HIGH- “G” DIGITAL MEMORY TELEMETERS

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1. Introduction

With the speedy development of microelectronics and computer technology, there has arisen a particular memory telemetry branch in projectile telemetry area. Researches and experiments have been done a lot by telemetry communities in many countries. Various memory telemetry devices have been evolved for mutifarious application objects or purposes.

The measurement of terminal environmental parameters is characterized by its ephemeral duration in which on-board system will undergo two, firing and impact, overloads, the latter, often reaching beyond 80,000g, is more severe than the former. Moreover, targets usually consist of such different materils as gravels, steel, or concrete, etc. In addition, the irregularity of these materits makes the mechanical conditions of the projectile penetrating into them a great deal more intricate.

In order to measure the acceleration, the axial and tangential forces, the mechanism actions and the like of the parts of a fuze on impact, a high-g memory telemeter and accelerometer with an integrated operational amplifier have been developed. Field tests have also been carried out.

2. System Composition

The entire telemeter is composed of a sensor, an impedance transformer, a samples retainer, an A/D converter, a program memory, a transfer memory, a memory, a controller, a standard interface, a self-triggered signal generator, etc. as shown in figure 1.

In accordance with the requirement of the measurement of the terminal environmental parameters, the telemeter is miniaturized with adoption of software operation mode to reduce as much hardware as possible.

A calibration interface is also set up. The stardard interface of the memory is capable of directly sending stored data to a computer for processing.

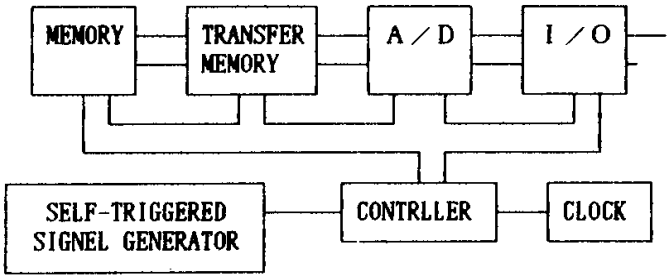

Figure 1. Telemeter Composition

3. The Features of the Telemeter

The extremely short time, about 1ms~5ms , of the terminal course and mechanical high intricacy of the penetration of the projectile into, for example, a concrete target, requires of the telemeter a frequency respouse up to at least 80KHz, or the course parameters may not otherwise not be measured exactly. The sampling rate of the telemeter is one sample per 1.5μs, therefore, its frequercy resonse exceeds 100KHz.

The selection of the bit number of the A/D converter depends mainly on measurement accuracy. The bigger the number is, the smaller quantization errors will be. However, the accuracy does not rest completely on the bit number. It pertains intimately to the accuracy of the sensor. The telemeter is of a bit number 8 .

Memory space is determined by the sampling rate and measuring time. The telemeter can be equipped with either a 2Kx8 or an 8Kx8 memory. Due to the two overloads and long recovery time interval of the telemeter, the cut-off probability of on-loard electric supply is considerable. this telemeter is of nonvolatile function. The stored samples data in a RAM are soon transfered to an E2PROM. Meanwhile, the absence of crystal in clock circuit improves the reliability of the device.

The operation of the telemeter is commanded by the central controller with the software. It is programmalle for different mearurement tasks. for example, it can automatically fulfil “high-low” or “high-low-high” sampling rate conversions with regard to the frequency response of the signal under measurement.

Shown in figure 2 is the disconnected device.

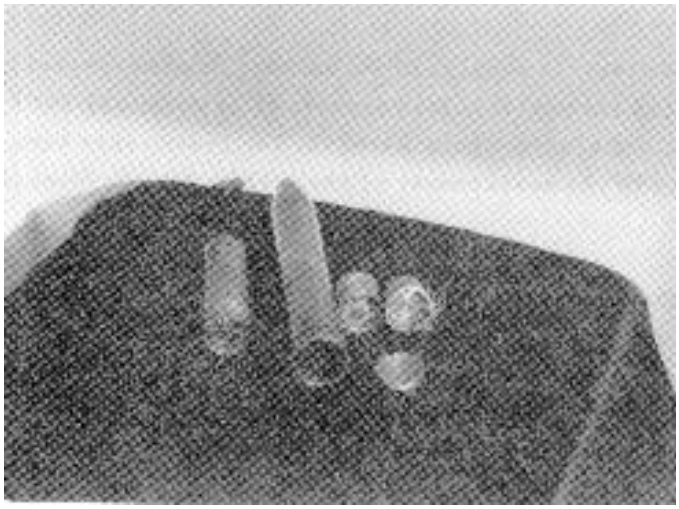

Figure 2. Memory Telemeter

4. Sensor and Electric Supply

For measuement of the penetration overload, an ad hoc acceleration sensor has been developed with the integrated operational amplifier, the range of which extends to 100,000g. Its specification is mainly as follows,

sensitivity: 0.05~0.08 nv/g
frequency response: 1~40kz
mount resonance point: 100kz
max. transverse sensitivity ratio: <5%
yearly stability: <3%
sizeϕxH: <20x20
accuracy: better than 10%
The sensor is shown in figure 3.

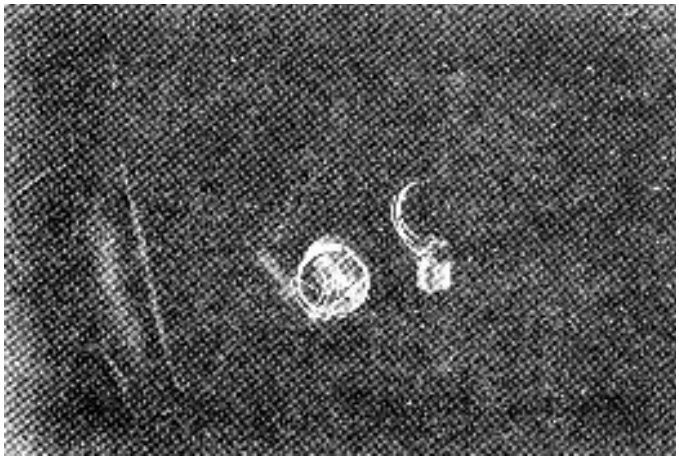

Figure 3. 100,000-g Sensor

As the on-board electric supply, Li-Mn battery is also specially designed in conjunction with its application purpose. It is marked by its compactness, high capacity, and high-g-resistantness. The field tests have demonstrated its raliability in the measurement of the terminal environmental parameters.

5. Field Test Example

The telemeter its application in the measurement of a bar-shaped projectile penetration field test. Its memory recorded the data from the accelerometer when the projectile rushed at a concrete target plate. The data are proximate to calculation results and more really reflect the acceleration variation exerted on the projectile of the penetration than the calcvation. The penetrated target plate and measured data curve are shown in figure 4 and 5 respectively.

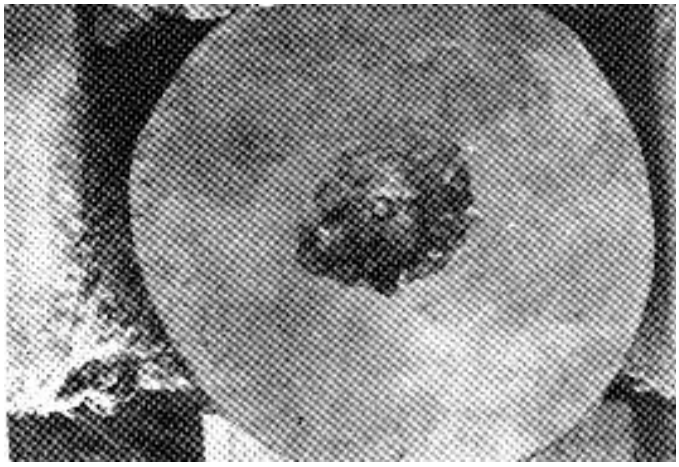

Figure 4. Target

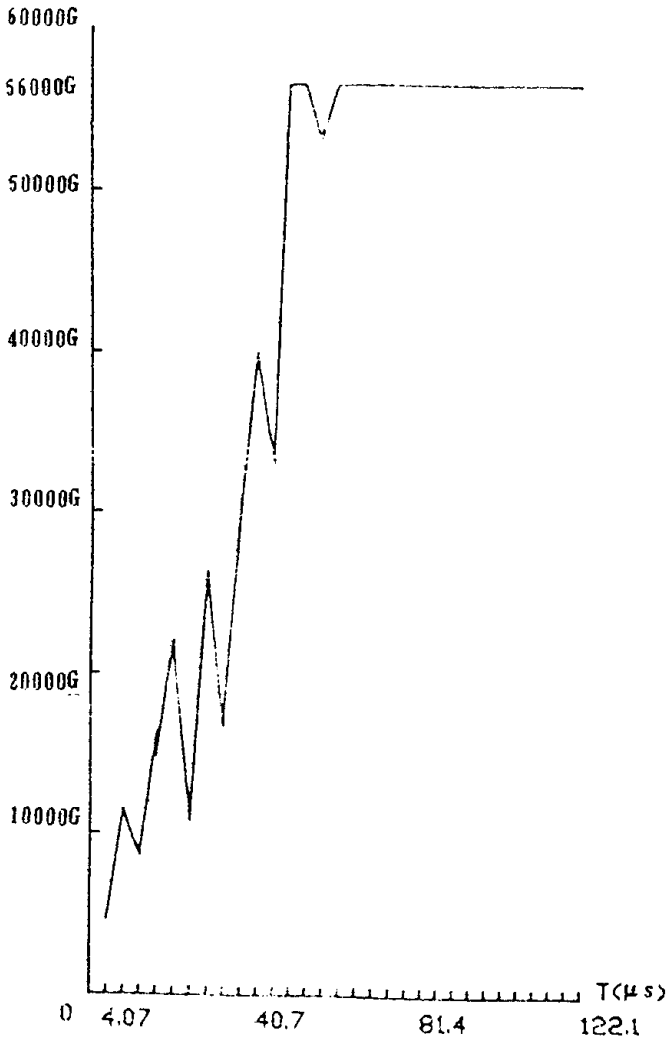

Figure 5. Trial Result