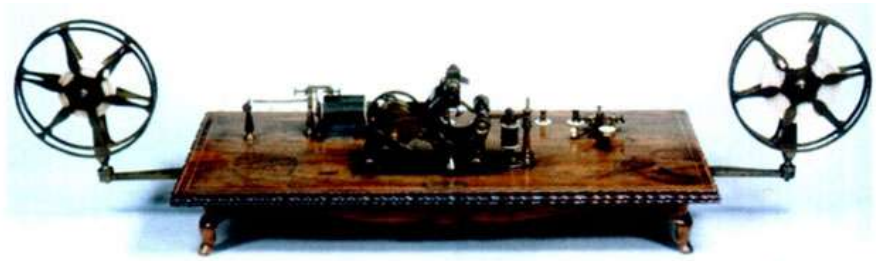
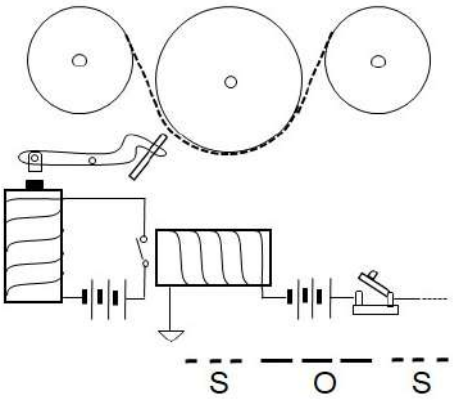
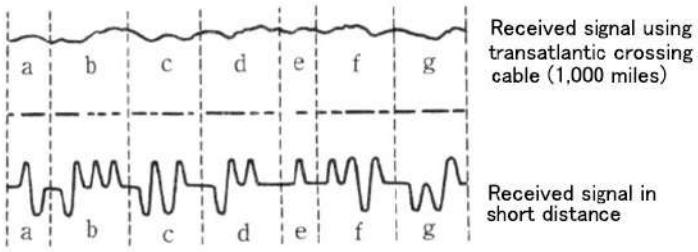
J1 Telegraph using electric wire in bottom of ocean



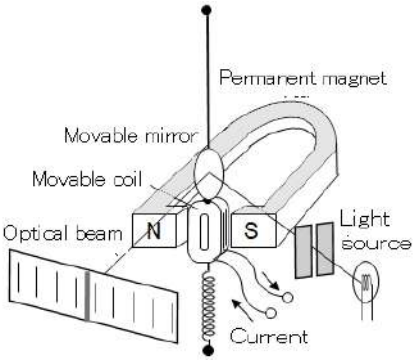


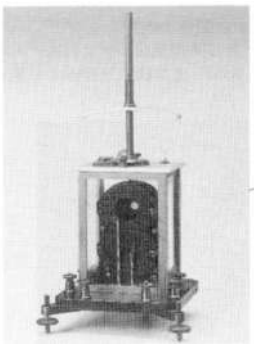
Enboshing Morse telegraph machine donated when Perry arrived in 1854

Enboshing Morse telegraph machine (POSTAL MUSEUM JAPAN)

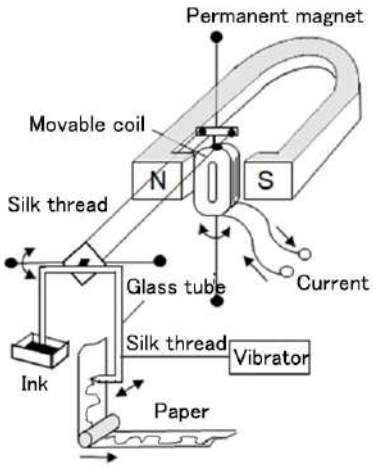


Distortion of received telegraph signal using electric cable in the sea





Kelvin type (optical) mirror galvanometer



Siphon recorder

Submarine electrical cable through straits of Dover was installed in 1850. The Great Britten tried to install the submarine cable in all over the world. Transatlantic crossing cable was planned in 1957 and it was once linked in 1858/8. Queen Victoria and President Buchanan exchanged congratulatory telegram. The telegram from the queen Victoria took 67 minutes to send 102 words at that time, which was 2 words per 1 minute.

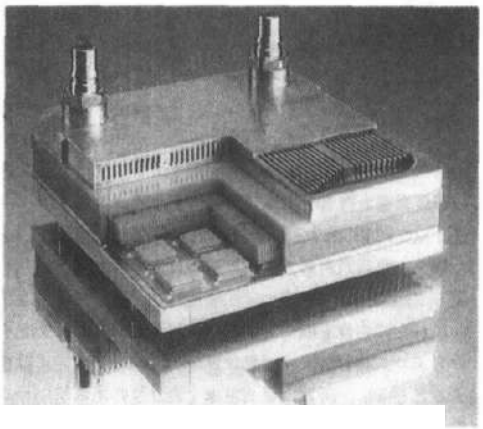
The received waveform was distorted. This is because the electrical resistance is increased by long distance and the capacitance is increased in submarine. Slow transmission was needed to solve this problem at that time. Kelvin type optical mirror galvanometer show left was used to receive the signal. The mirror was tilt by the received signal electromagnetically and reflected light was observed. Two person was needed for reading the signal and for keeping the record. This was hard work. Siphon recorder shown in lower left was invented to solve this problem and this could record the electrical signal by using pen and ink.

(Eiju Matsumoto : Submarine telegraph and Galvanometer, Measurement and Control, 38, 8 (1997) p.505) in Japanese

J2 CPU board for super computer (large computer)

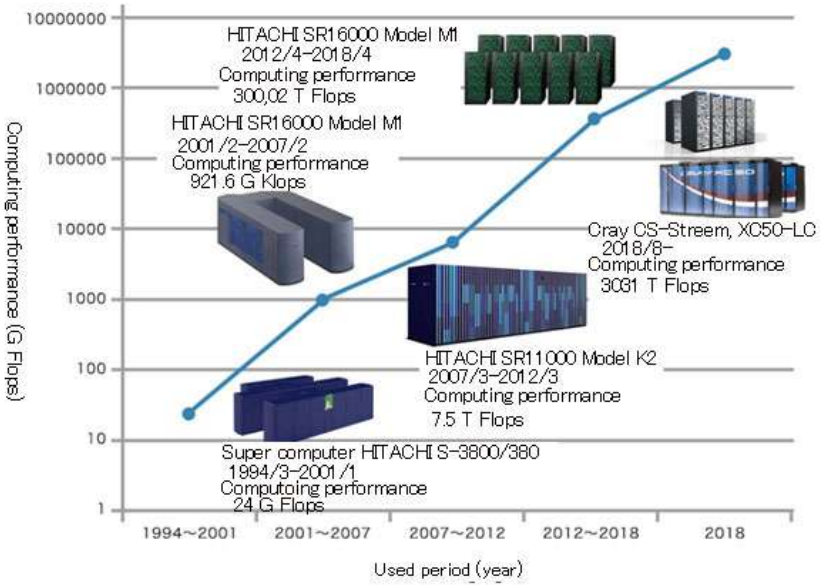
TCM (Thermal conduction module) for cooling CPU (Central processor Unit) (central part having no cover correspond to photograph shown below) (donated by Yoshiyuki Kawazoe)

(Ref) A. J. Blodgett and D. R. Barbour : Thermal conduction module : a high-performance multilayer ceramic package, IBM Journal of Research and Development, 26, 1 (1982) pp.30-36, https://doi.org/10.1147/rd.261.0030



Flipchip package MCM (HITAC M-880)

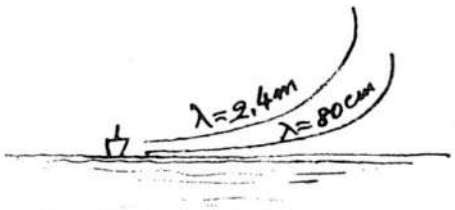
(Tadakatsu Nakajima : Cooling technology for 66, 8 (1997) 21-25) (in Japanese)



Super computer in Center of Mathematical Science in Inst. for Materials Research in Tohoku Univ.

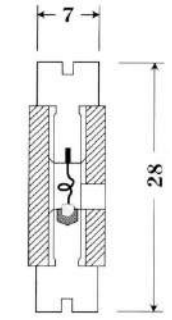
(https://www.sc.imr.tohoku.ac.jp/center/successive.html)

J3 Microwave radar using anode split magnetron

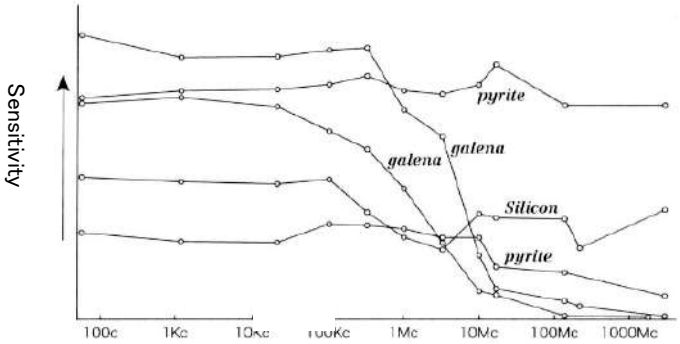


2.4 m と 80cm との
電波伝搬特性(伝播特性)の差異

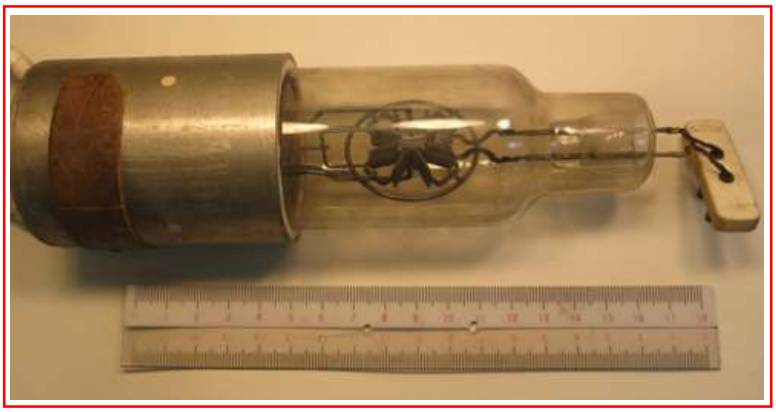
Technical transfer material from Germany during the 2nd world war (O plus E (2011/6)

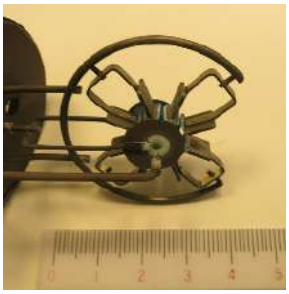


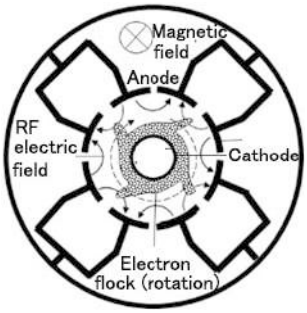
Cristal detector using pyrite



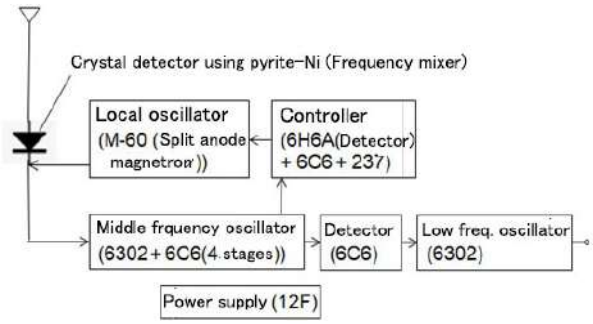
Frequency response of crystal detector with different crystals

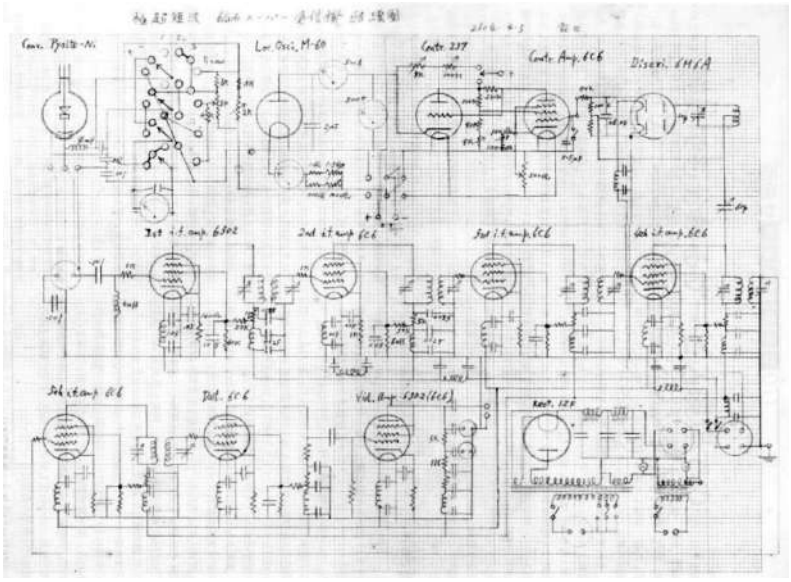






Anode split magnetron (Kinjiro Okabe)





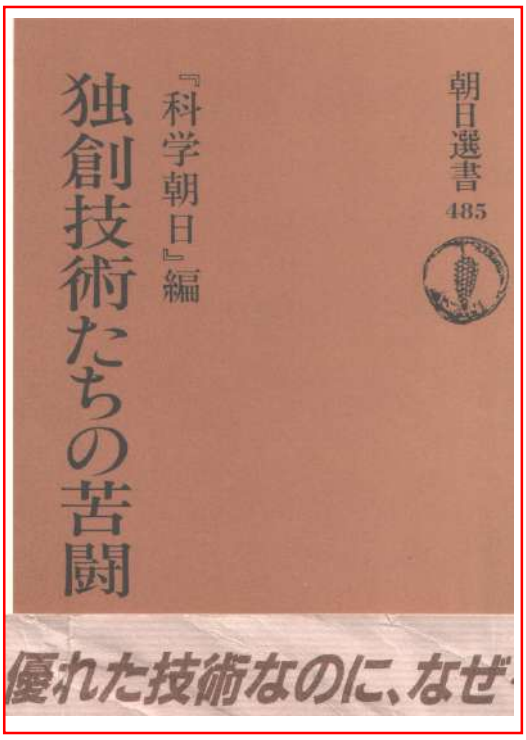
Receiver circuit of microwave radar (Koichi Shimoda : Development of domestic microwave radar, O plus E, **33**, 10 (2011) 1044-1052)

J4 Shimada laboratory in which high power anode split magnetron was developed before the end of war (Z project)

Shimada laboratory in which many scholars participated

Shimada laboratory in Shizuoka (6,600 m^2) was built in 1943 May. The director (part time) was Prof. Yasushi Watanabe in Tohoku Imperial Univ.. He was an acquaintance of Yoji Ito in Navy. Vise director was Shoichiro Mizuma. He gathered following full time staffs. They are Yanami Masao (Navy research center), Sohzabro Yamazaki and his supporting staff (Japan Radio Co. Ltd.), Yuzuru Watanabe (Associate Prof. in Kikuchi Lab. in Osaka Imperial Univ..), Zenuemon Abe (Associate Prof. in Watanabe Lab. in Tohoku Imperial Univ.), and Iwao Takao (Prof. in The Ryojun Engineering College, former engineer in Navy), Advisers from Tokyo Imperial Univ. were Prof. Masao Kotani (Physics), Prof. Yusuke Hagiwara (Astrophysics) and Prof. Sanichiro Mizushima (Chemistry). Prof, Shinichiro Tomonaga (Physics) in Univ. of Literature and Science Tokyo Imperial Univ. participated as well. They participated with their assistants as Minoru Ogawa (The director of The Institute of Physical and Chemical Research (RIKEN) now).

Many students in science and engineering were conscripted as supporters. Total number of staff were approximately 1,000 when it started. Many famous scholars participated as part-time staff, They are Masashi Kikuchi (Osaka Imperial Univ.), Yoshio Nishina (RIKEN), Fushimi Kohji (Osaka Imperial Univ.), Takeo Nagamiya (Osaka Imperial Univ.), Iwao Sato (Tohoku Imperial Univ.), and Juichi Hino (Tohoku Imperial Univ., Medicine).



(Asahi sensho 485 "Struggle of creative technology")

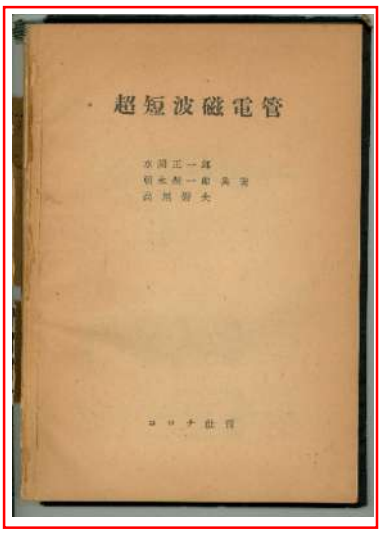
Shimada laboratory in Shizuoka

Murder ray

The navy "Z project" has revived as microwave oven

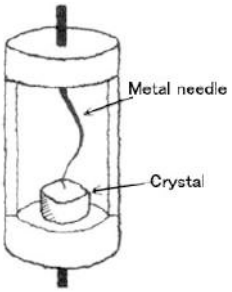
Yasuzo Nakagawa

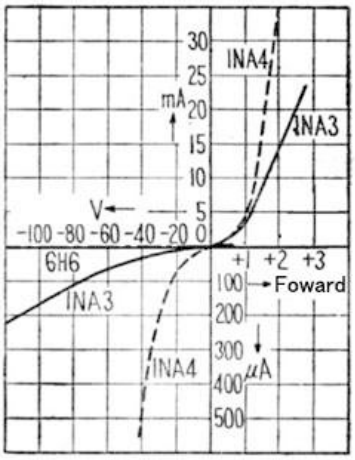
Absurd concept to shot down B29
Wave length 20 cm,
output 100 kW magnetron



Dr. Shinichiro Tomonaga participated the Z project

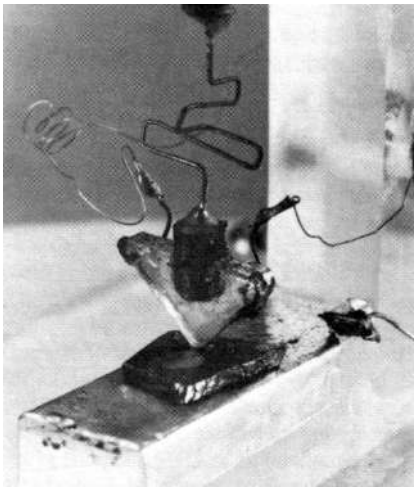
J5 Crystal detector and point contact transistor

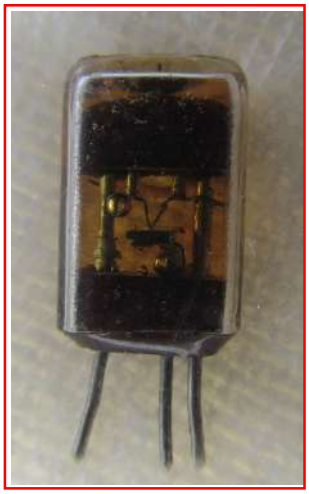




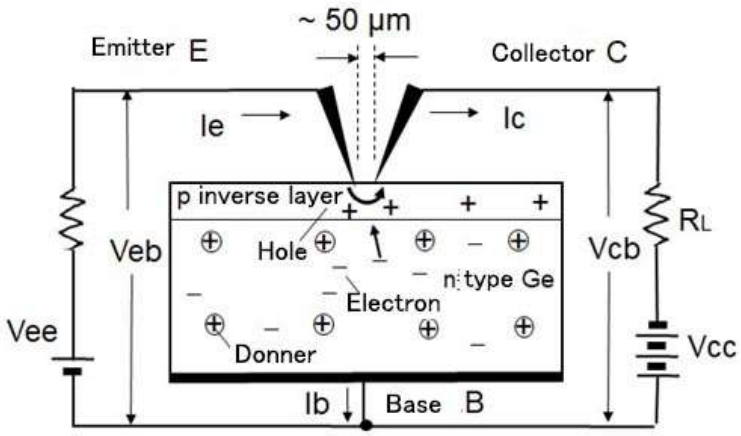
Principle of crystal detector　　Characteristic　　Inventor J.C. Bose　　Displayed crystal detector

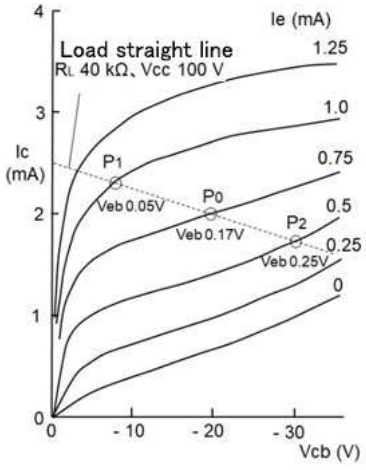
Crystal detector (point contact diode) (J.C. Bose : On the selective conductivity exhibited by certain polarizing substances, Proc. of the Royal Soc. London, vol.LX (1897) 433–436)





Photograph of point contact transistor and inventors　　Point contact transistor(Western electric Inc.)

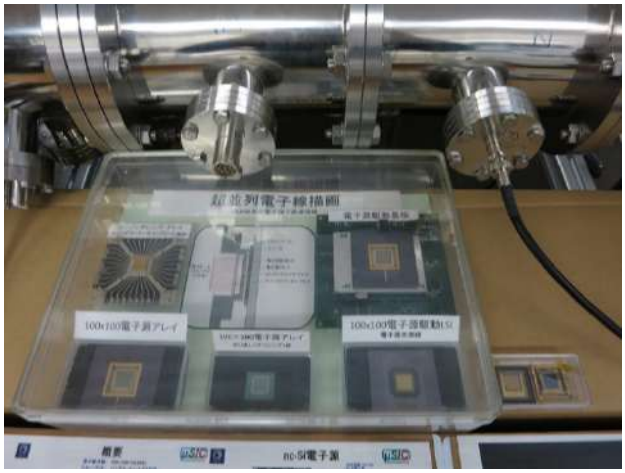




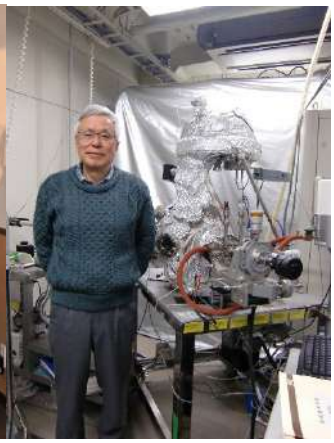
Principle and characteristics of point contact transistor

J. Bardeen and W.H. Brattain : Physical principles involved in transistor action, Physical Review, **75**, 8 (1949) 1208–1226.

J6 Massive parallel electron beam write

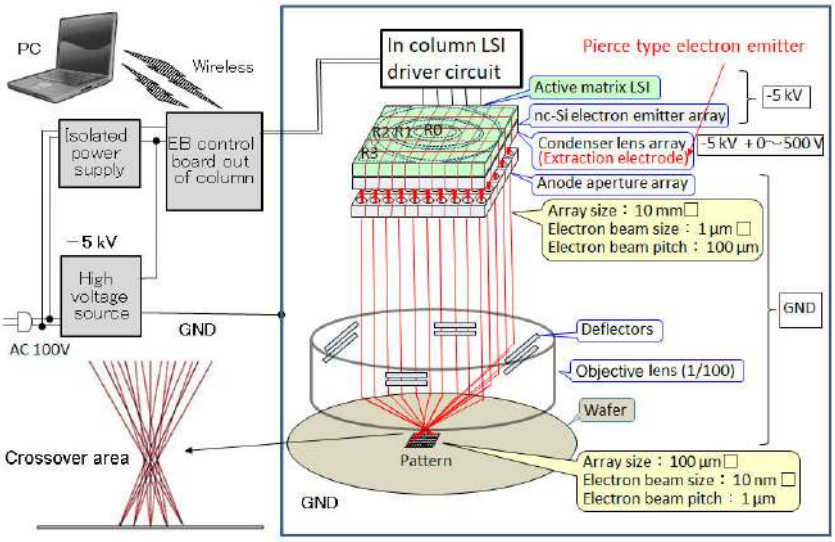


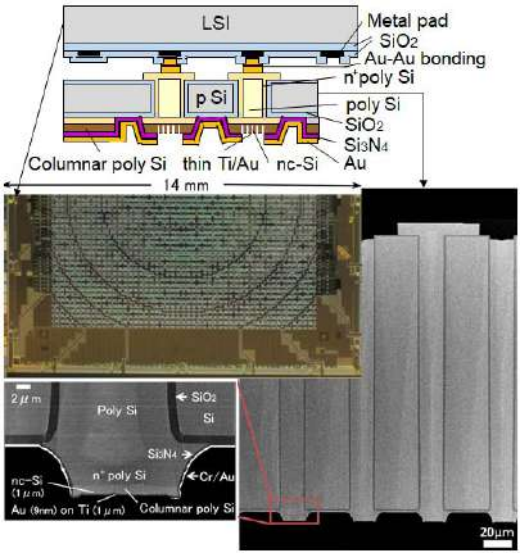
Massive parallel electron beam write using 100 × 100 active matrix electron sources (right)



Development member (2009 – 2016)
(Miyaguchi, Esashi, Kogima, Ikegami, Ohi, Sugata and Koshida (authors of the book))

Development of massive parallel electron beam write system
Tohoku Univ. Press (2018)





EB write System

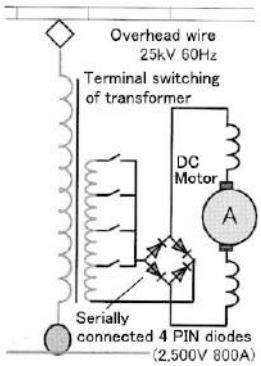
Active matrix nano crystal Si i(nc-Si) electron source

M. Esashi, H. Miyaguchi, A. Kojima, N. Ikegami, N. Koshida, and H. Ohyi : Development of a massively parallel electron beam write (MPEBW) system: aiming for the digital fabrication of integrated circuits, Jap. J. of Applied Physics 61, SD0807 (2022) 1-19

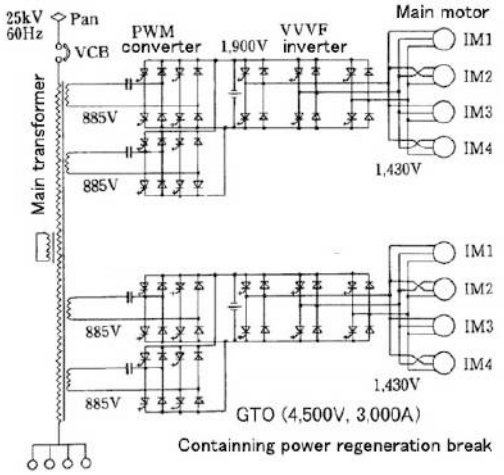
J7 Transitions of power devices used in Shinkansen

Veicle of Shinkansen	0系	100系	300系	700系	N700系/N700A	N700S
						
Completion year	1964	1985	1992	1999年	2007	2018
Used power devices	Diode	Thyrister	GTO	IGBT	low loss IGBT	SiC,
Cooling method	Forced air cooling				Travelling wind cooling power device	
Motor	DC motor		4 poles 3 phase induction motor			6 poles 3 phase induction motor

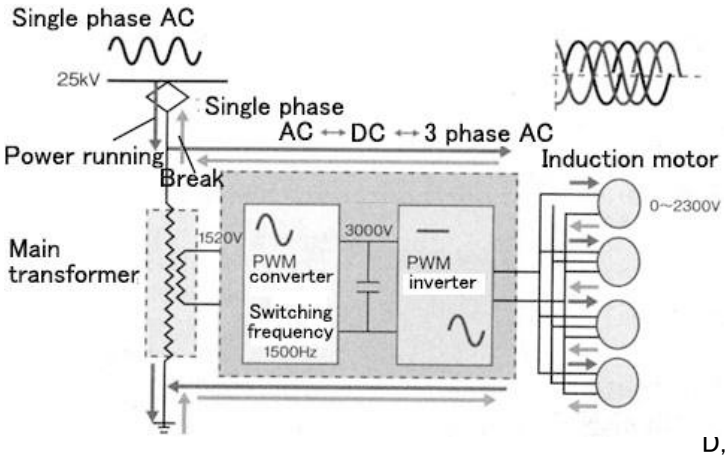
Transition of power devices and motors in Shinkansen

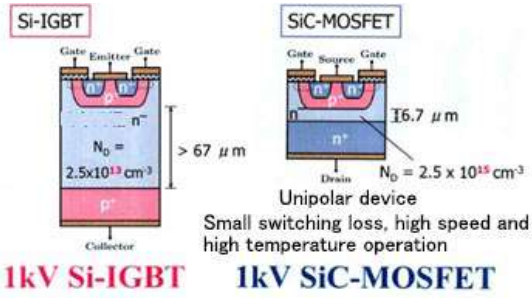


Main circuit of 0 type Shinkansen vehicle



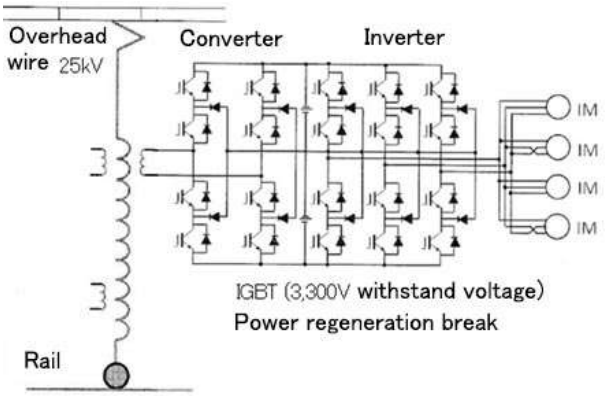
Main circuit of 300 type Shinkansen vehicle





(Tokyo Inst. of Technology, Prof. Hirofumi Akagi)

(Sakae Ishikawa, Ⅱ.Induction motor drive system which fruited in "Nozomi", Transaction of Electrical Eng, Japan D, 114, 6 (1994) pp.604-607) in Japanese



Main circuit of 700 type Shinkansen vehicle

(Tetsuo Uzuka, Electrical train and power devices, SEAJ J., No,159 (2017/11) 18-21) in Japanese

Main motor : Squirrel cage 3 phase induction motor

Control : VVVF inverter control using SiC

Maximum speed : Tokaido (285 km/h (curve +25 km/h)

Sanyo : 300 km/h, West kyushu : 250 km/h

Train : 16 trains (Tohkaido, Sanyo),6 trains (West kyushu)

Year of manufacture : Prototype 2018. production 2020

Manufacturing plant : Hitachi Kasado plant

Nihon sharyo seizo Toyokawa plant (except Y type)

Production quantity : 830 set (at 2024/10/1)

N700S type Shinkansen which used SiC devices

(Masayuki Ueno, Nikkei electronics, (2017) 9 (p107), 10 (p.101))

J8 Electromagnetically levitated lamp

Lamp by Flyte Ltd. in Sweden. The lamp is electromagnetically levitated by permanent magnet in the lamp and electromagnetic coil in stage. Wireless power supply for the lamp is carried out by electromagnetic coupling.
https://www.plywood.jp/36321001

Set the light bulb free

Flyte is a levitating light which hovers by magnetic levitation and is powered through the air. With Flyte, we've set the light bulb free.

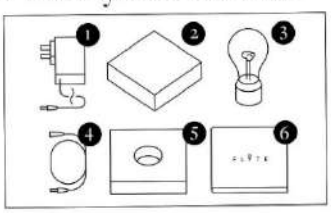
» About levitation

Achieving levitation will require some practice. If it is your first time, expect that it may take numerous attempts. As you gain experience, you will be able to levitate your Flyte Bulb every time effortlessly. If it is your first time levitating Flyte, use the Flyte Co-Pilot, a tool designed to make the levitation process even easier.

» You are about to defy gravity

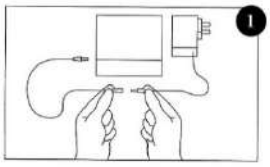
Levitation is achieved when the center of your Flyte Bulb is lowered directly over the center of your Flyte base. The challenge is to find the specific balancing levitation point.

» The Flyte kit includes :

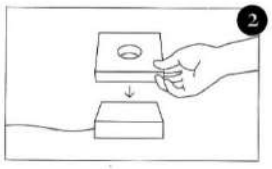


1. AC Adapter
2. Flyte Base
3. Flyte Bulb
4. Textile Cable
5. Flyte Co-Pilot (Setup tool)
6. User Manual / Warranty

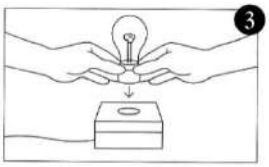
» Setting up your Flyte with Co-Pilot



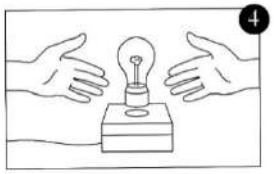
Place your Flyte Base on a flat non-metallic surface. Connect the textile cable to the Flyte Base. Connect the other end of the textile cable to the AC Adapter. Plug it into the outlet.



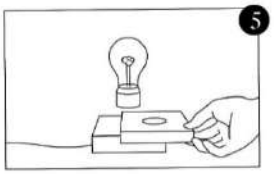
Place your Flyte Co-Pilot directly on top of the Flyte Base. This will act as target to the specific levitation balancing point.



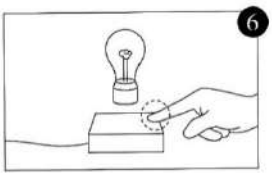
Start from a height of about 15cm/ 6 inches above the Flyte Base. Swiftly lower your Flyte Bulb with both hands directly over the center of the Flyte Base, keeping it level until you feel the upward magnetic force supporting the weight of the Flyte Bulb.



When you feel the magnetic force supporting the weight of the Flyte Bulb, gently let go keeping it centered and level. If it falls, simply lift the bulb by the cap and try again. Expect that it will take numerous attempts and may require some practice to master.



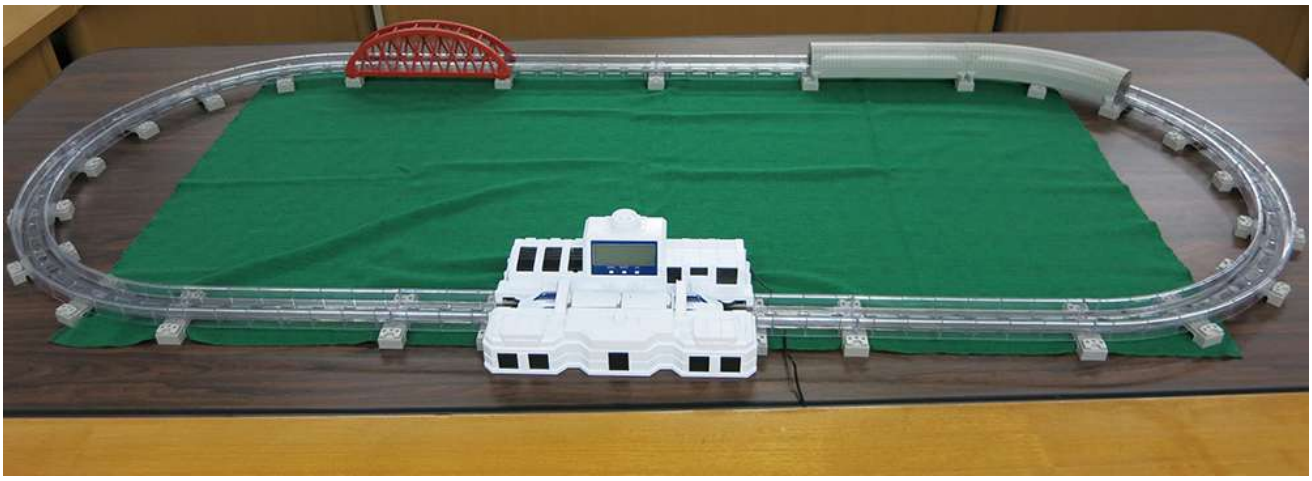
Once you have achieved levitation, remove the Flyte Co-Pilot. Each attempt to levitate your Flyte should last no longer than 5 seconds. After each attempt, start over once more by raising the Flyte Bulb at least 15cm/ 6 inches above the Flyte Base.



Gently tap the corner of your Flyte Base to turn On/Off the LED Light. The LED light will turn On/Off while levitation will remain intact. The touch sensitive corner is located diagonally across from the AC adapter jack.

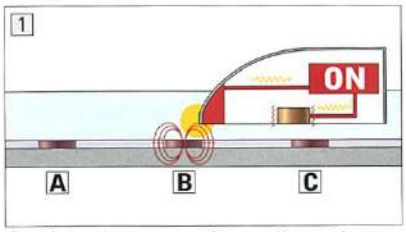
**To remove your Flyte Bulb lift the Bulb by the cap, and place it back in the foam container for storage.*

J9 Model railway of magnetically levitated linear liner (Tomy Co., Ltd.)

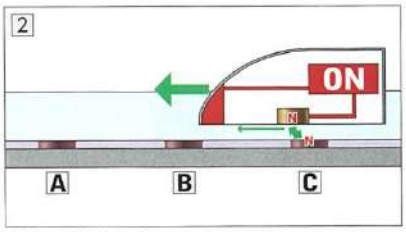


Principle of motion

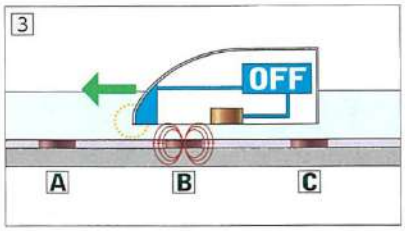
Foward magnetic field is detected by a high speed magnetic field sensor and magnetic field is generated by current in the coil on viecle. Repulsive force generated between the magnetic field by the coil on the viecle and that by the magnet on the rail moves foward the train.



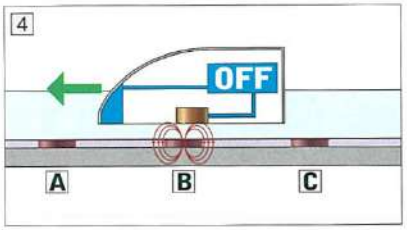
Apply current to the coil on the vehicle responding to the magnetic field generated by the front side magnet on the rail.



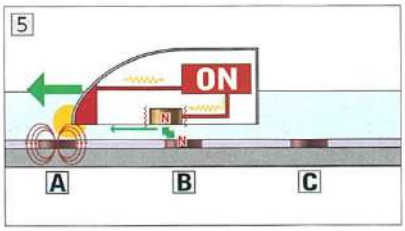
Propulsive force is generated by repulsive force between magnetic field by the coil and magnet on rail.



When the front side magnetic field is not detected, the current to the coil is cut off.



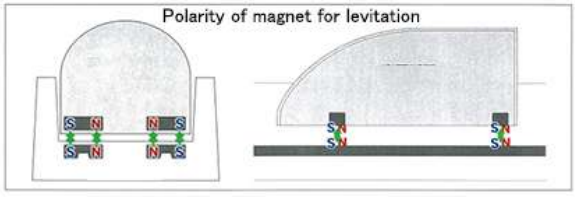
The viecle move forward by inertia.

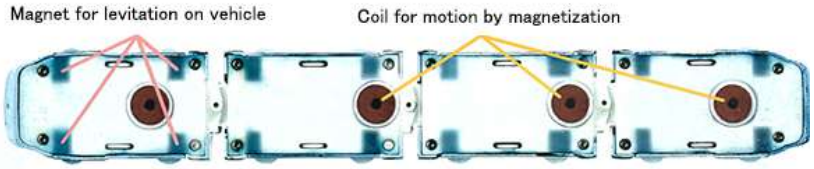


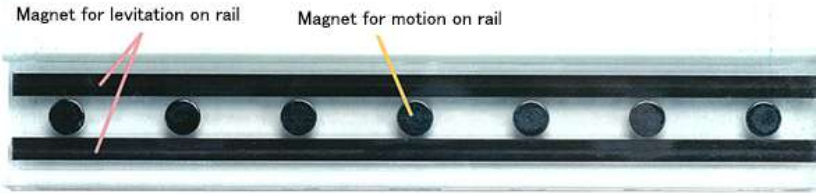
When magnetic field is detected in front side, current is applied to the coil on the vehicle again. These are are repeated for the motion of the viecle.

Principle of magnetic levitation

Magnet like belt on rail and 4 magnets on corners of vehicle cause repulsive which levitate the vehicle about 4mm.

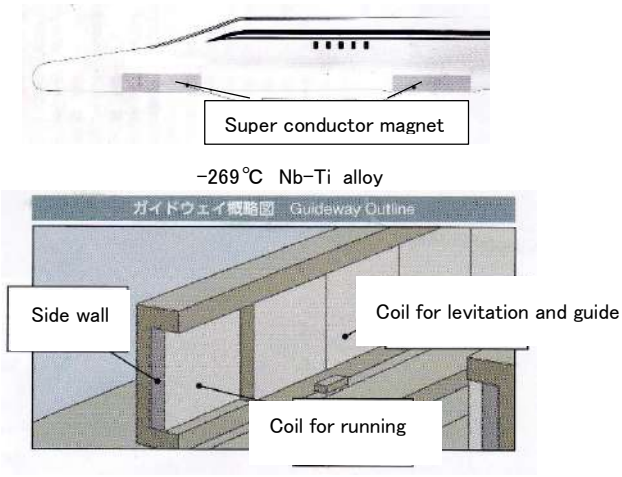




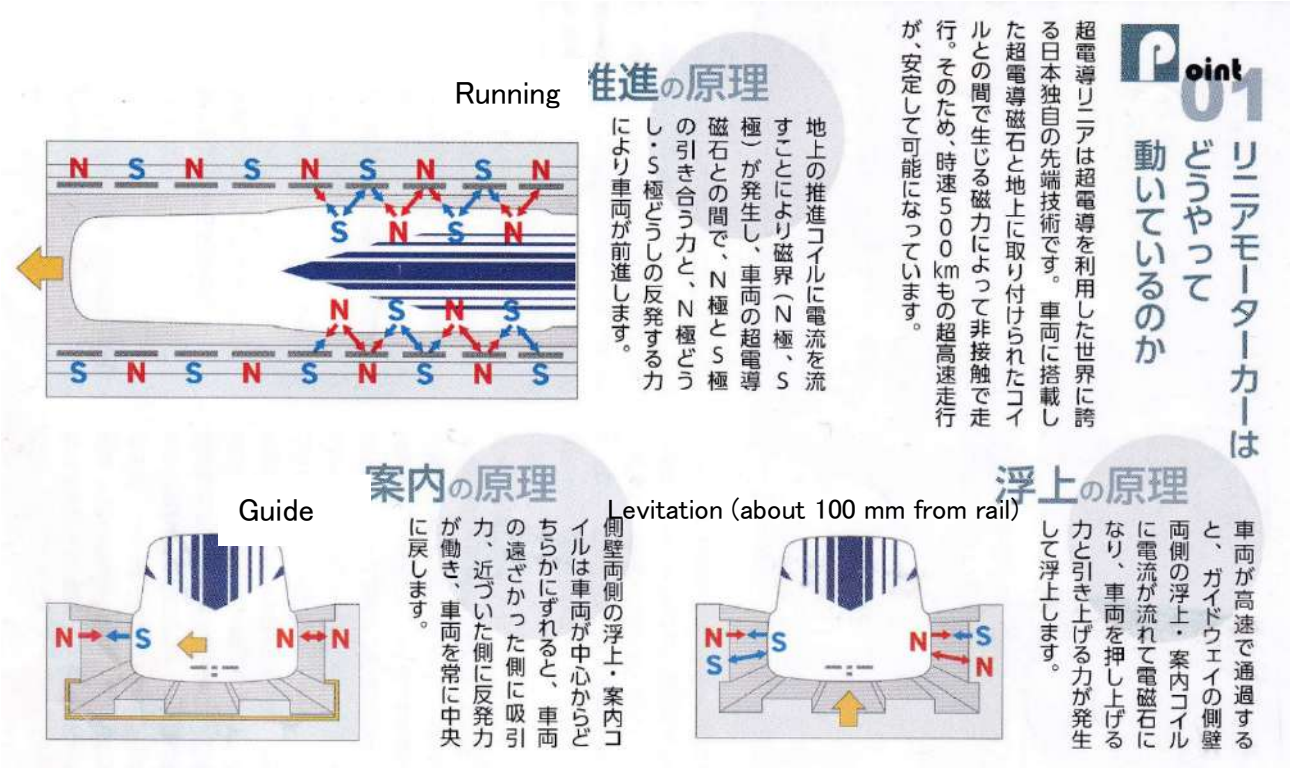


(Linear liner magazine (Tomy Co., Ltd.)) (in Japanese)

J10 Linear Chuo Shinkansen using superconductivity and its model railway



Linear Chuo Shinkansen (https://ja.wikipedia.org/wiki/%E4%B8%AD%E5%A4%AE%E6%96%B0%E5%B9%B9%E7%E7%)



Principle of running, levitation and guide (Linear liner magazine (Takara tommy))

Model railway of magnetically levitated linear liner using super Conductor (the rail has 3,600 Nd-Fe magnet)

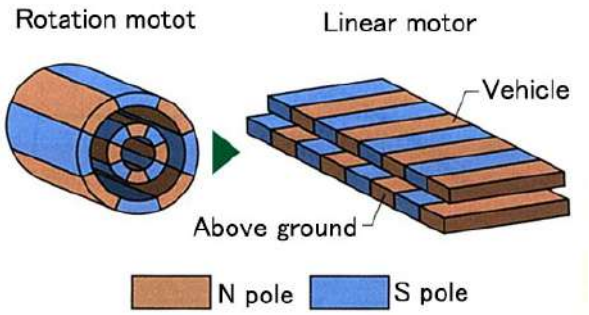
Cooling of the linear liner in liquid nitrogen (77K)

Kensuke Nakajima Lab. (Graduate school of Sci. and Eng., Yamagata Univ.) http://nakajima-lab.yz.yamagata-u.ac.jp/

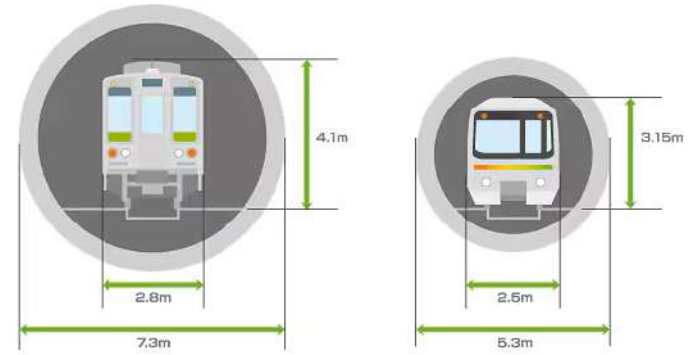
J11　Linear subway (Linear metro) travelling on wheels

“リニアメトロ方式”地下鉄路線一覧

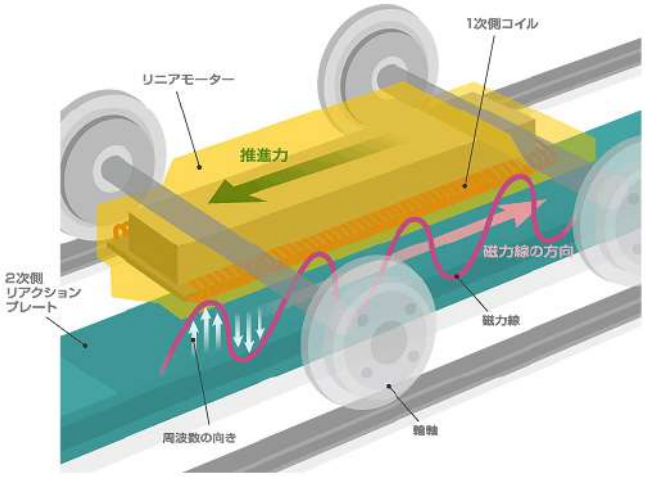
都　市	路線名	区　間	距　離
福岡市	七隈線	橋本～天神南	12.0km
神戸市	海岸線	新長田～三宮・花時計前	7.9km
大阪市	長堀鶴見緑地線	大正～門真南	15.0km
	今里筋線	井高野～今里	12.1km
横浜市	4号線（グリーンライン）	日吉～中山	13.1km
東京都	大江戸線	都庁前～光が丘	40.7km
仙台市	東西線	動物公園～荒井	14.4km



物理図鑑　視覚でとらえるフォトサイエンス、数研出版（2022）



通常の電車と鉄輪式リニアの車体寸法の比較



都営大江戸線などの鉄輪式リニアの原理

TDK　https://www.tdk.com/ja/tech-mag/knowledge/160

東西線（仙台市交通局）

「リニアメトロ」が、仙台の新たなまちづくりを支えます

仙台市では、自動車交通に過度に依存せず、軌道系交通機関を基軸とした集約型の都市構造を目指し、地下鉄東西線を建設しました。東西線の路線は、市南西部の八木山動物公園付近から東北大学等のある青葉山を経由し、都心部を経て、流通業務が集積する東部地区に至るルートです。導入したリニアモーター式地下鉄は、トンネル断面積が南北線の3分の2程度と小さく、建設費の低減が可能であることに加え、曲線半径を小さくでき、登坂能力にも優れており、勾配が大きいという東西線の路線特性に適合しています。
2015年12月に八木山動物公園～荒井間13.9kmで開業した東西線は、南北線との両線とで本市を東西南北に貫く十文字の骨格交通軸を形成し、仙台都市圏の基幹交通機関として重要な役割を担っています。

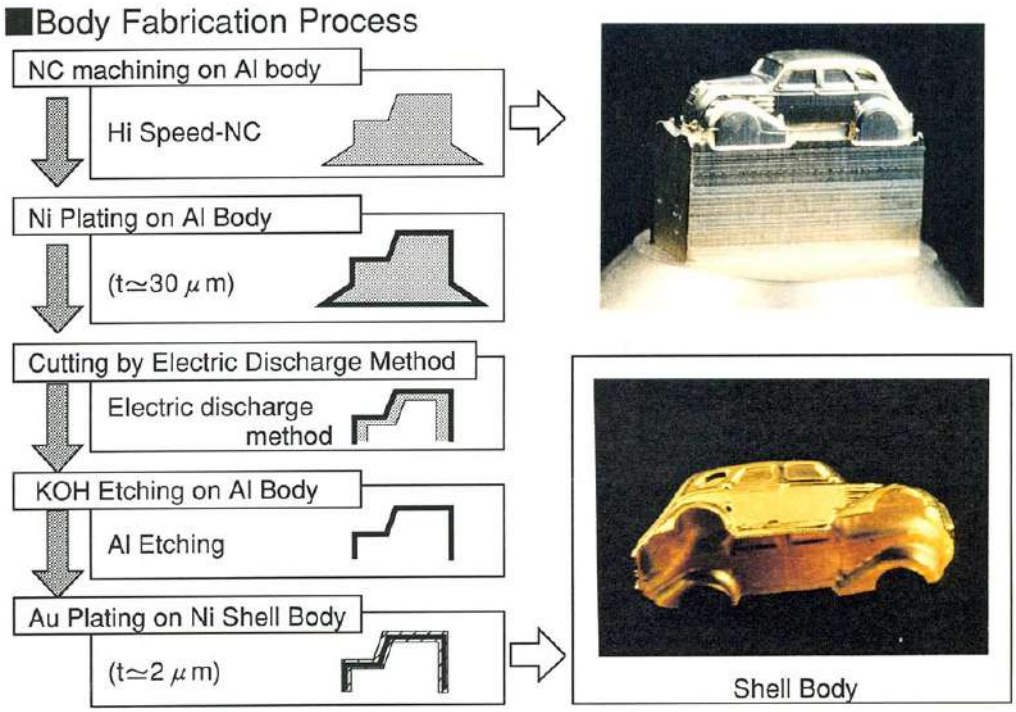
●車体長：先頭車16m/両
●車体幅：2．49m
●車体高さ：先頭車3．15m
●車両編成：4両

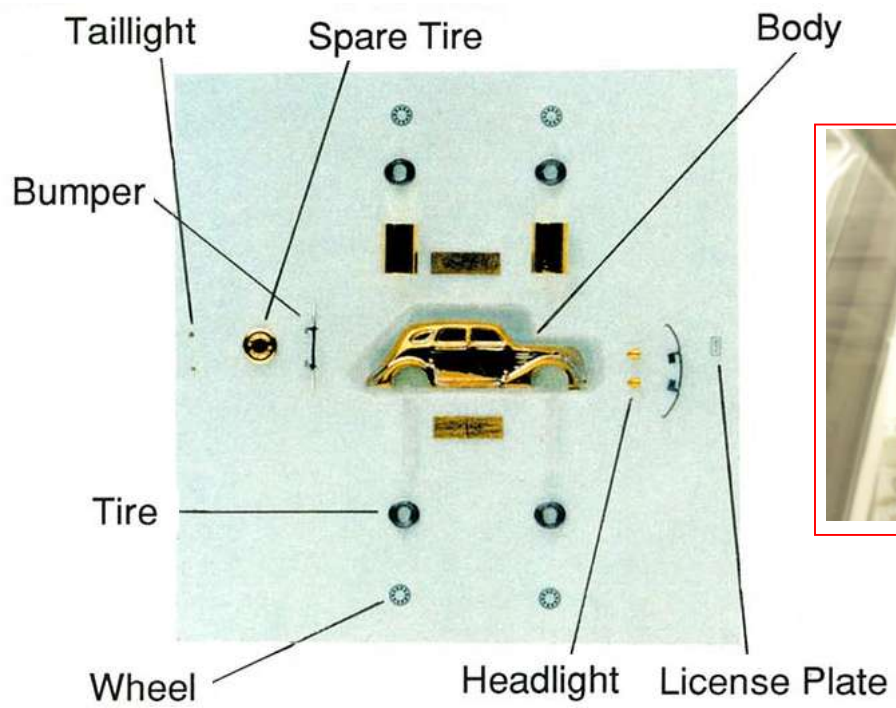
Above ground part of linear

Linear metro (Tozai line in Sendai)　http://www.jametro.or.jp/linear/touzai.html

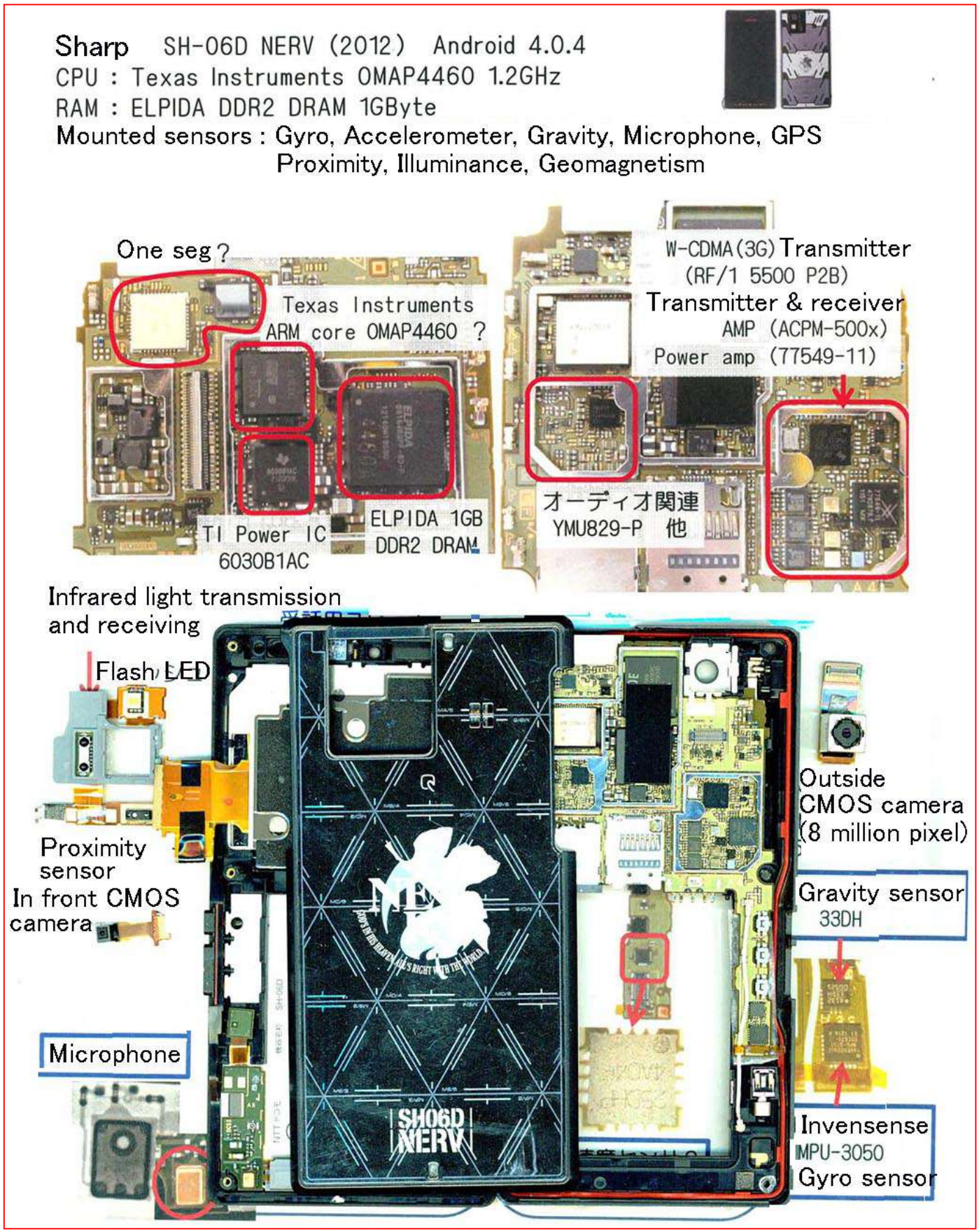
J12 Micro car (Denso Corp.)

1/1000 size model of Toyota AA model (1936) (62 mg、24 parts)

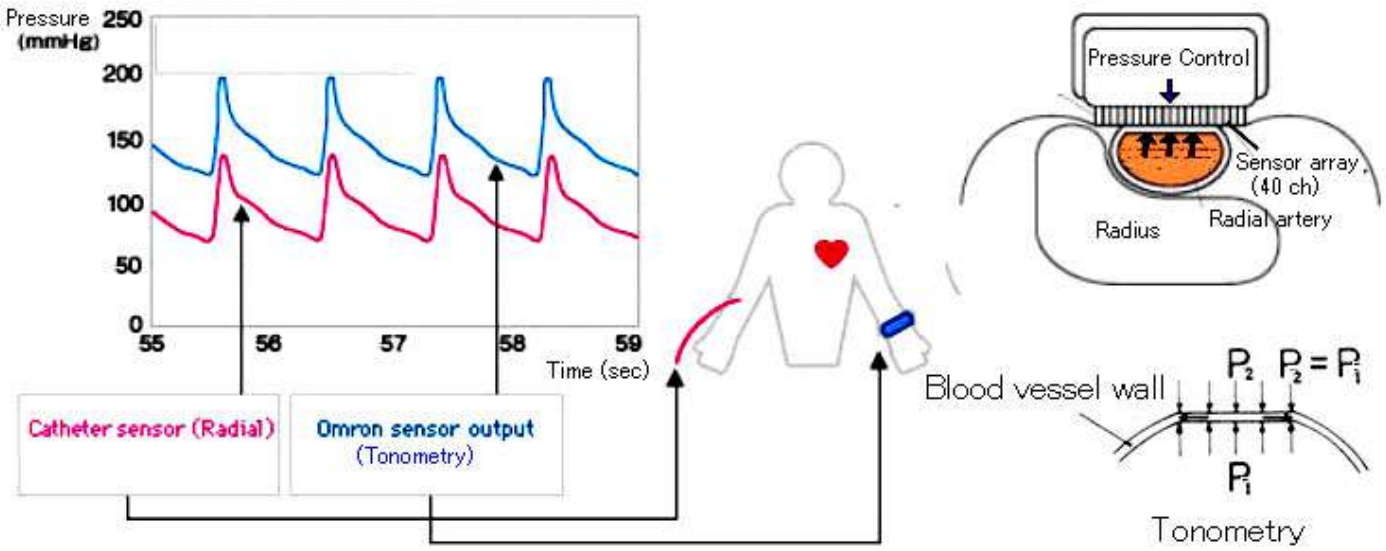




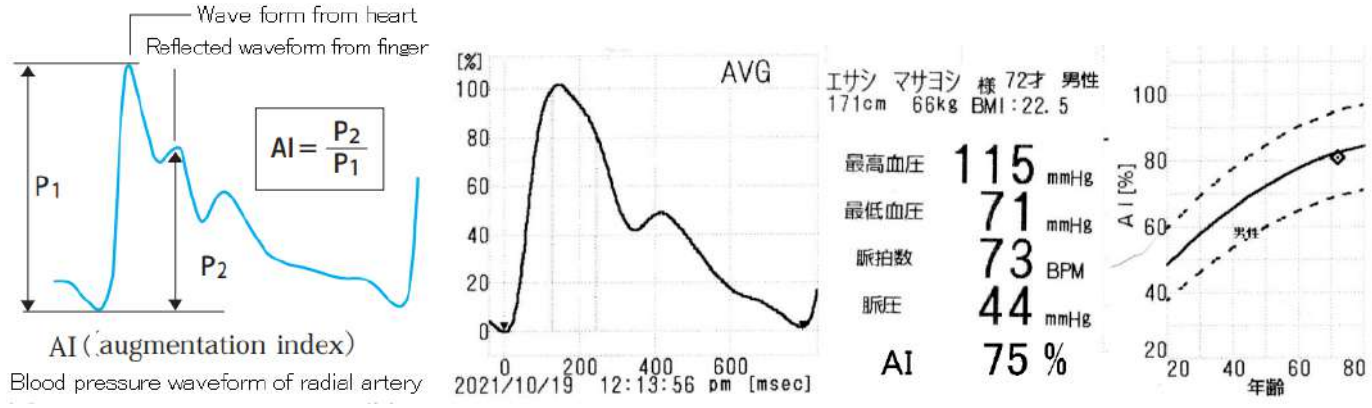
J13 Disassembly of FOMA (3G) smartphone



J14 Continuous arterial pressure waveform with Tonometry (OMRON HEM-9000AI)



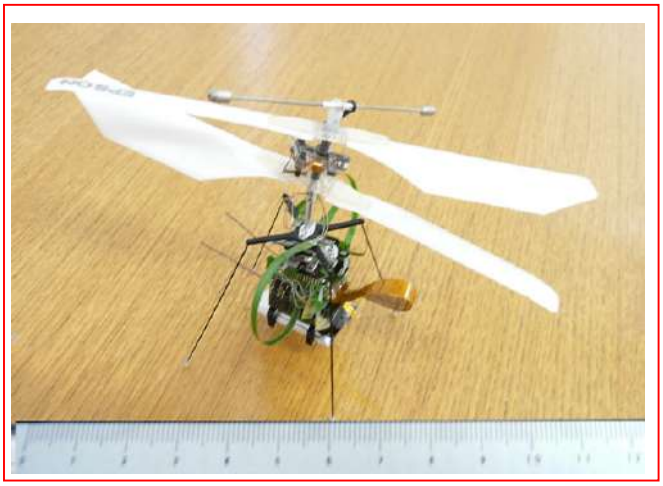
Comparison of pulse wave by catheter and tonometry

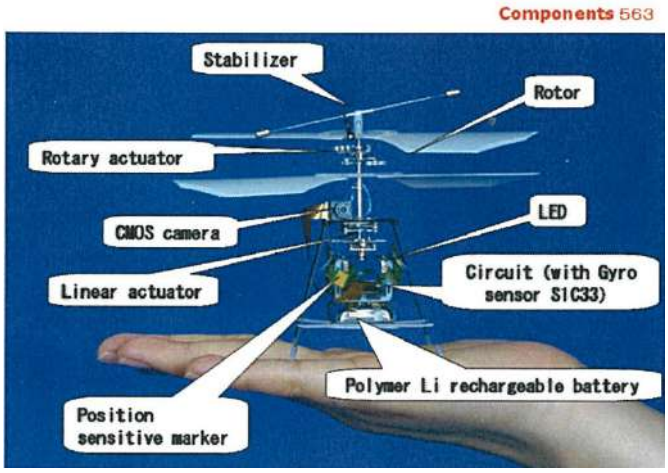


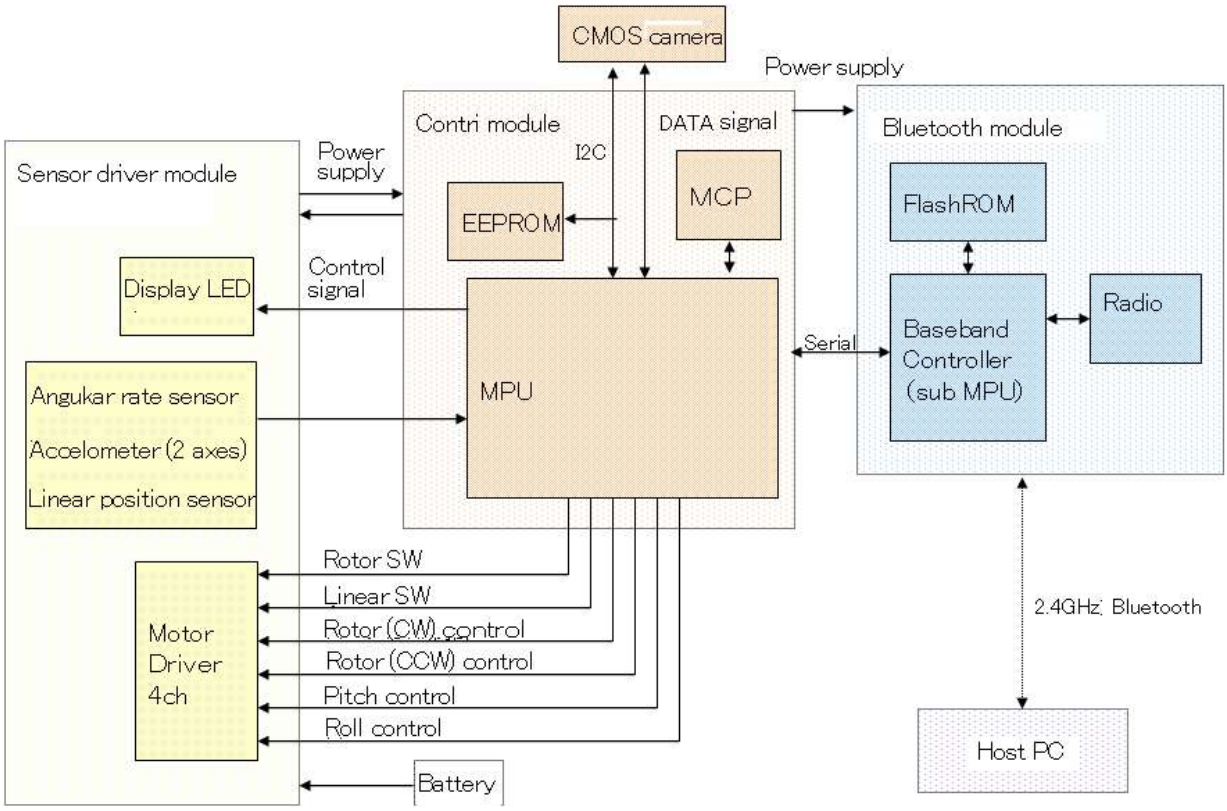
Measured pulse wave and AI value (Arterial Distensibility Index)

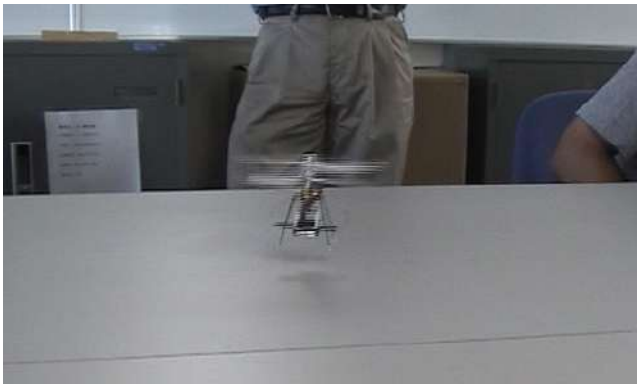
稲垣孝 (オムロンヘルスケア) : トノメトリ法による橈骨動脈波形の AI 測定-オムロン血圧脈波検査装置 HEM-9000AI-
Arterial Stiffness 動脈壁の硬化と老化, No.9 (2006)

J15　Micro Flying Robot (μFR) (Seiko Epson Corp.) (2003)

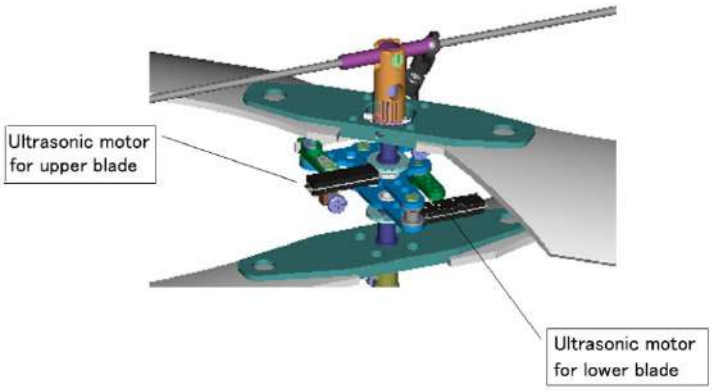








First flight of μFL



Ultrasonic motor for blade

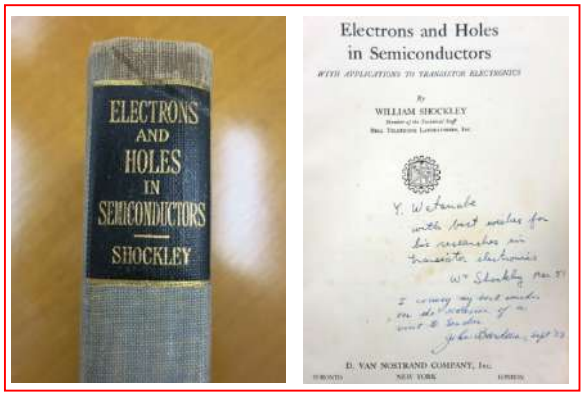
https://www.jstage.jst.go.jp/article/micromechatronics/50/194/50_KJ00004320100/pdf/-char/ja

(Seiko Epson Corp.　Osamu Miyazawa)

J16 Topics related to collected books

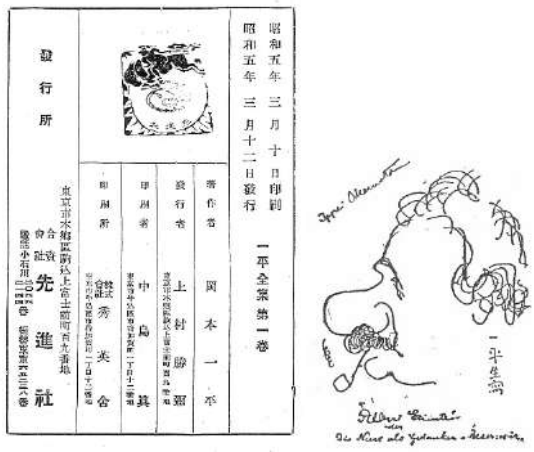
Books related to history of technology

Books related to Tohoku Univ. and companies



A book of return gift from W. Shockley to Nishizawa's paper which was send by his professor (Yasushi Watanabe).

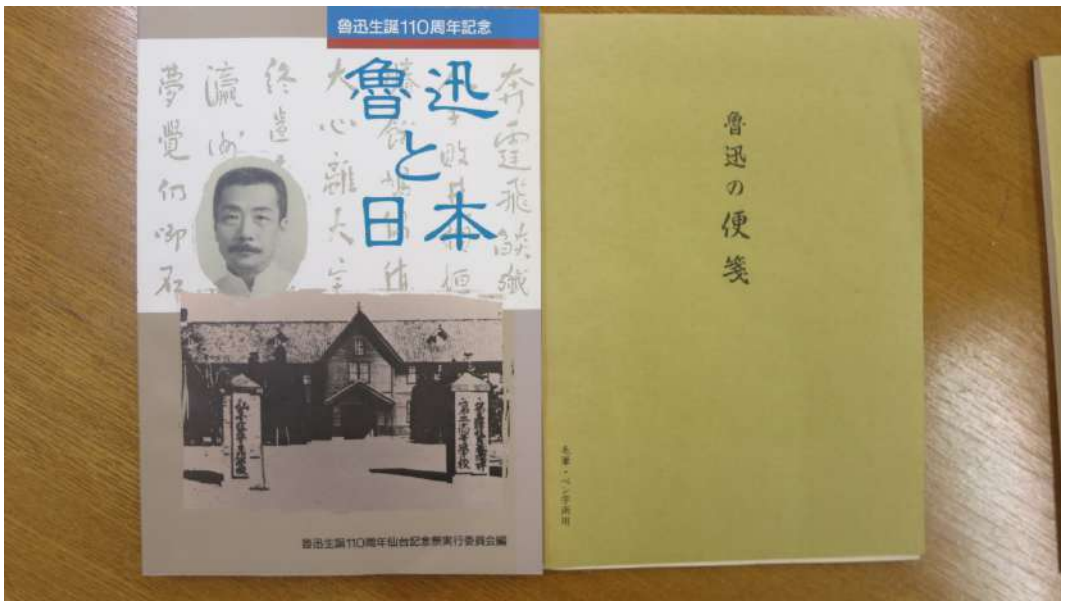
Book "Manabinomori" (2006) on the relationship between Jun Ishihara and Albert Einstein



Book on Albert Einstein's visiting Sendai (1930)

Book written by Jun Ishihara (1942)

J17 Documents on Kohtaro Honda and Lu Xun

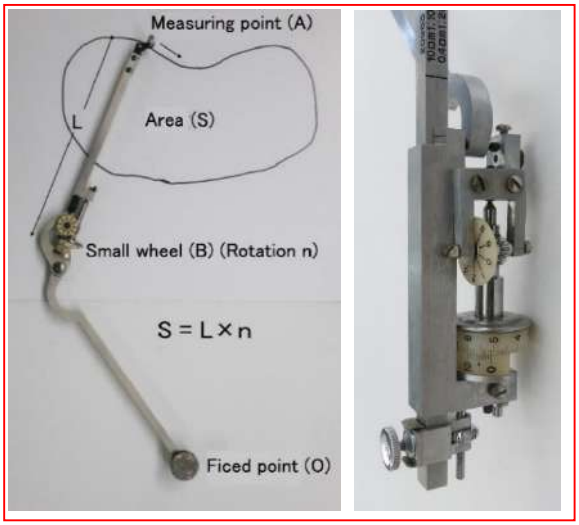


J18 Planimeter (area meter) and proportional compass

Photograph and principle of the planimeter (area meter) is shown in the figure (a). Small wheel is located at the bending point (B) of 2 rods. One rod rotates around the fixed point (O). Measuring point (A) of the other rod (length (L)) is moved around the area ((area (S)). The small wheel moves perpendicularly to the rod and the area (S) is obtained using the rotation (n) as S = L × n.

The principle will be explained in the following using the figure (b). When the measurement point moves from A to A' the small wheel moves from B to B'. The movement of A to A' is composed of parallel movement AA"and rotation A"A'. The area covered by parallel movement of the bar is Ldn where dn is the rotation of the small wheel. The dn is BB' cos α where α is the angle between the direction of small wheel rotation and that of the parallel motion (AA") of the bar. The area covered by the rotation is $L^2 d\theta/2$. From these, the area (dA) covered by the movement of the bar AB is expressed as $Ldn + L^2 d\theta/2$. The area (S) by the closed motion of the measurement point is obtained by integrating dA as follows, where integrated value of the closed loop ($\oint L^2 d\theta/2$) is zero.

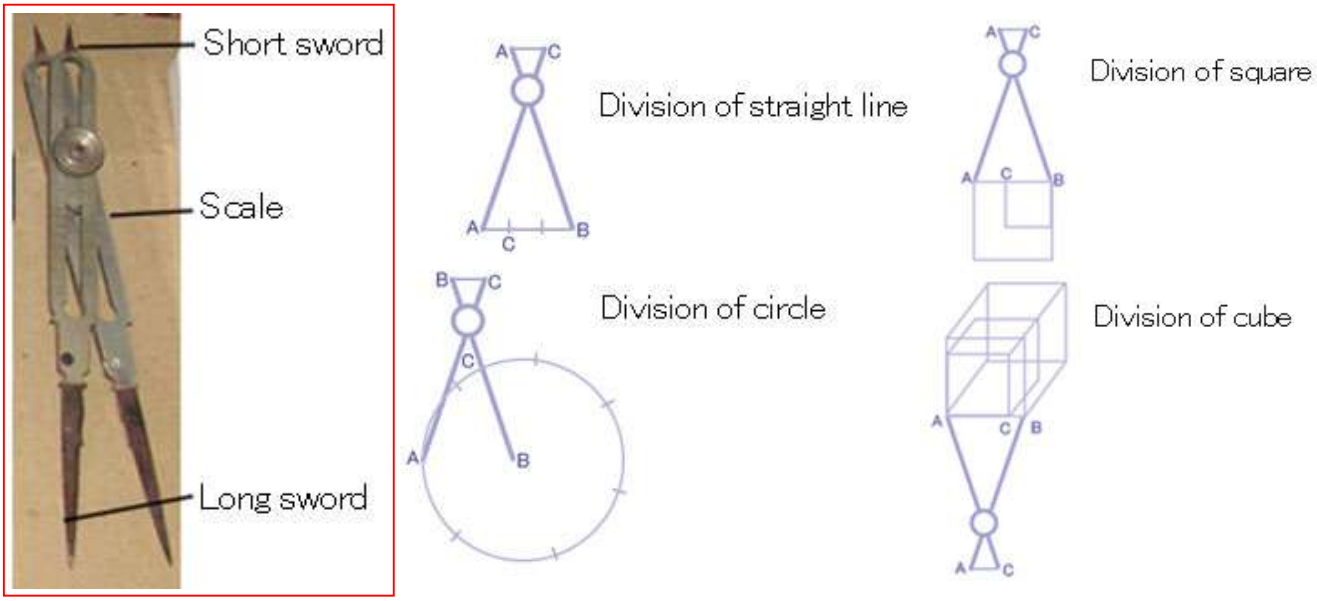
$S = \oint dA = \oint Ldn + \oint L^2 d\theta/2 = L \times n$



(a) Photograph and principle (b) Small wheel (c) The relationship between movement of A and B

Figure Planimeter

Ref. Yutaka Nishiyama : Area measurement, https://yutaka-nishiyama.sakura.ne.jp/math2010j/measuring_j.pdf



Proportional compass http://okadaenoguten.o.oo7.jp/ditail_desain3.html (Donated by Prof. Emeritus Yakichi Higo))