



Excellent
Korea
Technology



TULA

Tiny Ultrasonic Linear Actuator



PIEZOELECTRIC TECHNOLOGY .CO.,LTD

Since 2000

- TULA Series
- Butterfly Series
- Hollow PiezoMotor
- Multilayer PiezoMotor



WWW.PIEZO-TECH.COM

www.piezo-tech.com



Welcome to Piezo Tech!

This is a representative director, Seong-il, Yoon who takes the enormous responsibility for the company in running business.

Our piezo- tech, the word which was last 2000 a ultrasonic motor from the Republic of Korea which was unfamiliar, solely founded the company with only confidence and the belief against a technical power.

Until we've industrialized the ultrasonic motor at the domestic beginning and put out, we were in trouble. But we keep going our way.

Our piezo-tech which was feeble at first, we will be a leading company in the future.

We do our best for our future from C.E.O to all employees. With quality and technique of the best in the world, we pursue investment of positive R&D field to lead rather than the profit which is visible immediately in close at hand, and will return customer's favor. Please watch the figure we grow in the future.

C.E.O Seong-il, Yoon
Piezoelectric Technology Co., Ltd.



Piezoelectric Technology history



2000 ~ 2005 Basic technology Development stage

- 2000.11 Piezoelectric Technology Co.,Ltd was established
- 2001.07 Certified " Venture company" (SMBA, 2001112571-6881)
- 2001.08 Selected " INNO -BIZ" enterprise by SMBA of Government
- 2001.10 Awarded the Minister's prize of Ministry of commerce, Industry and Energy, Korea for Piezoelectric Ultrasonic Motors as the very best product
- 2002.04 Laboratory(R&D center)established, and certified by the government
- 2002.12 Acquired "NT"(New Technology) mark from KITA
- 2003.07 Selected "Export promising enterprise" by SMBA
- 2004.05 Developed TULA(Tiny Ultrasonic Linear Actuator)
- 2004.05 Designated as "Professional enterprise in parts and material industry" by Ministry of Commerce, Industry and Energy.
- 2005.05 Acquired "QS9000" Mark (Product quality management system) from KOTRIC
- 2005.06 Selected as a accomplishment enterprise in "Korea Materials and Components in dustry developing project" by Ministry of Commerce, Industry and Energy

2006 ~ 2010 Advanced technology and Module development stage

- 2006.03 Registered for "Foreign Direct Investment Company" by Woori bank (registration No:22218)
- 2006.06 Launched TULA50-165 Mass-production for DSC (Digital Still Camera of Samsung)
- 2007.04 Developed "Linear Actuator of Butterfly Type"
- 2007.06 Registered as a S-Partner certified supplier from Samsung Techwin (KSTW07-1061)
- 2007.08 Acquired a certificate of ISO9001 Quality Management System
- 2007.08 Acquired a certificate of ISO14001 Environmental Management System
- 2007.10 Awarded "Most Excellent Prize" with TULA in the 12th Contest of Excellent Development of Electronic Parts
- 2008.10 US Patent for TULA(No.14-240758)
- 2008.10 Acquired CE Certificate for "10W Ultrasonic Cutter" (PUC 10W)
- 2008.12 Selected as TULA- "30 Excellent Successful Cases of Technology Development" by Korea Institute of Industrial Technology Evaluation and Planning
- 2009.09 Acquired NEP(New Excellent Product) Certification by Ministry (Ministry of Knowledge Economy NEP-MKE-2009-030)
- 2009.10 Launched OIS module for Hybrid DSLR camera to Samsung Electronic (Model : NX10)
- 2010.04 Developed AF module for barcode with INTERMEC(U.S.A) as strategic business partner
- 2010.08 Registered European Patent for TULA (No. EP 1,721,382B1)
- 2011.06 Registered Chinese Patent for TULA (No. 200580001317.6)
- 2012.07 Developed TULA of Rectangular type
- 2012.11 Won an award for exporting tower of USD 1 Million from the Korea Trade Association

2011~ Growth stage Strengthen the market

TULA (Tiny Ultrasonic Linear Actuator)

Next generation actuator driven by linear motion of unimorph or bimorph piezoelectric body.

TULA XX-□□□



The diameter of piezoelectric ceramic
The length of the rod

■ FEATURES

- Very small size, light weight and simple structure
- Variable stroke
- Quick response
- Intrinsic holding force
- Excellent controllability
- Fine positioning / High resolution
- Quiet operation
- No EMI

PRODUCT LINE

■ TULA Series

Tiny Ultrasonic Linear Actuators

- TULA 35
- TULA 50
- TULA 70

■ Butterfly Series

Butterfly typed piezoelectric Linear Motor

- Butterfly 36
- Butterfly 48

■ Hollow type PiezoMotor

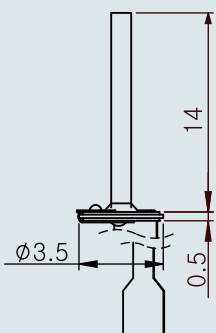
■ Multilayer Piezo Actuator for smart device



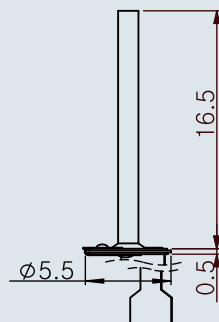
	TULA35	TULA50	TULA70
Mobile speed(mm/s)	<25	<35	<35
Max Thrust (g· f)	<20	<70	<70
Stroke (mm)	3~11	3~10	3~20
Driving voltage (V)	10~20	15~40	25~40
Driving frequency (kHz)	80~130	60~80	35~60
Current (mA)	<15	<15	<20
Power consumption (mW)	<450	<1000	<1500
Operating conditions (°C)	-10~50	-10~50	-10~50
Storage conditions (°C)	-20~80	-20~80	-20~80
Humidity (%)	15~90	15~90	15~90

APPLICATIONS

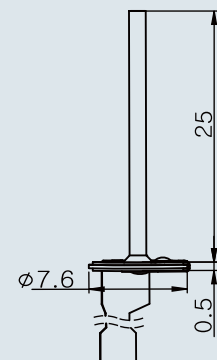
- ZOOM, AF of camera and mobile phone
- Optical Image Stabilizer (OIS) of camera
- Stage module
- ICR (infrared cut removal) of CCTV
- Medical equipments, MEMS, Optical equipments



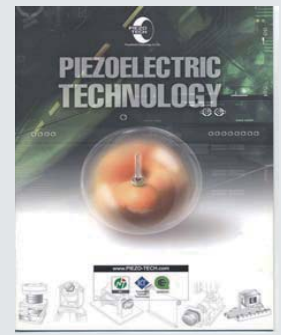
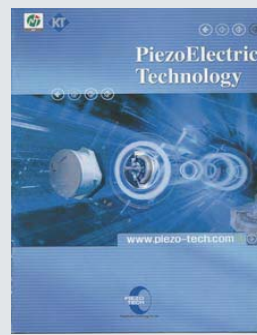
TULA35-140



TULA50-165



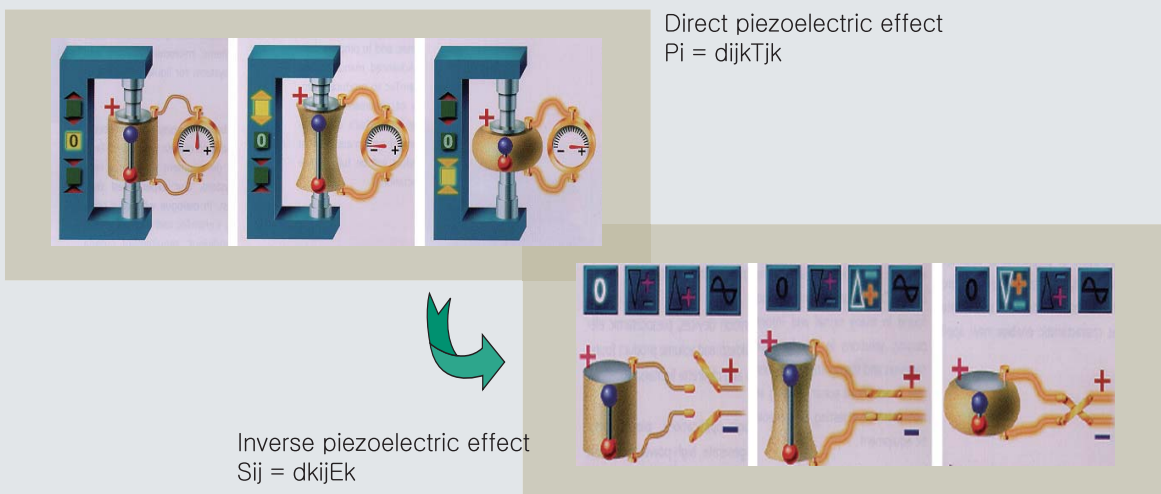
TULA70-250



PIEZOELECTRIC ULTRASONIC MOTOR

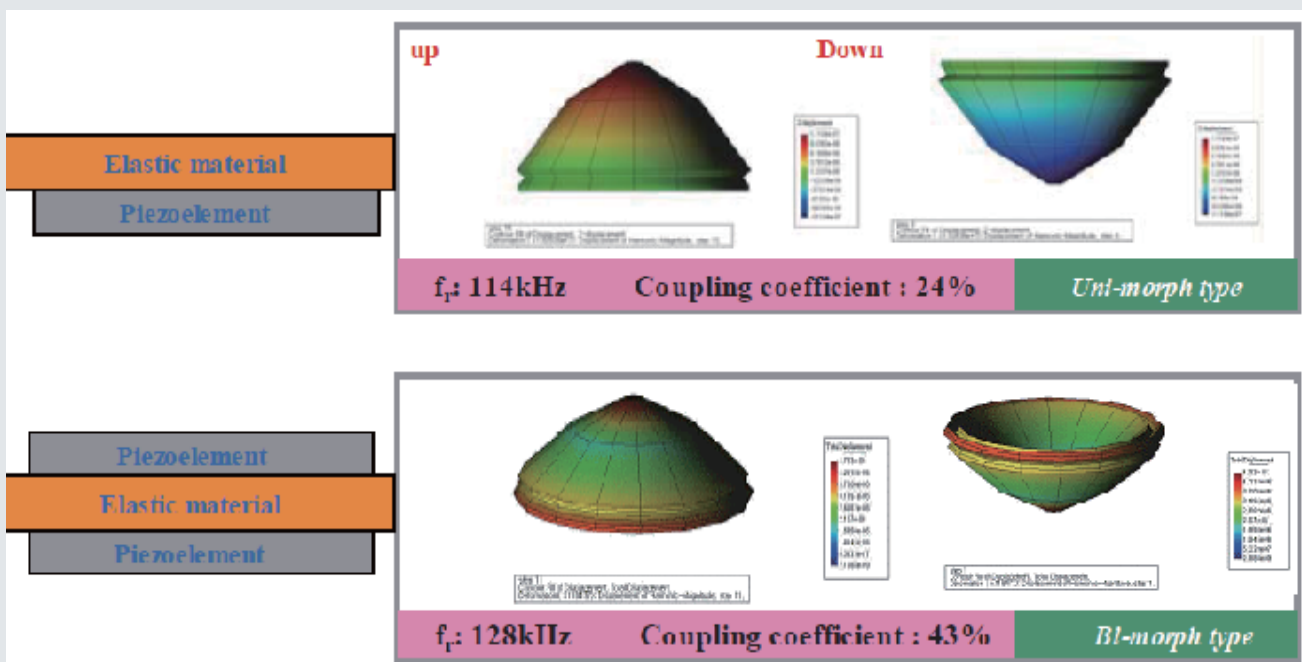
PIEZOELECTRIC EFFECT

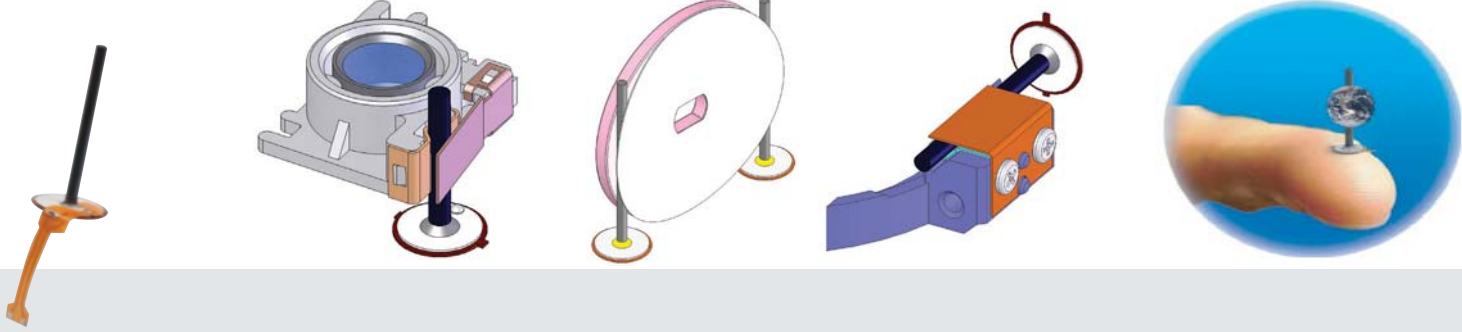
Piezoelectric effect is appearance of an electric potential across certain faces of piezoceramics when it is subjected to mechanical pressure. The word originates from the Greek word “piezein”, which means “to press”. A piezoelectric substance is one that produces an electric charge when a mechanical stress is applied (the substance is squeezed or stretched). Conversely, a mechanical deformation (the substance shrinks or expands) is produced when an electric field is applied.



OPERATING PRINCIPLE

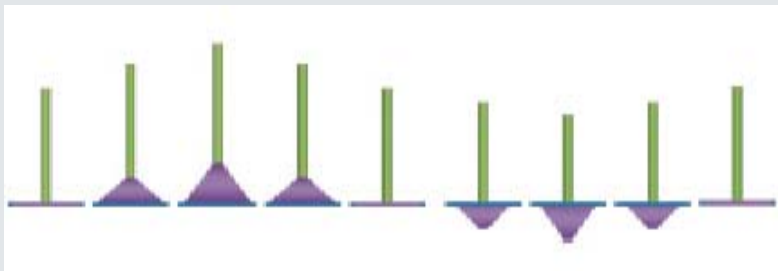
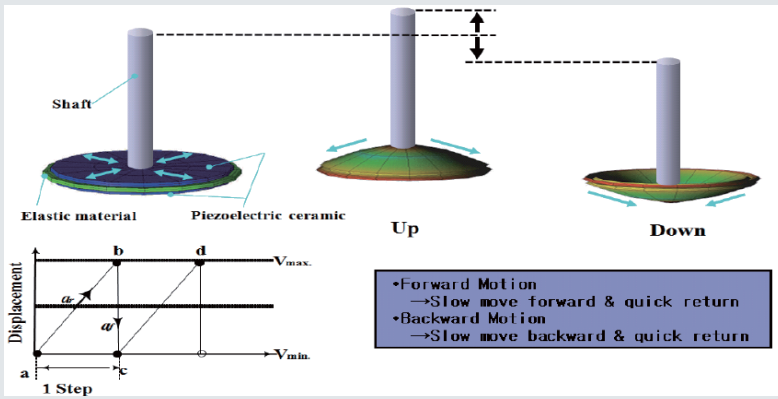
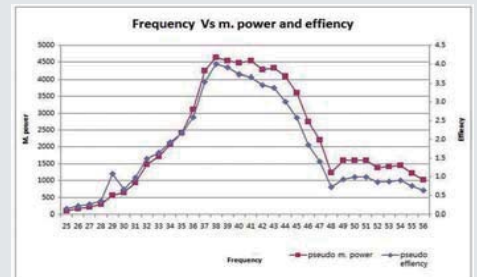
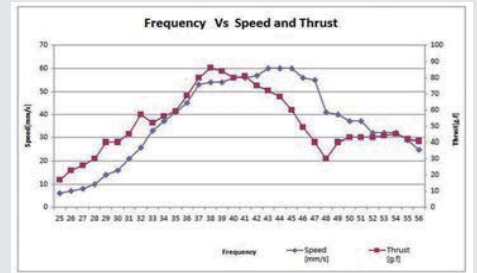
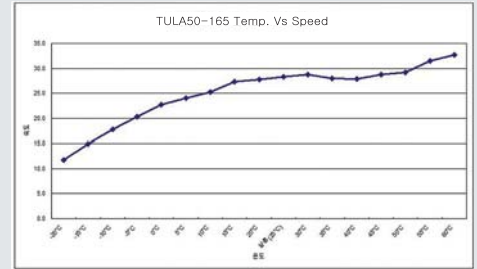
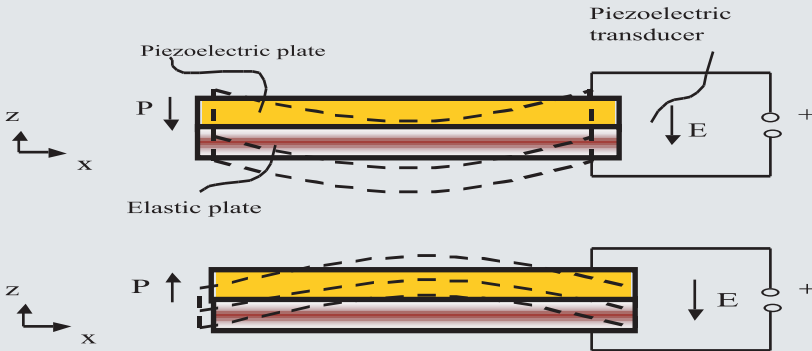
The operating principle of the TULA is explained by the characteristics of the piezoelectricity and Newton’s first law. In other words, the TULA exploits the vibration modes of the piezoelectric ceramics, the inertia principle and the contact force of the friction.





PIEZOELECTRIC ULTRASONIC MOTOR

OPERATING PRINCIPLE



Transference of vibration





APPLICATIONS

OIS(Optical Image Stabilizer) Module

Hybrid DSLR camera

■ PT-OIS50-14



Speed : 20mm/sec
 Thrust Force : 20gf
 Stroke : 2mm
 Resolution : 5 μ m(Hall Sensor)
 Power Consumption : <1000mW
 Size : 43mm \times 43mm \times 9.2mm
 Actuator : TULA50 \times 2
 Usage : Tele Zoom Lends

■ PT-OIS50-17



Speed : 15mm/sec
 Thrust Force : 20gf
 Stroke : 2mm
 Resolution : 5 μ m(Hall Sensor)
 Power Consumption : <1000mW
 Size : Φ 43mm \times 14.2mm
 Actuator : TULA50 \times 2
 Usage : Super Zoom Lends

AF Module

Digital camera
 Barcode reader
 Mobile phone camera

■ PT-AF50



Speed : 25mm/sec
 Thrust Force : 20gf
 Stroke : 5mm
 Resolution : 2 μ m(MR Sensor)
 Power Consumption : <400mW
 Size : 15.5mm \times 15.8mm \times 12mm
 Actuator : TULA50 \times 1

■ PT-OIS35



Speed : 20mm/sec
 Thrust Force : 20gf
 Stroke : 5mm
 Resolution : 2 μ m(MR Sensor)
 Power Consumption : <300mW
 Size : 15.5mm \times 15.8mm \times 13mm
 Actuator : TULA35 \times 1

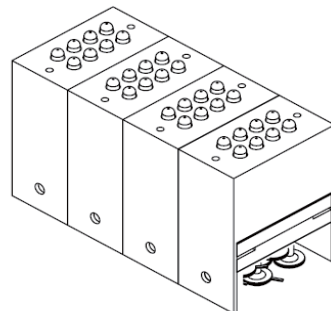
Braille/Haptic Module



Braille terminal
 It's applicable to bank ATM
 Customizing



Mobile Assembly

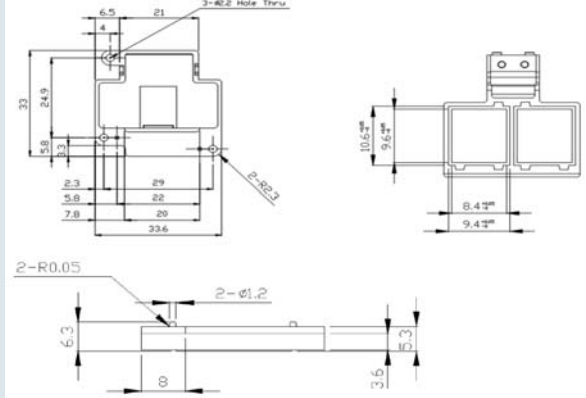


APPLICATIONS

ICR(Infrared Cut Removal) Module

IR Filter Change for day and night

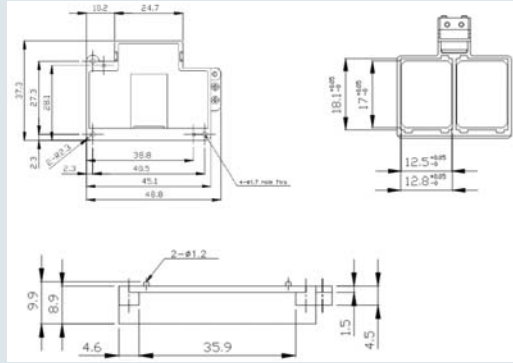
PT-ICR50-A



<Specifications>

Max Speed	>10mm/s
Resolution	On-Off System
Driving Frequency	70±10%kHz
Power Consumption	< 500mW
Operating Temperature	-15°C~70°C
Dimension(W×L×H)	33.6 × 33 × 5.3mm
Actuator	TULA50×1
Filter Size	10.6×9.4mm
Stroke	10.0mm

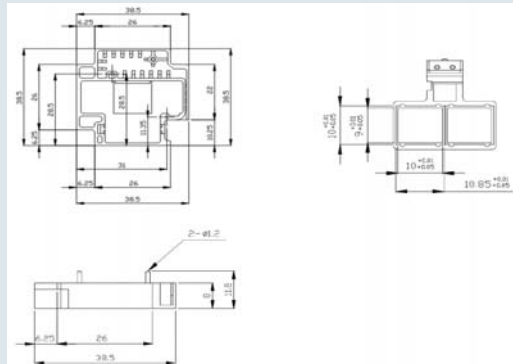
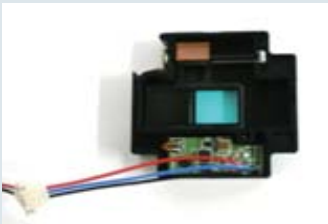
PT-ICR70-B



<Specifications>

Max Speed	>20mm/s
Resolution	On-Off System
Driving Frequency	50±10%kHz
Power Consumption	< 700mW
Operating Temperature	-15°C~70°C
Dimension(W×L×H)	45.1 × 37.3 × 8.9mm
Actuator	TULA70×1
Filter Size	18.1×12.8mm
Stroke	13.5mm

PT-ICR50-C



<Specifications>

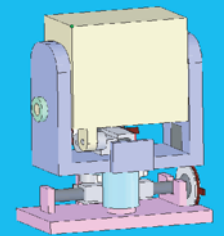
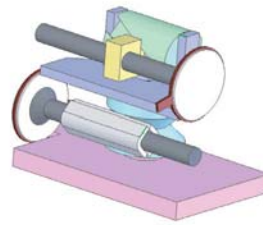
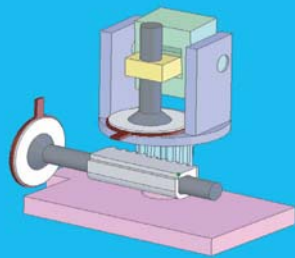
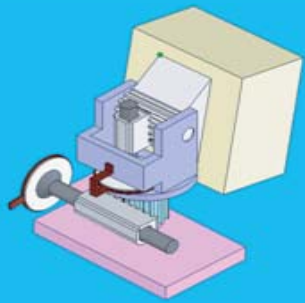
Max Speed	>10mm/s
Resolution	On-Off System
Driving Frequency	70±10%kHz
Power Consumption	< 500mW
Operating Temperature	-15°C~70°C
Dimension(W×L×H)	38.5 × 38.5 × 11.8mm
Actuator	TULA50×1
Filter Size	10.85×10mm
Stroke	8.5mm
Remarks	Driver included

Filter Specification

Item	Specification Outline	Options	
Dimensions	1/2 inch 10.7×10/12×11 (mm) ±0.1 1/2 inch 7.0×6.0/7.8×7.3 (mm) ±0.1	By Discussion	
The Composition Parts	Thickness	Quartz 0.35 mm Bond 15 µm	By Discussion
	Cut Angle Precision	Axis 45° 00' ±60' Tolerance ±60'	By Discussion
	Flatness	Rotation Angle 0° 00' ± Newton Ring 3 Line Max	
Transmission	Single Coating	> 85% / 550 mm	
	Multi Coating	> 90% / 450-650 mm	
Defect Limit	IR Cut Glass	40 µ 30 µ	
	IR Coat	40 µ 40 µ	



Made by TJH Corporation



APPLICATIONS

Rotating module



TULA70



RT70



Butterfly 48



RB48

<Specifications>

Rated Speed	90°/sec
Rated Torque	100gf•cm
Sensor	PI (Photo Interrupter) sensor (Mechanical encoder)
Resolution	1°(180pulse/rev)
Power Consumption	<2.5W
Dimensions(W×L×H)	25×25×12mm
Actuator	TULA70×1

<Specifications>

Rated Speed	720°/sec
Rated Torque	100gf•cm
Sensor	PI (Photo Interrupter) sensor (Mechanical encoder)
Resolution	1°(180pulse/rev)
Power Consumption	<2.5W
Dimensions(W×L×H)	32×35.0×12mm
Actuator	Butterfly48×2

PTM(Pan & Tilt) Module

■ PT-PTM-70



<Specifications>

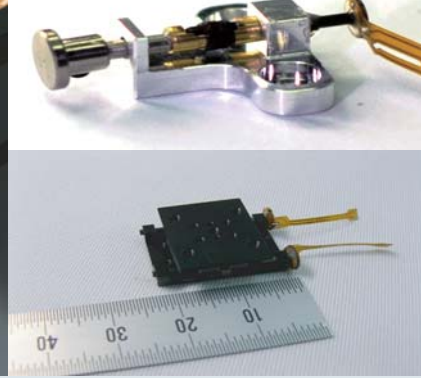
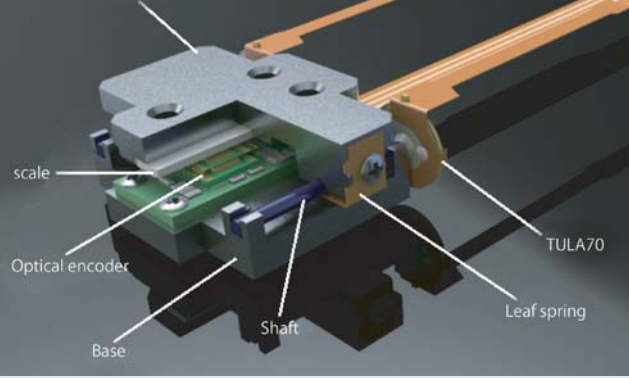
Pan Angle	360°
Tilt Angle	0°~ 90°
High Speed	90°/sec
Resolution	1°(180pulse/rev)
Sensor	Photo interrupter
Power Consumption	<6W
Dimensions(Dia×H)	Ø90×127mm(Without case)
Rotating Module	RT70

■ PT-PTM-B48



<Specifications>

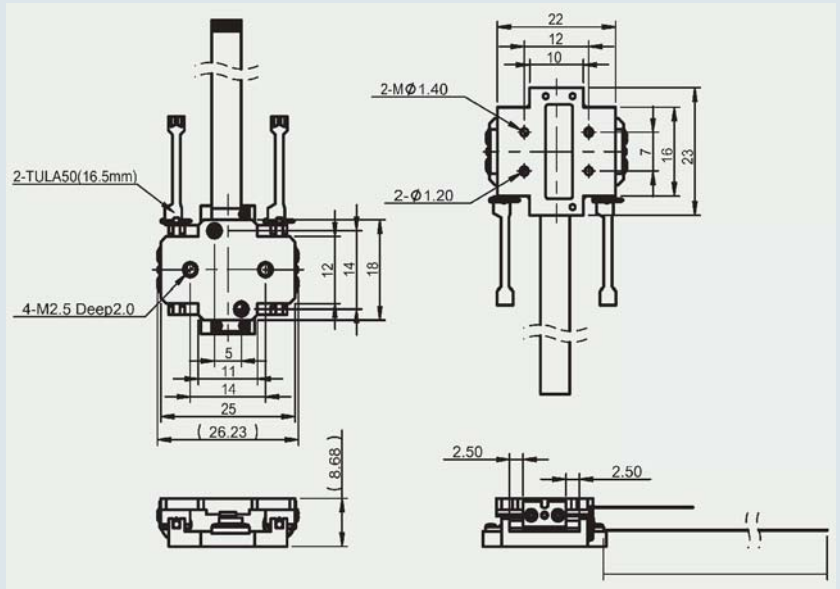
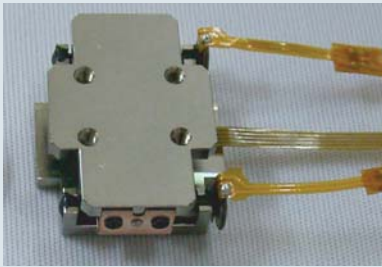
Pan Angle	360°
Tilt Angle	0°~ 90°
High Speed	>720°/sec
Resolution	1°(180pulse/rev)
Sensor	Photo interrupter
Power Consumption	<6W
Dimensions(Dia×H)	Ø90×127mm(Without case)
Rotating Module	RB48



Standard Product

X Stage Series(Encoder type)

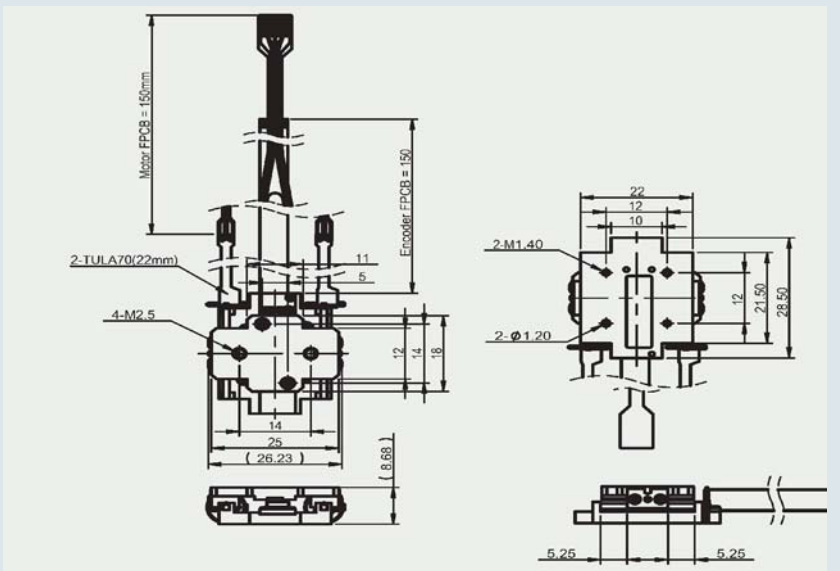
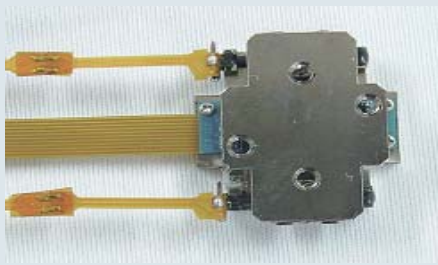
- X Axis Stage(Stroke:4mm)
Model Number : XDT50-042 type



<Specifications>

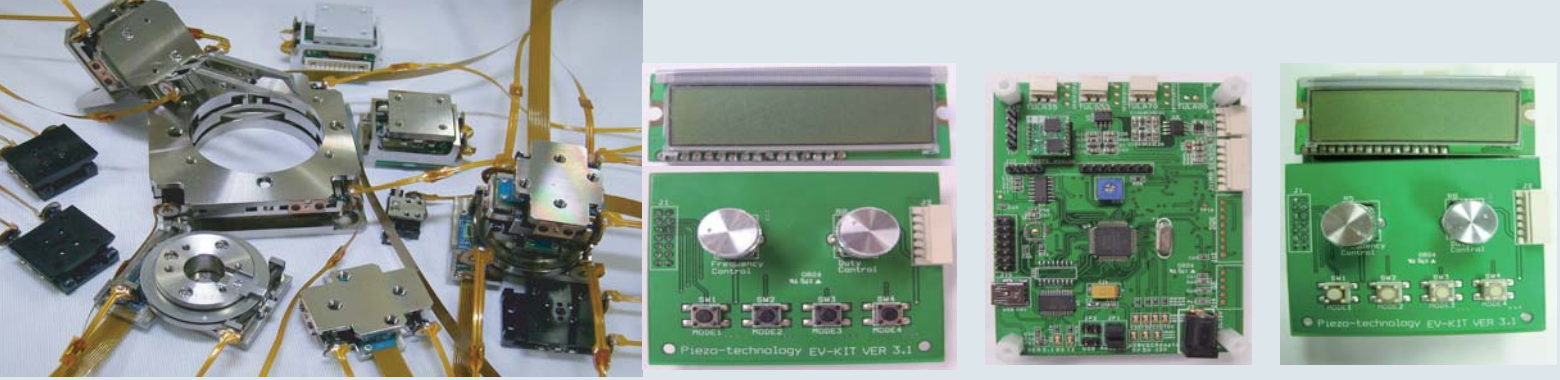
Stroke	$\pm 2\text{mm}$
Resolution	$1\mu\text{m/p(A,B Phase)}$
Repeatability	$\pm 3\mu\text{m}$
Thrust	80gf
Holding Force	300gf
Moving Speed	10mm/sec
Driver	PMC-1202 type
Actuator	TULA50

- X Axis Stage(Stroke:10mm)
Model Number : XDT70-102 type



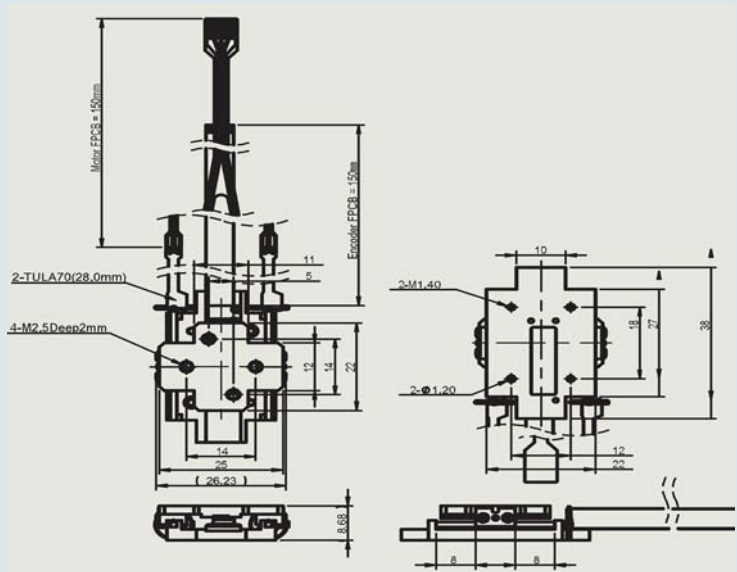
<Specifications>

Stroke	$\pm 5\text{mm}$
Resolution	$1\mu\text{m/p(A,B Phase)}$
Repeatability	$\pm 3\mu\text{m}$
Thrust	60gf
Holding Force	300gf
Moving Speed	10mm/sec
Driver	PMC-1202 type
Actuator	TULA70



Standard Product

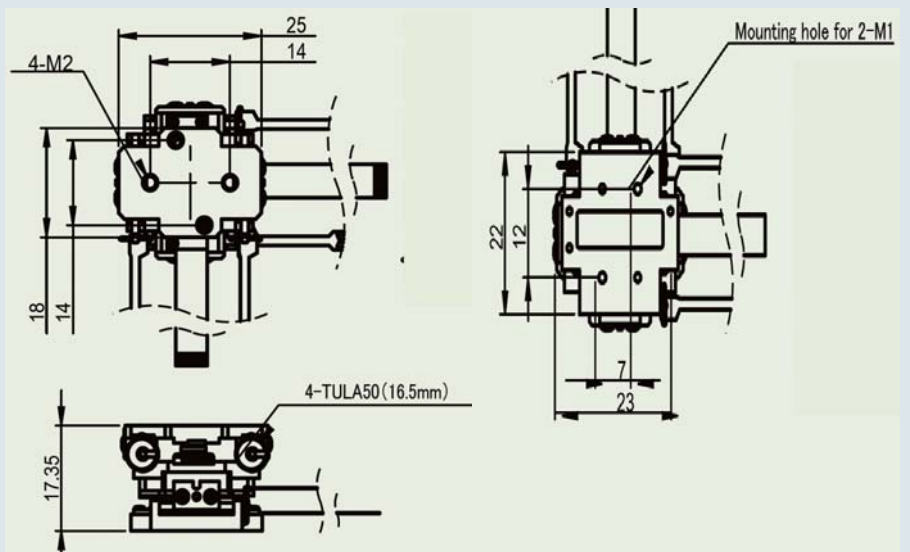
- X Axis Stage(Stroke:15mm)
Model Number : XDT70-152 type



<Specifications>

Stroke	±7.5mm
Resolution	1μm/p(A,B Phase)
Repeatability	±3μm
Thrust	50gf
Holding Force	300gf
Moving Speed	10mm/sec
Driver	PMC-1202 type
Actuator	TULA70

- XY Axis Stage(Stroke:XY±2mm)
Model Number : XYDT50-042 type



<Specifications>

Stroke	XY ±2mm
Resolution	1μm/p(A,B Phase)
Repeatability	±3μm
Thrust	60gf
Holding Force	250gf
Moving Speed	10mm/sec
Driver	PMC-1202 × 2
Actuator	TULA50



Standard Product

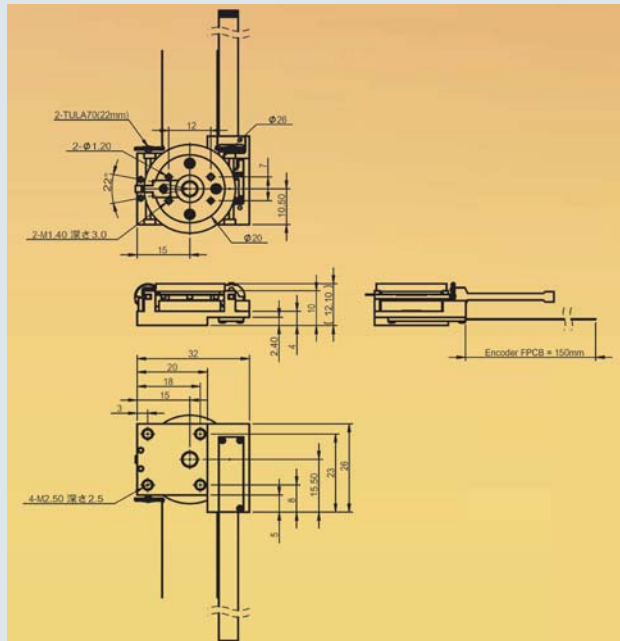
■ Theta Axis Stage

Model Number : Θ DT70-0062 type



<Specifications>

Moving Angle	$\pm 3^\circ$ (Customizing)
Resolution	1 pulse = 0.005°
Repeatability	$\pm 0.015^\circ$
Torque	50gcm
Holding Force	150gcm
Moving Speed	0.4 sec / $\pm 3^\circ$
Driver	PMC-1202 type
Actuator	TULA70



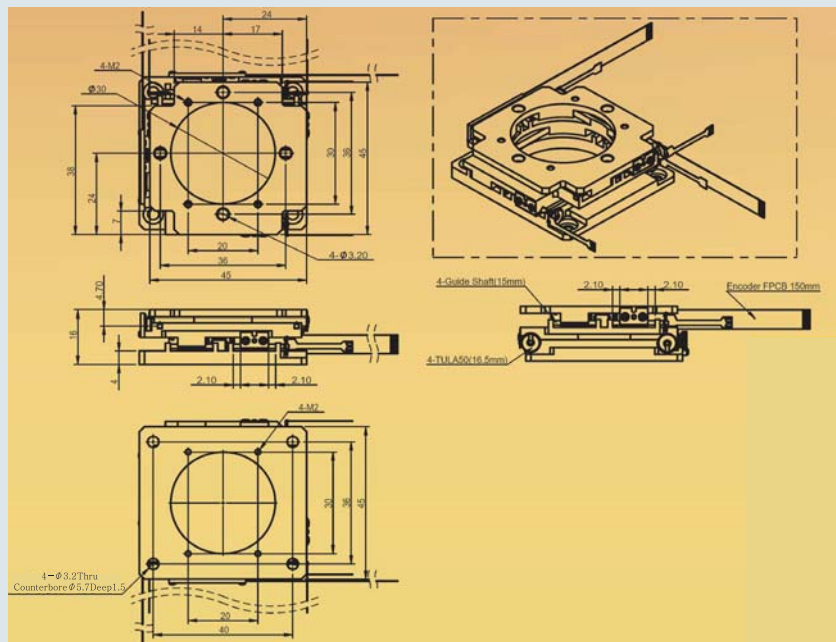
■ XY Axis Hollow Stage

Model Number : XYHDT50-042 type



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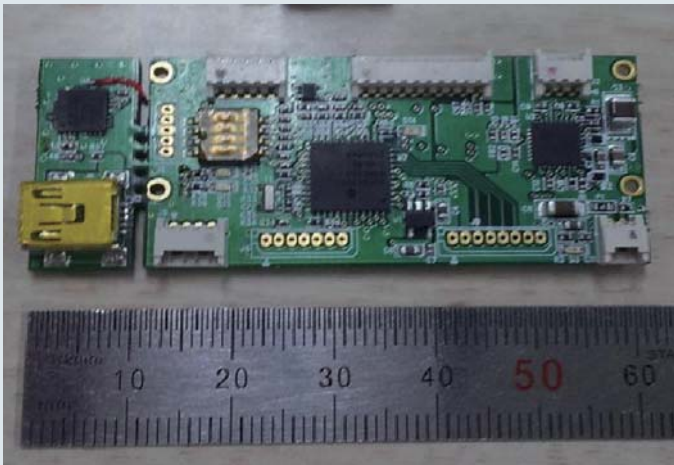
Stroke	± 2 mm
Resolution	1 μ m/p (A,B Phase)
Repeatability	± 3 μ m
Thrust	60gf
Holding Force	250gf
Moving Speed	10mm/sec
Driver	PMC-1202 \times 2
Actuator	TULA70





TULA EV-Kit (PMC-1202 type)

The TULA EV-KIT helps the user to understand the basic characteristics of the TULA by changing the duty ratio, driving voltage and driving frequency. The purpose of the TULA EV-KIT is to assist the development of user's application with TULA.



PMC-1202

FEATURES

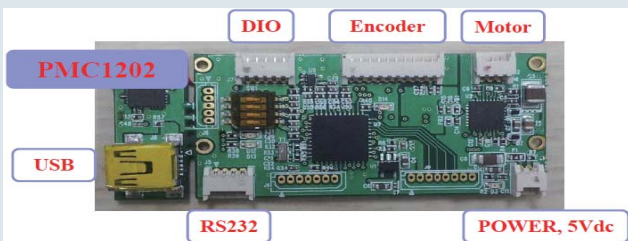
1. Control to TULA 35, TULA50, TULA70
2. Precision Position Control
 - High precision achieved with use of optical encoder
 - Open Pulse Drive
3. Auto Tuning
4. Input Command types
 - 1) External Digital Pulse Commands
 - step/dir
 - 2) Command Input
 - Serial over USB
 - 3) Analog Control Input (0 ~ 3.3V, Option)

SPECIFICATIONS

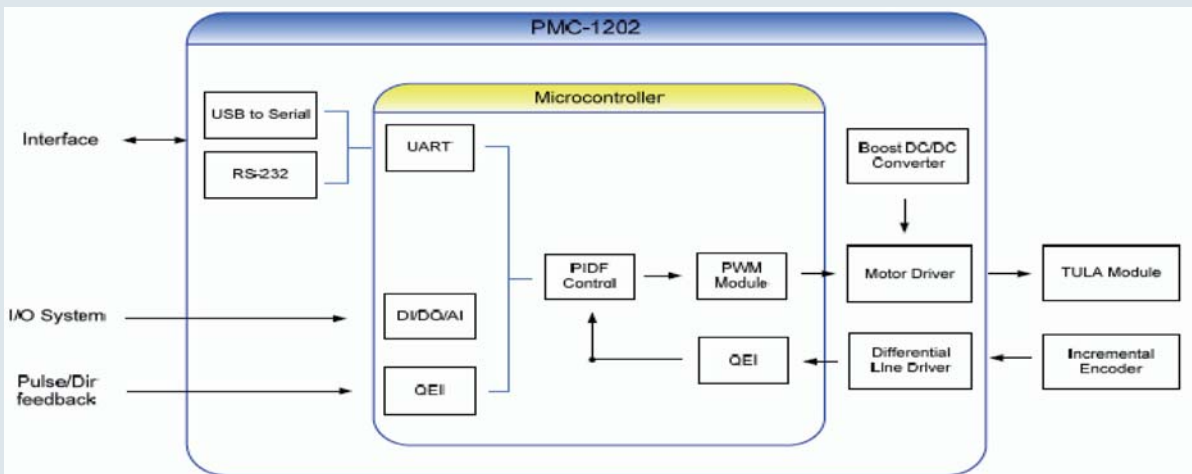
1. Driving Frequency: 25 ~ 100 kHz
2. Drive Voltage: 16 ~ 35V
3. Drive Duty: 10 ~ 40%
4. USB Interface to PC
5. Supply Power: DC5V, 1A
6. PC Monitor Program
7. Size : 25*65*10(mm)

COMMUNICATION

1. Baud rate : 115200 bps
2. Transmission code : ASC II
3. Data length : 8 bit
4. Stop bit length : 1 bit
5. Parity check : Nil
6. Data classification : STX . ETX
7. Serial over USB / RS-232



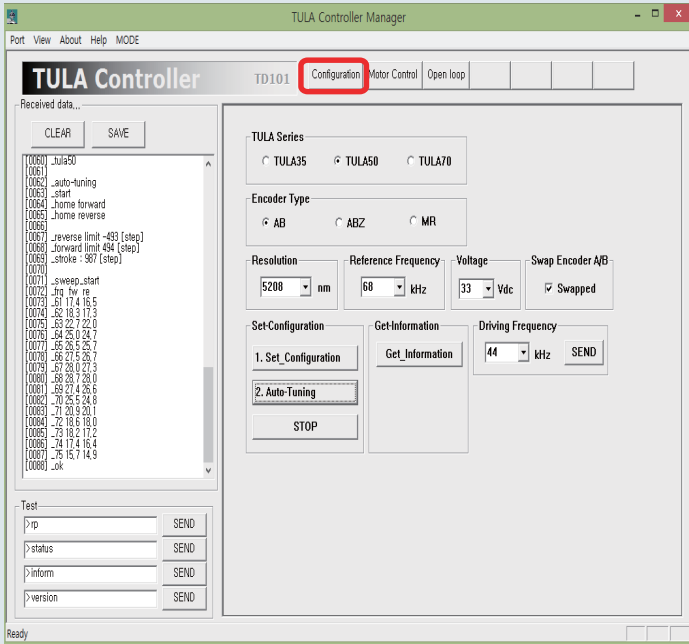
Pin Map



Block diagram

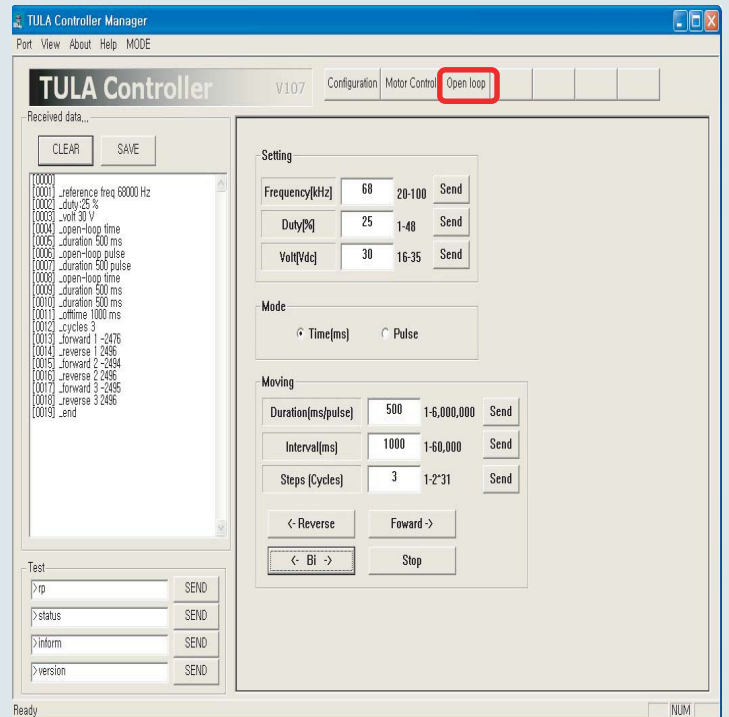


PMC-1202 PC Program



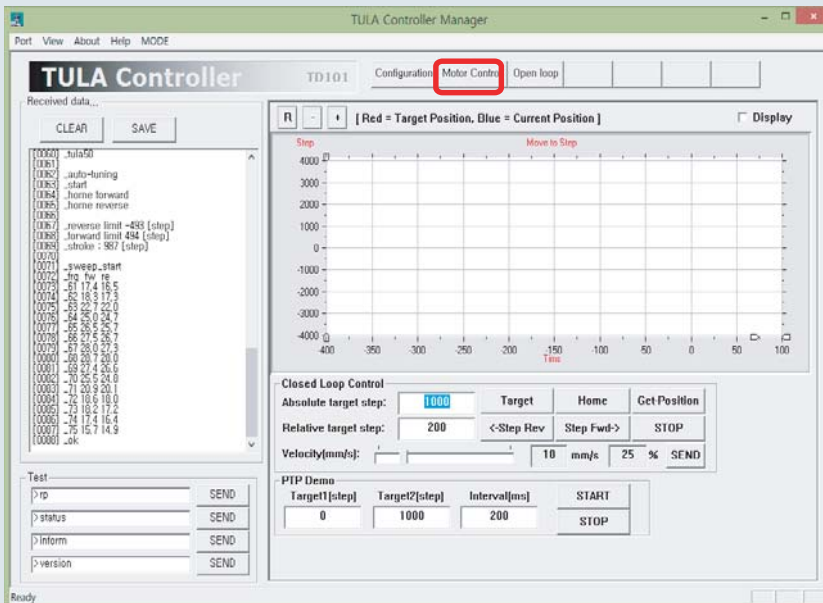
■ Configuration

1. TULA Series select(35,50,70)
2. Encoder type select(AB, ABZ)
3. Encoder Resolution Select (0.1µm, 0.5µm, 1µm, 5µm)
4. Autotuning



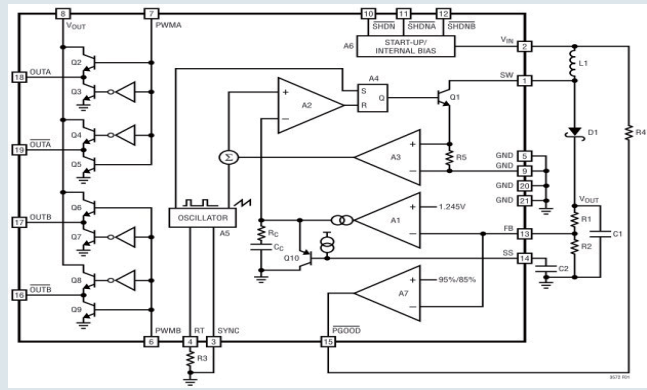
■ Open Loop Control

1. Frequency, Duty, Voltage setting
2. Time/Pulse Duration select



■ Closed Loop Control

1. Move to the absolute target position
2. Move to the relative target position
3. Reports the actual controller position
4. Display : During motion, the motion status can be continuously monitoring



Block Diagram(LT3572)

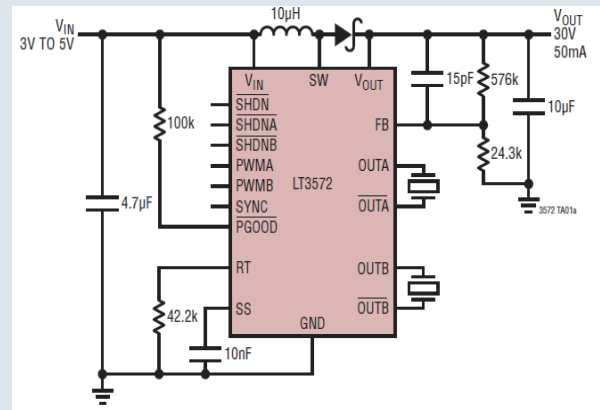
LT3572(Driver chip for TULA)

The Linear Technology has developed the driving IC for TULA series. Dual Full-Bridge Piezo Driver with 900mA Boost Converter

FEATURES

The Linear Technology has developed the driving IC for TULA series.

- 2.7V to 10V Input Voltage Range
- 900mA Boost Converter
- Dual 500mA Piezo Drivers
- Up to 180kHz PWM Frequency
- Programmable Switching Frequency from 500kHz to 2.5MHz
- Synchronizable Up to 2.5MHz
- Soft-Start
- Separate Enable for Each Piezo Driver and Boost Converter
- Available in a 4mm X 4mm 20-Pin QFN Package



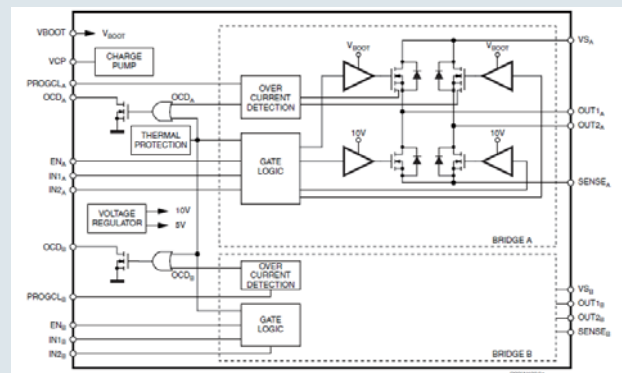
Dual Piezo Driver

L6226Q(DMOS dual full bridge driver)

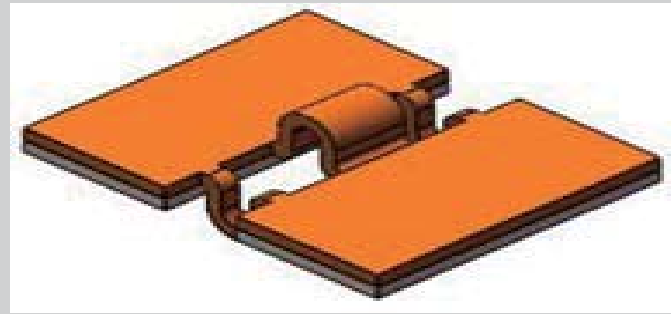
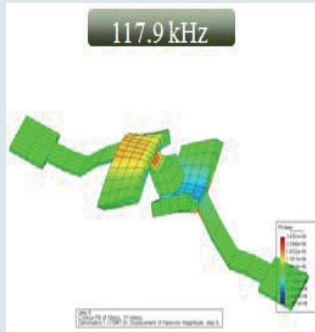
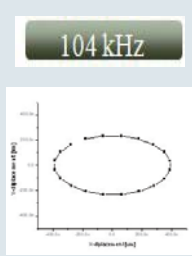
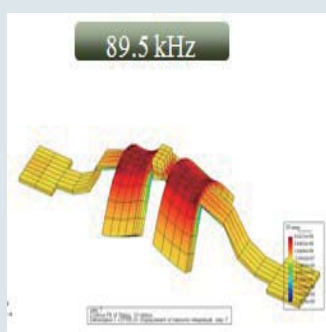
The L6226Q is a DMOS dual full bridge designed for motor control applications, realized in BCDmultipower technology, which combines isolated DMOS power transistors with CMOS and bipolar circuits on the same chip.

FEATURES

- Operating supply voltage from 8 to 52 V
- 2.8 A output peak current (1.4 A DC)
- RDS(on) 0.73 Ω typ. value @ TJ = 25 °C
- Operating frequency up to 100 kHz
- Programmable high side overcurrent detection and protection
- Diagnostic output
- Paralleled operation
- Cross conduction protection
- Thermal shutdown
- Under voltage lockout
- Integrated fast free wheeling diodes



Block Diagram



Butterfly (Butterfly typed Piezoelectric Linear Ultrasonic Motor)

Operated by two electrical signals with 90° phase difference and the mixed mode.
The moving distance of the motor can be prolonged without limit.

<Specifications>

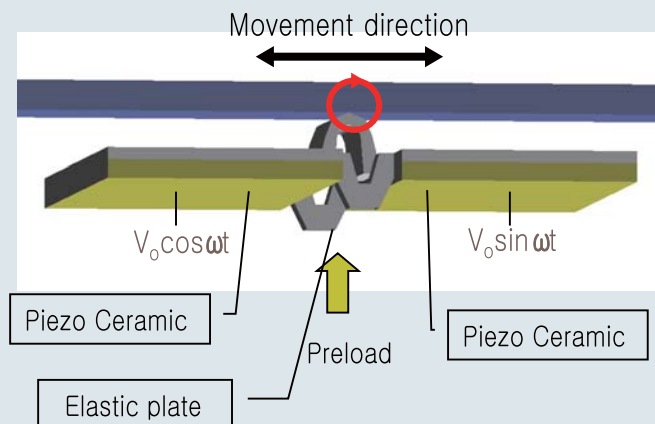
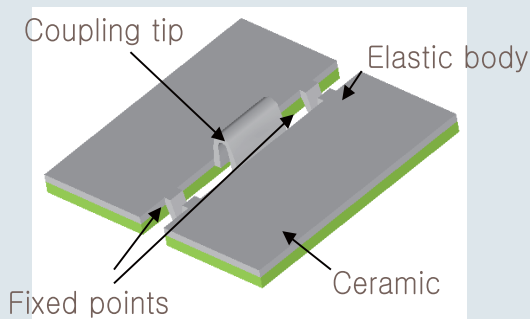
	B36	B48
Max Speed	>80mm/sec	>150mm/sec
Max Thrust	>15gf	>15gf
Stroke	Variable	
Driving Voltage	10~25(Bulk Ceramic) 3~5(Multilayer Ceramic)	
Driving Frequency	120±15kHz	80±10kHz
Power Consumption	<1.5W	<1.5W



Butterfly 36

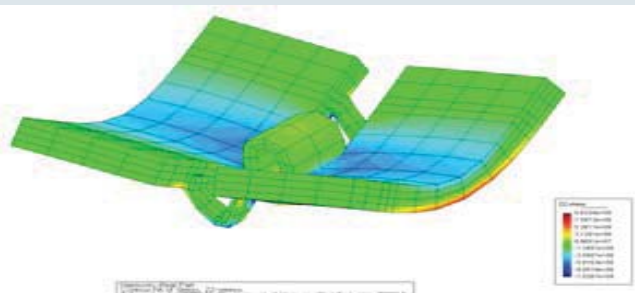
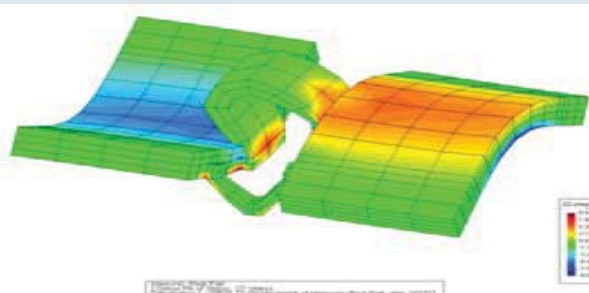


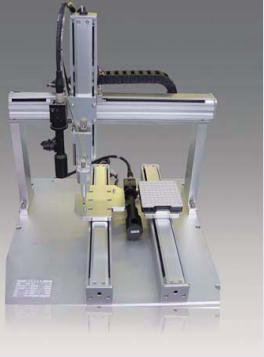
Butterfly 48



APPLICATIONS

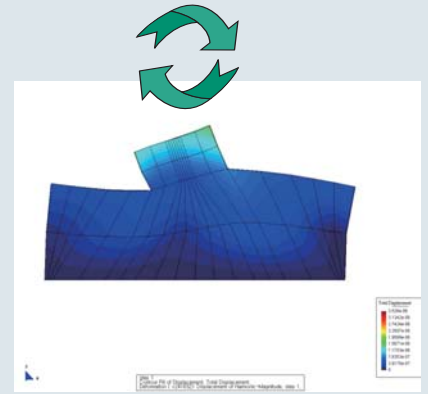
- Micro, Nano positioning
- Semiconductor handling system
- Precision lathe machinery, robotics for FA(Factory Automation)
- AF camera module
- Other driving system for industrial equipments



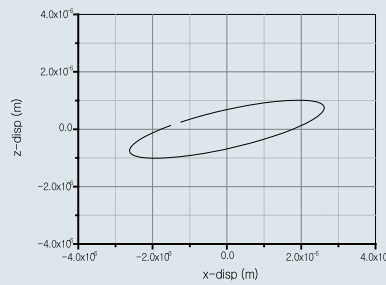
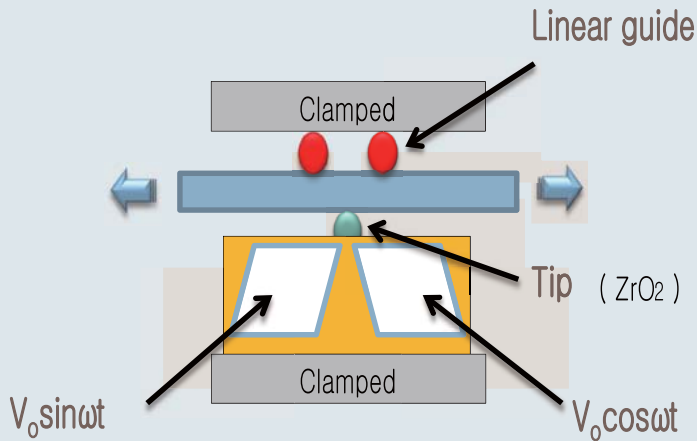


Multilayer Actuator

Multi-layer transducers with 2 electrodes
Coupling tip



Deformation at 590kHz

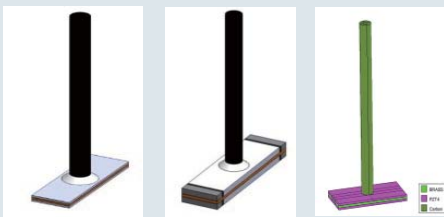


X-disp. : $\pm 2.62\mu\text{m}$
Z-disp. : $\pm 1.01\mu\text{m}$

PRINCIPLE

Combination of two flexural vibrations with 90 degree phase difference.

Rectangular TULA - Preliminary -



Rectangular TULA Image

<Specifications>

Type	Bi Morph
Driving Voltage	30V
Duty	25%
Holding force	85gf
Thrust force	30gf
Speed	>13mm/sec
Frequency	125kHz
Dimension	$7.8 \times 2.6 \times 0.7$

Moving Element Example





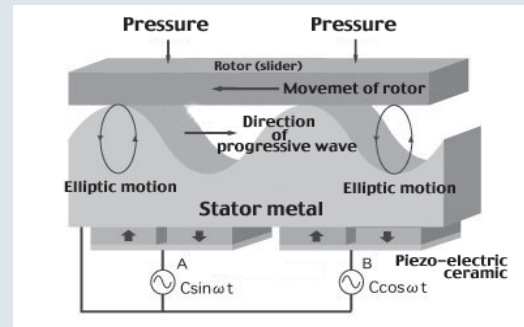
Standard Product

Hollow type Ultrasonic Motor

Hollow type Ultrasonic Motor

FEATURES

- Low speed with high torque without a gear reduction
- No heat is generated when paused with high positioning control
- Simple, slim and lightweight design
- High responsiveness and quiet operation
- Actuator for surveillance cameras



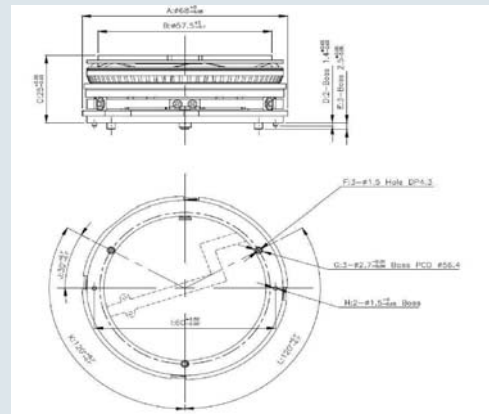
APPLICATION FIELD

- Micro actuator and manipulators for medical systems, robot, camera and process engineering
- Stage for precise position controlling of semiconductor and weapon system
- Actuators for intelligent FA, OA and HA

<Specifications>

Max Speed	≥ 30RPM
Max Load	400gf.cm
Driving Voltage	26.5Vdc ±5%
Driving Frequency	27 ~ 35 kHz
Signal Duty	50%
Phase Difference	90 degree
Power Consumption	≤ 1500mW
Operating Temperature	-15°C ~ +45°C
Storage Temperature	-30°C ~ +70°C

<Dimension>

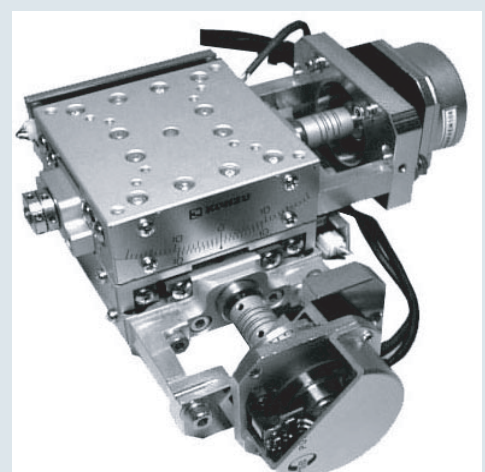


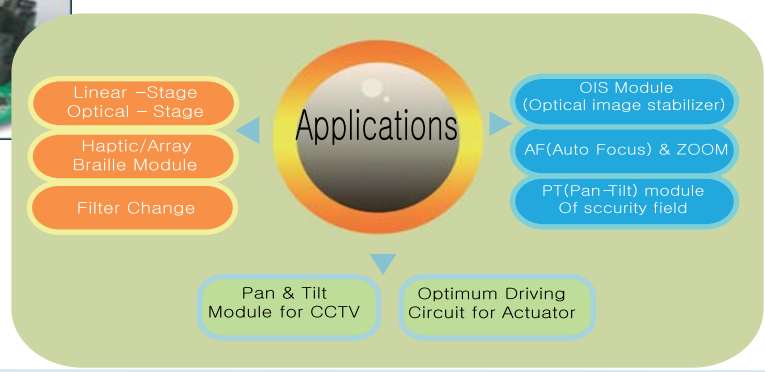
Rotary type Ultrasonic Motor

<Specifications>

	UMR40	UMR60
Shaft Dia.(mm)	Φ6	Φ8
Dimensions(mm)	44 × 44 × 19	65 × 65 × 22
Weight(g)	91	270
Drive Frequency(kHz)	34~37	40~44
Drive Voltage (Vrms)	120	120
Rated Speed(rpm)	80	100
Rated Torque(kgf · cm)	0.8	2.5
Max. Torque(kgf · cm)	>1.8	>7
Holding Toque(kgf · cm)	>2	>10
Encoder(p/r)	1,000 P/R (4,000 P/R)	
Allowable temperature rising (°C)	(On surface of the motor) 55 °C	
Operating temperature rising (°C)	-10 ~ 50	
Storage temperature rising (°C)	-20 ~ 60	
Life time (hrs)	3,000	

UMR60

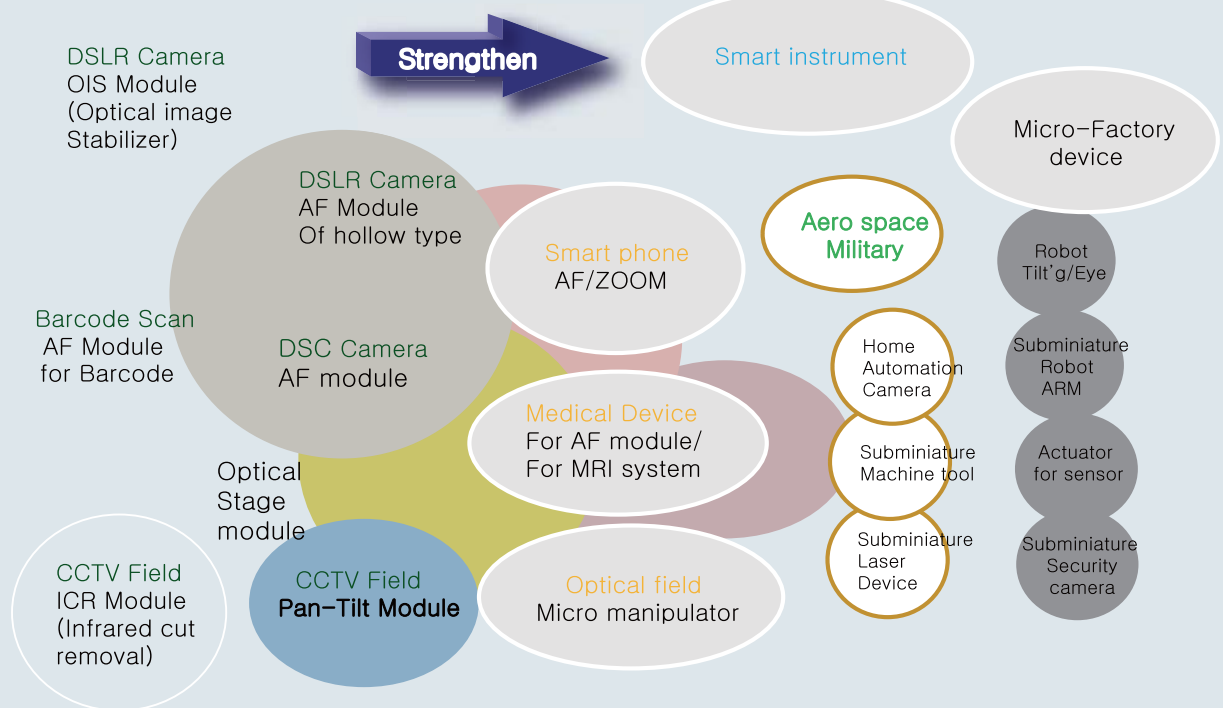




Present market

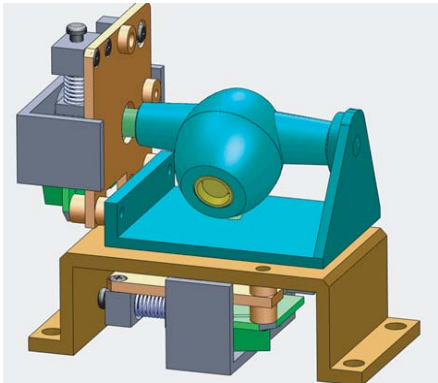
Development

Future market



Main Customer





대한민국 초음파모터 도전의역사 10년!
새로운 가치를 위하여 도전은 계속됩니다



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