MULTIPLEX Pico line

Transmitter for radio control of models

Technical description of basic transmitter including RF section

Manufacturer: MULTIPLEX Modelltechnik GmbH
Neuer Weg 2
D-75223 Niefern-Oeschelbronn
Germany

Type designation:	MULTIPLEX Pico-line
Mode of operation:	Simplex
Operating voltage:	7.2 Volts +/- 10%, 600 mAh Ni/Cd battery
No. of control functions:	7
Aerial:	Screw-fitting telescopic aerial, length approx. 100 cm

Description of operation of signal section:

The central control unit of the main circuit board of the Pico-line radio control transmitter consists of the Z86E08 micro-controller manufactured by ZILOG, marked IC3 on the circuit diagram. The micro-controller contains a ROM (Read Only Memory) in which the program data is permanently stored. The micro-controller also possesses RAM (Random Access Memory). A ceramic resonator stabilises the frequency of the controller's signal oscillator; the frequency of the resonator is 12 MHz.

IC5 is a serial programmable EEPROM which is used to store transmitter-specific tuning data and stick unit set-up values.

Transistor T6 and its associated circuitry produce a stabilised voltage of 5 Volts. This voltage serves as reference voltage for the A/D conversion process and is also the power supply voltage for the transmitter controls. This voltage is also the supply voltage to the transmitter RF section's crystal oscillator.

The transmitter is operated by means of the integral stick units. One auxiliary slider control, two potentiometers and two switches can be retro-fitted to form additional controls. The analogue values from the transmitter controls are passed via the 4052 multiplexer IC1 to the analogue inputs AN1 and AN2 of the micro-controller IC3. The transistor T5 and its associated circuitry serves as constant current source for the A/D conversion process. The switched states of the toggle switches and of the DIL switch for mode selection are read in digitally via the port inputs P2.1 to P2.6

An application-specific LCD screen acts as display for battery state and transmitter functions. An audible warning is also fitted which warns of low battery voltage.

Socket D1 is the charge socket for the integral Ni/Cd battery, and it can also accept a teacher-pupil cable. Plugging in the teacher-pupil cable switches the RF section out of circuit, so that the pupil transmitter does not broadcast an RF signal. The Pico-line transmitter can only be used as a pupil transmitter. A suitably equipped MULTIPLEX transmitter is required for the teacher (trainer) function, e.g. a Profi 3000.

Specification of transmitter RF section

Frequency:	72 MHz Band	72.010 MHz to 72.990 MHz 50 Channels from Channel 11 to Channel 60
Modulation:		FM-PPM F3D
Frequency deviation:		1.5 kHz
Channel spacing:		10 kHz
Frequency tolerance:		+/- 0.5 kHz
Operating voltage:		7.2 Volts +/- 10%
Temperature range:		- 15 to + 55°C

Technical description, transmitter RF section:

The RF section of the „MULTIPLEX Pico-line" transmitters, designed for the radio control of models, consists of a four-stage crystal-controlled transmitter. The stabilised voltage which powers the oscillator stage is produced by a stabiliser circuit consisting of the transistor T9 and the Zener diode D8.

The oscillator operates on frequency trebling. Frequency modulation is achieved by the capacitance diode D3 (BB209). The trimmer C12 compensates for tolerances in the capacitance diode. The limit frequencies for frequency modulation are adjusted by means of the potentiometer P1 and the trimmer C12. The RC low-pass circuit consisting of R1, C19, R2, C3, R3, C20 re-shapes the pulsed modulation signal in order to achieve the required values for adjacent channel suppression.

The crystal Q1 is excited in parallel resonance. The operating point of the oscillator transistor T3 (BF599) is optimised for maximum frequency stability and trebler efficiency. The oscillator circuit F13/C14 is tuned to treble the crystal frequency; the high frequency signal is passed to the base of the predriver transistor T12 (BF 599) via an inductive coupler. The driver stage T2 is coupled via the capacitor C49. In the collector circuit of this stage the high-frequency signal is inductively decoupled and passed to the base of the output stage transistor T1 (BFQ195) via the base resistor R8. The voltage to the output stage transistor is supplied via a collector choke which is in circuit with the attenuating resistor R9 to avoid parasitic oscillations.

The following Pi filter adjusts the output resistance of the output stage to match the base point resistance of the rod aerial.

Description of the modulation signal:
The information from one control function is contained in the width of the pulse between two sequential signals. The pulse width varies within the range 1.05 to 2.15 milliseconds, and the length of the signal itself is 0.350 ms. Eight pulses are required for the transmission of seven control functions. A minimum time of 3.5 ms is required as a synchronisation break. The entire packet is always
25 milliseconds long, regardless of the pulse width of the transmitted signals.