000
	10kHz to 20kHz	10mV	2mA [2]	0.7 Ohms	1200V	300	+	200000

AC Frequency Accuracy : 1ppm

Stability (Accuracy relative to calibration Standards)

Range	Frequency	Frequency Resolution	90 day Rel			180 Day Rel			1 year Rel			2 year Rel		
			ppm set		uV	ppm set		uV	ppm set		uV	ppm set		uV
1-20.2mV	10 to 45Hz	1Hz	600	+	8	675	+	9	750	+	10	1050	+	14
	45Hz to 1kHz	1Hz	160	+	8	180	+	9	200	+	10	280	+	14
	1 to 20kHz	1Hz	128	+	8	144	+	9	160	+	10	224	+	14
	20 to 50kHz	1Hz	904	+	8	1017	+	9	1130	+	10	1582	+	14
	50 to 100kHz	1Hz	2640	+	9.6	2970	+	10.8	3300	+	12	4620	+	17
	100 to 500kHz	1Hz	5600	+	40	6300	+	45	7000	+	50	9800	+	70
20-202mV	10 to 45Hz	1Hz	184	+	9.6	207	+	10.8	230	+	12	322	+	17
	45Hz to 1kHz	1Hz	112	+	8	126	+	9	140	+	10	196	+	14
	1 to 20kHz	1Hz	144	+	12	162	+	13.5	180	+	15	252	+	21
	20 to 50kHz	1Hz	584	+	16	657	+	18	730	+	20	1022	+	28
	50 to 100kHz	1Hz	640	+	32	720	+	36	800	+	40	1120	+	56
	100 to 500kHz	1Hz	1600	+	40	1800	+	45	2000	+	50	2800	+	70
0.2-2.02V [6]	10 to 45Hz	1Hz	216	+	9.6	243	+	10.8	270	+	12	378	+	17
	45Hz to 1kHz	1Hz	144	+	16	162	+	18	180	+	20	252	+	28
	1 to 20kHz	1Hz	144	+	40	162	+	45	180	+	50	252	+	70
	20 to 50kHz	1Hz	464	+	40	522	+	45	580	+	50	812	+	70
	50 to 100kHz	1Hz	360	+	136	405	+	153	450	+	170	630	+	238
	100kHz to 500kHz	1Hz	1200	+	240	1350	+	270	1500	+	300	2100	+	420
	500kHz to 1MHz	1Hz	800	+	360	900	+	405	1000	+	450	1400	+	630
2-20.2V	10 to 45Hz	1Hz	280	+	200	315	+	225	350	+	250	490	+	350
	45Hz to 1kHz	1Hz	128	+	160	144	+	180	160	+	200	224	+	280
	1 to 20kHz	1Hz	160	+	256	180	+	288	200	+	320	280	+	448
	20 to 50kHz	1Hz	224	+	400	252	+	450	280	+	500	392	+	700
	50 to 100kHz	1Hz	440	+	240	495	+	270	550	+	300	770	+	420
20V - 202V	10Hz to 45Hz	1Hz	280	+	5000	315	+	4500	350	+	5000	490	+	7000
	45Hz to 1kHz	1Hz	136	+	1800	153	+	1620	170	+	1800	238	+	2520
	1 to 20kHz	1Hz	184	+	2500	207	+	2250	230	+	2500	322	+	3500
	20 to 50kHz	1Hz	224	+	1000	252	+	900	280	+	1000	392	+	1400
	50 to 100kHz	1Hz	480	+	5000	540	+	4500	600	+	5000	840	+	7000
200-1020V [3,9]	30 to 45Hz	1Hz	440	+	15000	495	+	13500	550	+	15000	770	+	21000
	45Hz to 1kHz	1Hz	176	+	8000	198	+	7200	220	+	8000	308	+	11200
	1kHz to 10kHz	1Hz	224	+	12000	252	+	10800	280	+	12000	392	+	16800
	10kHz to 20kHz	1Hz	184	+	2E+05	207	+	180000	230	+	200000	322	+	280000

AC Frequency Accuracy : 1ppm

Notes	
Note 1:	Current limited by 50 ohms output resistance.
Note 2 :	Internally adjustable from 2mA to 30mA - Factory set to 20mA as standard For safety the trip is controlled by a fail-safe circuit independant of the processor which shuts the high voltage output off in the event of an overload.
Note 3 :	Frequency and voltage combinations are limited.
Note 4 :	Specifications apply up to 10% of maximum load current. Above this level, allowance must be made for output resistance.
Note 5 :	Zero or floor allowance.
Note 7 :	THD less than 0.39% of output - 10Hz to 1MHz bandwidth at frequencies up to 50kHz
Note 9 :	Maximum frequency 10kHz above 330V

2 Wire output / Remote sensing not available.

Maximum floating voltage : 100V.

Isolation : Floating or grounded selection available as standard.

Specifications apply at TCal ± 5°C. Outside this range an allowance of 0.18 x 1 Year Spec. per °C should be added.

High Voltage Safety
High voltage output is ramped to allow instruments under test to auto-range.
Standby is automatically activated when setting voltages greater than 20V or 200V from a lower voltage.
Standby is automatically selected for high voltage (>20V) after 20 minutes on the same setting for frequencies
This function can be disabled by the user
High voltage (> 20V) output is indicated to user through an audible warning beep. This can be disabled by the user

1 Year Total Accuracy Specifications at TCal ±5°C

Range	Frequency	Resolution	Max. Burden Voltage (peak)	Overload Protection	1 year Accuracy %Set		uA
20-202uA	10Hz to 45Hz	1nA	3 Volts	150V	0.20	+	0.1
	45Hz to 1kHz				0.07	+	0.1
	1kHz to 5kHz				0.80	+	0.25
	5kHz to 10kHz				0.80	+	0.25
	10kHz to 30kHz				1.60	+	0.4
0.2-2.02mA	10Hz to 45Hz	10nA	3 Volts	150V	0.15	+	0.1
	45Hz to 1kHz				0.06	+	0.15
	1kHz to 5kHz				0.50	+	0.3
	5kHz to 10kHz				0.50	+	0.3
	10kHz to 30kHz				1.00	+	0.6
2-20.2mA	10Hz to 45Hz	100nA	3 Volts	150V	0.17	+	1
	45Hz to 1kHz				0.04	+	1.5
	1kHz to 5kHz				0.25	+	3
	5kHz to 10kHz				0.25	+	3
	10kHz to 30kHz				0.50	+	4
20-202mA	10Hz to 45Hz	1uA	3 Volts	150V	0.15	+	20
	45Hz to 1kHz				0.04	+	8
	1kHz to 5kHz				0.30	+	40
	1kHz to 10kHz				0.50	+	40
	10kHz to 30kHz				0.70	+	200
0.2-2.02A	10Hz to 45Hz	10uA	3 Volts	150V	0.14	+	200
	45Hz to 1kHz				0.05	+	100
	1kHz to 5kHz				0.40	+	400
	5kHz to 10kHz				0.60	+	1000
	10kHz to 30kHz				2.50	+	5000
2-20.0A[1,4]	10Hz to 45Hz	100uA	2.8 Volts	150V	0.14	+	2000
	45Hz to 1kHz				0.13	+	2000
	1kHz to 5kHz				0.60	+	4000
	5kHz to 10kHz				3.00	+	5000
20-30.0A[1,4]	30Hz to 45Hz	100uA	2.8 Volts	150V	0.20	+	3000
	45Hz to 1kHz				0.30	+	4000
	1kHz to 5kHz				0.60	+	4000
	5kHz to 10kHz				3.00	+	5000

Settling Time: For 50% change in output: Less than 3 second from standby to within spec

Inductive Loads : Up to 1H may be connected without additional protection providing the frequency/inductance combination does not exceed the maximum burden voltage.

Stability (Accuracy relative to calibration Standards)

Range	Frequency	Frequency Resolution	90 Day Rel			180 Day Rel			1 Year Rel			2 Year Rel		
			%Set		uA	%Set		uA	%Set		uA	%Set		uA
20-202uA	10Hz to 45Hz	1Hz	0.136	+	0.08	0.153	+	0.09	0.170	+	0.1	0.238	+	0.14
	45Hz to 1kHz		0.032	+	0.08	0.036	+	0.09	0.040	+	0.1	0.056	+	0.14
	1kHz to 5kHz		0.616	+	0.2	0.693	+	0.23	0.770	+	0.25	1.078	+	0.35
	5kHz to 10kHz		0.616	+	0.2	0.693	+	0.23	0.770	+	0.25	1.078		0.35
	10kHz to 30kHz		1.256	+	0.32	1.413	+	0.36	1.570	+	0.4	2.198	+	0.56
0.2-2.02mA	10Hz to 45Hz	1Hz	0.096	+	0.1	0.108	+	0.1	0.120	+	0.1	0.168	+	0.14
	45Hz to 1kHz		0.024	+	0.15	0.027	+	0.15	0.030	+	0.15	0.042	+	0.21
	1kHz to 5kHz		0.376	+	0.3	0.423	+	0.3	0.470	+	0.3	0.658	+	0.42
	5kHz to 10kHz		0.376	+	0.3	0.423	+	0.3	0.470	+	0.3	0.658	+	0.42
	10kHz to 30kHz		0.776	+	0.6	0.873	+	0.6	0.970	+	0.6	1.358	+	0.84
2mA-20.2mA	10Hz to 45Hz	1Hz	0.112	+	1	0.126	+	1	0.140	+	1	0.196	+	1.4
	45Hz to 1kHz		0.008	+	1.5	0.009	+	1.5	0.010	+	1.5	0.014	+	2.1
	1kHz to 5kHz		0.176	+	3	0.198	+	3	0.220	+	3	0.308	+	4.2
	5kHz to 10kHz		0.176	+	3	0.198	+	3	0.220	+	3	0.308	+	4.2
	10kHz to 30kHz		0.376	+	4	0.423	+	4	0.470	+	4	0.658	+	5.6
20-202mA	10Hz to 45Hz	1Hz	0.096	+	20	0.108	+	20	0.120	+	20	0.168	+	28
	45Hz to 1kHz		0.008	+	8	0.009	+	8	0.010	+	8	0.014	+	11.2
	1kHz to 5kHz		0.216	+	40	0.243	+	40	0.270	+	40	0.378	+	56
	5kHz to 10kHz		0.376	+	40	0.423	+	40	0.470	+	40	0.658	+	56
	10kHz to 30kHz		0.536	+	200	0.603	+	200	0.670	+	200	0.938	+	280
0.2-2.02A [3]	10Hz to 45Hz	1Hz	0.088	+	200	0.099	+	200	0.110	+	200	0.154	+	280
	45Hz to 1kHz		0.016	+	100	0.018	+	100	0.020	+	100	0.028	+	140
	1kHz to 5kHz		0.296	+	400	0.333	+	400	0.370	+	400	0.518	+	560
	5kHz to 10kHz		0.456	+	1000	0.513	+	1000	0.570	+	1000	0.798	+	1400
	10kHz to 30kHz		1.976	+	5000	2.223	+	5000	2.470	+	5000	3.458	+	7000
2-20.0A [1,4]	10Hz to 45Hz	1Hz	0.088	+	2000	0.099	+	2000	0.110	+	2000	0.154	+	2800
	45Hz to 1kHz		0.080	+	2000	0.090	+	2000	0.100	+	2000	0.140	+	2800
	1kHz to 5kHz		0.456	+	4000	0.513	+	4000	0.570	+	4000	0.798	+	5600
	5kHz to 10kHz		2.376	+	5000	2.673	+	5000	2.970	+	5000	4.158	+	7000
20-30.0A [1,4]	30Hz to 45Hz	1Hz	0.136	+	3000	0.153	+	3000	0.170	+	3000	0.238	+	4200
	45Hz to 100Hz		0.216	+	4000	0.243	+	4000	0.270	+	4000	0.378	+	5600
	100Hz to 1kHz		0.456	+	4000	0.513	+	4000	0.570	+	4000	0.798	+	5600
	1kHz to 5kHz		2.376	+	5000	2.673	+	5000	2.970	+	5000	4.158	+	7000

Notes

Note 1 : Temperature sensor on 30A range - microprocessor monitors & protects from overheating.
Higher resistance loads allow a longer ON period. See graph 5 for details.
Note 2 : Specifications apply to loads of less than 10% of the maximum burden voltage.
Note 3 : Frequency limited to 10kHz above 1A
Note 4 : Frequency limited to 5kHz above 10A

Driving Coils and Inductive Loads

When driving any load exceeding the maximum compliance voltage will cause the calibrator to trip into standby

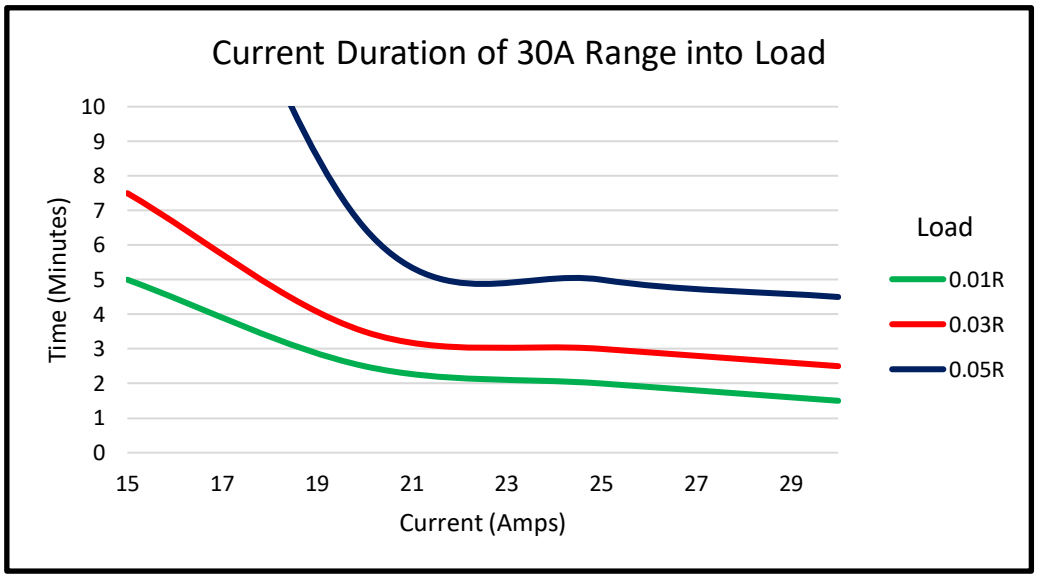
The maximum compliance voltage on the 30Amp range is specified at a max 2.8V RMS, 7.8V Peak to Peak at 220V supply

Slightly higher compliances are available when powered from a 240V supply.

When using EA002 with leads supplied it is possible to drive 30Amps/50Hz from a 230V supply, falling to 10Amps at 400Hz

Specifications apply at TCal ± 5°C

Outside this range an allowance of 0.18 x 1 Year Spec. per °C should be added.



Measurement Conditions : Ambient Temperature 20'C, Mains Voltage 230V, Mains Frequency 50Hz
Allow at least 7 minutes 'off' period between current output

Shorter periods will reduce the output time availiable.

A higher ohmic value load (for example, a 0.1R Shunt) allows greater output time as more heat is dissapated within the shunt / load. With lower loads more heat is dissapated within the instrument, reducing output time

Into a 0.1R Load outputs of up to 20A are available for periods of greater than 30 minutes continously, considerations of self heating of the external load/Uut should be considered due to the power being dissapated

Total Accuracy Specifications at TCal ±5°C

Range	Resolution	90 day ppm	180 Day ppm	1 year ppm	2 year ppm
1Hz - 1.2MHz*	1Hz	0.8	0.9	1	1.4

* Frequency continuously variable. Maximum frequency range available on the 2V AC Range

Specifications apply at TCal ± 5°C

Outside this range an allowance of 0.18 x 1 Year Spec. per °C should be added.

PWM (%) - Frequency Range 5Hz to 50kHz	Duty Cycle Accuracy
5% to 95%	Better than 0.1%

PWM (Level)	Level Accuracy
2V to 10V	Better than 0.1V

PWM (DC Offset)	Level Accuracy
+0V to +5V	Better than 0.2V

PWM Output provides a square wave output with variable level, duty cycle and DC offset

For the highest possible accuracy and dependability of the measured value, regardless of the measurement technique used, the 4000 Series calibrators use passive standard resistors, the calibrated value of which is displayed when selected.

1 year Total Accuracy Specifications at TCal ±5°C & Range Parameters

Range	Maximum Current	Maximum Voltage	Display Resolution	1 Year Total Accuracy		
				ppm set		Ohms
0Ω	0.5A	-	1uΩ	0		0.005
0.1Ω	0.5A	-	1uΩ	25	+	0.005
1Ω	0.4A	-	1uΩ	25	+	0.005
10Ω	0.3A	-	1uΩ	25	+	0.005
100Ω	0.1A	-	10uΩ	18	+	0.005
1kΩ	-	10V	100uΩ	18	+	0.005
10kΩ	-	50V	1mΩ	8	+	0.05
100kΩ	-	100V	10mΩ	18	+	0.5
1MΩ	-	100V	100mΩ	25	+	5
10MΩ	-	100V	1Ω	90	+	100
100MΩ	-	100V	1kΩ	1800	+	2000
1GΩ*		100V	10kΩ	10000	+	30000

*** 2-Wire only**

Stability (Accuracy relative to calibration Standards)

Range	90 Day Rel			180 Day Rel			1 Year Rel			2 Year Rel		
	%		Ohms	%		Ohms	%		Ohms	%		Ohms
0Ω	-		0.005	-		0.005	-		0.005	-		0.005
0.1Ω	0	+	0.005	0	+	0.005	0	+	0.005	0	+	0.005
1Ω	0	+	0.005	0	+	0.005	0	+	0.005	0	+	0.005
10Ω	0	+	0.005	0	+	0.005	0	+	0.005	0	+	0.005
100Ω	0.0012	+	0.005	0.00135	+	0.005	0.0015	+	0.005	0.0021	+	0.005
1kΩ	0.00128	+	0.005	0.00144	+	0.005	0.0016	+	0.005	0.0022	+	0.005
10kΩ	0.00048	+	0.05	0.00054	+	0.05	0.0006	+	0.05	0.0008	+	0.05
100kΩ	0.00096	+	0.5	0.00108	+	0.5	0.0012	+	0.5	0.0017	+	0.5
1MΩ	0.00144	+	5	0.00162	+	5	0.0018	+	5	0.0025	+	5
10MΩ	0.0064	+	100	0.0072	+	100	0.008	+	100	0.0112	+	100
100MΩ	0.136	+	2000	0.153	+	2000	0.17	+	2000	0.238	+	2000
1GΩ	0.72	+	30000	0.81	+	30000	0.9	+	30000	1.26	+	30000

For 2-Wire connection allow 35mW on all resistance specifications.

The 2 and 4 Wire value for each resistor is calibrated. The 2-Wire value is measured at the terminals

The 4-Wire values are taken using the zero position to NULL the measuring system.

Specifications apply at TCal ± 5°C.

Outside this range an allowance of 0.18 x 1 Year Spec. per °C should be added.

1 year Total Accuracy Specifications at TCal ±5°C

Range	Display Resolution	Measurement Current (Max.)	1 year	
			ppm Set	Zero
0Ω to 10Ω	1mΩ	100mA	150	6mΩ
10Ω to 33Ω	1mΩ	100mA	90	3mΩ
33Ω to 100Ω	10mΩ	50mA	80	9mΩ
100Ω to 330Ω	10mΩ	30mA	30	18mΩ
330Ω to 1kΩ	100mΩ	10mA	50	26mΩ
1kΩ to 3.3kΩ	100mΩ	3mA	60	60mΩ
3.3kΩ to 10kΩ	1Ω	1mA	60	220mΩ
10kΩ to 33kΩ	1Ω	300uA	60	620mΩ
33kΩ to 100kΩ	10Ω	100uA	60	2.2Ω
100kΩ to 330kΩ	10Ω	30uA	60	6.2Ω
330kΩ to 1MΩ	100Ω	10uA	100	9Ω
1MΩ to 3.3MΩ	100Ω	3uA	200	150Ω
3.3MΩ to 10MΩ	1kΩ	1uA	250	300Ω
10MΩ to 33MΩ	1kΩ	300nA	800	15kΩ
33MΩ to 100MΩ	10kΩ	100nA	1500	25kΩ
110MΩ to 330MΩ	10kΩ	30nA	1700	80kΩ
330MΩ to 1GΩ	100kΩ	10nA	10000	800kΩ

Simulated resistance is available as 2 Wire, 2 Wire Compensated and 4 Wire

Specifications apply for 4 Wire mode up to 100kΩ. Specifications above 100kΩ apply to 2 Wire

2 Wire compensated Output : Add 6uV divided by Measurement Current in Amps to floor specification

2 Wire output is relative to the 0Ω output of the calibrator. Connect multimeter and press REL/Null with 0Ω set

Input measurement current must be a constant DC current isolated from earth

Performance/compatibility may be affected using other measurement methods/techniques for the simulated resistance function eg. AC or pulsed, in which case passive resistance functionality may be employed.

Current must be stable for a period of 1s - it is therefore recommended the UUT range is selected manually

Specifications apply at TCal ± 5°C.

Outside this range an allowance of 0.18 x 1 Year Spec. per °C should be added.

For the highest possible accuracy and dependability of the measured value, regardless of the measurement technique used, the 4000 Series calibrators use passive standard capacitors, the calibrated value of which is displayed when selected.

General Specifications

Range	Maximum Voltage	Display Resolution	D	R_s
1nF	50V	0.1pF	0.006	N/A
2nF	50V	0.1pF	0.006	N/A
5nF	50V	0.1pF	0.006	N/A
10nF	50V	0.1pF	0.006	N/A
100nF	50V	10pF	0.006	N/A
1uF	30V	100pF	0.002	N/A
10uF	20V	1nF	0.014	0.2mΩ

Specifications apply at 1kHz. Allow 20pF for lead effects.
No appreciable variation is noticable at frequencies below 1kHz.

1 year Total Accuracy Specifications at TCal ±5°C

Range	90 day %	180 Day %	1 year %	2 year %
1nF	0.2	0.225	0.25	0.35
2nF	0.2	0.225	0.25	0.35
5nF	0.2	0.225	0.25	0.35
10nF	0.2	0.225	0.25	0.35
100nF	0.2	0.225	0.25	0.35
1uF	0.32	0.36	0.4	0.56
10uF	0.48	0.54	0.6	0.84

Measurement methods
C_p up to 1uF
C_s above 1uF

Capacitance is calibrated as value at the terminals
ie. displayed value incorporates capacitance of circuit up to and including the terminals

Specifications apply at TCal ±5°C.

Outside this range an allowance of 0.18 x 1 Year Spec. per °C should be added.

General Specifications

Range	Maximum Voltage	Display Resolution
300pF to 900pF	8V	1pF
0.9nF to 10nF	8V	10pF
10nF to 100nF	8V	100pF
100nF to 950nF	8V	100pF
0.95uF to 9.5uF	8V	1nF
9.5uF to 95uF	8V	10nF
95uF to 0.95mF	8V	1uF
0.95mF to 9.5mF	8V	1uF
9.5mF to 100mF	8V	10uF

1 year Total Accuracy Specifications at TCal ±5°C

Range	90 day % of Setting	180 Day % of Setting	1 year % of Setting	2 year % of Setting
300pF to 900pF	0.32 + 1.2pF	0.36 + 1.5pF	0.45 + 2pF	0.56 + 3pF
0.9nF to 10nF	0.32 + 9pF	0.36 + 9pF	0.45 + 10pF	0.56 + 15pF
10nF to 100nF	0.44	0.495	0.55	0.77
100nF to 950nF	0.4	0.45	0.5	0.7
0.95uF to 9.5uF	0.4	0.45	0.5	0.7
9.5uF to 95uF	0.6	0.675	0.75	1.05
95uF to 0.95mF	0.6	0.675	0.75	1.05
0.95mF to 9.5mF	0.6	0.675	0.75	1.05
9.5mF to 100mF	1.12	1.26	1.4	1.96

Specifications apply at TCal ±5°C.

Outside this range an allowance of 0.18 x 1 Year Spec. per °C should be added.

Specifications apply relative to the 0nF output

Minimum terminal voltage = 80mV

Maximum terminal voltage = 8V

Maximum current input = 20mA

Performance/compatibility may be affected using other measurement methods/techniques for the simulated capacitance function in which case passive capacitance functionality may be employed.

A constant charging current is required for specifications to apply. AC measurement techniques will fall outside of the specification

Connection	1 x Neutral (copper) industry standard thermocouple socket with **integral temperature sensor**
Sensor Type	Thermistor
Output impedance	10 Ohms

Thermocouple Type	Range Source / Measure	90 Day[1] Rel. (°C)	180 Day[1] Rel. (°C)	1 Year[1] Rel. (°C)	2 Year[1] Rel. (°C)
B	600°C to 800°C	0.58	0.66	0.73	1.02
	800°C to 1000°C	0.52	0.59	0.65	0.91
	1000°C to 1550°C	0.43	0.49	0.54	0.76
	1550°C to 1820°C	0.44	0.50	0.55	0.77
C	0°C to 150°C	0.25	0.28	0.31	0.43
	150°C to 650°C	0.22	0.24	0.27	0.38
	650°C to 1000°C	0.26	0.29	0.32	0.45
	1000°C to 1800°C	0.38	0.42	0.47	0.66
	1800°C to 2316°C	0.54	0.61	0.68	0.95
E	-250°C to -100°C	0.40	0.45	0.50	0.70
	-100°C to -25°C	0.08	0.09	0.10	0.14
	-25°C to 350°C	0.07	0.08	0.09	0.13
	350°C to 650°C	0.10	0.11	0.12	0.17
	650°C to 1000°C	0.12	0.14	0.15	0.21
J	-210°C to -100°C	0.18	0.21	0.23	0.32
	-100°C to -30°C	0.09	0.10	0.11	0.15
	-30°C to 150°C	0.07	0.08	0.09	0.13
	150°C to 760°C	0.11	0.13	0.14	0.20
	760°C to 1200°C	0.15	0.17	0.19	0.27
K	-200°C to -100°C	0.22	0.24	0.27	0.38
	-100°C to -25°C	0.12	0.14	0.15	0.21
	-25°C to 120°C	0.09	0.10	0.11	0.15
	-120°C to -1000°C	0.16	0.18	0.20	0.28
	1000°C to 1370°C	0.21	0.23	0.26	0.36
L	-200°C to -100°C	0.27	0.31	0.34	0.48
	-100°C to 800°C	0.26	0.30	0.33	0.46
	800°C to 900°C	0.27	0.31	0.34	0.48
N	-200°C to -100°C	0.34	0.38	0.42	0.59
	-100°C to -25°C	0.16	0.18	0.20	0.28
	-25°C to 120°C	0.13	0.14	0.16	0.22
	120°C to 410°C	0.12	0.14	0.15	0.21
	410°C to 1300°C	0.19	0.22	0.24	0.34
R	-0°C to 250°C	0.64	0.72	0.80	1.12
	250°C to 1000°C	0.35	0.40	0.44	0.62
	1000°C to 1760°C	0.41	0.46	0.51	0.71

S	0°C to 250°C	0.64	0.72	0.80	1.12
	250°C to 1000°C	0.35	0.40	0.44	0.62
	1000°C to 1760°C	0.41	0.46	0.51	0.71
T	-250°C to -150°C	0.48	0.54	0.60	0.84
	-150°C to 0°C	0.08	0.09	0.10	0.14
	0°C to 120°C	0.07	0.08	0.09	0.13
	-120°C to 400°C	0.09	0.10	0.11	0.15
U	-200°C to 0°C	0.34	0.38	0.42	0.59
	0°C to 600°C	0.24	0.27	0.30	0.42

Thermocouple Type	Range Source / Measure	90 Day[1] Zero + % Output	180 Day[1] Zero + % Output	1 Year[1] Zero + % Output	2 Year[1] Zero + % Output
1mV / °C	-100°C to +100°C	4uV + 0.011	4uV + 0.013	4uV + 0.014	6uV

Note 1 : Does not include cold junction compensation errors

Cold Junction Compensation Error = ± 0.2°C

All thermocouple measurement specifications assume correct compensation cable is being used

Specifications apply at TCal ±5°C.

Outside this range an allowance of 0.18 x 1 Year Spec. per °C should be added.

General Specifications

PRT Type	Range °C	1 Year * ± °C
PT25	-200 to 0	0.50
	0 to 800	0.60
PT100	-200 to 0	0.13
	0 to 800	0.55
PT250	-200 to 0	0.25
	0 to 800	0.30
PT500	-200 to 260	0.10
	260 to 500	0.90
PT1000	-200 to 0	0.08
	0 to 800	0.45

2, 2 Wire compensated and 4 Wire Simulated Output Available

Display resolution : 1m°C

Minimum terminal voltage = 80mV

Maximum current input = 20mA

Input measurement current must be a constant DC current isolated from earth

Performance/compatibility may be affected using other measurement methods/techniques for the variable PRT function e.g.. AC or pulsed, in which case passive resistance functionality may be employed.

Current must be stable for a period of 1s - it is therefore recommended the UUT range is selected manually

* Specifications apply at TCal ± 5°C.

Outside this range an allowance of 0.18 x 1 Year Spec. per °C should be added.

General Specifications	
Voltage Range	1V to 1000V DC
Current Range	0.5mA to 30A DC
Output Terminals	Voltage output from top (Black & White) terminals 0.5mA to 2A current output from middle 2A (Black & Red) terminals 2.01A to 30A current output from bottom 30A (Blue & Yellow) terminals Note : Indicator LEDs for both sets of terminals will illuminate to indicate DC Power mode

1 Year Accuracy Relative to Calibration standards

Current Range	Resolution	Setting	Zero
0.5mA to 300mA	10uA	0.100%	40uA
0.3A to 2A	0.1mA	0.015%	400uA
2.01A to 30A	1mA	0.04%	4mA

1 Year Accuracy Relative to Calibration standards

Voltage Range	Resolution	Setting	Zero
20V	1uV	0.0025%	40uV
200V	10uV	0.0030%	400uV
1000V	100uV	0.0030%	4000uV

High Voltage Safety

High voltage output is ramped to allow instruments to auto range

Standby is automatically activated when setting voltages greater than 20V or 200V from a lower voltage

Standby is automatically selected for high voltage (>20V) after 20 minutes on the same setting.This function can be disabled

High voltage (> 20V) output is indicated to user through an audible warning beep

An external high voltage output/standby control switch is available as an option

30A available as standard - external amplifier **not** required
Specifications apply at TCal ± 5°C.
Outside this range an allowance of 0.18 x 1 Year Spec. per °C should be added.

General Specifications	
Voltage Range	1V to 1000V AC
Current Range	0.5mA to 30A AC
Frequency Range	10Hz to 400Hz
Output Terminals	Voltage output from top (Black & White) terminals 0.5mA to 2A current output from middle 2A (Black & Red) terminals 2.01A to 30A current output from bottom 30A (Blue & Yellow) terminals Note : Indicator LEDs for both sets of terminals will illuminate to indicate AC Power mode

1 Year Accuracy Relative to Calibration standards

Current Range	Resolution	Setting	Zero
0.5mA to 0.2A	10uA	0.2%	40uA
0.2A to 2A	0.1mA	0.1%	400uA
2.01A to 30A	1mA	0.05%	4mA

1 Year Accuracy Relative to Calibration standards

Voltage Range	Resolution	Setting	Zero
20V	1uV	0.035%	900uV
200V	10uV	0.04%	7.5mV
1000V	100uV	0.04%	75mV

Frequency Specifications

Frequency	
Range	40 to 400Hz (1V to 699V) : 46 to 400Hz (700V to 1000V)

Phase Specifications

Phase Angle	Resolution	Accuracy
0° to 359.9°	0.1°	0.1° + 6us*

*6us represents 0.109° at 50Hz or 0.87° at 400Hz

Note : Phase accuracy specification applies for levels above 10V/.5A into loads of 100mOhms and greater

4600 calibrators **automatically correct for any errors in the phase** caused by inductive loading, for example when using the clamp coil adaptor.

Note that when in Power output mode the Voltage and Current negative terminals are internally tied together, and as default negative to ground is selected. Phase speciications apply only when the UUT current and voltage measurement channels are isolated from eachother. Ground loops caused by externally earthing or tieing low's together will cause phase errors

High Voltage Safety

High voltage output is ramped to allow instruments to auto range

Standby is automatically activated when setting voltages greater than 20V or 200V from a lower voltage

Standby is automatically selected for high voltage (>20V) after 20 minutes on the same setting. This function can be disabled

High voltage (> 20V) output is indicated to user through an audible warning beep

An external high voltage output/standby control switch is available as an option

30A available as standard - external amplifier **not** required

Specifications apply at TCal ± 5°C.

Outside this range an allowance of 0.18 x 1 Year Spec. per °C should be added.

DDS Harmonic Specifications (in addition to AC Power Specifications) (apply only if Power DDS Option fitted)

DDS Harmonic Power Simulation - General Specifications	
Harmonics in a User Defined Waveform ProWave PC software required to upload waveform data - supplied when PWRDDS option fitted	**48** from 2nd to 49th Harmonic
Fundamental Frequency	**40Hz to 400Hz**
Harmonic Frequency Range	**Up to 20kHz**
Harmonic Frequency Accuracy	**0.1% + (N x 0.08%)** Where N is the Harmonic number
Harmonic Amplitude Resolution	**0.10%** of Fundamental
Harmonic Phase Range (relative to fundamental)	**0 to 360°**
Harmonic Phase Resolution	**0.1°** Relative to Fundamental
Composite Voltage Waveform Range	**2V to 1000V**
Composite Current Waveform Range	**300mA to 30A**

DDS Harmonic Power Simulation - Pre Loaded Waveforms
3rd 5%
3rd 10%
5th 10%
12th 10%
21st 10%
USER+SINE
USER

We truly believe in offering Solutions in Calibration, offering bespoke solutions for calibration laboratories and manufacturers across the globe. Our mission statement is not just a phrase, it is our design and support philosophy, offering support and advice that cannot be found elsewhere with a friendly atmosphere.

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Transmille now produce over 600+ calibration instruments per year, shipping instruments to customers ranging from National Standards Laboratories and manufacturers through to small calibration test houses around the world.

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