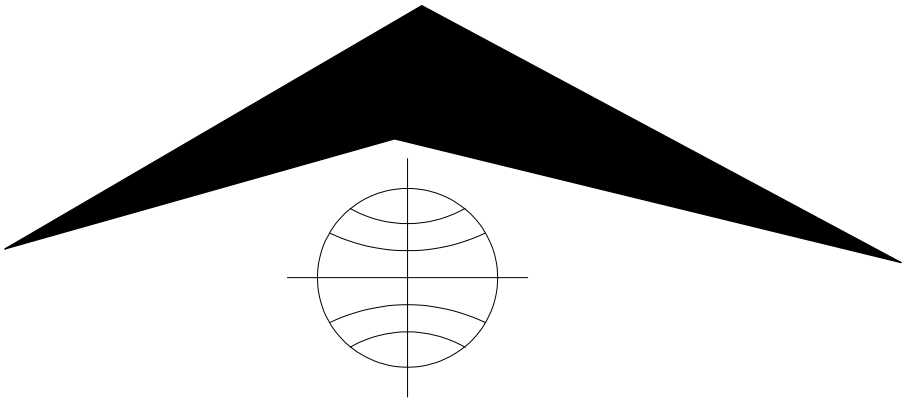
2SNA-1000
DX–GAMMA / R&SP PROBE



Mount Sopris Instrument Co., Inc.
Golden, CO U. S. A.
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General Information

Overview

The 2SNA-1000 is a DX series probe capable of providing simultaneous natural gamma, spontaneous potential (SP), and single point resistance (SPR), measurements. The operator can make these measurements in one individual run. The 2SNA-1000 probe is also based on the DX Series of Mount Sopris probes which allow certain probes to be run in a DX string or stack of different measurements. For example the 2SNA-1000 can be connected in a 2SAF or 2SAA(F) sonic string to obtain gamma and resistance while running a sonic log.

> Note this is only possible with one transmitter at the bottom of the sonic tool. If two transmitters are present the top one must be removed to operate the 2SNA-1000.

The probe can be used in a 2GDA Dual Density string as well. Check with Mount Sopris for other combinations the 2SNA probe may be compatible with. The 2SNA-1000 can also be run in a stand-alone mode. The probe requires a 2SMA-1000 Down Hole Modem section to be connected to it for power and communications. At the surface the DX series of probes require an MGX II (Console) with either a 5PMA or 5TMA peripheral modem installed in the MGX II. The DX series of probes utilizes the MSLog software.

The SP and SPR measurements should be run in open (uncased), fluid filled, boreholes. The natural gamma may be run in any borehole conditions within specifications.

Controls, Connectors, and Layout

Connectors for the tool are as follows. The probe top described below is a Mount Sopris standard DX Series connector. Each DX Series probe has a male and female end, which has the same wiring as listed below.

PROBE ELECTRICAL CONNECTIONS TOP and BOTTOM:

Pin	Signal	Origin
1	+5V DC	2SMA Modem
2	+15V DC	2SMA Modem
3	-15V DC	2SMA Modem
4	DATA	DX String
5 Top Connector	ADDRIN	2SNA Gamma
5 Bottom Connector	ADDROUT	2SNA Gamma
6	RX/TX	DX String
7	Cable Line	Logging System
8	Cable Line	Logging System
9	Armor	Logging System
10	Armor	Logging System

Layout for the tool in general is as follows starting at the top of the tool. The Probe top is for connection to other DX probes and is followed by the electronic section for the Gamma measurement. This section is then followed by the Photo multiplier tube and scintillation crystal, the detector for the Gamma circuit. Below the Gamma section is the electronics for the R & SP measurements. Following this section is the R & SP electrode and bottom connector of the probe.

(If configured for stand-alone mode the Bull nose is attached to the bottom connector of probe. The entire electronics are then housed in a 1.5” diameter stainless steel housing.

Theory of Operation

SINGLE POINT RESISTANCE

The single point resistance measurement is made by passing an AC current between the Armor and the probe electrode. The probe electrode is located towards the bottom of the probe and should be the only piece of metal exposed, except for the cable-head during the logging process. The probes internal electronics rectifies the AC voltage between these two electrodes and by using Ohms law the system calculates the resistance between them.

Ohms law: $r = E / I$

r = resistance in ohms;
E = potential in volts;
I = current in amperes.

The SPR measurement is the sum of cable armor and measuring electrode contact resistance with the resistance based on the composition of the medium, the cross sectional area and length of the path through the medium. Therefore the single point resistance log is not quantitative. Also since the system uses the Armor as a current return for the measurement most changes seen in the resistance log will be in close proximity to the probe electrode. The measurement is converted by an A to D and then data is combined with the Spontaneous Potential and Gamma measurement, then sent to the surface via the modem section.

SPONTANEOUS POTENTIAL

The spontaneous potential, also known as self-potential or SP uses the same electrodes as the SPR measurement. This natural potential, which originates from electrochemical differences between borehole and formation fluid, or electro-kinetic "streaming" is measured by internal probe electronics. The circuit measures a DC voltage between the Armor (return) electrode and the probe electrode. This potential may be positive and / or negative with respect to the return electrode. Using Armor as the return may affect the look of the SP but any changes in the borehole SP should be reflected in an amplitude change. The measurement is converted by an A to D and then data is combined with the Single Point Resistance and Gamma measurement, then sent to the surface via the modem section.

GAMMA

The natural gamma measurement is made by the use of a Sodium Iodide crystal, which when struck by a gamma ray emits a pulse of light. This pulse of light is then amplified by a Photo multiplier tube, which outputs a current pulse. These pulses are then detected, shaped and counted by an onboard processor. The data from the gamma counter is then combined with the R & SP measurement and sent to the surface via the modem section. The approximate location of the gamma detector is referenced by a band of colored tape on the housing of the probe. The user must maintain this band of tape, or marker, as it may tend to degrade with use of the tool in the borehole environment. **Special Note:** The crystal detector and the Photo multiplier tube are very fragile devises and are very expensive to replace. Mount Sopris has taken steps to afford these items as much protection as possible. These items are subject to be damaged by sudden shock so **when shipping or transporting the tool ensure it has proper protection from vibration and shock to reduce the chances of damage**.

Specifications:

Power Requirements
DC. Voltage +5 +15 and –15 Nominal current draw of 100 mA when connected to a 2SMA.

Tool Output
Digital data TTL level

Gamma Detector
NaI (tl) .875" dia X 3.0" long 22.22mm dia. X 76.2mm long

Gamma Detector location
From the center of the electrode measure up toward probe top 18.0 inches or 45.7cm
A colored band of tape denotes detector location. (Tape placed on probe at factory.)

Resistance Measurements

Single Point Resistance Range	0 to 1000 ohms
Single Point Resistance Accuracy	1% of full scale
Single Point Resolution	0.5 ohm
Spontaneous Potential Range	+2000mV to –2000mV DC
Spontaneous Potential Accuracy	1% of full scale
Spontaneous Potential Resolution	0.5 mV

Operating temperature range
0 to 60 degrees C 32 to 140 degrees F

Pressure rating
3000 PSI

Dimensions
2SNA-1000 Probe

Length	46.6 inches	118.3 cm	
Diameter	1.63 inches	4.1 cm	with neoprene heat shrink and PVC electrical tape
Weight	11 lbs	4.99 kg	

2SMA connected to 2SNA-1000 Probe

Length	71.3 inches	181 cm	
Diameter	1.63 inches	4.1 cm	with neoprene heat shrink and PVC electrical tape
Weight	171 lbs	7.71 kg	

Installation

Installing the 2SNA-1000 and support equipment

Before operating the 2SNA probe determine if it will be used in the stand-alone mode or in conjunction with other DX Series probes.

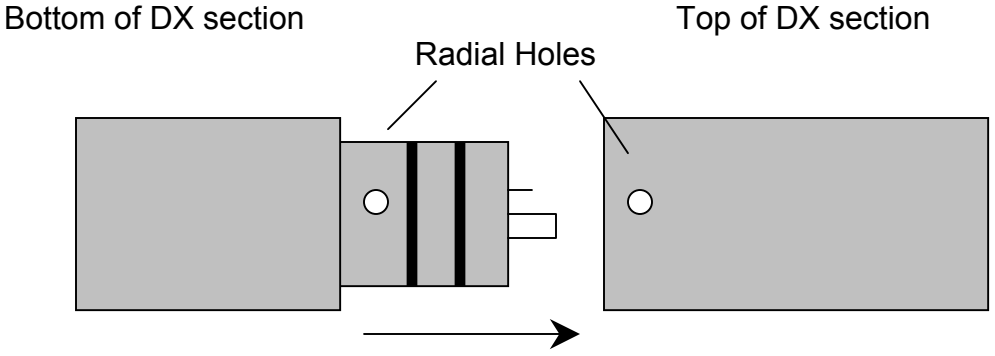
2SNA-1000 stand alone mode

In order to operate the probe in the borehole the lower Bull nose must be installed in the bottom of the probe. This Bull nose in addition to sealing the probe electronics from the borehole environment enables the probe to identify itself as the only DX probe in the string. Remove the housing protector from the probe top then connect the bottom of a 2SMA modem section into the 2SNA probe top. Align the guide pin and press probes together. Radial holes in housing should then align; secure probes together with the three radial screws removed from the 2SMA bottom section. Remove the thread protector from the top of the 2SMA modem; inspect the o-ring on the cable head for any cuts or abrasions. Turn probe string onto the cable head, not the cable head into the probe top. Ensure metal joint between the 2SMA modem and the 2SNA probe is covered completely with PVC tape. Select the proper TOL file for the 2SNA-1000 Stand–Alone Mode in MSLog when operating as a single probe.

2SNA-1000 DX Series stacking mode

If the 2SNA-1000 is to be used in conjunction with other DX probes you will need to remove the Bull nose from the bottom connection of the probe. To make a connection on the bottom of the probe you will need the three radial screws removed allowing the Bull nose to be separated from the housing. Mating another DX section to the bottom of the probe is the same as described in the stand-alone mode between the 2SMA modem probe and the probe top of the 2SNA. Most often the 2SNA Gamma probe will be connected directly below the 2SMA modem section. Other DX probe types will then be connected to the tool string below the 2SNA-1000 Gamma / R&SP probe. Ensure that after bottom connection is made to other probes that all exposed metal surfaces at this connection are covered with PVC electrical tape. **Do not cover the electrode** located just above this connection. Contact Mount Sopris if you have any questions about the possible configurations of the 2SNA-1000 probe in a DX string of probes. Follow the logging instructions in the MSLog manual or in the Help section of MSLog software before logging.

Probe Connections For DX Sections



Operating Procedure

Operation

GAMMA / SPR & SP MEASUREMENTS

Operation of the 2SNA-1000 probe is as follows. These operation procedures assume the user is familiar with using the MSLog data acquisition software. If you are not familiar with or do not understand these instructions, then refer to the MSLog users manual and familiarize yourself with basic logging procedures using the MSLog software. Start MSLog and in the dashboard choose the proper TOL file for using the 2SNA-1000 in the stand-alone mode or for the stack of DX probes you have attached to the cable head. Turn the probe ON in the dashboard and wait for the probe to initialize and power up. Once the probe has been powered go to the Acquisition window and place the system in Time Drive mode. Ensure the probe string is responding by checking the Communications window. Verify in the MchNum window that there is Gamma counts as well as variations in the SPR channel when the Armor of the logging cable is touched to the 2SNA-1000 measure electrode. Gamma count activity will be the natural surrounding back ground in your area unless you have a Gamma emitting test source available. When the Armor is connected to the measure electrode the reading in the SPR channel should be close to 0 ohms. The probe can now be place in the borehole and a zero or ground level mark obtained. Once the probe has been placed at a zero reference open the Depth window on the dashboard and chose the Zero Tool option. The acquisition system will automatically adjust depth and offsets for the system and the probe measurements. Now press the “Record” button and enter the data file name. If you are logging from the top of the borehole down choose the DOWN sampling mode and press “ON”. If you are logging from the bottom of the Borehole up then choose UP as the sampling mode, then press “ON”. When logging depth has been reached then turn the record option “OFF”. Remember to turn probe power OFF before removing the probe string from the cable head.

Performance Checks and Calibrations

Calibrations are performed at the factory and require a basic knowledge and understanding of the tool. In the event the user feels the tool needs to be calibrated it is advisable to speak with a representative of Mount Sopris. Performance checks for the gamma measurement can be made on the surface before logging with a small source of natural gamma radiation placed in close proximity to the detector area of the probe. An increase in gamma counts will then be observed on the MchNum window of MSLog if the tool is working properly. To verify the electric measurements are working the user may use a calibration box, available from Mount Sopris, which when connected across the measure electrode and Armor, provides different resistance and voltage values for calibration. A resistor value of 1000 ohms can be placed across the measure electrode and armor. The SPR channel should read 1000 ohms or within the specified accuracy range. Connecting a small DC voltage source across the measure electrode and the Cable Armor can check the SP. A common 1.5V “D” cell flash light battery works well for this application. If the + end of the battery is connected to the measure electrode the reading on the SP channel will be +1500 mV assuming the battery voltage is 1.5 volts DC. The battery voltage can be checked for proper voltage with a digital voltmeter prior to connection to the probe. The reading in the SP channel will reverse if the – end of the battery is connected to the measure electrode (-1500mV).

Preventative Maintenance

The 2SNA-1000 Gamma / R & SP probe requires little maintenance other than washing the probe off after each use. ***Never take the probe apart. This probe is very difficult to disassemble and requires special steps to be taken in order to gain access to the inside of the probe without damaging the electronics. If you have read this after attempting to disassemble the probe the probe has probably sustained damage and may require repair.*** Inspecting o-rings occasionally and keep both ends of the probe clean. This will minimize problems in the future. The heart of the gamma section is the Photo multiplier tube and the Sodium Iodide crystal. Both units are very fragile and can be damaged if the probe is dropped or sees very abrupt shock. Take great care while handling or packing the probe and during transportation.

Troubleshooting

Problems with the Tool

In the event the tool develops a problem, follow the troubleshooting procedure listed below.
NEVER DIS-ASSEMBLE THE PROBE WITHOUT KNOWLEDGE OF PROCEDURE

2SNA-1000 Problems

No communications from the probe.
1. Is the correct probe TOL file chosen?
2. Is bottom Bull nose installed? (stand-alone mode)
3. Is the 2SNA probe configuration in a DX stack of probes correct?
4. Check cable for conductive leakage across the center conductor to ARMOR. (20 Meg MIN.)
5. If available, does the 2SMA modem communicate with other DX type probes?
6. Is the logger supplying the correct voltage (100V) at logger?
7. If no results from the above, consult Mount Sopris.

Other problems

Troubles with one measurement.
1. Resistance is working but no gamma counts. (Was probe dropped or damaged?)
2. Gamma counting but count rate is lower than normal. (Was probe dropped or damaged?)
3. Gamma counting but no response from resistance. (Is electrode exposed to borehole fluid?)
4. Resistance response is suspect. (Are housings and probe connections covered with PVC tape, except for electrode?)
5. If no results from the above consult Mount Sopris.

Disassembly Instructions

The 2SNA-1000 Gamma / R & SP Probe should **never be disassembled** unless service is necessary. This is a very difficult probe to disassemble, and is highly recommended that any service be performed by Mount Sopris or a qualified technician. A locking screw has been placed near the bottom of the probe housing to prevent the housing from being accidentally turned off the probe. If probe must be entered first remove the probe top by unscrewing the three radial screws located towards the top of the probe. Pull the probe top out of the housing slowly, not in a quick manner. Pay close attention as to how the blue connector is attached to the connector on the PCB. Now remove the socket head screw from the housing located just above the measure electrode. Now unscrew the housing from the lower electrode assembly. **Use care with the fragile PMT and crystal inside.** Electronics and detectors are housed in a protective tube. Reverse steps to re-assemble.

Schematics

Available upon request

2SNA-1000

Drawing #	500S-2181	Sheet 1	Title: Digital Section
Drawing #	500S-2181	Sheet 2	Title: High Voltage Control Section
Drawing #	500S-2181	Sheet 3	Title: Dynode Section
Drawing #	500S-2181	Sheet 4	Title: Power, Reference Supply Section
Drawing #	500S-2181	Sheet 5	Title: Pulse Shaping Section
Drawing #	500S-2181	Sheet 6	Title: Discriminator 1, Sample and Hold Section
Drawing #	500S-2181	Sheet 7	Title: Discriminator 2, Sample and Hold Section

Appendix

Suggested QA Procedure

General notes for Quality Assurance are presented here for users who need to utilize these techniques when collecting data. These users will need to periodically calibrate their equipment using equipment whose calibration is traceable to an approved standard. Details of these calibrations must be recorded.

When an instrument is calibrated, records need to be kept regarding the calibration standard(s) used and what was changed on the instrument to calibrate it. Typically, the corrections made to the instrument involve changing constants that are used to scale the raw instrument reading so that the proper value is reported. The constants must be recorded during a calibration procedure. The Mt. Sopris acquisition software provides records of calibration constants. This aids the QA process, but does not replace the need for recording these constants at the time of calibration. The reason for this is that the length of time since the last calibration is unknown with only this information.

The device providing the standard must be traceable to an accepted standard. Examples of organizations providing standards for measuring instrumentation are: The U. S. National Bureau of Standards; The American Petroleum Institute; and the American Society for Testing Materials. For example, if the voltmeter or the density standard used for calibration is not traceable to an approved organization, such as those listed above, the calibration should not be considered valid. Records should be kept indicating the last time that standard being used for calibration was calibrated or checked against an approved standard. The QA procedure necessary for some programs mandate that the calibration standards be periodically checked against a standard approved by a proper agency.

A QA procedure may dictate that data taken from a given locale be associated with records indicating the exact time and location that the data was collected. The data itself may have to be collected in a certain format to meet requirements. Often, QA procedure specifies that surveys must be repeated and the data from the successive surveys compared. This technique is used to eliminate poor or invalid data.

Casing and Water Factors for 2SNA-1000

These figures are from a 2PGA Gamma probe. The 2SNA uses the same gamma detector as the 2PGA and results should be similar.