94GHz Millimeter Wave Radar

AMPLET Communication Laboratory

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Abstruct

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Helicopters and small aircraft flying at low altitude in the visual flight rules often strike against obstacles. According to the aircraft accident reports in Japan, many collisions with small aircraft were caused by long, thin artificial objects as power lines because they are often very difficult to find by pilot eyes even when visibility is good for flight.

An obstacle detection and warning system for civil helicopters is being developed. An infrared camera and a 94GHz millimeter wave (MMW) radar are used as its sensor. Experimental MMW radars have been built to examine their propagation properties and obstacle detection performance. The 94GHz Vivaldi antenna has been fabricated for a compact radar antenna. Measured results demonstrated that the experimental FM CW radar has a satisfactory range and accuracy.

Dr. Hideyuki Nebiya (President of AMPLET Communication Laboratory, and a member of the millimeter radar studying group at ENRI – Electronic Navigation Research Institute) will explain the technology of millimeter radar, laser radar, and RFID at this seminar.

94GHz Millimeter Wave Radar

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1. 94GHz Millimeter Wave Radar
   (Obstacle Detection for Hlicopter Flights)
2. Millimeter Wave Mono-pulse Radar
3. Constant Fraction Technology
4. Prototype of 94GHz Solid States Receiver
5. Laser Mono-pulse Radar
6. What is Difference between Millimeter Radar and Laser Rader ?
7. RFID

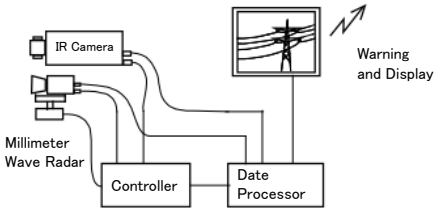
1. 94GHz Millimeter Wave Radar (Obstacle Detection for Hlicopter Flights)

Helicopter Crash

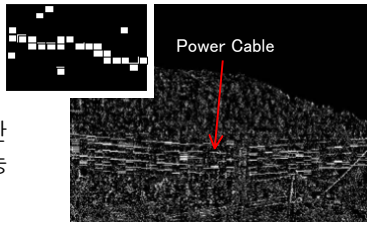
일본의 조사에 따르면, 민간 헬리콥터나 민간 경비행기의 사고원인 중 가장 큰 이유는 고압전선에 의한 충돌 사고라고 한다.

이를 방지하기 위해 헬리콥더와 경비행기에 적외선 카메라와 밀리미터파 레이더를 부착시켜 센서로 미리 고압전선을 발견할 수 있다.

Obstacle Detection for Helicopter Flights



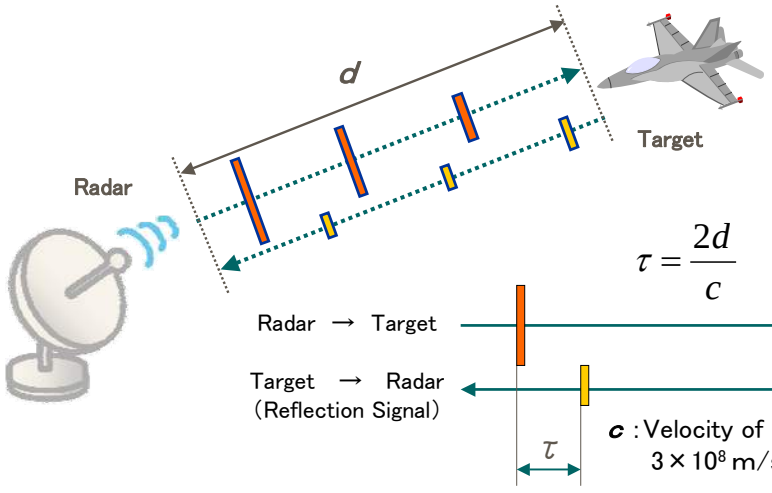
민간 헬리콥터에 부착할 수 있는 레이더는 개발됨
(연구기간 : 1998 ~ 2003).



오늘의 프레젠테이션에서는 이러한 레이더의 프로토타입을 사용한 성능 실험의 결과에 대해 발표하고자 함.

2. Millimeter Wave Mono-pulse Radar

Millimeter Wave Mono-pulse Radar



Blockdiagram of Experimental Mono-pulse Radar

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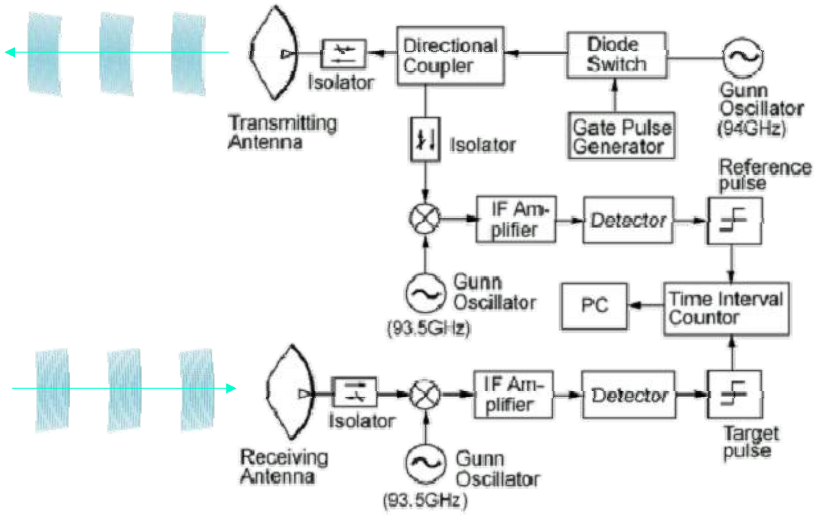

Blockdiagram of Transmitter of Mono-pulse Radar

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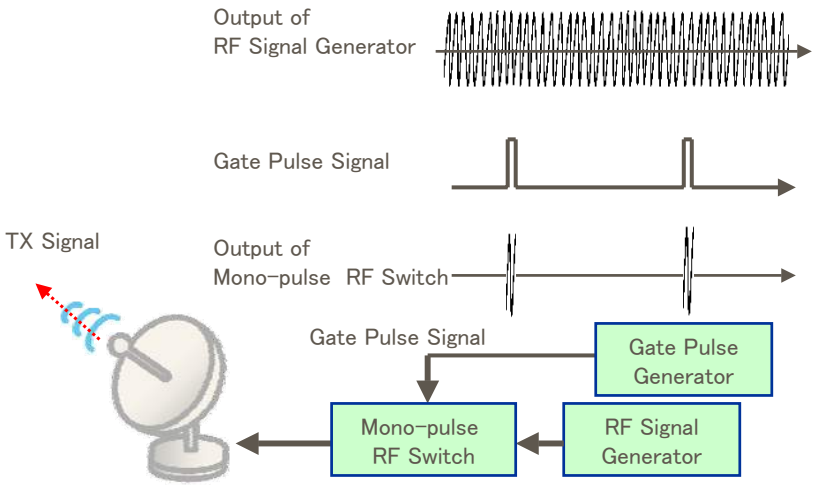
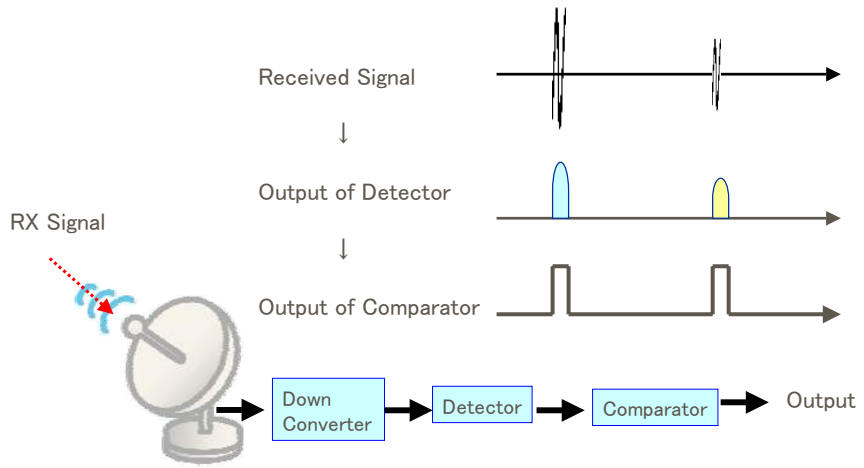
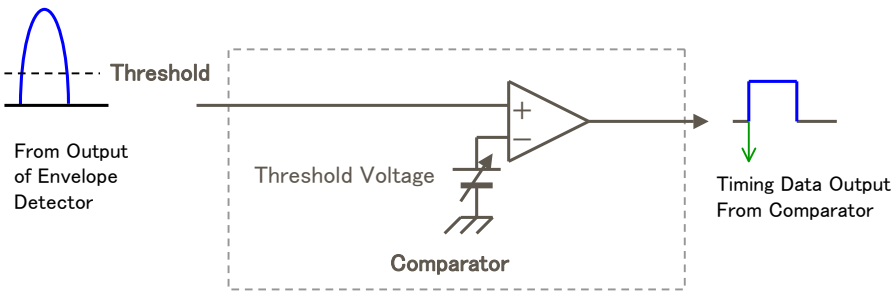


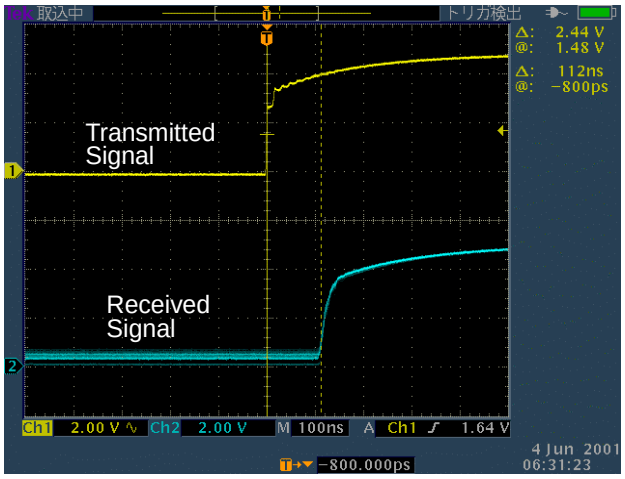
Blockdiagram of Receiver of Mono-pulse Radar



Measure Timing of Refrected Receiving Signal



Transmitted and Received Signals of Mono-pulse Radar



3. Constant Fraction Technology

Ranging Error by Timing Jitter

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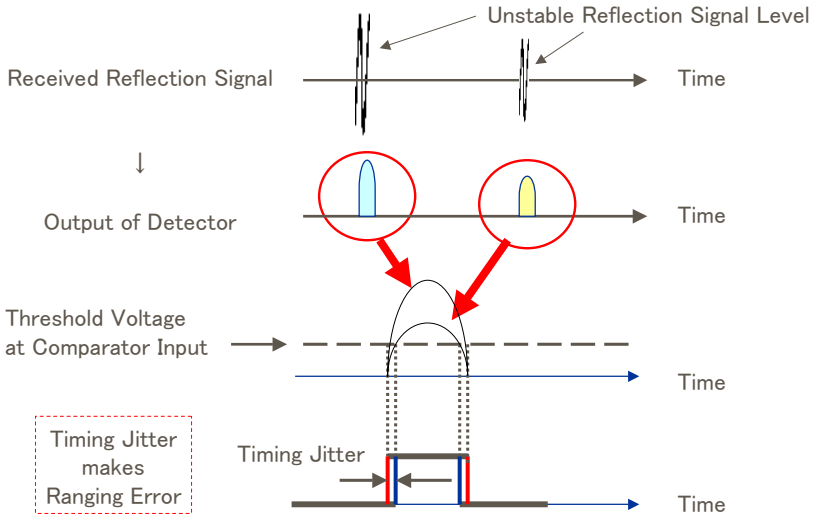
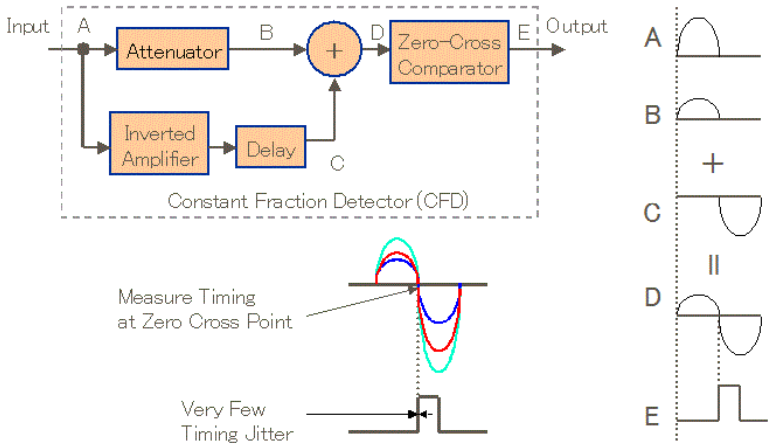
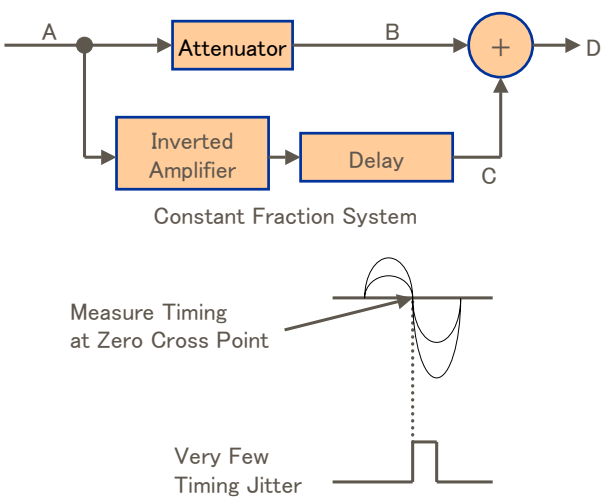


Ranging Error by Timing Jitter

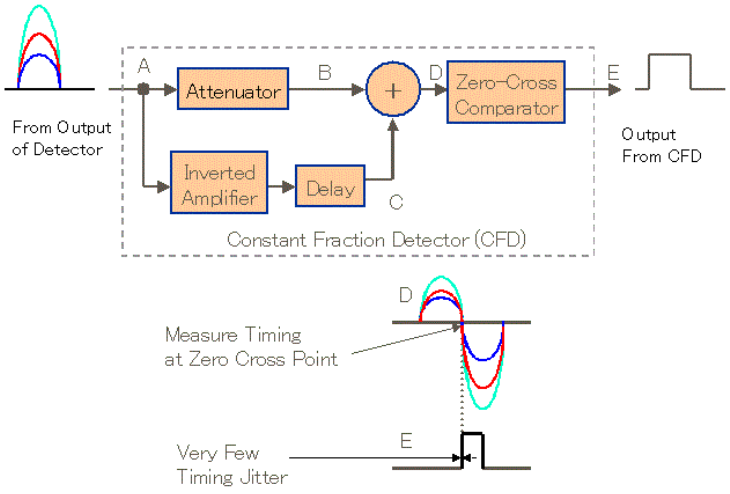
AMPLET Communication Laboratory



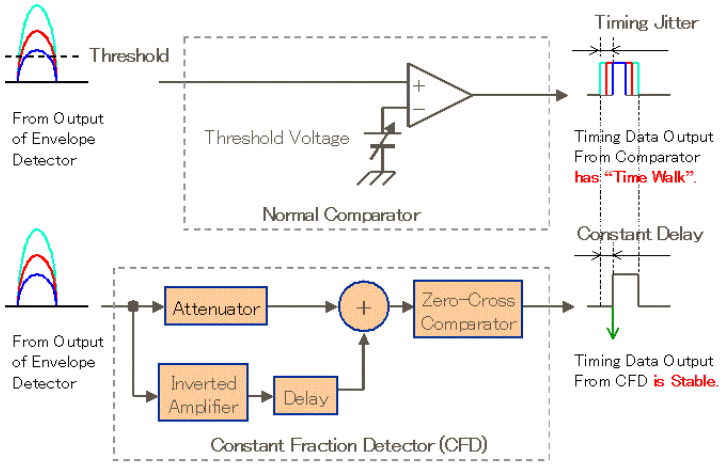
Constant Fraction System



Constant Fraction Detector



Advantage of CFD over Normal Comparator



4. Prototype of 94GHz Solid States Receiver

Prototype of 94GHz Solid States Receiver

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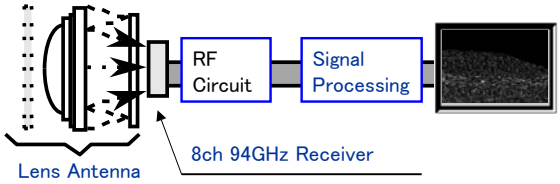

Prototype of Vivaldi Antenna

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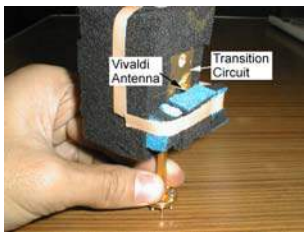

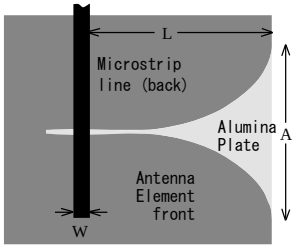

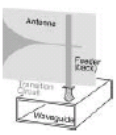

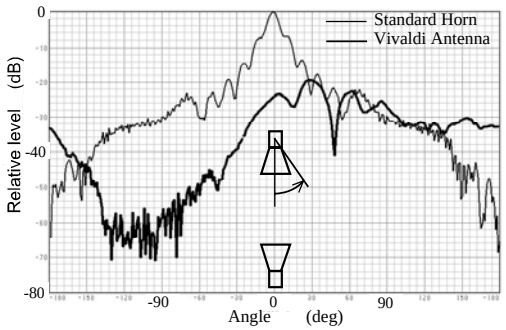

Radiation patterns of Standard Horn Antenna and Vivaldi Antenna

5. Laser Mono-pulse Radar

Satellite Laser Ranging System

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- Laser Wave Length 532nm
- YAG Laser
- TX Pulse Width 200pS
- RX Pulse Resolution 10pS
- Ranging Resolution 10cm@8000km

(Photo Courtesy of https://directory.eoportal.org/web/eoportal/satellite-missions/content/-/article/egs-ajisai)

Our Satellite Laser Ranging System

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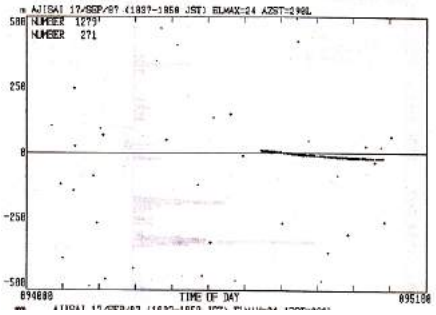
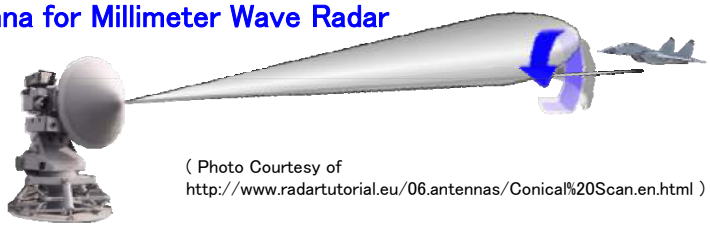


Station	Location	RMS(cm)
1181	Potsdam.GDR	20.6
7086	McDonald.Texas	4.5
7090	Yarragadee.Austr	1.2
7105	GSFC.Maryland	0.9
7109	Quincy.Calif	1.8
7110	Mon.Peak.Calif	2.4
7122	Mazatlan.Mexico	2.2
7210	Haleakala.Hawaii	3.1
7512	Rhodes.Greece	4.2
7525	Xrisokellaria.Greece	4.3
7530	Bar Giyyora Israel	32.5
7810	Zimmerwald.Switz	9.8
7834	Wettzell.FRG	5.2
7835	Grasse.France	3.6
7838	Simosato Japan	3.1
7839	Graz.Austria	2.4
7840	RGO.United Kingdom	5.8
7843	Orroral Australia	1.7
7907	Arequipa Peru	16.2
7939	Matera Italy	14.3
20	Weighted Avg.	5.4

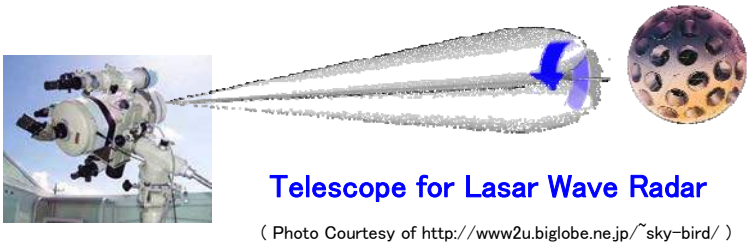
6. What is Difference between Millimeter Radar and Laser Rader ?

Antenna / Telescope

Antenna for Millimeter Wave Radar



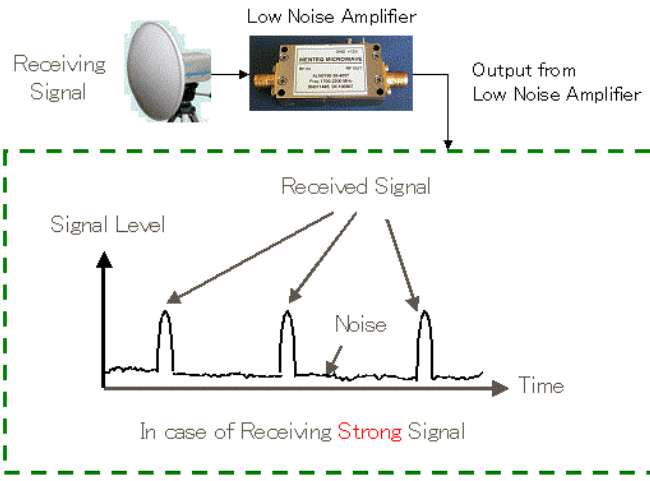
(Photo Courtesy of
http://www.radartutorial.eu/06.antennas/Conical%20Scan.en.html)



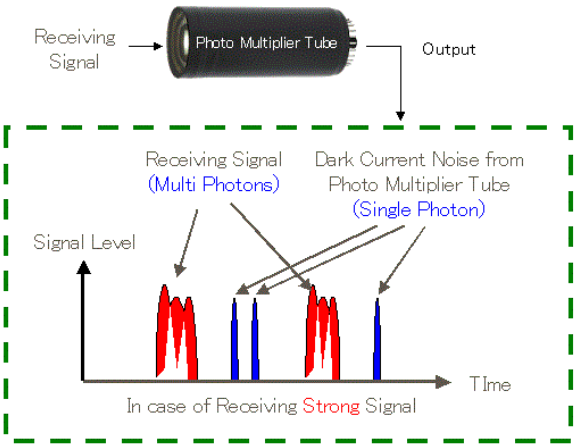
Telescope for Lasar Wave Radar

(Photo Courtesy of http://www2u.biglobe.ne.jp/~sky-bird/)

Signal vs. Noise of Millimeter Wave Radar



Signal vs. Noise of Laser Radar



7. RFID

RFID using Radar Technology

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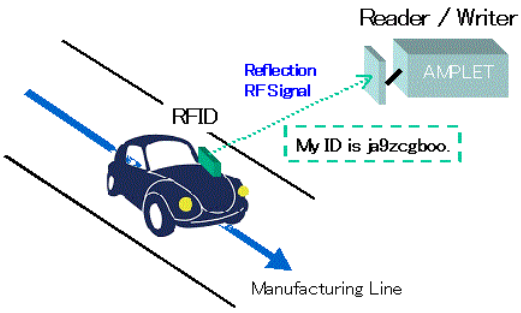


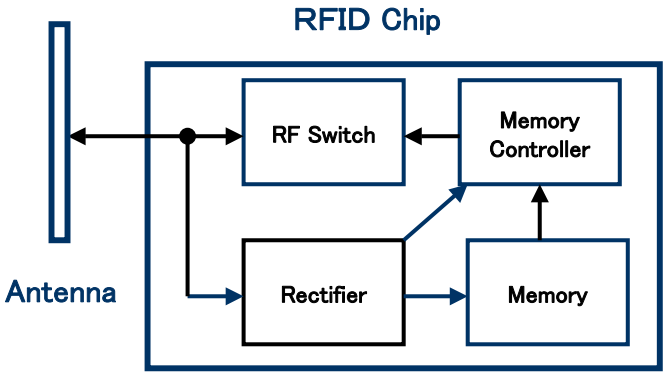
Reader

RFID Tag

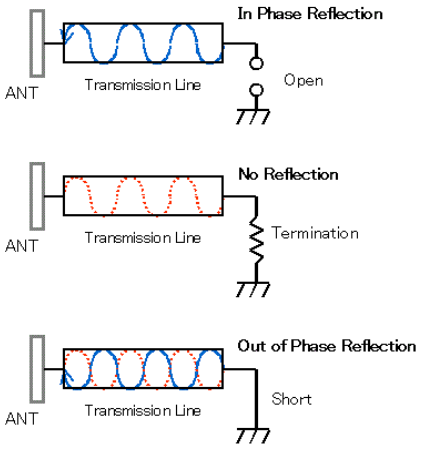
When I moved to Hitachi from Nissan, I considered efficiency of Manufacturing Lines using Radar Technology. Then I invented RFID in 1984.

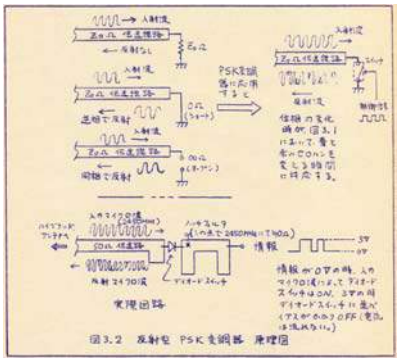
How does RFID work ?

Typical Block Diagram of RFID Tag

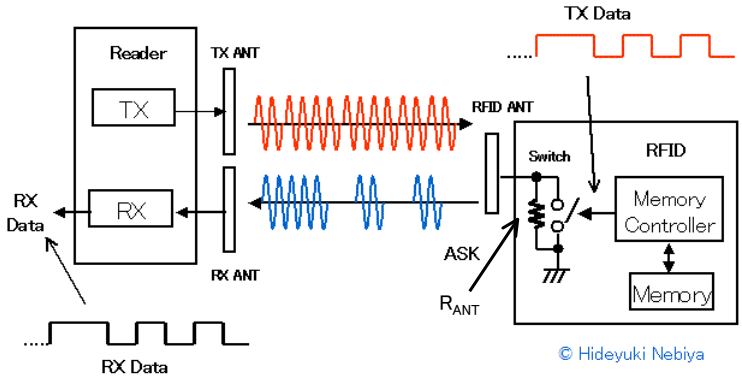


Reflection on Transmission Line

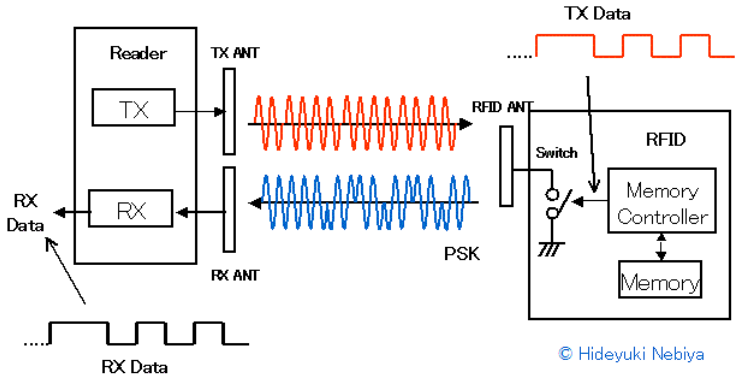




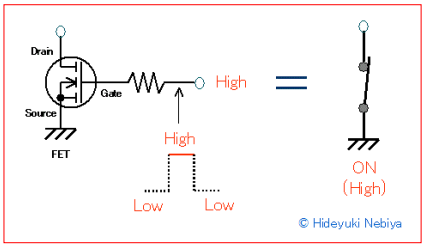
Passive ASK RFID



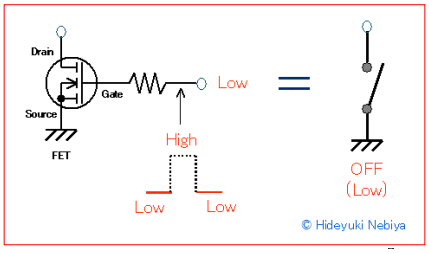
Passive PSK RFID



RF Switch



Switch ON



Switch OFF

RFID JOURNAL

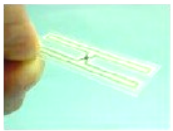
Found at: http://216.121.131.129/article/articleprint/279/-1/1/

Toppan to Produce $20 RFID Reader

The Japanese printing company says it will have an ultra-low-cost EPC reader on the market by June.

Jan. 23, 2003 - Toppan Printing Co., the $10 billion Japanese printing, electronics and industrial products manufacturer is working with two other Japanese firms to mass produce readers that will cost less than $20, as well as RFID tags and labels that will cost about 50 cents each.

Toppan has signed agreements with Telemidic and Amplet. The companies will jointly develop radio frequency identification tags chips and readers that are compliant with the Auto-ID Center's specifications.



An Amplet RFID tag

Amplet, an engineering services company, has worked with Telemidic to develop a dual-frequency, small-scale, low-power RFID reader. Yoko Aikawa, a spokesperson for Toppan, told RFID Journal that the readers will cost about 2,000 yen initially, or about US$17. Aikawa did not provide details on how the company could produce a reader that costs about one twentieth of what many others on the market sell for today.

Friendship with Prof. Dr. Jong Myung Woo

図 C-5 リアルタイム SAR 測定装置
リアルタイム SAR 測定装置。携帯電話機のアンテナ位置を決めるために RFID を用いた。忠南国立大学，アンプレット，ビジタシステムが共同研究を行っている。

Thank you for your attention.