

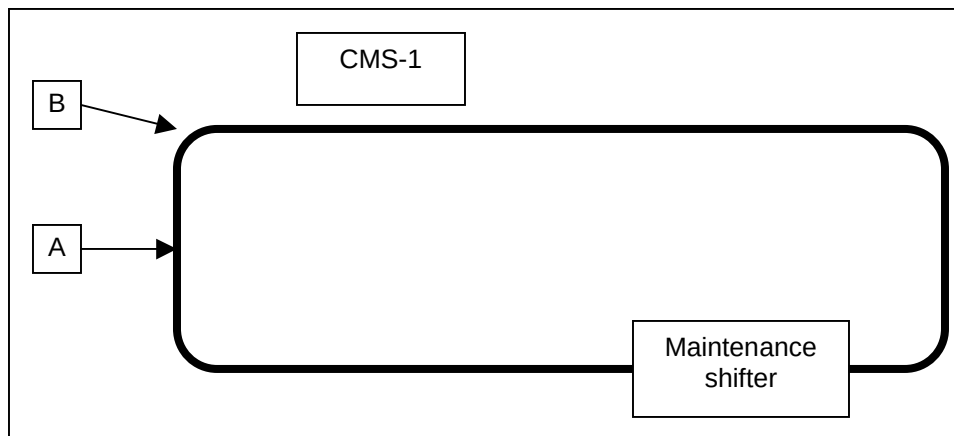
FCC-compliant Feeder Radio Test Results

Daifuku has tested the CSC-500 OHT to ensure that modifications made to the feeder radio system did not cause communication errors. The results of the test are given below.

1. Test date/time: May 8, 1999/1:00 p.m.
2. Test location: Daifuku Shiga Factory, I Building, 300mm test line
3. Test engineers: Daifuku: Ito, Ueda
Sankyo Tokushu Musen: 4 engineers
4. Modem frequencies during test:

	Original vehicle		FCC-compliant vehicle	
	Vehicle side	Controller side	Vehicle side	Controller side
Model	DVM-9601G12 Ch. A	DVM-9602D Ch. A	TBD	TBD
Frequency	138.15 MHz	170.15 MHz	151.9 MHz	221.9 MHz
Field Strength	500 μ V/m	500 μ V/m	150 μ V/m	200 μ V/m

5. Test locations along the track and distances between feeder line and vehicle modem:



	Distance between feeder line and track surface	Distance between feeder line and vehicle modem
Point A (straight)	23 mm	26 mm
Point B (curve)	23 mm	55 mm

6. Test method:
 - 1) Original modem
 - Stopped the vehicle at points A and B and measured the field strength generated
 - Stopped the vehicle at points A and B, transmitted a radio message 1,000 times and counted the number of communication errors

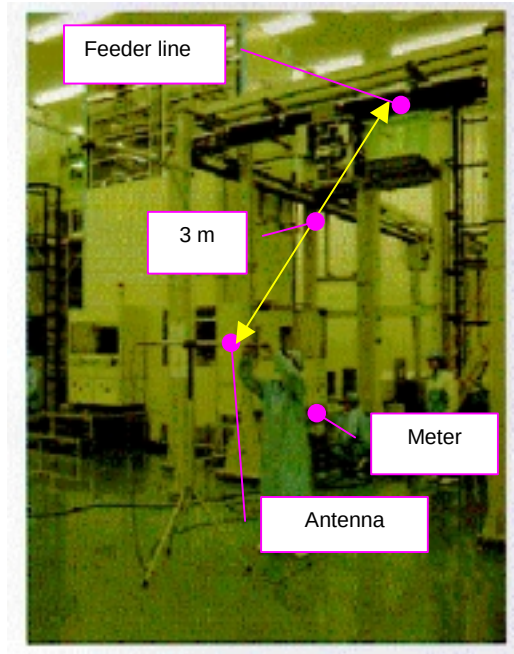
2) FCC-compliant modem

- Set the field strength to each of the values in the following table, stopped the vehicle at point A and measured the field strength generated
- For each field strength, stopped the vehicle at points A and B, transmitted a radio message 1,000 times and counted the number of communication errors

Field strength settings:

	Vehicle side	Controller side
Test 1	150 $\mu\text{V/m}$	200 $\mu\text{V/m}$
Test 2	112 $\mu\text{V/m}$	158 $\mu\text{V/m}$
Test 3	100 $\mu\text{V/m}$	126 $\mu\text{V/m}$

Field strength measurements were taken with the antenna positioned exactly 3 m from the feeder line as shown in the photograph at the right.



7. Field strength meter and measurement conditions

- 1) Antenna Name: tablet in-air line (antenna)
 Model: MZ18A
 Manufacturer: Anritsu
- Meter Name: Interference/Field Strength Meter
 Model: ML518A
 Manufacturer: Anritsu

2) Measurement conditions

All measurements were made with the target vehicle operating and the other vehicle powered OFF

8. FCC requirements summary (taken from pages 16-17 of OET BULLETIN NO. 63 published by the FCC):

Frequency Band	Band Usage	Field Strength @ 3 m
138-149.9 MHz (original modem)	Approved	$\leq 150 \mu\text{V/m}$
167.72-173.2 MHz (original modem)	Prohibited	
150.05-156.52 MHz (FCC-compliant modem)	Approved	$\leq 150 \mu\text{V/m}$
216-240 MHz (FCC-compliant modem)	Approved	$\leq 200 \mu\text{V/m}$

9. Test results:

The field strength meter displays measurements in decibels. The following equation was used to convert decibels to microvolts per meter: $\log_{10}(\mu\text{V/m}) = (\text{dB}/20)$.

1) Original modem

Measurement location		Point A (straight)	Point B (curve)
Field Strength	Vehicle side (138.15 MHz)	398.1 $\mu\text{V/m}$ (52 dB)	501.2 $\mu\text{V/m}$ (54 dB)
	Controller side (170.15 MHz)	631.0 $\mu\text{V/m}$ (56 dB)	251.2 $\mu\text{V/m}$ (48 dB)
No. of communication errors (out of 1,000 repetitions)		1	No errors

2) FCC-compliant modem

Measurement location		Point A (straight)	Point B (curve)
TEST 1			
Field Strength	Vehicle side (151.9 MHz)	141.3 $\mu\text{V/m}$ (43 dB)	
	Controller side (221.9 MHz)	199.5 $\mu\text{V/m}$ (46 dB)	
No. of communication errors (out of 1,000 repetitions)		No errors	No errors
TEST 2 (field strength reduced 2 dB from test 1)			
Field Strength	Vehicle side (151.9 MHz)	112.2 $\mu\text{V/m}$ (41 dB)	
	Controller side (221.9 MHz)	158.5 $\mu\text{V/m}$ (44 dB)	
No. of communication errors (out of 1,000 repetitions)		No errors	No errors
TEST 3 (field strength reduced 2 dB from test 2)			
Field Strength	Vehicle side (151.9 MHz)	100 $\mu\text{V/m}$ (40 dB)	
	Controller side (221.9 MHz)	125.9 $\mu\text{V/m}$ (42 dB)	
No. of communication errors (out of 1,000 repetitions)		No errors	No errors

10. Conclusions:

Daifuku concludes that with the following measures implemented, it is possible to operate the CSC-500 with an FCC-compliant feeder radio system:

- Separate the feeder line from the metal track
- Minimize the distance between the feeder line and the vehicle modem

The transmission field strength was observed to fluctuate depending on the surrounding environment and measurement position (inside the track vs. outside the track for example). For this reason, field strength settings were adjusted at the optimum (field strength most stable) location on the test line, which was point A.

FCC Appendix

The following appendix is provided to ensure that all information requested in section 2.1033 of the FCC Rules is included in this report. The content of the report preceding this appendix is unchanged from the original document submitted earlier to the FCC along with Form 731. The only change to the preceding pages is the replacement of the words “DAIFUKU CONFIDENTIAL” with “DAIFUKU AMERICA CORP.” in the page footer.

2.1033 (b) (1) Manufacturer name and mailing address

Manufacturer:

*Daifuku Co., Ltd.
1500, Komakihara-shinden
Komaki City, Aichi 485-8653
JAPAN*

OR

*Daifuku Co., Ltd.
2-14-5 Shiba, Minato-ku
Tokyo 105
JAPAN*

(this is the address given on form 731)

Applicant:

*Mark Magleby
Daifuku America Corporation
5225 W. Wiley Post Way, Ste. 125
Salt Lake City, UT 84116*

2.1033 (b) (2) FCC Identifier

The FCC identifier of the device is CEKDVM-9601F.

2.1033 (b) (3) Installation and operating instructions

The device in question is a low-level communications device used in an automatic vehicle transportation system. The manufacturer performs all installation, and operation of the device is completely transparent to the user. There are no installation or operation instructions furnished to the user.

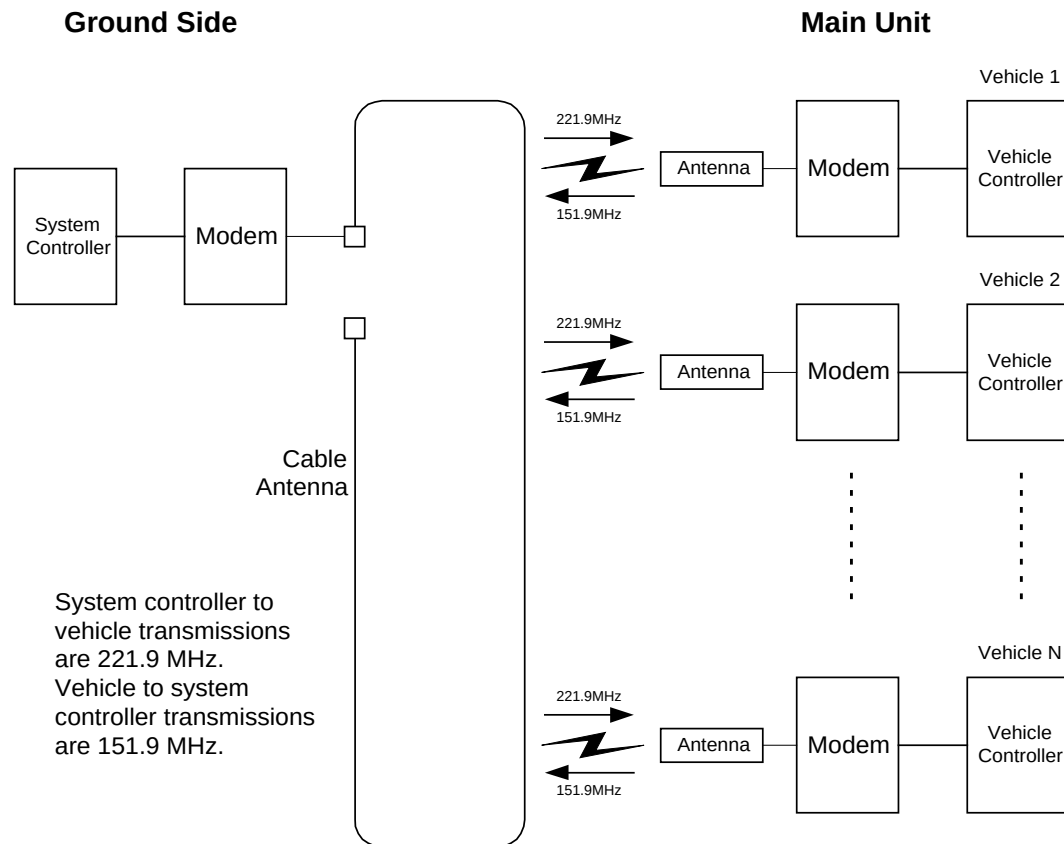
2.1033 (b) (4) Brief description of the circuit functions of the device and device operation

The overall system where the radio device is used is an automated material handling system used in semiconductor cleanrooms. The system consists of a controller that sits on the floor, a track that is suspended from the ceiling, and robotic vehicles that travel on the track. The radio device is used for communication between the controller and the vehicles. Radio signals are transmitted between a cable antenna located in the track and an antenna in each vehicle. The transmission distance of the radio signals is 1-2 inches (26-55mm).

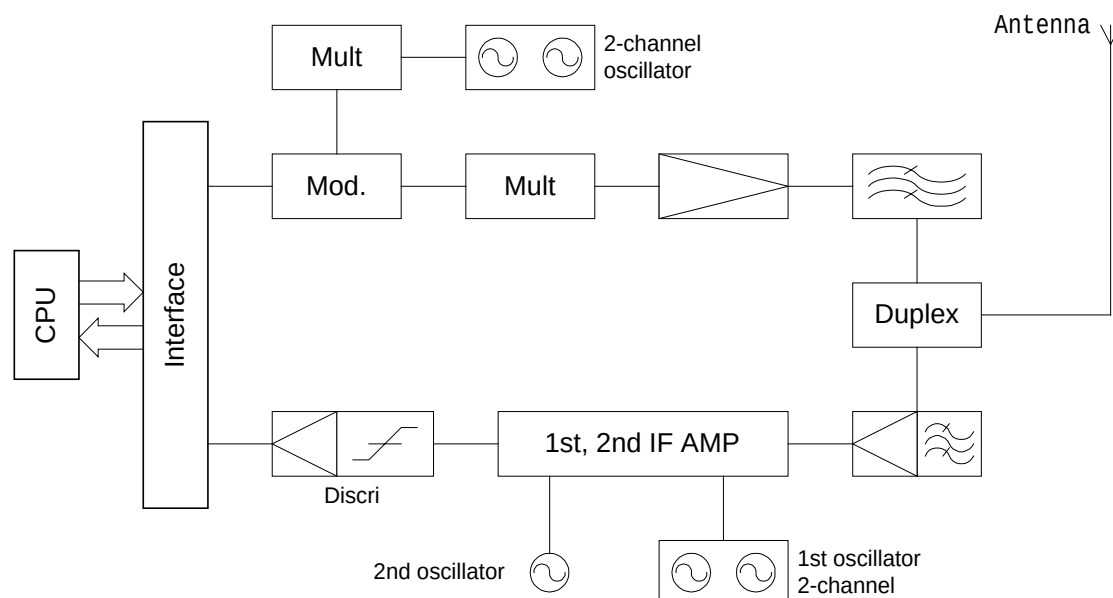
As shown in the block diagram in the next section, the system controller and each vehicle is equipped with a modem that modulates and demodulates the signals sent to and from the vehicles.

2.1033 (b) (5) Block diagram showing the frequency of all oscillators in the device

Block diagram:



Modem block schematic:



2.1033 (b) (6) Report of measurements showing FCC compliance

This is included in the main body of the report.

2.1033 (b) (7) Photographs of the device and the label

A photograph of the system is provided in the main body of the report. A diagram of the label and drawing of the device was submitted previously to the FCC as filename "990907 FCC label.pdf".

2.1033 (b) (8) Brief description of peripherals or accessory devices

The vehicle transportation system could be considered a peripheral or accessory device. The system is described in section 2.1033 (b) (4) above. The radio transmission device is never marketed separately, it is always provided as part of the overall vehicle transportation system.

2.1033 (b) (9) Indicate if the equipment is being authorized pursuant to 15.37

This section is not applicable.

2.1033 (b) (10) For spread spectrum transmitters

This section is not applicable.

2.1033 (b) (11) For scanning receivers

This section is not applicable.

2.1033 (b) (12) For transmitters operating within the 59.0-64.0 GHz band

This section is not applicable.