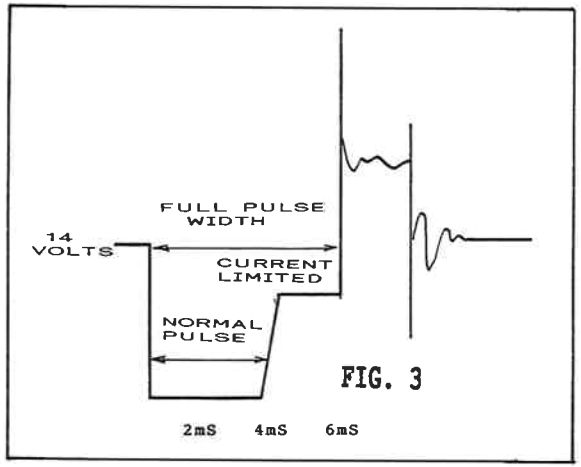

FIG. 3

TYPICAL VALUES:

Engine running — 4.0 mS Normal Pulse position. 6.0 mS Current Limited position at idle, reducing as engine speed increases eg. 4.2 mS

Engine cranking — 5 mS approximately, Normal Pulse. 25 mS approximately Current Limited. Ignition module output/coil input
25 mS distributor output / module input.

4.2 PETROL INJECTOR WAVEFORMS

NOTE: STARTING PROBLEMS - A reduced injector pulsewidth at cranking indicates no cold start mixture enrichment, the engine will fire but may not continue to run.
No pulse at one or all injectors indicates a circuit / control system fault.

4.2.1 PETROL INJECTOR "SQUARE" WAVEFORMS

Switch on the Pulsewidth meter and with the function switch set to normal pulse, connect the BLACK lead to battery negative and the BLUE lead to the injector negative (identify by trial of both leads or from wiring diagram). Start the engine and the duration of the injector pulse width in milli-seconds is displayed. The pulse width at engine idle depends mainly on engine temperature and will be greater when cold.

Increase engine speed a small amount, allow the reading to stabilise and observe the display. Repeat the speed increase, allow to stabilise and observe the display. Note that the injector pulse width reading is slightly reduced at higher engine speeds.
Return the engine to its idle speed and then rapidly open the throttle to increase engine speed. Note that the injector pulse width is increased dramatically as the engine rapidly accelerates and reduces to a low figure as the engine decelerates. Fuel is either reduced to below idle requirements or cut off completely on engine deceleration.

The values should compare with manufacturers data for the system.

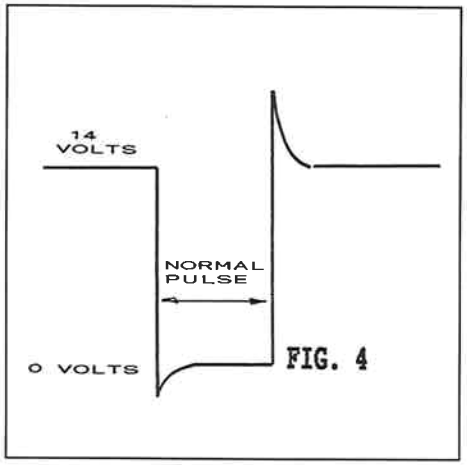

FIG. 4

TYPICAL VALUES:

Engine idle — 2 - 3 mS Hot, 4 - 6 mS Cold, in Normal Pulse position reducing by 0.3 mS approx at high engine speeds.

Engine cranking — Cold (0° deg C) 9 mS approximately, Hot 4 mS approximately Reducing after a few seconds if the engine does not start

Rapid acceleration — 6 mS or above.

Deceleration — 2 mS or less. (Early systems with complete cut-off may read off-scale (ie show 1.---).

IMPORTANT NOTE: IF INJECTOR PULSEWIDTH DISPLAY REMAINS CONSTANT AT APPROXIMATELY 1 mS THE SYSTEM IS PROBABLY OF THE CURRENT LIMITING TYPE. SWITCH TO CURRENT LIMITED FUNCTION AS BELOW.

4.2.2 PETROL INJECTOR "CURRENT LIMITING" WAVEFORMS

Switch on the Pulsewidth meter and with the function switch set to Current Limited, connect the BLACK lead to battery negative and the BLUE lead to the injector negative (identify by trial of both leads or from wiring diagram). Start the engine and the duration of the injector pulse width in milli-seconds is displayed. The pulse width at engine idle depends mainly on engine temperature and will be greater when cold.

Increase engine speed a small amount, allow the reading to stabilise and observe the display. Repeat the speed increase, allow to stabilise and observe the display. Note that the injector pulse width reading is slightly reduced at higher engine speeds. Return the engine to its idle speed and then rapidly open the throttle to increase engine speed. Note that the injector pulse width is increased dramatically as the engine rapidly accelerates and reduces to a low figure as the engine decelerates. Fuel is reduced to below idle requirements on engine deceleration.

The values should compare with manufacturers data for the system.

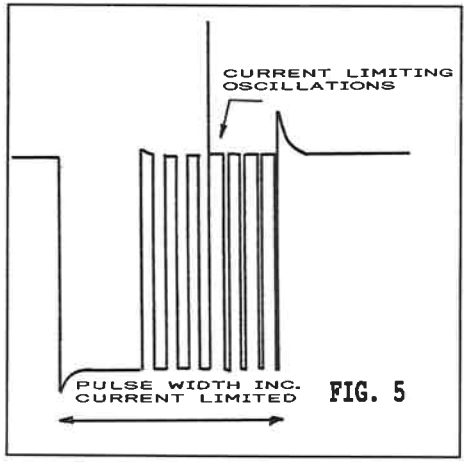

FIG. 5

CURRENT LIMITED SYSTEMS
TYPICAL VALUES:

Engine idle	2 - 3 mS Hot, 4 - 6 mS Cold, reducing by 0.3 mS approx at high engine speeds.
Engine cranking	Cold (0° deg C) 9 mS approximately, Hot 4 mS approximately reducing after a few seconds if the engine does not start.
Rapid acceleration	6 mS or above.
Deceleration	2 mS or less.

4.3 SQUARE WAVEFORMS FROM 5 TO 15 VOLTS SUPPLY.

The pulsewidth meter may be used to check for a pulsed signal or to accurately measure / analyse a square wave with a supply of 5 volts to 15 volts. This extends the uses of the instrument for problem diagnosis / investigation as pulsed circuits are common on modern vehicles.

Ignition and injector pulse measurement as described above displays the duration of pulse when the pulse is at low voltage, a pulse at supply voltage may also be encountered particularly in signal circuits (as opposed to power circuits).

The example shown below is from a distributorless ignition system (D.I.S) at the ignition module input and can be measured by connecting the black lead to the signal and the blue lead to positive with the function switch in normal pulse position.

This D.I.S. system has a pulse width of 5 mS.

The actual pulse width of this General Motors system reduces from 5 mS to 3 mS as engine

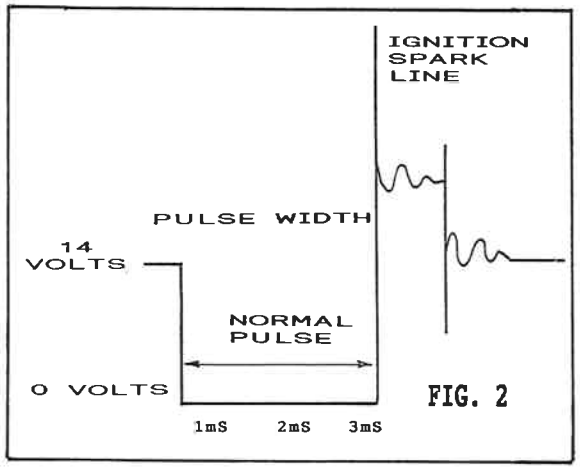

FIG. 2

TYPICAL VALUES:

Engine running	3.5 mS
Engine cranking	5 mS approximately, ignition module output / coil input. 25 mS approximately, distributor output / module input.
Early fixed dwell	Points/transistorised ignition - from 50 ms at cranking and 20 mS at idle, to 4 mS at high speed eg. 4000 rpm.

4.1.2 IGNITION "CURRENT LIMITING" WAVEFORMS

Switch on the Pulsewidth meter and with the function switch set to normal pulse, connect the BLACK lead to battery negative and the BLUE lead to the ignition coil negative. Start the engine and the duration of the ignition pulse width in milli-seconds is displayed. Increase engine speed and observe the display, the reading is maintained at a steady value identical at all engine speeds, switch to current limited function and the pulse width will reduce at higher engine speeds as the current limiting is reduced.

The values should compare with manufacturers data for the system.

The basic procedure for using the PULSEWIDTH METER is as follows:

1. Connect the BLACK lead to vehicle earth (eg battery (-) terminal.
2. Connect the BLUE lead either the injector plug or ignition coil as described below.
3. Set the upper switch to ON. (Note that when not connected, or receiving no signal, the display will read "over-range", ie 1.---).
4. Set the FUNCTION switch to either NORMAL or CURRENT limited as described below, and depending on the measurement that it is desired to make.
5. Read the display, which shows the pulsewidth in Milliseconds (mS).

For specific instructions for particular tests, see below.

4.1 ELECTRONIC IGNITION

In modern electronic ignition systems, the pulse-width is independent of engine speed. The duration of the pulse is controlled at all engine speeds such that current is allowed to build up to maximum just before the spark occurs. This maintains spark energy at all engine speeds, a longer duration would simply increase coil temperature and power consumed without any improvement in ignition performance.

On current limited ignition systems the coil current is limited electronically. This produces the characteristic hump in the waveform.

Note: early contact breaker points type ignition systems as well as early "transistorised" systems (eg TAC) have current flowing in the coil during a fixed angle of engine rotation (dwell angle), this is inefficient compared to modern systems and produces a long pulse width at slow speeds and a relatively short pulse width at higher speeds.

4.1.1 IGNITION "SQUARE" WAVEFORMS

Such waveforms are illustrated in Figure 2.

Switch on the Pulsewidth meter and with the lower switch set to NORMAL PULSE, connect the BLACK lead to battery negative and the BLUE lead to the ignition coil negative terminal. Start the engine and the duration of the ignition pulse width in milli-seconds is displayed. Increase engine speed and observe the display. The reading is maintained at a steady value at all engine speeds.

This value should compare with manufacturer's data for the particular system.

speed approaches approx 2500 rpm and then remains stable at speeds above this. Measurement at cranking on a non starting engine should reveal approximately 10 mS.

Connecting the instrument leads in the conventional way results in a pulse width measurement of 50 mS as the duration of the signal while it is at low voltage is then recorded.

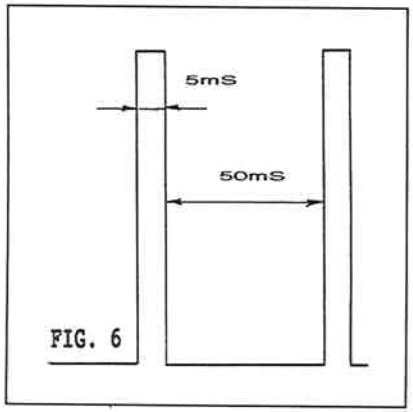

FIG. 6

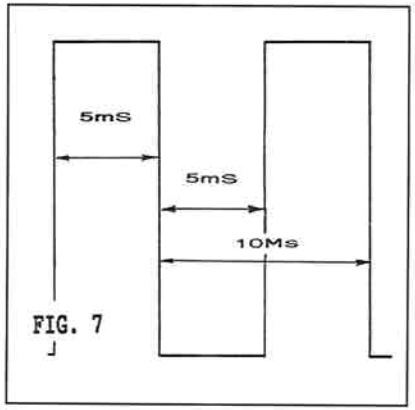

FIG. 7

It is possible to analyse the period / frequency and duty of a pulsed circuit by connecting the input leads as in the example above. Thus a square wave of 50% duty cycle as in figure 7 gives the following:

A pulse width of 5 mS black lead to battery negative, blue to pulsed signal.

A pulse width of 5 mS blue lead to battery positive, black to pulsed signal.

This demonstrates that the wave has a total period of 10 mS per cycle (equivalent to a frequency of 100 Hz (100 cycles per second) and the duration high is the same as the duration low.

4.4 SPECIAL WAVEFORMS:

The following sections deal with more specialised information which may be useful in fault diagnosis.

4.4.1 DISTORTED WAVEFORMS

When circuits containing electrical coils such as relays or solenoids are switched, square waves are distorted by spikes. The Pulsewidth Meter circuitry removes these distortions to allow measurement of the "filtered" wave.

When circuits containing capacitors are switched, square waves are distorted by rounding. In extreme cases there is no distinct switching point and the Normal / Current Limited switch positions will give entirely different readings.

4.4.2 WAVEFORM ANALYSIS:

The duration of a positive pulse can be measured by connecting the black lead to the signal and the blue lead to positive with the function switch in normal pulse position.

Connecting the instrument leads in the conventional way (blue to signal) results in a pulse width measurement of the low voltage pulse duration.

In Normal Pulse position the shorter pulse width shown in figure 8 is measured and in Current Limited position the longer pulse width is measured. A significant difference (more than 1 mS) indicates a non square wave form, a smaller difference indicates a low peak voltage e.g. 5 volts

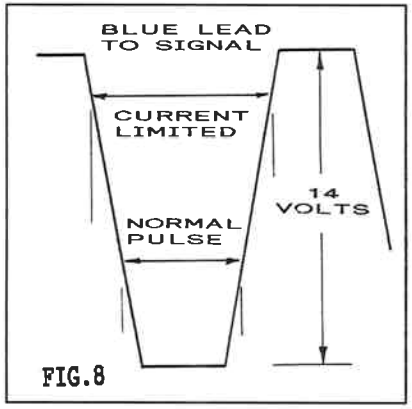

FIG.8

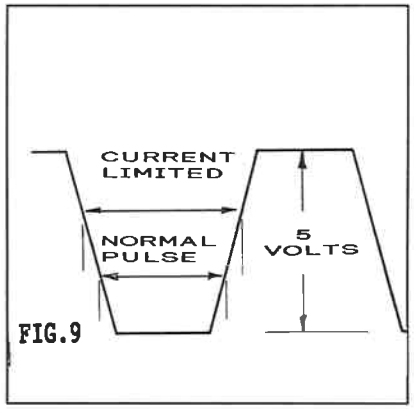

FIG.9

Current limited waveforms are either restricted (ignition) or switched on and off rapidly (injector) when the set current is exceeded. Refer to these instructions or manufacturers information for various types of waveform and applications.

INPUT LEADS. Connections to the vehicle are made using two leads, for pulsewidth measurement the blue lead generally connects to the measured signal and the black lead connects to 0 volts / battery earth. The resistance between these leads is high and connection to sensitive electronic circuits is therefore safe, but refer also to operating instructions, Section 4.

BATTERY COMPARTMENT. Access to the battery compartment is by removing the 4 screws on the back of the instrument. A 9V (PP3) battery must be fitted before use

WIRE PIERCING CONNECTOR. This is used to pierce leads in the circuit being tested, the crocodile clip is then connected to the screw head. Only minor marking of the insulation is caused and this is not a problem with low voltage wiring. Piercing the insulation can be avoided by using the terminal probe.

TERMINAL PROBE. A long thin probe is included in the kit. This is used to make a connection with a terminal by insertion in a plug or socket connector alongside the lead. Take care to avoid injury from the sharp point.

3. BEFORE USE

Fit a 9v PP3 type battery to the Pulsewidth Meter. Access to the battery compartment is achieved by unscrewing the 4 screws on the back of the case.

Read the precautions given in Section 8.

4. INSTRUCTIONS

The pulsewidth meter provides convenient rapid diagnosis for starting problems and may be used during engine cranking for ignition module input/output and coil input testing as well as injector pulse measurement. Pulsewidth figures at cranking may vary with specification but the presence of a pulse provides a convenient confirmation that the system is functioning. See information below relating to engine cranking.

Pulse width or pulse duration is accepted as the duration during which current is flowing in the circuit. Electronically switched circuits on motor vehicles usually have power continuously supplied from battery positive and current flows only when a switched connection is made to the battery negative. Thus it is the negative connection to the device (injector/coil) which provides the switched voltage for measurement. The following examples illustrate this.

2. DESCRIPTION

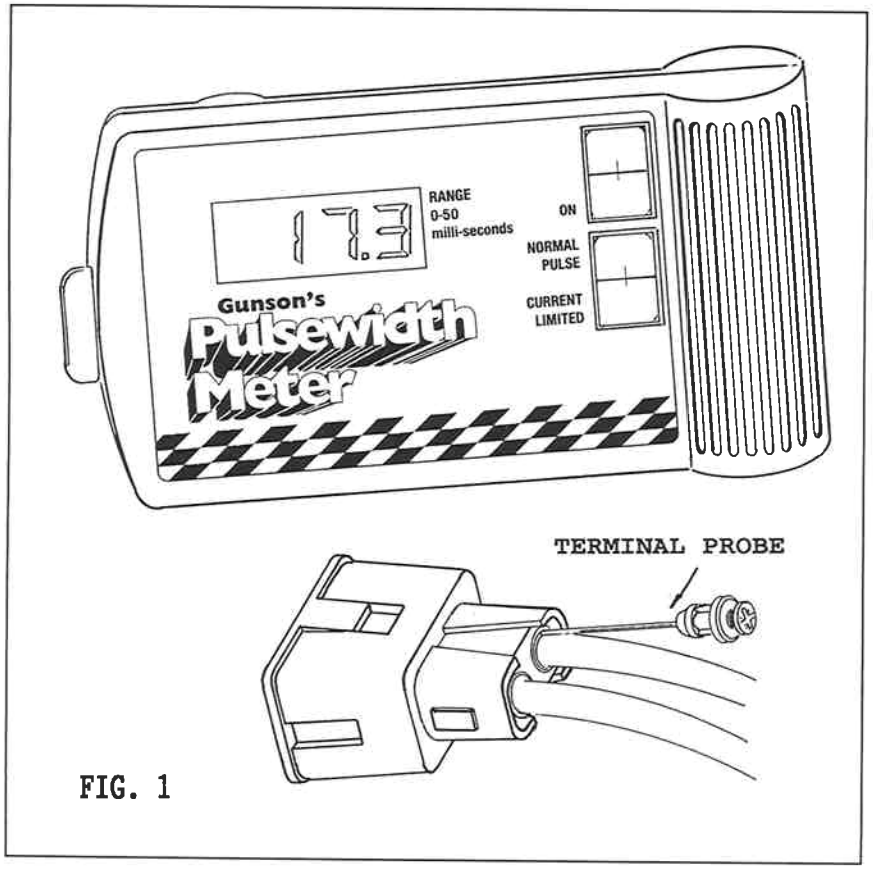

FIG. 1

DISPLAY. The display shows pulsewidth measured in milli-seconds (1 mS = 1/1000 seconds). It can accurately measure pulse-widths between 0 and 50.0 mS. This is adequate for all electronic ignition and petrol injection systems. The display also indicates when the internal battery needs replacing.

ON/OFF SWITCH. When switched to ON the display will indicate the figure 1 . when not connected to a circuit. Note - random figures may be displayed when one or more leads are connected to a non pulsed circuit .

FUNCTION SWITCH. Select NORMAL pulse position initially.
Switch to "CURRENT LIMITED" if: injector duration is short (eg. 1.4 mS) and does not show an increase on rapid acceleration, or: ignition "hump" is being measured (see section 4).

5. PRECAUTIONS

- Before using this product it is necessary to fit a battery. For battery type, and how to fit, see DESCRIPTION.

  Remember to switch the Pulsewidth Meter off at the ON/OFF switch after use, to protect the life of the internal battery.

- Do not allow the product to get wet, and store it in a dry frost-free environment.

- Using this product necessarily involves working on a car while the engine is running. This is a potentially hazardous situation, and the user should take every precaution to avoid any possibility of damage or injury. The following guidance should always be followed:

- Always ensure that the Pulsewidth Meter is located in a secure place, so that it can not be dislodged by, for example, engine vibration.

- Never wear loose clothing, particularly ties, long sleeves etc that can catch in moving engine parts, and always tie-up or cover long hair.

- Ensure that the car is on firm level ground, and is out of gear and the handbrake firmly applied at all times.

- If for any reason the car is jacked up or the wheels removed, always ensure that the car is well supported, and never rely on a car jack alone: always also use ramps or axle stands. Be wary of axle stands and jacks sinking into soft ground, and remember that asphalt and road surfaces may appear firm, but may give way after a short time under the concentrated load of a jack or axle stand.

- Do as much setting up, maintenance work and adjustments as possible with the engine not running.

- Always route cables well away from hot or moving parts, (particularly the exhaust pipe and cooling fan) and check that the meter and leads are in a safe position before starting the engine.

- Always guard against getting equipment or fingers too close to moving, hot or electrical parts. Be especially wary of the fan, fanbelt, fanbelt pulley, exhaust manifold, exhaust pipe, and HT parts of the ignition system. Remember that thermostatically controlled fans may suddenly start with no warning.

- Take care to avoid placing metal tools where they may cause an electrical short, such as near the car battery.

- Take care not to place tools etc where they may be dislodged by engine vibration.

- Treat High Tension components with respect, remembering that electrical shocks can cause involuntary movement which may result in secondary injury. Remember that sparks can jump quite a distance. Also remember that severe unexpected HT shocks

can be received from old, worn, damaged or wet components (eg HT leads, coil, distributor).

- Keep this product away from HT voltages, such as spark plug leads.
- Take care not to inhale exhaust gas. Never run the engine inside a garage or in a confined space. When running the engine, always ensure that there is adequate circulation of fresh air. Ensure that there are no leaks in the exhaust system near where you are working.
- When carrying out tests on a motor vehicle, remember NEVER run the engine with the car battery disconnected (either + or -) since the alternator would then run at a damaging over-voltage.
- Keep children and pets away from the car while work is being carried out.

6. SPECIFICATION

NORMAL PULSE

ACCURACY 1.0 TO 50 mS:

SQUARE WAVE 5v TO 15v, IGNITION AND INJECTOR ± 0.2 + 4%

CURRENT LIMITED

ACCURACY 1.0 TO 50 mS:

IGNITION AND INJECTOR ± 0.2 + 4%

THIS PRODUCT REQUIRES A PP3 (9V) BATTERY (NOT SUPPLIED)

1. INTRODUCTION

Motor vehicle technology has substantially changed in recent years and now pulses of constant or specific time duration play an important role in the operation of the engine. particularly in Electronic Ignition and Petrol Injection systems.

The so-called "Electronic Ignition" has now been adopted almost universally by car manufacturers for spark ignition engines, whereas the "Points" type of spark ignition (Contact Breaker, or "Kettering" ignition), universally popular only a few years ago, is now commonly found only in older vehicles. In modern electronic ignition systems, the pulse of electrical current in the ignition coil is of a particular time-length, and is not set by a particular angle of rotation of the distributor shaft as it was in the "points" system. Hence the "Dwell percent" and "Dwell degrees" of the traditional automotive multimeter is of little use in analysing electronic ignition systems.

What is needed is an instrument which can measure "PULSEWIDTH", ie the time-duration of the pulse (generally expressed in milliseconds (mS), one millisecond being 1/1000 second).

Gunson's Digimeter 320, introduced in 1994, broke new ground in offering the Pulsewidth in a modestly priced instrument, and can be used to measure the pulsewidth of many modern electronic ignition systems. However, the design of motor cars is becoming more diverse, as various manufacturers introduce different systems, and there are some types of electronic ignition systems, notably those with a current limiting "hump", which the Digimeter 320 can not fully analyse. This new Gunson's Pulsewidth Meter can analyse such waveforms.

Similarly, "Petrol Injection" has now been adopted almost universally by manufacturers, replacing the carburettor. Apart from brief period when petrol injection used a continuously varying injection method (eg the Bosch K-Jetronic and KE-Jetronic), modern petrol injection systems are all "intermittent", ie the injector is always either fully open or fully closed, and the amount of petrol that is injected is controlled by the ECU by setting the time for which the injector remains open.

As with electronic ignition, the design of petrol injection systems is becoming diverse, and there are now various fundamentally different types to be found. Digimeter 320 can measure the pulsewidth of those systems that use substantially a "square" wave, and the this Gunson's Pulsewidth Meter extends this use to those waveforms that have an oscillating component.

This product enables the analysis of switched waveforms which otherwise would be impossible without specialised equipment which would be not only expensive, but cumbersome and often difficult to use.

CONTENTS

WARRANTY

Gunson have made every effort to ensure that this product is of the highest quality and value to the customer. However, Gunson accept no responsibility for any damage arising from the use of this product.

All technical enquiries regarding this product should be accompanied by a stamped self-addressed envelope. Telephone enquiries may be made on the Gunson Helpline 0181-592 1967. Please note that Gunson can not provide technical advice or information on motor cars.

This Warranty does not affect the Statutory Rights of the user.

If this product should require service or repair, it should be returned to Gunson Ltd (Service Dept), Coppen Road, Dagenham, Essex RM8 1NU.

Postage may be refunded (UK only) and repairs will be completed free of charge for manufacturing defects within one year of purchase.

Defects due to other than manufacturing faults may be charged for.

When sending goods for service or repair, please give full details of faults requiring attention.

Gunson Limited
Crypton Technology Business Park
Bristol Road
Bridgwater
TA6 4BX
Helpline 01278 436247
Email: technical@Gunson.co.uk

Gunson Ltd,

Gunson's

PULSEWIDTH METER

PART No 4129

HANDBOOK

INCLUDING TECHNICAL INFORMATION ON TYPICAL VALUES AND METHODS OF TESTING

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