



# **VOLTAGE SENSING SWITCH**

## **VSS-Y**

### **OPERATIONS AND MAINTENANCE MANUAL**

#### **Manual Issue A Revision 0**

Edited By:	Kath Bolan
Manual Last Updated:	07-Sep-12
Manual Printed:	07-Sep-12
Document Name:	128-97045 VSS-Y Issue A Rev 0 Released
<b>GUARDIAN</b> Part Number:	128-97045

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**VSS-Y****Use of Manual and Quality Assurance****IMPORTANT**

**Read this manual thoroughly, especially the section concerning safety, prior to using any equipment described**

This manual is issued on the understanding that it is for use only by persons who have been appropriately trained both in the general use and practice of oilfield well-logging techniques and specifically in the storage, use, operation and maintenance of the equipment described. **GUARDIAN** accepts no responsibility whatsoever for any damage, injury or death to any equipment or person carrying out any of the instructions or procedures described in this manual. All personnel must satisfy themselves as to the safety of any of the procedures described being mindful of the circumstances in which any work is to be carried out.

No warranty, express or implied, is indicated by any statement in this manual, nor is any guarantee given of conformance to any specification. For details of warranties, conformance and specifications, please see the **GUARDIAN** 'General Terms of Sale' together with the appropriate equipment Data Sheets and tool test certificates.

All information provided in this manual is confidential and must not be distributed to anyone outside the recipient's organisation without prior written consent from **GUARDIAN**. The original purchaser of the equipment with which this manual was provided is authorised to make copies for distribution within the purchaser's organisation on condition that recipients are bound by the same conditions of confidentiality. No copies are authorised if this manual has been supplied with equipment on loan or for test and evaluation purposes.

Before requesting technical support, please review this manual carefully to ensure that your question is not answered within.



**VSS-Y**

**Use of Manual and Quality Assurance**

Manual Revisions -

Manual Release	Release Date:	Checked By:	Approved By:	Comments:
A	7 <sup>th</sup> Sep 2012	KB	JF	Initial Issue

**Table 0-1 – Manual Revisions**

Manual Applicability

Manual Issue:	VSS-Y			
A	Issue A			

**Table 0-2 – Manual Applicability**



**VSS-Y**

**Use of Manual and Quality Assurance**

**Tool Up-Issue Descriptions**

- None applicable.

**Manual Up-Issue Descriptions**

- Initial Release;

**VSS-Y****Use of Manual and Quality Assurance**

Upon delivery please check the following items are included in the shipping box -

<b>Item:</b>	<b>Qty:</b>	<b>Part No:</b>	<b>Description:</b>	<b>Reference:</b>
1	1	128-89045	Service Tool Kit, VSS-YXX	
2	1	128-95045	Exploded Assembly Drawing, VSS-YXX	
3	1	128-97045	Manual, VSS-YXX	
4	2	128-99045	VSS-YXX, Voltage Sensing Switch	
5	2	128-99645	Test Certificate, VSS-YXX	
6	1	210-00149	Ready Box Kit, VSS-YXX	

**Table 0-3 – Shipping List, VSS-Y**

**Product Naming Convention**

The naming convention for Guardian tools/panels is as follows:

Tool Name XXX-TOI

- where XXX is the tool/panel acronym.
- T is the tool type defined by Head Type, Telemetry Interface, Pressure Rating, Temperature Rating and Diameter.
- O defines any options available, e.g. 10ksi pressure gauge, 16ksi pressure gauge.
- I is the issue of the tool.

Trademarks:

All trademarks are recognised.



**VSS-Y**

**Use of Manual and Quality Assurance**

**Errors and Omissions**

Please photocopy this page and use it to notify the Technical Department at the address given below of any errors, omissions or suggestions in connection with this manual.

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**VSS-Y****Section 1 - Safety****1. Safety****1.1 Ballistic Safety**

The VSS has applications as a ballistic systems safety device. However, no specific safety procedures are provided in this manual as the circumstances of the deployment of the VSS products is completely out of the control of **GUARDIAN GLOBAL TECHNOLOGIES LTD**. The user of the equipment **MUST** review and understand the operational system and specifications of the VSS and assure themselves that the VSS is appropriate and safe to be deployed with the specific system(s) contemplated.

**GUARDIAN GLOBAL TECHNOLOGIES LTD** accepts no responsibility for any incident arising from use of the VSS system as the circumstances of use are beyond its control.

**1.2 General Safety Precautions**

Standard wireline/electric line safety precautions should be followed in maintenance, operation and use. When dismantling any downhole equipment, if a thread is unusually tight, suspect trapped pressure. Never stand in the 'firing line' of any piece of equipment being disassembled after it has been downhole.

- Ensure sufficient anti-static protection is available when working on the tool electronics. A grounded soldering iron should generally be used.
- Never connect the tool directly to the output of any surface interface panel or power supply unless specified within the maintenance text - always use a Cable Simulator Unit. (301-00001 or 301-00087 - monocable, 301-00002 - heptacable).
- Retention O'rings, if used within the tool, do not provide any pressure seal, but *should* be replaced each time the retained item is removed as minor damage caused to the o'ring may affect the effectiveness of retention. Use only 90 duro o'rings.
- If difficulty is experienced when breaking tool connections after a run in the well, never hammer spanners to separate tools. If necessary use cheater bars with the toolstring well supported.  
**SUSPECT TRAPPED PRESSURE!**
- When cleaning the tool, ensure thread protectors with o'rings are fitted or fluid can enter the tool and damage the electronics.
- Never use a heat gun to perform thermal testing of the tool as serious damage will be caused to the tool electronics. Use only a thermostatically-controlled oven designed for tool testing. Always heat test with pressure housings in place. When heat-testing the tool, never blow cold air onto an unshielded electronics assembly to cool it. This can dramatically reduce the life and reliability of



## VSS-Y

## Section 1 - Safety

the electronics. Allow the tool to cool naturally with the oven door closed or just ajar. Tools should not be subjected to a temperature gradient greater than 10°C per minute.

### 1.3 Tool Specific Precautions

- During lab testing of the tool and system, high voltages can be present on the wiring. Take appropriate precautions to prevent electric shock.

### 1.4 Operational Safety

- Do not thermally shock any tool by running into a low temperature (injection) well if it has been standing in a hot (desert) environment. Cool the tool gently with hot/warm water. Failure to do so will not only shorten the life of the tool but may cause seal failures due to differential rates of thermal expansion.
- Do not overtighten field or servicing connections. All tools designed with self-locking pressure seals and joints should be tightened using normal open-ended or 'C' spanners. **DO NOT** hammer spanners to tighten connections.
- **DO NOT** use Stillson (pipe) wrenches on tools to tighten or loosen tool joints. Doing so will damage and weaken pressure housings and may void the tool warranty. Use the correct size of open-ended wrench/spanner in good condition. **DO NOT** hammer or lever wrenches to tighten joints - tightening by hand with the correct wrenches is all that is required. The joints are designed to be self-locking once they are under pressure.

Note: If a tool returned to Guardian for repair or servicing is fitted with a pressure housing or sub damaged by use of pipe wrenches, the damaged component will be replaced as a chargeable item, even if the tool itself is under warranty.

- If a fault condition results in the failure of communication between the VCP and VPM, the operator must consider the possibility that the micro-switches could be in the fire position and therefore appropriate action should be taken. To avoid the possibility of firing the guns accidentally the tractor must not be powered until the VPM is in a known state.
- The down-hole voltage sensing switch (VSS) circuit employs a thyristor as the switching device. Thyristors remain ON once they have been switched and until voltage across them drops to zero volts. After each perforating operation, it is recommended that the operator leave sufficient delay for the line and perforating panel capacitors to discharge before running the tractor. Newer versions of the VPM/VSS contain an IGBT device which is not prone to this characteristic – (VSS board 128-00106 issue D and higher).

**VSS-Y****Section 1 - Safety**

- Guardian tools are supplied as standard with Viton 90 o’rings which are suitable for many downhole environments. They are not, however, suitable for all well conditions and may be degraded by the presence of gas, high temperatures and other environmental factors. It is ALWAYS the user’s responsibility to ensure that the o’ring type fitted to this product prior to running into a user’s well is suitable for the specific environmental conditions encountered in that well. Failure to do so may result in premature failure of the o’ring seals and potentially catastrophic damage to the tool; damage so caused is not covered by the standard warranty.

**Note:** If a tool returned to **GUARDIAN** for repair or servicing is fitted with a pressure housing or sub, has been damaged by use of pipe wrenches, the damaged component will be replaced as a chargeable item, even if the tool itself is under warranty.

### 1.5 Engineering Requirements

- All fasteners used in **GUARDIAN** tools are stainless steel (A2 or A4) except where otherwise stated. To maintain the standard of performance of the equipment, only similar corrosion-resistant fasteners should be used as replacements. These can be ordered as spare parts from **Guardian**.
- Unless otherwise stated, all fasteners in contact with well fluid are manufactured from A4 (316/321) stainless steel and those not in contact with well fluid from A2 (303/304) stainless steel.

### 1.6 Technical Support

- Before calling Technical Support, please ensure that you have reviewed the relevant pages of this manual for information on your question or problem and that you have a detailed description of the problem. The more information you are able to provide, the more likely is it that Technical Support will be able to help. Contact [techsupport@ggtg.net](mailto:techsupport@ggtg.net).

**VSS-Y****Section 2 - Introduction****2. Introduction****2.1 Description and Application**

The Voltage Sensing Switch (VSS) is deployed to prevent a short circuit in a perforating gun or ballistics device preventing the operation of any Guardian Ballistics Delivery System product located above the VSS. BDS products which should be protected include the ART, IDC, GBS, VPM and PSJ. A short circuit will frequently occur in a ballistics string once the detonator has been fired. As the electrical connection is a single line from surface through to the ballistics device, via any BDS tools in the string, a short in the ballistics device will prevent the operation of any BDS products.

The VSS is always deployed as the lowest Guardian electronic product in a BDS string. Only a shock absorber (SAT) would be placed below the VSS.

Functionally the VSS-Y is based on the VSS-B/D/H/I, a 2 1/8", 400F, GO A, 15,000psi, but with a U-type VSS module replacing the B/D/H & I type modules

**2.1.1 Applications**

- Perforating/plug setting;
- Standard Perforating Systems;
- Safe perforating systems;
- DynaEnergetics Switches;
- BA Guardian 2 Systems;
- Resistorised Detonators;

**Figure 2-1 - VSS-Y**



## VSS-Y

## Section 2 - Introduction

### 2.2 Tool Purpose

A short circuit will frequently occur in a ballistics string once a perforating gun or ballistics device has detonated. Because the electrical connection is a single line from surface through to the ballistics device, via any BDS tools in the string, a short in the ballistics device will prevent the operation of any BDS products (which operate on a voltage of between  $-50$  and  $-100\text{vdc}$ ).

Please contact [sales@ggtg.net](mailto:sales@ggtg.net) or [techsupport@ggtg.net](mailto:techsupport@ggtg.net) with your specific requirements, as various options are available for this product range.

### 2.3 Electronics Operation

The VSS is always deployed as the lowest Guardian product in a BDS string and allows all positive voltages to pass through the tool to fire a positively-configured ballistics device.

It will block any negative voltage of magnitude less than nominally  $-130\text{vdc}$  thereby isolating the BDS tools from the short circuit below. At applied voltages of greater than nominally  $-130\text{vdc}$ , the VSS 'switches on' passing the voltage to a negatively configured ballistics device.

Select fire ballistics devices are configured negative-positive-negative (or by using electronically addressable switches) etc. so a device creating a negative short circuit would not then be followed by another device fired on a negative voltage.

The U-type module can be jumper configurable to any of the types "B", "D", "H" or "I",

#### 2.3.1 Electronic Operation – B and D-type Modules

As the applied upper head voltage increases (negatively), a number of voltage sensing elements switch until the applied voltage reaches approximately  $-120$  to  $-160\text{vdc}$ . At this voltage a thyristor/IBGT (B-type) or relay contact (D-type) is switched on, conducting between the upper and lower heads.

The thyristor/IBGT of the B-type module remains switched on until the applied voltage is removed, so even if the applied voltage is reduced, the VSS will still conduct.

The B-type module is designed to block only negative voltages (up to the switching threshold). The D-type module is engineer-configurable to block either negative (default) or positive voltages via a number of jumpers within the module.



## VSS-Y

## Section 2 - Introduction

### 2.3.2 Electronic Operation – H-type Modules

A similar wide input voltage sensing arrangement to that in the D-type module controls the operation of a reed switch via an energising coil. When the applied voltage reaches between -30 and -35vdc (or +30 to +35 as selected by the user) the coil is energised and the switch opens. All voltages of the opposite polarity to that of the switching voltage are passed through the tool with two diode drops.

### 2.3.3 Electronic Operation – I-type Modules

As the applied upper head voltage increases (negatively), a number of voltage sensing elements switch until the applied voltage reaches approximately -120 to -160vdc. At this voltage a relay contact is switched on, conducting between the upper and lower heads.

The module is engineer-configurable to block either negative (default) or positive voltages via a number of jumpers within the module.

### 2.4 Downhole Equipment

The VSS-Y downhole tool is 2 1/8" in diameter. The VSS should be deployed below any Ballistics Delivery Systems equipment operating with the GUARDIAN MPT type telemetry

A CCL and PFC or other Gamma Ray (GR) correlating device can be run below the B-type module if the CCL bypass resistor is fitted.

A correlating tool cannot be run below the D-type module unless the signal from such a tool can be detected above the forward conducting diodes.

A conventional shooting CCL can be deployed below an H-type module as the relay contact will conduct the signal to the upper head. A powered correlating device would normally require to be run above the H-type module as the module will switch open at an applied voltage of 30-35vdc.

Ballistic devices are connected below any correlating devices. The engineer MUST assure himself that any powered correlating device can be used safely with the applicable gun firing system prior to deployment.

All VSS modules are auto resetting once the applied voltage causing the switching action is removed.



## VSS-Y

## Section 2 - Introduction

### 2.5 Surface Equipment

There is no specific surface equipment required for use with the VSS.

### 2.6 VSS Application Data

As application data is being continually updated, please go to [www.ggtg.net](http://www.ggtg.net) for the latest information. This can be found at Products – Protection & Safety – Voltage Protection Systems and download the application charts.



**VSS-Y**

**Section 3 – Specifications**

**3. Specifications**

3.1 Mechanical Specifications

<b>Shipping Length:</b>	15.84 in / mm
<b>Makeup Length:</b>	11.75 in / mm
<b>Tool Diameter:</b>	2 1/8 in. / mm
<b>Pressure (Max):</b>	15,000 psi / 103 MPa
<b>Temperature (Max):</b>	400°F / 204°C
<b>Weight:</b>	7.3 lb / 3.3 kg
<b>Fishing Strength:</b>	26,000 lb / 11,793 kg
<b>Upper Head Connection:</b>	GO Type A
<b>Lower Head Connection</b>	GO Type A
<b>H<sub>2</sub>S/CO<sub>2</sub> Operation:</b>	NACE MRO-175

**Table 3-1 – Mechanical Specifications, VSS-Y**

3.2 Electrical Specifications (U-Type Module)

<b>Parameter</b>	<b>Value</b>	<b>Requirements</b>
Min. Switching Voltage: (D,B,I-type/H-type)	-120vdc/ -30vdc	From minimum to maximum rated temperature;
Max. Switching Voltage: (D,B,I-type/H-type)	-160vdc/ -40vdc	From minimum to maximum rated temperature
Max Rated Voltage:	+ 1250vdc - 500vdc	From room to maximum rated temperature, 1 minute duration. Engineer specific electrical ‘weakpoint’ to fail if possible if over-voltage applied
Max. Through Current:	1A	From room to maximum rated temperature, 1 minute duration. Should be capable of make/break at this current, at switching voltage
Max. L/H Leakage Current:	25mA	From room to maximum rated temperature, U/H applied voltage minus 100vdc. No CCL bypass resistor fitted in the module.
Max. L/H Leakage Voltage:	25Vdc	Measured into 10kΩ impedance. U/H applied voltage minus 100vdc. No CCL bypass resistor fitted in the module.

**Table 3-2 – Electrical Specifications, VSS-Y**



## VSS-Y

## Section 4 – Operational Instructions

### 4. Operations

#### 4.1 Operating Instructions Overview

Pre- and post-job maintenance schedule is in Section 7.0 and a check sheet provided in Appendix A. It is recommended that these checks are carried out before and after every trip in the well.

#### 4.2 Calibration

There are no calibrations applicable to the VSS.

#### 4.3 Operational Check

An operational check can be carried out on any stand-alone VSS tool in the following manner. Note that for tools where a VSS module forms an integral part of that tool (e.g. VPM-E, G, H, L) user should refer to the appropriate Operations and Maintenance Manual for appropriate operational checks.

With the VSS installed in the toolstring connect a Voltmeter (DMM, Fluke) to the lower end of the string. Connect a perforating panel or similar DC power supply to the upper end of the string via a logging cable or cable simulator – **ENSURE THAT ALL SAFETY SOP'S ARE FOLLOWED AND THAT NO LIVE GUN IS CONNECTED TO THE STRING.**

Whilst monitoring the DMM, increase the applied upper head voltage until the DMM indicates the appropriate switching mode for the applicable VSS module type (see Section 7 for details).

#### 4.4 Tool String Assembly

The VSS tool or other tool containing a VSS module should always be installed below any other Guardian BDS tool(s) in the string (Ballistic Delivery System products - ART, IDC, PSJ, GBS,).

A BA PFC (GR/CCL correlating device) or other passive perforating CCL may be connected below a tool containing a B-type module. Any other equipment should be connected in accordance with SOP's.

#### 4.5 Perforating Safety

Standard Operating Procedures (SOPs) must be observed when performing operational checks of the VSS. Under no circumstances should an operational check of the system be made on the surface **WITH ARMED PERFORATING OR SETTING TOOLS CONNECTED.**



**VSS-Y**

**Section 4 – Operational Instructions**

4.6 Post Job Calibration

There are no post-job calibrations

4.7 Fishing Operations

There are no special fishing requirements.

**VSS-Y****Section 5 – Mechanical Description****5. Mechanical Description**

VSS-Y is a 2 1/8" in. tool with GO A heads. The VSS-Y consists of a Lower Sub on which are mounted all of the internal components and a single piece Pressure Housing screwed onto the Lower Sub.

A Chassis is mounted between the Lower Sub and Bulkhead. The Bulkhead is supported by two Support Rods.

Upper and lower heads are fitted with pressure isolation components (see General Assembly reference drawings for further details).

The VSS-Y Unipolarity module has Low leakage operation with configurable voltage switching thresholds. It is a 400°F type module with a current capability of 1A. The VSS-Y allows all positive voltages to pass through the tool to fire a positively-configured ballistics device; however it will block any negative voltage of magnitude less than nominally –130vdc thereby isolating the BDS tools from the short circuit below. At applied voltages of greater than nominally –130vdc, the VSS ‘switches on’ passing the voltage to a negatively configured ballistics device.

**5.1 Tool Assembly & Disassembly, VSS-Y****5.2 Recommended Equipment needed**

- Standard Hand Tools;
- Service Tool Pressure Isolation (301-00007)
- Tommy Bar 4mm (301-00038)
- Liquid O’ring 101 Grease (302-00030).

**5.3 Tool Disassembly****References:**

General Assembly Drawing, VSS-Y – 128-99045  
Exploded Assembly Drawing, VSS-Y – 128-95045  
Chassis Assembly, Complete, Drawing, VSS-Y – 128-00307  
Exploded Assy, Complete Chassis, Drawing, VSS-Y – 128-50307  
Lower Head, GO Type A, Connector Assembly, Drawing, 202-00330 (Option A tool)  
Upper Head, GO Type A, Connector Assembly, Drawing, 202-00331 (Option A tool)  
Upper Head, GO Type A Rev'd, Connector Assembly, Drawing, 202-00332 (Option B tool)  
Lower Head, GO Type A Rev'd, Connector Assembly, Drawing, 202-00333 (Option B tool)

**VSS-Y****Section 5 – Mechanical Description****5.3.1 Pressure Housing and Pressure Isolation Head**

It is recommended that the Upper Head connector sub-assembly be removed prior to removing the Pressure Housing from the Lower Sub. However, no damage will occur if the connector sub-assembly is left in place during removal of the Pressure Housing.

1. Remove the Circlip (9) from within the upper head of the Pressure Housing (3).
2. Extract the Upper Head Connector Sub-Assembly (8/10) from within the Pressure Housing (3).
3. Remove the Pressure Housing by unscrewing from the Lower Sub using 48/50mm spanners as required. Ensure that the Shock Absorber Discs (1) and the Compression Disc (2) are removed from the upper head end of the Complete Chassis Assembly (4) and retained.
4. With reference to drawings 202-00331/332, the Upper Head Connector Sub-Assembly (8/10) can be further dismantled.
5. Extract the Lower Head (7/11) from the Complete Chassis Assembly (4) using appropriate tools.
6. With reference to drawings 202-00330/333, the Lower Head Connector Sub-Assembly (7/11) can be further dismantled.
7. Replace the pressure isolation o'rings as required.

**5.3.2 Complete Chassis Disassembly (4)**

Refer to drawing 128-50307.

8. Remove the two Screws (16) and washers (15) securing the bulkhead (3) to the Support Rods (2).
9. Remove the Chassis plate (10) with VSS Module, Type U (9) attached, from the Lower Sub (8) and unscrew the two Support Rods (2).
10. Remove Screw (17) along with Shakeproof Washer (14), Solder Tag (18), Plain Washer (12) and Spring Washer (13) from Bulkhead (3).
11. Remove Aerotight Nut (19), Plain Washer (12), Upper Head Solder Tag (18), Half Nut (22) and Spring Washer (13) from threaded end of Connector Stud (1). Remove Connector Stud (1) and Top Hat Insulator (6) from Bulkhead Insulator (5).
12. If required, the Banana Pin (11) can be de-soldered from the Connector Stud (1) and unscrewed.



VSS-Y

Section 5 – Mechanical Description

13. To remove Socket Contact Locator (4) and Socket Contact (28) from Lower Sub (8), remove Internal Circlip (23) from Lower Sub (8).
14. To remove Assembled VSS U-Type Module (9), remove three Aerotight Nuts (24), three Crinkle Washers (26) and two Peek Top Hat Insulators from the three Screws (25).
15. Remove three Peek Spacers (30), three Full Nuts (21) and three Plain Washers (20) from Screws (25). These Screws (25) can then be removed from Chassis Plate (10).

5.4 Tool Assembly

- Prior to the assembling of the tool, ensure that the PCB Setting links are set to the correct Operational Mode for the specific tool build. Refer to Section Figure and Table below.
- JP2 should be inserted and permanently soldered.
- JP3 is NOT fitted.

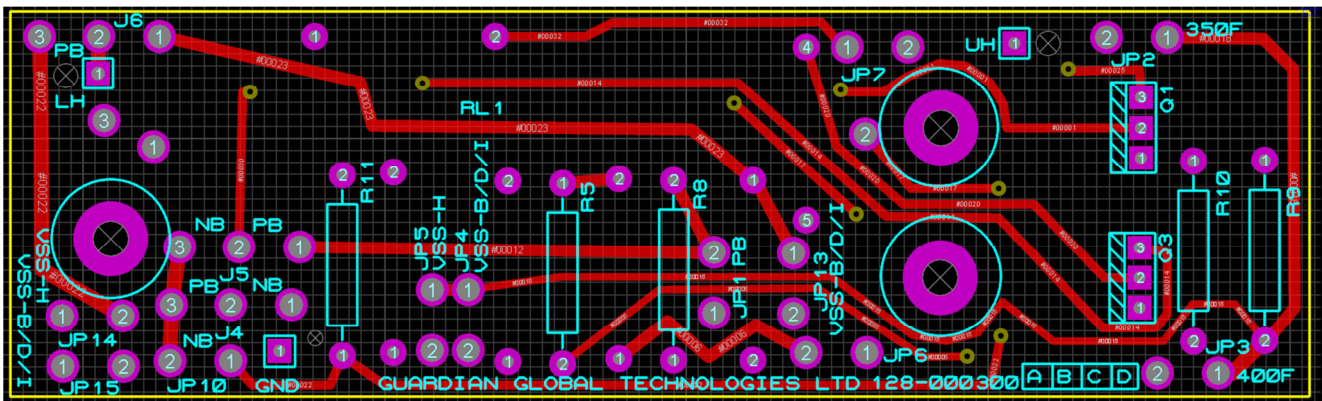


Figure 5-1 PCB Layout, VSS-Y - 128-00300

Polarity	Pos Blocking	JP1 (1-2)	J4(3-2)	J5(1-2)	J6(2-3)
	Neg Blocking	JP10 (1-2)	J4(1-2)	J5(2-3)	J6(1-2)
Mode	VSS-B Type with CCL bypass resistor	JP15(1-2)	JP13(1-2)	JP7(1-2)	-
	VSS-D Type	JP15(1-2)	JP13(1-2)	-	-
	VSS-I Type	JP15(1-2)	JP13(1-2)	-	-
	VSS-H Type	JP5(1-2)	JP6(1-2)	JP14(1-2)	-

Table 5-1 Link Settings, VSS-Y

**VSS-Y****Section 5 – Mechanical Description**

## References:

General Assembly Drawing, VSS-Y – 128-99045  
Exploded Assembly Drawing, VSS-Y – 128-95045  
Wiring Diagram, VSS-Y – 128-96045  
O’ring Drawing, VSS-Y – 128-94045  
General Assembly Drawing Complete Chassis Assembly – 128-00307  
Exploded Assembly Drawing Complete Chassis Assembly – 128-50307

1. During the assembly process wire the tool at the appropriate stages in accordance with Wiring Diagram 128-96045.
2. Solder wire to Socket contact (28) as per Wiring Diagram (128-96045). Feed wire through Socket Contact Locator (4) and RTV Socket Contact (28) to Socket Contact Locator (4). Solder wire to the VSS Module, U Type, assembled (9) as per Wiring Diagram (128-96045).
3. Solder wires to 2 x Solder Tags (18) and to VSS Module, U Type, assembled (9) as per Wiring Diagram (128-96045) as per Wiring Diagram (128-96045).
4. Install 3 x M2.5 x 16mm Screws (25) through Chassis Plate (10) and fit 3 x 2.5mm Plain Washer (20), 3 x Full Nut (21) and 3 x Peek Spacer (30).
5. Install 1 x Mica Pad (supplied with assembled type U VSS module, 9) between each Mosfet and the PCB board.
6. Install VSS Module, Type U, Assembled (9) onto Screws (25).
7. Install 2 x Peek Top Hat Insulators (supplied with assembled type U VSS module,9), 3 x Crinkle Washers (26) and fix using 3 x Aerotight Nuts (24).
8. Install Socket Contact (28) and Socket Contact Locator (4) into Lower Sub, VSS (8) and install 9mm Internal Circlip (23).
9. Screw 2.5mm Banana Pin (11) into Connector Stud (1) and secure using solder.
10. Install Top Hat Insulator (6) and Bulkhead Insulator (5) into Bulkhead (3).
11. Install Connector Stud (1) into Bulkhead Insulator (5) and install 1 x 3mm Spring Washer (13), 1 x M3 Half-nut (22), the Upper Head Solder Tag (18) (with attached VSS Module, Type U, Assembled (10)), 1 x 3mm plain washer (12). Secure with 1 x M3 Aerotight Nut (19).
12. Install 1 x 3mm Spring Washer (13), 1 x 3mm Plain Washer (12), 1 x Solder Tag (18) (attached to VSS Module, Type U, Assembled (10)) and 1 x Shakeproof Washer (14) onto 1 x M3 Screw (17). Install this screw into Bulkhead (3).
13. Place Heatshrink (27) onto 1 x VSS Support Rod (2) and install both Support Rods (2) into Lower Sub (8).
14. Install 1 x Chassis Plate Shock Absorber (7) into both the Lower Sub (8) and the Bulkhead (3). Locate the Chassis Plate (10) and associated parts into the Lower Sub (8) and secure in place by installing the Bulkhead onto the opposite end and securing with 2 x 4mm Spring Washers (15) and 2 x M4 x 20mm Screws (16). **Ensure the VSS Module, Type U, Assembled (9) and Connector Stud (1) do not make contact once assembled.**
15. Install 2 x 131 O-rings (5) onto Lower Sub.
16. Install 2 x Shock Absorber Discs (1) and 1 x PTFE Compression Disc (2) onto Upper Head of the Chassis Assembly (4).



**VSS-Y**

**Section 5 – Mechanical Description**

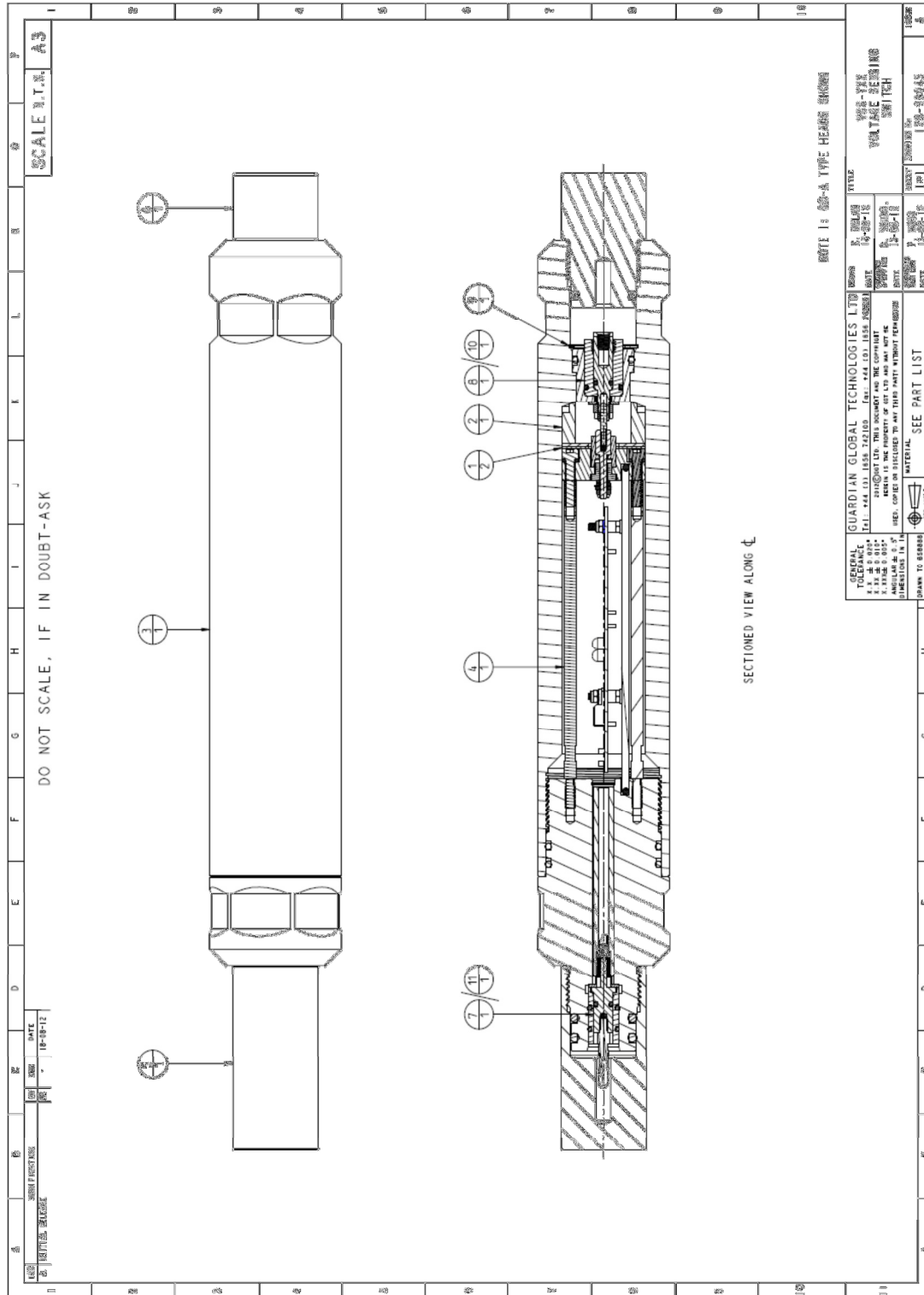
17. Screw Chassis Assembly (4) into Pressure Housing (3).
18. Install Lower Head (7/11) into Lower Sub and Upper Head (8/10) into Pressure Housing (3). Secure Upper Head with Circlip (9).
19. Install 2 x 211 O’rings (6) onto Lower Sub.



**VSS-Y**

**Section 5 – Mechanical Description**

5.5 Mechanical Drawings



**Figure 5-2 - General Assembly Drawing, VSS-Y – 128-99045-A**







VSS-Y

Section 5 – Mechanical Description

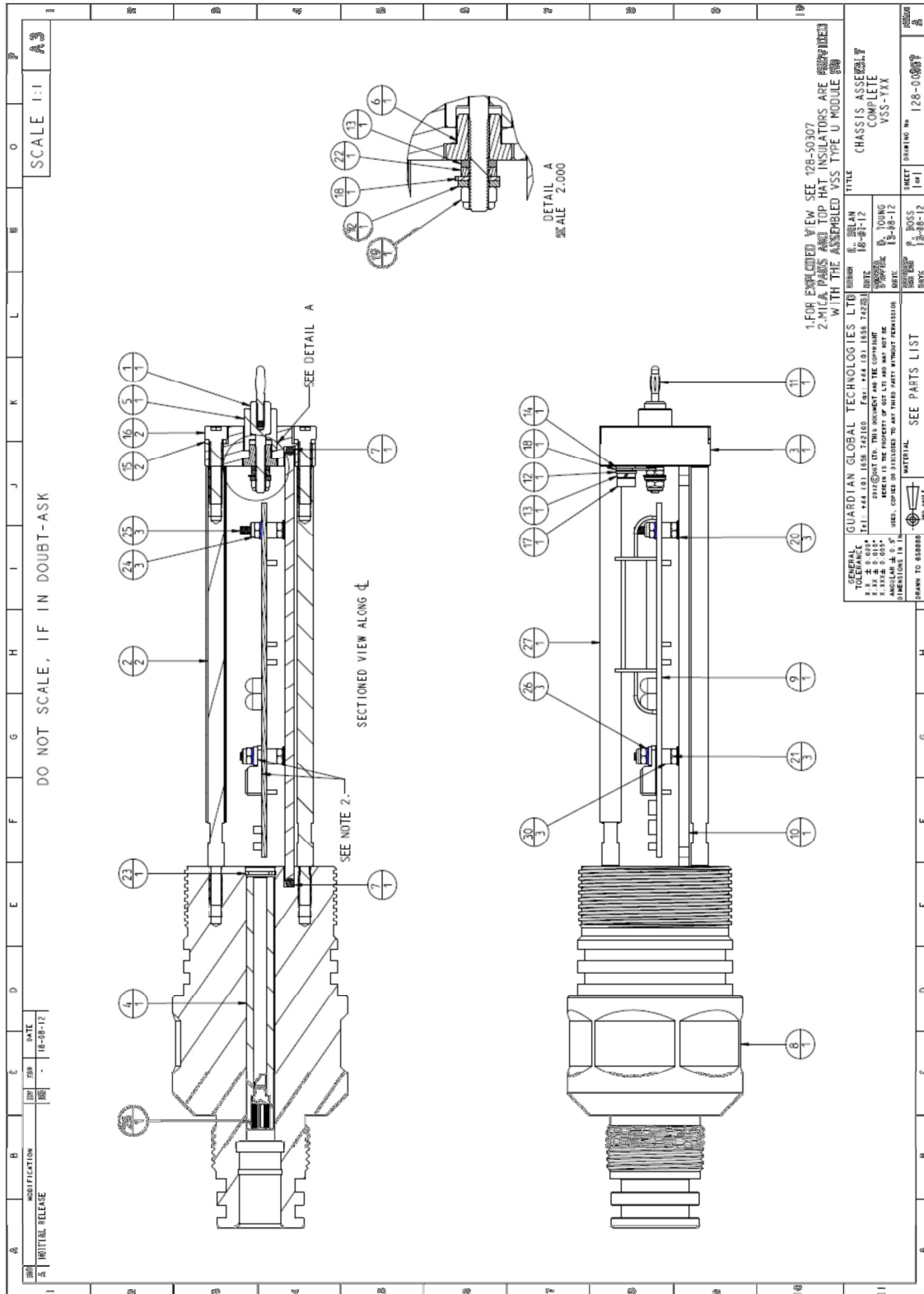


Figure 5-5 – General Assembly Completed Chassis Drawing, VSS-Y – 128-00307-A



VSS-Y

Section 5 – Mechanical Description

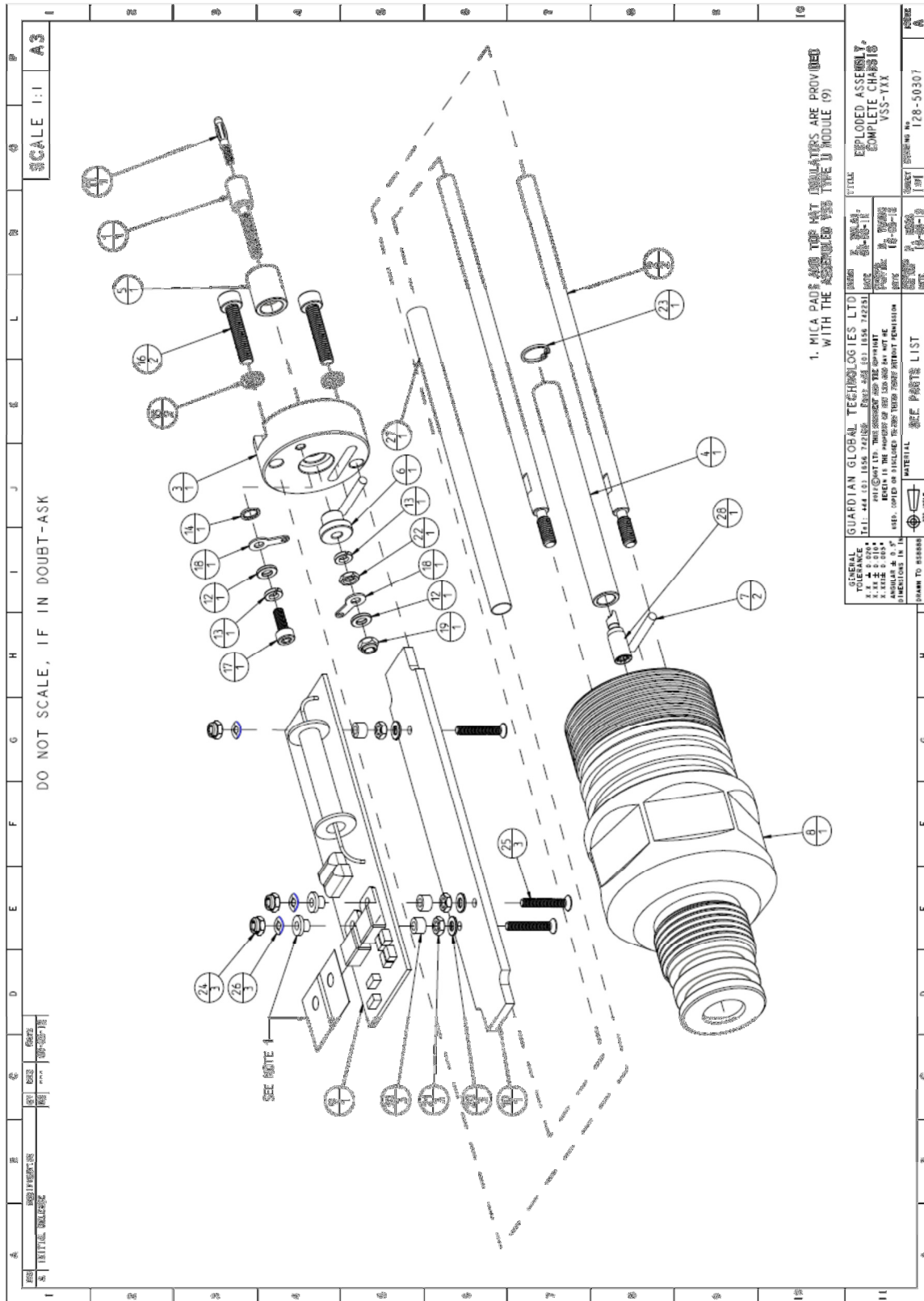


Figure 5-6 – Exploded Assembly Completed Chassis Drawing, VSS-Y – 128-50307-A



VSS-Y

Section 5 – Mechanical Description

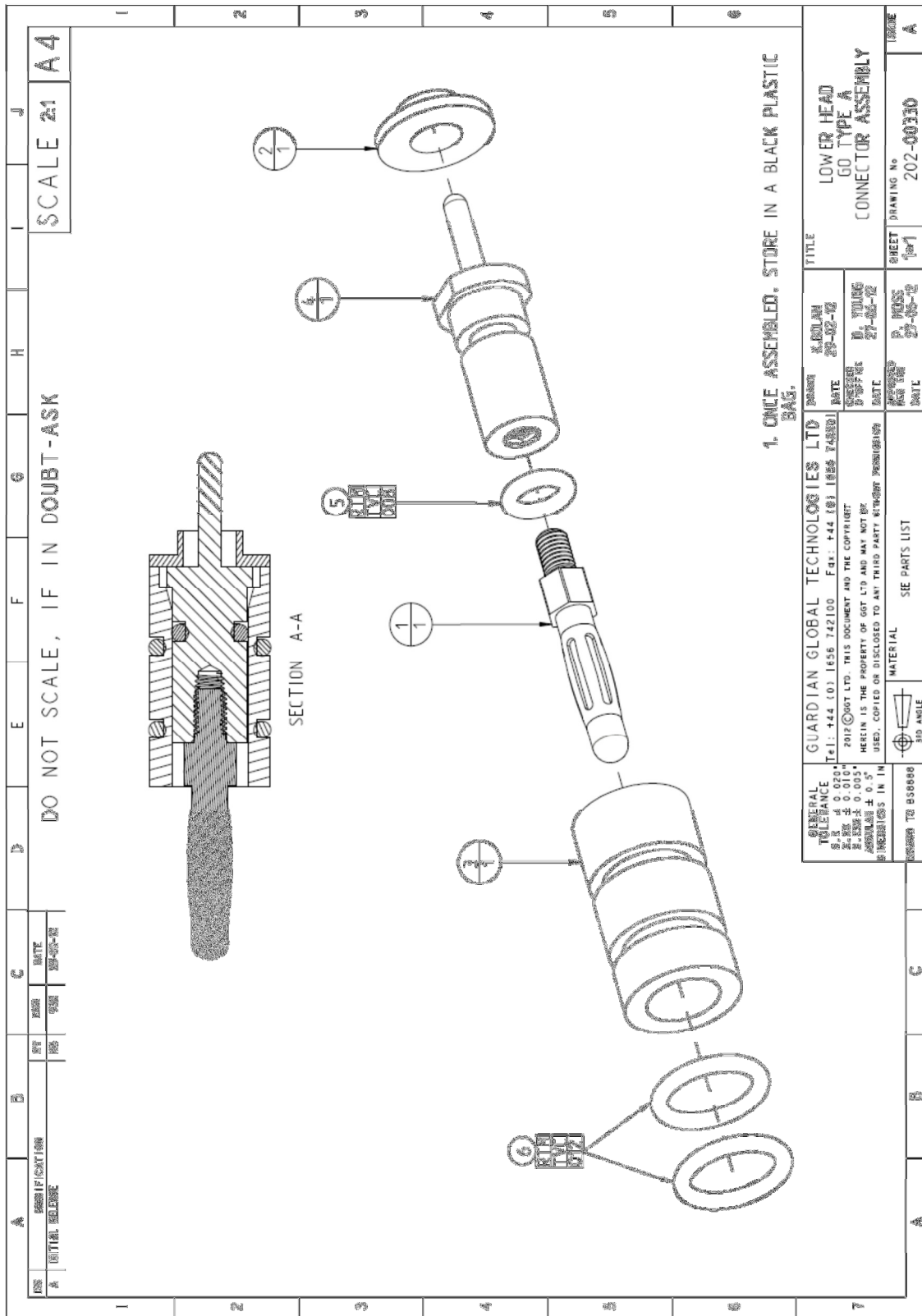


Figure 5-7 – Lower Head GO Type A Connector Assembly Drawing, 202-00330-A



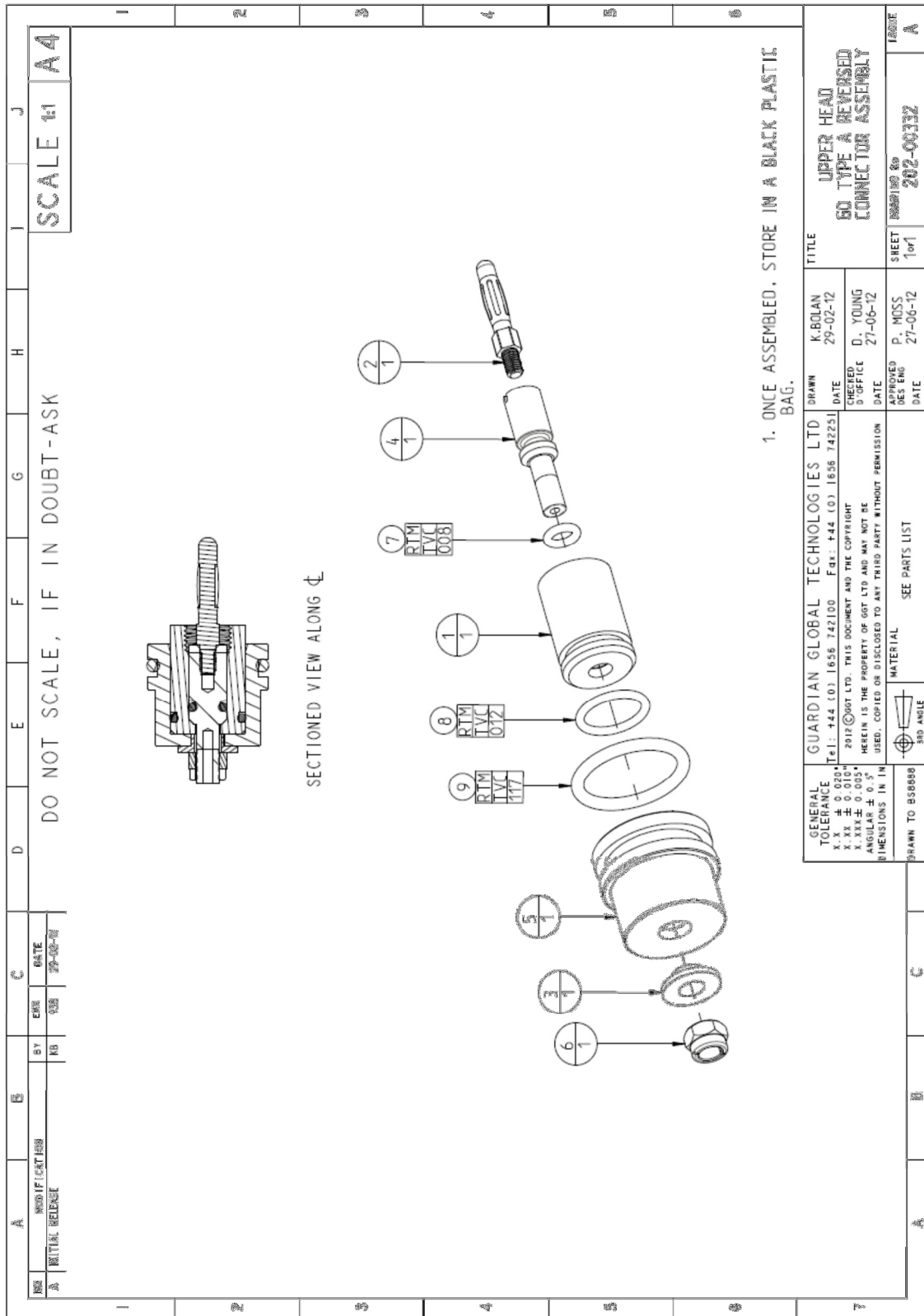


Figure 5-9 – Upper Head GO Type A Reversed Connector Assembly Drawing, 202-00332-A



VSS-Y

Section 5 – Mechanical Description

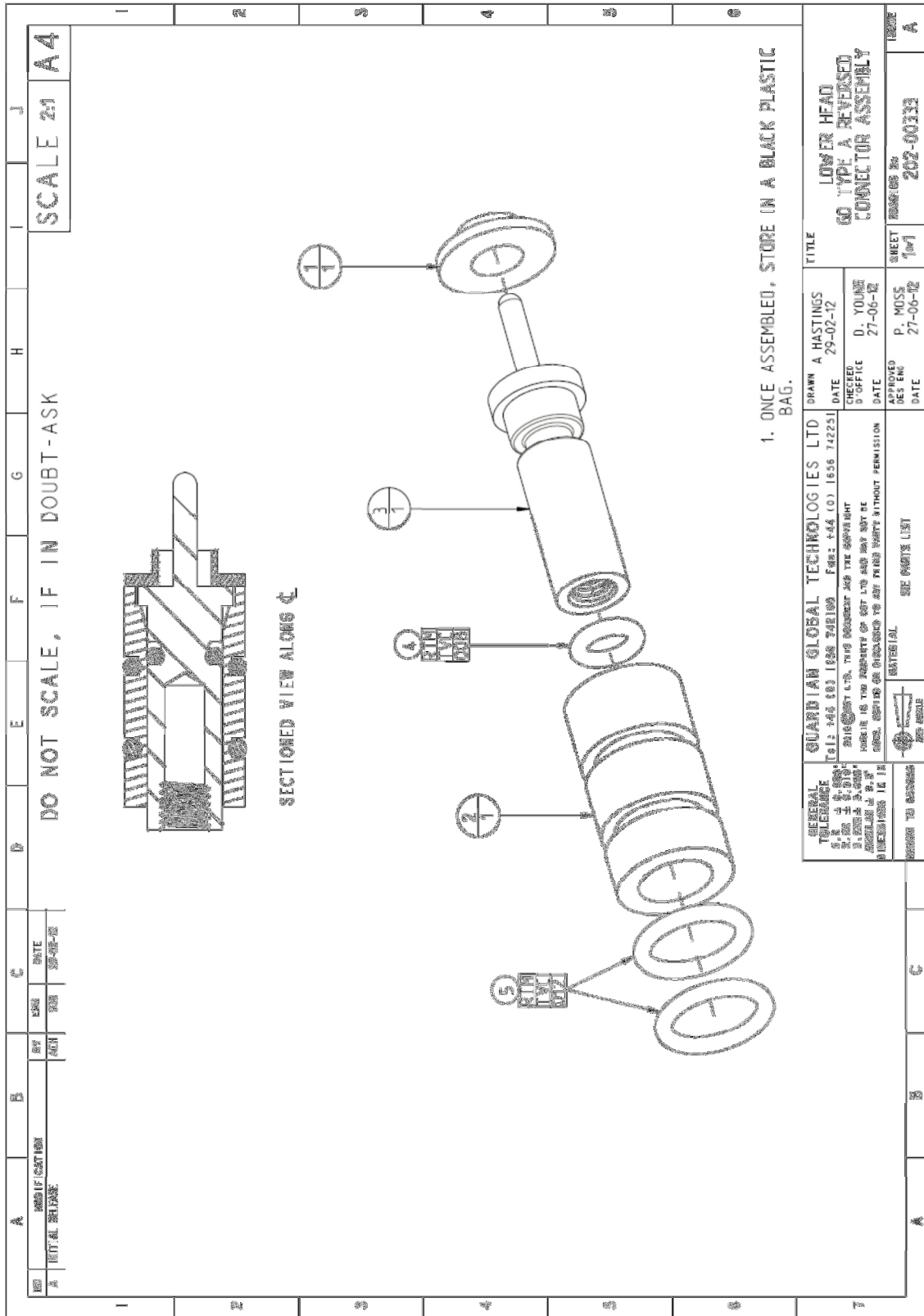


Figure 5-10 – Lower Head GO Type A Reversed Connector Assembly Drawing, 202-00333-A



VSS-Y

Section 6 – Electrical Drawings

6. Electrical Drawings

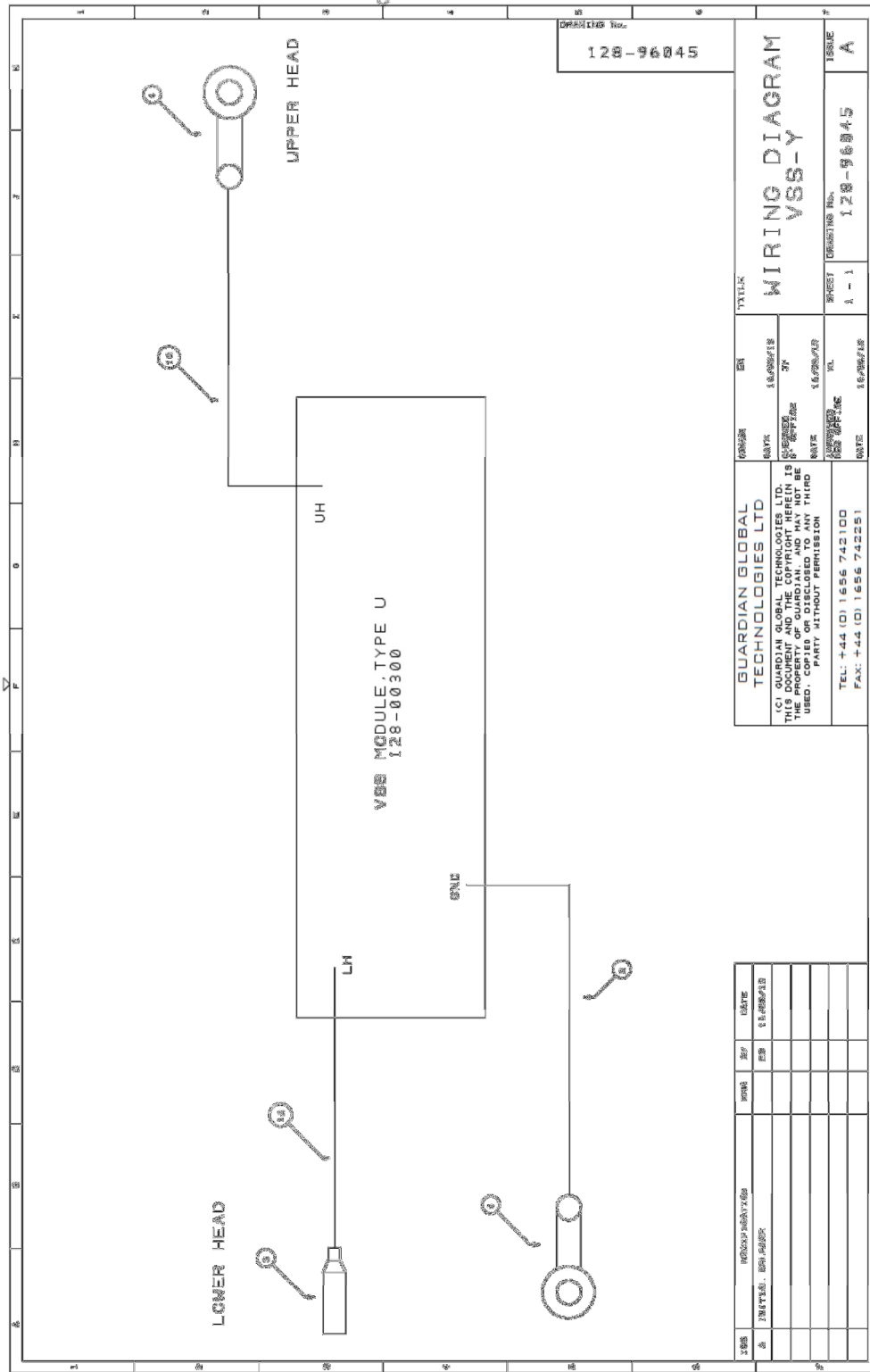


Figure 6-1 – Wiring Diagram, 128-96045-A



VSS-Y

Section 7 – Maintenance

7. Maintenance (Mechanical & Electronic)

**NOTE – SEE SECTION 1 FOR SAFETY PRECAUTIONS DURING MAINTENANCE PROCEDURES.**

7.1 Introduction

7.2 Recommended Products

The following products are recommended for use with Guardian products. Use of other products or the use of these products in other than the approved application during tool maintenance may degrade performance and/or void warranty.

Product	Part Number	Size	Application
Lubriplate 930AA	302-00001	14oz Tin	Lubrication of mechanical parts only or where lubricant will not be in close proximity to electronics boards or components. Should not be used where gasses given off at temperature could come into contact with electronics systems.
Lubriplate 930AA	302-00001	100ml Tube	
Lubriplate 1444	302-00031	14oz Tube	Lubrication of threads and seals – general application.
Liquid O’ring 101	302-00030	1 lb. Tin	Lubrication of threads and seals – general application (Preferred).
Silicone Grease	302-00002	100gr Tube	Pressure and fluid inlet ports where high retention under temperature is required. e.g. PWH/QPT Pressure Inlet Port, ART Pressure Balance Port. Do not use on threads. May be used on o’ring seals.
Loctite 242	302-00004	10ml Tube	Used to lock fasteners (> M4 Thread) which may require future release. Not recommended for use on any fastener < M4 thread. Do not use on plastic components.
Loctite 601	302-00005	10ml Tube	Used to lock small metallic components permanently in place. Not normally used during maintenance. Do not use on plastic components.
DC200/50	302-00035	1 l. Tub	Oil filling of pressure tool buffer tubes. e.g. PWH/QPT buffer tube.
Paratherm NF	302-00036	1 l. Tub	Oil filling of pressure tool buffer tubes. e.g. PWH/QPT buffer tube.(Preferred)

Table 7-1 – Recommended Maintenance Products

All threads should be lubricated with an approved grease during reassembly. Under no circumstances should silicone grease be used on, or be allowed to come into contact with mating threads as it will act as a thread locking compound making disassembly extremely difficult.

Retention O’rings used within the tool do not provide any pressure seal, but *should* be replaced each time the retained item is removed as minor damage caused to the o’ring may affect the effectiveness of retention.

**VSS-Y****Section 7 – Maintenance**

The preventative maintenance scheme suggested for use with all Guardian equipment is divided into three phases. These are:

#### 7.2.1 Post- Fishing Maintenance

Perform a full service on the tool replacing any suspect or damaged parts.

#### 7.2.2 Pre/Post-Job Maintenance

The pre/post-job maintenance covers tool operational checks, wellsite calibrations, primary pressure seal maintenance and general condition.

#### 7.2.3 Routine Tool maintenance (RTM)

Routine Tool Maintenance procedures are designed to be carried out every 6 jobs or two months if the equipment has been used infrequently. More frequent maintenance is recommended if the equipment is used in hot or high pressure environments. This should be scheduled according to maintenance policy. RTM is divided into electrical and mechanical tasks - RTM(E) and RTM(M). It covers all seal maintenance and the correct operation of sensors.

#### 7.2.4 Tool Verification Check (TVC)

The Tool Verification Check is a set of in-depth tests and measurements designed to ensure that the tool is operating correctly within specification. The TVC should be carried out every 12 - 15 jobs or 6 months as appropriate.



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Section 7 – Maintenance

7.3 Pre/Post-Job Maintenance

- A pre/post job maintenance check list is provided in Appendix A. It is recommended that the checks as described below are carried out before and after every trip in the well.
  - Ensure that the PCB jumpers correctly set (see Section 5.4).
1. Check condition of upper and lower head sealing surfaces. Look for scores, scratches, pits and damaged threads.
  2. Disconnect the VSS from the line and using a DVM, connect probes to points in the appropriate table below and record results.

Test No.	+ve Probe	-ve Probe	Expected Resistance:
1	L/H	GND	220KΩ ±11KΩ
2	GND	L/H	220KΩ ±11KΩ
3	U/H	L/H	6K8Ω ±340Ω

**Table 7-2 Tool Resistance Measurement Checks – Type B Mode with bypass resistor**

Test No.	+ve Probe	-ve Probe	Expected Resistance:
1	L/H	Chassis	220K ohms ±11K
2	Chassis	L/H	220K ohms ±11K
3	U/H	L/H	>500K ohms

**Table 7-3 Tool Resistance Measurement Checks – Type D/I Mode**

Test No.	+ve Probe	-ve Probe	Expected Resistance:
1	L/H	GND	220KΩ +/-11KΩ
2	GND	L/H	220KΩ +/-11KΩ
3	U/H	L/H	150Ω +/-7.5Ω

**Table 7-4 Tool Resistance Measurement Checks – Type H Mode**

3. Replace all o’rings referenced **PPJ** in o’ring location drawing (128-94045).



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Section 7 – Maintenance

7.4 Routine Tool Maintenance (RTM) Mechanical

The following equipment will be required to perform the RTM(M).

- Standard Hand Tools;
- O’rings as required;
- Allen Keys (Hex Wrench) – Metric;
- Open-ended Spanner x 2 to fit tool spanner flats;
- O’rings as required (See applicable XXX-94YYY drawing);
- VSS-specific Service Tool Kit (XXX-89YYY);
- Replacement spirol pins and fasteners as required;
- Liquid O’ring 101 (302-00030).

1. Perform all pre/post job checks as per Section 7.3 Pre/Post Job Maintenance.
2. Remove Pressure Housing; Check security of Electronics Assembly connection visible with Pressure Housing removed. Check for chaffed wires, loose pins and ‘burnt’ components.
3. Replace all o’rings referenced **RTM** in o’ring location drawings.

7.5 Routine Tool Maintenance (RTM) Electrical

See Appendix B for check sheet

The following equipment will be required to perform the RTM(E):

- Standard Hand Tools;
- Digital Multimeters;
- Test Loads as per Table 7-5;
- DC Power Supply (0-1000v).

Operational Mode	Load Size & Part/Number
VSS Type B/D/I	(301-00925) Set at 500Ω 500W Test Load
VSS Type B/D/I	(301-01083) 150 Ω 200W Test Load
VSS Type H	(301-00925) Set at 400Ω 400W Test Load
VSS Type H	(301-00982) 1KΩ 300W Test Load

Table 7-5 Operational Mode & Test Load



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Section 7 – Maintenance

1. Setup the VSS tool and test equipment according to Figure 7-1.
2. When using the DMM to measure current ensure the lead is connected to the high current input.
3. **Important!** Configure the HV PSU so that the current limit is set to 1.07A.
4. Set the Upper Voltage Limit (OVP ADJ) on the HV PSU to 550V in order to prevent the UH voltage from accidentally passing the maximum test voltage as this could cause damage to the VSS-U module.
5. When adjusting the HV PSU, unless the test specifies otherwise, always start from 0V and increase the voltage at a rate of approx. 50V/sec; use the stopwatch to help keep the ramp rate consistent. For example, if the Upper Head (UH) voltage is to be set to 150V, turn the dial gradually over 3 seconds up to 150V. Decrease the voltage promptly after completing the test.

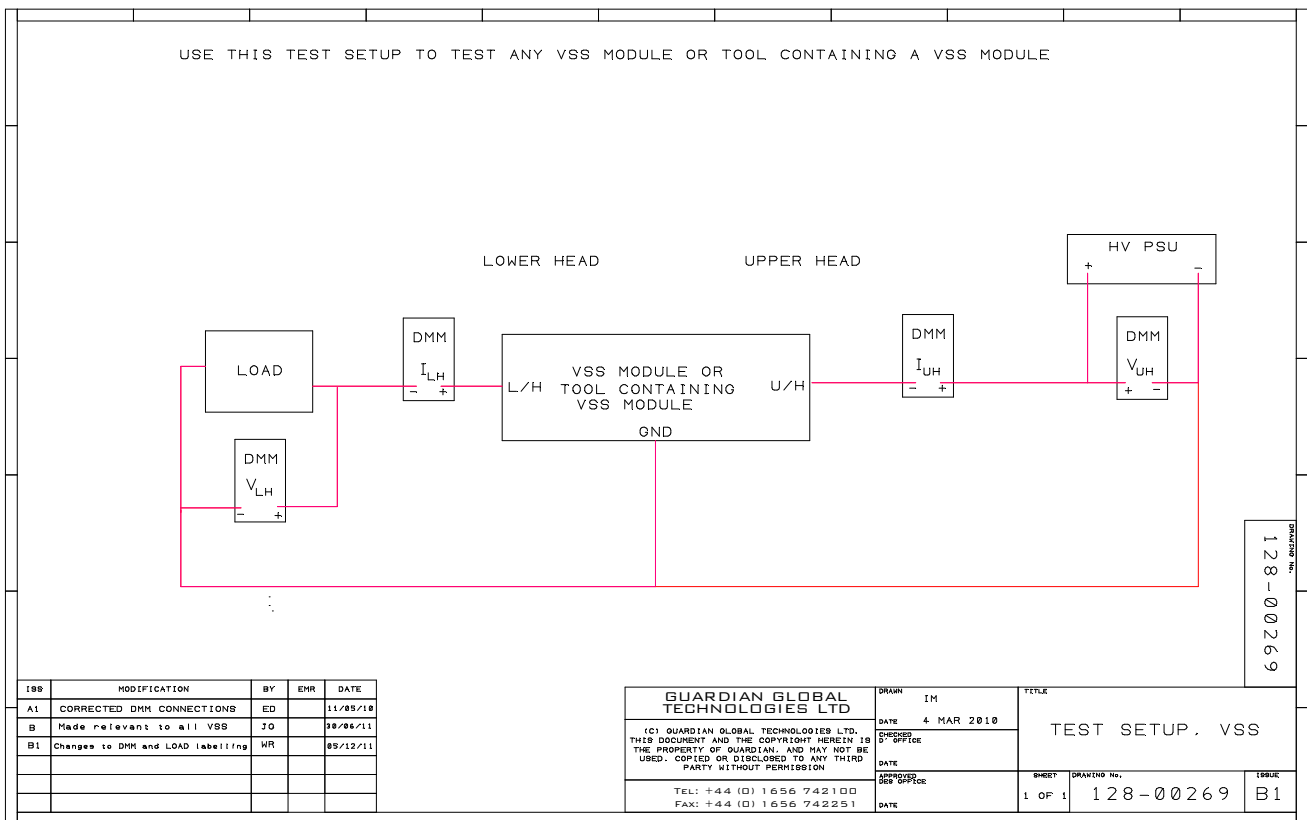


Figure 7-1 VSS Test Setup



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Section 7 – Maintenance

NOTE: Carry out only the tests that are relevant for the specific operational mode for tool setting as per Table 5-1 Link Settings, VSS-Y.

7.5.1 VSS Type B Mode (Negative Blocking)

- Ensure Bypass Resistor is fitted
1. Using a DVM to measure resistance, connect the probes to points in Table 7-6.

Test No.	+ve Probe	-ve Probe	Expected Resistance:
1	L/H	GND	220KΩ ±11KΩ
2	GND	L/H	220KΩ ±11KΩ
3	U/H	L/H	6K8Ω ±340Ω

Table 7-6 Tool Resistance Measurement Checks

2. Connect the VSS-U module on the bench as shown in Figure 7-1 using the 500 Ω 500W Test Load (301-00925).
3. Set the PSU to the voltages shown in Table 7-7; continue from one test voltage to the next. For +50V and +250V, the voltage is held just long enough to observe the measurements (max 10s) and for +500V the voltage is held for 30 seconds before quickly decreasing the voltage to 0V (~1sec).

PSU Voltage	V <sub>UH</sub> Limits (V)	V <sub>LH</sub> Limits (V)	I <sub>UH</sub> Limits (mA)	I <sub>LH</sub> Limits (mA)
+50 vdc	49 to 51	47 to 50	94 to 100	94 to 100
+250 vdc	249 to 251	246 to 250	480 to 520	470 to 510
+500 vdc	499 to 501	495 to 500	960 to 1070	950 to 1030

Table 7-7 Positive Voltage Tests

4. Switch-off the HV PSU.
5. Reverse the PSU connection so that; Positive connected to GND, Negative connected to U/H.



**VSS-Y**

**Section 7 – Maintenance**

6. Set the PSU to the voltages shown in Table 7-8; continue from one test voltage to the next. For -20V to -250V, the voltage is held just long enough to observe the measurements (max 10s) and for -500V the voltage is held for 30 seconds before quickly decreasing the voltage to 0V (~1sec).

PSU Voltage	V <sub>UH</sub> Limits (V)	V <sub>LH</sub> Limits (V)	I <sub>UH</sub> Limits (mA)	I <sub>LH</sub> Limits (mA)
-20 Vdc	-19 to -21	< -3	< -6	< -6
-110 Vdc	-109 to -111	< -15	< -20	< -20
-150 Vdc	-149 to -151	-145 to -151	-297 to -330	-297 to -306
-250 Vdc	-249 to -251	-242 to -250	-480 to -540	-470 to -520
-500 Vdc	495 to 501	485 to 501	-970 to -1070	-950 to -1010

**Table 7-8 – Negative Voltage Tests**

7. Switch off the HV PSU output and replace the Load with the 150 Ω 200W Test Load (301-01083).
8. Allow a 90 Seconds discharge delay before proceeding to the next step.
9. Set the PSU to -150V, and then decrease the voltage at a rate of approx. 50V/sec.
10. Observe the voltages at which the VSS switches on and off as per Table 7-9.

Switch-off voltage V <sub>LH</sub> Limits (V)	Switch-on voltage V <sub>LH</sub> Limits (V)
-120 to -140	-120 to -140

**Table 7-9 Switching Threshold Voltage Tests**



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11. Switch off the HV PSU output and replace the load with a short-circuit link.
12. Increase the PSU voltage to 100V; *DO NOT exceed 100V while the output is shorted; VSS-U module can be damaged.*
13. Observe Lower Head current ( $I_{LH}$ ) as below in Table 7-10.
14. Switch off the HV PSU.

$V_{UH}$	$I_{LH}$ Limits
99v to -101v	< -18mA

**Table 7-10 Short-Circuited Lower Head Test**

7.5.2 VSS Type D/I Mode (Negative Blocking) Test Procedure

1. Using a DVM to measure resistance, connect the probes to points in Table 7-11 below.

Test No.	+ve Probe	-ve Probe	Expected Resistance:
1	L/H	GND	220K $\Omega$ $\pm$ 11K $\Omega$
2	GND	L/H	220K $\Omega$ $\pm$ 11K $\Omega$
3	U/H	L/H	>500K $\Omega$

**Table 7-11 Tool Resistance Measurement Checks**

2. Connect the VSS-U module on the bench as shown in Figure 7-1 using the 500  $\Omega$  500W Test Load (301-00925).
3. Set the PSU to the voltages shown in Table 7-12; continue from one test voltage to the next. For +50V and +250V, the voltage is held just long enough to observe the measurements (max 10s) and for +500V the voltage is held for 30 seconds before quickly decreasing the voltage to 0V (~1sec).

PSU Voltage	$V_{UH}$ Limits (V)	$V_{LH}$ Limits (V)	$I_{UH}$ Limits (mA)	$I_{LH}$ Limits (mA)
+50 vdc	49 to 51	47 to 50	94 to 100	94 to 100
+250 vdc	249 to 251	246 to 250	480 to 540	470 to 510
+500 vdc	499 to 501	495 to 500	960 to 1070	950 to 1030

**Table 7-12 Positive Voltage Tests**



VSS-Y

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4. Switch-off the HV PSU.
5. Reverse the PSU connection so that; Positive connected to GND, Negative connected to U/H.
6. Set the PSU to the voltages shown in Table 7-13; continue from one test voltage to the next. For -20V to -250V, the voltage is held just long enough to observe the measurements (max 10s) and for -500V the voltage is held for 30 seconds before quickly decreasing the voltage to 0V (~1sec).

PSU Voltage	V <sub>UH</sub> Limits (V)	V <sub>LH</sub> Limits (V)	I <sub>UH</sub> Limits (mA)	I <sub>LH</sub> Limits (mA)
-20 Vdc	-19 to -21	0	-2	-1
-110 Vdc	-109 to -111	0	-2	-1
-150 Vdc	-149 to -151	-145 to -151	-297 to -330	-297 to -306
-250 Vdc	-249 to -251	-242 to -250	-480 to -540	-470 to -520
-500 Vdc	-495 to -501	-495 to -501	-970 to -1070	-950 to -1010

Table 7-13 Negative Voltage Tests

7. Switch off the HV PSU output and replace the Load with the 150 Ω 200W Test Load (301-01083).
8. Allow a 90 Seconds discharge delay before proceeding to the next step.
9. Set the PSU to -150V, and then decrease the voltage at a rate of approx. 50V/sec.
10. Observe the voltages at which the VSS switches on and off as per Table 7-14.

Switch-off voltage V <sub>LH</sub> Limits (V)	Switch-on voltage V <sub>LH</sub> Limits (V)
-120 to -140	-120 to -140

Table 7-14 Switching Threshold Voltage Tests

11. Switch off the HV PSU output and replace the load with a short-circuit link.
12. Increase the PSU voltage to 100V; *DO NOT exceed 100V while the output is shorted; VSS-U module can be damaged.*
13. Observe Lower Head current (I<sub>LH</sub>) as below in Table 7-15.
14. Switch off the HV PSU.

V <sub>UH</sub>	I <sub>LH</sub> Limits
99v to -101v	< -1mA

Table 7-15 Short-Circuited Lower Head Test



VSS-Y

Section 7 – Maintenance

7.5.3 VSS Type D/I Mode (Positive Blocking) Test Procedure

- Using a DVM to measure resistance, connect the probes to points in Table 7-16.

Test No.	+ve Probe	-ve Probe	Expected Resistance:
1	L/H	GND	220KΩ ±11KΩ
2	GND	L/H	220KΩ ±11KΩ
3	U/H	L/H	>99MΩ

**Table 7-16 Tool Resistance Measurement Checks**

- Connect the VSS-U module on the bench as shown in Figure 7-1 using the 500 Ω 500W Test Load (301-00925).
- Set the PSU to the voltages shown in Table 7-17; continue from one test voltage to the next. For -50V and -250V, the voltage is held just long enough to observe the measurements (max 10s) and for -500V the voltage is held for 30 seconds before quickly decreasing the voltage to 0V (~1sec).

PSU Voltage	V <sub>UH</sub> Limits (V)	V <sub>LH</sub> Limits (V)	I <sub>UH</sub> Limits (mA)	I <sub>LH</sub> Limits (mA)
-50 vdc	-49 to -51	-47 to -50	-94 to -100	-94 to -100
-250 vdc	-249 to -251	-246 to -250	-480 to -540	-470 to -510
-500 vdc	-499 to -501	-495 to -500	-960 to -1070	-950 to -1030

**Table 7-17 Negative Voltage Tests**

- Switch off the HV PSU.
- Reverse the PSU connection so that; Positive connected to GND, Negative connected to U/H.
- Set the PSU to the voltages shown in Table 7-18; continue from one test voltage to the next. For +20V to +250V, the voltage is held just long enough to record the measurements (max 10s) and for +500V the voltage is held for 30 seconds before quickly decreasing the voltage to 0V (~1sec).



**VSS-Y**

**Section 7 – Maintenance**

PSU Voltage	V <sub>UH</sub> Limits (V)	V <sub>LH</sub> Limits (V)	I <sub>UH</sub> Limits (mA)	I <sub>LH</sub> Limits (mA)
+20 Vdc	19 to 21	0	2	1
+110 Vdc	109 to 111	0	2	1
+150 Vdc	149 to 151	145 to 151	297 to 330	297 to 306
+250 Vdc	249 to 251	242 to 250	480 to 540	470 to 520
+500 Vdc	495 to 501	495 to 501	970 to 1070	950 to 1010

**Table 7-18 Positive Voltage Tests**

7. Switch off the HV PSU output and replace the Load with the 150 Ω 200W Test Load (301-01083).
8. Allow a 90 Seconds discharge delay before proceeding to the next step.
9. Set the PSU to +150V, and then decrease the voltage at a rate of approx. 50V/sec.
10. Observe the voltages at which the VSS switches on and off as per Table 7-19.

Switch-off voltage V <sub>LH</sub> Limits (V)	Switch-on voltage V <sub>LH</sub> Limits (V)
120 to 140	120 to 140

**Table 7-19 Switching Threshold Voltage Tests**

11. Switch off the HV PSU output and replace the load with a short-circuit link.
12. Increase the PSU voltage to 100V; *DO NOT exceed 100V while the output is shorted; VSS-U module can be damaged.*
13. Observe Lower Head current (I<sub>LH</sub>) as below in in Table 7-20.
14. Switch off the HV PSU.

V <sub>UH</sub>	I <sub>LH</sub> Limits
99v to -101v	< -1mA

**Table 7-20 Short-Circuited Lower Head Test**



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7.5.4 VSS Type H Mode (Negative Blocking) Test Procedure

- Using a DVM to measure resistance, connect the probes to points in Table 7-21.

Test No.	+ve Probe	-ve Probe	Expected Resistance:
1	L/H	GND	220KΩ +/-11KΩ
2	GND	L/H	220KΩ +/-11KΩ
3	U/H	L/H	150Ω +/-7.5Ω

Table 7-21 Tool Resistance Measurement Checks

- Connect the VSS-U module on the bench as shown in Figure 7-1 using the 1KΩ 300W Test Load (301-00982).
- Set the PSU to the voltages shown in Table 7-22; continue from one test voltage to the next. For +20V and +80V, the voltage is held just long enough to observe the measurements (max 10s) and for +160V the voltage is held for 30 seconds before quickly decreasing the voltage to 0V (~1sec).

PSU Voltage	V <sub>UH</sub> Limits (V)	V <sub>LH</sub> Limits (V)	I <sub>UH</sub> Limits (mA)	I <sub>LH</sub> Limits (mA)
+20 vdc	19 to 21	15 to 19	16 to 22	16 to 22
+80 vdc	79 to 81	68 to 72	65 to 80	65 to 75
+160 vdc	159 to 161	138 to 142	135 to 150	135 to 145

Table 7-22 Positive Voltage Tests

- Switch off the HV PSU.
- Reverse the PSU connection so that; Positive connected to GND, Negative connected to U/H.
- Replace the load with the 400Ω 400W Test Load (301-00925).
- Set the PSU to the voltages shown in Table 7-23; continue from one test voltage to the next. For -10V to -160V, the voltage is held just long enough to observe the measurements (max 10s) and for -160V the voltage is held for 30 seconds before quickly decreasing the voltage to 0V (~1sec).



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PSU Voltage	V <sub>UH</sub> Limits (V)	V <sub>LH</sub> Limits (V)	I <sub>UH</sub> Limits (mA)	I <sub>LH</sub> Limits (mA)
-10 Vdc	-9 to -11	-6 to -8	-16 to -22	-16 to -22
-20 Vdc	-19 to -21	-14 to -16	-30 to -40	-30 to -40
-30 Vdc	-29 to -31	-20 to -24	-45 to -60	-45 to -60
-50 Vdc	-49 to -51	0	-10 to -30	-1
-100 Vdc	-99 to -101	0	-10 to -30	-1
-160 Vdc	-159 to -161	0	-10 to -30	-1

Table 7-23 Negative Voltage Tests

8. Switch off the HV PSU output to allow a 90 Seconds discharge delay before proceeding to the next step.
9. Set the PSU to -100V, and then decrease the voltage at a rate of approx. 50V/sec.
10. Observe threshold voltages at which the VSS switches on and off as per Table 7-24.

Switch-off voltage V <sub>LH</sub> Limits (V)	Switch-on voltage V <sub>LH</sub> Limits (V)
-30 to -40	-30 to -40

Table 7-24 Switching Threshold Voltage Tests

**VSS-Y****Section 7 – Maintenance****7.6 Tool Verification Check (TVC)**

See Appendix C for check sheet

**7.6.1 Mechanical - TVC(M)**

The following equipment will be required to perform the TVC(M).

- Standard Hand Tools;
- O’rings as required;
- Allen Keys (Hex Wrench) – Metric;
- 38/48mm OE Spanner x 2;
- Replacement spirol pins and fasteners as required;
- Pressure Isolation Service Tool (301-00007);
- Vernier or Digital Calliper/Micrometer;
- Liquid O’ring 101 (302-00030);
- Loctite 242;

1. Perform all pre/post job checks as per Section 7.3
2. Perform all RTM checks as per Section 7.4
3. Perform a Pressure Housing wear measurement by measuring 3 diameters at 120 degrees at three positions along the pressure housing. Emphasis should be given to any area of obvious wear. If any of the diameters are 2.105” (53.47mm) or less, the pressure housing(s) should be replaced.
4. Check/renew Loctite on any fasteners not using Aerotite nuts.
5. Replace all o’rings referenced **TVC** in o’ring location drawings.

**7.6.2 Electrical - TVC(E)**

1. Perform all RTM checks as per Section 7.5
2. If required, perform a heat test on the tool to rated temperature (or the maximum temperature which the tool would normally see in service if lower). Hold the test temperature for a minimum of 1 hour. Perform the operational check give in Section 7.5



## VSS-Y

## Section 7 – Maintenance

7.7 Torque Settings

**NOTE:** The torque setting given in this section are guideline **Dry** torques according to industry standards for A2 and A4 Stainless Steel. If in doubt, please consult Guardian Technical Support at [techsupport@ggtg.net](mailto:techsupport@ggtg.net)

Thread size (mm)	Screw torque (in/lb) / (Nm)	Grubscrew torque (in/lb) / (Nm)
M2		
M2.5		
M3	8 / 0.9	
M4	17.7 / 2.0	10.6 / 1.2
M5	36 / 4.1	22 / 2.5
M6	62 / 7.0	37 / 4.2
M8	150 / 17	90 / 10.2
M10	292 / 33	175 / 19.8

Variations from this standard will be individually identified and noted.



**VSS-Y**

**Section 8 – Spares & Accessories**

**8. Parts, Spares and Accessories**

**8.1 Parts List**

<b>Item:</b>	<b>Qty:</b>	<b>Part No:</b>	<b>Description:</b>	<b>Reference:</b>
1	2	128-00237	Shock Absorber Disc	
2	1	128-00238	Compression Disc, PTFE	
3	1	128-00247	Pressure Housing, OD 2 1/8", VSS	
4	1	128-00307	Chassis Assembly, Complete, VSS-YXX	
5	1	201-00021	Thread Protector, Female, 1 3/16" GO A	
6	1	201-00022	Thread Protector, Male, 1 3/16" GO A	
7	1	202-00330	Lower Head, GO Type A, Connector Assembly	FOR TOOL OPTION A
8	1	202-00331	Upper Head, GO Type A, Connector Assembly	FOR TOOL OPTION A
9	1	208-00270	Circlip, 27mm, Internal, A2 S/S	
10	0	202-00332	Upper Head, GO Type A Rev'd, Connector Assembly	FOR TOOL OPTION B
11	0	202-00333	Lower Head, GO Type A Rev'd, Connector Assembly	FOR TOOL OPTION B
12	1	128-91045	A.T.I Instruction, VSS-YXX	
13	1	128-92045	BRS, VSS-YXX	
14	1	128-94045	O'Ring Build Set, VSS-YXX,	
15	1	128-95045	Exploded Assembly Drawing, VSS-YXX	
16	1	128-96045	Wiring Diagram, VSS-YXX	
17	1	128-99445	VSS-YXX, Block Diagram	

**Table 8-1 – Parts List, VSS-Y – 128-99045-A**

**8.2 O'ring List**

<b>Item:</b>	<b>Qty:</b>	<b>Part No:</b>	<b>Description:</b>	<b>Reference:</b>
1	2	204-90008	O'ring, Viton, 90, 008	
2	2	204-90012	O'ring, Viton, 90, 012	
3	1	204-90014	O'ring, Viton, 90, 014	
4	1	204-90117	O'ring, Viton, 90, 117	
5	2	204-90131	O'ring, Viton, 90, 131	
6	3	204-90211	O'Ring Viton 90, 211	

**Table 8-2 – O'ring List, VSS-Y – 128-94045-A**



**VSS-Y**

**Section 8 – Spares & Accessories**

8.3 Recommended Spares Lists

Item:	Qty:	Part No:	Description:	Reference:
1	1	128-00218	Connector Stud, Upper Head, VPM-G	
2	1	128-00233	Insulator, Bulkhead	
3	1	128-00234	Insulator, Top Hat	
4	1	128-00237	Shock Absorber Disc	
5	1	128-00238	Compression Disc, PTFE	
6	1	128-00300	VSS Module, Type U, Assembled	R.O.
7	1	202-00003	Cup Insulator, P I Head	OPTION A & B TOOLS
8	1	202-00007	Pin, Banana, 4mm, Male, M3x6mm	OPTION A & B TOOLS
9	2	202-00026	Insulator, Lower Head, Inner (Short)	OPTION A & B TOOLS
10	1	202-00040	Insulator, Lower Head, PPL Type.	OPTION A & B TOOLS
11	1	202-00041	Connector, Lower Head, GO Type A	OPTION A TOOLS
12	1	202-00047	Connector, Lower Head. GO A (Mod), 4mm socket	OPTION B TOOLS
13	1	202-00051	Connector, P I Head, Shoulder Type, GO Type A	OPTION A TOOLS
14	1	202-00052	Connector, P I Head, Shoulder Type, GO Modified	OPTION B TOOLS
15	1	202-00096	Head, Pressure Isolation (Shoulder Type)	OPTION A & B TOOLS
16	1	208-00245	Nut, M5, Aerotight	OPTION A & B TOOLS
17	1	208-00270	Circlip, 27mm, Internal, A2 S/S	

**Table 8-3 – Recommended Spares List, VSS-Y – 128-93045 - A**

8.4 Redress Kit, Level 1

Item:	Qty:	Part No:	Description:	Reference:
1	1	128-94045	O'Ring Build Set, VSS-YXX,	

**Table 8-4 – Redress Kit, Level 1, VSS-Y – 128-84045-A**



**VSS-Y**

**Section 8 – Spares & Accessories**

8.5 Accessories

Item:	Qty:	Part No:	Description:	Reference:
1	2	128-00236	Shock Absorber, Chassis Plate	
2	1	202-00007	Pin, Banana, 4mm, Male, M3x6mm	
3	1	202-00016	Pin, Banana, 2.5mm, Male, M2.5x6mm	
4	1	202-00026	Insulator, Lower Head, Inner (Short)	
5	2	208-00008	Washer, 3mm, Plain, S/S	
6	1	208-00009	Washer, 3mm, Spring, S/S Square Section.	
7	1	208-00010	Washer, 3mm, Shakeproof, S/S	
8	1	208-00013	Washer, 4mm, Spring, S/S	
9	1	208-00074	Screw, Skt Cap Hd, M4 x 20mm, S/S	
10	1	208-00080	Screw, Skt Cap Hd, M3 x 8,	
11	1	208-00110	Solder Tag, M3	
12	1	208-00126	Screw, Csk Hd Pozi, M3 x 16mm, S/S	
13	3	208-00141	Nut, Full, M3, S/S	
14	1	208-00180	Nut, M3, Aerotight A2 S/S	
15	3	208-00206	Washer, 2.5mm, Plain, S/S	
16	3	208-00207	Nut, Full, M2.5	
17	1	208-00222	Half-Nut, M3, S/S	
18	1	208-00240	Circlip, 9mm, Internal, S/S	
19	1	208-00245	Nut, M5, Aerotight	
20	1	208-00270	Circlip, 27mm, Internal, A2 S/S	
21	3	208-00280	Nut, M2.5, Aerotight	
22	3	208-00520	Screw, Csk Hd Pozi, M2.5 x 16mm, S/S	
23	3	208-00521	Washer, 2.5mm, Crinkle, S/S	

**Table 8-5 – Ready Box Kit, VSS-Y – 210-00149-A**



**VSS-Y**

**Section 9 – Interpretation & Data Processing**

**9. Interpretation and Data Processing**

There are no Interpretation or Data Processing criteria.



**VSS-Y**

**Section 10 – Trouble Shooting**

**10. Trouble Shooting**

Perform the checks described in section 7.



**VSS-Y**

**Section 11 – Care & Maintenance**

**11. Care and Maintenance**

Inspect .

<b>Item:</b>	<b>Qty:</b>	<b>Part No:</b>	<b>Description:</b>	<b>Reference:</b>
2	1	301-00007	Service Tool, Pressure Isolation	
3	1	301-00038	Tommy Bar.	

**Table 11-1 – Service Tool Kit, - VSS-Y – 128-89045**



**VSS-Y**

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VSS-Y

Appendix A

**Pre/Post Job Maintenance Check Sheet**

(See Section 7.2)

VSS-Y		S/N:
Item	Procedure	Completed
1	Check visual condition of Tool	
	Perform Resistance checks as per Section 7.3	
2	Feedthru and Housing - must be greater than 99Mohm	
3	L/H and Housing - must be greater than 99Mohm	
4	Using a Multimeter set to resistance ( $\Omega$ ) measurement, measure the resistance between Feedthru and L/H – must be less than 1 ohm	
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		



**VSS-Y**

**Appendix B**

**Routine Tool Maintenance Check Sheet - RTM(M&E)**

(See Section 7.3)

<b>VSS-Y</b>		<b>S/N:</b>
<b>Item</b>	<b>Procedure</b>	<b>Completed</b>
1	Perform all pre/post job checks as per Section 7.3	
2	Check all connections and fasteners are securely in place	
3	Perform RTM Mechanical and Electrical checks as per Section 7.4 and 7.5	
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		



**VSS-Y**

**Appendix C**

**Tool Verification Check Sheet - TVC(M&E)**

(See Section 7.4)

<b>VSS-Y</b>		<b>S/N:</b>
<b>Item</b>	<b>Procedure</b>	<b>Completed</b>
1	Perform Pre/Post Job Maintenance checks as per Section 7.3	
2	Per Section 7.4	
3	Section 7.5	
4	Section 7.6.1 and 7.6.2	
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		