



Specification For The MSB Design Single Line Simulator SLS-1

Introduction

The Single Line Simulator SLS-1 provides a combination of a line / exchange simulator and a test unit. In the line exchange simulator mode it emulates a modern exchange line, with feed currents and supervisory tones as you would find in a real exchange situation. In the test mode it displays many parameters of the equipment under test, as well as providing test tones and pulses. With this unit you can test and measure your equipment to determine its function as if you were plugged into a real exchange system. All the functions are closely matched to those that you would find in the real world, and the test results displayed are to a high accuracy.

The unit is mains powered, 240v ac @ 50Hz, and it is completely self-contained. Just switch on, plug in your equipment to be tested, and you are ready to go. The learning curve will be very short as the unit will appear, in simulation mode, as if you were attached to your familiar exchange line.

The test functions are very straightforward, and largely self-explanatory.

Let's look in more detail at the unit :-

Front Panel Controls

As soon as you have plugged the unit into the mains and switched on you will notice that the display will illuminate and that the two rows of LED's at the bottom of the front panel have each got one LED illuminated, hopefully the left one in each case. The display will in all probability initially show nothing in particular as it will be waiting for you to initiate a test. The first thing to do is to decide upon the main function that you wish to carry out, and that is done by use of the left bottom push button and its associated LED's. By pressing this button you will advance the LED along the row, choosing as you go the required functions, as marked. The first position will display the MAKE time of pulse dialling, measured in mS. The next position will display the BREAK time, again in mS. The next position will display the SPEED of the dial pulses, in pulses per second. The next position will display the NUMBER dialled. The next position will display the LEVEL of any tone or traffic on the line, in dBm. The final position changes the unit from test to Simulate mode, and the display will show the level on the line and the unit will function as an exchange simulator, giving supervisory tones etc. as with a normal line.

Thus you can choose the required function. However, there is much more that can be done, so let's look briefly at the other controls :-

The second push button and row of LED's correspond to your choice of Payphone Answer pulse. When you dial the other extension and the called party goes off-hook you can choose from four different payphone answer signals. In the first position, on going off-hook the caller will experience a dc polarity reversal; for this particular function only extension 1 experiences the reversal. In the next position the caller will receive a 50Hz longitudinal pulse. In the next position the caller will receive a 1111Hz pulse, and in the last position the caller will receive a 16kHz pulse. Actually, this is not the last position as if you press the button once more, all the LED's will extinguish and there will be no payphone pulses at all.

Looking now at the push buttons in the top row, the first enables a Sweep Generator. This sends to the line a swept tone starting at 300Hz and ending at 3.6kHz, the sweep taking about 3 seconds. The level of this tone is approximately -14dBV.

The next button has two functions; pressing it will ring extension 1 as long as the button is depressed. At the same time the REN value of the equipment plugged into extension 1 will be displayed.

The next button allows manual Meter pulses to be produced. The actual type of pulse is selected by choosing the payphone pulse, as described earlier. Pressing the meter button will send that pulse in the same way that the automatic payphone answer function did. Note that, as described in more detail later, under the relevant heading, this function does not apply to line reversal, which can be accomplished by use of the manual line reversal switch.

The next button is used in conjunction with the Earth Recall display. If you press the Earth Recall button on the unit under test, and it is functioning correctly, an "E" will appear in the centre of the display. If the PSTN Seize button is depressed then on receipt of the Earth Recall signal the unit will send out a PSTN Seize signal, this being the application to the line of 5v ac @ 50Hz, for the duration of the earth recall signal.

The next button chooses between Pulse and DTMF dialling. As far as dialling in the simulation mode is concerned, this does not matter, as the unit will automatically deal with the decoding. However, you must choose between the two for dial measurements to be displayed.

Going to the next row, the first button chooses between the continuous 400Hz Unobtainable tone and the cadenced Busy tone.

The next button, when depressed, switches in an Artificial Line of approximately 7.5km. This impedance is switched into extension 1.

The next button allows the manual Reversal of the dc feed to extension 1.

The final button switches to the line a White Noise source, this being variable in level via the front panel control, up to a maximum of -14dBV.

The final displayed functions are the LED's next to the line sockets, and these display, for each extension, the OFF-HOOK, LINE SEIZE and RINGING status of these extensions.

In addition to these selectable features, there is automatic generation of the Call Party Clear signal as soon as an extension goes back on hook.

Dial Parameter Measurements

When the MAKE function is chosen you must choose between Pulse and DTMF, using the front panel button so marked. If you choose DTMF, as there is no make or break to be measured the display will show the number dialled, duplicating the function to be looked at later. If Pulse is chosen then take the apparatus under test off-hook and dial a number - it must be greater than 1 or else the test will not terminate, it needing a further pulse to do that. On completion of the digit its MAKE value, in mS, will be displayed. Do not be concerned by the flashing "E" in the centre of the display whilst dialling as that is just a function of the Earth Recall display, and will disappear when the digit has been dialled.

When the BREAK function is chosen, the same applies as has been explained above.

Both the MAKE and BREAK are measured to an accuracy of +/- 1mS.

When the SPEED function is chosen, and once again bearing in mind the Pulse / DTMF choice above, after a digit has been dialled its SPEED will be displayed in Pulses Per Second.

Note that if the Pulse / DTMF button is depressed whilst these readings are being made the value is held and will still be there when returning to the correct mode. However, each test must be done separately for either MAKE, BREAK or SPEED for each function chosen.

When NUMBER is chosen we see displayed the digit dialled. Once again the Pulse / DTMF button must select the mode required, and this is the official position for the DTMF number display, although as stated earlier this is displayed in the previous positions as well. In Pulse mode the digit '0' is displayed as '10'. In the DTMF mode the STAR character is displayed as three parallel horizontal lines, and the HASH character is displayed as an 'H'. All DTMF numbers are displayed, plus STAR, HASH and the letters A to D.

When LEVEL is chosen the display shows the level on the line. Thus, if a button is depressed on a DTMF keypad, the level of that tone will be displayed. Note that the level is not sampled but is measured 'live' so a varying level will be reflected in the display. The measurement units are dBm.

Finally, the last position will select the Simulate mode, when the unit will function as an exchange line, and the display will continue to show the level on the line.

Simulate Mode

When the SIMULATE mode is chosen the unit stops testing the parameters described and functions as an exchange line simulator. This does not mean that no testing is performed, as the level is displayed, but that is all (with the exception of REN and Earth recall, as we will see later). Note that only in SIMULATE mode do you get supervisory and ringing tones. This prevents the ringing of an extension whilst carrying out dial measurements.

There is no need to choose between Pulse and DTMF now, as the unit will automatically recognise the dialling, and you can have a mixture of the types in each extension. When one of the extensions goes off-hook it will receive dial tone. Dialling any digit will stop that dial tone, and the unit will wait for a second digit. Dialling a second digit will send ringing to the other extension, and ring tone will be heard by the caller. In all of these situations the LED's beside the extension will show the line status. Thus, when the first extension goes off-hook the LOOP LED will illuminate, as will the SEIZE LED, as the line was clear and this extension may seize the line. The dialled digit, if Pulse, will flash the LOOP LED as the digits dial out. When the second digit is dialled, the called extension will illuminate its RING LED to show that ringing voltage is being applied to it, and it should ring. When this called extension goes off-hook to answer the call, its LOOP and SEIZE LED's will illuminate, and the connection between the two will be made.

If one of the PAYPHONE answer choices has been selected, for example the 1111Hz option, then when the called party goes off-hook the caller will hear the payphone tone pulse. The two extensions are now connected and speech or data can be sent. The level of this traffic is continuously displayed.

If the AL button is depressed, an Artificial Line of approximately 7.5km will be switched into the line of extension 1, so attenuating the path in this line. This will apply to both the dc feed and the traffic on that line.

If the NOISE button is depressed, white noise will be sent to extension 1, and if the two extensions have been connected then both will hear the white noise. The level of this noise can be adjusted via the front panel control.

When one extension goes back on-hook a CALL PARTY CLEAR or K-Break signal will be triggered. This will result in the dc feed being interrupted for approximately 70mS. The extension that is left off-hook will then seize the line and receive dial tone, ready to initiate another call.

In the situation where one extension goes off hook whilst the other is already off-hook, the dial tone will be sent to the second extension only. You will notice that the second extension has its LOOP LED illuminated but not its SEIZE LED. If the second extension tries to dial out, after the second digit it will receive an engaged tone, which will either be the BUSY signal of 400Hz cadenced 375mS / 375mS, or the unobtainable signal of continuous 400Hz. This will depend on the depression of the BUSY / UNOB. button on the front panel.

Incidentally, if the first extension tries to dial out instead of the second then no tones will be heard at all. This is of no consequence as the idea of this test is to check the result of attempting to dial an engaged number.

Payphone Answer

You have a choice of payphone answer signals by pressing the push button associated with these choices. The first position will cause the dc feed to extension 1 to REVERSE when the called party goes off-hook. This reversal will hold until the line clears. Please note that this function will only happen if the Manual Reverse button is in the NORMAL position.

The next choice will generate a 50Hz longitudinal pulse of approximately 45v ac at extension 1, once again on the called party going off-hook.

The next position will generate a normal tone pulse of 1111Hz on either extension.

The next choice does the same but the tone frequency will be 16kHz.

All of these pulse are of a duration of approximately 150mS.

If the button is pressed once more, all the choice LED's will be extinguished, and in this position there will be no automatic pulse generated.

Sweep Tone

The remaining functions operate whether the unit is in Simulate mode or not. If the SWEEP button is pressed momentarily, a swept tone is generated at either extension. This tone starts at 300Hz and ends at 3.6kHz. Duration of the sweep is approximately 3 seconds, the ramp is almost linear, and the level is constant at approximately -14dBV.

Ring Function

The RING button has two functions, that of sending ringing to extension 1, and in addition measuring the REN value of the apparatus plugged into that extension. The ringing is not cadenced, but is applied for the duration of the button depression. The way the REN value is measured is slightly different from that laid down in the British Standard BS6305, and I think that this method provides a more meaningful reading. The unit measures the actual current flowing through the apparatus under test, and computes the equivalent number of standard bells that would produce such a current, and the number displayed is the number of bells that would give this current. Although this is not exactly the method used in the BS REN test, I feel that it gives a more worthwhile indication of the bell equivalence, as it is the current sinking of the apparatus that is needed to be determined.

Do note though that the situation in the real world is complicated by the different ring sensitivities found in different makes of tone caller, and this can lead to situations where different makes of apparatus in parallel will achieve a condition where only one will ring, even though the apparent REN value is identical. This situation is not addressed in the British Standard REN tests.

Meter Pulse Generation

As has been described earlier, the unit, when in Simulate mode, will automatically generate the chosen Payphone Answer pulse when the called party goes off-hook. The METER button performs the same function, only manually.

Thus, when the button is momentarily depressed the pulse chosen via the Payphone button will be produced. Once again this pulse will be of approximately 150mS duration. Please note that there is one exception, and that is the REVERSE choice. This can be catered for by using the manual REV / NORM button.

PSTN Seize / Earth Recall Display

For apparatus that has an Earth Recall function, if this function is initiated, for instance by pressing the Earth recall button on a telephone handset, the display will show an "E" in the centre of the display, providing that the function is working correctly. Now, in the case of a PBX that calls by this method, the exchange can send back a PSTN Seize signal to let the PBX know that it has succeeded in seizing the line. This can be the application of up to 5v ac applied to the line, and this is the one we have chosen to use. On initiation of the Earth Recall signal, if the PSTN Seize button is depressed the unit will generate the PSTN Seize signal by applying approximately 5v ac to the line, for the duration of the Earth Recall signal. Note that the display of "E" will only function with the Re v/ Norm button in the Norm position.

It should be noted that if the PSTN Seize button is depressed whilst the unit is ringing an extension the Seize signal relay will chatter, so either ignore it or make sure that the button is only depressed when you are testing the Earth Recall function, as described above.

Pulse / DTMF

This function has been dealt with already, but for completeness we will repeat it here.

For the purposes of exchange simulation it does not matter which choice is made, as the unit will automatically recognise which dial method is used and decode the number accordingly. However, when it comes to measuring the dial parameters the choice does matter. The display will only show the parameters that apply to the particular mode chosen. Hence, if the apparatus under test is a Pulse dialler and Pulse is chosen then for MAKE, BREAK and NUMBER the display will show these measurements as normal. However, if the DTMF mode had been chosen then as these parameters do not apply to this mode then the display will have no significance, and will show whatever was in there the last time DTMF was chosen. Equally, if the apparatus being tested is DTMF and DTMF is chosen, then for MAKE, BREAK and SPEED, as these do not apply to the DTMF mode, then the display will show the number dialled for all these positions., duplicating the Number function. If Pulse is chosen then the display will again not be significant. For the last three functions, Number will apply to the mode chosen, and LEVEL and SIMULATE don't care.

Busy / Unobtainable

This chooses between the continuous Unobtainable tone and the cadenced Busy tone. When an extension tries to dial out whilst the other is already seizing the line, then the second extension will receive the engaged tone, as chosen above. The tone is 400Hz, the busy cadence is 375mS / 375mS.

Artificial Line (AL)

The push button marked 'AL' will switch in an artificial line between the extensions, simulating approximately 7.5km of copper cable. The simulation is not as exact as that used in our stand-alone Artificial Lines, but is a single section T-network. However, the values chosen give a close approximation to the characteristics of an accurate line of this length. The Artificial Line is switched into the path of extension 1.

Normal / Reverse

The dc feed to extension 1 can be manually reversed by depressing this button. This is also the means by which the payphone answer reverse signal can be manually applied. The dc feed to extension 2 is fixed at normal.

White Noise

If this button is depressed, White Noise is sent to the line at extension 1. This noise level is controllable via the front panel control, to a maximum of approximately -14dBV. The noise is from a good white noise source, analogue generated, not by digital means. It will be present whenever the button is depressed, whatever the mode.

Call Party Clear

Whenever a call has been established, and one of the parties goes back on-hook, the Call Party Clear signal is generated. This consists of the removal of the dc feed for approximately 70mS.

Specifications

dc Feed	approx. 25mA constant current backed by > 50v
Supervisory Tones	Dial Tone - 350Hz + 440Hz Ring Tone - 400Hz + 450Hz, cadenced 400mS/200mS/400mS/2S Busy Tone - 400Hz cadenced 375mS Unobtainable - 400Hz continuous
Ring Voltage	25Hz near sinusoidal @ 65v RMS, cadenced 400mS/200mS/400mS/2S
Sweep Tone	300Hz to 3.6kHz over approx. 3S, level approximately -14dBV
REN Test	measures value for 0.1 to 2.0 REN
Meter Pulses	dc feed reverse 50Hz longitudinal @ 45v for 150mS 1111Hz for 150mS 16kHz for 150mS
PSTN Seize	approximately 5v ac
Artificial Line	7.5km in one T-network section
White Noise	white noise source adjustable via front panel control to a maximum of -14dBV

Parameters Displayed	Pulse - Make, Break, Speed
	DTMF - Level
	Both - Number
Status Displayed	Off-Hook (LOOP)
	Line Seize (SEIZE)
	Extension Called (RING)
Call Party Clear	dc feed interrupt for 70mS
Tolerances	voltage +/- 5%
	current +/- 5%
	frequency +/- 1%
	pulse period +/- 1mS
	cadence +/- 1mS
	level +/- 5%
	REN test +/- 0.1 REN

The unit is housed in a steel / aluminium enclosure, with all switches and connectors on the front and rear panels. It is mains powered, via an IEC connector on the rear panel. Enclosure dimensions are 220mm x 220mm x 70mm.