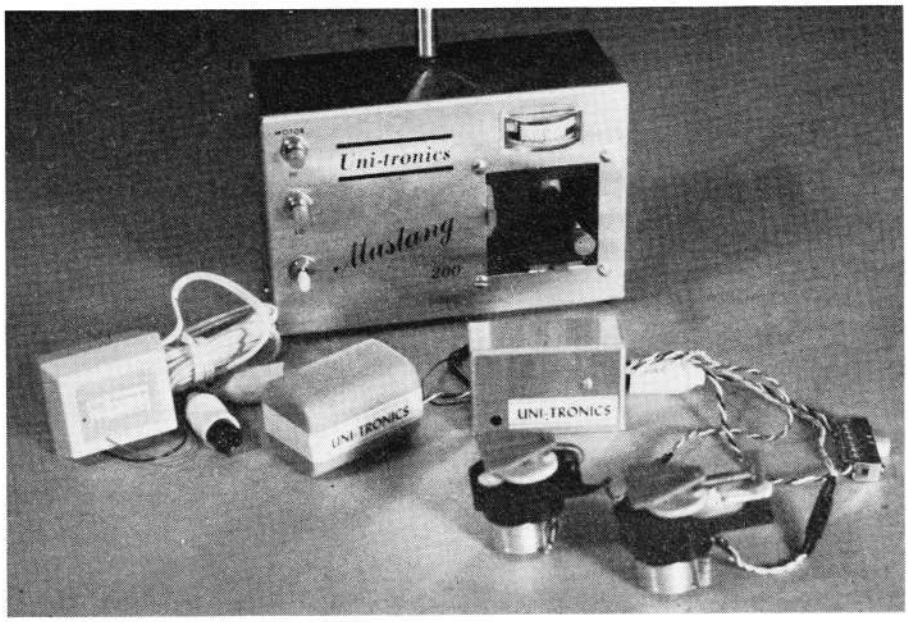


A Shop & Field Product Report

UNI-TRONICS MUSTANG 200

NEWEST ENTRY IN THE PULSE PROPORTIONAL FIELD

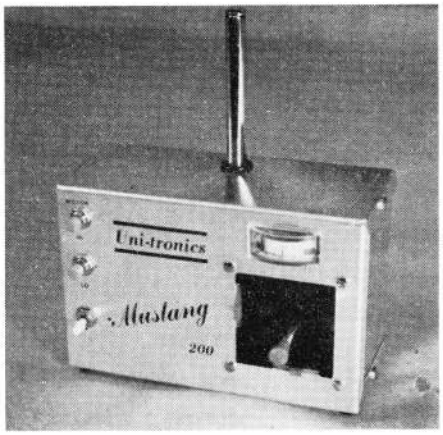
THE Unitronics Mustang 200 is the newest pulse proportional system to enter the R/C market. Extensive lab as well as field tests have been made on this unit, and the results are as follows:

Transmitter, Unitronics Mustang 200.

The Mustang 200 transmitter is a pulse rate, pulse width single channel proportional transmitter with a solid state all transistorized circuit. R.F. transmission is designed for the 27 MHZ band. The carrier is modulated with an 85% to 95% 700 cycle tone. A pulse rate of 4 to 12 pulses per second and 6 P.P.S. neutral and a pulse width change of 70% to 30% with a 50% to 50% neutral. The 2 servo model pulse rate 12-14 neutral.

Battery Requirements:

A 9-volt Burgess #D6 or Eveready #276 battery is required to make the transmitter operate properly. Total current drain of the transmitter is under 40 milliamps. The battery should be replaced when voltage drops below 8 volts. As the battery voltage decreases below 8 volts, range will decrease in proportion to the voltage drop.



Tuning:

The Mustang 200 is tuned and adjusted at the factory and should not require any additional tuning. Only qualified personnel with an F.C.C. license can tune the transmitter.

Antenna:

When range checking or preparing for flight, be sure to extend the antenna to its full length. While flying, **never** point the antenna directly at the model. Always keep the antenna orientated 90 degrees from the model to transmit maximum power to the receiver.

Stick Assembly:

Right and left motion of the stick assembly controls the pulse width (rudder) and up and down motion controls pulse rate (elevator). Rudder and elevator trims are located on the outer edges of the stick assembly. The lever on the left of the stick, controls elevator trim and the lever located at the bottom of the stick assembly, controls rudder trim.

Hi-Lo Buttons:

The push button switches on the upper left of the transmitter, controls the engine speed. When hi button is depressed, a full on tone is transmitted to the receiver to operate the engine throttle to high speed. When lo button is depressed tone is turned off allowing engine throttle to go to low speed or idle position. Intermediate positions are determined by the type of actuator used in the model.

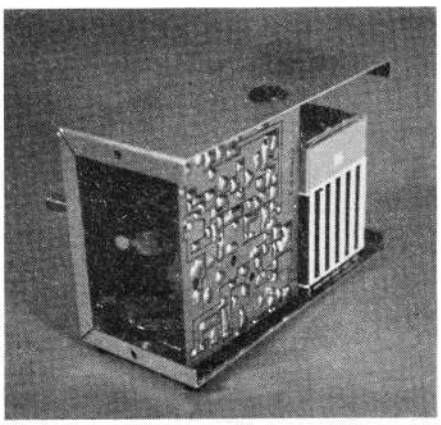
R.F. Meter:

The meter indicates the R.F. output in the antenna circuit as well as showing if the transmitter is pulsing. When depressing lo motor button a rise in output will be noted. This indicates that there is no tone signal modulating the carrier. When hi motor button is depressed a decrease in the meter is noted. This indicates that a full tone is modulating the carrier. The meter does **not** read battery voltage. Its primary use is to show if the transmitter is operating properly.

TEST SAMPLE

DESCRIPTION: Hand Held Radio Control Transmitter
MFGR: Unitronics
TYPE: 200
FREQUENCY: 27 MHz citizens band xtal controlled
MODULATION: A. M. Pulsed Tone
FCC CLASS: C
POWER SOURCE: 9V Dry Cell
ANTENNA: Multi-Section Telescoping 53" Max.
R.F. POWER INPUT: 112 Milliwatts — Nominal at 9V
MOD PULSE: Variable in Width and Rate
MODE TONE: Keyed, Approx. 900 Hz

1. **Foreward**
   a. The test sample was subjected to the tests described herein and measurements taken during the test period.
2. **Conclusions**
   a. The test sample successfully met the requirements outlined throughout the test period.
3. **Test Results**
   a. **Frequency vs. Temperature:** The unit was subjected to tests outlined in Figures 1 and 2 and the frequency measured during the test period. The maximum devia-



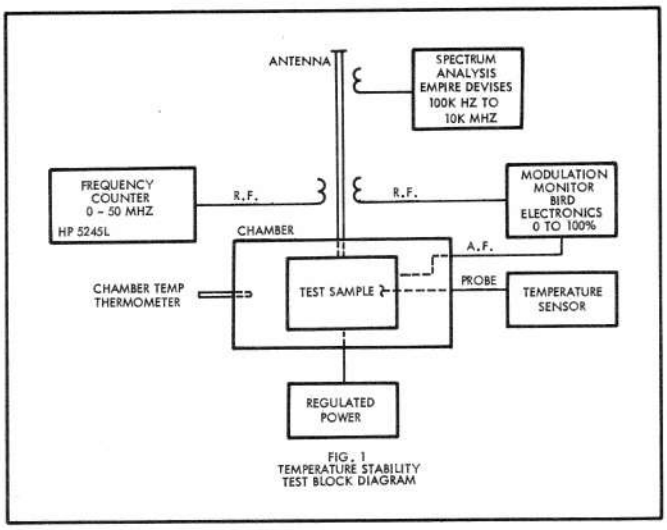


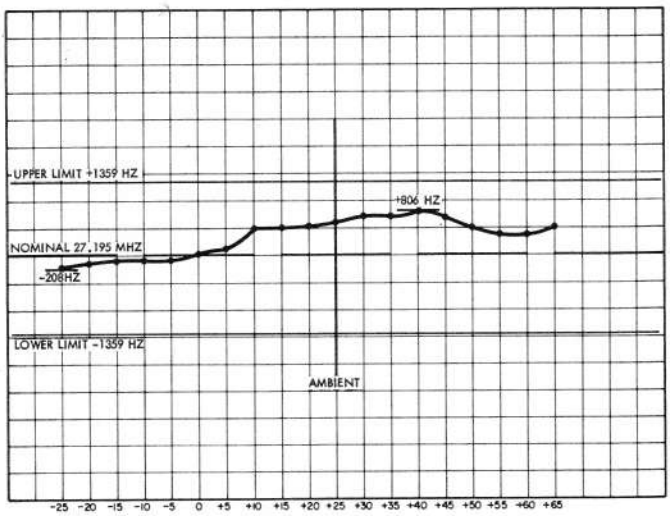
FIG. 1
TEMPERATURE STABILITY
TEST BLOCK DIAGRAM

DATA LOG SHEET — TEMPERATURE:

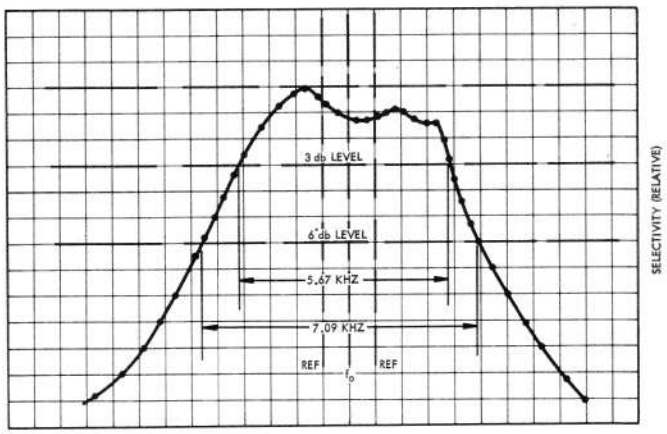
Date	Time	Temp °C	Freq. MH	Deviat. H	Mod. %	
5-12-67	1900	+25° C	27.195682	+682	87	
"	2000	+31° C	27.195781	+781	87	
"	2100	+35° C	27.195782	+782	87	
"	2200	+40° C	27.195806	+806	87	
"	2300	+45° C	27.195698	+698	88	
"	2400	+50° C	27.195499	+499	88	
"	0100	+55° C	27.195411	+411	89	
"	0200	+60° C	27.195420	+420	90	
"	0300	+65° C	27.195458	+458	90	
"	0600	+65° C	27.195509	+509	91	Stabilized
Return to Ambient						
5-13-67	1300	+25° C	27.195676	+676	87	
"	1400	+20° C	27.195581	+581	87	
"	1500	+15° C	27.195522	+522	86	
"	1600	+10° C	27.195490	+490	86	
"	1700	+ 5° C	27.195117	+117	84	*Note 1
"	1800	0° C	27.195027	+ 27	84	
"	1900	− 5° C	27.194906	− 94	80	
"	2000	−10° C	27.194892	−108	80	
"	2100	−15° C	27.194894	−106	71	
"	2200	−20° C	27.194842	−158	67	
"	2300	−25° C	27.194803	−197	65	
5-14-67	0200	−25° C	27.194792	−208	60	Stabilized
Return to Ambient						

NOTE 1: Oscillator required adjustment to sustain oscillations. System had previously been de-tuned.
NOTE 2: Measurements made with varying input voltage. Max. dev. noted 27 Hz.

FIG. 2



FREQUENCY DEVIATION CHART 3A



tions noted on log sheets indicated a total frequency spread of 1014 Hz. whereas allowable tolerance of +.005% of the specified crystal frequency of 27.195000 MHz permits 1359 Hz. Chart 3A reflects the frequency deviation.

b. **Frequency vs. Supply Voltage:** The unit was subjected to test conditions of varying supply voltage from specified limits of 8.5 VDC to 10.5 VDC during which time the fundamental output frequency was monitored.
The maximum deviation noted throughout the range was 27 Hz and within the limits specified in 3.a above.

c. **Amplitude Modulation Percentage:** The unit was subjected to test conditions outlined in Figure 1 and 2 and modulation monitored during the test cycle. Maximum modulation percentage encountered during this test was 91% relative and well within limits. Chart 3.c reflects the modulation readings.

d. **Frequency Modulation:** The unit was monitored while being subjected to test shown in Figures 1 and 2 and the F.M. component was below the 50 cps capability of the test instrument and well within the limits specified in 3.a above.

e. **Power Input:** The unit was monitored while being subjected to the test shown in Figures 1 and 2 and the power input to the final R.F. stage monitored as voltage and current. The maximum D.C. input power at maximum D.C. input voltage indicated 123 milliwatts and well within the 5 watt limits.

f. **Harmonic Radiation:** The unit was subjected to test throughout the frequency range of 100 KHz to 10 KMHz and found to be below 60 db in all harmonic and spurious radiations.

g. **Operational Mode:** The frequency determining network consisting of the crystal and related oscillator circuit was found to be functional only on the fundamental operational mode.

Receiver, Uni-Tronics SHG-200:

The SHG-200 superhet is a digital pulse width, pulse rate, single channel proportional receiver with a solid state all transistor circuit. The receiver is selective and has a high signal gain with full A.G.C. control. It was designed to fill a need in the single channel field where digital pulse and width are used to control a motor driven actuator, such as the Rand LR-3, HR-1, HR-2, Controlaire Gallophing Ghost actuator, Bellamatics, and other similar actuators.

Battery Requirements:

No additional battery pack is required for actuator operation. The actuator and receiver operate from the same 4.8 volt nicad battery pack. Models using .010 to .049 engines with small control surfaces can use a nicad battery pack of 4.8 volts @ 500 milliamps. For models with .09 and higher displacement engines, we recommend using 4.8 volts @ 600 milliamps. For engine sizes .35 and .40 and jr. pylon racing having larger control surfaces, we recommend using 4.8 volts @ 1.2 amp "C" size nicad battery pack. The reason for the above recommended battery sizes is that the motor driven actuator when it drives larger control surfaces with higher air loads, requires batteries with a greater current drain.

Receiver Output:

Switching transistors are used to drive the motor actuator eliminating the relay with all of its problems, like sticking

points, bounce, arcing, chattering and engine vibration. The SHG-200 uses dual transistor switches with 100% power cut off to the actuator motor. There is no feedback between the motor switching transistors, as commonly found in battery switchers, therefore, eliminating any current loss and any unnecessary drain on the battery supply, giving you 20% to 50% more flying time on the same nicad pack.

Actuator Noise:

The SHG-200 receiver is a well filtered unit, which will allow the flyer to use most any motor driven actuator. In some instances, however, an extremely noisy actuator motor will make it cycle through. The actuator motor can be filtered with a motor noise suppression kit.

Tuning and Antenna:

The SHG-200 receiver is tuned and adjusted at the factory. Only the antenna coil may need adjustment. After the receiver is installed in the plane, if ground range is adequate (1000 ft. or more), retuning is not necessary. Proper antenna length is 28 to 30 inches. If antenna length appears too long do not cut off, but let trail behind the model. When stringing antenna wire from receiver to rudder do not let wire rub or come near metal pushrods or any metal surfaces.

Control Hook-Up:

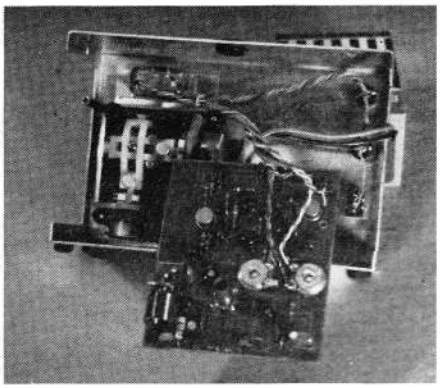
Use nylon horns on elevator and rudder, and a nylon quick link on engine throttle. Never metal to metal hook-up due to static interferences from metal surfaces.

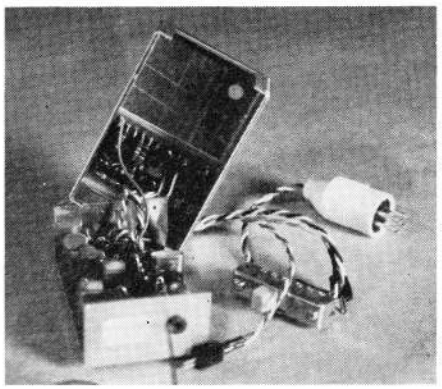
Wiring and Hook-Up:

Use a **good** D.P.S.T. toggle or slide switch. Keep wires twisted and short as possible. Excessive or sloppy wiring will sometimes induce unwanted signals. Hook up actuator wires directly to actuator. Do not go through connectors or plugs, because of high current flowing back and forth to actuator.

TEST SAMPLE

DESCRIPTION: Airborne Radio Control Receiver





Left: Transmitter with P.C. board and battery removed. Right: Miniature receiver showing decoder in case top.

MFGR: Unitronics

TYPE: Superhet

FREQ: 27 MHz Citizens Band xtal Controlled

POWER SOURCE: 2.4 to 3 VDC Battery 4.8

ANTENNA: Insulated Wire

OUTPUT: Relayless — Direct Servo Drive on-off

Foreward. The following general tests were conducted to determine the operational characteristics of the test sample under specific controlled conditions.

Test Results

A. **Frequency** — Frequency determined xtal, at a nominal 455 KHz below the operating frequency.
The xtal osc frequency measured for a desired frequency of 26.740 MHz or operating frequency of 27.195 MHz was 26,742,305 Hz. This resulted in a nominal intermediate frequency of 452.695 KHz. Since the difference in desired operating frequency and the actual operating frequency is 2.305 KHz the intermediate frequency may be shifted for the matching of a specific xmtr frequency.
Further, since the measured bandwidth is 5.67 KHz at the 3 dh points the operational frequency shift will permit satisfactory operation.

B. **Sensitivity** — The unit was tested for operation of circuit shown in Figure 1 for minimum level of input signal for reliable operation (19 out of 20 or better). The results indicated satisfactory operation throughout the range of 10 microvolts to 1.5 volts, while sustaining a 50% modulation level. This sensitivity decreased to 15 microvolts with 30% modulation. Increased modulation levels up to 100% did not appear to enhance the operation.

C. **Selectivity** — The selectivity curve shown in Figure 2 reflects the general characteristics of 5.67 KHz at 3 dh points and 7.09 KHz at 6 dh points.

D. **Adjacent Channel Interference** — The unit was tested at various levels of adjacent interference and maintained operation with ratios of 10 to 1. This would permit operation with this unit in areas with other units running 10 times more power.

E. **Image Rejection** — Image rejection tests indicated over 40 dh.

F. **Mechanical Stability** — The unit was subjected to operation while being vibrated from 40 Hz to 500 Hz at amplitudes up to 5 g's with satisfactory operation and no unwanted response.

G. **Spurious Radiation** — Spurious

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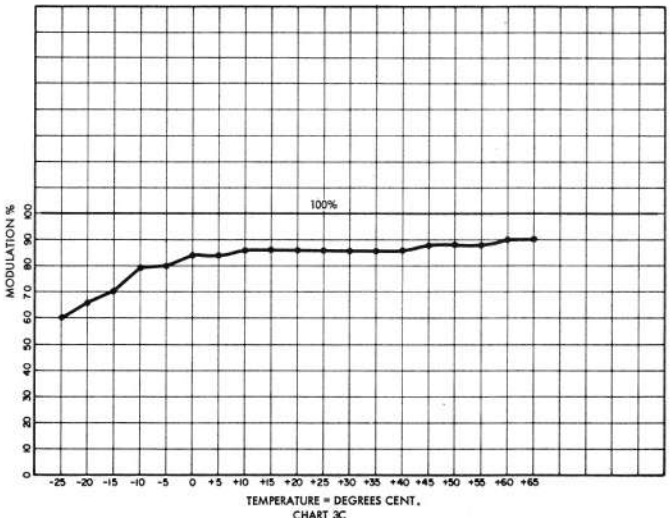

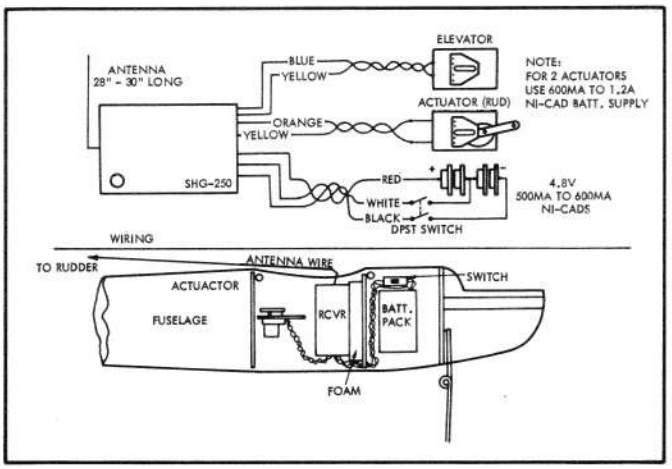

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Radiations throughout the frequency range of 100 KHz to 10 KMHz indicated radiations below ambient conditions and general relative of — 60 dh.

H. **AGC Range** — Operation maintained throughout the input range of 11 microvolts to 1.5 V.

I. **Battery Range** — Satisfactory operation was maintained from 1.8 VDC to 3.25 VDC both sides.

Flight Evaluation: Uni-Tronics Mustang 200:

The Uni-Tronics Mustang 200 was flown extensively in powered aircraft from .09 to .19 size utilizing all available control functions, i.e., rudder, elevator and throttle. In addition, a scale model Ercoupe was flown using this system on ailerons, elevator, and throttle. The Uni-Tronics was also tested in an 84" slope soaring glider to note the effect of excessively large control surfaces as well as the feasibility of such a system in this type of aircraft. In all cases, Rand actuators were utilized with the exception of one series of flights where modified (Dee Bee) Bellamatic servos were used.

In all flight tests, range, performance, and reliability were excellent. Where the normal rudder actuator was used to actuate the ailerons, performance was exceptional compared to the normal rudder operation of a pulse proportional system.

In excess of 150 flights were performed with no equipment malfunctions excepting the loosening of one actuator motor, caused by improper seating of the motor hold-down screws.

Some interesting features of the Unitronics Mustang system include a relayless superhet receiver which is fully filtered to eliminate actuator, or other unwanted noise; no overloading or "swamping" of receiver even when the antenna was wrapped around the transmitter antenna; full AGC control with an "extra range" circuit; no elevator cycling through with motor command and no noticeable interaction between rudder and elevator commands; no overheating in switcher section; up elevator uses **high rate** pulse, thus eliminating "galloping" in up control; reduced battery drain partially due to no current feedback in switcher section; and base loaded antenna to reduce "in-flight glitches' caused by concentrations of low and high RF power.

The Unitronics Mustang 200, as manufactured by Uni-Tronics, P. O. Box 208, Covina, California 91722, has been tested, and is approved and recommended by RCM.