APPLICATION SPECIFIC
DUPLEX TRANSCEIVER
FRS 610D-id

NEW

- DATA transmission over UHF-FM radio channel
- Embedded FFSK modem 1200/2400b/s
- Extremely short transmitter attack time
- Very high stability frequency synthesizers
- Double serial communication interface
- Remote controll. of the transmission parameters
- Service voice channel (Handset with PTT key)

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DESIGNATION AND DESCRIPTION

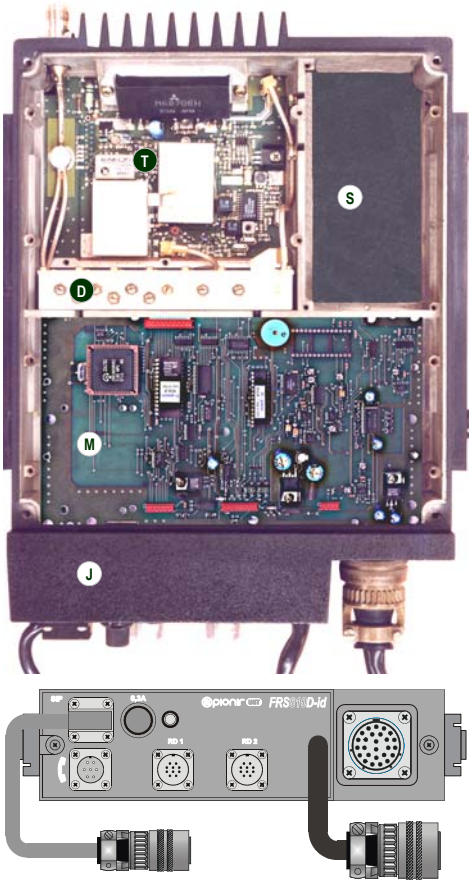
Transceiver is intended to fulfil specific tasks within system for of identification of vehicles, apartainig to the fleet of Urban Public Passenger Traffic (busses, trolleybus, trams). For this reason a powerfull built-in microcomputer substitutes the standard µC control unit.

Data represents basic type of transmission, while a voice channel is provided for service personel. High sensitivity receiver and built-in FFSK synchronous duplex modem grant a reliable data communication link. Transmitter's output power, rated 20W, may be set manually to 2÷20W and submitted to AGC; alternativelly, RF power control may be tied to RSSI in order to reduce the RF spectrum congestion.

Transceiver (T) with duplexer (D) occupies the same compartment. A 4-layer PCB and succesful overall RF design resulted in a stable duplex transciever and an extremly short attack time of transmitter (0,25ms). Free compartment (S) allows for additional funcionalities.

Microcomputer (M) performs the following tasks:

- Controles frequency syntesizers of both transmitter and receiver;
- Receives and logs Data from 2 Roadside µW readers, adding exact time and direction of arrival;
- Organizes received Data for transmitting when polled by Central Computer via Base Station;
- Allows for re-programming working parameters of transceiver, via one of two RS232 interfaces;
- Senses an attacked handset and switches transceiver to voice channel. Junction Box (J) enables wiring of connected Readers and an external power supply (13,5V DC, negative ground) to the transceiver's waterproof box;
- Senses status of opereting parameters, vital for radio link: incident and reflected RF power, receiving signal streinght, supply voltage, kind of currently used power supply (mains/battery), supply status of connected Readers'. Those Data are transmitted to Central Computer periodicaly or on its special requirement



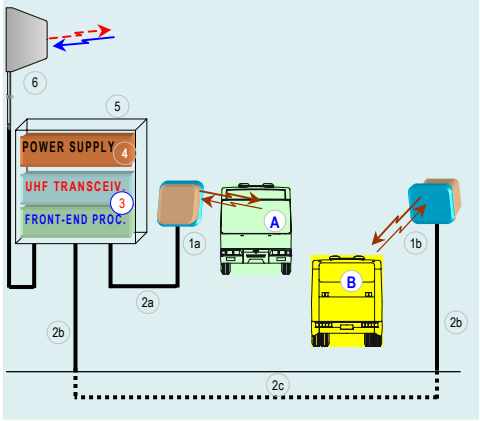
Transceiver FRS-610D-id

Transceiver *FRS-610D-id* is designed by using well-proven radio circuitry from *MRS-610D*, used in *ASU-2000 Total Fleet Management System*.

Microcomputer it-self is of the same origin - coming from *MORAT-680*, the control and Indication Unit of the on-board ASU-2000 equipment (BRK-610). Redesign is mostly referred to additional capacity of the EEPROM.

Equipment is designed to be remotelly controlled and monitored.

Microcomputer unit within the *FRS-610D-id* receives data from two 'Readers' - µW transceivers, receiving ID number from RFID tag, mounted on vehicle. The process used for RF IDentification is known as "Backscatter modulation": Reader, a low power transceiver (50...200mW) permanently irradiates non-modulated carrier wave. EM energy is reflecting from all conducting object and a part is reaching the Reader's antenna in form of an ASK modulated wave. This waveform is created by variable reflection from Tag. The RF Tag, being a patch antenna, is provided by a built-in flash memory, supplied by small lithium battery. Received RF energy activates Tag's electronics, which in turn provokes a mismatching of antenna in the rhythm of stored data clock. Receiving part of the Reader detects variations of the signal strength (as an AMSK signal) and decodes data i.e. the on-Tag encoded vehicle ID number.



Vehicle identifying site - Equipment configuration

Described RFID system is in use for Electronic Toll Ticketing on motorway and for Access Control with bare. In such cases each Reader is interfaced, in real time, to PC.

In a case with as many as 40 RFID checking locations, each with two Readers and distributed over a large area, short in communication infrastructure, PMR links are promising. Connection of two Readers to one PMR FM transceiver is should be provided by an application specific interface, performing all other above-mentioned functions.

On the picture (left) is sketched an equipment configuration for a typical vehicle identifying site (location), with separate Reader for each traffic direction.

Legend:
1a &1b- Readers (Communicators, µW Transceivers), one for each traffic direction; 2a...2c- Cables, connecting both Readers to 3- UHF-FM Two-way radio (Transceiver & Front-End Processing Unit - Microcomputer) and 4- Power Supply; 5- Common Enclosure; 6- Directional Antenna (Yagi); **A** & **B** - arriving and departing vehicle.

Received data from Readers are transmitted to the Control Center using well-proven communication protocol, enabling error detection and error correction.

TECHNICAL SPECIFICATIONS

1 - FUNCTIONAL

- Operating mode ..... Half-duplex, Duplex
- Number of selectable channels 10
- Type of transmission ..... DATA or Voice (serv. channel)
- Controlling t) *RS-232*
- Serial comm. interface 2x *RS-232*

Commands
- Power ON ..... direct
- Channel selection t) *RS-232*
- DATA rate selection t) *RS-232*
- Output power selection t) *RS-232*
- Service channel (voice) ... automatic (Handset connected)

Indications
- Power ON ..... LED
- Working channel t) *RS-232*
- Connected periferal devices t) *RS-232*
- DATA rate t) *RS-232*
- Output power (directional) t) *RS-232*
- Reflected power t) *RS-232*
- RSSI t) *RS-232*

Connectors
- Antenna ..... TNC (female)
- Serial interface ..... 2x10-cont. (male), PC10Г-ТВ
- Handset ..... 7-cont. (female), PCГ-ТВ
- Power supply ..... 6-cont. (female), bayonet

t) - WITH CONNECTED PC

2 - ELECTRICAL

General
- Frequency range (MHz) ..... 300÷350
- Duplex separation (MHz) 36
- System channel spacing (kHz) 25
- Syntesizer step (kHz) 12,5
- Type of modulation ..... FM
- Output impedance (Ω) 50
- Operating temperature range (°C) ..... -25…+55
- Frequency stability; over temp. range (10^{-6}) ..... ± 2,5

Transmitter
- Switchable bandwidth (MHz) 10
- Output RF power (W):
  - nominal 20
  - reduced 10
- Class of emission ..... 16K2C2D and 16KOF3E
- Maximum SWR (1:) 2,5
- Attack time (ms) ..... < 0,3
- Spurious emission (μW) ..... ≤ 2,5
- Adjacent channel emission (μW) ..... ≤ 2,5
- Residual AM (%) ..... ≤ 3
- Residual FM (dB_{NOM}) ..... ≤ -40
- Transmitter bandwidth (kHz) at level:
  - -30 dBc ..... ≤ 16
  - -60 dBc ..... ≤ 32

Voice transmission (service channel)
- Maximum deviation (kHz) ..... ±5
- Nominal deviation (kHz) ..... ±3

- Microphone input sensitivity (mV) 5
- Total harmonic distortion (%) ..... ≤ 5
- AF bandwith (kHz) ..... 0,3…3
- AF response resp. +6 dB /oct ..... < +1,5/-3

DATA transmission
- Frequency deviation (κHz) at modulation:
  - FFSK 1200 b/s ..... ±4,0
  - FFSK 2400 b/s ..... ±3,0

Receiver
- Switchable bandwidth (MHz) 10
- Type ..... double heterodyne
- Bandwidth $_{-6dB}$ ..... ≥ 16
- Reflection attenuation (dB) ..... ≥ 14
- Adjacent channel selectivity (dB) ..... ≥ 75
- Intermodulation rejection IM_3/2sg. (dB) ..... ≥ 70
- Spurious response rejection (dB) ..... ≥ 80
- Co-channel selectivity (dB) ..... ≥ -8
- Desensitization by Tx ON (dB) ..... ≤ 0,5
- LO emission (nW) ..... ≤ 2
- Supply lines EMI rejection (dB). ..... ≥ 80
- Hum & noise level (dB) ..... ≤ - 50

Voice reception (service channel)
- Sensitivity for 12dB SINAD (μV/50 Ω) ..... ≤ 0,40
- Squelch:
  - activating level (μV) ..... ≤0,25
  - hysteresis (dB) ..... 2...2,5
- AF bandwith (kHz) ..... 0,3…3
- AF response resp. -6 dB /okt ..... < +1,5/-3
- Total harmonic distortion (%) ..... ≤ 5

DATA reception
- Sensitivity for BER = 10^{-3} (μV/50Ω)
  - FFSK 1200 b/s (at ±4,0 kHz) ..... ≤ 0,40
  - FFSK 2400 b/s (at ±3,0kHz) ..... ≤ 0,60

Handset (with PTT key)
- Impedance - mike and earphone (Ω) 40
- Earphone level (mV) 0,06-0,16

Power supply
- Supply voltage (V) ..... +10,8....15
- Currtent drain (A):
  - Transmission (20W) ..... ≤ 5,0
  - Reception/Stand-by ..... ≤ 0,4

3 - Dimensions & weight
- Dimensions (mm):
  - Width 212
  - Height 55
  - Length (without connect. cables) 310
- Weight (kg) 3,0

- May be changed without notice -

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