

ET2001 AC-DC Transfer Standard System

General:

A new compact AC-DC transfer standard based on the fast-reversed DC method. The system has been developed through a collaborative research between SunJEM co. Ltd. and AIST (National Institute of Advanced Industrial Science and Technology, Japan).

Function:

1. Evaluation of thermoelectric transfer difference of a thermal converter
2. AC-DC difference comparison measurement of thermal converters
3. Generation of precision ac sine-wave (1V - 10V, 10Hz - 1MHz)
4. Calibration of ac voltage (using external DC voltage standard)

Composition:

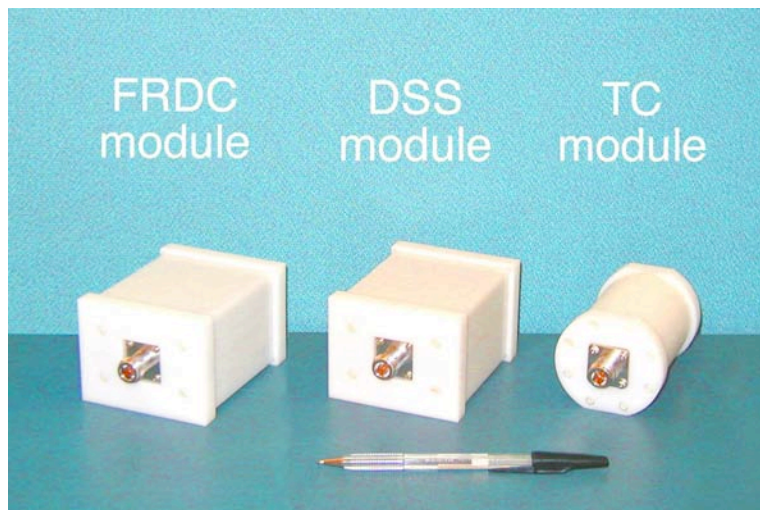
1. Thermal Converter (TC module)
2. Fast-Reversed DC source (FRDC module)
3. Precision Digital Sine-wave Synthesizer (DSS module)
4. Power Supply with USB-Interface (PS/USB module)
5. Precision Amplifier Module (AMP module)
6. Special Thermal Converters (HF-TVC / LF-TVC)

Feature:

1. Measurement monitoring over Internet
2. Easy operation by fully automated measurement
3. Compact, transportable system

Application:

1. Establishment of primary ac-dc transfer standard
2. International comparison at highest level of accuracy (@3V, up to 1MHz)
3. Calibration of ac-dc standard instruments such as Fluke 792A (at 1V to 10V)
4. Calibration of precision ac voltmeter such as Agilent 3458 (at 1V to 10V)



ET2001 AC-DC Transfer Standard System

Initial "Monitor" Price (Domestic/Overseas)

FRDC Module	553,350 / 565,000 JPY
DSS Module	553,350 / 565,000 JPY
TC Module	372,750 / 380,000 JPY
AMP Module	303,450 / 310,000 JPY
USB/PS Module	249,900 / 255,000 JPY
HF-TVC	105,000 / 100,000 JPY
LF-TVC	136,500 / 130,000 JPY

(The "monitor" price is available for a limited number and period)
(Price does not include transportation/Handling fee to overseas)

Contact Address for Purchasing

Keytechno Co., Ltd.
1-14-6 Suda-cho, Kanda
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TEL : +81-3-3251-3161
FAX : +81-3-3251-3166
e-mail: keytechno@pop14.odn.ne.jp

Technical Inquiries

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<http://www.iquantum.jp>



IQUANTUM Corporation, Japan
<http://www.iquantum.jp>

ET2001ADS-FRDC-V02

FRDC (Fast-Reversed DC) Module

Function:

FRDC module is a rectangular-waveform voltage source to be used in FRDC-DC difference measurement. It produces accurate FRDC and DC waveforms with amplitudes from 1 V to 10 V and switching frequencies between 0.1 Hz and 10 kHz. The design of the FRDC circuit is based on the "source A/B switching" scheme, in order to establish the equality of rms values between the FRDC and DC waveforms.

Specifications:

1. Output Characteristics	
Output Voltage	
Setting Range	1.00V to 10.23V
Setting Resolution	0.0025V * 12 bit
Accuracy	1% (all four sources)
Voltage Adjustment	
Setting Range	- 4.094 % to + 4.094 %
Resolution	0.002%
Accuracy (> 0.1%)	< 1% (MAX)
Stability	
Thermal Drift	< 10 ppm/deg (typ.)
Short Term (0.1Hz - 10Hz)	< 2 ppm (typ)
Current Compliance	20 mA
2. Switching Period (Frequency)	
Setting Range	10 s (0.1 Hz) to 0.1 ms (10 kHz)
Resolution	0.001/0.01/1.0/10/100 ms * 10 bit
Accuracy	<1%
3. Isolation between Sources	
0.1 Hz to 100 Hz	< 1 ppm
100 Hz to 1 kHz	< 2 ppm
4. Power Consumption	
Analog ($\pm 18V^2$)	<50mA (MAX)
Analog (+5V ²)	<50mA (MAX)
Digital (+5V)	<50mA (MAX)

ET2001ADS-FRDC-V02**FRDC (Fast-Reversed DC) Module****5. Miscellaneous**

Connectors

Control/Power Supply

MDR-26 pin

Voltage Output

Type N-R

Serial Interface

RS232C compatible

Dimension

8 cm x 6 cm x 11cm

Weight

0.6 kg

Options/Accessories:

1. MDR interface cable 26p (1m) with EMI core
Order#: ET2001-CMN-MDR26P
2. Output cable (30cm) with NP at both ends
Order#: ET2001-NP/NP-CABLE



ET2001ADS-DSS-V02

DSS (Digital Sine-wave Synthesizer) Module

Function:

DSS module generates highly stable sinusoidal ac and dc outputs to be used in ac-dc difference measurements. The module is based on a direct digital synthesizer device and generate frequencies between 10 Hz and 1 MHz at rms voltages from 1 V to 10 V. In the evaluation of low-frequency characteristics of thermal converters, the DSS module is used as a reference in ac voltage standard.

Specifications:
1. Output Characteristics

Output Voltage	
Setting Range	1.00V to 10.23V
Setting Resolution	
(1V to 2V)	0.0005V * 12 bit
(2V to 5V)	0.00125V * 12 bit
(5V to 10V)	0.0025V * 12 bit
Accuracy	1%
Voltage Adjustment	
Setting Range	- 4.094 % to + 4.094 %
Resolution	0.002%
Accuracy (> 0.1%)	< 1% (MAX)
Stability	
Thermal Drift	< 20 ppm/deg (typ.)
Short Term (0.1Hz - 10Hz)	< 2 ppm (typ)
Current Compliance	30 mA

2. AC Characteristics

Frequency Setting Range	
Normal Mode	10 Hz to 1 MHz
Low-Frequency Mode	4Hz to 1 kHz
Frequency Setting Resolution	
Normal Mode	(1/32) μ s * 32 bit in period
Low-Frequency Mode	0.5/1.0 ms * 8 bit in period
Accuracy	<1%
DC Offset Correction	
Uncorrected Offset	1% (typ.)
Adjustment Range	- 4.094 % to + 4.094 %
Setting Resolution	0.002%
Correction Sensitivity	< 0.05%

ET2001ADS-DSS-V02**DSS (Digital Sine-wave Synthesizer) Module****Distortion**

DAC Resolution	10 bit (-62dB)
Total Harmonic Distortion	< - 40dBc
Spurious Noise >100kHz	< - 60dBc

3. Power Consumption

Analog-Main ($\pm 18V$)	< 50mA (MAX)
Analog-Main (+5V)	< 50mA (MAX)
Analog-Sub ($\pm 18V$)	< 80mA (MAX)
Analog-Sub (+5V)	< 20mA (MAX)
Digital (+5V)	< 50mA (MAX)

4. Miscellaneous**Connectors**

Control/Power Supply	MDR-26 pin
Voltage Output	Type N-R

Serial Interface

RS232C compatible

Dimension

8 cm x 6 cm x 11cm

Weight

0.6 kg

Options/Accessories:

- MDR interface cable 26p (1m) with EMI core
Order#: ET2001-CMN-MDR26P
- Output cable (30cm) with NP at both ends
Order#: ET2001-NP/NP-CABLE



ET2001ADS-TC-01

TC (Thermal Converter) Module

Function:

TC module is a digital-output thermal converter. The module consists of a thermal converter element, a precision A/D converter as a nV detector, a D/A converter for offset compensation, and an optically isolated digital control circuit.

Specifications:

1. Thermal Conversion

10V Model (ET2001-TC01-10V)

Input Voltage Range	5 V to 10 V
Max. Input Voltage	20 V
Input Resistance	1k Ω
Output EMF Voltage	
10V Input	30 mV/ 40 mV (min./typ)
5V Input	7 mV/ 10 mV (min./typ)

5V Model (ET2001-TC01-5V)

Input Voltage Range	2 V to 5 V
Max. Input Voltage	10 V
Input Resistance	500 Ω
Output EMF Voltage	
5V Input	30 mV/ 40 mV (min./typ)
2V Input	5 mV/ 7 mV (min./typ)

2V Model (ET2001-TC01-2V)

Input Voltage Range	1 V to 2 V
Max. Input Voltage	6 V
Input Resistance	200 Ω
Output EMF Voltage	
2V Input	12 mV/ 16 mV (min./typ)
1V Input	3 mV/ 4 mV (min./typ)

2. A/D Conversion

Nominal Input Range	0 mV to +250 mV
Input Equivalent Noise	<100 nV / $\sqrt{\text{Hz}}$ (Typ.)
Effective Resolution	23 bit
Linearity	0.001%
Update Rate	
Line Frequency 50 Hz	6.25 rdg/s***
Line Frequency 60 Hz	7.5 rdg/s***

3. Back-up Voltage

Setting Range	0 mV to 250 mV
Setting Resolution	(250 mV/4096) * 12 bit

ET2001ADS-TC-01**TC (Thermal Converter) Module**

Thermal Drift	< 10 ppm/deg (typ.)
Short Term (0.1Hz - 10Hz)	< 2 ppm (typ)
4. Power Consumption	
Analog ($\pm 5V$)	< 50mA (MAX)
Digital (+5V)	< 50mA (MAX)
5. Miscellaneous	
Connectors	
Control/Power Supply	MDR-20 pin
Voltage Input	Type N-R
Serial Interface	RS232C compatible
Dimension	7 cm (DIA) x 11cm
Weight	0.3 kg
Weight	0.6 kg

Options/Accessories:

- MDR interface cable 20p (1m) with EMI core
Order#: ET2001-CMN-MDR20P
- Input cable (30cm) with NP at both ends
Order#: ET2001-NP/NP-CABLE



ET2001ADS-AMP-01

AMP (Precision A/D Converter) Module

Function:

The AMP module has a similar function to the TC module, except that it does not contain a dedicated thermal converter element, and the type-N input connector is replaced with a low-thermal DC input connector to be combined with an external thermal converter such as HF-TVC.

Specifications:

1. A/D Conversion		
Max. Input Voltage		- 2.5 V to +2.5 V
Nominal Input Range		0 mV to +250 mV
Input Equivalent Noise		< 100 nV / $\sqrt{\text{Hz}}$ (Typ.)
Effective Resolution		23 bit
Linearity		0.001%
Update Rate		
Line Frequency 50 Hz		6.25 rdg/s***
Line Frequency 60 Hz		7.5 rdg/s***
2. Back-up Voltage		
Setting Range		0 mV to 250 mV
Setting Resolution		(250 mV/4096) * 12 bit
Thermal Drift		< 10 ppm/deg (typ.)***
Short Term (0.1Hz - 10Hz)		< 2 ppm (typ)
3. Power Consumption		
Analog ($\pm 5\text{V}$)		< 50mA (MAX)
Digital (+5V)		< 50mA (MAX)
4. Miscellaneous		
Connectors		
Control/Power Supply		MDR-20 pin
DC Input		LEMO FBB 3-pin
Serial Interface		RS232C compatible
Dimension		7 cm (DIA) x 11cm
Weight		0.3 kg

Options/Accessories:

1. MDR interface cable 20p (1m) with EMI core
Order#: ET2001-CMN-MDR20P
2. Input cable (40cm) with two LEMO connectors at both ends
Order#: ET2001-AMP-CABLE-L3P/L3P

ET2001ADS-USB&PS-02

USB&PS (Power Supply with USB I/F) Module

Function:

USB&PS module provides isolated DC power sources to the main modules. Switching regulator circuits are avoided to minimize the effect of high-frequency interference to the sensitive nano-volt detection circuit. The module also provides an optically isolated USB-to-serial interface circuit between a PC controller and the FRDC, DSS, and TC modules.

Specifications:

Channel-1 (DSS/FRDC Module)

Power Supply	
Analog ($\pm 18V \times 2$ ch)	>200mA
Analog (+5V $\times 2$ ch)	>100mA
Digital (+5V)	>100mA
Connector	MDR-26 pin

Channel-2 (TC/AMP Module)

Power Supply	
Analog($\pm 5V$)	>100mA
Digital (+5V)	>100mA
Connector	MDR-20 pin

Channel-3 (TC/AMP Module)

Power Supply	
Analog($\pm 5V$)	>100mA
Digital (+5V)	>100mA
Connector	MDR-20 pin

Miscellaneous

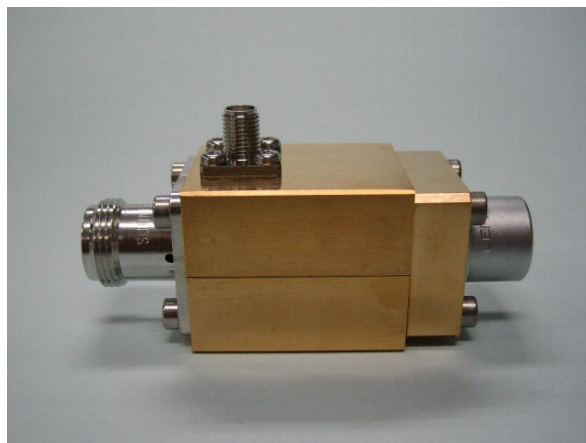
Interface	
Module Control	RS232C compatible
PC (controller)	USB 1.0
AC Power Line	
Voltage Selector	100 V - 120V / 200V - 240V
Frequency	50 Hz / 60 Hz (auto-detect)
Dimension	7 cm x 16 cm x 11cm
Weight	1.3 kg

Options/Accessories:

1. MDR interface cable 26p (1m) with EMI core
Order#: ET2001-CMN-MDR26P
2. Output cable (30cm) with NP at both ends
Order#: ET2001-NP/NP-CABLE

高周波TVC

HIGH FREQUENCY THERMAL VOLTAGE CONVERTER HF-TVC



特長用途

独立行政法人産業技術総合研究所(AIST)との共同研究によって開発されたJSTC04型サーマルコンバータを、専用の高周波シャーシに内蔵して入出力コネクタを取り付けた、すぐに標準器として利用の可能な完成品のサーマルコンバータです。オーディオ周波数を越える周波数帯域(10kHz-1MHz)において、0.01%以下の交直変換誤差(交直差)を有しています。また交流入力部に仮想TEE方式(*)を用いているため、周波数特性を0.001%のレベルで精密に評価することが可能です。更にファストリバースDC法などを用いて交直差の精密評価を行うことによって、国家標準クラスのAC-DCトランスファー標準が実現できます。出荷する高周波TVCには、全て個体識別用の製品番号が付され、入出力抵抗値、感度(出力電圧)、正逆差の特性データ、および交直差の参考データが添付されます。

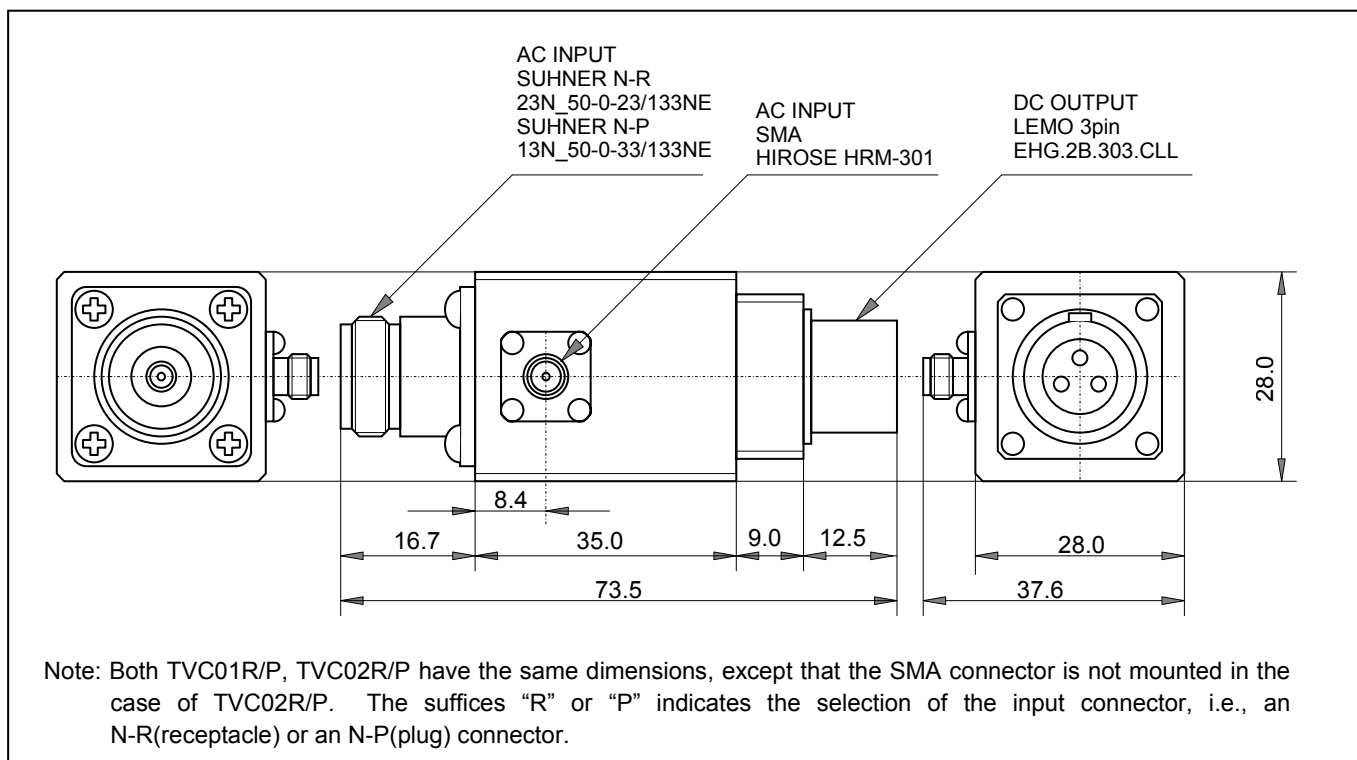
*仮想TEE方式---二個のサーマルコンバータの比較測定の際に用いられるTEE型コネクタを内蔵し、コネクタの分岐点(定義点)にサーマルコンバータ素子を直接接続することによって、JSTC04B素子の有する優れた高周波特性を最大限に引き出すことができます。

Features and Applications

The HF-TVC (High-Frequency Thermal Voltage Converter) is a complete thermal converter module using the JSTC04 thermal converter as a core device. The JSTC04 device is built in a dedicated high-frequency chassis with input and output connectors, and is ready to be used as a high-precision AC-DC transfer standards. The HF-TVC employs the virtual-TEE configuration ("internal" or "built-in" TEE), making the evaluation of frequency characteristic of the ac-dc transfer difference possible at 10⁻⁶ level up to 1MHz.

All the HF-TVC modules are identified by serial production numbers, and are individually inspected and guaranteed for the specifications. The inspection data include input resistance, output resistance, sensitivity (output voltage), reversal error. The ac-dc transfer difference data with respect to the NIKKOHM's reference standard will also be attached to the HF-TVC.

The HF-TVC has been developed through the collaboration with AIST (National Institute of Advanced Industrial Science and Technology, Japan).



高周波 TVC HIGH FREQUENCY THERMAL VOLTAGE CONVERTER

HF-TVC

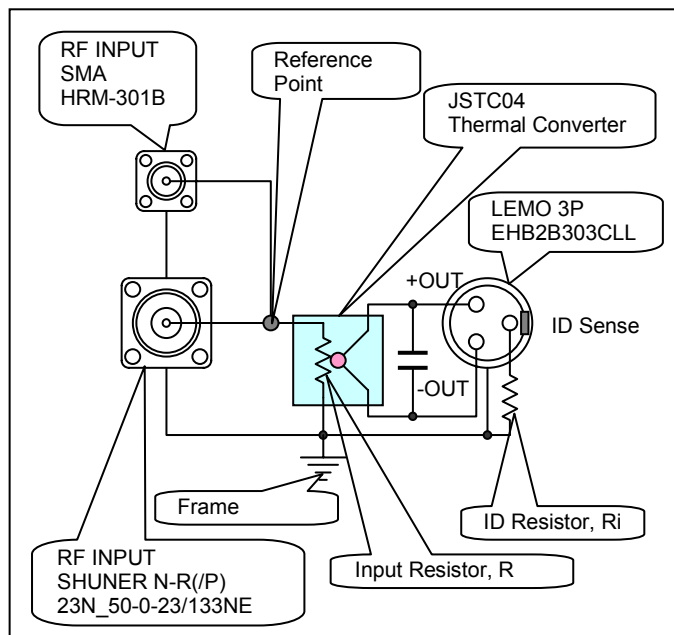
形名呼称 Ordering Information

Ordering P/N	Type	Input Connect	Input resistance TC	Input resistance	Input resistance Tolerance	Remarks
TVC01RE100ohmG	TVC01	R	E (+/-25ppm/K)	100 Ohms	G (+/-2%)	
TVC01PE500ohmG	TVC01	P	E (+/-25ppm/K)	500 Ohms	G (+/-2%)	
TVC02RE1000ohmG	TVC02	R	E (+/-25ppm/K)	1000 Ohms	G (+/-2%)	No SMA

仕様性能 Specifications and Performances

		TVC01, TVC02	Conditions
[入力]	INPUT		
定格電力	Rated Power	0.1 W	
最大入力電力	Max Applied Power	0.5 W	
公称抵抗値	Resistance	50,100, 200, 500, 1K, 2K Ohms	
抵抗温度係数	TCR	+/-25ppm/K (E)	
抵抗値許容差	Tolerance	+/-2% (G)	
周波数範囲	Frequency Range	DC-10MHz	
[出力]	OUTPUT		
定格出力電圧	Rating output voltage	More than 60mV	
出力内部抵抗	Output resistance	340 Ohms +/- 30%	
内部抵抗の TCR	TC of Output resistance	+/- 300ppm/K	
[総合]	INPUT/OUTPUT		
変換感度	Sensitivity	More than 0.6 V/W	
感度の温度依存性	TC of Sensitivity	-0.001mV/mW/K	Typical
応答時間	Response Time	2.5 +/-0.6 seconds	63% response
交直変換誤差	AC-DC Difference, 10k-100kHz	Less than 10ppm	Typical
交直変換誤差	AC-DC Difference, 100K-1MHz	Less than 100ppm	Typical
	Environmental		
動作温度	Operating Temp.	25 +/- 5 degree C	
保存温度	Storage Temp.	-20 to 60 degree C	

内部の構造 Internal schematic



Values of the ID Resistor (Ri)

Input Resistance, R	ID Sense Resistors, Ri
50 Ohm	50 - (56) - 82 Ohms
100 Ohm	100 - (120) -180 Ohms
200 Ohm	200 - (220) - 470 Ohms
500 Ohm	500 - (560) - 820 Ohms
1K Ohm	1k - (1.2K) - 1.8k Ohms
2K Ohm	2k - (2.2K) - 4.7k Ohms

Note: The values in parenthesis are nominal values. Other values are available on request..

Note: Output Capacitance
The shunting capacitance between the output pins is 10 nF. Other values are available on request.

低周波 T V C

LOW FREQUENCY THERMAL VOLTAGE CONVERTER LF-TVC



特長用途

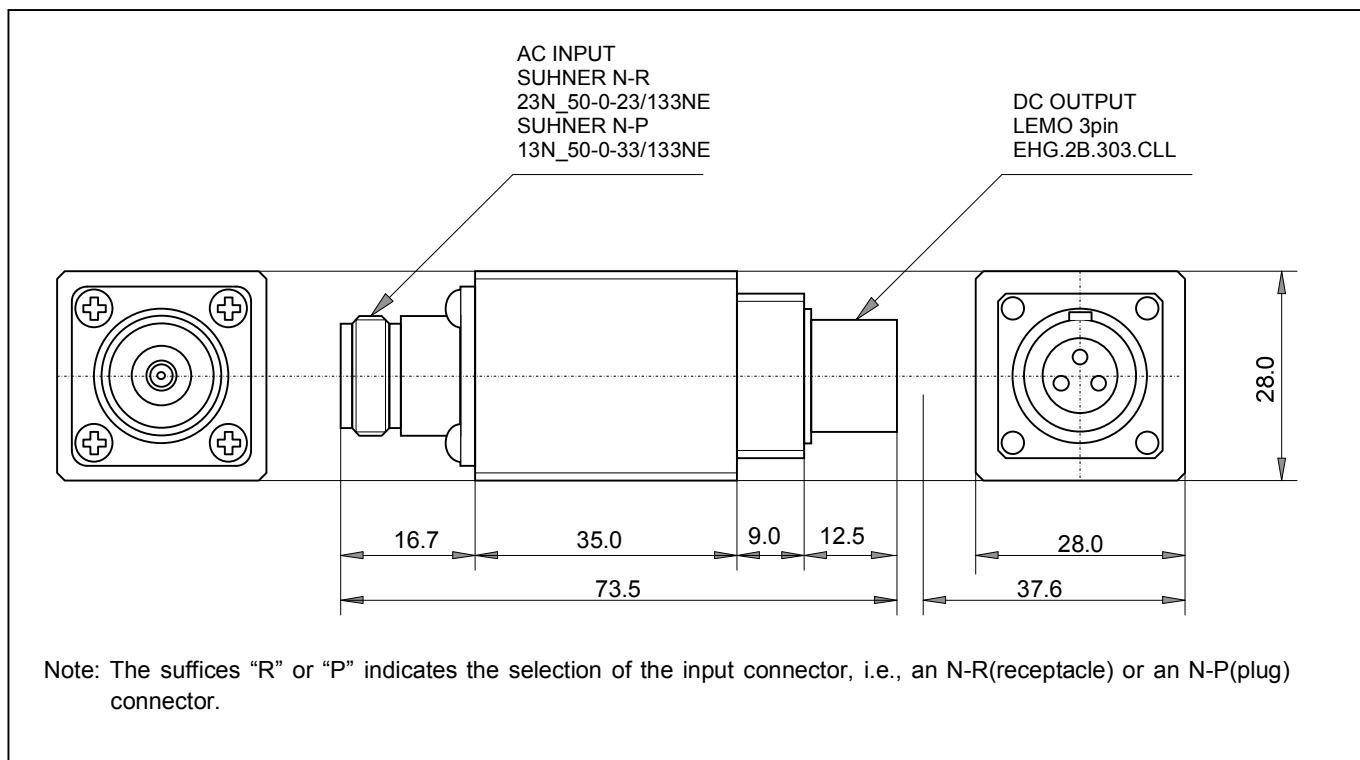
独立行政法人産業技術総合研究所(AIST)との共同研究によって開発された低周波特性に優れたサーマルコンバーターです。超低周波領域での測定用に開発された JSTC05 型サーマルコンバーターを、入出力コネクタ付の専用シャーシに内蔵しました。JSTC05 型サーマルコンバーターは、JSTC04 型と比較してヒーターの熱時定数が 2 倍（6 秒）に、また、ヒーター抵抗温度係数が約 1/3（<math><10\text{ppm/K}</math>）に改善されているため、通常のサーマルコンバーターでは熱リップルの影響で測定制度の劣化する低周波数領域（10Hz-100Hz）においても、その影響は 1/10 以下に抑制されます。高周波 TVC（HF-TVC）やファストリバース DC 法と組み合わせることによって、国家標準クラスの AC-DC トランスファー標準が実現できます。出荷する低周波 TVC には、全て個体識別用の製品番号が付され、入出力抵抗値、感度（出力電圧）、正逆差の特性データ、および交直差の参考データが添付されます。

Features and Applications

The LF-TVC is specially designed as a high-precision reference standard in AC-DC transfer standard at low frequency range (10 Hz - 100 Hz). The LF-TVC uses a JSTC05 thermal converter element as a core device. The JSTC05 element has exceptionally large time constant of 6 seconds and temperature coefficient smaller than 10 ppm (<math><5\text{ ppm optional}</math>), which helps to suppress the effect of thermal ripple to more than one order of magnitude smaller than that of the standard JSTC04 elements.

All the LF-TVC modules are identified by serial production numbers, and are individually inspected and guaranteed for the specifications. The inspection data include input resistance, output resistance, sensitivity (output voltage), reversal error. The ac-dc transfer difference data with respect to the NIKKOHM's reference standard will also be attached to the LF-TVC.

The LF-TVC has been developed through the collaboration with AIST (National Institute of Advanced Industrial Science and Technology, Japan).



低周波 TVC LOW FREQUENCY THERMAL VOLTAGE CONVERTER

LF-TVC

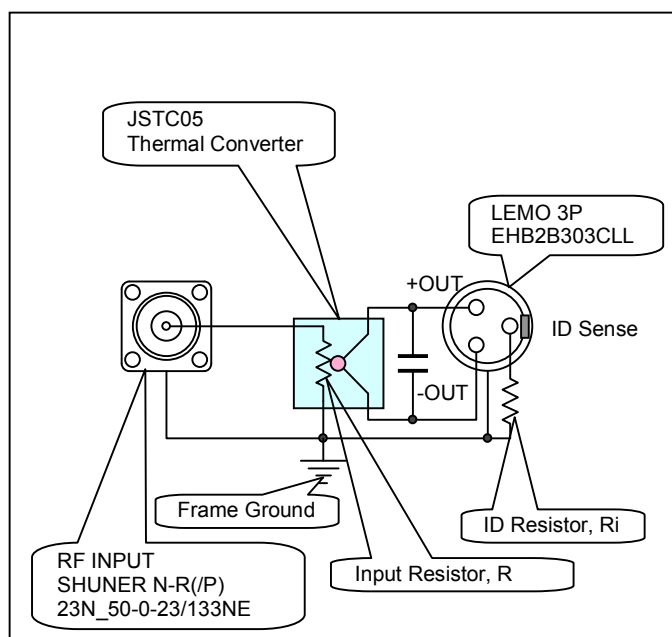
形名呼称 Ordering Information

Ordering P/N	Type	Input Connect	Input resistance TC	Input resistance	Input resistance Tolerance	Remarks
LFTVC01RN200ohmK	LFTVC01	R	N (+/-10ppm/K)	200 Ohms	K (+/-10%)	
LFTVC01RZ200ohmK	LFTVC01	R	Z (+/-5ppm/K)	200 Ohms	K (+/-10%)	

仕様性能 Specifications and Performances

		LFTVC01,	Conditions
[入力]	INPUT		
定格電力	Rated Power	0.1 W	
最大入力電力	Max Applied Power	0.5 W	
公称抵抗値	Resistance	200 Ohm	
抵抗温度係数	TCR	+/-5ppm/K (Z)、 +/-10ppm/K (N)	
抵抗値許容差	Tolerance	+/-10% (K)	
周波数範囲	Frequency Range	DC-100kHz	
[出力]	OUTPUT		
定格出力電圧	Rating output voltage	More than 60mV	
出力内部抵抗	Output resistance	340 Ohms +/- 30%	
内部抵抗のTCR	TC of Output resistance	+/- 300ppm/K	
[総合]	INPUT/OUTPUT		
変換感度	Sensitivity	More than 0.6 V/W	
感度の温度依存性	TC of Sensitivity	-0.001mV/mW/K	Typical
応答時間	Response Time	6.0 +/-1.0 seconds	63% response
交直変換誤差	AC-DC Difference, 10Hz-1kHz	Less than 10ppm	Typical
	Environmental		
動作温度	Operating Temp.	25 +/- 5 degree C	
保存温度	Storage Temp.	-10 to 60 degree C	

内部の構造 Internal schematic



Values of the ID Resistor (Ri)

Input Resistance, R	ID Sense Resistors, Ri
200 Ohm	200 - (220) - 470 Ohms

Note: The values in parenthesis are nominal values. Other values are available on request..

Note: Output Capacitance
The shunting capacitance between the output pins is 10 nF. Other values are available on request.