Samyak

OPERATING MANUAL

FOR

PROCESS INDICATOR TOTALISER

SMIT 101

Manufactured By:

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INTRODUCTION:

This is a microcontroller based Indicator Totaliser unit. It is highly versatile, accurate and different from the conventional indicators.

The set Parameters and integrated total are stored in serial NVRAM. No battery back up is required.

***General Specifications of this unit are*:**

- This is a Microcontroller (89S51RD2) based unit.
- On board V to F Converter (0 to 10KHz) is provided for Digitising Analog Input
- Power Supply: 230VAC/115VAC is field selectable from back panel
- **Input Options** (Factory settable): 4.0 to 20.0mA, 0 to 20 mA
  1.0 to 5.0 V, 0 to 5 V
  Pulse input: 0 to 10 KHZ
- **Output Options:**
  - ☐ Transmitter Power Supply: +24V DC +/- 5%, 100mA
  - ☐ Relay Output: 2 nos. 1 C/O type 2A/230 VAC contact rating
  - ☐ RS232/485 serial output
  - ☐ Re-transmission: 4 to 20 mA

- Zero and Full Scale : Programmable Thro' front Keypad
- Decimal position : Selectable
- Indication : Process variable : Four Digit 0.5" Seven Segment Red LED
- Integrated total : Non resettable Six digit 0.5" 7-segment red LED
- Key board : Four keys membrane like
- Accuracy : 0.2% + +/- 1 digit
- Warm up time : 15 minutes
- Configuration Data & Integrated total are stored in serial NVRAM
- Calibration thro' software (Offset : CALZ & Span : CALS stored in NVRAM)
- Scaling : Linear or Non linear (KB Selectable)
- Mechanical data :
  Mounting: Panel mounting
  Cut-out size : 92mm x 92 mm
  Outer dimension: 96mm x 96mm x 160mm (Depth)

SYSTEM DESCRIPTION:

The unit is based on an 8-bit microcontroller (89v51rd2 series). It displays analog signal (mA/V) or Pulse in engineering values and performs integration.

With the help of the keypad and display, unit allows to set and modify various configuration parameters and calibration.

HARDWARE DESCRIPTION:

The unit consists of a CPU and KB/Display card.

The CPU card has necessary hardware for:

- Driving Twelve (8+4) digit multiplexed Display
- Four key keypad interface.
- Watch dog circuit
- DC regulated supply : +5V,+24V,+12V
- Signal conditioner (I/V converter) and V to F converter
- The transformer is fitted on this PCB on two mounting screws thro' a clamp.

The CPU card carries Male connectors (3+5 way) for interface

The connectors are accessible from back panel cutout.
Mating female connectors are supplied along with the instrument.

The card is soldered with KB/Display card and it slides in frame of the enclosure. No mounting screws are required. The KB/Display card is fixed with front bezel.

Mains selection for 110V/220V is to be done from back panel. There are total five terminals for mains connection. One of them is for Earthing. Necessary connection for configuration of 230V/115V mains is indicated on the sticker on the back panel.

For 230V Mains Input: Connect a shorting link betn. Terminals 5 & 6
Apply 230 VAC mains between terminal 4 & 7

For 115V Mains Input: Connect one shorting link between terminals 4 & 5
Connect another shorting link between terminals 6 & 7
Apply 115 VAC mains between terminal 4 & 7

ENCLOSURE:

This is general purpose Powder coated metallic enclosure suitable for panel mounting. Panel mounting is to be done using side brackets.

OUTPUT CARD:

The output card is connected with CPU card thro' an eight pin connector. Separate AC power supply is given to the card from Transformer. Regulator circuit is on the card to generate isolated supply for analog output.

Circuit for retransmission output is installed on this card.
Two alarm relays and necessary driving circuit is installed on this card.

RS232/RS485 interface circuit is also installed on this card.

KB/DISPLAY CARD AND FRONT PANEL:

A display/KB card has two set of displays:

Four digit display for rate indication
Six digit display for totaliser display

Four keys are also mounted on this card. The card is soldered with CPU card. The card is fitted with the bezel. An overlay is provided on the front side.

INSTALLATION GUIDE:

Unpack the instrument from the packing box carefully.
Mount the instrument in the panel cut-out of 92mm * 92mm.
Fix the instrument with the panel using two side brackets.

All the electrical connections to be done at the back panel on screw type terminals
Refer the Appendix for back panel layout.
Make sure that no wire is connected loosely to avoid generation of spark and RFI.
Before connecting the mains, check the mains configuration on the back panel.
Apply mains supply between terminals 4 & 7.
Earth the instrument properly.

Applying Analog Input:

The instrument takes analog input form back panel
Connect analog input between terminals 1 & 2.
Transmitter supply is available between terminal 1 & 3.

OPERATING DETAILS:

The following paragraphs give detailed description of how to operate the unit. Before using the instrument, make sure to study and understand this section.

DISPLAY & KEYBOARD:

The unit has Two groups of 0.5" 7-segment Red LED display.

Display on top row is organised as 4 digit. It displays rate of input OR Process variable.

The second group of display is Six digits. In normal mode of operation, it displays integrated total. While in EDIT mode, parameters are displayed in this window.

Unit has 4 key membrane keypad organized as 4 x 1 matrix.

List of keys and their functions:

Keys	Function
Index	Enter into data entry/verification mode Select parameter
Enter	Save new data and Terminate Edit mode. If 'Enter' key is pressed twice, unit comes out of EDIT mode. (i.e. comes to normal mode)
Digit Select (→)	Select next digit and also used as START key while batching.
Increment (↑)	Increment selected digit value and also can be used as STOP key while batching.

Normal Mode of Operation:

When ever mains is switched on to the unit,

Engineering value proportional to the input signal will be displayed as Process variable.
Decimal point is displayed at selected position.
Last saved integrated total will also be displayed on the lower window.

EDIT MODE:

In this mode user can verify or modify: Zero, Full scale, decimal point, Time base and Conversion mode settings. Integrated total can also be cleared to Zero using a command from this mode. Entry into Edit mode is protected by Password.

Press 'Index' key to enter into edit mode.

First three parameter displayed in Lower display window with each depression of 'Index' Key is: Integrated Total, Batch Total & Roll count. These are non-editable parameters.

Fourth Parameter is Password. When 'Index' Key is pressed after third parameter, lower display window will show 'PASS' for a moment and then it will start displaying '0000' with flashing Left most digit .The unit is prompting for Password. Password is a four digit no. There are two different passwords.

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Operator's Password: 0101 Engineer's Password: 1234

Enter any one of the above password using data entry keys. When 'Enter' key is pressed, the validity of Password is checked. If wrong password is entered the unit comes out of edit mode and displays engineering value.

Press 'Index' key again if you want to enter into edit mode.

If correct password is entered, then also the unit starts Indicating Engineering value of input. Now press 'Index' key, the display will show name of the parameter to be modified and it's value after a moment.

Pressing the 'Index' key again will display next parameter. The various parameter that will appear on the display with successive depression of the 'Index' key are:

Parameter description	**Display**	**Min value**	**Max. Value**
Integration total	INTTOT	0	999999
Batch total	BATTOT	0	999999
Roll count	RC	0000	9999
Password	PASS	1234 / 0101	
Calibration Zero/Offset	CALZ		
Calibration Span	CALS		
Relay1 definition	Relays -1	Lo – AL, or SetPnt	
Relay2 definition	Relays -2	Hi - AL, or Prewarn	
Conversion factor	Conv-F	00.50	99.99
Zero	2ero	0	
Full Scale	F.S.	Up to 9999	
Decimal point	dP	0, 0.1, 0.01	
Base	bASE	0,1,2,3	
Set point/Low Alarm	SEtPnt/Lo-AL	0 to 65535	
Pre-warn/High Alarm	PrEvrn/Hi-AL	0 to 65535	
Clear Total	Clrtot	3210	
Mode of Conversion	nOdE	Linear, square root	
Default Display	dEF.dSP	bAttot/inttot	
Unit No	unitno	000 -999	
BaudRate	baud	19200,9600,4800	

Following the above process, one can select any of the above listed parameters. First two parameters listed in the table (CALS & CALZ) after Password are displayed in engineer's Password mode only. We will discuss about the same in calibration mode.

When a parameter is selected, its name will be first displayed for a moment and then current value is displayed in the same field of display. The left most digit will start flashing.

Use Increment (Up arrow) key, if you want to modify the flashing digit.

Press increment key, flashing digit will increment up to 9 and rolls back to 0 when it reaches at 9. In case of the left most digits it scrolls between 0, 1, 2 and 3.

Once desired digit is set, press digit select key (Right arrow) to select next digit. The next selected digit will flash. Set it to desired value as per the above step.

Once all the four digits are set, press 'Enter' key. The parameter value will be modified as per new set value. Display will start indicating Input.

When in data entry/EDIT mode, if no key is pressed for 25 Seconds, the unit will terminate data entry mode automatically and start indicating Process value.

Press 'Index' key to go to next parameter. If 'Index' key is not pressed for more then 25 seconds, the unit will terminate 'Edit' mode automatically and start indicating Process value. To enter into 'Edit' mode, one has to enter Password again.

Password, Zero, Full scale and Clear Total are four digit numbers. These parameters have to be modified using above procedure.

RELAY 1 Configuration (rELAY-1):

This parameter is used to define relay 1 either as Low alarm relay (for process variable only) or Set-point relay (for batch process only). Once it is configured as Low alarm relay, it will generate an alarm when the process value is less than the Set value.

If it is configured as Set point relay, it will be ON till the batch total reaches set point value.

RELAY 2 Configuration(rELAY-2):

This parameter is used to define relay 2 either as High alarm relay(for process variable only) or Pre-warn relay(for batch process only).

Once it is configured as High alarm relay, it will generate an alarm when the process value exceeds set value.

If it is configured as Pre-warn relay, it will be remain On till the Batch total reaches to the pre-warn value. Pre-warn value is always less then the set point value.

CLEAR INTEGRATED TOTAL:

Value of integration total, batch total and rollover count can be reset to Zero using this command from EDIT mode. Go to this command in EDIT mode using Index key. On entering a four-digit value: '3210', the integrated total is cleared to Zero.

DECIMAL POINT SELECTION:

One can select decimal point position on the indication thro' keyboard. Go to 'EDIT' mode after entering correct password. Using Index key, select 'dp'. The currently selected decimal position will be displayed. Using 'Up arrow' key select desired decimal point position and press 'Enter' key. The decimal point will be displayed at newly selected position.

Select	Decimal position
0	No decimal
.1	One decimal
.01	Two decimals
.001	Three decimals

MODE OF CONVERSION:

As explained earlier, the instrument supports Linear and square root extraction as built-in feature. One can select the mode thro' keyboard. The last parameter in setting is mode. One can select the mode by pressing Increment key. Press 'Enter' key for desired mode. The conversion from process parameter to engineering unit will be done as per the selected setting.

TIME BASE SELECTION:

As explained, the unit performs integration over time period. This function is useful mainly for flow measurement. The integration will be based on rate of flow. The process variable will be flow rate. The time base for the flow rate is selectable using 'base' function from EDIT mode. There are four possible settings for time base. Select one of these time base for integration.

Select	Time base	Divisor
0	Second	1
1	Minute	60 (1x60)
2	Hour	3600 (60x60)
3	Day	86400 (24x60x60)

Value of Integrated total for time period of t (in seconds) will be

It = (flow rate * time 't" in seconds)/divisor

DEFAULT DISPLAY (dEF.dSP):

Depending upon selection of "Default Display" parameter in menu as batch total or integration total (use up-arrow) the respective value of the parameter (batch total/integration total) will be displayed in normal mode.

INDICATION:

For conversion in engineering value, the input is scaled between Zero and Full scale set values as per following formula (for linear mode):

For any type of input:

$$\text{Indication (Engineering Value)} = \left(\frac{\text{Input signal - CALZ} * \text{(Full scale - Zero)}}{\text{(CALS-CALZ)}}\right) + \text{Zero}$$

CALZ = Value of input applied during zero calibration
CALS = Value of input applied during Span calibration

If input signal is outside the set Zero and Full-scale limit, all the four digits of the Process variable display starts flashing. Only when input signal comes back into the allowed range, display becomes steady.

FOR NON LINEAR MODE:

For Indication in non linear mode refer appendix.

INTEGRATED TOTAL (It):

This is a six digit totalised value, displayed as integrated total. As per the selected time base, Zero and Full-scale settings, this total is updated continuously, proportional to input.

On power fail detection, current value of integrated total is stored in NVRAM.

RETRANSMISSION OUTPUT:

This is an optional feature. Re-transmission output is between 4 to 20 mA. This will be linearly proportional to indication.

Output current = [(Indication/Full scale) * 16] + 4

For current output, Compliance resistance is 500 Ohms.

SERIAL INTERFACE:

Smit-301 optionally supports serial interface. This can be rs232 to rs485 (factory configured).

A 9-pin D-type male connector is provided on the back panel. It follows ASCII protocol. Protocol details can be provided on request.

CALIBRATION PROCEDURE:

The Instrument is duly calibrated at the factory. For any reason, if re-calibration is required follow the procedure as defined below.

As explained earlier, One can do calibration thro' the keyboard itself, no trimming of potentiometer is required. The Zero and Full-scale values are stored in NVRAM. The calibration is allowed only in Engineer's Password mode.

1.Switch on the instrument and allow 15 minutes of warm up time before starting calibration.

2.Take a standard source. Set it's output at desired Zero (CALZ) value. Apply output of the source to the input terminals (1 & 2) of the indicator.

4. Go to EDIT mode:

Enter engineers; Password '1234'.
Press INDEX key after entering this Password.
The parameter 'CALZ ' for Zero will be displayed.
Actual row counts will be displayed.
Allow the reading to settle, press 'Enter' Key.
This count will be stored as Zero/Offset reading.

5.Now apply input equal to Full scale/Span (CALS):

Press 'Index' key again.
'CALS' for Span calibration will be displayed.
Row counts of VFC will be displayed.
Allow the reading to settle and Press ' Enter' key.
This reading will be stored as Span/Full scale.

Now the instrument is calibrated.

For again entering into calibration mode, you have to wait till the instruments go to normal mode. After that go to EDIT mode thro' Engineers' Password and perform calibration.

NOTE:
An **OPEN** msg. will appear in Upper Display window, when input is 5% less than its minimum value.
An **OVER** msg. will be displayed, when input is 5% higher than its maximum value.

If input terminals are open, then also upper window will show 'OPEN' message.

MODBUS PROTOCOL:-

Function code:
03h: for reading analog parameter value.
06h: for writing analog parameter value.
01h: for reading digital parameter value.
05h: for writing digital parameter value.

Command message consist of 4 fields as shown below.

Command message.

Station no (1 byte).
Function code (1 byte)
Data (4 byte)
Crc (2 byte)

Here master will send command to the slave and slave will response to the master if its unit no. Matches with command message's station no. Field.
To a relevant message, slave station creates and sends back a response message, which corresponds to the command message.
If the content of the command message have any abnormality (for example, non actual function code is designated) other than transmission error, slave does not execute that command but creates and sends back a response at error detection.
The composition of error message at error detection is shown below.

Error message

Station no
Function code +80H
Error code
Error check (crc-16)

Error code:

01H: illegal function
02H: illegal data address
03H: illegal data value.
08H: crc error.

Here slave will first check crc, if crc is o.k. it will assume that there is no transmission error. And if crc is not matched with crc calculated by slave station, slave station will send back error message with error code 08H. After crc slave will check unit no. If it matches with its own unit no. It will go ahead with command. Otherwise it will neglect the command.

REGESTERS TABLE

DIGITAL PARAMETERS READ:

Hex address	Register No.	Parameter	Function
00	00001	Relay status	Status of Relay1(SP\LA)
01	00002	Relay status	Status of Relay 2(PW/HA)

Relay registers bit pattern :

MSB														1	0
														Relay2 (PW/HA)	Relay1 (SP\LA)

Bit will be '0' if relay is OFF.
Bit will be '1' if relay is ON.

DIGITAL PARAMETER WRITE:

Hex address	Register No.	Parameter	Function
02	00003	Start / Stop	Start / Stop Batching If Data = 0001, Batch starts. Data = 0000 , toggle Batch Status Between Start / Stop.

ANALOG PARAMETERS:

Hex Add.	**Reg. No.**	**Parameter**	**Function**
00	**40001**	**Batch Total LSW (2 Byte)**	**Read the Batch Total Value (4 Byte)**
01	**40002**	**Batch Total MSW (2 Byte)**	
02	**40003**	**Integrated Total LSW (2 Byte)**	**Read the Integrated Total Value (4 Byte)**
03	**40004**	**Integrated Total MSW (2 Byte)**	
04	**40005**	**Set point/ Low Alarm LSW (2 Byte)**	**Read/Write the Set point / Low Alarm Value**
05	**40006**	**Set point/ Low Alarm MSW (2 Byte)**	
06	**40007**	**Prewarn/High Alarm LSW (2 Byte)**	**Read/Write the Prewarn/ High Alarm Value**
07	**40008**	**Prewarn/High Alarm MSW (2 Byte)**	
08	**40009**	**Conversion Factor (2 Byte)**	**Read/Write**
09	**40010**	**Flow Rate (2 Byte)**	**Read the Flow Rate Value**
0A	**40011**	**Zero Value (2 Byte)**	**Read/Write the Zero Value**
0B	**40012**	**Full Scale (2 Byte)**	**Read/Write the FullScale Value**
OC	**40013**	**TRC + Null**	**Read**
OD	**40014**	**DP Value + Null**	**Read/Write the DP Value**
OE	**40015**	**BASE. + Null**	**Read/Write the Unit No. (0000 to 0003)**
0F	**40016**	**DEFAULT DISPLAY**	**Read/Write (0 & 1)**
10	**40017**	**Output Zero**	**Read the Zero Value**
11	**40018**	**Output Span**	**Read the Full Scale Value**

Serial Connector detail for MODBUS (MAS1006): 9 pin D type.

Pin no. 2: Data - (Rx / Tx -)
Pin no. 3: Data + (Rx / Tx +)
Pin no. 5: Ground

How to Test: -

To test this all parameters in MBUS Tester application, do the following settings:

1. Set **Device Id** to 1 for all.
2. Set **Length** according to requirements.
3. Set **Modbus point Type** according to the parameter type.

a). For Analog parameters **READ**: Set the **Modbus point Type** to HOLDING REGISTER and **Address** from 0001 to 0016 in Modbus application**.**

For Example1:

Suppose the Batch total Value displayed is 562017 (or 56201.7), To read it, Set address to 0001 and **Modbus point Type** to HOLDING REGISTER. (Length -for displaying only batch total could be to 2).

Its hex value will be 0x00089361. Four bytes are used to display batch total (bt) in serial application according to the table shown above.

So, the modscan32 will show at address

40001 [9361](lower 2 byte)

40002 [0008](higher 2 byte)

Example2:

If Full-scale value (**FS**) = 800.0(hex will be 1F40, converted according to 8000, no decimal point consideration) Two bytes for full scale (FS).

Then the modscan32 will show at address

40012 [1F40]

Note: In serial decimal point is not taken into consideration.

b). For Digital parameters **READ**:

To read the relay status, set the **Modbus point Type** to COIL STATUS and Address to 0001 to 0002.

Example1: If Loalarm/setpoint relay is on, Modbus application will show at Address:

00001 [1].

00002 [0] (If Hialarm/prewarn led is off)

Example2:

If start is given then SP and WP relay will be on .Set **Address** to 0001 and **Length** to 2. So, Modbus App. will show:

00001 [1]. (Loalarm/setpoint relay will be on)

00002 [1]. (Hialarm/prewarn relay will be on)

c). For digital /Analog parameters **WRITE:**

We can only do START and STOP function from serial Application.

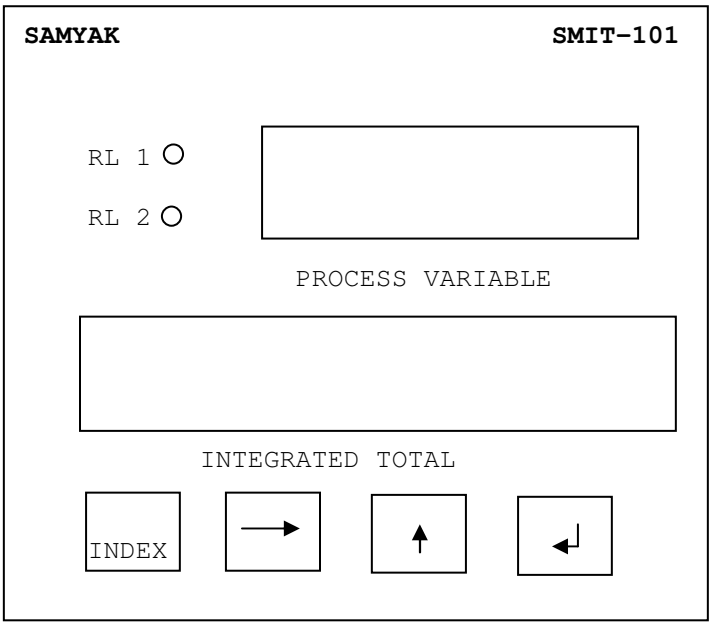
For this the address should be displayed in the application first. Then double click on the address to be modified and then a screen will be opened with name

1. **Write coil (**for digital parameter –start -stop)

2. Write Register (for analog parameter –for all**)**

Change the status or value according to parameter (for start stop on off is to be done, but for analog parameters value should be entered) and click on UPDATE/WRITE icon. The value will be updated.

FRONT LAYOUT:



BACK PANEL DETAILS:

Pin No.	Signal		
1	Input –ve/Common		
2	Input +ve		
3	+24VDC/50 ma		
4	L1	Apply Mains between 4(L1) & 7 (N2) For 115V : Short 4 with 5 And 6 with 7 For 203V : Short 5 with 6	
5	L2		
6	N1		
7	N2		
8	Earth		
11	Relay NC		Alarm2 Relay
12	Relay C		
13	Relay NO		
14	Relay NC		Alarm1 Relay
15	Relay C		
16	Relay NO		
17	Re-transmission O/P +		
18	Re-transmission O/P –		

SERIAL INTERFACE CONNECTOR:

This is a 9-pin D-type male connector. Pin details of the same are:

Pin No.	Signal
2	Transmit data (TX+/RX+)
3	Receive data (TX -/RX-)
5	Gnd