



# **System operation manual of Vehicle Communication Unit MCOM**

**AD-03-0218**

**Revision 0**

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## Revision History

Rev.	Monthly/Day/Year	Description	Author
0	Feb. 27, 2004	The first edition(Preliminary)	M.Kuroda
1			

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## 1. Introduction

### 1.1. Application

This document describes the operation of communication unit for transport system, OHT, OHS, etc.

### 1.2. Related Rules, Laws

FCC part 15 subpart C

### 1.3. Abbreviations

- (1) MCOM: Merge/diverge Communication Modem
- (2) COM-TR: power line Communication Transformer
- (3) IND-TR: INDuction line communication Transformer
- (4) CMC : Communication Modem Controller
- (5) CMC-BM: Communication Modem Controller : Base Modem
- (6) CMC-BC: Communication Modem Controller : Base Controller
- (7) CMC-TR: Communication Modem Controller : TRansformer

## 2. Safety

### 2.1. Alert Boxes

#### 2.1.1.General

- (1) Read and understand fully this manual and attached documents before operating the products.
- (2) Engage specialists in electrical and mechanical works.
- (3) Don't improve the product by yourselves.
- (4) Be sufficiently proficient with the equipment, the relevant safety knowledge and the precautions prior to using this product.

In the content of this "Safety Precautions", items which need to be alert shall be classified into "DANGER", "WARNING" and "CAUTION".

#### 2.1.2.Definitions of DANGER, WARNING and CAUTION



**DANGER:** An imminently hazardous situation which, if not avoided, will result in death or serious injury.



**WARNING:** A potentially hazardous situation which, if not avoided, could result in death or serious injury.



**CAUTION:** A potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

##### [Note 1]






Medium degree of injuries or light injuries refers to injuries, e.g., burns and electric shock, which do not require hospitalization or prolonged hospital visit by the victims. As material losses refers to expanded losses pertaining to the damage of property and equipment.

##### [Note 2]





Depending on the situation, the events described under "WARNING" may also result in severe outcome. In either case, make sure that the advice is followed.

After reading, make sure this information shall be kept at places where it can always be read by users.






## 2.1.3. Precautions on use

	 DANGER
	Follow the following advice strictly to avoid electric shock or burns.
	1. Only those who received training for maintenance and teaching can do maintenance and teaching.
	2. Don't break the cable, impose excessive stress, place heavy weights, or pinch it between items. Doing so may cause electric shock.
	 WARNING
	1. Don't use the equipment at locations where water, corrosive atmosphere, or flammable gas is present, or beside flammable items. Doing so may cause life and fails.





## 2.1.4. Storage

	 PROHIBITION
	1. Don't store the equipment at locations where it is subject to rain, ater hazardous gas or liquid.
	 MANDATORY ACTION
	1. Store the equipment at locations in not subjected to sunshine. Store it at predetermined relative humidity and temperature. 0 degrees C. - 50 degrees C., 90% RH and below, no dew.

### 2.1.5. Installation

	 <b>WARNING</b>
	1. Don't climb on top of the equipment or place heavy items on it. Doing so may cause injuries.
	2. Don't block the air inlet and outlet ports or allow foreign particles to enter them. Doing so may cause fire.
	3. Follow the installation direction strictly as it is so design for dissipation of heat, fails or fire.
	4. Don't hit the equipment with strong impact. Doing so may cause equipment fails.

### 2.1.6. Maintenance and Inspection

	 <b>PROHIBITION</b>
	1. Don't engage non-specialist technicians to disassemble and repair the equipment.
	 <b>DANGER</b>
	1. Before servicing MCOM unit , always shut off the power supply. Shut off the power source of the non-conductive power line before starting maintenance on MCOM unit. Not doing so may cause electric shock.



### 3. Outline of the Vehicle communication unit MCOM

#### 3.1. Overview

The communication unit MCOM (Merge/diverge Communication Modem) meet the requirements of FCC Part15 Subpart C. The FCC ID is as follows.

FCC ID of MCOM: RVEVEHICLEMCOM

#### **1) Power line communication**

MCOM is used for the communication between vehicle and the ground vehicle controller in the transport system.

The communication signals are overlaid onto the power line for non-contact power supply to the vehicles. In some systems, a separate signal lines may be used.

The communication unit CMC (Communication Modem Controller) is the groundside communication unit. CMC is used for the communication between the groundside vehicle controller and several vehicles.

CMC meet the requirements of FCC Part15 Subpart C. The FCC ID is as follows.

FCC ID of CMC: OPO199909010003

MCOM modulate the signals sent from the vehicle and receive the modulated signals from the ground vehicle controller. MCOM also demodulate the signals sent from the groundside vehicle controller and transmit them to the ground vehicle controller.

The communication method in use is 2 levels FSK (frequency shift keying).

The communication frequencies are as follows.

	From	to	Frequency
(1)	CMC	MCOM :	285.7 kHz and 315.8 kHz
(2)	MCOM	CMC :	342.9 kHz and 363.6 kHz

#### **2) Induction line communication**

MCOM is used for the communication between vehicle and other Vehicle in the transport system.

MCOM outputs the detection signal of one bit in the controller when the existence of the signal which other vehicle transmitted.

An Induction line is installed on both sides of the track. Therefore one transformer and circuit are each right and left, and they are equal. It can be changed if one transformer is used for the reception or it is used for the transmission. A left-right IND-TR is combined with the loop line, and it can watch each other's transmitting signal. Then, a trouble such as the breakage of the transformer can be diagnosed.

The communication method in use is Adoption of On Off Keying Method.

The communication frequencies are 88.8kHz.

### 3.2. MCOM configuration

**Fig. 1** and **Fig. 2** show the basic configuration of MCOM. MCOM consists of the following units.

The MCOM unit may vary in its outward form depending on the transport system. However, the internal configuration is common.

- (1) M-COM2 (Printed circuit board)
- (2) COM-TR (power line Communication Transformer)
  - The power line communication transformer of transmission
  - The power line communication transformer of reception
- (3) IND-TR (INDuction line communication Transformer)
  - The induction line Communication transformer (transmission and reception)

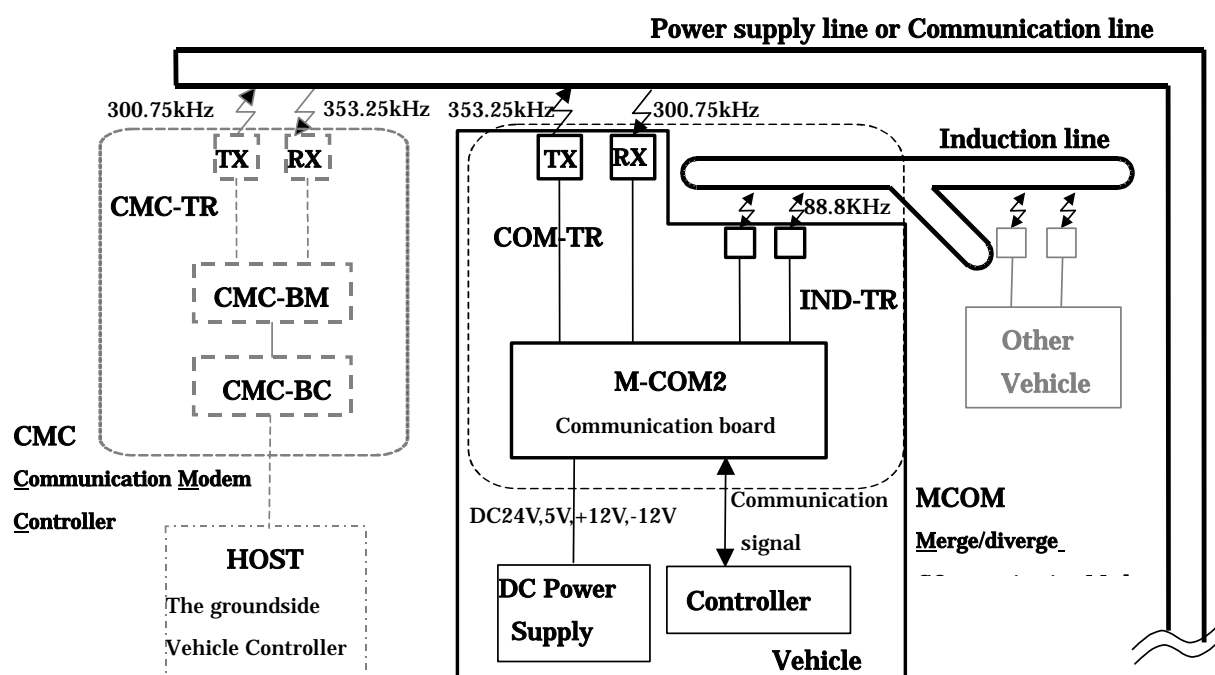


Fig. 1 Basic configuration of MCOM

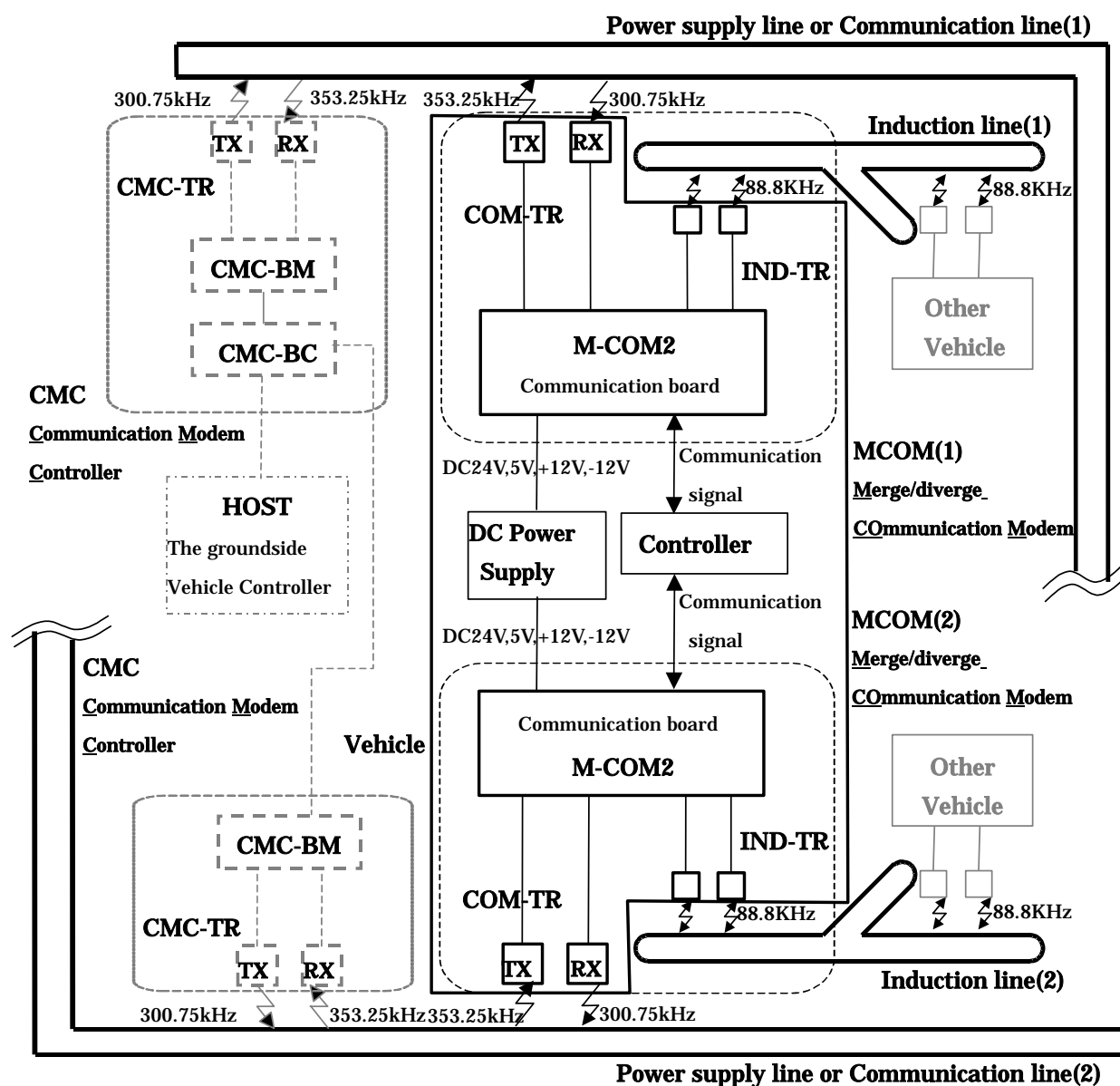


Fig. 2 Modified MCOM configuration

### 3.3. Function of each unit

Fig. 3 shows the block diagram of M-COM2.

In addition, the MCOM unit may vary in its outward form depending on the transport system. However, the internal configuration is common.

All units are connected by the cable.

#### 3.3.1. M-COM2 (Printed circuit board )

M-COM2 is a print board with two communication functions, power line communication and induction line communication.

Fig. 4 shows the outward form of the printed circuit board M-COM2.

##### **1) Power line communication**

M-COM2 board is an interface unit to handle the signals from/to the groundside vehicle controller.

A signal is transmitted and received by the order of the controller.

This is a modem unit to handle the signals from/to the groundside vehicle controller.

It incorporates a driver that modulates the digital signals sent from the controller to analog signals and overlay the converted signals onto the non-contact power supply line or signal line.

It also demodulates the analog signals sent from the groundside vehicle controller to digital signals and transmit them to controller.

##### **2) Induction line communication**

M-COM2 board is an interface unit to handle the signals from/to the other vehicles.

A signal is transmitted and received by the order of the controller.

This is a modem unit to handle the signals from/to the other vehicles.

It incorporates a driver that modulates the digital signals sent from the controller to analog signals and overlay the converted signals onto the induction line.

It also demodulates the analog signals sent from the other vehicles to digital signals and transmit them to controller.

The receiving circuit and the transmitting circuit are prepared by the set to the induction coil on either side. It can change whether a receiving circuit is connected or a transmitting circuit is connected with the setting signal from the controller to a right-and-left IND-TR.

Intermittent sending of the 88.88kHz digital signal is carried out from the signal generating circuit, and a transmitted signal is amplified with transmitting amplifier, and is transmitted with a coil.

The capacitor for resonance is connected to a coil in series, and voltage amplification of the 88.88kHz is carried out alternatively.

A receiving circuit converts into a pulse signal the modulation signal received with the receiving coil, and counts the number of pulses by the signal detector.

If it becomes beyond a value with the number of counts, it will be considered that other vehicles were detected.

### 3.3.2.COM-TR (power line **CO**munication **TR**ansformer)

The transmission transformer overlays the signals from the controller onto the non-conductive power line or signal line.

The reception transformer receives the signals from vehicles overlaid in the non-conduct power line or signal line.

**Fig. 5** shows the outer forms of the transformers.

\*The COM-TR may vary in its outward form depending on the transport system. However, the internal configuration is common.

### 3.3.3.IND-TR (**IND**uction line communication **TR**ansformer)

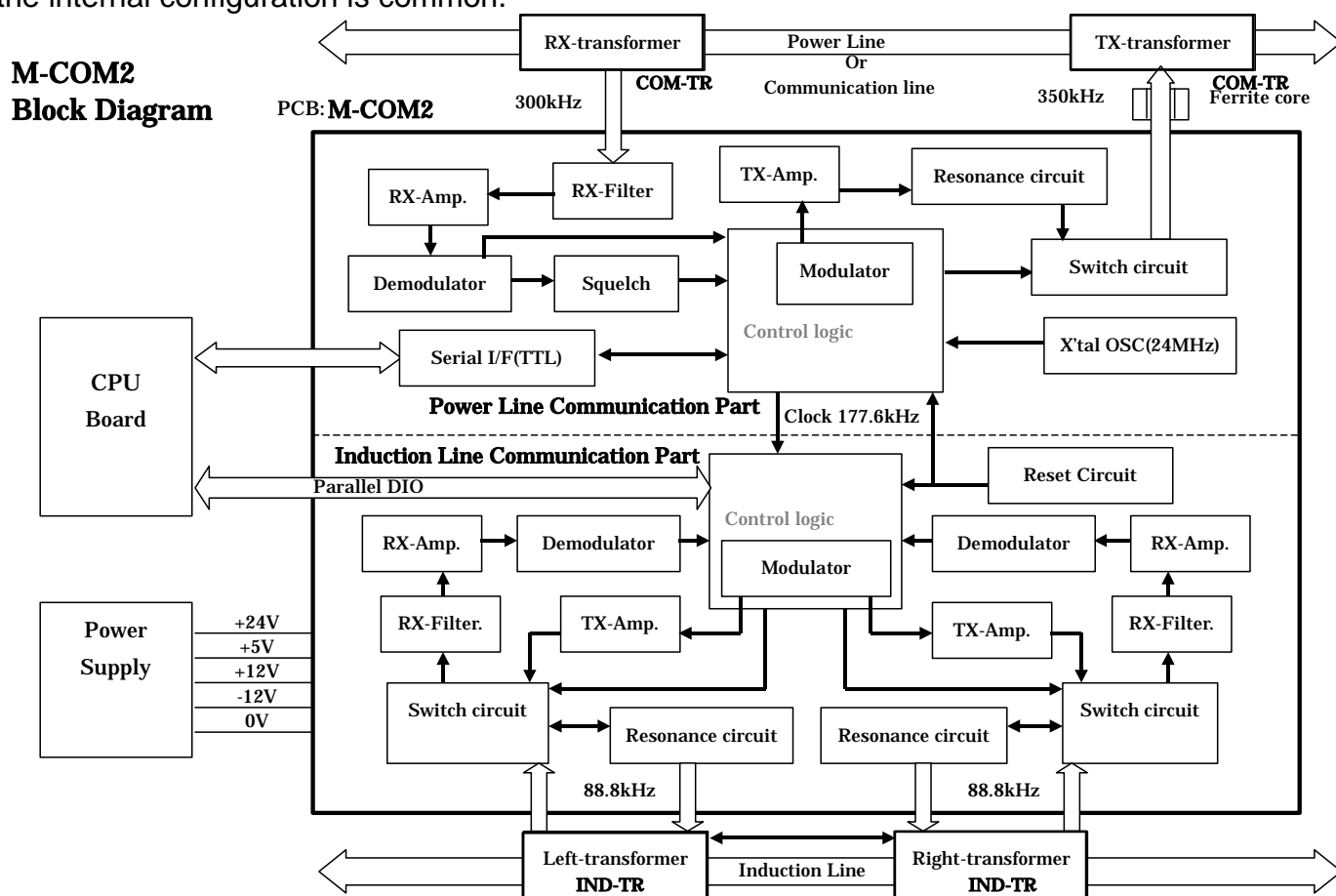
The transmission transformer overlays the signals from the controller onto the induction line.

The reception transformer receives the signals from vehicles overlaid in the induction line. It can be changed if one transformer is used for the reception or it is used for the transmission.

A left-right IND-TR is combined with the loop line, and it can watch each other's transmitting signal. Then, a trouble such as the breakage of the transformer can be diagnosed.

**Fig. 6** shows the outer forms of the transformers.

\*The IND-TR may vary in its outward form depending on the transport system. However, the internal configuration is common.



**Fig. 3** The block diagram of MCOM

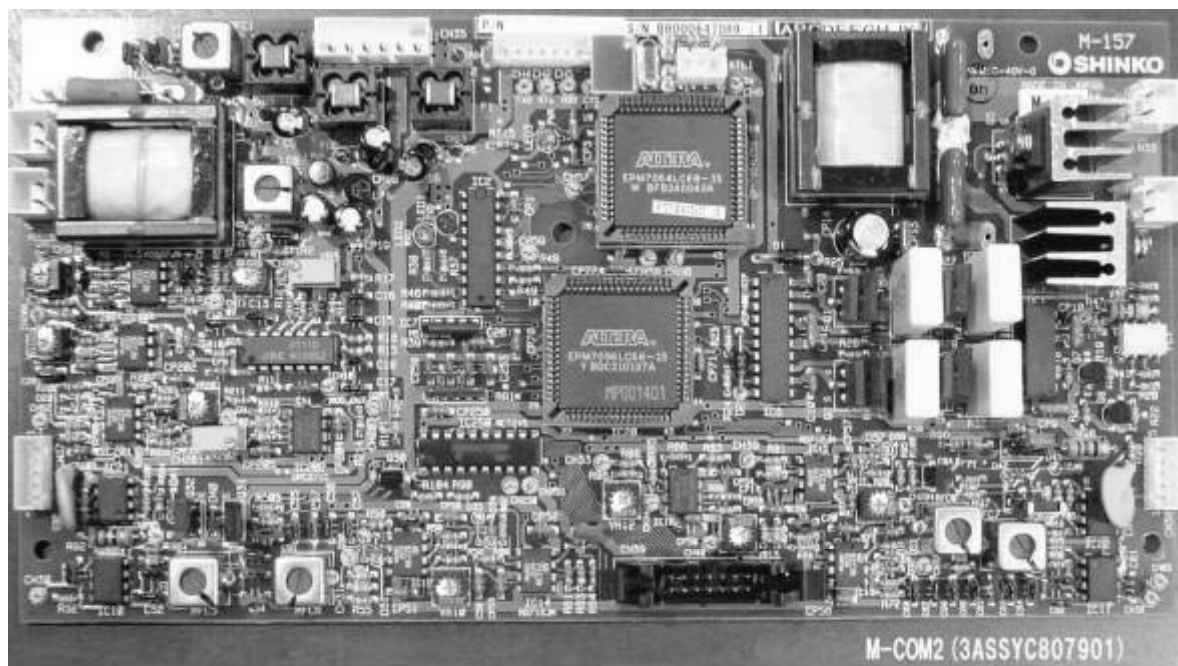


Fig. 4 Outward form of the MCOM's main printed circuit board M-COM2

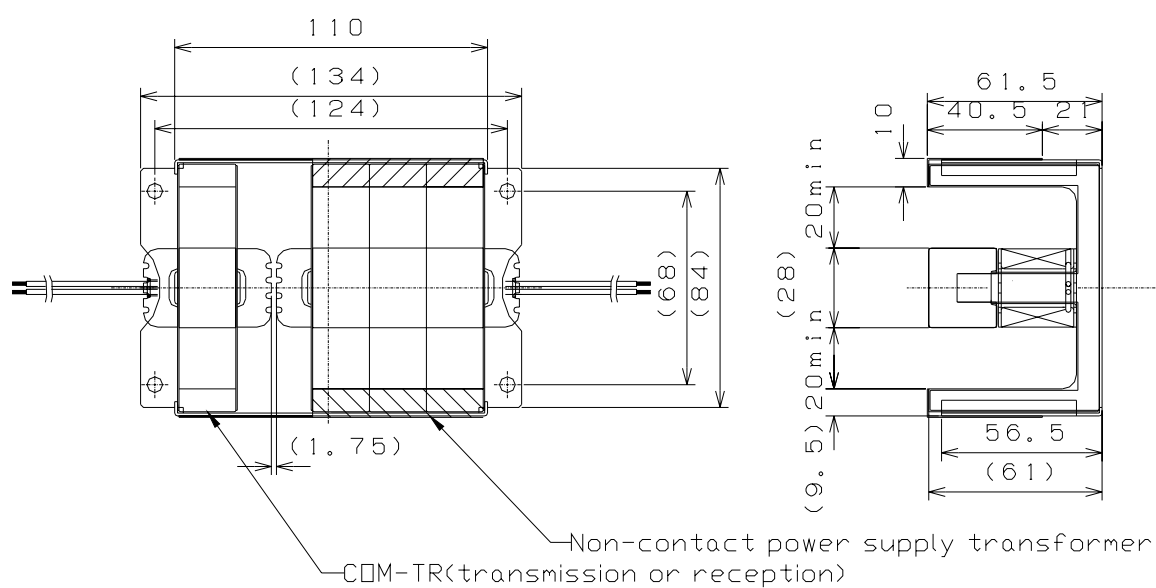


Fig. 5 For example the outline form of the transformer COM-TR

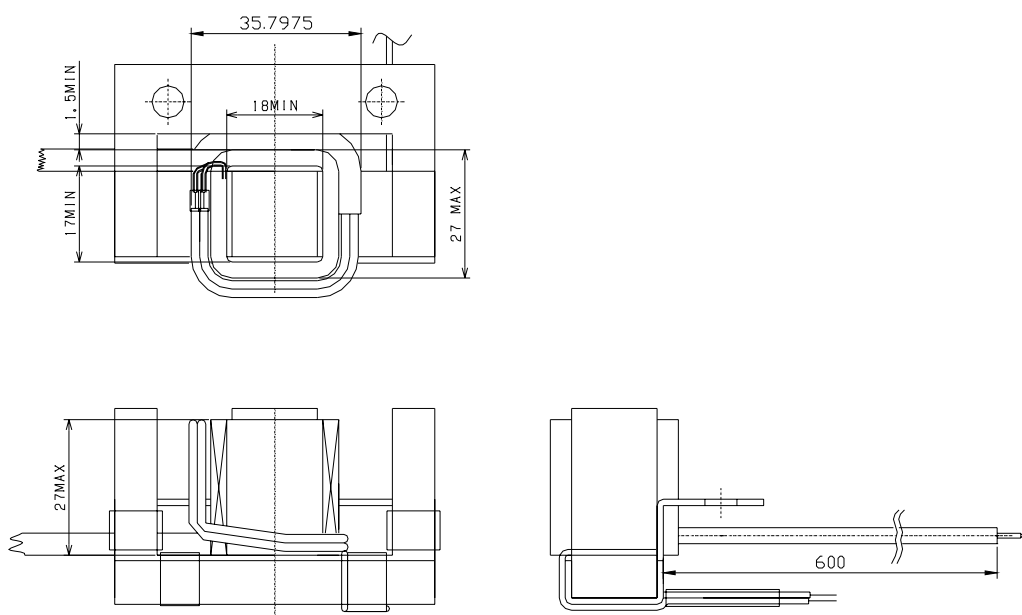


Fig. 6 The outer forms of the transformer IND-TR

### 3.4. FCC standard

The transmission assembly in the communication unit MCOM meets FCC Part15 Subpart C as the intentional radiator.

FCC ID of MCOM: RVEVEHICLEMCOM

[Note.1]

The FCC certificate position may vary because different case materials and shapes are adopted for different customers.

This device complies with part 15 of the FCC Rules.

Operation is subject to the following two conditions;

- (1) this device may not cause interference, and
- (2) this device must accept any interference received, including interference that may cause undesired operation of the device.

## NOTICE

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

## FCC WARNING

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

### 3.5. Control/modulating of communication

#### 3.5.1. Power line communication

Control/modulating of communication use the connector CN30.

A communication-timing chart is shown in the Fig. 7.

Please control signal according to the communication chart shown in Fig. 7.

In addition, all the signals are TTL-Level.

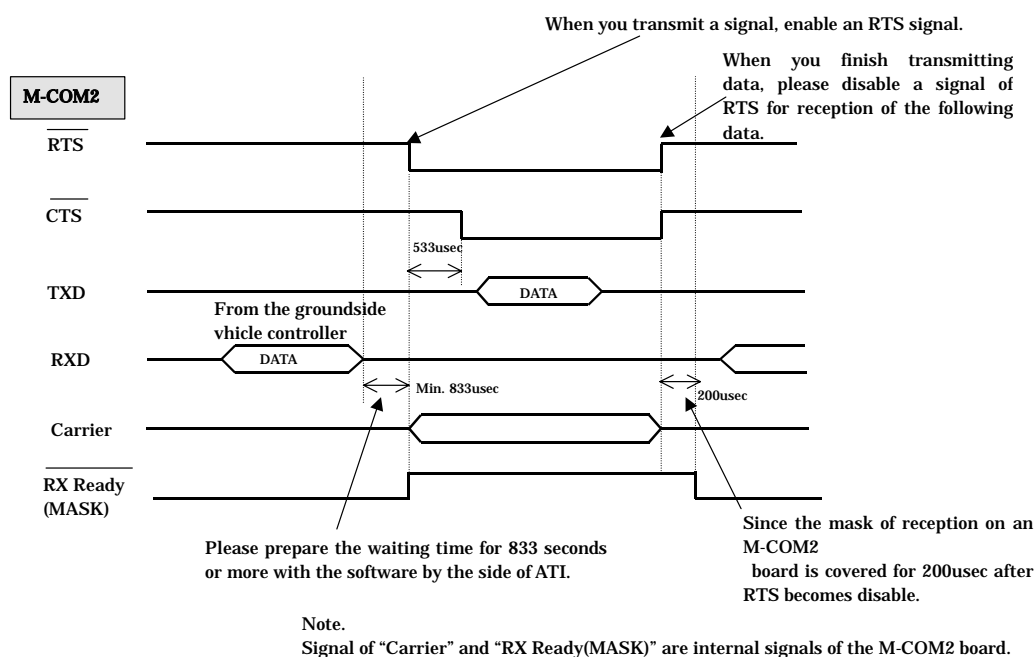


Fig. 7 Power net line communication-timing chart of MCOM



- 1) The 533usec delay circuit is the circuit to guarantee, from the time that a request-to-send signal (RTS) outputted from the controller is generated, to the time that a transmitting circuit attains to the rated value. Time is up in 533usec after RTS was set to ON, and a clear-to-send signal (CTS) returns to controller.
- 2) The 200-  $\mu$  sec Delay circuit masks transmitted signal during the time from the end of the request-to-send (RTS) till the lapse of transmitted signal against received signal, as the enabled transmitted signal may affect receiving circuit, Resulting in erratic output. This delay circuit times out in 200  $\mu$  sec after the RTS is ended.
- 3) After receiving data from the groundside vehicle controller, please prepare the waiting time for 833 seconds or more with the software by the side of ATI. When fewer than this time, it is because a NBV-BC substrate cannot receive data.

### 3.5.2. Induction line communication

Control/modulating of communication use the connector CN39.

A communication-Logic table is shown in the Table. 2.

Please control signal according to the communication table shown in Table. 2.

In addition, all the signals are TTL-Level.

For example, when you want to transmit from a left IND-TR and to receive from a right IND-TR, please make a signal into

Table. 1

**Table. 1 Signal status (transmit: left IND-TR, receive: right IND-TR)**

CN39 pin	Signal name	Direction	signal
1	L	Input	L
2	R	Input	H
3	LON	Input	L
4	RON	Input	X

## 4. Specification

### 4.1. Input/Output

Input and output ,and pin assigns of M-COM2 board are shown in Table. 2.

**Table. 2 Input and output ,and pin assigns of M-COM2 board**

Pin Number	Signal name	Direction	Operation		I/F
			L	H	
CN35: DC power supply					
1	24V	Input			Analog
2	5V	Input			Analog
3	0V				
4	12V	Input			Analog
5	0V				
6	-12V	Input			Analog
CN30: Power line communication control/modulating signal					
1	0V				
2	CTS	Output	Clear to send		TTL
3	RXD	Output	0	1	TTL
4	0V				
5	RTS	Input	Request to send		TTL
6	TXD	Input	0	1	TTL
7	0V				
CN39: Induction line communication control/modulating signal					
1	L	Input	Left IND-TR transmission	Left IND-TR reception	TTL
2	R	Input	Right IND-TR transmission	Right IND-TR reception	TTL
3	LON	Input	Left transmission ON	Left transmission OFF	TTL
4	RON	Input	Right transmission ON	Right transmission OFF	TTL
5	0V				
6	0V				
7	QL *1	Output	Left State Light OFF	Right State Light ON	TTL
8	QR *1	Output	Right State Light OFF	Right State Light ON	TTL
9		N/A			
10	ERR	Output	Normal	Error	TTL
11	YOB1	Output	Left IND-TR un-detecting.	Left IND-TR detecting.	TTL
12	YOB2	Output	Right IND-TR un-detecting.	Right IND-TR detecting.	TTL
13	0V				
14	0V				

- \*1 QL and QR indicates the condition of the IND-TR of the left and the right.  
 Always H : detection  
 Repetition H and L : transmitting  
 Always L : (Transmitting mode) transmission off, (Receiving mode) non-detection.

Pin Number	Signal name	Direction	Operation		I/F
			L	H	
CN31: Connect to COM-TR (Reception)					
1	RX1-1	Input			Analog
2	RX1-2	Input			Analog
CN32: Connect to COM-TR (Reception)					
1	RX2-1	Input			Analog
2	RX2-2	Input			Analog
CN33: Connect to COM-TR (Transmission)					
1	TX1-1	Output			Analog
2	TX1-2	Output			Analog
CN34: Connect to COM-TR (Transmission)					
1	TX2-1	Output			Analog
2	TX2-2	Output			Analog
CN37: Connect to left IND-TR					
1	Signal 1-1	Input/Output			Analog
2	Signal 1-2	Input/Output			Analog
3	0V				
4		N/A			
5		N/A			
CN38: Connect to Right IND-TR					
1	Signal 1-1	Input/Output			Analog
2	Signal 1-2	Input/Output			Analog
3	0V				
4		N/A			
5		N/A			
CN1: Connect to other M-COM2 board					
1	24MHz	Input/Output			TTL
2	0V				
3	0V				

## 4.2. Specification

Power line communication speed: 19.2 kbps ( MAX 38.4 kbps )

Power line communication method: 2 levels FSK

Induction line communication method: On/Off keying

### 4.2.1.M-COM2

Name	Printed circuit board:M-COM2		
Manufacturer	ASYST SHINKO, INC.		
Model number	3ASSYC807901		
Weight	Approx. 0.5 kgf		
Size	125 (W) x 240mm (L) x 30mm (H)		
Input Voltage	DC power supply 24V, 5V, 12V, -12V		
Power consumption	27W	DC24V	22.5W
		DC5V	2W
		DC12V	1.5W
		DC-12V	1W

### 4.2.2.CMC-TR

Unit name	COM-TR
Manufacturer	ASYST SHINKO, INC.
Model number	3CL520A011500-01(Transmission) 3CL520A011500-02(Reception)
Weight	Approx.1.6kgf *Case materials, shape and power supply transformer vary with the system.
Size	90mm (W) x 134 mm (L) x 61 mm (H) *Case materials, shape and power supply transformer vary with the system.
Power consumption	MAX 1W *When communication signal transmitted through the non-contact power line.

### 4.2.3.IND-TR

Unit name	IND-TR
Manufacturer	ASYST SHINKO, INC.
Model number	3CL520A011400
Weight	Approx.0.3kgf *Case materials and shape vary with the system.
Size	67.5mm (W) x 50mm (L) x 43mm (H) *Case materials and shape vary with the system.
Power consumption	MAX 1W *When communication signal transmitted through the induction line.

## 5. Error process

[Note.1]

Before servicing MCOM , always shut off the power supply.

[Note.2]

If the communication signals are overlaid onto the non-conductive power line, also shut off the power source of the non-conductive power line before starting maintenance on MCOM.

### <Power net line Communication error trouble shooting>

Communication error

- Is the Controller sending communication signals ?
  - Check the settings for the Controller.
- Are the power indicator lights of M-COM2 illuminated ?
  - Is the power supply of DC24V,5V and  $\pm 12V$  connected ?
    - Turn the power supply OFF. Is the input resistance of the DC power almost 0 ohm ?
      - Replace the DC power supply.
- Is the connection between the controller and M-COM2 normal ?
  - Restore connection.
- Is the connection between the COM-TR and M-COM2 normal ?
  - Restore connection.
- Is the noise of a power net line normal ?
  - The noise of a power net line is reduced.

### <Induction line Communication error trouble shooting>

Communication error

- Is the Controller sending communication signals ?
  - Check the settings for the Controller.
- Are the power indicator lights of M-COM2 illuminated ?
  - Is the power supply of DC24V,5V and  $\pm 12V$  connected ?
    - Turn the power supply OFF. Is the input resistance of the DC power almost 0 ohm ?
      - Replace the DC power supply.
- Is the connection between the controller and M-COM2 normal ?
  - Restore connection.
- Is the connection between the IND-TR and M-COM2 normal ?
  - Restore connection.
- Isn't the source of a noise that emits 100kHz near IND-TR?
  - Remove the source of a noise.
- Doesn't it disconnect a induction line?
  - Restore disconnection of a guidance line.

## 6. Cautions on Use

- (1) If the noise of a power net line is large, since communication quality will deteriorate, please reduce a noise.
- (2) When the noise generation source near 100kHz is in near, in order that induction line communication may cause incorrect detection, please remove a noise generation source.
- (3) Don't arrange a choke coil and a power system switching circuit near the IND-TR.
- (4) Since the pulse signal of a self-vehicle and other vehicles may synchronize, please be sure to perform a pulse output timing change to different timing for every cart during transmission from the exterior in induction line communication..
- (5) If the communication signals are overlaid onto the non-conductive power line, also shut off the power source of the non-conductive power line before starting maintenance on MCOM.