

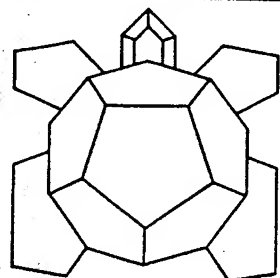


TITLE

TURTLE SYSTEM DESCRIPTION

DOCUMENT N^o VDL1/145

ISSUE N ^o	PREPARED	CHECKED	APPROVED	COMMENTS
A	D.A. EWINS			21.5.85



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Valiant Designs Ltd Park House 140 Battersea Park Road LONDON SW11 4NB ENGLAND

Tel: 01-720 3947/627 1351/627 0470 Telex: 946461 (Attn Valiant) NIMTEX G

Directors: Prof T Stonier, AB, MS, PhD, FRSA (President) R R Fawcett, ACMA, MBCS (Chairman)
D Catlin, B Tech (Managing) G M Marvell (Marketing) T M Airey, BSc, FCA (Finance) (Secretary)

Reg in England No 1626393 Reg Office: 56-60 St Mary Axe, London EC3A 8BJ VAT No 237 711955

1.0 INTRODUCTION

The Turtle hardware/software package comprises five items:

- 1 Turtle Robot
- 2 Communicator
- 3 Power Adaptor
- 4 Interface Lead to connect Communicator to Host Computer
- 5 Software Interface as required

The Turtle is a remotely controlled robot receiving commands from the Communicator via a one way infra-red data link.

It is fitted with two stepper motors, port and starboard, to provide linear motion, and a third DC motor to provide the lift and drop pen action.

A power pack comprising ten 0.5 Ampere Hour (SAFT VR0.5AA) batteries is contained in two base pods and is user accessible by means of removable covers.

The electronics control board provides all of the necessary infra-red reception circuitry, decoding and control tasks necessary to enable the robot to perform exactly according to the input command stream. An additional circuit on the same printed circuit board provides a fast/slow battery charge option. In this circuitry there is also a sensory cut-off system which turns off the fast charge current following attainment of full charge in order to protect the batteries from overcharge damage.

The base mounted resistor provides a rudimentary level of control over the fast charge current.

A base mounted fuse is incorporated to protect the system from overcurrents due to incorrect battery insertion, PCB faults and wiring shorts.

The rear mounted switch provides the unit ON-OFF control as well as the fast or slow charge selection option. A DIL switch mounted on the underside of the unit provides the user with a one out of four Turtle ident (or address) selection option when using the Turtle in a multi-turtle environment.

The two red leds (eyes) mounted at the forward end of the unit provide indication of the current state of battery discharge.

The Communicator is the interface between the Host Computer and Turtle robot, translating electrical signals from the Host into an infra-red transmission.

The unit may connect to either parallel or serial output ports, the interface configuration being selectable via the side mounted DIL switches.

In serial mode, the unit will connect to standard RS232 or RS423 type interfaces.

Baud rate selection is automatic providing the transmission rate from the Host Computer lies between 2k and 5k.

In parallel mode, the system may be operated in single or multi-turtle configurations depending on the software (LOGO).

The Power Adaptor, consisting of a free standing transformer and DC rectification pack, provides both the power to the Communicator and charge supply to the Turtle.

The Interface Lead depends both on the Host Computer and the interface type from which the system will run.

In many instances, the lead selection will be LOGO (or software driver) dependent.

The Software, supplied on either 5¼ inch floppy disc or cassette tape, provides the link between the LOGO software and Turtle hardware drive requirements.

In a number of instances, this interface software is imbedded into the LOGO type language, thus eliminating the necessity for a separate interface driver.

2.0 TURTLE OPERATIONAL DETAILS

2.1 Infra-Red Communication

The Turtle robot is a remotely controlled device that receives infra-red commands from the Communicator unit. The operational range of the infra-red link is typically 6 metres but may be more, depending on the physical (i.e. reflective) nature of the room in which the unit is operating. Although it is recommended that the unit operates within the line of sight of the Communicator, it is possible, with smaller dimensioned rooms, to obstruct the line of sight while maintaining operation. There is also a near range limit, whereby the infra-red signal saturates the receiving amplifier - this may occur for ranges nearer than 1 to 2 metres. (This problem may be easily overcome by pointing the Communicator away from the Turtle so that the maximum power axis is orientated at the far 6 metre point. In this instance, it is recommended that the Communicator is above the Turtle operating plane by between 1 to 2 metres). Finally, the unit will not operate in strong sunlight, as again the infra-red amplifier becomes saturated.

Mounted at the rear end of the PCB is a red LED.

The purpose of this LED is to indicate that the unit is correctly receiving infra-red commands - changing state for each command.

During motion, the LED goes on and off at such a rate that a dimming may be detected, rather than a toggling action: however, toggling may be detected at the beginning and end of motion.

Under one normal operational circumstance the LED will not toggle, even though commands may well be correctly

decoded. This relates to the situation whereby the Turtle ident (or address) does not correspond to the actual command ident transmitted.

For most systems, the Turtle is operating in a single unit environment, and as such the underside DIL switches should be set to the default ident setting of both off - Turtle Ø.

2.2 Motion

Motion is achieved by rotational activation of the stepper motor windings; each step produces a 1/3 millimetre movement.

The on-board processing capability is rather fundamental in nature, and requires an infra-red command for each stepper movement.

Each stepper motor is individually controlled within each transmitted command, so that reverse, forward, or freeze step movements may be produced.

This capability enables the unit to move linearly, rotate or even arc, depending on the host software capability. At the end of each complete movement cycle (e.g. after moving forward 10cm) the motors are turned off to conserve power.

Typical power consumption in a non-motoring condition is 80 milliamps. The motoring power consumption increases to about 250 milliamps.

The linear speed is typically 140 to 150 steps per second, producing a velocity of approximately 5cm per second.

The mechanical performance of the unit is critically affected both by the wheelbase setting and the distance of each wheel from the pen tip. In order to optimise these settings, wheel position trimmers are provided for each wheel. The method for setting these up is detailed in Appendix A of this document.

2.3 Battery Stack

The battery pack of ten 0.5Ah batteries provides enough power for about 2 hours continuous motoring, or 3 to 4 hours of intermittent motoring.

The batteries are nickel cadmium rechargeable, with over pressure venting to release excess gases when subjected to overcharging - the gas released is oxygen.

This venting prevents battery rupture and the consequential electrolyte spillage in the event of gross overcharging due to a charge system failure.

The charge system is dual mode providing optimal fast and slow charge selection.

The charge current is provided by the voltage adaptor unit and connects into the socket mounted on the port stepper motor housing.

The charge mode selection is made by a combinational sequencing of 'CHARGE' switch selection and power-adaptor application.

Setting the rear switch to the 'CHARGE' position in advance of applying external power will set the unit into a fast charge mode, and is signified by the illuminated yellow LED on the PCB. Reversing this sequence will cause the unit to adopt a slow charge condition with the yellow LED extinguished.

The fast charge rate is typically 0.5Amps, roughly regulated by the base mounted 5.6ohm resistor, and will normally charge the batteries to 70% full capacity in one hour, from a discharged condition. The fast charge will continue for typically another hour, after which time the unit will adopt a slow charge condition, signified by the yellow LED going out.

The time at which the fast charge system cuts out is

dependent on the battery stack voltage and temperature, the temperature being the dominant factor: the temperature is continuously monitored by the charge circuitry by means of a battery pod mounted thermistor, and cuts off at about 40°C.

The slow charge rate is around 50 milliamps and will be maintained indefinitely by the unit.

The life span of the batteries is generally in the order of 500 cycles, yielding an average of well over one year's use before replacement.

Battery replacement, when required, may be carried out by the user by removing the base caps.

The boards are protected from incorrect battery insertion (e.g. voltage reversal), although the internal fuse may blow, requiring repair by a service agent.

At the front of the unit are two series connected red LEDs. Apart from their decorative appeal, they also serve a more practical function as battery charge state indicators. They will remain illuminated until the batteries are nearly discharged. However, depending on the battery circuit resistance, which will vary between units, some amount of flickering will be detected before they remain permanently off.

This flickering is caused by power surges at the beginning and end of movements and pen actuations.

The final cut off voltage is typically 11 volts and it is expected that mechanical functions are maintained at least to this point.

2.4 Pen System

The pen system obtains its lift, drop action by means of a bi-directional DC motor drive system.

The motor drive current is typically 0.5 Amps and is applied for approximately one second following reception of a single change state command; the pen drive will not be activated if either a received pen command does not call for a change in pen state, or if the unit is in an existing motor drive mode.

In later models, the current limiter resistors R39 and R40 (22ohms) found at the rear of the PCB, may be replaced by thermistors. This replacement was found necessary to protect the circuitry from invalid processor modes which could occur under certain conditions of unit misuse.

The recommended pen type is the BEROL (except Fineline and Highlighter) and it is inserted into the pen holder receptacle from the underside of the unit.

The pens should push fully home, with the top protruding out of the top most end of the tube by about one millimetre. The pen is retained within the holder by a plastic pressure clip action.

Removal of the pen is by exerting similar forces but in the reverse direction.

It should be possible to remove the pen by clipping on its cap, and then pulling against this.

There are, however, manufacturing tolerances, both in the pens themselves and in the holder, which may not always make this possible.

The pen 'lift to drop' movement is typically 7 millimetres.

2.5 Multi-Turtle

On the underside of the unit may be found a small DIL switch.

The purpose of this switch is to define the Turtle ident between 0 and 3, yielding a facility to drive up to 4

Turtles individually, within a confined area.
However, most LOGOS are only capable of driving single
Turtles, such that the Turtle should always be configured
to recognise the default ident.

3.0 COMMUNICATOR OPERATIONAL DETAILS

3.1 General Description

The Communicator provides the interfacing between the Turtle and Host Computer, converting either serial or parallel data into an infra-red output signal.

The electronics is contained on a single printed circuit board within the 30mm x 100mm x 130mm enclosure. At the rear end of the unit are three sockets: a 5 pin DIN type serial connector, a 15 pin 'D' type parallel connector and a power socket.

3.2 Power Up and Initialisation

Turning the unit on is simply by means of plugging in the power adaptor supply: there is no separate on/off switch.

The plugging action should be a firm push action to ensure that the unit powers up correctly - the processor reset depends on a reasonably clean supply power up waveform. In circumstances where the power jack is plugged in in a faltering manner, the processor may not reset correctly, causing the unit to refuse to initialise. There will be no resulting damage to the unit and a re-powering will normally remove the incorrect condition.

The unit should always be turned on according to the user instructions. This is because the unit requires a number of check characters to set it into an operational mode, and powering up at the wrong moment may cause the unit to receive these characters incorrectly. Accordingly, the unit should be powered up as the last act prior to initialisation - such that all preliminary activities, like powering up the host machine, connecting

cables, and setting the Communicator switches should be completed prior to this. In many systems, the host computer will inform the user when to power the Communicator.

3.3 Mode Setting

The Communicator will connect to either parallel (centronics) or serial (RS232, RS423) interfaces. A set of DIL switches are provided on the unit side to configure the Communicator for the interface type. The first two switches configure the firmware into one of three modes: serial, single byte parallel or double byte parallel - the fourth configuration is also a serial mode, but not used.

Both the serial and single byte parallel modes are for single Turtle systems. The second byte of the double byte configuration is an address or ident byte which defines the Turtle ident. This latter mode relates to multi-Turtle logos such as Acornsoft.

The Communicator automatically defaults the ident to Turtle \emptyset for single Turtle operating systems.

3.4 Serial Mode

When configured for serial mode operation, the Communicator requires a specific serial data form for initialisation, normally 'carriage return', in order that it may synchronise its receiving baud rate sampling to the transmitted rate.

A second byte is transmitted following this and is used as a check character; if the Communicator receives this character correctly, then it is set up and, as a user indication, turns off the red LED at the front of the unit. (The red LED should always be illuminated prior to initialisation to indicate that the unit is powered).

Usually, the serial data interface of the host computer is set up via the interface software, but generally the unit will operate on any serial data rate between 2K and 5K. The unit will operate on both 7 and 8 data bit serial systems, as all characters following the first 7 data bits are ignored, including parity and stop bits. Thereafter, each command received from the host computer will be encoded prior to infra-red transmission; for each command transmitted, the red LED at the front of the unit will change state, such that for continuous move operations, the LED will appear permanently illuminated, but dimmed.

3.5 Parallel Mode

When configured into a parallel mode, as defined by the user instructions, data is transferred via the parallel data highway into the 15 pin 'D' type connector. There is no comparable rate set up condition for parallel operation, although for consistency, the same data words are transferred, enabling the unit to check and respond by extinguishing the red LED as a system integrity check. In this instance, the functioning of the red LED is identical to the serial mode of operation. Again, the first two side mounted DIL switches are used for firmware mode selection, but in this case the last two switches are used to set up the STROBE signal logic level. This strobe is used to indicate to the Communicator that data is being transferred via the eight bit highway to its data buffer latch, and it is important that it is set up correctly. However, all systems to date have been set up so that the switch settings are identical. For single Turtle systems, only one transfer per command is required, with the ident bits being defaulted by the

Communicator to Turtle Ø prior to infra-red transmission. For multi-Turtle systems, a second byte is required for each transmission and defines the Turtle ident, selectable by the operator, between 0 and 3, according to the LOGO facilities.

3.6 Multi-Turtle Parallel Mode

For multi-Turtle operation, two methods of system set up are possible.

The first method concerns a single host computer system, which can transmit to one or more Turtles at a time or in a sequential manner, depending on the LOGO and capabilities of the machine. In this instance, only one Communicator is required - connecting to the host machine in the normal manner. Transmission interlacing is organised by the host machine.

The second set up method concerns the situation where it is required to drive more than one Turtle in an enclosed area but from separate machines. In this instance, the Communicators cannot be allowed to transmit without some form of interlacing control: this control may be exerted by an external unit which interconnects between each of the Communicators.

3.7 Handshake

For both interface types, a handshake line, which indicates the presence of a functional Communicator, is provided. However, this system is not rigorous and may not inform the user, via the host machine, that the Communicator is not operative.

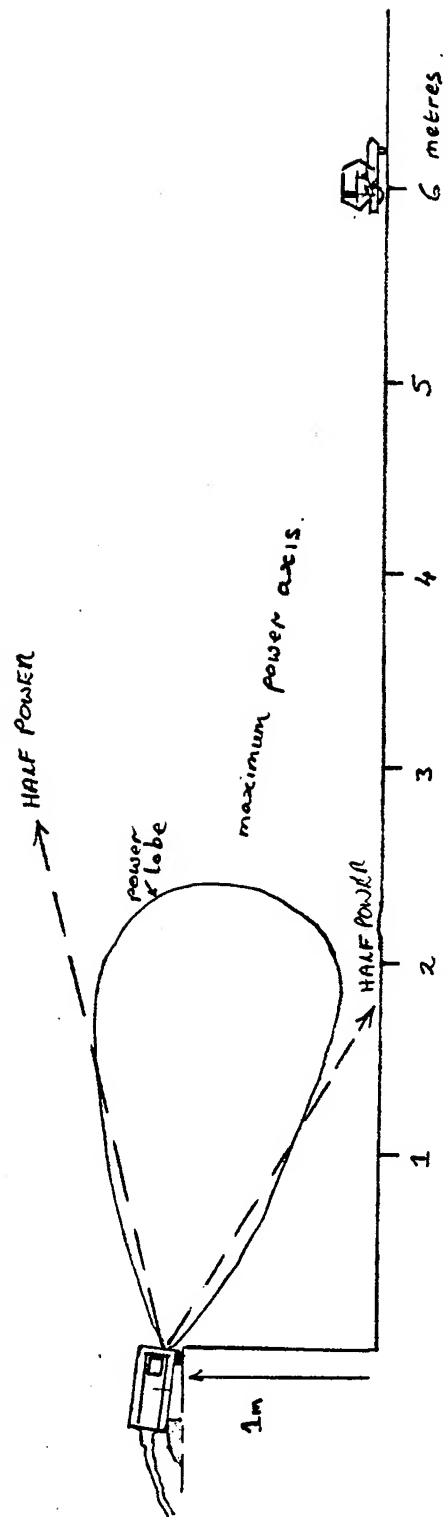
The necessity for the handshake line only becomes apparent in multi-Turtle systems where it is used to hold transmissions from the host computer in order to realise the interlacing control over infra-red outputs.

3.8 Infra-Red Beam

The infra-red transmission beam is essentially a solid angle about a central line of axis taken from the Communicator window. The solid angle is approximately 50° between half power points. Accordingly, the maximum power is along the central axis and it is this axis that should be directed at the far operational point some 6 metres distant from the source.

It is recommended that the Communicator be raised by some 1 to 2 metres from the Turtle plane of operation, in order to avoid Turtle infra-red receiver saturation at near range.

Depending on the nature of the room, a considerable amount of infra-red signal may be bounced off ceilings and walls, reducing the requirement for unobscured line of sight transmission.



Infra-red Power Output lobe

4.0 POWER ADAPTOR

4.1 General Description

The power adaptor is a dual purpose unit, acting as a voltage supply to the Communicator and a charger unit to the Turtle.

There is no conflict in use between these two modes.

The item is a free standing durable plastic box which converts mains input voltage to a low level DC output.

The unit is designed to satisfy current safety standards and has been cleared by a number of evaluation bodies.

4.2 Protection

The unit is built to double insulation standards with overheating protection in the form of a thermal fuse incorporated into the mains winding of the transformer. This provides additional user protection from overload damage.

For UK systems, it is also recommended that the mains plug be fitted with a 3 Amp fuse.

The main unit is sealed, offering no service access.

4.3 Output Voltage

The no load output voltage is typically 26.5 Volts DC, with the centre pole of the jack plug positive.

Under Communicator loading, the output reduces to approximately 23 Volts, with a typical loading of 145 milliamps for that unit.

Under Turtle fast charge loading, the output further reduces to approximately 19.5 Volts at the typical loading of 0.5 Amp: the unit output rating is 20VDC at 0.5 Amp.

5.0 INTERFACING LEADS

Each Turtle System is provided with an interface lead according to type of interface required (serial or parallel) and computer, as appropriate.

Although the interface types may be roughly categorised as RS232, RS423 and Centronic, the total lack of standardisation in connector types used and wiring configuration means that there are a large number of different cables, with little commonality between machines.

Serial lead interfaces comprise three connections: the data line, the return (handshake) line and OV reference.

Parallel lead interfaces comprise eleven connections: 8 data lines, the strobe line, busy (handshake) line and OV reference.

In order to rationalise the grounding requirements for the basic three interfaces, the serial OV connection is approximately 6 Volts above the parallel OV connection within the computer, so that on no account should both parallel and serial cable interfaces be connected at the same time.

6.0 SOFTWARE

Each Turtle System is supplied with a software pack relating to the host computer.

A single software pack is normally supplied, which permits interfacing to any one of the Valiant specified LOGOS.

Some attention is required to ensure that, when supplying software for a particular machine, the correct cable is enclosed according to the LOGO interface requirements.

Where possible, optional interfacing has been supplied enabling the user to choose between serial and parallel interface types, according to the computer and personal requirements. However, where build up computers are encountered, such as the Apple 2e, the optional interfacing is dependent on the add-on cards incorporated and it may be necessary for the user to purchase the appropriate card from his local computer dealer.

Details of interfacing requirements and software availability are enclosed in the S/W and H/W Interfacing Record documents produced for each computer.

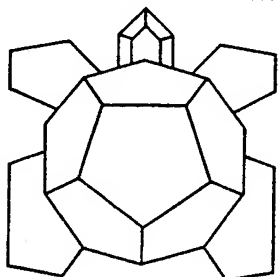


TITLE

CUSTOMER ENQUIRY AND FAULT REPORT SHEET

DOCUMENT N° VDL1/146

ISSUE N°	PREPARED	CHECKED	APPROVED	COMMENTS
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Valiant Designs Ltd Park House 140 Battersea Park Road LONDON SW11 4NB ENGLAND
Tel: 01-720 3947/627 1351/627 0470 Telex: 946461 (Attn Valiant) NIMTEX G
Directors: Prof T Stonier, AB, MS, PhD, FRSA (President) R R Fawcett, ACMA, MBCS (Chairman)
D Catlin, B Tech (Managing) G M Manvell (Marketing) T M Airey, BSc, FCA (Finance) (Secretary)
Reg in England No 1626393 Reg Office: 56-60 St Mary Axe, London EC3A 8BJ VAT No 237 711955

CUSTOMER ENQUIRY AND FAULT REPORT SHEET

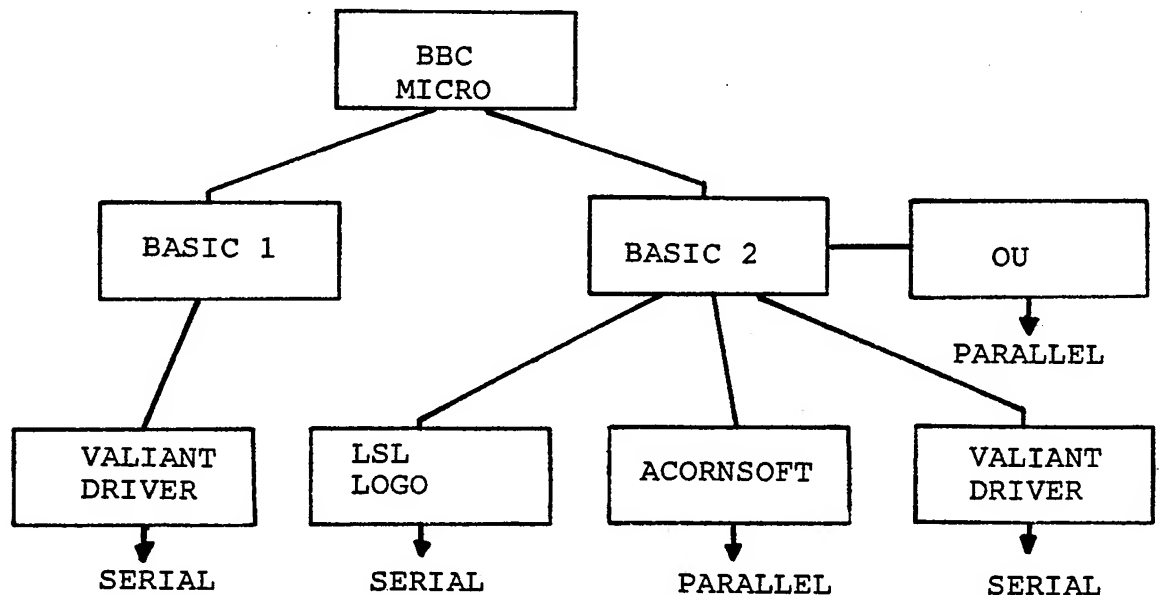
1.0 CUSTOMER SERVICE

For a service department to run efficiently, a Customer Support service is required, both from the point of view of helping the user to clarify misunderstandings with the equipment and, as far as possible, to prevent the return of otherwise correctly functioning units.

It is important to understand the nature of the Turtle product. Firstly, it is obviously necessary to understand the workings of the product itself as a stand alone item, and an in-depth account of this is given in the System Operation Description Document - VDL1/145.

However, the Turtle is NOT a stand alone item. Its operation is dependent on the provision of a host computer and of software (LOGO) to run it: this is where difficulties may occur.

Figure 1 indicates an example of the complexity of the task facing Customer Support. It shows the number of variants to which the Turtle interfaces for the BBC Microcomputer.



Five differently configured systems may be indentified immediately, and the situation is being repeated for most of the other microcomputers at one level or another. As another example, the Apple 2e may be fitted with any one of a number of different interface boards and then there are LOGO options available, again rapidly increasing the number of configurations.

At a deeper level of involvement, various computers have evolved with changes in resident firmware, as for the BBC, or changes in the amount of memory, or options on mass memory storage, disc drive or cassette, and so on. And then there are inevitable problems in the host computers or LOGO softwares themselves - batches may be released which have inherent, but otherwise unnoticed, faults which only identify themselves when the customer attempts to run his Turtle for the first time.

It becomes an obvious pre-requisite that a system is required to keep on top of this potentially mountainous problem. Information sheets have been produced detailing the H/W and S/W Interfacing requirements to each computer; for each issue of software, a sheet is produced detailing the contents of that software, and any problems that have been found with it. The sheets also contain any specific host computer requirements - e.g. memory size, etc. In addition, any problems found to be specific to that host computer may be mentioned. However, it may not always be possible or appropriate to include certain 'problems' on these sheets and accordingly a User Problem Advice Sheet is also produced. Finally, the system will not function efficiently without feedback between the Customer Service Departments and Valiant. A CUSTOMER ENQUIRY AND FAULT REPORT SHEET is therefore provided to each Customer Support Service

installation and each enquiry must be logged in this document in order that the pertinent information be recorded for eventual appraisal. Particularly when a new software interface is placed on the market, or even more so, when a new host computer is involved, the initial problems arising require careful attention in order to detect the presence of unforeseen problems at the earliest opportunity.

Normally, only small quantity 'field trials' batches will be issued initially in order to allow market assimilation, but this may not always be possible if the new software is added on to an existing product. In this instance it is expected that the Customer Support Service will detect any abnormal increases in problems and convey the information to Valiant without delay.

2.0 RECORD SHEET

The Customer Enquiry and Fault Report Sheet is detailed as follows:

2.1 Enquiry Ref.

This shall be an unique number that can be referenced by the Diagnostics Summary Sheet.

2.2 Name, Address and Tel. No.

Name, address and telephone number of enquirer.

2.3 Date

Date of enquiry.

2.4 Nature of Problem

This shall record the nature of the problem as conveyed by the enquirer.

2.5 System Details

This shall record details of the host system and interfacing software.

2.6 Description of Faulty Equipment and Serial Numbers

This shall record the details, including serial numbers, of items being returned as possibly faulty.

2.7 Special Notes

This section shall record any special notes relating to this enquiry.

2.8 Action Notes

This section records details of actions to be undertaken as appropriate. The sub-classifications are as follows:

- a) Awaiting Reply (AR). Waiting on enquirer to come back.
- b) No Action - enquiry closed (EC).
- c) Immediate Replacement (IR) according to equipment details recorded under 2.6.
- d) Return and Repair (RR).
- e) Equipment Received (ER).
- f) Equipment Damaged on Receipt (DAM).
- g) Replacement Equipment Despatched (ED).

CUSTOMER ENQUIRY AND FAULT REPORT SHEET

ENQUIRY REF.	NAME, ADDRESS & TEL. NO.	DATE	NATURE OF PROBLEM	DESCRIPTION OF FAULTY EQUIPMENT & SER. NOS.	SYSTEM DETAILS	SPECIAL NOTE	ACTION *
							AR
							EC
							IR
							RR
							ER
							DAM
							ED
							AR
							EC
							IR
							RR
							ER
							DAM
							ED
							AR
							EC
							IR
							RR
							ER
							DAM
							ED

* AR - Writing Reply EC - No action: Enquiry closed IR - Immediate replacement

RR - Return and Repair ER - Equipment Received DAM - Equipment Damaged ED - Replacement Despatched

USER PROBLEM NOTES

These notes are intended to be supplementary to the user notes and instructions supplied with the Turtle kit. These notes are confidential to Valiant Designs and are not to be supplied without authorisation to any person not employed by Valiant Designs Ltd.

These notes are intended as a backup to user problems and indicate the action required to alleviate the problem.

<u>PROBLEM</u>	<u>ASCERTAIN THE FOLLOWING</u>	<u>ACTION</u>
1. Communicator will not initialise on RML480 system	Ensure that RML480 is not CJ serial numbered. If so, then possible problem with SI02 being incorrectly wired.	Inform user to check this and contact RML as appropriate for modification.
2. Cannot load Turtle Driver S/W on BBC Serial System	Inquire as to the display of Syntax error 7620	If syntax error 7620, BBC system fitted with Basic 1 Inform user that Turtle Driver will only run on Basic 2
3. Interface software for Apple 2e or 2 plus will not load.	Almost certainly fault with Apple LOGO disc. A large number of discs have been issued with COPYDEF fault.	Inform user to contact Apple dealer for replacement disc.
4. Turtle set to Ident 3 will not function correctly when operating under multi-Turtle operating systems.	Noise problems within the MKII Turtle Electronics have reduced the effective I.R. range, with the possibility of spasmodic control for far range systems. This problem relates to MKII Turtles Ser. Nos. 1000 to 1999.	Suggest that enquirer uses problem Turtle on ident 0, 1 or 2

/contd.

5. Communicator
may not function
on IBM Parallel
System

System problem:
overcome by cable fix.
Only applies to about 25
off systems max.

Get user to check
cable at 25pin D
end for link
between pins 1 and
11, or supply Issue
B IBM S/W.

ELECTRONICS DIAGNOSTICS REPORT 001

Nature of Failure

Pen resistor (R39 and R40) burn out on Turtle Controller Board.

Description of Circuit

The pen circuitry is a high current bi-directional d.c. motor driver. The pen mechanism is such that the bi-directional drive need only be applied for a short duration in order to achieve a lift or drop action. This duration is approximately one second.

During this period, the current is approximately 0.5 amps through either of the current limiting resistors R39 and R40, with a consequential surge dissipation of 5 to 6 watts.

The resistors are of metal glaze construction and can adequately cope with this surge provided the pen mechanism is cycled up-down at a rate not faster than once per 12 seconds.

Instructions in the User Guide do point out that the pen system should not be continuously activated, and in normal use this will not happen.

Reason for Failure

The pen system is driven via power driver circuits directly from the board processor. Loss of processor control may cause overdriving and consequential pen system burn-out.

Prime Cause of Failure

Under normal circumstances, the processor should always retain control of the pen drive system such that resistor burn out should never occur.

However, fault diagnoses of returned units have revealed a number of modes of failure by which the processor can lose control.

These failure modes are detailed below:

- A Faulty battery pod contacts caused by contact corrosion.
- B Unit vibration.
- C Faulty on-off switch.
- D Faulty processor.
- E Faulty electronic components other than processor.
- F Misuse.

Contact Corrosion

The contact corrosion problem is caused by battery alkaline leakage occurring when the batteries are fully discharged.

A change is in hand to nickel plate all contacts to avoid this problem in future.

Unit Vibration

The unit vibration problem is very dependent on battery pod spring strength and level of vibration. It may be assumed that all units will suffer from this problem, although the level of vibration will depend on spring strength.

Under normal circumstance units should not be immobilised by this problem, but a number of units have been found to have weaker than normal springs, and this is being investigated.

Faulty On-Off Switch

This failure mode relates to switches which do not make reliably during turn-on.

These first three failure types result in the on-board processor reset requirements being contravened and consequential loss of control over the pen-drive circuitry: a similar problem was encountered with the Communicator during power up, which was nullified by incorporation of a protective thermistor in the I.R. output stage.

Faulty Processor

A number of units (three to date) have burnt out due to faulty 8048 processors.

Each of these failures was identical and they have been termed "leaky ram" failures.

Essentially, the firmware is structured into modules, with routines being "called" at the appropriate point.

When the Turtle unit has been left in a "waiting for I.R. input" condition for some minutes, the sub-routine return address has become corrupted causing loss of program control and burn out.

However, limited program control is re-attained enabling the unit to move as normal while the pen system continues to burn out.

The nature of the failure indicates an internal device failure, requiring device replacement.

Faulty Electronics Components

This failure mode relates to any of the components in the pen system electronics, the processor reset capacitor, oscillator circuits and five volt regulator. Specifically, a number of burn outs have occurred immediately following unit turn on, which cannot be related to any of the above failure modes, but may be pinpointed to incorrect processor 'time constant' reset conditions. This has been due to a faulty timing capacitor on the processor reset pin.

Misuse

This is possibly the most obscure problem and, for a returned unit, not easily diagnosed.

A number of methods of misuse may be identified:

- 1) Software overdriving of pen system.
- 2) Incorrect battery pod re-assembly.
- 3) Dropping of unit.

The first mode has been discussed earlier.

The second mode may relate to incorrectly tightened lid screws, wrong batteries, and so on.

The third mode is an extreme level of vibration, which has been discussed earlier.

Each of these misuse conditions may result in a unit being returned.

Conclusions

A number of failure modes by which the pen-system may burn out have been identified.

Obviously, those units with definite faults will be returned regardless, but other units may experience a burn out condition only on a very infrequent basis.

Under these latter circumstances, provided the unit is modified to withstand a full pen-system turn-on situation, simply turning the unit off and then on again will remove the fault. In circumstances where the condition occurs more frequently, a recommended cleaning of battery contacts will be necessary.

Recommendation

It is recommended that the pen drive limiting resistors R39 and R40 be replaced with thermistors in order that board damage is avoided when a potential burn-out condition is experienced by the unit due to misuse. Refer to change request dated 16.3.85.

ELECTRONICS DIAGNOSTICS REPORT 002

Nature of Failure

The fast charge circuit condition is not reliably invoked when setting the power switch on the turtle to the 'CHARGE' position.

Description of Circuit

The charger system consists primarily of a comparator based single flip latch circuit which is thrown on detection of a charged battery stack, when operating in the 'FAST' charge mode only.

By appropriate sequencing of 'CHARGE' switch selection and application of external power, the 'SLOW' charge mode may be selected in preference to the 'FAST' condition.

When illuminated, the PCB mounted yellow Led indicates that the charger circuit is operating in the FAST charge mode.

In this mode, approximately 0.5 Amps is drawn as the charge current and bypasses the slow charge resistive limiter.

A battery thermal detection circuit causes the latch circuit to flip to the 'SLOW' charge condition, reducing the charge current to approximately 60 milliamps via the limiter resistor.

Reason for Failure

Switching into the fast charge mode is reliant on a clean power switching action by the ON-OFF-CHARGE switch.

A capacitor, C17, is incorporated to slug the comparator circuit in the event of incomplete switch contact and was found to be adequate initially. However, a number of units have proved unreliable and this is due to an elongated power application phase, whereby the supply makes and breaks over a period exceeding 1 millisecond.

Prime Causes of Failure

The prime cause is attributed to the variation in quality of the three position switch on the Turtle - a fact which was not apparent during the first manufacturing batches. An alternative cause may be a change in switch wiring practice, but this has not yet been determined.

In addition, it is not known how well these switches will age: with the likelihood of increasing charge mode selection difficulties.

Conclusion

The failure to switch into fast charge mode is not a permanent feature - normally the mode can be invoked after one or two repeated tries. However, this characteristic is likely to prove bothersome to the user.

Recommendation

It is recommended that the slugging capacitor C17 be increased to reduce the effect of the faulty charge mode switching. This will not entirely eliminate the problem, but will greatly reduce the occurrence.

The modification is as detailed in change 2 of the Change Request dated 16.3.85.

ELECTRONICS DIAGNOSTICS REPORT 003

Nature of Failure

Variable responsiveness of Turtle Mk II Unit to infra-red commands when set to ident (address) 3. The unit, when set to this address, will operate correctly over a much reduced range.

Description of Circuit

Refer to document VDL1/103.

Reason for Failure

Noise pick-up in the I.R. receiver-amplifier from the detector latch control signals causing signal garbling at low input intensities and consequent lack of response.

Prime Cause of Failure

The addition of the remote D.I.L. switch for ident selection and minor PCB layout changes from the MK I production variant have caused the I.R. receiver to become more prone to noise pick-up.

Although difficult to confirm, the changes in the PCB layout and the incorporation of a remote D.I.L. switch appear to have changed the board decoupling requirements.

Accordingly, the performance of the default turtle (ident 0) remains at the same level as the MK I units, with each switch closure causing a progressive increase in noise pick-up. (This pick-up only signifies itself for units set to ident 3).

Conclusion

The noise problem will not identify itself unless the Turtle is being used in a Multi-Turtle mode.

Recommendation

1. A change in the decoupling capacitor C3 reduces noise levels for all idents onto a parallel with the MK I Turtle. Accordingly, the change recommended is detailed in the change note dated 16.3.85 (clause 3).
2. In the event of field problems, recommend that the unmodified Turtle is used with an ident setting of 0. These susceptible units should be identifiable from serial numbers.

ELECTRONICS DIAGNOSTICS REPORT 005

Nature of Failure

Turtle intermittent movement (juddering) in response to infra-red commands.

Description of Circuit

Refer to VDL1/103

Reason for Failure

Noisy infra-red receiver diode (or diodes) D22-D27 Type BPW41D. Scope testing at IC8 Pin 2 with respect to board ground plane reveals high amplitude spikey noise far in excess of 100mV pk-pk typical noise signal attributed to a 'healthy' board.

This noise may be very intermittent, but may be induced by mechanically flexing the components in turn on the board.

Prime Cause of Failure

The prime cause is essentially an internal BPW41D mechanical bonding failure between the receiver chip and lead.

The manufacturer has modified manufacture procedures to eliminate the supply of faulty batches of components such that this fault should no longer occur.

Conclusion

The juddering fault attributable to faulty manufactured BPW41D diodes should no longer occur, as the manufacturer has incorporated additional procedures to eliminate this type of fault.

However, all Turtle units numbered VDL1/01/01000 through to VDL1/01/01999 may be considered at risk, although these units were subjected to extensive screen testing prior to delivery, so the majority should not suffer from this problem.

Recommendation

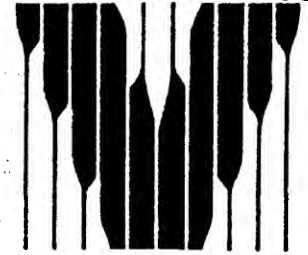
Although it is often possible to identify the faulty component, it is possibly more cost effective to replace all 6 diodes.

DAE 9.4.85.

TURTLE PROJECT

VALIANT

Designs
LTD



TITLE <u>TEST SPECIFICATION FOR MK IV COMMUNICATOR BOARD</u>
--

DOCUMENT N^o VDL1/102

ISSUE N ^o	PREPARED	CHECKED	APPROVED	COMMENTS
A	DAE	DC	DC	10/8/84

TEST SPECIFICATION FOR MK IV COMMUNICATOR BOARD

VALIANT DESIGNS SPECIFICATION NO.: VDL1/102

ISSUE	A					
BUILD	30025					
DATE	10/8/84					
PREPARED	DAE					
CHANGE NOTE	-					

VALIANT DESIGNS LTD., Unit 13, Park House, 140 Battersea
Park Road, Battersea, LONDON SW11 4NB

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1.0 INTRODUCTION

The purpose of this document is to define test procedures for the MK IV Communicator.

Because of the nature of the unit, whereby 'slow' inputs are translated into a fast data stream of infra-red pulses, it is assumed that a reception unit is available to receive the infra-red output and translate it into a 'static' digital signal suitable for input into either a computer or ATE system.

The document is split into three sections - A, B, and C: Section A relates to circuit testing where individual components, or parts of circuits, may be tested.

Section B relates to functional testing, where the unit is tested as a fully functional unit.

Section C defines the dynamic behaviour of those circuit functions which are not adequately covered in the first two sections.

2.0 FUNCTIONAL DESCRIPTION

The Communicator is a single board unit, designed to receive either parallel or serial data from a host computer and to translate that data into a pulse position encoded infra red transmission.

With reference to the block diagram of Fig. 1, the Central Computer block comprises a single chip microcomputer programmed to carry out all major control, decoding and encoding operations within the unit.

Via the DIL switch, the unit may be configured for either serial or parallel reception modes. When operating in the serial mode, the computer functions as an asynchronous serial receiver, baud rate selection being a firmware time measurement function reliant on the correct initialisation codes being transmitted to the unit immediately following power up. As a self check procedure, the unit will only become functional if the correct two byte initialisation codes are received, and this applies to both parallel and serial operation.

The Serial Interface block comprises line receiver circuitry converting RS423/232 bipolar voltage signals into TTL equivalent for input to the computer, and three bipolar voltage outputs providing the RS232 RTS function, RTS, and a handshake line IROP. The bipolar I/O 0V reference is not at the same potential as the main digital 0V within the unit, being nominally at +6V.

The Parallel Interface block comprises an 8 bit latch into which data is strobed from the host system and which connects on output directly to the computer; a pulse stretcher to ensure that short duration strobes are detected by the processor; and two handshake lines equivalent to the IEE 488 NRFD and NDAC functions. By means of the DIL switch and external cabling options, the logic status of the strobe, NDAC and NRFD lines may be customised according to the host system requirements. All lines are TTL compatible.

The I.R. Pulser stage comprises a dual D Type Flip-Flop which provides a single 2.5 microsecond pulse following a clock input from the computer. The output from this feeds directly to the I.R. Output Stage.

The I.R. output stage comprises a CMOS to TTL buffer stage, TTL to FET driver stage and I.R. output array pulsed via the FET transistor.

The Led Indicator consists of a simple driver circuit and is controlled directly from the computer to indicate power application, initialisation and transmission activities.

The power supply provides a nominal \pm 12V supply and + 5V supply and is driven from a D.C. power adaptor providing 24V D.C.

SECTION A: CIRCUIT TESTING

3.0 POWER SUPPLY AND CONSUMPTION TEST

Special Note: The power supply test should be implemented on a short duration power application basis in order to prevent possible component burn up. This specifically relates to R26, whereby any failure to re-set the I.R. output stage will cause excessive power dissipation in this component, due to this stage being permanently enabled.

- 3.1 Apply 24 Volts DC to unit between Sk2/2 (positive) and Sk2/1 with current limit set to 200 milliamp.
- 3.2 Confirm that the current consumption lies between 70mA and 200mA.
- 3.3 Confirm that the voltage across D8 is 12 ± 1 Volts.
- 3.4 Confirm that the voltage between PSR1 Pin 2 and PSR1 Pin 3 is $5V \pm 0.25V$ (PSR1 Pin 2 is positive).
- 3.5 Confirm that the voltage across R15 is $12V \pm 1V$.

4.0 SERIAL INTERFACE OUTPUT CIRCUIT TEST

4.1 Set DIL switch position 1 to off.

4.2 Apply 24V DC to board with 200mA current limit.

4.3 Short IC1 Pin 4 to 0V.

4.4 Apply TTL level '0' to IC1/Pins 21,37,38 and confirm that the outputs at PL3/2, PL3/3 and PL3/5 w.r.t. 0V are all greater than +8 volts.

4.5 Apply TTL level '1' (or otherwise float) to IC1/Pins 21,37,38 and confirm that the outputs at PL3/2, PL3/3 and PL3/5 w.r.t. 0V are between 0V and -1V.

4.0 SERIAL INTERFACE OUTPUT CIRCUIT TEST

- 4.1 Set DIL switch position 1 to off.
- 4.2 Apply 24V DC to board with 200mA current limit.
- 4.3 Short IC1 Pin 4 to 0V.
- 4.4 Apply TTL level '0' to IC1/Pins 37, 38 and confirm that the outputs at PL3/3 and PL3/5 w.r.t. 0V are all greater than +8 volts.
- 4.5 Apply TTL level '1' (or otherwise float) to IC1/Pins 37, 38 and confirm that the outputs at PL3/3 and PL3/5 w.r.t. 0V are between 0V and -1V.
- 4.6 Apply TTL level '0' to IC1 Pin 21 and confirm that the output at PL3/2 w.r.t. 0V is more positive than +8 volts.
- 4.7 Apply TTL level '1' (or otherwise float) to IC1 Pin 21 and confirm that the output at PL3/2 w.r.t. 0V is more negative than -8 volts.

5.0 SERIAL INTERFACE INPUT CIRCUIT TEST

5.1 Apply 24V DC to board with 200mA current limit.

5.2 Short IC1 Pin 4 to 0V.

5.3 Apply to P3/1 -0.4 volts w.r.t. PL3/4.
(Note: This input is required to be floating as signal
0V at PL3/4 is 6V above the main board 0V)
Confirm that the signal at IC1 Pin 1 is TTL level '1'.

5.4 Apply to PL3/1 +0.4V w.r.t. PL3/4 and confirm that the
signal at IC1 Pin 1 is TTL level '0'.

6.0 PARALLEL INTERFACE CIRCUIT TEST

6.1 Set DIL switch as follows:

Position 3 to on

Position 4 to on

6.2 Apply 24V DC to board with 200mA current limit.

6.3 Short IC1 Pin 4 to 0V.

6.4 Strobe Input Test

6.4.1 Apply TTL logic '1' to PL1/15.

6.4.2 Confirm that IC4 Pin 11 is at TTL logic '1'.

6.4.3 Confirm that IC6 Pins 14 and 7 are within 0.1 volts of the +5v supply.

6.4.4 Confirm that the level at IC1 Pins 23 and 6 is at logic 1.

6.4.5 Confirm that the level at IC3 Pin 11 is at logic '1'.

6.4.6 Set PL1/15 to logic 0.
Confirm that the following positions are all at logic 0:

IC6 Pins 14 and 7

IC1 Pins 23 and 6

IC3 Pin 11

6.5 Latch Test

6.5.1 Apply the following codes to the input pins as detailed below and confirm that the same code is present on the output pins following application of the strobe pulse, as instructed in clause 6.5.2. All levels are TTL.

Data Line	Input	Output	Applied Code					
			1	2	3	4	5	6
DAT 1	PL1/1	IC1/27	0	1	0	1	1	0
DAT 2	PL1/2	IC1/28	0	1	1	0	1	0
DAT 3	PL1/3	IC1/29	0	1	0	1	0	1
DAT 4	PL1/4	IC1/30	0	1	1	0	0	1
DAT 5	PL1/5	IC1/31	0	1	0	1	1	0
DAT 6	PL1/6	IC1/32	0	1	1	0	1	0
DAT 7	PL1/7	IC1/33	0	1	0	1	0	1
DAT 8	PL1/8	IC1/34	0	1	1	0	0	1

6.5.2 With Strobe at PL1/15 at logic 1, set to logic 0, then back to logic 1.
Data is clocked into latch on rising edge of Strobe when SW1 Positions 3 and 4 are set to on.

6.6 Control Line Test

6.6.1 With reference to the tables below, apply the TTL input combinations as listed and confirm that the outputs conform accordingly.

a) NDAC Output

Inputs		Output
IC1/37	PL1/11	PL1/13
0	FLOAT	1
1	FLOAT	0
0	0	0
1	0	1

b) NRFD Output

Inputs		Output
IC1/38	PL1/12	PL1/14
0	FLOAT	1
1	FLOAT	0
0	0	0
1	0	1

7.0 LED INDICATOR TEST

7.1 Apply 24V DC to board with 200mA current limit.

7.2 Short IC1 Pin 4 to 0V.

7.3 Confirm that TR2 collector is within 0.3V of 0V.



7.4 Set IC1 Pin 36 to logic '0'.

7.5 Confirm that TR2 collector is at +12Vp potential.

8.0 I.R. DRIVER CONTROL STAGE TEST

Note: Although the microcomputer reset pin is held low throughout In-circuit testing, causing port outputs to be held in a high impedance '1' state, the Address Latch Enable (ALE) line from IC1 Pin 11 continues output. For this test, this line requires external over-riding control, subjecting the IC output to possible back driving stress. In order to avoid stress on this component, the duration of the test will have to be limited to a 'safe' operating period.

- 8.1 Apply 24V DC to board with 200mA current limit.
- 8.2 Short IC1 Pin 4 to 0V.
- 8.3 Short TR1 Gate to -12V rail.
- 8.4 Confirm that the voltage at the node R13/R21 w.r.t. 0V is between +1.42V and +1.70V.
- 8.5 Confirm that the output nodes are at the logic states as defined in the table below against each control input condition.

Comment	Control Inputs		Outputs		
	IC1/35	IC1/11	IC2/9	IC6/10	IC5/5
Initial Condition Free Run ALE	1		0	0	1
*	0	0	0	0	1
Control Clock	1	0	1	0	1
*	0	0	1	0	1
ALE Clock	0	1	0	1	0
*	0	0	0	1	0
ALE Clock	0	1	0	0	1
*	0	0	0	0	1
ALE Free Run	0		0	0	1

* No output change

9.0 I.R. OUTPUT STAGE TEST

Note: Pulse application to the I.R. output stage must be limited to less than 20us to avoid over-stressing of stage.

- 9.1 Apply 24DC to board with 200mA current limit.
- 9.2 Short IC1 Pin 4 to 0V.
- 9.3 Confirm that the voltage at IC5 Pin 5 is logic 1.
- 9.4 Confirm that the voltage at IC5 Pin 6 is within 5V of the -12V rail.
- 9.5 Confirm that the differential voltage across R1 is less than 30mV.
- 9.6 Set IC5 Pin 5 to logic 0 (Refer to section note above).
- 9.7 Confirm that the voltage at IC5 Pin 6 is within 3V of +12Vp.
- 9.8 Confirm that the differential voltage across R1 is greater than 4 volts but less than 7 volts.
- 9.9 Set IC5 Pin 5 to logic 1.

SECTION B: FUNCTIONAL TESTS

This section defines the Functional Test requirements of the Unit. It assumes the availability of an I.R. Reception Unit capable of receiving, decoding and transmitting the resultant code word(s) back to the host system via an 8 bit parallel interface. It assumes that the Unit has passed at least the power supply test of section 3.0.

10.0 PARALLEL INTERFACE OPERATION

10.1 Equipment Set Up Procedure

- a) Connect Communicator to parallel output port of Host System, via Parallel Cable defined in Appendix A.
- b) Set SW1 as follows:
Position 1 off
Position 2 off
Position 3 on
Position 4 on
- c) Connect I.R. Reception Unit into input port of Host System via second Parallel Cable defined in Appendix A.

10.2 Apply power to Communicator and I.R. Reception Unit.

10.3 Confirm that the Indicator Led within the Communicator is illuminated.

10.4 Output the initialisation code words 0DH and 55H to the Communicator according to signal control sequence defined in section 13.0.

10.5 Ensure that the unit has initialised by confirming that the Indicator Led has extinguished.

10.6 For each double byte output sequence to the Communicator, read and confirm that the codes received by the I.R. Reception Unit are those defined according to the table below.

Refer to Appendix B for details on operation of the I.R. Reception Unit.

Outputs to Communicator		Received Code	
1st Byte	2nd Byte	1st Byte	2nd Byte
00H	00H	00H	00H
FFH	FFH	FFH	03H
55H	02H	55H	06H
AAH	01H	AAH	05H

11.0 SERIAL INTERFACE OPERATION

11.1 Equipment Set Up Procedure

- a) Connect Communicator into serial RS232 output port of Host System via serial cable defined in Appendix C.
- b) Set SW1 Position 1 to ON
Position 2 to OFF
Position 3 Don't Care
Position 4 Don't Care
- c) Connect I.R. Reception Unit into input port of Host System via parallel cable, type according to Appendix A.
- d) Set Host System serial I/O baud rate to either 2.4k or 4.8k; set to 8 data bits; parity and stop bits are don't care.

11.2 Apply power to Communicator and I.R. Reception Unit.

11.3 Confirm that the Indicator Led within the Communicator is illuminated.

11.4 Output from the Host System the two initialisation characters 0DH and 55H according to the signalling requirements defined in section 14.0

11.5 Ensure that the Unit has initialised by confirming that the Indicator Led has extinguished.

11.6 For each single byte transfer to the Communicator, read and confirm that the codes received by the I.R. Reception Unit are those defined according to the table below.

Refer to Appendix B for details on operation of the I.R. Reception Unit.

Serial Output to Communicator	Received Code	
	1st Byte	2nd Byte
00H	00H	03H
FFH	FFH	03H
55H	55H	03H
ABH	ABH	07H

SECTION C: DYNAMIC PERFORMANCE

This section details the dynamic operation of the unit under normal operating conditions.

12.0 SYSTEM CLOCK

All system (firmware) operations are timed against the ALE output clock from IC1 Pin 11. This clock is itself derived from a 6MHz oscillator circuit formed by the on-chip IC1 circuitry and externally connected crystal.

The ALE output is required to be of 2.5 microsecond \pm 0.05% period, with a high to low ratio of very approximately 1 to 4.

13.0 PARALLEL INTERFACE OPERATION

The Parallel Interface is essentially designed to function as a 'cut-down' IEEE 488 listener only port, consisting of DAT1 to DAT8, DAV, NDAC and NRFD. However, in the majority of instances, utilisation of all these lines is not necessary, such that in the minimal interface case only DAT1 to DAT8 and DAV may be used.

The signal lines conform in terms of logic sense to the IEEE specification on input/output to IC1 as follows:

Input: DAT1 to DAT8	= IC1 Pin 27 through to Pin 34 respectively
Input: DAV	= IC1 Pins 6 and 23
Output: NDAC	= IC1 Pin 37
Output: NRFD	= IC1 Pin 38

Figure 2 shows the operational sequence of this interface.

To provide additional flexibility of this interface, each control line passes through an exclusive or-gate - providing the option to invert the logic sense of the signal presented at the board plug PL1.

As may be seen from the figure an additional signal denoted DAV(PL1/15) is shown with a minimum timing of 0.5 microseconds, as may be expected from a Centronics type interface. In such circumstances, it is unlikely that the microcomputer would detect this signal except on rare occasions. Accordingly, the signal is pulse stretched prior to input to IC1.

When operating this interface against a host system that can be 'hand shaken', DAV (or Strobe) may be held in its active state until the Communicator has signalled back to the host system via NDAC that it has received DAV true. At this point, the Host may clear the signal and allow the Communicator to read the data from the eight bit latch

It is also worth noting that the clocking edge for data into the latch may also be selected according to requirement, although it would normally be set to the trailing edge of DAV.

A further facility offered by the interface is the NRFD (or Not Ready For Data) line, and this may be used by the Host System to ensure that data is only outputted when this line indicates readiness of the Communicator to receive. However, for a trailing edge DAV clock, this facility need not be used.

The facilities offered by the interface allow operation against very fast strobed ports, or, at the opposite extreme, very slow hand shaken systems.

14.0 SERIAL INTERFACE OPERATON

14.1 This interface primarily conforms to the signal type and form normally attributed to RS232. Three signals are provided:

Received Data (RxD) (Input)

Ready to Send (RTS) (Output)

Inverted Ready to Send ($\overline{\text{RTS}}$) - not normally used (Output)

All signals are referenced against the serial interface Signal 0V, which is held some 6V above the main digital 0 Volts within the Communicator.

Accordingly, CAUTION must be exercised when subjecting the Communicator to testing to ensure that the two 0 Volt systems are not unbalanced by means of test equipment earthing. It is recommended that the serial interface is transmitted via an isolation Receiver-Transmitter in order that the main Test Equipment be grounded.

In order to account for those host systems which specify RS423 signal levels rather than RS232, the two outputs are voltage limited to conform to the former. However, under normal circumstances, both interfaces are compatible. Figure 3 details voltage levels for the interface.

14.2 Received Data

Serial Data is received via a buffer circuit designed to convert RS232/423 voltage levels to TTL before input to the microcomputer input PL1 Pin 1.

With reference to Figure 3, it may be seen that the input line is quiescently logic 1.

The signal start is denoted by a logic 0 start bit, followed by 7 or 8 data bits (The Communicator requires DIL switch setting for data bit selection).

The status of the trailing parity bit and number of stop bits is not firmware tested.

14.3 Request to Send (RTS)

This signal, output from IC1 Pin 37, is used to inform the host computer that the Communicator is busy, and is set to logic 1 shortly after a serial input has been completed.

It is cleared, i.e. set to logic 0, when the infra-red transmission is completed and ready to receive the next serial input.

The $\overline{\text{RTS}}$ line output from IC1 Pin 38 is an exact replica of the RTS signal, but inverted.

14.4 Baud Rate

There are no Communicator facilities for baud rate selection.

The system has been designed as self adjusting, requiring an initialisation character following power-up, but timing limitations constrain flexibility to only two standard rates: 2400kB and 4800kB.

15.0 INDICATOR LED OPERATION

This function has been provided to enable the user to ascertain certain operational conditions of his system and provide him with a level of confidence that his system is functioning.

The Led provides three specific functions, depending on the time of observation.

a) Power Up

On power application to the Communicator, the led will become illuminated.

b) Following initialisation involving the transfer of two specific codes from the Host System, the led should normally go out, indicating that the unit has initialised correctly.

Failure to go out would usually indicate incorrect Host operation, cables not connected, or wrong switch settings within the Communicator.

c) Following initialisation, each command transmitted to the Communicator will be encoded into an infra-red output.

For each infra-red command output, the led will change state, providing a toggling action.

16.0 I.R. OUTPUT OPERATION

Following reception of a command code from the host, the microcomputer translates this command into a string of infra-red output pulses which are time position dependent on logic state.

The processor outputs a string of clock edges to the dual D-Type Flip-Flop IC2. These clock edges are converted into 2.5 microsecond pulses by virtue of the cross-coupling of the D-Types and the secondary ALE Clock input.

These pulses are then sent via a comparator circuit IC6, which converts the CMOS output signal levels from IC2 to TTL prior to input to the RS232 transmitter interface IC5. The function of this circuit is to provide a full 24V supply swing on the power FET gate terminal, in order to ensure full turn-off and turn-on. The turn-on current through the I.R. diodes D1 to D4 is between 1.5 and 2 Amps, and may be monitored by differential sensing across the 3.3 ohm resistor R1.

R26 is provided as a protection device to limit the driver current in the event of above normal pulsing periods of the I.R. output stage, as may be experienced during unit power-up and power-down. However, permanent turn-on situations will cause R26 to burn out and would only occur as a result of a unit fault.

Figure 4 shows typical waveform as would be found at the various nodes in the circuit for a command output from the host of 01101000.

17.0 IROP CONTROL FUNCTION

In order to allow individual and concurrent operation of more than one Turtle robot within a confined area, the infra-red transmissions require sequential control in order to avoid timing conflicts.

The IROP output line has been provided to facilitate this control and is used in conjunction with the RxD input. The facility is only relevant when the Communicator is being operated in a parallel interface mode.

Normally, when sequencing control is not required, the serial input RxD is biased such that the input at IC1 Pin 1 is held permanently in a logic 1 state, thus permanently enabling transmissions. Holding this line in the other state will halt transmissions until such time as the line is taken back to its logic '1' condition.

The IROP line has been provided to indicate when the Communicator is ready, and indeed demanding, to transmit, such that via an external Sequencing Control Unit, the necessary timing control may be exerted on the RxD line in order to phase or interlace transmissions. Accordingly, the IROP output at PL3/2 goes to logic 0 when a transmission demand is present and is cleared only when the transmission is completed. Refer to Figure 5 for typical timing diagram.

FIGURE 1. SYSTEM BLOCK DIAGRAM.

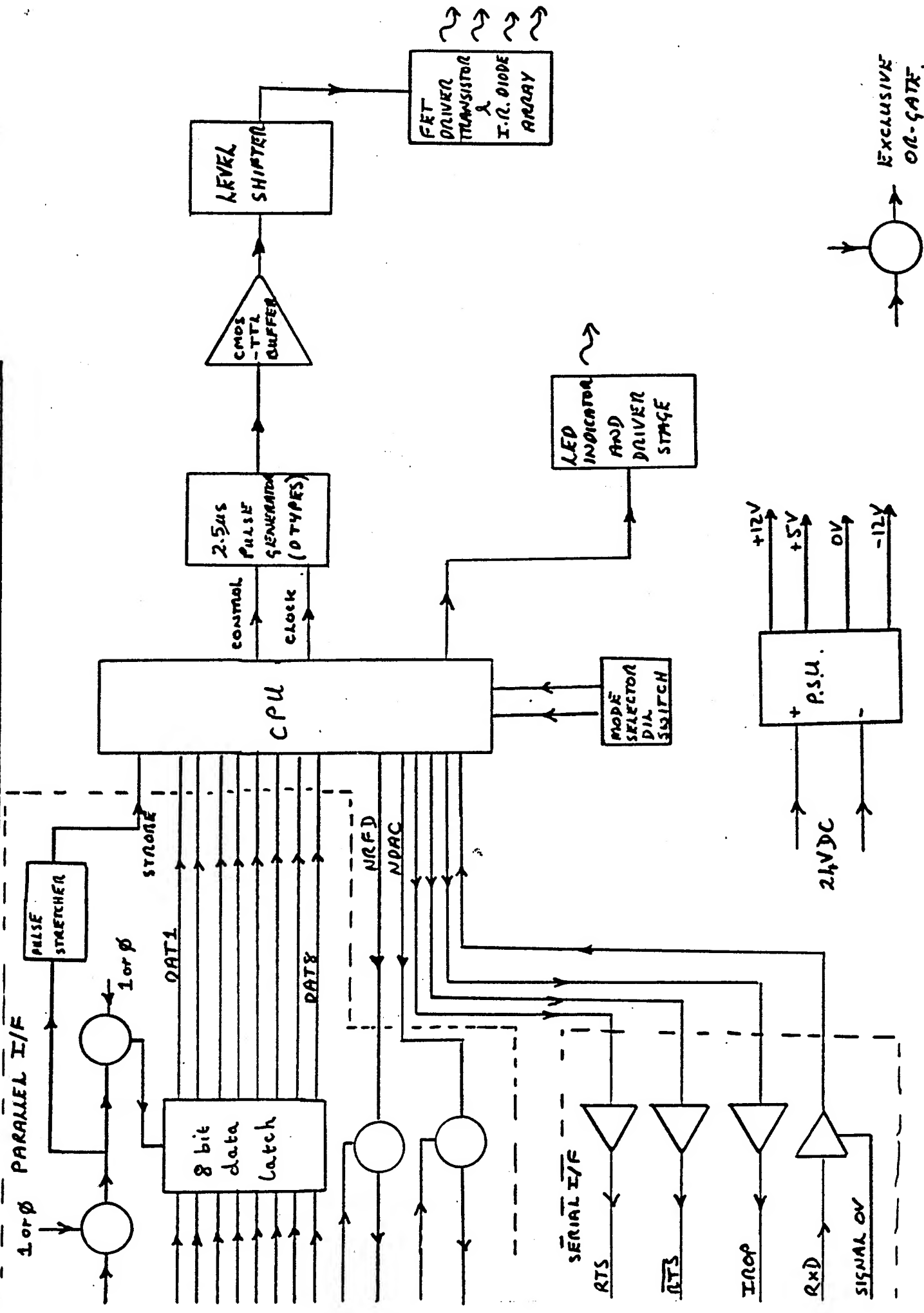
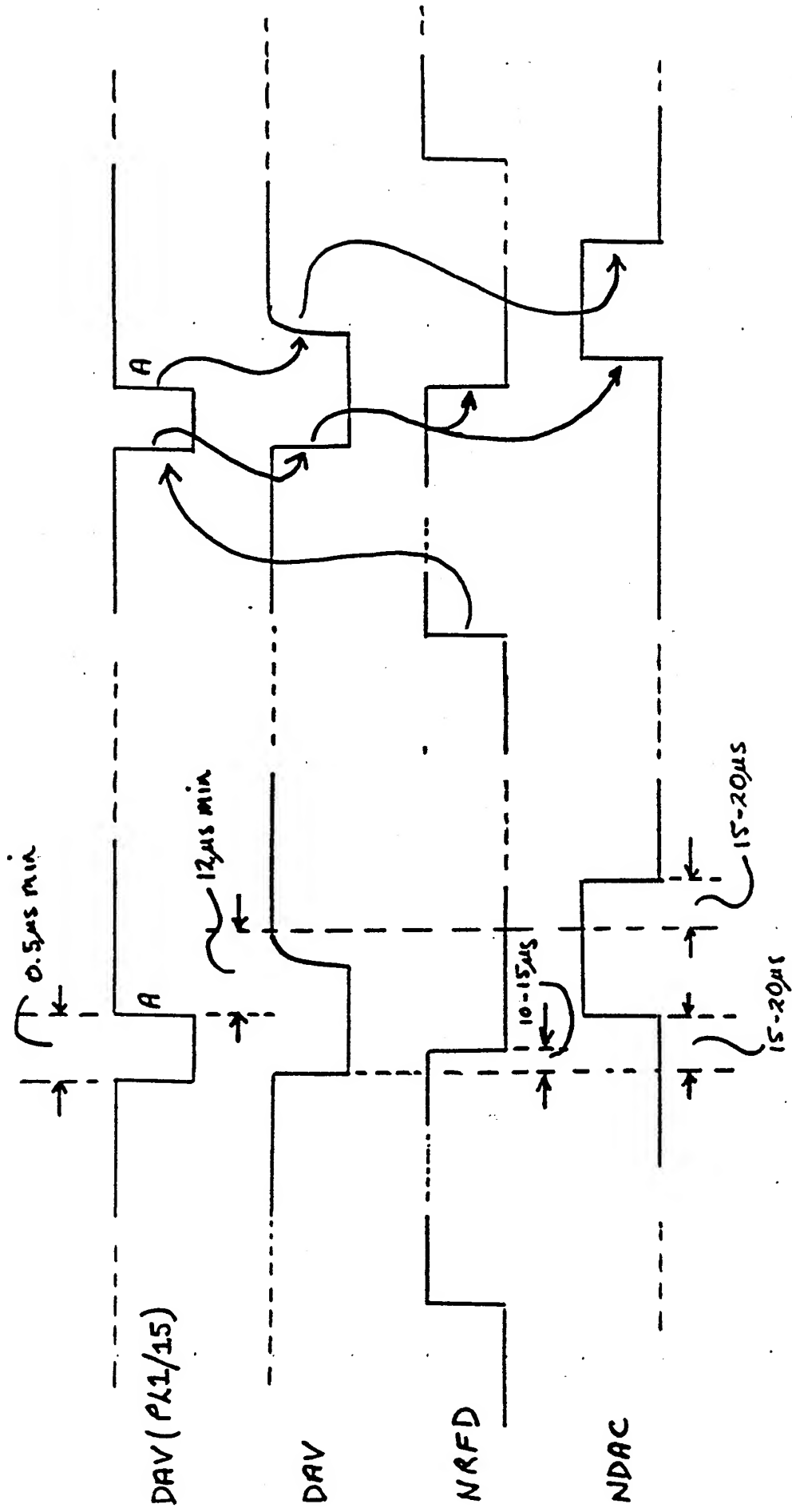
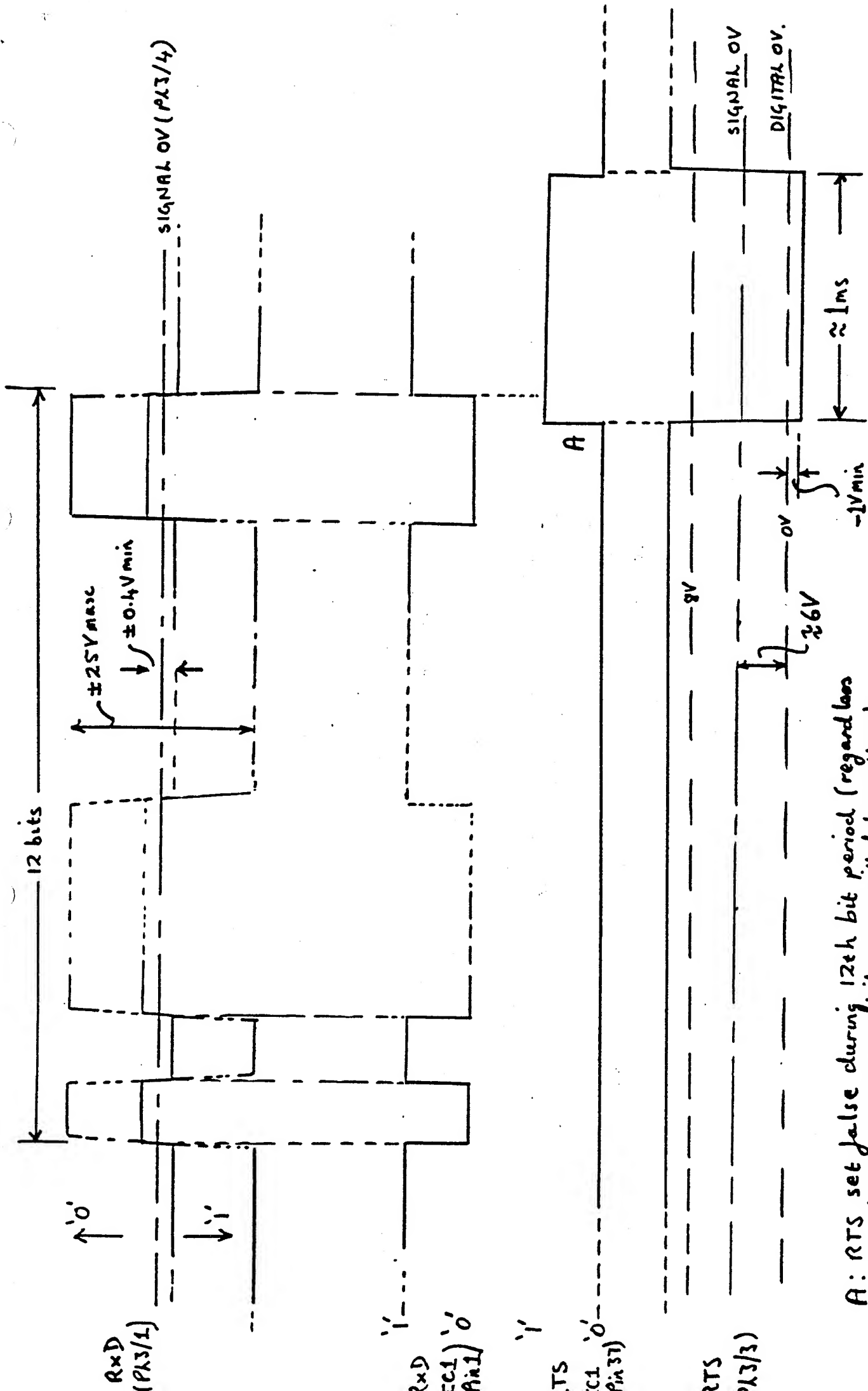


FIGURE 2. PARALLEL I/F SIGNALLING DIAGRAM.



A = normal clocking edge for data storage into latch;
 data set up in advance of this edge.



A: RTS set false during 12th bit period (regardless of whether or not 12 bits transmitted from Host)

FIGURE 3 SERIAL I/F SIGNALING DIAGRAM.

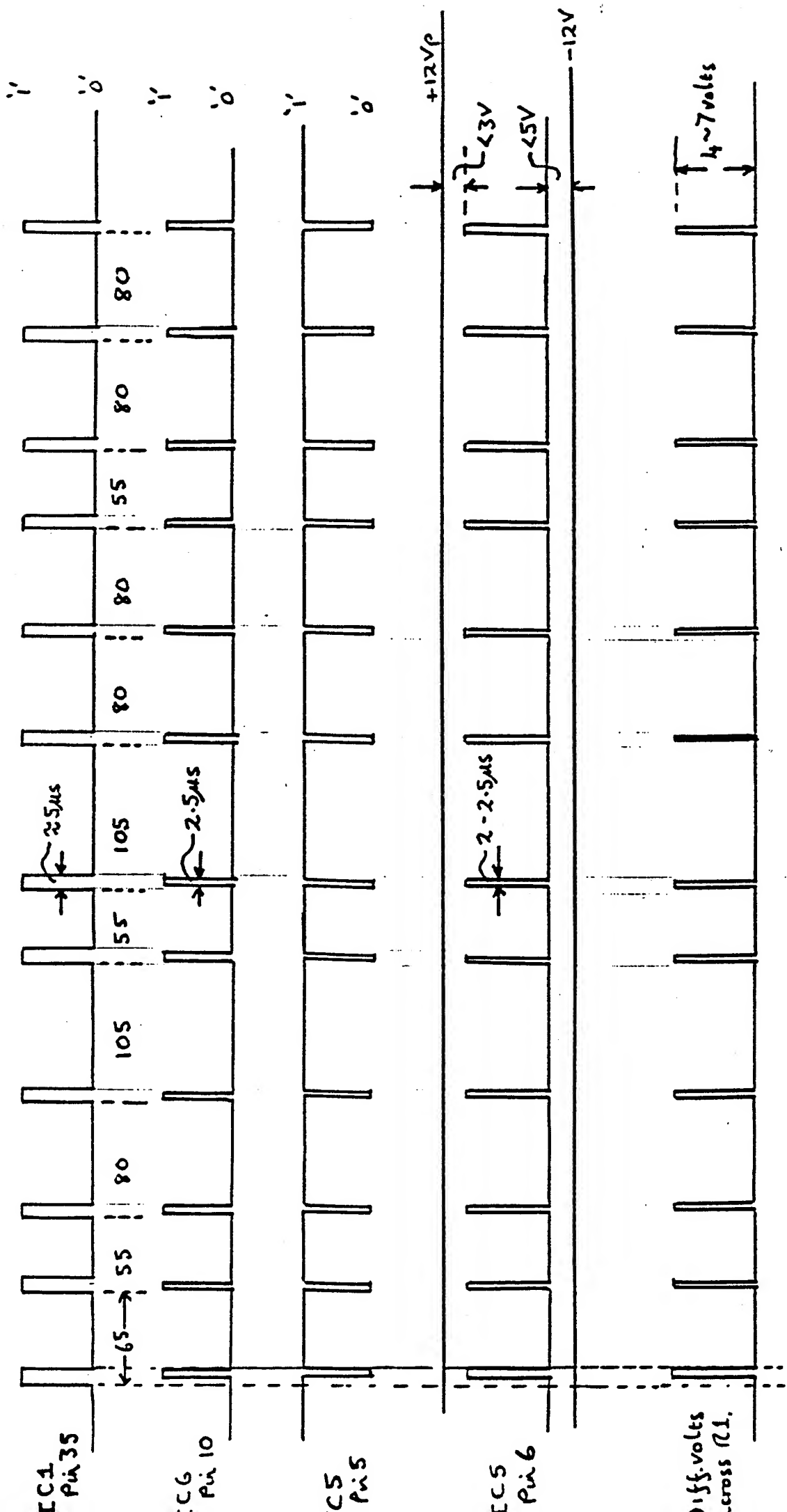


Figure 4 I.R % System Signalling Diagram .

TEST SPECIFICATION FOR MK IV TURTLE CONTROLLER BOARD

VALIANT DESIGNS SPECIFICATION NO.: VDL1/103

ISSUE	A					
BUILD	30024					
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VALIANT DESIGNS LTD., Unit 13, Park House, 140 Battersea
Park Road, Battersea, LONDON SW11 4NB

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1.0 INTRODUCTION

The purpose of this document is to define the test procedures for the MK IV Turtle Controller Board.

The document is split into three sections - A,B, and C:
Section A relates to individual circuit testing on a block by block basis;
Section B relates to functional testing, where the board may be tested in conjunction with a representative Turtle test chassis, or as a fully built production Turtle;
Section C relates to the dynamic behaviour of those circuit functions or elements not sufficiently covered in the previous two sections.

2.0 FUNCTIONAL DESCRIPTION

2.1 Turtle Robot

The Turtle Robot is a remotely controlled educational instrument which performs as a perfect slave to commands transmitted from the Host Computer System.

The unit receives commands via an infra-red link, and, following decoding, will activate its stepper motors, as appropriate, to provide unit motion, or its pen motor to either lift or lower a pen in order to provide drawing control.

The unit is powered via a nicad battery pack and fast charge facility is provided in order to minimise down time.

2.2 Turtle Controller Board

The Turtle Controller board provides all of the circuitry necessary to facilitate the functions described in 2.1 above.

Figure 1 is a block schematic of the board showing the major constituent parts and inter-connections.

The charge controller is used only during battery charging and is powered only during this mode - selected by the Turtle three position power switch. The circuit permits unit fast charging until such time as the on-board monitoring circuitry detects a charged stack status, causing reversion to a slow charge condition, which may be maintained indefinitely.

The charger supply is the same power unit as used to power the Communicator.

The Infra-Red Receiver performs the task of I.R. detection and amplification in order that the signal be digitised prior to input to the Detection Gate.

The Detection Gate 'opens' under microcomputer control at specific times in order to search and store infra-red detections. At the end of the gating period, the microcomputer reads the status of the circuit and then resets it in readiness for the next detection period.

The microcomputer reads and decodes the input I.R. command read from the Detection Gate and powers the Pen Motor or Stepper Motor drive circuits accordingly.

SECTION A: CIRCUIT TESTS

3.0 POWER SUPPLY AND CONSUMPTION TEST

Special Note: Power supply application should be implemented on a short duration power application basis in order to prevent component burn up. Special consideration must be attributed to the Pen Motor Drive Circuit which is toleranced for short drive durations (of order of 1 second).

- 3.1 Short IC5 Pins 1,2,3,4 to 0V in order to disable Pen Motor Drive Circuits.
- 3.2 Apply 12 Volts D.C. ± 0.1 between PL2/6 (positive) and PL2/2 with current limit set to 200mA.
- 3.3 Confirm that current consumption lies between 60mA and 140mA.
- 3.4 Confirm that voltage between IC1 Pin 40 and main ground plane is $+5V \pm 0.25V$.
- 3.5 Confirm that voltage between PSR2 output terminal and main ground plane is $6V \pm 0.4V$.
- 3.6 Confirm that voltage at R6/R22 node with respect to main ground plane is T.B.A.
- 3.7 Turn off supply - end of test.

4.0 BATTERY STATUS CIRCUIT TEST

- 4.1 Connect PL3/2 to PL3/1.
- 4.2 Short IC5 Pins 1,2,3,4 to 0V ground plane in order to disable the Pen Motor Drive Circuits.
- 4.3 Apply +12V between PL2/6 (positive) and PL2/2 with current limit set to 200mA.
- 4.4 Confirm that the voltage at IC8 Pin 7 w.r.t. ground plane is less than 0.4 Volts.
- 4.5 Reduce supply to 10 Volts \pm 0.1 Volts.
- 4.6 Confirm that the voltage at IC8 Pin 7 w.r.t. ground plane is 10 Volts \pm 0.1 Volts.
- 4.7 Turn off supply volts.

5.0 CHARGER CIRCUIT TEST

Special Note: To enable testing of this circuit, constant voltage source of 12V with current sink capability of up to 0.7 Amp is required in order to simulate the Turtle battery pack. Refer to Figure 2 for details of wiring inter-connection.

5.1 Unloaded Charger Circuit Test

- 5.1.1 Apply short circuit between PL2/4 and PL2/3.
- 5.1.2 Apply 12.0 ± 0.1 Volts between PL2/5 (positive) and PL2/2 with current limit set to 25mA.
- 5.1.3 Confirm that the voltage at IC7 Pin 2 w.r.t. 0V ground plane is $5.5V \pm 0.5V$.
- 5.1.4 Confirm that the voltage at IC7 Pin 1 w.r.t. 0V is less than 1 Volt.
- 5.1.5 Open circuit connection between PL2/4 and PL2/3.
- 5.1.6 Confirm that the voltage at IC7 Pin 2 w.r.t. 0V is between 0.5 Volts and 0.7 Volts.
- 5.1.7 Confirm that the voltage at IC7 Pin 1 is greater than 10 Volts.
- 5.1.8 Confirm that the voltage at IC7 Pin 3 is 12.0 ± 0.1 Volts.
- 5.1.9 Turn off supply and disconnect.

5.2 Loaded Charger Circuit Test

- 5.2.1 Short PL2/4 to PL2/3.
- 5.2.2 Connect 12V voltage source/sink between PL2/5 (positive) and PL2/2.
- 5.2.3 Connect 17V D.C. source (output capability 0.7 Amp max.) between PL2/1 (positive) via limiter resistor 5R6 4W and PL2/2 (Refer to Figure 2).
- 5.2.4 Confirm that the current dump out of terminal PL2/5 is $0.5 \text{ Amp} \pm 0.1 \text{ Amp}$.
- 5.2.5 Open circuit PL2/3 from PL2/4.
- 5.2.6 Confirm that the current dump out of terminal PL2/5 is $60\text{mA} \pm 20\text{mA}$.
- 5.2.7 Turn off supply and disconnect voltage source - end of test.

6.0 INFRA-RED RECEIVER TEST

Special Note: The following test assumes the availability of an I.R. Reference source producing two levels of infra-red radiation at the detection diodes mounted on the board under test.

6.1 D.C. Measurements

- 6.1.1 Short IC5 Pins 1,2,3,4 to 0V ground plane in order to disable the Pen Motor Drive Circuit.
- 6.1.2 Apply 12.0 ± 0.1 Volts between PL2/6 (positive) and PL2/2 with current limit set to 200mA.
- 6.1.3 With the infra-red source turned off, confirm that the voltage w.r.t. 0V ground plane at IC8 Pin 2 is between 2.0 and 3.1 Volts.
- 6.1.4 Confirm that the voltage at IC8 Pin 3 is $0.955 \pm 2\%$ of the voltage measured in 6.1.3
- 6.1.5 Confirm that the noise level at IC8 Pin 2 is between 80mV pk-pk and 120mV pk-pk (2σ level).
- 6.1.6 Confirm that the output at IC8 Pin 1 is logic '0'.

6.2 Non-Saturating Receiver Test

- 6.2.1 With circuit board already powered from 6.1, turn on I.R. Reference Source and set to low level output position.
- 6.2.2 Confirm that negative going pulses of approx. 5 microsecond duration and amplitude of 500 + 100mV are present at IC8 Pin 2 (Refer to Figure 4 Trace 4).
- 6.2.3 Confirm that positive going pulses of 5 microsecond duration are output from IC8 Pin 1.

6.3 Saturating Receiver Test

- 6.3.1 With circuit board already powered and I.R. Reference Source on, set I.R. Reference output level to high.
- 6.3.2 Confirm that the voltage at IC8 Pin 3 has reduced to less than 1.5V w.r.t. ground plane potential.
- 6.3.3 Test completed - turn off I.R. Reference Source and turn off power to board.

7.0 DETECTION GATE TEST

- 7.1 Short IC5 Pins 1,2,3,4 to 0V ground plane in order to disable the Pen Motor Drive Circuits.
- 7.2 Short IC1 Pin 4 to 0V on order to disable the micro-computer.
- 7.3 Apply $12V \pm 0.1V$ between PL2/6 and PL2/2.
- 7.4 Confirm that IC1 Pin 36 is logic 1.
- 7.5 Confirm that IC1 Pin 39 is logic 1.
- 7.6 Confirm that IC3 Pin 3 is logic 0.
- 7.7 Set IC1 Pin 36 to logic 0.
- 7.8 Apply momentary short across R55 in order to generate a positive going TTL pulse at IC3 Pin 3.
- 7.9 Confirm that IC1 Pin 39 is logic 0.
- 7.10 Set IC1 Pin 36 to logic 1.
- 7.11 Confirm that IC1 Pin 39 is logic 1.
- 7.12 Remove power - end of test.

The Pen Motor Drive Circuit provides the power amplification and bi-directional drive output required to rotate the pen motor in either direction in order to achieve the 'pen lift' or 'pen lower' operations.

The Stepper Motor Drive Circuits provide the power amplification and drive outputs required to function the port and starboard stepper motors.

The Indicator Led provides a function similar to its equivalent on the Communicator Board, by essentially providing the user with a means of assessing certain operational states.

The Battery Status Circuit provides the function of continuously monitoring the charge state of the battery stack. It provides an output drive which illuminates the Turtle Eyes, mounted at the 'head' of the unit, extinguishing these only when the level of charge approaches a discharged state.

8.0 PEN MOTOR DRIVE CIRCUIT TEST

Special Note: This test must be carried out on a short duration basis because of the power dissipations involved. It is recommended that testing of each driver be limited to less than one second.

- 8.1 Short to 0V ground plane IC5 Pins 1,2,3,4.
- 8.2 Short to 0V ground plane IC1 Pin 4 to disable the processor.
- 8.3 Apple 12V supply between PL2/6 (positive) and PL2/2.
- 8.4 Confirm that the differential voltage across R39 is less than 10mV.
- 8.5 Repeat 8.4, but for R40.
- 8.6 Allow IC5 Pins 1 and 2 to float.
- 8.7 Confirm that the differential voltage across R39 is greater than 10.5 volts. (Note that current consumption in this on-condition is approximateley 0.5 Amps).
- 8.8 Short IC5 Pins 1 and 2 to 0V.
- 8.9 Allow IC5 Pins 3 and 4 to float.
- 8.10 Confirm that the differential voltage across R40 is greater than 10.5 volts.
- 8.11 Short IC5 Pins 3 and 4 to 0V.
- 8.12 Remove power from board.

9.0 STEPPER MOTOR DRIVE CIRCUIT TEST

Special Note: In order to test each of the stepper motor drive circuits, each output requires to be loaded externally to the board via a resistor up to 12Vp. The resistor value should be 47R and wattage rating of 1 watt, based on a maximum per line test duration of 0.25 seconds.
Current = 0.25A approx.

- 9.1 Short IC5 Pins 1,2,3,4 to 0V.
- 9.2 Short IC1 Pin 4 to 0V.
- 9.3 Apply 12V to board between PL2/6 and PL2/2.
- 9.4 For each of the stepper drive lines, confirm
 - a) that the output voltage w.r.t. 0V is less than 1 volt when the corresponding input is floating (high);
 - b) that the output voltage w.r.t. 0V is at the supply voltage of 12 volts when the corresponding input is shorted to 0V.

Inputs versus outputs are tabulated below:

Input	Output
IC1 Pin 27	PL5/2
IC1 Pin 28	PL5/5
IC1 Pin 29	PL5/1
IC1 Pin 30	PL5/4
IC1 Pin 31	PL4, 2
IC1 Pin 32	PL4/5
IC1 Pin 33	PL4/1
IC1 Pin 34	PL4/4

10.0 INDICATOR TEST

- 10.1 Short IC5 Pins 1,2,3,4 to 0V.
- 10.2 Short IC1 Pin 4.
- 10.3 Apply 12V between PL2/6 and PL2/2.
- 10.4 Confirm that IC5 Pin 12 is within 0.4 volts of 0V.
- 10.5 Short IC1 Pin 38 to 0V.
- 10.6 Confirm that IC5 Pin 12 is at the supply level of 12 volts.
- 10.7 Remove supply - end of test.

SECTION B: FUNCTIONAL TESTS

Note: This section of the document assumes the availability of a Turtle Test Chassis fitted electrically in such a manner as to provide, as far as possible, a simulation of the true chassis.

It is assumed that the Charger test has been sufficiently completed at the in-circuit stage so as not to require testing in this stage.

Conversely, the Loaded Charger test (section 5.2) may be re-allocated or repeated as a Functional Test according to test equipment capabilities.

For the same reasons, the Battery Status test need not be repeated in both sections.

Functional Testing is therefore limited to testing those circuits that either provide command signals to, or are provided with control signals from, the microcomputer. Functional Testing therefore requires the transmission of defined I.R. commands from a Communicator in order to stimulate the required functions within the Turtle Controller.

11.0 POWER-UP INITIALISATION

- 11.1 Apply 12 volts between PL2/6 and PL2/2.
- 11.2 Confirm that the Pen Drive circuit activates for approx. 1 second following initialisation and causes the Pen System to set itself to the 'Up' condition. Accordingly, drive output lines from IC5 Pins 14 and 15 are pulled to within 0.4V of 0V for the duration.
- 11.3 Confirm that the red Indicator Led D2 is illuminated.
- 11.4 Check that the stepper motor drives are turned off: this may be carried out by checking for free wheel movement.
- 11.5 Confirm that the eyes are illuminated.

12.0 PEN CONTROL

- 12.1 Output the command code 10H from the Host Computer connected to the Communicator.
- 12.2 Confirm that the Pen Motor Circuit activates for approx. 1 second in such a manner as to cause the Pen to move to the 'DOWN' position: accordingly, drive output lines IC5 Pins 13 and 16 are pulled to within 0.4V of 0V for the duration.
- 12.3 Confirm that D2 is turned out.
- 12.4 Output code 00H from the Host System.
- 12.5 Confirm that the pen state reverts again to the 'UP' position.
- 12.6 Confirm that D2 is turned on.

13.0 STEPPER MOTOR CONTROL

13.1 Output from the Host Computer command codes as defined in column 1 of the table below, and confirm that the response is as defined in columns 2 and 3.

INPUT ACTION	OUTPUT LINE STATUS								OUTPUT ACTION
	IC 4/10	IC 4/11	IC 4/12	IC 4/13	IC 4/14	IC 4/15	IC 4/16	IC 5/10	
TURN ON BOARD (INITIALISED)	1	1	1	1	1	1	1	1	MOTORS OFF
TX CODE 76H	1	0	0	1	0	1	1	0	FWD 1 STEP
TX CODE 76H	1	0	1	0	1	0	1	0	FWD 1 STEP
TX CODE 76H	0	1	1	0	1	0	0	1	FWD 1 STEP
TX CODE 76H	0	1	0	1	0	1	0	1	FWD 1 STEP
TX CODE 76H	1	0	0	1	0	1	1	0	FWD 1 STEP
TX CODE 70H	1	1	1	1	1	1	1	1	MOTORS OFF

1 = Drive off, voltage high

0 = Drive on, voltage low

SECTION C: DYNAMIC PERFORMANCE

This section details the dynamic operation of the unit under normal operating conditions.

14.0 SYSTEM CLOCK

All system (firmware) operations are timed against the ALE output clock from IC1 Pin 11.

This clock is itself derived from a 6MHz oscillator circuit formed by the on-chip IC1 circuitry and externally connected crystal.

The ALE output is required to be of a 2.5 microsecond \pm 0.05% period, with a high to low ratio of approx. 1 to 4.

15.0 INFRA-RED RECEIVER

15.1 Infra-Red Receiver Circuit

With reference to Figure 3, it may be seen that the infra-red receiver circuit may be split into a number of discrete functional blocks.

15.1.1 Receiver Diodes

The series of fast infra-red pulses output from the Communicator are converted back to electrical signals by an array of p.i.n. photo-diodes mounted on the Turtle Controller board.

These signals comprise of current pulses directly proportional to the intensity of the infra-red wavelengths received by the diodes.

Refer to Figure 4 Trace 1 for an example of the signal type to be found at the output of this receiving stage for a repetitive 5us I.R. pulse signal.

15.1.2 First Stage Amplifier

The current pulses from the receiver diodes are capacitively coupled to the input of the first stage amplifier.

This amplifier is of transconductance type, exhibiting low input impedance and required to convert the current input into a voltage output. The transconductance gain = 9.8K typical.

Refer to Trace 2 of Figure 4 for typical output from this stage.

15.1.3 Second Stage Amplifier

The second stage amplifier receives as input the output voltage from the first stage.

The voltage gain of the circuit is 25, typically.

15.1.4 Third Stage Amplifier

The third stage common emitter amplifier receives as a capacitively coupled input the output voltage from the second stage.

The voltage gain of this amplifier is 20, typically.

15.1.5 Auto-Reference Level Circuit

The output from the third stage amplifier is fed to a high input impedance voltage comparator via the Auto-Reference Level Circuit. The purpose of this circuit is to provide a nominal

reference level to the comparator which is potted down from the third stage quiescent d.c. output: however, for large amplitude pulse signals, a pulldown transistor TR1 conducts in order to, in voltage terms, reduce the threshold voltage; in thresholding terms, the circuit sensitivity is reduced, decreasing the probability of random noise interference.

15.1.6 Comparator

The comparator receives as inputs the direct signal output from the third stage amplifier and the reference level from the Auto-Reference Level Circuit.

The circuit digitises the I.R. pulses received to TTL compatible levels suitable for input to the Detection Gate Flip-Flop.

15.2 Band Width

The amplifier band width is typically 10MHz with band stop below 100kHz.

15.3 Amplifier Noise Output

The amplifier output noise measured at IC8 Pin 2 is typically 100mV pk-pk under normal indoor lighting conditions.

16.0 DETECTION GATE CIRCUIT

This circuit is based on a single D-type flip-flop. The purpose of the circuit in conjunction with control (reset) signals from the microcomputer is to sense and record the presence of I.R. inputs during defined 'gating' periods.

The relationship of detected signal against gate period is analysed by the microcomputer in order to decode the digital command.

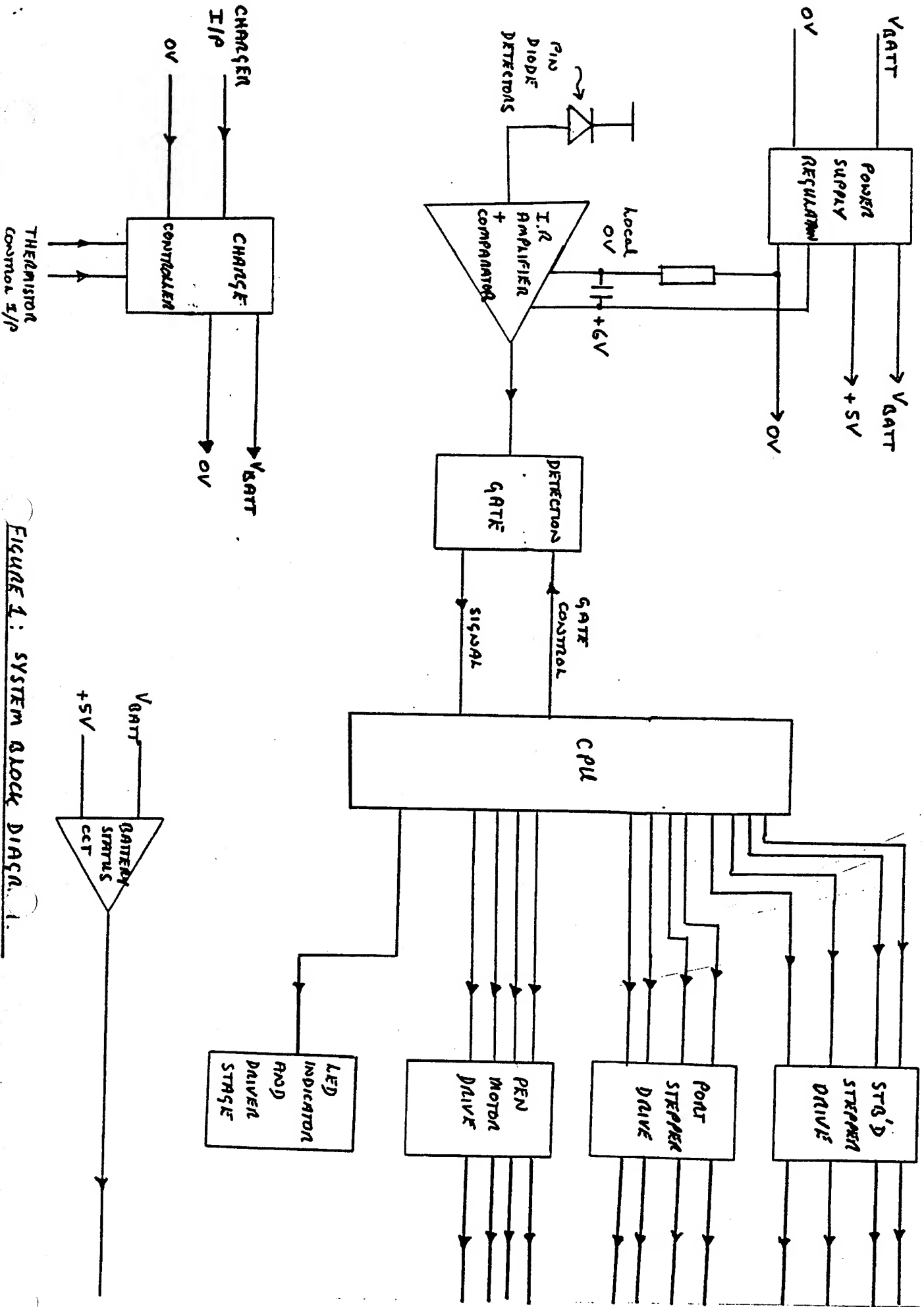


FIGURE 1: SYSTEM BLOCK DIAGN. 1.

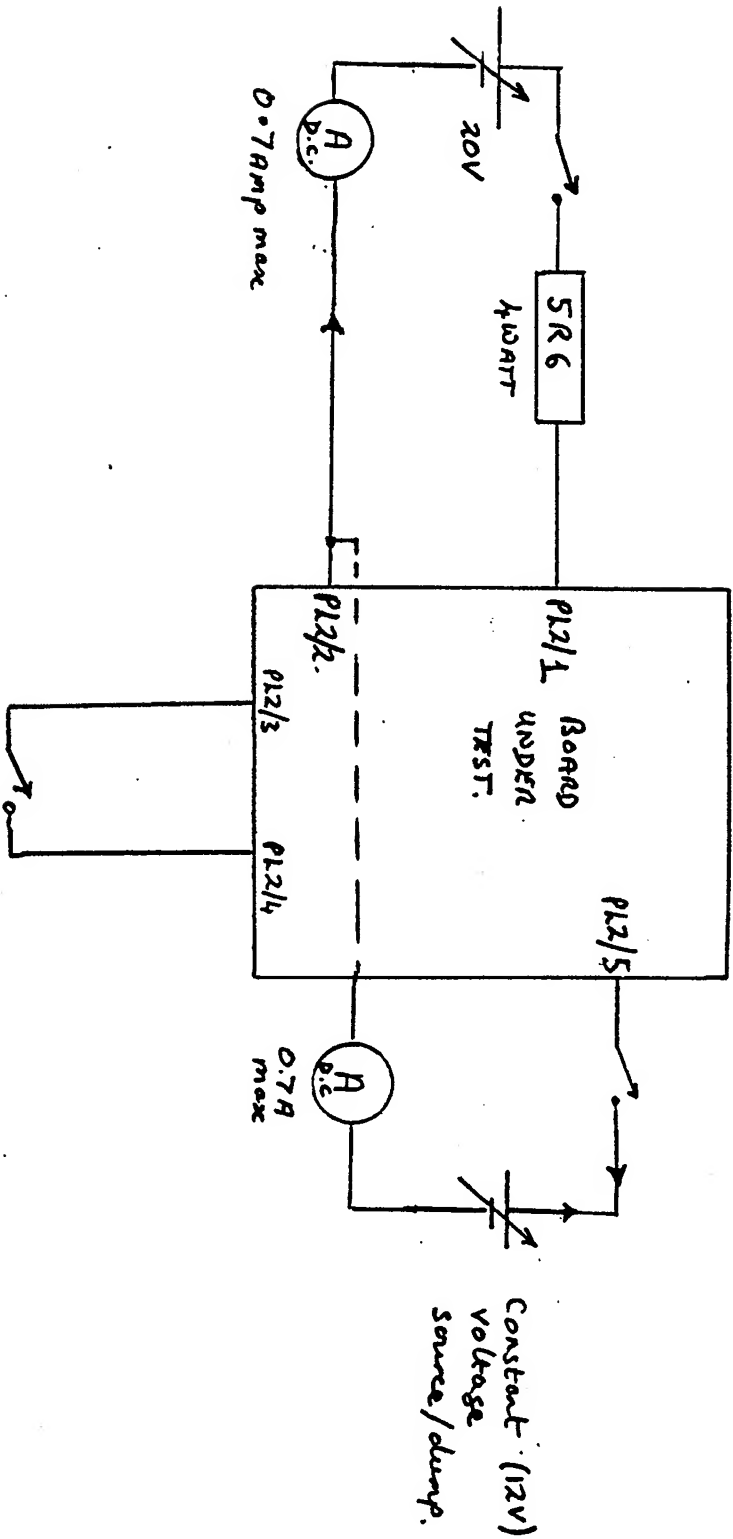


FIGURE 2: CHARGER TEST SCHEME.

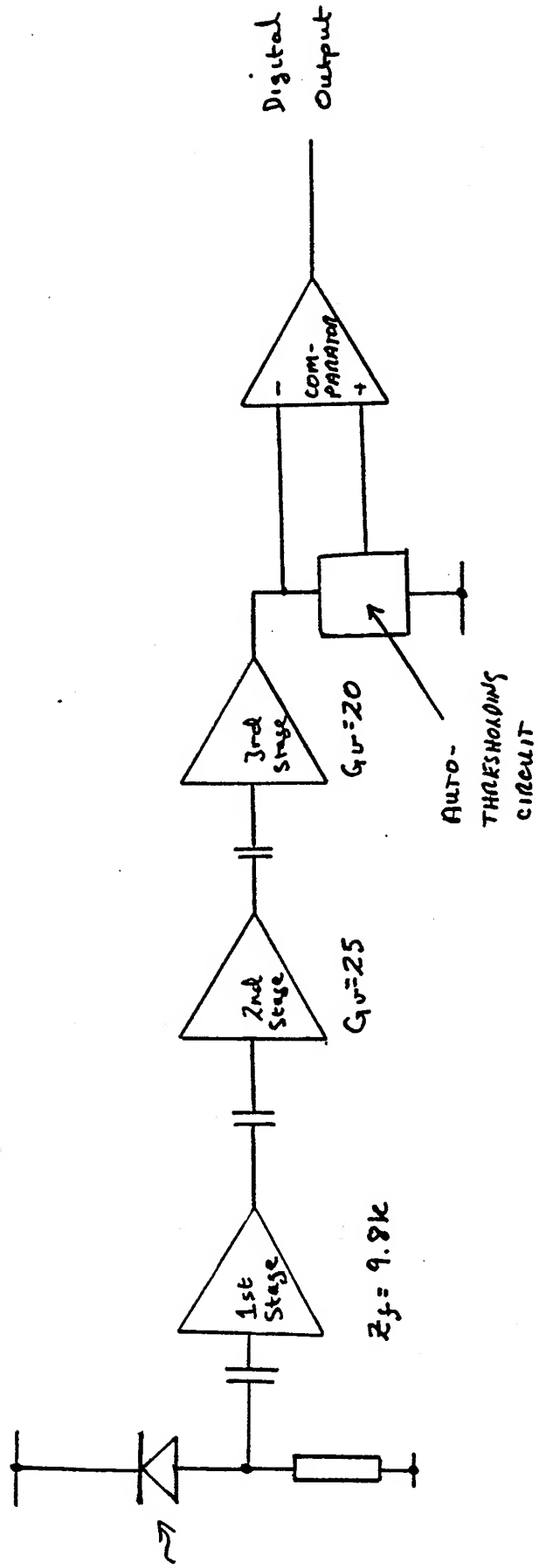
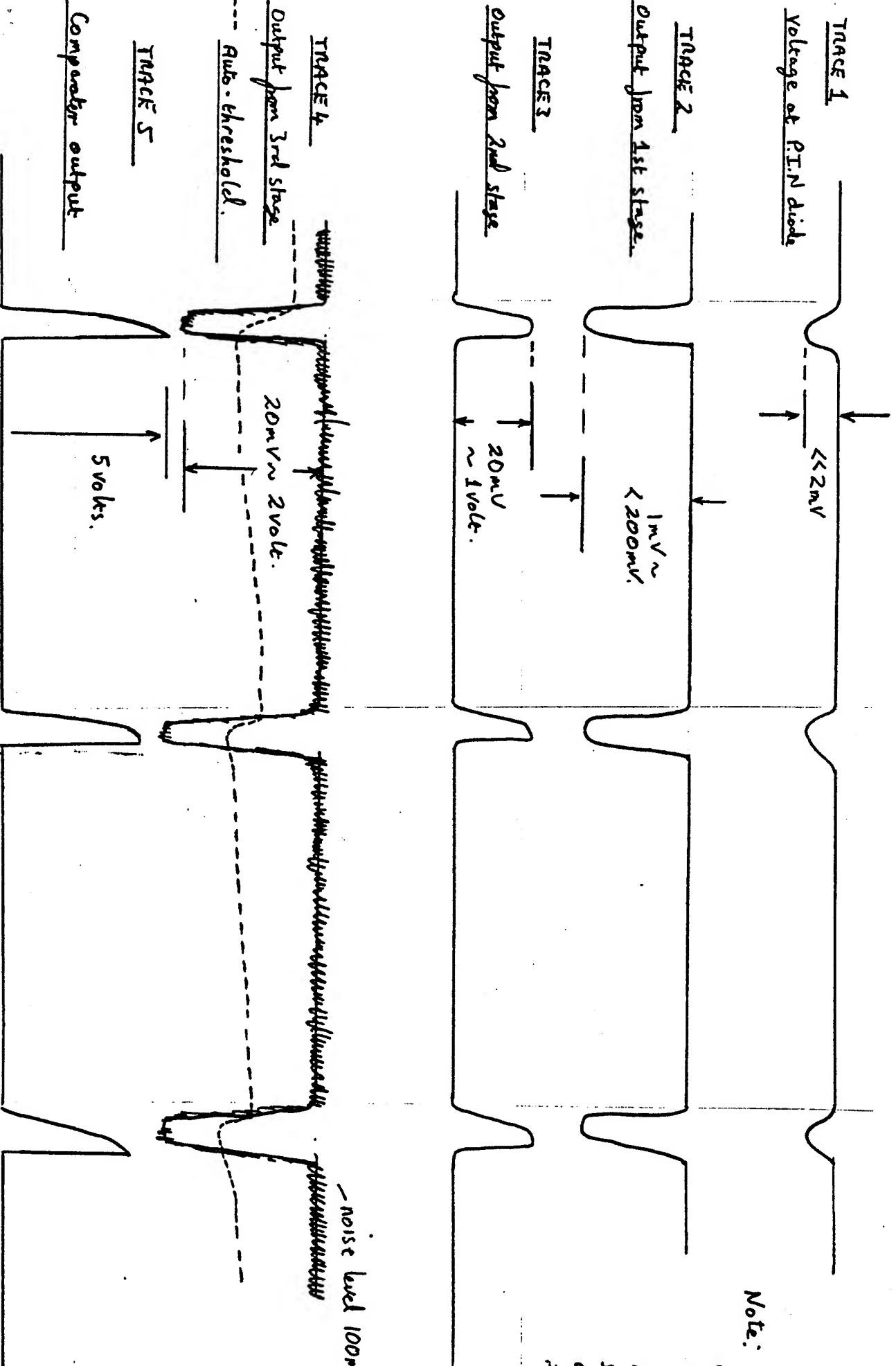


FIGURE 3: Infra-Red Receiver/Amplifier Block Diagram.



Note: signal amplitude
 are dependent
 on level of I.
 input. Traces
 refer to non-
 saturated signal
 at referenced
 locations.

- noise level 100mVpk-pk typ.

Figure 4: I.R. Amplifier Signal Diagram.

POWER ADAPTOR TEST SPECIFICATION: VDL1/148

The following parameters define the output requirements in order to assess the integrity of the power adaptor. It is assumed that the input mains voltage is applied according to its nominal rating.

The output levels should be as follows:

Recommended No Load output nominally 26VDC

Recommended output with 139ohm Load nominally 23VDC*

Recommended output with 39ohm Load nominally 19VDC*

* Notes: A tolerance of $\pm 0.5V$ is normal, although manufacturing spreads may take this up to $\pm 1V$. However, faulty units normally show a gross discrepancy from the nominal value.

All output levels are DC measurements with the power jack centre pole positive.

The units are sealed at manufacture and are not repairable.

I N D E X

- 1.0 INTRODUCTION
- 2.0 EQUIPMENT REQUIRED
- 3.0 CHARGER SYSTEM TESTS
- 4.0 MAIN SYSTEM TEST
 - 4.1 Initial Power Up Test
 - 4.2 I.R. Reception Test
 - 4.3 Pen Control
 - 4.4 Port Motor Control
 - 4.5 Starboard Motor Control
- 5.0 STEPPER MOTOR ADJUSTMENT

1.0 INTRODUCTION

This document is a diagnostic test guide for fault finding on malfunctioning MKII production Turtle units. It is intentionally brief, whereby the majority of faults will be quickly diagnosed. However, in those circumstances where the fault is rather more elusive, it is recommended that document VDL1/103 (Test Spec. for MKIV Controller Board) is referenced. However, where applicable a reference to the most likely cause of a fault is identified in the text.

It is also recommended that the individual electronics diagnostics reports are referenced in order to provide further information on the nature of faults, diagnoses and remedies.

All tests assume removal of the Turtle lid.

2.0 EQUIPMENT REQUIRED

- a) Oscilloscope
- b) Variable power supply unit providing up to 1 Amp at 30 Volts DC.
- c) Charge socket lead assembly.
- d) Board voltage supply cable and connector assembly.
- e) Microcomputer system and diagnostics software pack (Sinclair Spectrum and cassette recorder kit), as per document VDL1/147.
- f) Communicator Unit.

3.0 CHARGER SYSTEM TESTS

Assuming that the Turtle is wired normally, a properly functioning charger system should perform according to the following:

- 3.0.1 Set main Turtle switch to the 'CHARGE' position.
- 3.0.2 Confirm that the yellow PCB LED is illuminated (its level of illumination will be dependent on the current state of battery charge).
- 3.0.3 Connect the charge lead into the PSU and set to 19 volts.
- 3.0.4 Connect the charge plug into the socket at the side of the Turtle.
Confirm that the yellow LED remains on and that the current drawn is approximately 0.6Amp.
If the current is above 0.7Amp or lower than 0.45Amp it is possible that there is a battery pod fault. (If the yellow LED fails to illuminate, check that the pod thermistor is in circuit).
- 3.0.5 Reduce the voltage supply to 10 volts whilst still connected. The yellow LED should remain on.
- 3.0.6 Set the Turtle switch to 'OFF'.
- 3.0.7 Increase the voltage of the PSU until the yellow LED is turned off. Confirm that the voltage is approximately 19 volts. (If the LED fails to go out, check that the pod thermistor is not shorted out. Typical room temperature resistance is 70 ohms).
- 3.0.8 Increase the voltage further to 24 volts.
- 3.0.9 Set the Turtle switch to 'CHARGE'.
- 3.0.10 Confirm that the current consumption does not exceed 100 milliamps, and that the yellow LED remains off.
- 3.0.11 Set the Turtle switch to the 'OFF' position and confirm that the residual current does not exceed 30 milliamps.

4.0 MAIN SYSTEM TEST

The following should be carried out using the Spectrum Computer Kit.

Connect the Spectrum system to the Communicator and load the Diagnostics Test Software, according to the instructions in VDL1/147.

Set the Power Supply Unit to 12 volts and connect the voltage supply cable to its outlets.

Turn the PSU off.

Disconnect the main power connector PL2 from the controller board.

Connect the plug end of the supply cable into the board. Ensure that the Turtle underside DIL switches are both set to the off position.

4.1 Initial Power Up Test

4.1.1 Manually rotate the pen gearing such that the pen mechanism is in the 'down' position.

4.1.2 Switch on the PSU whilst monitoring the current.

4.1.3 Confirm that the initial current drawn is 0.6Amp (approx.) and then drops back to around 80milliamps following a delay of 1 second (approx.).

Confirm that the initial burst of current is complemented by a pen lift action.

4.1.4 Confirm that the board red LED is illuminated.

4.1.5 Confirm that the eyes are illuminated.

4.1.6 Reduce the PSU voltage to 10volts, and confirm that the eyes are now out.

4.1.7 Set PSU back to 12volts output.

4.2 I.R. Reception Test

4.2.1 With the Communicator initialised according to the instructions in VDL1/147, set up the transmit

coding on the computer as follows:

ØØØØØØØØ

and transmit for one shot.

- 4.2.2 Confirm that the board red LED has turned off, but that no other change has occurred - i.e. no change in current consumption beyond the 5mA (max.) deflection required to drive the LED. If the LED does not change state, then refer to VDL1/103, Section 15. Specifically, refer to 15.3 as the measurement yields a very useful indication as to the integrity of the I.R. receiver/amplifier stage.

4.3 Pen Control

- 4.3.1 Set the transmit coding as ØØØ1ØØØØ and transmit for single shot.
- 4.3.2 Confirm that the current consumption increases to 0.6Amp approximately for about 1 second, and then drops back to its quiescent level of 80milliamps. Confirm that the current surge is complemented by a pen drop action.
- 4.3.3 Set the transmit coding as ØØØØØØØØ and single shot transmit. The pen system should lift again, with the associated 1 second current surge.

4.4 Port Motor Control

- 4.4.1 Set transmit coding as Ø11ØØØØ1 and one shot transmit.
- 4.4.2 Confirm that the current consumption is now approximately 0.4Amps and complemented by a backward step of the port motor.
- 4.4.3 Repeat 4.4.1 and 4.4.2 at least once to ensure circuit integrity.

4.4.4 Set the transmit coding to 00000000 and one shot transmit to turn off motor control circuitry, reducing current to the quiescent level.

4.5 Starboard Motor Control

4.5.1 Set the transmit coding as 01101000 and one shot transmit.

4.5.2 Confirm that the current consumption is now approximately 0.4Amps and complemented by a backward step of the starboard motor.

4.5.3 Repeat 4.5.1 and 4.5.2 at least once to ensure circuit integrity.

4.5.4 Set transmit coding to 00000000 and one shot transmit to turn off motor control circuitry, reducing current to quiescent level.

5.0 STEPPER MOTOR ADJUSTMENT

Each stepper motor is mounted on the main plastic base by means of two screw fixings. These mountings provide a level of adjustment whereby the degree of gear engagement between the motor shaft gear and wheel gear may be optimally set. The adjustment is such that there should be no residual backlash in the gearing, whilst avoiding over tight gear meshing. Assessment of the existence of backlash is a manual skill, whilst assessment of the degree of gear meshing is related to obtaining smooth rotational movement at a designated drive voltage and step rate.

5.1 Backlash

5.1.1 With the Turtle power turned off, apply finger light pressure to each wheel in turn and attempt to move rapidly in a backward-forward motion. If wheel movement is detected relative to no movement of the stepper motor gear, then backlash is present. Readjust motor setting by loosening screws, rotating motor unit and tightening again.

5.2 Gear Mesh

Once the motor-drive system has been adjusted to remove any backlash, the system requires checking to ensure that the gearing has not been over meshed. (During the manual motor setting process, it is possible to sense for over-tightened drives: however, this skill only develops with experience!)

5.2.1 Set the PSU unit to 8.5volts.

5.2.2 Select the Drive Test 'Forward' option on the computer and ensure that the wheels rotate smoothly without faltering.

5.2.3 Repeat 5.2.2 but with the 'Reverse' option.

I N D E X

- 1.0 INTRODUCTION
- 2.0 EQUIPMENT REQUIRED
- 3.0 FUNCTIONAL TESTS
 - 3.1 Parallel Initialisation
 - 3.2 Transmission Test
 - 3.3 Serial Test

1.0 INTRODUCTION

This document is a diagnostics test guide for fault finding malfunctioning MKII production Communicator Units.

It is intentionally brief, as detailed functional descriptions and tests are contained in VDL1/102 (Test Specification for MKIV Prototype Communicator Board).

It is recommended that the individual electronics diagnostics reports be referenced to provide further information on the nature of faults, diagnosis and remedy.

2.0 EQUIPMENT REQUIRED

- a) Oscilloscope
- b) Test kit comprising Sinclair Spectrum, Interface One, cassette recorder and Valiant Parallel Interface, as per document VDL1/147 Section 3.0.

3.0 FUNCTIONAL TESTS

3.1 Parallel Initialisation

- 3.1.1 Set up Spectrum kit with Communicator parallel lead connected to kit via Parallel Interface. Load up test software.
- 3.1.2 Set DIL switches on side of Communicator as follows:
SW1 = OFF SW2 to 4 incl. to ON
- 3.1.3 Connect up parallel lead to Communicator and turn on unit.
- 3.1.4 Ensure that the red LED at the front end of the Communicator is illuminated.
- 3.1.5 Select the Parallel Initialisation option on the Computer and activate.
- 3.1.6 The red LED should now be out, indicating that the unit has initialised.
(If the unit has not initialised, first check the 5V supply and processor ALE clock. Select a continuous run option on the Computer and check that the processor is responding to the data input strobe by toggling of the NRFD and NDAC outputs, according to VDL1/102.
If the unit is not responding, check that the DAV input strobe is being received by the processor in its pulse stretched form (15us typically).
If this signal is being received, carry out a bit by bit check using the single shot software test facility).

3.2 Transmission Test

It is assumed that the system is set up, including an initialised Communicator, resulting from Section 3.1. Individual bit tests are necessary for a parallel system, as it is possible for a Communicator to initialise and transmit, but to corrupt certain

command bits.

In the absence of reception and decoding equipment, the most appropriate method of I.R. output and individual bit test is by monitoring the mechanical movement and current consumption of a Turtle powered externally by a DC power supply unit.

(Refer to sections 4.2 to 4.5 inclusive in document VDL1/150.)

(As the output stage is serial, only bit failures will be located in either the parallel input stage or the processor itself).

3.3 Serial Test

- 3.3.1 Disconnect the power supply and parallel cable from the Communicator.

Set DIL switches 1 and 2 to the ON position. (Switch positions 3 and 4 are not relevant to this configuration).

Connect the serial cable between the Test kit and the Communicator.

- 3.3.2 Power up the Communicator and confirm that the red LED is on.

- 3.3.3 Select the 'Serial Initialise' option on the Computer and activate.

Confirm that the red LED is now OFF.

If the LED is not off, disconnect and reconnect the Communicator supply and retry the initialisation.

(If the unit does not initialise, select the continuous output option on the computer and activate - the data word format is irrelevant.

Check that the RTS line is operating, indicating that the processor is responding to data received at its serial input. If not, check that the data is being received at the processor pin.)

3.3.4 As a final check, following successful initialisation, transmit the bit pattern 01100110 continuously and confirm that the 'monitor' Turtle moves forward.

ELECTRONICS DIAGNOSTICS REPORT 004

Nature of Failure

Communicator fails to transmit I.R. commands, although it may initialise correctly.
When the unit is opened, the fault distinguishes itself by the thermistor at R26 becoming hot.

Description of Circuit

IC5 (SN75188 RS232 driver IC) performs a dual role within the Communicator unit.

Three of the four individual driver circuits are used as standard RS232 driver outputs, the fourth is used as a level shifter circuit to drive the I.R. output stage. The device supply is sourced directly from the power jack 24 volt input.

Reason for Failure

Scope testing reveals no logic inversion between IC5 pins 5 and 6.

No specific reason for the failure can be determined.

The incidence of failures is low, yet significant on the basis that it is the predominant failure type.

However, investigation of the failed devices shows damage between the 0 volt and negative terminals of the device: all devices are damaged, indicating that the failure is power supply related.

In this instance, during power up the negative rail limits are exceeded for a short duration (approx. 7 milliseconds), and it is considered that this is responsible for the failures.

Conclusion

There is no certain cause of failure, although the signs indicate a supply orientated problem.

To date, four out of five failures have been of this type - in percentage terms, the failure rate is approx. 0.5%.

Recommendation

It is recommended that a circuit change be implemented in order to prevent the negative power rail exceeding the device supply limits.

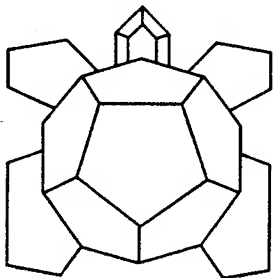
If this is indeed the problem, then the incidence of this type of failure will drop. The change is defined in the change request dated 19.3.85.



TITLE

QUALITY AND TEST

DOCUMENT N ^o VDL1/147				
ISSUE N ^o	PREPARED	CHECKED	APPROVED	COMMENTS
A	D.A. EWINS			21.5.85



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Valiant Designs Ltd Park House 140 Battersea Park Road LONDON SW11 4NB ENGLAND
Tel: 01-720 3947/627 1351/627 0470 Telex: 946461 (Attn Valiant) NIMTEX G
Directors: Prof T Stonier, AB, MS, PhD, FRSA (President) R R Fawcett, ACMA, MBCS (Chairman)
D Catlin, B Tech (Managing) G M Manvell (Marketing) T M Airey, BSc, FCA (Finance) (Secretary)
Reg in England No 1626393 Reg Office: 56-60 St Mary Axe, London EC3A 8BJ VAT No 237 711955

QUALITY AND TEST

1.0 GENERAL

At the manufacturing stage, all units are subjected to rigorous quality check procedures - during each sub-part assembly to the fully assembled unit.

Every circuit board produced is automatically tested on GEN RAD equipment under software control.

As a final check, every unit is subjected to Functional Testing procedures, when it is tested for mechanical and electrical integrity.

In particular, the complex nature of the Turtle unit dictates a prolonged functional test phase involving T1 and T2 test procedures: the full functional test program for a single Turtle takes approximately four hours - two hours for a full charge, and two hours of T1 and T2 testing.

Regular failure reports are produced by the manufacturers and assembly plants in order that an ongoing assessment of product reliability may be maintained. This enables rapid identification of areas needing improvement, both in the design and assembly techniques.

In addition, an ongoing field failure record is kept, whereby any trends or problems may be identified, allowing remedial action to be implemented as appropriate. To maintain this assessment, we require that all authorised test and repair centres record failure details and supply a copy of their findings to Valiant Designs each month.

Every failure is analysed for its possible significance as either an indication of a new or undetected problem,

a random or batch failure, or as a trend indicating a more subtle failure mode.

To date, this monitoring procedure has resulted in the definition of a number of design changes, or assembly procedures, to further reduce the current MKII early return failures of 1% and 5% for Communicator and Turtle respectively.

Where specific faults rise to prominence, through any of the reasons above, diagnostics reports are produced and, as appropriate, a related change request.

As previously mentioned, all failures require logging; in order to keep paperwork to a minimum, each failure is recorded as a single line entry on the Diagnostics Summary Sheet and it is a copy of these sheets that is required at the beginning of each month.

Testing falls into two categories: the T1 and T2 functional tests (mentioned briefly above) and Diagnostics Tests.

Whereas the T1 and T2 tests run under LOGO and are unmodifiable, the Diagnostics Test facility allows individual bit patterns to be set up, with single shot or continuous transmission modes, in order to facilitate fault detection.

2.0 FUNCTIONAL T1,T2 TESTS

2.1 General

The T1 and T2 test plan is primarily designed for Turtle Unit functional testing at the production stage; however, these procedures may equally well be taken, in whole or part, as a final unit check following repair centre servicing.

Various tests are software based and as such require the provision of a host machine. A standard test kit has been selected and is based on the Sinclair Spectrum. The T1,T2 test routines require to run in conjunction with the Sinclair LOGO and may be used to test Communicators. However, because of the excessive time taken to load the cassette based software, using T1 procedures for Communicator test becomes impractical.

2.2 Equipment

The Sinclair Spectrum based T1,T2 test kit comprises:

- 1 off Sinclair Spectrum
- 1 off Sinclair Interface 1
- 1 off Sinclair LOGO cassette
- 1 off Cassette Recorder
- 1 off Test Tape including T1,T2 'Test' Program
- 1 off Communicator and Power Pack and Spectrum to Communicator Lead
- 1 off Valiant Interface Tape

It is assumed that a Power Supply unit is also available by consequence of kitting out for the diagnostics tests.

2.3 Software Loading Procedure

Load Sinclair LOGO cassette:

enter single key LOAD "" and then start tape running.

When loaded, connect up the Communicator to the Interface 1 via the serial lead, ensure that the side switches SW1 and SW2 are both set to ON and then power up the Communicator.

Ensure that the red led at the front of the Communicator is on.

With the Valiant Interface tape in the cassette recorder (serial side), load the program by typing STARTROBOT and press the play button on the recorder.

On completion of the load, confirm that the Communicator has initialised by checking that the red led has gone out.

With the T1,T2 'test' tape now in the recorder type load "test and press play.

Your software has loaded when ? is displayed.

To run, type TEST and a menu is displayed.

2.4 Running the Test Software

It is assumed that the tests are run in conjunction with the T1,T2 documentation in which an explanation of each option is given.

The menu displayed is as follows:

- 1 T1 PEN
- 2 T2 PEN
- 3 T1 DRIVE
- 4 MOTION TEST
- 5 SQUARE TEST
- 6 360° TEST
- 7 INITIALISE COMMUNICATOR
- 8 EXIT

SELECT AN OPTION (1-8)?

Each option outputs operator instructions in order to perform the test.

The INITIALISE COMMUNICATOR option does provide for running Communicator tests, but the interface type (either serial or parallel) is determined during the software loading procedure detailed above.

Accordingly, to run a parallel interface Communicator, the parallel side of the Valiant Interface cassette must be loaded and, unfortunately, the nature of the Sinclair LOGO dictates a time consuming entire software reload.

3.0 DIAGNOSTICS TEST FACILITY

3.1 General

This software facility is primarily intended as a necessary tool to aid the diagnosis of faulty Communicator units. However, by nature of the system, it can also be used to help diagnose faulty Turtle units, when used in conjunction with a working Communicator. Accordingly, the diagnostic procedures contained in documents VDL1/149 and VDL1/150 assume the utilisation of this facility. Finally, because of the nature of the loading requirements for the T1,T2 tests, it is recommended that the Diagnostics Test facility be used for Communicator Functional Tests.

3.2 Equipment

The Diagnostic Software is written to run on a Sinclair Spectrum based test kit; the total equipment requirement is as follows:

- Sinclair Spectrum or Spectrum Plus
- Sinclair Interface 1
- Cassette Recorder
- Test Tape including Diagnostics Program 'd test'
- Valiant Parallel Interface Board with integral Parallel Cable
- Monitor TV
- Serial Interface Cable

3.3 Software Loading Procedure

- 3.3.1 Set up Sinclair based test system with Valiant Parallel Interface Board connected into the PCB edge connector outlet from the Interface 1.
- 3.3.2 With equipment turned on, load the Diagnostics Tape into the Cassette Recorder.

- 3.3.3 Enter LOAD "dtest" and press the PLAY button on the recorder. The software should now load.
- 3.3.4 On completion of the load, the monitor will display a test option menu.

3.4 Running the Test Software

- 3.4.1 Following a successful software load, a primary option test menu is displayed on the monitor as follows:

- 1 INITIALISE COMMUNICATOR
- 2 SEND BIT PATTERN
- 3 EXIT

On the first run, 1 will normally be selected.

- 3.4.2 On selection of the INITIALISE COMMUNICATOR option, the next display provides the option for Serial or Parallel Interface?

SERIAL (S) OR PARALLEL (P)

Connect up the Communicator to the desired interface type:

If Serial, connect the Communicator directly to the 9 pin D Type connector at the back of the Interface 1 using the Serial Cable, and set the side mounted DIL switches as follows:

SW1 = ON, SW2 = ON, SW3 = DON'T CARE, SW4 = DON'T CARE
Now depress S on the keyboard.

If Parallel, then connect the Communicator to the Parallel Interface Board, using the integral cable, and set the side mounted DIL switch as follows:

SW1 = OFF, SW2 = ON, SW3 = ON, SW4 = ON
Now depress P on the keyboard.

NOTE: On no account should both the parallel and serial

cables be connected from the Communicator to the Test Kit at the same time as this will cause the Communicator voltage biasing to become unbalanced.

3.4.3 The next display instruction informs the operator to power up the Communicator.

On powering up, confirm that the red LED at the forward end of the Communicator is illuminated. If it is not, then the Communicator has failed to reset itself correctly.

Refer to the Diagnostics and Test Manuals for guidance.

On successful power up, depress the SPACE key as instructed, and confirm that the LED is now out. If not, then the Communicator has failed to initialise, possibly because the correct coding has not been received.

3.4.4 The menu now reverts to the original form of 3.4.1 above.

Typically, option 2, SEND BIT PATTERN, should now be selected. On depression of key 2, the following menu is displayed:

CURRENT BIT PATTERN

A M M P L L R R

Ø Ø Ø Ø Ø Ø Ø Ø

1 CHANGE BIT PATTERN

2 SEND BIT PATTERN - CONTINUOUS

3 SEND BIT PATTERN - ONE SHOT

4 EXIT

a) Option 1 allows redefinition of the transmitted bit pattern (defaulted to all 0s for first run) and following depression of key 1, the display is as follows:

CURRENT BIT PATTERN

A M M P L L R R

Ø Ø Ø Ø Ø Ø Ø Ø

ENTER NEW PATTERN

Enter Øs and 1s only as appropriate to test.
Following entry of the eighth bit, the display
reverts automatically to the menu of 3.4.4

- b) Selection of option 2 causes a continuous
transmission of the selected bit pattern to the
Communicator.
For each transmission (8 bit command) the red
LED should change state.
- c) Selection of option 3 will cause the chosen bit
pattern to be transmitted once to the Communicator.

4.0 DIAGNOSTICS SUMMARY SHEET

The Diagnostics Summary Sheet is required to be filled in for each item that is diagnosed as faulty.

The sheet is specifically designed to keep paperwork to a minimum; however, a number of rules must be followed:

4.1 Monthly Returns

A new sheet should be started for each month, commencing on the first. The sheet should be marked with the relevant month and year and a copy of the previous month's entries forwarded to Valiant Designs.

4.2 Entry Date

The Entry Date is the date the item was diagnosed.

4.3 Unit Serial No.

The serial number of the unit diagnosed as faulty should be entered in this column. Where specific serial numbers are not appropriate (e.g. for cables or software), then details of the failed item should be recorded.

4.4 Failure Symptoms

This should record the overall message as conveyed by the customer and should reflect the comparable entry made on the Customer Fault Report and Enquiry Summary Sheet. (Refer to Customer Service Document VDL

4.5 Exact Cause of Fault

This entry should record the details of the failure - the part number of the failed device(s), the nature of the failure and the cause, if known.

In certain circumstances, as in the case of a partly functioning item, that part of the device that has failed (e.g. particular input or gate) should be detailed,

if known. For instance, for early MKI and MKII units, the current limiting resistors in the pen system (R39,R40) may burn out: the direct cause of the unit being returned is the obvious burn out, but the real cause may be a battery pod problem.

4.6 Failure Classification

This column should contain a single entry as to the nature or cause of the fault.

A number of classifications are defined:

- a) PCB : This classification relates to a PCB tracking problem.
- b) SOLDER : This classification refers to a soldering related fault - e.g. dry joint, solder bridge between two pins etc.
- c) ASSEM : This classification refers to an assembly related problem - i.e. where the unit has been incorrectly assembled at the manufacturing stage.
- d) WIRING : This classification refers to a wiring related problem - e.g. broken wire, dodgy crimp, etc.
This classification may include interface cables and battery contacts.
- e) COMP : This relates to an electrical component failure, and may be any electronic or electrical part, excluding wiring but including batteries.
- f) HAND : This classification relates the prime cause of the fault to misuse or otherwise bad handling.
- g) SW : This classification refers to a failure that is software related.

4.6 Enquiry Ref.

This should correspond to the reference entered on the Customer Enquiry and Fault Report Sheet.

VALIANT TURTLE TEST PROGRAM

1.0 INTRODUCTION

The Turtle tests, T1 and T2, are conducted using the test software described in this document.

2.0 EQUIPMENT

- a) The equipment required is any computer supporting a full Logo.
- b) A special Test Program written by Valiant Designs is necessary.
- c) A Valiant communicator and power adaptor is required plus appropriate interface cable.

3.0 SETTING UP TEST EQUIPMENT

- a) The computer and communicator should be set up as normal.
- b) The software should be loaded as per the machine dependent software instructions.

4.0 TEST MENU

The test program presents a test menu.

Code	Test
1	T1 PEN
2	T2 PEN
3	DRIVE
4	MOTION
5	SQUARE
6	360°

Pressing any code will activate the appropriate test.

The program supplies the Inspector with step by step instructions.

5.0 TEST DEFINITIONS

- a) T1 PEN
 - i) Pen down and Pen up once at 14 volts.
 - ii) Pen down and Pen up 10 times at 10.5 volts.
- b) T2 PEN

Pen up and down 50 times at battery voltage.

c) DRIVE

The Turtle is instructed to follow the motions:

- i) Pen down.
- ii) Forward 2 cm 16 times.
- iii) Forward 1 cm.
- iv) Back 2 cm 16 times.
- v) Back 1 cm.
- vi) Pen up.

d) MOTION

The Turtle is instructed to follow the movements:

- i) Pen up.
- ii) Forward 20 cm.
- iii) Right 30° .
- iv) Left 30° .
- v) Back 20 cm.
- vi) Pen up.

e) SQUARE

The Turtle is instructed to draw a 20 cm right handed square with a Pen down and Pen up instruction at the start and completion.

This square will be drawn continuously until interrupted at the computer or the Turtle runs out of power.

f) 360°

The Turtle is instructed to turn on the spot through 360° with a pen down instruction at the start and pen up at the finish. This is to check the correct setting of the stabiliser.

VALIANT TURTLE TESTING PROCEDURES

A. TEST T1

1.0 T1 is a thorough functional test designed to test every aspect of the Turtle and its operation.

2.0 TEST EQUIPMENT

The test equipment consists of:

- a) A variable d.c. power supply capable of supplying up to 1 Amp and 30 volts.
- b) A 1 metre long twin 7/0.25mm cable capable of connecting the power supply to the on-board power supply of the Turtle.
- c) A cable with a connector capable of connecting the power supply to the Turtle's recharging socket.
- d) A Valiant Communicator.
- e) A Valiant Power Adaptor.
- f) An appropriate computer and software capable of driving the Communicator - programmed with the test routines of T1

OR

- g) A discreet electronic circuit capable of driving the Communicator in T1 modes.
- h) Valiant Turtle Test Software.

3.0 VISUAL CHECK

This is an inspection procedure intended to ensure:

- a) All work has been done and is satisfactory.
- b) The quality of workmanship is good.
- c) The appearance and finish are excellent.

A checklist in Appendix A should be completed for each Turtle to ensure all aspects of the product are inspected.

4.0 CHARGE CIRCUIT TEST

- Part 1: a) Switch the Turtle into CHARGE mode.

- b) Connect the power supply to the Turtle recharging socket.
 - c) Set the voltage supply to 20 volts.
 - d) Complete the Part 1 Charge Circuit section of the checklist in Appendix A.
- Part 2:
- e) Switch the Turtle switch to OFF.
 - f) Increase the voltage (up to a maximum of 30 volts) until the yellow LED goes out on the PCB.
 - g) Complete the Part 2 section on the check list in Appendix A.

5.0 PEN TEST

5.1 TEST PROCEDURES (HIGH VOLTAGE 14V)

- a) The power supply should be set on 14 volts.

5.2 TEST PROCEDURES (LOW VOLTAGE 10.5V)

- a) The power supply should be set on 10.5 volts and connected to the PCB's power system.
- b) A pen should be inserted into the pen holder.
- c) The Turtle should be switched on.
- d) The computer and the Valiant Communicator should be powered up and the test program software loaded (see VDL1/).
- E) The T1 pen test program should be activated.
- f) The pen should be raised and lowered ten times.

N.B. ON NO ACCOUNT SHOULD THE PEN BE RAISED AND LOWERED WITHOUT THE "PAUSE" INSTRUCTION BETWEEN EACH COMMAND.

- g) Complete the checklist of Appendix A.

6.0 DRIVE UNIT TEST

- a) With the computer and Valiant Communicator and Turtle set up with the pen inserted into the Turtle pen tube, activate Pen Test routine on the computer.

- b) Make sure the pen is down (i.e. lowered for drawing).
- c) Set the power supply to 10.5 volts.
- d) The Turtle should move forward in a series of move-and-stop motions and return along the same line.
- e) If there is a significant difference between the forward and return lines, the Turtle drive mechanism needs adjustment.
- f) Complete the checklist of Appendix A.

7.0 MOTION TEST

- a) With the set up as as the previous section, activate TIM routine.
- b) Complete the checklist of Appendix A.

N.B. IT IS NOT NECESSARY TO ADJUST THE TURTLE'S ACCURACY.

8.0 EYE TEST

- a) Connect the Turtle to the power supply.
- b) Set the power supply to 12 volts.
- c) Switch on the Turtle.
- d) Reduce the voltage from 12 volts to 10 volts.
- e) Complete the checklist of Appendix A.

APPENDIX A

TURTLE TEST T1 CHECK LIST

TURTLE TEST T1 CHECK LIST
cont.

WIRING

Connections

- (a) Stepper Motor Port
- (b) Stepper Motor Starboard
- (c) d.c. motor
- (d) Eyes
- (e) DIL switch
- (f) Main loom

Loose Wires

- (a) Stepper motor port
- (b) Stepper motor starboard
- (c) d.c. motor
- (d) Eyes
- (f) DIL switch
- (g) Main loom

Untidy Screws

Loose Screws

- (a) PCB mounts
- (b) Switch mounts
- (c) Battery pods top
- (d) Battery pods bottom
- (e) Stepper motor port
- (f) Stepper motor starboard
- (g) d.c. motor screws
- (h) Headcover

TURTLE TEST T1 CHECK LIST
cont.

MISCELLANEOUS

- (a) Switch operation
- (b) Fuse in place
- (c) Charge resistor fixed down
- (d) General workmanship
- (e) Quality of finish

CHARGE CIRCUIT TEST

Part 1

- (a) Is charge light on (Yellow LED) after switching into CHARGE
- (b) Is current between and mA
- (c) If the turtle is switched off is the current less than mA

Part 2

- (a) Does charge light (Yellow LED) go out before 30v is reached

PEN TEST

High Voltage (14v)

- (a) Is pen raised and lowered once
- (b) No evidence of pen sticking

Low Voltage (10.5v)

- (a) Is the pen raised and lowered times
- (b) No evidence of the pen mechanism sticking
- (c) Is the pinion securely stuck to the pen motor

TURTLE TEST T1 CHECK LIST
cont.

DRIVE UNIT TEST

(a) No significant difference between the
two lines of driving

MOTION TEST

(a) Are all movements smooth

EYE TEST

(a) Do the eyes go out at voltage.

INSPECTOR'S COMMENTS

PASS

DATE

INSPECTOR'S SIGNATURE

TURTLE TEST T1 CHECK LIST

TURTLE SERIAL NO. _____

VISUAL CHECK

Please indicate in the box whether the check is ✓ satisfactory or X not satisfactory.

DRIVE UNIT	Starboard	Port
(a) No backlash in gear unit	<input type="checkbox"/>	<input type="checkbox"/>
(b) Wheel joint not broken	<input type="checkbox"/>	<input type="checkbox"/>
(c) No adhesive on tyre	<input type="checkbox"/>	<input type="checkbox"/>
(d) Traction wheel assembly/ base joints not broken	<input type="checkbox"/>	<input type="checkbox"/>

STABILISER

(a) Ball bearing free to move	<input type="checkbox"/>
(b) Ball bearing not too loose	<input type="checkbox"/>
(c) No rust on ball bearing	<input type="checkbox"/>

LABELS

Nameplate

(a) Label on	<input type="checkbox"/>
(b) Serial number on label	<input type="checkbox"/>

ON-OFF-CHARGE Label

(a) Labels on	<input type="checkbox"/>
(b) Label correctly positioned	<input type="checkbox"/>
(c) Letters correct	<input type="checkbox"/>

PEN

(a) Easy to load	<input type="checkbox"/>
(b) Easy to unload	<input type="checkbox"/>

EYES

(a) Eyes fixed	<input type="checkbox"/>
(b) Eye rings in place	<input type="checkbox"/>

VALIANT TURTLE TESTING PROCEDURES

TEST T2

1.0 INTRODUCTION

This test is the test to be performed as the Q.A. examination of the Turtle.

2.0 TEST OBJECTIVES

This test is to be performed on the completed and packed Turtle. Its objective is to ascertain that all phases of the production, testing and packaging have been completed satisfactorily. This test should be performed without removing the Turtle shell.

3.0 Q.A. BASIS

- a) The test should be performed to a 1% AQL to BS 6001:1972.
- b) The purpose of the Q.A. is to ensure product confidence and consequentially Valiant may request samples in variation to the rules of BS 6001.
- c) Changes in sample size should be approved by the Valiant Q.A. engineer.

4.0 TEST EQUIPMENT

- a) Power supply as used on T1 (see VDL1/126).
- b) Valiant Turtle Communicator.
- c) Computer and software as T1 (see VDL1/126).
- d) Valiant power adaptors.

5.0 MULTI TURTLE TESTING

It is possible to test several Turtles at once. This is only limited by the range of the communicator (8m).

6.0 VISUAL CHECK

This is an inspection procedure intended to ensure:

- a) All the work has been satisfactorily completed.
- b) The quality of workmanship is good.
- c) The appearance and finish are excellent.

The check list of Appendix A should be completed for each Turtle subjected to T2 testing.

7.0 CHARGE THE TURTLE

7.1 The first charge for the Turtle is best done in a slow charge mode over a 14 hour period. If time is restricted for completing the tests then it is permissible to charge in the fast charge mode for a maximum of one hour and then charge in the slow charge mode for 3 hours.

7.2 How to charge the Turtle in slow charge mode:

- a) Plug in the power adaptor to the Turtle charge socket.
- b) Switch the Turtle into charge mode.
- c) The yellow LED light should not illuminate.

7.3 How to charge the Turtle in the fast charge mode:

- a) Switch the Turtle into charge mode.
- b) Plug in the power adaptor to the Turtle charge socket.
- c) The yellow LED charge light should illuminate.

8.0 CHARGE CIRCUIT TEST

Repeat the charge circuit test of VDL1/126 and complete the appropriate part of Appendix A.

9.0 T2 PEN TEST

- a) Set up the computer, powering up the Communicator and loading the test software (see VDL1/130).
- b) Position the Turtle with the others to be tested.
- c) Switch on the turtles.
- d) Activate T2 Pen Test Program.
- e) Complete Appendix A checklist.

10.0 DRIVE TEST

- a) Set the Turtles in a position to perform the DRIVE UNIT Test of T1.
- b) Activate the Drive Unit Test.
- c) Complete the check list of Appendix A for each Turtle under test.

11.0 SQUARE TEST

- a) Set the Turtles in a position to perform the Square Test (drawing-a square).
- b) Activate the Square Test.
- c) This is a continuous test designed to run for the full life of a battery charge (approximately 2 hours).
- d) Checks should be made regarding the operation of the Turtles at frequent intervals and the relevant aspects of Appendix A checked.

Note: It is not necessary to tune the Turtle's accuracy in this test.

12.0 360° TEST

- a) Set turtles in a position to perform the 360° test.
- b) Activate the 360° test.
- c) This test checks the setting of the stabiliser (on MKI only).

APPENDIX A

TURTLE TEST T2 CHECK LIST

TURTLE TEST T2 CHECK LIST

TURTLE SERIAL NO. _____

Please indicate in the box whether the check is ✓ satisfactory or ✗ not satisfactory.

VISUAL CHECK

Packaging

- (a) Satisfactory condition of Turtle carton
- (b) User Guide packed
- (c) Pen UP packed
- (d) "Turtle Talk" packed
- (e) User Guide in satisfactory condition
- (f) Pen UP in satisfactory condition
- (g) "Turtle Talk" in satisfactory condition
- (h) Polystyrene box in satisfactory condition
- (i) Berol pen packed
- (j) Screwdriver packed
- (k) Turtle packed in polythene bag
- (l) Turtle and shell clean

<input type="checkbox"/>
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<input type="checkbox"/>

DRIVE UNIT

- (a) No backlash in gear unit
- (b) Wheel joint not broken
- (c) No adhesive on tyre
- (d) Traction wheel assembly/base joints not broken

Starboard

Port

Starboard	Port
<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>

TURTLE TEST T2 CHECK LIST contd.

(d) Eyes

(e) DIL switch

(f) Main loom

Loose wires

(a) General appearance of no loose wires
is satisfactory

Loose screws

(a) There are no loose screws

MISCELLANEOUS

(a) Switch operation

(b) Fuse in place

(c) General workmanship

PEN TEST

(a) Is pen raised and lowered 50 times

(b) No evidence of pen mechanism sticking

DRIVE UNIT TEST

(a) No significant difference between the
two lines of driving i.e. no more than 2 mm

SQUARE TEST

(a) All motions are smooth

(b) Duration of continuous running in
excess of 1½ hours

(c) Eye lights flickering or gone out
prior to battery charge expiring

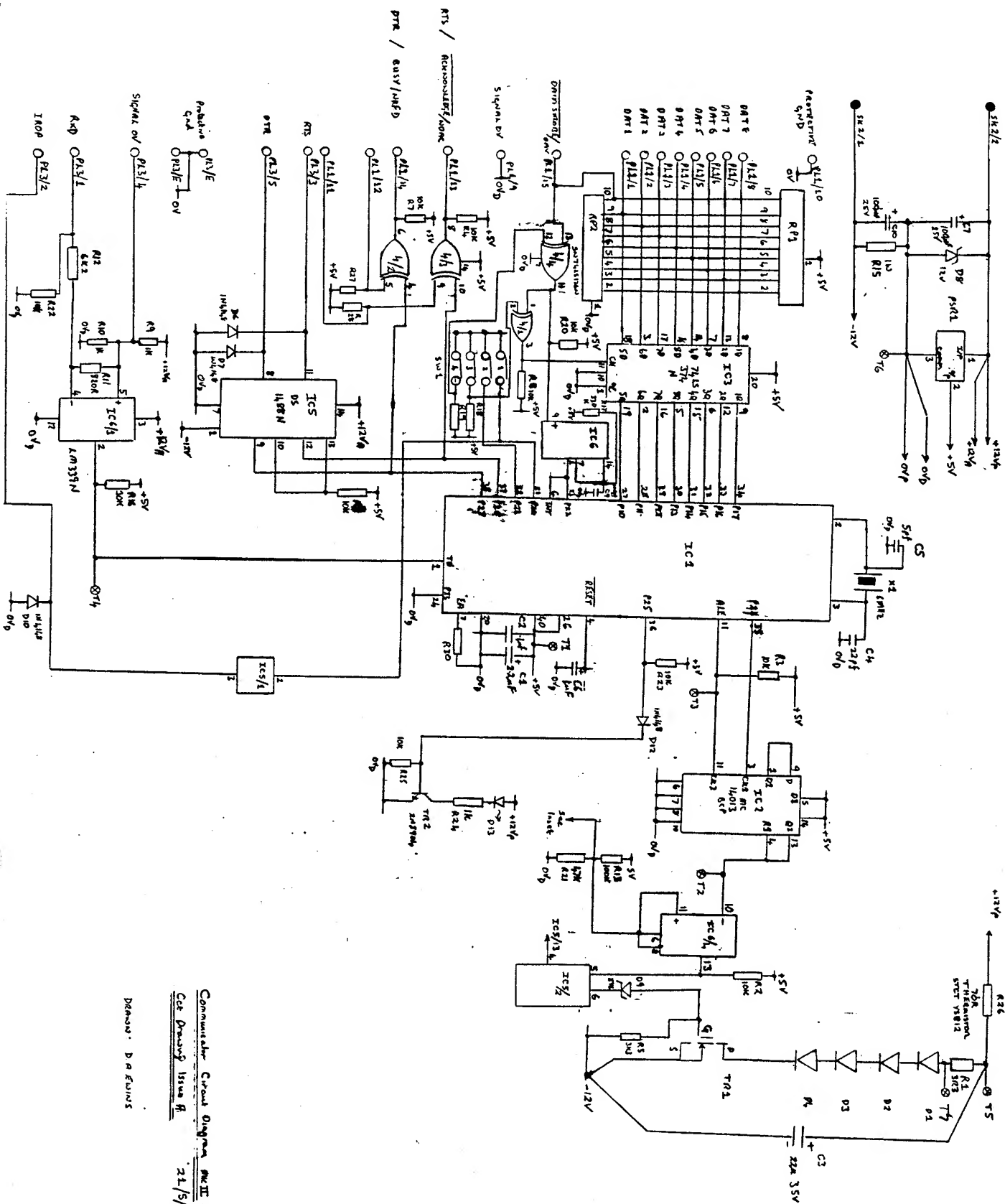
TURTLE TEST T2 CHECK LIST contd.

INSPECTOR'S COMMENTS

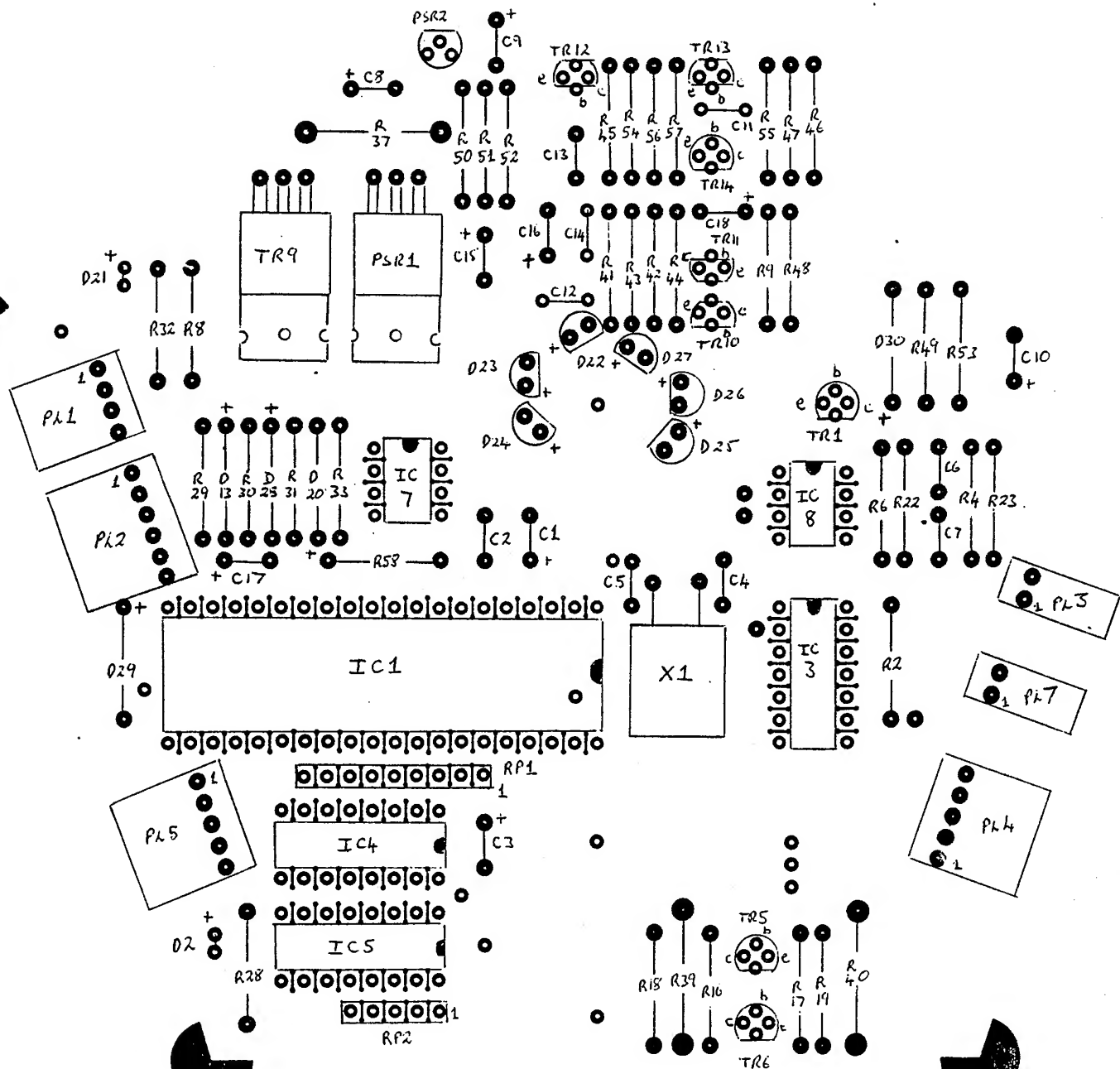
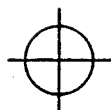
PASS

DATE

INSPECTOR'S SIGNATURE

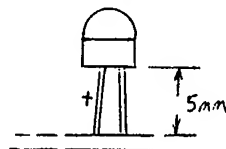
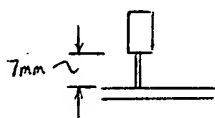
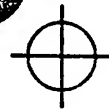


Computer Control Diagram, Rev II Production
 See Drawing Issue # 21/5/85
 Design: D. A. Evans



D22 to D27 mounting

D21, D2 mounting



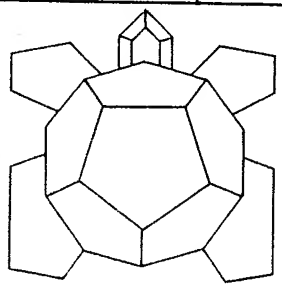


TITLE

PARTS LIST FOR MARK II VALIANT TURTLE

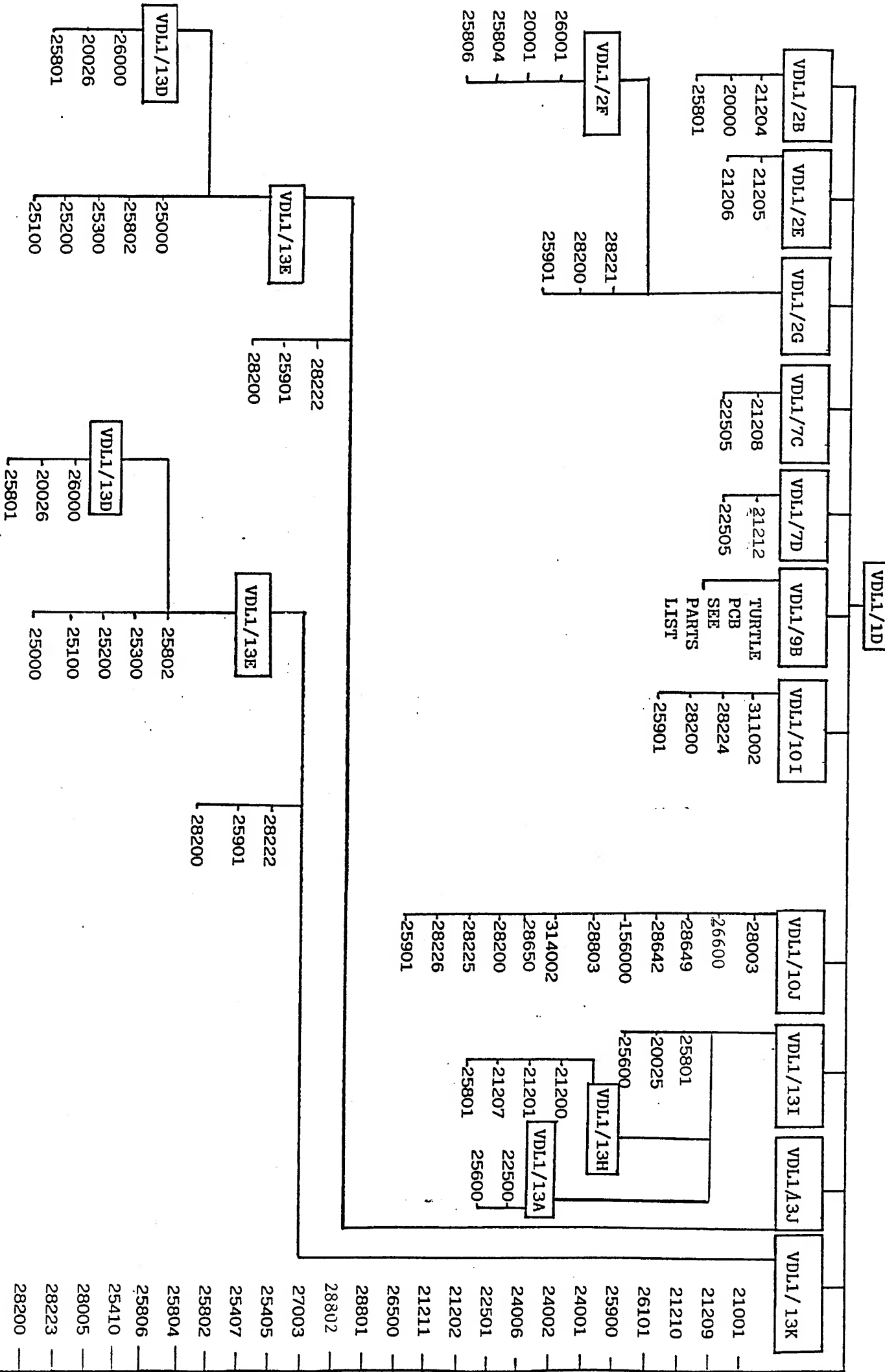
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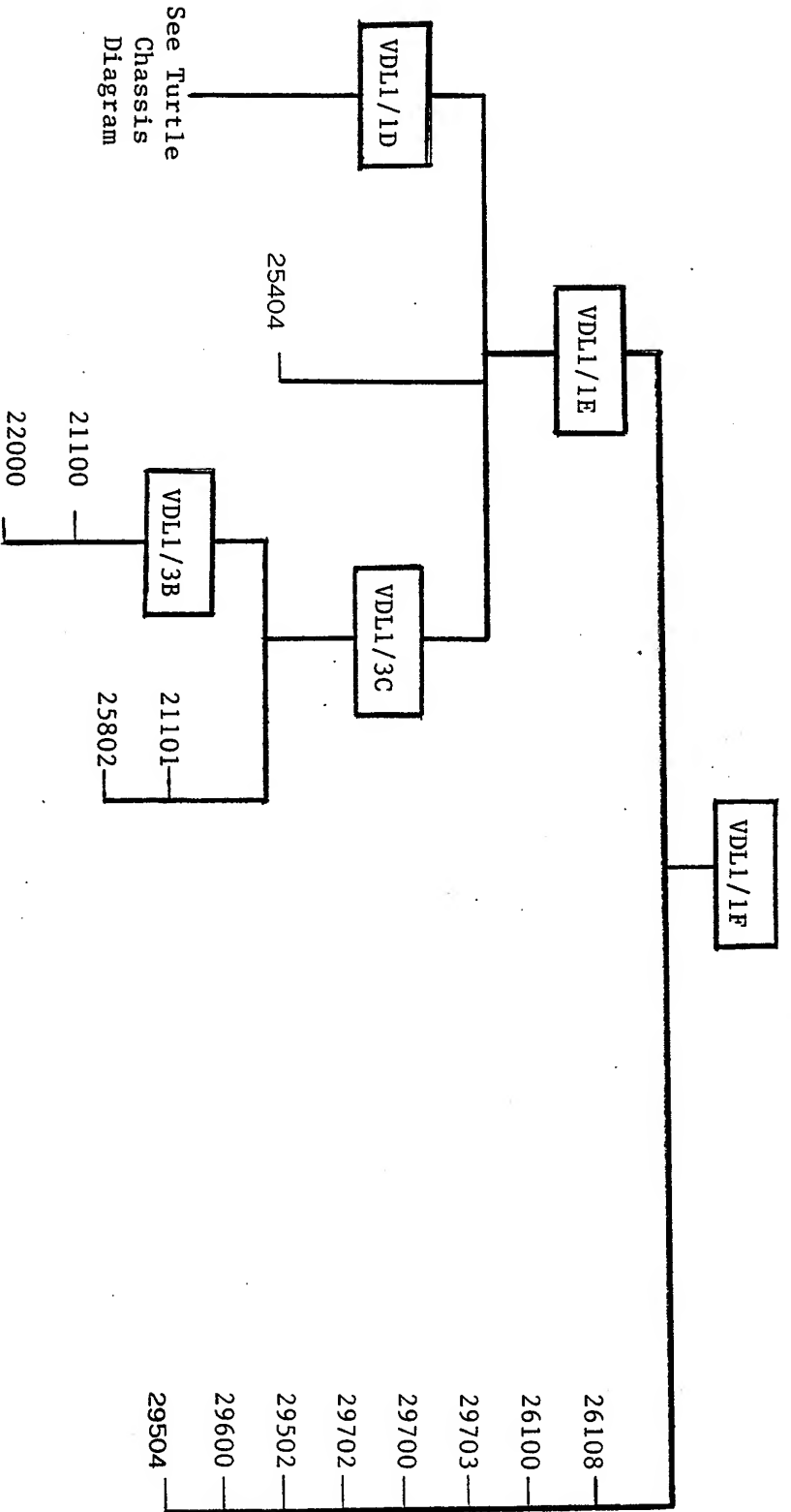
ISSUE N°	PREPARED	CHECKED	APPROVED	COMMENTS
A	DC		DC	8.10.84
B	PP/AG			23.4.85



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Valiant Designs Ltd Park House 140 Battersea Park Road LONDON SW11 4NB ENGLAND
 Tel: 01-720 3947/627 1351/627 0470 Telex: 946461 (Attn Valiant) NIMTEX G
 Directors: Prof T Stonier, AB, MS, PhD, FRSA (President) R R Fawcett, ACMA, MBCS (Chairman)
 D Catlin, B Tech (Managing) G M Manvell (Marketing) T M Airey, BSc, FCA (Finance) (Secretary)
 Reg in England No 1626393 Reg Office: 56-60 St Mary Axe, London EC3A 8BJ VAT No 237 711955





MK II TURTLE ASSEMBLY CHART

VALIANT DESIGNS LIMITED

PARTS LIST FOR MARK II VALIANT TURTLE

ASSEMBLY: MKII TURTLE CHASSIS ASSEMBLY REF: VDL1/1D

ITEM NO.	DESCRIPTION	QTY PER ASSEMBLY	COMPONENT OR ASSM'Y NO.	SUPPLIER OR MANUFACTURER	MANUFAC'S REF.
1	Pen Housing	1	VDL1/2E		
2	Cam Shaft	1	VDL1/2B		
3	D.C. Motor Assembly	1	VDL1/2G		
4	Bottom Battery Cover - Port	1	VDL1/7C		
5	Bottom Battery Cover - Starboard	1	VDL1/7D		
6	PCB	1	VDL1/9B		
7	Turtle Loom	1	VDL1/10J		
8	Eye Assembly	1	VDL1/10I		
9	Traction Wheel Assembly	2	VDL1/13I		
10	Wired Starboard Stepper	1	VDL1/13J		
11	Wired Port Stepper	1	VDL1/13K		
12	Turtle Base	1	21001	CAMALLO	
13	Battery Cover Top	2	21209	CAMALLO	
14	Head Cover Plate	1	21210	CAMALLO	
15	3/4" Diameter Ball Bearing	1	26101		
16	PCB Mounting Pillars	3	25900	CONDALE LTD.	
17	ON/OFF/CHARGE Label	1	24001	MOCKRIDGE LABELS	
18	Name Plate	1	24002	MOCKRIDGE LABELS	
19	Eye Ring	2	24006	MOCKRIDGE LABELS	
20	Clamping Strap	1	22501	AYDEN	
21	Plain Bush	2	21202	CAMALLO	
22	Threaded Bush	2	21211	CAMALLO	
23	Helical Spring	2	26500	GILLSAN	
24	Short Conical Spring	3	28801	GILLSAN	
25	Long Conical Springs Connector	1	28802	GILLSAN	
26	1.2 Volt Batteries Nicad	10	27003	SAFT	

ITEM NO.	DESCRIPTION	QTY PER ASSEM'Y	COMPONENT OR ASSM'Y NO.	SUPPLIER OR MANUFACTURER	MANUFAC'S REF.
27	No.6 Type B Tapping Screw ¼" Long Pan Head	10	25405	T.L. CASTLE	
28	No.8 Type B Self Tapping Pozidrive Pan Head screw ⅝" long	8	25408	T.L. CASTLE	
29	Adhesive	As reqd	25802	GEN.ENG. SUPPLY	BOSTIK 7434
30	DIL switch	1	28005	ERG COMPONENTS	
31	4 Pin IDC & 90mm Long Ribbon Cable	1	28223	SWANSE INDUSTRIAL	
32	1.5mm Rubber Sleeves	4	28200	CROYLEK LTD	
33	Solder	As reqd	25901	TO BE SUPPLIED BY CONTRACTOR	
34	Fuse	1	28805		

VALIANT DESIGNS LIMITED

PARTS LIST FOR MARK II VALIANT TURTLE

ASSEMBLY: MK II TURTLE

ASSEMBLY REF: VDL1/1E

ITEM NO.	DESCRIPTION	QTY PER ASSEM'Y	COMPONENT OR ASSEM'Y NO.	SUPPLIER OR MANUFACTURER	MANUFAC'S REF.
1	MK II Turtle Chassis	1	VDL1/1D		
2	Shell Assembly	1	VDL1/3C		
3	No.6 type B self tapping screw $\frac{1}{2}$ " long	3	25404	T.L. CASTLE	

VALIANT DESIGNS LIMITED

PARTS LIST FOR MARK II VALIANT TURTLE

ASSEMBLY: PACKAGED TURTLE ASSEMBLY REF: VDL1/1F
(ENGLISH VERSION)

ITEM NO.	DESCRIPTION	QTY PER ASSEM'Y	COMPONENT OR ASS'MY NO.	SUPPLIER OR MANUFACTURER	MANUFAC'S REF.
1	MK II Turtle	1	VDL1/1E		
2	Screwdriver	1	26108	MILLS	
3	Berol Colour Stick Pen	1	26100	BEROL	
4	User Guide	1	29703	EMBASSY PRESS	
5	Pen Up	1	29700	EMBASSY PRESS	
6	Talking Turtle	1	29702	EMBASSY PRESS	
7	Polystyrene Pack	1	29502	MIMO	
8	Turtle Carton	1	29600	EMBASSY PRESS	
9	Polythene Bag	1	29504	PREMIER POLYTHENE	

VALIANT DESIGNS LIMITED

PARTS LIST FOR MARK II VALIANT TURTLE

ASSEMBLY: CAM SHAFT

ASSEMBLY REF: VDL1/2B

ITEM NO.	DESCRIPTION	QTY PER ASSEM'Y	COMPONENT OR ASSEM'Y NO.	SUPPLIER OR MANUFACTURER	MANUFAC'S REF.
1	Cam	1	21204	CAMALLO	
2	40T/40DP Gear Wheel	1	20000	PENATUBE	
3	Adhesive	As Reqd	25801	BOSTIK	7431

VALIANT DESIGNS LIMITED

PARTS LIST FOR MARK II VALIANT TURTLE

ASSEMBLY: PEN HOUSING

ASSEMBLY REF: VDL1/2E

ITEM NO.	DESCRIPTION	QTY PER ASSEM'Y	COMPONENT OR ASSEM'Y NO.	SUPPLIER OR MANUFACTURER	MANUFAC'S REF.
1	Top Housing	1	21205	CAMALLO	
2	Bottom Housing	1	21206	CAMALLO	

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PARTS LIST FOR MARK II VALIANT TURTLE

ASSEMBLY: D.C. MOTOR AND PINION

ASSEMBLY REF: VDL1/2F

ITEM NO.	DESCRIPTION	QTY PER ASSEM'Y	COMPONENT OR ASSEM'Y NO.	SUPPLIER OR MANUFACTURER	MANUFAC'S REF.
1	1.5 Volt D.C. Motor	1	26001	PROOPS	RE-140-18100
2	10T/40DP Pinion	1	20001	PENATUBE	
3	Adhesive	As Reqd	25804	GEN ENG SUPPLY	BOSTIK M890
4	Adhesive Activator	As Reqd	25806	GEN ENG SUPPLY	Bostik Activator AX

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PARTS LIST FOR MARK II VALIANT TURTLE

ASSEMBLY: D.C. MOTOR ASSEMBLY

ASSEMBLY REF: VDL1/2G

ITEM NO.	DESCRIPTION	QTY PER ASSEM'Y	COMPONENT OR ASSM'Y NO.	SUPPLIER OR MANUFACTURER	MANUFAC'S REF.
1	2 Pin IDC & 125mm Long Ribbon Cable	1	28221	SWANSEA INDUSTRIAL	
2	D.C. Motor and Pinion	1	VDL1/2F		
3	Rubber Sleeve 1.5mm	2	28200	CROYLEK LTD	
4	Solder	As Reqd	25901	TO BE SUPPLIED BY SUBCONTRACTOR	

VALIANT DESIGNS LIMITED

PARTS LIST FOR MARK II VALIANT TURTLE

ASSEMBLY: SHELL TOP AND DUMMY LENS ASSEMBLY REF: VDL1/3B

ITEM NO.	DESCRIPTION	QTY PER ASSM'Y	COMPONENT OR ASSM'Y NO.	SUPPLIER OR MANUFACTURER	MANUFAC'S REF
1	Shell Top	1	21100	CAMALLO	
2	Dummy Lens	1	22000	DICE & GAMES	16mm Counter
3	Adhesive	As req'd	25302	GEN.ENG.SUPPLY	BOSTIK 7434

VALIANT DESIGNS LIMITED

PARTS LIST FOR MARK II VALIANT TURTLE

ASSEMBLY: SHELL ASSEMBLY ASSEMBLY REF: VDL1/3C

ITEM NO.	DESCRIPTION	QTY PER ASSM'Y	COMPONENT OR ASSM'Y NO.	SUPPLIER OR MANUFACTURER	MANUFAC'S REF.
1	Shell Top and Dummy Lens	1	VDL/3B		
2	Shell Bottom	1	21101	CAMALLO	
3	Adhesive	As Reqd.	25804	GEN.ENG.SUPPLY	BOSTIK M890
4	Activator	As Reqd.	25806	GEN. ENG.SUPPLY	BOSTIK AX

VALIANT DESIGNS LIMITED

PARTS LIST FOR MARK II VALIANT TURTLE

ASSEMBLY: BOTTOM BATTERY COVER - PORT

ASSEMBLY REF: VDL1/7C

ITEM NO.	DESCRIPTION	QTY PER ASSEM'Y	COMPONENT OR ASSM'Y NO.	SUPPLIER OR MANUFACTURER	MANUFAC'S REF.
1	Bottom Battery Cap	1	21208	CAMALLO	
2	Battery Connecting Plate	2	28806	AYDEN	

VALIANT DESIGNS LIMITED

PARTS LIST FOR MARK II VALIANT TURTLE

ASSEMBLY: BOTTOM BATTERY COVER - STARBOARD ASSEMBLY REF: VDL1/7D

ITEM NO.	DESCRIPTION	QTY PER ASSEM'Y	COMPONENT OR ASSEM'Y NO.	SUPPLIER OR MANUFACTURER	MANUFAC'S REF.
1	Bottom Battery Cap	1	21212	CAMALLO	
2	Battery Connecting Plate	3	28806	AYDEN	

VALIANT DESIGNS LIMITED

PARTS LIST FOR MARK II VALIANT TURTLE

ASSEMBLY: MKII COMMUNICATOR
PCB

ASSEMBLY REF: VDL1/8AZ

ITEM NO.	DESCRIPTION	QTY PER ASS'Y	COMPONENT OR ASSM'Y NO.	SUPPLIER OR MANUFACTURER	MANUFACTURER'S REFERENCE
1	THERMISTOR	1	314003	STC	YS 812
2	RESISTOR 75R 4 W	1	175100	VTM	KH-206-0-75R
3	RESISTOR 1K	4	110300	NEOHM	CFR25-1K0-5%
4	RESISTOR 10K	15	110403/ 4	NEOHM ITT	CFR25-10K-5% 77072F
5	RESISTOR 100K	1	110500	NEOHM	CFR25-100K-5%
6	RESISTOR 3R3	1	133000/ 1/ 2/ 3	NEOHM	RGPO207-3R3
7	RESISTOR 3K3	1	133300	NEOHM	CFR25-3K3-5%
8	RESISTOR 330K	1	133500	NEOHM	CFR25-330K-5%
9	3K9X9 SIL RESISTOR	1	139300	NEOHM	ME-9-392-J
10	RESISTOR 47K	1	147400	NEOHM	CFR25-47K-5%
11	RESISTOR 6K2	1	162300	NEOHM	CFR25-6K2-5%
12	RESISTOR 820R	1	18220	NEOHM	CFR25-820R-5%
13	8K2X9 SIL RESISTOR	1	182300	NEOHM	ME9-822-J
14	+5V REGULATOR	1	193000/ 1	NSC NSC	LM7805CT LM340T-5.0
15	100PF CAPACITOR	1	210201/ 0	FARNELL	146-447
16	0.1UF CAPACITOR	1	210500/	THOMSON	IRE/707/100NF
17	CAPACITOR 1UF 35V	1	210600/ 2	THOMSON	FAG 3031 MFM
18	100UF 25V CAPACITOR	1	210800/ 1	FARNELL DUB	143-652 CEA 10025
		1			
19	2U2 16V CAPACITOR	1	222601/ 2/ 3	DUB THOMSON NAT	100-876 FAC302 2.2MF10V ECSFIA E 225H

PARTS LIST FOR COMMUNICATOR PCB

VDL1/8AZ

ITEM NO.	DESCRIPTION	QTY PER ASS'Y	COMPONENT OR ASSM'Y NO.	SUPPLIER OR MANUFACTURER	MANUFACTURER'S REFERENCE
22	CAPACITOR 22UF 35V	1	222701/ 2/ 3/ 0	DUB RS MULLARD FARNELL	K22MF-351 104-017 035-90005 143-243
23	COMMUNICATOR BOARD	1	23205	PLESSEY	
25	DUAL FLIP FLOP	1	270001/ 2 7	NSC MOTOROLLA SIGNETIC	CD4013BCN MC14013BCP HEF 4013 BPR
26	OCTAL LATCH	1	270003/ 8	SIGNETIC TI	N74LS374N SN74L S 374N
27	QUAD O/C GATE	1	270004	NSC	SN74LS136N
28	MICROPROCESSOR	1	270006	SIGNETIC	8048
29	RS232 LINE DRIVER	1	270009/ 10	NSC TEXAS	DS1488N SN75188N
30	DIL SWITCH	1	28004	ERG	SDES-4 023
31	QUAD COMPARATOR	1	285000	NSC	LM339N
32	5 PIN PCB MTG DIN	1	28635		
33	15PIN PCB MRG D TYPE PLG	1	28636	G.ENGLISH	XTR-CO-HV-52
34	SUB MIN PCB MTG SKT	1	28641	G.ENGLISH	HEC 0470-01-640
35	TRANSISTOR	1	300007/ 8	MACRO	2N3904
36	POWER FET	1	304500/ 1	FERRANTI	ZVN2104A
37	DIODE	4	309003	MULLARD	1N4148
38	IR TX DIODE	4	31000 2/ 3	AEG	CQW-
39	LIGHT EMITTING RED DIODE	1	311000	TOS	TLR 102A
40	5.6V ZENER DIODE	1	312000	NSC	BZX 79C 5V6
41	12V ZENER DIODE	1	312001/ 2/ 3	MULLARD RS MULLARD	BZX 61-12V 282-707 BZT03-C12
42	6MHz CRYSTAL	1	315000/ 1/ 2/ 3/ 4	SEI FARNELL AEL SEI	P00600 ABI 103-884 4082 600ABZ

VALIANT DESIGNS LIMITED

PARTS LIST FOR MARK II VALIANT TURTLE

ASSEMBLY: MK II COMMUNICATOR ASSEMBLY ASSEMBLY REF: VDL1/8BA

ITEM NO.	DESCRIPTION	QTY PER ASSEM'Y	COMPONENT OR ASSM'Y NO.	SUPPLIER OR MANUFACTURER	MANUFAC'S REF.
1	Mk II Communicator Box	2	21102	CAMALLO	
2	Backplate	1	22506	AYDEN	
3	Window	1	22008	VISIJAR TUCKER	
4	No.6 type B self tapping screws countersunk head x 1" long zinc plated	4	25411/09	T.L. CASTLE	
5	Name plate label	1	24003	MOCKRIDGE	
6	MKII Communicator PCB	1	VDL1/8AZ		
7	"Valiant" Turtle label	1	24011	MOCKRIDGE	
8	Stick on feet	4	26104	SYNTHOTECH MARINE	602202
9	Heat Sink Compound	1	26800	R.S.	
10	Heat Sink	1	22507	AYDEN	
11	Transistor Heat Sink	1	22508	Made from component no. 22501	
12	Screw M3	1	25000	T.L. CASTLE	
13	Nut M3	1	25100	T.L. CASTLE	
14	Washer M3	1	25200	T.L. CASTLE	
15	Spring Washer M3	1	25300	T.L. CASTLE	

VALIANT DESIGNS LIMITED

PARTS LIST FOR MARK II VALIANT TURTLE

ASSEMBLY: MKII COMMUNICATOR PACKAGE ASSEMBLY REF: VDL1/8BB
(240v 50HZ MAINS SUPPLY)

ITEM NO.	DESCRIPTION	QTY PER ASSEM'Y	COMPONENT OR ASSM'Y NO:	SUPPLIER OR MANUFACTURER	MANUFAC'S REF.
1	Assembled Power Adaptor	1	VDL1/12B		
2	MKII Communicator	1	VDL1/8BA		
3	Polystyrene Packaging	1	29503	MIMO	
4	Communicator Carton	1	29601	EMBASSY PRESS	

VALIANT DESIGNS LIMITED

PARTS LIST FOR MARK II VALIANT TURTLE

ASSEMBLY: MKII COMMUNICATOR PACKAGE
(220v 50HZ MAINS SUPPLY)

ASSEMBLY REF: VDL1/8BC

ITEM NO.	DESCRIPTION	QTY PER ASSEM'Y	COMPONENT OR ASSEM'Y NO.	SUPPLIER OR MANUFACTURER	MANUFAC'S REF.
1	Assembled Power Adaptor	1	VDL1/12C		
2	MKII Communicator	1	VDL1/8 BA		
3	Polystyrene Packaging	1	29503	MIMO	
4	Communicator Carton	1	29601	EMBASSY PRESS	

VALIANT DESIGNS LIMITED

PARTS LIST FOR MARK II VALIANT TURTLE

ASSEMBLY: MK II COMMUNICATOR PACKAGE
(110v 60HZ MAINS SUPPLY)

ASSEMBLY REF: VDL1/8BD

ITEM NO.	DESCRIPTION	QTY PER ASSEM'Y	COMPONENT OR ASSEM'Y NO.	SUPPLIER OR MANUFACTURER	MANUFAC'S REF.
1	Assembled Power Adaptor	1	VDL1/12D		
2	MKII Communicator	1	VDL1/8BA		
3	Polystyrene Packaging	1	29503	MIMO	
4	Communicator Carton	1	29601	EMBASSY PRESS	

PARTS LIST FOR MARK II VALIANT TURTLEASSEMBLY: TURTLE PCB ASSEMBLY REF: VDL1/9B

ITEM NO.	DESCRIPTION	QTY PER ASSM'Y	COMPONENT OR ASSM'Y NO.	SUPPLIER OR MANUFACTURER	MANUFAC'S REF.
1	RESISTOR 100R	1	110200	NEOHM	CFR25-100R-5%
2	RESISTOR 1K0	6	110300	NEOHM	CFR25-1K0-5%
3	RESISTOR LOW NOISE 10K	2	110400/1/2	NEOHM	LR1-10K-1%
4	RESISTOR 10K	3	110403	NEOHM	CFR25-10K-5%
5	10K x 8 SIL RESISTOR PK	1	100405/7	NEOHM	ME-8-103-J
6	SIL RESISTOR 4 x 10K	1	110408	NEOHM	ME-4-103-J
7	RESISTOR 100K	1	110500	NEOHM	CFR25-100K-5%
8	RESISTOR 100K 1%	1	110501	NEOHM	LR1-100K-1%
9	RESISTOR 1K8	2	118300	NEOHM	CFR25-1K8-5%
10	RESISTOR 2K0	1	120300	NEOHM	CFR25-2K0-5%
11	RESISTOR 20K	1	120400	NEOHM	CFR25-20K-5%
12	RESISTOR 22R	2	122100/1	NEOHM	RGPO207-22R
13	RESISTOR 220R 1%	1	122200	NEOHM	LR1-220R-1%
14	RESISTOR 220R	1	122201/2/3	NEOHM	RGPO414-220R
15	RESISTOR 2K2	1	122300	NEOHM	CFR25-2K2-5%
16	RESISTOR LOW NOISE 22K	1	122400/2	NEOHM	LR1-22K-1%
17	RESISTOR 22K	1	122401	NEOHM	CFR25-22K-5%
18	RESISTOR 27R	1	127100	NEOHM	CFR25-27R-5%
19	RESISTOR 270R	1	127200	NEOHM	CFR25-270R-5%
20	RESISTOR LOW NOISE 2K7	1	127300/1	NEOHM MUL	LR1-2K7-1% SFR25-2K7-5%
21	RESISTOR 2K7	1	127302	NEOHM	CFR25-2K7-5%
22	RESISTOR 330R	1	133202	NEOHM	CFR25-330R-5%
23	RESISTOR 4K7	2	147300	NEOHM	CFR25-4K7-5%
24	RESISTOR 47K	1	147400	NEOHM	CFR25-47K-5%
25	RESISTOR 510R	1	151200	NEOHM	CFR25-510R-5%
26	RESISTOR 5K6	1	156300	NEOHM	CFR25-5K6-5%
27	RESISTOR 820R 1%	1	182201	NEOHM	LR1-820R-1%
28	RESISTOR 82K	1	182400		
29	+5V REGULATOR	1	193000/1	NSC	LM780-5CT

ITEM NO.	DESCRIPTION	QTY PER ASSM'Y	COMPONENT OR ASSM'Y NO.	SUPPLIER OR MANUFACTURER	MANUFAC'S REF.
30	ADJUSTABLE REGULATOR	1	193002	NSC	LM 317 L2
31	CAPACITOR 0.01UF	5	210401/0	FARNELL	629 0103
32	CAPACITOR 0.1UF	1	210500/1/2	THOMPSON	IRE/707/100NE
33	CAPACITOR 1UF	6	210600/2	THOMPSON	FAG 303 IMFM
34	CAPACITOR 10UF	3	210700/1/2/3	THOMPSON	FAC 305 10MFM
35	CAPACITOR 22PF	1	222101/0	FARNELL	146-483
36	CAPACITOR 0.22UF	1	222500/1/2	THOMPSON	IRD/807/220NE
37	PCB	1	23206	PLESSEY	
38	CAPACITOR 4.7PF	1	247001/6	FARNELL	146-477
39	PCB PLUG RT ANGLE 4 WAY	1	28651	MOLEX	22-05-1042
40	PCB PLUG RT ANGLE 6 WAY	1	28652	MOLEX	22-05-1062
41	PCB PLUG RT ANGLE 2 WAY	2	28653	MOLEX	22-05-1022
42	PCB PLUG RT ANGLE 5 WAY	2	28654	MOLEX	22-05-1052
43	DUAL FLIP FLOP	1	270001/2/7	MACRO	HEF-4013-BP
44	DARLINGTON DRIVER x 7	2	270005	TEXAS	ULN-2001AN
45	MICROCOMPUTER	1	270006	MACRO	8048
46	DUAL COMPARATOR	2	285001/6	TEXAS	LM-393P
47	TRANSISTOR	4	30000/1	FERRANTI	2N 5086L
48	TRANSISTOR	1	300002	NSC	2N5771
49	TRANSISTOR	1	300003	MOT	2N3906
50	TRANSISTOR	1	300004	TEXAS	TIP115
51	TRANSISTOR	2	300005/6	MACRO	BC327
52	DIODE	3	309000/1/2	MOT	IN40015
53	LIGHT EMITTING DIODE RED	1	311000	TOS	TL-R-102A
54	LIGHT EMITTING DIODE YELLOW	1	311001	TOS	TLY-102A
55	ZENER DIODE 5V6	1	312000	MUL	B2X-79C-5V6
56	ZENER 12V	1	312004	MUL	B2X-79C-12
57	PHOTODIODES	6	313000/1	FERRANTI	BPW-41D
58	6MHz CRYSTAL	1	315000/1/2 /3/4	SEI	600 AB2
59	RESISTOR 8K2	1	182301	NEOHM	CFR25-8K2-5%

VALIANT DESIGNS LIMITED

PARTS LIST FOR MARK II VALIANT TURTLE

ASSEMBLY: EYE ASSEMBLY ASSEMBLY REF: VDL1/10I

ITEM NO.	DESCRIPTION	QTY PER ASSEM'Y	COMPONENT OR ASSM'Y NO.	SUPPLIER OR MANUFACTURER	MANUFAC'S REF.
1	LED	2	311002	IMO	5119/RDA
2	2 Pin IDC & 200mm Ribbon Cable	1	28224	SWANSEA IND.	
3	1.5mm Rubber Sleeve	2	28200	CROYLEK LTD.	
4	Solder	As Reqd	25901	TO BE SUPPLIED BY SUBCONTRACTOR	

VALIANT DESIGNS LIMITED

PARTS LIST FOR MARK II VALIANT TURTLE

ASSEMBLY: MAIN WIRE LOOM ASSEMBLY REF: VDL1/10J

ITEM NO.	DESCRIPTION	QTY PER ASSEM'Y NO.	COMPONENT OR ASSM'Y	SUPPLIER OR MANUFACTURER	MANUFAC'S REF.
1	ON-OFF-CHARGE Switch 2P 3T	1	28003	G.ENGLISH	SS-23F19
2	Fuse Holder	1	28804	ARIEL PRESSINGS	RA 3395
3	Power Socket	1	28642	G.ENGLISH	HEC0749-01-020
4	Resistor	1	156000	FARNELL	104-251
5	Battery Spring	2	28803	GILLSAN	
6	Thermistor	1	314002	STC	YBA020TB
7	6 Way Cable Shell	1	28650	FARNELL	143-095 (22-01-1063)
8	1.5mm Rubber Sleeving	12	28200	CROYLEK LTD.	
9	Stranded core, single 7/0.2mm copper conductors PVC wall coverings 100mm long	6	28225		Supplied by subcontractor
10	Stranded core, single 7/0.2mm sopper conductors PVC wall coverings 55mm long	3	28226		Supplied by subcontractor
11	Crimp terminals	6	28649	FARNELL	143-201
12	Solder	As Reqd.	25901		Supplied by Subcontractor
13	PTFE Sleeving	35mm	28227	RS	

VALIANT DESIGNS LIMITED

PARTS LIST FOR MARK II VALIANT TURTLE

ASSEMBLY: ASSEMBLED POWER ADAPTOR
(240v 50HZ MAINS SUPPLY)

ASSEMBLY REF: VDL1/12B

ITEM NO.	DESCRIPTION	QTY PER ASSEM'Y	COMPONENT OR ASSM'Y NO.	SUPPLIER OR MANUFACTURER	MANUFAC'S REF.
1	Power Adaptor and label	1	VDL1/12E		
2	Stick on feet	4	26104	SYNTHOTECH MARINE	N 602202
3	Sealant	As reqd.			

VALIANT DESIGNS LIMITED

PARTS LIST FOR MARK II VALIANT TURTLE

ASSEMBLY: ASSEMBLED POWER ADAPTOR
(220v 50HZ MAINS SUPPLY)

ASSEMBLY REF: VDL1/12C

ITEM NO.	DESCRIPTION	QTY PER ASSEM'Y	COMPONENT OR ASSM'Y NO.	SUPPLIER OR MANUFACTURER	MANUFAC'S REF.
1	Power Adaptor and label	1	VDL1/12F		
2	Stick on feet	4	26104	SYNTHOTECH MARINE	N 602202
3	Sealant	As reqd.			

VALIANT DESIGNS LIMITED

PARTS LIST FOR MARK II VALIANT TURTLE

ASSEMBLY: ASSEMBLED POWER ADAPTOR
(110v 50HZ MAINS SUPPLY)

ASSEMBLY REF: VDL1/12D

ITEM NO.	DESCRIPTION	QTY PER ASSEM'Y	COMPONENT OR ASSM'Y NO.	SUPPLIER OR MANUFACTURER	MANUFAC'S REF.
1	Power Adaptor and label	1	VDL1/12G		
2	Stick on feet	4	26104	SYNTHOTECH MARINE	N 602202
3	Sealant	As reqd.			

VALIANT DESIGNS LIMITED

PARTS LIST FOR MARK II VALIANT TURTLE

ASSEMBLY: POWER ADAPTOR AND LABEL
(240v 50HZ MAINS SUPPLY)

ASSEMBLY REF: VDL1/12E

ITEM NO.	DESCRIPTION	QTY PER ASSEM'Y	COMPONENT OR ASSEM'Y NO.	SUPPLIER OR MANUFACTURER	MANUFAC'S REF.
1	Power Adaptor 240v/50HZ	1	27006	FERROGLEN	TV202
2	Typed label 240v/50HZ	1	24008	MOCKRIDGE	(from 24004)

VALIANT DESIGNS LIMITED

PARTS LIST FOR MARK II VALIANT TURTLE

ASSEMBLY: POWER ADAPTOR AND LABEL
(220v 50HZ MAINS SUPPLY)

ASSEMBLY REF: VDL1/12F

ITEM NO.	DESCRIPTION	QTY PER ASSEM'Y	COMPONENT OR ASSM'Y NO.	SUPPLIER OR MANUFACTURER	MANUFAC'S REF.
1	Power Adaptor 220v/50HZ	1	27007	FERROGLEN	
2	Typed label 220v/50HZ	1	24009	MOCKRIDGE	(from 24004)

VALIANT DESIGNS LIMITED

PARTS LIST FOR MARK II VALIANT TURTLE

ASSEMBLY: POWER ADAPTOR AND LABEL
110v 60HZ MAINS SUPPLY)

ASSEMBLY REF: VDL1/12G

ITEM NO.	DESCRIPTION	QTY PER ASSEM'Y	COMPONENT OR ASSM'Y NO.	SUPPLIER OR MANUFACTURER	MANUFAC'S REF.
1	Power Adaptor 110v/60HZ	1	27005	FERROGLEN	TV201
2	Typed label 110v/60HZ	1	24010	MOCKRIDGE	(from 24004)

VALIANT DESIGNS LIMITED

PARTS LIST FOR MARK II VALIANT TURTLE

ASSEMBLY: SHAFT AND CIRCLIP ASSEMBLY REF: VDL1/13A

ITEM NO.	DESCRIPTION	QTY PER ASSEM'Y	COMPONENT OR ASSEM'Y NO.	SUPPLIER OR MANUFACTURER	MANUFAC'S REF.
1	Shaft	1	22500	HARVILL	
2	Circlip	1	25600	MECRO	AM 1800-15

VALIANT DESIGNS LIMITED

PARTS LIST FOR MARK II VALIANT TURTLE

ASSEMBLY: MOTOR & PINION ASSEMBLY REF: VDL1/13D

ITEM NO.	DESCRIPTION	QTY PER ASSEM'Y	COMPONENT OR ASSM'Y NO.	SUPPLIER OR MANUFACTURER	MANUFAC'S REF.
1	Stepper Motor	1	26000	IMPEX	9904-112-31004
2	Pinion	1	20026	CAMALLO	
3	Adhesive	As Reqd	25801	GEN.ENG. SUPPLY	BOSTIK 7431

VALIANT DESIGNS LIMITED

PARTS LIST FOR MARK II VALIANT TURTLE

ASSEMBLY: STEPPER MOTOR & FIXING SCREWS

ASSEMBLY REF: VDL1/13E

ITEM NO.	DESCRIPTION	QTY PER ASSEM'Y	COMPONENT OR ASSEM'Y NO.	SUPPLIER OR MANUFACTURER	MANUFAC'S REF.
1	Stepper Motor & Pinion	1	VDL1/13D		
2	Screw M3 x 12	2	25000	T.L.CASTLE	
3	Adhesive	As	25802	SMAIL	BOSTIK 7434
4	M3 Washer	Reqd 1	25200	T.L.CASTLE	
5	M3 Single Coil Spring Washer	2	25300	T.L.CASTLE	
6	M3 Full Hexagon Nut	2	25100	T.L.CASTLE	

VALIANT DESIGNS LIMITED

PARTS LIST FOR MARK II VALIANT TURTLE

ASSEMBLY: WHEEL & TYRE ASSEMBLY

ASSEMBLY REF: VDL1/13H

ITEM NO.	DESCRIPTION	QTY PER ASSEM'Y	COMPONENT OR ASSM'Y NO.	SUPPLIER OR MANUFACTURER	MANUFAC'S REF.
1	Tyre	1	21200	RITMAN & SMITH	
2	Traction Wheel	1	21201	CAMALLO	
3	Retaining Ring	1	21207	CAMALLO	
4	Adhesive	As Reqd	25801	GEN.ENG. SUPPLY	BOSTIK 7434

VALIANT DESIGNS LIMITED

PARTS LIST FOR MARK II VALIANT TURTLE

ASSEMBLY: TRACTION WHEEL ASSEMBLY ASSEMBLY REF: VDL1/13 I

ITEM NO.	DESCRIPTION	QTY PER ASSEM'Y	COMPONENT OR ASSM'Y NO.	SUPPLIER OR MANUFACTURER	MANUFAC'S REF.
1	Shaft and Circlip	1	VDL1/13A		
2	Wheel and Tyre Assembly	1	VDL1/13 H		
3	Anti-Backlash Gear	1	20025	CAMALLO	
4	Circlip	1	25600	ANDERTON	AM 1800-S
5	Adhesive	As Reqd.	25804	GEN ENG SUPPLY	BOSTIK M890
6	Activator	As Reqd.	25806	GEN ENG SUPPLY	BOSTIK AX

VALIANT DESIGNS LIMITED

PARTS LIST FOR MARK II VALIANT TURTLE

ASSEMBLY: WIRED STARBOARD STEPPER MOTOR

ASSEMBLY REF: 13 J

ITEM NO.	DESCRIPTION	QTY PER ASSEM'Y	COMPONENT OR ASSM'Y NO.	SUPPLIER OR MANUFACTURER	MANUFAC'S REF.
1	Stepper Motor and Fixing Screws	1	VDL1/13E		
2	5 Pin IDC Connector & 75mm Long Ribbon Cable	1	28222	SWANSEA INDUSTRIAL	
3	Solder	As Reqd	25901	SUPPLIED BY SUBCONTRACTOR	
4	1.5mm Rubber Sleeve	5	28200	CROYLEK LTD	

VALIANT DESIGNS LIMITED

PARTS LIST FOR MARK II VALIANT TURTLE

ASSEMBLY: WIRED PORT STEPPER MOTOR ASSEMBLY REF: VDL1/13K

ITEM NO.	DESCRIPTION	QTY PER ASSEM'Y	COMPONENT OR ASSM'Y NO.	SUPPLIER OR MANUFACTURER	MANUFAC'S REF.
1	Stepper Motor & Fixing Screws	1	VDL1/13E		
2	5 Pin IDC Connector & 50mm Long Ribbon Cable	1	28221	SWANSEA INDUSTRIAL	
3	Solder	As Reqd	25901	SUPPLIED BY SUBCONTRACTOR	
4	1.5mm Rubber Sleeve	5	28200	CROYLEK LTD	

VALIANT DESIGNS LIMITED

PARTS LIST FOR MARK II VALIANT TURTLE

ASSEMBLY: COMMUNICATOR LEAD FOR
SPECTRUM WITH INTERFACE 1

ASSEMBLY REF: VDL1/14A

ITEM NO.	DESCRIPTION	QTY PER ASSEM'Y	COMPONENT OR ASSEM'Y NO.	SUPPLIER OR MANUFACTURER	MANUFAC'S REF.
1	9 PIN 'D' PLUG	1	28415	R.S.	466.179
2	9 PIN 'D' COVER	1	28416	R.S.	
3	5 PIN DIN 180° PLUG	1	28417	R.S.	
4	1.5mm RUBBER SLEEVE	3	28235	CROYLEK	
5	1.3 mts OF 3 CORE CABLE	1	28226	R.S.	358.141

VALIANT DESIGNS LIMITED

PARTS LIST FOR MARK II VALIANT TURTLE

ASSEMBLY: COMMUNICATOR LEAD FOR
APPLE SUPER SERIAL

ASSEMBLY REF: VDL1/14D

ITEM NO.	DESCRIPTION	QTY PER ASSEM'Y	COMPONENT OR ASSEM'Y NO.	SUPPLIER OR MANUFACTURER	MANUFAC'S REF.
1	25 PIN 'D' PLUG	1	28405	R.S.	466.191
2	25 PIN 'D' COVER	1	28411	R.S.	467.706
3	5 PIN DIN 180° PLUG	1	28417	R.S.	
4	1.5mm RUBBER SLEEVE	3	28235	CROYLEK	
5	3 CORE CABLE	1.3mts	28226	R.S.	358.141

VALIANT DESIGNS LIMITED

PARTS LIST FOR MARK II VALIANT TURTLE

ASSEMBLY: COMMUNICATOR LEAD FOR
IBM PC PARALLEL

ASSEMBLY REF: VDL1/14E

ITEM NO.	DESCRIPTION	QTY PER ASSEM'Y	COMPONENT OR ASSEM'Y NO.	SUPPLIER OR MANUFACTURER	MANUFAC'S REF.
1	25 PIN 'D' PLUG	1	28405	R.S.	466.191
2	25 PIN 'D' COVER	1	28411	R.S.	467.706
3	11 CORE SCREENED CABLE & MOULDED ON 15 PIN 'D' SOCKET	1	24026	G. ENGLISH	
4	1.5mm RUBBER SLEEVE	3	28235	CROYLEK	

VALIANT DESIGNS LIMITED

PARTS LIST FOR MARK II VALIANT TURTLE

ASSEMBLY: COMMUNICATOR LEAD FOR
IBM PC **SERIAL.**

ASSEMBLY REF: VDL1/14F

ITEM NO.	DESCRIPTION	QTY PER ASSEM'Y	COMPONENT OR ASSEM'Y NO.	SUPPLIER OR MANUFACTURER	MANUFAC'S REF.
1	25 PIN 'D' SOCKET	1	28412	R.S.	466.220
2	25 PIN 'D' COVER	1	28411	R.S.	467.706
3	5 PIN DIN 180° PLUG	1	28417	R.S.	
4	3 CORE CABLE 7/0.2	1.3 mts	28226	R.S.	358.141
5	1.5mm RUBBER SLEEVE		28235	CROYLEK	

VALIANT DESIGNS LIMITED

PARTS LIST FOR MARK II VALIANT TURTLE

ASSEMBLY: COMMUNICATOR LEAD FOR
CBM 64

ASSEMBLY REF: VDL1/14G

ITEM NO.	DESCRIPTION	QTY PER ASSEM'Y	COMPONENT OR ASSEM'Y NO.	SUPPLIER OR MANUFACTURER	MANUFAC'S REF.
1	CBM 64 PCB EDGE CONNECTOR	1	28400	ROXBOROUGH	031.12134.200
2	KEY	2	28401	ROXBOROUGH	01.1100
3	CBM 64 CONNECTOR COVER	1	28404	STACK	
4	11 CORE SCREENED CABLE 1.3M LONG & MOULDED ON ON 15 PIN 'D' SOCKET	1	24026	G. ENGLISH	
5	1.5 RUBBER SLEEVE	11	28235	CROYLEK	

VALIANT DESIGNS LIMITED

PARTS LIST FOR MARK II VALIANT TURTLE

ASSEMBLY: COMMUNICATOR LEADS

ITEM NO.	DESCRIPTION	QTY PER ASSEM'Y	COMPONENT OR ASSEM'Y NO.	SUPPLIER OR MANUFACTURER	MANUFAC'S REF.
1	BBC SERIAL	1	24025	G. ENGLISH	
2	RML 480Z	1	24027	G. ENGLISH	
3	RML 380Z	1	24028	G. ENGLISH	
4	BBC PARALLEL	1	24029	3M	
5	APPLE ARISTOCARD	1	24030	3M	
6	APPLE ORANGE MICRO STANDARD GRAPPLER	1	24031	3M	
